

## VFM Step-Up DC/DC Converter

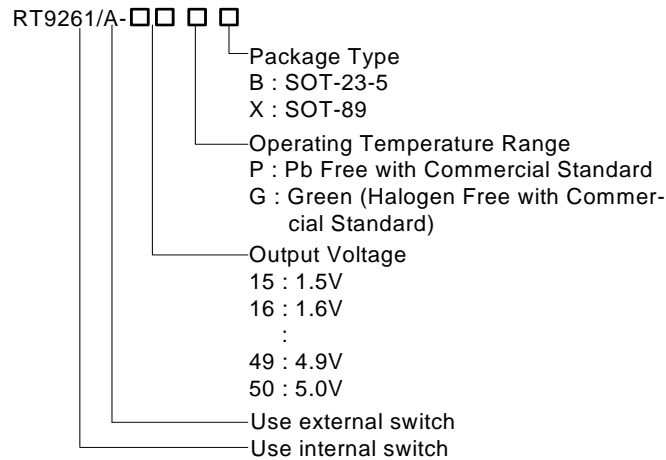
### General Description

The RT9261 Series are VFM Step-up DC/DC ICs with ultra low supply current by CMOS process and suitable for use with battery-powered instruments.

The RT9261 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 of this RT9261 IC with only three external components.

The RT9261A IC provides with a drive pin (EXT) for an external transistor, so that a power transistor can be externally applied. Therefore, the RT9261A IC is recommended for applications where large currents are required. EN pin enables circuit to set the standby supply current at a maximum of 0.5µA.

### Ordering Information



Note :

Richtek Pb-free and 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.

### Marking Information

For marking information, contact our sales representative directly or through a Richtek distributor located in your area, otherwise visit our website for detail.

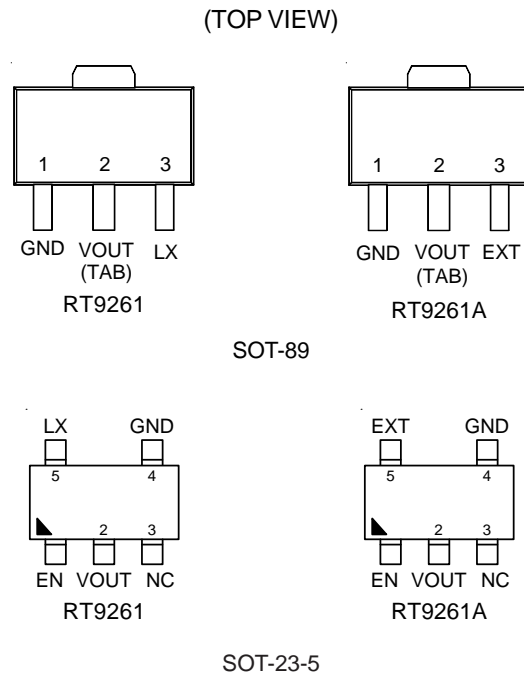
### Features

- Minimal Number of External Components ( Only an Inductor, a Diode, and a Capacitor)
- Ultra Low Input Current ( 5µA at Switch Off)
- ±2% High Output Voltage Accuracy
- Low Ripple and Low Noise
- Low Start-up Voltage, 0.85V at 1mA
- 75% Efficiency with Low Cost Inductor
- +50 ppm/ °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 applications, which require higher voltage than that of batteries used in the appliances

### Pin Configurations



## Typical Application Circuit

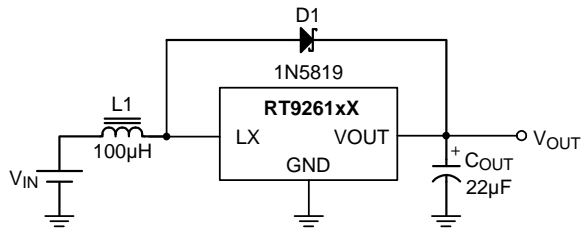


Figure 1

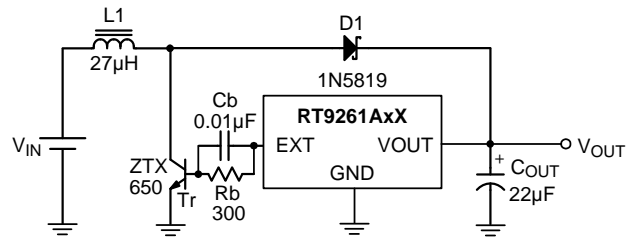


Figure 2

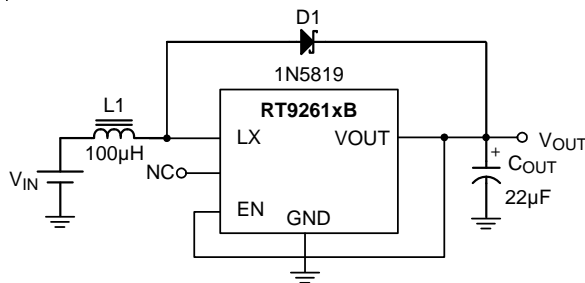


Figure 3

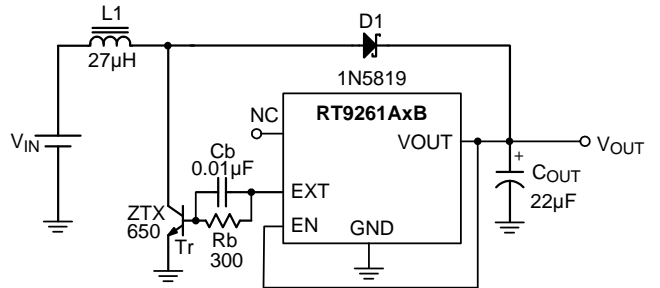


Figure 4

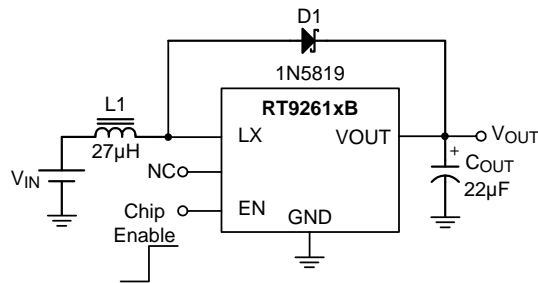
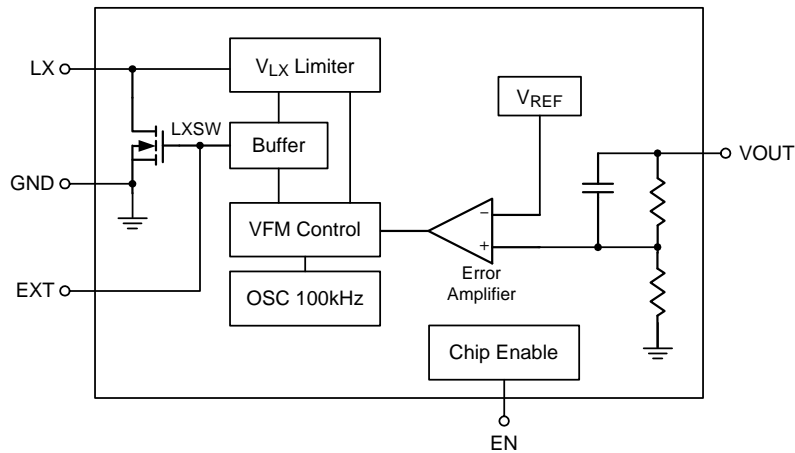


Figure 5

**Functional Pin Description**

| Pin No.     |              |             |              | Pin Name | Pin Function               |
|-------------|--------------|-------------|--------------|----------|----------------------------|
| RT9261-□□□X | RT9261A-□□□X | RT9261-□□□B | RT9261A-□□□B |          |                            |
| 1           | 1            | 4           | 4            | GND      | Ground.                    |
| 2           | 2            | 2           | 2            | VOUT     | Output Voltage.            |
| 3           | --           | 5           | --           | LX       | Pin for Switching.         |
| --          | 3            | --          | 5            | EXT      | Drive External Device.     |
| --          | --           | 1           | 1            | EN       | Chip Enable (Active High). |
| --          | --           | 3           | 3            | NC       | No Internal Connected.     |

**Function Block Diagram**



Notes:

- (1) LX Pin..... only for 9261-□□□X and 9261-□□□B
- (2) EXT Pin..... only for 9261A-□□□X and 9261A-□□□B
- (3) EN Pin..... only for 9261-□□□B and 9261A-□□□B

## Absolute Maximum Ratings

- Output Voltage ----- 8V
- LX Pin Voltage <sup>(1)</sup> ----- 8V
- EXT Pin Voltage <sup>(2)</sup> ----- -0.3 to V<sub>OUT</sub> +0.3V
- EN Pin Voltage <sup>(3)</sup> ----- -0.3 to V<sub>OUT</sub> +0.3V
- LX Pin Output Current <sup>(1)</sup> ----- 250mA
- EXT Pin Current <sup>(2)</sup> ----- ±50mA
- 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 ----- 165°C
- Lead Temperature (Soldering, 10 sec.) ----- 260°C

Notes:

- (1) Applicable to RT9261-□□xX and RT9261-□□xB
- (2) Applicable to RT9261A-□□xX and RT9261A-□□xB
- (3) Applicable to RT9261-□□xB and RT9261A-□□xB

## Electrical Characteristics (Refer to Figure 1)

| Parameter                     | Symbol                 | Test Conditions                                  | Min   | Typ  | Max | Units |    |
|-------------------------------|------------------------|--|---|------|-----|-------|----|
| 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 | --  | 0.85 | 1.0 | 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> at no load                       | V <sub>OUT</sub> ≤ 3.5V <sup>(1)</sup>      | --   | 15  | 18    | μA |
|                               |                        |  | 3.5V < V <sub>OUT</sub> ≤ 5V <sup>(2)</sup> | --   | 18  | 24    |    |
| Input Current 2               |                        | V <sub>OUT</sub> in switch off condition         | --  | 5    | 8   | μA    |    |
| LX Switching Current          | I <sub>SWITCHING</sub> | V <sub>LX</sub> = 0.4V                           | V <sub>OUT</sub> ≤ 3.5V <sup>(1)</sup>      | 60   | --  | --    | mA |
|                               |                        |  | 3.5V < V <sub>OUT</sub> ≤ 5V <sup>(2)</sup> | 80   | --  | --    |    |
| LX Leakage Current            | I <sub>LEAKAGE</sub>   | V <sub>LX</sub> = 6V                             | --  | --   | 0.5 | μA    |    |
| Maximum Oscillator            | F <sub>MAX</sub>       |  | 80  | 120  | 160 | kHz   |    |
| 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                    |                        |  | --  | 75   | --  | %     |    |
| V <sub>LX</sub> Voltage Limit |                        | L <sub>X</sub> switch on                         | 0.65  | 0.8  | 1.0 | V     |    |

Notes:

- (1) Unless otherwise provided, V<sub>IN</sub> = 1.8V, V<sub>SS</sub> = 0V, I<sub>OUT</sub> = 10mA, T<sub>OPT</sub> = 25°C, and External Circuit of Typical Application
- (2) Unless otherwise provided, V<sub>IN</sub> = 3V, V<sub>SS</sub> = 0V, I<sub>OUT</sub> = 10mA, 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 | Units |         |
|------------------------------|------------------|--|--------------------------------|------|-----|-------|---------|
| Output Voltage Accuracy      | $\Delta V_{OUT}$ |  | -2                             | --   | +2  | %     |         |
| Input Voltage                | $V_{IN}$         |  | --                             | --   | 7   | V     |         |
| Start-up Voltage             | $V_{ST}$         | $I_{OUT} = 1mA, V_{IN} : 0 \rightarrow 2V$ | --                             | 0.85 | 1.0 | V     |         |
| Input Current 1              |                  | $V_{IN}$ at no load                        | $V_{OUT} \leq 3.5V^{(1)}$      | --   | 30  | 50    | $\mu A$ |
|                              |                  |  | $3.5V < V_{OUT} \leq 5V^{(2)}$ | --   | 60  | 90    |         |
| Input Current 2              |                  | $V_{OUT}$ in switch off condition          | $V_{OUT} \leq 3.5V^{(1)}$      | --   | 6   | 10    | $\mu A$ |
|                              |                  |  | $3.5V < V_{OUT} \leq 5V^{(2)}$ |      |     |       |         |
| EXT "H" Output Current       |                  | $V_{EXT} = V_{OUT} - 0.4V$                 | $V_{OUT} \leq 3.5V^{(1)}$      | -1.5 | --  | --    | mA      |
|                              |                  |  | $3.5V < V_{OUT} \leq 5V^{(2)}$ | -2   | --  | --    |         |
| EXT "L" Output Current       |                  | $V_{EXT} = 0.4V$                           | $V_{OUT} \leq 3.5V^{(1)}$      | 1.5  | --  | --    | mA      |
|                              |                  |  | $3.5V < V_{OUT} \leq 5V^{(2)}$ | 2    | --  | --    |         |
| Maximum Oscillator Frequency | $F_{MAX}$        |  | 80                             | 120  | 160 | kHz   |         |
| Oscillator Duty Cycle        | $D_{OSC}$        | $V_{EXT}$ "H" side                         | $V_{OUT} = 2.5V$ to $5V$       | 65   | 75  | 85    | %       |
|                              |                  |  | $V_{OUT} = 1.5V$ to $2.4V$     | 60   | 70  | 80    | %       |

Notes:

(1)Unless otherwise provided,  $V_{IN} = 1.8V, V_{SS} = 0V, I_{OUT} = 10mA, T_{OPT} = 25^{\circ}C$ , and use External Circuit of Typical Application

(2)Unless otherwise provided,  $V_{IN} = 3V, V_{SS} = 0V, I_{OUT} = 10mA, T_{OPT} = 25^{\circ}C$ , and External Circuit of Typical Application

**Electrical Characteristics** (Refer to Figure 3)

| Parameter                    | Symbol           | Test Conditions  | Min  | Typ  | Max | Units         |               |
|------------------------------|------------------|--|--|------|-----|---------------|---------------|
| Output Voltage Accuracy      | $\Delta V_{OUT}$ |  | -2   | --   | +2  | %             |               |
| Input Voltage                | $V_{IN}$         |  | --   | --   | 7   | V             |               |
| Start-up Voltage             | $V_{ST}$         | $I_{OUT} = 1\text{mA}$ , $V_{IN}: 0 \rightarrow 2\text{V}$ | --   | 0.85 | 1.0 | V             |               |
| Hold-on Voltage              | $V_{HO}$         | $I_{OUT} = 1\text{mA}$ , $V_{IN}: 2 \rightarrow 0\text{V}$ | 0.7  | --   | --  | V             |               |
| Efficiency                   |                  | $V_{OUT} \leq 3.5\text{V}^{(1)}$                           | --   | 75   | --  | %             |               |
|                              |                  | $3.5\text{V} < V_{OUT} \leq 5\text{V}^{(2)}$               | --   | 85   | --  |               |               |
| Input Current 1              |                  | $V_{IN}$ at no load  | $V_{OUT} \leq 3.5\text{V}^{(1)}$             | --   | 15  | 18            | $\mu\text{A}$ |
|                              |                  |  | $3.5\text{V} < V_{OUT} \leq 5\text{V}^{(2)}$ | --   | 18  | 24            |               |
| Input Current 2              |                  | $V_{OUT}$ in switch off condition                          | $V_{OUT} \leq 3.5\text{V}^{(1)}$             | --   | 5   | 8             | $\mu\text{A}$ |
|                              |                  |  | $3.5\text{V} < V_{OUT} \leq 5\text{V}^{(2)}$ | --   | 6   | 10            |               |
| LX Switching Current         | $I_{SWITCHING}$  | $V_{LX} = 0.4\text{V}$                                     | $V_{OUT} \leq 3.5\text{V}^{(1)}$             | 60   | --  | --            | mA            |
|                              |                  |  | $3.5\text{V} < V_{OUT} \leq 5\text{V}^{(2)}$ | 80   | --  | --            |               |
| LX Leakage Current           | $I_{LEAKAGE}$    | $V_{LX} = 6\text{V}$                                       | --   | --   | 0.5 | $\mu\text{A}$ |               |
| EN "H" Level                 |                  | $V_{IN} = V_{OUT} \times 0.9$                              | $0.4 \times V_{OUT}$                         | --   | --  | V             |               |
| EN "L" Level                 |                  | $V_{IN} = V_{OUT} \times 0.9$                              | --   | --   | 0.2 | V             |               |
| EN "H" Input Current         |                  | $EN = V_{OUT}$   | --   | --   | 0.5 | $\mu\text{A}$ |               |
| EN "L" Input Current         |                  | $EN = 0\text{V}$   | -0.5   | --   | --  | $\mu\text{A}$ |               |
| Maximum Oscillator Frequency | $F_{MAX}$        |  | 80   | 120  | 160 | kHz           |               |
| Oscillator Duty Cycle        | $D_{OSC}$        | On ( $V_{LX}$ "L") side                                    | $V_{OUT} = 2.5\text{V to } 5\text{V}$        | 65   | 75  | 85            | %             |
|                              |                  |  | $V_{OUT} = 1.5\text{V to } 2.4\text{V}$      | 60   | 70  | 80            | %             |
| $V_{LX}$ Voltage Limit       |                  | LX switch on   | 0.65   | 0.8  | 1.0 | V             |               |

## Notes:

(1) Unless otherwise provided,  $V_{IN} = 1.8\text{V}$ ,  $V_{SS} = 0\text{V}$ ,  $I_{OUT} = 10\text{mA}$ ,  $T_{OPT} = 25^\circ\text{C}$ , and use External Circuit of Typical Application

(2) Unless otherwise provided,  $V_{IN} = 3\text{V}$ ,  $V_{SS} = 0\text{V}$ ,  $I_{OUT} = 10\text{mA}$ ,  $T_{OPT} = 25^\circ\text{C}$ , and External Circuit of Typical Application

**Electrical Characteristics** (Refer to Figure 4)

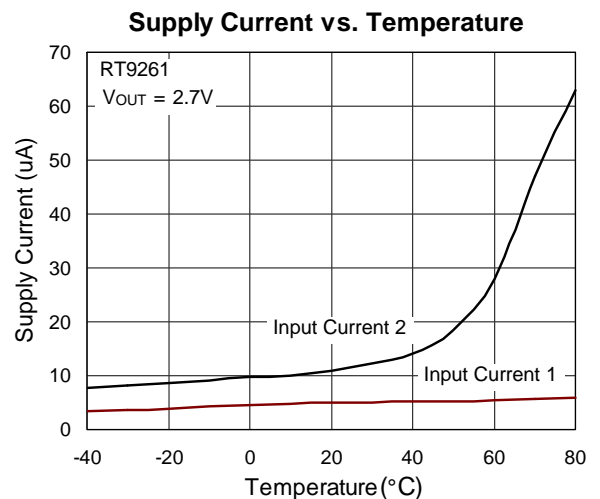
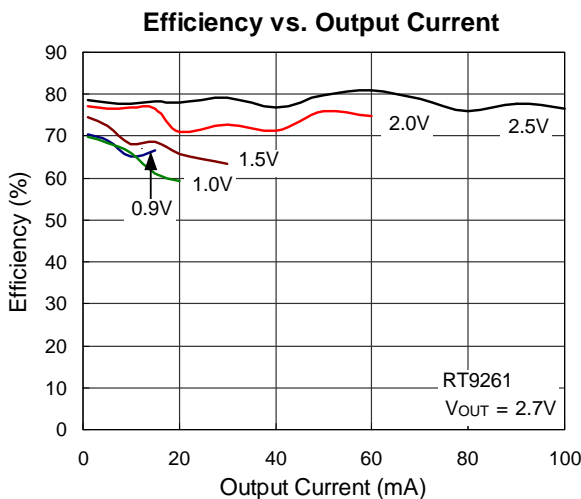
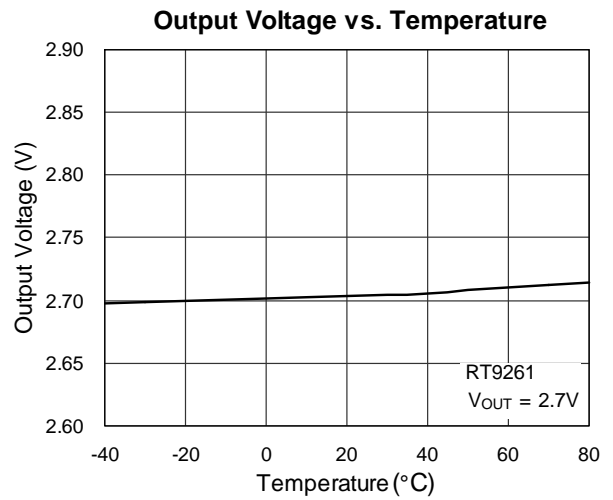
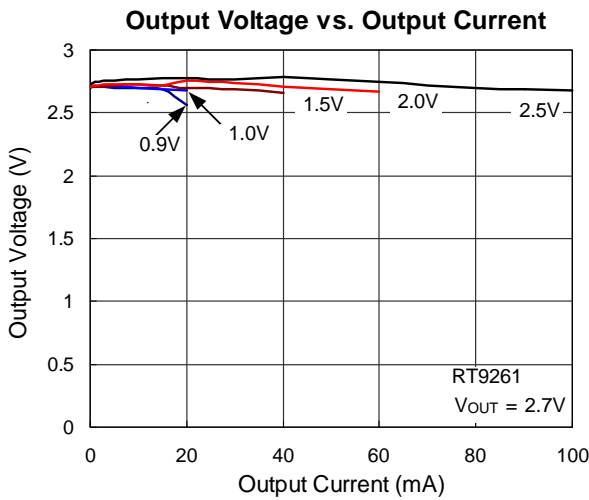
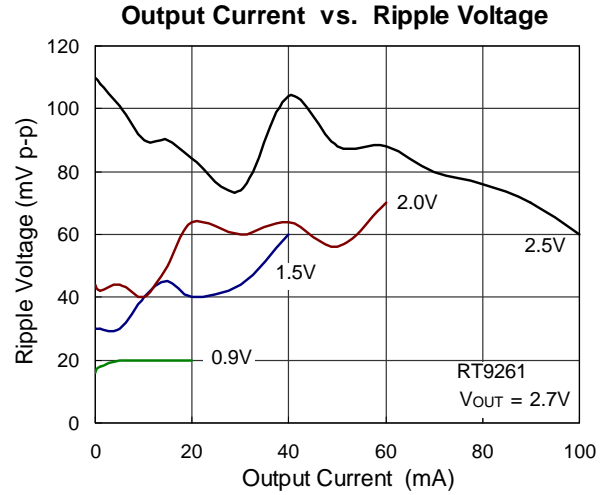
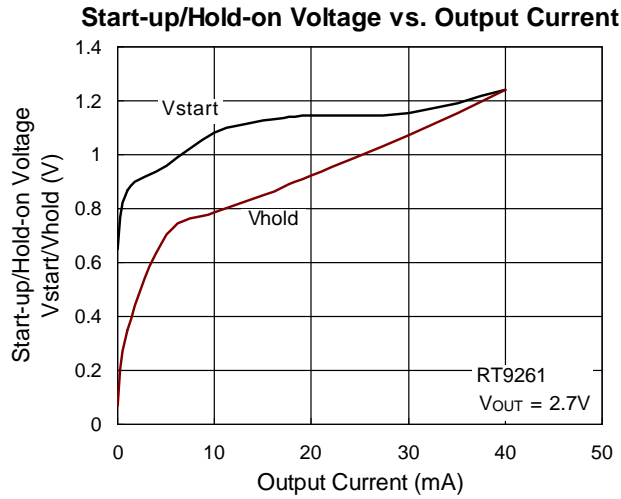
| Parameter                    | Symbol           | Test Conditions                           | Min                            | Typ  | Max | Units   |         |
|------------------------------|------------------|---|--------------------------------|------|-----|---------|---------|
| Output Voltage Accuracy      | $\Delta V_{OUT}$ |   | -2                             | --   | +2  | %       |         |
| Input Voltage                | $V_{IN}$         |   | --                             | --   | 7   | V       |         |
| Start-up Voltage             | $V_{ST}$         | $I_{OUT} = 1mA, V_{IN}: 0 \rightarrow 2V$ | --                             | 0.85 | 1.0 | V       |         |
| Efficiency                   |                  | $V_{OUT} \leq 3.5V^{(1)}$                 | --                             | 75   | --  | %       |         |
|                              |                  | $3.5V < V_{OUT} \leq 5V^{(2)}$            | --                             | 85   | --  |         |         |
| Input Current 1              |                  | $V_{IN}$ at no load                       | $V_{OUT} \leq 3.5V^{(1)}$      | --   | 30  | 50      | $\mu A$ |
|                              |                  |   | $3.5V < V_{OUT} \leq 5V^{(2)}$ | --   | 60  | 90      |         |
| Input Current 2              |                  | $V_{OUT}$ in switch off condition         | $V_{OUT} \leq 3.5V^{(1)}$      | --   | 6   | 10      | $\mu A$ |
|                              |                  |   | $3.5V < V_{OUT} \leq 5V^{(2)}$ | --   |     |         |         |
| EXT "H" Output Current       |                  | $V_{EXT} = V_{OUT} - 0.4V$                | $V_{OUT} \leq 3.5V^{(1)}$      | -1.5 | --  | --      | mA      |
|                              |                  |   | $3.5V < V_{OUT} \leq 5V^{(2)}$ | -2   | --  | --      |         |
| EXT "L" Output Current       |                  | $V_{EXT} = 0.4V$                          | $V_{OUT} \leq 3.5V^{(1)}$      | 1.5  | --  | --      | mA      |
|                              |                  |   | $3.5V < V_{OUT} \leq 5V^{(2)}$ | 2    | --  | --      |         |
| EN "H" Level                 |                  | $V_{IN} = V_{OUT} \times 0.9$             | $0.4 \times V_{OUT}$           | --   | --  | V       |         |
| EN "L" Level                 |                  | $V_{IN} = V_{OUT} \times 0.9$             | --                             | --   | 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 | $F_{MAX}$        |   | 80                             | 120  | 160 | kHz     |         |
| 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)Unless otherwise provided,  $V_{IN} = 1.8V, V_{SS} = 0V, I_{OUT} = 10mA, T_{OPT} = 25^{\circ}C$ , and use External Circuit of Typical Application

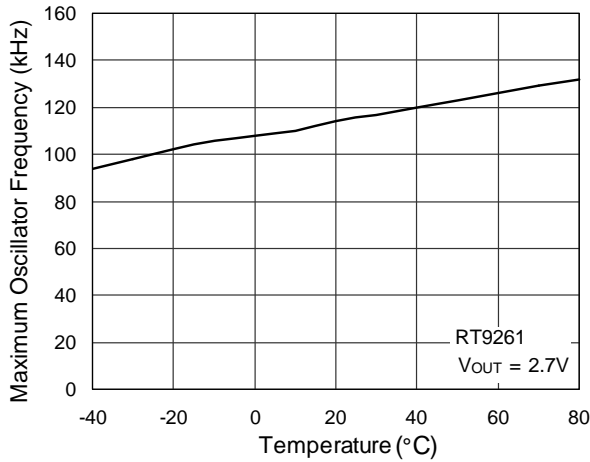
(2)Unless otherwise provided,  $V_{IN} = 3V, V_{SS} = 0V, I_{OUT} = 10mA, T_{OPT} = 25^{\circ}C$ , and External Circuit of Typical Application

Typical Operating Characteristics

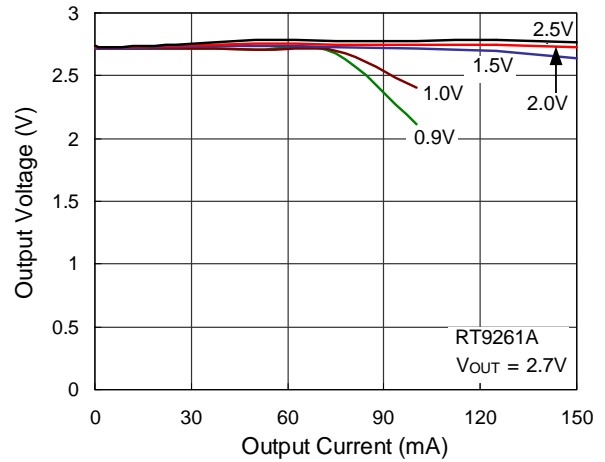




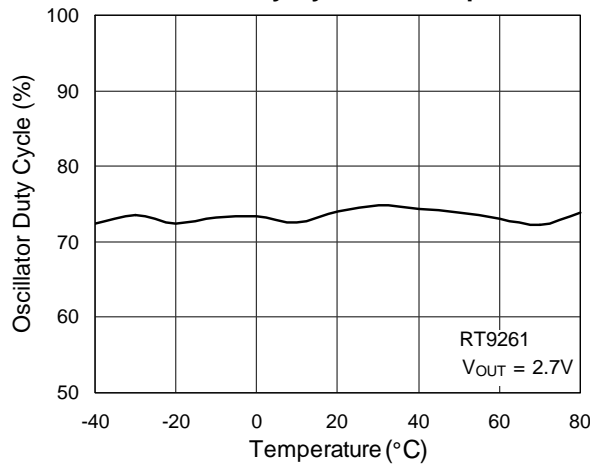
Maximum Oscillator Frequency vs. Temperature



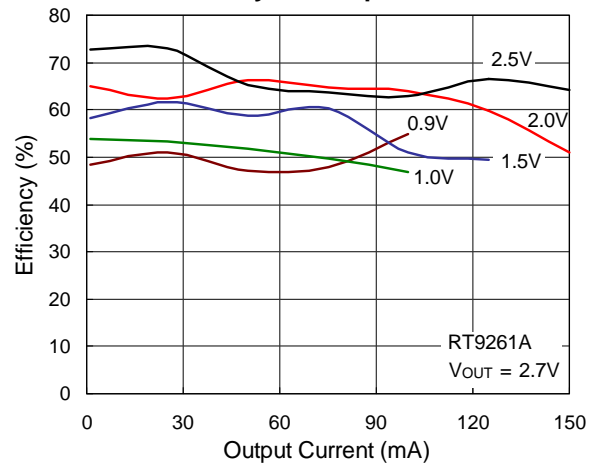
Output Voltage vs. Output Current



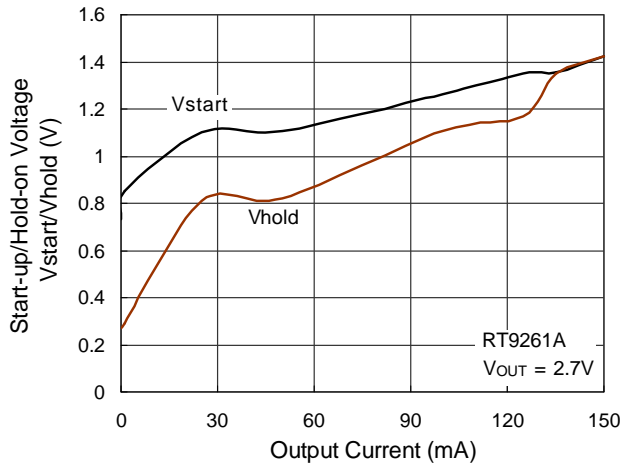
Oscillator Duty Cycle vs. Temperature



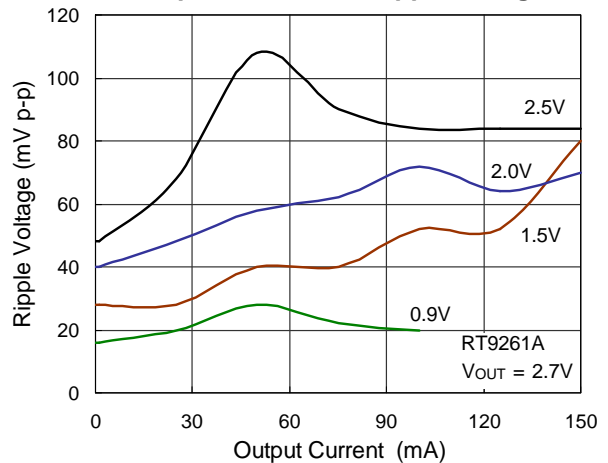
Efficiency vs. Output Current



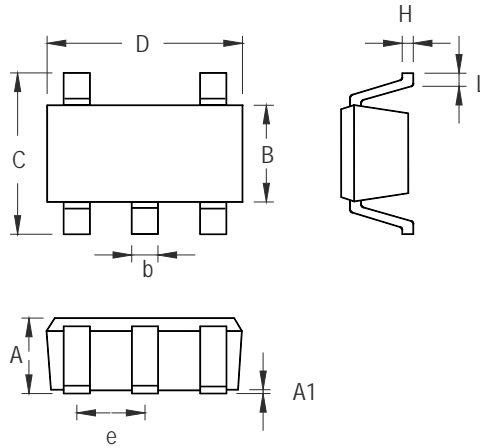
Start-up/Hold-on Voltage vs. Output Current



Output Current vs. Ripple Voltage

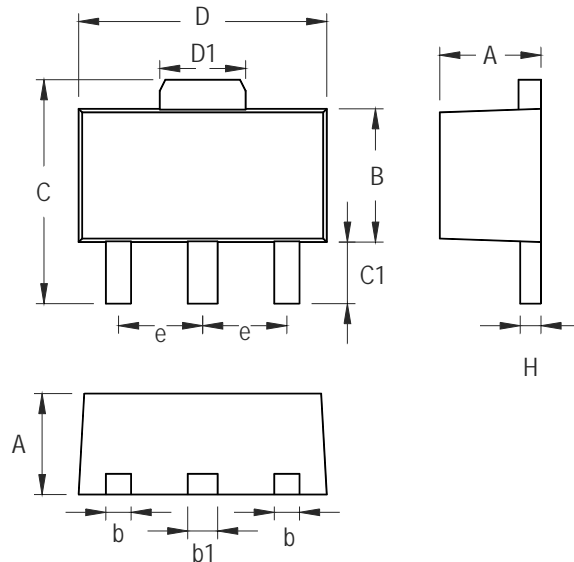


Outline Dimension



| 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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