WIDE INPUT VOLTAGE RANGE, 150mA ULDO REGULATOR

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: 2.6V 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
- **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-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

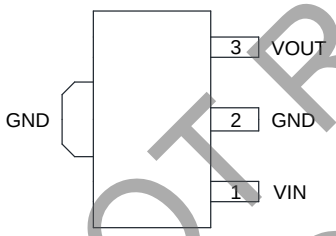
Applications

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

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.

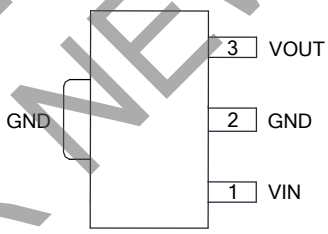
Pin Assignments

(Top View)



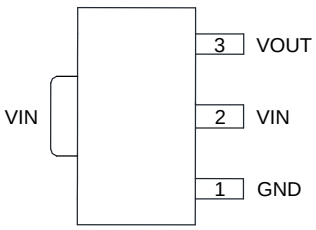
SOT-89 (Option 1)
R (Note 4)

(Top View)



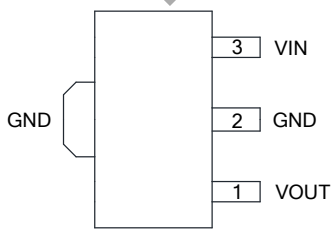
SOT-89 (Option 2)
R (Note 4)

(Top View)



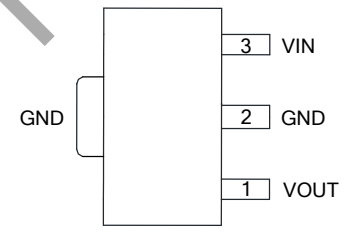
SOT-89 (Option 2)
RA (Note 5)

(Top View)



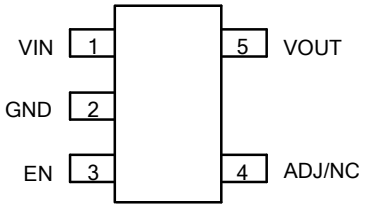
SOT-89 (Option 1)
RB (Note 4)

(Top View)



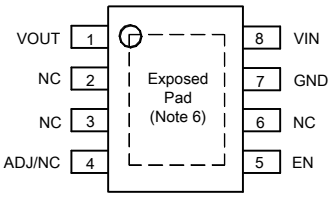
SOT-89 (Option 2)
RB (Note 4)

(Top View)



SOT-23-5

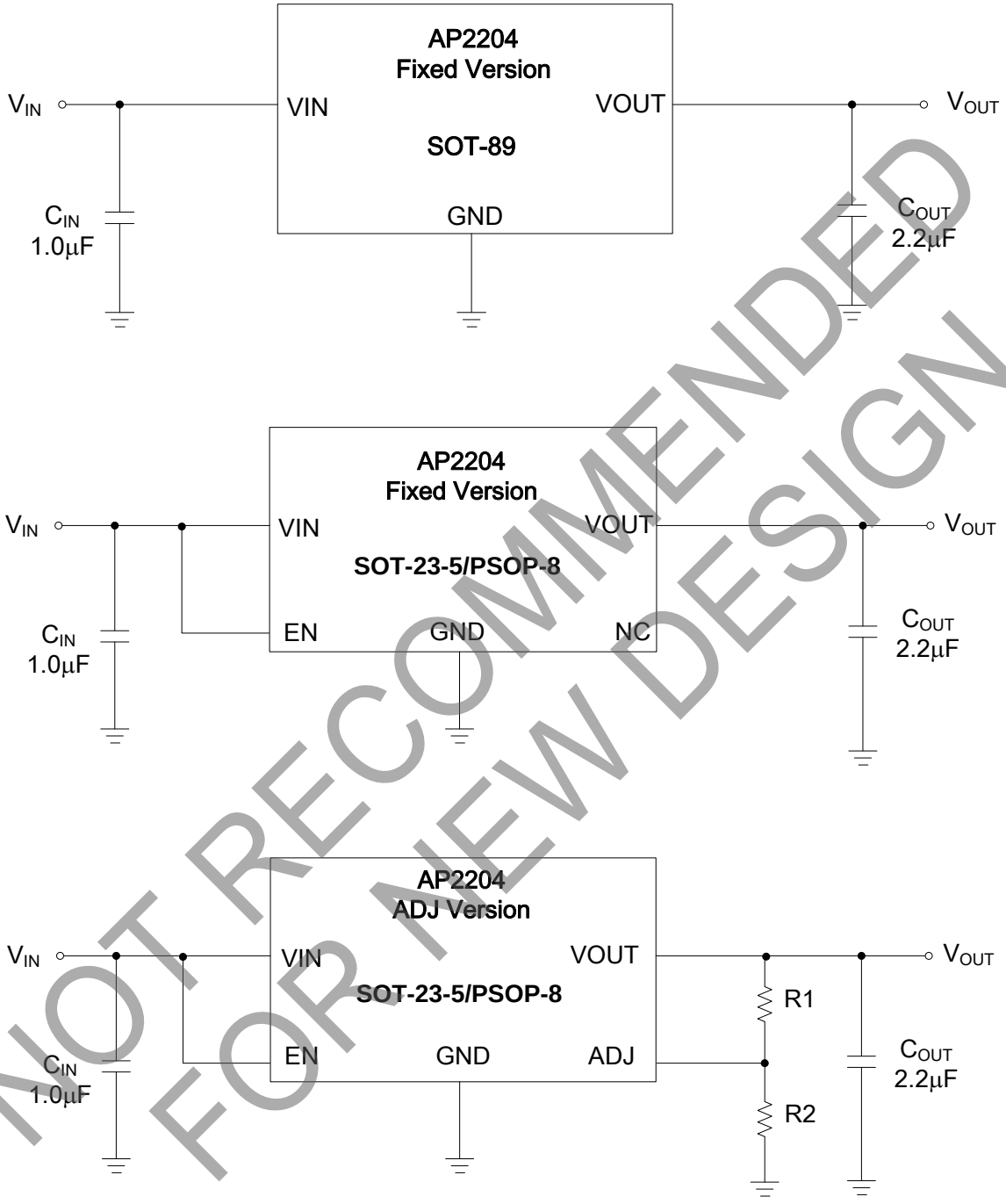
(Top View)



PSOP-8

Notes: 4. The substrate/exposed pad should be connected to GND.
5. The substrate/exposed pad should be connected to VIN.
6. The exposed pad should be connected to GND for better dissipation.

Typical Applications Circuit

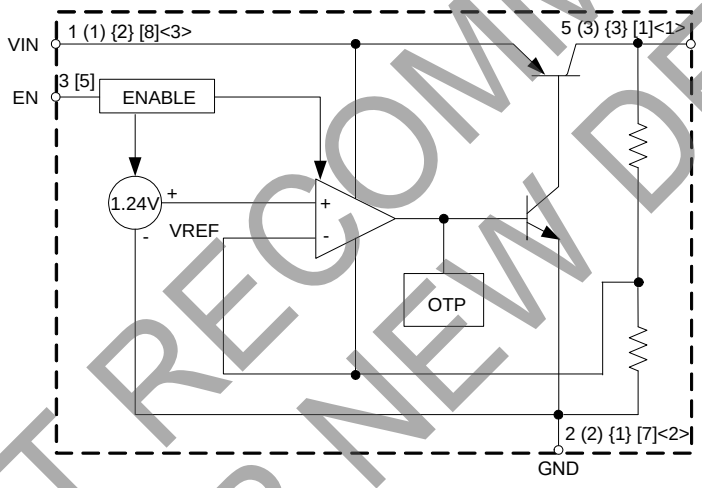


$V_{OUT}=V_{REF}(1+(R1/R2))$

Pin Descriptions

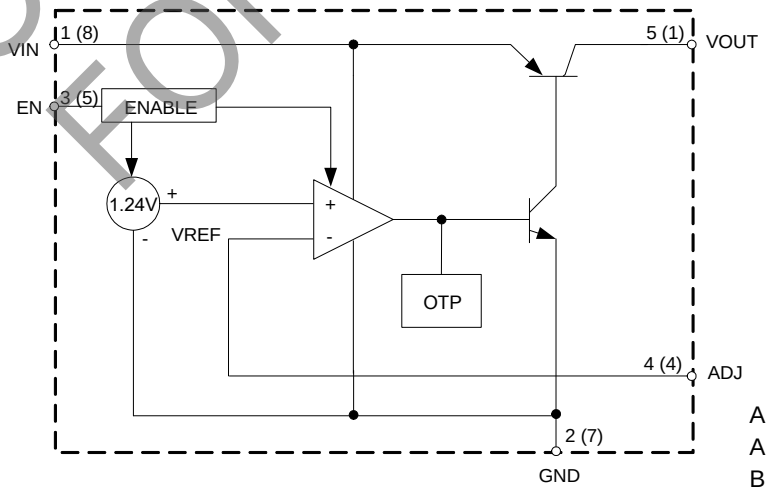
Pin Number					Pin Name	Function
SOT-23-5	PSOP-8	SOT-89				
		R	RA	RB		
1	8	1	2	3	VIN	Input voltage
2	7	2	1	2	GND	Ground
3	5	—	—	—	EN	Enable input
4	4	—	—	—	ADJ/NC	ADJ- Adjust output for ADJ version NC- Not connected for fixed version, Not Connected internally. Recommend connection to GND to maximize PCB copper for thermal dissipation.
5	1	3	3	1	VOUT	Regulated output voltage

Functional Block Diagram



A (B) {C} [D] <E>
A for SOT-23-5
B for SOT-89 (R)
C for SOT-89 (RA)
D for PSOP-8
E for SOT-89 (RB)

Fixed Output Voltage



A (B)
A for SOT-23-5
B for PSOP-8

Adjustable Output Voltage

Absolute Maximum Ratings (Note 7)

Symbol	Parameter	Rating		Unit
V_{IN}	Supply Input Voltage	38		V
V_{CE}	Enable Input Voltage	38		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	SOT-23-5	250	°C/W
		SOT-89	165	
		PSOP-8 (Note 8)	51	
T_{STG}	Storage Temperature Range	-65 to +150		°C
—	ESD (Machine Model)	275		V
—	ESD (Human Body Model)	2000		V

Notes: 7. 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.

8. 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	2.6 (Note 9)	24	V
T_J	Operating Junction Temperature	-40	+125	°C

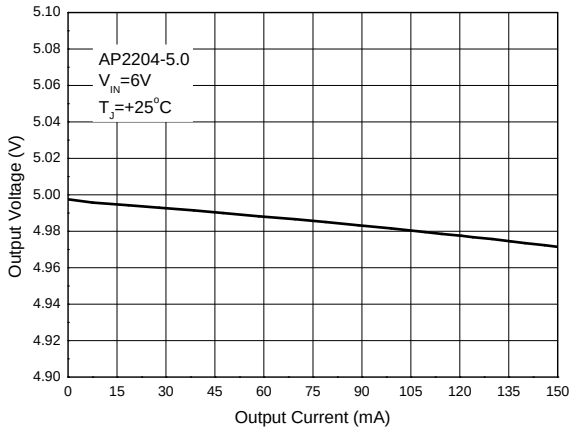
Note: 9. Minimum recommended input voltage is the larger of 2.6V or V_{OUT} + 1V. Below this value the device may enter drop-out conditions and cease to regulate the output voltage correctly.

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.)

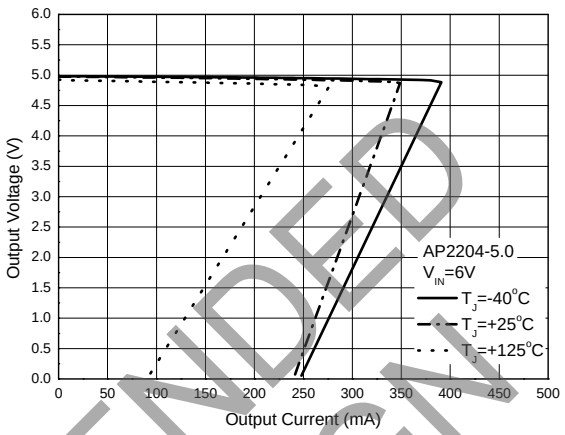
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OUT}	Output Voltage	Variation from Specified V_{OUT}	V_{OUT} ×98%	—	V_{OUT} ×102%	V
V_{REF}	Reference Voltage	—	1.215	1.24	1.265	V
V_{IN}	Input Voltage	—	—	—	24	V
$I_{OUT(max)}$	Maximum Output Current	V_{IN}-V_{OUT} = 1V, V_{OUT} = 98% × V_{OUT}	150	200	—	mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{OUT}+1V ≤ V_{IN} ≤ 24V	—	0.05	—	%
$\Delta V_{OUT}/V_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA	—	0.5	—	%
V_{DROP}	Dropout Voltage	I_{OUT} = 100µA	—	100	150	mV
		I_{OUT} = 50mA	—	270	350	
		I_{OUT} = 100mA	—	320	460	
		I_{OUT} = 150mA	—	360	500	
I_{GND}	Ground Current	I_{OUT} = 0A	—	20	—	µA
		I_{OUT} = 100µA	—	50	—	
		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
		Ripple 0.5V_{P-P}, V_{IN} = V_{OUT}+1V, f = 1kHz	—	60	—	
$\Delta V_{OUT}/(V_{OUT}\times\Delta T)$	Output Voltage Temperature Coefficient	I_{OUT} = 100µA, -40 °C ≤ T_J ≤ +125°C	—	**±100**	—	ppm/°C
V_{NOI}	RMS Output Noise	T_J = +25°C, 10Hz ≤ f ≤ 100kHz	—	30	—	μV_{rms}
I_{ADJ}	ADJ Pin Current	I_{OUT} = 100µA	—	0.5	—	µA
I_{EN}	EN Pin Current	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
θ_{JC}	Thermal Resistance (Junction to Case)	SOT-23-5	—	43	—	°C/W
		SOT-89	—	27	—	
		PSOP-8	—	22	—	

Performance Characteristics

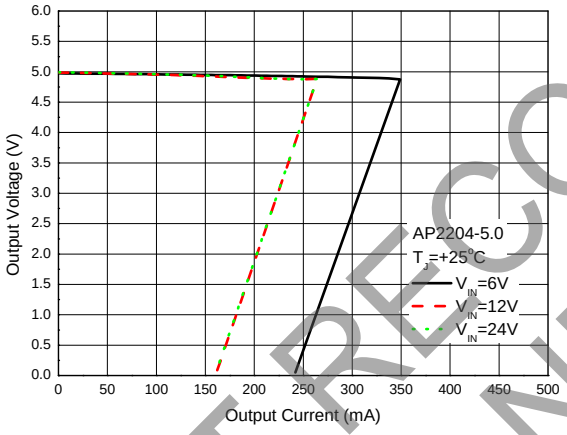
Output Voltage vs. Output Current



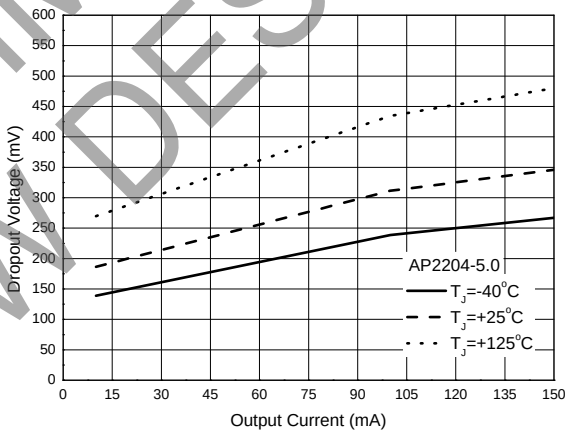
Output Voltage vs. Output Current



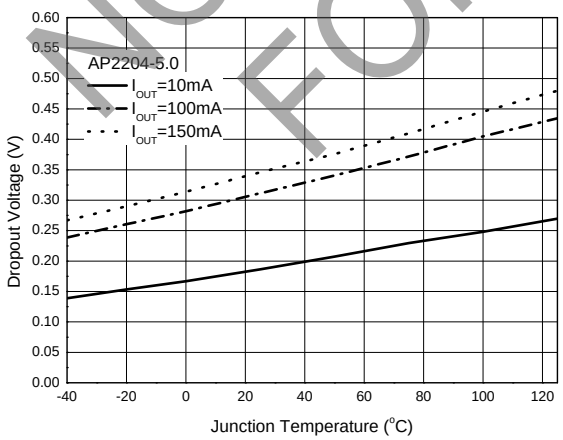
Output Voltage vs. Output Current



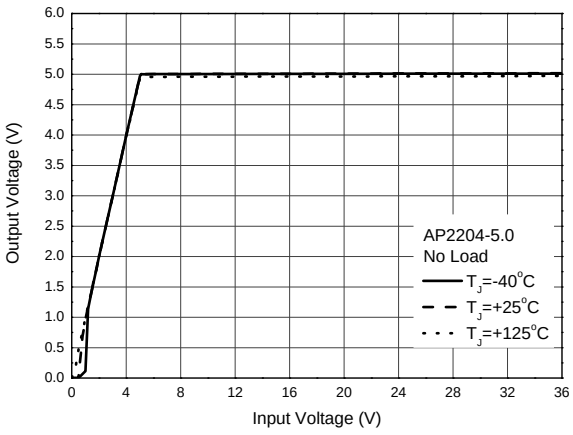
Dropout Voltage vs. Output Current



Dropout Voltage vs. Junction Temperature

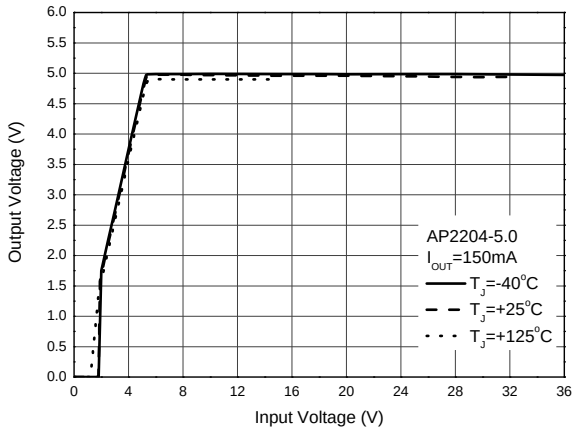


Output Voltage vs. Input Voltage

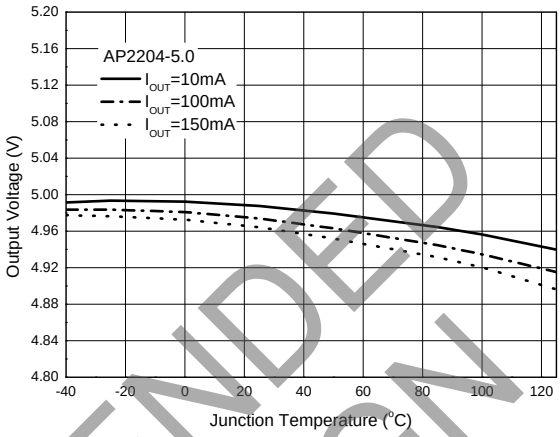


Performance Characteristics (continued)

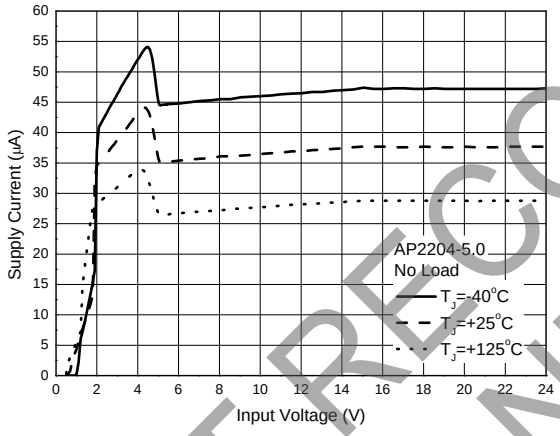
Output Voltage vs. Input Voltage



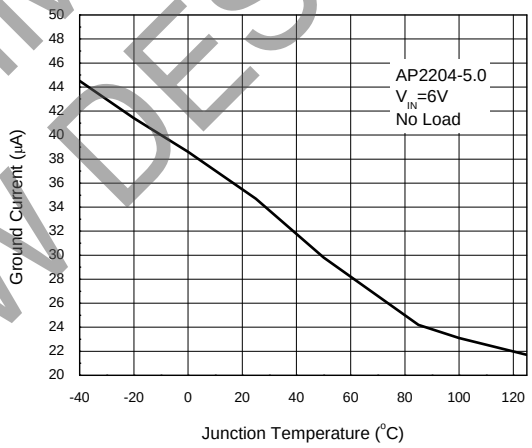
Output Voltage vs. Junction Temperature



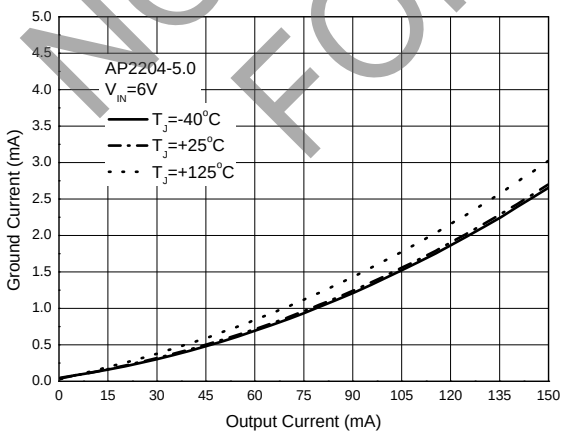
Supply Current vs. Input Voltage



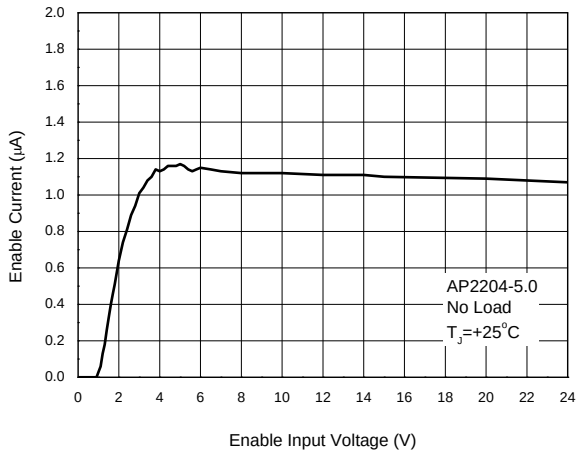
Ground Current vs. Junction Temperature



Ground Current vs. Output Current

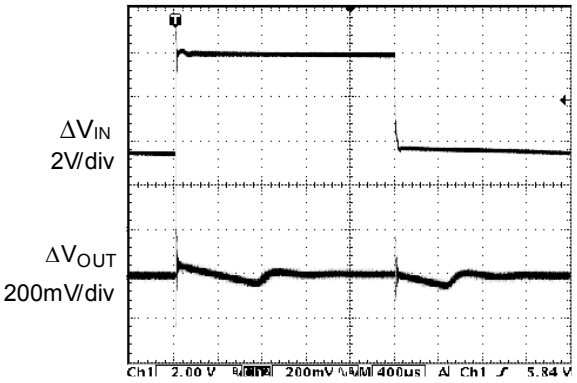


Enable Current vs. Enable Input Voltage

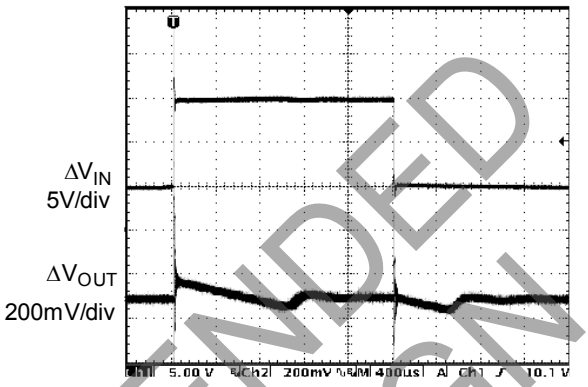


Performance Characteristics (continued)

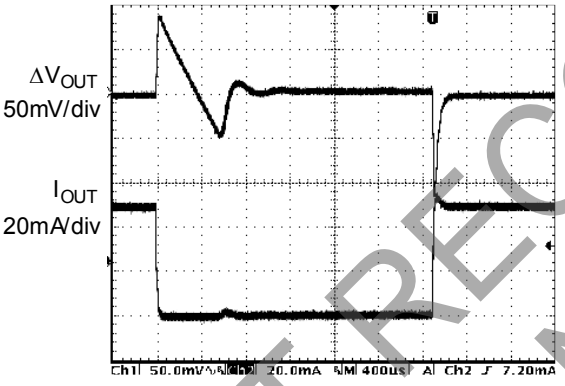
Line Transient
(Conditions: V_{IN}=V_{EN}=3.5V to 8V, C_{IN}=1.0μF, C_{OUT}=2.2μF, I_{OUT}=1mA)



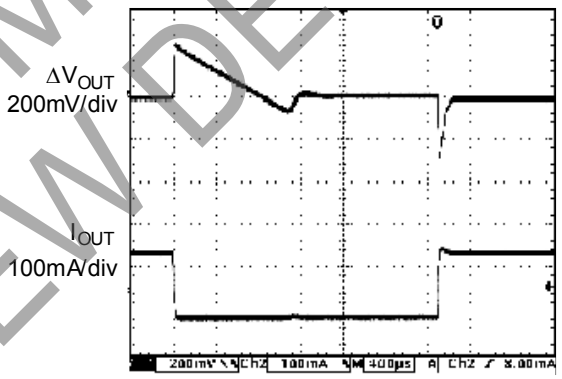
Line Transient
(Conditions: V_{IN}=V_{EN}=5V to 15V, C_{IN}=1.0μF, C_{OUT}=2.2μF, I_{OUT}=1mA)



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



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



Enable Input Response

Start-up Response