Portable Power Management 300mA Dual LDO Regulator

General Description

The RP1230 is a dual channel, low noise, and low dropout regulator sourcing up to 300mA at each channel. The range of output voltage is from 1.2V to 3.6V by operating from 2.5V to 5.5V input.

The RP1230 offers 2% accuracy, extremely low dropout voltage (240mV @ 300mA), and extremely low ground current, only 27μA per LDO. The shutdown current is near zero current which is suitable for battery-power devices. Other features include current limiting, over temperature, output short circuit protection.

The RP1230 is short circuit thermal folded back protected. The IC lowers its OTP trip point from 165°C to 110°C when output short circuit occurs (VOUT < 0.4V) providing maximum safety to end users.

The RP1230 can operate stably with very small ceramic output capacitors, reducing required board space and component cost. The RP1230 is available in fixed output voltages in the SOT-23-6 package.

Ordering Information

RP1230-□□□□

- Package Type
  E: SOT-23-6
- Operating Temperature Range
  G : Green (Halogen Free with Commercial Standard)
- Output Voltage: VOUT1/VOUT2

Note :

Richpower Green products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Features

- **Wide Operating Voltage Ranges : 2.5V to 5.5V**
- **Low-Noise for RF Application**
- **No Noise Bypass Capacitor Required**
- **Fast Response in Line/Load Transient**
- **TTL-Logic-Controlled Shutdown Input**
- **Low Temperature Coefficient**
- **Dual LDO Outputs (300mA/300mA)**
- **Ultra-low Quiescent Current 27μA/LDO**
- **High Output Accuracy 2%**
- **Short Circuit Protection**
- **Thermal Shutdown Protection**
- **Current Limit Protection**
- **Short Circuit Thermal Folded Back Protection**
- **RoHS Compliant and 100% Lead (Pb)-Free**

Applications

- CDMA/GSM Cellular Handsets
- Battery-Powered Equipment
- Laptop, Palmtops, Notebook Computers
- Hand-Held Instruments
- PCMCIA Cards
- Portable Information Appliances

Marking Information

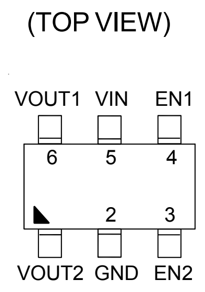
For marking information, contact our sales representative directly or through a Richpower distributor located in your area.

Available Voltage Version

VOUT1/VOUT2 Code	VOUT1/VOUT2 Voltage(V)
MG	2.8V/1.8V

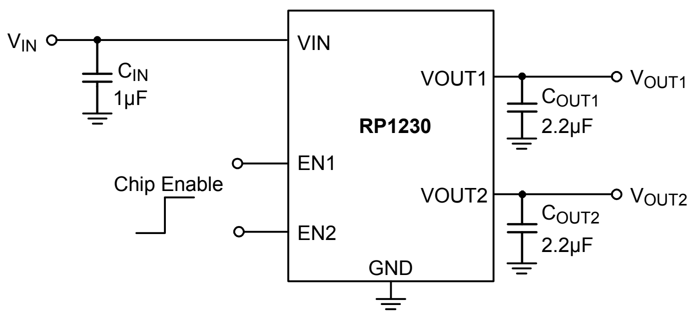
Note: For other specific voltage version, please contact our sales representative.

Pin Configurations



SOT-23-6

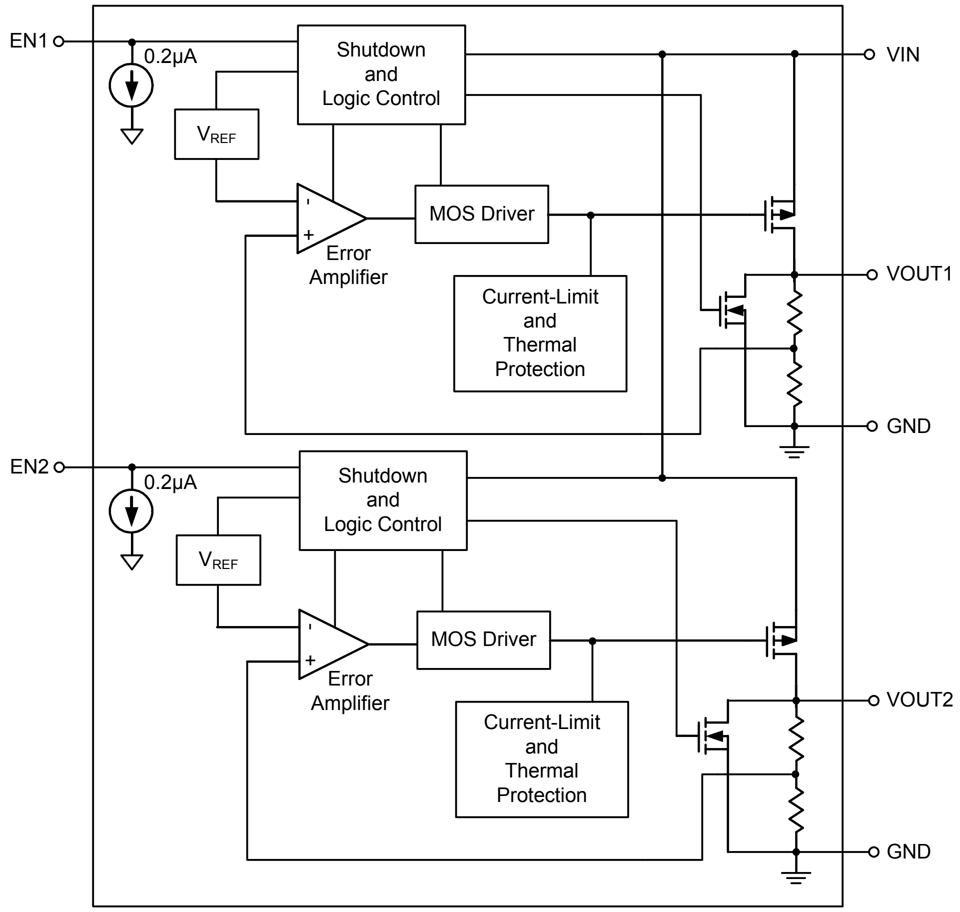
Typical Application Circuit



Functional Pin Description

Pin No.	Pin Name	Pin Function
1	VOUT2	Channel 2 Output Voltage.
2	GND	Common Ground. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation.
3	EN2	Chip Enable 2 (Active High).
4	EN1	Chip Enable 1 (Active High).
5	VIN	Supply Input.
6	VOUT1	Channel 1 Output Voltage.

Function Block Diagram



Absolute Maximum Ratings (Note 1)

- Supply Input Voltage ---------- −0.3V to 7V
- Other I/O Pin Voltages ---------- −0.3V to 7V
- Power Dissipation, P_D @ T_A = 25°C
  SOT-23-6 ---------- 0.4W
- Package Thermal Resistance (Note 4)
  SOT-23-6, θ_{JA} ---------- 250°C/W
- Junction Temperature ---------- 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Storage Temperature Range ---------- −65°C to 150°C
- ESD Susceptibility (Note 2)
  HBM (Human Body Mode) ---------- 2kV
  MM (Machine Mode) ---------- 200V

Recommended Operating Conditions (Note 3)

- Supply Input Voltage ---------- 2.5V to 5.5V
- Enable Input Voltage ---------- 0V to 5.5V
- Junction Temperature Range ---------- −40°C to 125°C
- Ambient Temperature Range ---------- −40°C to 85°C

Electrical Characteristics

(V_{IN} = V_{OUT} + 1V, V_{EN} = V_{IN}, C_{IN} = C_{OUT} = 1μF, T_A = 25°C, unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Input Voltage		V_{IN} = 2.5V to 5.5V	2.5	--	5.5	V
Dropout Voltage (Note 5)	V_{DROP}	I_{OUT} = 300mA	--	240	330	mV
V_{OUT} Accuracy	ΔV	I_{OUT} = 10mA	-2	--	+2	%
Line Regulation	ΔV_{LINE}	V_{IN} = (V_{OUT} + 0.3V) to 5.5V or V_{IN} > 2.5V, whichever is larger	--	--	0.2	%/V
Load Regulation	ΔV_{LOAD}	1mA < I_{OUT}< 300mA	--	--	0.6	%
Current Limit		R_{LOAD} = 1Ω	330	450	700	mA
Quiescent Current	I_Q	V_{EN} > 1.5V	--	58	80	μA
Shutdown Current	I_{Q_SD}	V_{EN} < 0.4V	--	--	1	μA
EN Threshold	V_{IH}	V_{IN} = 2.5V to 5.5V, Power On	1.5	--	--	V
	V_{IL}	V_{IN} = 2.5V to 5.5V, Shutdown	--	--	0.4	

To be continued

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
V_{OUT} Discharge Resistance in Shutdown (Note 6)		V_{IN} = 5V, EN1 = EN2 = GND	--	3	--	kΩ
EN Pull Low Current	I_{EN}		--	0.2	--	μA
Thermal Shutdown	T_{SD}		--	170	--	°C
Thermal Shutdown Hysteresis	ΔT_{SD}		--	40	--	°C
PSRR V_{IN} = V_{OUT} + 1V, C_{OUT} = 2.2μF I_{LOAD} = 50mA	PSRR	f = 100Hz	--	70	--	dB
		f = 1kHz	--	70	--	
		f = 10kHz	--	50	--	
		f = 100kHz	--	40	--	
		f = 200kHz	--	35	--	
		f = 300kHz	--	35	--	
Output Voltage Noise		C_{OUT1} = C_{OUT2} = 10μF, 10Hz to 100kHz, I_{OUT1} = I_{OUT2} = 1mA	--	100	--	uVrms

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. The device is not guaranteed to function outside its operating conditions.

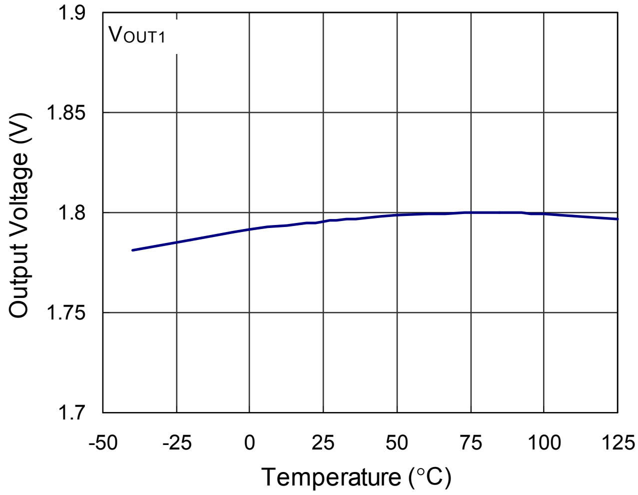
Note 4. θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

Note 5. The dropout voltage is defined as V_{IN} -V_{OUT}, which is measured when V_{OUT} is $V_{OUT(NORMAL)}$ – 100mV.

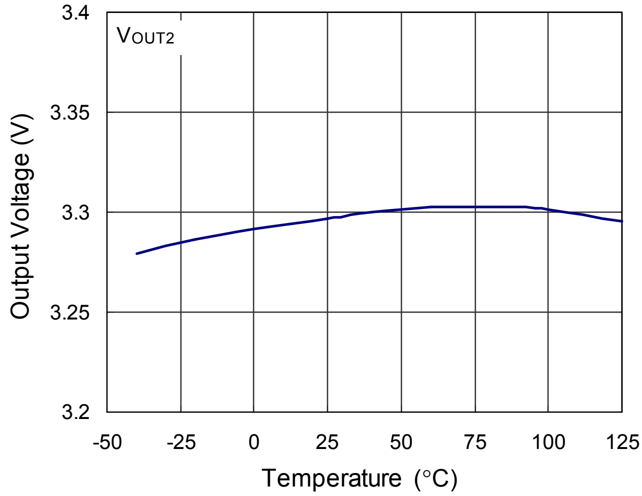
Note 6. It is guaranteed by design.

Typical Operating Characteristics

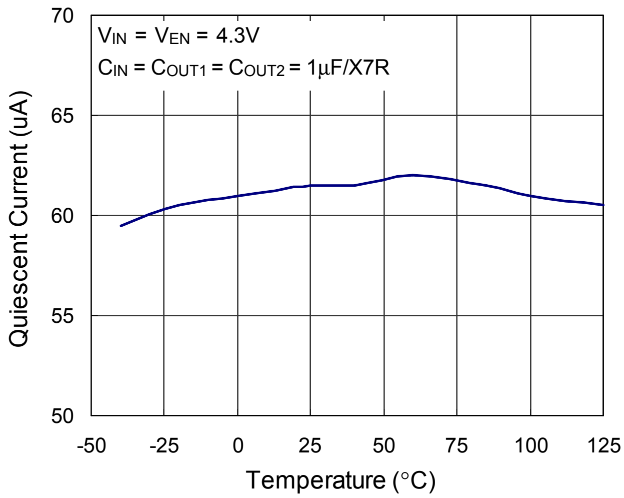
Output Voltage vs. Temperature



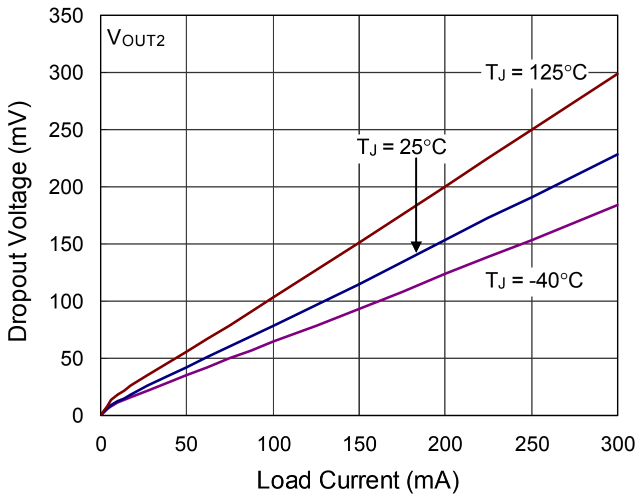
Output Voltage vs. Temperature



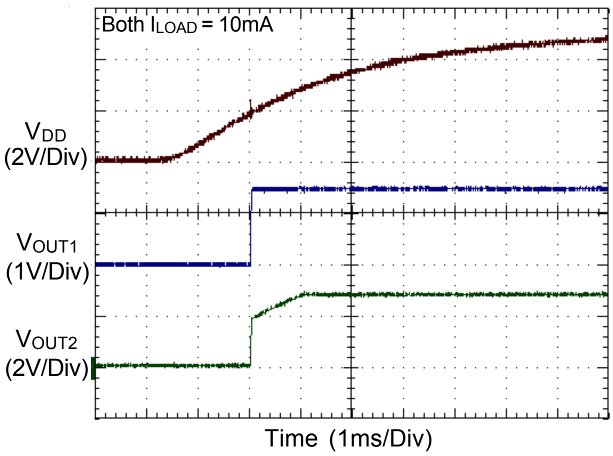
Quiescent Current vs. Temperature



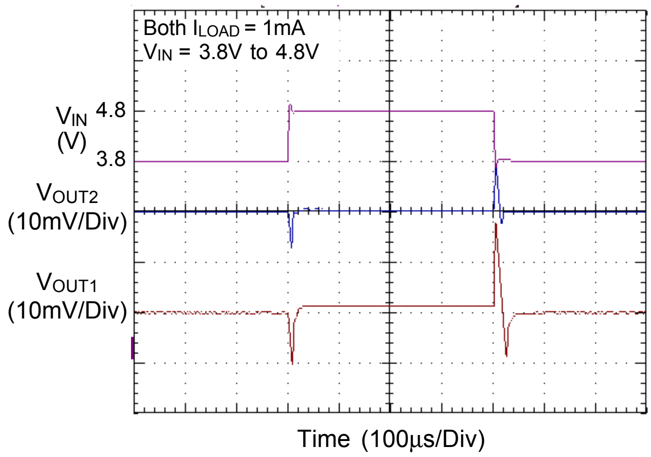
Dropout Voltage vs. Load Current



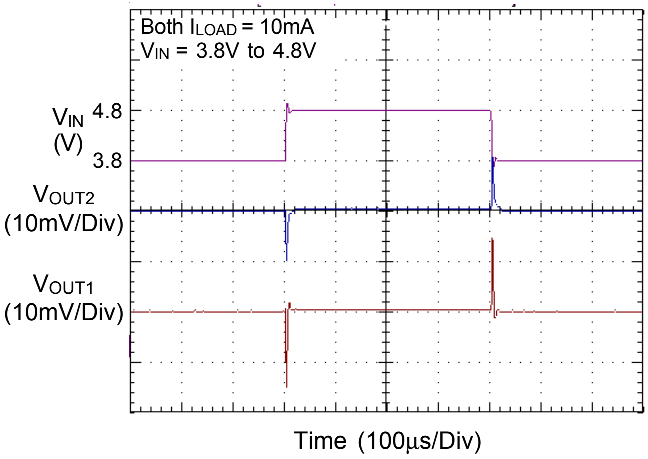
Power-On



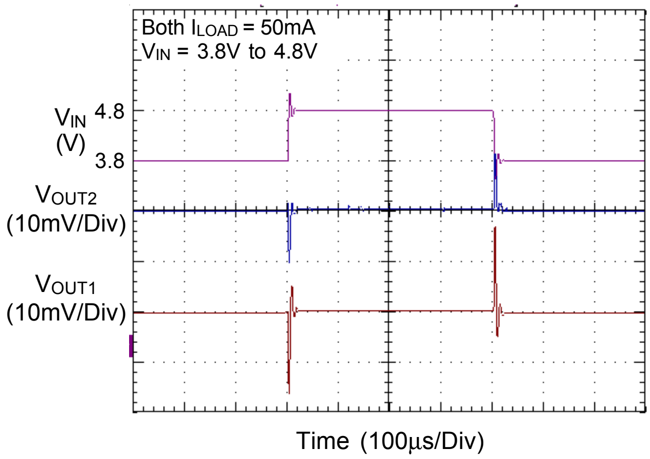
Line Transient Response



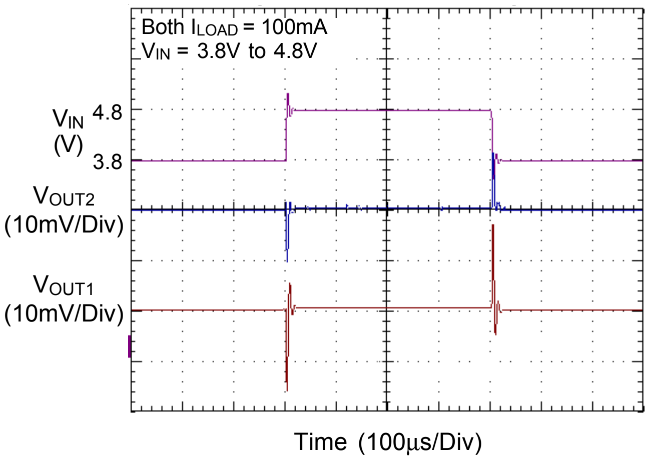
Line Transient Response



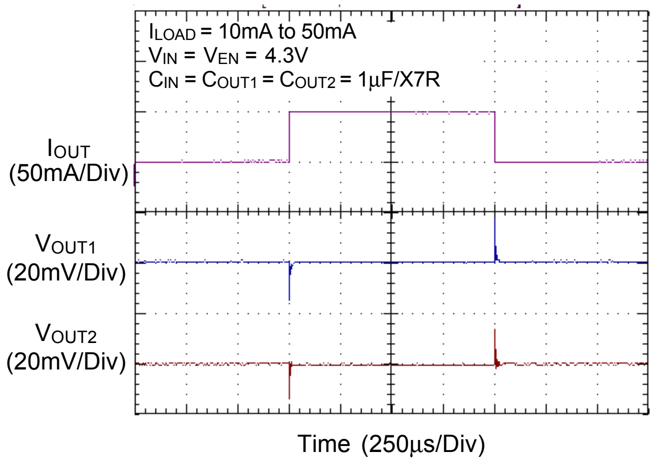
Line Transient Response



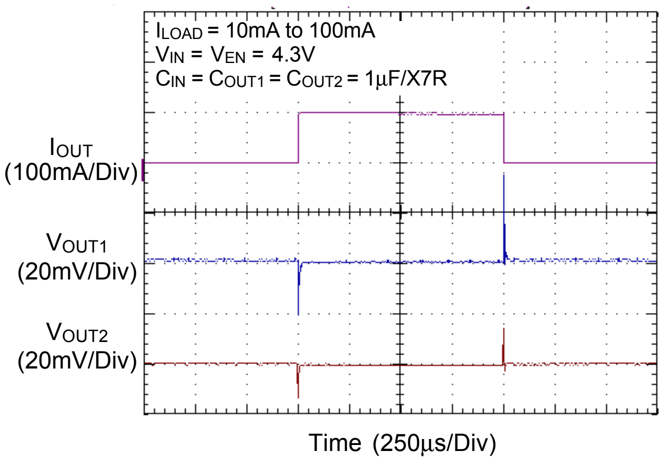
Line Transient Response



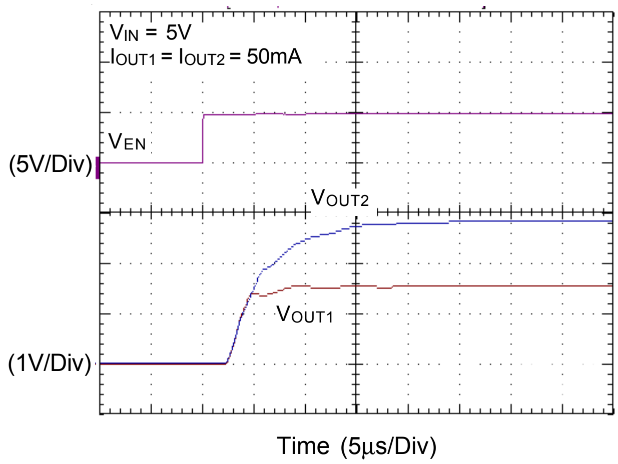
Load Transient Response



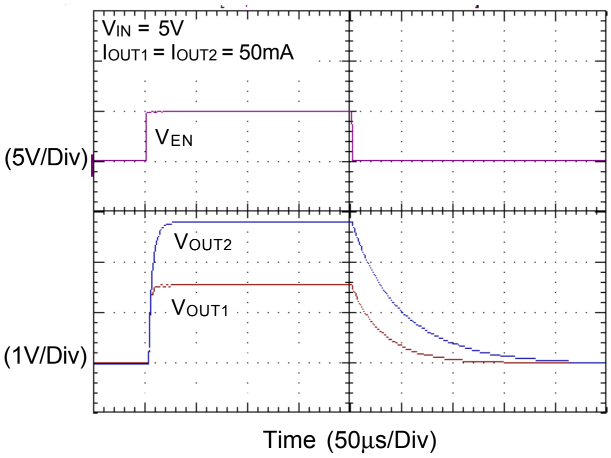
Load Transient Response



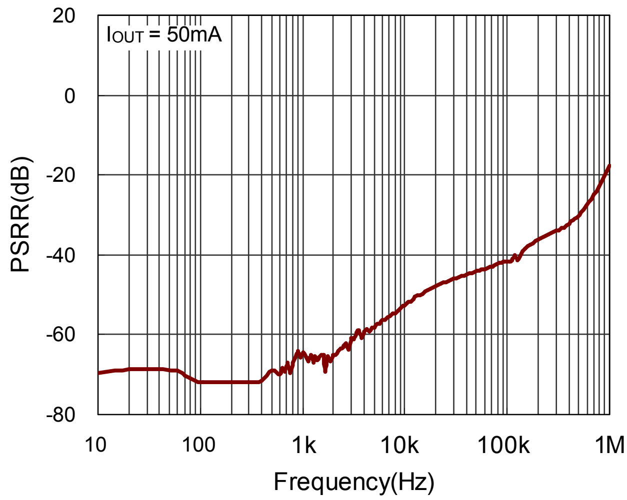
Start Up



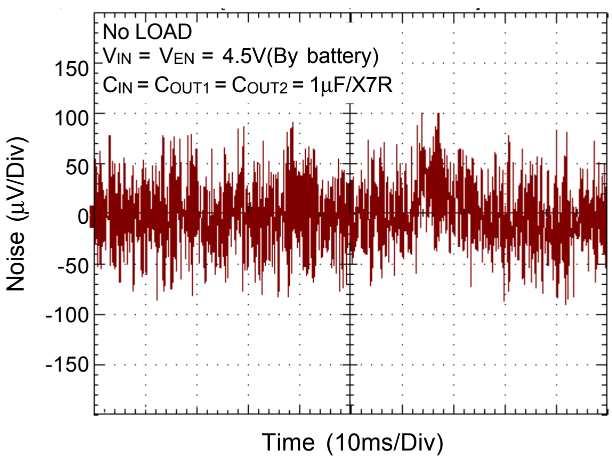
EN Pin Shutdown Response



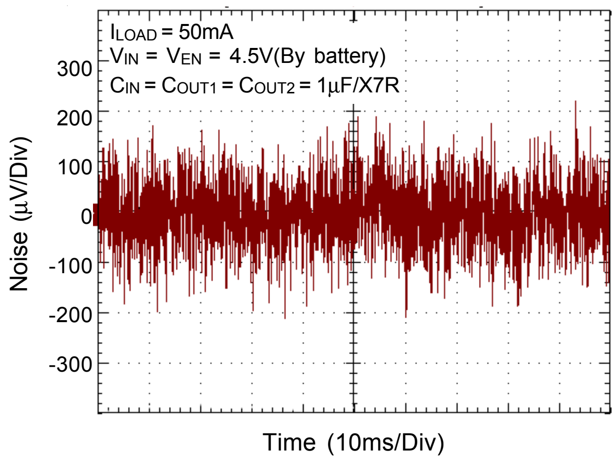
PSRR



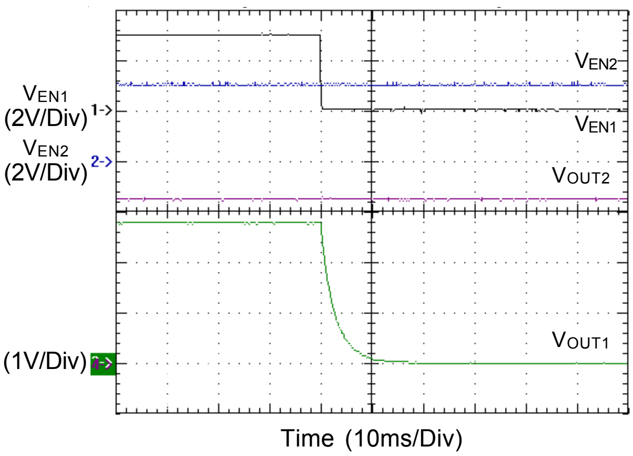
Noise



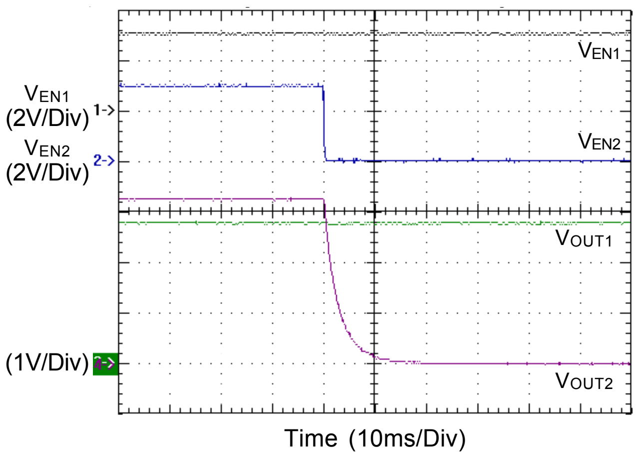
Noise



EN1 Pin Response



EN2 Pin Response



Applications Information

Like any low-dropout regulator, the external capacitors used with the RP1230 must be carefully selected for regulator stability and performance. Using a capacitor whose value is > 1μF on the RP1230 input and the amount of capacitance can be increased without limit. The input capacitor must be located a distance of not more than 0.5 inch from the input pin of the IC and returned to a clean analog ground. Any good quality ceramic or tantalum can be used for this capacitor. The capacitor with larger value and lower ESR (equivalent series resistance) provides better PSRR and line-transient response.

The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDOs application. The RP1230 is designed specifically to work with low ESR ceramic output capacitor in space-saving and performance consideration. Using a ceramic capacitor whose value is at least 2.2μF with ESR is > 20mΩ on the RP1230 output ensures stability. The RP1230 still works well with output capacitor of other types due to the wide stable ESR range. Figure 1 shows the curves of allowable ESR range as a function of load current for various output capacitor values. Output capacitor of larger capacitance can reduce noise and improve load transient response, stability, and PSRR. The output capacitor should be located not more than 0.5 inch from the VOUT pin of the RP1230 and returned to a clean analog ground.

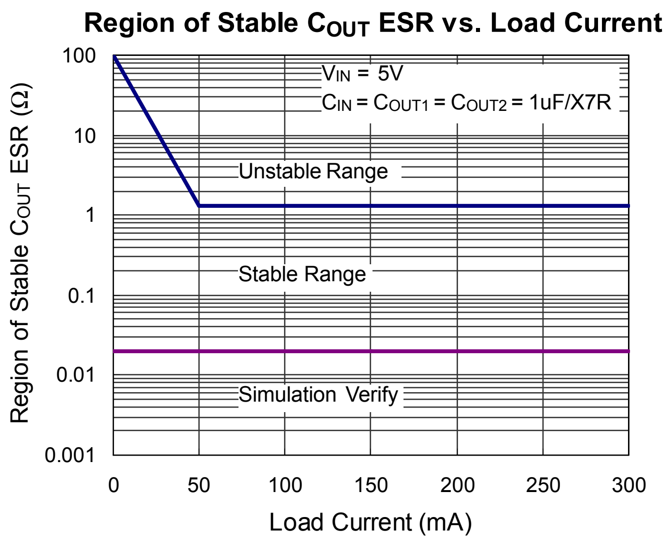


Figure 1. Stable Cout ESR Range

Thermal Considerations

Thermal protection limits power dissipation in RP1230. When the operation junction temperature exceeds 170°C, the OTP circuit starts the thermal shutdown function and turns the pass element off. The pass element turns on again after the junction temperature cools by 40°C. RP1230 lowers its OTP trip level from 170°C to 110°C when output short circuit occurs (V_{OUT} < 0.4V) as shown in Figure 2. It limits IC case temperature under 100°C and provides maximum safety to customer while output short circuit occurring.

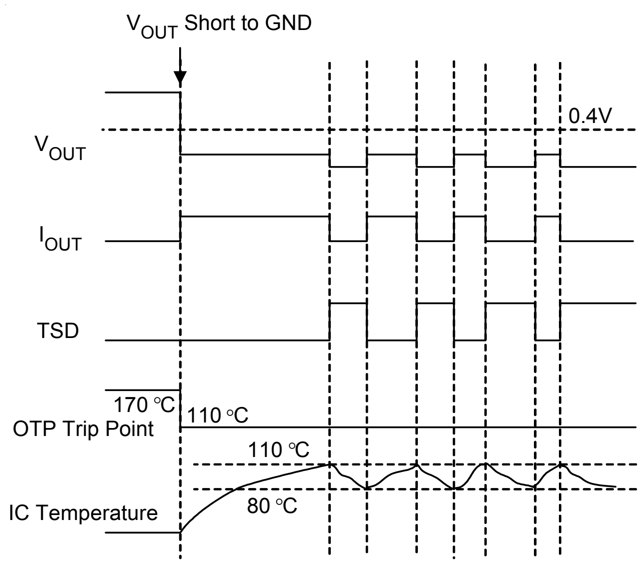


Figure 2. Short Circuit Thermal Folded Back Protection when Output Short Circuit Occurs (Patent)

For continuous operation, do not exceed absolute maximum operation junction temperature 125°C. The power dissipation definition in device is :

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_Q$$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula :

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

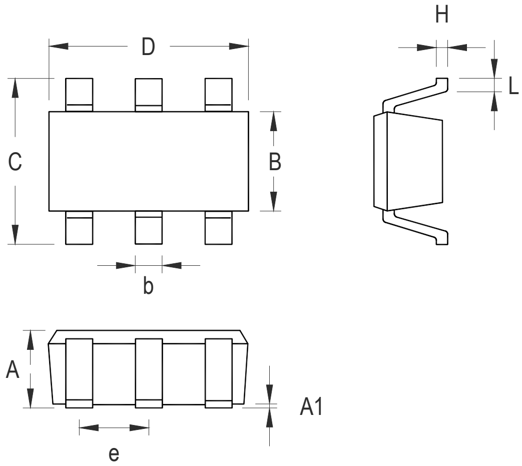
Where $T_{J(MAX)}$ is the maximum operation junction temperature, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance.

For recommended operating conditions specification of RP1230, the maximum junction temperature is 125°C. The junction to ambient thermal resistance (θ_{JA} is layout dependent) for SOT-23-6 is 250°C/W on the standard JEDEC 51-3 single-layer thermal test board. The maximum power dissipation at T_A = 25°C can be calculated by following formula :

$P_{D(MAX)}$ = (125°C − 25°C) / (250°C/W) = 0.4W for SOT-23-6 packages

The maximum power dissipation depends on operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance θ_{JA}.

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.031	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.250	0.560	0.010	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

SOT-23-6 Surface Mount Package

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