

Description

The AP2205 series is a positive voltage regulator IC fabricated by a high voltage EPNP process.

The AP2205 has various features such as a wide input voltage range, high accuracy, high ripple rejection, low dropout voltage, low noise, current limit, and ultra-low quiescent current—which make it ideal for use in various USB and portable devices.

The IC consists of a voltage reference, an error amplifier, a resistor network for setting output voltage, a current limit circuit for current protection, a chip enable circuit, a low power shutdown mode for extended battery life, over-current protection, over-temperature protection, as well as reverse current protection.

The AP2205 has 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 5.0V fixed voltage versions and an adjustable voltage version.

The AP2205 is available in the space-saving SOT25 and SOT89 packages.

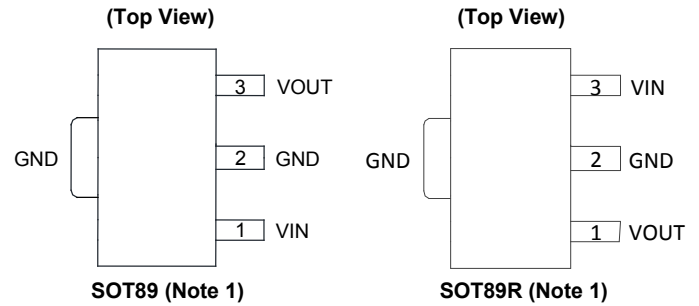
Features

- Wide Input Voltage Range: 2.3V to 24V
- Wide Output Voltage Range: 1.24V to 22V
- Excellent Ripple Rejection: 60dB@ f = 1kHz
- Low Dropout Voltage: $V_{DROP} = 100\text{mV}@ I_{OUT} = 100\mu\text{A}$
- Low Ground Current
- High Output Voltage Accuracy
- Compatible with Low ESR Ceramic Capacitor
- Excellent Line/Load Regulation
- Thermal Shutdown Function
- Moisture Sensitivity:
 - SOT89: Level 3 Per J-STD-020
 - SOT25: Level 1 Per J-STD-020
- Terminals: SOT89/ SOT25: Finish—Mate Tin Plated Leads, Solderable per MIL-STD-202, Method 208 ③
- Weight:
 - SOT89: 0.062 grams (Approximate)
 - SOT25: 0.0157 grams (Approximate)
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](https://www.diodes.com/quality/product-definitions/) or your local Diodes representative.**
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen- and Antimony-Free. “Green” Device (Note 3)**

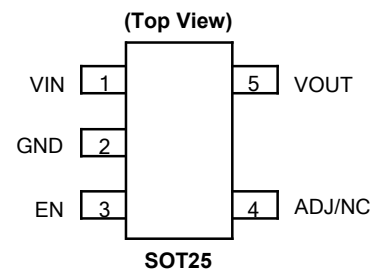
Notes:

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



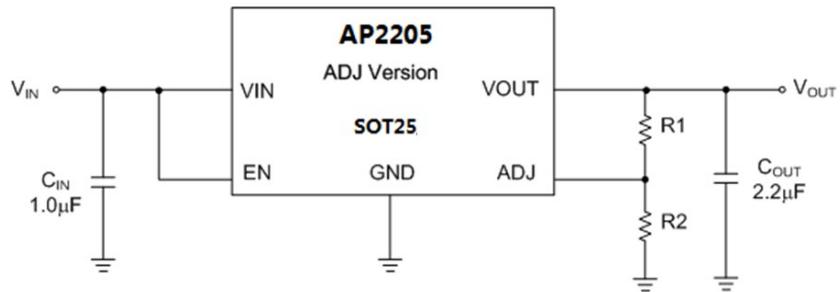
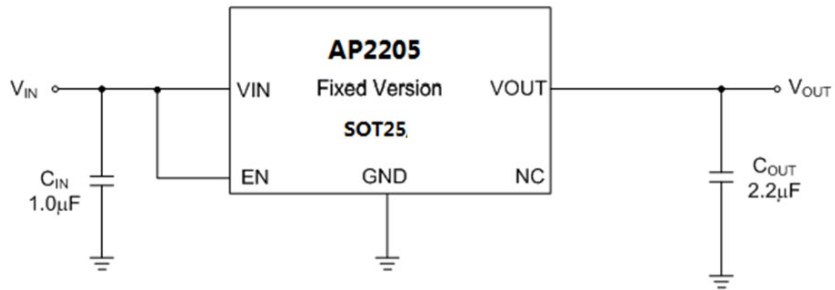
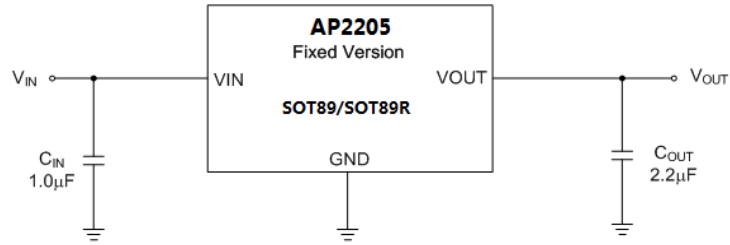
Note: The substrate/exposed pad should be connected to GND or open.



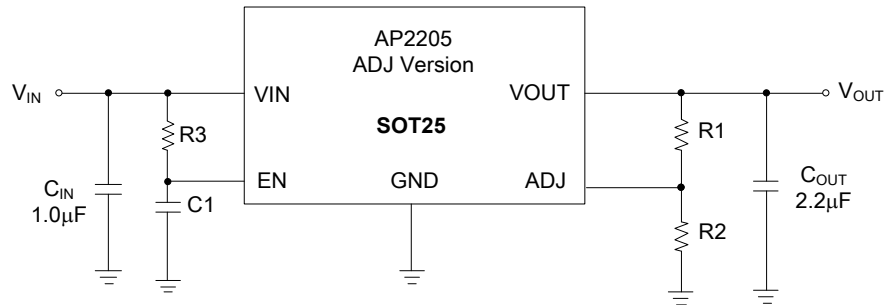
Applications

- Battery-powered Equipment
- Laptop, Palmtops, Notebook Computers
- Portable Information Appliances
- Industrial/Automotive Applications

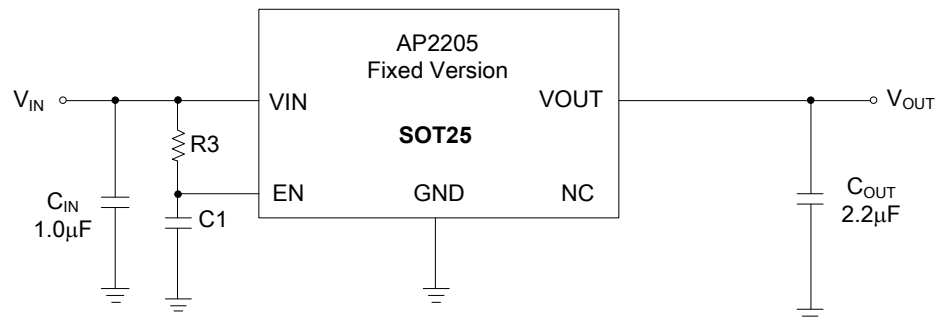
Typical Applications Circuit



$$V_{OUT} = V_{REF}(1+(R1/R2))$$



Startup Time Adjustable by External R3C1 Circuit

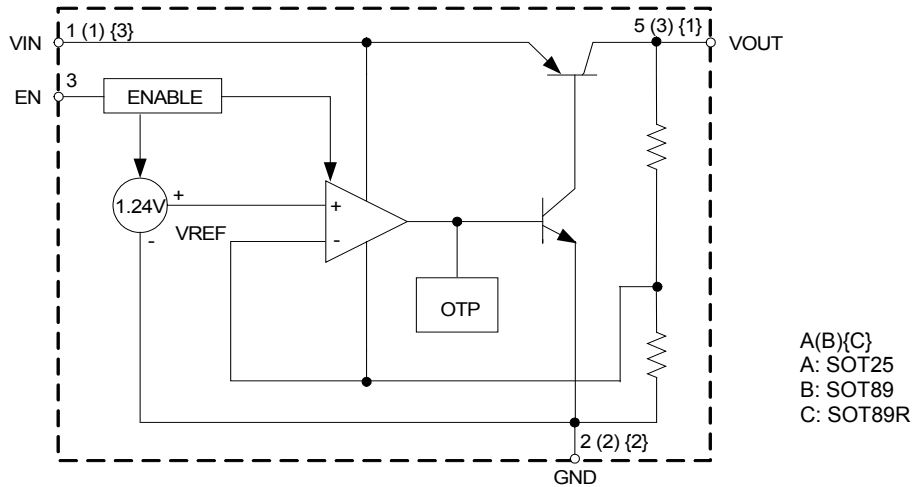


Startup Time Adjustable by External R3C1 Circuit

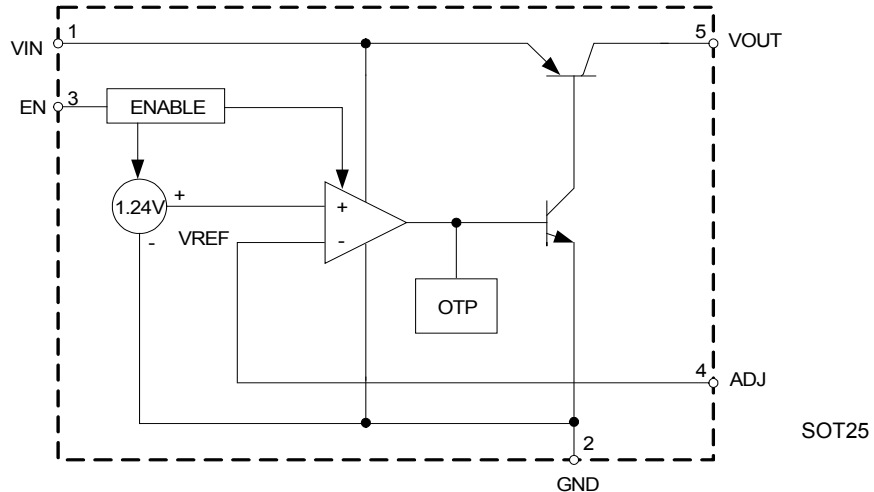
Pin Descriptions

| Pin Number | | | Pin Name | Function |
|------------|-------|--------|----------|---|
| SOT25 | SOT89 | SOT89R | | |
| | Y | YR | | |
| 1 | 1 | 3 | VIN | Input voltage |
| 2 | 2 | 2 | GND | Ground |
| 3 | — | — | EN | Enable input |
| 4 | — | — | ADJ/NC | Adjust output for ADJ version/Not connected for fixed version |
| 5 | 3 | 1 | VOUT | Regulated output voltage |

Functional Block Diagram



Fixed Version



Adjustable Version

Absolute Maximum Ratings (Note 5)

| Symbol | Parameter | Rating | | Unit |
|-------------------|-------------------------------------|--------------|-----|------|
| V _{IN} | Supply Input Voltage | 36 | | V |
| V _{CE} | Enable Input Voltage | 36 | | V |
| I _{OUT} | Output Current | 250 | | mA |
| T _{LEAD} | Lead Temperature (Soldering, 10sec) | +260 | | °C |
| T _J | Operating Junction Temperature | +150 | | °C |
| θ _{JA} | Thermal Resistance (Note 6) | SOT25 | 160 | °C/W |
| | | SOT89/SOT89R | 129 | |
| θ _{JC} | Thermal Resistance | SOT25 | 29 | °C/W |
| | | SOT89/SOT89R | 26 | |
| T _{STG} | Storage Temperature Range | -65 to +150 | | °C |
| — | ESD (Charge Device Model) | 1000 | | V |
| — | ESD (Human Body Model) | 2000 | | V |

- Notes:
- 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.
 - θ_{JA} is measured with the component mounted on a 2-Layer FR-4 PCB board with 1.5cm*1.5cm thermal sink pad in free air.

Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|------------------|--------------------------------|-------------------------|------|------|
| V _{IN} | Supply Input Voltage | 2.3 | 24 | V |
| T _J | Operating Junction Temperature | -40 | +125 | °C |
| I _{OUT} | Output Current | V _{OUT} ≤ 1.8V | 150 | mA |
| | | V _{OUT} > 1.8V | 200 | |

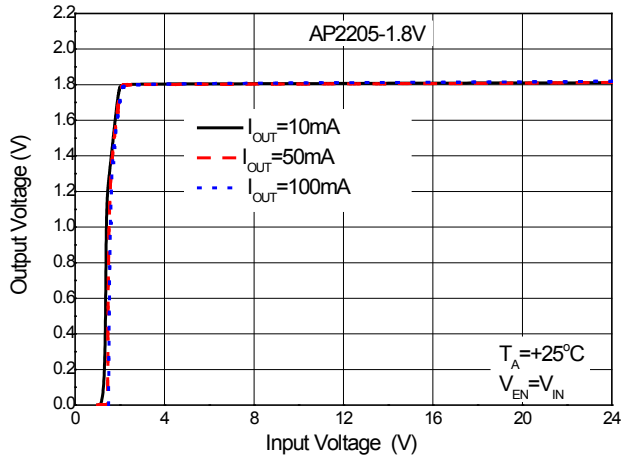
Electrical Characteristics (@ $V_{IN} = V_{OUT} + 1V$, $T_J = +25^\circ C$, $I_{OUT} = 100\mu A$, $C_{IN} = 1.0\mu F$, $C_{OUT} = 2.2\mu F$, **Bold** typeface applies over $-40^\circ C \leq T_J \leq +125^\circ C$, unless otherwise specified.)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|--|--|--|-----------------------|-----------------------------|------------------------|-----------------|----|
| V_{OUT} | Output Voltage | Variation from Specified V_{OUT} | $V_{OUT} \times 98\%$ | — | $V_{OUT} \times 102\%$ | V | |
| V_{REF} | Reference Voltage | — | 1.215 | 1.24 | 1.265 | V | |
| V_{IN} | Input Voltage | — | 2.3 | — | 24 | V | |
| $I_{OUT(Max)}$ | Maximum Output Current | $V_{IN} - V_{OUT} = 1V$, $V_{OUT} = 98\% \times V_{OUT}$ | 200 | 250 | — | mA | |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line Regulation | $V_{OUT} + 1V \leq V_{IN} \leq 24V$ | — | 0.05 | — | % | |
| $\Delta V_{OUT}/V_{OUT}$ | Load Regulation | $1mA \leq I_{OUT} \leq 200mA$ | — | 0.5 | — | % | |
| V_{DROP} | Dropout Voltage (Note 7) | $I_{OUT} = 100\mu A$ | — | 100 | 150 | mV | |
| | | $I_{OUT} = 50mA$ | — | 270 | 350 | | |
| | | $I_{OUT} = 100mA$ | — | 320 | 460 | | |
| | | $I_{OUT} = 150mA$ | — | 360 | 500 | | |
| I_{GND} | Ground Current | $I_{OUT} = 100\mu A$ | — | 36 | — | μA | |
| | | $I_{OUT} = 50mA$ | — | 0.5 | — | mA | |
| | | $I_{OUT} = 100mA$ | — | 1.3 | — | | |
| | | $I_{OUT} = 150mA$ | — | 2.5 | — | | |
| I_{STD} | Standby Current | $V_{IN} = V_{OUT} + 1V$ V_{EN} in OFF Mode | — | 0.01 | 1.0 | μA | |
| PSRR | Power Supply Rejection Ration | Ripple 0.5V _{P-P} $V_{IN} = V_{OUT} + 1V$ | f = 100Hz | — | 60 | — | dB |
| | | | f = 1kHz | — | 60 | — | |
| $\Delta V_{OUT}/(V_{OUT} \times \Delta T)$ | Output Voltage Temperature Coefficient | $I_{OUT} = 100\mu A$, $-40^\circ C \leq T_J \leq +125^\circ C$ | — | ± 100 | — | ppm/ $^\circ C$ | |
| V_{NOI} | RMS Output Noise | $T_J = +25^\circ C$, $10Hz \leq f \leq 100kHz$ | — | 30 | — | μV_{rms} | |
| I_{ADJ} | ADJ Pin Current | $I_{OUT} = 100\mu A$ | — | 0.5 | — | μA | |
| I_{EN} | EN Pin Current | $V_{EN} = V_{OUT} + 1V$ | — | 3 | — | μA | |
| — | EN "High" Voltage | EN Input Voltage "High" | 2.0 | — | — | V | |
| — | EN "Low" Voltage | EN Input Voltage "Low" | — | — | 0.4 | V | |

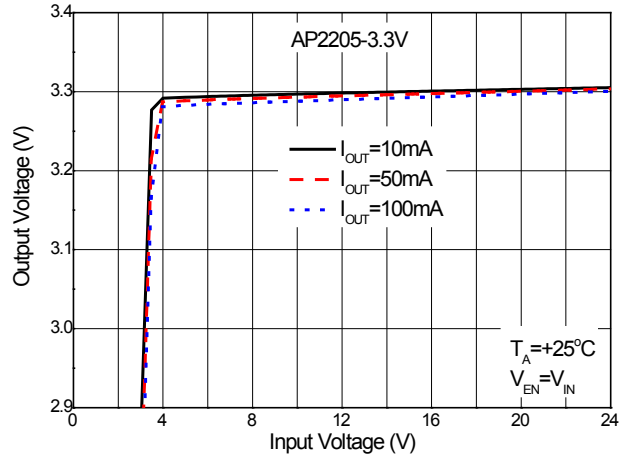
Notes: 7. Dropout voltage is only valid when $V_{OUT} \geq 2.3V$ because of the minimum input voltage limits.

Performance Characteristics

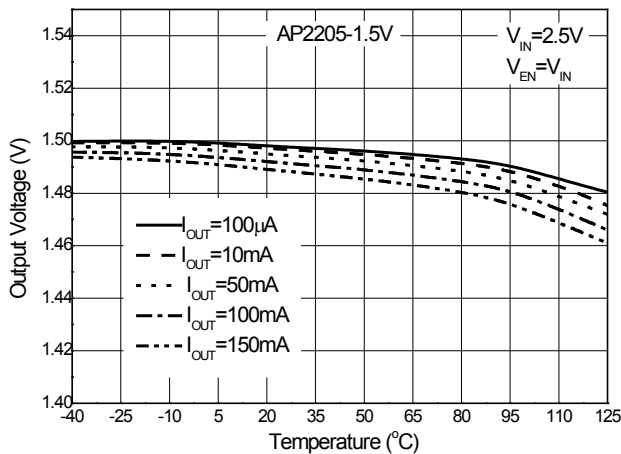
Output Voltage vs. Input Voltage



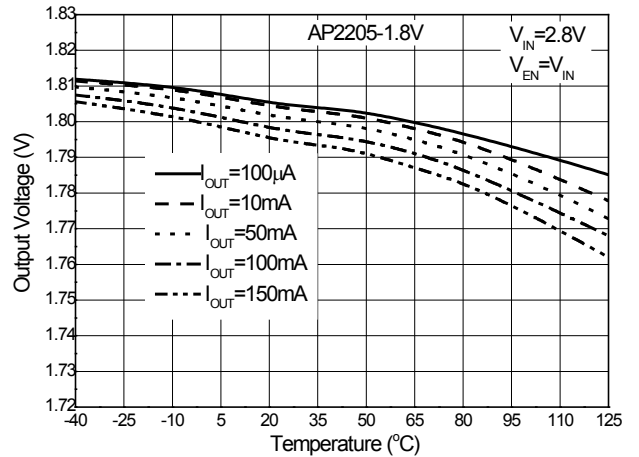
Output Voltage vs. Input Voltage



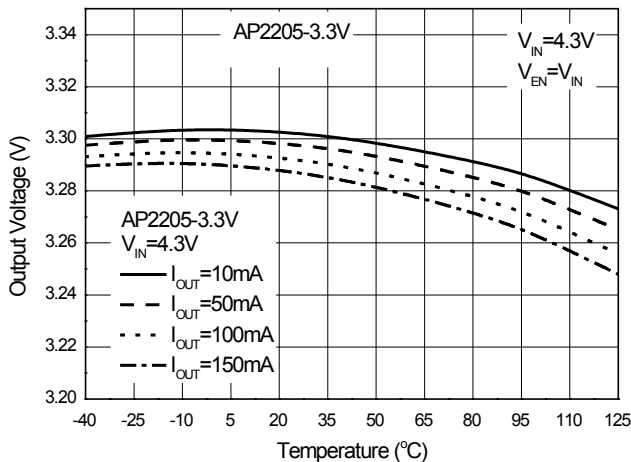
Output Voltage vs. Temperature



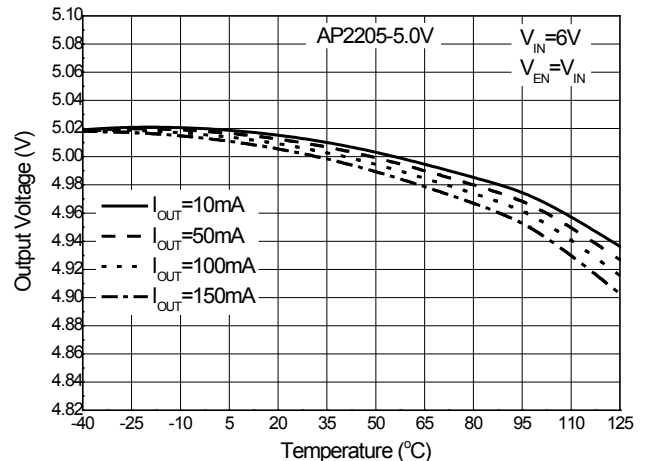
Output Voltage vs. Temperature



Output Voltage vs. Temperature

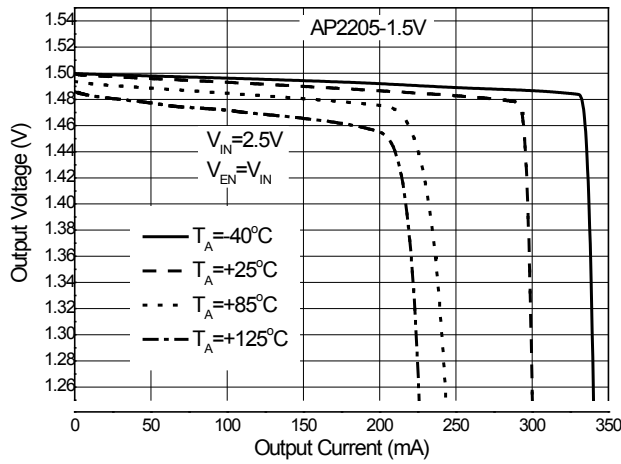


Output Voltage vs. Temperature

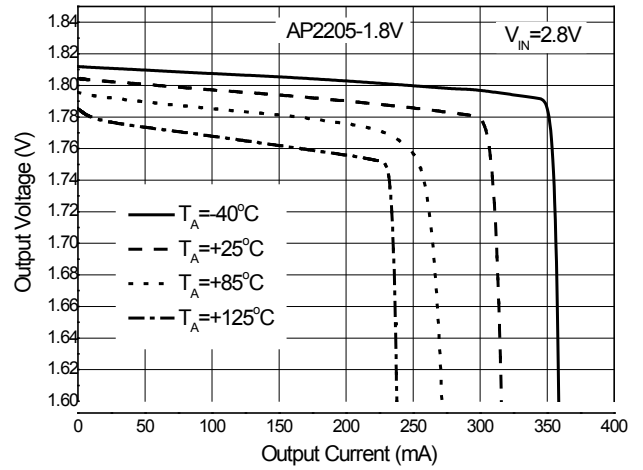


Performance Characteristics (Cont.)

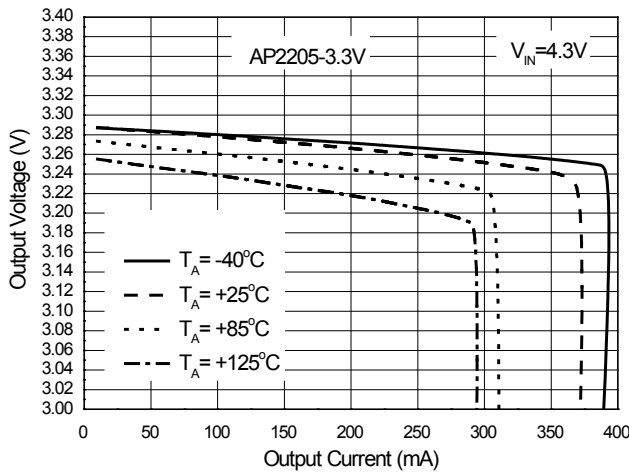
Output Voltage vs. Output Current



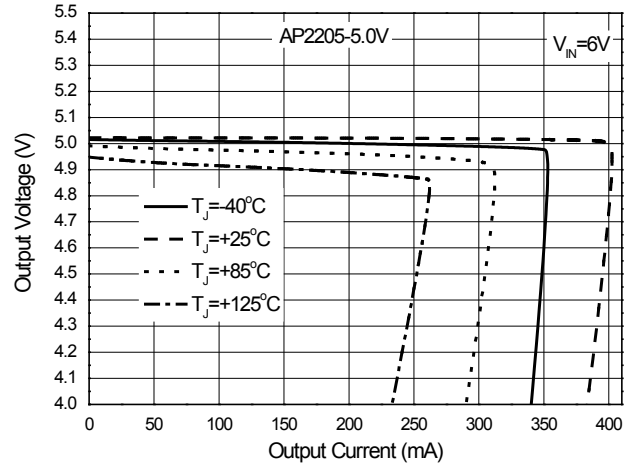
Output Voltage vs. Output Current



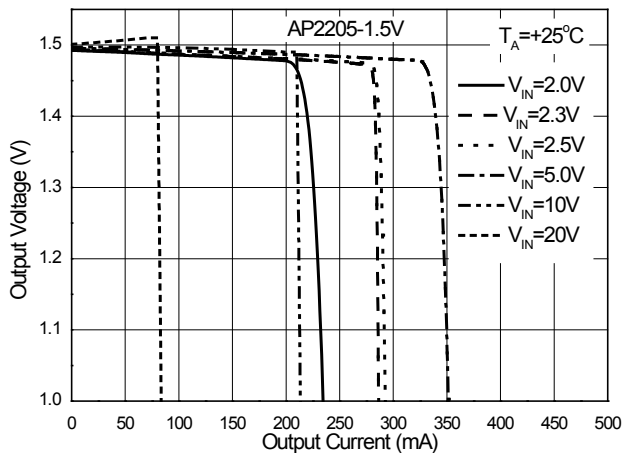
Output Voltage vs. Output Current



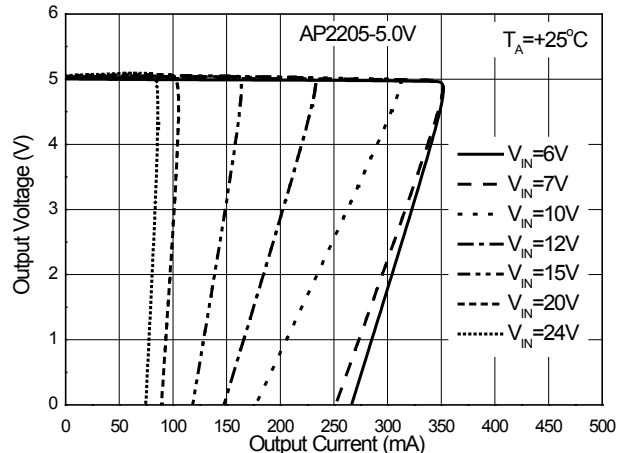
Output Voltage vs. Output Current



Output Voltage vs. Output Current

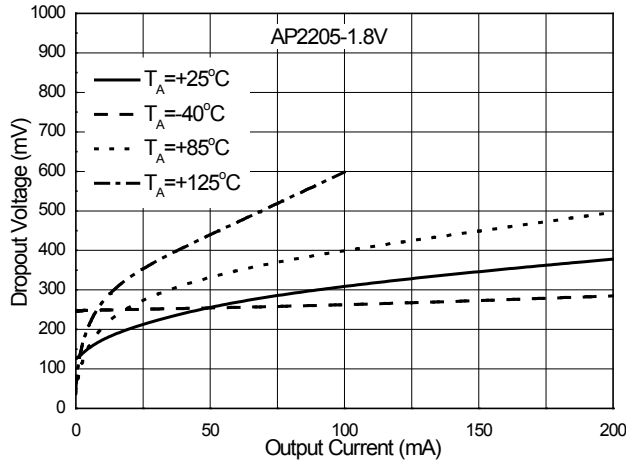


Output Voltage vs. Output Current

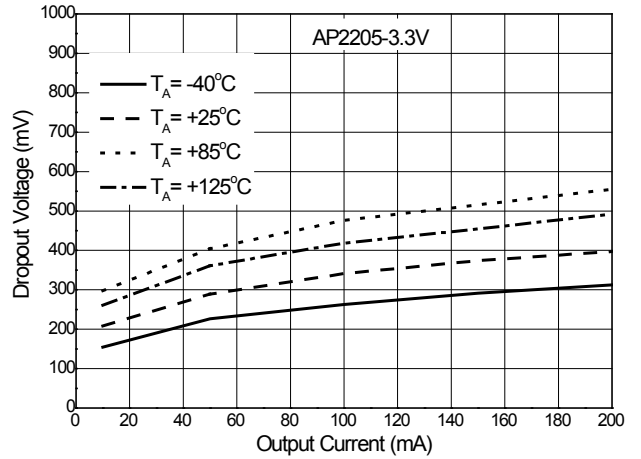


Performance Characteristics (Cont.)

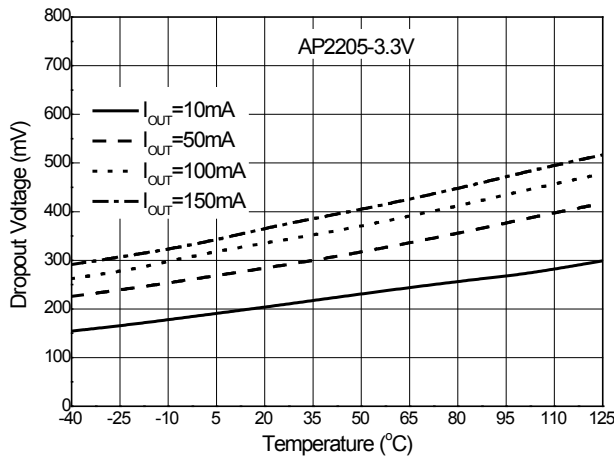
Dropout Voltage vs. Output Current



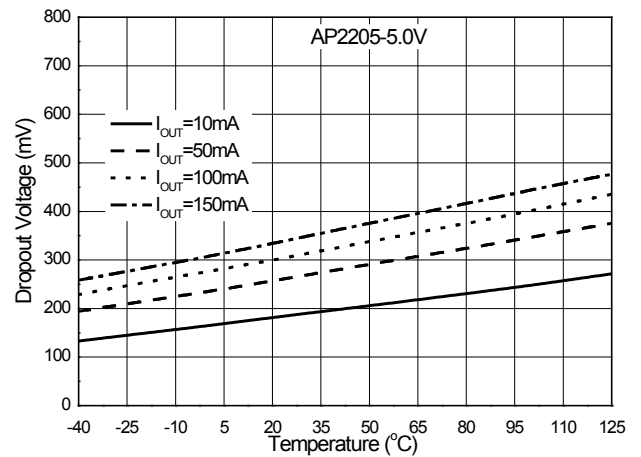
Dropout Voltage vs. Output Current



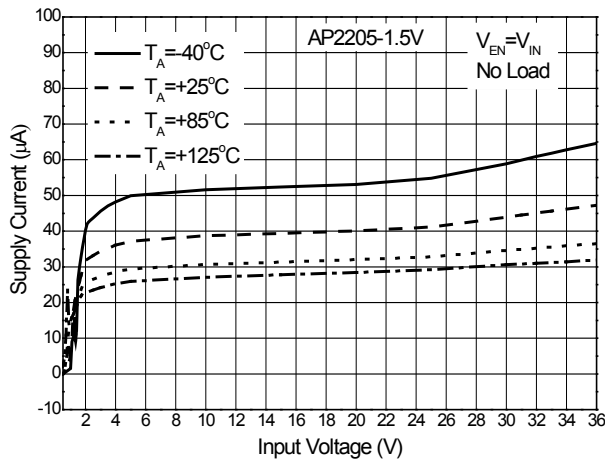
Dropout Voltage vs. Temperature



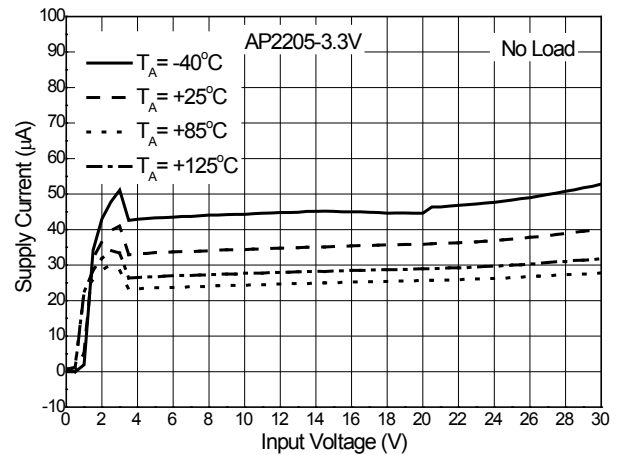
Dropout Voltage vs. Temperature



Supply Current vs. Input Voltage

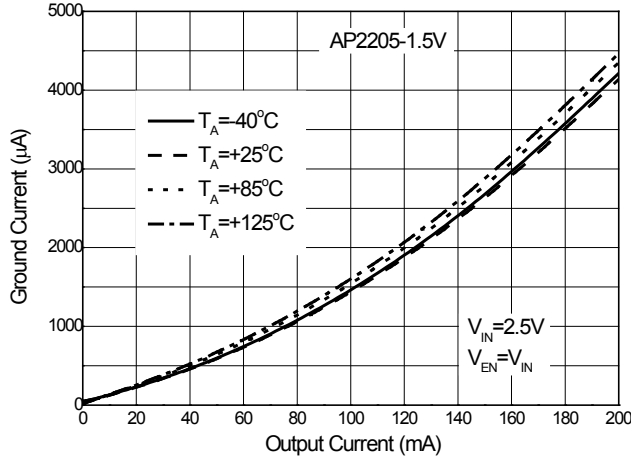


Supply Current vs. Input Voltage

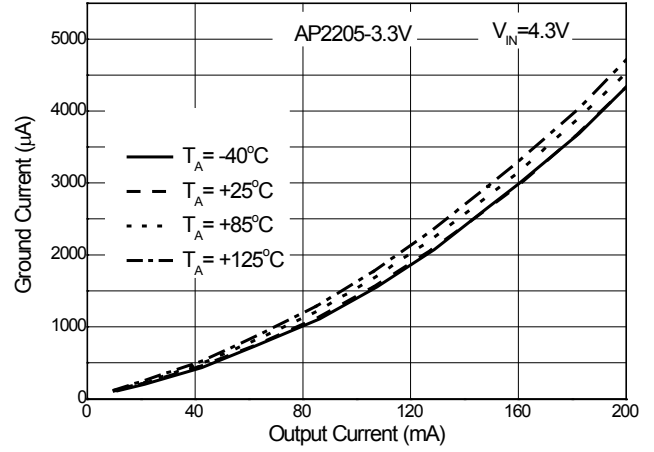


Performance Characteristics (Cont.)

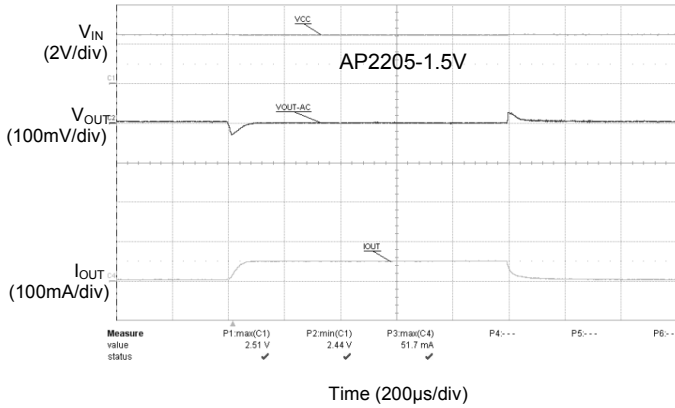
Ground Current vs. Output Current



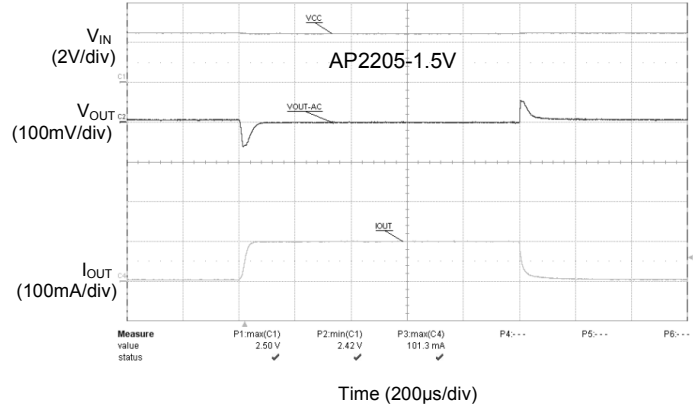
Ground Current vs. Output Current



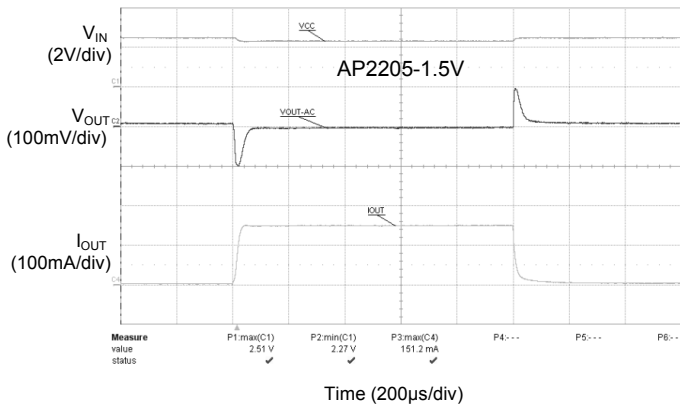
Load Transient
(Conditions: $V_{IN} = 2.5V$, $C_{IN} = 1.0\mu F$, $C_{OUT} = 2.2\mu F$, $I_{OUT} = 1mA$ to $50mA$)



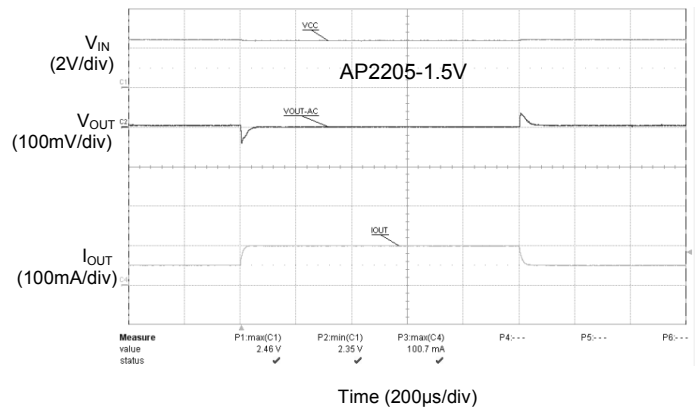
Load Transient
(Conditions: $V_{IN} = 2.5V$, $C_{IN} = 1.0\mu F$, $C_{OUT} = 2.2\mu F$, $I_{OUT} = 1mA$ to $100mA$)



Load Transient
(Conditions: $V_{IN} = 2.5V$, $C_{IN} = 1.0\mu F$, $C_{OUT} = 2.2\mu F$, $I_{OUT} = 1mA$ to $150mA$)

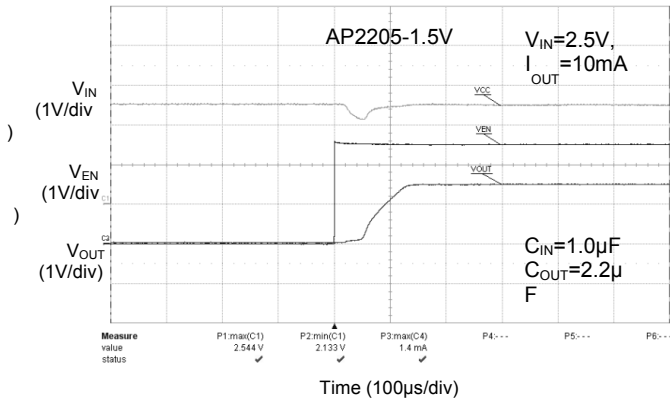


Load Transient
(Conditions: $V_{IN} = 2.5V$, $C_{IN} = 1.0\mu F$, $C_{OUT} = 2.2\mu F$, $I_{OUT} = 50mA$ to $100mA$)

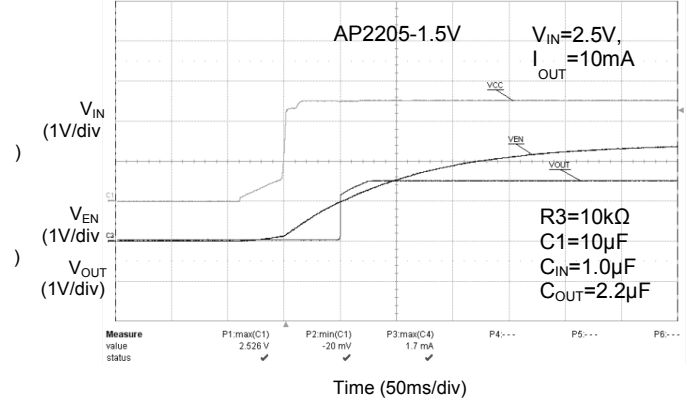


Performance Characteristics (Cont.)

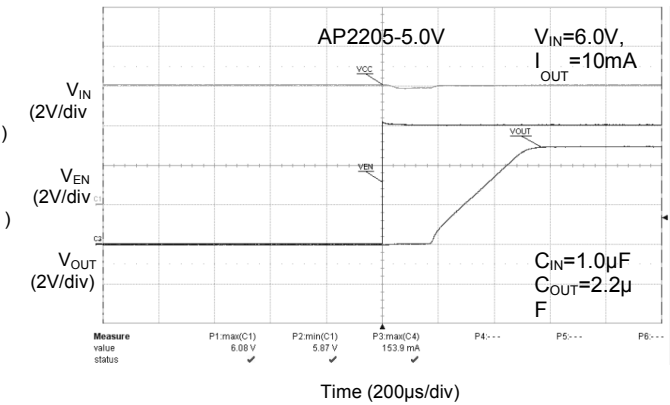
Enable Input Response



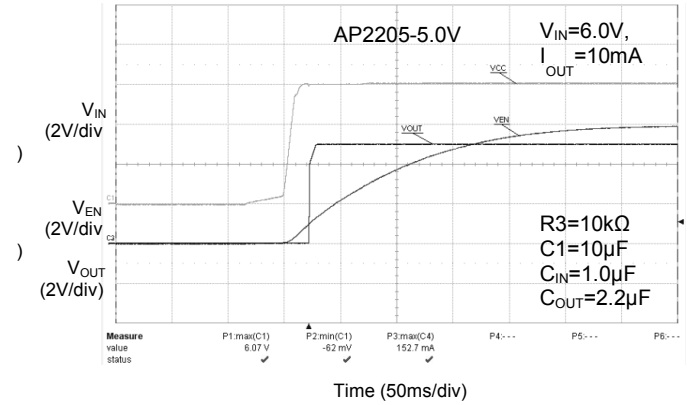
Adjustable Start-up Time by RC



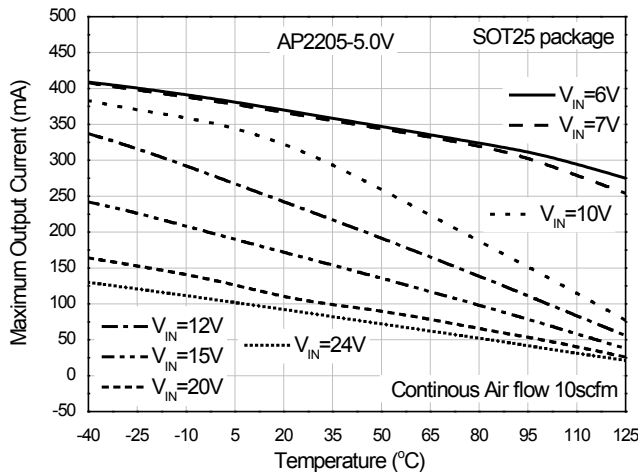
Enable Input Response



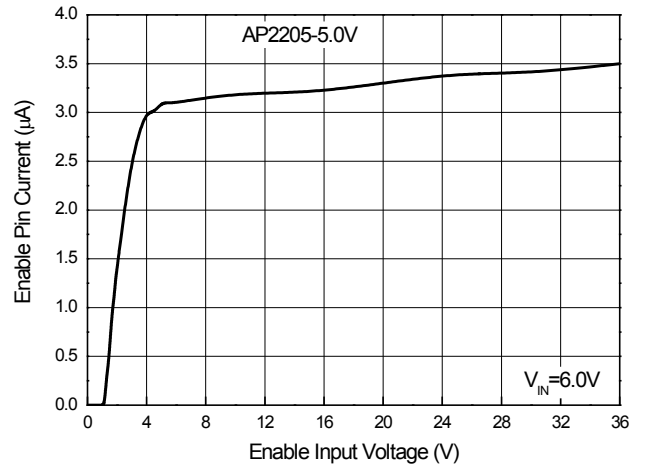
Adjustable Start-up Time by RC



Maximum Output Current vs. Ambient Temperature

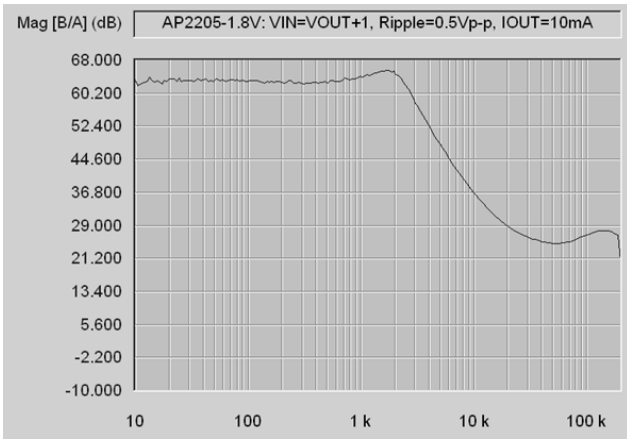


Enable Pin Current vs. Enable Input Voltage

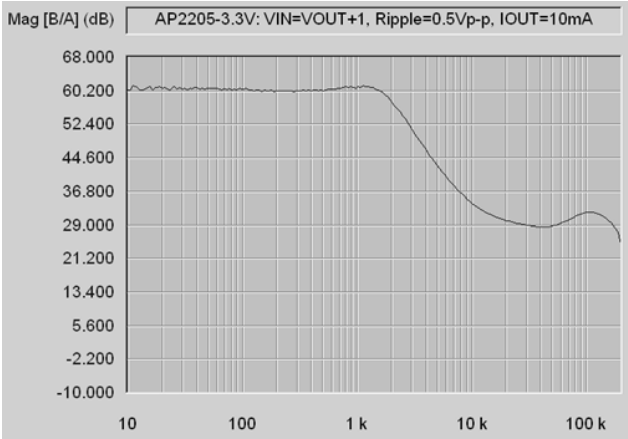


Performance Characteristics (Cont.)

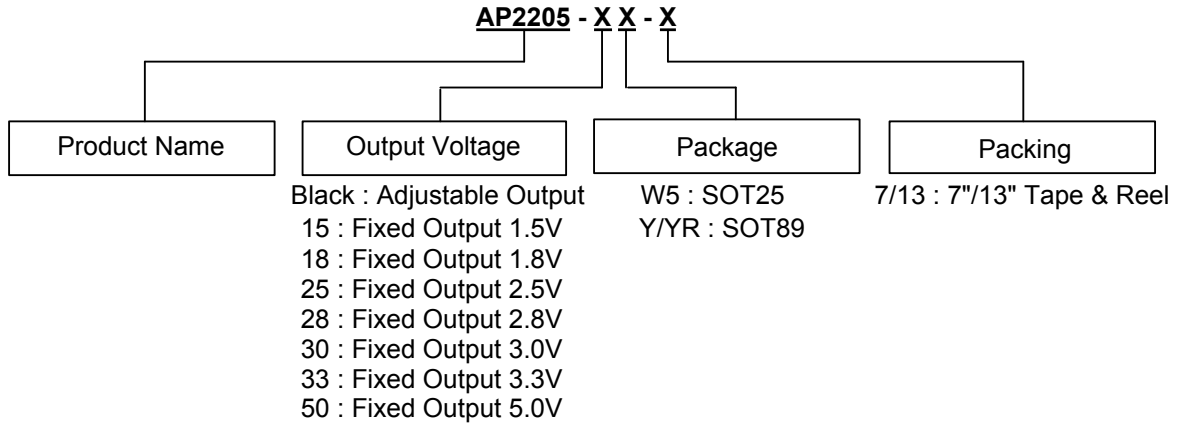
PSRR vs. Frequency



PSRR vs. Frequency



Ordering Information

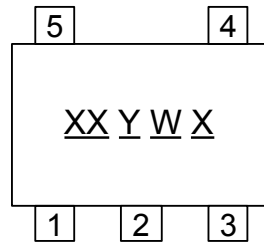


| Part Number | Package Code | Package | 13"/7" Tape and Reel | |
|----------------|--------------|---------|----------------------|--------------------|
| | | | Quantity | Part Number Suffix |
| AP2205-XXY-13 | Y | SOT89 | 2,500/Tape & Reel | -13 |
| AP2205-XXYR-13 | YR | SOT89 | 2,500/Tape & Reel | -13 |
| AP2205-W5-7 | W5 | SOT25 | 3,000/Tape & Reel | -7 |
| AP2205-XXW5-7 | W5 | SOT25 | 3,000/Tape & Reel | -7 |

Marking Information

(1) SOT25

(Top View)



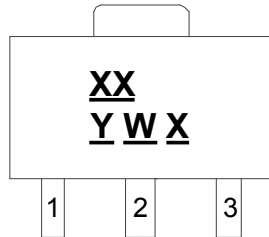
XX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
 a to z : 27 to 52 week; z represents
 52 and 53 week
X : Internal Code

| Part Number | Package | Identification Code |
|---------------|---------|---------------------|
| AP2205-W5-7 | SOT25 | 5A |
| AP2205-15W5-7 | SOT25 | 5B |
| AP2205-18W5-7 | SOT25 | 5C |
| AP2205-25W5-7 | SOT25 | 5D |
| AP2205-28W5-7 | SOT25 | 5E |
| AP2205-30W5-7 | SOT25 | 5F |
| AP2205-33W5-7 | SOT25 | 5G |
| AP2205-50W5-7 | SOT25 | 5H |

Marking Information (Cont.)

(2) SOT89

(Top View)



XX : Identification code

Y : Year : 0~9

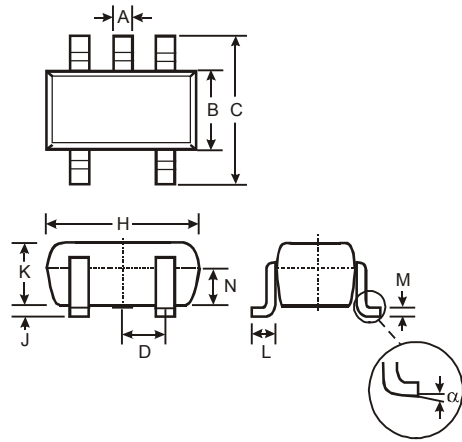
W : Week : A~Z : 1~26 week;
a~z : 27~52 week;
z represents 52 and 53 week

X : Internal code

| Part Number | Package | Identification Code |
|----------------|---------|---------------------|
| AP2205-15Y-13 | SOT89 | 5B |
| AP2205-18Y-13 | SOT89 | 5C |
| AP2205-25Y-13 | SOT89 | 5D |
| AP2205-28Y-13 | SOT89 | 5E |
| AP2205-30Y-13 | SOT89 | 5F |
| AP2205-33Y-13 | SOT89 | 5G |
| AP2205-50Y-13 | SOT89 | 5H |
| AP2205-15YR-13 | SOT89 | 6B |
| AP2205-18YR-13 | SOT89 | 6C |
| AP2205-25YR-13 | SOT89 | 6D |
| AP2205-28YR-13 | SOT89 | 6E |
| AP2205-30YR-13 | SOT89 | 6F |
| AP2205-33YR-13 | SOT89 | 6G |
| AP2205-50YR-13 | SOT89 | 6H |

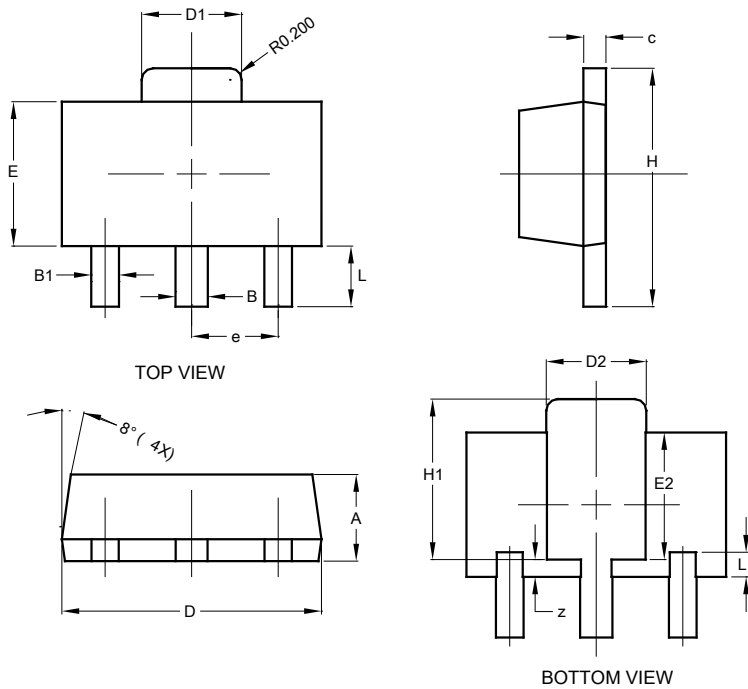
Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: SOT25



| SOT25 | | | |
|----------------------|-------|------|------|
| Dim | Min | Max | Typ |
| A | 0.35 | 0.50 | 0.38 |
| B | 1.50 | 1.70 | 1.60 |
| C | 2.70 | 3.00 | 2.80 |
| D | - | - | 0.95 |
| H | 2.90 | 3.10 | 3.00 |
| J | 0.013 | 0.10 | 0.05 |
| K | 1.00 | 1.30 | 1.10 |
| L | 0.35 | 0.55 | 0.40 |
| M | 0.10 | 0.20 | 0.15 |
| N | 0.70 | 0.80 | 0.75 |
| α | 0° | 8° | - |
| All Dimensions in mm | | | |

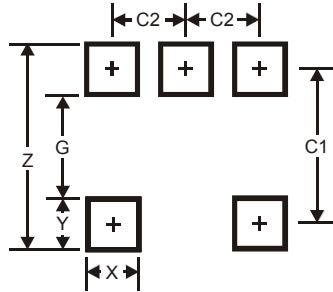
(2) Package Type: SOT89



| SOT89 | | | |
|----------------------|-------|-------|-------|
| Dim | Min | Max | Typ |
| A | 1.40 | 1.60 | 1.50 |
| B | 0.50 | 0.62 | 0.56 |
| B1 | 0.42 | 0.54 | 0.48 |
| c | 0.35 | 0.43 | 0.38 |
| D | 4.40 | 4.60 | 4.50 |
| D1 | 1.62 | 1.83 | 1.733 |
| D2 | 1.61 | 1.81 | 1.71 |
| E | 2.40 | 2.60 | 2.50 |
| E2 | 2.05 | 2.35 | 2.20 |
| e | - | - | 1.50 |
| H | 3.95 | 4.25 | 4.10 |
| H1 | 2.63 | 2.93 | 2.78 |
| L | 0.90 | 1.20 | 1.05 |
| L1 | 0.327 | 0.527 | 0.427 |
| z | 0.20 | 0.40 | 0.30 |
| All Dimensions in mm | | | |

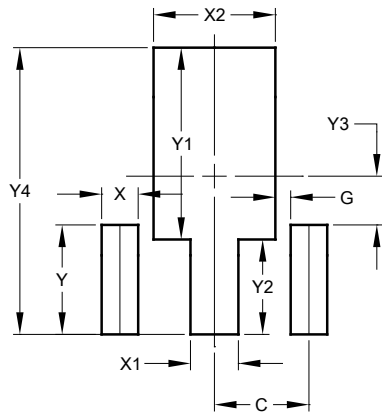
Suggested Pad Layout

(1) Package Type: SOT25



| Dimensions | Value |
|------------|-------|
| Z | 3.20 |
| G | 1.60 |
| X | 0.55 |
| Y | 0.80 |
| C1 | 2.40 |
| C2 | 0.95 |

(2) Package Type: SOT89



| Dimensions | Value (in mm) |
|------------|---------------|
| C | 1.500 |
| G | 0.244 |
| X | 0.580 |
| X1 | 0.760 |
| X2 | 1.933 |
| Y | 1.730 |
| Y1 | 3.030 |
| Y2 | 1.500 |
| Y3 | 0.770 |
| Y4 | 4.530 |

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