

POWER MANAGEMENT

Features

- Input Voltage Range from 1.6V to 6.0V
- 150mV Maximum Dropout @ 1A
- Adjustable Output from 0.5V with $\pm 1\%$ Accuracy
- 12 μ A Quiescent Current in Shutdown
- Enable Input
- 250 μ s Internal Soft-Start
- Over Current and Over Temperature Protection
- Reverse Blocking from Output to Input
- Full Industrial Temperature Range
- 3mm x 3mm x 1mm MLPD-8 Package
- Fully WEEE and RoHS Compliant

Applications

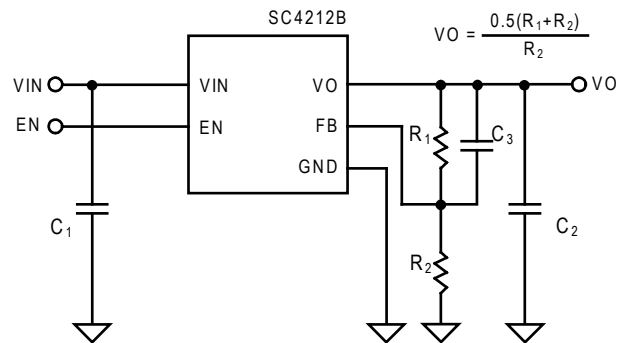
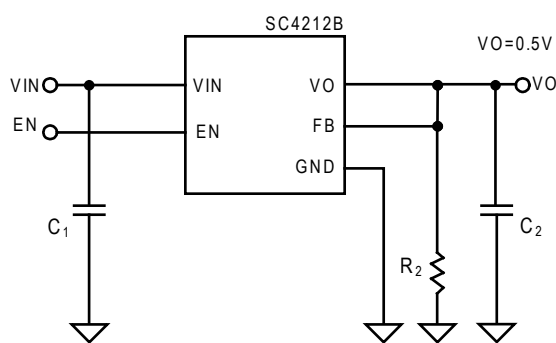
- Telecom and Networking Cards
- Motherboards and Peripheral Cards
- Industrial Applications
- Wireless Infrastructure
- Medical Equipment

Description

The SC4212B is a high performance linear voltage regulator designed for applications requiring very low dropout voltage at load currents up to 1 Ampere. It operates with VIN as low as 1.6V and up to 6V, making it useful for a wide range of different applications and rails. The output voltage is programmable down to 0.5V, set via an external resistor divider, or to a fixed setting of 0.5V depending upon how the FB pin is configured.

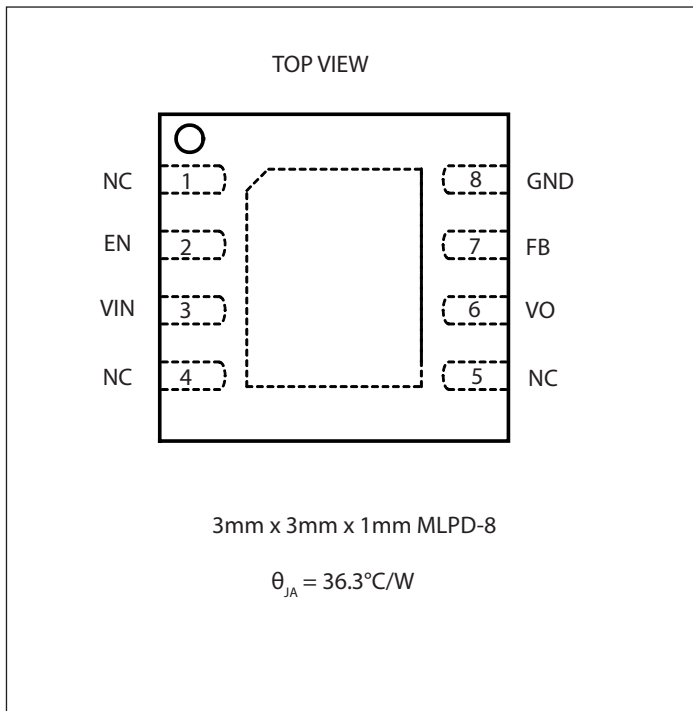
The SC4212B has an enable pin to further reduce power dissipation while shut down. Protection features include over current protection, over temperature protection and reverse blocking from output to input. The SC4212B is available in a 3mm x 3mm MLPD-8 package.

Typical Application Circuit



* C₃ is a placeholder

Pin Configuration



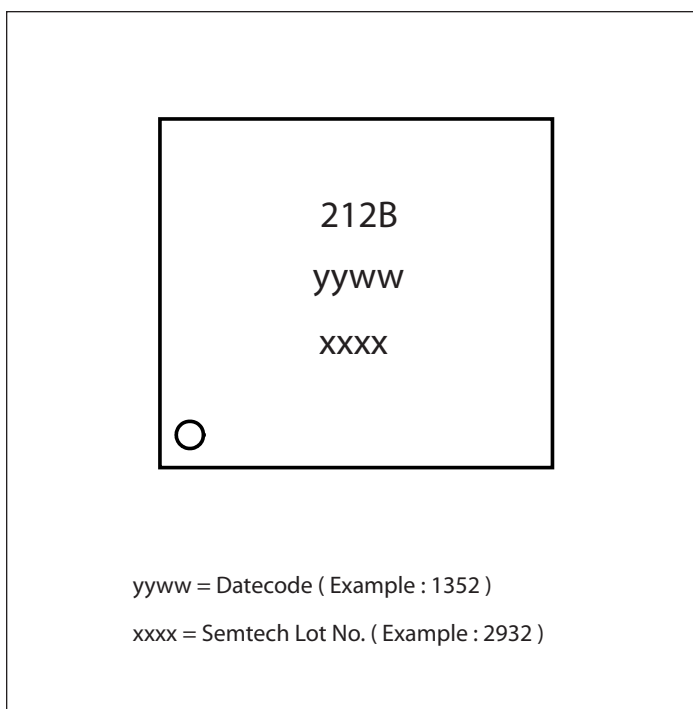
Ordering Information

| Device | Package |
|--------------------------------|------------------------|
| SC4212BMLTRC ⁽¹⁾⁽²⁾ | 3mm x 3mm x 1mm MLPD-8 |
| SC4212BEVB | Evaluation Board |

Notes:

- (1) Available in tape and reel only. A reel contains 3,000 devices.
- (2) Available in lead-free package only. Device is WEEE and RoHS compliant and halogen free.

Marking Information



Absolute Maximum Ratings

| | |
|--|-------------------------------|
| V _{IN} , V _O to GND (V) | -0.3 to 6.5 |
| EN to GND (V) | -0.3 to V _{IN} + 0.3 |
| FB to GND (V) | -0.3 to V _{IN} + 0.3 |
| Power Dissipation | Internally Limited |
| ESD Protection Level HBM ⁽¹⁾ (kV) | 4 |
| ESD Protection Level CDM ⁽²⁾ (kV) | 1 |

Recommended Operating Conditions

| | |
|---------------------------------------|----------------------------|
| V _{IN} (V) | $1.6 \leq V_{IN} \leq 6.0$ |
| Junction Temperature Range (°C) | $-40 \leq T_J \leq +125$ |
| Output Current Range | $50\mu A \leq I_O \leq 1A$ |

Thermal Information

| | |
|--|-------------|
| Thermal Resistance, Junction to Ambient ⁽³⁾ (°C/W) .. | 36.3 |
| Thermal Resistance, Junction to Case (°C/W) | 3.77 |
| Storage Temperature (°C) | -65 to +150 |
| Peak IR Reflow Temperature (10s to 30s) | +260 |

Exceeding the above specifications may result in permanent damage to the device or device malfunction. Operation outside of the parameters specified in the Electrical Characteristics section is not recommended.

NOTES:

- (1) Tested according to standard ANSI/ESDA/JEDEC JS-001-2012.
- (2) Tested according to standard JESD-C101E.
- (3) Calculated from package in still air, mounted to 3" x 4.5", 4 layer FR4 PCB with thermal vias under the exposed pad per JESD51 standards.

Electrical Characteristics

Unless noted otherwise T_J = 25° C for typical, -40° C ≤ T_J ≤ 125° C for min and max. V_{EN} = V_{IN'}, V_{FB} = V_{O'}, V_{IN} = 1.6V to 6.0V, C_{IN} = 10μF, C_{OUT} = 10μF.

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|--|-----------------|---|-------|-------|-------|-------|
| V_{IN} | | | | | | |
| V _{IN} operating range ⁽¹⁾ | | | 1.6 | | 6.0 | V |
| Quiescent current | I _Q | V _{IN} = 3.3V, I _O = 0A | | 325 | 680 | μA |
| | | I _O = 1A | | | 2 | mA |
| | | V _{EN} = 0V | | 12 | 50 | μA |
| Feedback | | | | | | |
| Feedback voltage ⁽²⁾ | V _{FB} | I _O = 10mA to 1A | 0.495 | 0.500 | 0.505 | V |
| Feedback pin current | I _{FB} | V _{FB} = V _{OUT} | | 80 | 200 | nA |
| V_O | | | | | | |
| Line regulation ⁽²⁾ | | I _O = 10mA | | 0.01 | 0.2 | %/V |
| Load regulation ⁽²⁾ | | I _O = 10mA to 1A | | 0.21 | 1.0 | % |

Electrical Characteristics (continued)

| Parameter | Symbol | Conditions | Min | Typ | Max | Units | |
|------------------------------------|------------|---|------------------------------|-----|-----|-------------|---------|
| Dropout voltage ⁽³⁾ | V_{DO} | $I_o = 0.5A$ | $1.6V \leq V_{IN} < 2.2V$ | | 86 | mV | |
| | | | $2.2V \leq V_{IN} \leq 6.0V$ | | 75 | | |
| | | $I_o = 1A$ | $1.6V \leq V_{IN} < 2.2V$ | | 175 | | |
| | | | $2.2V \leq V_{IN} \leq 6.0V$ | | 150 | | |
| Current limit | I_{CL} | | 1.2 | | 2.6 | A | |
| EN | | | | | | | |
| Enable pin current | I_{EN} | $V_{EN} = 0V, V_{IN} = 1.6V \text{ to } 6.0V$ | | | 1.5 | 10 | μA |
| | | $V_{EN} = V_{IN}$ | | | 80 | 200 | nA |
| Enable pin threshold | V_{IH} | $V_{IN} = 1.6V \text{ to } 6.0V$ | 1.2 | | | V | |
| | V_{IL} | | | | 0.4 | | |
| Over Temperature Protection | | | | | | | |
| High trip level | T_{HI} | | | 150 | | $^{\circ}C$ | |
| Hysteresis | T_{HYST} | | | 10 | | $^{\circ}C$ | |

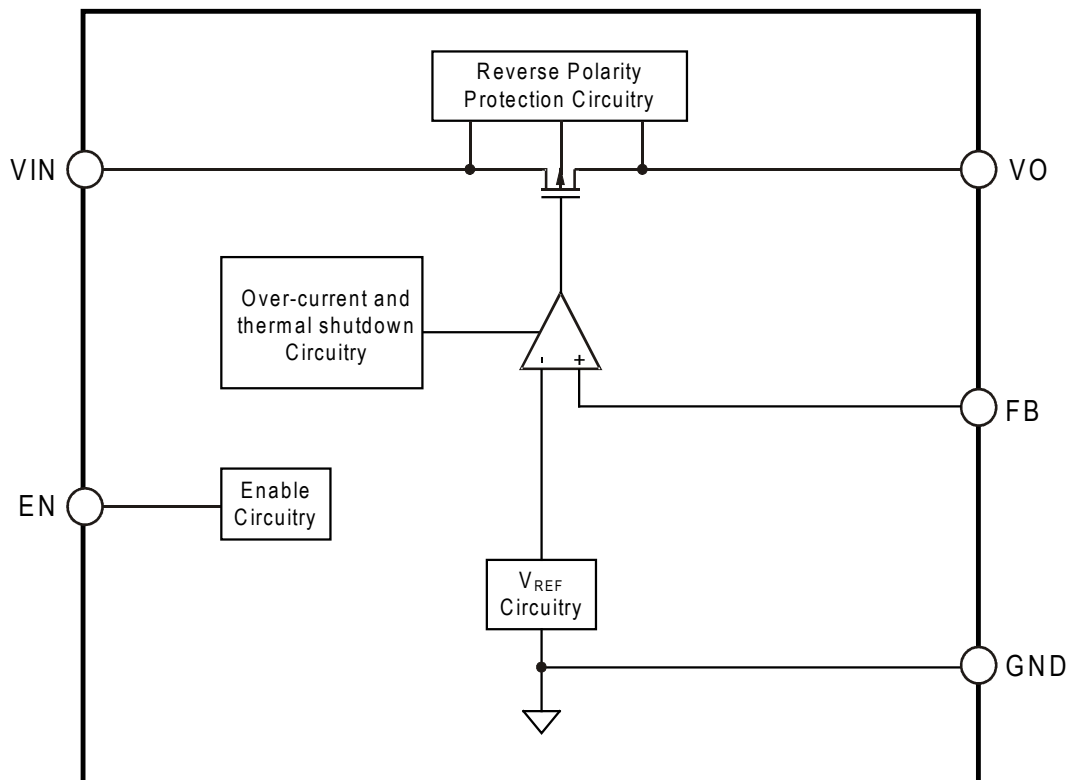
Notes:

- (1) Minimum $V_{IN} = V_{OUT} + V_{DO}$ or 1.6V, whichever is greater.
- (2) Low duty cycle pulse testing with Kelvin connections required.
- (3) $V_{DO} = V_{IN} - V_o$ when $V_{FB} = GND$.

Pin Descriptions

| Pin # | Pin Name | Pin Function |
|---------|-------------|---|
| 1, 4, 5 | NC | No connection. Do not connect to any node electrically. |
| 2 | EN | Enable input. Driving this pin high turns on the regulator. Driving this pin low shuts off the regulator. If not driven from a control circuit, tie this pin directly to the VIN pin, or via a resistor up to 400k Ω . |
| 3 | VIN | Input supply pin. A large bulk capacitance should be placed close to this pin to ensure that the input supply does not sag below the minimum V_{IN} . |
| 6 | VO | Regulator output pin. Refer to the Applications Information section for output capacitor selection. |
| 7 | FB | Input of the error amplifier. This pin is used to set the output voltage (See typical Application Circuits on page 1). |
| 8 | GND | Ground pin. |
| | THERMAL PAD | The exposed pad enhances thermal performance and is not electrically connected inside the package. It is recommended to connect the exposed pad to the ground plane using multiple vias. |

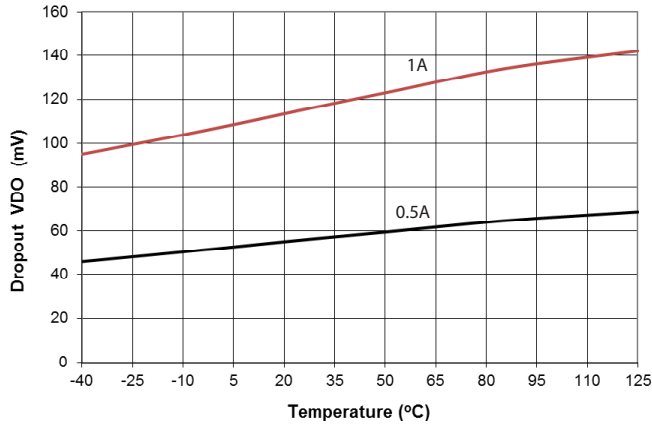
Block Diagram



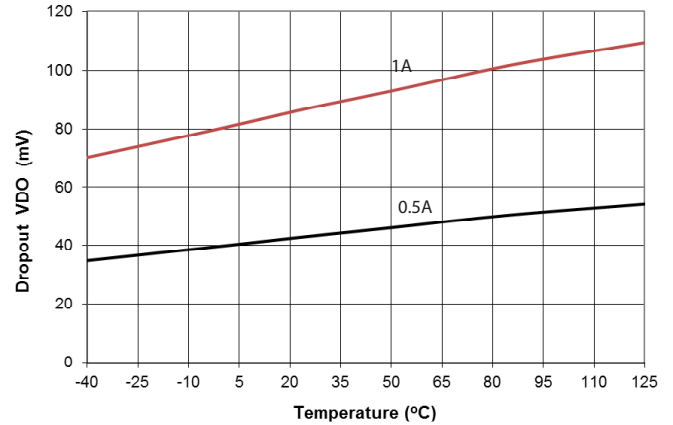
Typical Characteristics

Unless noted otherwise $C_{IN}=10\mu F/10V$ X7R 0805, $C_{OUT}=10\mu F/10V$ X7R 0805.

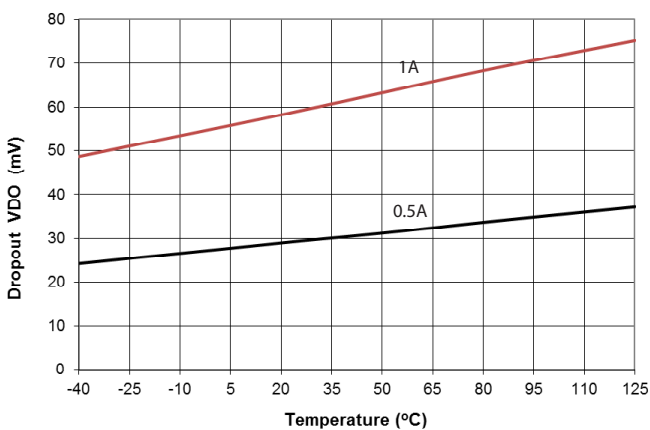
Dropout Voltage at $V_{in} = 1.6V$



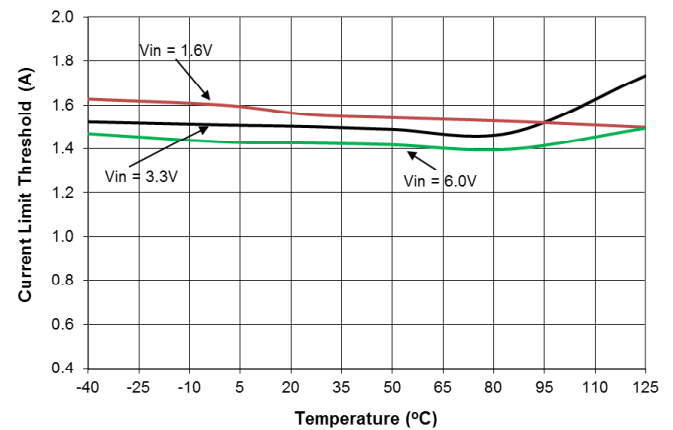
Dropout Voltage at $V_{in} = 2.2V$



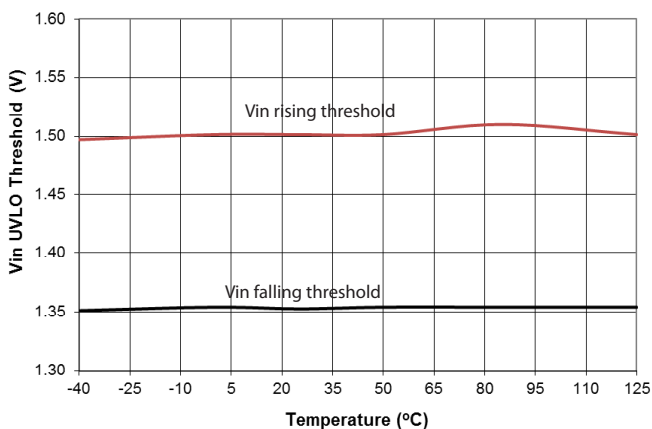
Dropout Voltage at $V_{in} = 6.0V$



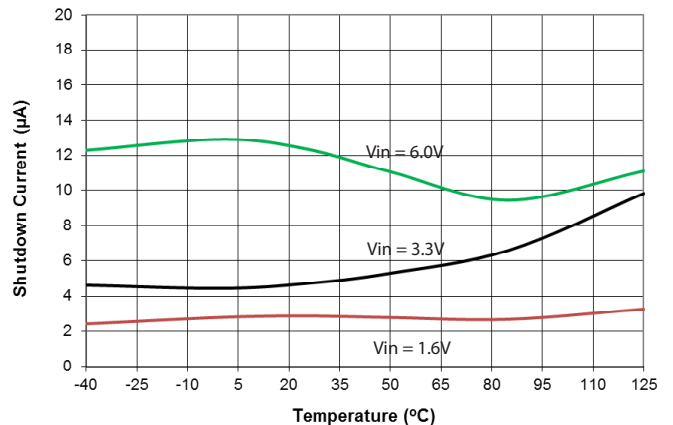
Current Limit Threshold



Input Under-voltage Lockout Threshold



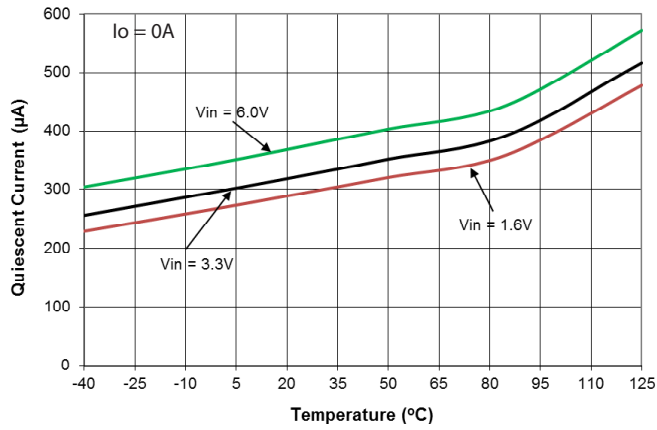
Shutdown Current



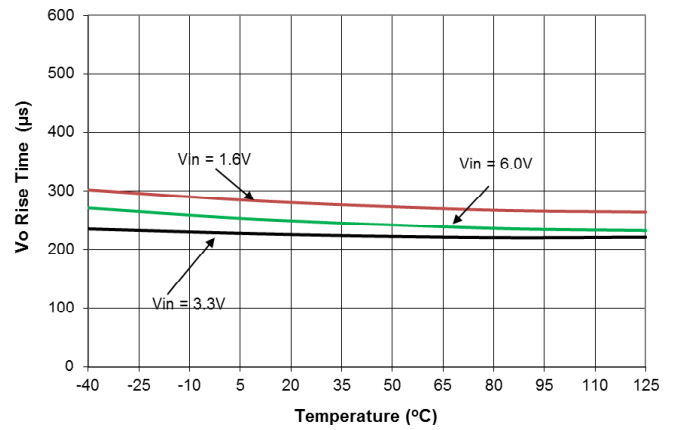
Typical Characteristics (Continued)

Unless noted otherwise $C_{IN}=10\mu\text{F}/10\text{V X7R 0805}$, $C_{OUT}=10\mu\text{F}/10\text{V X7R 0805}$.

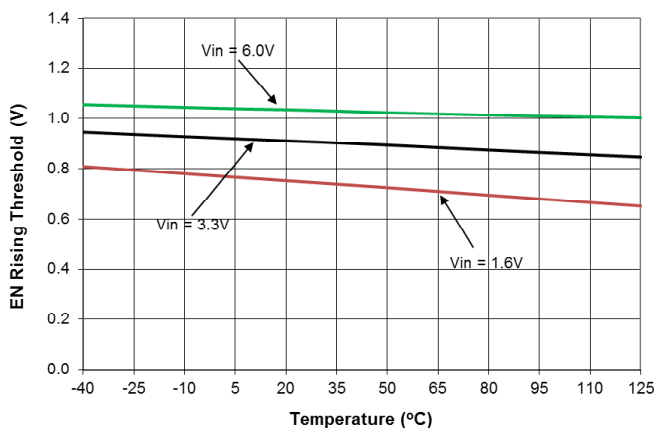
Quiescent Current



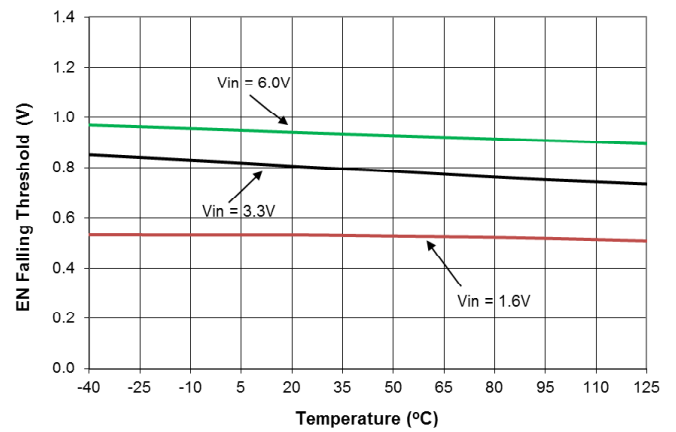
Output Rise Time



ENABLE Rising Threshold

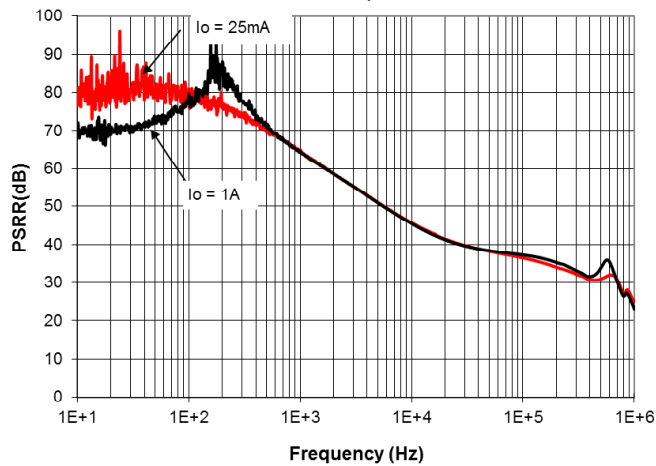


ENABLE Falling Threshold



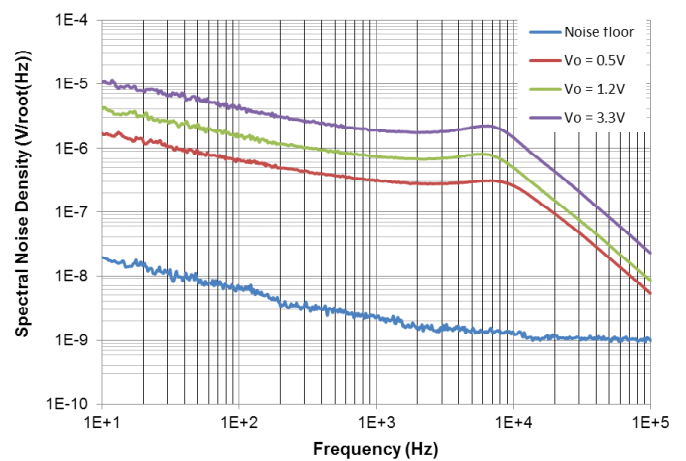
Power Supply Ripple Rejection

$V_{in} = 1.8\text{V}$, $V_o = 0.5\text{V}$



Output Spectral Noise Density

$R_L = 50\Omega$



Applications Information

Introduction

The SC4212B is intended for applications where high current capability and very low dropout voltage are required. It provides a very simple, low cost solution that uses very little PCB area. Additional features include an enable pin to allow for a very low power consumption in standby mode, and a fully adjustable output.

V_O Setting: $V_O = V_{REF}$

By connecting the FB pin directly to the VO pin, the output voltage will be regulated to the 0.5V internal reference. In this configuration, R2 should be 10kΩ.

V_O Setting with External Resistors

The use of 1% resistors, and designing for a current flow $\geq 50\mu\text{A}$ is recommended to ensure a well regulated output (thus $R_2 \leq 10\text{k}\Omega$). R_1 can then be calculated from

$$R_1 = R_2 (V_O - V_{REF}) / V_{REF}$$

Enable

Pulling this pin below 0.4V turns the regulator off, reducing the quiescent current to a fraction of its operating value. Driving this pin high enables the regulator. A pull up resistor $\leq 400\text{k}\Omega$ should be connected from this pin to the VIN pin in applications where the Enable pin is not driven from a control circuit.

Input Capacitor

A 10μF X5R or X7R ceramic capacitor, along with a 0.1μF ceramic decoupling capacitor is recommended to be placed directly next to the VIN pin. This allows for the device being some distance from the input source, reducing the input droop due to load transients and improving load transient response. Additional capacitance may be needed if large step, fast di/dt load transients are required or the LDO is located far away from the input source.

Output Capacitor

A 10μF or larger X5R or X7R ceramic capacitor, along with a 0.1μF ceramic decoupling capacitor is recommended.

Over-Current and Thermal Shutdown

The over-current protection and thermal shutdown functions protect the regulator against damage due to excessive power dissipation. The SC4212B is designed to current limit when the output current reaches 1.6A (typical). When the load exceeds 1.6A, the output voltage is reduced to maintain a constant current limit.

The thermal shutdown function limits the junction temperature to a maximum of 150°C (typical). Thermal shutdown turns off the regulator as the junction temperature reaches the high trip level of 150°C. When the junction temperature drops below 140°C (typical), the regulator is turned on once again.

Thermal Considerations

The power dissipation in the SC4212B is given by the following equation:

$$P_D \approx I_O (V_{IN} - V_O)$$

The allowable power dissipation will be dependant upon the thermal impedance achieved in the application. The derating curve below is valid for the thermal impedance specified in the Thermal Information section on page 3.

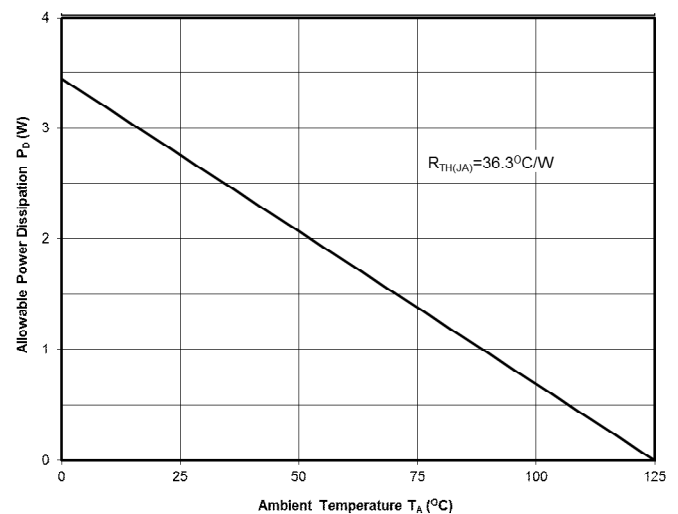
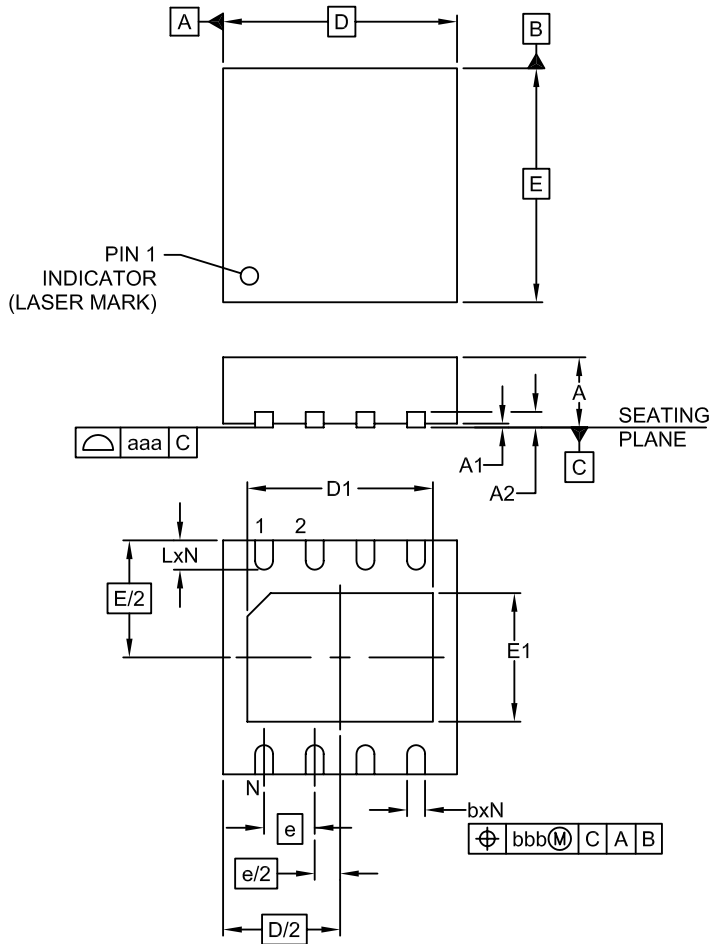


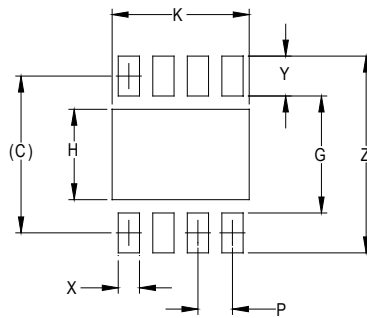
Figure 1. Power Derating Curve

Outline Drawing — 3mm x 3mm MLPD-8


| DIM | INCHES | | | MILLIMETERS | | |
|-----|----------|--------|------|-------------|--------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | .031 | .035 | .039 | 0.80 | 0.90 | 1.00 |
| A1 | .000 | .001 | .002 | 0.00 | 0.02 | 0.05 |
| A2 | - | (.008) | - | - | (0.20) | - |
| b | .010 | .012 | .014 | 0.25 | 0.30 | 0.35 |
| D | .114 | .118 | .122 | 2.90 | 3.00 | 3.10 |
| D1 | .085 | - | .098 | 2.15 | - | 2.48 |
| E | .114 | .118 | .122 | 2.90 | 3.00 | 3.10 |
| E1 | .053 | - | .069 | 1.35 | - | 1.75 |
| e | .026 BSC | | | 0.65 BSC | | |
| L | .012 | .016 | .020 | 0.30 | 0.40 | 0.50 |
| N | 8 | | | 8 | | |
| aaa | .003 | | | 0.08 | | |
| bbb | .004 | | | 0.10 | | |

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS TERMINALS.

Land Pattern — 3mm x 3mm MLPD-8


| DIMENSIONS | | |
|------------|--------|-------------|
| DIM | INCHES | MILLIMETERS |
| C | (.116) | (2.95) |
| G | .087 | 2.20 |
| H | .067 | 1.70 |
| K | .102 | 2.58 |
| P | .026 | 0.65 |
| X | .016 | 0.40 |
| Y | .030 | 0.75 |
| Z | .146 | 3.70 |

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.
3. THERMAL VIAS IN THE LAND PATTERN OF THE EXPOSED PAD SHALL BE CONNECTED TO A SYSTEM GROUND PLANE. FAILURE TO DO SO MAY COMPROMISE THE THERMAL AND/OR FUNCTIONAL PERFORMANCE OF THE DEVICE.

© Semtech 2015

All rights reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent or other industrial or intellectual property rights. Semtech assumes no responsibility or liability whatsoever for any failure or unexpected operation resulting from misuse, neglect improper installation, repair or improper handling or unusual physical or electrical stress including, but not limited to, exposure to parameters beyond the specified maximum ratings or operation outside the specified range.

SEMTECH PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF SEMTECH PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE UNDERTAKEN SOLELY AT THE CUSTOMER'S OWN RISK. Should a customer purchase or use Semtech products for any such unauthorized application, the customer shall indemnify and hold Semtech and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs damages and attorney fees which could arise.

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

Contact Information

Semtech Corporation
Power Management Products Division
200 Flynn Road, Camarillo, CA 93012
Phone: (805) 498-2111 Fax: (805) 498-3804

www.semtech.com