

150mA Low-Noise LDO in SC-82 Without A Bypass Capacitor

DESCRIPTION

The EUP7914 is an efficient CMOS low dropout (LDO) voltage regulator optimized for ultra-low-noise applications. It offers high output accuracy, extremely low dropout voltage, low ground current and fast start-up time. The EUP7914 provides a very low noise output without a bypass capacitor, ideal for RF applications where a clean supply voltage source is required. Specifically designed for handheld and battery-powered devices, the EUP7914 provides a TTL-logic-compatible enable pin. When the EUP7914 is disabled, power consumption drops nearly to zero. Key features include current limit, thermal shutdown and faster transient response.

The EUP7914 works with low-ESR ceramic capacitors. Available in the SC-82 space saving package which reduces the amount of board space for power applications. The EUP7914 offers wide fixed output voltage versions.

FEATURES

- 2.5V to 5.5V Input Voltage Range
- 30 μ V(rms) Output Noise
- 90mV Dropout @ 150mA
- 70dB PSRR at 1kHz No Bypass Capacitor
- Low 30 μ A Ground Current
- Guaranteed 150mA Output Current
- Stable with a 1 μ F Ceramic Output Capacitor when $V_{OUT} \geq 1.5V$, or 2.2 μ F when $V_{OUT} < 1.5V$
- Excellent Load/Line Transient
- Thermal Shutdown and Current Limit Protection
- Available 1.2V to 3.6V Fixed Output Voltages (50mV increments)
- Space-Saving 4-pin SC-82 Package
- RoHS Compliant and 100% Lead (Pb)-Free

APPLICATIONS

- Cellular Phones
- Camera Modules
- PDA and Palmtop Computers
- Consumer/Personal Electronics

Block Diagram

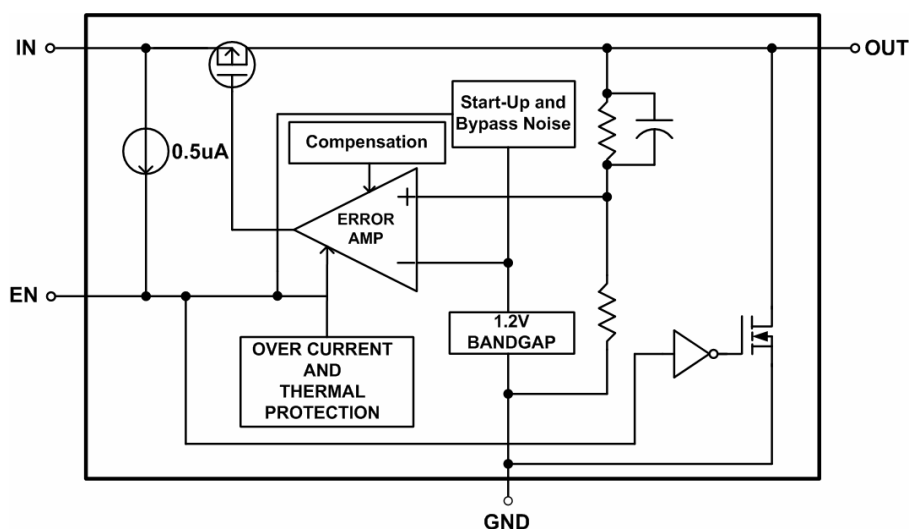


Figure 1.

Typical Application Circuit

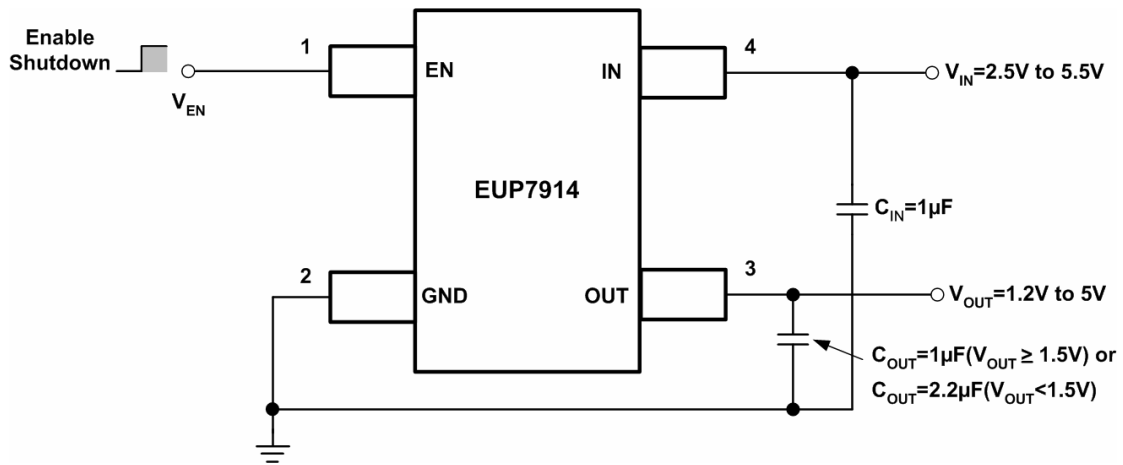


Figure 2. Fixed-Voltage LDO Regulator

Pin Configurations

| Package Type | Pin Configurations |
|--------------|--------------------|
| SC-82 | <p>(Top View)</p> |

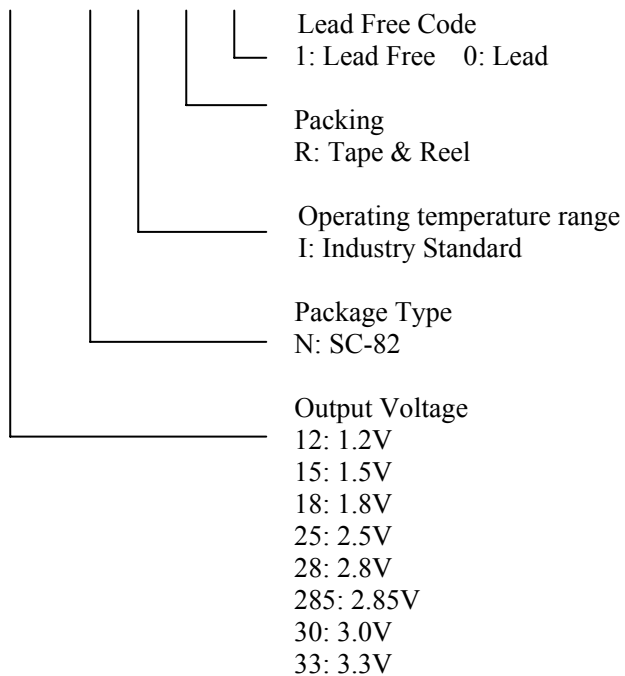
Pin Description

| NAME | PIN | DESCRIPTION |
|------|-----|--|
| EN | 1 | The device enable input. Set logic high to enable the device, and connect logic low to disable the device. |
| GND | 2 | Ground pin |
| OUT | 3 | Output voltage of the LDO |
| IN | 4 | Input voltage of the LDO |

Ordering Information

| Order Number | Package Type | Marking | Operating Temperature Range |
|-----------------|--------------|---------|-----------------------------|
| EUP7914-12NIR1 | SC-82 | ET xx | -40 °C to +85°C |
| EUP7914-15NIR1 | SC-82 | EC xx | -40 °C to +85°C |
| EUP7914-18NIR1 | SC-82 | ED xx | -40 °C to +85°C |
| EUP7914-25NIR1 | SC-82 | EB xx | -40 °C to +85°C |
| EUP7914-28NIR1 | SC-82 | EE xx | -40 °C to +85°C |
| EUP7914-285NIR1 | SC-82 | EF xx | -40 °C to +85°C |
| EUP7914-30NIR1 | SC-82 | EG xx | -40 °C to +85°C |
| EUP7914-33NIR1 | SC-82 | EH xx | -40 °C to +85°C |

EUP7914-



Absolute Maximum Ratings (1)

- IN,OUT and EN to GND----- -0.3V to 6V
- Junction Temperature ----- 150°C
- Storage Temperature Range ----- -65°C to +150°C
- Lead Temperature ----- 260°C
- Maximum Power Dissipation SC-82 ----- 0.3W
- Thermal Resistance θ_{JA} (SC-82) ----- 320°C/W
- ESD Rating
Human Body Model ----- $\pm 2kV$

Recommend Operating Conditions (2)

- V_{IN} ----- 2.5V to 5.5V
- V_{EN} ----- 0V to 5.5V
- Operating Temperature Range ----- -40°C to +85°C

Note (1): Stress beyond those listed under “Absolute Maximum Ratings” may damage the device.

Note (2): The device is not guaranteed to function outside the recommended operating conditions.

Electrical Characteristics

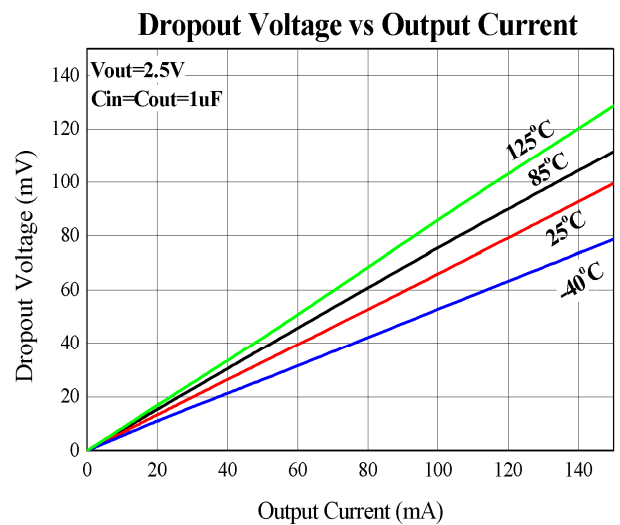
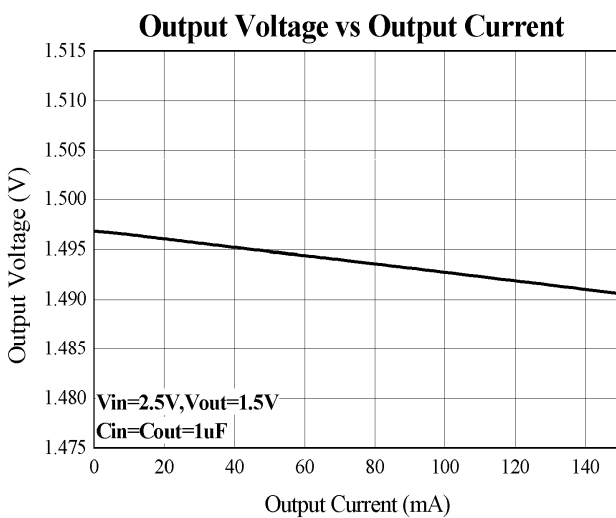
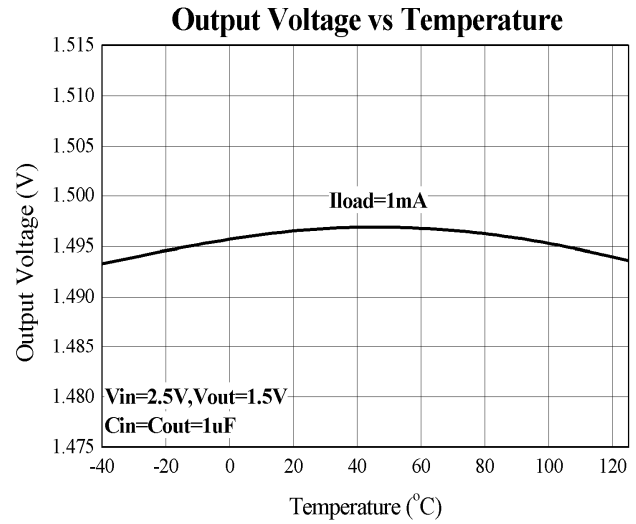
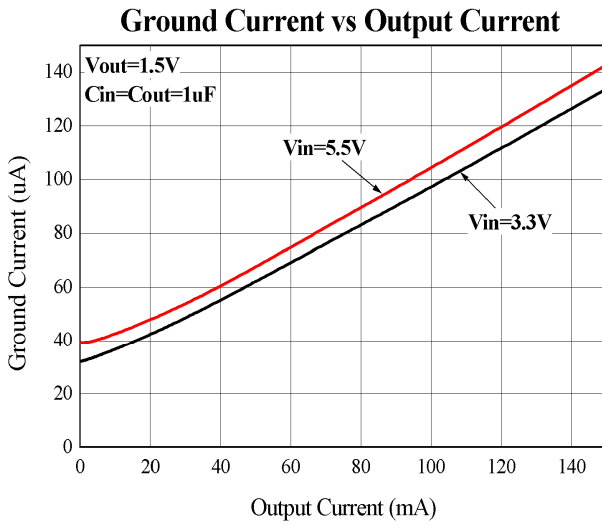
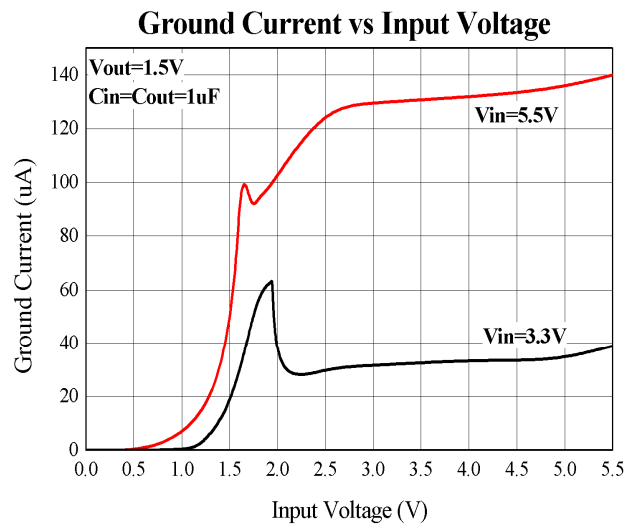
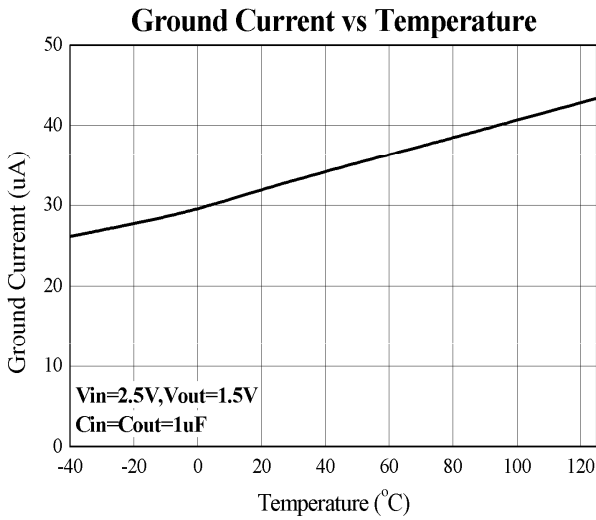
Conditions: $V_{IN}=V_{OUT}+0.5V$ or 2.5V whichever is greater, $V_{EN}=V_{IN}$, $C_{IN}=C_{OUT}=1\mu F$, $T_A=-40^\circ C$ to +85, unless otherwise specified.

| Symbol | Parameter | Conditions | EUP7914 | | | Unit |
|------------------|-------------------------------|--|---------|------|------|----------|
| | | | Min | Typ | Max. | |
| | Input Voltage | | 2.5 | | 5.5 | V |
| ΔV_{OUT} | Output Voltage Accuracy | $I_{OUT}=1mA$ to 30mA, $T_A=+25^\circ C$ | -2 | | 2 | % |
| | | $I_{OUT}=1mA$ to 30mA, $T_A=-40^\circ C$ to +85 | -3 | | 3 | % |
| I_{OUTMAX} | Maximum Output Current | | 150 | | | mA |
| I_{LIMIT} | Current Limit | $V_{OUT}=V_{OUT(nom)} \times 90\%$ | 160 | 300 | | mA |
| V_{DROP} | Dropout Voltage (3) | $V_{OUT} \geq 3V$, $I_{OUT}=150mA$ | | 90 | 135 | mV |
| | | $2.4 \leq V_{OUT} \leq 3V$, $I_{OUT}=150mA$ | | 100 | 150 | |
| I_Q | Quiescent Current | No Load | | 30 | 50 | μA |
| V_{LNR} | Line Regulation | $V_{IN}=(V_{OUT}+0.5V)$ to 5.5V, $I_{OUT}=10mA$ | | 0.02 | 0.15 | %/V |
| V_{LDR} | Load Regulation | $1mA \leq I_{OUT} \leq 150mA$ | | 7 | 15 | mV |
| I_{SHDN} | Shutdown Supply Current | $V_{EN}=0$, $T_A=+25^\circ C$ | | 0.3 | 1.5 | μA |
| PSRR | Power Supply Ripple Rejection | $V_{IN}=(V_{OUT}+1V)$ $f=1kHz$, $I_{LOAD}=10mA$ | | 70 | | dB |
| | | $V_{IN}=(V_{OUT}+1V)$ $f=10kHz$, $I_{LOAD}=10mA$ | | 55 | | |
| | | $V_{IN}=(V_{OUT}+1V)$ $f=100kHz$, $I_{LOAD}=10mA$ | | 45 | | |
| | Output Noise Voltage (RMS) | $f=10Hz \sim 100kHz$, $V_{OUT}=1.5V$, No Load | | 30 | | μV |
| | Turn-on Time (4) | $R_{LOAD}=50\Omega$, $T_A=+25^\circ C$ | | 100 | | μs |
| V_{ENL} | VENL (EN logic low) | $V_{IN}=2.5V$ to 5.5V | | | 0.4 | V |
| V_{ENH} | VENH (EN logic high) | $V_{IN}=2.5V$ to 5.5V | 1.5 | | | V |
| | VEN Input Bias Current | $V_{IN}=5.5V$, $V_{EN}=0$ or 5.5V | -1 | | 1 | μA |
| RDIS | Output Discharge Switch | $V_{EN}=0$, $V_{IN}=3.6V$ | | 500 | | Ω |
| T_{SD} | Thermal Shutdown Temperature | | | 155 | | |
| ΔT_{SD} | Thermal Shutdown Hysteresis | | | 15 | | |

Note (3): Dropout is defined as $V_{IN}-V_{OUT}$ when V_{OUT} is 100mV below the value of V_{OUT} for $V_{IN}=V_{OUT}+0.5V$

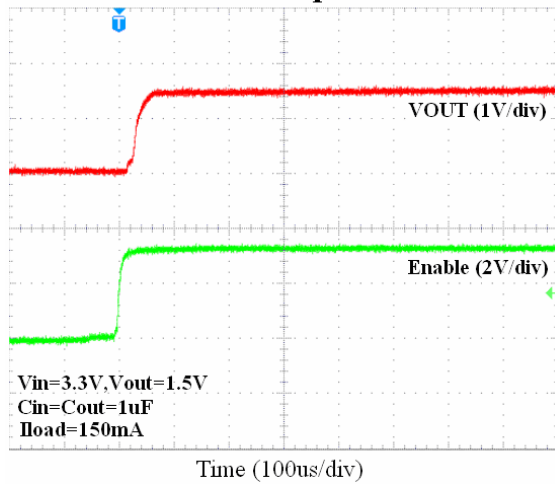
Note (4): Time needed for V_{OUT} to reach 90% of final value.

Typical Characteristics ($C_{IN}=C_{OUT}=1\mu F$)

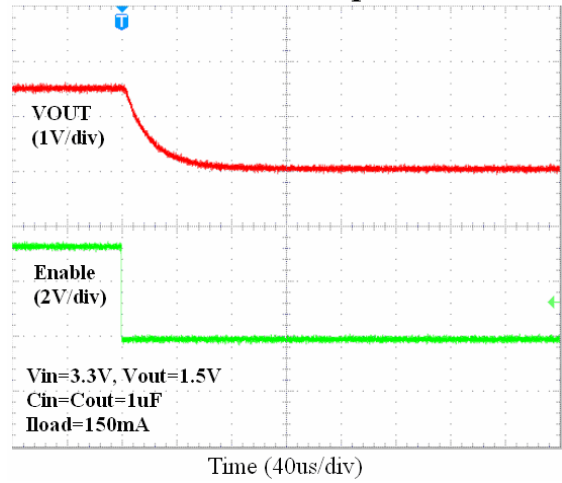


Typical Characteristics (continued)

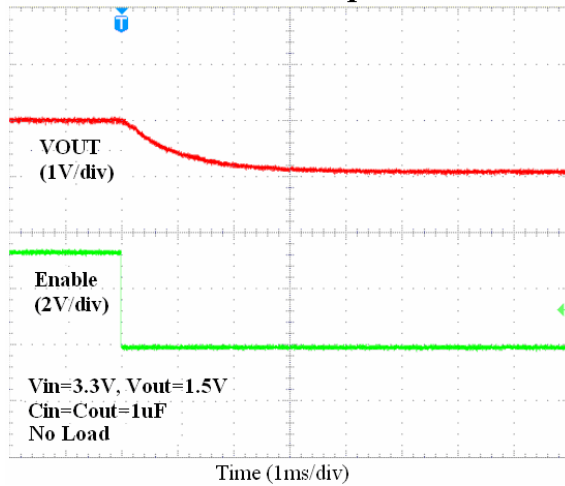
Enable Response



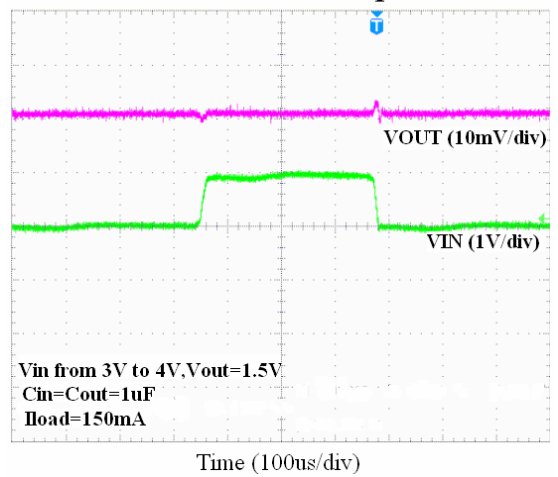
Shutdown Response



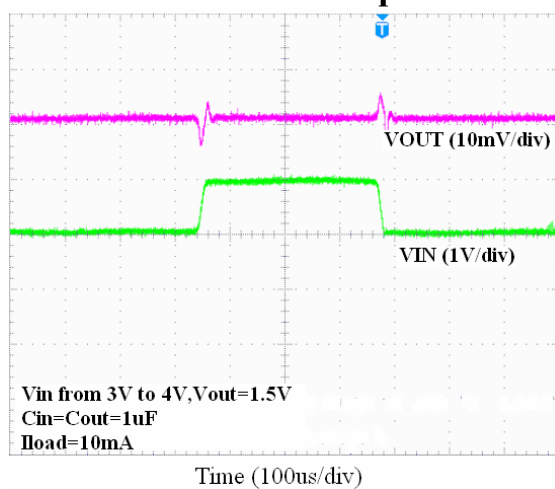
Shutdown Response



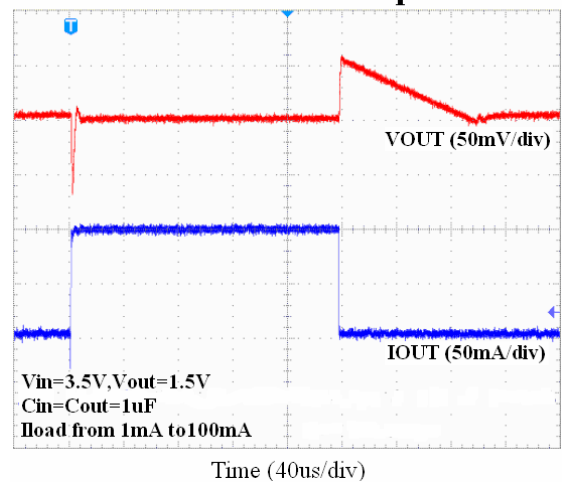
Line Transient Response



Line Transient Response

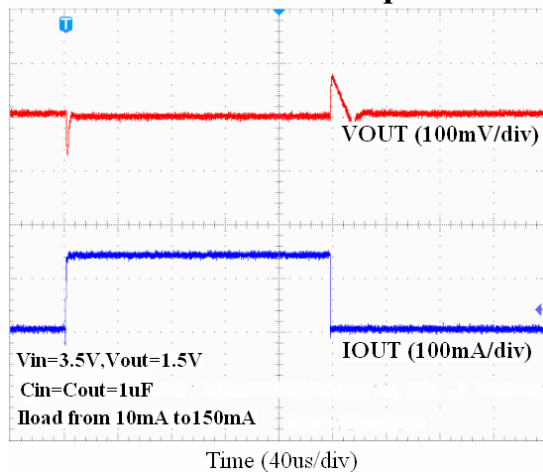


Load Transient Response

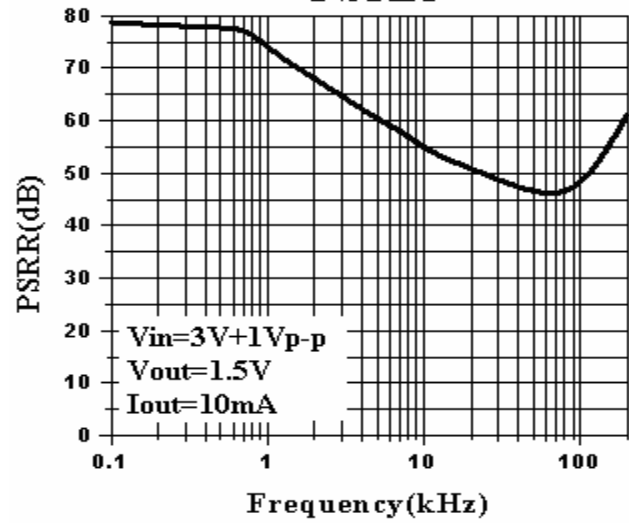


Typical Characteristics (continued)

Load Transient Response



PSRR



Application Note

Input Capacitor

An input capacitance of $1\mu\text{F}$ or higher is required between the EUP7914 input pin IN and ground (the amount of the capacitance may be increased without limit). This capacitor must be located a distance of not more than 1cm from the input pin and returned to a clean analog ground. Any good quality ceramic, tantalum, or film capacitor may be used at the input. If a tantalum capacitor is used at the input, it must be guaranteed by the manufacturer to have a surge current rating sufficient for the application. There are no requirements for the ESR on the input capacitor, but tolerance and temperature coefficient must be considered when selecting the capacitor to ensure the capacitance will be $1\mu\text{F}$ over the entire operating temperature range.

Output Capacitor

The EUP7914 is designed specifically to work with very small ceramic output capacitors. A ceramic capacitor (temperature characteristics X7R or X5R) in $1\mu\text{F}$ to $10\mu\text{F}$ range with $5\text{m}\Omega$ to $500\text{m}\Omega$ ESR range is suitable in the EUP7914 application circuit. The output capacitor must meet the requirement for minimum amount of capacitance to maintain good loop stability and phase margin. See the table below.

| Output Voltage | Output Capacitor Minimum Value |
|----------------|--------------------------------|
| 1.2~1.45 | 2.2 μF |
| 1.5~3.6 | 1 μF |

No-Load Stability

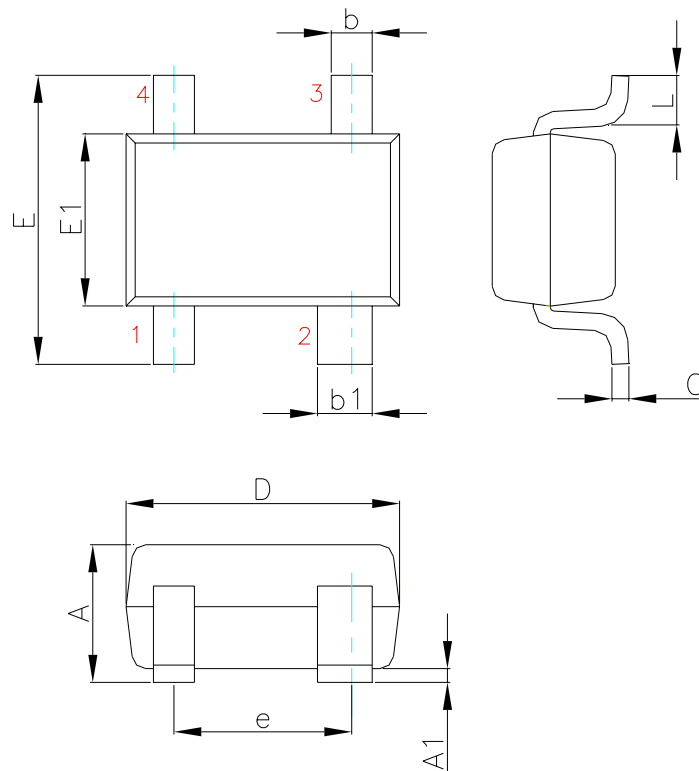
The EUP7914 is stable without any external load. This is specially important for CMOS RAM keep-alive applications.

On/Off Input Operation

The EUP7914 is turned off by pulling the EN pin low, and turned on by pulling it high. If this pin is floating, the regulator will always be on. To assure proper operation, the signal source used to drive the V_{EN} input must be able to swing above and below the specified turn-on/off voltage thresholds listed in the Electrical Characteristics. When EN is logic low, output is internally discharged to GND through a 500 resistor.

Packaging Information

SC-82



| SYMBOLS | MILLIMETERS | | INCHES | |
|---------|-------------|------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.80 | 1.10 | 0.031 | 0.044 |
| A1 | 0.00 | 0.10 | 0.000 | 0.004 |
| b | 0.25 | 0.40 | 0.010 | 0.016 |
| b1 | 0.35 | 0.50 | 0.014 | 0.020 |
| D | 2.00 | | 0.079 | |
| E | 1.80 | 2.40 | 0.071 | 0.094 |
| E1 | 1.25 | | 0.049 | |
| e | 1.30 | | 0.051 | |
| L | 0.21 | 0.46 | 0.008 | 0.018 |