

GENERAL DESCRIPTION

The SGM2232 is a high voltage, ultra-low quiescent current, high PSRR and low dropout voltage linear regulator. It is capable of supplying 150mA output current with typical dropout voltage of 570mV. The operating input voltage range is from 4V to 40V and output voltage range is from 2.5V to 12V.

Other features include under-voltage lockout, short-circuit current limit and thermal shutdown protection. The SGM2232 is suitable for various applications.

The SGM2232 is available in Green SOT-89-3, SOT-223-3 and SOT-23-5 packages. It operates over an operating temperature range of -40°C to $+125^{\circ}\text{C}$.

FEATURES

- Operating Input Voltage Range: 4V to 40V
- Fixed Output from 2.5V to 12V
- 150mA Output Current
- Output Voltage Accuracy: $\pm 3\%$ at $T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
- Low Quiescent Current: 16 μA (TYP)
- Low Dropout Voltage: 570mV (TYP) at 150mA
- High PSRR:
 - ◆ 84dB (TYP) at 1kHz
 - ◆ 56dB (TYP) at 100kHz
 - ◆ 63dB (TYP) at 1MHz
- Current Limiting and Thermal Protection
- Under-Voltage Lockout (UVLO)
- Stable with Low ESR Ceramic Capacitors
- -40°C to $+125^{\circ}\text{C}$ Operating Temperature Range
- Available in Green SOT-89-3, SOT-223-3 and SOT-23-5 Packages

APPLICATIONS

Industrial Equipment
 Medical Equipment
 Telecom Equipment
 Wireless Equipment

TYPICAL APPLICATION

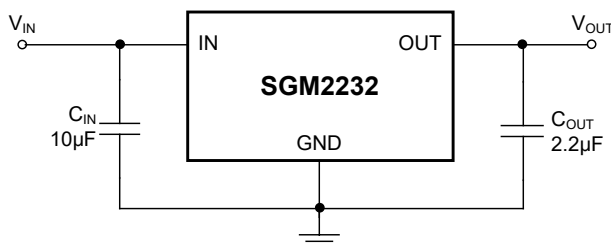


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

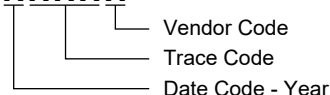
MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2232-2.5	SOT-89-3	-40°C to +125°C	SGM2232-2.5XK3G/TR	150XX	Tape and Reel, 1000
SGM2232-3.3	SOT-89-3	-40°C to +125°C	SGM2232-3.3XK3G/TR	151XX	Tape and Reel, 1000
SGM2232-5.0	SOT-89-3	-40°C to +125°C	SGM2232-5.0XK3G/TR	152XX	Tape and Reel, 1000
SGM2232-8.0	SOT-89-3	-40°C to +125°C	SGM2232-8.0XK3G/TR	171XX	Tape and Reel, 1000
SGM2232-9.0	SOT-89-3	-40°C to +125°C	SGM2232-9.0XK3G/TR	172XX	Tape and Reel, 1000
SGM2232-12	SOT-89-3	-40°C to +125°C	SGM2232-12XK3G/TR	173XX	Tape and Reel, 1000
SGM2232-2.5	SOT-223-3	-40°C to +125°C	SGM2232-2.5XKC3G/TR	0UA XXXXXX	Tape and Reel, 2500
SGM2232-3.3	SOT-223-3	-40°C to +125°C	SGM2232-3.3XKC3G/TR	0UB XXXXXX	Tape and Reel, 2500
SGM2232-5.0	SOT-223-3	-40°C to +125°C	SGM2232-5.0XKC3G/TR	0UC XXXXXX	Tape and Reel, 2500
SGM2232-2.5	SOT-23-5	-40°C to +125°C	SGM2232-2.5XN5G/TR	0U7XX	Tape and Reel, 3000
SGM2232-3.3	SOT-23-5	-40°C to +125°C	SGM2232-3.3XN5G/TR	0U8XX	Tape and Reel, 3000
SGM2232-5.0	SOT-23-5	-40°C to +125°C	SGM2232-5.0XN5G/TR	0U9XX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXXX = Date Code, Trace Code and Vendor Code. XX = Date Code.

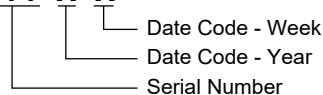
SOT-223-3

XXXXX



SOT-89-3/SOT-23-5

YYY X X



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 45V
OUT to GND	-0.3V to MIN((V _{IN} + 0.3V), 45V)
Package Thermal Resistance	
SOT-89-3, θ_{JA}	52.5°C/W
SOT-89-3, θ_{JB}	6.9°C/W
SOT-89-3, $\theta_{JC(TOP)}$	86.1°C/W
SOT-89-3, $\theta_{JC(BOT)}$	4°C/W
SOT-223-3, θ_{JA}	57.7°C/W
SOT-223-3, θ_{JB}	10.4°C/W
SOT-223-3, θ_{JC}	32.6°C/W
SOT-23-5, θ_{JA}	164.1°C/W
SOT-23-5, θ_{JB}	28.6°C/W
SOT-23-5, θ_{JC}	51.8°C/W
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility ^{(1) (2)}	
HBM.....	±3000V
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	4V to 40V
Input Effective Capacitance, C _{IN}	2.2μF (MIN)
Output Effective Capacitance, C _{OUT}	1.5μF to 100μF
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

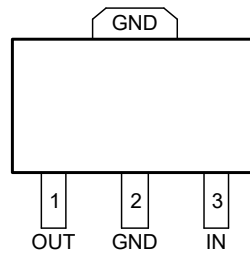
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

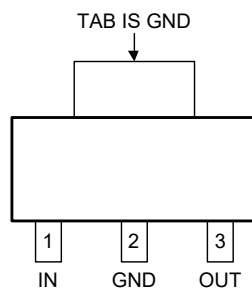
PIN CONFIGURATIONS

SGM2232 (TOP VIEW)



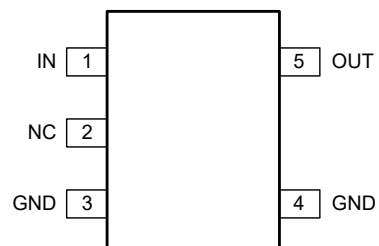
SOT-89-3

SGM2232 (TOP VIEW)



SOT-223-3

SGM2232 (TOP VIEW)



SOT-23-5

PIN DESCRIPTION

PIN			NAME	FUNCTION
SOT-89-3	SOT-223-3	SOT-23-5		
1	3	5	OUT	Regulator Output Pin. It is recommended to use a ceramic capacitor with effective capacitance in the range of 1.5 μ F to 100 μ F. This ceramic capacitor should be placed as close as possible to the OUT pin.
2	2, TAB	3, 4	GND	Ground.
3	1	1	IN	Input Supply Voltage Pin. It is recommended to use a 10 μ F or larger ceramic capacitor from IN pin to ground. This ceramic capacitor should be placed as close as possible to the IN pin.
—	—	2	NC	Connect It to GND or Floating.

FUNCTIONAL BLOCK DIAGRAM

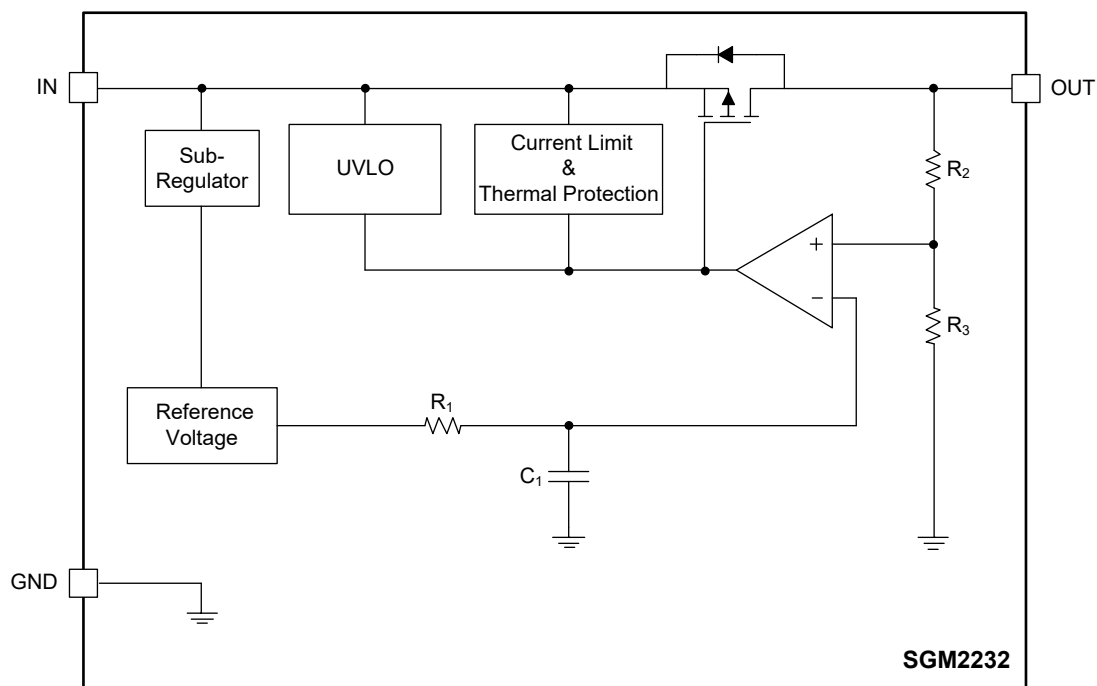


Figure 2. Block Diagram

ELECTRICAL CHARACTERISTICS

(V_{IN} = V_{OUT(NOM)} + 1.5V, C_{IN} = 10μF, C_{OUT} = 2.2μF, T_J = -40°C to +125°C, typical values are at T_J = +25°C, unless otherwise noted.)

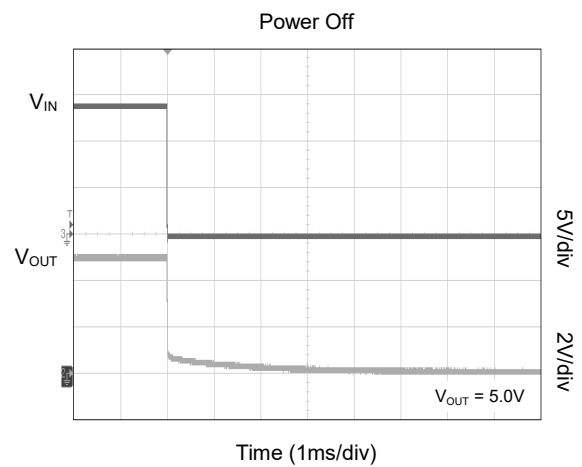
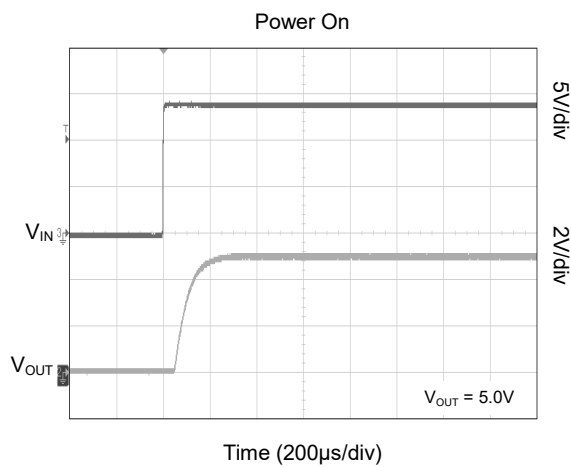
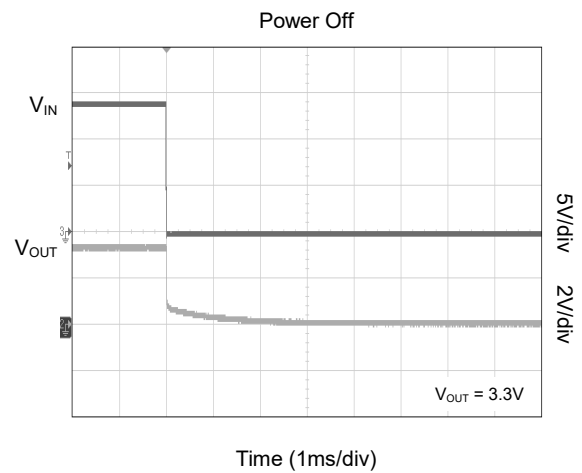
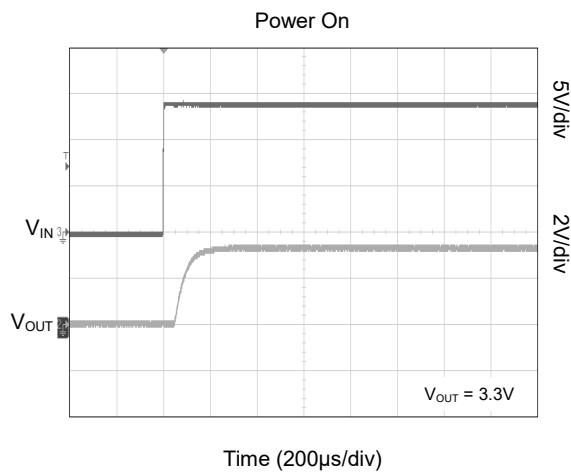
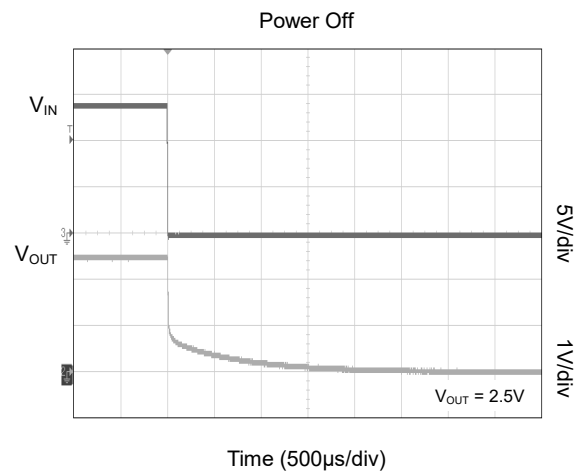
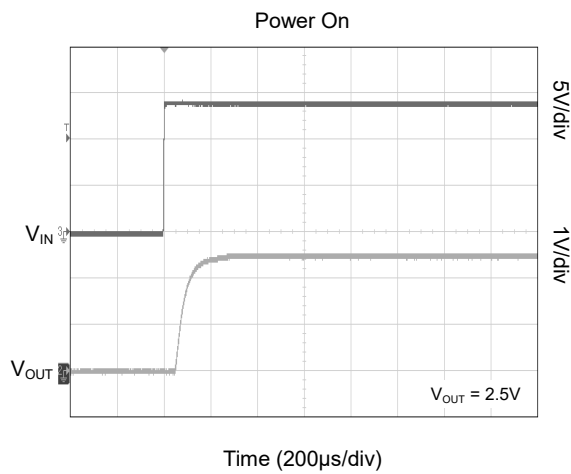
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V _{IN}	V _{OUT(NOM)} = 2.5V	4		40	V
		V _{OUT(NOM)} = 3.3V	4		40	
		V _{OUT(NOM)} = 5.0V	5.5		40	
Output Voltage Accuracy	V _{OUT}	V _{IN} = (V _{OUT(NOM)} + 1.5V) to 40V, I _{OUT} = 1mA to 150mA	-3		+3	%
Under-Voltage Lockout Thresholds	V _{UVLO}	V _{IN} rising			2.6	V
		V _{IN} falling	1.3			
Line Regulation	ΔV _{LNR}	V _{IN} = (V _{OUT(NOM)} + 1.5V) to 40V, I _{OUT} = 1mA		0.5	10	mV
Load Regulation	ΔV _{LDR}	I _{OUT} = 1mA to 150mA		12	20	mV
Dropout Voltage ⁽¹⁾	V _{DROP}	I _{OUT} = 50mA		200	450	mV
		I _{OUT} = 100mA		400	850	
		I _{OUT} = 150mA		570	1100	
Output Current Limit	I _{LIMIT}	V _{OUT} = 90% × V _{OUT(NOM)}	200	350		mA
Short-Circuit Current Limit	I _{SHORT}	V _{OUT} = 0V		285		mA
Quiescent Current	I _Q	I _{OUT} = 0mA		16	30	μA
Start-Up Time	t _{STR}	From V _{IN} rising from 0V to V _{IN} to V _{OUT} = 90% × V _{OUT(NOM)}		200	400	μs
Power Supply Rejection Ratio	PSRR	V _{OUT} = 5V, ΔV _{RIPPLE} = 0.2V _{P-P} , V _{IN} = 14V, I _{OUT} = 10mA	f = 100Hz	95		dB
			f = 1kHz	84		
			f = 100kHz	56		
			f = 1MHz	63		
		V _{OUT} = 12V, ΔV _{RIPPLE} = 0.2V _{P-P} , V _{IN} = 14V, I _{OUT} = 10mA	f = 100Hz	82		
			f = 1kHz	79		
			f = 100kHz	51		
			f = 1MHz	54		
Output Voltage Noise	e _n	V _{OUT} = 5V, V _{IN} = 14V, I _{OUT} = 10mA, C _{OUT} = 4.7μF, f = 10Hz to 100kHz		195		μV _{RMS}
Thermal Shutdown Temperature	T _{SHDN}	T _J rising		180		°C
Thermal Shutdown Hysteresis	ΔT _{SHDN}	Hysteresis		30		°C

NOTE:

1. The dropout voltage is defined as the difference between V_{IN} and V_{OUT} when V_{OUT} falls to 95% × V_{OUT(NOM)}.

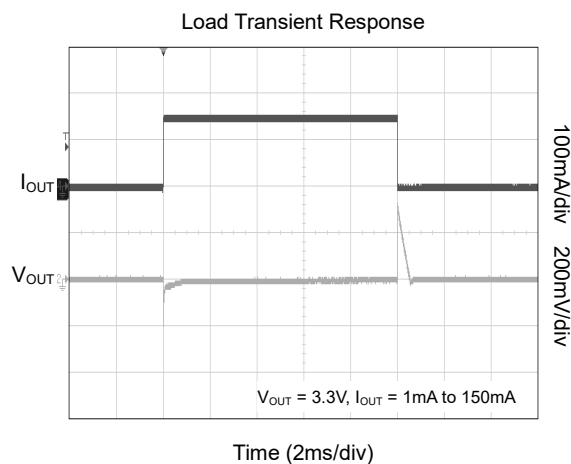
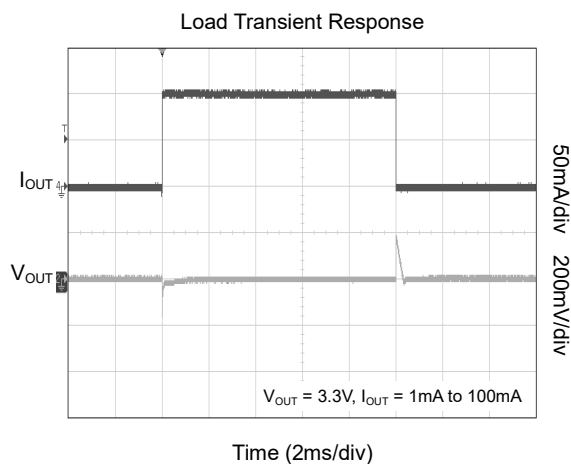
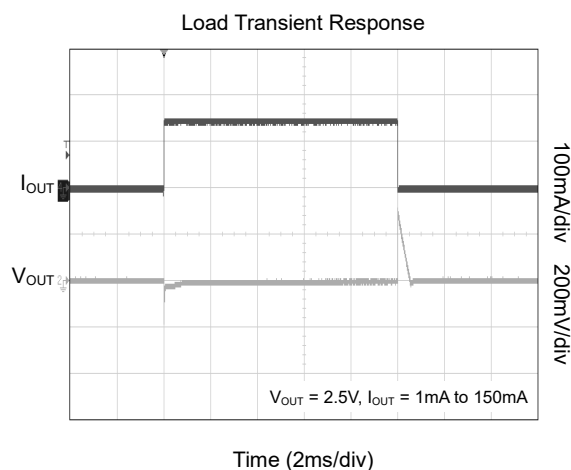
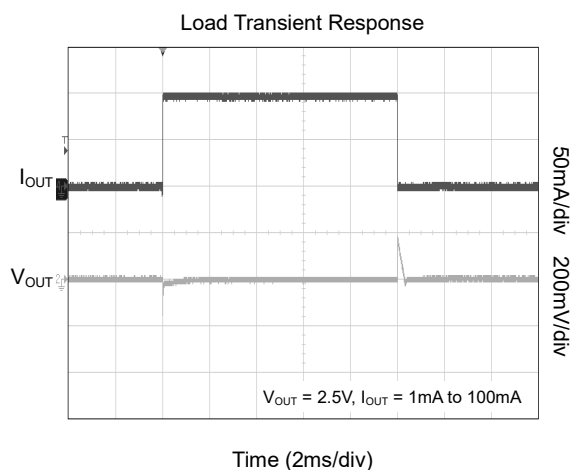
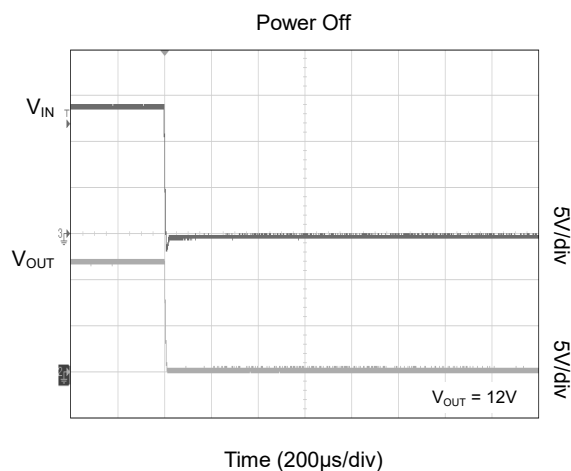
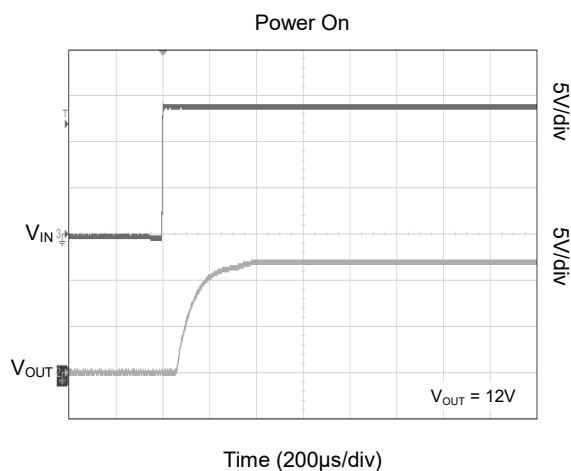
TYPICAL PERFORMANCE CHARACTERISTICS

$T_J = +25^\circ\text{C}$, $V_{IN} = 14\text{V}$, $I_{OUT} = 10\text{mA}$, $C_{IN} = 10\mu\text{F}$, $C_{OUT} = 2.2\mu\text{F}$, unless otherwise noted.



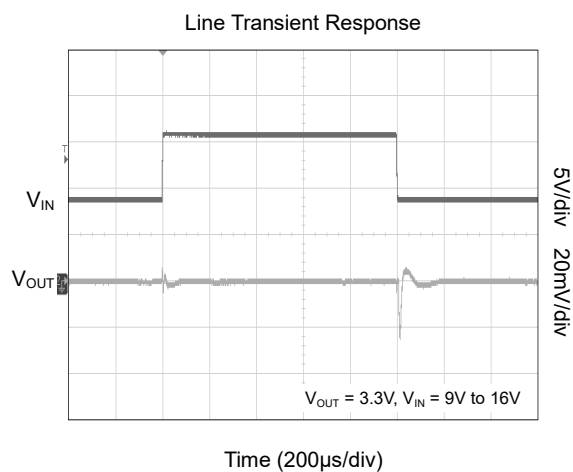
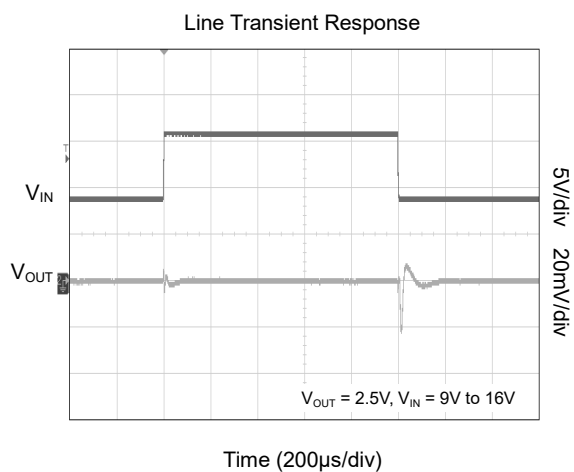
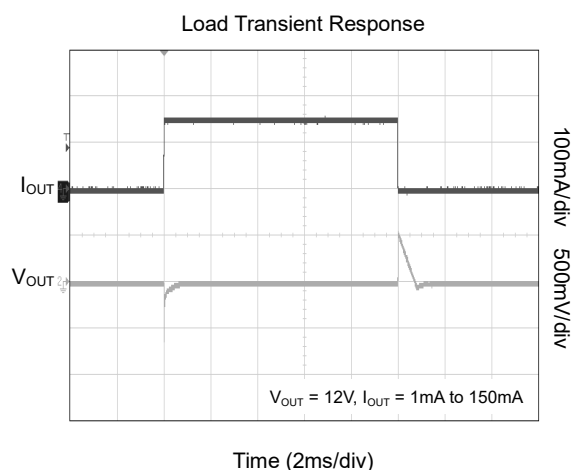
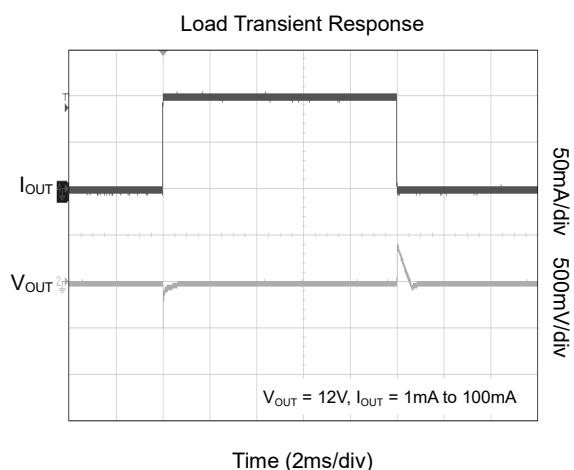
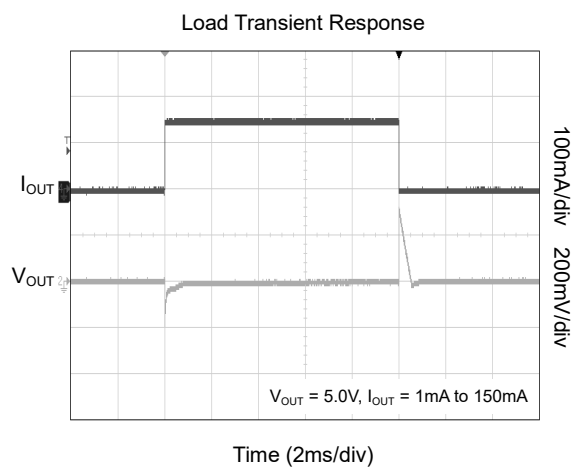
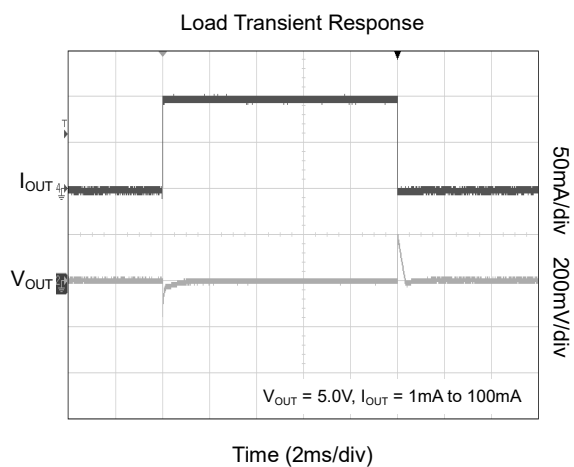
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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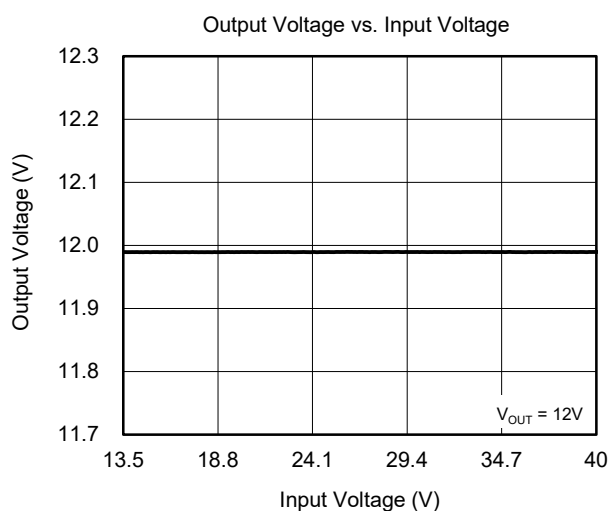
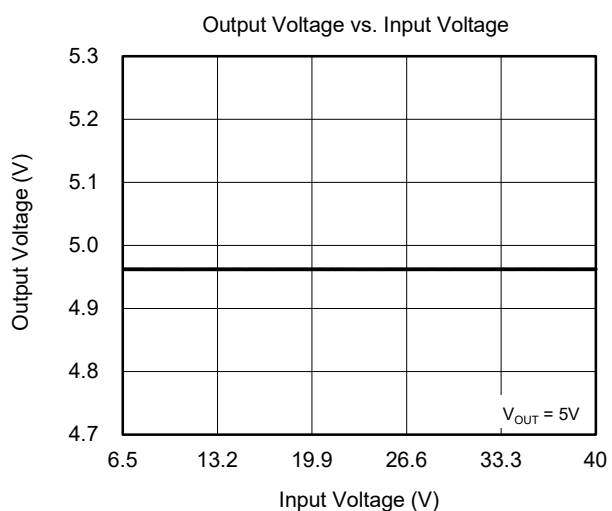
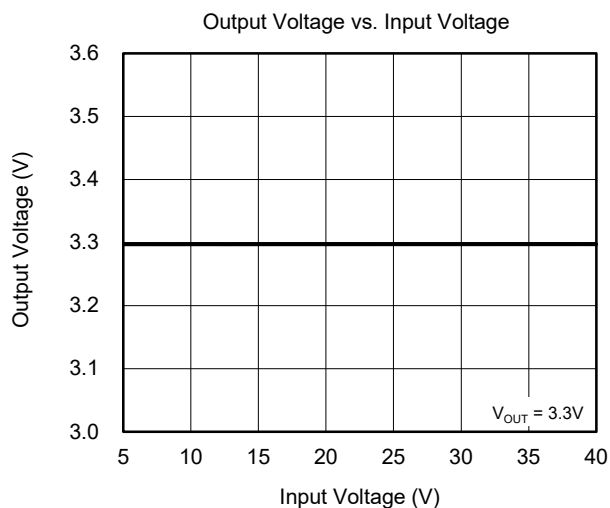
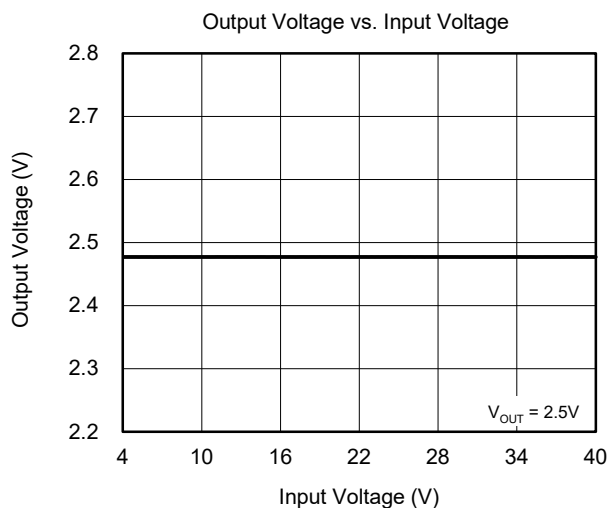
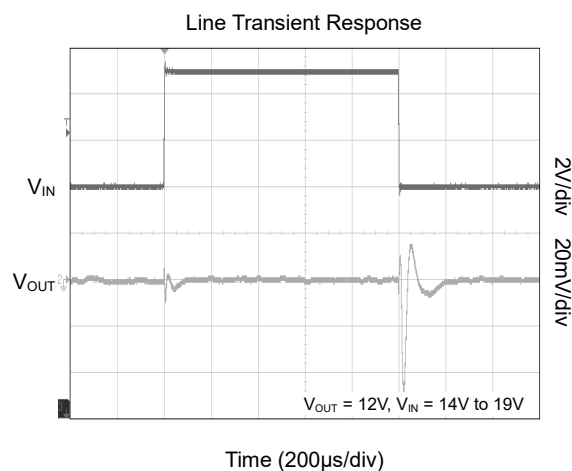
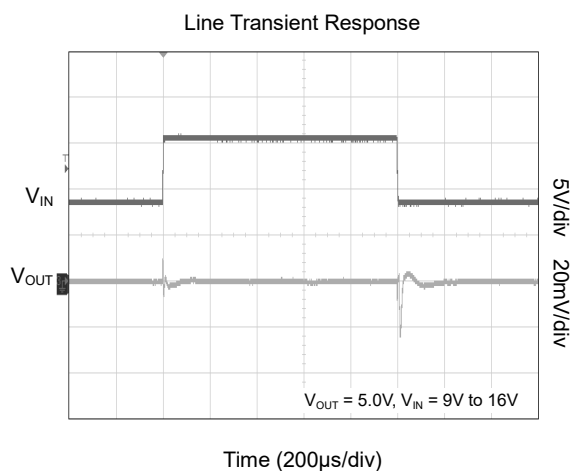
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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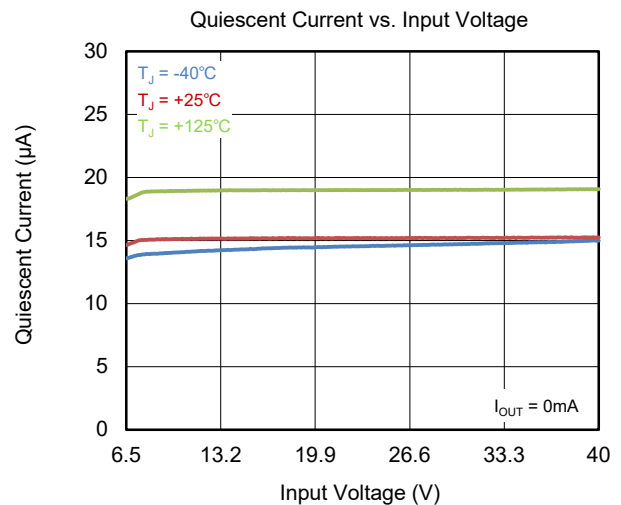
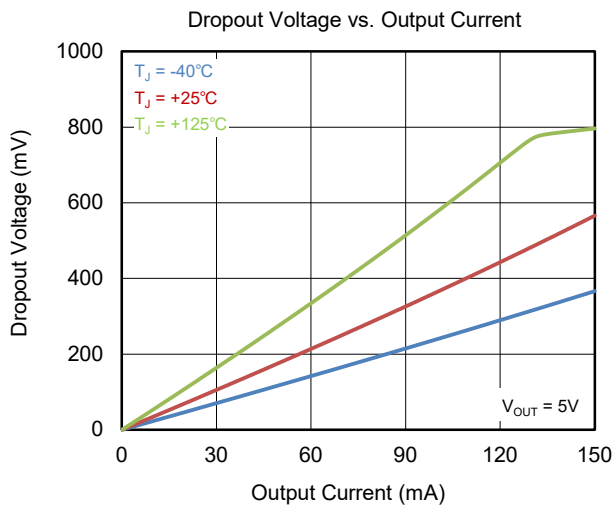
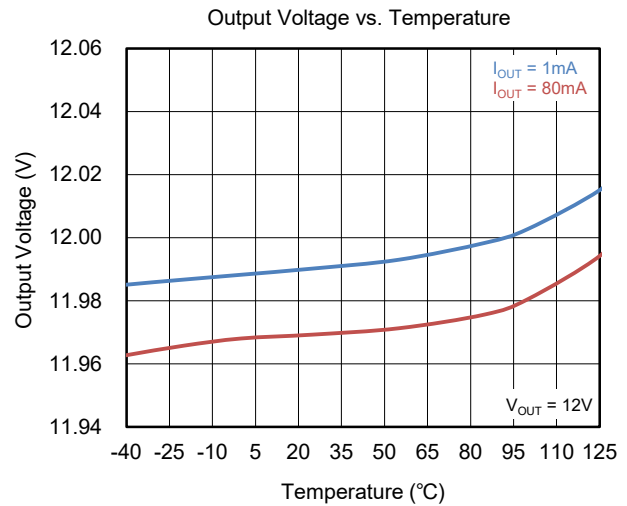
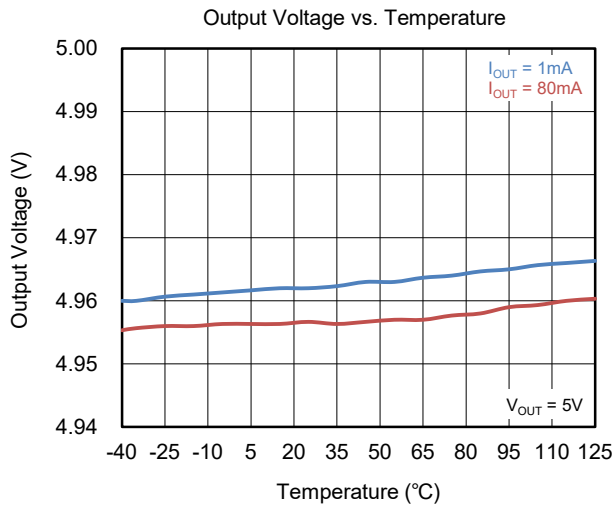
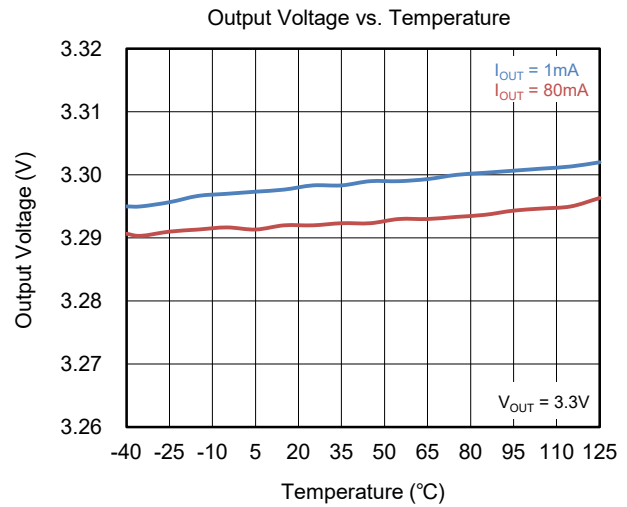
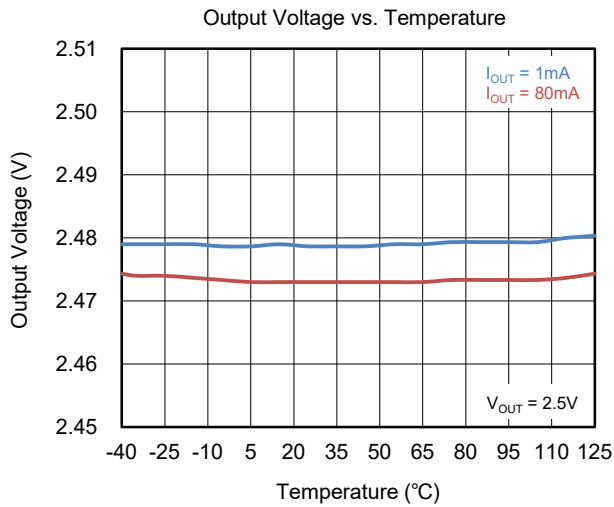
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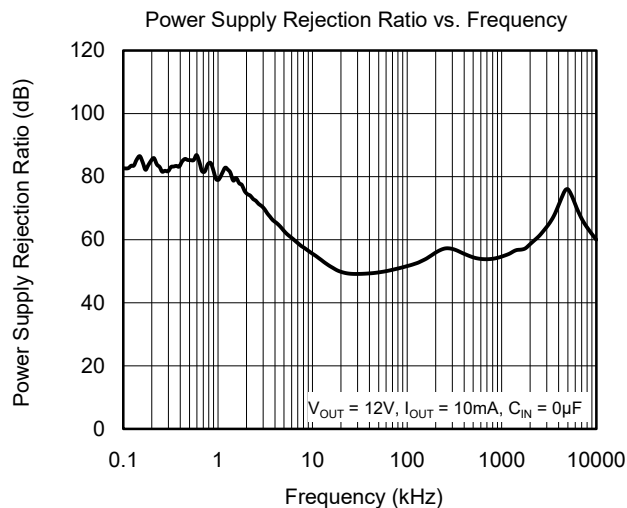
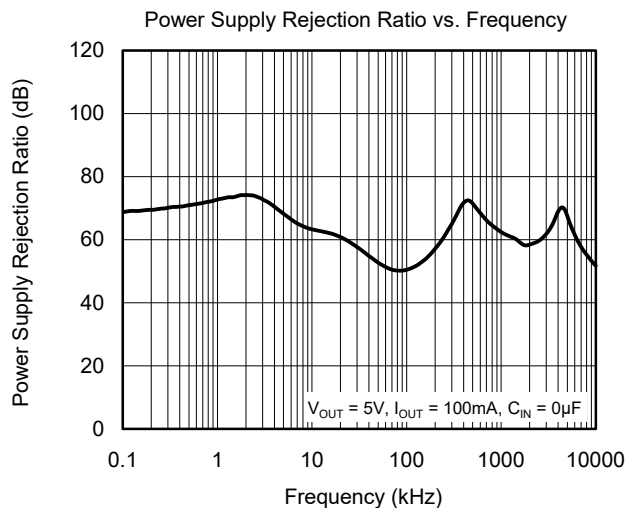
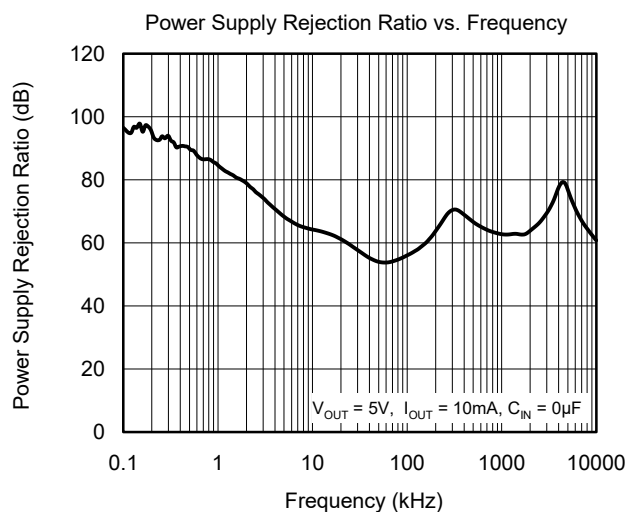
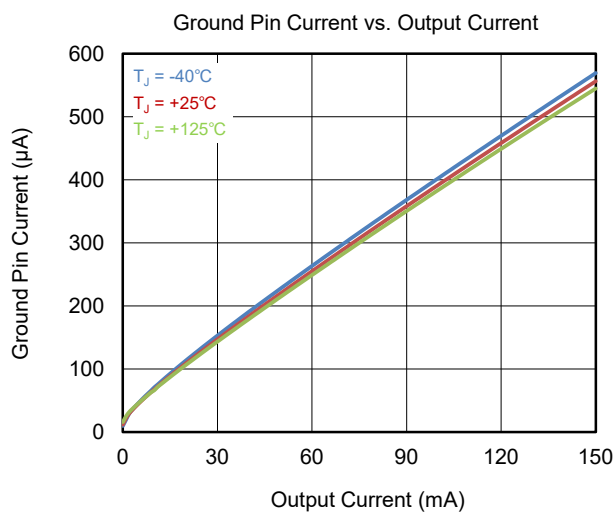
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_J = +25^\circ\text{C}$, $V_{IN} = 14\text{V}$, $I_{OUT} = 10\text{mA}$, $C_{IN} = 10\mu\text{F}$, $C_{OUT} = 2.2\mu\text{F}$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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APPLICATION INFORMATION

The SGM2232 is a high voltage, ultra-low quiescent current, high PSRR and low dropout LDO and provides 150mA output current. These features make the device useful in a variety of applications. The SGM2232 provides protection functions for output overload, output short-circuit condition and overheating.

Input Capacitor Selection (C_{IN})

The input decoupling capacitor should be placed as close as possible to the IN pin to ensure the device stability. 10 μ F 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 3 shows the capacitance and DC bias and temperature characteristics of 0805, 10V, 10 μ F $\pm$ 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.

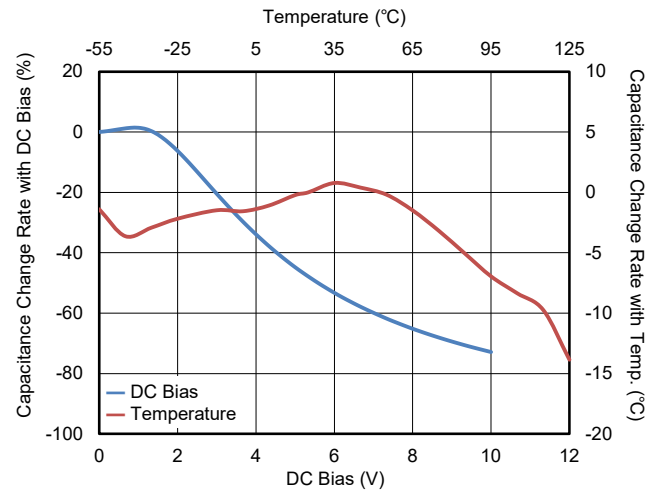


Figure 3. Capacitance vs. DC Bias and Temperature Characteristics

The SGM2232 requires a minimum effective capacitance of 1.5 μ F 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.

Under-Voltage Lockout (UVLO)

The UVLO circuit monitors the input voltage to prevent the device from turning on before V_{IN} rises above the V_{UVLO} threshold. The UVLO circuit responds quickly to glitches on the IN pin and attempts to disable the output of the device if any of these rails collapses. The local input capacitance prevents severe brownouts in most applications.

Reverse Current Protection

The power transistor has an inherent body diode. This body diode will be forward biased when $V_{OUT} > (V_{IN} + 0.3V)$. When $V_{OUT} > (V_{IN} + 0.3V)$, the reverse current flowing from the OUT pin to the IN pin will damage the SGM2232. If $V_{OUT} > (V_{IN} + 0.3V)$ event would happen in system, one external Schottky diode will be added between OUT pin and IN pin in circuit design to protect the SGM2232.

APPLICATION INFORMATION (continued)**Output Current Limit and Short-Circuit Protection**

When overload events happen, the output current is internally limited to 350mA (TYP). When the OUT pin is shorted to ground, the short-circuit protection will limit the output current to 285mA (TYP).

Thermal Shutdown

When the die temperature exceeds the threshold value of thermal shutdown, the SGM2232 will be in shutdown state and it will remain in this state until the die temperature decreases to +150°C.

Power Dissipation (P_D)

Power dissipation (P_D) of the SGM2232 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 SGM2232 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:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA} \quad (1)$$

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.

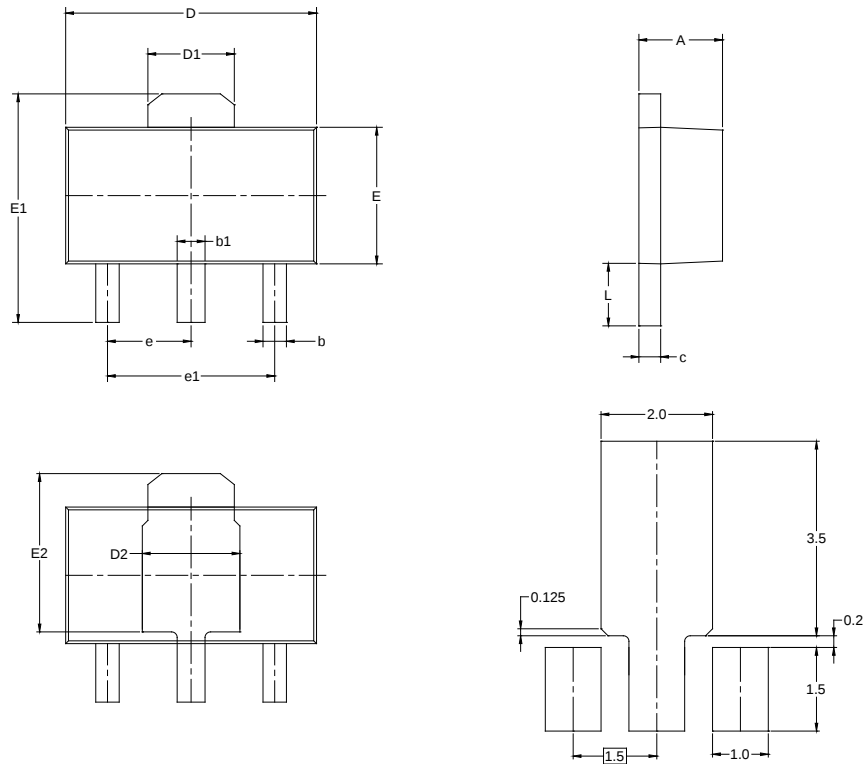
REVISION HISTORY

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

JUNE 2025 – REV.A.2 to REV.A.3	Page
Updated Pin Description section.....	4
Updated Package Outline Dimensions section	15
NOVEMBER 2024 – REV.A.1 to REV.A.2	Page
Updated Electrical Characteristic section.....	6
NOVEMBER 2024 – REV.A to REV.A.1	Page
Added SOT-89-3 Package.....	All
Added Package/Ordering Information	2
Added the Electrical Parameters and Characteristic Curves of SGM2232-12 version	All
Changes from Original (JUNE 2024) to REV.A	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

SOT-89-3



RECOMMENDED LAND PATTERN (Unit: mm)

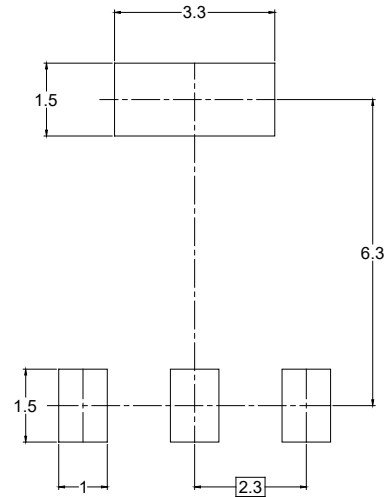
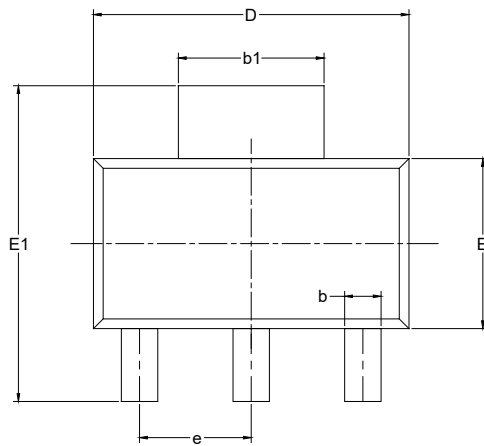
Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.400	-	1.600
b	0.320	-	0.520
b1	0.400	-	0.580
c	0.350	-	0.440
D	4.400	-	4.600
D1	1.550 REF		
D2	1.750 REF		
E	2.300	-	2.600
E1	3.940	-	4.250
E2	2.840 REF		
e	1.500 BSC		
e1	3.000 BSC		
L	0.900	-	1.200

NOTES:

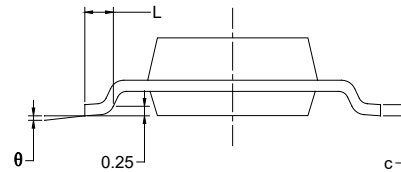
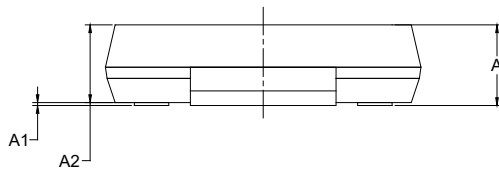
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC TO-243.

PACKAGE OUTLINE DIMENSIONS

SOT-223-3



RECOMMENDED LAND PATTERN (Unit: mm)



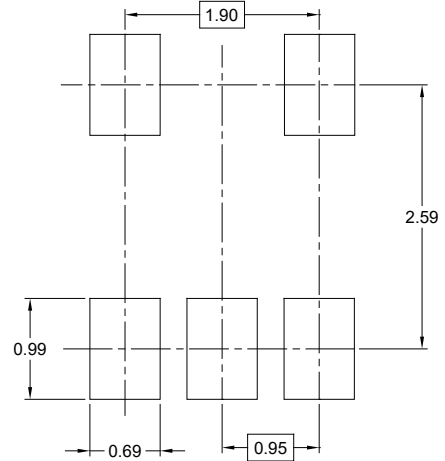
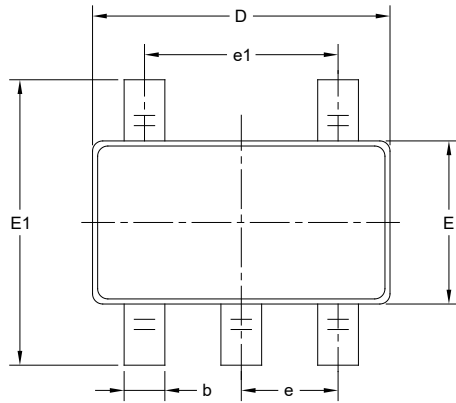
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.800		0.071
A1	0.020	0.100	0.001	0.004
A2	1.500	1.700	0.059	0.067
b	0.660	0.840	0.026	0.033
b1	2.900	3.100	0.114	0.122
c	0.230	0.350	0.009	0.014
D	6.300	6.700	0.248	0.264
E	3.300	3.700	0.130	0.146
E1	6.700	7.300	0.264	0.287
e	2.300 BSC		0.091 BSC	
L	0.750		0.030	
θ	0°	10°	0°	10°

NOTES:

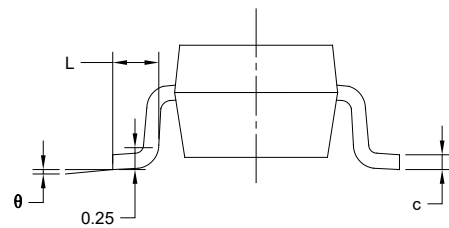
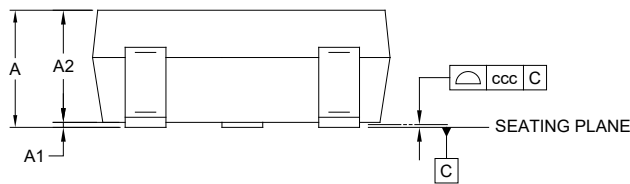
1. Body dimensions do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

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		

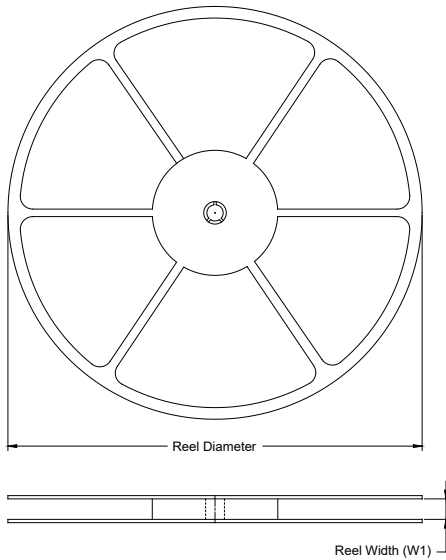
NOTES:

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.

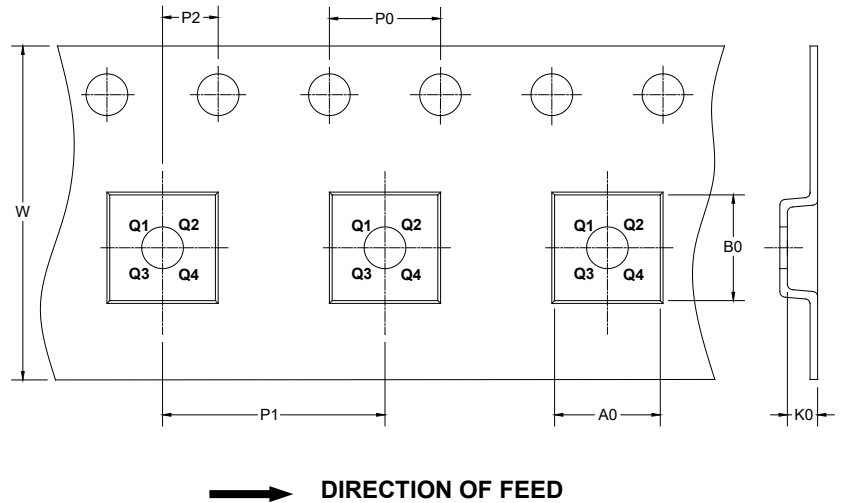
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

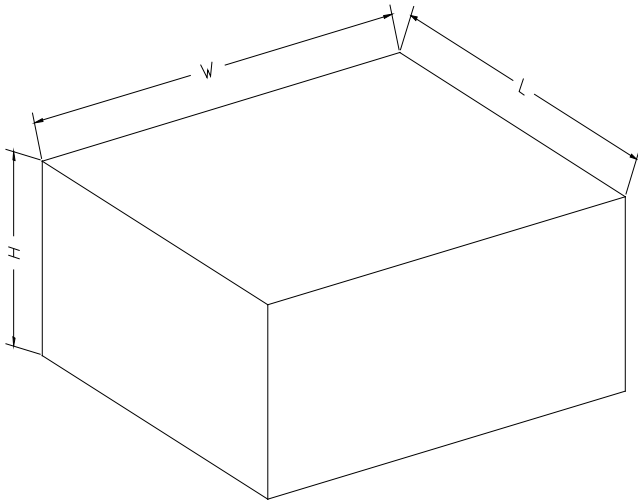
KEY PARAMETER LIST OF TAPE AND REEL

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-89-3	7"	13.2	4.85	4.45	1.85	4.0	8.0	2.0	12.0	Q3
SOT-223-3	13"	12.4	6.55	7.25	1.90	4.0	8.0	2.0	12.0	Q3
SOT-23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3

DD0001

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
13"	386	280	370	5

DD0002