General Description

The VS2204 series is a positive voltage regulator IC fabricated by high voltage EPNP process.

The VS2204 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 VS2204 has 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 5.0V fixed voltage versions and adjustable voltage version.

The VS2204 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 Rejetion: 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
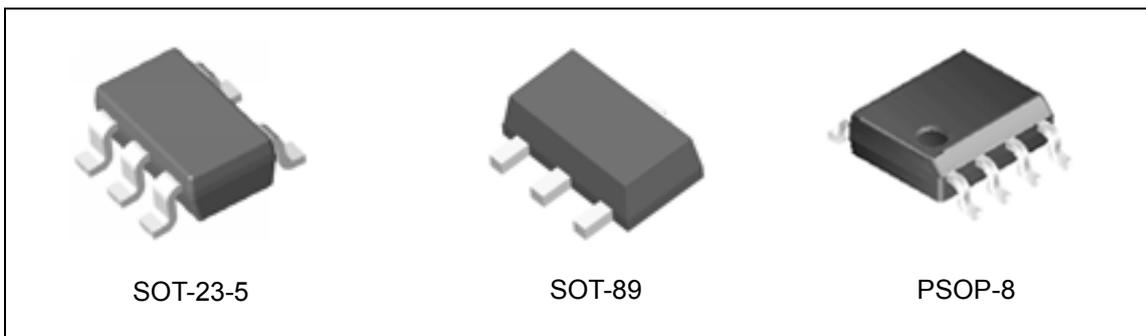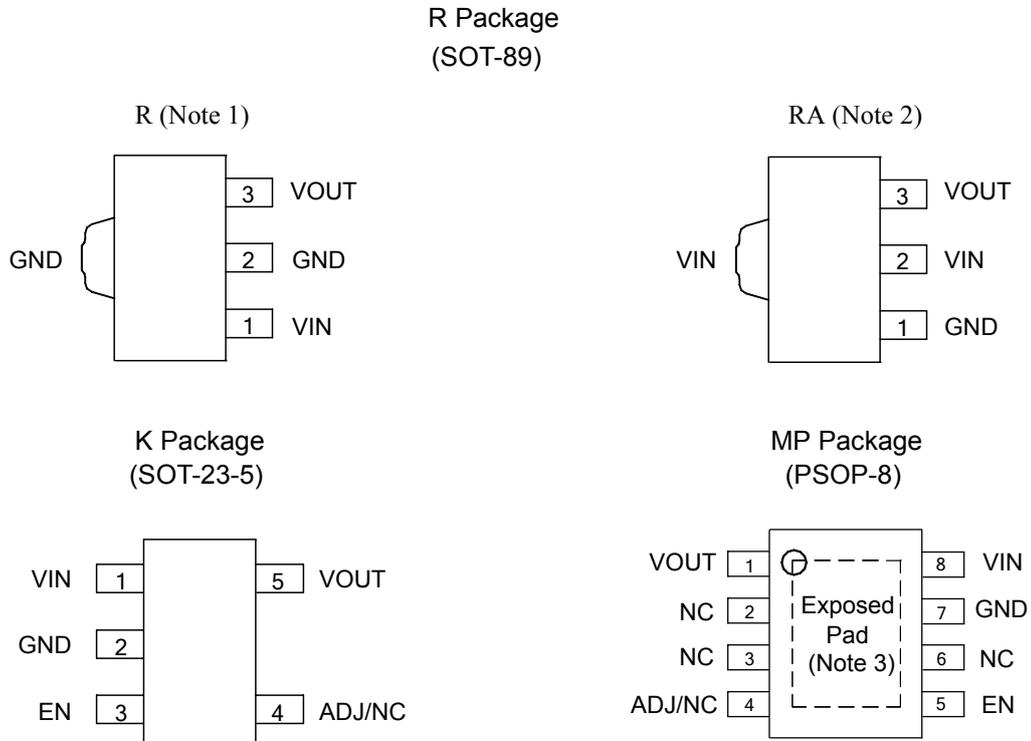- Laptop, Palmtops, Notebook Computers
- Portable Information Appliances

| SOT-23-5 | SOT-89 | PSOP-8 |

Figure 1. Package Types of VS2204

Pin Configuration

R Package
(SOT-89)

R (Note 1)

RA (Note 2)

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 VS2204 (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

VSS SEMICONDUCTOR

Functional Block Diagram
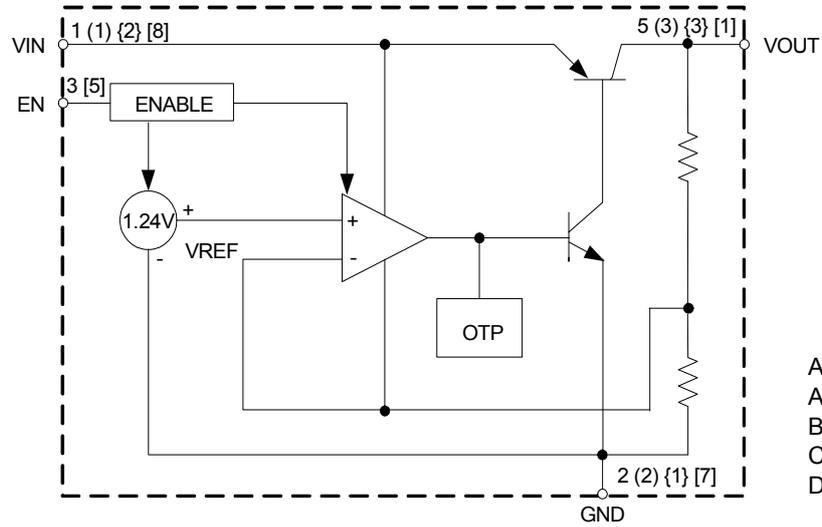
A (B) {C} [D]
A for SOT-23-5
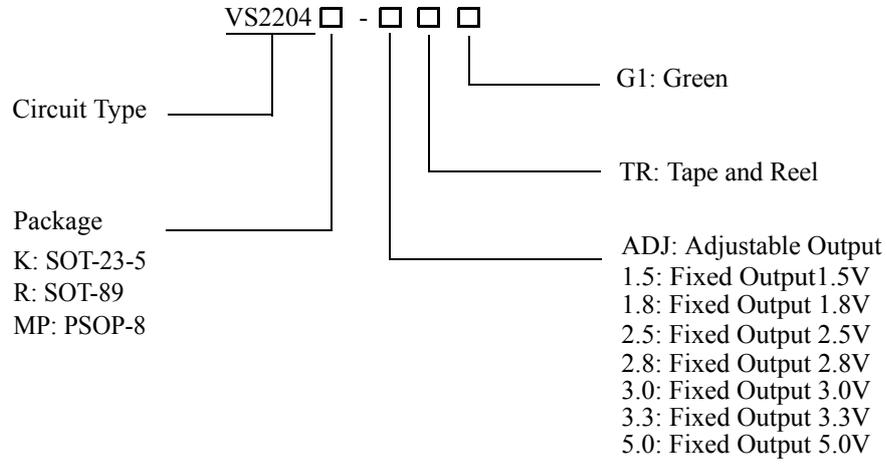B for SOT-89 (R)
C for SOT-89 (RA)
D for PSOP-8

Fixed Output Voltage
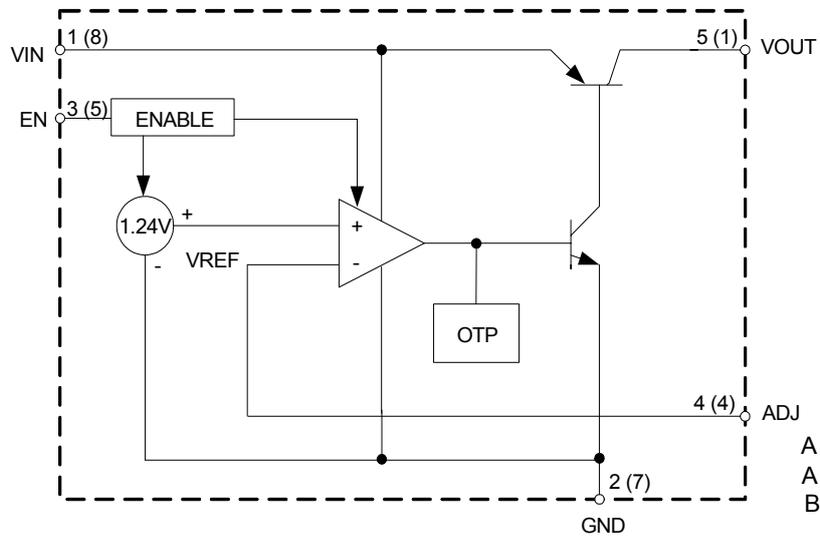
A (B)
A for SOT-23-5
B for PSOP-8

Adjustable Output Voltage

Figure 3. Functional Block Diagram of VS2204

Ordering Information

VS2204☐ - ☐ ☐ ☐

Circuit Type ────────

Package
K: SOT-23-5
R: SOT-89
MP: PSOP-8

G1: Green

TR: Tape and Reel

ADJ: Adjustable Output
1.5: Fixed Output1.5V
1.8: Fixed Output 1.8V
2.5: Fixed Output 2.5V
2.8: Fixed Output 2.8V
3.0: Fixed Output 3.0V
3.3: Fixed Output 3.3V
5.0: Fixed Output 5.0V

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		ºC
Operating Junction Temperature	T_J	150		ºC
Thermal Resistance	θ_{JA}	SOT-23-5	250	ºC/W
		SOT-89	165	
		PSOP-8 (Note 5）	51	
Storage Temperature Range	T_{STG}	-65 to 150		ºC
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	ºC

Electrical Characteristics

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

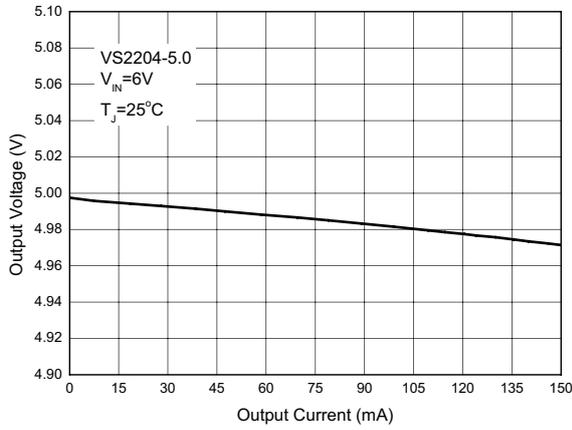| Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_{OUT}	Variation from Specified V_{OUT}		$V_{OUT} \times 98\%$		$V_{OUT} \times 102\%$	V
Reference Voltage	V_{REF}			1.215	1.24	1.265	V
Input Voltage	V_{IN}					24	V
Maximum Output Current	$I_{OUT(max)}$	$V_{IN}-V_{OUT}=1V$ $V_{OUT}=98\% \times V_{OUT}$		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		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 $0.5V_{P-P}$ $V_{IN}=V_{OUT}+1V$	f=100Hz		60		dB
			f=1kHz		60		
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/(V_{OUT} \times \Delta T)$	$I_{OUT}=100\mu A$, $-40^oC \leq T_J \leq 125^oC$			**±100**		ppm/^oC
RMS Output Noise	V_{NOI}	$T_J=25^oC$, $10Hz \leq f \leq 100kHz$			30		μV_{rms}
ADJ Pin Current	I_{ADJ}	$I_{OUT}=100\mu A$			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		^oC/W
		SOT-89			27		
		PSOP-8			22		

Typical Performance Characteristics

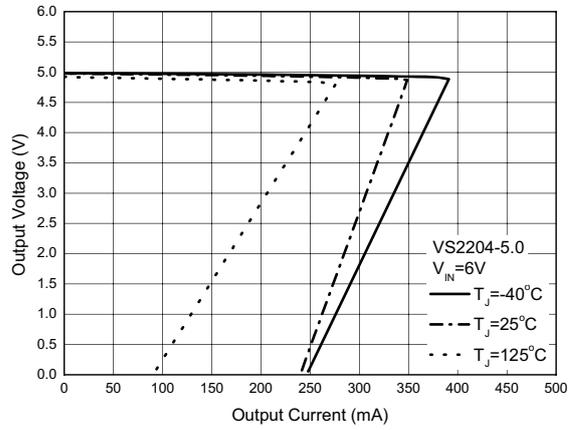Figure 4. Output Voltage vs. Output Current
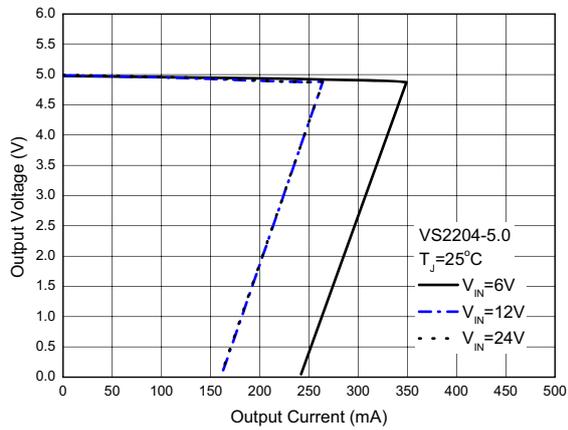

Figure 5. Output Voltage vs. Output Current

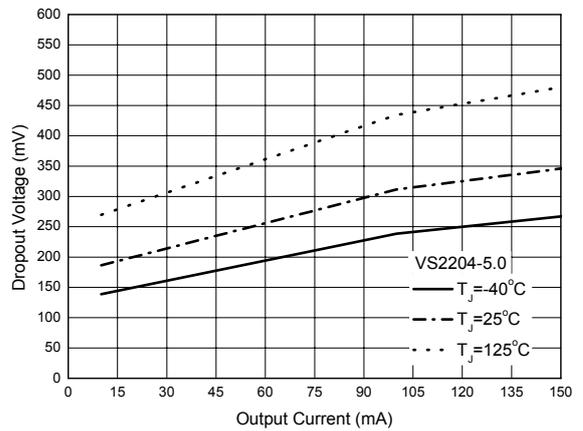Figure 6. Output Voltage vs. Output Current

Figure 7. Dropout Voltage vs. Output Current

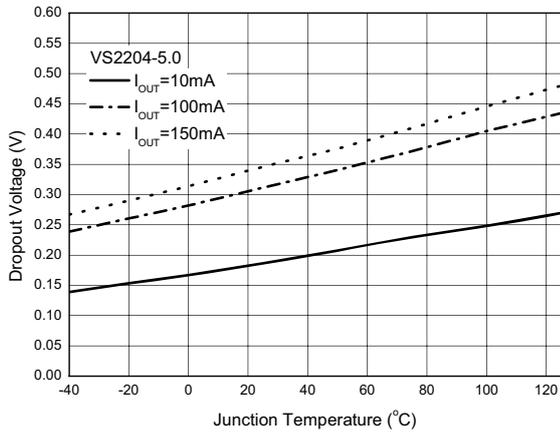## Typical Performance Characteristics (Continued)

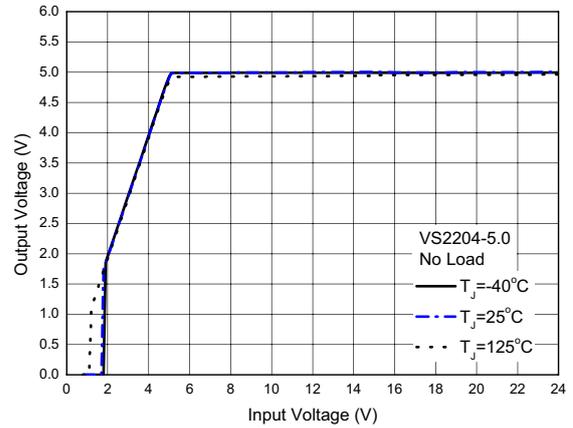Figure 8. Dropout Voltage vs. Junction Temperature
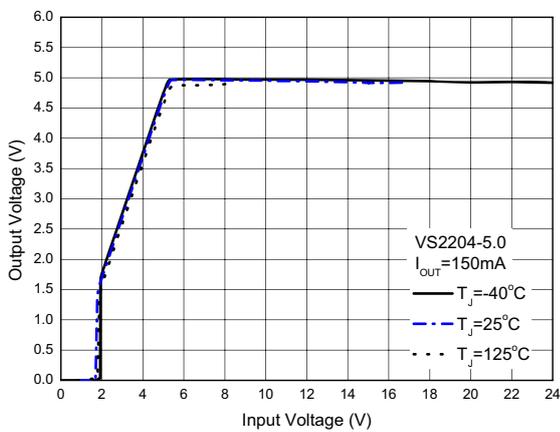

Figure 9. Output Voltage vs. Input Voltage
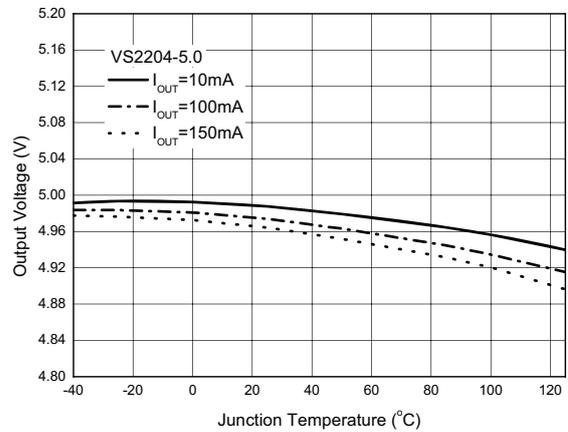

Figure 10. Output Voltage vs. Input Voltage

Figure 11. Output Voltage vs. Junction Temperature

Typical Performance Characteristics (Continued)
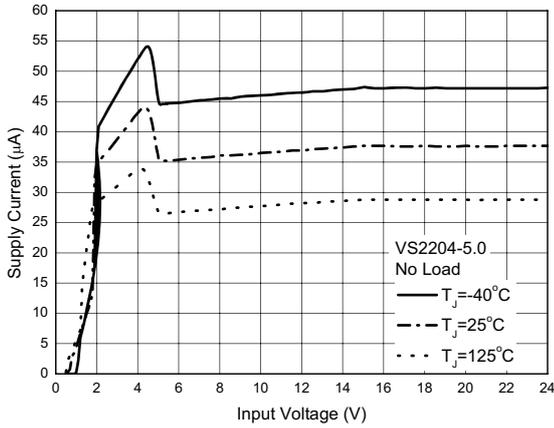
Figure 12. Supply Current vs. Input Voltage
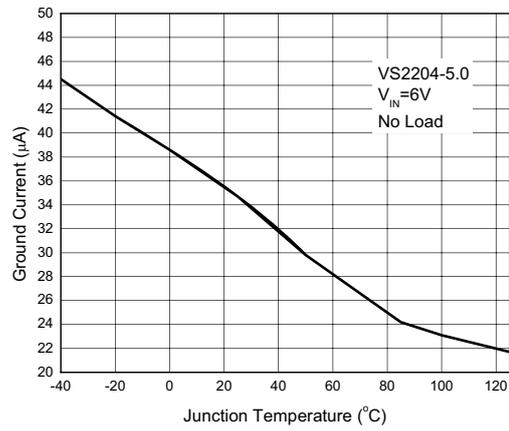
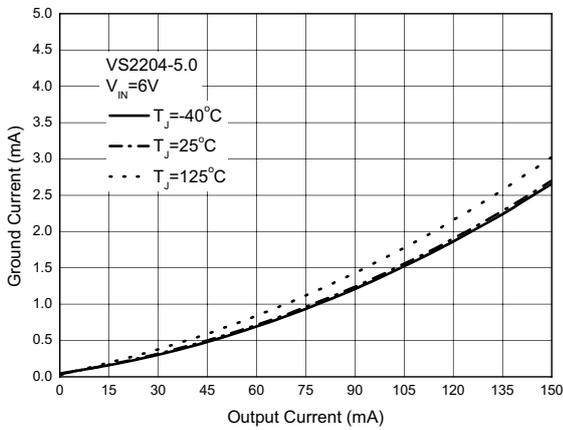Figure 13. Ground Current vs. Junction Temperature

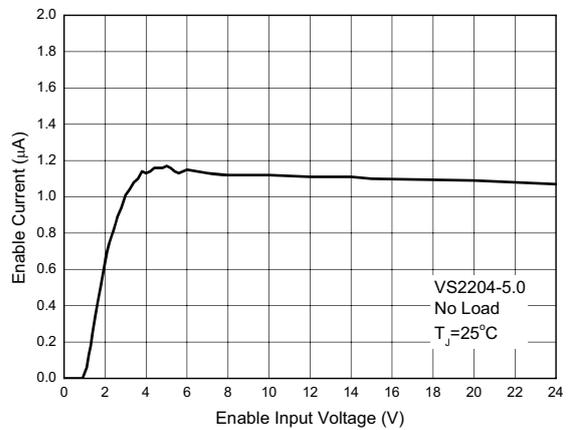Figure 14. Ground Current vs. Output Current

Figure 15. Enable Current vs. Enable Input Voltage

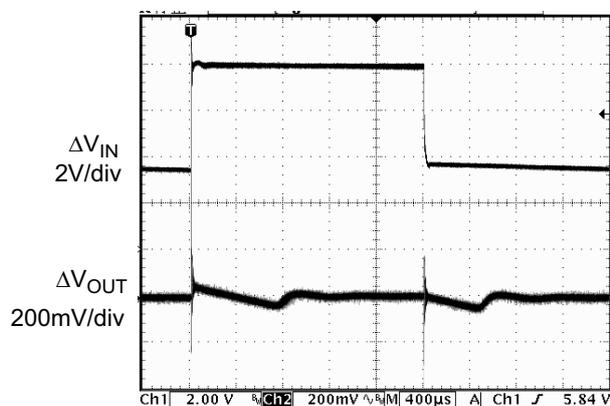## Typical Performance Characteristics (Continued)

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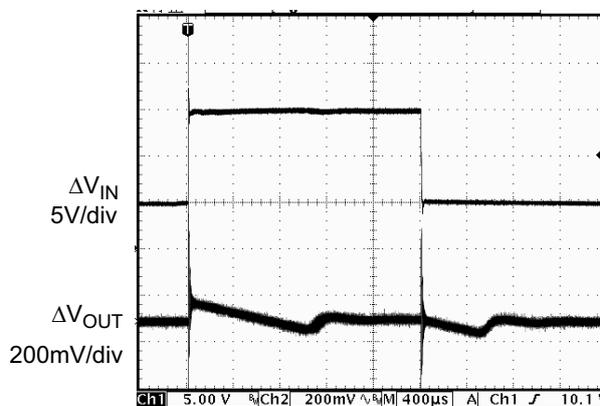$C_{OUT}=2.2\mu F$, $I_{OUT}=1mA$)

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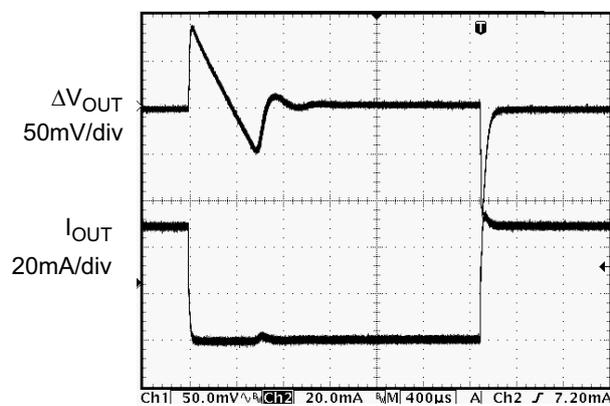$C_{OUT}=2.2\mu F$, $I_{OUT}=1mA$)

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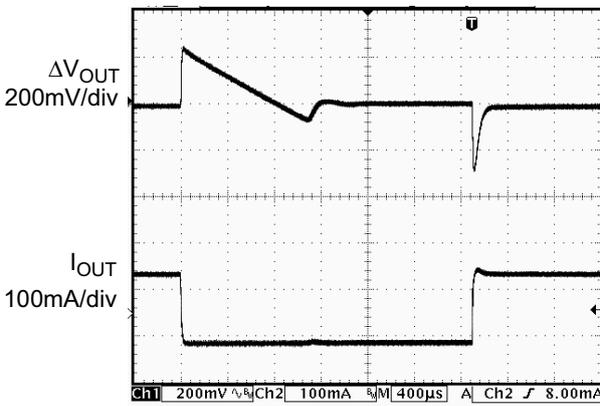(Conditions: $V_{IN}=5V$, $C_{IN}=1.0\mu F$, $C_{OUT}=2.2\mu F$
$I_{OUT}=1mA$ to $50mA$)

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)
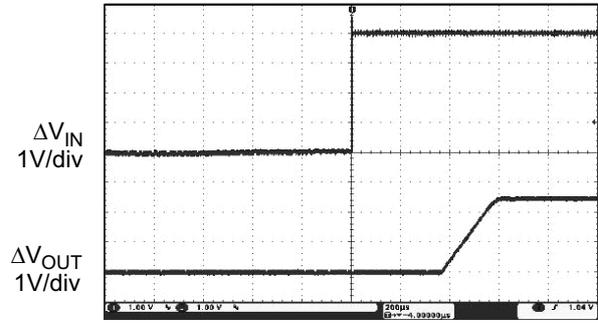

Figure 20. Enable Input Response

Figure 21. Start-up Response

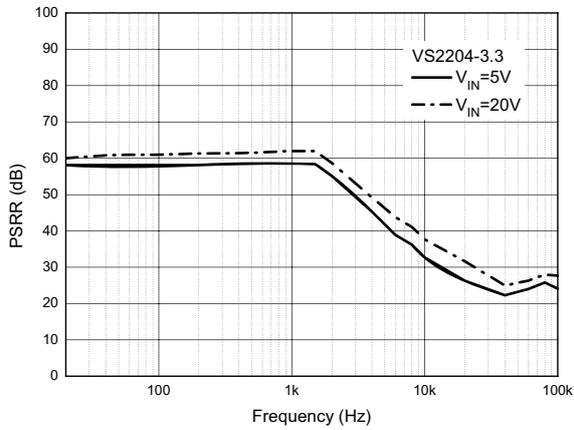Figure 22. PSRR vs. Frequency

(Conditions: V_{PP}=2V, I_{OUT}=10mA)
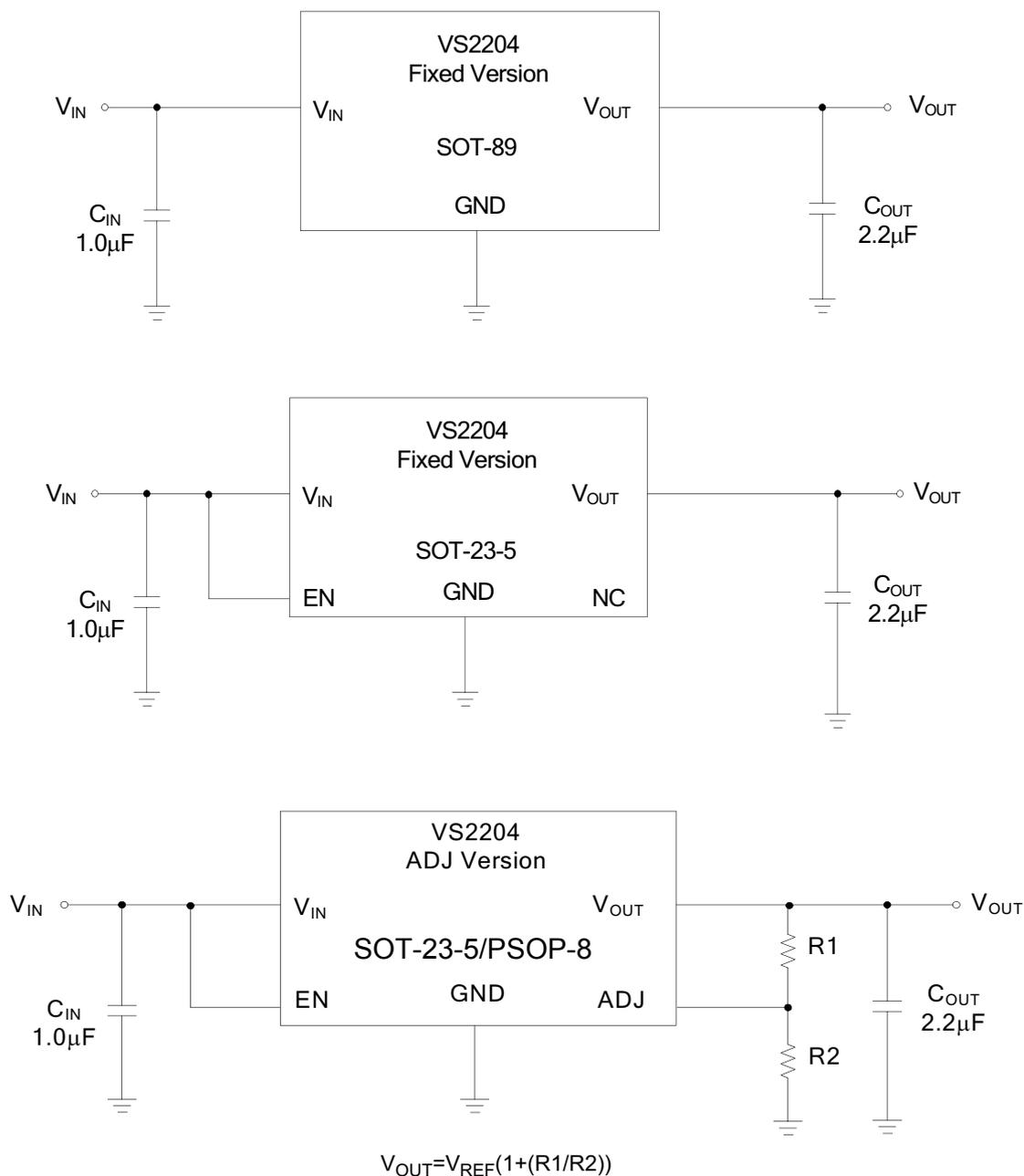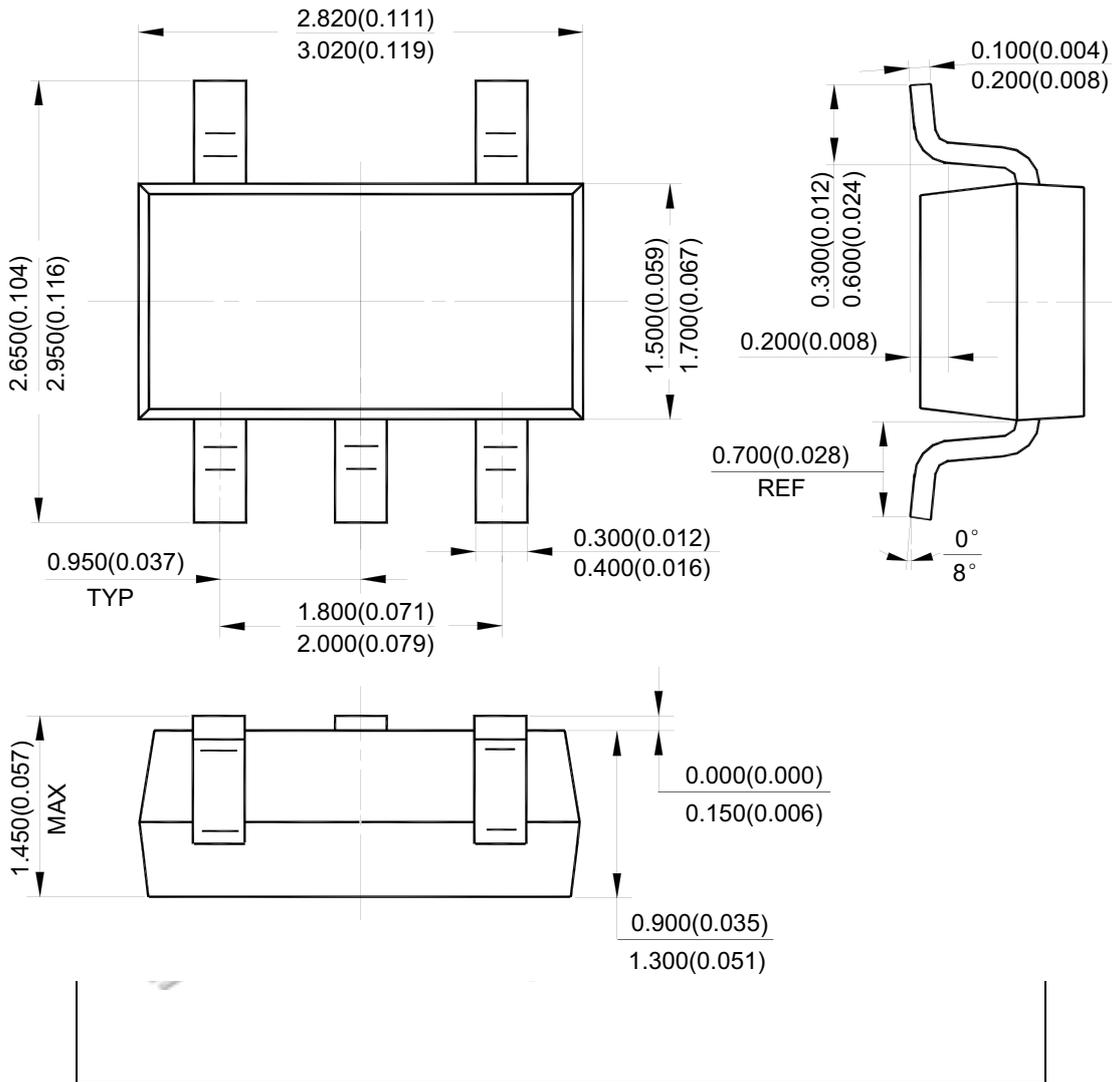
Typical Application

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

Figure 23. Typical Application of VS2204

Mechanical Dimensions

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

Mechanical Dimensions

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

4.400(0.173)
4.600(0.181)

1.630(0.064)
1.830(0.072)

1.400(0.055)*

0.000(0.000)
0.076(0.003)

R0.200(0.008)

3.950(0.156)
4.250(0.167)

0.900(0.035)

1.200(0.047)

2.300(0.091)
2.600(0.102)

0.360(0.014)
0.520(0.020)

0.360(0.014)
0.480(0.019)

0.440(0.017)
0.560(0.022)

3.000(0.118)

1.400(0.055)
1.600(0.063)

3°   10°

0.360(0.014)
0.440(0.017)

3°

10°

R0.150(0.006)

VSS
SEMICONDUCTOR
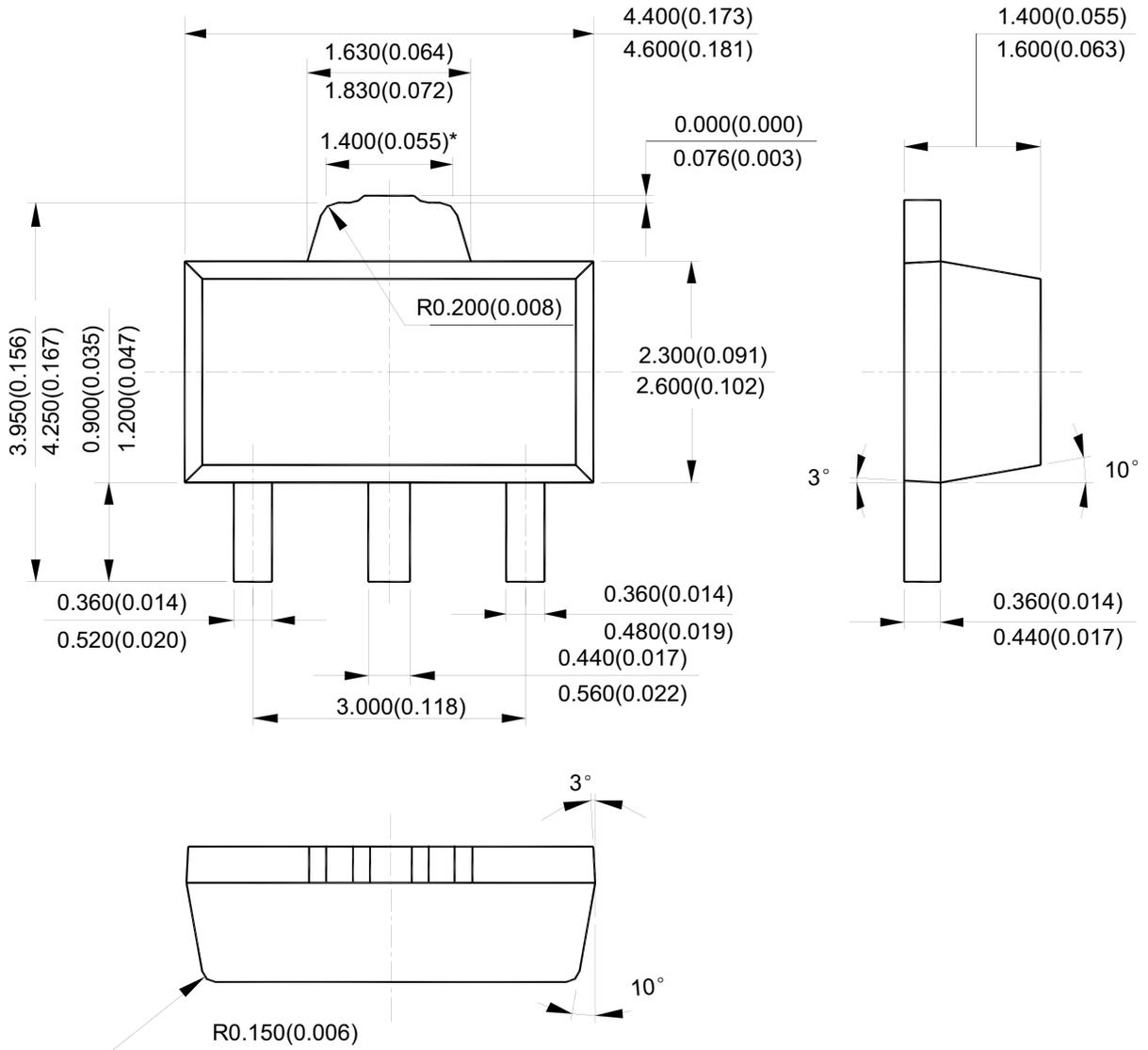
Mechanical Dimensions (Continued)

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

3.800(0.150)
4.000(0.157)

2.313(0.091)
2.513(0.099)

3.202(0.126)
3.402(0.134)

0.330(0.013)
0.510(0.020)

5.800(0.228)
6.200(0.244)

1.270(0.050)
TYP

4.700(0.185)
5.100(0.201)

0.050(0.002)
0.150(0.006)

1.350(0.053)
1.550(0.061)

1.350(0.053)
1.750(0.069)

0°
8°

0.400(0.016)
1.270(0.050)

0.170(0.007)
0.250(0.010)
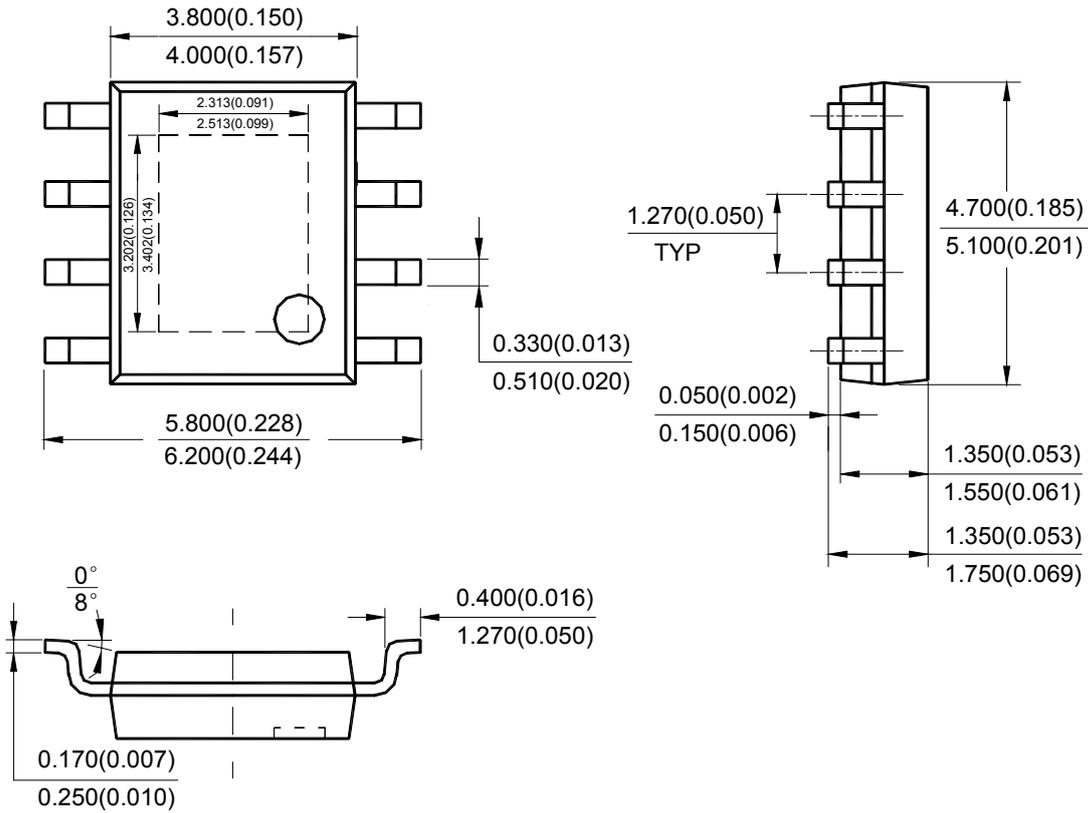
Note: Eject hole, oriented hole and mold mark is optional.