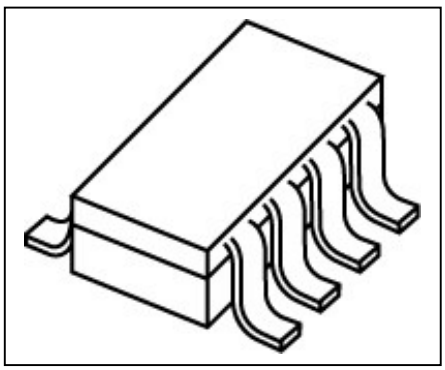
Low Drop-out Backlight Driver for LED

Features

- 3 constant-current output channels
- 320mV dropout at a 20mA load
- High efficiency, up to 92%
- Adjustable output current: 15~ 25 mA
- 3V to 5.5V Supply Voltage Range
- Tiny 8-pin SOT package



SOT28

Applications

- Handheld Devices
- Cellular Phones
- PDAs
- Digital Cameras

General Description

The MBI1011, a low dropout constant current driver, provides three regulated current sources. It is designed to drive three LEDs with matched currents (within 5 %) to produce balanced light sources for backlight applications. The MBI1011 accepts an input voltage range from 3V to 5.5V and maintains a constant current up to 25mA determined by an external resistor, R1. It is ideal for driving LEDs whose light intensity is proportional to the current passing through, not upon the voltage across their terminal. The low voltage dropout also significantly improves power efficiency.

The MBI1011's high efficiency, ease of use, and spacing-saving 8-pin SOT28 package fits most of portable applications which requires uniform LED illumination.

Typical Application Circuit

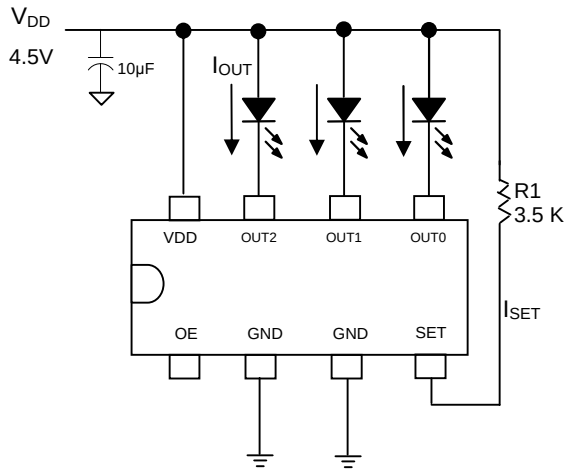


Fig. 1 Typical Application Circuit

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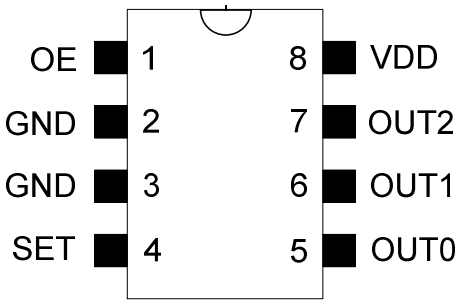
Terminal Description

Pin No.	Pin Name	Function
1	OE	Output enable terminal (All outputs are off with “L” level input of OE terminal)
2, 3	GND	Ground terminal for control logic and current sinks
4	SET	A resistor between this terminal and V_{DD} regulates the LED current of output terminals
5, 6, 7	OUT0, OUT1, OUT2	Output terminal of Constant Current
8	VDD	Supply voltage terminal

Pin Description



Maximum Ratings

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0 ~ 7.0	V
Input Voltage	V_{IN}	-0.4 ~ V_{DD}+0.4	V
Output Current	I_{OUT}	+25	mA
Output Voltage	V_{DS}	-0.5 ~ +7.0	V
Operating Temperature	T_{opr}	-40 ~ +85	°C
Storage Temperature	T_{stg}	-55 ~ +150	°C

Electrical Characteristics

(V_{DD}= 4V, I_{SET}= 1mA, OE= V_{DD}, Ta = 25°C, unless otherwise noted)

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage		V_{DD}	-	3	-	5.5	V
Supply Current		I_{DD}	I_{OUT} excluded	-	250	-	μA
SET Input Current		I_{SET}	R_{SET}= 3.5K	-	50	-	μA
SET Bias Voltage		V_{SET}		0.1	0.15	0.2	V
OE Input Level	H level	V_{IH}	-	$0.4V_{DD}$	-	V_{DD}	V
	L level	V_{IL}		0	-	1.0	V
		I_{IL}		1	-	-	mA
OE Input Frequency		F_{OE}		1	-	10	KHz
OE Pulse Width		T_m	F_{OE}= 10KHz	5	-	-	μS
Output Current		I_{OUT}※	R_{SET}= 3.5K	19	20	21	mA
Output Current Regulation		$\%I_{OUT}$	V_{OUT}= 0.32V~ 1.5V	-	-	±1	%
Channel Skew		$\%I_{OUT}$	I_{OUT}= 20mA	-	-	5	%
Chip Skew		$\%I_{CHIP}$		-	-	5	%
Output Dropout Voltage		V_{DROP}	I_{OUT}= 20mA		320		mV
Output Leakage Current		$I_{OUT(OFF)}$	V_{IL}= 0V, V_{OUT}= 5V	-	-	1	μA
Off-State Current		$I_{DD(OFF)}$	V_{IL}= 0V	-	15	50	μA

※ I_{OUT} vs. R_{SET} @ different power supply is shown in Fig.4.

Test Circuit for Electrical Characteristics

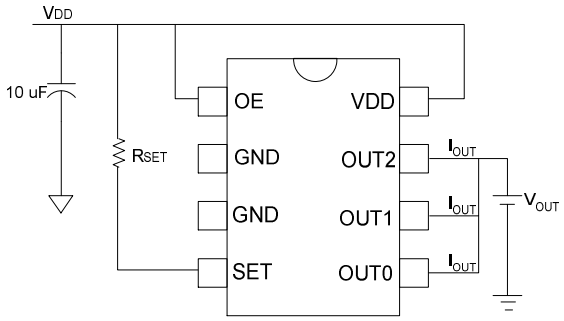


Fig. 2 Test Circuit

Typical Operating Characteristics

The test circuit for the below figure 3 and 4 refers to Figure 2.

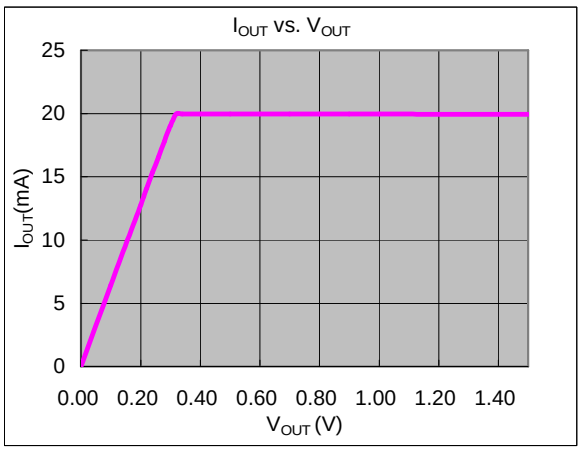


Fig. 3 I_{OUT} vs. V_{OUT} at V_{DD}=5V

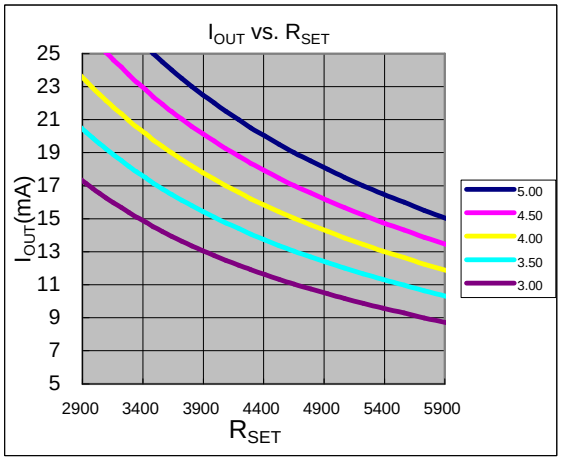


Fig. 4 I_{OUT} vs. R_{SET} at V_{DD}= 5V, 4.5V, 4.0V, 3.5V and 3.0V

Application Information

Resistor Selection

R_{SET} is used to regulate the LED current. For the best accuracy, a resistor with ±1% precision should be used.

Regulating Output Current

The value of I_{OUT} can be calculated via the equation: **$I_{OUT} = (16.9/R1 + 0.16) * V_{DD}$**

Also, users can choose a suitable value of R1 via the above equation when I_{OUT} is known. A typical operating characteristic of I_{OUT} vs. R_{SET} is shown in Fig. 4.

Efficiency Consideration

Except the output driver stage, the control parts of MBI1011 consume so little power (typical value ≤ 8 mW) that it can be neglected. The power efficiency can be estimated as (V_{DD} - V_{OUT}) / V_{DD}. To get higher efficiency, V_{OUT} should be kept as low as possible, and the minimum value is 0.32V. Since $V_{OUT} = V_{DD} - V_F$, V_{DD} should be high enough to let V_{OUT} be in the range between 0.32V to 1.5V.

The following example shows how to achieve high power efficiency. (See Fig.1.)

For white LEDs, the forward voltage, V_F, ranges from 3.0V to 4.0V.

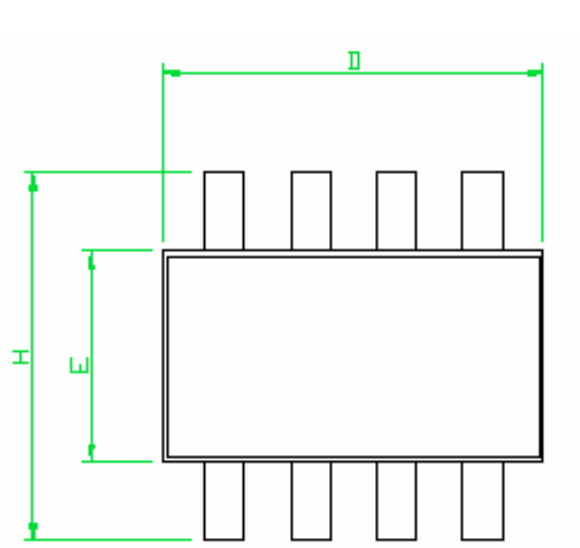
If $V_F = 3.6$ V

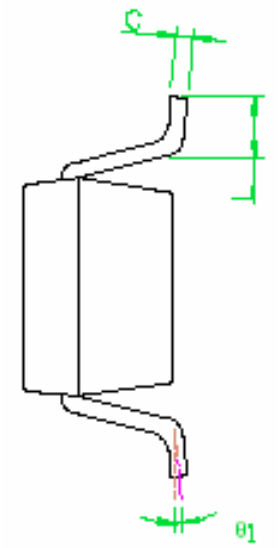
$V_{DD} = V_F + V_{OUT} = 3.92$V, (assuming $V_{OUT} = 0.32$V)

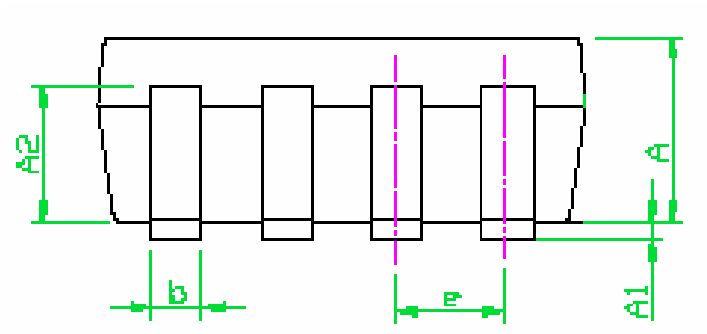
then Efficiency = (V_{DD} - V_{OUT}) / V_{DD} = 3.6V / 3.92V = 92.3%

Therefore, a proper design of V_{DD} is strongly recommended in order to let V_{OUT} be its minimum specification value, 0.32V, that is the key to get the high efficiency.

Outline Drawings







Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	1.00	1.10	1.30	E	1.50	1.60	1.70
A1	0.00	--	0.15	e	--	0.65	--
A2	0.70	0.80	0.90	H	2.60	2.80	3.00
b	0.25	0.30	0.40	L	0.10	--	0.60
C	0.10	0.15	0.20	Θ1	1°	5°	9°
D	2.80	2.90	3.00				