# PAM3106

**300mA High PSRR Low Dropout CMOS Linear Regulator**

## Features

- Maximum Output Current: 300mA
- Dropout Voltage:180mV @ $I_{OUT}$=300mA and Vo=3.3V
- Operating Voltage Range:2.7V to 5.5V
- Standby Current: Less than 0.1uA (TYP.)
- High Ripple Rejection: 80dB (1kHz)
- Fast Start-Up
- Quick Discharge
- Operating Temperature Range:-40°C~+ 85°C
- Low ESR Capacitor Compatible: Ceramic Capacitor
- Ultra Small Packages: SOT23-5, SOT23-3 and WDFN-6L 1.6X1.6 package
- Pb-Free Package

## Applications

- Mobile Phones, Cordless Phones
- Wireless Communication Equipment
- Portable Games
- Cameras, Video Recorders
- Portable AV Equipment
- Reference Voltage
- Battery Powered Equipment

## General Description

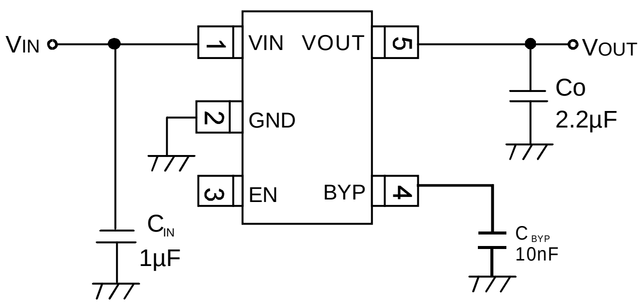
The PAM3106 series are precise, low noise, positive voltage LDO regulators manufactured using CMOS processes. The series achieves high ripple rejection and low dropout and consists of a voltage reference, an error amplifier, a current limiter and a phase compensation circuit plus a driver transistor.

The series is also compatible with low ESR ceramic capacitors which give added output stability. This stability can be maintained even during load fluctuations due to the excellent transient response of the series.

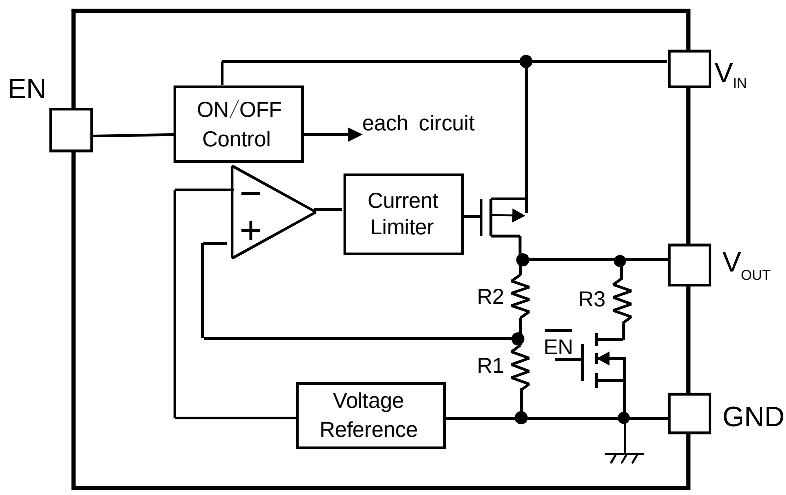
The current limiter's foldback circuit also operates as a short protect for the output current limiter and the output pin.

The EN function enables the output to be turned off, resulting in greatly reduced power consumption.

## Typical Application

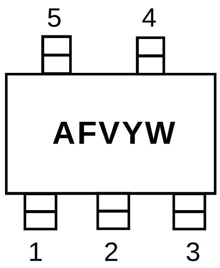



## Block Diagram

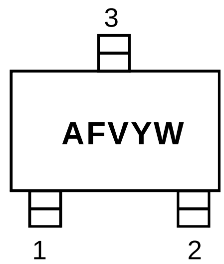


## Pin Configuration & Marking Information

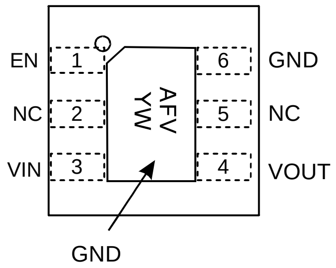
Top View
SOT23-5




Top View
SOT23-3




Top View
WDFN-6L 1.6X1.6




AF: Product Code
V: Voltage Code
Y: Year
W: Weekly

## Pin Configuration Available

| Pin | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| SOT23-3 | GND | VOUT | VIN | | | |
| SOT23-5 | VIN | GND | EN | BYP | VOUT | |
| | VIN | GND | EN | NC | VOUT | |
| WDFN-6L | EN | NC | VIN | VOUT | NC | GND |

## Pin Descriptions

| Name | Function |
|---|---|
| VIN | Input |
| GND | Ground |
| VOUT | Output |
| EN | Chip Enable(active high) |
| NC | No Connected |
| BYP | Bypass |

## 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............................................5.5V
Output Current.......................................300mA
Output Pin Voltage ........GND -0. 3V to VIN+0. 3V
Lead Soldering Temperature (5sec)............ 300°C
Storage Temperature..................−65℃ to 150°C
ESD Rating..........................................Class B
HBM.........................................................2kV
MM.......................................................200V

## Recommended Operating Conditions

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) | $\theta_{JC}$ | SOT-23 | 130 | °C/W |
| | | DFN1.6X1.6 | 160 | |
| Thermal Resistance (Junction to Ambient) | $\theta_{JA}$ | SOT-23 | 250 | °C/W |
| | | DFN1.6X1.6 | 175 | |
| Internal Power Dissipation | $P_D$ | SOT-23 | 400 | mW |
| | | DFN1.6X1.6 | 570 | |

## Electrical Characteristic

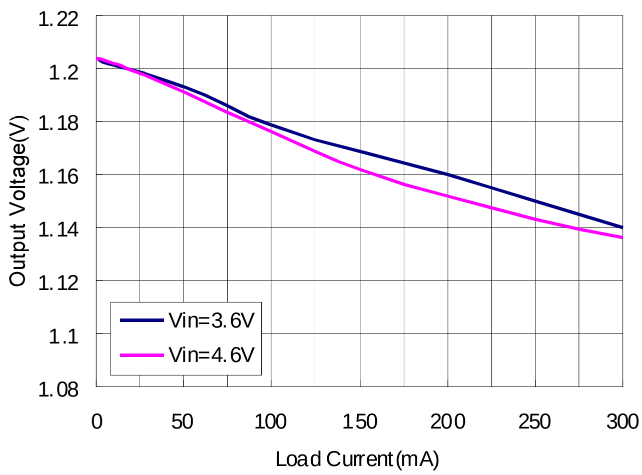
$V_{IN}$=$V_O$+1V, $T_A$=25°C, $C_{IN}$=1µF, $C_O$=2.2µF, Cbyp=10nF,unless otherwise noted

| Parameter | Symbol | Conditions | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $V_{OUT}$ | $I_{OUT}$=150mA | -2 | | 2 | % |
| Maximum Output Current | $I_{OUTMAX}$ | | 300 | | | mA |
| Load Regulation | LDR | 1mA≤$I_{OUT}$≤300mA | | 0.5 | | % |
| Quiescent Current | $I_Q$ | Io=0mA | | 90 | | µA |
| Standby Current | Istdby | VCE=VSS | | 0.1 | 1 | µA |
| Line Regulation | LNR | $V_{OUT}$+1.0V≤$V_{IN}$≤5.5V<br>$I_{OUT}$=30mA | | 0.01 | 0.20 | %/V |
| Input Voltage | VIN | | 2.7 | | 5.5 | V |
| Temperature Characteristics | Tc | $I_{OUT}$=30mA<br>-40℃≤Topr≤85℃ | | 40 | | ppm/°C |
| Power Supply Rejection Rate | PSRR | $I_{OUT}$=50mA,f=1kHz,Cby=0nF | | 60 | | dB |
| | | $I_{OUT}$=50mA,f=1kHz,Cby=10nF<br>Cin=Co=2.2uF | | 80 | | |
| Current Limiter | $I_{lim}$ | | | 400 | | mA |
| Short-circuit Current | Ishort | | | 120 | | mA |
| Fast start Time | tf | Cbyp=0nF | | 50 | | us |
| Over Temperature Shutdown | OTS | no load | | 150 | | ℃ |
| Over Temperature Hysteresis | OTH | no load | | 30 | | ℃ |
| EN "High" Voltage | $V_{ENH}$ | | 1.6 | | VIN | V |
| EN "Low" Voltage | $V_{ENL}$ | | | | 0.3 | V |
| Enable Pin Current | $I_{EN}$ | | | 1 | 3 | uA |

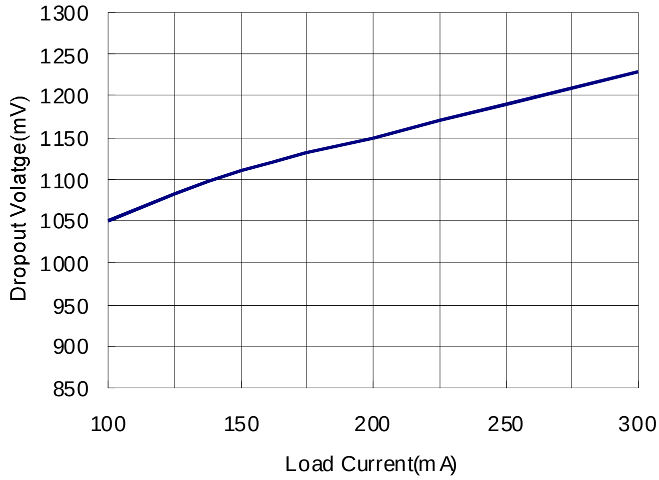
## Typical Performance Characteristics

$V_{IN}=V_O+1V$, $T_A=25°C$, $C_{IN}=1\mu F$, $C_O=2.2\mu F$, Cbyp=10nF,Vo=1.2V,unless otherwise noted

1. Output Voltage vs Output Current

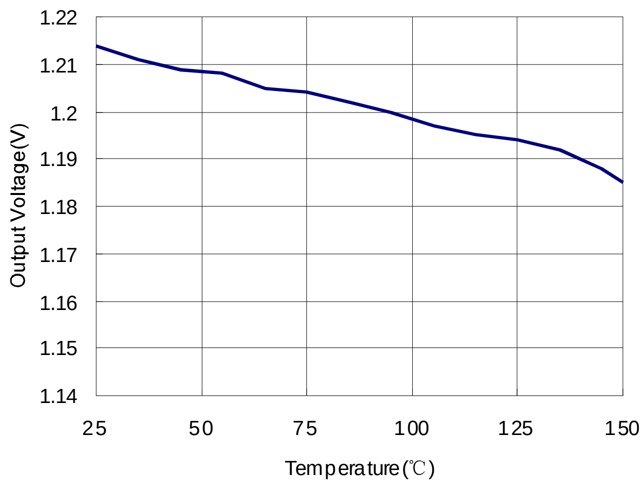



2. Dropout Voltage vs Output Current

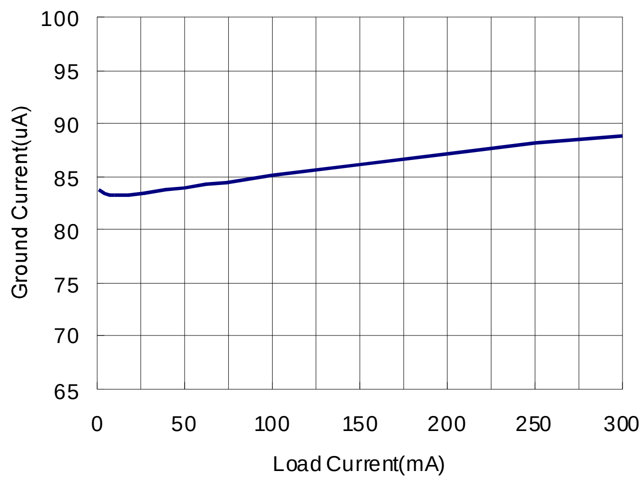



3. Quiescent Current vs Input Voltage


4. Temperature vs Output Voltage



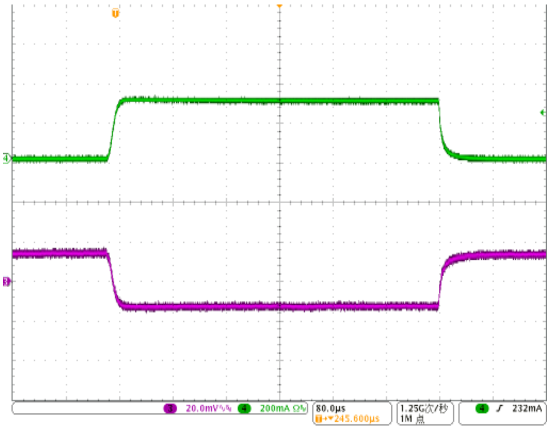

5. Ground Current vs Output Current



## Typical Performance Characteristics

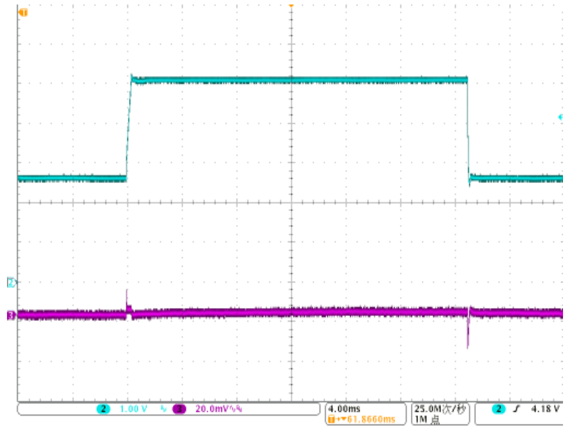
$V_{IN}=V_O+1V$, $T_A=25°C$, $C_{IN}=1\mu F$, $C_O=2.2\mu F$, Cbyp=10nF,Vo=1.2V,unless otherwise noted

6. Load Regulation Transient



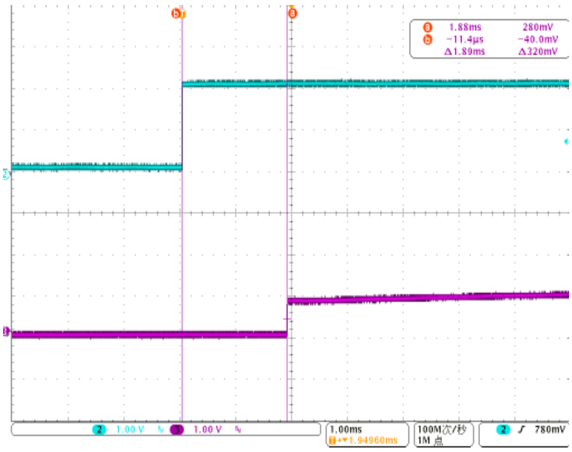

$I_O$=0mA to 300mA

7. Line Regulation Transient



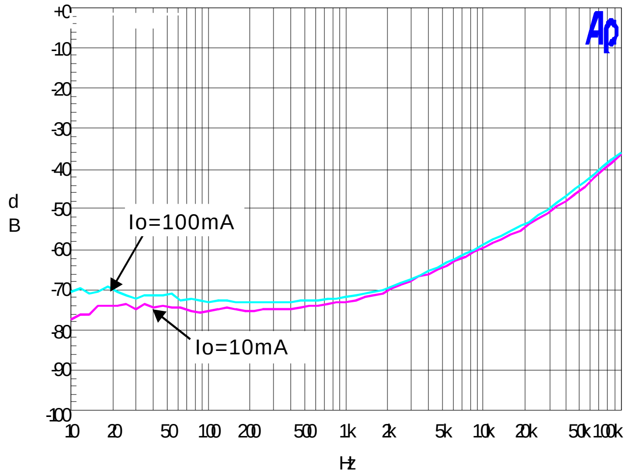

$V_{IN}$=2.7V to 5V,Io=100mA

8.EN Start Up Response(Cbyp=10nF)



$V_{IN}$ =5V, VEN=0 to 2V,Io=100mA

9.PSRR




$V_{IN}$=3.6V, Vpp=500mV,Cbyp=10nF

## Application Information

### Capacitor Selection and Regulator Stability

Similar to any low dropout regulator, the external capacitors used with the PAM3106 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 PAM3106 should not exceed 0.5 inch. Ceramic capacitors are suitable for the PAM3106. Capacitors with larger values and lower ESR (equivalent series resistance) provide better PSRR and line-transient response.

The PAM3106 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.

A 10nF bypass capacitor connected to BYP pin is suggested for suppressing output noise. The capacitor, in series connection with an internal 200kΩ 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 6 of the PAM3106 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 PAM3106. 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 PAM3106 is shut down by pulling the EN input low, and is turned on by tying the EN input to VIN or leaving the EN input floating.

### Internal P-Channel Pass Transistor

The PAM3106 features a 0.75Ω P-Channel MOSFET device as a pass transistor. The P-MOS pass transistor enables the PAM3106 to consume only 90µA of ground current during low dropout, light-load, or heavy-load operations. This feature increases 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 PAM3106 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 PAM3106 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 PAM3106 also has a built-in short circuit current limit.

**Thermal considerations**

Thermal protection limits power dissipation in the PAM3106. 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:

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

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 $\theta_{JA}$ is the thermal resistance from the junction to the ambient.

For example, as $\theta_{JA}$ is 250°C/W for the SOT-23 package and 180°C/W for the SOT-89 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:

$$P_{D(MAX)} = (125°C - 25°C)/250 = 0.4W \quad \text{SOT-23}$$
$$P_{D(MAX)} = (125°C - 25°C)/180 = 0.55W \quad \text{SOT-89}$$

It is also useful to calculate the junction temperature of the PAM3106 under a set of specific conditions. For example, 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 thermalcouple during operation, the power dissipation for the Vo=2.8V version of the PAM3106 can be calculated as:

$$P_D = (3.3V - 2.8V) * 300mA + 3.3V * 90\mu A \cong 150mW$$

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 operating condition, $T_J$ is lower than the absolute maximum operating junction temperature, 125°C, so it is safe to use the PAM3106 in this configuration.

## Ordering Information

PAM3106 X X X xxx

- xxx — Output Voltage
- X (3rd) — Number of Pins
- X (2nd) — Package Type
- X (1st) — Pin Configuration

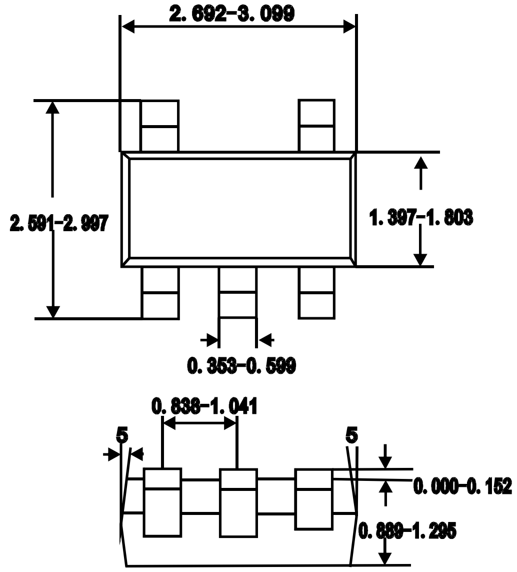
| Pin Configuration | | Package Type | Number of Pins | Output Voltage |
|---|---|---|---|---|
| A Type | F Type | A: SOT-23 | A: 3 | 330: 3.3V |
| 1. GND | 1. EN | K:DFN1.6X1.6 | B: 5 | 280: 2.8V |
| 2. VOUT | 2. NC | | F:6 | 250: 2.5V |
| 3. VIN | 3. VIN | | | 180: 1.8V |
| C Type | 4.VOUT | | | 150: 1.5V |
| 1. VIN | 5.NC | | | 120:1.2V |
| 2. GND | 6.GND | | | |
| 3. EN | | | | |
| 4. NC | | | | |
| 5. VOUT | | | | |
| D Type | | | | |
| 1. VIN | | | | |
| 2. GND | | | | |
| 3. EN | | | | |
| 4. BYP | | | | |
| 5. VOUT | | | | |

## Ordering Information (continued)

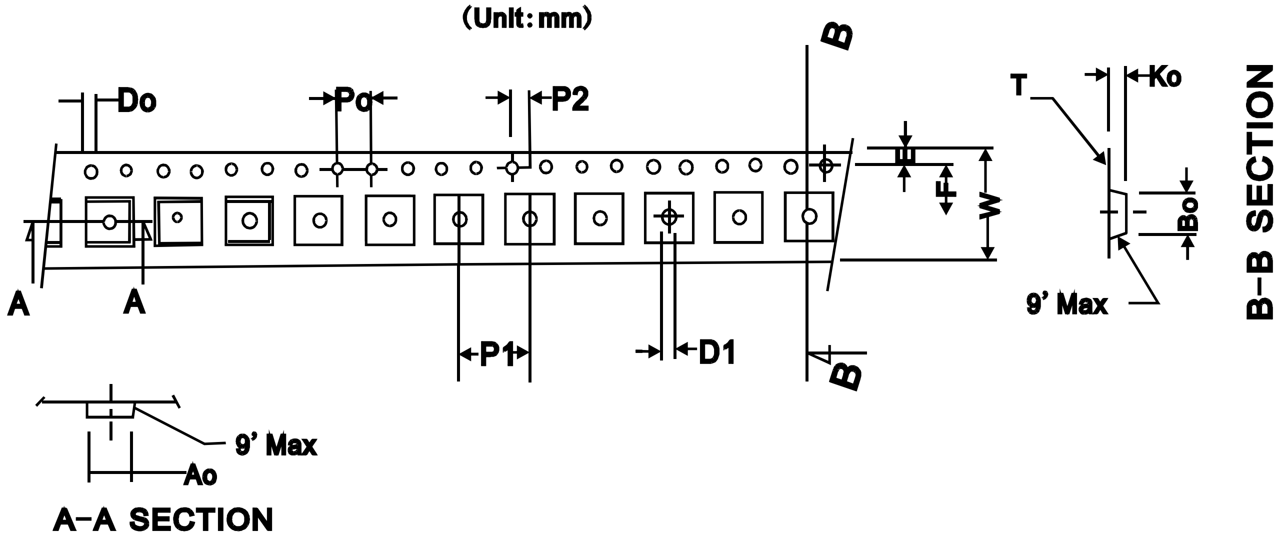
| Part Number | Output Voltage | Marking | Package Type | Shipping Package |
|---|---|---|---|---|
| PAM3106AAA330 | 3.3V | AFKYW | SOT23-3 | 3,000Units/Tape&Reel |
| PAM3106AAA280 | 2.8V | AFHYW | SOT23-3 | 3,000Units/Tape&Reel |
| PAM3106AAA250 | 2.5V | AFGYW | SOT23-3 | 3,000Units/Tape&Reel |
| PAM3106AAA180 | 1.8V | AFEYW | SOT23-3 | 3,000Units/Tape&Reel |
| PAM3106AAA150 | 1.5V | AFCYW | SOT23-3 | 3,000Units/Tape&Reel |
| PAM3106AAA120 | 1.2V | AFBYW | SOT23-3 | 3,000Units/Tape&Reel |
| PAM3106CAB330 | 3.3V | AFKYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106CAB280 | 2.8V | AFHYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106CAB250 | 2.5V | AFGYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106CAB180 | 1.8V | AFEYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106CAB150 | 1.5V | AFCYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106CAB120 | 1.2V | AFBYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106DAB330 | 3.3V | AFKYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106DAB280 | 2.8V | AFHYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106DAB250 | 2.5V | AFGYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106DAB180 | 1.8V | AFEYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106DAB150 | 1.5V | AFCYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106DAB120 | 1.2V | AFBYW | SOT23-5 | 3,000Units/Tape&Reel |
| PAM3106FKF330 | 3.3V | AFKYW | WDFN1.6X1.6 | 3,000Units/Tape&Reel |
| PAM3106FKF280 | 2.8V | AFHYW | WDFN1.6X1.6 | 3,000Units/Tape&Reel |
| PAM3106FKF250 | 2.5V | AFGYW | WDFN1.6X1.6 | 3,000Units/Tape&Reel |
| PAM3106FKF180 | 1.8V | AFEYW | WDFN1.6X1.6 | 3,000Units/Tape&Reel |
| PAM3106FKF150 | 1.5V | AFCYW | WDFN1.6X1.6 | 3,000Units/Tape&Reel |
| PAM3106FKF120 | 1.2V | AFBYW | WDFN1.6X1.6 | 3,000Units/Tape&Reel |

## Outline Dimension

SOT23-5



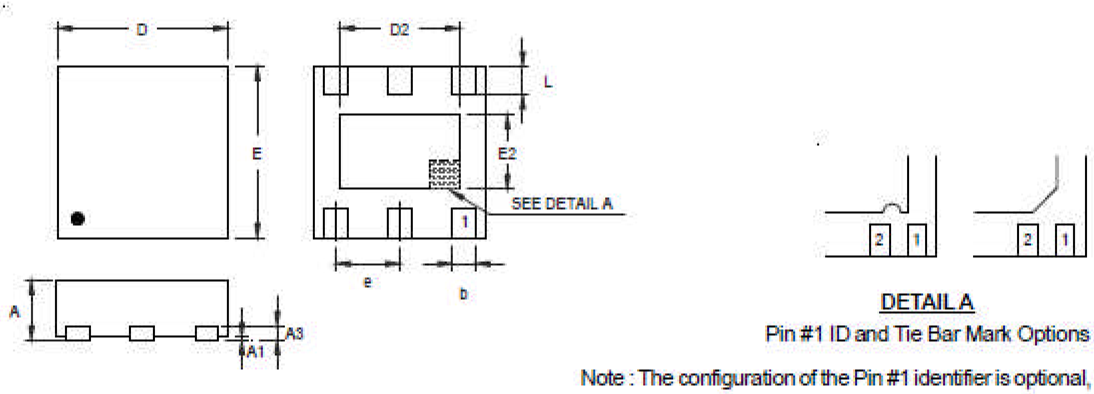

(Unit: mm)




| Symbol | Ao | Bo | Ko | Po | P1 | P2 | T |
|---|---|---|---|---|---|---|---|
| Spec | 3.20±0.1 | 3.10±0.1 | 1.40±0.1 | 4.0±0.1 | 4.0±0.10 | 2.0±0.05 | 0.254±0.013 |
| Symbol | E | F | Do | D1 | W | 10Po | |
| Spec | 1.75±0.1 | 3.5±0.05 | 1.55±0.05 | 1.0±0.25 | 8.0+0.3 -0.1 | 40.0±0.2 | |

## Outline Dimension

### WDFN-6L




DETAIL A
Pin #1 ID and Tie Bar Mark Options

Note : The configuration of the Pin #1 identifier is optional, but must be located within the zone indicated.

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.175 | 0.250 | 0.007 | 0.010 |
| b | 0.200 | 0.300 | 0.008 | 0.012 |
| D | 1.550 | 1.650 | 0.061 | 0.065 |
| D2 | 0.950 | 1.050 | 0.037 | 0.041 |
| E | 1.550 | 1.650 | 0.061 | 0.065 |
| E2 | 0.550 | 0.650 | 0.022 | 0.026 |
| e | 0.500 | | 0.020 | |
| L | 0.190 | 0.290 | 0.007 | 0.011 |

W-Type 6L DFN 1.6x1.6 Package