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**SMALL PACKAGE  
VOLTAGE REGULATOR  
RQ5RW SERIES**

**APPLICATION MANUAL**

**RICOH**

**ELECTRONIC DEVICES DIVISION**

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NO. EA-048-9803

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June 1995

# RQ5RW SERIES

## APPLICATION MANUAL

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**RQ5RW SERIES**

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**OUTLINE**

The RQ5RW Series are voltage regulator ICs with high accuracy output voltage and ultra-low supply current developed by CMOS process. Each of these ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage and a current limit circuit.

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

Even if  $V_{OUT}$  is shorted to GND, the included current limit circuit protects the ICs from the 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 are SC-82AB (Super Mini-mold) package, high density mounting of the ICs on boards is possible.

**FEATURES**

- Ultra-Low Supply Current.....TYP. 1.5 $\mu$ A
- Standby Current .....TYP. 0.1 $\mu$ A
- Dropout Voltage.....TYP. 40mV ( $I_{OUT}=1mA$ , RQ5RW30A/B)
- Low Temperature-Drift Coefficient of  
Output Voltage.....TYP.  $\pm 100ppm/^{\circ}C$
- Excellent Line Regulation.....TYP. 0.05%/V
- High Accuracy Output Voltage..... $\pm 2.0\%$
- Ultra-Small Package .....SC-82AB (Super Mini-mold)
- Built-in Current Limit Circuits

**APPLICATIONS**

- Power source for battery-powered equipment.
- Power source for cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- Precision voltage references.

## BLOCK DIAGRAM



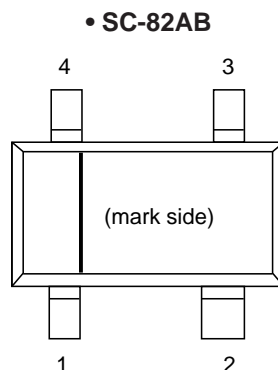
## SELECTION GUIDE

The output voltage, the active type, the packing type 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:

RQ5RW  $\times\times\times\times$ - $\times\times$  ← Part Number  
 $\uparrow \uparrow \uparrow \uparrow$   
 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	Designation of Chip enable Active Type : A : "L" active type B : "H" active type
c	Designation of Packing Type : A : Taping B : Antistatic bag (for Sample only)
d	Designation of Taping Type : TR (refer to Taping Specifications)

## PIN CONFIGURATION



## PIN DESCRIPTION

Pin No.	Symbol	Pin Description
1	GND	Ground Pin
2	V <sub>DD</sub>	Input Pin
3	V <sub>OUT</sub>	Output Pin
4	$\overline{\text{CE}}$ or CE	Chip Enable Pin

## ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V <sub>IN</sub>	Input Voltage	9	V
V <sub>CE</sub>	Input Voltage for CE/ $\overline{\text{CE}}$ 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	150	mW
T <sub>opt</sub>	Operating Temperature	-40 to +85	°C
T <sub>stg</sub>	Storage Temperature	-55 to +125	°C

### 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

## • RQ5RW30A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =5.0V 10μA≤I <sub>OUT</sub> ≤10mA	2.940	3.000	3.060	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> =5.0V	50			mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V <sub>IN</sub> =5.0V 1mA≤I <sub>OUT</sub> ≤50mA		40	60	mV
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =1mA		40	60	mV
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =5.0V		1.5	3.0	μA
I <sub>standby</sub>	Standby Current	V <sub>IN</sub> =5.0V, V <sub>CE</sub> =5.0V		0.1	1.0	μA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I <sub>OUT</sub> =1mA V <sub>OUT</sub> +0.5V≤V <sub>IN</sub> ≤8V	0	0.05	0.20	%/V
V <sub>IN</sub>	Input Voltage				8.0	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			40		mA
R <sub>PU</sub>	Pull up resistance for $\overline{CE}$ pin		1.5	4.0	12.0	MΩ
V <sub>CEH</sub>	$\overline{CE}$ Input Voltage "H"		1.5			V
V <sub>CEL</sub>	$\overline{CE}$ Input Voltage "L"				0.25	V



## • RQ5RW30B

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =5.0V 10μA≤I <sub>OUT</sub> ≤10mA	2.940	3.000	3.060	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> =5.0V	50			mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V <sub>IN</sub> =5.0V 1mA≤I <sub>OUT</sub> ≤50mA		40	60	mV
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =1mA		40	60	mV
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =5.0V		1.5	3.0	μA
I <sub>standby</sub>	Standby Current	V <sub>IN</sub> =5.0V, V <sub>CE</sub> =GND		0.1	1.0	μA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I <sub>OUT</sub> =1mA V <sub>OUT</sub> +0.5V≤V <sub>IN</sub> ≤8V	0	0.05	0.20	%/V
V <sub>IN</sub>	Input Voltage				8.0	V
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =1mA -40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/°C
I <sub>lim</sub>	Short Current Limit			40		mA
R <sub>PD</sub>	Pull down resistance for CE pin		1.5	4.0	12.0	MΩ
V <sub>CEH</sub>	CE Input Voltage "H"		1.5			V
V <sub>CEL</sub>	CE Input Voltage "L"				0.25	V

## ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE

T<sub>opt</sub>=25°C

Part Number	Output Voltage				Output Current			Load Regulation			Dropout Voltage		
	V <sub>out</sub> (V)				I <sub>out</sub> (mA)			ΔV <sub>out</sub> /ΔI <sub>out</sub> (mV)			V <sub>DIF</sub> (mV)		
	Conditions	MIN.	TYP.	MAX.	Conditions	MIN.	TYP.	Conditions	TYP.	MAX.	Conditions	TYP.	MAX.
RQ5RW20	V <sub>IN</sub> - V <sub>OUT</sub> =2.0V  10μA≤ I <sub>OUT</sub> ≤10mA	1.960	2.000	2.040	V <sub>IN</sub> - V <sub>OUT</sub> =2.0V	35		V <sub>IN</sub> - V <sub>OUT</sub> =2.0V  1mA≤ I <sub>OUT</sub> ≤35mA	30	45	I <sub>OUT</sub> =1mA	60	90
RQ5RW21		2.058	2.100	2.142									
RQ5RW22		2.156	2.200	2.244									
RQ5RW23		2.254	2.300	2.346									
RQ5RW24		2.352	2.400	2.448									
RQ5RW25		2.450	2.500	2.550									
RQ5RW26		2.548	2.600	2.652									
RQ5RW27		2.646	2.700	2.754									
RQ5RW28		2.744	2.800	2.856									
RQ5RW29		2.842	2.900	2.958									
RQ5RW30		2.940	3.000	3.060									
RQ5RW31		3.038	3.100	3.162									
RQ5RW32		3.136	3.200	3.264									
RQ5RW33		3.234	3.300	3.366									
RQ5RW34		3.332	3.400	3.468									
RQ5RW35		3.430	3.500	3.570									
RQ5RW36		3.528	3.600	3.672									
RQ5RW37		3.626	3.700	3.774									
RQ5RW38		3.724	3.800	3.876									
RQ5RW39		3.822	3.900	3.978									
RQ5RW40		3.920	4.000	4.080									
RQ5RW41		4.018	4.100	4.182									
RQ5RW42		4.116	4.200	4.284									
RQ5RW43		4.214	4.300	4.386									
RQ5RW44		4.312	4.400	4.488									
RQ5RW45		4.410	4.500	4.590									
RQ5RW46		4.508	4.600	4.692									
RQ5RW47		4.606	4.700	4.794									
RQ5RW48		4.704	4.800	4.896									
RQ5RW49		4.802	4.900	4.998									
RQ5RW50	4.900	5.000	5.100										
RQ5RW51	4.998	5.100	5.202										
RQ5RW52	5.096	5.200	5.304										
RQ5RW53	5.194	5.300	5.406										
RQ5RW54	5.292	5.400	5.508										
RQ5RW55	5.390	5.500	5.610										
RQ5RW56	5.488	5.600	5.712										
RQ5RW57	5.586	5.700	5.814										
RQ5RW58	5.684	5.800	5.916										
RQ5RW59	5.782	5.900	6.018										
RQ5RW60	5.880	6.000	6.120										
						65		V <sub>IN</sub> - V <sub>OUT</sub> =2.0V  1mA≤ I <sub>OUT</sub> ≤65mA	50	70		25	40
						80		V <sub>IN</sub> - V <sub>OUT</sub> =2.0V  1mA≤ I <sub>OUT</sub> ≤80mA	60	90			

## ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE (common characteristics)

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =setV <sub>OUT</sub> +2.0V		1.5	3.0	μA
I <sub>standby</sub>	Standby Current	V <sub>IN</sub> =setV <sub>OUT</sub> +2.0V V <sub>CE</sub> =V <sub>IN</sub> (RQ5RW××A), V <sub>CE</sub> =GND(RQ5RW××B)		0.1	1.0	μA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I <sub>OUT</sub> =1mA setV <sub>OUT</sub> +0.5V ≤ V <sub>IN</sub> ≤ 8V	0	0.05	0.20	%/V
V <sub>IN</sub>	Input Voltage				8.0	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			40		mA
R <sub>PU</sub> /R <sub>PD</sub>	$\overline{CE}$ Pull-up / CE Pull-down Resistance		1.5	4.0	12.0	MΩ
V <sub>CEH</sub>	$\overline{CE}$ /CE Input Voltage “H”		1.5			V
V <sub>CEL</sub>	$\overline{CE}$ /CE Input Voltage “L”				0.25	V

## OPERATION



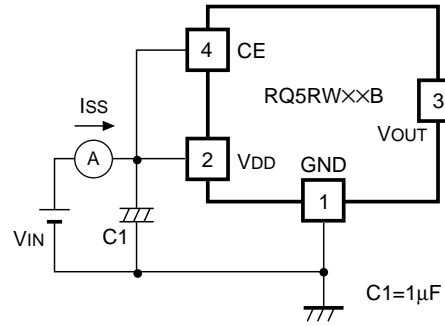
In these ICs, Output Voltage V<sub>OUT</sub> is detected by Feed-back Registers R1, R2, and the detected Output Voltage is compared with a reference voltage by Error Amplifier, so that a constant voltage is output.

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

## TEST CIRCUITS



Standard Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection and Line Transient Response



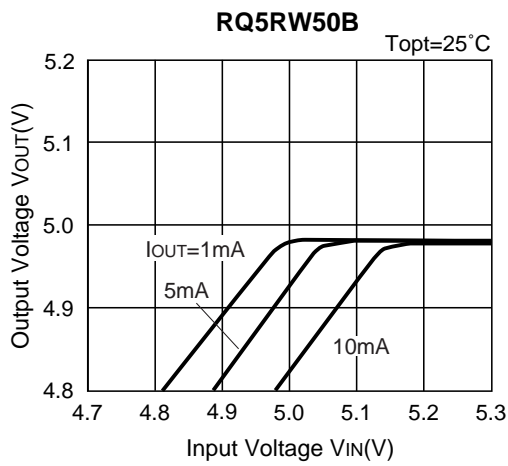
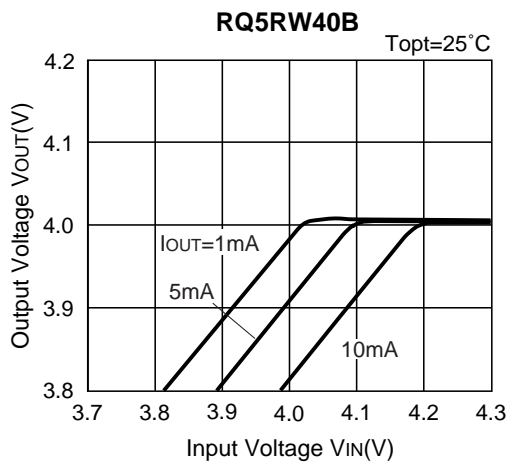
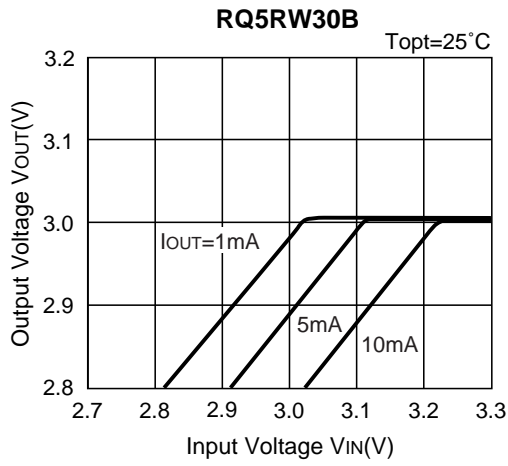
Test Circuit for Load Transient Response

# TYPICAL CHARACTERISTICS

## 1) Output Voltage vs. Output Current



2) Output Voltage vs. Input Voltage



3) Dropout Voltage vs. Output Current

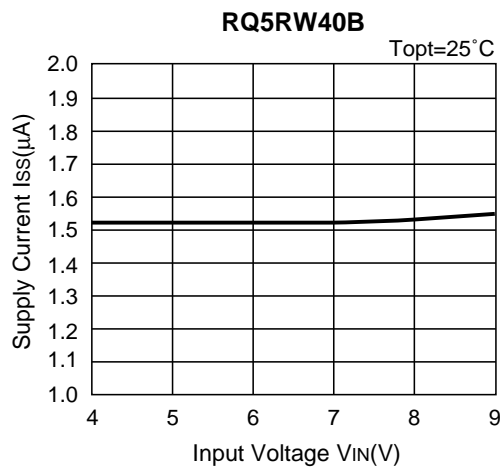


4) Output Voltage vs. Temperature





5) Supply Current vs. Input Voltage





6) Supply Current vs. Temperature



7) Dropout Voltage vs. Set Output Voltage



8) Line Transient Response



9) Load Transient Response



10) Ripple Rejection

**RQ5RW30B**

$V_{IN}=5V_{DC}+0.5V_{p-p}$   
 $I_{OUT}=10mA$   
 $C_{OUT}=1\mu F$



**RQ5RW40B**

$V_{IN}=6V_{DC}+0.5V_{p-p}$   
 $I_{OUT}=10mA$   
 $C_{OUT}=1\mu F$

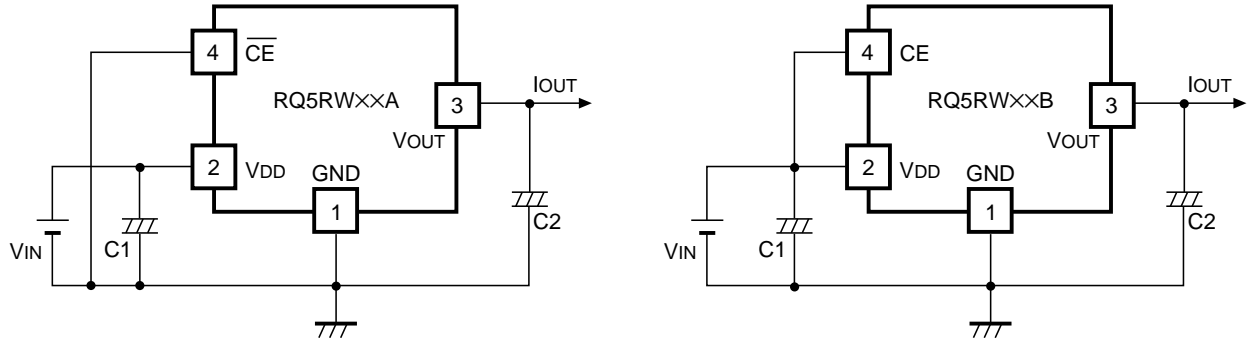


**RQ5RW50B**

$V_{IN}=7V_{DC}+0.5V_{p-p}$   
 $I_{OUT}=10mA$   
 $C_{OUT}=1\mu F$



## TYPICAL APPLICATION



In RQ5RW Series, a constant voltage can be obtained without using Capacitor C1 and C2. However, when the wire connected  $V_{IN}$  is long, use Capacitor C1. Output noise can be reduced by using Capacitor 2.

Insert Capacitors C1 and C2 with the capacitance of  $0.1\mu\text{F}$  to  $0.2\mu\text{F}$  between Input/Output Pins and GND Pin with minimum wiring.

## PACKAGE DIMENSION (Unit : mm)

- SC-82AB



### TAPING SPECIFICATION (Unit : mm)

- SC82AB





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