

## VFM Step-Up DC/DC Converter

### General Description

The RT9261B Series are VFM Step-up DC/DC converter ICs with ultra low supply current by CMOS process and suitable for use with battery-powered instruments.

The RT9261B IC consists of an oscillator, a VFM control circuit, a driver transistor (LX switch), a reference voltage unit, an error amplifier, resistors for voltage detection, and a LX switch protection circuit. A low ripple and high efficiency step-up DC/DC converter can be constructed with the RT9261B IC and only three external components.

The EN pin enables the circuit to set the standby supply current at a maximum of 0.5 $\mu$ A.

### Ordering Information

|          |                                      |   |   |   |
|----------|--------------------------------------|---|---|---|
| RT9261B- | □                                    | □ | □ | □ |
|          | Package Type                         |   |   |   |
|          | B : SOT-23-5                         |   |   |   |
|          | X : SOT-89                           |   |   |   |
|          | Lead Plating System                  |   |   |   |
|          | P : Pb Free                          |   |   |   |
|          | G : Green (Halogen Free and Pb Free) |   |   |   |
|          | Output Voltage                       |   |   |   |
|          | 15 : 1.5V                            |   |   |   |
|          | 16 : 1.6V                            |   |   |   |
|          | :                                    |   |   |   |
|          | 49 : 4.9V                            |   |   |   |
|          | 50 : 5.0V                            |   |   |   |

Note :

Richtek 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.

### Marking Information

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

### Features

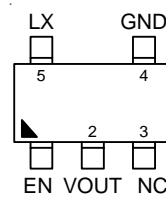
- Minimal Number of External Components (Only an Inductor, a Diode, and a Capacitor)
- Ultra Low Input Current (6.5 $\mu$ A at Switch Off)
- Capable of Supplying 50mA Output Current with Internal Switch
- $\pm 2\%$  Output Voltage Accuracy
- Low Ripple and Low Noise
- Low Start-up Voltage, 0.8V at 1mA
- 80% Efficiency with Low Cost Inductor
- +50 ppm/ $^{\circ}$ C Low Temperature-Drift
- SOT-89 and SOT-23-5 Small Packages
- RoHS Compliant and 100% Lead (Pb)-Free

### Applications

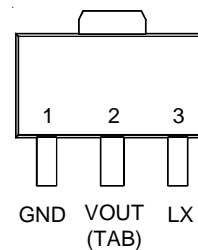
- Power source for battery-powered equipment
- Power source for cameras, camcorders, VCRs, PDAs, pagers, electronic data banks, and hand-held communication equipment
- Power source for appliances, which require higher voltage than that of batteries used in the appliances

### Pin Configurations

(TOP VIEW)

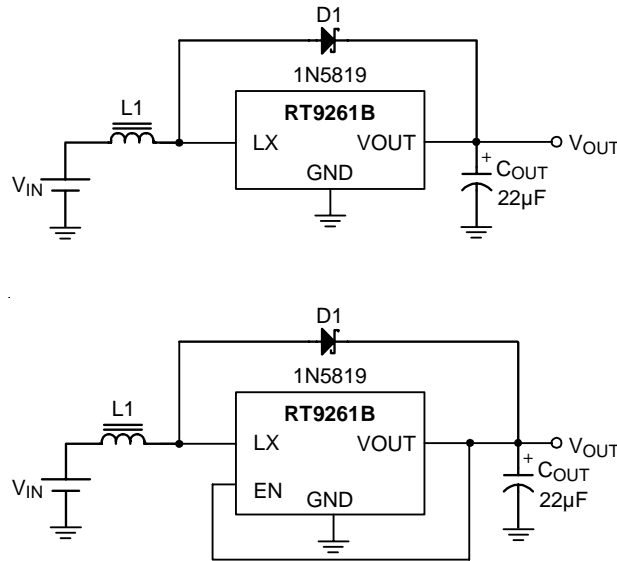


SOT-23-5



SOT-89

## Typical Application Circuit

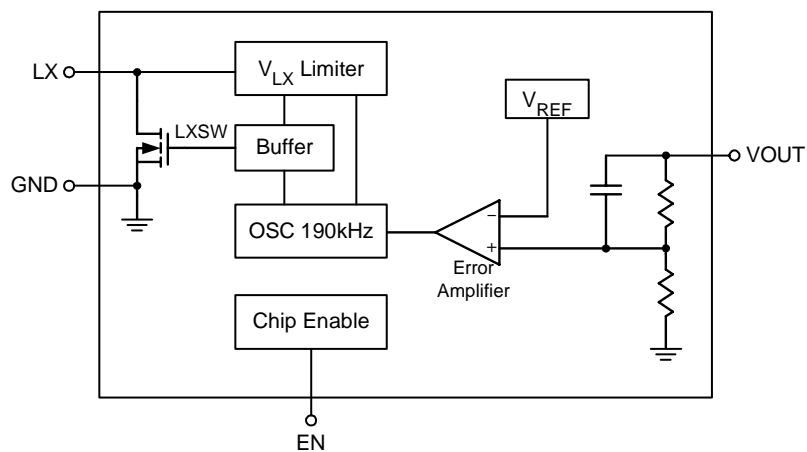


\* L1 ranges from 27µH to 120µH

## Functional Pin Description

| Pin No.  |        | Pin Name | Pin Function               |
|----------|--------|----------|----------------------------|
| SOT-23-5 | SOT-89 |          |                            |
| 1        | --     | EN       | Chip Enable (Active High). |
| 2        | 2      | VOUT     | Output Voltage.            |
| 3        | --     | NC       | No Internal Connection.    |
| 4        | 1      | GND      | Ground.                    |
| 5        | 3      | LX       | Pin for Switching.         |

## Function Block Diagram



**Absolute Maximum Ratings**

- Output Voltage ----- 8V
- LX Pin Voltage ----- 8V
- EN Pin Voltage<sup>(1)</sup> ----- -0.3 to V<sub>OUT</sub> +0.3V
- LX Pin Output Current ----- 400mA
- Power Dissipation, P<sub>D</sub> @ T<sub>A</sub> = 25°C
  - SOT-89 ----- 0.5W
  - SOT-23-5 ----- 0.25W
- Package Thermal Resistance
  - SOT-89, θ<sub>JC</sub> ----- 100°C/W
  - SOT-89, θ<sub>JA</sub> ----- 300°C/W
  - SOT-23-5, θ<sub>JA</sub> ----- 250°C/W
- Operating Temperature Range ----- -20 to +85°C
- Storage Temperature Range ----- -65°C to 150°C
- Lead Temperature (Soldering, 10 sec.) ----- 260°C

Notes: (1) Applicable to RT9261B-xxCB

**Electrical Characteristics** (Refer to Figure 1)

| Parameter  | Symbol                 | Test Conditions                                  | Min   | Typ | Max | Unit |    |
|--|------------------------|--|---|-----|-----|------|----|
| Output Voltage Accuracy  | ΔV <sub>OUT</sub>      |  | -2  | --  | +2  | %    |    |
| Input Voltage  | V <sub>IN</sub>        |  | --  | --  | 7   | V    |    |
| Start-up Voltage   | V <sub>ST</sub>        | I <sub>OUT</sub> = 1mA, V <sub>IN</sub> : 0 → 2V | --  | 0.8 | 1   | V    |    |
| Hold-on Voltage  | V <sub>HO</sub>        | I <sub>OUT</sub> = 1mA, V <sub>IN</sub> : 2 → 0V | 0.7   | --  | --  | V    |    |
| Input Current 1  |                        | V <sub>IN</sub> in continuous switching          | V <sub>OUT</sub> ≤ 3.5V <sup>(1)</sup>      | --  | 24  | 36   | μA |
|  |                        |  | 3.5V < V <sub>OUT</sub> ≤ 5V <sup>(2)</sup> | --  | 36  | 45   |    |
| Input Current 2 <sup>(1)(2)</sup>                                  |                        | V <sub>OUT</sub> in switch off condition         | --  | 6.5 | 10  | μA   |    |
| Input Current 3 (guaranteed by I <sub>1</sub> and I <sub>2</sub> ) |                        | V <sub>IN</sub> in no load                       | V <sub>OUT</sub> ≤ 3.5V <sup>(1)</sup>      | --  | 18  | 36   | μA |
|  |                        |  | 3.5V < V <sub>OUT</sub> ≤ 5V <sup>(2)</sup> | --  | 20  | 45   |    |
| LX Switching Current   | I <sub>SWITCHING</sub> | V <sub>LX</sub> = 0.4V                           | V <sub>OUT</sub> ≤ 3.5V <sup>(1)</sup>      | 120 | --  | --   | mA |
|  |                        |  | 3.5V < V <sub>OUT</sub> ≤ 5V <sup>(2)</sup> | 160 | --  | --   |    |
| LX Leakage Current   | I <sub>LEAKAGE</sub>   | V <sub>LX</sub> = 6V                             | --  | --  | 0.5 | μA   |    |
| Maximum Oscillator Frequency                                       | F <sub>MAX</sub>       | V <sub>OUT</sub> = 2.5V to 5V                    | 140   | 190 | 240 | kHz  |    |
|  |                        | V <sub>OUT</sub> = 1.5V to 2.4V                  | 140   | 190 | 320 |      |    |
| Oscillator Duty Cycle  | D <sub>OSC</sub>       | On (V <sub>LX</sub> "L" side)                    | V <sub>OUT</sub> = 2.5V to 5V               | 65  | 75  | 85   | %  |
|  |                        |  | V <sub>OUT</sub> = 1.5V to 2.4V             | 60  | 70  | 80   |    |
| Efficiency   |                        |  | --  | 80  | --  | %    |    |
| V <sub>LX</sub> Voltage Limit                                      |                        | LX switch on                                     | 0.65  | 0.8 | 1.0 | V    |    |

Notes:

(1) V<sub>IN</sub> = 1.8V, V<sub>SS</sub> = 0V, I<sub>OUT</sub> = 1mA, T<sub>opt</sub> = 25°C, and use External Circuit of Typical Application

(2) V<sub>IN</sub> = 3V, V<sub>SS</sub> = 0V, I<sub>OUT</sub> = 1mA, T<sub>opt</sub> = 25°C, and External Circuit of Typical Application

**Electrical Characteristics** (Refer to Figure 2)

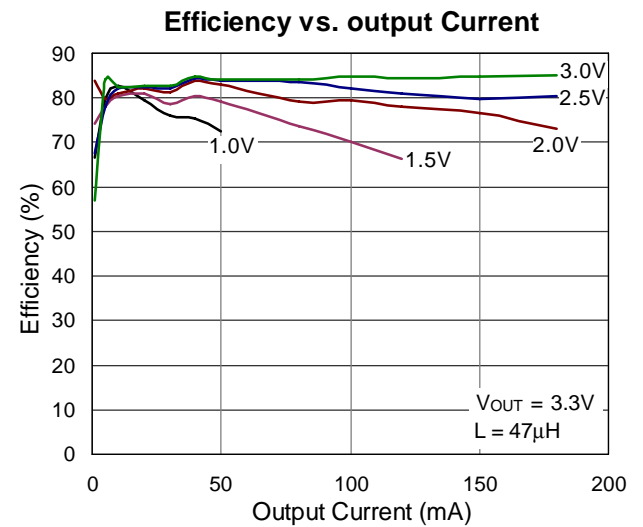
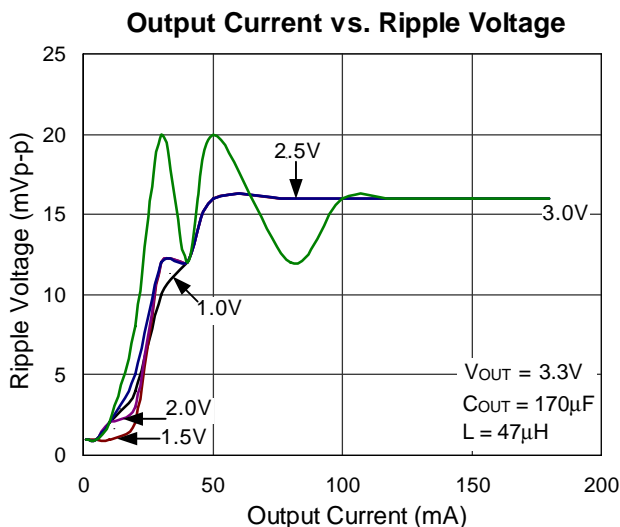
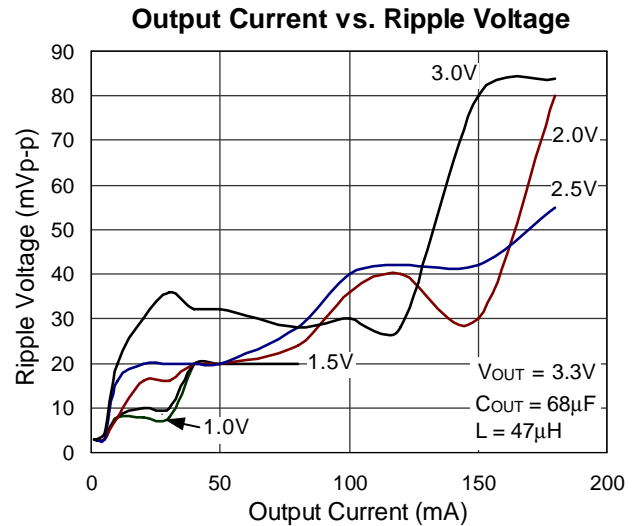
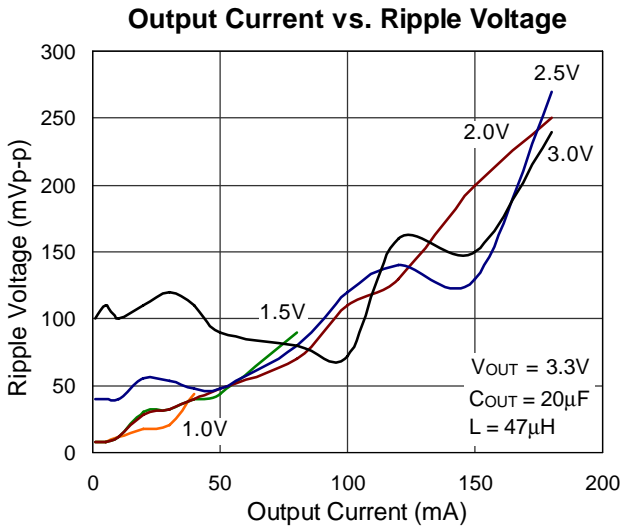
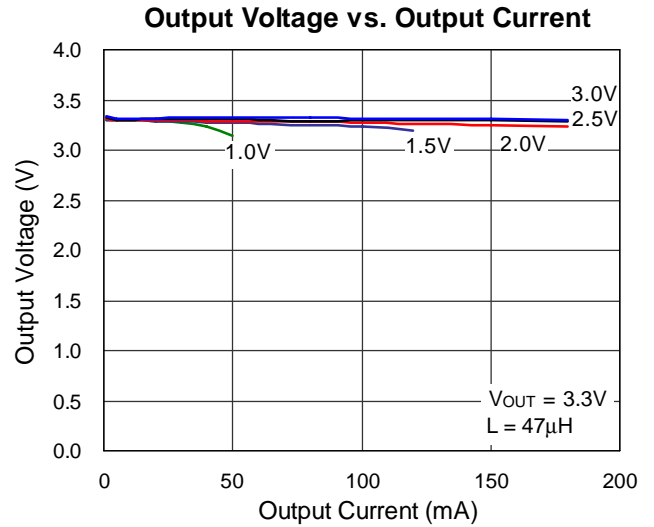
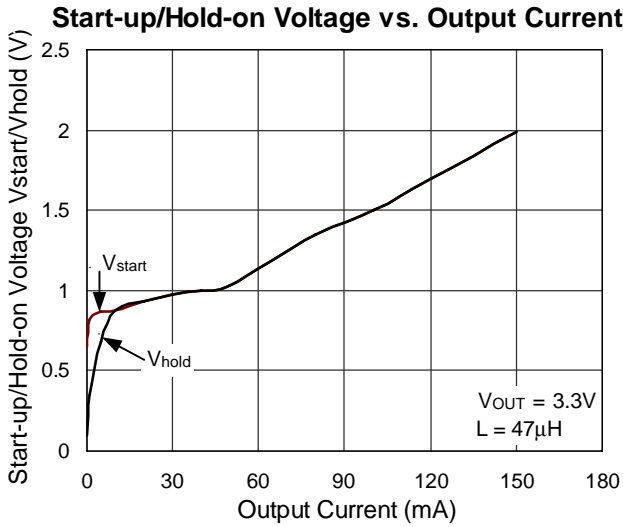
| Parameter  | Symbol           | Test Conditions                           | Min                            | Typ | Max | Unit    |         |
|--|------------------|---|--------------------------------|-----|-----|---------|---------|
| Output Voltage Accuracy                          | $\Delta V_{OUT}$ |   | -2                             | --  | +2  | %       |         |
| Input Voltage                                    | $V_{IN}$         |   | --                             | --  | 7   | V       |         |
| Start-up Voltage                                 | $V_{ST}$         | $I_{OUT} = 1mA, V_{IN}: 0 \rightarrow 2V$ | --                             | 0.8 | 1   | V       |         |
| Hold-on Voltage                                  | $V_{HO}$         | $I_{OUT} = 1mA, V_{IN}: 2 \rightarrow 0V$ | 0.7                            | --  | --  | V       |         |
| Efficiency                                       |                  |   | --                             | 80  | --  | %       |         |
| Input Current 1                                  |                  | $V_{IN}$ in continuous switching          | $V_{OUT} \leq 3.5V^{(1)}$      | --  | 24  | 36      | $\mu A$ |
|  |                  |   | $3.5V < V_{OUT} \leq 5V^{(2)}$ | --  | 36  | 45      |         |
| Input Current 2 <sup>(1)(2)</sup>                |                  | $V_{OUT}$ in switch off condition         | --                             | 6.5 | 10  | $\mu A$ |         |
| Input Current 3 (guaranteed by $I_1$ and $I_2$ ) |                  | $V_{IN}$ in no load                       | $V_{OUT} \leq 3.5V^{(1)}$      | --  | 18  | 36      | $\mu A$ |
|  |                  |   | $3.5V < V_{OUT} \leq 5V^{(2)}$ | --  | 20  | 45      |         |
| LX Switching Current                             | $I_{SWITCHING}$  | $V_{LX} = 0.4V$                           | $V_{OUT} \leq 3.5V^{(1)}$      | 120 | --  | --      | mA      |
|  |                  |   | $3.5V < V_{OUT} \leq 5V^{(2)}$ | 160 | --  | --      |         |
| LX Leakage Current                               | $I_{LEAKAGE}$    | $V_{LX} = 6V$                             | --                             | --  | 0.5 | $\mu A$ |         |
| EN "H" Level                                     |                  | $V_{IN} = V_{OUT} * 0.9$                  | 0.4 x $V_{OUT}$                | --  | --  | V       |         |
| EN "L" Level                                     |                  | $V_{IN} = V_{OUT} * 0.9$                  | --                             | --  | 0.2 | V       |         |
| EN "H" Input Current                             |                  | $EN = V_{OUT}$                            | --                             | --  | 0.5 | $\mu A$ |         |
| EN "L" Input Current                             |                  | $EN = 0V$                                 | -0.5                           | --  | --  | $\mu A$ |         |
| Maximum Oscillator Frequency                     | $F_{MAX}$        | $V_{OUT} = 2.5V$ to $5V$                  | 140                            | 190 | 240 | kHz     |         |
|  |                  | $V_{OUT} = 1.5V$ to $2.4V$                | 140                            | 190 | 320 |         |         |
| Oscillator Duty Cycle                            | $D_{OSC}$        | On ( $V_{LX}$ "L") side                   | $V_{OUT} = 2.5V$ to $5V$       | 65  | 75  | 85      | %       |
|  |                  |   | $V_{OUT} = 1.5V$ to $2.4V$     | 60  | 70  | 80      |         |
| $V_{LX}$ Voltage Limit                           |                  | LX switch on                              | 0.65                           | 0.8 | 1.0 | V       |         |

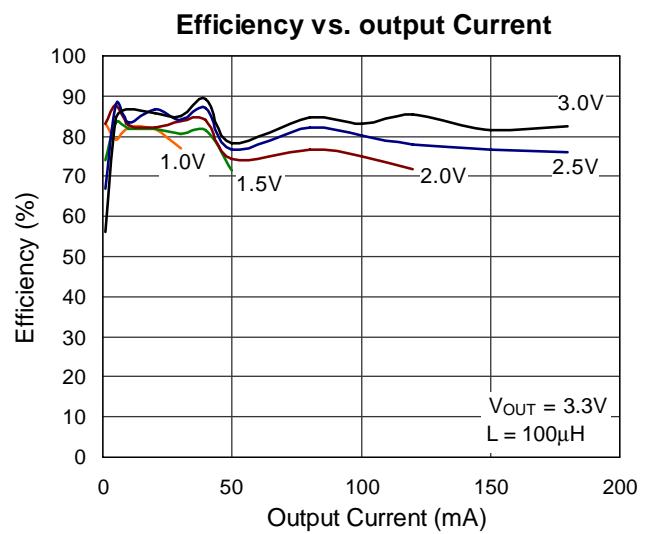
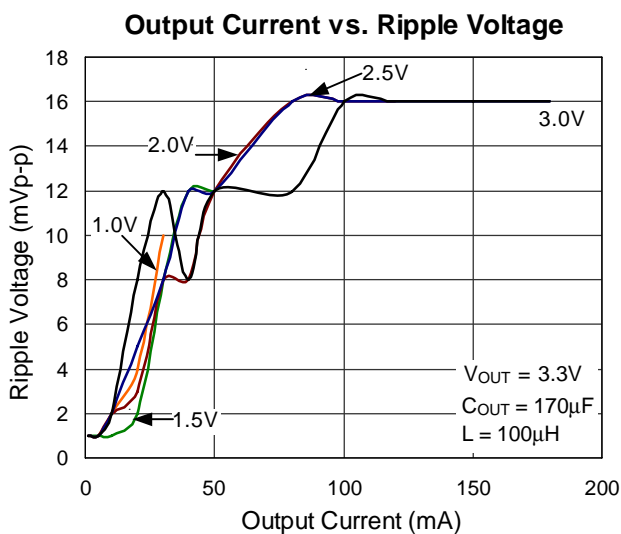
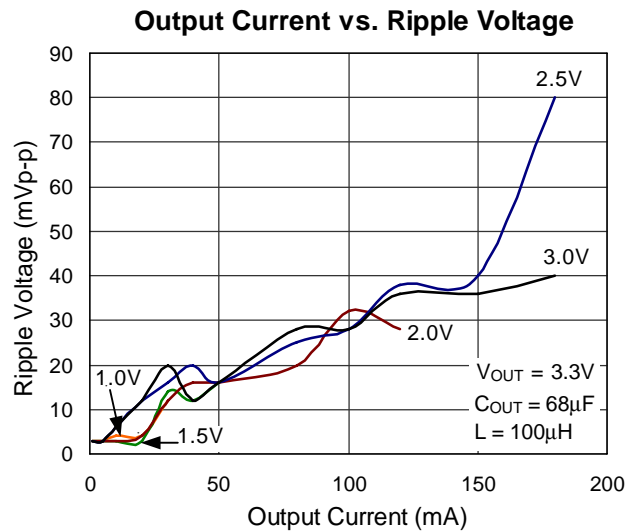
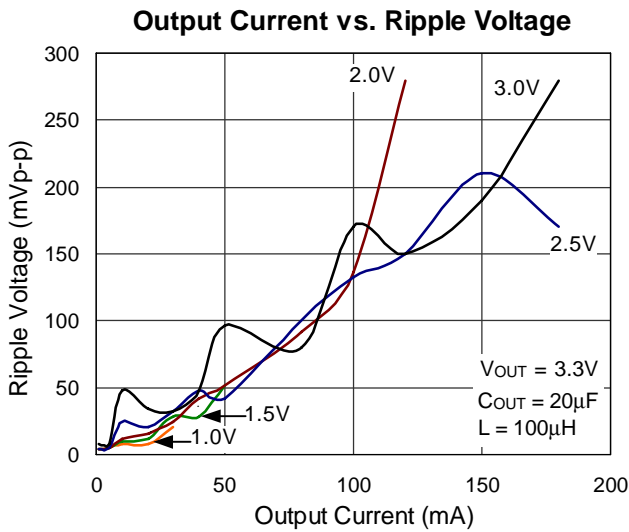
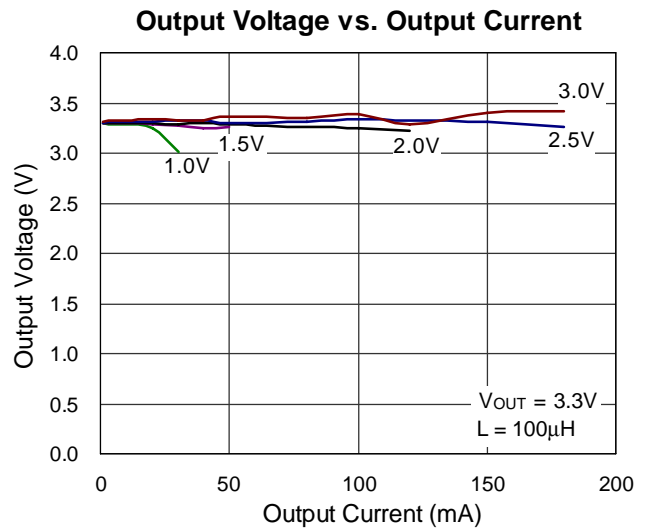
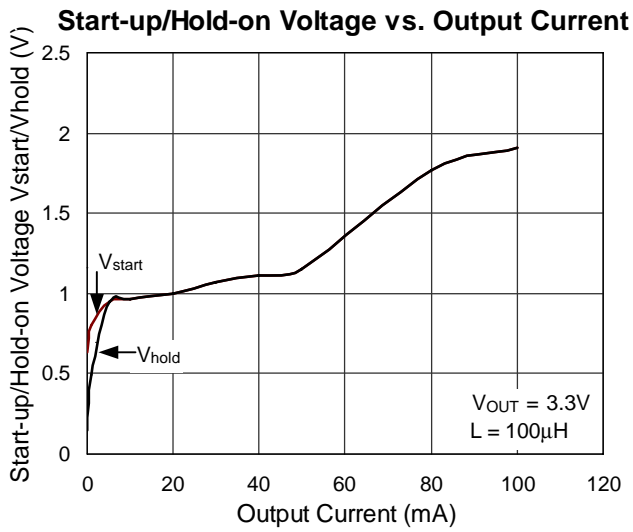
Notes:

(1)  $V_{IN} = 1.8V, V_{SS} = 0V, I_{OUT} = 1mA, T_{opt} = 25^\circ C$ , and use External Circuit of Typical Application

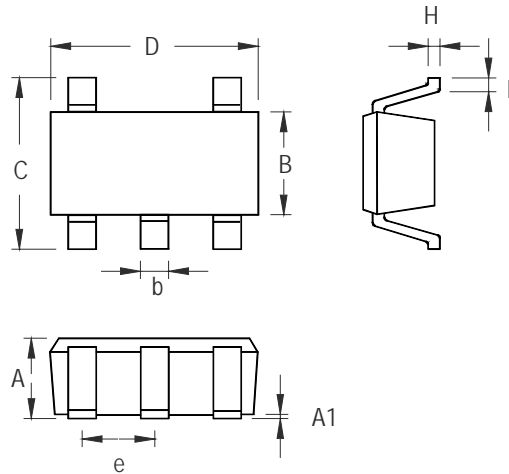
(2)  $V_{IN} = 3V, V_{SS} = 0V, I_{OUT} = 1mA, T_{opt} = 25^\circ C$ , and External Circuit of Typical Application

Typical Operating Characteristics



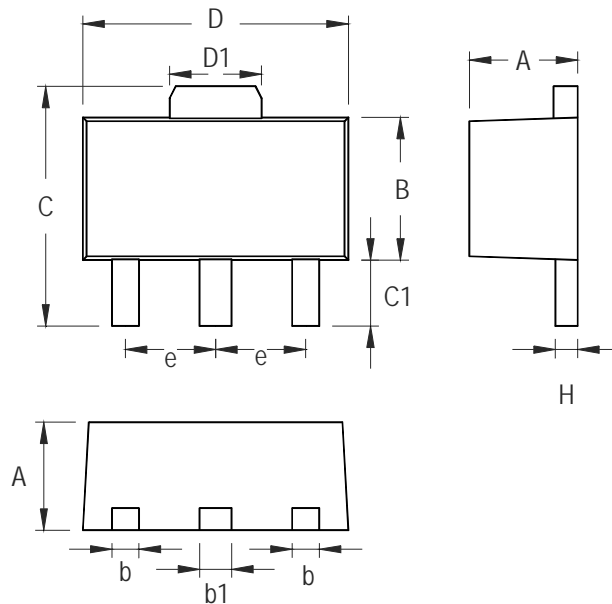


**Outline Dimension**



| 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**



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.397                     | 1.600 | 0.055                | 0.063 |
| b      | 0.356                     | 0.483 | 0.014                | 0.019 |
| B      | 2.388                     | 2.591 | 0.094                | 0.102 |
| b1     | 0.406                     | 0.533 | 0.016                | 0.021 |
| C      | 3.937                     | 4.242 | 0.155                | 0.167 |
| C1     | 0.787                     | 1.194 | 0.031                | 0.047 |
| D      | 4.394                     | 4.597 | 0.173                | 0.181 |
| D1     | 1.397                     | 1.753 | 0.055                | 0.069 |
| e      | 1.448                     | 1.549 | 0.057                | 0.061 |
| H      | 0.356                     | 0.432 | 0.014                | 0.017 |

3-Lead SOT-89 Surface Mount

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