LOW DROPOUT VOLTAGE REGULATOR

NO. EA-038-091028

RN5RT SERIES

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.

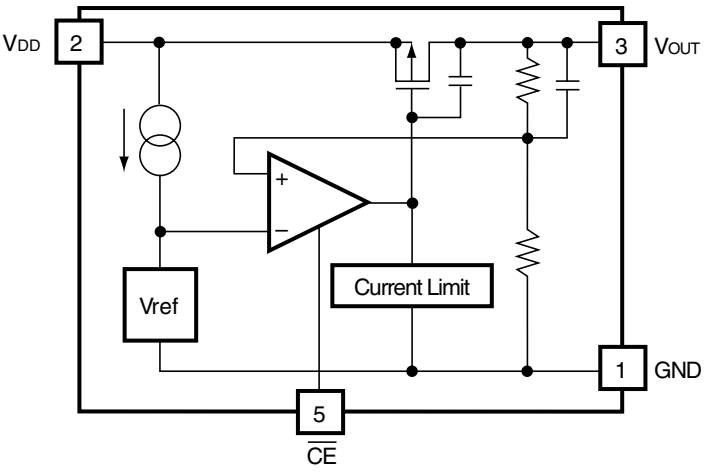
FEATURES

- Ultra-Low Supply Current ····· Typ. 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 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

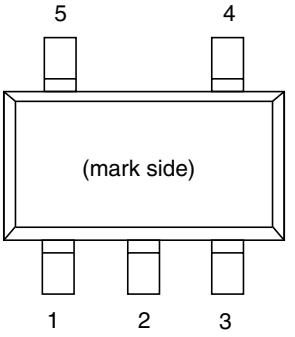
The output voltage, the packing type, and the taping type for the ICs can be selected at the user's request. These selections can be made by designating the part number as shown below:

RN5RTxxxx-x ← Part Number
↑↑↑ ↑
a bc 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	420*	mW
Topt	Operating Temperature	–40 to +85	˚C
Tstg	Storage Temperature	–55 to +125	˚C
Tsolder	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

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}≤8.0V	0.00	0.15	0.30	%/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	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}≤8.0V		0.15	0.30	%/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	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}≤8.0V		0.15	0.30	%/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	0.1	µA
I_{CEL}	$\overline{CE}$ Input Current "L"	V_{CE}=0V	–4.0	–2.0	–0.1	µA

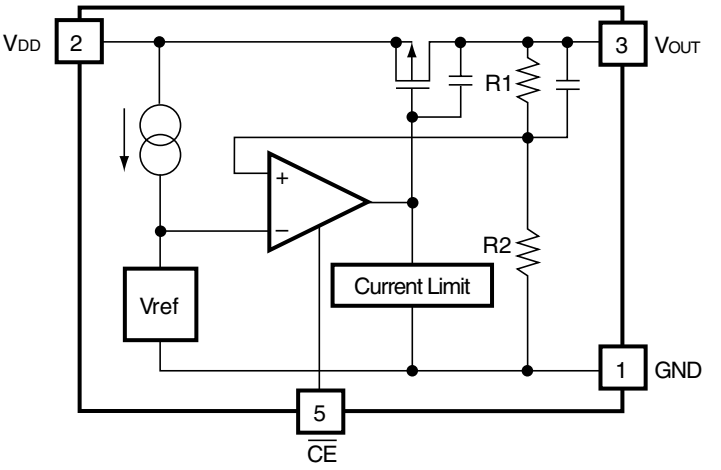
ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE

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 (except 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, the output voltage VOUT 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

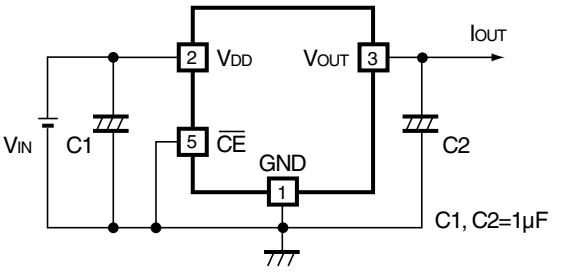


Fig.1 Standard Test Circuit

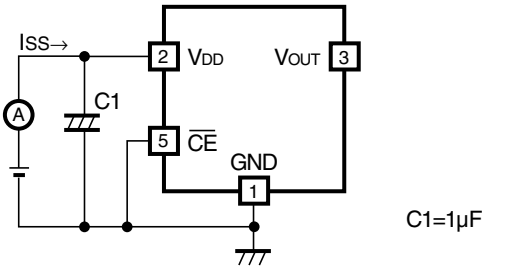


Fig.2 Supply Current Test Circuit

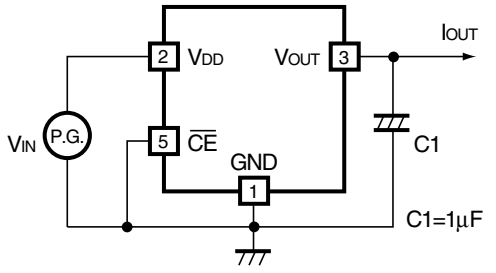
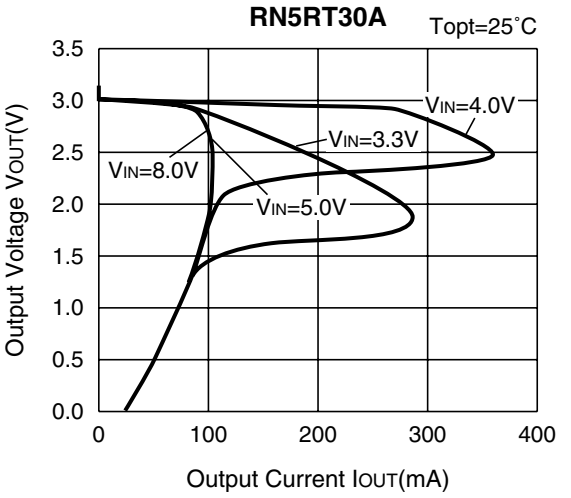
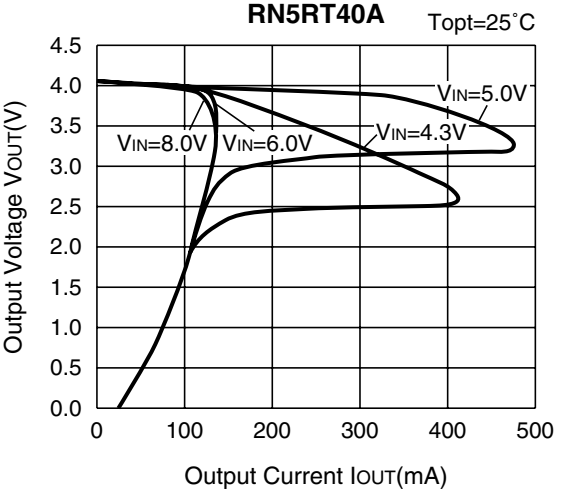


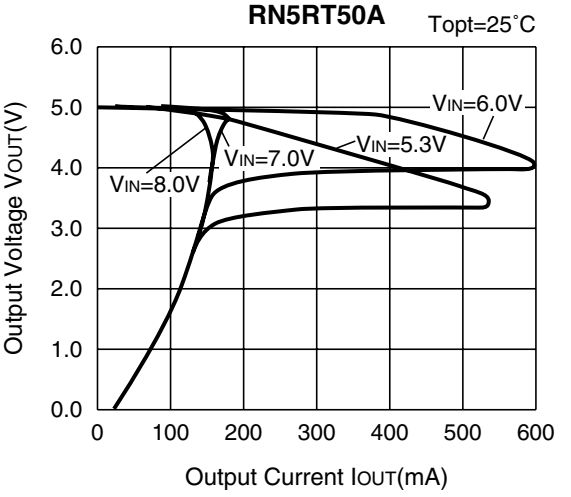
Fig.3 Line Transient Response Test Circuit

TYPICAL CHARACTERISTICS

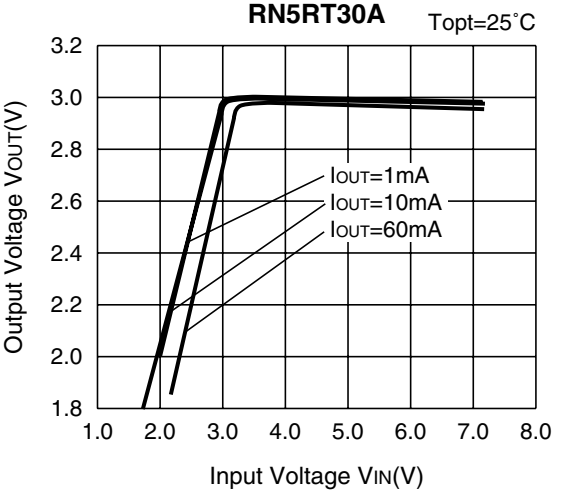
1) Output Voltage vs. Output Current

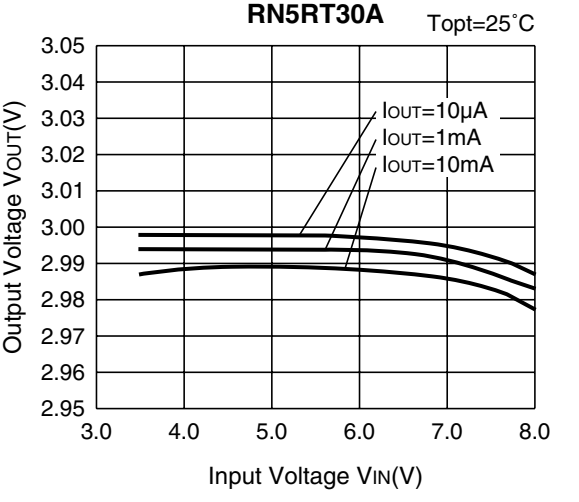


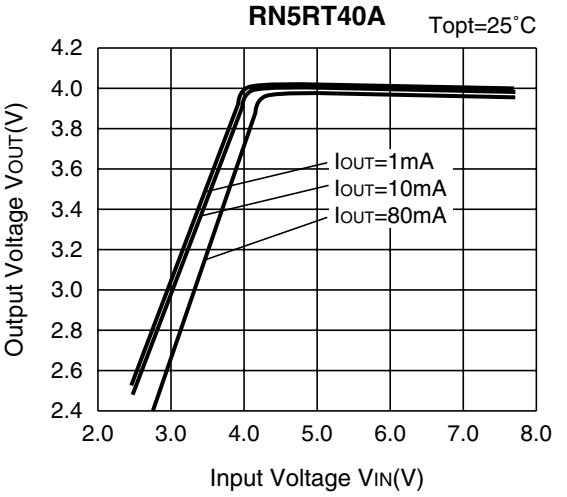


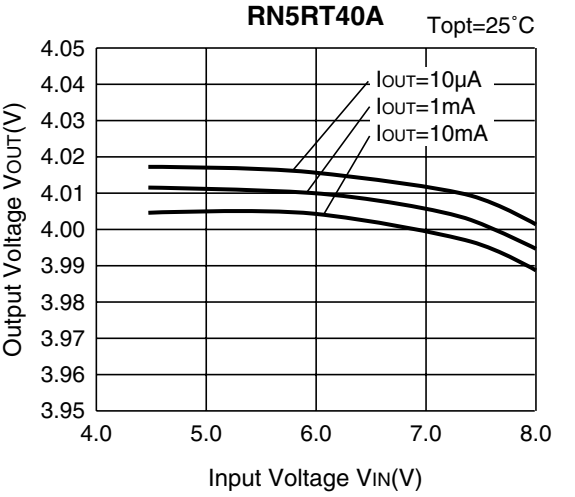


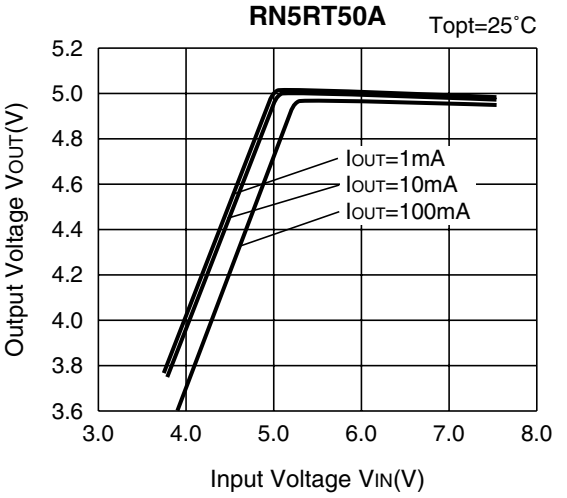
2) Output Voltage vs. Input Voltage

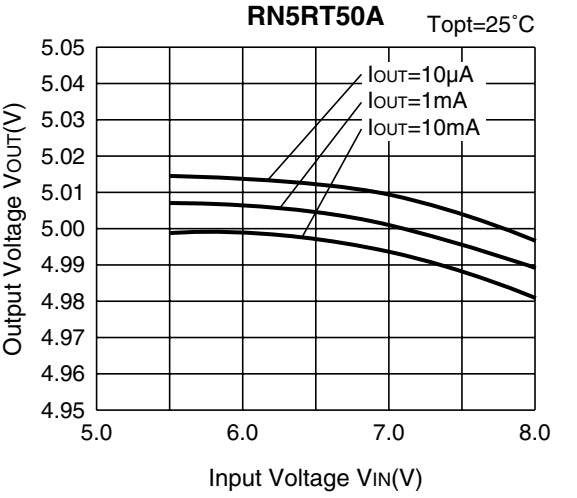




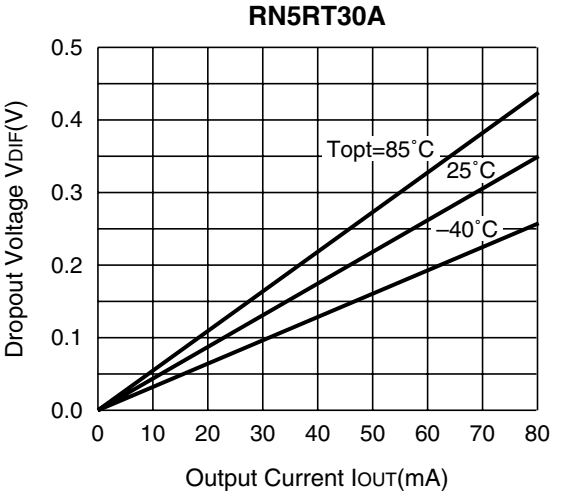


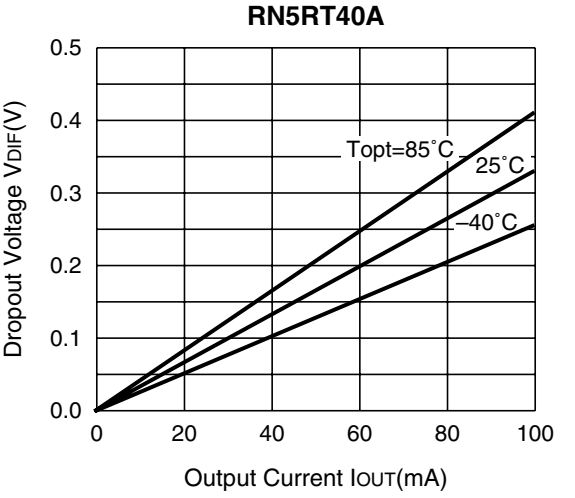




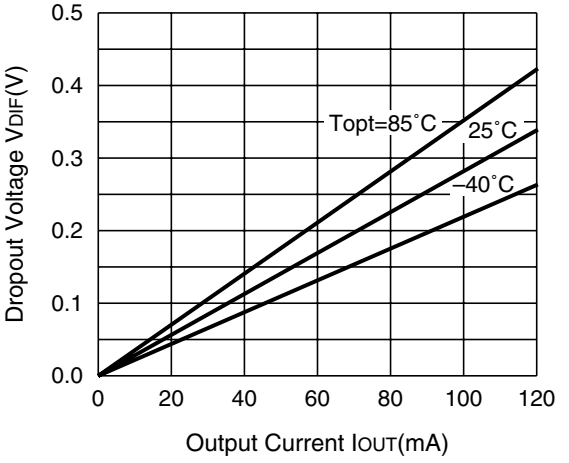


3) Dropout Voltage vs. Output Current



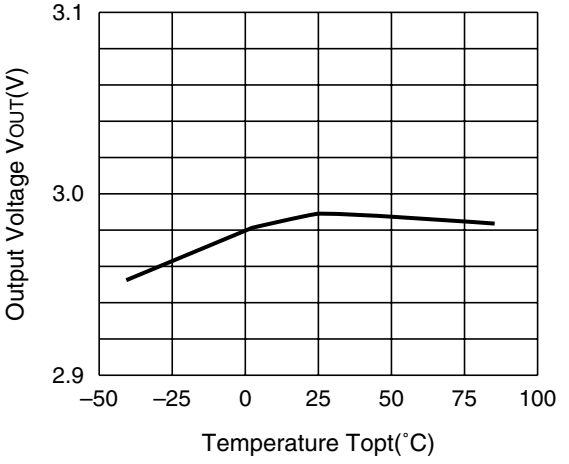


RN5RT50A

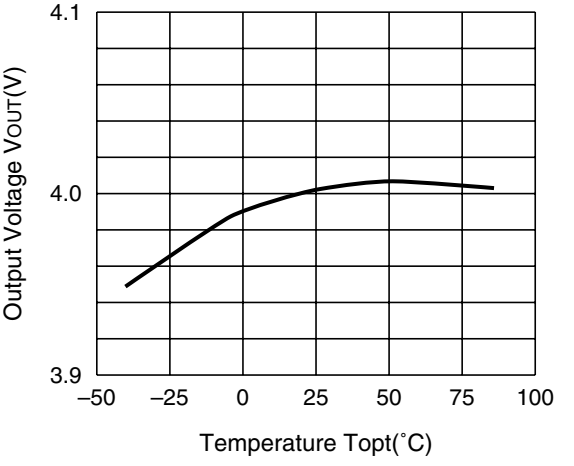


4) Output Voltage vs. Temperature

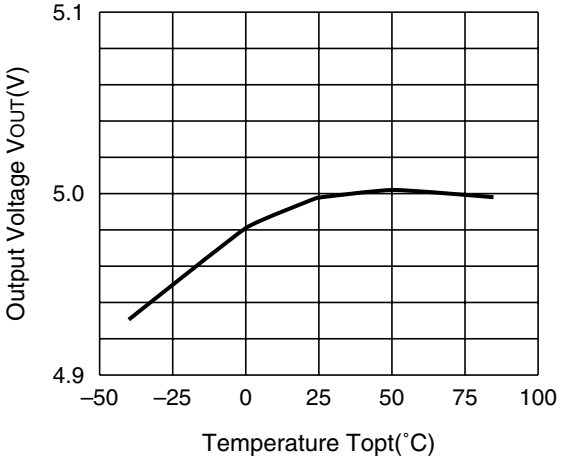
RN5RT30A V_{IN}=4V I_{OUT}=10mA



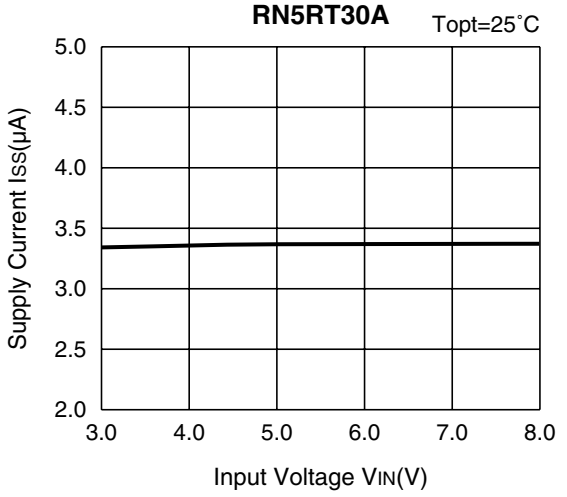
RN5RT40A V_{IN}=5V I_{OUT}=10mA

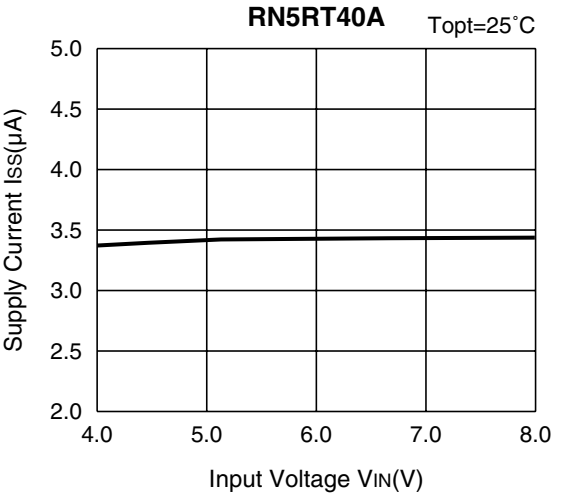


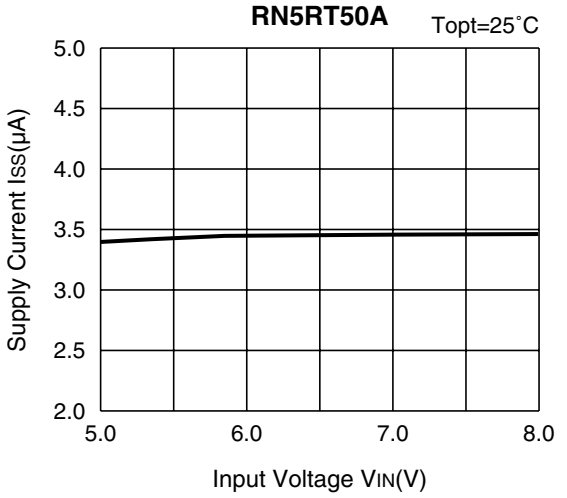
RN5RT50A V_{IN}=6V I_{OUT}=10mA



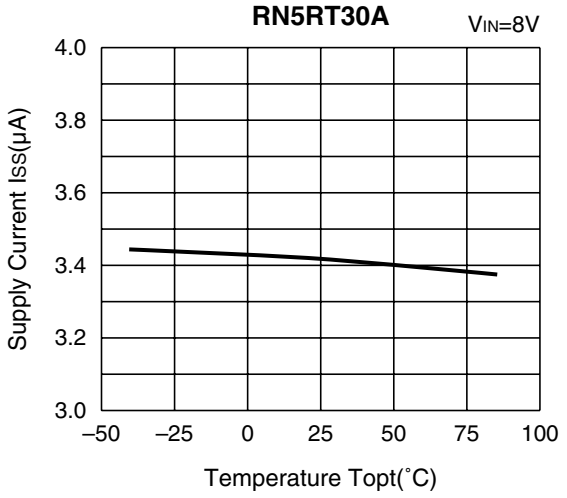
5) Supply Current vs. Input Voltage

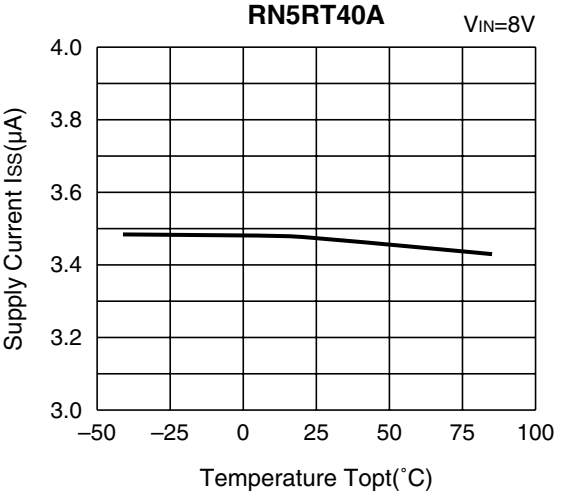


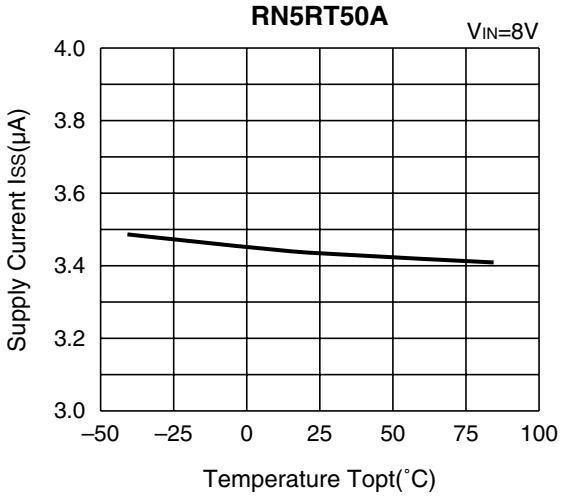




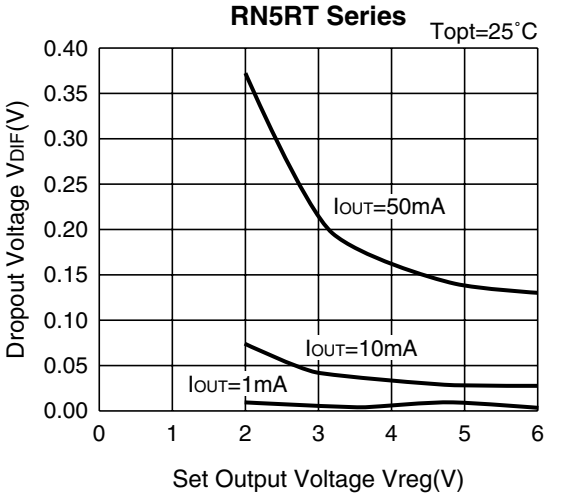
6) Supply Current vs. Temperature



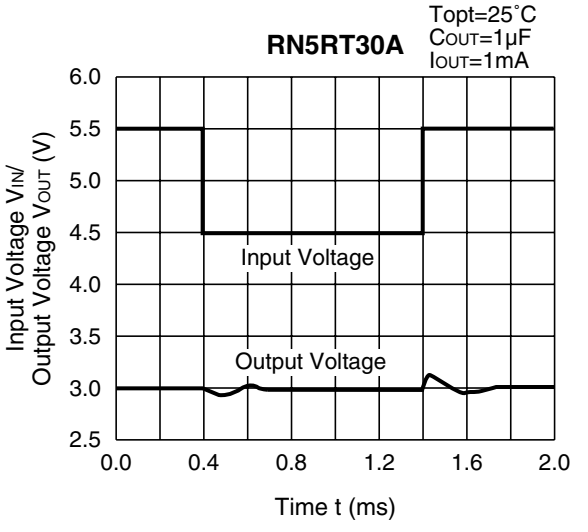


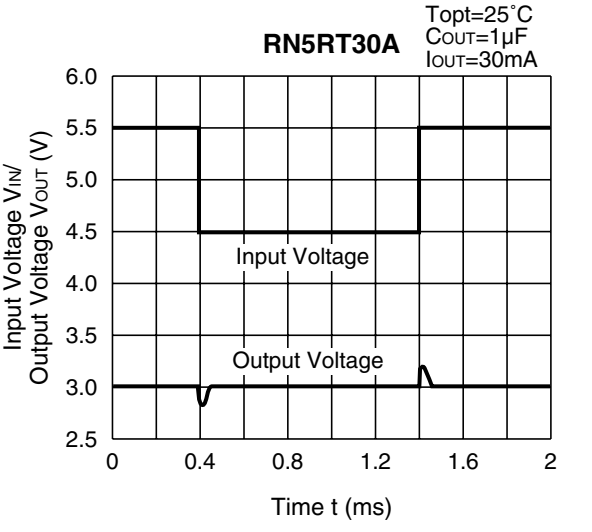


7) Dropout Voltage vs. Set Output Voltage

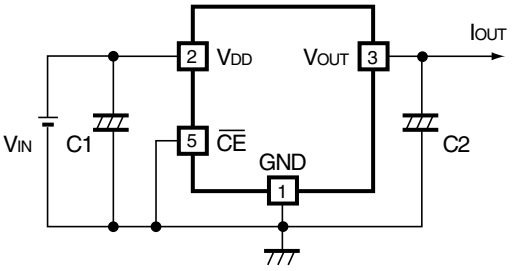


8) Line Transient Response





TYPICAL APPLICATION



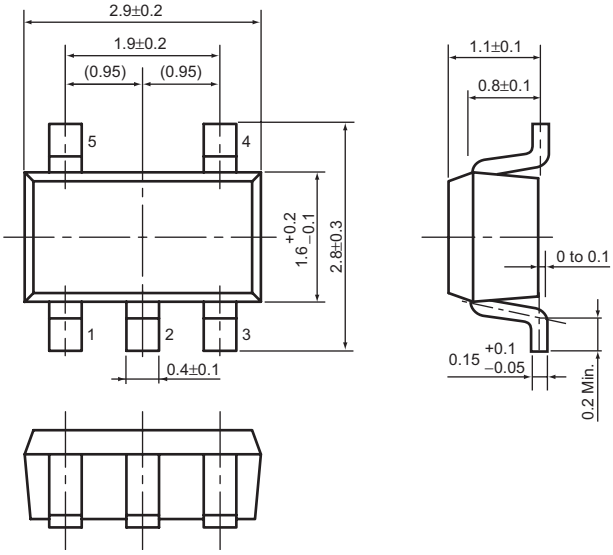
In the RN5RT Series, a constant voltage can be obtained without using capacitor C1 and C2. However, when the wire connected to V_{IN} is long, use a capacitor C1. Transient noise of output voltage occurred due to load deviation can be reduced by using a capacitor C2.

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

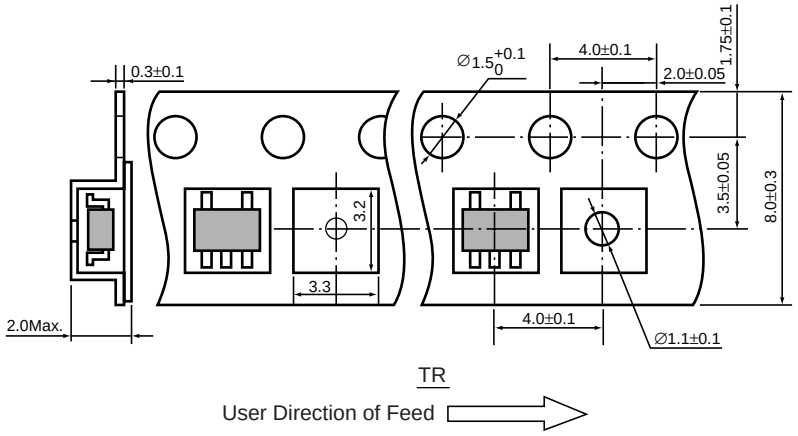
- **SOT-23-5 (SC-74A)**

Unit: mm

PACKAGE DIMENSIONS

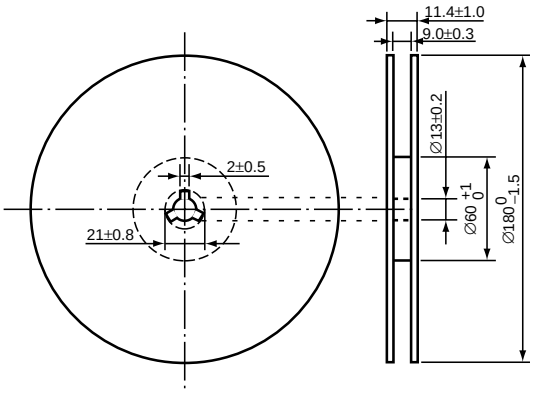


TAPING SPECIFICATION



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-08Bc)

(1reel=3,000pcs)



POWER DISSIPATION (SOT-23-5)

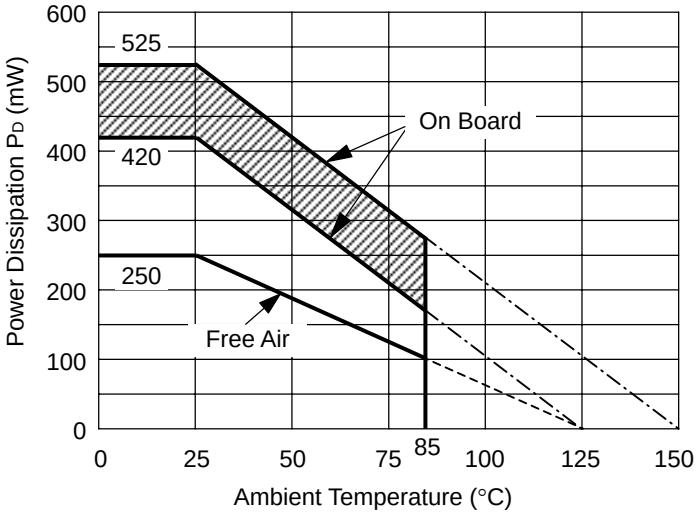
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-holes	ϕ0.5mm × 44pcs

Measurement Results (Topt=25°C, Tjmax=125°C)

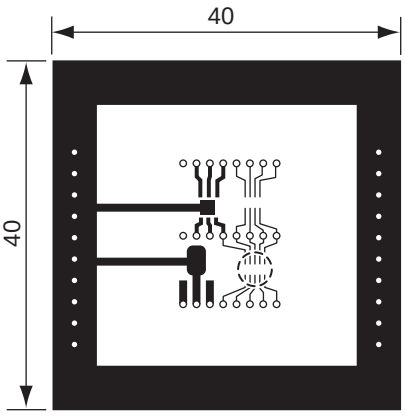
	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	θja=(125−25°C)/0.42W=238°C/W	400°C/W



Power Dissipation

The above graph shows the Power Dissipation of the package based on Tjmax=125°C and Tjmax=150°C.
Operating the IC in the shaded area in the graph might have an influence it's lifetime.
Operating time must be within the time limit described in the table below, in case of operating in the shaded area.

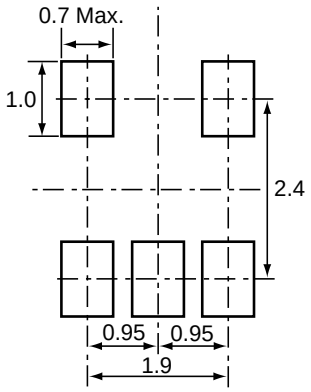
Product Name	Operating time	Estimated years (Operating four hours/day)
RP100N	9,000 hrs	6 years
RP101N	9,000 hrs	6 years
RP102N	2,300 hrs	1.5 years
RP103N	9,000 hrs	6 years
RP104N	9,000 hrs	6 years
RP130N	9,000 hrs	6 years
RP200N	9,000 hrs	6 years



Measurement Board Pattern

IC Mount Area (Unit: mm)

RECOMMENDED LAND PATTERN



(Unit: mm)

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RICOH COMPANY, LTD.
Electronic Devices Company
● **Shin-Yokohama office (International Sales)**
3-2-3, Shin-Yokohama, Kohoku-ku, Yokohama City, Kanagawa 222-8530, Japan
Phone: +81-45-477-1697 Fax: +81-45-477-1698

RICOH EUROPE (NETHERLANDS) B.V.
● **Semiconductor Support Centre**
Prof. W.H.Keesomlaan 1, 1183 DL Amstelveen, The Netherlands
P.O.Box 114, 1180 AC Amstelveen
Phone: +31-20-5474-309 Fax: +31-20-5474-791

RICOH ELECTRONIC DEVICES KOREA Co., Ltd.
11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.
Room403, No.2 Building, 690#Bi Bo Road, Pu Dong New district, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH COMPANY, LTD.
Electronic Devices Company
● **Taipei office**
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623