# 300mA RF ULDO REGULATOR AP2210

## General Description

The AP2210 is a 300mA ULDO regulator which provides very low noise, ultra low dropout voltage (typically 250mV at 300mA), very low standby current (1μA maximum) and excellent power supply ripple rejection (PSRR 75dB at 100Hz) in battery powered applications, such as handsets, PDAs and in noise sensitive applications, such as RF electronics.

The AP2210 also features individual logic compatible enable/shutdown control inputs, a low power shutdown mode for extended battery life, over current protection, over temperature protection, as well as reversed-battery protection.

The AP2210 has 2.5V, 2.8V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V and ADJ versions.

The AP2210 is available in space saving SOT-23-3 and SOT-23-5 packages.

## Features

- Up to 300mA Output Current
- Excellent ESR Stability
- Low Standby Current
- Low Dropout Voltage: $V_{DROP}$=250mV at 300mA
- High Output Accuracy: ± 1%
- Good Ripple Rejection Ability: 75dB at 100Hz and $I_{OUT}$=100μA
- Tight Load and Line Regulation
- Low Temperature Coefficient
- Over Current Protection
- Thermal Protection
- Reverse-battery Protection
- Logic-controlled Enable

## Applications

- Cellular Phones
- Cordless Phones
- Wireless Communicators
- PDAs/Palmtops
- PC Mother Board
- Consumer Electronics

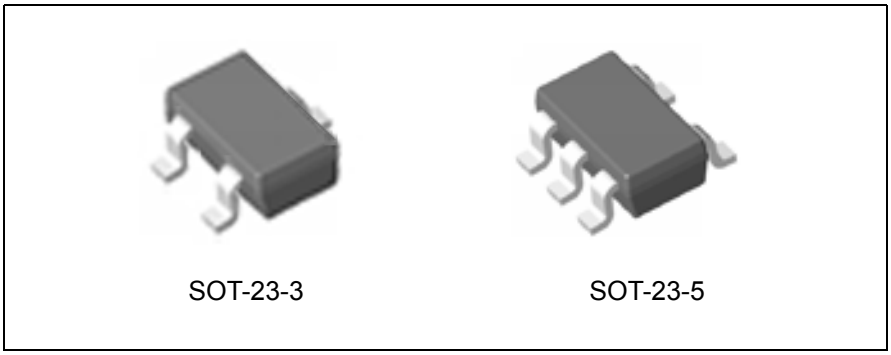



Figure 1. Package Types of AP2210

## Pin Configuration

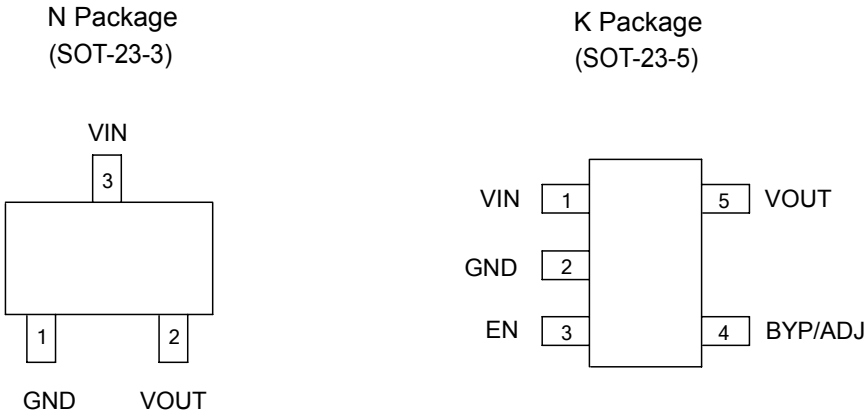
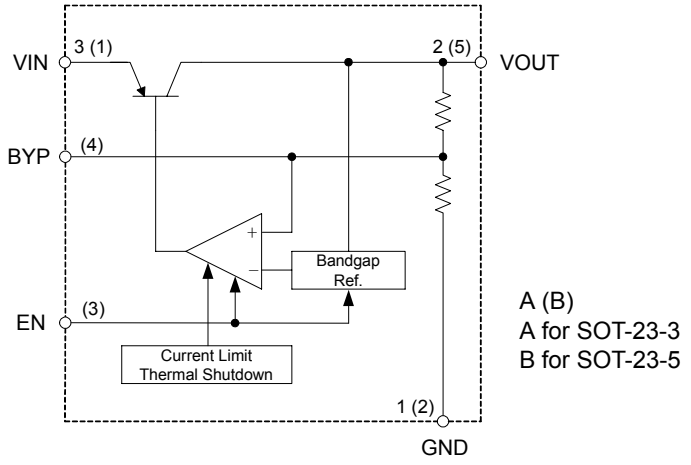



Figure 2. Pin Configuration of AP2210 (Top View)

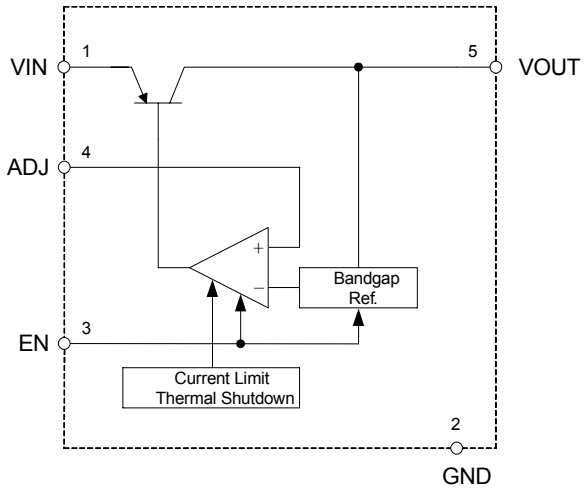
## Pin Description

| Pin Number | | Pin Name | Function |
|---|---|---|---|
| SOT-23-3 | SOT-23-5 | | |
| 1 | 2 | GND | Ground |
| 2 | 5 | VOUT | Regulated output voltage |
| 3 | 1 | VIN | Input voltage |
| | 3 | EN | Enable input: CMOS or TTL compatible input. Logic high=enable, logic low=shutdown |
| | 4 | BYP/ADJ | Bypass capacitor for low noise operation/Adjustable Output |

## Functional Block Diagram



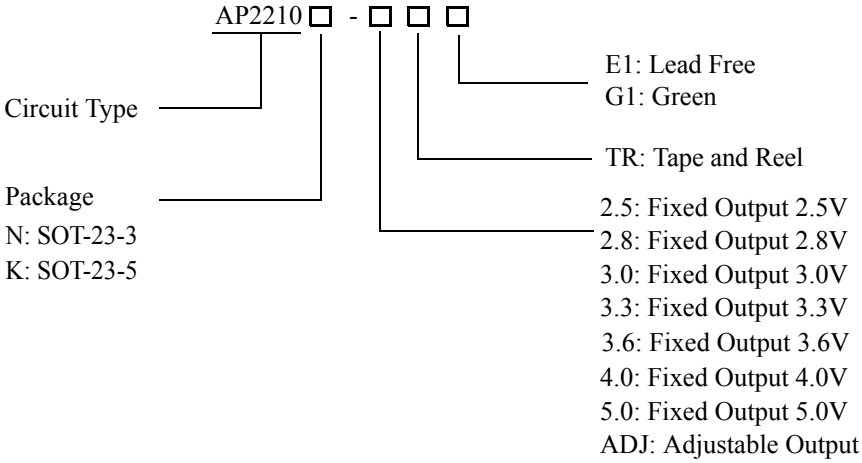

Fixed Version




ADJ Version (For SOT-23-5)

Figure 3. Functional Block Diagram of AP2210

## Ordering Information




| Package | Temperature Range | Part Number | | Marking ID | | Packing Type |
|---|---|---|---|---|---|---|
| | | Lead Free | Green | Lead Free | Green | |
| SOT-23-3 | -40 to 125°C | AP2210N-2.5TRE1 | AP2210N-2.5TRG1 | EH2 | GH2 | Tape & Reel |
| | | AP2210N-2.8TRE1 | AP2210N-2.8TRG1 | EH3 | GH3 | Tape & Reel |
| | | AP2210N-3.0TRE1 | AP2210N-3.0TRG1 | EH4 | GH4 | Tape & Reel |
| | | AP2210N-3.3TRE1 | AP2210N-3.3TRG1 | EH5 | GH5 | Tape & Reel |
| | | | AP2210N-3.6TRG1 | | GB7 | Tape & Reel |
| | | | AP2210N-4.0TRG1 | | GC7 | Tape & Reel |
| | | | AP2210N-5.0TRG1 | | GH9 | Tape & Reel |
| SOT-23-5 | -40 to 125°C | AP2210K-2.5TRE1 | AP2210K-2.5TRG1 | E5C | G5C | Tape & Reel |
| | | AP2210K-2.8TRE1 | AP2210K-2.8TRG1 | E5F | G5F | Tape & Reel |
| | | AP2210K-3.0TRE1 | AP2210K-3.0TRG1 | E5H | G5H | Tape & Reel |
| | | AP2210K-3.3TRE1 | AP2210K-3.3TRG1 | E5K | G5K | Tape & Reel |
| | | | AP2210K-3.6TRG1 | | G5I | Tape & Reel |
| | | | AP2210K-4.0TRG1 | | G5J | Tape & Reel |
| | | | AP2210K-5.0TRG1 | | G5L | Tape & Reel |
| | | | AP2210K-ADJTRG1 | | G5M | Tape & Reel |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

## Absolute Maximum Ratings (Note 1)

| Parameter | Symbol | Value | | Unit |
|---|---|---|---|---|
| Supply Input Voltage | $V_{IN}$ | 15 | | V |
| Enable Input Voltage | $V_{EN}$ | 15 | | V |
| Power Dissipation | $P_D$ | Internally Limited (Thermal Protection) | | W |
| Lead Temperature (Soldering, 10sec) | $T_{LEAD}$ | 260 | | °C |
| Junction Temperature | $T_J$ | 150 | | °C |
| Storage Temperature | $T_{STG}$ | -65 to 150 | | °C |
| ESD (Machine Model) | ESD | 300 | | V |
| Thermal Resistance (No Heatsink) | $\theta_{JA}$ | SOT-23-3 | 200 | °C/W |
| | | SOT-23-5 | 200 | |

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 |
|---|---|---|---|---|
| Supply Input Voltage | $V_{IN}$ | 2.5 | 13.2 | V |
| Enable Input Voltage | $V_{EN}$ | 0 | 13.2 | V |
| Operating Junction Temperature | $T_J$ | -40 | 125 | °C |

## Electrical Characteristics (Continued)

### AP2210-2.5 Electrical Characteristics

$V_{IN}$=3.5V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **48** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=3.5V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Dropout Voltage (Note 5) | $V_{DROP}$ | $I_{OUT}$=100μA | | 15 | 50 | mV |
| | | | | | **70** | |
| | | $I_{OUT}$=50mA | | 110 | 150 | |
| | | | | | **230** | |
| | | $I_{OUT}$=100mA | | 140 | 250 | |
| | | | | | **300** | |
| | | $I_{OUT}$=150mA | | 165 | 275 | |
| | | | | | **350** | |
| | | $I_{OUT}$=300mA | | 250 | 400 | |
| | | | | | **500** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |

## Electrical Characteristics (Continued)

### AP2210-2.5 Electrical Characteristics

$V_{IN}$=3.5V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output differential at which the output voltage drops 1% ($T_J$=25°C) or 2% (-40°C≤$T_J$≤125°C) below its nominal value measured at 1V differential.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Electrical Characteristics (Continued)

### AP2210-2.8 Electrical Characteristics

$V_{IN}$=3.8V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **42.8** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=3.8V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Dropout Voltage (Note 5) | $V_{DROP}$ | $I_{OUT}$=100μA | | 15 | 50 | mV |
| | | | | | **70** | |
| | | $I_{OUT}$=50mA | | 110 | 150 | |
| | | | | | **230** | |
| | | $I_{OUT}$=100mA | | 140 | 250 | |
| | | | | | **300** | |
| | | $I_{OUT}$=150mA | | 165 | 275 | |
| | | | | | **350** | |
| | | $I_{OUT}$=300mA | | 250 | 400 | |
| | | | | | **500** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |

## Electrical Characteristics (Continued)

### AP2210-2.8 Electrical Characteristics

$V_{IN}$=3.8V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output differential at which the output voltage drops 1% ($T_J$=25°C) or 2% (-40°C≤$T_J$≤125°C) below its nominal value measured at 1V differential.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Electrical Characteristics (Continued)

### AP2210-3.0 Electrical Characteristics

$V_{IN}$=4V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **40** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=4V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Dropout Voltage (Note 5) | $V_{DROP}$ | $I_{OUT}$=100μA | | 15 | 50 | mV |
| | | | | | **70** | |
| | | $I_{OUT}$=50mA | | 110 | 150 | |
| | | | | | **230** | |
| | | $I_{OUT}$=100mA | | 140 | 250 | |
| | | | | | **300** | |
| | | $I_{OUT}$=150mA | | 165 | 275 | |
| | | | | | **350** | |
| | | $I_{OUT}$=300mA | | 250 | 400 | |
| | | | | | **500** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |

## Electrical Characteristics (Continued)

### AP2210-3.0 Electrical Characteristics

$V_{IN}$=4V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output differential at which the output voltage drops 1% ($T_J$=25°C) or 2% (-40°C≤$T_J$≤125°C) below its nominal value measured at 1V differential.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Electrical Characteristics (Continued)

### AP2210-3.3 Electrical Characteristics

$V_{IN}$=4.3V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **36.3** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=4.3V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Dropout Voltage (Note 5) | $V_{DROP}$ | $I_{OUT}$=100μA | | 15 | 50 | mV |
| | | | | | **70** | |
| | | $I_{OUT}$=50mA | | 110 | 150 | |
| | | | | | **230** | |
| | | $I_{OUT}$=100mA | | 140 | 250 | |
| | | | | | **300** | |
| | | $I_{OUT}$=150mA | | 165 | 275 | |
| | | | | | **350** | |
| | | $I_{OUT}$=300mA | | 250 | 400 | |
| | | | | | **500** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |

## Electrical Characteristics (Continued)

### AP2210-3.3 Electrical Characteristics

$V_{IN}$=4.3V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output differential at which the output voltage drops 1% ($T_J$=25°C) or 2% (-40°C≤$T_J$≤125°C) below its nominal value measured at 1V differential.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Electrical Characteristics (Continued)

### AP2210-3.6 Electrical Characteristics

$V_{IN}$=4.6V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **48** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=4.6V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Dropout Voltage (Note 5) | $V_{DROP}$ | $I_{OUT}$=100μA | | 15 | 50 | mV |
| | | | | | **70** | |
| | | $I_{OUT}$=50mA | | 110 | 150 | |
| | | | | | **230** | |
| | | $I_{OUT}$=100mA | | 140 | 250 | |
| | | | | | **300** | |
| | | $I_{OUT}$=150mA | | 165 | 275 | |
| | | | | | **350** | |
| | | $I_{OUT}$=300mA | | 250 | 400 | |
| | | | | | **500** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |

## Electrical Characteristics (Continued)

### AP2210-3.6 Electrical Characteristics

$V_{IN}$=4.6V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output differential at which the output voltage drops 1% ($T_J$=25°C) or 2% (-40°C≤$T_J$≤125°C) below its nominal value measured at 1V differential.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Electrical Characteristics (Continued)

### AP2210-4.0 Electrical Characteristics

$V_{IN}$=5.0V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **48** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=5.0V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Dropout Voltage (Note 5) | $V_{DROP}$ | $I_{OUT}$=100μA | | 15 | 50 | mV |
| | | | | | **70** | |
| | | $I_{OUT}$=50mA | | 110 | 150 | |
| | | | | | **230** | |
| | | $I_{OUT}$=100mA | | 140 | 250 | |
| | | | | | **300** | |
| | | $I_{OUT}$=150mA | | 165 | 275 | |
| | | | | | **350** | |
| | | $I_{OUT}$=300mA | | 250 | 400 | |
| | | | | | **500** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |

## Electrical Characteristics (Continued)

### AP2210-4.0 Electrical Characteristics

$V_{IN}$=5.0V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output differential at which the output voltage drops 1% ($T_J$=25°C) or 2% (-40°C≤$T_J$≤125°C) below its nominal value measured at 1V differential.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Electrical Characteristics (Continued)

### AP2210-5.0 Electrical Characteristics

$V_{IN}$=6.0V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **48** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=6.0V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Dropout Voltage (Note 5) | $V_{DROP}$ | $I_{OUT}$=100μA | | 15 | 50 | mV |
| | | | | | **70** | |
| | | $I_{OUT}$=50mA | | 110 | 150 | |
| | | | | | **230** | |
| | | $I_{OUT}$=100mA | | 140 | 250 | |
| | | | | | **300** | |
| | | $I_{OUT}$=150mA | | 165 | 275 | |
| | | | | | **350** | |
| | | $I_{OUT}$=300mA | | 250 | 400 | |
| | | | | | **500** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |

## Electrical Characteristics (Continued)

### AP2210-5.0 Electrical Characteristics

$V_{IN}$=6.0V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output differential at which the output voltage drops 1% ($T_J$=25°C) or 2% (-40°C≤$T_J$≤125°C) below its nominal value measured at 1V differential.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Electrical Characteristics (Continued)

### AP2210-ADJ Electrical Characteristics

$V_{IN}$=$V_{OUT}$+1V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $\Delta V_{OUT}/V_{OUT}$ | Variation from specified $V_{OUT}$ | -1 | | 1 | % |
| | | | **-2** | | **2** | |
| Output Voltage Temperature Coefficient (Note 3) | $\Delta V_{OUT}/\Delta T$ | | | **120** | | μV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | | **48** | | ppm/°C |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=$V_{OUT}$+1V to 13.2V | | 1.5 | 4.5 | mV |
| | | | | | **12** | |
| Load Regulation (Note 4) | $V_{RLOAD}$ | $I_{OUT}$=0.1mA to 300mA | | 1 | 6 | mV |
| | | | | | **30** | |
| Standby Current | $I_{STD}$ | $V_{EN}$≤0.4V (shutdown) | | 0.01 | 1 | μA |
| | | $V_{EN}$≤0.18V (shutdown) | | | **5** | |
| Ground Pin Current (Note 6) | $I_{GND}$ | $V_{EN}$≥2.0V, $I_{OUT}$=100μA | | 100 | 150 | μA |
| | | | | | **180** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=50mA | | 350 | 600 | |
| | | | | | **800** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=150mA | | 1.3 | 1.9 | mA |
| | | | | | **2.5** | |
| | | $V_{EN}$≥2.0V, $I_{OUT}$=300mA | | 4 | 10 | |
| | | | | | **15** | |
| Ripple Rejection | PSRR | f=100Hz, $I_{OUT}$=100μA | | 75 | | dB |
| Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | **450** | 900 | mA |
| Output Noise | $e_{no}$ | $I_{OUT}$=50mA, $C_{OUT}$=2.2μF, 100pF from BYP to GND | | 260 | | $nV/\sqrt{Hz}$ |
| Enable Input Logic-low Voltage | $V_{IL}$ | Regulator shutdown | | | 0.4 | V |
| | | | | | **0.18** | |
| Enable Input Logic-high Voltage | $V_{IH}$ | Regulator enabled | **2.0** | | | V |
| Enable Input Logic-low Current | $I_{IL}$ | $V_{IL}$≤0.4V | | 0.01 | 1 | μA |
| | | $V_{IL}$≤0.18V | | | **2** | |
| Enable Input Logic-high Current | $I_{IH}$ | $V_{IL}$≥2.0V | | 5 | 20 | μA |
| | | $V_{IL}$≥2.0V | | | **25** | |

## Electrical Characteristics (Continued)

## AP2210-ADJ Electrical Characteristics

$V_{IN}$=$V_{OUT}$+1V, $I_{OUT}$=100μA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF, $V_{EN}$≥2.0V, $T_J$=25°C, **Bold** typeface applies over -40°C≤$T_J$≤125°C (Note 2), unless otherwise specified.

Note 2: Specifications in bold type are limited to -40°C≤$T_J$≤125°C. Limits over temperature are guaranteed by design, but not tested in production.

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 6: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## Typical Performance Characteristics

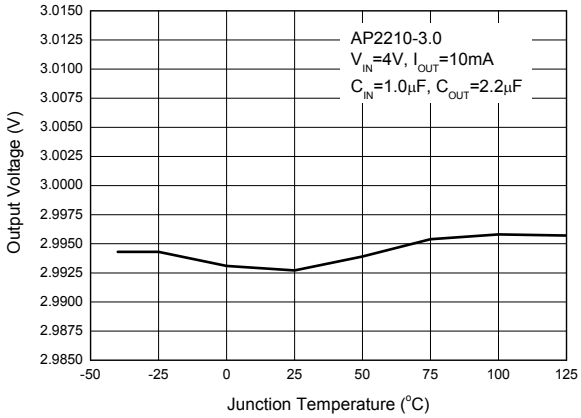



Figure 4. Output Voltage vs. Junction Temperature

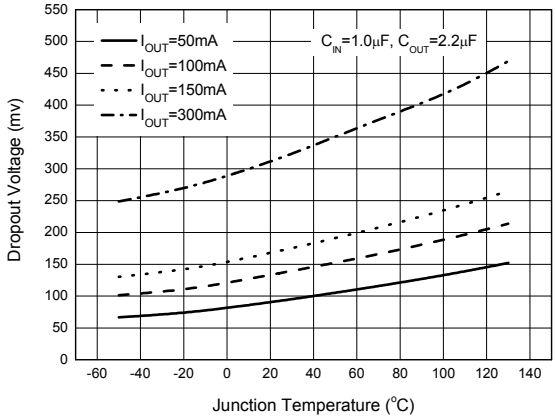



Figure 5. Dropout Voltage vs. Junction Temperature

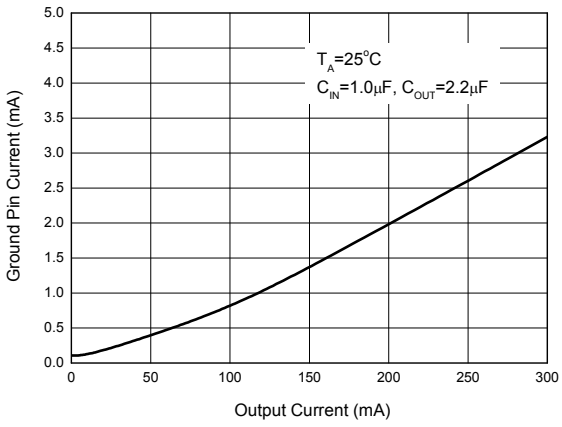



Figure 6. Ground Pin Current vs. Output Current

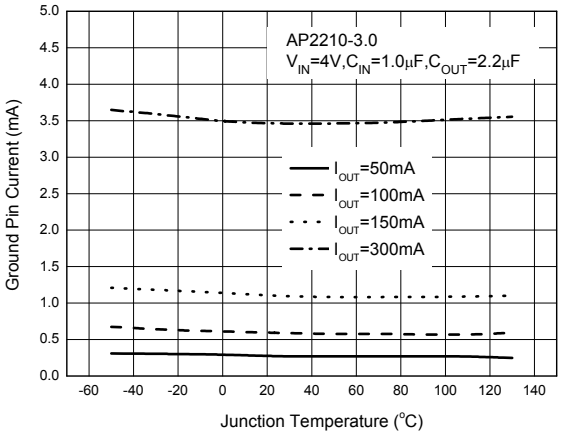



Figure 7. Ground Pin Current vs. Junction Temperature

## Typical Performance Characteristics (Continued)

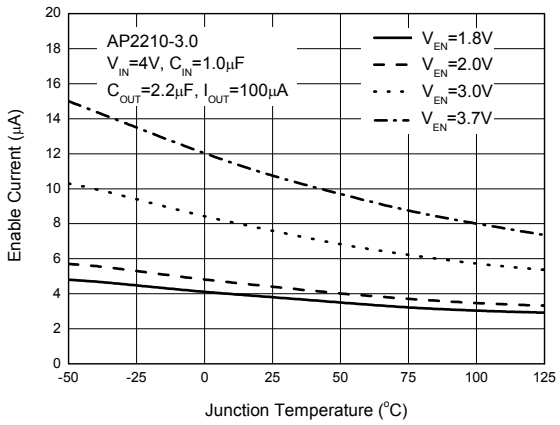



Figure 8. Enable Current vs. Junction Temperature

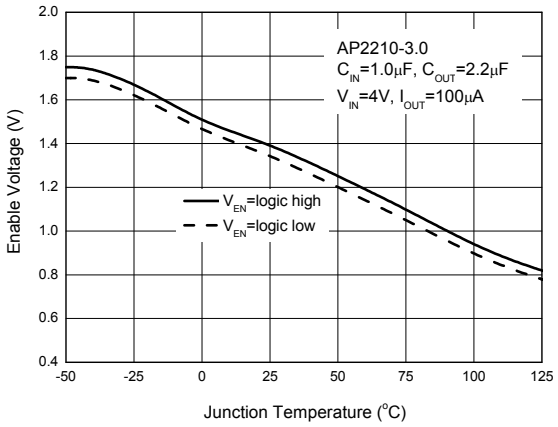



Figure 9. Enable Voltage vs. Junction Temperature

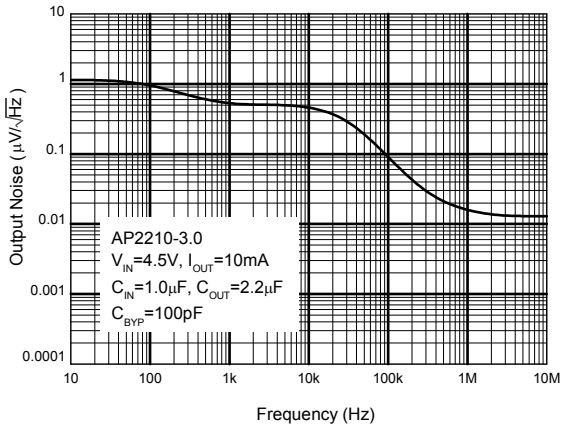



Figure 10. Output Noise vs. Frequency

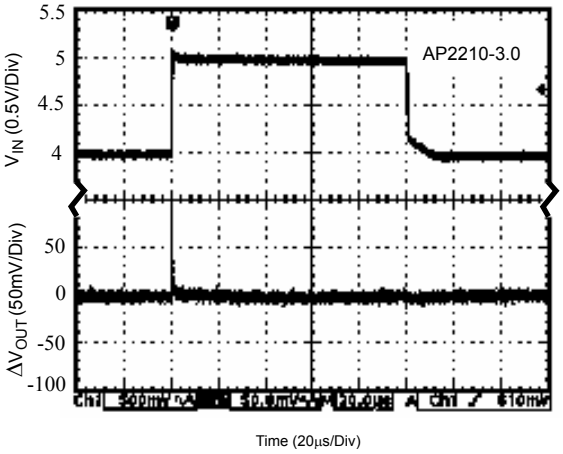



Figure 11. Line Transient
(Conditions: $V_{IN}$=4 to 5V, $V_{EN}$=2V, $I_{OUT}$=1mA, $C_{OUT}$=2.2μF)

## Typical Performance Characteristics (Continued)

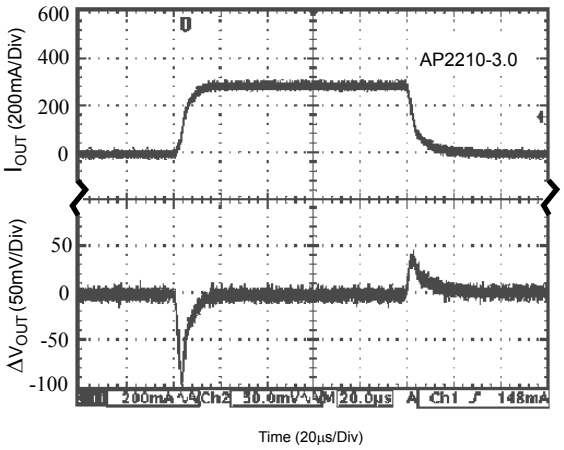



Figure 12. Load Transient
(Conditions: $V_{IN}$=4V, $V_{EN}$=2V, $I_{OUT}$=10mA to 300mA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF)

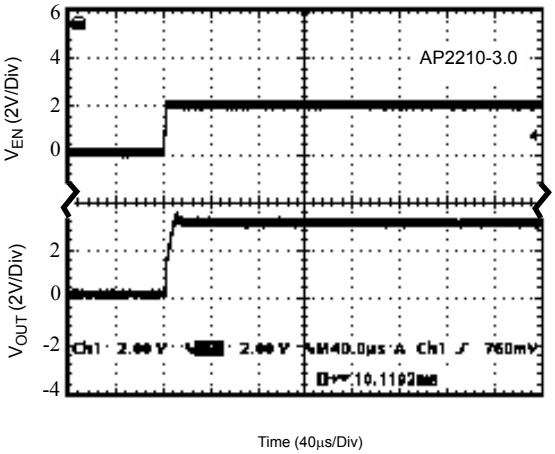



Figure 13. $V_{EN}$ vs. $V_{OUT}$
(Conditions: $V_{EN}$=0 to 2V, $V_{IN}$=4V, $I_{OUT}$=30mA, $C_{IN}$=1.0μF, $C_{OUT}$=2.2μF)

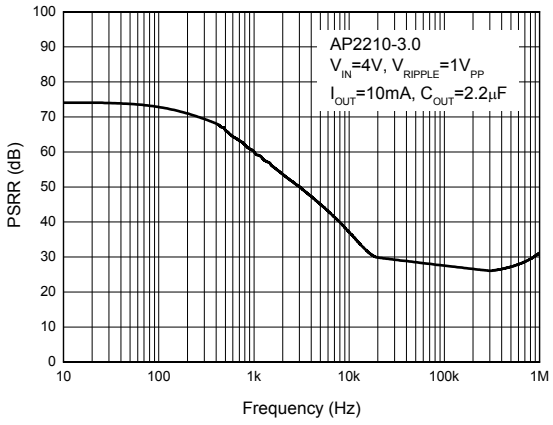



Figure 14. PSRR vs. Frequency

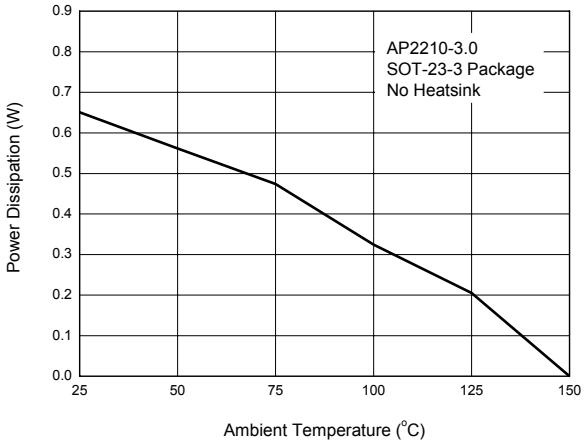



Figure 15. Power Dissipation vs. Ambient Temperature

## Typical Performance Characteristics (Continued)

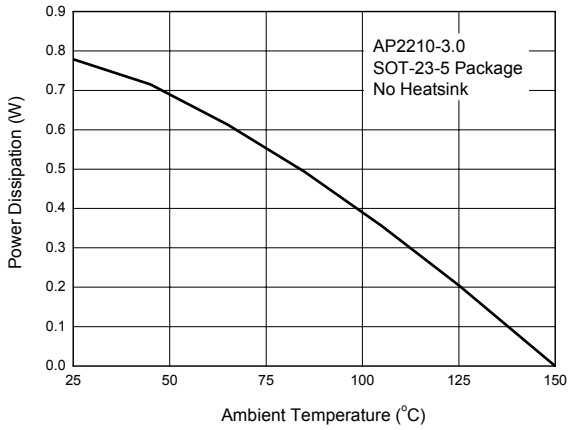



Figure 16. Power Dissipation vs. Ambient Temperature

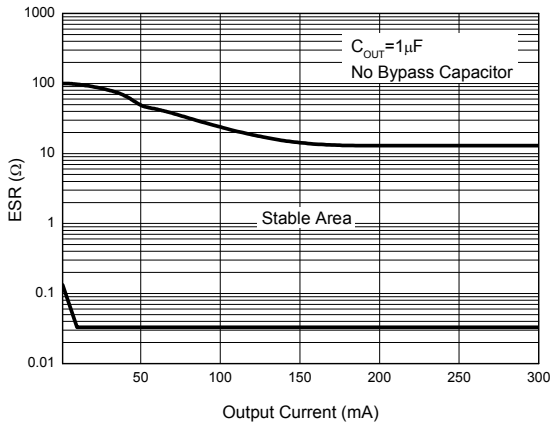



Figure 17. ESR vs. Output Current

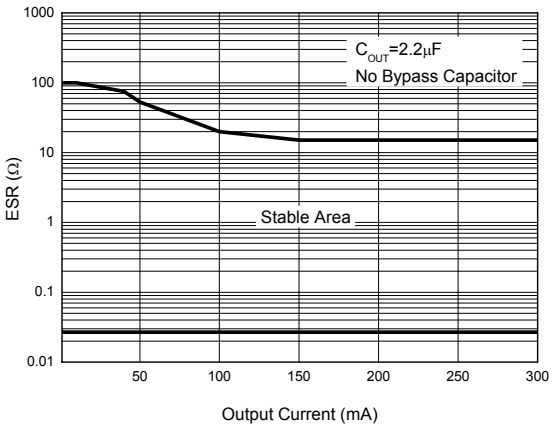



Figure 18. ESR vs. Output Current

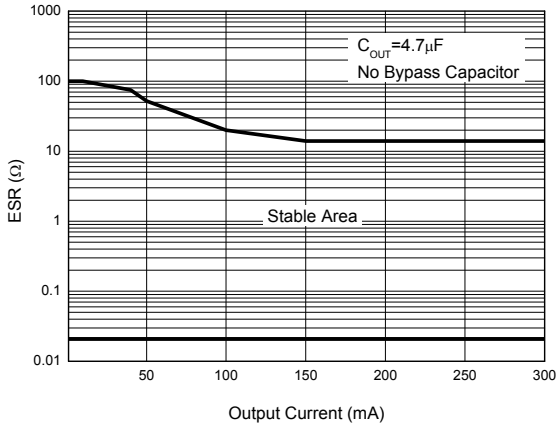
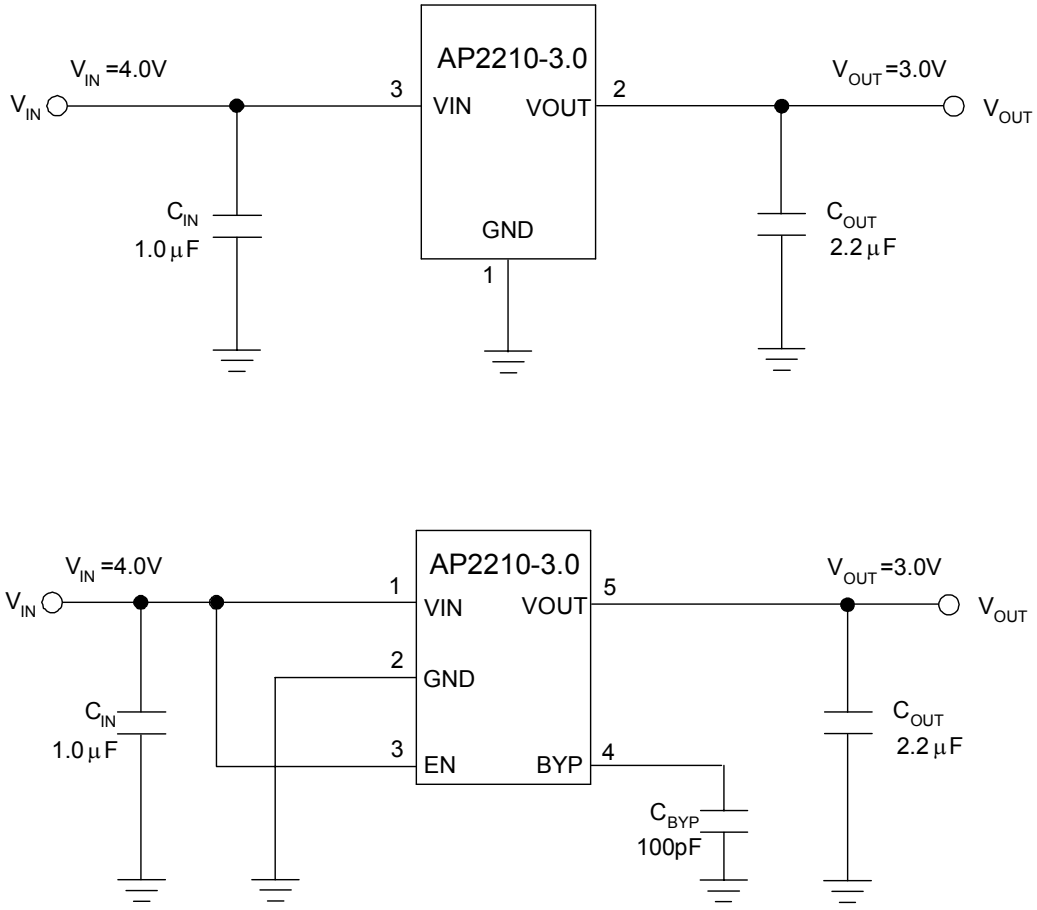


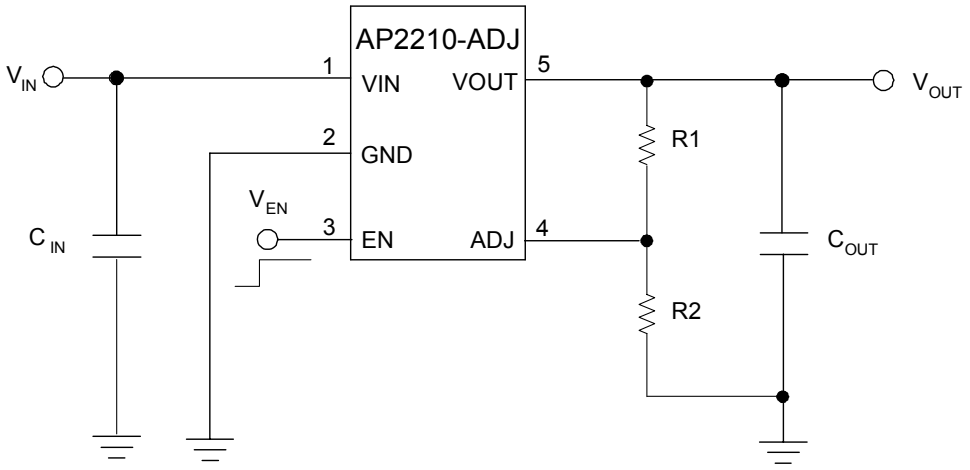

Figure 19. ESR vs. Output Current

## Typical Application




For Fixed Version

## Typical Application (Continued)




$V_{OUT}$=1.25V*(1+R2/R1)

For Adjustable Version

Figure 20. Typical Application of AP2210 (Note 7)

Note 7: Dropout voltage is 250mV when $T_A$=25°C. In order to obtain a normal output voltage, $V_{OUT}$+0.25V is the minimum input voltage which will results a low PSRR, imposing a bad influence on system. Therefore, the recommended input voltage is $V_{OUT}$+1V to 13.2V. For AP2210-3.0 version, its input voltage can be set from 4V($V_{OUT}$+1V) to 13.2V.

## Application Information

**Input Capacitor**
A 1μF minimum capacitor is recommended to be placed between $V_{IN}$ and GND.

**Output Capacitor**
It is required to prevent oscillation. 1.0μF minimum is recommended when $C_{BYP}$ is unused. 2.2μF minimum is recommended when $C_{BYP}$ is 100pF. The output capacitor may be increased to improve transient response.

**Noise Bypass Capacitor**
Bypass capacitor is connected to the internal voltage reference. A small capacitor connected from BYP to GND make this reference quiet, resulting in a significant reduction in output noise, but the ESR stable area will be narrowed. In order to keep the output stability, it is recommended to use the bypass capacitor no more than 100pF.

The start-up speed of the AP2210 is inversely proportional to the value of reference bypass capacitor. In some cases, if output noise is not a major concern and rapid turn-on is necessary, omit $C_{BYP}$ and leave BYP open.

**Power Dissipation**
Thermal shutdown may take place if exceeding the maximum power dissipation in application. Under all possible operating conditions, the junction temperature must be within the range specified under absolute maximum ratings to avoid thermal shutdown.
To determine if the power dissipated in the regulator reaches the maximum power dissipation (see figure 16, 17), using:
$T_J = P_D*\theta_{JA} + T_A$
$P_D=(V_{IN}-V_{OUT})*I_{OUT}+V_{IN}*I_{GND}$

Where: $T_J \le T_{J(max)}$, $T_{J(max)}$ is absolute maximum ratings for the junction temperature; $V_{IN}*I_{GND}$ can be ignored due to its small value.

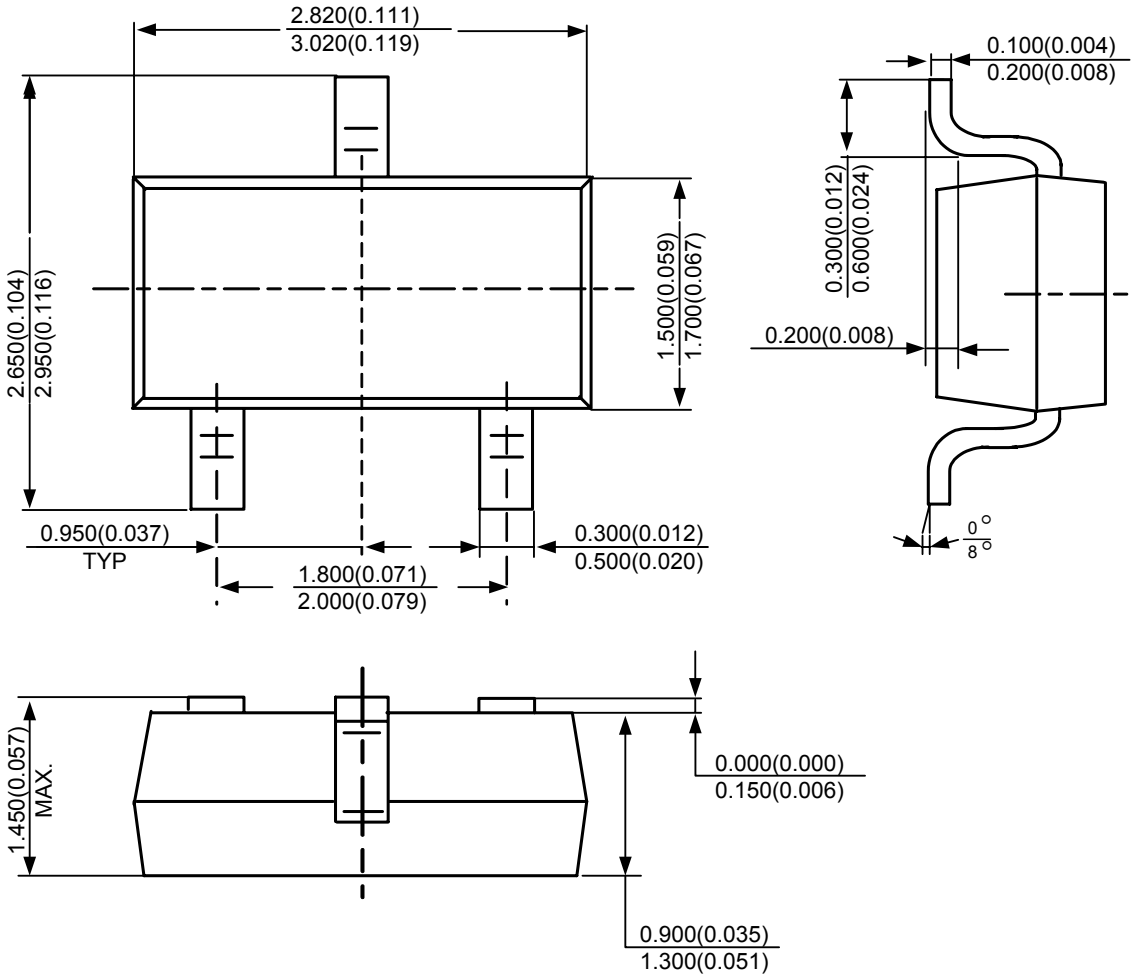
$T_{J(max)}$ is 150°C, $\theta_{JA}$ is 200°C/W, no heatsink is required since the package alone will dissipate enough heat to satisfy these requirements unless the calculated value for power dissipation exceeds the limit.

Example (3.0V version):
$I_{OUT}$=300mA, $T_A$=50°C, $V_{IN(Max)}$ is:
(150°C-50°C)/(0.3A*200°C/W)+3.0V=4.67V

Therefore, for good performance, please make sure that input voltage is less than 4.67V without heatsink when $T_A$=50°C.

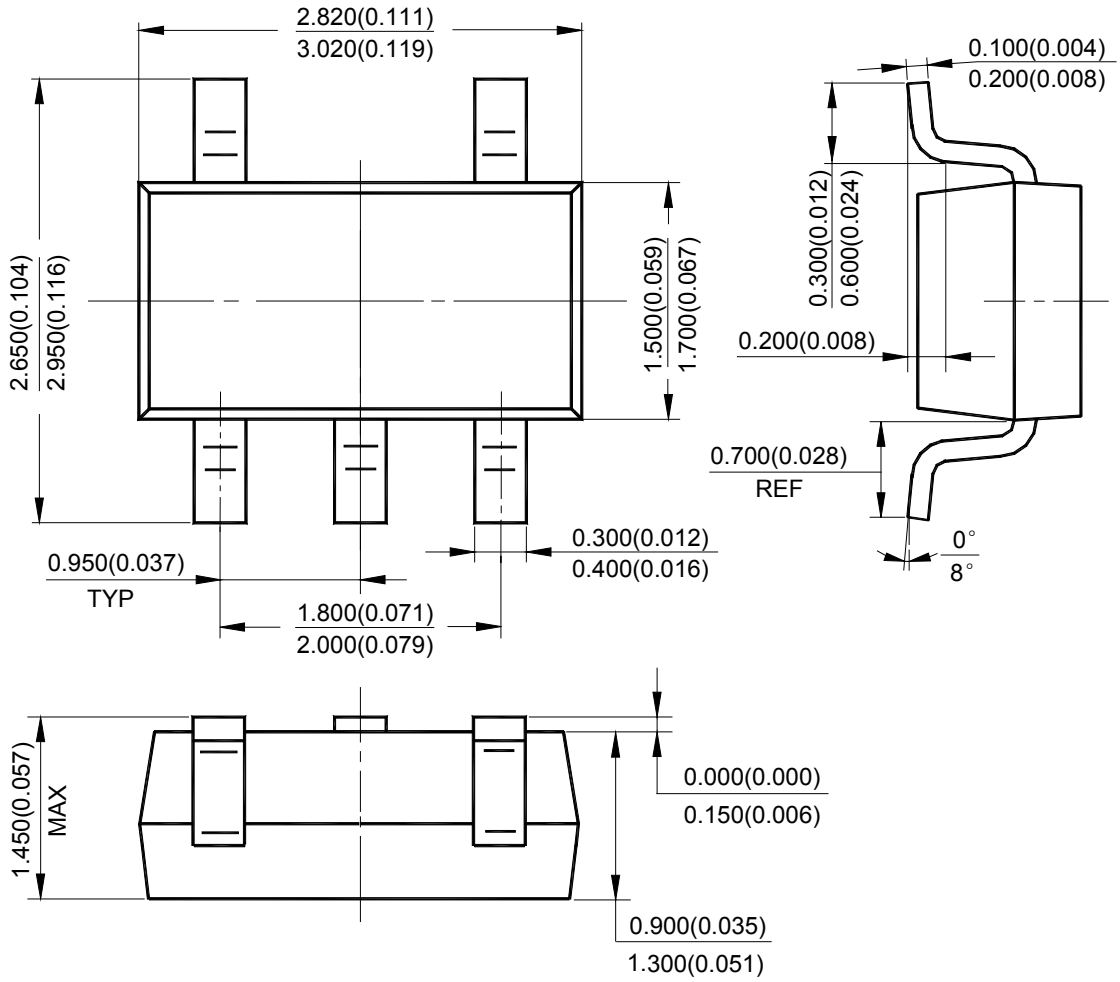
## Mechanical Dimensions

**SOT-23-3** **Unit: mm(inch)**



## Mechanical Dimensions (Continued)

**SOT-23-5** **Unit: mm(inch)**



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