VFM STEP-UP DC/DC CONVERTER CONTROLLER

RN5RY××1 SERIES

OUTLINE

The RN5RY××1 Series are VFM Control ICs for step-up DC/DC converter with an external driver transistor featuring high output voltage accuracy and low supply current by CMOS process. The RN5RY××1 Series ICs consist of a voltage reference unit, an error amplifier, an oscillator, a VFM control circuit and feed back resistors. A low ripple, high efficiency step-up DC/DC converter can be constructed of the RN5RY××1 Series with only an inductor, a diode, a capacitor, and a drive transistor.

Since the package for these ICs are SOT-23-5(Mini-mold)package, high density mounting of the ICs on boards is possible.

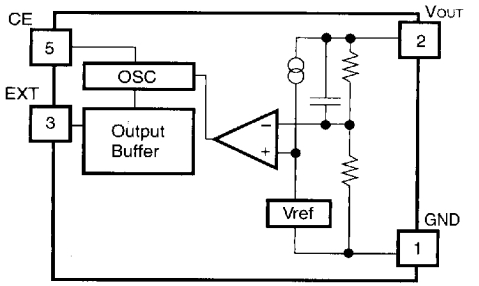
FEATURES

- Low Supply Current ..... TYP. 3μA
- Low Standby Current ..... TYP. 0.6μA
- Low Temperature-Drift Coefficient of Output Voltage ..... TYP. ±50ppm / °C
- High Accuracy Output Voltage ..... ±2.5%
- Low Oscillation Start-up Voltage ..... MAX. 0.8V
- Small Package ..... SOT-23-5(Mini-Mold)

APPLICATIONS

- Power source for battery-powered instruments.
- Power source for cameras, VCRs, camcorders, pagers, and other hand-held communication instruments.

BLOCK DIAGRAM



SELECTION GUIDE

In the RN5RY××1 Series, the output voltage, the version and the taping type for the ICs can be selected at the user's request. The selection can be made by designating the part number as shown below :

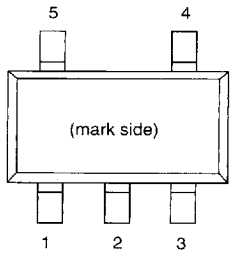
RN5RY××××-×× ← Part Number
↑ ↑↑ ↑
a bc d

Code	Contents
a	Designation of Output Voltage (V_{OUT}) V_{OUT} can be designated within the range of 2.0 to 6.0V
b	1
c	Designation of Packing Type: A: Taping C: Antistatic bag for samples
d	Designation of Taping Type: Ex. SOT-23-5: TR, TL (refer to Taping Specification) "TR" is prescribed as a standard

For example, the product with Output Voltage 2.0V, Taping Type TR, is designated by Part Number RN5RY201A–TR.

PIN CONFIGURATION

• SOT-23-5



PIN DESCRIPTION

Pin No.	Symbol	Description
1	GND	Ground Pin
2	VOUT	Output Pin
3	EXT	External Transistor Drive Pin (CMOS Output)
4	NC	No Connection
5	CE	Chip Enable Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Ratings	Unit
V_{IN}	Input Voltage	+12	V
V_{CE}	CE Pin Input Voltage	−0.3 to V_{OUT}+0.3	V
V_{EXT}	EXT Pin Output Voltage	−0.3 to V_{OUT}+0.3	V
I_{EXT}	EXT Pin Output Current	±50	mA
P_D	Power Dissipation	150	mW
Topt	Operating Temperature	−30 to +85	°C
Tstg	Storage temperature	−55 to +125	°C
Tsolder	Lead Temperature (Soldering)	260°C, 10s	

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum ratings are threshold limit values that must not be exceeded even for an instant under any conditions. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

ELECTRICAL CHARACTERISTICS

• **RN5RY301**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}=1.5V, I_{OUT}=10mA	2.925	3.000	3.075	V
V_{IN}	Input Voltage				10	V
I_{DD1}	Supply Current 1	EXT No load, V_{OUT}=3.15V, Test circuits1		3	5	μA
I_{DD2}	Supply Current 2	EXT No load, V_{OUT}=2.85V, Test circuits1		25	50	μA
Istandby	Standby Current	V_{OUT}=1.5V, Test circuits2		0.6	1.5	μA
fosc	Maximum Oscillator Frequency	V_{OUT}=2.85V, Test circuits3		180		kHz
Duty	Oscillator Duty Cycle	V_{OUT}=2.85V, EXT High side, Test circuits3	60	75		%
Vstart	Oscillator Start-Up Voltage	EXT No load, Test circuits4		0.7	0.8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA −30°C≤Topt≤85°C		±50		ppm/°C
I_{EXTH}	EXT "H" Output Current	V_{OUT}=2.85V, V_{EXT}=GND, Test circuits5			−1.5	mA
I_{EXTL}	EXT "L" Output Current	V_{OUT}=2.85V, V_{EXT}=2.85V, Test circuits6	1.5			mA
V_{CEH}	CE "H" Input Voltage	V_{OUT}=2.85V, Test circuits4	1.5			V
V_{CEL}	CE "L" Input Voltage	V_{OUT}=2.85V, Test circuits4			0.25	V
I_{CEH}	CE "H" Input Current	CE=3.0V, Test circuits7		0	0.1	μA
I_{CEL}	CE "L" Input Current	CE=GND, Test circuits8	−0.1	0		μA

• **RN5RY401**

Topt=25°C

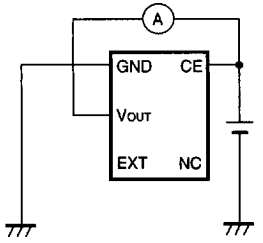
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}=2.0V, I_{OUT}=10mA	3.900	4.000	4.100	V
V_{IN}	Input Voltage				10	V
I_{DD1}	Supply Current 1	EXT No load, V_{OUT}=4.2V, Test circuits1		3	5	μA
I_{DD2}	Supply Current 2	EXT No load, V_{OUT}=3.8V, Test circuits1		50	90	μA
Istandby	Standby Current	V_{OUT}=2.0V, Test circuits2		0.6	1.5	μA
fosc	Maximum Oscillator Frequency	V_{OUT}=3.8V, Test circuits3		180		kHz
Duty	Oscillator Duty Cycle	V_{OUT}=3.8V, EXT High side, Test circuits3	60	75		%
Vstart	Oscillator Start-Up Voltage	EXT No load, Test circuits4		0.7	0.8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA −30°C≤Topt≤85°C		±50		ppm/°C
I_{EXTH}	EXT "H" Output Current	V_{OUT}=3.8V, V_{EXT}=GND, Test circuits5			−1.5	mA
I_{EXTL}	EXT "L" Output Current	V_{OUT}=3.8V, V_{EXT}=3.8V, Test circuits6	1.5			mA
V_{CEH}	CE "H" Input Voltage	V_{OUT}=3.8V, Test circuits4	1.5			V
V_{CEL}	CE "L" Input Voltage	V_{OUT}=3.8V, Test circuits4			0.25	V
I_{CEH}	CE "H" Input Current	CE=4.0V, Test circuits7		0	0.1	μA
I_{CEL}	CE "L" Input Current	CE=GND, Test circuits8	−0.1	0		μA

• **RN5RY501**

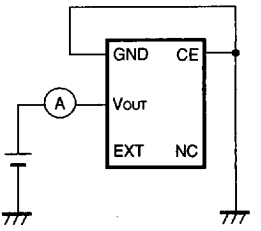
Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}=2.5V, I_{OUT}=10mA	4.875	5.000	5.125	V
V_{IN}	Input Voltage				10	V
I_{DD1}	Supply Current 1	EXT No load, V_{OUT}=5.25V, Test circuits1		3	5	μA
I_{DD2}	Supply Current 2	EXT No load, V_{OUT}=4.75V, Test circuits1		90	150	μA
Istandby	Standby Current	V_{OUT}=2.5V, Test circuits2		0.6	1.5	μA
fosc	Maximum Oscillator Frequency	V_{OUT}=4.75V, Test circuits3		180		kHz
Duty	Oscillator Duty Cycle	V_{OUT}=4.75V, EXT High side, Test circuits3	60	75		%
Vstart	Oscillator Start-Up Voltage	EXT No load, Test circuits4		0.7	0.8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA −30°C≤Topt≤85°C		±50		ppm/°C
I_{EXTH}	EXT "H" Output Current	V_{OUT}=4.75V, V_{EXT}=GND, Test circuits5			−1.5	mA
I_{EXTL}	EXT "L" Output Current	V_{OUT}=4.75V, V_{EXT}=4.75V, Test circuits6	1.5			mA
V_{CEH}	CE "H" Input Voltage	V_{OUT}=4.75V, Test circuits4	1.5			V
V_{CEL}	CE "L" Input Voltage	V_{OUT}=4.75V, Test circuits4			0.25	V
I_{CEH}	CE "H" Input Current	CE=5.0V, Test circuits7		0	0.1	μA
I_{CEL}	CE "L" Input Current	CE=GND, Test circuits8	−0.1	0		μA

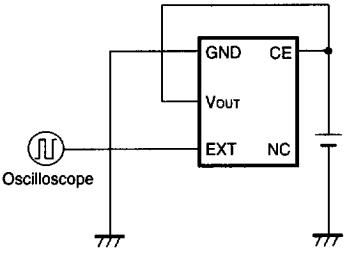
TEST CIRCUIT



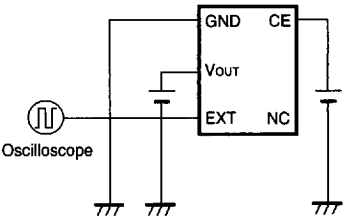
Test Circuit 1



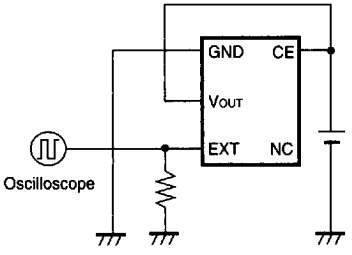
Test Circuit 2



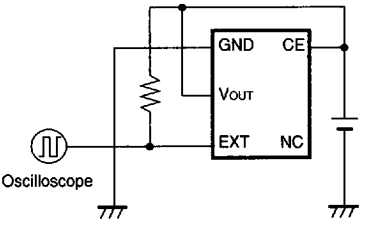
Test Circuit 3



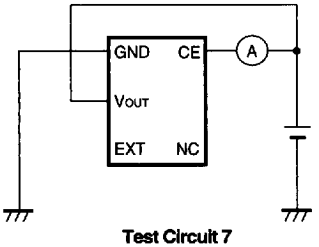
Test Circuit 4



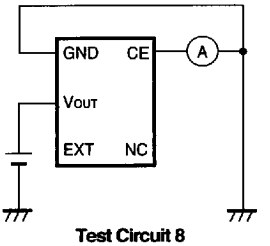
Test Circuit 5



Test Circuit 6



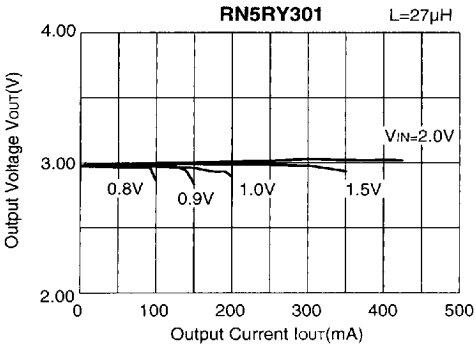
Test Circuit 7

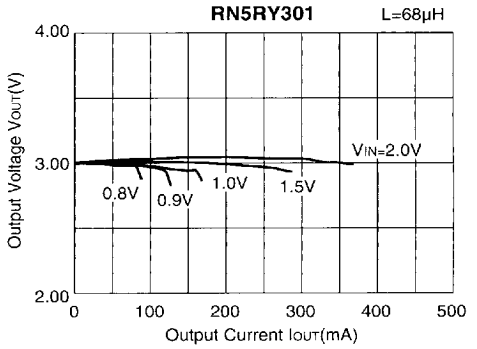


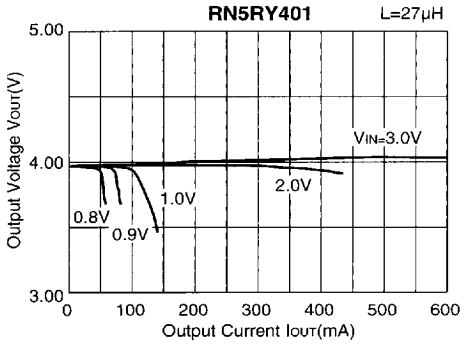
Test Circuit 8

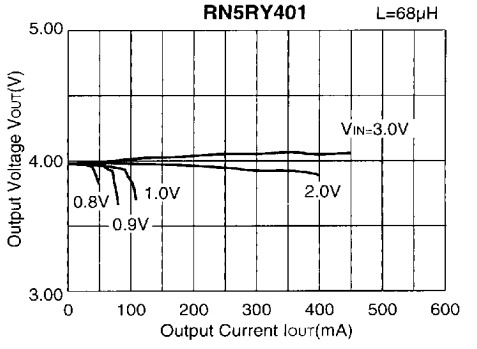
TYPICAL CHARACTERISTICS

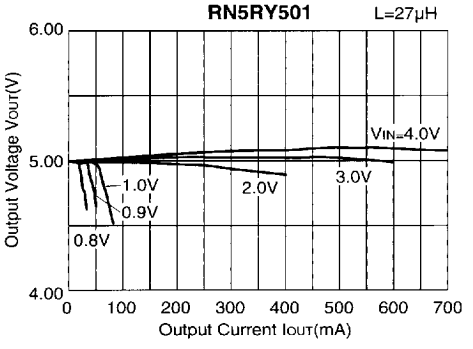
1) Output Voltage vs. Output Current

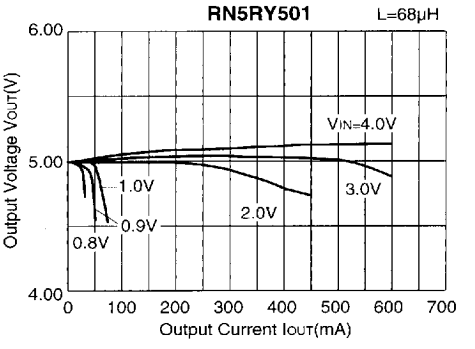




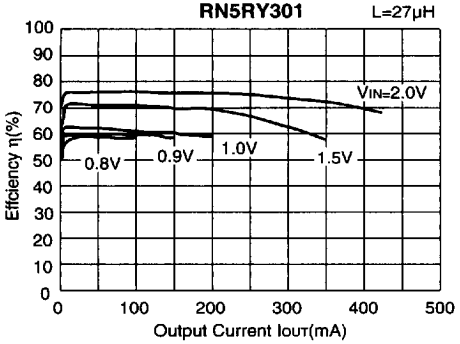


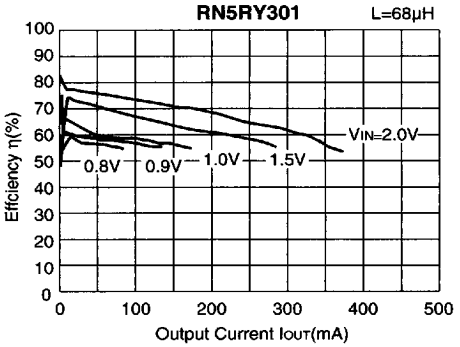


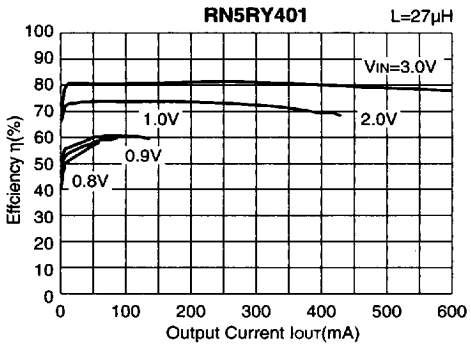


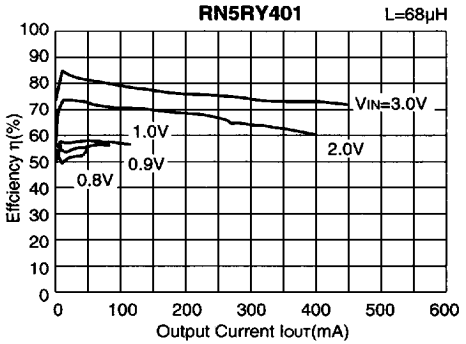


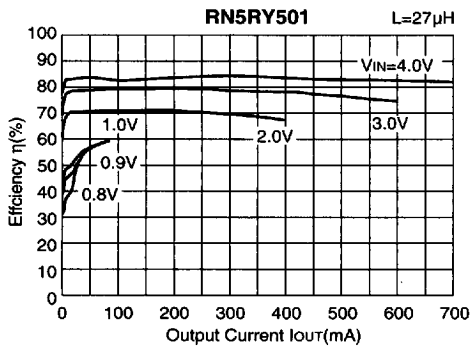
2) Efficiency vs. Output Current

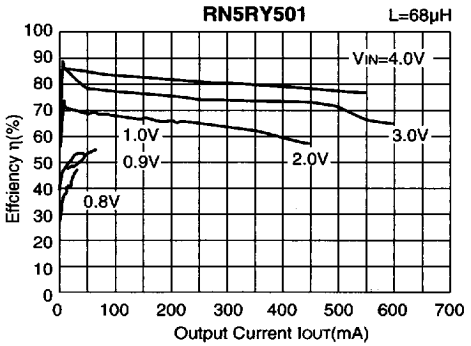




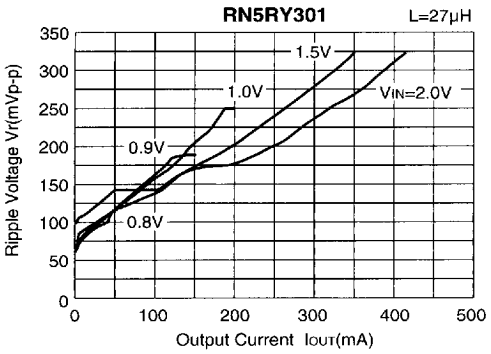


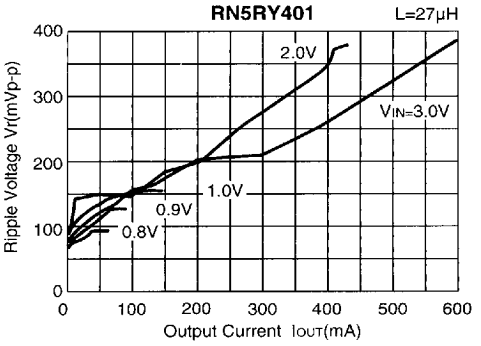


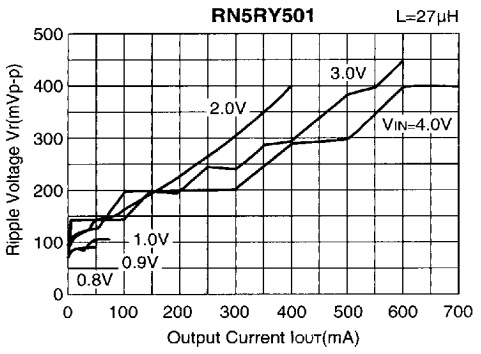




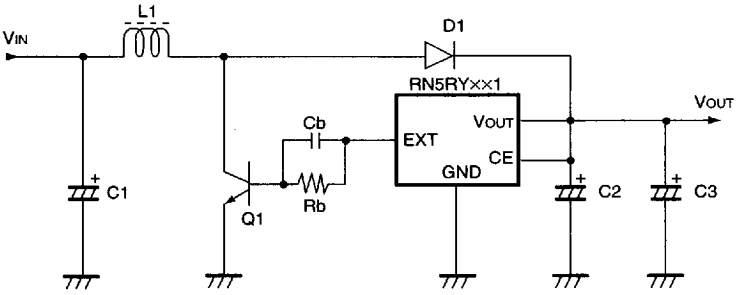
3) Ripple Voltage vs. Output Current







TYPICAL APPLICATIONS



Components : Inductor (L1) : CD105
Diode (D1) : D1FS4A (Schottky Type)
Capacitor (C1) : 33μF (Tantalum Type)
Capacitor (C2) : 47μF (Tantalum Type)
Capacitor (C3) : 47μF (Tantalum Type)
Transistor (Q1) : 2SD1628G
Base Resistor (Rb) : 220Ω
Base Capacitor (Cb) : 2200pF

APPLICATION HINTS

- A spike-shaped voltage higher than output voltage may be applied to the driver transistor. Therefore, care should be paid regarding its absolute maximum ratings (V_{DS}, V_{CF}). We recommend to use a transistor having absolute maximum ratings of at least twice the set output voltage.
- We also recommend the use of an output capacitor with an allowable voltage which is at least 1.5 times the set output voltage. This is because there may be the case where a spike-shaped voltage higher than the set output voltage is generated.
  Use capacitor with good high frequency characteristics such as tantalum capacitor.
- Choose such an inductor that a sufficiently small d.c. resistance and large allowable current, and hardly reaches magnetic saturation.
- Use a diode of a Schottky type with high switching speed, and also take care of the rated current.
- Set external components as close as possible to the IC and minimize the current between the components and the IC. In particular, make minimum connection with the output capacitor.
- Make sufficient grounding. A large current flows through GND Pin by switching. When the impedance of the GND connection is high, the potential within the IC is varied by the switching current. This may result in unstable operation of the IC.