

## OUTLINE

The RN5RT Series are CMOS-based voltage regulator ICs with high output voltage accuracy and low supply current developed. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, output voltage setting resistors and a current limit circuit.

The output voltage of these ICs is fixed with high accuracy.

The built-in Driver Transistor of low ON Resistance permits developing of low dropout CMOS type regulator as RN5RT Series.

Even if  $V_{OUT}$  is shorted to GND, the current limit circuit protects the ICs from destruction.

Furthermore, these ICs have a chip enable function, so that the supply current on standby can be minimized.

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

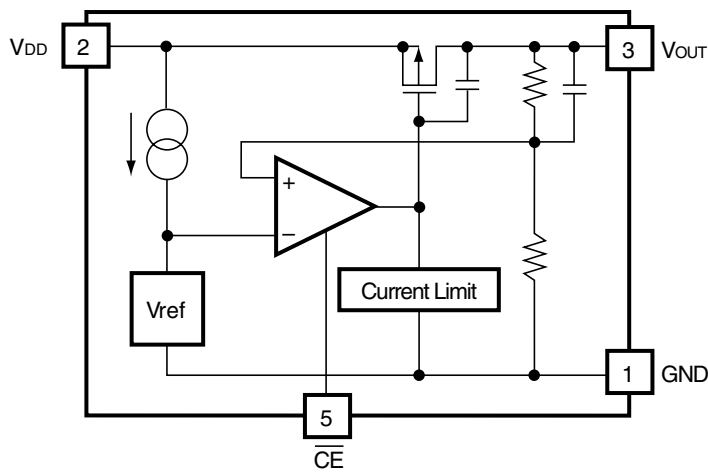
## FEATURES

- Ultra-Low Supply Current.....Typ. 4 $\mu$ A (except ICEL)
- Standby Mode.....Typ. 0.1 $\mu$ A
- Low Dropout Voltage.....Typ. 0.3V ( $I_{OUT}=60\text{mA}$ , RN5RT30A)
- Low Temperature-Drift Coefficient of Output Voltage.....Typ.  $\pm 100\text{ppm}/^{\circ}\text{C}$
- Excellent Line Regulation.....Typ. 0.15%/V
- Output Voltage.....Stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible (refer to Selection Guide).
- High Accuracy Output Voltage..... $\pm 2.0\%$
- Built-in Current Limit Circuit.....Typ. 30mA
- Small Package.....SOT-23-5 (Mini-mold)

## APPLICATIONS

- Power source for battery-powered equipment.
- Power source for cellular phones, cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- Power source for domestic appliances.

## BLOCK DIAGRAM



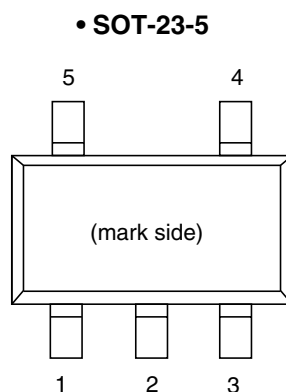
## SELECTION GUIDE

The output voltage, the packing type, and the taping type for the ICs can be selected at the user's request. These selections can be made by designating the part number as shown below:

RN5RT xxxx-x ← Part Number  
 ↑↑↑ ↑  
 a b c d

Code	Contents
a	Setting Output Voltage (V <sub>OUT</sub> ) : Stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible.
b	A
c	Designation of Packing Type : A : Taping C : Antistatic bag (for Samples only)
d	Designation of Taping Type : Ex. TR, TL (refer to Taping Specifications ; TR type is the standard direction.)

## PIN CONFIGURATION



## PIN DESCRIPTION

Pin No.	Symbol	Description
1	GND	Ground Pin
2	VDD	Input Pin
3	VOUT	Output Pin
4	NC	No Connection
5	$\overline{\text{CE}}$	Chip Enable Pin

## ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Ratings	Unit
V <sub>IN</sub>	Input Voltage	9	V
V <sub>CE</sub>	Input Voltage ( $\overline{\text{CE}}$ Pin)	-0.3 to V <sub>IN</sub> +0.3	V
V <sub>OUT</sub>	Output Voltage	-0.3 to V <sub>IN</sub> +0.3	V
I <sub>OUT</sub>	Output Current	150	mA
P <sub>D</sub>	Power Dissipation	420*	mW
T <sub>opt</sub>	Operating Temperature	-40 to +85	°C
T <sub>stg</sub>	Storage Temperature	-55 to +125	°C
T <sub>solder</sub>	Lead Temperature (Soldering)	260°C, 10s	

\*) For Power Dissipation, please refer to PACKAGE INFORMATION.

### 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

## • RN5RT30A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =4.0V, I <sub>OUT</sub> =10mA	2.940	3.000	3.060	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> =4.0V	40	60		mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V <sub>IN</sub> =4.0V 1mA ≤ I <sub>OUT</sub> ≤ 60mA		40	80	mV
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =60mA		0.3	0.5	V
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =4.0V (except I <sub>CEL</sub> )		4.0	10	μA
I <sub>standby</sub>	Supply Current (Standby)	V <sub>IN</sub> =V <sub>CE</sub> =4.0V		0.1	1.0	μA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I <sub>OUT</sub> =30mA V <sub>OUT</sub> +0.5V ≤ V <sub>IN</sub> ≤ 8.0V	0.00	0.15	0.30	%/V
V <sub>IN</sub>	Input Voltage				8	V
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
I <sub>lim</sub>	Short Current Limit	V <sub>OUT</sub> =0V		30		mA
V <sub>CEH</sub>	$\overline{CE}$ Input Voltage "H"		1.5			V
V <sub>CEL</sub>	$\overline{CE}$ Input Voltage "L"				0.25	V
I <sub>CEH</sub>	$\overline{CE}$ Input Current "H"	V <sub>CE</sub> =V <sub>IN</sub>		0.0	0.1	μA
I <sub>CEL</sub>	$\overline{CE}$ Input Current "L"	V <sub>CE</sub> =0V	-4.0	-2.0	-0.1	μA

## • RN5RT40A

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =5.0V, I <sub>OUT</sub> =10mA	3.920	4.000	4.080	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> =5.0V	50	80		mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V <sub>IN</sub> =5.0V 1mA≤I <sub>OUT</sub> ≤80mA		40	80	mV
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =80mA		0.3	0.5	V
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =5.0V (except I <sub>CEL</sub> )		4	10	μA
I <sub>standby</sub>	Supply Current (Standby)	V <sub>IN</sub> =V <sub>CE</sub> =5.0V		0.1	1.0	μA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I <sub>OUT</sub> =30mA V <sub>OUT</sub> +0.5V≤V <sub>IN</sub> ≤8.0V		0.15	0.30	%/V
V <sub>IN</sub>	Input Voltage				8	V
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/°C
I <sub>lim</sub>	Short Current Limit	V <sub>OUT</sub> =0V		30		mA
V <sub>CEH</sub>	$\overline{CE}$ Input Voltage "H"		1.5			V
V <sub>CEL</sub>	$\overline{CE}$ Input Voltage "L"				0.25	V
I <sub>CEH</sub>	$\overline{CE}$ Input Current "H"	V <sub>CE</sub> =V <sub>IN</sub>		0.0	0.1	μA
I <sub>CEL</sub>	$\overline{CE}$ Input Current "L"	V <sub>CE</sub> =0V	-4.0	-2.0	-0.1	μA

## • RN5RT50A

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =6.0V, I <sub>OUT</sub> =10mA	4.900	5.000	5.100	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> =6.0V	65	100		mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V <sub>IN</sub> =6.0V 1mA≤I <sub>OUT</sub> ≤100mA		40	80	mV
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =100mA		0.3	0.5	V
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =6.0V (except I <sub>CEL</sub> )		4	10	μA
I <sub>standby</sub>	Supply Current (Standby)	V <sub>IN</sub> =V <sub>CE</sub> =6.0V		0.1	1.0	μA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I <sub>OUT</sub> =30mA V <sub>OUT</sub> +0.5V≤V <sub>IN</sub> ≤8.0V		0.15	0.30	%/V
V <sub>IN</sub>	Input Voltage				8	V
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/°C
I <sub>lim</sub>	Short Current Limit	V <sub>OUT</sub> =0V		30		mA
V <sub>CEH</sub>	$\overline{CE}$ Input Voltage "H"		1.5			V
V <sub>CEL</sub>	$\overline{CE}$ Input Voltage "L"				0.25	V
I <sub>CEH</sub>	$\overline{CE}$ Input Current "H"	V <sub>CE</sub> =V <sub>IN</sub>		0.0	0.1	μA
I <sub>CEL</sub>	$\overline{CE}$ Input Current "L"	V <sub>CE</sub> =0V	-4.0	-2.0	-0.1	μA

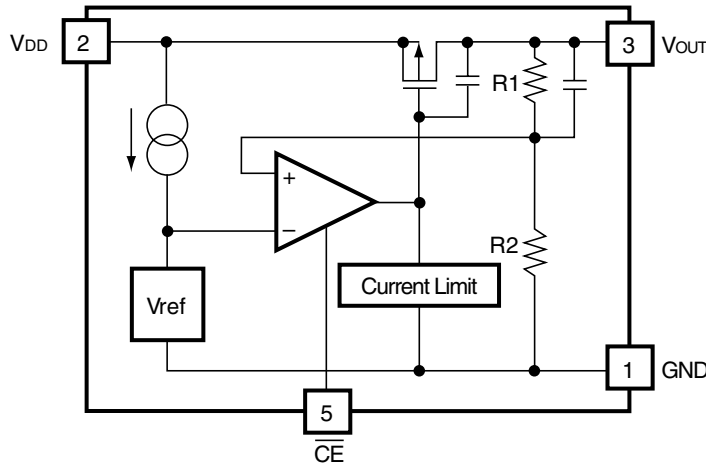
## ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE

Part Number	Output Voltage			Output Current			Load Regulation			Dropout Voltage			Supply Current				
	V <sub>OUT</sub> (V)			I <sub>OUT</sub> (mA)			ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub> (mA)			V <sub>DIF</sub> (V)			I <sub>SS</sub> (μA)				
	Conditions	Min.	Typ.	Max.	Conditions	Min.	Typ.	Conditions	Typ.	Max.	Conditions	Typ.	Max.	Conditions	Typ.	Max.	
RN5RT20A	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V  I <sub>OUT</sub> =10mA	1.960	2.000	2.040	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V	25	40	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V  1mA ≤ I <sub>OUT</sub> ≤ 40mA	40	80	0.3	0.5	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V (except I <sub>CEL</sub> )	4.0	10		
RN5RT21A		2.058	2.100	2.142													
RN5RT22A		2.156	2.200	2.244													
RN5RT23A		2.254	2.300	2.346													
RN5RT24A		2.352	2.400	2.448													
RN5RT25A		2.450	2.500	2.550													
RN5RT26A		2.548	2.600	2.652													
RN5RT27A		2.646	2.700	2.754													
RN5RT28A		2.744	2.800	2.856													
RN5RT29A		2.842	2.900	2.958													
RN5RT30A		2.940	3.000	3.060													
RN5RT31A		3.038	3.100	3.162		40	60	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V  1mA ≤ I <sub>OUT</sub> ≤ 60mA	40	80	0.3	0.5					
RN5RT32A		3.136	3.200	3.264													
RN5RT33A		3.234	3.300	3.366													
RN5RT34A		3.332	3.400	3.468													
RN5RT35A		3.430	3.500	3.570													
RN5RT36A		3.528	3.600	3.672													
RN5RT37A		3.626	3.700	3.774													
RN5RT38A		3.724	3.800	3.876													
RN5RT39A		3.822	3.900	3.978													
RN5RT40A		3.920	4.000	4.080													
RN5RT41A		4.018	4.100	4.182		50	80	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V  1mA ≤ I <sub>OUT</sub> ≤ 80mA	40	80	0.3	0.5					
RN5RT42A		4.116	4.200	4.284													
RN5RT43A		4.214	4.300	4.386													
RN5RT44A		4.312	4.400	4.488													
RN5RT45A		4.410	4.500	4.590													
RN5RT46A		4.508	4.600	4.692													
RN5RT47A		4.606	4.700	4.794													
RN5RT48A		4.704	4.800	4.896													
RN5RT49A		4.802	4.900	4.998													
RN5RT50A	4.900	5.000	5.100														
RN5RT51A	4.998	5.100	5.202	65	100	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V  1mA ≤ I <sub>OUT</sub> ≤ 100mA	40	80	0.3	0.5							
RN5RT52A	5.096	5.200	5.304														
RN5RT53A	5.194	5.300	5.406														
RN5RT54A	5.292	5.400	5.508														
RN5RT55A	5.390	5.500	5.610														
RN5RT56A	5.488	5.600	5.712														
RN5RT57A	5.586	5.700	5.814														
RN5RT58A	5.684	5.800	5.916														
RN5RT59A	5.782	5.900	6.018														
RN5RT60A	5.880	6.000	6.120														

T<sub>opt</sub>=25°C

Supply Current (Standby)			Line Regulation			Input Voltage	Output Voltage Temperature Coefficient		Short Current Limit		CE Input Voltage		CE Input Current						
											"H"	"L"	"H"			"L"			
Istandby (μA)			ΔV <sub>OUT</sub> /ΔV <sub>IN</sub> (%/V)			V <sub>IN</sub> (V)	ΔV <sub>OUT</sub> /ΔT (ppm/°C)		I <sub>lim</sub> (mA)	V <sub>CEH</sub> (V)	V <sub>CEL</sub> (V)	I <sub>CEH</sub> (μA)			I <sub>CEL</sub> (μA)				
Conditions	Typ.	Max.	Conditions	Typ.	Max.	Max.	Conditions	Typ.	Conditions	Typ.	Min.	Max.	Conditions	Typ.	Max.	Conditions	Min.	Typ.	Max.
V <sub>IN</sub> -V <sub>OUT</sub> =1.0V	0.1	1.0	I <sub>OUT</sub> =30mA V <sub>OUT</sub> +0.5V ≤V <sub>IN</sub> ≤8V	0.15	0.3	8	I <sub>OUT</sub> =10mA -40°C ≤T <sub>opt</sub> ≤85°C	±100	V <sub>OUT</sub> =0V	30	1.5	0.25	V <sub>CE</sub> =V <sub>IN</sub>	0	0.1	V <sub>CE</sub> =0V	-4.0	-2.0	-0.1

## OPERATION



In these ICs, the output voltage  $V_{OUT}$  is detected by feed-back registers R1, R2, and the detected output voltage is compared with a reference voltage by the error amplifier, so that a constant voltage is output.

A current limit circuit working for short protection and a chip enable circuit for standby function are included.

## TEST CIRCUITS

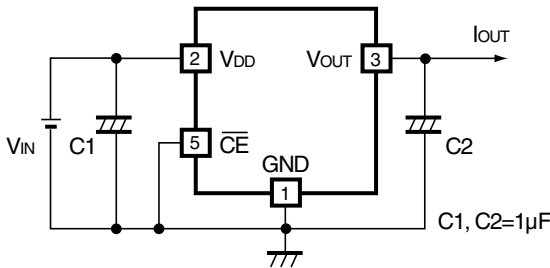


Fig.1 Standard Test Circuit

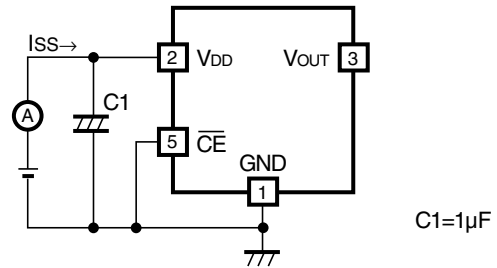


Fig.2 Supply Current Test Circuit

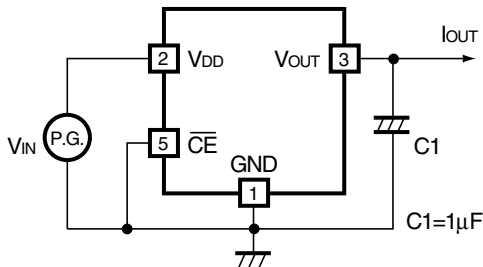
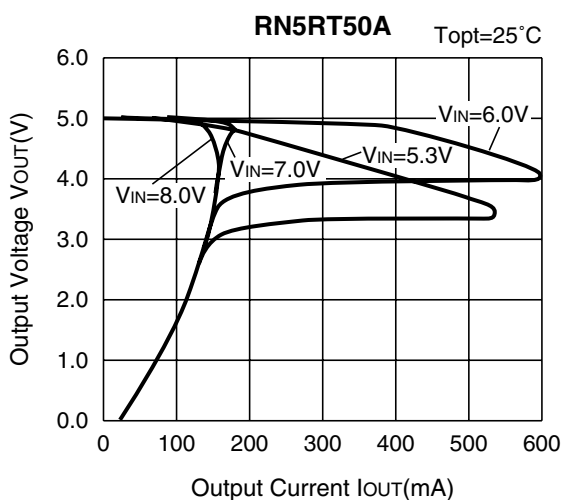
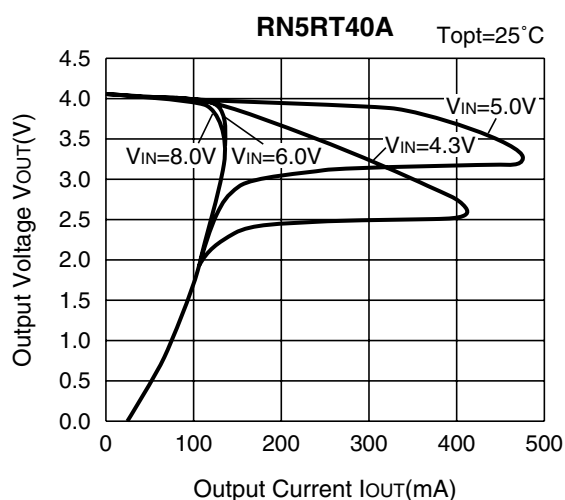
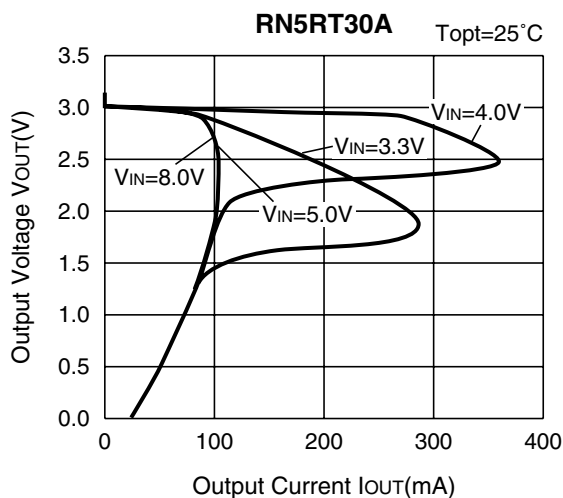


Fig.3 Line Transient Response Test Circuit

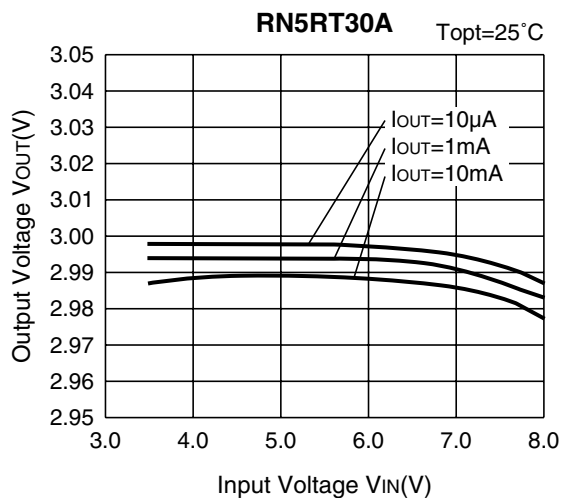
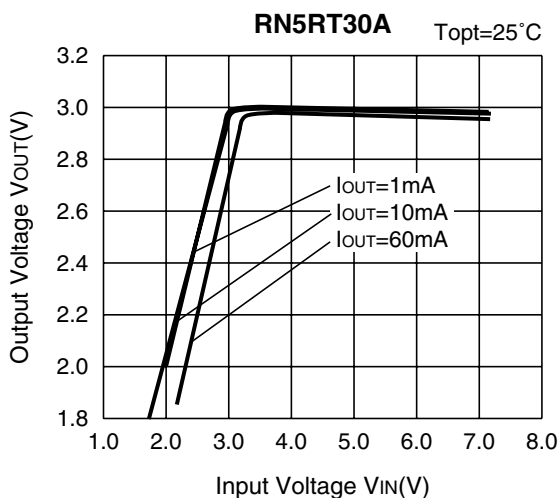


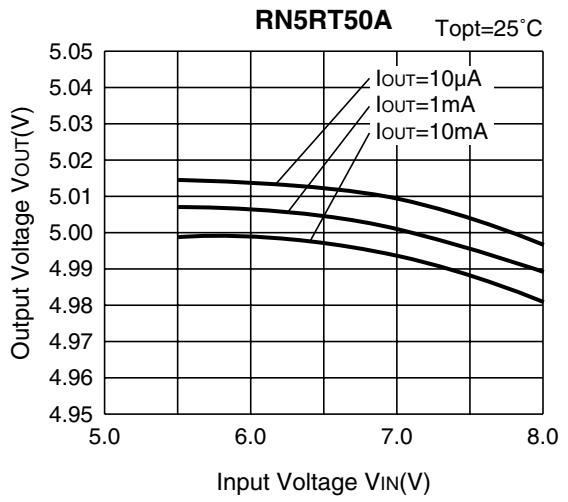
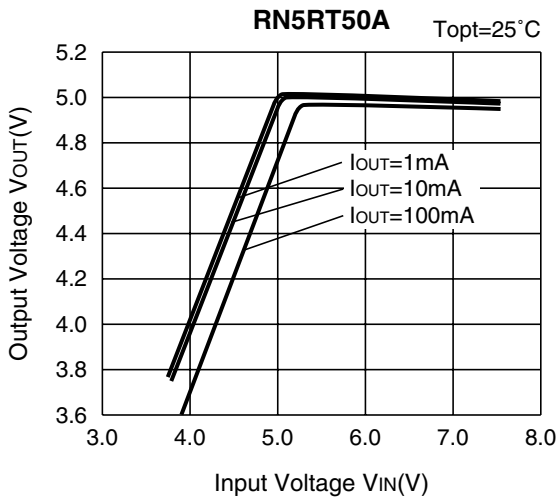
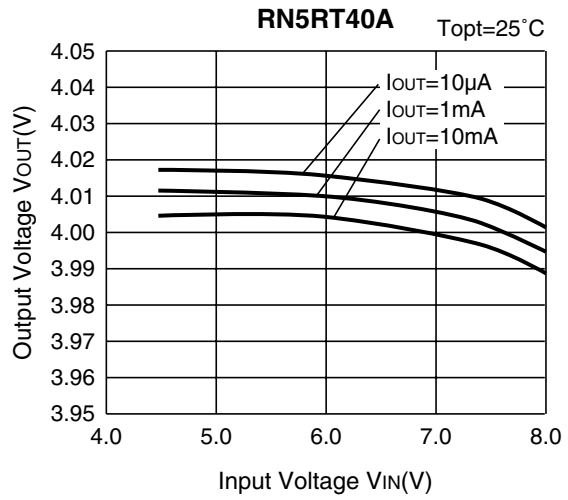
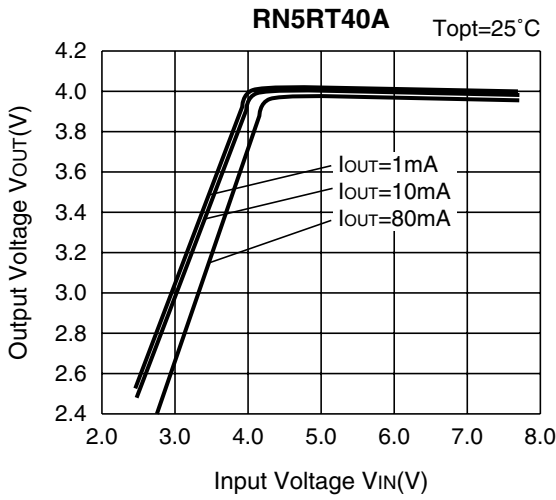
# TYPICAL CHARACTERISTICS

## 1) Output Voltage vs. Output Current

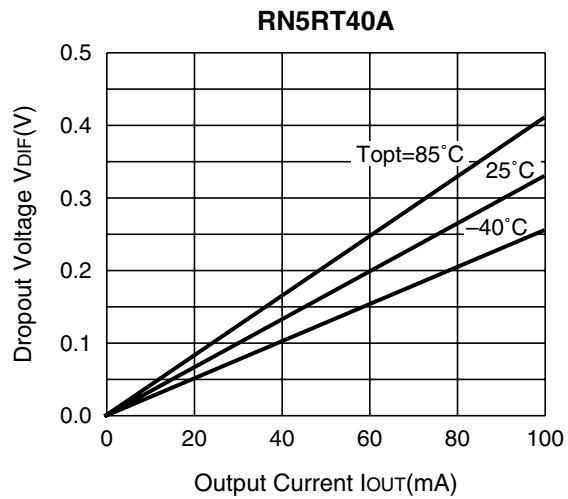
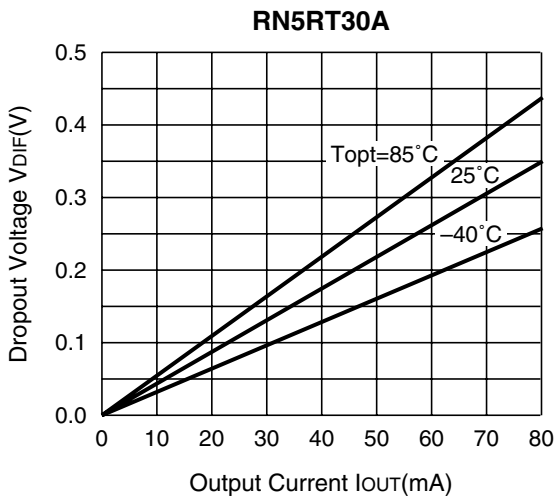


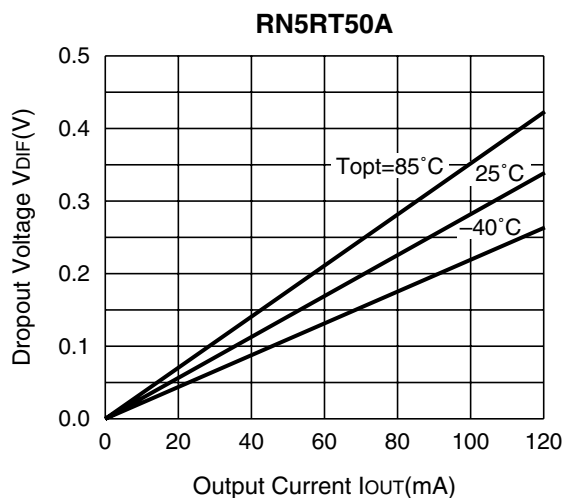
## 2) Output Voltage vs. Input Voltage



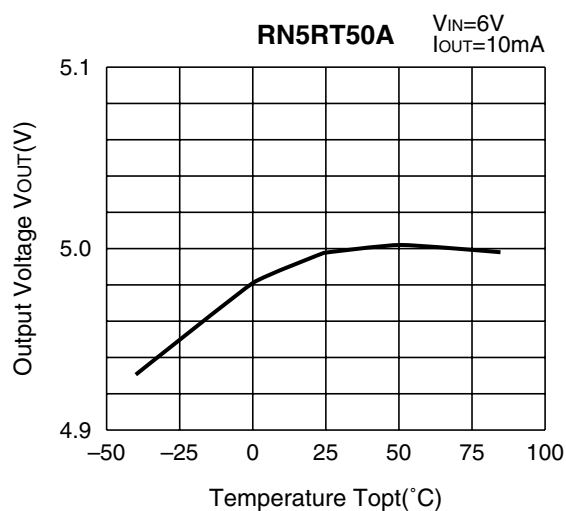
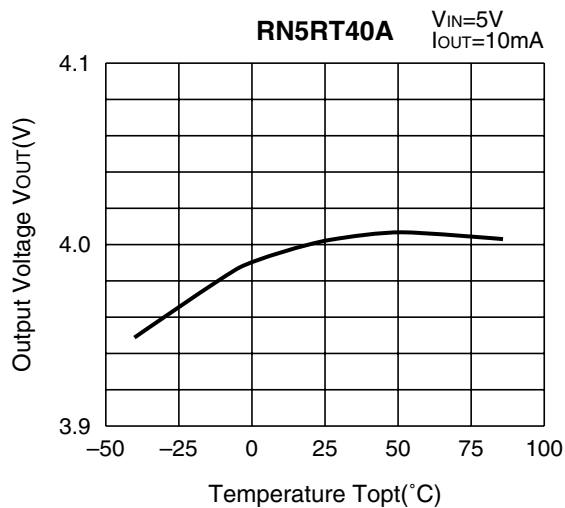
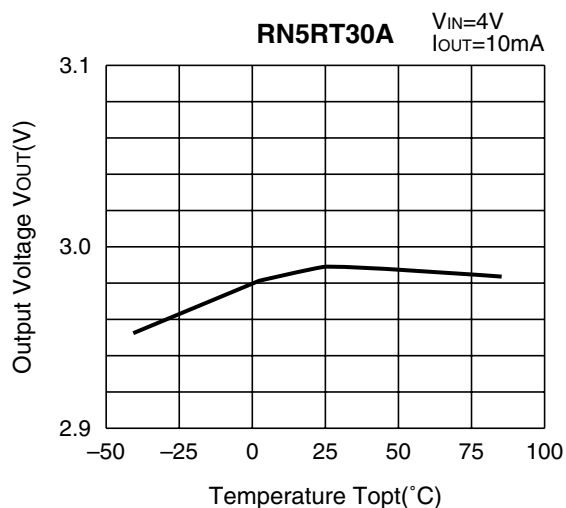


**3) Dropout Voltage vs. Output Current**

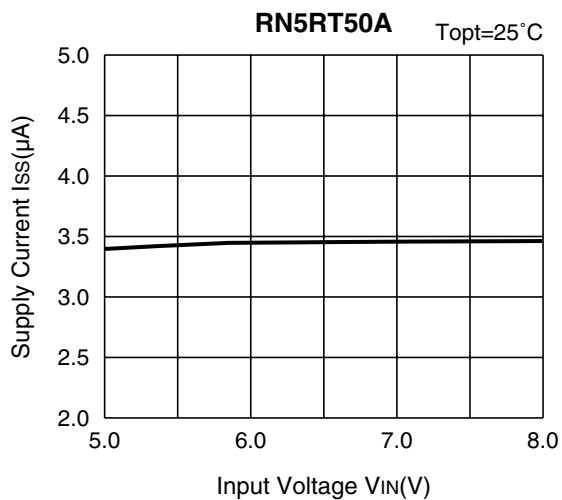
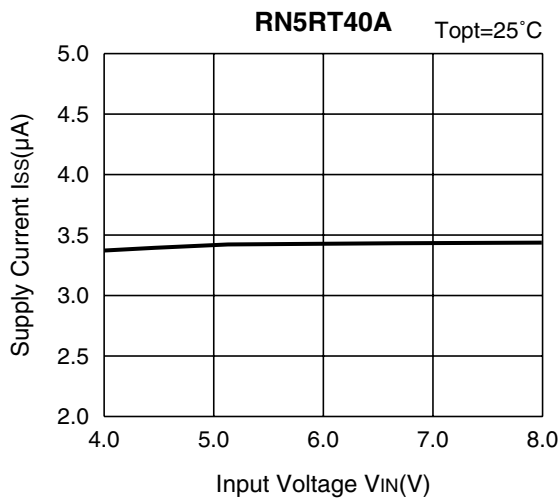
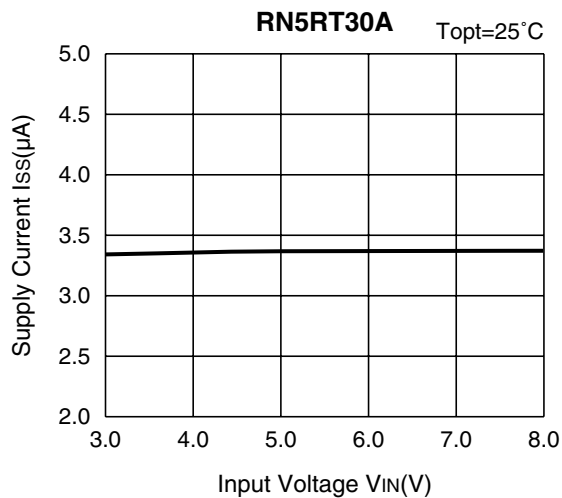




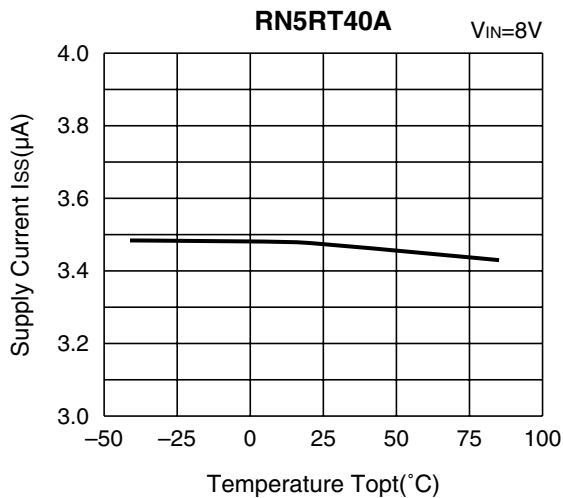
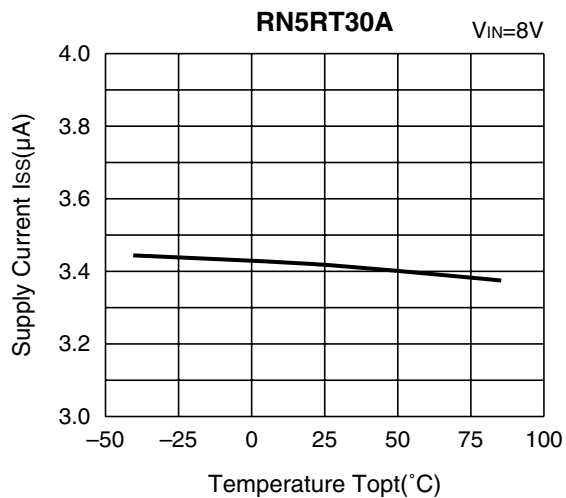
**4) Output Voltage vs. Temperature**

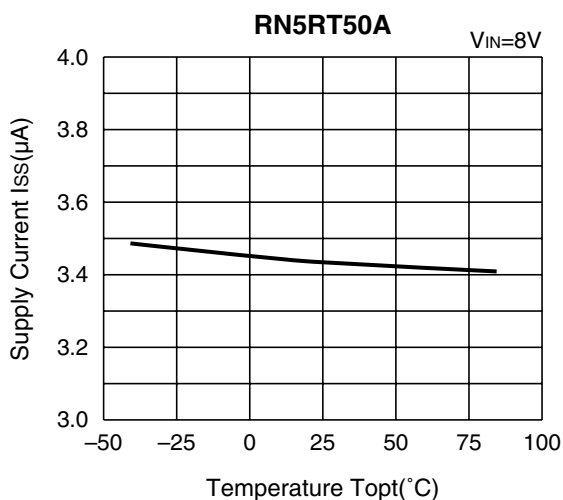


5) Supply Current vs. Input Voltage

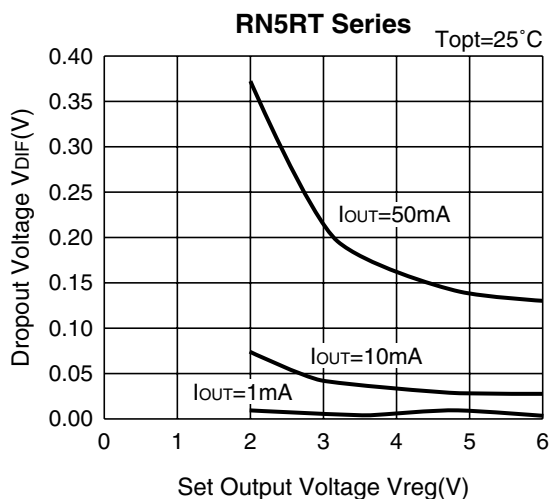


6) Supply Current vs. Temperature

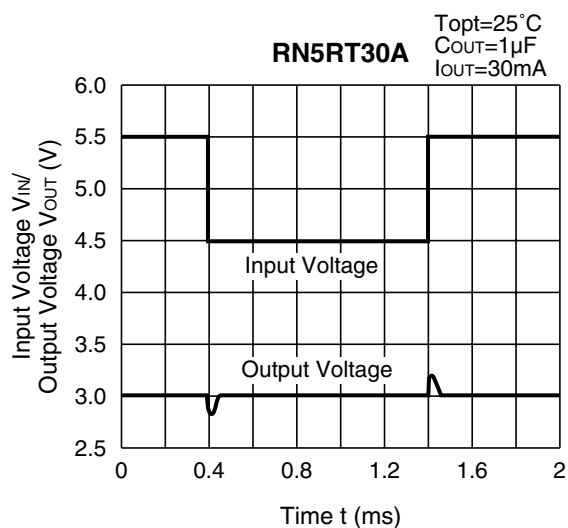
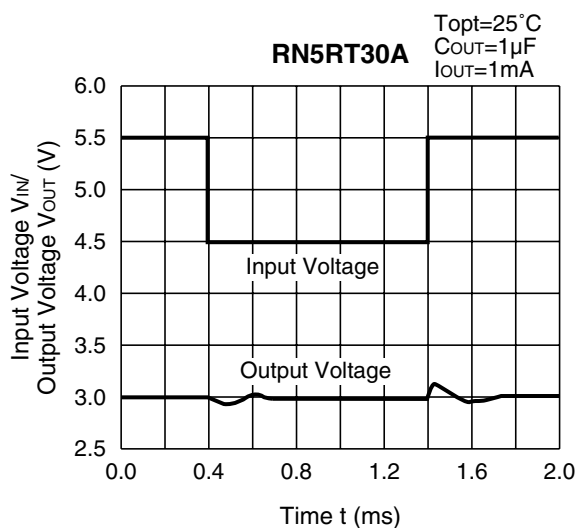




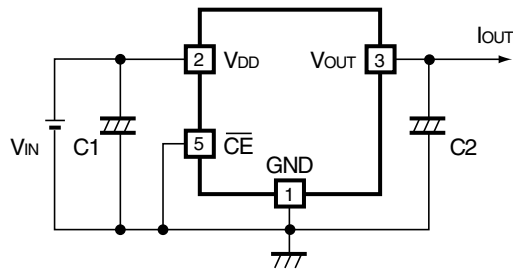
**7) Dropout Voltage vs. Set Output Voltage**



**8) Line Transient Response**



## TYPICAL APPLICATION



In the RN5RT Series, a constant voltage can be obtained without using capacitor C1 and C2. However, when the wire connected to  $V_{IN}$  is long, use a capacitor C1. Transient noise of output voltage occurred due to load deviation can be reduced by using a capacitor C2.

Insert capacitors C1 and C2 with the capacitance of 0.1 $\mu$ F to 2.0 $\mu$ F between input/output pins and GND pin with minimum wiring.



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5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, firecontainment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

## RICOH COMPANY., LTD. Electronic Devices Company



■ Ricoh presented with the Japan Management Quality Award for 1999.  
Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.



■ Ricoh awarded ISO 14001 certification.  
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

<http://www.ricoh.com/LSI/>

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Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.