



# SGM2033

## 250mA, Ultra Low Noise and High PSRR LDO Regulators for RF and Analog Circuits

### GENERAL DESCRIPTION

The SGM2033 series are ultra low noise linear regulators capable of supplying 250mA output current. Designed to meet the requirements of RF and analog circuits, the SGM2033 device provides ultra low noise, high PSRR, low quiescent current and very good load/line transients. The device is designed to work with a 1 $\mu$ F input and a 1 $\mu$ F output ceramic capacitors.

The SGM2033 is available in Green SOT-23-5 and UTDFN-1 $\times$ 1-4AL packages. It operates over an ambient temperature range of -40 $^{\circ}$ C to +125 $^{\circ}$ C.

### FEATURES

- Operating Input Voltage Range: 1.8V to 5.5V
- Available in Fixed Voltage Option: 1.2V to 5.0V
- Output Short to GND Protection
- Output Current Limit: 530mA (TYP)
- Over-Temperature Protection: +160 $^{\circ}$ C
- Fast Load Transient Response
- Ultra Low Quiescent Current: 14 $\mu$ A (TYP)
- Shutdown Current: 0.1 $\mu$ A (TYP)
- Stable with a 1 $\mu$ F Small Case Size Ceramic Capacitor
- -40 $^{\circ}$ C to +125 $^{\circ}$ C Operating Temperature Range
- Available in Green SOT-23-5 and UTDFN-1 $\times$ 1-4AL Packages

### APPLICATIONS

Battery-Powered Equipment  
Wireless LAN Devices  
Smart-phones and Tablets  
Cameras and Camcorders

### TYPICAL APPLICATION

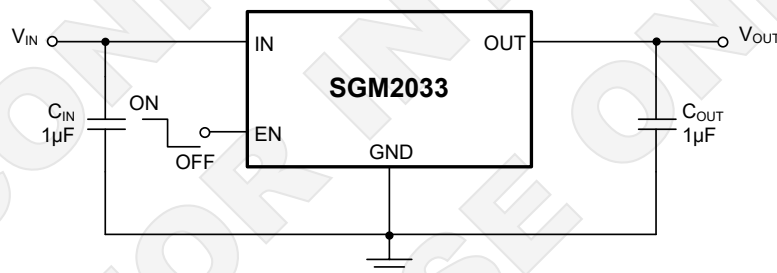


Figure 1. Typical Application Circuit

## 250mA, Ultra Low Noise and High PSRR LDO Regulators for RF and Analog Circuits

| MODEL        | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER       | PACKAGE MARKING | PACKING OPTION       |
|--------------|---------------------|-----------------------------|-----------------------|-----------------|----------------------|
| SGM2033-1.2  | SOT-23-5            | -40°C to +125°C             | SGM2033-1.2XN5G/TR    | GP1XX           | Tape and Reel, 3000  |
| SGM2033-1.8  | SOT-23-5            | -40°C to +125°C             | SGM2033-1.8XN5G/TR    | GTFXX           | Tape and Reel, 3000  |
| SGM2033-2.5  | SOT-23-5            | -40°C to +125°C             | SGM2033-2.5XN5G/TR    | GU0XX           | Tape and Reel, 3000  |
| SGM2033-2.8  | SOT-23-5            | -40°C to +125°C             | SGM2033-2.8XN5G/TR    | GU1XX           | Tape and Reel, 3000  |
| SGM2033-2.85 | SOT-23-5            | -40°C to +125°C             | SGM2033-2.85XN5G/TR   | GU2XX           | Tape and Reel, 3000  |
| SGM2033-2.9  | SOT-23-5            | -40°C to +125°C             | SGM2033-2.9XN5G/TR    | GU3XX           | Tape and Reel, 3000  |
| SGM2033-2.95 | SOT-23-5            | -40°C to +125°C             | SGM2033-2.95XN5G/TR   | GU4XX           | Tape and Reel, 3000  |
| SGM2033-3.0  | SOT-23-5            | -40°C to +125°C             | SGM2033-3.0XN5G/TR    | GU5XX           | Tape and Reel, 3000  |
| SGM2033-3.3  | SOT-23-5            | -40°C to +125°C             | SGM2033-3.3XN5G/TR    | GU6XX           | Tape and Reel, 3000  |
| SGM2033-4.2  | SOT-23-5            | -40°C to +125°C             | SGM2033-4.2XN5G/TR    | GP5XX           | Tape and Reel, 3000  |
| SGM2033-5.0  | SOT-23-5            | -40°C to +125°C             | SGM2033-5.0XN5G/TR    | GU7XX           | Tape and Reel, 3000  |
| SGM2033-1.2  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-1.2XUDH4G/TR  | 63X             | Tape and Reel, 10000 |
| SGM2033-1.8  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-1.8XUDH4G/TR  | U8X             | Tape and Reel, 10000 |
| SGM2033-2.5  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-2.5XUDH4G/TR  | U9X             | Tape and Reel, 10000 |
| SGM2033-2.8  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-2.8XUDH4G/TR  | UAX             | Tape and Reel, 10000 |
| SGM2033-2.85 | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-2.85XUDH4G/TR | UBX             | Tape and Reel, 10000 |
| SGM2033-2.9  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-2.9XUDH4G/TR  | UCX             | Tape and Reel, 10000 |
| SGM2033-2.95 | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-2.95XUDH4G/TR | UDX             | Tape and Reel, 10000 |
| SGM2033-3.0  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-3.0XUDH4G/TR  | UEX             | Tape and Reel, 10000 |
| SGM2033-3.3  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-3.3XUDH4G/TR  | UFX             | Tape and Reel, 10000 |
| SGM2033-4.2  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-4.2XUDH4G/TR  | 61X             | Tape and Reel, 10000 |
| SGM2033-5.0  | UTDFN-1×1-4AL       | -40°C to +125°C             | SGM2033-5.0XUDH4G/TR  | V0X             | Tape and Reel, 10000 |

NOTE: XX = Date Code. X = Date Code.

Date Code - Week  
Date Code - Year  
Serial Number

Date Code - Quarter  
Serial Number

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

**ABSOLUTE MAXIMUM RATINGS**

|                                         |                              |
|-----------------------------------------|------------------------------|
| IN to GND .....                         | -0.3V to 6V                  |
| OUT to GND .....                        | -0.3V to ( $V_{IN} + 0.3V$ ) |
| EN to GND.....                          | -0.3V to 6V                  |
| Package Thermal Resistance              |                              |
| SOT-23-5, $\theta_{JA}$ .....           | 207°C/W                      |
| UTDFN-1×1-4AL, $\theta_{JA}$ .....      | 238°C/W                      |
| Junction Temperature .....              | +150°C                       |
| Storage Temperature Range .....         | -65°C to +150°C              |
| Lead Temperature (Soldering, 10s) ..... | +260°C                       |

**RECOMMENDED OPERATING CONDITIONS**

|                                   |                 |
|-----------------------------------|-----------------|
| Input Voltage Range .....         | 1.8V to 5.5V    |
| Operating Temperature Range ..... | -40°C to +125°C |

**OVERSTRESS CAUTION**

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

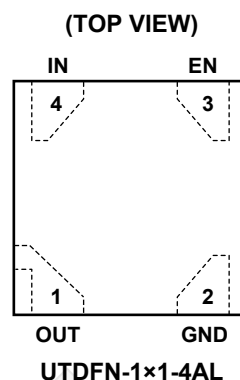
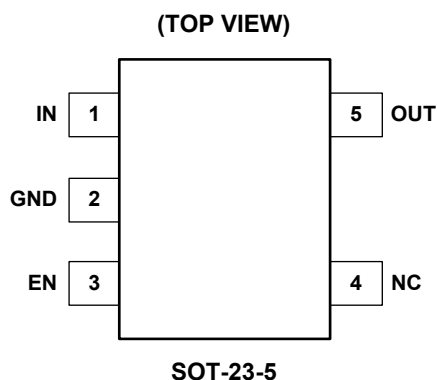
**ESD SENSITIVITY CAUTION**

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

## PIN CONFIGURATIONS



## PIN DESCRIPTION

| PIN      |               | NAME | FUNCTION                                                                                                     |
|----------|---------------|------|--------------------------------------------------------------------------------------------------------------|
| SOT-23-5 | UTDFN-1x1-4AL |      |                                                                                                              |
| 1        | 4             | IN   | Input Voltage Supply Pin.                                                                                    |
| 2        | 2             | GND  | Common Ground Connection.                                                                                    |
| 3        | 3             | EN   | Chip Enable. Applying $V_{EN} \leq 0.2V$ disables the regulator; pulling $V_{EN} \geq 1.7V$ enables the LDO. |
| 4        | —             | NC   | Not Connected.                                                                                               |
| 5        | 1             | OUT  | Regulated Output Voltage. The output should be bypassed with a $1\mu F$ ceramic capacitor.                   |

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = V_{OUT(NOM)} + 1V$ ,  $I_{OUT} = 1mA$ ,  $V_{EN} = V_{IN}$ ,  $C_{IN} = C_{OUT} = 1\mu F$ , Full =  $-40^{\circ}C$  to  $+125^{\circ}C$ , typical values are at  $T_A = +25^{\circ}C$ , unless otherwise noted.)

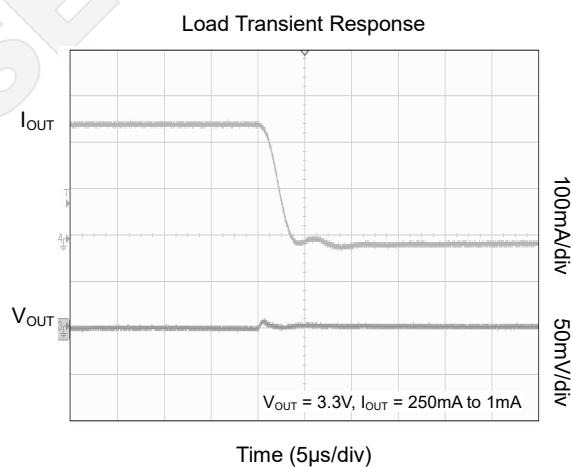
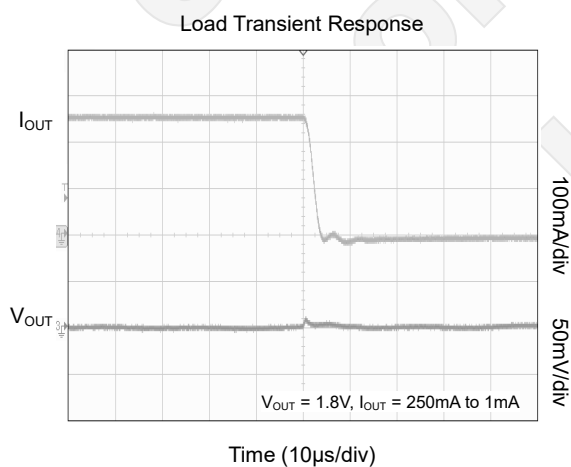
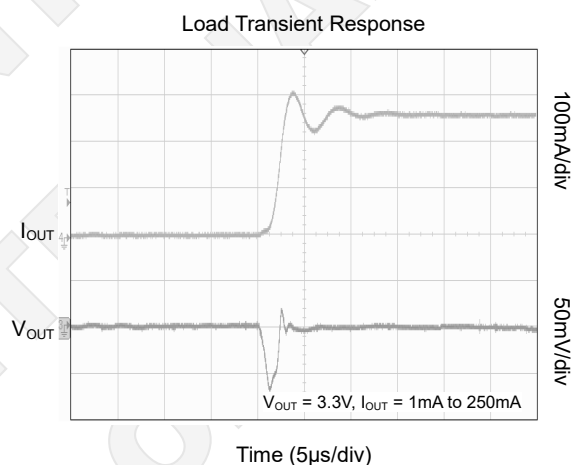
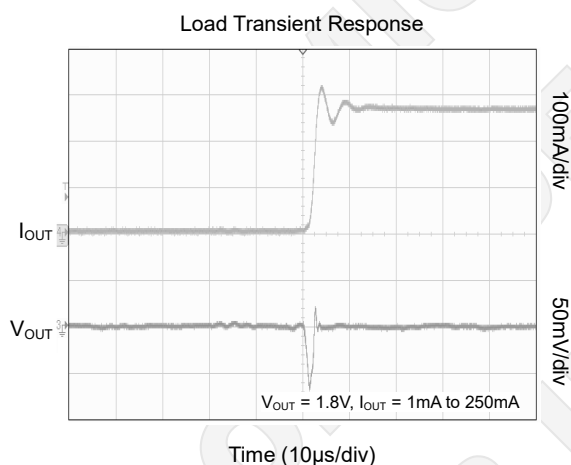
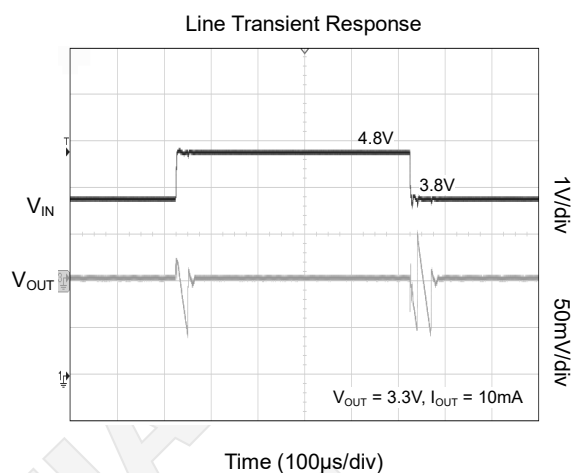
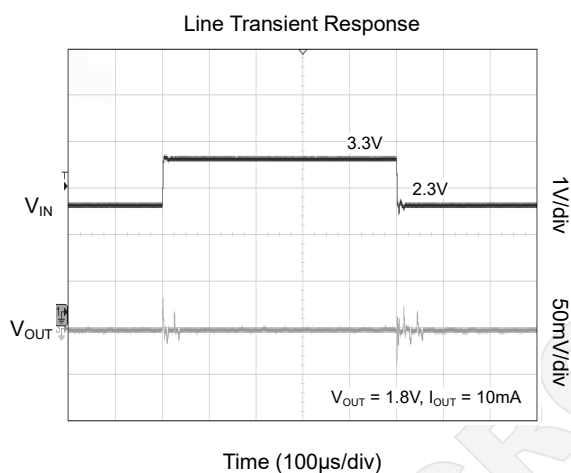
| PARAMETER                      | SYMBOL                                                | CONDITIONS                                                                                   | TEMP              | MIN            | TYP  | MAX | UNITS         |
|--------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------|-------------------|----------------|------|-----|---------------|
| Operating Input Voltage Range  | $V_{IN}$                                              |                                                                                              | $+25^{\circ}C$    | 1.8            |      | 5.5 | V             |
| Line Regulation                | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$ | $V_{OUT(NOM)} + 1V \leq V_{IN} \leq 5.5V$                                                    | $+25^{\circ}C$    |                | 0.02 |     | %/V           |
| Load Regulation                | $\Delta V_{OUT}$                                      | $I_{OUT} = 1mA$ to 250mA                                                                     | $+25^{\circ}C$    |                | 10   |     | mV            |
| Dropout Voltage <sup>(1)</sup> | $V_{DROP}$                                            | $I_{OUT} = 250mA$                                                                            | $V_{OUT} = 1.8V$  | $+25^{\circ}C$ | 185  |     | mV            |
|                                |                                                       |                                                                                              | $V_{OUT} = 2.8V$  | $+25^{\circ}C$ | 120  |     |               |
|                                |                                                       |                                                                                              | $V_{OUT} = 3.3V$  | $+25^{\circ}C$ | 110  |     |               |
| Output Current Limit           | $I_{LIM}$                                             | $V_{OUT} = 90\% V_{OUT(NOM)}$                                                                | $+25^{\circ}C$    |                | 530  |     | mA            |
| Short Circuit Current          | $I_{SC}$                                              | $V_{OUT} = 0V$                                                                               | $+25^{\circ}C$    |                | 220  |     | mA            |
| Quiescent Current              | $I_Q$                                                 | No load                                                                                      | $+25^{\circ}C$    |                | 14   |     | $\mu A$       |
| Shutdown Current               | $I_{SHDN}$                                            | $V_{EN} = 0V$ , $V_{IN} = 5.5V$                                                              | $+25^{\circ}C$    |                | 0.1  |     | $\mu A$       |
| EN Pin Threshold Voltage       | $V_{IH}$                                              | EN input voltage high                                                                        | $+25^{\circ}C$    | 1.7            |      |     | V             |
|                                | $V_{IL}$                                              | EN input voltage low                                                                         | $+25^{\circ}C$    |                |      | 0.2 |               |
| EN Pull-Down Current           | $I_{EN}$                                              | $V_{EN} = 5.5V$                                                                              | $+25^{\circ}C$    |                | 0.2  |     | $\mu A$       |
| Turn-On Time                   | $t_{ON}$                                              | From assertion of $V_{EN}$ to $V_{OUT} = 90\% V_{OUT(NOM)}$                                  | $+25^{\circ}C$    |                | 120  |     | $\mu s$       |
| Power Supply Rejection Ratio   | PSRR                                                  | $I_{OUT} = 20mA$                                                                             | $f = 100Hz$       | $+25^{\circ}C$ | 84   |     | dB            |
|                                |                                                       |                                                                                              | $f = 1kHz$        | $+25^{\circ}C$ | 94   |     |               |
|                                |                                                       |                                                                                              | $f = 10kHz$       | $+25^{\circ}C$ | 73   |     |               |
|                                |                                                       |                                                                                              | $f = 100kHz$      | $+25^{\circ}C$ | 33   |     |               |
| Output Voltage Noise           | $e_n$                                                 | $f = 10Hz$ to 100kHz                                                                         | $I_{OUT} = 1mA$   | $+25^{\circ}C$ | 26   |     | $\mu V_{RMS}$ |
|                                |                                                       |                                                                                              | $I_{OUT} = 250mA$ | $+25^{\circ}C$ | 20   |     |               |
| Output Discharge Resistance    | $R_{DISCH}$                                           | $V_{EN} \leq 0.2V$ , $V_{IN} = 5V$                                                           | $+25^{\circ}C$    |                | 220  |     | $\Omega$      |
| Line Transient                 |                                                       | $V_{IN} = (V_{OUT(NOM)} + 1V)$ to $(V_{OUT(NOM)} + 1.6V)$ in 30 $\mu s$ ,<br>$I_{OUT} = 1mA$ | $+25^{\circ}C$    |                | 5    |     | mV            |
|                                |                                                       | $V_{IN} = (V_{OUT(NOM)} + 1.6V)$ to $(V_{OUT(NOM)} + 1V)$ in 30 $\mu s$ ,<br>$I_{OUT} = 1mA$ | $+25^{\circ}C$    |                | 5    |     |               |
| Load Transient                 |                                                       | $I_{OUT} = 1mA$ to 200mA in 10 $\mu s$                                                       | $+25^{\circ}C$    |                | 40   |     | mV            |
|                                |                                                       | $I_{OUT} = 200mA$ to 1mA in 10 $\mu s$                                                       | $+25^{\circ}C$    |                | 40   |     |               |

## NOTE:

1. Dropout voltage is characterized when  $V_{OUT}$  falls 5% below  $V_{OUT(NOM)}$ .

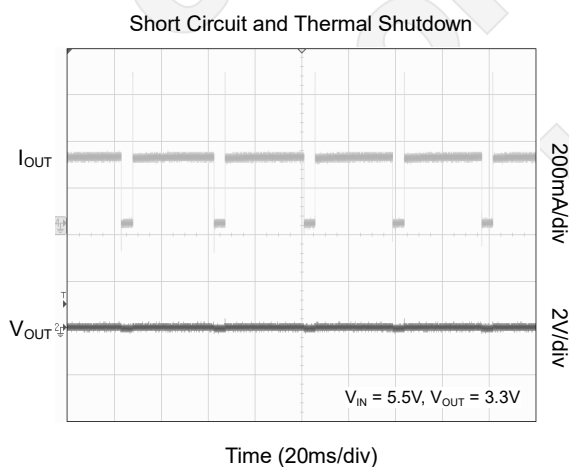
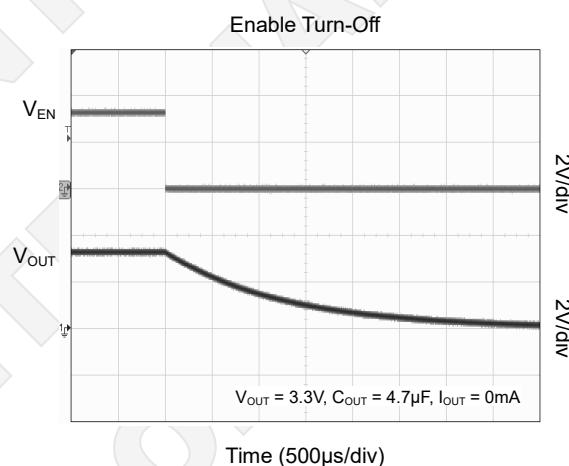
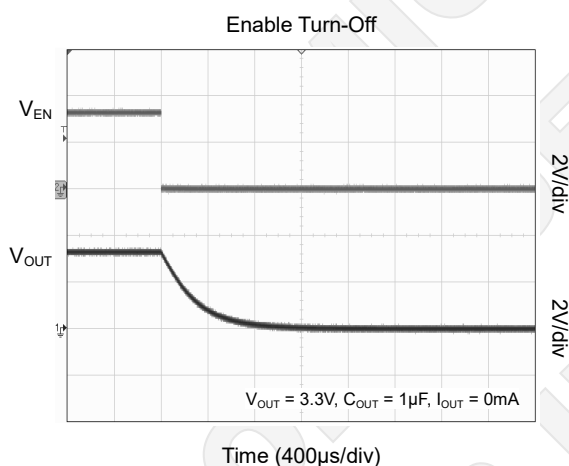
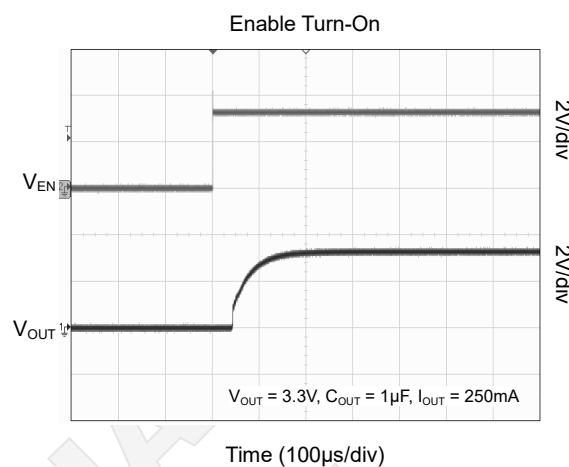
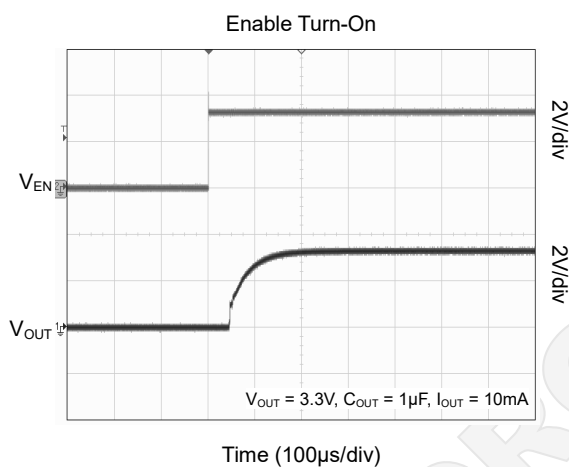
## TYPICAL PERFORMANCE CHARACTERISTICS

$T_A = +25^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 1\text{V}$ ,  $V_{EN} = V_{IN}$ ,  $C_{IN} = C_{OUT} = 1\mu\text{F}$ , unless otherwise noted.



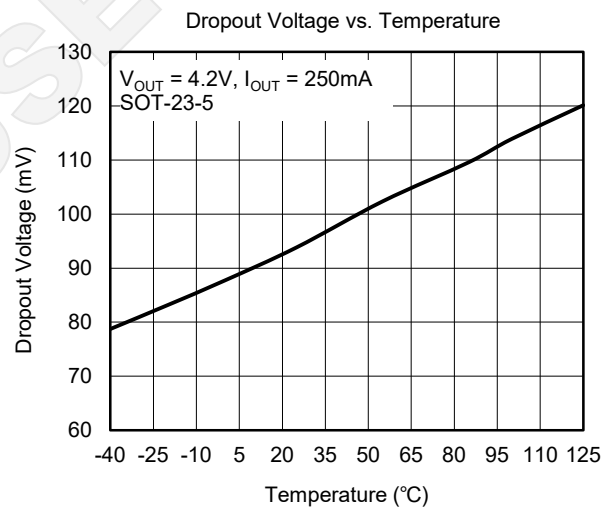
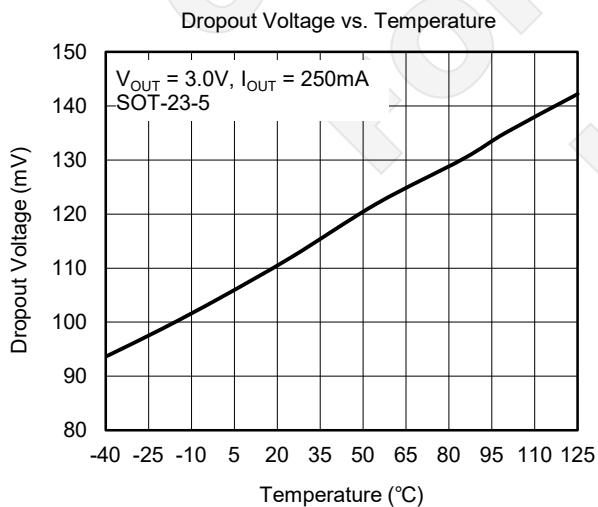
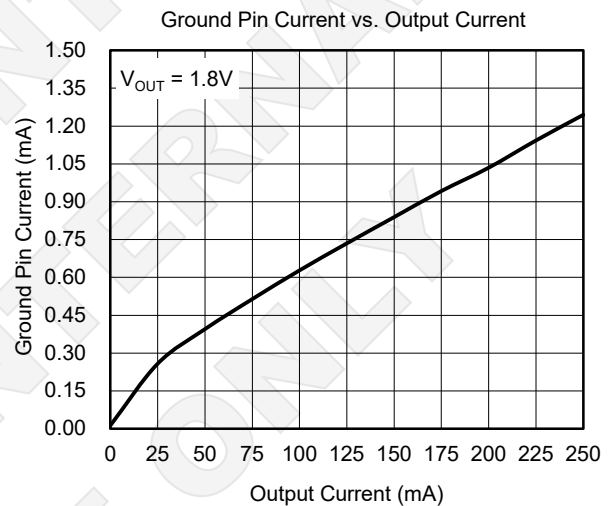
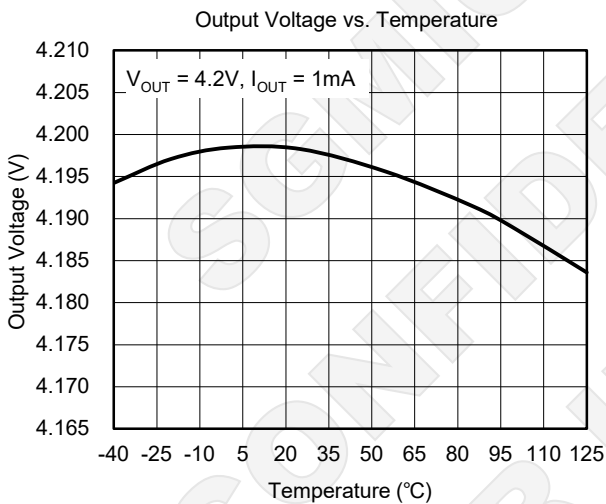
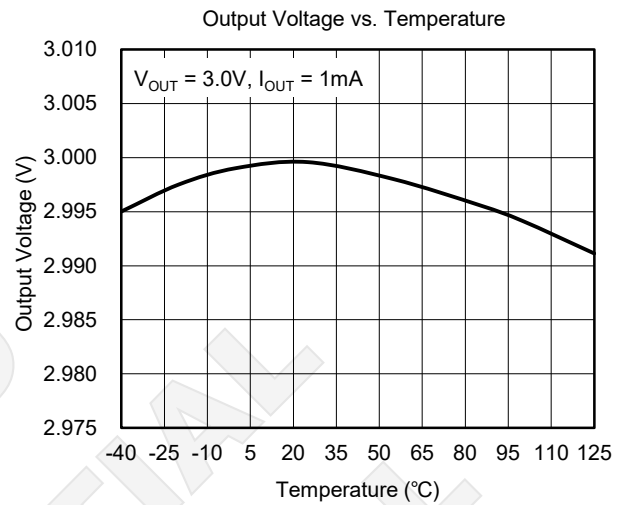
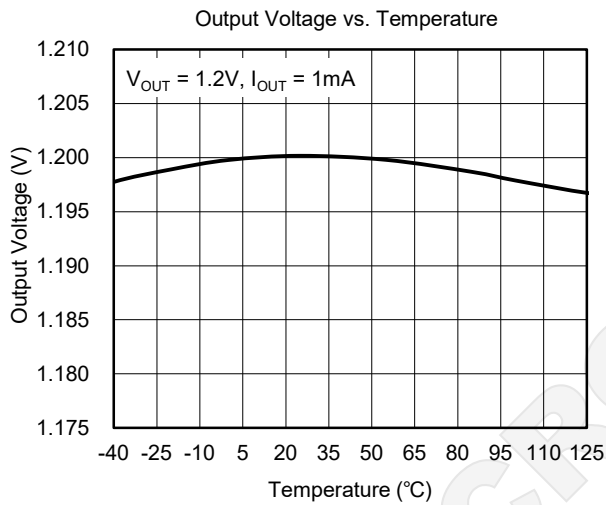
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_A = +25^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 1\text{V}$ ,  $V_{EN} = V_{IN}$ ,  $C_{IN} = C_{OUT} = 1\mu\text{F}$ , unless otherwise noted.



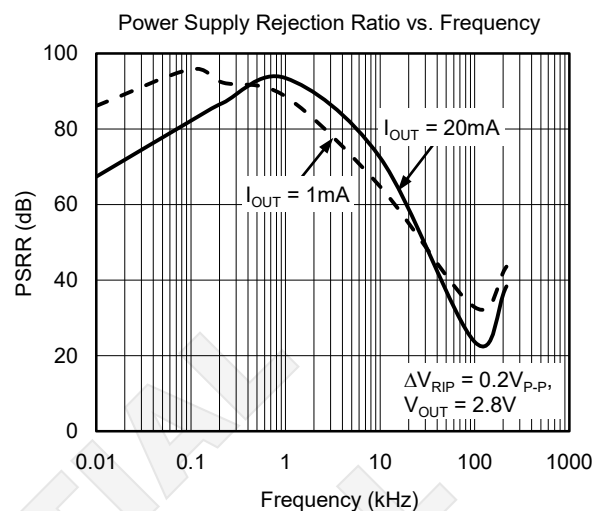
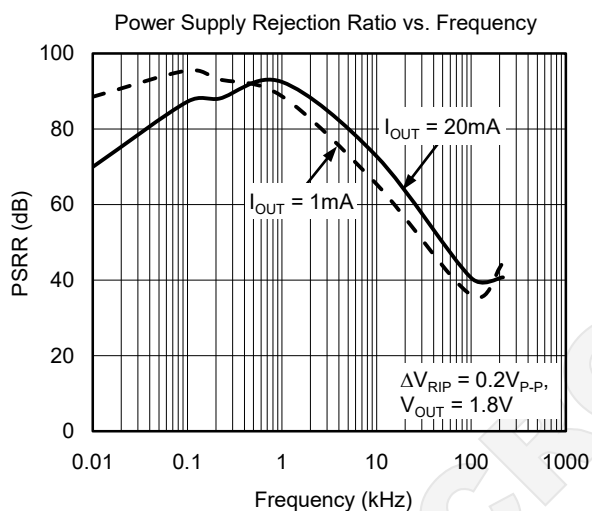
### TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_A = +25^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 1\text{V}$ ,  $V_{EN} = V_{IN}$ ,  $C_{IN} = C_{OUT} = 1\mu\text{F}$ , unless otherwise noted.



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_A = +25^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 1\text{V}$ ,  $V_{EN} = V_{IN}$ ,  $C_{IN} = C_{OUT} = 1\mu\text{F}$ , unless otherwise noted.



## FUNCTIONAL BLOCK DIAGRAM

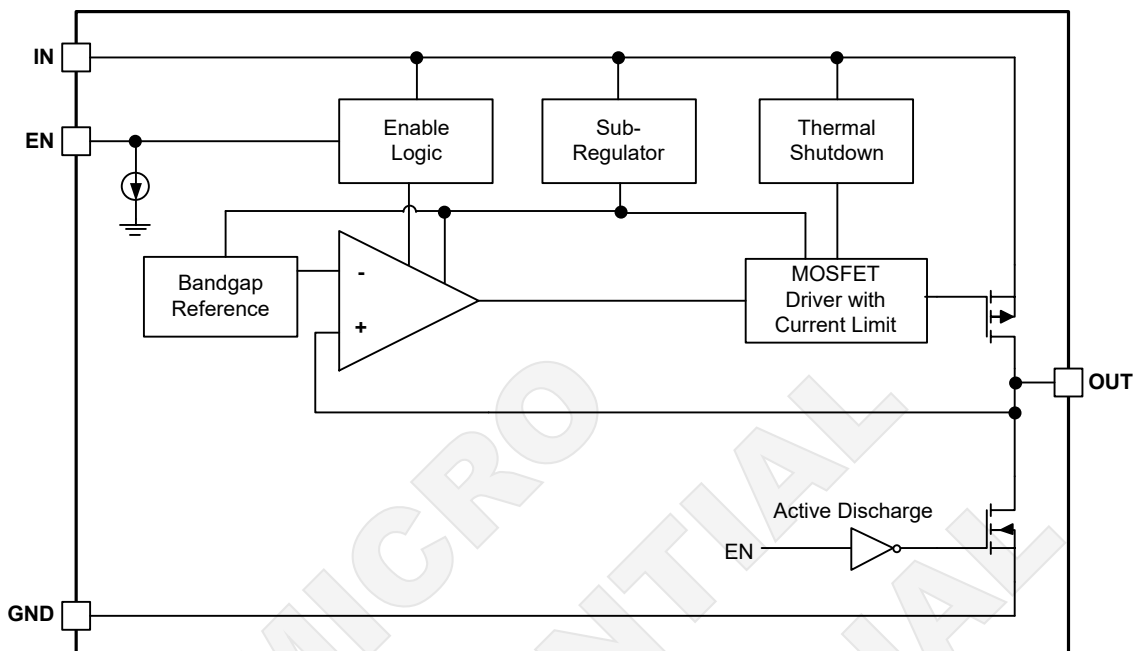


Figure 2. Block Diagram

## APPLICATION INFORMATION

The SGM2033 series are ultra low noise 250mA low dropout regulators designed to meet the requirements of RF applications and high performance analog circuits. The SGM2033 device provides very high PSRR and excellent dynamic response. In connection with low quiescent current this device is well suitable for battery powered application such as cell phones, tablets and others. The SGM2033 is fully protected in case of current overload, output short circuit and overheating.

### Input Capacitor Selection ( $C_{IN}$ )

Input capacitor connected as close as possible is necessary for ensuring device stability. The X7R or X5R capacitor should be used for reliable performance over temperature range. The value of the input capacitor should be  $1\mu\text{F}$  or greater to ensure the best dynamic performance. This capacitor will provide a low impedance path for unwanted AC signals or noise modulated onto constant input voltage. There is no requirement for the ESR of the input capacitor but it is recommended to use ceramic capacitors for their low ESR and ESL. A good input capacitor will limit the influence of input trace inductance and source resistance during sudden load current changes.

### Enable Operation

The SGM2033 uses the EN pin to enable/disable its device and to deactivate/activate the active discharge function.

If the EN pin voltage is  $\leq 0.2\text{V}$  the device is guaranteed to be disabled. The pass transistor is turned off so that there is virtually no current flow between the IN and OUT. The active discharge transistor is active so that the output voltage  $V_{OUT}$  is pulled to GND through a  $220\Omega$  resistor. In the disable state the device consumes as low as typical  $0.1\mu\text{A}$  from the  $V_{IN}$ .

If the EN pin voltage  $\geq 1.7\text{V}$  the device is guaranteed to be enabled. The SGM2033 regulates the output voltage and the active discharge transistor is turned off.

The EN pin has internal pull-down current source with typical value of  $200\text{nA}$  which ensures that the device is turned off when the EN pin is not connected. In the case where the EN function isn't required the EN should be tied directly to IN.

### Output Current Limit

Output current is internally limited within the IC to a typical  $530\text{mA}$ . The SGM2033 will source this amount of current measured with a voltage drop on the 90% of the nominal  $V_{OUT}$ . If the output voltage is directly shorted to ground ( $V_{OUT} = 0\text{V}$ ), the short circuit protection will limit the output current to  $220\text{mA}$  (typical). The current limit and short circuit protection will work properly over whole temperature range and also input voltage range. There is no limitation for the short circuit duration.

### Power Dissipation

As power dissipated in the SGM2033 increases, it might become necessary to provide some thermal relief. The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material, and the ambient temperature affect the rate of junction temperature rise for the part.

### Reverse Current

The PMOS pass transistor has an inherent body diode which will be forward biased in the case that  $V_{OUT} > V_{IN}$ . Due to this fact, in cases where the extended reverse current condition can be anticipated the device may require additional external protection.

### Power Supply Rejection Ratio

The SGM2033 features very high power supply rejection ratio. If desired the PSRR at higher frequencies in the range from  $100\text{kHz}$  to  $10\text{MHz}$  can be tuned by the selection of  $C_{OUT}$  capacitor and proper PCB layout.

### Turn-On Time

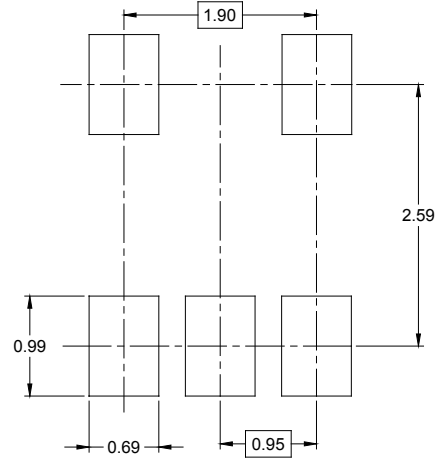
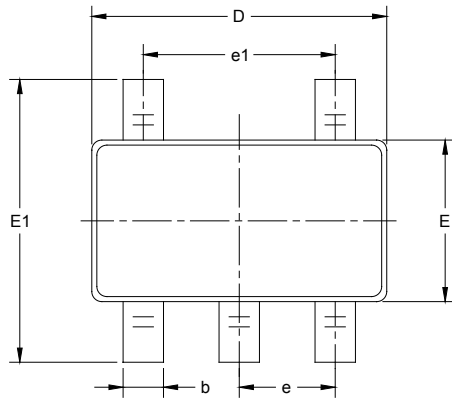
The turn-on time is defined as the time period from EN assertion to the point in which  $V_{OUT}$  will reach 90% of its nominal value.

### PCB Layout Recommendations

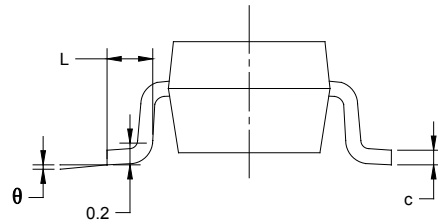
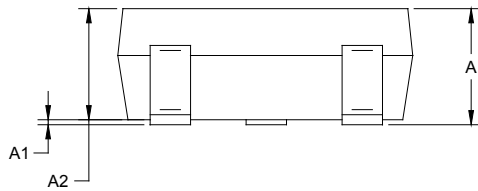
To obtain good transient performance and good regulation characteristics, place input and output capacitors close to the device pins and make the PCB traces wide. In order to minimize the solution size, use 0402 or 0201 capacitors with appropriate capacity. Larger copper area connected to the pins will also improve the device thermal resistance. Exposed pad can be tied to the GND pin for improved power dissipation and lower device temperature.

## PACKAGE OUTLINE DIMENSIONS

### SOT-23-5



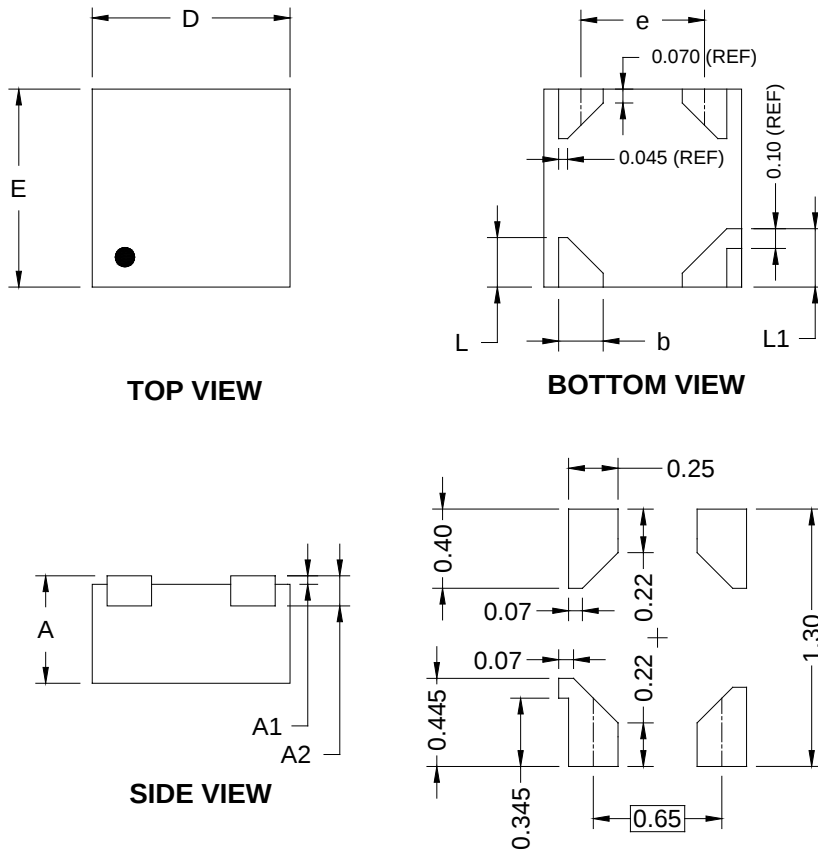
RECOMMENDED LAND PATTERN (Unit: mm)



| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | MIN                          | MAX   | MIN                     | MAX   |
| A      | 1.050                        | 1.250 | 0.041                   | 0.049 |
| A1     | 0.000                        | 0.100 | 0.000                   | 0.004 |
| A2     | 1.050                        | 1.150 | 0.041                   | 0.045 |
| b      | 0.300                        | 0.500 | 0.012                   | 0.020 |
| c      | 0.100                        | 0.200 | 0.004                   | 0.008 |
| D      | 2.820                        | 3.020 | 0.111                   | 0.119 |
| E      | 1.500                        | 1.700 | 0.059                   | 0.067 |
| E1     | 2.650                        | 2.950 | 0.104                   | 0.116 |
| e      | 0.950 BSC                    |       | 0.037 BSC               |       |
| e1     | 1.900 BSC                    |       | 0.075 BSC               |       |
| L      | 0.300                        | 0.600 | 0.012                   | 0.024 |
| θ      | 0°                           | 8°    | 0°                      | 8°    |

## PACKAGE OUTLINE DIMENSIONS

### UTDFN-1×1-4AL



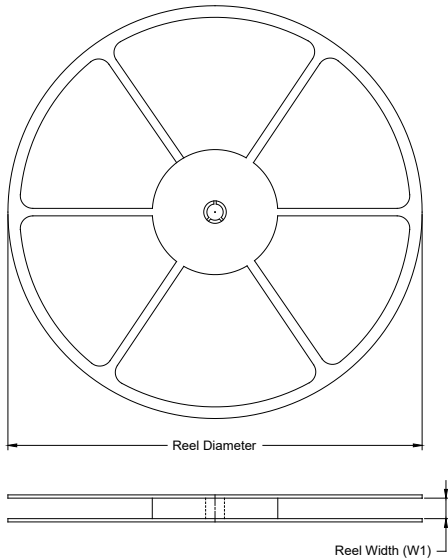
RECOMMENDED LAND PATTERN (Unit: mm)

| Symbol | Dimensions In Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | MIN                       | MOD   | MAX   |
| A      | 0.500                     | 0.550 | 0.600 |
| A1     | 0.000                     |       | 0.050 |
| A2     | 0.152 REF                 |       |       |
| e      | 0.625 BSC                 |       |       |
| D      | 0.950                     | 1.000 | 1.050 |
| E      | 0.950                     | 1.000 | 1.050 |
| b      | 0.175                     | 0.225 | 0.275 |
| L      | 0.200                     | 0.250 | 0.300 |
| L1     | 0.245                     | 0.295 | 0.345 |

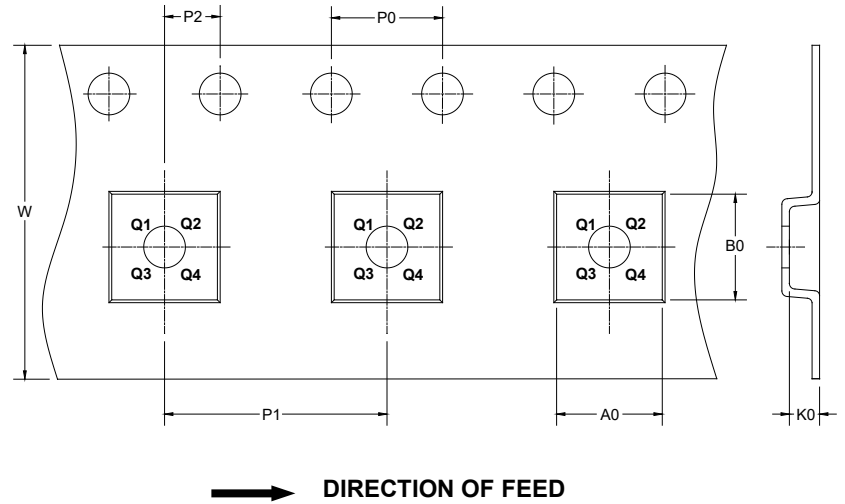
# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

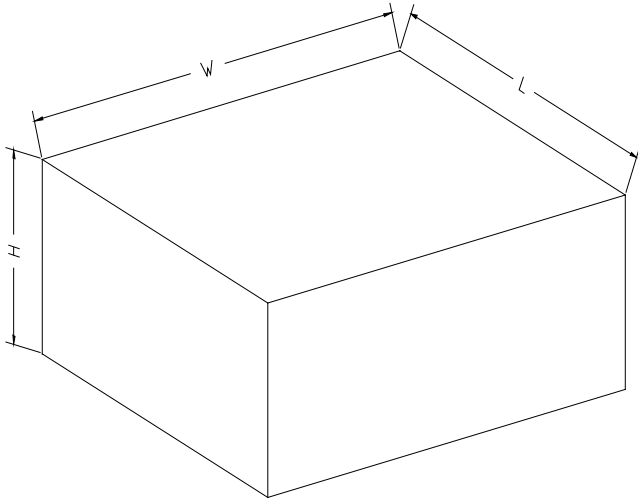
### KEY PARAMETER LIST OF TAPE AND REEL

| Package Type  | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|---------------|---------------|--------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| SOT-23-5      | 7"            | 9.5                | 3.20    | 3.20    | 1.40    | 4.0     | 4.0     | 2.0     | 8.0    | Q3            |
| UTDFN-1×1-4AL | 7"            | 9.0                | 1.16    | 1.16    | 0.63    | 4.0     | 2.0     | 2.0     | 8.0    | Q1            |

DD0001

## PACKAGE INFORMATION

### CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF CARTON BOX

| Reel Type   | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|-------------|-------------|------------|-------------|--------------|
| 7" (Option) | 368         | 227        | 224         | 8            |
| 7"          | 442         | 410        | 224         | 18           |

DD0002