

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°C to $+125^{\circ}\text{C}$.

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: 95mV (TYP) at $V_{OUT} = 5.0\text{V}$**
- **High PSRR: 93dB (TYP) at 1kHz**
- **Turn-On Time: 70 μs (TYP)**
- **Low Output Noise: 20 μV_{RMS} (TYP)**
- **Fast Load Transient Response**
- **Thermal Shutdown Protection**
- **Output Current Limit**
- **Output Auto-Discharge in Shutdown**
- **-40°C to $+125^{\circ}\text{C}$ Operating Temperature Range**
- **Available in a Green SOT-23-6 Package**

APPLICATIONS

- Portable Equipment
- Smartphone
- Industrial and medical Equipment

TYPICAL APPLICATION

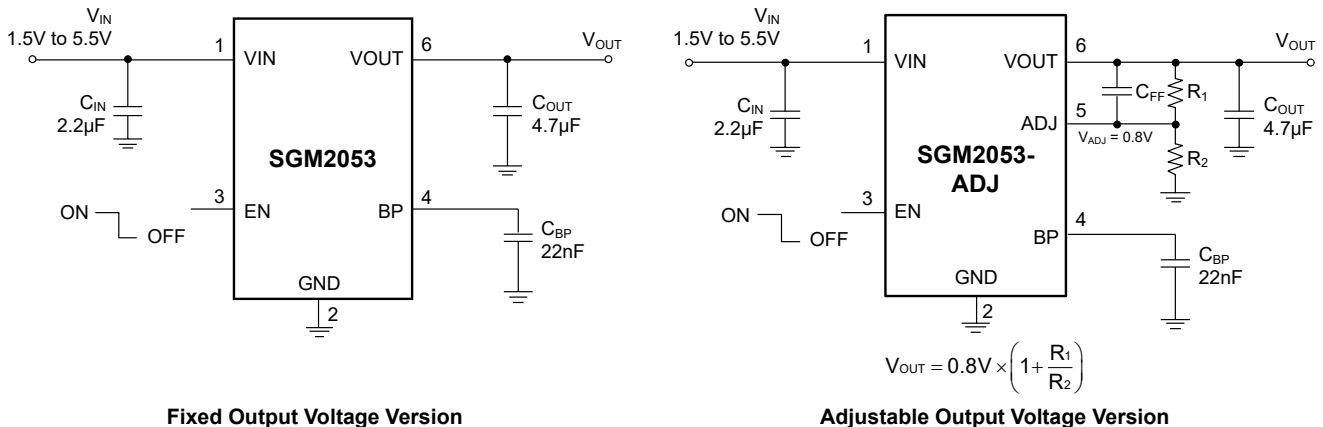


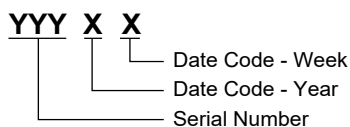
Figure 1. Typical Application Circuits

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2053-1.0	SOT-23-6	-40°C to +125°C	SGM2053-1.0XN6G/TR	CYAXX	Tape and Reel, 3000
SGM2053-1.05	SOT-23-6	-40°C to +125°C	SGM2053-1.05XN6G/TR	CY8XX	Tape and Reel, 3000
SGM2053-1.1	SOT-23-6	-40°C to +125°C	SGM2053-1.1XN6G/TR	CYCXX	Tape and Reel, 3000
SGM2053-1.8	SOT-23-6	-40°C to +125°C	SGM2053-1.8XN6G/TR	CYDXX	Tape and Reel, 3000
SGM2053-2.8	SOT-23-6	-40°C to +125°C	SGM2053-2.8XN6G/TR	CYEXX	Tape and Reel, 3000
SGM2053-3.0	SOT-23-6	-40°C to +125°C	SGM2053-3.0XN6G/TR	CYFXX	Tape and Reel, 3000
SGM2053-3.3	SOT-23-6	-40°C to +125°C	SGM2053-3.3XN6G/TR	CZ0XX	Tape and Reel, 3000
SGM2053-ADJ	SOT-23-6	-40°C to +125°C	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 6V
- EN to GND -0.3V to 6V
- VOUT, BP, ADJ to GND -0.3V to (VIN + 0.3V)
- Package Thermal Resistance
- SOT-23-6, θ_{JA} 196°C/W
- SOT-23-6, θ_{JB} 61°C/W
- SOT-23-6, θ_{JC} 81°C/W
- Junction Temperature +150°C
- Storage Temperature Range -65°C to +150°C
- Lead Temperature (Soldering, 10s) +260°C
- ESD Susceptibility
- HBM 8000V
- CDM 1000V

RECOMMENDED OPERATING CONDITIONS

- Input Supply Voltage Range 1.5V to 5.5V
- Input Effective Capacitance, CIN 1.5µF (MIN)
- Output Effective Capacitance, COUT 1µF to 10µF
- 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.

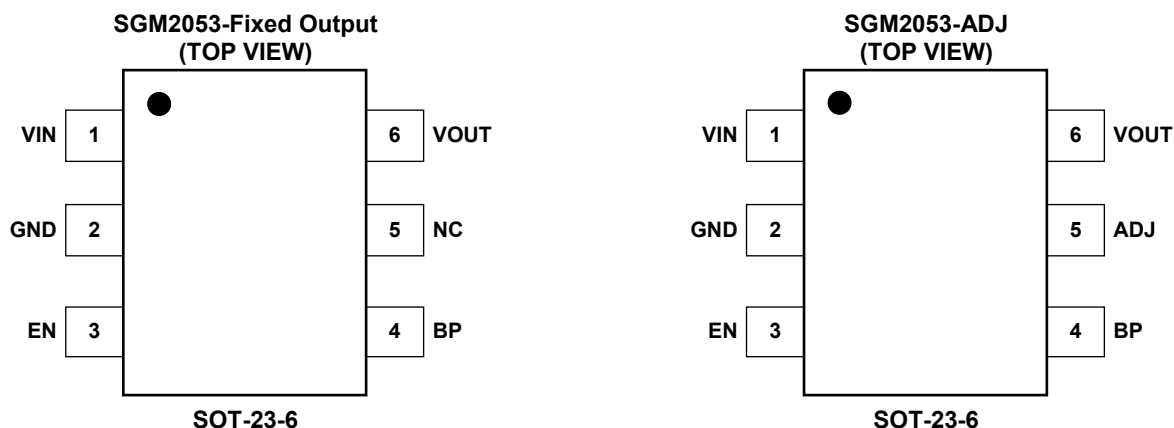
ESD SENSITIVITY CAUTION

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



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	VIN	Input Voltage Supply Pin. It is recommended to use a 2.2 μ F or larger ceramic capacitor from VIN pin to ground.
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 0.03 μ A pull-down current source which ensures that the device is turned off when the EN pin is floated.
4	BP	Reference-Noise Bypass Pin. Bypass with an external capacitor C_{BP} can reduce output noise to very low level.
5	NC	Not Connected (fixed voltage version only).
	ADJ	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.
6	VOUT	Regulator Output Pin. It is recommended to use an output capacitor with effective capacitance in the range of 1 μ F to 10 μ F. This ceramic capacitor should be placed as close as possible to VOUT pin.

ELECTRICAL CHARACTERISTICS

($V_{IN} = (V_{OUT(NOM)} + 0.5V)$ or 1.5V (whichever is greater). For SGM2053-ADJ, $V_{OUT} = 0.8V$, $V_{ADJ} = V_{OUT}$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$ and $C_{BP} = 22nF$, $T_J = -40^\circ C$ to $+125^\circ C$, typical values are at $T_J = +25^\circ C$, unless otherwise noted.)

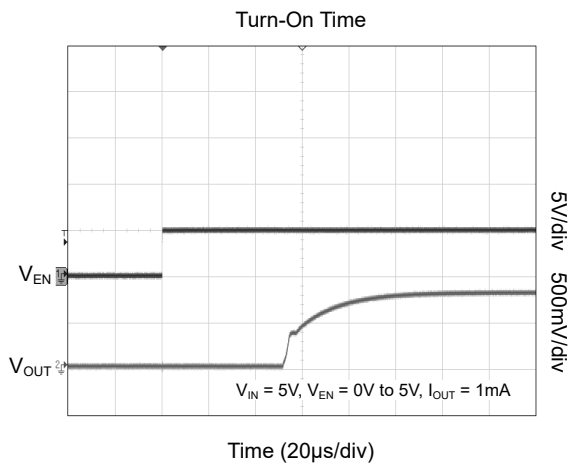
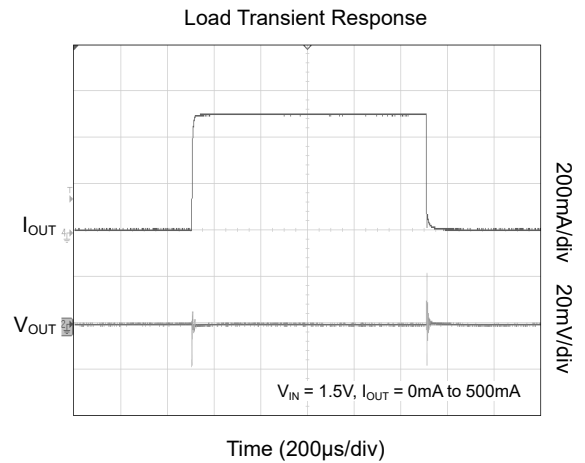
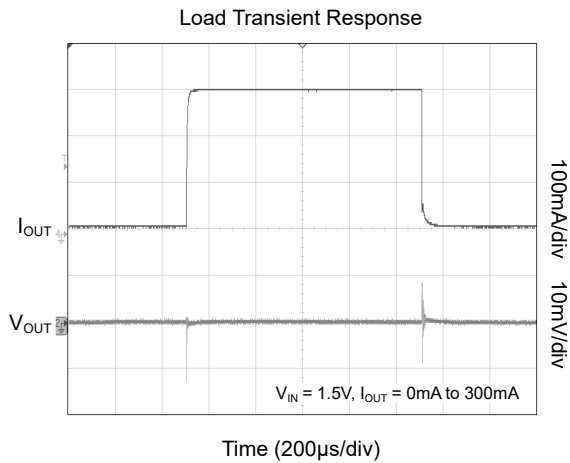
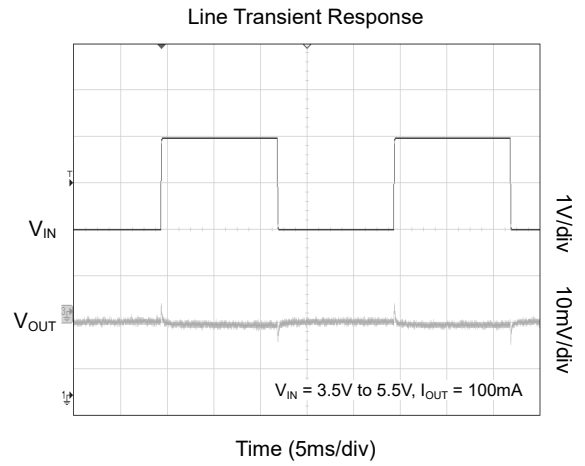
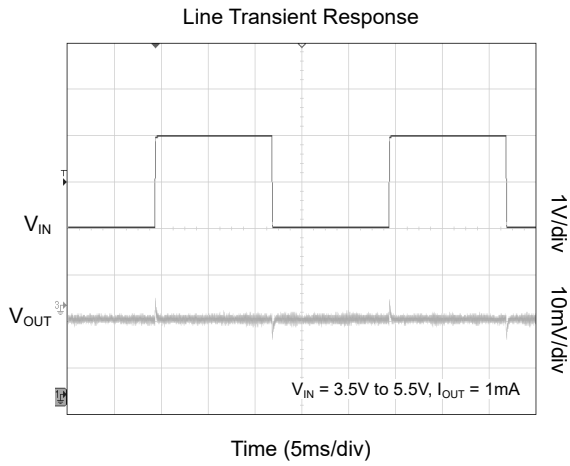
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
Input Voltage Range	V_{IN}		1.5		5.5	V	
Output Voltage Accuracy	V_{OUT}	$V_{IN} = (V_{OUT(NOM)} + 0.5V)$ to 5.5V, $I_{OUT} = 0.1mA$	-1		1	%	
		$T_J = +25^\circ C$					
		$T_J = -40^\circ C$ to $+125^\circ C$	-2.5		2.5		
Feedback Voltage	V_{ADJ}	$V_{IN} = (V_{OUT(NOM)} + 0.5V)$ to 5.5V, $I_{OUT} = 0.1mA$	0.792	0.8	0.808	V	
		$T_J = -40^\circ C$ to $+125^\circ C$	0.78		0.82		
ADJ Pin Input Bias Current	I_{ADJ}	$V_{OUT} = 0.9V$		0	20	nA	
Output Current Limit	I_{LIMIT}	$V_{OUT} = 0.9 \times V_{OUT(NOM)}$, $V_{OUT(NOM)} = 5V$	550	980		mA	
Short-Circuit Current	I_{SHORT}	$V_{OUT} = 0V$		560		mA	
Ground Pin Current	I_Q	No load, $V_{EN} = V_{IN} = 5.5V$		17	40	μA	
Line Regulation	ΔV_{LNR}	$V_{IN} = (V_{OUT(NOM)} + 0.5V)$ to 5.5V, $I_{OUT} = 0.1mA$		0.05	2	mV	
Load Regulation	$\Delta V_{LDR}/I_{OUT}$	$I_{OUT} = 0.1mA$ to 500mA		0.001	0.05	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 Voltage Noise	e_n	$V_{IN} = 1.5V$, $V_{OUT} = 0.8V$, $I_{OUT} = 50mA$, $f = 10Hz$ to 100kHz		20		μV_{RMS}	
Power Supply Rejection Ratio	PSRR	$V_{IN} = 1.5V$, $V_{OUT} = 0.8V$, $I_{OUT} = 50mA$	$f = 217Hz$		92		dB
			$f = 1kHz$		93		dB
			$f = 10kHz$		89		dB
Shutdown							
EN Input Threshold	V_{IH}	$V_{IN} = 1.5V$ to 5.5V	0.7			V	
	V_{IL}				0.3		
EN Input Bias Current	I_{ENH}	$V_{EN} = V_{IN} = 5.5V$		0.03	1	μA	
	I_{ENL}	$V_{EN} = 0V$, $V_{IN} = 5.5V$		0	1		
Shutdown Current	I_{SHDN}	$V_{EN} = 0V$, $V_{IN} = 5.5V$		0.03	2	μA	
Turn-On Time	t_{ON}	From EN rising from 0V to V_{IN} to $0.9 \times V_{OUT}$, $C_{BP} = 22nF$, no load		70	150	μs	
Output Discharge Resistance	R_{DIS}	$V_{EN} = 0V$, $V_{OUT} = 0.5V$, $V_{IN} = 1.5V$		60		Ω	
Thermal Protection							
Thermal Shutdown Temperature	T_{SHDN}			160		$^\circ C$	
Thermal Shutdown Hysteresis	ΔT_{SHDN}			20		$^\circ C$	

NOTE:

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

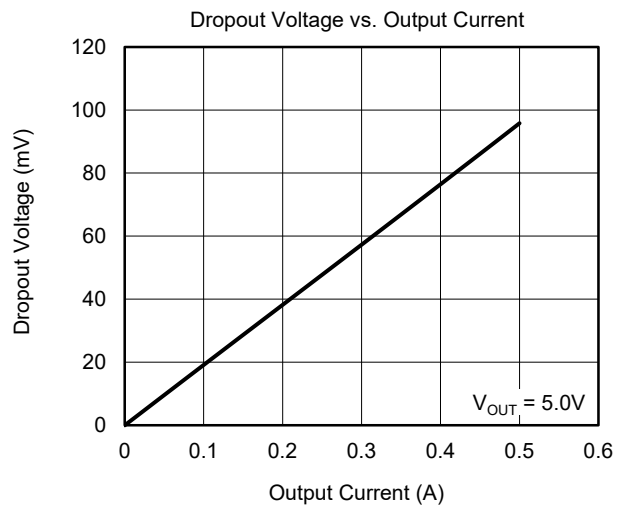
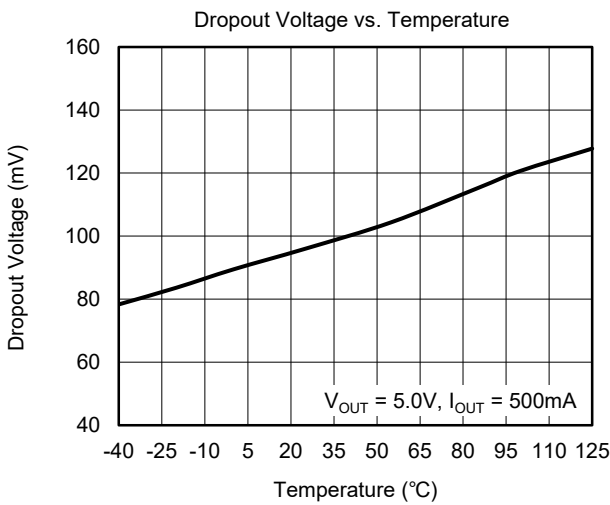
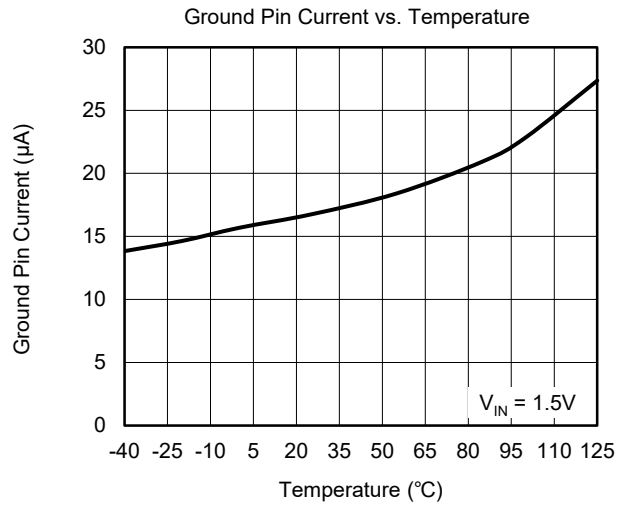
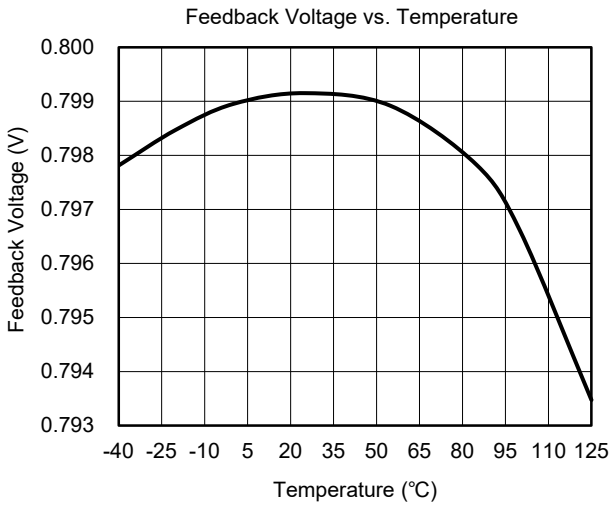
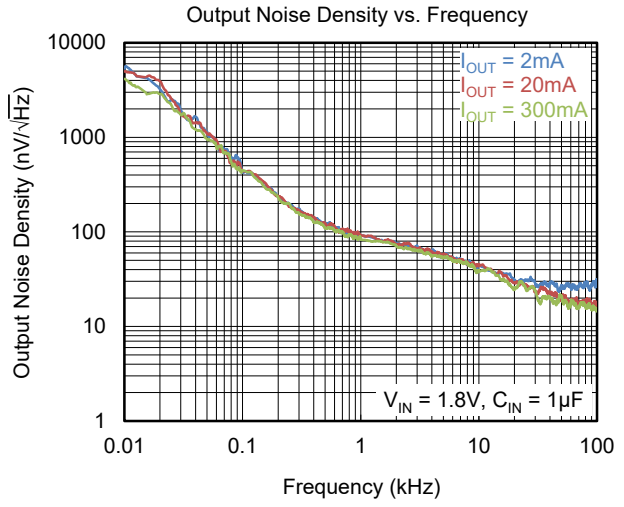
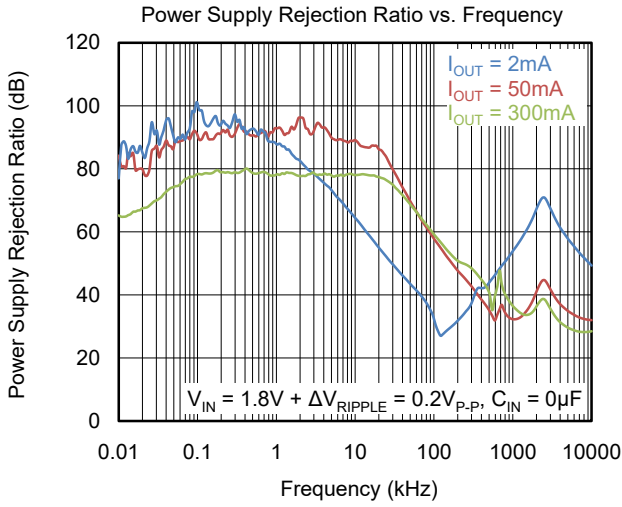
TYPICAL PERFORMANCE CHARACTERISTICS

$T_J = +25^{\circ}\text{C}$, $V_{IN} = V_{OUT(NOM)} + 1\text{V}$, $V_{OUT} = 0.8\text{V}$, $V_{ADJ} = V_{OUT}$, $C_{IN} = 2.2\mu\text{F}$, $C_{OUT} = 1\mu\text{F}$ and $C_{BP} = 22\text{nF}$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_J = +25^\circ\text{C}$, $V_{IN} = V_{OUT(NOM)} + 1\text{V}$, $V_{OUT} = 0.8\text{V}$, $V_{ADJ} = V_{OUT}$, $C_{IN} = 2.2\mu\text{F}$, $C_{OUT} = 1\mu\text{F}$ and $C_{BP} = 22\text{nF}$, unless otherwise noted.



FUNCTIONAL BLOCK DIAGRAMS

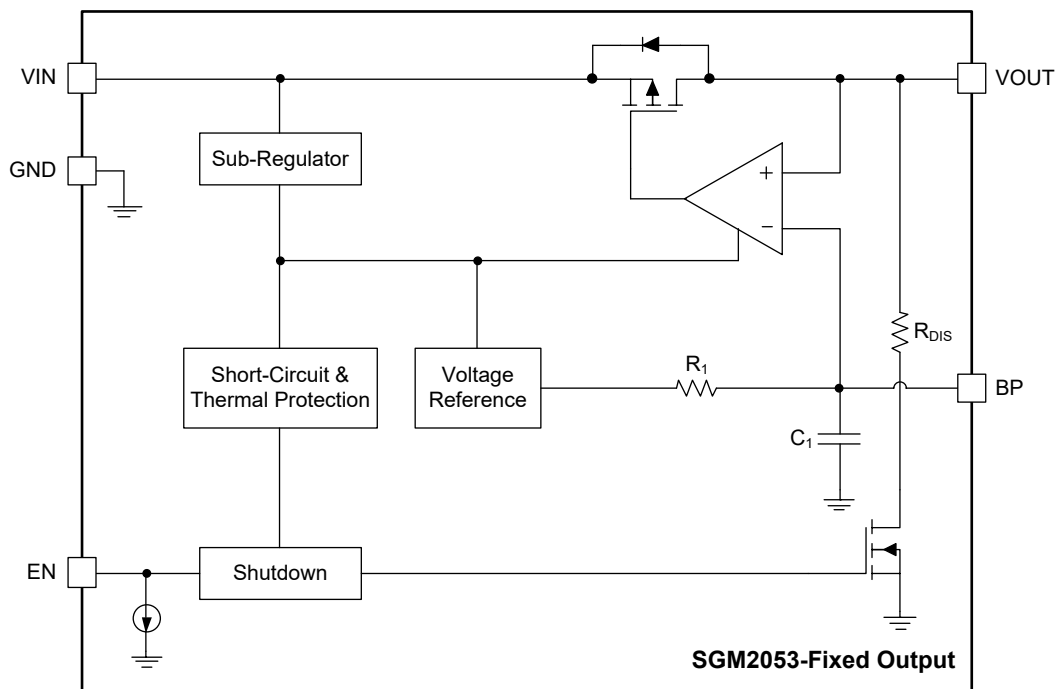


Figure 2. Fixed Output Regulator Block Diagram

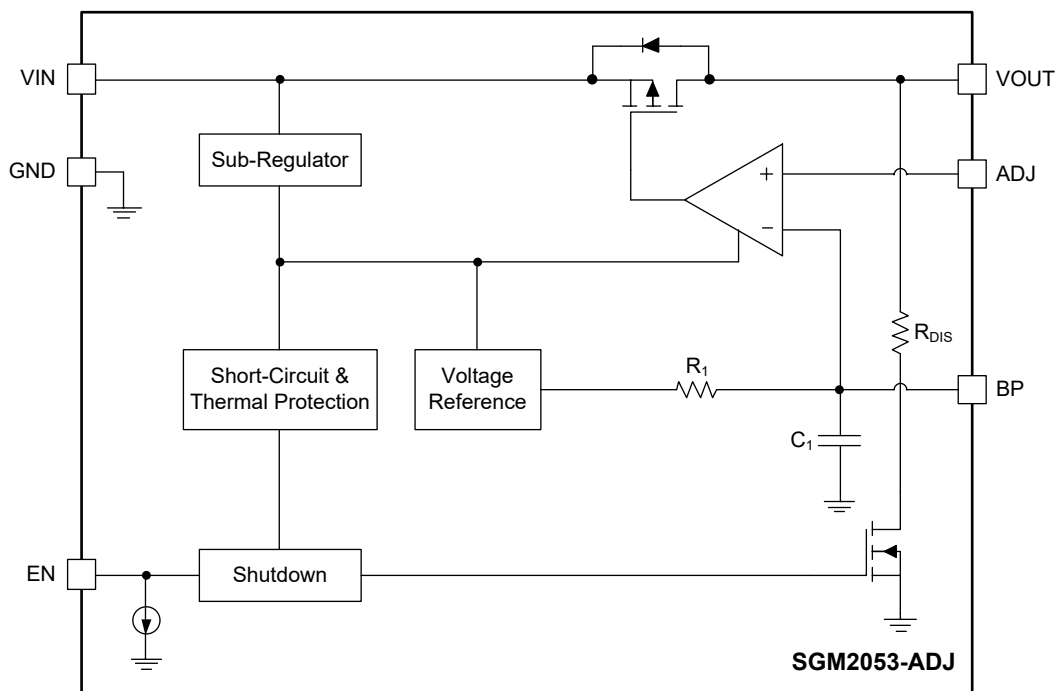


Figure 3. Adjustable Output Regulator Block Diagram

APPLICATION INFORMATION

The SGM2053 is a low input voltage, 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 SGM2053 useful in a variety of applications. The SGM2053 provides the protection function for output overload, output short-circuit condition and overheating.

The SGM2053 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 is necessary to be connected as close as possible to the VIN pin for ensuring the device stability. A 2.2μF or greater 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 reduce the impact from input trace 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 located as close as possible to the VOUT pin. A 4.7μF or greater X7R or X5R ceramic capacitor is selected to get good dynamic performance. The minimum effective capacitance of C_{OUT} that SGM2053 can remain stable is 1μF. 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. Larger capacitance and lower ESR C_{OUT} will help improve the load transient response and increase the high frequency PSRR.

Enable Control

The SGM2053 uses the EN pin 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 VIN to VOUT 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 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 SGM2053 in shutdown state and reduce the power dissipation in system.

Adjustable Regulator

For the SGM2053-ADJ, set the output voltage by using a resistor divider as shown in Figure 4. Capacitance $C_{FF} = 10nF$ can be added to improve stability and reduce noise. Choose $R_2 = 40k\Omega$ to maintain a 20μA minimum load. Calculate the value for R_1 using the following equation:

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

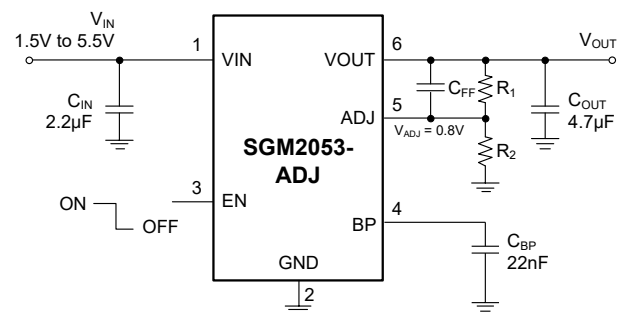


Figure 4. Adjustable Output Voltage Application

Output Current Limit and Short-Circuit Protection

When overload events happen, the output current is internally limited to 980mA (TYP). When the VOUT pin is shorted to ground, the short-circuit protection will limit the output current to 560mA (TYP).

APPLICATION INFORMATION (continued)

Negatively Biased Output

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

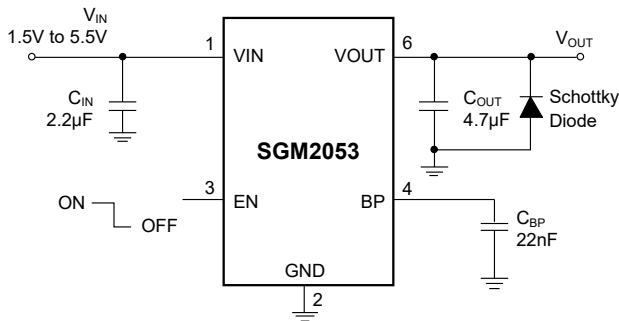


Figure 5. Negatively Biased Output Application

Reverse Current

The pass transistor has an inherent body diode which will be forward biased in the case when $V_{OUT} > (V_{IN} + 0.3V)$. If extended reverse voltage operation is anticipated, external limiting might be appropriate.

Power Dissipation (P_D)

Thermal protection limits power dissipation in the SGM2053. When power dissipation on pass element

($P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$) is too much that raise the operation junction temperature exceeds +160°C, the OTP circuit starts the thermal shutdown function and turns the pass element off.

Therefore, thermal analysis for the chosen application is important to guarantee reliable performance over all conditions. To guarantee reliable operation, the junction temperature of the SGM2053 must not exceed +125°C.

The maximum allowable power dissipation depends on the thermal resistance of the IC package, the PCB layout, the rate of surrounding airflow, and the difference between the junction and ambient temperatures. The maximum power dissipation can be approximated using the following formula:

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

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.

Thermal Shutdown

The SGM2053 can detect the temperature of die. When the die temperature exceeds the threshold value of thermal shutdown, the SGM2053 will be in shutdown state and it will remain in this state until the die temperature decreases to +140°C.

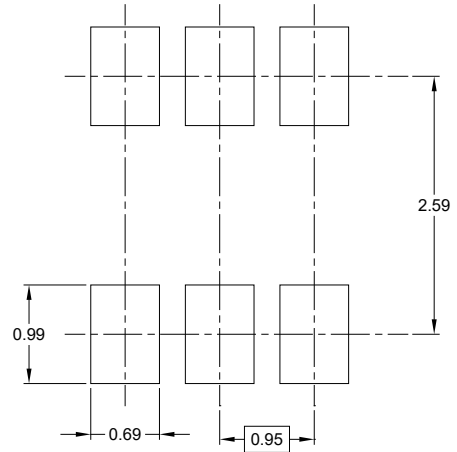
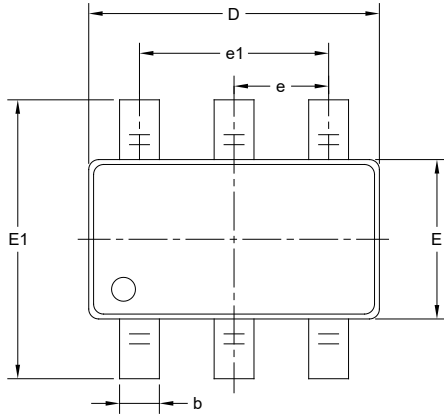
REVISION HISTORY

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

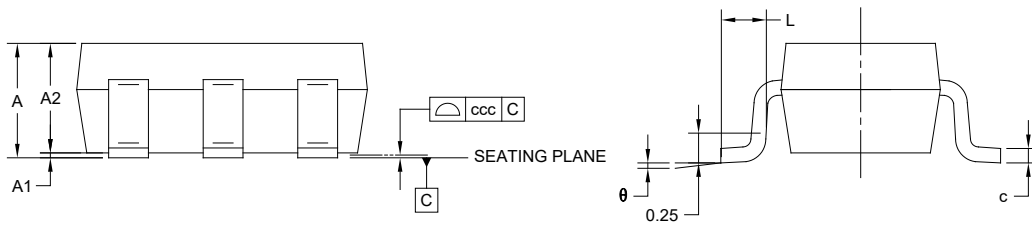
Changes from Original (MARCH 2022) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

SOT-23-6



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		
	MIN	MOD	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.

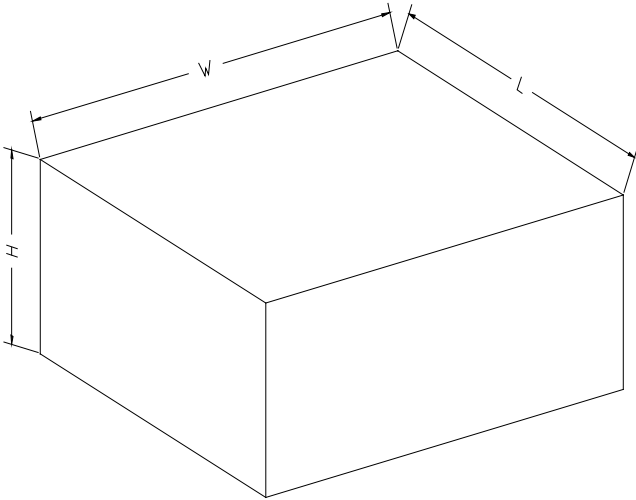
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT-23-6	7"	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3

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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

DD0002