# ULTRA-LOW QUIESCENT CURRENT CMOS LDO

Lead-free Green

## Description

The AP2138/2139 series are CMOS-based positive voltage regulator ICs. Each of these ICs consists of a voltage reference, an error amplifier, a resistor network for setting output voltage and a current limit circuit for current protection.

The difference between AP2138 and AP2139 is the AP2139 has an enable circuit with a quick discharge function.

These ICs feature high output voltage accuracy, extremely low quiescent current and low dropout voltage which make them ideal for use in various power sources for portable applications.

The AP2138/2139 series have 1.2V, 1.4V, 1.5V, 1.8V, 2.1V, 2.2V, 2.5V, 2.8V, 3.0V, 3.3V, 3.6V and 4.0V fixed output voltage versions.

The AP2138 series is available in SOT-23-3 and SOT-89 packages, the AP2139 series is available in SOT-23-5 package.

## Features

- Ultra-Low Quiescent Current: 1.0µA typical
- Output Voltages: 1.2V, 1.4V, 1.5V, 1.8V, 2.1V, 2.2V, 2.5V, 2.8V, 3.0V, 3.3V, 3.6V and 4.0V
- High Output Voltage Accuracy: ±2%
- Output Current: 250mA
- Low Dropout Voltage:
  - 25mV typical at $I_{OUT}$ = 10mA and $V_{OUT}$ = 3V
  - 200mV typical at $I_{OUT}$ = 100mA and $V_{OUT}$ = 3V
- Line Regulation: 6mV typical
- Load Regulation: 25mV typical
- Low Output Voltage Temperature Coefficient: ±100ppm/°C
- Low Standby Current: 0.1µA typical (AP2139)
- Active Quick Output Discharge (AP2139)
- Logic-Controlled Enable (AP2139)
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

## Applications

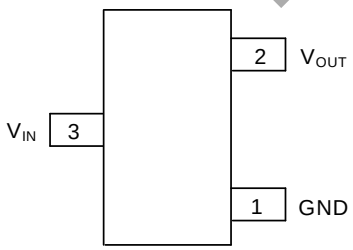
- Battery powered equipment
- Reference voltage sources
- Cameras, video cameras
- Portable AV systems
- Mobile phones
- Communication tools
- Portable games

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.



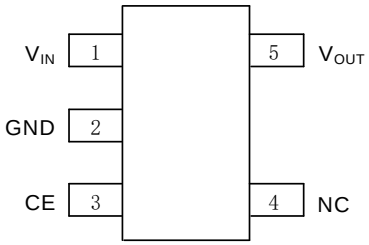
## Pin Assignments

(Top View)



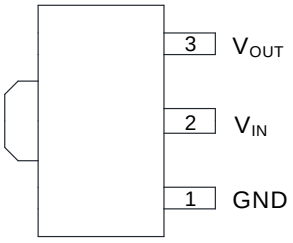

SOT-23-3

(Top View)



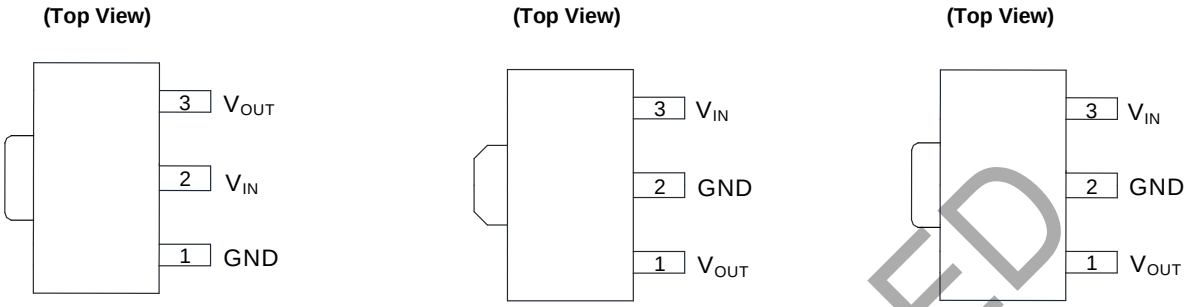

SOT-23-5

(Top View)



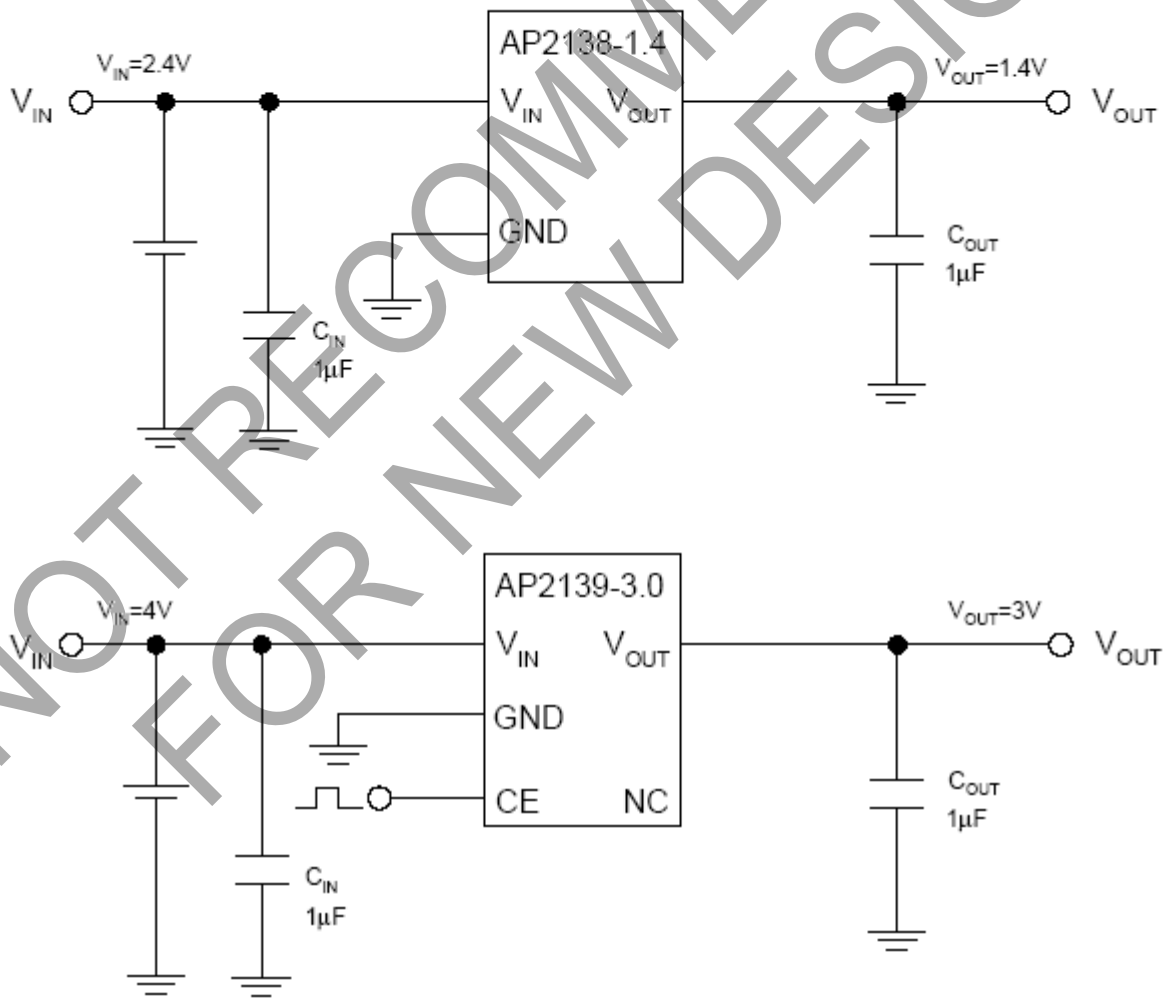

SOT-89 (Option 1)/R Package

## Pin Assignments (continued)




**SOT-89 (Option 2)/ R Package** | **SOT-89 (Option 1)/ RA Package** | **SOT-89 (Option 2)/ RA Package**

## Typical Applications Circuit (Note 4)



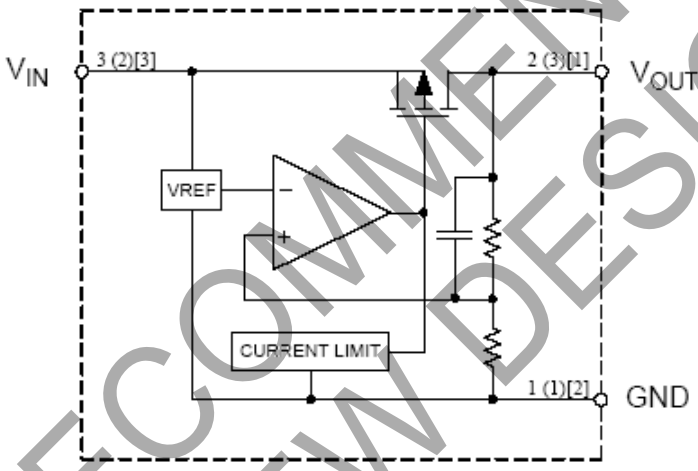



Note 4: Filter capacitors are required at the AP2138/2139's input and output. 1µF capacitor is required at the input. The minimum output capacitance required for stability should be more than 1µF with ESR from 0.01Ω to 100Ω. Ceramic capacitors are recommended.

## Pin Description

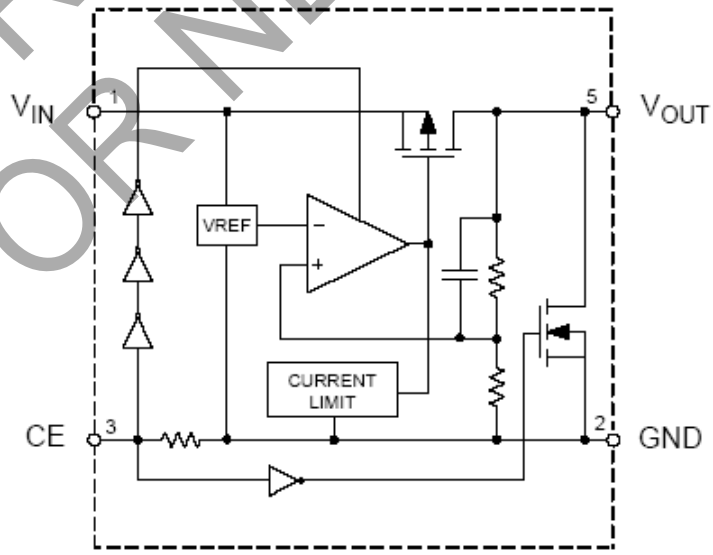
| Pin Number | | | | Pin Name | Function |
|---|---|---|---|---|---|
| SOT-23-3 | SOT-89 (R Package) | SOT-89 (RA Package) | SOT-23-5 | | |
| 1 | 1 | 2 | 2 | GND | Ground |
| 2 | 3 | 1 | 5 | $V_{OUT}$ | Regulated output voltage |
| 3 | 2 | 3 | 1 | $V_{IN}$ | Input voltage |
| — | — | — | 3 | CE | Active high enable input.<br>Logic high = enable, logic low = shutdown |
| — | — | — | 4 | NC | No connection |

## Functional Block Diagram




A(B)[C]
A: SOT-23-3
B: SOT-89 (R)
C: SOT-89 (RA)

AP2138




AP2139

## Absolute Maximum Ratings (Note 5)

| Symbol | Parameter | Rating | | Unit |
|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | 6.6 | | V |
| $V_{CE}$ | Enable Input Voltage (AP2139) | -0.3 to $V_{IN}$+0.3 | | V |
| $T_{LEAD}$ | Lead Temperature | +260 | | °C |
| $T_J$ | Junction Temperature | +150 | | °C |
| $T_{STG}$ | Storage Temperature Range | -65 to +150 | | °C |
| ESD | ESD (Machine Model) | 350 | | V |
| ESD | ESD (Human Body Model) | 2000 | | V |
| $\theta_{JA}$ | Thermal Resistance (Note 6) | SOT-23-3 | 250 | °C/W |
| | | SOT-23-5 | 250 | |
| | | SOT-89 | 165 | |

Notes:
5. Stresses greater than those listed under "*Absolute Maximum Ratings*" can 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 can affect device reliability.
6. Absolute maximum ratings indicate limits beyond which damage to the component can occur. Electrical specifications do not apply when operating the device outside of its operating ratings. The maximum allowable power dissipation is a function of the maximum junction temperature, $T_{J(MAX)}$, the junction-to-ambient thermal resistance, $\theta_{JA}$, and the ambient temperature, $T_A$. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D(MAX)} = (T_{J(MAX)} - T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature.

## Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | 2.5 | 6.0 | V |
| $T_A$ | Operating Ambient Temperature Range | -40 | +85 | °C |

## Electrical Characteristics AP2138/2139-1.2 (@$V_{IN}$ = 2.5V, $V_{CE}$ = 2.5V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 1.176 | 1.200 | 1.224 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 2.2V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 100 | 300 | mV |
| | | $I_{OUT}$ = 30mA | — | 400 | 700 | |
| | | $I_{OUT}$ = 100mA | — | 700 | 1000 | |
| | | $I_{OUT}$ = 250mA | — | 1000 | 1300 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±140 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-1.4 (@$V_{IN}$ = 2.5V, $V_{CE}$ = 2.5V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 1.372 | 1.400 | 1.428 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 2.4V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 100 | 300 | mV |
| | | $I_{OUT}$ = 30mA | — | 400 | 700 | |
| | | $I_{OUT}$ = 100mA | — | 600 | 900 | |
| | | $I_{OUT}$ = 250mA | — | 1000 | 1300 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±140 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-1.5 (@$V_{IN}$ = 2.5V, $V_{CE}$ = 2.5V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 1.470 | 1.500 | 1.530 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 2.5V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 100 | 300 | mV |
| | | $I_{OUT}$ = 30mA | — | 200 | 400 | |
| | | $I_{OUT}$ = 100mA | — | 600 | 900 | |
| | | $I_{OUT}$ = 250mA | — | 1000 | 1300 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±150 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-1.8 (@$V_{IN}$ = 2.8V, $V_{CE}$ = 2.8V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 1.764 | 1.800 | 1.836 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 2.8V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 25 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 120 | 250 | |
| | | $I_{OUT}$ = 100mA | — | 400 | 700 | |
| | | $I_{OUT}$ = 250mA | — | 850 | 1100 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±180 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-2.1 (@$V_{IN}$ = 3.1V, $V_{CE}$ = 3.1V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 2.058 | 2.100 | 2.142 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 3.1V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 25 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 120 | 250 | |
| | | $I_{OUT}$ = 100mA | — | 400 | 700 | |
| | | $I_{OUT}$ = 250mA | — | 750 | 1100 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±180 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |

## Electrical Characteristics AP2138/2139-2.2 (@$V_{IN}$ = 3.2V, $V_{CE}$ = 3.2V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 2.156 | 2.2 | 2.244 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 3.2V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 25 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 120 | 250 | |
| | | $I_{OUT}$ = 100mA | — | 400 | 700 | |
| | | $I_{OUT}$ = 250mA | — | 700 | 1050 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±180 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |

## Electrical Characteristics AP2138/2139-2.5 (@$V_{IN}$ = 3.5V, $V_{CE}$ = 3.5V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 2.450 | 2.500 | 2.550 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 3.5V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 25 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 100 | 250 | |
| | | $I_{OUT}$ = 100mA | — | 250 | 500 | |
| | | $I_{OUT}$ = 250mA | — | 650 | 1000 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±250 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-2.8 (@$V_{IN}$ = 3.8V, $V_{CE}$ = 3.8V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 2.744 | 2.800 | 2.856 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 3.8V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 25 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 70 | 200 | |
| | | $I_{OUT}$ = 100mA | — | 250 | 500 | |
| | | $I_{OUT}$ = 250mA | — | 500 | 800 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±280 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-3.0 (@$V_{IN}$ = 4V, $V_{CE}$ = 4V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 2.940 | 3.000 | 3.060 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 4V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 25 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 70 | 200 | |
| | | $I_{OUT}$ = 100mA | — | 200 | 400 | |
| | | $I_{OUT}$ = 250mA | — | 450 | 700 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±300 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-3.3 (@$V_{IN}$ = 4.3V, $V_{CE}$ = 4.3V (AP2139), $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 3.234 | 3.300 | 3.366 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{STD}$ | Standby Current (AP2139) | $V_{CE}$ = 0 | — | 0.1 | 1 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 4.3V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 20 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 50 | 200 | |
| | | $I_{OUT}$ = 100mA | — | 160 | 300 | |
| | | $I_{OUT}$ = 250mA | — | 400 | 600 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±330 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $I_{PD}$ | CE Pull-Down Constant Current (AP2139) | — | — | 0.2 | — | µA |
| $V_{IH}$ | CE Input Logic-High Voltage (AP2139) | — | 1.2 | — | — | V |
| $V_{IL}$ | CE Input Logic-Low Voltage (AP2139) | — | — | — | 0.3 | V |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-23-5 | — | 81.9 | — | |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-3.6 (@$V_{IN}$ = 4.6V, $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

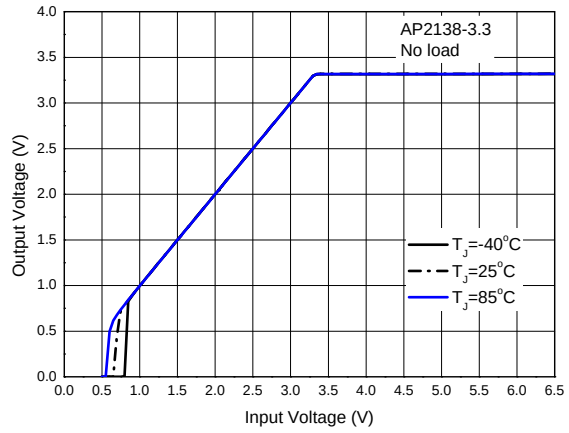
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 3.528 | 3.600 | 3.672 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 4.6V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 20 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 50 | 200 | |
| | | $I_{OUT}$ = 100mA | — | 160 | 300 | |
| | | $I_{OUT}$ = 250mA | — | 400 | 600 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±330 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |
| | | SOT-89 | — | 51.1 | — | |

## Electrical Characteristics AP2138/2139-4.0 (@$V_{IN}$ = 5.0V, $T_J$ = +25°C, $I_{OUT}$ = 40mA, $C_{IN}$ = $C_{OUT}$ = 1µF, **Bold** typeface applies -40°C ≤ $T_J$ ≤ +85°C, unless otherwise specified.) (continued)

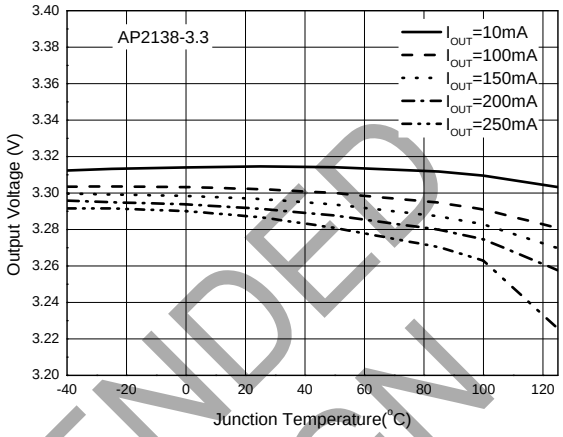
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | — | — | — | 6.0 | V |
| $V_{OUT}$ | Output Voltage | — | 3.920 | 4.000 | 4.080 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$ = 0 | — | 1.0 | 1.5 | µA |
| $I_{OUT}$ | Output Current | — | 250 | — | — | mA |
| $V_{RLOAD}$ | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 100mA | — | 25 | 40 | mV |
| $V_{RLINE}$ | Line Regulation | 5V ≤ $V_{IN}$ ≤ 6V | — | 6 | 18 | mV |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$ = 10mA | — | 20 | 100 | mV |
| | | $I_{OUT}$ = 30mA | — | 50 | 200 | |
| | | $I_{OUT}$ = 100mA | — | 160 | 300 | |
| | | $I_{OUT}$ = 250mA | — | 400 | 600 | |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | — | — | ±330 | — | µV/°C |
| $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | — | — | ±100 | — | ppm/°C |
| $I_{SHORT}$ | Short Circuit Current | $V_{OUT}$ = 0 | — | 50 | — | mA |
| $\theta_{JC}$ | Thermal Resistance | SOT-23-3 | — | 81.9 | — | °C/W |

## Performance Characteristics

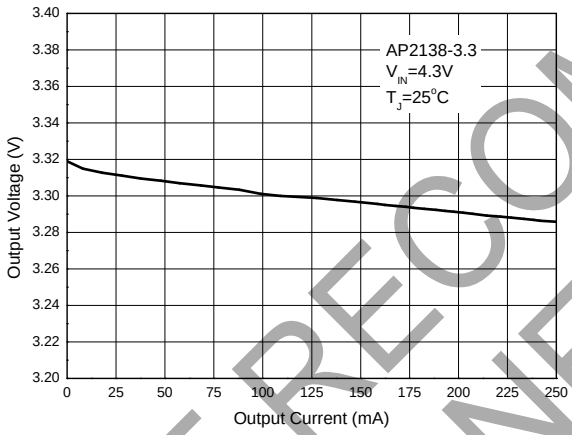
### Output Voltage vs. Input Voltage



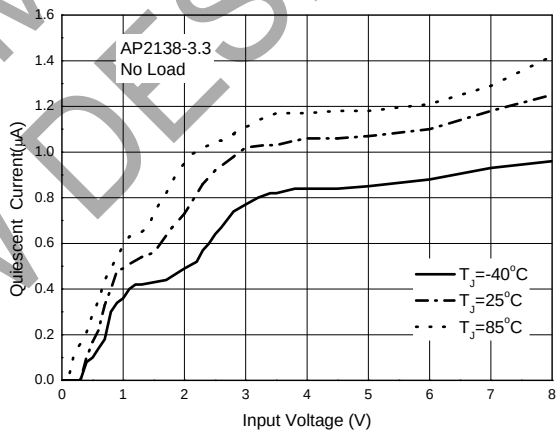

### Output Voltage vs. Junction Temperature



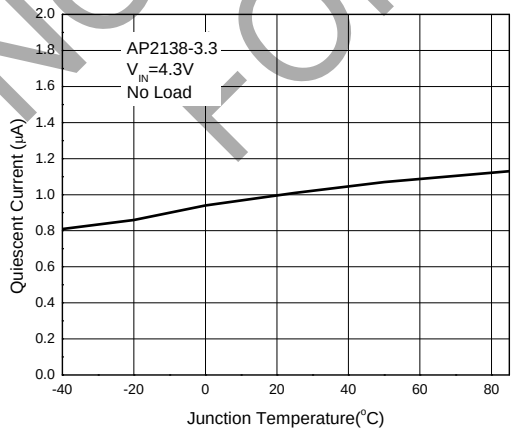

### Output Voltage vs. Output Current



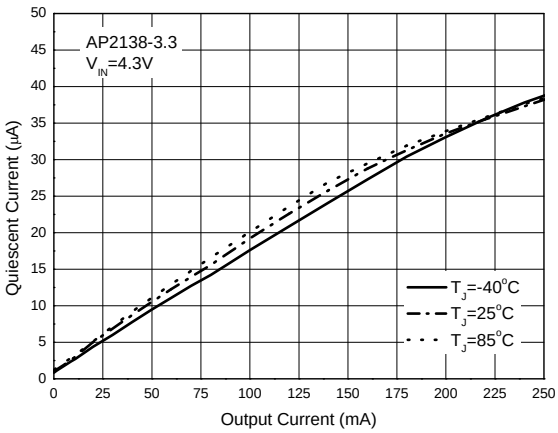

### Quiescent Current vs. Input Voltage




### Quiescent Current vs. Junction Temperature

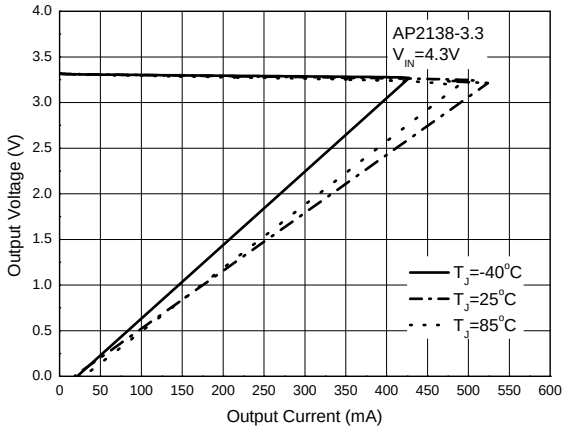



### Quiescent Current vs. Output Current

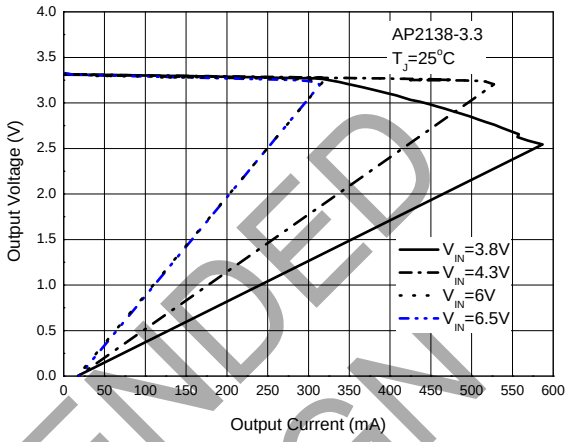


## Performance Characteristics (continued)

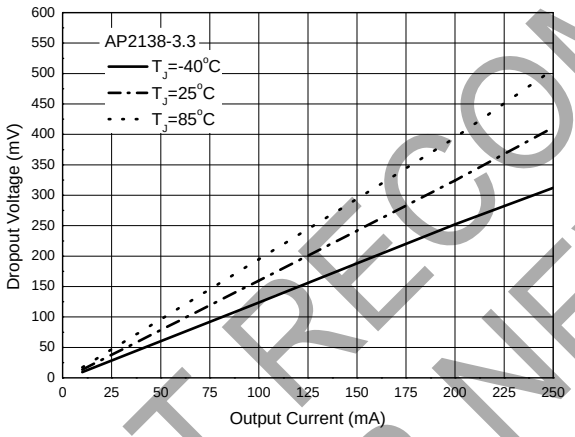
### Output Voltage vs. Output Current



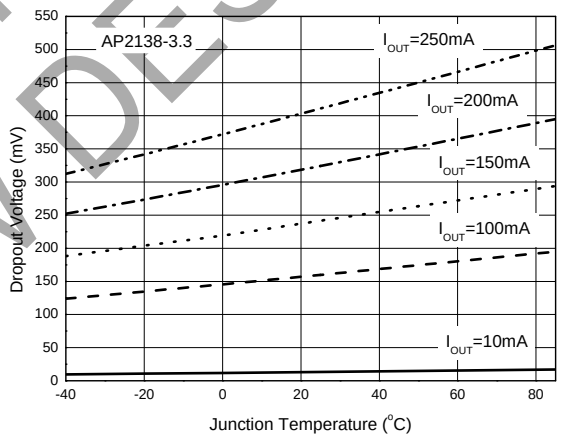

### Output Voltage vs. Output Current



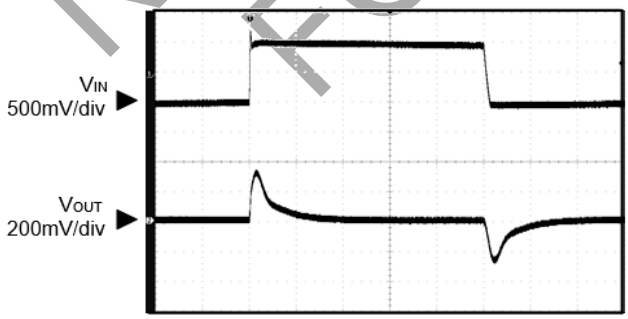

### Dropout Voltage vs. Output Current




### Dropout Voltage vs. Junction Temperature

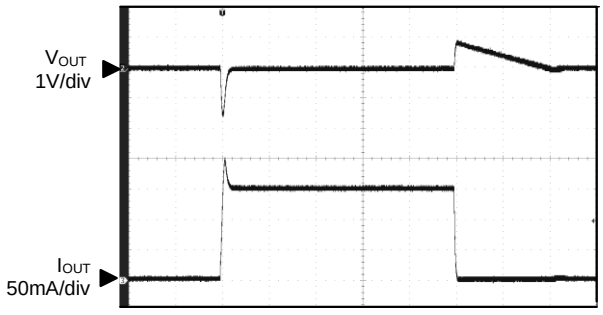



### Line Transient ($V_{IN}$=4.3V to 5.3V, $I_{OUT}$=10mA)




Time 100µs/div

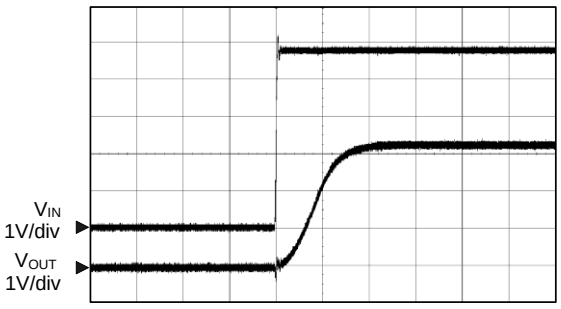
### Load Transient ($V_{IN}$=4.3V, $I_{OUT}$=1mA to 150mA)




Time 2ms/div

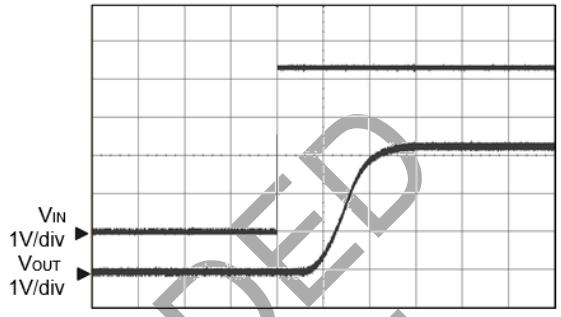
## Performance Characteristics (continued)

**Start-Up Response**



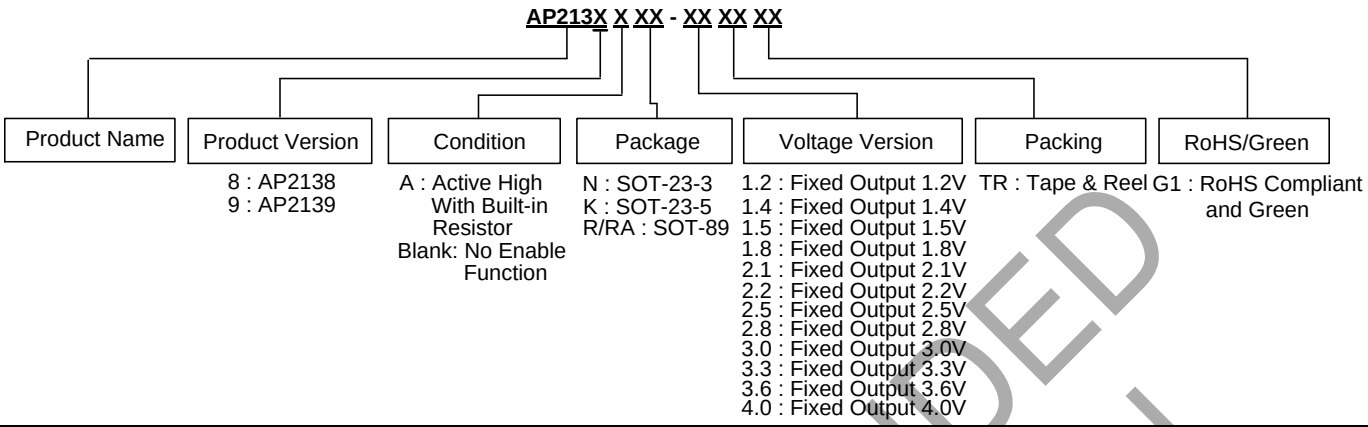

Time 200µs/div

**Enable Input Response**




Time 200µs/div

## Ordering Information




| Orderable Part Number | Package | Temperature Range | Condition | Marking ID | Packing | |
|---|---|---|---|---|---|---|
| | | | | | Qty. | Carrier |
| AP2138N-1.2TRG1 | SOT-23-3 | -40 to +85°C | 1.2V | JB | 3000 | Tape & Reel |
| AP2138N-1.4TRG1 | | | 1.4V | JC | 3000 | Tape & Reel |
| AP2138N-1.5TRG1 | | | 1.5V | JD | 3000 | Tape & Reel |
| AP2138N-1.8TRG1 | | | 1.8V | JE | 3000 | Tape & Reel |
| AP2138N-2.1TRG1 | | | 2.1V | JF | 3000 | Tape & Reel |
| AP2138N-2.2TRG1 | | | 2.2V | PT | 3000 | Tape & Reel |
| AP2138N-2.5TRG1 | | | 2.5V | PU | 3000 | Tape & Reel |
| AP2138N-2.8TRG1 | | | 2.8V | PV | 3000 | Tape & Reel |
| AP2138N-3.0TRG1 | | | 3.0V | PW | 3000 | Tape & Reel |
| AP2138N-3.3TRG1 | | | 3.3V | PX | 3000 | Tape & Reel |
| AP2138N-3.6TRG1 | | | 3.6V | PY | 3000 | Tape & Reel |
| AP2138N-4.0TRG1 | | | 4.0V (NRND) (Note 7) | UA | 3000 | Tape & Reel |
| AP2138R-1.2TRG1 | SOT-89 | -40 to +85°C | 1.2V (R) (NRND) (Note 7) | J2A | 1000 | Tape & Reel |
| AP2138R-1.4TRG1 | | | 1.4V (R) (NRND) (Note 7) | J2B | 1000 | Tape & Reel |
| AP2138R-1.5TRG1 | | | 1.5V (R) (NRND) (Note 7) | J2C | 1000 | Tape & Reel |
| AP2138R-1.8TRG1 | | | 1.8V (R) (NRND) (Note 7) | J2D | 1000 | Tape & Reel |
| AP2138R-2.5TRG1 | | | 2.5V (R) (NRND) (Note 7) | J2E | 1000 | Tape & Reel |
| AP2138R-2.8TRG1 | | | 2.8V ® (NRND) (Note 7) | J2F | 1000 | Tape & Reel |
| AP2138R-3.0TRG1 | | | 3.0V (R) (NRND) (Note 7) | J2G | 1000 | Tape & Reel |
| AP2138R-3.3TRG1 | | | 3.3V (R) (NRND) (Note 7) | J2H | 1000 | Tape & Reel |

Note 7: NRND: Not Recommended for New Design.

## Ordering Information (continued)

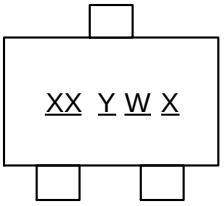
| Orderable Part Number | Package | Temperature Range | Condition | Marking ID | Packing | |
|---|---|---|---|---|---|---|
| | | | | | Qty. | Carrier |
| AP2138R-3.6TRG1 | SOT-89 | -40 to +85°C | 3.6V (R) (NRND) (Note 7) | J2J | 1000 | Tape & Reel |
| AP2138RA-1.2TRG1 | | | 1.2V (RA) (NRND) (Note 7) | J2K | 1000 | Tape & Reel |
| AP2138RA-1.4TRG1 | | | 1.4V (RA) (NRND) (Note 7) | J2M | 1000 | Tape & Reel |
| AP2138RA-1.5TRG1 | | | 1.5V (RA) (NRND) (Note 7) | J2N | 1000 | Tape & Reel |
| AP2138RA-1.8TRG1 | | | 1.8V (RA) (NRND) (Note 7) | J2P | 1000 | Tape & Reel |
| AP2138RA-2.5TRG1 | | | 2.5V (RA) (NRND) (Note 7) | J2R | 1000 | Tape & Reel |
| AP2138RA-2.8TRG1 | | | 2.8V (RA) (NRND) (Note 7) | J2S | 1000 | Tape & Reel |
| AP2138RA-3.0TRG1 | | | 3.0V (RA) (NRND) (Note 7) | J2T | 1000 | Tape & Reel |
| AP2138RA-3.3TRG1 | | | 3.3V (RA) (NRND) (Note 7) | J2U | 1000 | Tape & Reel |
| AP2139AK-1.2TRG1 | SOT-23-5 | -40 to +85°C | Active High with Built-in Resistor | J2A | 3000 | Tape & Reel |
| AP2139AK-1.4TRG1 | | | Active High with Built-in Resistor | J2B | 3000 | Tape & Reel |
| AP2139AK-1.5TRG1 | | | Active High with Built-in Resistor | J2C | 3000 | Tape & Reel |
| AP2139AK-1.8TRG1 | | | Active High with Built-in Resistor | J2D | 3000 | Tape & Reel |
| AP2139AK-2.5TRG1 | | | Active High with Built-in Resistor | J2E | 3000 | Tape & Reel |
| AP2139AK-2.8TRG1 | | | Active High with Built-in Resistor | J2F | 3000 | Tape & Reel |
| AP2139AK-3.0TRG1 | | | Active High with Built-in Resistor | J2G | 3000 | Tape & Reel |
| AP2139AK-3.3TRG1 | | | Active High with Built-in Resistor | J2H | 3000 | Tape & Reel |

Note 7: NRND: Not Recommended for New Design.

## Marking Information

**(1) SOT-23-3**

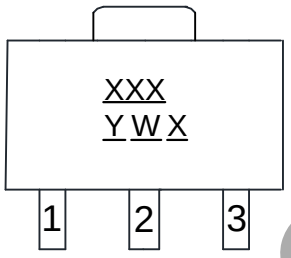
**(Top View)**




XX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal Code

**(2) SOT-89**

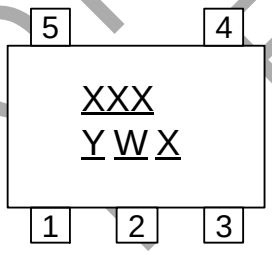
**(Top View)**




XXX : Identification Code
Y : Year : 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week;
z represents 52 and 53 week
X : Internal Code

**(3) SOT-23-5**

**(Top View)**

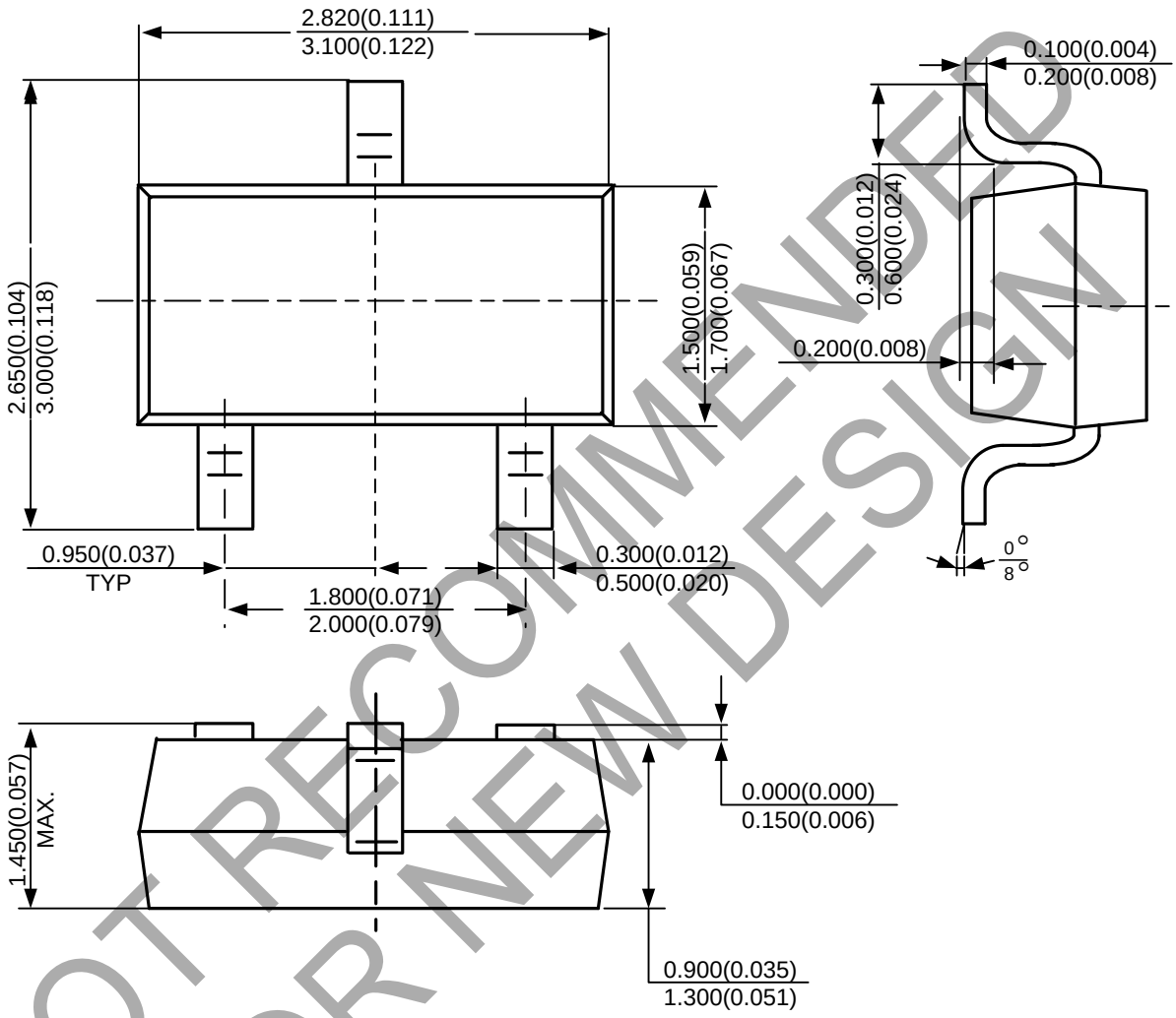



XXX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal Code

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

Please see http://www.diodes.com/package-outlines.html for the latest version.

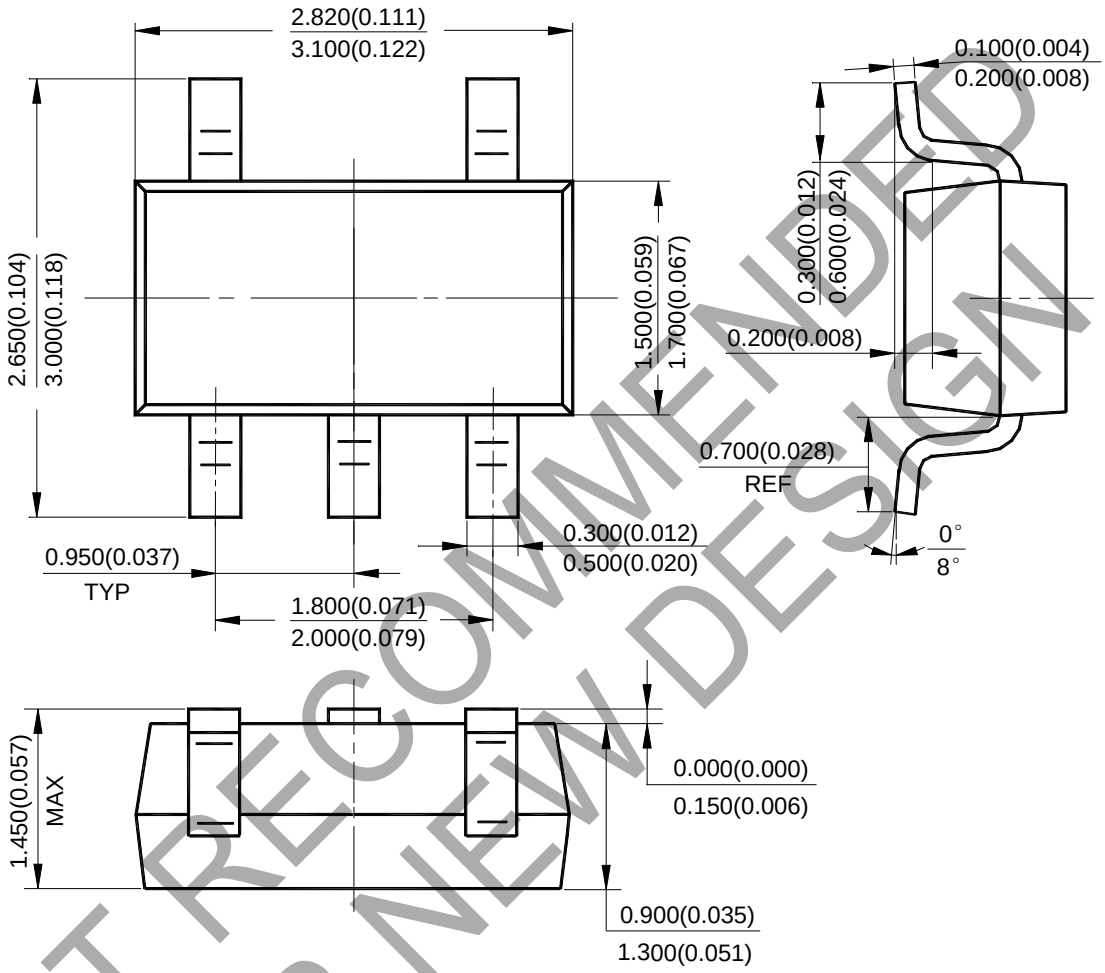
**(1) Package Type: SOT-23-3**



## Package Outline Dimensions (continued) (All dimensions in mm(inch).)

Please see http://www.diodes.com/package-outlines.html for the latest version.

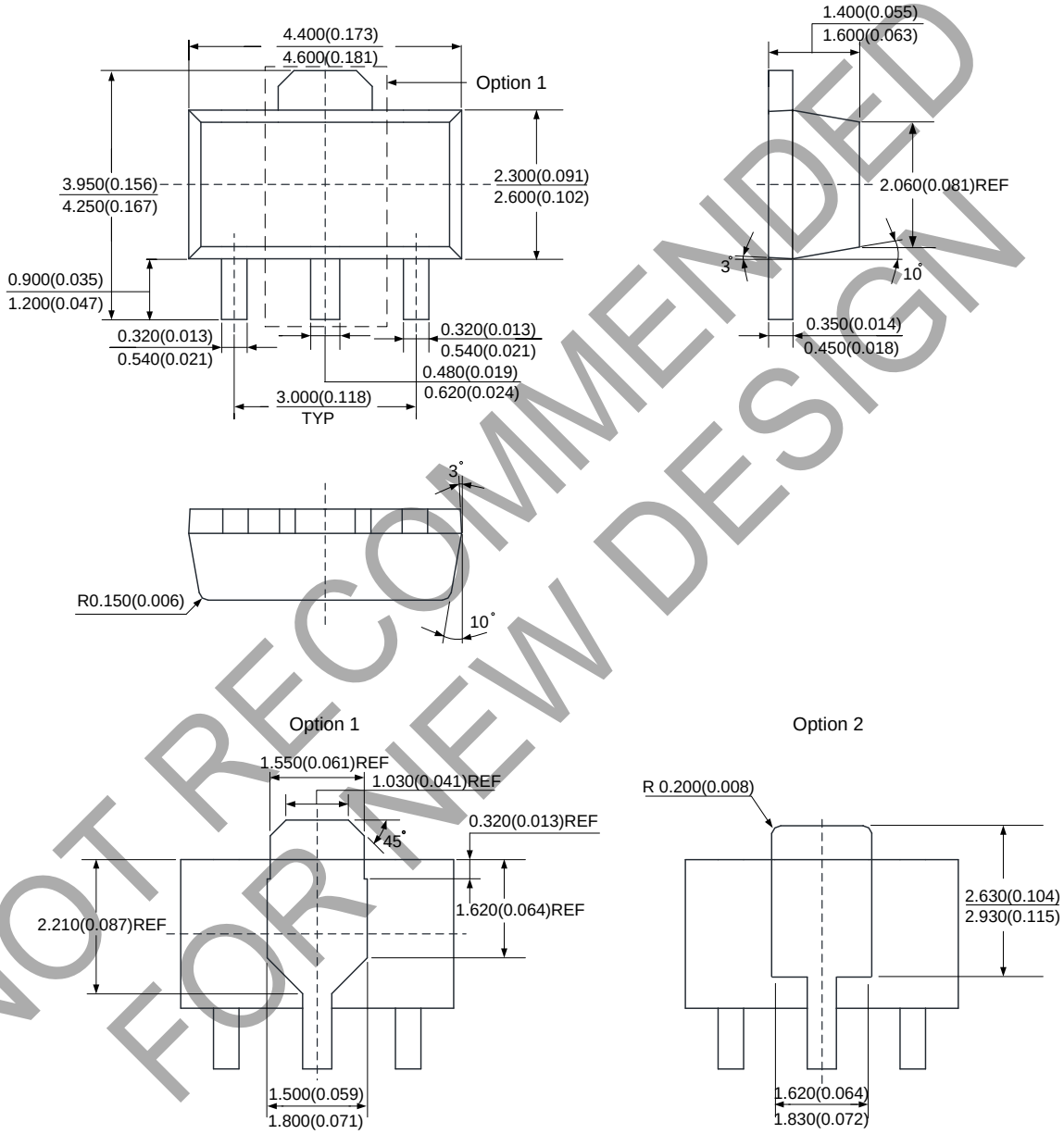
**(2) Package Type: SOT-23-5**



## Package Outline Dimensions (continued) (All dimensions in mm(inch).)

Please see http://www.diodes.com/package-outlines.html for the latest version.

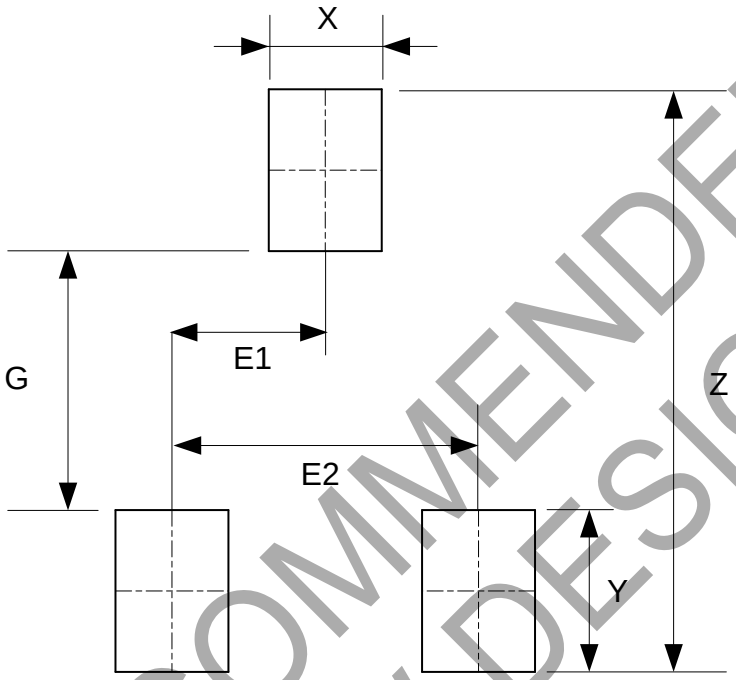
**(3) Package Type: SOT-89**



## Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

**(1) Package Type: SOT-23-3**

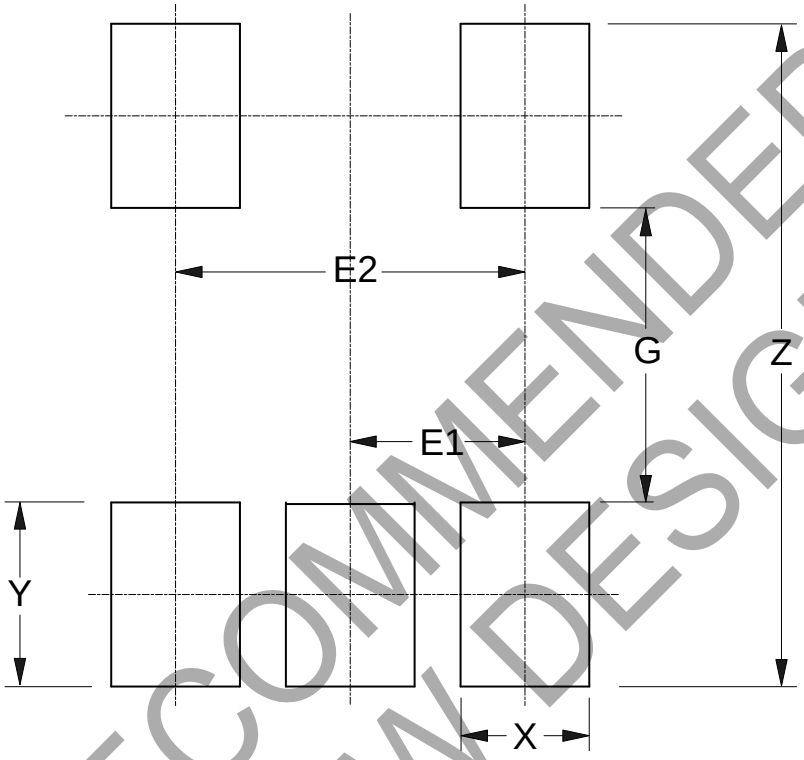



| Dimensions | Z (mm)/(inch) | G (mm)/(inch) | X (mm)/(inch) | Y (mm)/(inch) | E1 (mm)/(inch) | E2 (mm)/(inch) |
|---|---|---|---|---|---|---|
| Value | 3.600/0.142 | 1.600/0.063 | 0.700/0.028 | 1.000/0.039 | 0.950/0.037 | 1.900/0.075 |

## Suggested Pad Layout (continued)

Please see http://www.diodes.com/package-outlines.html for the latest version.

**(2) Package Type: SOT-23-5**

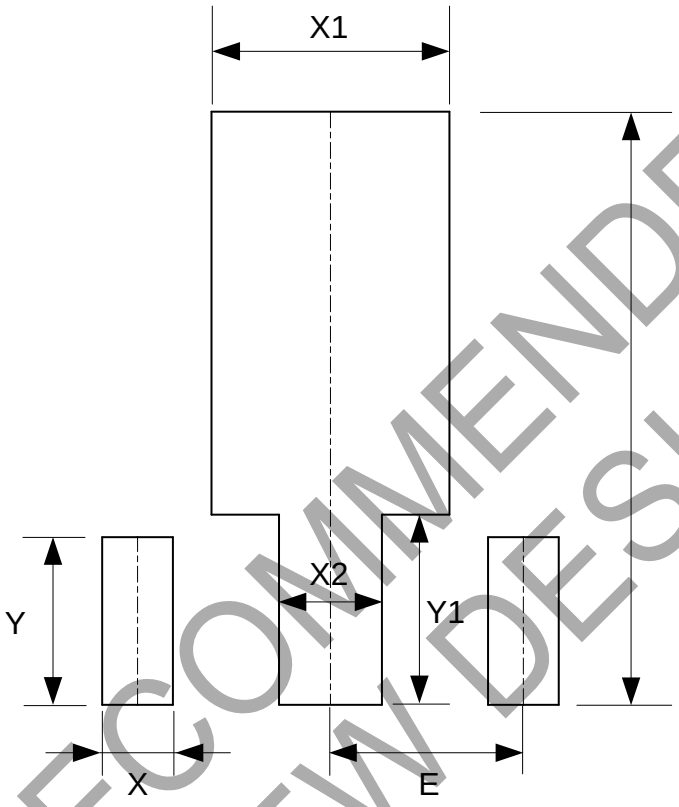



| Dimensions | Z (mm)/(inch) | G (mm)/(inch) | X (mm)/(inch) | Y (mm)/(inch) | E1 (mm)/(inch) | E2 (mm)/(inch) |
|---|---|---|---|---|---|---|
| Value | 3.600/0.142 | 1.600/0.063 | 0.700/0.028 | 1.000/0.039 | 0.950/0.037 | 1.900/0.075 |

## Suggested Pad Layout (continued)

Please see http://www.diodes.com/package-outlines.html for the latest version.

**(3) Package Type: SOT-89**




| Dimensions | Z (mm)/(inch) | X (mm)/(inch) | X1 (mm)/(inch) | X2 (mm)/(inch) | Y (mm)/(inch) | Y1 (mm)/(inch) | E (mm)/(inch) |
|---|---|---|---|---|---|---|---|
| Value | 4.600/0.181 | 0.550/0.022 | 1.850/0.073 | 0.800/0.031 | 1.300/0.051 | 1.475/0.058 | 1.500/0.059 |

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