澎湃驅動力 源於力生美

LN2202

2A 27V Synchronous Buck Converter

Features

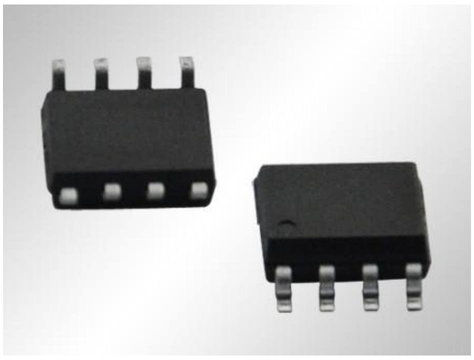
- 2A Output Current Synchronous Buck
- Wide 4.5V to 27V Operating Input Range
- Fixed 340KHZ Frequency
- Integrated Power MOSFET switches
- Output Adjustable from 0.925V to 0.8Vin
- Up to 96% Efficiency
- Programmable Soft-Start
- Stable with Low ESR Ceramic Output Capacitors
- Cycle by Cycle Over Current Protection
- Short Circuit Protection
- Input Under Voltage Lockout
- Package： SOP-8L

Applications

- Distributed Power Systems
- Networking Systems
- FPGA, DSP, ASIC Power Supplies
- Green Electronics/ Appliances
- Notebook Computers

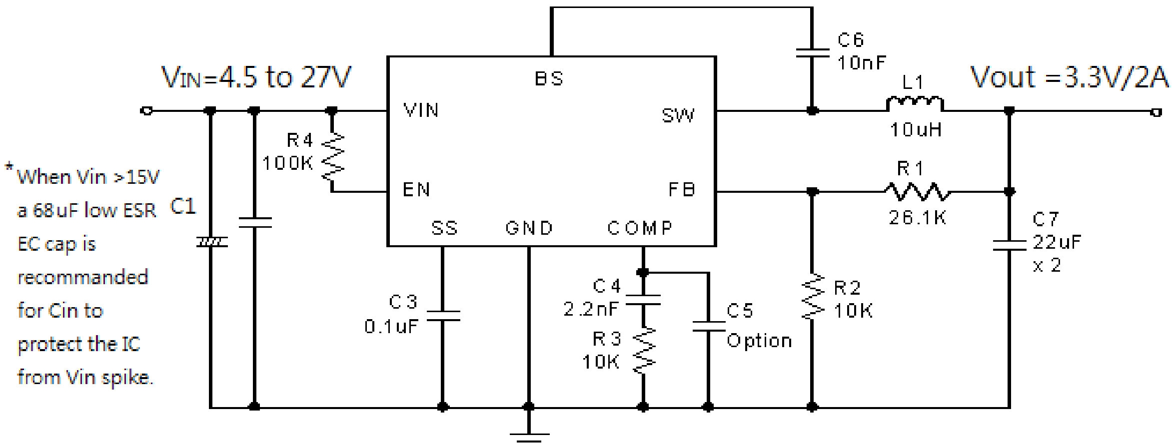
Description

The LN2202 is a monolithic synchronous buck regulator. The device integrates 95 mΩ MOSFETS that provide 2A continuous load current over a wide operating input voltage of 4.5V to 27V. Current mode control provides fast transient response and cycle by-cycle current limit. An adjustable soft start prevents inrush current at turn on.

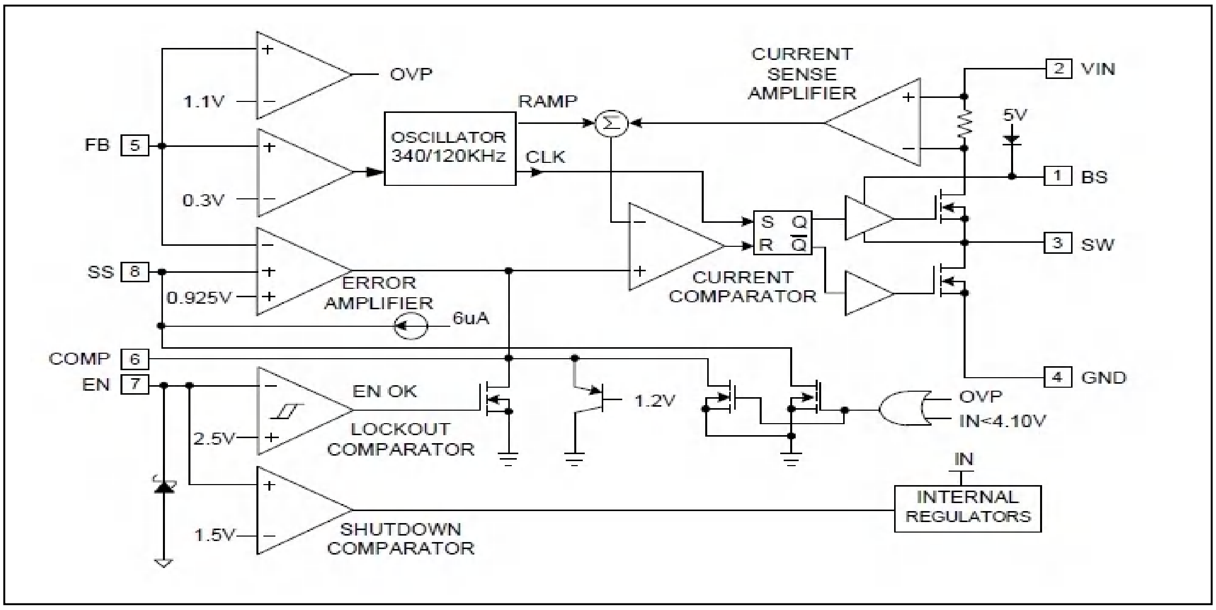


SOP-8L Package

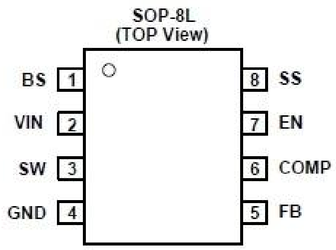
Typical Application Circuit



Block Diagram



Pin Assignments



Pin Descriptions

Pin Number	Name	Description
1	BS	Bootstrap. This pin acts as the positive rail for the high-side switch's gate driver. Connect a 0.01uF capacitor between BS and SW.
2	VIN	Input Supply. Bypass this pin to GND with a low ESR capacitor. See Input Capacitor in the Application Information section.
3	SW	Switch Output. Connect this pin to the switching end of the inductor.
4	GND	Ground.
5	FB	Feedback Input. The voltage at this pin is regulated to 0.925V. Connect to the resistor divider between output and ground to set output voltage.
6	COMP	Compensation Pin. See Stability Compensation in the Application Information section.
7	EN	Enable Input. When higher than 2.7V, this pin turns the IC on. When lower than 1.1V, this pin turns the IC off. Output voltage is discharged when the IC is off. This pin should not be left open. Recommend to put a 100KΩ pull up resistor to Vin for start up.
8	SS	Soft-Start Control Input. SS controls the soft-start period. Connect a capacitor from SS to GND to set the soft-start period. A 0.1uF capacitor sets the soft-start period to 15ms. To disable the soft-start feature, leave SS unconnected.

Absolute Maximum Ratings

Parameter	Value	Unit
Input Supply Voltage	-0.3 to 30	V
SW Voltage	-0.3 to VIN + 0.3	V
BS Voltage	VSW – 0.3 to VSW + 6	V
EN, FB, COMP Voltage	-0.3 to 5	V
Continuous SW Current	Internally limited	A
Junction to Ambient Thermal Resistance (θJA) (Test on Approximately 3 in2 Copper Area 1oz copper FR4 board)	87	°C/W
SOP-8L Power Dissipation	Internally limited	W
Maximum Junction Temperature	150	°C
Storage Temperature Range	-65 to 150	°C
Moisture Sensitivity (MSL)	Please refer the MSL label on the IC package bag/carton for detail	

(Note: Exceeding these limits may damage the device. Even the duration of exceeding is very short. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

Recommended Operating Conditions

Parameter	Min	Max	Unit
Input Supply Voltage	4.5	27 (1)	V
Operating Junction Temperature	-20	+125 (2)	°C

(Note (1): Operating the IC over this voltage is very easy to cause over voltage condition to VIN pin, SW pin, BS pin & EN pin)

(Note (2): If the IC experienced OTP, then the temperature may need to drop to <125 degree C to let the IC recover.)

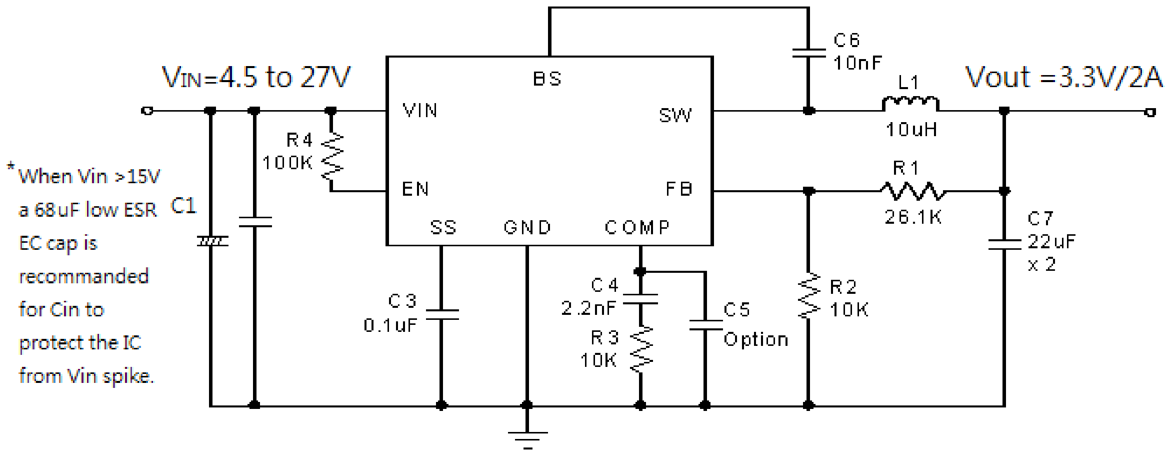
Electrical Characteristics

(V_{IN} = 12V, T_A= 25°C unless otherwise specified.)

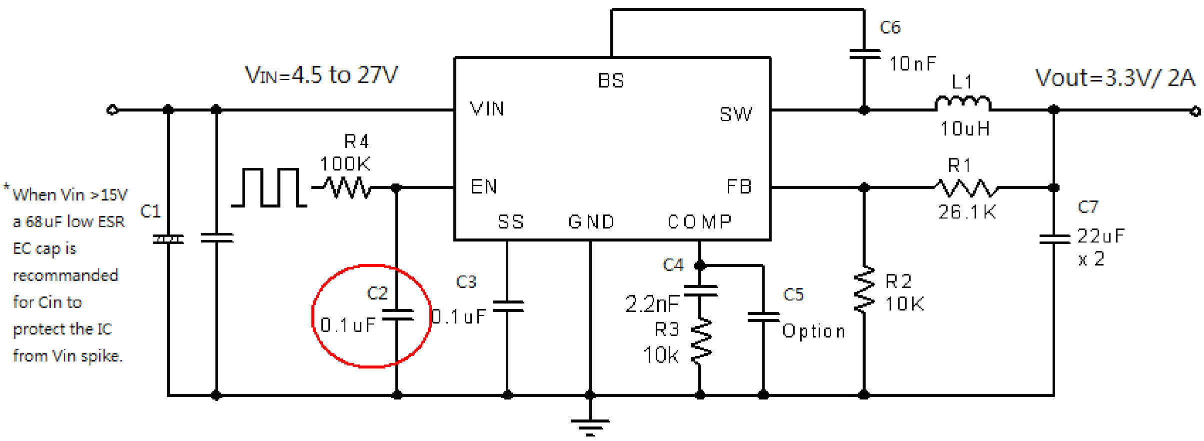
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Feedback Voltage	VFB	4.5V ≤ VIN ≤ 27V	0.900	0.925	0.950	V
Feedback Overvoltage Threshold				1.1		V
High-Side Switch-On Resistance*				95		mΩ
Low-Side Switch-On Resistance*				95		mΩ
High-Side Switch Leakage		VEN = 0V, VSW = 0V			10	uA
Upper Switch Current Limit*		Minimum Duty Cycle	2.7	3.5		A
COMP to Current Limit Transconductance	GCOMP			3.3		A/V
Error Amplifier Transconductance	GEA	ΔICOMP = ±10uA		920		uA/V
Error Amplifier DC Gain*	AVEA			480		V/V
Switching Frequency	fSW			340		KHz
Short Circuit Switching Frequency		VFB = 0		120		KHz
Maximum Duty Cycle	Dmax	VFB = 0.8V		92		%
Minimum On Time*				220		nS
EN Shutdown Threshold Voltage		VEN Rising	1.1	1.4	2	V
EN Shutdown Threshold Voltage Hysteresis				180		mV
EN Lockout Threshold Voltage			2.2	2.5	2.7	V
EN Lockout Hysteresis				130		mV
Supply Current in Shutdown		VEN = 0		0.3	3.0	uA
IC Supply Current in Operation		VEN = 3V, VFB = 1.0V		1.3	1.5	mV
Input UVLO Threshold Rising	UVLO	VEN Rising	3.80	4.05	4.40	V
Input UVLO Threshold Hysteresis				100		mV
Soft-start Current		VSS = 0V		6		uA
Soft-start Period		CSS = 0.1uF		15		mS
Thermal Shutdown Temperature*		Hysteresis =25°C		160		°C

Note: * Guaranteed by design, not tested

Application Description



LN2202 application circuit, 3.3V/2A output.



LN2202 application circuit, 3.3V/2A output with EN function

Note: C2 is required for separate EN signal.

Output Voltage Setting

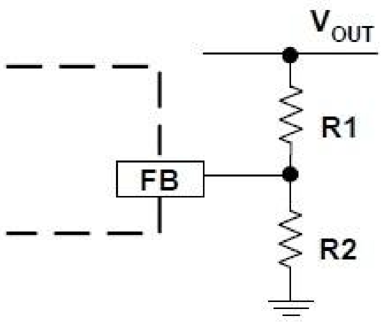


Figure1. Output Voltage Setting

Figure 1 shows the connections for setting the output voltage. Select the proper ratio of the two feedback resistors R1 and R2 based on the output voltage. Typically, use R2 ≈ 10KΩ and determine R1 from the following equation:

$$R1 = R2\left(\frac{V_{OUT}}{0.925V} - 1\right)$$

VOUT	R1	R2
1.0V	1.0 KΩ	12 KΩ
1.2V	3.0 KΩ	10 KΩ
1.8V	9.53 KΩ	10 KΩ
2.5V	16.9 KΩ	10 KΩ
3.3V	26.1 KΩ	10 KΩ
5V	44.2 KΩ	10 KΩ
12V	121 KΩ	10 KΩ

Table1. Recommended Resistance Values

Inductor Selection

The inductor maintains a continuous current to the output load. This inductor current has a ripple that is dependent on the inductance value: higher inductance reduces the peak-to-peak ripple current. The trade off for high inductance value is the increase in inductor core size and series resistance, and the reduction in current handling capability. In general, select an inductance value L based on the ripple current requirement:

$$L = \frac{V_{OUT} \bullet (V_{IN} - V_{OUT})}{V_{IN} f_{SW} I_{OUTMAX} K_{RIPPLE}}$$

Where V_{IN} is the input voltage, V_{OUT} is the output voltage, f_{SW} is the switching frequency, I_{OUTMAX} is the maximum output current, and K_{RIPPLE} is the ripple factor. Typically, choose K_{RIPPLE} =~ 30% to correspond to the peak-to-peak ripple current being ~30% of the maximum output current.

With this inductor value, the peak inductor current is $I_{OUT} \bullet (1 + K_{RIPPLE} / 2)$. Make sure that this peak inductor current is less than the upper switch current limit. Finally, select the inductor core size so that it does not saturate at the current limit. Typical inductor values for various output voltages are shown in Table 2.

VOUT	1.0V	1.2V	1.5V	1.8V
L	4.7uH	4.7uH	10uH	10uH
VOUT	2.5V	3.3V	5V	9V
L	10uH	10uH	10uH	22uH

Table 2. Typical Inductor Values

Input Capacitor

The input capacitor needs to be carefully selected to maintain sufficiently low ripple at the supply input of the converter. A low ESR **Electrolytic (EC) capacitor** is highly recommended. Since large current flows in and out of this capacitor during switching, its ESR also affects efficiency.

When EC cap is used, the input capacitance needs to be equal to or higher than 68uF. The RMS ripple current rating

needs to be higher than 50% of the output current. The input capacitor should be placed close to the VIN and GND pins of the IC, with the shortest traces possible. The input capacitor can be placed a little bit away if a small parallel 0.1uF ceramic capacitor is placed right next to the IC.
When Vin is >15V, pure ceramic Cin (* no EC cap) is not recommended. This is because the ESR of a ceramic cap is often too small, Pure ceramic Cin will work with the parasite inductance of the input trace and forms a Vin resonant tank. When Vin is hot plug in/out, this resonant tank will boost the Vin spike to a very high voltage and damage the IC.

Output Capacitor

The output capacitor also needs to have low ESR to keep low output voltage ripple. In the case of ceramic output capacitors, R_{ESR} is very small and does not contribute to the ripple. Therefore, a lower capacitance value can be used for ceramic capacitors. In the case of tantalum or electrolytic capacitors, the ripple is dominated by R_{ESR} multiplied by the ripple current. In that case, the output capacitor is chosen to have sufficiently low ESR.
For ceramic output capacitors, typically choose of about 22uF. For tantalum or electrolytic capacitors, choose a capacitor with less than 50mΩ ESR.

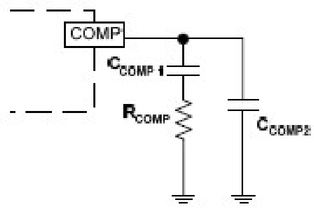
Optional Schottky Diode

During the transition between high-side switch and low-side switch, the body diode of the low side power MOSFET conducts the inductor current. The forward voltage of this body diode is high. An optional Schottky diode may be paralleled between the SW pin and GND pin to improve overall efficiency. Table 3 lists example Schottky diodes and their Manufacturers.

Vin max	Part Number	Voltage/Current Rating
<20V	B130	30V, 1A
<20V	SK13	30V, 1A
>20V	B140	40V,1A
>20V	SK14	40V,1A

Table 3. Diode Selection Guide

Stability Compensation



C_{COMP2} is needed only for high ESR output capacitor

Figure 2. Stability Compensation

The feedback loop of the IC is stabilized by the components at the COMP pin, as shown in Figure 2. The DC loop gain of the system is determined by the following equation:

$$A_{VDC} = \frac{0.925V}{I_{OUT}} A_{VEA} G_{COMP}$$

The dominant pole P1 is due to C_{COMP1}:

$$f_{P1} = \frac{G_{EA}}{2\pi A_{VEA} C_{COMP1}}$$

The second pole P2 is the output pole:

$$f_{P2} = \frac{I_{OUT}}{2\pi V_{OUT} C_{OUT}}$$

The first zero Z1 is due to R_{COMP} and C_{COMP1}:

$$f_{Z1} = \frac{1}{2\pi R_{COMP} C_{COMP1}}$$

And finally, the third pole is due to R_{COMP} and C_{COMP2} (if C_{COMP2} is used):

$$f_{P3} = \frac{1}{2\pi R_{COMP} C_{COMP2}}$$

The following steps should be used to compensate the IC:

STEP1. Set the crossover frequency at 1/10 of the switching frequency via R_{COMP}:

$$R_{COMP} = \frac{2\pi V_{OUT} C_{OUT} f_{SW}}{10 G_{EA} G_{COMP} \bullet 0.925V}$$

But limit R_{COMP} to 10KΩ maximum. More than 10 KΩ is easy to cause overshoot at power on.

STEP2. Set the zero fZ1 at 1/4 of the crossover frequency. If R_{COMP} is less than 10KΩ, the equation for C_{COMP} is:

$$C_{COMP1} = \frac{0.637}{R_{COMP} \times fc} \quad (F)$$

STEP3. If the output capacitor's ESR is high enough to cause a zero at lower than 4 times the crossover frequency, an additional compensation capacitor C_{COMP2} is required. The condition for using C_{COMP2} is:

$$\pi \times C_{OUT} \times R_{ESR} \times fs \geq 1$$

And the proper value for C_{COMP2} is:

$$C_{COMP2} = \frac{C_{OUT} R_{ESRCOUT}}{R_{COMP}}$$

Though C_{COMP2} is unnecessary when the output capacitor has sufficiently low ESR, a small value C_{COMP2} such as 100pF may improve stability against PCB layout parasitic effects.

Vin Range (V)	Vout (V)	Cout	Rcomp (R3) (kΩ)	Ccomp (C4) (nF)	Ccomp2 (C5) (pF)	Inductor (uH)
5 – 12	1.0	22uF x2 Ceramic	3.3	5.6	none	4.7
5 - 15	1.2		3.9	4.7	none	4.7
5 - 15	1.8		5.6	3.3	none	10
5 - 15	2.5		8.2	2.2	none	10
5 - 15	3.3		10	2	none	10
7 - 15	5		10	3.3	none	10
5 - 12	1.0	470uF/ 6.3V/ 120mΩ	10	6.8	680	4.7
5 - 15	1.2					
5 - 23	1.8					10
5 - 27	2.5					
5 -27	3.3					
7 -27	5					

Table 4 Component Selection Guide for Stability Compensation

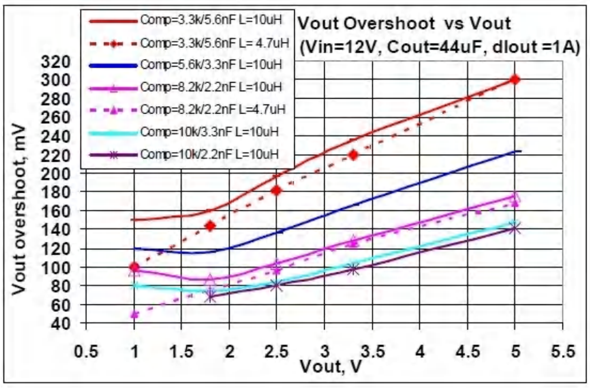


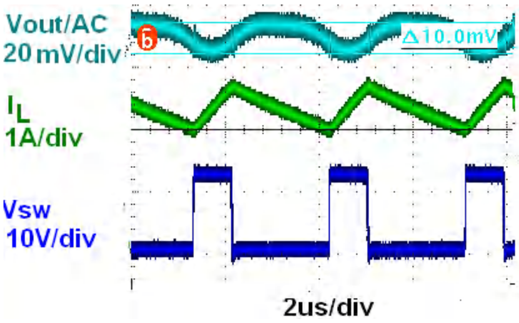
Figure 3. Load Transient Testing VS Compensation Value

Typical Performance Characteristics

(Vin=12V, Io=0 mA, Temperature = 25 ℃, unless otherwise specified)

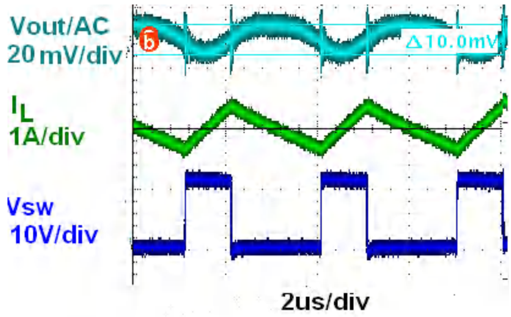
Light Load Operation (No load)

Vin=12V, Iin=8.2 mA, Vout=3,3V



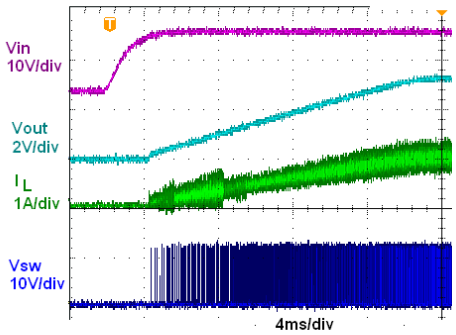
Heavy Load Operation (2A Load)

Vin=12V, Vout=3,3V

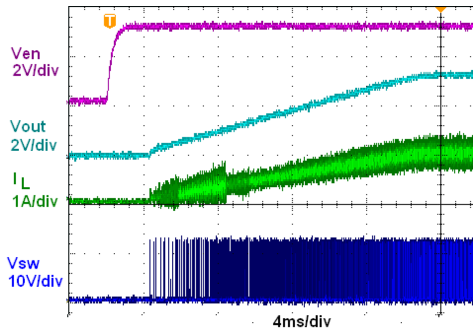


Startup Vin=12V, Vout=3.3V, Iout=1A

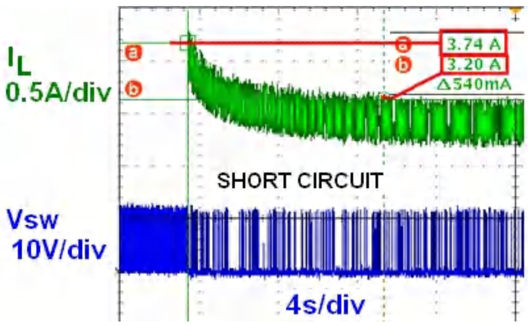
Through Vin.

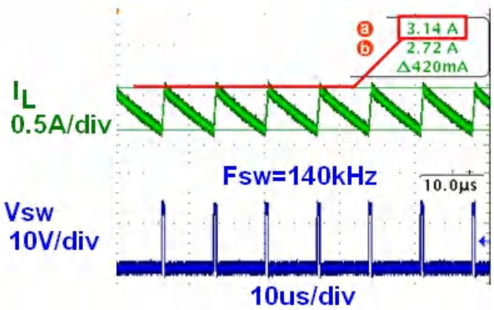


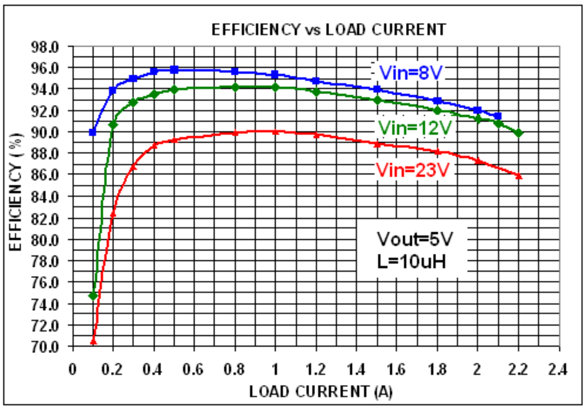
Through Enable.

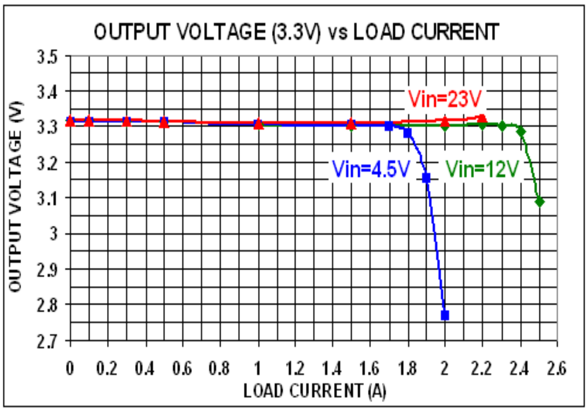


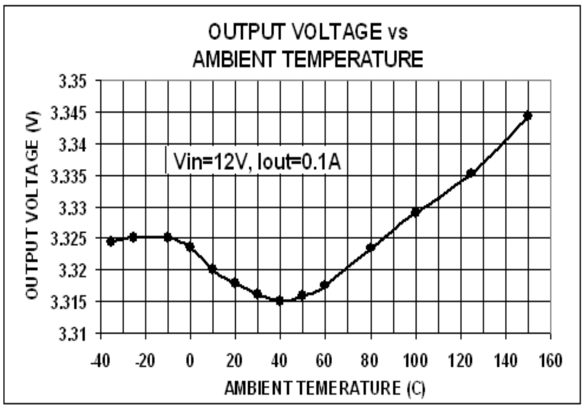
Short Circuit Protection Vin=12V

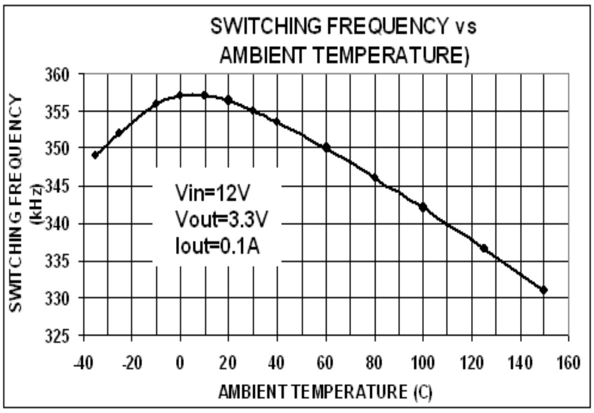


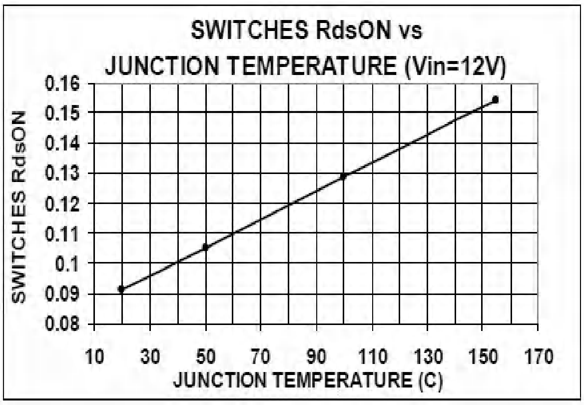


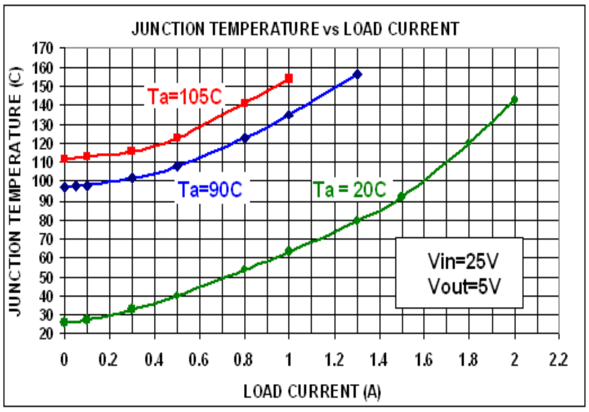

EFFICIENCY vs LOAD CURRENT
EFFICIENCY (%)
LOAD CURRENT (A)
Vin=8V
Vin=12V
Vin=23V
Vout=5V
L=10uH


OUTPUT VOLTAGE (3.3V) vs LOAD CURRENT
OUTPUT VOLTAGE (V)
LOAD CURRENT (A)
Vin=23V
Vin=4.5V
Vin=12V


OUTPUT VOLTAGE vs
AMBIENT TEMPERATURE
OUTPUT VOLTAGE (V)
AMBIENT TEMERATURE (C)
Vin=12V, Iout=0.1A

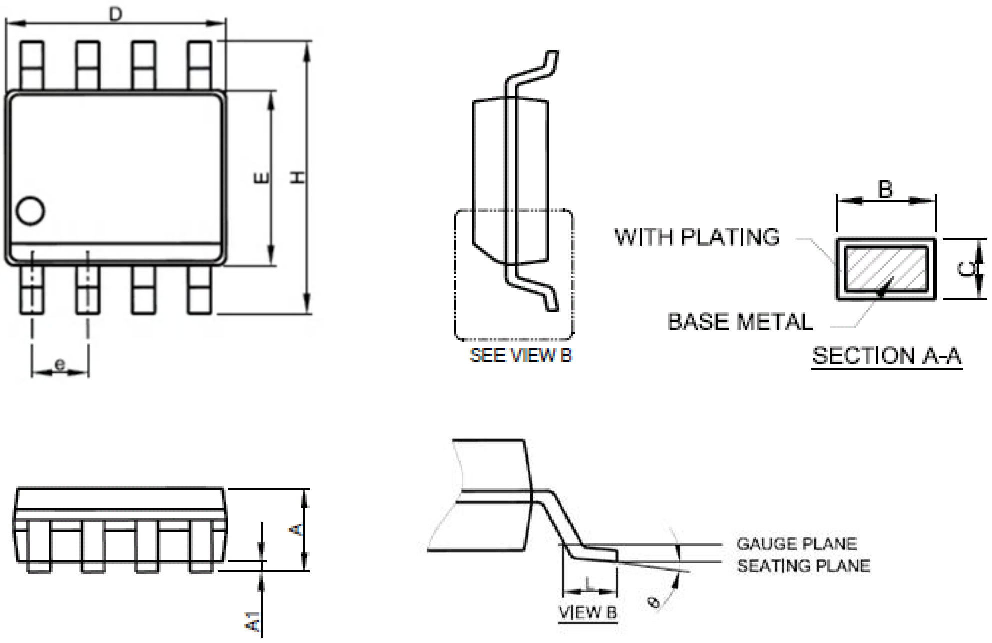

SWITCHING FREQUENCY vs
AMBIENT TEMPERATURE)
SWITCHING FREQUENCY
(kHz)
AMBIENT TEMERATURE (C)
Vin=12V
Vout=3.3V
Iout=0.1A


SWITCHES RdsON vs
JUNCTION TEMPERATURE (Vin=12V)
SWITCHES RdsON
JUNCTION TEMPERATURE (C)


JUNCTION TEMPERATURE vs LOAD CURRENT
JUNCTION TEMPERATURE (C)
LOAD CURRENT (A)
Ta=105C
Ta=90C
Ta = 20C
Vin=25V
Vout=5V

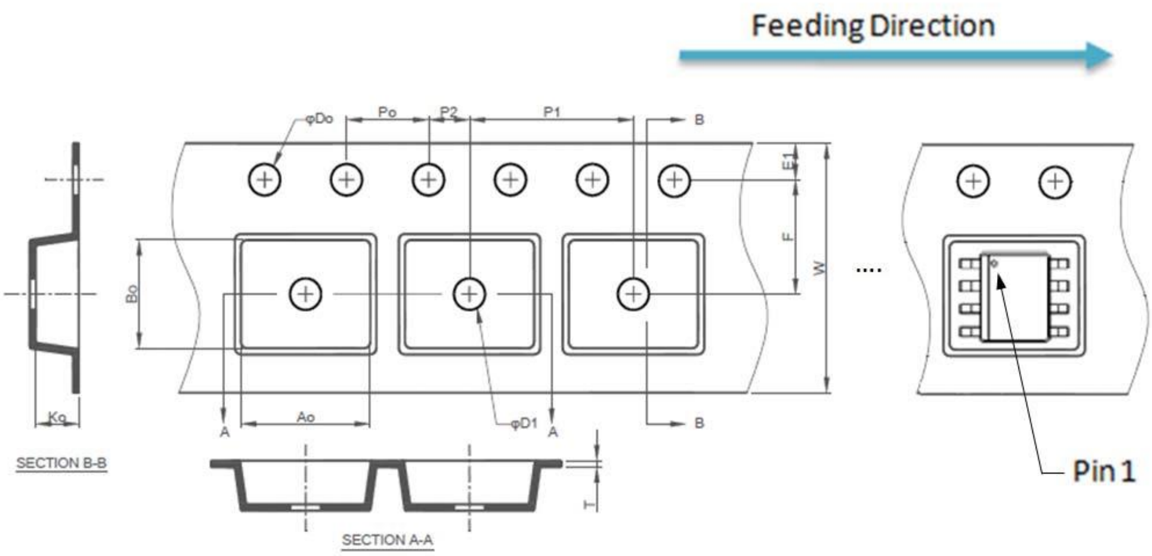
Package Information (All Dimensions in mm)

SOP-8L

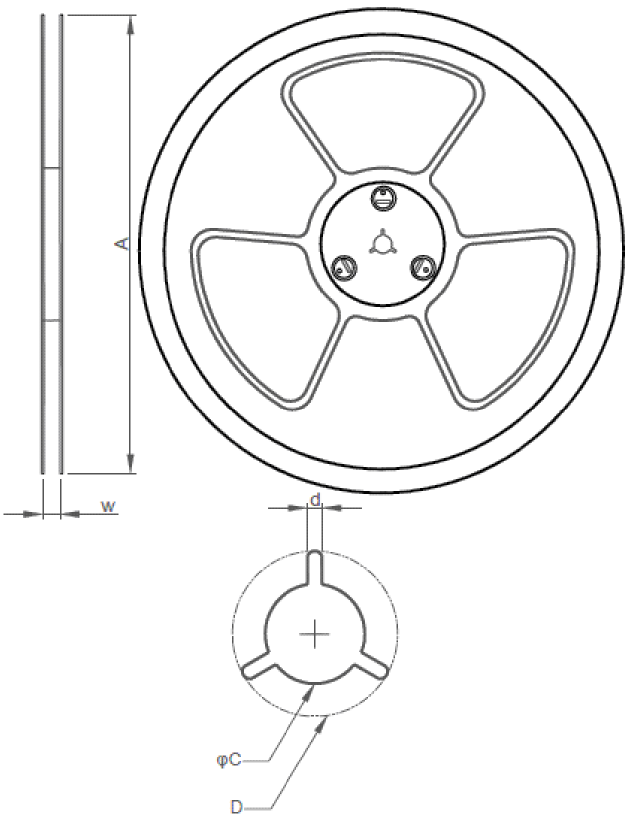


Symbol	Dimensions In Millimeters	
	Min	Max
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.17	0.25
D	4.70	5.10
E	3.70	4.10
e	1.27BSC	
H	5.80	6.20
L	0.40	1.27
θ	0	8°

Tape/Reel



SYMBOL	Ao	Bo	Ko	T	Do	D1
SPEC.	6.90± 0.20	5.40± 0.20	2.10± 0.20	0.30± 0.05	1.50 +0.10 -0.00	1.50 min.
SYMBOL	Po	P1	P2	E1	F	W
SPEC.	4.00± 0.10	8.00± 0.10	2.00± 0.05	1.75± 0.10	5.50± 0.05	12.00± 0.30



Package Type	A	W	C	d	D
TO-252-3L	330± 2	16.4 +2.0 -0.0	13.0 +0.5 -0.2	1.5 MIN.	20.2 MIN.
SOP-8 SOT-223	330± 2	12.4 +2.0 -0.0	13.0 +0.5 -0.2	1.5 MIN.	20.2 MIN.
SOT-89-3L	178± 2	12.4 +2.0 -0.0	13.0 +0.5 -0.2	1.5 MIN.	20.2 MIN.

Note: Refer to EIA-481-B

聲明

力生美、Liisemi、 等均為力生美半導體器件有限公司的商標或注冊商標，未經書面允許任何單位、公司、個人均不得擅自使用，所發布產品規格書之著作權均受相關法律法規所保護，力生美半導體保留全部所有之版權，未經授權不得擅自複制其中任何部分或全部之內容用於商業目的。

產品規格書僅為所描述產品的特性說明之用，僅為便於使用相關之產品，力生美半導體不承諾對文檔之錯誤完全負責，並不承擔任何因使用本文檔所造成的任何損失，本著產品改進的需要，力生美半導體有權在任何時刻對本文檔進行必要的修改，並不承擔任何通知之義務。

力生美半導體系列產品均擁有相關技術之自主專利，並受相關法律法規保護，未經授權不得擅自複制、抄襲或具有商業目的的芯片反向工程，力生美半導體保留相關依法追究之權利。

力生美半導體不對將相關產品使用於醫學、救護等生命設備所造成的任何損失承擔責任或連帶責任，除非在交易條款中明確約定。

最新信息請訪問：

www.liisemi.com