# 4A 220KHz 36V Buck LED Constant Current Driver XL3003

## Features

- Wide 8V to 36V Input Voltage Range
- Output Current Sence Voltage is 0.21V
- Maximum Duty Cycle 100%
- Minimum Drop Out 0.3V
- Fixed 220KHz Switching Frequency
- 4A Constant Output Current Capability
- Internal Optimize Power MOSFET
- High efficiency
- Excellent line and load regulation
- Built in thermal shutdown function
- Built in current limit function
- Built in output short protection function
- Available in TO-252 package

## Applications

- Buck constant current driver
- Monitor LED Backlighting
- General purpose LED lighting

## General Description

The XL3003 is a 220 KHz fixed frequency PWM buck (step-down) LED constant current driver, capable of driving a 4A load with high efficiency, low ripple and excellent line and load regulation. Requiring a minimum number of external components, the regulator is simple to use and include internal frequency compensation and a fixed-frequency oscillator.

The PWM control circuit is able to adjust the duty ratio linearly from 0 to 100%. An over current protection function is built inside. When short protection function happens, the operation frequency will be reduced from 220KHz to 60KHz. An internal compensation block is built in to minimize external component count.



Figure1. Package Type of XL3003

## Pin Configurations

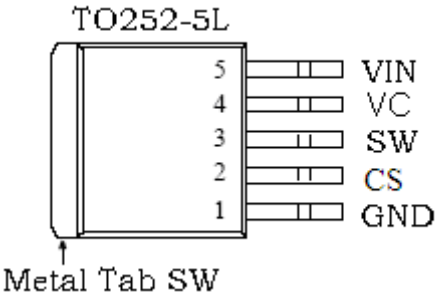



Figure2. Pin Configuration of XL3003 (Top View)

Table 1 Pin Description

| Pin Number | Pin Name | Description |
|---|---|---|
| 1 | GND | Ground Pin. Care must be taken in layout. This pin should be placed outside of the Schottky Diode to output capacitor ground path to prevent switching current spikes from inducing voltage noise into XL3003. |
| 2 | CS | Output constant current sense Pin (CS). The CS reference voltage is 0.21V. |
| 3 | SW | Power Switch Output Pin (SW). SW is the switch node that supplies power to the output. |
| 4 | VC | Internal Voltage Regulator Bypass Capacity. In typical system application, The VC pin connect a 1uf capacity to VIN. |
| 5 | VIN | Supply Voltage Input Pin. XL3003 operates from a 8V to 36V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input. |

## Function Block

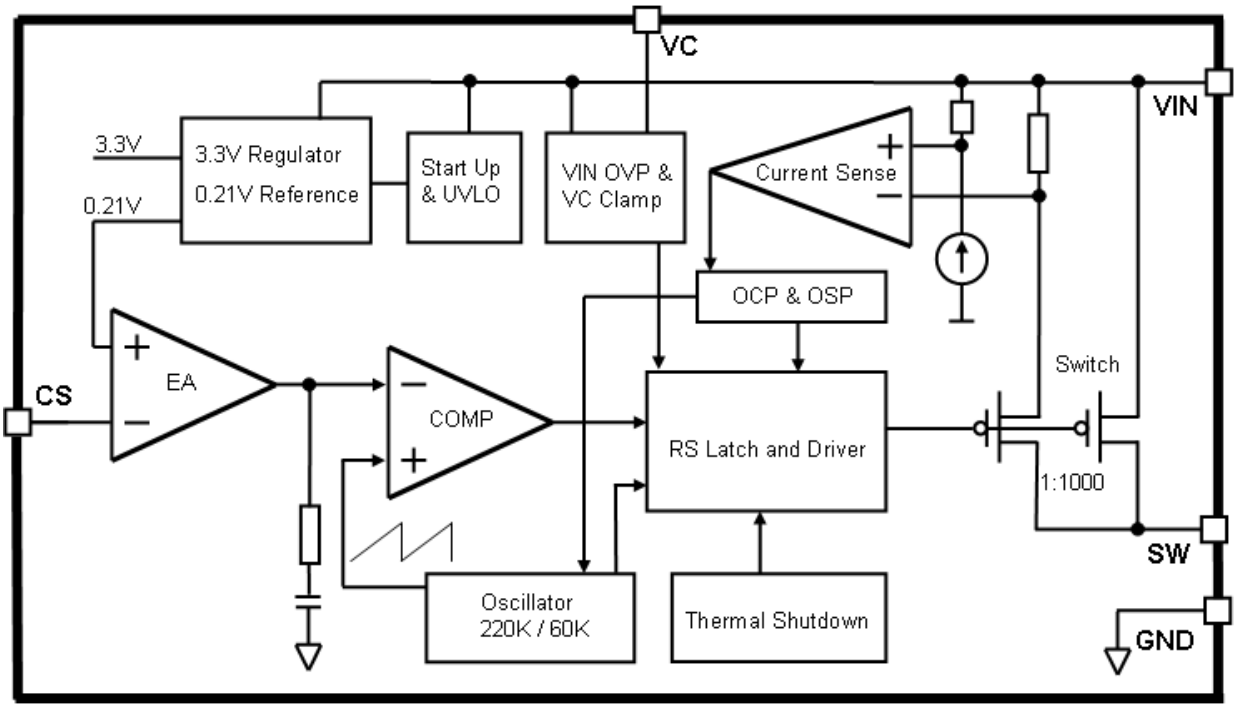



Figure3. Function Block Diagram of XL3003

## Typical Application Circuit

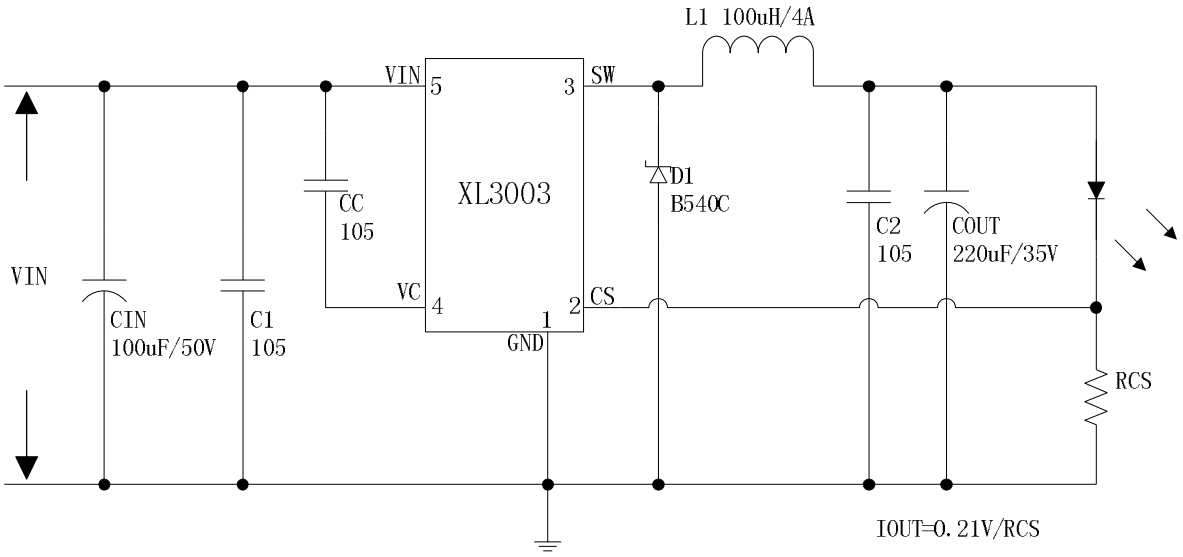



Figure4. XL3003 Typical Application Circuit

## Ordering Information

| Order Information | Marking ID | Package Type | Packing Type Supplied As |
|---|---|---|---|
| XL3003E1 | XL3003E1 | TO252-5L | 2500 Units on 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 | Vin | -0.3 to 40 | V |
| CS Pin Voltage | $V_{CS}$ | -0.3 to Vin | V |
| Output Switch Pin Voltage | $V_{Output}$ | -0.3 to Vin | V |
| Power Dissipation | $P_D$ | Internally limited | mW |
| Thermal Resistance (TO252)<br>(Junction to Ambient, No Heatsink, Free Air) | $R_{JA}$ | 50 | ºC/W |
| Maximum Junction Temperature | $T_J$ | -40 to 150 | ºC |
| Operating Junction Temperature | $T_J$ | -40 to 125 | ºC |
| Storage Temperature | $T_{STG}$ | -65 to 150 | ºC |
| Lead Temperature (Soldering, 10 sec) | $T_{LEAD}$ | 260 | ºC |
| 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.

## XL3003 Electrical Characteristics

$T_a$ = 25℃;unless otherwise specified.

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| ***System parameters test circuit figure4*** | | | | | | |
| VCS | Current Sense Voltage | Vin = 8V to 36V, Vout=6.4V Iload=0.1A to 3A | 203.7 | 210 | 216.3 | mV |
| ŋ | Efficiency | Vin=12V ,Vout=10V Iout=0.3A | - | 95 | - | % |
| ŋ | Efficiency | Vin=24V ,Vout=16V Iout=1A | - | 96 | - | % |
| ŋ | Efficiency | Vin=36V ,Vout=19V Iout=1A | - | 95 | - | % |

## Electrical Characteristics (DC Parameters)

Vin = 12V, GND=0V, Vin & GND parallel connect a 100uf/50V capacitor; Iout=500mA, $T_a$ = 25℃; the others floating unless otherwise specified.

| Parameters | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Input operation voltage | Vin | | 8 | | 36 | V |
| VIN UVLO | Vin_uvlo | | | 5 | | V |
| Quiescent Supply Current | $I_q$ | $V_{CS}$=Vin | | 2.1 | 5 | mA |
| Oscillator Frequency | Fosc | | 187 | 220 | 253 | KHz |
| Output Short Frequency | Fosp | | 48 | 60 | 72 | KHz |
| Switch Current Limit | $I_L$ | $V_{CS}$=0 | | 6 | | A |
| Max. Duty Cycle | $D_{MAX}$ | $V_{CS}$=0V | | 100 | | % |
| Output Power PMOS | Rdson | $V_{CS}$=0V, Vin=12V, $I_{SW}$=4A | | 60 | 80 | mohm |

## Typical System Application (Recommend output voltage safe work range)

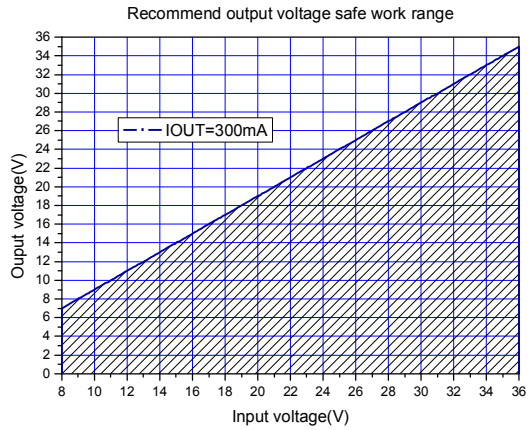



Figure5.Max output voltage(IOUT=300mA)

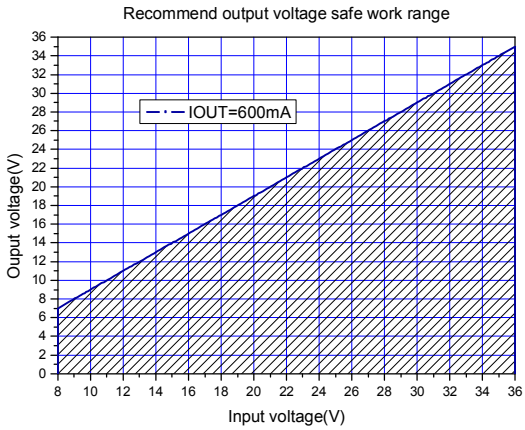



Figure6.Max output voltage(IOUT=600mA)

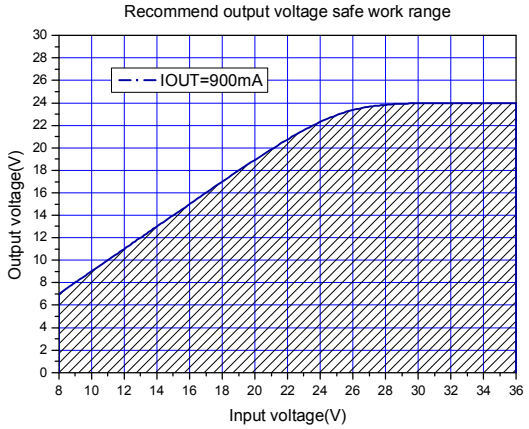



Figure7.Max output voltage(IOUT=900mA)

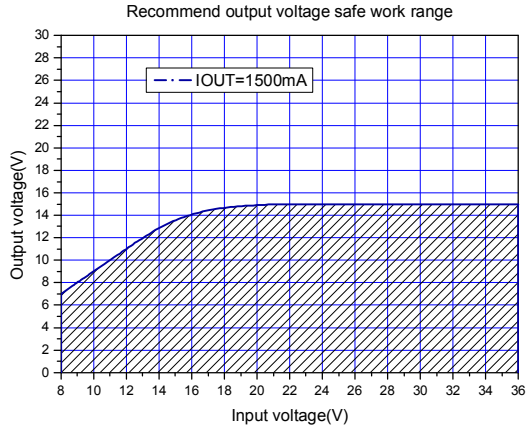



Figure8.Max output voltage(IOUT=1500mA)

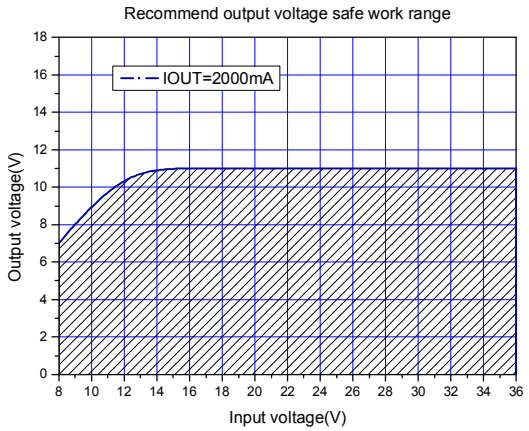



Figure9.Max output voltage(IOUT=2000mA)

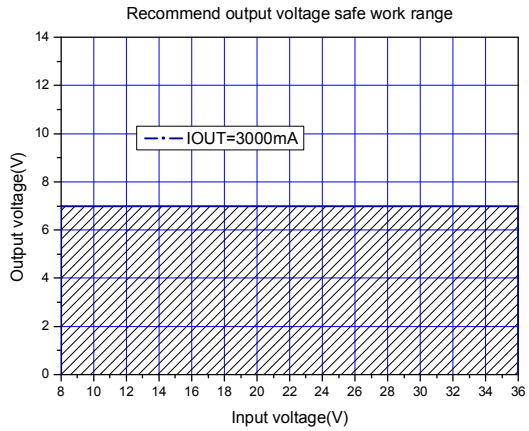



Figure10.Max output voltage(IOUT=3000mA)

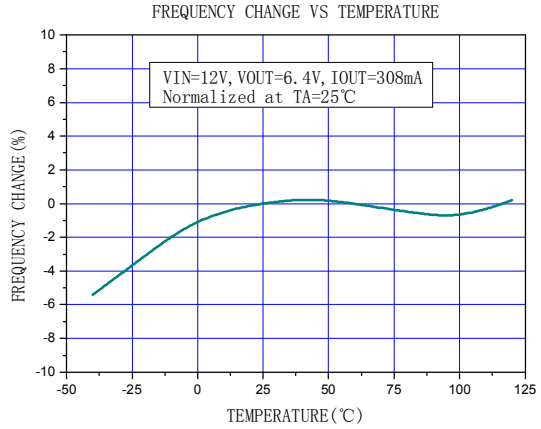



Figure11. Frequency change Curve

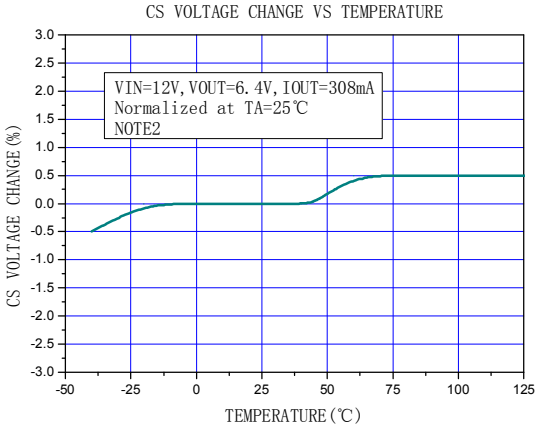



Figure12. CS Voltage change Curve

**Note2:** Internal temperature compensation circuitry is provided to compensation the PCB and external line loss in system application. When the junction temperature or the output power rise，the CS voltage will be compensated. This function is provided to compensation the PCB and external line loss in system application.

## Typical System Application (VIN=8V~36V, IOUT=308mA)

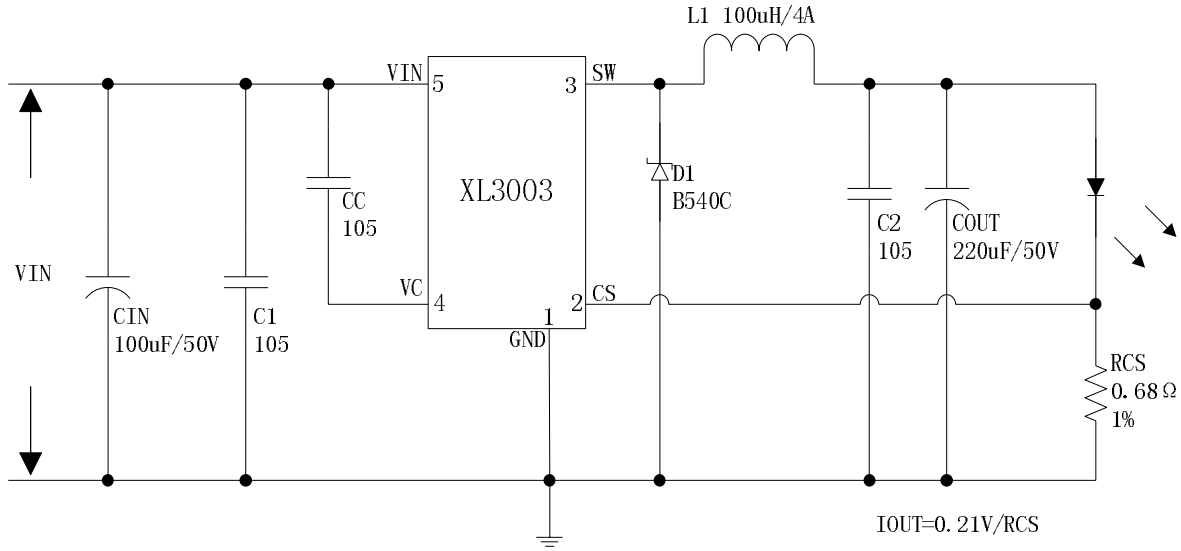



Figure13. XL3003 System Parameters Test Circuit (VIN=8V~36V, IOUT=308mA)

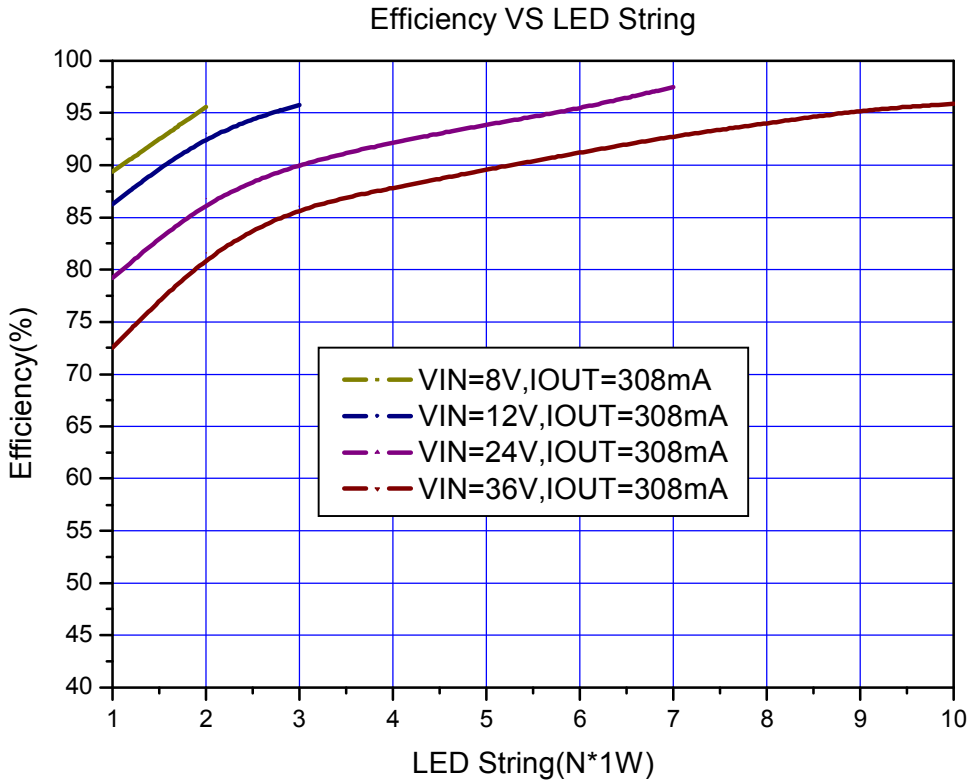



Figure14. XL3003 System Efficiency Curve

## Typical System Application (VIN=8V~36V, IOUT=615mA)

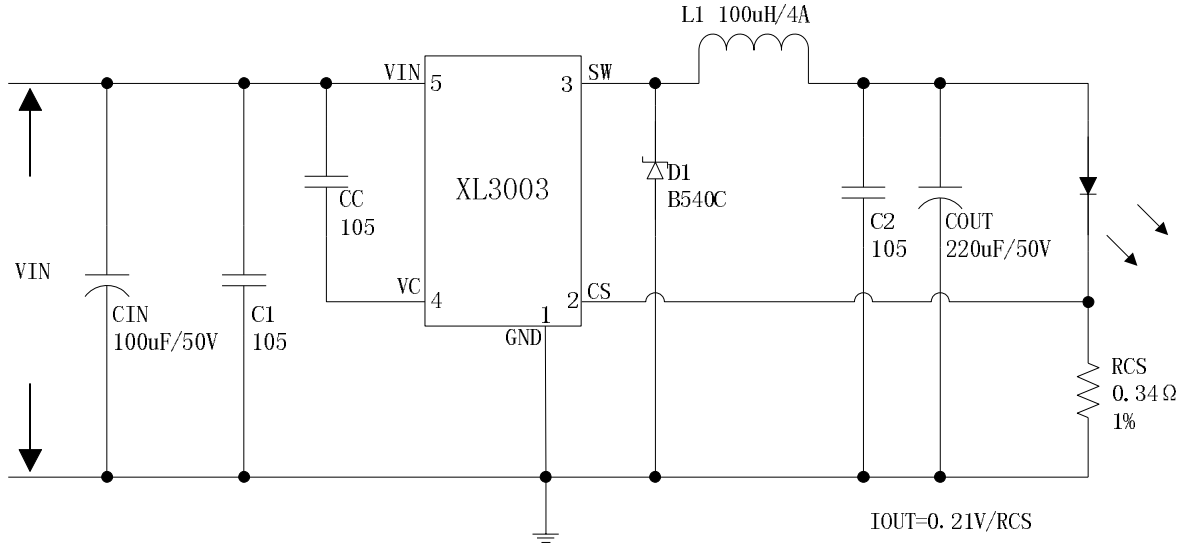



Figure15. XL3003 System Parameters Test Circuit (VIN=8V~36V, IOUT=615mA)

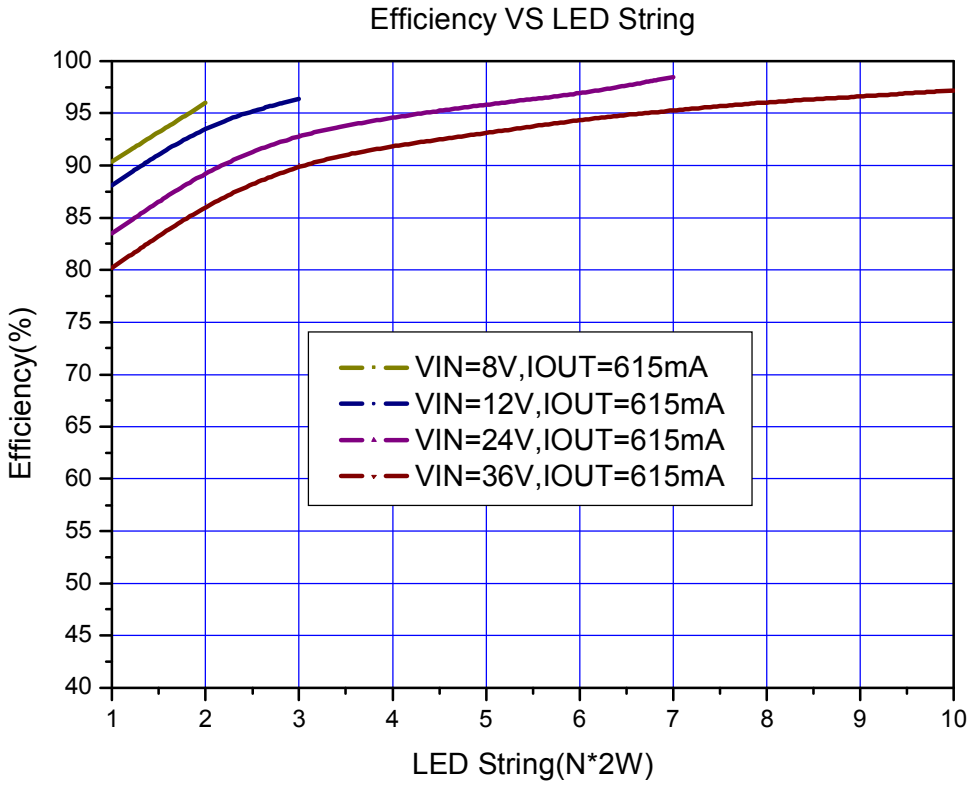



Figure16. XL3003 System Efficiency Curve

## Typical System Application (VIN=8V~36V, IOUT=925mA)

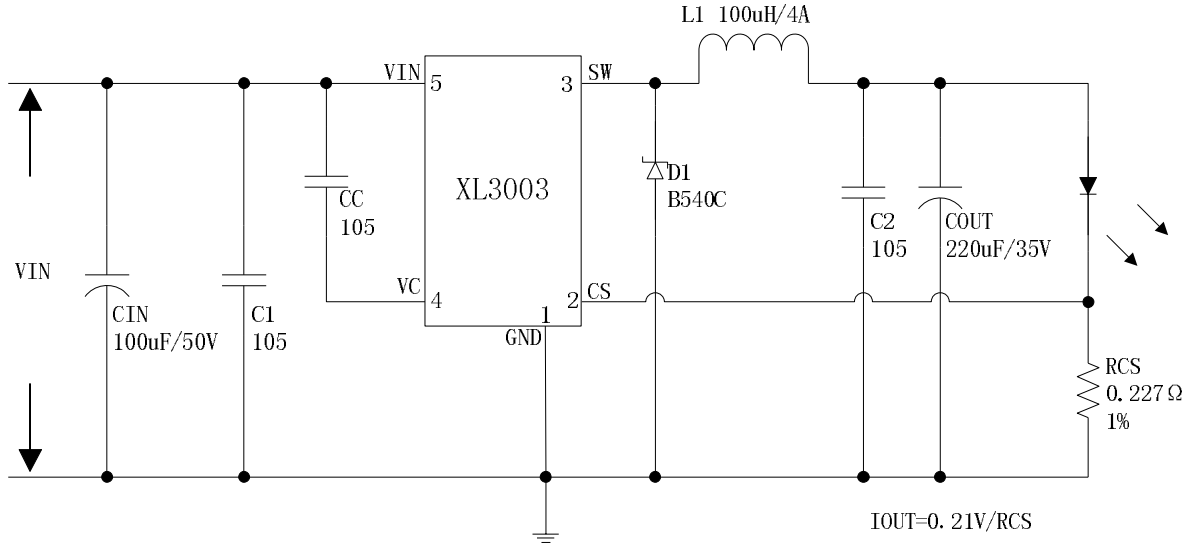



Figure17. XL3003 System Parameters Test Circuit (VIN=8V~36V, IOUT=925mA)

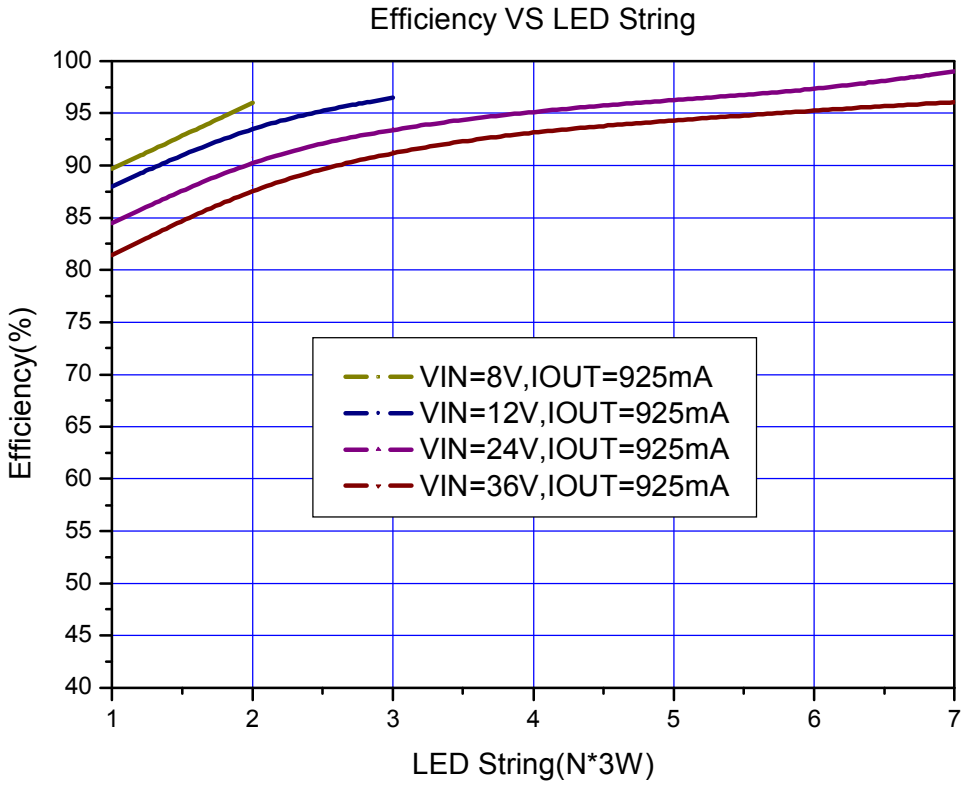



Figure18. XL3003 System Efficiency Curve

## Typical System Application (PWM DIMMING)

PWM dimming function can be used in typical system application with external components. Changing the duty cycle of PWM signal can get different LED current. The PWM signal high voltage above 3.3V(referenced to ground, lower than VIN), Low voltage below 0.2V(referenced to ground).

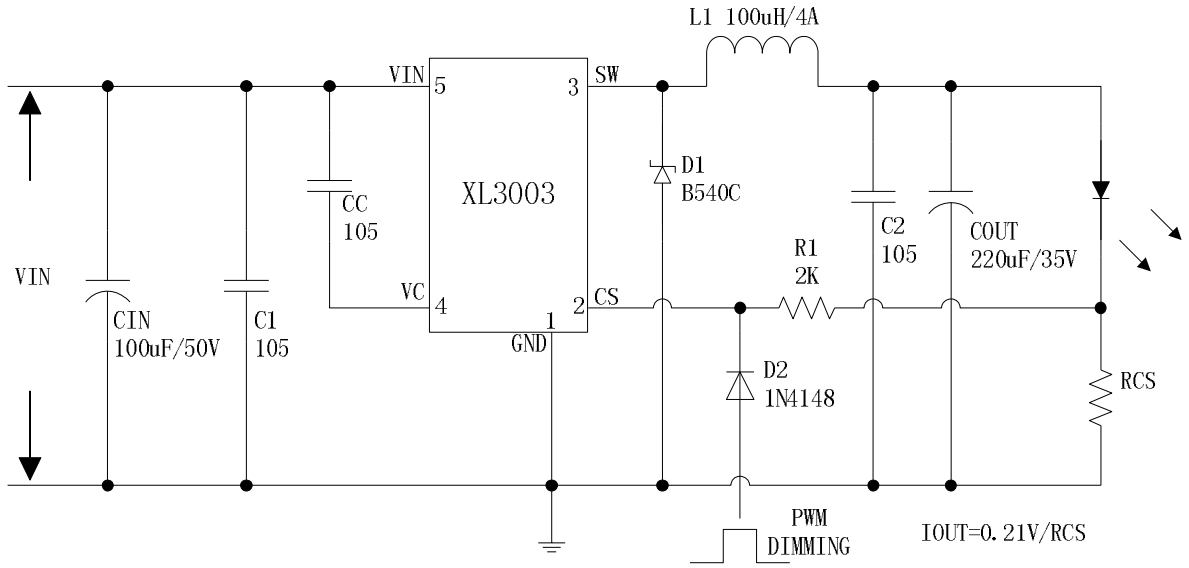



Figure19. XL3003 System Parameters Test Circuit (PWM DIMMING)

## Typical System Application (LED OVP)

LED OVP function can be used in typical system application with external components. The output voltage can be limited in a suitable value by choose different zener diode when the output LED open. the zener diode voltage choosed by output led voltage's 1.3 times.

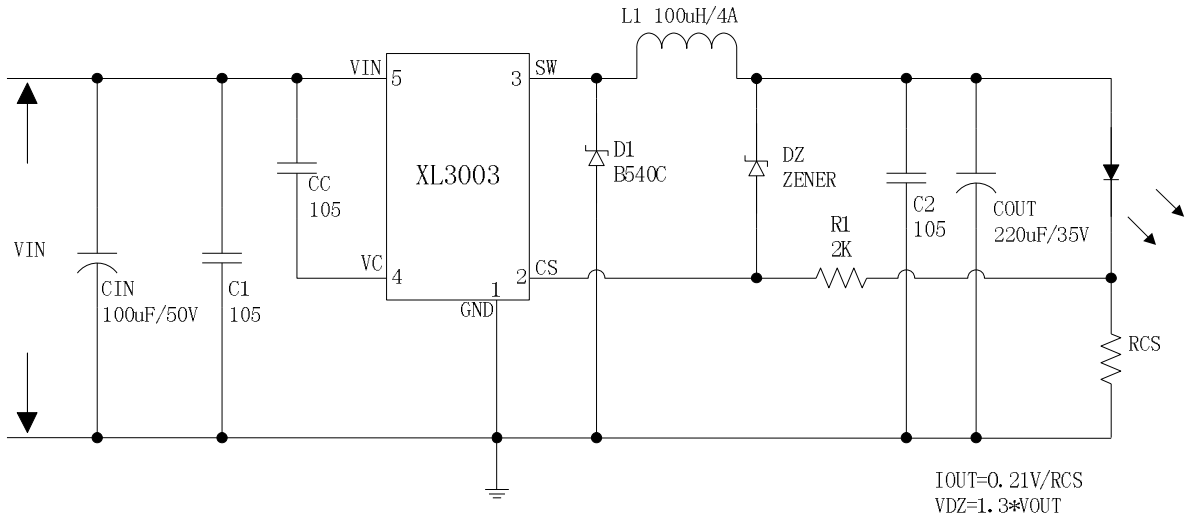


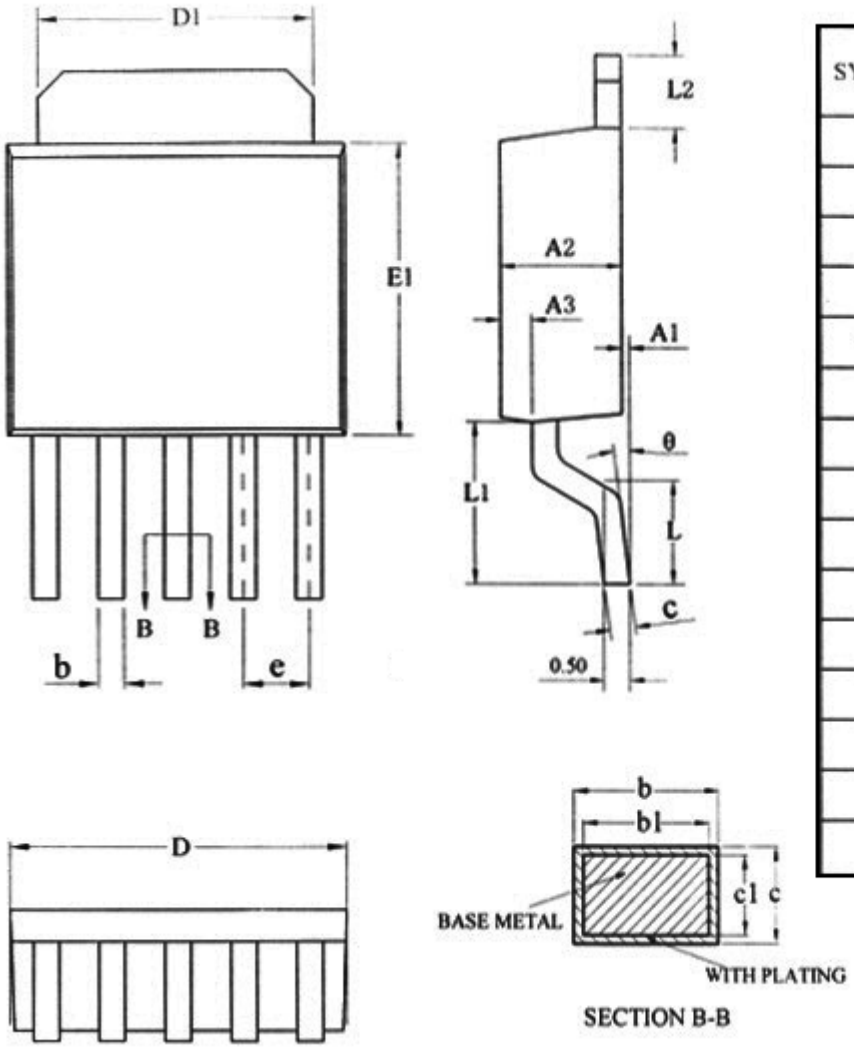

Figure19. XL3003 System Parameters Test Circuit (LED OVP)

## 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 |
| | | | | | | | |
| 5A | | √ | 1N5823 | 1N5824 | 1N5825 | | |
| | | √ | SR502 | SR503 | SR504 | SR505 | SR506 |
| | | √ | SB520 | SB530 | SB540 | SB550 | SB560 |
| | √ | | | 50WQ03 | 50WQ04 | 50WQ05 | |
| | | | | | | | |
| 8A | | √ | SR820 | SR830 | SR840 | SR850 | SR860 |

## Package Information

### TO252-5L




| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A1 | 0.05 | 0.15 | 0.25 |
| A2 | 2.10 | 2.30 | 2.50 |
| A3 | 0.50 | 0.60 | 0.70 |
| b | 0.46 | — | 0.60 |
| b1 | 0.45 | 0.50 | 0.55 |
| c | 0.49 | — | 0.56 |
| c1 | 0.48 | 0.50 | 0.52 |
| D | 6.30 | 6.50 | 6.70 |
| D1 | 5.30REF | | |
| E1 | 5.30 | 5.50 | 5.70 |
| e | 1.27BSC | | |
| L | 1.40 | 1.50 | 1.60 |
| L1 | 3.00 | 3.10 | 3.30 |
| L2 | 1.40BSC | | |
| θ | 0 | — | 8° |

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