

VFM Step-up DC/DC Converter

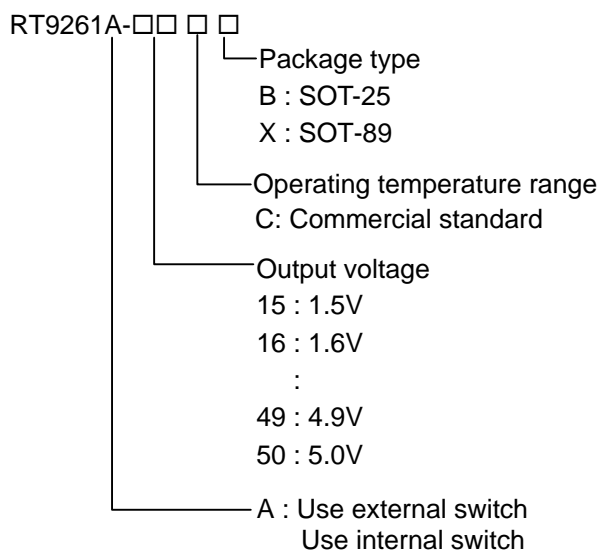
General Description

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 0.5 μ A.

Ordering Information



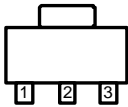
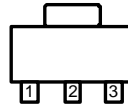
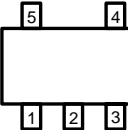
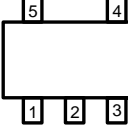
Features

- **Minimal Number of External Components (Only an inductor, a diode, and a capacitor)**
- **Ultra Low Input Current (5 μ A at Switch Off)**
- **$\pm 2\%$ 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/ $^{\circ}$ 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)	 <p>TOP VIEW</p> <ol style="list-style-type: none"> 1. GND 2. VOUT (TAB) 3. LX
RT9261A-□□CX (Plastic SOT-89)	 <p>TOP VIEW</p> <ol style="list-style-type: none"> 1. GND 2. VOUT (TAB) 3. EXT
RT9261-□□CB (Plastic SOT-25)	 <p>TOP VIEW</p> <ol style="list-style-type: none"> 1. CE 2. VOUT 3. NC 4. GND 5. LX
RT9261A-□□CB (Plastic SOT-25)	 <p>TOP VIEW</p> <ol style="list-style-type: none"> 1. CE 2. VOUT 3. NC 4. GND 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, θ _{JC}	-----	100°C/W
• SOT-89, θ _{JA}	-----	300°C/W
• SOT-25, θ _{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	ΔV _{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} ≤ 3.5V ⁽¹⁾	To be measured at V _{IN} at no load	--	15	18	μA
	3.5V < V _{OUT} ≤ 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} ≤ 3.5V ⁽¹⁾	I _{SWITCHING} V _{LX} = 0.4V	60	--	--	mA
	3.5V < V _{OUT} ≤ 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, V_{SS} = 0V, I_{OUT} = 10mA, T_{OPT} = 25°C, and External Circuit of Typical Application
- (2) V_{IN} = 3V, V_{SS} = 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	ΔV_{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	$V_{OUT} \leq 3.5V^{(1)}$	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, $V_{IN} = 1.8V, V_{SS} = 0V, I_{OUT} = 10mA, T_{OPT} = 25^{\circ}C$, 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 Fig. 3)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Output Voltage Accuracy	ΔV_{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	$V_{OUT} \leq 3.5\text{V}^{(1)}$	To be measured at V_{IN} at no load	--	15	18	μA
	$3.5\text{V} < V_{OUT} \leq 5\text{V}^{(2)}$		--	18	24	
Input Current 2	$V_{OUT} \leq 3.5\text{V}^{(1)}$	To be measured at V_{OUT} in switch off condition	--	5	8	μA
	$3.5\text{V} < V_{OUT} \leq 5\text{V}^{(2)}$		--	6	10	
LX Switching Current	$V_{OUT} \leq 3.5\text{V}^{(1)}$	$I_{SWITCHING}$ $V_{LX} = 0.4\text{V}$	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	μA
CE "H" Level		$V_{IN} = V_{OUT} \times 0.9$	$0.4 \times V_{OUT}$	--	--	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		$CE = 0\text{V}$	-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, $V_{IN} = 1.8\text{V}$, $V_{SS} = 0\text{V}$, $I_{OUT} = 10\text{mA}$, $T_{OPT} = 25^\circ\text{C}$, 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

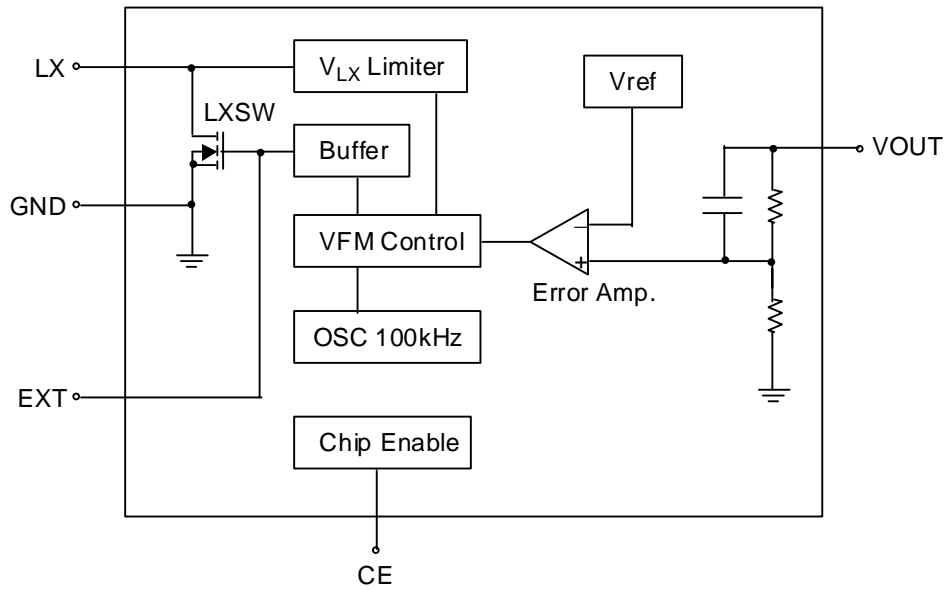
Electrical Characteristics (Refer to Fig. 4)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Output Voltage Accuracy	ΔV_{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	$V_{OUT} \leq 3.5V^{(1)}$	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		$V_{IN} = V_{OUT} \times 0.9$	$0.4 \times V_{OUT}$	--	--	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, $V_{IN} = 1.8V, V_{SS} = 0V, I_{OUT} = 10mA, T_{OPT} = 25^{\circ}C$, 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

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

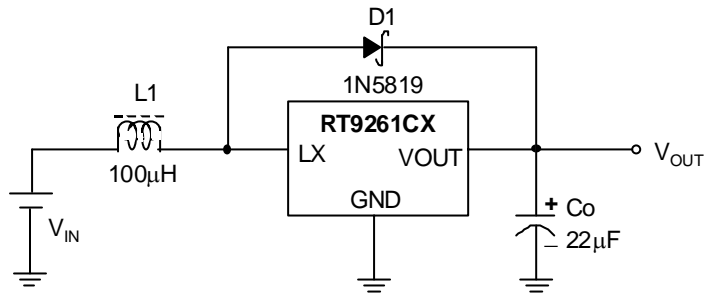


Fig. 1

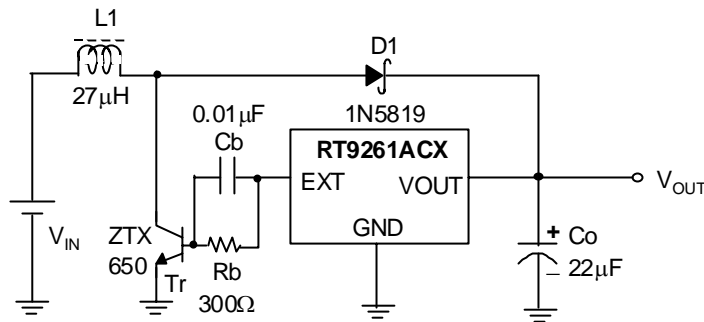


Fig. 2

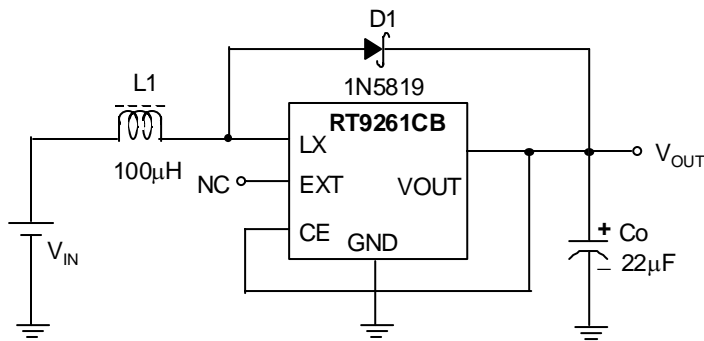


Fig. 3

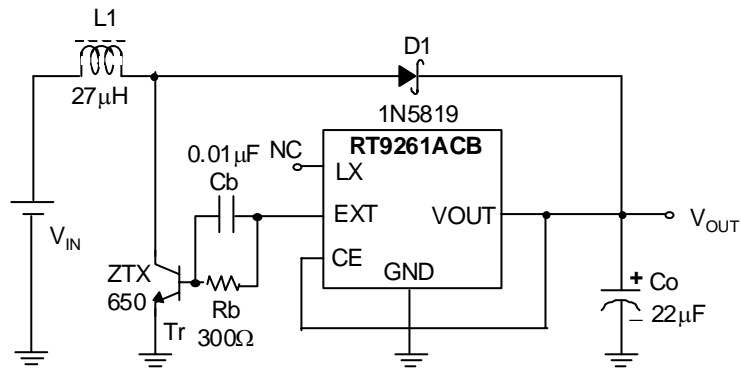


Fig. 4

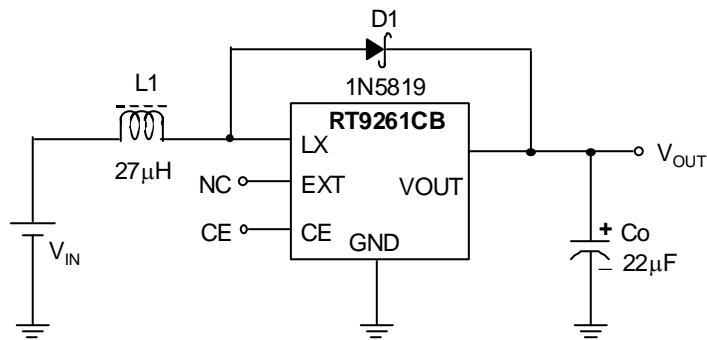
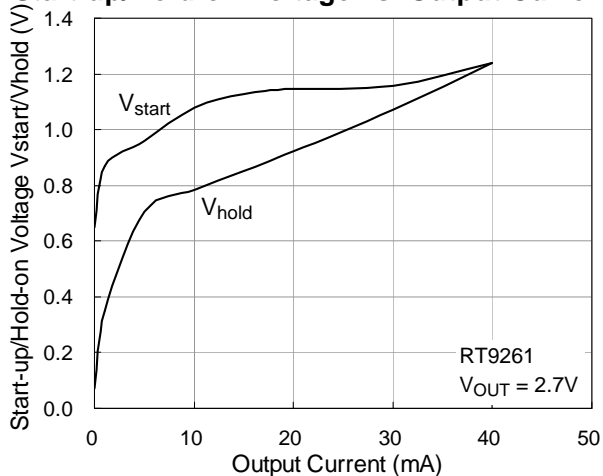


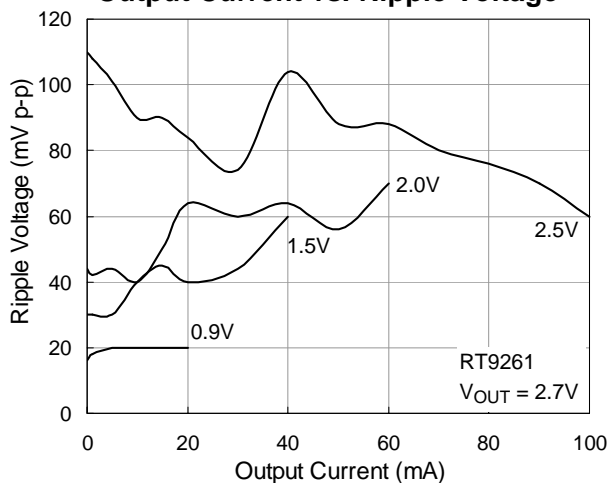
Fig. 5

Typical Operating Characteristics

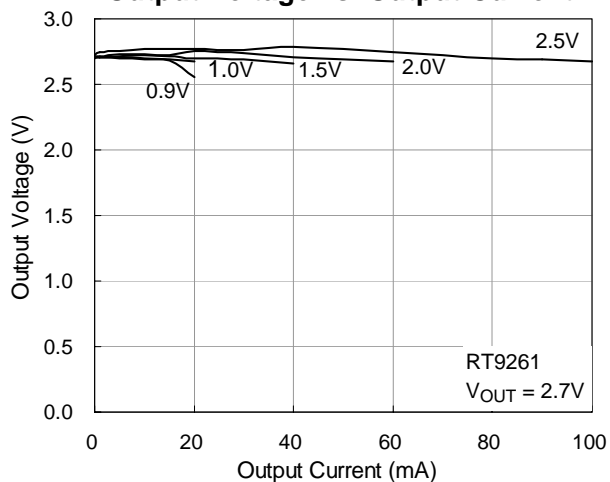
Start-up/Hold-on Voltage vs. Output Current



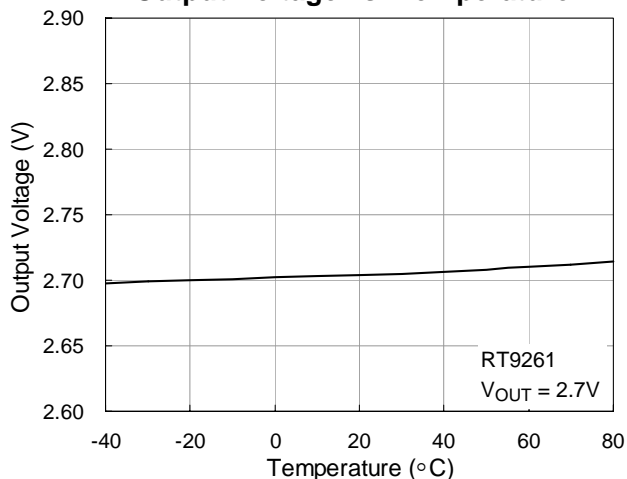
Output Current vs. Ripple Voltage



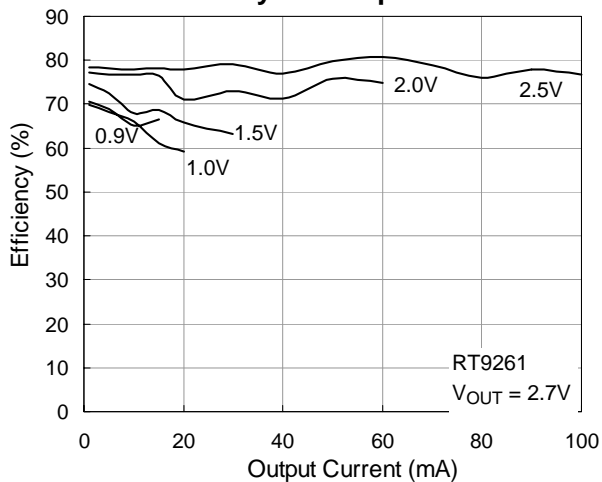
Output Voltage vs. Output Current



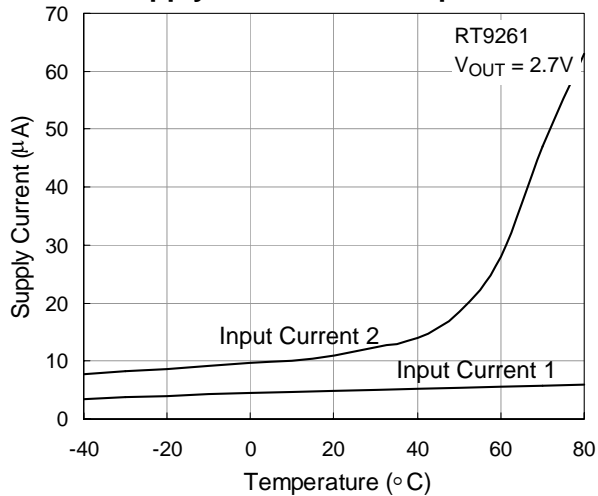
Output Voltage vs. Temperature



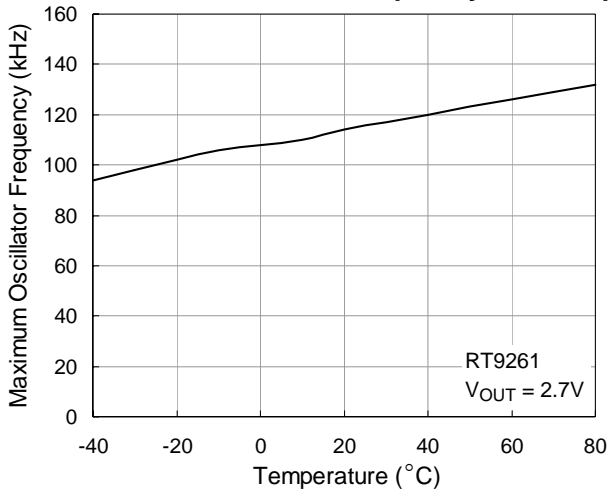
Efficiency vs. Output Current



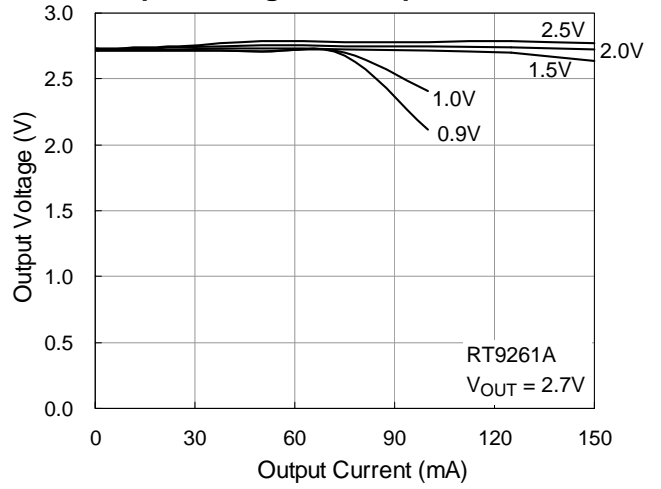
Supply Current vs. Temperature



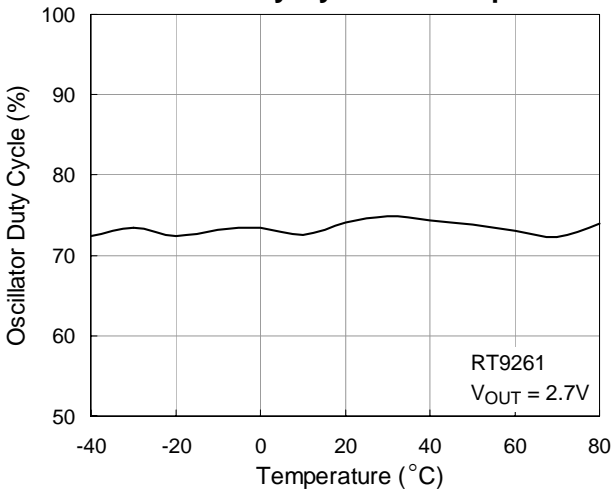
Maximum Oscillator Frequency vs. Temp.



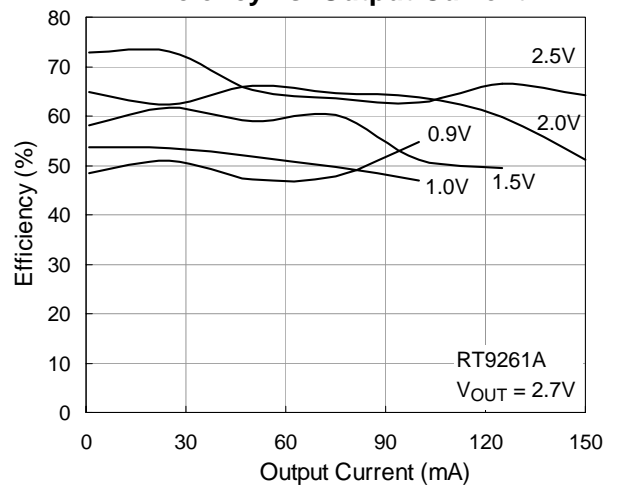
Output Voltage vs. Output Current



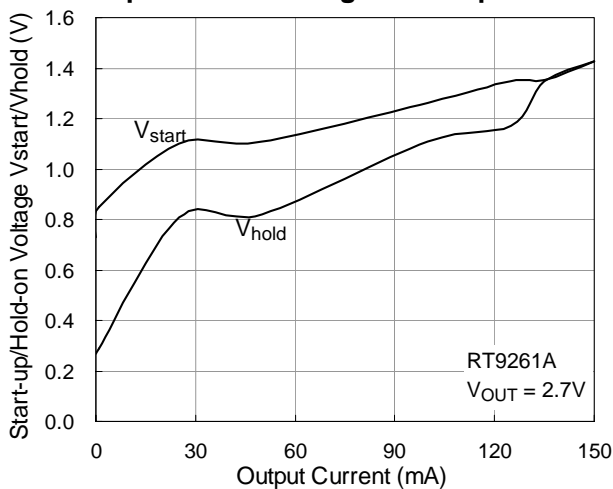
Oscillator Duty Cycle vs. Temperature



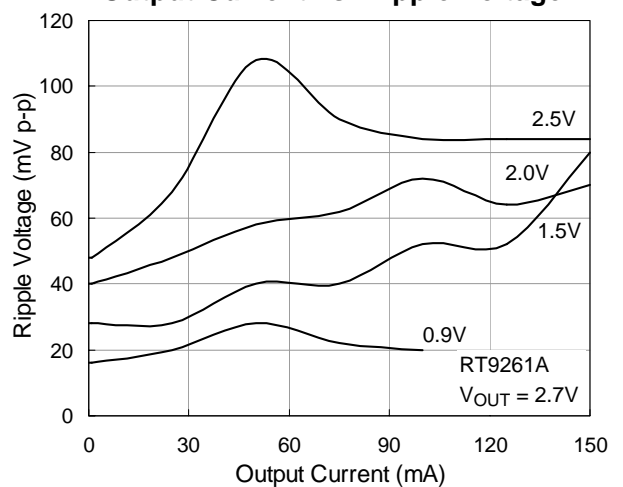
Efficiency vs. Output Current



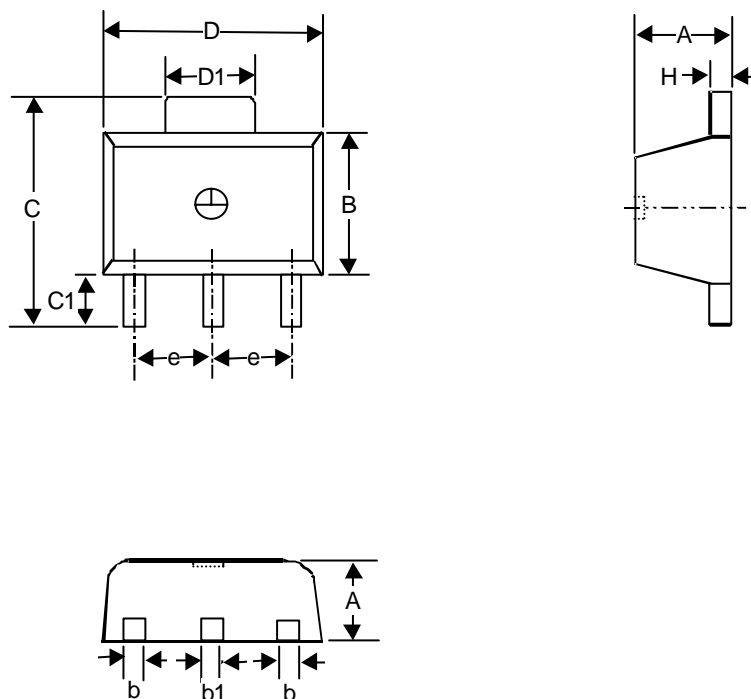
Start-up/Hold-on Voltage vs. Output Current



Output Current vs. Ripple Voltage

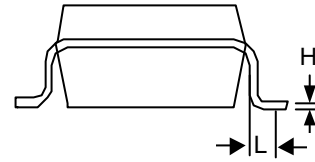
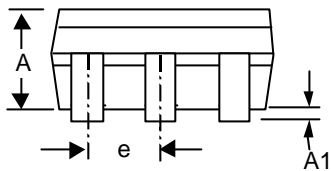
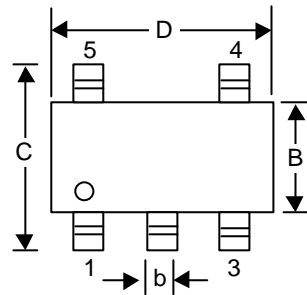


Package Information



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

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