# 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. CE pin enables circuit to set the standby supply current at a maximum of 0.5μA.

## Ordering Information

RT9261A-□□ □ □

- Package type
  - B : SOT-25
  - X : SOT-89
- Operating temperature range
  - C: Commercial standard
- Output voltage
  - 15 : 1.5V
  - 16 : 1.6V
  - :
  - 49 : 4.9V
  - 50 : 5.0V
- A : Use external switch
  - Use internal switch

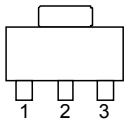
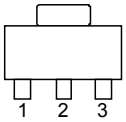
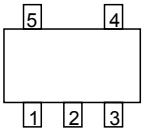
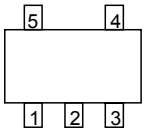
## Features

- **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-25 Small Packages**

## 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

| Part Number | Pin Configurations |
|---|---|
| RT9261-□□CX (Plastic SOT-89) |  TOP VIEW<br>1. GND<br>2. VOUT (TAB)<br>3. LX |
| RT9261A-□□CX (Plastic SOT-89) |  TOP VIEW<br>1. GND<br>2. VOUT (TAB)<br>3. EXT |
| RT9261-□□CB (Plastic SOT-25) |  TOP VIEW<br>1. CE<br>2. VOUT<br>3. NC<br>4. GND<br>5. LX |
| RT9261A-□□CB (Plastic SOT-25) |  TOP VIEW<br>1. CE<br>2. VOUT<br>3. NC<br>4. GND<br>5. EXT |

## Absolute Maximum Ratings

- Output Voltage ---- 8V
- LX Pin Voltage (1) ---- 8V
- EXT Pin Voltage (2) ---- -0.3 to $V_{OUT}$ +0.3V
- CE 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-25 ---- 0.25W
- Package Thermal Resistance
  SOT-89, $\theta_{JC}$ ---- 100°C/W
  SOT-89, $\theta_{JA}$ ---- 300°C/W
  SOT-25, $\theta_{JA}$ ---- 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-□□CX and RT9261-□□CB

(2) Applicable to RT9261A-□□CX and RT9261A-□□CB

(3) Applicable to RT9261-□□CB and RT9261A-□□CB

## Electrical Characteristics (Refer to Fig. 1)

| 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 → 2V | -- | 0.85 | 1.0 | V |
| Hold-on Voltage | | $V_{HO}$ | $I_{OUT}$ = 1mA, $V_{IN}$: 2 → 0V | 0.7 | -- | -- | V |
| Input Current 1 | $V_{OUT} \leq 3.5V$ (1) | | To be measured at $V_{IN}$ at no load | -- | 15 | 18 | μA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -- | 18 | 24 | |
| Input Current 2 | | | To be measured at $V_{OUT}$ in switch off condition | -- | 5 | 8 | μA |
| LX Switching Current | $V_{OUT} \leq 3.5V$ (1) | $I_{SWITCHING}$ | $V_{LX}$ = 0.4V | 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 | 65 | 75 | 85 | % |
| Efficiency | | | | -- | 75 | -- | % |
| $V_{LX}$ Voltage Limit | | | $L_X$ switch on | 0.65 | 0.8 | 1.0 | V |

Notes:

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

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

## Electrical Characteristics (Refer to Fig. 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 → 2V | -- | 0.85 | 1.0 | V |
| Input Current 1 | $V_{OUT} \leq 3.5V$ (1) | | To be measured at $V_{IN}$ at no load | -- | 30 | 50 | μA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -- | 60 | 90 | |
| Input Current 2 | $V_{OUT} \leq 3.5V$ (1) | | To be measured at $V_{OUT}$ in switch off condition | -- | 6 | 10 | μA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | | | | |
| EXT "H" Output Current | $V_{OUT} \leq 3.5V$ (1) | | $V_{EXT} = V_{OUT} - 0.4V$ | -1.5 | -- | -- | mA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -2 | -- | -- | |
| EXT "L" Output Current | $V_{OUT} \leq 3.5V$ (1) | | $V_{EXT}$ = 0.4V | 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 | 65 | 75 | 85 | % |

Notes:

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

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

## Electrical Characteristics (Refer to Fig. 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 | | $V_{ST}$ | $I_{OUT}$ = 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 | $V_{OUT} \leq 3.5V$ (1) | | To be measured at $V_{IN}$ at no load | -- | 15 | 18 | µA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -- | 18 | 24 | |
| Input Current 2 | $V_{OUT} \leq 3.5V$ (1) | | To be measured at $V_{OUT}$ in switch off condition | -- | 5 | 8 | µA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -- | 6 | 10 | |
| LX Switching Current | $V_{OUT} \leq 3.5V$ (1) | $I_{SWITCHING}$ | $V_{LX}$ = 0.4V | 60 | -- | -- | mA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | 80 | -- | -- | |
| LX Leakage Current | | $I_{LEAKAGE}$ | $V_{LX}$ = 6V | -- | -- | 0.5 | µA |
| CE "H" Level | | | $V_{IN} = V_{OUT} \times 0.9$ | 0.4× $V_{OUT}$ | -- | -- | V |
| CE " L" Level | | | $V_{IN} = V_{OUT} \times 0.9$ | -- | -- | 0.2 | V |
| CE " H" Input Current | | | CE = $V_{OUT}$ | -- | -- | 0.5 | µA |
| CE " L" Input Current | | | CE = 0V | -0.5 | -- | -- | µA |
| Maximum Oscillator Frequency | | $F_{MAX}$ | | 80 | 120 | 160 | KHz |
| Oscillator Duty Cycle | | $D_{OSC}$ | On ($V_{LX}$ " L" ) side | 65 | 75 | 85 | % |
| $V_{LX}$ Voltage Limit | | | LX switch on | 0.65 | 0.8 | 1.0 | V |

Notes:

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

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

## Electrical Characteristics (Refer to Fig. 4)

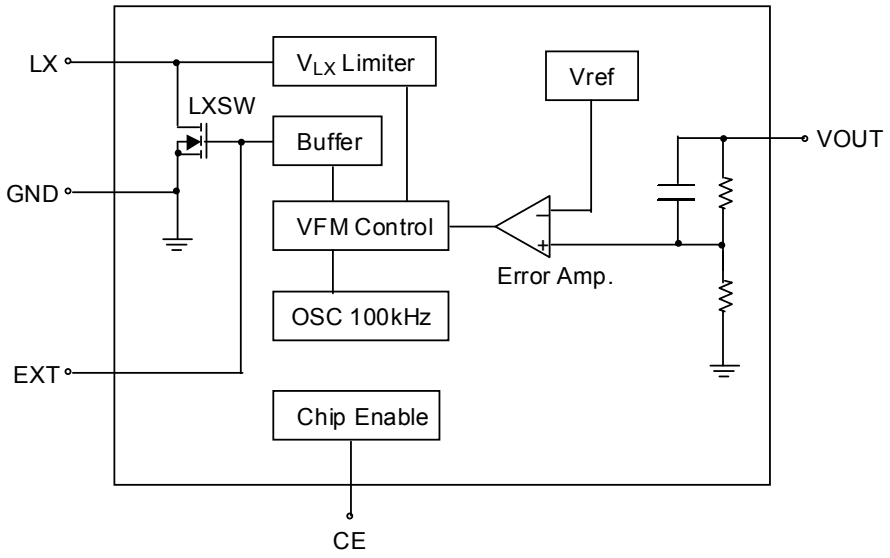
| Parameter | | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| Output Voltage Accuracy | | $\Delta V_{OUT}$ | | -2 | -- | +2 | % |
| Input Voltage | | $V_{IN}$ | | -- | -- | 7 | V |
| Start-up Voltage | | $V_{ST}$ | $I_{OUT}$ = 1mA, $V_{IN}$ : 0 → 2V | -- | 0.85 | 1.0 | V |
| Efficiency | $V_{OUT} \leq 3.5V$ (1) | | | -- | 75 | -- | % |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -- | 85 | -- | |
| Input Current 1 | $V_{OUT} \leq 3.5V$ (1) | | To be measured at $V_{IN}$ at no load | -- | 30 | 50 | µA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -- | 60 | 90 | |
| Input Current 2 | $V_{OUT} \leq 3.5V$ (1) | | To be measured at $V_{OUT}$ in switch off condition | -- | 6 | 10 | µA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | | | | |
| EXT "H" Output Current | $V_{OUT} \leq 3.5V$ (1) | | $V_{EXT} = V_{OUT} - 0.4V$ | -1.5 | -- | -- | mA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | -2 | -- | -- | |
| EXT "L" Output Current | $V_{OUT} \leq 3.5V$ (1) | | $V_{EXT}$ = 0.4V | 1.5 | -- | -- | mA |
| | $3.5V < V_{OUT} \leq 5V$ (2) | | | 2 | -- | -- | |
| CE "H" Level | | | $V_{IN} = V_{OUT} \times 0.9$ | 0.4× $V_{OUT}$ | -- | -- | V |
| CE " L" Level | | | $V_{IN} = V_{OUT} \times 0.9$ | -- | -- | 0.2 | V |
| CE " H" Input Current | | | CE = $V_{OUT}$ | -- | -- | 0.5 | µA |
| CE " L" Input Current | | | CE = 0V | -0.5 | -- | -- | µA |
| Maximum Oscillator Frequency | | $F_{MAX}$ | | 80 | 120 | 160 | KHz |
| Oscillator Duty Cycle | | $D_{OSC}$ | On ($V_{LX}$ " L" ) side | 65 | 75 | 85 | % |
| $V_{LX}$ Voltage Limit | | | LX switch on | 0.65 | 0.8 | 1.0 | V |

Notes:

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

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

## Function Block Diagram




Notes:

(1) LX Pin ……. only for 9261-□□CX and 9261-□□CB
(2) EXT Pin …… only for 9261A-□□CX and 9261A-□□CB
(3) CE Pin …… only for 9261-□□CB and 9261A-□□CB

## Pin Description

| Pin No. | | | | Pin Name | Pin Function |
|---|---|---|---|---|---|
| -xxCX | A-xxCX | -xxCB | A-xxCB | | |
| 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 | CE | Chip Enable (Active High) |
| -- | -- | 3 | 3 | NC | No Connected |

## Typical Application Circuit

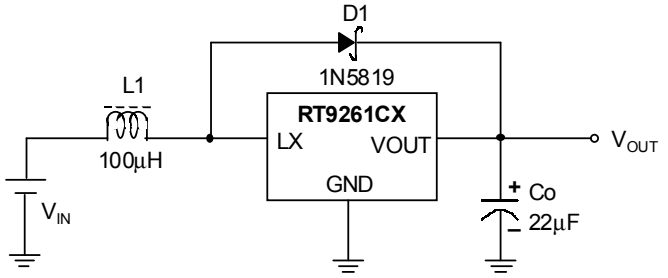



**Fig. 1**

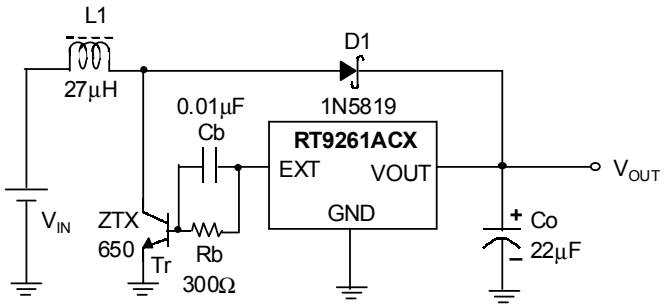



**Fig. 2**

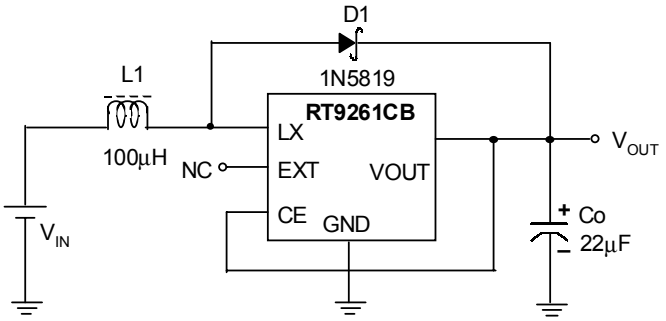



**Fig. 3**

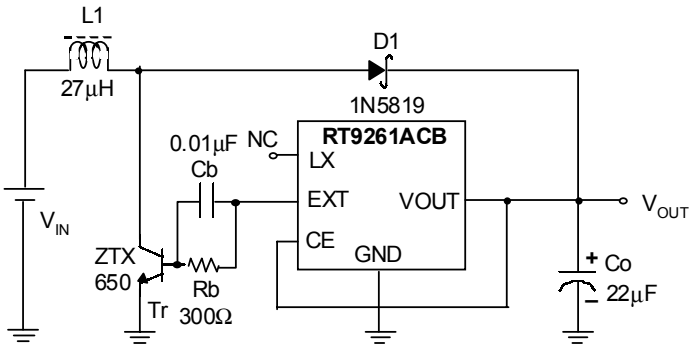



**Fig. 4**

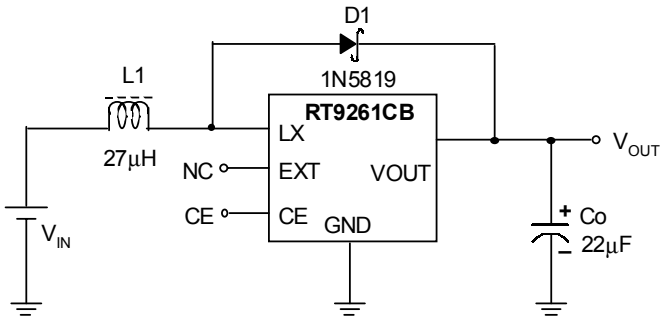
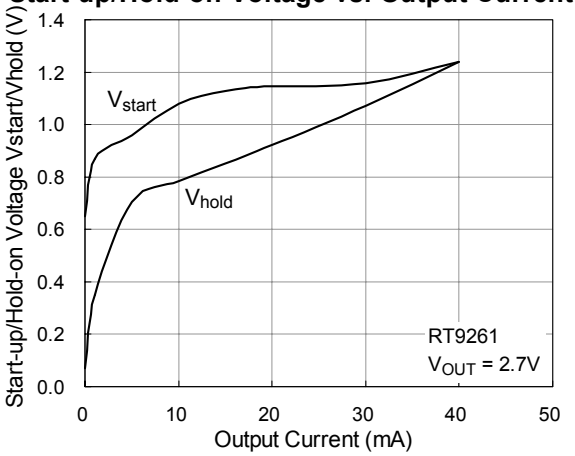


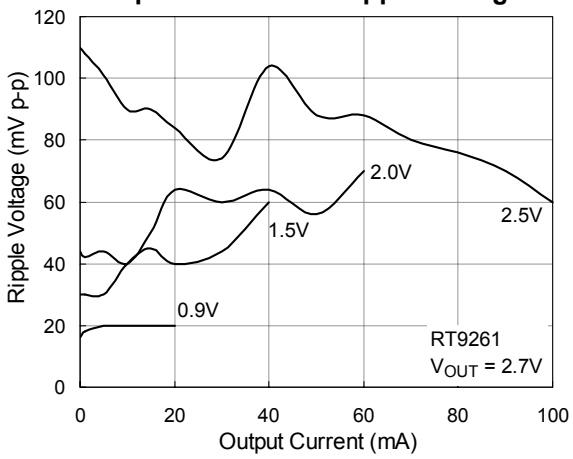

**Fig. 5**

## Typical Operating Charateristics

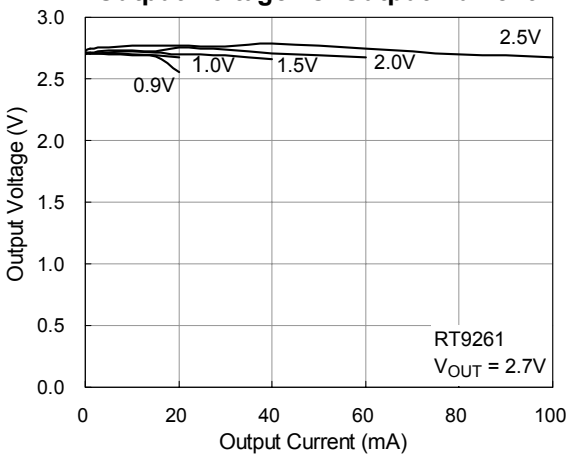
**Start-up/Hold-on Voltage vs. Output Current**



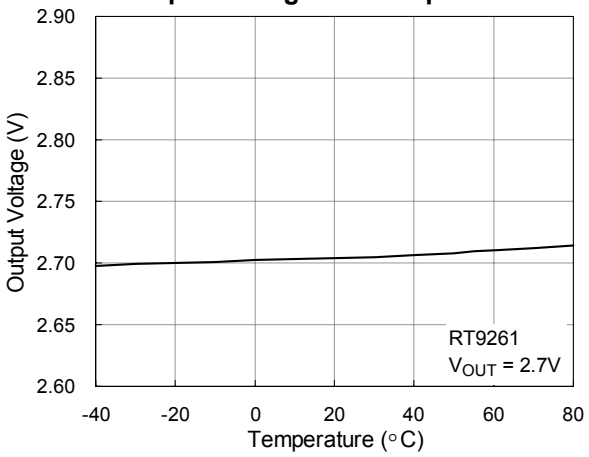

**Output Current vs. Ripple Voltage**



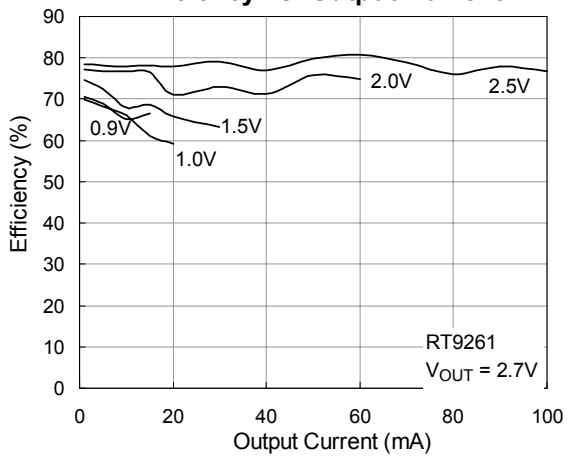

**Output Voltage vs. Output Current**



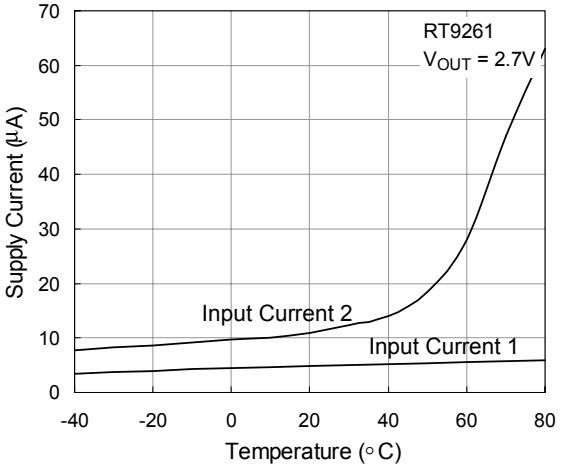

**Output Voltage vs. Temperature**



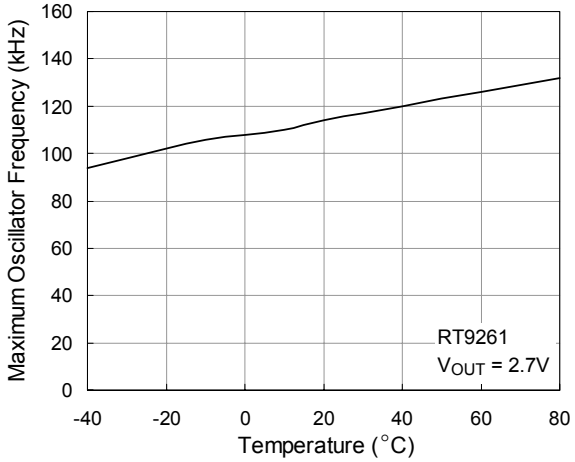

**Efficiency vs. Output Current**



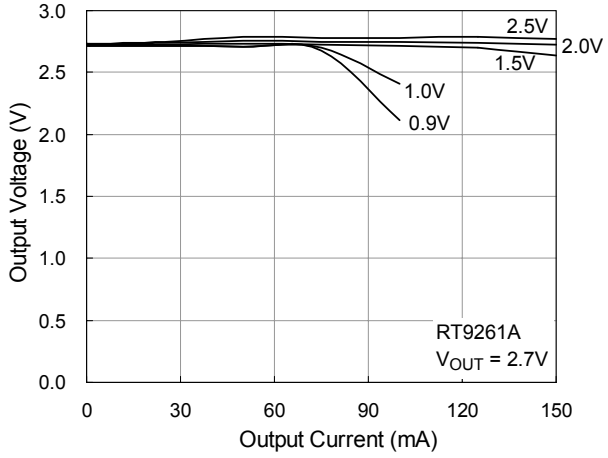

**Supply Current vs. Temperature**



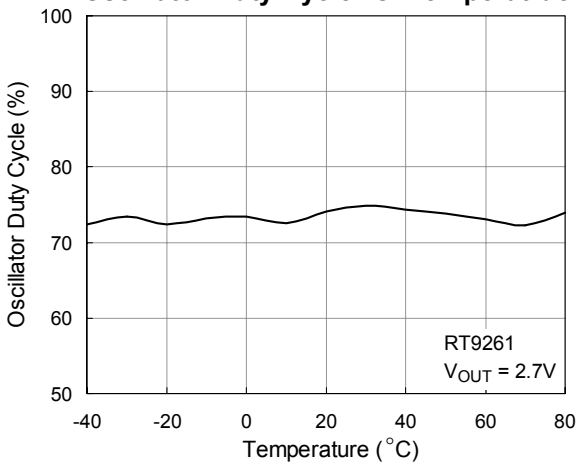
**Maximum Oscillator Frequency vs. Temp.**



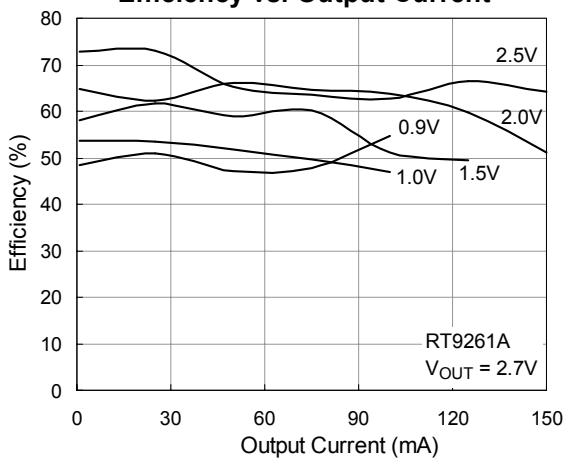

**Output Voltage vs. Output Current**



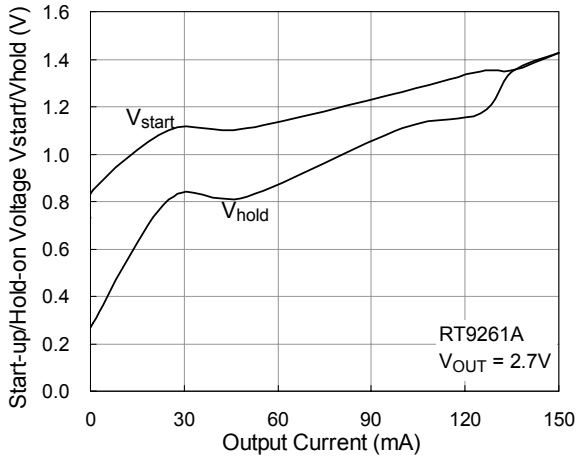

**Oscillator Duty Cycle vs. Temperatrue**



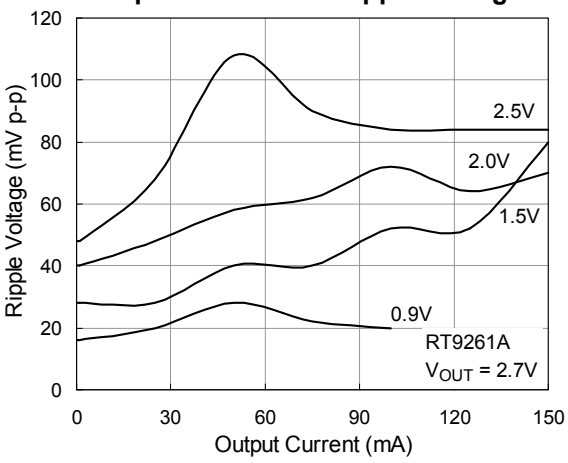

**Efficiency vs. Output Current**



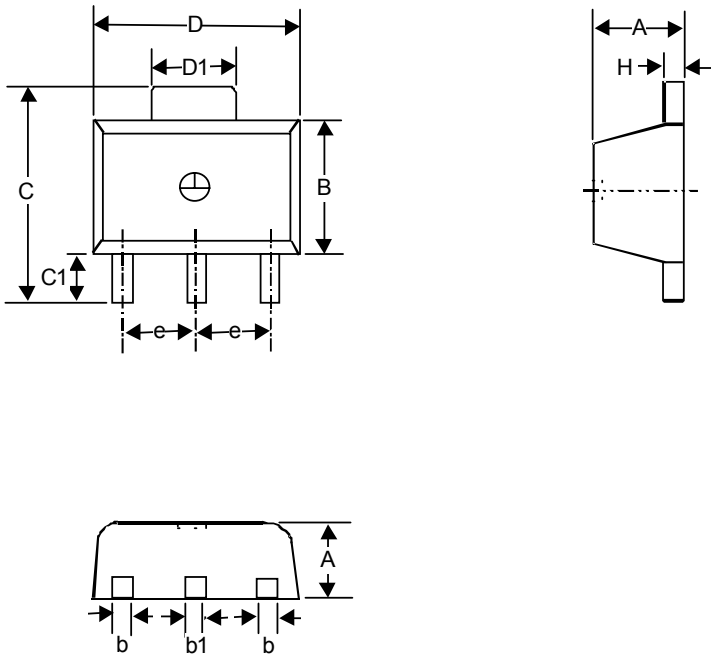

**Start-up/Hold-on Voltage vs. Output Current**




**Output Current vs. Ripple Voltage**

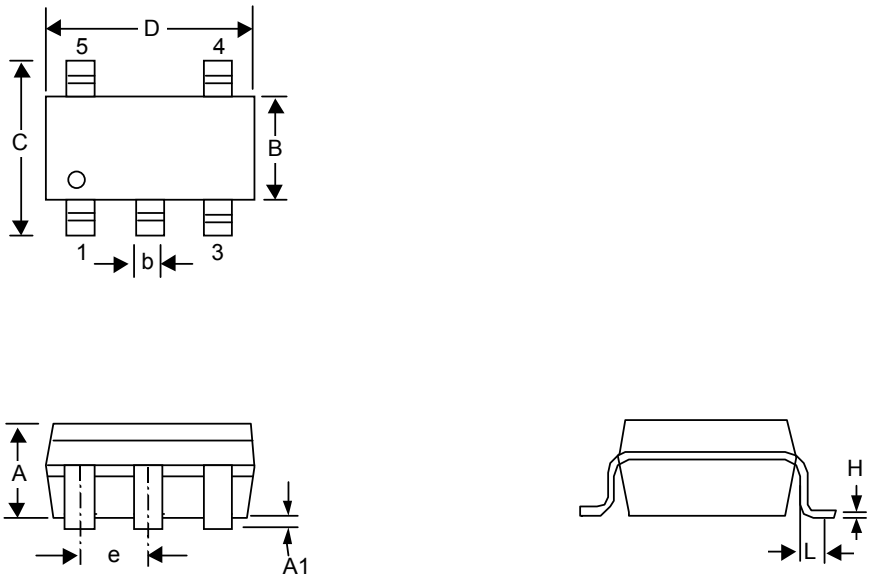


## Package Information




| 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 | -- | 4.242 | -- | 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 | 0.355 | 0.432 | 0.014 | 0.017 |

**3-Lead SOT-89 Surface Mount**




| 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 | 0.102 | 0.254 | 0.004 | 0.010 |
| L | 0.356 | 0.610 | 0.014 | 0.024 |

**SOT- 25 Surface Mount Package**

**RICHTEK TECHNOLOGY CORP.**
Headquarter
6F, No. 35, Hsintai Road, Chupei City
Hsinchu, Taiwan, R.O.C.
Tel: (8863)5510047 Fax: (8863)5537749

**RICHTEK TECHNOLOGY CORP.**
Taipei Office (Marketing)
8F-1, No. 137, Lane 235, Paochiao Road, Hsintien City
Taipei County, Taiwan, R.O.C.
Tel: (8862)89191466 Fax: (8862)89191465
Email: marketing@richtek-ic.com.tw