



**THE DATASHEET OF
AP2205-33YR-13**



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, overcurrent protection, overtemperature 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.

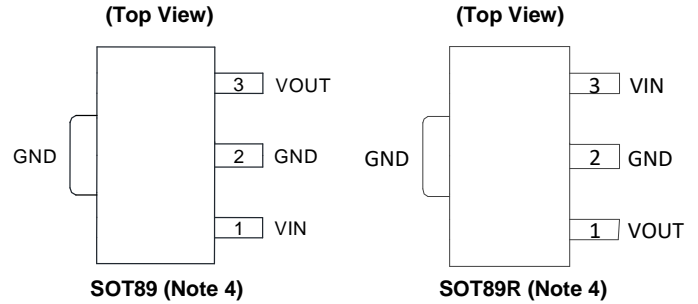
The AP2205 is available in the space-saving SOT25 and SOT89 packages.

Features

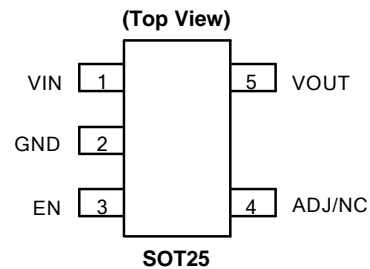
- Wide Input Voltage Range: 2.3V to 24V
- Wide Output Voltage Range: 1.24V to 22V
- Excellent Ripple Rejection: 60dB @ $f = 1\text{kHz}$
- Low Dropout Voltage: $V_{\text{DROP}} = 100\text{mV}$ @ $I_{\text{OUT}} = 100\mu\text{A}$
- Low Ground Current
- High Output Voltage Accuracy
- Compatible with Low ESR Ceramic Capacitor
- Excellent Line/Load Regulation
- Thermal Shutdown Function
- **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-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](mailto:contact@diodes.com) or your local Diodes representative. <https://www.diodes.com/quality/product-definitions/>**

- 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



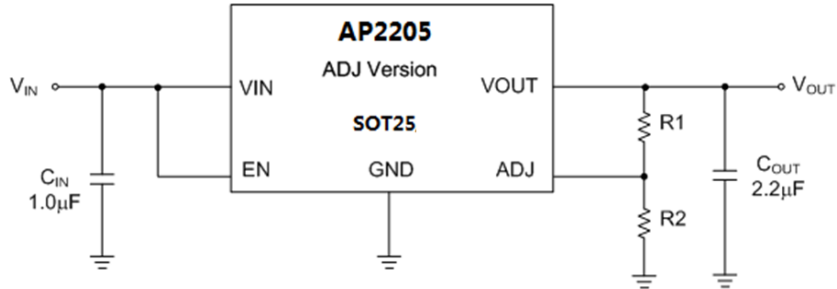
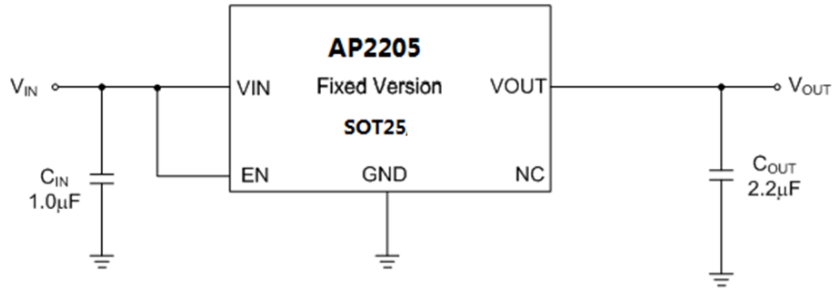
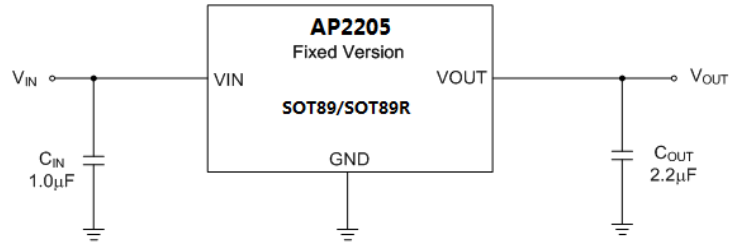
Note 4: The substrate/exposed pad should be connected to GND or open.



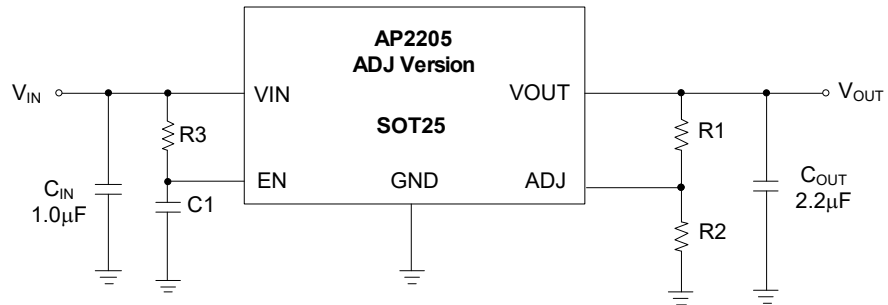
Applications

- Battery-powered equipments
- Laptops, palmtops, notebook computers
- Portable information appliances
- Industrial/Automotive applications

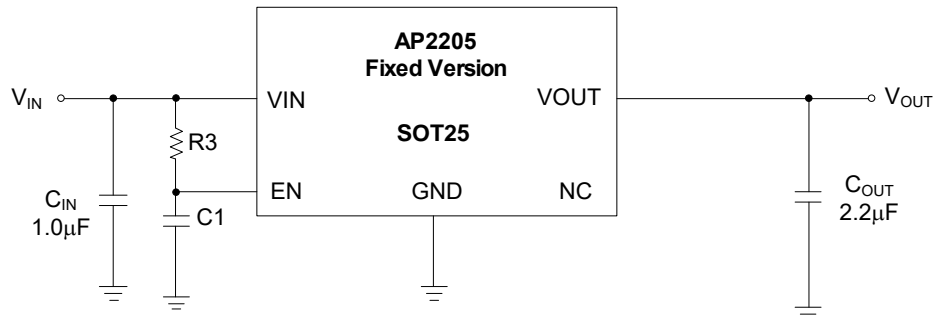
Typical Applications Circuit



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



Startup Time Adjustable by External R3C1 Circuit

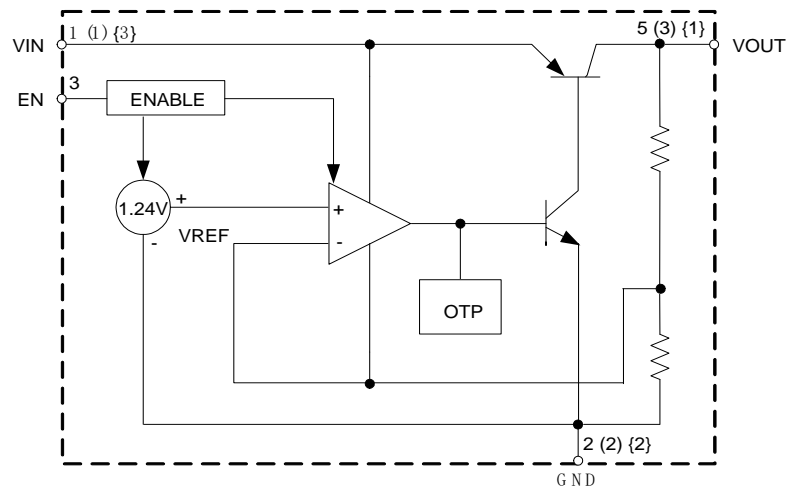


Startup Time Adjustable by External R3C1 Circuit

Pin Descriptions

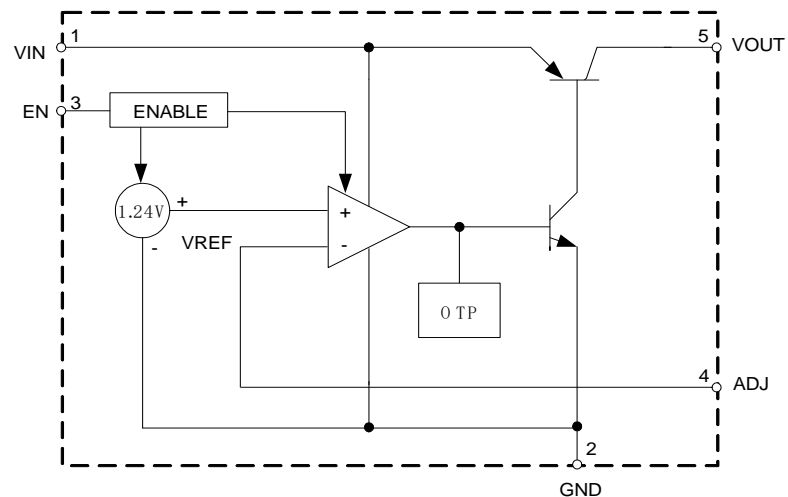
Pin Number			Pin Name	Function
SOT25	SOT89	SOT89R		
1	1	3	VIN	Input voltage
2	2	2	GND	Ground
3	—	—	EN	Enable input
4	—	—	ADJ/NC	Adjust output for ADJ version/Not connected for fixed version
5	3	1	VOUT	Regulated output voltage

Functional Block Diagram



A(B){C}
A: SOT25
B: SOT89
C: SOT89R

Fixed Version



SOT25

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*” 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.
 - 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	

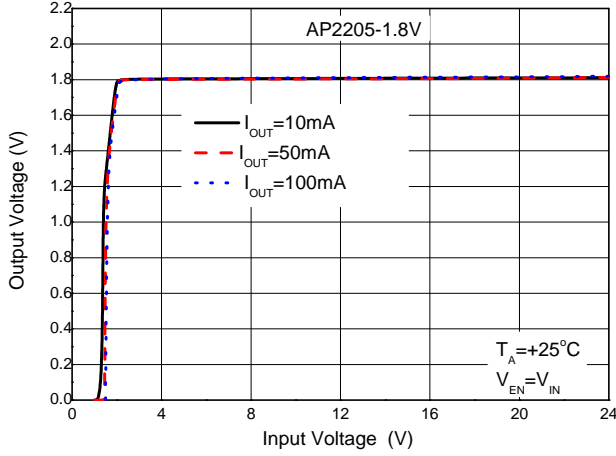
Electrical Characteristics (@ $V_{IN} = V_{OUT} + 1V$, $T_J = +25^\circ C$, $I_{OUT} = 100\mu A$, $C_{IN} = 1.0\mu F$, $C_{OUT} = 2.2\mu F$, **Bold** typeface applies over $-40^\circ C \leq T_J \leq +125^\circ C$, unless otherwise specified.)

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	

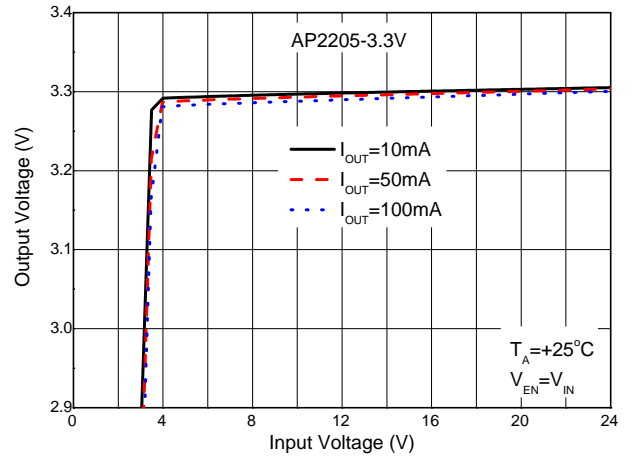
Note: 7. Dropout voltage is only valid when $V_{OUT} \geq 2.3V$ because of the minimum input voltage limits.

Performance Characteristics

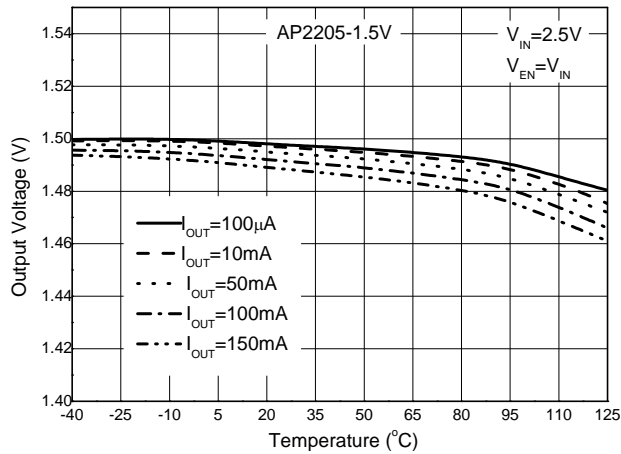
Output Voltage vs. Input Voltage



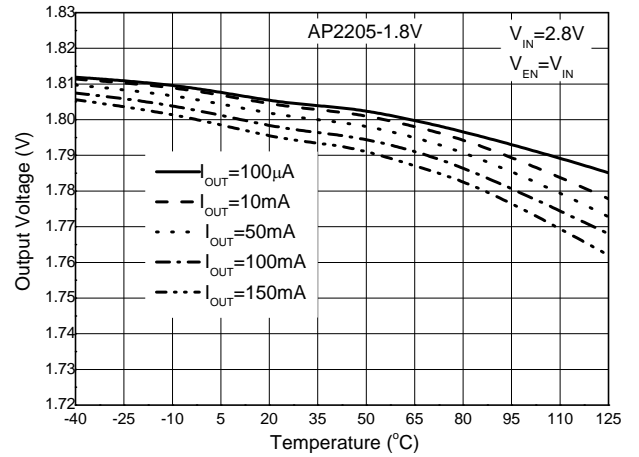
Output Voltage vs. Input Voltage



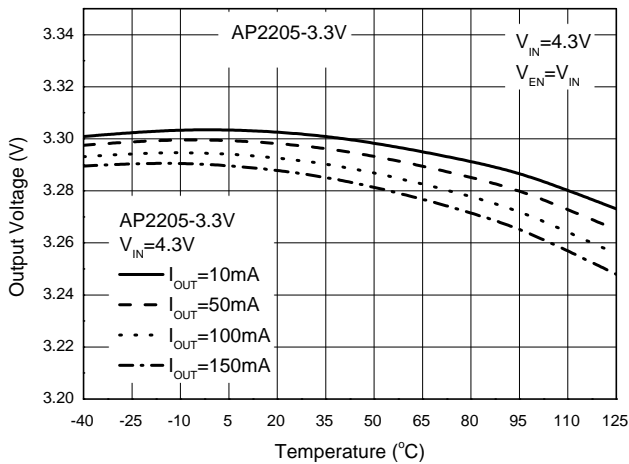
Output Voltage vs. Temperature



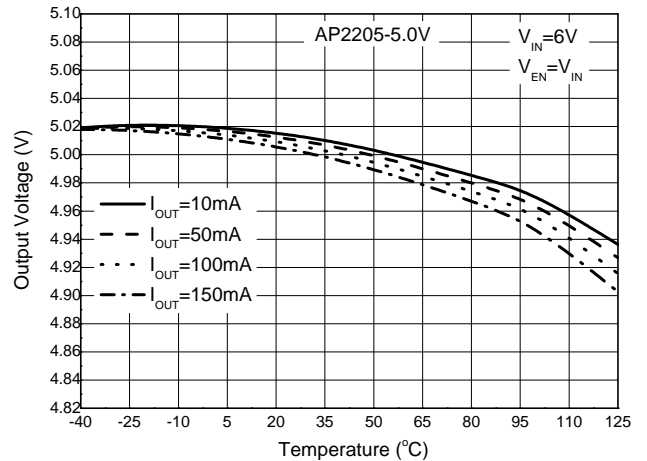
Output Voltage vs. Temperature



Output Voltage vs. Temperature

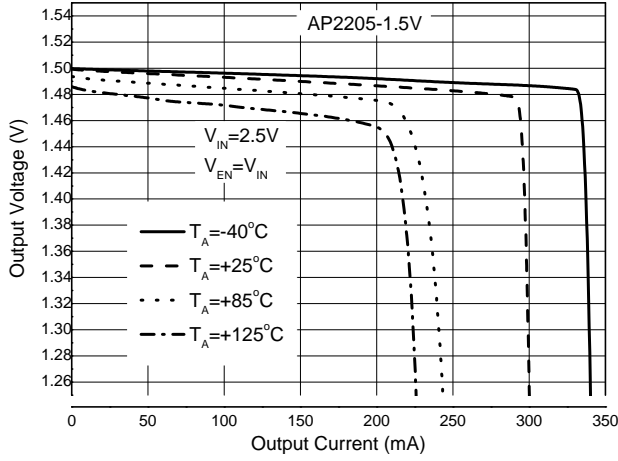


Output Voltage vs. Temperature

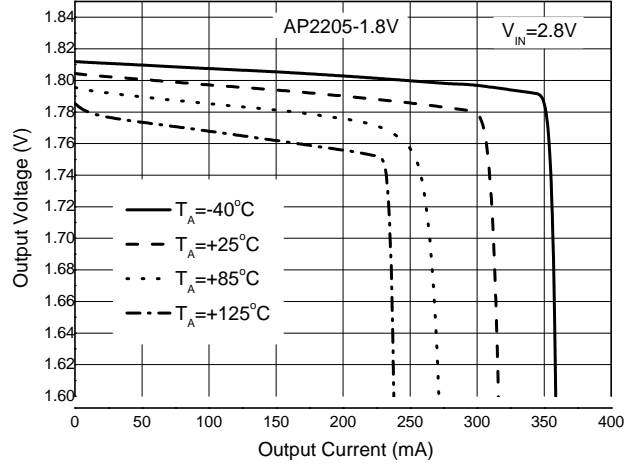


Performance Characteristics (continued)

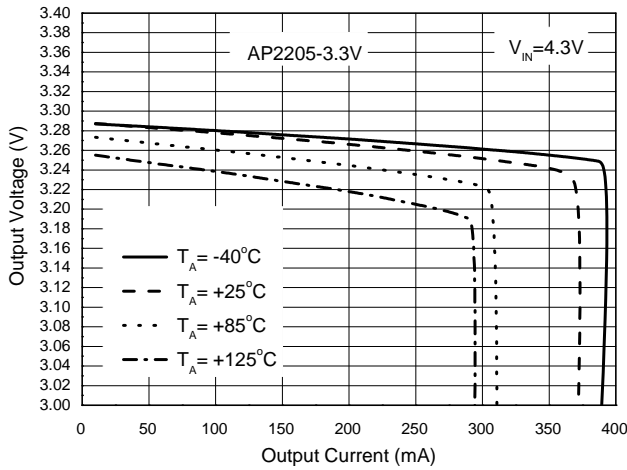
Output Voltage vs. Output Current



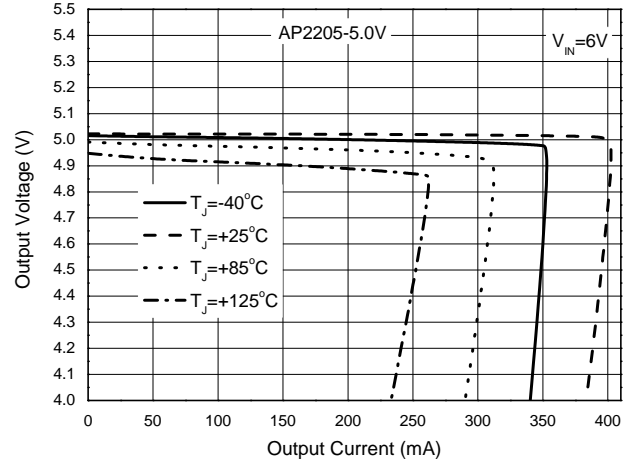
Output Voltage vs. Output Current



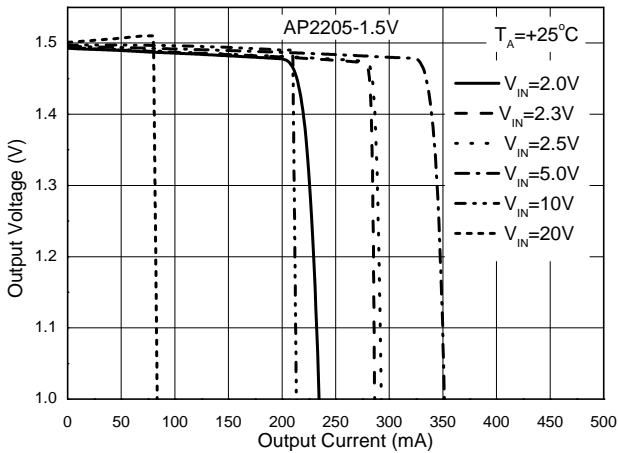
Output Voltage vs. Output Current



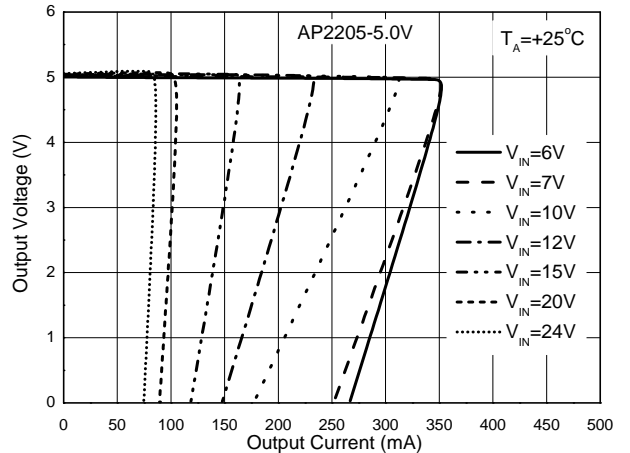
Output Voltage vs. Output Current



Output Voltage vs. Output Current

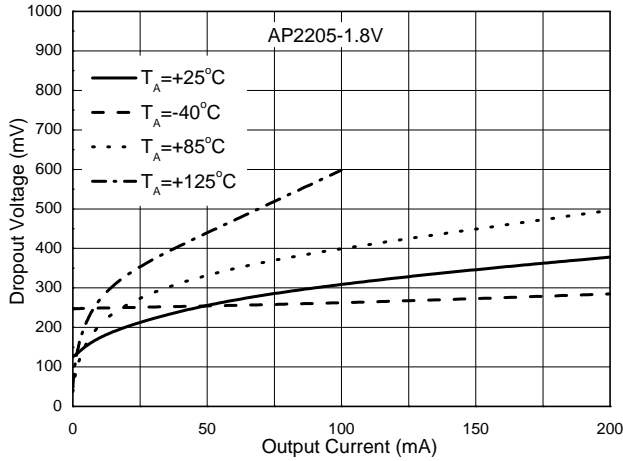


Output Voltage vs. Output Current

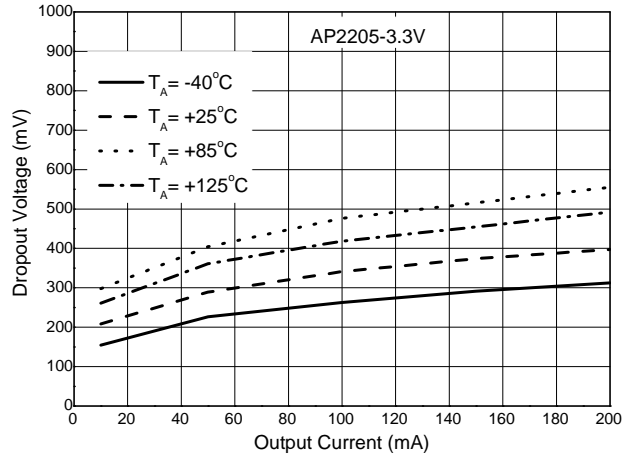


Performance Characteristics (continued)

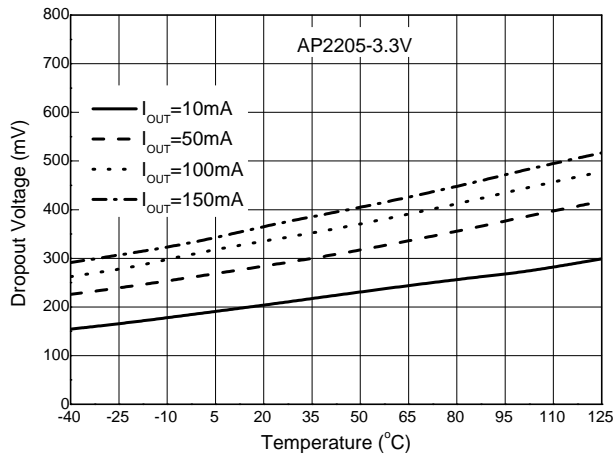
Dropout Voltage vs. Output Current



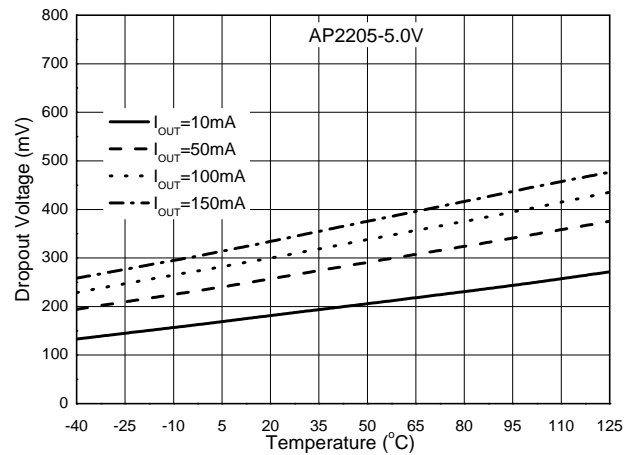
Dropout Voltage vs. Output Current



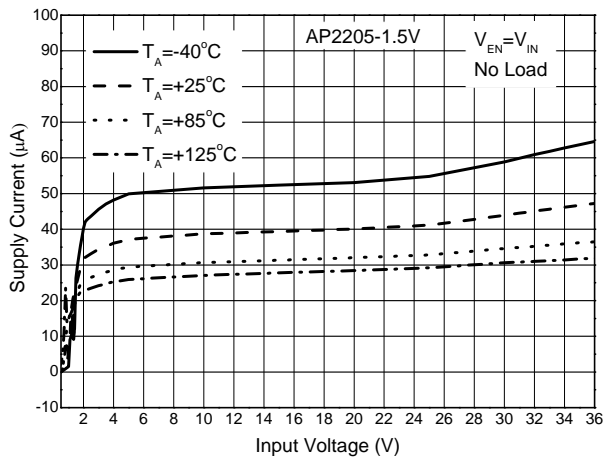
Dropout Voltage vs. Temperature



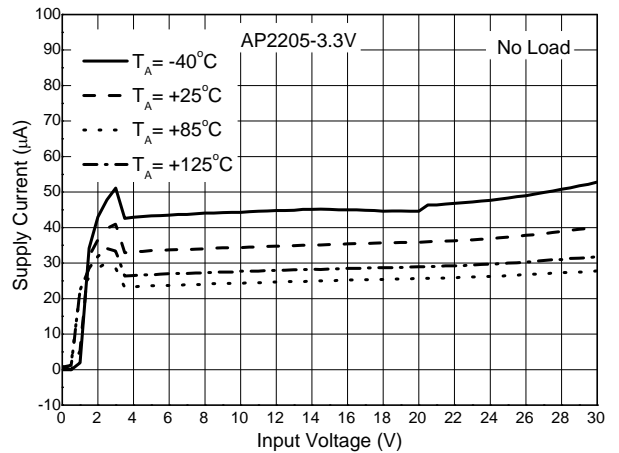
Dropout Voltage vs. Temperature



Supply Current vs. Input Voltage

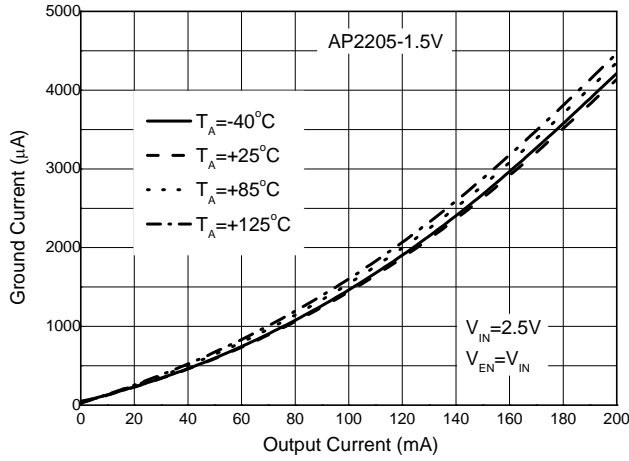


Supply Current vs. Input Voltage

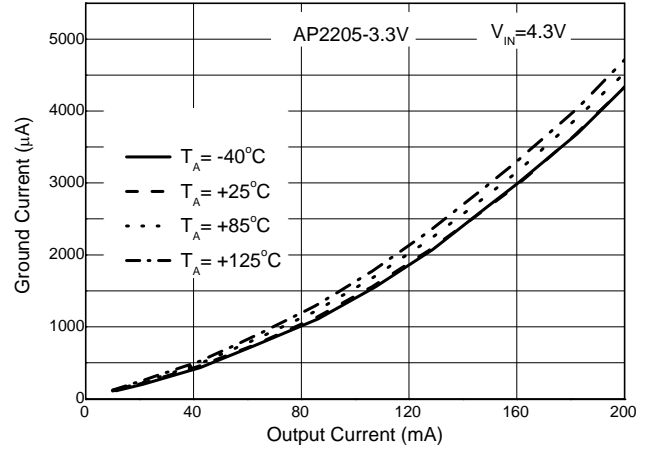


Performance Characteristics (continued)

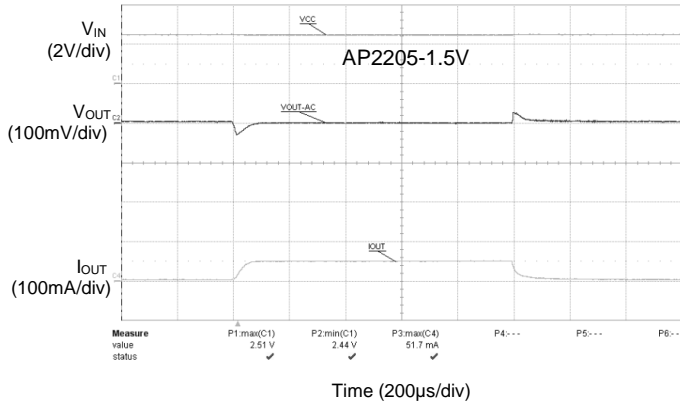
Ground Current vs. Output Current



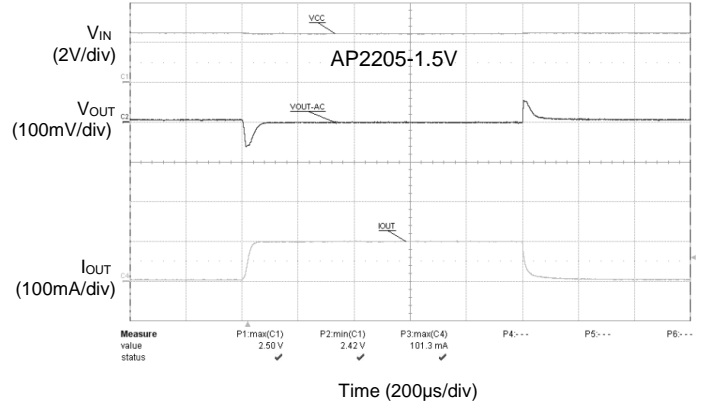
Ground Current vs. Output Current



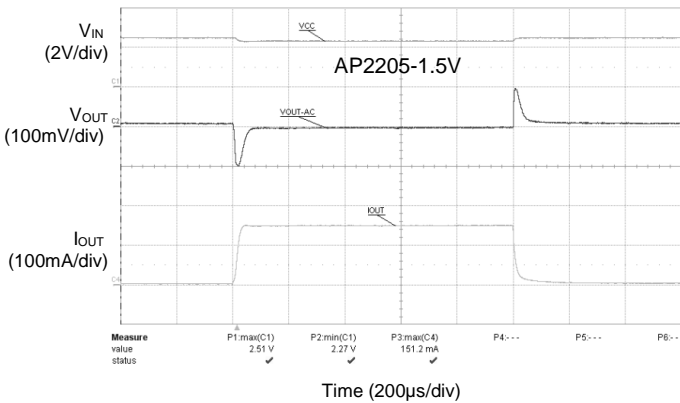
Load Transient
 (Conditions: $V_{IN}=2.5V$, $C_{IN}=1.0\mu F$, $C_{OUT}=2.2\mu F$,
 $I_{OUT}=1mA$ to $50mA$)



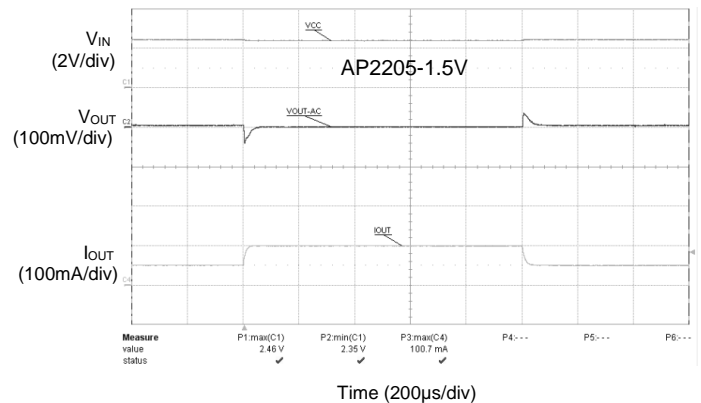
Load Transient
 (Conditions: $V_{IN}=2.5V$, $C_{IN}=1.0\mu F$, $C_{OUT}=2.2\mu F$,
 $I_{OUT}=1mA$ to $100mA$)



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

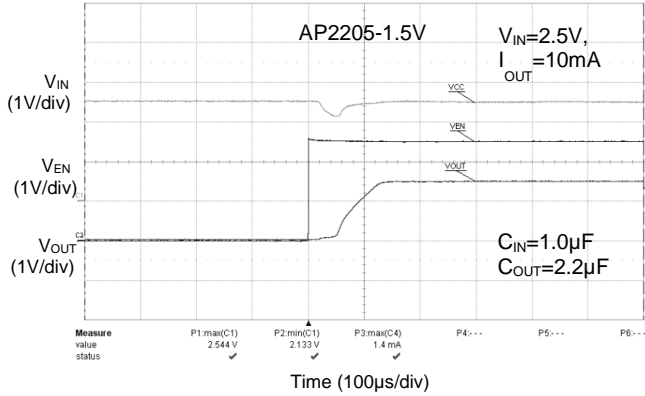


Load Transient
 (Conditions: $V_{IN}=2.5V$, $C_{IN}=1.0\mu F$, $C_{OUT}=2.2\mu F$,
 $I_{OUT}=50mA$ to $100mA$)

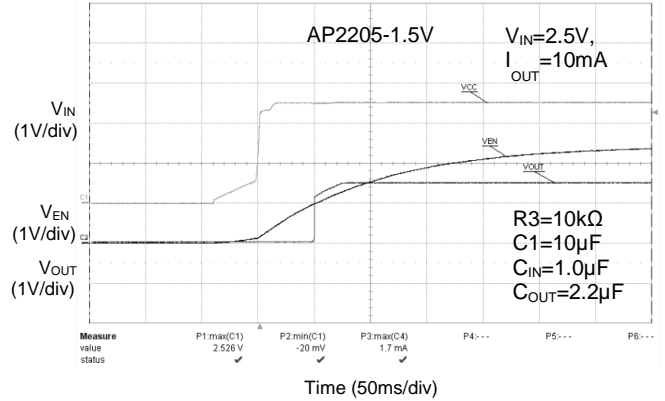


Performance Characteristics (continued)

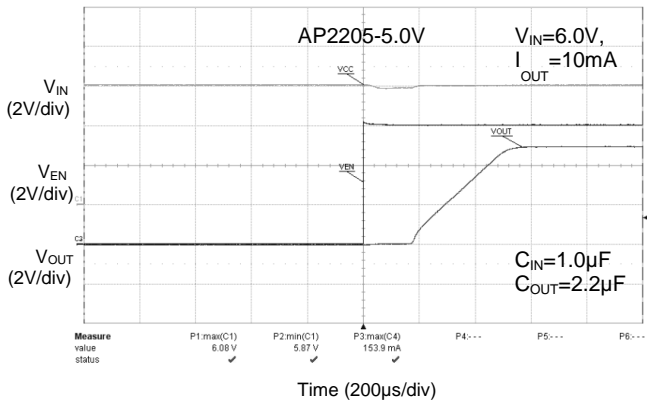
Enable Input Response



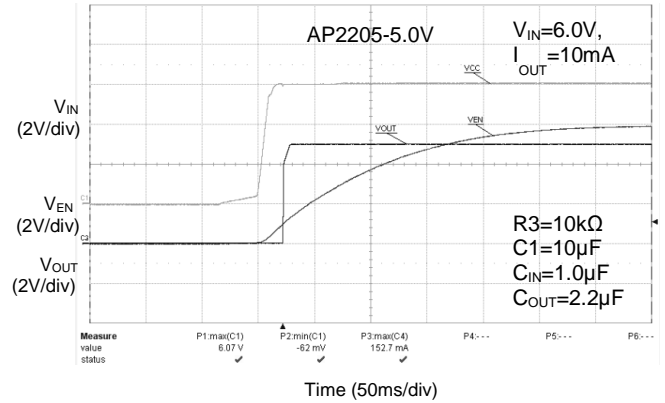
Adjustable Start-up Time by RC



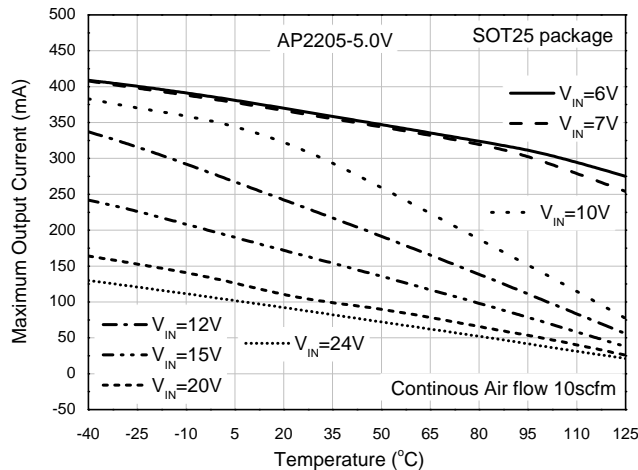
Enable Input Response



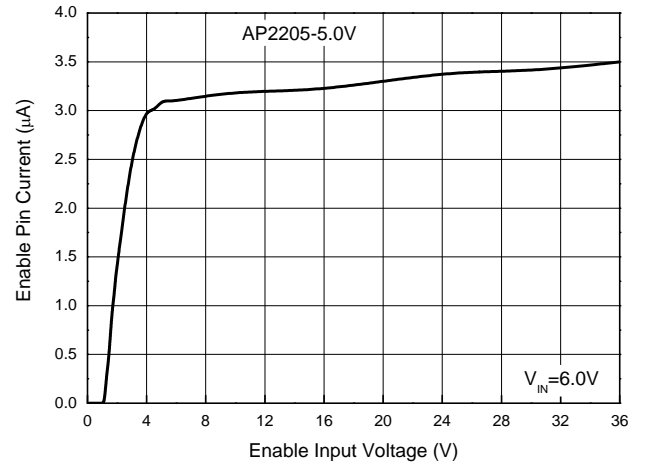
Adjustable Start-up Time by RC



Maximum Output Current vs. Ambient Temperature

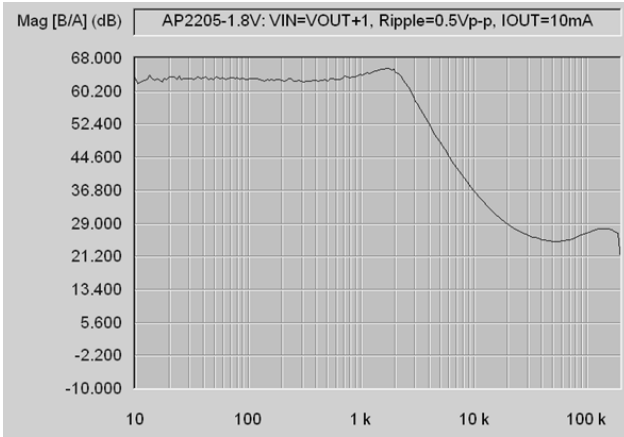


Enable Pin Current vs. Enable Input Voltage

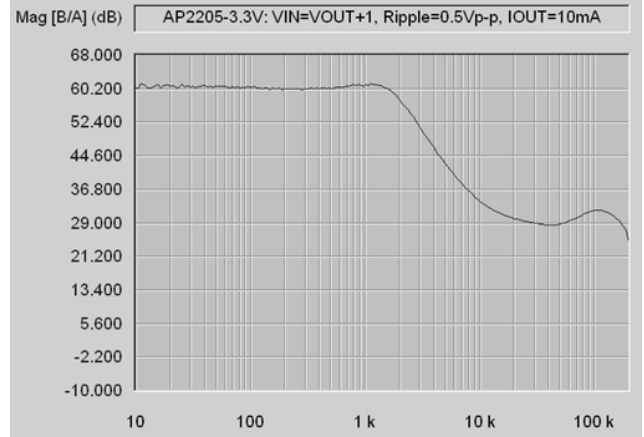


Performance Characteristics (continued)

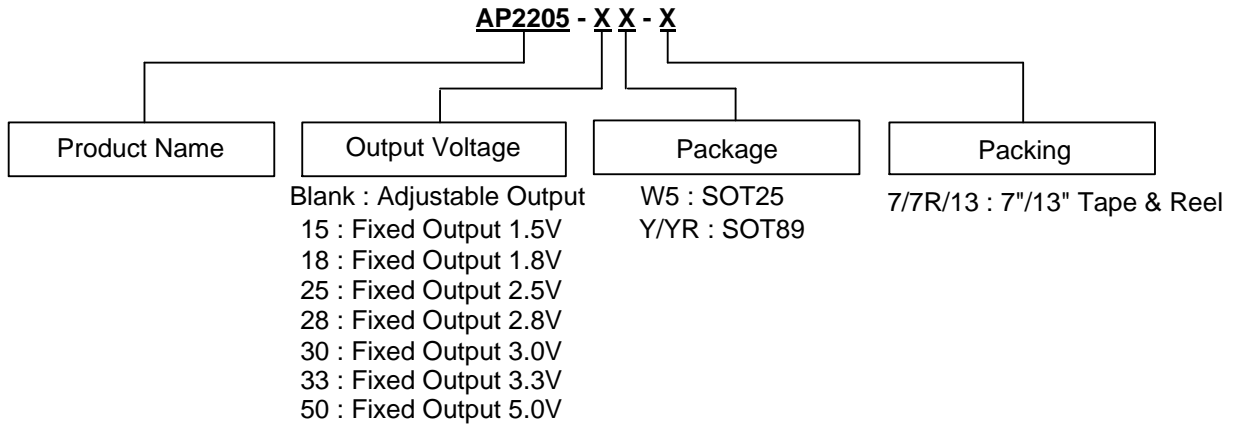
PSRR vs. Frequency



PSRR vs. Frequency



Ordering Information

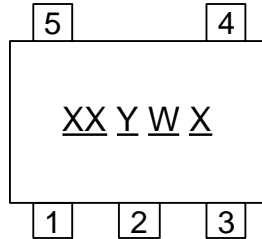


Part Number	Package Code	Package	Packing	
			Qty.	Carrier
AP2205-XXY-13	Y	SOT89	2,500	13" Tape & Reel
AP2205-XXY-7R	Y	SOT89	1,000	7" Tape & Reel
AP2205-XXYR-13	YR	SOT89	2,500	13" Tape & Reel
AP2205-W5-7	W5	SOT25	3,000	7" Tape & Reel
AP2205-XXW5-7	W5	SOT25	3,000	7" Tape & Reel

Marking Information

(1) SOT25

(Top View)



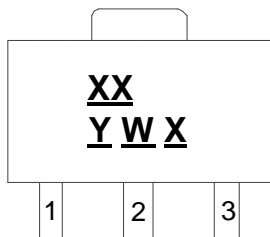
XX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 Week;
a to z : 27 to 52 Week; z Represents
52 and 53 Week
X : Internal Code

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 (continued)

(2) SOT89

(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

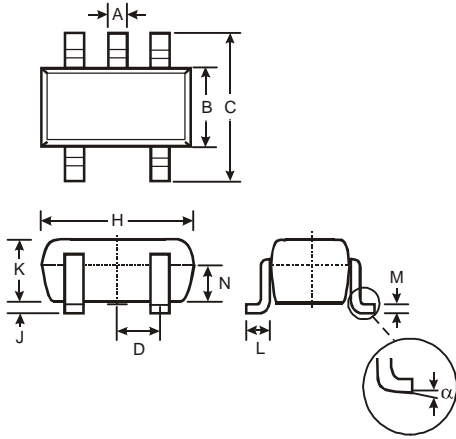
Part Number	Package	Identification Code
AP2205-15Y-13	SOT89	5B
AP2205-18Y-13	SOT89	5C
AP2205-25Y-13	SOT89	5D
AP2205-28Y-13	SOT89	5E
AP2205-30Y-13	SOT89	5F
AP2205-33Y-13	SOT89	5G
AP2205-50Y-13	SOT89	5H
AP2205-15YR-13	SOT89	6B
AP2205-18YR-13	SOT89	6C
AP2205-25YR-13	SOT89	6D
AP2205-28YR-13	SOT89	6E
AP2205-30YR-13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

Part Number	Package	Identification Code
AP2205-33Y-7R	SOT89	6G
AP2205-50Y-7R	SOT89	6H

Package Outline Dimensions

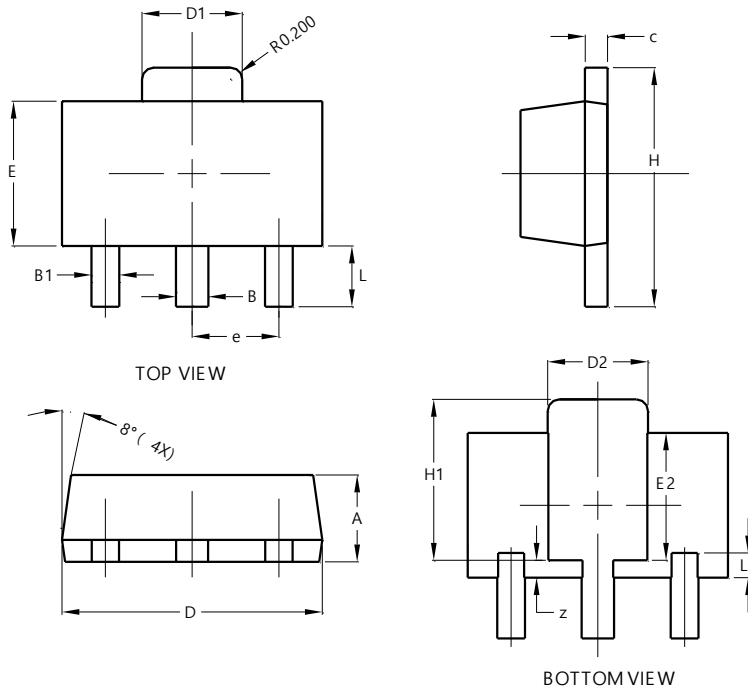
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(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

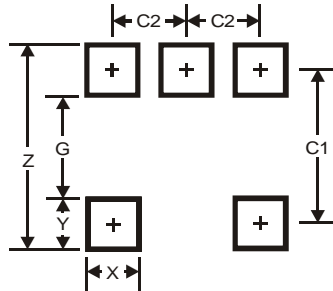


SOT89			
Dim	Min	Max	Typ
A	1.40	1.60	1.50
B	0.50	0.62	0.56
B1	0.42	0.54	0.48
c	0.35	0.43	0.38
D	4.40	4.60	4.50
D1	1.62	1.83	1.733
D2	1.61	1.81	1.71
E	2.40	2.60	2.50
E2	2.05	2.35	2.20
e	-	-	1.50
H	3.95	4.25	4.10
H1	2.63	2.93	2.78
L	0.90	1.20	1.05
L1	0.327	0.527	0.427
z	0.20	0.40	0.30
All Dimensions in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

Suggested Pad Layout

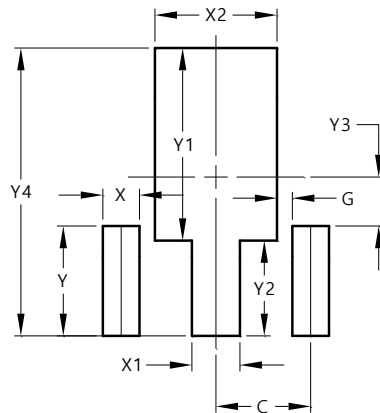
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(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

Mechanical Data

- 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 208③
- Weight:
 - SOT89: 0.062 grams (Approximate)
 - SOT25: 0.0157 grams (Approximate)

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