

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Features

- Operation Voltage: 5V~45V
- Output Adjustable from 1.25V to 40V
- Maximum Duty Cycle up to 100%
- Feedback Voltage Accuracy  $\pm 2\%$
- Fixed 120KHz Switching Frequency
- 6A Constant Output Current Capability
- Internal Optimize Power MOSFET
- High efficiency up to 96%
- Max. Output power up to 60W
- Excellent line and load regulation
- Built in thermal shutdown function
- Built in current limit protection function
- Built in output short protection function
- Built in constant voltage loop and constant current loop
- Temperature Grade 1:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  Ambient Operating Temperature Range
- Device HBM ESD Classification Level Class3A
- Available in TO263-7L package

### General Description

The XL9028 is a 120KHz fixed frequency PWM synchronous buck DC/DC converter, capable of driving a 6A load with high efficiency, low ripple and excellent line and load regulation. XL9028 supports wide input operating voltage range of 5V ~ 45V and a maximum duty cycle of 100% output. Output supports constant voltage loop and constant current loop. A built-in loop compensation module reduces components in the system, lowering power system cost and reducing printed circuit board space.

The XL9028 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 120KHz to 30KHz.

### Applications

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

### Typical application schematic

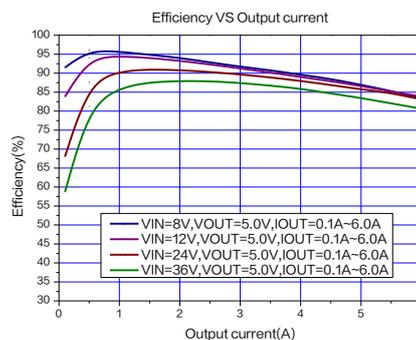
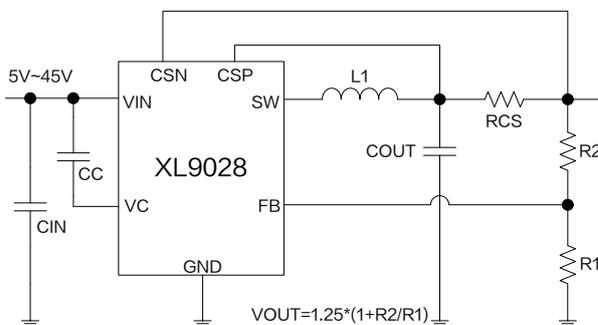


Figure1. XL9028 Typical application schematic and efficiency curve

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Pin Configurations

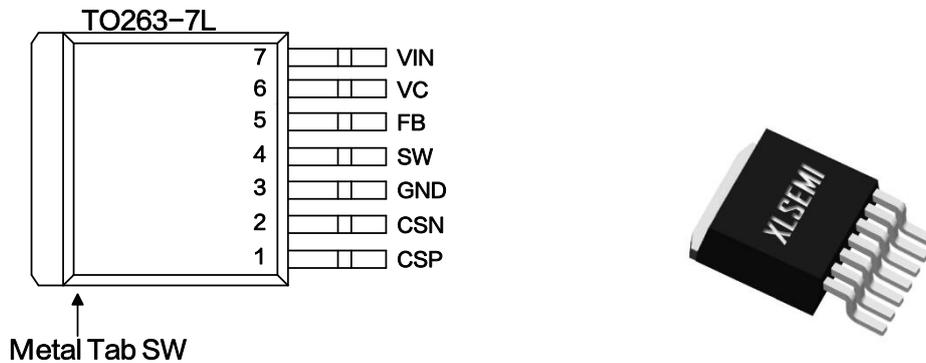


Figure2. Pin Configuration of XL9028

Table 1 Pin Description

Pin Number	Pin Name	Description
1	CSP	Current detection positive terminal pin.
2	CSN	Current detection negative terminal pin.
3	GND	Ground Pin.
4	SW	Power Switch Output Pin (SW). Output is the switch node that supplies power to the output.
5	FB	Feedback Pin (FB). Through an external resistor divider network, Feedback senses the output voltage and regulates it. The feedback threshold voltage is 1.25V.
6	VC	Internal Voltage Regulator Bypass Capacity. In typical system application, The VC pin connect a 1uF capacitor to VIN.
7	VIN	Supply Voltage Input Pin. XL9028 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
XL9028	XL9028	TO263-7L	RoHS & HF	800 Units on Reel

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Function Block

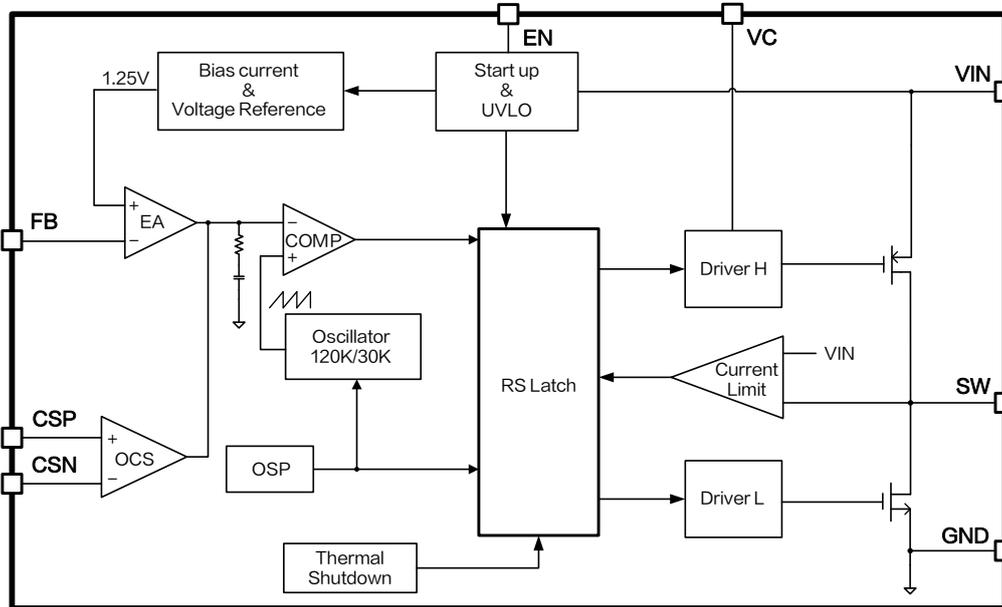


Figure3. Function Block Diagram of XL9028

### Absolute Maximum Ratings ( Note1 )

Parameter	Symbol	Value	Unit
Input Voltage	$V_{IN}$	-0.3~50	V
Internal Voltage Regulator Bypass Capacity.	$V_C$	-0.3~ $V_{IN}$	V
CSP Pin Voltage	$V_{CSP}$	-0.3~ $V_{IN}$	V
CSN Pin Voltage	$V_{CSN}$	-0.3~ $V_{IN}$	V
Feedback Pin Voltage	$V_{FB}$	-0.3~7	V
Output Switch Pin Voltage	$V_{SW}$	-0.3~ $V_{IN}$	V
Power Dissipation	$P_D$	Internally limited	mW
Thermal Resistance (TO263-7L) (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)		>6000	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.

### 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

#### XL9028 Electrical Characteristics

$T_A = 25^\circ\text{C}$ ; system parameters test circuit figure6, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{FB}$	Feedback Voltage	$V_{IN}=12\text{V}, V_{OUT}=5.0\text{V}$ $I_{OUT}=0.5\text{A}$	1.225	1.25	1.275	V
$\eta$	Efficiency	$V_{IN}=12\text{V}, V_{OUT}=5.0\text{V}$ $I_{OUT}=1.0\text{A}$	-	94.5	-	%
$\eta$	Efficiency	$V_{IN}=24\text{V}, V_{OUT}=15\text{V}$ $I_{OUT}=1.5\text{A}$	-	96.9	-	%

#### Electrical Characteristics (DC Parameters)

$T_A=25^\circ\text{C}, V_{IN}=12\text{V}$ ; system parameters test circuit figure6, unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input operation voltage	$V_{IN}$		5		45	V
Quiescent Supply Current	$I_Q$	$V_{FB}=2\text{V}$		2.3	5	mA
Oscillator Frequency	$F_{OSC}$		96	120	144	KHz
Switch Current Limit	$I_L$	$V_{FB}=0$		6		A
High side MOS On-resistance	$R_{DS(ON)H}$			38		$\text{m}\Omega$
Low side MOS On-resistance	$R_{DS(ON)L}$			50		$\text{m}\Omega$
Thermal Shutdown Temperature	$T_{SD}$			170		$^\circ\text{C}$
Thermal Shutdown Hysteresis	$T_D$			50		$^\circ\text{C}$
Maximum Duty Cycle	$D_{MAX}$			100		%

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Typical System Application Schematic ( $V_{OUT}=3.3V, I_{OUT}=0\sim 6A$ )

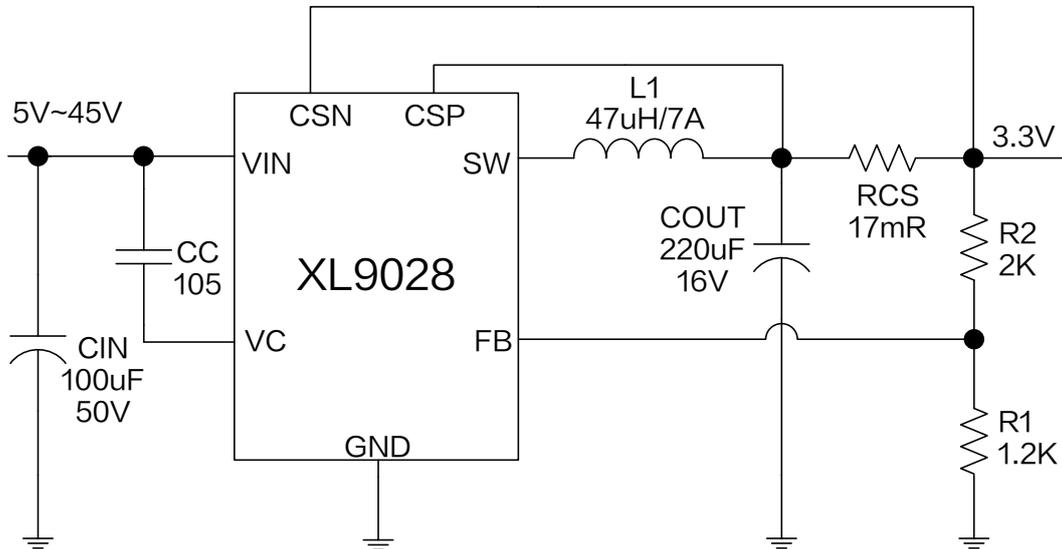


Figure4. XL9028 System Application ( $V_{IN}=5V\sim 45V, V_{OUT}=3.3V, I_{OUT}=0\sim 6A$ )

### Typical System Application Transfer Efficiency

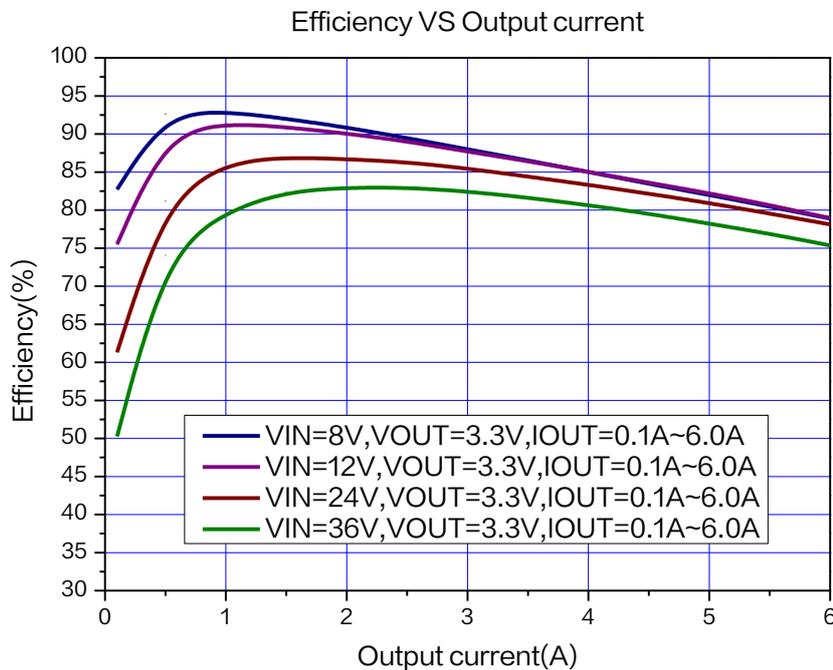


Figure5. XL9028 System Efficiency Curve ( $V_{OUT}=3.3V$ )

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Typical System Application Schematic ( $V_{OUT}=5.0V$ , $I_{OUT}=0\sim6A$ )

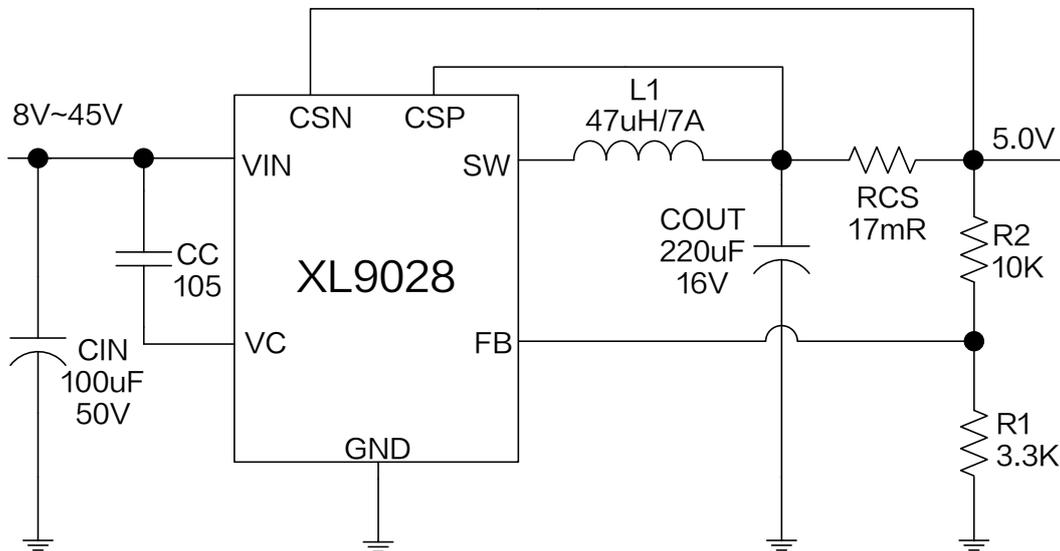


Figure6. XL9028 System Application ( $V_{IN}=8V\sim45V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0\sim6A$ )

### Typical System Application Transfer Efficiency

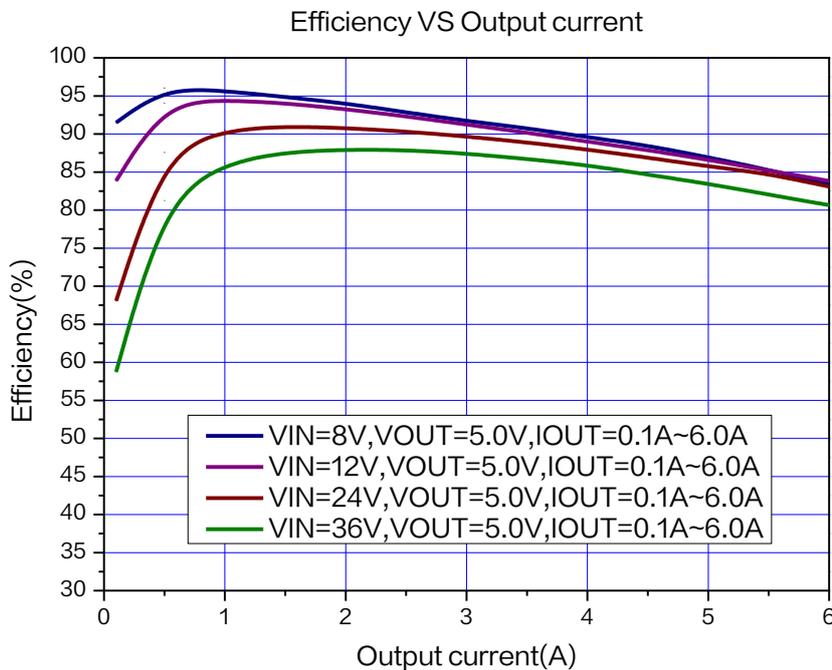


Figure7. XL9028 System Efficiency Curve ( $V_{OUT}=5.0V$ )

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Typical System Application Schematic ( $V_{OUT}=12V, I_{OUT}=0\sim 5A$ )

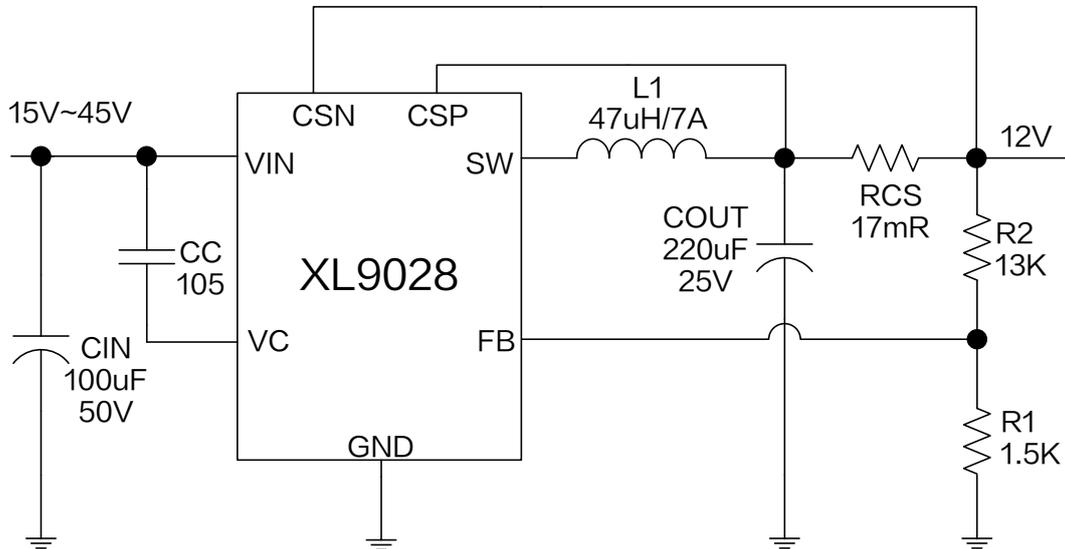


Figure8. XL9028 System Parameters Test Circuit ( $V_{IN}=15V\sim 45V, V_{OUT}=12V, I_{OUT}=0\sim 5A$ )

### Typical System Application Transfer Efficiency

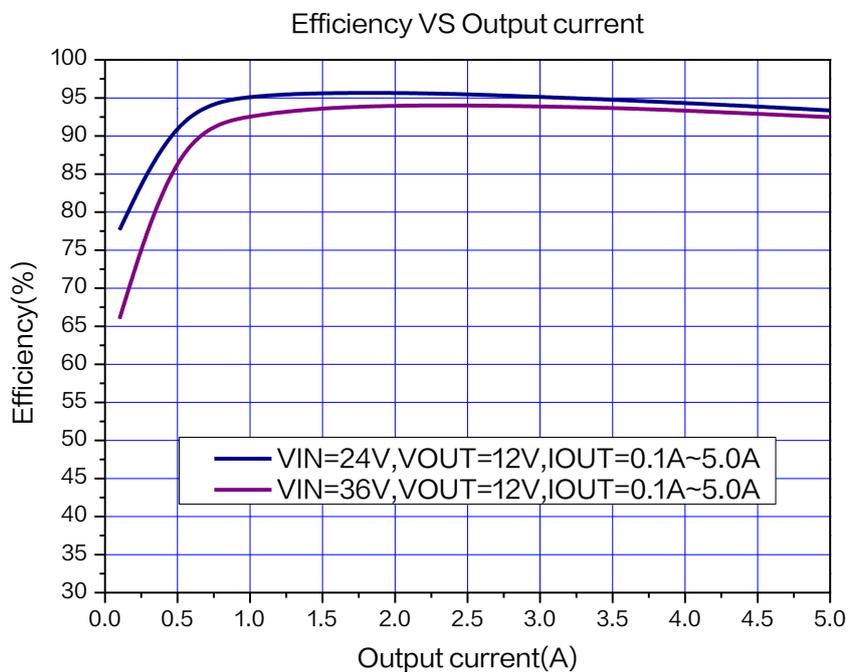


Figure9. XL9028 System Efficiency Curve ( $V_{OUT}=12V$ )

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Typical System Application Schematic ( $V_{OUT}=15V, I_{OUT}=0\sim 4.5A$ )

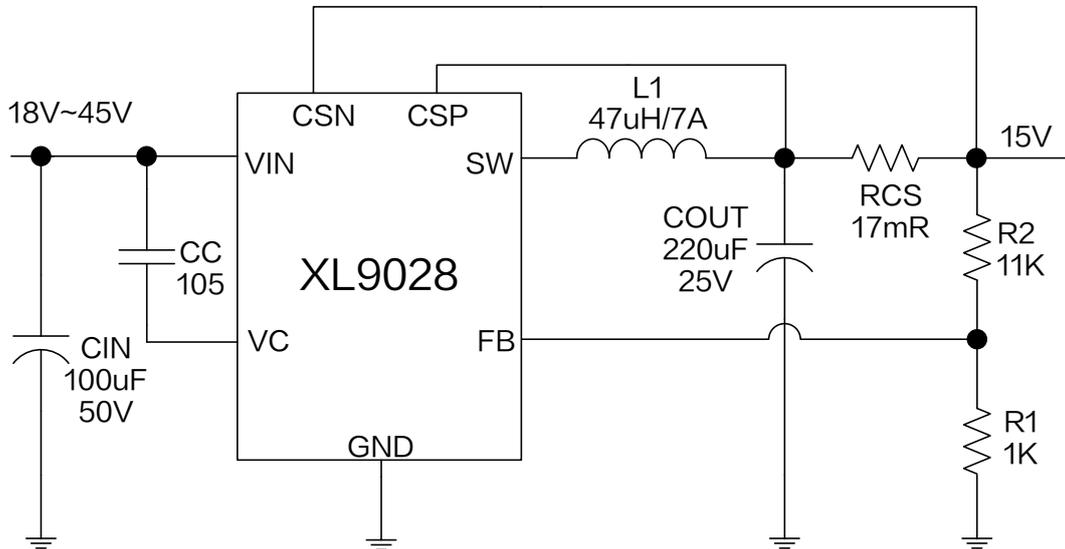


Figure10. XL9028 System Parameters Test Circuit ( $V_{IN}=18V\sim 45V, V_{OUT}=15V, I_{OUT}=0\sim 4.5A$ )

### Typical System Application Transfer Efficiency

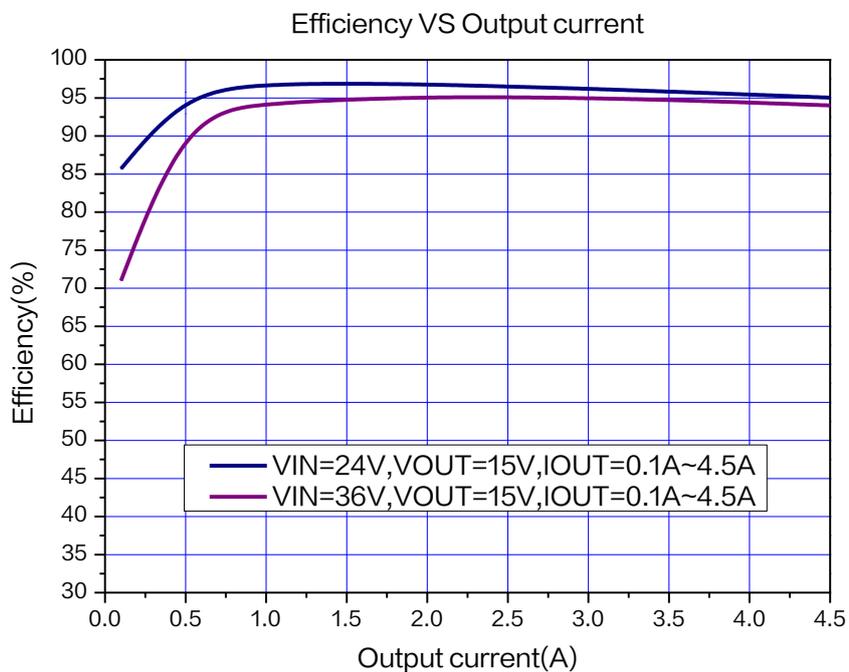


Figure11. XL9028 System Efficiency Curve ( $V_{OUT}=15V$ )

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Typical Characteristics

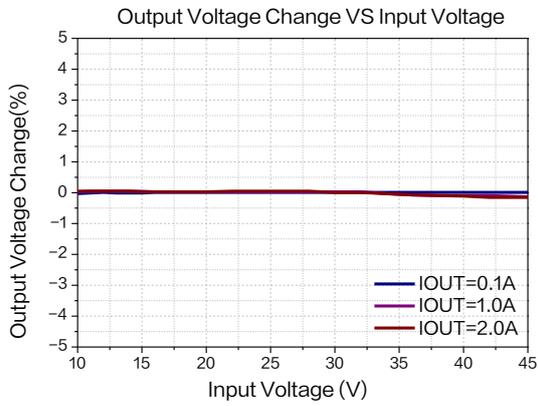


Figure12.Line Regulation

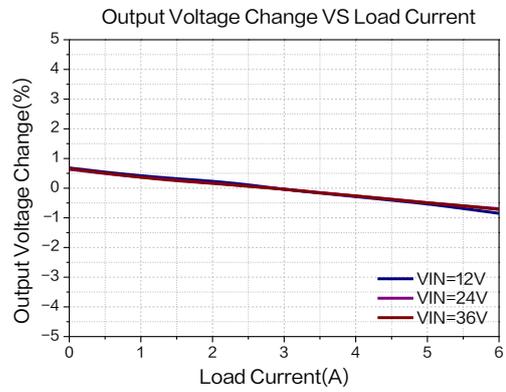


Figure13.Load Regulation

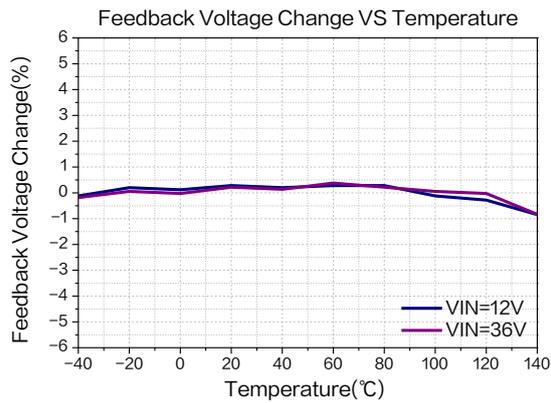


Figure14.Feedback Voltage Regulation

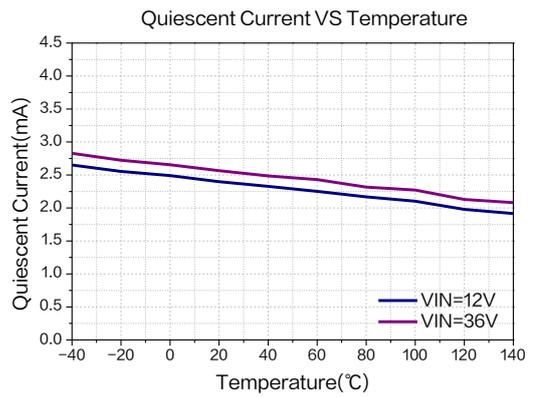


Figure15.Quiescent Current

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

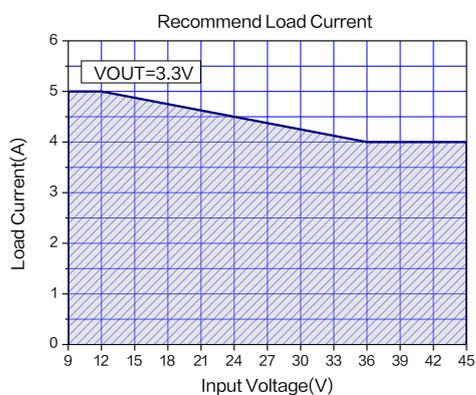


Figure 16. Max Output Current  
(V<sub>OUT</sub>=3.3V, T<sub>A</sub>=25°C)

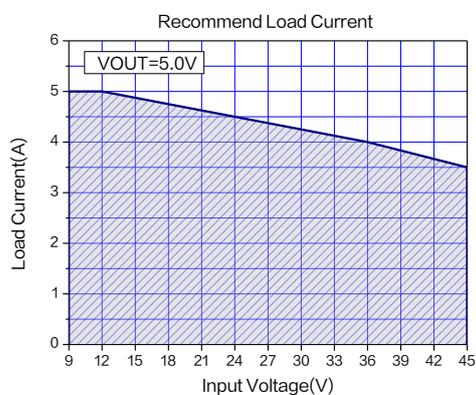


Figure 17. Max Output Current  
(V<sub>OUT</sub>=5.0V, T<sub>A</sub>=25°C)

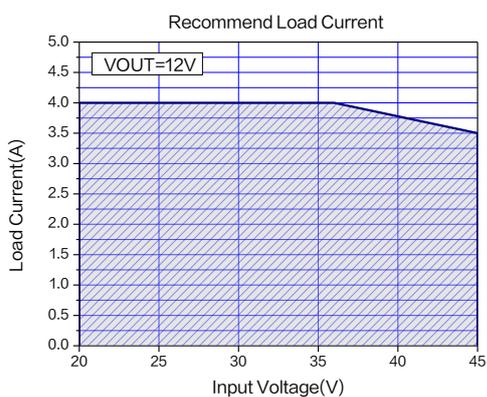


Figure 18. Max Output Current  
(V<sub>OUT</sub>=12V, T<sub>A</sub>=25°C)

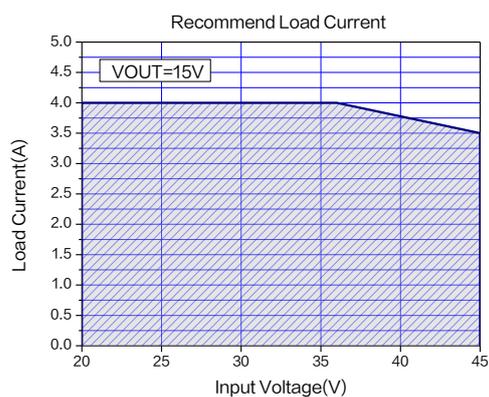


Figure 19. Max Output Current  
(V<sub>OUT</sub>=15V, T<sub>A</sub>=25°C)

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

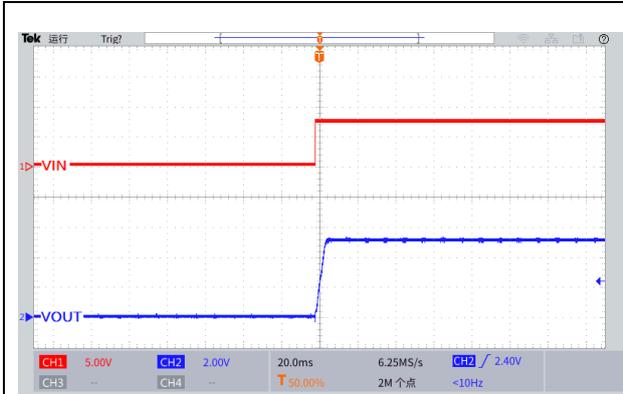


Figure 20. Start-Up Characteristic  
( $V_{IN}=8V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0.1A$ )

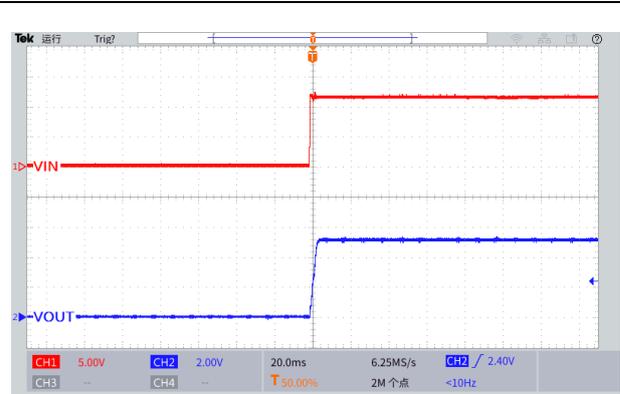


Figure 21. Start-Up Characteristic  
( $V_{IN}=12V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0.1A$ )

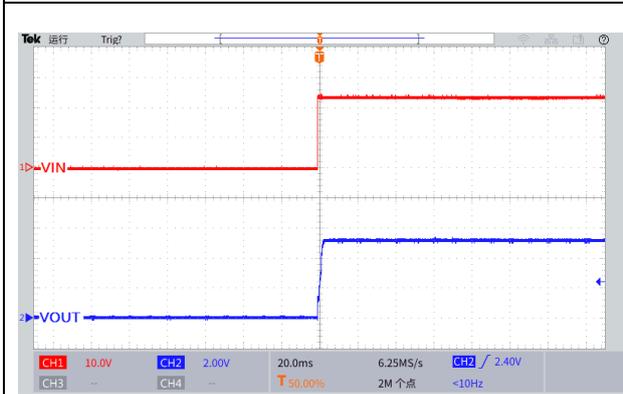


Figure 22. Start-Up Characteristic  
( $V_{IN}=24V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0.1A$ )

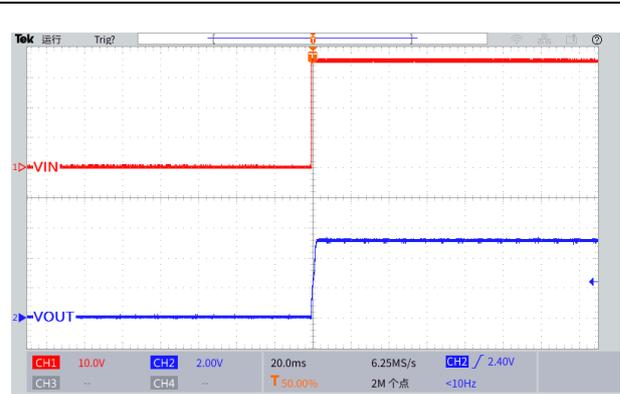


Figure 23. Start-Up Characteristic  
( $V_{IN}=36V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0.1A$ )

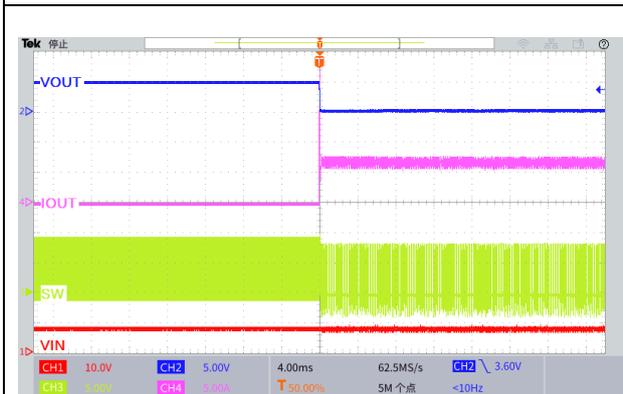


Figure 24. Output Short Circuit Waveform  
( $V_{IN}=8V$ ,  $V_{OUT}=5.0V$ )

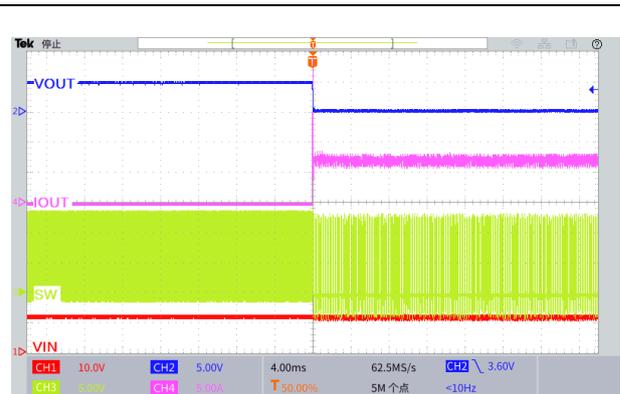


Figure 25. Output Short Circuit Waveform  
( $V_{IN}=12V$ ,  $V_{OUT}=5.0V$ )

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

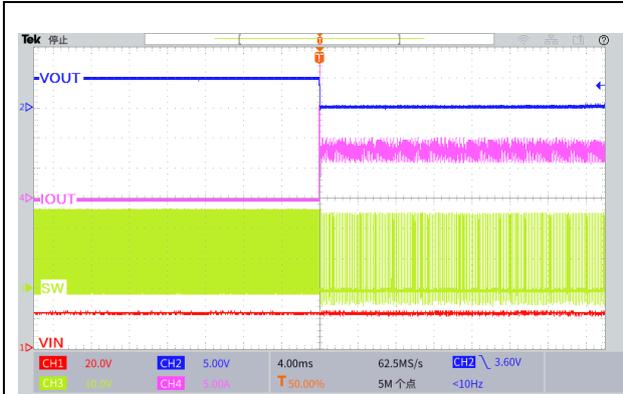


Figure 26. Output Short Circuit Waveform  
( $V_{IN}=24V$ ,  $V_{OUT}=5.0V$ )

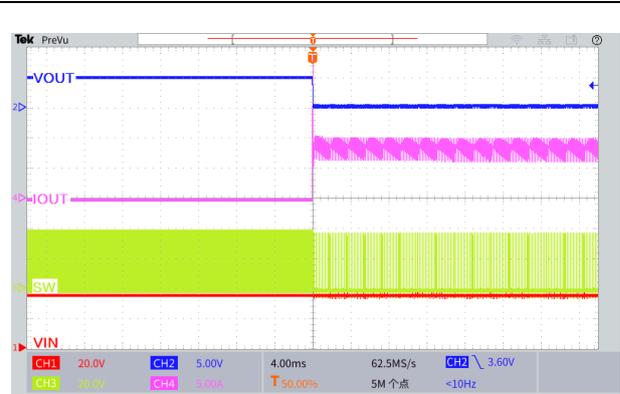


Figure 27. Output Short Circuit Waveform  
( $V_{IN}=36V$ ,  $V_{OUT}=5.0V$ )

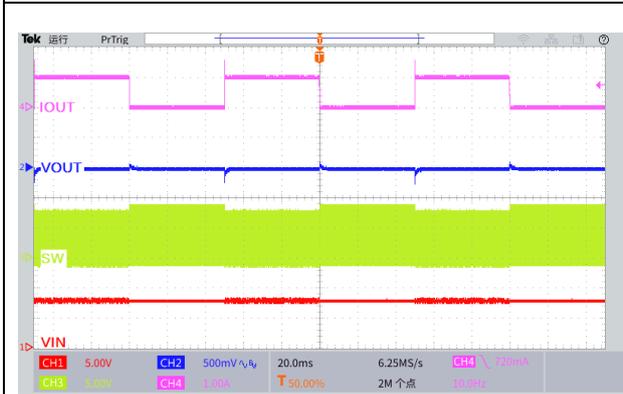


Figure 28. Load Transient Response  
( $V_{IN}=8V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0$  to 1A)

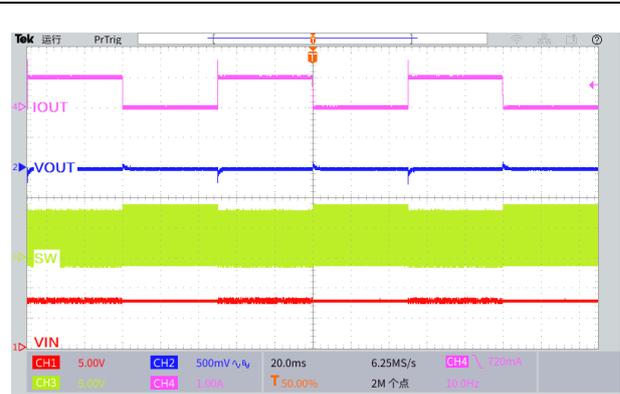


Figure 29. Load Transient Response  
( $V_{IN}=12V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0$  to 1A)

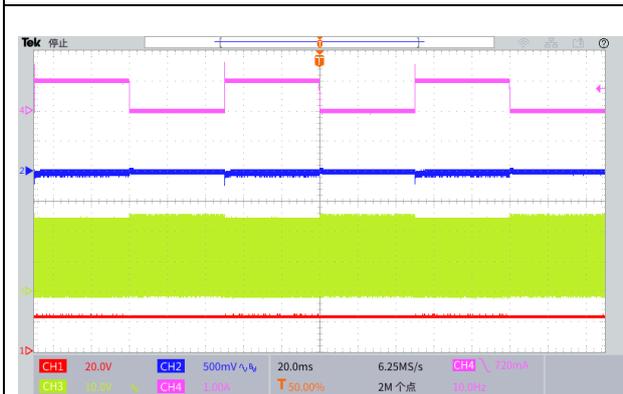


Figure 30. Load Transient Response  
( $V_{IN}=24V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0$  to 1A)

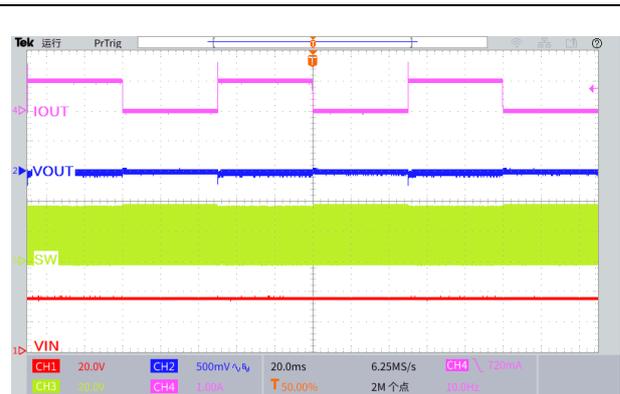
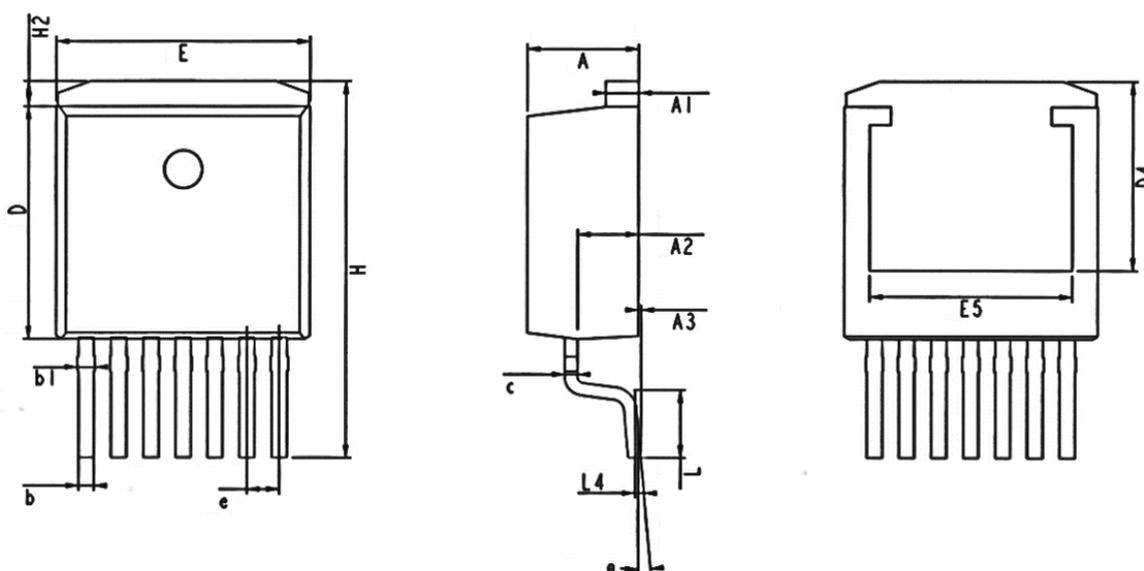


Figure 31. Load Transient Response  
( $V_{IN}=36V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=0$  to 1A)

## 6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028

### Package Information

#### TO263-7L



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	4.25	4.40	4.55	0.167	0.173	0.179
A1	1.20	1.30	1.40	0.047	0.051	0.055
A2	2.25	2.40	2.55	0.088	0.094	0.100
A3	0.01	0.13	0.25	0.000	0.005	0.010
B	0.50	0.60	0.70	0.020	0.024	0.028
B1	0.58	0.68	0.84	0.023	0.027	0.033
C	0.40	0.50	0.60	0.016	0.020	0.024
D	9.05	9.25	9.45	0.356	0.364	0.372
D4	6.90	-	-	0.271	-	-
E	9.80	10.00	10.20	0.386	0.394	0.402
E5	7.25	-	-	0.285	-	-
e	1.27 REF.			0.050 REF.		
H	14.65	15.00	15.35	0.577	0.591	0.604
H2	0.80	1.00	1.20	0.031	0.039	0.047
L	2.40	2.70	3.00	0.094	0.106	0.118
L4	0.25 REF.			0.010 REF.		
θ	2°	5°	8°	2°	5°	8°

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**6A 120KHz 50V Synchronous Buck DC to DC Converter With CV/CC Loop XL9028**

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