



PAM3112

300mA CMOS Linear Regulator

Features

- Accuracy within $\pm 2\%$
- Quiescent Current: 65 μ A Typ.
- Excellent Line/Load Regulation
- Guaranteed 300mA Output Current
- Fast Response
- Current Limiting
- Short Circuit Protection
- Low Temperature Coefficient
- Thermal Shutdown
- Space Saving Package: SOT-23, SOT-89 and SC70
- Pb-Free Package

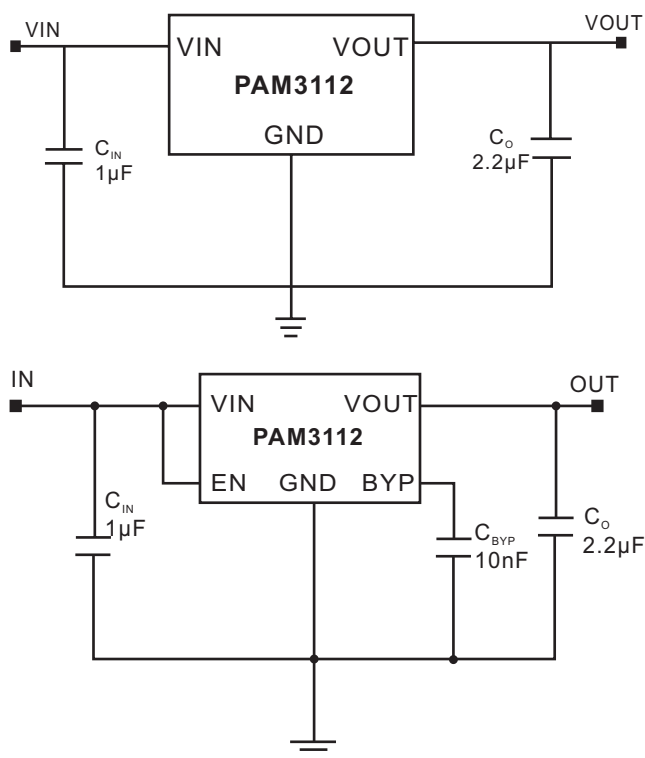
Applications

- Cordless Phone
- Cellular Phone
- Bluetooth Earphone
- Digital Camera
- Portable Electronics
- WLAN
- MP3 Player

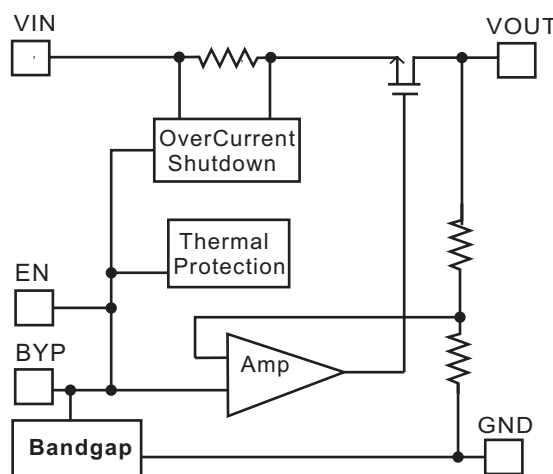
General Description

The PAM3112 regulator features low quiescent current (65 μ A Typ.) and excellent line/load regulation, making it ideal for battery powered applications. The output voltage can be 1.2V or 1.3V. Space-saving packages SOT-23, SOT-89 and SC70 are attractive for portable and handheld applications. It has both thermal shutdown and a current limit features to prevent device failure under extreme operating conditions. The device is stable with an output capacitance of 2.2 μ F or greater.

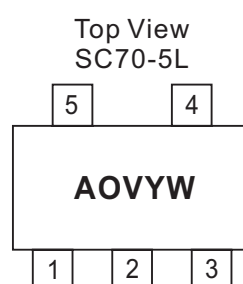
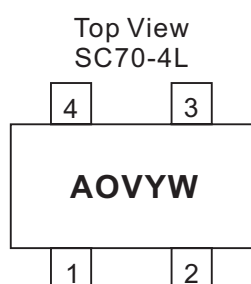
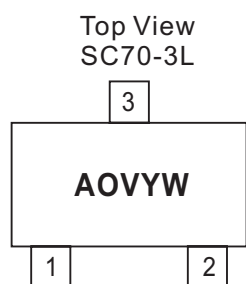
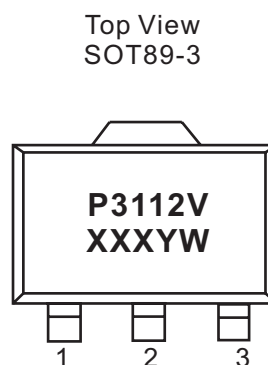
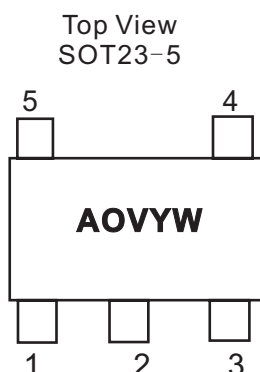
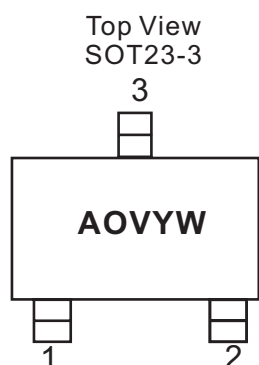
Typical Application



Block Diagram



Pin Configuration & Marking Information



AO: Product Code
of PAM3112
X: Internal Code
V: Voltage Code
Y: Year
W: Week

Pin Description

Pin	1	2	3	4	5
SOT23-3	VOUT	GND	VIN		
	GND	VOUT	VIN		
SOT23-5	VIN	GND	EN	BYP	VOUT
SOT89-3	GND	VIN	VOUT		
	VOUT	GND	VIN		
SC70-3L	VIN	VOUT	GND		
SC70-4L	EN	GND	VOUT	VIN	
SC70-5L	VIN	GND	EN	BYP	VOUT

Name	Function
VIN	Input
GND	Ground
EN	Chip Enable(active high)
BYP	Bypass Pin, need a 10nF capacitor connect to GND
VOUT	Output



Absolute Maximum Ratings

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability. All voltages are with respect to ground.

Input Voltage.....	6V	Lead Soldering Temperature (5sec).....	300°C
Output Current.....	$P_D/(V_{IN}-V_O)$	Maximum Junction Temperature.....	150°C
Output Pin Voltage.....	GND-0.3V to $V_{IN}+0.3V$	Storage Temperature.....	-65°C to 150°C
		ESD Rating.....	Class B

Recommended Operating Conditions

Junction Temperature.....	-40°C to 125°C	Ambient Temperature.....	-40°C to 85°C
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Thermal Information

Parameter	Symbol	Package	Maximum	Unit
Thermal Resistance (Junction to Case)	θ_{JC}	SOT-23	130	°C/W
		SOT-89	45	
		SC70	TBD	
Thermal Resistance (Junction to Ambient)	θ_{JA}	SOT-23	250	°C/W
		SOT-89	160	
		SC70	300	
Internal Power Dissipation	P_D	SOT-23	400	mW
		SOT-89	550	
		SC70	300	



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Electrical Characteristic

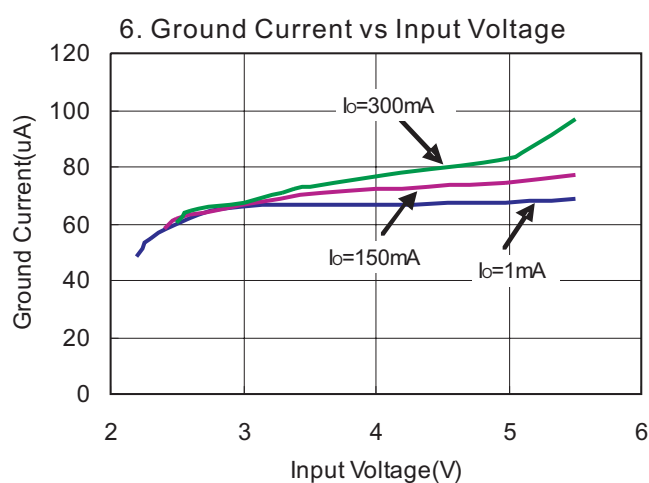
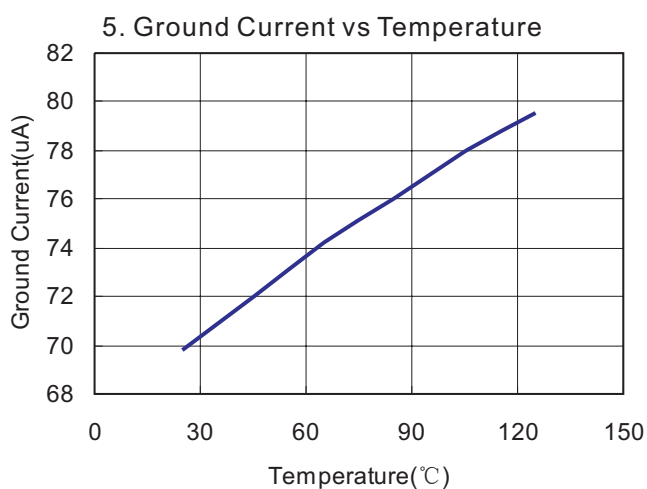
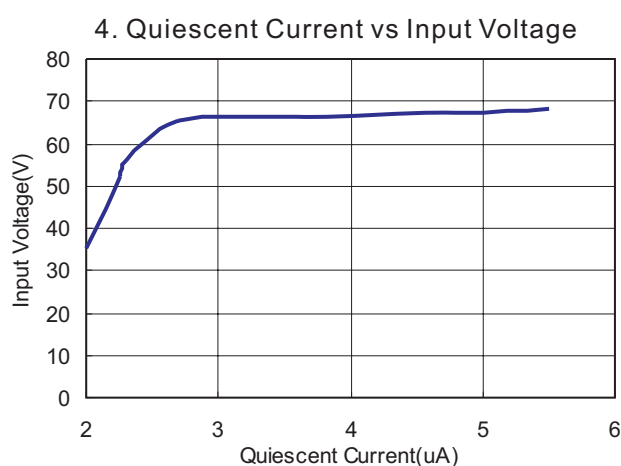
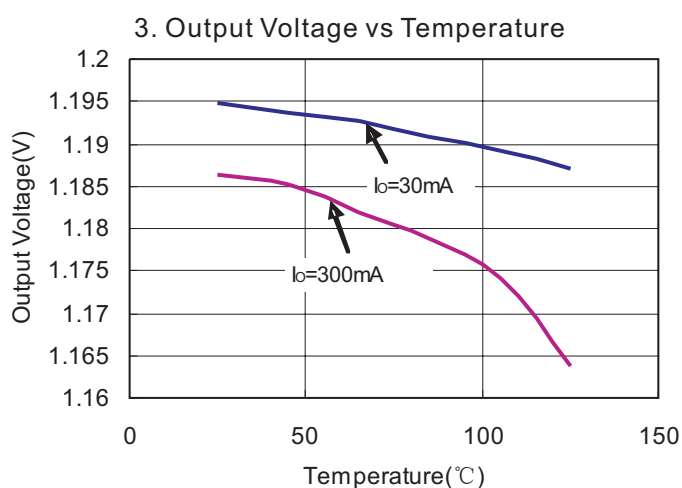
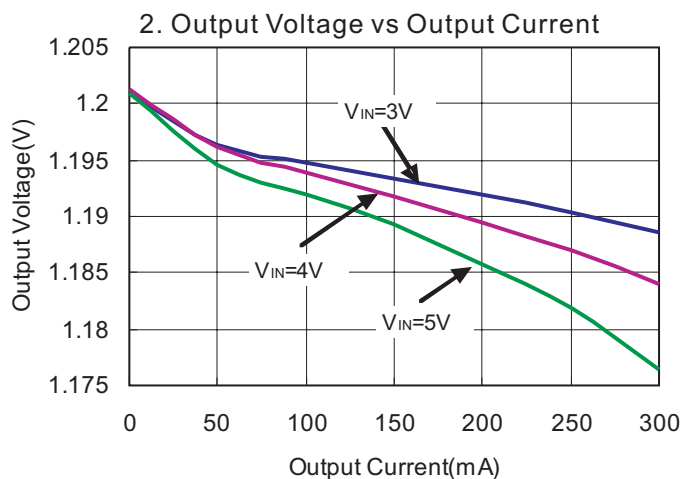
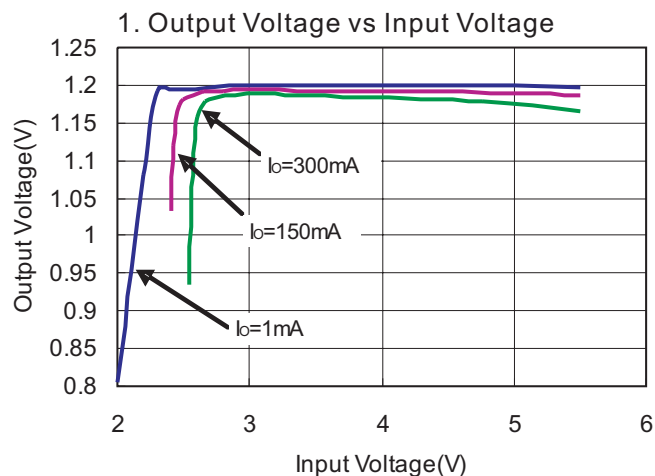
$T_A=25^{\circ}\text{C}$, $V_{IN}=3\text{V}$, $C_{IN}=1\mu\text{F}$, $C_O=2.2\mu\text{F}$, unless otherwise noted.

Parameter	Symbol	Test Conditions	MIN	TYP	MAX	Units
Input Voltage	V_{IN}		2.5		5.5	V
Output Voltage Accuracy	V_O	$I_O=1\text{mA}$	-2		2	%
Output Current	I_O		300		Note 1	mA
Ground Current	I_{GND}	$I_O=1\text{mA}$ to 300mA		70	90	μA
Quiescent Current	I_Q	$I_O=0\text{mA}$		65	90	μA
Line Regulation	LNR	$V_{IN}=2.5\text{V}$ to 5.0V $I_O=10\text{mA}$	-0.15	0.1	0.15	%/V
Load Regulation	LDR	$I_O=1\text{mA}$ to 300mA		30	60	mV
Short Circuit Current	I_{SC}	$V_O=0\text{V}$		130		mA
Temperature Coefficient	T_C			40		ppm/ $^{\circ}\text{C}$
Over Temperature Shutdown	OTS	$I_O=1\text{mA}$		150		$^{\circ}\text{C}$
Over Temperature Hysteresis	OTH	$I_O=1\text{mA}$		30		$^{\circ}\text{C}$
Power Supply Ripple Rejection	PSRR	$I_O=100\text{mA}$ $C_{BYP}=10\text{nF}$	$f=100\text{Hz}$	70		dB
			$f=1\text{kHz}$	65		
Output Noise	V_n	$f=10\text{Hz}$ to 100kHz, $C_{BYP}=10\text{nF}$		50		μVrms
EN Input High Threshold	V_{IH}	$V_{IN}=2.5\text{V}$ to 5V	1.5			V
EN Input Low Threshold	V_{IL}	$V_{IN}=2.5\text{V}$ to 5V			0.3	V
Shutdown Current	I_{SD}	$V_{EN}=0\text{V}$		0.01	1	μA

Note 1: Output current is limited by P_D , Maximum $I_O=400\text{mW}/(V_{IN}(\text{MAX.})-V_O)$.

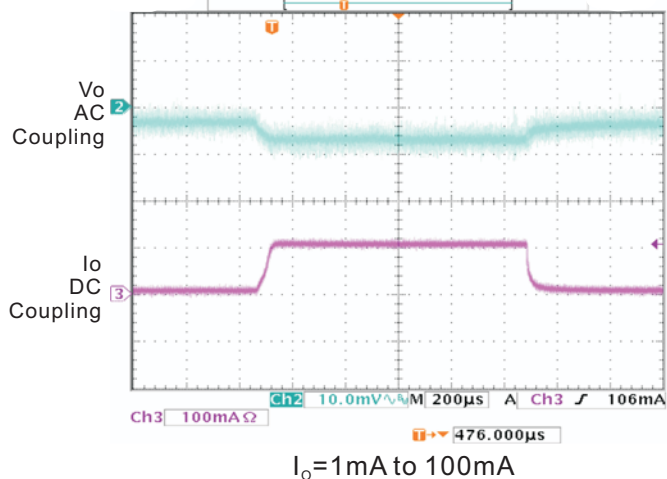
Typical Performance Characteristics

$T_A=25^{\circ}\text{C}$, $C_{IN}=1\mu\text{F}$, $C_O=2.2\mu\text{F}$, $V_O=1.2\text{V}$, unless otherwise noted.

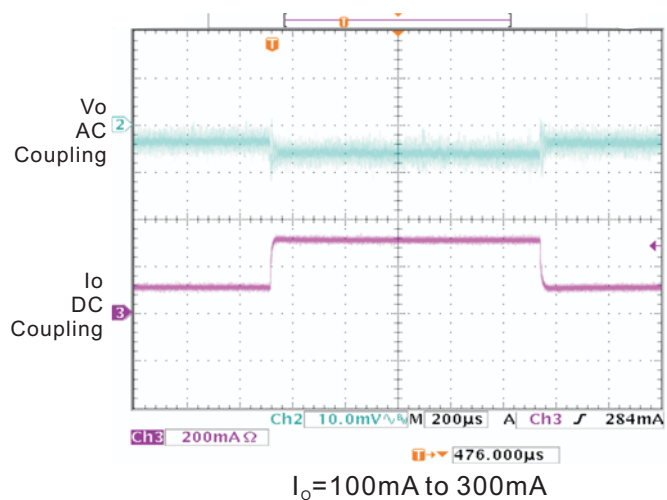
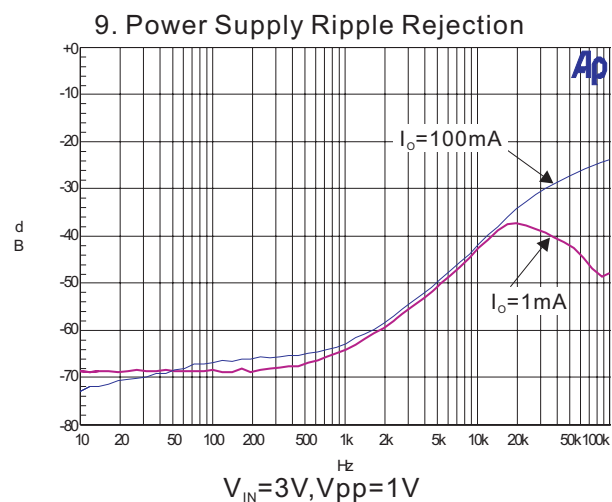
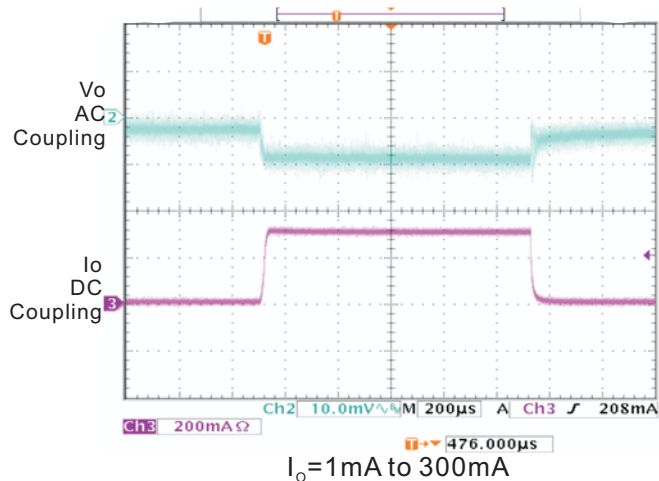
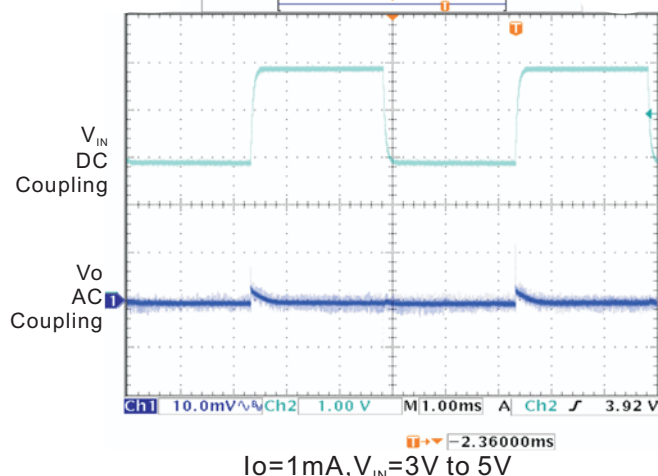


Typical Performance Characteristics(continued)

7. Load Regulation Transient Response



8. Line Regulation Transient Response



Application Information

Capacitor Selection and Regulator Stability

Similar to any low dropout regulator, the external capacitors used with the PAM3112 must be carefully selected for regulator stability and performance.

A capacitor C_{IN} of more than $1\mu F$ can be used at the PAM3112 input pin, while there is no upper limit for the capacitance of C_{IN} . Please note that the distance between C_{IN} and the input pin of the PAM3112 should not exceed 0.5 inch. Ceramic capacitors are suitable for the PAM3112. Capacitors with larger values and lower ESR (equivalent series resistance) provide better PSRR and line-transient response.

The PAM3112 is designed specifically to work with low ESR ceramic output capacitors in order to save space and improve performance. Using an output ceramic capacitor whose value is $>2.2\mu F$ with $ESR > 5m\Omega$ ensures stability.

A $10nF$ bypass capacitor connected to BYP pin is suggested for suppressing output noise. The capacitor, in series connection with an internal $200k\Omega$ resistor, forms a low-pass filter for noise reduction. Increasing the capacitance will slightly decrease the output noise, but increase the start-up time.

Load Transient Considerations

Curve 7 of the PAM3112 load-transient response on page 6 shows two components of the output response, a DC shift from the output impedance due to the load current change and transient response. The DC shift is quite small due to excellent load regulation of the PAM3112. The transient spike, resulting from a step change in the load current from $1mA$ to $300mA$, is $20mV$. The ESR of the output capacitor is critical to the transient spike. A larger capacitance along with smaller ESR results in a smaller spike.

Shutdown Input Operation

The PAM3112 is shut down by pulling the EN input low and turned on by tying the EN input to V_{IN} or leaving the EN input floating.

Internal P-Channel Pass Transistor

The PAM3112 features a 0.75Ω P-Channel MOSFET device as a pass transistor. The P-MOS pass transistor enables the PAM3112 to consume only $65\mu A$ of ground current during low dropout, light-load, or heavy-load operation. These features increase the battery operation life time.

Input-Output (Dropout) Voltage

A regulator's minimum input-output voltage difference (or dropout voltage) determines the lowest usable supply voltage. The PAM3112 has a typical $300mV$ dropout voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage.

Current Limit and Short Circuit Protection

The PAM3112 features a current limit, which monitors and controls the gate voltage of the pass transistor. The output current can be limited to $400mA$ by regulating the gate voltage. The PAM3112 also has a built-in short circuit current limit.

Thermal considerations

Thermal protection limits power dissipation in the PAM3112. When the junction temperature exceeds $150^{\circ}C$, the OTP (Over Temperature Protection) starts the thermal shutdown and turns the pass transistor off. The pass transistor resumes operation after the junction temperature drops below $120^{\circ}C$.

For continuous operation, the junction temperature should be maintained below $125^{\circ}C$. The power dissipation is defined as:

$$P_D = (V_{IN} - V_{OUT}) * I_O + V_{IN} * I_{GND}$$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surrounding airflow and temperature difference between junction and ambient. The maximum power dissipation can be calculated by the following formula:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$



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Where $T_{J(MAX)}$ is the maximum allowable junction temperature 125°C , T_A is the ambient temperature and θ_{JA} is the thermal resistance from the junction to the ambient.

For example, as θ_{JA} is 250°C/W for the SOT-23 package based on the standard JEDEC 51-3 for a single-layer thermal test board, the maximum power dissipation at $T_A=25^{\circ}\text{C}$ can be calculated by following formula:

$$P_{D(MAX)} = (125^{\circ}\text{C} - 25^{\circ}\text{C}) / 250 = 0.4\text{W SOT-23}$$

It is also useful to calculate the junction temperature of the PAM3112 under a set of specific condition. Suppose the input voltage $V_{IN}=3.3\text{V}$, the output current $I_O=150\text{mA}$ and the case temperature $T_A=40^{\circ}\text{C}$ measured by a

thermal couple during operation, the power dissipation is defined as:

$$P_D = (3.3\text{V} - 1.2\text{V}) * 150\text{mA} + 3.3\text{V} * 70\mu\text{A} \cong 315\text{mW}$$

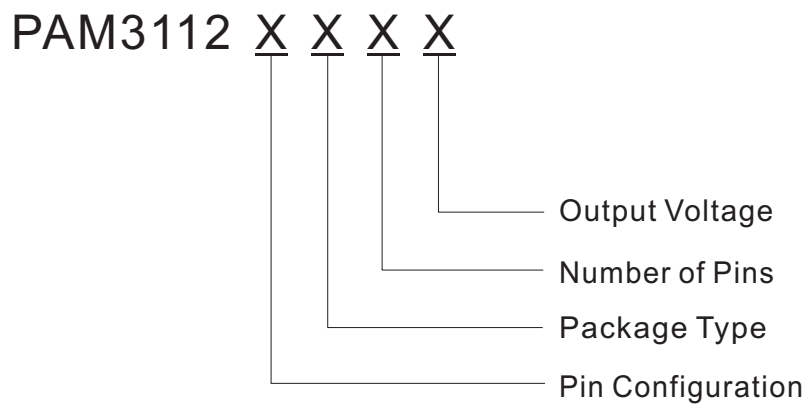
And the junction temperature T_J can be calculated as follows:

$$\begin{aligned} T_J &= T_A + P_D * \theta_{JA} \\ T_J &= 40^{\circ}\text{C} + 0.35\text{W} * 250^{\circ}\text{C/W} \\ &= 40^{\circ}\text{C} + 78.75^{\circ}\text{C} \\ &= 118.75^{\circ}\text{C} < T_{J(MAX)} = 125^{\circ}\text{C} \end{aligned}$$

For this application, T_J is lower than the absolute maximum operating junction temperature 125°C , so it is safe to use the PAM3112 in this configuration.



Ordering Information



Pin Configuration	Package Type	Number of Pins	Output Voltage
A Type	A: SOT-23	A: 3	120: 1.2V
1. VOUT	C: SOT89	B: 5	130: 1.3V
2. GND	U: SC70	K: 4	
3. VIN			
B Type			
1.GND			
2. VOUT			
3. VIN			
D Type			
1. VIN			
2. GND			
3. EN			
4. BYP			
5. VOUT			
F Type			
1. EN			
2. GND			
3. VOUT			
4. VIN			
G Type			
1. VIN			
2. VOUT			
3. GND			
H Type			
1. GND			
2. VIN			
3. VOUT			



PAM3112

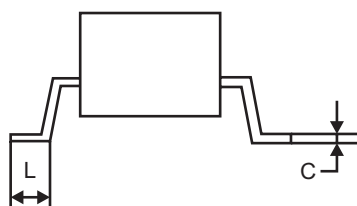
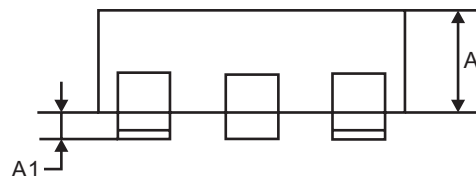
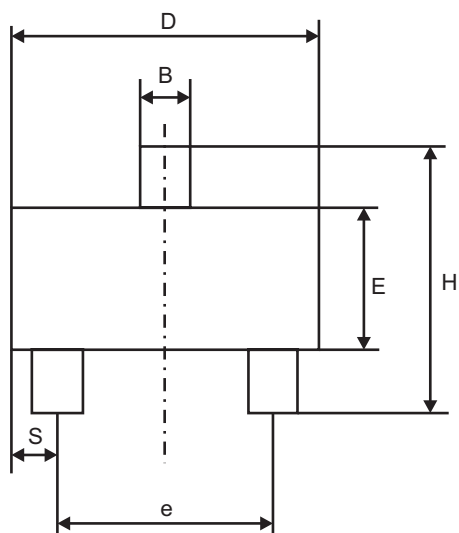
300mA CMOS Linear Regulator

Ordering Information

Part Number	Output Voltage	Marking	Package Type	Standard Package
PAM3112AAA120	1.2V	AOBYW	SOT23-3	3,000 Units/Tape & Reel
PAM3112BAA120	1.2V	AOBYW	SOT23-3	3,000 Units/Tape & Reel
PAM3112DAB120	1.2V	AOBYW	SOT23-5	3,000 Units/Tape & Reel
PAM3112ACA120	1.2V	P3112B XXXYW	SOT89-3	1,000 Units/Tape & Reel
PAM3112HCA120	1.2V	P3112B XXXYW	SOT89-3	1,000 Units/Tape & Reel
PAM3112GUA120	1.2V	AOBYW	SC70-3	3,000 Units/Tape & Reel
PAM3112FUK120	1.2V	AOBYW	SC70-4	3,000 Units/Tape & Reel
PAM3112DUB120	1.2V	AOBYW	SC70-5	3,000 Units/Tape & Reel
PAM3112AAA130	1.3V	AOWYW	SOT23-3	3,000 Units/Tape & Reel
PAM3112BAA130	1.3V	AOWYW	SOT23-3	3,000 Units/Tape & Reel
PAM3112DAB130	1.3V	AOWYW	SOT23-5	3,000 Units/Tape & Reel
PAM3112ACA130	1.3V	P3112W XXXYW	SOT89-3	1,000 Units/Tape & Reel
PAM3112HCA130	1.3V	P3112W XXXYW	SOT89-3	1,000 Units/Tape & Reel
PAM3112GUA130	1.3V	AOWYW	SC70-3	3,000 Units/Tape & Reel
PAM3112FUK130	1.3V	AOWYW	SC70-4	3,000 Units/Tape & Reel
PAM3112DUB130	1.3V	AOWYW	SC70-5	3,000 Units/Tape & Reel

Outline Dimension

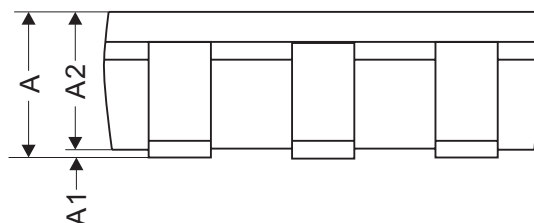
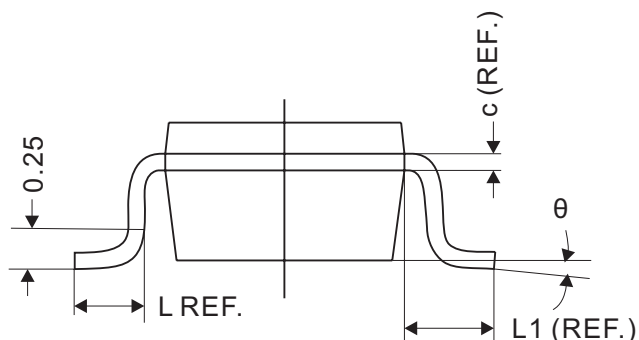
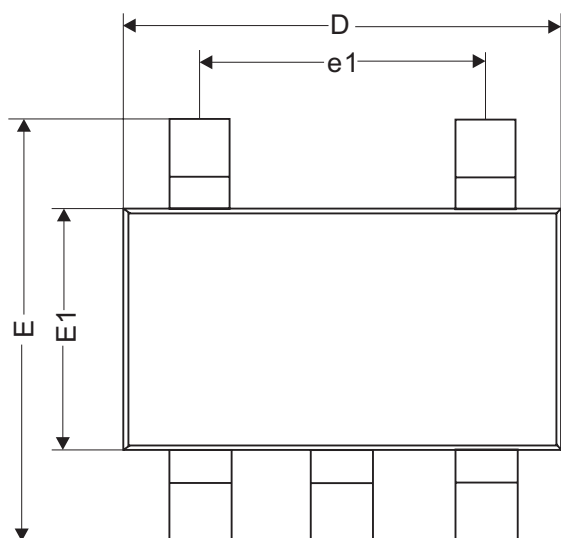
SOT23-3



Dim	Millimeters		
	Min.	Typ.	Max.
A	1.00	1.15	1.30
A1	0.00	0.05	0.10
B	0.35	0.43	0.51
C	0.10	0.175	0.25
D	2.70	2.90	3.10
E	1.40	1.60	1.80
e	1.90BSC		
H	2.40	2.70	3.00
L	0.37		

Outline Dimension

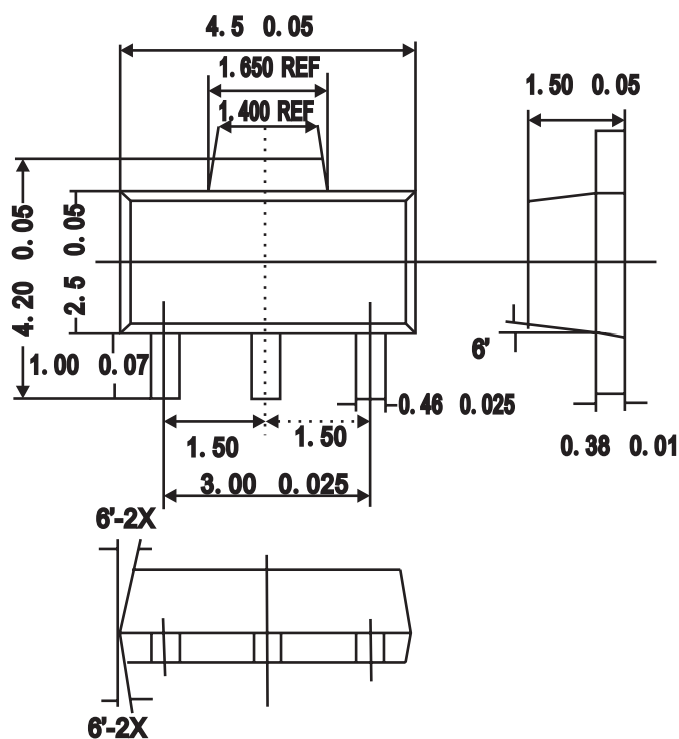
SOT23-5



REF.	Millimeter		
	Min	Nom	Max
A	1.10MAX		
A1	0	0.05	0.10
A2	0.70	1.00	1.295
c	0.12REF.		
D	2.70	2.90	3.10
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
L	0.45REF.		
L1	0.60REF.		
θ	0°	5°	10°
b	0.30	0.40	0.50
e	0.95REF.		
e1	1.90REF.		

Outline Dimension

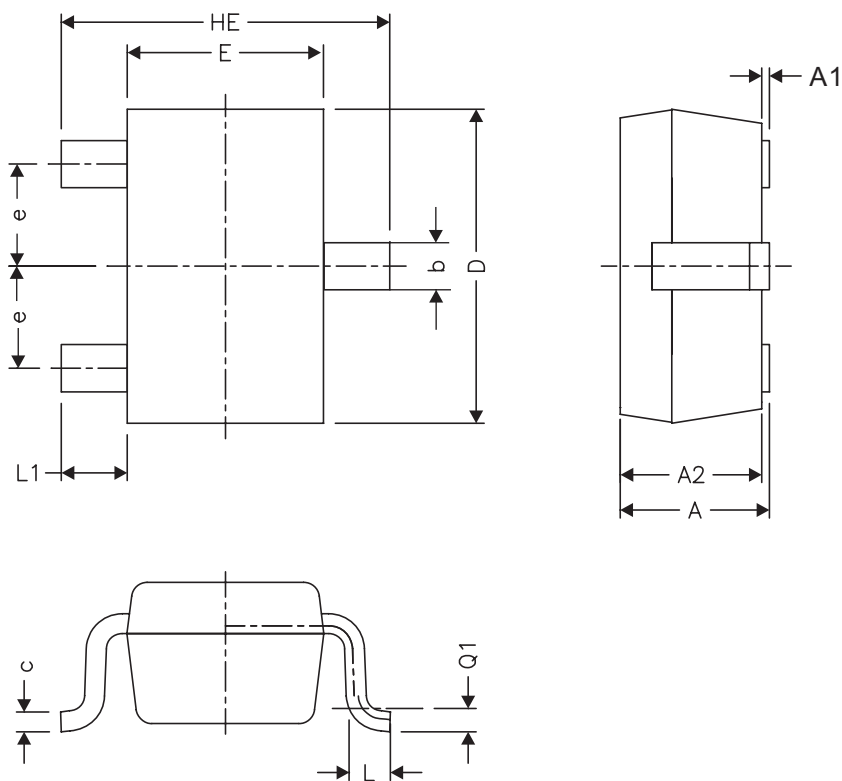
SOT89-3



(Unit: mm)

Outline Dimension

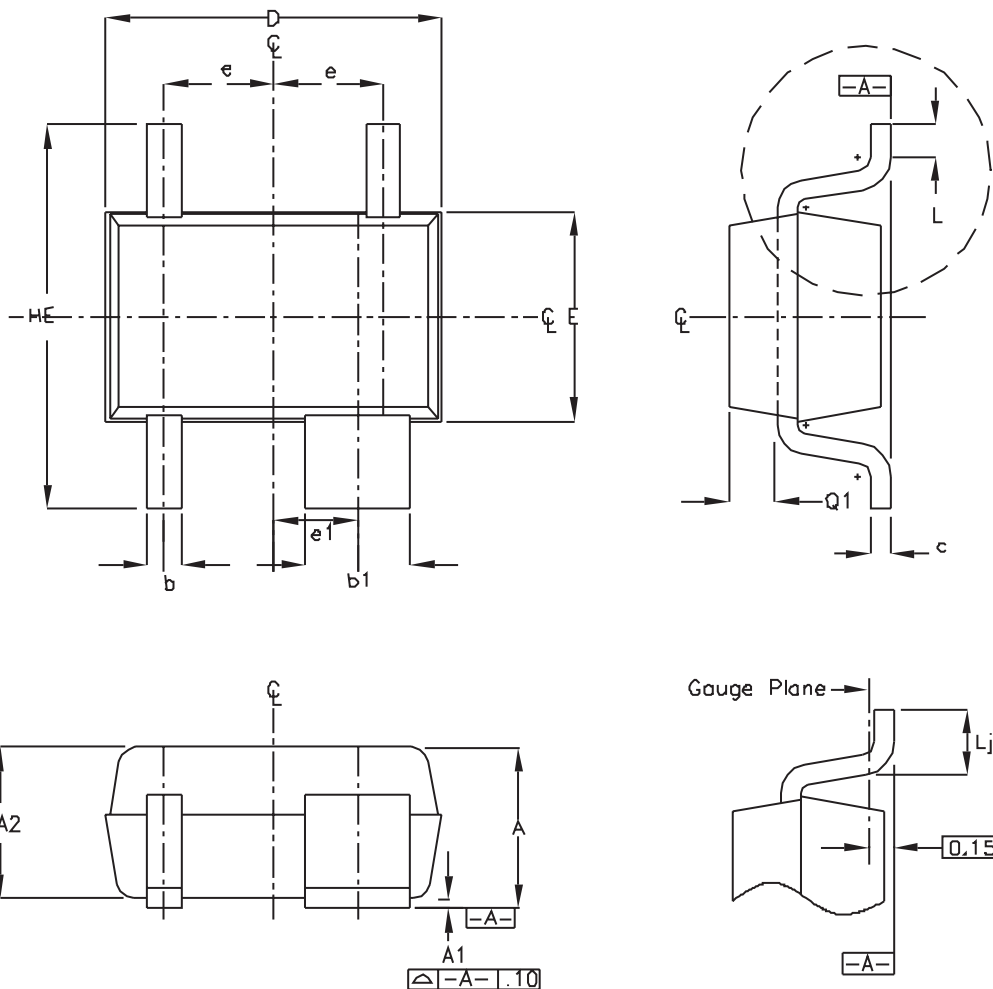
SC70-3



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	0.80	1.10	L1	0.42 REF.	
A1	0	0.10	L	0.15	0.35
A2	0.80	1.00	b	0.25	0.40
D	1.80	2.20	c	0.10	0.25
E	1.15	1.35	e		
HE	1.80	2.40			

Outline Dimension

SC70-4

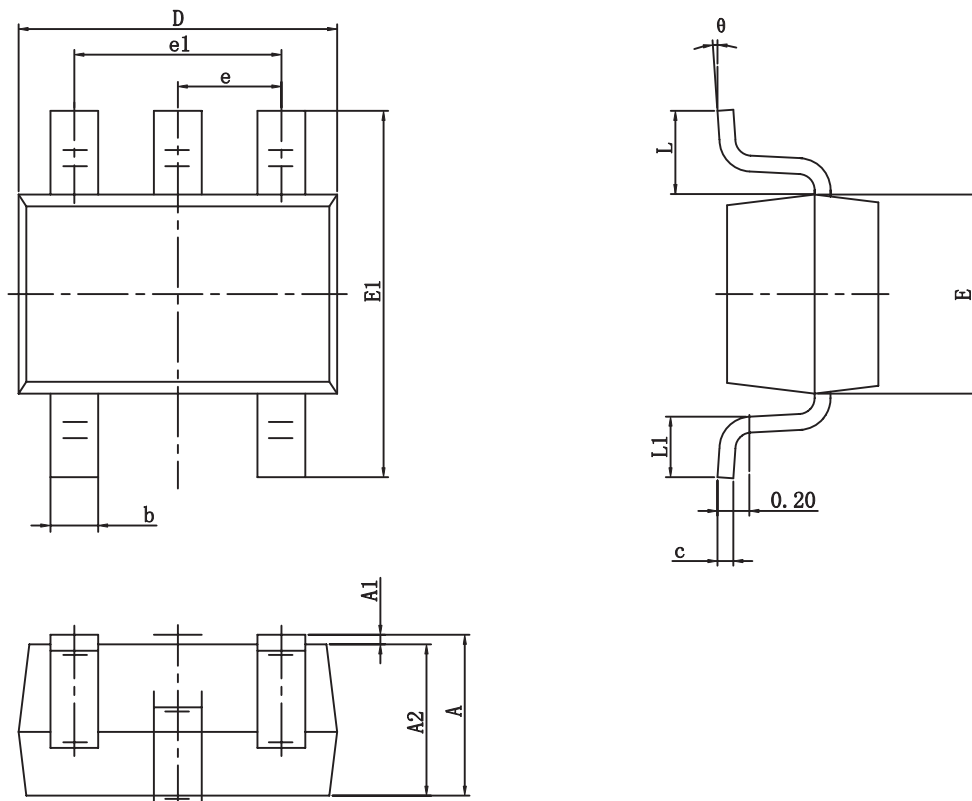


SYMBOL	MIN	MAX
e	0.65 BSC	
e1	0.50 BSC	
D	1.80	2.20
b	0.15	0.30
b1	0.575	0.700
E	1.15	1.35
HE	1.80	2.40
Q1	0.10	0.40
A2	0.80	1.00
A1	0.00	0.10
A	0.80	1.10
c	0.10	0.18
L	0.10	0.30
Lj	0.26	0.46

- 1) ALL DIMENSIONS ARE IN MILLIMETERS
- 2) DIMENSIONS ARE INCLUSIVE OF PLATING
- 3) DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR
- 4) CUSTOM LEADCOUNT VARIATION OF JEITA SC70

Outline Dimension

SC70-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650 TYP		0.026 TYP	
e1	1.200	1.400	0.047	0.055
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0	8	0	8