LC2328

18V (30V spike)2A Synchronous PFM/PWM Buck Converter

DESCRIPTION

The LC2328 is a high efficiency current-mode synchronous, 18V/2A buck converter. Its input voltage ranges from 3.5V to 18V and it provides an adjustable regulated output voltage from 0.923V to 15V while delivering up to 2A of output current.

The internal synchronous switches increase efficiency and eliminate the need for an external Schottky diode. The switching frequency is set to 350KHz. And the LC2328 will automatically switch between PFM and PWM mode based on the load current, thus to enhance the converter efficiency at light load.

LC2328 consists of many protection block such as UVLO, input voltage over voltage protection to stand much higher input voltage spike, thermal protection and output short circuit protection.
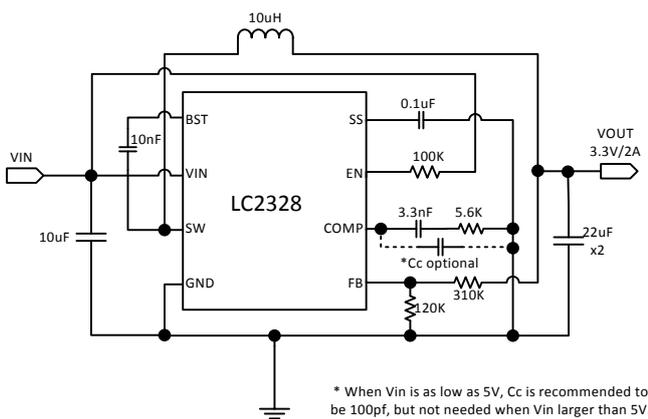
The LC2328 is available in the SOP8 package.

FEATURES

- Adjustable Output Voltage, Vfb=0.923V
- Maximum output current is 2A
- Range of operation input voltage: Max 18V
- UVLO: 3.4V (typ.)
- Withstand input voltage spike >30V
- Shut down current: 6uA (typ.)
- Operating current at zero load: 1.3mA (typ.)
- Line regulation: 0.1%/V (typ.)
- Load regulation: 10mV (typ.)
- High efficiency, up to 95%
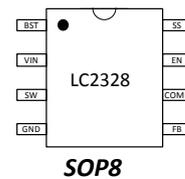- Environment Temperature: -20°C~85°C

APPLICATIONS

- Set-top-box
- Consumer Electronic Device for automobile
- LCD Monitor and LCD TV
- Portable DVD
- ADSL Modem, WLAN router
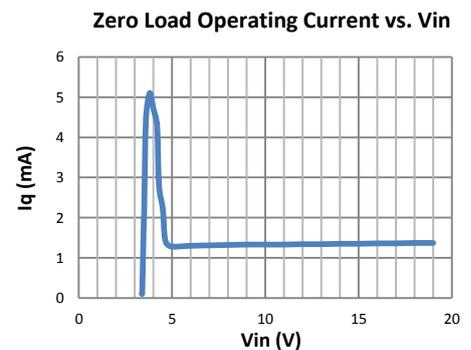- Other 12V or double cell Li-ion battery powered device
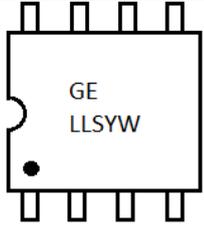
TYPICAL APPLICATION

* When Vin is as low as 5V, Cc is recommended to be 100pf, but not needed when Vin larger than 5V.

PIN OUT

SOP8

PFM at Light Load

Zero Load Operating Current vs. Vin

MARK and ORDERING INFORMATION

Mark Explanation		Ordering Information	
GE: Product Code LL: Lot No. S: Fab code YW: Date code	GE LLSYW	SOP8 2500pcs/reel	LC2328CD8TR

PINOUT DESCRIPTION

PIN #	NAME	DESCRIPTION
1	BST	High side power transistor gate drive boost input
2	VIN	Power input, the input capacitor should be placed as close to VIN and GND pin as possible
3	SW	Power switching node to connect inductor
4	GND	Ground.
5	FB	Feedback input with reference voltage set to 0.923
6	COMP	Compensation node. A serial RC connected to this pin is required to maintain the Buck converter control loop stable.
7	EN	Enable input. Setting it to high level or connecting to Vin via a resistor may turn on the chip, while setting it to ground level will turn off the chip.
8	SS	Soft-start node. Connecting a 0.1uF capacitor to ground make the Buck converter output rise smoothly.

BLOCK DIAGRAM
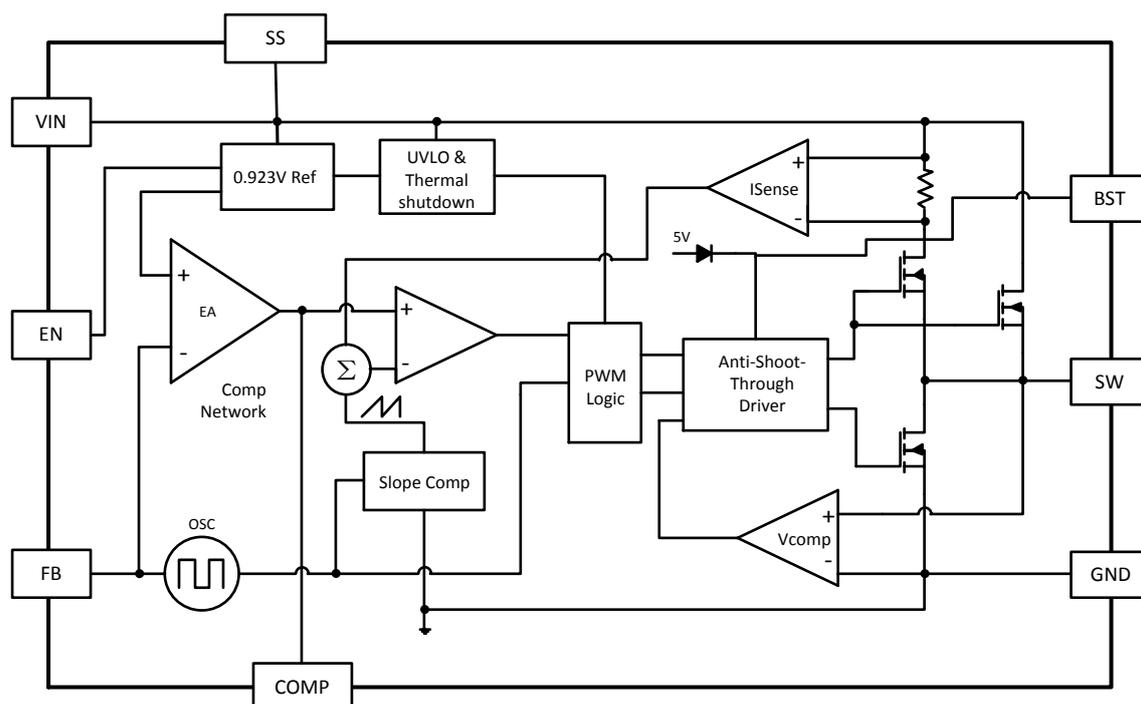
ABSOLUTE MAXIMUM RATING

Parameter		Value
Max Input Voltage		30V
Max Operating Junction Temperature(Tj)		125°C
Ambient Temperature(Ta)		-20°C – 85°C
Package Thermal Resistance (θjc)	SOP-8L	45°C / W
Storage Temperature(Ts)		-40°C - 150°C
Lead Temperature & Time		260°C, 10S
ESD (HBM)		>2000V

Note: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

RECOMMENDED WORK CONDITIONS

Parameter	Value
Input Voltage Range	Max. 18V
Operating Junction Temperature(Tj)	-20°C –125°C

ELECTRICAL CHARACTERISTICS

(Vin=12V, T_A=25°C)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vin	Input Voltage Range		3.5		18	V
Vref	Feedback Voltage	Vin=12V, Ven=5V	0.900	0.923	0.946	V
V_{UVLO}	UVLO Voltage	Vin H-->L, Iout=0.5A		3.4		V
Ifb	Feedback Leakage current			0.1	0.4	uA
Iq	Quiescent Current	Active, Vfb=1V, No Switching		1.3	1.5	mA
		Shutdown, Vin=8V		6	10	uA
LnReg	Line Regulation	Vin=5V to 12V		0.1		%/V
LdReg	Load Regulation	Iout=0.1 to 2A		0.02		%/A
Fsoc	Switching Frequency	Ven=2V, Vin=12V		350		KHz
RdsonP	PMOS Rdson			130		mohm
RdsonN	NMOS Rdson			110		mohm
Ilimit	Peak Current Limit			2.7		A
Venh	EN High Threshold		1	1.5	2	V
Venl	EN Low Threshold				0.5	V
Vovp	Input Over-Voltage Protection	Ven=2V	20			V
TSD	Over Temperature Proection			160		°C

TYPICAL PERFORMANCE CHARACTERISTICS

(Vin=12V, Vout=3.3V, L=10uH, Cin=10uF, Cout=44uF, T$_A$=25°C, unless otherwise stated)

Efficiency (Vout=3.3V)
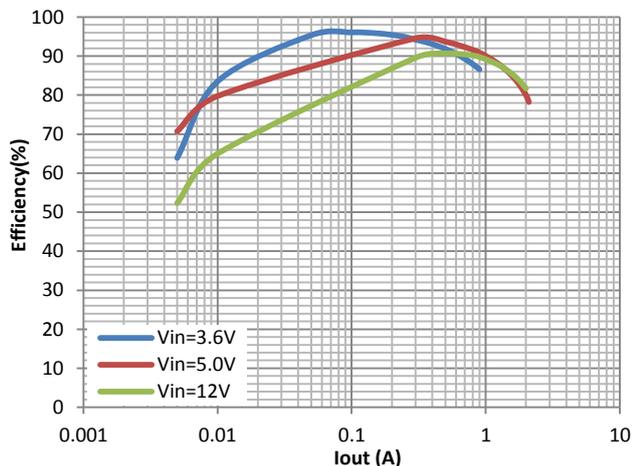
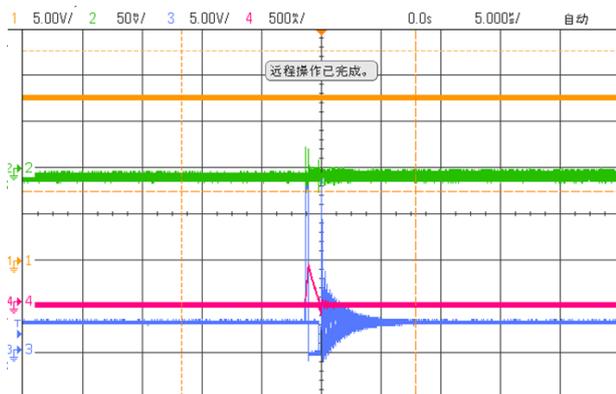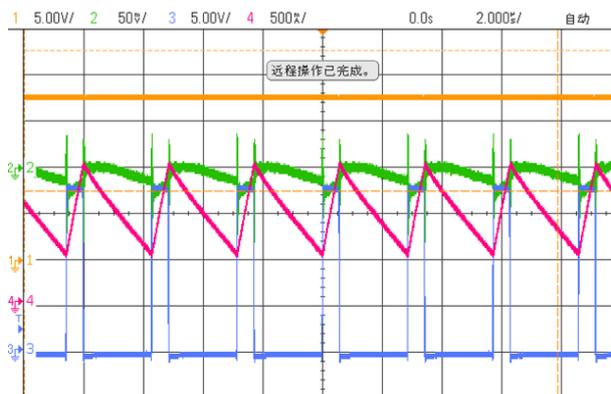### Vout vs. Iout
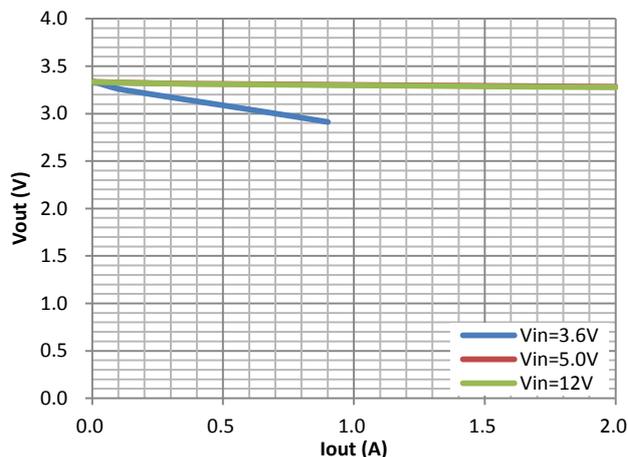
Vout vs. Vin
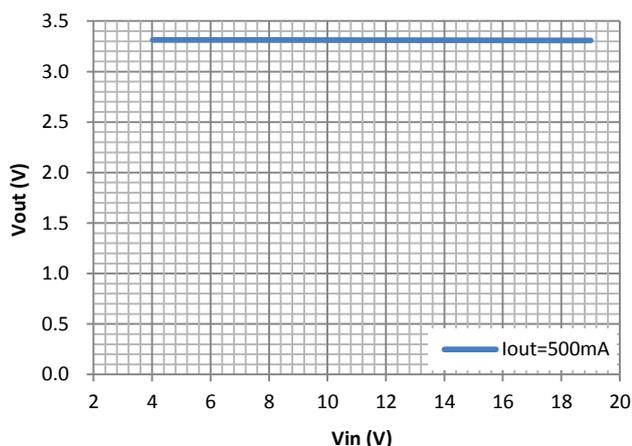
Zero Load Operating Current vs. Vin
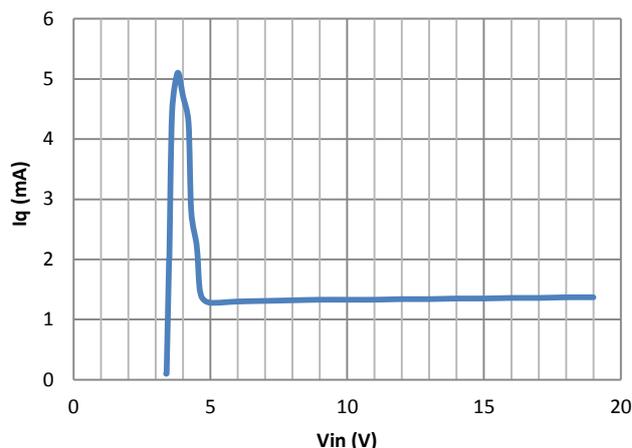
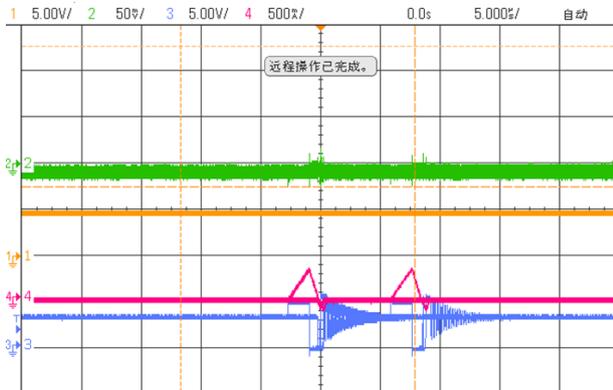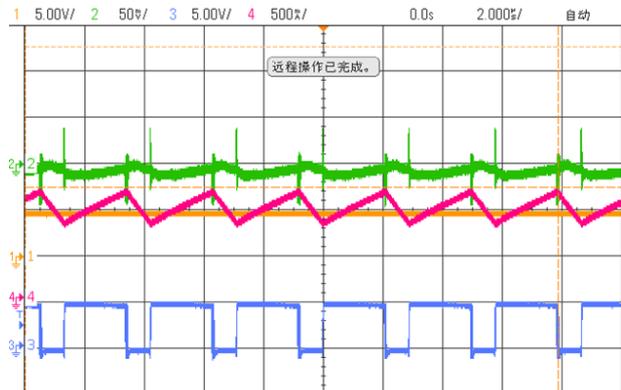### Switching waveform Vin=18V, Iout=0
(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)

Switching waveform Vin=18V, Iout=1A
(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)

Switching waveform Vin=5V, Iout=0
(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)

Switching waveform Vin=5V, Iout=1A
(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)

FUNCTIONAL DECRIPTIONS

Loop Operation

The LC2328 is a wide input range, high-efficiency, DC-to-DC step-down switching regulator, capable of delivering up to 2A of output current, integrated with a 110mΩ synchronous MOSFET, eliminating the need for external diode. It uses a PWM current-mode control scheme. An error amplifier integrates error between the FB signal and the internal reference voltage. The output of the integrator is then compared to the sum of a current-sense signal and the slope compensation ramp. This operation generates a PWM signal that modulates the duty cycle of the power MOSFETs to achieve regulation for output voltage.

Current Limit

There is a cycle-by-cycle current limit on the high-side MOSFET of 2.7A (typ). When the current flowing out of SW exceeds this limit, the high-side MOSFET turns off and the synchronous rectifier turns on. Unlike the traditional method of current limiting by limiting the voltage at the compensation pin, which usually has large variation due to duty cycle variance, this type of peak current limiting scheme provides a relatively more accurate limit for output current, thereby lowering the requirements for system design.

Light Load Operation

Traditionally, a fixed current mode constant frequency PWM DC-DC regulator always switches even when the output load is small. When energy is shuffling back and forth through the power MOSFETs, power is lost due to the finite RDSONs of the MOSFETs and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. LC2328 employs a proprietary control scheme that improves efficiency in this situation by enabling the device into a power save mode during light load, thereby extending the range of high efficiency operation.

Faster Transient Response

Normally, people use 3.3nF and 5.6Kohm RC for compensation to keep the loop stable. However, if one needs to have faster load transient response, 3.3nF and 8.5Kohm is recommended.

COMPONENT SELECTRION

When setting up the LC2328 for different output voltage, please use following recommended component value for the best performance.

V_{OUT} (V)	C_{OUT} (µF)	L (µH)
8	22x2	22
5	22x2	15
3.3	22x2	10
2.5	22x2	6.8
1.8	22x2	4.7
1.2	22x2	3.3

THERMAL CONSIDERATION

LC2328 is high efficiency Buck converter, which means it consumes very few power when converting the high voltage to low voltage. However, when output power is very large, like 5V/2A, the output power is as high as 10W, a heat dissipation path is strongly recommended to be routed on PCB. LC2328 has two different SOP8 package. For the normal SOP8, the heat is conducted out via Pin 4 (GND), so the heat dissipation route on PCB should be connected to the Pin 4 of the chip.

PACKAGE OUTLINE

Package	SOP8	Devices per reel	2500	Unit	mm

Package specification：

COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)			
SYMBOL	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.15	0.25
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	–	0.51
b1	0.37	0.42	0.47
c	0.17	–	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
L	0.45	0.60	0.80
L1	1.04REF		
L2	0.25BSC		
R	0.07	–	–
R1	0.07	–	–
h	0.30	0.40	0.50
θ	0°	–	8°
θ1	15°	17°	19°
θ2	11°	13°	15°
θ3	15°	17°	19°
θ4	11°	13°	15°