

DUAL 150mA HIGH PSRR LOW-DROPOUT CMOS REGULATOR

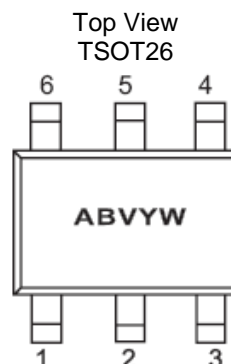
Description

The dual LDO PAM3102 series of positive voltage linear regulators feature high output voltage accuracy, low quiescent current and low dropout voltage, making them ideal for battery powered applications. The line transient response and load transient response are excellent. Their high PSRR make them useful in applications where AC noise on the input power supply must be suppressed. Space-saving TSOT26 package for 2-ch LDOs is attractive for portable and handheld applications. They have both thermal shutdown and a current limit feature to prevent device failure under extreme operating conditions. They are stable with an output capacitance of 2.2 μ F or greater.

Features

- Output Accuracy: $\pm 2\%$
- Low Dropout Voltage: 180mV@150mA
- High PSRR: 70dB@100Hz
- Low Noise Output
- Current Limiting
- Short Circuit Protection
- Thermal Shutdown
- Space Saving Package TSOT26
- Pb-Free Package

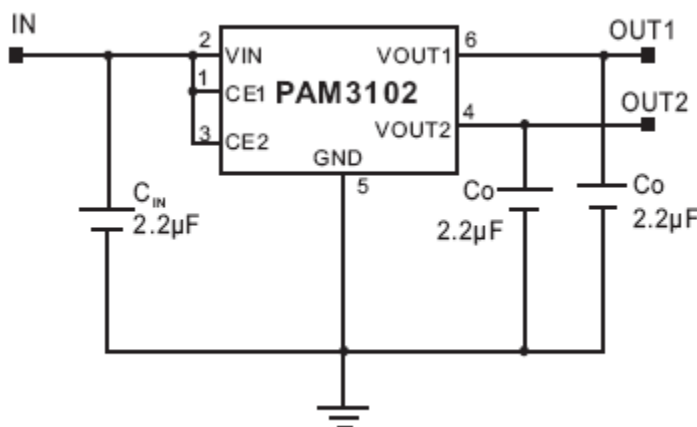
Pin Assignments



Applications

- Cellular Phone
- Portable Electronics, PDA
- Wireless Devices, Wireless LAN
- Computer Peripherals
- Camera Module
- GPS Receiver

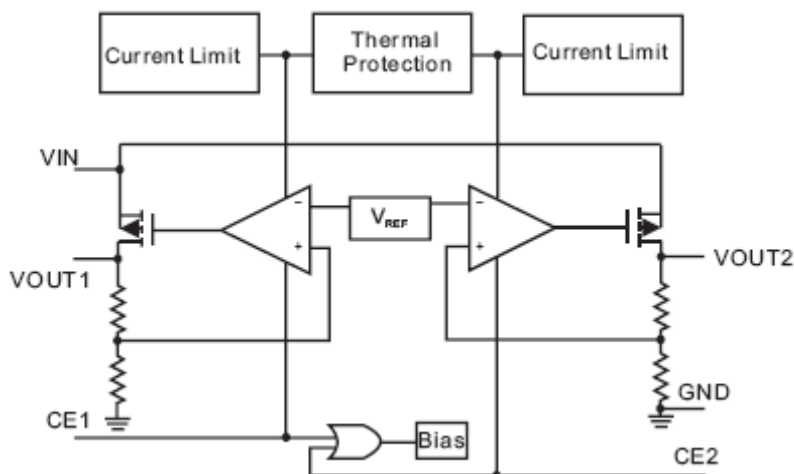
Typical Applications Circuit



Pin Descriptions

| Pin Number | Pin Name | Function |
|------------|----------|-----------------|
| 1 | CE1 | Output 1 Enable |
| 2 | VIN | Input |
| 3 | CE2 | Output 2 Enable |
| 4 | VOUT2 | Output 2 |
| 5 | GND | Ground |
| 6 | VOUT1 | Output 1 |

Functional Block Diagram



Absolute Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

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.

| Parameter | Rating | Unit |
|----------------------------|-----------------------------------|------|
| Input Voltage | 6.0 | V |
| Output Current | 150/150 | mA |
| Output Pin Voltage | GND -0.3 to V _{IN} +0.3V | V |
| Storage Temperature | -40 to +125 | °C |
| ESD Rating (HBM) | 2 | kV |
| Lead Soldering Temperature | 300, (5sec) | °C |

Recommended Operating Conditions (@T_A = +25°C, unless otherwise specified.)

| Parameter | Rating | Unit |
|-------------------------|----------------------|------|
| Supply Voltage Range | 5.5 | V |
| Enable Input Resistance | 0 to V _{IN} | V |
| Junction Temperature | -40 to +125 | °C |
| Operation Temperature | -40 to +85 | |

Thermal Information

| Parameter | Symbol | Package | Max | Unit |
|--|-----------------|---------|-----|------|
| Thermal Resistance Junction to Case) | θ _{JC} | TSOT26 | 130 | °C/W |
| Thermal Resistance (Junction to Ambient) | θ _{JA} | TSOT26 | 250 | |
| Internal Power Dissipation | P _D | TSOT26 | 400 | mW |

Electrical Characteristics (@T_A = +25°C, V_{CE1} = V_{CE2} = V_{IN} = V_O + 1V, C_{IN} = 2.2μF, C_O = 2.2μF, unless otherwise specified.)

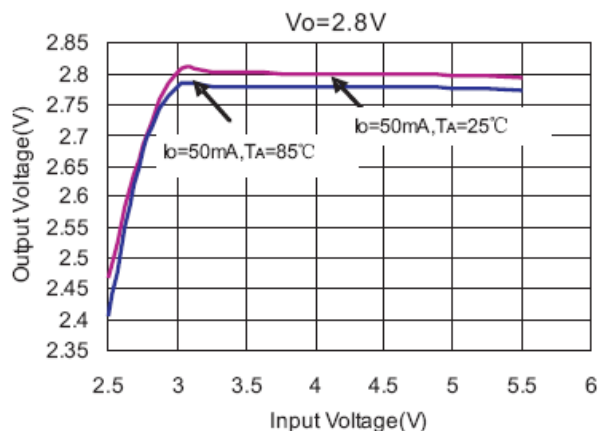
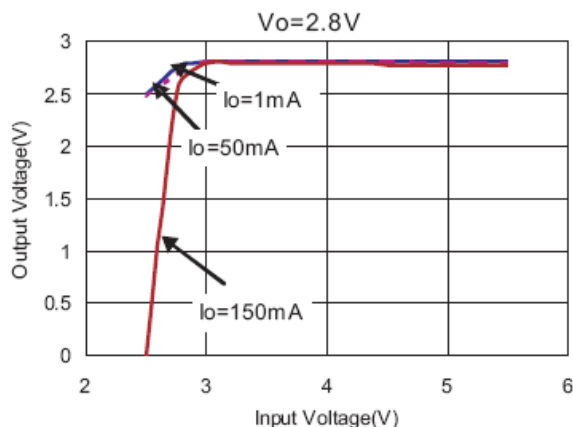
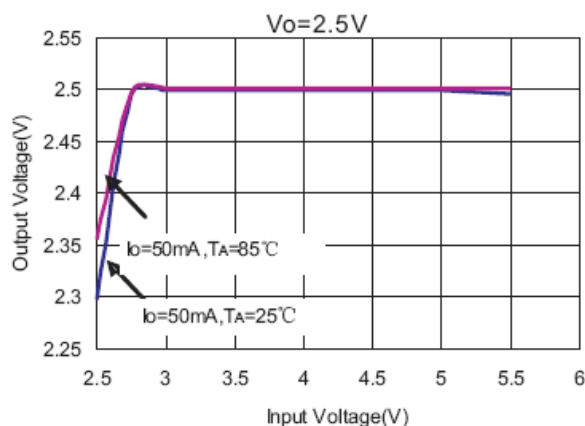
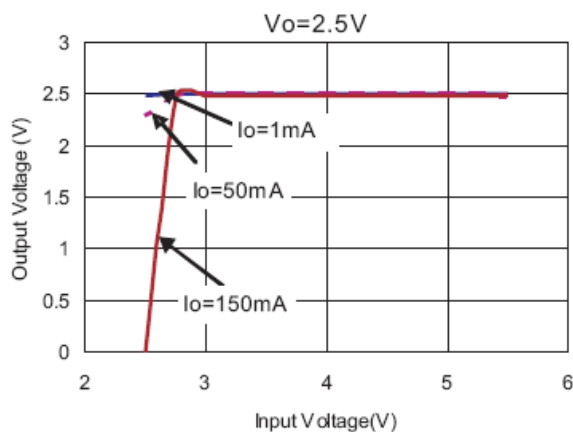
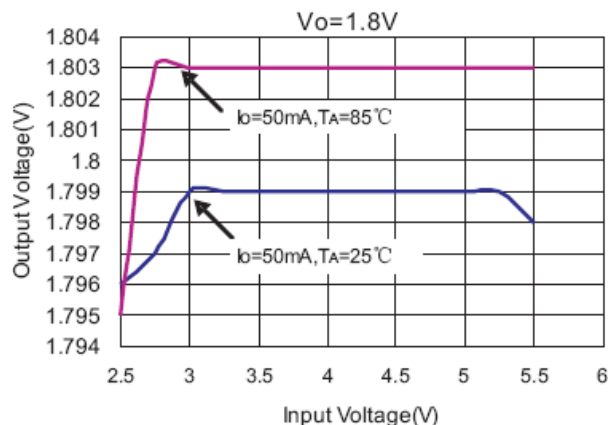
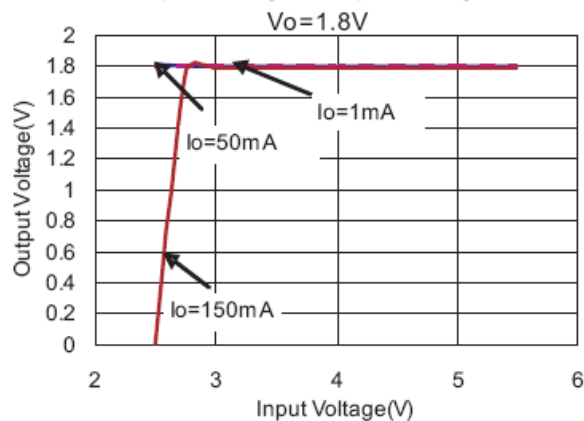
| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|-------------------------------|-------------------|--|-----------|-----|--------|-------------------|
| Input Voltage | V _{IN} | | Note 1 | | 5.5 | V |
| Output Voltage | V _O | I _O = 1mA | -2.0 | | +2.0 | % |
| Dropout Voltage | V _{DROP} | V _O = 1.8V, I _O = 150mA | | 950 | | mV |
| | | V _O = 2.5V, I _O = 150mA | | 350 | | |
| | | V _O = 2.8V, I _O = 150mA | | 180 | | |
| Output Current | I _O | | 150 | | Note 2 | mA |
| Current Limit | I _{LIM} | V _O ≥ 1.2V | | 200 | | mA |
| Quiescent Current | I _Q | I _O = 0mA | | 175 | 250 | μA |
| Ground Pin Current | I _{GND} | I _O = 1mA to 150mA | | 200 | 250 | μA |
| Shutdown Current | I _{SD} | V _{CE1} = V _{CE2} = 0V | | 0.1 | 1 | μA |
| Short Circuit Current | I _{SC} | V _O = 0V | | 150 | | mA |
| Line Regulation | LNR | I _O = 50mA, V _{IN} = 3V to 4V, V _O = 1.8V | -0.15 | 0.1 | 0.15 | % / V |
| | | I _O = 50mA, V _{IN} = 3.5V to 4.5V, V _O = 2.5V | | | | |
| | | I _O = 50mA, V _{IN} = 3.8V to 4.8V, V _O = 2.8V | | | | |
| Load Regulation | LDR | V _{IN} = 3.3V, I _O = 1mA to 150mA | -2 | 1.0 | 2 | % |
| Power Supply Ripple Rejection | PSRR | I _O = 50mA, V _O = 1.8V | f = 100Hz | 70 | | dB |
| | | | f = 1kHz | 63 | | dB |
| | | | f = 10kHz | 45 | | dB |
| Output Noise | V _N | f = 10Hz to 100kHz | | 35 | | μV _{RMS} |
| CE Input High Threshold | V _{TH} | | 1.5 | | | V |
| CE Input Low Threshold | V _{TL} | | | | 0.3 | V |
| CE Pull-Up Resistance | R _{CE} | | 1.7 | 5 | 15 | MΩ |
| Temperature Coefficient | TC | | | 40 | | ppm/°C |
| Over Temperature Shutdown | OTS | I _O = 1mA | | 155 | | °C |
| Over Temperature Hysteresis | OTH | I _O = 1mA | | 40 | | °C |

Notes: 1. The minimum input voltage (V_{IN(MIN)}) of the PAM3102 is determined by output voltage and dropout voltage. The minimum input voltage is defined as:

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

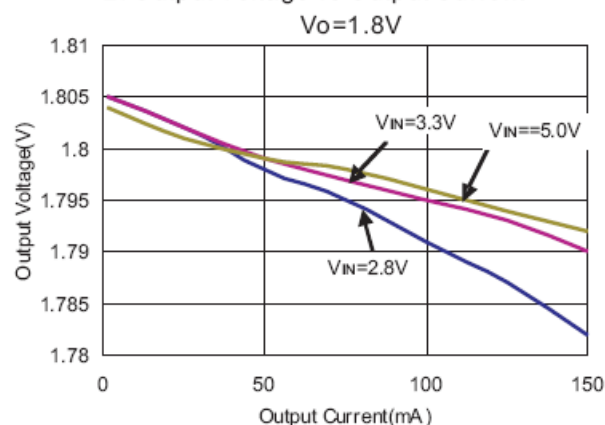
Typical Performance Characteristics (@ $T_A = +25^\circ\text{C}$, $C_{IN} = 2.2\mu\text{F}$, $C_O = 2.2\mu\text{F}$, unless otherwise specified.)

1. Output Voltage vs Input Voltage

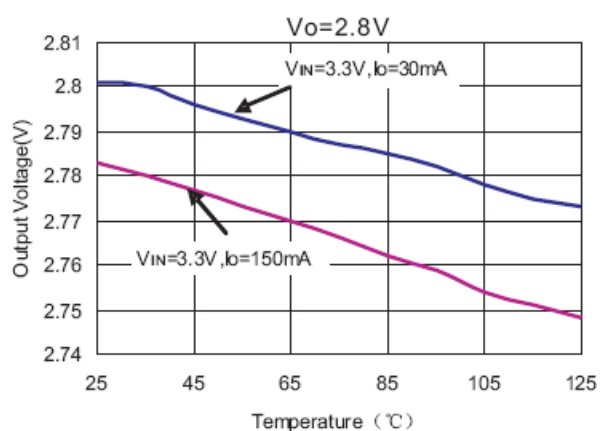
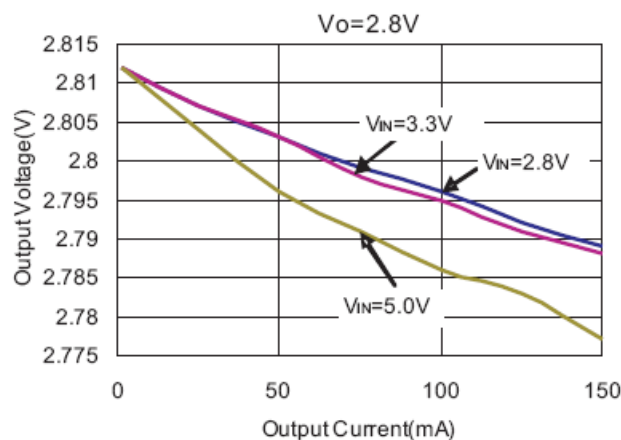
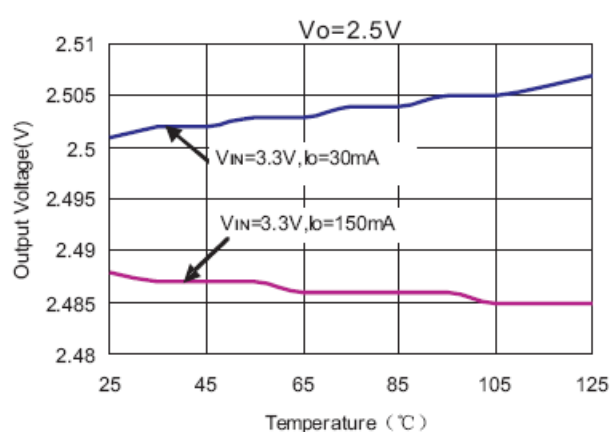
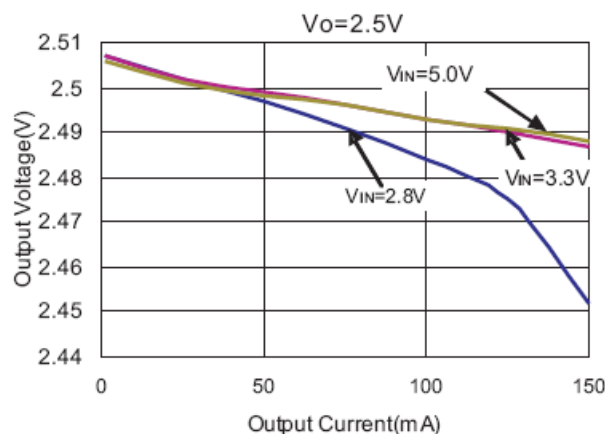
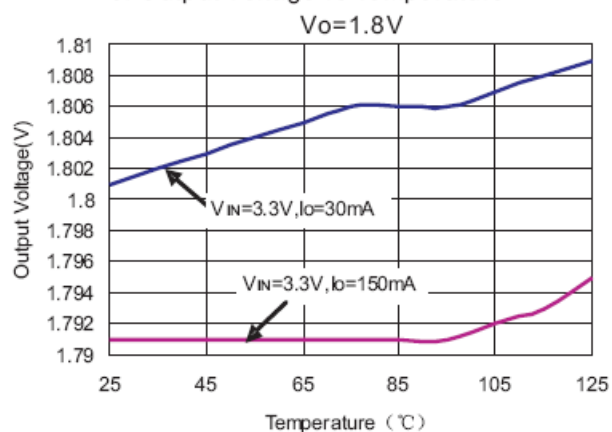


Typical Performance Characteristics (cont.)

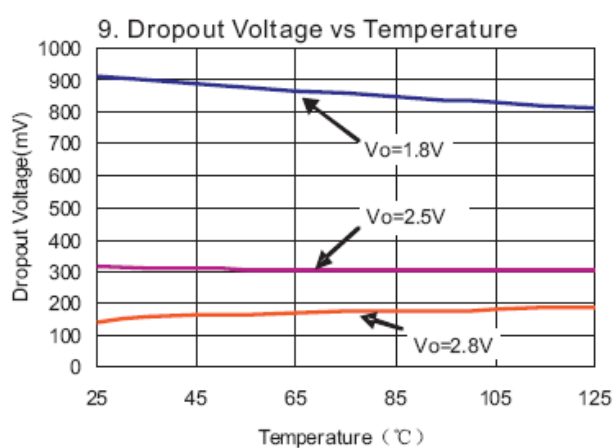
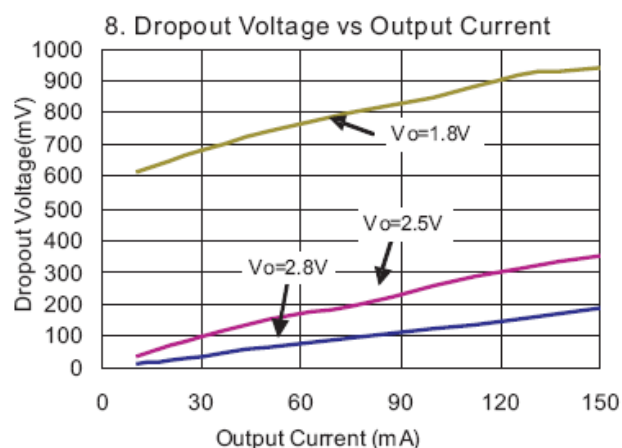
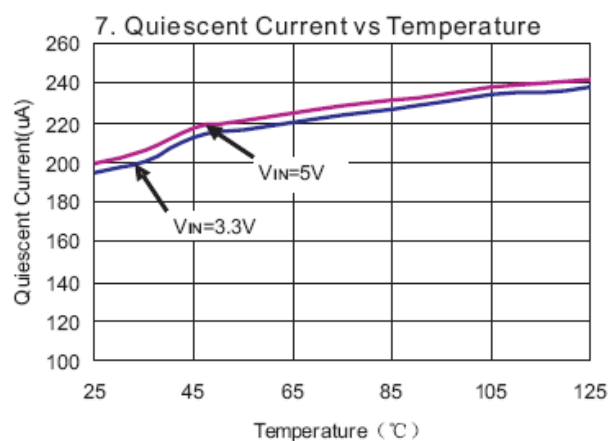
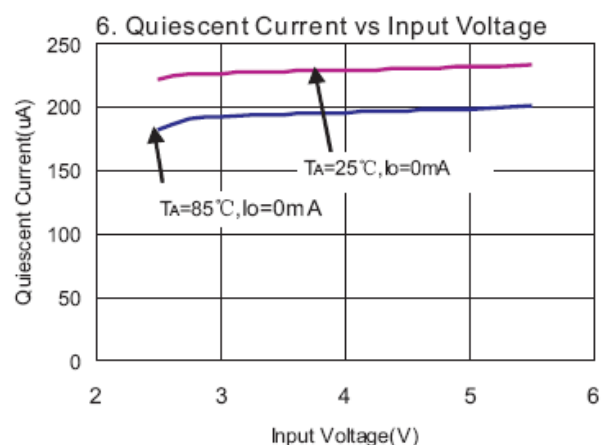
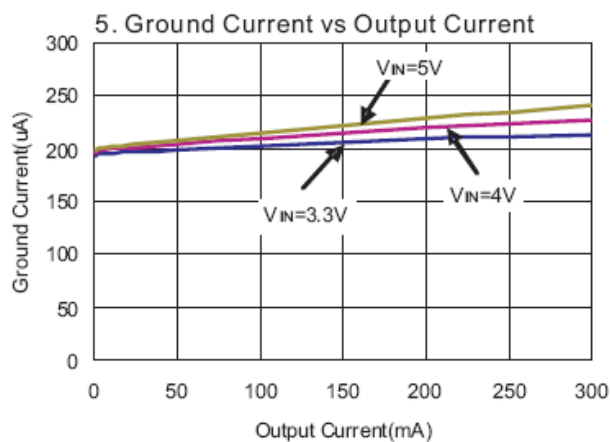
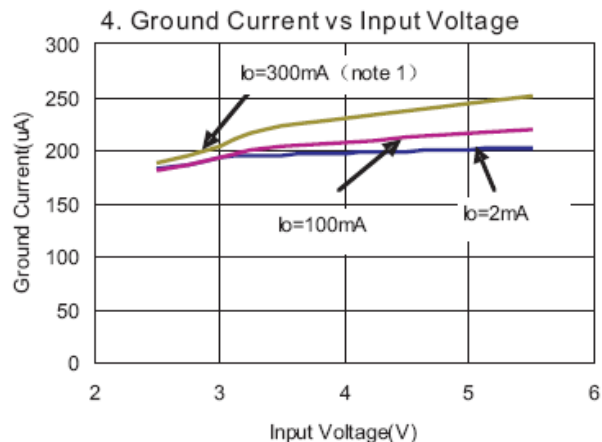
2. Output Voltage vs Output Current



3. Output Voltage vs Temperature



Typical Performance Characteristics (cont.)

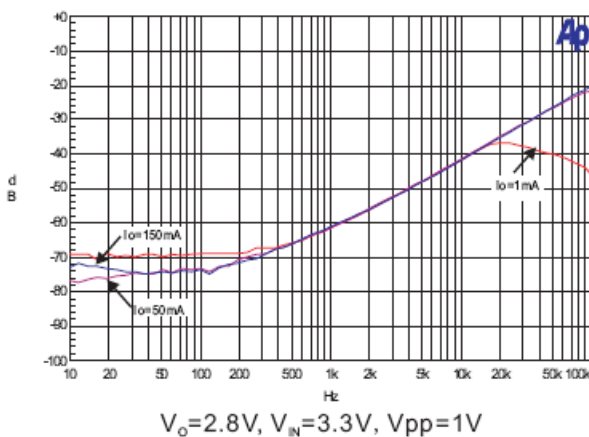
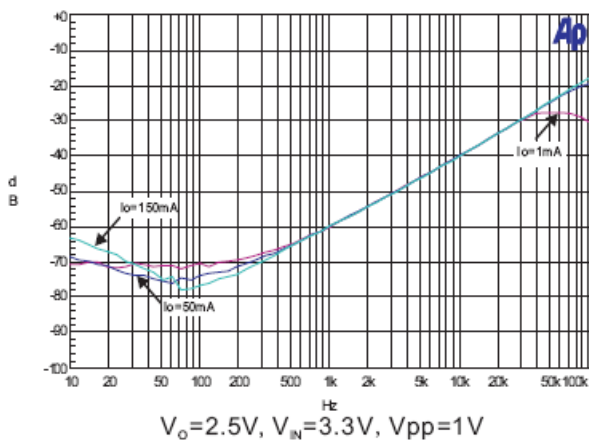
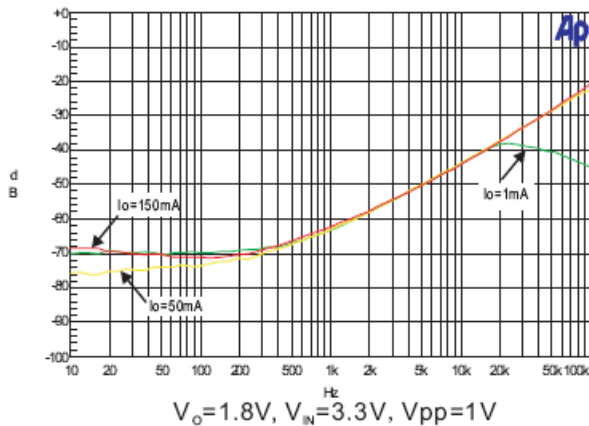


note 1: 2 channels total output current

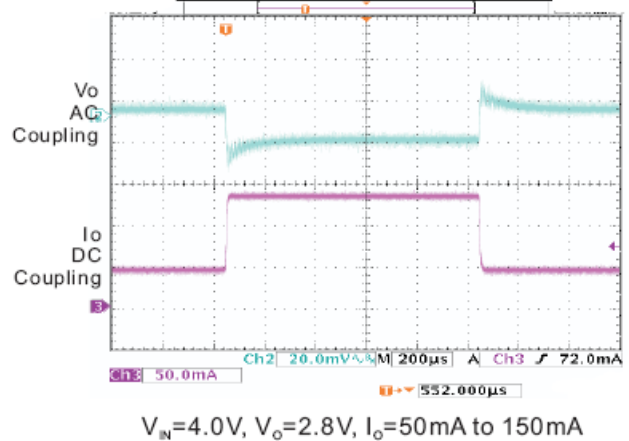
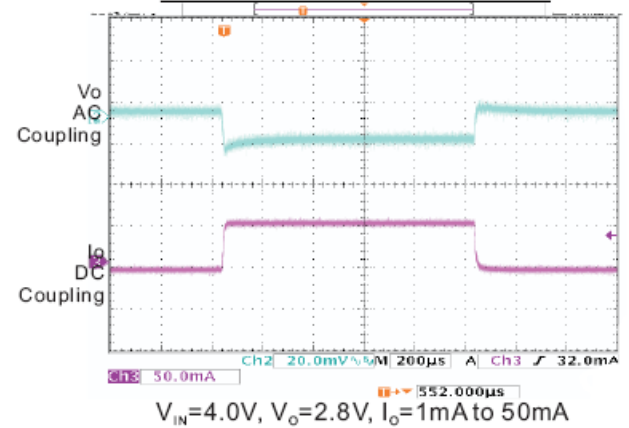
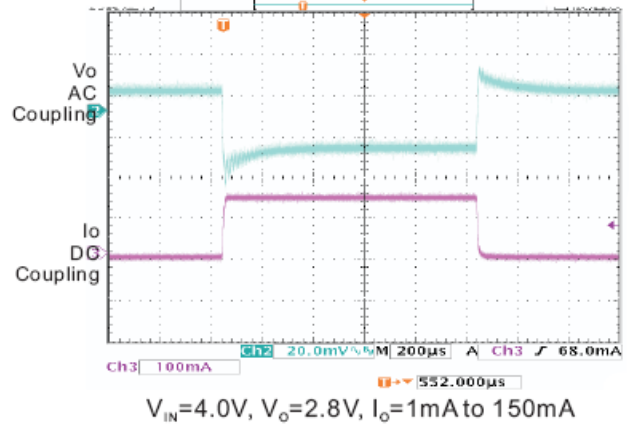
$I_o=150\text{mA}$

Typical Performance Characteristics (cont.)

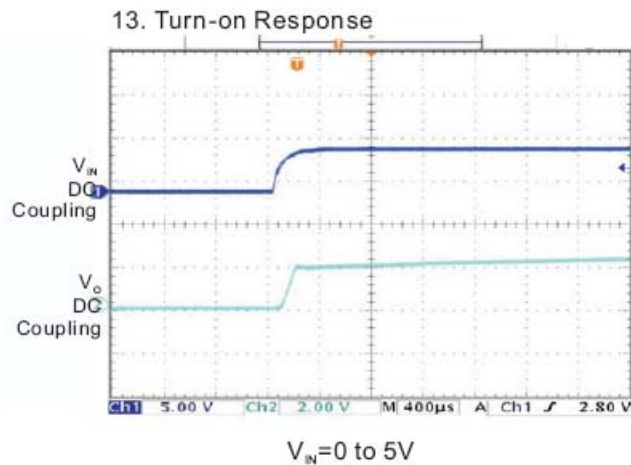
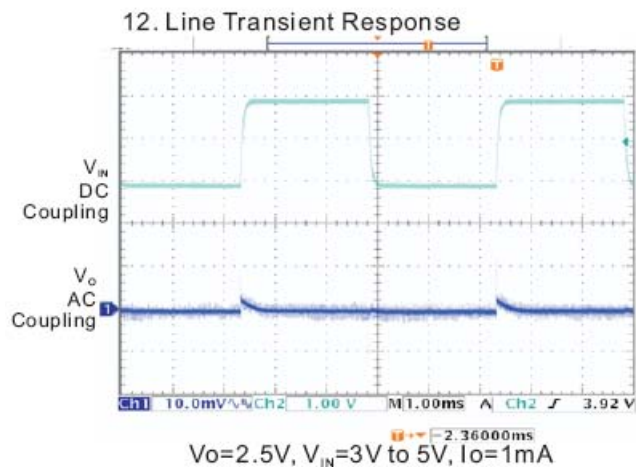
10. Power Supply Ripple Rejection



11. Load Transient Response



Typical Performance Characteristics (cont.)



Application Information

Capacitor Selection and Regulator Stability

Similar to any low dropout regulator, the external capacitors used with the PAM3102 must be carefully selected for regulator stability and performance.

A capacitor C_{IN} of more than $1\mu F$ 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 PAM3102 should not exceed 0.5 inch. Ceramic capacitors are suitable for the PAM3102. Capacitors with larger values and lower ESR (equivalent series resistance) provide better PSRR and line-transient response.

The PAM3102 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.

Shutdown Input Operation

The PAM3102 is shutdown by pulling the CE input low, and turned on by tying the CE input to V_{IN} or leaving the CE input floating.

Input-Output (Dropout) Voltage

A regulator's minimum input-output voltage differential (or dropout voltage) determines the lowest usable supply voltage. The PAM3102 has a typical 180mV dropout voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage.

Current Limit and Short Circuit Protection

The PAM3102 features a current limit, which monitors and controls the gate voltage of the pass transistor. The output current can be limited to 300mA by regulating the gate voltage. The PAM3102 also has a built-in short circuit current limit.

Thermal Considerations

Thermal protection limits power dissipation in the PAM3102. 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:

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

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 $+125^{\circ}C$, T_A is the ambient temperature and θ_{JA} is the thermal resistance from the junction to the ambient.

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

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

It is also useful to calculate the junction temperature of the PAM3102 under a set of specific conditions. Suppose the input voltage $V_{IN} = 3.3V$, the output current $I_O = 300mA$ and the case temperature $T_A = +40^{\circ}C$ measured by a thermal couple during operation, the power dissipation is defined as:

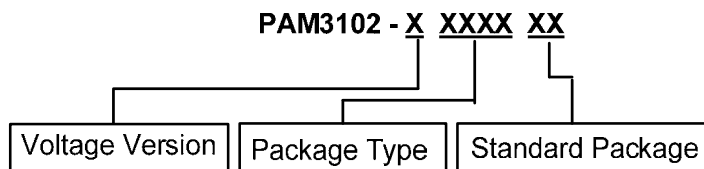
$$P_D = (3.3V - 2.8V) * 150mA + (3.3V - 1.8V) * 150mA + 3.3V * 200\mu A \cong 300mW$$

And the junction temperature T_J can be calculated as follows:

$$\begin{aligned} T_J &= T_A + P_D * \theta_{JA} \\ T_J &= 40^{\circ}C + 0.3W * 250^{\circ}C/W \\ &= 40^{\circ}C + 75^{\circ}C \\ &= 115^{\circ}C < T_{J(MAX)} = +125^{\circ}C \end{aligned}$$

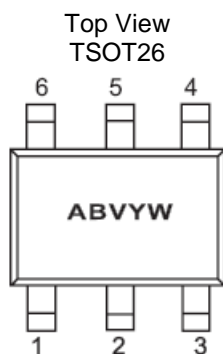
For this application, T_J is lower than the absolute maximum operating junction temperature, $+125^{\circ}C$, so it is safe to use the PAM3102 in this configuration.

Ordering Information



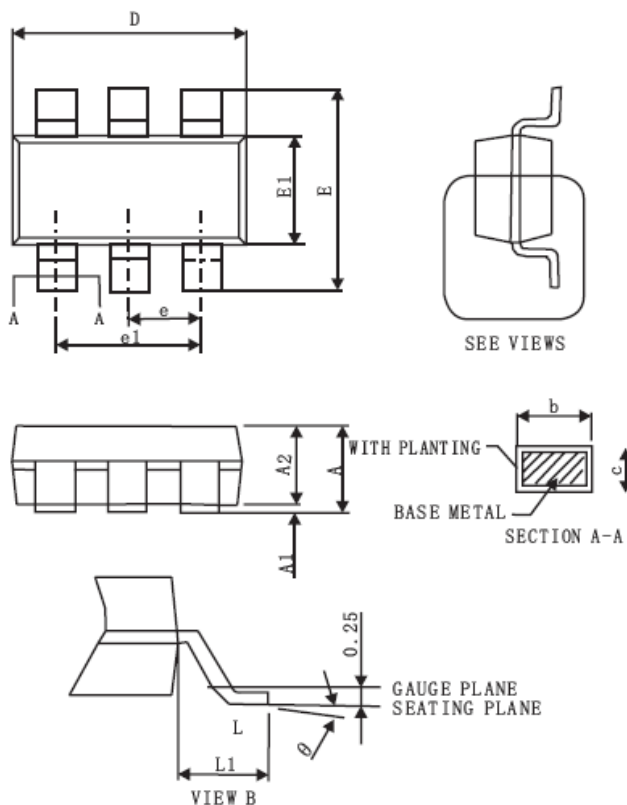
| Part Number | Output Voltage | Part Marking | Package Type | Standard Package |
|-----------------|--------------------------|--------------|--------------|---------------------|
| PAM3102-AST26R1 | VOUT1 1.8V VOUT2 2.8V | ABAYW | TSOT26 | 3000Units/Tape&Reel |
| PAM3102-BST26R1 | VOUT1 1.8V VOUT2 2.5V | ABBYW | TSOT26 | 3000Units/Tape&Reel |

Marking Information



AB: Product Code of PAM3102
V: Voltage Code
Y: Year
W: Week

Package Outline Dimensions (All dimensions in mm.)



| Symbol | A | A1 | A2 | b | c | D | E |
|--------|-----------|-----------|----------|-----------|-----------|----------|----------|
| Spec | 1.20±0.25 | 0.10±0.05 | 1.10±0.2 | 0.40±0.1 | 0.15±0.07 | 2.90±0.1 | 2.80±0.2 |
| Symbol | E1 | e | e1 | L | L1 | θ | |
| Spec | 1.60±0.1 | 0.95BSC | 1.90BSC | 0.55±0.25 | 0.60REF | 4°±4° | |

Unit: Millimeter

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