Backlight Driver for RGB LED

Features

- Constant-current output
- 3 separately regulated current sources for RGB-composite white LED
- High efficiency, up to 92%
- Adjustable output current : 15~ 25 mA
- Very small size,16-pin QFN package

Applications

- LCD Backlights
- Portable DVD Player
- Handheld Equipments
- RGB LED Drivers

General Description

The MBI1312 is a CMOS constant-current driver that provides three sets of regulated current sources. It is designed to match the luminous intensity of each channel with dedicated currents to produce deserved white light. MBI1312 has 8-channel constant current drivers that are adjustable by 3 sets of corresponding external resistor. Neither an inductor nor Schottky diode is needed. MBI1312 delivers up to 25mA with 5 % current match accuracy. In addition, customers can get very high efficiency (up to 92%) by well matching V_{LED} voltage and LED forward voltages, V_F.

MBI1312 features low dropout, high efficiency, ease of use, and space-saving QFN-16 package for applications that need RGB-composite white light.

Typical Application Circuit

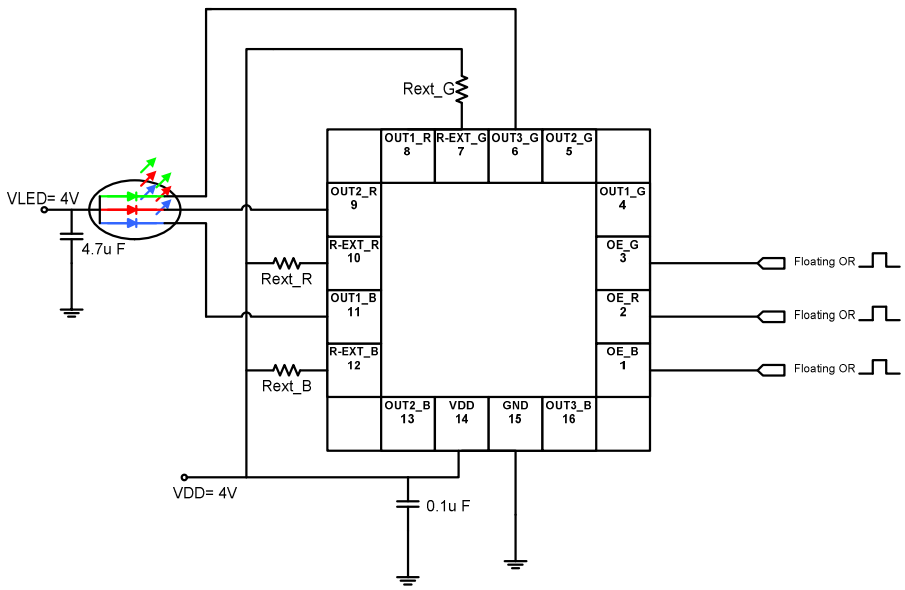

Fig. 1

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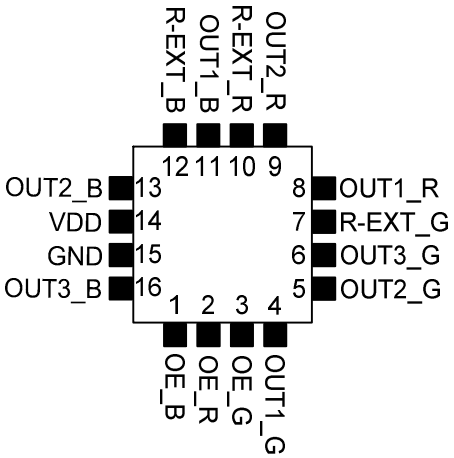
Terminal Description

Pin No.	Pin Name	Function
1, 2, 3	OE_B, OE_R, OE_G	Output enable terminal
4, 5, 6	OUT1_G, OUT2_G, OUT3_G	Constant current output terminal
8, 9	OUT1_R, OUT2_R	
11, 13, 16	OUT1_B, OUT2_B, OUT3_B	
7	R-EXT_G	The resistor connected to the terminal and a voltage supply determines the current flowing into the terminal and thus determines the corresponding output current of OUT1_G, OUT2_G, OUT3_G.
10	R-EXT_R	The resistor connected to the terminal and a voltage supply determines the current flowing into the terminal and thus determines the corresponding output current of OUT1_R, OUT2_R.
12	R-EXT_B	The resistor connected to the terminal and a voltage supply determines the current flowing into the terminal and thus determines the corresponding output current of OUT1_B, OUT2_B, OUT3_B.
14	VDD	Supply voltage terminal
15	GND	Ground terminal for control logic and current sink

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_{R-EXT}= 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	-	750	-	μA
R-EXT Input Current		I_{R-EXT}	R_{ext}= 3.5K	-	50	-	μA
R-EXT Bias Voltage		V_{R-EXT}	for all R-EXT terminals	0.1	0.15	0.2	V
OE Input Frequency	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, for all output terminals	5	-	-	μS
Output Current		I_{OUT}※	R_{ext}= 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 Supply Current		$I_{DD(OFF)}$	V_{IL}= 0V	-	50	150	μA

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

Test Circuit for Electrical Characteristics

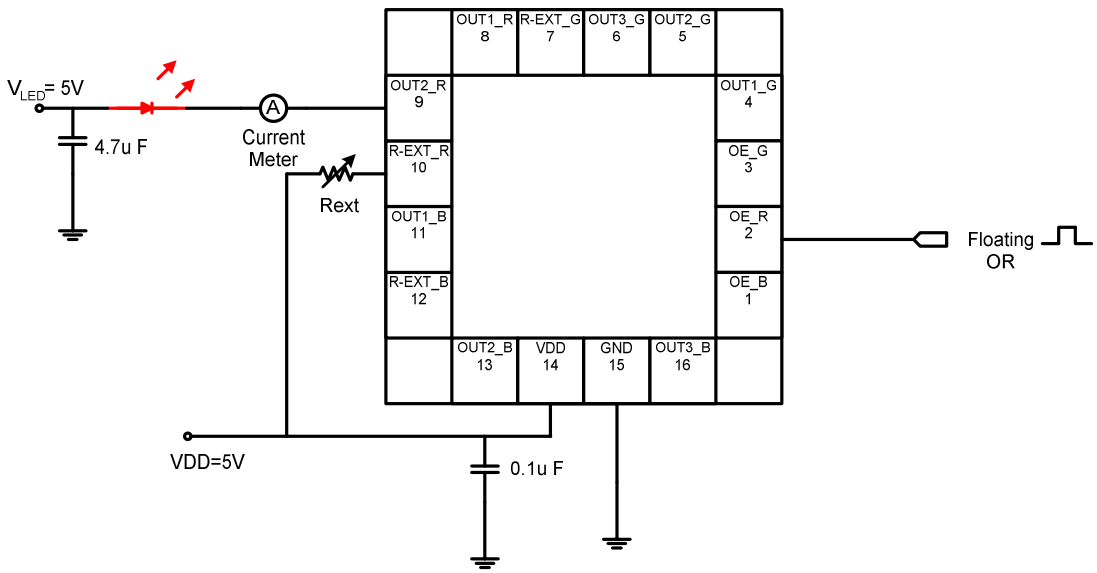


Fig. 2 Test Circuit

Typical Operating Characteristics

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

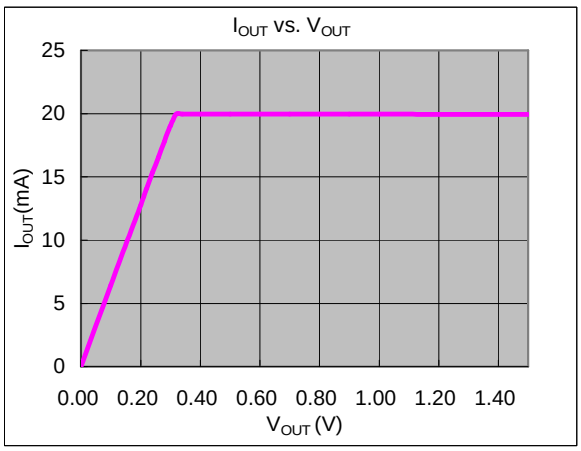


Fig. 3 I_{OUT} vs. V_{OUT} at V_{DD}=5V

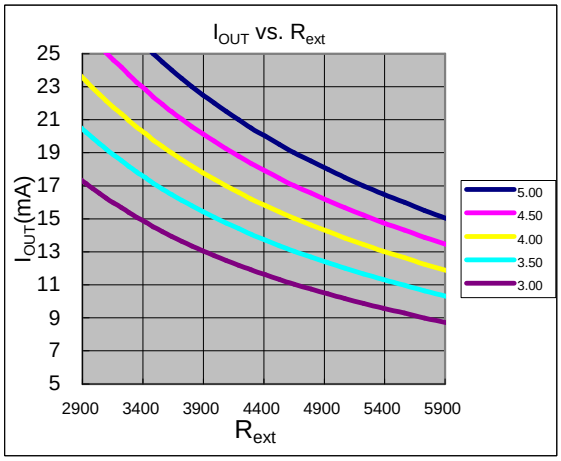


Fig. 4 I_{OUT} vs. R_{ext} at V_{DD}= 5V, 4.5V, 4.0V, 3.5V and 3.0V

Application Information

Resistor Selection

Rext 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/Rext + 0.16) * V_{DD}

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

Efficiency Consideration

Except the output driver stage, the control parts of MBI1312 consume so little power (typical value ≤ 8 mW) that it can be neglected. The power efficiency can be estimated as (V_{LED} - V_{OUT}) / V_{LED}. To ensure to get higher efficiency, V_{OUT} should be kept as low as possible, and the minimum value is 0.32V. Since V_{OUT} = V_{LED} - V_F , V_{LED} 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.

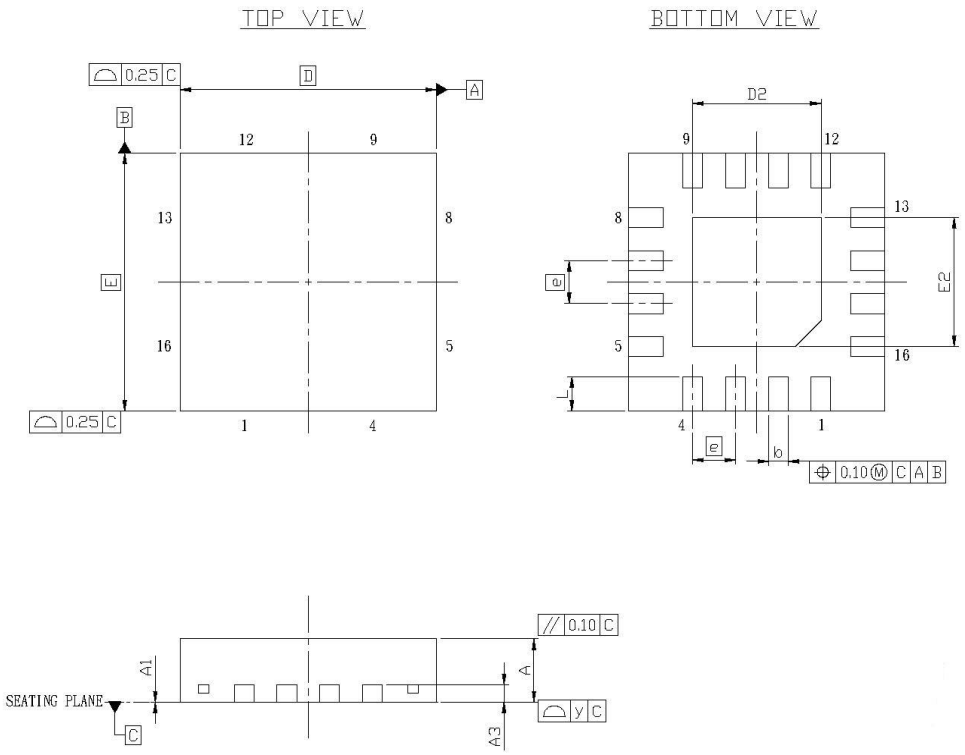
If V_F = 3.6 V

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

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

Therefore, a proper design of V_{LED} 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)			Dimension (mil)		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.70	0.75	0.80	27.6	29.5	31.5
A1	0	0.02	0.05	0	0.79	1.97
A3		0.23 REF			8.00 REF	
b	0.18	0.23	0.30	7.09	9.06	11.81
D	2.90	3.00	3.10	114.17	118.11	122.05
D2	1.40	1.50	1.60	55.12	59.06	62.99
E	2.90	3.00	3.10	114.17	118.11	122.05
E2	1.40	1.50	1.60	55.12	59.06	62.99
e		0.50 BSC			19.69 BSC	
L	0.30	0.40	0.50	11.81	15.75	19.69
y		0.08			3.15	