

150KHz 60V 3A Buck DC to DC Converter

XL2596HVT

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
- 3A 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 TO220-5L package

General Description

The XL2596HVT is a 150 KHz fixed frequency buck DC/DC converter, capable of driving a 3A load with high voltage, high efficiency. The XL2596HVT 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 XL2596HVT is available in adjustable, fixed 3.3V, 5.0V and 12V versions. The XL2596HVT 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

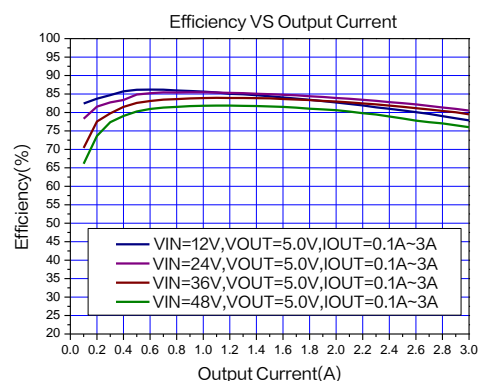
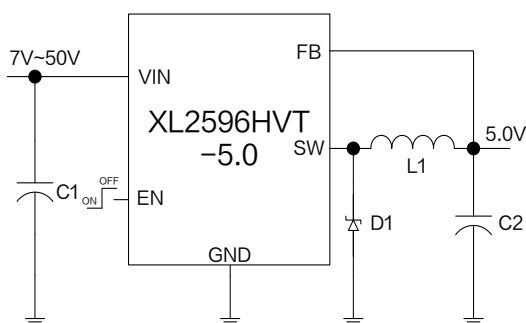


Figure1.XL2596HVT-5.0 Typical application schematic and efficiency curve

Pin Configurations

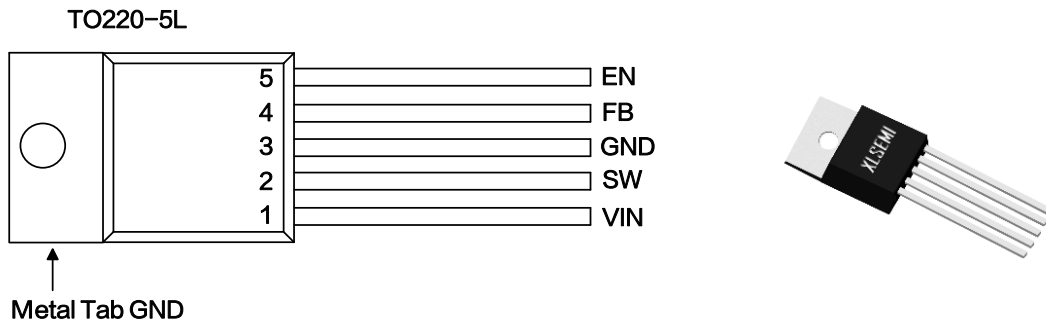


Figure2. Pin Configuration of XL2596HVT

Table 1. Pin Description

Pin Number	Pin Name	Description
1	VIN	Supply Voltage Input Pin. XL2596HVT 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	GND	Ground Pin.
4	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.
5	EN	Enable Pin. Drive EN pin low to turn on the device, drive it high to turn it off. Floating is default low.

Ordering Information

Order Information	Marking ID	Package Type	Packing Type Supplied As
XL2596HVT-ADJE1	XL2596HVT-ADJE1	TO220-5L	50 Units Per Tube
XL2596HVT-3.3E1	XL2596HVT-3.3E1	TO220-5L	50 Units Per Tube
XL2596HVT-5.0E1	XL2596HVT-5.0E1	TO220-5L	50 Units Per Tube
XL2596HVT-12E1	XL2596HVT-12E1	TO220-5L	50 Units Per Tube

Green (RoHS & HF): XLSEMI defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances.

Function Block

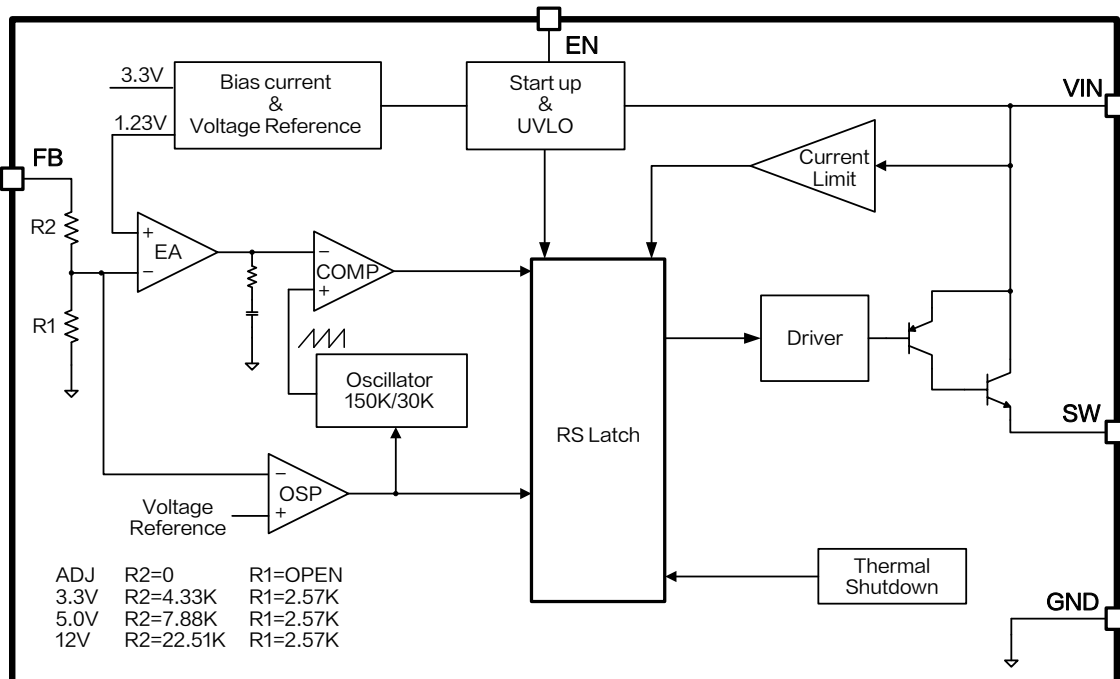


Figure3. Function Block Diagram of XL2596HVT

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 (TO220-5L) (Junction to Ambient, No Heatsink, Free Air)	R_{JA}	30	°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)		> 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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XL2596HVT –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} = 2A	–	82.7	–	%
η	Efficiency	V _{IN} = 24V, V _{OUT} = 15V I _{OUT} = 1A	–	92.8	–	%

XL2596HVT –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} = 2A	–	78.4	–	%

XL2596HVT –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} = 2A	–	82.7	–	%

XL2596HVT –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} = 2A	–	90.5	–	%

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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 Supply Current	I_S	$V_{EN}=2\text{V}$		46	100	μA
Quiescent Supply Current	I_Q	Note2		1.3	2.0	mA
Oscillator Frequency	F_{OSC}		135	150	165	KHz
Switch Current Limit	I_L	$V_{FB}=0\text{V}$		3.2		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			40		$^\circ\text{C}$

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

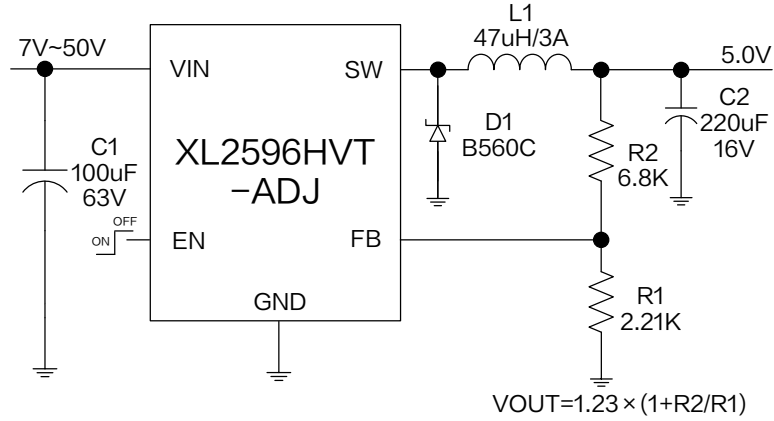


Figure4. XL2596HVT-ADJ System Parameters Test Circuit($V_{OUT}=5.0V$)

Typical System Application Transfer Efficiency

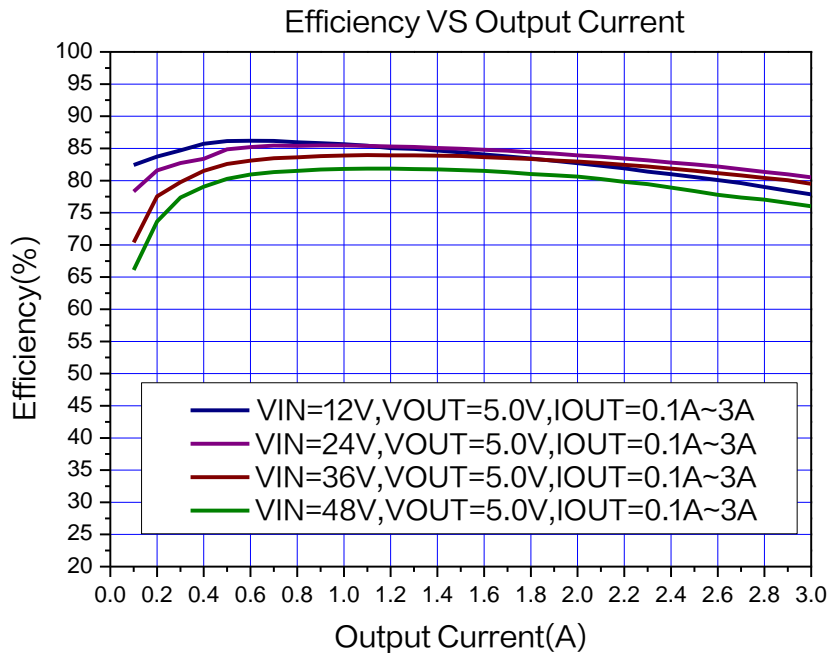


Figure5. XL2596HVT-ADJ System Efficiency Curve

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Typical System Application Schematic for ADJ Version

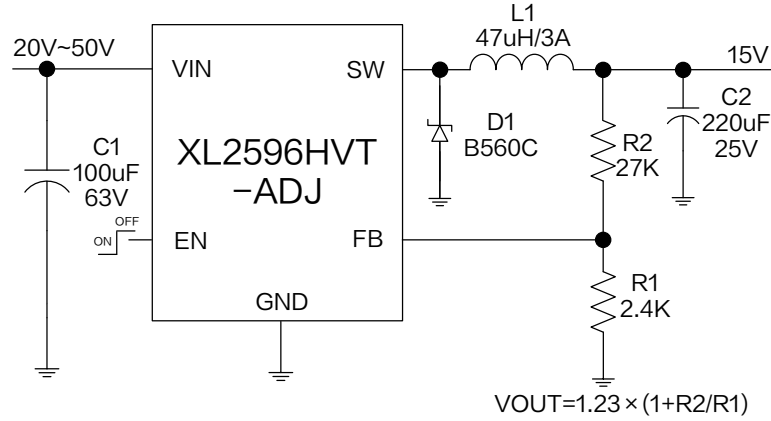


Figure6. XL2596HVT-ADJ System Parameters Test Circuit($V_{OUT}=15V$)

Typical System Application Transfer Efficiency

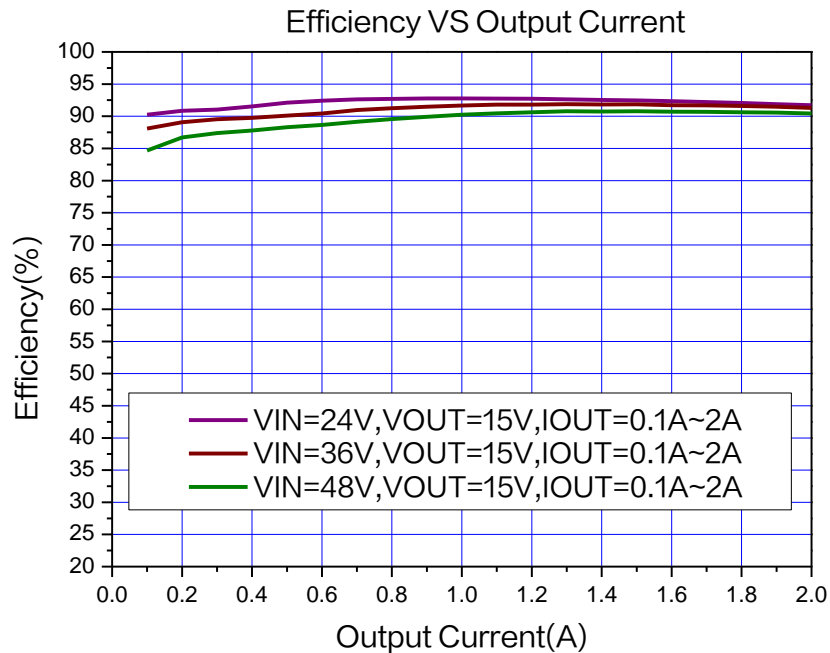


Figure7. XL2596HVT-ADJ System Efficiency Curve

Typical System Application Schematic for 3.3V Version

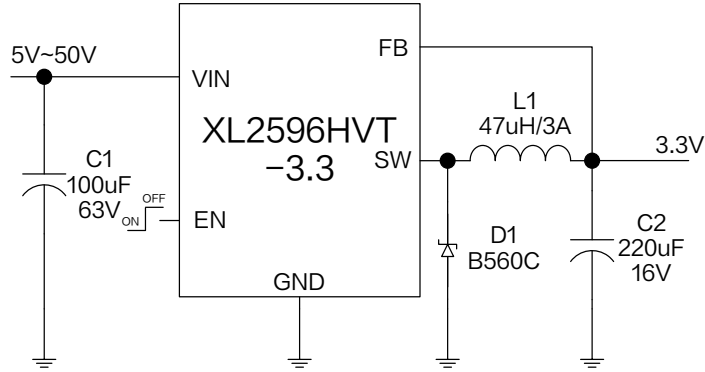


Figure8. XL2596HVT-3.3 System Parameters Test Circuit

Typical System Application Transfer Efficiency

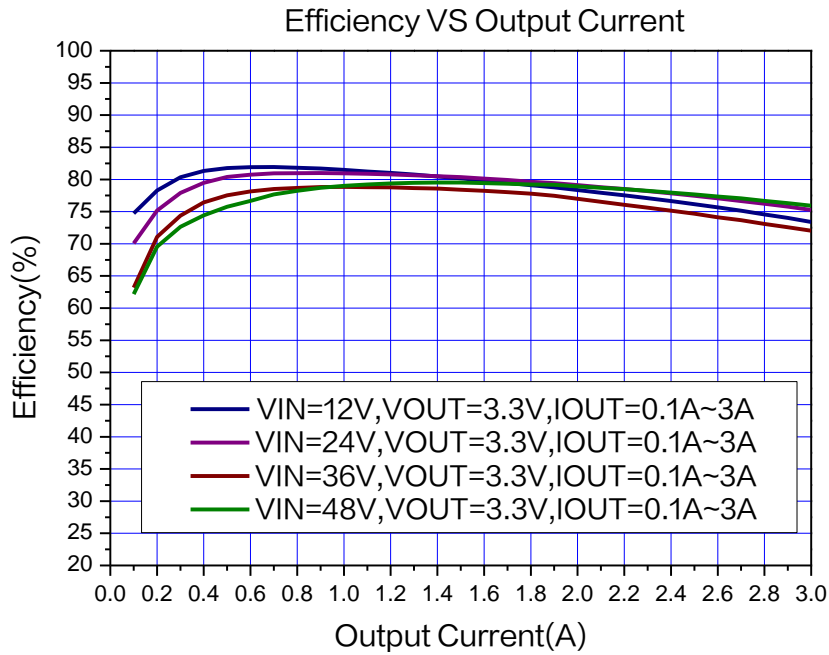


Figure9. XL2596HVT-3.3 System Efficiency Curve

Typical System Application Schematic for 5.0V Version

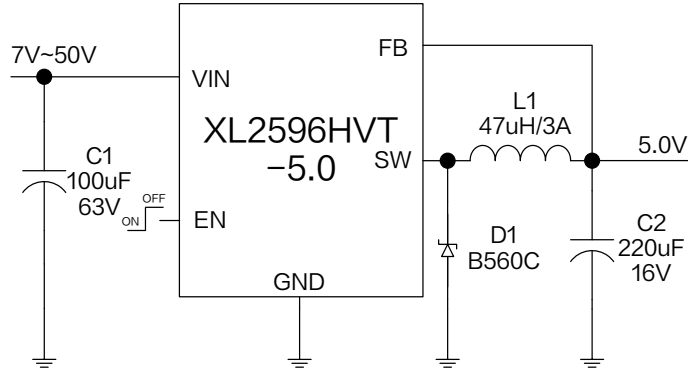


Figure10. XL2596HVT-5.0 System Parameters Test Circuit

Typical System Application Transfer Efficiency

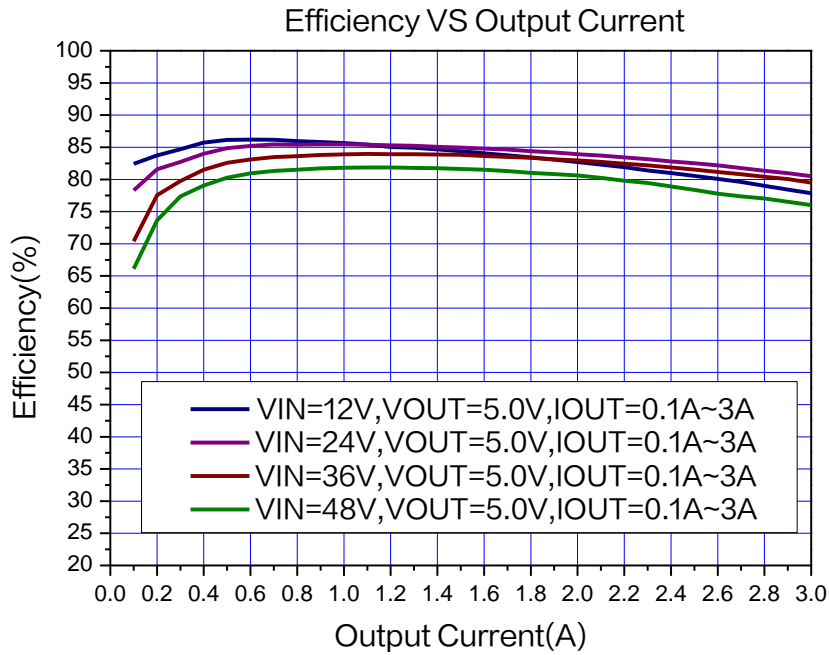


Figure11. XL2596HVT-5.0 System Efficiency Curve

Typical System Application Schematic for 12V Version

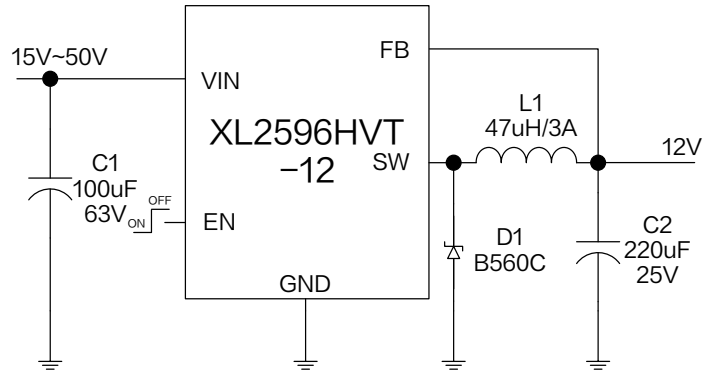


Figure12. XL2596HVT-12 System Parameters Test Circuit

Typical System Application Transfer Efficiency

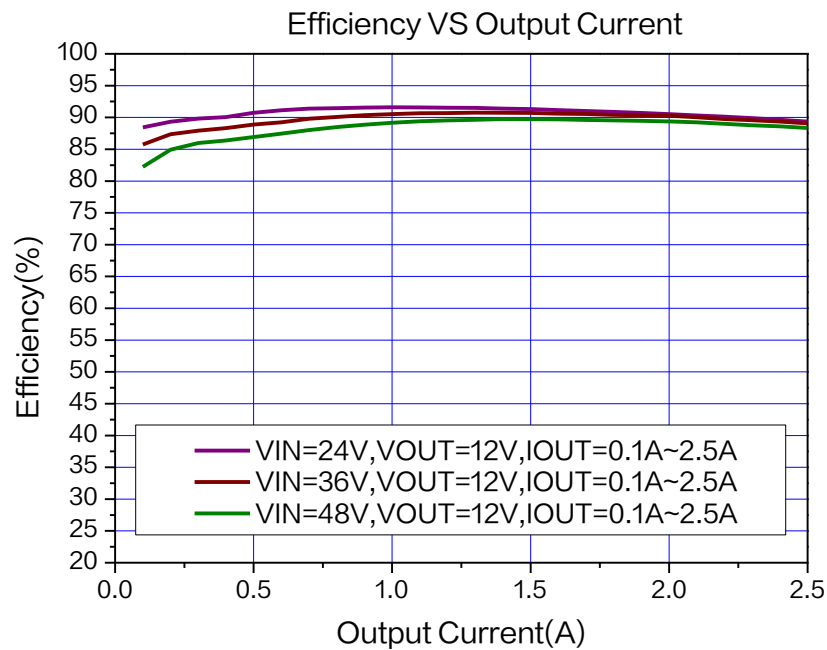


Figure13. XL2596HVT-12 System Efficiency Curve

Typical Characteristics

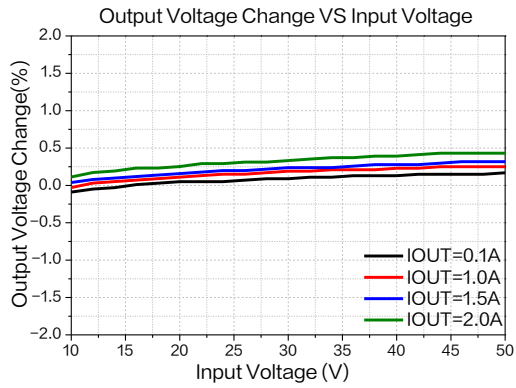


Figure14.Line Regulation

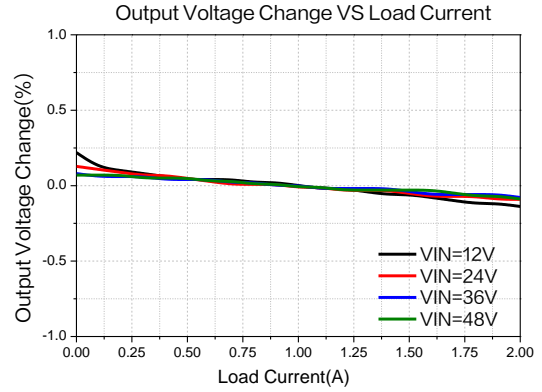


Figure15.Load Regulation

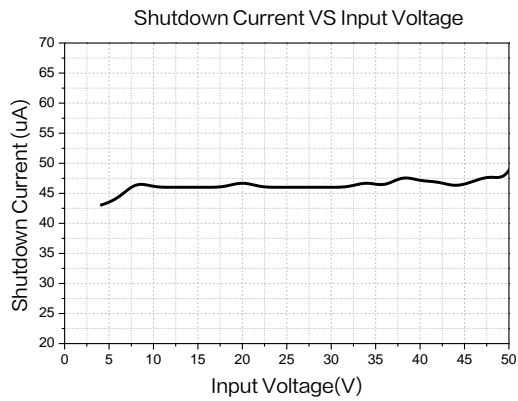


Figure16.Shutdown Current

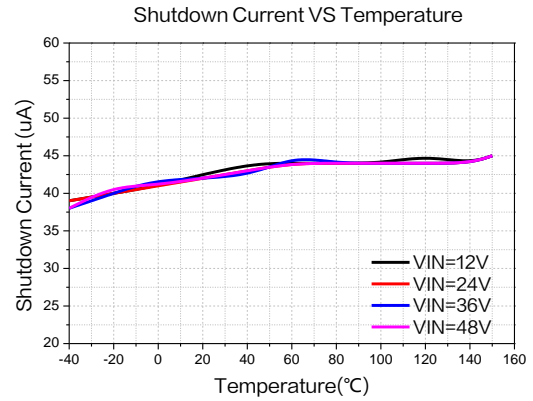


Figure17.Shutdown Current

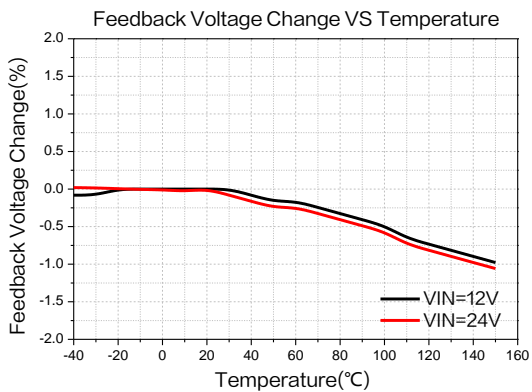


Figure18.Feedback Voltage Regulation

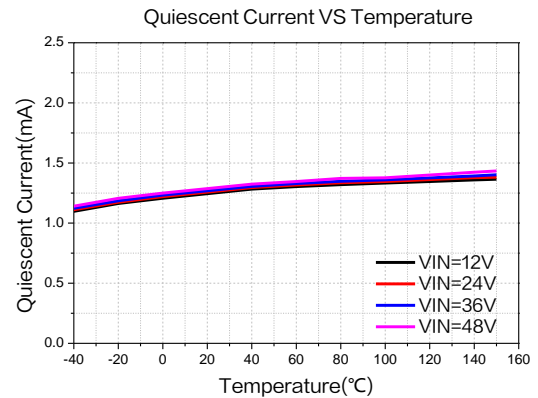


Figure19. Quiescent Current

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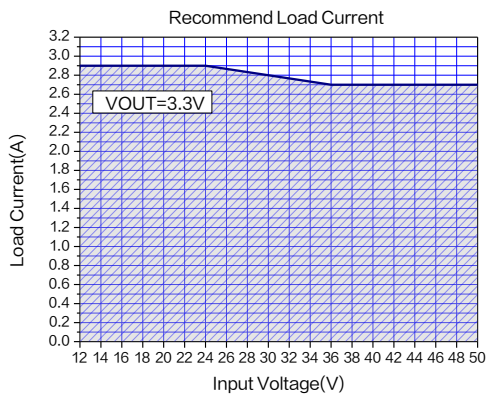


Figure 20.Max Output Current
($V_{OUT}=3.3V$, $T_A=25^{\circ}C$)

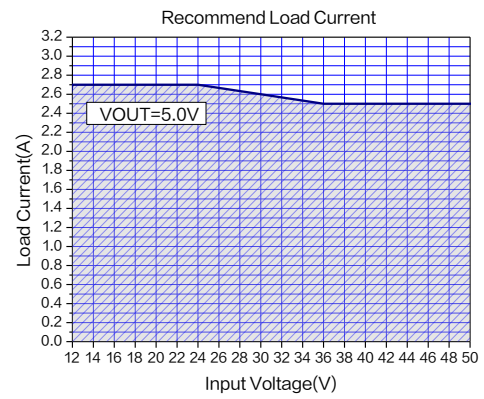


Figure 21.Max Output Current
($V_{OUT}=5.0V$, $T_A=25^{\circ}C$)

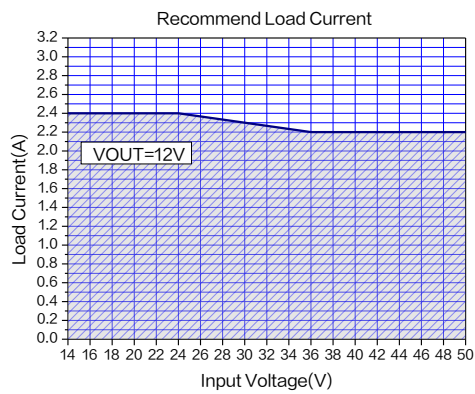


Figure 22.Max Output Current
($V_{OUT}=12V$, $T_A=25^{\circ}C$)

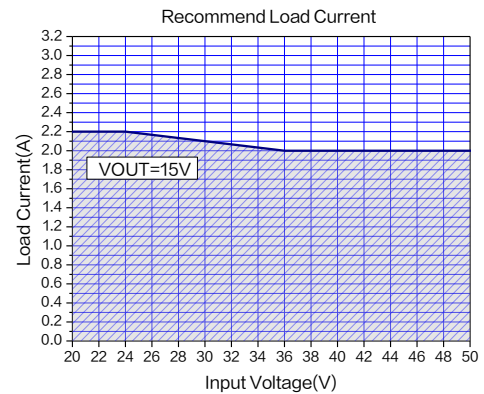


Figure 23.Max Output Current
($V_{OUT}=15V$, $T_A=25^{\circ}C$)

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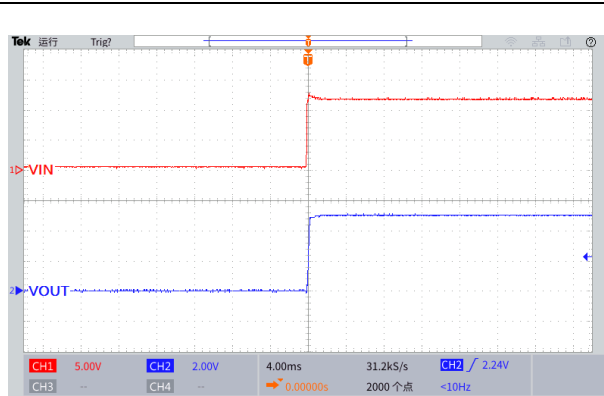


Figure24. Start-Up Characteristic
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

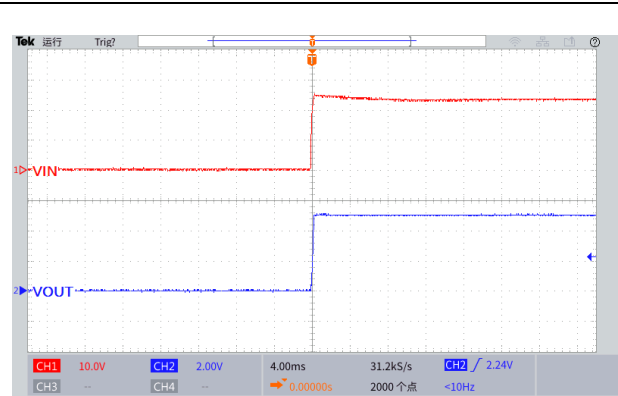


Figure25. Start-Up Characteristic
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

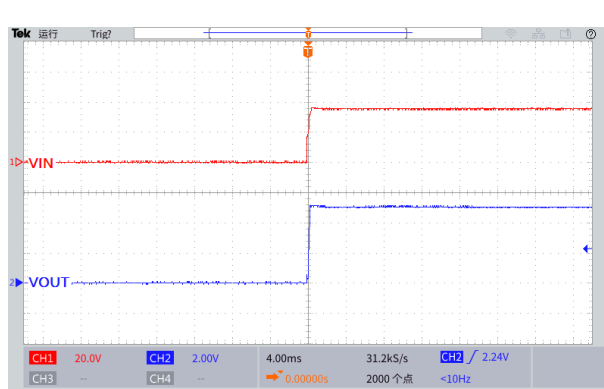


Figure26. Start-Up Characteristic
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

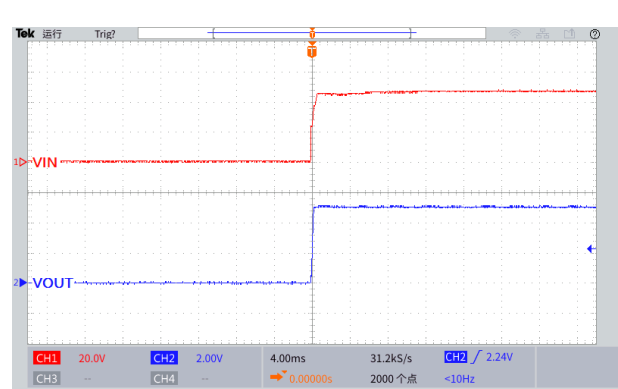


Figure27. Start-Up Characteristic
($V_{IN}=48V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

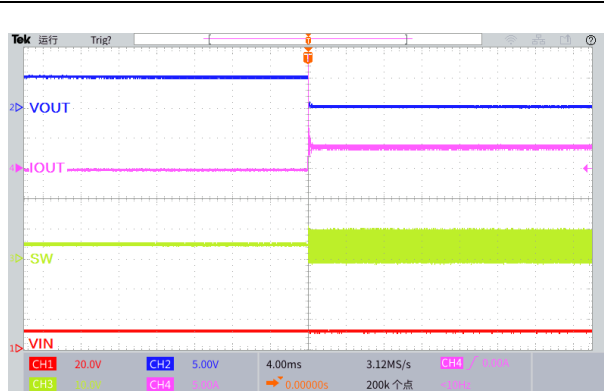


Figure28. Output Short Circuit Waveform
($V_{IN}=12V$, $V_{OUT}=5.0V$)

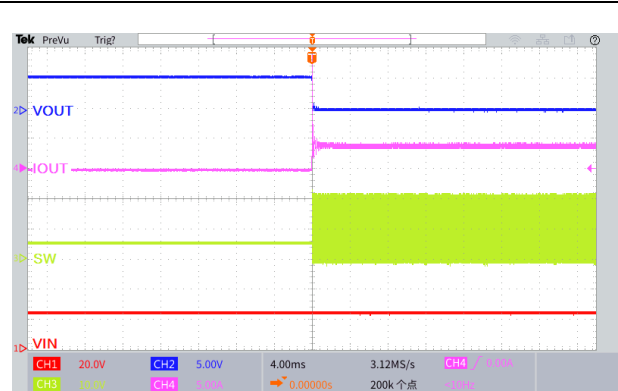


Figure29. Output Short Circuit Waveform
($V_{IN}=24V$, $V_{OUT}=5.0V$)

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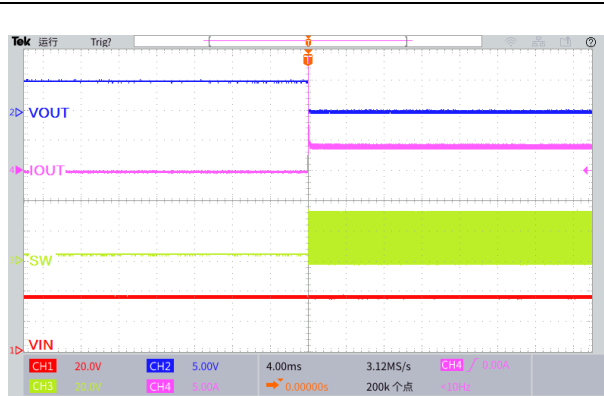


Figure30. Output Short Circuit Waveform
($V_{IN}=36V$, $V_{OUT}=5.0V$)

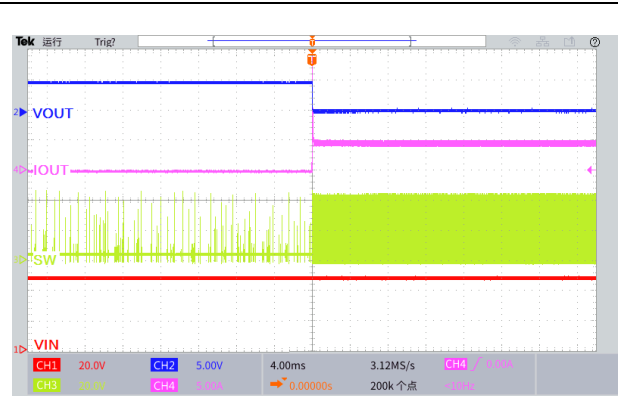


Figure31. Output Short Circuit Waveform
($V_{IN}=48V$, $V_{OUT}=5.0V$)

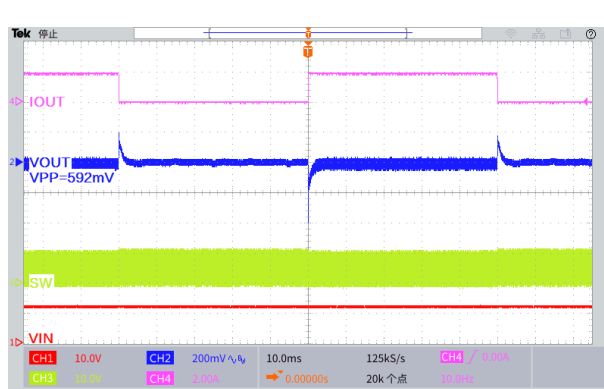


Figure32. Load Transient Response
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 2A)

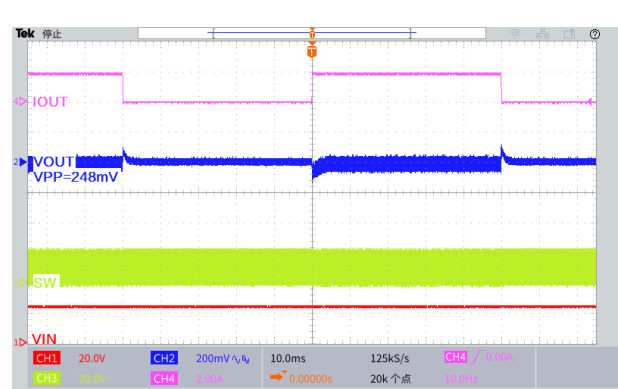


Figure33. Load Transient Response
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 2A)

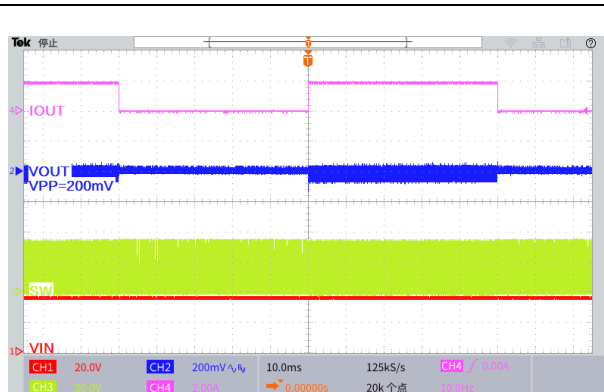


Figure34. Load Transient Response
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 2A)

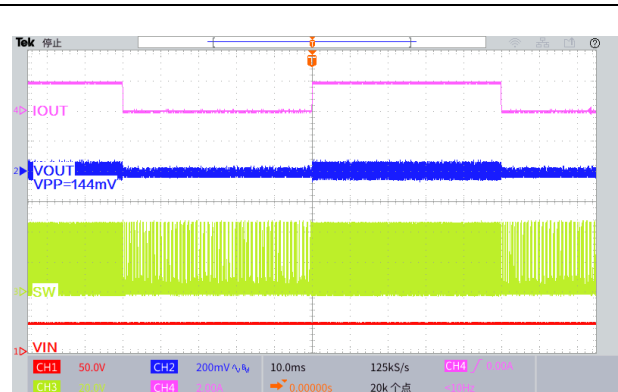


Figure35. Load Transient Response
($V_{IN}=48V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to 2A)

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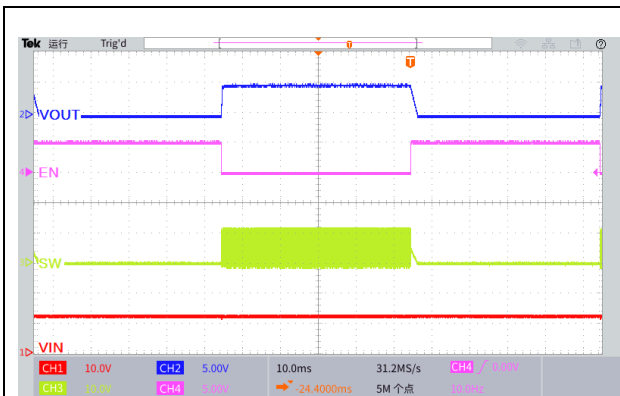


Figure36. Start or Shutdown Using EN Pin
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

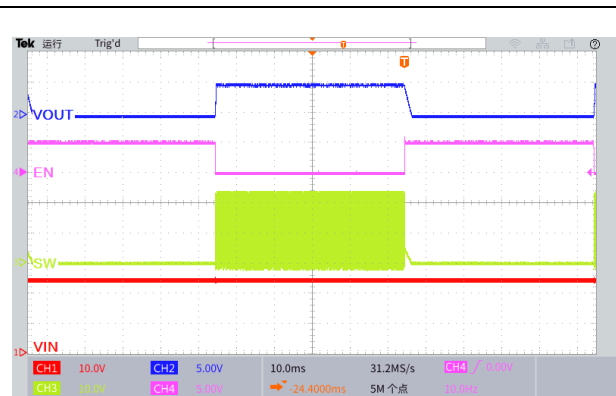


Figure37. Start or Shutdown Using EN Pin
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

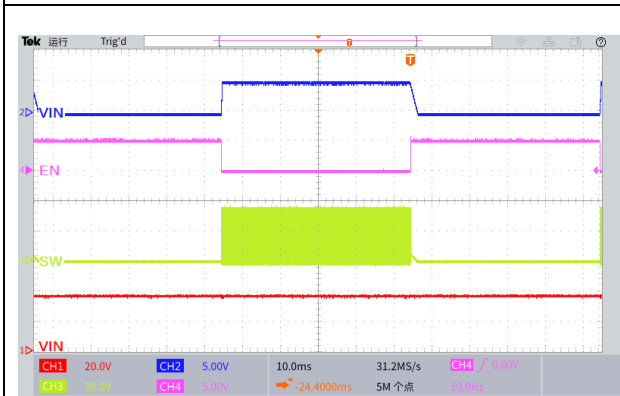


Figure38. Start or Shutdown Using EN Pin
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

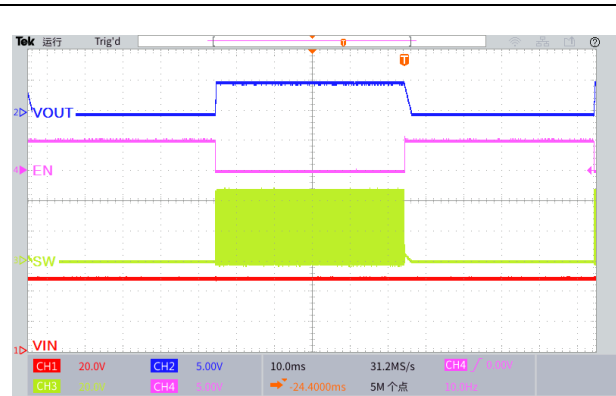
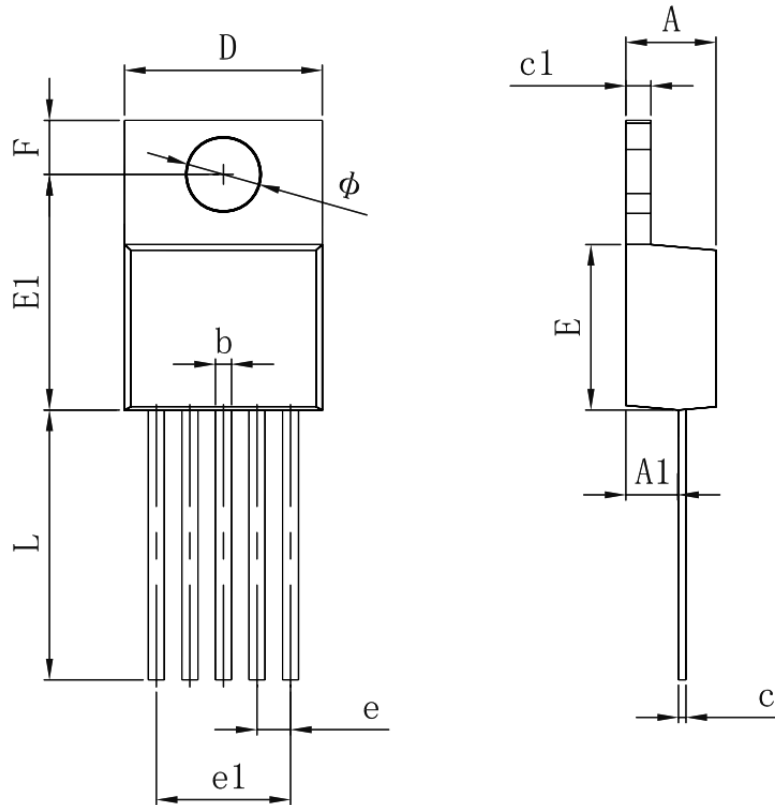


Figure39. Start or Shutdown Using EN Pin
($V_{IN}=48V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

Package Information

TO220-5L



COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	2.52	2.67	2.82
b	0.71	0.89	1.02
c	0.31	0.38	0.64
c1	1.17	1.27	1.42
D	9.85	10.26	10.39
E	8.20	8.70	9.00
E1	11.76	-	12.55
e	1.55	1.70	1.85
e1	6.70	-	6.90
F	2.54	-	3.05
L	13.34	13.74	14.10
ϕ	3.70	-	3.95

150KHz 60V 3A Buck DC to DC Converter**XL2596HVT**

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