SGM2053
500mA, Ultra-Low Dropout, Low Power, RF Linear Regulator

GENERAL DESCRIPTION

The SGM2053 is a low power, low noise, fast transient response 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 1.5V to 5.5V. The adjustable output voltage range is from 0.8V to 5.0V.

Other features include logic-controlled shutdown mode, short-circuit current limit and thermal shutdown protection. The SGM2053 has automatic discharge function to quickly discharge V_{OUT} in the disabled status.

The SGM2053 is available in a Green SOT-23-6 package. It operates over an operating temperature range of -40℃ to +125℃.

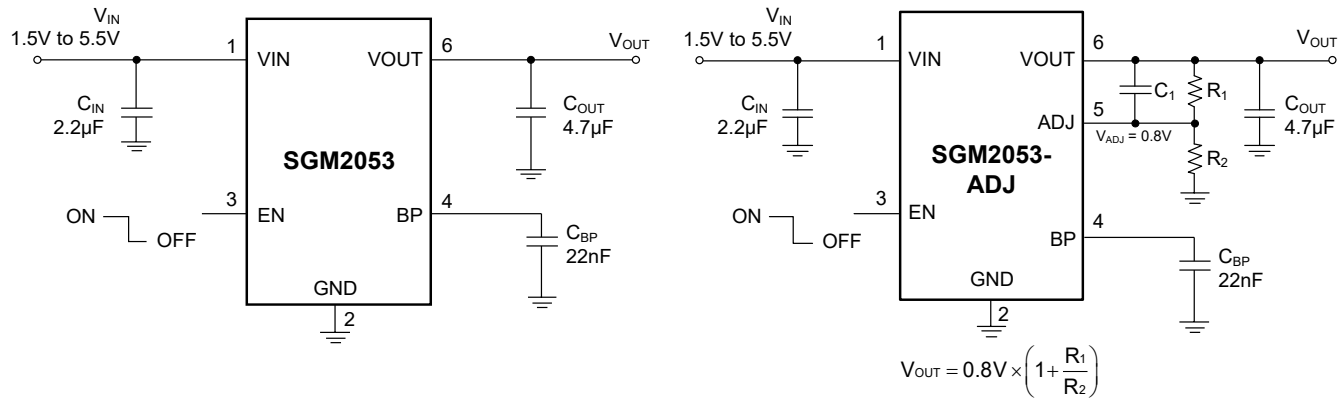
FEATURES

- **Input Supply Voltage Range: 1.5V to 5.5V**
- **Fixed Output Voltages:**
  1.0V, 1.05V, 1.1V, 1.8V, 2.8V, 3.0V and 3.3V
- **Adjustable Output Voltage Range: 0.8V to 5.0V**
- **500mA Guaranteed Output Current**
- **Ultra-Low Dropout Voltage:**
  110mV (TYP) at V_{OUT} = 5.0V
- **High PSRR: 93dB (TYP) at 1kHz**
- **Turn-On Time: 70μs (TYP)**
- **Low Output Noise**
- **Fast Load Transient Response**
- **Thermal Shutdown Protection**
- **Output Current Limit**
- **Pull-Down Current at EN Pin**
- **Output Auto-Discharge in Shutdown**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green SOT-23-6 Package**

APPLICATIONS

Portable Equipment
Smartphone
Industrial and medical Equipment

TYPICAL APPLICATION



Fixed Output Voltage Version **Adjustable Output Voltage Version**

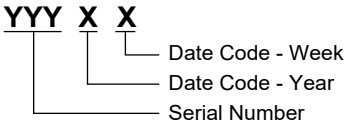
Figure 1. Typical Application Circuits

PACKAGE/ORDERING INFORMATION

MODEL	V_{OUT} (V)	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2053-1.0	1.0	SOT-23-6	-40℃ to +125℃	SGM2053-1.0XN6G/TR	CYAXX	Tape and Reel, 3000
SGM2053-1.05	1.05	SOT-23-6	-40℃ to +125℃	SGM2053-1.05XN6G/TR	CY8XX	Tape and Reel, 3000
SGM2053-1.1	1.1	SOT-23-6	-40℃ to +125℃	SGM2053-1.1XN6G/TR	CYCXX	Tape and Reel, 3000
SGM2053-1.8	1.8	SOT-23-6	-40℃ to +125℃	SGM2053-1.8XN6G/TR	CYDXX	Tape and Reel, 3000
SGM2053-2.8	2.8	SOT-23-6	-40℃ to +125℃	SGM2053-2.8XN6G/TR	CYEXX	Tape and Reel, 3000
SGM2053-3.0	3.0	SOT-23-6	-40℃ to +125℃	SGM2053-3.0XN6G/TR	CYFXX	Tape and Reel, 3000
SGM2053-3.3	3.3	SOT-23-6	-40℃ to +125℃	SGM2053-3.3XN6G/TR	CZ0XX	Tape and Reel, 3000
SGM2053-ADJ	ADJ	SOT-23-6	-40℃ to +125℃	SGM2053-ADJXN6G/TR	CZ1XX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = Date Code.



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 to GND ..... -0.3V to 6.0V
EN to GND ..... -0.3V to 6.0V
VOUT, BP, ADJ to GND ..... -0.3V to (V_{IN} + 0.3V)
Package Thermal Resistance
SOT-23-6, θ_{JA} ..... 196℃/W
SOT-23-6, θ_{JB} ..... 61℃/W
SOT-23-6, θ_{JC} ..... 81℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 8000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 1.5V to 5.5V
Input Effective Capacitance, C_{IN} ..... 1.5μF (MIN)
Output Effective Capacitance, C_{OUT} ..... 1μF to 10μF
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

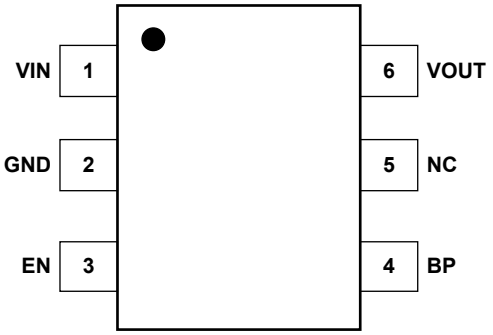
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

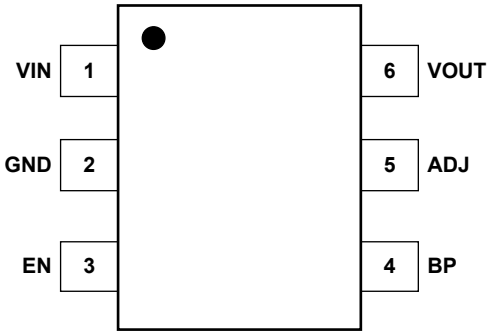
PIN CONFIGURATIONS

SGM2053-Fixed Output
(TOP VIEW)



SOT-23-6

SGM2053-ADJ
(TOP VIEW)



SOT-23-6

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	VIN	Input Voltage Supply Pin.
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 30nA pull-down current source which ensures that the device is turned off when the EN pin is floated.
4	BP	Reference-Noise Bypass Pin. Using an external capacitor C_{BP} to decouple this pin to GND can reduce output noise to very low level.
5	NC	Not Connected (fixed voltage version only).
	ADJ	Feedback Input Pin. Connect this pin to the external resistor divider to adjust the output voltage. Place the resistors as close as possible to this pin.
6	VOUT	Regulator Output Pin. It is recommended to use an output capacitor with effective capacitance in the range of 1μF to 10μF.

ELECTRICAL CHARACTERISTICS

(V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) or 1.5V, whichever is greater. For SGM2053-ADJ, V_{OUT} = 0.8V, V_{ADJ} = V_{OUT}, C_{IN} = 2.2μF, C_{OUT} = 1μF and C_{BP} = 22nF, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}			+25℃	1.5		5.5	V
ADJ Pin Input Bias Current	I_{ADJ}	V_{OUT} = 0.9V		+25℃		0.05		nA
Output Current Limit	I_{LIMIT}	V_{OUT} = 0.9 × $V_{OUT(NOM)}$, $V_{OUT(NOM)}$ = 5.0V		+25℃		1		A
Short Circuit Current	I_{SC}	V_{OUT} = 0V		+25℃		530		mA
Ground Pin Current	I_Q	No load, V_{EN} = V_{IN}		+25℃		17		μA
Line Regulation	ΔV_{LNR}	V_{IN} = ($V_{OUT(NOM)}$ + 0.5V) to 5.5V, I_{OUT} = 0.1mA		+25℃		0.2		mV
Load Regulation	ΔV_{LDR}	I_{OUT} = 0.1mA to 500mA		+25℃		1		mV
Dropout Voltage (1)	V_{DROP}	I_{OUT} = 500mA	$V_{OUT(NOM)}$ = 1.8V	+25℃		180		mV
			$V_{OUT(NOM)}$ = 5.0V	+25℃		110		
Output Voltage Noise	e_n	I_{OUT} = 50mA, f = 10Hz to 100kHz		+25℃		20		μV_{RMS}
Power Supply Rejection Ratio	PSRR	V_{IN} = $V_{OUT(NOM)}$ + 1.0V, I_{OUT} = 50mA	f = 217Hz	+25℃		92		dB
			f = 1kHz	+25℃		93		dB
			f = 10kHz	+25℃		89		dB
Shutdown								
EN Input Threshold	V_{IH}	V_{IN} = 1.5V to 5.5V		+25℃	1			V
	V_{IL}			+25℃			0.3	
EN Input Bias Current	I_{ENH}	V_{EN} = 5.5V, V_{IN} = 5.5V		+25℃		30		nA
	I_{ENL}	V_{EN} = 0V, V_{IN} = 5.5V		+25℃		0.5		
Shutdown Supply Current	I_{SHDN}	V_{EN} = 0V, V_{IN} = 5.5V		+25℃		0.03		μA
Turn-On Time	t_{ON}	From EN rising from 0V to V_{IN} to 0.9 × V_{OUT}, C_{BP} = 22nF, no load		+25℃		70		μs
Discharge Resistor	R_{DIS}	V_{EN} = 0V, V_{OUT} = 0.5V, V_{IN} = 1.5V		+25℃		60		Ω
Thermal Protection								
Thermal Shutdown Temperature	T_{SHDN}					160		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}					20		℃

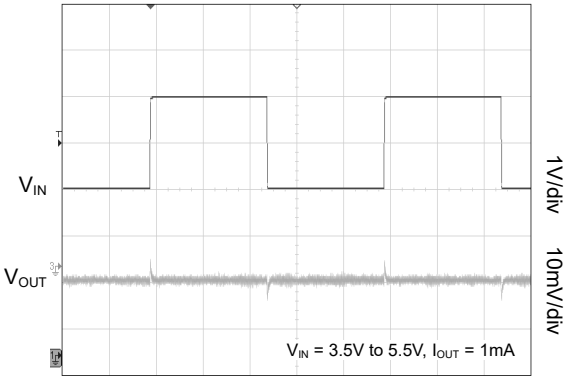
NOTE:

1. The dropout voltage is defined as V_{IN} - V_{OUT}, when V_{OUT} is 50mV below the value of V_{OUT} for V_{IN} = $V_{OUT(NOM)}$ + 0.5V or 1.5V.

TYPICAL PERFORMANCE CHARACTERISTICS

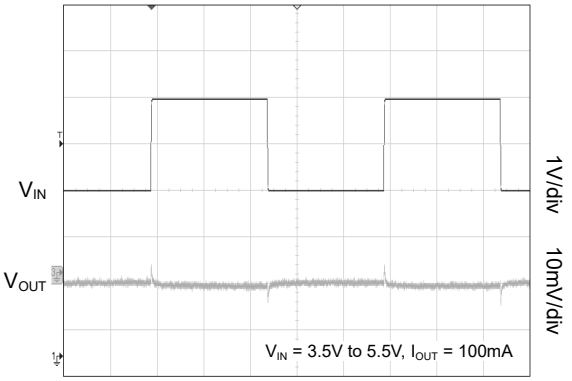
T_J = +25℃, V_{IN} = $V_{OUT(NOM)}$ + 1V, V_{OUT} = 0.8V, V_{ADJ} = V_{OUT}, C_{IN} = 2.2μF, C_{OUT} = 1μF and C_{BP} = 22nF, unless otherwise noted.

Line Transient Response



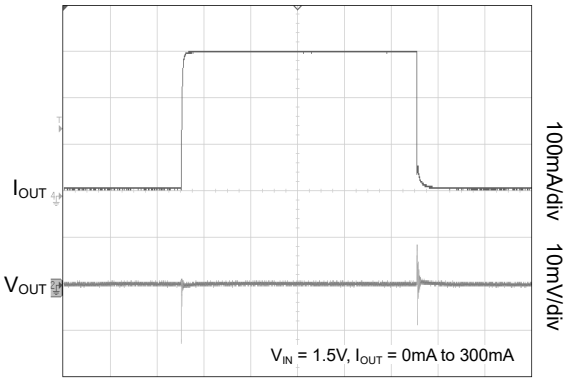
Time (5ms/div)

Line Transient Response



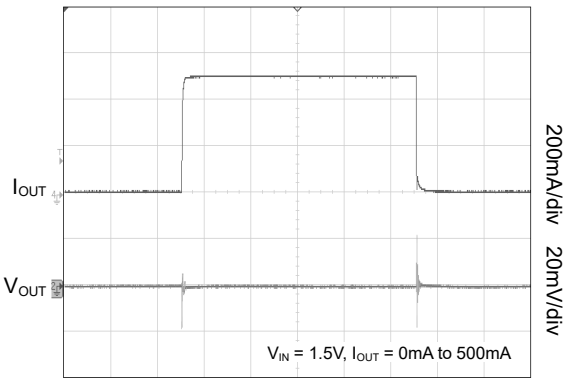
Time (5ms/div)

Load Transient Response



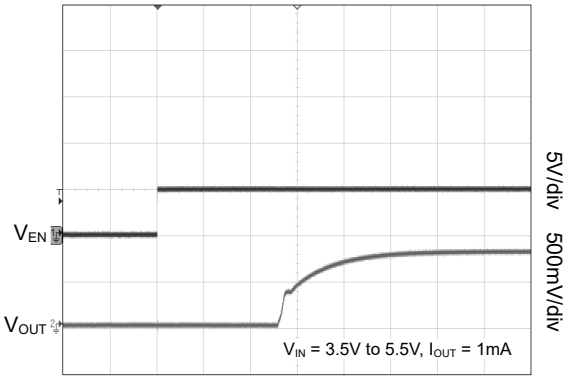
Time (200μs/div)

Load Transient Response



Time (200μs/div)

Turn-On Time

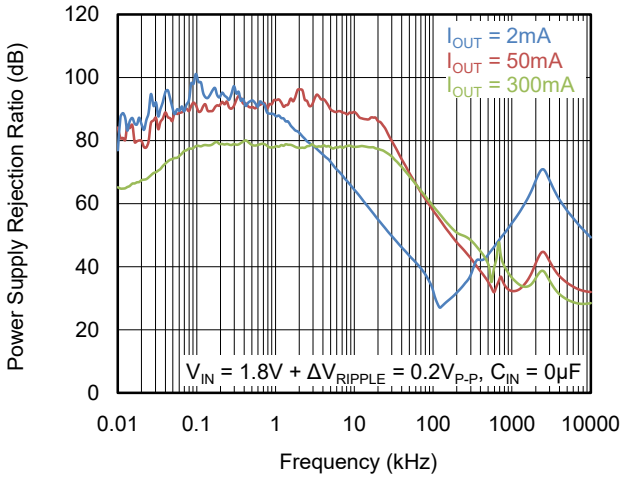


Time (20μs/div)

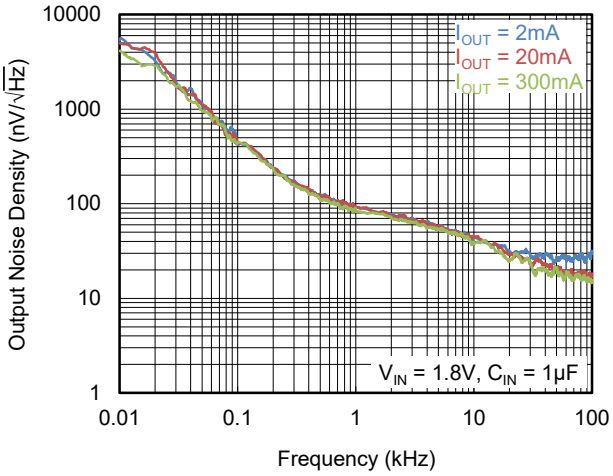
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = $V_{OUT(NOM)}$ + 1V, V_{OUT} = 0.8V, V_{ADJ} = V_{OUT}, C_{IN} = 2.2μF, C_{OUT} = 1μF and C_{BP} = 22nF, unless otherwise noted.

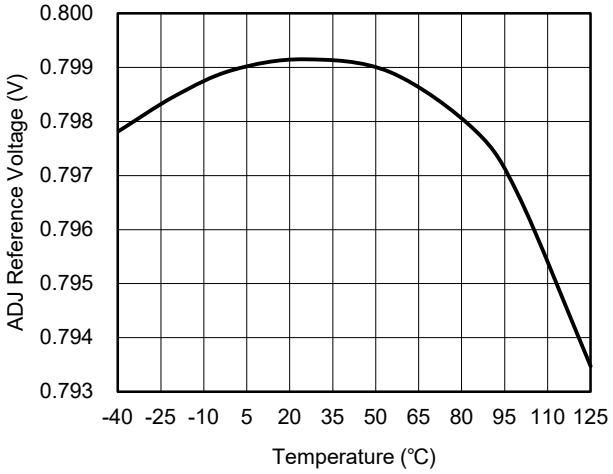
Power Supply Rejection Ratio vs. Frequency



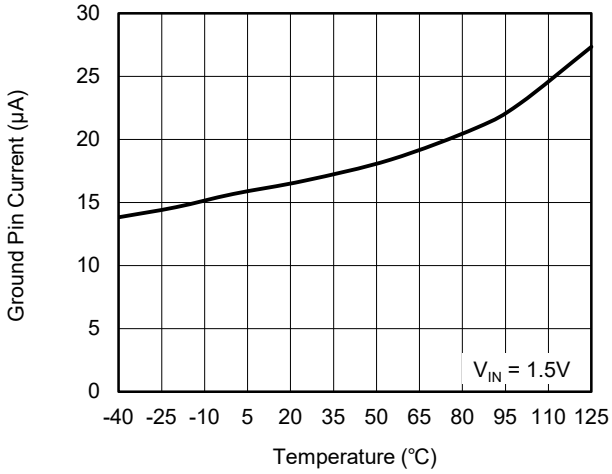
Output Noise Density vs. Frequency



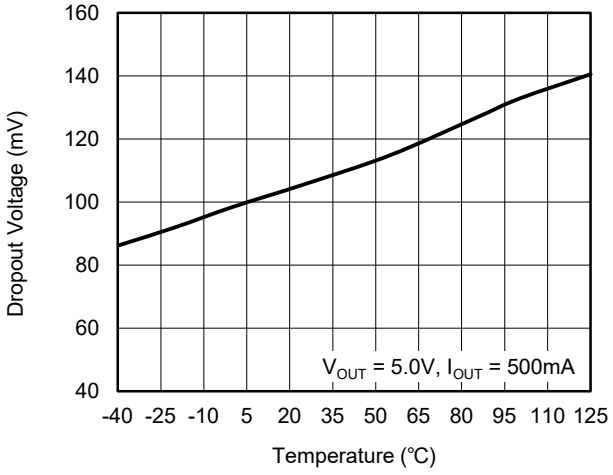
ADJ Reference Voltage vs. Temperature



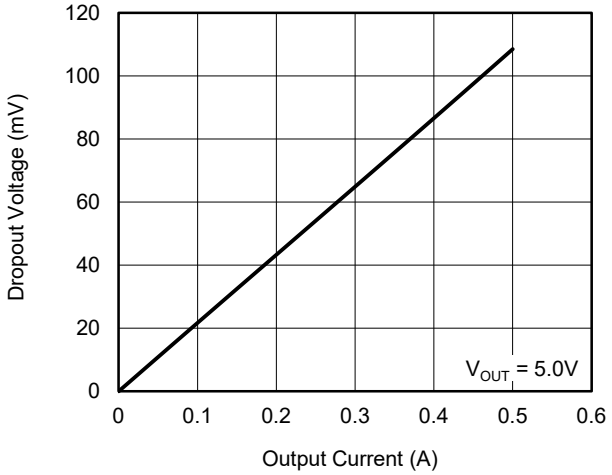
Ground Pin Current vs. Temperature



Dropout Voltage vs. Temperature



Dropout Voltage vs. Output Current



APPLICATION NOTE

When LDO is used in handheld products, attention must be paid to voltage spikes which could damage the SGM2053. In such applications, voltage spikes will be generated at charger interface and V_{BUS} pin of USB interface when charger adapters and USB equipment are hot-plugged. Besides, handheld products will be tested on the production line without battery. Test engineer will apply power from the connector pin which connects with positive pole of the battery. When external power supply is turned on suddenly, the voltage spikes will be generated at the battery connector. The voltage spikes will be very high and it always exceeds the absolute maximum input voltage (6.0V) of LDO. In order to get robust design, design engineer needs to clear up this voltage spike. Zener diode is a cheap and effective solution to eliminate such voltage spike. For example, BZM55B5V6 is a 5.6V small package Zener diode which can be used to remove voltage spikes in cell phone designs. The schematic is shown below.

For the SGM2053-ADJ, set the output voltage by using a resistor divider as shown in Figure 3. Capacitance C_1 = 10nF can be added to improve stability and reduce noise. Choose R_2 = 40kΩ to maintain a 20μA minimum load. Calculate the value for R_1 using the following equation:

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

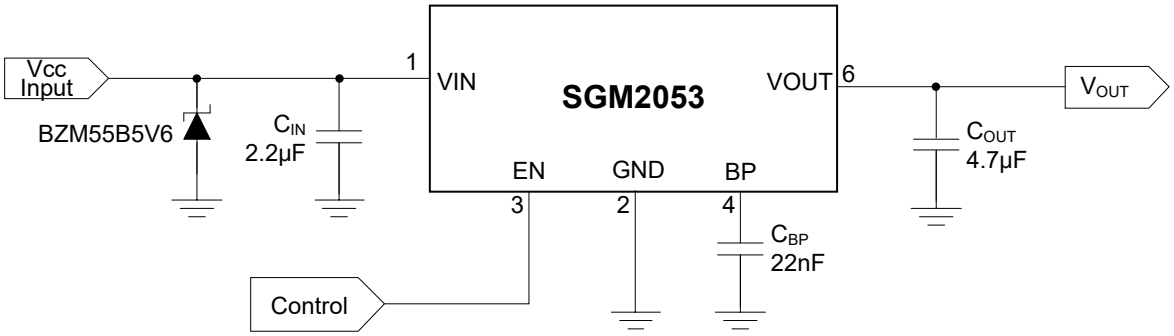


Figure 2. Fixed Output Voltage Version

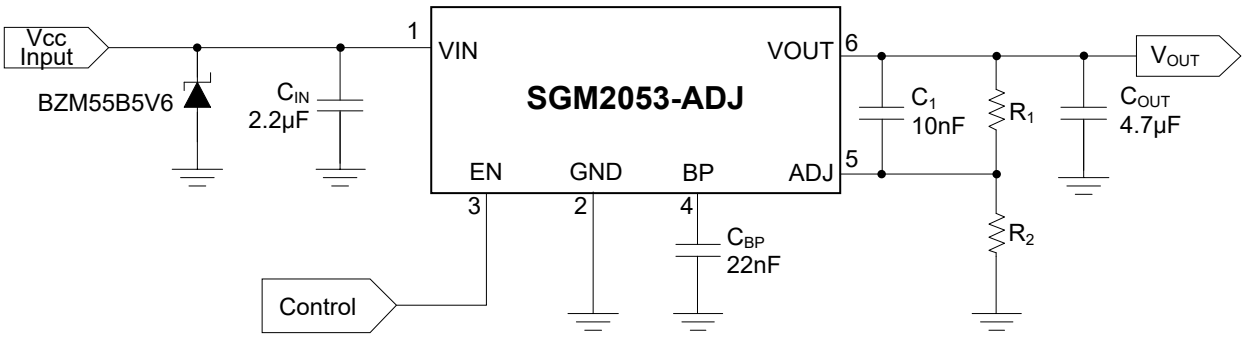
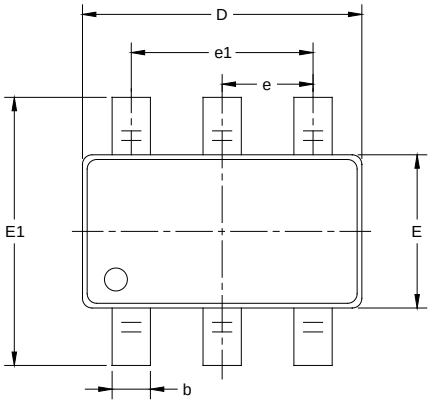
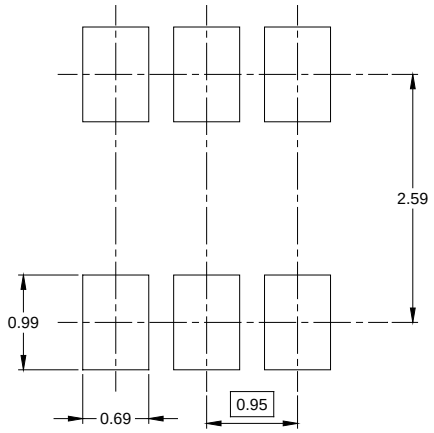


Figure 3. Adjustable Output Voltage Version

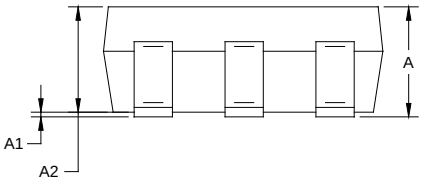
PACKAGE OUTLINE DIMENSIONS

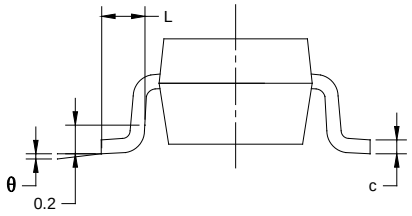
SOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)



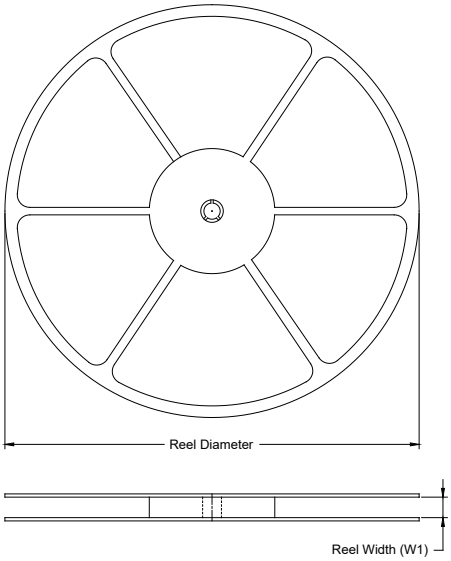


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

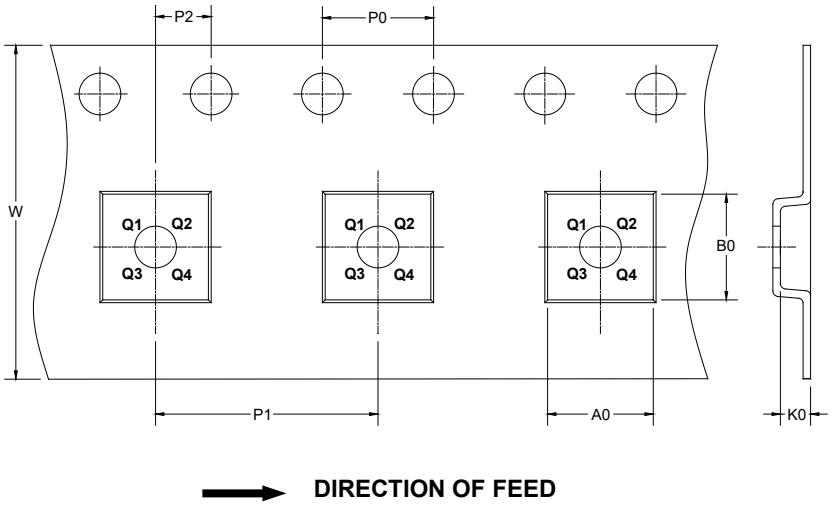
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



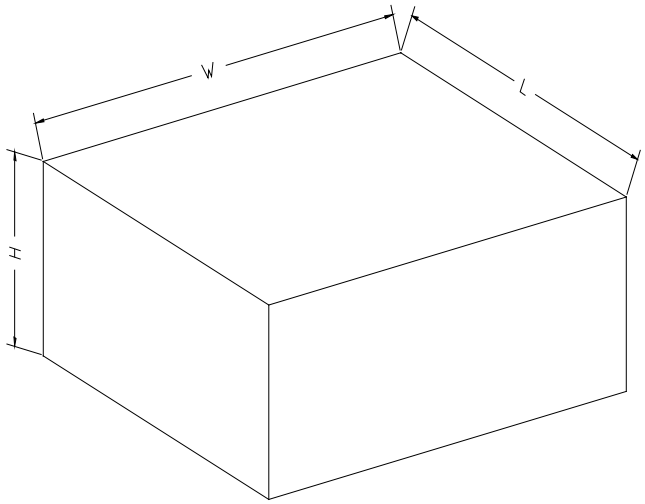
NOTE: The picture is only for reference. Please make the object as the standard.

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-23-6	7″	9.5	3.17	3.23	1.37	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