SMALL PACKAGE VOLTAGE REGULATOR

RQ5RW SERIES

APPLICATION MANUAL

RICOH

ELECTRONIC DEVICES DIVISION

NO. EA-048-9803

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June 1995

RQ5RW SERIES

APPLICATION MANUAL

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RICOH

SMALL PACKAGE VOLTAGE REGULATOR

RQ5RW SERIES

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 VOUT 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

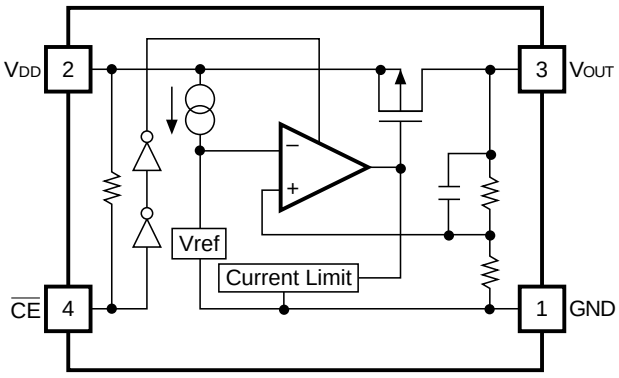
- Ultra-Low Supply Current ..... TYP. 1.5µA
- Standby Current ..... TYP. 0.1µA
- Dropout Voltage ..... TYP. 40mV (IOUT=1mA, RQ5RW30A/B)
- Low Temperature-Drift Coefficient of Output Voltage ..... TYP. ±100ppm/°C
- Excellent Line Regulation ..... TYP. 0.05%/V
- High Accuracy Output Voltage ..... ±2.0%
- Ultra-Small Package ..... SC-82AB (Super Mini-mold)
- Built-in Current Llimit Circuits

APPLICATIONS

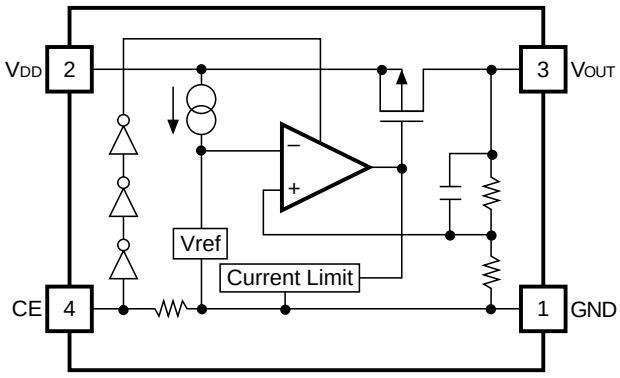
- Power source for battery-powered equipment.
- Power source for cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- Precision voltage references.

BLOCK DIAGRAM

RQ5RW××A



RQ5RW××B



SELECTION GUIDE

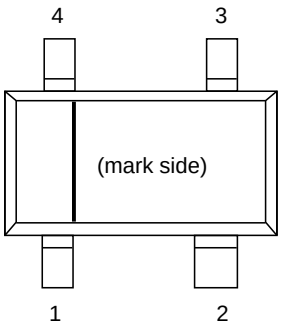
The output voltage, the active type, the packing type and the taping type for the ICs can be selected at the user's request. The selection can be made by designating the part number as shown below:

RQ5RW ×××× – ×× ← 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	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

• **SC-82AB**



PIN DESCRIPTION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	9	V
V_{CE}	Input Voltage for CE/$\overline{CE}$ 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

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

Topt=25°C

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

• **RQ5RW30B**

Topt=25°C

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

ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE

Topt=25˚C

Part Number	Output Voltage				Output Current			Load Regulation			Dropout Votage		
	V_{OUT}(V)				I_{OUT}(mA)			$\Delta V_{OUT}/\Delta I_{OUT}$(mV)			V_{DIF}(mV)		
	Conditions	MIN.	TYP.	MAX.	Conditions	MIN.	TYP.	Conditions	TYP.	MAX.	Conditions	TYP.	MAX.
RQ5RW20	V_{IN}–V_{OUT} =2.0V 10μA≤ I_{OUT} ≤10mA	1.960	2.000	2.040	V_{IN}–V_{OUT} =2.0V	35		V_{IN}–V_{OUT} =2.0V 1mA≤ I_{OUT} ≤35mA	30	45	I_{OUT} =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								50	75
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								40	60
RQ5RW29		2.842	2.900	2.958									
RQ5RW30		2.940	3.000	3.060		50		V_{IN}–V_{OUT} =2.0V 1mA≤ I_{OUT} ≤50mA	40	60			
RQ5RW31		3.038	3.100	3.162									
RQ5RW32		3.136	3.200	3.264								35	55
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								30	45
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		65		V_{IN}–V_{OUT} =2.0V 1mA≤ I_{OUT} ≤65mA	50	70		25	40
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		80		V_{IN}–V_{OUT} =2.0V 1mA≤ I_{OUT} ≤80mA	60	90			
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									

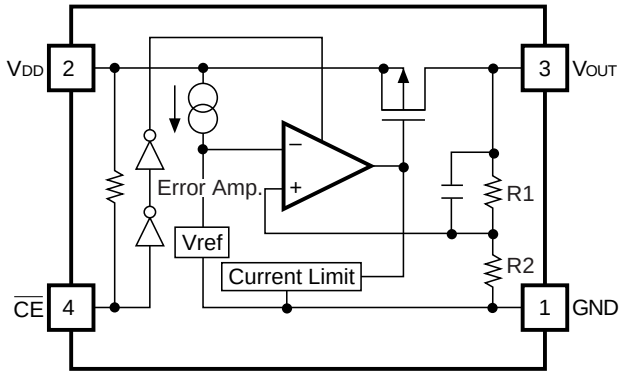
ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE
(common characteristics)

Topt=25°C

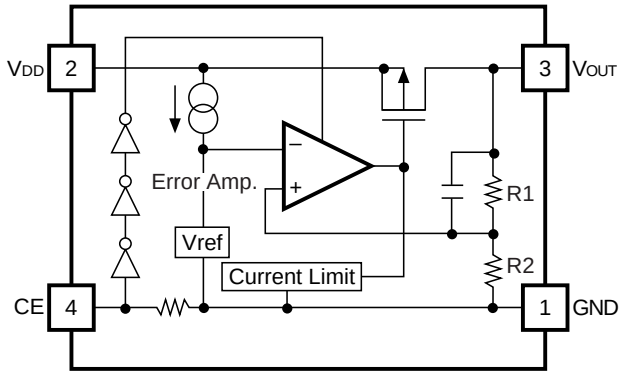
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
I_{SS}	Supply Current	V_{IN}=setV_{OUT}+2.0V		1.5	3.0	µA
Istandby	Standby Current	V_{IN}=setV_{OUT}+2.0V V_{CE}=V_{IN}(RQ5RW××A), V_{CE}=GND(RQ5RW××B)		0.1	1.0	µA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	I_{OUT}=1mA setV_{OUT}+0.5V≤V_{IN}≤8V	0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

OPERATION

RQ5RW××A

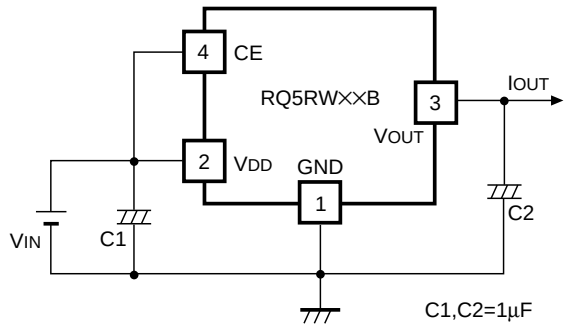


RQ5RW××B

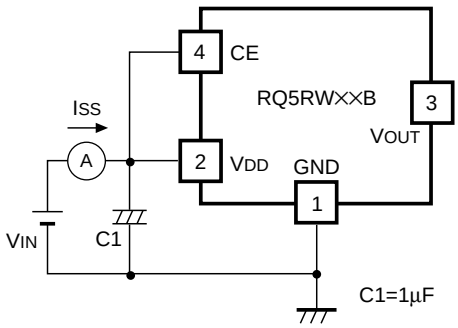


In these ICs, Output Voltage V_{OUT} is detected by Feed-back Registers R1, R2, and the detected Output Voltage is compare with a reference voltage by Error Amplifier, so that a constant voltage is output.
A current limit circuit working for Short Protect and a chip enable circuit are included.

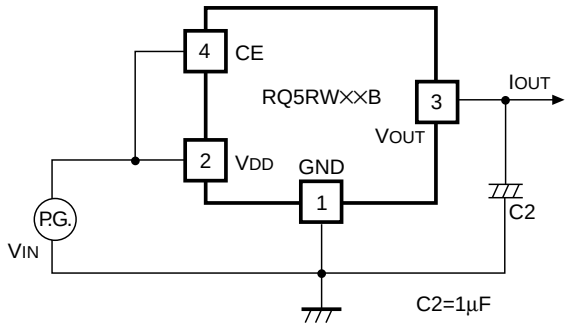
TEST CIRCUITS



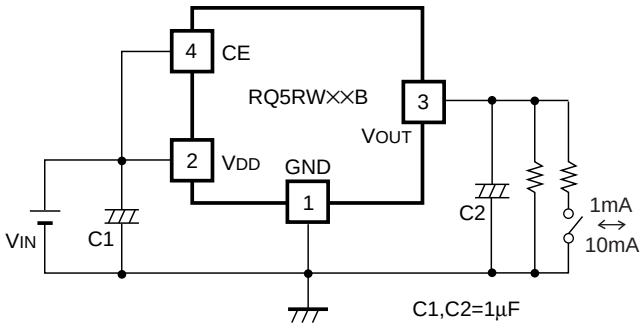
Standard Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection and Line Transient Response

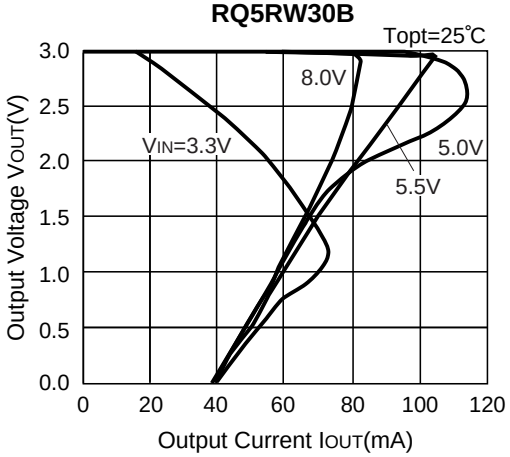


Test Circuit for Load Transient Response

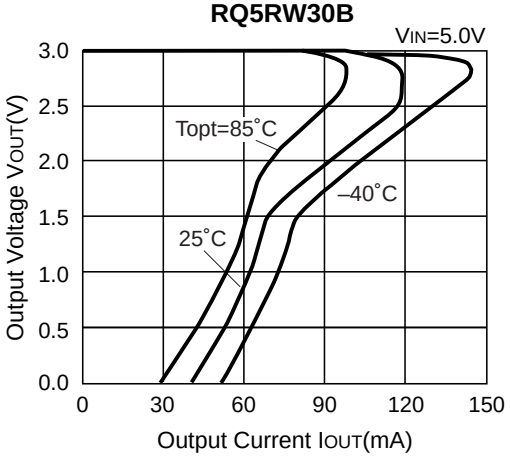
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

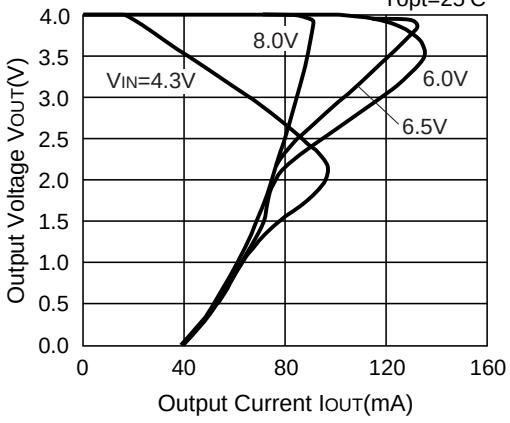
RQ5RW30B



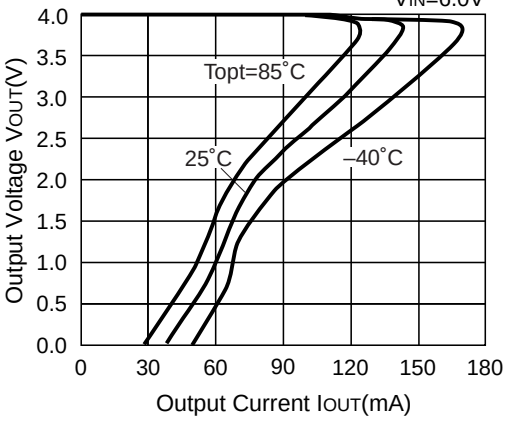
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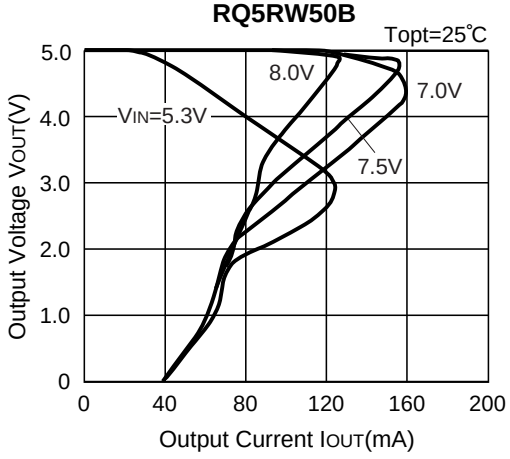
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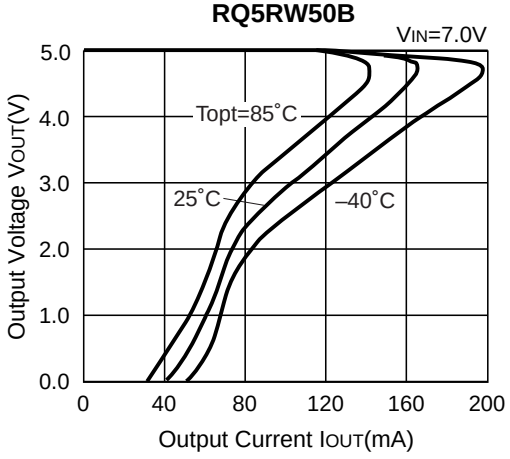
RQ5RW40B



RQ5RW50B

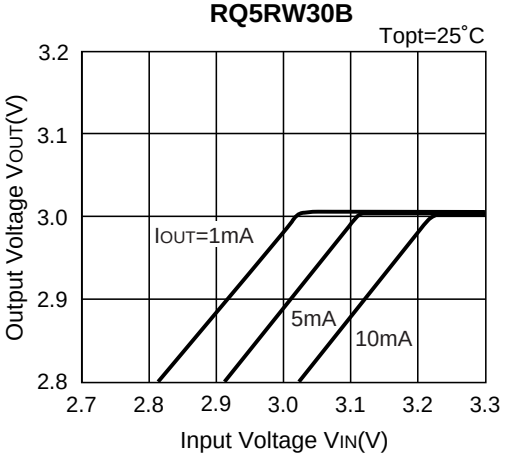


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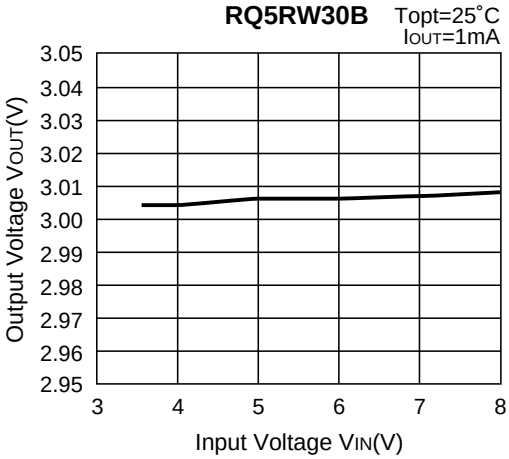


2) Output Voltage vs. Input Voltage

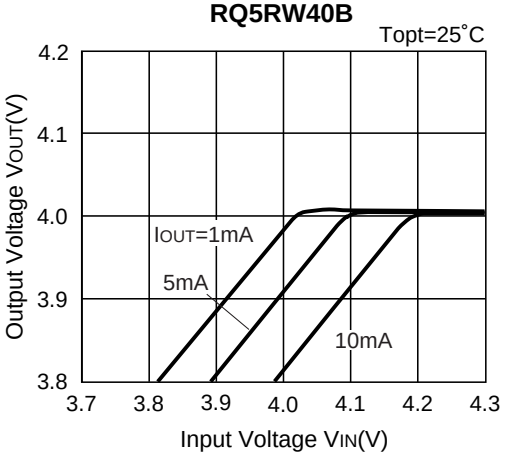
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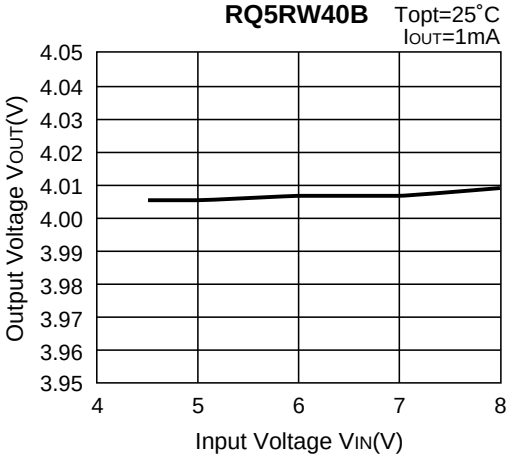
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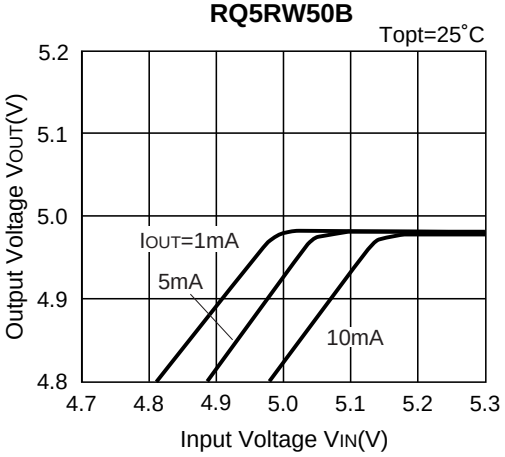
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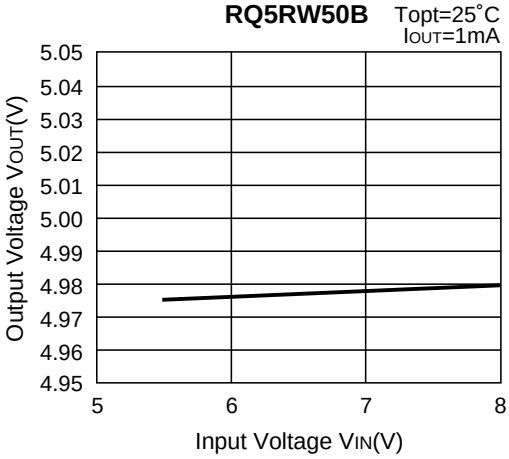
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RQ5RW50B

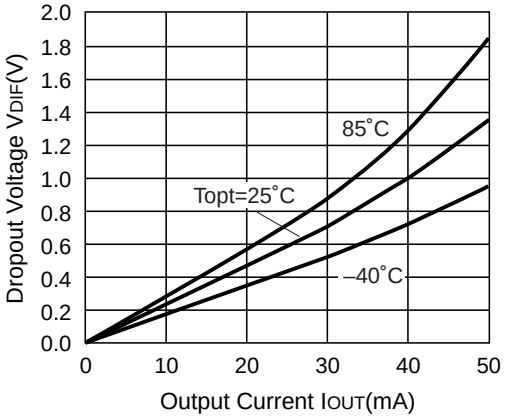


RQ5RW50B

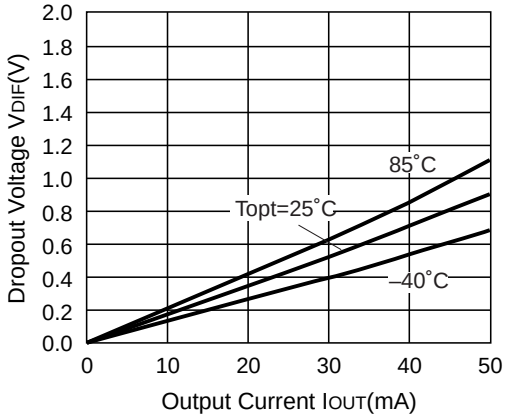


3) Dropout Voltage vs. Output Current

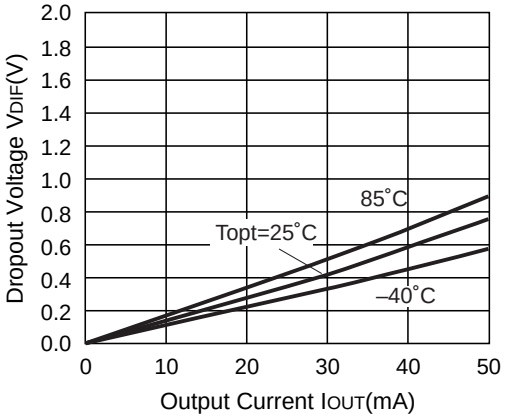
RQ5RW30B



RQ5RW40B

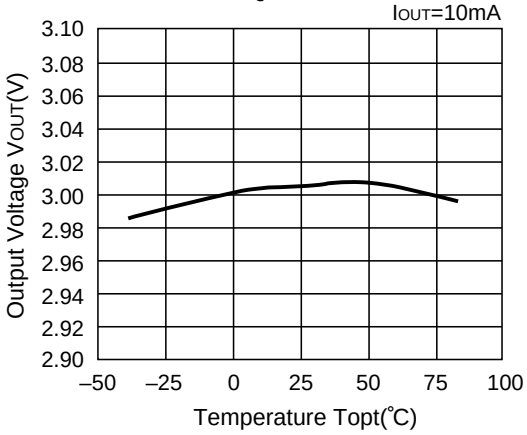


RQ5RW50B

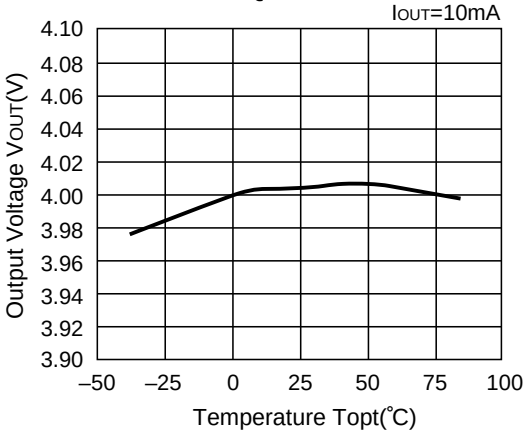


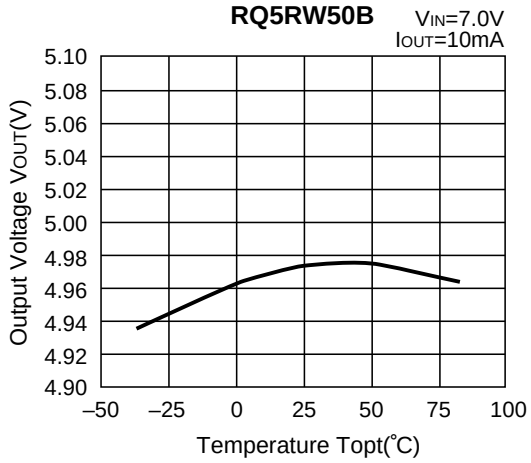
4) Output Voltage vs. Temperature

RQ5RW30B V_{IN}=5.0V I_{OUT}=10mA

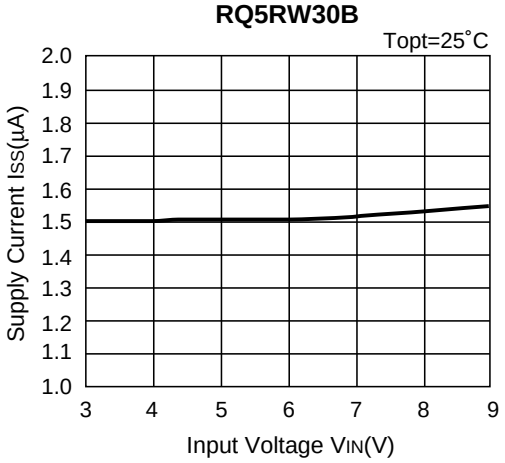


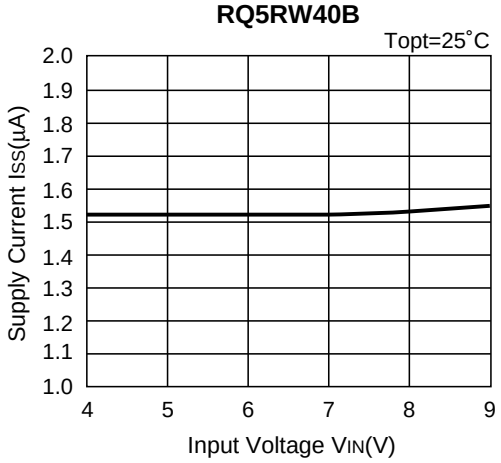
RQ5RW40B V_{IN}=6.0V I_{OUT}=10mA

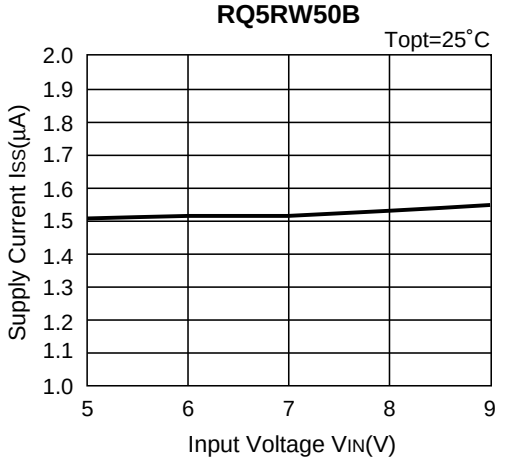




5) Supply Current vs. Input Voltage

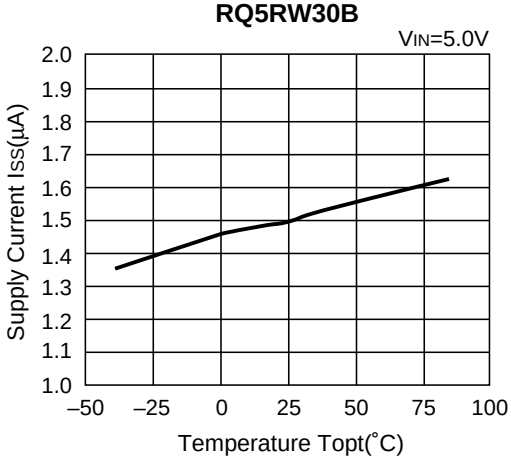




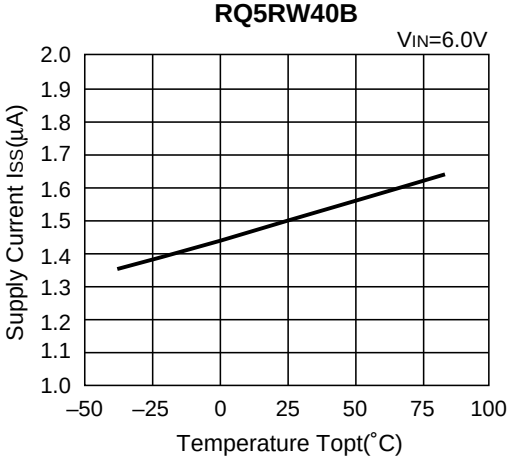


6) Supply Current vs. Temperature

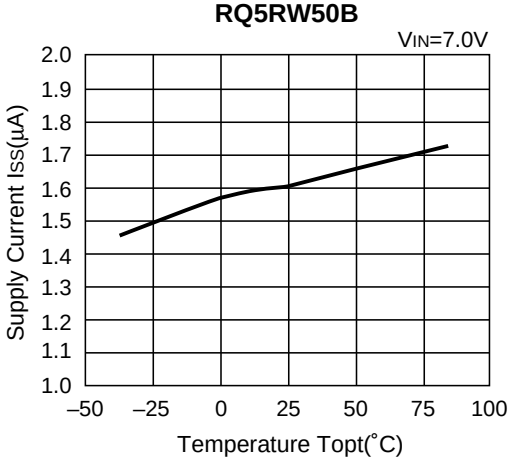
RQ5RW30B



RQ5RW40B

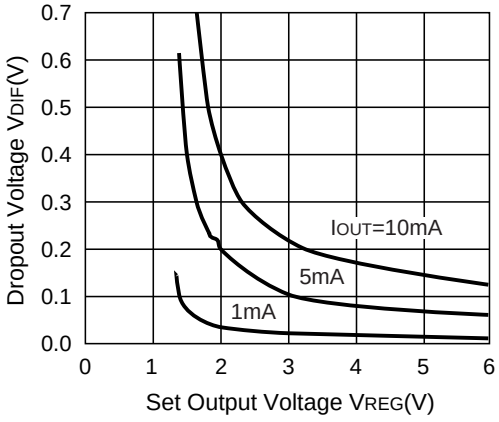


RQ5RW50B



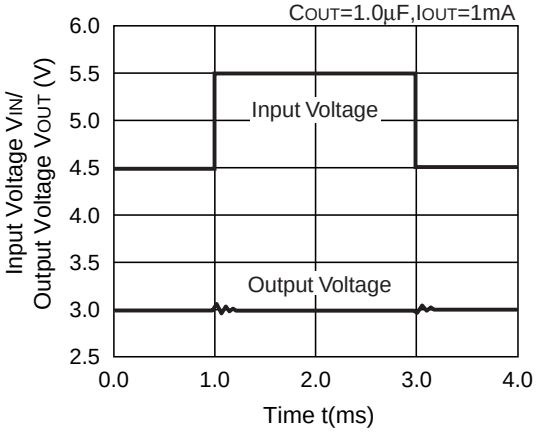
7) Dropout Voltage vs. Set Output Voltage

RQ5RW××B

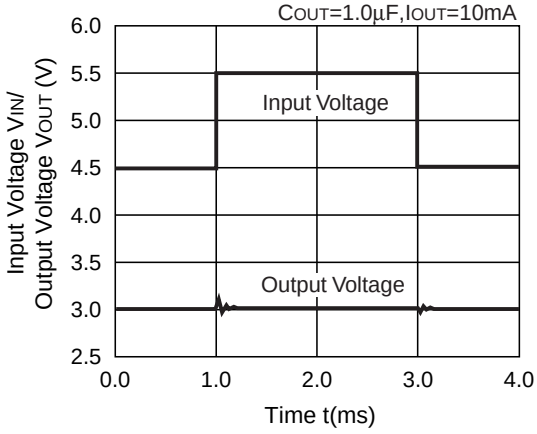


8) Line Transient Response

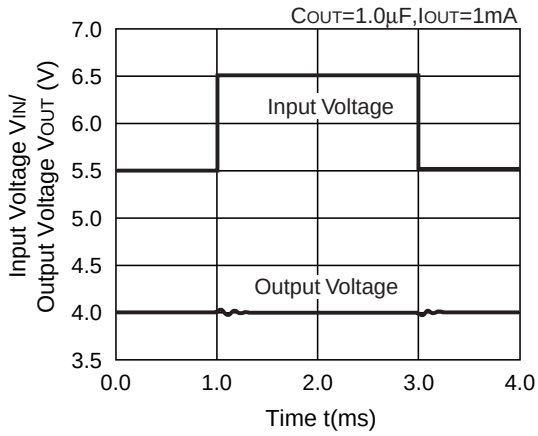
RQ5RW30B



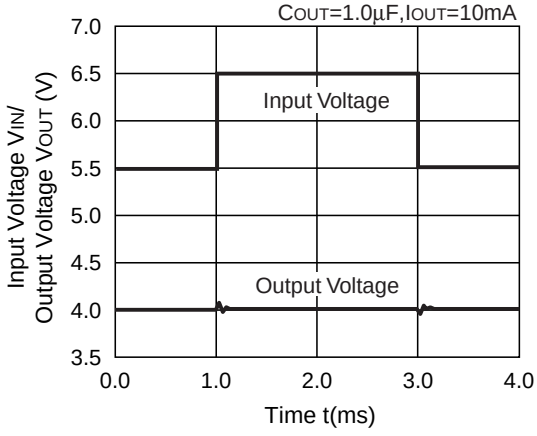
RQ5RW30B



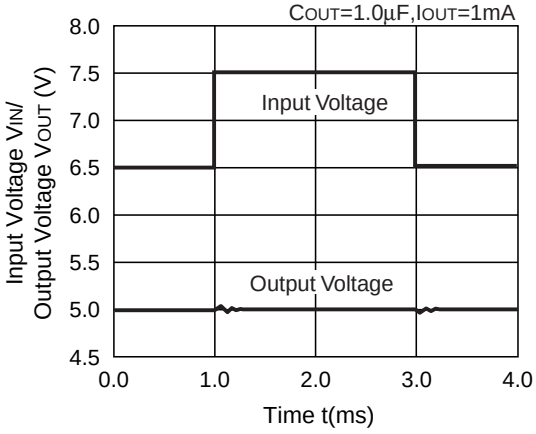
RQ5RW40B



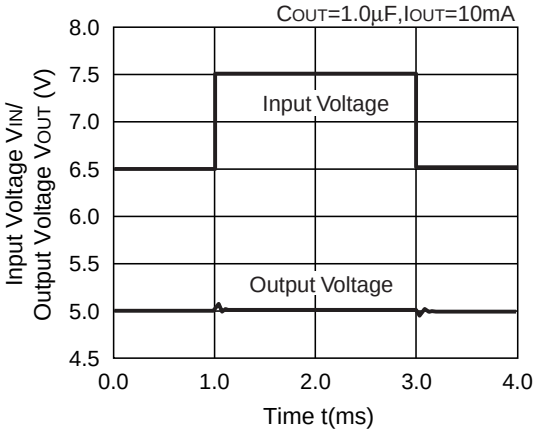
RQ5RW40B



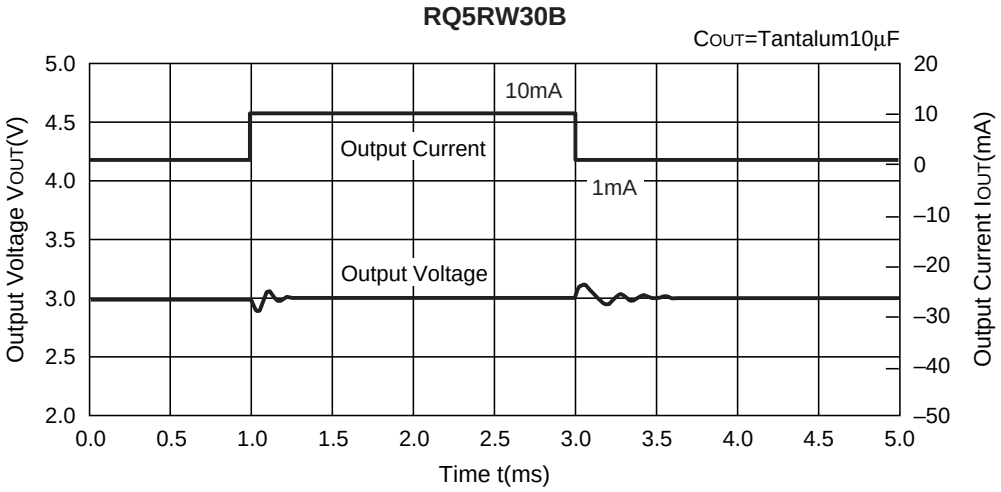
RQ5RW50B

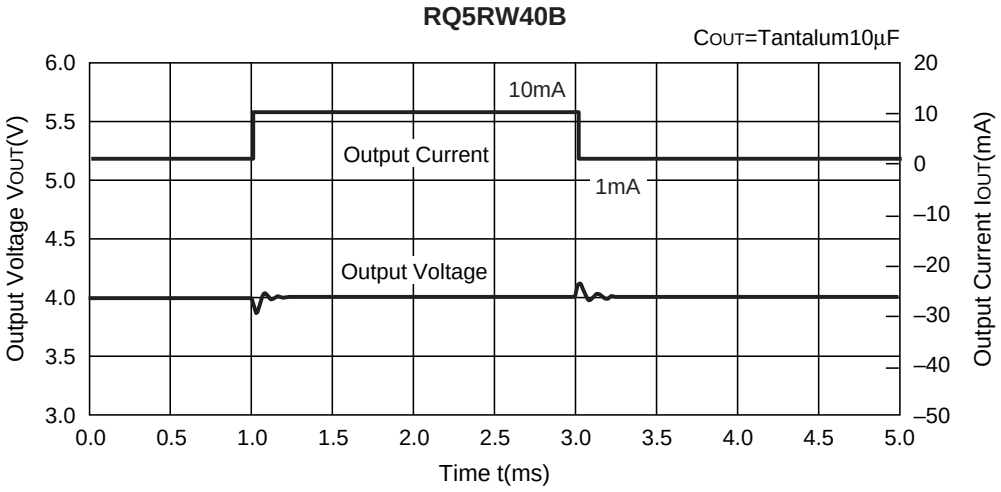


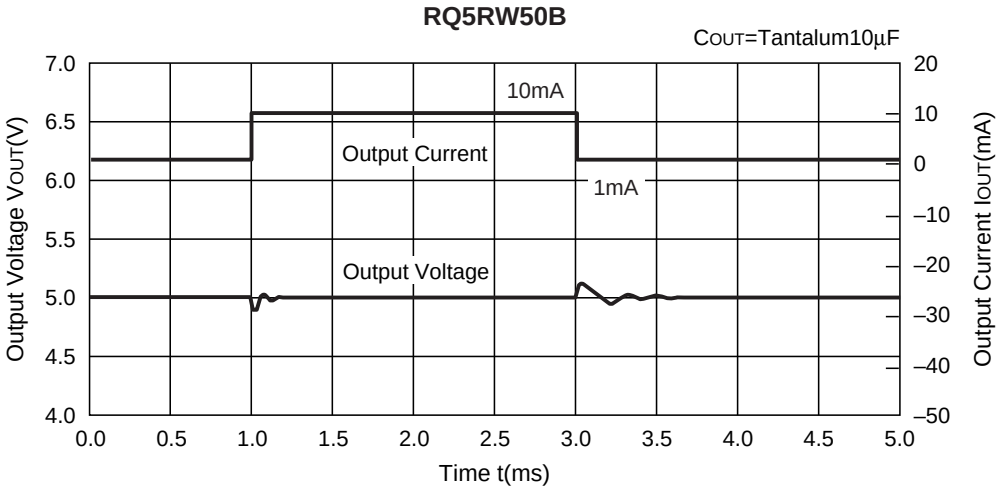
RQ5RW50B



9) Load Transient Response



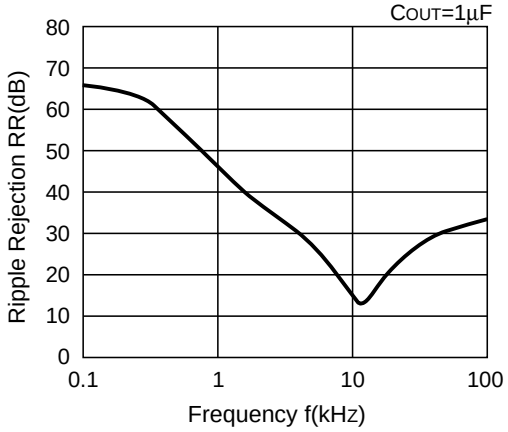




10) Ripple Rejection

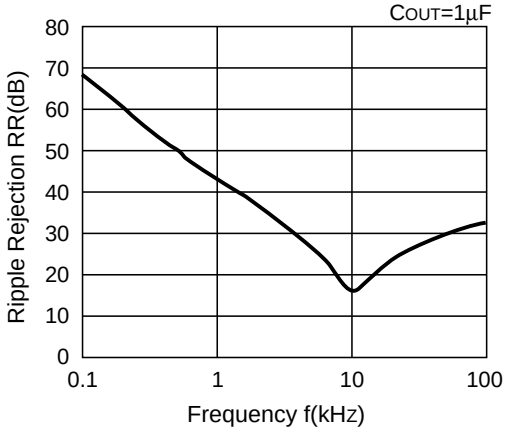
RQ5RW30B

V_{IN}=5V_{DC}+0.5Vp-p
I_{OUT}=10mA
C_{OUT}=1µF



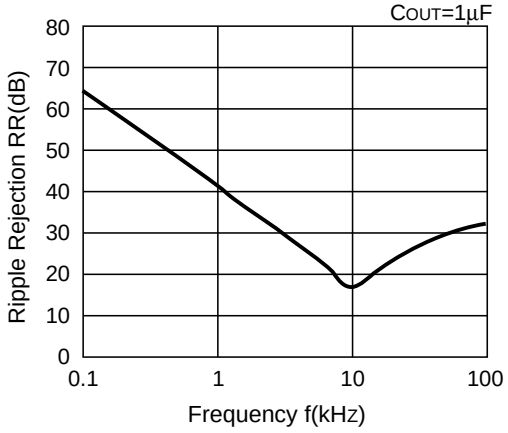
RQ5RW40B

V_{IN}=6V_{DC}+0.5Vp-p
I_{OUT}=10mA
C_{OUT}=1µF

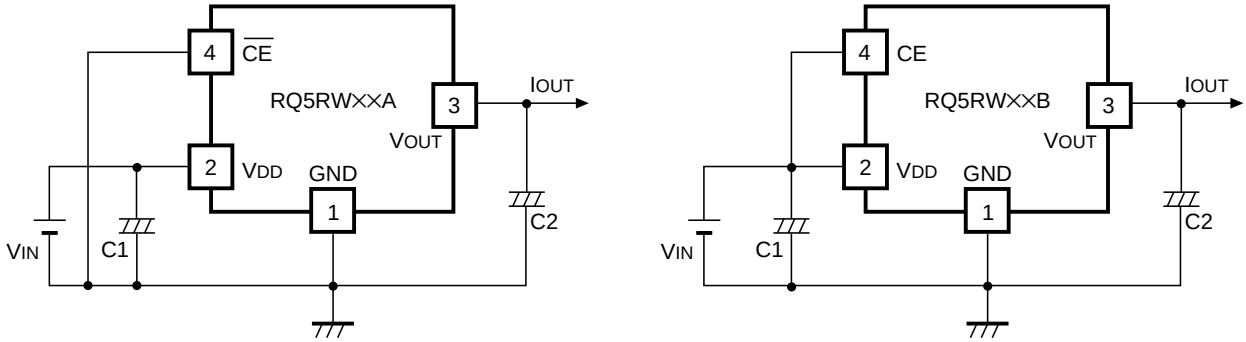


RQ5RW50B

V_{IN}=7V_{DC}+0.5Vp-p
I_{OUT}=10mA
C_{OUT}=1µF



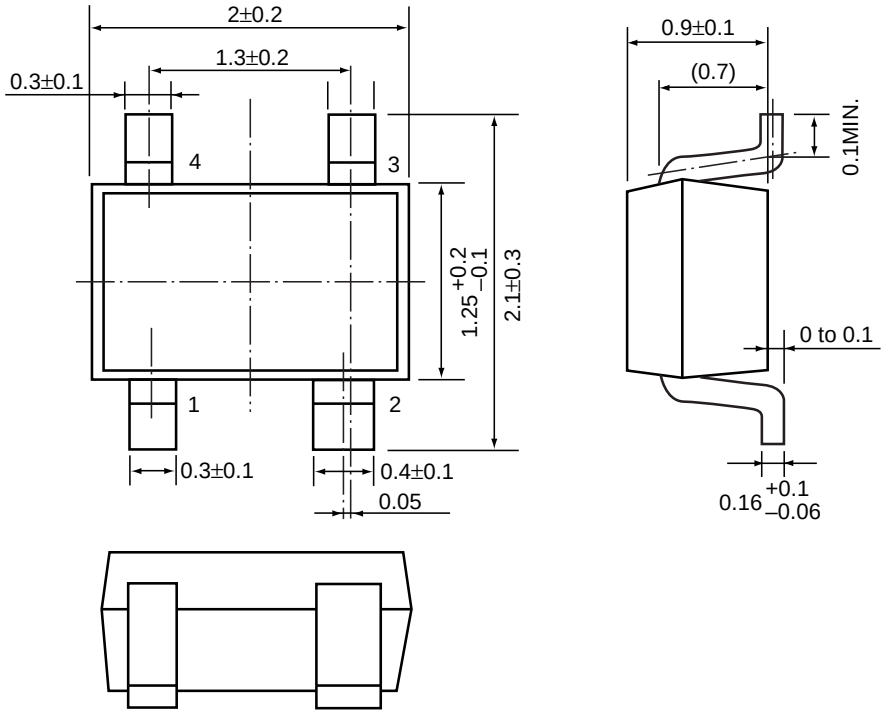
TYPICAL APPLICATION



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 0.1µF to 0.2µF between Input/Output Pins and GND Pin with minimum wiring.

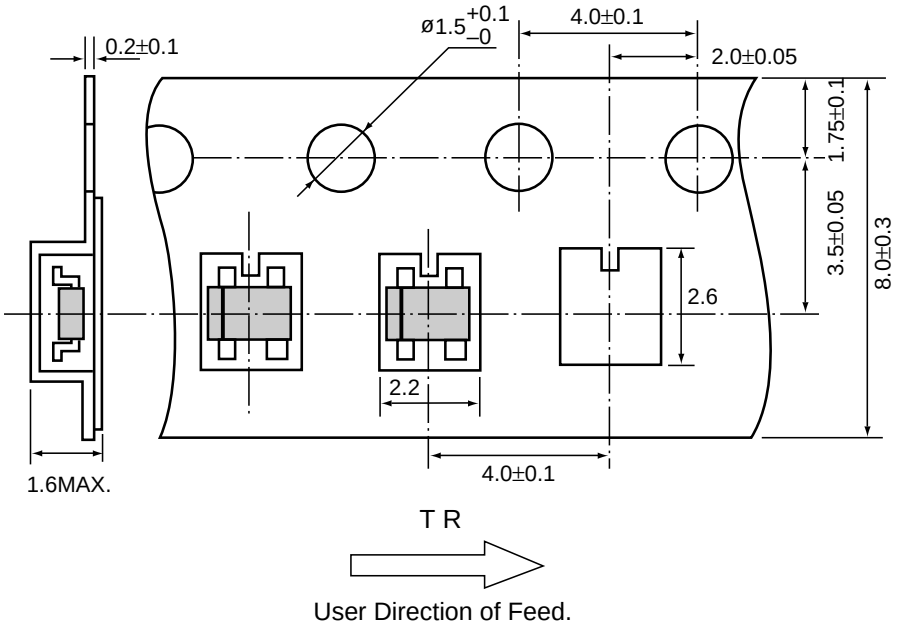
PACKAGE DIMENSION (Unit : mm)

• SC-82AB



TAPING SPECIFICATION (Unit : mm)

• SC82AB





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