

**WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR****AP2204****General Description**

The AP2204 series is a positive voltage regulator IC fabricated by high voltage EPNP process.

The AP2204 has features of 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, and a chip enable circuit.

The AP2204 has 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 5.0V fixed voltage versions and adjustable voltage version.

The AP2204 is available in space-saving SOT-23-5, SOT-89 and PSOP-8 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:  $V_{DROP}=100mV@$   
 $I_{OUT}=100\mu A$
- Low Ground Current
- High Output Voltage Accuracy
- Compatible with Low ESR Ceramic Capacitor
- Excellent Line/Load Regulation
- Thermal Shutdown Function

**Applications**

- Battery-powered Equipment
- Laptop, Palmtops, Notebook Computers
- Portable Information Appliances

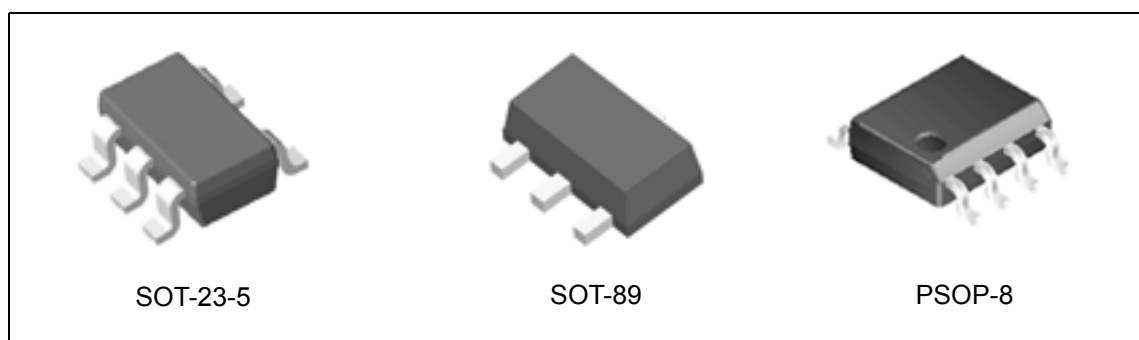


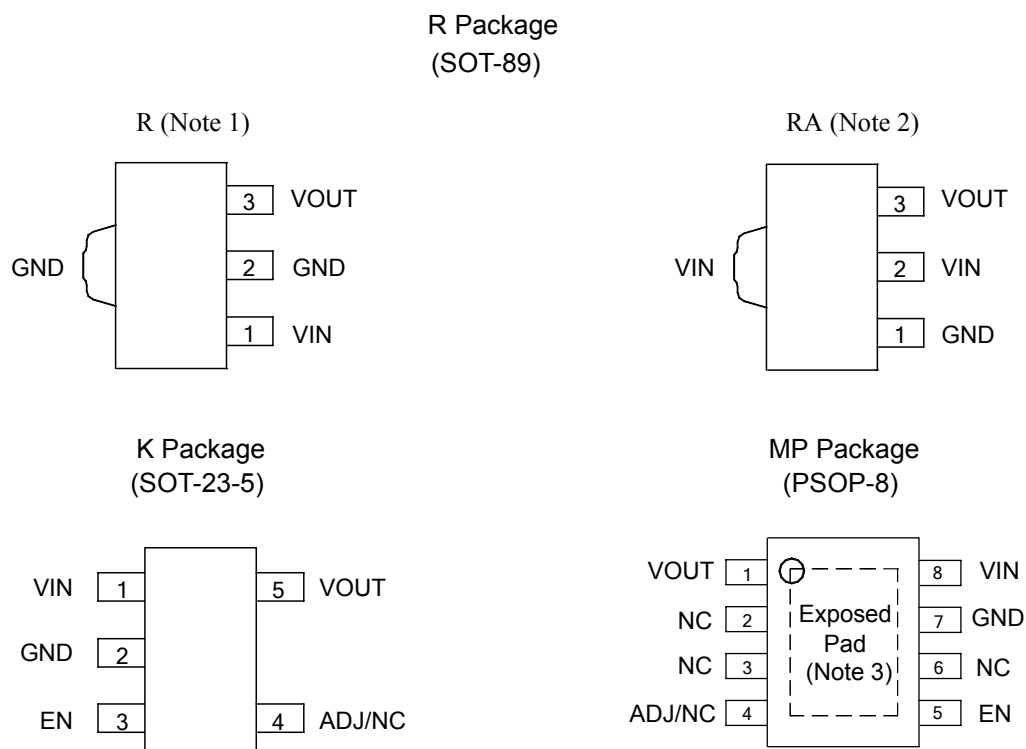
Figure 1. Package Types of AP2204



# WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR

AP2204

## Pin Configuration



Note 1: The substrate/exposed pad should be connected to GND or open.

Note 2: The substrate/exposed pad should be connected to VIN or open.

Note 3: The exposed pad should be connected to GND for better dissipation.

Figure 2. Pin Configuration of AP2204 (Top View)

## Pin Description

| Pin Number |        |        |    | Pin Name | Function                                                     |
|------------|--------|--------|----|----------|--------------------------------------------------------------|
| SOT-23-5   | PSOP-8 | SOT-89 |    |          |                                                              |
|            |        | R      | RA |          |                                                              |
| 1          | 8      | 1      | 2  | VIN      | Input voltage                                                |
| 2          | 7      | 2      | 1  | GND      | Ground                                                       |
| 3          | 5      |        |    | EN       | Enable input                                                 |
| 4          | 4      |        |    | ADJ/NC   | Adjust output for ADJ version/No connected for fixed version |
| 5          | 1      | 3      | 3  | VOUT     | Regulated output voltage                                     |

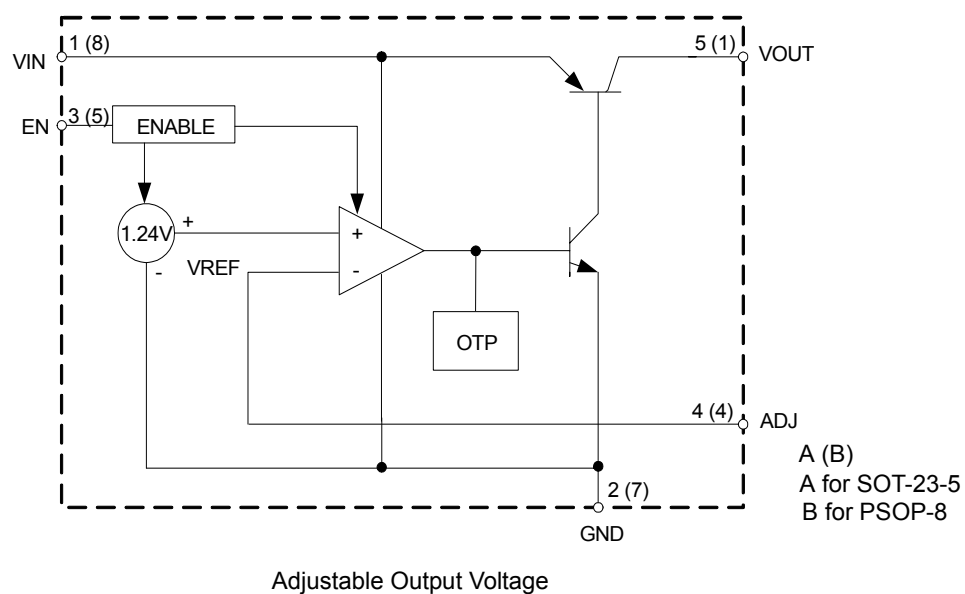
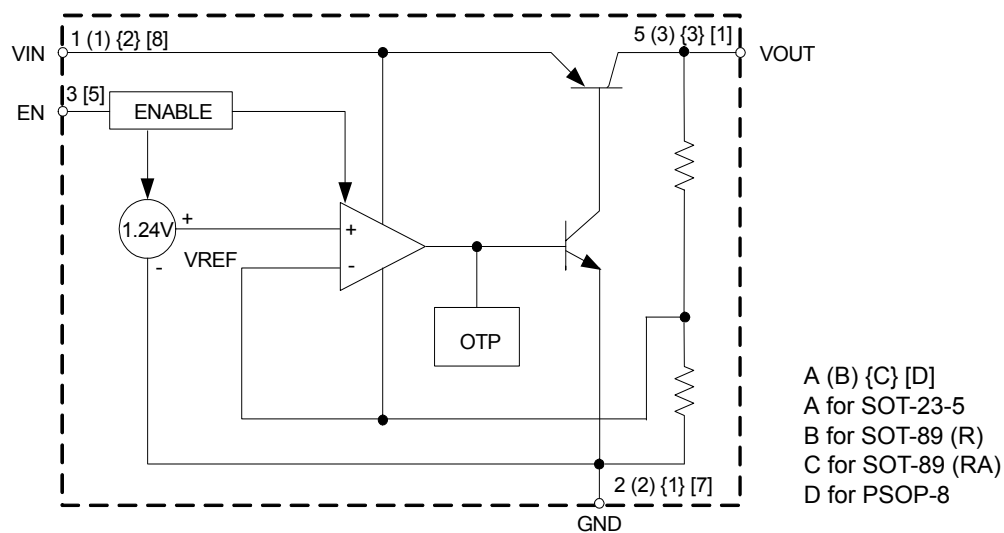
**WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR****AP2204****Functional Block Diagram**

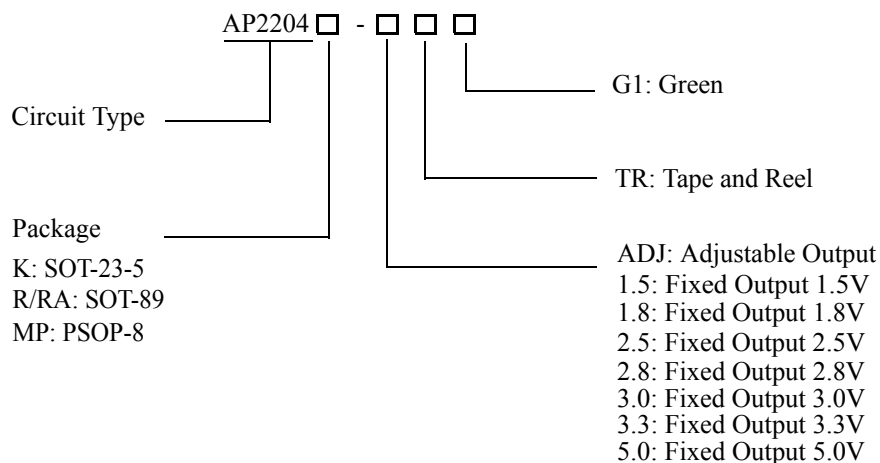
Figure 3. Functional Block Diagram of AP2204



**WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR**

**AP2204**

**Ordering Information**



| Package  | Temperature Range | Output Voltage | Part Number     | Marking ID | Packing Type |
|----------|-------------------|----------------|-----------------|------------|--------------|
|          |                   |                | Green           | Green      |              |
| SOT-23-5 | -40 to 85°C       | ADJ            | AP2204K-ADJTRG1 | GAF        | Tape & Reel  |
|          |                   | 1.5V           | AP2204K-1.5TRG1 | GBH        | Tape & Reel  |
|          |                   | 1.8V           | AP2204K-1.8TRG1 | GAG        | Tape & Reel  |
|          |                   | 2.5V           | AP2204K-2.5TRG1 | GAD        | Tape & Reel  |
|          |                   | 2.8V           | AP2204K-2.8TRG1 | GAE        | Tape & Reel  |
|          |                   | 3.0V           | AP2204K-3.0TRG1 | GEF        | Tape & Reel  |
|          |                   | 3.3V           | AP2204K-3.3TRG1 | GAH        | Tape & Reel  |
|          |                   | 5.0V           | AP2204K-5.0TRG1 | GAI        | Tape & Reel  |
| SOT-89   | -40 to 85°C       | 1.5V (R)       | AP2204R-1.5TRG1 | G22C       | Tape & Reel  |
|          |                   | 1.8V (R)       | AP2204R-1.8TRG1 | G31C       | Tape & Reel  |
|          |                   | 2.5V (R)       | AP2204R-2.5TRG1 | G22D       | Tape & Reel  |
|          |                   | 2.8V (R)       | AP2204R-2.8TRG1 | G22E       | Tape & Reel  |
|          |                   | 3.0V (R)       | AP2204R-3.0TRG1 | G22F       | Tape & Reel  |
|          |                   | 3.3V (R)       | AP2204R-3.3TRG1 | G31D       | Tape & Reel  |
|          |                   | 5.0V (R)       | AP2204R-5.0TRG1 | G31E       | Tape & Reel  |

**WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR****AP2204****Ordering Information (Continued)**

| Package | Temperature Range | Output Voltage | Part Number      | Marking ID   | Packing Type |
|---------|-------------------|----------------|------------------|--------------|--------------|
|         |                   |                | Green            | Green        |              |
| SOT-89  | -40 to 85°C       | 1.5V (RA)      | AP2204RA-1.5TRG1 | G22O         | Tape & Reel  |
|         |                   | 1.8V (RA)      | AP2204RA-1.8TRG1 | G27O         | Tape & Reel  |
|         |                   | 2.5V (RA)      | AP2204RA-2.5TRG1 | G28O         | Tape & Reel  |
|         |                   | 2.8V (RA)      | AP2204RA-2.8TRG1 | G31O         | Tape & Reel  |
|         |                   | 3.0V (RA)      | AP2204RA-3.0TRG1 | G33O         | Tape & Reel  |
|         |                   | 3.3V (RA)      | AP2204RA-3.3TRG1 | G37O         | Tape & Reel  |
|         |                   | 5.0V (RA)      | AP2204RA-5.0TRG1 | G41O         | Tape & Reel  |
| PSOP-8  | -40 to 85°C       | ADJ            | AP2204MP-ADJTRG1 | 2204MP-ADJG1 | Tape & Reel  |
|         |                   | 1.5V           | AP2204MP-1.5TRG1 | 2204MP-1.5G1 | Tape & Reel  |
|         |                   | 1.8V           | AP2204MP-1.8TRG1 | 2204MP-1.8G1 | Tape & Reel  |
|         |                   | 2.5V           | AP2204MP-2.5TRG1 | 2204MP-2.5G1 | Tape & Reel  |
|         |                   | 2.8V           | AP2204MP-2.8TRG1 | 2204MP-2.8G1 | Tape & Reel  |
|         |                   | 3.0V           | AP2204MP-3.0TRG1 | 2204MP-3.0G1 | Tape & Reel  |
|         |                   | 3.3V           | AP2204MP-3.3TRG1 | 2204MP-3.3G1 | Tape & Reel  |
|         |                   | 5.0V           | AP2204MP-5.0TRG1 | 2204MP-5.0G1 | Tape & Reel  |

BCD Semiconductor's products, as designated with "G1" suffix in the part number, are RoHS compliant and Green.

**WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR****AP2204****Absolute Maximum Ratings (Note 4)**

| Parameter                           | Symbol        | Value           |     | Unit |
|-------------------------------------|---------------|-----------------|-----|------|
| Supply Input Voltage                | $V_{IN}$      | 38              |     | V    |
| Enable Input Voltage                | $V_{CE}$      | 38              |     | V    |
| Output Current                      | $I_{OUT}$     | 250             |     | mA   |
| Lead Temperature (Soldering, 10sec) | $T_{LEAD}$    | 260             |     | °C   |
| Operating Junction Temperature      | $T_J$         | 150             |     | °C   |
| Thermal Resistance                  | $\theta_{JA}$ | SOT-23-5        | 250 | °C/W |
|                                     |               | SOT-89          | 165 |      |
|                                     |               | PSOP-8 (Note 5) | 51  |      |
| Storage Temperature Range           | $T_{STG}$     | -65 to 150      |     | °C   |
| ESD (Machine Model)                 |               | 275             |     | V    |
| ESD (Human Body Model)              |               | 2000            |     | V    |

Note 4: 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 5:  $\theta_{JA}$  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**

| Parameter                      | Symbol   | Min | Max | Unit |
|--------------------------------|----------|-----|-----|------|
| Supply Input Voltage           | $V_{IN}$ | 2.3 | 24  | V    |
| Operating Junction Temperature | $T_J$    | -40 | 125 | °C   |


**WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR**
**AP2204**
**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.

| Parameter                              | Symbol                                     | Conditions                                                        | Min                   | Typ                         | Max                    | Unit             |
|----------------------------------------|--------------------------------------------|-------------------------------------------------------------------|-----------------------|-----------------------------|------------------------|------------------|
| Output Voltage                         | $V_{OUT}$                                  | Variation from Specified $V_{OUT}$                                | $V_{OUT} \times 98\%$ |                             | $V_{OUT} \times 102\%$ | V                |
| Reference Voltage                      | $V_{REF}$                                  |                                                                   | 1.215                 | 1.24                        | 1.265                  | V                |
| Input Voltage                          | $V_{IN}$                                   |                                                                   |                       |                             | 24                     | V                |
| Maximum Output Current                 | $I_{OUT(max)}$                             | $V_{IN}-V_{OUT}=1V$<br>$V_{OUT}=98\% \times V_{OUT}$              | 150                   | 200                         |                        | mA               |
| Line Regulation                        | $\Delta V_{OUT}/\Delta V_{IN}$             | $V_{OUT}+1V \leq V_{IN} \leq 24V$                                 |                       | 0.05                        |                        | %                |
| Load Regulation                        | $\Delta V_{OUT}/V_{OUT}$                   | $1mA \leq I_{OUT} \leq 150mA$                                     |                       | 0.5                         |                        | %                |
| Dropout Voltage                        | $V_{DROP}$                                 | $I_{OUT}=100\mu A$                                                |                       | 100                         | 150                    | mV               |
|                                        |                                            | $I_{OUT}=50mA$                                                    |                       | 270                         | 350                    |                  |
|                                        |                                            | $I_{OUT}=100mA$                                                   |                       | 320                         | 460                    |                  |
|                                        |                                            | $I_{OUT}=150mA$                                                   |                       | 360                         | 500                    |                  |
| Ground Current                         | $I_{GND}$                                  | $I_{OUT}=100\mu A$                                                |                       | 50                          |                        | $\mu A$          |
|                                        |                                            | $I_{OUT}=50mA$                                                    |                       | 0.5                         |                        | mA               |
|                                        |                                            | $I_{OUT}=100mA$                                                   |                       | 1.3                         |                        |                  |
|                                        |                                            | $I_{OUT}=150mA$                                                   |                       | 2.5                         |                        |                  |
| Standby Current                        | $I_{STD}$                                  | $V_{IN}=V_{OUT}+1V$<br>$V_{EN}$ in OFF Mode                       |                       | 0.01                        | 1.0                    | $\mu A$          |
| Power Supply Rejection Ration          | PSRR                                       | Ripple 0.5V <sub>P-P</sub><br>$V_{IN}=V_{OUT}+1V$                 | $f=100Hz$             | 60                          |                        | dB               |
|                                        |                                            |                                                                   | $f=1kHz$              | 60                          |                        |                  |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}/(V_{OUT} \times \Delta T)$ | $I_{OUT}=100\mu A$ ,<br>$-40^{\circ}C \leq T_J \leq 125^{\circ}C$ |                       | <b><math>\pm 100</math></b> |                        | ppm/ $^{\circ}C$ |
| RMS Output Noise                       | $V_{NOI}$                                  | $T_J=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                     |                       | 30                          |                        | $\mu V_{rms}$    |
| ADJ Pin Current                        | $I_{ADJ}$                                  | $I_{OUT}=100\mu A$                                                |                       | 0.5                         |                        | $\mu A$          |
| EN Pin Current                         | $I_{EN}$                                   | $V_{EN}=V_{OUT}+1V$                                               |                       | 1                           |                        | $\mu A$          |
| EN “High” Voltage                      |                                            | EN Input Voltage “High”                                           | 2.0                   |                             |                        | V                |
| EN “Low” Voltage                       |                                            | EN Input Voltage “Low”                                            |                       |                             | 0.4                    | V                |
| Thermal Resistance (Junction to Case)  | $\theta_{JC}$                              | SOT-23-5                                                          |                       | 43                          |                        | $^{\circ}C/W$    |
|                                        |                                            | SOT-89                                                            |                       | 27                          |                        |                  |
|                                        |                                            | PSOP-8                                                            |                       | 22                          |                        |                  |

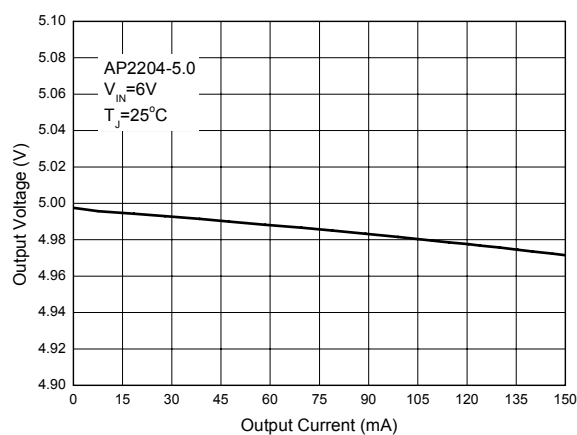
**WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR****AP2204****Typical Performance Characteristics**

Figure 4. Output Voltage vs. Output Current

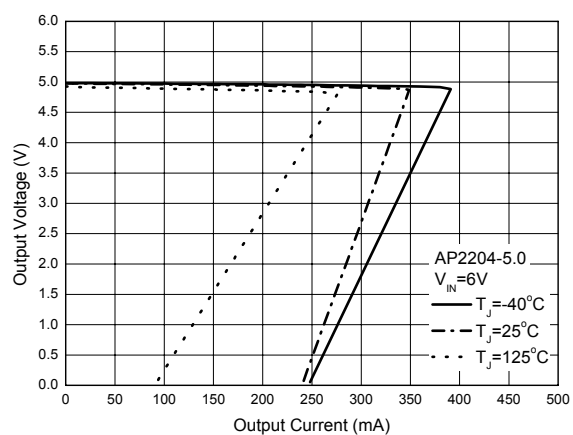


Figure 5. Output Voltage vs. Output Current

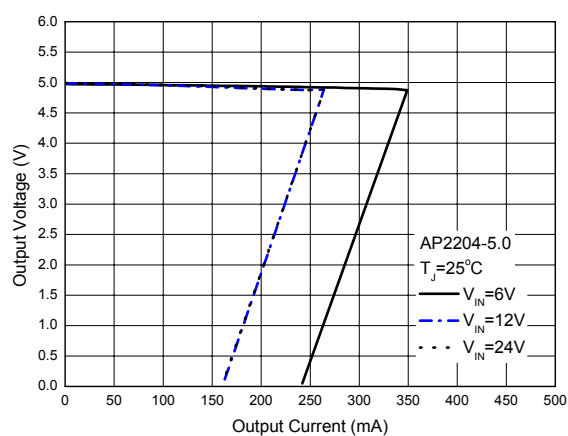


Figure 6. Output Voltage vs. Output Current

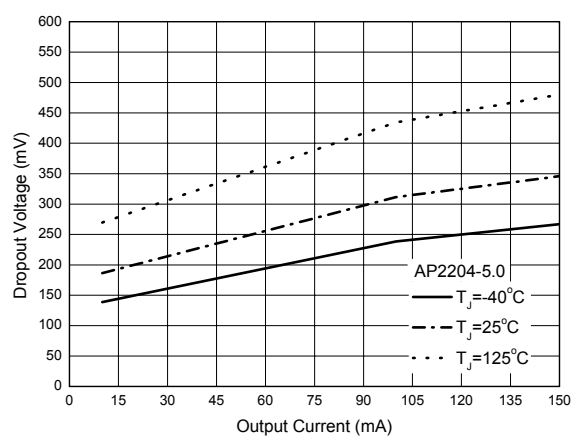


Figure 7. Dropout Voltage vs. Output Current



## Typical Performance Characteristics (Continued)

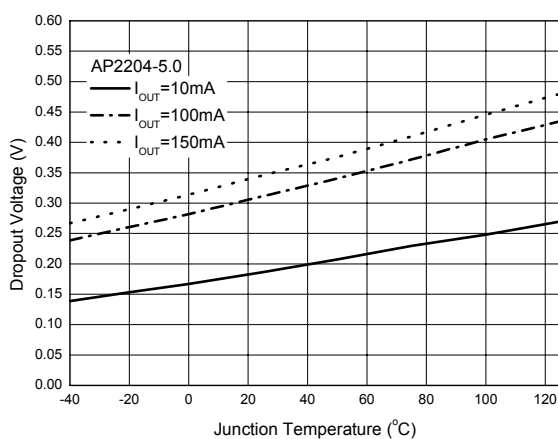


Figure 8. Dropout Voltage vs. Junction Temperature

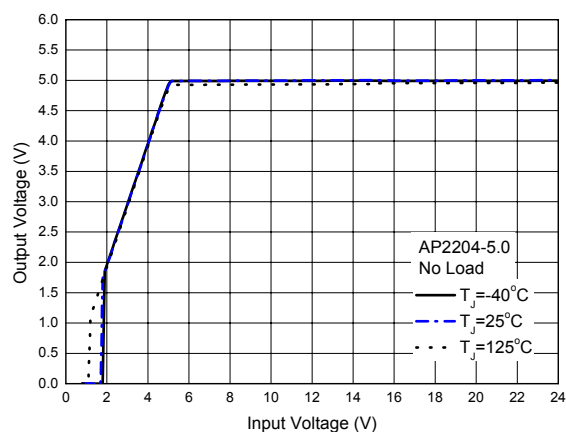


Figure 9. Output Voltage vs. Input Voltage

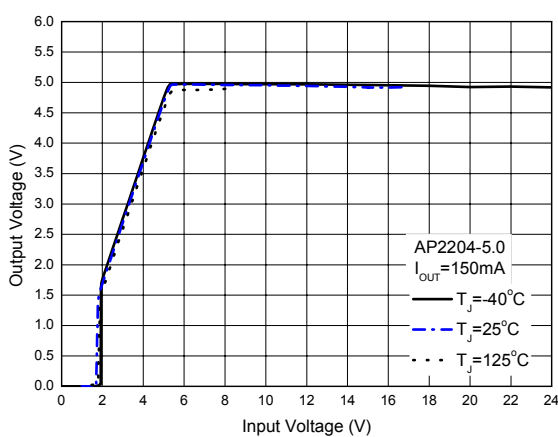


Figure 10. Output Voltage vs. Input Voltage

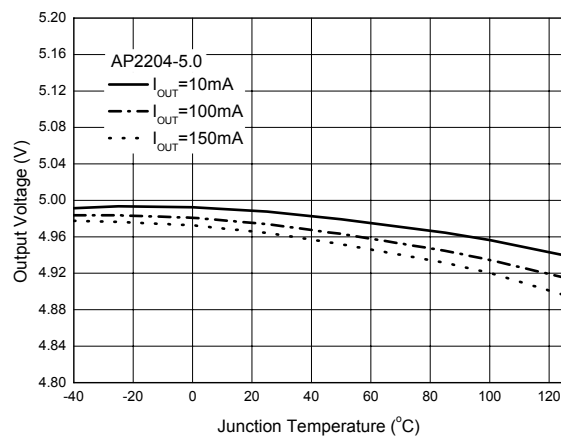


Figure 11. Output Voltage vs. Junction Temperature

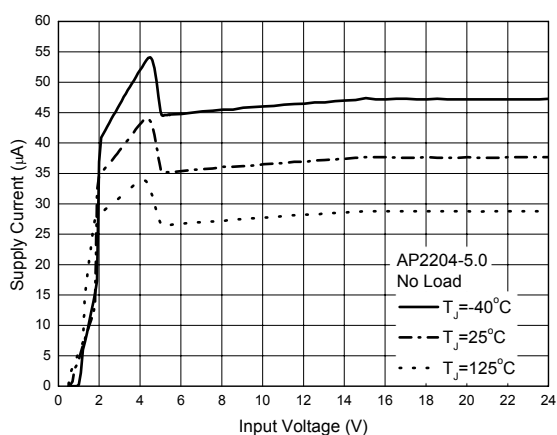
**Typical Performance Characteristics (Continued)**

Figure 12. Supply Current vs. Input Voltage

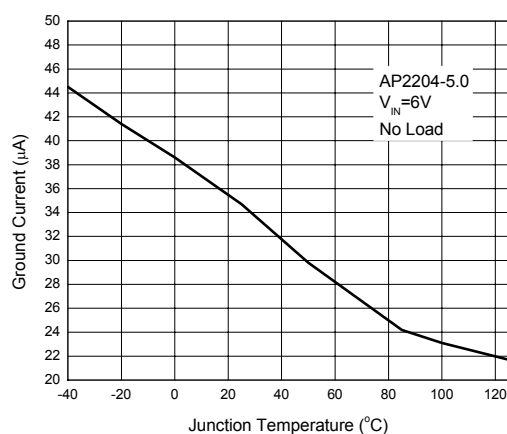


Figure 13. Ground Current vs. Junction Temperature

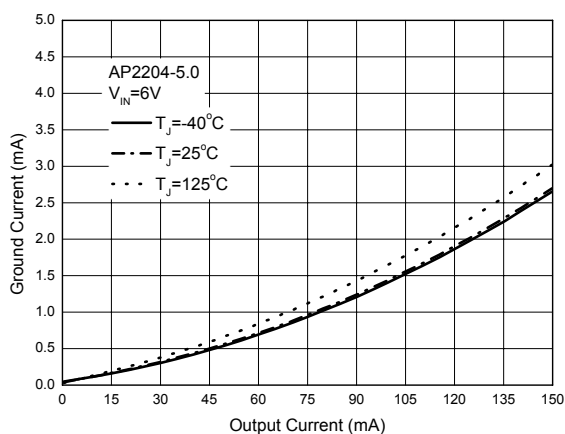


Figure 14. Ground Current vs. Output Current

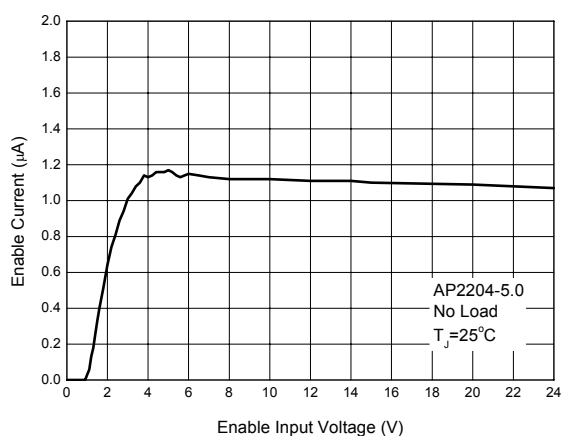


Figure 15. Enable Current vs. Enable Input Voltage



**Typical Performance Characteristics (Continued)**

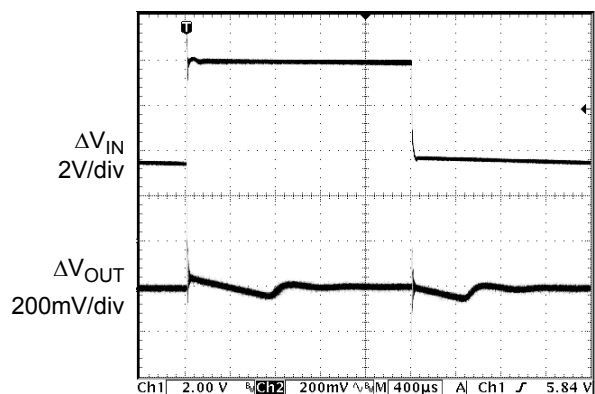


Figure 16. Line Transient  
(Conditions:  $V_{IN}=V_{EN}=3.5V$  to  $8V$ ,  $C_{IN}=1.0\mu F$ ,  
 $C_{OUT}=2.2\mu F$ ,  $I_{OUT}=1mA$ )

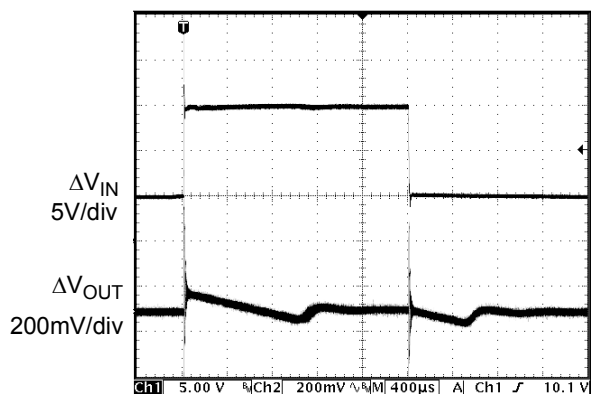


Figure 17. Line Transient  
(Conditions:  $V_{IN}=V_{EN}=5V$  to  $15V$ ,  $C_{IN}=1.0\mu F$ ,  
 $C_{OUT}=2.2\mu F$ ,  $I_{OUT}=1mA$ )

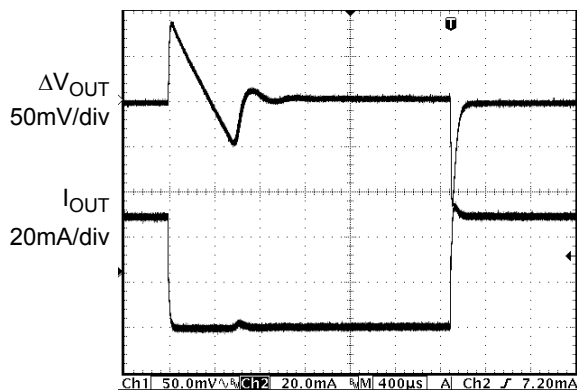


Figure 18. Load Transient  
(Conditions:  $V_{IN}=5V$ ,  $C_{IN}=1.0\mu F$ ,  $C_{OUT}=2.2\mu F$   
 $I_{OUT}=1mA$  to  $50mA$ )

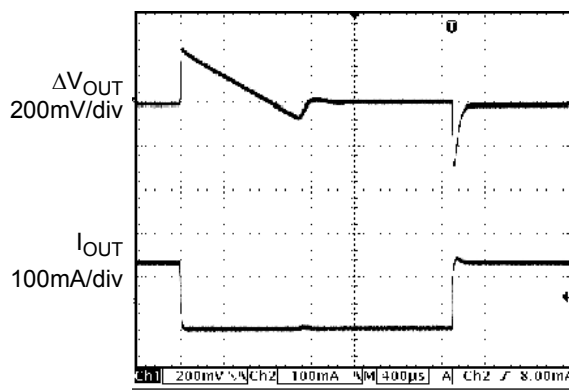


Figure 19. Load Transient  
(Conditions:  $V_{IN}=5V$ ,  $C_{IN}=1.0\mu F$ ,  $C_{OUT}=2.2\mu F$   
 $I_{OUT}=1mA$  to  $150mA$ )



**Typical Performance Characteristics (Continued)**

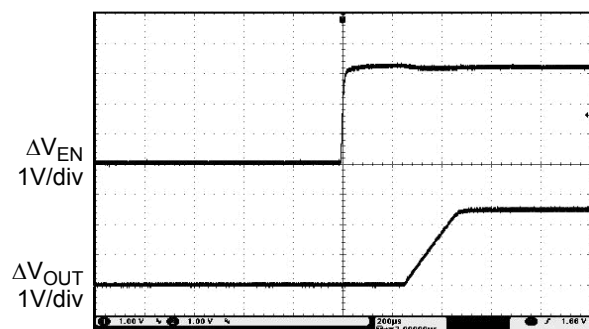


Figure 20. Enable Input Response

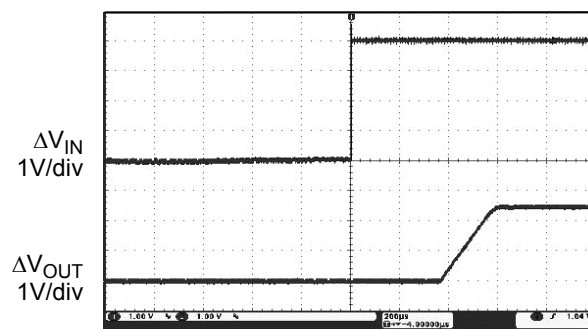


Figure 21. Start-up Response

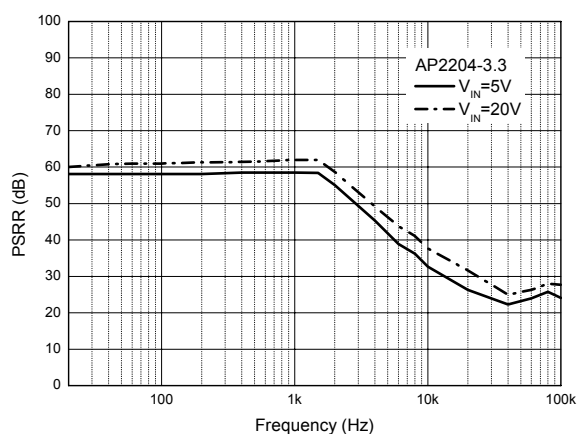


Figure 22. PSRR vs. Frequency  
(Conditions:  $V_{PP}=2V$ ,  $I_{OUT}=10mA$ )

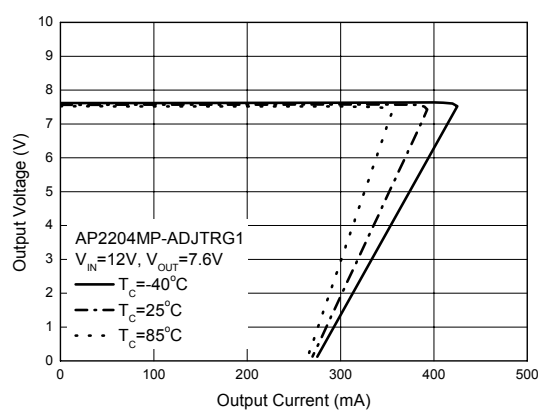


Figure 23. Output Voltage vs. Output Current

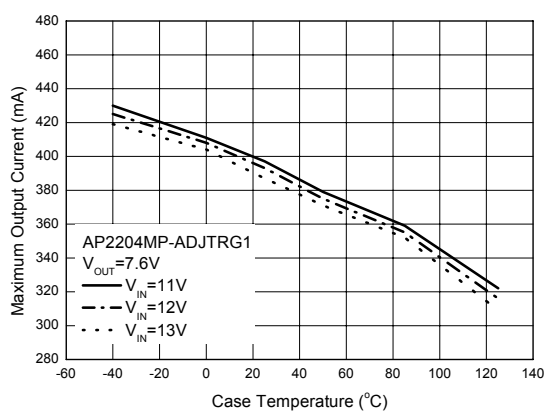
**Typical Performance Characteristics (Continued)**

Figure 24. Maximum Output Current vs. Case Temperature

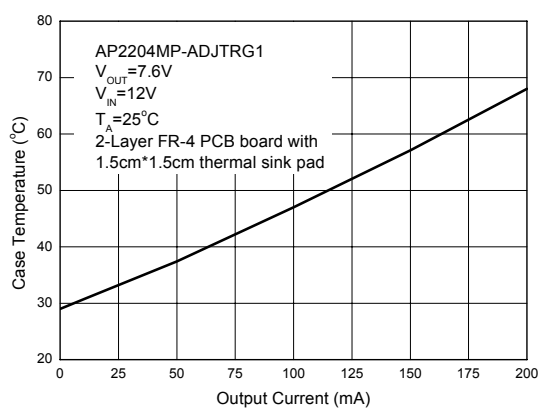


Figure 25. Case Temperature vs. Output Current

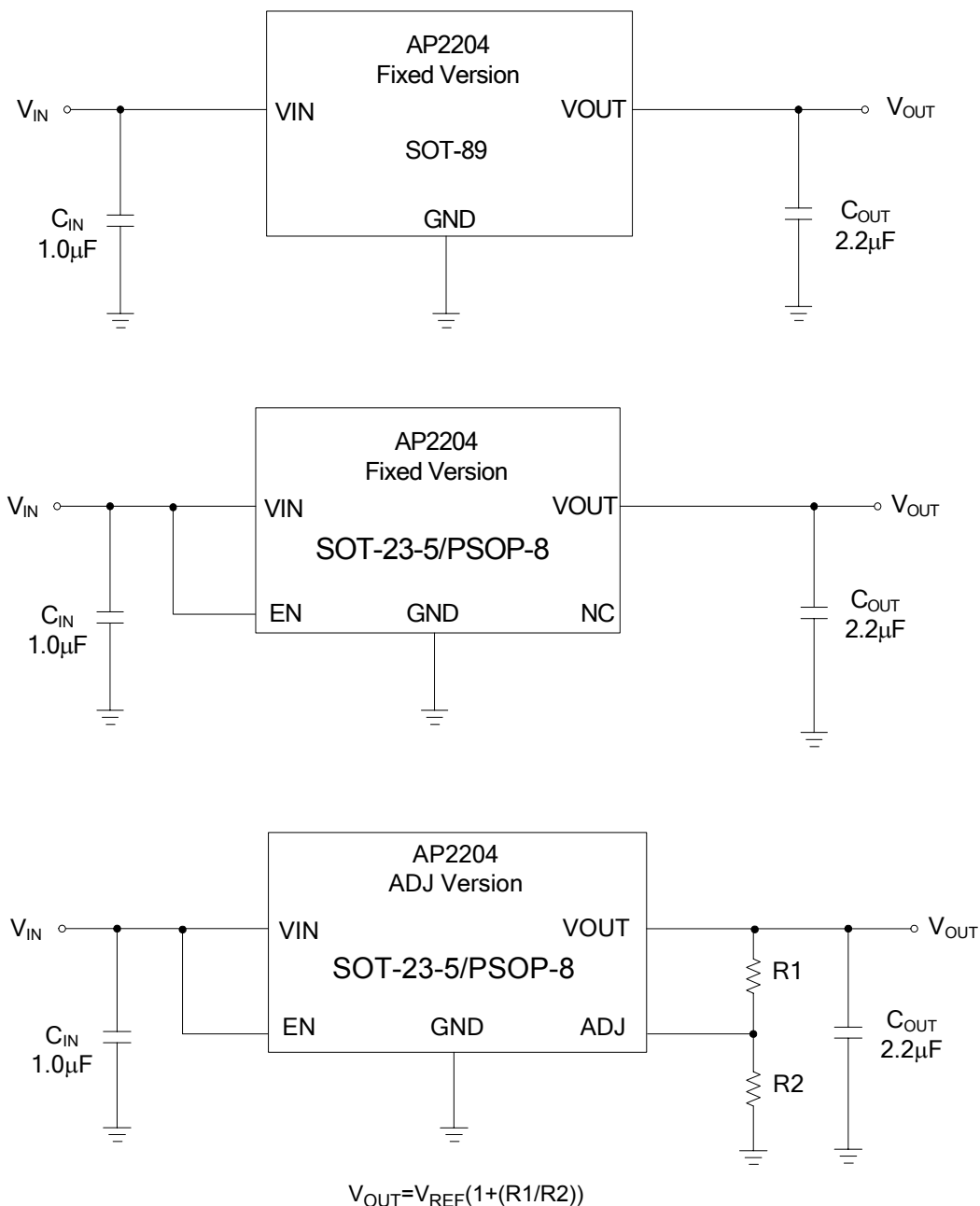
**Typical Application**

Figure 26. Typical Application of AP2204

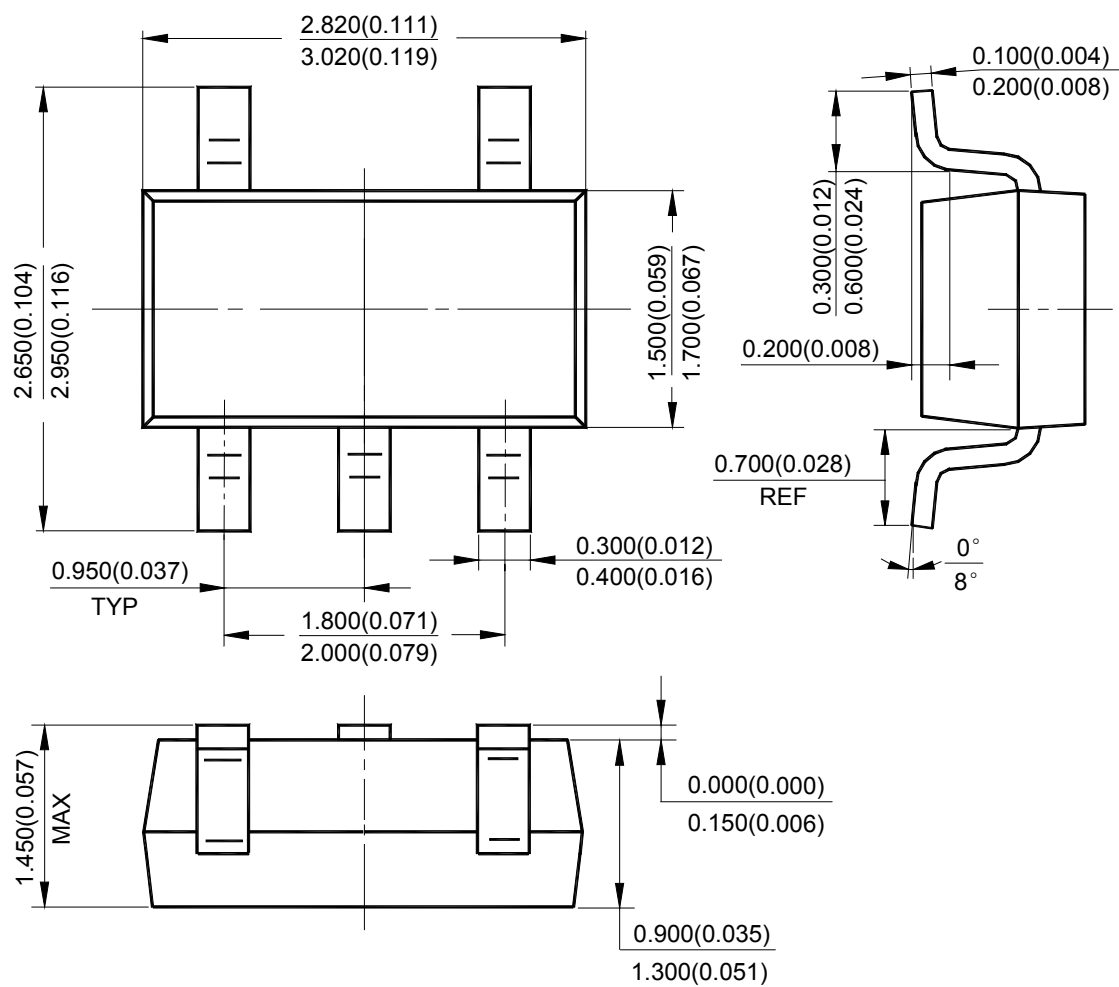
## WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR

**AP2204**

## Mechanical Dimensions

## SOT-23-5

Unit: mm(inch)





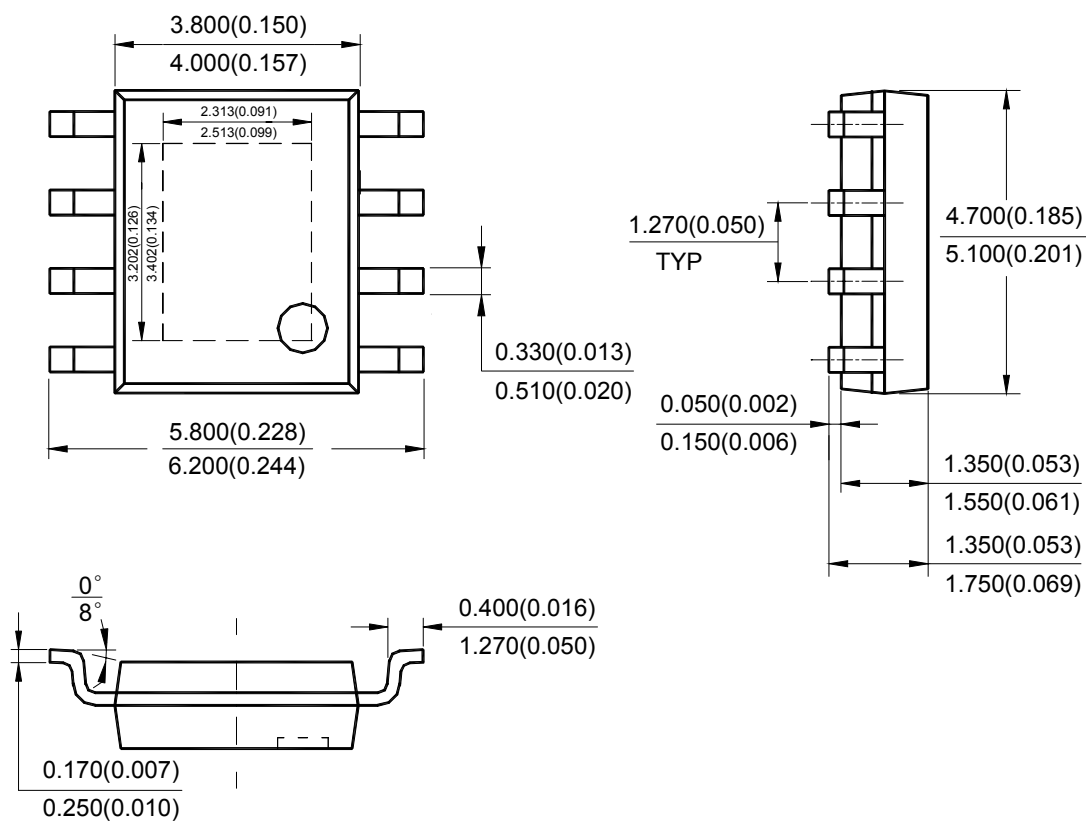
**AP2204**

### Mechanical Dimensions (Continued)

## SOT-89

**Unit: mm(inch)**



**Mechanical Dimensions (Continued)****PSOP-8****Unit: mm(inch)**

Note: Eject hole, oriented hole and mold mark is optional.



## **BCD Semiconductor Manufacturing Limited**

<http://www.bcdsemi.com>

### **IMPORTANT NOTICE**

BCD Semiconductor Manufacturing Limited reserves the right to make changes without further notice to any products or specifications herein. BCD Semiconductor Manufacturing Limited does not assume any responsibility for use of any its products for any particular purpose, nor does BCD Semiconductor Manufacturing Limited assume any liability arising out of the application or use of any its products or circuits. BCD Semiconductor Manufacturing Limited does not convey any license under its patent rights or other rights nor the rights of others.

---

#### **MAIN SITE**

##### **- Headquarters**

##### **BCD Semiconductor Manufacturing Limited**

No. 1600, Zi Xing Road, Shanghai ZiZhu Science-based Industrial Park, 200241, China  
Tel: +86-21-24162266, Fax: +86-21-24162277

##### **- Wafer Fab**

##### **Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd.**

800 Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

#### **REGIONAL SALES OFFICE**

##### **Shenzhen Office**

##### **Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd., Shenzhen Office**

Unit A Room 1203, Skyworth Bldg., Gaoxin Ave. I.S., Nanshan District, Shenzhen, China  
Tel: +86-755-8826 7951  
Fax: +86-755-8826 7865

##### **Taiwan Office**

##### **BCD Semiconductor (Taiwan) Company Limited**

4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei, Taiwan  
Tel: +886-2-2656 2808  
Fax: +886-2-2656 2806

##### **USA Office**

##### **BCD Semiconductor Corp.**

30920 Huntwood Ave. Hayward, CA 94544, USA  
Tel : +1-510-324-2988  
Fax: +1-510-324-2788



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.