AC/DC HVBUCK Power Switch IC

1. Feature

Designed for HVBUCK™ high voltage step-down conversion

High precision regulated rated output voltage is 12 V

Maximum output current capability up to 350 mA

Built-in High-Voltage MOSFET BVdss voltage up to 650 V

Built-in smartEnergy™ energy efficiency control technology

Ultra-low cost minimalist peripheral device architecture design

Internal fixed peak switch current cycle-by-cycle limit

Built-in no-current overshoot soft start control

Short circuit, overload and overheat protection

Built-in 650 V high voltage start current source

Very low standby power and extremely high conversion efficiency

Standby power is less than 0.05 W

Meet energy efficiency requirements such as ErP/CoC/DoE

High and low voltage pins distribution on both sides of the IC to form a high isolation pin layout

2. Applications

Induction Cooker Power Supply

Household Appliance Controller Board Power Supply

Non-isolated Auxiliary Power Supply

Other High Voltage Step-down Power Supply Applications

3. Description

LN8K18B is a high performance current mode switching power supply power switch controller IC, fixed high precision 12 V output voltage, designed for non-isolated converters such as electrical, household appliance control board power supply, and auxiliary power supply. It integrates a complete PWM/PFM hybrid control circuit, a power switch circuit with up to 650 V withstand voltage, fault detection and protection circuit, clock and delay control circuit, etc., which can be provided up to 350mA maximum output current capability under the ultra-wide grid voltage of 85-380 Vac. The highly integrated internal circuit design minimizes the number of external components, and requires only a few devices (the chip itself requires only one decoupling capacitor) to implement a typical BUCK topology switching power supply design. The well-functioning multiple fault protection circuit further simplify the design of the power supply and reduce the system cost.

The maximum switching current of the system is internally set and has a cycle-by-cycle limit function. The external inductor matching system can work in the interrupted current mode to reduce the diode requirement or the shallow continuous current mode to improve the output capability. According to different requirements of the output characteristics, the circuit can be flexibly operated in different connection structures, so that the positive voltage or the negative voltage output can be conveniently realized to meet the different requirements of driving the relay or the thyristor circuit.

The chip integrates comprehensive protection circuit functions, including a clock generation circuit with maximum time limit function, cycle-by-cycle current limit circuit with leading edge blanking, thermal shutdown circuit with hysteresis, output short circuit , overload protection and restart circuit, etc.

Optimized energy efficiency processing circuitry allows the system to easily meet 0.5 W standby requirements and the latest energy efficiency standards.

Available in SOP8 standard green package with high isolation capability due to high and low voltage pins distribution on both sides of the IC.

4. Functional Block Diagram

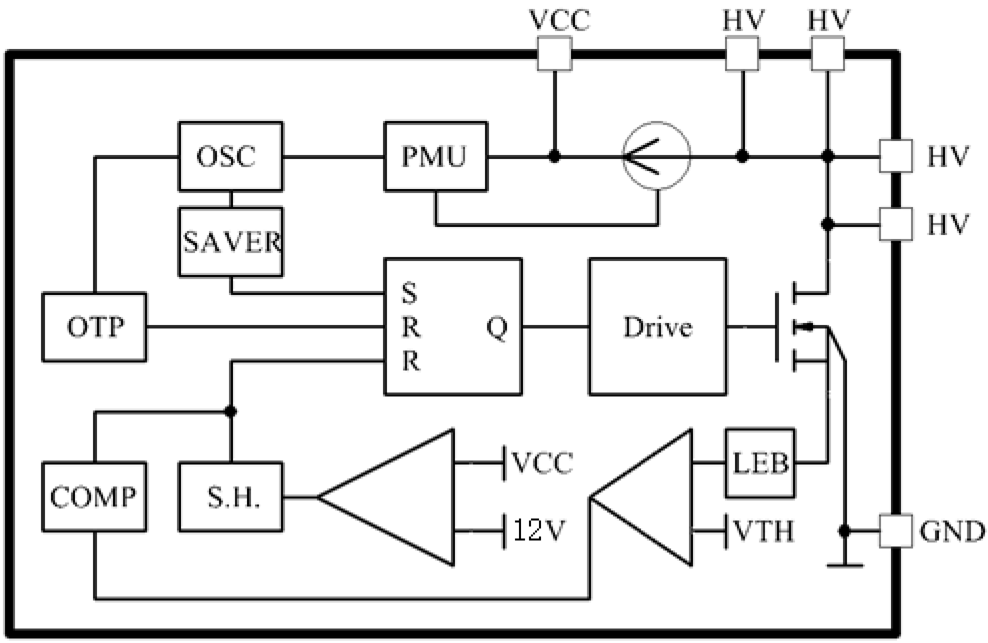

Fig1. Internal functional block diagram

5. Pin Definitions

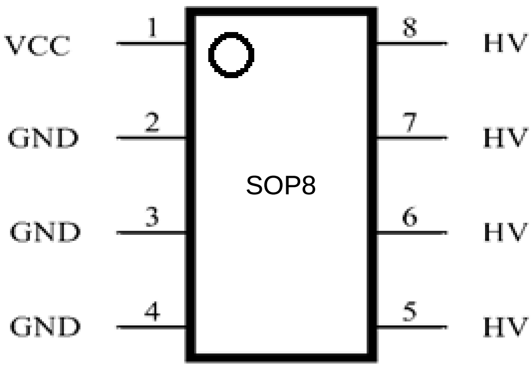

Fig2. Pin Definitions

6. Pin Function Description

PIN	Symbol	Function
1	VCC	Power supply pin
2,3,4	GND	Ground pin, Pin 3/4 can be left floating but it is recommended to connect with Pin2
5,6,7,8	HV	High voltage switch pin, connected to input DC positive (BUCK) or transformer (flyback) , PIN5~8 must be connected on the PCB

7. Typical Simplified Schematic

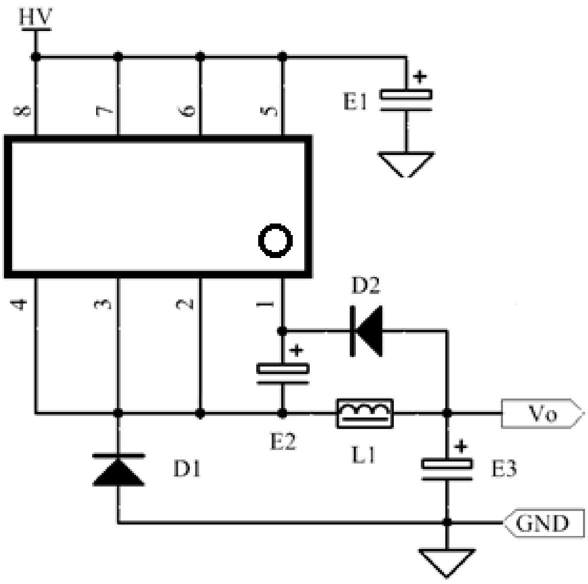

Fig3. Typical Simplified Schematic

8. Absolute Maximum Ratings *

Parameter		Rating	Units
VCC pin Voltage		-0.3 to +35	V
HV Pin Voltage		-0.3 to +650**	V
Peak Switch Current		3.2***	A
PD		1200	mW
Min/Max Operating Junction Temperature T_J		-40 to +150	℃
Min/Max Operating Ambient Temperature Ta		-20 to +105	℃
Min/Max Storage Temperature Tstg		-55 to +150	℃
Recommended Soldering Conditions		+260 ℃,10 S	
ESD	HBM	2500	V
	MM	250	V

Note*: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum-rated conditions for ex tended periods may affect device reliability. **: Single pulse test, pulse width is 1ms, period is 1s, current with 1mA limit; ***: single pulse test, pulse width is 300us, period is 1s.

9. Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Units
V_{IN}	Input DC Voltage	100	-	550	Vdc
I_{PEAK}	Peak Switching Current	-	-	750	mA
TA	Operating Ambient Temperature	-20	-	+85	℃

10. Electrical Characteristics(Ta = 25 ℃, VCC=12 V, C_{VCC}=4.7uF, if not otherwise noted)

Power Switch Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV_{HV}	Max. Switching pin Voltage	V_{CC}=0 V, I_{HV}=1 mA	650	700	-	V
I_{HV}	Switch Leakage Current	HV=650 V	-	-	100	uA
V_{HVON}	Switch Forward Voltage	I_{HV}=500 mA	-	4.7	6	V
Ton	Switch on Delay	I_{HV}=500 mA	-	30	-	nS
Toff	Switch off Delay	I_{HV}=500 mA	-	30	-	nS

OSC Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
F_{OSC}	Switching Frequency		-	42	-	kHz
ΔF_{OSC}_T	F_{OSC} VS Ta	T_J=0-100	-3	-	+3	%
ΔF_{OSC}_V	F_{OSC} VS VCC	I_{HV}=0.2-0.4 A	-3	-	+3	%
F_{CT}	Cycle Turn Back Frequency Range	F_{OSC}=42 kHz	-2.3	-	+2.3	kHz
T_{CT}	Cycle Turn Back Time		-	4	-	mS

PWM Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
T_{ONMIN}	Min. Turn-on Time		-	400	-	nS
T_{ONMAX}	Max. Turn-on Time		-	10	-	nS
Gain	PWM Gain		-	3.5	-	V/V

Current Limit Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{LIMIT}	Peak Current Limit		-	0.70	-	A
T_{LEB}	Leading Edge Blanking Time		-	300	-	nS
T_{ILD}	Current Limit Delay	L=900 uH	-	100	-	nS

Over Temperature Protection Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
t_{OTPON}	Over Temperature Protection On		130	140	150	℃
T_{OPT}	Over Temperature Protection Delay		-	500	-	nS

Power Supply Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_{ST}	Starting Current	VCC<14 V	-	30	50	UA
I_{OP}	Operating Current	F_{OSC}=42 kHz	0.55	1	1.5	mA
V_{ST}	Starting Voltage		16	17.5	18.5	V
V_{OFF}	VCC Undervoltage Shutdown Voltage		8	9	10	V
V_{ROVP}	Feedback Enable Threshold Voltage		11.3	12.3	13.3	V
VCC_{MAX}	Max. VCC voltage	With I_{VDD}=10mA limit	30	32	34	V

Thermal Data

Symbol	Parameter	Rating	Unit
θ_{JA}[1]	Thermal Resistance Junction-Ambient	60	℃/W
θ_{JC}[2]	Thermal Resistance Junction-Case	25	℃/W

Notes: 1. All leads are soldered on a 200 mm^2 copper foil with 2 oz thick to measuring. 2. Measured on the surface of the package near pin 5/6/7/8.

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12. Application and Implementation

12.1 Start-up Section

At startup, the internal high-voltage current source charges the VCC capacitor. When the VCC voltage rises to 16 V, the power management circuit starts to work, turns on the internal reference voltage, the switching pulse triggers the power switch to turn on, and the high-voltage current source turns off. After normal operation, it is external (the output) supplies the required energy to VCC. Before the circuit works stable, ensure that the VCC voltage does not fall to the VCC undervoltage protection point, otherwise the circuit will enter the fault protection mode and try to start again after a certain time.

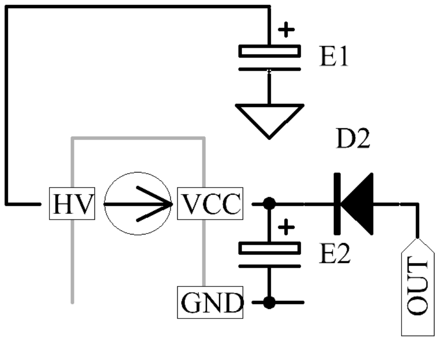


Fig4. Start-up Circuit diagram

12.2 PMW and VCC Feedback Control

The control circuit operates in current mode, and the power switch is turned on at the leading edge of each clock in the non-fault state. When the peak inductor current reaches the internally set maximum current comparator threshold current or the limit current corresponding to the error amplifier output, the switch is turned off, and the peak current is controlled by the condition for each switching cycle, thereby implementing current mode control. By feeding back the output voltage to VCC and comparing it to the internal reference on the VCC voltage comparator inside the chip, the current cycle is terminated when the VCC voltage reaches the voltage limit point, and the internal feedback control circuit thus establishes and maintains an error signal, which is constantly adjusted according to the error signal-like turn-off time, thereby maintaining the output voltage stable under specified load conditions. If the VCC feedback loop is disconnected, the system will continue to enter a restart state to protect the chip from damage.

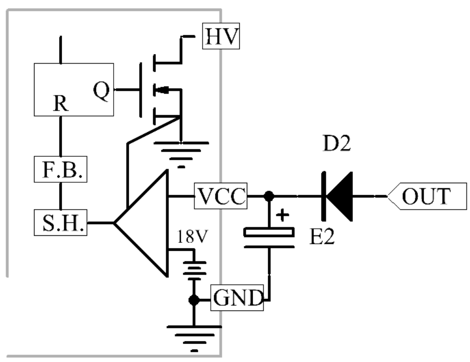


Fig5. Feedback Circuit diagram

12.3 Cycle-by-cycle Current Limit

During each turn-on cycle, the voltage developed by the sampled inductor current is compared to the internal reference voltage or the current-limit threshold determined by the output voltage of the error amplifier. If the specified value is reached, the current cycle is immediately aborted and the output shutdown state is locked until the next switching pulse comes, thereby achieving cycle-by-cycle current limiting, which is limited by the internal circuit for the maximum current during overload. The leading edge blanking circuit automatically masks the sampling circuit for 300 nS time at the beginning of each current signal to eliminate the influence of the turn-on current spike caused by the transformer turn-to-turn capacitance and the output diode reverse recovery time on the switching action detection.

12.4 VCC Undervoltage Protection

When the circuit starts, the output is automatically locked in the off state before the VCC voltage reaches 17.5 V. After the VCC reaches16 V, the reference voltage is established to make the internal circuit fully work. If the VCC voltage drops to 9V during operation, the undervoltage comparator operates. The output is reset to the shutdown state and the trigger circuit enters the restart mode; if the VCC voltage reaches the overvoltage comparator threshold, the current cycle is turned off and latched until the next clock pulse switch is turned back on.

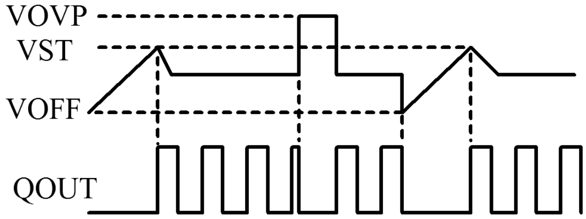


Fig6. UVLO Waveform diagram

12.5 Intelligent Energy Efficiency Processing

After the output load drops to a certain value, the system energy-efficiency processing circuit automatically switches the working mode to the light-load mode to improve the light load efficiency. Keeping fewer switching times and switching currents when the output is completely no-load allows the system to consume very little power.

12.6 No Noise Mode

At no-load and light-load conditions, the system operates in an advanced pulse output state, locking the output pulse train out of the human audible audio range in real time, thereby avoiding audible noise.

12.7 Over Temperature Protection

When the circuit works normally, the internal temperature detection circuit detects the core temperature of the chip in real time. If the temperature reaches the set over temperature protection threshold, the output will be turned off and locked until the VCC voltage drops below 9 V, and the system enters the restart mode. A typical over temperature protection threshold is 140 °C.

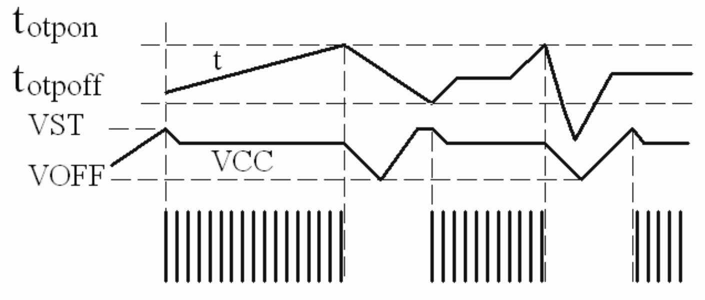


Fig7. OTP Waveform diagram

12.8 Output Overload and Short Circuit Protection

In the normal output of the system, the switch current is set by the current limiting resistor. When the output power continues to increase and tries to exceed the maximum design limit current of the system, the output voltage will start to decrease rapidly with the further increase of the output current until the VCC voltage drops to 9 V. The circuit enters the restart mode; when the output is shorted, it will directly cause the VCC voltage to drop rapidly to 9 V, and the circuit enters the restart mode.

13. Layout Guidelines

13.1 Principles of high-frequency layout

Minimize area of switched current loops. In a buck regulator there are two loops where currents are switched very fast. The first loop starts from the input capacitor, to the regulator HV pin, to the regulator VCC pin, to the inductor then out to the output capacitor and load. The second loop starts from the output capacitor ground, to the regulator GND pins, to the in ductor and then out to the load (see Fig.7).

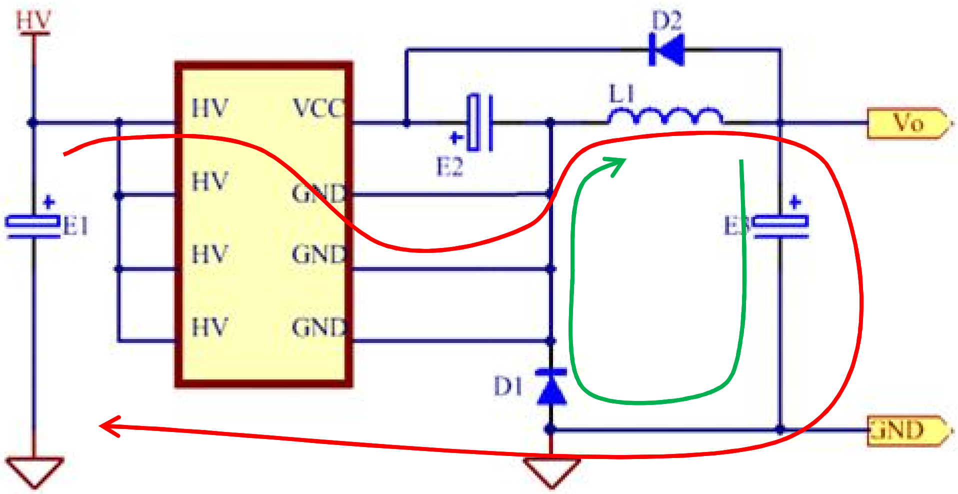


Fig8. Typical current loop diagram

13.2 Typical layout reference

An example of a typical PCB layout is shown below.

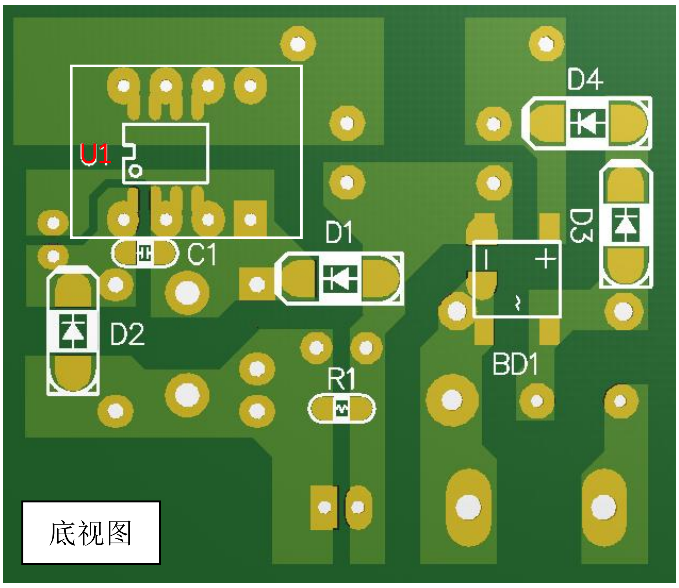


Fig9. Typical layout reference (bottom view)

14. Typical Application Circuit Schematic (input：90~265 Vac)

Schematic 1

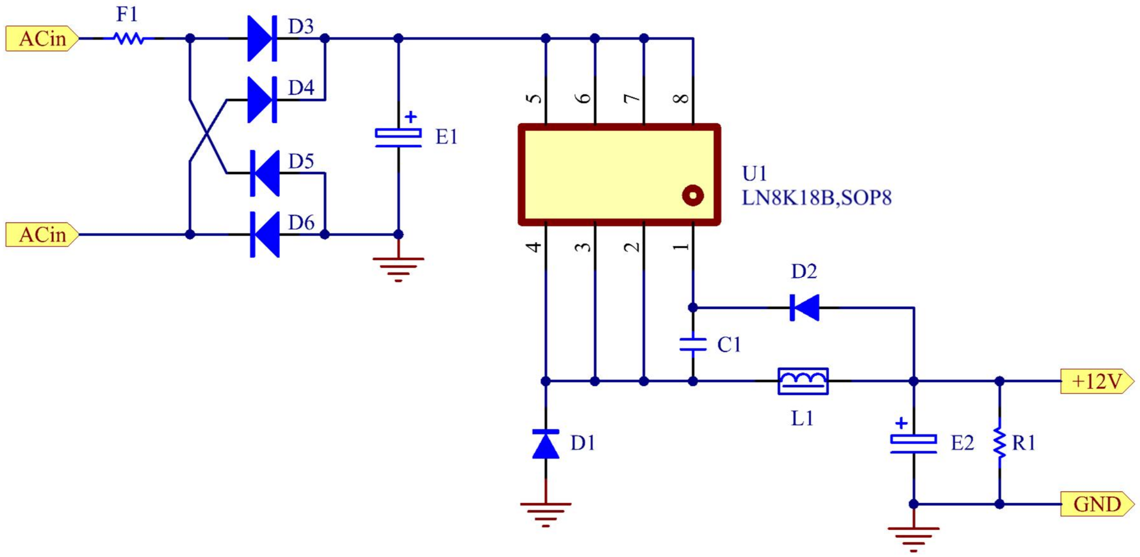


Fig10. Typical Application Circuit Schematic For +12V out

Schematic 2

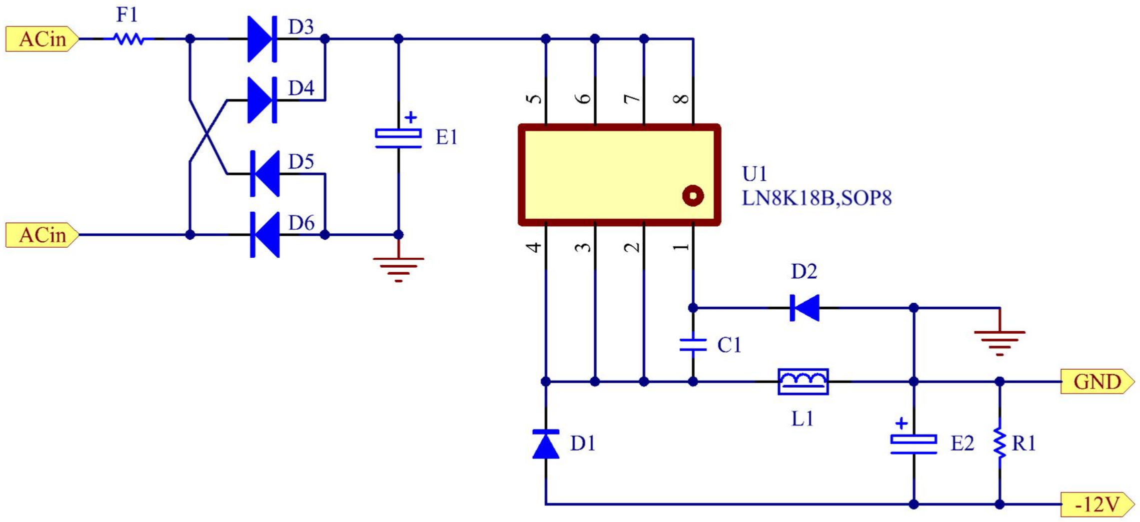
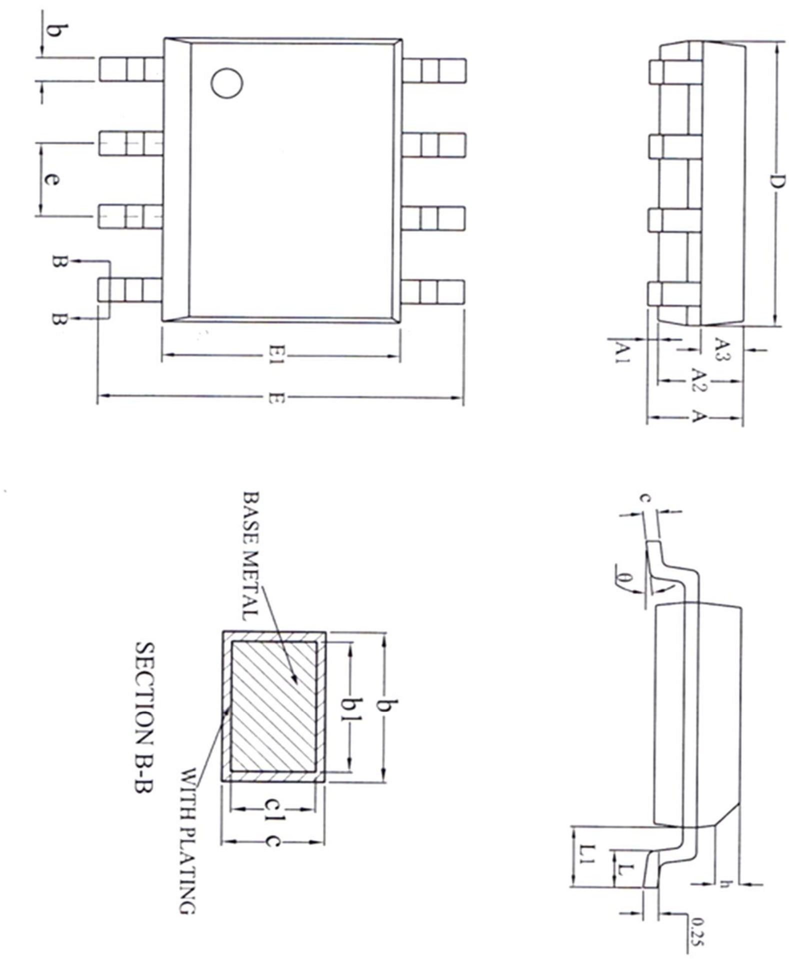


Fig11. Typical Application Circuit Schematic For -12V out

15. Mechanical and Packaging

SOP8



SYMBOL	MILLIMETER MIN	MILLIMETER NOM	MILLIMETER 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°

Fig12. Mechanical Dimensional Drawings

16. Orderable Information

Part Number	Marking	package	Quantity per Tube
LN8K18B	LN8K18B	SOP8	100 PCS/TUBE 4000PCS/REEL

17. Important Notice

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