

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(FC6261B1 only)
- Thermal Shutdown Protection
- Hot Plug-In Application (Soft-Start)
- SOT-23-6/SOT-23-5 Package

GENERAL DESCRIPTION

The FC6261 series 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.

APPLICATIONS

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

TYPICAL APPLICATION

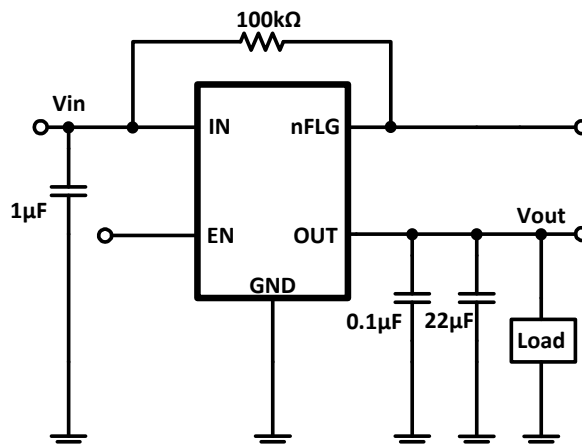
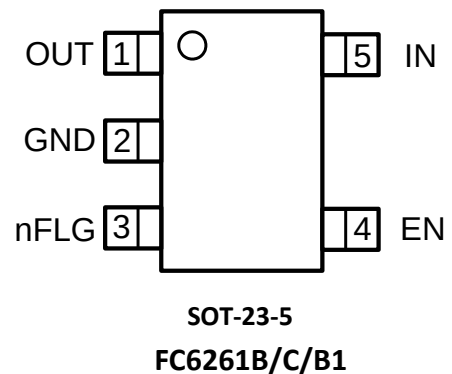
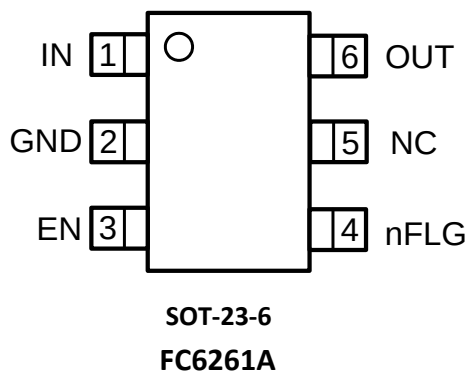


Figure 1. FC6261 Application Circuit

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
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



Part Number	Package	Top mark	Quantity/ Reel
FC6261A	SOT-23-6	T14BXXX	3000
FC6261B	SOT-23-5	T15AXXX	3000
FC6261C	SOT-23-5	T16AXXX	3000
FC6261B1	SOT-23-5	T17EXXX	3000

FC6261A/FC6261B/FC6261C/FC6261B1 devices are Pb-free and RoHS compliant.



FC6261

PIN FUNCTIONS

Pin No.		Name	Function
FC6261A	FC6261B/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



FC6261

ELECTRICAL CHARACTERISTICS (Note 3)

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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	$CL=1\mu F$, $RL=100\Omega$		0.2		ms
T_{OFF}	Turn off time	$CL=1\mu F$, $RL=100\Omega$		0.1		ms
OUT section						
I_{OC}	Over Current CC Regulation	FC6261A $V_{IN}=5V$, $V_{OUT}=3.5V$	0.64	0.8	0.96	A
		FC6261B and FC6261B1 $V_{IN}=5V$, $V_{OUT}=3.5V$	1.27	1.5	1.73	A
		FC6261C $V_{IN}=5V$, $V_{OUT}=3.5V$	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	$CL=1\mu F$, $RL=100\Omega$		0.1		ms
T_{FALL}	Output fall time	$CL=1\mu F$, $RL=100\Omega$		0.3		ms
T_{IOS}	Response time to short circuit			12		μs
R_{DIS}	OUT Discharge Resistance (FC6261B1 Only)	$V_{IN}=5V$, $V_{EN}=0V$, $V_{OUT}=5V$		42		Ω

ELECTRICAL CHARACTERISTICS (continued)

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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
		V _{OUT} -V _{IN} >100mV, reverse blocking protection		2.5		ms
Power switch						
R _{DS_ON}		I _{OUT} =0.5A(FC6261A) I _{OUT} =1A(FC6261B/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 P_D according to the following formula: $T_J = T_A + P_D \times \theta_{JA}$.

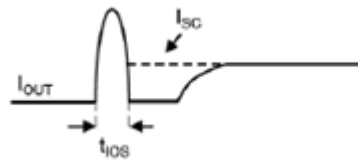


Figure 2. Short Circuits Response time

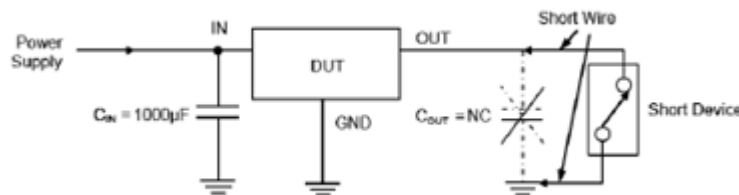


Figure 3. test circuits

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 1000 μF of capacitor between V_{IN} and GND, and close to IC.
2. Remove output capacitor.
3. Shorter the short circuit device wire.
4. Measure output current (I_{OUT}).

FUNCTIONAL BLOCK DIAGRAM

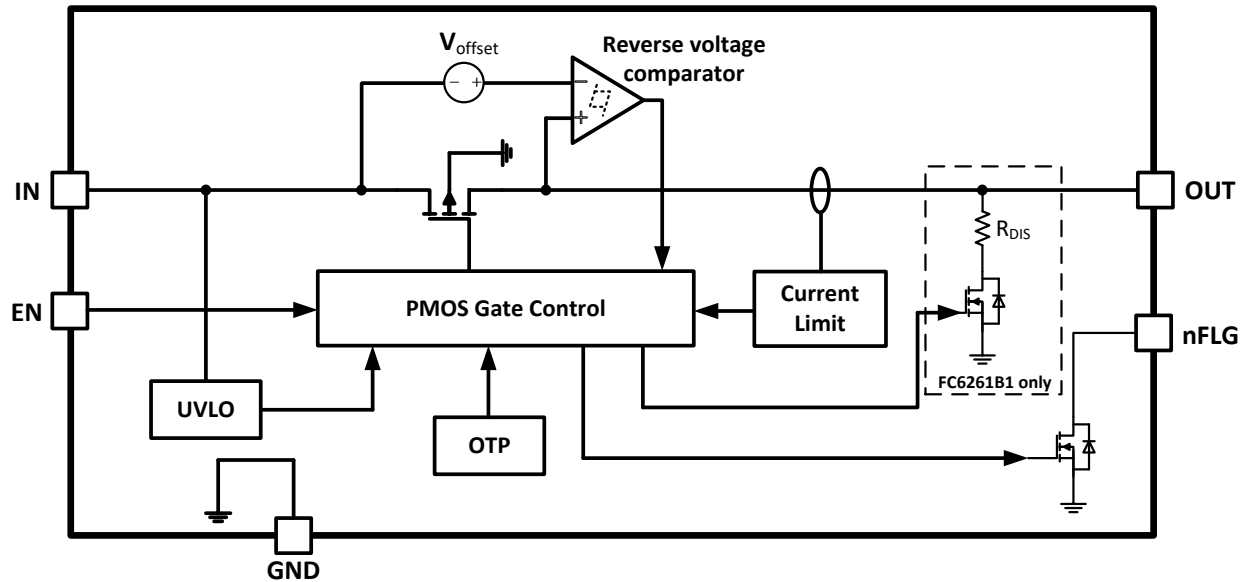
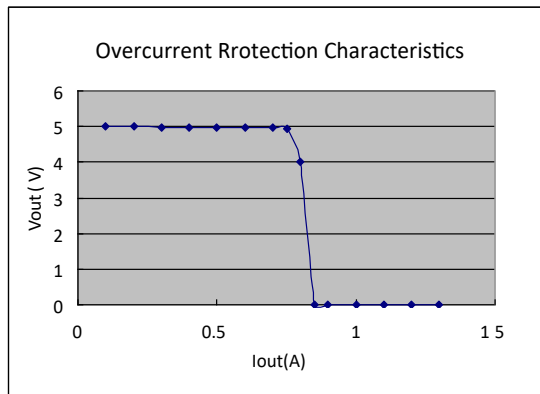


Figure 4. FC6261 Block Diagram

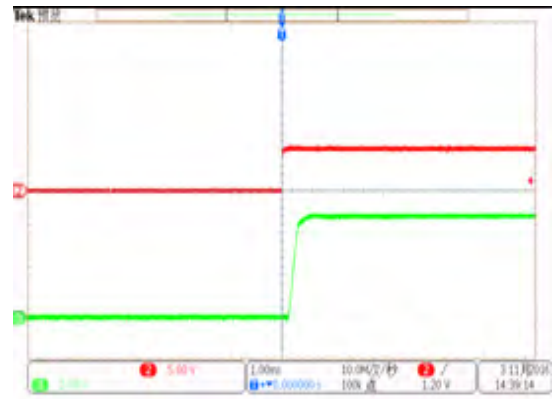
TYPICAL PERFORMANCE CHARACTERISTICS

FC6261A characteristic

Over current Protection Characteristics

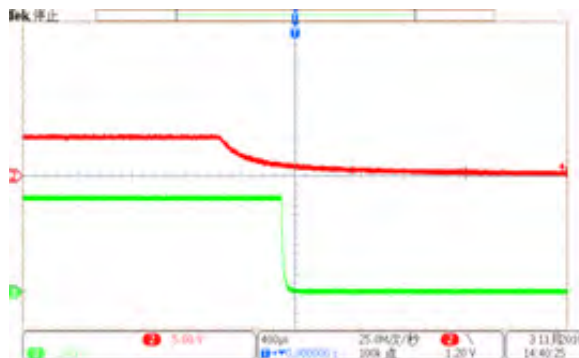


Turn on Delay Time and Rise Time



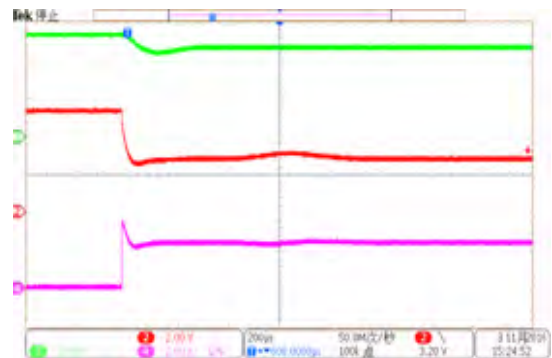
CH2:EN CH3:VOUT 1ms/div

Turn off Delay Time and Fall Time



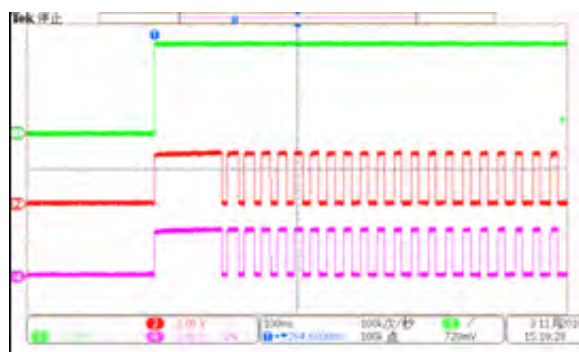
CH2:EN CH3:VOUT 400uS/div

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 FC6261 Series 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 FC6261 Series 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 FC6261 Series 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 FC6261B1, when its EN is disabled, an internal typical 42Ω resistor is connected between OUT and GND to discharge output capacitor C_{OUT}.

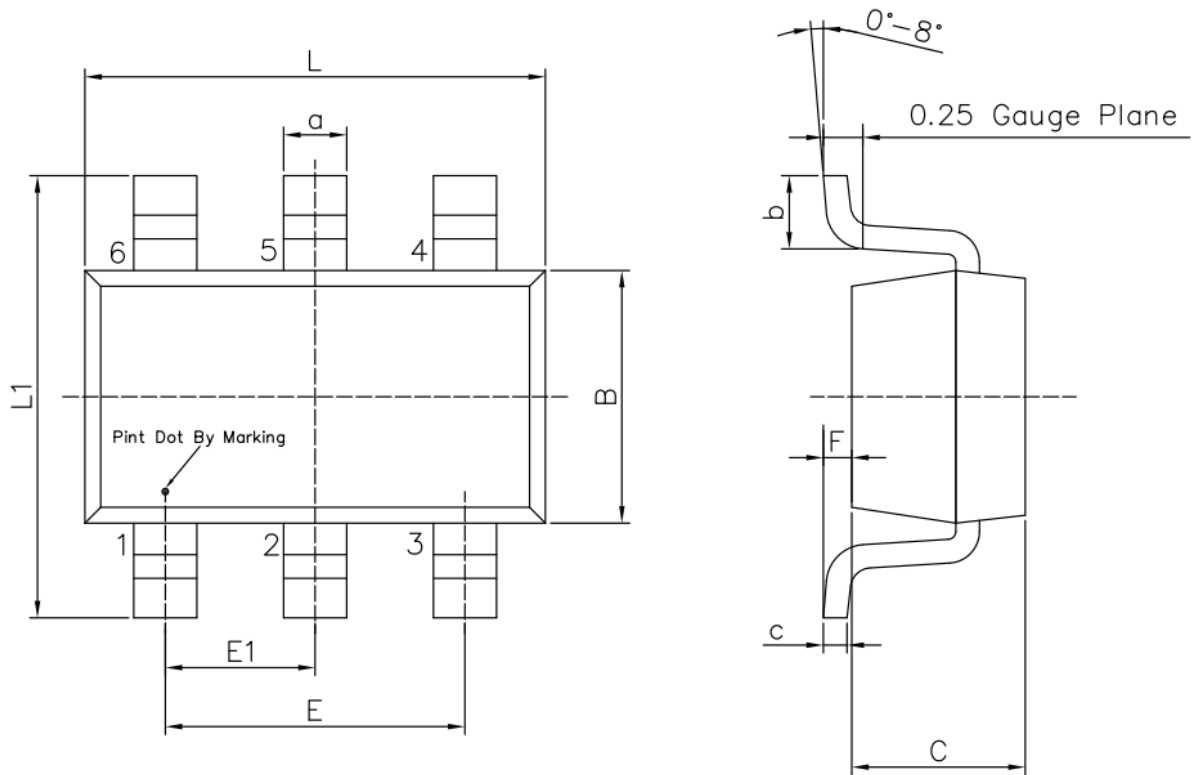
Layout Consideration

For best performance of the FC6261 Series, 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

SOT-23-6



Unit: mm

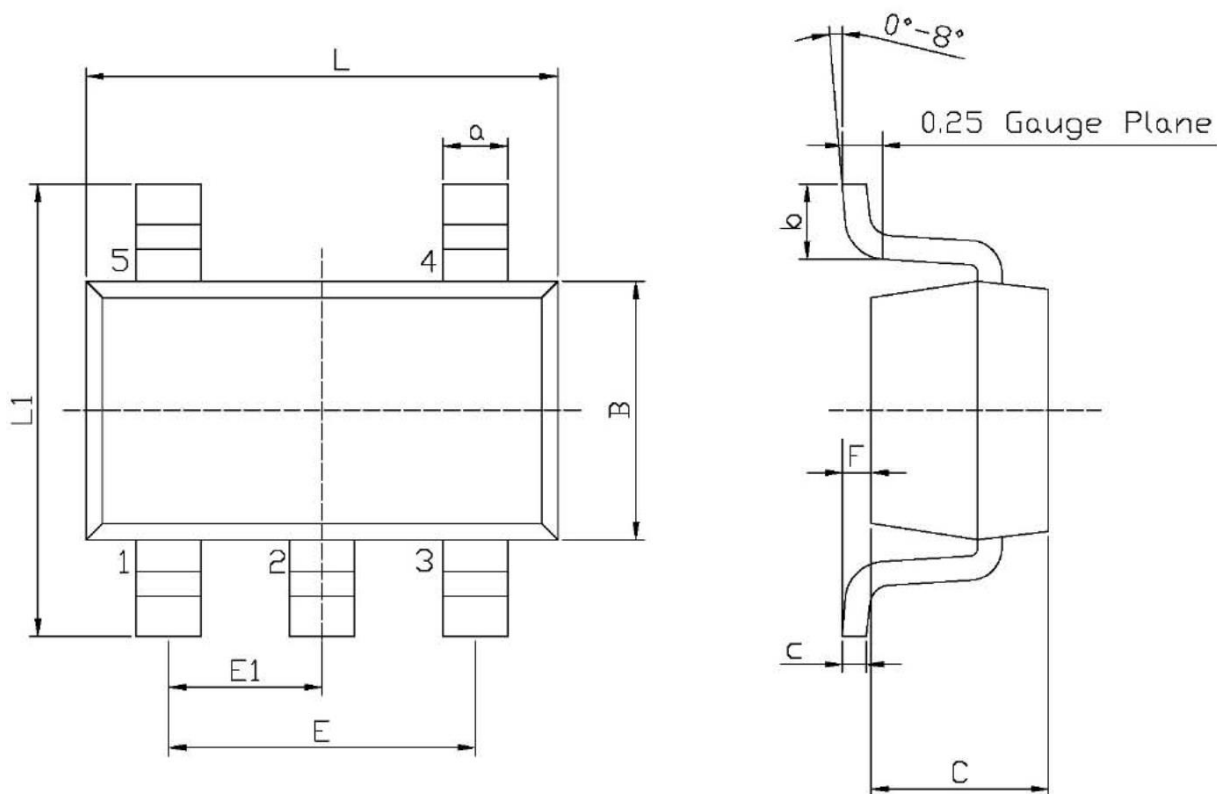
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

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

SOT-23-5



Unit: mm

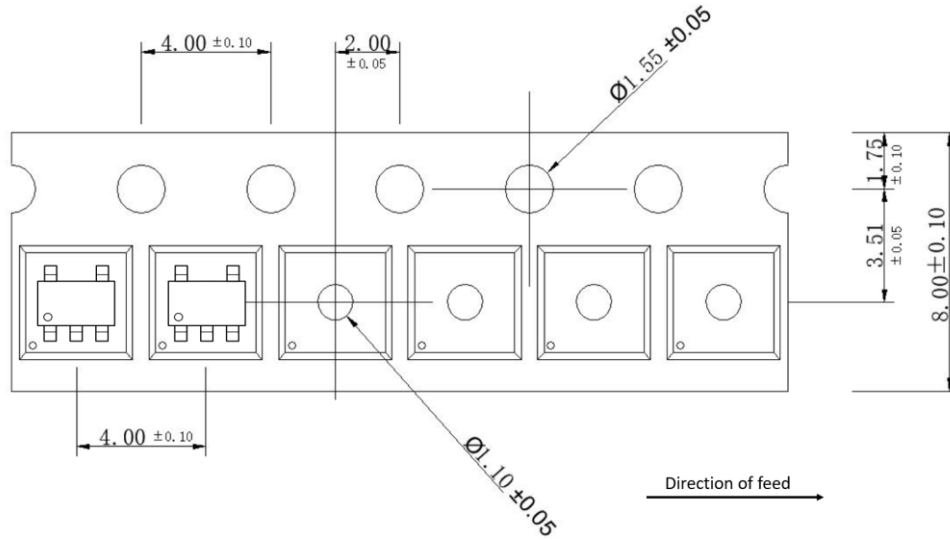
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

Note:

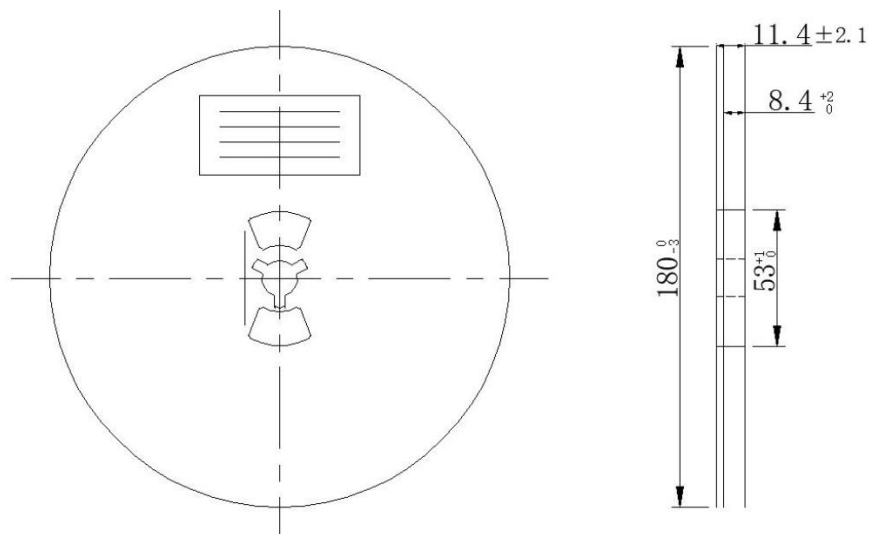
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- 5) Pin 1 is lower left pin when reading top mark from left to right.

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.