RICOH

# Rx5RW SERIES

## ULTRA SMALL PACKAGE VOLTAGE REGULATOR

NO.EA-048-111020

## OUTLINE

The Rx5RW Series are CMOS-based voltage regulator ICs with high accuracy output voltage and ultra-low supply current developed. Each of these ICs consists of a driver transistor, a voltage reference unit, an error amplifier, resistors for setting output volt-age 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, Rx5RWxxA/B have a chip enable function, so that the supply current on standby can be minimized.

Since the packages for these ICs are SC-82AB and SON1612-6, high density mounting of the ICs on boards is possible.

## FEATURES

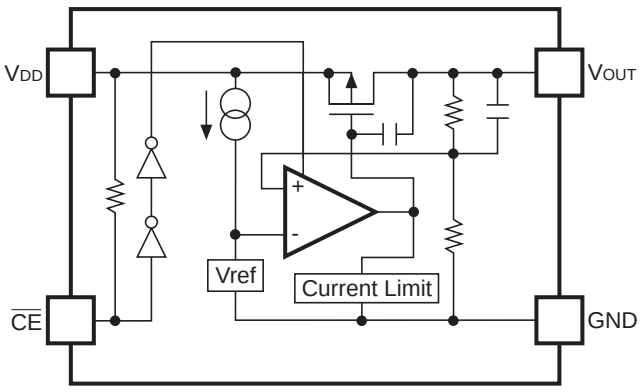
- Supply Current ..... Typ. 1.5μA
  (except pull-up/pull-down current for $\overline{CE}$ /CE pin)
- Standby Current ..... Typ. 0.1μA (applied to A/B version)
- Dropout Voltage ..... Typ. 40mV ($I_{OUT}$=1mA, Rx5RW30A/B/C)
- Temperature-Drift Coefficient of Output Voltage ..... Typ. ±100ppm/°C
- Line Regulation ..... Typ. 0.05%/V
- Input Voltage Range ..... Max. 8.0V
- Output Voltage Range ..... 1.5V to 6.0V (0.1V steps)
- Output Voltage Accuracy ..... ±2.0%
- Packages ..... SC-82AB, SON1612-6
- Built-in Current Limit Circuits

## APPLICATIONS

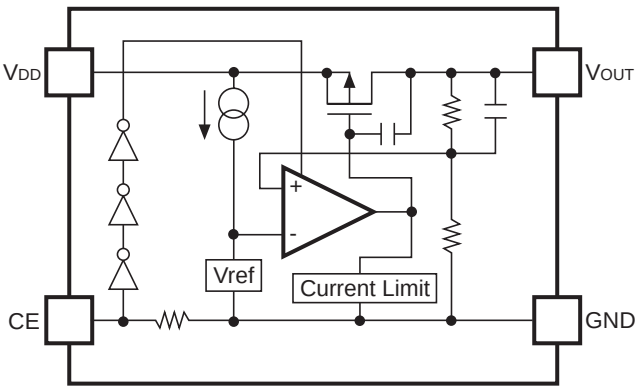
- Power source for battery-powered equipment.
- Power source for cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- Precision voltage references.

# BLOCK DIAGRAMS

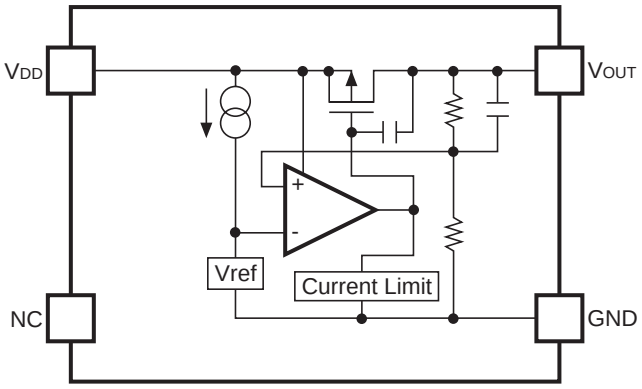
**Rx5RWxxA**




**Rx5RWxxB**




**Rx5RWxxC**




# SELECTION GUIDE

The output voltage, chip enable polarity, and package, etc. for the ICs can be selected at the user's request.

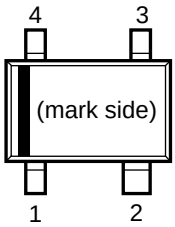
| Product Name | Package | Quantity per Reel | Pb Free | Halogen Free |
|---|---|---|---|---|
| RD5RWxx∗A-TR-FE | SON1612-6 | 4,000 pcs | Yes | Yes |
| RQ5RWxx∗A-TR-FE | SC-82AB | 3,000 pcs | Yes | Yes |

xx: The output voltage can be designated in the range from 1.5V(15) to 6.0V(60) in 0.1V steps.

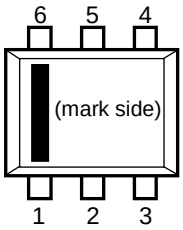
∗ : CE pin polarity are options as follows.
(A) "L" active
(B) "H" active
(C) without chip enable

# PIN CONFIGURATION

● **SC-82AB**




● **SON1612-6**




# PIN DESCRIPTION

● **SC-82AB**

| Pin No | Symbol | Pin Description |
|---|---|---|
| 1 | GND | Ground Pin |
| 2 | $V_{DD}$ | Input Pin |
| 3 | $V_{OUT}$ | Output Pin |
| 4 | $\overline{CE}$ or CE or NC | Chip Enable Pin ("L" active/"H" active) or No Connection |

● **SON1612-6**

| Pin No | Symbol | Pin Description |
|---|---|---|
| 1 | $\overline{CE}$ or CE or NC | Chip Enable Pin ("L" active/"H" active) or No Connection |
| 2 | $V_{DD}$ | Input Pin |
| 3 | $V_{OUT}$ | Output Pin |
| 4 | NC | No Connection |
| 5 | $V_{DD}$ | Input Pin |
| 6 | GND | Ground Pin |

# ABSOLUTE MAXIMUM RATINGS

| Symbol | Item | Rating | Unit |
|---|---|---|---|
| $V_{IN}$ | Input Voltage | 9.0 | V |
| $V_{CE}$ | Input Voltage for $\overline{CE}$ /CE Pin (applied to A/B version) | −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 (SC-82AB) * | 380 | mW |
| | Power Dissipation (SON1612-6) * | 500 | |
| Topt | Operating Temperature | −40 to +85 | °C |
| Tstg | Storage Temperature | −55 to +125 | °C |

∗ ) For Power Dissipation, please refer to PACKAGE INFORMATION.

**ABSOLUTE MAXIMUM RATINGS**

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.
The functional operation at or over these absolute maximum ratings is not assured.

# ELECTRICAL CHARACTERISTICS

- **Rx5RW30A**

Topt=25°C

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$=5.0V<br>10μA≤$I_{OUT}$≤10mA | 2.940 | 3.000 | 3.060 | V |
| $I_{OUT}$ | Output Current | $V_{IN}$=5.0V | 50 | | | mA |
| $\Delta V_{OUT}/\Delta I_{OUT}$ | 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 |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line Regulation | $I_{OUT}$=1mA<br>$V_{OUT}$+0.5V≤$V_{IN}$≤8V | 0 | 0.05 | 0.20 | %/V |
| $V_{IN}$ | Input Voltage | | | | 8.0 | V |
| $\Delta V_{OUT}/\Delta Topt$ | Output Voltage Temperature Coefficient | $I_{OUT}$=10mA<br>−40°C≤Topt≤85°C | | ±100 | | ppm/°C |
| $I_{SC}$ | Short Current Limit | | | 40 | | mA |
| $R_{PU}$ | Pull up resistance for 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 |

- **Rx5RW30B**

Topt=25°C

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$=5.0V<br>10μA≤$I_{OUT}$≤10mA | 2.940 | 3.000 | 3.060 | V |
| $I_{OUT}$ | Output Current | $V_{IN}$=5.0V | 50 | | | mA |
| $\Delta V_{OUT}/\Delta I_{OUT}$ | Load Regulation | $V_{IN}$=5.0V<br>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 |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line Regulation | $I_{OUT}$=1mA<br>$V_{OUT}$+0.5V≤$V_{IN}$≤8V | 0 | 0.05 | 0.20 | %/V |
| $V_{IN}$ | Input Voltage | | | | 8.0 | V |
| $\Delta V_{OUT}/\Delta Topt$ | Output Voltage Temperature Coefficient | $I_{OUT}$=1mA<br>−40°C≤Topt≤85°C | | ±100 | | ppm/°C |
| $I_{SC}$ | 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 |

- **Rx5RW30C**

Topt=25°C

| Symbol | Item | Conditions | Min. | Tyo. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$=5.0V<br>10μA≤$I_{OUT}$≤10mA | 2.940 | 3.000 | 3.060 | V |
| $I_{OUT}$ | Output Current | $V_{IN}$=5.0V | 50 | | | mA |
| $\Delta V_{OUT}/\Delta I_{OUT}$ | Load Regulation | $V_{IN}$=5.0V<br>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 |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line Regulation | $I_{OUT}$=1mA<br>3.5V≤$V_{IN}$≤8.0V | 0 | 0.05 | 0.20 | %/V |
| $V_{IN}$ | Input Voltage | | | | 8.0 | V |
| $\Delta V_{OUT}/\Delta Topt$ | Output Voltage Temperature Coefficient | $I_{OUT}$=10mA<br>−40°C≤Topt≤85°C | | ±100 | | ppm/°C |
| $I_{SC}$ | Short Current Limit | | | 40 | | mA |

**RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)**

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

# ELECTRICAL CHARACTERISTICS BY OUTPUT VOLTAGE

Topt=25°C

| Part Number | Output Voltage | | | | Output Current | | Load Regulation | | | Dropout Voltage | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{OUT}$ (V) | | | | $I_{OUT}$ (mA) | | $\Delta V_{OUT}/\Delta I_{OUT}$ (mV) | | | $V_{DIF}$ (mV) | | |
| | Conditions | Min. | Typ. | Max. | Conditions | Min. | Conditions | Typ. | Max. | Conditions | Typ. | Max. |
| Rx5RW15 | $V_{IN}$-$V_{OUT}$ =2.0V<br>10μA≤$I_{OUT}$ ≤10mA | 1.470 | 1.500 | 1.530 | $V_{IN}$-$V_{OUT}$ =2.0V | 35 | $V_{IN}$-$V_{OUT}$ =2.0V<br>1mA≤$I_{OUT}$ ≤35mA | 30 | 45 | $I_{OUT}$=1mA | 120 | 200 |
| Rx5RW16 | | 1.568 | 1.600 | 1.632 | | | | | | | 90 | 135 |
| Rx5RW17 | | 1.666 | 1.700 | 1.734 | | | | | | | | |
| Rx5RW18 | | 1.764 | 1.800 | 1.836 | | | | | | | 60 | 90 |
| Rx5RW19 | | 1.862 | 1.900 | 1.938 | | | | | | | | |
| Rx5RW20 | | 1.960 | 2.000 | 2.040 | | | | | | | | |
| Rx5RW21 | | 2.058 | 2.100 | 2.142 | | | | | | | | |
| Rx5RW22 | | 2.156 | 2.200 | 2.244 | | | | | | | | |
| Rx5RW23 | | 2.254 | 2.300 | 2.346 | | | | | | | | |
| Rx5RW24 | | 2.352 | 2.400 | 2.448 | | | | | | | 50 | 75 |
| Rx5RW25 | | 2.450 | 2.500 | 2.550 | | | | | | | | |
| Rx5RW26 | | 2.548 | 2.600 | 2.652 | | | | | | | | |
| Rx5RW27 | | 2.646 | 2.700 | 2.754 | | | | | | | | |
| Rx5RW28 | | 2.744 | 2.800 | 2.856 | | | | | | | 40 | 60 |
| Rx5RW29 | | 2.842 | 2.900 | 2.958 | | | | | | | | |
| Rx5RW30 | | 2.940 | 3.000 | 3.060 | | 50 | $V_{IN}$-$V_{OUT}$ =2.0V<br>1mA≤$I_{OUT}$ ≤50mA | 40 | 60 | | 35 | 55 |
| Rx5RW31 | | 3.038 | 3.100 | 3.162 | | | | | | | | |
| Rx5RW32 | | 3.136 | 3.200 | 3.264 | | | | | | | | |
| Rx5RW33 | | 3.234 | 3.300 | 3.366 | | | | | | | | |
| Rx5RW34 | | 3.332 | 3.400 | 3.468 | | | | | | | | |
| Rx5RW35 | | 3.430 | 3.500 | 3.570 | | | | | | | | |
| Rx5RW36 | | 3.528 | 3.600 | 3.672 | | | | | | | 30 | 45 |
| Rx5RW37 | | 3.626 | 3.700 | 3.774 | | | | | | | | |
| Rx5RW38 | | 3.724 | 3.800 | 3.876 | | | | | | | | |
| Rx5RW39 | | 3.822 | 3.900 | 3.978 | | | | | | | | |
| Rx5RW40 | | 3.920 | 4.000 | 4.080 | | 65 | $V_{IN}$-$V_{OUT}$ =2.0V<br>1mA≤$I_{OUT}$ ≤65mA | 50 | 70 | | 25 | 40 |
| Rx5RW41 | | 4.018 | 4.100 | 4.182 | | | | | | | | |
| Rx5RW42 | | 4.116 | 4.200 | 4.284 | | | | | | | | |
| Rx5RW43 | | 4.214 | 4.300 | 4.386 | | | | | | | | |
| Rx5RW44 | | 4.312 | 4.400 | 4.488 | | | | | | | | |
| Rx5RW45 | | 4.410 | 4.500 | 4.590 | | | | | | | | |
| Rx5RW46 | | 4.508 | 4.600 | 4.692 | | | | | | | | |
| Rx5RW47 | | 4.606 | 4.700 | 4.794 | | | | | | | | |
| Rx5RW48 | | 4.704 | 4.800 | 4.896 | | | | | | | | |
| Rx5RW49 | | 4.802 | 4.900 | 4.998 | | | | | | | | |
| Rx5RW50 | | 4.900 | 5.000 | 5.100 | | 80 | $V_{IN}$-$V_{OUT}$ =2.0V<br>1mA≤$I_{OUT}$ ≤80mA | 60 | 90 | | | |
| Rx5RW51 | | 4.998 | 5.100 | 5.202 | | | | | | | | |
| Rx5RW52 | | 5.096 | 5.200 | 5.304 | | | | | | | | |
| Rx5RW53 | | 5.194 | 5.300 | 5.406 | | | | | | | | |
| Rx5RW54 | | 5.292 | 5.400 | 5.508 | | | | | | | | |
| Rx5RW55 | | 5.390 | 5.500 | 5.610 | | | | | | | | |
| Rx5RW56 | | 5.488 | 5.600 | 5.712 | | | | | | | | |
| Rx5RW57 | | 5.586 | 5.700 | 5.814 | | | | | | | | |
| Rx5RW58 | | 5.684 | 5.800 | 5.916 | | | | | | | | |
| Rx5RW59 | | 5.782 | 5.900 | 6.018 | | | | | | | | |
| Rx5RW60 | | 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 | $V_{IN}$=Set $V_{OUT}$+2.0 | | 1.5 | 3.0 | μA |
| $I_{standby}$ | Standby Current | $V_{IN}$=Set $V_{OUT}$+2.0V<br>$V_{CE}$=$V_{IN}$ (Rx5RWxxA),<br>$V_{CE}$=GND (Rx5RWxxB) | | 0.1 | 1.0 | μA |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line Regulation | $I_{OUT}$=1mA<br>Set $V_{OUT}$+0.5V≤$V_{IN}$≤8V | 0 | 0.05 | 0.20 | %/V |
| $V_{IN}$ | Input Voltage | | | | 8.0 | V |
| $\Delta V_{OUT}/\Delta Topt$ | Output Voltage Temperature Coefficient | $I_{OUT}$=10mA<br>−40°C≤Topt≤85°C | | ±100 | | ppm/°C |
| $I_{SC}$ | Short Current Limit | | | 40 | | mA |
| $R_{PU}/R_{PD}$ | $\overline{CE}$ Pull-up / CE Pull-down Resistance | applied to A/B version | 1.5 | 4.0 | 12.0 | MΩ |
| $V_{CEH}$ | $\overline{CE}$ /CE Input Voltage "H" | applied to A/B version | 1.5 | | | V |
| $V_{CEL}$ | $\overline{CE}$ /CE Input Voltage "L" | applied to A/B version | | | 0.25 | V |

**RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)**

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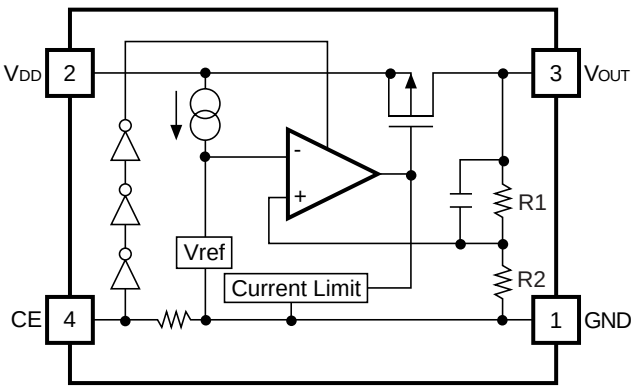
# OPERATION

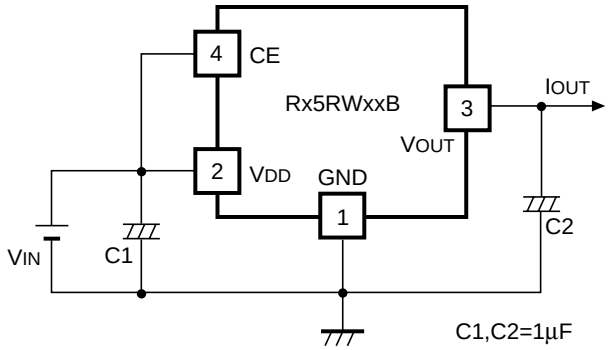
**Rx5RWxxB**



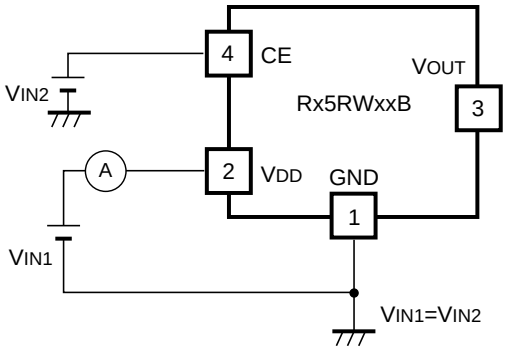

In these ICs, output voltage $V_{OUT}$ is detected by Feedback Registers R1, R2, and the detected output voltage is compare with a reference voltage by the error amplifier, so that a constant voltage is output.

A current limit circuit working for short protect, and a chip enable circuit are included.

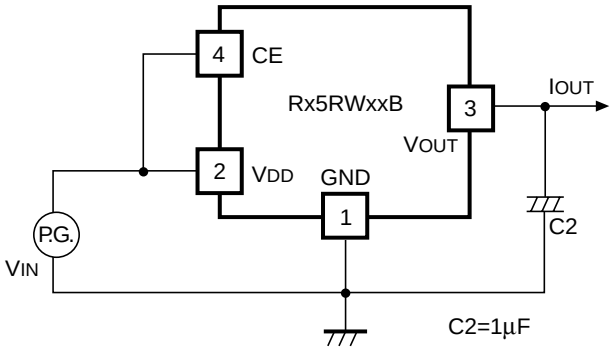
# TEST CIRCUITS



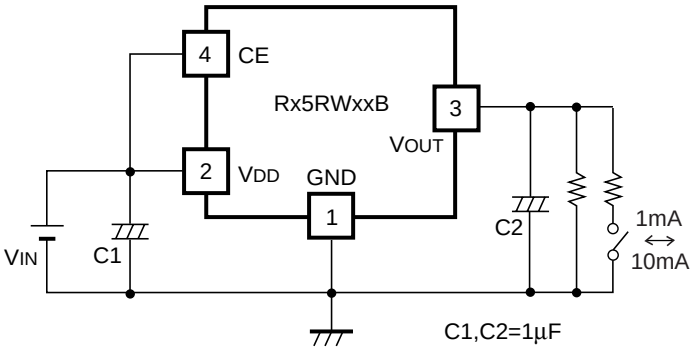

**Standard Test Circuit**




**Supply Current Test Circuit**

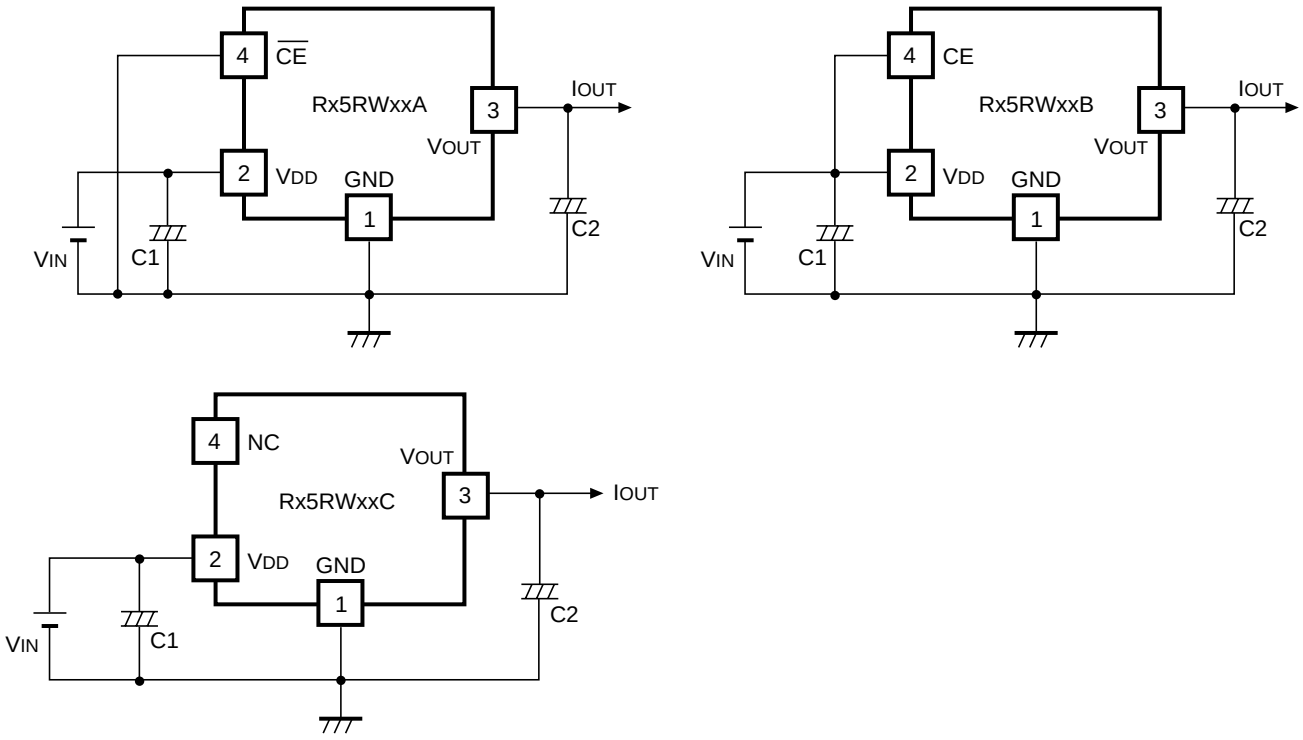



**Ripple Rejection and Line Transient Response Test Circuit**




**Load Transient Response Test Circuit**

# TYPICAL APPLICATION



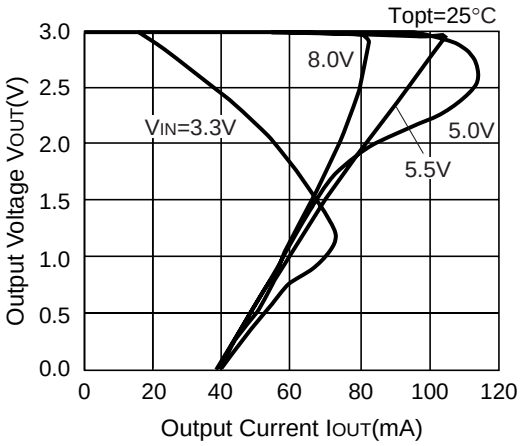

In Rx5RW Series, a constant voltage can be obtained without using capacitors, C1 and C2. However, when the wire connected $V_{IN}$ is long, use capacitor C1. Output noise can be reduced with using capacitor 2.

Insert capacitors C1 and C2 with the capacitance of 0.1μF to 2μF between input/output pins and GND pin with minimum wiring.

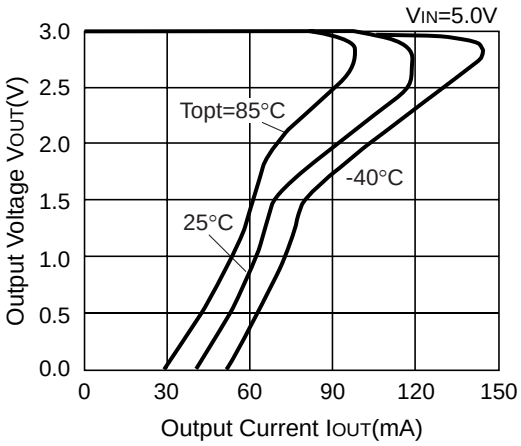
# TYPICAL CHARACTERISTICS

**1) Output Voltage vs. Output Current**

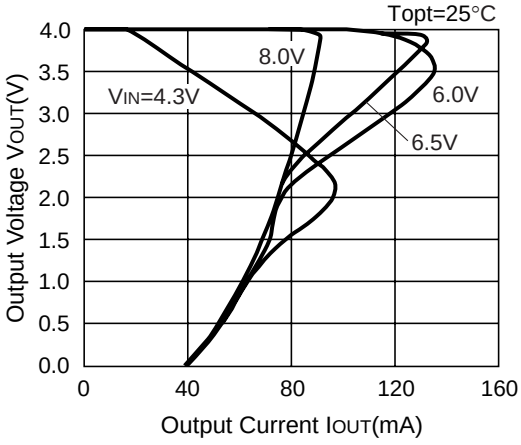
**Rx5RW30B**



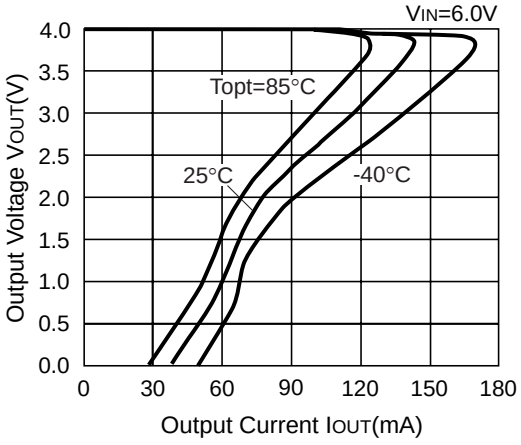

**Rx5RW30B**



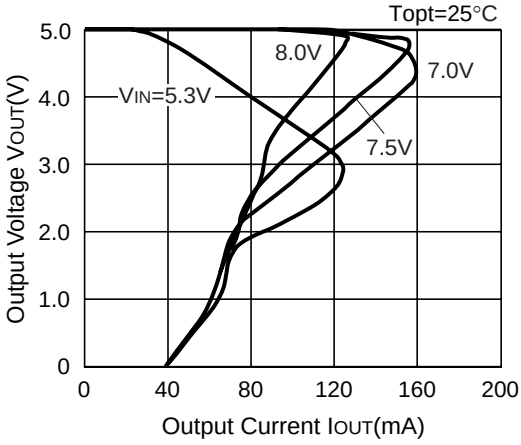

**Rx5RW40B**



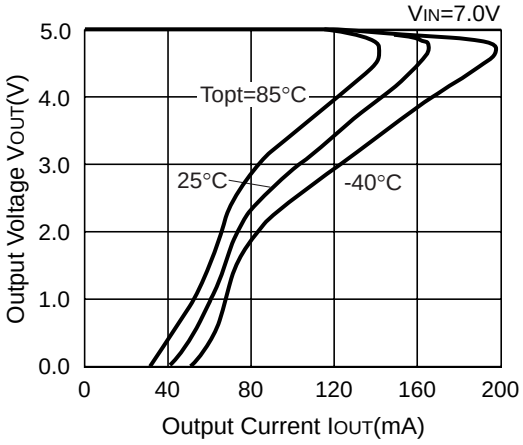

**Rx5RW40B**




**Rx5RW50B**

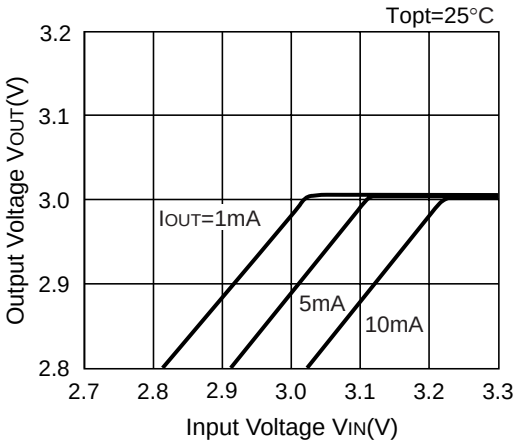



**Rx5RW50B**

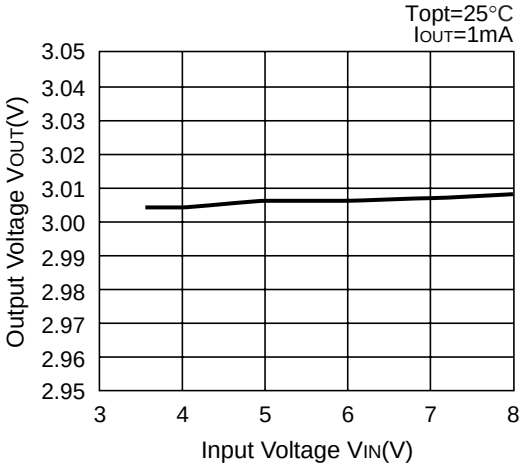


**2) Output Voltage vs. Input Voltage**

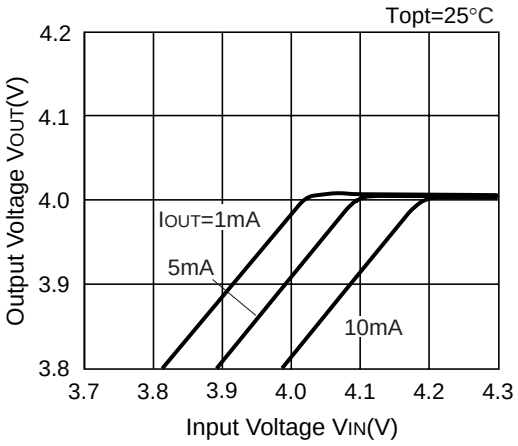
**Rx5RW30B**



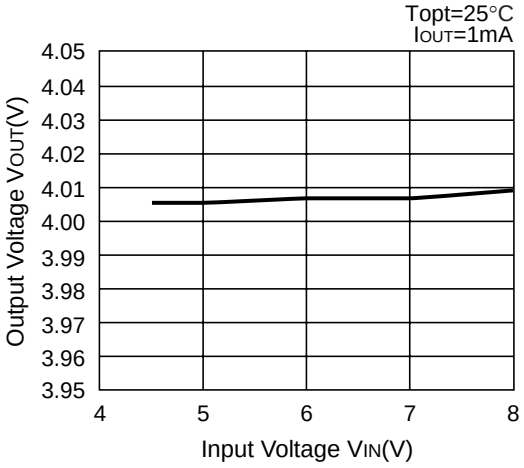

**Rx5RW30B**




**Rx5RW40B**




**Rx5RW40B**

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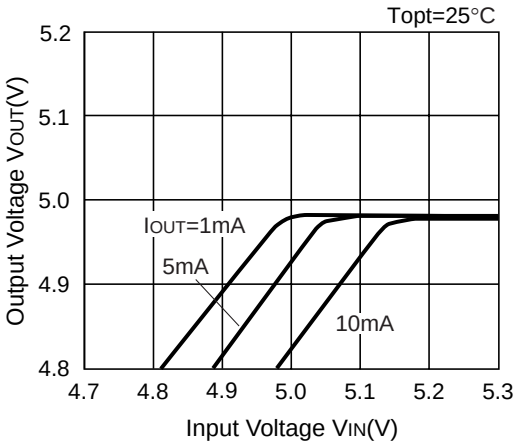


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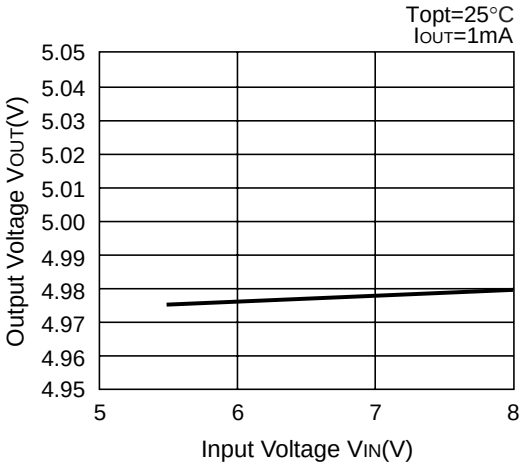

### 3) Dropout Voltage vs. Output Current

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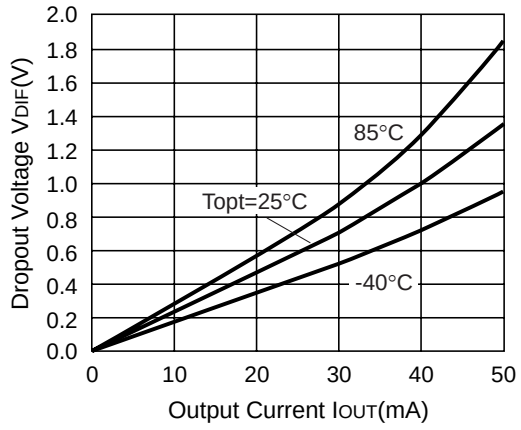


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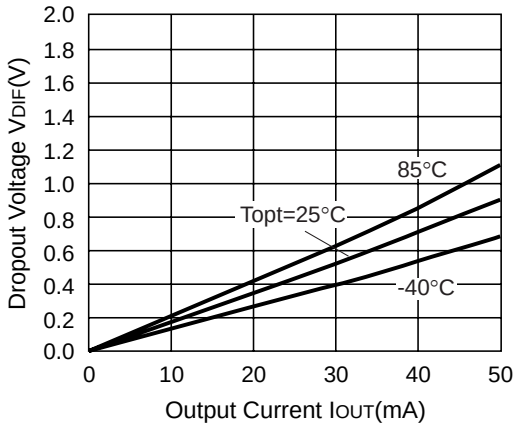


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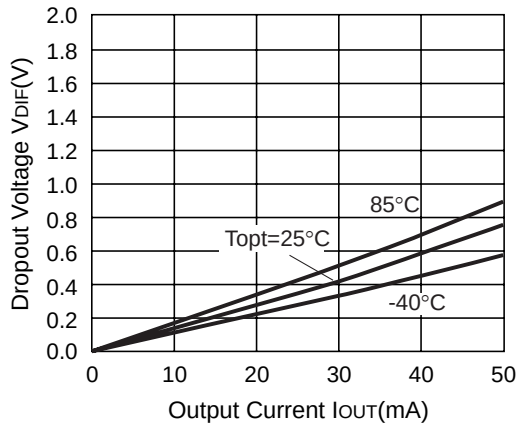


### 4) Output Voltage vs. Temperature

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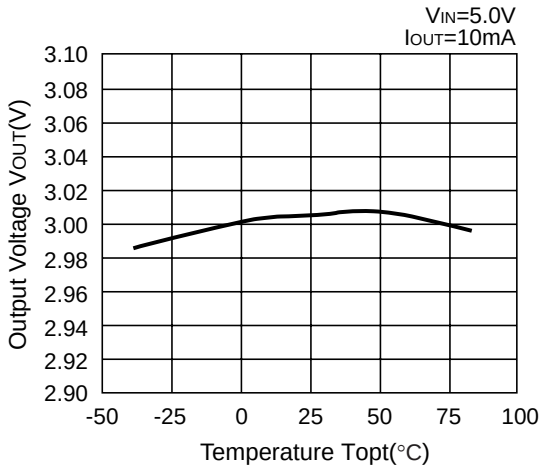


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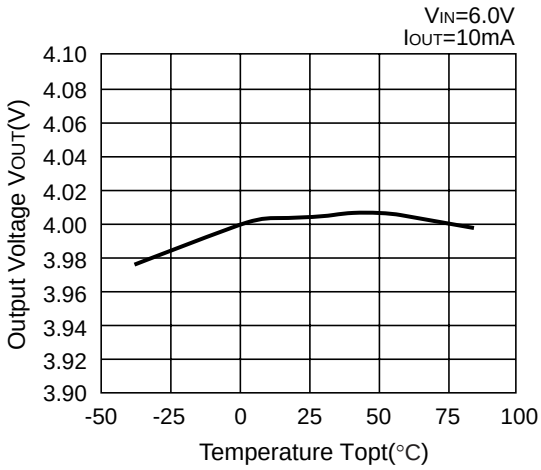

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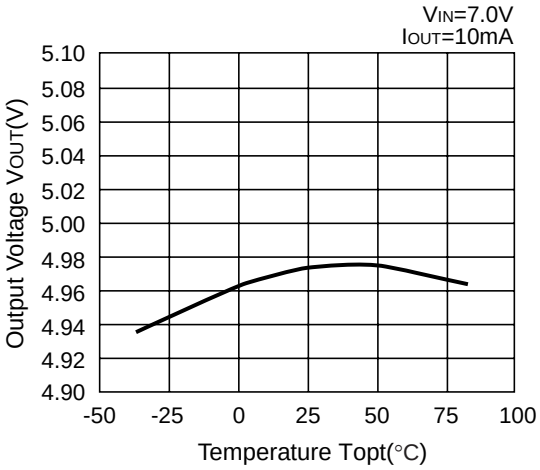


**5) Supply Current vs. Input Voltage**

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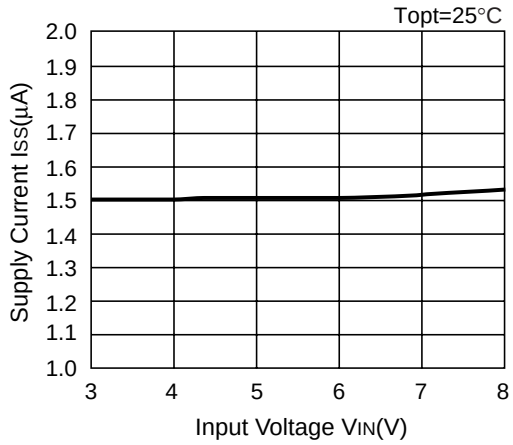


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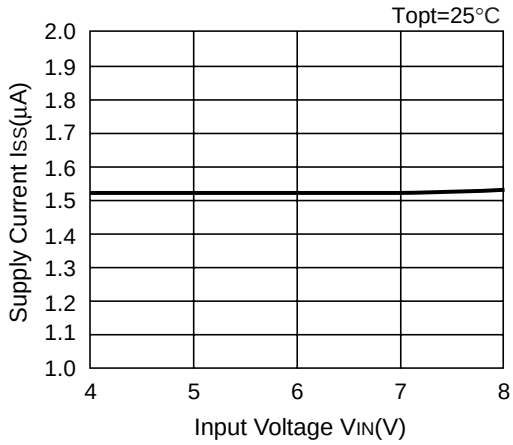


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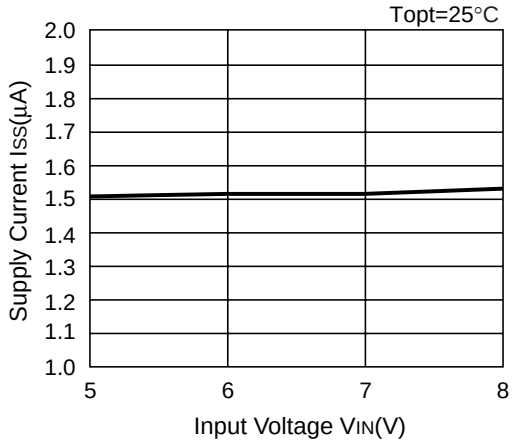
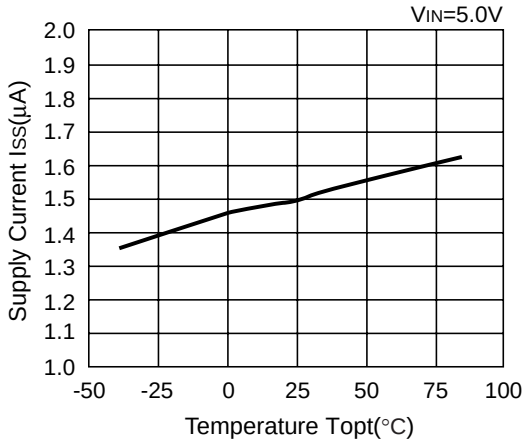


### 6) Supply Current vs. Temperature

**Rx5RW30B**

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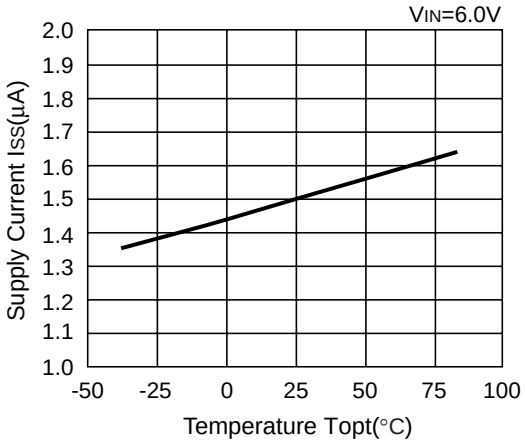


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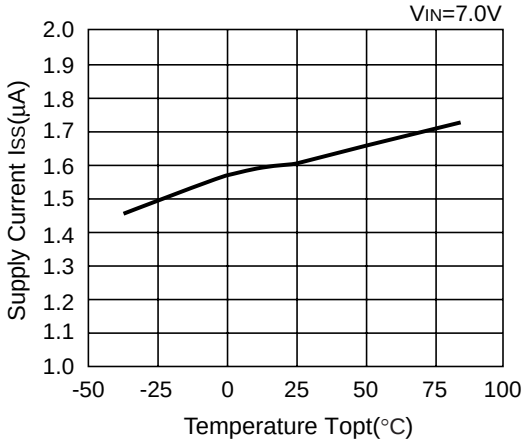
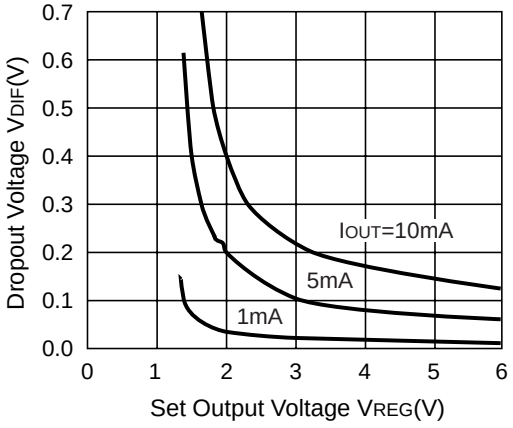


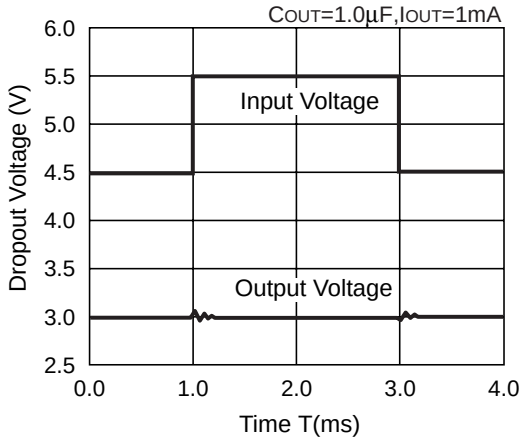

### 7) Dropout Voltage vs. Set Output Voltage

**Rx5RWxxB**



**8) Line Transient Response**

**Rx5RW30B**

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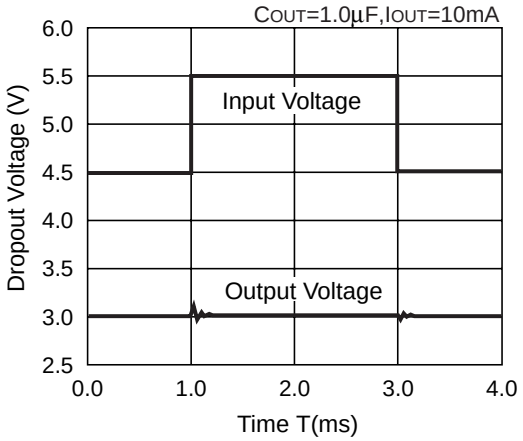


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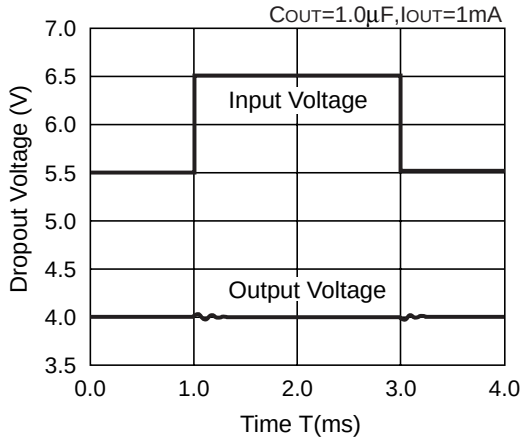


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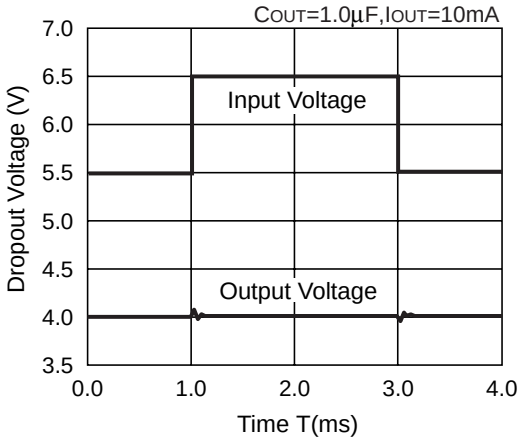


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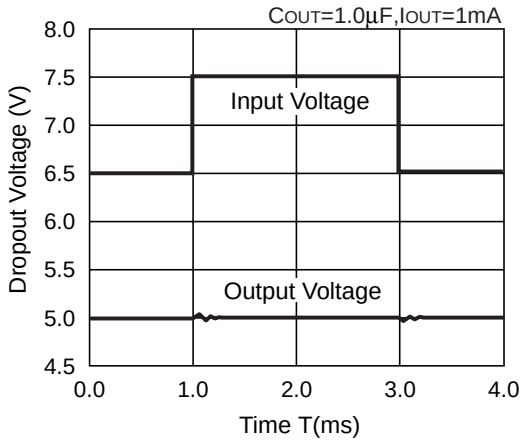


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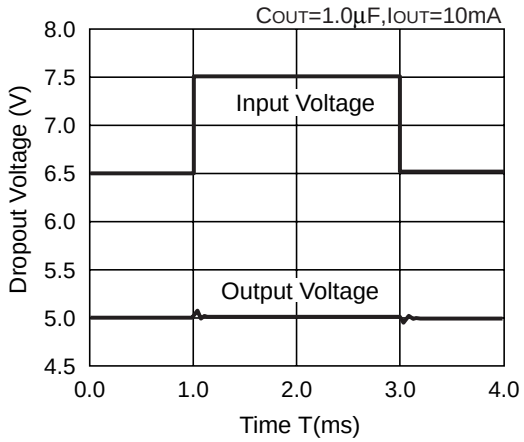
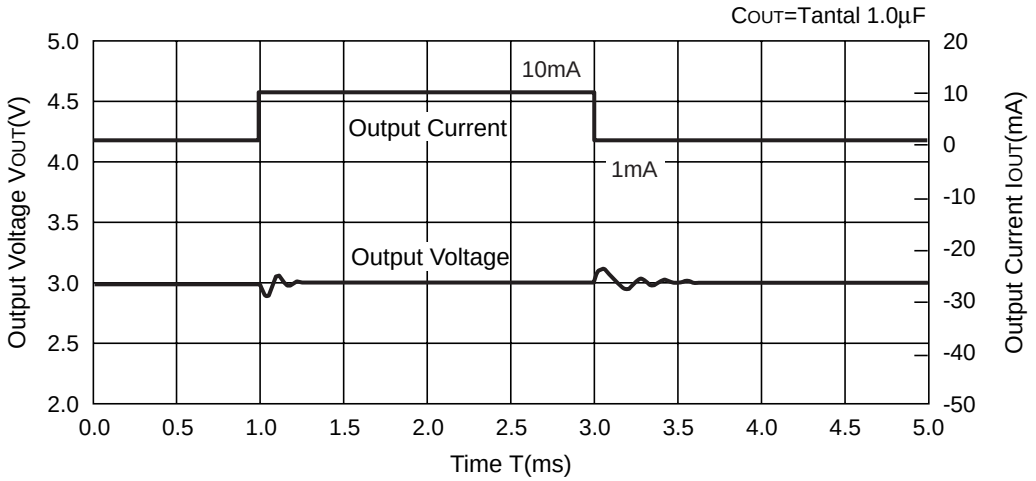


**9) Load Transient Response**

**Rx5RW30B**

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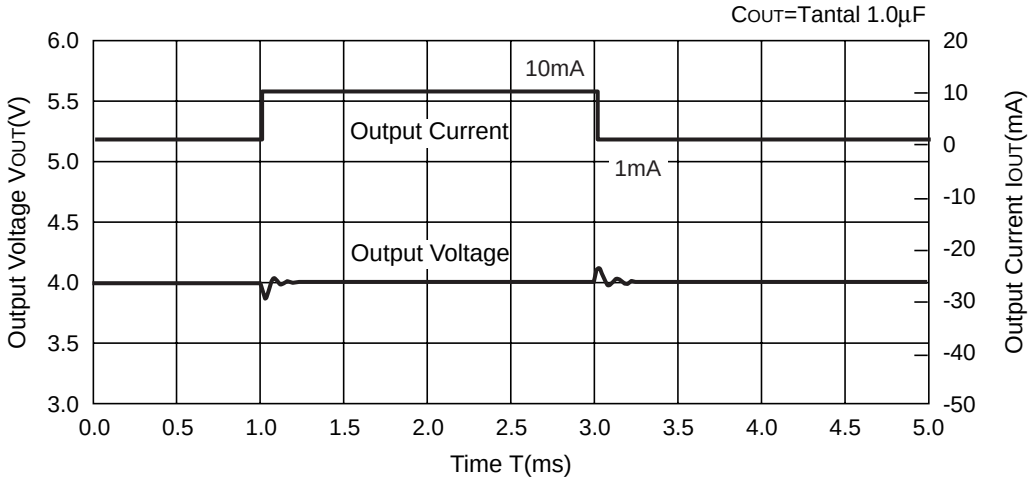


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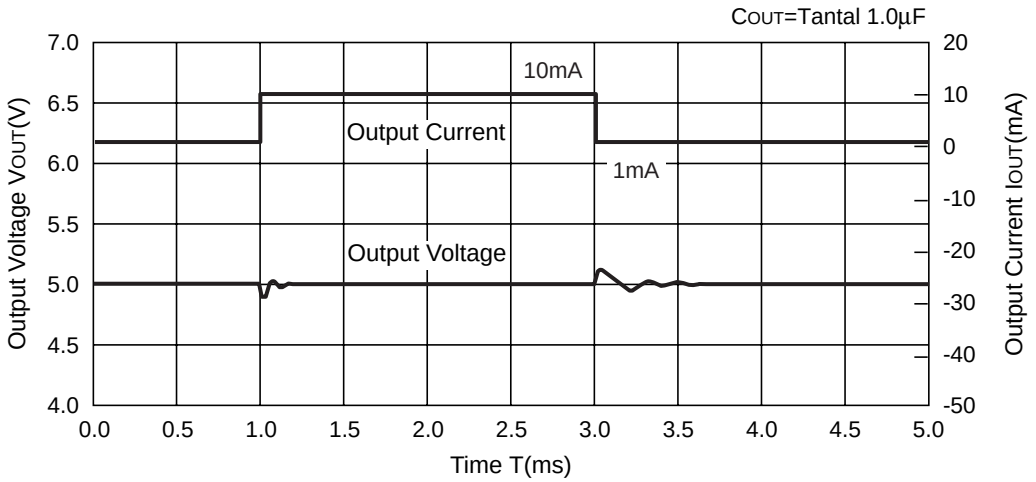
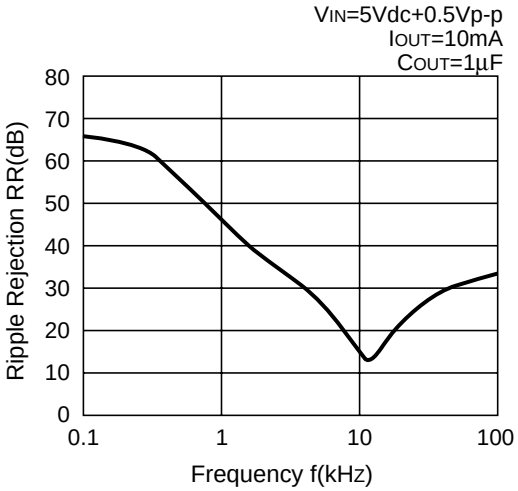


### 10) Ripple Rejection

**Rx5RW30B**

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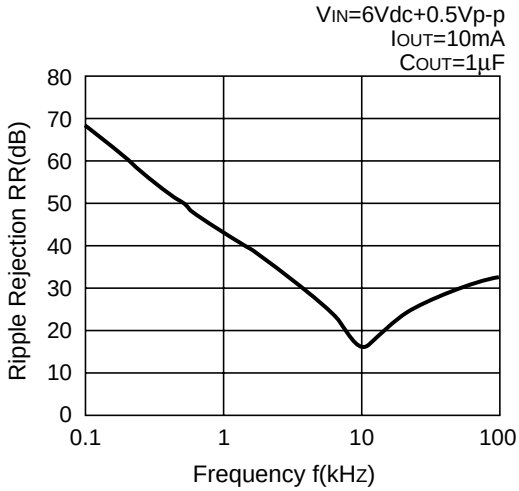


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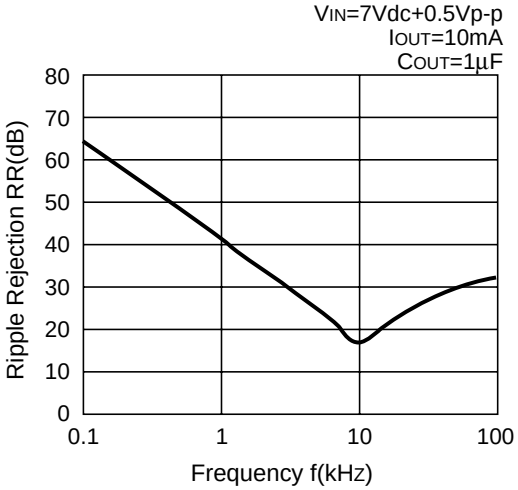

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