PAM3103

300mA Adjustable High PSRR CMOS Linear Regulator

Features

- Low Dropout Voltage: 180mV@ 300mA (V_O=3.3V)
- Accuracy within ±2%
- Quiescent Current: 65µA Typ.
- High PSRR: 67dB@100Hz
- Excellent Line/Load Regulation
- Fast Response
- Current Limiting
- Short Circuit Protection
- Low Temperature Coefficient
- Shutdown Current: 0.5µA
- Thermal Shutdown
- Space Saving Packages SOT23-5 and SC70-5
- Pb-Free Package

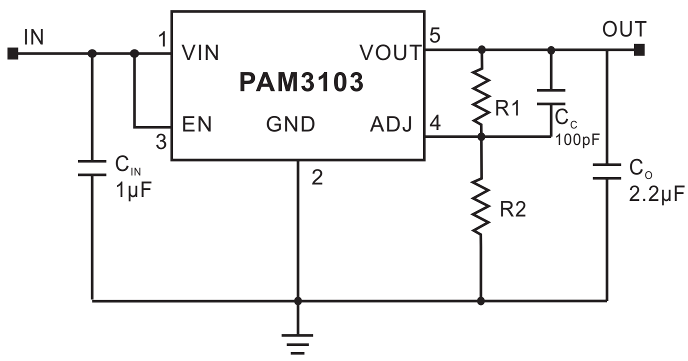
Applications

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

General Description

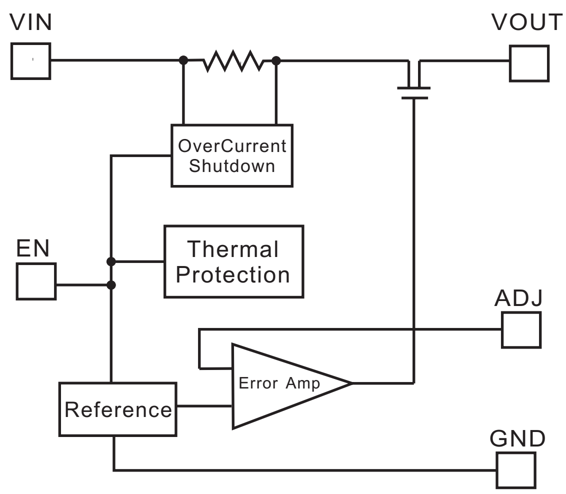
The PAM3103 is a positive, adjustable linear regulator. It features low quiescent current (65µA Typ.) and low dropout voltage, making it ideal for battery powered applications. The output voltage is adjustable from 1.2V through 5V. Its high PSRR makes it useful in applications that require AC noise suppression on the input power supply. Space-saving SOT23-5 and SC70-5 packages 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. It is stable with an output capacitor of 2.2µF or greater.

Typical Application



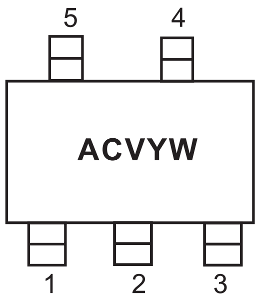
$V_O = V_{REF} * (R1+R2)/R2$

Block Diagram

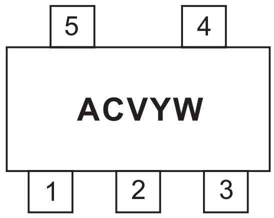


Pin Configuration & Marking Information

Top View
SOT23-5



Top View
SC70-5



AC: Product Code of PAM3101
V: Voltage Code
Y: Year
W: Week

Pin Number	Name	Function
1	VIN	Input
2	GND	Ground
3	EN	Chip Enable (Active High)
4	ADJ	Adjustable Pin
5	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..6.6V
Output Current..300mA
Output Pin Voltage................GND-0.3 to V_{IN}+0.3V
Lead Soldering Temperature(5sec)............300°C
Storage Temperature....................-65°C to 150°C

Recommended Operating Conditions

Max. Supply Voltage (for Max. duration of 30 minutes)..6.4V
Junction Temperature..................-40°C to 125°C
Ambient Temperature.....................-40°C to 85°C

Thermal Information

Parameter	Symbol	Package	Maximum	Unit
Thermal Resistance (Junction to Case)	θ_{JC}	SOT23-5	130	°C/W
		SC70-5	TBD	
Thermal Resistance (Junction to Ambient)	θ_{JA}	SOT23-5	250	°C/W
		SC70-5	300	
Internal Power Dissipation	P_D	SOT23-5	400	mW
		SC70-5	300	

Electrical Characteristic

T_A=25°C, V_{IN}=4V, V_O=3V, C_{IN}=1µF, C_O=2.2µF, unless otherwise noted.

PARAMETER	SYMBOL	Test Conditions		MIN	TYP	MAX	UNITS
Input Voltage	V_{IN}			Note 1		5.5	V
Output Voltage	V_O			1.2		5	V
Reference Voltage	V_{REF}				1.235		V
Output Voltage Accuracy	V_O	I_O=1mA		-2		2	%
Output Current	I_O			300		Note 2	mA
Short Circuit Current	I_{SC}	Vo=0V			150		mA
Dropout Voltage	V_{drop}	I_O =300mA	2.5V≤Vo<3.3V		370	450	mV
			Vo≥3.3V		180	230	
Ground Current	I_{GND}	I_O=1mA to 300mA			70	90	µA
Quiescent Current	I_Q	I_O=0mA			65	90	µA
Line Regulation	LNR	I_O=1mA, V_{IN} =3Vto 5V		-0.4	0.2	0.4	%/V
Load Regulation	LDR	I_O=1mA to 300mA		-1	0.2	1	%
Temperature Coefficient	Tc				40		ppm/°C
Over Temperature Shutdown	OTS	I_O=1mA			150		°C
Over Temperature Hysteresis	OTH	I_O=1mA			30		°C
Power Supply Ripple Rejection	PSRR	Io=100mA, Vo=1.2V	f=100Hz		67		dB
			f=1kHz		65		dB
			f=10kHz		42		dB
Output Noise	Vn	f =10Hz to 100kHz			50		µVrms
EN Input High Threshold	V_{IH}	V_{IN}=2.5V to 5V		1.5			V
EN Input Low Threshold	V_{IL}	V_{IN}=2.5V to 5V				0.3	V
Shutdown Current	I_{SD}	V_{EN}=0V			0.01	1	µA

Note1: The minimum input voltage ($V_{IN(MIN)}$) of the PAM3103 is determined by output voltage and dropout voltage. The minimum input voltage is defined as:

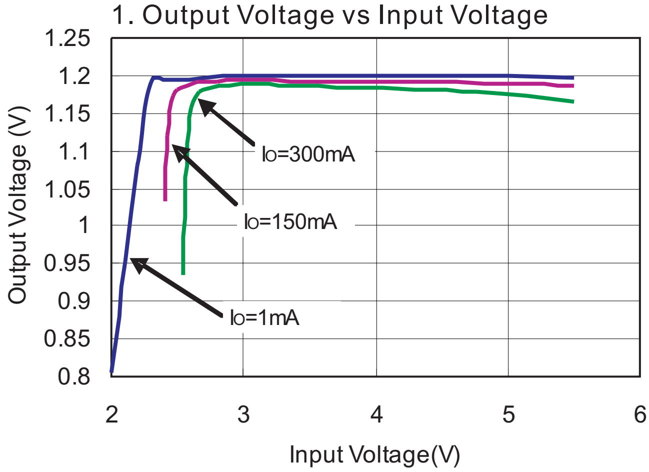
$V_{IN(MIN)}=V_O+V_{drop}$

Note 2: Output current is limited by P_D, maximum $I_O=P_D/(V_{IN(MAX)}-V_O)$.

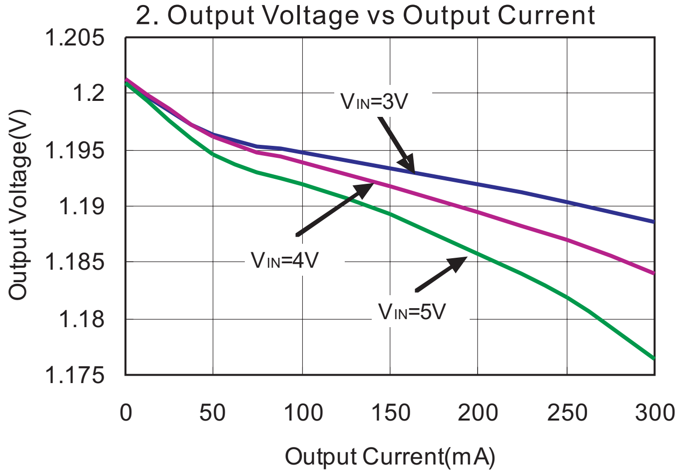
Typical Performance Characteristics

T_A=25°C, V_O=1.2V, C_{IN}=1μF, C_O=2.2μF, unless otherwise noted.

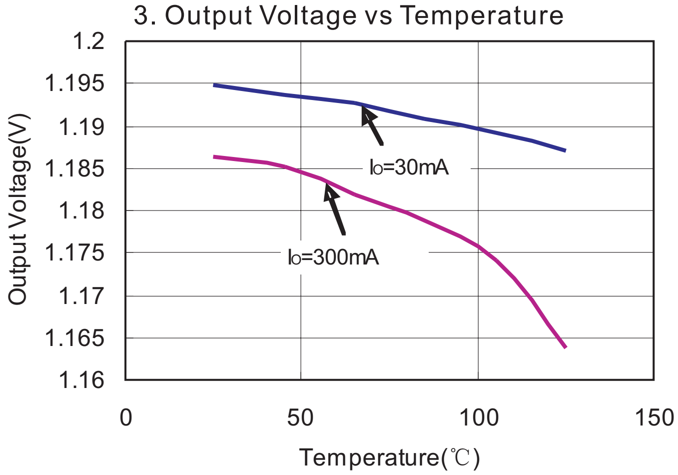
1. Output Voltage vs Input Voltage



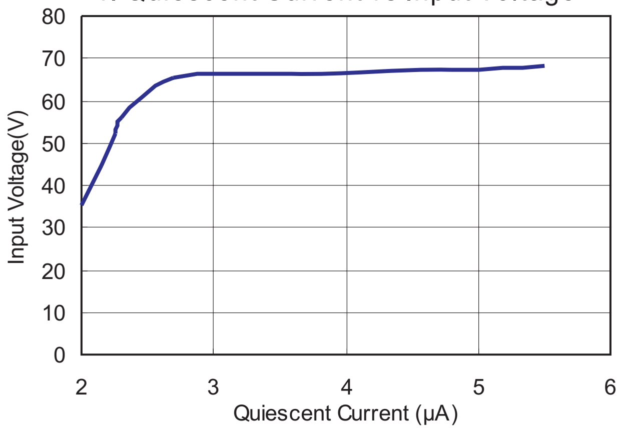
2. Output Voltage vs Output Current



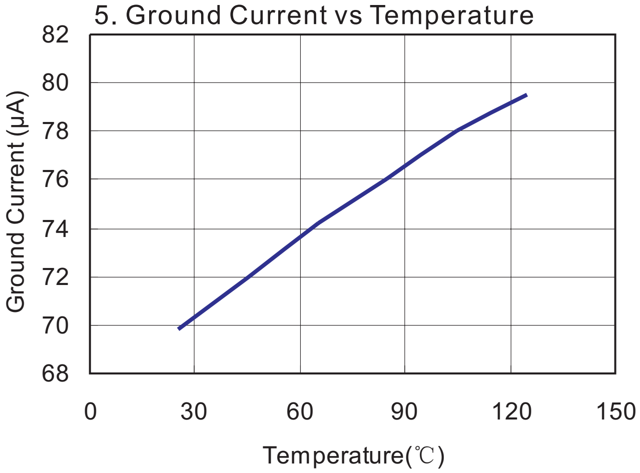
3. Output Voltage vs Temperature



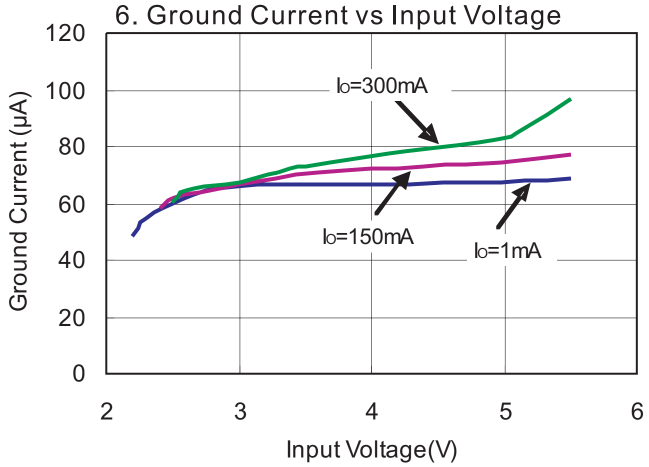
4. Quiescent Current vs Input Voltage



5. Ground Current vs Temperature

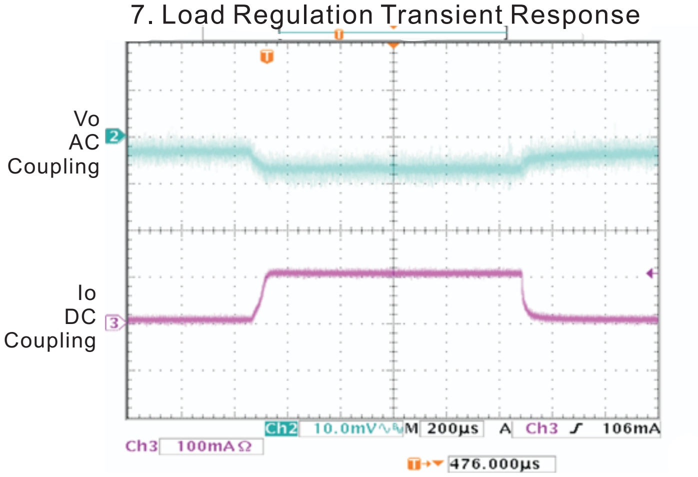


6. Ground Current vs Input Voltage

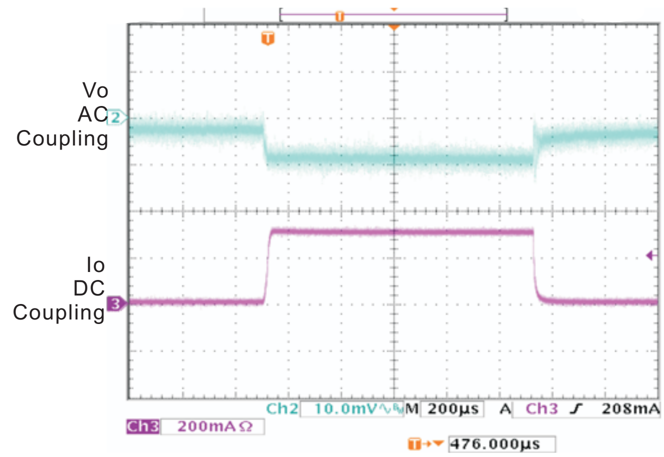


Typical Performance Characteristics (continued)

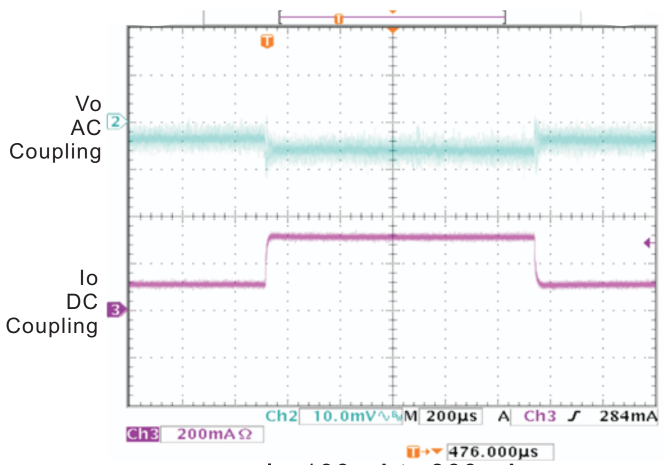
7. Load Regulation Transient Response



I_O=1mA to 100mA

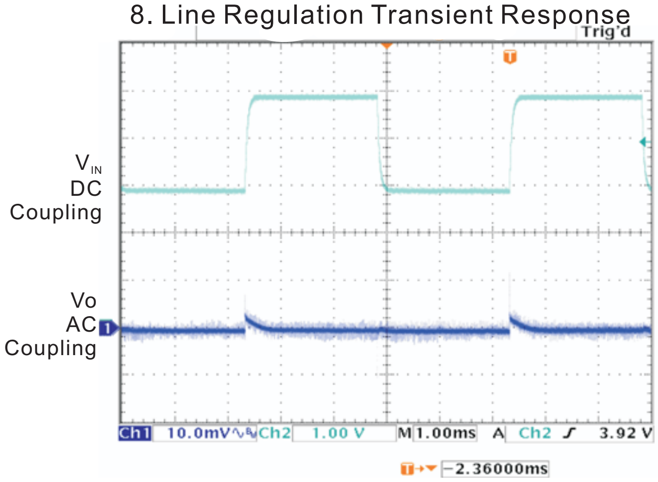


I_O=1mA to 300mA



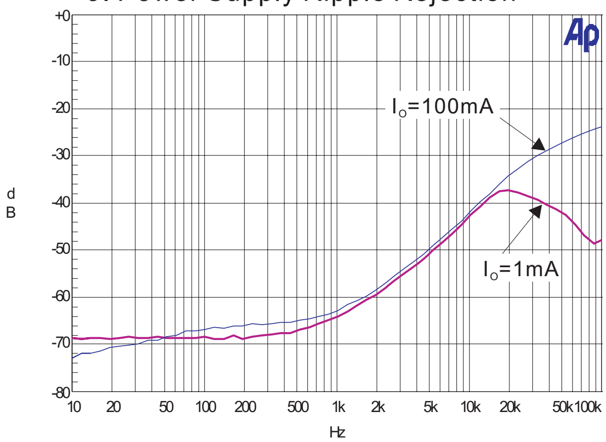
I_O=100mA to 300mA

8. Line Regulation Transient Response



Io=1mA, V_{IN}=3V to 5V

9. Power Supply Ripple Rejection



V_{IN}=3V, Vpp=1V

Application Information

Capacitor Selection and Regulator Stability

Similar to any low dropout regulator, the external capacitors used with the PAM3103 must be carefully selected for regulator stability and performance.

A capacitor C_{IN} of more than 1μF can be employed in the 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 PAM3103 should not exceed 0.5 inch. Ceramic capacitors are suitable for the PAM3103. Capacitors with larger values and lower ESR (equivalent series resistance) provide better PSRR and line-transient response.

The PAM3103 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 >2.2μF with ESR>5mΩ ensures stability.

ADJ Output Voltage Programming

The output voltage of the PAM3103 adjustable regulator is programed by using an external resistor divider as shown in Figure1. The output voltage is calculated as below:

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

Resistor R1 and R2 should be chosen for approximately 7μA divider current. Lower value resistors can be used but offer no advantage and waste more power. Higher value should be avoided as leakage current at ADJ pin increase the output voltage error. C_C is unnecessary when R1 or R2 <20kΩ. The recommended design procedure is to choose R2=169kΩ to set the divider current at 7μA and then calculate R1 as below:

$$R1=(V_O/V_{REF} - 1)R2$$

Load Transient Considerations

Curve 7 of the PAM3103 load-transient response on page 5 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 PAM3103. 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 PAM3103 can be shut down by pulling the EN input low, and turned on by tying the EN input to VIN or leaving the EN input floating.

Internal P-Channel Pass Transistor

The PAM3103 features a 0.75Ω P-Channel MOSFET device as a pass transistor. The P-MOS pass transistor enables the PAM3103 to consume only 65μA of ground current during low dropout, light-load, or heavy-load operation. This feature increases the battery operation life time.

Input-Output (Dropout) Voltage

A regulator's minimum input-output voltage differential (or dropout voltage) determines the lowest usable supply voltage. The PAM3103 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 PAM3103 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 PAM3103 also has a built-in short circuit current limit.

Thermal considerations

Thermal protection limits power dissipation in the PAM3103. When the junction temperature exceeds 150°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°C.

For continuous operation, the junction temperature should be maintained below 125°C. The power dissipation is defined as below:

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

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:

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

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°C can be calculated by following formula:

$$P_{D(MAX)} = (125°C-25°C)/250=0.4W$$

It is also useful to calculate the junction temperature of the PAM3103 under a set of specific conditions. Suppose the input voltage V_{IN}=3.3V, the output current I_O=300mA and the case temperature T_A=40°C measured by a thermal couple during operation, the power dissipation is defined as:

$$P_D=(3.3V-2.8V)*300mA+3.3V*70uA \cong 150mW$$

And the junction temperature T_J can be calculated as follows:

$$T_J = T_A+P_D*\theta_{JA}$$
$$T_J = 40°C+0.15W*250°C/W$$
$$=40°C+37.5°C$$
$$=77.5°C<T_{J(MAX)} = 125°C$$

For this application, T_J is lower than the absolute maximum operating junction temperature 125°C, so it is safe to use the PAM3103 in this configuration.

Ordering Information

PAM3103 X X X XXX

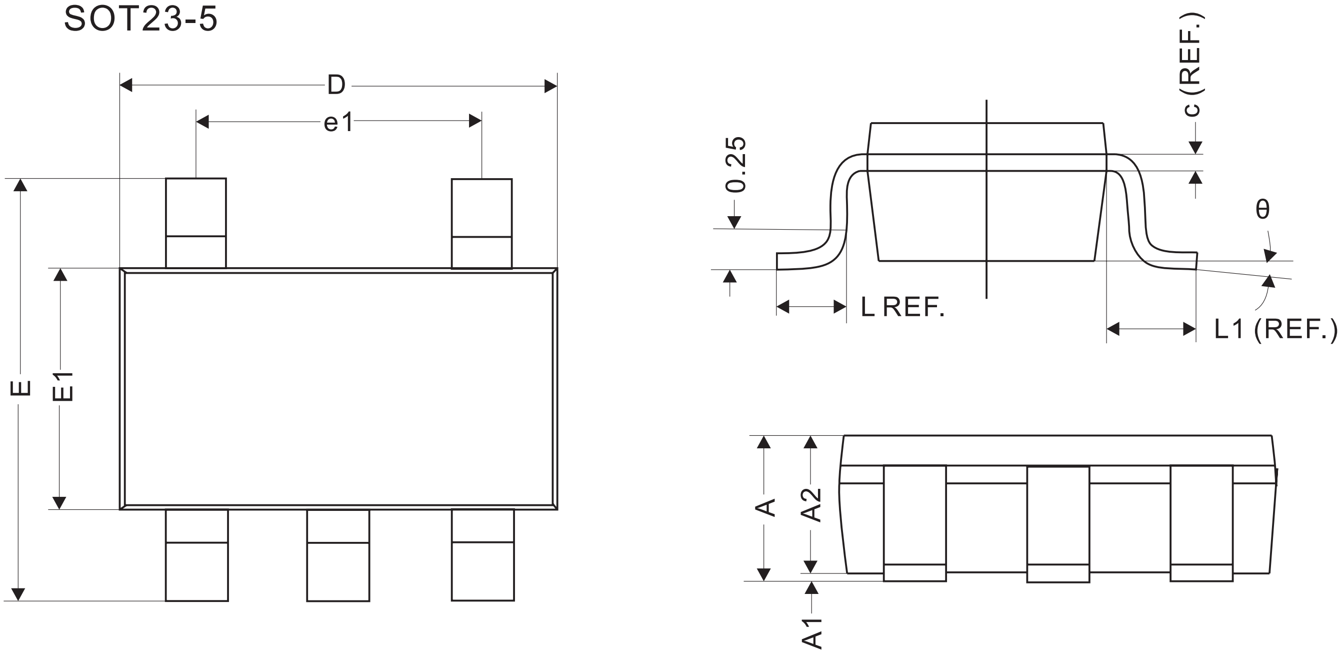
- XXX: Output Voltage
- X (third): Number of Pins
- X (second): Package Type
- X (first): Pin Configuration

Pin Configuration	Package Type	Number of Pins	Output Voltage
A Type 1. VIN 2. GND 3. EN 4. ADJ 5. VOUT	A: SOT-23 U: SC70	B: 5	ADJ

Part Number	Output Voltage	Marking	Package Type	Standard Package
PAM3103AABADJ	ADJ	ACAYW	SOT23-5	3,000Units/Tape&Reel
PAM3103AUBADJ	ADJ	ACAYW	SC70-5	3,000Units/Tape&Reel

Outline Dimension

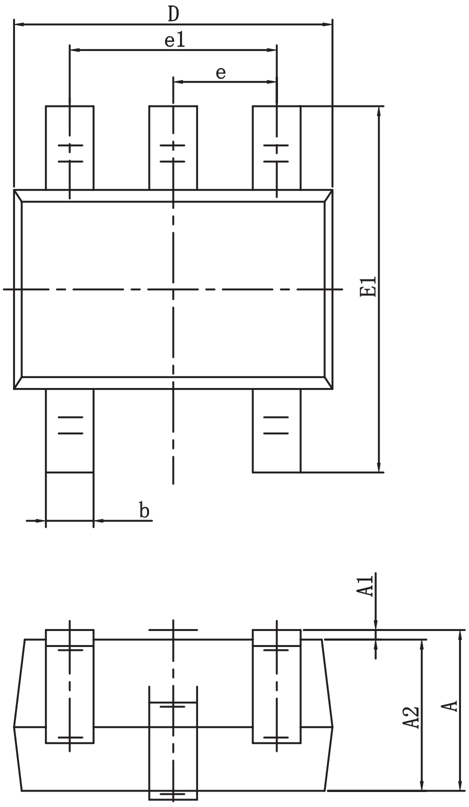
SOT23-5



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	0º	5º	10º
b	0.30	0.40	0.50
e	0.95REF.		
e1	1.90REF.		

Outline Dimension

SC70-5



<table>
<tr><th rowspan="2">Symbol</th><th colspan="2">Dimensions In Millimeters</th><th colspan="2">Dimensions In Inches</th></tr>
<tr><th>Min</th><th>Max</th><th>Min</th><th>Max</th></tr>
<tr><td>A</td><td>0.900</td><td>1.100</td><td>0.035</td><td>0.043</td></tr>
<tr><td>A1</td><td>0.000</td><td>0.100</td><td>0.000</td><td>0.004</td></tr>
<tr><td>A2</td><td>0.900</td><td>1.000</td><td>0.035</td><td>0.039</td></tr>
<tr><td>b</td><td>0.150</td><td>0.350</td><td>0.006</td><td>0.014</td></tr>
<tr><td>c</td><td>0.080</td><td>0.150</td><td>0.003</td><td>0.006</td></tr>
<tr><td>D</td><td>2.000</td><td>2.200</td><td>0.079</td><td>0.087</td></tr>
<tr><td>E</td><td>1.150</td><td>1.350</td><td>0.045</td><td>0.053</td></tr>
<tr><td>E1</td><td>2.150</td><td>2.450</td><td>0.085</td><td>0.096</td></tr>
<tr><td>e</td><td colspan="2">0.650 TYP</td><td colspan="2">0.026 TYP</td></tr>
<tr><td>e1</td><td>1.200</td><td>1.400</td><td>0.047</td><td>0.055</td></tr>
<tr><td>L</td><td colspan="2">0.525 REF</td><td colspan="2">0.021 REF</td></tr>
<tr><td>L1</td><td>0.260</td><td>0.460</td><td>0.010</td><td>0.018</td></tr>
<tr><td>θ</td><td>0</td><td>8</td><td>0</td><td>8</td></tr>
</table>