SGM2212
800mA, Low Noise, Low Quiescent Current, High PSRR, Low Dropout Linear Regulator

GENERAL DESCRIPTION

The SGM2212 is a low noise, low quiescent current, high PSRR and low dropout voltage regulator with a dropout of 420mV at 800mA of load current.

The SGM2212 is available in an adjustable version, which can set the output voltage from 1.25V to 15V with only two external resistors. In addition, it is available in five fixed voltages, 1.8V, 2.5V, 2.8V, 3.3V and 5V.

The SGM2212 offers current limiting and thermal shutdown. A minimum of 1μF ceramic capacitor is required at the output to improve the transient response and stability.

The SGM2212 is available in Green SOT-223-3 and TDFN-3×3-8L packages. It operates over an ambient temperature range of -40℃ to +125℃.

FEATURES

- **Input Voltage Range: 2.7V to 20V**
- **Available in 1.8V, 2.5V, 2.8V, 3.3V, 5V and Adjustable Versions**
- **Current Limiting and Thermal Protection**
- **Output Current: 800mA**
- **Line Regulation: 0.03% (TYP)**
- **Load Regulation: 0.1% (TYP)**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green SOT-223-3 and TDFN-3×3-8L Packages**

APPLICATIONS

Post Regulator for Switching DC-DC Converters
High Efficiency Linear Regulators
Portable Instrumentation

TYPICAL APPLICATION

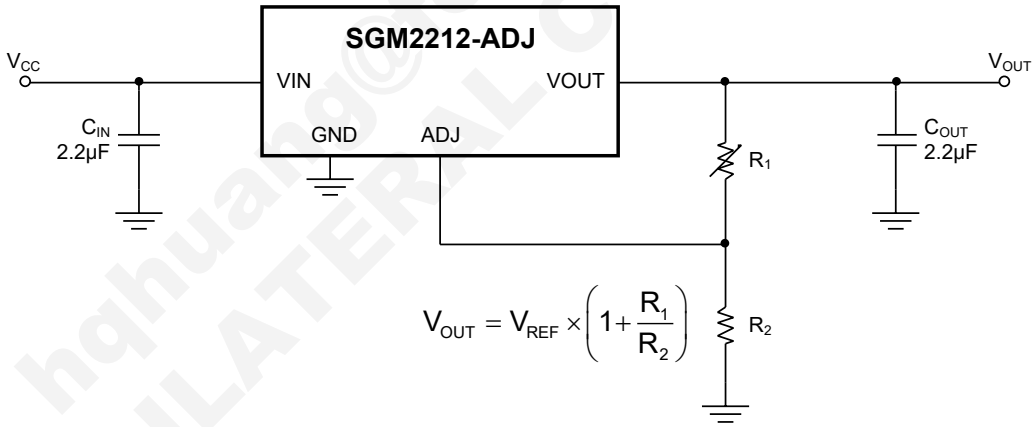


Figure 1. Typical Application Circuit

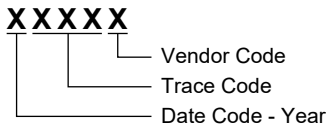
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2212-3.3	SOT-223-3	-40℃ to +125℃	SGM2212-3.3XKC3G/TR	MN4 XXXXX	Tape and Reel, 2500
SGM2212-5.0	SOT-223-3	-40℃ to +125℃	SGM2212-5.0XKC3G/TR	MN5 XXXXX	Tape and Reel, 2500
SGM2212-ADJ	TDFN-3×3-8L	-40℃ to +125℃	SGM2212-ADJXTDB8G/TR	SGM MN6DB XXXXX	Tape and Reel, 4000

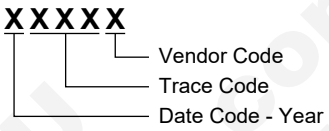
MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.

SOT-223-3



TDFN-3×3-8L



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

Maximum Input Voltage (VIN to GND) 22V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.7V to 20V
Operating Temperature Range ..... -40℃ to +125℃

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

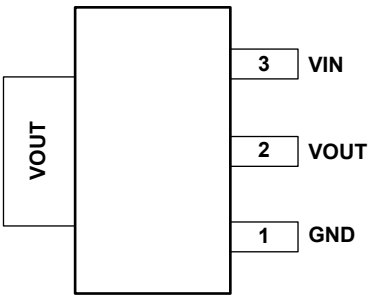
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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, or specifications without prior notice.

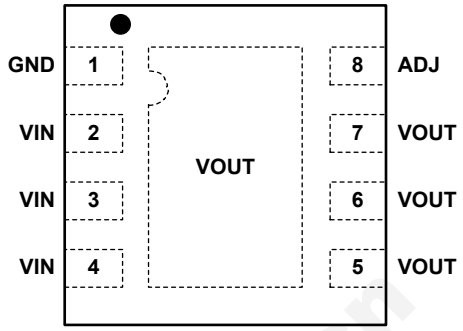
PIN CONFIGURATIONS

(TOP VIEW)



SOT-223-3

(TOP VIEW)



TDFN-3×3-8L

NOTE: When using the TDFN-3×3-8L package, Pins 2, 3 and 4 must be connected together and Pins 5, 6 and 7 must be connected together.

PIN DESCRIPTION

PIN		NAME	FUNCTION
SOT-223-3	TDFN-3×3-8L		
1	1	GND	Ground Pin for Fixed Output Option.
2	5, 6, 7	VOUT	Output Voltage Pin for the Regulator.
3	2, 3, 4	VIN	Input Voltage Pin for the Regulator.
–	8	ADJ	Adjust Pin for Adjustable Output Option.
–	Exposed Pad	VOUT	Connected to VOUT Pin.

ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, V_{IN} = $V_{OUT(NOM)}$ + 1V, C_{OUT} = 2.2μF, I_{OUT} = 100μA, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Voltage	V_{IN}		+25℃	2.7		20	V
Reference Voltage	V_{REF}	SGM2212-ADJ, I_{OUT} = 10mA	+25℃		1.185		V
Output Voltage	V_{OUT}	SGM2212-3.3, I_{OUT} = 10mA	+25℃		3.3		V
		SGM2212-5.0, I_{OUT} = 10mA	+25℃		5		V
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	SGM2212-ADJ, I_{OUT} = 10mA	+25℃		0.03		%/V
	ΔV_{OUT}	SGM2212-3.3, I_{OUT} = 0mA	+25℃		1		mV
		SGM2212-5.0, I_{OUT} = 0mA	+25℃		1		mV
Load Regulation	$\frac{\Delta V_{OUT}}{V_{OUT}}$	SGM2212-ADJ, I_{OUT} = 0 to 800mA	+25℃		0.1		%
	ΔV_{OUT}	SGM2212-3.3, I_{OUT} = 0 to 800mA	+25℃		3.5		mV
		SGM2212-5.0, I_{OUT} = 0 to 800mA	+25℃		3		mV
Dropout Voltage (1)	V_{DROP}	I_{OUT} = 100mA	+25℃		50		mV
		I_{OUT} = 500mA	+25℃		260		mV
		I_{OUT} = 800mA	+25℃		420		mV
Output Current Limit	I_{LIM}	V_{OUT} = 90%$V_{OUT(NOM)}$	+25℃		900		mA
Ground Pin Current	I_{GND}	I_{OUT} = 0mA	+25℃		80		μA
	I_{GND}	I_{OUT} = 100mA	+25℃		270		μA
	I_{GND}	I_{OUT} = 800mA	+25℃		1400		μA
ADJ Pin Current			+25℃		10		nA
RMS Output Noise		(% of V_{OUT}), f = 10Hz to 100kHz, I_{OUT} = 50mA	+25℃		0.002		%

NOTE:

1. The dropout voltage is defined as V_{IN} - V_{OUT}, when V_{OUT} falls 5% below the nominal value of V_{OUT}.

FUNCTIONAL BLOCK DIAGRAM

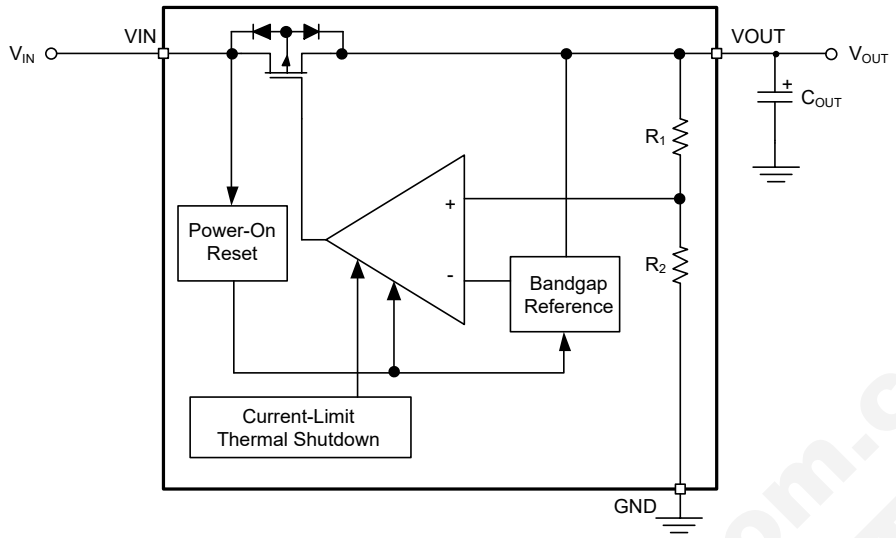


Figure 2. Fixed Output Regulator Block Diagram

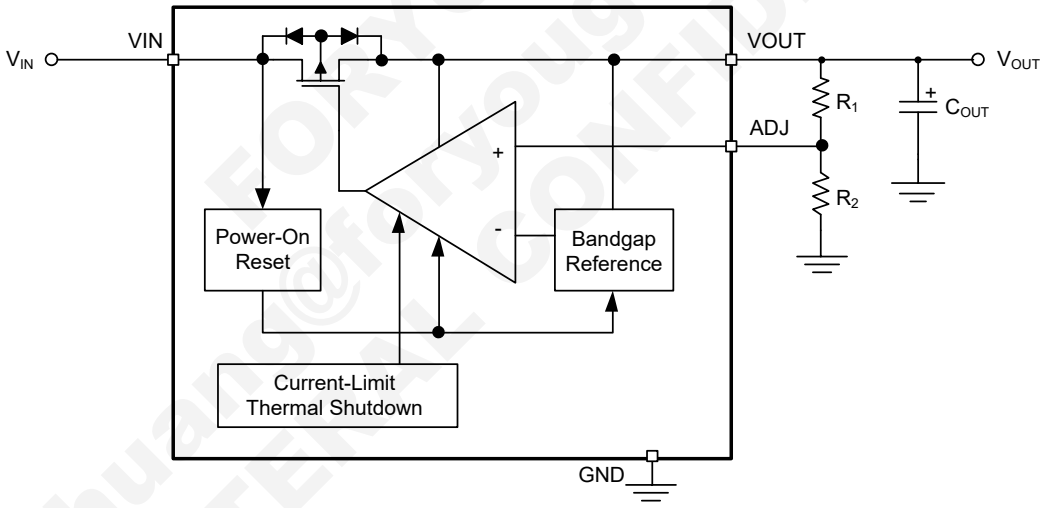


Figure 3. Adjustable Output Regulator Block Diagram

DETAILED DESCRIPTION

The SGM2212 adjustable version develops a 1.185V voltage reference, V_{REF}. As shown in Figure 4, this feedback voltage is generated by resistor R_1 and R_2. The feedback voltage is compared with internal voltage reference and adjusts the output voltage.

For fixed voltage SGM2212, R_1 and R_2 are integrated inside the device.

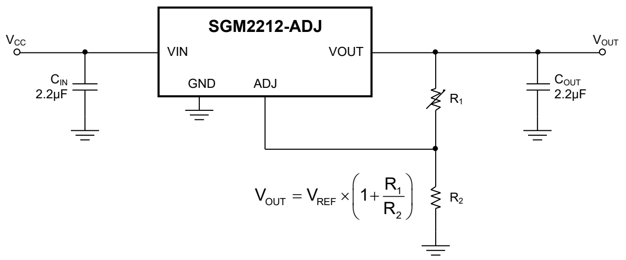
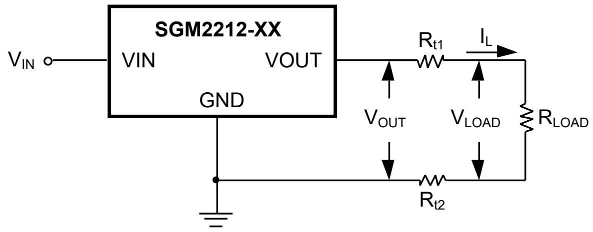


Figure 4. Adjustable Output Regulator

Load Regulation

The SGM2212 regulates the voltage that appears between its output and ground pins. In some cases, line resistances can introduce errors to the voltage across the load. To obtain the best load regulation, a few precautions are needed.

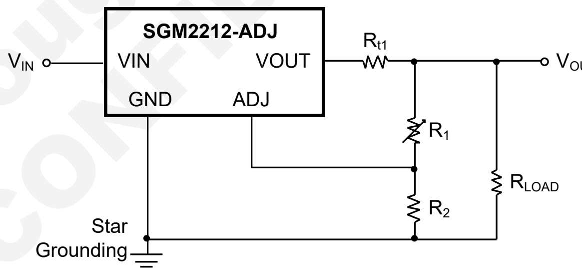
Figure 5 shows a typical application using a fixed output regulator. The R_{t1} and R_{t2} are the line resistances. It is obvious that the V_{LOAD} is less than the V_{OUT} by the sum of the voltage drops along the line resistances. In this case, the load regulation seen at the R_{LOAD} would be degraded from the datasheet specification. To improve this, the load should be tied directly to the output terminal on the positive side and directly tied to the ground terminal on the negative side.



$V_{LOAD} = V_{OUT} - I_L(R_{t1}+R_{t2})$

Figure 5. Typical Application Using Fixed Output Regulator

When the adjustable regulator is used (Figure 6), the best performance is obtained with the positive side of the resistor R_1 tied directly to the load, then the line drops will be eliminated. For example, a 5V regulator with 0.05Ω resistance between the regulator and load will have a load regulation due to line resistance of 0.05Ω × I_L. In addition, the ground side of the resistor R_2 can be returned near the ground of SGM2212 to provide remote ground sensing and improve load regulation.



$V_{LOAD} = V_{REF}(R_1+R_2)/R_2 - I_LR_{t1}$

Figure 6. Best Load Regulation Using Adjustable Output Regulator

APPLICATION INFORMATION

The SGM2212 is a versatile and high performance linear regulator with a wide temperature range and tight line/load regulation operation. An output capacitor is required to further improve transient response and stability. The SGM2212 is versatile in its applications, including its uses as a post regulator for DC/DC converters, battery chargers and microprocessor supplies.

Design Requirements

The device component count is very minimal, employing two resistors as part of a voltage divider circuit and an output capacitor for load regulation. A 1μF or 10μF on the input is a suitable input capacitor for almost all applications.

Detailed Design Procedure

The output voltage is set based on the selection of the two resistors, R_1 and R_2, as shown in Figure 4. For details on capacitor selection, refer to External Capacitors section.

External Capacitors

Input Bypass Capacitor

An input capacitor is recommended. A 1μF ceramic capacitor on the input is a suitable input capacitor for almost all applications.

Output Capacitor

An output capacitor is required between VOUT and GND to prevent oscillation. The minimum size of the output capacitor is 1μF. Larger values improve the regulator's transient response.

POWER SUPPLY RECOMMENDATIONS

The input supply to the SGM2212 must be kept at a voltage level such that its maximum rating is not exceeded. The minimum dropout voltage must also be met with extra headroom when possible to keep the SGM2212 in regulation. An input capacitor is recommended. For more information regarding capacitor selection, refer to External Capacitors.

LAYOUT

Layout Guidelines

Some layout guidelines must be followed to ensure proper regulation of the output voltage with minimum noise. In cases when VIN shorts to ground, an external diode must be placed from VOUT to VIN to divert the surge current from the output capacitor and protect the IC. The diode must be placed close to the corresponding IC pins to increase their effectiveness.

When an integrated circuit operates with an appreciable current, its junction temperature is elevated. It is important to quantify its thermal limits in order to achieve acceptable performance and reliability. This limit is determined by summing the individual parts consisting of a series of temperature rises from the semiconductor junction to the operating environment. The heat generated at the device junction flows through the die to the die attach pad, through the lead frame to the surrounding case material, to the printed circuit board, and eventually to the ambient environment. Below is a list of variables that may affect the thermal resistance and in turn the need for a heatsink.

Table 1. Component and Application Variables

$R_{\theta JC}$ (COMPONENT VARIABLES)	$R_{\theta JA}$ (APPLICATION VARIABLES)
Leadframe Size and Material	Mounting Pad Size, Material, and Location
No. of Conduction Pins	Placement of Mounting Pad
Die Size	PCB Size and Material
Die Attach Material	Traces Length and Width
Molding Compound Size and Material	Adjacent Heat Sources
	Volume of Air
	Ambient Temperatue
	Shape of Mounting Pad

The SGM2212 regulators have internal thermal shutdown to protect the device from over-heating. Under all possible operating conditions, the junction temperature of the SGM2212 must be within the range of -40℃ to +125℃. A heatsink may be required depending on the maximum power dissipation and maximum ambient temperature of the application. To determine if a heatsink is needed, the power dissipated by the regulator, P_D, must be calculated:

$$I_{IN} = I_L + I_G \quad (1)$$

$$P_D = (V_{IN} - V_{OUT})I_L + V_{IN}I_G \quad (2)$$

Figure 7 shows the voltages and currents which are present in the circuit.

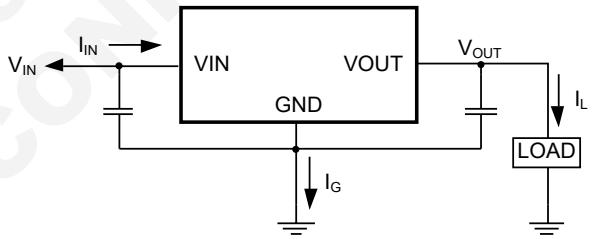


Figure 7. Power Dissipation Diagram

The next parameter which must be calculated is the maximum allowable temperature rise, $T_{R(max)}$:

$$T_{R(max)} = T_{J(max)} - T_{A(max)} \quad (3)$$

where

• $T_{J(max)}$ is the maximum allowable junction temperature (+125℃) which will be encountered in the application.

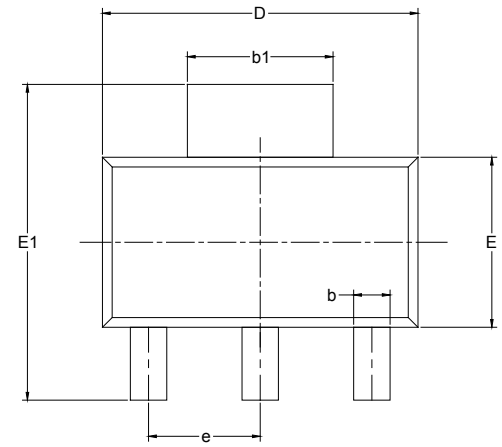
• $T_{A(max)}$ is the maximum ambient temperature which will be encountered in the application.

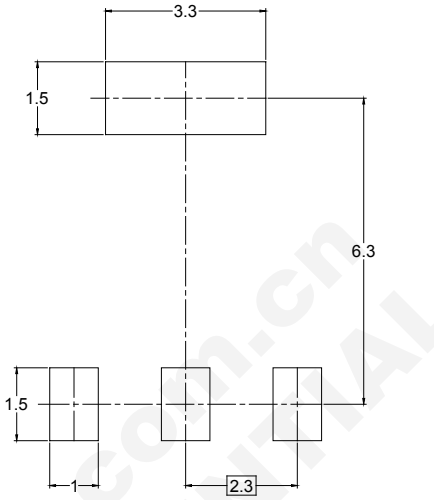
Using the calculated values for $T_{R(max)}$ and P_D, the maximum allowable value for the junction-to-ambient thermal resistance ($R_{\theta JA}$) can be calculated:

$$R_{\theta JA} = T_{R(max)}/P_D \quad (4)$$

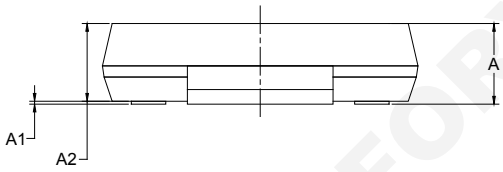
PACKAGE OUTLINE DIMENSIONS

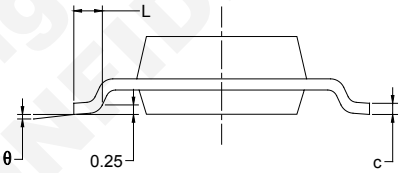
SOT-223-3





RECOMMENDED LAND PATTERN (Unit: mm)

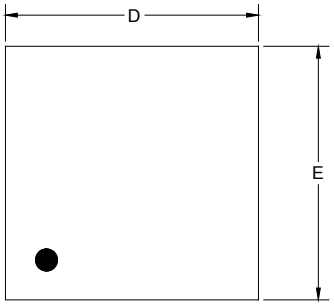




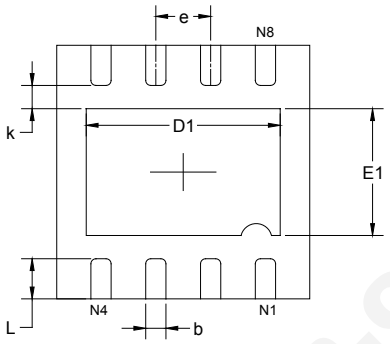
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.800		0.071
A1	0.020	0.100	0.001	0.004
A2	1.500	1.700	0.059	0.067
b	0.660	0.840	0.026	0.033
b1	2.900	3.100	0.114	0.122
c	0.230	0.350	0.009	0.014
D	6.300	6.700	0.248	0.264
E	3.300	3.700	0.130	0.146
E1	6.700	7.300	0.264	0.287
e	2.300 BSC		0.091 BSC	
L	0.750		0.030	
θ	0°	10°	0°	10°

PACKAGE OUTLINE DIMENSIONS

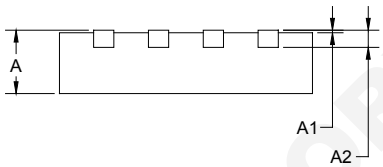
TDFN-3×3-8L



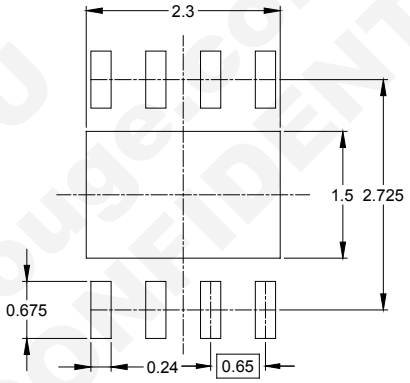
TOP VIEW



BOTTOM VIEW



SIDE VIEW

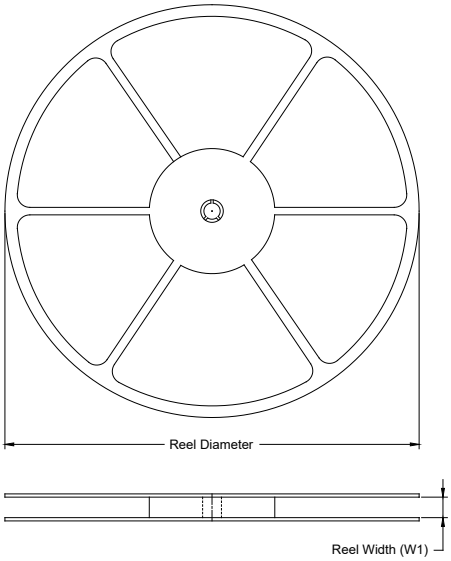


RECOMMENDED LAND PATTERN (Unit: mm)

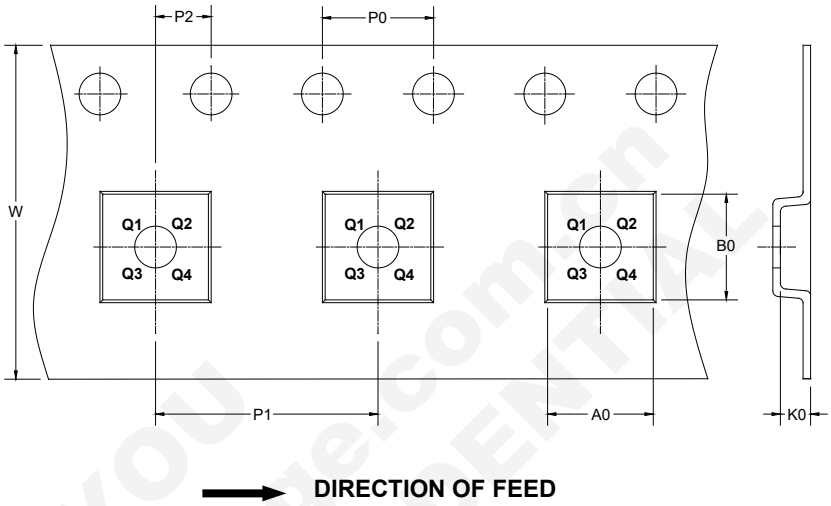
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	2.200	2.400	0.087	0.094
E	2.900	3.100	0.114	0.122
E1	1.400	1.600	0.055	0.063
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.650 TYP		0.026 TYP	
L	0.375	0.575	0.015	0.023

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



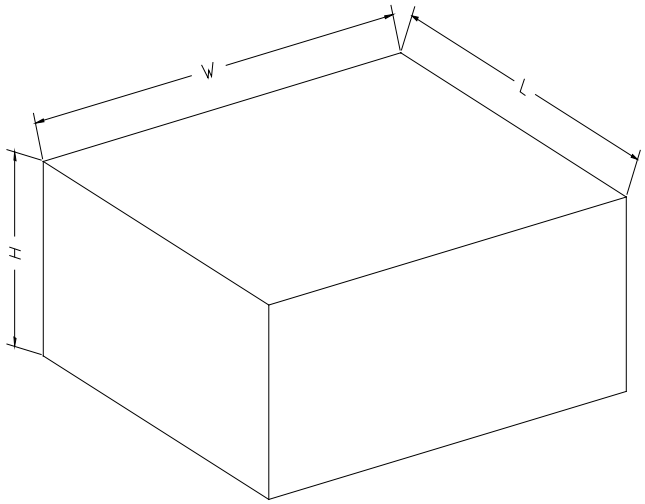
NOTE: The picture is only for reference. Please make the object as the standard.

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-223-3	13″	12.4	6.55	7.25	1.90	4.0	8.0	2.0	12.0	Q3
TDFN-3×3-8L	13″	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q1

DD0001

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
13″	386	280	370	5

DD0002