# 300mA FIXED OUTPUT VOLTAGE LDO REGULATOR AP2115

## General Description

The AP2115 is positive voltage regulator IC designed by CMOS process. The AP2115 has features of low dropout voltage, high output voltage accuracy and low current consumption. It consists of a voltage reference, an error amplifier, a resistor network for setting output voltage, a current limit circuit for current protection, a circuit for over temperature protection and a chip enable circuit. Thus, the AP2115 is suitable for various power sources for portable application.

The AP2115 is available in standard SOT-23-5 package.

## Features

- High Ripple Rejection: 70dB at f=1KHz
- Ultra Low Dropout Voltage: 0.3V Typical at $I_{OUT}$=300mA
- Low Operation Current: 80μA Typical
- High Line Regulation: 4mV Typical
- High Load Regulation: 12mV Typical at $I_{OUT}$=300mA
- Low Temperature-drift Coefficient of Output Voltage
- High Output Voltage Accuracy: ± 2%
- Excellent Line Transient Response and Load Transient Response
- Output Voltage: 1.8V, 2.5V, 2.8V, 3.0V, 3.3V
- Low ESR Capacitor Compatible
- Wide Temperature Range: -40°C to 125°C
- Current and Thermal Protection

## Application

- Mobile Phones, Cordless Phones
- Portable Games
- Cameras
- Portable AV Equipment
- Battery Powered Equipment



SOT-23-5

Figure 1. Package Type of AP2115

## Pin Configuration

K Package
(SOT-23-5)

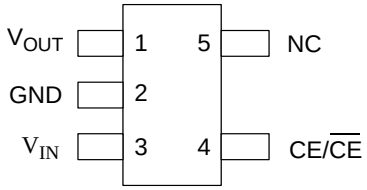
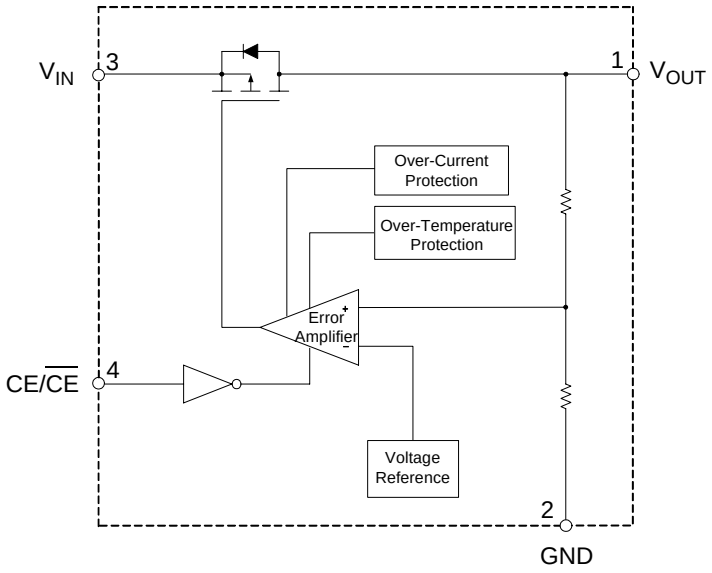



Figure 2. Pin Configuration of AP2115 (Top View)

## Pin Description

| Pin Number | Pin Name | Function |
|---|---|---|
| 1 | $V_{OUT}$ | Voltage regulator output pin |
| 2 | GND | Ground pin |
| 3 | $V_{IN}$ | Input voltage pin |
| 4 | CE/$\overline{CE}$ | Active high/low enable input pin (active high for AP2115B) |
| 5 | NC | No connection |

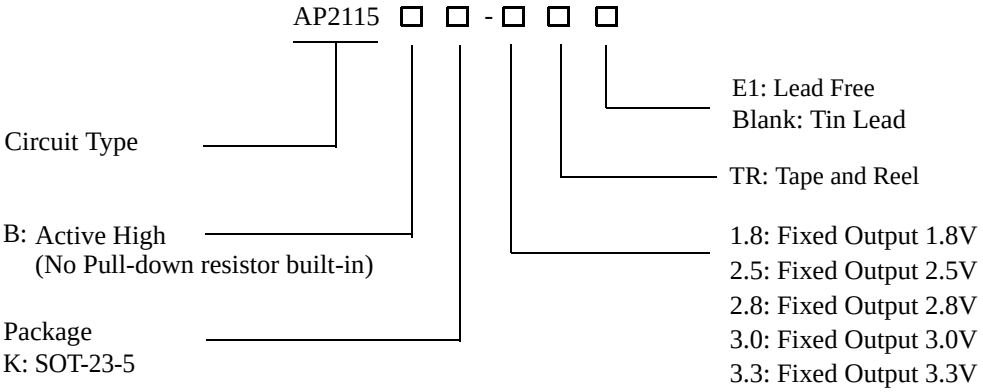
## Functional Block Diagram




Active High Version

Figure 3. Functional Block Diagram of AP2115

## Ordering Information



## Ordering Information (Continued)

| Package | Temperature Range | Part Number | | Marking ID | | Packing Type |
|---|---|---|---|---|---|---|
| | | Tin Lead | Lead Free | Tin Lead | Lead Free | |
| SOT-23-5 | -40 to 125°C | AP2115BK-1.8TR | AP2115BK-1.8TRE1 | K7B | E7B | Tape & Reel |
| | | AP2115BK-2.5TR | AP2115BK-2.5TRE1 | K7D | E7D | Tape & Reel |
| | | AP2115BK-2.8TR | AP2115BK-2.8TRE1 | K7F | E7F | Tape & Reel |
| | | AP2115BK-3.0TR | AP2115BK-3.0TRE1 | K7H | E7H | Tape & Reel |
| | | AP2115BK-3.3TR | AP2115BK-3.3TRE1 | K7J | E7J | Tape & Reel |

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

## Absolute Maximum Ratings (Note 1)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Input Voltage (Note 2) | $V_{IN}$ | -0.3 to 8 | V |
| Input Voltage (CE/$\overline{CE}$ Pin) | $V_{SHDN}$ | -0.3 to $V_{IN}$+0.3 | V |
| Output Voltage | $V_{OUT}$ | -0.3 to $V_{IN}$+0.3 | V |
| Output Current | $I_{OUT}$ | 500 | mA |
| Power Dissipation | $P_D$ | 250 | mW |
| Storage Temperature Range | $T_{STG}$ | -65 to 150 | °C |
| Lead Temperature (Soldering, 10sec) | $T_{LEAD}$ | 300 | °C |
| ESD (Machine Model) | ESD | 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.
Note 2: All voltage values are with respect to network ground terminal.

## Recommended Operating Conditions

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Input Voltage (Note 3) | $V_{IN}$ | 2.2 | 6.5 | V |
| Operating Junction Temperature Range | $T_J$ | -40 | 125 | °C |

Note 3: To calculate the minimum input voltage for maximum output current, the following formula is recommended:
$V_{IN(Min)}=V_{OUT(Max)}+V_{DROP(Max\ load)}$

## Electrical Characteristics

### AP2115-1.8V Electrical Characteristics

$V_{IN}=V_{OUT}+1V$, $T_A=25^oC$, $C_{IN}=1\mu F$, $C_L=1\mu F$, unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | $1mA\leq I_{OUT}\leq 30mA$ | 1.764 | 1.8 | 1.836 | V |
| Output Current | $I_{OUT}$ | | 300 | | | mA |
| Current Limit | | | | 500 | | mA |
| Quiescent Current | | | | 80 | 150 | μA |
| Ground Pin Current | $I_{GND}$ | $I_{OUT}$=300mA | | 90 | 150 | μA |
| Dropout Voltage (Note 4) | $V_{DROP}$ | $I_{OUT}$=1mA | | 400 | 600 | mV |
| | | $I_{OUT}$=50mA | | 400 | 600 | |
| | | $I_{OUT}$=200mA | | 400 | 600 | |
| | | $I_{OUT}$=300mA | | 600 | 900 | |
| Load Regulation | $V_{RLOAD}$ | $1mA\leq I_{OUT}\leq 300mA$ | | 7.2 | 18 | mV |
| Line Regulation | $V_{RLINE}$ | $V_{OUT}+0.5V\leq V_{IN}\leq 6V$<br>$I_{OUT}$=30mA | | 4 | 15 | mV |
| CE/$\overline{CE}$ Input High Threshold | $V_{IH}$ | | 1.5 | | | V |
| CE/$\overline{CE}$ Input Low Threshold | $V_{IL}$ | | | | 0.4 | V |
| CE/$\overline{CE}$ Bias Current | $I_{SD}$ | | | | 100 | nA |
| Shutdown Supply Current | $I_{GSD}$ | $V_{OUT}$=0V | | 0.1 | 1 | μA |
| Thermal Shutdown Temperature | $T_{SD}$ | | | 165 | | $^oC$ |
| Power Supply Ripple Rejection | PSRR | Ripple $0.5V_{P-P}$<br>f=1kHz, $I_{OUT}$=30mA | | 70 | | dB |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}$=30mA<br>$-40^oC\leq T_J\leq 125^oC$ | | 180 | | $\mu V/^oC$ |
| Short Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | 450 | | mA |
| Turn-on Time (Note 5) | $T_{ON}$ | | | 60 | | μs |
| RMS Output Noise | $V_{NOISE}$ | $T_A=25^oC$<br>10Hz≤f≤100kHz | | 200 | | μVrms |

Note 4: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 98% of its nominal value which is measured at $V_{OUT}$+1V applied to $V_{IN}$. The 1.8V version dropout voltage is limited by the input voltage range.

Note 5: Turn-on time is time measured between the enable input just exceeding $V_{IH}$ and the output voltage just reaching 95% of its nominal value.

## Electrical Characteristics (Continued)

### AP2115-2.5V Electrical Characteristics

$V_{IN}=V_{OUT}+1V$, $T_A=25^oC$, $C_{IN}=1\mu F$, $C_L=1\mu F$, unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | $1mA\leq I_{OUT}\leq 30mA$ | 2.45 | 2.5 | 2.55 | V |
| Output Current | $I_{OUT}$ | | 300 | | | mA |
| Current Limit | | | | 500 | | mA |
| Quiescent Current | | | | 80 | 150 | μA |
| Ground Pin Current | $I_{GND}$ | $I_{OUT}$=300mA | | 90 | 150 | μA |
| Dropout Voltage (Note 4) | $V_{DROP}$ | $I_{OUT}$=1mA | | 1 | 5 | mV |
| | | $I_{OUT}$=50mA | | 50 | 75 | |
| | | $I_{OUT}$=200mA | | 200 | 300 | |
| | | $I_{OUT}$=300mA | | 300 | 450 | |
| Load Regulation | $V_{RLOAD}$ | $1mA\leq I_{OUT}\leq 300mA$ | | 10 | 25 | mV |
| Line Regulation | $V_{RLINE}$ | $V_{OUT}+0.5V\leq V_{IN}\leq 6V$<br>$I_{OUT}$=30mA | | 4 | 15 | mV |
| CE/$\overline{CE}$ Input High Threshold | $V_{IH}$ | | 1.5 | | | V |
| CE/$\overline{CE}$ Input Low Threshold | $V_{IL}$ | | | | 0.4 | V |
| CE/$\overline{CE}$ Bias Current | $I_{SD}$ | | | | 100 | nA |
| Shutdown Supply Current | $I_{GSD}$ | $V_{OUT}$=0V | | 0.1 | 1 | μA |
| Thermal Shutdown Temperature | $T_{SD}$ | | | 165 | | $^oC$ |
| Power Supply Ripple Rejection | PSRR | Ripple $0.5V_{P-P}$<br>f=1kHz, $I_{OUT}$=30mA | | 70 | | dB |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}$=30mA<br>$-40^oC\leq T_J\leq 125^oC$ | | 250 | | μV/$^oC$ |
| Short Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | 450 | | mA |
| Turn-on Time (Note 5) | $T_{ON}$ | | | 60 | | μs |
| RMS Output Noise | $V_{NOISE}$ | $T_A=25^oC$<br>10Hz≤f≤100kHz | | 200 | | μVrms |

Note 4: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 98% of its nominal value which is measured at $V_{OUT}$+1V applied to $V_{IN}$.

Note 5: Turn-on time is time measured between the enable input just exceeding $V_{IH}$ and the output voltage just reaching 95% of its nominal value.

## Electrical Characteristics (Continued)

### AP2115-2.8V Electrical Characteristics

$V_{IN}=V_{OUT}+1V$, $T_A=25^oC$, $C_{IN}=1\mu F$, $C_L=1\mu F$, unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | $1mA \le I_{OUT} \le 30mA$ | 2.744 | 2.8 | 2.856 | V |
| Output Current | $I_{OUT}$ | | 300 | | | mA |
| Current Limit | | | | 500 | | mA |
| Quiescent Current | | | | 80 | 150 | μA |
| Ground Pin Current | $I_{GND}$ | $I_{OUT}$=300mA | | 90 | 150 | μA |
| Dropout Voltage (Note 4) | $V_{DROP}$ | $I_{OUT}$=1mA | | 1 | 5 | mV |
| | | $I_{OUT}$=50mA | | 50 | 75 | |
| | | $I_{OUT}$=200mA | | 200 | 300 | |
| | | $I_{OUT}$=300mA | | 300 | 450 | |
| Load Regulation | $V_{RLOAD}$ | $1mA \le I_{OUT} \le 300mA$ | | 11.2 | 28 | mV |
| Line Regulation | $V_{RLINE}$ | $V_{OUT}+0.5V \le V_{IN} \le 6V$<br>$I_{OUT}$=30mA | | 4 | 15 | mV |
| CE/$\overline{CE}$ Input High Threshold | $V_{IH}$ | | 1.5 | | | V |
| CE/$\overline{CE}$ Input Low Threshold | $V_{IL}$ | | | | 0.4 | V |
| CE/$\overline{CE}$ Bias Current | $I_{SD}$ | | | | 100 | nA |
| Shutdown Supply Current | $I_{GSD}$ | $V_{OUT}$=0V | | 0.1 | 1 | μA |
| Thermal Shutdown Temperature | $T_{SD}$ | | | 165 | | $^oC$ |
| Power Supply Ripple Rejection | PSRR | Ripple $0.5V_{P-P}$<br>f=1kHz, $I_{OUT}$=30mA | | 70 | | dB |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}$=30mA<br>$-40^oC \le T_J \le 125^oC$ | | 280 | | μV/$^oC$ |
| Short Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | 450 | | mA |
| Turn-on Time (Note 5) | $T_{ON}$ | | | 60 | | μs |
| RMS Output Noise | $V_{NOISE}$ | $T_A=25^oC$<br>10Hz≤f ≤100kHz | | 200 | | μVrms |

Note 4: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 98% of its nominal value which is measured at $V_{OUT}$+1V applied to $V_{IN}$.

Note 5: Turn-on time is time measured between the enable input just exceeding $V_{IH}$ and the output voltage just reaching 95% of its nominal value.

## Electrical Characteristics (Continued)

### AP2115-3.0V Electrical Characteristics

$V_{IN}=V_{OUT}+1V$, $T_A=25^oC$, $C_{IN}=1\mu F$, $C_L=1\mu F$, unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | $1mA \le I_{OUT} \le 30mA$ | 2.94 | 3.0 | 3.06 | V |
| Output Current | $I_{OUT}$ | | 300 | | | mA |
| Current Limit | | | | 500 | | mA |
| Quiescent Current | | | | 80 | 150 | μA |
| Ground Pin Current | $I_{GND}$ | $I_{OUT}$=300mA | | 90 | 150 | μA |
| Dropout Voltage (Note 4) | $V_{DROP}$ | $I_{OUT}$=1mA | | 1 | 5 | mV |
| | | $I_{OUT}$=50mA | | 50 | 75 | |
| | | $I_{OUT}$=200mA | | 200 | 300 | |
| | | $I_{OUT}$=300mA | | 300 | 450 | |
| Load Regulation | $V_{RLOAD}$ | $1mA \le I_{OUT} \le 300mA$ | | 12 | 30 | mV |
| Line Regulation | $V_{RLINE}$ | $V_{OUT}+0.5V \le V_{IN} \le 6V$<br>$I_{OUT}$=30mA | | 4 | 15 | mV |
| CE/$\overline{CE}$ Input High Threshold | $V_{IH}$ | | 1.5 | | | V |
| CE/$\overline{CE}$ Input Low Threshold | $V_{IL}$ | | | | 0.4 | V |
| CE/$\overline{CE}$ Bias Current | $I_{SD}$ | | | | 100 | nA |
| Shutdown Supply Current | $I_{GSD}$ | $V_{OUT}$=0V | | 0.1 | 1 | μA |
| Thermal Shutdown Temperature | $T_{SD}$ | | | 165 | | $^oC$ |
| Power Supply Ripple Rejection | PSRR | Ripple $0.5V_{P-P}$<br>f=1kHz, $I_{OUT}$=30mA | | 70 | | dB |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}$=30mA<br>$-40^oC \le T_J \le 125^oC$ | | 300 | | μV/$^oC$ |
| Short Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | 450 | | mA |
| Turn-on Time (Note 5) | $T_{ON}$ | | | 60 | | μs |
| RMS Output Noise | $V_{NOISE}$ | $T_A=25^oC$<br>10Hz≤f≤100kHz | | 200 | | μVrms |

Note 4: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 98% of its nominal value which is measured at $V_{OUT}$+1V applied to $V_{IN}$.

Note 5: Turn-on time is time measured between the enable input just exceeding $V_{IH}$ and the output voltage just reaching 95% of its nominal value.

## Electrical Characteristics (Continued)

### AP2115-3.3V Electrical Characteristics

$V_{IN}=V_{OUT}+1V$, $T_A=25^oC$, $C_{IN}=1\mu F$, $C_L=1\mu F$, unless otherwise specified.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | $1mA \le I_{OUT} \le 30mA$ | 3.234 | 3.3 | 3.366 | V |
| Output Current | $I_{OUT}$ | | 300 | | | mA |
| Current Limit | | | | 500 | | mA |
| Quiescent Current | | | | 80 | 150 | μA |
| Ground Pin Current | $I_{GND}$ | $I_{OUT}$=300mA | | 90 | 150 | μA |
| Dropout Voltage (Note 4) | $V_{DROP}$ | $I_{OUT}$=1mA | | 1 | 5 | mV |
| | | $I_{OUT}$=50mA | | 50 | 75 | |
| | | $I_{OUT}$=200mA | | 200 | 300 | |
| | | $I_{OUT}$=300mA | | 300 | 450 | |
| Load Regulation | $V_{RLOAD}$ | $1mA \le I_{OUT} \le 300mA$ | | 13.2 | 33 | mV |
| Line Regulation | $V_{RLINE}$ | $V_{OUT}+0.5V \le V_{IN} \le 6V$<br>$I_{OUT}$=30mA | | 4 | 15 | mV |
| CE/$\overline{CE}$ Input High Threshold | $V_{IH}$ | | 1.5 | | | V |
| CE/$\overline{CE}$ Input Low Threshold | $V_{IL}$ | | | | 0.4 | V |
| CE/$\overline{CE}$ Bias Current | $I_{SD}$ | | | | 100 | nA |
| Shutdown Supply Current | $I_{GSD}$ | $V_{OUT}$=0V | | 0.1 | 1 | μA |
| Thermal Shutdown Temperature | $T_{SD}$ | | | 165 | | $^oC$ |
| Power Supply Ripple Rejection | PSRR | Ripple $0.5V_{P-P}$<br>f=1kHz, $I_{OUT}$=30mA | | 70 | | dB |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}$=30mA<br>$-40^oC \le T_J \le 125^oC$ | | 330 | | μV/$^oC$ |
| Short Current Limit | $I_{LIMIT}$ | $V_{OUT}$=0V | | 450 | | mA |
| Turn-on Time (Note 5) | $T_{ON}$ | | | 60 | | μs |
| RMS Output Noise | $V_{NOISE}$ | $T_A=25^oC$<br>10Hz≤f≤100kHz | | 200 | | μVrms |

Note 4: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 98% of its nominal value which is measured at $V_{OUT}$+1V applied to $V_{IN}$.

Note 5: Turn-on time is time measured between the enable input just exceeding $V_{IH}$ and the output voltage just reaching 95% of its nominal value.

## Typical Performance Characteristics

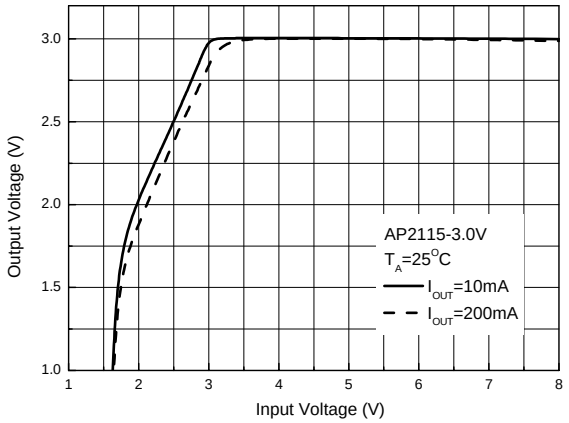



Figure 4. Output Voltage vs. Input Voltage

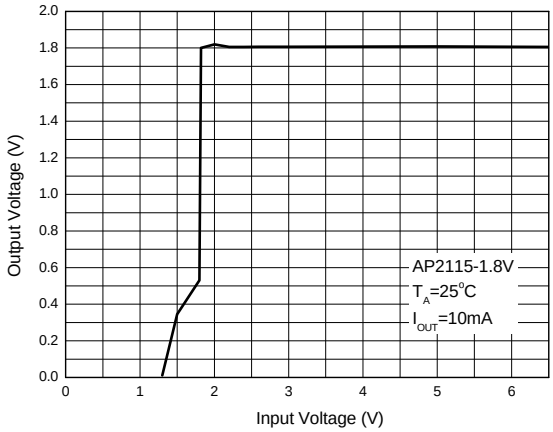



Figure 5. Output Voltage vs. Input Voltage

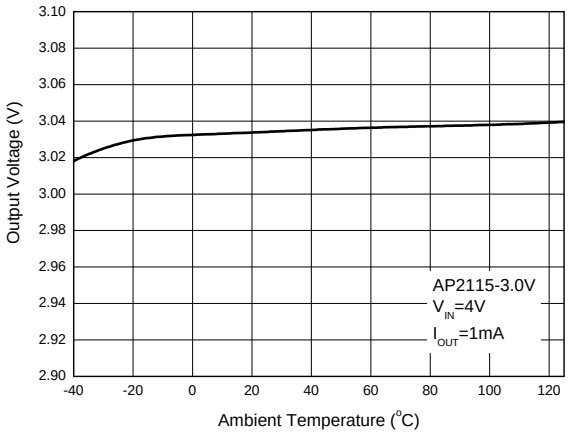



Figure 6. Output Voltage vs. Temperature

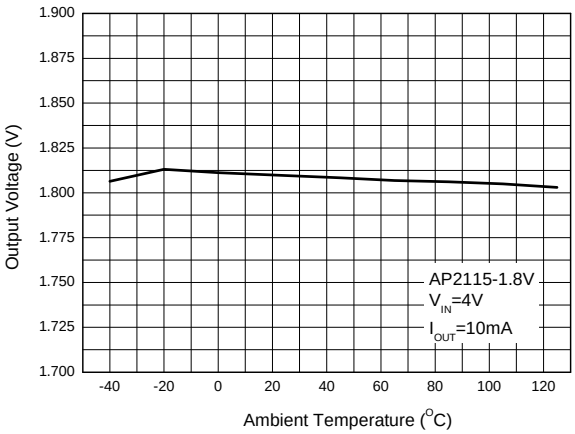



Figure 7. Output Voltage vs. Temperature

## Typical Performance Characteristics

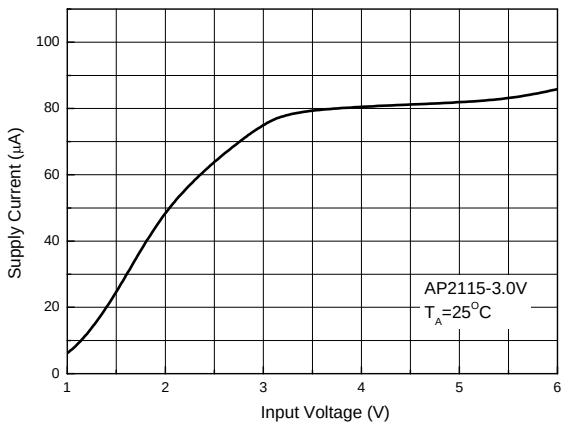



Figure 8. Input Voltage vs. Supply Current (No Load)

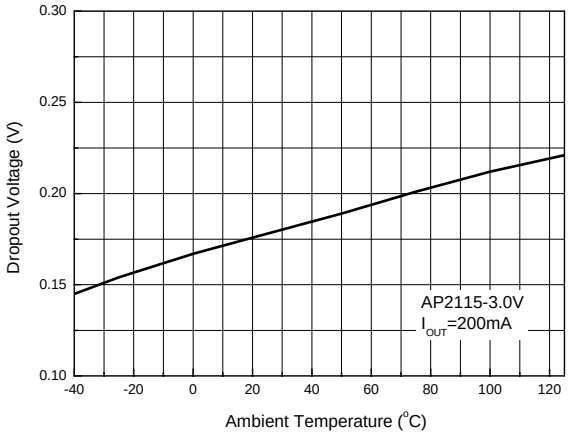



Figure 9. Dropout Voltage vs. Ambient Temperature

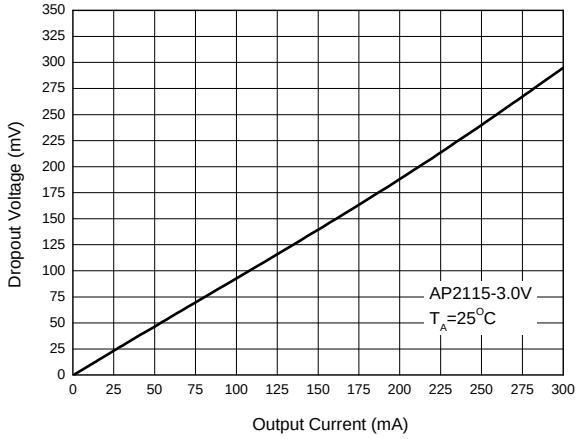



Figure 10. Dropout Voltage vs. Output Current

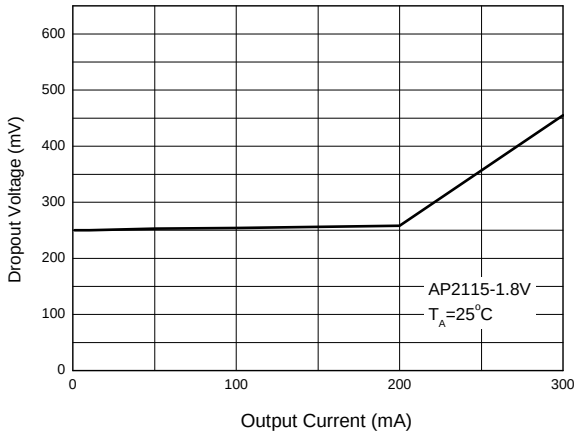



Figure 11. Dropout Voltage vs. Output Current

## Typical Performance Characteristics (Continued)

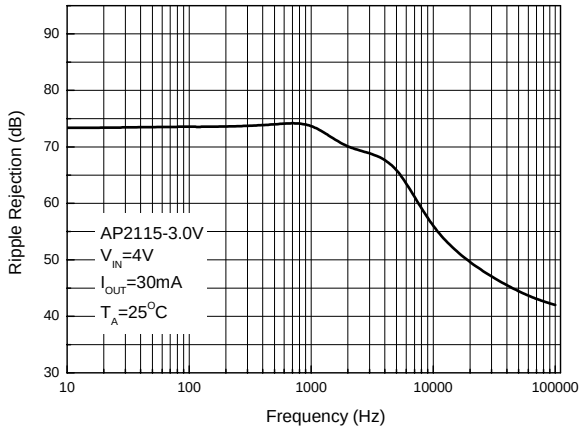



Figure 12. Ripple Rejection vs. Frequency

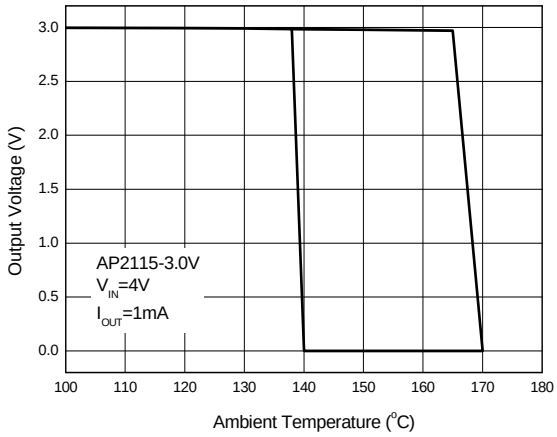



Figure 13. Output Voltage vs. Ambient Temperature

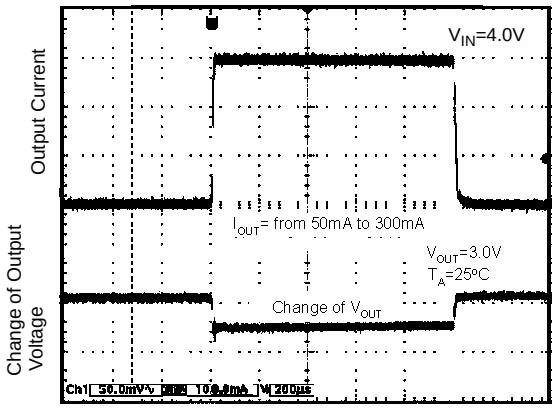



Figure 14. Load Transient

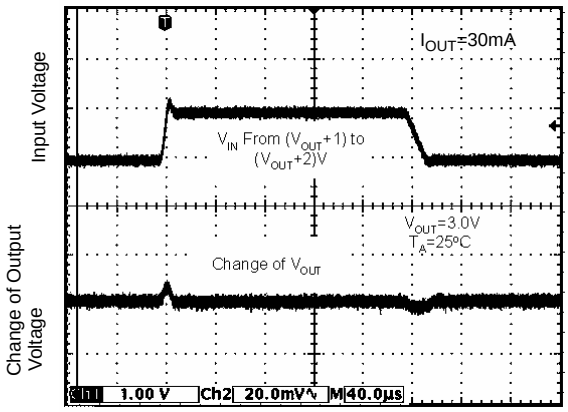



Figure 15. Line Transient

## Typical Performance Characteristics (Continued)

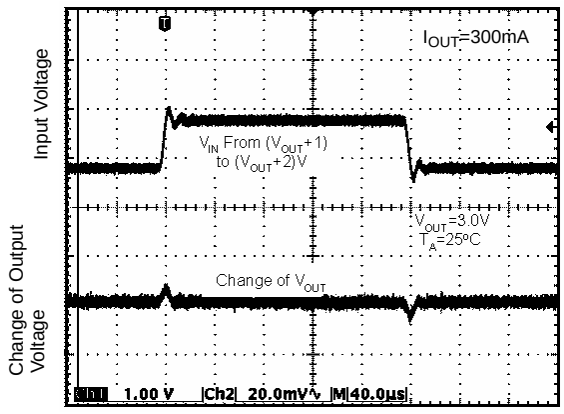



Figure 16. Line Transient

## Typical Application

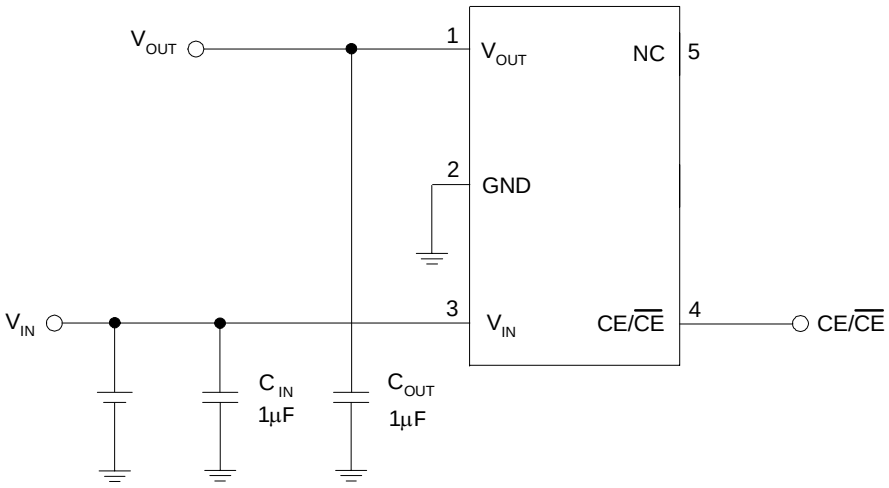
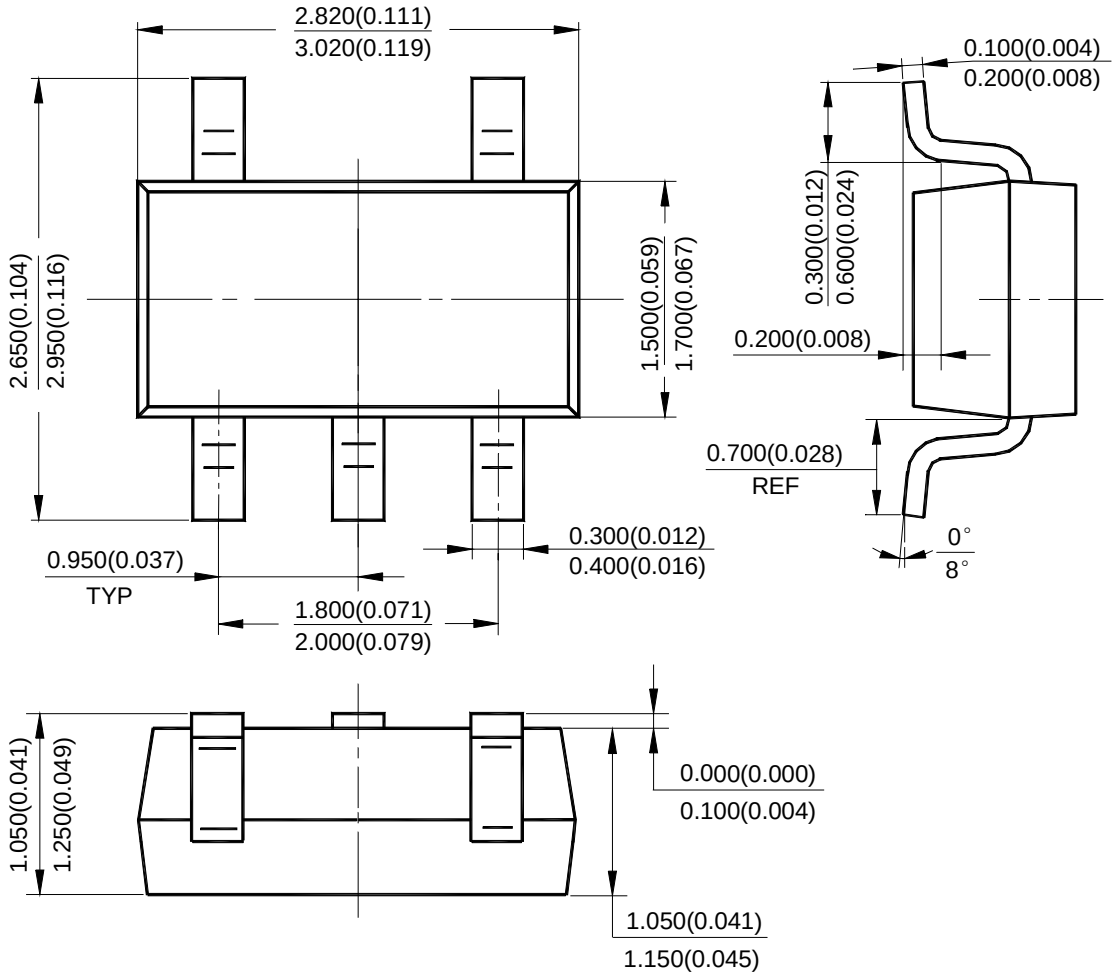



Figure 17. Typical Application of AP2115

Note: Filter capacitors are required at the AP2115's input and output. 1μF capacitors are required at the input. The minimum output capacitance required for stability should be≥1μF with ESR from 0.1Ω to 10Ω.

## Mechanical Dimensions

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





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