High Efficiency, 18V Input, 2 A, Sync DC-DC BUCK Converter

Description

ME3182 is a sync BUCK DC-DC converter IC, which integrates two NMOSFET power switches with low on-resistance. And R_{DSON} of high side and low side switches are 70mΩ and 110mΩ respectively. This product is capable of delivering 2A load current. In light load condition, ME3182 works in the PFM mode which has good efficiency performance. When load current goes heavy, ME3182 works in a quasi PWM mode. At this time, it has a constant switching frequency of 650KHZ. ME3182 incorporates OTP, input UVLO, cycle by cycle current limit protection and output short circuit protection to improve reliability.

Features

- Input Voltage Range：4.1V ~ 18V
- Shutdown Current：6uA
- Quiescent Current：90uA
- R_{DSON}(LSD/HSD)：70mΩ/110mΩ
- Switching Frequency：650KHz@D=50%
- Reference Voltage：0.6V ± 2%
- Cycle by Cycle Peak Current Limit：3.3A
- Cycle by Cycle Valley Current Limit：2.3A
- Short Circuit Protection：Hiccup Mode
- Overtemperature Protection：155°C

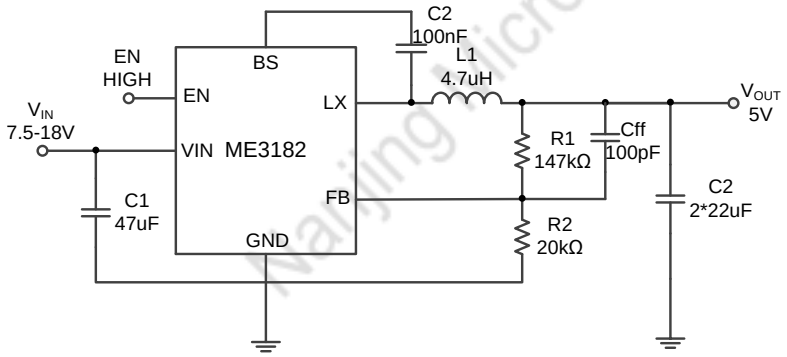
Applications

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

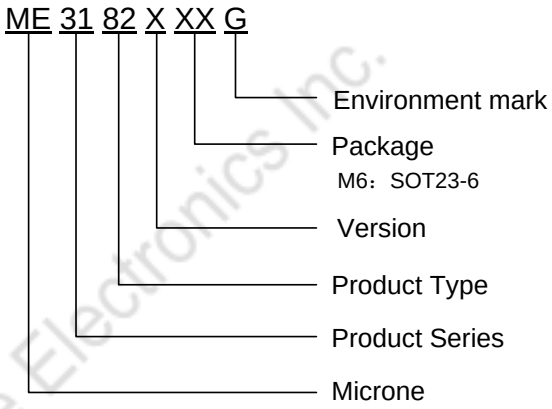
Package

- 6-pin SOT23-6

Typical Application Circuit

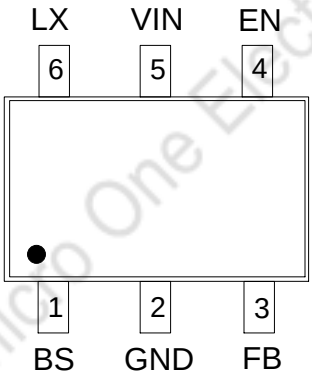


Selection Guide



product series	product description
ME3182AM6G	Package：SOT23-6

Pin Configuration

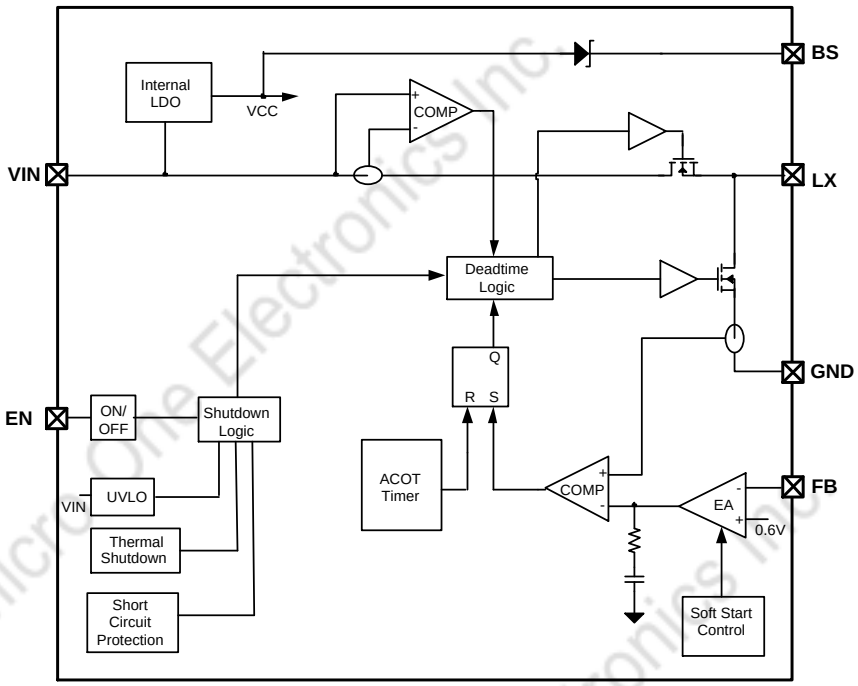


SOT23-6

Pin Assignment

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

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
VIN pin voltage range	V_{IN}	-0.3 ~ 18	V
LX pin voltage range	V_{LX}	-0.3 ~ 18	V
voltage between BS pin and SW pin	V_{BS_SW}	-0.3 ~ 6	V
EN pin voltage range	V_{EN}	-0.3 ~ 18	V
FB pin voltage range	V_{FB}	-0.3 ~ 18	V
Internal Power Dissipation	P_d	0.63	W
Thermal resistance (Junction to air)	θ_{JA}	200	℃/W
Operating Temperature Range	T_A	-40 ~ +85	℃
Storage Temperature Range	T_{STG}	-55 ~ +150	℃
Maximum junction temperature	T_J	-40 ~ +150	℃

NOTES:

1）The absolute maximum rating is the maximum physical damage limit that the product can withstand. Please do not exceed the rating under any circumstances.

2) The maximum allowable power dissipation is a function of the maximum junction temperature $T_{J\ (MAX)}$, the junction-to- ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_{D(MAX)}=(T_{J(MAX)}-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation produces an excessive die temperature, and the regulator goes into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.

3） The θ_{JA} values given in this table are for comparison with other packages only and cannot be used for design purposes. They do not represent the performance achieved in real-world applications.

Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit
V_{IN}	Input voltage	4.1	12	18	V
V_{OUT}	Output voltage	0.6	5.0	12	V
L	Inductor value	1.2	4.7	-	uH
C_{IN}	Input capacitor	-	47	-	uF
C_{OUT}	Output capacitor	20	47	-	uF
T_A	Operating ambient temperature	-40	-	85	ºC

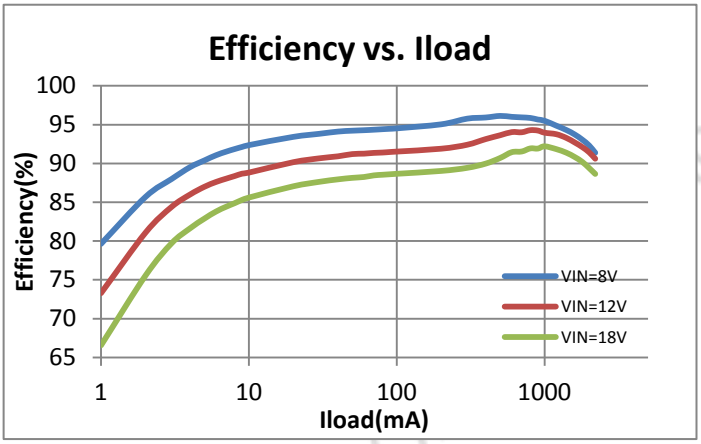
Electrical Characteristic

ME3182 test conditions：V_{IN} = 12 V，V_{OUT} = 3.3 V，T_A = 25℃，unless otherwise noted。

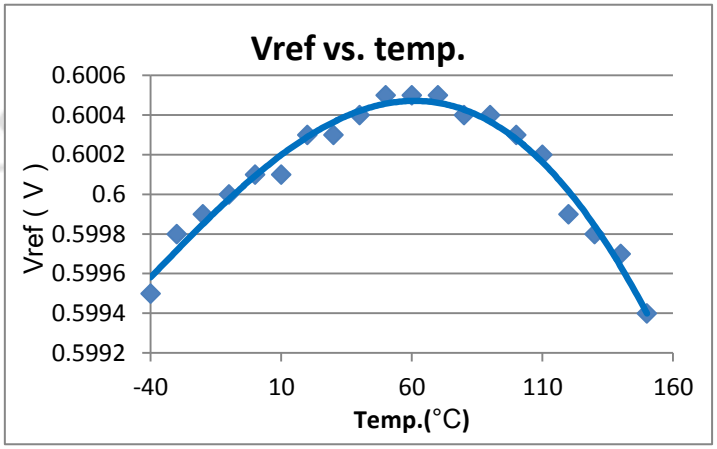
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input voltage range	V_{IN}		4.1	-	18	V
Shutdown current	I_{SD}	V_{IN} =18 V, IC is disabled.	-	6	10	uA
Quiescent current	I_Q	V_{IN} = 18 V, V_{FB} = 0.7 V, IC is enabled.	-	90	120	uA
Feedback reference voltage	V_{REF}		0.588	0.6	0.612	V
High side on-resistance	R_{DSON_H}	V_{BOOT} - V_{LX} = 4.85 V	-	110	130	mΩ
Low side on-resistance	R_{DSON_L}		-	70	90	mΩ
Peak current limit	I_{LIM_PEAK}		-	3.3	4.5	A
Valley current limit	I_{LIM_VALLEY}		-	2.3	2.8	A
EN rising threshold	V_{ENH}	V_{EN} rises.	1.6	-	-	V
EN falling threshold	V_{ENL}		-	-	0.5	V
Input UVLO threshold	V_{IN_UVLO}	V_{IN} rises.	3.7	3.84	4.1	V
Input UVLO hysteresis	V_{IN_HYS}		-	0.2	-	V
Minimum on time	T_{min_on}		-	100	-	ns
Minimum off time	T_{min_off}	@Iload=0A	-	100	150	ns
		@Iload=2A		150	200	ns
Switching frequency	F_{SW}	@D=50%	-	650	-	kHz
Soft startup time	t_{ss}		-	1.1	-	ms
Over temperature protection	T_{OTP}		-	155	-	°C
Over temperature protection hysteresis	T_{HYS}		-	30	-	°C

Typical Performance Characteristics

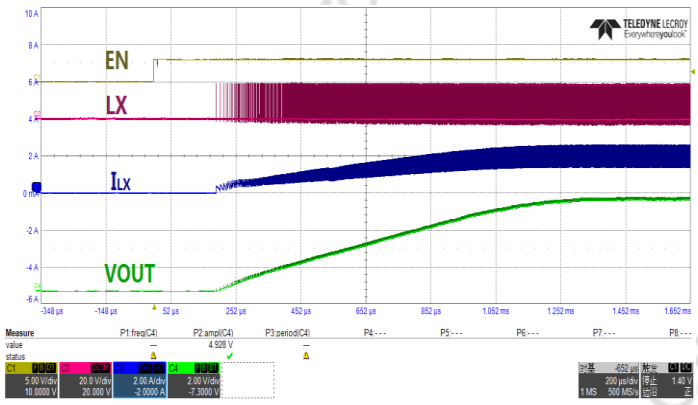
Efficiency vs. I_{OUT}(V_{OUT}=5V)



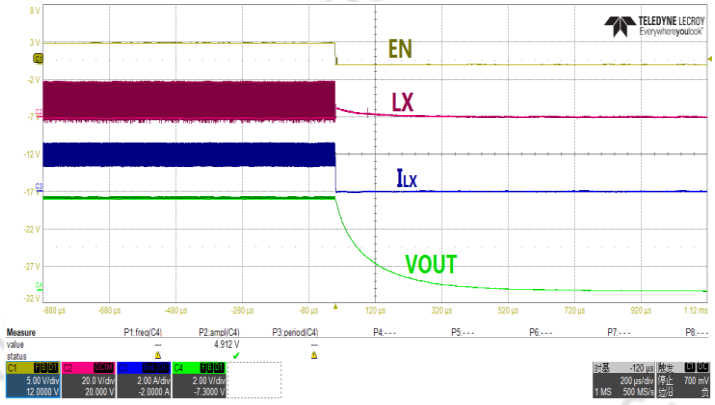
Reference Voltage vs. Temp.



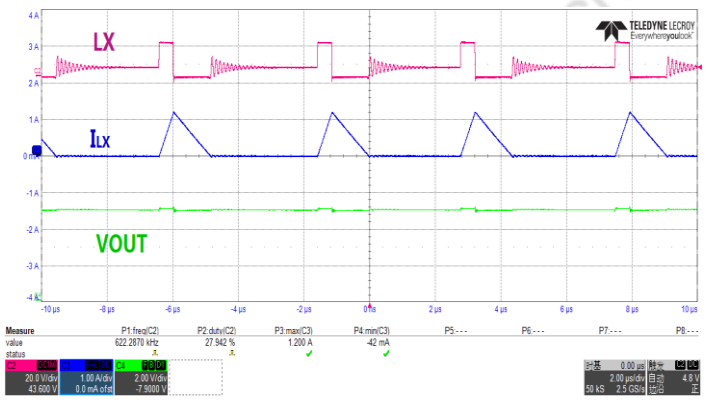
Soft Startup (V_{IN}=18V,V_{OUT}=5V,I_{OUT}=2A)



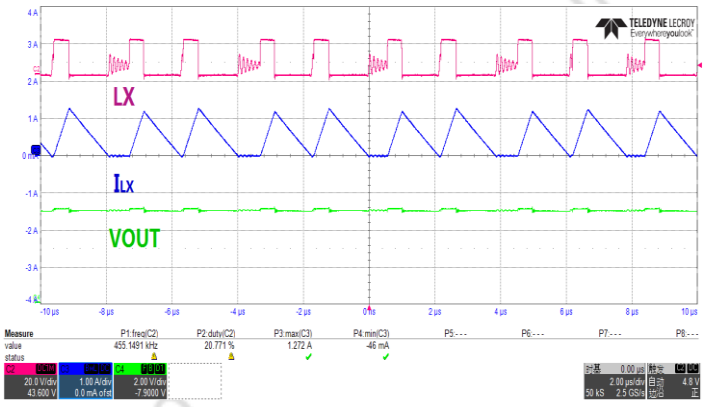
Shutdown



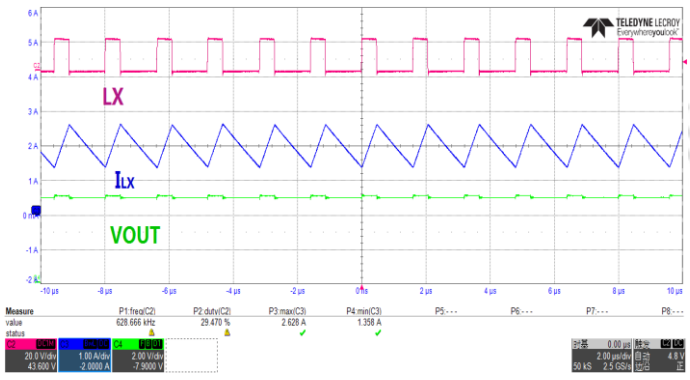
Switching Waveform (V_{IN}=18V,V_{OUT}=5V, , I_{OUT}=0.2A)



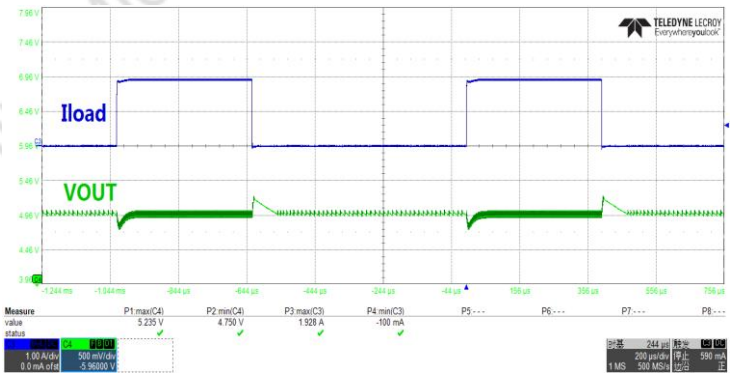
Switching Waveform (V_{IN}=18V,V_{OUT}=5V,I_{OUT}=0.5A)



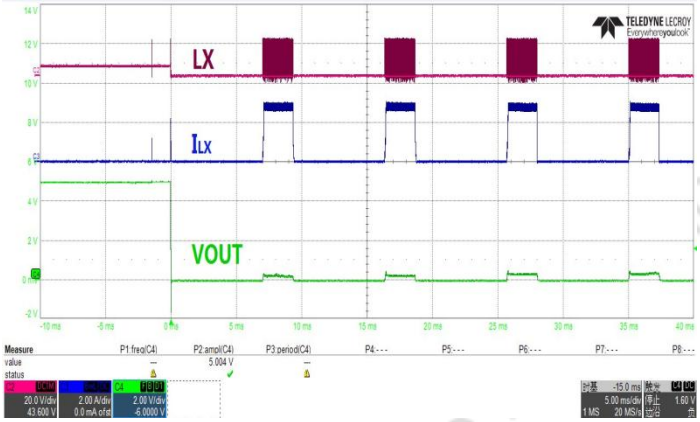
Switching Waveform (V_{IN}=18V,V_{OUT}=5V, , I_{OUT}=2A)



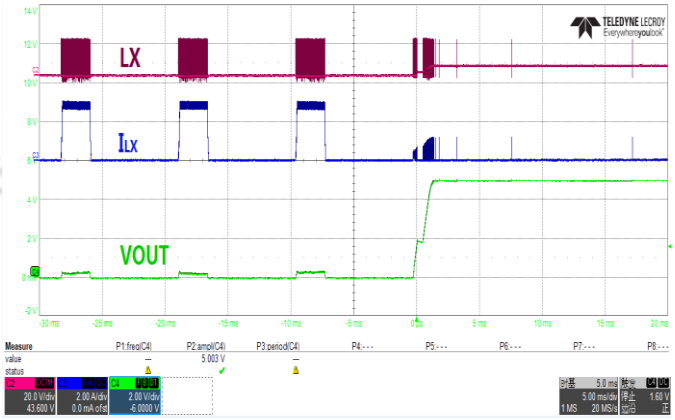
Load Transient Response (V_{IN}=18V,V_{OUT}=5V,I_{OUT}:0.05A-2A)



Short Circuit Protection



Short Circuit Recovery



Operation

ME3182 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 18 V. This converter can deliver 2A output current. ME3182 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 1.1 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 7ms. Then the chip can resume soft startup automatically. After it maintains working for about 2.3ms, 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

ME3182 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 kΩ and 1 MΩ. 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

It is recommended to choose inductors with V_{OUT} rated value * 1uH to ensure optimal loop and zero crossing detection points. At the same time, it is necessary to ensure that the inductor current is below the current limit point when operating at full load. The calculation formula for the peak value of the inductor current is as follows. It is necessary to ensure that the I_{PEAK} at the maximum output current is less than the chip peak current limit of 3.3A and the saturation current of the inductor. At the same time, the DCR of the inductor should be small enough to ensure that the system meets the expected efficiency requirements.

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

Bootstrap Capacitor

A 0.1 uF ceramic capacitor connected between the LX pin and the BS pin is required to supply power for the high side switch in applications based on ME3182.

Input Capacitor

In the BUCK converter system, several interference exists between the V_{IN} 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 we recommend 47uF ceramic capacitor and the input capacitor should be placed as closely as possible to the V_{IN} pin of the ME3182.

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. We recommend 47uF ceramic capacitor as the output capacitor.

Layout Guidelines

1）BUCK converter implemented by ME3182 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.

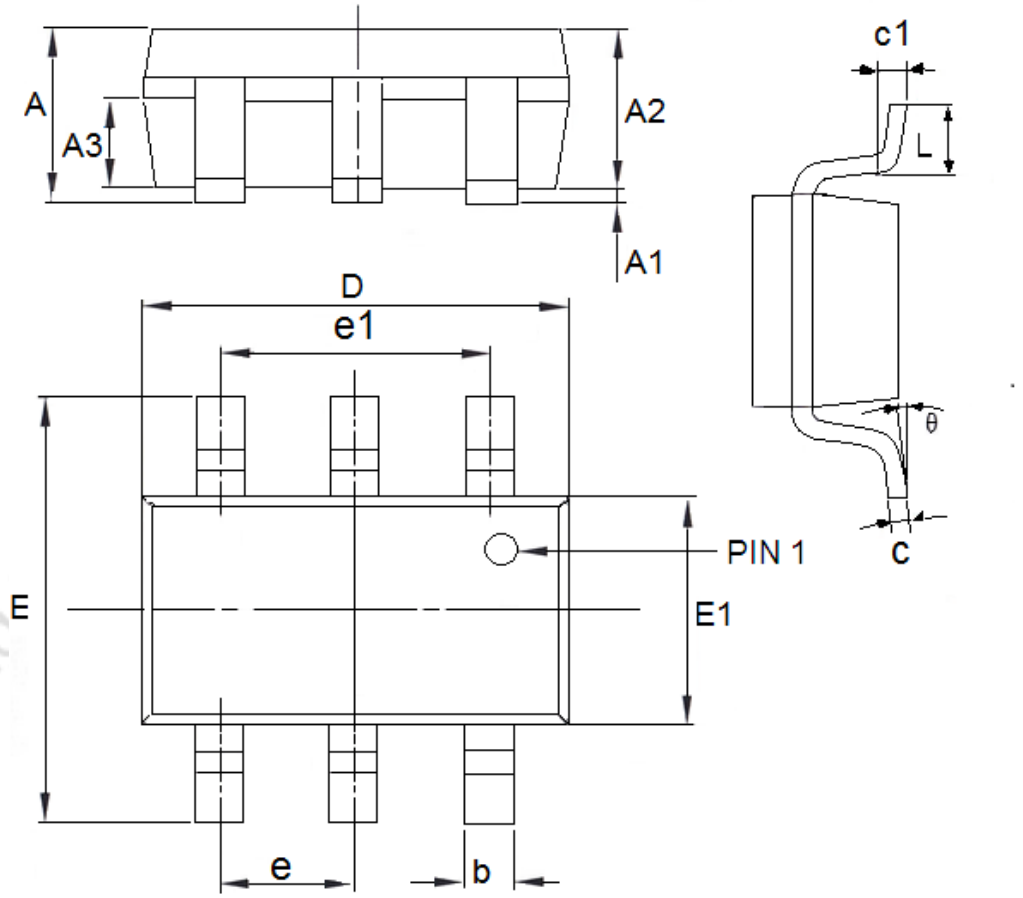
3）To improve thermal dissipation and power efficiency, it is recommended to cover the back of PCB with ground plane. More thermal vias and thick PCB copper are desirable.

Package Quantity

Package Type	Minimum Packing QTY	UNITS	Small Box	Large BOX
SOT23-6	3000	Tape & Reel	30K	120K

Package Information

- **Package Type: SOT23-6**



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.55	0.75	0.0217	0.0295
b	0.25	0.5	0.0098	0.0197
c	0.1	0.25	0.0039	0.0098
D	2.7	3.12	0.1063	0.1228
e1	1.9(TYP)		0.0748(TYP)	
E	2.6	3.1	0.1024	0.1220
E1	1.4	1.8	0.0551	0.0709
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	

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