SGM2220
300mA, 0.9μA Low Quiescent Current, Low Dropout and High Voltage Regulator

GENERAL DESCRIPTION

The SGM2220 is a low quiescent current, low dropout and high input voltage linear regulator. It is capable of supplying 300mA output current with typical dropout voltage of 330mV. The operating input voltage range is from 2.2V to 13V and fixed output voltage range is from 0.8V to 5.0V.

Other features include short-circuit current limit and thermal shutdown protection.

The SGM2220 is available in Green SOT-23-5 and SOT-89-3 packages. It operates over an operating temperature range of -40℃ to +125℃.

FEATURES

- **Operating Input Voltage Range: 2.2V to 13V**
- **Fixed Outputs of 0.8V, 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 3.6V, 3.9V, 4.0V, 4.1V, 4.2V, 4.5V and 5.0V**
- **Low Power Consumption:**
  0.9μA (TYP) at No Load
- **Low Dropout Voltage:**
  330mV (TYP) at 300mA, V_{OUT} = 5V
- **Current Limiting and Thermal Protection**
- **Stable with Small Case Size Ceramic Capacitors**
- **UVLO with Hysteresis**
- **Reverse Current Protection when V_{OUT} > V_{IN}**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green SOT-23-5 and SOT-89-3 Packages**

APPLICATIONS

Portable Electronics
Smartphone
Industrial and Medical Equipment
Digital Cameras and Audio Devices

TYPICAL APPLICATION

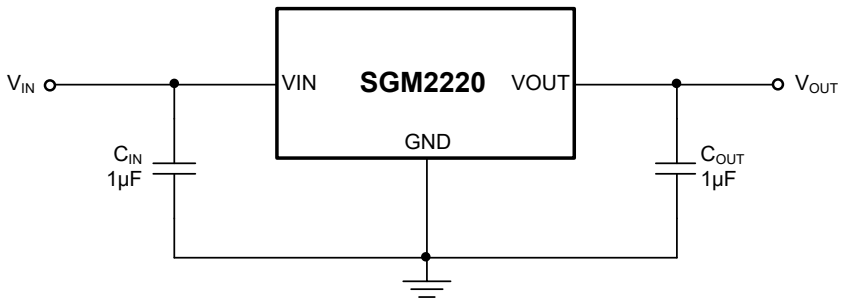


Figure 1. Typical Application Circuit

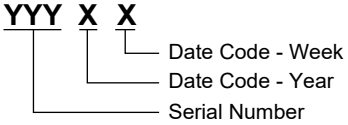
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2220-1.2	SOT-23-5	-40℃ to +125℃	SGM2220-1.2XN5G/TR	0P5XX	Tape and Reel, 3000
SGM2220-1.5	SOT-23-5	-40℃ to +125℃	SGM2220-1.5XN5G/TR	0P6XX	Tape and Reel, 3000
SGM2220-1.8	SOT-23-5	-40℃ to +125℃	SGM2220-1.8XN5G/TR	02SXX	Tape and Reel, 3000
SGM2220-2.5	SOT-23-5	-40℃ to +125℃	SGM2220-2.5XN5G/TR	0P7XX	Tape and Reel, 3000
SGM2220-2.8	SOT-23-5	-40℃ to +125℃	SGM2220-2.8XN5G/TR	02TXX	Tape and Reel, 3000
SGM2220-3.0	SOT-23-5	-40℃ to +125℃	SGM2220-3.0XN5G/TR	02UXX	Tape and Reel, 3000
SGM2220-3.3	SOT-23-5	-40℃ to +125℃	SGM2220-3.3XN5G/TR	00LXX	Tape and Reel, 3000
SGM2220-3.6	SOT-23-5	-40℃ to +125℃	SGM2220-3.6XN5G/TR	0P8XX	Tape and Reel, 3000
SGM2220-3.9	SOT-23-5	-40℃ to +125℃	SGM2220-3.9XN5G/TR	02VXX	Tape and Reel, 3000
SGM2220-4.0	SOT-23-5	-40℃ to +125℃	SGM2220-4.0XN5G/TR	02WXX	Tape and Reel, 3000
SGM2220-4.1	SOT-23-5	-40℃ to +125℃	SGM2220-4.1XN5G/TR	02XXX	Tape and Reel, 3000
SGM2220-4.2	SOT-23-5	-40℃ to +125℃	SGM2220-4.2XN5G/TR	02YXX	Tape and Reel, 3000
SGM2220-5.0	SOT-23-5	-40℃ to +125℃	SGM2220-5.0XN5G/TR	00MXX	Tape and Reel, 3000
SGM2220-0.8	SOT-89-3	-40℃ to +125℃	SGM2220-0.8XK3G/TR	00NXX	Tape and Reel, 1000
SGM2220-1.2	SOT-89-3	-40℃ to +125℃	SGM2220-1.2XK3G/TR	0NZXX	Tape and Reel, 1000
SGM2220-1.5	SOT-89-3	-40℃ to +125℃	SGM2220-1.5XK3G/TR	0O1XX	Tape and Reel, 1000
SGM2220-1.8	SOT-89-3	-40℃ to +125℃	SGM2220-1.8XK3G/TR	00OXX	Tape and Reel, 1000
SGM2220-2.5	SOT-89-3	-40℃ to +125℃	SGM2220-2.5XK3G/TR	0O2XX	Tape and Reel, 1000
SGM2220-2.8	SOT-89-3	-40℃ to +125℃	SGM2220-2.8XK3G/TR	0O3XX	Tape and Reel, 1000
SGM2220-3.0	SOT-89-3	-40℃ to +125℃	SGM2220-3.0XK3G/TR	0NUXX	Tape and Reel, 1000
SGM2220-3.3	SOT-89-3	-40℃ to +125℃	SGM2220-3.3XK3G/TR	00PXX	Tape and Reel, 1000
SGM2220-3.6	SOT-89-3	-40℃ to +125℃	SGM2220-3.6XK3G/TR	0O4XX	Tape and Reel, 1000
SGM2220-3.9	SOT-89-3	-40℃ to +125℃	SGM2220-3.9XK3G/TR	00QXX	Tape and Reel, 1000
SGM2220-4.0	SOT-89-3	-40℃ to +125℃	SGM2220-4.0XK3G/TR	02ZXX	Tape and Reel, 1000
SGM2220-4.5	SOT-89-3	-40℃ to +125℃	SGM2220-4.5XK3G/TR	0O5XX	Tape and Reel, 1000
SGM2220-5.0	SOT-89-3	-40℃ to +125℃	SGM2220-5.0XK3G/TR	07AXX	Tape and Reel, 1000

MARKING INFORMATION

NOTE: XX = Date Code.

SOT-23-5/SOT-89-3



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 16V
VOUT to GND ..... -0.3V to 6V
Package Thermal Resistance
SOT-23-5, θ_{JA} ..... 161℃/W
SOT-23-5, θ_{JB} ..... 39℃/W
SOT-23-5, $\theta_{JC(TOP)}$ ..... 111℃/W
SOT-89-3, θ_{JA} ..... 53℃/W
SOT-89-3, θ_{JB} ..... 16℃/W
SOT-89-3, $\theta_{JC(TOP)}$ ..... 93℃/W
SOT-89-3, $\theta_{JC(BOT)}$ ..... 17℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 6000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.2V to 13V
Input Effective Capacitance, C_{IN} ..... 0.5μF (MIN)
Output Effective Capacitance, C_{OUT} ..... 0.47μF 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

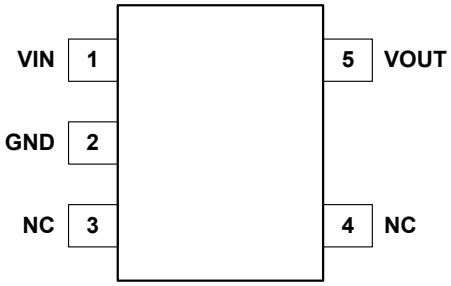
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

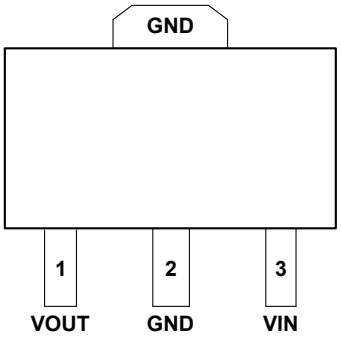
PIN CONFIGURATIONS

(TOP VIEW)



SOT-23-5

(TOP VIEW)



SOT-89-3

PIN DESCRIPTION

PIN		NAME	FUNCTION
SOT-23-5	SOT-89-3		
1	3	VIN	Input Supply Voltage Pin. It is recommended to use a 1μF or larger ceramic capacitor from VIN pin to ground to get good power supply decoupling. This ceramic capacitor should be placed as close as possible to VIN pin.
2	2	GND	Ground.
3, 4	–	NC	No Connection.
5	1	VOUT	Regulator Output Pin. It is recommended to use a ceramic capacitor with effective capacitance in the range of 0.47μF to 10μF to ensure stability. This ceramic capacitor should be placed as close as possible to VOUT pin.

FUNCTIONAL BLOCK DIAGRAM

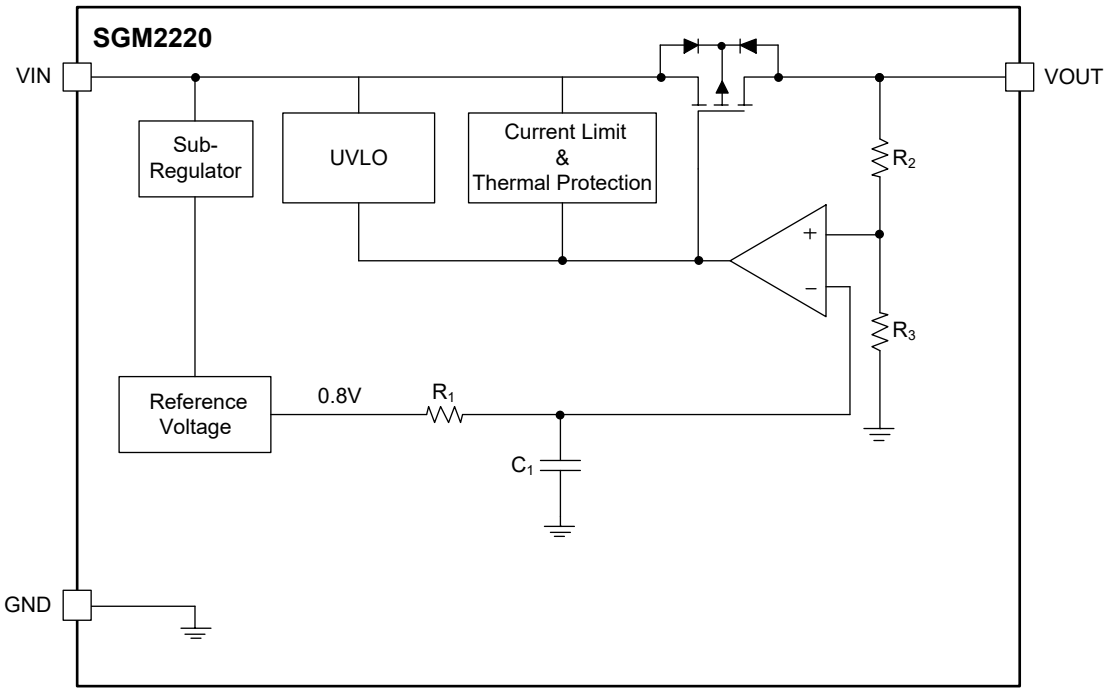


Figure 2. Internal Block Diagram

ELECTRICAL CHARACTERISTICS

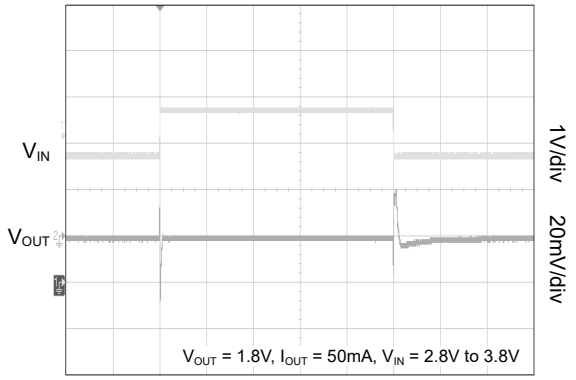
(V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}			2.2		13	V
Output Voltage Accuracy	V_{OUT}	I_{OUT} = 0.1mA	T_J = +25℃	-1.5		1.5	%
			T_J = -40℃ to +85℃	-2		2	
			T_J = -40℃ to +125℃	-2.5		2.5	
Maximum Output Current				300			mA
Under-Voltage Lockout	V_{UVLO}	V_{IN} rising			1.8		V
		Hysteresis			0.35		
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{IN} = ($V_{OUT(NOM)}$ + 1V) to 13V, I_{OUT} = 0.1mA			0.01	0.045	%/V
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	I_{OUT} = 0.1mA to 300mA			0.5	4	%
Dropout Voltage	V_{DROP}	I_{OUT} = 300mA, V_{OUT} falls to 95% × $V_{OUT(NOM)}$	V_{OUT} = 1.8V		590	830	mV
			V_{OUT} = 3.3V		390	590	
			V_{OUT} = 5V		330	530	
Output Current Limit	I_{LIMIT}	V_{IN} = V_{OUT} + 2V, V_{OUT} forced at 95% × $V_{OUT(NOM)}$		350	720		mA
Short-Circuit Current Limit	I_{SHORT}	V_{OUT} = 0V			370		mA
Ground Pin Current	I_{GND}	No load			0.9	2.2	μA
		I_{OUT} = 50mA			70	93	
		I_{OUT} = 300mA			280	335	
Reverse Leakage Current	I_{RL}	V_{OUT} = 5.2V, V_{IN} = 2.2V			10	30	μA
		V_{OUT} = 5.2V, V_{IN} = 0V			22	40	μA
Power Supply Rejection Ratio	PSRR	V_{OUT} = 3.3V, V_{IN} = $V_{OUT(NOM)}$ + 1V, ΔV_{RIPPLE} = 0.2V_{P-P}, I_{OUT} = 40mA	f = 217Hz		61		dB
			f = 1kHz		51		
Output Voltage Noise	e_n	f = 10Hz to 100kHz, I_{OUT} = 40mA	V_{OUT} = 0.8V		40		μV_{RMS}
			V_{OUT} = 3.3V		74		
Thermal Shutdown Temperature	T_{SHDN}				160		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}				30		℃

TYPICAL PERFORMANCE CHARACTERISTICS

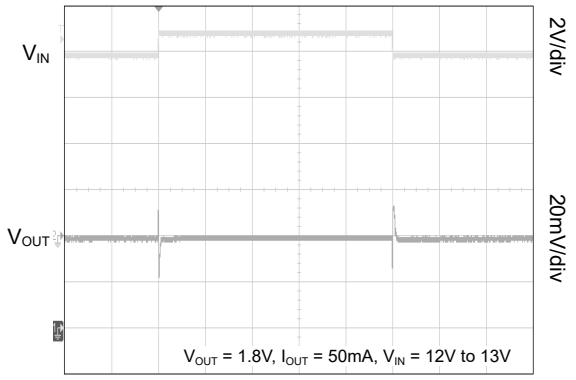
T_J = +25℃, V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

Line Transient Response



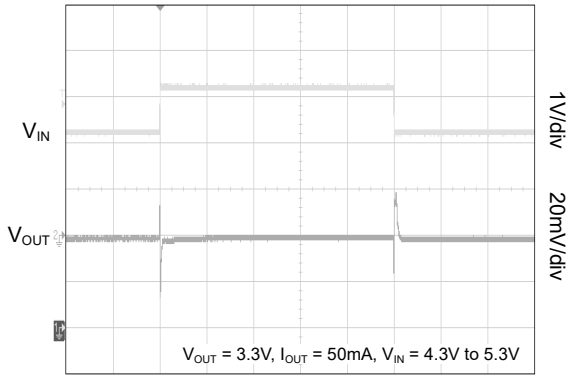
Time (500μs/div)

Line Transient Response



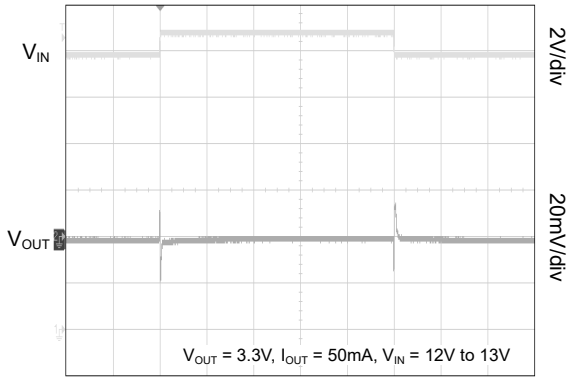
Time (500μs/div)

Line Transient Response



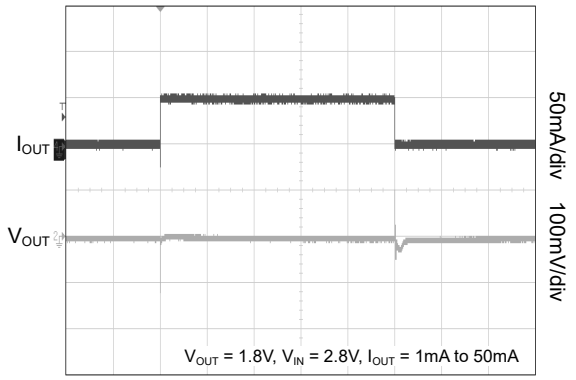
Time (500μs/div)

Line Transient Response



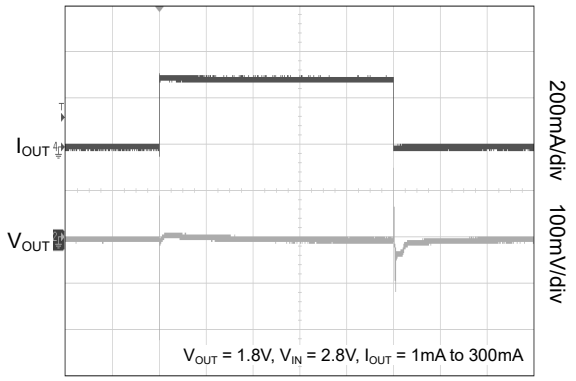
Time (500μs/div)

Load Transient Response



Time (5ms/div)

Load Transient Response

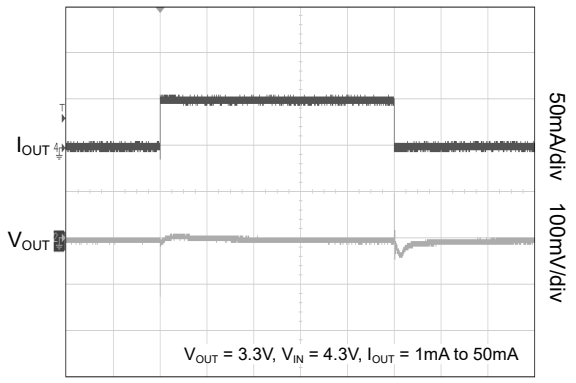


Time (5ms/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

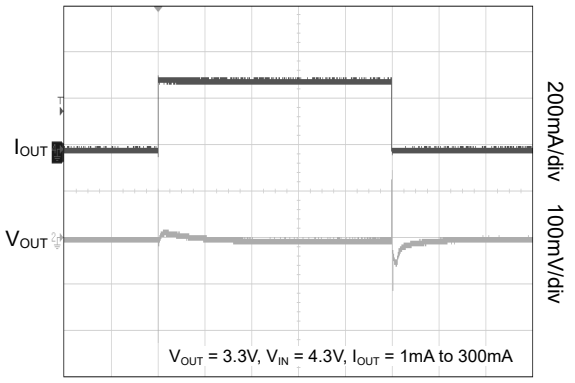
T_J = +25℃, V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

Load Transient Response



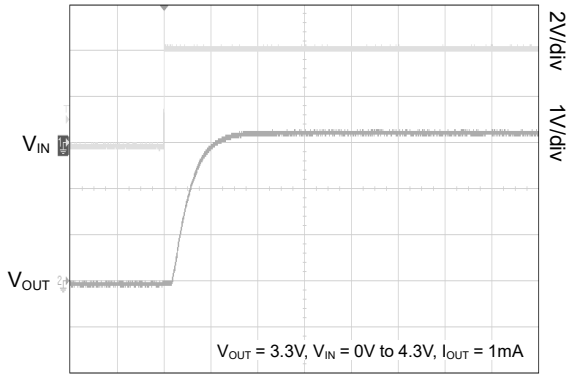
Time (5ms/div)

Load Transient Response



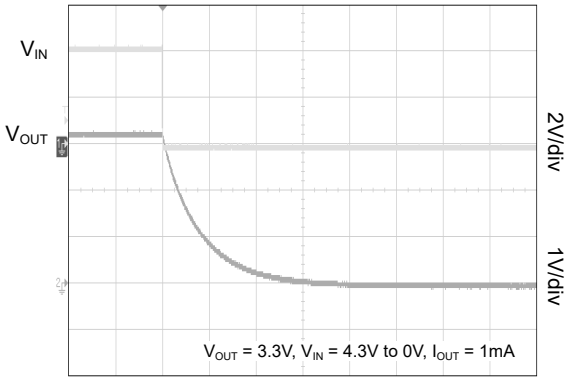
Time (10ms/div)

Power-On Time



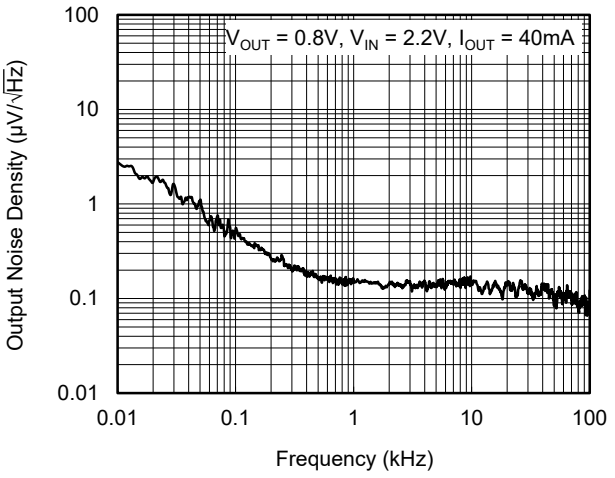
Time (500μs/div)

Power-Off Time

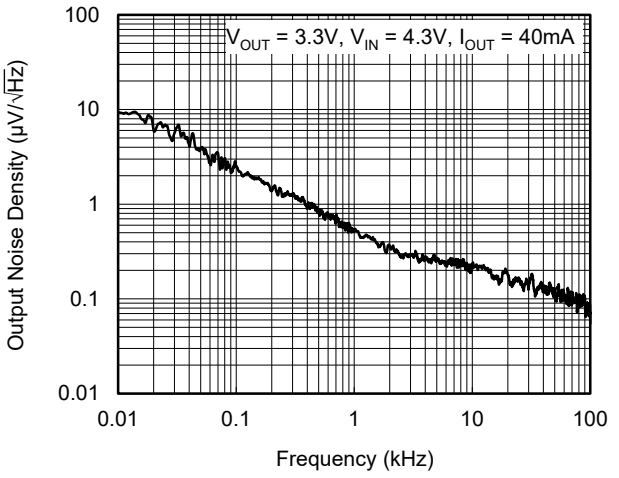


Time (5ms/div)

Output Noise Density vs. Frequency



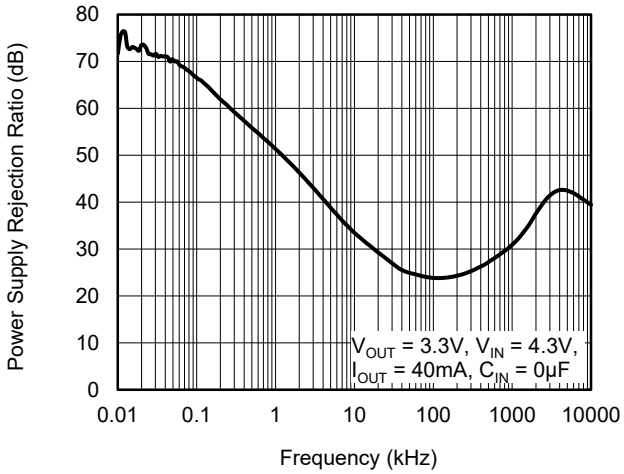
Output Noise Density vs. Frequency



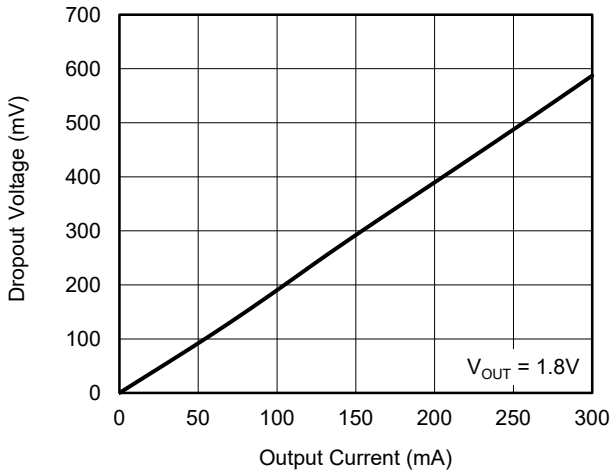
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

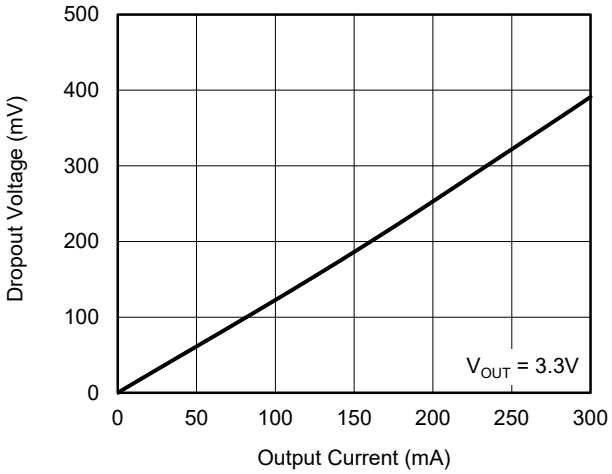
Power Supply Rejection Ratio vs. Frequency



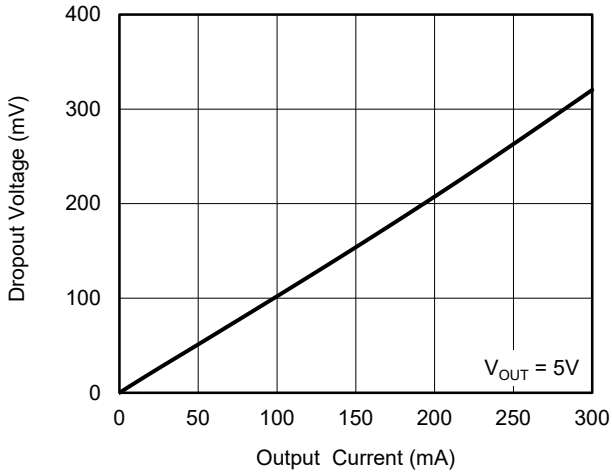
Dropout Voltage vs. Output Current



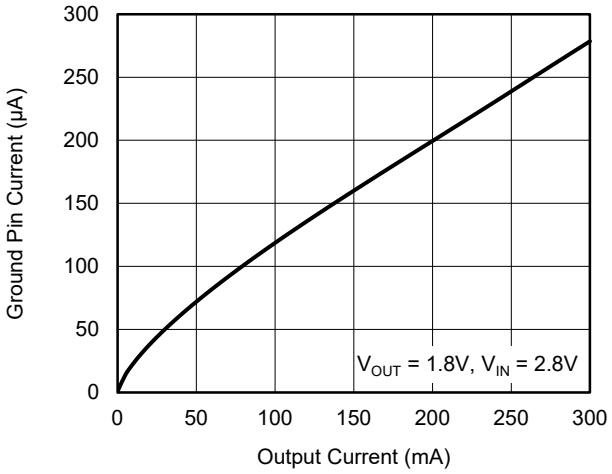
Dropout Voltage vs. Output Current



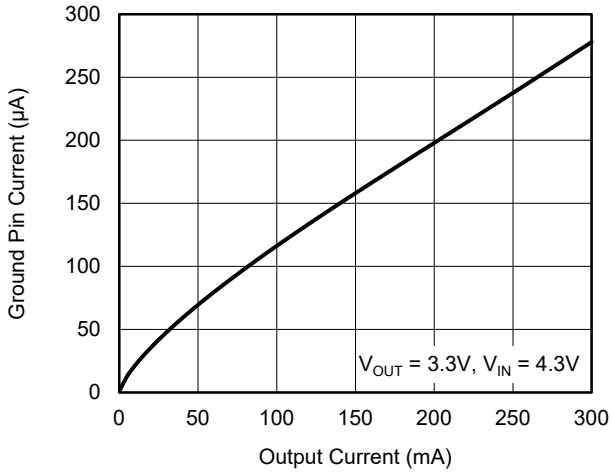
Dropout Voltage vs. Output Current



Ground Pin Current vs. Output Current



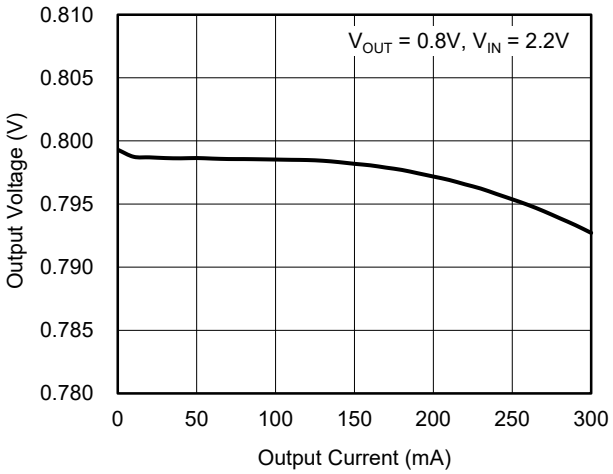
Ground Pin Current vs. Output Current



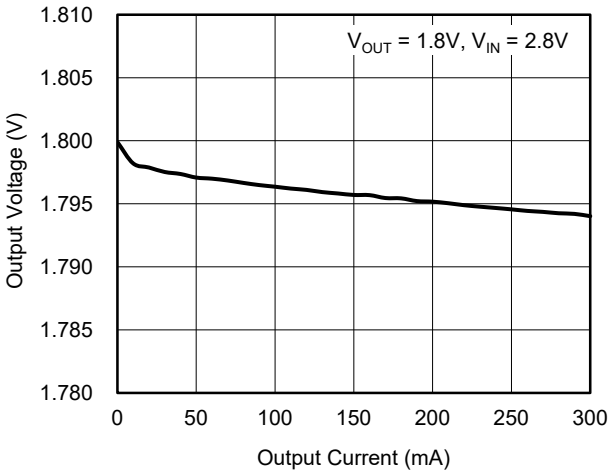
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

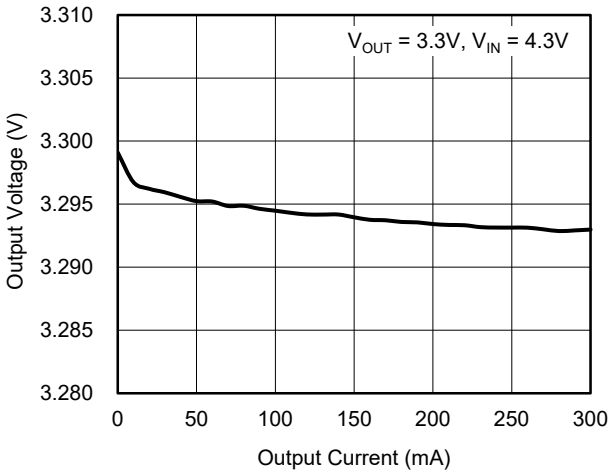
Output Voltage vs. Output Current



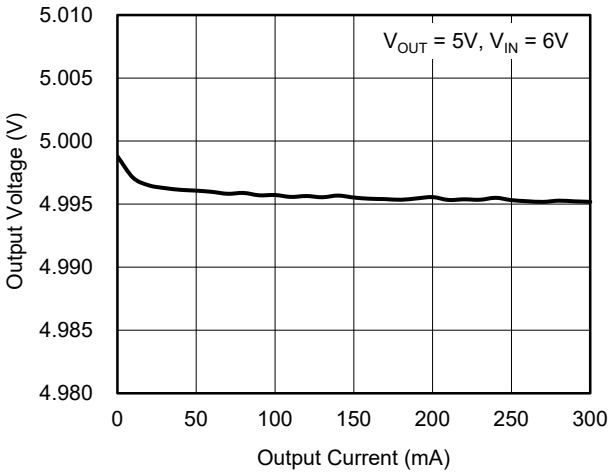
Output Voltage vs. Output Current



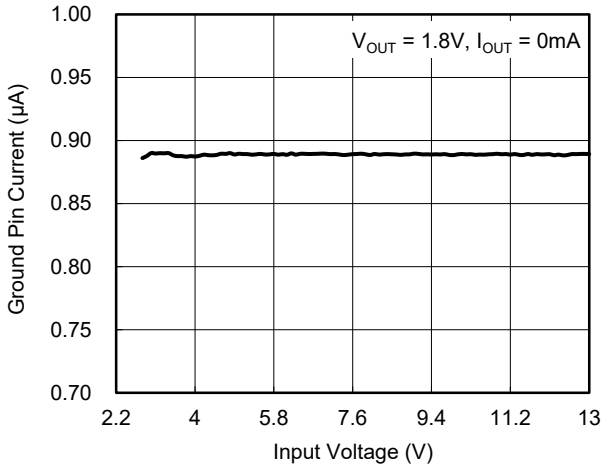
Output Voltage vs. Output Current



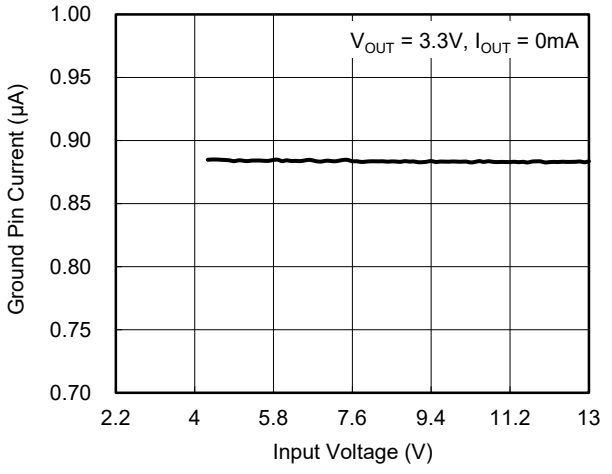
Output Voltage vs. Output Current



Ground Pin Current vs. Input Voltage



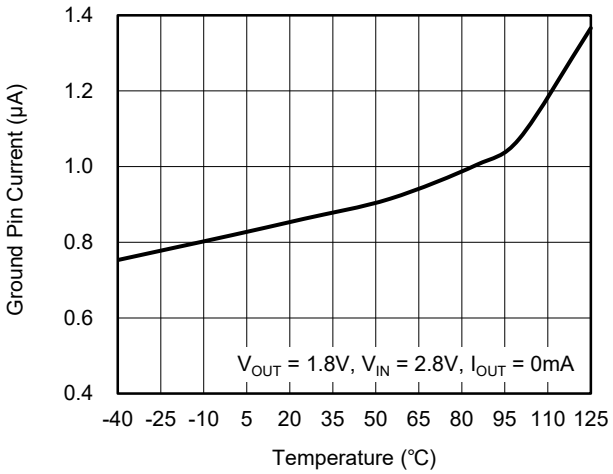
Ground Pin Current vs. Input Voltage



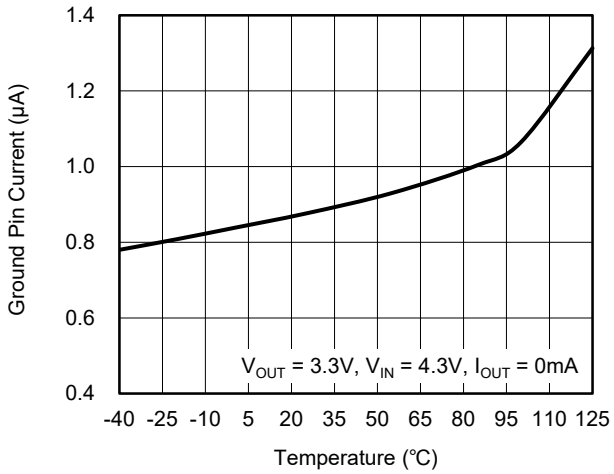
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

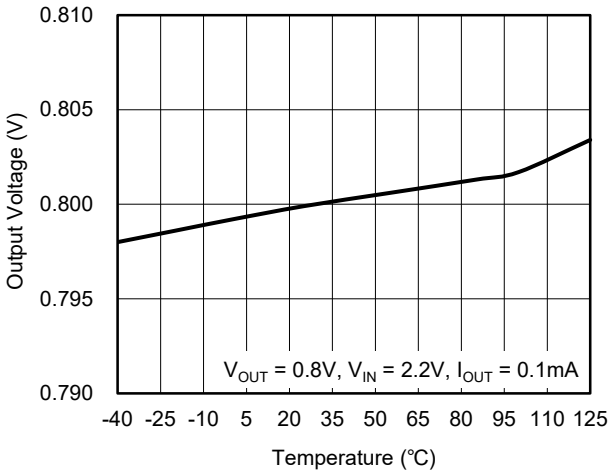
Ground Pin Current vs. Temperature



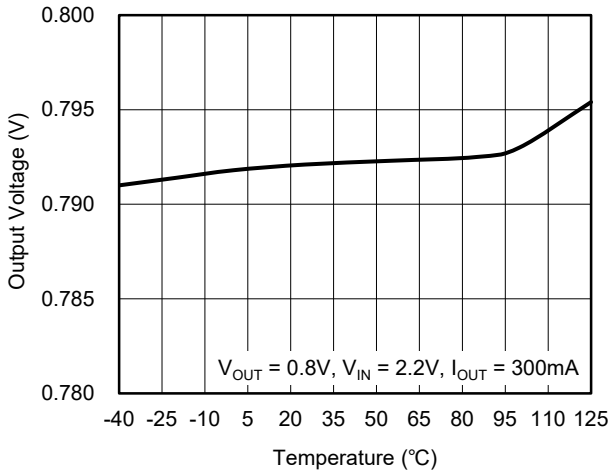
Ground Pin Current vs. Temperature



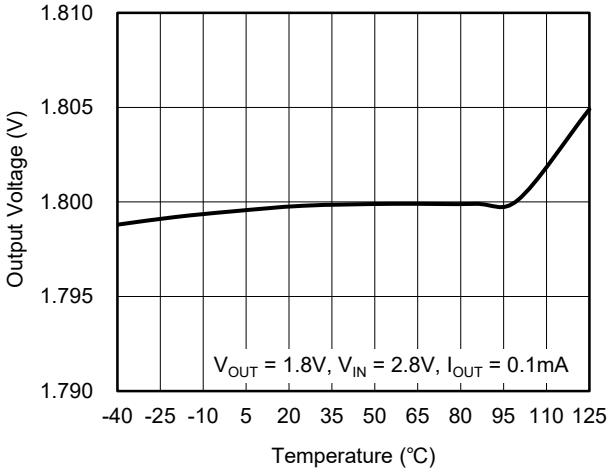
Output Voltage vs. Temperature



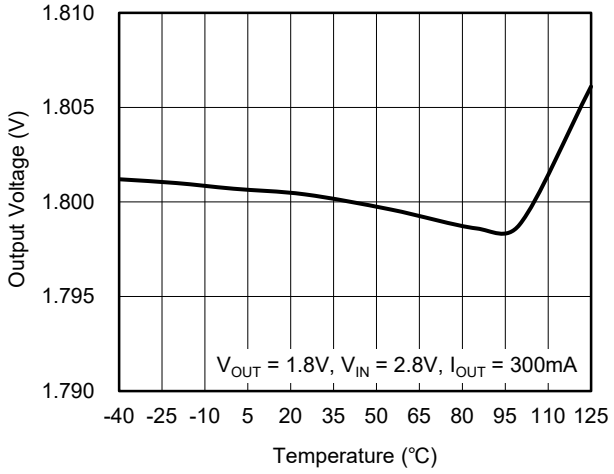
Output Voltage vs. Temperature



Output Voltage vs. Temperature



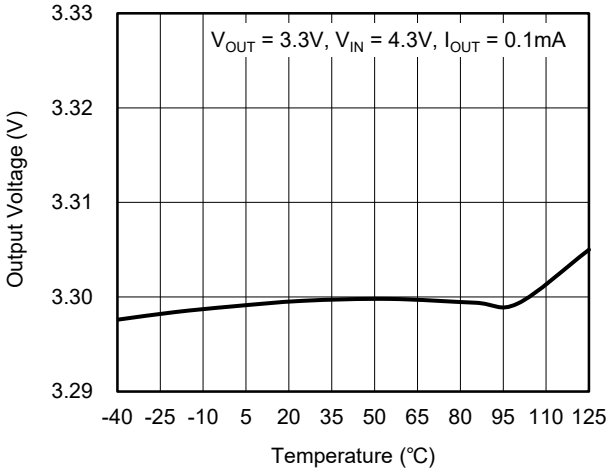
Output Voltage vs. Temperature



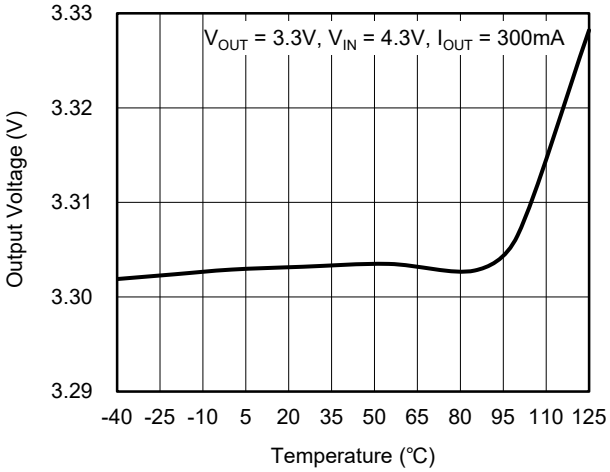
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

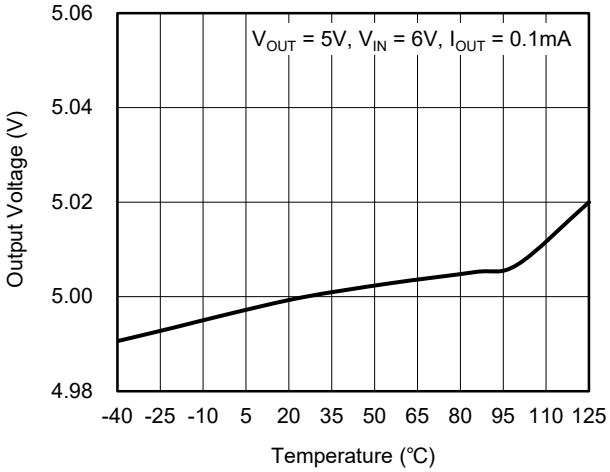
Output Voltage vs. Temperature



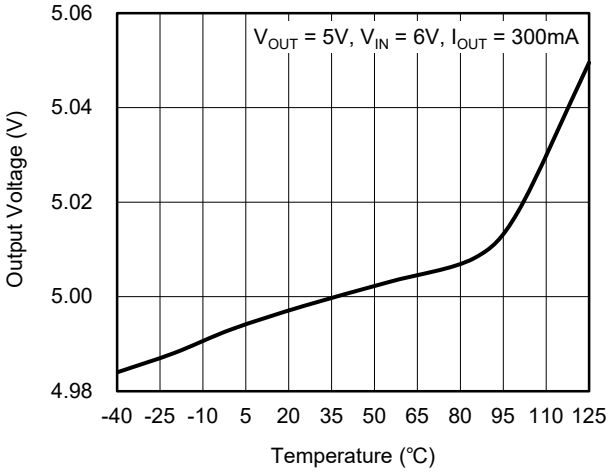
Output Voltage vs. Temperature



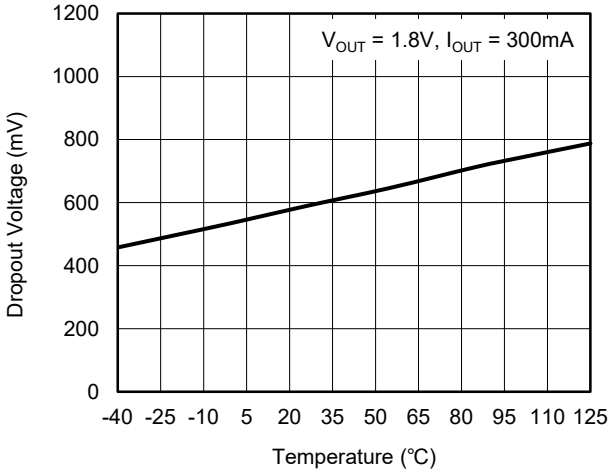
Output Voltage vs. Temperature



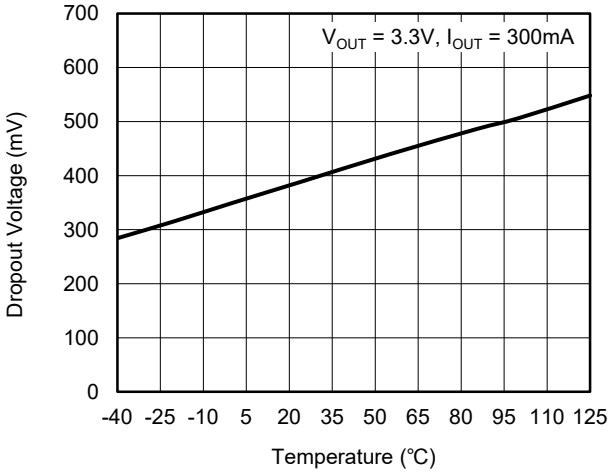
Output Voltage vs. Temperature



Dropout Voltage vs. Temperature



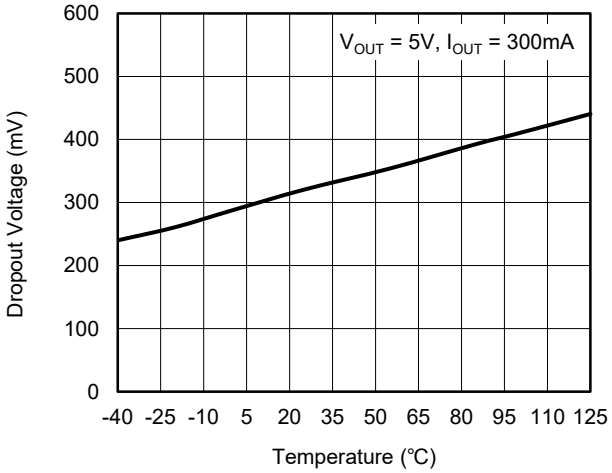
Dropout Voltage vs. Temperature



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_J = +25℃, V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.2V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, unless otherwise noted.

Dropout Voltage vs. Temperature



APPLICATION INFORMATION

The SGM2220 is a low quiescent current, low dropout and high input voltage LDO and provides 300mA 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 SGM2220 useful in a variety of applications.

Input Capacitor Selection (C_{IN})

The input decoupling capacitor should be placed as close as possible to the VIN pin for ensuring the device stability. A 1μF 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.

Output Capacitor Selection (C_{OUT})

The output capacitor should be placed as close as possible to the VOUT pin. A 1μF to 10μF X7R or X5R ceramic capacitor is selected to get good dynamic performance. 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. Additionally, C_{OUT} with larger capacitance and lower ESR will help increase the high frequency PSRR and improve the load transient response.

Thermal Shutdown

The SGM2220 can detect the temperature of die. When the die temperature exceeds the threshold value of thermal shutdown, the SGM2220 will be in shutdown state and it will remain in this state until the die temperature decreases to +130℃.

REVISION HISTORY

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

NOVEMBER 2024 – REV.A.2 to REV.A.3	**Page**
Updated Electrical Characteristics section	6

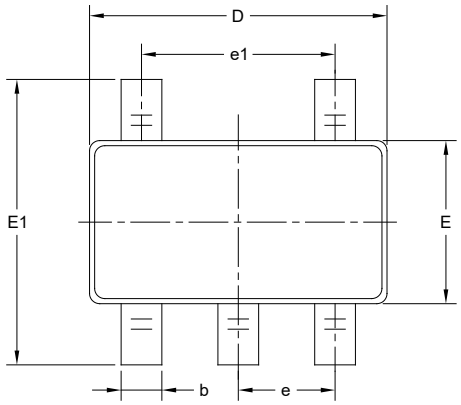
OCTOBER 2023 – REV.A.1 to REV.A.2	**Page**
Added SGM2220-1.2/1.5/2.5/2.8/3.6/4.5 to Package/Ordering Information section	All

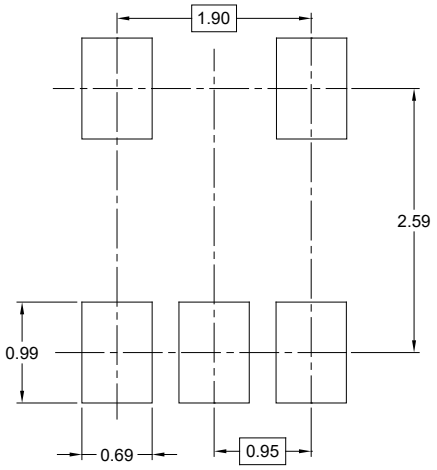
SEPTEMBER 2023 – REV.A to REV.A.1	**Page**
Added SGM2220-3.0XK3G/TR to Package/Ordering Information section	2

Changes from Original (JULY 2023) to REV.A	**Page**
Changed from product preview to production data	All

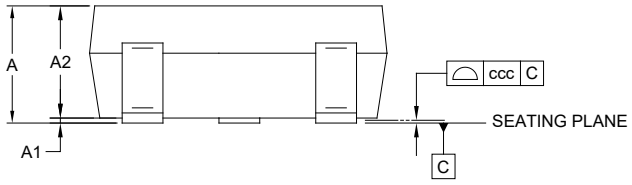
PACKAGE OUTLINE DIMENSIONS

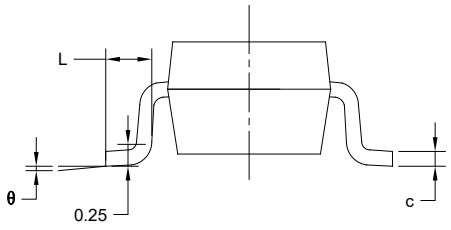
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)



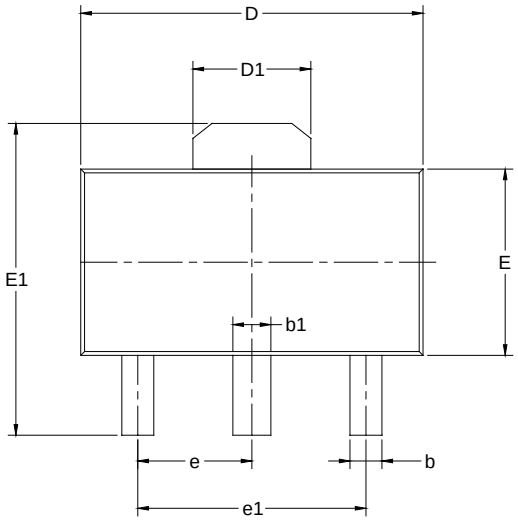


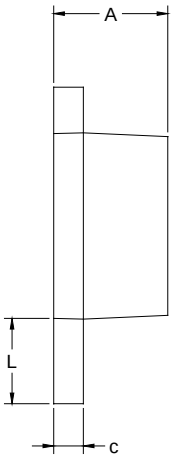
Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

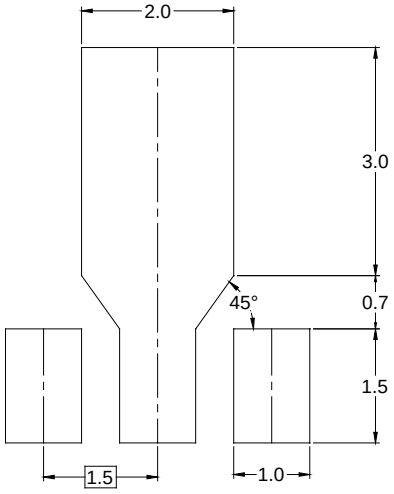
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

PACKAGE OUTLINE DIMENSIONS

SOT-89-3







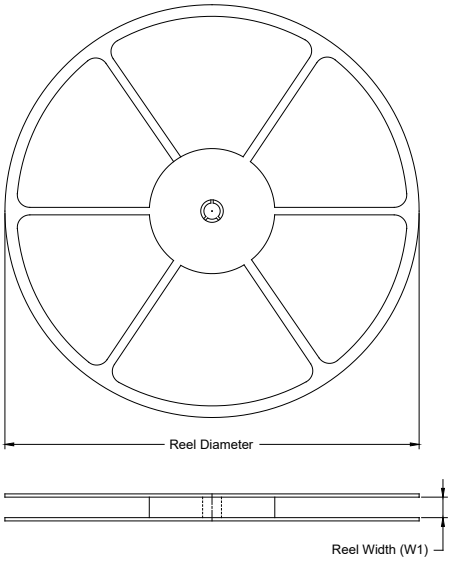
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060 TYP	
e1	3.000 TYP		0.118 TYP	
L	0.900	1.200	0.035	0.047

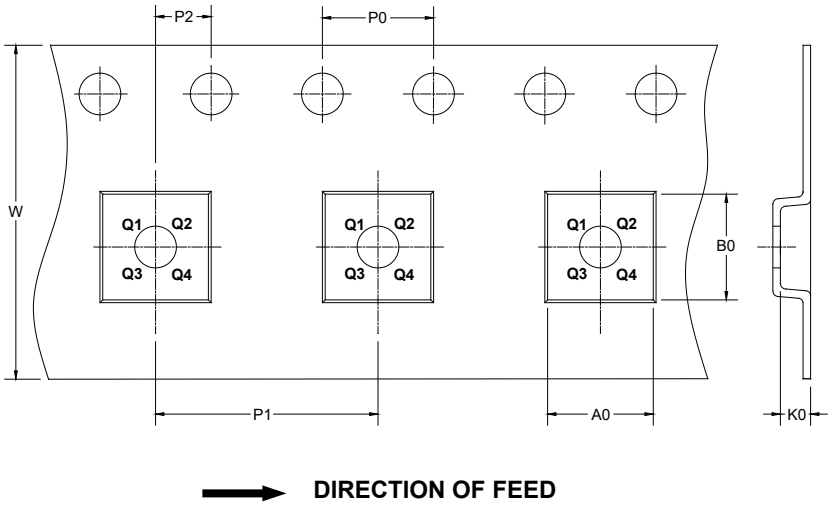
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



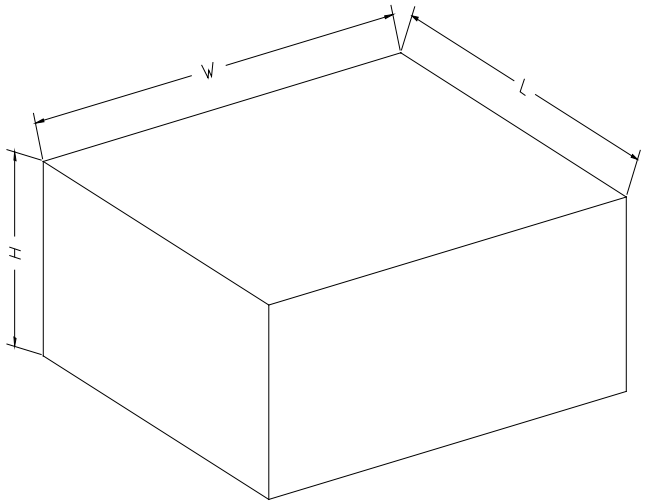
NOTE: The picture is only for reference. Please make the object as the standard.

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-23-5	7″	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
SOT-89-3	7″	13.2	4.85	4.45	1.85	4.0	8.0	2.0	12.0	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