Precision Power Distribution Switch

FEATURES

- Integrated Typical 60mΩ Power MOSFET
- Low Supply Current
- 30μA Typical at Switch On State
- 1μA Typical at Switch Off State
- Wide Input Voltage Range: 2.5V to 5.5V
- Fast Transient Response: 8μs
- 0.1ms Typical Rise Time
- Reverse Current Flow Blocking
- Deglitched Open-Drain Over-Current Flag Output
- Output Discharge at shutdown (TMI6261B1 only)
- Thermal Shutdown Protection
- Hot Plug-In Application (Soft-Start)
- CB Test Certification by IEC62368-1:2014
- UL 2367 Certification - E528420
- SOT-23-6/SOT-23-5 Package

APPLICATIONS

- USB Bus/Self Powered Hubs
- Battery-Charger Circuits
- Personal Communication Devices
- Notebook Computers

GENERAL DESCRIPTION

The TMI6261X is a cost-effective, low voltage, single P-MOSFET load switch, optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. This switch operates with inputs ranging from 2.4V to 5.5V, making it ideal for both 3V and 5V systems. The switch's low $R_{DS(ON)}$, 60mΩ, meets USB voltage drop requirements. A built-in P-channel MOSFET with true shutdown function to eliminate any reversed current flow across the switch when it is powered off. When the output voltage is higher than input voltage, the power switch is turned off by internal output reverse-voltage comparator.

nFLG is an open-drain output report over-current or over temperature event. In addition, nFLG also has typical 8ms deglitch timeout period and reports output reverse-voltage condition.

TYPICAL APPILCATION

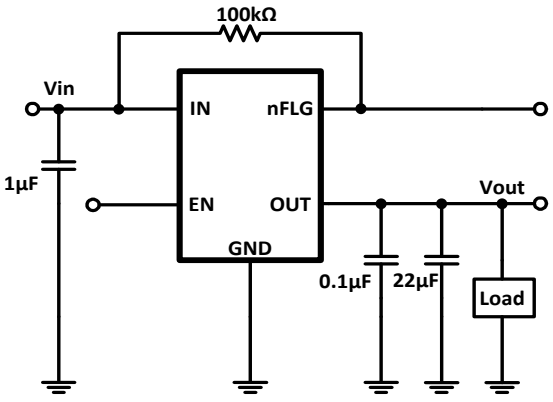
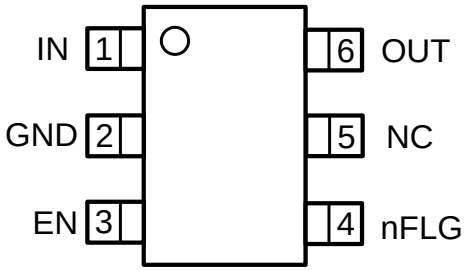


Figure 1. TMI6261X Application Circuit

ABSOLUTE MAXIMUM RATINGS (Note 1)

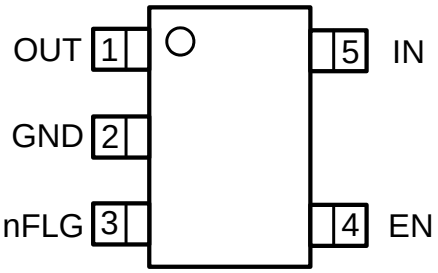
Parameter	Value	Unit
Input Supply Voltage	-0.3~7	V
EN Voltages	-0.3~V_{IN}+0.3	V
VOUT Voltage	-0.3~V_{IN}+0.3	V
Junction Temperature (Note2)	160	°C
Storage Temperature Range	-65~150	°C
Power Dissipation (SOT23-6)	1200	mW
Power Dissipation (SOT23-5)	1000	mW
Lead Temperature (Soldering,10s)	260	°C

PIN CONFIGURATION



SOT23-6

TMI6261A



SOT23-5

TMI6261B/C/B1

Top Mark: TXXXXXX (TXXX: Device Code, XXX: Inside code)

Part Number	Package	Top mark	Quantity/ Reel
TMI6261A	SOT23-6	T14BXXX	3000
TMI6261B	SOT23-5	T15BXXX	3000
TMI6261C	SOT23-5	T16BXXX	3000
TMI6261B1	SOT23-5	T17EXXX	3000

TMI6261A/TMI6261B/TMI6261C/TMI6261B1 devices are Pb-free and RoHS compliant.

PIN FUNCTIONS

Pin No.		Name	Function
TMI6261A	TMI6261B/C/B1		
1	5	IN	Input Supply: Output MOSFET Drain, which also supplies IC's internal circuitry. Connect to positive supply.
2	2	GND	IC ground connection
3	4	EN	Enable: Logic level enable input. Do not floating. Make sure EN pin never floating. Pull high to enable IC.
4	3	nFLG	Over-Current: Open-Drain Fault Flag Output.
5		NC	
6	1	OUT	Switch Output: Output MOSFET Source of switch. Typically connect to switched side of load.

ESD RATINGS

Items	Description	Value	Unit
V_{ESD}	Human Body Model for all pins	±2000	V

JEDEC specification JS-001

RECOMMENDED OPERATING CONDITIONS

Items	Description	Min	Max	Unit
Voltage Range	IN	2.5	5.5	V
T_J	Operating Junction Temperature Range	-40	125	°C

THERMAL RESISTANCE

Items	Description	Value	Unit
θ_{JA}	Junction-to-ambient thermal resistance (SOT23-6)	135	°C/W
θ_{JC}	Junction-to-case(top) thermal resistance (SOT23-6)	55	°C/W
ψ_{JT}	Junction-to-case(top) characterization parameter (SOT23-6)	7.5	°C/W
θ_{JA}	Junction-to-ambient thermal resistance (SOT23-5)	220	°C/W
θ_{JC}	Junction-to-case(top) thermal resistance (SOT23-5)	62	°C/W
ψ_{JT}	Junction-to-case(top) characterization parameter (SOT23-5)	11	°C/W

ELECTRICAL CHARACTERISTICS (Note 3)

(V_{IN}=5V, C_{IN}=1μF, C_{OUT}=1μF, T_A = 25°C.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IN section						
V_{IN}	Input voltage		2.5		5.5	V
I_{IN_ON}	Supply current, Enable	V_{IN}=5.5V, No load on OUT		30	60	μA
I_{IN_OFF}	Shutdown current, Disable	V_{IN}=5.5V, No load on OUT		0.1	1	μA
I_{REV}	Reverse leakage current	V_{OUT}=5.5V, V_{IN}=0V		2	5	μA
V_{UVLO_ON}	Under voltage lockout exit	V_{IN} rising from 0-5V		2	2.3	V
V_{UVLO_HY}	UVLO Hysteresis			100		mV
EN section						
V_{EN_H}	High-level enable voltage	V_{IN}=5.5V	1.5			V
V_{EN_L}	Low-level disable voltage	V_{IN}=2.5V			0.4	V
I_{EN}	EN input current	V_{EN}=5.5V or 0V	-0.5	5	10	μA
T_{ON}	Turn on time	CL=1μF, RL=100Ω		0.2		ms
T_{OFF}	Turn off time	CL=1μF, RL=100Ω		0.1		ms
OUT section						
I_{OC}	Over Current CC Regulation	TMI6261A V_{IN}=5V, V_{OUT}=3.5V	0.64	0.8	0.96	A
		TMI6261B and TMI6261B1 V_{IN}=5V, V_{OUT}=3.5V	1.27	1.5	1.73	A
		TMI6261C V_{IN}=5V, V_{OUT}=3.5V	1.95	2.1	2.25	A
$V_{REVERSE}$	Reverse voltage protection	V_{OUT}-V_{IN}	5	20	50	mV
T_{RISE}	Output rise time	CL=1μF, RL=100Ω		0.1		ms
T_{FALL}	Output fall time	CL=1μF, RL=100Ω		0.3		ms
T_{IOS}	Response time to short circuit			12		μs
R_{DIS}	OUT Discharge Resistance (TMI6261B1 Only)	V_{IN}=5V, V_{EN}=0V, V_{OUT}=5V		42		Ω

ELECTRICAL CHARACTERISTICS (continued)

(V_{IN}=5V, C_{IN}=1μF, C_{OUT}=1μF, T_A = 25°C.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
FLG(Fault flag) section						
V_{OL}	Output low voltage	I_{FLG}=1mA			180	mV
I_{FLG}	Continuous FLG sink				10	mA
I_{FLG_LEAK}		Off-state leakage			1	μA
T_{FLG}	Fault flag deglitch time	I_{OUT}= 0A to 2A, over current condition		8		ms
		VOUT-VIN>100mV, reverse blocking protection		2.5		ms
Power switch						
R_{DS_ON}		I_{OUT}=0.5A(TMI6261A) I_{OUT}=1A(TMI6261B/C/B1)		60		mΩ
Thermal Shutdown						
T_{NORMAL}	Thermal shutdown temperature			150		°C
T_{NORMAL_HY}	Thermal shutdown threshold hysteresis			20		°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation PD according to the following formula: $T_J = T_A + P_D \times \theta_{JA}$.

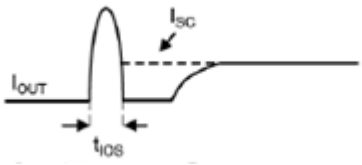


Figure 2. Short Circuits Response time

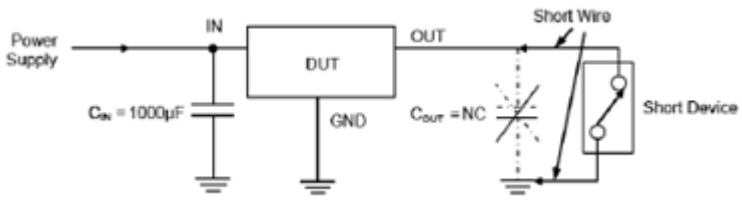


Figure 3. test circuits

Note:

To exactly identify the short circuit characteristic of IC, avoid the test result interfered by parasitic inductor, output capacitor, and contact resistor. It is necessary to follow the recommendation as follows.

1. Add 1000μF of capacitor between VIN and GND, and close to IC.
2. Remove output capacitor.
3. Shorter the short circuit device wire.
4. Measure output current (IOUT).

FUNCTIONAL BLOCK DIAGRAM

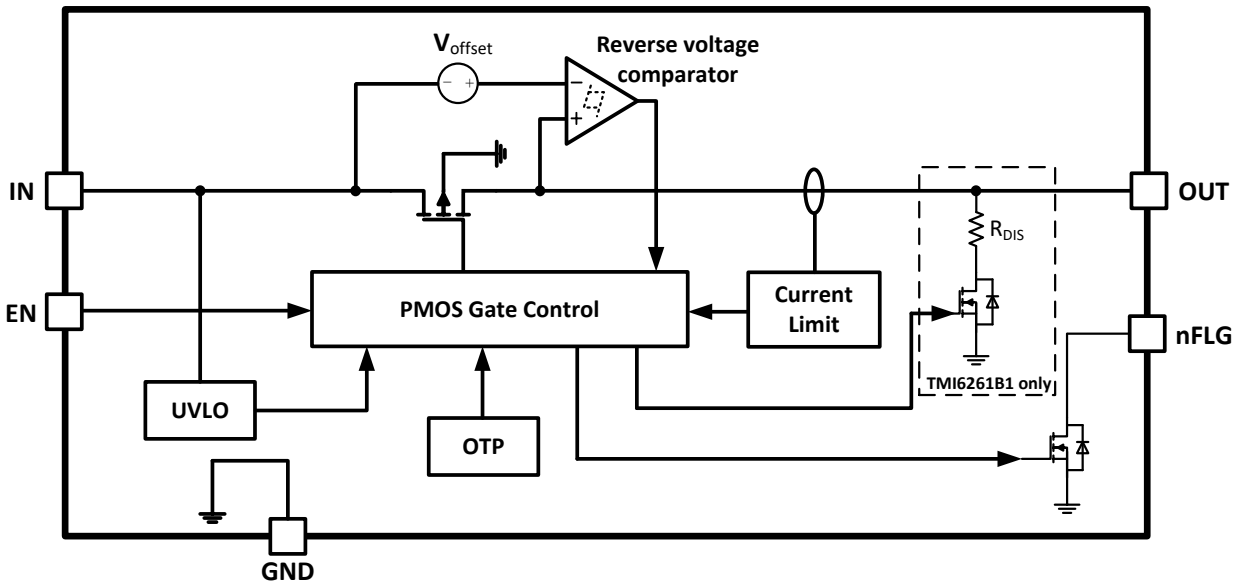
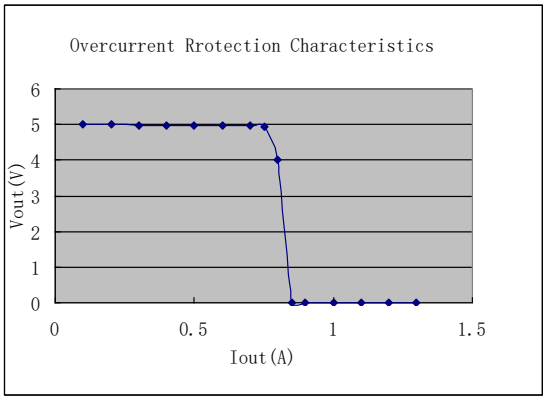


Figure 4. TMI6261X Block Diagram

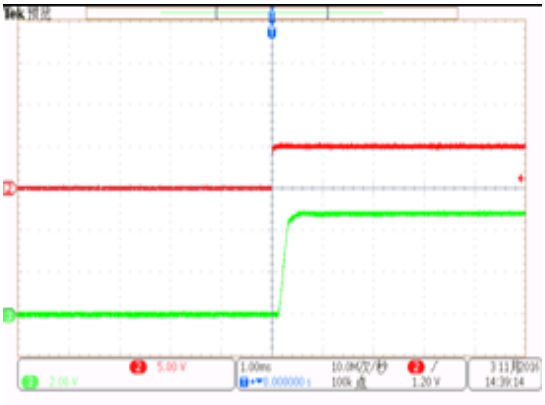
TYPICAL PERFORMANCE CHARACTERISTICS

TMI6261A characteristic

Over current Protection Characteristics

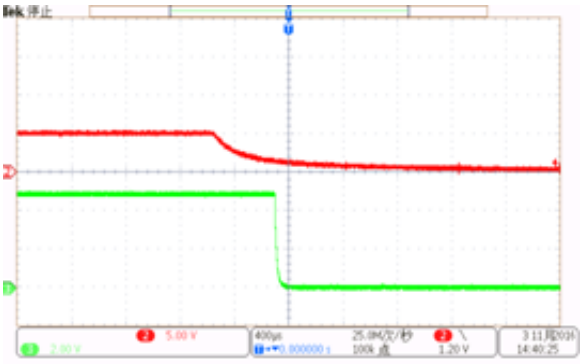


Turn on Delay Time and Rise Time



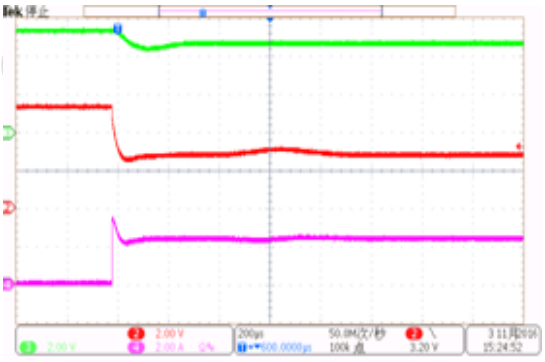
CH2:EN CH3:VOUT 1mS/div

Turn off Delay Time and Fall Time



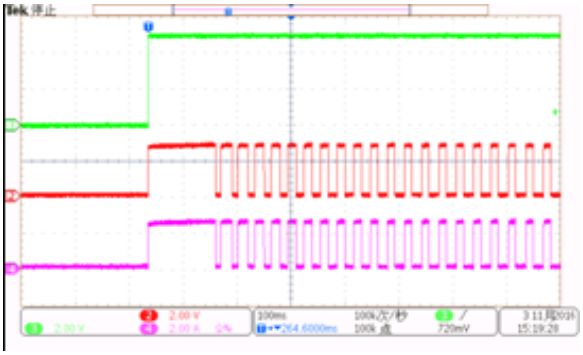
CH2:EN CH3:VOUT 400uS/div

Resistance Load Inrush Response



CH2:VOUT CH3:VIN CH4:IOUT 200uS/div

Over current Response



CH2:VOUT CH3:EN CH4:IOUT 200uS/div

APPLICATION INFORMATION

The TMI6261X is current-limited, power distribution switches using P-channel MOSFETs. Additional device shutdown features include over temperature protection and reverse-voltage protection. The driver controls the gate voltage of the power switch. The driver incorporates circuitry that controls the rise and fall times of the output voltage to limit large current and voltage surges and provides built-in soft-start functionality. The TMI6261X enters constant current mode when the load exceeds the current-limit threshold.

Input and Output

IN (input) is the power supply connection to the logic circuitry and the drain of the output MOSFET. OUT (output) is the source of the output MOSFET. In a typical application, current flows through the switch from IN to OUT toward the load. OUT pin must be connected together to the load.

Soft Start for Hot Plug-In Applications

In order to eliminate the upstream voltage droop caused by the large inrush current during hot-plug events, the “soft-start” feature effectively isolates the power source from extremely large capacitive loads, satisfying the USB voltage droop requirements.

FLG Function

The nFLG open-drain output is asserted (active low) when an over current condition is encountered after a 8ms deglitch timeout. The nFLG output remains asserted until the over-current condition is removed. Over temperature condition is also reported by nFLG open-drain output. In addition, nFLG is also asserted (active low) in output reverse-voltage condition when the output reverse-voltage condition is removed.

Thermal Shutdown

The TMI6261x has internal over temperature protection to shut down the device when its junction temperature exceeds 150°C with over load current condition, then after the device is disabled, if the junction temperature drops 20°C hysteresis typically the device will resume and restart to work. The switch continues to cycle off and on until the over current fault is removed.

EN, the Enable Input

EN must be driven logic high or logic low for a clearly defined input. Floating the input may cause unpredictable operation, so please do not float EN input pin.

Output Auto Discharge

Only for TMI6261B1, when its EN is disabled, an internal typical 42Ω resister is connected between OUT and GND to discharge output capacitor C_{OUT}.

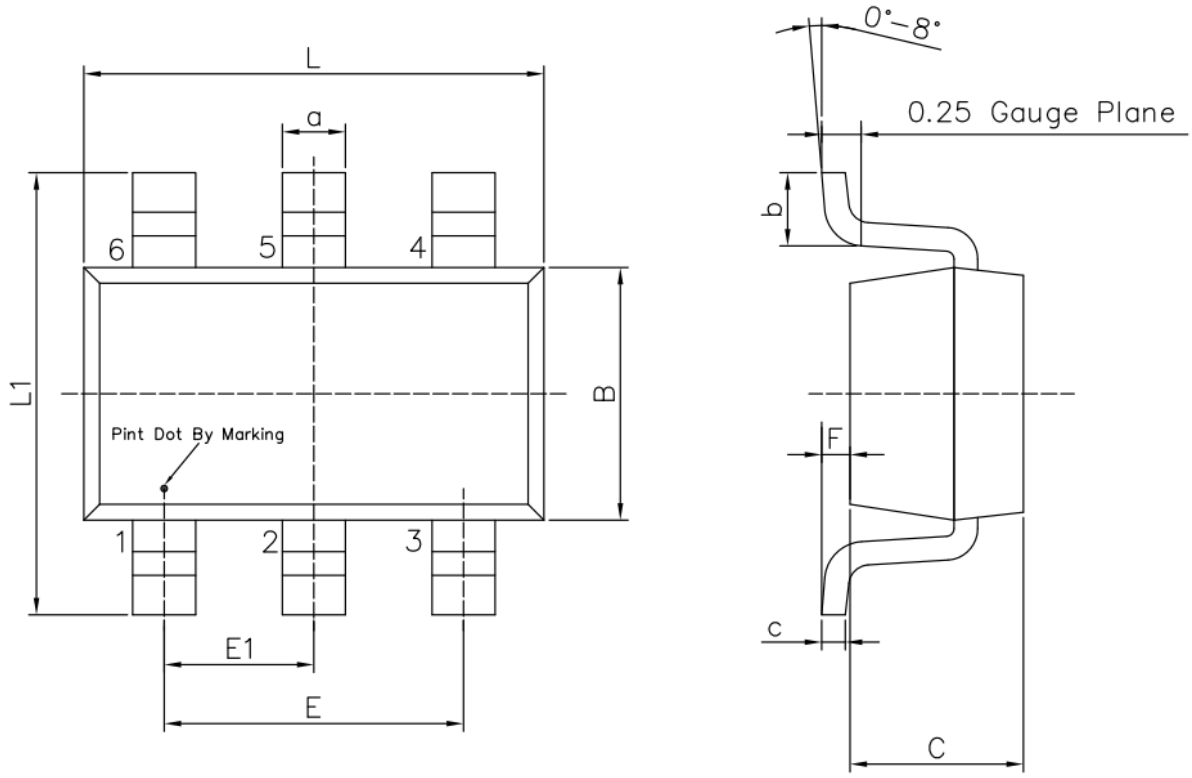
Layout Consideration

For best performance of the TMI6261X, the following guidelines must be strictly followed.

1) Input and output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.
2) The GND should be connected to a strong ground plane for heat sink.
3) Keep the main current traces as possible as short and wide.

PACKAGE INFORMATION

SOT23-6



Unit: mm

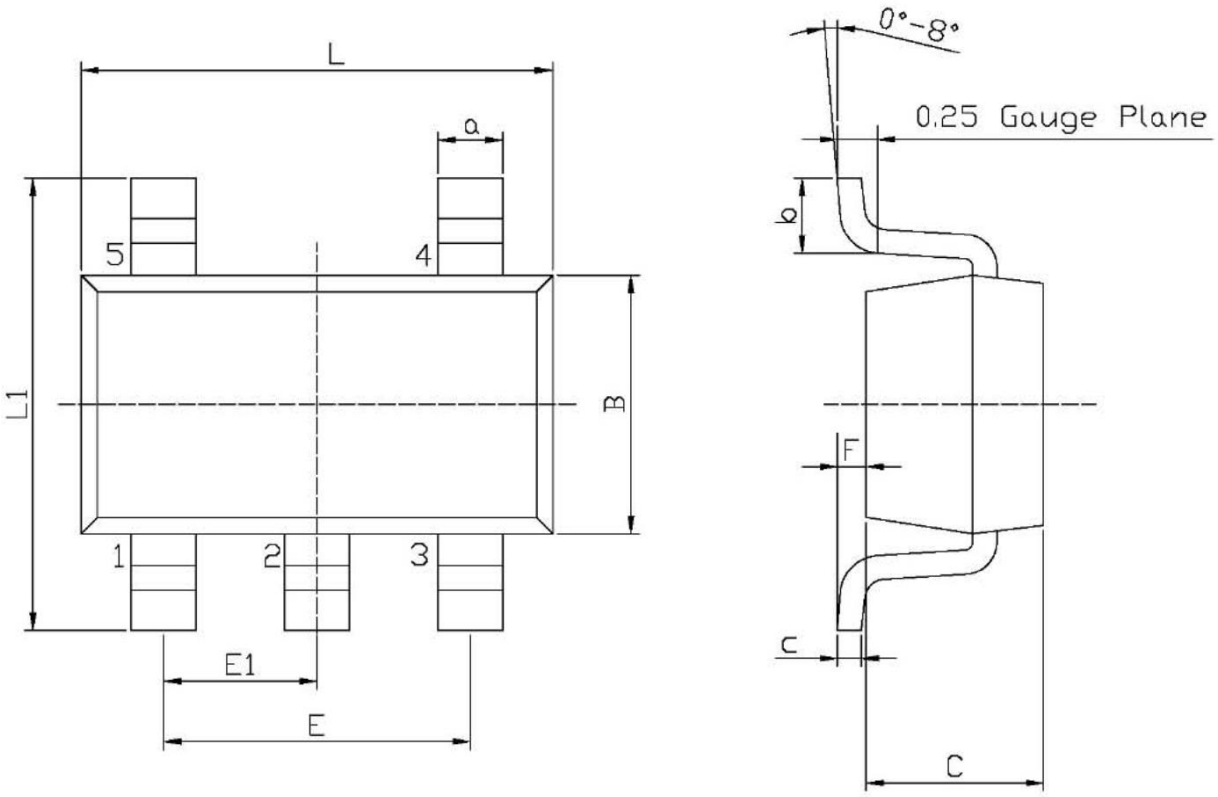
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

Note:

1) All dimensions are in millimeters.
2) Package length does not include mold flash, protrusion or gate burr.
3) Package width does not include inter lead flash or protrusion.
4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
5) Pin 1 is lower left pin when reading top mark from left to right.

PACKAGE INFORMATION

SOT23-5



Unit: mm

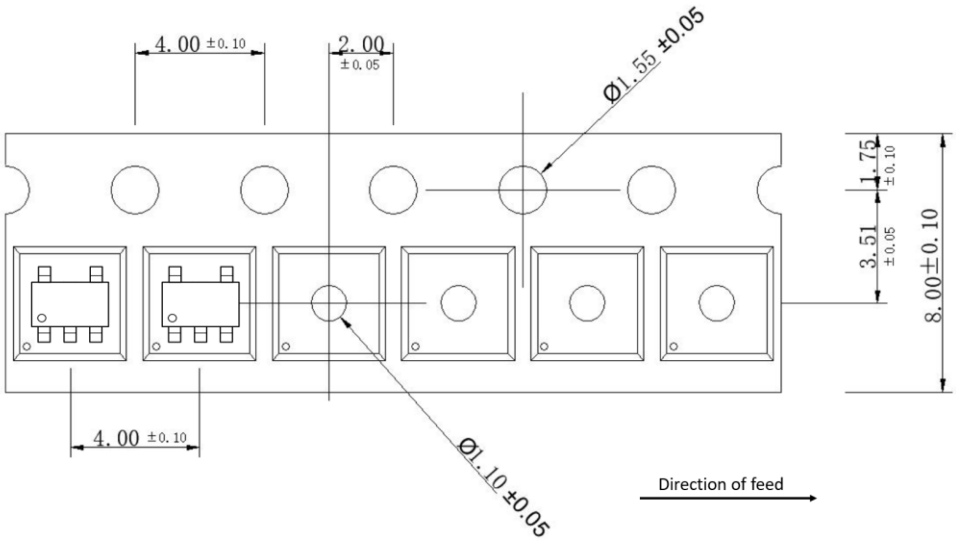
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

Note:

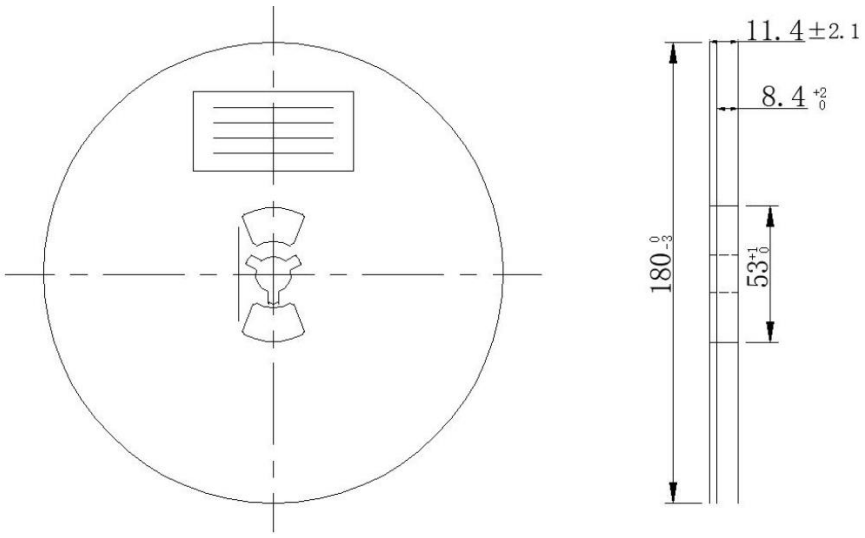
1) All dimensions are in millimeters.
2) Package length does not include mold flash, protrusion or gate burr.
3) Package width does not include inter lead flash or protrusion.
4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
5) Pin 1 is lower left pin when reading top mark from left to right.

TAPE AND REEL INFORMATION

TAPE DIMENSIONS:



REEL DIMENSIONS:



Note:

1) All Dimensions are in Millimeter
2) Quantity of Units per Reel is 3000
3) MSL level is level 3.

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