
**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

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.

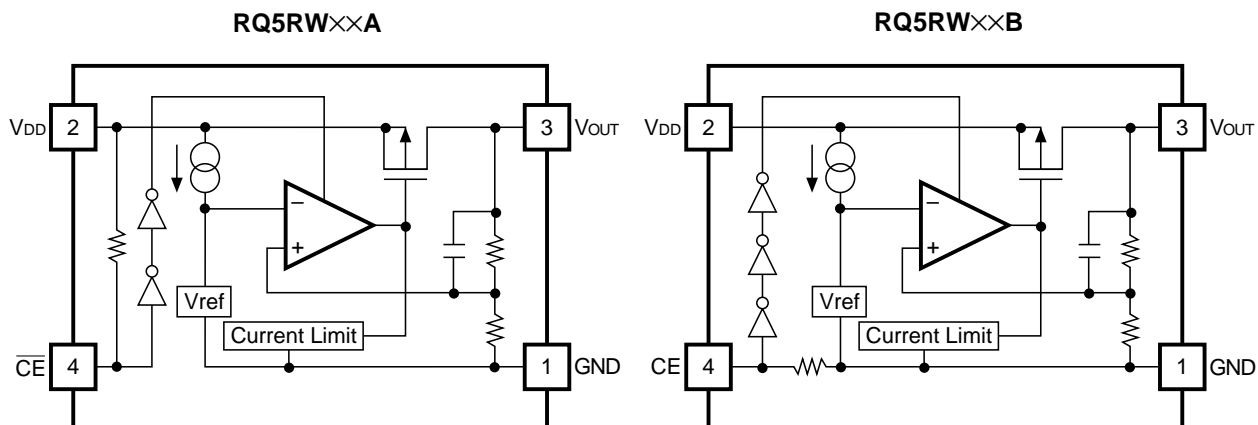
FEATURES

- 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. $\pm 100ppm/^{\circ}C$
- 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



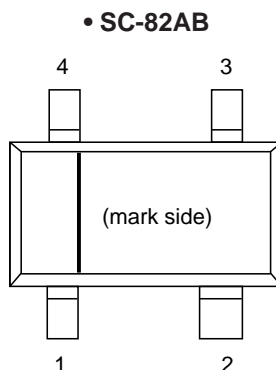
SELECTION GUIDE

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:

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 _{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

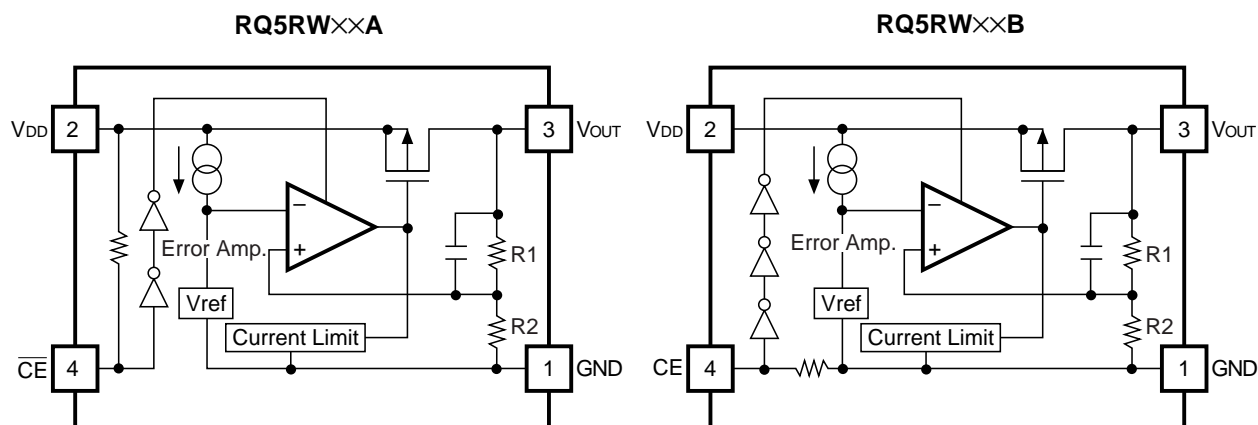
| Part Number | Output Voltage | | | | Output Current | | | Load Regulation | | | Dropout Voltage | | |
|-------------|--|-------|-------|-------|--|------|------|---|------|------|--------------------------|------|------|
| | V _{out} (V) | | | | I _{out} (mA) | | | ΔV _{out} /ΔI _{out} (mV) | | | V _{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 | | | | | | | | | |
| 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 _{IN} - V _{OUT} =2.0V 1mA≤ I _{OUT} ≤65mA | 50 | 70 | | 25 | 40 |
| | | | | | | 80 | | V _{IN} - V _{OUT} =2.0V 1mA≤ I _{OUT} ≤80mA | 60 | 90 | | | |

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 |

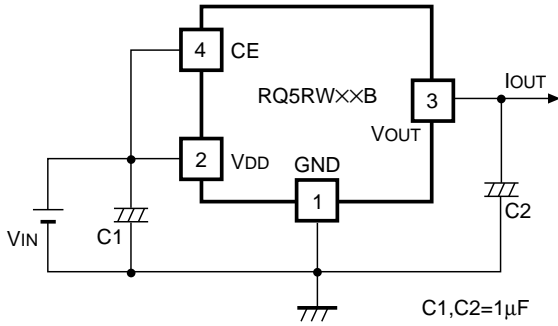
OPERATION



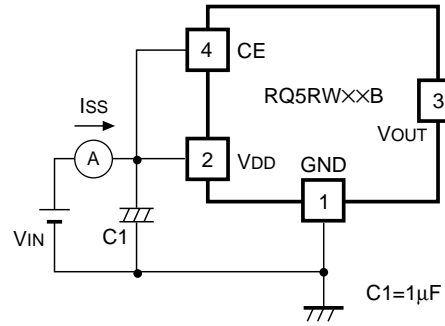
In these ICs, Output Voltage V_{OUT} is detected by Feed-back Registers R1, R2, and the detected Output Voltage is compared with a reference voltage by Error Amplifier, so that a constant voltage is output.

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

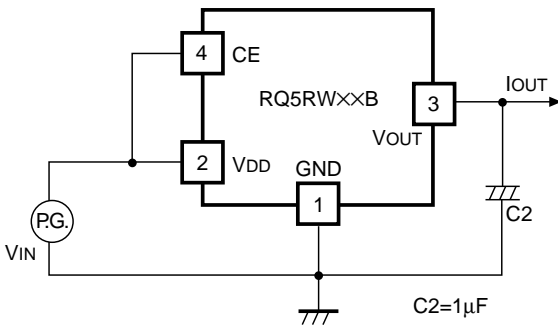
TEST CIRCUITS



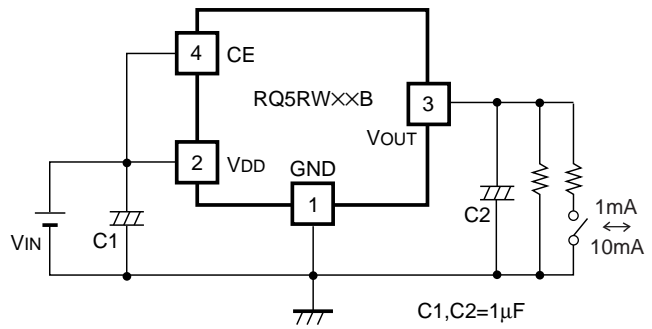
Standard Test Circuit



Test Circuit for Supply Current



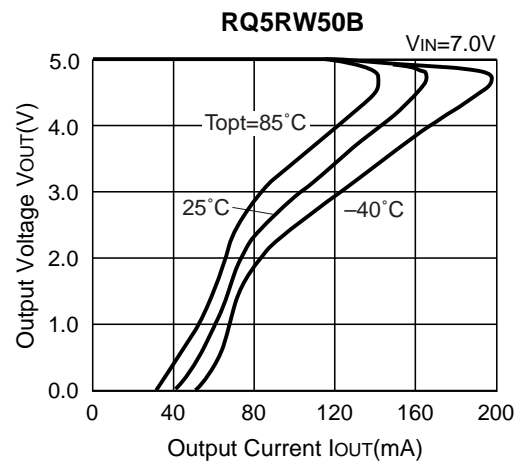
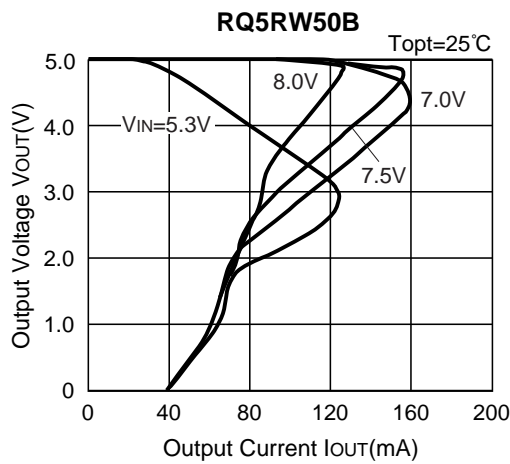
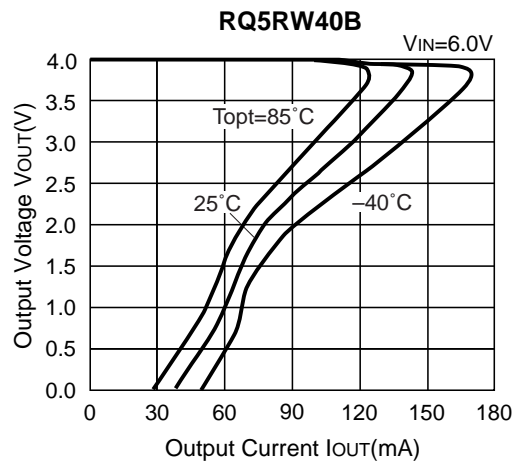
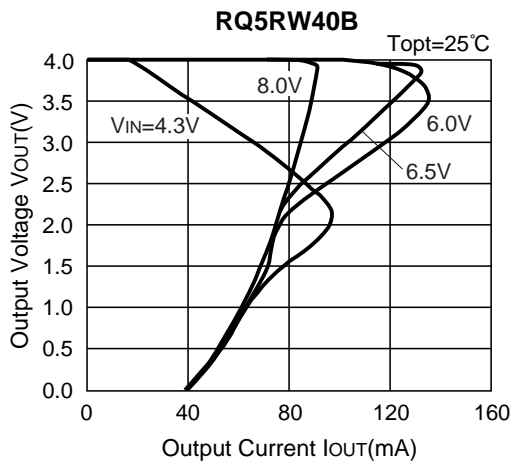
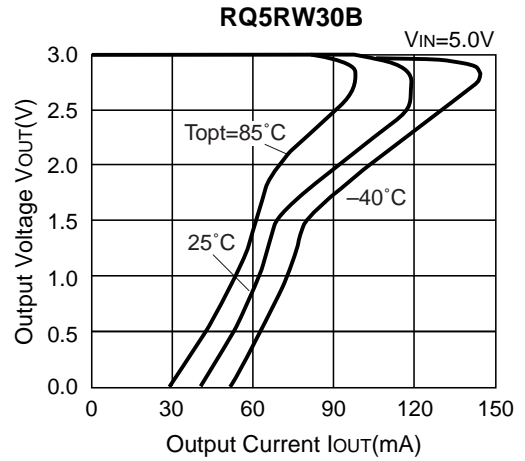
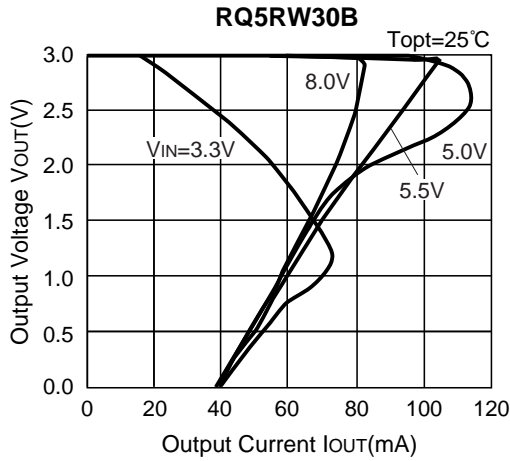
Test Circuit for Ripple Rejection and Line Transient Response



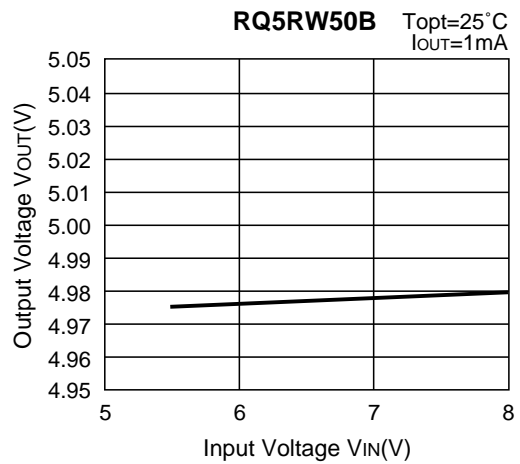
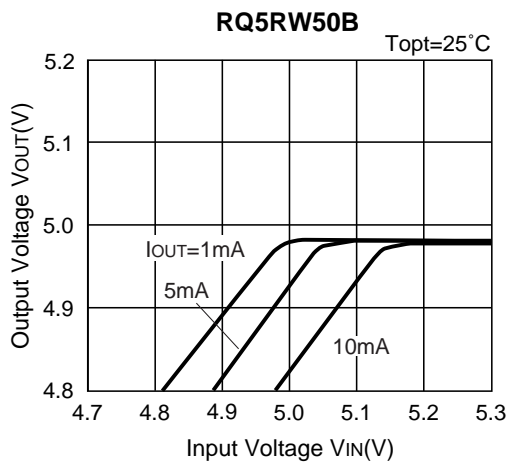
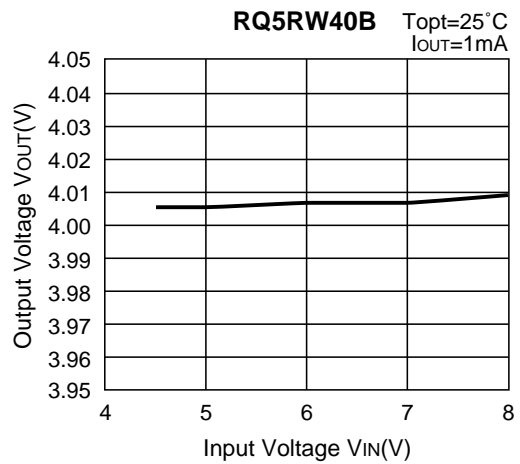
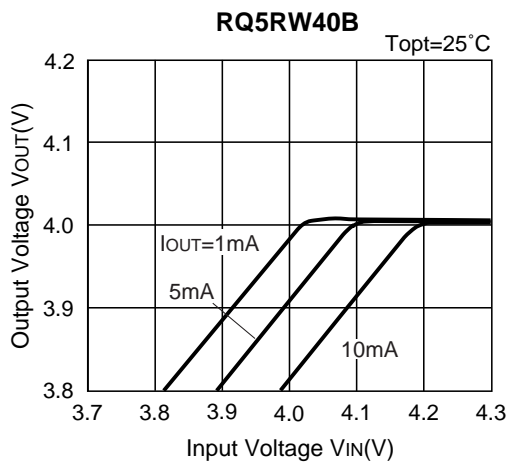
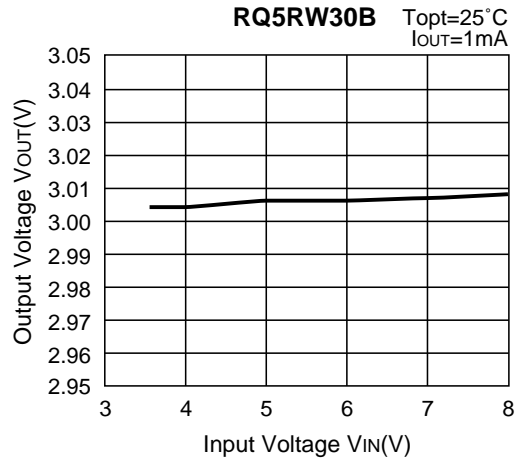
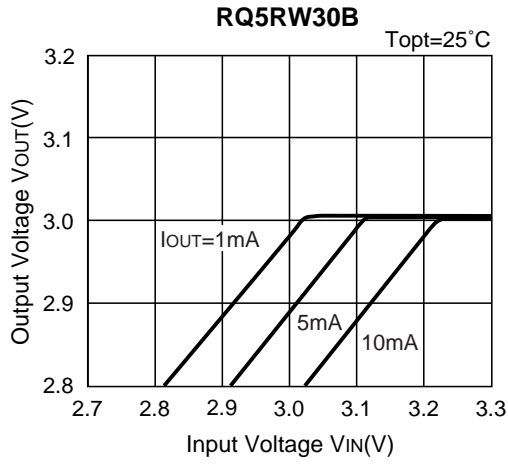
Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

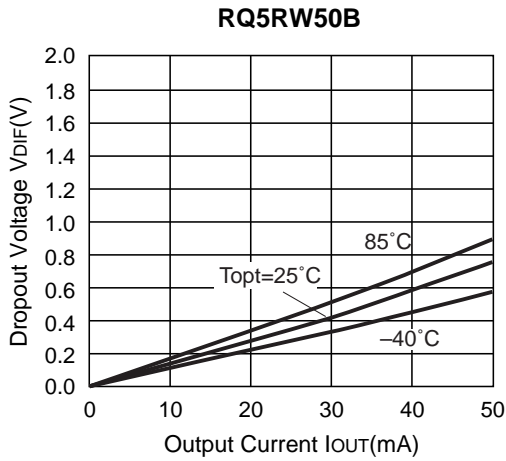
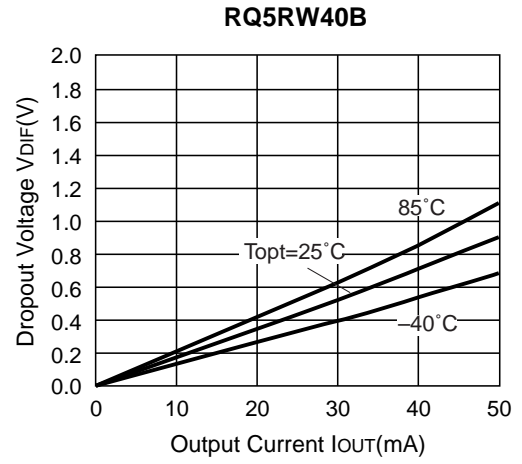
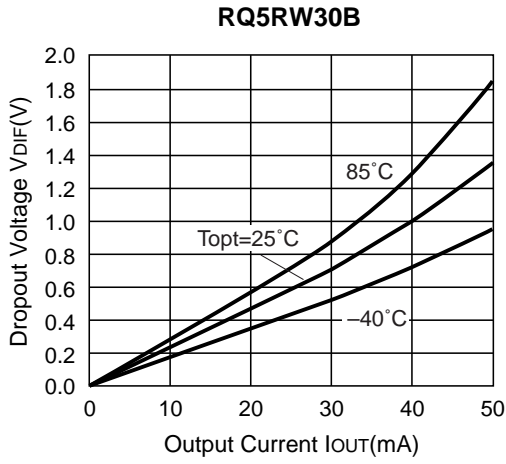
1) Output Voltage vs. Output Current



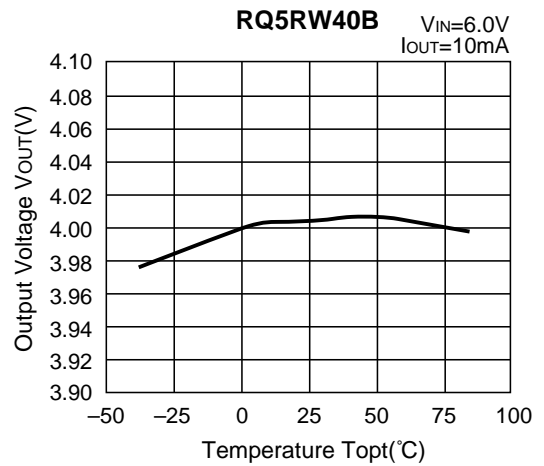
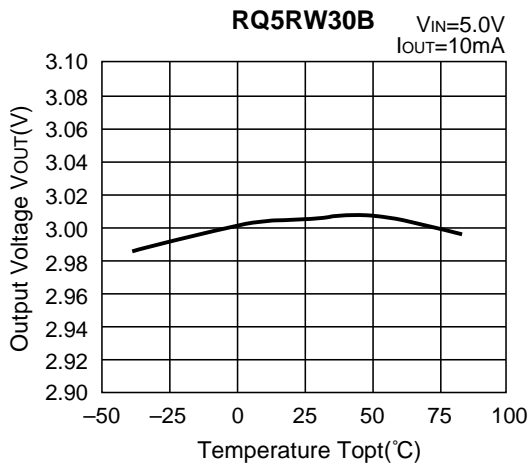
2) Output Voltage vs. Input Voltage

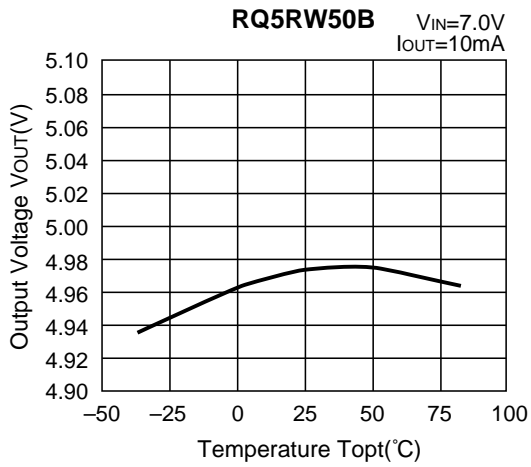


3) Dropout Voltage vs. Output Current

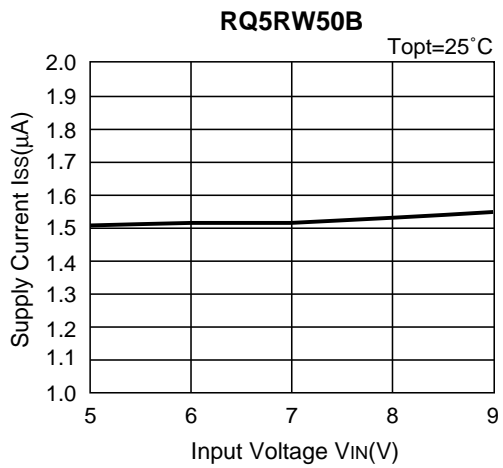
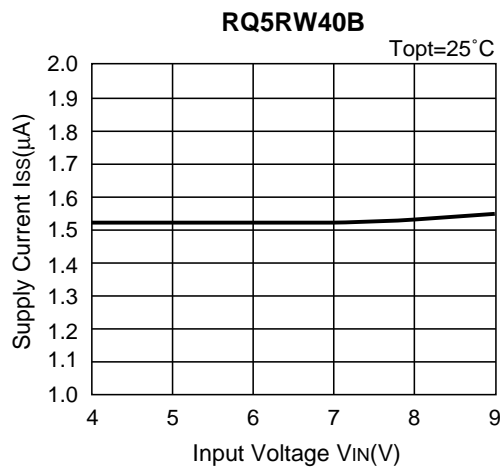
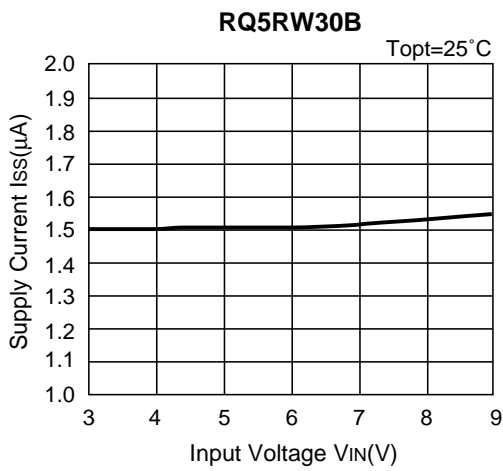


4) Output Voltage vs. Temperature

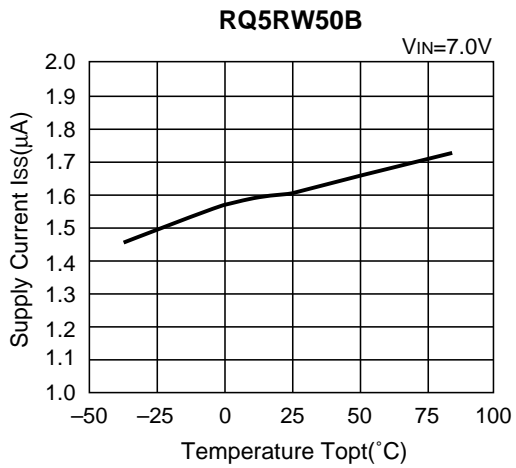
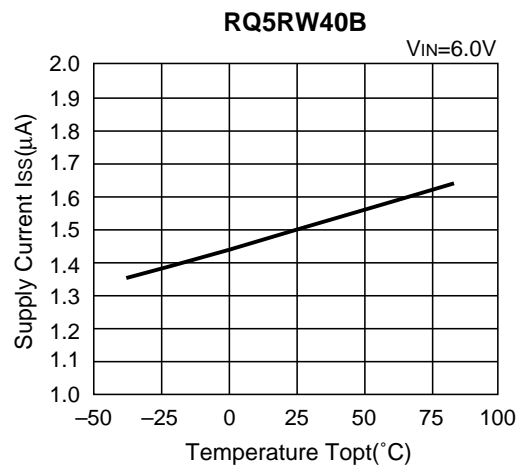
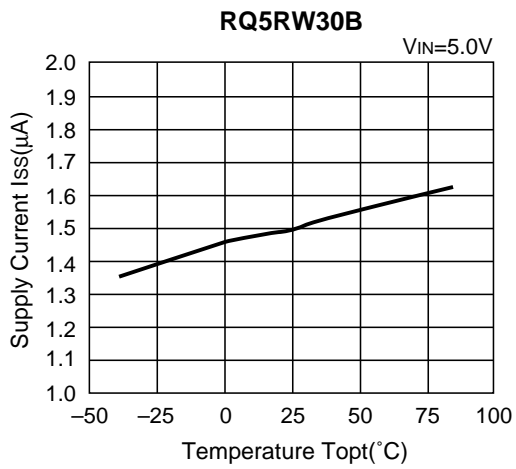




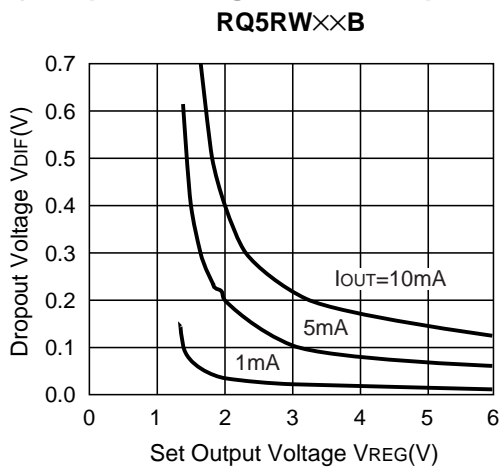
5) Supply Current vs. Input Voltage



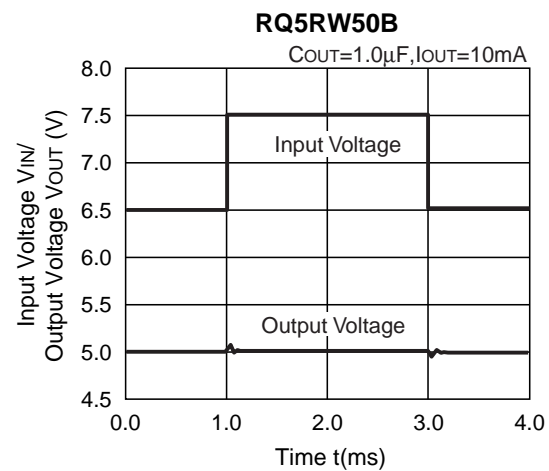
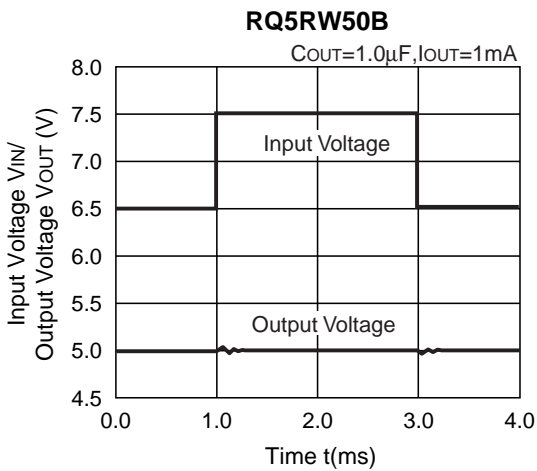
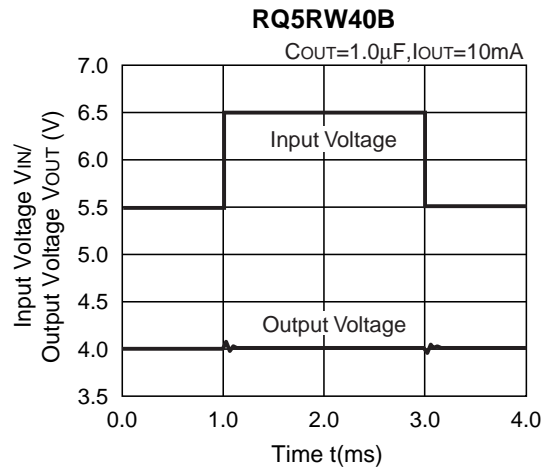
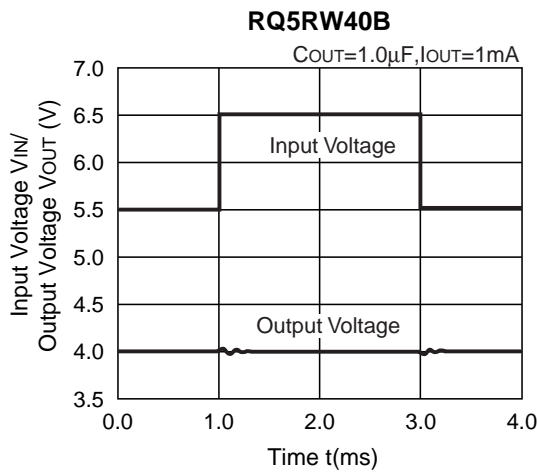
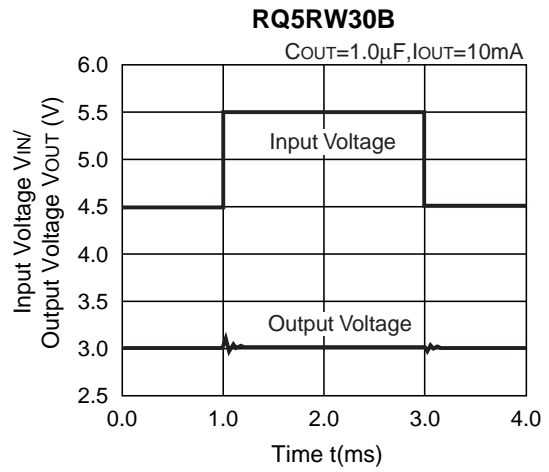
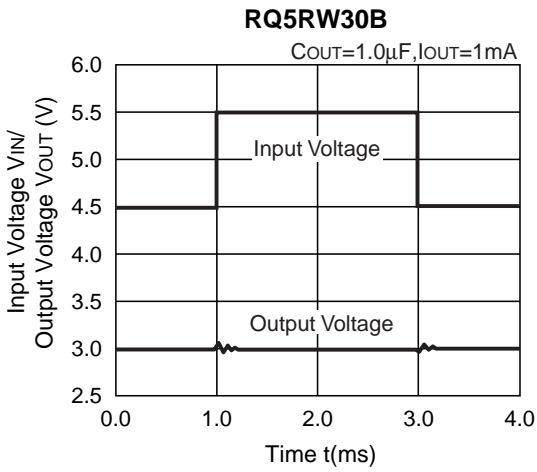
6) Supply Current vs. Temperature



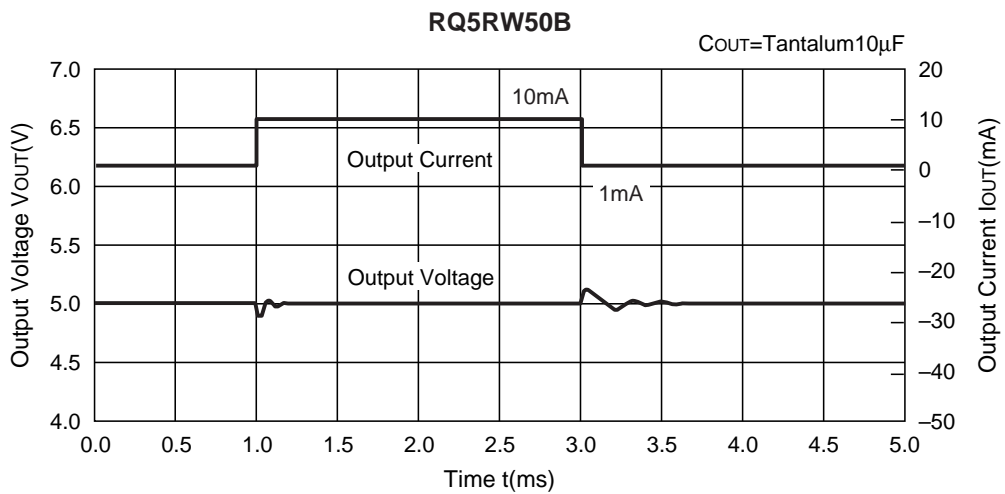
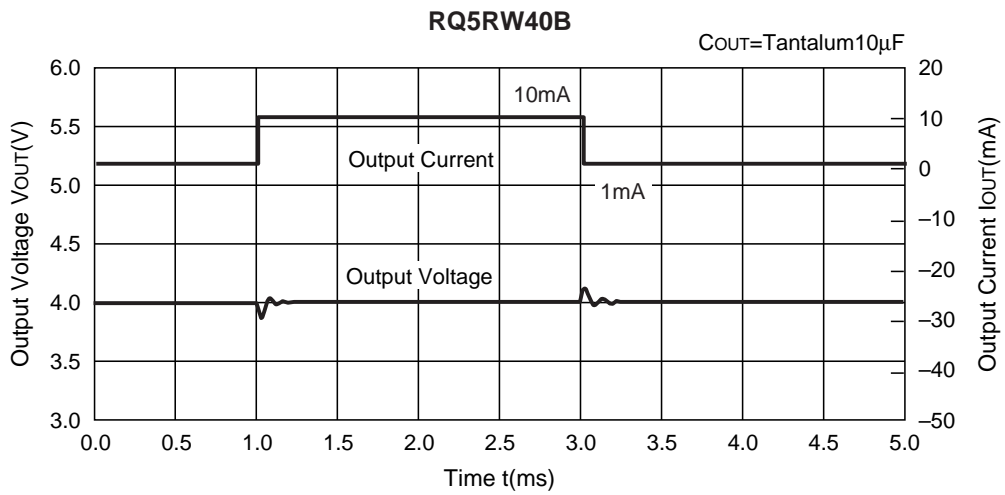
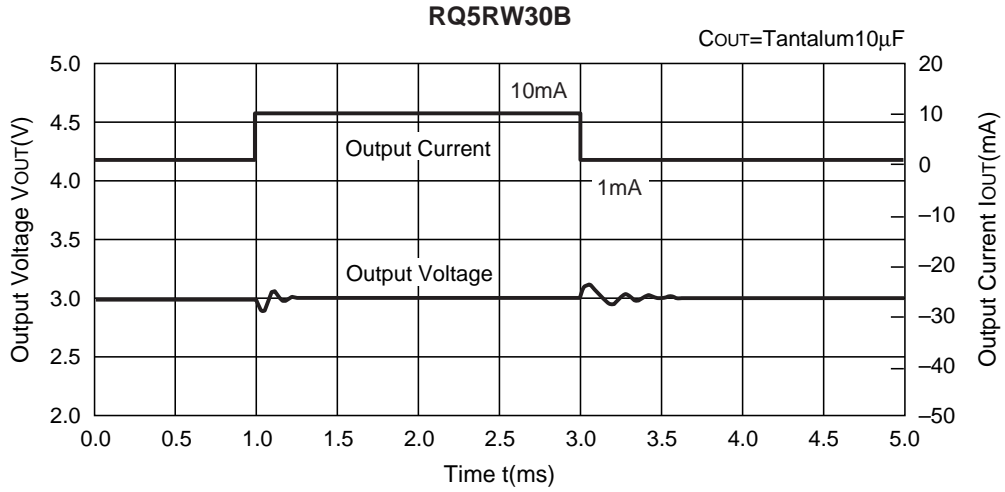
7) Dropout Voltage vs. Set Output Voltage



8) Line Transient Response



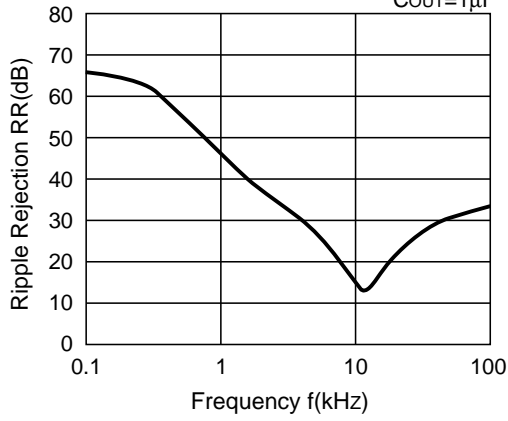
9) Load Transient Response



10) Ripple Rejection

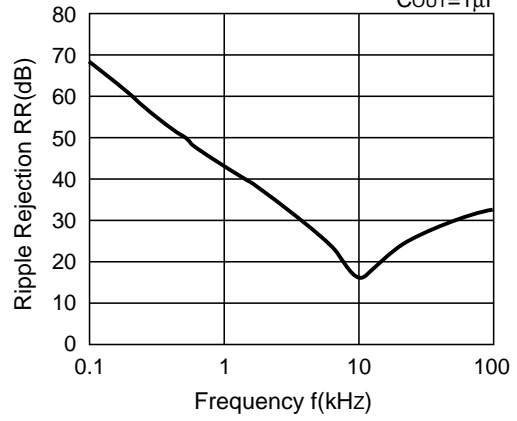
RQ5RW30B

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



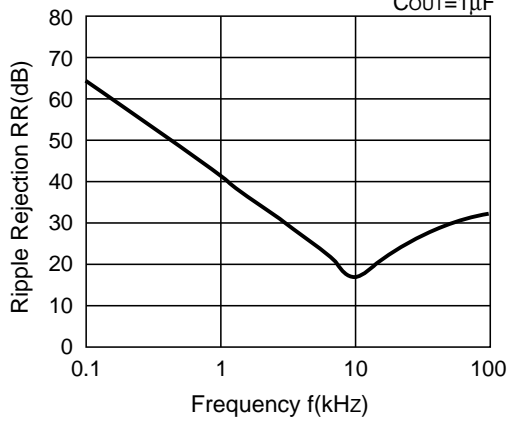
RQ5RW40B

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

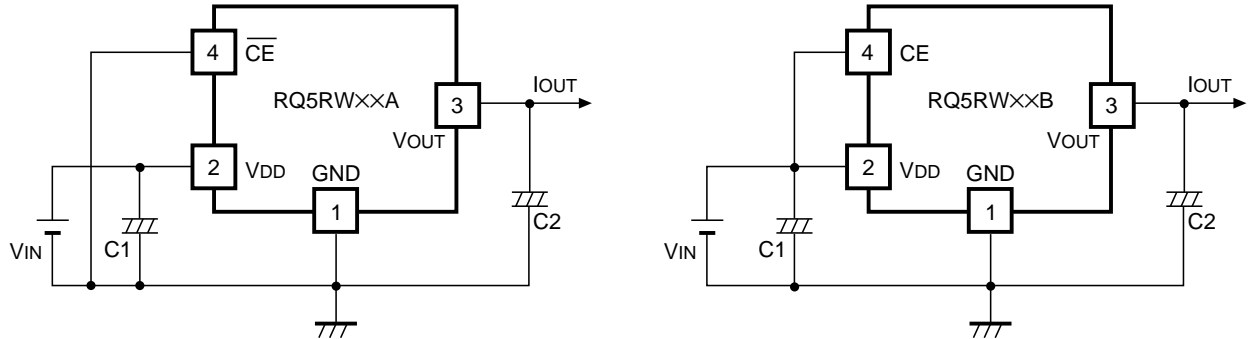


RQ5RW50B

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



TYPICAL APPLICATION

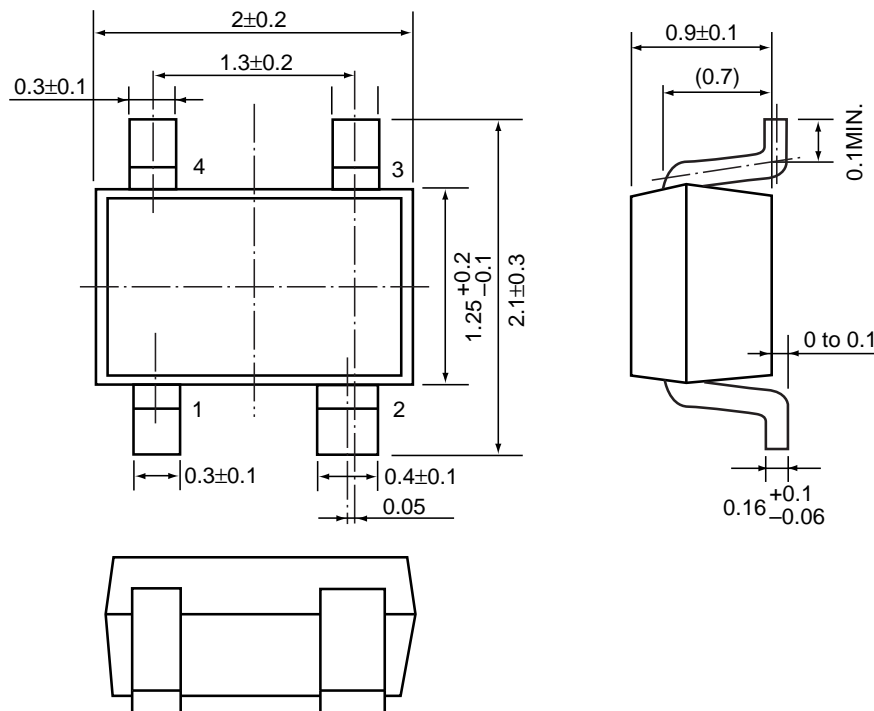


In RQ5RW Series, a constant voltage can be obtained without using Capacitor C1 and C2. However, when the wire connected V_{IN} is long, use Capacitor C1. Output noise can be reduced by using Capacitor 2.

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.

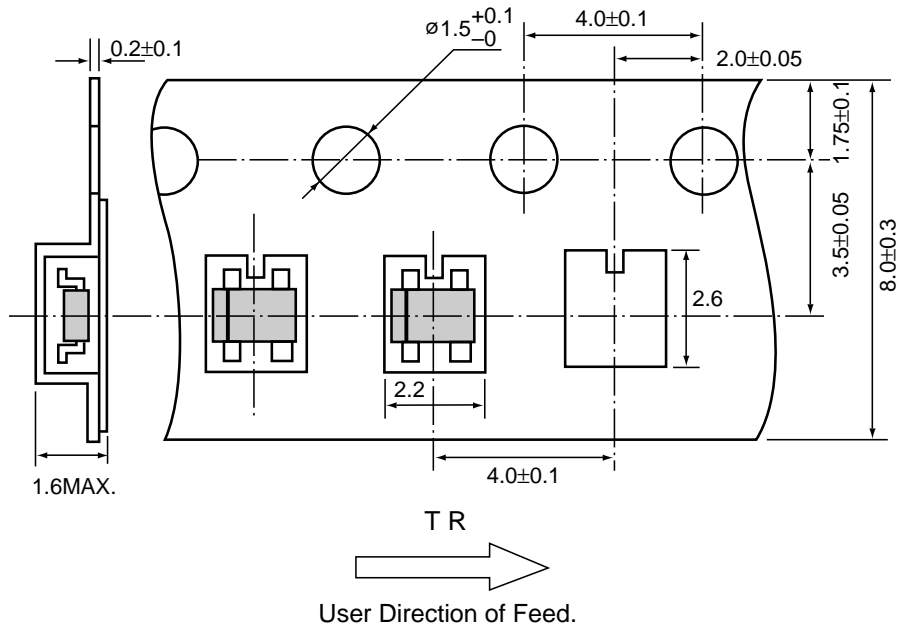
PACKAGE DIMENSION (Unit : mm)

- SC-82AB



TAPING SPECIFICATION (Unit : mm)

- SC82AB





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