# 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

RT9261/A-□□□□

- 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
- Use external switch
- Use internal switch

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

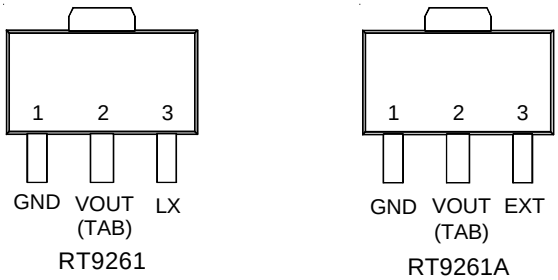
- **Minimal Number of External Components ( Only an Inductor, a Diode, and a Capacitor)**
- **Ultra Low Input Current ( 5μA at Switch Off)**
- **±2% High Output Voltage Accuracy**
- **Low Ripple and Low Noise**
- **Low Start-up Voltage, 0.85V at 1mA**
- **75% Efficiency with Low Cost Inductor**
- **+50 ppm/ °C Low Temperature-Drift**
- **SOT-89 and SOT-23-5 Small Packages**
- **RoHS Compliant and 100% Lead (Pb)-Free**

## Applications

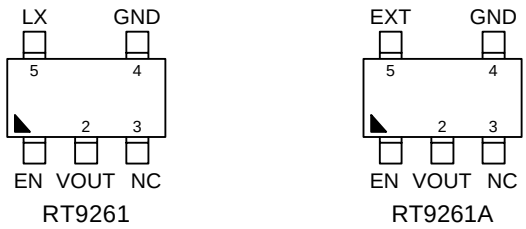
- Power source for battery-powered equipment
- Power source for cameras, camcorders, VCRs, PDAs, pagers, electronic data banks, and hand-held communication equipment
- Power source for applications, which require higher voltage than that of batteries used in the appliances

## Pin Configurations

(TOP VIEW)




SOT-89




SOT-23-5

## Typical Application Circuit

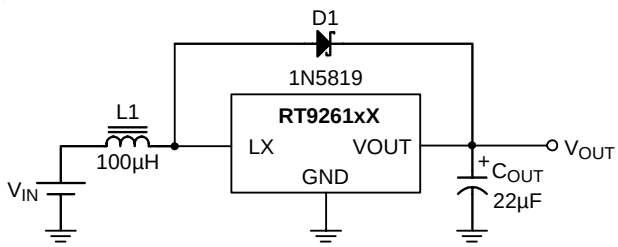



Figure 1

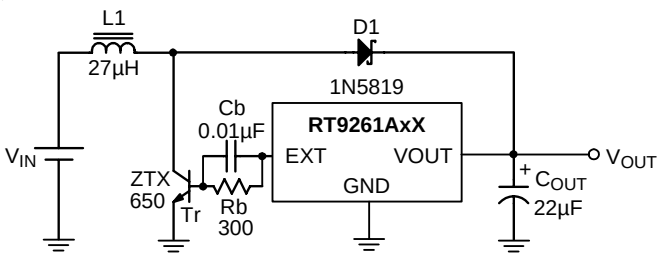



Figure 2

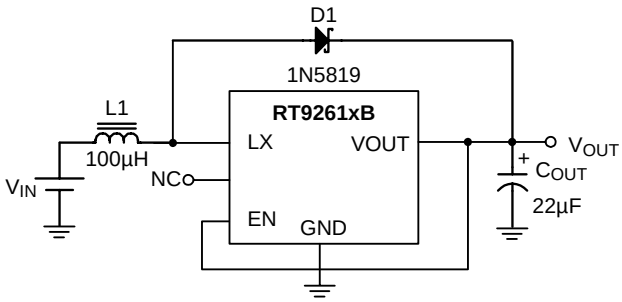



Figure 3

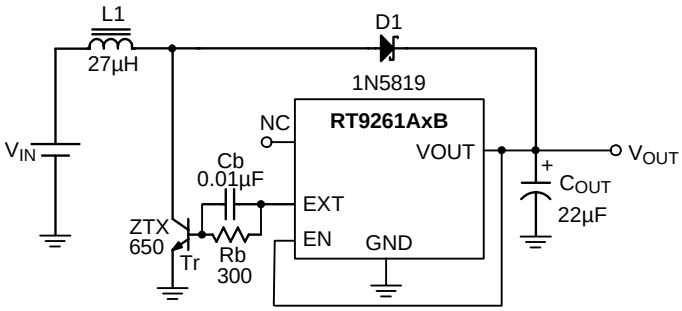



Figure 4

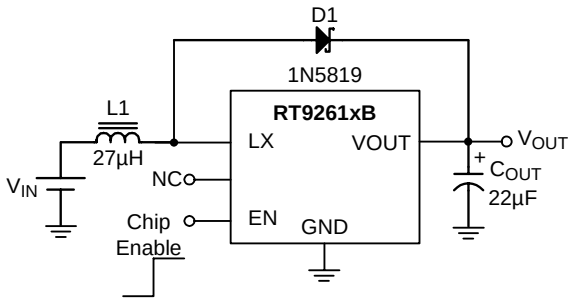
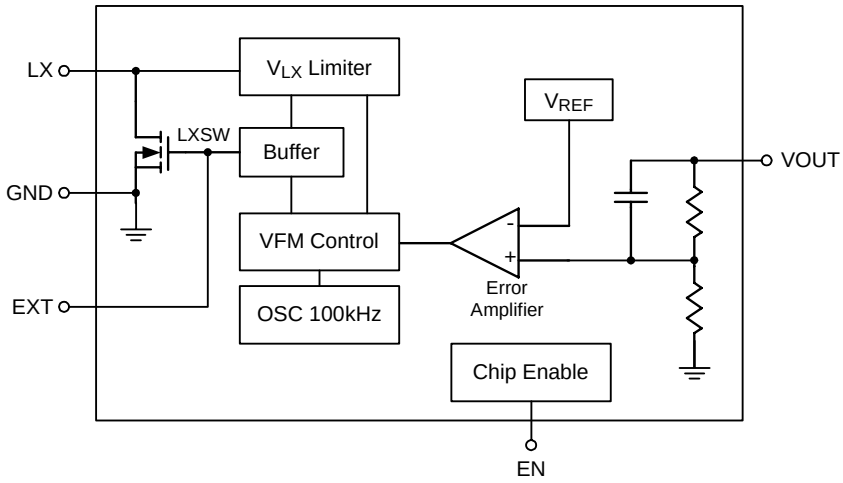



Figure 5

## 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-□□xX and 9261-□□xB

(2) EXT Pin.... only for 9261A-□□xX and 9261A-□□xB

(3) EN Pin..... only for 9261-□□xB and 9261A-□□xB

## Absolute Maximum Ratings

- Output Voltage ---------- 8V
- LX Pin Voltage (1) ---------- 8V
- EXT Pin Voltage (2) ---------- −0.3 to $V_{OUT}$ +0.3V
- EN Pin Voltage (3) ---------- −0.3 to $V_{OUT}$ +0.3V
- LX Pin Output Current (1) ---------- 250mA
- EXT Pin Current (2) ---------- ±50mA
- Power Dissipation, $P_D$ @ $T_A$ = 25°C
  - SOT-89 ---------- 0.5W
  - SOT-23-5 ---------- 0.25W
- Package Thermal Resistance
  - SOT-89, $\theta_{JC}$ ---------- 100°C/W
  - SOT-89, $\theta_{JA}$ ---------- 300°C/W
  - SOT-23-5, $\theta_{JA}$ ---------- 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 | 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 → 2V | | -- | 0.85 | 1 | V |
| Hold-on Voltage | $V_{HO}$ | $I_{OUT}$ = 1mA, $V_{IN}$: 2 → 0V | | 0.7 | -- | -- | V |
| Input Current 1 | | $V_{IN}$ at no load | $V_{OUT} \leq 3.5V$ (1) | -- | 15 | 18 | μA |
| | | | $3.5V < V_{OUT} \leq 5V$ (2) | -- | 18 | 24 | |
| Input Current 2 | | $V_{OUT}$ in switch off condition | | -- | 5 | 8 | μA |
| LX Switching Current | $I_{SWITCHING}$ | $V_{LX}$ = 0.4V | $V_{OUT} \leq 3.5V$ (1) | 60 | -- | -- | mA |
| | | | $3.5V < V_{OUT} \leq 5V$ (2) | 80 | -- | -- | |
| LX Leakage Current | $I_{LEAKAGE}$ | $V_{LX}$ = 6V | | -- | -- | 0.5 | μA |
| Maximum Oscillator | $F_{MAX}$ | | | 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 | % |
| Efficiency | | | | -- | 75 | -- | % |
| $V_{LX}$ Voltage Limit | | $L_X$ switch on | | 0.65 | 0.8 | 1 | V |

Notes:

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

(2)Unless otherwise provided, $V_{IN}$ = 3V, $V_{SS}$ = 0V, $I_{OUT}$ = 10mA, $T_{OPT}$ = 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 → 2V | | -- | 0.85 | 1.0 | V |
| Input Current 1 | | $V_{IN}$ at no load | $V_{OUT} \leq 3.5V$ (1) | -- | 30 | 50 | μA |
| | | | $3.5V < V_{OUT} \leq 5V$ (2) | -- | 60 | 90 | |
| Input Current 2 | | $V_{OUT}$ in switch off condition | $V_{OUT} \leq 3.5V$ (1) | -- | 6 | 10 | μA |
| | | | $3.5V < V_{OUT} \leq 5V$ (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°C, and use External Circuit of Typical Application

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

## Electrical Characteristics (Refer to Figure 3)

| 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 → 2V | | -- | 0.85 | 1.0 | V |
| Hold-on Voltage | $V_{HO}$ | $I_{OUT}$ = 1mA, $V_{IN}$ : 2 → 0V | | 0.7 | -- | -- | 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) | -- | 15 | 18 | μA |
| | | | $3.5V < V_{OUT} \leq 5V$ (2) | -- | 18 | 24 | |
| Input Current 2 | | $V_{OUT}$ in switch off condition | $V_{OUT} \leq 3.5V$ (1) | -- | 5 | 8 | μA |
| | | | $3.5V < V_{OUT} \leq 5V$ (2) | -- | 6 | 10 | |
| LX Switching Current | $I_{SWITCHING}$ | $V_{LX}$ = 0.4V | $V_{OUT} \leq 3.5V$ (1) | 60 | -- | -- | mA |
| | | | $3.5V < V_{OUT} \leq 5V$ (2) | 80 | -- | -- | |
| LX Leakage Current | $I_{LEAKAGE}$ | $V_{LX}$ = 6V | | -- | -- | 0.5 | μA |
| EN “H” Level | | $V_{IN} = V_{OUT} \times 0.9$ | | 0.4 x $V_{OUT}$ | -- | -- | V |
| EN “ L” Level | | $V_{IN} = V_{OUT} \times 0.9$ | | -- | -- | 0.2 | V |
| EN “ H” Input Current | | EN = $V_{OUT}$ | | -- | -- | 0.5 | μA |
| EN “ L“ Input Current | | EN = 0V | | −0.5 | -- | -- | μA |
| 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°C, and use External Circuit of Typical Application

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

## Electrical Characteristics (Refer to Figure 4)

| 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 → 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 | µA |
| | | | $3.5V < V_{OUT} \leq 5V$ (2) | -- | 60 | 90 | |
| Input Current 2 | | $V_{OUT}$ in switch off condition | $V_{OUT} \leq 3.5V$ (1) | -- | 6 | 10 | µA |
| | | | $3.5V < V_{OUT} \leq 5V$ (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 | µA |
| EN “ L“ Input Current | | EN = 0V | | –0.5 | -- | -- | µA |
| 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 |

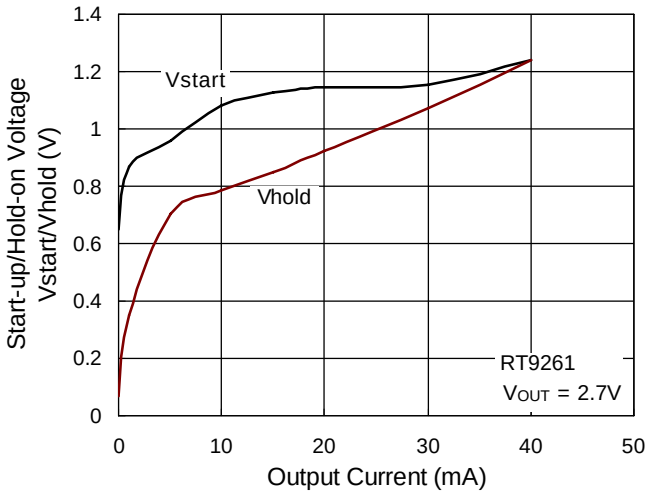
Notes:

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

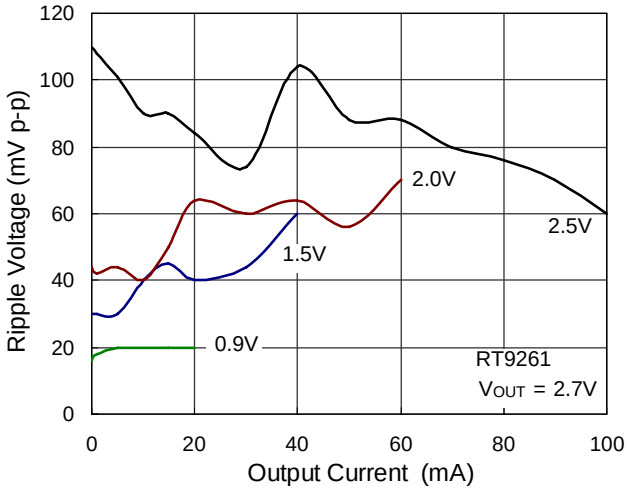
(2)Unless otherwise provided, $V_{IN}$ = 3V, $V_{SS}$= 0V, $I_{OUT}$ = 10mA, $T_{OPT}$ = 25°C, and External Circuit of Typical Application

## Typical Operating Characteristics

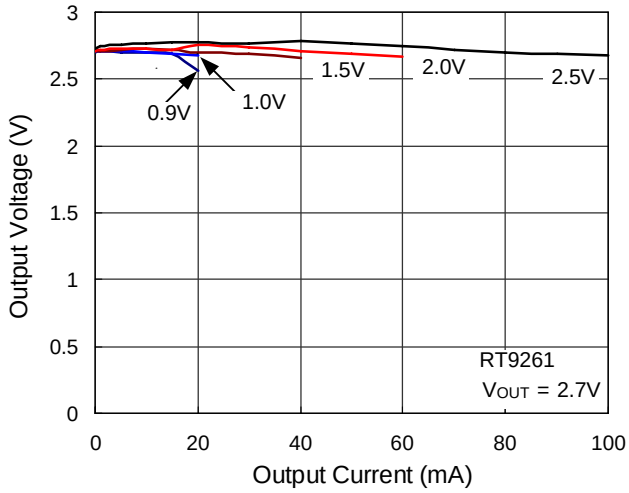
### Start-up/Hold-on Voltage vs. Output Current



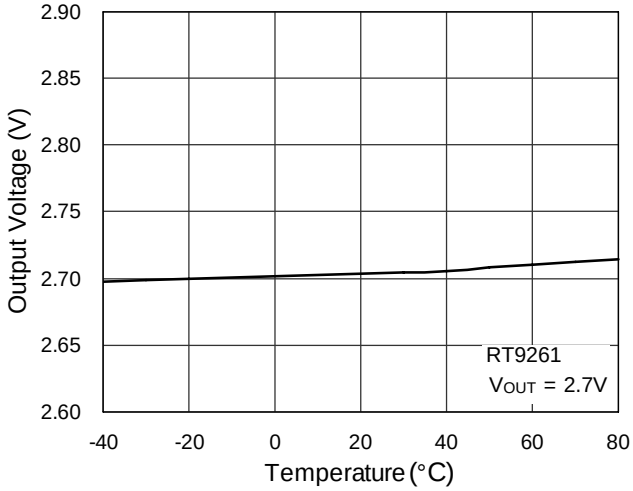

### Output Current vs. Ripple Voltage



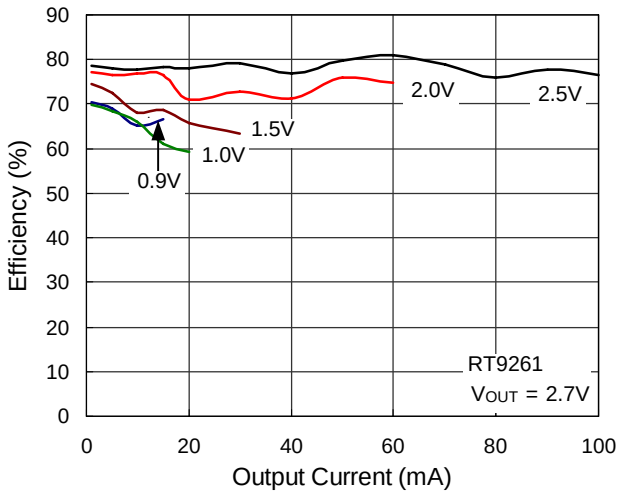

### Output Voltage vs. Output Current



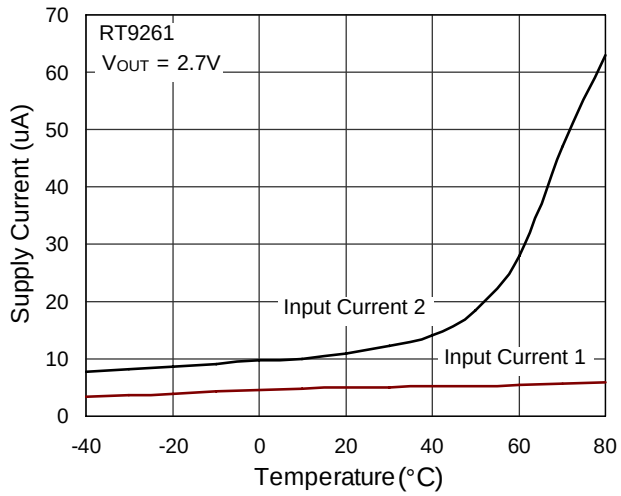

### Output Voltage vs. Temperature



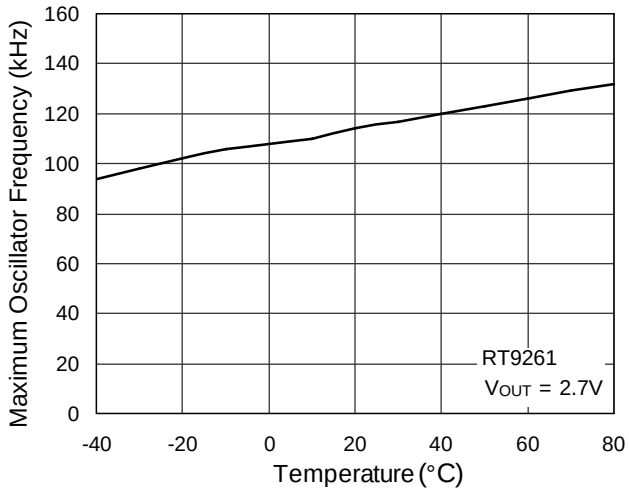

### Efficiency vs. Output Current



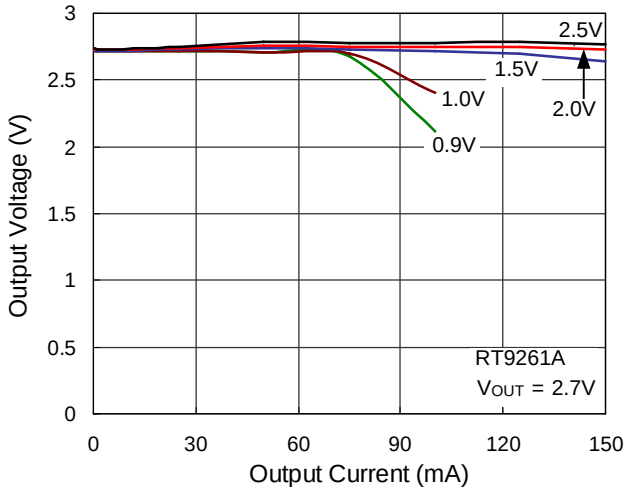

### Supply Current vs. Temperature



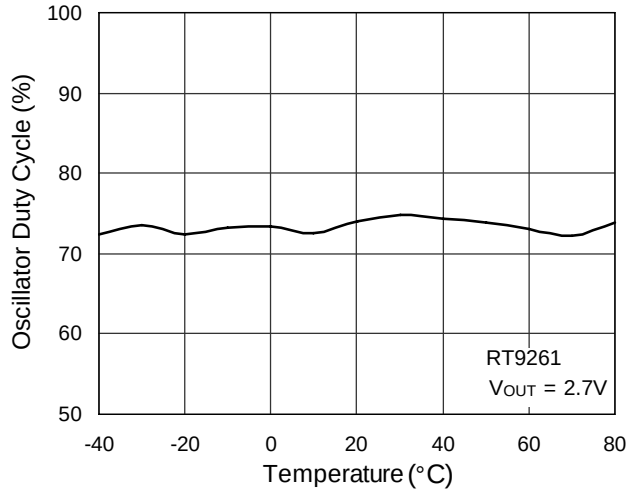
**Maximum Oscillator Frequency vs. Temperature**



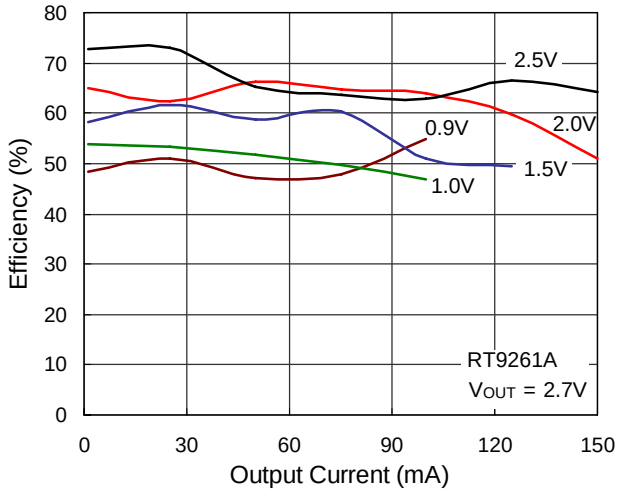

**Output Voltage vs. Output Current**



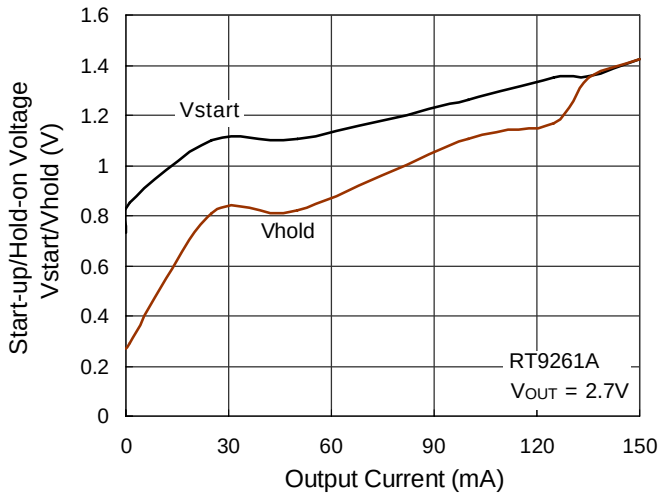

**Oscillator Duty Cycle vs. Temperature**



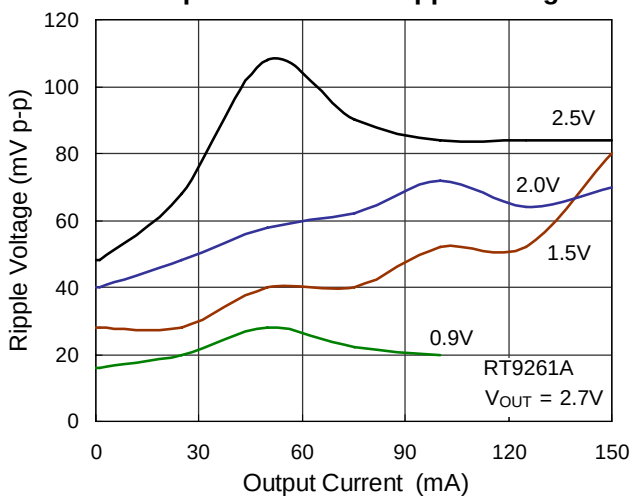

**Efficiency vs. Output Current**



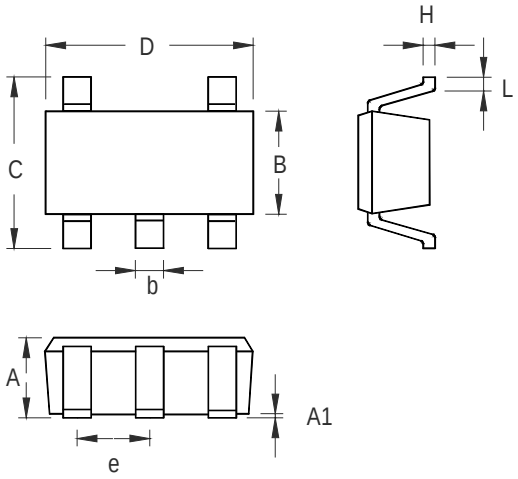

**Start-up/Hold-on Voltage vs. Output Current**




**Output Current vs. Ripple Voltage**

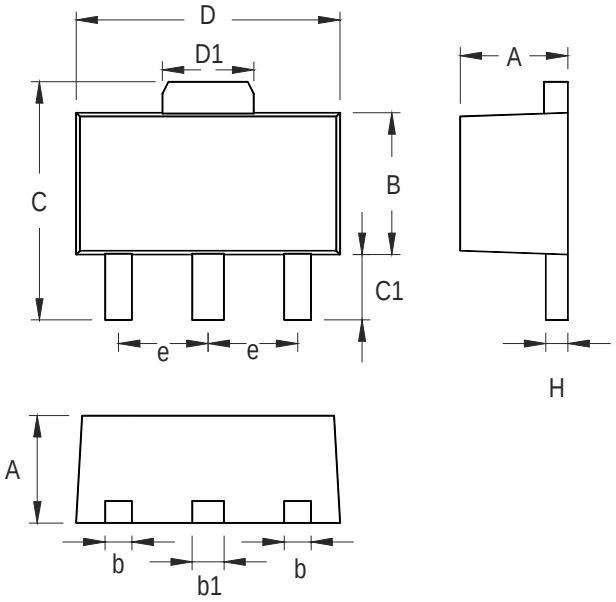


## Outline Dimension




| 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**


## Richtek Technology Corporation

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