600mA Adjustable Output Voltage CMOS LDO Regulator

General Description

The RP1215 is designed for portable RF and wireless applicaiton with demanding performance and space requirements. The RP1215 performance is optimized for battery-powered systems to deliver low noise and low quiescent current. Regulator ground current increase only slightly in dropout, further prolonging the battery life. The RP1215 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, ciritical in hand-held wireless devices. The RP1215 has fast turn-on time typical 90us.The other features include ultra low dropout voltage, current limiting protection, and high ripple rejection ratio. Availabe in the 5-lead of SOT-23 package.

Features

- **Adjustable Output Voltage**
- **Ultra-Fast Response in Line/Load Transient**
- **Quick Start-Up (Typically 90μs)**
- **< 0.1μA Standby Current When Shutdown**
- **Low Dropout : 370mV @ 600mA**
- **Wide Operating Voltage Ranges : 2.5V to 5.5V**
- **TTL-Logic-Controlled Shutdown Input**
- **Low Temperature Coefficient**
- **Current Limiting Protection**
- **Thermal Shutdown Protection**
- **Only 1μF Output Capacitor Required for Stability**
- **High Power Supply Rejection Ratio**
- **RoHS Compliant and 100% Lead (Pb)-Free**

Ordering Information

RP1215□□□

Package Type
B : SOT-23-5

Operating Temperature Range
G : Green (Halogen Free with Comme-
-rcial Standard)

Output Voltage
A : High Enable without Discharge
B : High Enable with Discharge
C : Low Enable without Discharge
D : Low Enable with Discharge

Note :

Richpower Green products are :

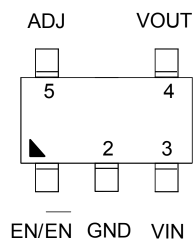
- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Applications

- Power source for battery-powered equipment
- Power source for cameras, camcorders, VCRs, PDAs, pagers, electronic data banks, and hand-held communication equipment
- Power source for appliances, which require higher voltage than that of batteries used in the appliances

Pin Configurations

(TOP VIEW)

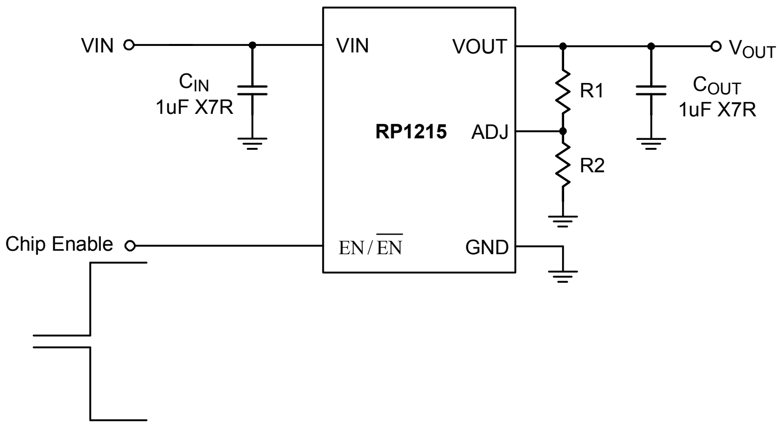


SOT-23-5

Marking Information

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

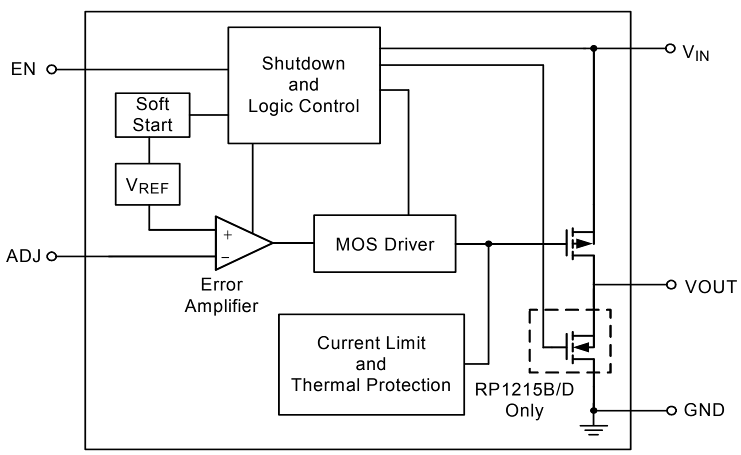
Typical Application Circuit



Functional Pin Description

Pin NO.	Pin Name	Pin Function
1	EN / $\overline{EN}$	Chip Enable (Active High/Low). Note that this pin is high impedance. There should be a pull low/high 100kΩ resistor connected to GND/VIN when the control signal is floating.
2	GND	Ground.
3	VIN	Power Input Voltage.
4	VOUT	Output Voltage.
5	ADJ	Adjust Output.

Function Block Diagram



Absolute Maximum Ratings (Note 1)

- Supply Voltage (V_{IN}) ---------- −0.3V to 6V
- Chip Enable Input Voltage (V_{EN}) ---------- −0.3V to 6V
- Output Voltage (V_{OUT}) ---------- −0.3V to V_{OUT} +0.3V
- Adjust Output (V_{ADJ}) ---------- −0.3V to V_{OUT} +0.3V
- Power Dissipation, P_D @ T_A = 25° C
  SOT-23-5 ---------- 0.4W
- Package Thermal Resistance (Note 4)
  SOT-23-5, θ_{JA} ---------- 250°C/W
- Operating Temperature Range ---------- −40°C to 85°C
- Storage Temperature Range ---------- −65°C to 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- ESD Susceptibility (Note 2)
  HBM (Human Body Mode) ---------- 2kV
  MM (Machine Mode) ---------- 200V

Recommended Operating Conditions (Note 3)

- Supply Voltage V_{IN} ---------- 2.4V to 5.5V
- Junction Temperature Range ---------- −40°C to 125°C

Electrical Characteristics

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		2.4	--	5.5	V
ADJ Reference Voltage	V_{ADJ}	V_{IN} = 5V, I_{OUT} = 100mA	0.788	0.8	0.812	V
Current Limit	I_{LIM}	R_{OUT} = 1Ω	650	--	--	mA
Quiescent Current	I_Q	I_{OUT} = 0mA	--	120	160	μA
Dropout Voltage	V_{DROP}	I_{OUT} = 300mA ,V_{OUT} > 2.8V	--	220	300	mV
		I_{OUT} = 600mA ,V_{OUT} > 2.8V	--	370	450	mV
Line Regulation	ΔV_{LINE}	V_{IN} = (V_{OUT} +1V) >2.8V I_{OUT} = 1mA	--	--	0.3	%
Load Regulation	ΔV_{LOAD}	1mA < I_{OUT} < 600mA	--	--	0.6	%
Standby Current	I_{STBY}	V_{EN} = GND or Shutdown	--	0.01	1	μA
EN Input Bias Current	I_{IBSD}	V_{EN} = GND or V_{IN}	--	0	100	nA
EN / $\overline{EN}$ Threshold	V_{IL}		--	--	0.4	V
	V_{IH}		1.2	--	--	V

To be continued

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Soft Start Time	T_{SS}	V_{OUT} Rising from 10% to 90%	60	90	120	μs
Under-Voltage Lockout	V_{UVLO}	V_{IN} Rising	2.0	2.2	2.4	V
Under-Voltage Lockout Hysteresis	ΔV_{UVLO}	V_{IN} Failing	--	0.2	–	V
Thermal Shutdown Temperature	T_{SD}		--	165	–	°C
Hysteresis	ΔT_{SD}		--	30	–	°C

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.

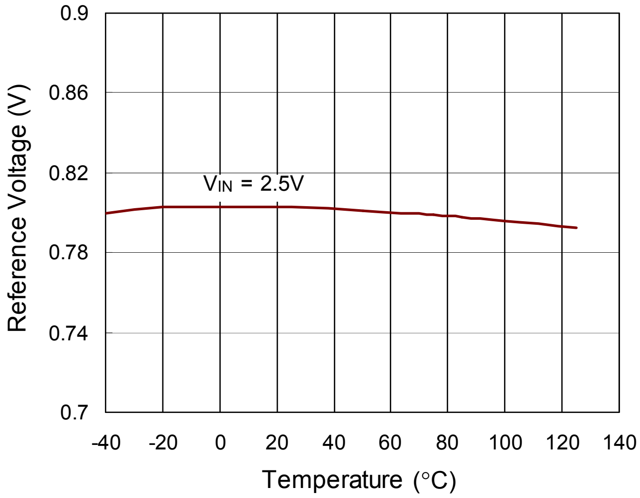
Note 2. Devices are ESD sensitive. Handling precaution recommended.

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

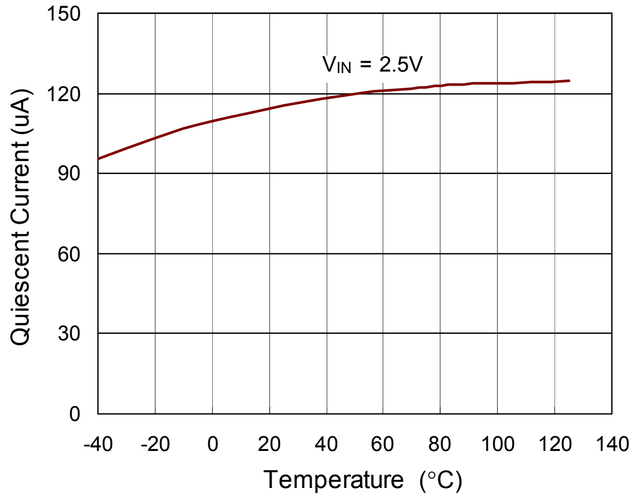
Note 4. θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective thermal conductivity test board (Single Layer, 1S) of JEDEC 51-3 thermal measurement standard.

Typical Operating Characteristics

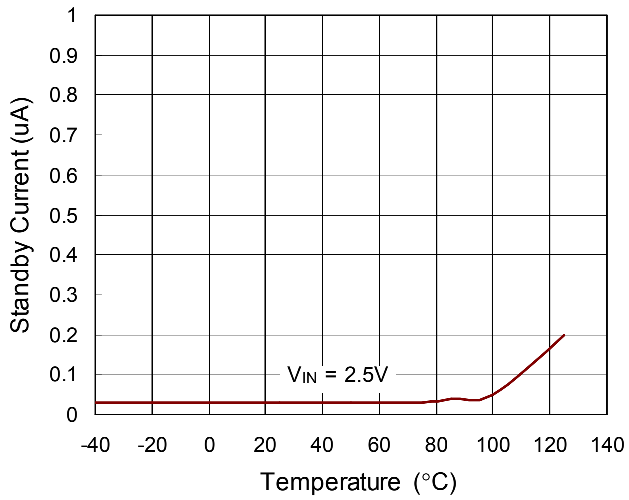
Reference Voltage vs. Temperature



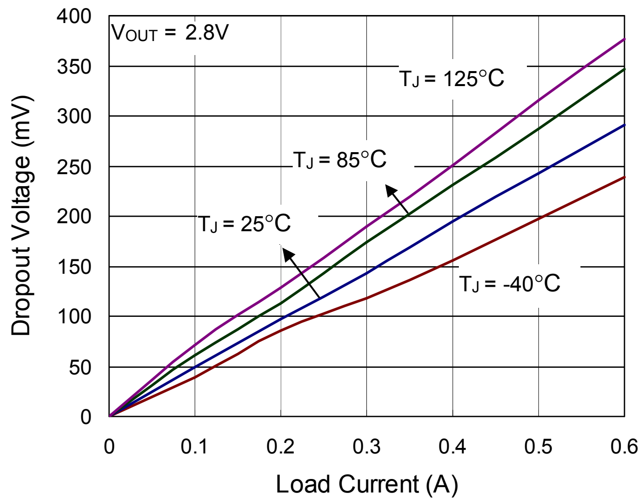
Quiescent Current vs. Temperature



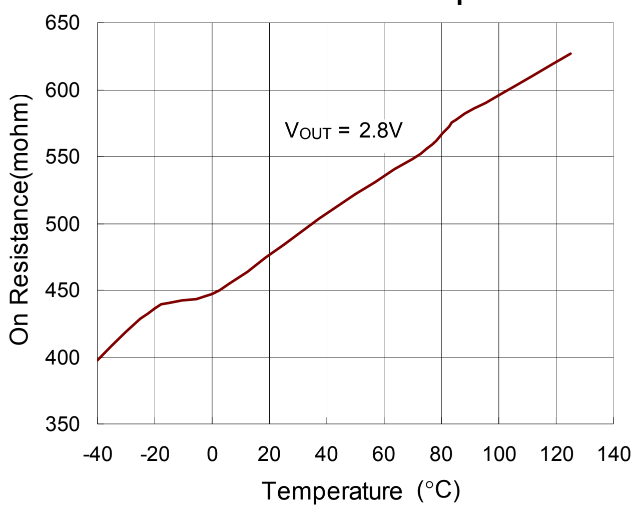
Standby Current vs. Temperature



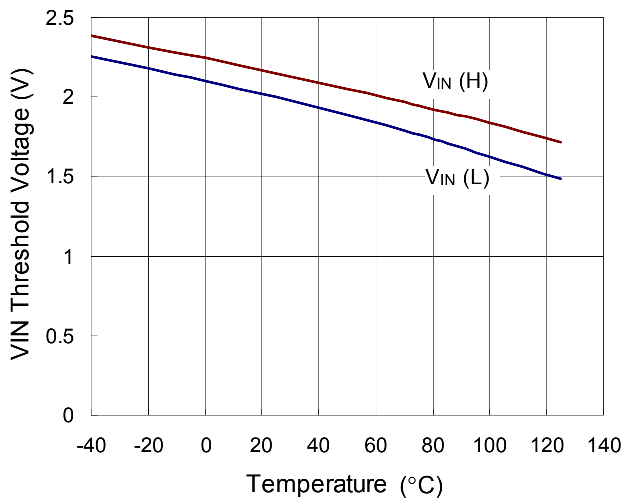
Dropout Voltage vs. Load Current

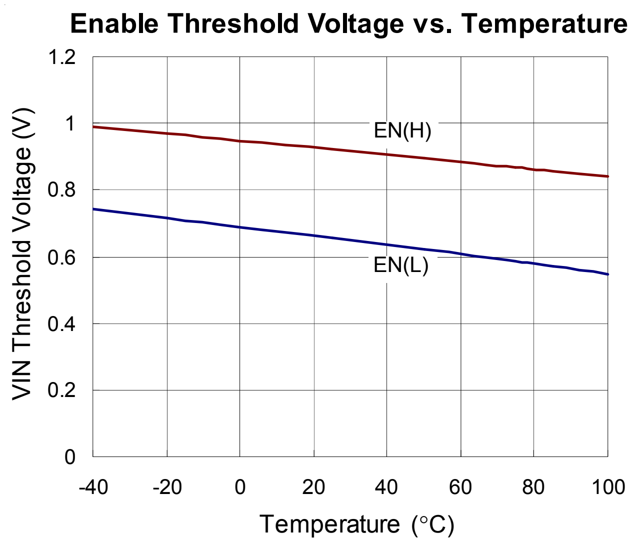


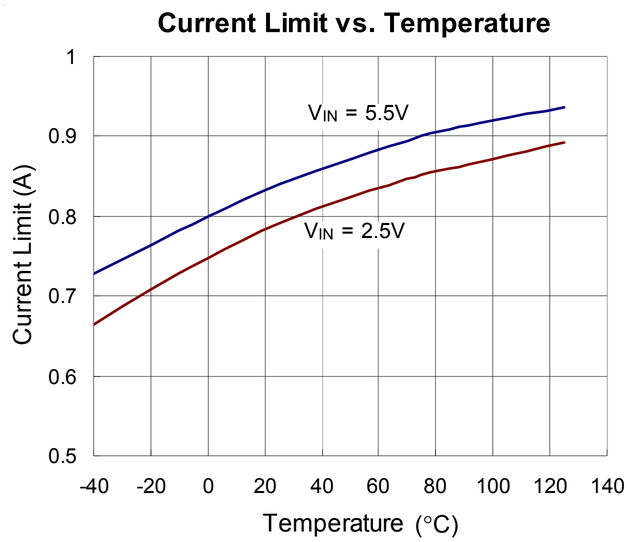
On Resistance vs. Temperature

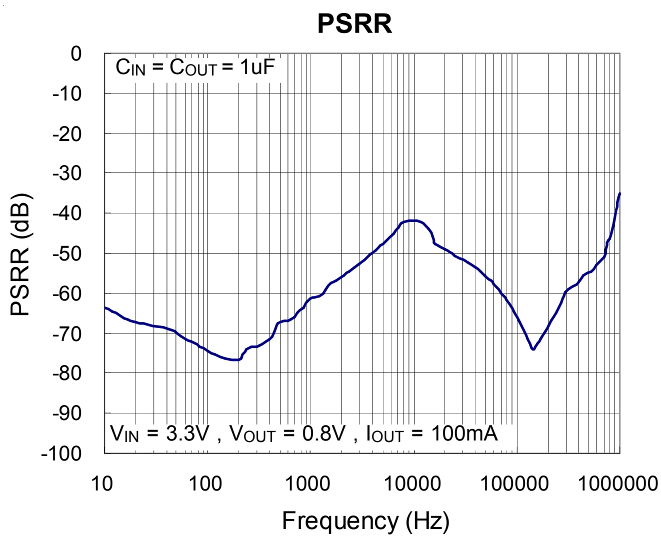


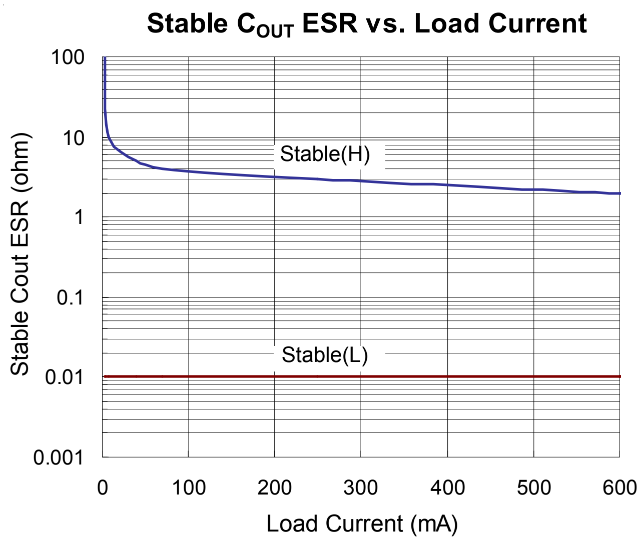
VIN Threshold Voltage vs. Temperature

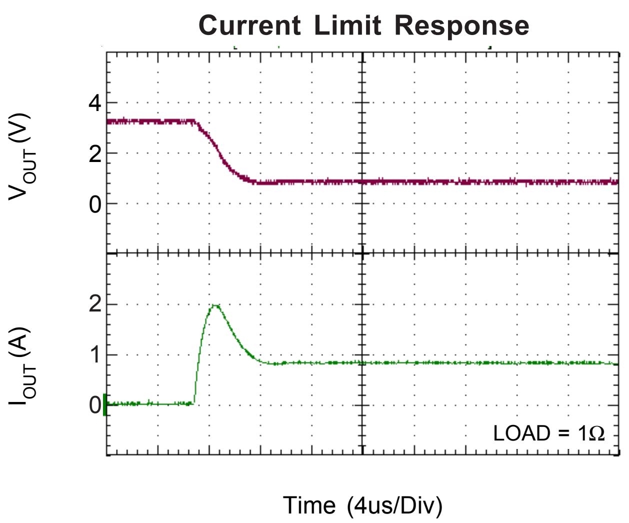


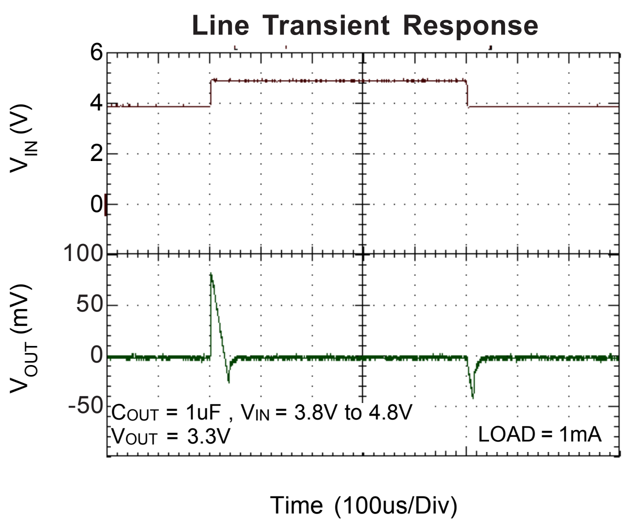

Enable Threshold Voltage vs. Temperature
VIN Threshold Voltage (V)
EN(H)
EN(L)
1.2
1
0.8
0.6
0.4
0.2
0
-40
-20
0
20
40
60
80
100
Temperature (°C)


Current Limit vs. Temperature
Current Limit (A)
VIN = 5.5V
VIN = 2.5V
1
0.9
0.8
0.7
0.6
0.5
-40
-20
0
20
40
60
80
100
120
140
Temperature (°C)

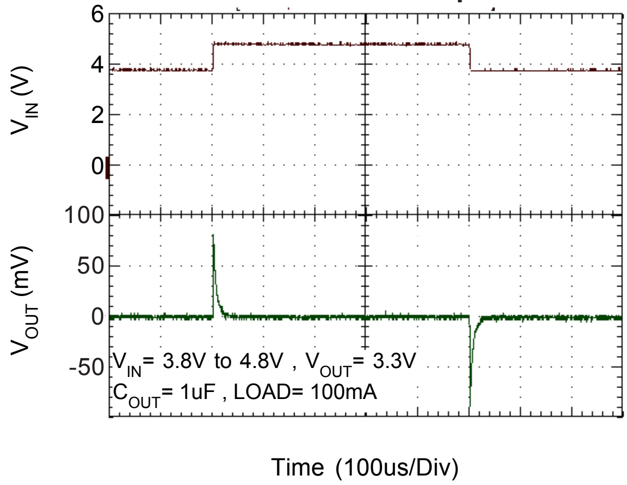

PSRR
PSRR (dB)
CIN = COUT = 1uF
VIN = 3.3V , VOUT = 0.8V , IOUT = 100mA
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
10
100
1000
10000
100000
1000000
Frequency (Hz)


Stable COUT ESR vs. Load Current
Stable Cout ESR (ohm)
Stable(H)
Stable(L)
100
10
1
0.1
0.01
0.001
0
100
200
300
400
500
600
Load Current (mA)

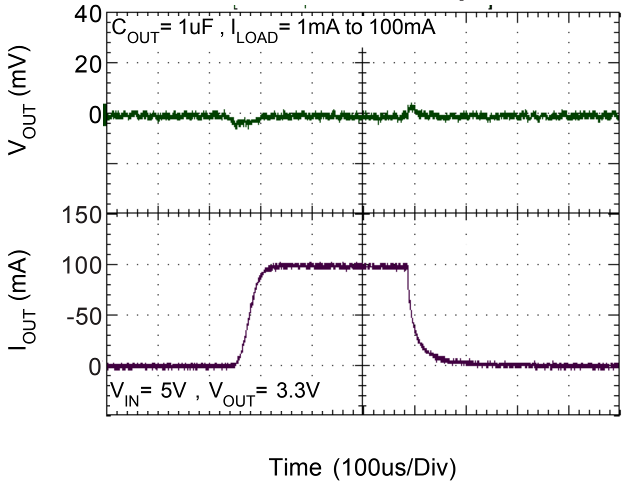

Current Limit Response
VOUT (V)
IOUT (A)
4
2
0
2
1
0
LOAD = 1Ω
Time (4us/Div)


Line Transient Response
VIN (V)
VOUT (mV)
6
4
2
0
100
50
0
-50
COUT = 1uF , VIN = 3.8V to 4.8V
VOUT = 3.3V
LOAD = 1mA
Time (100us/Div)

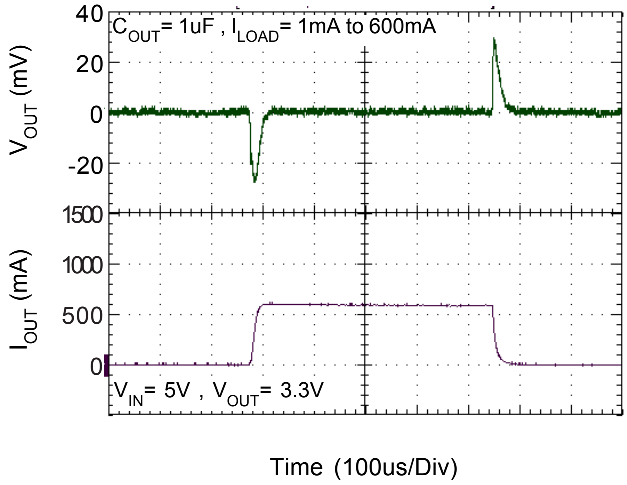
Line Transient Response



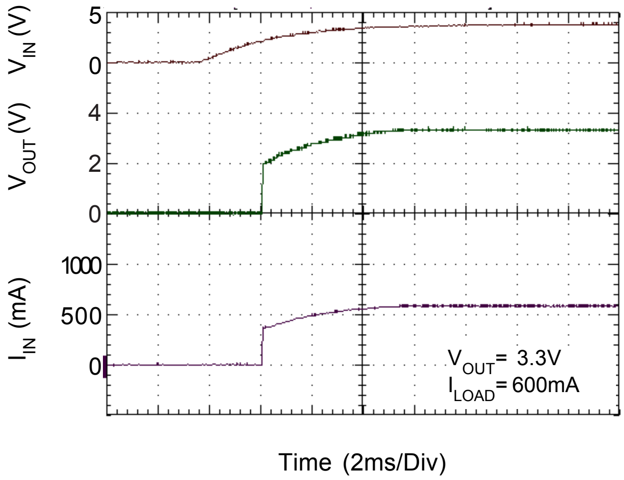
Load Transient Response



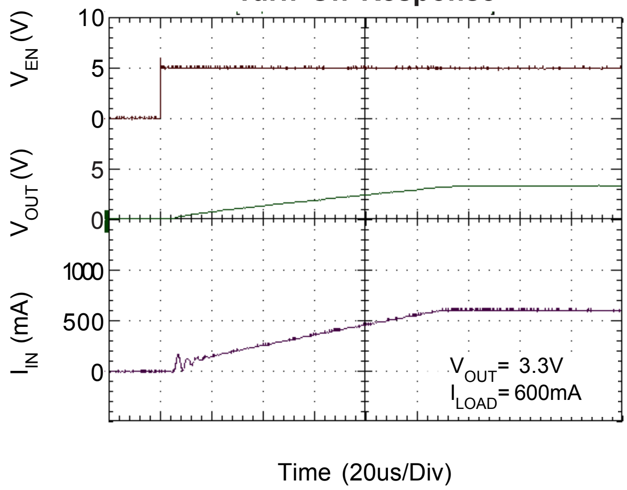
Load Transient Response



Power On Response



Turn On Response



Application Information

The RP1215 requires input and output decoupling capacitors. These capacitors must be correctly selected for good performance and insufficient decoupling capacitance may cause oscillation.

Input Capacitor

Use a capacitor with value >= 1µF on the RP1215 input and the amount of capacitance can be increased without limit. The input capacitor must be placed within 1cm from the device to assure input stability. There are no requirements for the ESR (equivalent series resistance) on the input capacitor, but low-ESR ceramic capacitor with larger value provides better PSRR and line transient response.

Output Capacitor

The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all applications. The recommended output capacitor type is ceramic capacitor (temperature characteristics X7R or X5R) and capacitance range is from 0.1µFto 10µF (typical 1µF) with ESR > 25mΩ for transient stability. However, in some application which low output voltage is required (lower than 1.8V), it is recommended that the maximum output capacitor is not larger than 2.2µF(As to ESR, please refer to Stable C_{OUT} ESR vs. Load Current).

Adjustable Output Voltage

The output voltage is set by the ratio of two external resistors as:

$$V_{OUT} = 0.8 \times (1 + \frac{R1}{R2})\text{Volts}$$

No Load Stability

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

Dropout Voltage

A LDO's minimum input-to-output voltage difference (dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the RP1215 uses a PMOS as pass element, its dropout voltage is a function of drain-to-source on-resistance, $R_{DS(ON)}$, multiplied by the load current :

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

Enable Function

The RP1215 features an enable/disable function. There are high-active and low-active options in this function. In high-active option, the enable control level must be greater than 1.2 volts to turn on the device. The LDO will be shut down when the voltage on the EN pin falls below 0.4 volts and reduces its quiescent current to less than 1µA. If the enable function is not needed in a specific application, it should be tied to VIN to keep the LDO in a continuous on state.

Current Limit

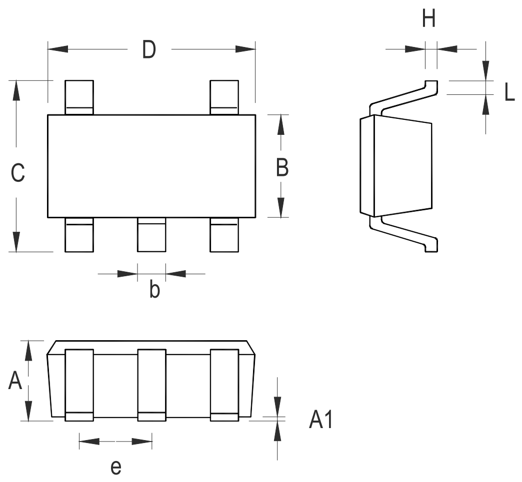
The RP1215 equips an over-current protection function to avoid large output current drain due to abnormalities. It monitors the output current and controls the PMOS' gate voltage, limiting the output current to minimum 650mA. The output can be shorted to ground for an indefinite period of time without damaging the part.

Over Temperature Protection

The RP1215 has an over-temperature protection function to limit the maximum power dissipation. When the operation junction temperature exceeds 165°C, the OTP circuit will turn off the pass element. The pass element turns on again after the junction temperature cools below 135°C. For continue operation, the junction temperature should not exceed absolute maximum operation junction temperature 125°C. The power dissipation definition in device is:

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

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.035	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.356	0.559	0.014	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-23-5 Surface Mount Package

RICHPOWER MICROELECTRONICS CORP.

Headquarter

Room 2102, 1077 ZuChongZhi Road, Zhang Jiang
Hi-TechPark, Pudong New Area, Shanghai, China

Tel: (8621)50277077 Fax: (8621)50276966