SGM2053LC
500mA, Low V_{IN}, Ultra-Low Noise, Low Start-Up Current, High PSRR Linear Regulator

GENERAL DESCRIPTION

The SGM2053LC is an ultra-low noise, low V_{IN}, high PSRR and low dropout voltage linear regulator. It is capable of supplying 500mA output current with typical dropout voltage of only 95mV. The operating input voltage range is from 1.5V to 5.5V and output voltage range is from 0.6V to 5.0V.

Other features include logic-controlled shutdown mode, current limit and thermal shutdown protection. The SGM2053LC has automatic discharge function to quickly discharge V_{OUT} in the disabled status.

The SGM2053LC is suitable for applications which need low noise and fast transient response power supply, such as power supply of camera module in smart phone, etc.

The SGM2053LC is available in a Green SOT-23-5 package. It operates over an operating temperature range of -40℃ to +125℃.

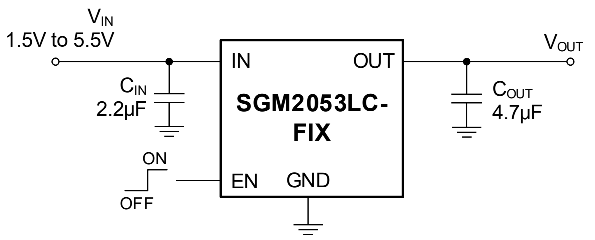
FEATURES

- **Operating Input Voltage Range: 1.5V to 5.5V**
- **Fixed Output Voltage Range: 0.6V to 4.2V**
- **Adjustable Output Voltage Range: 0.8V to 5.0V**
- **500mA Output Current**
- **Low Quiescent Current: 13μA (TYP)**
- **Low Dropout Voltage:**
  95mV (TYP) at $V_{OUT(NOM)}$ = 5.0V
- **Ultra-Low Noise: 9μV_{RMS} (TYP)**
- **High PSRR: 90dB (TYP) at 1kHz**
- **Low Start-Up Current**
- **Current Limiting and Thermal Protection**
- **Excellent Load and Line Transient Responses**
- **With Output Automatic Discharge**
- **Stable with Small Case Size Ceramic Capacitors**
- **Shutdown Supply Current: 0.03μA (TYP)**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green SOT-23-5 Package**

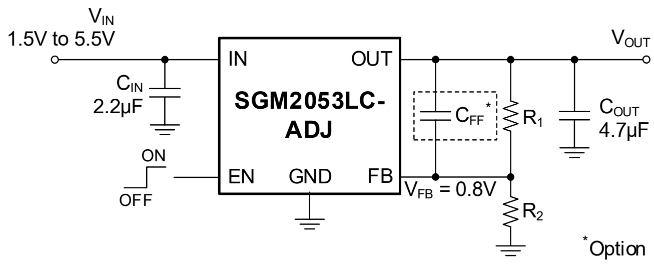
APPLICATIONS

Portable Electronic Devices
Smoke Detectors
IP Cameras
Wireless LAN Devices
Battery-Powered Equipment
Smartphones and Tablets
Digital Cameras and Audio Devices

TYPICAL APPLICATION



Fixed Output Voltage Version



$$V_{OUT} = 0.8V \times \left(1 + \frac{R_1}{R_2}\right)$$

Adjustable Output Voltage Version

Figure 1. Typical Application Circuits

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2053LC-0.6	SOT-23-5	-40℃ to +125℃	SGM2053LC-0.6XN5G/TR	27B XXXXX	Tape and Reel, 3000
SGM2053LC-0.8	SOT-23-5	-40℃ to +125℃	SGM2053LC-0.8XN5G/TR	27C XXXXX	Tape and Reel, 3000
SGM2053LC-0.9	SOT-23-5	-40℃ to +125℃	SGM2053LC-0.9XN5G/TR	27D XXXXX	Tape and Reel, 3000
SGM2053LC-1.0	SOT-23-5	-40℃ to +125℃	SGM2053LC-1.0XN5G/TR	209 XXXXX	Tape and Reel, 3000
SGM2053LC-1.1	SOT-23-5	-40℃ to +125℃	SGM2053LC-1.1XN5G/TR	20A XXXXX	Tape and Reel, 3000
SGM2053LC-1.2	SOT-23-5	-40℃ to +125℃	SGM2053LC-1.2XN5G/TR	208 XXXXX	Tape and Reel, 3000
SGM2053LC-1.5	SOT-23-5	-40℃ to +125℃	SGM2053LC-1.5XN5G/TR	27E XXXXX	Tape and Reel, 3000
SGM2053LC-1.8	SOT-23-5	-40℃ to +125℃	SGM2053LC-1.8XN5G/TR	20B XXXXX	Tape and Reel, 3000
SGM2053LC-2.5	SOT-23-5	-40℃ to +125℃	SGM2053LC-2.5XN5G/TR	20C XXXXX	Tape and Reel, 3000
SGM2053LC-2.8	SOT-23-5	-40℃ to +125℃	SGM2053LC-2.8XN5G/TR	20D XXXXX	Tape and Reel, 3000
SGM2053LC-3.0	SOT-23-5	-40℃ to +125℃	SGM2053LC-3.0XN5G/TR	20E XXXXX	Tape and Reel, 3000
SGM2053LC-3.3	SOT-23-5	-40℃ to +125℃	SGM2053LC-3.3XN5G/TR	20F XXXXX	Tape and Reel, 3000
SGM2053LC-4.2	SOT-23-5	-40℃ to +125℃	SGM2053LC-4.2XN5G/TR	27F XXXXX	Tape and Reel, 3000
SGM2053LC-ADJ	SOT-23-5	-40℃ to +125℃	SGM2053LC-ADJXN5G/TR	20G XXXXX	Tape and Reel, 3000

MARKING INFORMATION

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

XXXXX
- Vendor Code
- Trace Code
- Date Code - Year

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
EN to GND.. -0.3V to 6V
OUT, FB to GND .... -0.3V to (V_{IN} + 0.3V)
Package Thermal Resistance
SOT-23-5, θ_{JA}.. 175.9℃/W
SOT-23-5, θ_{JB}.. 40.5℃/W
SOT-23-5, θ_{JC} .... 65.7℃/W
Junction Temperature...+150℃
Storage Temperature Range .... -65℃ to +150℃
Lead Temperature (Soldering, 10s)............................+260℃
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 ....1.5V to 5.5V
Enable Input Voltage Range ....0V to 5.5V
Input Effective Capacitance, C_{IN} .... 0.1μF (MIN)
Output Effective Capacitance, C_{OUT} .... 0.5μF to 100μF
Operating Junction 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

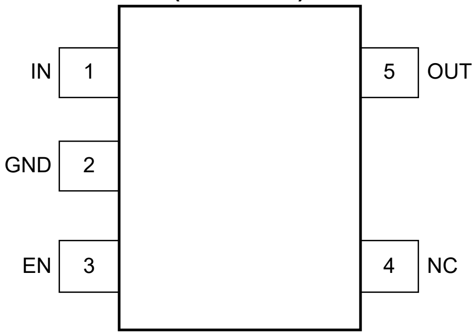
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

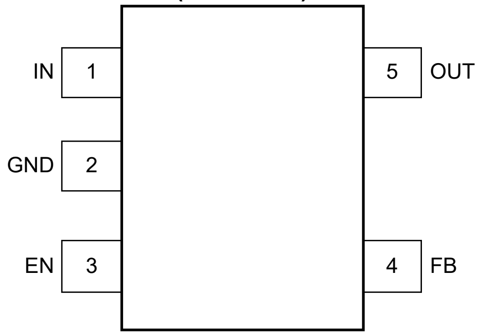
PIN CONFIGURATIONS

SGM2053LC-FIX
(TOP VIEW)



SOT-23-5

SGM2053LC-ADJ
(TOP VIEW)



SOT-23-5

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	IN	Input Voltage Supply Pin. It is recommended to use a 2.2μF or larger ceramic capacitor from IN pin to ground to get good power supply decoupling.
2	GND	Ground.
3	EN	Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator. The EN pin has an internal pull-down resistance which ensures that the device is turned off when the EN pin is floated.
4	FB	Feedback Input Pin (adjustable voltage version only). Connect this pin to the external resistor divider to adjust the output voltage. Place the resistors as close as possible to this pin.
	NC	Not Connected (fixed voltage version only).
5	OUT	Regulator Output Pin. It is recommended to use an output capacitor with effective capacitance in the range of 0.5μF to 100μF to ensure stability. This ceramic capacitor should be placed as close as possible to OUT pin.

FUNCTIONAL BLOCK DIAGRAMS

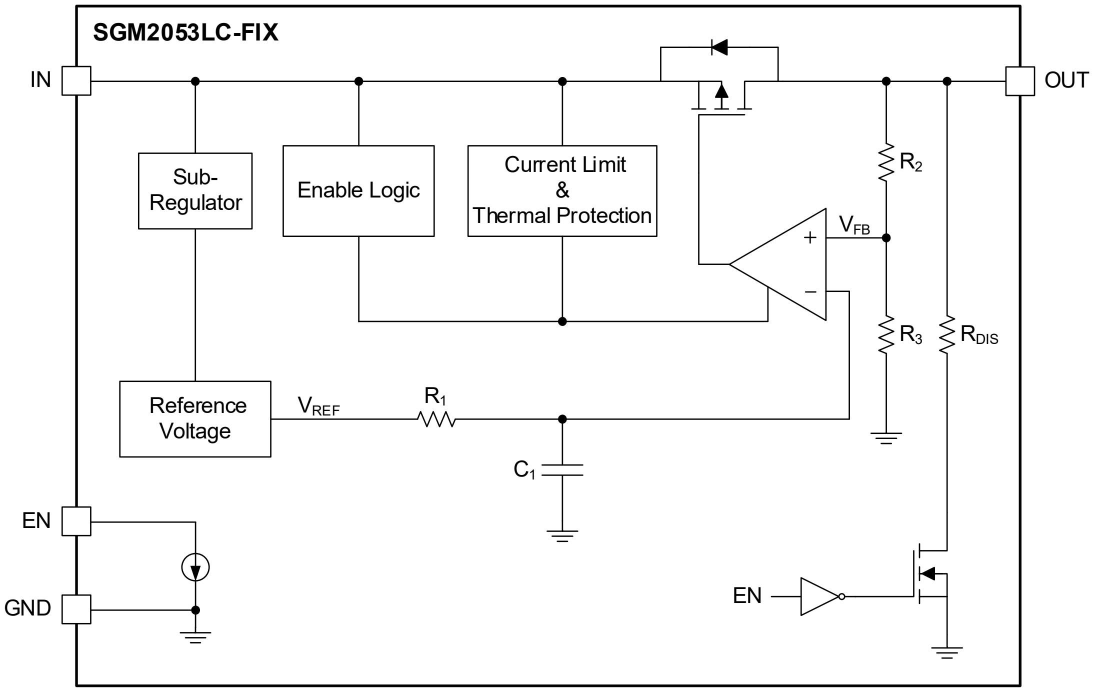


Figure 2. Fixed Output Regulator Block Diagram

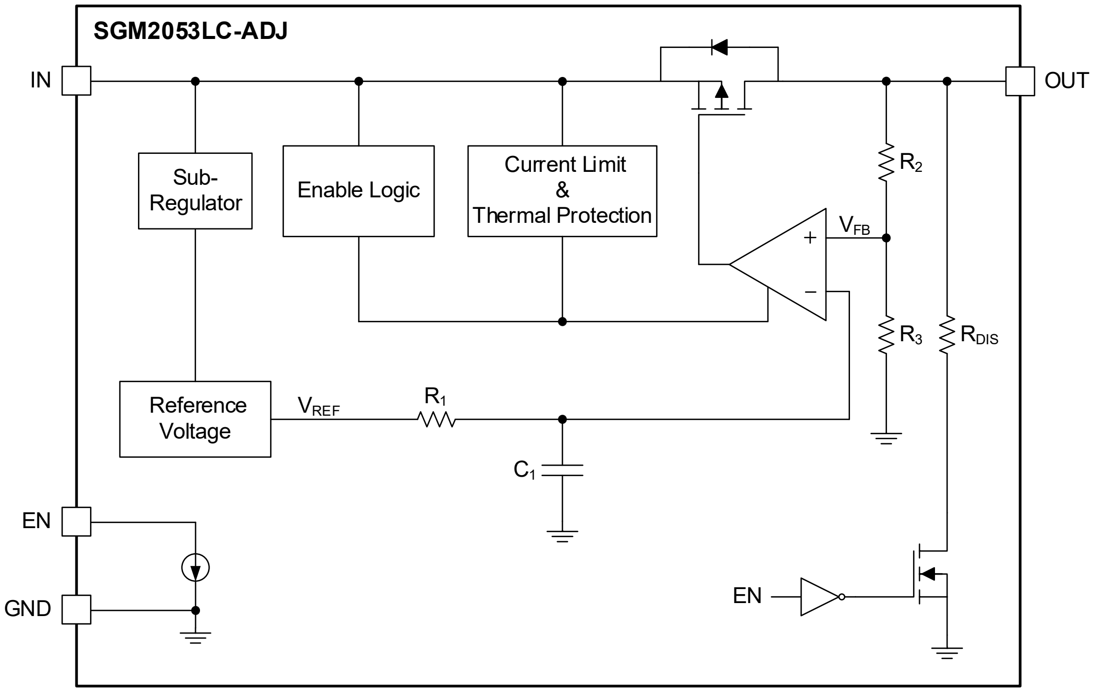


Figure 3. Adjustable Output Regulator Block Diagram

ELECTRICAL CHARACTERISTICS

(V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) or 1.5V (whichever is greater). For SGM2053LC-ADJ, V_{OUT} = 0.8V, V_{ADJ} = V_{OUT}, C_{IN} = 1μF, C_{OUT} = 1μF. T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}			1.5		5.5	V
Output Voltage Range	V_{OUT}			0.6		5	V
Output Voltage Accuracy	V_{OUT}	I_{OUT} = 0.1mA, $V_{OUT(NOM)}$ < 1.2V, T_J = +25℃		-12		12	mV
		I_{OUT} = 0.1mA, V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) to 5.5V, $V_{OUT(NOM)}$ < 1.2V, T_J = -40℃ to +125℃		-30		30	
		I_{OUT} = 0.1mA, $V_{OUT(NOM)}$ ≥ 1.2V, T_J = +25℃		-1		1	%
		I_{OUT} = 0.1mA, V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) to 5.5V, $V_{OUT(NOM)}$ ≥ 1.2V, T_J = -40℃ to +125℃		-2.5		2.5	
Feedback Voltage	V_{FB}	V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) to 5.5V, I_{OUT} = 0.1mA	T_J = +25℃	0.792	0.8	0.808	V
			T_J = -40℃ to +125℃	0.78		0.82	
ADJ Pin Input Bias Current	I_{FB}	V_{OUT} = 0.9V			0	20	nA
Line Regulation	ΔV_{OUT_LNR}	V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) to 5.5V, I_{OUT} = 0.1mA			0.05	2	mV
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	I_{OUT} = 0.1mA to 500mA			0.001	0.005	mV/mA
Dropout Voltage [1]	V_{DROP}	I_{OUT} = 500mA	$V_{OUT(NOM)}$ = 1.0V		440	500	mV
			$V_{OUT(NOM)}$ = 1.1V		360	430	
			$V_{OUT(NOM)}$ = 1.8V		165	250	
			$V_{OUT(NOM)}$ = 5.0V		95	160	
Output Current Limit	I_{LIMIT}	V_{OUT} = 0.9 × $V_{OUT(NOM)}$, T_J = +25℃		550	980		mA
Short-Circuit Current	I_{SHORT}	V_{OUT} = 0V			560		mA
Ground Pin Current	I_{GND}	No load, V_{EN} = V_{IN} = 5.5V			13	40	μA
Shutdown Current	I_{SHDN}	V_{EN} = 0V, V_{IN} = 5.5V			0.03	2.5	μA
EN Input Threshold	V_{IH}	V_{IN} = 1.5V to 5.5V		0.7		5.5	V
	V_{IL}			0		0.3	
EN Input Current	I_{ENH}	V_{EN} = V_{IN} = 5.5V			0.03	1	μA
	I_{ENL}	V_{EN} = 0V, V_{IN} = 5.5V			0	1	
Output Discharge Resistance	R_{DIS}	V_{EN} = 0V, V_{OUT} = 0.5V, V_{IN} = 1.5V			60		Ω
Turn-On Time	t_{ON}	From EN rising from 0V to V_{IN} to 0.9 × $V_{OUT(NOM)}$, $V_{OUT(NOM)}$ = 1.8V			260	550	μs
Power Supply Rejection Ratio	PSRR	V_{IN} = 2.8V, $V_{OUT(NOM)}$ = 1.8V, I_{OUT} = 50mA	f = 217Hz		88		dB
			f = 1kHz		90		
			f = 10kHz		84		
Output Voltage Noise	e_n	$V_{OUT(NOM)}$ = 1.8V, f = 10Hz to 100kHz	I_{OUT} = 2mA		13		μV_{RMS}
			I_{OUT} = 50mA		10		
			I_{OUT} = 300mA		9		
Thermal Shutdown Temperature	T_{SHDN}	T_J rising			170		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}	Hysteresis			25		℃

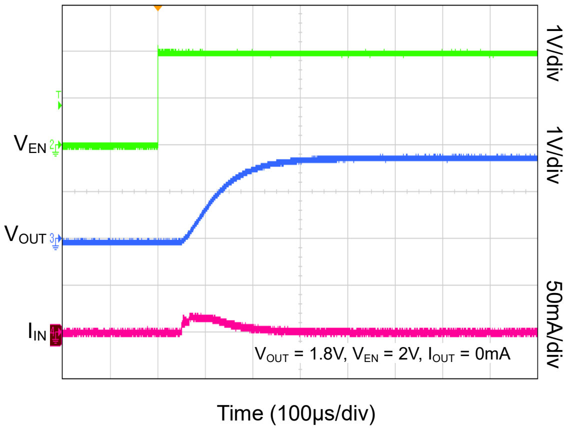
NOTE:

1. The dropout voltage is defined as the difference between V_{IN} and V_{OUT} when V_{OUT} falls to $V_{OUT(NOM)}$ - 50mV.

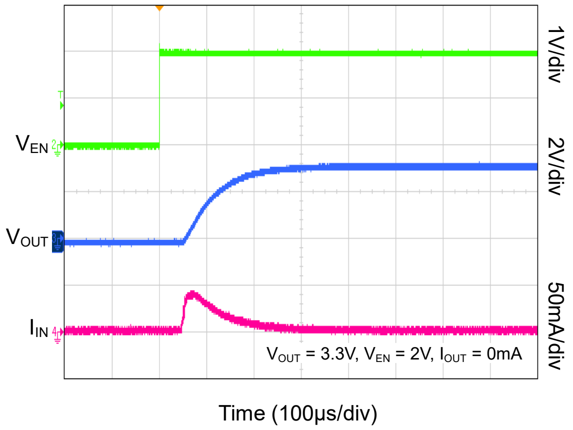
TYPICAL PERFORMANCE CHARACTERISTICS

T_J = +25℃, V_{IN} = $V_{OUT(NOM)}$ + 0.5V, V_{EN} = V_{IN}, C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

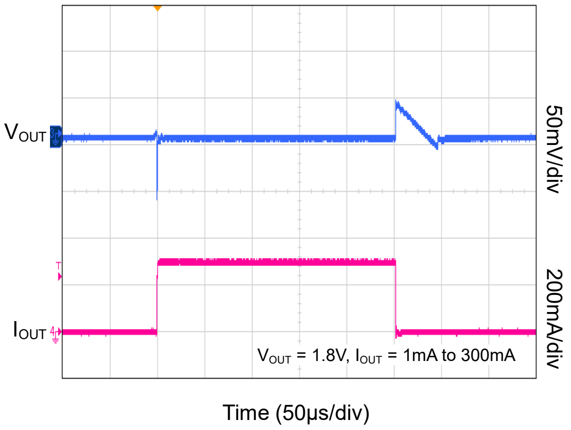
Enable Turn-On Response



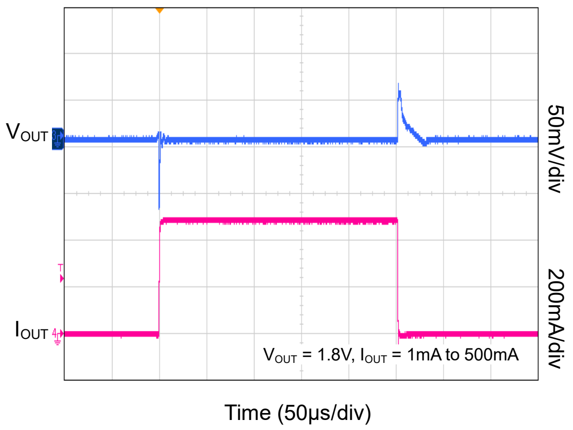
Enable Turn-On Response



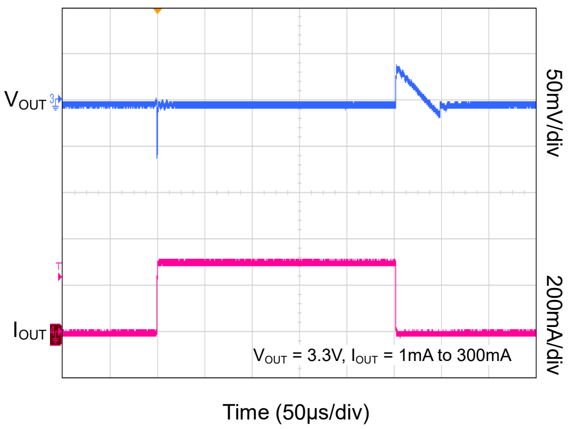
Load Transient Response



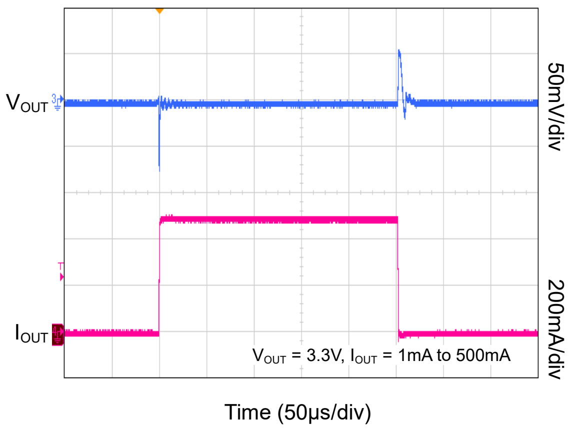
Load Transient Response



Load Transient Response

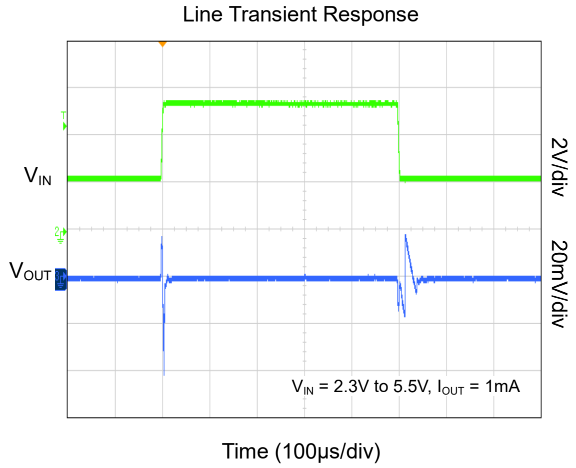


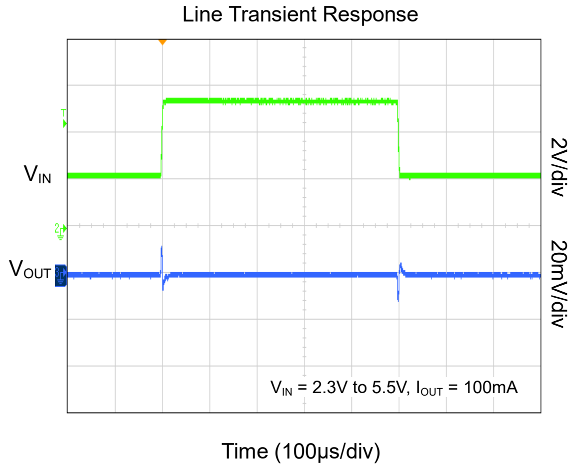
Load Transient Response

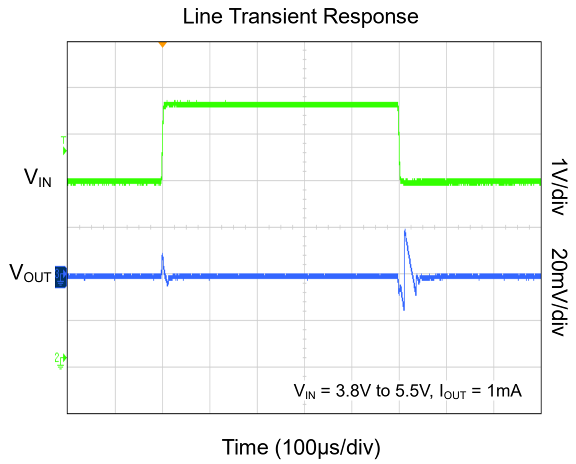


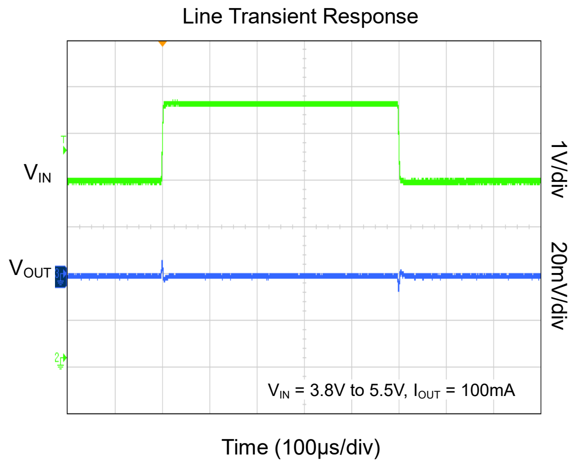
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

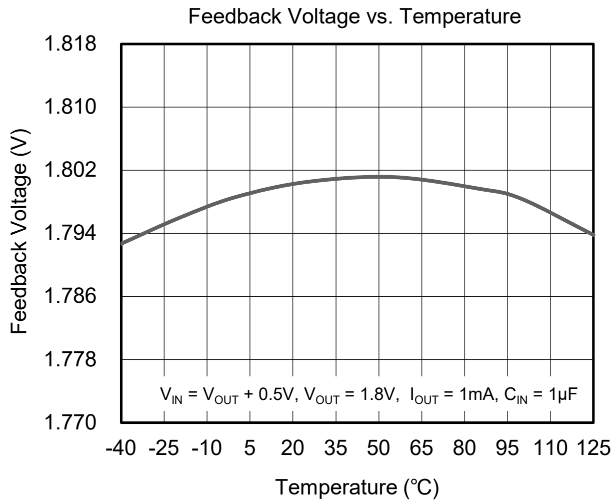
T_J = +25℃, V_{IN} = $V_{OUT(NOM)}$ + 0.5V, V_{EN} = V_{IN}, C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

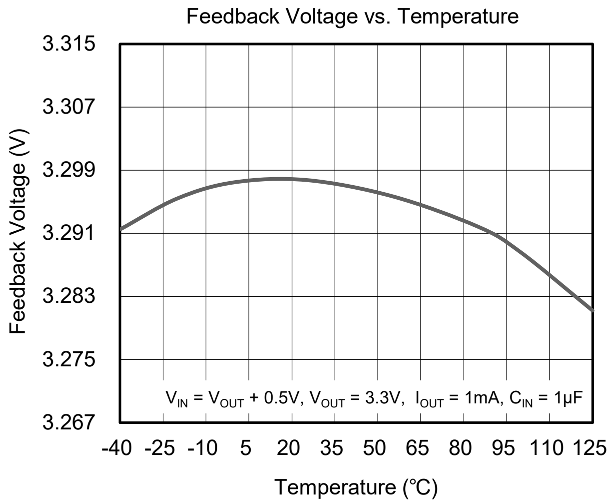






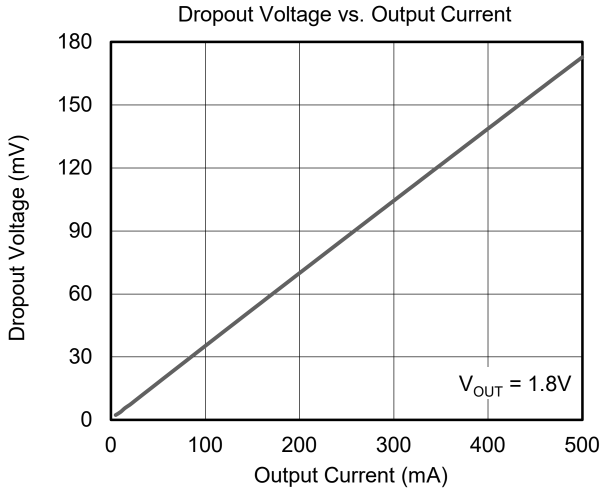


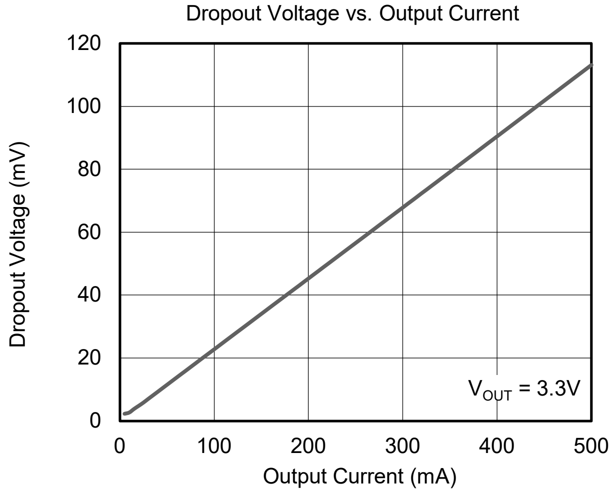


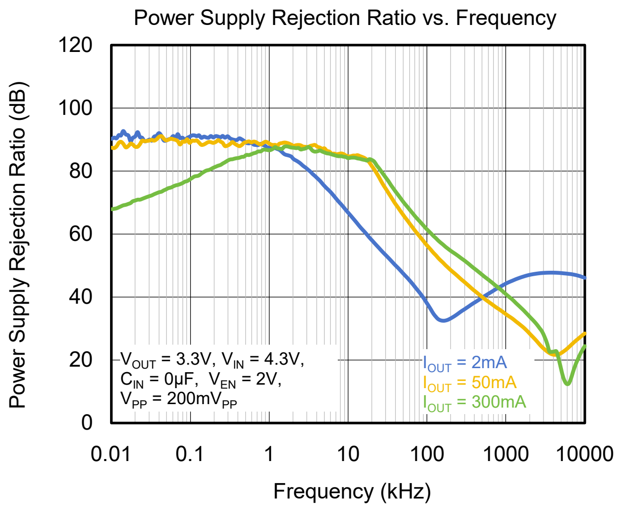


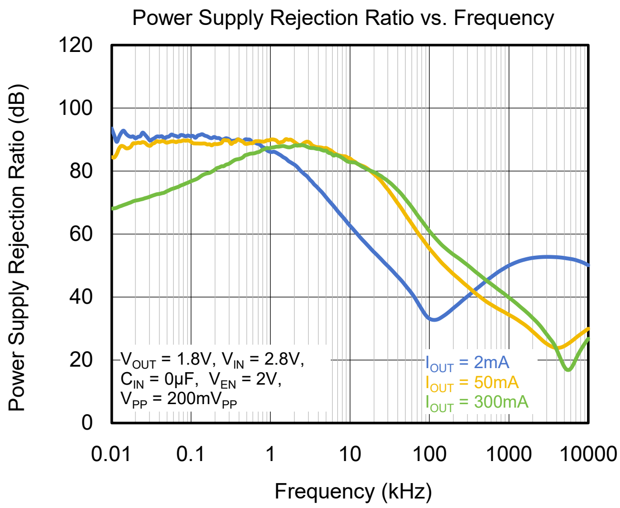
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

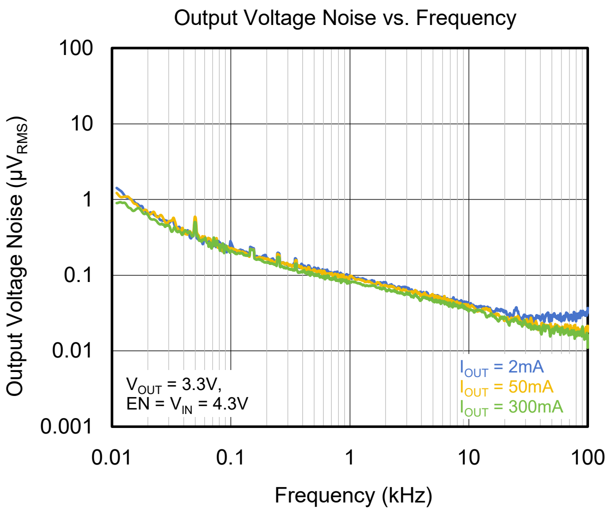
T_J = +25℃, V_{IN} = $V_{OUT(NOM)}$ + 0.5V, V_{EN} = V_{IN}, C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

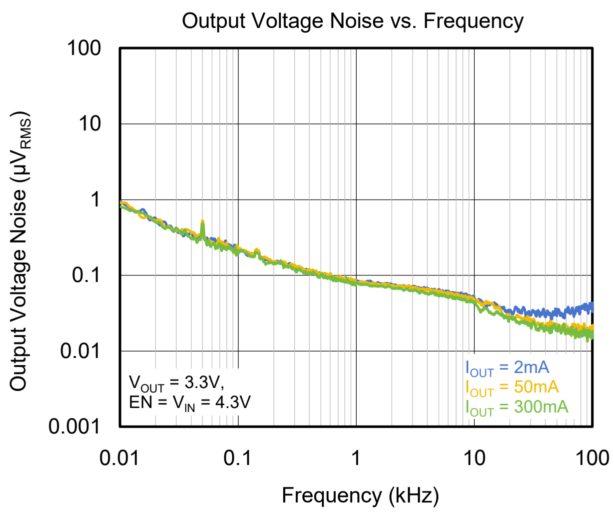






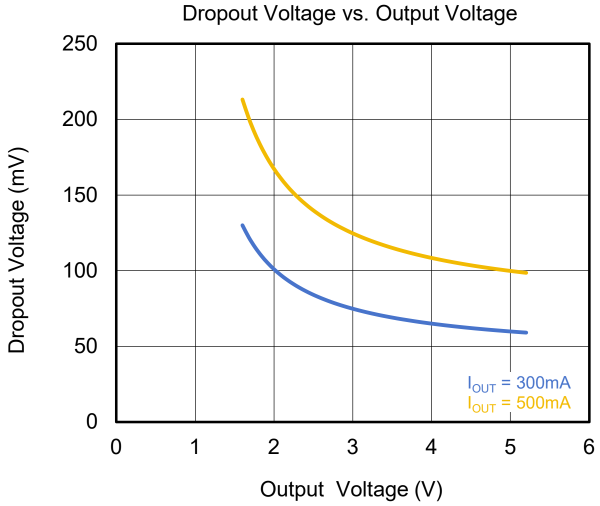






TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = $V_{OUT(NOM)}$ + 0.5V, V_{EN} = V_{IN}, C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.



APPLICATION INFORMATION

The SGM2053LC is a low V_{IN}, ultra-low noise and low dropout LDO and provides 500mA 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 SGM2053LC useful in a variety of applications. The SGM2053LC provides the protection functions for output overload and overheating.

The SGM2053LC 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 0.03μA (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. C_{IN} = 2.2μF or larger 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. For C_{OUT} with larger capacitance, it is recommended to choose the larger capacitance C_{IN}.

Output Capacitor Selection (C_{OUT})

One or more output capacitors are required to maintain the stability of the LDO, and the output capacitors should be placed as close as possible to the OUT pin. In addition, in order to obtain the best transient performance, it is recommended to use X7R and X5R ceramic capacitors as output capacitors. Ceramic capacitors have low equivalent series resistance (ESR), excellent temperature and DC bias characteristics. However, it cannot be ignored that the effective capacitance of ceramic capacitors is affected by temperature, DC bias and package size.

For example, Figure 4 shows the capacitance and DC bias and temperature characteristics of 0805, 10V, 10μF±10%, X7R capacitor. Therefore, it is necessary to evaluate whether the effective capacitance of the output capacitor can meet the stability requirements of the LDO in practical applications. In general, a capacitor in higher voltage rating and a larger package exhibits better stability, and the effective capacitance can be obtained from the manufacturer datasheet.

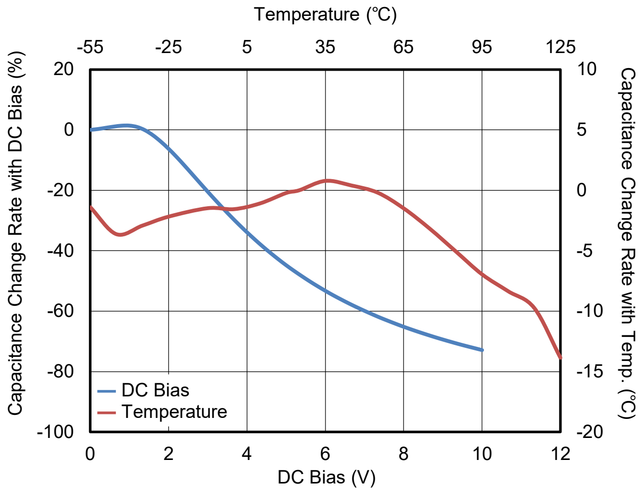


Figure 4. Capacitance vs. DC Bias and Temperature Characteristics

The SGM2053LC requires a minimum effective capacitance of 0.5μF for C_{OUT} to ensure stability. 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 SGM2053LC is used to enable/ disable its device and to deactivate/activate the output automatic discharge function.

When the EN pin voltage is lower than 0.3V, the device is in shutdown state. There is no current flowing from IN to OUT pins. In this state, the automatic discharge transistor is active to discharge the output voltage through a 60Ω (TYP) resistor.

When the EN pin voltage is higher than 0.7V, the device is in active state. The output voltage is regulated to the expected value and the automatic discharge transistor is turned off.

The EN pin is pulled down by internal 0.03μA (TYP) current source when the EN pin is floated. This current source will ensure the SGM2053LC in shutdown state and reduce the power dissipation in system.

APPLICATION INFORMATION (continued)

Adjustable Regulator

For the SGM2053LC-ADJ, set the output voltage by using a resistor divider as shown in Figure 5. Capacitance C_{FF} = 10nF can be added to improve stability and reduce noise. Choose $R_2 \le 40k\Omega$ to maintain a 20μA minimum load. Calculate the value for R_1 using the following equation:

$$R_1 = R_2 \times \left(\frac{V_{OUT}}{0.8V} - 1\right) \quad (1)$$

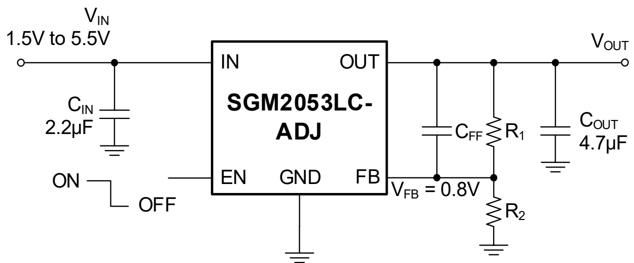


Figure 5. Adjustable Output Voltage Application

Negatively Biased Output

When the output voltage is negative, the chip may not start up due to parasitic effects. Ensure that the output is greater than -0.3V under all conditions. If negatively biased output is excessive and expected in the application, a Schottky diode can be added between the OUT pin and GND pin.

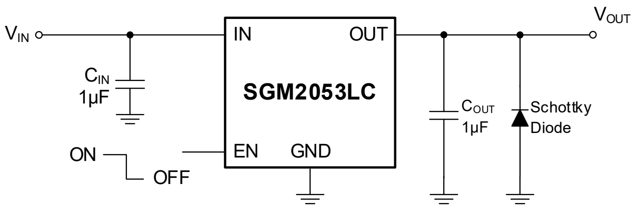


Figure 6. Negatively Biased Output Application

Output Current Limit Protection

When overload events happen, the output current is internally limited to 980mA (TYP). When the OUT pin is shorted to ground, the output current is internally limited to 560mA (TYP).

Thermal Shutdown

The SGM2053LC can detect the temperature of die. When the die temperature exceeds the threshold value of thermal shutdown, the SGM2053LC will be in shutdown state and it will remain in this state until the die temperature decreases to +145℃.

Power Dissipation (P_D)

Power dissipation (P_D) of the SGM2053LC can be calculated by the equation $P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$. The maximum allowable power dissipation ($P_{D(MAX)}$) of the SGM2053LC is affected by many factors, including the difference between junction temperature and ambient temperature ($T_{J(MAX)} - T_A$), package thermal resistance from the junction to the ambient environment (θ_{JA}), the rate of ambient airflow and PCB layout. $P_{D(MAX)}$ can be approximated by the following equation:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A)/\theta_{JA} \quad (2)$$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction-to-ambient thermal resistance.

Layout Guidelines

To get good PSRR, low output noise and high transient response performance, the input and output bypass capacitors must be placed as close as possible to the IN pin and OUT pin separately.

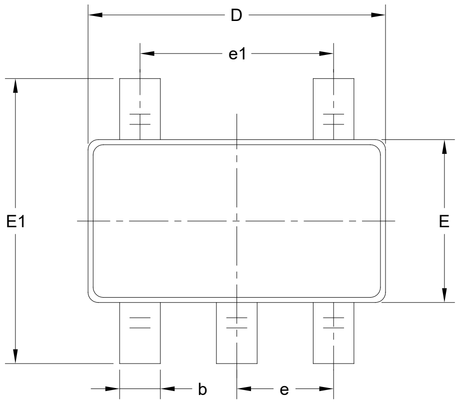
REVISION HISTORY

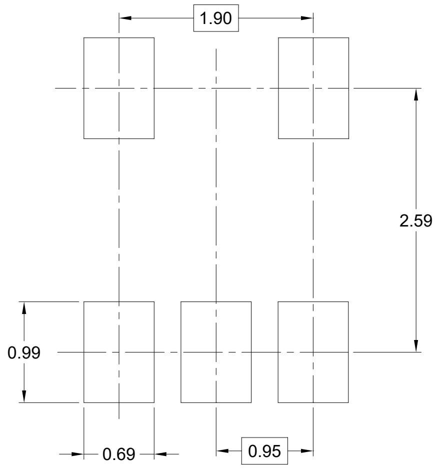
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original to REV.A (JUNE 2025)	Page
Changed from product preview to production data	All

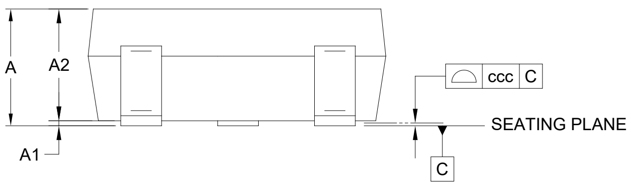
PACKAGE OUTLINE DIMENSIONS

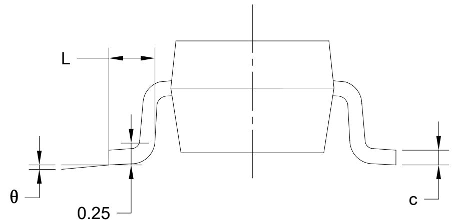
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)



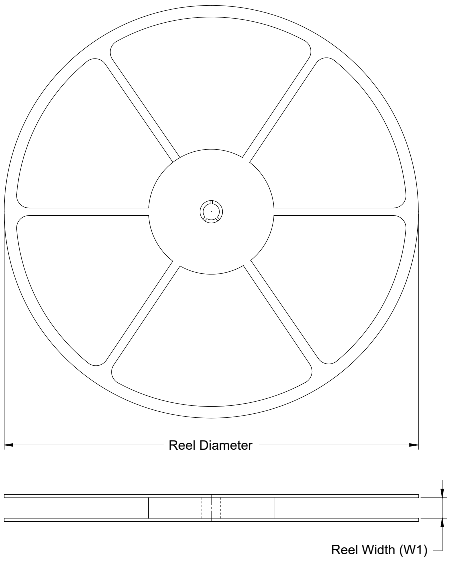


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

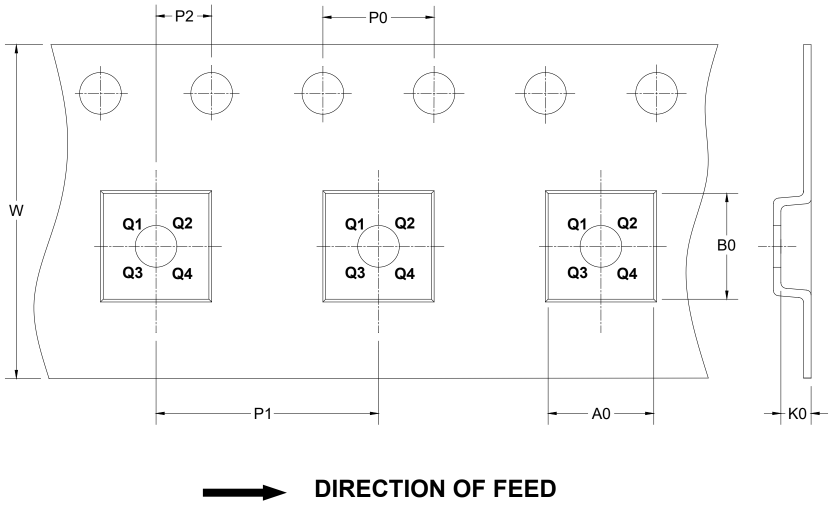
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



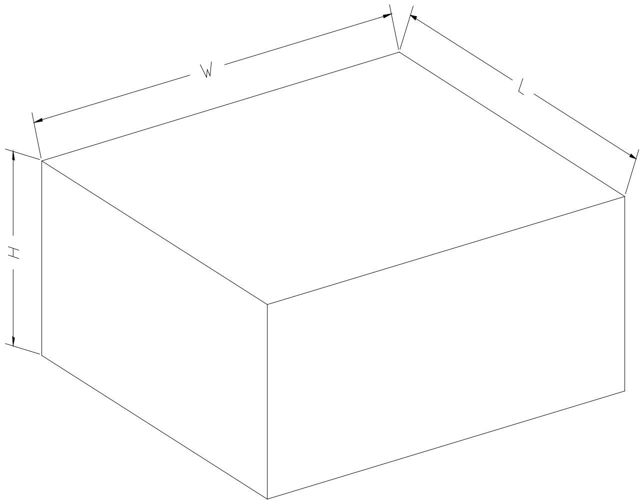
NOTE: The picture is only for reference. Please make the object as the standard.

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

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