

## 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

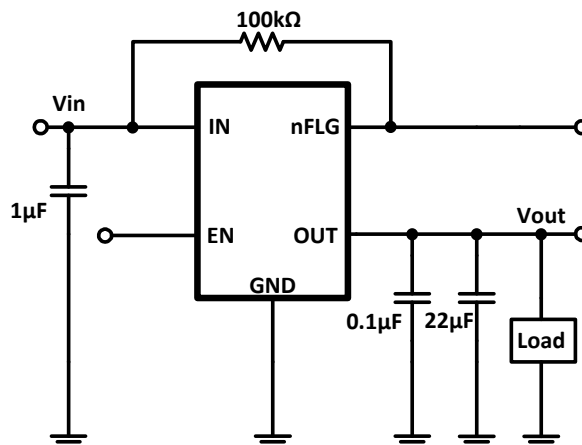
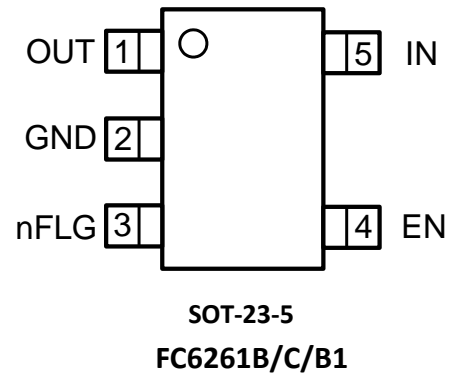
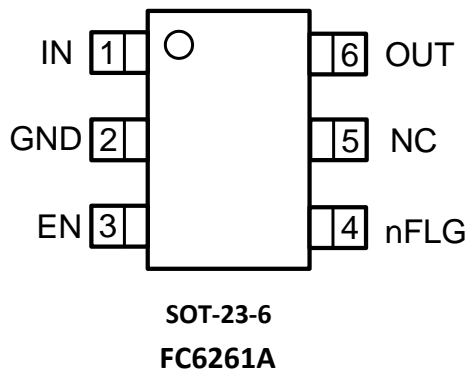


Figure 1. FC6261 Application Circuit

## ABSOLUTE MAXIMUM RATINGS (Note 1)

| Parameter                                   | Value                     | Unit |
|---|---------------------------|------|
| Input Supply Voltage                        | -0.3~7                    | V    |
| EN Voltages                                 | -0.3~V <sub>IN</sub> +0.3 | V    |
| VOUT Voltage                                | -0.3~V <sub>IN</sub> +0.3 | V    |
| Junction Temperature <small>(Note2)</small> | 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.<br>Make sure EN pin never floating.<br>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 | $\pm 2000$ | 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     |
|--------------------|--|--|------|-----|------|----------|
| <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>  |  |  |      |     |      |          |
| $V_{EN\_H}$        | 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   | $\mu A$  |
| $T_{ON}$           | 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       |
| <b>OUT section</b> |  |  |      |     |      |          |
| $I_{OC}$           | Over Current CC Regulation               | FC6261A<br>$V_{IN}=5V$ , $V_{OUT}=3.5V$              | 0.64 | 0.8 | 0.96 | A        |
|                    |  | FC6261B and FC6261B1<br>$V_{IN}=5V$ , $V_{OUT}=3.5V$ | 1.27 | 1.5 | 1.73 | A        |
|                    |  | FC6261C<br>$V_{IN}=5V$ , $V_{OUT}=3.5V$              | 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  |      | $\mu s$  |
| $R_{DIS}$          | OUT Discharge Resistance (FC6261B1 Only) | $V_{IN}=5V$ , $V_{EN}=0V$ , $V_{OUT}=5V$             |      | 42  |      | $\Omega$ |

## 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       |
|--------------------------------|---------------------------------------|---|-----|-----|-----|------------|
| <b>FLG(Fault flag) section</b> |                                       |   |     |     |     |            |
| $V_{OL}$                       | Output low voltage                    | $I_{FLG}=1mA$   |     |     | 180 | mV         |
| $I_{FLG}$                      | Continuous FLG sink                   |   |     |     | 10  | mA         |
| $I_{FLG\_LEAK}$                |                                       | Off-state leakage                                     |     |     | 1   | $\mu A$    |
| $T_{FLG}$                      | 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         |
| <b>Power switch</b>            |                                       |   |     |     |     |            |
| $R_{DS\_ON}$                   |                                       | $I_{OUT}=0.5A(FC6261A)$<br>$I_{OUT}=1A(FC6261B/C/B1)$ |     | 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  $P_D$  according to the following formula:  $T_J = T_A + P_D \times \theta_{JA}$ .

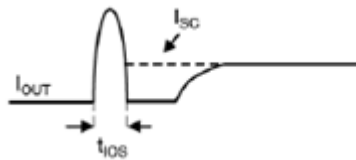


Figure 2. Short Circuits Response time

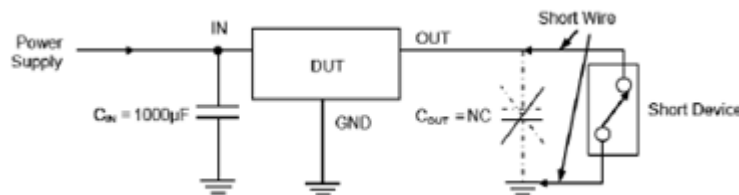


Figure 3. test circuits

**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 $\mu F$  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

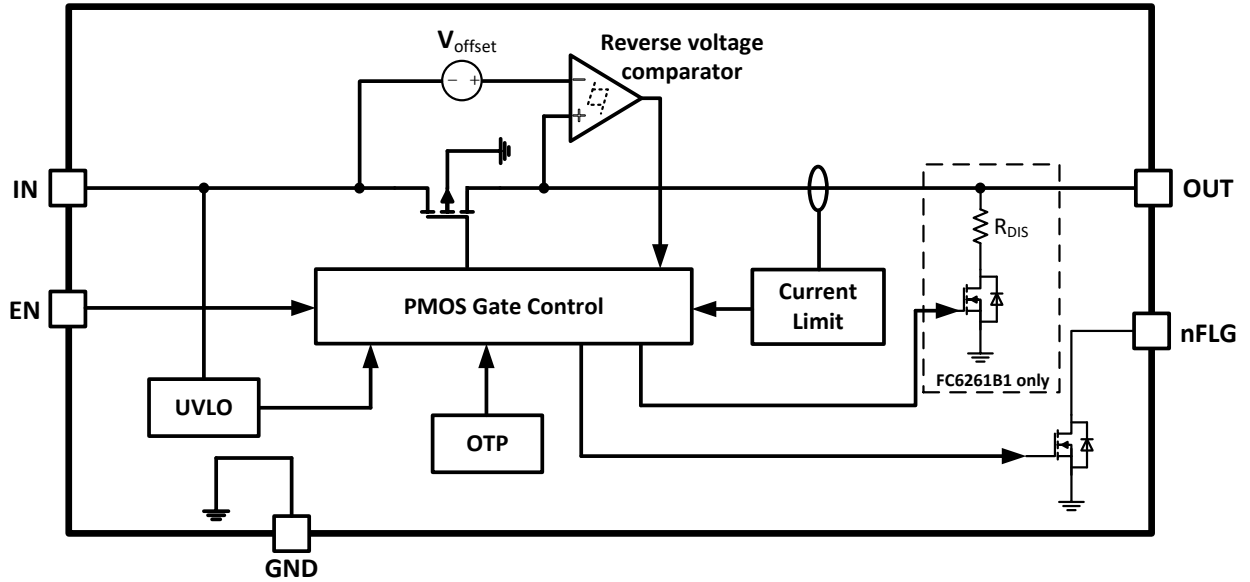
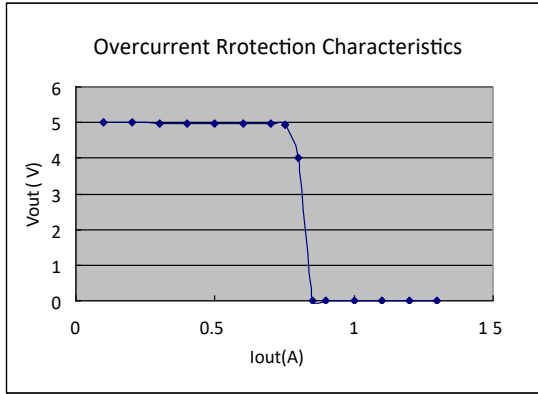


Figure 4. FC6261 Block Diagram

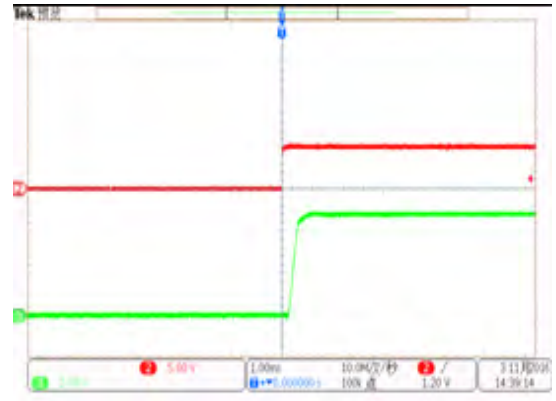
## TYPICAL PERFORMANCE CHARACTERISTICS

### FC6261A characteristic

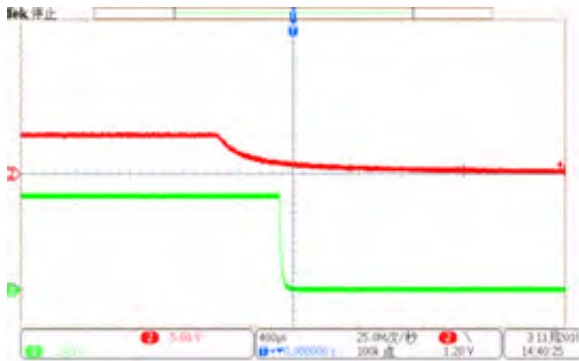
#### Over current Protection Characteristics



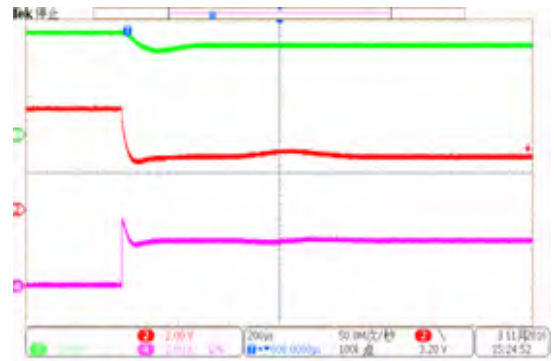
#### Turn on Delay Time and Rise Time



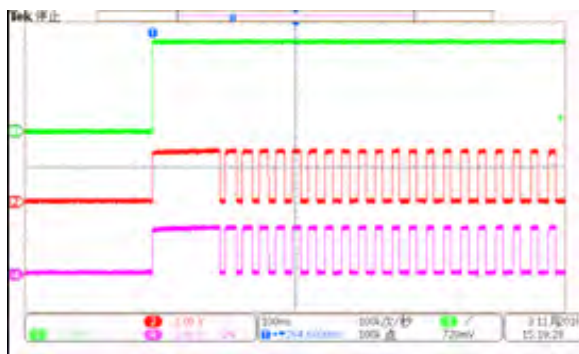
#### Turn off Delay Time and Fall Time



#### Resistance Load Inrush Response



#### Over current Response





## 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<sub>OUT</sub>.

### Layout Consideration

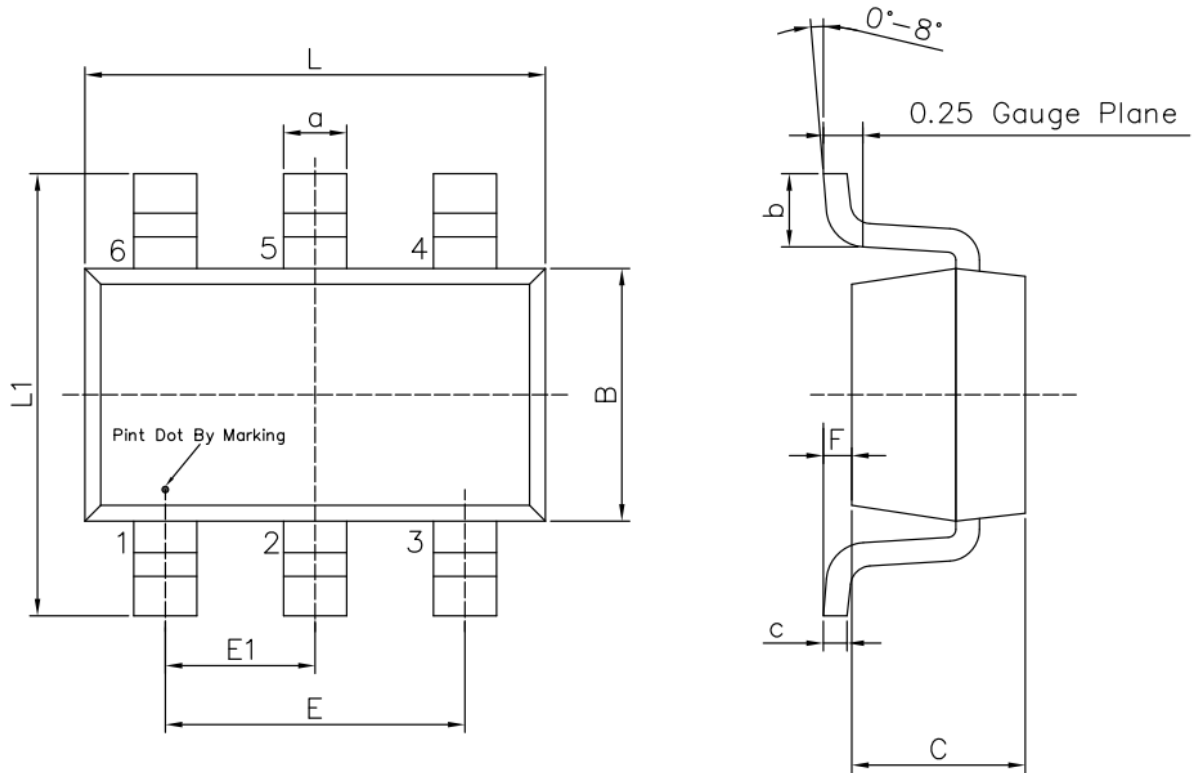
For best performance of the FC6261 Series, the following guidelines must be strictly followed.

- 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

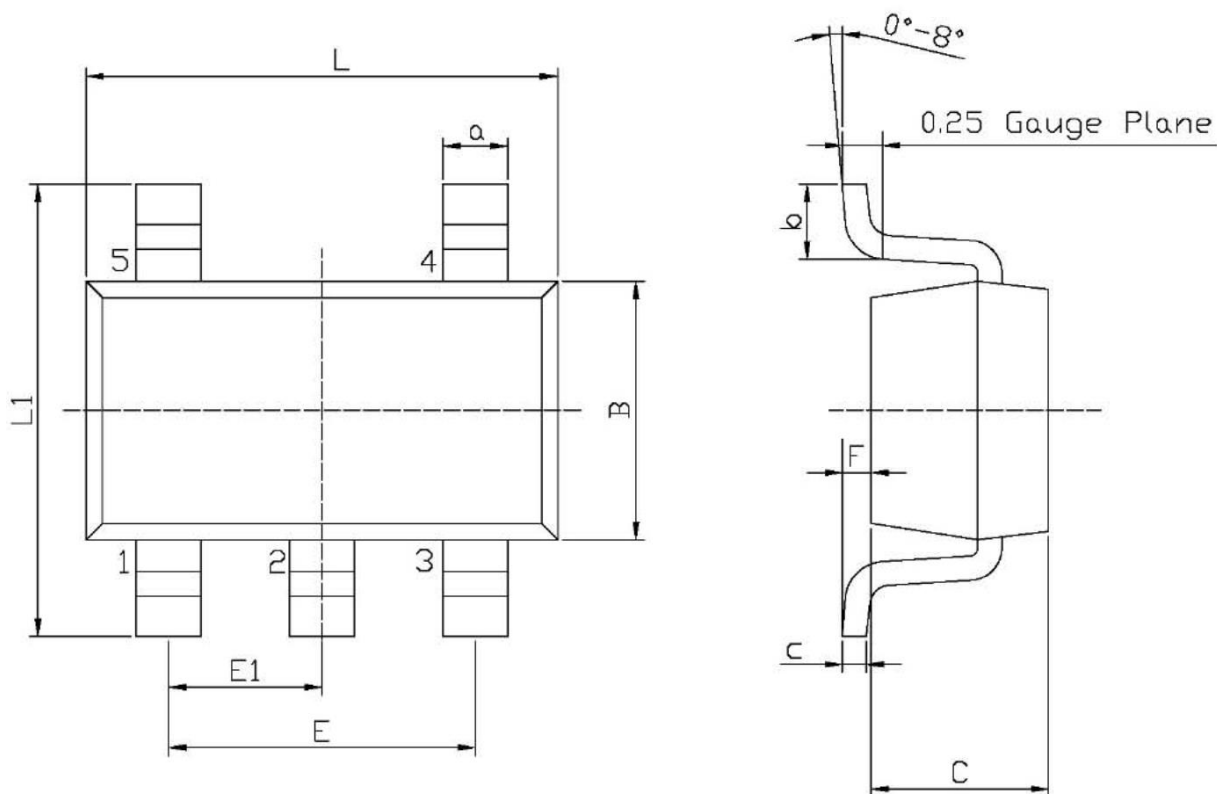
| Symbol | Dimensions In Millimeters |      | Symbol | Dimensions In Millimeters |      |
|--------|---------------------------|------|--------|---------------------------|------|
|        | Min                       | Max  |        | Min                       | Max  |
| L      | 2.82                      | 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

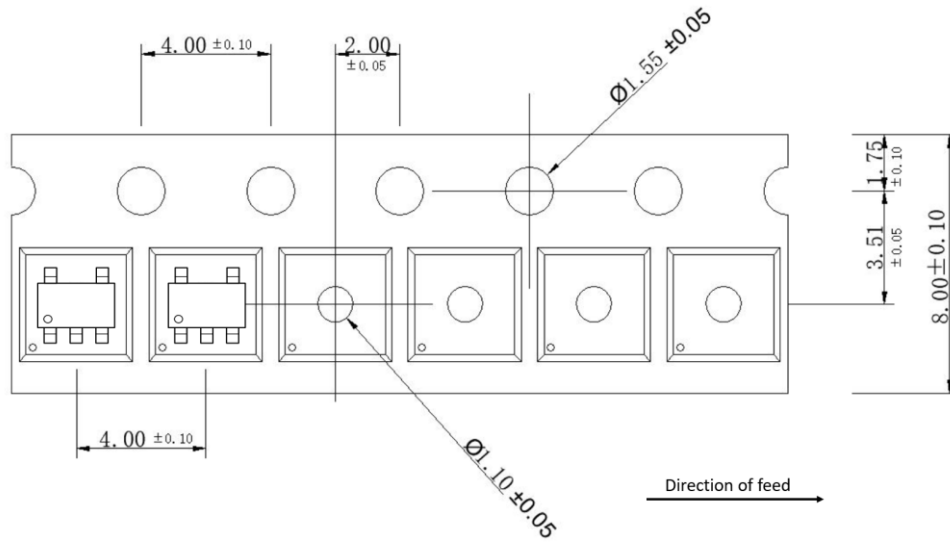
| Symbol | Dimensions In Millimeters |      | Symbol | Dimensions In Millimeters |      |
|--------|---------------------------|------|--------|---------------------------|------|
|        | Min                       | Max  |        | Min                       | Max  |
| L      | 2.82                      | 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:**

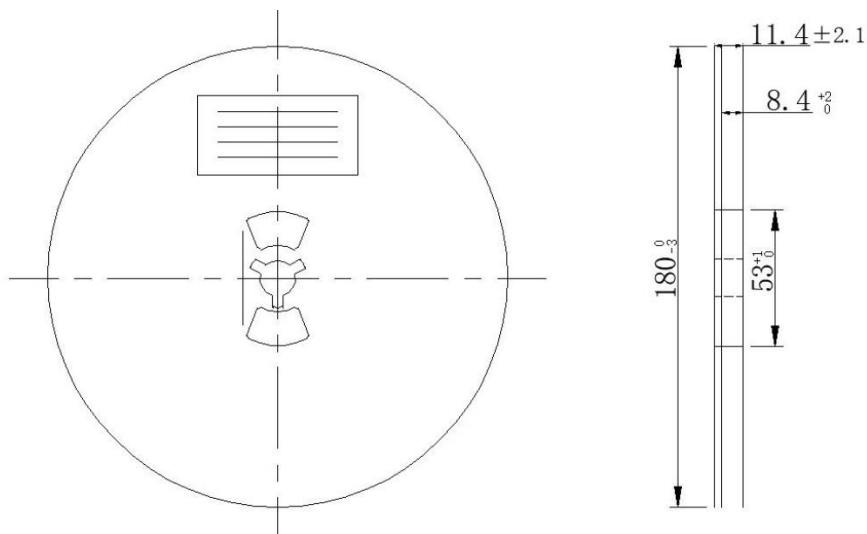
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- 5) Pin 1 is lower left pin when reading top mark from left to right.

## 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.