

400KHz 60V 3A Switching Current Boost LED Constant Current Driver

XL6004

Features

- n Wide 3.6V to 32V Input Voltage Range
- n 0.22V FB adjustable LED drive current
- n Directly drive up to 16 Series 1W LED
- n Fixed 400KHz Switching Frequency
- n Max. 3A Switching Current Capability
- n Up to 92% efficiency
- n Excellent line and load regulation
- n EN PIN TTL shutdown capability
- n Internal Optimize Power MOSFET
- n Built in Soft-Start Function
- n Built in Frequency Compensation
- n Built in Thermal Shutdown Function
- n Built in Current Limit Function
- n Available in TO252-5L package

Applications

- n LED Lighting
- n Boost constant current driver
- n Monitor LED Backlighting
- n 7' to 15' LCD Panels

General Description

The XL6004 regulator is fixed frequency PWM Boost (step-up) LED constant current driver, capable of driving Series 1W/3W LED units with excellent line and load regulation. The regulator is simple to use because it includes internal frequency compensation and a fixed-frequency oscillator so that it requires a minimum number of external components to work.

The XL6004 could directly drive 12 Series 1W LED units at VIN>12V.

The PWM control circuit is able to adjust the duty ratio linearly from 0 to 95%. An enable function, an over current protection function is built inside. An internal compensation block is built in to minimize external component count.

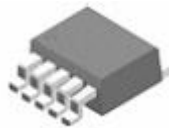


Figure1. Package Type of XL6004

Pin Configurations

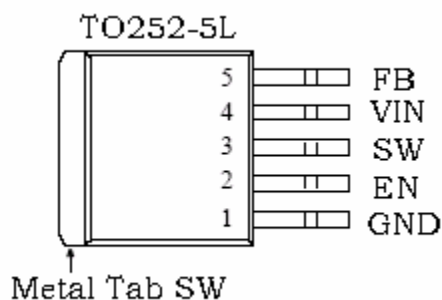


Figure2. Pin Configuration of XL6004 (Top View)

Table 1 Pin Description

Pin Number	Pin Name	Description
1	GND	Ground Pin.
2	EN	Enable Pin. Drive EN pin low to turn off the device, drive it high to turn it on. Floating is default high.
3	SW	Power Switch Output Pin (SW).
4	VIN	Supply Voltage Input Pin. XL6004 operates from a 3.6V to 32V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.
5	FB	Feedback Pin (FB). The feedback threshold voltage is 0.22V.

Function Block

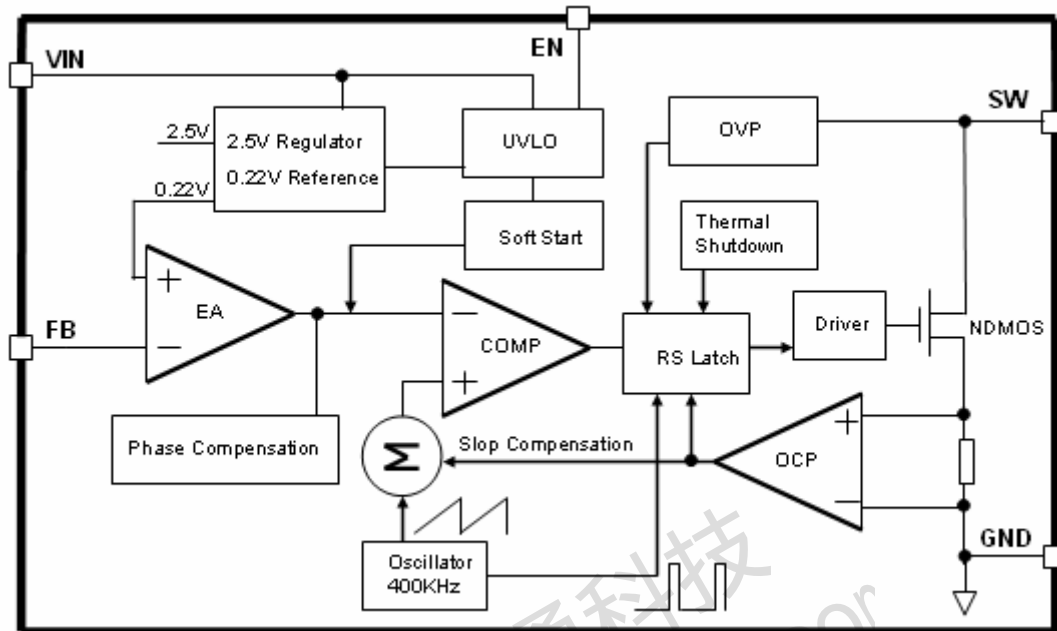


Figure3. Function Block Diagram of XL6004

Typical Application Circuit

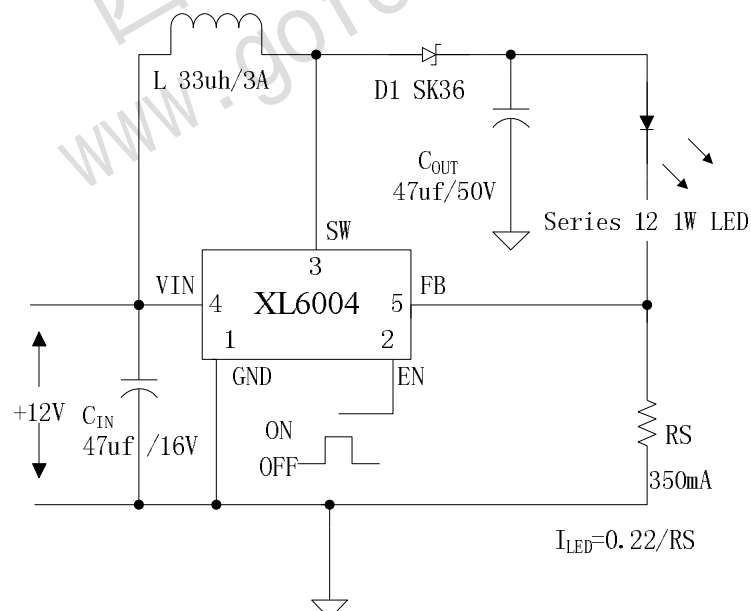


Figure4. XL6004 Typical Application Circuit

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Ordering Information

Package	Temperature Range	Part Number	Marking ID	Packing Type
		Lead Free	Lead Free	
		XL6004E1	XL6004E1	Tube
		XL6004TRE1	XL6004E1	Tape & Reel

XLSEMI Pb-free products, as designated with “E1” suffix in the par number, are RoHS compliant.

Absolute Maximum Ratings (Note1)

Parameter	Symbol	Value	Unit
Input Voltage	V _{IN}	-0.3 to 36	V
Feedback Pin Voltage	V _{FB}	-0.3 to V _{IN}	V
EN Pin Voltage	V _{EN}	-0.3 to V _{IN}	V
Output Switch Pin Voltage	V _{Output}	-0.3 to 60	V
Power Dissipation	P _D	Internally limited	mW
Thermal Resistance (TO252-5L) (Junction to Ambient, No Heatsink, Free Air)	R _{JA}	50	°C/W
Operating Junction Temperature	T _J	-40 to 125	°C
Storage Temperature	T _{STG}	-65 to 150	°C
Lead Temperature (Soldering, 10 sec)	T _{LEAD}	260	°C
ESD (HBM)		>2000	V

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

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XL6004 Electrical Characteristics
 $T_a = 25^{\circ}\text{C}$; unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<i>System parameters test circuit figure4</i>						
VFB	Feedback Voltage	$V_{in} = 5\text{V to } 12\text{V}, V_{out}=24\text{V}$ $I_{load}=100\text{mA}$	209	220	231	mV
Efficiency	η	$V_{in}=12\text{V}, V_{out}=24\text{V}$ $I_{out}=0.5\text{A}$	-	92	-	%

Electrical Characteristics (DC Parameters)
 $V_{in} = 12\text{V}$, $GND=0\text{V}$, V_{in} & GND parallel connect a 100uf/50V capacitor; $I_{out}=100\text{mA}$, $T_a = 25^{\circ}\text{C}$; the others floating unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input operation voltage	V_{in}		3.6		32	V
Shutdown Supply Current	I_{STBY}	$V_{EN}=0\text{V}$		70	100	μA
Quiescent Supply Current	I_q	$V_{EN}=2\text{V},$ $V_{FB}=V_{in}$		2.5	5	mA
Oscillator Frequency	F_{osc}		320	400	480	Khz
Switch Current Limit	I_L	$V_{FB}=0$		3		A
Output Power NMOS	R_{dson}	$V_{in}=12\text{V},$ $I_{SW}=3\text{A}$		110	120	mohm
EN Pin Threshold	V_{EN}	High (Regulator ON) Low (Regulator OFF)		1.4 0.8		V
EN Pin Input Leakage Current	I_H	$V_{EN}=2\text{V (ON)}$		3	10	μA
	I_L	$V_{EN}=0\text{V (OFF)}$		3	10	μA
Max. Duty Cycle	D_{MAX}	$V_{FB}=0\text{V}$		90		%

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Schottky Diode Selection Table

Current	Surface Mount	Through Hole	VR (The same as system maximum input voltage)				
			20V	30V	40V	50V	60V
1A		✓	1N5817	1N5818	1N5819		
3A		✓	1N5820	1N5821	1N5822		
		✓	MBR320	MBR330	MBR340	MBR350	MBR360
	✓		SK32	SK33	SK34	SK35	SK36
	✓			30WQ03	30WQ04	30WQ05	
		✓		31DQ03	31DQ04	31DQ05	
		✓	SR302	SR303	SR304	SR305	SR306

Typical System Application for VIN=5V to driver 8 x 1W series LED units

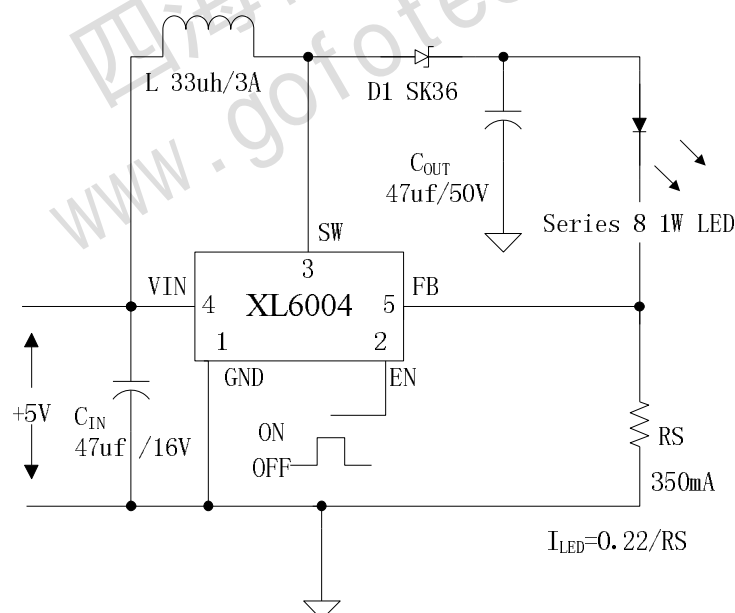


Figure5. XL6004 System Parameters Test Circuit (5V ~ 8 x 1W LED)

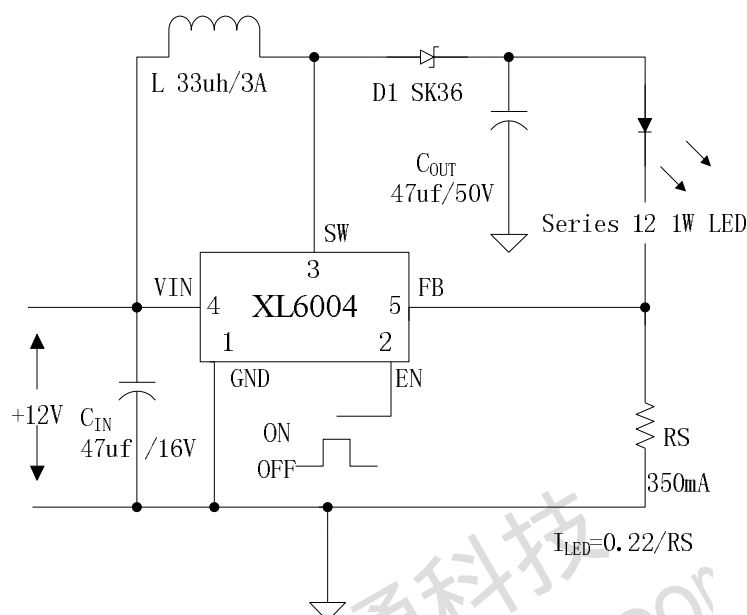
Typical System Application for VIN=12V to driver 12 x 1W series LED units


Figure6. XL6004 System Parameters Test Circuit (12V ~ 12 x 1W LED)

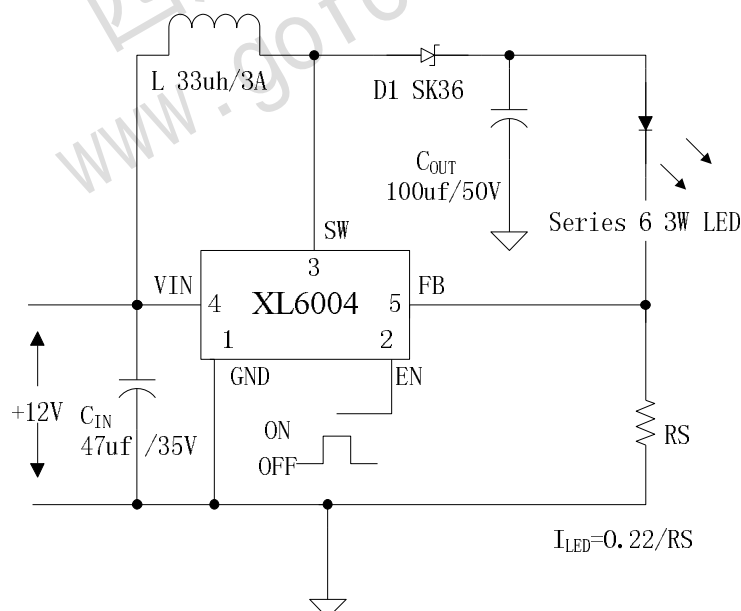
Typical System Application for VIN=12V to driver 6 x 3W series LED units


Figure7. XL6004 System Parameters Test Circuit (12V ~ 6 x 3W LED)

Typical System Application for VIN=24V to driver 16 x 1W series LED units

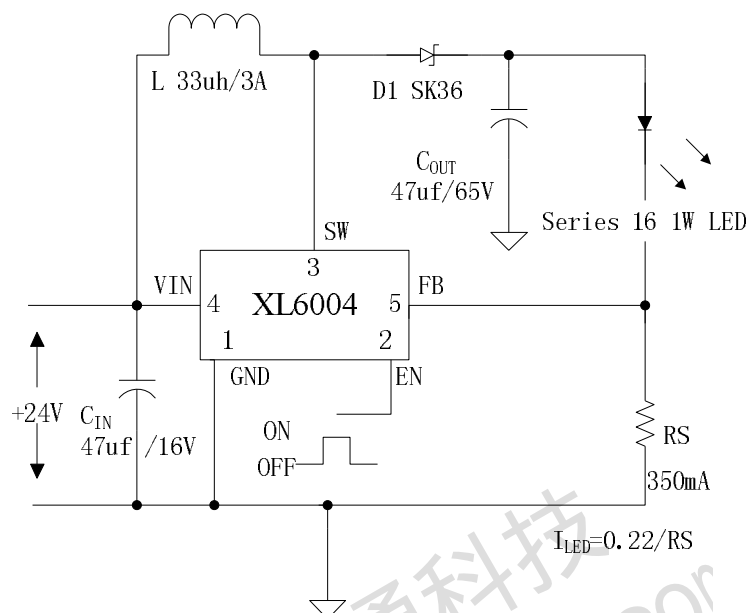


Figure8. XL6004 System Parameters Test Circuit (24V ~ 16 x 1W LED)

Typical System Application for SEPIC Buck-Boost LED Driver

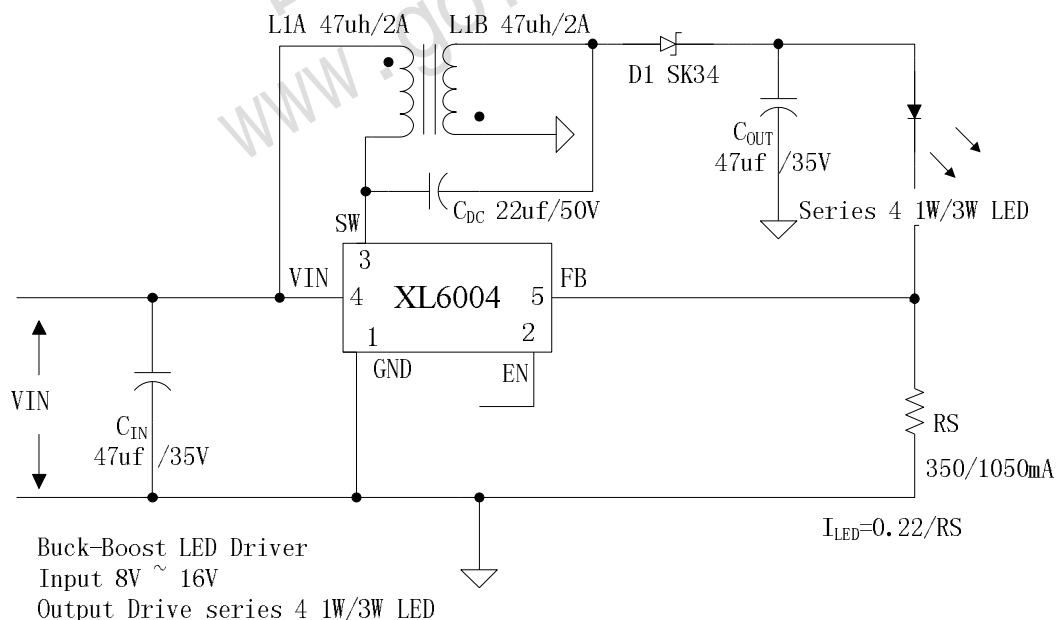


Figure9. XL6004 System Parameters Test Circuit (Buck-Boost LED Driver)

Typical System Application for VIN=12V to driver 12 series x 24 parallel White LED Array

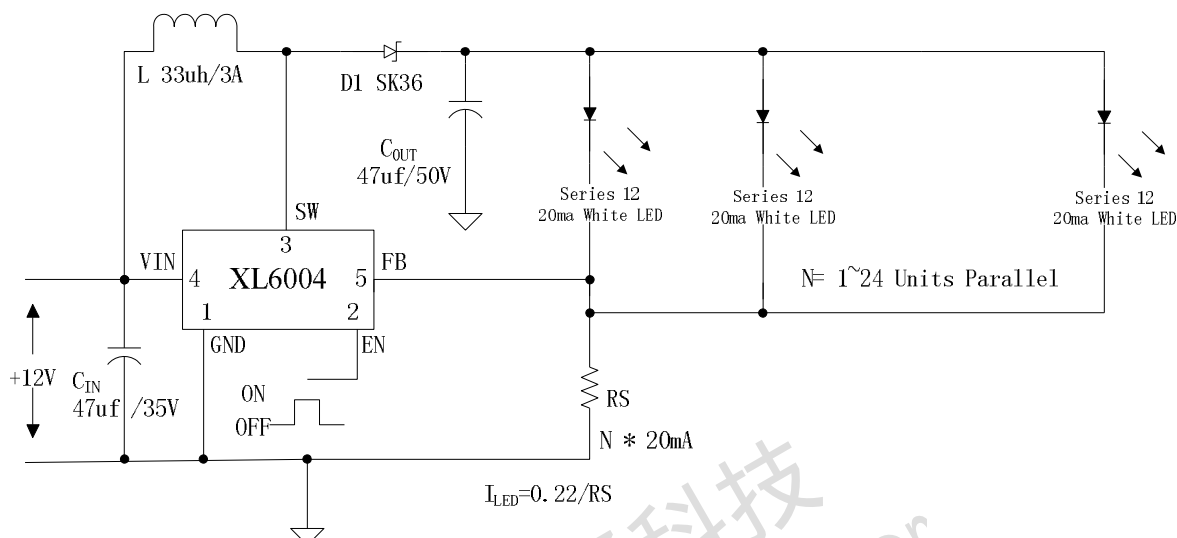


Figure10. XL6004 System Parameters Test Circuit (12V ~ 12 x 24 White LED)

Typical System Application for VIN=12V to driver 12 x 1W series LED units With Dimming Function

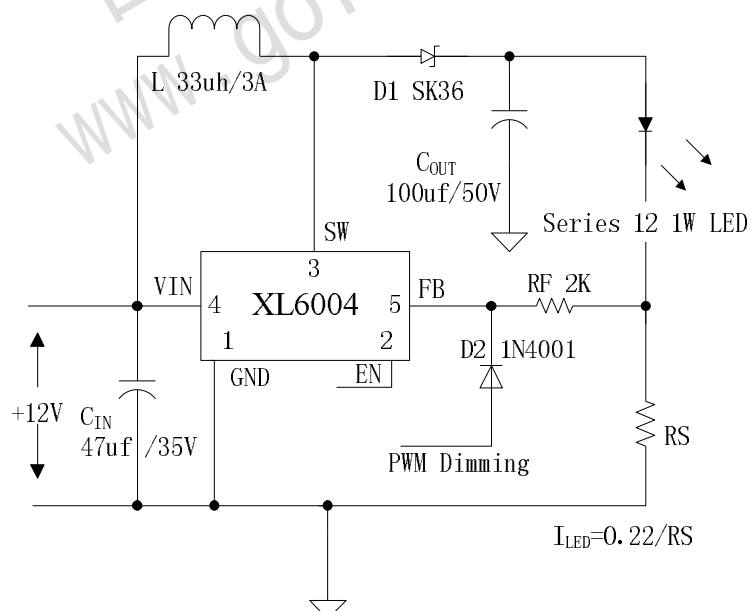
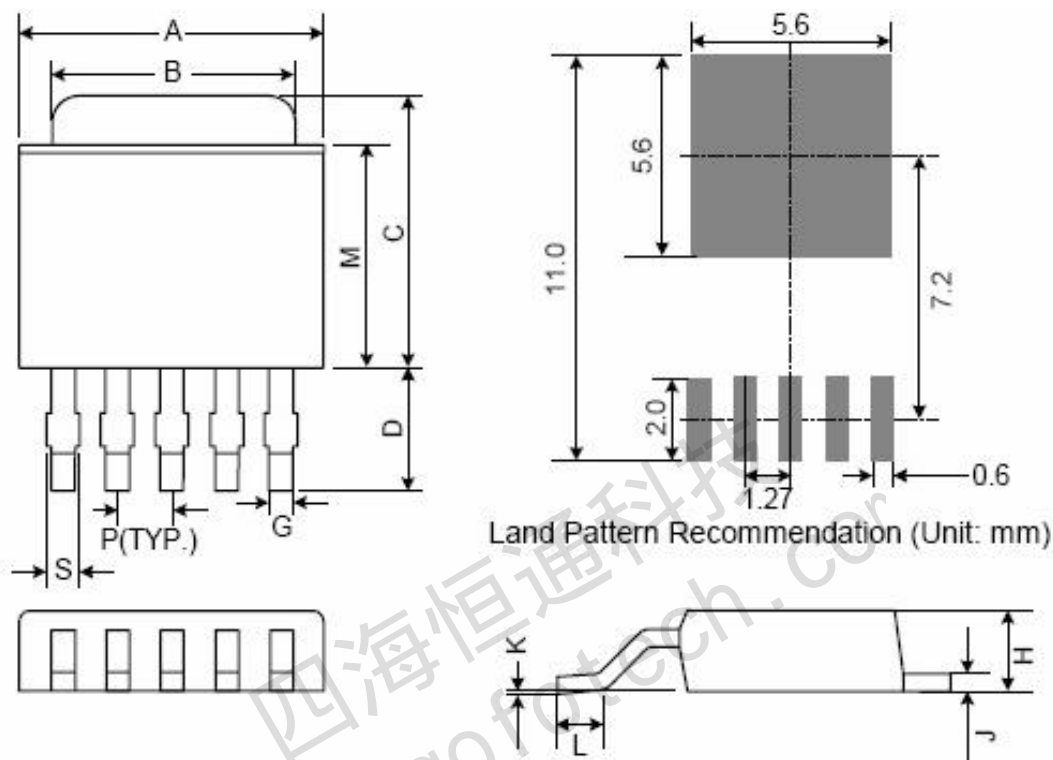


Figure11. XL6004 System Test Circuit (12V ~ 12 x 1W LED with Dimming Function)

Package Information
TO252-5L


Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	6.35	6.60	6.85	0.250	0.260	0.270
B	5.20	5.35	5.50	0.205	0.211	0.217
C	6.80	7.00	7.30	0.268	0.276	0.287
D	2.40	2.80	3.20	0.094	0.110	0.126
P	1.27 REF.			0.050 REF.		
S	0.50	0.65	0.80	0.020	0.026	0.031
G	0.40	0.50	0.63	0.016	0.020	0.025
H	2.20	2.30	2.40	0.087	0.091	0.094
J	0.45	0.52	0.58	0.018	0.020	0.023
K	0.00	0.08	0.15	0.000	0.003	0.006
L	0.90	1.20	1.63	0.035	0.047	0.064
M	5.40	5.80	6.20	0.213	0.228	0.244