



SGM4041

Micro-Power Precision Shunt Voltage Reference

GENERAL DESCRIPTION

The SGM4041 is a micro-power, precision shunt voltage reference which is easy to use in many applications. The device is available in a fixed output voltage of 1.225V and an adjustable version. It draws operating current up to 12mA. The device has no need for external capacitors and can keep stable with any capacitive load.

The SGM4041 features low temperature coefficient, low output noise, and low dynamic impedance. These characteristics enable the device to output stable voltage over a wide operating temperature and current range.

The SGM4041 offers high accuracy of 0.3% (MAX) for B grade and 0.5% (MAX) for C grade.

The SGM4041 is available in Green SOT-23 and SC70-5 packages. It operates over an ambient temperature range of -40°C to +125°C.

FEATURES

- **Fixed Output Voltage: 1.225V**
- **Adjustable Output Voltage: 1.206V to 10V**
- **Wide Operating Current Range:
45 μ A to 12mA (TYP)**
- **Output Voltage Accuracy:**
 - ◆ **SGM4041B: 0.3% (MAX)**
 - ◆ **SGM4041C: 0.5% (MAX)**
- **Low Temperature Coefficient: 20ppm/°C (TYP)**
- **Low Output Noise: 16 μ V_{RMS} (TYP)**
- **Stable without External Capacitors**
- **Stable with Any Capacitive Load**
- **-40°C to +125°C Operating Temperature Range**
- **Available in Green SOT-23 and SC70-5 Packages**

APPLICATIONS

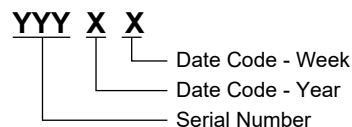
Precision Data-Acquisition Systems
Instrumentation and Test Equipment
Industrial Process Controls
Precision Audio Components
Power Management
Battery-Powered Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4041B-1.2	SOT-23	-40°C to +125°C	SGM4041B-1.2XN3LG/TR	SZRXX	Tape and Reel, 3000
SGM4041C-1.2	SOT-23	-40°C to +125°C	SGM4041C-1.2XN3LG/TR	G5SXX	Tape and Reel, 3000
	SC70-5	-40°C to +125°C	SGM4041C-1.2XC5G/TR	00TXX	Tape and Reel, 3000
SGM4041B-ADJ	SOT-23	-40°C to +125°C	SGM4041B-ADJXN3LG/TR	00UXX	Tape and Reel, 3000
	SC70-5	-40°C to +125°C	SGM4041B-ADJXC5G/TR	00VXX	Tape and Reel, 3000
SGM4041C-ADJ	SOT-23	-40°C to +125°C	SGM4041C-ADJXN3LG/TR	CZ3XX	Tape and Reel, 3000
	SC70-5	-40°C to +125°C	SGM4041C-ADJXC5G/TR	OREXX	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

Junction Temperature+150°C
 Storage Temperature Range.....-65°C to +150°C
 Lead Temperature (Soldering, 10s)+260°C
 ESD Susceptibility
 HBM..... 5000V
 CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Operating 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

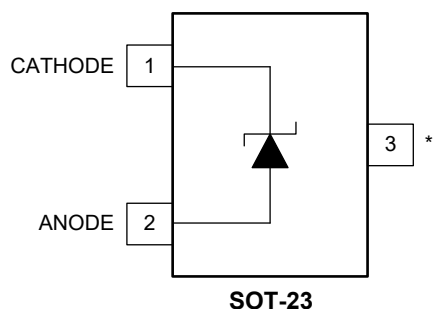
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

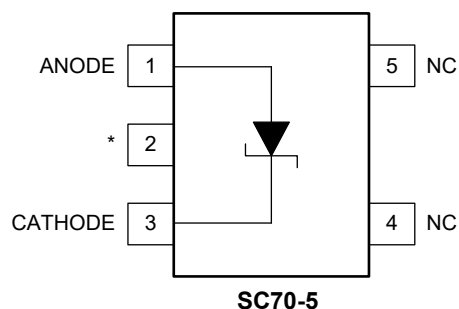
SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATIONS

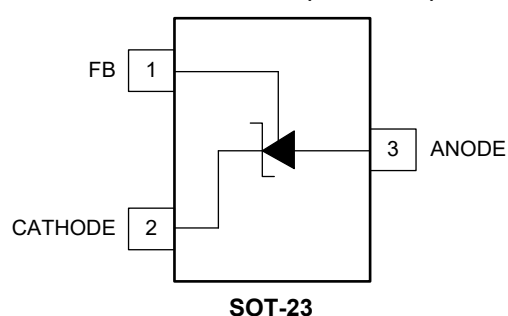
SGM4041B/C-1.2 (TOP VIEW)



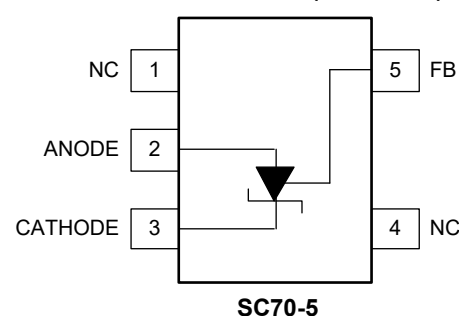
SGM4041C-1.2 (TOP VIEW)



SGM4041B/C-ADJ (TOP VIEW)



SGM4041B/C-ADJ (TOP VIEW)



PIN DESCRIPTION

PIN				NAME	I/O	FUNCTION
SGM4041 B/C-1.2 SOT-23	SGM4041 C-1.2 SC70-5	SGM4041 B/C-ADJ SOT-23	SGM4041 B/C-ADJ SC70-5			
1	3	2	3	CATHODE	I/O	Cathode Pin. Shunt current and output voltage.
2	1	3	2	ANODE	O	Anode Pin. Connect to GND directly.
3	2	—	—	*	—	Must be connected to ANODE pin or left floating.
—	4, 5	—	1, 4	NC	—	Not Connected.
—	—	1	5	FB	I	Feedback Pin. Used for Adjusting Output Voltage.

SGM4041B-1.2 ELECTRICAL CHARACTERISTICS

(Full = -40°C to +125°C, typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Reverse Breakdown Voltage (V _Z)	I _Z = 100μA	+25°C		1.225		V
Reverse Breakdown Voltage Tolerance	I _Z = 100μA	+25°C	-3.67		3.67	mV
		Full	-10.5		10.5	
Minimum Cathode Current (I _{Z(MIN)})		+25°C		45	70	μA
		Full			90	
Average Temperature Coefficient of Reverse Breakdown Voltage (αV _Z)	I _Z = 10mA	Full		20		ppm/°C
	I _Z = 1mA	Full		20		
	I _Z = 100μA	Full		15		
Reverse Breakdown Voltage Change with Cathode Current Change (ΔV _Z /ΔI _Z)	I _{Z(MIN)} < I _Z < 1mA	+25°C		0.55	1.3	mV
		Full			2.8	
	1mA < I _Z < 12mA	+25°C		1.5	3	
		Full			4	
Reverse Dynamic Impedance (Z _Z)	I _Z = 1mA, I _{AC} = 0.5I _Z	+25°C		0.5	1.2	Ω
		Full			1.5	
Wideband Noise (e _n)	I _Z = 100μA, 10Hz ≤ f ≤ 10kHz	+25°C		16		μV _{RMS}
Thermal Hysteresis ⁽¹⁾ (V _{HYST})	ΔT _A = -40°C to +125°C			0.3		mV

SGM4041C-1.2 ELECTRICAL CHARACTERISTICS

(Full = -40°C to +125°C, typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Reverse Breakdown Voltage (V _Z)	I _Z = 100μA	+25°C		1.225		V
Reverse Breakdown Voltage Tolerance	I _Z = 100μA	+25°C	-6.1		6.1	mV
		Full	-10.5		10.5	
Minimum Cathode Current (I _{Z(MIN)})		+25°C		45	70	μA
		Full			90	
Average Temperature Coefficient of Reverse Breakdown Voltage (αV _Z)	I _Z = 10mA	Full		20		ppm/°C
	I _Z = 1mA	Full		20		
	I _Z = 100μA	Full		15		
Reverse Breakdown Voltage Change with Cathode Current Change (ΔV _Z /ΔI _Z)	I _{Z(MIN)} < I _Z < 1mA	+25°C		0.55	1.3	mV
		Full			2.8	
	1mA < I _Z < 12mA	+25°C		1.5	3	
		Full			4	
Reverse Dynamic Impedance (Z _Z)	I _Z = 1mA, I _{AC} = 0.5I _Z	+25°C		0.5	1.2	Ω
		Full			1.5	
Wideband Noise (e _n)	I _Z = 100μA, 10Hz ≤ f ≤ 10kHz	+25°C		16		μV _{RMS}
Thermal Hysteresis ⁽¹⁾ (V _{HYST})	ΔT _A = -40°C to +125°C			0.3		mV

NOTE: 1. Thermal hysteresis is defined as the output voltage difference at the +25°C after a temperature excursion to -40°C, then to +125°C, and back to +25°C.

SGM4041B-ADJ ELECTRICAL CHARACTERISTICS

(Full = -40°C to +125°C, typical values are at $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Reverse Breakdown Voltage (V_Z)	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		1.206		V
Reverse Breakdown Voltage Tolerance	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C	-3.62		3.62	mV
		Full	-13.50		13.50	
Minimum Cathode Current ($I_{Z(\text{MIN})}$)	$V_{\text{OUT}} = 1.206\text{V}$	+25°C		39	60	μA
		Full			75	
Average Temperature Coefficient of Reverse Breakdown Voltage (α_{V_Z})	$I_Z = 12\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		20		ppm/°C
	$I_Z = 1\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		20		
	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		20		
Reverse Breakdown Voltage Change with Cathode Current Change ($\Delta V_Z/\Delta I_Z$)	$I_{Z(\text{MIN})} < I_Z < 1\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		0.6	1.5	mV
		Full			2.8	
	$1\text{mA} < I_Z < 12\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		0.45	1.2	
		Full			2.4	
Reference Voltage Change with Output Voltage Change ($\Delta V_{\text{REF}}/\Delta V_{\text{KA}}$)	$I_Z = 1\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}/10\text{V}$	+25°C		0.08	0.18	mV/V
		Full			0.23	
Reverse Dynamic Impedance (Z_Z)	$I_Z = 1\text{mA}$, $I_{\text{AC}} = 0.5I_Z$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		0.36	1.5	Ω
		Full			2	
Feedback Current (I_{FB})	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}/15\text{V}$	+25°C		200	300	nA
		Full			350	
Wideband Noise (e_n)	$I_Z = 100\mu\text{A}$, $10\text{Hz} \leq f \leq 10\text{kHz}$	+25°C		16		μV_{RMS}
Long-Term Stability of Reverse Breakdown Voltage	$I_Z = 100\mu\text{A}$, $t = 1000\text{h}$, $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$	+25°C		100		ppm

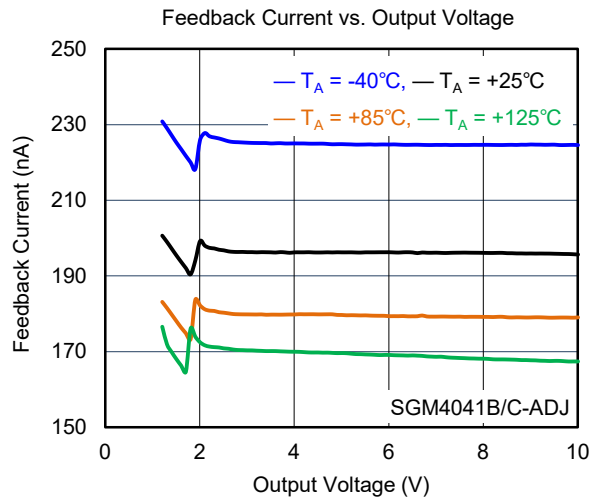
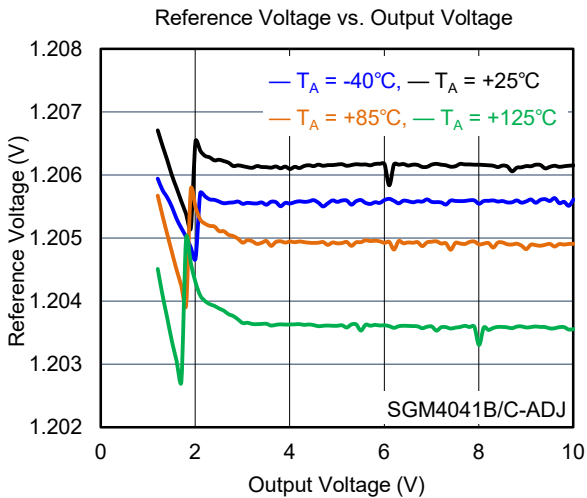
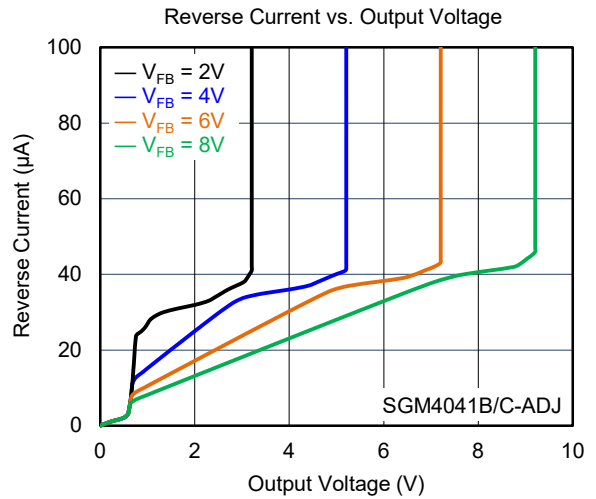
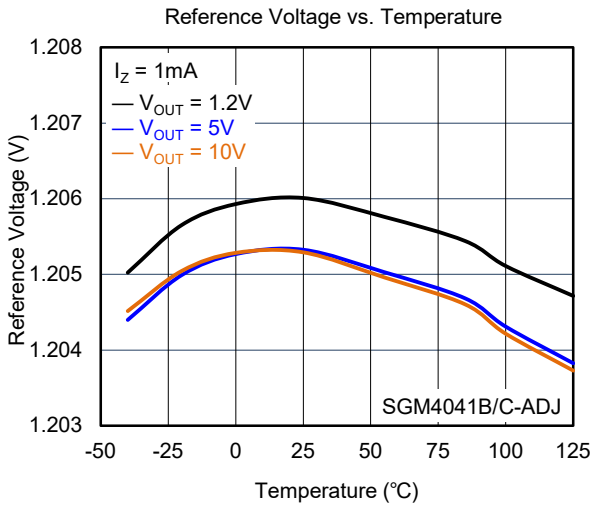
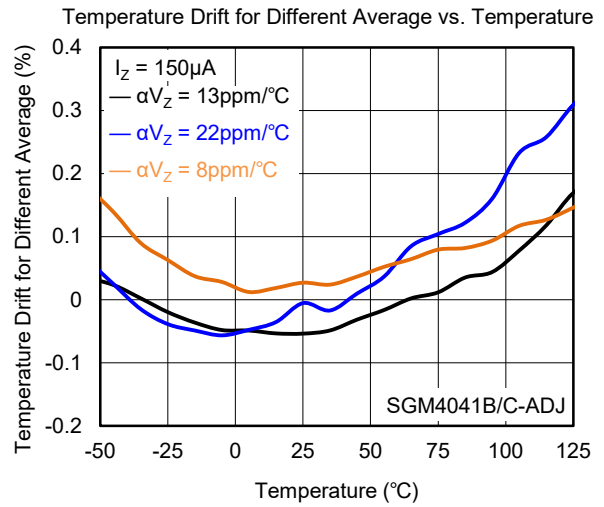
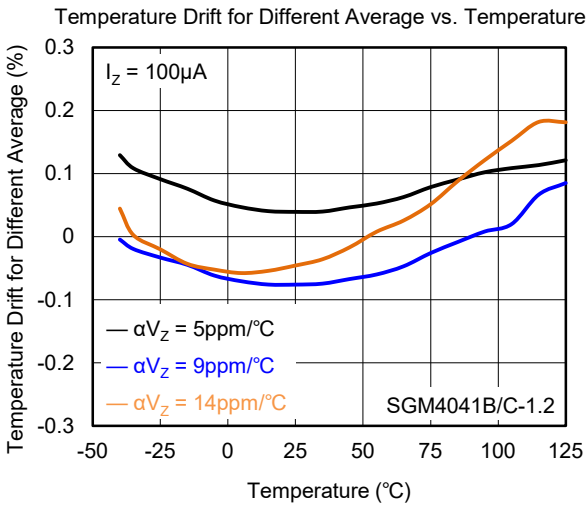
SGM4041C-ADJ ELECTRICAL CHARACTERISTICS

(Full = -40°C to +125°C, typical values are at $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Reverse Breakdown Voltage (V_Z)	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		1.206		V
Reverse Breakdown Voltage Tolerance	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C	-6.03		6.03	mV
		Full	-15.50		15.50	
Minimum Cathode Current ($I_{Z(\text{MIN})}$)	$V_{\text{OUT}} = 1.206\text{V}$	+25°C		39	60	μA
		Full			75	
Average Temperature Coefficient of Reverse Breakdown Voltage (α_{V_Z})	$I_Z = 12\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		20		ppm/°C
	$I_Z = 1\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		20		
	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		20		
Reverse Breakdown Voltage Change with Cathode Current Change ($\Delta V_Z/\Delta I_Z$)	$I_{Z(\text{MIN})} < I_Z < 1\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		0.6	1.5	mV
		Full			2.8	
	$1\text{mA} < I_Z < 12\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		0.45	1.2	
		Full			2.4	
Reference Voltage Change with Output Voltage Change ($\Delta V_{\text{REF}}/\Delta V_{\text{KA}}$)	$I_Z = 1\text{mA}$, $V_{\text{OUT}} = 1.206\text{V}/10\text{V}$	+25°C		0.08	0.18	mV/V
		Full			0.23	
Reverse Dynamic Impedance (Z_Z)	$I_Z = 1\text{mA}$, $I_{\text{AC}} = 0.5I_Z$, $V_{\text{OUT}} = 1.206\text{V}$	+25°C		0.36	1.5	Ω
		Full			2	
Feedback Current (I_{FB})	$I_Z = 100\mu\text{A}$, $V_{\text{OUT}} = 1.206\text{V}/15\text{V}$	+25°C		200	300	nA
		Full			350	
Wideband Noise (e_n)	$I_Z = 100\mu\text{A}$, $10\text{Hz} \leq f \leq 10\text{kHz}$	+25°C		16		μV_{RMS}
Long-Term Stability of Reverse Breakdown Voltage	$I_Z = 100\mu\text{A}$, $t = 1000\text{h}$, $T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$	+25°C		100		ppm

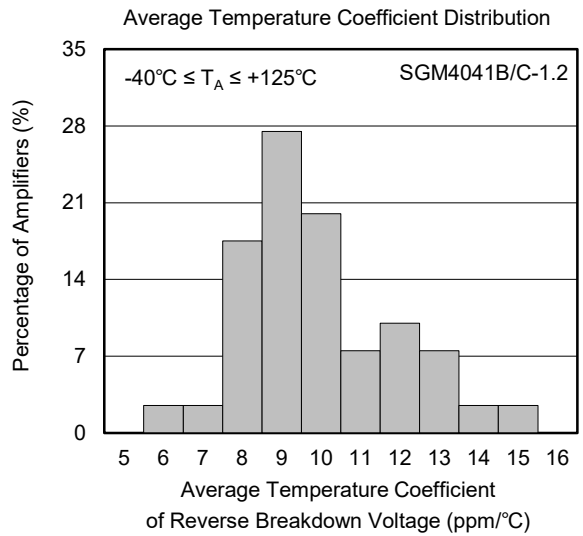
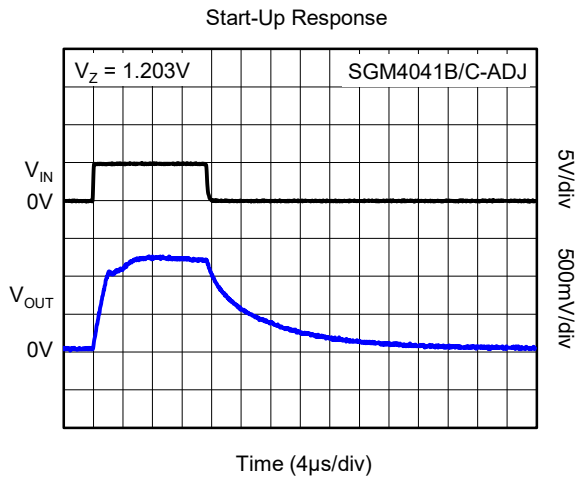
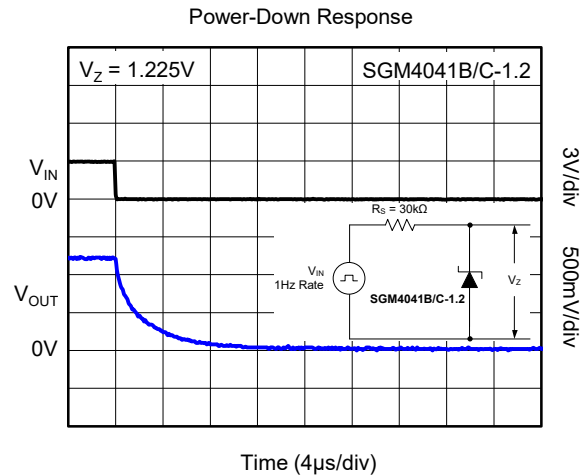
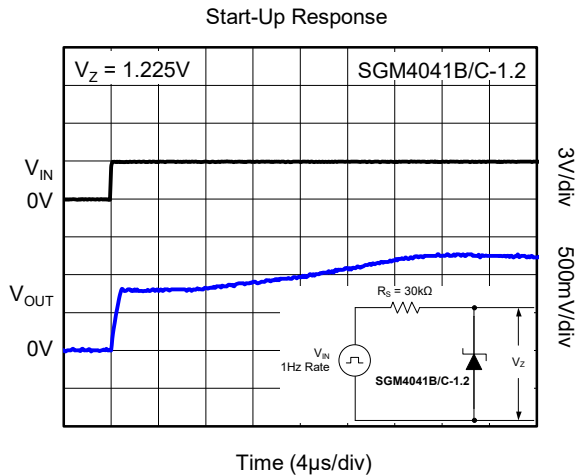
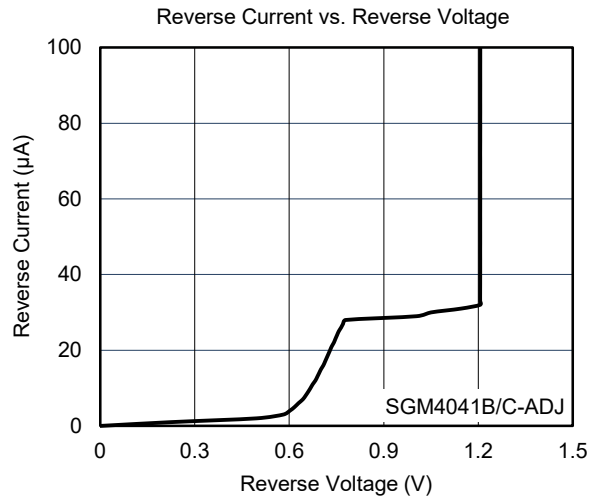
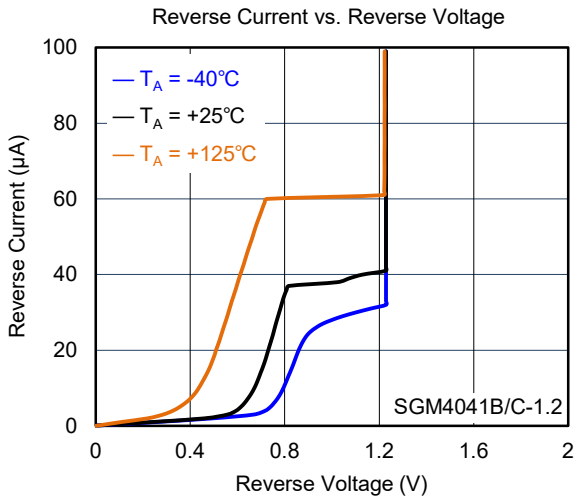
TYPICAL PERFORMANCE CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, unless otherwise noted.



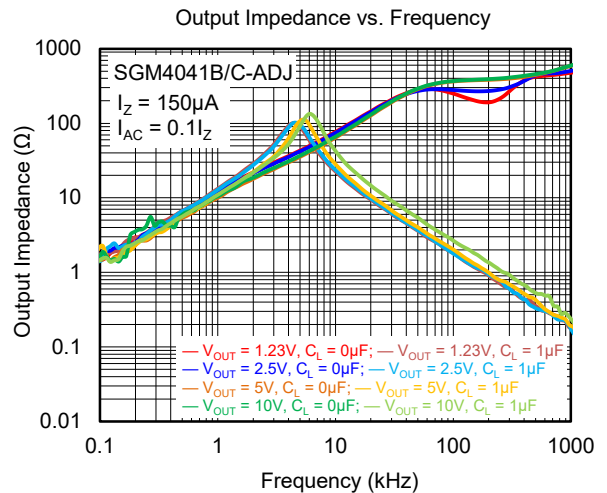
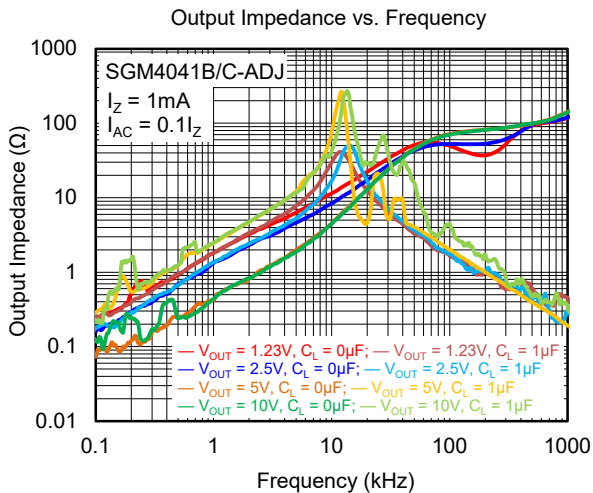
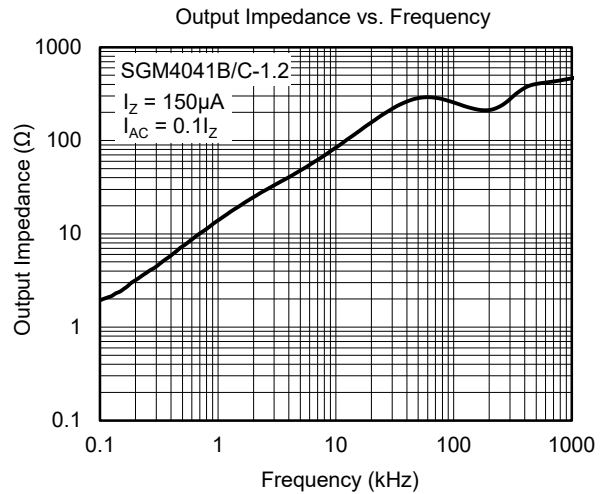
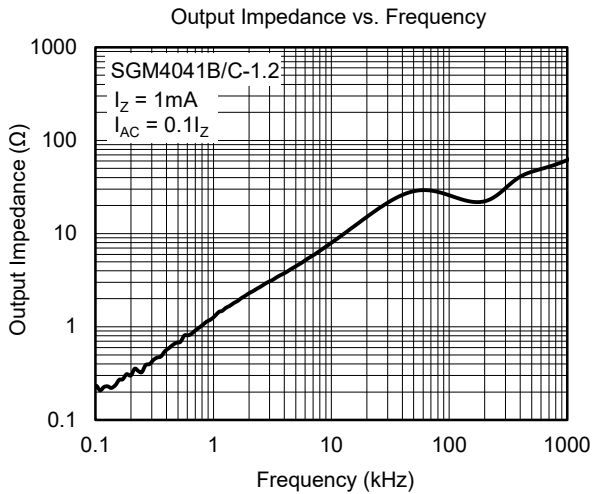
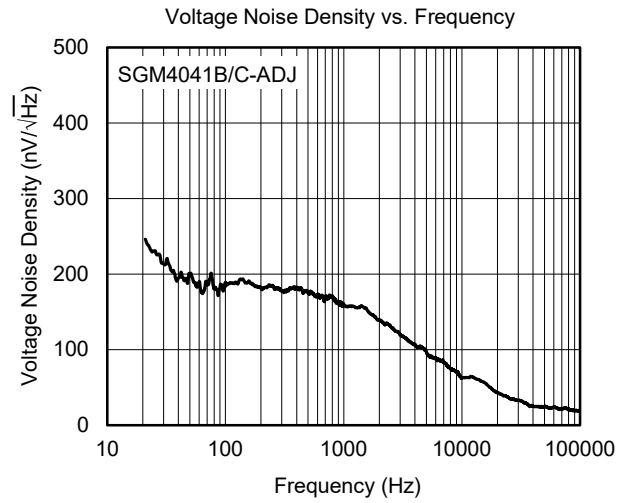
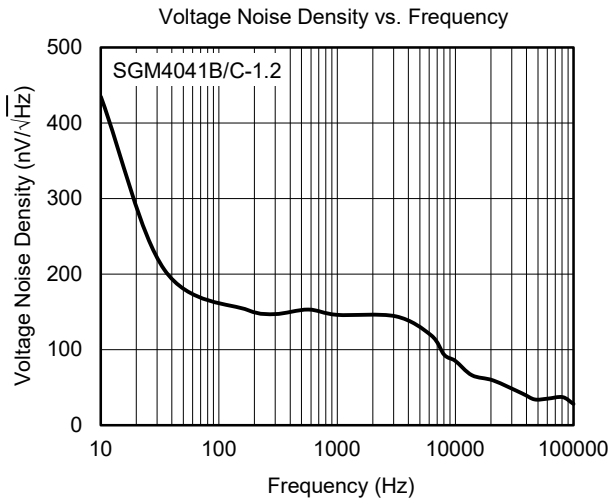
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, unless otherwise noted.



APPLICATION INFORMATION

Output Capacitor

Because of the excellent stability of the shunt voltage reference, the capacitors are not required to be connected between CATHODE and ANODE pins. However, if a bypass capacitor is required, the stability of SGM4041 will not be reduced.

Adjustable Version

The advantage of this version is that the users can adjust the output voltage by simply changing the resistance of the voltage divider R_1 and R_2 . Also, the relationship between V_{REF} and V_Z is shown as below:

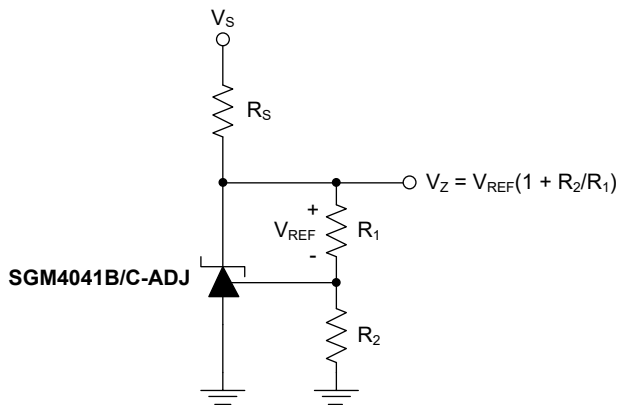


Figure 1. Adjustable Shunt Regulator

Load Current and Cathode

For the shunt regulator shown in Figure 2, R_S is required to be connected between V_S and the cathode of SGM4041. The value of R_S is significant for this shunt regulator because it determines how much

current can be flowed to the voltage reference itself (I_Z) and the load (I_L), and the user needs to make sure that the cathode current (I_Z) is operated within the design specification. However, for one extreme case, if the supply voltage and load is varied (the load current I_L is maximum and the V_S is minimum), it is recommended that the resistance of R_S should be selected low enough to guarantee normal operation of the shunt regulator. For the other extreme, I_L is minimum and V_S is maximum, the resistance of R_S should be large enough to guarantee that the operating current I_Z is less than 12mA.

The equation 1 shows the calculation of R_S .

$$R_S = \frac{V_S - V_Z}{I_L + I_Z} \quad (1)$$

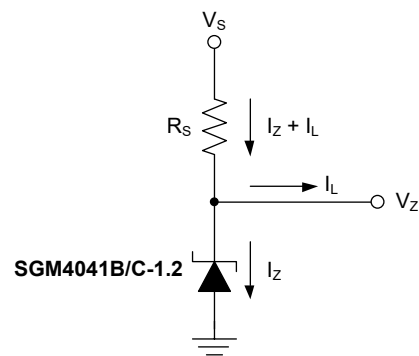


Figure 2. Shunt Regulator

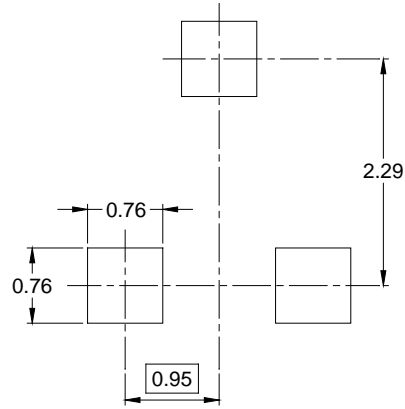
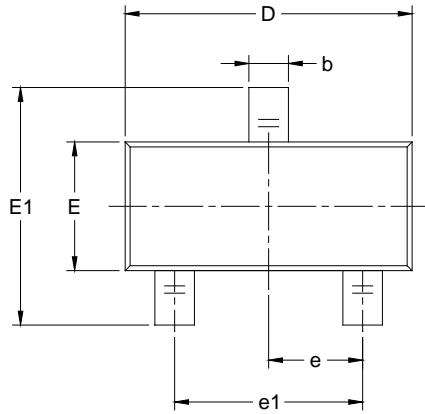
REVISION HISTORY

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

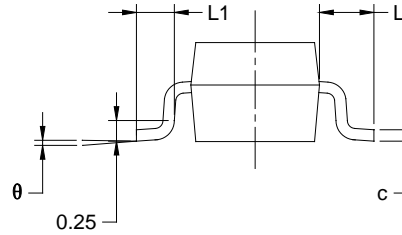
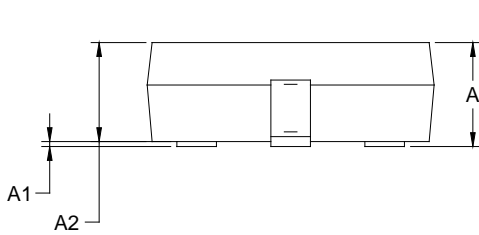
Changes from Original (MARCH 2022) to REV.A	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

SOT-23



RECOMMENDED LAND PATTERN (Unit: mm)



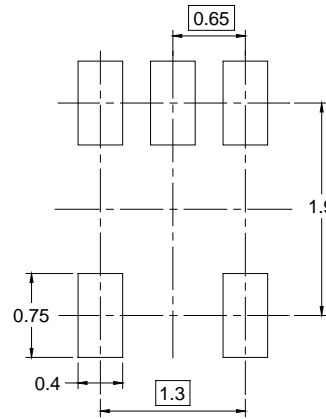
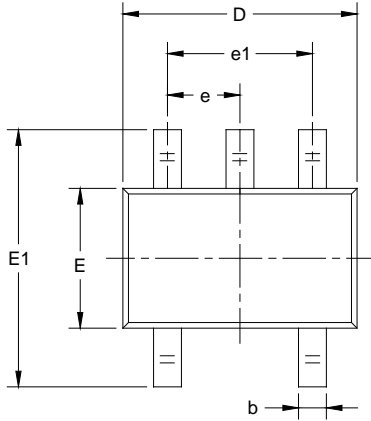
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.89	1.12	0.035	0.044
A1	0.01	0.10	0.000	0.004
A2	0.88	1.02	0.035	0.040
b	0.30	0.50	0.012	0.020
c	0.08	0.20	0.003	0.008
D	2.80	3.04	0.110	0.120
E	1.20	1.40	0.047	0.055
E1	2.10	2.64	0.083	0.104
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.54 REF		0.021 REF	
L1	0.40	0.60	0.016	0.024
θ	0°	8°	0°	8°

NOTES:

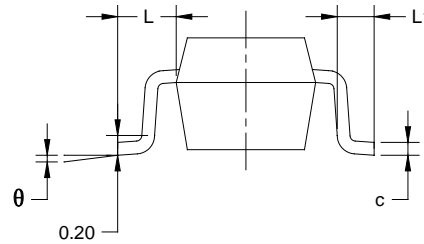
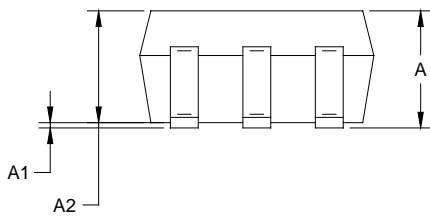
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

SC70-5



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.220	0.003	0.009
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
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	7"	9.5	3.15	2.77	1.22	4.0	4.0	2.0	8.0	Q3
SC70-5	7"	9.5	2.25	2.55	1.20	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

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