

Features

- Operation Voltage: 5V~45V
- 0.23V Constant Current Sense Voltage
- Directly drive 1~10 Series LED
- Current Sense Voltage Accuracy $\pm 4\%$
- Fixed 200KHz Switching Frequency
- 4A Constant Output Current Capability
- Internal Optimize Power MOSFET
- High efficiency up to 95%
- Max. Output power up to 30W
- Maximum Duty Cycle 100%
- Excellent line and load regulation
- Built in thermal shutdown function
- Built in current limit protection function
- Temperature Grade 1: -40°C to 125°C
Ambient Operating Temperature Range
- Available in TO252-5L package

General Description

The XL9504 is a 200KHz fixed frequency PWM synchronous buck LED constant current driver, capable of driving a 4A load with high efficiency, low ripple and excellent line and load regulation. XL9504 supports wide input operating voltage range of 5V ~ 45V and a maximum duty cycle of 100% output. A built-in loop compensation module reduces components in the system, lowering power system cost and reducing printed circuit board space.

The XL9504 has built-in thermal shutdown, current limit protection and so on.

Applications

- Buck constant current driver
- LED backlight driver
- General purpose LED lighting

Typical application schematic

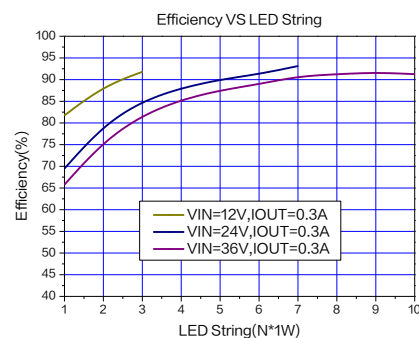
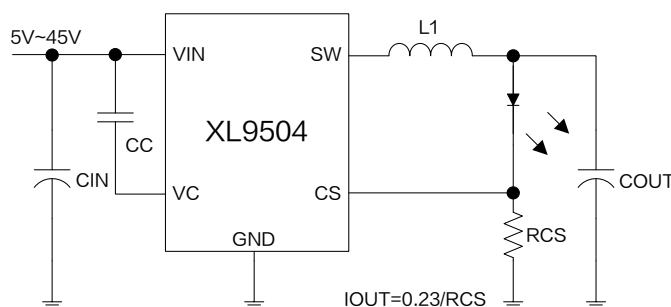


Figure1. XL9504 Typical application schematic and efficiency curve

Pin Configurations

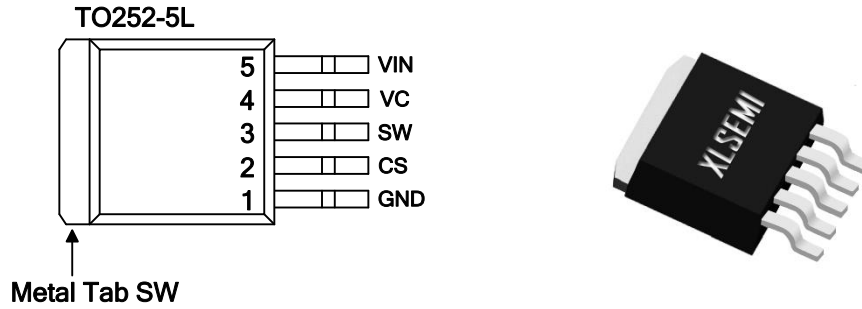


Figure2. Pin Configuration of XL9504

Table 1 Pin Description

Pin Number	Pin Name	Description
1	GND	Ground Pin.
2	CS	Output constant current sense Pin (CS). The CS reference voltage is 0.23V.
3	SW	Power Switch Output Pin (SW). Output 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 capacitor to VIN.
5	VIN	Supply Voltage Input Pin. XL9504 operates from 5V to 45V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.

Ordering Information

Order Information	Marking ID	Package Type	Eco Plan	Packing Type Supplied As
XL9504	XL9504	TO252-5L	RoHS & HF	2500 Units on Reel

Function Block

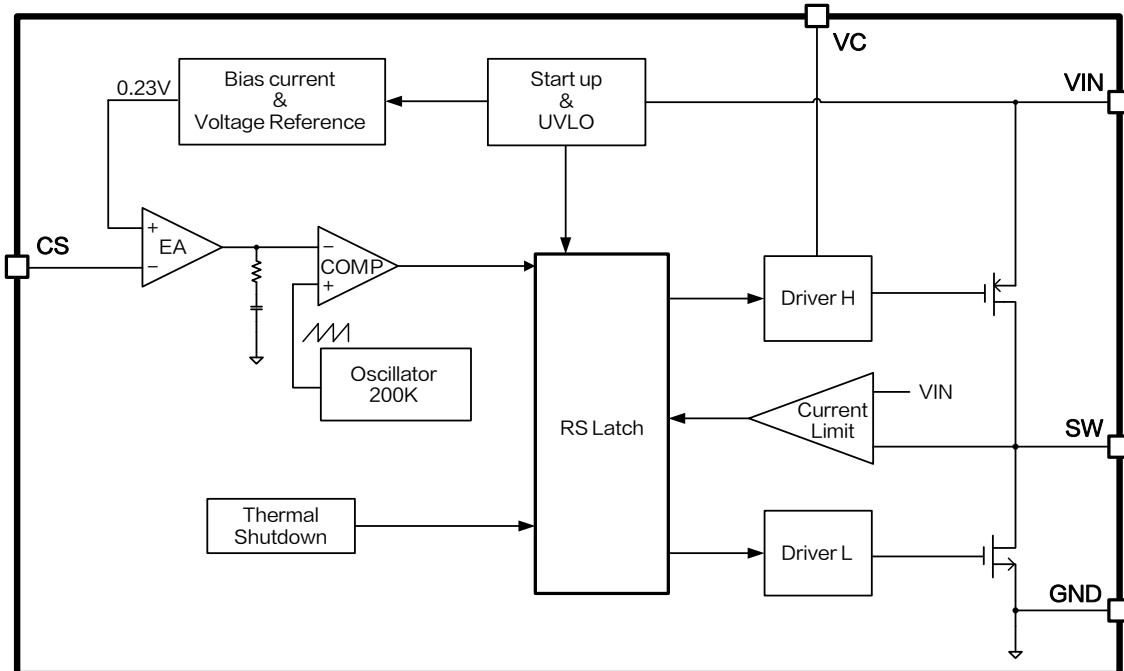


Figure3. Function Block Diagram of XL9504

Absolute Maximum Ratings (Note1)

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	-0.3~50	V
VC Pin Voltage	V_C	-0.3~ V_{IN}	V
Output Switch Pin Voltage	V_{SW}	-0.3~ V_{IN}	V
Current Sense Pin Voltage	V_{CS}	-0.3~7	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	-40~150	°C
Storage Temperature	T_{STG}	-65~150	°C
Lead Temperature (Soldering, 10 sec)	T_{LEAD}	260	°C
ESD (HBM)		>2500	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.

4A 200KHz 50V Synchronous Buck LED Constant Current Driver

XL9504

XL9504 Electrical Characteristics

$T_A = 25^\circ\text{C}$; system parameters test circuit figure4, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{CS}	Current Sense Voltage	$V_{IN} = 12\text{V}, V_{OUT} = 3.3\text{V}$ $I_{OUT} = 0.3\text{A}$	220.8	230.0	239.2	mV
η	Efficiency	$V_{IN} = 12\text{V}, V_{OUT} = 9.9\text{V}$ $I_{OUT} = 0.3\text{A}$	-	93.3	-	%
η	Efficiency	$V_{IN} = 12\text{V}, V_{OUT} = 9.9\text{V}$ $I_{OUT} = 1.2\text{A}$	-	95.9	-	%

Electrical Characteristics (DC Parameters)

$T_A = 25^\circ\text{C}, V_{IN} = 12\text{V}, I_{OUT} = 0.3\text{A}$; system parameters test circuit figure4, unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input operation voltage	V_{IN}		5		45	V
VIN UVLO	V_{IN_UVLO}			4.5		V
Quiescent Supply Current	I_Q	$V_{CS} = 2\text{V}$		2.5	5	mA
Oscillator Frequency	F_{OSC}		160	200	240	KHz
Switch Current Limit	I_L			4.1		A
High side MOS On-resistance	$R_{DS(ON)H}$			68		m Ω
Low side MOS On-resistance	$R_{DS(ON)L}$			50		m Ω
Thermal Shutdown Temperature	T_{SD}			145		$^\circ\text{C}$
Thermal Shutdown Hysteresis	T_D			40		$^\circ\text{C}$
Max. Duty Cycle	D_{MAX}	$V_{CS} = 0\text{V}$		100		%

4A 200KHz 50V Synchronous Buck LED Constant Current Driver **XL9504**

Typical System Application Schematic ($I_{OUT}=0.3A$)

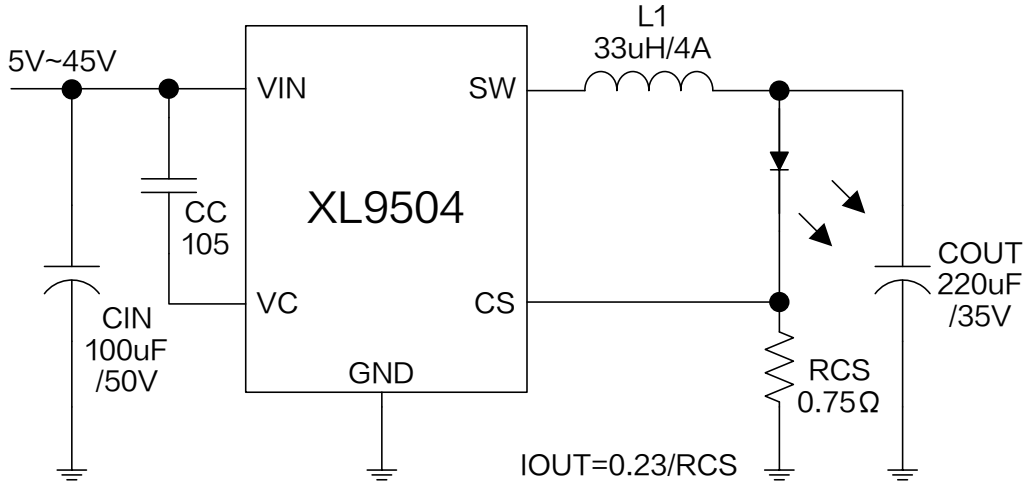


Figure4. XL9504 System Parameters Test Circuit ($V_{IN}=5V\sim 45V, I_{OUT}=0.3A$)

Typical System Application Transfer Efficiency

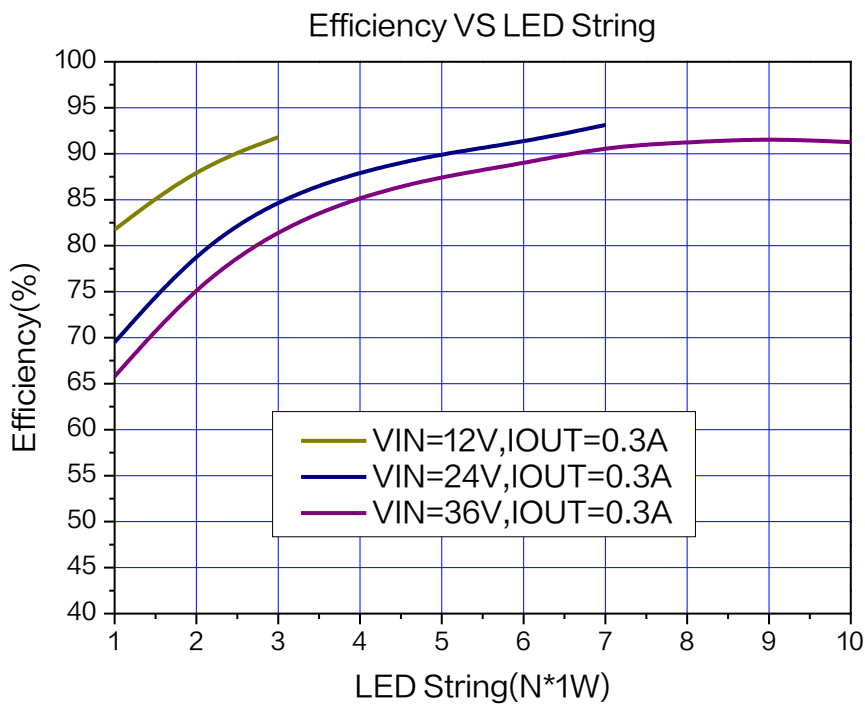


Figure5. XL9504 System Efficiency Curve ($I_{OUT}=0.3A$)

Typical System Application Schematic ($I_{OUT}=0.9A$)

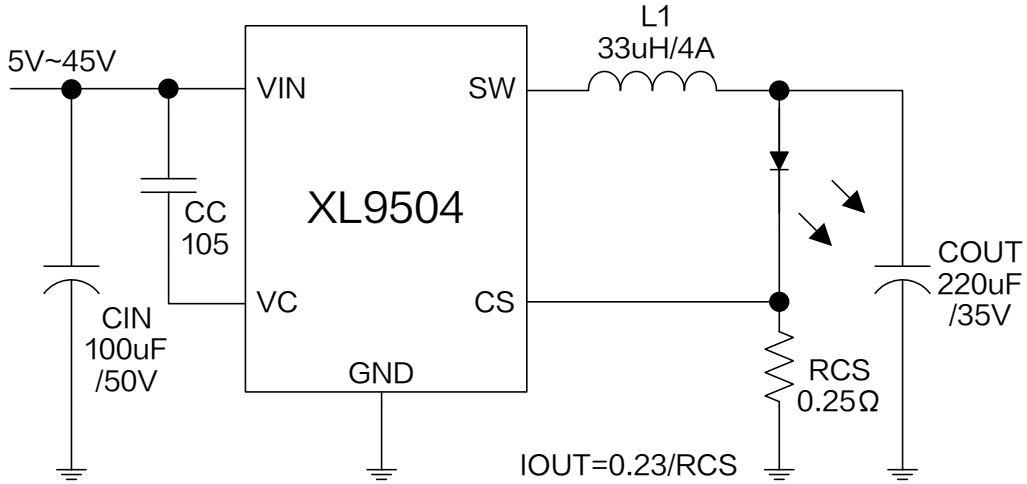


Figure6. XL9504 System Parameters Test Circuit ($V_{IN}=5V\sim 45V, I_{OUT}=0.9A$)

Typical System Application Transfer Efficiency

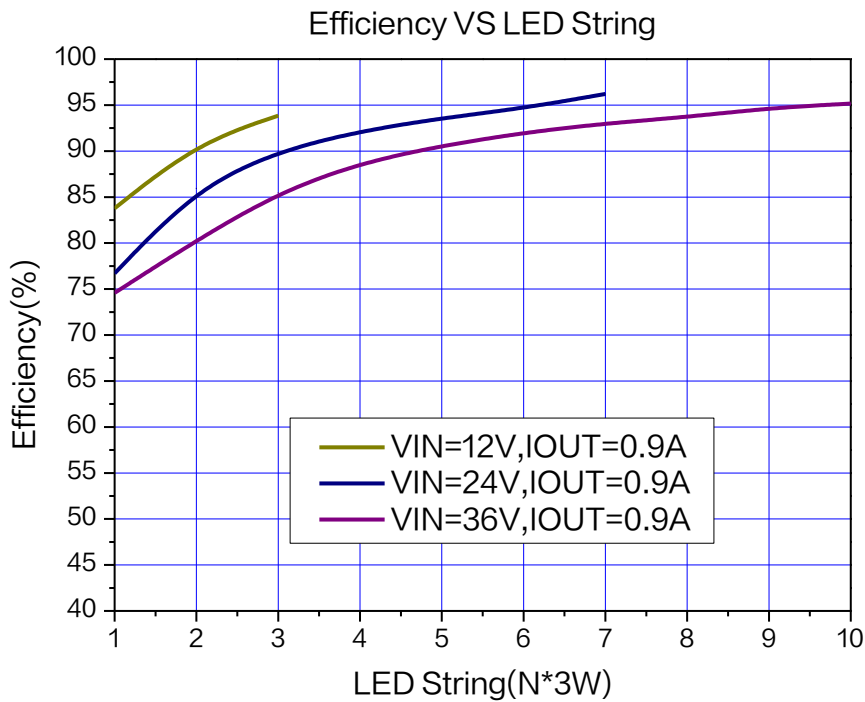


Figure7. XL9504 System Efficiency Curve ($I_{OUT}=0.9A$)

Typical System Application Schematic ($I_{OUT}=1.5A$)

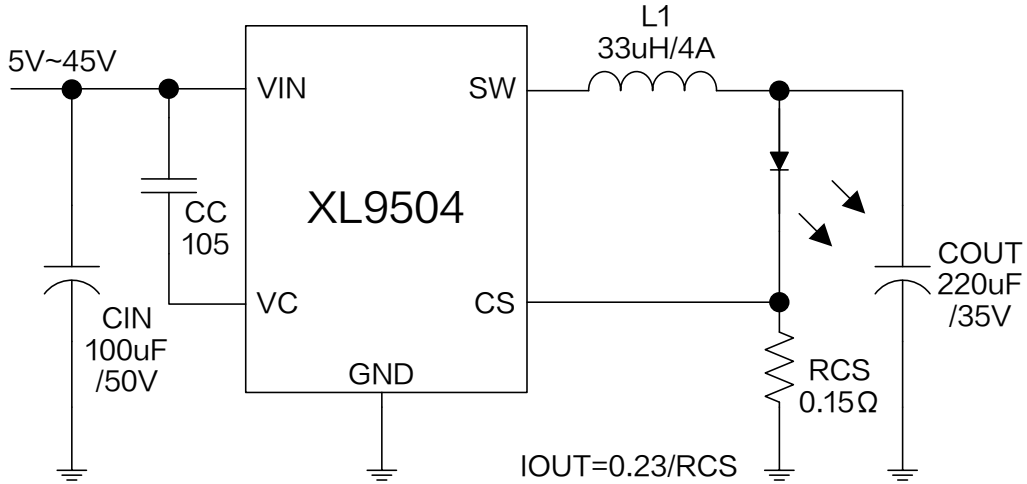


Figure8. XL9504 System Parameters Test Circuit ($V_{IN}=5V\sim 45V, I_{OUT}=1.5A$)

Typical System Application Transfer Efficiency

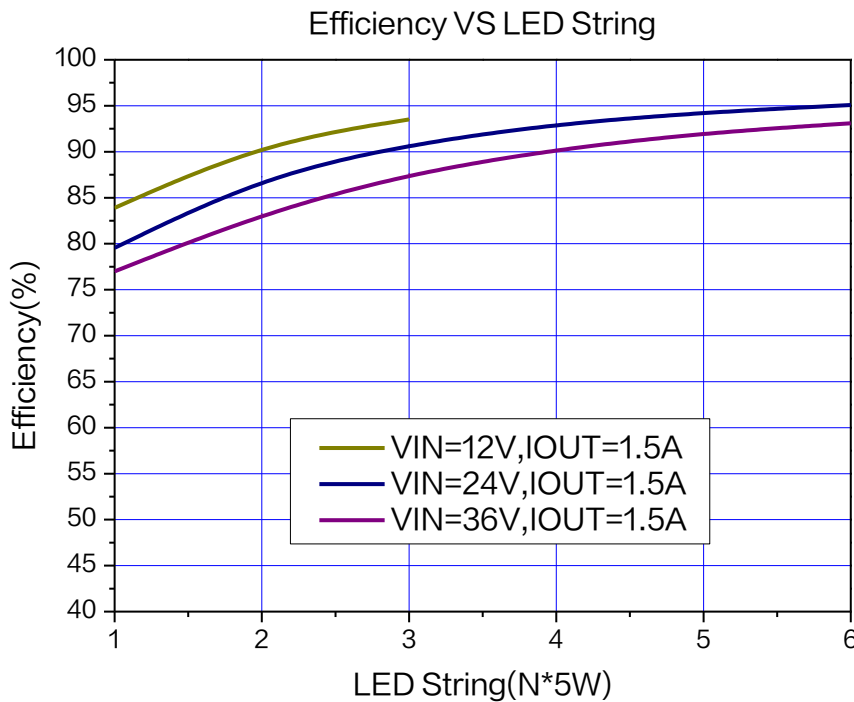


Figure9. XL9504 System Efficiency Curve ($I_{OUT}=1.5A$)

Typical System Application Schematic ($I_{OUT}=2.1A$)

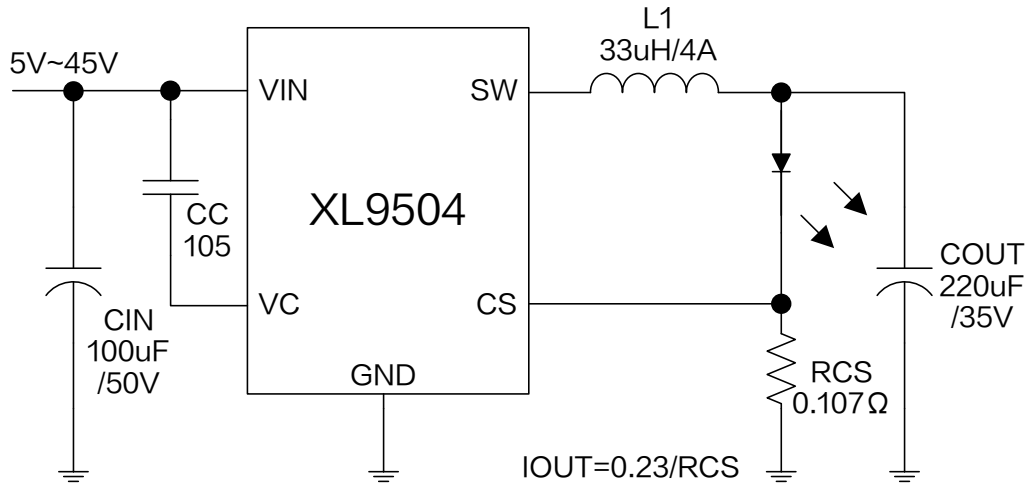


Figure10. XL9504 System Parameters Test Circuit ($V_{IN}=5V\sim 45V, I_{OUT}=2.1A$)

Typical System Application Transfer Efficiency

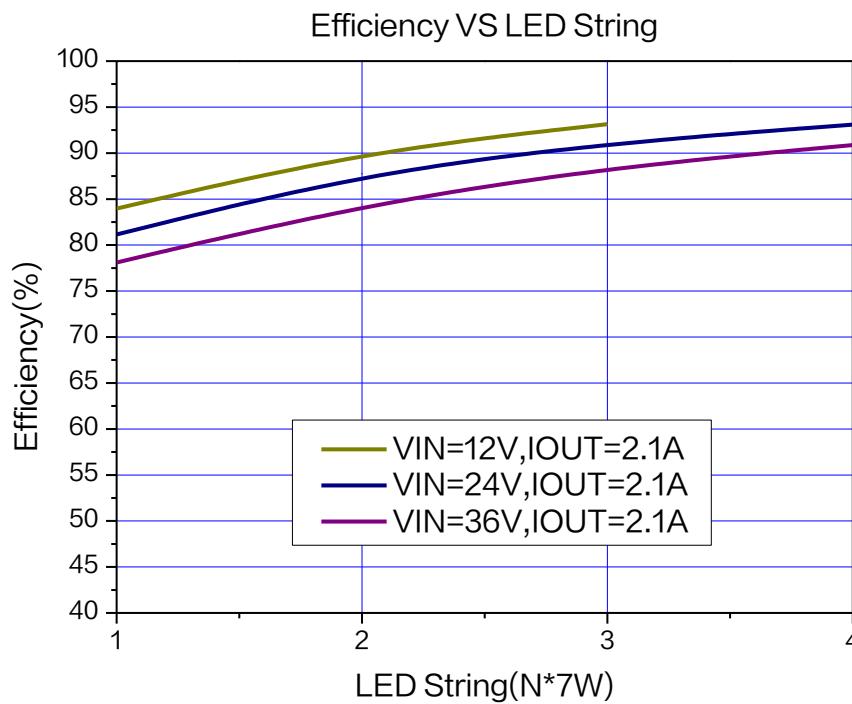


Figure11. XL9504 System Efficiency Curve ($I_{OUT}=2.1A$)

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 voltage is 5V.

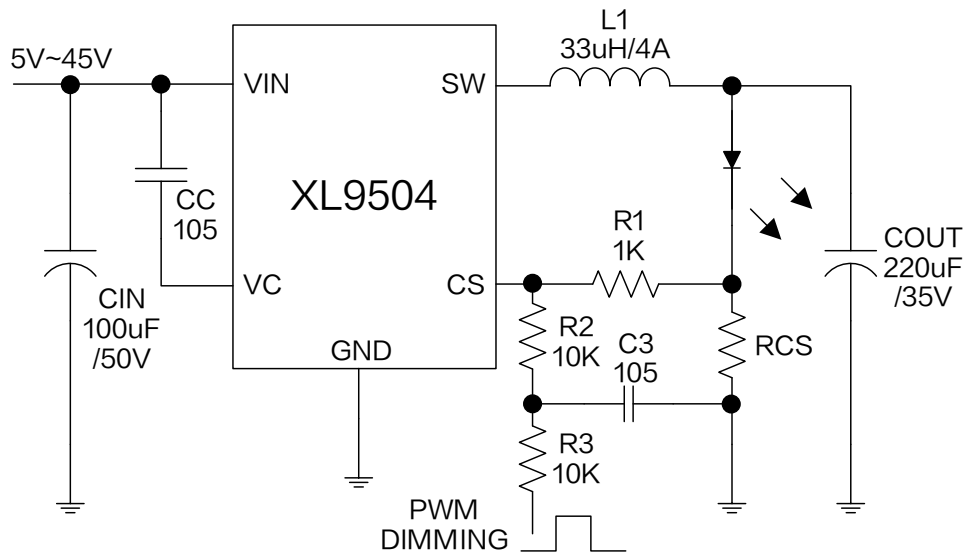


Figure12. XL9504 System Parameters Test Circuit (PWM DIMMING)

Typical System Application (EMI Countermeasures)

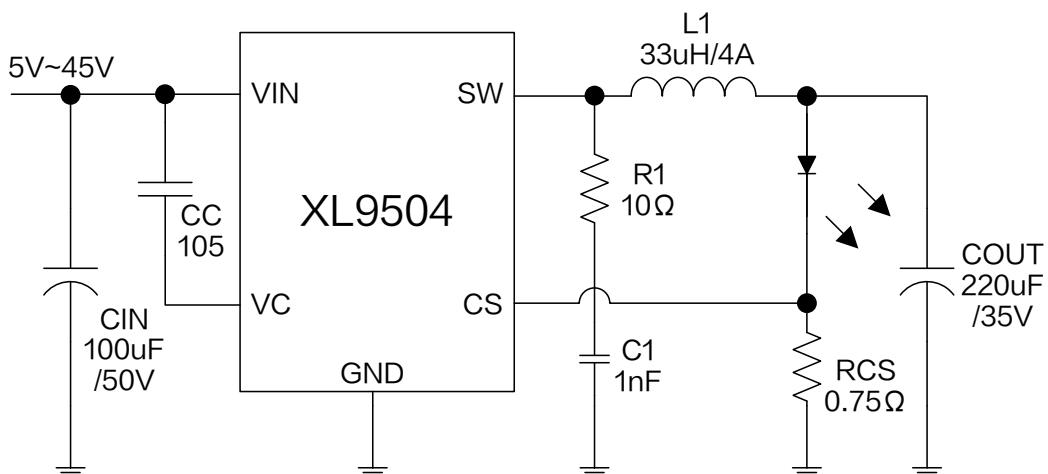


Figure13. XL9504 System Parameters Test Circuit (EMI Countermeasures)

Typical Characteristics (LED forward voltage V_F is 3.3V at $I_F=0.3A$, unless otherwise noted.)

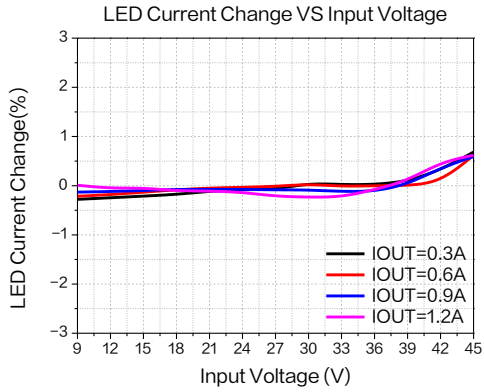


Figure14.Line Regulation

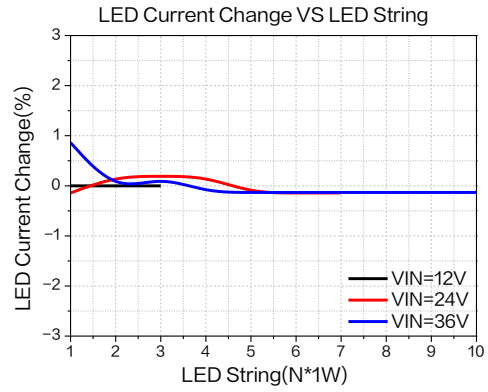


Figure15.Load Regulation

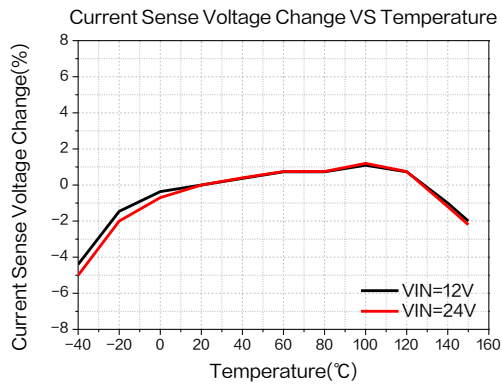


Figure16.Current Sense Voltage Regulation

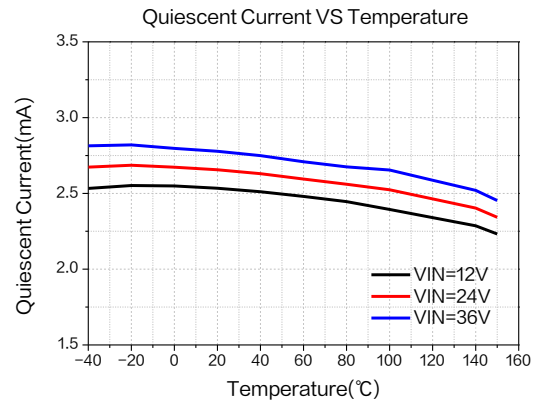


Figure17.Quiescent Current

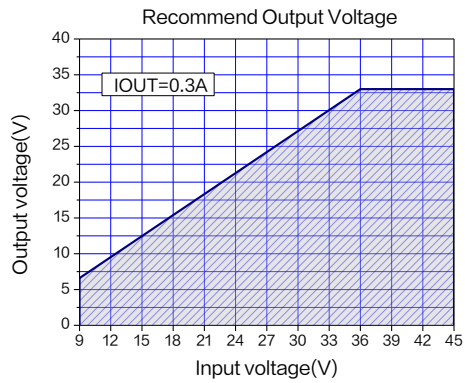


Figure18.Max Output Voltage
($I_{OUT}=0.3A$, $T_A=25^{\circ}C$)

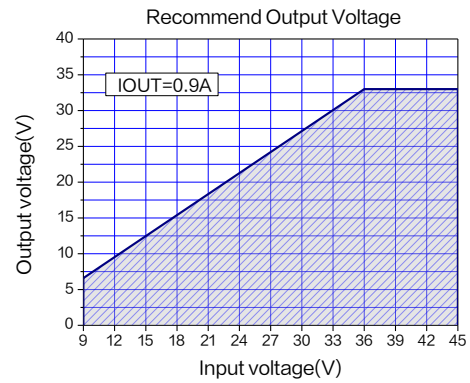


Figure19.Max Output Voltage
($I_{OUT}=0.9A$, $T_A=25^{\circ}C$)

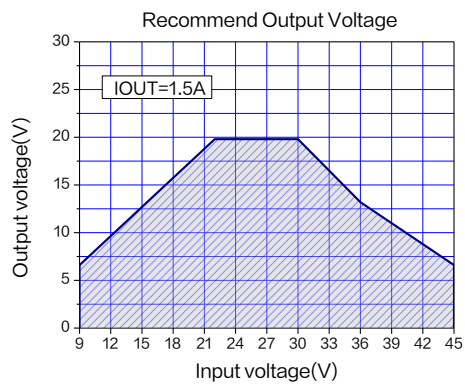


Figure20.Max Output Voltage
($I_{OUT}=1.5A$, $T_A=25^{\circ}C$)

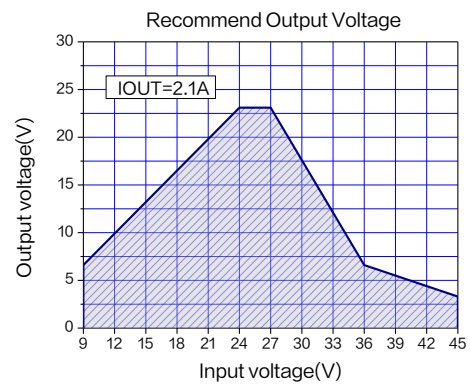


Figure21.Max Output Voltage
($I_{OUT}=2.1A$, $T_A=25^{\circ}C$)

4A 200KHz 50V Synchronous Buck LED Constant Current Driver

XL9504

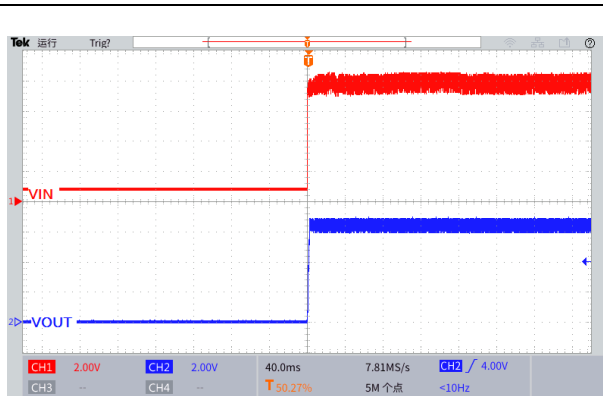


Figure22. Start-Up Characteristic
($V_{IN}=8V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

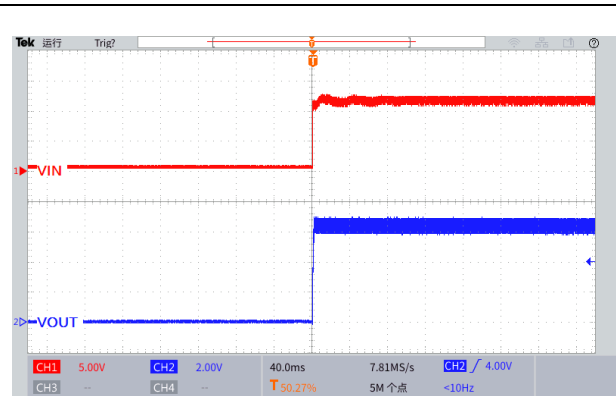


Figure23. Start-Up Characteristic
($V_{IN}=12V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

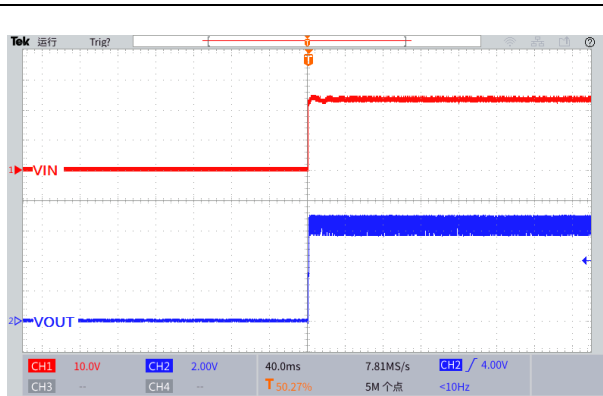


Figure24. Start-Up Characteristic
($V_{IN}=24V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

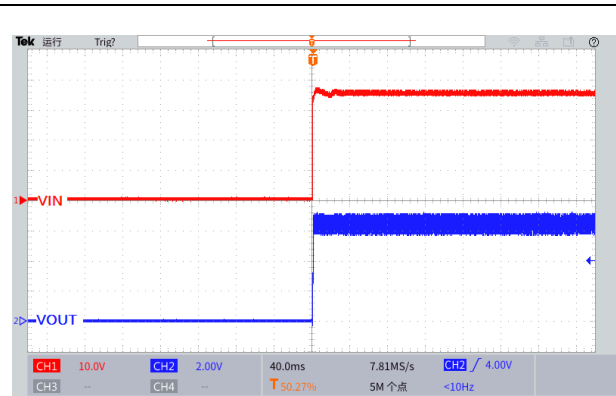


Figure25. Start-Up Characteristic
($V_{IN}=36V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

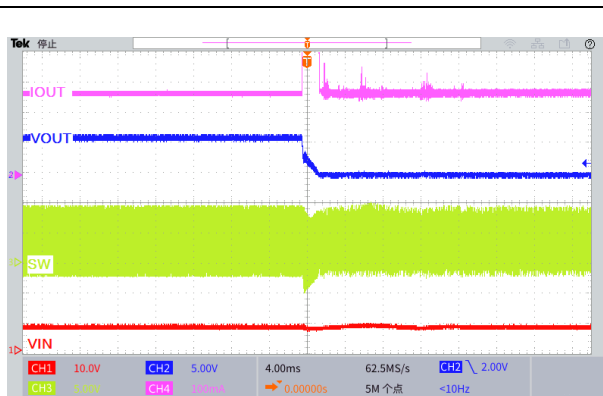


Figure26. LED Short Protection
($V_{IN}=8V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

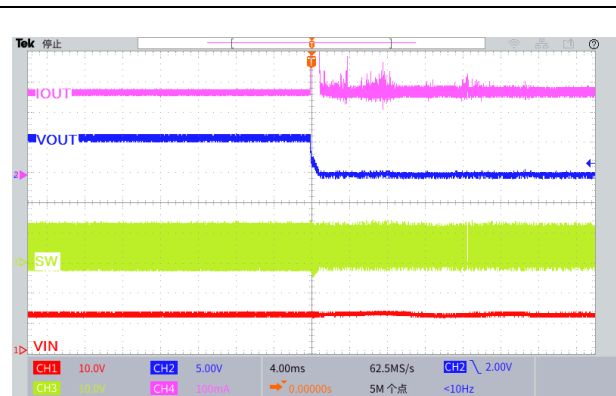


Figure27. LED Short Protection
($V_{IN}=12V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

4A 200KHz 50V Synchronous Buck LED Constant Current Driver

XL9504

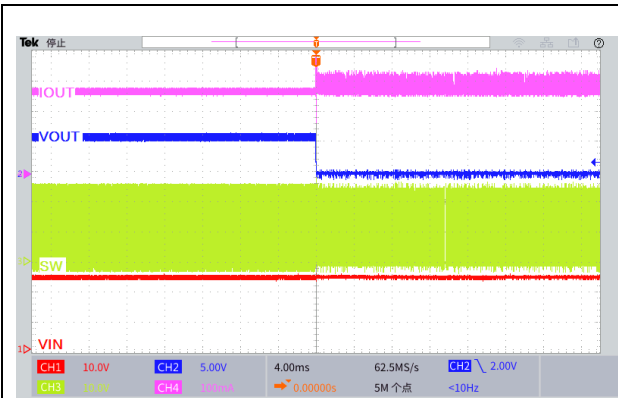


Figure28. LED Short Protection
($V_{IN}=24V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

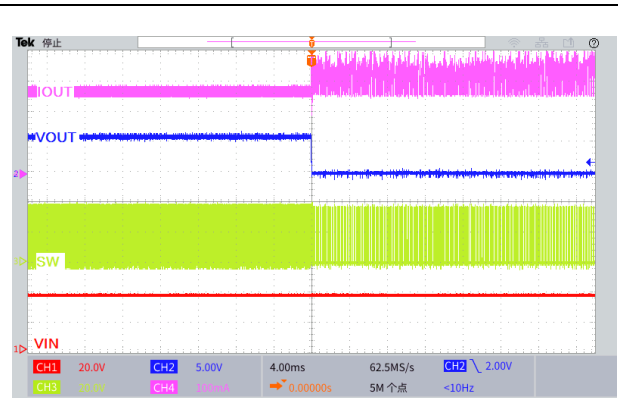


Figure29. LED Short Protection
($V_{IN}=36V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

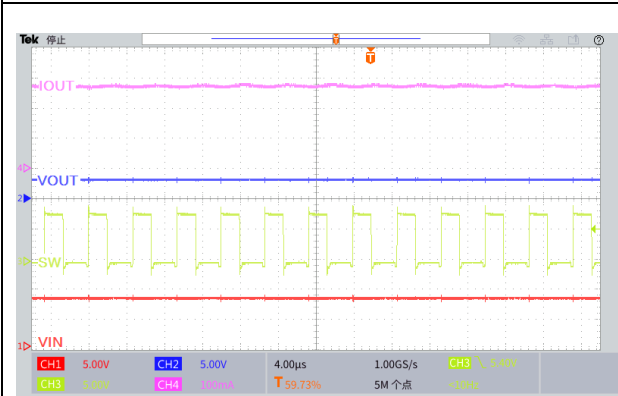


Figure30. LED Current Ripple
($V_{IN}=8V$, $V_{OUT}=3.3V$, $I_{OUT}=0.3A$)

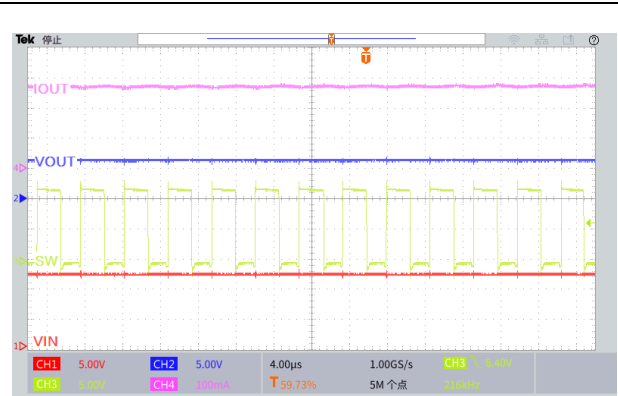


Figure31. LED Current Ripple
($V_{IN}=12V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)



Figure32. LED Current Ripple
($V_{IN}=24V$, $V_{OUT}=6.6V$, $I_{OUT}=0.3A$)

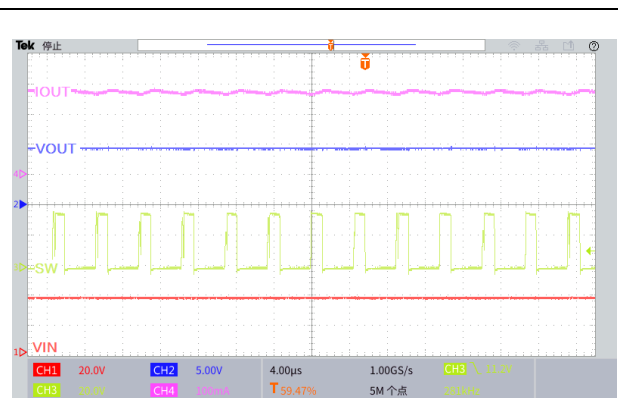
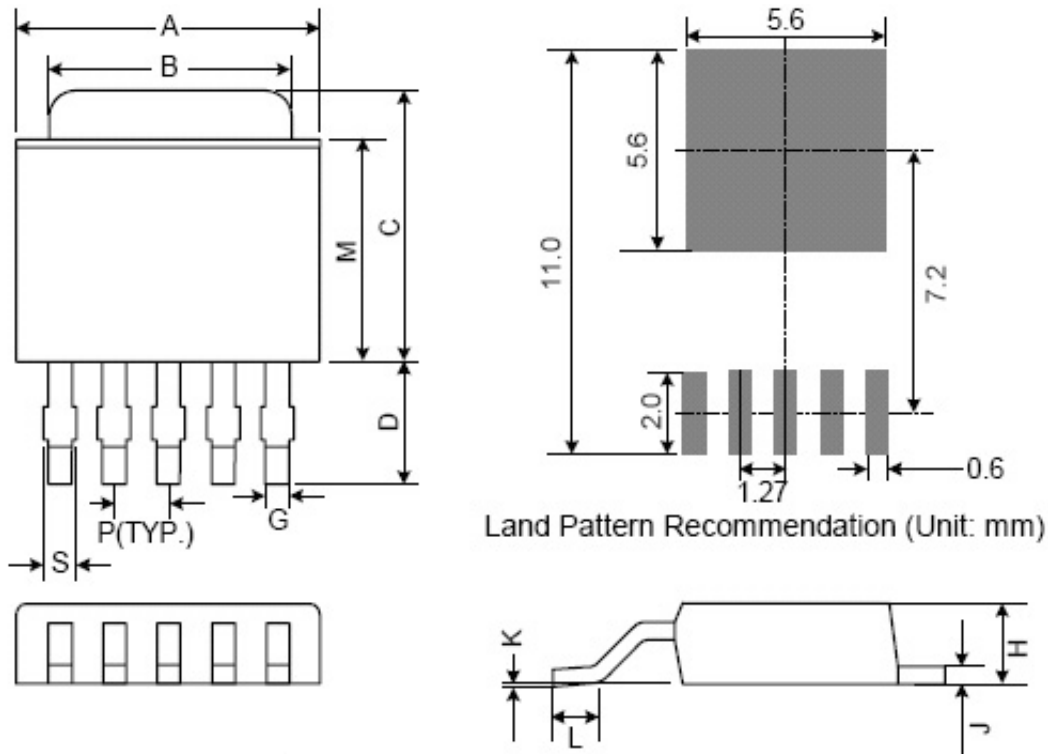


Figure33. LED Current Ripple
($V_{IN}=36V$, $V_{OUT}=9.9V$, $I_{OUT}=0.3A$)

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.			0.05 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	1.77	0.035	0.047	0.064
M	5.40	5.80	6.20	0.213	0.228	0.244

4A 200KHz 50V Synchronous Buck LED Constant Current Driver**XL9504**

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