

150KHz 60V 2A Buck DC to DC Converter

XL1509A

Features

- Operating Voltage: 4.5V~50V
- Adjustable, 3.3V, 5.0V and 12V Versions
- Output Adjustable from 1.23V to 48V
- Maximum Duty Cycle 100%
- Feedback Voltage Accuracy $\pm 1.5\%$
- Minimum Drop Out 1.5V
- Fixed 150KHz Switching Frequency
- 2A Constant Output Current Capability
- Internal Optimize HV Power Transistor
- High efficiency up to 90%
- Excellent line and load regulation
- TTL shutdown capability
- Built in thermal shutdown function
- Built in current limit protection function
- Built in output short protection function
- Temperature Grade 1: -40°C to 125°C
Ambient Operating Temperature Range
- Device HBM ESD Classification Level Class3B
- Available in SOP8 package

General Description

The XL1509A is a 150 KHz fixed frequency buck DC/DC converter, capable of driving a 2A load with high voltage, high efficiency. The XL1509A supports wide input operating voltage range of 4.5V ~ 50V 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 XL1509A is available in adjustable, fixed 3.3V, 5.0V and 12V versions. The XL1509A has built-in thermal shutdown, current limit protection and output short protection function and so on. When the output short protection function happens, the operation frequency will be reduced about from 150KHz to 30KHz.

Applications

- Automotive Electronics
- Industrial Control
- Networking Equipment
- Internet of Things

Typical application schematic

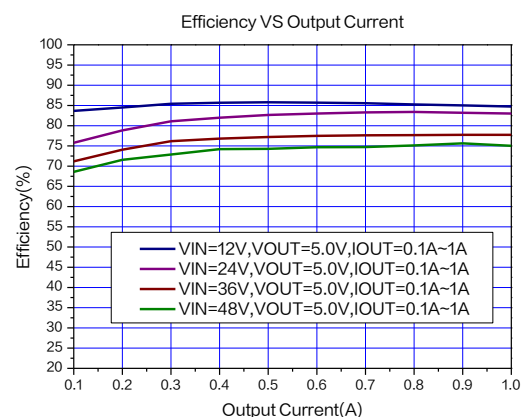
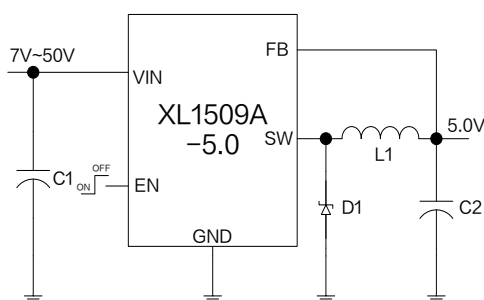


Figure1.XL1509A-5.0 Typical application schematic and efficiency curve

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Pin Configurations

VIN	1	8	GND
SW	2	7	GND
FB	3	6	GND
EN	4	5	GND

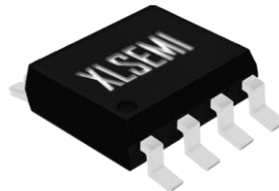


Figure2. Pin Configuration of XL1509A

Table 1. Pin Description

Pin Number	Pin Name	Description
1	VIN	Supply Voltage Input Pin. XL1509A DC operating voltage range from a 4.5V to 50V. Bypass VIN to GND with a suitably large capacitor to eliminate noise on the input.
2	SW	Power Switch Output Pin (SW). Output is the switch node that supplies power to the output.
3	FB	Feedback Pin (FB). Through an external resistor divider network, detects the output voltage for adjustment, with an adjustable version reference voltage of 1.23V.
4	EN	Enable Pin. Drive EN pin low to turn on the device, drive it high to turn it off. Floating is default low.
5~8	GND	Ground Pin.

Ordering Information

Order Information	Marking ID	Package Type	Packing Type Supplied As
XL1509A-ADJE1	XL1509A-ADJE1	SOP8	4000 Units on Reel
XL1509A-3.3E1	XL1509A-3.3E1	SOP8	4000 Units on Reel
XL1509A-5.0E1	XL1509A-5.0E1	SOP8	4000 Units on Reel
XL1509A-12E1	XL1509A-12E1	SOP8	4000 Units on Reel

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

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Function Block

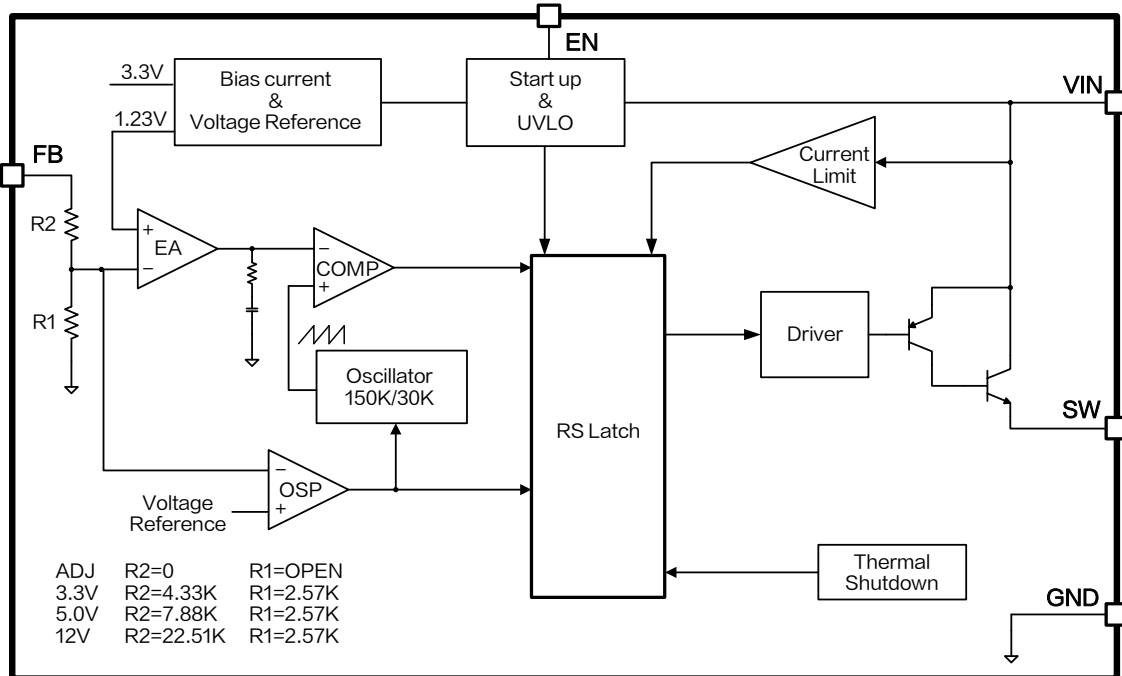


Figure3. Function Block Diagram of XL1509A

Absolute Maximum Ratings(Note1)

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	-0.3~60	V
Feedback Pin Voltage	V_{FB}	-0.3~20	V
EN Pin Voltage	V_{EN}	-0.3~7	V
Output Switch Pin Voltage	V_{SW}	-0.3~ V_{IN}	V
Power Dissipation	P_D	Internally limited	mW
Thermal Resistance (SOP8) (Junction to Ambient, No Heatsink, Free Air)	R_{JA}	100	$^{\circ}C/W$
Operating Junction Temperature	T_J	-40~150	$^{\circ}C$
Storage Temperature	T_{STG}	-65~150	$^{\circ}C$
Lead Temperature (Soldering, 10 sec)	T_{LEAD}	260	$^{\circ}C$
ESD (HBM)		> 8000	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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XL1509A-ADJ Electrical Characteristics

T_A = 25°C; System parameters test circuit figure4 and figure6, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V _{FB}	Feedback Voltage	V _{IN} = 12V, V _{OUT} = 5.0V I _{OUT} = 0.5A	1.212	1.23	1.248	V
η	Efficiency	V _{IN} = 12V, V _{OUT} = 5.0V I _{OUT} = 1A	-	84.7	-	%
η	Efficiency	V _{IN} = 24V, V _{OUT} = 15V I _{OUT} = 0.5A	-	92.6	-	%

XL1509A-3.3 Electrical Characteristics

T_A = 25°C; System parameters test circuit figure8, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V _{OUT}	Output Voltage	V _{IN} = 12V I _{OUT} = 0.5A	3.250	3.3	3.350	V
η	Efficiency	V _{IN} = 12V, V _{OUT} = 3.3V I _{OUT} = 1A	-	80	-	%

XL1509A-5.0 Electrical Characteristics

T_A = 25°C; System parameters test circuit figure10, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V _{OUT}	Output Voltage	V _{IN} = 12V I _{OUT} = 0.5A	4.925	5.0	5.075	V
η	Efficiency	V _{IN} = 12V, V _{OUT} = 5.0V I _{OUT} = 1A	-	84.7	-	%

XL1509A-12 Electrical Characteristics

T_A = 25°C; System parameters test circuit figure12, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V _{OUT}	Output Voltage	V _{IN} = 24V I _{OUT} = 0.25A	11.82	12	12.18	V
η	Efficiency	V _{IN} = 24V, V _{OUT} = 12V I _{OUT} = 0.5A	-	91.3	-	%

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Electrical Characteristics (DC Parameters)

$T_A = 25^\circ\text{C}$, $V_{IN}=12\text{V}$, $V_{EN}=0\text{V}$, System parameters test circuit figure4, unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Operating Voltage	V_{IN}		4.5		50	V
Shutdown Current	I_S	$V_{EN}=2\text{V}$		46	100	μA
Quiescent Current	I_Q	Note2		1.3	2.0	mA
Oscillator Frequency	F_{OSC}		135	150	165	KHz
Switch Current Limit	I_L	$V_{FB}=0\text{V}$		3.0		A
EN Pin Threshold Voltage	V_{EN_H}	High (Regulator OFF)	1.4			V
	V_{EN_L}	Low (Regulator ON)			0.8	V
EN Pin Current	I_{EN}	$V_{EN}=2.0\text{V}$		5		μA
Output Saturation Voltage	V_{CE}	$V_{FB}=0\text{V}$ $I_{OUT}=2\text{A}$		1.1	1.3	V
Max. Duty Cycle	D_{MAX}	$V_{FB}=0\text{V}$		100		%
Thermal Shutdown Temperature	T_{SD}			180		$^\circ\text{C}$
Thermal Shutdown Hysteresis	T_D			50		$^\circ\text{C}$

Note 2: In the adjustable, fixed 3.3V and 5.0V versions, $V_{FB}=10\text{V}$; In the fixed 12V version, $V_{FB}=15\text{V}$.

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Typical System Application Schematic for ADJ Version

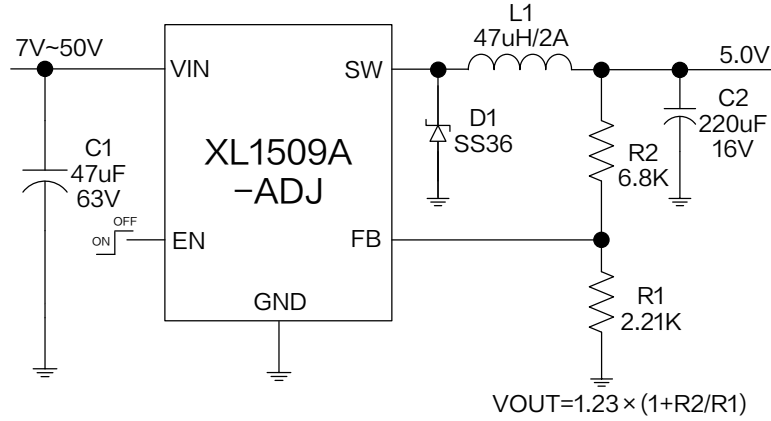


Figure4. XL1509A-ADJ System Parameters Test Circuit($V_{OUT}=5.0V$)

Typical System Application Transfer Efficiency

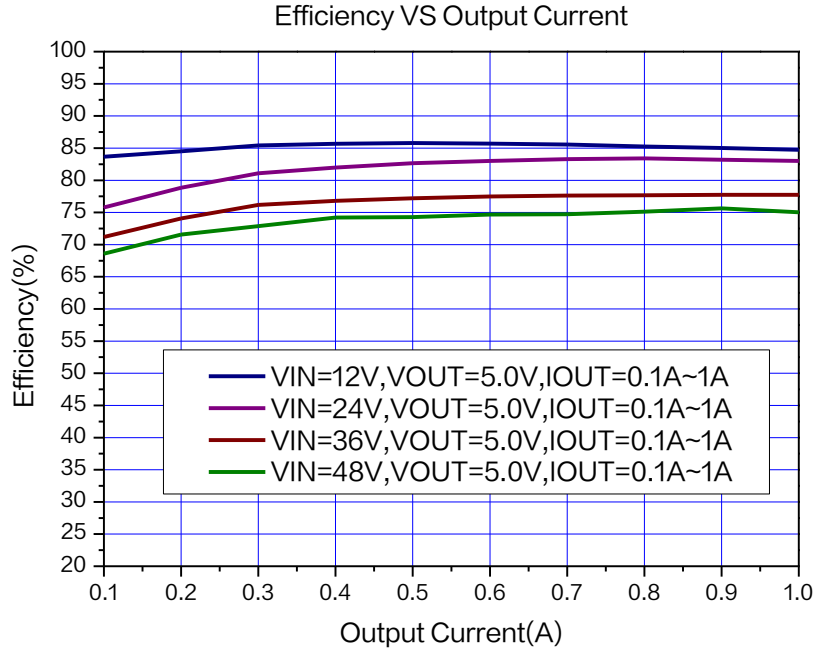


Figure5. XL1509A-ADJ System Efficiency Curve

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Typical System Application Schematic for ADJ Version

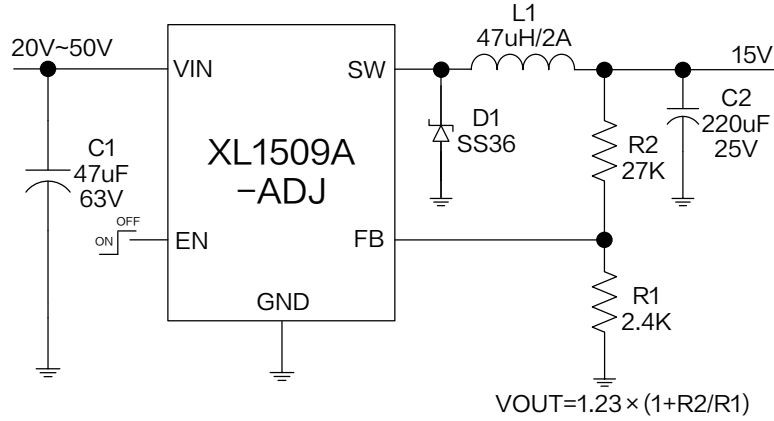


Figure6. XL1509A-ADJ System Parameters Test Circuit($V_{OUT}=15V$)

Typical System Application Transfer Efficiency

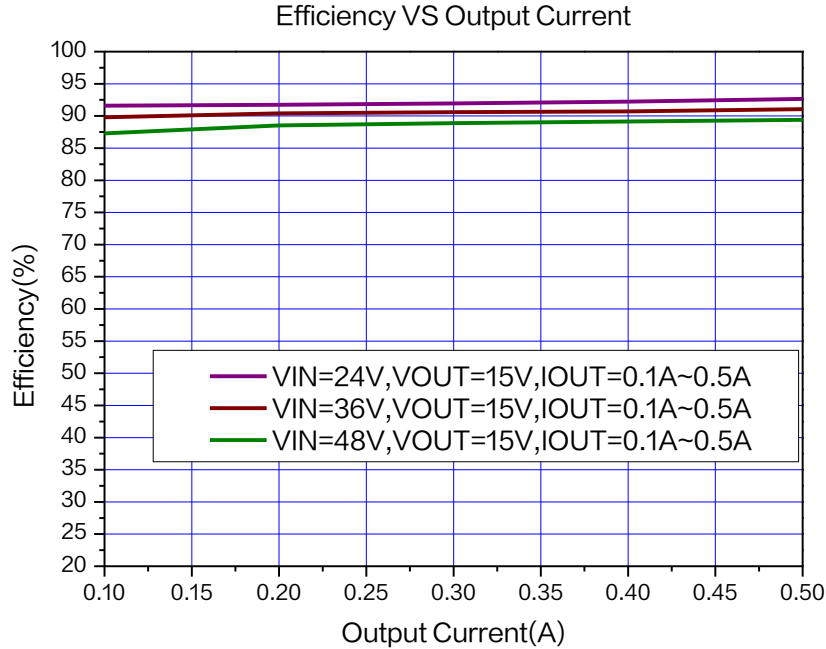


Figure7. XL1509A-ADJ System Efficiency Curve

Typical System Application Schematic for 3.3V Version

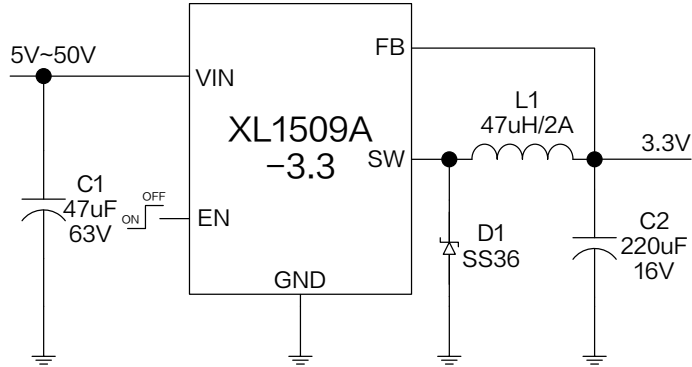


Figure8. XL1509A-3.3 System Parameters Test Circuit

Typical System Application Transfer Efficiency

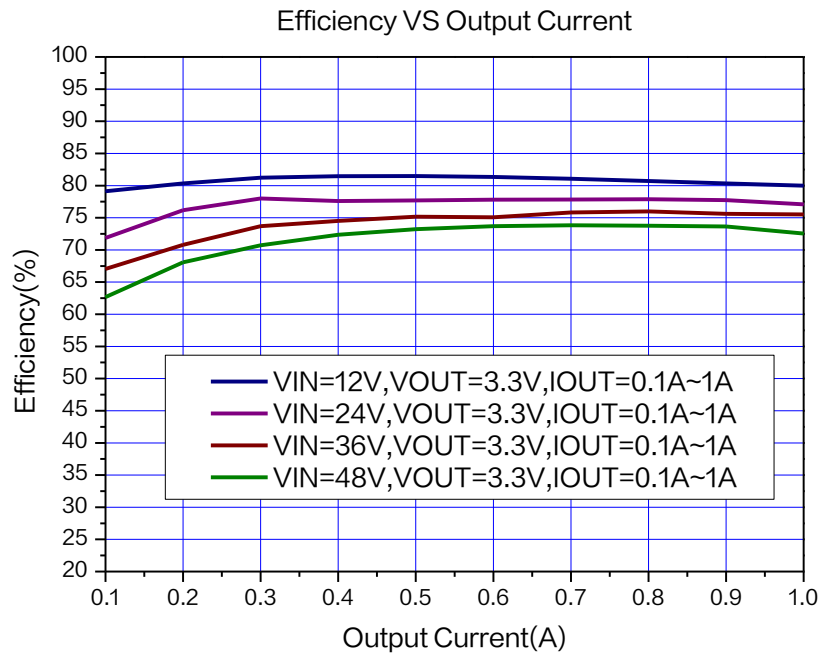


Figure9. XL1509A-3.3 System Efficiency Curve

Typical System Application Schematic for 5.0V Version

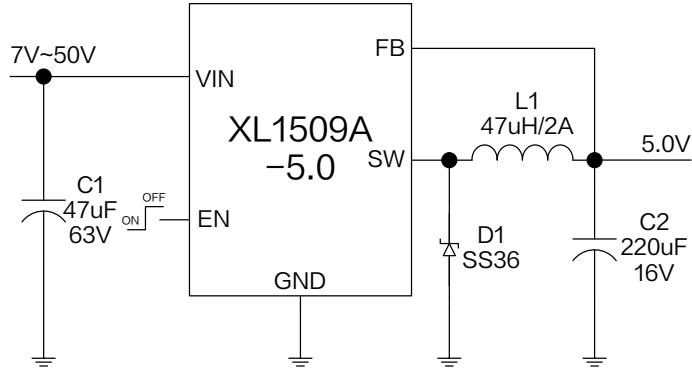


Figure10. XL1509A-5.0 System Parameters Test Circuit

Typical System Application Transfer Efficiency

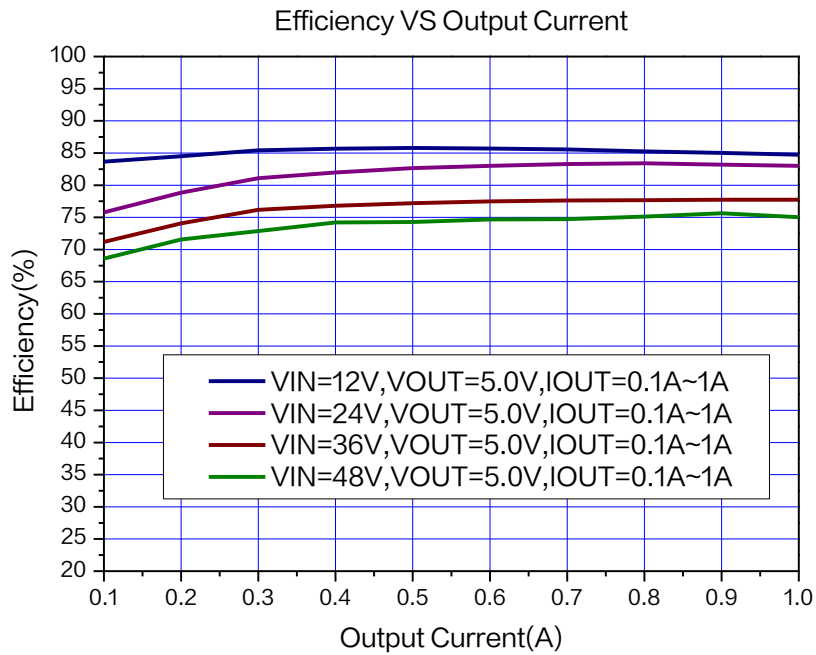


Figure11. XL1509A-5.0 System Efficiency Curve

Typical System Application Schematic for 12V Version

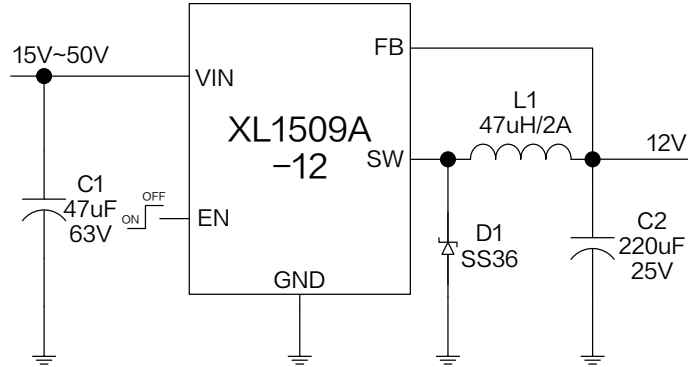


Figure12. XL1509A-12 System Parameters Test Circuit

Typical System Application Transfer Efficiency

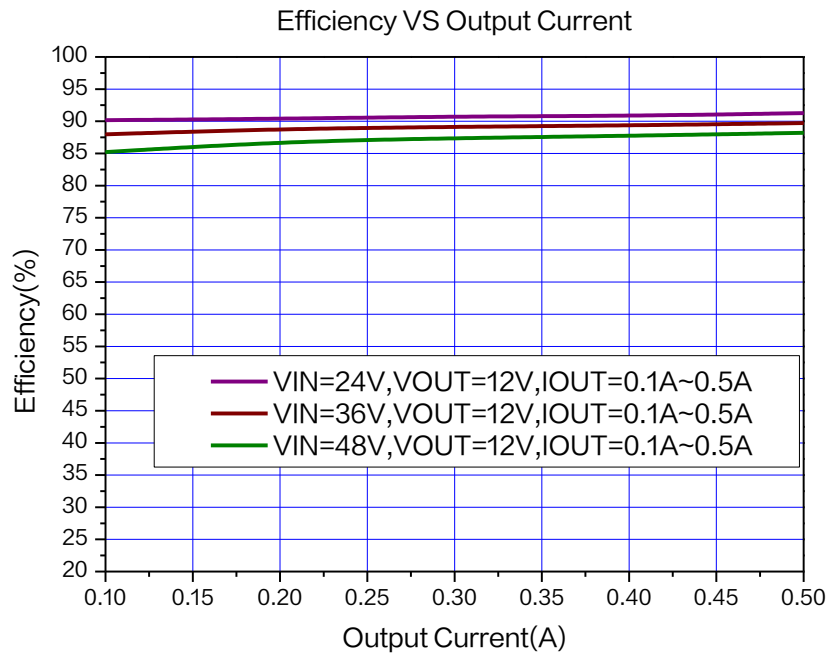


Figure13. XL1509A-12 System Efficiency Curve

Typical Characteristics

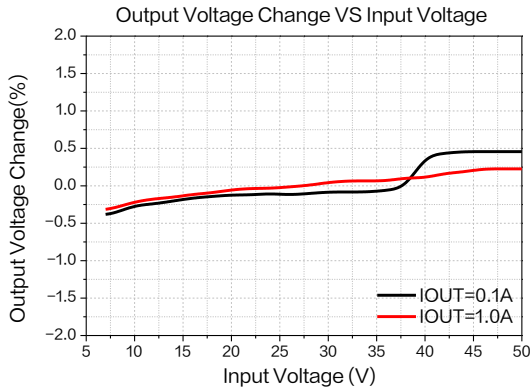


Figure14.Line Regulation

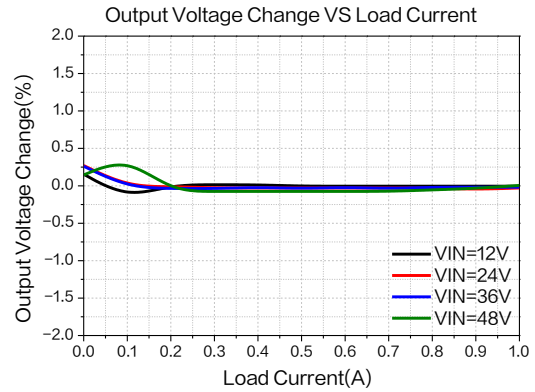


Figure15.Load Regulation

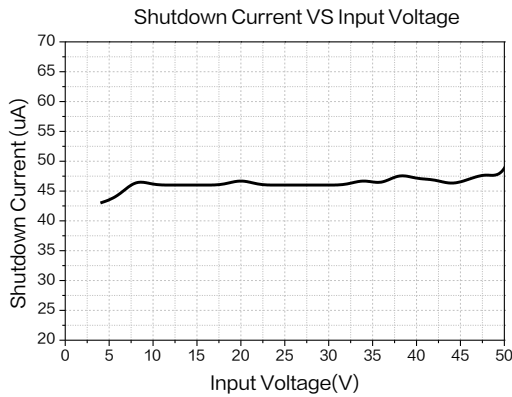


Figure16.Shutdown Current

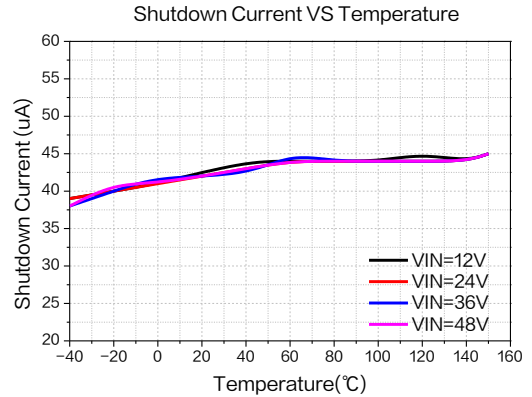


Figure17.Shutdown Current

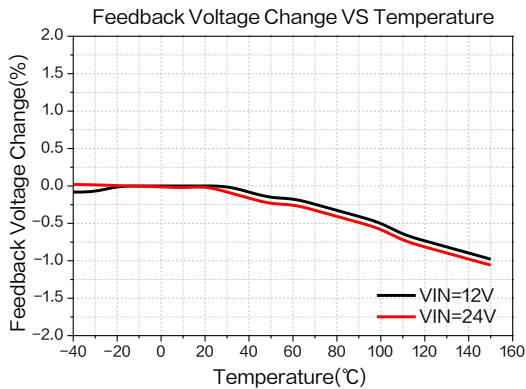


Figure18.Feedback Voltage Regulation

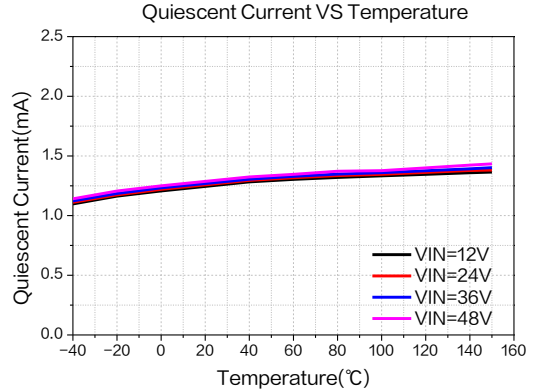


Figure19. Quiescent Current

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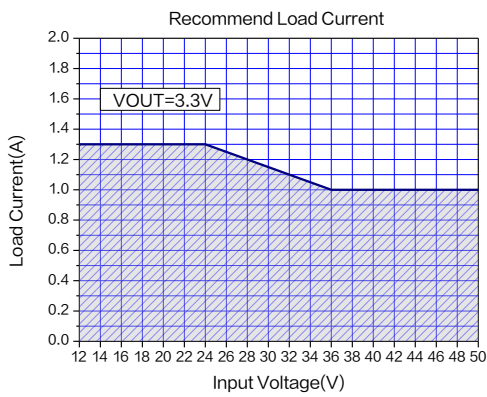


Figure 20. Max Output Current
(V_{OUT}=3.3V, T_A=25°C)

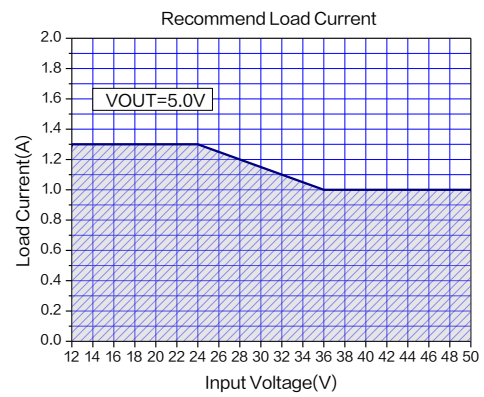


Figure 21. Max Output Current
(V_{OUT}=5.0V, T_A=25°C)

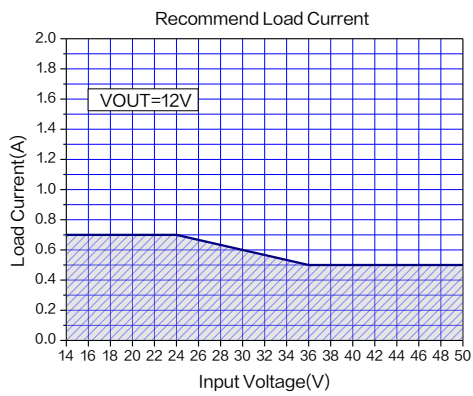


Figure 22. Max Output Current
(V_{OUT}=12V, T_A=25°C)

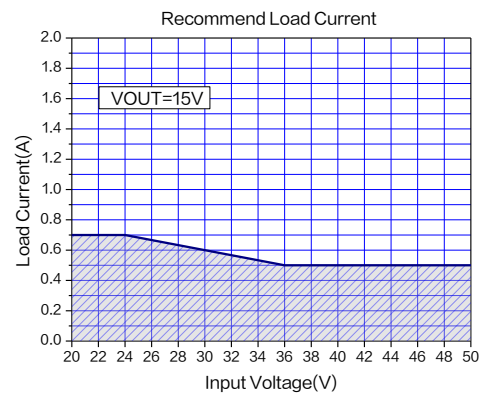


Figure 23. Max Output Current
(V_{OUT}=15V, T_A=25°C)

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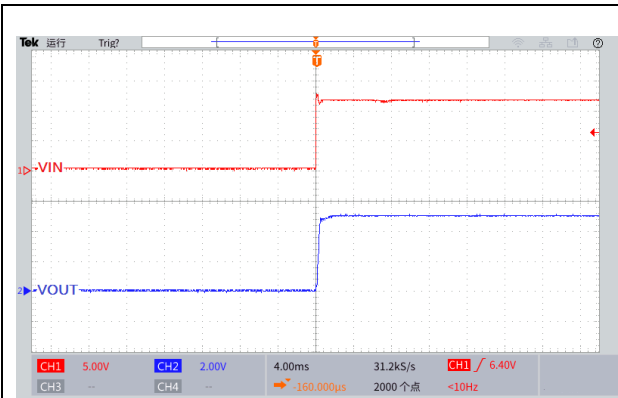


Figure 24. Start-Up Characteristic
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

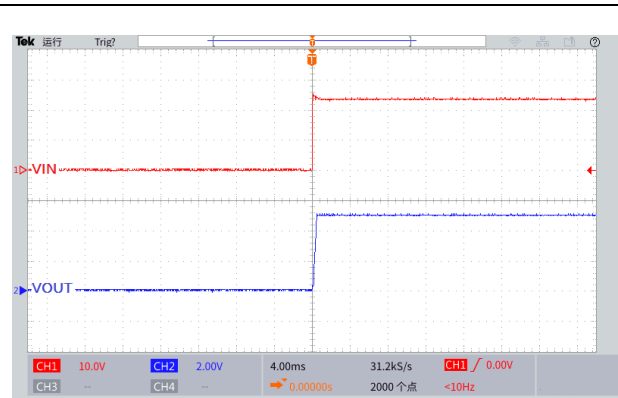


Figure 25. Start-Up Characteristic
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

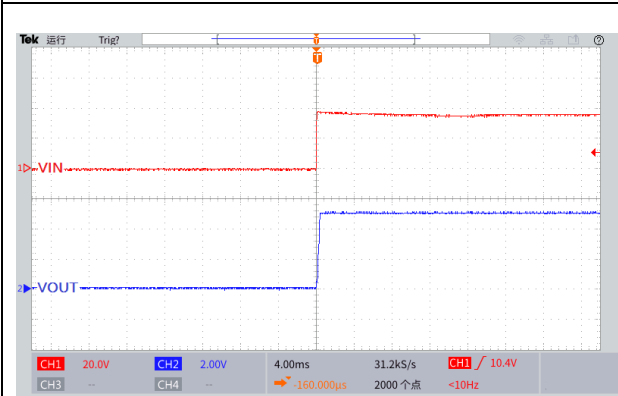


Figure 26. Start-Up Characteristic
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

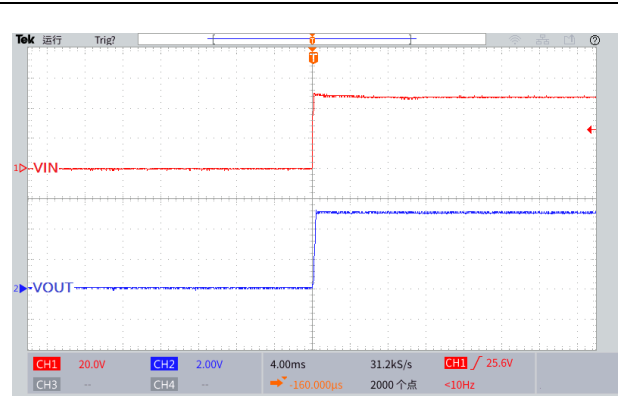


Figure 27. Start-Up Characteristic
($V_{IN}=48V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

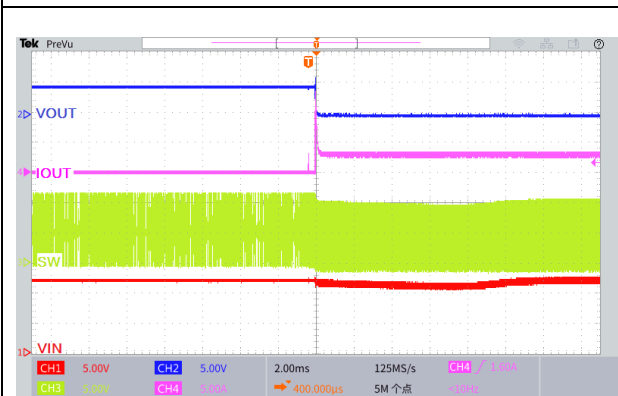


Figure 28. Output Short Circuit Waveform
($V_{IN}=12V$, $V_{OUT}=5.0V$)

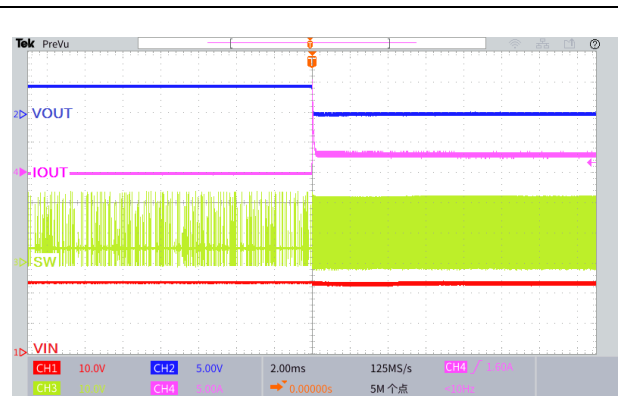


Figure 29. Output Short Circuit Waveform
($V_{IN}=24V$, $V_{OUT}=5.0V$)

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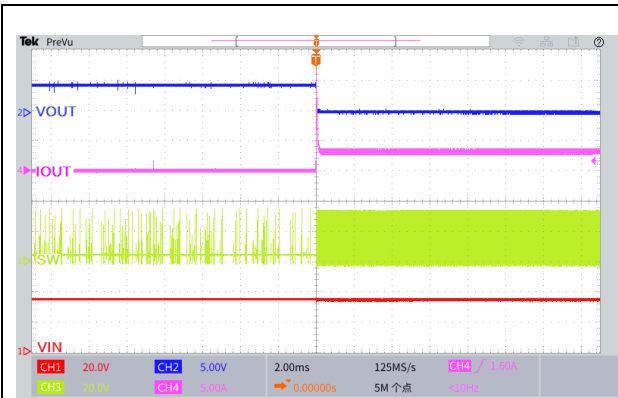


Figure 30. Output Short Circuit Waveform
($V_{IN}=36V$, $V_{OUT}=5.0V$)

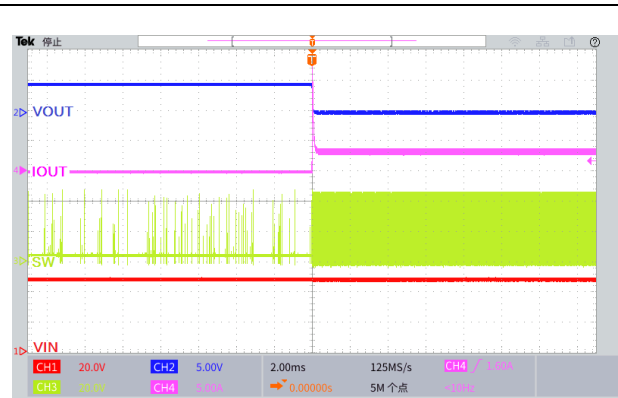


Figure 31. Output Short Circuit Waveform
($V_{IN}=48V$, $V_{OUT}=5.0V$)

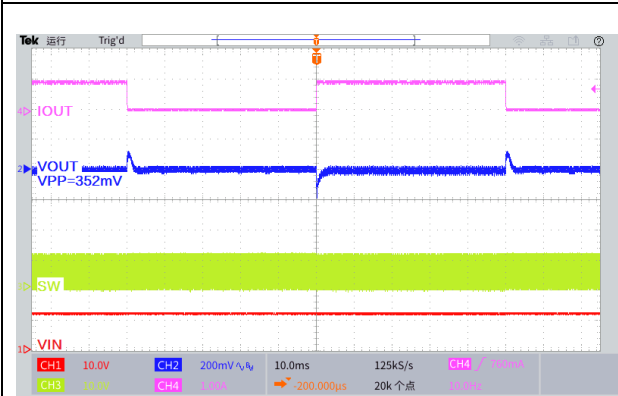


Figure32. Load Transient Response
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 1A)

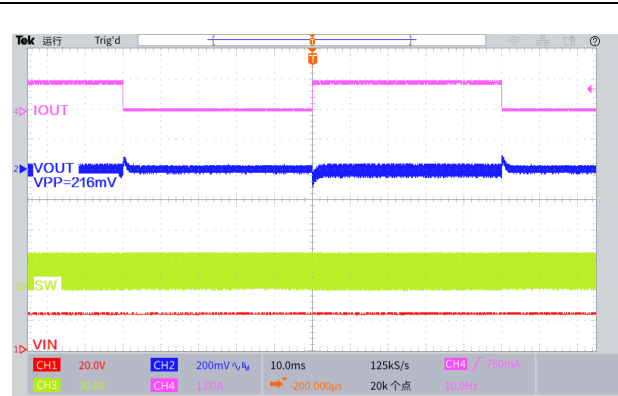


Figure33. Load Transient Response
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 1A)

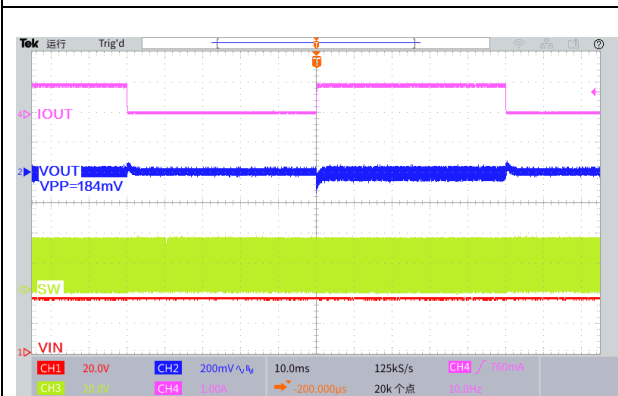


Figure34. Load Transient Response
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 1A)

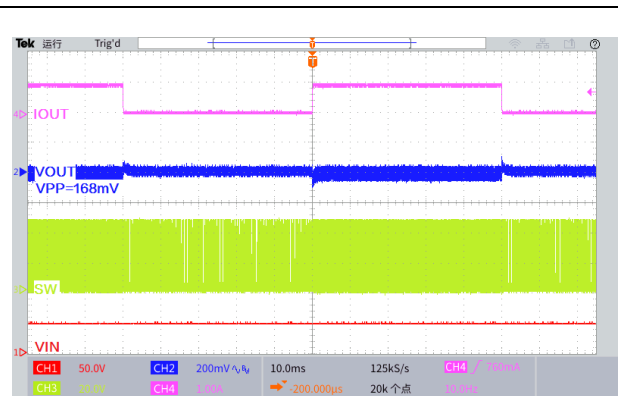


Figure35. Load Transient Response
($V_{IN}=48V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 1A)

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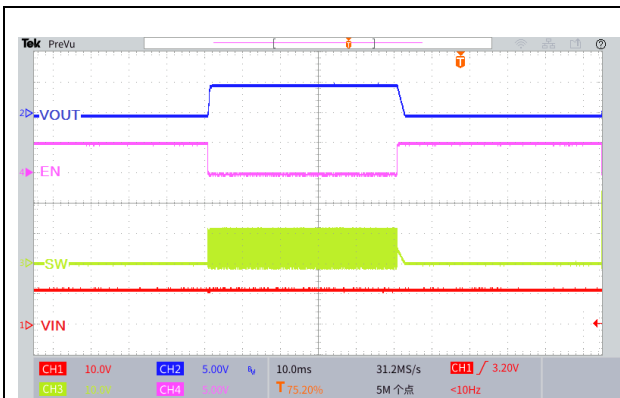


Figure36. Start or Shutdown Using EN Pin
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

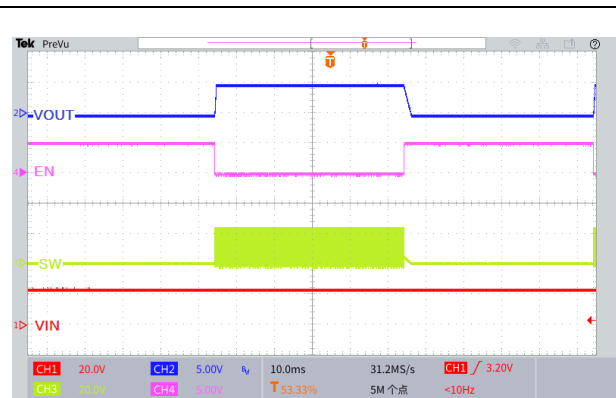


Figure37. Start or Shutdown Using EN Pin
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

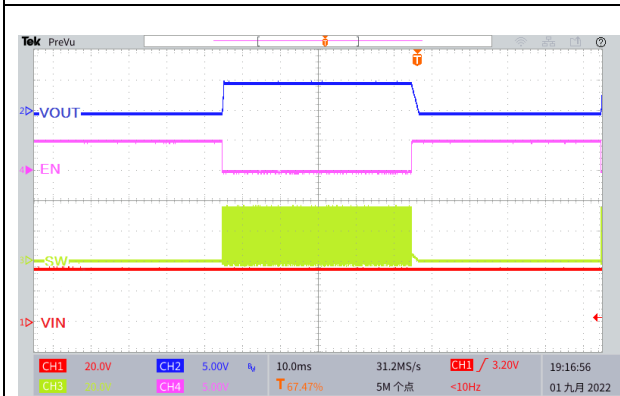


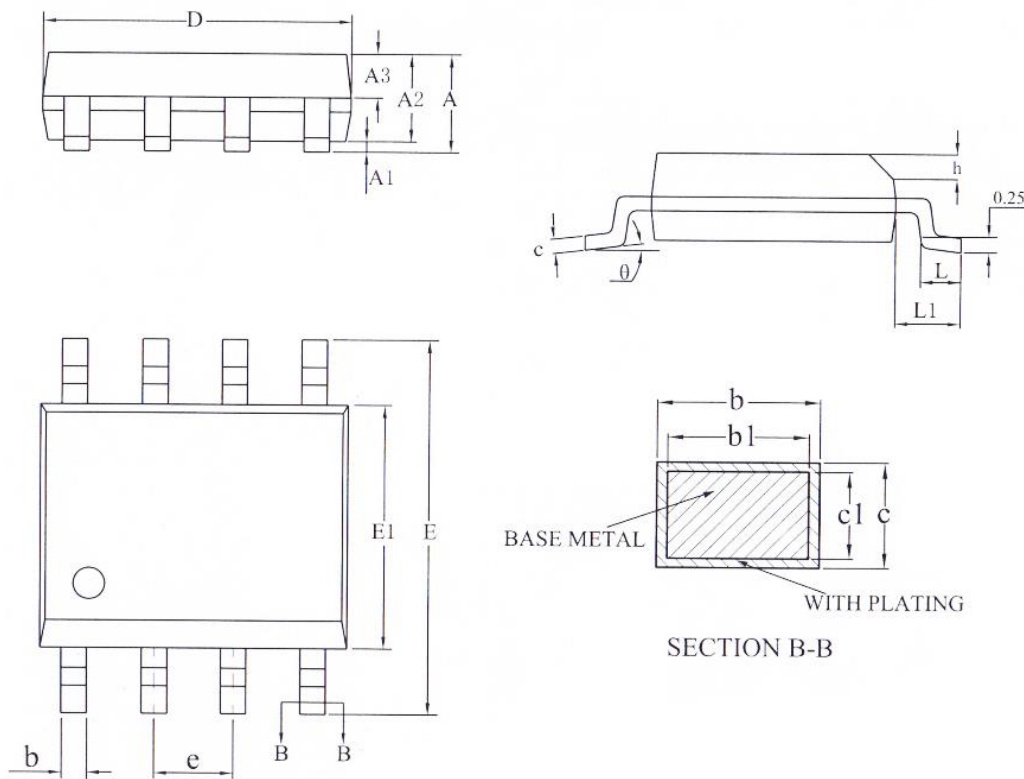
Figure38. Start or Shutdown Using EN Pin
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)



Figure39. Start or Shutdown Using EN Pin
($V_{IN}=48V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

Package Information

SOP8



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	-	0.47
b1	0.38	0.41	0.44
c	0.20	-	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	-	0.50
L	0.50	-	0.80
L1	1.05REF		
θ	0	-	8°

150KHz 60V 2A Buck DC to DC Converter**XL1509A**

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