1.0MHz Boost Converter with a 4.6A Switch

General Description

The KI8837 is a high efficiency boost DC-DC converter which combines a current mode, 1.0 MHz fixed frequency PWM architecture with a built-in n-channel power MOSFET for TFT LCD displays and other portable applications.

KI8837 operates over a wide range of input supply voltage (2.6V < VIN < 5.5V) and provides a regulated boost voltage (from VIN up to as high as 30V). The KI8837 also features a skip cycle mode operation for power saving at light loads.

The built-in soft-start circuitry (externally programmable through the CSS pin) provides the freedom for the control of input current ramp rate. Overall current consumption during the power down mode (by pulling SHDN~ pin to logic low) is typically less than 0.1uA. Under-voltage lockout (UVLO), Thermal Shutdown (TSD), Over Current detection/protection (OCP), input overvoltage protection (OVP), and other protection features are also incorporated onto the KI8837 to ensure the reliable operation under different operating circumstances.

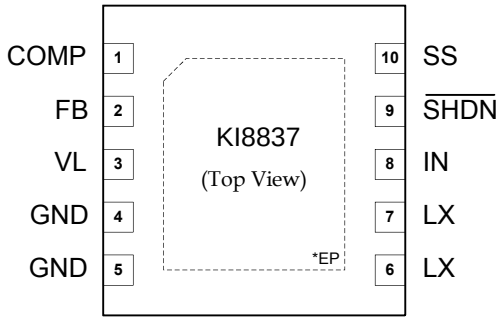
Features

- 90% efficiency
- Built-in 4.6A, 0.11Ω, 30V power NMOS switch
- 1.0MHz fixed frequency PWM operation
- Adjustable Output from VIN to 30V
- Programmable Soft-Start for optimizing control of input current ramp rate
- Built-in Skip Cycle mode to maintain high power efficiency at light loads
- Built-in Thermal Shutdown (TSD), Over-current detection/protection (OCP), and Input Over-voltage protection (OVP)
- Built-in maximum duty cycle detection/ protection
- Built-in slope compensation circuitry to ensure system stability
- Small 10-pin TDFN Package

Applications

- Notebook Display
- LCD Monitor
- TFT LCD displays
- Portable Applications
- Handheld Devices

Pin Assignment



Ordering Information

Package	Part Number	Tape & Reel
10-pin TDFN (Halogen Free)	KI8837LL	-
	KI8837LL-TR	13”

Typical Application Circuit

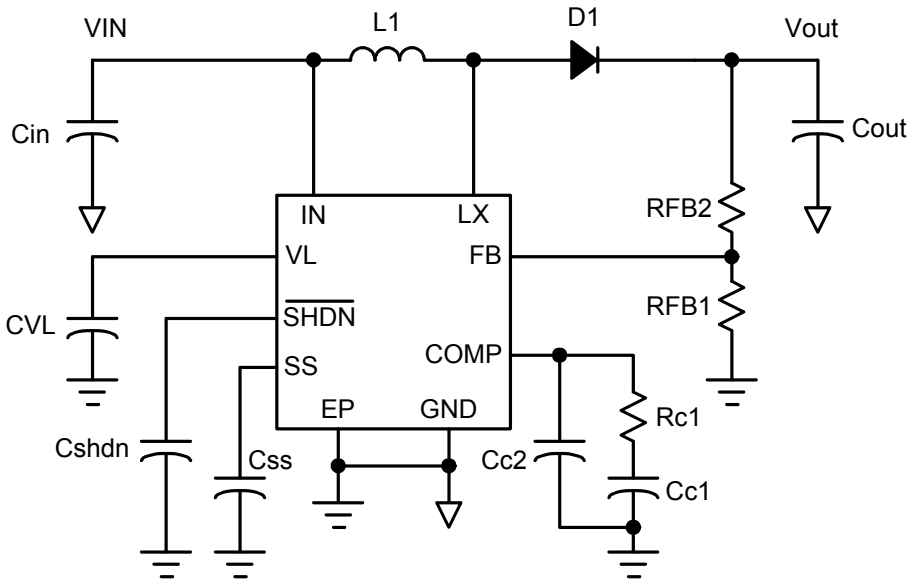


Figure 1

Pin Description

Pin Number	Pin Name	Pin description
1	COMP	Compensation pin for Error Amplifier. Connect RC1 and CC1 in series in-between COMP pin and ground (GND). Optional CC2 between COMP and GND pins will introduce the extra pole to cancel the unwanted zero due to the non-ideal ESR of the output capacitor.
2	FB	Output Voltage Feedback Loop pin. Connect an external precision resistor divider (RFB1 and RFB2) tap to FB pin (reference voltage is 1.24V nominal) will determine the nominal output voltage. i.e. VOUT=1.24* (1+RFB1/RFB2).
3	VL	IC Supply. There is an internal switch between IN and VL and the switch disconnects when an overvoltage condition on IN is detected. Bypass VL to GND with a 1μF capacitor.
4, 5	GND	Ground.
6, 7	LX	Boost converter power switch pin. Connect the inductor (L1) and catch (Schottky) diode (D1) to LX pin with minimum trace area.
8	VIN	Supply voltage input pin (2.6V to 5.5V recommended).
9	SHDN~	Master power down pin (active low). When SHDN~ pin goes low, the KI8837 will enter the power down mode.
10	CSS	Soft-Start current ramp rate control pin. Connect a soft start capacitor (C_{SS}) between this pin and ground (GND) to set the proper input current ramp rate.
-	EP	Exposed Pad. Connect to GND.

Functional Block Diagram

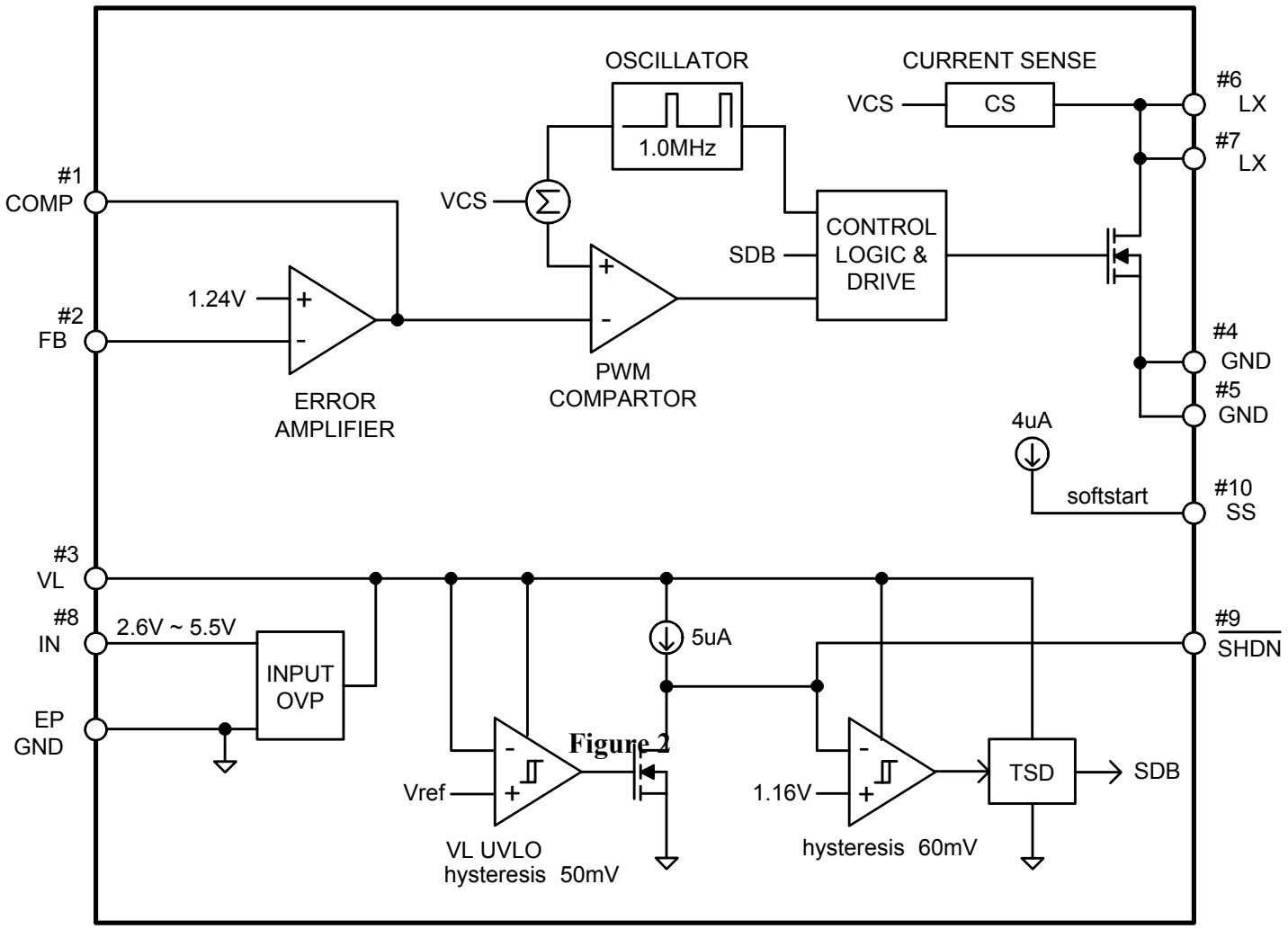


Figure 2

Absolute Maximum Ratings

VIN	-0.3V to 6.0V
Lx to GND pin	-0.3V to +30V
SHDN~, FB, VL to GND pin	-0.3V to (VIN+0.3V)
CSS, COMP to GND pin	-0.3V to (VIN+0.3V)
RMS LX pin Current	2.4A
ESD Susceptibility	2KV (Human Body Model) 200V (Machine Model)
Continuous Power Dissipation	1952mW
Operating Temperature Range	–40°C to 85°C
Junction Temperature	+150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10s)	+260°C

Recommended Operating Conditions

VIN Supply Voltage Range	2.6V to 5.5V
Operating Ambient Temperature (T_A)	-40°C to 85°C
Output Voltage (VOUT)	VIN to 30V maximum

Electrical Characteristics

Unless otherwise specified, VL= 3V, T_A = 0°C to 85°C. Typical values are at T_A = 25°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
VIN	Input Supply Voltage Range	VOUT<18V	2.6		5.5	V
		VOUT>18V	4.0		5.5	V
VOVP	OVP Threshold	VIN rising	6.1	7.4	8.6	V
UVLO	VL Pin Under Voltage Lockout	VL rising; typical hysteresis is 50mV; LX remains off below this level	2.30	2.45	2.57	V
I_Q	VIN Quiescent Current	V_{FB} = 1.3V, not switching		0.35	0.65	mA
		V_{FB} = 1.0V, switching		1.5	2.5	
I_{SD}	Shut Down Current	SHDN=GND		160	250	μA
TSD	Thermal Shutdown			160		℃
	Hysteresis			20		
V_{FB}	Feedback Voltage		1.22	1.24	1.26	V
IFB	FB Bias current	V_{FB} = 1.24V	-50		50	nA
G_m	Error Amp (E/A) Transconductance		110	300	450	μS
A_V	E/A Voltage Gain			2400		V/V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
ΔV_{FB}	Feedback Voltage Line Regulation	2.6V < VIN < 5.5V		0.05	0.15	%/V
VSD	Shutdown FB Input Voltage		0.05	0.1	0.15	V
F_{OSC}	Oscillator Frequency		0.8	1.0	1.2	MHz
Dmax	Maximum Duty Cycle		89	92	95	%
I_{OCP}	Switch Current Limit	V_{FB} = 1V, VL=5V Duty Cycle = 75%	3.9	4.6	5.2	A
$R_{DS(}$on)	ON Resistance	VL=5V (Typ.@T_A = 25°C)		100	170	mΩ
		VL=3V (Typ.@T_A = 25°C)		135	210	
I_{LX}(off)	Leakage Current	V_{LX} = 20V		12	25	μA
ISS	Soft Start Charge Current	VCSS = 1.24V	1.5	3.5	5.5	μA
RSS	Soft Start Discharge Resistance	SHDN=GND			25	Ω
VSHDN	SHDN Threshold	Hysteresis=60mV	1.10	1.16	1.22	V
ISHDN	SHDN Charge Current		4.5	6.0	7.5	μA
RSHDN	Shut Down Discharge Resistance	VL<UVLO		20		Ω

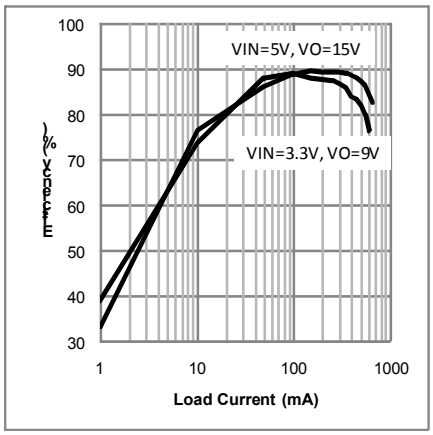
Application Components (refer to Figure 1)

RFB1	20KΩ ±1%	Css (note2)	33nF (10V) for 8ms soft start
RFB2	221KΩ ±1% (Vout = 15V)	Cin	4.7uF(x2) (10V)
Rc1	10KΩ - 82KΩ ±5%	Cout	10uF(x2) (25V)
Cc1	560pF - 3nF (10V)	D1	5A 40V
Cc2 (note1)	10pF (10V)	L1	2.7uH ±20% (4.4A, 27mΩ) 2.7uH ±20% (3.9A, 65mΩ)

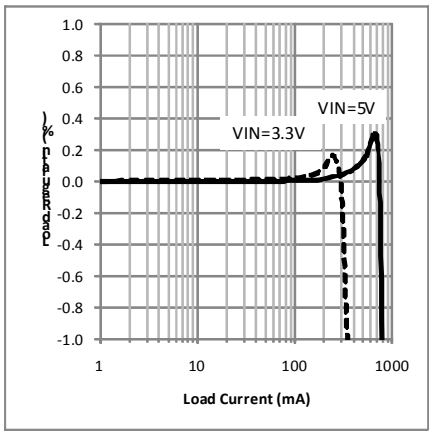
Note1: Capacitor must be present.
Note2: Soft Start Time Tss = $2.4x10^5$ x Css.

Typical Operating Characteristics per figure 1 applications circuit and applications component table with Rc1=20KΩ and Cc1=2nF VIN=5V VOUT=15V TA=25C

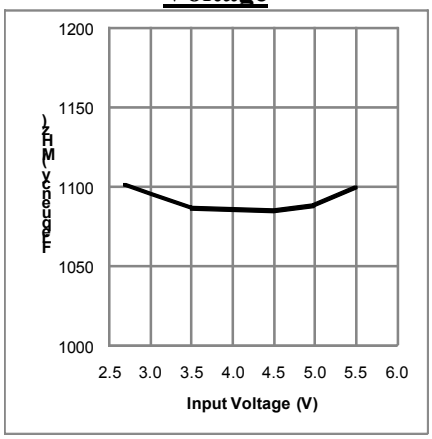
Efficiency vs. Load Current



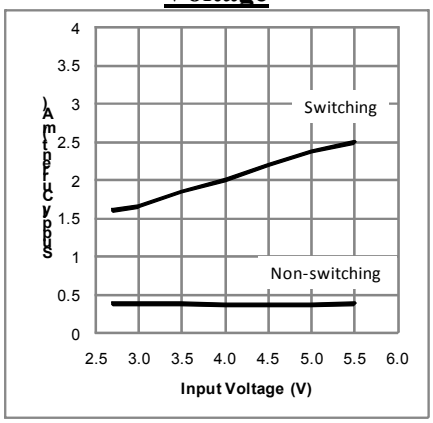
Load Regulation



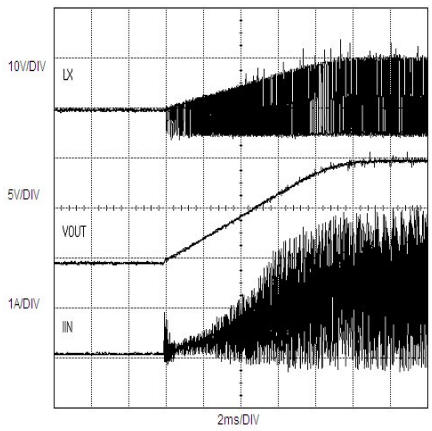
Switching Frequency vs. Input Voltage



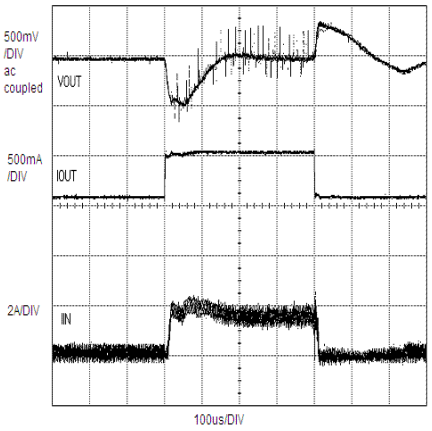
Input Current vs. Input Voltage



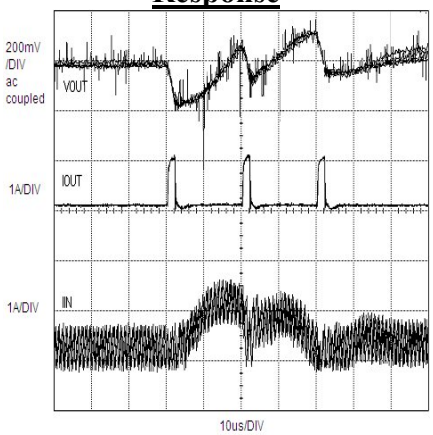
Soft Start (Load=30 Ohm)



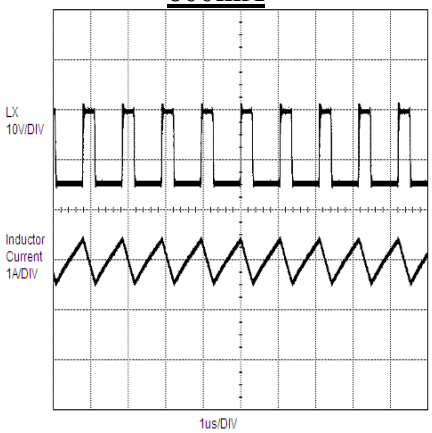
Load Transient



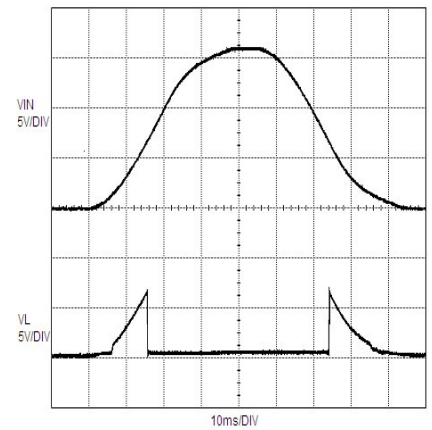
Pulsed Load Transient Response



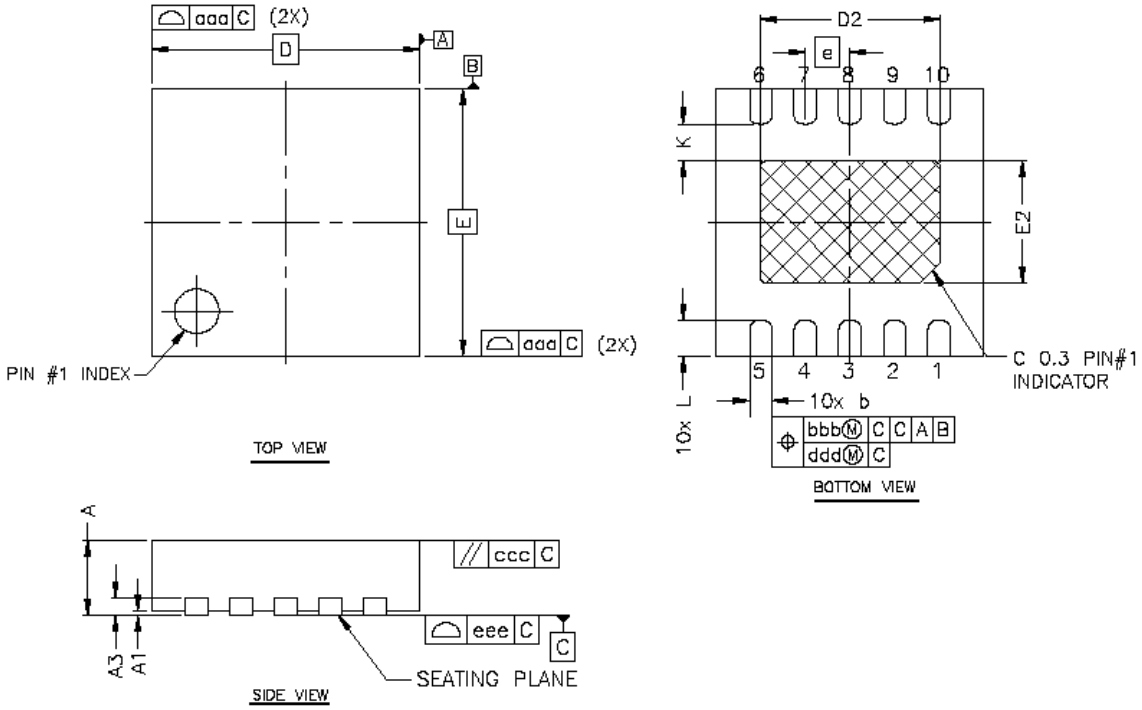
Switching Waveforms Load = 600mA



VIN OVP vs. Input Voltage



10-pin TDFNPackage Information



COMMON DIMENSIONS			
SYMBOL	MIN.	NOM.	MAX.
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
A3		0.203 REF	
b	0.18	0.25	0.30
D		3.00 BSC	
E		3.00 BSC	
D2	1.92	2.02	2.12
E2	1.11	1.21	1.31
e		0.50 BSC	
L	0.27	0.37	0.47
K	0.20		
aaa		0.10	
bbb		0.10	
ccc		0.10	
ddd		0.05	
eee		0.08	

NOTES :

1. DRAWING CONFORM TO JEDEC REFERENCE MO-229.
2. DIMENSIONING AND TOLERANCING SCHEMES CONFORM TO ASEM Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS.
4. ⊠ HATCH AREA IS SOLDERABLE EXPOSED PAD.