70mΩ，2.1A 5V USB High Side Current Limited Load Switch

Description

ME1501 is a high side current limited load switch designed for 5V 2.1A USB application. The device integrates over current protection, short protection, over temperature protection, under voltage lock-out protection functions, etc. It can limit output current when short event happens or heavy capacitive load is applied to the USB output, so as to protect the supply voltage source from collapsing.

Features

- Low on resistance: 70mΩ
- Current limit accuracy over full operating conditions：±15%
- Output short fast response and protection
- No parasitic substrate diode, and reverse current blocking when switch is off.

Typical Application

- USB hub
- USB periphery
- Notebook and tablet
- Charger and adapter

Package

- 5-pin SOT23-5
- 3-pin SOT23-3

Typical Application Circuit

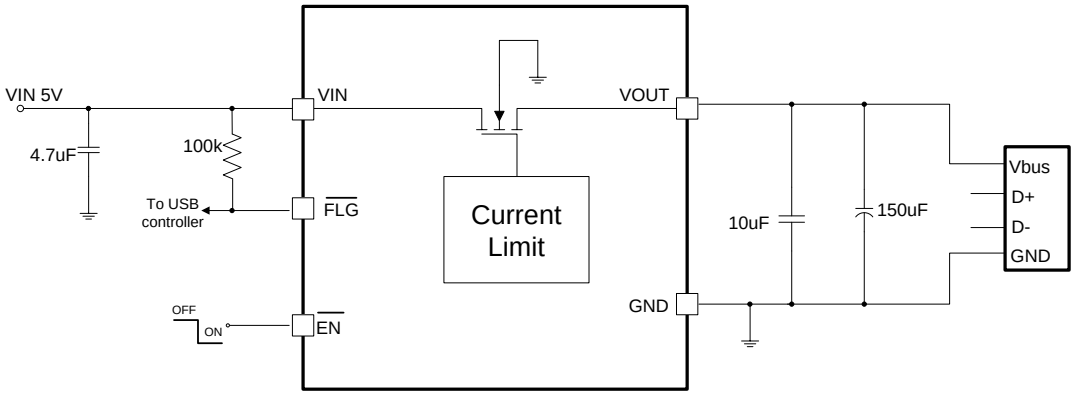


Figure.1 ME1501CM5G、ME1501DM5G typical application

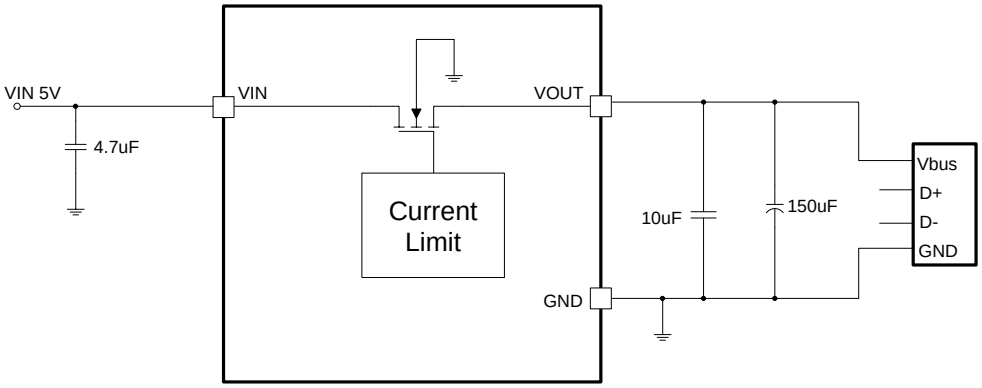
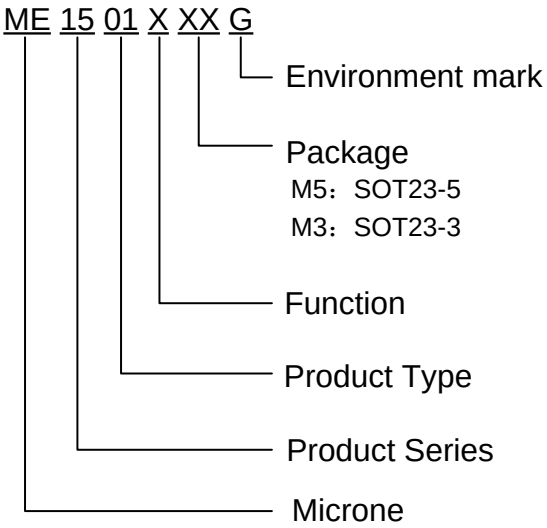


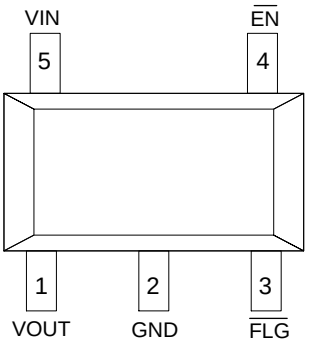
Figure.2 ME1501AM3G typical application

Selection Guide

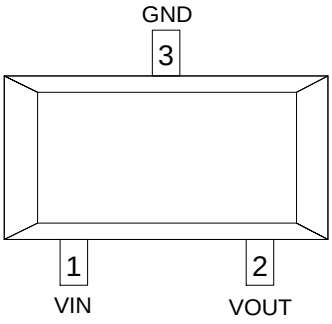


Part Number	Description
ME1501AM3G	EN is connected to GND inside the device. No error flag reporting function. Package：SOT23-3
ME1501CM5G	EN can be controlled. Has error flag reporting function. Package：SOT23-5
ME1501DM5G	EN can be controlled. Has error flag reporting function. Infinite-flow threshold reentrant feature. Package：SOT23-5

Pin Configuration



SOT23-5



SOT23-3

Pin Assignment

Pin# (SOT23-5)	Pin# (SOT23-3)	Symbol	Pin Description
1	2	VOUT	Output, connected to USB port VBUS.
2	3	GND	Chip ground.
3		$\overline{FLG}$	Error flag output, open drain output. Assert low when over current or over temperature happens.
4		$\overline{EN}$	Chip enable pin. Logic low effective.
5	1	VIN	Power supply pin.

Block Diagram

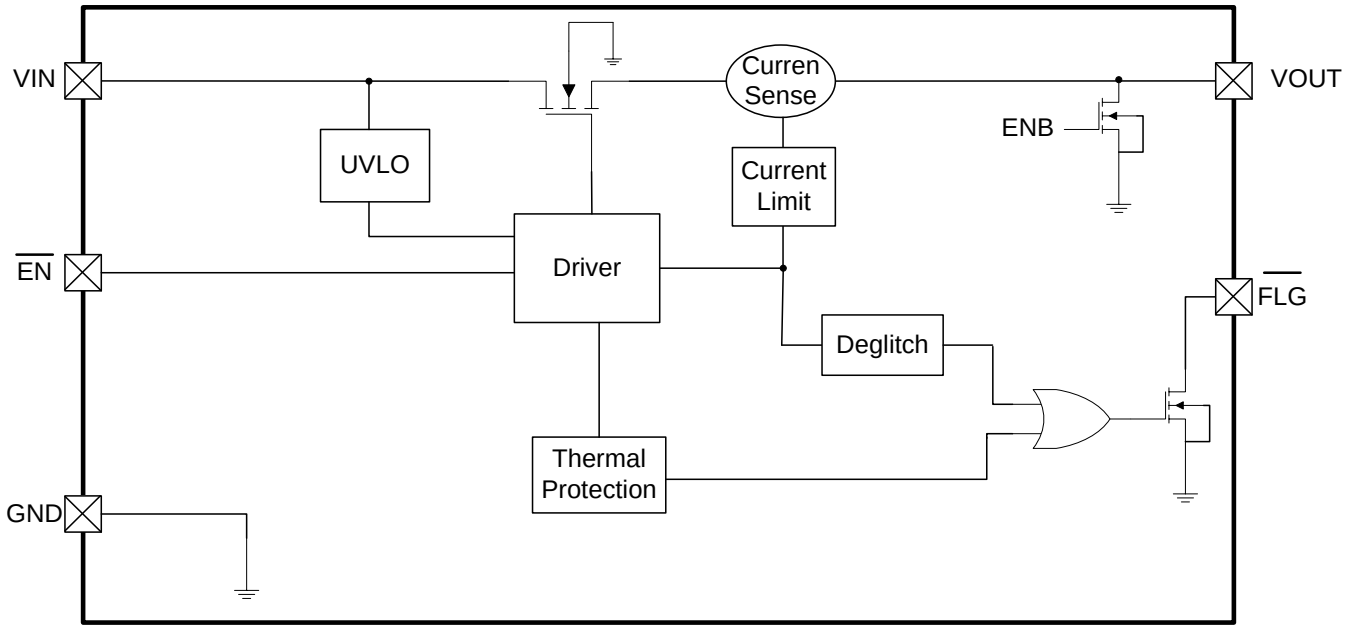


Figure.3 ME1501CM5G internal block diagram

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Power supply	VIN	6	V
Output voltage	VOUT	-0.3 to VIN	V
Dissipation power SOT23-3/5	P_D	300	mW
Junction temperature	T_J	-40~+150	℃
Storage temperature	T_{STG}	-55~+150	℃
Soldering temperature (5 seconds)	T_{LEAD}	260	℃

Caution：Exceeding these ratings may damage the device.

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply	VIN	2.7	5.0	5.5	V
Operating ambient temperature	Ta	-40	25	85	℃

Electrical Characteristics

ME1501CM5G (Unless otherwise noticed, Ta=25℃, VIN=5V)

Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply voltage range		2.7		5.5	V
Quiescent current	$\overline{EN}$=0	30	50	80	uA
Shutdown current	$\overline{EN}$=5V	0	0.01	1.0	uA
On resistance	Iout=500mA		70		mΩ
Current limit threshold	Current ramping（<0.1A/mS） VIN： 2.7~ 5V Ta： -40℃~ 85℃	2.3	2.7	3.0	A
Short current	VOUT short to GND		1.6		A
FLAG output resistance	I_{SINK}=1mA		60		Ω
FLAG delay time	From fault assertion to FLG turning to 0		8		mS
UVLO	VIN increasing	1.8	2.2	2.6	V
UVLO hysterisis	VIN decreasing		0.2		V
EN high level		1.6			V
EN low level				0.4	V
Over temperature protection threshold			155		℃
Over temperature protection hysterisis			20		℃

ME1501AM3G (Unless otherwise noticed, Ta=25℃, VIN=5V)

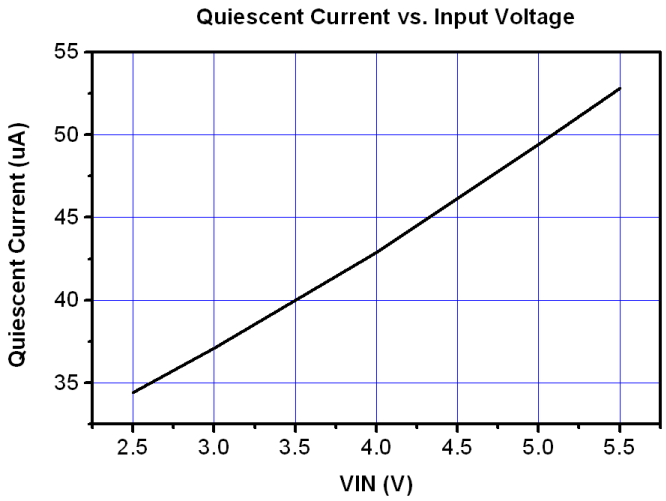
Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply voltage range		2.7		5.5	V
Quiescent current	$\overline{EN}$=0	30	50	80	uA
On resistance	Iout = 500mA		70		mΩ
Current limit threshold	Current ramping（<0.1A/mS） VIN： 2.7~ 5V Ta： -40℃~ 85℃	2.3	2.7	3.0	A
Short current	VOUT short to GND		1.6		A
UVLO	VIN increasing	1.8	2.2	2.6	V
UVLO hysteresis	VIN decreasing		0.2		V
Over temperature protection threshold			155		℃
Over temperature protection hysteresis			20		℃

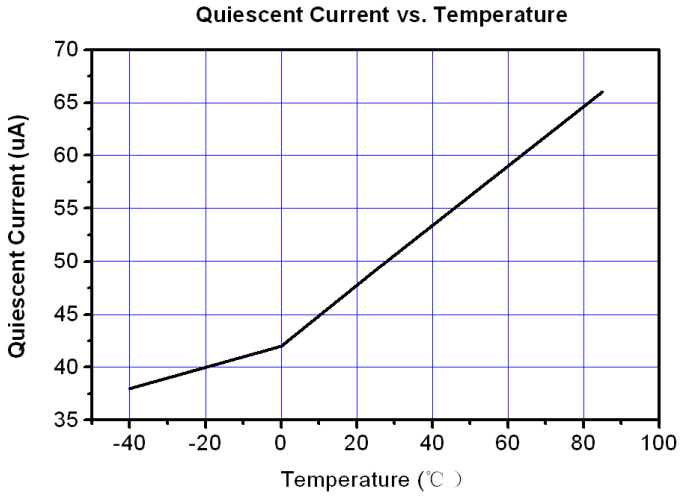
ME1501DM5G (Unless otherwise noticed, Ta=25℃, VIN=5V)

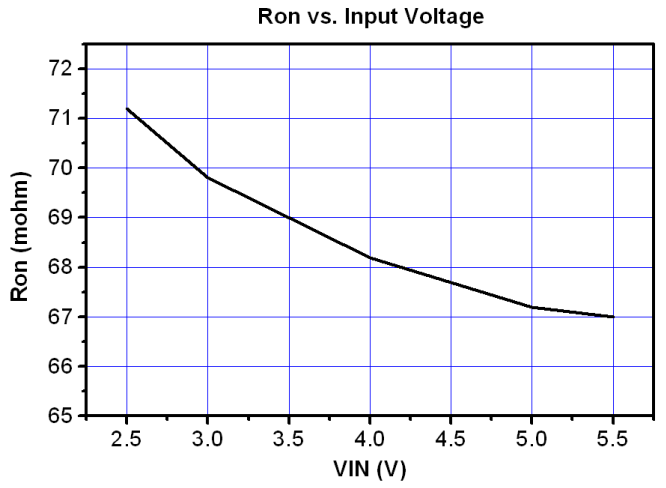
Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply voltage range		2.7		5.5	V
Quiescent current	$\overline{EN}$=0	30	50	80	uA
Shutdown current	$\overline{EN}$=5V	0	0.01	1.0	uA
On resistance	Iout=500mA		70		mΩ
Current limit threshold	Current ramping（<0.1A/mS） VIN： 2.7~ 5V Ta： -40℃~ 85℃	2.3	2.7	3.0	A
Short current	VOUT short to GND		2.7		A
FLAG output resistance	I_{SINK}=1mA		60		Ω
FLAG delay time	From fault assertion to FLG turning to 0		8		mS
UVLO	VIN increasing	1.8	2.2	2.6	V
UVLO hysterisis	VIN decreasing		0.2		V
EN high level		1.6			V
EN low level				0.4	V
Over temperature protection threshold			155		℃
Over temperature protection hysterisis			20		℃

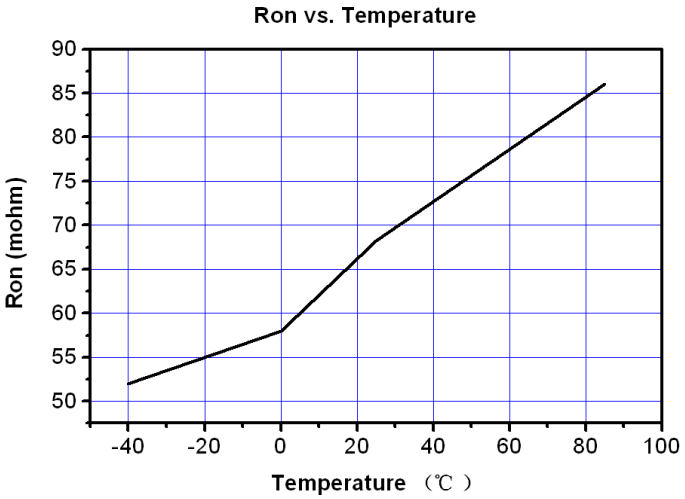
Typical Operating Characteristics

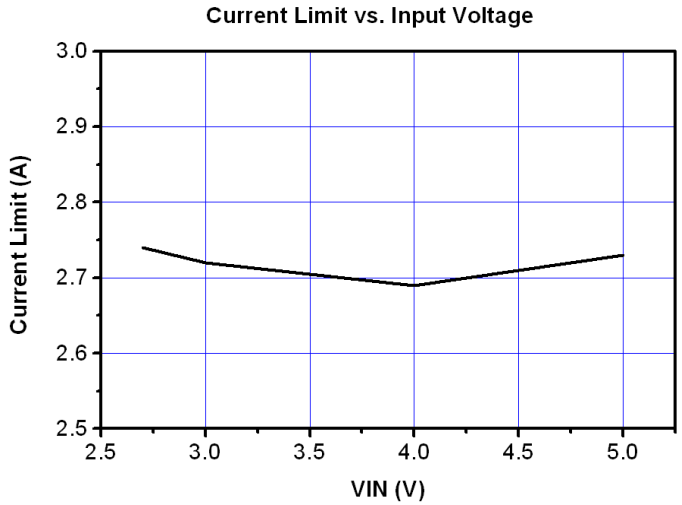
(Unless otherwise noticed: Ta=25℃ VIN=5V)

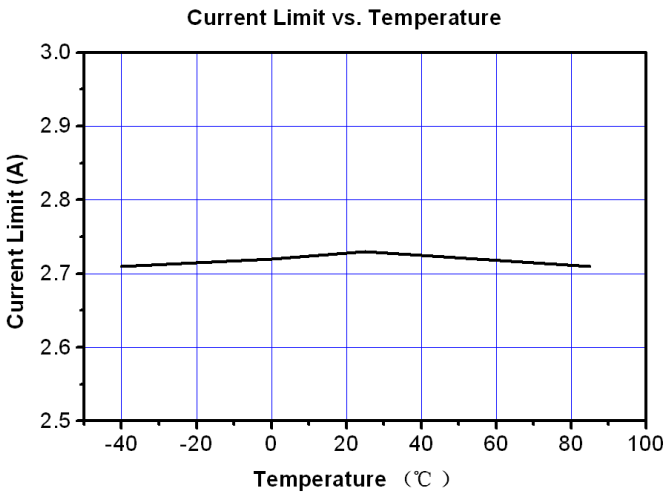












Operation Theory

- Startup / Shutdown / On resistance

The device is enabled when EN pin is tied to low，and VIN voltage is higher than UVLO threshold. When device is enabled, the power NMOS between VIN and VOUT is turned on, and exhibits low resistance. The typical on resistance is 70 mΩ .

When EN pin is tied to high, or VIN voltage decreases to lower than UVLO hysteresis voltage, the device is shut down, and the power NMOS is turned off, which exhibits high resistance. When device is shutdown, the output discharge function accelerates VOUT voltage decreasing.

The current limit circuit takes effect during startup, which will limit the inrush current caused by attaching to a large capacitive load.

- Current limiting

When output current is larger than current limit threshold, the internal power NMOS resistance increases, which makes VOUT to decrease, and the output current is limited. The internal current limit circuit will set the output current value according to VOUT voltage. If VOUT keep decreasing, the output current will decrease as well, and reaches to short current if VOUT is shorted to GND.

- Over temperature protection

In current limiting status, the internal power dissipation of the device increases due to VOUT decreasing, which makes junction temperature increase. When the junction temperature exceeds over temperature threshold, the device is shut down, which will cool down the device. When junction temperature decreases to lower than OT hysteresis threshold, the device is auto restarted.

- Under voltage lock out protection

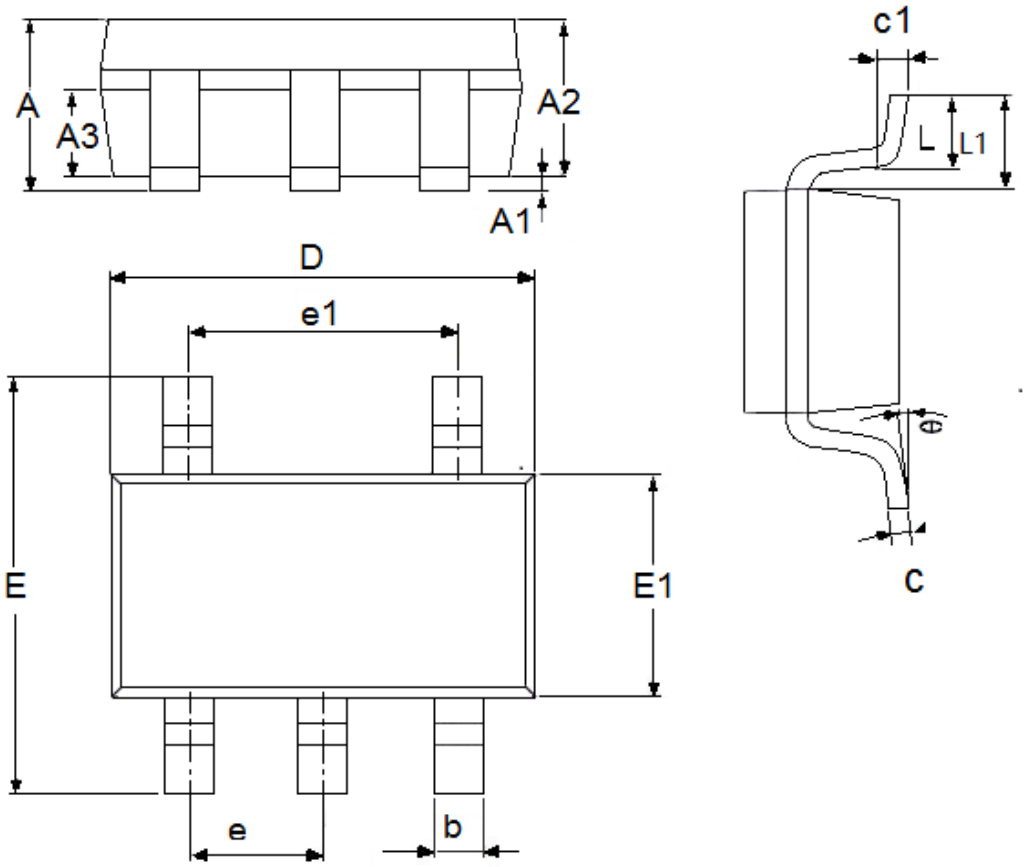
When power on, the device is turned on when VIN voltage ramps to higher than UVLO threshold. When power off, the device is shut down when VIN voltage decreases to lower than UVLO hysteresis threshold.

Application Information

- Cin and Cout capacitor should be placed as near as device pin.
- VIN and VOUT routings should be as wide as possible on PCB.
- Makes copper area as large as possible.

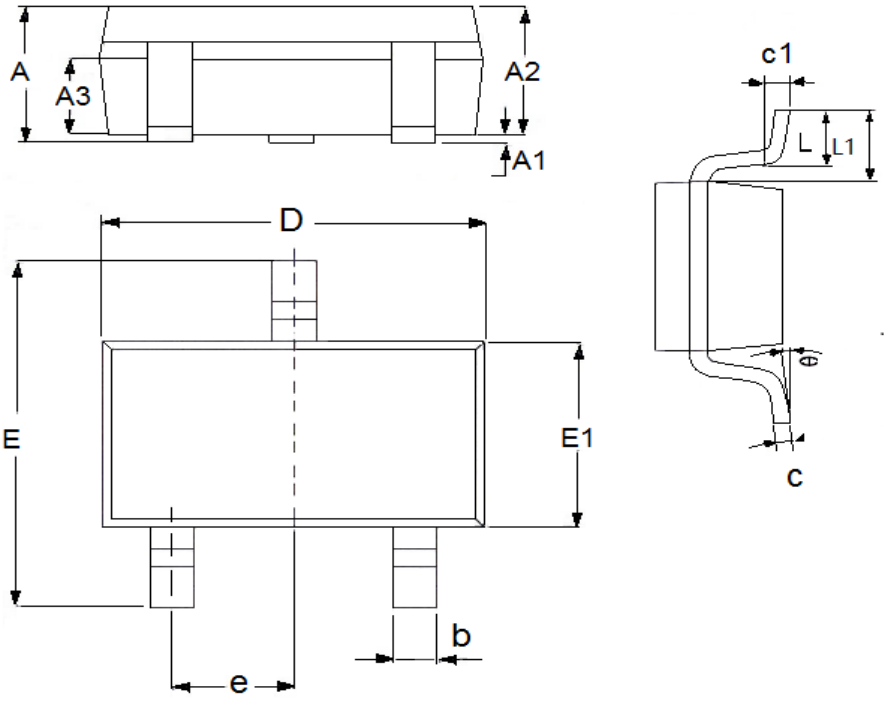
Package Information

- **Packaging Type:SOT23-5**



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	0.6	0.7	0.0236	0.0276
b	0.25	0.5	0.0098	0.0197
c	0.1	0.23	0.0039	0.0091
D	2.82	3.05	0.1110	0.1201
e1	1.9(TYP)		0.0748(TYP)	
E	2.6	3.05	0.1024	0.1201
E1	1.5	1.75	0.0512	0.0689
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
L1	0.59(TYP)		0.0232(TYP)	
θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	

- **Packaging Type:SOT23-3**



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	0.6	0.7	0.0236	0.0276
b	0.25	0.5	0.0098	0.0197
c	0.1	0.25	0.0039	0.0098
D	2.8	3.1	0.1102	0.1220
E	2.6	3.1	0.1023	0.1220
E1	1.5	1.8	0.0591	0.0709
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
L1	0.59(TYP)		0.0232(TYP)	
θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	

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