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1.5A LOW DROPOUT VOLTAGE CMOS REGULATOR

Description

The PAM3116 is a 1.5A CMOS LDO regulator that features a low quiescent current and low dropout voltages, as well as over temperature shutdown. The PAM3116 is stable with a ceramic output capacitor of 4.7µF or higher.

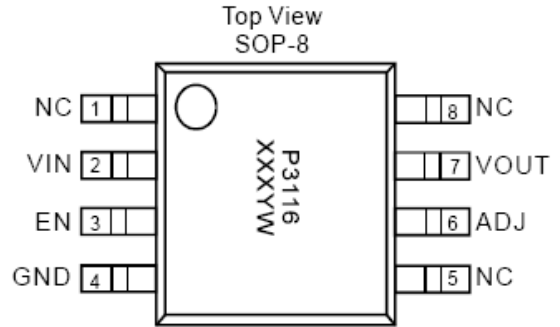
This family of regulators can provide either a stand-alone power supply solution or act as a post regulator for switch mode power supplies. They are particularly suitable for applications requiring low input and output voltages.

PAM3116 is available in SOP-8 package.

Features

- High Output Current Up to 1.5A
- Output Voltage Available in ADJ(0.8V)
- Stable with a Ceramic Output Capacitor
- Dropout Voltage: 300mV@1.5A, Vo = 3.3V
- Low Quiescent Current
- Over Temperature Shutdown
- Short Circuit Protection
- Low Temperature Coefficient
- Standard SOP-8 Packages
- Pb-Free Package

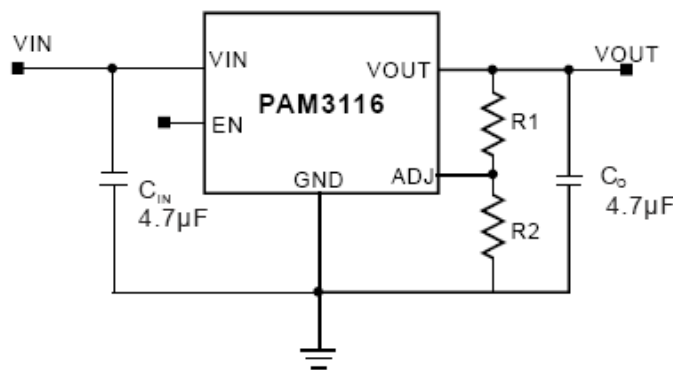
Pin Assignments



Applications

- LCD TV/Monitors
- Set-top Box
- iPhone Charger
- Communication Devices

Typical Applications Circuit

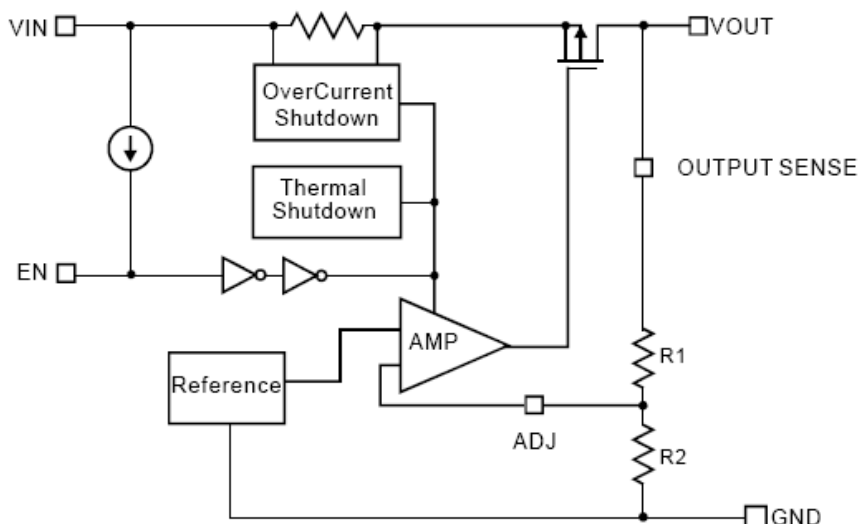


$$V_{OUT} = 0.8 \times (1 + R1/R2)$$

Pin Description

| Pin Name | Pin Number | Function |
|----------|------------|---|
| | SOP-8 | |
| VIN | 2 | Supply Input Voltage. |
| EN | 3 | Chip Enable |
| ADJ | 6 | Set the output voltage by the feedback resistors. |
| VOUT | 7 | Output Voltage. |
| NC | 1, 5, 8 | No Internal Connection. |
| GND | 4 | Ground |

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 | 6.5 | V |
| Output Pin Voltage | -0.3 to V _{IN} +0.3 | V |
| EN, ADJ, OUTPUT SENSE Pin Voltage | -0.3 to V _{IN} +0.3 | V |
| Maximum Output Current | P _D /(V _{IN} -V _O) | — |
| Storage Temperature | -65 to +150 | °C |
| Maximum Junction Temperature | 150 | °C |
| Lead Soldering Temperature | 300, (5sec) | °C |

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

| Parameter | Rating | Unit |
|----------------------------|-------------|------|
| Maximum Supply Voltage | 6 | V |
| Ambient Temperature Range | -40 to +85 | °C |
| Junction Temperature Range | -40 to +125 | |

Thermal Information

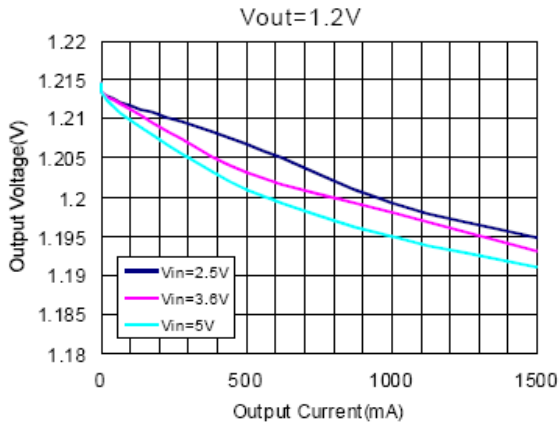
| Parameter | Symbol | Package | Max | Unit |
|--|-----------------|---------|------|------|
| Thermal Resistance (Junction to Case) | θ _{JC} | SOP-8 | 11 | °C/W |
| Thermal Resistance (Junction to Ambient) | θ _{JA} | SOP-8 | 90 | |
| Internal Power Dissipation | P _D | SOP-8 | 1100 | mW |

Electrical Characteristics (@T_A = +25°C, V_{IN} = V_O + 1V, C_{IN} = 4.7μF, C_O = 4.7μF, unless otherwise specified.)

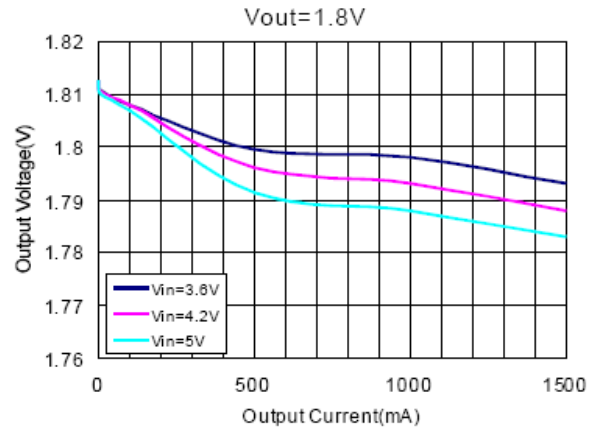
| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|-------------------------------|-------------------|--|------------------------------|------|-------|-------------------|
| Input Voltage Range | V _{IN} | | 2.5 | | 6.0 | V |
| Output Voltage Range | V _O | | 0.8 | | 5 | V |
| ADJ Reference Voltage | V _{REF} | I _O = 1mA | 0.788 | 0.8 | 0.812 | V |
| Output Voltage Accuracy | V _O | I _O = 1mA | -1.5 | | 1.5 | % |
| Output Current | I _O | V _O > 0.8V | 1500 | | | mA |
| Output Current Limit | I _{LIM} | V _O > 0.8V | 1500 | 2500 | | mA |
| Short Circuit Current | I _{SC} | I _O = 0mA | | 700 | | mA |
| Dropout Voltage | V _{DROP} | I _O = 1.5A | 0.8V ≤ V _O < 2.5V | | 1700 | mV |
| | | | V _O ≥ 2.5V | | 300 | |
| Quiescent Current | I _Q | I _O = 0mA | | 90 | 150 | μA |
| Line Regulation | LNR | I _O = 1mA, V _{IN} = V _O + 1 to V _O + 2 | -0.4 | | 0.4 | %/V |
| Load Regulation | LDR | I _O = 1mA to 1500mA | -1.0 | 0.2 | +1.0 | % |
| Temperature Coefficient | T _C | | | 40 | | ppm/°C |
| Over Temperature Shutdown | OTS | I _O = 1mA | | 150 | | °C |
| Over Temperature Hysteresis | OTH | I _O = 1mA | | 40 | | °C |
| Power Supply Ripple Rejection | PSRR | I _O = 100mA, V _O = 1.2mA | f = 100Hz | | 70 | dB |
| | | | f = 1kHz | | 65 | |
| | | | f = 10kHz | | 50 | |
| Output Noise | V _n | f = 10Hz to 100kHz, I _O = 10mA | | 50 | | μV _{RMS} |
| EN Input High Threshold | V _{EH} | V _{IN} = 2.5V to 5V | 1.5 | | | V |
| EN Input Low Threshold | V _{EL} | V _{IN} = 2.5V to 5V | | | 0.3 | V |
| EN Input High Bias Current | I _{EH} | V _{EN} = 5V, V _{IN} = 5V | | | 0.5 | μA |
| EN Input Low Bias Current | I _{EL} | V _{EN} = 0V, V _{IN} = 5V | | | 0.5 | μA |
| Shutdown Current | I _{SD} | V _{EN} = 0V | | | 1 | μA |

Typical Performance Characteristics (@T_A = +25°C, C_{IN} = 2.2µF, C_O = 4.7µF, unless otherwise specified.)

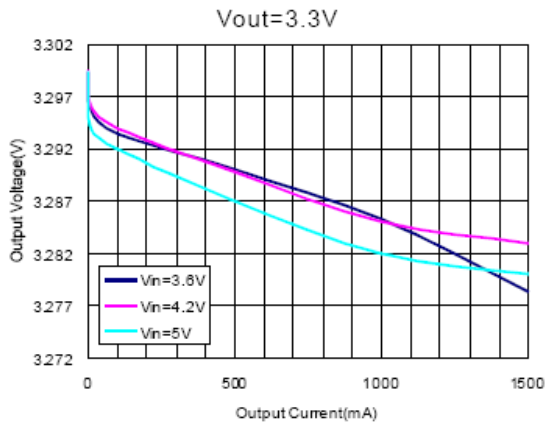
1. Output Voltage vs Output Current



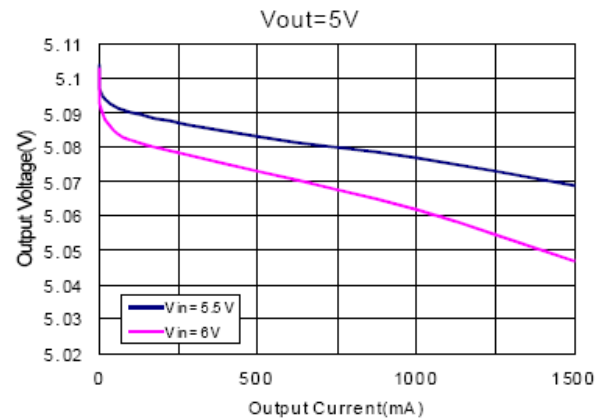
2. Output Voltage vs Output Current



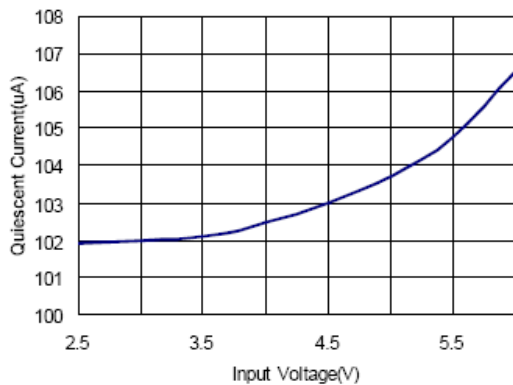
3. Output Voltage vs Output Current



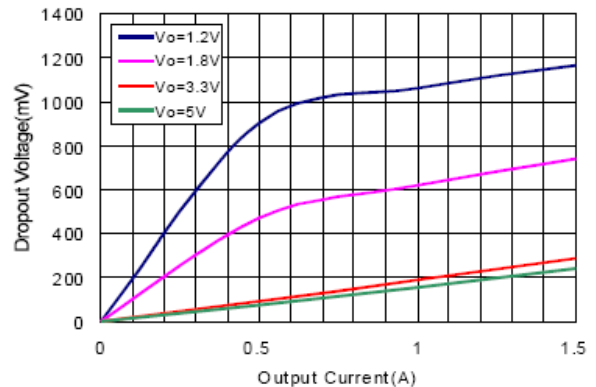
4. Output Voltage vs Output Current



5. Quiescent Current vs Input Voltage

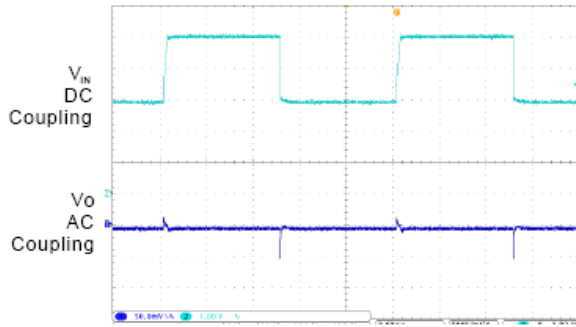


6. Dropout Voltage vs Output Current



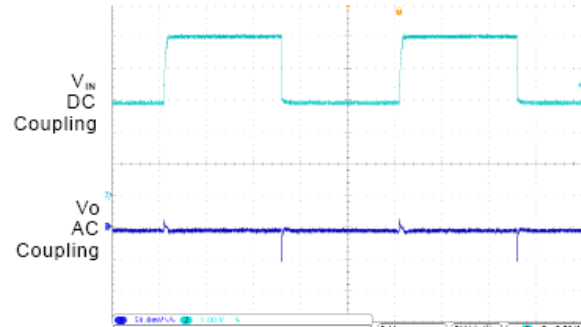
Typical Performance Characteristics (cont.) (@ $T_A = +25^\circ\text{C}$, $C_{IN} = 4.7\mu\text{F}$, $C_O = 4.7\mu\text{F}$, unless otherwise specified.)

7. Line Transient



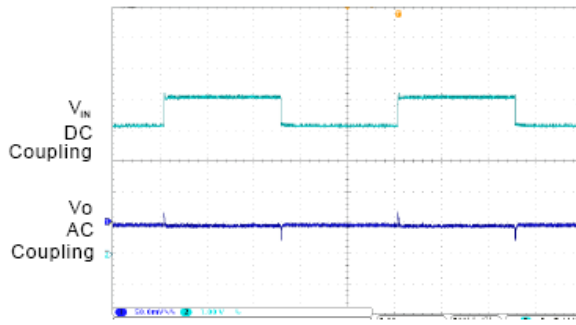
$V_O = 1.2\text{V}$, $V_{IN} = 3\text{V to } 5\text{V}$, $I_O = 100\text{mA}$

8. Line Transient



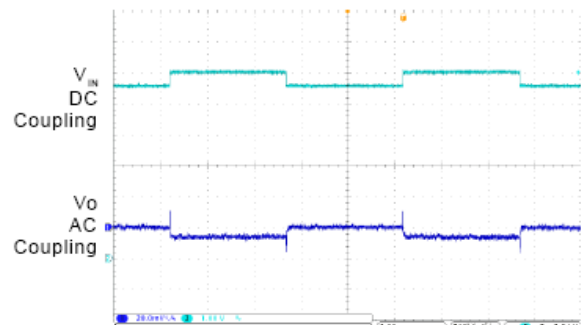
$V_O = 1.8\text{V}$, $V_{IN} = 3\text{V to } 5\text{V}$, $I_O = 100\text{mA}$

9. Line Transient



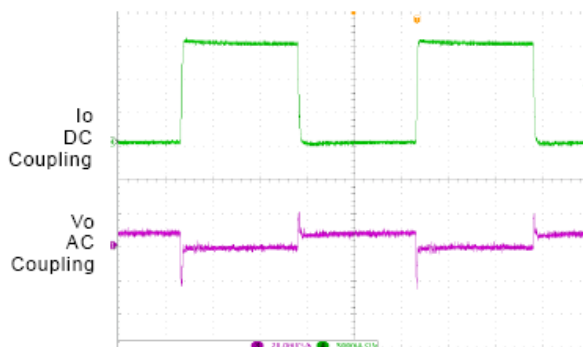
$V_O = 3.3\text{V}$, $V_{IN} = 4\text{V to } 5\text{V}$, $I_O = 100\text{mA}$

10. Line Transient



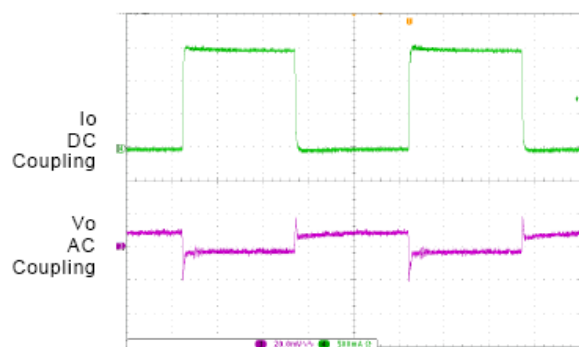
$V_O = 5\text{V}$, $V_{IN} = 5.5\text{V to } 6\text{V}$, $I_O = 100\text{mA}$

11. Load Transient



$V_O = 1.2\text{V}$, $V_{IN} = 3\text{V}$, $I_O = 0\text{A to } 1.5\text{A}$

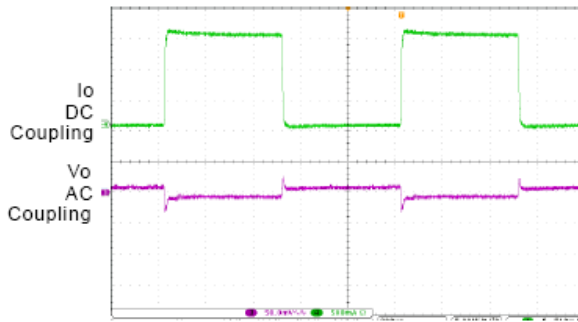
12. Load Transient



$V_O = 1.8\text{V}$, $V_{IN} = 3.6\text{V}$, $I_O = 0\text{A to } 1.5\text{A}$

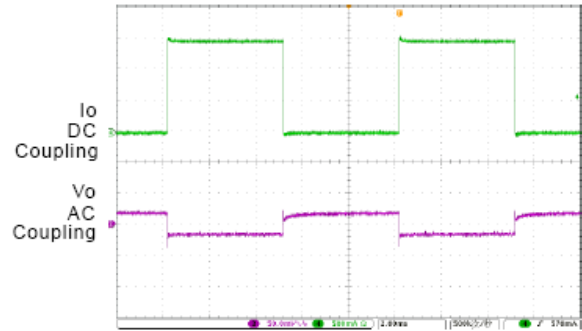
Typical Performance Characteristics (cont.) (@ $T_A = +25^\circ\text{C}$, $C_{IN} = 4.7\mu\text{F}$, $C_O = 4.7\mu\text{F}$, unless otherwise specified.)

13. Load Transient



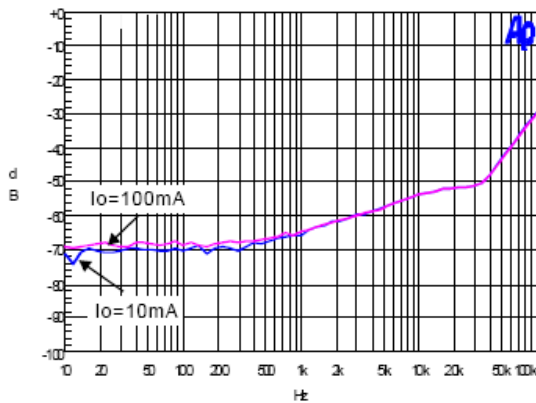
$V_O = 3.3\text{V}$, $V_{IN} = 5\text{V}$, $I_O = 0\text{A}$ to 1.5A

14. Load Transient



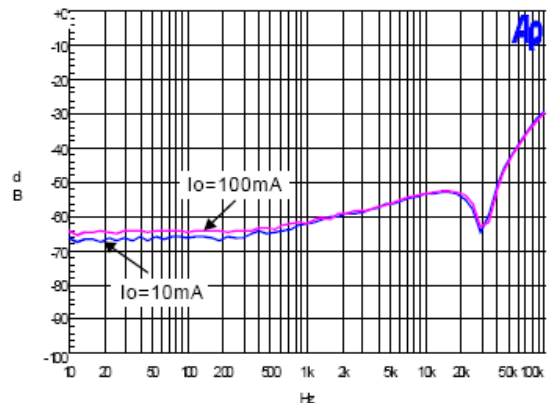
$V_O = 5\text{V}$, $V_{IN} = 5.5\text{V}$, $I_O = 0\text{A}$ to 1.5A

15. PSRR



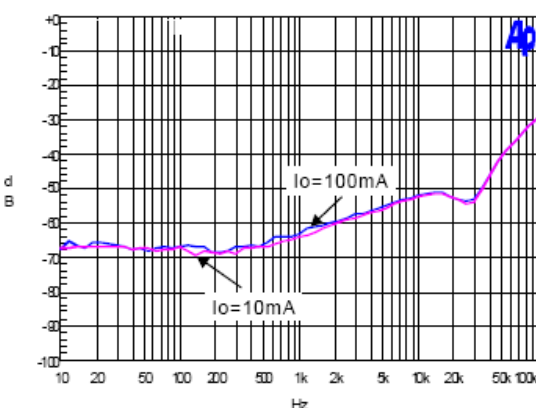
$V_O = 1.2\text{V}$, $V_{IN} = 3\text{V}$, $V_{pp} = 200\text{mV}$

16. PSRR



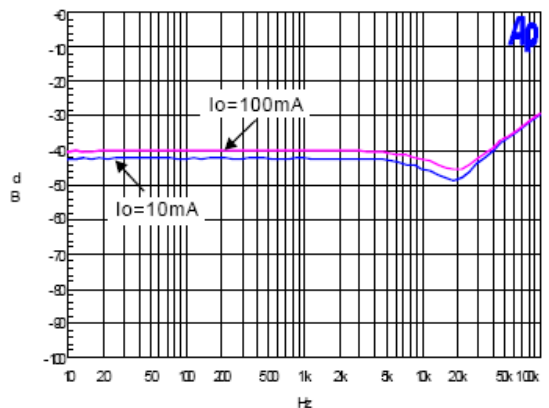
$V_O = 1.8\text{V}$, $V_{IN} = 3\text{V}$, $V_{pp} = 200\text{mV}$

17. PSRR



$V_O = 3.3\text{V}$, $V_{IN} = 4\text{V}$, $V_{pp} = 200\text{mV}$

18. PSRR



$V_O = 5\text{V}$, $V_{IN} = 5.5\text{V}$, $V_{pp} = 200\text{mV}$

Application Information

The PAM3116 family of low-dropout (LDO) regulators have several features that allow them to apply to a wide range of applications. The family operates with very low input voltage and low dropout voltage (typically 300mV at full load), making it an efficient stand-alone power supply or post regulator for battery or switch mode power supplies. The 1.5A output current make the PAM3116 family suitable for powering many microprocessors and FPGA supplies. The PAM3116 family also has low output noise (typically 50µVRMS with 4.7µF output capacitor), making it ideal for use in telecom equipment.

External Capacitor Requirements

A 4.7µF or larger ceramic input bypass capacitor, connected between V_{IN} and GND and located close to the PAM3116, is required for stability. A 4.7µF minimum value capacitor from V_O to GND is also required. To improve transient response, noise rejection, and ripple rejection, an additional 10µF or larger, low ESR capacitor is recommended at the output. A higher-value, low ESR output capacitor may be necessary if large, fast-rise-time load transients are anticipated and the device is located several inches from the power source, especially if the minimum input voltage of 2.5V is used.

Regulator Protection

The PAM3116 features internal current limiting, thermal protection and short circuit protection. During normal operation, the PAM3116 limits output current to about 2.5A. When current limiting engages, the output voltage scales back linearly until the over current condition ends. While current limiting is designed to prevent gross device failure, care should be taken not to exceed the power dissipation ratings of the package. If the temperature of the device exceeds +150°C, thermal-protection circuitry will shut down. Once the device has cooled down to approximately +40°C below the high temp trip point, regulator operation resumes. The short circuit current of the PAM3116 is about 0.7A when its output pin is shorted to ground.

Thermal Information

The amount of heat that an LDO linear regulator generates is:

$$P_D = (V_{IN} - V_O)I_O$$

All integrated circuits have a maximum allowable junction temperature ($T_{J(MAX)}$) above which normal operation is not assured. A system designer must design the operating environment so that the operating junction temperature (T_J) does not exceed the maximum junction temperature ($T_{J(MAX)}$). The two main environmental variables that a designer can use to improve thermal performance are air flow and external heat sinks. The purpose of this information is to aid the designer in determining the proper operating environment for a linear regulator that is operating at a specific power level.

In general, the maximum expected power ($P_{D(MAX)}$) consumed by a linear regulator is computed as:

Where:

- $V_{I(AVG)}$ is the average input voltage.
- $V_{O(AVG)}$ is the average output voltage.
- $I_{O(AVG)}$ is the average output current.
- $I_{(Q)}$ is the quiescent current.

For most LDO regulators, the quiescent current is insignificant compared to the average output current; therefore, the term $V_{I(AVG)} \times I_Q$ can be neglected. The operating junction temperature is computed by adding the ambient temperature (T_A) and the increase in temperature due to the regulator's power dissipation. The temperature rise is computed by multiplying the maximum expected power dissipation by the sum of the thermal resistances between the junction and the case ($R_{\theta JC}$), the case to heatsink ($R_{\theta CS}$), and the heatsink to ambient ($R_{\theta SA}$). Thermal resistances are measures of how effectively an object dissipates heat. Typically, the larger the device, the more surface area available for power dissipation so that the object's thermal resistance will be lower.

Application Information (cont.)

Setting the Output Voltage

The internal reference is 0.8V (Typical). The output voltage is calculated as below:

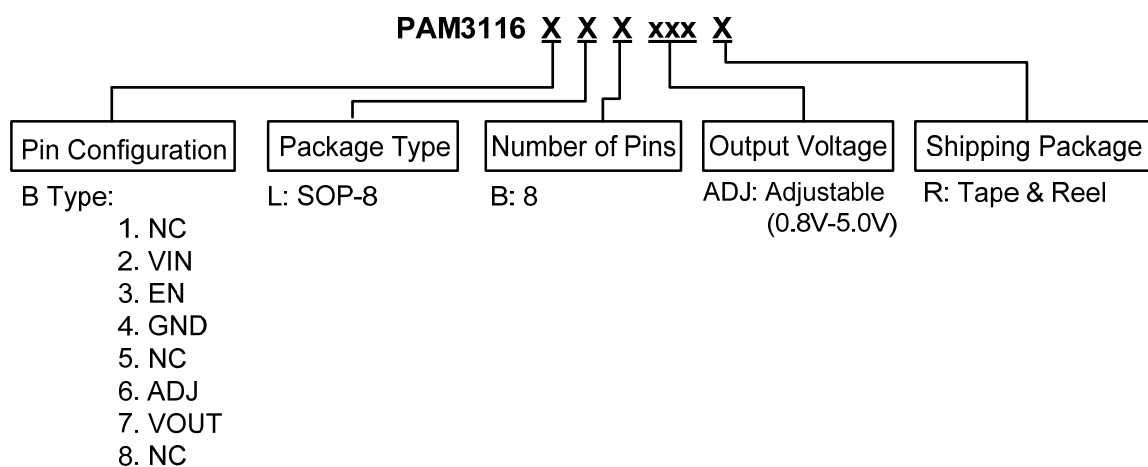
$$V_O = 0.8x \left(1 + \frac{R1}{R2} \right)$$

The output voltage is given by Table 1.

Table 1: Resistor selection for output voltage setting.

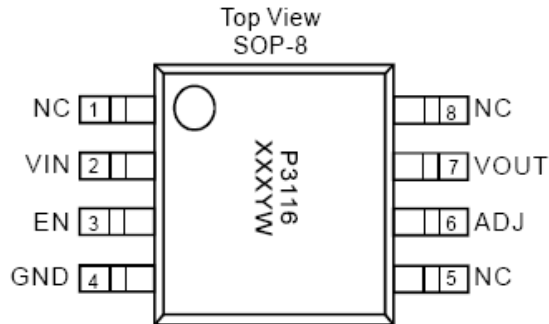
| V _O | R1 | R2 |
|----------------|------|------|
| 1.2V | 56k | 110k |
| 1.5V | 130k | 150k |
| 1.8V | 150k | 120k |
| 2.5V | 215k | 100k |
| 3.3V | 374k | 120k |
| 5.0V | 620k | 120k |

Ordering Information



| Part Number | Output Voltage | Marking | Package Type | Standard Package |
|----------------|----------------|----------------|--------------|----------------------|
| PAM3116BLBADJR | Adjustable | P3116 XXXYW | SOP-8 | 2500 Units/Tape&Reel |

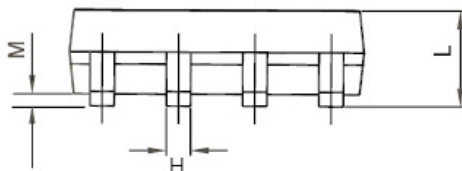
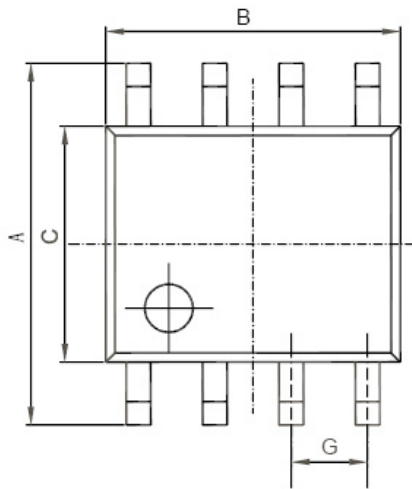
Marking Information



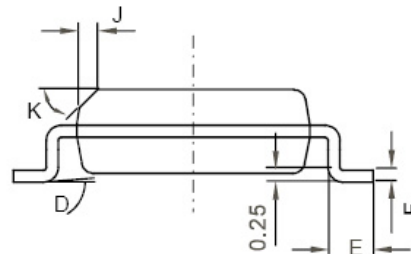
V: Voltage Code
X: Internal Code
Y: Year
W: Week

Package Outline Dimensions (All dimensions in mm.)

SOP-8



| REF | DIMENSIONS | |
|-----|-------------|------|
| | Millimeters | |
| | Min | Max |
| A | 5.80 | 6.20 |
| B | 4.80 | 5.00 |
| C | 3.80 | 4.00 |
| D | 0° | 8° |
| E | 0.40 | 0.90 |
| F | 0.19 | 0.25 |
| M | 0.10 | 0.25 |
| H | 0.35 | 0.49 |
| L | 1.35 | 1.75 |
| J | 0.375 REF | |
| K | 45° | |
| G | 1.27 TYP | |





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PAM3116

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