

## Description

The AP3211 is a 1.4MHz fixed frequency, current mode, PWM buck (step-down) DC-DC converter, capable of driving a 1.5A load with high efficiency, excellent line and load regulation. The device integrates N-channel power MOSFET switch with low on-resistance. Current mode control provides fast transient response and cycle-by-cycle current limit.

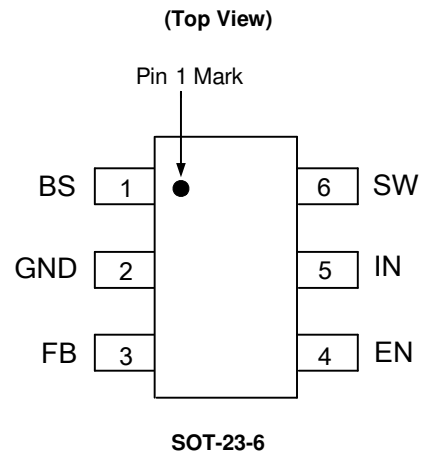
A standard series of inductors are available from several different manufacturers optimized for use with the AP3211. This feature greatly simplifies the design of switch-mode power supplies.

The AP3211 is available in SOT-23-6 package.

## Features

- Input Voltage Range: 4.5V to 18V
- Output Voltage Adjustable from 0.81V to 15V
- Fixed 1.4MHz Frequency
- High Efficiency: up to 92%
- Output Current: 1.5A
- Current Mode Control
- Built-In Over Current Protection
- Built-In Thermal Shutdown Function
- Built-In UVLO Function
- Built-In Over Voltage Protection
- Built-In Soft-Start

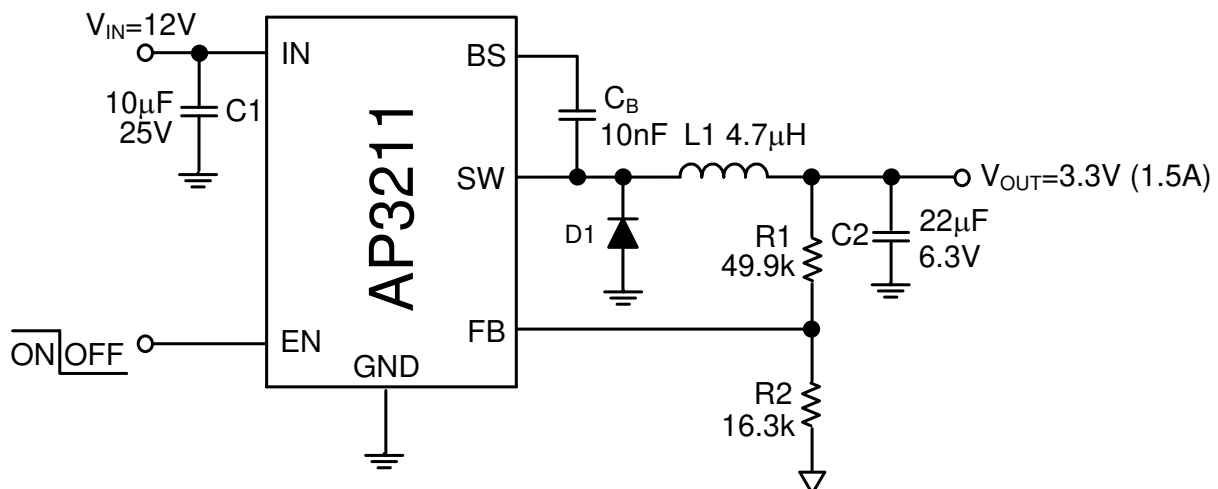
## Pin Assignments



## Applications

- LCD TV
- DPF
- Portable DVD

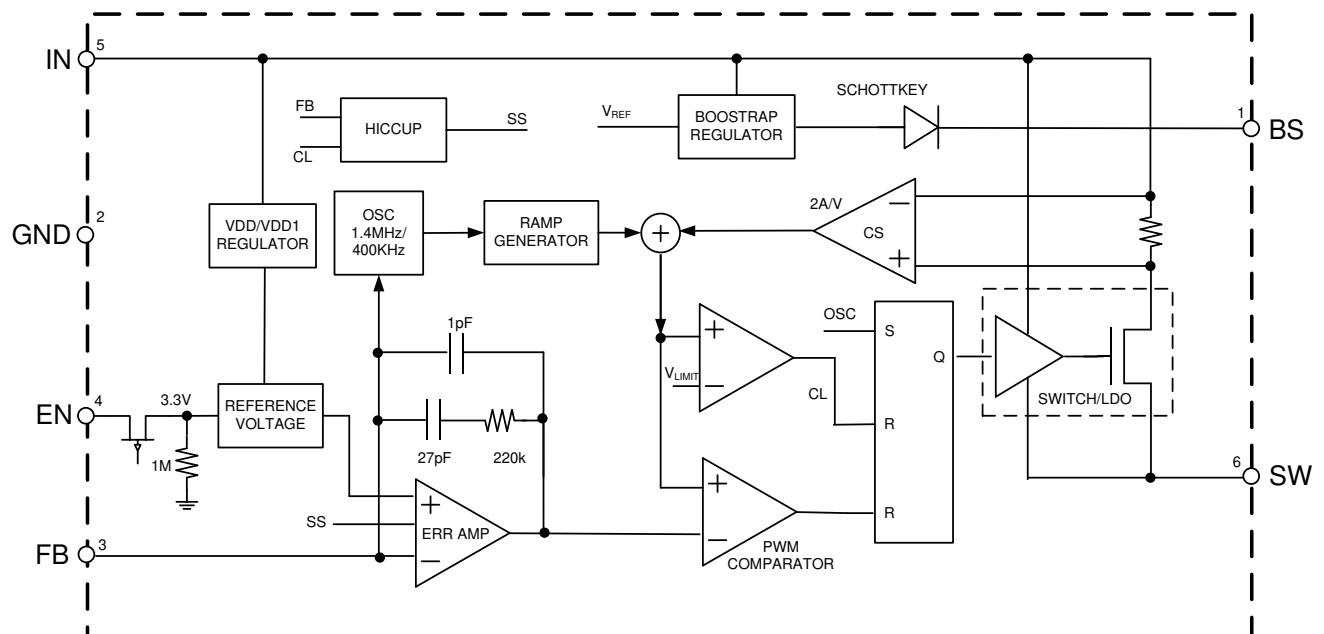
## Typical Applications Circuit



## Pin Descriptions

| Pin Number | Pin Name | Function   |
|------------|----------|--|
| 1          | BS       | Bootstrap pin. A bootstrap capacitor is connected between the BS pin and SW pin. The voltage across the bootstrap capacitor drives the internal high-side NMOS switch.   |
| 2          | GND      | Ground pin   |
| 3          | FB       | Feedback pin. This pin is connected to an external resistor divider to program the system output voltage. When $V_{FB}$ exceeds 20% of the nominal regulation value of 0.81V, the OVP is triggered. When $V_{FB} < 0.25V$ , the oscillator frequency is lowered to realize short circuit protection. |
| 4          | EN       | Control input pin. Forcing this pin above 1.5V enables the IC. Forcing this pin below 0.4V shuts down the IC. When the IC is in shutdown mode, all functions are disabled to decrease the supply current below $1\mu A$ .  |
| 5          | IN       | Supply input pin. A capacitor should be connected between the IN pin and GND to keep the DC input voltage constant.  |
| 6          | SW       | Power switch output pin. This pin is connected to the inductor and bootstrap capacitor.  |

## Functional Block Diagram



## Absolute Maximum Ratings (Note 1)

| Symbol        | Parameter                           | Rating               | Unit |
|---------------|-------------------------------------|----------------------|------|
| $V_{IN}$      | Input Pin Voltage                   | -0.3 to 20           | V    |
| $V_{EN}$      | EN Pin Voltage                      | -0.3 to $V_{IN}+0.3$ | V    |
| $V_{SW}$      | SW Pin Voltage                      | 21                   | V    |
| $V_{BS}$      | Bootstrap Pin Voltage               | -0.3 to $V_{SW}+6$   | V    |
| $V_{FB}$      | Feedback Pin Voltage                | -0.3 to 6V           | V    |
| $\theta_{JA}$ | Thermal Resistance                  | 220                  | °C/W |
| $T_J$         | Operating Junction Temperature      | +150                 | °C   |
| $T_{STG}$     | Storage Temperature                 | -65 to +150          | °C   |
| $T_{LEAD}$    | Lead Temperature (Soldering, 10sec) | +260                 | °C   |
| –             | ESD (Human Body Model)              | 2000                 | V    |
| –             | ESD (Machine Model)                 | 200                  | V    |

Note 1: Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

## Recommended Operating Conditions

| Symbol          | Parameter                     | Min | Max | Unit |
|-----------------|-------------------------------|-----|-----|------|
| $V_{IN}$        | Input Voltage                 | 4.5 | 18  | V    |
| $I_{OUT (MAX)}$ | Maximum Output Current        | 1.5 | –   | A    |
| $T_A$           | Operating Ambient Temperature | -40 | +85 | °C   |

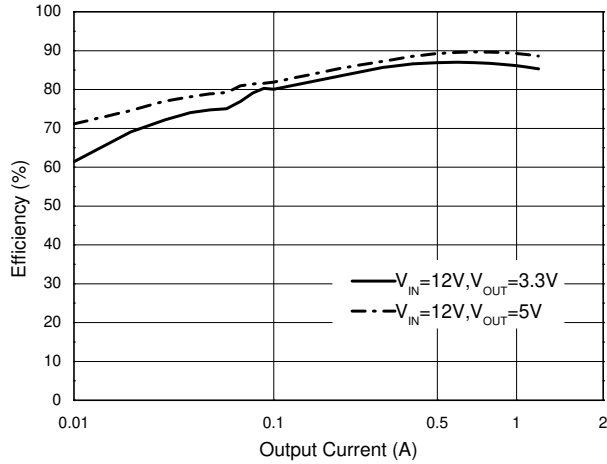
**Electrical Characteristics** ( $V_{IN} = V_{EN} = 12V$ ,  $V_{OUT} = 3.3V$ ,  $T_A = +25^\circ C$ , unless otherwise specified.)

| Symbol     | Parameter                       | Conditions                     | Min   | Typ   | Max   | Unit       |
|------------|---------------------------------|--------------------------------|-------|-------|-------|------------|
| $V_{IN}$   | Input Voltage                   | –                              | 4.5   | –     | 18    | V          |
| $I_Q$      | Quiescent Current               | $V_{FB} = 0.9V$                | –     | 0.8   | 1.1   | mA         |
| $I_{SHDN}$ | Shutdown Supply Current         | $V_{EN} = 0V$                  | –     | 0.1   | 1.0   | $\mu A$    |
| $V_{FB}$   | Feedback Voltage                | –                              | 0.785 | 0.810 | 0.835 | V          |
| $V_{FBOV}$ | Feedback Over Voltage Threshold | –                              | –     | 0.972 | –     | V          |
| $I_{FB}$   | Feedback Bias Current           | $V_{FB} = 0.85V$               | -0.1  | –     | 0.1   | $\mu A$    |
| $R_{DSON}$ | Switch On-resistance            | $I_{SW} = 1A$                  | –     | 0.35  | –     | $\Omega$   |
| $I_{LEAK}$ | Switch Leakage Current          | $V_{IN} = 18V$ , $V_{EN} = 0V$ | –     | 0.1   | 10    | $\mu A$    |
| $I_{LIM}$  | Switch Current Limit            | –                              | 1.8   | 2.4   | –     | A          |
| $V_{ENH}$  | EN Pin Threshold                | –                              | 1.5   | –     | –     | V          |
| $V_{ENL}$  |                                 | –                              | –     | –     | 0.4   |            |
| $V_{UVLO}$ | Input UVLO Threshold            | $V_{IN}$ Rising                | 3.3   | 3.8   | 4.3   | V          |
| $V_{HYS}$  | Input UVLO Hysteresis           | –                              | –     | 0.2   | –     | V          |
| $f_{OSC1}$ | Oscillator Frequency            | –                              | 1.1   | 1.4   | 1.7   | MHz        |
| $f_{OSC2}$ |                                 | Short Circuit                  | –     | 460   | –     | kHz        |
| $D_{MAX}$  | Max. Duty Cycle                 | $V_{FB} = 0.6V$                | –     | 90    | –     | %          |
| $D_{MIN}$  | Min. Duty Cycle                 | $V_{FB} = 0.9V$                | –     | –     | 0     | %          |
| $t_{ON}$   | Minimum On Time                 | –                              | –     | 100   | –     | ns         |
| $T_{OTSD}$ | Thermal Shutdown                | –                              | –     | +160  | –     | $^\circ C$ |
| $T_{HYS}$  | Thermal Shutdown Hysteresis     | –                              | –     | +20   | –     | $^\circ C$ |
| $t_{SS}$   | Soft-start Time                 | –                              | –     | 200   | –     | $\mu s$    |

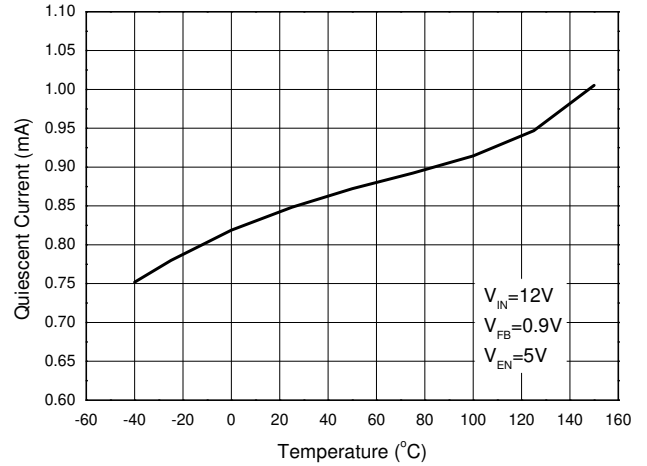
Note 2:  $R_{DSON}$ ,  $t_{ON}$ ,  $T_{OTSD}$ ,  $T_{HYS}$  and  $t_{SS}$  are guaranteed by design.

**Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $V_{EN} = 5\text{V}$ ,  $V_{OUT} = 3.3\text{V}$ , unless otherwise noted.)

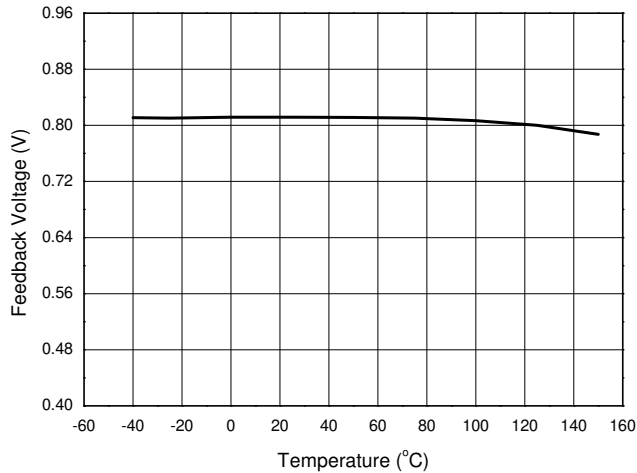
**Efficiency vs. Output Current**



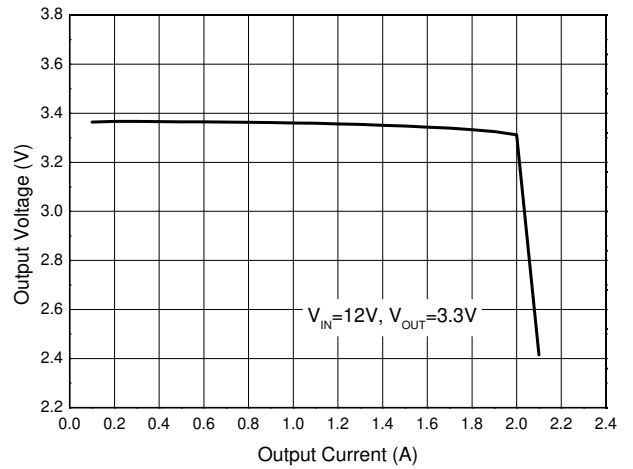
**Quiescent Current vs. Temperature**



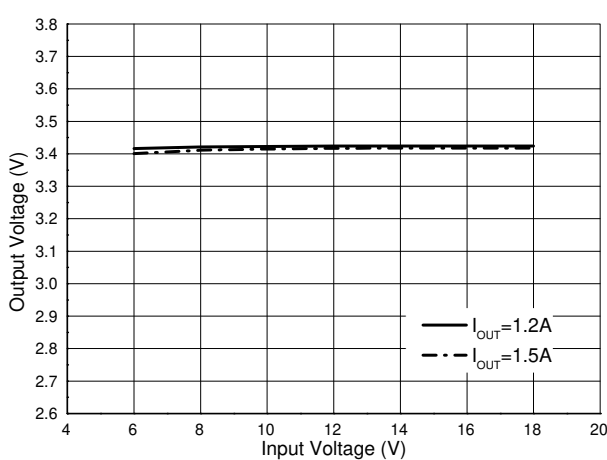
**Feedback Voltage vs. Temperature**



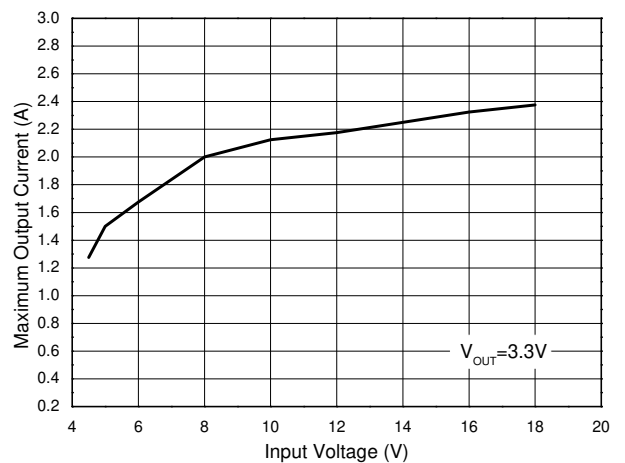
**Output Voltage vs. Output Current**



**Output Voltage vs. Input Voltage**

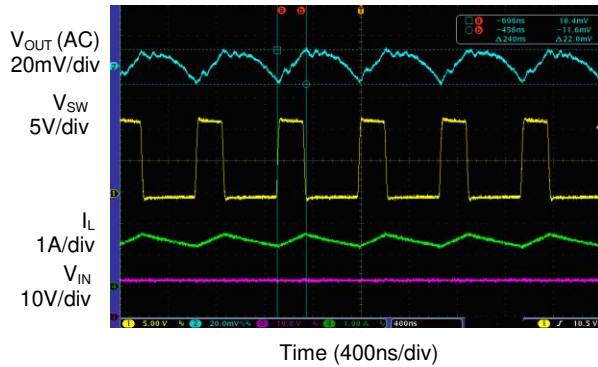


**Maximum Output Current vs. Input Voltage**

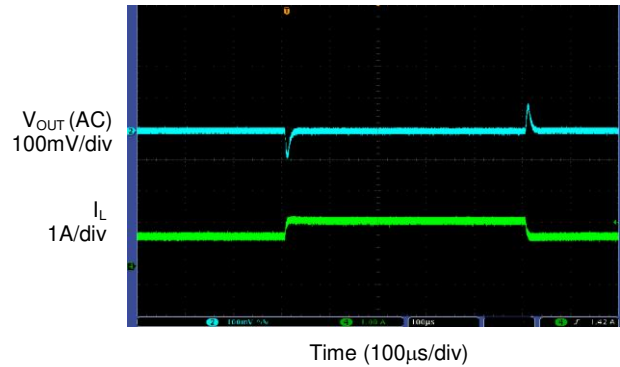


**Performance Characteristics** (Cont.  $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $V_{EN} = 5\text{V}$ ,  $V_{OUT} = 3.3\text{V}$ , unless otherwise noted.)

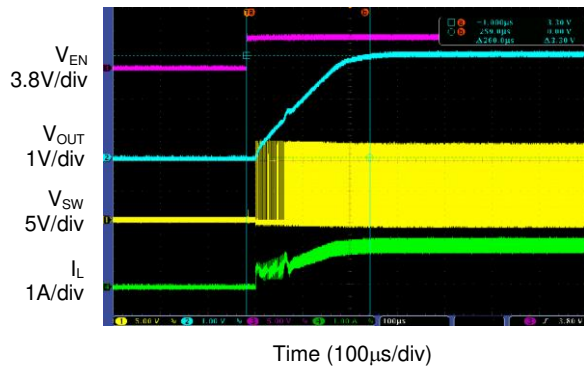
**Output Ripple ( $I_{OUT}=1.5\text{A}$ )**



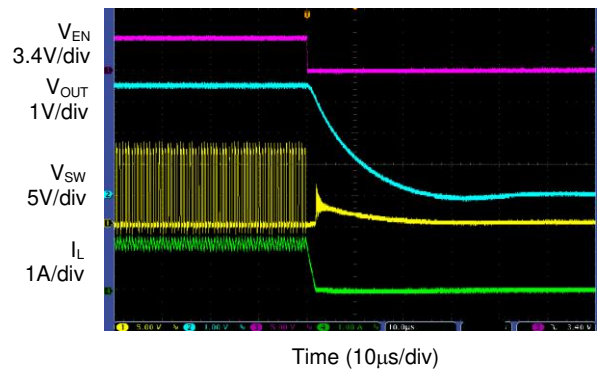
**Load Transient ( $I_{OUT}=1$  to  $1.5\text{A}$ )**



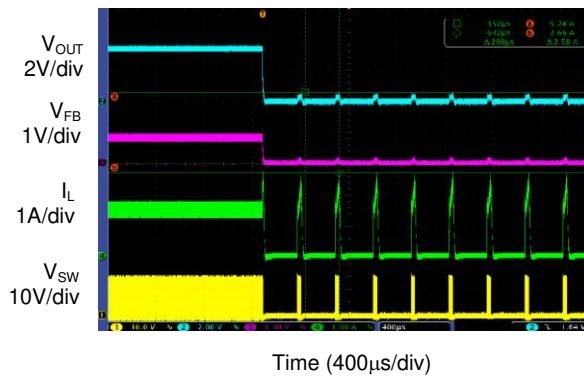
**Enable Turn-on Characteristic (Resistance Load,  $R_{LOAD}=2.6\Omega$ )**



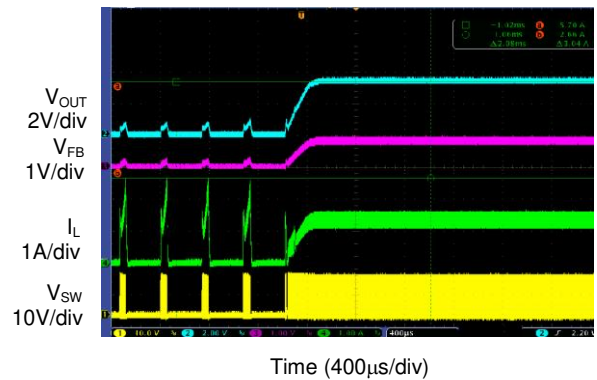
**Enable Turn-off Characteristic (Resistance Load,  $R_{LOAD}=2.6\Omega$ )**



**Short Circuit Protection ( $I_{OUT}=1.5\text{A}$ )**

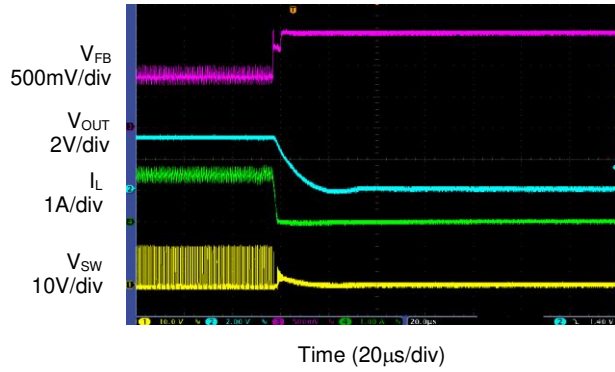


**Short Circuit Recovery ( $R_{LOAD}=2.6\Omega$ )**

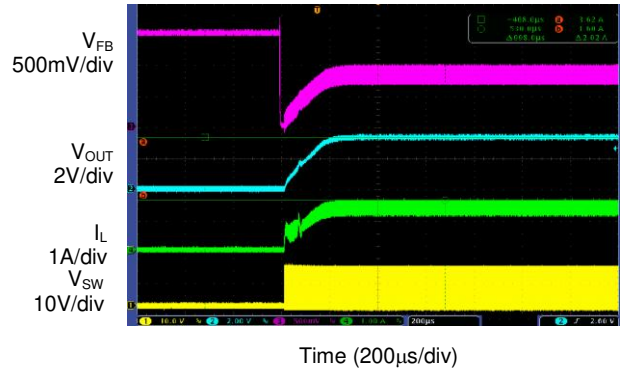


**Performance Characteristics** (Cont.  $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $V_{EN} = 5\text{V}$ ,  $V_{OUT} = 3.3\text{V}$ , unless otherwise noted.)

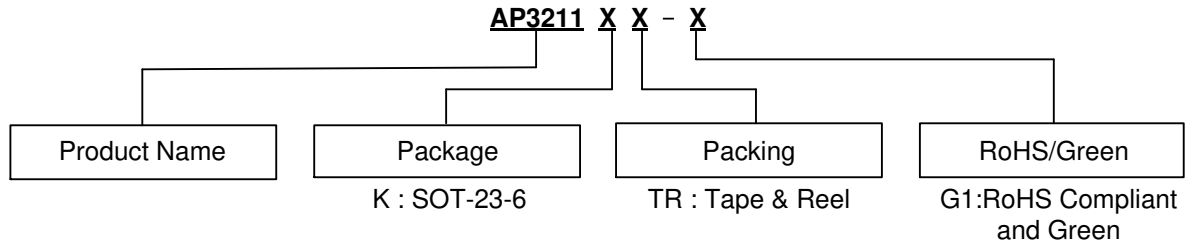
**Over Voltage Protection ( $I_{OUT}=1.5\text{A}$ )**



**Over Voltage Recovery ( $I_{OUT}=1.5\text{A}$ )**



**Ordering Information**

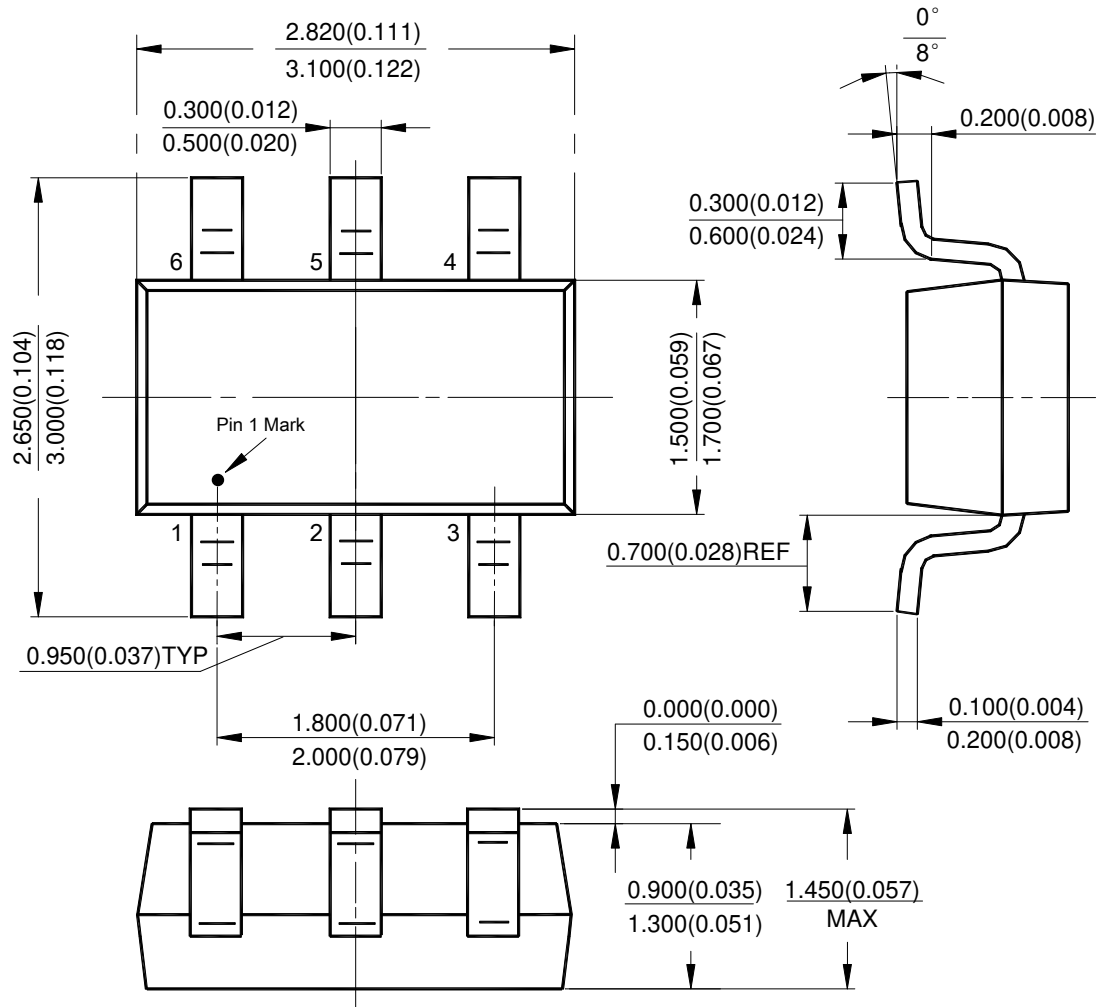


| Package  | Temperature Range | Part Number  | Marking ID | Packing     |
|----------|-------------------|--------------|------------|-------------|
| SOT-23-6 | -40 to +85°C      | AP3211KTR-G1 | GCI        | Tape & Reel |



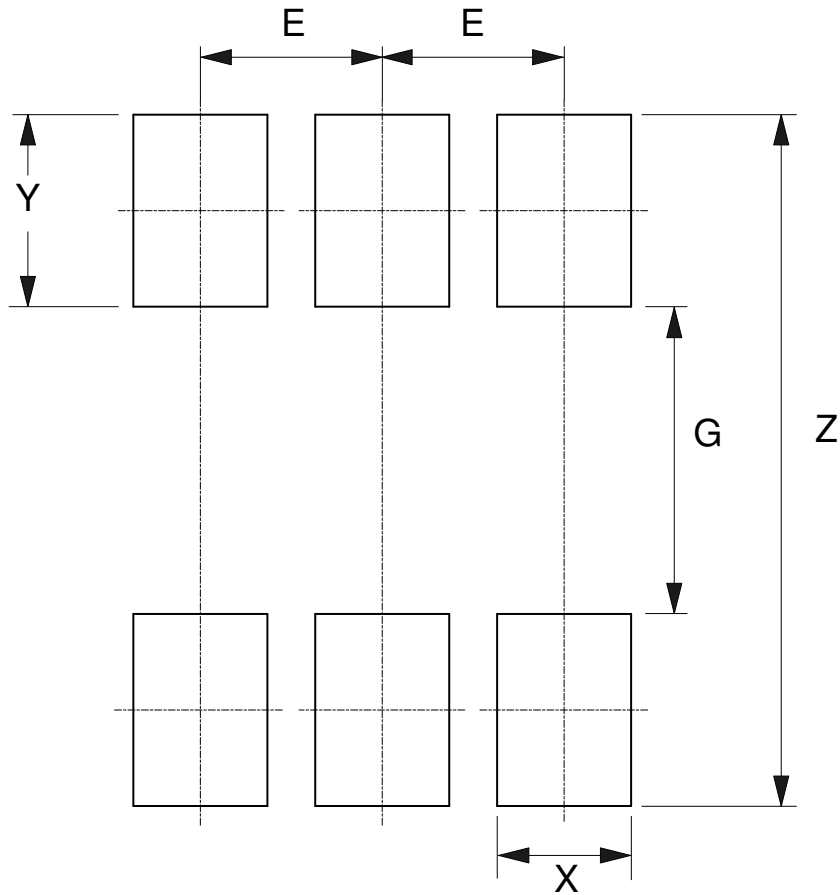
**Package Outline Dimensions** (All dimensions in mm(inch).)

(1) Package Type: SOT-23-6



**Suggested Pad Layout**

(1) Package Type: SOT-23-6



| Dimensions | Z<br>(mm)/(inch) | G<br>(mm)/(inch) | X<br>(mm)/(inch) | Y<br>(mm)/(inch) | E<br>(mm)/(inch) |
|------------|------------------|------------------|------------------|------------------|------------------|
| Value      | 3.600/0.142      | 1.600/0.063      | 0.700/0.028      | 1.000/0.039      | 0.950/0.037      |

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