SGM2201
36V, 150mA, Low Power Adjustable Output Linear Regulator

GENERAL DESCRIPTION

The SGM2201 is a high voltage and low dropout voltage linear regulator. It is capable of supplying 150mA output current. The operating input voltage is up to 36V. The output voltage can be adjusted from 0.8V to 13.2V by using external resistors.

Other features include logic-controlled shutdown mode current limit and thermal shutdown protection.

The SGM2201 is available in Green TSOT-23-5 and TDFN-2×3-8L packages. It is rated over the -40℃ to +85℃ temperature range.

FEATURES

- **Input Voltage Range: 2.7V to 36V**
- **Adjustable Output from 0.8V to 13.2V**
- **150mA Guaranteed Output Current**
- **Output Voltage Accuracy: ±2.5% at +25℃**
- **Low Dropout Voltage**
- **Low Power Consumption: 4.2μA (TYP)**
- **Thermal Shutdown Protection**
- **Output Current Limit**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green TSOT-23-5 and TDFN-2×3-8L Packages**

APPLICATIONS

Palmtops
High-Power Boost Applications
Power Source for Battery-Powered Equipment
Home Electric/Electronic Appliances

TYPICAL APPLICATION

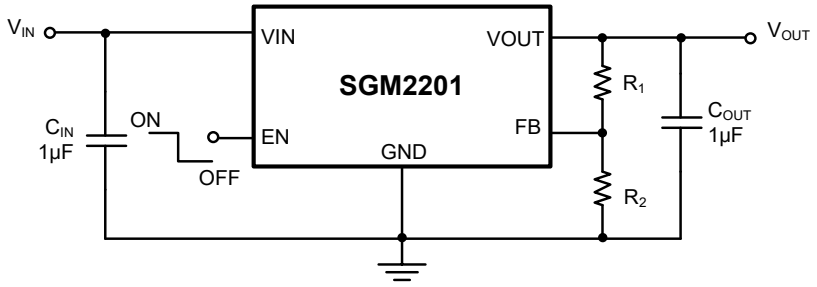


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	V_{OUT} (V)	PACKAGE DESCRIPTION	ORDERING NUMBER	MARKING INFORMATION	PACKAGE OPTION
SGM2201	Adjustable	TSOT-23-5	SGM2201-ADJYTN5G/TR	SVDXX	Tape and Reel, 3000
	Adjustable	TDFN-2×3-8L	SGM2201-ADJYTDC8G/TR	SXE XXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = Date Code.

YYY X X
- Date Code - Month
- Date Code - Year
- 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

VIN, EN to GND ..... -0.3V to 44V
VOUT to GND ..... -0.3V to Min(V_{IN} + 0.3V, 15V)
FB to GND ..... -0.3V to Min(V_{IN} + 0.3V, 6V)
Power Dissipation, P_D @ T_A = +25℃
TSOT-23-5 ..... 0.510W
TDFN-2×3-8L 1.563W
Package Thermal Resistance
TSOT-23-5, θ_{JA} ..... 245℃/W
TDFN-2×3-8L, θ_{JA} ..... 80℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 4000V
MM 200V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.7V to 36V
Operating Temperature Range ..... -40℃ to +85℃

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

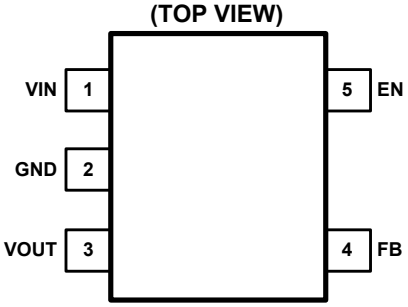
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

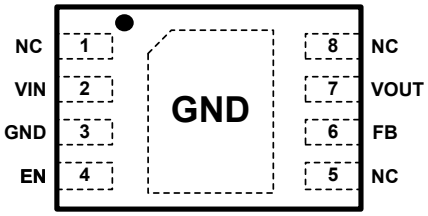
PIN CONFIGURATIONS

(TOP VIEW)



TSOT-23-5

(TOP VIEW)



TDFN-2×3-8L

PIN DESCRIPTION

PIN		NAME	FUNCTION
TSOT-23-5	TDFN-2×3-8L		
1	2	VIN	Input Supply Voltage Pin. It is recommended to use a 1μF or larger ceramic capacitor from VIN pin to ground. This ceramic capacitor should be placed as close as possible to VIN pin.
2	3	GND	Ground.
3	7	VOUT	Regulator Output Pin. It is recommended to use a ceramic capacitor with effective capacitance in the range of 1μF to 10μF to get good power supply decoupling. This ceramic capacitor should be placed as close as possible to VOUT pin.
4	6	FB	Feedback Voltage Input Pin. 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.
5	4	EN	Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator.
–	1, 5, 8	NC	Not Connected.
–	Exposed Pad	GND	Exposed Pad. Connect it to GND internally. Connect it to a large ground plane to maximize thermal performance; this pad is not an electrical connection point.

ELECTRICAL CHARACTERISTICS

(V_{IN} = 15V, V_{EN} = 2V, C_{IN} = C_{OUT} = 1μF, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
Input Voltage	V_{IN}	V_{OUT} < 3.3V		Full	2.7		32	V
		V_{OUT} ≥ 3.3V		Full	2.7		36	
Output Voltage Accuracy		I_{OUT} = 1mA		+25℃	-2.5		2.5	%
Feedback Voltage	V_{FB}	V_{FB} = V_{OUT}, I_{OUT} = 1mA		+25℃		0.8		V
FB Input Current	I_{FB}	V_{FB} = 0.9V		Full	-15		15	nA
Ground Pin Current		No load		+25℃		4.2	5.4	μA
				Full			6.5	
		I_{OUT} = 50mA		+25℃		4.2		
Maximum Output Current		V_{IN} = V_{OUT} + 2V or 4V, whichever is greater		+25℃	150			mA
Dropout Voltage (2)	V_{DROP}	I_{OUT} = 150mA, V_{OUT} ≥ 2.5V		+25℃		1300	1840	mV
				Full			2380	
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{FB} = V_{OUT} = 0.8V, V_{IN} = 4V to 32V, I_{OUT} = 1mA		+25℃		0.005	0.01	%/V
Load Regulation	ΔV_{OUT}	V_{FB} = V_{OUT} = 0.8V, V_{IN} = 4V, I_{OUT} = 1mA to 150mA		+25℃		2	6	mV
Power Supply Rejection Ratio	PSRR	V_{OUT} = 3.3V, I_{OUT} = 10mA	f = 217Hz	+25℃		55		dB
			f = 1kHz	+25℃		40		
Output Voltage Temperature Coefficient	$\frac{\Delta V_{OUT}}{\Delta T_A \times V_{OUT}}$	V_{IN} = V_{OUT} + 2V or 4V, I_{OUT} = 1mA		Full		35		ppm/℃
Shutdown								
EN Input Threshold	V_{IH}	V_{IN} = 2.7V to 36V		Full	1.2			V
	V_{IL}			Full			0.4	
EN Input Bias Current	I_{BH}	V_{EN} = V_{IN}		Full		0.02	1	μA
	I_{BL}	V_{EN} = 0V		Full	-1		1	
Shutdown Supply Current	$I_{Q\ (SHDN)}$	V_{EN} = 0V		+25℃		1.5	2	μA
Start-Up Time (2)	t_{STR}	No load		+25℃		5		ms
R_{ON} of Discharge MOSFET		V_{IN} = 2.7V, V_{EN} = 0V, I_{OUT} = -1mA		+25℃		75		Ω
Thermal Protection								
Thermal Shutdown Temperature	T_{SHDN}					150		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}					20		℃

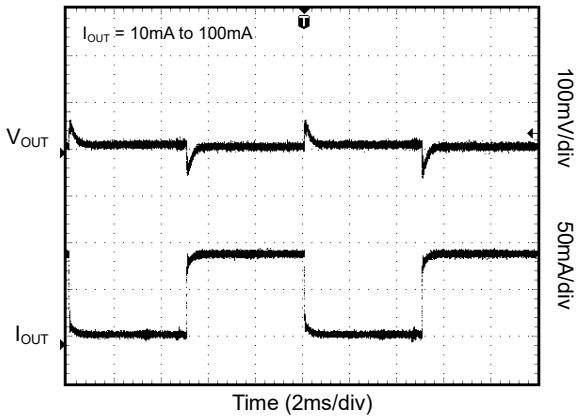
NOTES:

1. The dropout voltage is defined as V_{IN} - V_{OUT}, when V_{OUT} is 95% of the value of V_{OUT} for V_{IN} = V_{OUT} + 2V.
2. Time needed for V_{OUT} to reach 90% of final value.

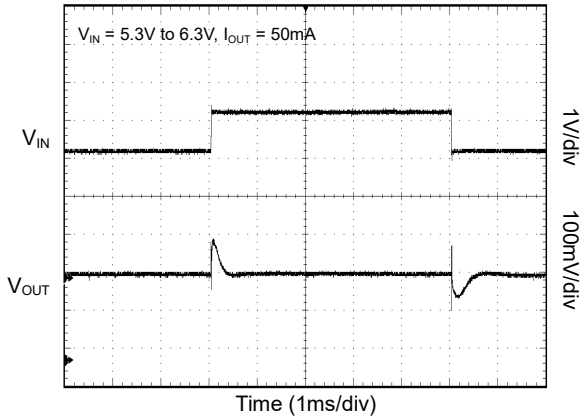
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 5.3V, V_{EN} = 2V, V_{OUT} = 3.3V, C_{IN} = C_{OUT} = 1μF, T_A = +25℃, unless otherwise noted.

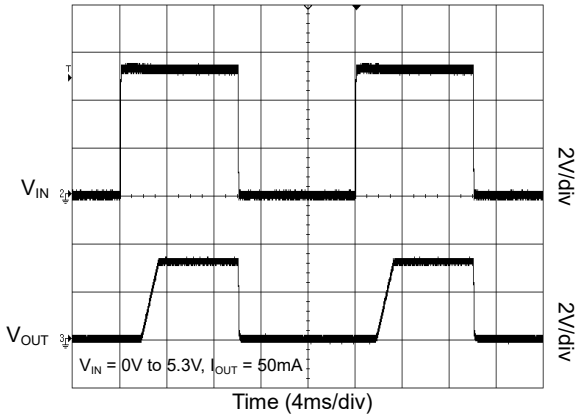
Load-Transient Response



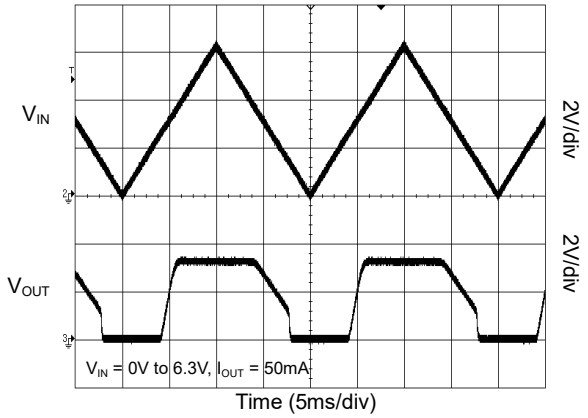
Line-Transient Response



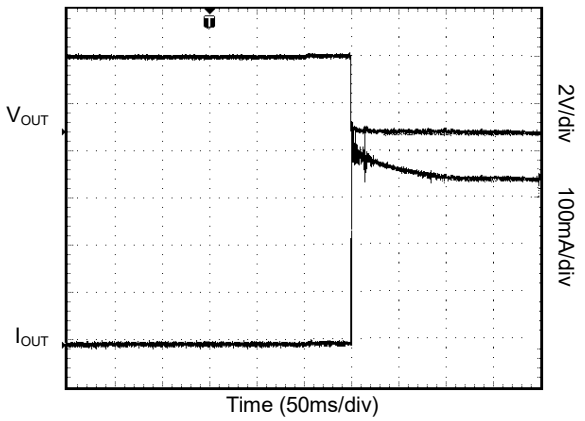
Power-Up/Power-Down Output Waveform



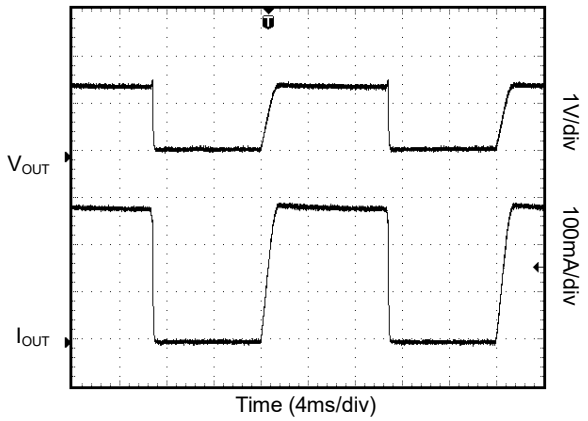
Power Ramp-Up/Ramp-Down Output Waveform



Output Short Waveform



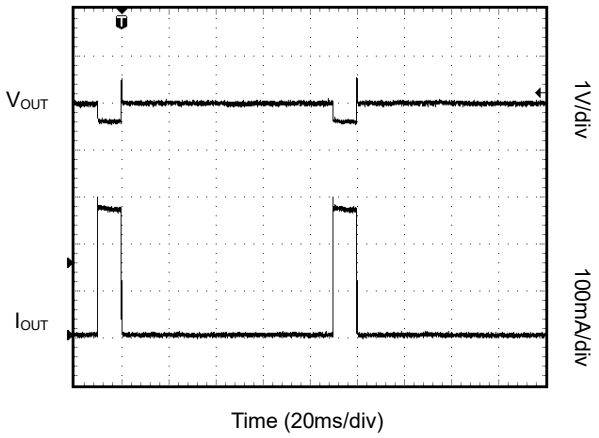
Thermal Protection Waveform



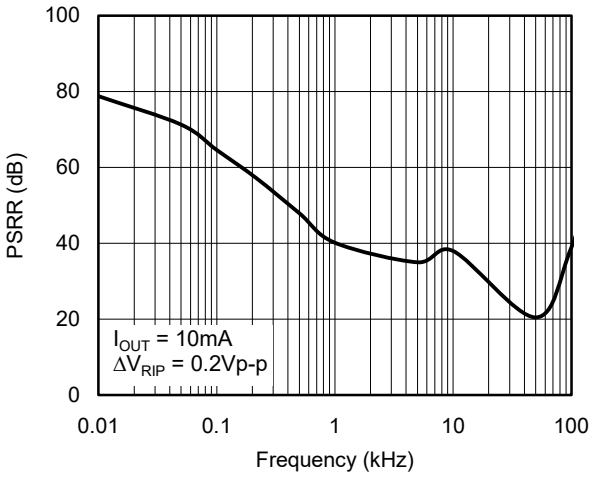
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN} = 5.3V, V_{EN} = 2V, V_{OUT} = 3.3V, C_{IN} = C_{OUT} = 1μF, T_A = +25℃, unless otherwise noted.

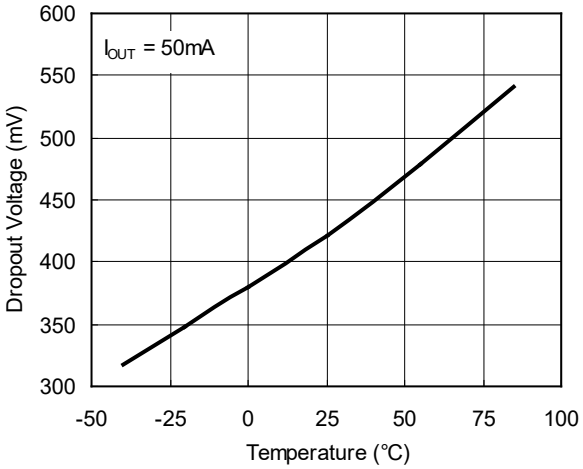
Pulse Load Current Output Waveform



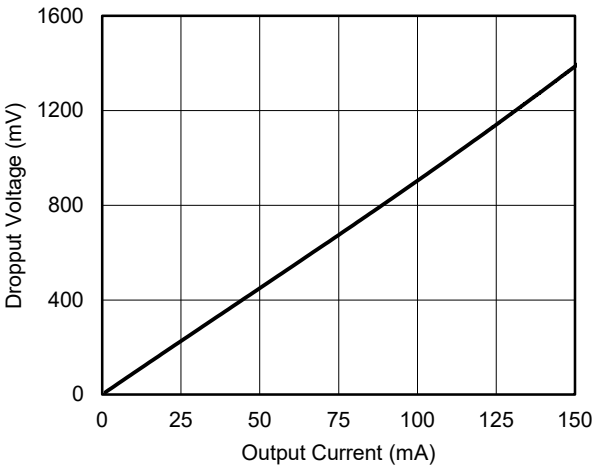
Power Supply Rejection Ratio vs. Frequency



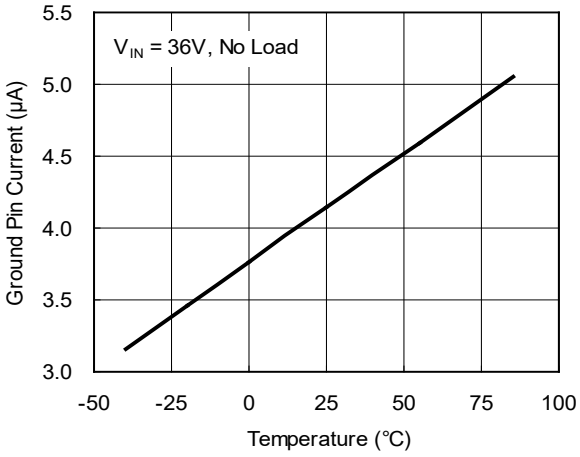
Dropout Voltage vs. Temperature



Dropout Voltage vs. Output Current



Ground Pin Current vs. Temperature



APPLICATION INFORMATION

The SGM2201 is a high input voltage and low dropout LDO and provides 150mA output current. These features make the device a reliable solution to solve many challenging problems in the generation of clean and accurate power supply. The high performance also makes the SGM2201 useful in a variety of applications.

The SGM2201 provides an EN pin as an external chip enable control to enable/disable the device. When the regulator is in shutdown state, the shutdown current consumes as low as 0.02μA (TYP).

Input Capacitor Selection (C_{IN})

The input decoupling capacitor should be placed as close as possible to the IN pin for ensuring the device stability. A 1μF to 10μF X7R or X5R ceramic capacitor is selected to get good dynamic performance.

When V_{IN} is required to provide large current instantaneously, a large effective input capacitor is required. Multiple input capacitors can limit the input tracking inductance. Adding more input capacitors is available to restrict the ringing and to keep it below the device absolute maximum ratings.

Output Capacitor Selection (C_{OUT})

The output decoupling capacitor should be placed as close as possible to the OUT pin. A 1μF to 10μF X7R or X5R ceramic capacitor is selected to get good dynamic performance. For ceramic capacitor, temperature, DC bias and package size will change the effective capacitance, so enough margin of C_{OUT} must be considered in design. Additionally, C_{OUT} with larger capacitance and lower ESR will help increase the high frequency PSRR and improve the load transient response.

Enable Operation

The EN pin of the SGM2201 is used to enable/disable the device and to deactivate/activate the output automatic discharge function.

When the EN pin voltage is lower than 0.4V, the device is in shutdown state. There is no current flowing from VIN to VOUT pins. In this state, the automatic discharge transistor is active to discharge the output voltage through a 75Ω (TYP) resistor.

When the EN pin voltage is higher than 1.2V, the device is in active state. The output voltage is regulated to expected value and the automatic discharge transistor is turned off.

Adjustable Regulator

The output voltage of the SGM2201 can be adjusted from 0.8V to 13.2V. The FB pin will be connected to two external resistors as shown in Figure 2. The output voltage is determined by the following equation:

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R_1}{R_2}\right) \quad (1)$$

where:

V_{OUT} is output voltage and V_{FB} is the internal voltage reference, V_{FB} = 0.8V.

One parallel capacitor (C_1) with R_1 can be used to improve the feedback loop stability and PSRR, increase the transient response and reduce the output noise. Use R_2 = 2MΩ to maintain a 0.4μA minimum load.

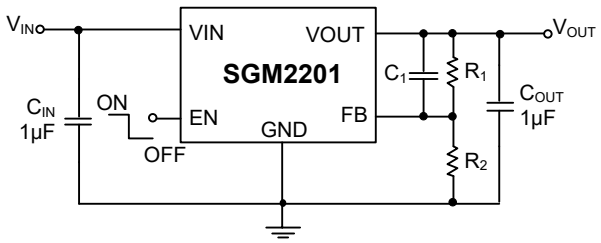


Figure 2. Adjustable Output Voltage Application

Thermal Shutdown

The SGM2201 can detect the temperature of die. When the die temperature exceeds the threshold value of thermal shutdown, the SGM2201 will be in shutdown state and it will remain in this state until the die temperature decreases to +130℃.

REVISION HISTORY

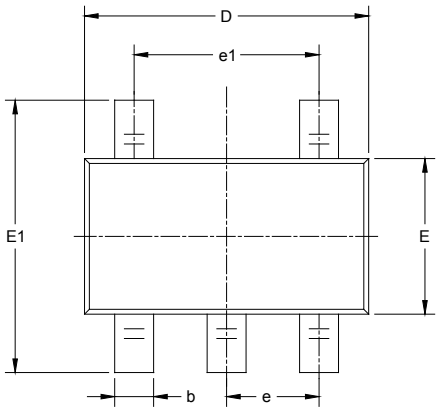
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

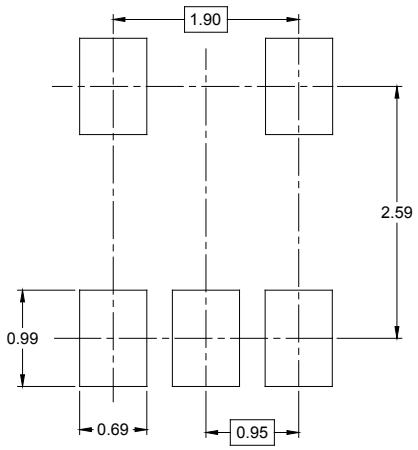
Changes from Original (APRIL 2017) to REV.A

Changed from product preview to production data	All

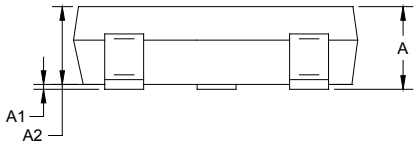
PACKAGE OUTLINE DIMENSIONS

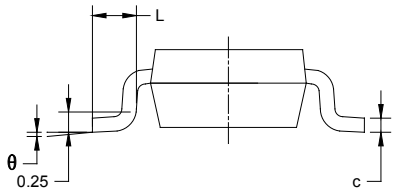
TSOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

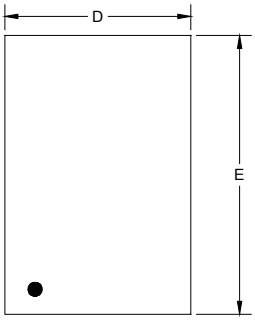




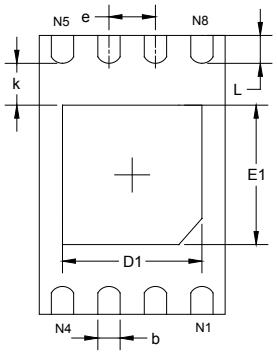
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.900	0.028	0.035
A1	0.000	0.100	0.000	0.004
A2	0.700	0.800	0.028	0.031
b	0.350	0.500	0.014	0.020
c	0.080	0.200	0.003	0.008
D	2.820	3.020	0.111	0.119
E	1.600	1.700	0.063	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 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

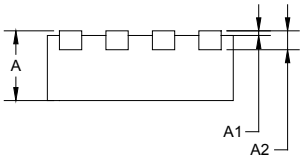
TDFN-2×3-8L



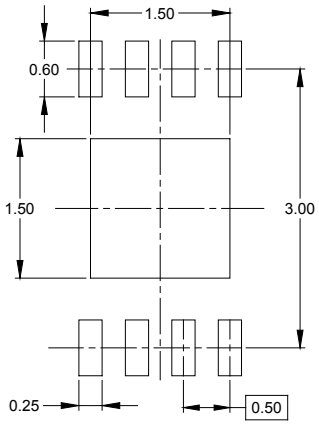
TOP VIEW



BOTTOM VIEW



SIDE VIEW

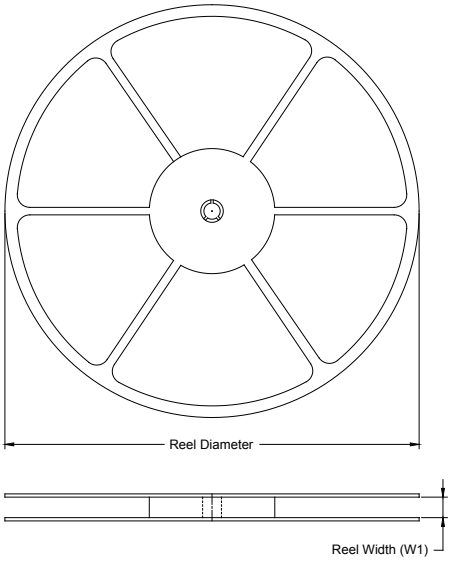


RECOMMENDED LAND PATTERN (Unit: mm)

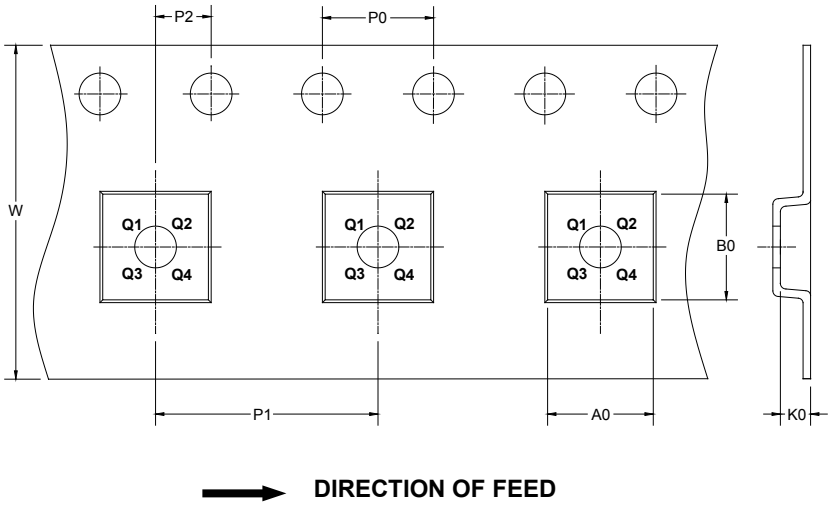
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	1.924	2.076	0.076	0.082
D1	1.400	1.600	0.055	0.063
E	2.924	3.076	0.115	0.121
E1	1.400	1.600	0.055	0.063
k	0.200 MIN		0.008 MIN	
b	0.200	0.300	0.008	0.012
e	0.500 TYP		0.020 TYP	
L	0.224	0.376	0.009	0.015

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



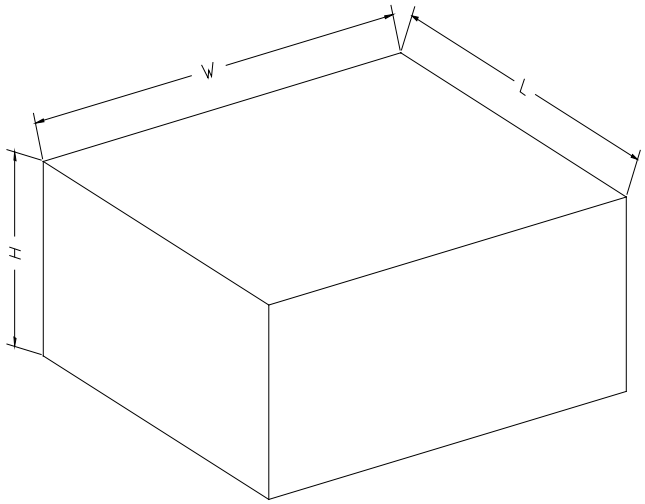
NOTE: The picture is only for reference. Please make the object as the standard.

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
TSOT-23-5	7″	9.5	3.17	3.10	1.10	4.0	4.0	2.0	8.0	Q3
TDFN-2×3-8L	7″	9.5	2.30	3.30	1.10	4.0	4.0	2.0	8.0	Q2

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
7″ (Option)	368	227	224	8
7″	442	410	224	18

DD0002