

Micropower, 150mA / 3.3V Low Dropout CMOS Regulator

Features

- Regulated 3.3V output
- Delivers up to 150mA output current
- Very low dropout (150mV at 150mA)
- Low quiescent operating current (100 μ A)
- "Zero" disable mode current consumption
- Thermal overload protection
- Foldback overload current protection
- -40°C to +85°C temperature operation
- Thermally enhanced MSOP-8 and SOT23 package options

Applications

- CompactFlash memory cards
- Battery-Powered Devices
- PC Cards
- Peripheral Adapter Cards
- Wireless Handsets
- PDAs/Handheld PCs

Product Description

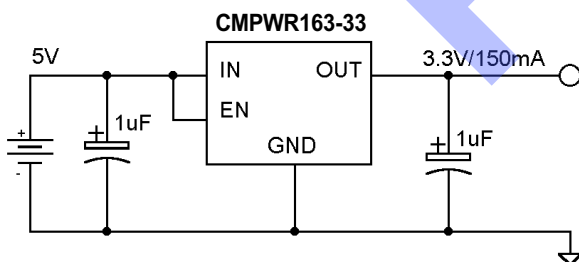
The CMPWR163-33 is a very low dropout regulator that delivers up to 150mA of load current at a fixed 3.3V output (when powered from 5V). The dropout characteristics of the device also allows it to be powered from a 3.3V supply, in which case, the device simply appears as a low resistance switch (1.0 ohm).

A dedicated control input (EN, active high) provides power-up sequencing flexibility. When this input is taken low, the regulator is disabled. In this state, the supply current will drop to near zero. An internal discharge MOSFET (300 Ω) impedance will force the output to ground whenever the device has been shutdown.

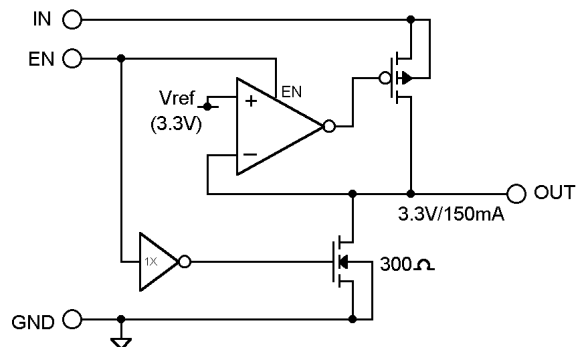
The CMPWR163-33 is fully protected, offering both overload current limiting and high temperature thermal shutdown.

Two package options are available—a 5-pin SOT23 and a space saving 8-pin MSOP package, thermally enhanced through use of an integral leadframe to ensure maximum junction to ambient power dissipation.

Typical Application Circuit

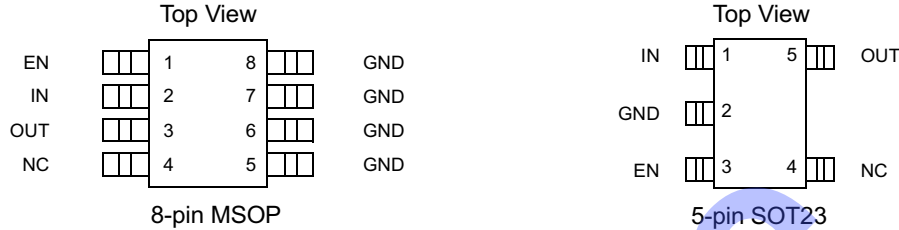


Simplified Electrical Schematic





PACKAGE / PINOUT DIAGRAMS



Note: MSOP and SOT23 package sizes may differ. These drawings are not to scale.

PIN DESCRIPTIONS

| PIN(S) | | NAME | DESCRIPTION |
|---------|-------|------|---|
| MSOP | SOT23 | | |
| 1 | 3 | EN | A logic input control to enable the regulator output. When EN is asserted (logic high), it allows output regulation to commence. When EN is deasserted (logic low), the regulator pass transistor is forced into a high impedance mode, and an internal discharge resistance (300Ω) is applied to the output. |
| 2 | 1 | IN | The input power supply (5.0V, 3.3V nominal) for the regulator. If this input is within a few inches of the main supply filter, a capacitor may not be necessary. Otherwise an input filter capacitor of approximately 1uF will ensure adequate filtering. |
| 3 | 5 | OUT | The regulator voltage output (3.3V) used to power the load. A nominal output capacitor of 1uF is sufficient to minimize any transient disturbances under normal operating conditions. Additional output capacitance can be used to further improve transient load response. |
| 5,6,7,8 | 2 | GND | The negative reference for all voltages. |
| 4 | 4 | NC | This pin has no connection to the internal device. To provide additional thermal performance, this pin can be connected directly to the PC board GND plane. |

Ordering Information

PART NUMBERING INFORMATION

| Pins | Package | Ordering Part Number ¹ | Part Marking |
|------|--------------|-----------------------------------|--------------|
| 8 | Power MSOP-8 | CMPWR163MA | 163M |
| 5 | SOT23 | Note 2 | Note 2 |

Note 1: Parts are shipped in Tape & Reel form unless otherwise specified.

Note 2: Consult California Micro Devices for part number and part marking information.



Specifications

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | RATING | UNITS |
|-------------------------------|-----------------------------------|-------|
| ESD Protection (HBM) | ± 2000 | V |
| Pin Voltages | | |
| IN (pin 2) | [GND - 0.6] to [+6.0] | V |
| EN (pin 1) | [GND - 0.6] to [$V_{IN} + 0.6$] | V |
| OUT (pin 3) | [GND - 0.6] to [$V_{IN} + 0.6$] | V |
| Storage Temperature Range | -40 to +150 | °C |
| Operating Temperature Range | | |
| Ambient | -40 to +85 | °C |
| Junction | -40 to +125 | °C |
| Power Dissipation (Notes 1,2) | Internally Limited | W |

Note 1: The CMPWR163-33 packaged in the MSOP-8 package contains a thermal overload circuit that automatically disables the device, thereby preventing excessive junction temperatures. The MSOP package housing the device is thermally enhanced through the use of a fused integral leadframe; when mounted on a typical multi-layer board with moderate heat-spreading copper area (2 square inches), it will allow up to 0.45W to be dissipated safely. (Please consult CAMD Technical Support for thermal evaluation assistance.)

Note 2: Consult CAMD Technical Support for power dissipation information regarding the CMPWR163-33 packaged in the SOT23 package.

STANDARD OPERATING CONDITIONS

| PARAMETER | RATING | UNITS |
|-------------------------------------|--------------|---------|
| V_{IN} | 2.7 to 5.5 | V |
| Ambient Operating Temperature Range | -40 to +85 | °C |
| Load Current | 0 to +150 | mA |
| C_{EXT} | 1 $\pm 20\%$ | μF |



Specifications (continued)

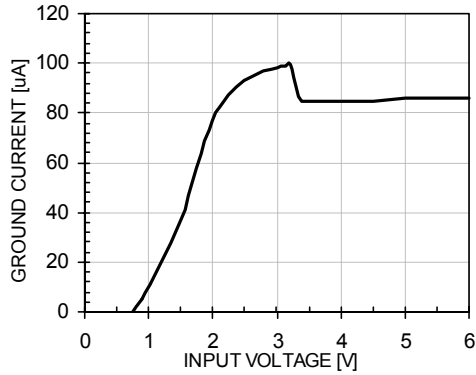
| ELECTRICAL OPERATING CHARACTERISTICS | | | | | | |
|--------------------------------------|-----------------------------|---|------|------------------|------------------|-------------------------------|
| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
| V_{OUT} | Regulator Output Voltage | $0mA < I_{LOAD} < 150mA$; $V_{IN}=5.0V$ | 3.10 | 3.30 | 3.50 | V |
| $R_{DROPOUT}$ | Dropout Resistance | $0mA < I_{LOAD} < 150mA$; $V_{IN}=3.3V$ | | 1 | 1.3 | Ω |
| $V_{R\,LOAD}$ | Load Regulation | $10mA < I_{LOAD} < 150mA$; $V_{IN}=5.0V$ | | 5 | | mV |
| $V_{R\,LINE}$ | Line Regulation | $I_{LOAD} = 5mA$; $4.5V \leq V_{IN} \leq 5.5V$ | | 20 | | mV |
| I_{LIM} | Overload Current Limit | | | 400 | | mA |
| I_{SC} | Short Circuit Current Limit | $V_{OUT} < 1V$ | | 200 | | mA |
| R_{DISCH} | Discharge Resistance | EN tied to ground; $V_{IN}=3.0V$ | | 300 | | Ω |
| I_{GND} | Ground Current | with EN tied to V_{IN} ; $I_{LOAD} = 0mA$: with EN tied to V_{IN} ; $I_{LOAD} = 150mA$: with EN tied to GND (Disable Mode): | | 80 100 0.1 | 200 250 10 | μA μA μA |
| V_{IH} | Enable High Threshold | Regulator becomes enabled | | 0.8 | 1.2 | V |
| V_{IL} | Enable Low Threshold | Regulator enters shutdown | 0.4 | 0.7 | | V |
| $T_{DISABLE}$ | Shutdown Temperature | | | 150 | | $^{\circ}C$ |
| T_{HYST} | Thermal Hysteresis | | | 20 | | $^{\circ}C$ |



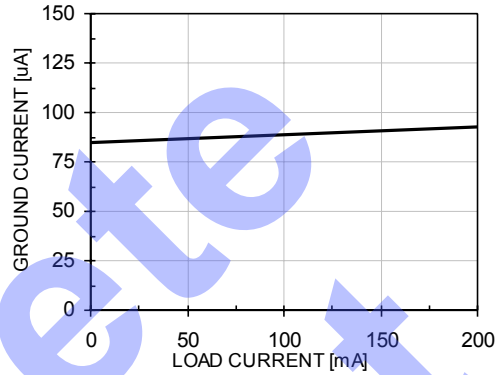
Performance Information

Typical DC Characteristics (nominal conditions unless specified otherwise)

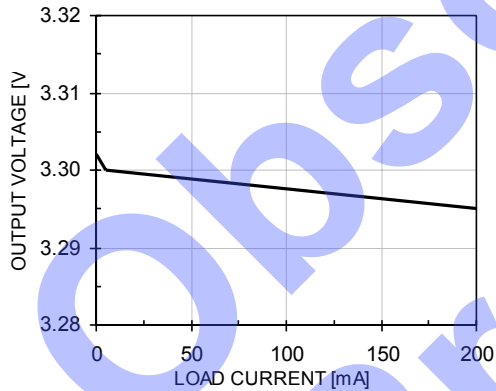
Ground Current vs. Input



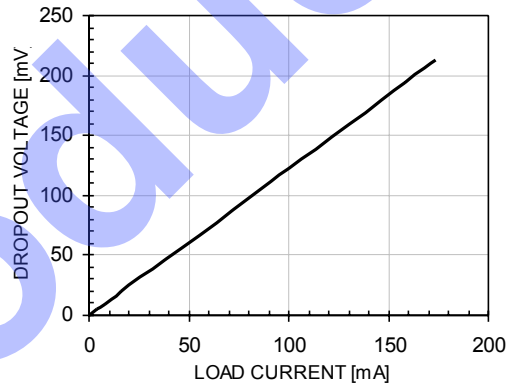
Ground Current vs. Load



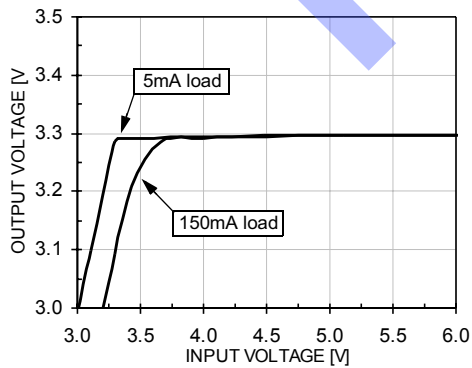
Load Regulation ($V_{IN} = 5V$)



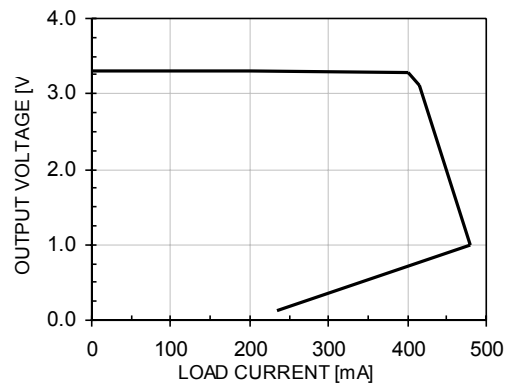
Dropout Voltage vs. Load Current ($V_{IN} = 2.7V$)



Line Regulation (5mA and 150mA load)



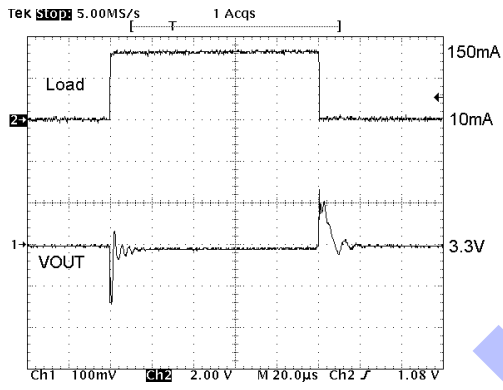
Foldback Current Limiting



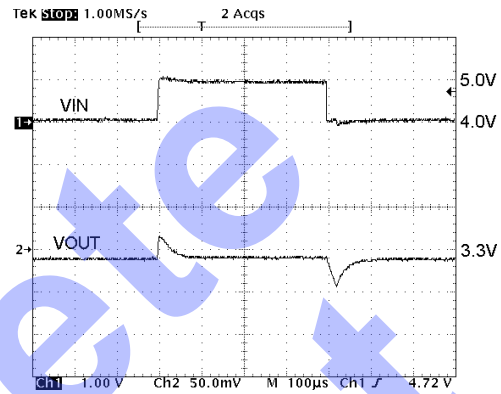
Performance Information (continued)

Typical Transient Characteristics (nominal conditions unless specified otherwise)

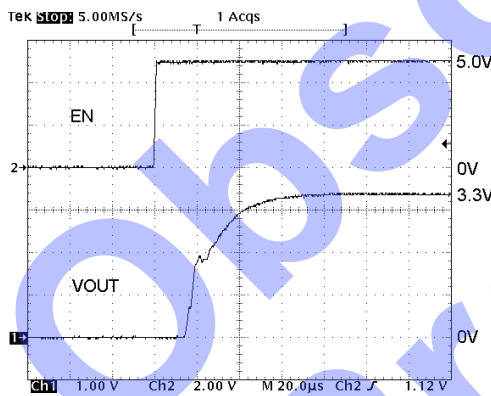
Load Transient (1% to 100%) Step Response



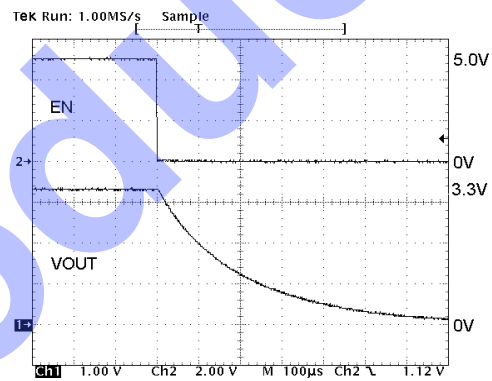
Line Transient (1Vpp) Step Response



Enable Response (No Load)



Disable Response (No Load)



Performance Information (continued)

Typical Thermal Characteristics

The overall junction to ambient thermal resistance (θ_{JA}) for device power dissipation (P_D) consists primarily of two paths in series. The first path is the junction to the case (θ_{JC}) which is defined by the package style, and the second path is case to ambient (θ_{CA}) thermal resistance which is dependent on board layout. The final operating junction temperature for any set of conditions can be estimated by the following thermal equation:

$$T_{JUNC} = T_{AMB} + P_D * (\theta_{JC}) + P_D * (\theta_{CA})$$

$$= T_{AMB} + P_D * (\theta_{JA})$$

The CMPWR163-33MA with the Power MSOP packaging option uses a thermally enhanced MSOP-8 package where all the GND pins (5 through 8) are integral to the leadframe. When this package is mounted on a double sided printed circuit board with two square inches of copper allocated for “heat spreading”, the resulting θ_{JA} is 70°C/W.

Based on a maximum power dissipation of 0.255W (Load x Vin-Vout = 150mA x 1.7V) with an ambient of 70°C the resulting junction temperature will be:

$$T_{JUNC} = T_{AMB} + P_D * (\theta_{JA})$$

$$= 70^\circ\text{C} + 0.255\text{W} * (70^\circ\text{C}/\text{W})$$

$$= 70^\circ\text{C} + 18^\circ\text{C} = 88^\circ\text{C}$$

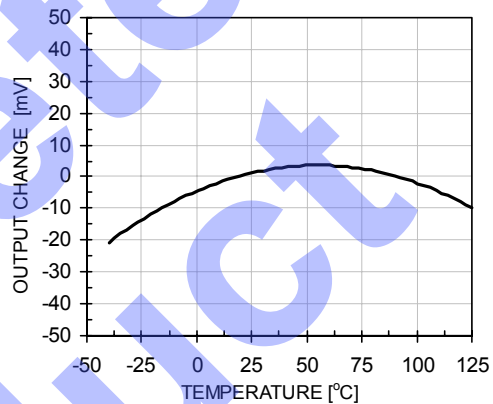
Thermal characteristics were measured using a double sided board with two square inches of copper area connected to the GND pins for “heat spreading”.

Measurements showing performance up to a junction temperature of 125°C are presented in Figure 1. They were performed under light load conditions (5mA); this allows the ambient temperature to be representative of the internal junction temperature.

Note: The use of multi-layer board construction with separate ground and power planes will further enhance the overall thermal performance. In the event of no copper area being dedicated for heat spreading, a multi-layer board construction using only the minimum size pad layout will typically provide the CMPWR163-33MA (in an MSOP package) with an overall θ_{JA} of 90°C/W, which allows up to 600mW to be dissipated safely.

Please consult CAMD Technical Support for assistance with thermal analysis of the CMPWR163-33 in either an MSOP or SOT23 package with respect to a specific application.

Output Voltage Change vs. Temperature (5mA load)



Ground Current vs. Temperature

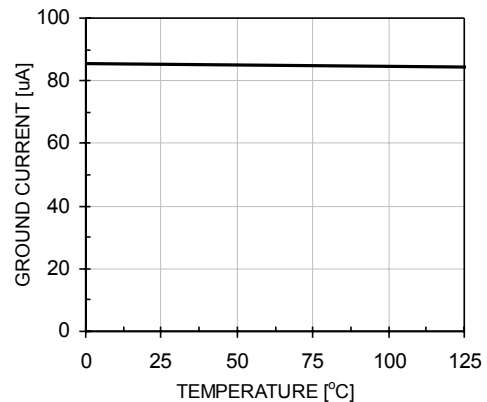


Figure 1. CMPWR163-33 Performance vs. Temperature



Mechanical Details

CMPWR163-33 devices are packaged in either 8-pin MSOP packages or 5-pin SOT23 packages.

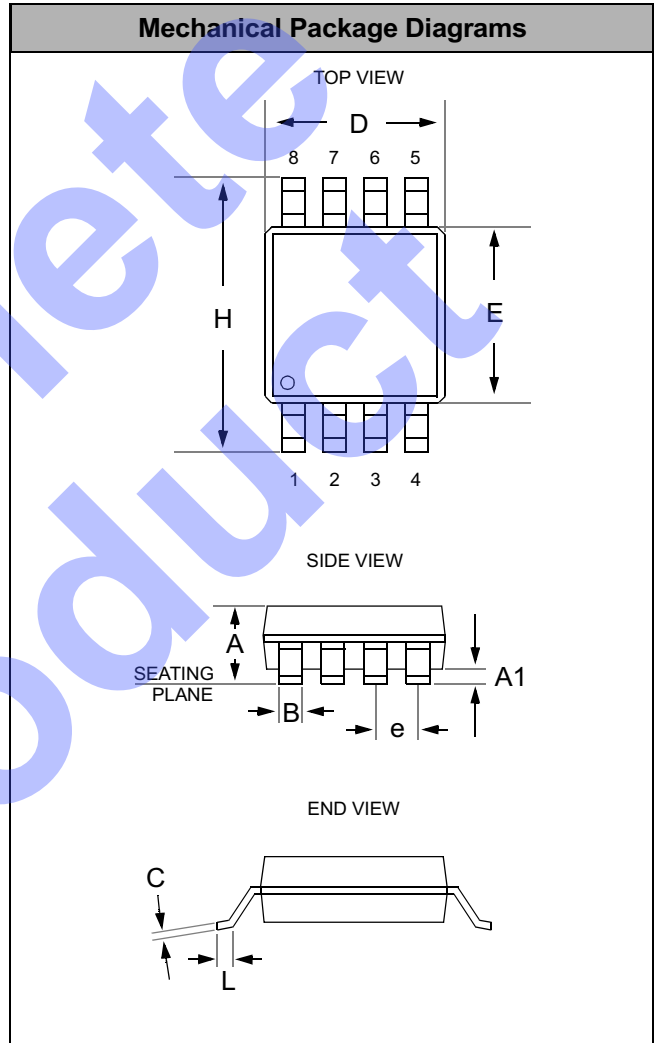
MSOP-8 Mechanical Specifications:

Dimensions for CMPWR163-33 devices packaged in 8-pin MSOP packages are presented below.

For complete information on the MSOP-8 package, see the California Micro Devices MSOP Package Information document.

| PACKAGE DIMENSIONS | | | | |
|-------------------------------|-------------|------|-------------|-------|
| Package | MSOP | | | |
| Pins | 8 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | 0.87 | 1.17 | 0.034 | 0.046 |
| A1 | 0.05 | 0.25 | 0.002 | 0.010 |
| B | 0.30 (typ) | | 0.012 (typ) | |
| C | 0.18 | | 0.007 | |
| D | 2.90 | 3.10 | 0.114 | 0.122 |
| E | 2.90 | 3.10 | 0.114 | 0.122 |
| e | 0.65 BSC | | 0.025 BSC | |
| H | 4.78 | 4.98 | 0.188 | 0.196 |
| L | 0.52 | 0.54 | 0.017 | 0.025 |
| # per tube | 80 pieces* | | | |
| # per tape and reel | 4000 pieces | | | |
| Controlling dimension: inches | | | | |

* This is an approximate amount which may vary.



Package Dimensions for MSOP-8



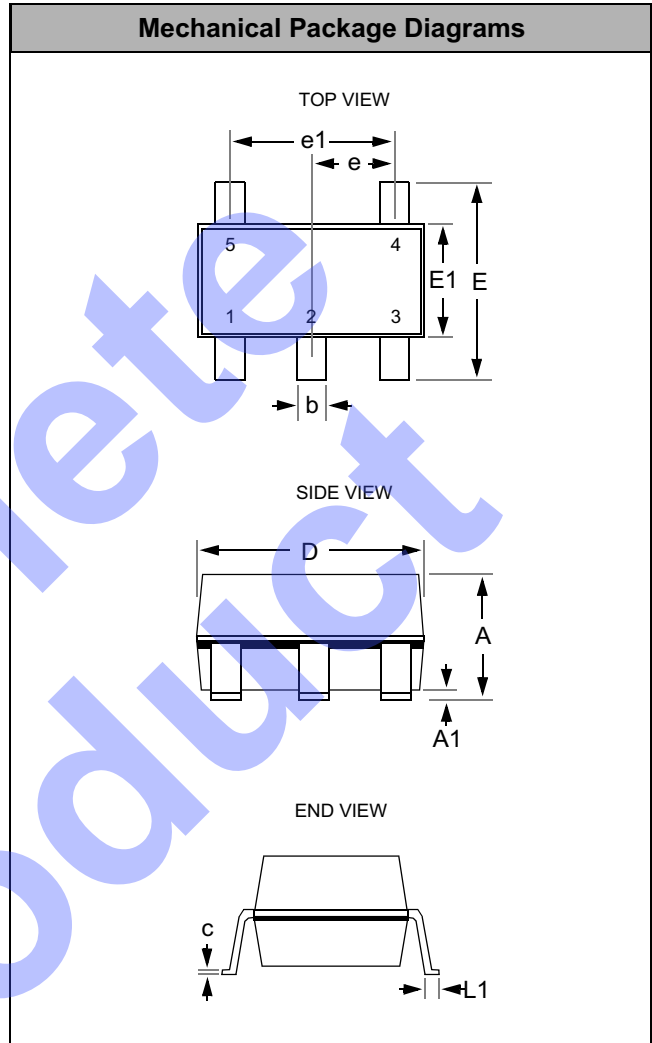
Mechanical Details (continued)

SOT23 Mechanical Specifications

Dimensions for CMPWR163-33 devices packaged in 5-pin SOT23 packages are presented below.

For complete information on the SOT23 package, see the California Micro Devices SOT23 Package Information document.

| PACKAGE DIMENSIONS | | | | |
|-------------------------------|------------------------------|------|------------|-------|
| Package | SOT23 (JEDEC name is MO-178) | | | |
| Pins | 5 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | -- | 1.45 | -- | 0.057 |
| A1 | 0.00 | 0.15 | 0.000 | 0.006 |
| b | 0.30 | 0.50 | 0.012 | 0.020 |
| c | 0.08 | 0.22 | 0.003 | 0.009 |
| D | 2.75 | 3.05 | 0.108 | 0.120 |
| E | 2.60 | 3.00 | 0.102 | 0.118 |
| E1 | 1.45 | 1.75 | 0.057 | 0.069 |
| e | 0.95 BSC | | 0.0374 BSC | |
| e1 | 1.90 BSC | | 0.0748 BSC | |
| L | 0.60 REF | | 0.0236 REF | |
| # per tape and reel | 3000 pieces | | | |
| Controlling dimension: inches | | | | |



Package Dimensions for SOT23-5.