# SGM2211
# 20V, 500mA, Low Noise, Low Dropout Linear Regulator

## GENERAL DESCRIPTION

The SGM2211 is a low dropout linear regulator that operates from 2.7V to 20V and provides up to 500mA of output current. This high input voltage LDO provides wide output voltage range from 19V down to 1.2V rails that high performance analog and mixed signal circuits need. The SGM2211 provides high PSRR, low noise and excellent line and load transient responses with a small 2.2μF ceramic output capacitor. These features are very important for noise sensitive circuits.

The SGM2211 is available in fixed output voltage versions and an adjustable version that allows the output voltage to range from 1.2V to ($V_{IN}$ - $V_{DROP}$) via an external feedback divider.

The SGM2211 regulator output noise is 9.3μ$V_{RMS}$ at 1.2V output voltage and 14μ$V_{RMS}$ at 5V output voltage.

The SGM2211 is available in Green TDFN-2×2-6AL and SOT-23-5 packages. It operates over an operating temperature range of -40℃ to +125℃.

## APPLICATIONS

Power of Noise Sensitive Application: ADC and DAC Circuits, Precision Amplifiers, Power for VCO $V_{TUNE}$ Control
Communications and Infrastructure
Medical and Healthcare
Industrial and Instrumentation

## FEATURES

- **Input Voltage Range: 2.7V to 20V**
- **Low Noise:**
  - **9.3μ$V_{RMS}$ at $V_{OUT}$ = 1.2V**
  - **11μ$V_{RMS}$ at $V_{OUT}$ = 2.8V**
  - **14μ$V_{RMS}$ at $V_{OUT}$ = 5.0V**
- **PSRR ($V_{IN}$ = $V_{OUT(NOM)}$ + 1V):**
  - **100dB at 1kHz**
  - **83dB at 10kHz**
  - **52dB at 100kHz**
  - **55dB at 1MHz**
- **Maximum Output Current: 500mA**
- **Output Voltage Accuracy: ±1% at +25℃**
- **Low Dropout Voltage:**
  **360mV (TYP) at 500mA Load when $V_{OUT}$ = 5.0V**
- **User Programmable Soft-Start (TDFN Package Only)**
- **Low Quiescent Current: 39μA (TYP)**
- **Shutdown Current: 1.2μA (TYP)**
- **Stable with a 2.2μF Ceramic Output Capacitor**
- **Adjustable Output from 1.2V to ($V_{IN}$ - $V_{DROP}$), Output can be Adjusted above Initial Set Point**
- **Reverse Current Protection when $V_{OUT}$ > $V_{IN}$**
- **Foldback Current-Limit Protection when VOUT is Shorted to GND**
- **Automatic VOUT Discharge when Disabled**
- **Precision Enable**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green TDFN-2×2-6AL and SOT-23-5 Packages**

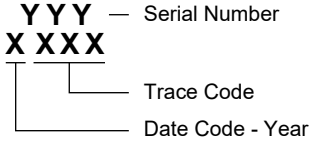
# PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---|---|---|---|---|---|
| SGM2211-1.2 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-1.2XTDI6G/TR | C1B<br>XXXX | Tape and Reel, 3000 |
| SGM2211-1.5 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-1.5XTDI6G/TR | C1C<br>XXXX | Tape and Reel, 3000 |
| SGM2211-1.8 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-1.8XTDI6G/TR | C1D<br>XXXX | Tape and Reel, 3000 |
| SGM2211-2.5 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-2.5XTDI6G/TR | C1E<br>XXXX | Tape and Reel, 3000 |
| SGM2211-2.8 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-2.8XTDI6G/TR | C1F<br>XXXX | Tape and Reel, 3000 |
| SGM2211-3.0 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-3.0XTDI6G/TR | C20<br>XXXX | Tape and Reel, 3000 |
| SGM2211-3.3 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-3.3XTDI6G/TR | C21<br>XXXX | Tape and Reel, 3000 |
| SGM2211-3.8 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-3.8XTDI6G/TR | C22<br>XXXX | Tape and Reel, 3000 |
| SGM2211-4.2 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-4.2XTDI6G/TR | C23<br>XXXX | Tape and Reel, 3000 |
| SGM2211-5.0 | TDFN-2×2-6AL | -40℃ to +125℃ | SGM2211-5.0XTDI6G/TR | C24<br>XXXX | Tape and Reel, 3000 |
| SGM2211-1.2 | SOT-23-5 | -40℃ to +125℃ | SGM2211-1.2XN5G/TR | C11XX | Tape and Reel, 3000 |
| SGM2211-1.5 | SOT-23-5 | -40℃ to +125℃ | SGM2211-1.5XN5G/TR | C12XX | Tape and Reel, 3000 |
| SGM2211-1.8 | SOT-23-5 | -40℃ to +125℃ | SGM2211-1.8XN5G/TR | C13XX | Tape and Reel, 3000 |
| SGM2211-2.5 | SOT-23-5 | -40℃ to +125℃ | SGM2211-2.5XN5G/TR | C14XX | Tape and Reel, 3000 |
| SGM2211-2.8 | SOT-23-5 | -40℃ to +125℃ | SGM2211-2.8XN5G/TR | C15XX | Tape and Reel, 3000 |
| SGM2211-3.0 | SOT-23-5 | -40℃ to +125℃ | SGM2211-3.0XN5G/TR | C16XX | Tape and Reel, 3000 |
| SGM2211-3.3 | SOT-23-5 | -40℃ to +125℃ | SGM2211-3.3XN5G/TR | C17XX | Tape and Reel, 3000 |
| SGM2211-3.8 | SOT-23-5 | -40℃ to +125℃ | SGM2211-3.8XN5G/TR | C18XX | Tape and Reel, 3000 |
| SGM2211-4.2 | SOT-23-5 | -40℃ to +125℃ | SGM2211-4.2XN5G/TR | C19XX | Tape and Reel, 3000 |
| SGM2211-5.0 | SOT-23-5 | -40℃ to +125℃ | SGM2211-5.0XN5G/TR | C1AXX | Tape and Reel, 3000 |
| SGM2211-ADJ | SOT-23-5 | -40℃ to +125℃ | SGM2211-ADJXN5G/TR | C2FXX | Tape and Reel, 3000 |

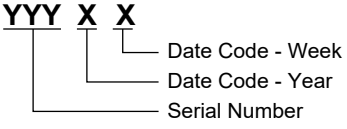
## MARKING INFORMATION

NOTE: XX = Date Code. XXXX = Date Code and Trace Code.

**TDFN-2×2-6AL**




**SOT-23-5**




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 24V
VOUT to GND ..... -0.3V to 24V
EN to GND ..... -0.3V to 24V
SENSE/ADJ to GND ..... -0.3V to 24V
SS to GND ..... -0.3V to $V_{IN}$ or 6V (whichever is less)
Package Thermal Resistance
TDFN-2×2-6AL, $\theta_{JA}$ ..... 100℃/W
TDFN-2×2-6AL, $\theta_{JB}$ ..... 37℃/W
TDFN-2×2-6AL, $\theta_{JC}$ ..... 77℃/W
SOT-23-5, $\theta_{JA}$ ..... 182℃/W
SOT-23-5, $\theta_{JB}$ ..... 44℃/W
SOT-23-5, $\theta_{JC}$ ..... 70℃/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 ..... 2.7V to 20V
Operating Junction Temperature Range ..... -40℃ to +125℃
Input Capacitance, $C_{IN}$ ..... 1.5μF (MIN)
Output Capacitance, $C_{OUT}$ ..... 1.5μF to 10μF

## 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.

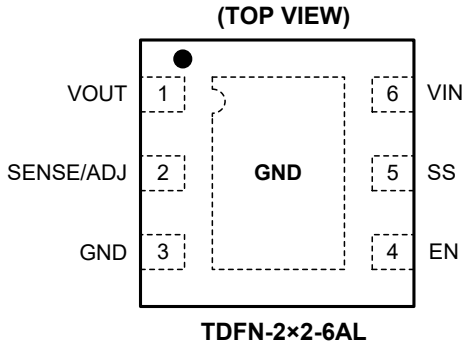
## ESD SENSITIVITY CAUTION

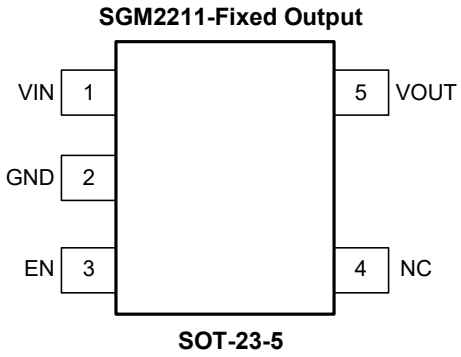
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

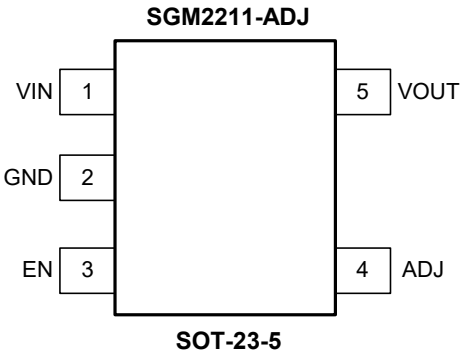
## DISCLAIMER

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 |
|---|---|---|---|
| TDFN-2×2-6AL | SOT-23-5 | | |
| 1 | 5 | VOUT | Regulated Output Voltage. It is recommended to use output capacitor with effective capacitance in the range of 1.5μF to 10μF. The capacitor should be located very close to this pin. |
| 2 | – | SENSE/ADJ | Sense Input (SENSE). Connect to load. An external resistor divider may also set the output voltage higher than the fixed output voltage (ADJ). |
| 3 | 2 | GND | Ground. |
| 4 | 3 | EN | Enable Pin. Driving EN high to turn on the regulator. Driving EN low to turn off the regulator. For automatic startup, connect EN pin to VIN pin. |
| 5 | – | SS | Soft-Start. An external capacitor connected to this pin determines the soft-start time. Leave this pin open for a typical 150μs start-up time. Do not ground this pin. |
| 6 | 1 | VIN | Regulator Input Supply. Additional bypass capacitance may be required to provide a stable input voltage. Bypass VIN pin to GND with a 2.2μF or larger capacitor. The capacitor should be located very close to this pin. |
| – | 4 | NC | Not Connected (fixed voltage version only). |
| | | ADJ | Adjustable Input (adjustable voltage version only). This is used to set the output voltage of the device. The typical ADJ pin voltage is 1.2V. |
| Exposed Pad | – | GND | Exposed Pad. The exposed pad on the bottom of the package enhances thermal performance and is electrically connected to GND inside the package. It is recommended that the exposed pad connect to the ground plane on the board. |

# ELECTRICAL CHARACTERISTICS

($V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) or 2.7V, whichever is greater, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 10mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF and $C_{SS}$ = 0nF, $T_J$ = -40℃ to +125℃, typical values are at $T_J$ = +25℃, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|---|
| Input Voltage Range | $V_{IN}$ | | | -40℃ to +125℃ | 2.7 | | 20 | V |
| Under-Voltage Lockout Thresholds | $V_{UVLO}$ | $V_{IN}$ rising | | -40℃ to +125℃ | | 2.52 | 2.70 | V |
| | | $V_{IN}$ falling | | -40℃ to +125℃ | 2.16 | 2.33 | | |
| Operating Supply Current | $I_{GND}$ | $I_{OUT}$ = 0μA | | -40℃ to +125℃ | | 39 | 62 | μA |
| | | $I_{OUT}$ = 500mA | | -40℃ to +125℃ | | 980 | 1200 | |
| Shutdown Current | $I_{SHDN}$ | $V_{EN}$ = GND | | -40℃ to +125℃ | | 1.2 | 2.2 | μA |
| | | $V_{EN}$ = GND, $V_{IN}$ = 20V | | -40℃ to +125℃ | | 1.3 | 2.5 | |
| ADJ Input Bias Current | $I_{ADJ}$ | $V_{ADJ}$ = $V_{OUT(NOM)}$ + 0.1V | | -40℃ to +125℃ | -6 | | 6 | nA |
| Output Voltage Accuracy | $V_{OUT}$ | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 100μA to 500mA | | +25℃ | -1 | | 1 | % |
| | | | | -40℃ to +125℃ | -1.6 | | 1.6 | |
| Feedback Voltage | $V_{ADJ}$ | $I_{OUT}$ = 10mA | | +25℃ | 1.188 | 1.2 | 1.212 | V |
| | | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V, $I_{OUT}$ = 100μA to 500mA | | -40℃ to +125℃ | 1.181 | | 1.219 | |
| Input Reverse Current | $I_{REV-INPUT}$ | $V_{EN}$ = GND, $V_{IN}$ = 0V, $V_{OUT}$ = 20V | | -40℃ to +125℃ | | 0.05 | 1 | μA |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$ | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) to 20V | | -40℃ to +125℃ | | 0.001 | 0.007 | %/V |
| Load Regulation | $\Delta V_{OUT}$ | $I_{OUT}$ = 100μA to 500mA | | -40℃ to +125℃ | | 3 | 26 | mV |
| Dropout Voltage (1) | $V_{DROP}$ | $I_{OUT}$ = 500mA | $V_{OUT(NOM)}$ = 2.5V | -40℃ to +125℃ | | 500 | 730 | mV |
| | | | $V_{OUT(NOM)}$ = 3.0V | -40℃ to +125℃ | | 450 | 680 | |
| | | | $V_{OUT(NOM)}$ = 5.0V | -40℃ to +125℃ | | 360 | 580 | |
| Soft-Start Source Current | $SS_{I-SOURCE}$ | SS = GND | | -40℃ to +125℃ | | 1 | 3 | μA |
| Output Current Limit | $I_{LIMIT}$ | $V_{OUT}$ = $V_{OUT(NOM)}$ - 1V (2) | | +25℃ | 0.51 | 0.80 | | A |
| Output Voltage Noise | $e_n$ | f = 10Hz to 100kHz, $I_{OUT}$ = 1mA | $V_{OUT}$ = 1.2V | +25℃ | | 9.3 | | $\mu V_{RMS}$ |
| | | | $V_{OUT}$ = 2.8V | +25℃ | | 11 | | |
| | | | $V_{OUT}$ = 5.0V | +25℃ | | 14 | | |
| Power Supply Rejection Ratio | PSRR | $V_{IN}$ = $V_{OUT(NOM)}$ + 1V | f = 1kHz | +25℃ | | 100 | | dB |
| | | | f = 10kHz | +25℃ | | 83 | | |
| | | | f = 100kHz | +25℃ | | 52 | | |
| | | | f = 1MHz | +25℃ | | 55 | | |
| Precision EN Input | $V_{IH}$ | Logic high, $V_{IN}$ = 2.7V to 20V | | -40℃ to +125℃ | 1.120 | 1.210 | 1.295 | V |
| | $V_{IL}$ | Logic low, $V_{IN}$ = 2.7V to 20V | | -40℃ to +125℃ | 1.050 | 1.120 | 1.195 | |
| Leakage Current | $I_{EN-LKG}$ | $V_{EN}$ = $V_{IN}$, $V_{IN}$ = 2.7V to 20V | | -40℃ to +125℃ | | 0.1 | 1 | μA |
| Start-Up Time | $t_{STR}$ | From EN rising from 0V to $V_{IN}$ to 0.9 × $V_{OUT}$, $V_{OUT}$ = 1.2V | | +25℃ | | 150 | | μs |
| Discharge Resistor | $R_{DIS}$ | $V_{EN}$ = 0V, $V_{OUT}$ = 0.5V | | -40℃ to +125℃ | | 100 | 140 | Ω |
| Thermal Shutdown Temperature | $T_{SHDN}$ | | | | | 160 | | ℃ |
| Thermal Shutdown Hysteresis | $\Delta T_{SHDN}$ | | | | | 20 | | ℃ |

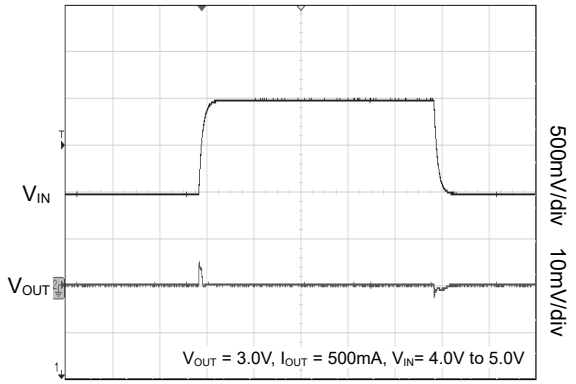
NOTES:

1. Dropout voltage is characterized when $V_{OUT}$ falls 5% below $V_{OUT(NOM)}$.
2. $V_{OUT}$ = $V_{OUT(NOM)}$ - 0.2V when $V_{OUT}$ = 1.2V.

## TYPICAL PERFORMANCE CHARACTERISTICS

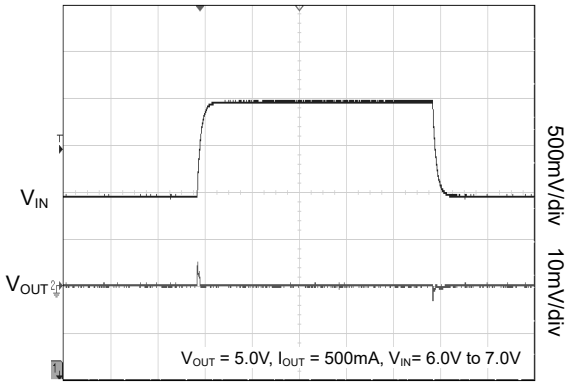
$V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) or 2.7V, whichever is greater, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 10mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = +25℃, unless otherwise noted.

Line Transient Response



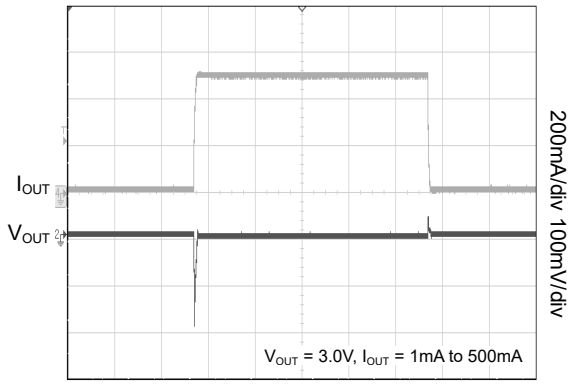

Time (20μs/div)

Line Transient Response



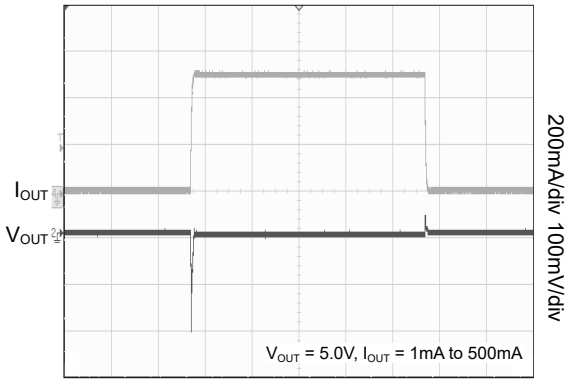

Time (20μs/div)

Load Transient Response



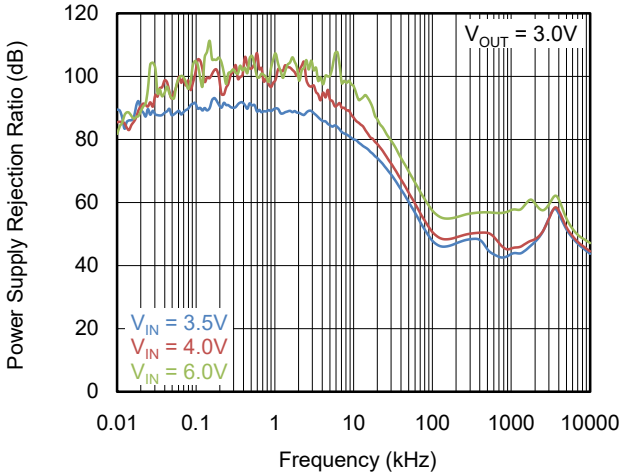

Time (100μs/div)

Load Transient Response

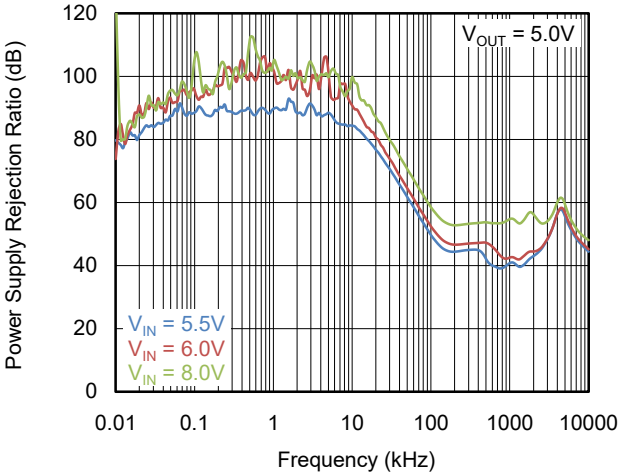



Time (100μs/div)

Power Supply Rejection Ratio vs. Frequency



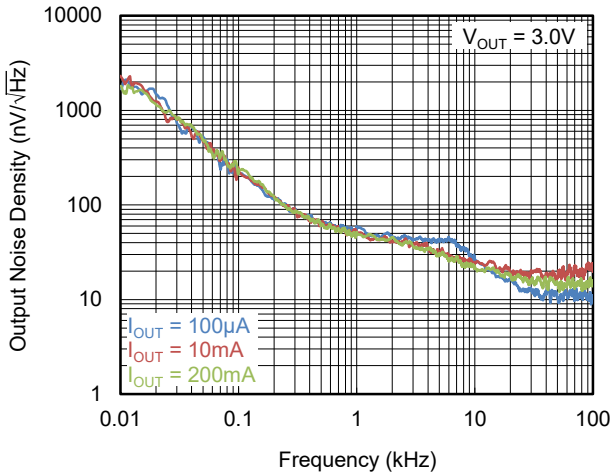

Power Supply Rejection Ratio vs. Frequency



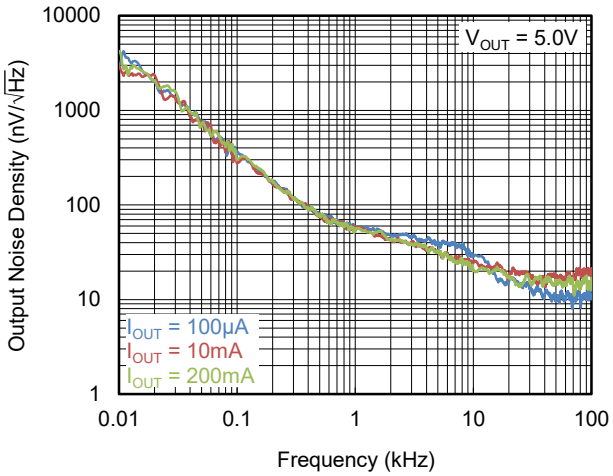
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) or 2.7V, whichever is greater, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 10mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = +25℃, unless otherwise noted.

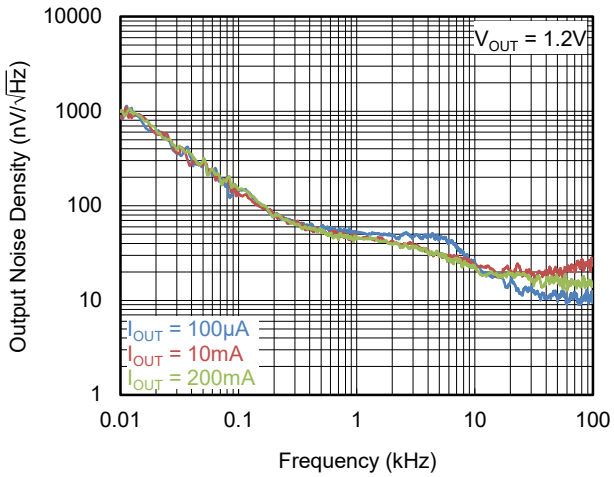
Output Noise Density vs. Frequency



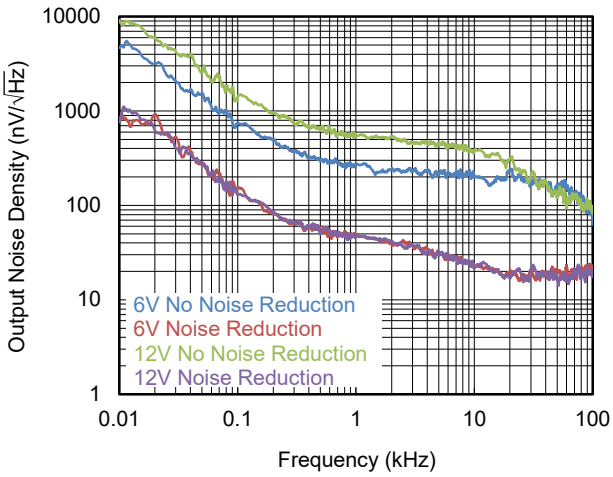

Output Noise Density vs. Frequency



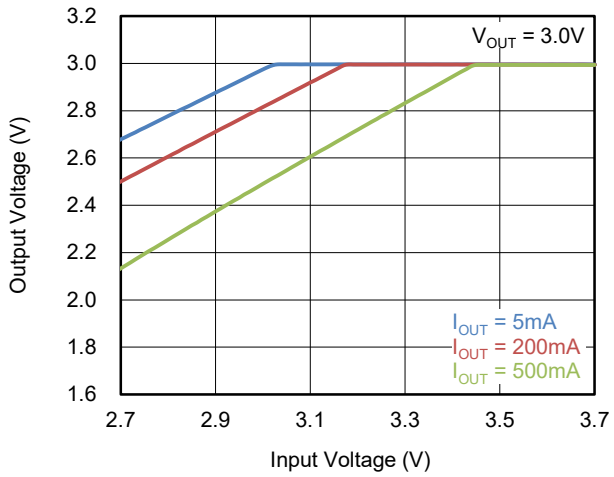

Output Noise Density vs. Frequency



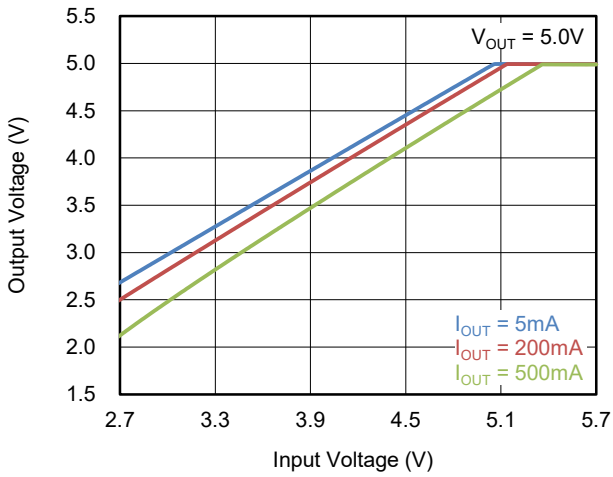

Output Voltage with/without Noise Reduction




Output Voltage vs. Input Voltage in Dropout



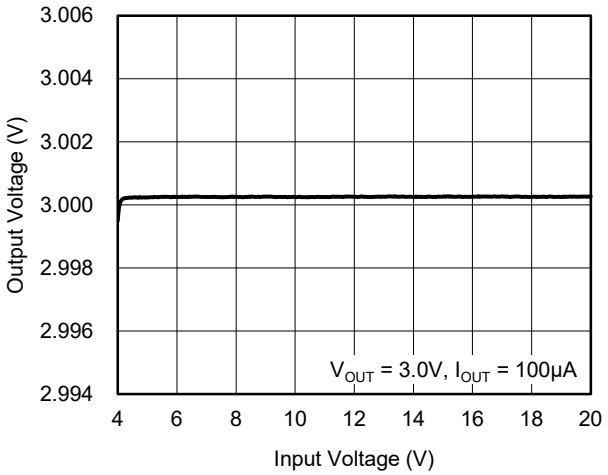

Output Voltage vs. Input Voltage in Dropout



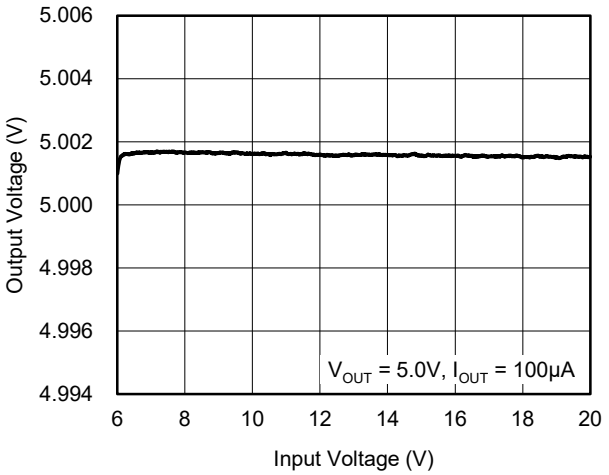
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) or 2.7V, whichever is greater, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 10mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = +25℃, unless otherwise noted.

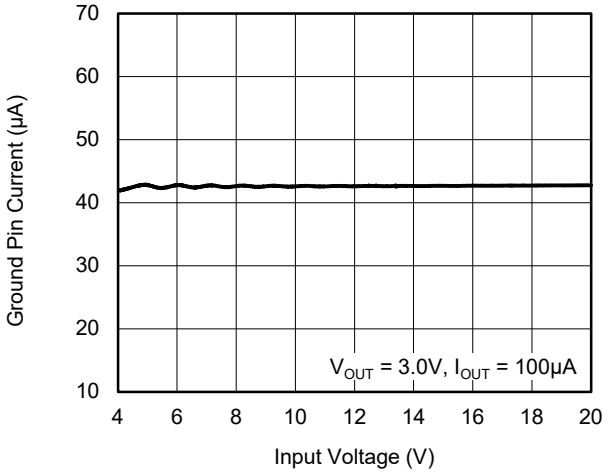
Output Voltage vs. Input Voltage



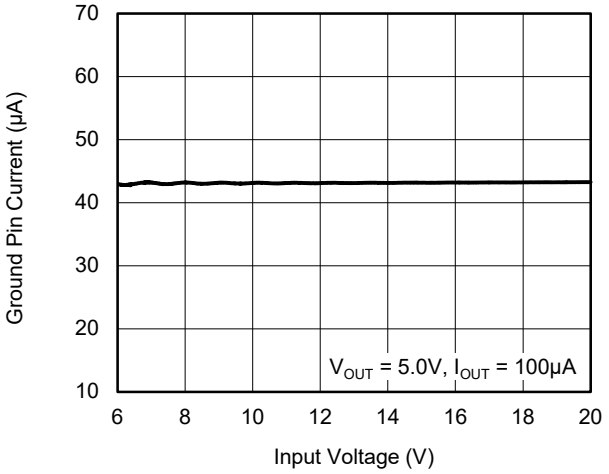

Output Voltage vs. Input Voltage



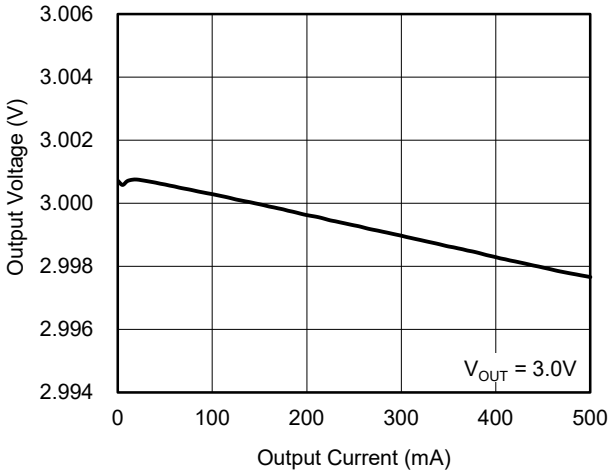

Ground Pin Current vs. Input Voltage



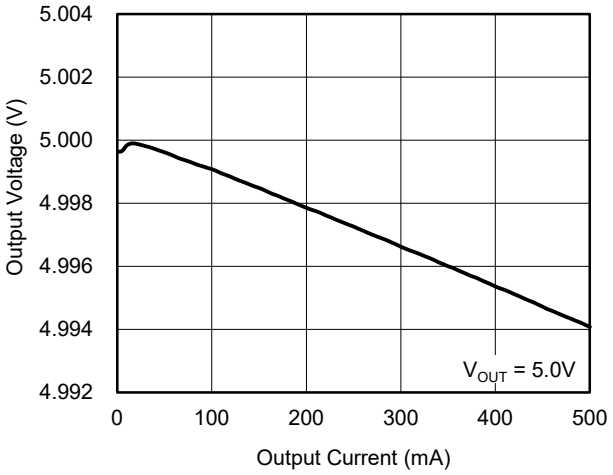

Ground Pin Current vs. Input Voltage




Output Voltage vs. Output Current



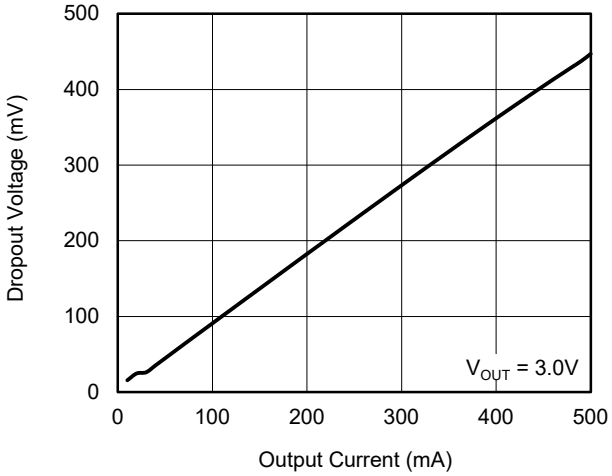

Output Voltage vs. Output Current



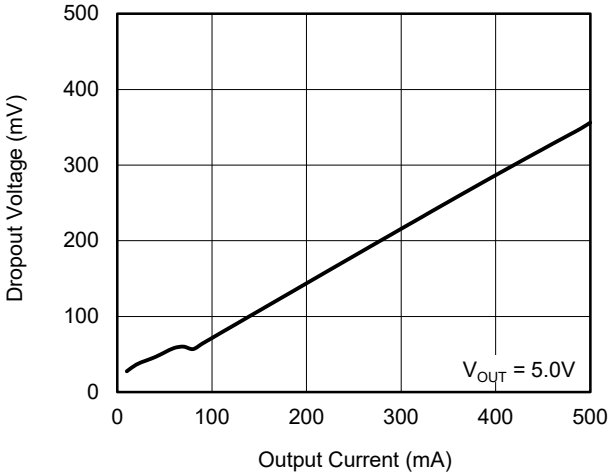
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) or 2.7V, whichever is greater, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 10mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = +25℃, unless otherwise noted.

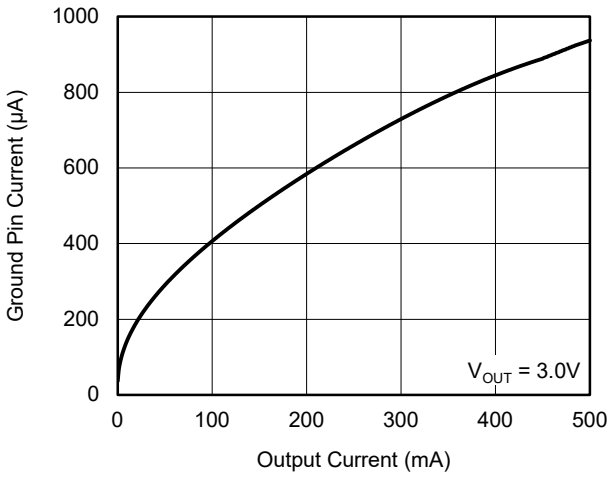
Dropout Voltage vs. Output Current



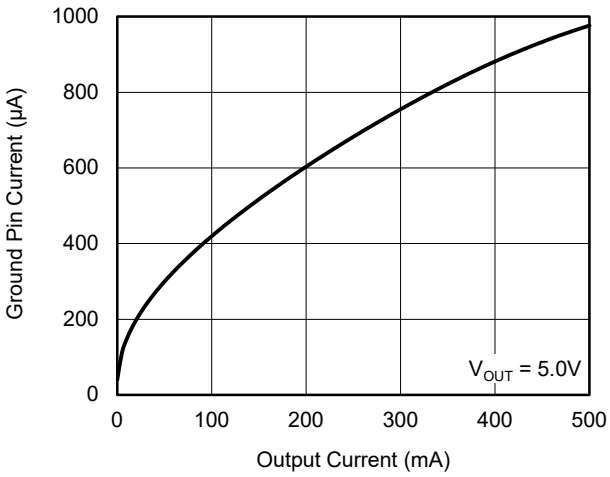

Dropout Voltage vs. Output Current



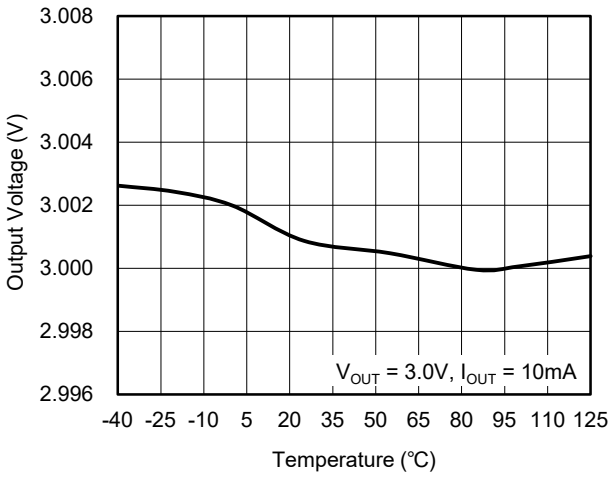

Ground Pin Current vs. Output Current



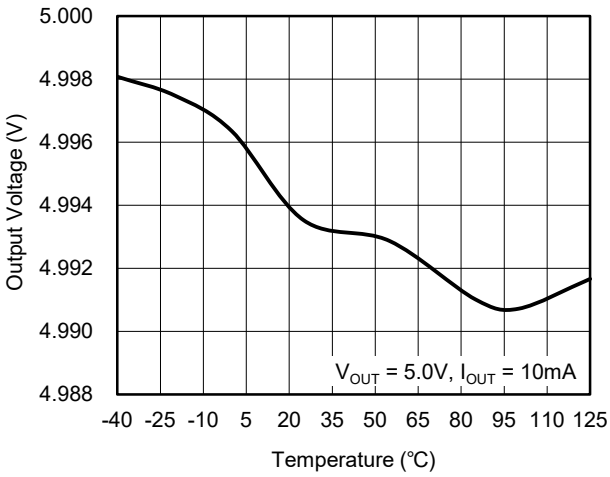

Ground Pin Current vs. Output Current




Output Voltage vs. Temperature



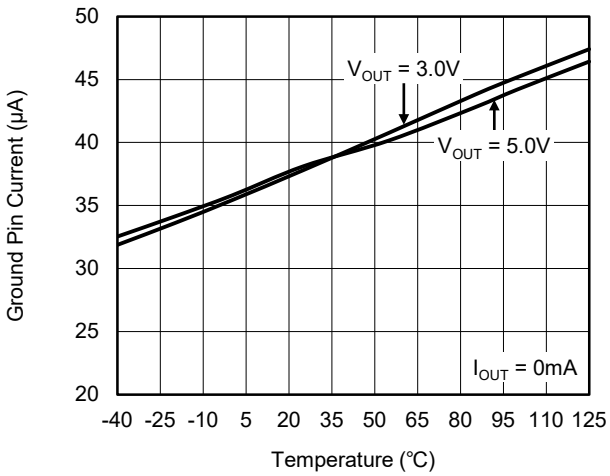

Output Voltage vs. Temperature



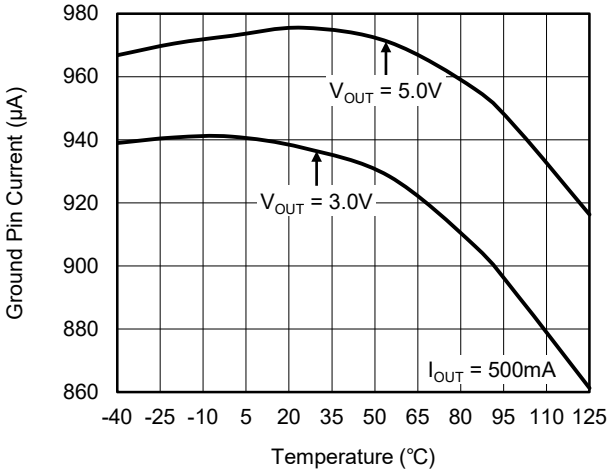
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) or 2.7V, whichever is greater, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 10mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = +25℃, unless otherwise noted.

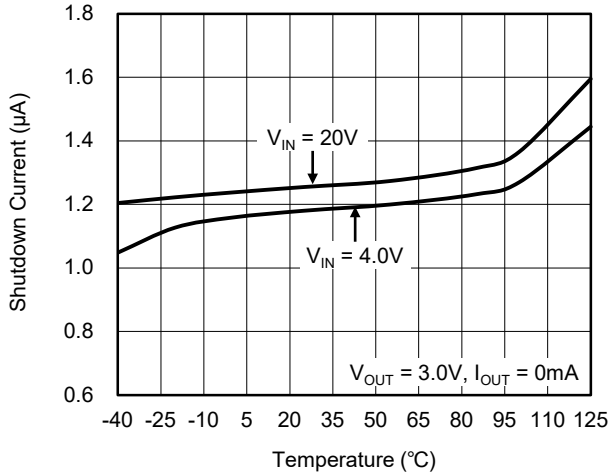
Ground Pin Current vs. Temperature



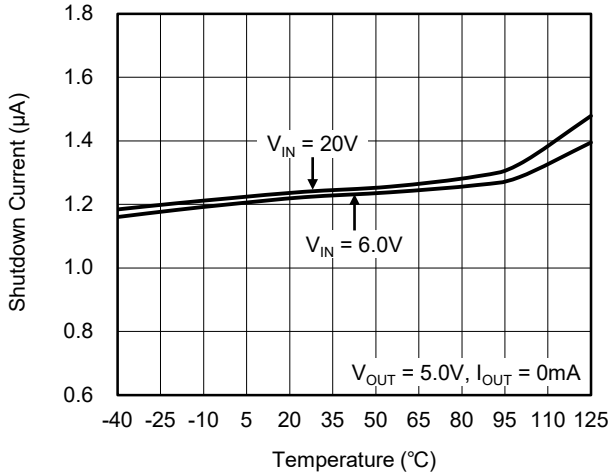

Ground Pin Current vs. Temperature



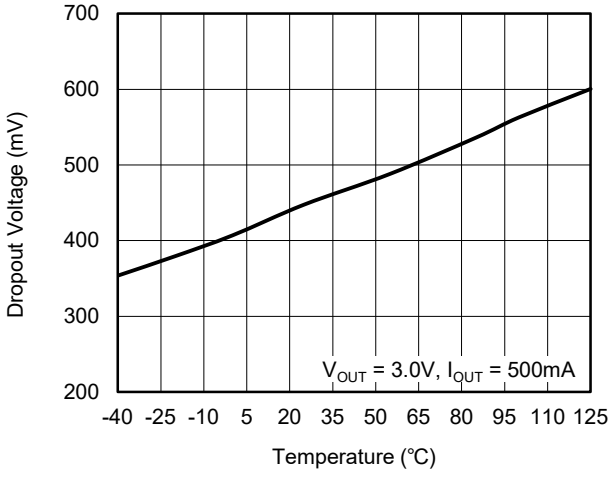

Shutdown Current vs. Temperature



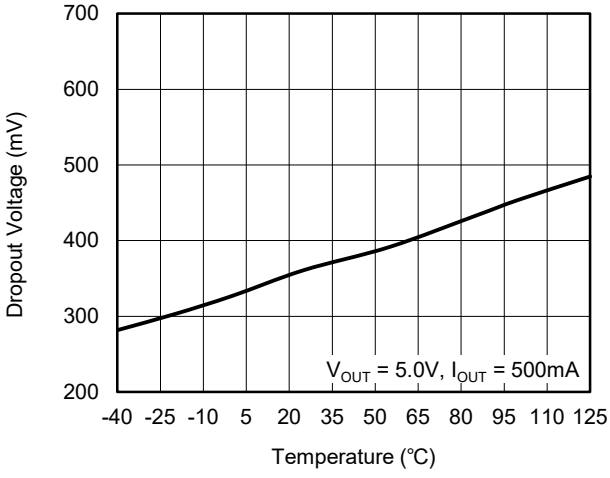

Shutdown Current vs. Temperature




Dropout Voltage vs. Temperature



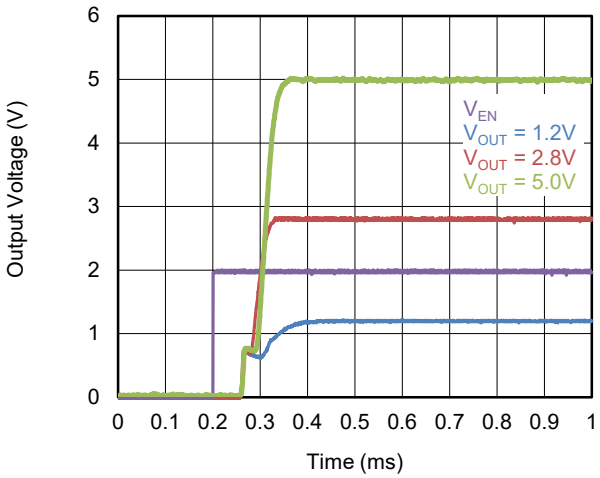

Dropout Voltage vs. Temperature



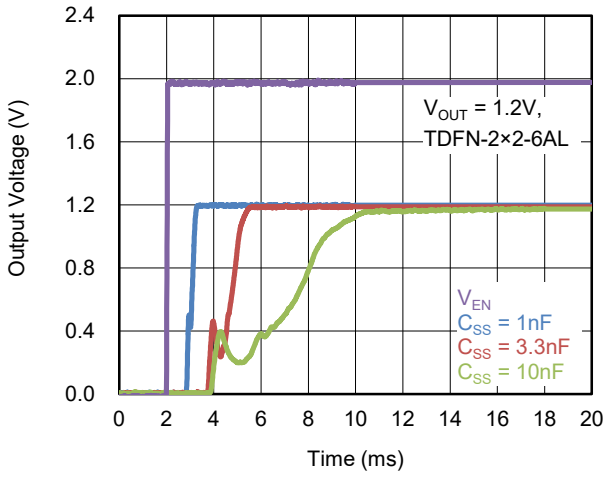
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN}$ = ($V_{OUT(NOM)}$ + 1V) or 2.7V, whichever is greater, $V_{EN}$ = $V_{IN}$, $I_{OUT}$ = 10mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_J$ = +25℃, unless otherwise noted.

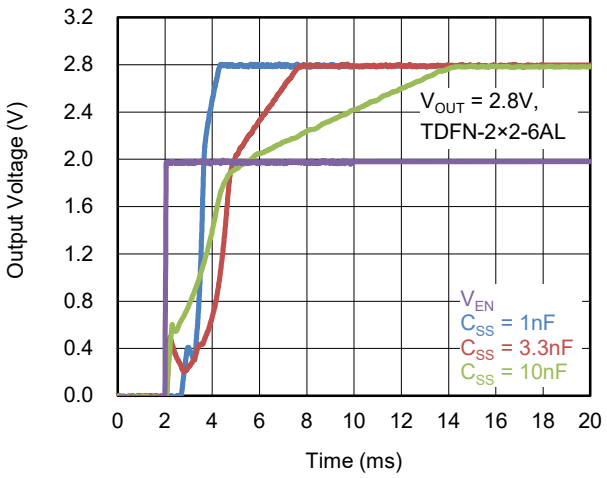
Typical Start-Up Behavior



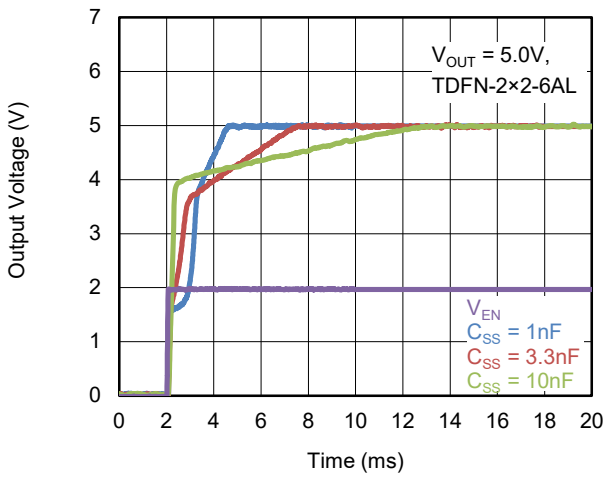

Typical Soft-Start Behavior, Different $C_{SS}$




Typical Soft-Start Behavior, Different $C_{SS}$




Typical Soft-Start Behavior, Different $C_{SS}$



# TYPICAL APPLICATION CIRCUITS

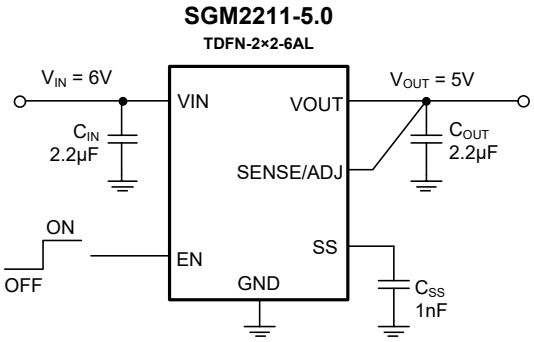



**Figure 1. SGM2211 with Fixed Sense Output Voltage, 5V**

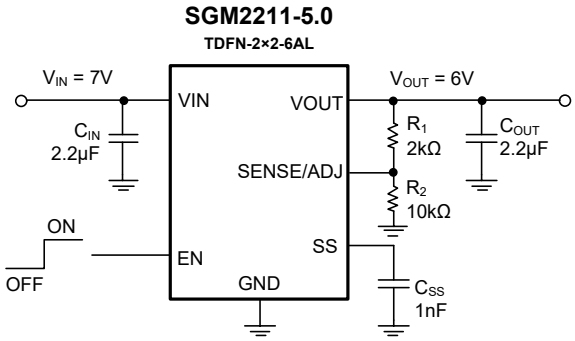



**Figure 2. SGM2211 with 5V Output Adjusted to 6V**

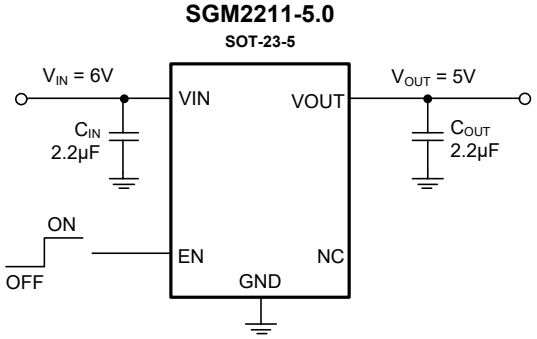



**Figure 3. SGM2211 with Fixed Output Voltage, 5V**

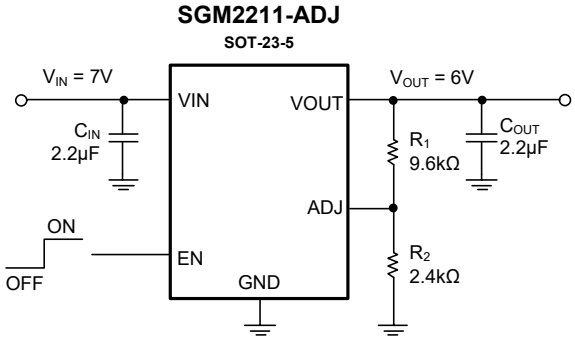



**Figure 4. SGM2211 with 1.2V Output Adjusted to 6V**

## FUNCTIONAL BLOCK DIAGRAM

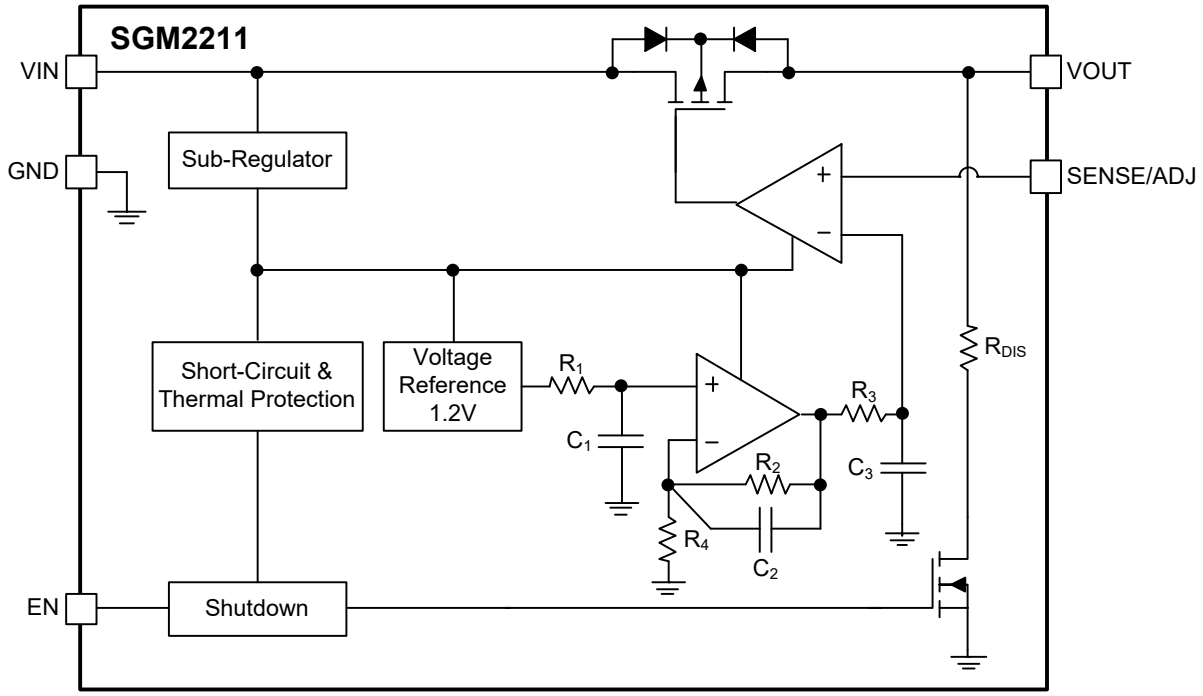



**Figure 5. Block Diagram (TDFN-2×2-6AL and SOT-23-5 Adjustable Version)**

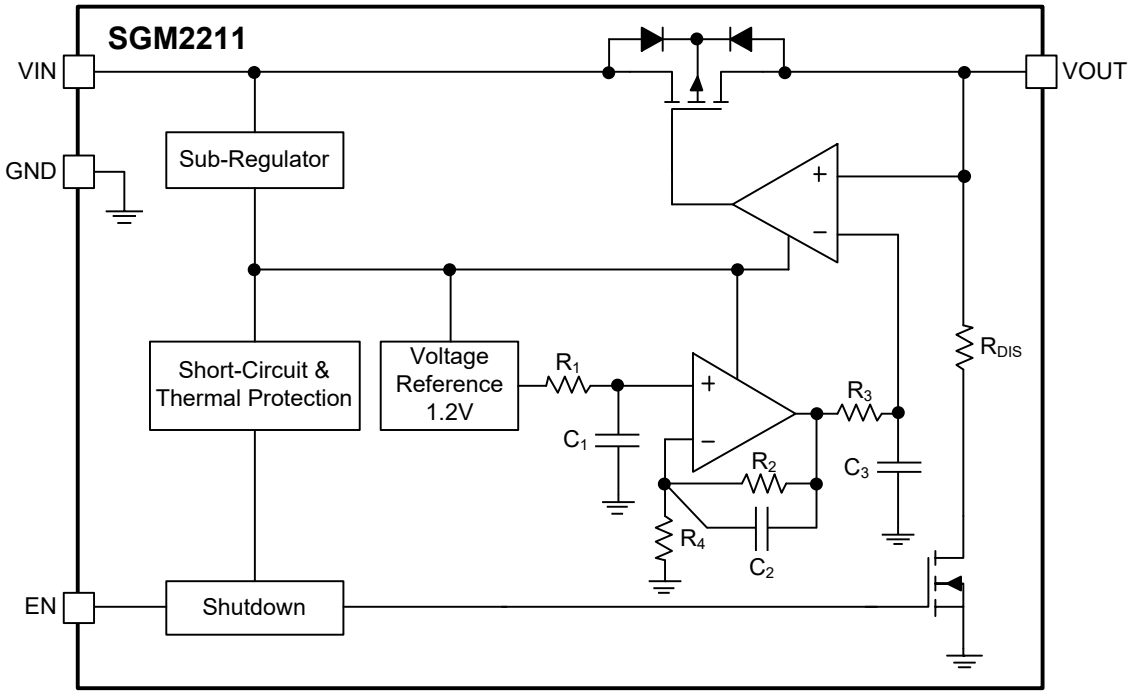



**Figure 6. Block Diagram (SOT-23-5 Fixed Version)**

# DETAILED DESCRIPTION

The SGM2211 is a low noise, low quiescent current and low dropout voltage linear regulator that operates from 2.7V to 20V and can provide up to 500mA of output current. Typical shutdown current consumption is 1.2μA.

The SGM2211 is optimized to use small 2.2μF ceramic capacitors ($C_{IN}$ and $C_{OUT}$) to achieve excellent transient performance.

The SGM2211 is available in fixed output voltage options, ranging from 1.2V to 5.0V. The SGM2211 architecture allows any fixed output voltage to be set to a higher voltage with an external voltage divider. For example, a fixed 5V output can be set to a 6V output according to the following equation:

$$V_{OUT} = 5V \times (1 + R_1/R_2)$$

where $R_1$ and $R_2$ are the resistors in the output voltage divider shown in Figure 7. It is recommended that the $R_2$ value be less than 200kΩ to minimize errors in the output voltage caused by the input current of SENSE/ADJ pin.

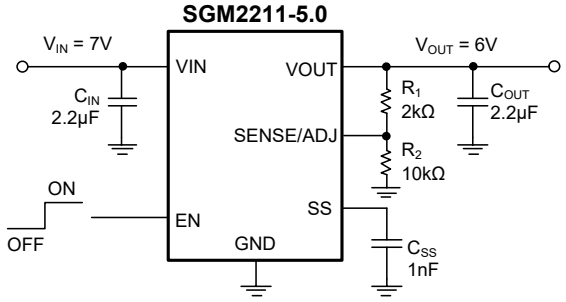



**Figure 7. Typical 5V Adjustable Output Voltage Application Schematic**

To set the output voltage of the adjustable SGM2211, replace 5V in the equation with 1.2V:

$$V_{OUT} = 1.2V \times (1 + R_1/R_2)$$

For example, when $R_1$ and $R_2$ each equal 200kΩ and the default output voltage is 1.2V as shown in Figure 8, the adjusted output voltage is 2.4V.

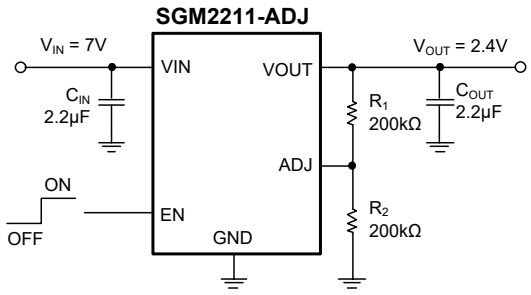



**Figure 8. SGM2211 with 1.2V Output Adjusted to 2.4V**

# APPLICATION INFORMATION

## Output Capacitor Selection

The SGM2211 is designed to work with small size ceramic capacitors; however, other types of capacitor also can be used. The ESR of capacitor is the most important parameter to be taken into account, and the ESR of the output capacitor affects the stability of the LDO. A minimum of 2.2μF capacitance with an ESR of 0.2Ω or less is recommended to ensure the stability of the SGM2211. If good load transient is important in application, larger output capacitor can be used.

## Input Bypass Capacitor Selection

In applications, if high source impedance or long input traces are encountered, a 2.2μF capacitor is connected from VIN pin to GND pin to reduce the circuit sensitivity to PCB layout. A larger input capacitor will be selected if the output capacitor is increased.

## Input and Output Capacitor Properties

Ceramic capacitors are manufactured with a variety of dielectrics and each type of dielectrics has different behavior over temperature and applied voltage. Capacitors must have an adequate dielectric constant to ensure the minimum capacitance over the necessary temperature range and DC bias conditions.

## Programmable Precision Enable

The EN pin is used to enable and disable the VOUT pin under normal operating conditions. When a rising voltage on EN is at 1.2V, VOUT turns on and when a falling voltage on EN is at 1.1V, VOUT turns off. For automatic startup, EN pin be connected to VIN pin. The hysteresis of the EN threshold is approximately 100mV. The enable voltage can be positive or negative with respect to ground.

The upper and lower thresholds are user programmable and can be set higher than the nominal 1.2V threshold by using two resistors. The resistance values, $R_{EN1}$ and $R_{EN2}$, can be determined from the following:

$$R_{EN2} = \text{nominally } 10k\Omega \text{ to } 100k\Omega$$

$$R_{EN1} = R_{EN2} \times (V_{IN} - 1.2V)/1.2V$$

where $V_{IN}$ is the desired turn-on voltage.

The hysteresis voltage increases by the factor ($R_{EN1}$ + $R_{EN2}$)/$R_{EN2}$. For the example shown in Figure 9, the enable threshold is 3.6V with a hysteresis of 300mV.

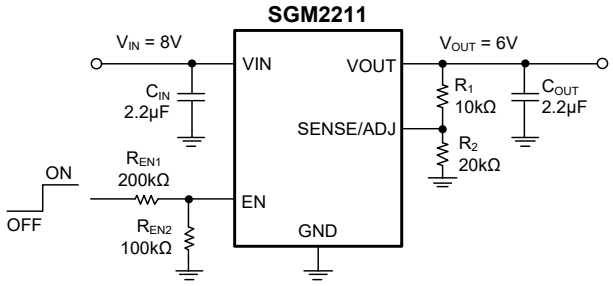



**Figure 9. Typical EN Pin Voltage Divider**

## Soft-Start

The SGM2211 uses an internal soft-start (SS pin open) to limit the inrush current when the device is enabled. The start-up time for the 1.2V option is approximately 150μs from the time the EN active threshold is crossed to when the output reaches 90% of the final value.

## Noise Reduction of the Adjustable SGM2211

The disadvantage of the conventional LDO architecture is that the output voltage noise is proportional to the output voltage. The output noise of adjustable LDO circuit can be modified slightly to levels close to that of the fixed output LDO. The circuit shown in Figure 10 adds two additional components to the output voltage setting resistor divider. $C_{NR}$ and $R_{NR}$ are added in parallel with $R_1$ to reduce the AC gain of the error amplifier. $R_{NR}$ is chosen to be small with respect to $R_2$. If $R_{NR}$ is 1% to 10% of the value of $R_2$, the minimum AC gain of the error amplifier is approximately 0.1dB to 0.8dB. The actual gain is determined by the parallel combination of $R_{NR}$ and $R_1$. This gain ensures that the error amplifier always operates at slightly greater than unity gain.

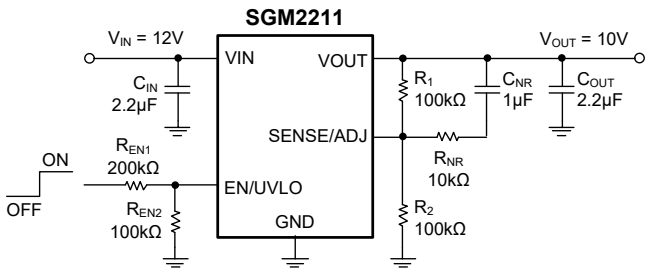



**Figure 10. Noise Reduction Modification**

$C_{NR}$ is chosen by setting the reactance of $C_{NR}$ equal to $R_1$ - $R_{NR}$ at a frequency between 1Hz and 50Hz. This setting places the frequency where the AC gain of the error amplifier is 3dB down from the DC gain.

## APPLICATION INFORMATION (continued)

### Current-Limit and Thermal Overload Protection

The SGM2211 is protected against damage due to excessive power dissipation by current-limit and thermal overload protection circuits. The SGM2211 is designed to current limit when the output load reaches 0.8A (TYP). When the output load exceeds 0.8A, the output voltage is reduced to maintain a constant current limit.

Under the extreme conditions of high ambient temperature or power dissipation, when the junction temperature is above +160℃, the output is turned off, reducing the output current to 0mA. When the junction temperature falls below +140℃, the output is turned on again and the output current is restored to the nominal value.

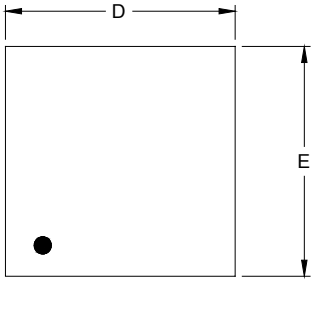
For reliable operation, device power dissipation must be externally limited so that the junction temperature do not exceed +125℃.

### PCB Layout Considerations

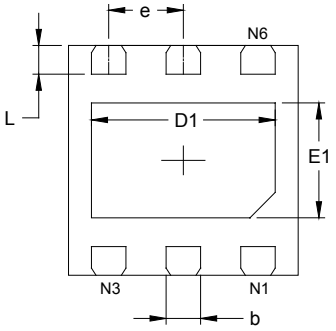
Place the input capacitor as close as possible to the VIN and GND pins. Place the output capacitor as close as possible to the VOUT and GND pins.

# PACKAGE OUTLINE DIMENSIONS

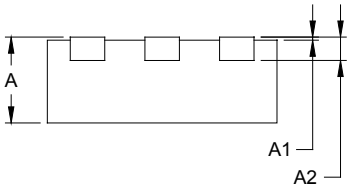
## TDFN-2×2-6AL



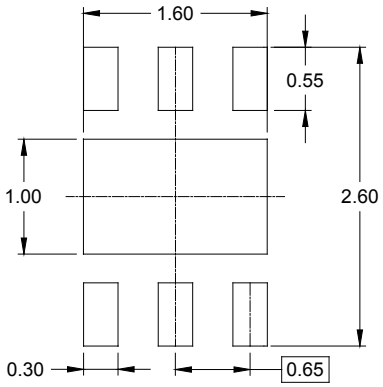

TOP VIEW




BOTTOM VIEW




SIDE VIEW

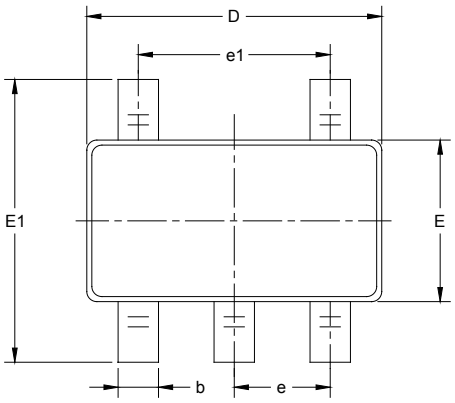


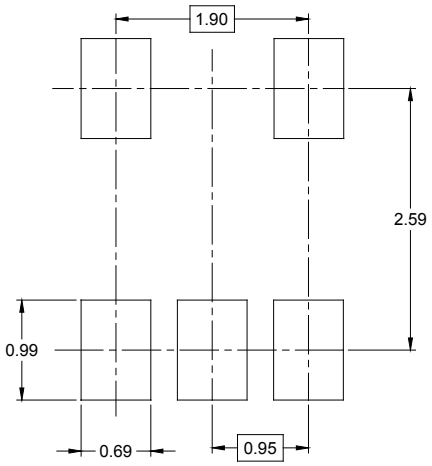

**RECOMMENDED LAND PATTERN** (Unit: mm)

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | **MIN** | **MAX** | **MIN** | **MAX** |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.203 REF | | 0.008 REF | |
| D | 1.900 | 2.100 | 0.075 | 0.083 |
| D1 | 1.500 | 1.700 | 0.059 | 0.067 |
| E | 1.900 | 2.100 | 0.075 | 0.083 |
| E1 | 0.900 | 1.100 | 0.035 | 0.043 |
| b | 0.250 | 0.350 | 0.010 | 0.014 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.174 | 0.326 | 0.007 | 0.013 |

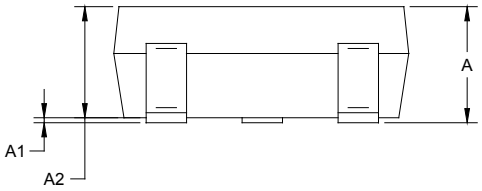
# PACKAGE OUTLINE DIMENSIONS

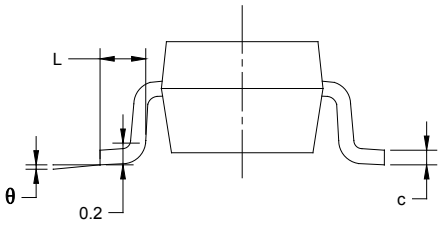
## SOT-23-5




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

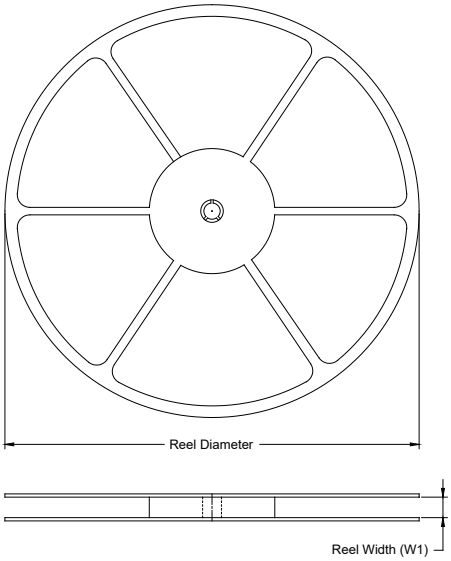


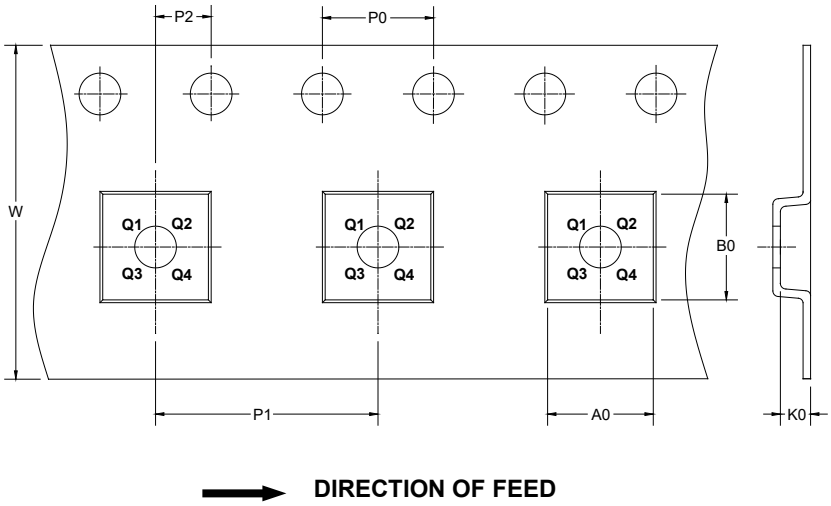

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| 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 |
| θ | 0° | 8° | 0° | 8° |

# TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS




DIRECTION OF FEED

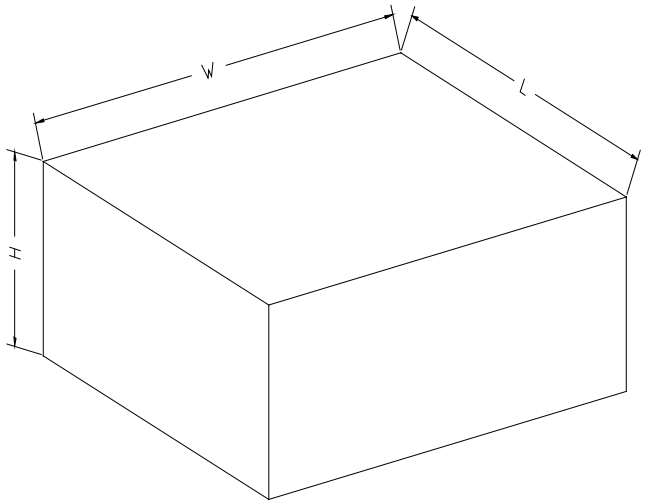
NOTE: The picture is only for reference. Please make the object as the standard.

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| TDFN-2×2-6AL | 7″ | 9.5 | 2.30 | 2.30 | 1.10 | 4.0 | 4.0 | 2.0 | 8.0 | Q1 |
| 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