# AS1360

## 1.5µA Low-Power, Positive Voltage Regulator

## 1 General Description

The AS1360 low-power, positive voltage regulator was designed to deliver up to 250mA while consuming only 1.5µA of quiescent current. The device is available in fixed output voltages of 1.8, 2.1, 2.5, 3.0, 3.3, 4.0, 4.5 and 5.0V.

The device features integrated short-circuit and overcurrent protection.

The wide input voltage range, low-dropout voltage, and high-accuracy output voltage makes the device perfectly suited for 2- and 3-cell battery-powered and portable applications.

The low dropout voltage (650mV) prolongs battery life and allows high current in small applications when operated with minimum input-to-output voltage differentials.

The device features very stable output voltage (using only 1µF tantalum or aluminum-electrolytic capacitors), strict output voltage regulation tolerances (±0.5%), and excellent line-regulation.

The AS1360 is available in a 3-pin SOT23 package.

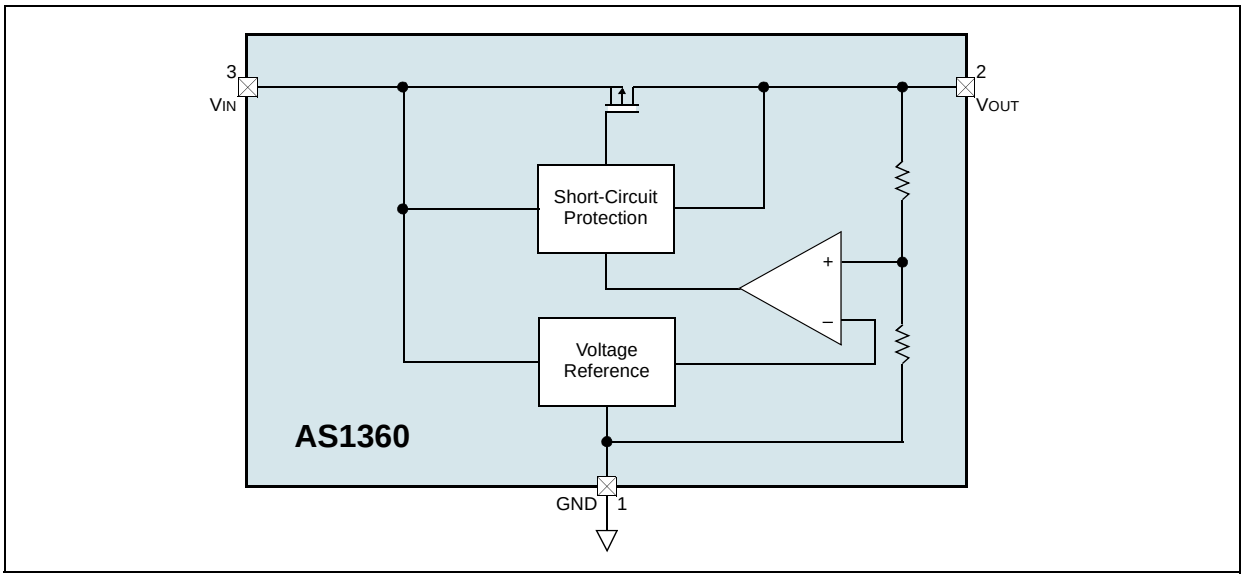
## 2 Key Features

- Low Quiescent Current: 1.5µA
- Input Voltage Range: Up to 20V
- Low Dropout Voltage
  - 250mV @ 100mA
  - 400mV @ 200mA
- Fixed Output Voltages: 1.8, 2.1, 2.5, 3.0, 3.3, 4.0, 4.5, 5.0V
- High Output Current: 250mA ($V_{OUT}$ = 5.0V)
- High-Accuracy Output Voltage: ±1.5%
- Exceptional Line Regulation: 0.1%/V
- Low Temperature Drift: ±100ppm/ºC
- Integrated Short-Circuit and Overcurrent Protection
- 3-pin SOT23 Package

## 3 Applications

The device is ideal for mobile phones, PDAs, digital cameras, smart battery packs, battery-powered alarms, solar-powered instruments, intelligent instruments, CO2 and smoke detectors, CPU power supplies, and any battery-powered application.

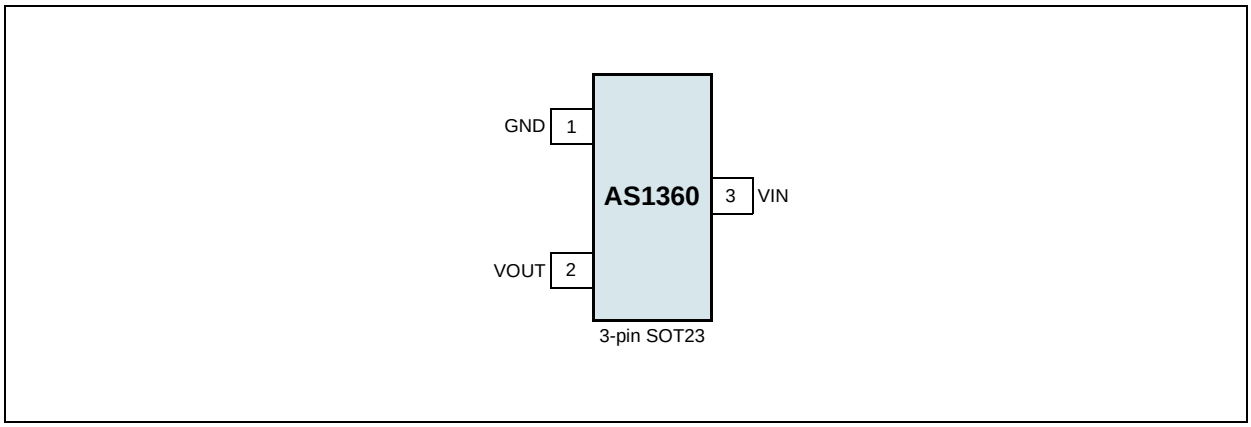
*Figure 1. AS1360 - Block Diagram*



# 4 Pinout and Packaging

## Pin Assignments

*Figure 2. Pin Assignments (Top View)*




## Pin Descriptions

*Table 1. Pin Descriptions*

| Pin Number | Pin Name | Description |
|---|---|---|
| 1 | GND | **Ground**. This pin should be connected to the negative side of the output and the negative terminal of the input capacitor. No high-current flows out of this pin, only bias current (1.5µA, typ).<br>**Note:** Voltage drops between this pin and the negative side of the load should be minimized. |
| 2 | VOUT | Regulated Output Voltage. This pin should be connected to the positive side of the load and the positive terminal of the output capacitor. Current flowing out of this pin is equivalent DC load current.<br>**Note:** The positive side of the output capacitor should be mounted as close as is practical to this pin. |
| 3 | VIN | Unregulated Input Voltage. This pin should be connected to the positive terminal of the input capacitor.<br>**Note:** The input capacitor should be mounted as close as is practical to this pin. |

# 5 Absolute Maximum Ratings

Stresses beyond those listed in Table 2 may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in Section 6 Electrical Characteristics on page 4 is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

*Table 2. Absolute Maximum Ratings*

| Parameter | Min | Max | Units | Comments |
|---|---|---|---|---|
| **Electrical Parameters** | | | | |
| Input Voltage | | +30 | V | |
| Continuous Output Current | | PD/ ($V_{IN}$ - $V_{OUT}$) | mA | |
| Peak Output Current | | 500 | mA | |
| Output Voltage | - 0.3V | $V_{IN}$ + 0.3V or +7V | V | Minimum of the two values |
| **Electrostatic Discharge** | | | | |
| Electrostatic Discharge HBM | +/- 1 | | kV | Norm: MIL 883 E method 3015 |
| **Thermal Information** | | | | |
| Thermal Resistance $\Theta_{JA}$ | | 230 | ºC/W | Typical FR4, 4-layer application |
| **Temperature Ranges and Storage Conditions** | | | | |
| Storage Temperature Range | -40 | +125 | ºC | |
| Package Body Temperature | | +260 | ºC | The reflow peak soldering temperature (body temperature) specified is in compliance with *IPC/ JEDEC J-STD-020 "Moisture/ Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices".* |
| Humidity non-condensing | 5 | 85 | % | |
| Moisture Sensitive Level | 1 | | | Represents a max. floor life time of unlimited |

# 6 Electrical Characteristics

Typical values are at TAMB = +25°C, VDD = 3.3V (unless otherwise specified). All limits are guaranteed. The parameters with min and max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

*Table 3. Electrical Characteristics*

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| TAMB | Operating Temperature Range | | -40 | | +85 | °C |
| VIN | Input Voltage | | | | 20 | V |
| VOUT | Output Voltage | IOUT = 40mA[1], IOUT = 15mA if VOUT = 1.8V | VOUTNOM - 1.5% | VOUTNOM ± 0.5% | VOUTNOM + 1.5% | V |
| IOUT(MAX) | Maximum Output Current | VOUT = 5.0V (VIN = VOUTNOM + 1.0V) | 250 | | | mA |
| | | VOUT = 4.0V | 200 | | | |
| | | VOUT = 3.3V | 150 | | | |
| | | VOUT = 3.0V | 150 | | | |
| | | VOUT = 2.5V | 125 | | | |
| | | VOUT = 2.1V | 115 | | | |
| | | VOUT = 1.8V | 110 | | | |
| ΔVOUT/VOUT | Load Regulation [2] | VOUT = 5.0V, 1mA ≤ IOUT ≤ 100mA | -1.60 | ±0.8 | +1.60 | % |
| | | VOUT = 4.0V, 1mA ≤ IOUT ≤ 100mA | -2.25 | ±1.1 | +2.25 | |
| | | VOUT = 3.3V, 1mA ≤ IOUT ≤ 80mA | -2.72 | ±1.3 | +2.72 | |
| | | VOUT = 3.0V, 1mA ≤ IOUT ≤ 80mA | -3.00 | ±1.5 | +3.00 | |
| | | VOUT = 2.5V, 1mA ≤ IOUT ≤ 60mA | -3.60 | ±1.8 | +3.60 | |
| | | VOUT = 2.1V, 1mA ≤ IOUT ≤ 40mA | -2.60 | ±1.6 | +2.60 | |
| | | VOUT = 1.8V, 1mA ≤ IOUT ≤ 30mA | -1.60 | ±0.8 | +1.60 | |
| ΔVOUT x 100/ ΔVIN x VOUT | Line Regulation | IOUT = 40mA, (VOUTNOM +1.0) ≤ VIN ≤ 10.0V | | 0.1 | 0.25 | %/V |
| VIN - VOUT | Dropout Voltage | IOUT = 200mA, VOUTNOM = 5.0V | | 400 | 630 | mV |
| | | IOUT = 200mA, VOUTNOM = 4.0V | | 400 | 700 | |
| | | IOUT = 160mA, VOUTNOM = 3.3V | | 400 | 700 | |
| | | IOUT = 160mA, VOUTNOM = 3.0V | | 400 | 700 | |
| | | IOUT = 120mA, VOUTNOM = 2.5V | | 400 | 700 | |
| | | IOUT = 60mA, VOUTNOM = 2.1V | | 200 | 500 | |
| | | IOUT = 20mA, VOUTNOM = 1.8V | | 180 | 300 | |
| IQ | Input Quiescent Current | VIN = VOUTNOM +1.0V | | 1.5 | 3.0 | µA |
| TCVOUT | Temperature Coefficient of VOUT [3] | IOUT = 40mA, -40°C ≤ TAMB ≤ +85°C | | ±100 | | ppm/°C |
| tR | Output Rise Time | 10% VOUTNOM to 90% VOUTNOM, VIN = 0V to VOUTNOM + 1V, RLOAD = 25Ω resistive | | 150 | | µs |

1. VOUTNOM is the nominal device output voltage.
2. Measured at a constant junction temperature using low duty cycle pulse testing.
3. TCVOUT = (VOH - VOL) x $10^6$/(VOUTNOM x Temperature).
   **Where:**
   VOH is the highest voltage measured over the device temperature range.
   VOL is the lowest voltage over the device temperature range.

# 7 Typical Operating Characteristics

*VOUT = 3.3V, ILOAD = 100µA, VIN = 4.3V, CIN 1µF (tantalum), COUT = 1µF (tantalum), TAMB = +25ºC (unless otherwise specified).*

*Figure 3. Supply Current vs. Input Voltage*

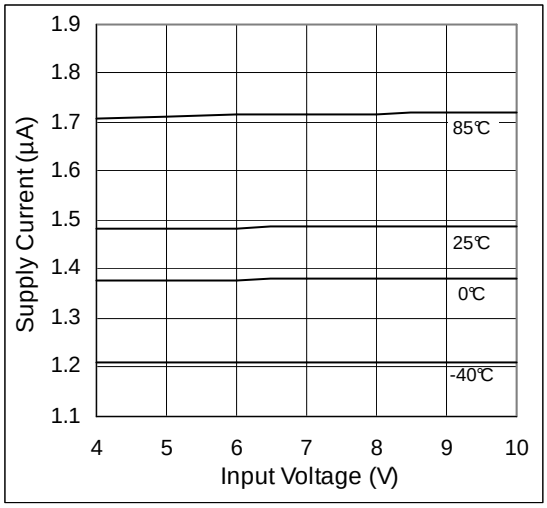



*Figure 4. Supply Current vs. Load Current*

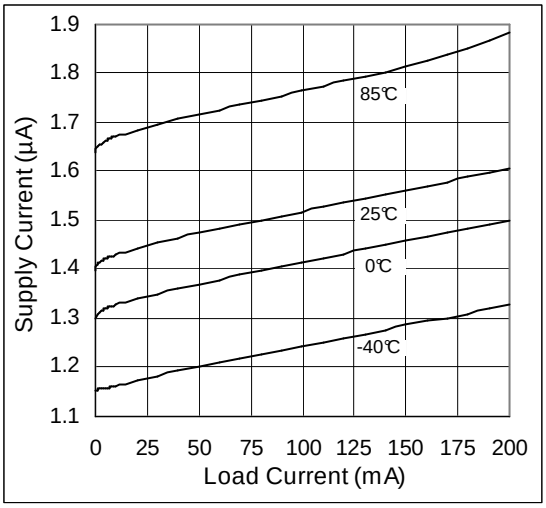



*Figure 5. Supply Current vs. Temperature*

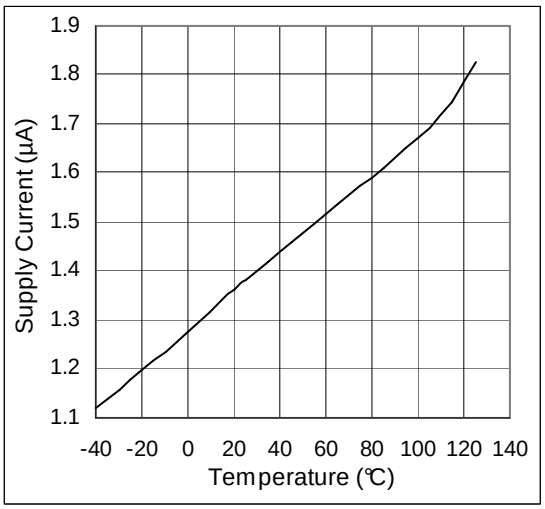



*Figure 6. Output Voltage vs. Input Voltage*

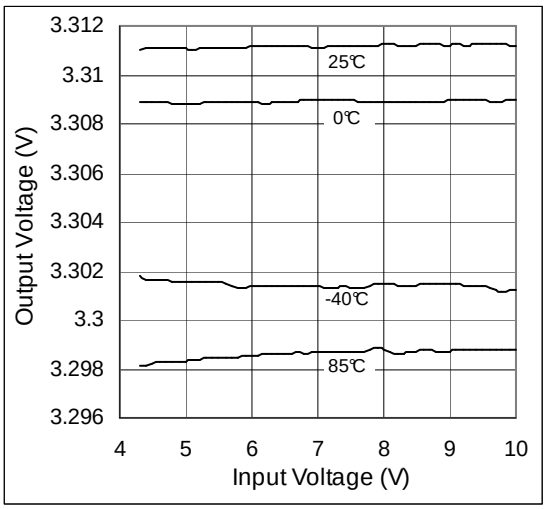



*Figure 7. Output Voltage vs. Load Current*

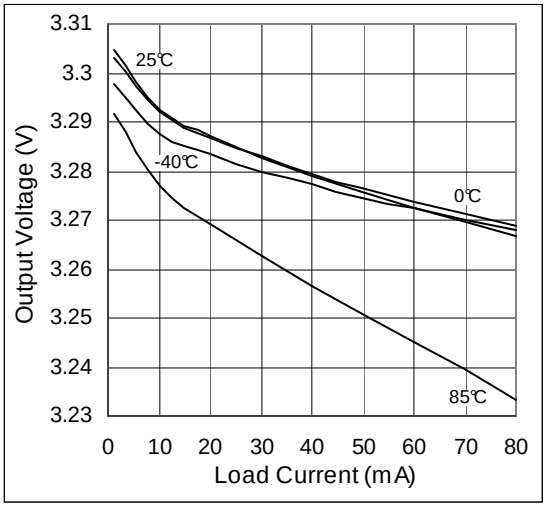



*Figure 8. Dropout Voltage vs. Load Current*

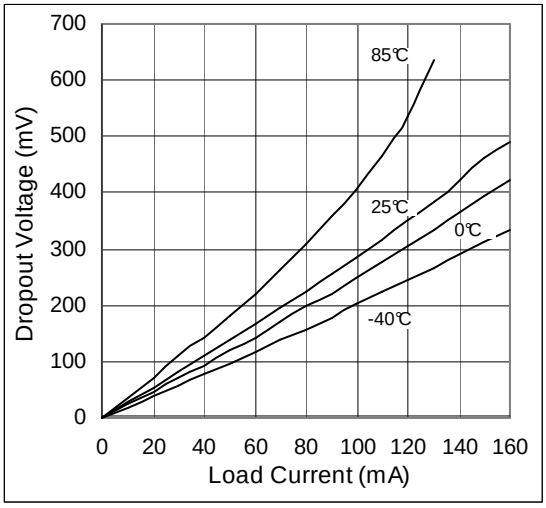


*Figure 9. Load Regulation vs. Temperature*

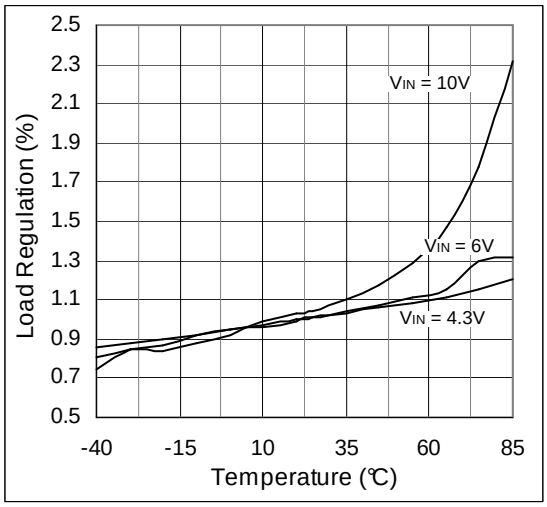



*Figure 10. Line Regulation vs. Temperature*

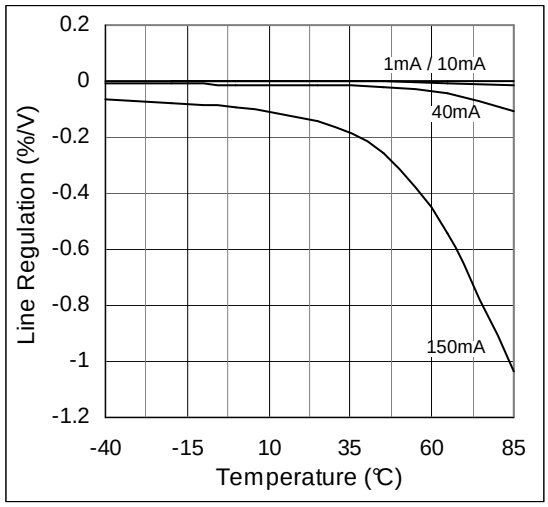



*Figure 11. Output Voltage vs. Input Voltage; Dropout*

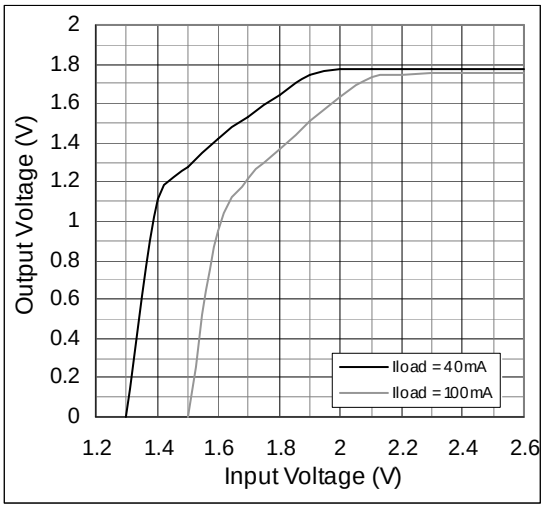



*Figure 12. Startup Rise Time*

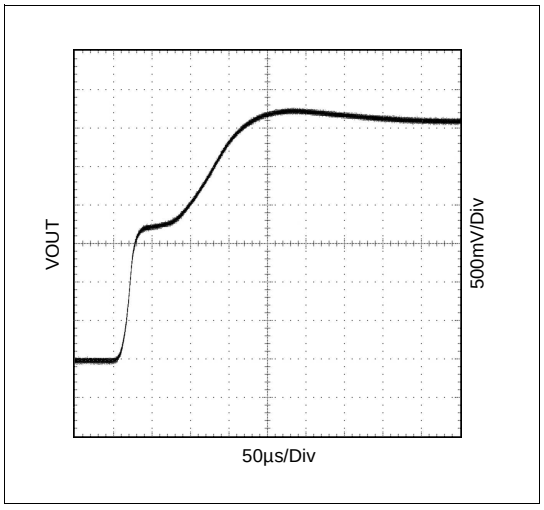
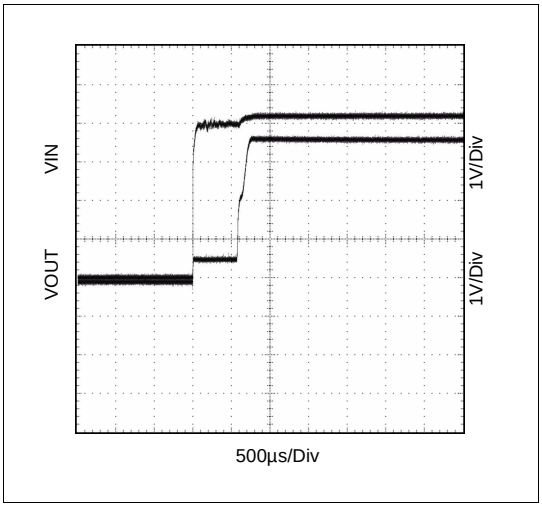



*Figure 13. Startup Delay*




**Note:** All graphs where measured without additional heat sinks, with the SOT23 package mounted on a 4-layer PCB. Adding additional heat sinks will improve performance in high temperature enviroment.

# 8 Detailed Description

The AS1360 is a low-power, positive voltage regulator designed in such a way that the supply current is independent from the load current. The device regulates the output by comparing the output voltage to an internally generated reference voltage.

The device is available in fixed output voltages of 1.8, 2.5, 3.0, 3.3, and 5.0V. Fixed output voltages are generated using the internal resistor divider network (see Figure 1 on page 1).

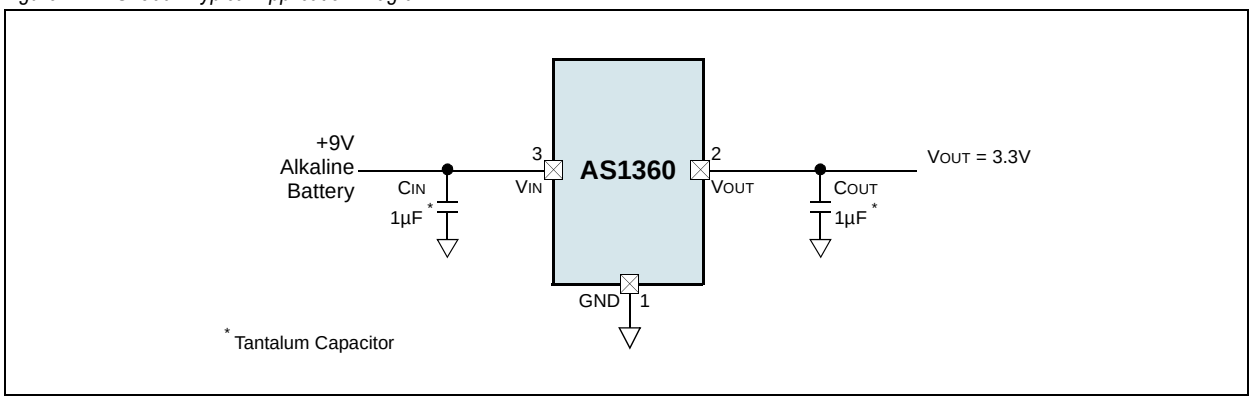
## Short Circuit/Overcurrent Protection

The AS1360 monitors current flow through the p-channel MOSFET. In short-circuit or overcurrent conditions, the integrated short-circuit protection circuitry will limit output current.

**Note:** Thermal Dissipation according to Absolute Maximum Ratings on page 3 must be considered.

# 9 Application Information

*Figure 14. AS1360 - Typical Application Diagram*




## Power Dissipation

Power dissipation (PD) of the AS1360 is the sum of the power dissipated by the p-channel MOSFET and the quiescent current required to bias the internal voltage reference and the internal power amplifier, and is calculated as:

$$PD\ (P\text{-}Channel\ MOSFET) = (V_{IN} - V_{OUT})I_{OUT} \quad (EQ\ 1)$$

Internal power dissipation as a result of the bias current for the internal voltage reference and the error amplifier is calculated as:

$$PD\ (Bias) = V_{IN}I_{GND} \quad (EQ\ 2)$$

Total AS1360 power dissipation is calculated as:

$$PD(Total) = PD\ (P\text{-}Channel\ MOSFET) + PD\ (Bias) \quad (EQ\ 3)$$

The internal quiescent bias current (2µA, typ) is such that the PD(Bias) term of (EQ 3) can be disregarded and the maximum power dissipation can be estimated using $V_{IN(MAX)}$ and $V_{OUT(MIN)}$ to obtain a maximum voltage differential between $V_{IN}$ and $V_{OUT}$, and multiplying the maximum voltage differential by the maximum output current:

$$PD = (V_{IN(MAX)}V_{OUT(MIN)})I_{OUT(MAX)} \quad (EQ\ 4)$$

**Where:**

$V_{IN}$ = 3.3 to 4.1V
$V_{OUT}$ = 3.0V ±2%
$I_{OUT}$ = 1 to 100mA
$T_{AMB(MAX)}$ = 55ºC
$P_{MAX}$ = (4.1V - (3.0V x 0.98)) x 100mA = 116.0mW

## Junction Temperature

The AS1360 junction temperature ($T_J$) can be determined by first calculating the thermal resistance from junction temperature-to-ambient temperature.

**Note:** Thermal resistance is estimated to be the junction temperature-to-air temperature $R_{\Phi JA}$, and is approximately 230°C/W or 335ºC/W (when mounted on 1 square inch of copper). $R_{\Phi JA}$ will vary depending on PCB layout, air-flow and application specific conditions.

The AS1360 junction temperature is determined by calculating the rise in $T_J$ above $T_{AMB}$, and then adding the increase of $T_{AMB}$:

$$T_J = P_{D(MAX)} \times R_{\Phi JA} + T_{AMB} \quad (EQ\ 5)$$

From (EQ 5), the value of $T_J$ can be calculated as:

$$T_J = 116.0mW \times 230ºC/W + 55ºC$$

Therefore:

$$T_J = 81.68ºC$$

## External Component Selection

### Input Capacitor

In applications where input impedance is approximately 10Ω, a 1µF capacitor is sufficient for CIN (see Figure 14 on page 8).

In cases where the AS1360 is operated from a battery, or when there is significant distance between the input source to the AS1360, larger values for CIN may be required for output stability.

**Note:** For values of COUT > 1µF, the value of CIN should be increased to prevent high source-impedance oscillations.

### Output Capacitor

In most applications for the AS1360, a 1µF capacitor (ESR > 0.1Ω/< 5Ω, fRES > 1MHz) is sufficient for COUT (see Figure 14 on page 8).

For improved power supply noise rejection and device transient response, larger values can be used for COUT.

**Note:** For values of COUT > 1µF, the input impedance must not be so large that it causes high-input impedance oscillations.

# 10 Package Drawings and Markings

*Figure 15. 3-pin SOT23 Marking*

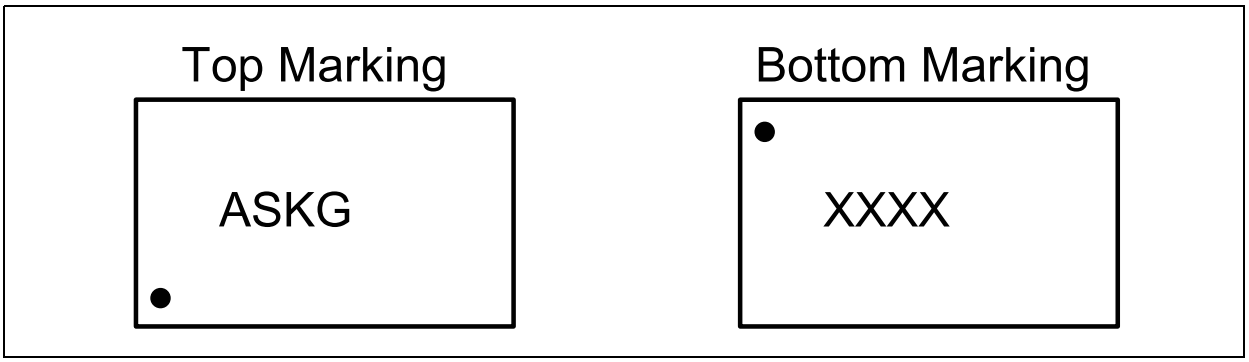
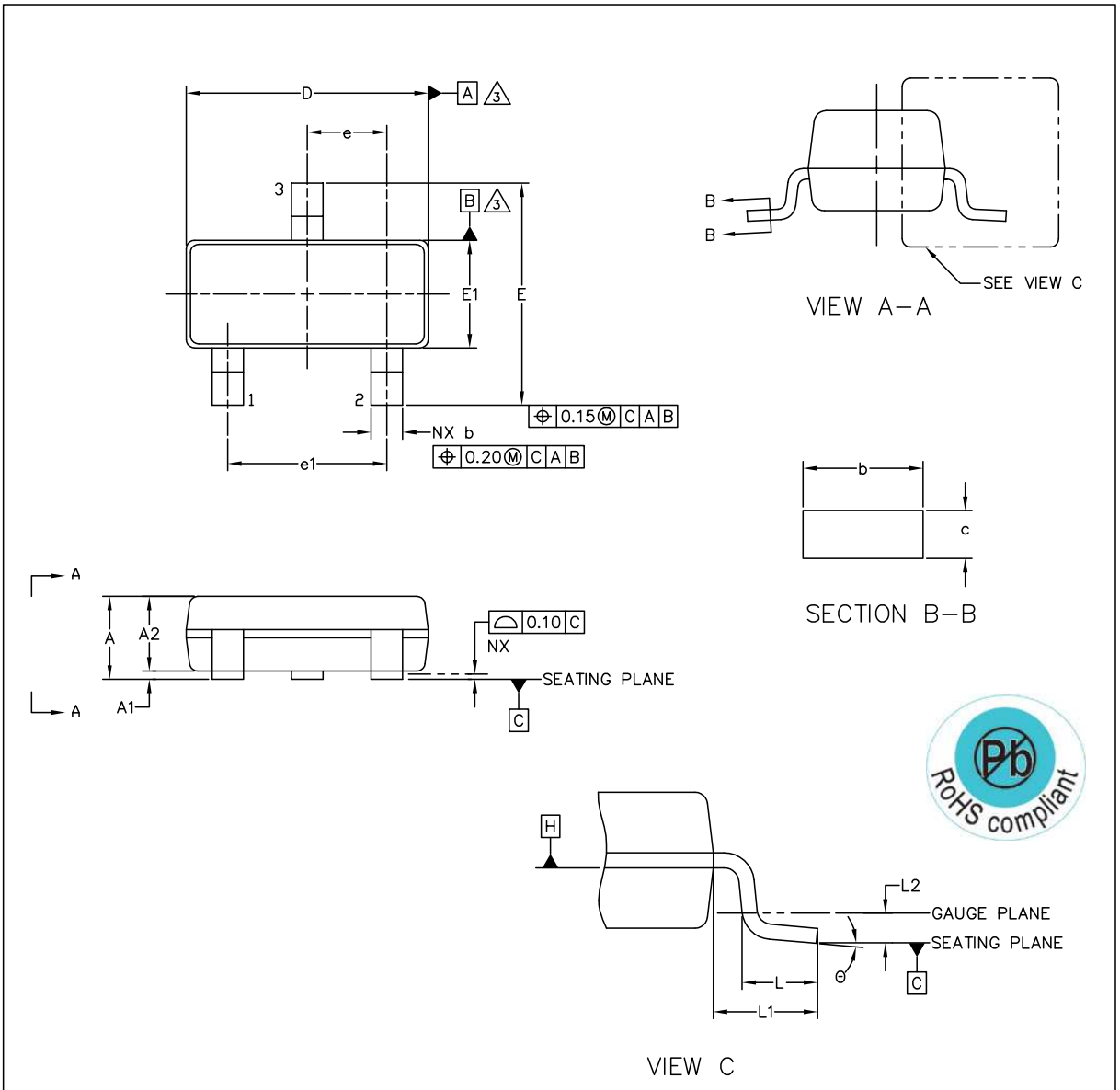



*Table 4. Packaging Code xxxx*

| xxxx |
|---|
| encoded Datecode |

*Figure 16. 3-pin SOT23 Package*




| REF. | MIN | NOM | MAX |
|---|---|---|---|
| A | 0.89 | – | 1.12 |
| A1 | 0.01 | – | 0.10 |
| A2 | 0.88 | 0.95 | 1.02 |
| b | 0.30 | – | 0.50 |
| c | 0.08 | – | 0.20 |
| D | 2.80 | 2.90 | 3.04 |
| E | 2.10 | – | 2.64 |
| E1 | 1.20 | 1.30 | 1.40 |
| e | 0.95 BSC | | |
| e1 | 1.90 BSC | | |
| L | 0.40 | 0.50 | 0.60 |
| L1 | 0.54 REF | | |
| L2 | 0.25 BSC | | |
| θ | 0° | – | 8° |
| N | 3 | | |

NOTE:

1. DIMENSIONS & TOLERANCEING CONFIRM TO ASME Y14.5M–1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGELS ARE IN DEGREES.
3. DATUMS A AND B TO BE DETERMINED AT DATUM PLANE H.

| | | | | |
|---|---|---|---|---|
| austriamicrosystems a leap ahead in analog | | | ASSEMBLY ENGINEERING | |
| DRAWN RH8 | DATE 2010.12.22 | REV. N/C | TITLE SOT23, 3 LEAD | REFERENCE DOCUMENT JEDEC TO – 236 LATEST REVISION |
| CHECKED GBO | DATE 2010.12.22 | | DRAWING NO. JAZ | UNIT |
| APPROVED MKR | DATE 2010.12.22 | SHEET 1 OF 1 | DIMENSION AND TOLERANCE | SCALE NOT IN SCALE |

# 11 Ordering Information

The device is available as the standard products shown in Table 5.

*Table 5. Ordering Information*

| Ordering Code | Marking | Description | Delivery Form | Package |
|---|---|---|---|---|
| AS1360-18-T | ASKD | HV low-quiescent current LDO, 1.8V | Tape and Reel | 3-pin SOT23 |
| AS1360-21-T | ASRO | HV low-quiescent current LDO, 2.1V | Tape and Reel | 3-pin SOT23 |
| AS1360-25-T | ASKE | HV low-quiescent current LDO, 2.5V | Tape and Reel | 3-pin SOT23 |
| AS1360-30-T | ASKF | HV low-quiescent current LDO, 3.0V | Tape and Reel | 3-pin SOT23 |
| AS1360-33-T | ASKG | HV low-quiescent current LDO, 3.3V | Tape and Reel | 3-pin SOT23 |
| AS1360-40-T | ASQV | HV low-quiescent current LDO, 4.0V | Tape and Reel | 3-pin SOT23 |
| AS1360-45-T | ASTQ | HV low-quiescent current LDO, 4.5V | Tape and Reel | 3-pin SOT23 |
| AS1360-50-T | ASKH | HV low-quiescent current LDO, 5.0V | Tape and Reel | 3-pin SOT23 |

**Note:** All products are RoHS compliant.
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Technical Support is found at http://www.austriamicrosystems.com/Technical-Support

For further information and requests, please contact us mailto:sales@austriamicrosystems.com
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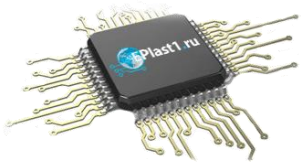
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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.




**Как с нами связаться**

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