

## 500mA 20V Low-Noise LDO Regulator

### Features

- Input Voltage Range: 2.5V to 20V
- Output Voltage Range:
  - Adjustable Operation: 1.2V to 18V
  - Fixed Operation: 1.8V, 2.5V, 3.0V, 3.3V, 5.0V
- Maximum output current: 500mA
- Low Dropout Voltage: 270mV at 500mA
- Low Noise When Using External Bypass Cap
- Low Quiescent Current
- Output Voltage Accuracy: 2%
- Excellent Load and Line Transient Responses
- Thermal Shutdown and Over-Current Protection
- Stable with 1 $\mu$ F or Larger Ceramic Capacitor
- Operating Junction Temperature: -40°C to +125°C
- Available package: SOT23-5

### Description

The device is an efficient linear voltage regulator with 500mA output current capability, very low dropout voltage, and better than 2% output voltage accuracy over line, load and temperature. Dropout voltage is 270mV at full load of 500mA.

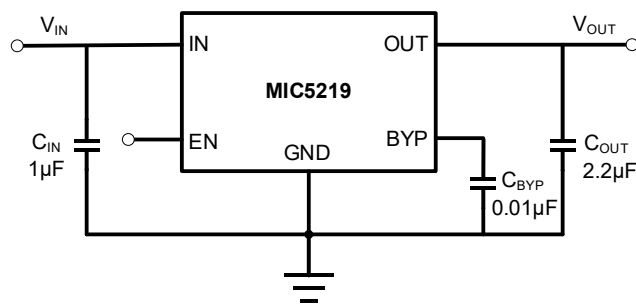
The device is available in adjustable or fixed output voltages in the space-saving SOT23-5 package.

The device also features short-circuit current limit and thermal shutdown protection, as well as automatic discharge function to quickly discharge  $V_{OUT}$  in the disabled states.

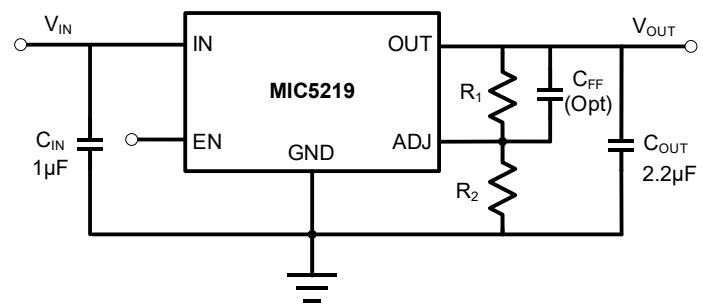
### Applications

- Laptop, Notebook, and Palmtop Computers
- Cellular Telephones and Battery-Powered Equipment
- Consumer and Personal Electronics
- SMPS Post-Regulation/DC-to-DC Modules
- High-Efficiency Linear Power Supplies

### Typical Application Circuits

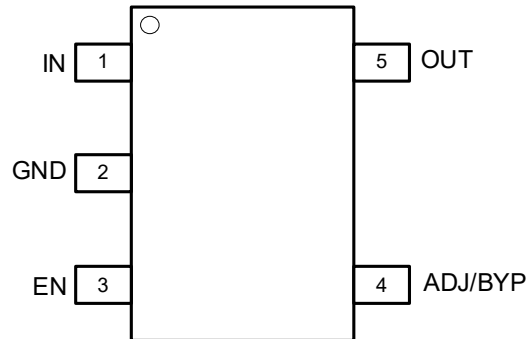


Fixed Output Voltage



Adjustable Output Voltage

## Pin Configuration and Functions



**5-Pin SOT-23 (Top View)**

## Pin Descriptions

| PIN Number | PIN Name | I/O | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------|----------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | IN       | I   | Input supply voltage pin. It is recommended to use a 1 $\mu$ F or larger ceramic capacitor from IN pin to ground to get a good power supply decoupling.                                                                                                                                                                                                                                                                                                           |
| 2          | GND      | -   | Ground.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3          | EN       | I   | Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator.                                                                                                                                                                                                                                                                                                                                                                       |
| 4          | ADJ/BYP  | I   | For adjustable voltage version this is feedback voltage input pin. Connect this pin to the midpoint of an external resistor divider to adjust the output voltage. Place the resistors as close as possible to this pin. For fixed voltage version this is reference bypass pin. Connect an external 10nF capacitor from this pin to ground can reduce the output to a very low noise level. This pin can be left open if low noise at the output is not required. |
| 5          | OUT      | O   | Regulator output voltage pin. A 2.2 $\mu$ F or larger ceramic capacitor from OUT to ground is required to ensure regulator stability. The capacitor should be placed as close to the output as possible. Minimize the impedance from the OUT pin to the load.                                                                                                                                                                                                     |

## Ordering Information

| DEVICE            | PACKAGE TYPE | MARKING      | OUTPUT VOLTAGE | PACKING OPTION      |
|-------------------|--------------|--------------|----------------|---------------------|
| MIC5219-1.8YM5-TR | SOT23-5      | <u>LG</u> 18 | 1.8V           | Tape and Reel, 3000 |
| MIC5219-2.5YM5-TR | SOT23-5      | <u>LG</u> 25 | 2.5V           | Tape and Reel, 3000 |

|                   |         |              |      |                     |
|-------------------|---------|--------------|------|---------------------|
| MIC5219-3.0YM5-TR | SOT23-5 | <u>LG</u> 30 | 3.0V | Tape and Reel, 3000 |
| MIC5219-3.3YM5-TR | SOT23-5 | <u>LG</u> 33 | 3.3V | Tape and Reel, 3000 |
| MIC5219-5.0YM5-TR | SOT23-5 | <u>LG</u> 50 | 5.0V | Tape and Reel, 3000 |
| MIC5219YM5-TR     | SOT23-5 | <u>LG</u> AA | ADJ  | Tape and Reel, 3000 |

## Electrical Specifications

### Absolute Maximum Ratings

| Parameter                 | Symbol           | Value       | Unit |
|---------------------------|------------------|-------------|------|
| IN, OUT and EN Pins       | IN, OUT and EN   | -0.3 to 22  | V    |
| ADJ Pin                   | ADJ/BYP          | -0.3 to +6  | V    |
| Storage temperature range | T <sub>STG</sub> | -65 to +150 | °C   |
| Output current            | I <sub>OUT</sub> | 500         | mA   |

#### Notes:

1. Exposure of the device under conditions beyond the limits specified by Maximum Ratings for extended periods may cause permanent damage to the device and affect product reliability. These conditions represent a stress rating only, and functional operations of the device at these or any other conditions above the operational limits noted in this specification is not implied.

### ESD Ratings

|                  |                         | Value                     | Unit |
|------------------|-------------------------|---------------------------|------|
| V <sub>ESD</sub> | Electrostatic Discharge | HBM (Human Body Model)    | 3000 |
|                  |                         | CDM (Charge Device Model) | 1000 |

### Recommended Operation Conditions

Over operating temperature range unless otherwise noted

| Parameter                      | Symbol           | Min | Max | Unit |
|--------------------------------|------------------|-----|-----|------|
| Input Supply Voltage           | V <sub>IN</sub>  | 2.5 | 20  | V    |
| Enable Input Voltage           | EN               | 0   | 20  | V    |
| Output Voltage                 | V <sub>OUT</sub> | 1.2 | 18  | V    |
| Adjustable/Bypass Pin Voltage  | ADJ/BYP          | 0   | 5   | V    |
| Output Capacitance             | C <sub>OUT</sub> | 1   | 47  | μF   |
| Output Current                 | I <sub>OUT</sub> | 0   | 500 | mA   |
| Operating Junction Temperature | T <sub>J</sub>   | -40 | 125 | °C   |

### Thermal Information

| Package | R <sub>θJA</sub> | Unit |
|---------|------------------|------|
| SOT23-5 | 195              | °C/W |

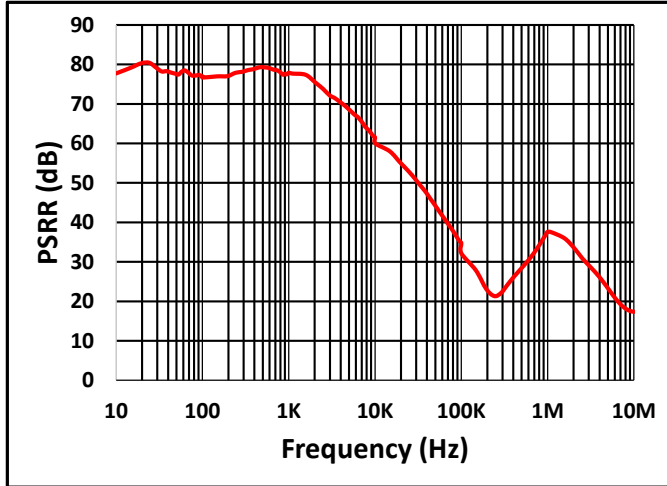
**Electrical Characteristics**

$V_{IN} = 2.5V$  or  $V_{IN} = V_{OUT} + 1V$  (whichever is greater),  $I_{OUT} = 1mA$ ,  $C_{OUT} = 2.2\mu F$ , typical values are at  $T_A = 25^\circ C$  unless otherwise noted

| Parameter                                        | Symbol                                            | Test Conditions                                                                                        | Min  | Typ  | Max | Unit          |
|--------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------|------|------|-----|---------------|
| Input Voltage                                    | $V_{IN}$                                          |                                                                                                        | 2.5  | -    | 20  | V             |
| Reference Voltage                                | $V_{REF}$                                         |                                                                                                        |      | 1.2  |     | V             |
| Output Voltage Accuracy                          |                                                   | $0.1mA \leq I_{OUT} \leq 500mA$                                                                        | -2.0 | 0    | 2.0 | %             |
| GND Pin Current                                  | $I_{GND}$                                         | $V_{IN} = 2.5V$ , No Load                                                                              |      | 69   |     | $\mu A$       |
|                                                  |                                                   | $V_{IN} = 2.5V$ , $I_{OUT} = 500mA$                                                                    |      | 185  |     | $\mu A$       |
| Shutdown Current                                 | $I_{SHDN}$                                        | $V_{IN} = 2.5V$ , $V_{EN} = 0V$                                                                        |      | 2.3  |     | $\mu A$       |
| Dropout Voltage                                  | $V_{DO}$                                          | $V_{OUT} = 3.3V$ , $I_{OUT} = 500mA$                                                                   |      | 270  |     | mV            |
| Output Current Limit                             | $I_{LIM}$                                         | $V_{OUT} = 0V$                                                                                         | 500  |      |     | mA            |
| Line Regulation                                  | $\Delta V_{OUT(LINE)}$                            | $V_{IN} = V_{OUT} + 1V$ to 20V                                                                         |      | 0.05 |     | mV/V          |
| Load Regulation                                  | $\frac{\Delta V_{OUT}}{(V_{OUT} \Delta I_{OUT})}$ | $V_{IN} = 6V$ , $I_{OUT} = 1mA$ to 500mA                                                               |      | 0.8  |     | %/A           |
| EN pin low-level input voltage (device disabled) | $V_{IL(EN)}$                                      |                                                                                                        |      |      | 0.5 | V             |
| EN pin high-level input voltage (device enabled) | $V_{IH(EN)}$                                      |                                                                                                        | 1.6  |      |     | V             |
| EN PIN Leakage Current                           | $I_{EN}$                                          | $V_{EN} = 20V$                                                                                         |      | 0.8  |     | $\mu A$       |
| Power Supply Ripple Rejection                    | PSRR                                              | $f = 1kHz$ , $V_{OUT} = 5V$ , $I_{OUT} = 500mA$                                                        |      | 64   |     | dB            |
| Output Noise Voltage                             | $V_N$                                             | $BW = 100Hz$ to 100kHz, $C_{BYP} = 10nF$ , $C_{OUT} = 2.2\mu F$ , $V_{OUT} = 1.8V$ , $I_{OUT} = 500mA$ |      | 45   |     | $\mu V_{RMS}$ |
| Thermal Shutdown Temperature                     | TSD                                               |                                                                                                        |      | 160  |     | $^\circ C$    |
| Thermal Shutdown Hysteresis                      | $T_{HYS}$                                         |                                                                                                        |      | 20   |     | $^\circ C$    |

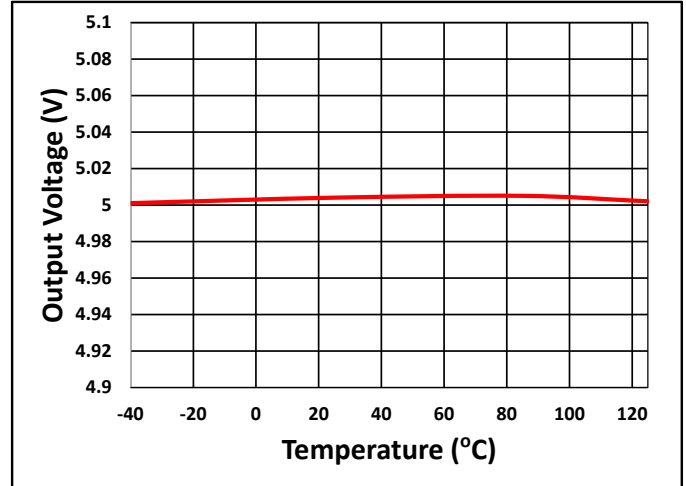
## Typical Characteristics

$C_{IN} = 1\mu F$ ,  $C_{OUT} = 2.2\mu F$ ,  $I_{OUT} = 500mA$ ,  $T_A = 25^\circ C$  unless otherwise noted



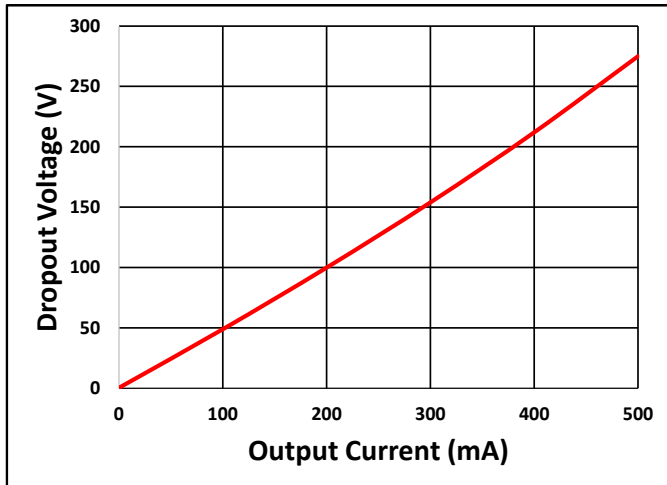
$V_{IN} = 6V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 500mA$ ,  $C_{OUT} = 2.2\mu F$

Fig. 1 PSRR



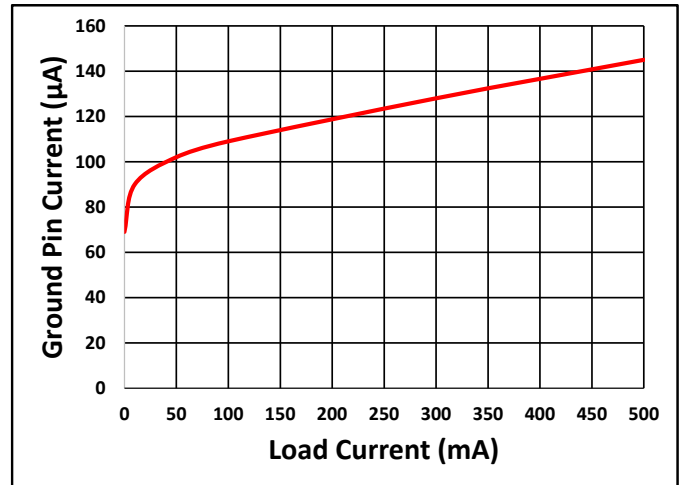
$V_{IN} = 6V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0.1mA$

Fig. 2 Output Voltage vs Temperature



$V_{IN} = 6V$

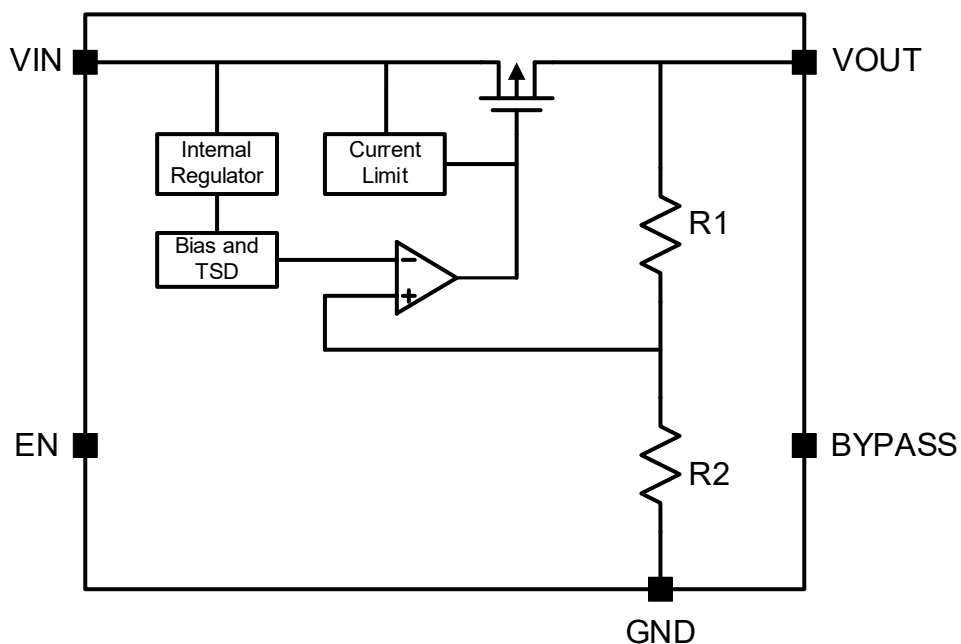
Fig. 3 Dropout Voltage



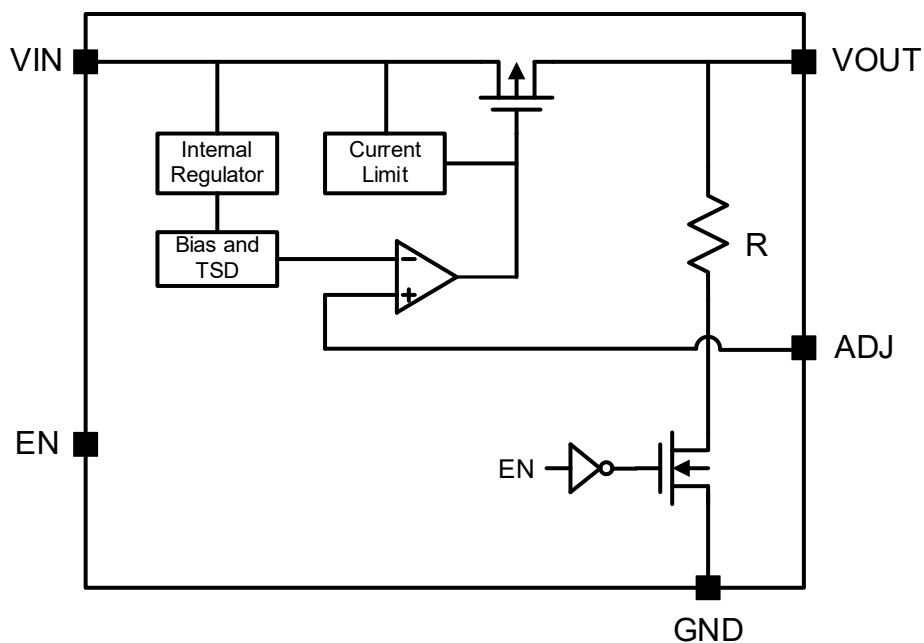
$V_{IN} = 2.5V$

Fig. 4 Ground Current vs Load Current

**Functional Block Diagram**



**Block Diagram of Fixed Output Voltage**



**Block Diagram of Adjustable Output Voltage**

**Feature Description*****Enable***

The enable pin for the LDO is active high. The device is enabled when the enable pin voltage is greater than  $V_{IH(EN)}$  and disabled with the enable pin voltage less than  $V_{IL(EN)}$ . If independent control of chip enable is not needed, then connect the enable pin to the input. The LDO has an internal pulldown MOSFET that connects a discharge resistor from  $V_{OUT}$  to ground when the device is disabled to actively discharge the output voltage.

***Output Current Limit***

When overload events happen, the output current is internally limited.

***Undervoltage Lockout (UVLO)***

The LDO uses an undervoltage lockout circuit to keep the output shut off until the internal circuitry is operating properly.

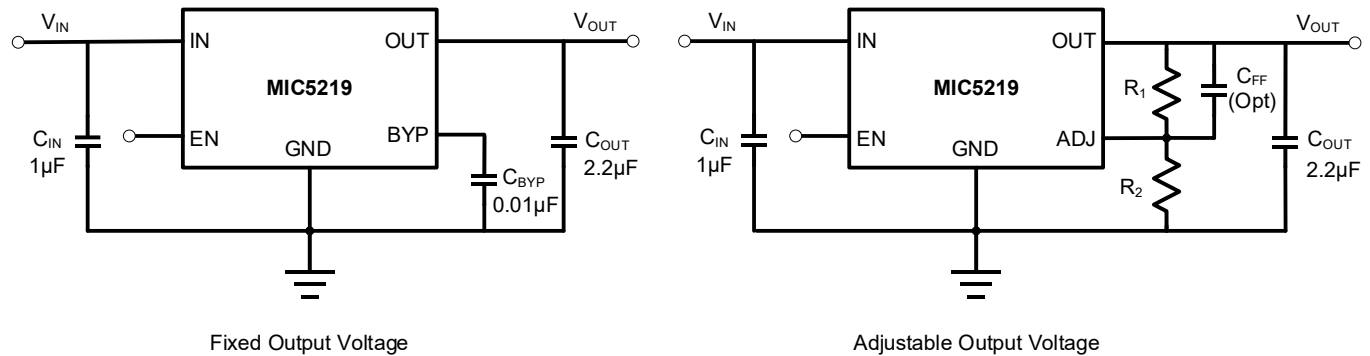
***Thermal Protection***

The LDO contains a thermal shutdown protection circuit to turn off the output current when excessive heat is dissipated in the LDO.



## Application Information

### Typical Application for Fixed and Adjustable Output Voltage



### Input Capacitor and Output Capacitor

The LDO is designed and characterized for operation with ceramic capacitors of 1µF or greater at the input and 1µF or greater at the output. Locate the input and output capacitors as near as practical to the input and output pins to minimize the trace inductance from the capacitor to the device.

### Adjustable Output Voltage

The output voltage of the LDO can be adjusted from 1.2V to 18V according to the following equation.

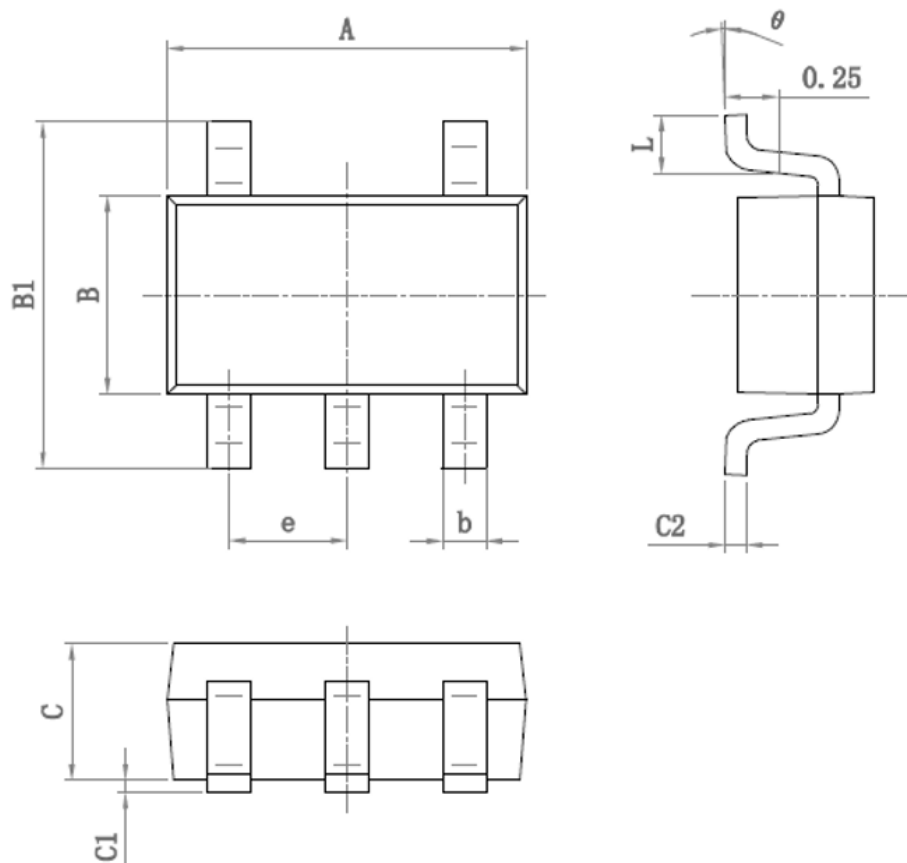
$$V_{OUT} = 1.2V \times \left(1 + \frac{R1}{R2}\right)$$

### Feed Forward Capacitor

A Feed-Forward Capacitor ( $C_{FF}$ ) in parallel with the R1 resistor as shown in the Figure above can be used to improve the output noise and PSRR performance. This  $C_{FF}$  is user optional for performance improvements not for LDO stability.

PACKAGE OUTLINE DIMENSIONS

SOT23-5



| Symbol | Dimensions (mm) |      | Symbol | Dimensions (mm) |      |
|--------|-----------------|------|--------|-----------------|------|
|        | Min             | Max  |        | Min             | Max  |
| A      | 2.82            | 3.02 | C      | 1.05            | 1.15 |
| e      | 0.95 (BSC)      |      | C1     | 0.03            | 0.15 |
| b      | 0.28            | 0.45 | C2     | 0.12            | 0.23 |
| B      | 1.50            | 1.70 | L      | 0.35            | 0.55 |
| B1     | 2.60            | 3.00 | θ      | 0°              | 8°   |