LOW DROPOUT VOLTAGE REGULATOR

RN5RT SERIES

APPLICATION MANUAL

NO.EA-038-0006

RICOH

LOW DROPOUT VOLTAGE REGULATOR

RN5RT SERIES

OUTLINE

The RN5RT Series are voltage regulator ICs with high output voltage accuracy and low supply current developed through the use of a CMOS process. 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.

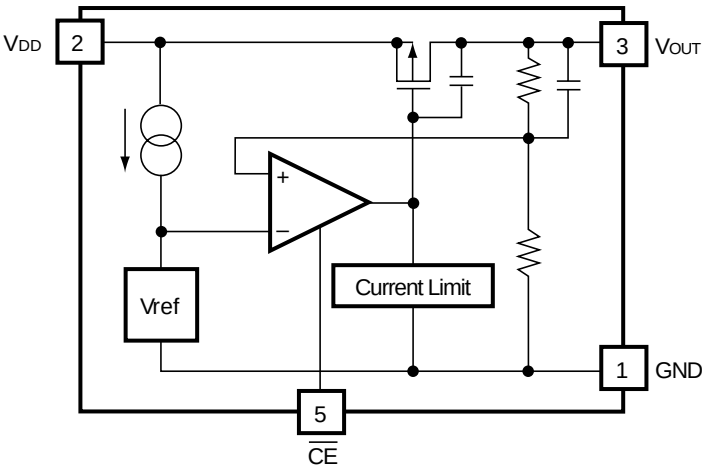
FEATURES

- Ultra-Low Supply Current ····· TYP. 4μA (except I_{CEL})
- Standby Mode ····· TYP. 0.1μA
- Low Dropout Voltage ····· TYP. 0.3V (I_{OUT}=60mA, RN5RT30A)
- Low Temperature-Drift Coefficient of Output Voltage..... TYP. ±100ppm/°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 ····· ±2.0%
- Built-in Current Limit Circuits ····· 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

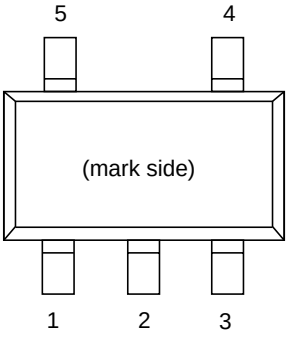
The output voltage, the packing type, and the taping type for the ICs can be selected at the user's request. These selections can be made by designating the part number as shown below:

RN5RT××××-× ← Part Number
↑ ↑↑ ↑
a b c d

Code	Contents
a	Setting Output Voltage (VOUT) : 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

• SOT-23-5



PIN DESCRIPTION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Ratings	Unit
V_{IN}	Input Voltage	9	V
V_{CE}	Input Voltage ($\overline{CE}$ Pin)	–0.3 to V_{IN} +0.3	V
V_{OUT}	Output Voltage	–0.3 to V_{IN} +0.3	V
I_{OUT}	Output Current	150	mA
P_D	Power Dissipation	150	mW
Topt	Operating Temperature	–40 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

• RN5RT30A

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}=4.0V, I_{OUT}=10mA	2.940	3.000	3.060	V
I_{OUT}	Output Current	V_{IN}=4.0V	40	60		mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V_{IN}=4.0V 1mA≤I_{OUT}≤60mA		40	80	mV
V_{DIF}	Dropout Voltage	I_{OUT}=60mA		0.3	0.5	V
I_{SS}	Supply Current	V_{IN}=4.0V (except I_{CEL})		4.0	10	µA
Istandby	Supply Current (Standby)	V_{IN}=V_{CE}=4.0V		0.1	1.0	µA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I_{OUT}=30mA V_{OUT}+0.5V≤V_{IN}≤8V	0	0.15	0.3	%/V
V_{IN}	Input Voltage				8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA –40°C≤Topt≤85°C		±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V		30		mA
V_{CEH}	$\overline{CE}$ Input Voltage “H”		1.5			V
V_{CEL}	$\overline{CE}$ Input Voltage “L”				0.25	V
I_{CEH}	$\overline{CE}$ Input Current “H”	V_{CE}=V_{IN}		0	0.1	µA
I_{CEL}	$\overline{CE}$ Input Current “L”	V_{CE}=0V	–4.0	–2.0	–0.1	µA

• **RN5RT40A**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}=5.0V, I_{OUT}=10mA	3.920	4.000	4.080	V
I_{OUT}	Output Current	V_{IN}=5.0V	50	80		mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V_{IN}=5.0V 1mA≤I_{OUT}≤80mA		40	80	mV
V_{DIF}	Dropout Voltage	I_{OUT}=80mA		0.3	0.5	V
I_{SS}	Supply Current	V_{IN}=5.0V (expect I_{CEL})		4	10	µA
Istandby	Supply Current (Standby)	V_{IN}=V_{CE}=5.0V		0.1	1.0	µA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I_{OUT}=30mA V_{OUT}+0.5V≤V_{IN}≤8V		0.15	0.3	%/V
V_{IN}	Input Voltage				8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA –40°C≤Topt≤85°C		±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V		30		mA
V_{CEH}	$\overline{CE}$ Input Voltage “H”		1.5			V
V_{CEL}	$\overline{CE}$ Input Voltage “L”				0.25	V
I_{CEH}	$\overline{CE}$ Input Current “H”	V_{CE}=V_{IN}		0	0.1	µA
I_{CEL}	$\overline{CE}$ Input Current “L”	V_{CE}=0V	–4.0	–2.0	–0.1	µA

• **RN5RT50A**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}=6.0V, I_{OUT}=10mA	4.900	5.000	5.100	V
I_{OUT}	Output Current	V_{IN}=6.0V	65	100		mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V_{IN}=6.0V 1mA≤I_{OUT}≤100mA		40	80	mV
V_{DIF}	Dropout Voltage	I_{OUT}=100mA		0.3	0.5	V
I_{SS}	Supply Current	V_{IN}=6.0V (except I_{CEL})		4	10	µA
Istandby	Supply Current (Standby)	V_{IN}=V_{CE}=6.0V		0.1	1.0	µA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I_{OUT}=30mA V_{OUT}+0.5V≤V_{IN}≤8V		0.15	0.3	%/V
V_{IN}	Input Voltage				8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA –40°C≤Topt≤85°C		±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V		30		mA
V_{CEH}	$\overline{CE}$ Input Voltage “H”		1.5			V
V_{CEL}	$\overline{CE}$ Input Voltage “L”				0.25	V
I_{CEH}	$\overline{CE}$ Input Current “H”	V_{CE}=V_{IN}		0	0.1	µA
I_{CEL}	$\overline{CE}$ Input Current “L”	V_{CE}=0V	–4.0	–2.0	–0.1	µA

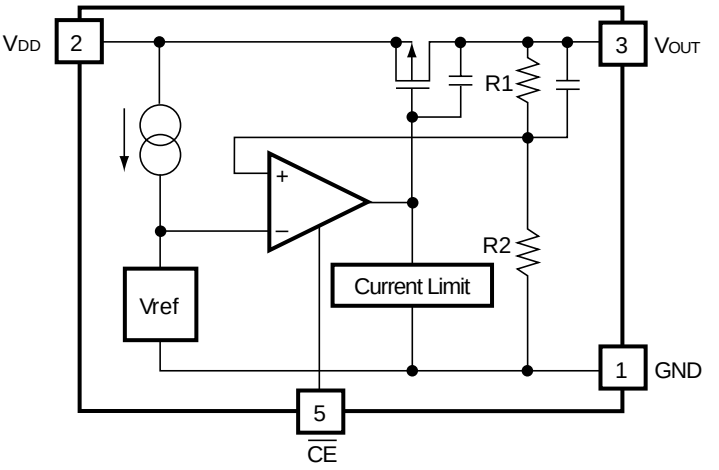
ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE

Part Number	Output Voltage				Output Current			Load Regulation			Dropout Voltage			Supply Current		
	V_{OUT} (V)				I_{OUT} (mA)			$\Delta V_{OUT}/\Delta I_{OUT}$ (mA)			V_{DIF} (V)			I_{SS} (μA)		
	Conditions	MIN.	TYP.	MAX.	Conditions	MIN.	TYP.	Conditions	TYP.	MAX.	Conditions	TYP.	MAX	Conditions	TYP.	MAX.
RN5RT20A		1.960	2.000	2.040												
RN5RT21A		2.058	2.100	2.142												
RN5RT22A		2.156	2.200	2.244				V_{IN}-V_{OUT} =1.0V								
RN5RT23A		2.254	2.300	2.346												
RN5RT24A		2.352	2.400	2.448		25	40				I_{OUT} =40mA					
RN5RT25A		2.450	2.500	2.550				1mA≤ I_{OUT} ≤40mA								
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												
RN5RT32A		3.136	3.200	3.264				V_{IN}-V_{OUT} =1.0V								
RN5RT33A		3.234	3.300	3.366												
RN5RT34A		3.332	3.400	3.468		40	60				I_{OUT} =60mA					
RN5RT35A		3.430	3.500	3.570				1mA≤ I_{OUT} ≤60mA								
RN5RT36A		3.528	3.600	3.672												
RN5RT37A		3.626	3.700	3.774												
RN5RT38A	V_{IN}–V_{OUT}	3.724	3.800	3.876										V_{IN}-V_{OUT}		
RN5RT39A	=1.0V	3.822	3.900	3.978	V_{IN}-V_{OUT} =1.0V				40	80		0.3	0.5	=1.0V (expect I_{CEL})	4.0	10
RN5RT40A		3.920	4.000	4.080												
RN5RT41A	I_{OUT}	4.018	4.100	4.182												
RN5RT42A	=10mA	4.116	4.200	4.284				V_{IN}-V_{OUT} =1.0V								
RN5RT43A		4.214	4.300	4.386												
RN5RT44A		4.312	4.400	4.488		50	80				I_{OUT} =80mA					
RN5RT45A		4.410	4.500	4.590				1mA≤ I_{OUT} ≤80mA								
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												
RN5RT52A		5.096	5.200	5.304				V_{IN}-V_{OUT} =1.0V								
RN5RT53A		5.194	5.300	5.406												
RN5RT54A		5.292	5.400	5.508		65	100				I_{OUT} =100mA					
RN5RT55A		5.390	5.500	5.610				1mA≤ I_{OUT} ≤100mA								
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												

Topt=25°C

Supply Current (Standby)			Line Regulation			Input Voltage	Output Voltage Temperature Coefficient		Short Current Limit		$\overline{CE}$ Input Voltage		$\overline{CE}$ Input Current						
											"H"	"L"	"H"			"L"			
Istandby (μA)			ΔVOUT/ΔVIN (%/V)			VIN (V)	ΔVOUT/ΔT (ppm/°C)		Ilim (mA)		VCEH (V)	VCEL (V)	ICEH (μA)			ICEL (μA)			
Conditions	TYP.	MAX.	Conditions	TYP.	MAX.	MAX.	Conditions	TYP.	Conditions	TYP.	MIN.	MAX.	Conditions	TYP.	MAX.	Conditions	MIN.	TYP.	MAX.
VIN–VOUT =1.0V	0.1	1.0	IOUT= 30mA VOUT+ 0.5V ≤VIN ≤8V	0.15	0.3	8	IOUT= 10mA –40°C ≤Topt ≤85°C	±100	VOUT =0V	30	1.5	0.25	VCE= VIN	0	0.1	VCE= 0V	–4.0	–2.0	–0.1

OPERATION



In these ICs, Output Voltage VOUT is detected by Feed-back Registers R1, R2, and the detected Output Voltage is compared with a reference voltage by Error Amplifier, so that a constant voltage is output.

A current limit circuit working for Short Protect and a chip enable circuit for standby function are included.

TEST CIRCUITS

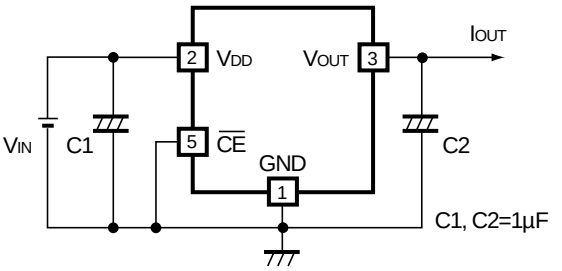


Fig.1 Standard Test Circuit

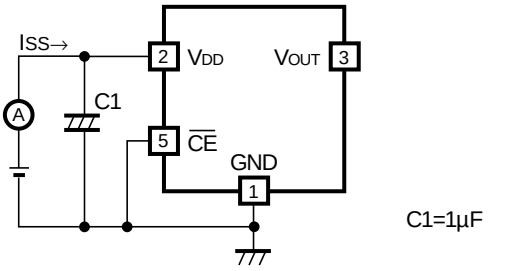


Fig.2 Supply Current Test Circuit

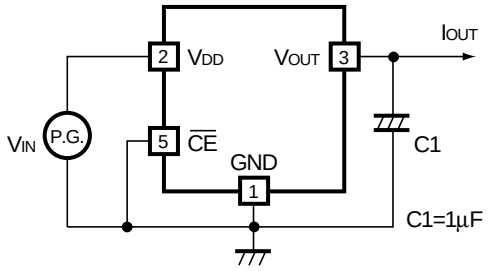
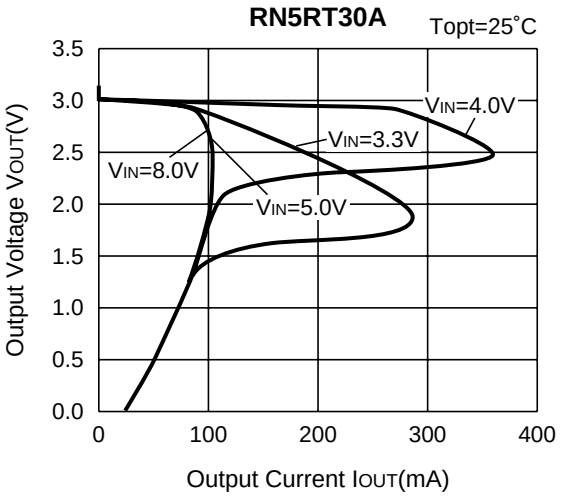
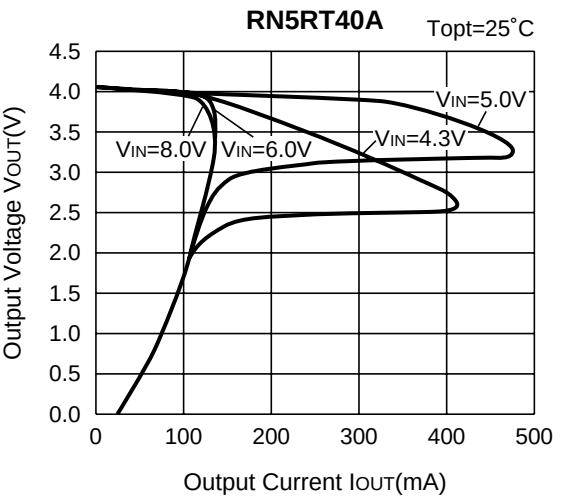


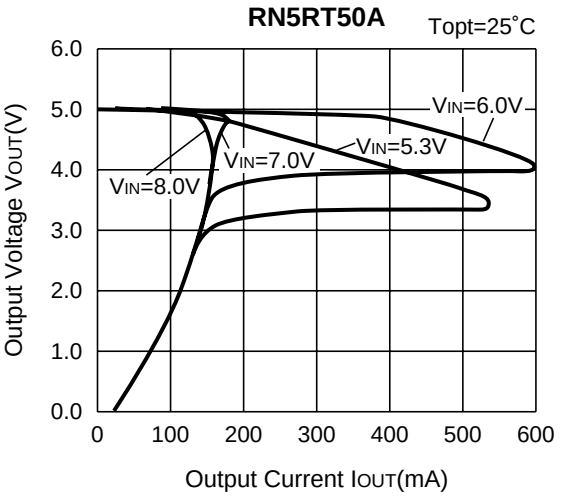
Fig.3 Line Transient Response Test Circuit

TYPICAL CHARACTERISTICS

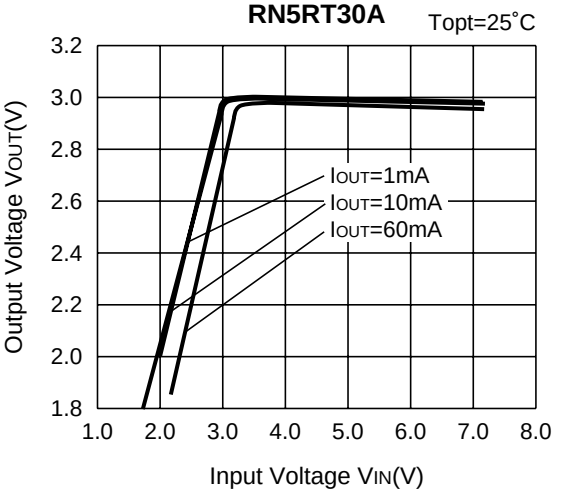
1) Output Voltage vs. Output Current

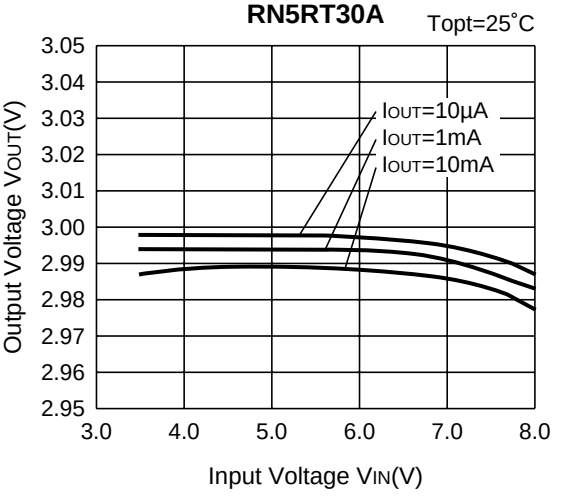


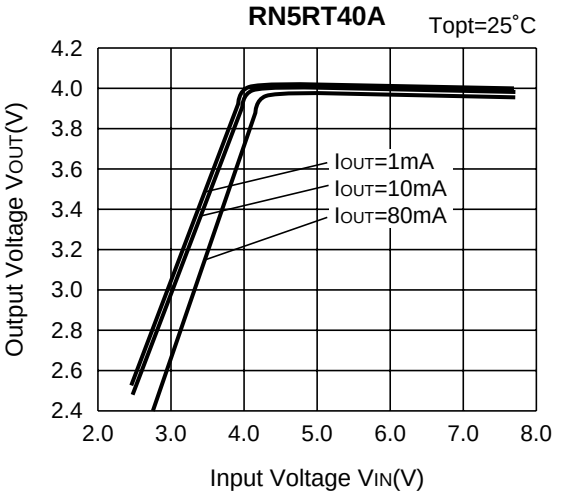


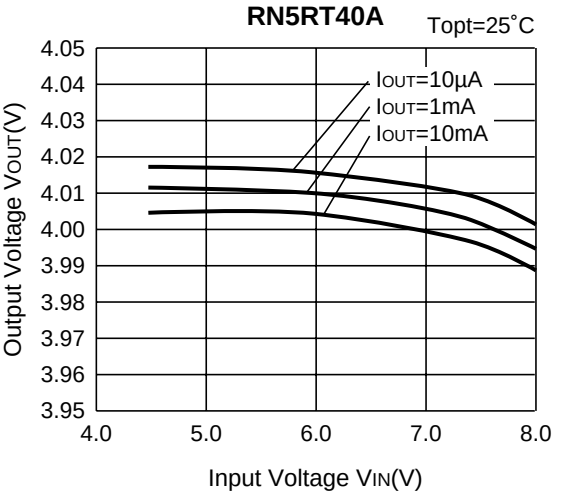


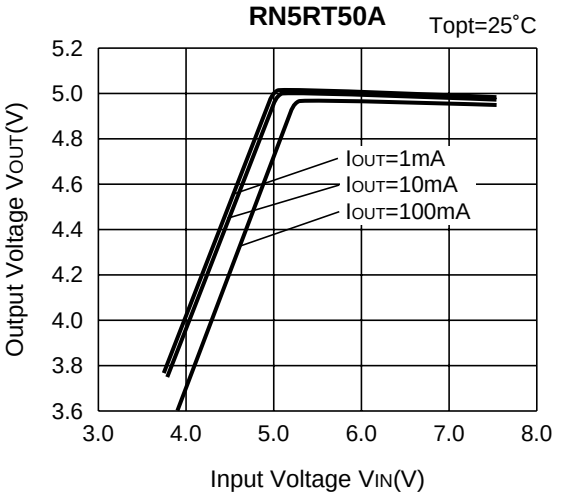
2) Output Voltage vs. Input Voltage

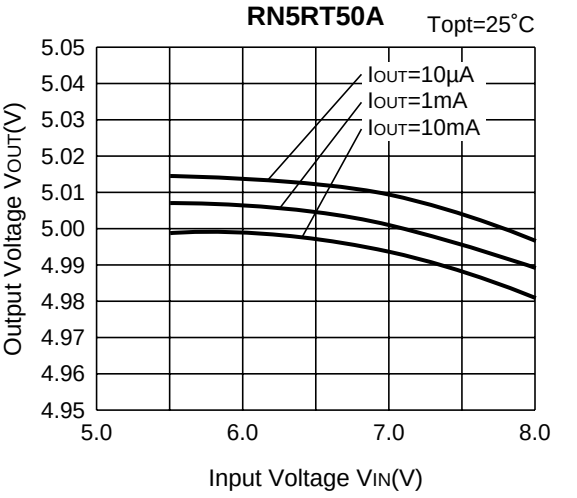




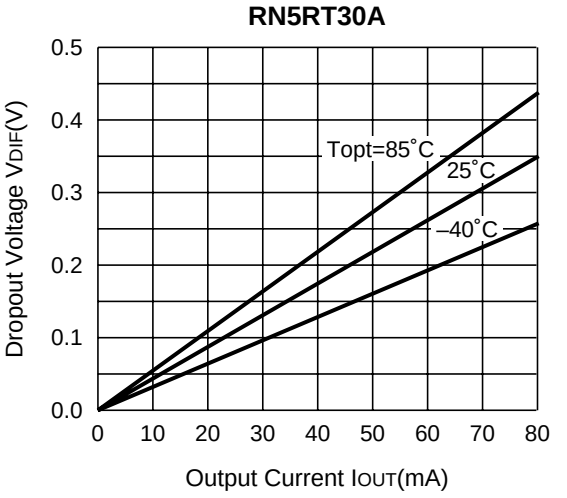


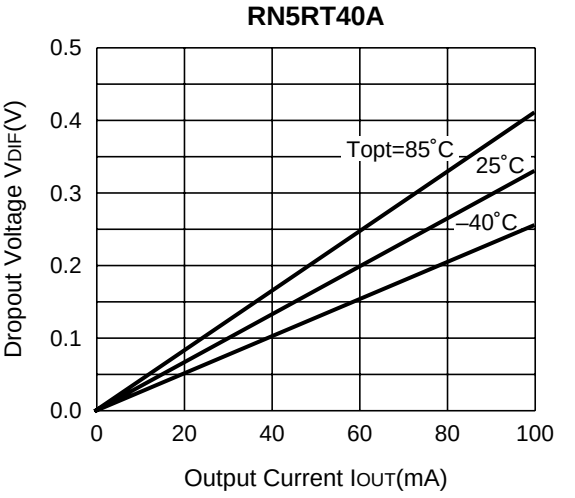


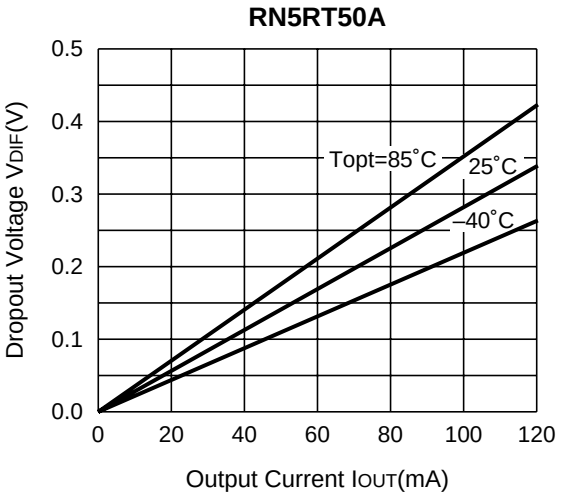




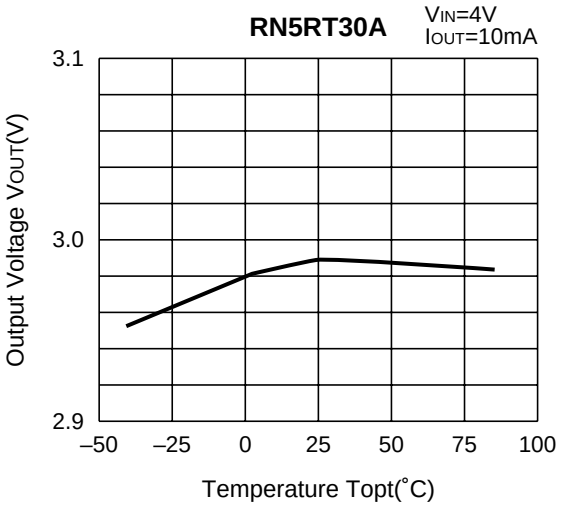
3) Dropout Voltage vs. Output Current

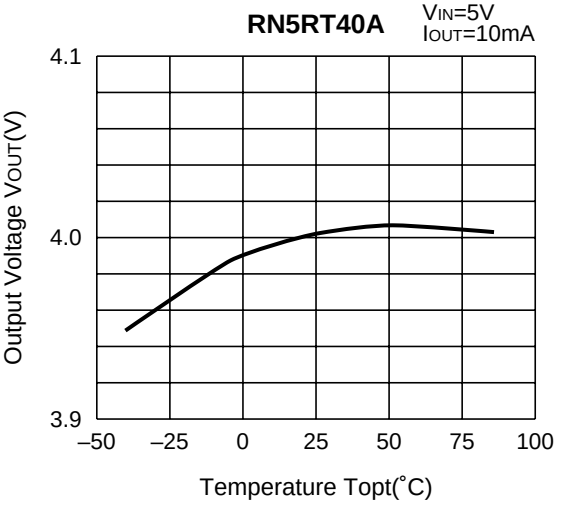


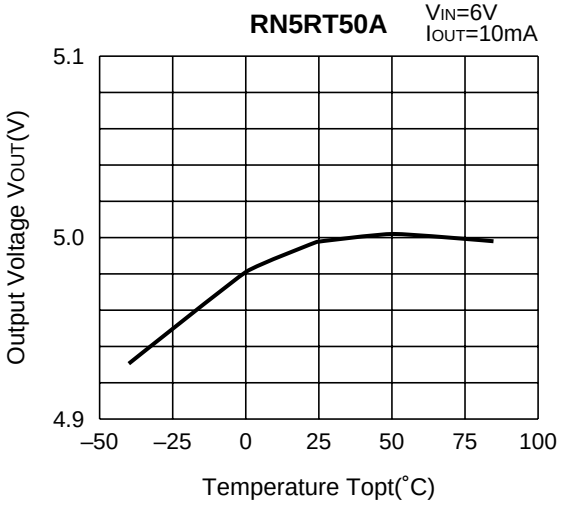




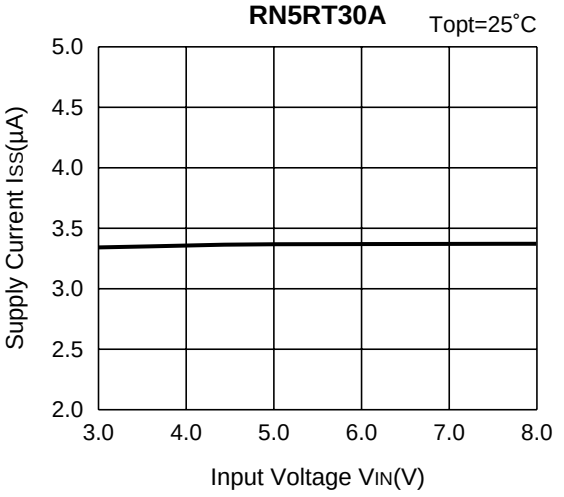
4) Output Voltage vs. Temperature

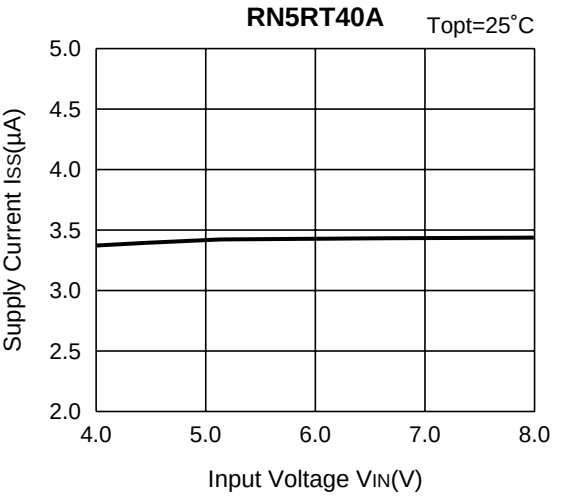


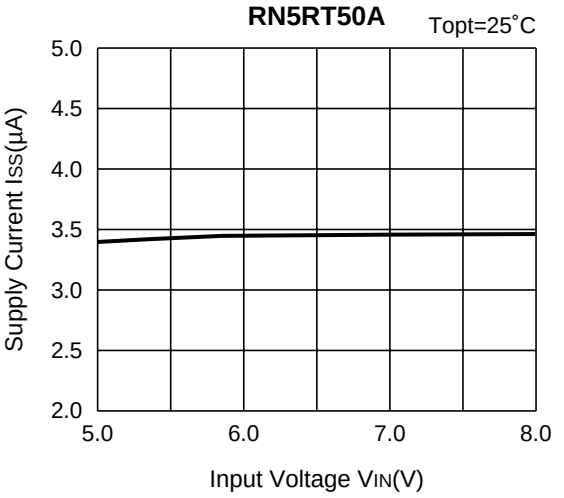




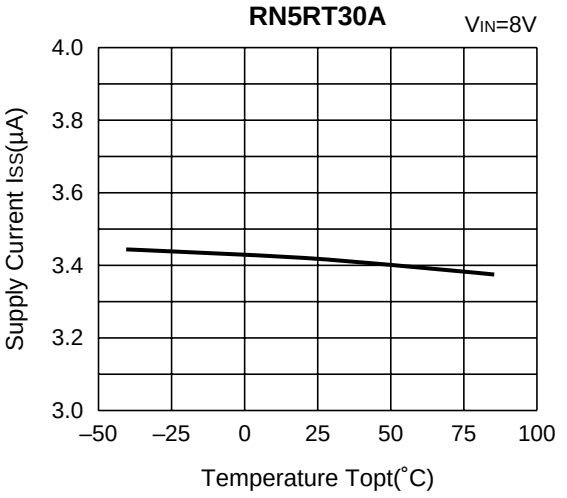
5) Supply Current vs. Input Voltage

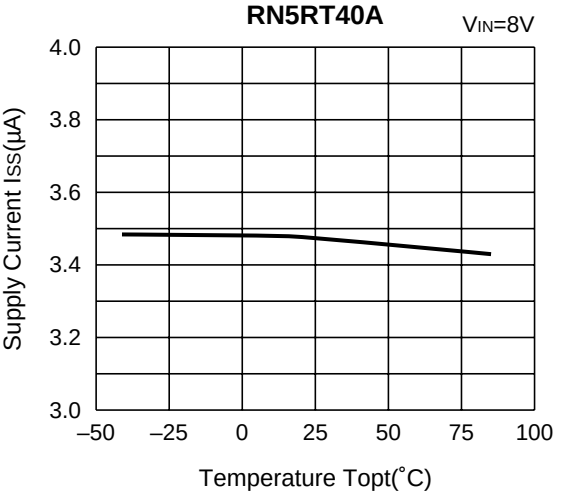


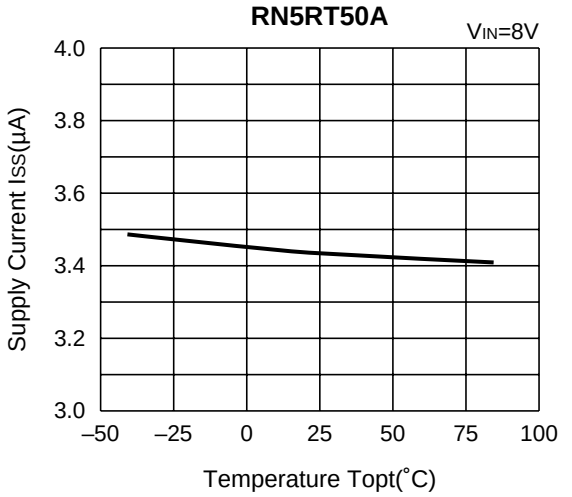




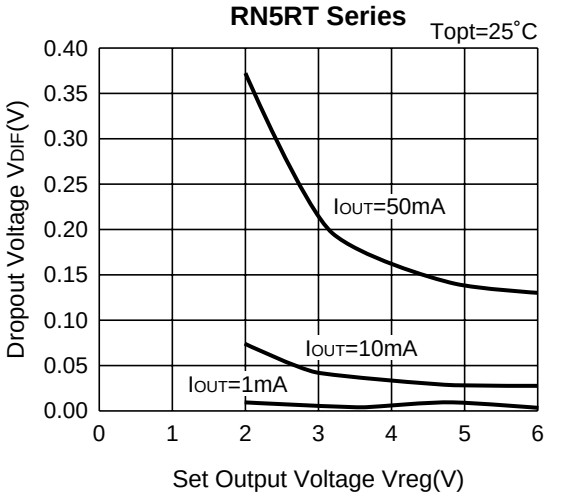
6) Supply Current vs. Temperature



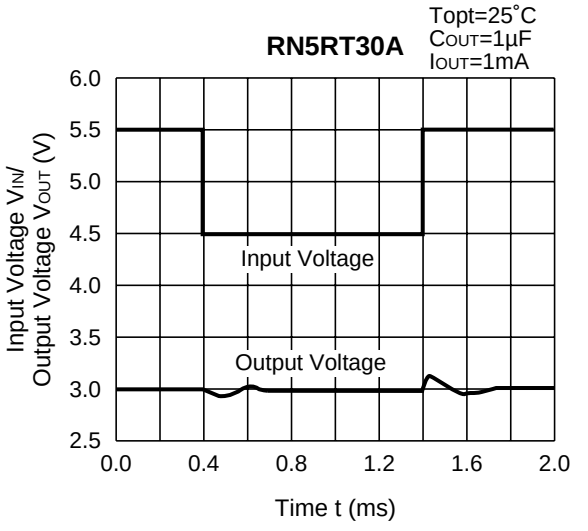


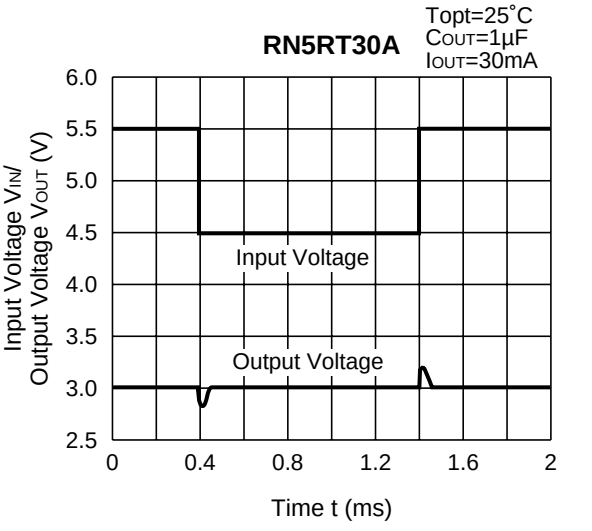


7) Dropout Voltage vs. Set Output Voltage

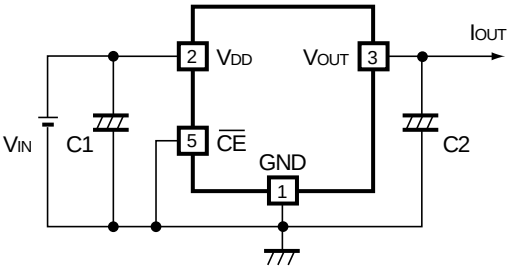


8) Line Transient Response





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 Capacitor C1. Transient noise of output voltage occurred due to load deviation can be reduced by using Capacitor C2.

Insert Capacitors C1 and C2 with the capacitance of 0.1µF to 2.0µF between Input/Output Pins and GND Pin with minimum wiring.