
SMALL PACKAGE VOLTAGE REGULATOR

RQ5RW SERIES

APPLICATION MANUAL

RICOH

ELECTRONIC DEVICES DIVISION

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June 1995

RQ5RW SERIES

APPLICATION MANUAL

CONTENTS

OUTLINE	1
FEATURES	1
APPLICATIONS	1
BLOCK DIAGRAM	2
SELECTION GUIDE	2
PIN CONFIGURATION	3
PIN DESCRIPTION	3
ABSOLUTE MAXIMUM RATINGS	3
ELECTRICAL CHARACTERISTICS	4
ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE	6
ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE (common characteristics)	7
OPERATION	7
TEST CIRCUITS	8
TYPICAL CHARACTERISTICS	9
1) Output Voltage vs. Output Current	9
2) Output Voltage vs. Input Voltage	10
3) Dropout Voltage vs. Output Current	11
4) Output Voltage vs. Temperature	11
5) Supply Current vs. Input Voltage	12
6) Supply Current vs. Temperature	13
7) Dropout Voltage vs. Set Output Voltage	13
8) Line Transient Response	14
9) Load Transient Response	15
10) Ripple Rejection	16



TYPICAL APPLICATION	17
PACKAGE DIMENSION	17
TAPING SPECIFICATION	18



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 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.

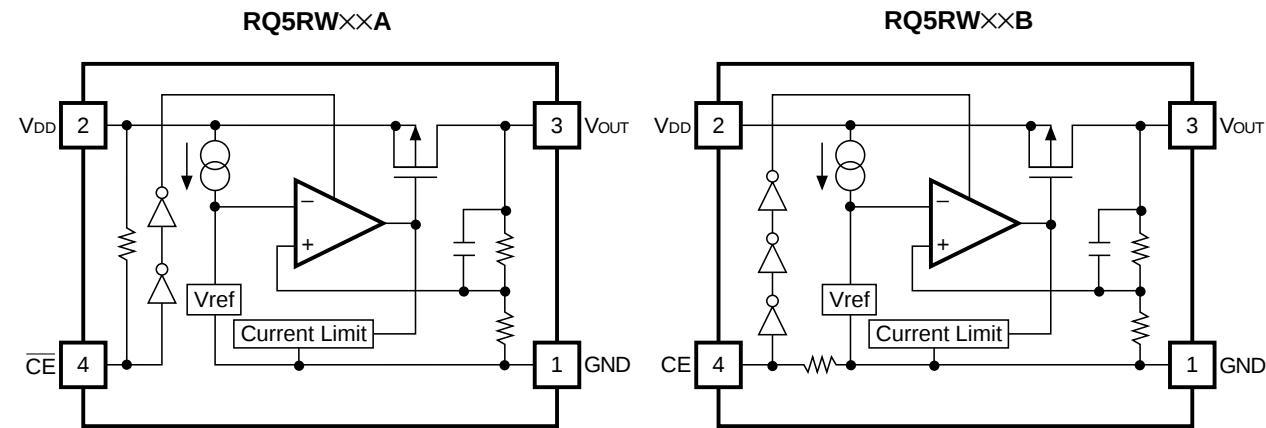
FEATURES

- Ultra-Low Supply Current.....TYP. 1.5 μ A
- Standby CurrentTYP. 0.1 μ A
- Dropout Voltage.....TYP. 40mV (I_{OUT} =1mA, RQ5RW30A/B)
- Low Temperature-Drift Coefficient of
Output Voltage.....TYP. ± 100 ppm/ $^{\circ}$ C
- Excellent Line Regulation.....TYP. 0.05%/V
- High Accuracy Output Voltage..... $\pm 2.0\%$
- Ultra-Small PackageSC-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



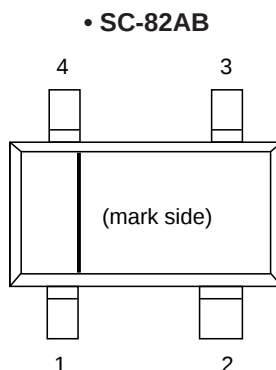
SELECTION GUIDE

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:

RQ5RWxxxx-xx ← 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



PIN DESCRIPTION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V _{IN}	Input Voltage	9	V
V _{CE}	Input Voltage for CE/ $\overline{\text{CE}}$ 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
T _{opt}	Operating Temperature	−40 to +85	°C
T _{stg}	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_{opt}=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
I _{SS}	Supply Current	V _{IN} =5.0V		1.5	3.0	μA
I _{standby}	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
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	I _{OUT} =10mA -40°C≤T _{opt} ≤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

T_{opt}=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
I _{SS}	Supply Current	V _{IN} =5.0V		1.5	3.0	μA
I _{standby}	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
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	I _{OUT} =1mA -40°C≤T _{opt} ≤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

T_{opt}=25°C

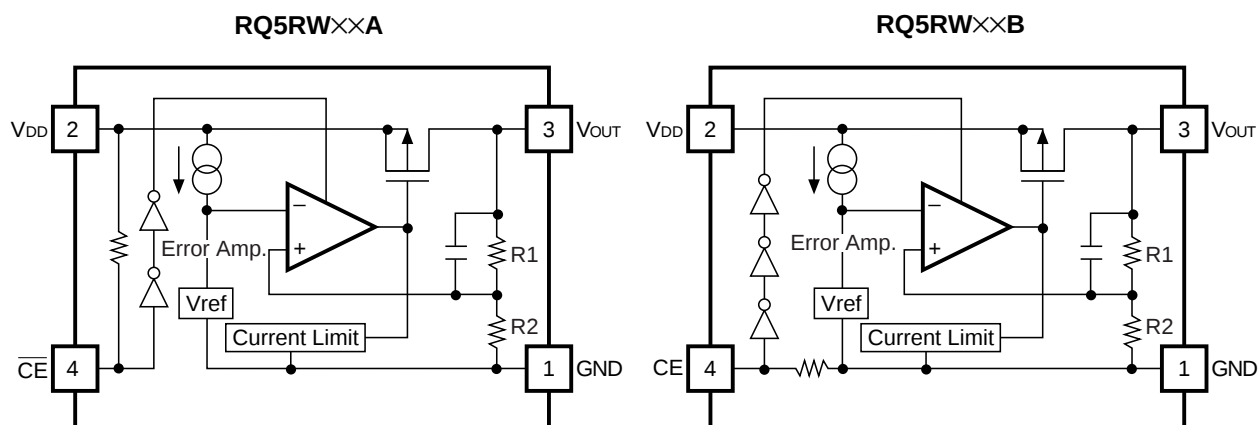
Part Number	Output Voltage				Output Current			Load Regulation			Dropout Votage			
	Vout(V)				Iout(mA)			ΔVout/ΔIout(mV)			V _{DIF} (mV)			
	Conditions	MIN.	TYP.	MAX.	Conditions	MIN.	TYP.	Conditions	TYP.	MAX.	Conditions	TYP.	MAX.	
RQ5RW20	V _{IN} – V _{OUT} =2.0V 10μA≤ I _{OUT} ≤10mA	1.960	2.000	2.040	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										
RQ5RW31		3.038	3.100	3.162		50		V _{IN} – V _{OUT} =2.0V 1mA≤ I _{OUT} ≤50mA	40	60		35	55	
RQ5RW32		3.136	3.200	3.264										
RQ5RW33		3.234	3.300	3.366										
RQ5RW34		3.332	3.400	3.468								30	45	
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										65
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)

T_{opt}=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
I _{SS}	Supply Current	V _{IN} =setV _{OUT} +2.0V		1.5	3.0	μA
I _{standby}	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
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	I _{OUT} =10mA -40°C ≤ T _{opt} ≤ 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

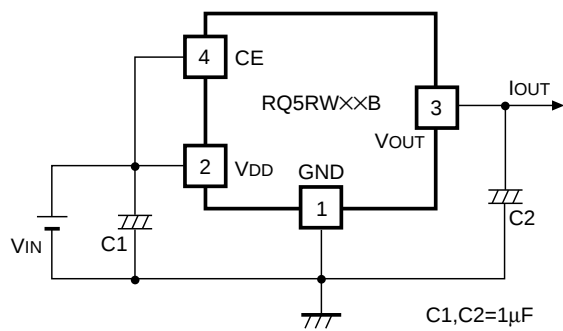
OPERATION



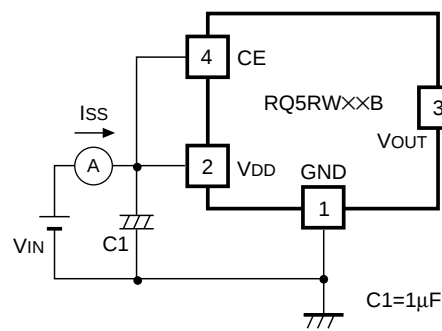
In these ICs, Output Voltage V_{OUT} is detected by Feed-back Registers R1, R2, and the detected Output Voltage is compared with a reference voltage by Error Amplifier, so that a constant voltage is output.

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

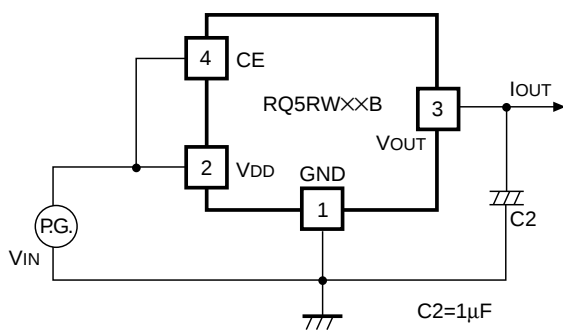
TEST CIRCUITS



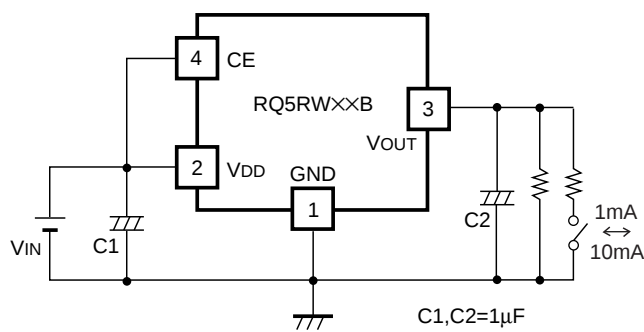
Standard Test Circuit



Test Circuit for Supply Current



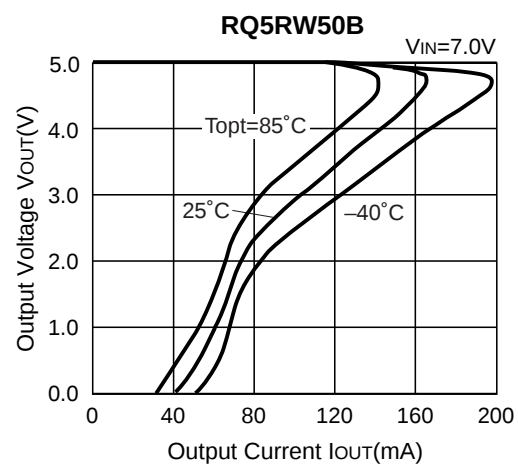
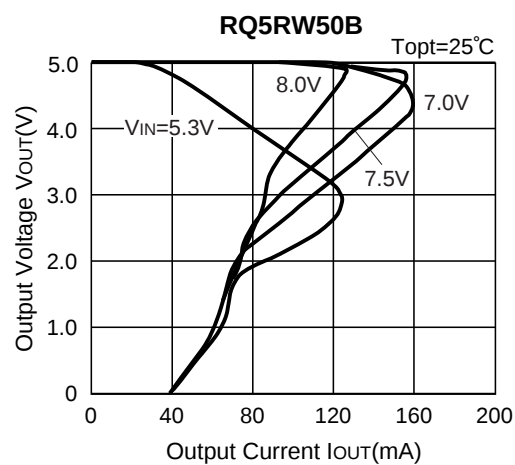
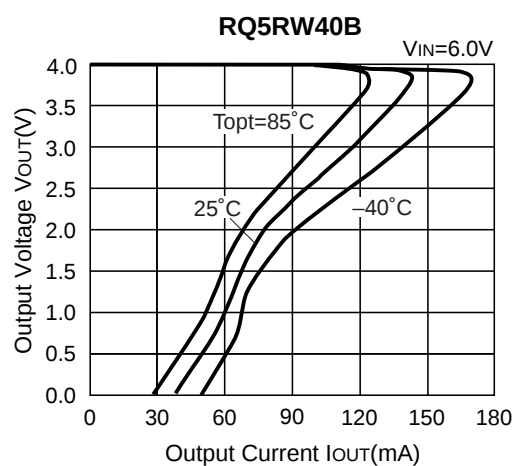
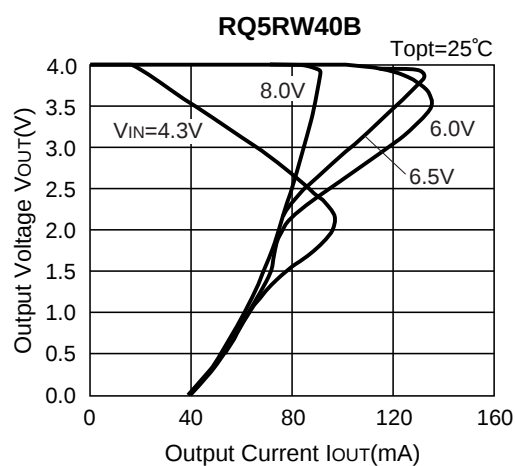
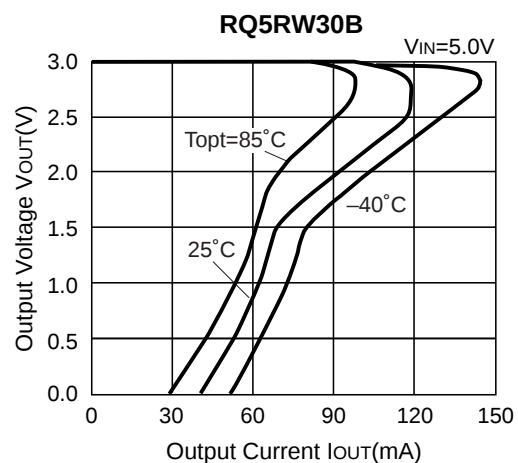
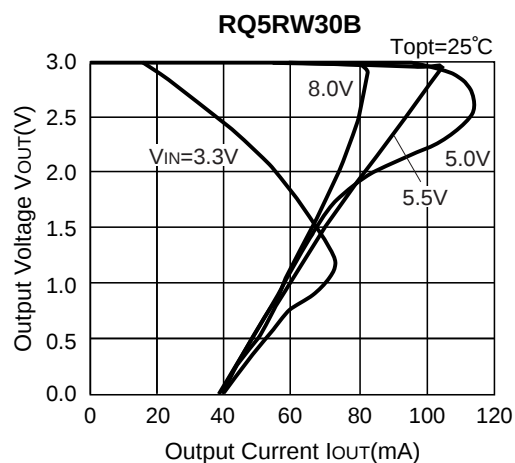
Test Circuit for Ripple Rejection and Line Transient Response



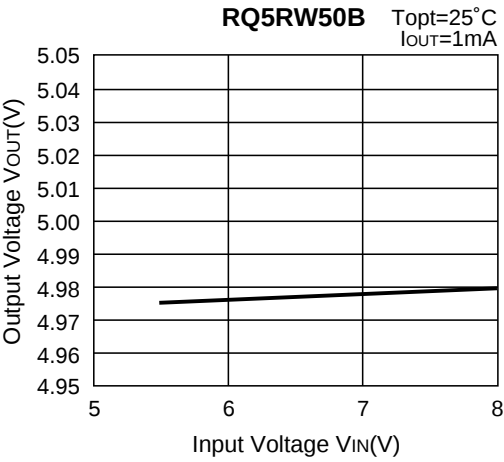
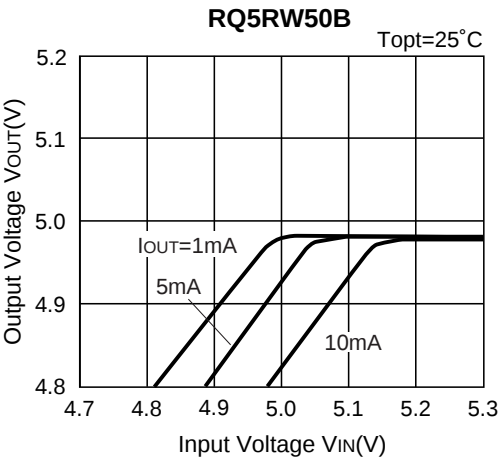
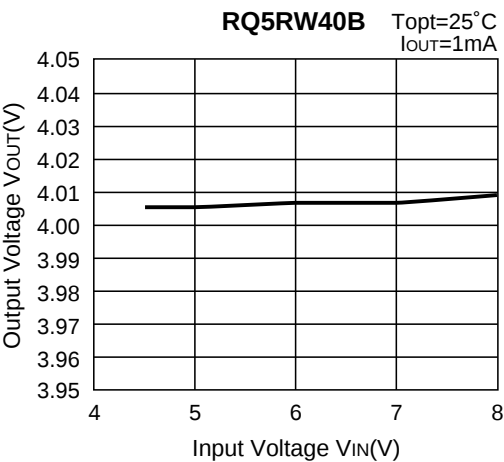
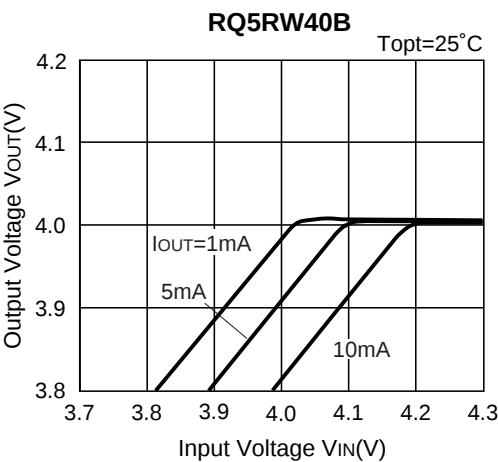
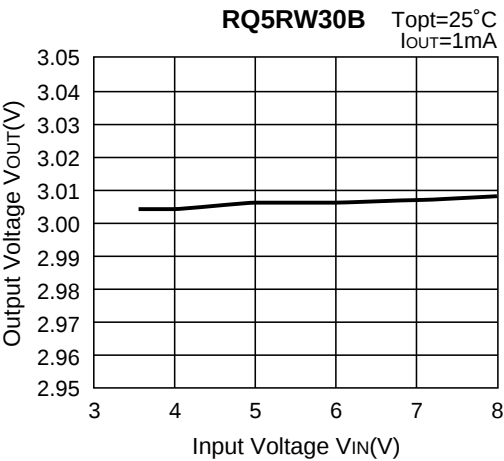
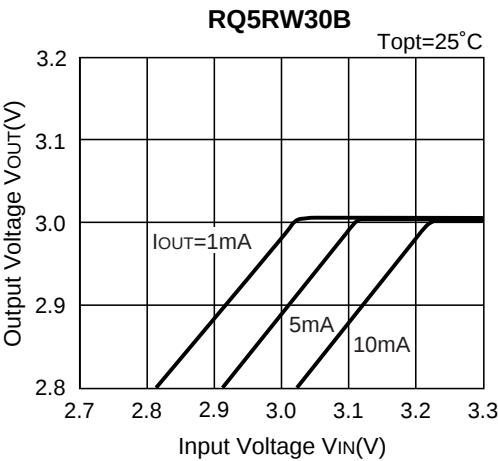
Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

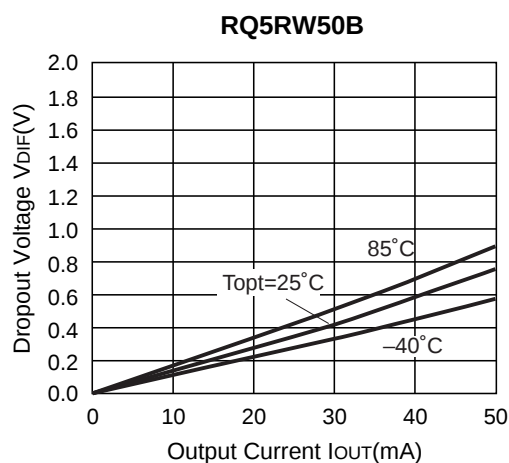
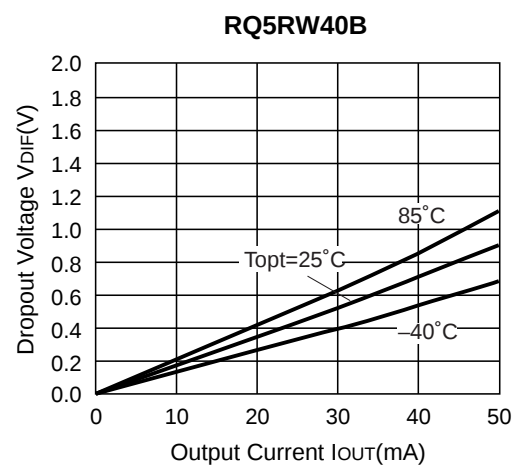
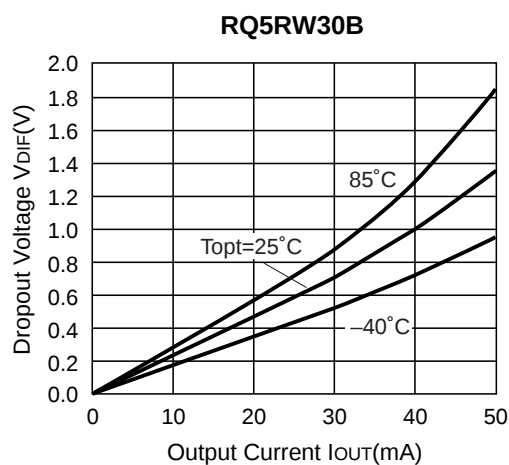
1) Output Voltage vs. Output Current



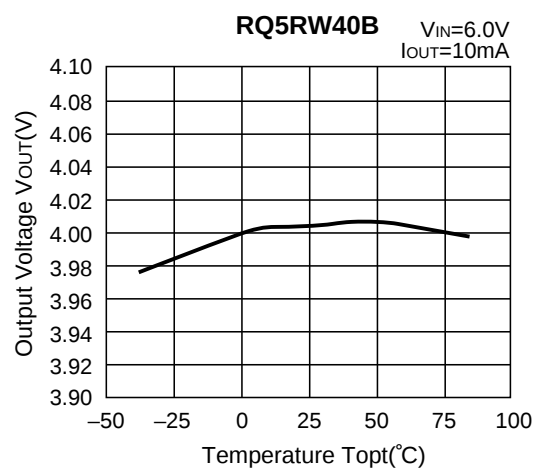
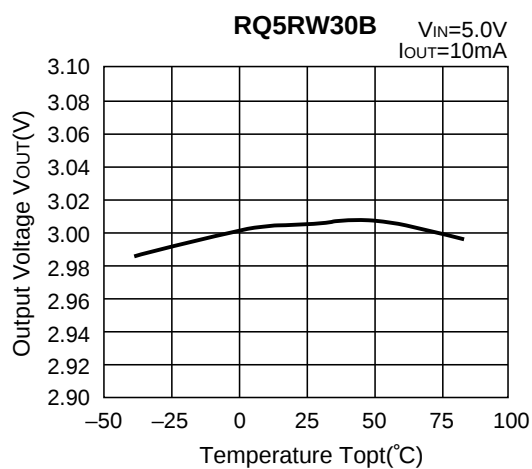
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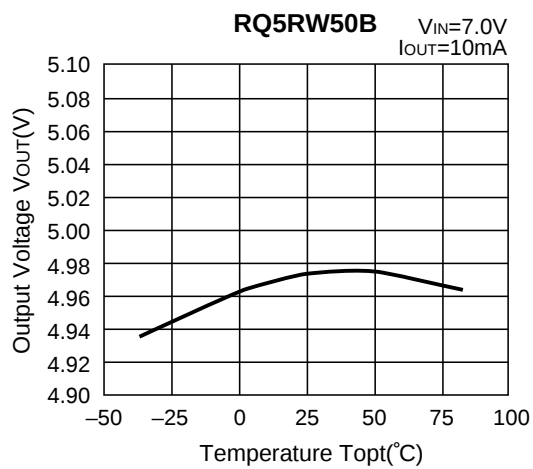


3) Dropout Voltage vs. Output Current

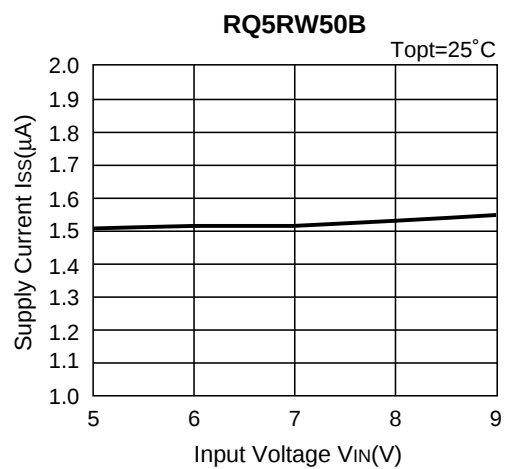
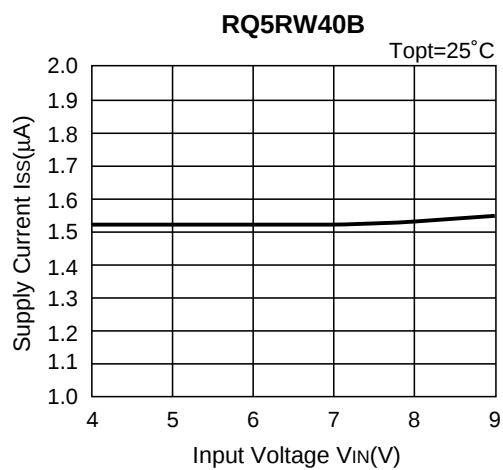
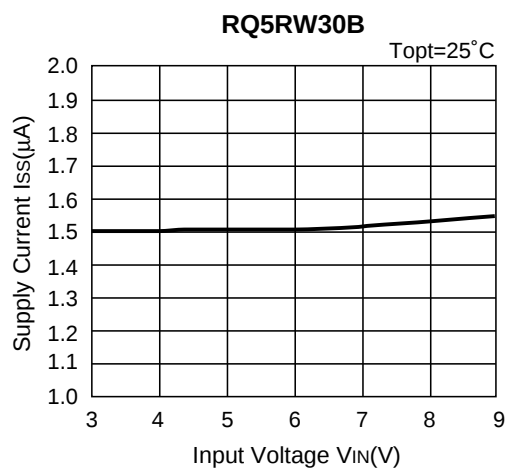


4) Output Voltage vs. Temperature

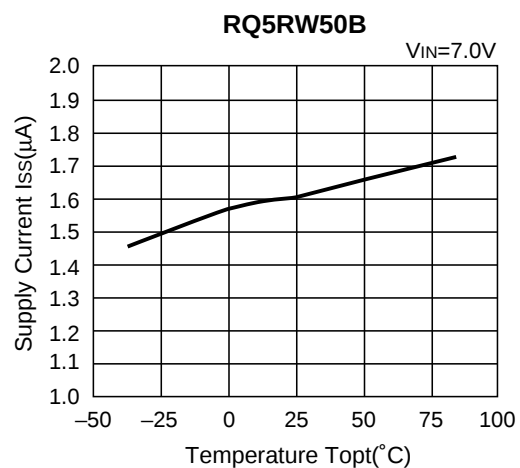
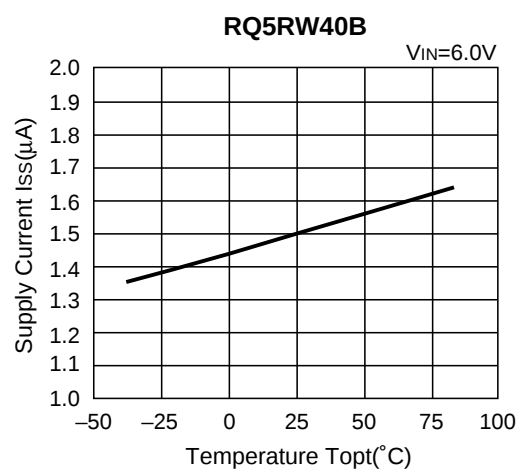
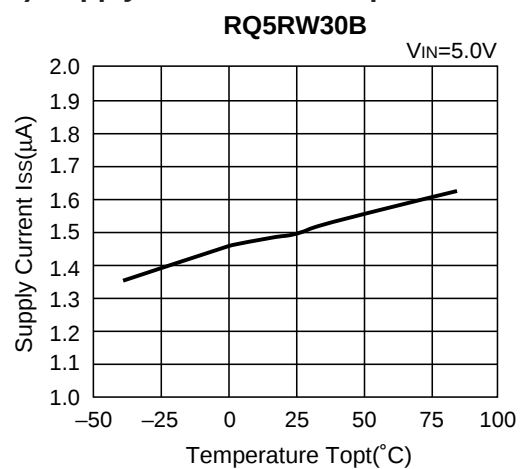




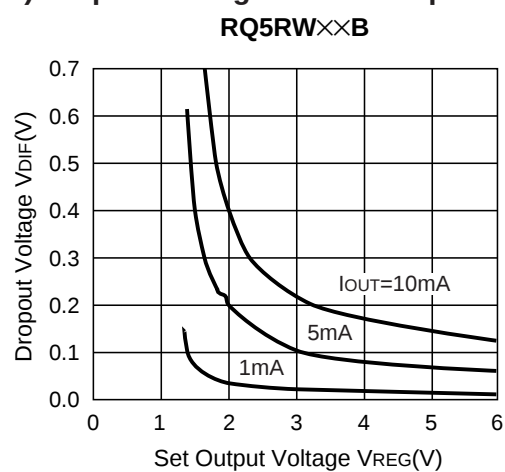
5) Supply Current vs. Input Voltage



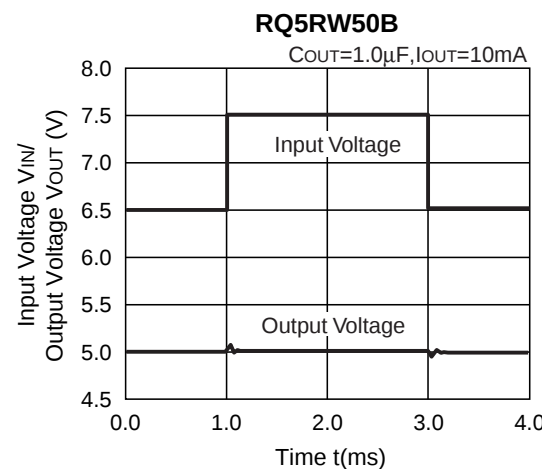
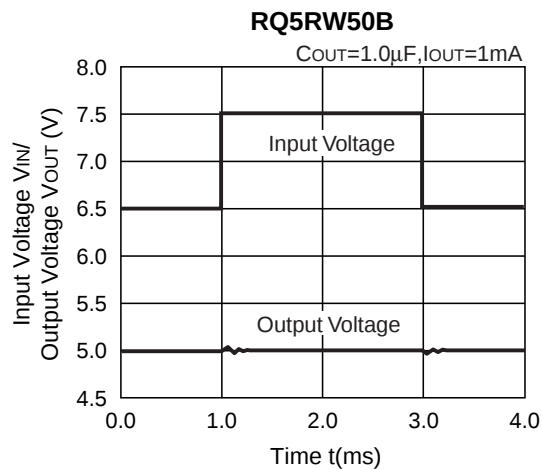
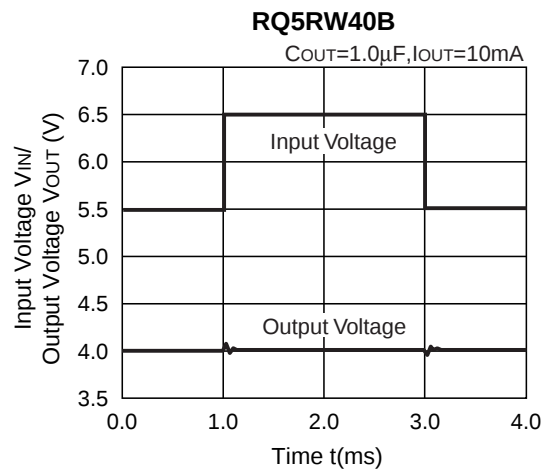
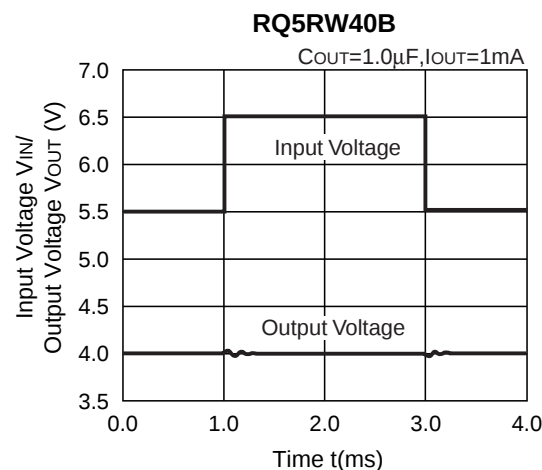
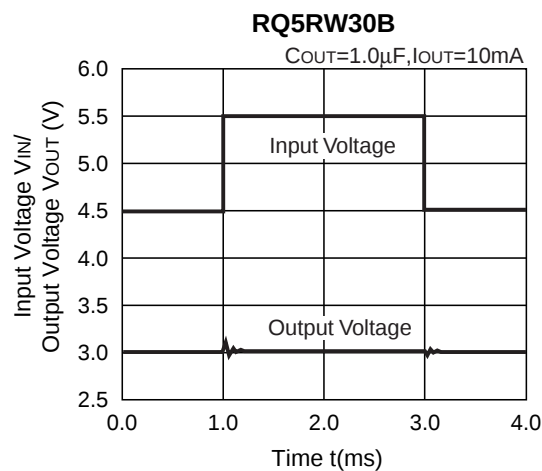
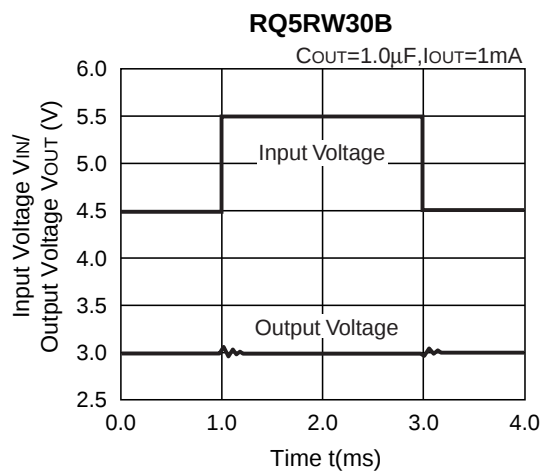
6) Supply Current vs. Temperature



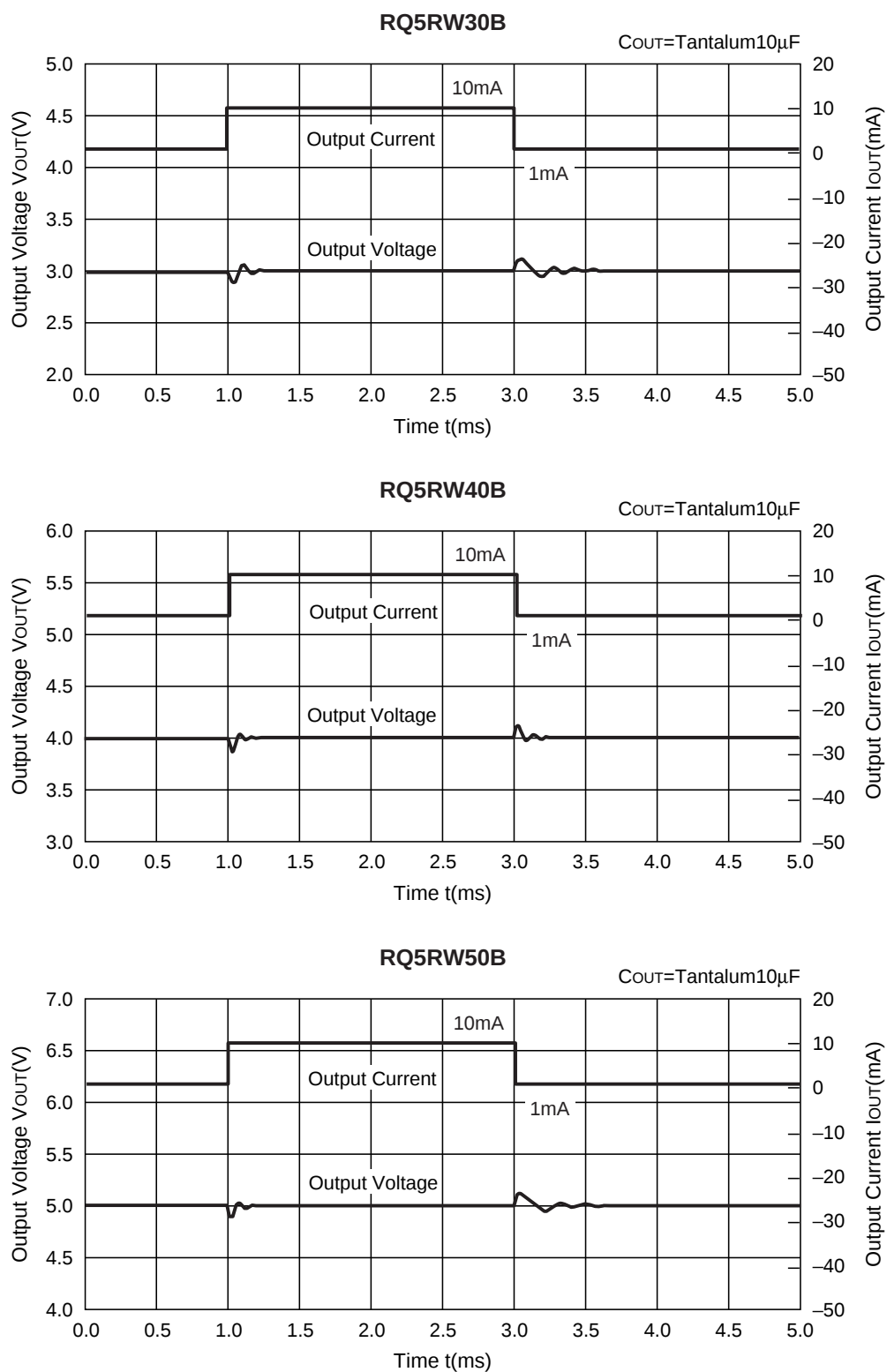
7) Dropout Voltage vs. Set Output Voltage



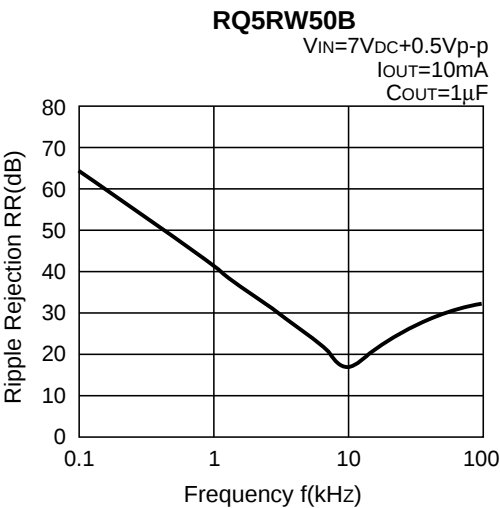
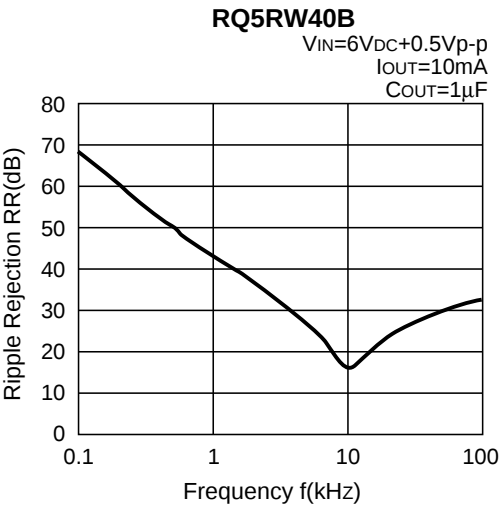
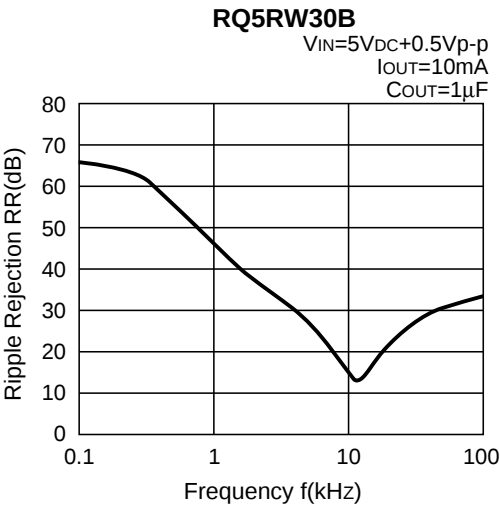
8) Line Transient Response



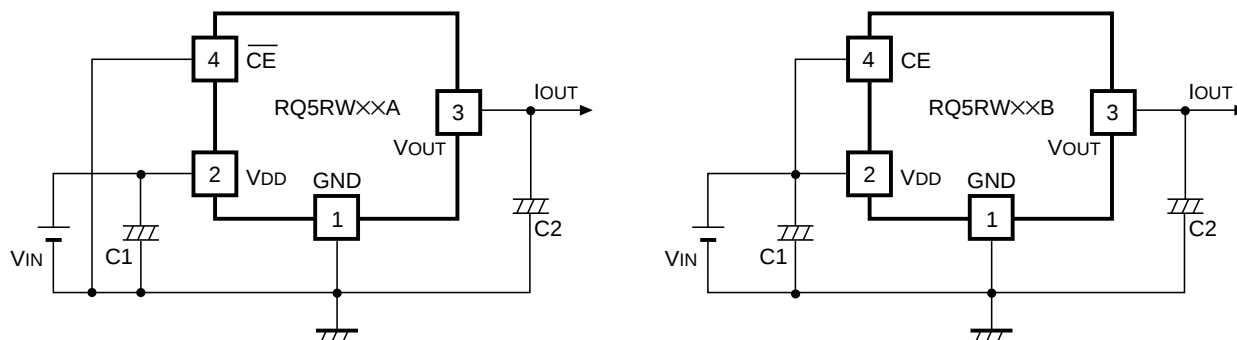
9) Load Transient Response



10) Ripple Rejection



TYPICAL APPLICATION

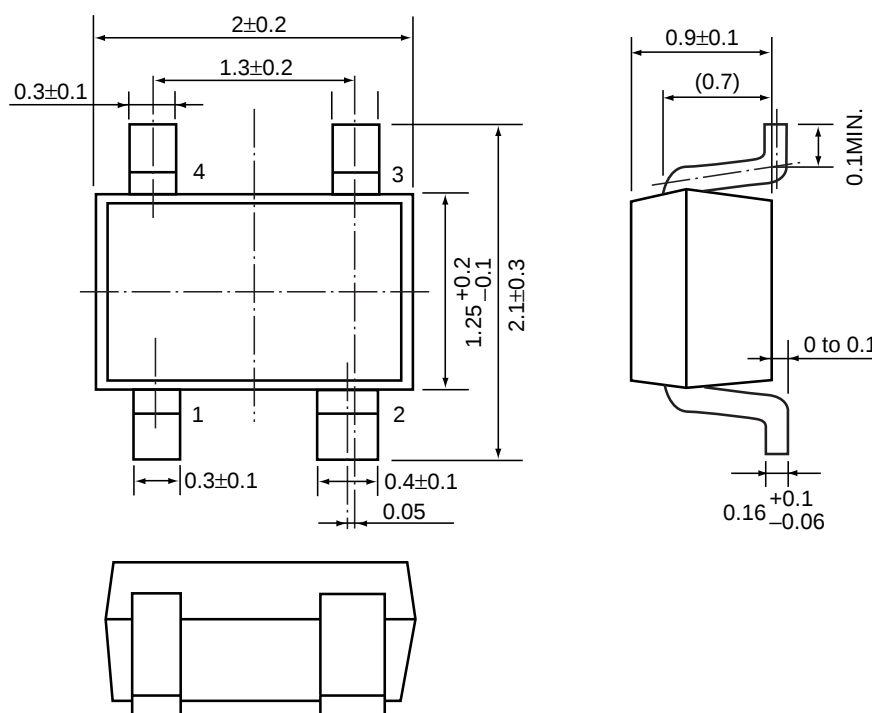


In RQ5RW Series, a constant voltage can be obtained without using Capacitor C1 and C2. However, when the wire connected V_{IN} is long, use Capacitor C1. Output noise can be reduced by using Capacitor 2.

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.

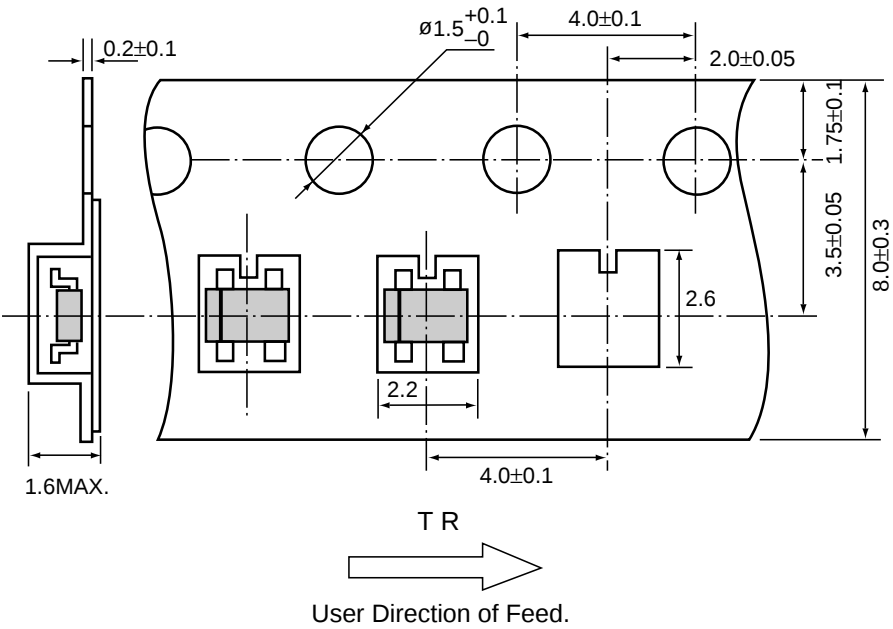
PACKAGE DIMENSION (Unit : mm)

• SC-82AB



TAPING SPECIFICATION (Unit : mm)

• SC82AB





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