



SGM2228

20V, 500mA, Low Noise, Low Dropout Linear Regulator

GENERAL DESCRIPTION

The SGM2228 is a low noise, high accuracy, high PSRR and low dropout voltage linear regulator which is designed using CMOS technology. It provides 500mA output current capability. The operating input voltage range is from 2.7V to 20V. The adjustable output voltage range is from 1.2V to $(V_{IN} - V_{DROP})$.

Other features include under-voltage lockout, logic-controlled shutdown mode, current limit and thermal shutdown protection. The SGM2228 has automatic discharge function to quickly discharge V_{OUT} in the disabled status.

The SGM2228 is available in Green WLCSP-0.95×1.16-6B, TDFN-2×2-6AL and SOT-23-5 package. It operates over an operating temperature range of -40°C to +125°C.

APPLICATIONS

Instrumentation
Precision ADC and DAC
Precision Amplifiers in Industrial Equipment
Low Noise VCO
RF System
Medical Equipment

FEATURES

- Operating Input Voltage Range: 2.7V to 20V
- Enable Pin Accept Voltages Higher than the Supply Voltage and up to 20V
- Fixed Output from 1.2V to 5V
- Adjustable Output from 1.2V to $(V_{IN} - V_{DROP})$
- 500mA Output Current
- Output Voltage Accuracy: $\pm 1\%$ at +25°C
- Low Quiescent Current: 40 μ A (TYP)
- Shutdown Supply Current: 1.8 μ A (TYP)
- Low Dropout Voltage:
 - ◆ 185mV (TYP) at 500mA Load when $V_{OUT(NOM)} = 5V$ (WLCSP-0.95×1.16-6B)
 - ◆ 220mV (TYP) at 500mA Load when $V_{OUT(NOM)} = 5V$ (TDFN-2×2-6AL and SOT-23-5)
- Low Noise:
 - ◆ 7 μ V_{RMS} at $V_{OUT(NOM)} = 1.2V$
 - ◆ 10 μ V_{RMS} at $V_{OUT(NOM)} = 5V$
- High PSRR:
 - ◆ 105dB at 1kHz
 - ◆ 87dB at 10kHz
 - ◆ 61dB at 100kHz
 - ◆ 55dB at 1MHz
- Current Limiting and Thermal Protection
- Foldback Current-Limit Protection when V_{OUT} is Shorted to GND
- Programmable Precision Enable
- Programmable Soft-Start Output
- UVLO with Hysteresis
- With Output Automatic Discharge
- Stable with Small Case Size Ceramic Capacitors
- -40°C to +125°C Operating Temperature Range
- Available in Green WLCSP-0.95×1.16-6B, TDFN-2×2-6AL and SOT-23-5 Packages

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2228-1.2	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-1.2XG/TR	XXXX 1WZ	Tape and Reel, 3000
SGM2228-1.5	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-1.5XG/TR	XXXX 2DB	Tape and Reel, 3000
SGM2228-1.8	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-1.8XG/TR	XXXX 1X0	Tape and Reel, 3000
SGM2228-2.5	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-2.5XG/TR	XXXX 2DC	Tape and Reel, 3000
SGM2228-2.8	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-2.8XG/TR	XXXX 2DD	Tape and Reel, 3000
SGM2228-3.0	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-3.0XG/TR	XXXX 2DE	Tape and Reel, 3000
SGM2228-3.3	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-3.3XG/TR	XXXX 265	Tape and Reel, 3000
SGM2228-3.8	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-3.8XG/TR	XXXX 2DF	Tape and Reel, 3000
SGM2228-4.2	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-4.2XG/TR	XXXX 2DG	Tape and Reel, 3000
SGM2228-5.0	WLCSP-0.95×1.16-6B	-40°C to +125°C	SGM2228-5.0XG/TR	XXXX 1X1	Tape and Reel, 3000
SGM2228-1.2	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-1.2XTDI6G/TR	27K XXXX	Tape and Reel, 3000
SGM2228-1.8	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-1.8XTDI6G/TR	2DH XXXX	Tape and Reel, 3000
SGM2228-2.5	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-2.5XTDI6G/TR	2DI XXXX	Tape and Reel, 3000
SGM2228-2.8	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-2.8XTDI6G/TR	2DJ XXXX	Tape and Reel, 3000
SGM2228-3.0	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-3.0XTDI6G/TR	2DK XXXX	Tape and Reel, 3000
SGM2228-3.3	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-3.3XTDI6G/TR	2DL XXXX	Tape and Reel, 3000
SGM2228-5.0	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-5.0XTDI6G/TR	27L XXXX	Tape and Reel, 3000
SGM2228-ADJ	TDFN-2×2-6AL	-40°C to +125°C	SGM2228-ADJXTDI6G/TR	27M XXXX	Tape and Reel, 3000
SGM2228-1.2	SOT-23-5	-40°C to +125°C	SGM2228-1.2XN5G/TR	27H XXXXX	Tape and Reel, 3000
SGM2228-1.8	SOT-23-5	-40°C to +125°C	SGM2228-1.8XN5G/TR	27I XXXXX	Tape and Reel, 3000
SGM2228-2.5	SOT-23-5	-40°C to +125°C	SGM2228-2.5XN5G/TR	2DM XXXXX	Tape and Reel, 3000
SGM2228-2.8	SOT-23-5	-40°C to +125°C	SGM2228-2.8XN5G/TR	2DN XXXXX	Tape and Reel, 3000
SGM2228-3.0	SOT-23-5	-40°C to +125°C	SGM2228-3.0XN5G/TR	2DO XXXXX	Tape and Reel, 3000
SGM2228-3.3	SOT-23-5	-40°C to +125°C	SGM2228-3.3XN5G/TR	269 XXXXX	Tape and Reel, 3000
SGM2228-5.0	SOT-23-5	-40°C to +125°C	SGM2228-5.0XN5G/TR	27J XXXXX	Tape and Reel, 3000

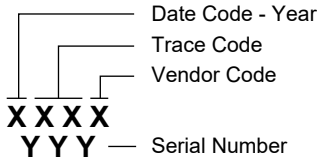
PACKAGE/ORDERING INFORMATION (continued)

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2228-ADJ	SOT-23-5	-40°C to +125°C	SGM2228-ADJXN5G/TR	26A XXXXX	Tape and Reel, 3000

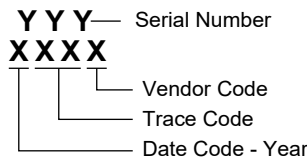
MARKING INFORMATION

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

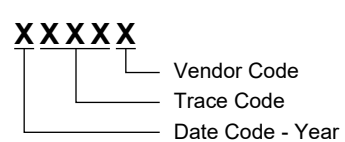
WLCSP-0.95x1.16-6B



TDFN-2x2-6AL



SOT-23-5



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 22V
OUT to GND	-0.3V to (V _{IN} + 0.3V)
EN to GND	-0.3V to 22V
SENSE/ADJ to GND	-0.3V to 22V
SS to GND	-0.3V to MIN(V _{IN} + 0.3V, 6V)
Package Thermal Resistance	
WLCSP-0.95x1.16-6B, θ _{JA}	178.9°C/W
WLCSP-0.95x1.16-6B, θ _{JB}	75.1°C/W
WLCSP-0.95x1.16-6B, θ _{JC}	55°C/W
TDFN-2x2-6AL, θ _{JA}	56.4°C/W
TDFN-2x2-6AL, θ _{JB}	23.2°C/W
TDFN-2x2-6AL, θ _{JC(TOP)}	77°C/W
TDFN-2x2-6AL, θ _{JC(BOT)}	3.9°C/W
SOT-23-5, θ _{JA}	148.5°C/W
SOT-23-5, θ _{JB}	26.7°C/W
SOT-23-5, θ _{JC}	68.9°C/W
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility ⁽¹⁾⁽²⁾	
HBM	±8000V
CDM	±1000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range	2.7V to 20V
Enable Input Voltage Range	0V to 20V
Input Effective Capacitance, C _{IN}	1.5µF (MIN)
Output Effective Capacitance, C _{OUT}	1.5µF to 220µF
Operating Ambient Temperature Range	-40°C to +125°C
Operating Junction Temperature Range	-40°C to +125°C

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

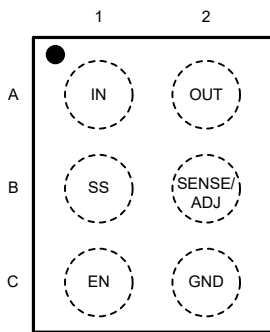
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

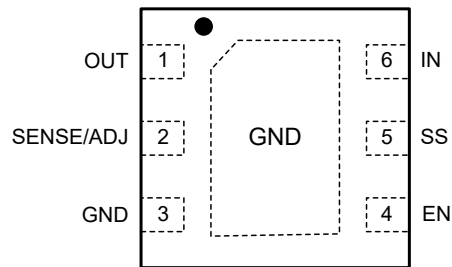
PIN CONFIGURATIONS

SGM2228 (TOP VIEW)



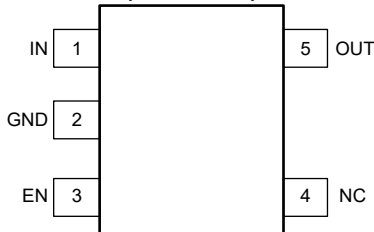
WLCSP-0.95x1.16-6B

SGM2228 (TOP VIEW)



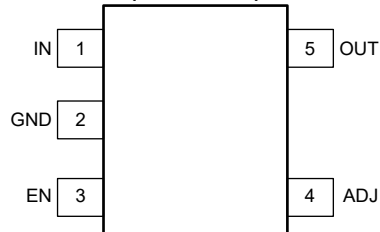
TDFN-2x2-6AL

SGM2228-FIX
(TOP VIEW)



SOT-23-5

SGM2228-ADJ
(TOP VIEW)



SOT-23-5

PIN DESCRIPTION

PIN			NAME	FUNCTION
WLCSP-0.95x1.16-6B	TDFN-2x2-6AL	SOT-23-5		
A2	1	5	OUT	Regulator Output Pin. It is recommended to use a ceramic capacitor with effective capacitance in the range of 1.5µF to 220µF to ensure stability. This ceramic capacitor should be placed as close as possible to OUT pin.
B2	2	–	SENSE/ADJ	Sense Input (SENSE). Connect to load. An external resistor divider may also set the output voltage higher than the fixed output voltage (ADJ).
C2	3	2	GND	Ground.
C1	4	3	EN	Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator.
B1	5	–	SS	Soft-Start Pin. The soft-start time is determined by an external capacitor connected to this pin.
A1	6	1	IN	Input Voltage Supply Pin. It is recommended to use a ceramic capacitor with a minimum effective capacitance of 1.5µF from IN pin to ground to get good power supply decoupling.
–	–	4	NC	No Connection (fixed voltage version only).
–	–	–	ADJ	Feedback Voltage Input Pin (adjustable voltage version only). Connect this pin to the midpoint of an external resistor divider to adjust the output voltage. Place the resistors as close as possible to this pin.
–	Exposed Pad	–	GND	Exposed Pad. Connect it to a large ground plane to maximize thermal performance. This pad is not an electrical connection point.

FUNCTIONAL BLOCK DIAGRAMS

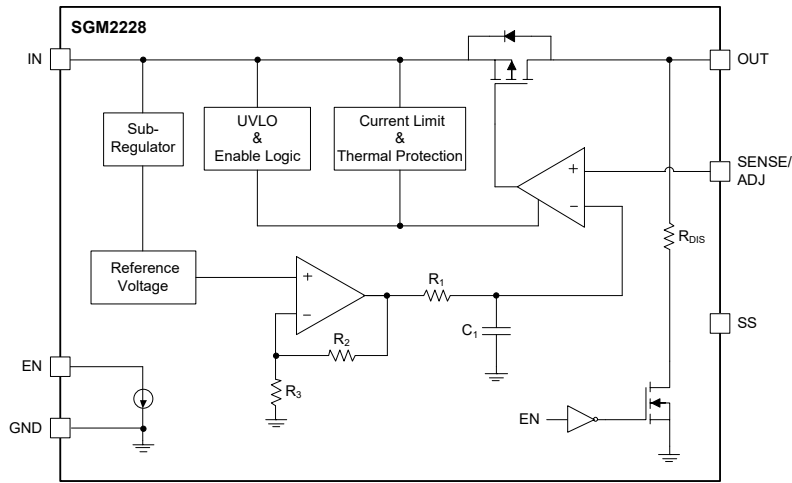


Figure 1. Internal Block Diagram (WLCSP-0.95x1.16-6B and TDFN-2x2-6AL Versions)

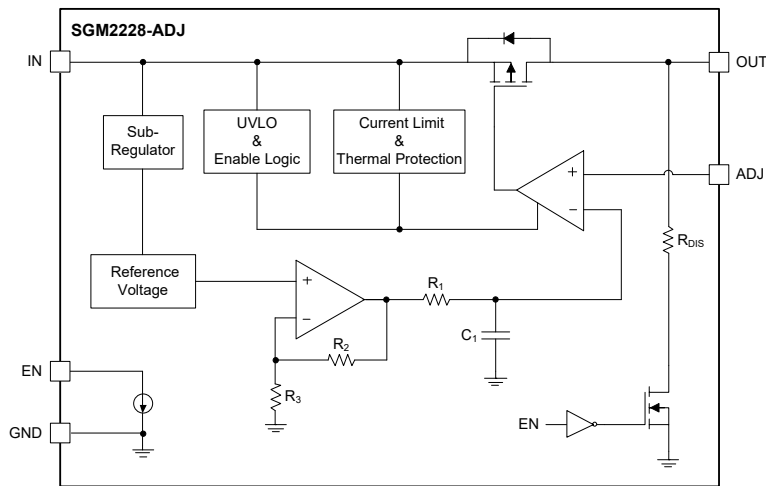


Figure 2. Internal Block Diagram of Adjustable Output Voltage (SOT-23-5 Version Only)

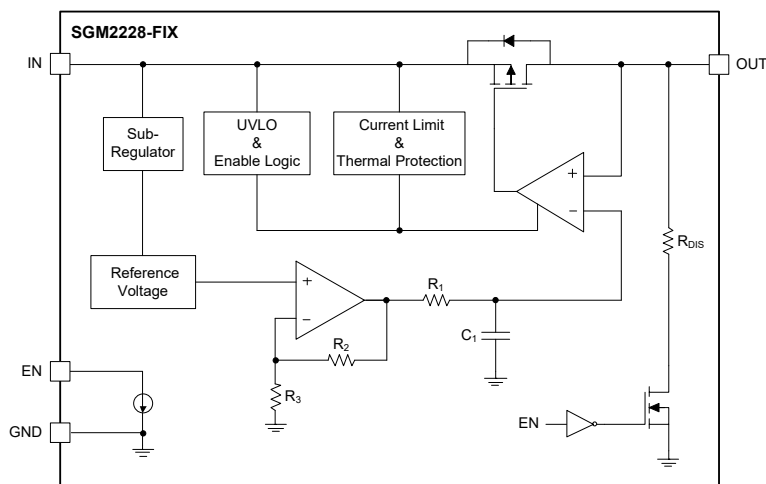
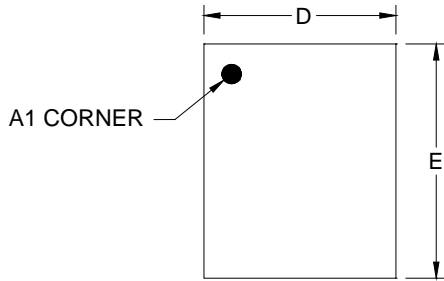


Figure 3. Internal Block Diagram of Fixed Output Voltage (SOT-23-5 Version Only)

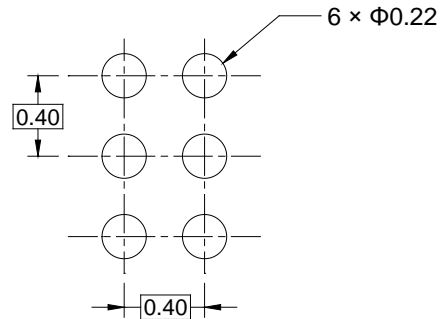
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

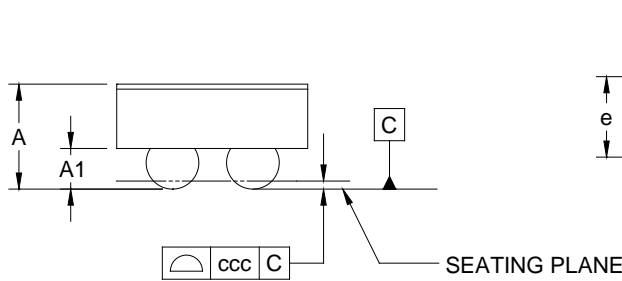
WLCSP-0.95x1.16-6B



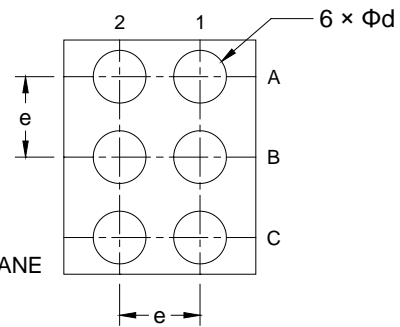
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



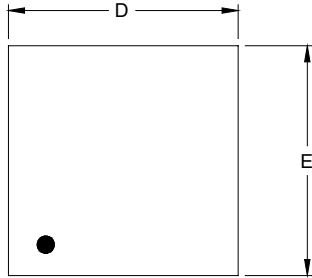
BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	0.560
A1	0.182	-	0.222
D	0.925	-	0.985
E	1.135	-	1.195
d	0.232	-	0.292
e	0.400 BSC		
ccc	0.050		

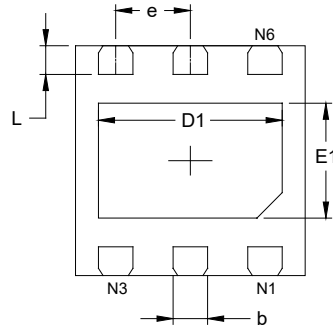
NOTE: This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

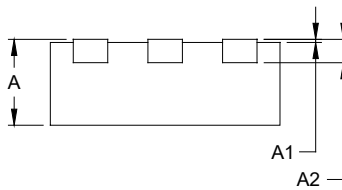
TDFN-2x2-6AL



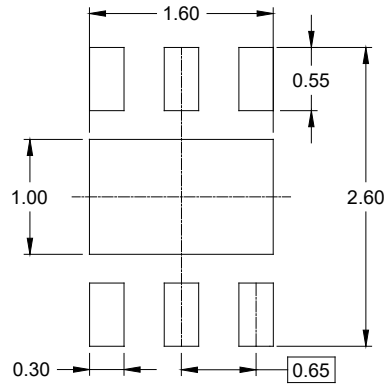
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)

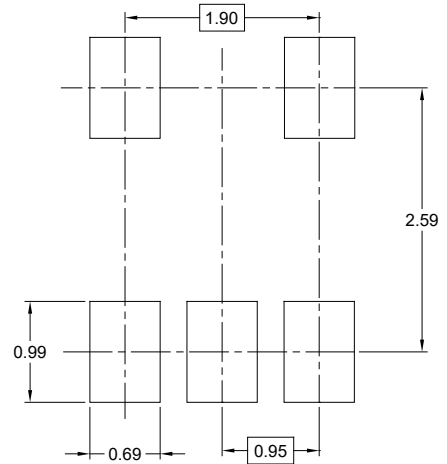
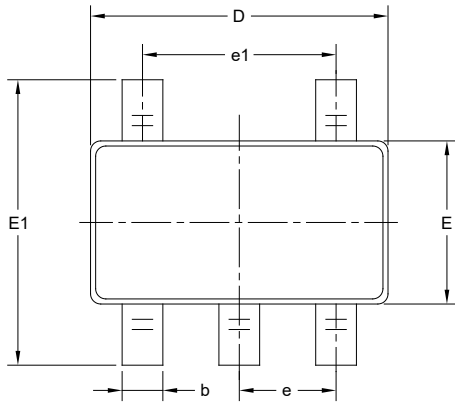
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	1.900	2.100	0.075	0.083
D1	1.500	1.700	0.059	0.067
E	1.900	2.100	0.075	0.083
E1	0.900	1.100	0.035	0.043
b	0.250	0.350	0.010	0.014
e	0.650 BSC		0.026 BSC	
L	0.174	0.326	0.007	0.013

NOTE: This drawing is subject to change without notice.

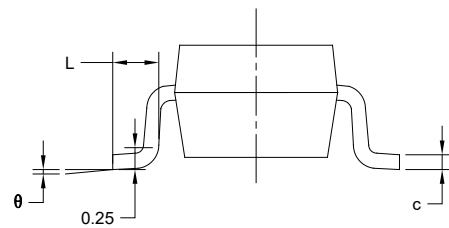
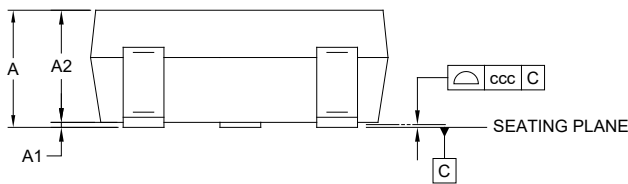
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

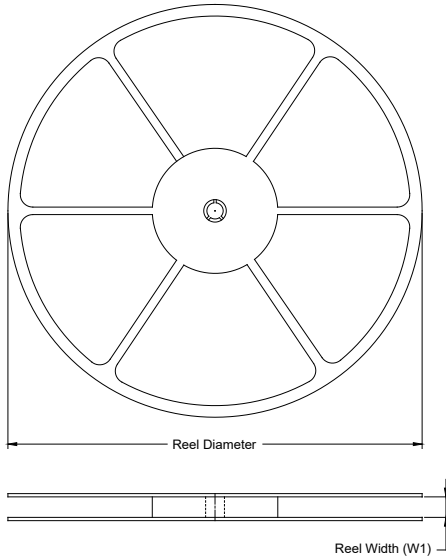
NOTES:

1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

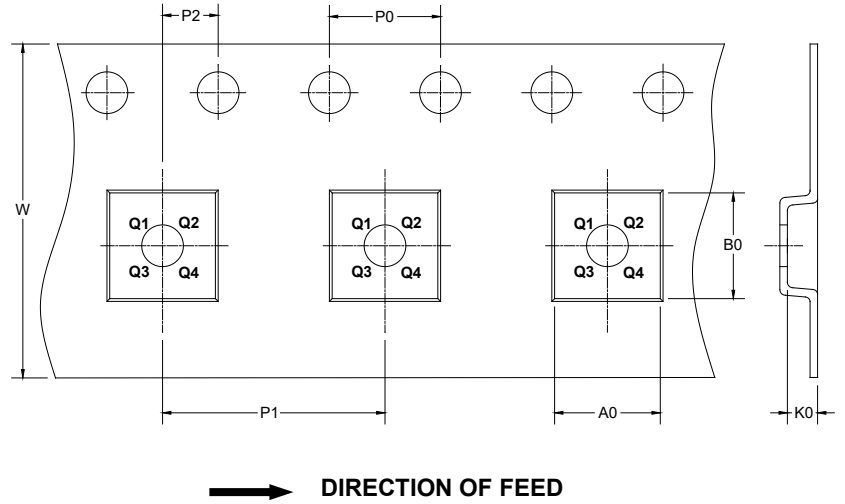
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

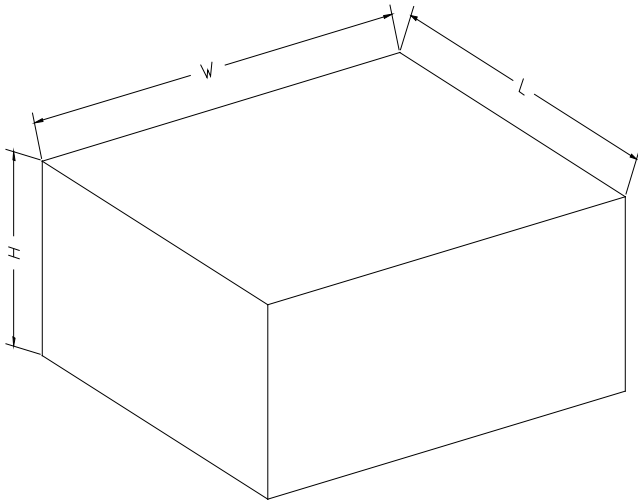
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
WLCSP-0.95×1.16-6B	7"	9.5	1.07	1.25	0.69	4.0	4.0	2.0	8.0	Q1
TDFN-2×2-6AL	7"	9.5	2.30	2.30	1.10	4.0	4.0	2.0	8.0	Q1
SOT-23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3

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

D00002