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 accurcay, 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}=100μA
- 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

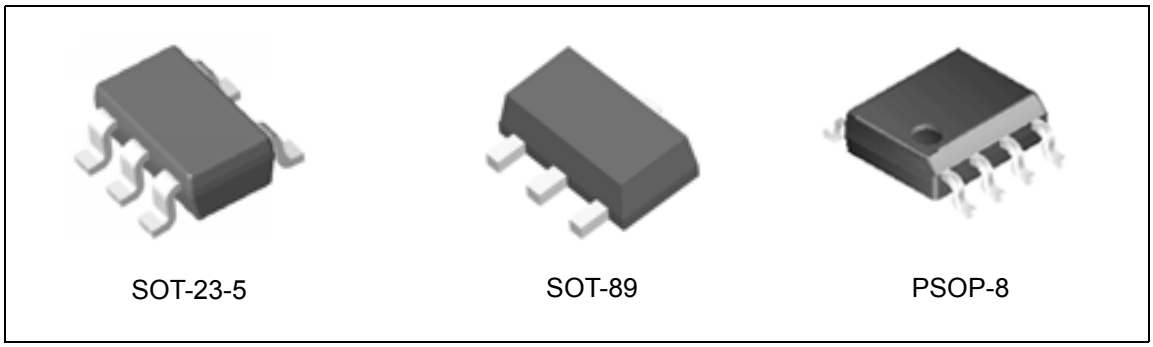
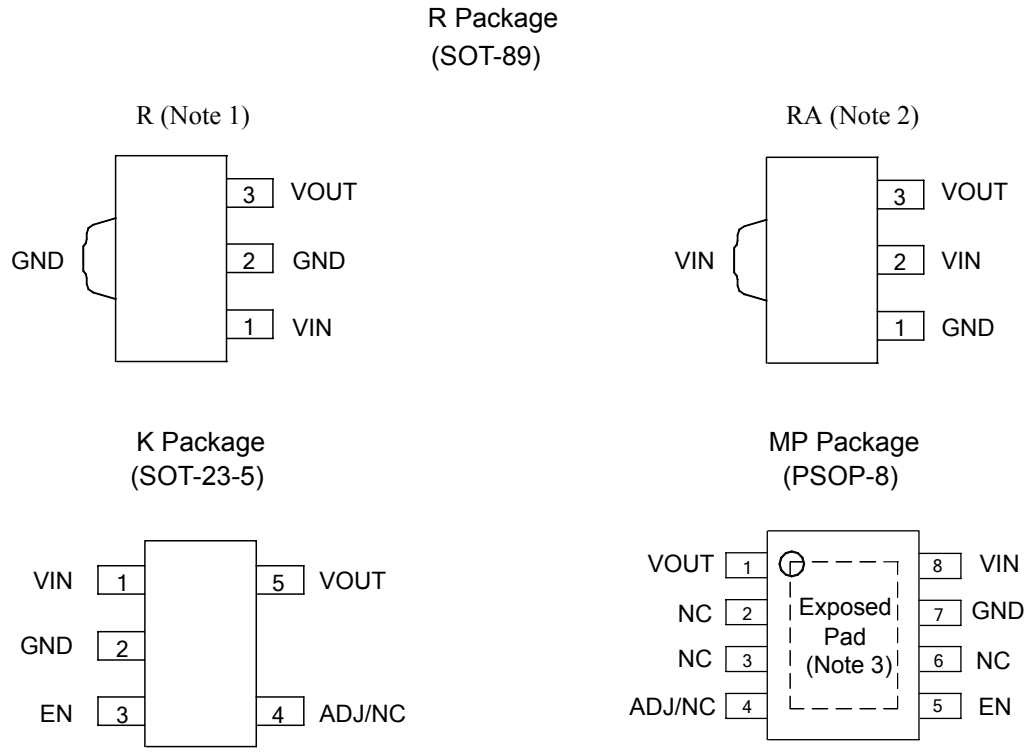


Figure 1. Package Types of AP2204

Pin Configuration



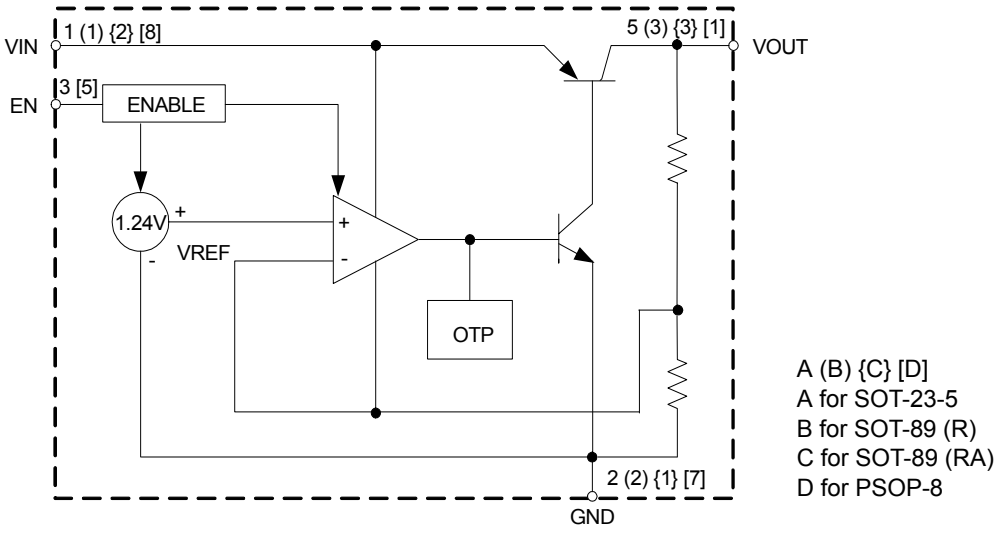
Note 1: The substrate/exposed pad should be connected to GND or open.
Note 2: The substrate/exposed pad should be connected to VIN or open.
Note 3: The exposed pad should be connected to GND for better dissipation.

Figure 2. Pin Configuration of AP2204 (Top View)

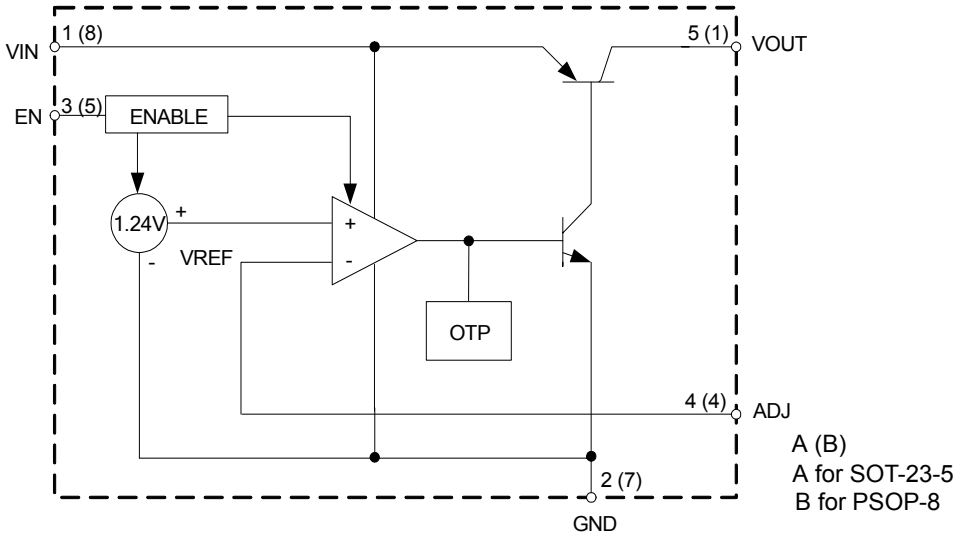
Pin Description

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

Functional Block Diagram



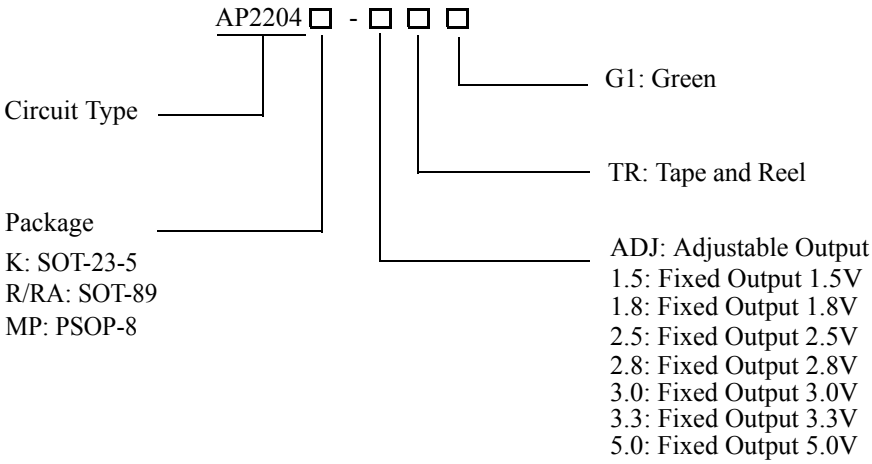
Fixed Output Voltage



Adjustable Output Voltage

Figure 3. Functional Block Diagram of 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

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.

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	θ_{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: 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

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

Electrical Characteristics

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	Variation from Specified V_{OUT}	V_{OUT} ×98%		V_{OUT} ×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 V_{OUT}=98% ×V_{OUT}	150	200		mA
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT}+1V≤V_{IN}≤24V		0.05		%
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	1mA≤I_{OUT}≤150mA		0.5		%
Dropout Voltage	V_{DROP}	I_{OUT}=100μA		100	150	mV
		I_{OUT}=50mA		270	350	
		I_{OUT}=100mA		320	460	
		I_{OUT}=150mA		360	500	
Ground Current	I_{GND}	I_{OUT}=100μA		50		μA
		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 V_{EN} in OFF Mode		0.01	1.0	μA
Power Supply Rejection Ration	PSRR	Ripple 0.5V_{P-P}, f=100Hz V_{IN}=V_{OUT}+1V		60		dB
		Ripple 0.5V_{P-P}, f=1kHz V_{IN}=V_{OUT}+1V		60		
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/(V_{OUT} \times \Delta T)$	I_{OUT}=100μA, -40 °C≤T_J≤125°C		**±100**		ppm/°C
RMS Output Noise	V_{NOI}	T_J=25°C, 10Hz≤f≤100kHz		30		μV_{rms}
ADJ Pin Current	I_{ADJ}	I_{OUT}=100μA		0.5		μA
EN Pin Current	I_{EN}	V_{EN}=V_{OUT}+1V		1		μA
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)	θ_{JC}	SOT-23-5		43		°C/W
		SOT-89		27		
		PSOP-8		22		

Typical Performance Characteristics

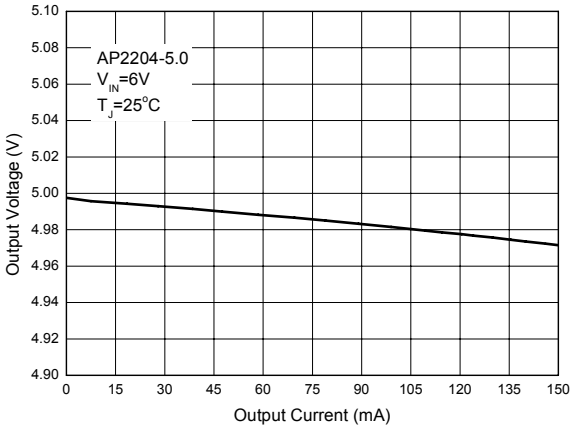


Figure 4. Output Voltage vs. Output Current

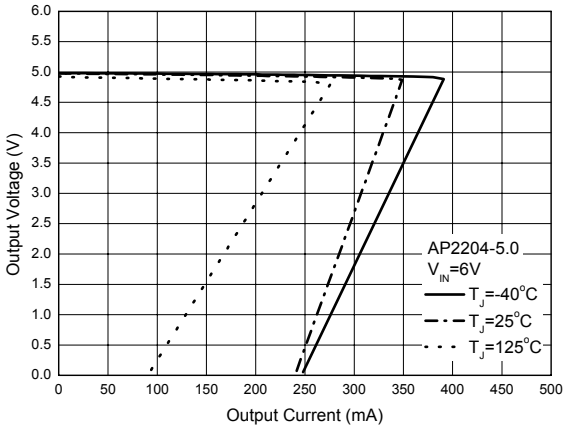


Figure 5. Output Voltage vs. Output Current

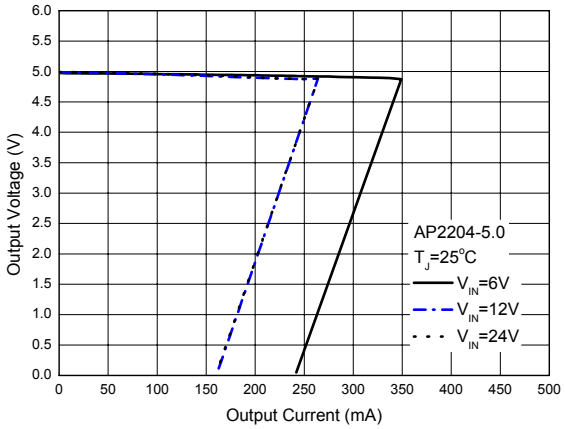


Figure 6. Output Voltage vs. Output Current

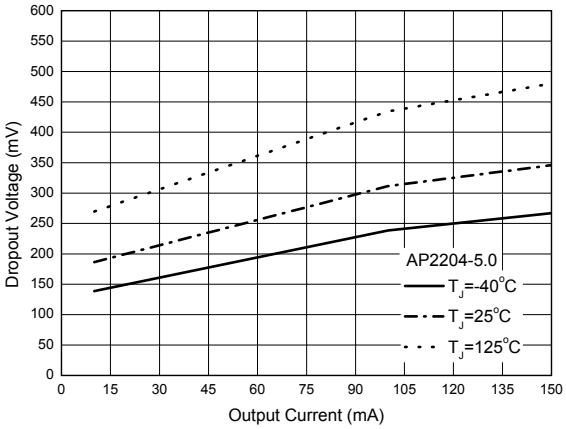


Figure 7. Dropout Voltage vs. Output Current

Typical Performance Characteristics (Continued)

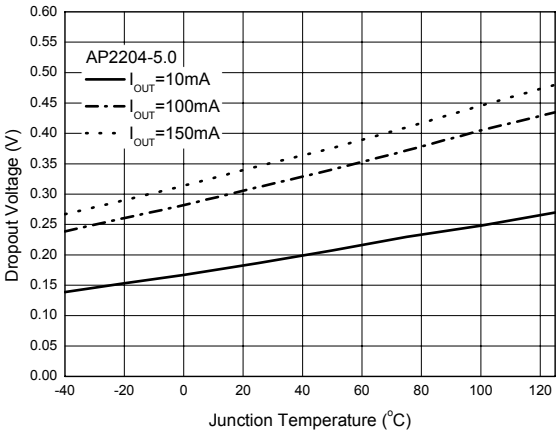


Figure 8. Dropout Voltage vs. Junction Temperature

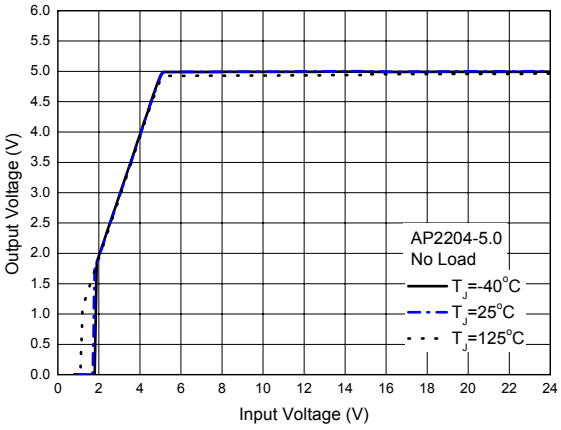


Figure 9. Output Voltage vs. Input Voltage

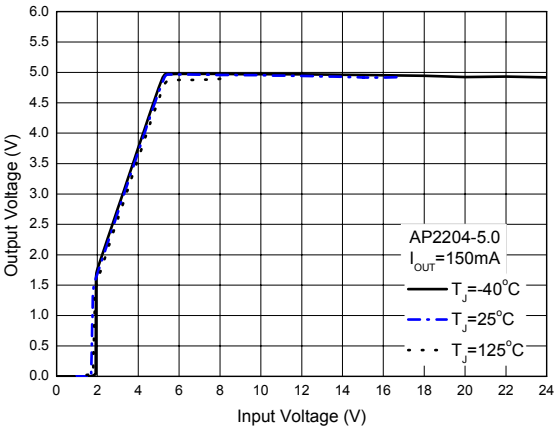


Figure 10. Output Voltage vs. Input Voltage

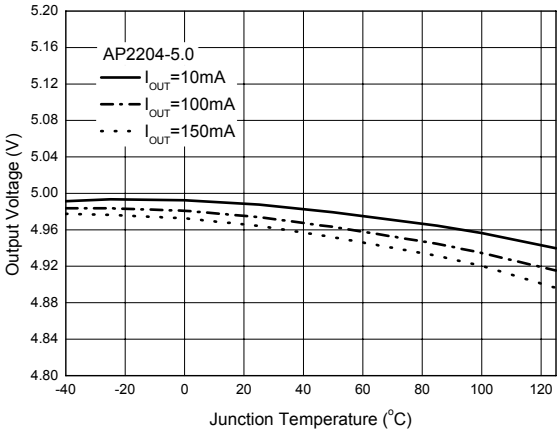


Figure 11. Output Voltage vs. Junction Temperature

Typical Performance Characteristics (Continued)

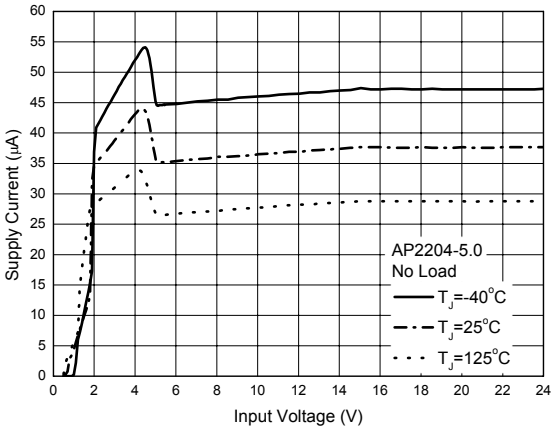


Figure 12. Supply Current vs. Input Voltage

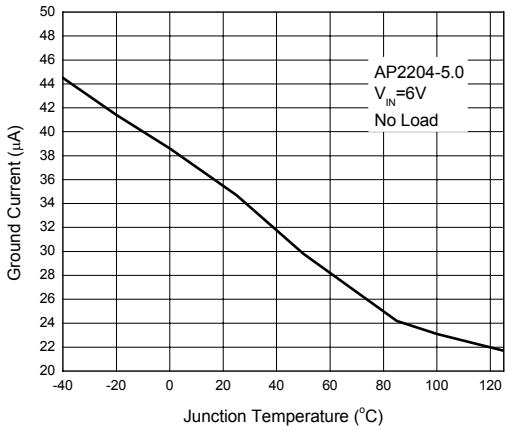


Figure 13. Ground Current vs. Junction Temperature

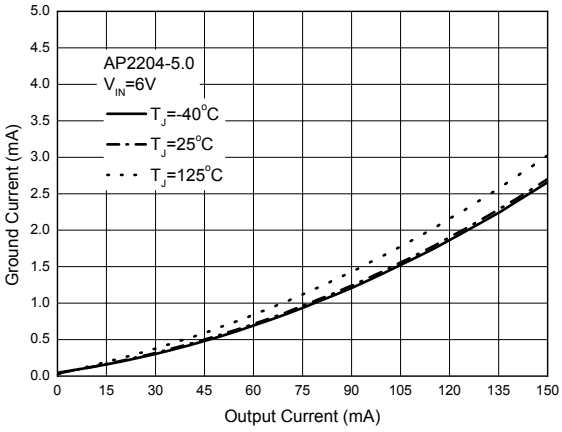


Figure 14. Ground Current vs. Output Current

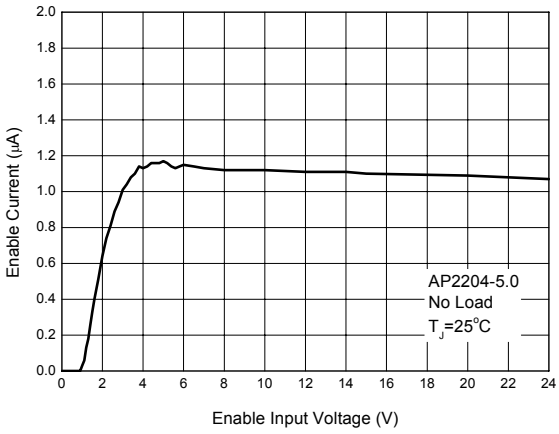


Figure 15. Enable Current vs. Enable Input Voltage

Typical Performance Characteristics (Continued)

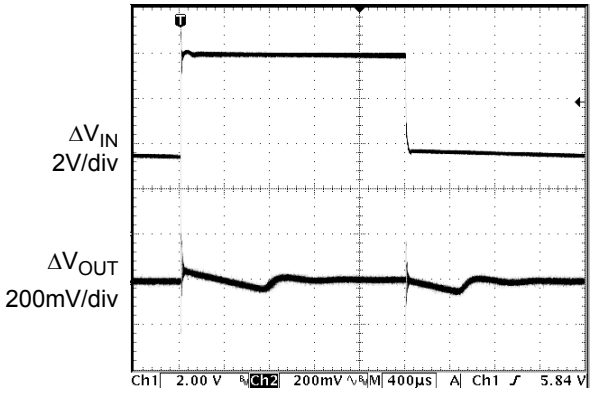


Figure 16. Line Transient
(Conditions: V_{IN}=V_{EN}=3.5V to 8V, C_{IN}=1.0µF, C_{OUT}=2.2µF, I_{OUT}=1mA)

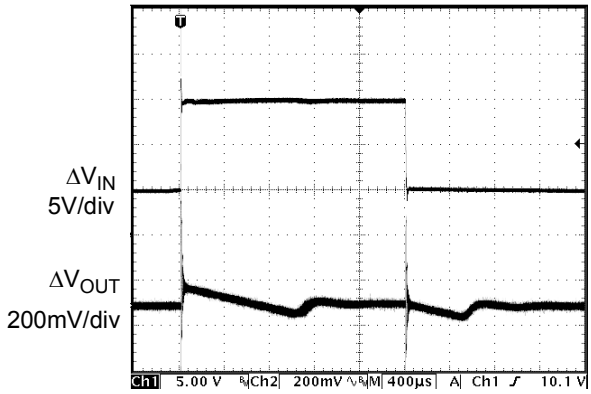


Figure 17. Line Transient
(Conditions: V_{IN}=V_{EN}=5V to 15V, C_{IN}=1.0µF, C_{OUT}=2.2µF, I_{OUT}=1mA)

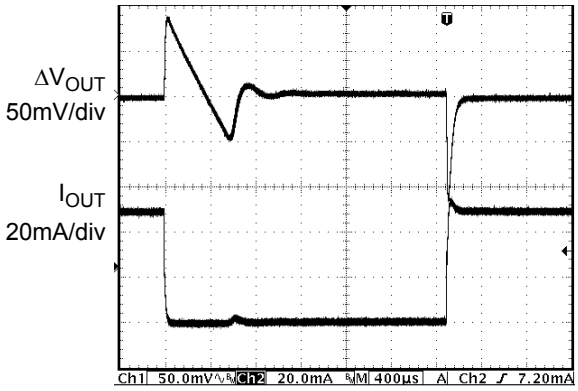


Figure 18. Load Transient
(Conditions: V_{IN}=5V, C_{IN}=1.0µF, C_{OUT}=2.2µF I_{OUT}=1mA to 50mA)

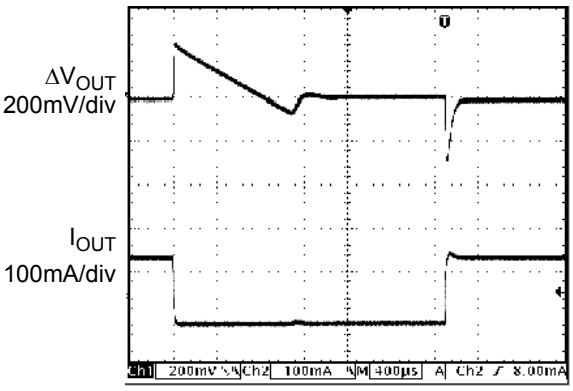


Figure 19. Load Transient
(Conditions: V_{IN}=5V, C_{IN}=1.0µF, C_{OUT}=2.2µF I_{OUT}=1mA to 150mA)

Typical Performance Characteristics (Continued)

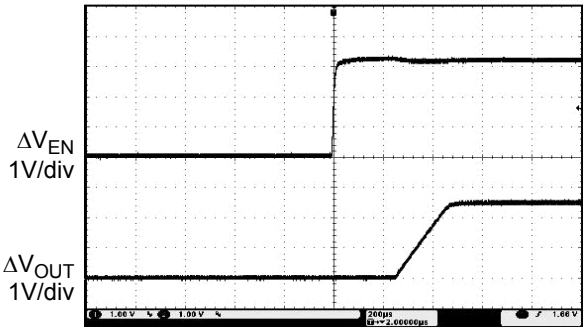


Figure 20. Enable Input Response

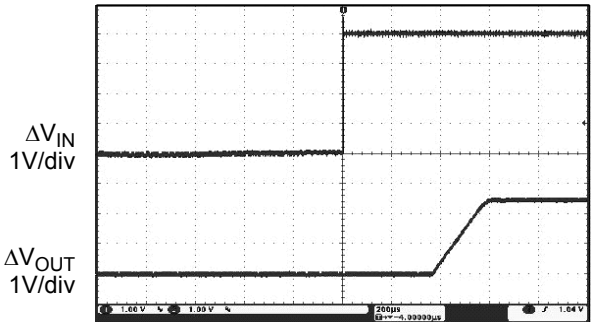


Figure 21. Start-up Response

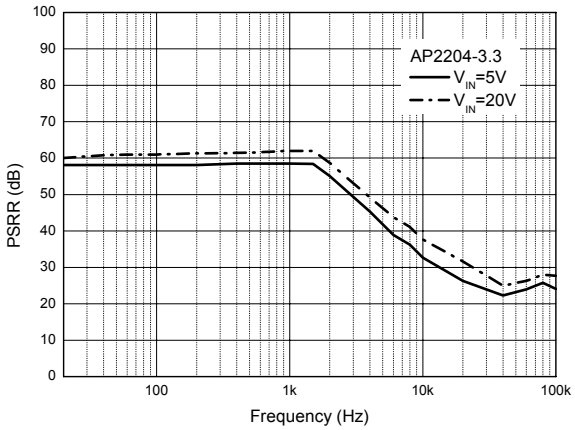


Figure 22. PSRR vs. Frequency
(Conditions: V_{PP}=2V, I_{OUT}=10mA)

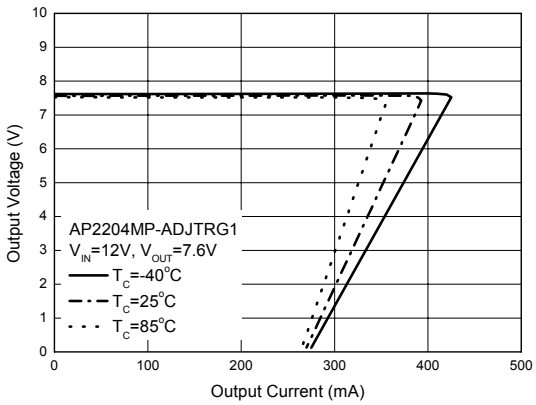


Figure 23. Output Voltage vs. Output Current

Typical Performance Characteristics (Continued)

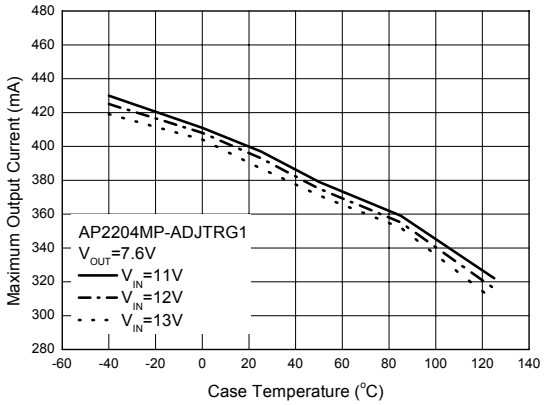


Figure 24. Maximum Output Current vs. Case Temperature

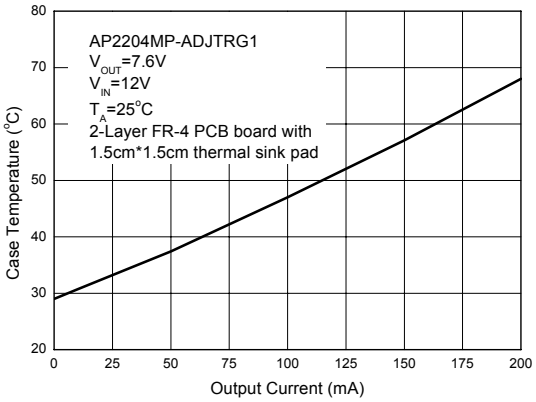


Figure 25. Case Temperature vs. Output Current

Typical Application

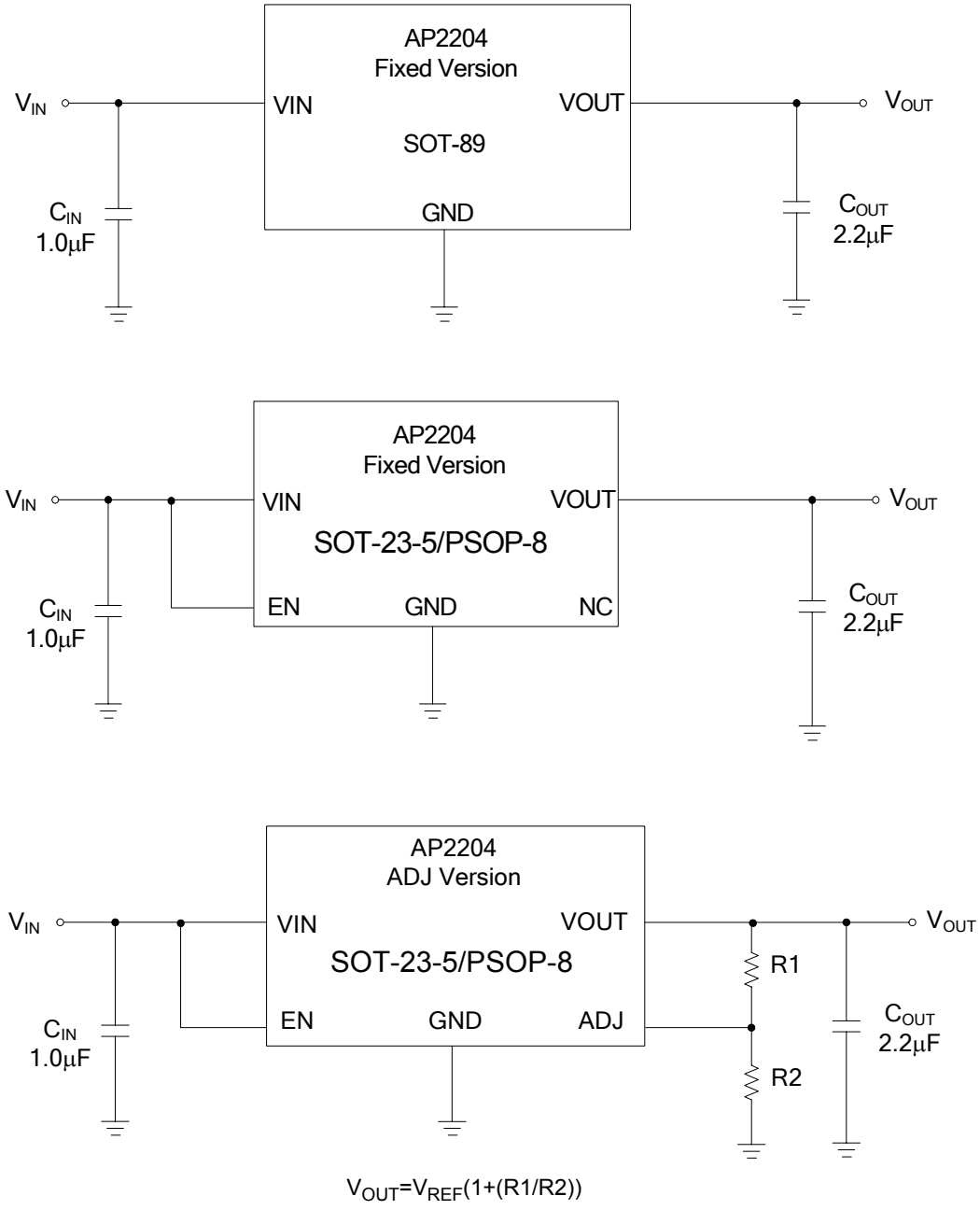
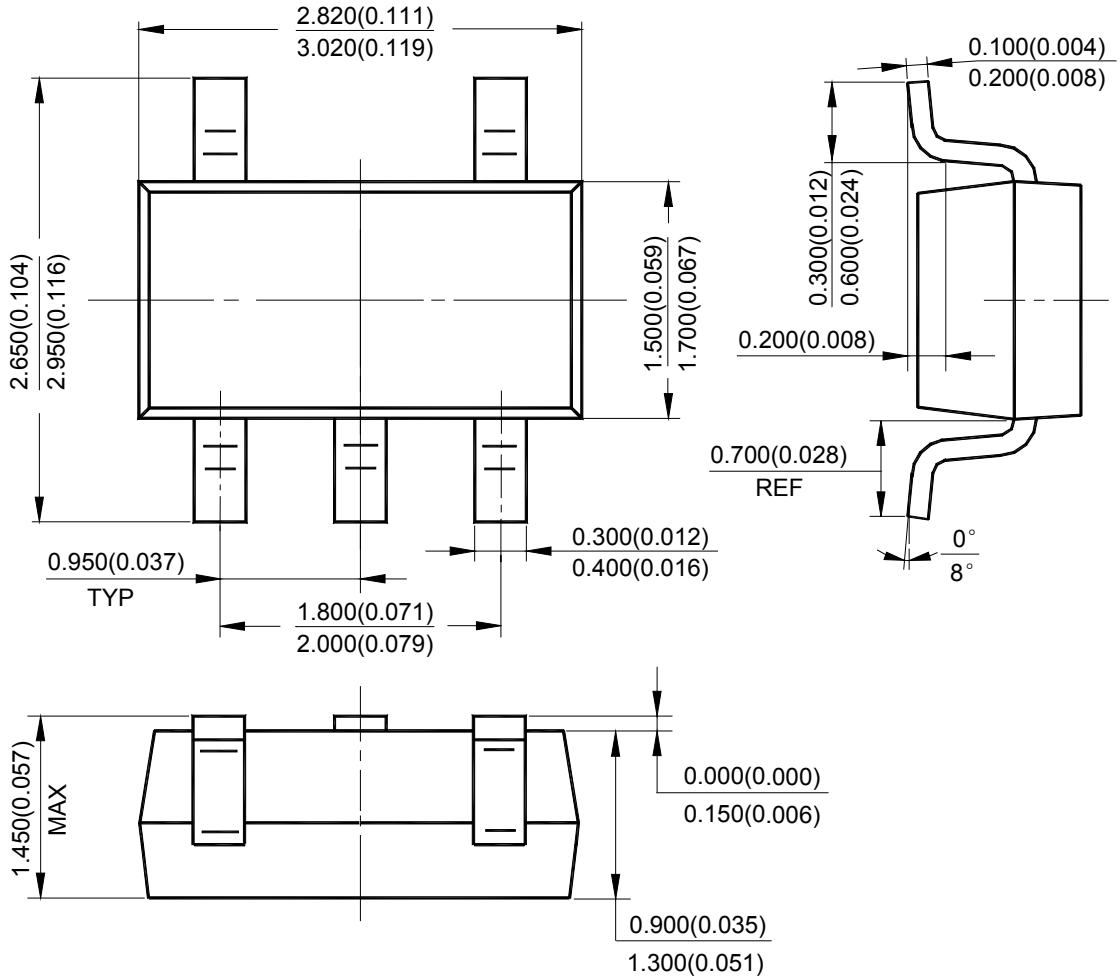


Figure 26. Typical Application of AP2204

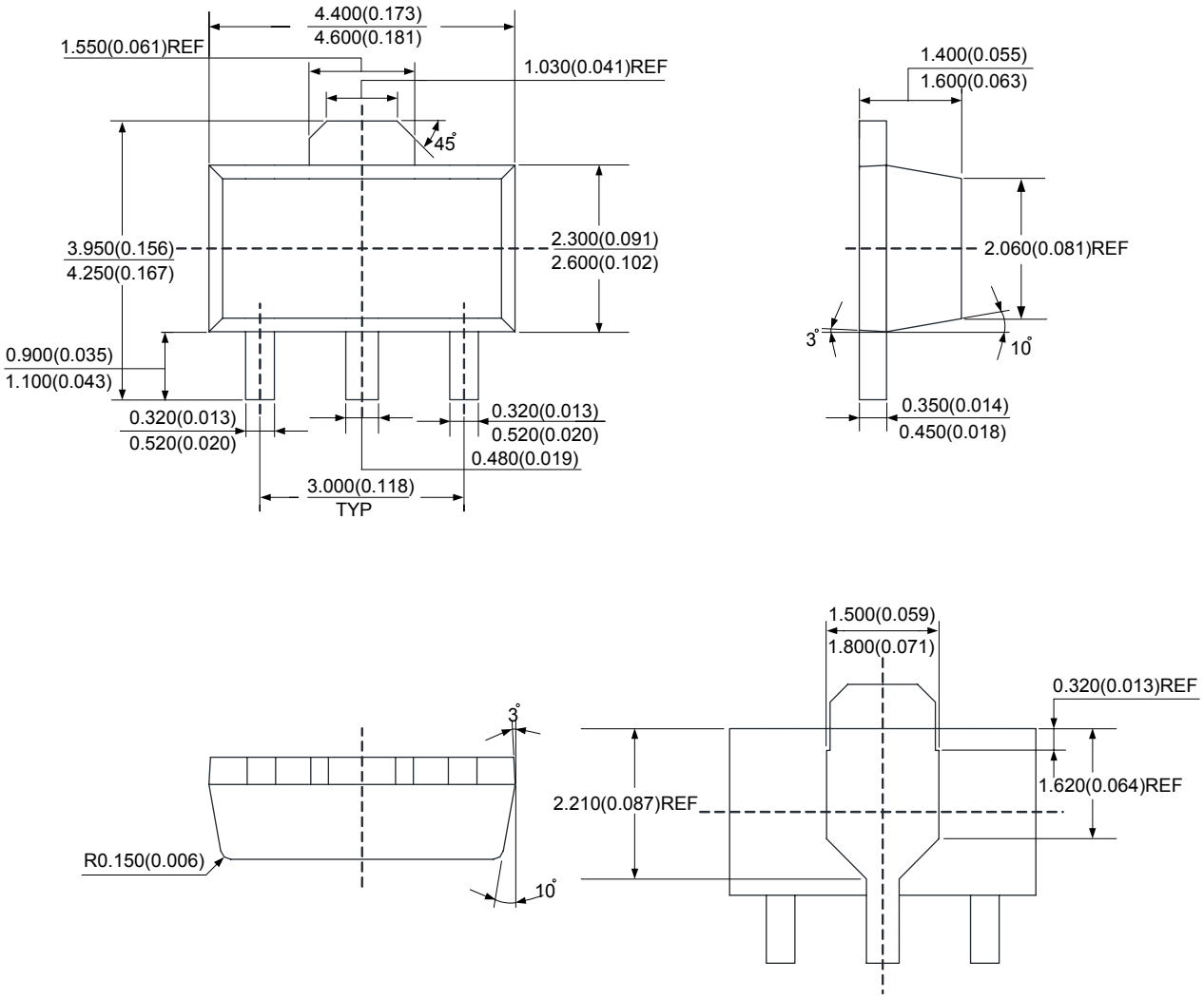
Mechanical Dimensions

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



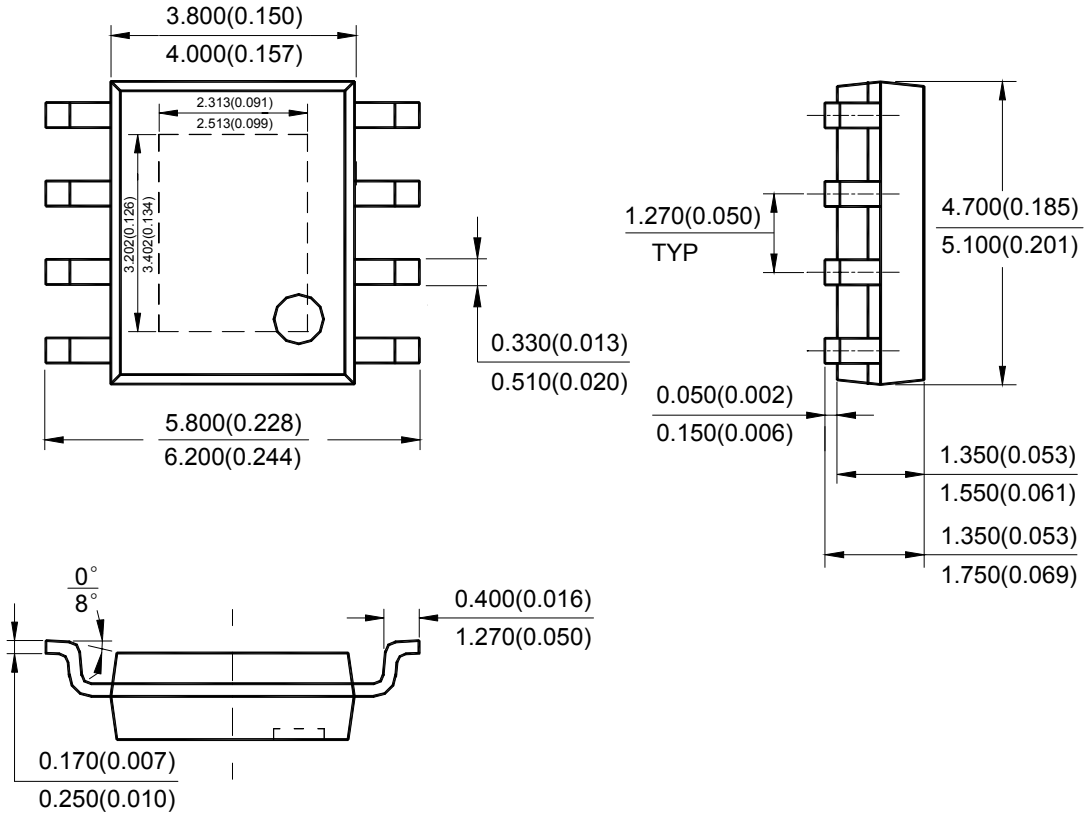
Mechanical Dimensions (Continued)

SOT-89 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

PSOP-8 **Unit: mm(inch)**



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

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