

## Precision Power Distribution Switch

### FEATURES

- Integrated Typical 60mΩ Power MOSFET
- Adjustable Current Limit: 400mA to 2.4A
- 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
- Thermal Shutdown Protection
- Hot Plug-In Application (Soft-Start)
- SOT23-5 Package

### GENERAL DESCRIPTION

The TMI6262AL 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 2.5V 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.

The TMI6262AL offers a programmable current limit threshold between 400mA to 2.4A via an external resistor.

### APPLICATIONS

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

### TYPICAL APPLICATION

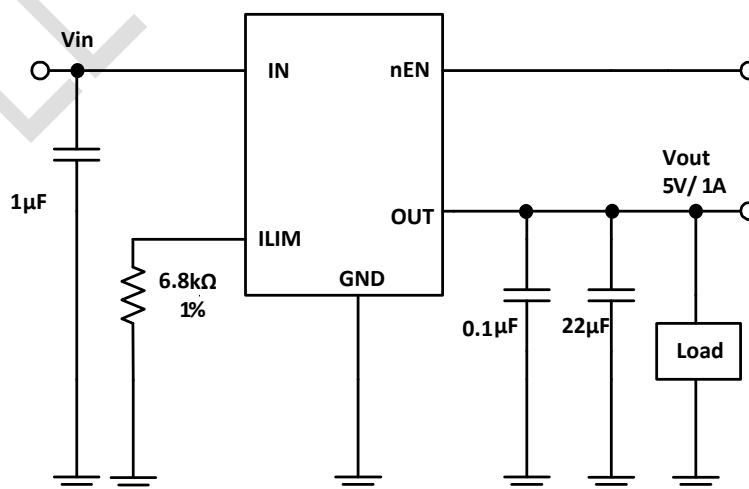
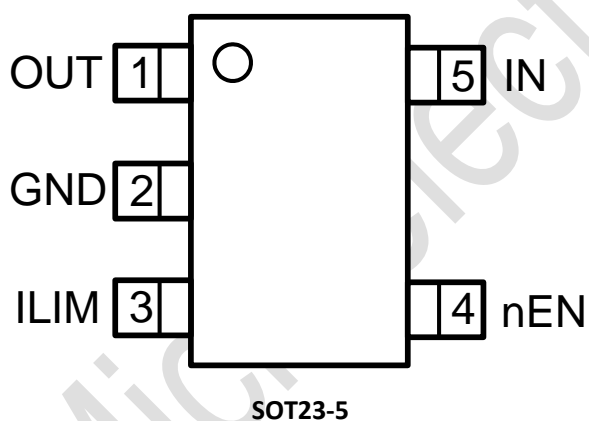


Figure 1. TMI6262AL Application Circuit

## ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Value	Unit
Input Supply Voltage	-0.3~7	V
All other pins Voltages	-0.3~ $V_{IN}+0.3$	V
Junction Temperature <small>(Note2)</small>	-40~160	°C
Storage Temperature Range	-65~150	°C
Junction-to-ambient Thermal Resistance	220	°C/W
Junction-to-case(top) Thermal Resistance	62	°C/W
Lead Temperature(Soldering,10s)	260	°C

## PIN CONFIGURATION



**Top Mark: T07AXXX (T07A: Device Code, XXX: Inside code)**

Part Number	Package	Top mark	Quantity/ Reel
TMI6262AL	SOT23-5	T07AXXX	3000

TMI6262AL devices are Pb-free and RoHS compliant.

**PIN FUNCTIONS**

Pin	Name	Function
1	OUT	Switch Output: Output MOSFET Source of switch. Typically connect to switched side of load.
2	GND	Ground Pin
3	ILIM	External resistor used to set current-limit ILIM threshold
4	nEN	Enable: Logic level enable input. Make sure nEN pin never floating. Pull low to enable IC.
5	IN	Input Supply: Output MOSFET Drain, which also supplies IC's internal circuitry. Connect to positive supply.

**ESD RATINGS**

Items	Description	Value	Unit
V <sub>ESD_HBM</sub>	Human Body Model for all pins	±2000	V
V <sub>ESD_CDM</sub>	Charged Device 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 <sub>J</sub>	Operating Junction Temperature Range	-40	125	°C

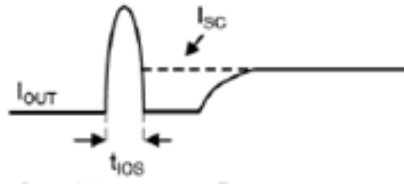
## ELECTRICAL CHARACTERISTICS

( $V_{IN}=5V$ ,  $C_{IN}=1\mu F$ ,  $C_{OUT}=1\mu F$ ,  $T_A = 25^\circ C$ .)

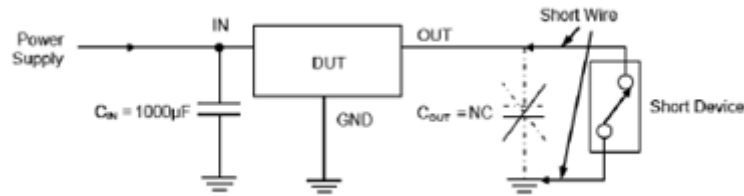
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>IN section</b>						
$V_{IN}$	Input voltage		2.5		5.5	V
$I_{IN\_ON}$	Supply current, Enable	$V_{IN}=5.5V$ , No load on OUT		30	60	$\mu A$
$I_{IN\_OFF}$	Shutdown current, Disable	$V_{IN}=5.5V$ , No load on OUT		0.1	1	$\mu A$
$I_{REV}$	Reverse leakage current	$V_{OUT}=5.5V$ , $V_{IN}=0V$		2	5	$\mu A$
$V_{UVLO\_ON}$	Under voltage lockout exit	$V_{IN}$ rising from 0-5V		2	2.3	V
$V_{UVLO\_HY}$	UVLO Hysteresis			100		mV
<b>EN section</b>						
$V_{nEN\_H}$	High-level enable voltage	$V_{IN}=5.5V$	1.5			V
$V_{nEN\_L}$	Low-level disable voltage	$V_{IN}=2.5V$			0.8	V
$I_{nEN}$	EN input current	$V_{EN}=5.5V$ or 0V	-0.5	5	10	$\mu A$
<b>OUT section</b>						
$I_{OC}$	Over Current CC Regulation	TMI6262AL $R_{LIM}=6.8k\Omega$ $V_{IN}=5V$ , $V_{OUT}=3.5V$	0.8	1	1.2	A
$V_{REVERSE}$	Reverse voltage protection	$V_{OUT}-V_{IN}$	5	20	50	mV
$T_{RISE}$	Output rise time	$CL=1\mu F$ , $RL=100ohm$		0.1		ms
$T_{FALL}$	Output fall time	$CL=1\mu F$ , $RL=100ohm$		0.3		ms
$T_{IOS}$	Response time to short circuit			12		$\mu s$
<b>Power switch</b>						
$R_{DS\_ON}$		$I_{OUT}=1A$		60		m $\Omega$
<b>Thermal Shutdown</b>						
$T_{NORMAL}$	Thermal shutdown temperature			150		$^\circ C$
$T_{NORMAL\_HY}$	Thermal shutdown threshold hysteresis			20		$^\circ C$

**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:  $T_J = T_A + (PD) \times \theta_{JA}$ .



**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.

Please,

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 (I<sub>OUT</sub>).

FUNCTIONAL BLOCK DIAGRAM

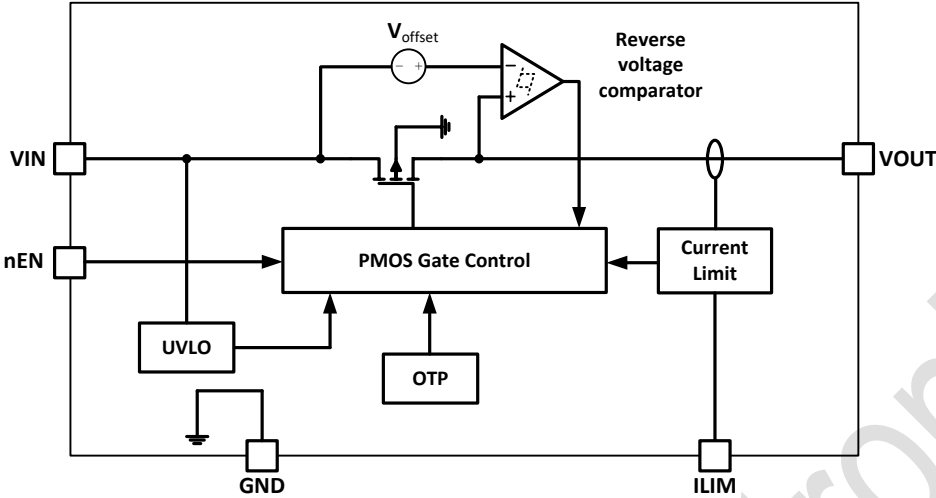
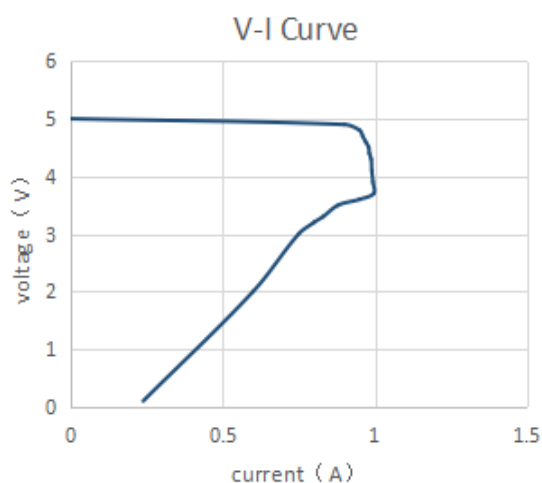


Figure 4. TMI6262AL Block Diagram

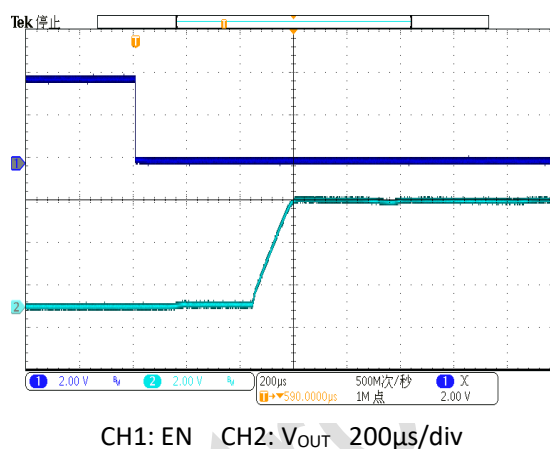
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## TYPICAL PERFORMANCE CHARACTERISTICS

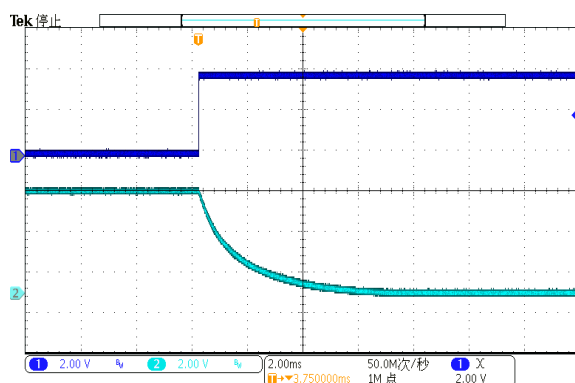
### Over current Protection Characteristics



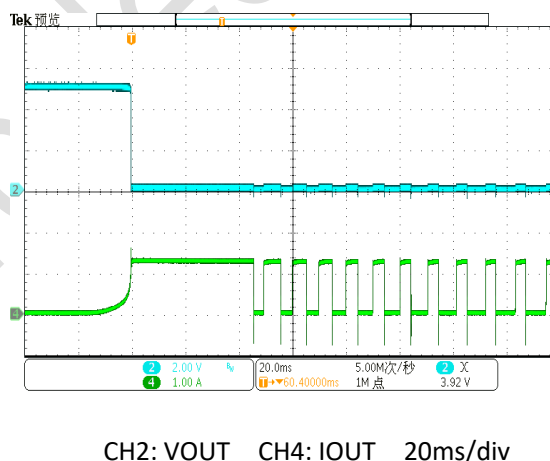
### Turn on Delay Time and Rise Time



### Turn off Delay Time and Fall Time



### Short Circuit Response



## APPLICATION INFORMATION

The TMI6262AL is current-limited, power distribution switches using P-channel MOSFETs for applications where short circuits or heavy capacitive loads will be encountered and provide up to 2.4 A of continuous load current. 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 TMI6262AL 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.

## Setting Current Limit

The over-current threshold is user programmable via an external resistor. The TMI6262AL use an internal regulation loop to provide a regulated voltage on the ILIM pin. The current-limit threshold is proportional to the current sourced out of ILIM. The recommended 1% resistor range for  $R_{ILIM}$  is  $1k\Omega \leq R_{ILIM} \leq 30k\Omega$  to ensure stability of the internal regulation loop. Many applications require that the minimum current limit is above a certain current level or that the maximum current limit is below a certain current level, so it is important to consider the tolerance of the over current threshold when selecting a value for  $R_{ILIM}$ . The following Figure 6 can be used to select the resulting type over-current threshold for a given external resistor value ( $R_{ILIM}$ ).

$$I_{LIMIT} = 6800 / R_{ILIM}$$

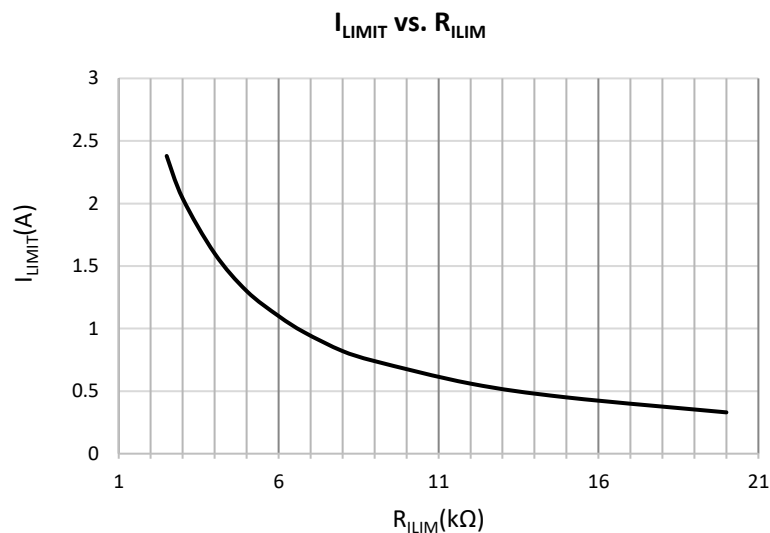


Figure 5. Ilimit vs. Rlimit

## Thermal Shutdown

The TMI6262AL 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.

## nEN, the Enable Input

nEN 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 nEN input pin.



### Layout Consideration

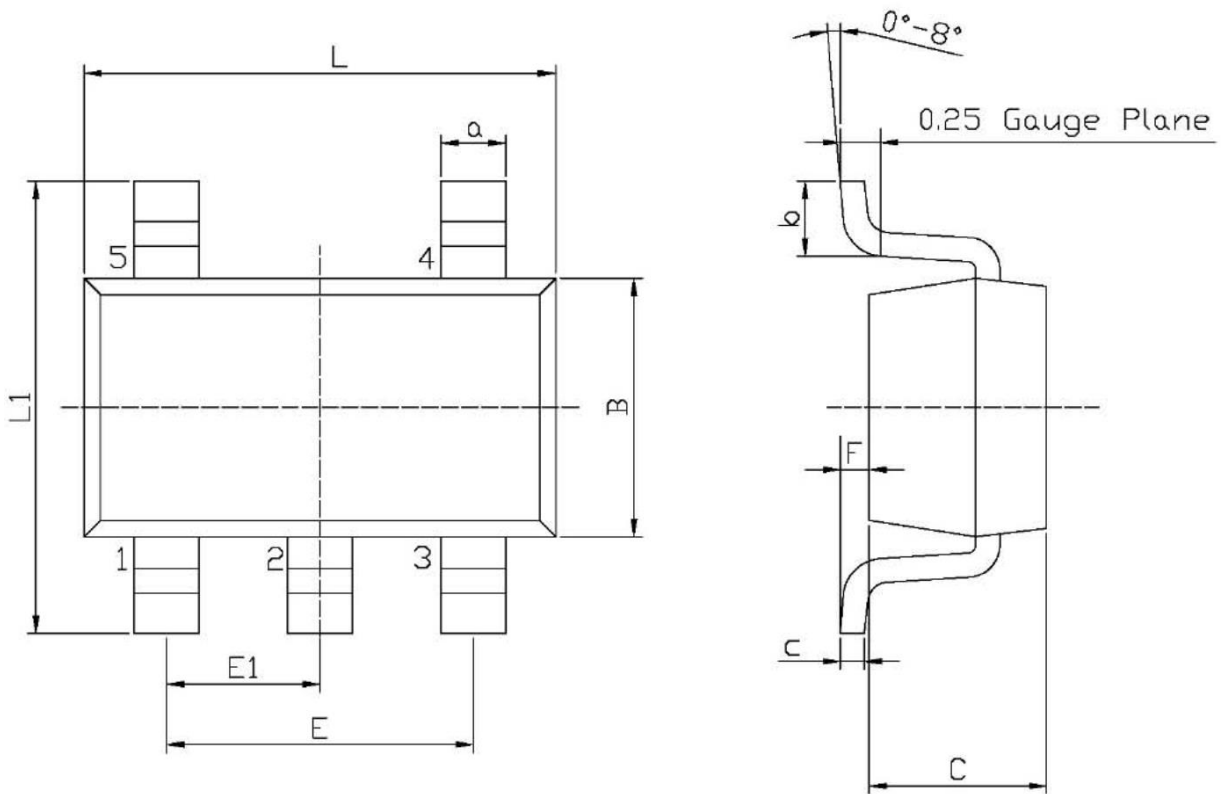
For best performance of the TMI6262AL, the following guidelines must be strictly followed.

- 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.

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## PACKAGE INFORMATION

### SOT23-5



Unit: mm

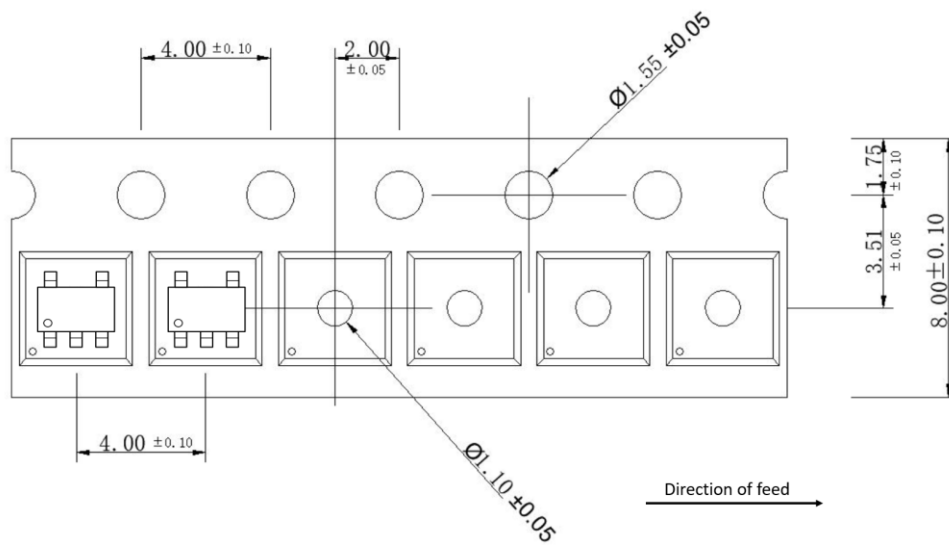
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

**Note:**

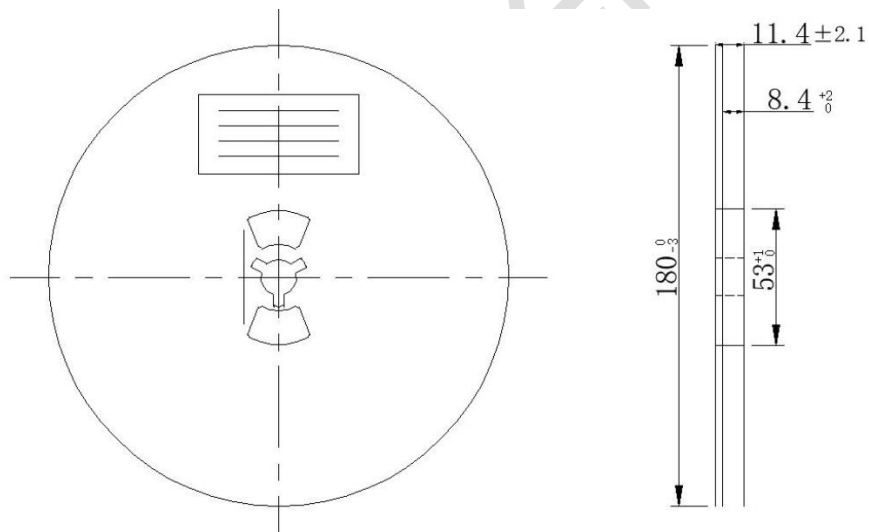
- 1) All dimensions are in millimeters.
- 2) Package length does not include mold flash, protrusion or gate burr.
- 3) Package width does not include inter lead flash or protrusion.
- 4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
- 5) Pin 1 is lower left pin when reading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