



## High Efficiency, 40 V Input, 3 A, Sync DC-DC BUCK Converter

### Description

ME3123 is a sync BUCK DC-DC converter IC, which integrates two NMOSFET power switches with low on-resistance. And  $R_{DS(ON)}$  of high side and low side switches are 110mΩ and 45mΩ respectively. This product is capable of delivering 3A load current. In light load condition, ME3123 works in the PFM mode which has good efficiency performance. When load current goes heavy, ME3123 works in a quasi PWM mode. At this time, it has a constant switching frequency of 500kHz. ME3123 incorporates OTP, input UVLO, cycle by cycle current limit protection and output short circuit protection to improve reliability.

### Features

- Input Voltage Range: 4.7V ~ 40V
- Shutdown Current: 10uA
- Quiescent Current: 120uA
- $R_{DS(ON)}$ (LSD/HSD): 110mΩ/45mΩ
- Switching Frequency: 500kHz
- Reference Voltage: 0.6V ± 2%
- Cycle by Cycle Peak Current Limit: 5.7A
- Short Circuit Protection: Hiccup Mode
- Overtemperature Protection: 160°C

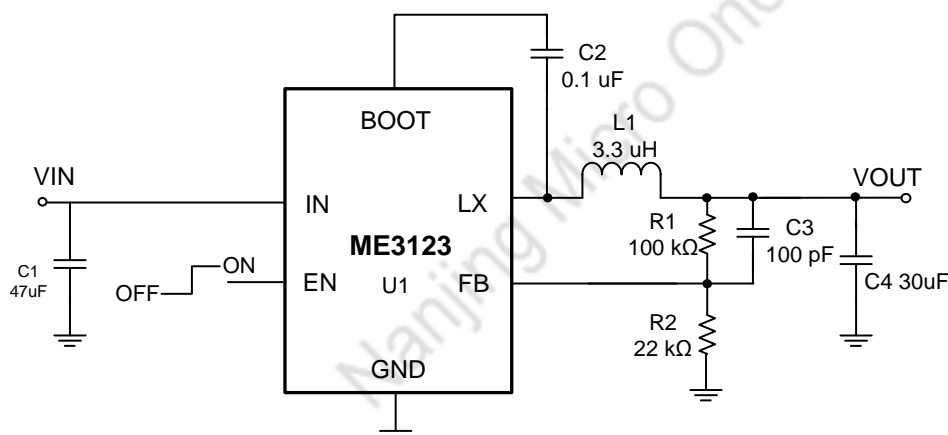
### Applications

- Set Top Box
- LCD TV
- DSL Modem
- Digital TV

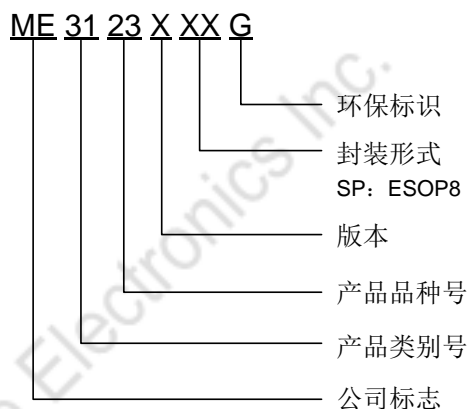
### Package

- 8-pin ESOP8

### Typical Application Circuit

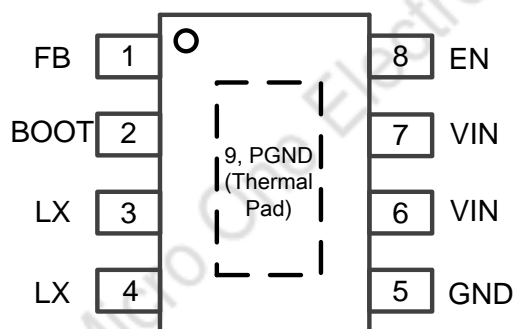


## Selection Guide



产品型号	产品说明
ME3123ASPG	Package: ESOP8

## Pin Configuration

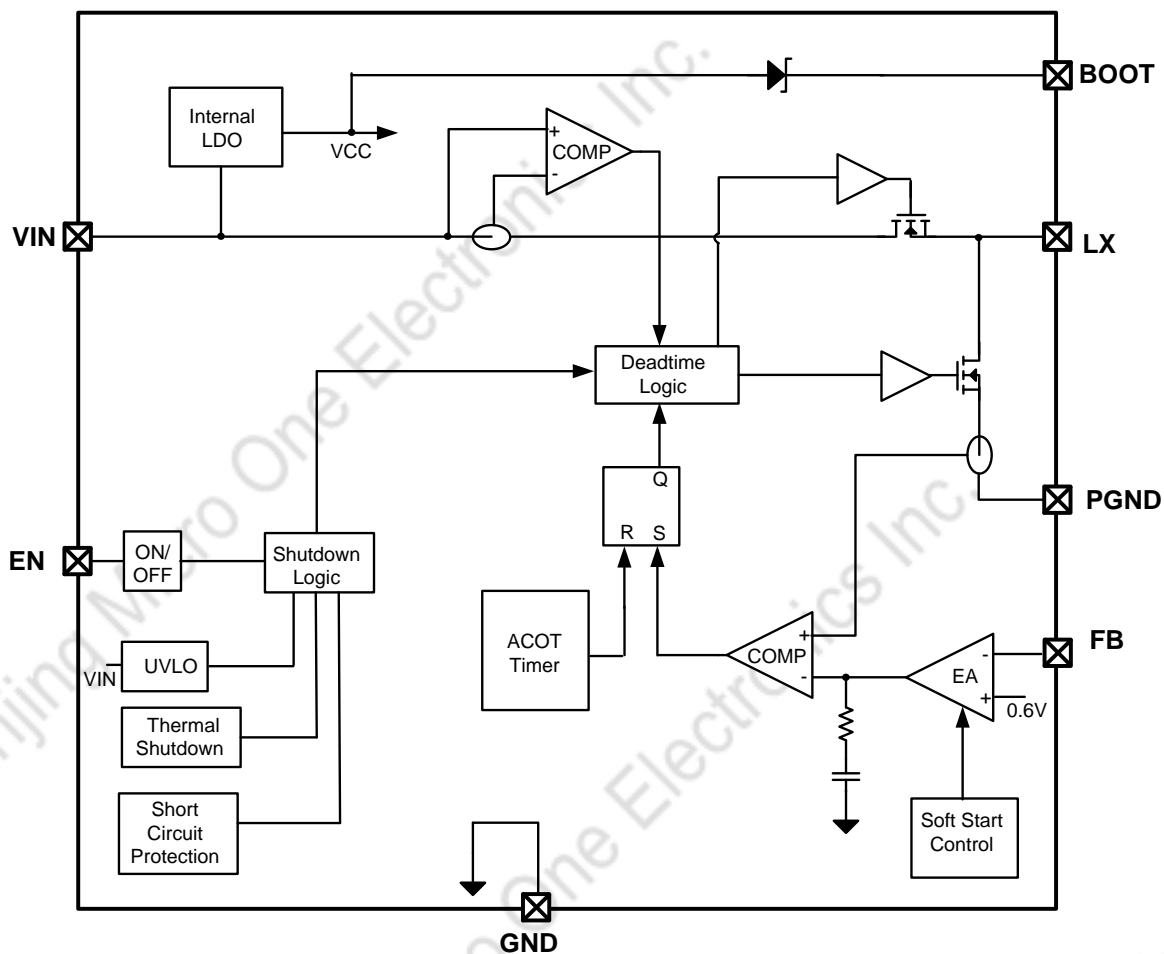


ESOP8

## Pin Assignment

Pin Number	Pin name	Function
1	FB	Feedback voltage pin. Inverting input port of error amplifier.
2	BOOT	A ceramic capacitor more than 0.1 uF is needed between BOOT and LX. Power supply for driver of high side switch.
3, 4	LX	Switching node and connecting inductor.
5	GND	Signal ground of the IC.
6, 7	VIN	Power input pin. Power supply for controller and switches.
8	EN	Enable input pin. High logic enables the IC.
9	PGND	Power ground of the IC.

## Block Diagram



## Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
VIN pin voltage range	$V_{IN}$	-0.3 ~ 40	V
LX pin voltage range	$V_{LX}$	-0.3 ~ 40	V
voltage between BOOT pin and SW pin	$V_{BOOT\_SW}$	-0.3 ~ 6	V
EN pin voltage range	$V_{EN}$	-0.3 ~ 40	V
FB pin voltage range	$V_{FB}$	-0.3 ~ 40	V
Internal Power Dissipation	$P_d$	1.98	W
Thermal resistance (Junction to air)	$\theta_{JA}$	63	$^{\circ}C/W$
Operating Temperature Range	$T_A$	-40 ~ +85	$^{\circ}C$
Storage Temperature Range	$T_{STG}$	-55 ~ +150	$^{\circ}C$
Maximum junction temperature	$T_J$	-40 ~ +160	$^{\circ}C$

**Attention:** Stresses beyond those listed under **Absolute Maximum Ratings** may cause permanent damage to the device

## Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit
$V_{IN}$	Input voltage	4.7	12	40	V
$V_{OUT}$	Output voltage	0.6	3.3	12	V
L	Inductor value	1.2	3.3	10	$\mu$ H
$C_{OUT}$	Output capacitor	20	30	-	$\mu$ F
$T_A$	Operating ambient temperature	-40	-	85	$^{\circ}$ C

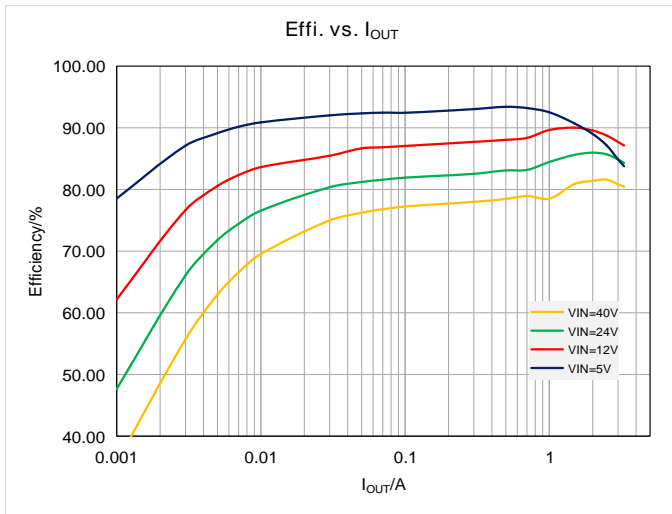
## Electrical Characteristic

ME3123 test conditions:  $V_{IN} = 12$  V,  $V_{OUT} = 3.3$  V,  $T_A = 25^{\circ}$ C, unless otherwise noted.

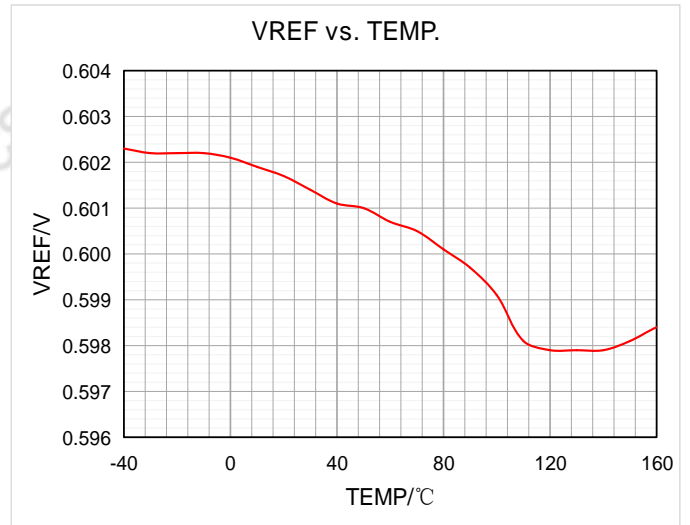
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input voltage range	$V_{IN}$		4.7	-	40	V
Shutdown current	$I_{SD}$	$V_{IN} = 40$ V, IC is disabled.	-	10	15	$\mu$ A
Quiescent current	$I_Q$	$V_{IN} = 40$ V, $V_{FB} = 0.7$ V, IC is enabled.	-	120	180	$\mu$ A
Feedback reference voltage	$V_{REF}$		0.588	0.6	0.612	V
High side on-resistance	$R_{DSON\_H}$	$V_{BOOT} - V_{LX} = 4$ V	-	110	130	m $\Omega$
Low side on-resistance	$R_{DSON\_L}$		-	45	55	m $\Omega$
Peak current limit	$I_{LIM\_PEAK}$		-	5.7	6.5	A
Valley current limit	$I_{LIM\_VALLEY}$		-	3.7	4.5	A
EN rising threshold	$V_{ENH}$	$V_{EN}$ rises.	-	1.3	1.5	V
EN falling threshold	$V_{ENL}$		0.8	1	-	V
Input UVLO threshold	$V_{IN\_UVLO}$	$V_{IN}$ rises.	-	4.6	4.7	V
Input UVLO hysteresis	$V_{IN\_HYS}$		-	0.2	-	V
Minimum on time	$T_{min\_on}$		-	100	130	ns
Minimum off time	$T_{min\_off}$		-	200	260	ns
Switching frequency	$F_{SW}$		-	500	-	kHz
Soft startup time	$t_{ss}$		-	2.3	-	ms
Over temperature protection	$T_{OTP}$		-	160	-	$^{\circ}$ C
Over temperature protection hysteresis	$T_{HYS}$		-	30	-	$^{\circ}$ C

## Typical Performance Characteristics

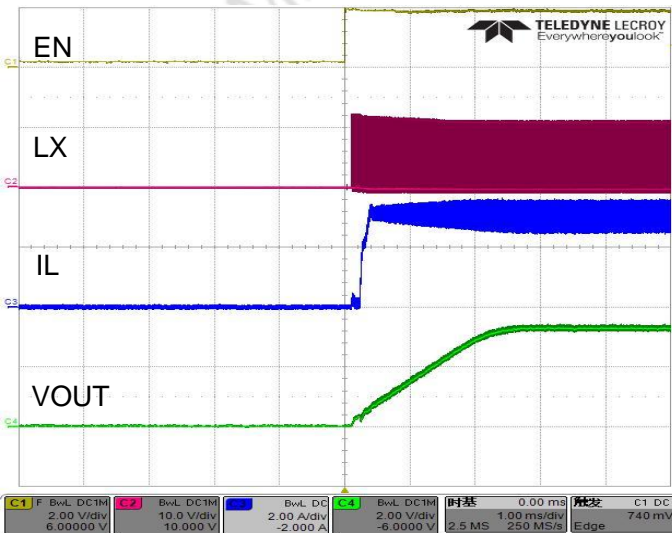
Efficiency vs.  $I_{OUT}$  ( $V_{OUT}=3.3V$ )



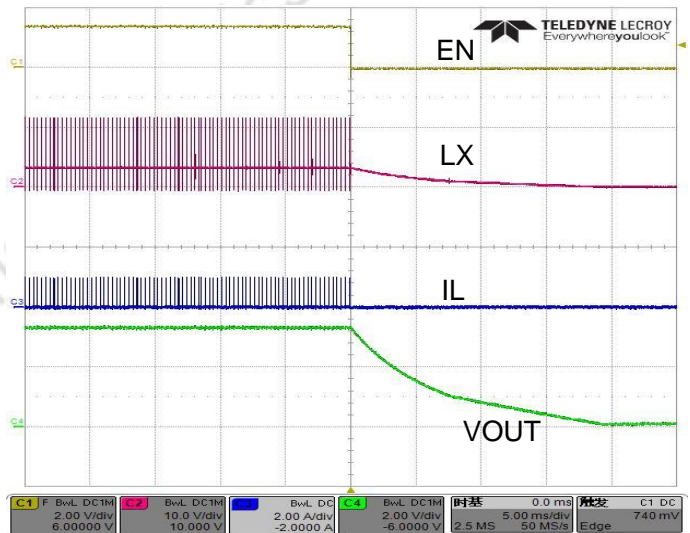
Reference Voltage vs. Temp.



Soft Startup ( $V_{IN}=12V$ ,  $V_{OUT}=3.3V$ ,  $I_{OUT}=3A$ )

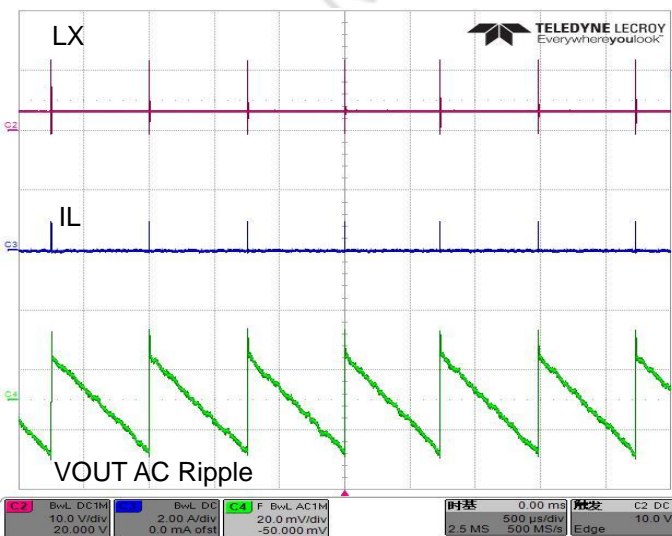


Shutdown



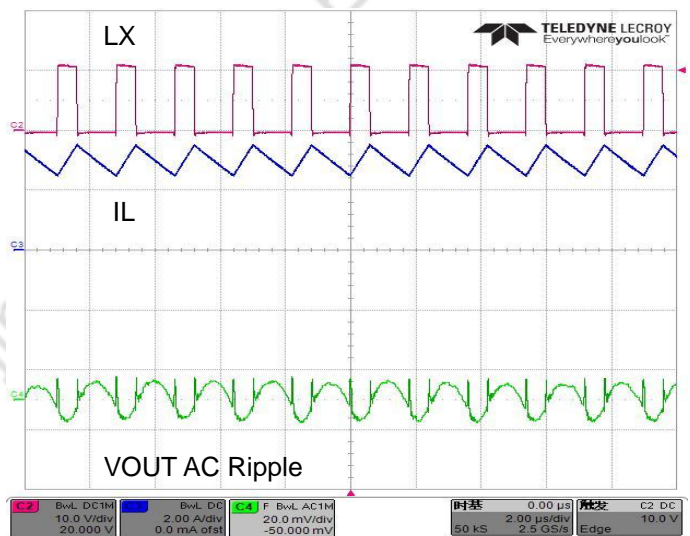
Switching Waveform

( $V_{IN}=12V$ ,  $V_{OUT}=3.3V$ ,  $I_{OUT}=10mA$ )



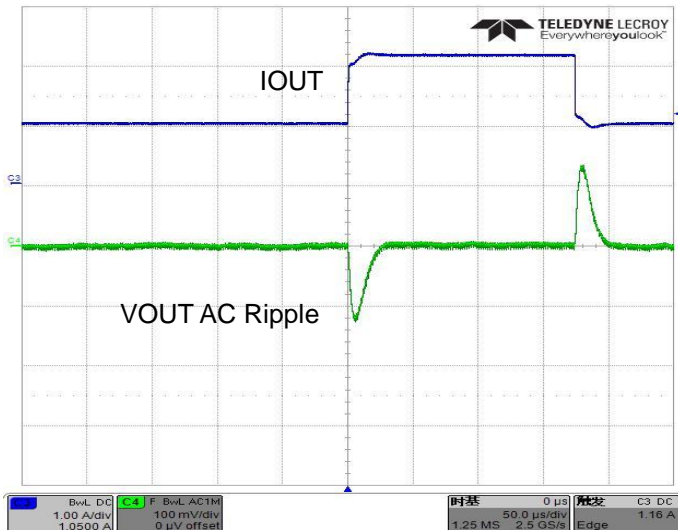
Switching Waveform

( $V_{IN}=12V$ ,  $V_{OUT}=3.3V$ ,  $I_{OUT}=3A$ )

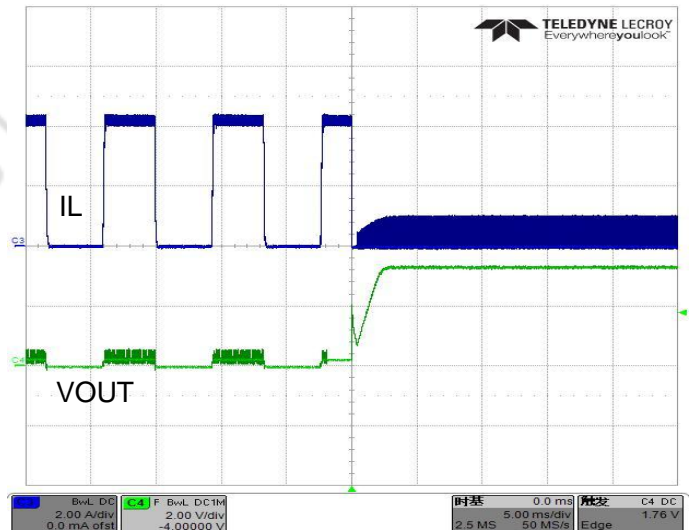


## Load Transient Response

( $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}:1A-2A$ )



## Short Circuit Protection and Recovery



## Operation

ME3123 is a highly efficient sync BUCK converter integrated circuits. It integrates two NMOSFET power switches of low on resistance. Power of driver of high side switch is supplied by bootstrap capacitor. The input voltage reaches up to 40 V. This converter can deliver 3 A output current. ME3123 adopts constant on time architecture and has fast load transient response. In light load condition, it works in the PFM mode. In heavy load condition, it works in the quasi PWM mode.

## Soft Startup

When the EN pin is pulled high, the blocks in the IC start to work in order. After the 0.6 V reference voltage settles down, a small current charges the soft startup capacitor. And the voltage of soft startup capacitor is used to control error amplifier. During the soft startup phase of about 2.3 ms, the soft startup voltage rises to 0.6 V gradually and  $V_{OUT}$  ramps up to the setting point accordingly. Soft startup can avoid large inrush current and  $V_{OUT}$  overshoot.

## PFM Mode

When the load current decreases from heavy load, inductor current is reduced accordingly. And if the inductor valley current touches zero level, the device works in the DCM. Each switching period starts with charging inductor with constant time. Then the output voltage rises to a higher level. After the constant on time, the high side switch cuts off and the inductor current discharges to zero level. Because of the smaller load current, it takes longer time to discharge the output voltage to the reference level. And the switching frequency is reduced, proportional to the load current.

## Shot Circuit Protection

When output is short to the ground, the device will shutdown for about 3.5ms. Then the chip can resume soft

startup automatically. After it maintains working for about 3ms, the device will stop from switching again. The device will repeat to shutdown and resume soft startup until the output short condition is released. Then output voltage will softly start up to the setting value..

## Application Information

ME3123 can be used in applications in which power supply is converted from high level to low level. Because of the integrated power switches in IC, only input capacitor  $C_{IN}$ , output inductor L, output capacitor  $C_{OUT}$  and feedback resistors are selected for the desired application.

### Setting Output Voltage

The output voltage can be set by selecting proper feedback resistors R1 and R2. To achieve good noise and power performance, it's recommended to using resistors between 10 k $\Omega$  and 1 M $\Omega$ . The resistor R1 can be calculated by the following equation.

$$R_1 = R_2 \times \left( \frac{V_{OUT}}{0.6V} - 1 \right)$$

### Inductor Selection

To guarantee the normal work of the power system, the output inductor peak current should be below the peak current limit of 5.7A. The inductor peak current can be calculated by the following equation. In consideration of magnetic saturation of inductor, the peak current should be also smaller than the saturate current of the inductor. And low DCR can help to meet desired power efficiency requirement.

$$I_{PEAK} = I_{OUT} + \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{2 \times V_{IN} \times L} \times T$$

### Bootstrap Capacitor

A 0.1 uF ceramic capacitor connected between the LX pin and the BOOT pin is required to supply power for the high side switch in applications based on ME3123.

### Input Capacitor

In the BUCK converter system, severe interference exists between the VIN pin and ground. The input capacitor  $C_{IN}$  can help to reduce interference and improve system stability. Because the effective capacitance can be reduced significantly at the DC biasing voltage, so the rated voltage of input capacitor should exceed the highest input voltage. And ME recommends the input capacitor should be placed as closely as possible to the VIN pin of the ME3123.

### Output Capacitor

The step down DC-DC converter needs output filter capacitor. Small output capacitor may result in system instability. When the output short circuit condition is removed, the output voltage may overshoot the safe level, which can damage the following devices permanently.

## Layout Guidelines

- 1) BUCK converter implemented by ME3123 is sensitive to PCB layout. For reducing nonideality, external components such as inductor, input capacitor, output capacitor and resistor divider should be placed as nearly as possible to the chip.
- 2) For reducing EMI caused by high frequency switching, the trace connected to LX pin should be as short as possible. It is recommended to use ground plane to shield signal from interplane coupling.
- 3) To improve thermal dissipation and power efficiency, it is recommended to cover the back of PCB with ground plane. More thermal vias and thick PCB copper are desirable.

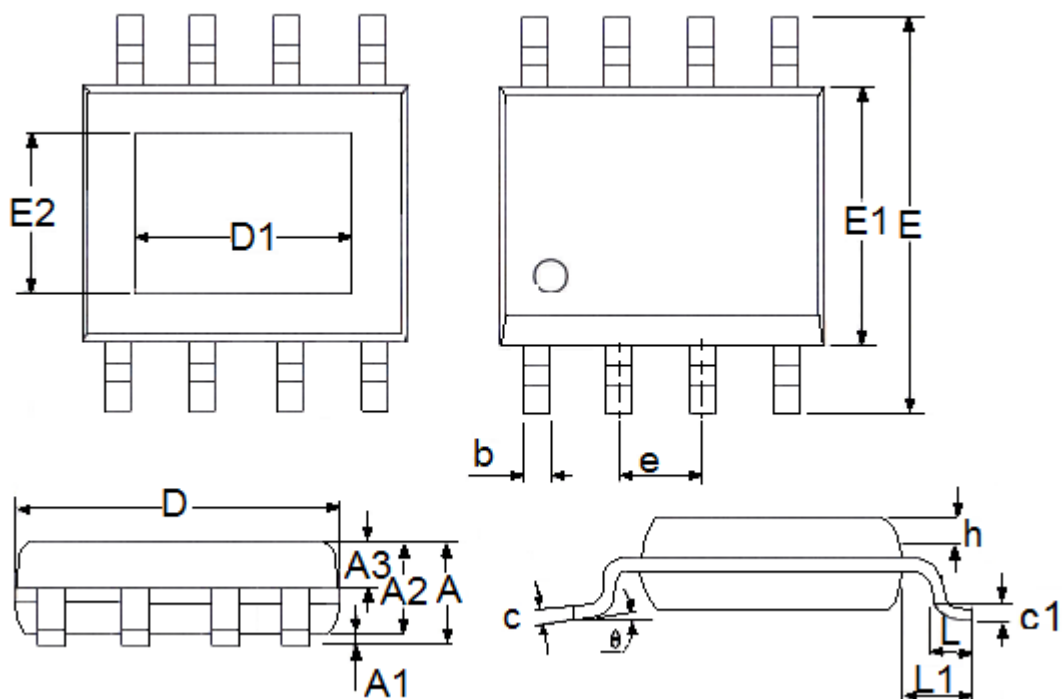
## Package Quantity

Package Type	Minimum Packing QTY	UNITS	Small Box	Large BOX
ESOP8	3000	Tape & Reel	6K	48K



## Package Information

- Package Type: ESOP8



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.3	1.75	0.0512	0.0689
A1	0	0.2	0.0000	0.0079
A2	1.25	1.65	0.0492	0.0650
A3	0.5	0.7	0.0197	0.0276
b	0.33	0.51	0.0130	0.0201
c	0.17	0.25	0.0067	0.0098
D	4.7	5.1	0.1850	0.2008
E	5.8	6.2	0.2283	0.2441
E1	3.8	4	0.1496	0.1575
e	1.27(TYP)		0.05(TYP)	
h	0.25	0.5	0.0098	0.0197
L	0.4	1.27	0.0157	0.0500
L1	1.04(TYP)		0.0409(TYP)	
$\theta$	0	8°	0.0000	8°
c1	0.25(TYP)		0.0098(TYP)	
D1	3.1(TYP)		0.122(TYP)	
E2	2.21(TYP)		0.087(TYP)	

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