

**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306****General Description**

The AP4306 is a highly integrated solution for a constant voltage/constant current mode SMPS application.

The AP4306 contains one 1.21V voltage reference with  $\pm 0.5\%$  accuracy, one low voltage reference used in current sensing circuit and two operational amplifiers. The 1.21V voltage reference, combined with one operational amplifier, makes of an ideal voltage controller for use in adapters and battery chargers. The low voltage reference, combined with another operational amplifier, makes of an ideal current limiter for output low side current sensing.

The AP4306 is fully compatible with AP4305 in functionality and electrical characteristics except its lower reference voltage for current control loop, thus higher power efficiency in SMPS applications such as low power charger can be realized with AP4306 compared to AP4305.

The AP4306 is available in SOT-23-6 package.

**Features**

- Constant Voltage and Constant Current Control
- Precision Internal Voltage Reference
- Low External Component Count
- Easy Compensation
- Low Supply Current: 0.5mA
- Operating Temperature Range: -40 to 105°C
- Operating Supply Voltage: 2.5V to 18V

**Applications**

- Adapters
- Battery Chargers

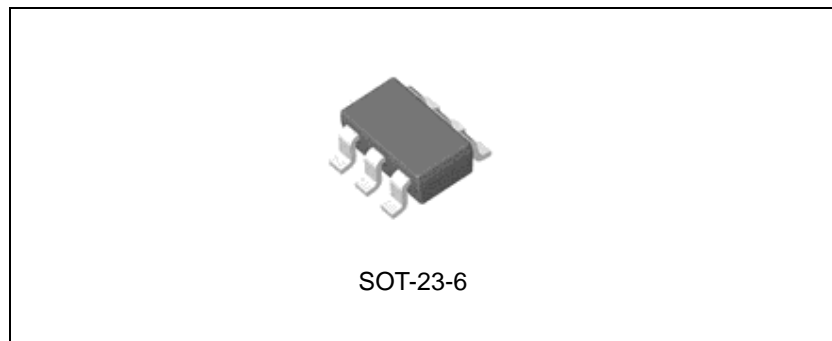


Figure 1. Package Type of AP4306

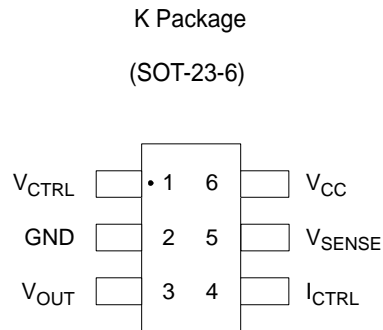
**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306**
**Pin Configuration**


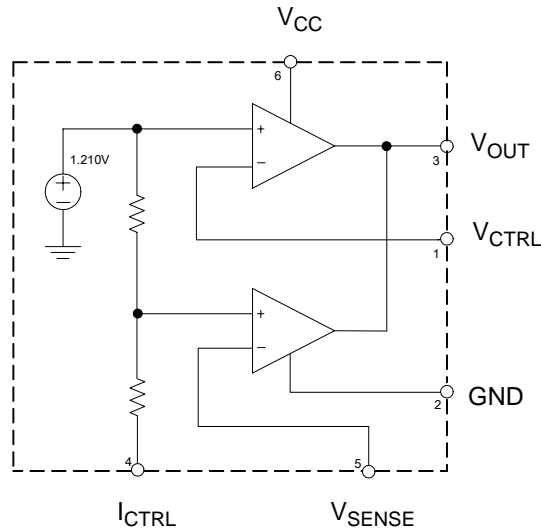
Figure 2. Pin Configuration of AP4306 (Top View)

**Pin Description**

| Pin Number | Pin Name    | Function                               |
|------------|-------------|--|
| 1          | $V_{CTRL}$  | Input pin of the voltage control loop. |
| 2          | $GND$       | Ground.                                |
| 3          | $V_{OUT}$   | Output pin. Sinking current only.      |
| 4          | $I_{CTRL}$  | Input pin of the current control loop. |
| 5          | $V_{SENSE}$ | Input pin of the current control loop. |
| 6          | $V_{CC}$    | Power supply.                          |

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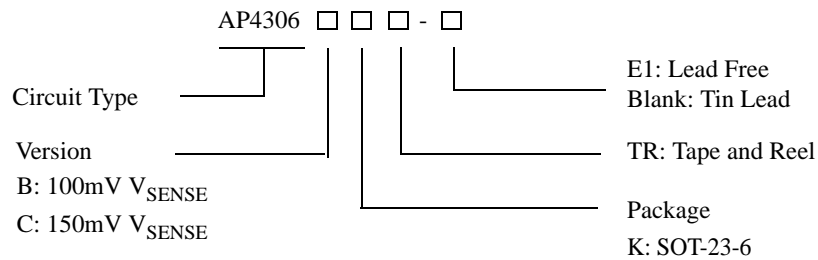
**Functional Block Diagram**



For B,C Version

Figure 3. Functional Block Diagrams of AP4306

**Ordering Information**



| Package  | Version           | Part Number   | Marking ID | Packing Type |
|----------|-------------------|---------------|------------|--------------|
|          |                   | Lead Free     | Lead Free  |              |
| SOT-23-6 | 100mV $V_{SENSE}$ | AP4306BKTR-E1 | E7M        | Tape & Reel  |
|          | 150mV $V_{SENSE}$ | AP4306CKTR-E1 | E7N        | Tape & Reel  |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306****Absolute Maximum Ratings (Note 1)**

| Parameter                                | Symbol                          | Value            | Unit |
|--|---------------------------------|------------------|------|
| Power Supply Voltage                     | $V_{CC}$                        | 20               | V    |
| Input Voltage                            | $V_{IN}$                        | -0.3 to $V_{CC}$ | V    |
| Junction Temperature                     | $T_J$                           | 150              | °C   |
| Storage Temperature                      | $T_{STG}$                       | -65 to 150       | °C   |
| Lead Temperature (Soldering, 5sec)       | $T_{LEAD}$                      | 260              | °C   |
| Thermal Resistance (Junction to Ambient) | For SOT-23-6<br>$R_{\theta JA}$ | 250              | °C/W |

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**

| Parameter                   | Symbol   | Min | Max | Unit |
|-----------------------------|----------|-----|-----|------|
| Power Supply Voltage        | $V_{CC}$ | 2.5 | 18  | V    |
| Operating Temperature Range | $T_A$    | -40 | 105 | °C   |



**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306**

**Electrical Characteristics**

( $V_{CC}=5V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified.)

| Parameter   | Symbol      | Conditions                          | Min                                 | Typ  | Max   | Unit  |         |
|---|-------------|-------------------------------------|-------------------------------------|------|-------|-------|---------|
| <b>TOTAL CURRENT CONSUMPTION</b>  |             |                                     |                                     |      |       |       |         |
| Total Supply Current<br>Not Including the Output Sinking<br>Current     | $I_{CC}$    | $T_A=25^{\circ}C$                   |                                     | 0.5  | 1     | mA    |         |
|   |             | $-40^{\circ}C < T_A < 105^{\circ}C$ |                                     | 0.6  |       |       |         |
| <b>VOLTAGE CONTROL LOOP</b>   |             |                                     |                                     |      |       |       |         |
| Transconductance Gain ( $V_{CTRL}$ ).<br>Sink Current Only              | $G_{mv}$    | $T_A=25^{\circ}C$                   | 1                                   | 3.5  |       | mA/mV |         |
|   |             | $-40^{\circ}C < T_A < 105^{\circ}C$ |                                     | 2.5  |       |       |         |
| Voltage Control Loop Reference  | $V_{REF}$   | $T_A=25^{\circ}C$                   | 1.204                               | 1.21 | 1.216 | V     |         |
|   |             | $-40^{\circ}C < T_A < 105^{\circ}C$ | 1.186                               |      | 1.234 |       |         |
| Input Bias Current ( $V_{CTRL}$ )                                       | $I_{IBV}$   | $T_A=25^{\circ}C$                   |                                     | 50   |       | nA    |         |
|   |             | $-40^{\circ}C < T_A < 105^{\circ}C$ |                                     | 100  |       |       |         |
| <b>CURRENT CONTROL LOOP</b>   |             |                                     |                                     |      |       |       |         |
| Transconductance Gain ( $I_{CTRL}$ ).<br>Sink Current Only              | $G_{mi}$    | $T_A=25^{\circ}C$                   | 1.5                                 | 7    |       | mA/mV |         |
|   |             | $-40^{\circ}C < T_A < 105^{\circ}C$ | 1.5                                 | 7    |       |       |         |
| Current Control Loop Reference  | $V_{SENSE}$ | B Version                           | $T_A=25^{\circ}C$                   | 97   | 100   | 103   | mV      |
|   |             |                                     | $-40^{\circ}C < T_A < 105^{\circ}C$ | 94   |       | 106   |         |
|   |             | C Version                           | $T_A=25^{\circ}C$                   | 147  | 150   | 153   |         |
|   |             |                                     | $-40^{\circ}C < T_A < 105^{\circ}C$ | 143  |       | 157   |         |
| Current Out of Pin $I_{CTRL}$ at<br>$V_{SENSE}$                         | $I_{IBI}$   | B Version                           | $T_A=25^{\circ}C$                   |      | 25    |       | $\mu A$ |
|   |             |                                     | $-40^{\circ}C < T_A < 105^{\circ}C$ |      | 50    |       |         |
|   |             | C Version                           | $T_A=25^{\circ}C$                   |      | 37.5  |       |         |
|   |             |                                     | $-40^{\circ}C < T_A < 105^{\circ}C$ |      | 75    |       |         |
| <b>OUTPUT STAGE</b>   |             |                                     |                                     |      |       |       |         |
| Low Output Voltage at 10mA<br>Sinking Current                           | $V_{OL}$    | $T_A=25^{\circ}C$                   |                                     | 100  |       | mV    |         |
|   |             | $-40^{\circ}C < T_A < 105^{\circ}C$ |                                     | 100  |       |       |         |
| Output Short Circuit Current.<br>Output to $V_{CC}$ . Sink Current Only | $I_{OS}$    | $T_A=25^{\circ}C$                   |                                     | 27   | 50    | mA    |         |
|   |             | $-40^{\circ}C < T_A < 105^{\circ}C$ |                                     | 35   |       |       |         |



**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306**

**Typical Performance Characteristics**

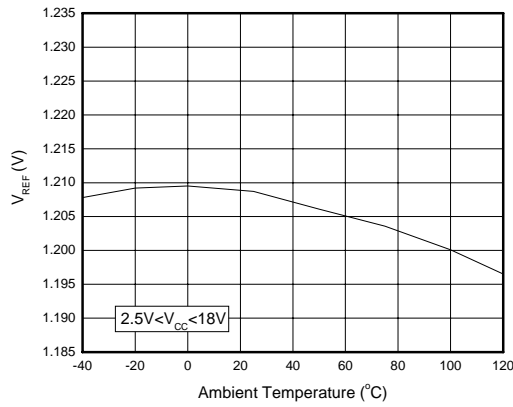


Figure 4. AP4306 V<sub>REF</sub> vs. Ambient Temperature

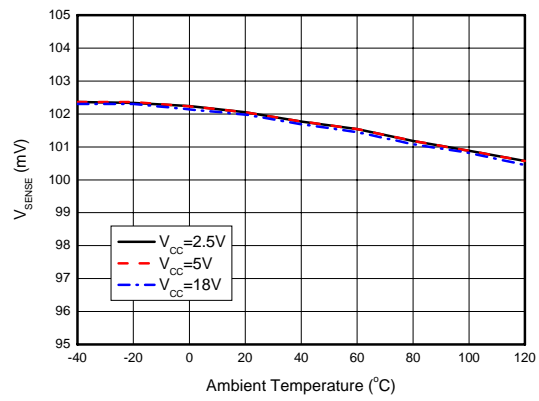


Figure 5. AP4306B V<sub>SENSE</sub> vs. Ambient Temperature

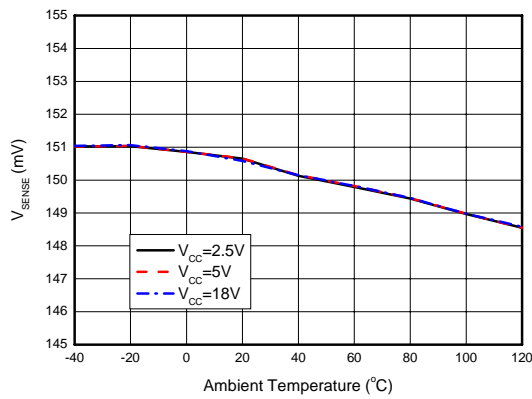


Figure 6. AP4306C V<sub>SENSE</sub> vs. Ambient Temperature

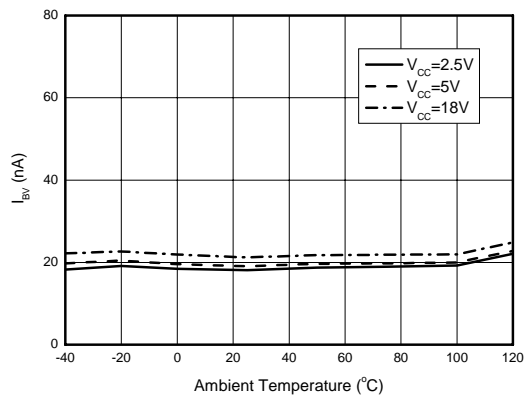


Figure 7. AP4306 I<sub>BV</sub> vs. Ambient Temperature



**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306**

**Typical Performance Characteristics (Continued)**

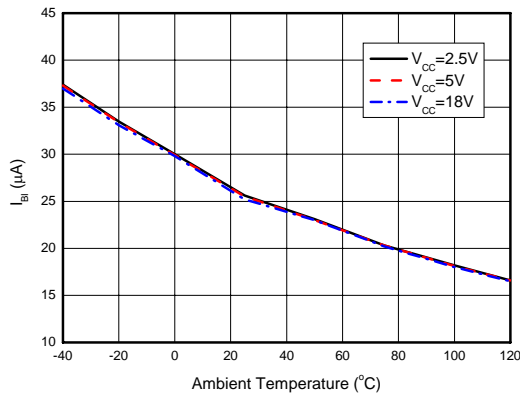


Figure 5. AP4306B  $I_{BI}$  vs. Ambient Temperature

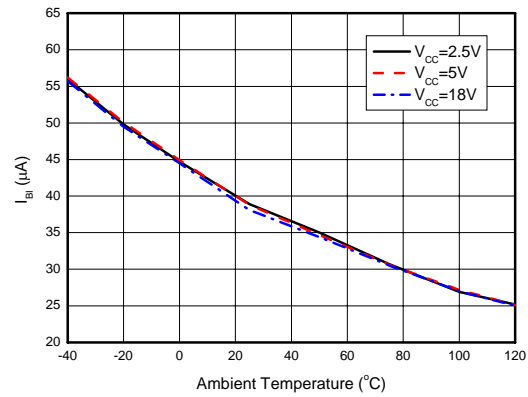


Figure 6. AP4306C  $I_{BI}$  vs. Ambient Temperature

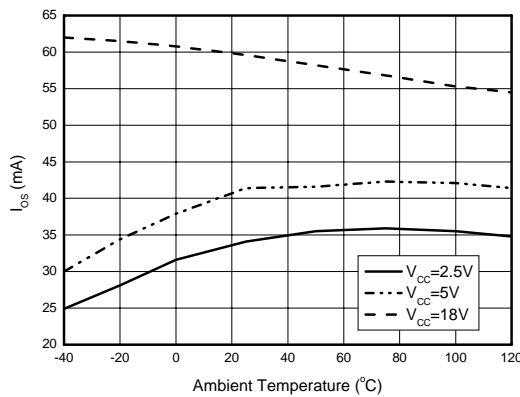


Figure 7. AP4306  $I_{OS}$  vs. Ambient Temperature

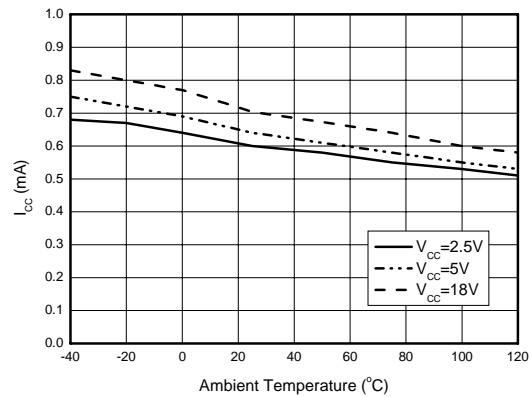
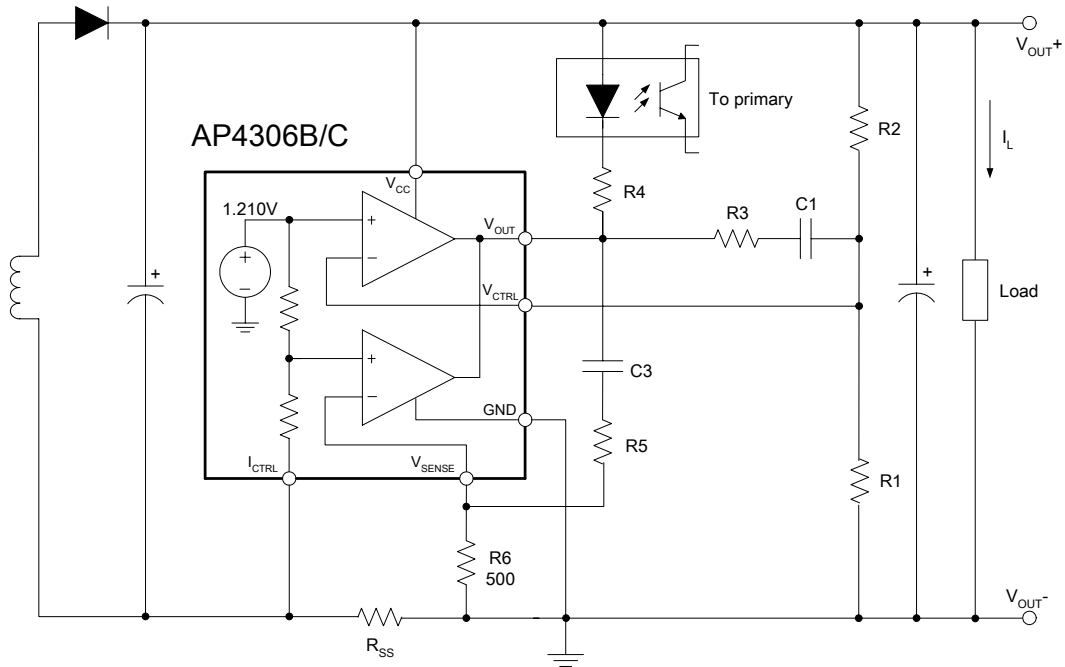


Figure 8. AP4306  $I_{CC}$  vs. Ambient Temperature

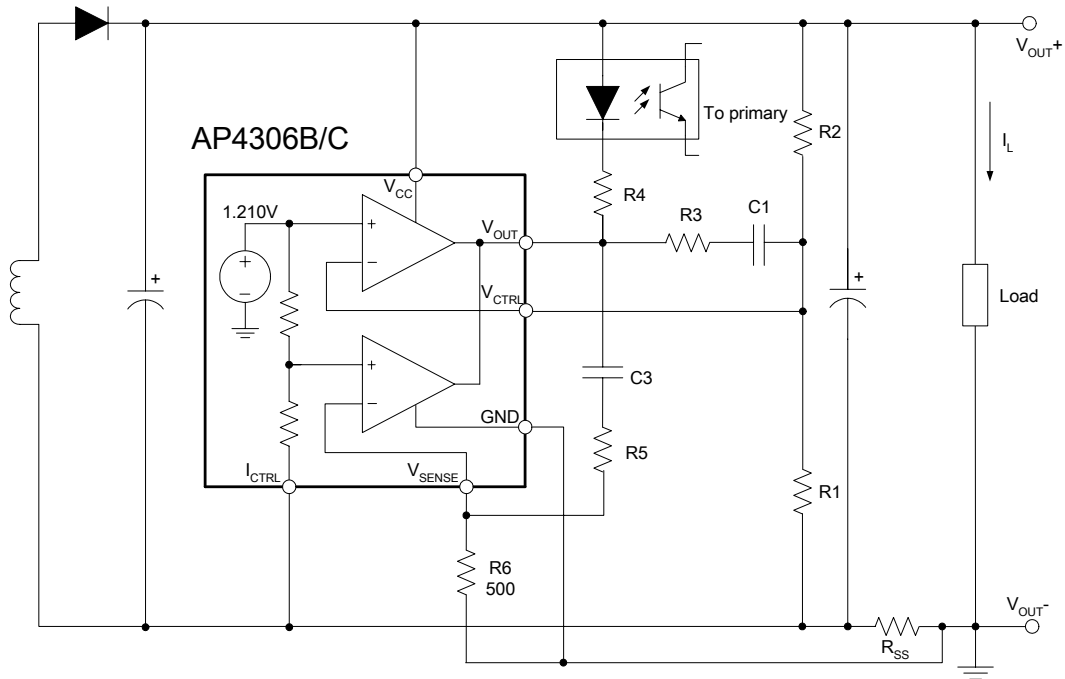
**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306**
**Typical Application**


$$V_{OUT} = V_{REF} \times \frac{R1 + R2}{R1} \quad (\text{V})$$

$$\text{CurrentLimit} = \frac{V_{SENSE}}{R_{SS}} \quad (\text{A})$$

Figure 10. Typical Application 1 of AP4306B/C



**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306**
**Typical Application (Continued)**


$$V_{OUT} = [V_{REF} + (I_L \times R_{SS})] \times \frac{R1 + R2}{R1} - (I_L \times R_{SS}) \quad (V)$$

$$CurrentLimit = \frac{V_{SENSE}}{R_{SS}} \quad (A)$$

Figure 11. Typical Application 2 of AP4306B/C



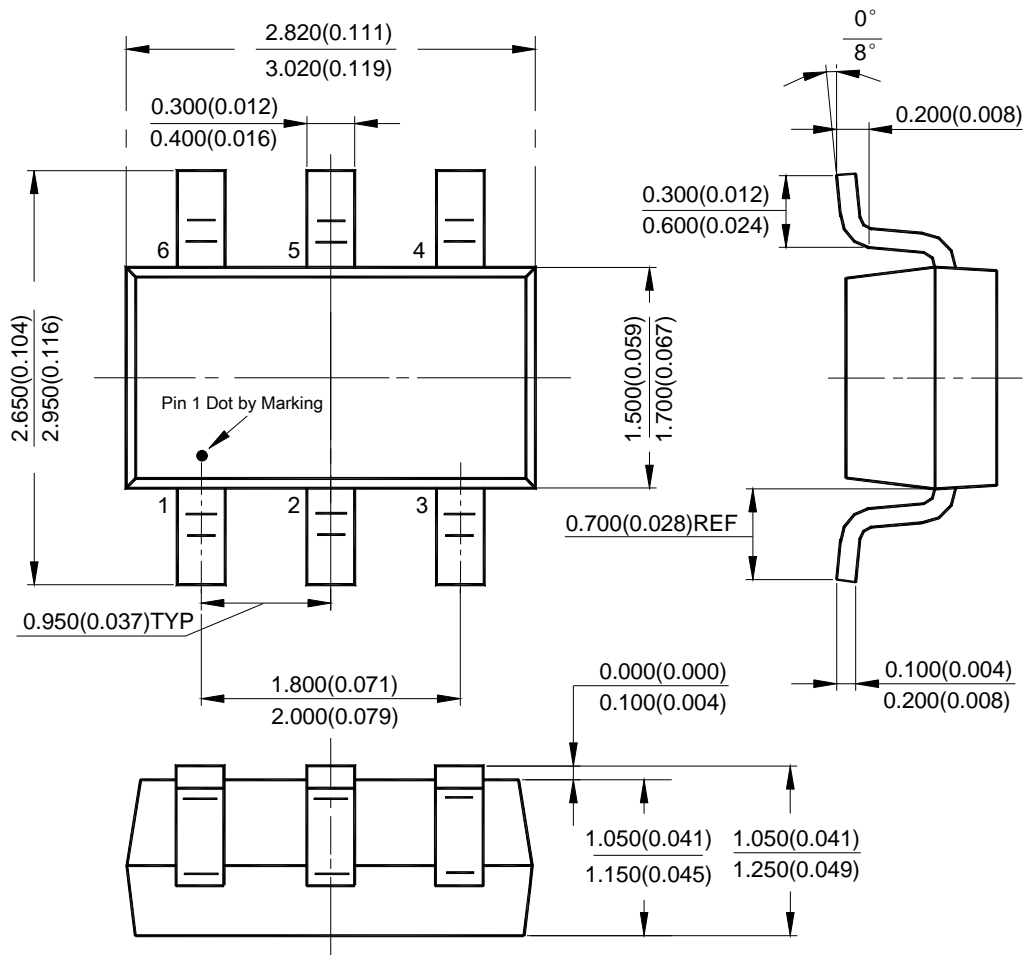


**CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER AP4306**

**Mechanical Dimensions**

**SOT-23-6**

**Unit: mm(inch)**





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