# SGM2210
# 300mA, Low Quiescent Current and Low Noise Linear Regulator

## GENERAL DESCRIPTION

The SGM2210 is a low dropout voltage regulator, which provides a maximum output current of 300mA from an input voltage in the range of 2.5V to 20V, with a typical dropout voltage of 80mV at 100mA output current.

The very low dropout voltage, low quiescent current and low noise make it suitable for battery-powered applications. The enable logic control function puts the SGM2210 in shutdown mode, allowing a total current consumption of 0.5μA (TYP). The device also includes a short-circuit constant current limiting and thermal protection.

The SGM2210 is available in a Green SOT-23-5 package. It operates over an operating temperature range of -40℃ to +125℃.

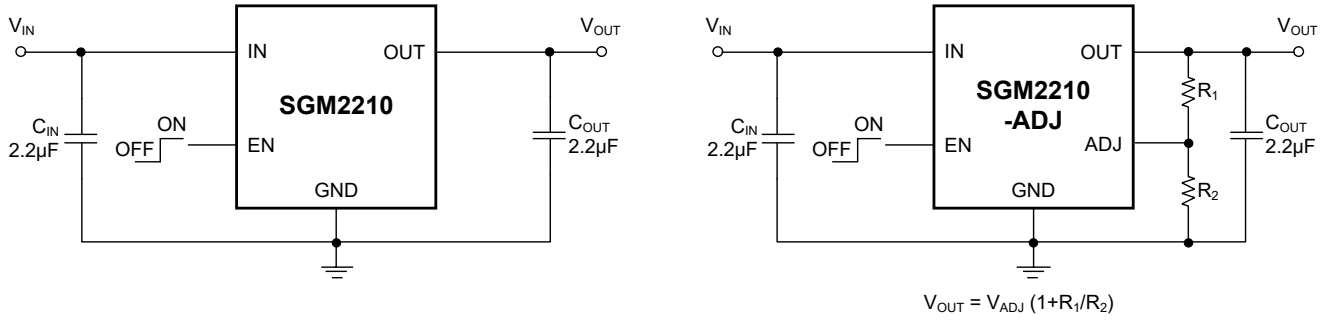
## FEATURES

- **Input Voltage Range: 2.5V to 20V**
- **Low Dropout Voltage: 80mV (TYP) at 100mA Load**
- **Low Quiescent Current: 36μA (TYP)**
- **Shutdown Current: 0.5μA (TYP)**
- **Output Voltage Accuracy: ±1% at +25℃**
- **300mA Guaranteed Output Current**
- **Fixed Output Voltage Versions: 1.2V to 5.0V with 100mV per Step**
- **Adjustable Output Voltages: 1.2V to 12V**
- **Logic-Controlled Shutdown**
- **Output Short-Circuit Constant Current Limiting and Thermal Protection**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green SOT-23-5 Package**

## APPLICATIONS

Battery-Powered Equipment
TV
Set-Top Box
PC and Laptop
Industrial

## TYPICAL APPLICATION




**Fixed Output Voltage Version**

**Adjustable Output Voltage Version**

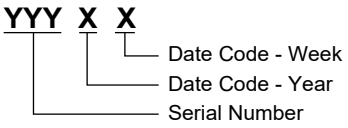
**Figure 1. Typical Application Circuits**

# PACKAGE/ORDERING INFORMATION

| MODEL | $V_{OUT}$ (V) | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---|---|---|---|---|---|---|
| SGM2210-1.2 | 1.2 | SOT-23-5 | -40℃ to +125℃ | SGM2210-1.2XN5G/TR | CC0XX | Tape and Reel, 3000 |
| SGM2210-1.8 | 1.8 | SOT-23-5 | -40℃ to +125℃ | SGM2210-1.8XN5G/TR | CC6XX | Tape and Reel, 3000 |
| SGM2210-2.5 | 2.5 | SOT-23-5 | -40℃ to +125℃ | SGM2210-2.5XN5G/TR | CCDXX | Tape and Reel, 3000 |
| SGM2210-3.3 | 3.3 | SOT-23-5 | -40℃ to +125℃ | SGM2210-3.3XN5G/TR | MWDXX | Tape and Reel, 3000 |
| SGM2210-5.0 | 5.0 | SOT-23-5 | -40℃ to +125℃ | SGM2210-5.0XN5G/TR | MWEXX | Tape and Reel, 3000 |
| SGM2210-ADJ | Adjustable | SOT-23-5 | -40℃ to +125℃ | SGM2210-ADJXN5G/TR | MWFXX | 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

DC Input Voltage Range ..... -0.3V to 22V
DC Output Voltage Range ..... -0.3V to $V_{IN}$ + 0.3V
Enable Input Voltage Range ..... -0.3V to $V_{IN}$ + 0.3V
ADJ Pin Voltage Range ..... -0.3V to 2V
Output Current ..... Internally Limited
Package Thermal Resistance
SOT-23-5, $\theta_{JA}$ ..... 170℃/W
SOT-23-5, $\theta_{JB}$ ..... 38℃/W
SOT-23-5, $\theta_{JC}$ ..... 52℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM ..... 8000V
CDM ..... 1000V

## RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.5V to 20V
Input Effective Capacitance, $C_{IN}$ ..... 1.5μF (MIN)
Output Effective Capacitance, $C_{OUT}$ ..... 2.2μF to 22μF
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.

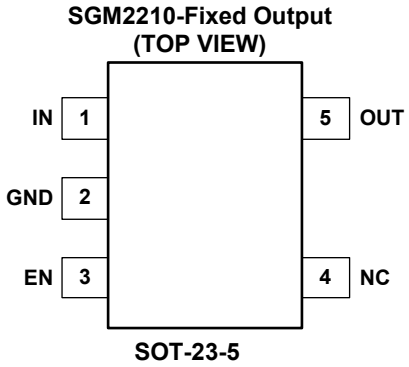
## ESD SENSITIVITY CAUTION

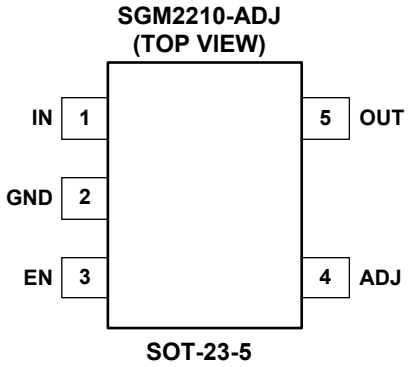
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its 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 | IN | Regulator Input. |
| 2 | GND | Common Ground. |
| 3 | EN | Enable Pin Logic Input. Low = Shutdown, High = Active. |
| 4 | NC | Not Connected (fixed voltage version only). |
| | ADJ | Adjustable Pin (adjustable voltage version only). An external resistor divider sets the output voltage. |
| 5 | OUT | Regulator Output. It is recommended to use output capacitor with effective capacitance in the range of 2.2μF to 22μF. |

## ELECTRICAL CHARACTERISTICS

(Fixed version, $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 1mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = -40℃ to +125℃, typical values are at $T_J$ = +25℃, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Operating Input Voltage | $V_{IN}$ | | +25℃ | 2.5 | | 20 | V |
| Output Voltage Accuracy | $V_{OUT}$ | $I_{OUT}$ = 1mA | +25℃ | -1 | | 1 | % |
| | | $I_{OUT}$ = 1mA to 300mA | -40℃ to +125℃ | -1.5 | | 1.5 | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$ | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 1mA | +25℃ | | 0.001 | 0.005 | %/V |
| | | | -40℃ to +125℃ | | | 0.01 | |
| Load Regulation | $\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta I_{OUT}}$ | $I_{OUT}$ = 1mA to 300mA | +25℃ | | 0.0005 | 0.001 | %/mA |
| | | | -40℃ to +125℃ | | | 0.003 | |
| Dropout Voltage (1) | $V_{DROP}$ | $I_{OUT}$ = 100mA, $V_{OUT}$ = 3.3V | +25℃ | | 80 | 95 | mV |
| | | | -40℃ to +125℃ | | | 130 | |
| | | $I_{OUT}$ = 300mA, $V_{OUT}$ = 3.3V | +25℃ | | 240 | 280 | |
| | | | -40℃ to +125℃ | | | 380 | |
| Output Voltage Noise | $e_n$ | f = 10Hz to 100kHz, $I_{OUT}$ = 10mA, $V_{OUT}$ = 3.3V | +25℃ | | 48 | | $\mu V_{RMS}$ |
| Power Supply Rejection Ratio | PSRR | $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $\Delta V_{RIPPLE}$ = 0.2$V_{P-P}$ f = 1kHz, $I_{OUT}$ = 10mA, $V_{OUT}$ = 3.3V | +25℃ | | 100 | | dB |
| | | $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $\Delta V_{RIPPLE}$ = 0.2$V_{P-P}$ f = 10kHz, $I_{OUT}$ = 10mA, $V_{OUT}$ = 3.3V | +25℃ | | 82 | | |
| Quiescent Current | $I_Q$ | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 0mA | +25℃ | | 36 | 50 | μA |
| | | | -40℃ to +125℃ | | | 60 | |
| | | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 300mA | +25℃ | | 620 | 720 | |
| | | | -40℃ to +125℃ | | | 760 | |
| Shutdown Current | $I_{SHDN}$ | $V_{EN}$ = GND | +25℃ | | 0.5 | 1 | μA |
| | | | -40℃ to +125℃ | | | 1.5 | |
| Output Current Limit (2) | $I_{LIMIT}$ | $V_{OUT}$ = 90%$V_{OUT(NOM)}$ | +25℃ | 550 | 900 | | mA |
| Short Circuit Current | $I_{SHORT}$ | $V_{OUT}$ = 0V | +25℃ | | 600 | | mA |
| Enable Input Logic Low | $V_{IL}$ | $V_{IN}$ = 2.5V to 20V | -40℃ to +125℃ | | | 0.4 | V |
| Enable Input Logic High | $V_{IH}$ | $V_{IN}$ = 2.5V to 20V | -40℃ to +125℃ | 1.3 | | | |
| EN Pin Input Current | $I_{EN}$ | $V_{EN}$ = $V_{IN}$ | +25℃ | | 300 | 600 | nA |
| | | | -40℃ to +125℃ | | | 1000 | |
| Output Discharge Resistance | $R_{DIS}$ | $V_{IN}$ = 2.5V, $V_{EN}$ = 0V | +25℃ | | 95 | | Ω |
| Thermal Shutdown Temperature | $T_{SHDN}$ | | | | 155 | | ℃ |
| Thermal Shutdown Hysteresis | $\Delta T_{SHDN}$ | | | | 20 | | ℃ |

NOTES:

1. Dropout voltage is characterized when $V_{OUT}$ falls 5% below $V_{OUT(NOM)}$.
2. The maximum current has to be limited according to the maximum power dissipation.

## ELECTRICAL CHARACTERISTICS (continued)

(Adjustable version, $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 1mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = -40℃ to +125℃, typical values are at $T_J$ = +25℃, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Operating Input Voltage | $V_{IN}$ | | +25℃ | 2.5 | | 20 | V |
| Adjustable Voltage | $V_{ADJ}$ | | +25℃ | | 1.2 | | V |
| Adjustable Voltage Accuracy | | $I_{OUT}$ = 1mA | +25℃ | -1 | | 1 | % |
| | | $I_{OUT}$ = 1mA to 300mA | -40℃ to +125℃ | -1.5 | | 1.5 | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$ | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 1mA | +25℃ | | 0.001 | 0.005 | %/V |
| | | | -40℃ to +125℃ | | | 0.01 | |
| Load Regulation | $\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta I_{OUT}}$ | $I_{OUT}$ = 1mA to 300mA | +25℃ | | 0.0005 | 0.001 | %/mA |
| | | | -40℃ to +125℃ | | | 0.003 | |
| Dropout Voltage (1) | $V_{DROP}$ | $I_{OUT}$ = 100mA, $V_{OUT}$ = 3.3V | +25℃ | | 80 | 95 | mV |
| | | | -40℃ to +125℃ | | | 130 | |
| | | $I_{OUT}$ = 300mA, $V_{OUT}$ = 3.3V | +25℃ | | 240 | 280 | |
| | | | -40℃ to +125℃ | | | 380 | |
| Output Voltage Noise | $e_n$ | f = 10Hz to 100kHz, $I_{OUT}$ = 10mA, $V_{OUT}$ = 3.3V | +25℃ | | 48 | | $\mu V_{RMS}$ |
| ADJ Pin Current | $I_{ADJ}$ | | +25℃ | | 1 | 3 | nA |
| | | | -40℃ to +125℃ | | | 5 | |
| Power Supply Rejection Ratio | PSRR | $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $\Delta V_{RIPPLE}$ = 0.2$V_{P-P}$ f = 1kHz, $I_{OUT}$ = 10mA, $V_{OUT}$ = 3.3V | +25℃ | | 100 | | dB |
| | | $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $\Delta V_{RIPPLE}$ = 0.2$V_{P-P}$ f = 10kHz, $I_{OUT}$ = 10mA, $V_{OUT}$ = 3.3V | +25℃ | | 82 | | |
| Quiescent Current | $I_Q$ | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 0mA | +25℃ | | 36 | 50 | μA |
| | | | -40℃ to +125℃ | | | 60 | |
| | | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 300mA | +25℃ | | 620 | 720 | |
| | | | -40℃ to +125℃ | | | 760 | |
| Shutdown Current | $I_{SHDN}$ | $V_{EN}$ = GND | +25℃ | | 0.5 | 1 | μA |
| | | | -40℃ to +125℃ | | | 1.5 | |
| Current Limit (2) | $I_{LIMIT}$ | $V_{OUT}$ = 90%$V_{OUT(NOM)}$ | +25℃ | 550 | 900 | | mA |
| Short Circuit Current | $I_{SHORT}$ | $V_{OUT}$ = 0V | +25℃ | | 600 | | mA |
| Enable Input Logic Low | $V_{IL}$ | $V_{IN}$ = 2.5V to 20V | -40℃ to +125℃ | | | 0.4 | V |
| Enable Input Logic High | $V_{IH}$ | $V_{IN}$ = 2.5V to 20V | -40℃ to +125℃ | 1.3 | | | |
| EN Pin Input Current | $I_{EN}$ | $V_{EN}$ = $V_{IN}$ | +25℃ | | 300 | 600 | nA |
| | | | -40℃ to +125℃ | | | 1000 | |
| Output Discharge Resistance | $R_{DIS}$ | $V_{IN}$ = 2.5V, $V_{EN}$ = 0V | +25℃ | | 95 | | Ω |
| Thermal Shutdown Temperature | $T_{SHDN}$ | | | | 155 | | ℃ |
| Thermal Shutdown Hysteresis | $\Delta T_{SHDN}$ | | | | 20 | | ℃ |

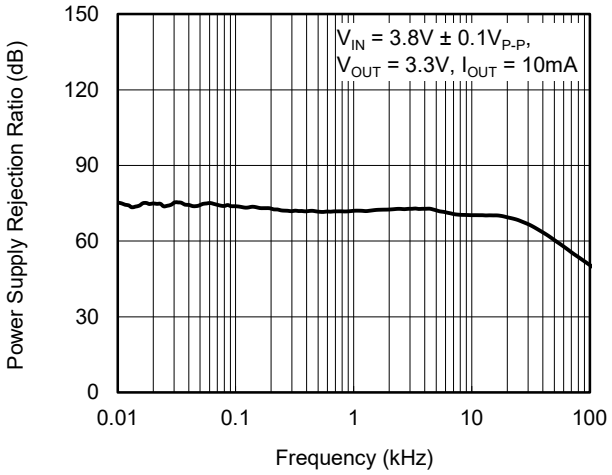
NOTES:

1. Dropout voltage is characterized when $V_{OUT}$ falls 5% below $V_{OUT(NOM)}$.
2. The maximum current has to be limited according to the maximum power dissipation.

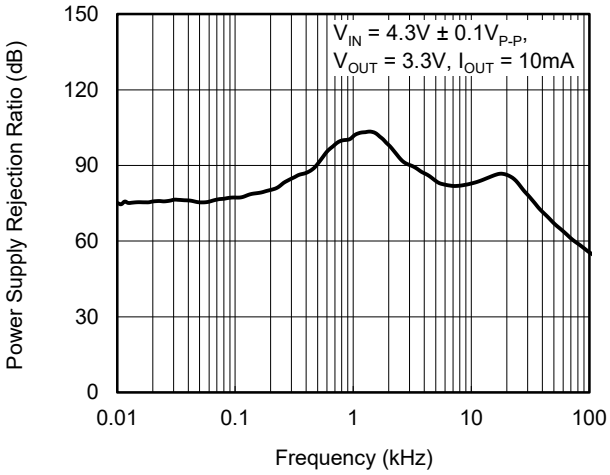
## TYPICAL PERFORMANCE CHARACTERISTICS

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

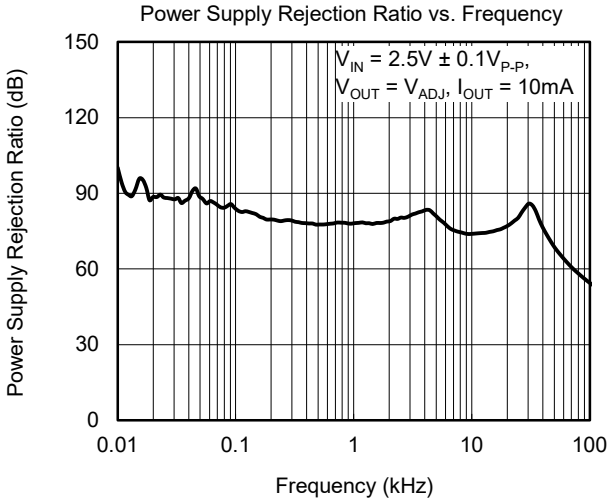
Power Supply Rejection Ratio vs. Frequency



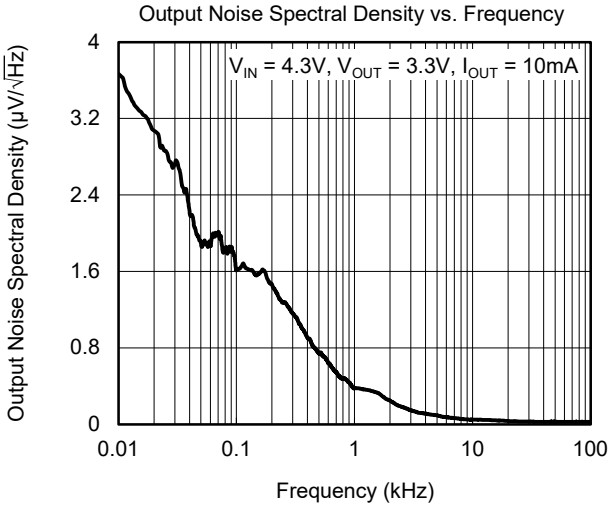

Power Supply Rejection Ratio vs. Frequency



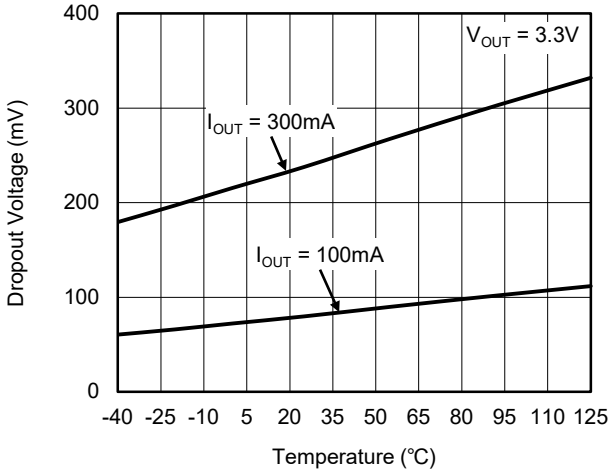

Power Supply Rejection Ratio vs. Frequency



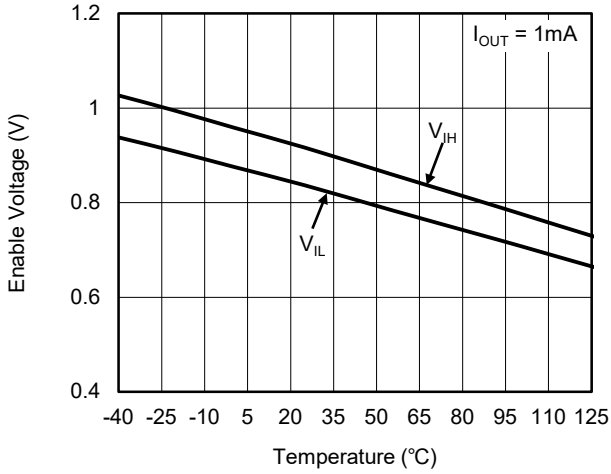

Output Noise Spectral Density vs. Frequency




Dropout Voltage vs. Temperature



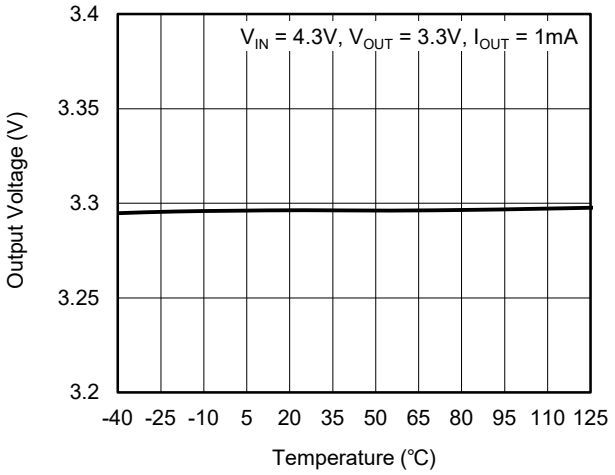

Enable Thresholds vs. Temperature



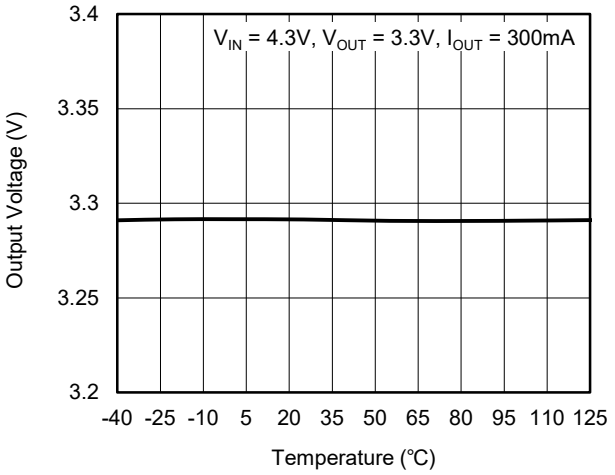
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

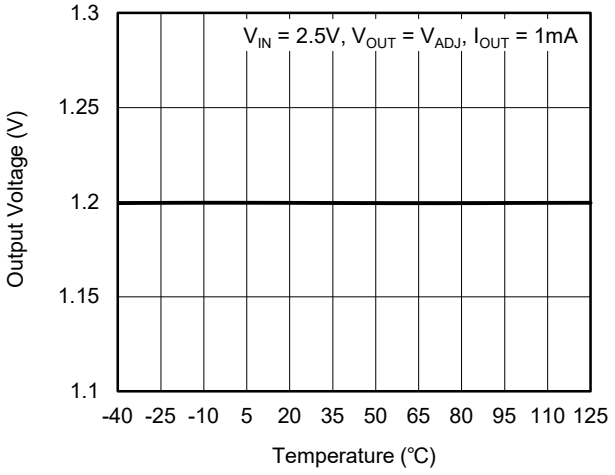
Output Voltage vs. Temperature



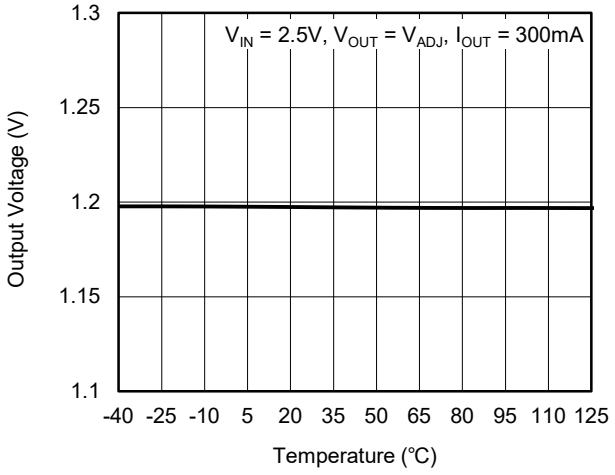

Output Voltage vs. Temperature



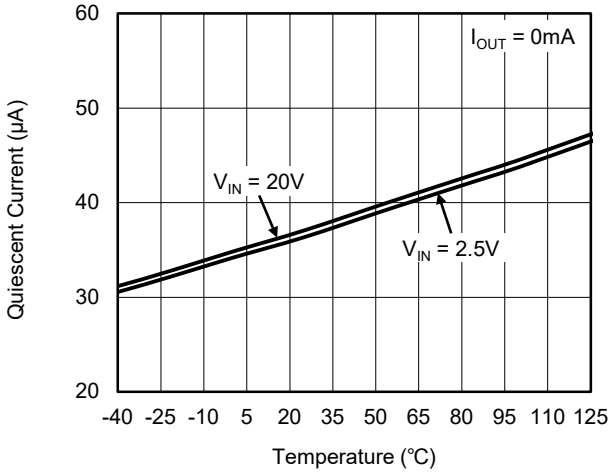

Output Voltage vs. Temperature



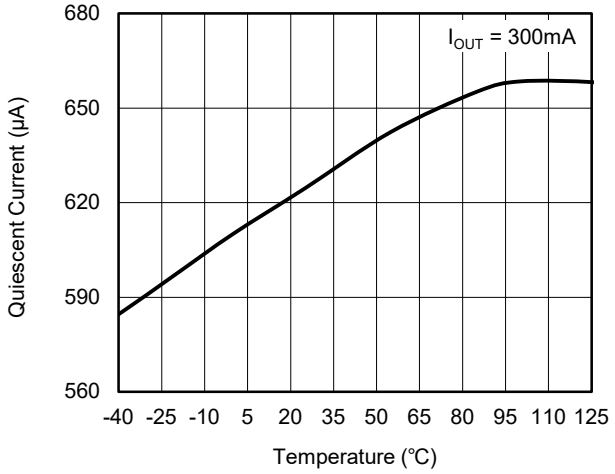

Output Voltage vs. Temperature




Quiescent Current vs. Temperature



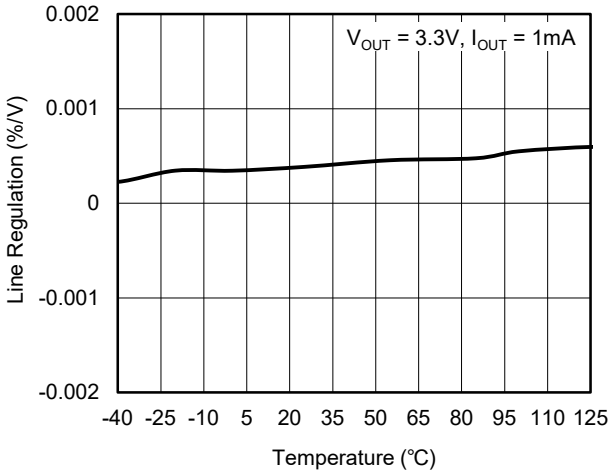

Quiescent Current vs. Temperature



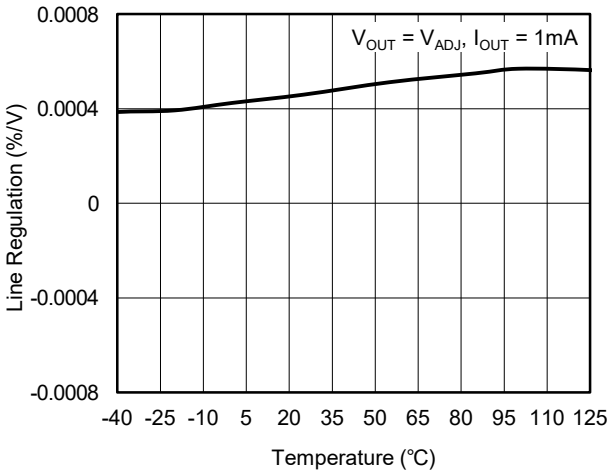
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

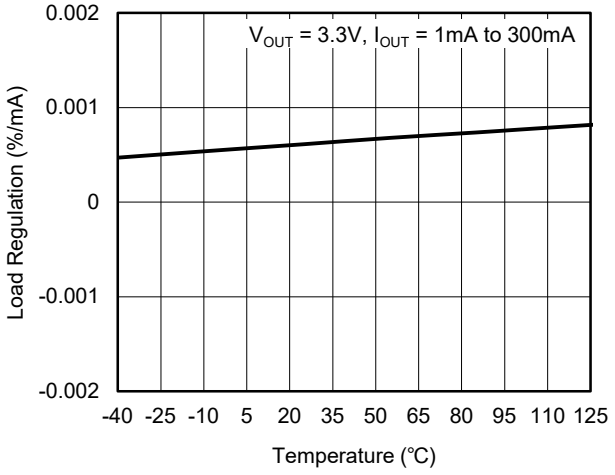
Line Regulation vs. Temperature



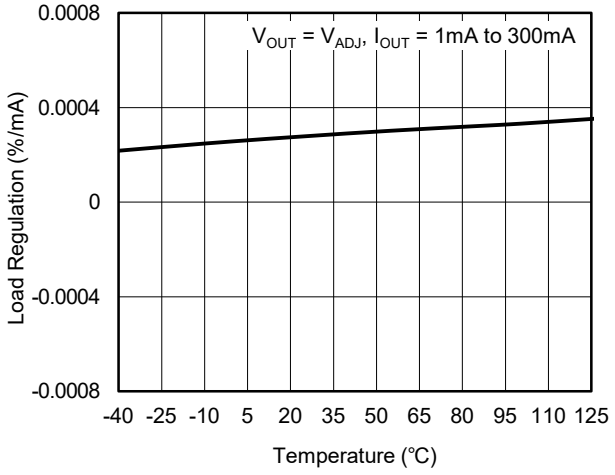

Line Regulation vs. Temperature



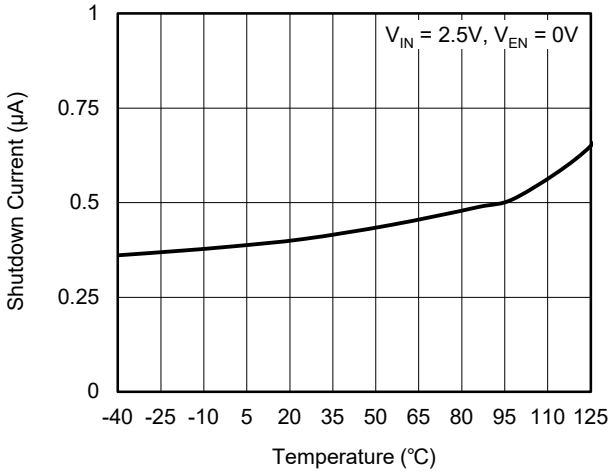

Load Regulation vs. Temperature



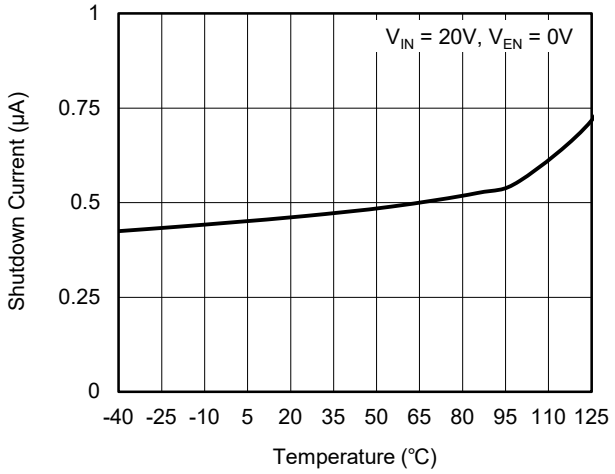

Load Regulation vs. Temperature




Shutdown Current vs. Temperature



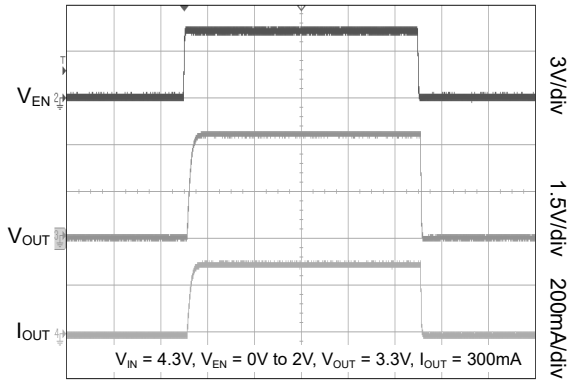

Shutdown Current vs. Temperature



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

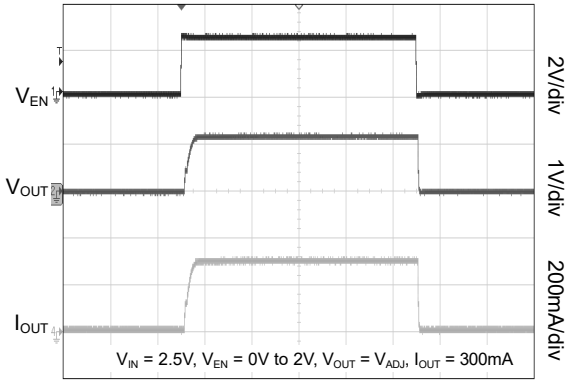
$T_J$ = +25℃, $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $V_{EN}$ = $V_{IN}$, $C_{IN}$ = $C_{OUT}$ = 2.2μF, unless otherwise noted.

Start-Up with Enable



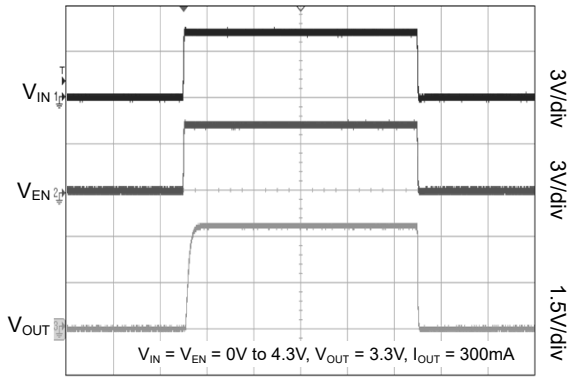

Time (1ms/div)

Start-Up with Enable



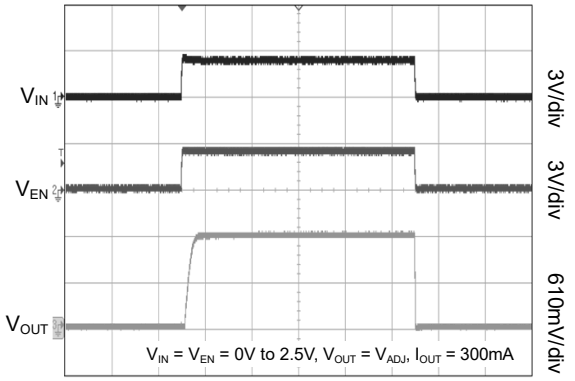

Time (1ms/div)

Turn-On Time



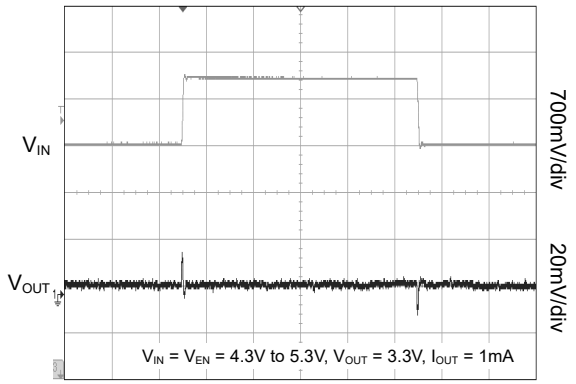

Time (1ms/div)

Turn-On Time



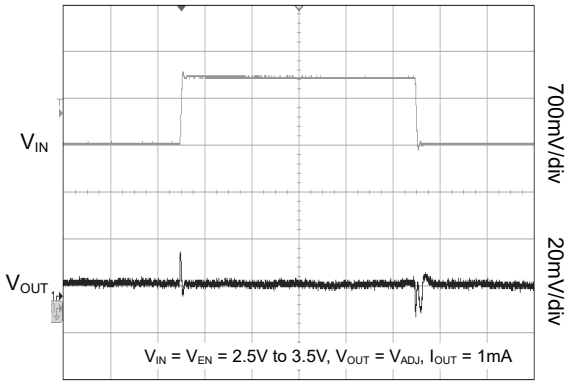

Time (1ms/div)

Line Transient Response




Time (100μs/div)

Line Transient Response

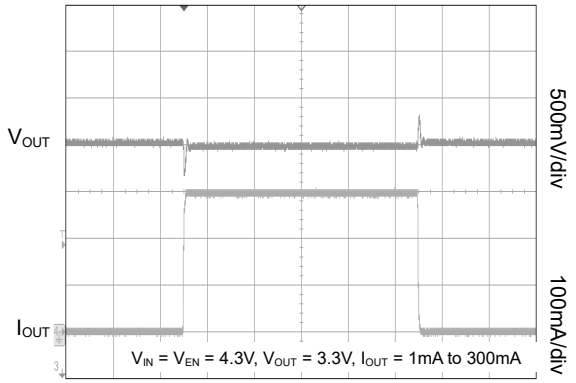



Time (100μs/div)

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

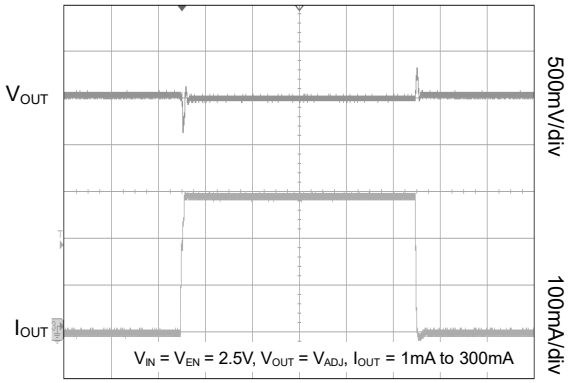
$T_J$ = +25℃, $V_{IN}$ = $V_{OUT(NOM)}$ + 1V, $V_{EN}$ = $V_{IN}$, $C_{IN}$ = $C_{OUT}$ = 2.2μF, unless otherwise noted.

Load Transient Response




Time (100μs/div)

Load Transient Response




Time (100μs/div)

## FUNCTIONAL BLOCK DIAGRAM

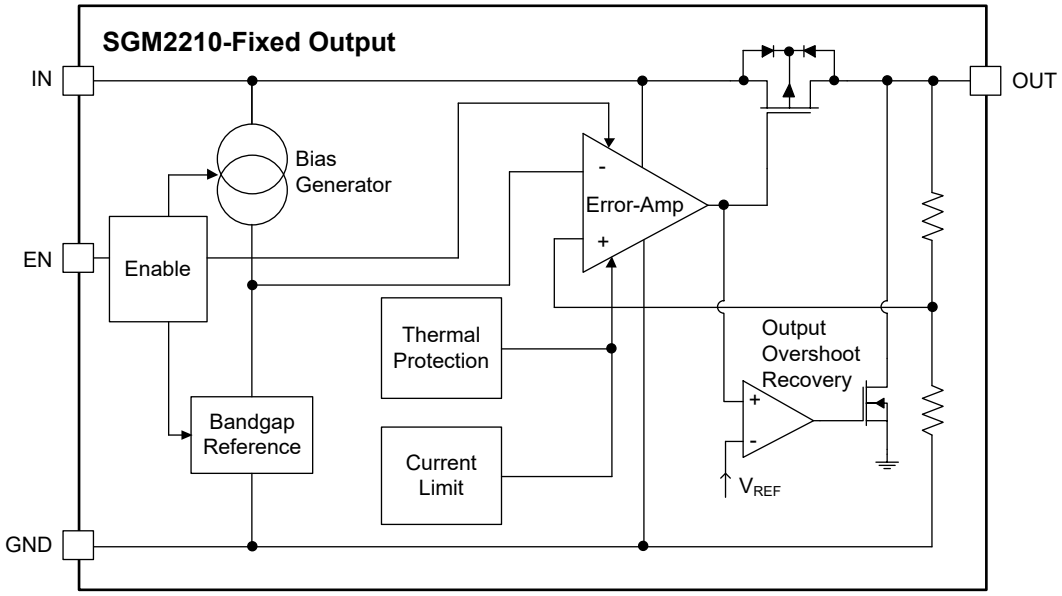



**Figure 2. Fixed Version Block Diagram**

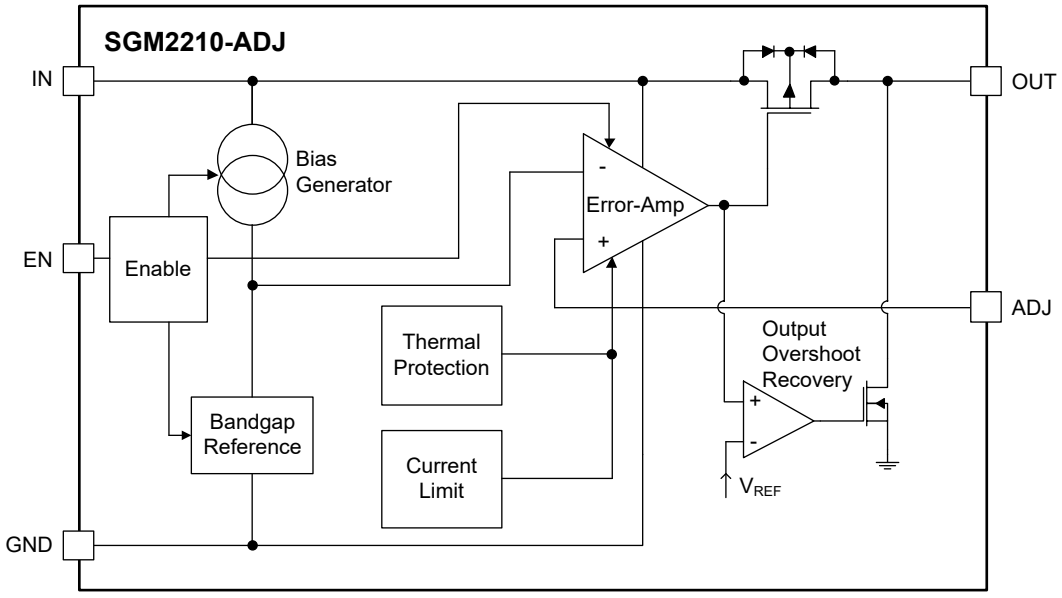



**Figure 3. Adjustable Version Block Diagram**

# APPLICATION INFORMATION

## Overview

The SGM2210 is a linear regulator designed primarily for high input voltage applications. The SGM2210 series is available in several fixed output voltages and adjustable output version (from 1.2V to 12V with a simple resistor divider). The maximum output current is dependent on the package's maximum power dissipation for a given temperature.

The SGM2210 uses external feedback, allowing the user to set the output voltage with an external resistor divider. The typical ADJ pin voltage is 1.2V.

The IC enters shutdown mode when EN is low. In shutdown mode, the pass transistor and control circuitry are turned off, reducing the supply current to 1μA (MAX). Connect EN to VIN for automatic startup.

## Setting the Output Voltage

Set the output voltage of the SGM2210 by using a resistor divider as shown:

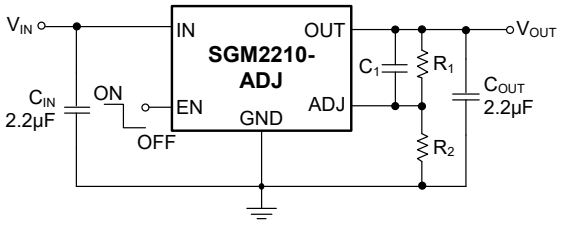



**Figure 4. SGM2210-ADJ with External Resistor Divider**

Choose $R_2$ = 150kΩ to maintain an 8μA load. Calculate the value for $R_1$ using the following equation:

$$R_1 = R_2 \times \left( \frac{V_{OUT}}{1.2V} - 1 \right)$$

## Input Capacitor and Output Capacitor

For proper operation, place a 2.2μF ceramic capacitor ($C_{IN}$) between the input pin and ground. Larger values in this range will help improve line transient response.

For stable operation, use a ceramic capacitor ($C_{OUT}$) between 2.2μF and 22μF. Larger values in this range will help improve load transient response and reduce noise. Output capacitors of other dielectric types may be used, but are not recommended as their capacitance can deviate greatly from their rated value over temperature.

## Thermal Considerations

When the junction temperature is too high, the thermal protection circuitry sends a signal to the control logic that will shut down the IC. The IC will restart when the temperature has sufficiently cooled down.

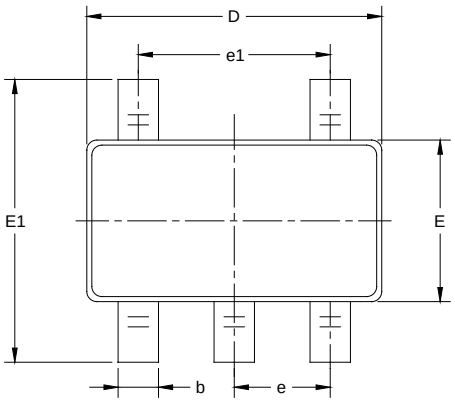
The maximum power dissipation is dependent on the thermal resistance of the case and the circuit board, the temperature difference between the die junction and the ambient air, and the rate of air flow.

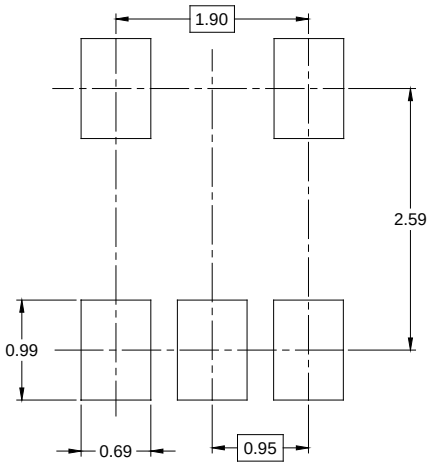
## Output Noise

The SGM2210 will exhibit noise on the output during normal operation. This noise is negligible for most applications. However, in applications that include analog-to-digital converters (ADCs) of more than 12 bits, one needs to consider the ADC's power supply rejection specifications.

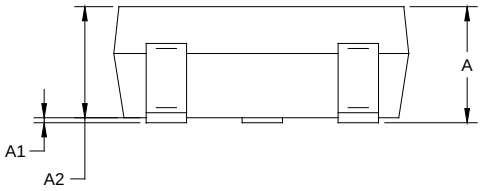
# PACKAGE OUTLINE DIMENSIONS

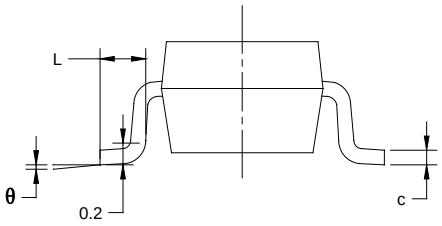
## SOT-23-5




**RECOMMENDED LAND PATTERN** (Unit: mm)

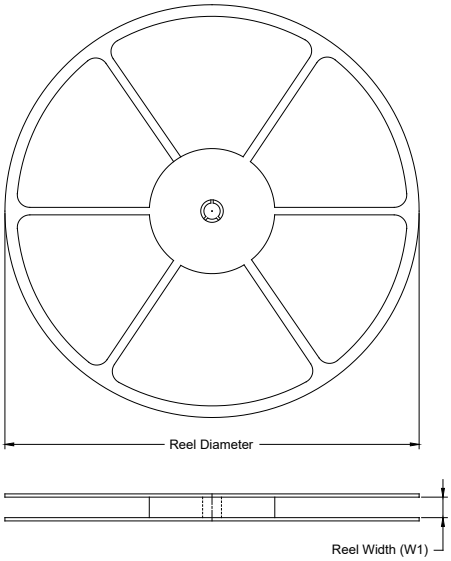


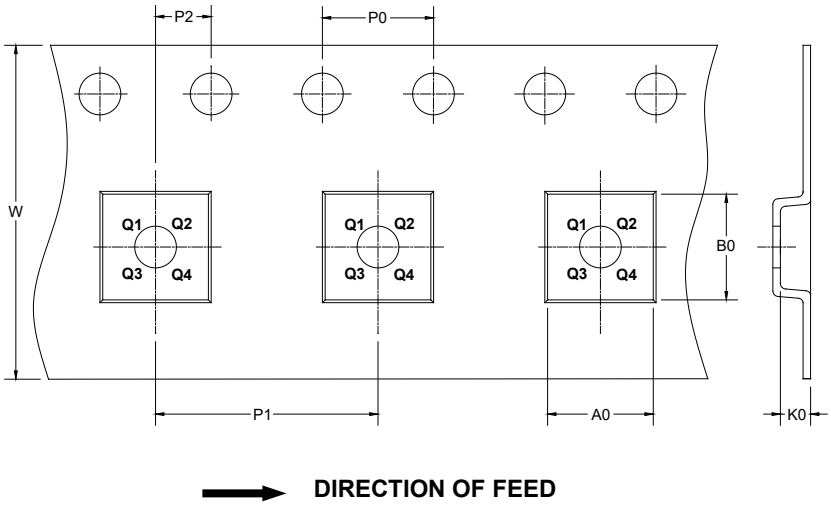

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008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

# TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS




DIRECTION OF FEED

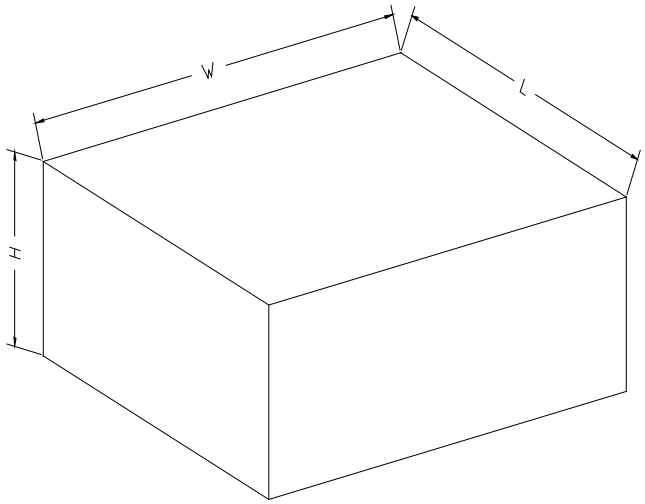
NOTE: The picture is only for reference. Please make the object as the standard.

## 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 |

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