# Dual ,Low-Noise,150mA LDO Regulator

## DESCRIPTION

The EUP7201 is highly accurate, Dual, low noise, CMOS LDO voltage regulator. Performance features include low output noise, high ripple rejection ratio, low dropout and very fast turn-on times.

The EUP7201 is also fully compatible with low ESR ceramic capacitors, reducing cost and improving output stability. This high level of output stability is maintained even during frequent load fluctuations, due to the excellent transient response performance and high PSRR achieved across a broad range of frequencies.

The EN function allows the output of each regulator to be turned off independently, resulting in greatly reduced power consumption. The EUP7201 is available in the SOT23-6 , TDFN-6 and USP-6 package.

## FEATURES

- Up to 150mA Output Current (Each LDO)
- Dual Shutdown Pins Control Each Output
- 124 μ $V_{RMS}$ Low Noise Output
- Current Limiting and Thermal Protection
- Short Circuit Protection
- 100mV Dropout at 100mA Load
- Current Limiting Protection
- Available in SOT23-6 ,TDFN-6 and USP-6 Package
- RoHS Compliant and 100% Lead (Pb)-Free

## APPLICATIONS

- Cellular Phones
- Camera, Video Recorders
- PDAs
- Hand-held Equipment

## Typical Application Circuit

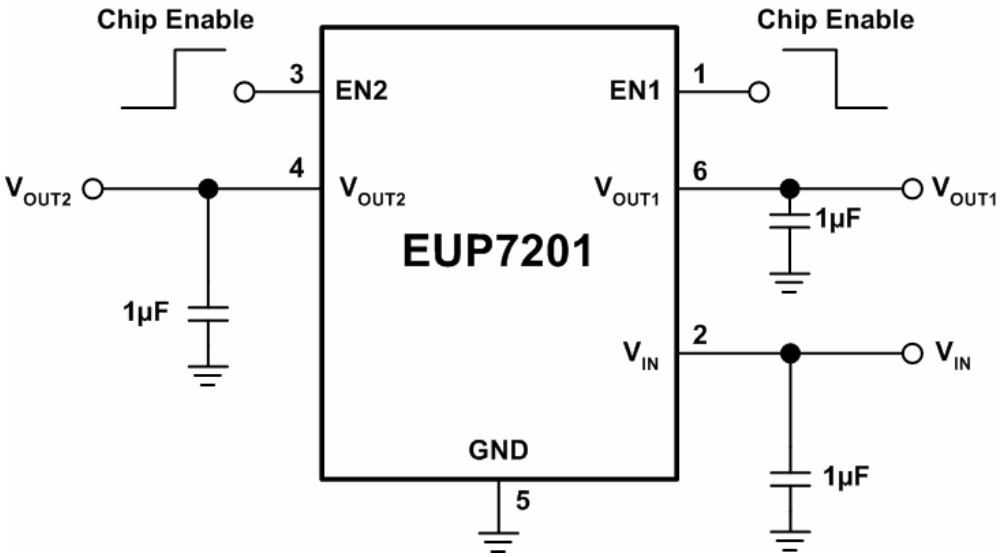
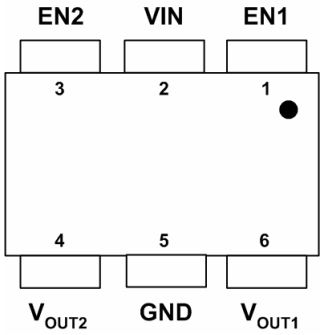
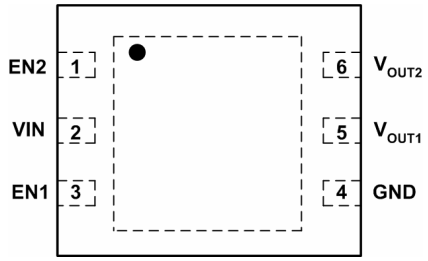
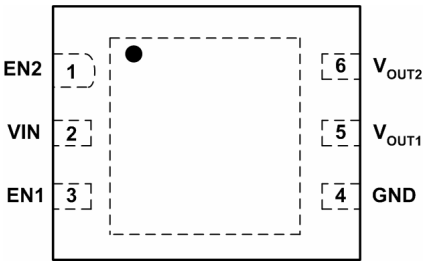



**Figure 1.**

## Pin Configurations

| Package Type | Pin Configurations | Package Type | Pin Configurations |
|---|---|---|---|
| SOT23-6 |  | TDFN-6 |  |

| Package Type | Pin Configurations |
|---|---|
| USP-6 |  |

## Pin Description

| PIN | SOT23-6 | TDFN-6 | USP-6 | DESCRIPTION |
|---|---|---|---|---|
| EN1 | 1 | 3 | 3 | ON/OFF Control $V_{OUT1}$ |
| VIN | 2 | 2 | 2 | Supply Input |
| EN2 | 3 | 1 | 1 | ON/OFF Control $V_{OUT2}$ |
| $V_{OUT2}$ | 4 | 6 | 6 | Channel 2 Output Voltage |
| GND | 5 | 4 | 4 | Ground |
| $V_{OUT1}$ | 6 | 5 | 5 | Channel1 Output Voltage |

Note: If EN1 and EN2 are both low, both regulators and the reference turn off.

## Block Diagram

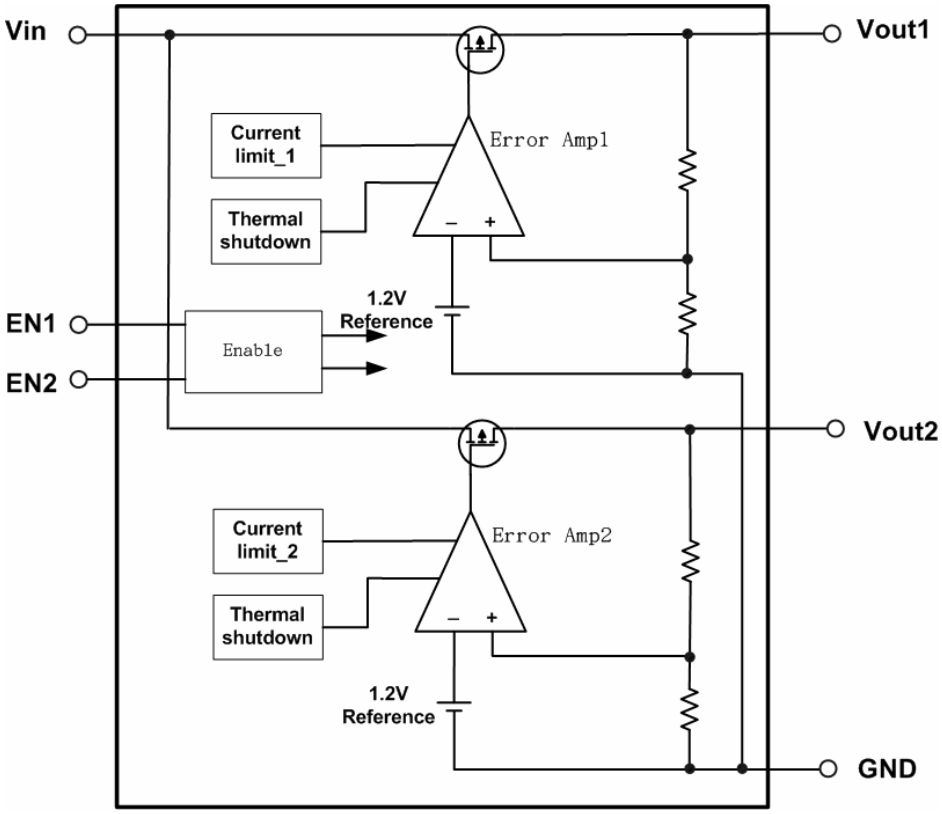


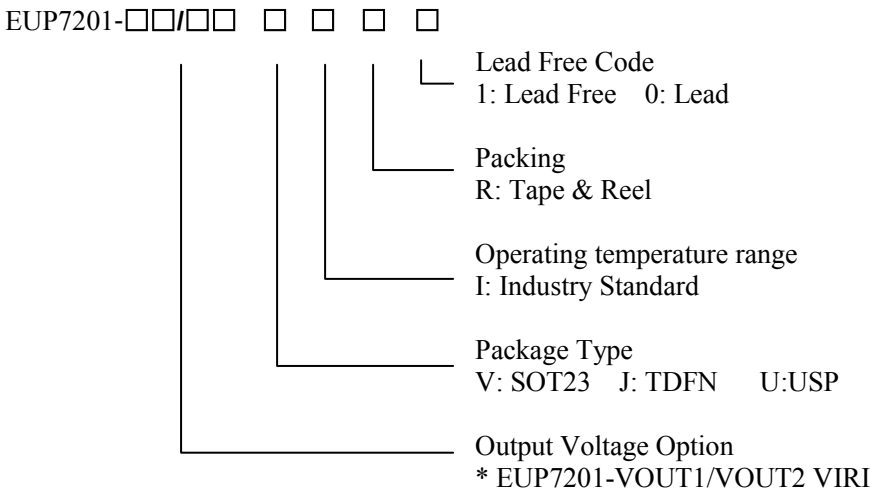

**Figure 2.**

## Ordering Information

| Order Number | Package Type | Marking | Operating Temperature range |
|---|---|---|---|
| EUP7201-1.5/2.8VIR1 | SOT23-6 | N C ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-1.8/2.8VIR1 | SOT23-6 | N A ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-1.8/2.6VIR1 | SOT23-6 | N U ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-1.8/3.3VIR1 | SOT23-6 | N H ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-2.5/2.8VIR1 | SOT23-6 | N D ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-2.8/1.2VIR1 | SOT23-6 | N P ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-2.8/2.8VIR1 | SOT23-6 | N M ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-2.8/3.0VIR1 | SOT23-6 | N K ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-2.8/3.3VIR1 | SOT23-6 | N L ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-3.0/3.0VIR1 | SOT23-6 | N N ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-3.0/3.3VIR1 | SOT23-6 | N T ☐ ☐ ☐ ☐ | -40 °C to 85°C |
| EUP7201-3.3/3.3VIR1 | SOT23-6 | N J ☐ ☐ ☐ ☐ | -40 °C to 85°C |

## Ordering Information (Continued)

| Order Number | Package Type | Marking | Operating Temperature range |
|---|---|---|---|
| EUP7201-1.8/2.8JIR1 | TDFN-6 | xxxxx<br>7201A | -40 °C to 85°C |
| EUP7201-1.5/2.8UIR1 | USP-6 | xxx<br>NC | -40 °C to 85°C |
| EUP7201-1.8/2.8UIR1 | USP-6 | xxx<br>NA | -40 °C to 85°C |
| EUP7201-1.8/2.6UIR1 | USP-6 | xxx<br>NU | -40 °C to 85°C |
| EUP7201-1.8/3.3UIR1 | USP-6 | xxx<br>NH | -40 °C to 85°C |
| EUP7201-2.5/2.8UIR1 | USP-6 | xxx<br>ND | -40 °C to 85°C |
| EUP7201-2.8/1.2UIR1 | USP-6 | xxx<br>NP | -40 °C to 85°C |
| EUP7201-2.8/2.8UIR1 | USP-6 | xxx<br>NM | -40 °C to 85°C |
| EUP7201-2.8/3.0UIR1 | USP-6 | xxx<br>NK | -40 °C to 85°C |
| EUP7201-2.8/3.3UIR1 | USP-6 | xxx<br>NL | -40 °C to 85°C |
| EUP7201-3.0/3.0UIR1 | USP-6 | xxx<br>NN | -40 °C to 85°C |
| EUP7201-3.0/3.3UIR1 | USP-6 | xxx<br>NT | -40 °C to 85°C |
| EUP7201-3.3/3.3UIR1 | USP-6 | xxx<br>NJ | -40 °C to 85°C |



## Absolute Maximum Ratings

- Supply Input Voltage ---------- 6V
- Power Dissipation, $P_D$ @ $T_A$ =25℃
  SOT23-6 ---------- 0.4W
- Package Thermal Resistance
  SOT23-6, $\theta_{JA}$ ---------- 250°C/W
- Lead Temperature (Soldering,10 sec .) ---------- 260°C
- Storage Temperature Range ---------- -65°C to 150°C
- ESD Rating
  HBM ---------- 2kV

## Recommended Operating Conditions

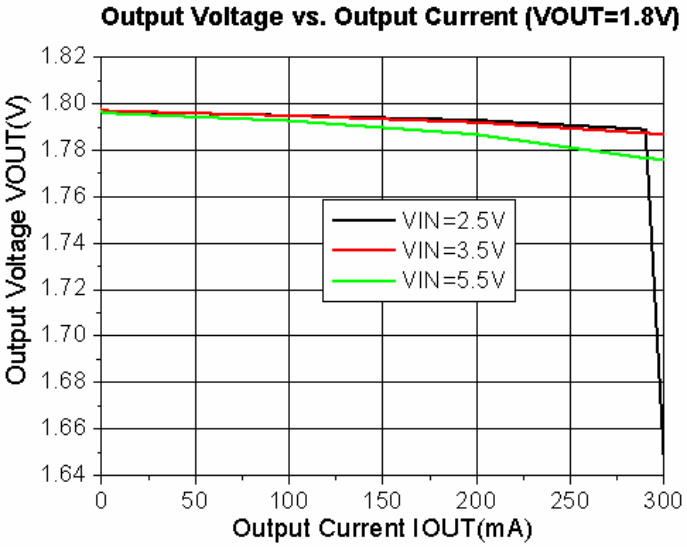
- Supply Input Voltage ---------- 2.5V to 5.5V
- Enable Input Voltage ---------- 0V to 5.5V
- Junction Temperature Range ---------- -40°C to 125°C

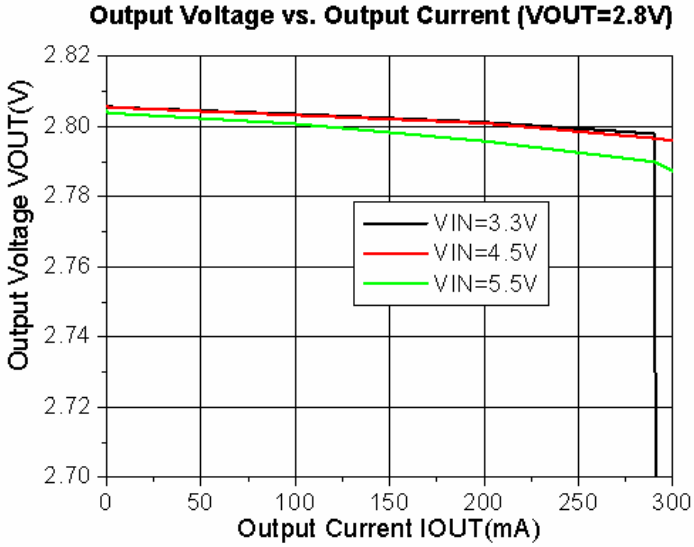
## Electrical Characteristics

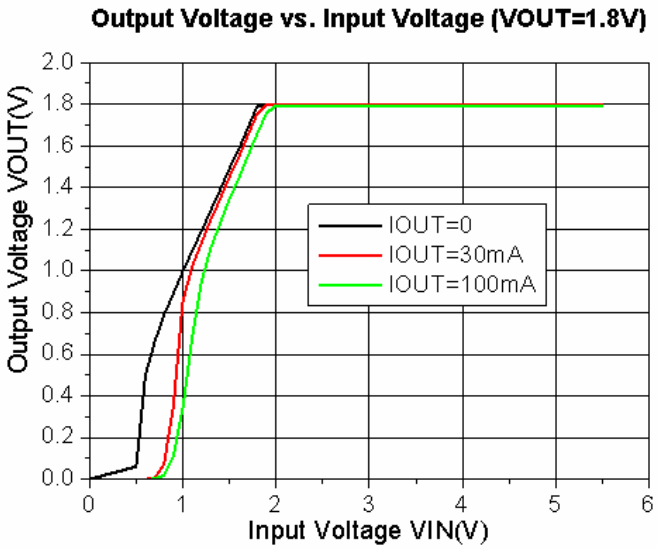
$V_{IN}$= ($V_{OUT}$+0.5V) or $V_{IN}$=2.5V whichever is greater, $C_{IN}$ =$C_{OUT}$=1μF , EN1=EN2= $V_{IN}$. $T_A$=25°C.
Unless otherwise noted

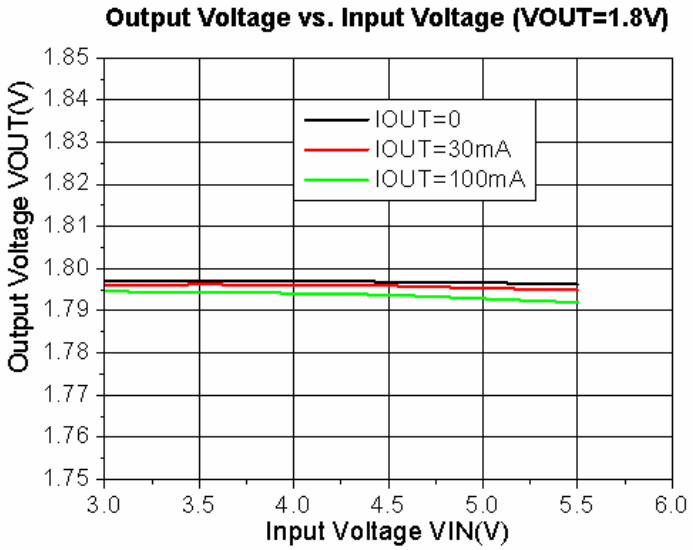
| Symbol | Parameter | Conditions | EUP7201 | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max. | |
| $V_{OUT}$ | Output voltage | $I_L$=30mA | -2 | | 2 | % |
| | | $I_L$=30mA, $T_A$=-40°C~85°C. | -3 | | 3 | |
| $I_{MAX}$ | Maximum Output Current | Continuous ,$T_A$=-40°C~85°C. | 150 | | | mA |
| $I_{LIM}$ | Current Limit | Output Grounded (Steady State) | 180 | 300 | | mA |
| $I_G$ | Quiescent Current | No Load (Both LDOs) | | 110 | 180 | μA |
| | | $I_{OUT}$=150mA (Both LDOs) | | 260 | | μA |
| $V_{DROP}$ | Dropout Voltage | $I_{OUT}$=30mA | | 30 | | mV |
| | | $I_{OUT}$=100mA, $T_A$=-40°C~85°C. | | 80 | 220 | mV |
| $\Delta V_{OUT}$ | Load Regulation | 1mA< $I_{OUT}$ < 150mA | | 13 | 60 | mV |
| $\Delta V_{LINE}$ | Line Regulation | $V_{IN}$=$V_{OUT}$+0.5V to 5.5V<br>$I_{OUT}$=1mA | | 0.02 | 0.2 | %/V |
| $V_{IH}$ | EN Input High Threshold | $V_{IN}$=2.5V to 5.5V, $T_A$=-40°C~85°C. | 1.6 | | | V |
| $V_{IL}$ | EN Input Low Threshold | $V_{IN}$=2.5V to 5.5V, $T_A$=-40°C~85°C. | | | 0.4 | V |
| $I_{SD}$ | EN Input Bias Current | EN=GND or $V_{IN}$ | | | 0.1 | μA |
| $I_{GSD}$ | Shutdown Supply Current | EN1=EN2=GND | | 0.01 | 1 | μA |
| $T_{SD}$ | Thermal Shutdown Temperature | | | 155 | | ℃ |
| $\Delta T_{SD}$ | Thermal Shutdown Hysteresis | | | 15 | | ℃ |
| PSRR | Ripple Rejection Rate | $V_{IN}$=($V_{OUT}$+1V) DC+0.5V p-p AC<br>$I_{OUT}$=1mA, f=1kHz | | 60 | | dB |

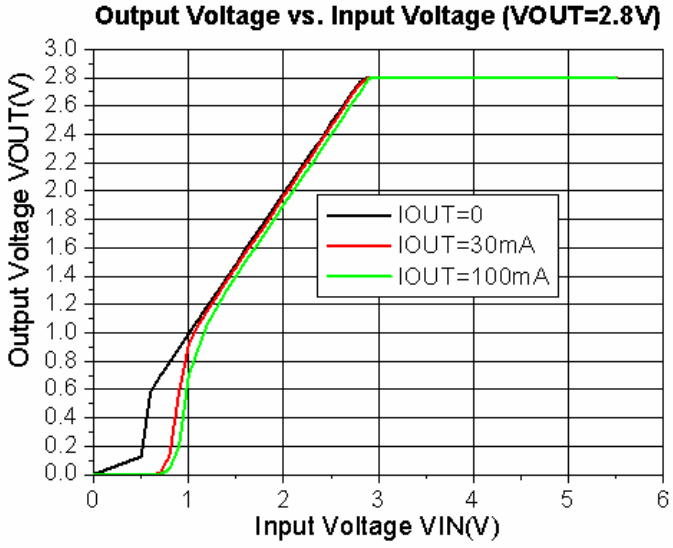
## Typical Operating Characteristics

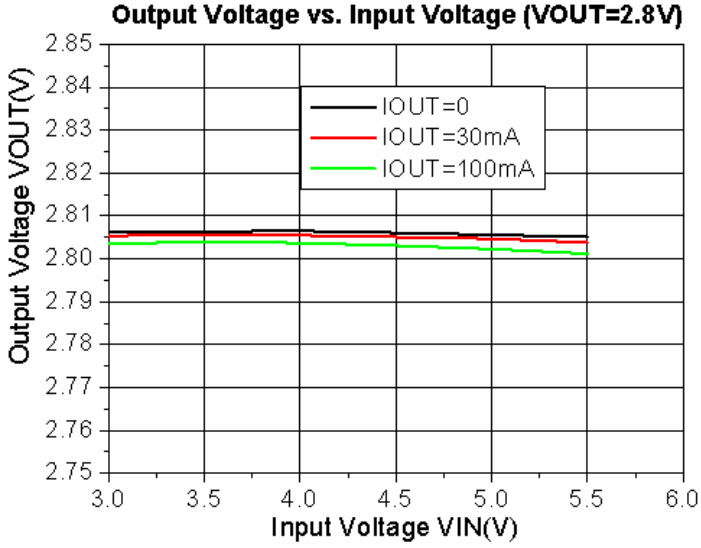


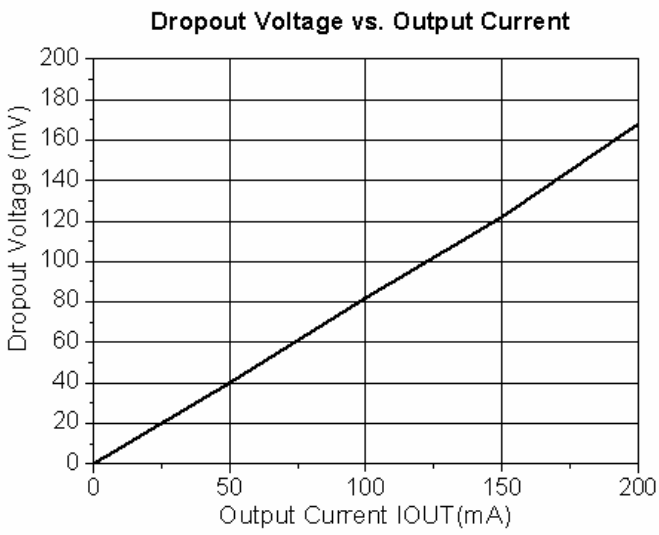



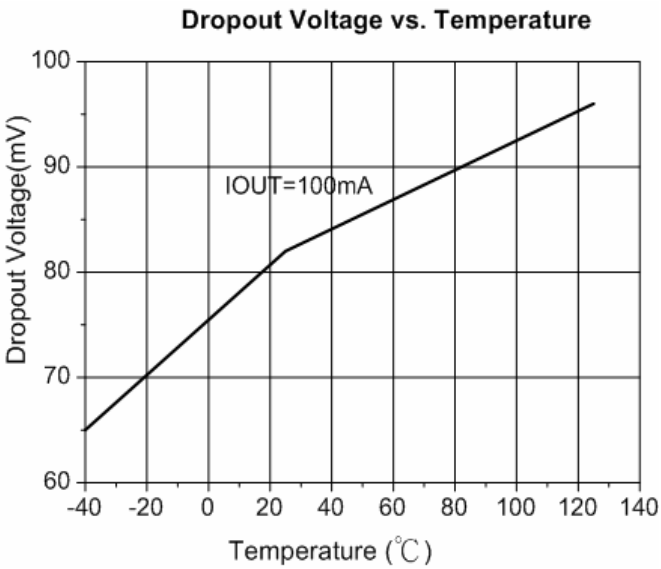



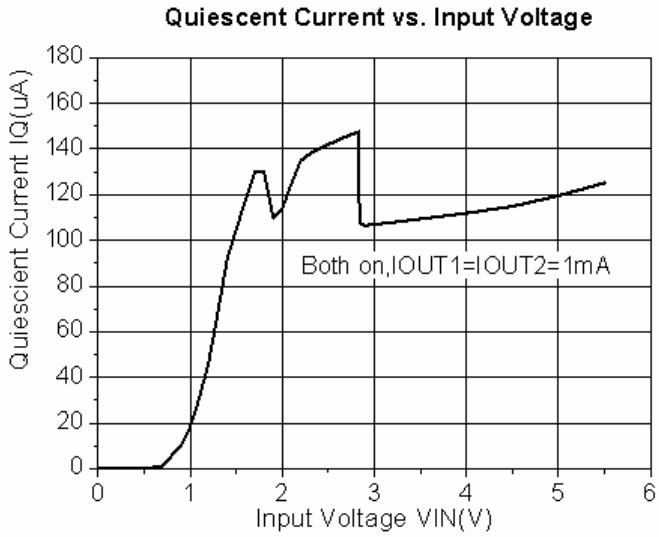



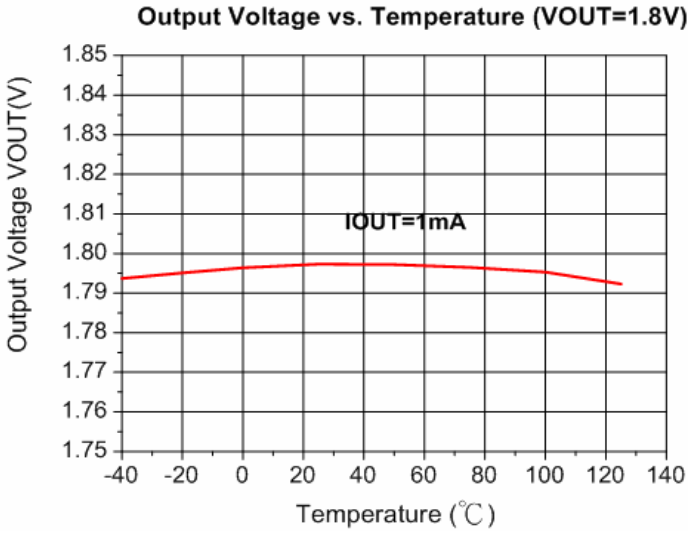



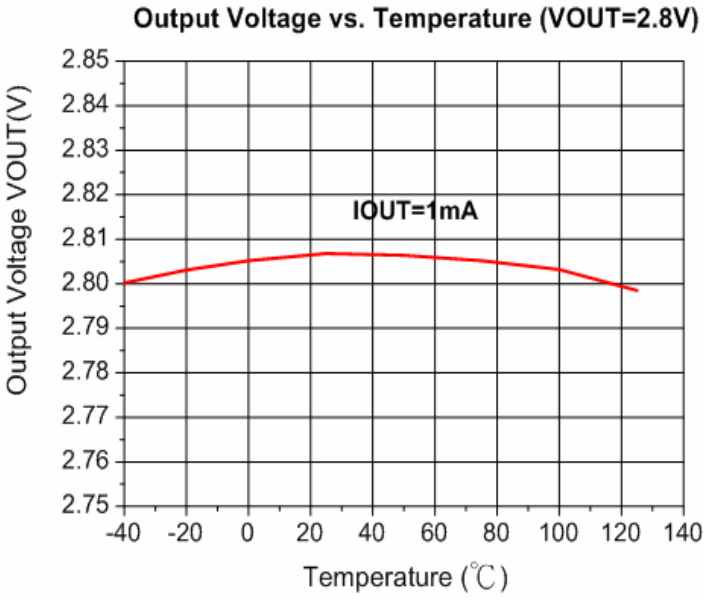



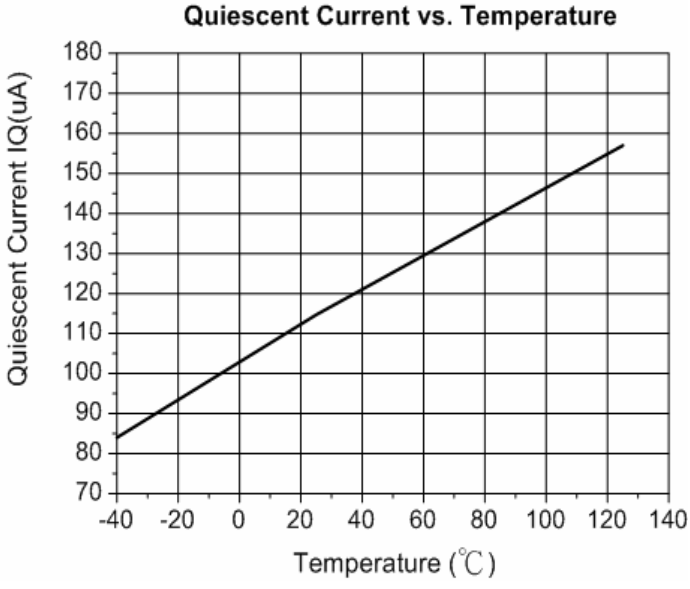

Dropout Voltage vs. Output Current
Dropout Voltage (mV)
Output Current IOUT(mA)
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200


Dropout Voltage vs. Temperature
Dropout Voltage(mV)
Temperature (℃)
IOUT=100mA
60
70
80
90
100
-40
-20
0
20
40
60
80
100
120
140

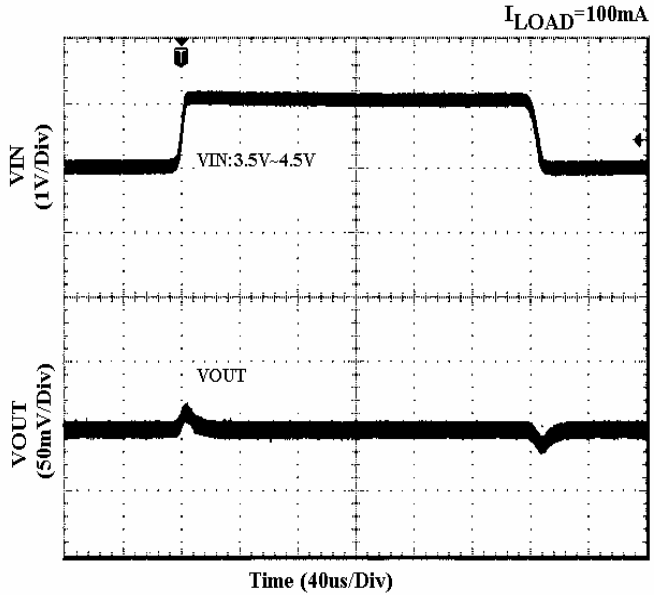

Quiescent Current vs. Input Voltage
Quiescient Current IQ(uA)
Input Voltage VIN(V)
Both on,IOUT1=IOUT2=1mA
0
20
40
60
80
100
120
140
160
180
0
1
2
3
4
5
6


Output Voltage vs. Temperature (VOUT=1.8V)
Output Voltage VOUT(V)
Temperature (℃)
IOUT=1mA
1.75
1.76
1.77
1.78
1.79
1.80
1.81
1.82
1.83
1.84
1.85
-40
-20
0
20
40
60
80
100
120
140

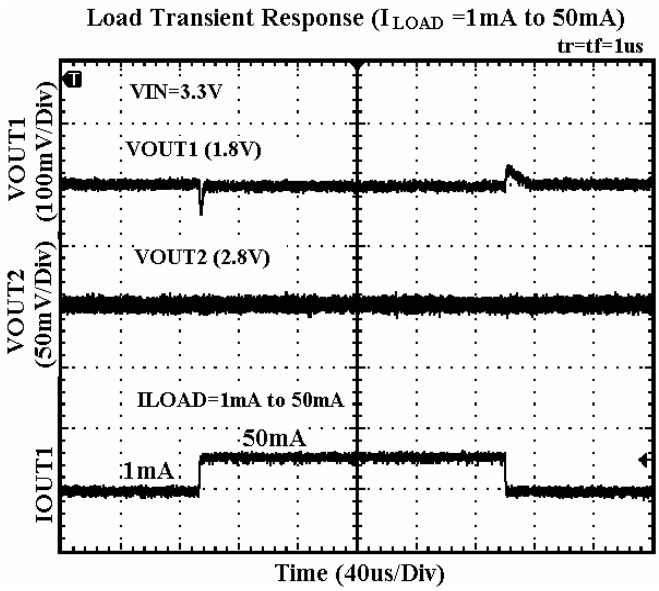

Output Voltage vs. Temperature (VOUT=2.8V)
Output Voltage VOUT(V)
Temperature (℃)
IOUT=1mA
2.75
2.76
2.77
2.78
2.79
2.80
2.81
2.82
2.83
2.84
2.85
-40
-20
0
20
40
60
80
100
120
140


Quiescent Current vs. Temperature
Quiescent Current IQ(uA)
Temperature (℃)
70
80
90
100
110
120
130
140
150
160
170
180
-40
-20
0
20
40
60
80
100
120
140

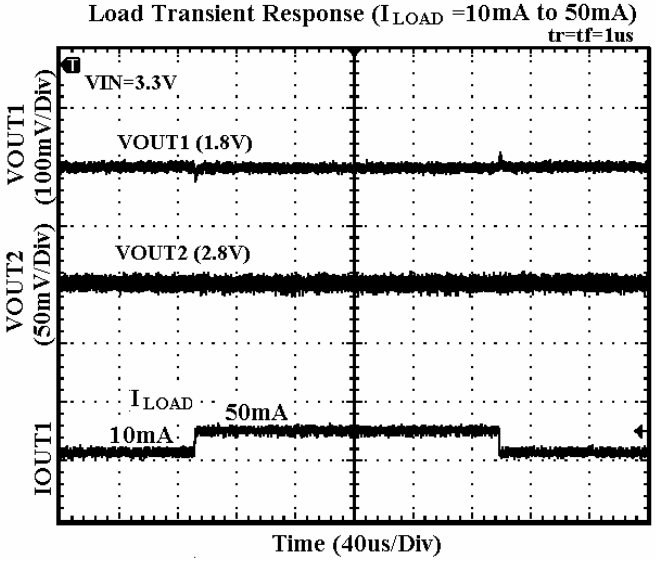
Line Transient Response (VIN=3.5V to 4.5V)



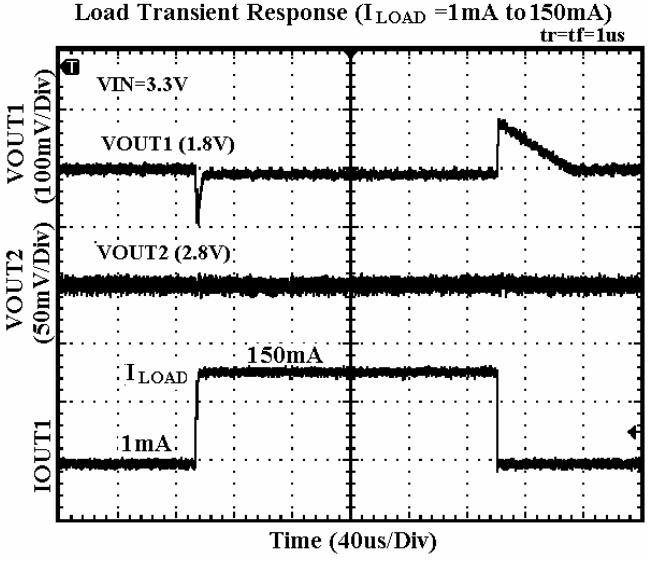

Load Transient Response ($I_{LOAD}$ =1mA to 50mA)



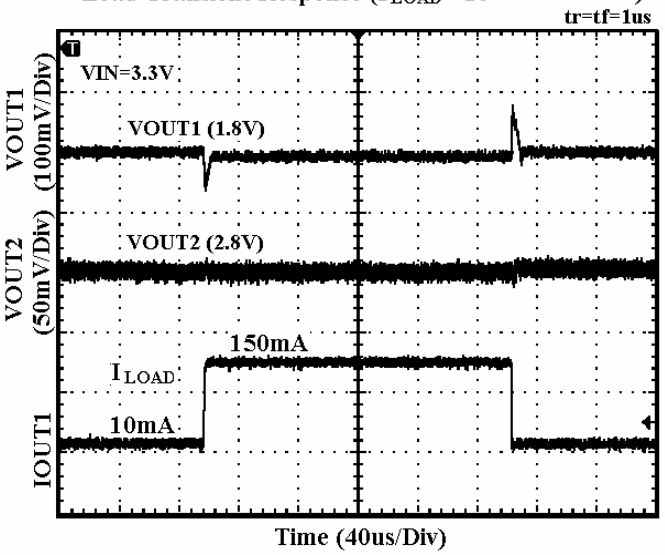

Load Transient Response ($I_{LOAD}$ =10mA to 50mA)



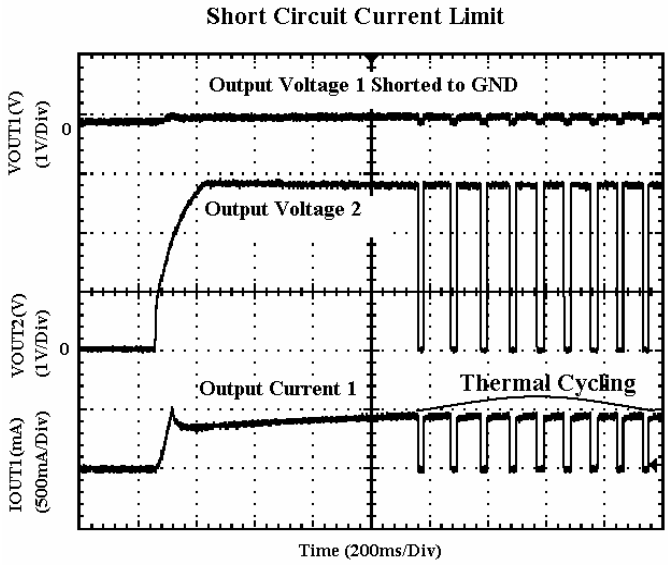

Load Transient Response ($I_{LOAD}$ =1mA to150mA)

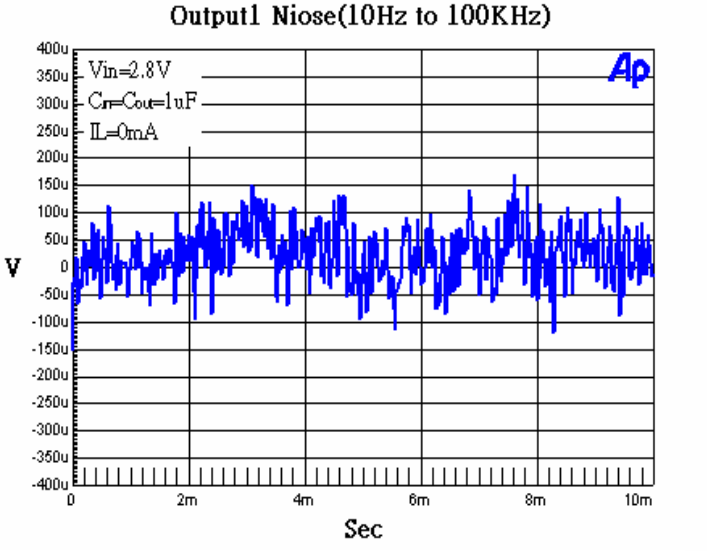


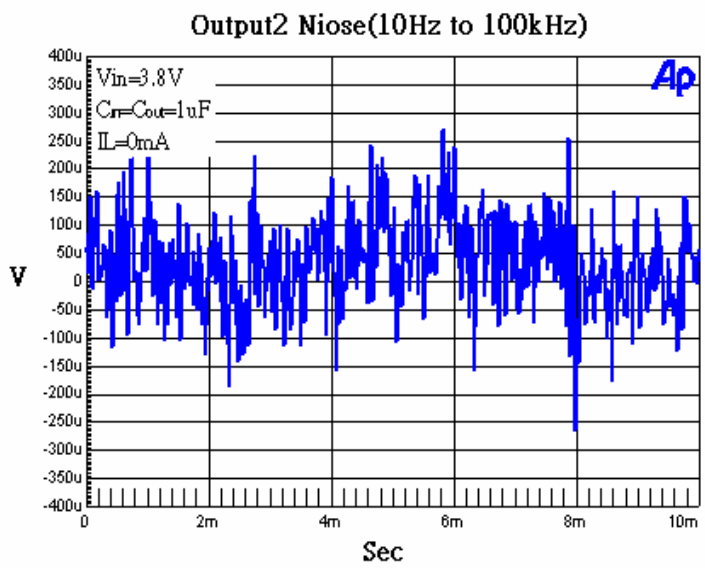

Load Transient Response ($I_{LOAD}$ =10mA to150mA)

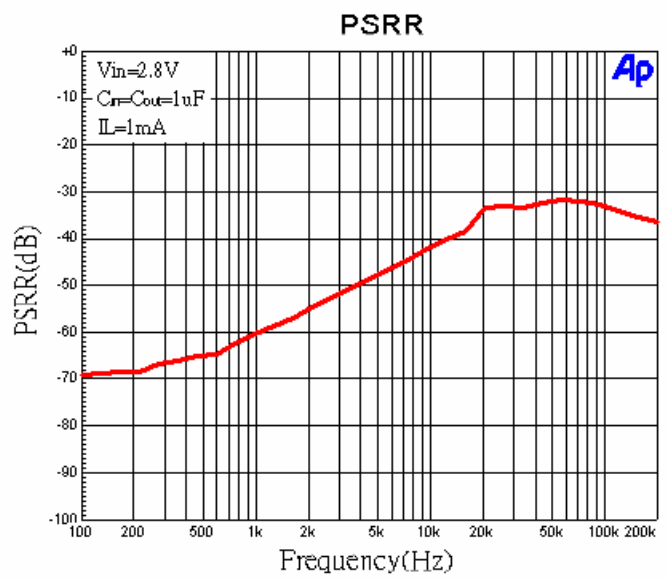


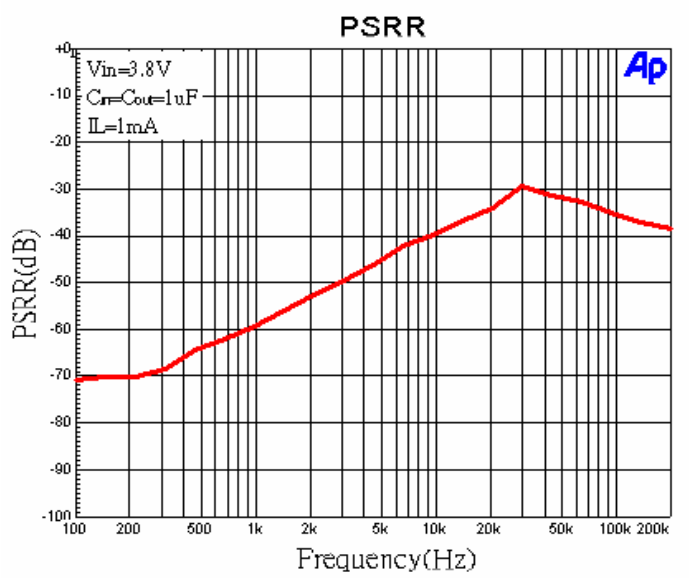

Short Circuit Current Limit




Output1 Niose(10Hz to 100KHz)
Vin=2.8V
Cin=Cout=1uF
IL=0mA
V
Sec


Output2 Niose(10Hz to 100kHz)
Vin=3.8V
Cin=Cout=1uF
IL=0mA
V
Sec


PSRR
Vin=2.8V
Cin=Cout=1uF
IL=1mA
PSRR(dB)
Frequency(Hz)


PSRR
Vin=3.8V
Cin=Cout=1uF
IL=1mA
PSRR(dB)
Frequency(Hz)

## Application Note

### External Capacitors

Like any low-dropout regulator, the EUP7201 requires external capacitors for regulator stability. The EUP7201 is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance.

### Input Capacitor

An input capacitance of ≈1μF is required between the EUP7201 input pin 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 ≈ 1μF over the entire operating temperature range.

### Output Capacitor

The EUP7201 is designed specifically to work with very small ceramic output capacitors. A ceramic capacitor (temperature characteristics X7R, X5R, Z5U, or Y5V) in 1 to 22μF range with 5mΩ to 500mΩ ESR range is suitable in the EUP7201 application circuit.

The output capacitor must meet the requirement for minimum amount of capacitance and also have an ESR (Equivalent Series Resistance) value which is within a stable range (5mΩ to 500mΩ)

### No-Load Stability

The EUP7201 will remain stable and in regulation with no external load. This is specially important in CMOS RAM keep-alive applications.

### Capacitor Characteristics

The EUP7201 is designed to work with ceramic capacitors on the output to take advantage of the benefits they offer: for capacitance values in the range of 1μF to 4.7μF range, ceramic capacitors are the smallest, least expensive and have the lowest ESR values (which makes them best for eliminating high frequency noise). The ESR of a typical 1μF ceramic capacitor is in the range of 20mΩ to 40mΩ, which easily meets the ESR requirement for stability by the EUP7201.

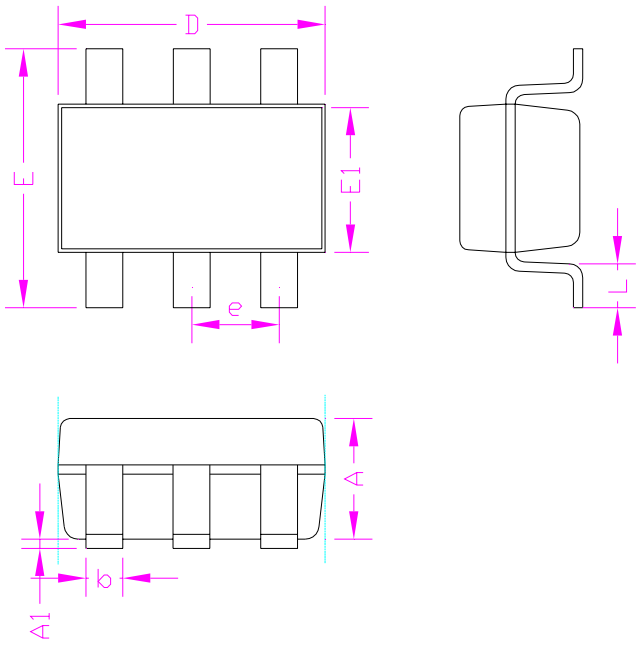
The ceramic capacitor's capacitance can vary with temperature. The capacitor type X7R, which operates over a temperature range of -55°C to +125°C, will only vary the capacitance to within ±15%. Most large value ceramic capacitors (≈2.2μF) are manufactured with Z5U or Y5V temperature characteristics. Their capacitance can drop by more than 50% as the temperature goes from 25°C to 85°C. Therefore, X7R is recommended over Z5U and Y5V in applications where the ambient temperature will change significantly above or below 25°C.

### On/Off Input Operation

The EUP7201 is turned off by pulling the $V_{EN}$ pin low, and turned on by pulling it high. If this feature is not used, the $V_{EN}$ pin should be tied to $V_{IN}$ to keep the regulator output on at all time. 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 section under $V_{IL}$ and $V_{IH}$.

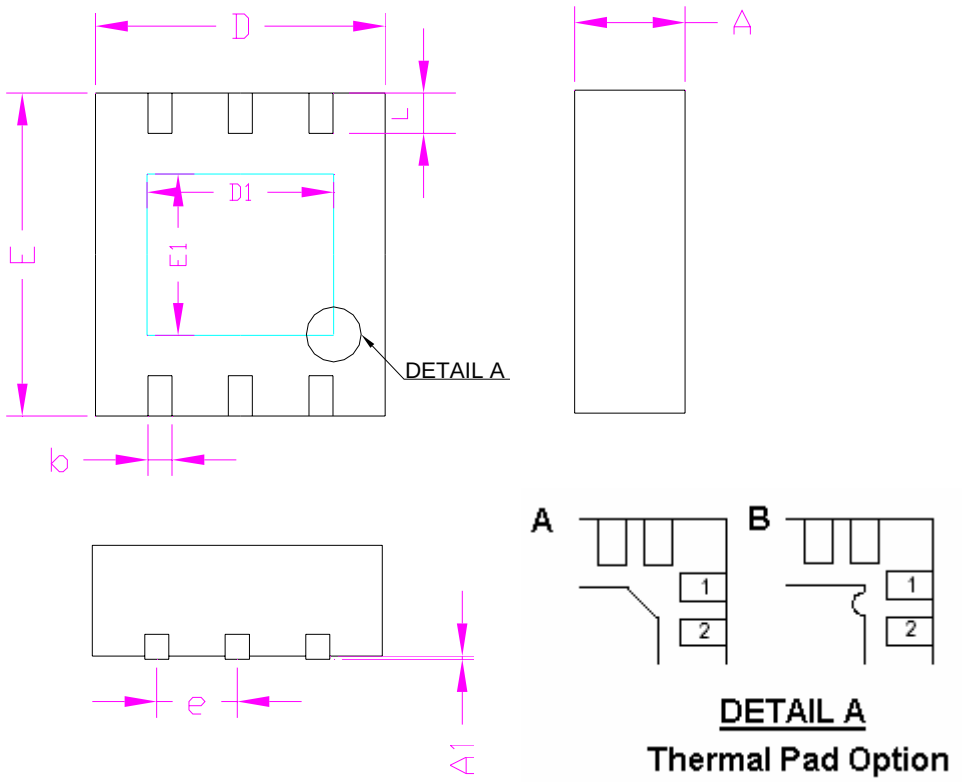
## Packaging Information

**SOT23-6**



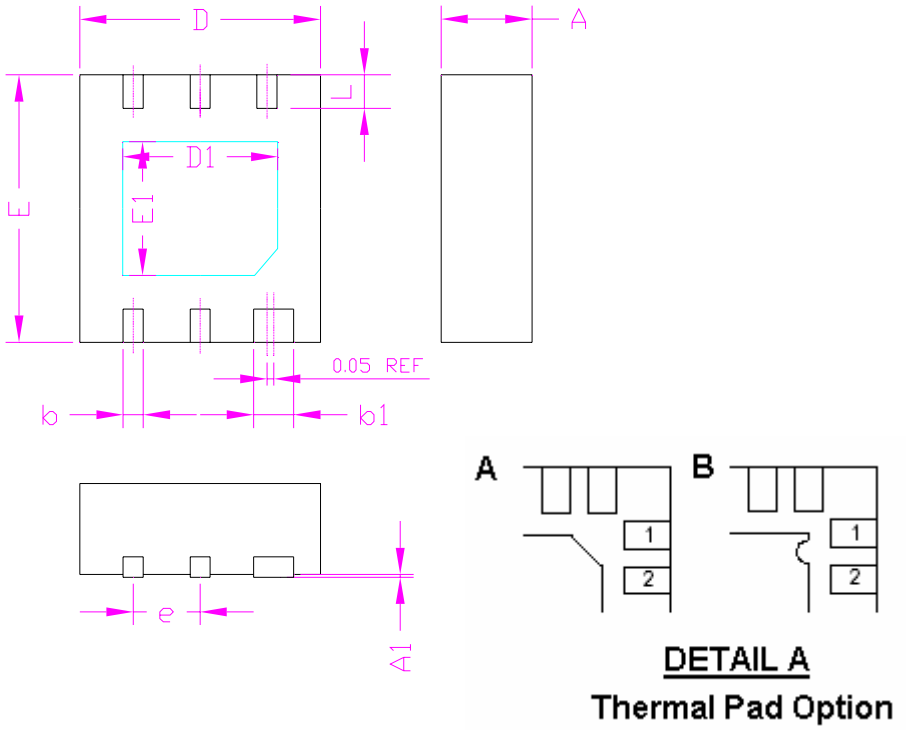

| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | - | 1.45 | - | 0.057 |
| A1 | 0.00 | 0.15 | 0.000 | 0.006 |
| b | 0.30 | 0.50 | 0.012 | 0.020 |
| D | 2.90 | | 0.114 | |
| E1 | 1.60 | | 0.063 | |
| e | 0.95 | | 0.037 | |
| E | 2.60 | 3.00 | 0.102 | 0.118 |
| L | 0.30 | 0.60 | 0.012 | 0.024 |

**TDFN-6**




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.70 | 0.80 | 0.028 | 0.031 |
| A1 | 0.00 | 0.05 | 0.000 | 0.002 |
| b | 0.30 | 0.50 | 0.012 | 0.020 |
| D | 2.90 | 3.10 | 0.114 | 0.122 |
| D1 | 2.30 | | 0.090 | |
| E | 2.90 | 3.10 | 0.114 | 0.122 |
| E1 | 1.50 | | 0.059 | |
| e | 0.95 | | 0.037 | |
| L | 0.38 | 0.58 | 0.015 | 0.023 |

**USP-6**




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.70 | 0.80 | 0.028 | 0.031 |
| A1 | 0.00 | 0.05 | 0.000 | 0.002 |
| b | 0.10 | 0.30 | 0.004 | 0.012 |
| b1 | 0.20 | 0.40 | 0.008 | 0.016 |
| D | 1.70 | 1.90 | 0.067 | 0.075 |
| D1 | 1.50 | | 0.059 | |
| E | 1.90 | 2.10 | 0.075 | 0.083 |
| E1 | 0.90 | | 0.035 | |
| e | 0.50 | | 0.020 | |
| L | 0.15 | 0.35 | 0.006 | 0.014 |