RICOH

RP104x SERIES

150mA ULTRA LOW SUPPLY CURRENT LDO REGULATOR

NO.EA-150-120404

OUTLINE

The RP104x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, extremely low supply current and low ON-resistance. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit and a chip enable circuit.

These ICs perform with ultra low supply current (Typ.1.0μA), which prolong the battery life.

Since the packages for these ICs are DFN(PLP)1010-4, SOT-23-5 and SC-82AB (Limited), therefore high density mounting of the ICs on boards is possible.

FEATURES

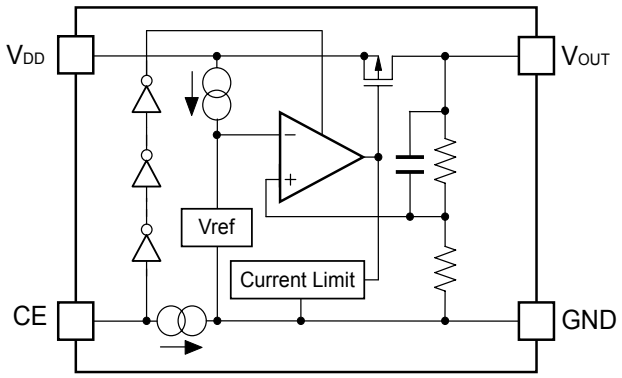
- Supply Current ..... Typ. 1.0μA
  (Except the current through CE pull down circuit)
- Standby Current ..... Typ. 0.1μA
- Dropout Voltage..... Typ. 0.24V (I_{OUT}=150mA, V_{OUT}=2.8V)
- Temperature-Drift Coefficient of Output Voltage ..... Typ. ±40ppm/°C
- Line Regulation ..... Typ. 0.02%/V
- Output Voltage Accuracy..... ±0.8%
- Packages..... DFN(PLP)1010-4, SC-82AB (Limited), SOT-23-5
- Input Voltage Range..... 1.7V to 5.25V
- Output Voltage Range..... ..... 1.2V to 3.3V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Built-in Fold Back Protection Circuit..... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC .... 0.1μF or more

APPLICATIONS

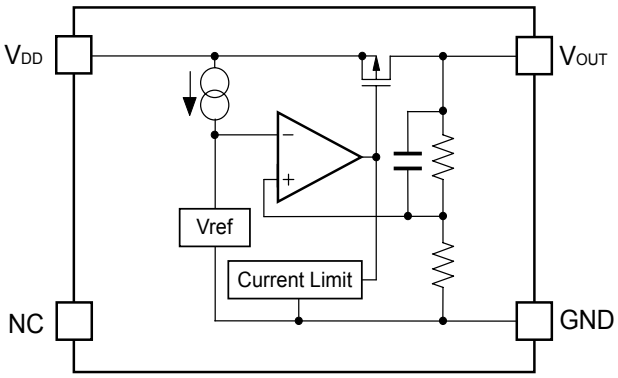
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

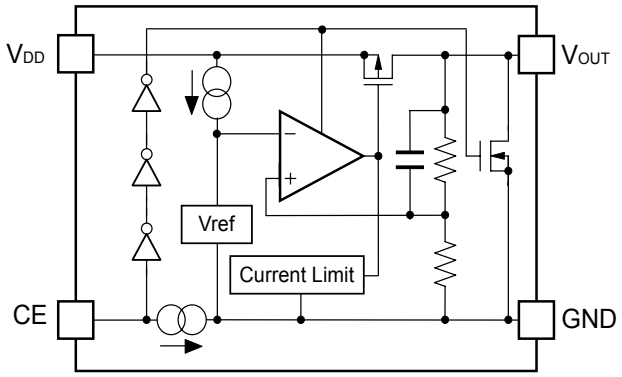
RP104xxx1B



RP104xxx1C



RP104xxx1D



SELECTION GUIDE

The output voltage, chip enable circuit, auto discharge function, package, and the taping type, etc. for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP104Kxx1∗-TR	DFN(PLP)1010-4	10,000 pcs	Yes	Yes
RP104Qxx1∗-TR-FE	SC-82AB (Limited)	3,000 pcs	Yes	Yes
RP104Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.2V(12) to 3.3V(33) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : CE pin polarity and auto discharge function at off state are options as follows.
(B) "H" active, without auto discharge function at off state
(C) without chip enable circuit
(D) "H" active, with auto discharge function at off state

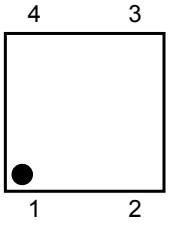
The products scheduled to be discontinued (be sold to limited customer) : "Limited"

These products will be discontinued in the future. You can not select these products newly.
We will provide these products to the customer who has been using or has ordered them before.
But we recommend changing to other products as soon as possible.

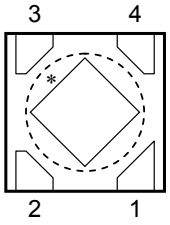
PIN CONFIGURATIONS

● DFN(PLP)1010-4

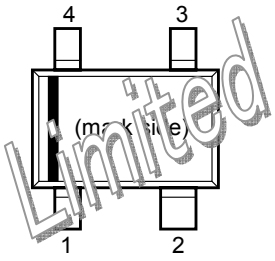
Top View



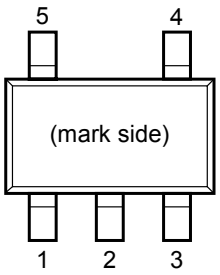
Bottom View



● SC-82AB



● SOT-23-5



PIN DESCRIPTIONS

● **DFN(PLP)1010-4**

Pin No	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	CE / NC	Chip Enable Pin ("H" Active) or No Connection
4	V_{DD}	Input Pin

*) Tab is GND level. (They are connected to the reverse side of this IC.)
The tab is better to be connected to the GND, but leaving it open is also acceptable.

● **SC-82AB (Limited)**

Pin No	Symbol	Pin Description
1	CE / NC	Chip Enable Pin ("H" Active) or No Connection
2	GND	Ground Pin
3	V_{OUT}	Output Pin
4	V_{DD}	Input Pin

● **SOT-23-5**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE / NC	Chip Enable Pin ("H" Active) or No Connection
4	NC	No Connection
5	V_{OUT}	Output Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	V
V_{CE}	Input Voltage (CE Pin)	6.0	V
V_{OUT}	Output Voltage	−0.3 to V_{IN}+0.3	V
I_{OUT}	Output Current	200	mA
P_D	Power Dissipation (DFN(PLP)1010-4)*	400	mW
	Power Dissipation (SC-82AB)* (Limited)	380	
	Power Dissipation (SOT-23-5)*	420	
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	Storage Temperature Range	−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

- **RP104xxx1B/C/D**

V_{IN}=Set V_{OUT}+1V for V_{OUT} options greater than 1.5V. V_{IN}=2.5V for V_{OUT} ≤ 1.5V.
I_{OUT}=1mA, C_{IN}=C_{OUT}=0.1μF, unless otherwise noted.
☐ values indicate –40°C ≤ Topt ≤ 85°C, unless otherwise noted.

Topt=25°C

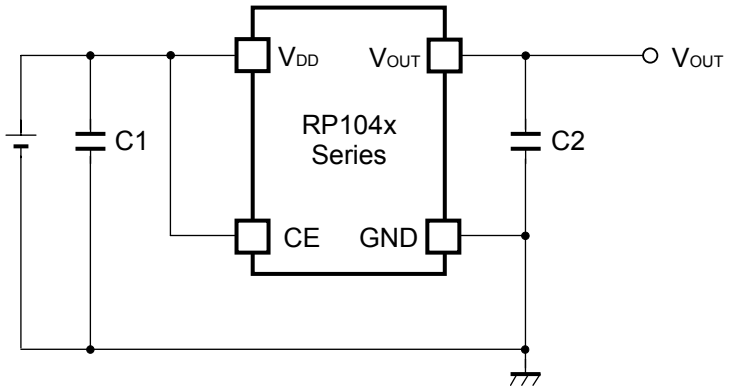
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{OUT} > 2.0V	×0.992		×1.008	V
			V_{OUT} ≤ 2.0V	–16		+16	mV
		–40°C ≤ Topt ≤ 85°C	V_{OUT} > 2.0V	×0.985		×1.015	V
			V_{OUT} ≤ 2.0V	–30		+30	mV
I_{OUT}	Output Current			150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA			10	20	mV
V_{DIF}	Dropout Voltage	I_{OUT}=150mA	1.2V ≤ V_{OUT} < 1.5V		0.76	1.05	V
			1.5V ≤ V_{OUT} < 1.7V		0.53	0.80	
			1.7V ≤ V_{OUT} < 2.0V		0.44	0.65	
			2.0V ≤ V_{OUT} < 2.5V		0.34	0.50	
			2.5V ≤ V_{OUT} < 2.8V		0.28	0.40	
			2.8V ≤ V_{OUT} ≤ 3.3V		0.24	0.32	
I_{SS}	Supply Current	I_{OUT}=0mA			1.0	1.5	μA
Istandby	Standby Current	V_{CE}=0V			0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 5.0V			0.02	0.10	%/V
V_{IN}	Input Voltage*			1.7		5.25	V
$\Delta V_{OUT}/\Delta$Topt	Output Voltage Temperature Coefficient	–40°C ≤ Topt ≤ 85°C			±40		ppm /°C
I_{SC}	Short Current Limit	V_{OUT}=0V			40		mA
I_{PD}	CE Pull-down Current				0.3		μA
V_{CEH}	CE Input Voltage "H"			1.5			V
V_{CEL}	CE Input Voltage "L"					0.3	V
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V_{IN}=4.0V V_{CE}=0V			30		Ω

All of units are tested and specified under load conditions such that Tj≈Topt=25°C except for Output Voltage Temperature Coefficient.
*) When Input Voltage is 5.5V, the total operational time must be within 500hrs.

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.

TYPICAL APPLICATION



(External Components)
C2 0.1μF MURATA: GRM155B31C104KA87B

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

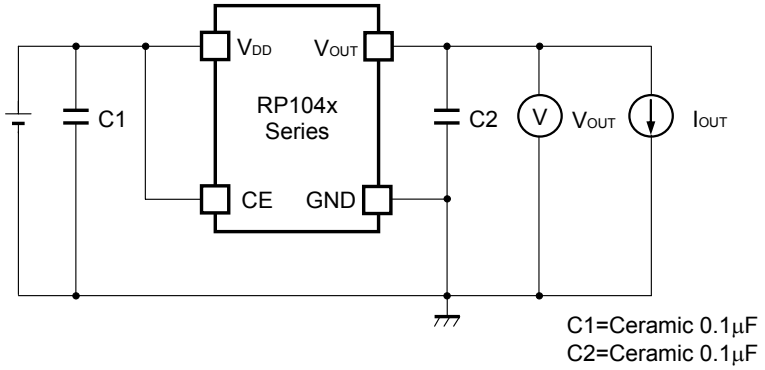
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 with good frequency characteristics and ESR (Equivalent Series Resistance).
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

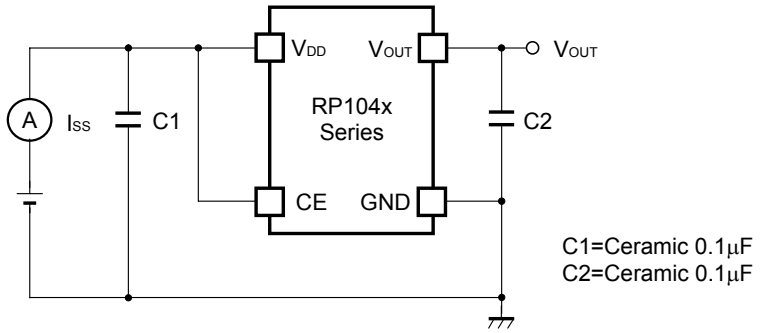
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 0.1μF or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

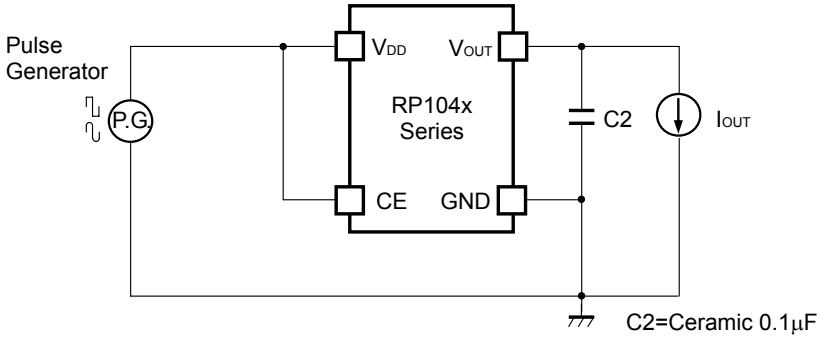
TEST CIRCUITS



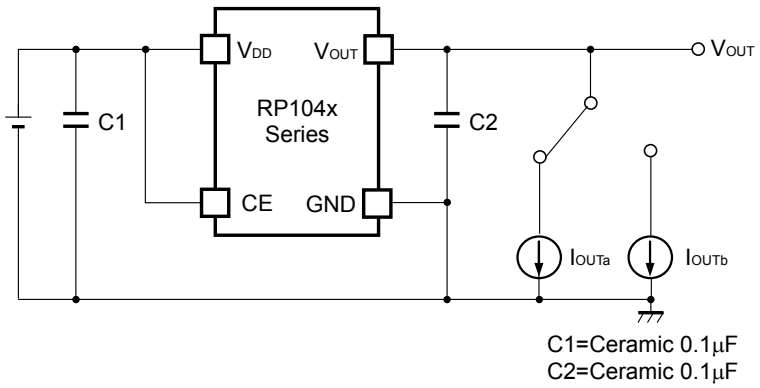
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection



Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, Topt=25°C)

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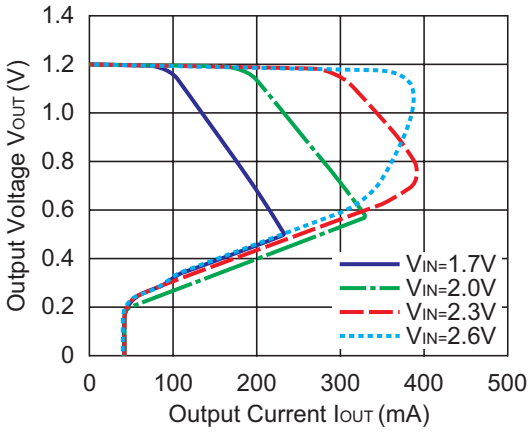

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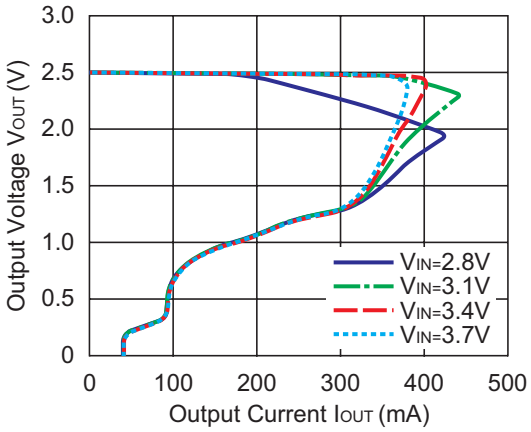

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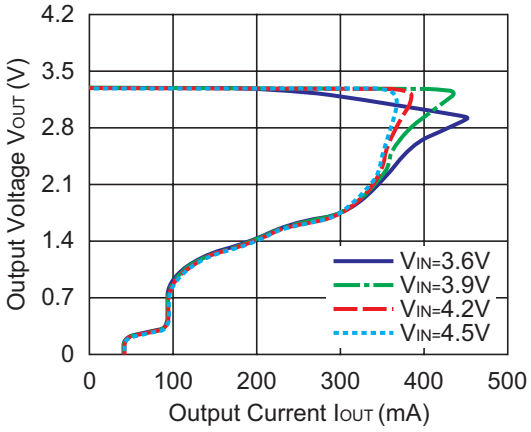

2) Output Voltage vs. Input Voltage (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, Topt=25°C)

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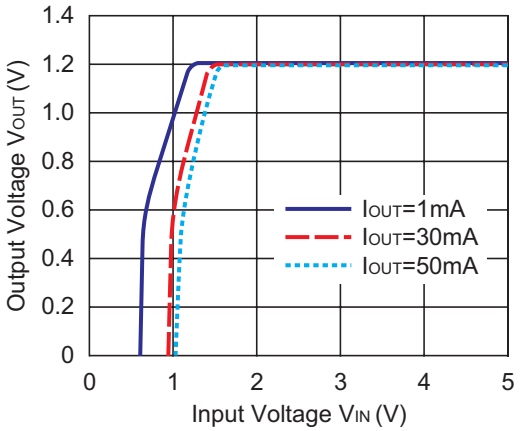

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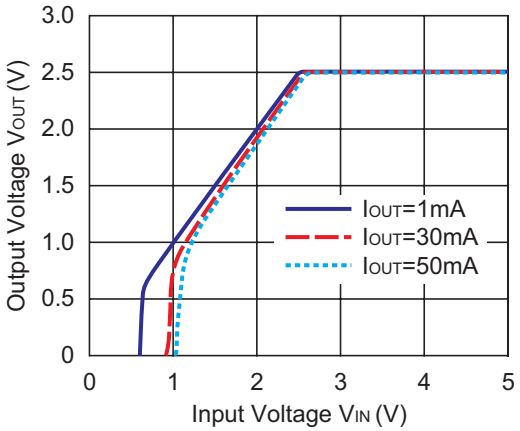

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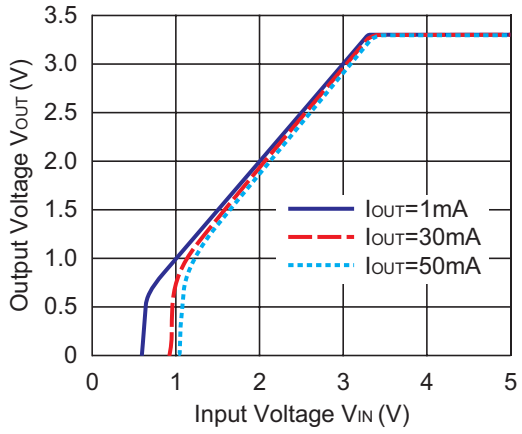

3) Supply Current vs. Input Voltage (C1=Ceramic 0.1μF, C2=Ceramic 0.1μF, Topt=25°C)

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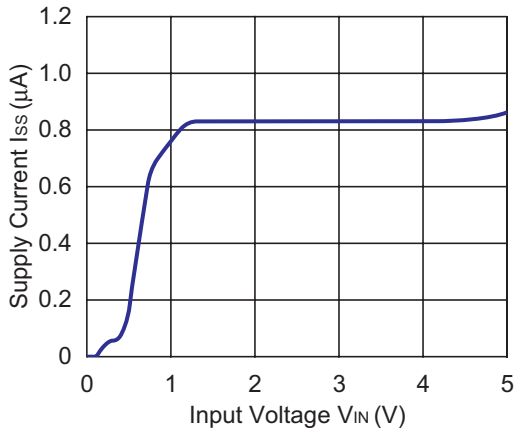

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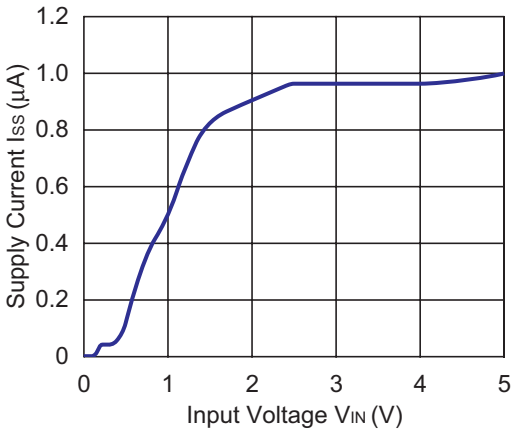

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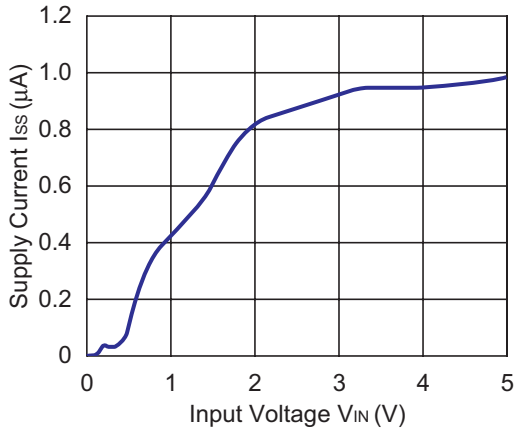

4) Output Voltage vs. Temperature (C1=Ceramic 0.1μF, C2=Ceramic 0.1μF, I_{OUT}=1mA)

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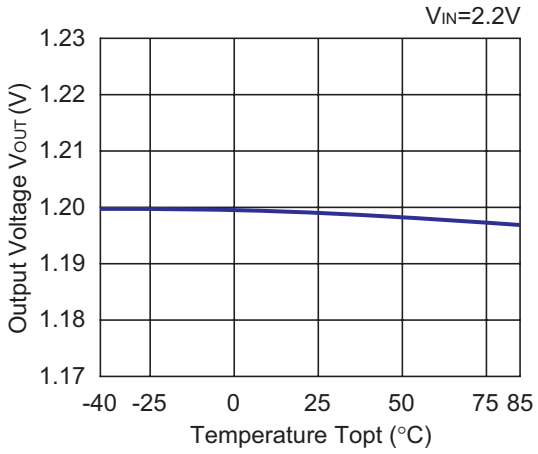

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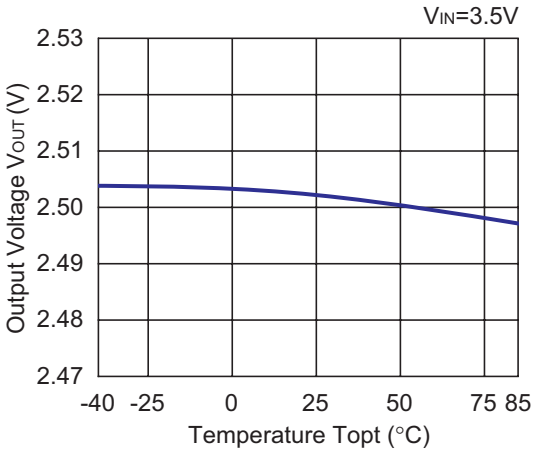

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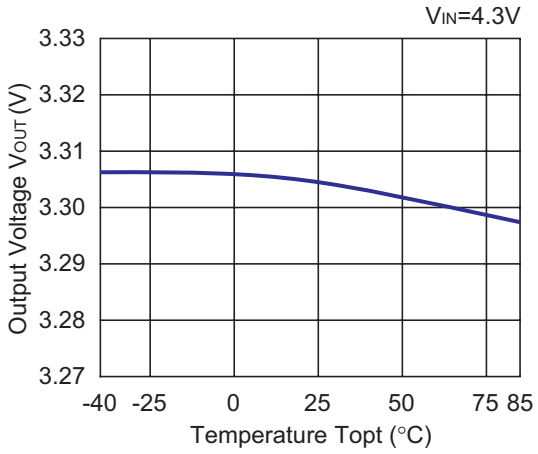

5) Supply Current vs. Temperature (C1=Ceramic 0.1μF, C2=Ceramic 0.1μF)

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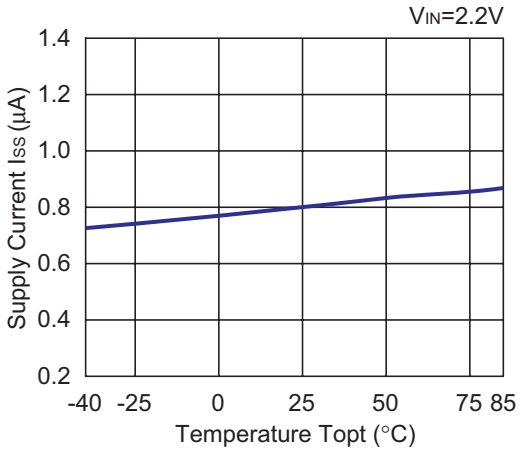

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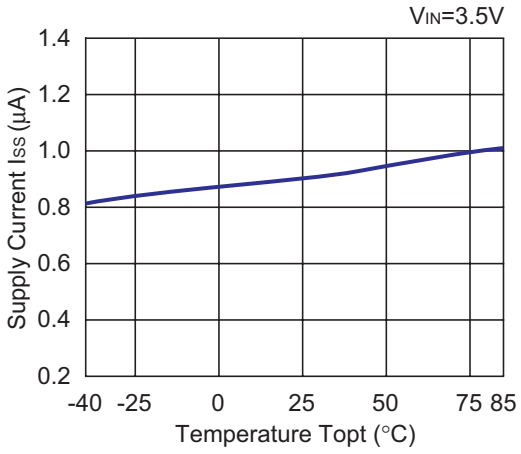

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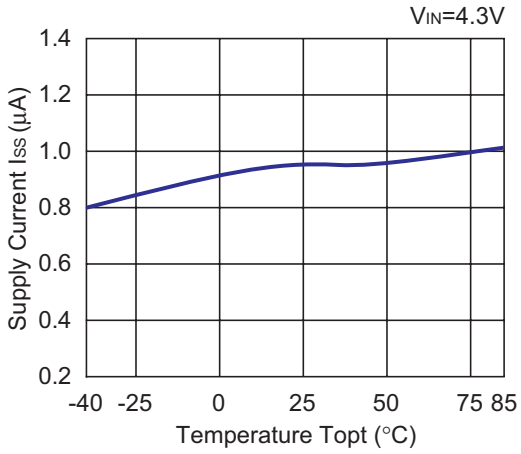

6) Dropout Voltage vs. Output Current (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, Topt=25°C)

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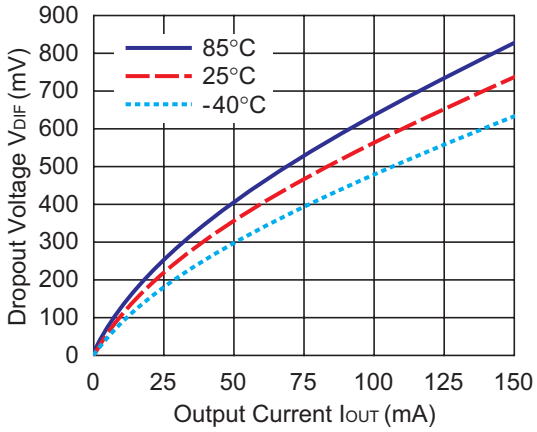

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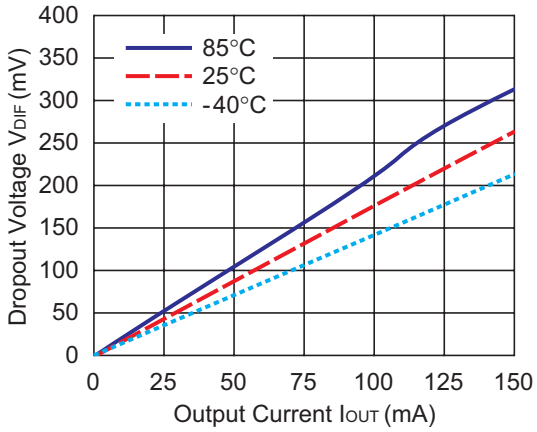

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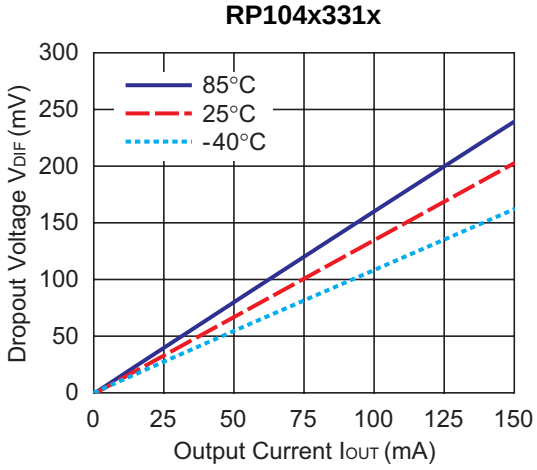
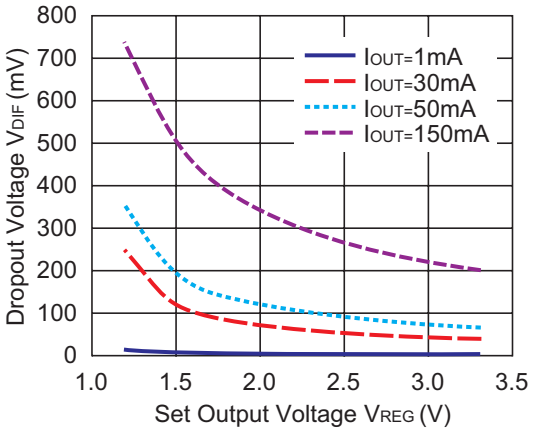


7) Dropout Voltage vs. Set Output Voltage (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, Topt=25°C)



8) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=Ceramic 0.1µF, Topt=25°C)

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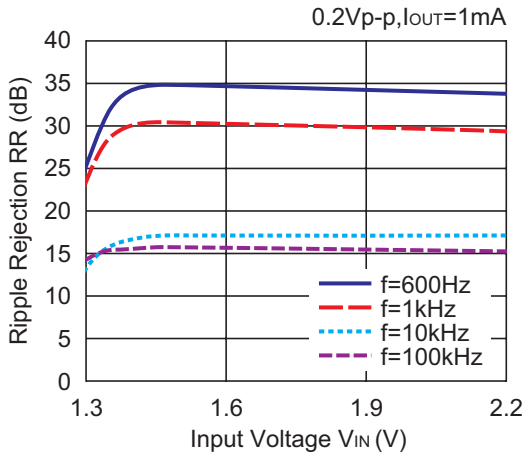

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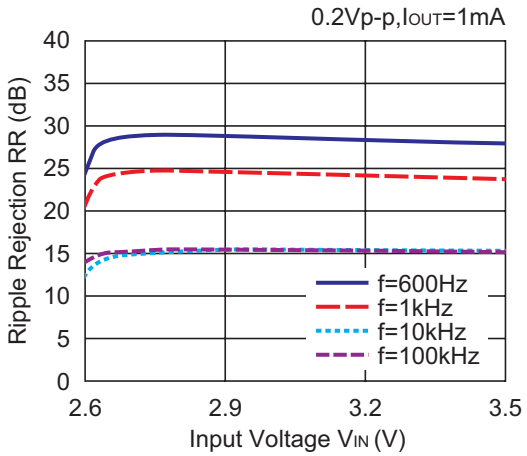

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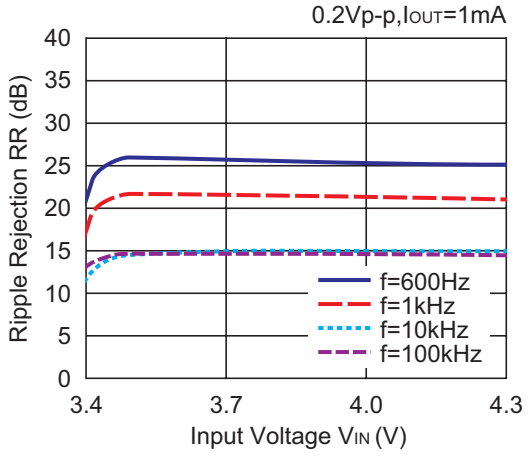

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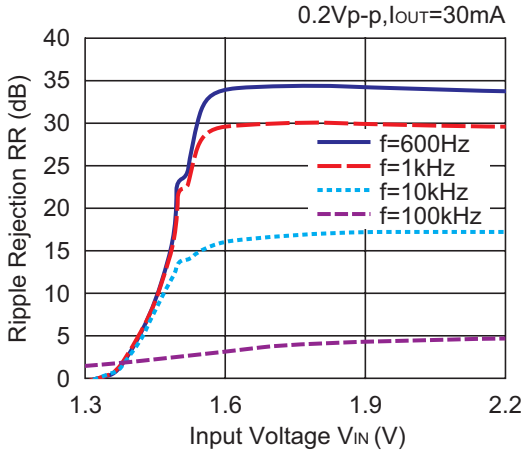

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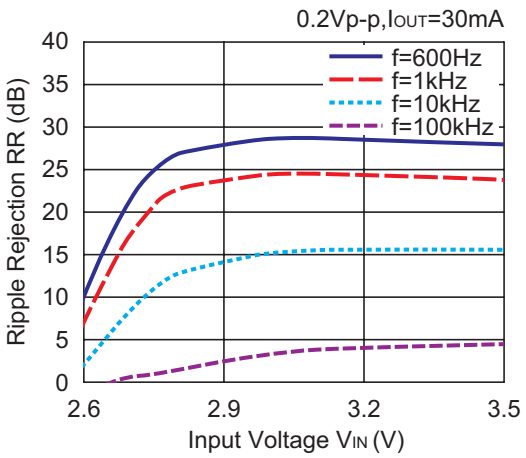

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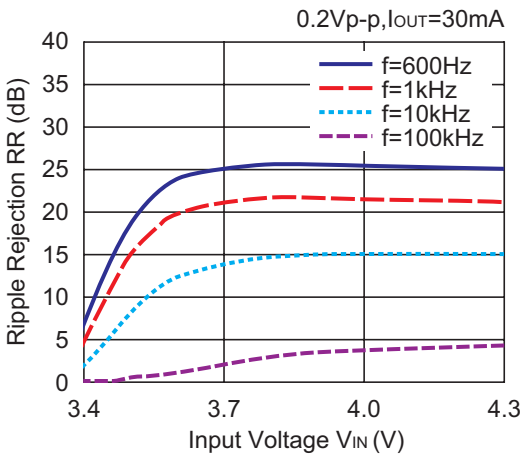

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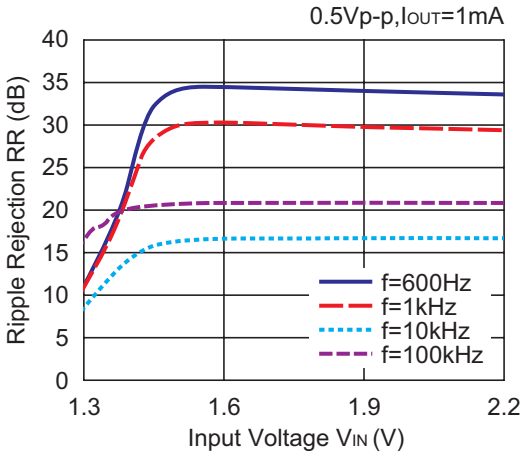
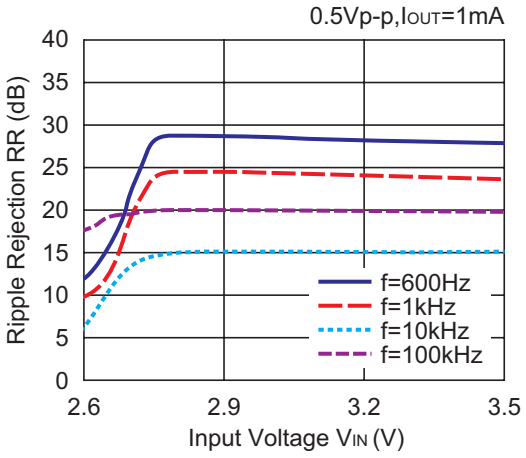
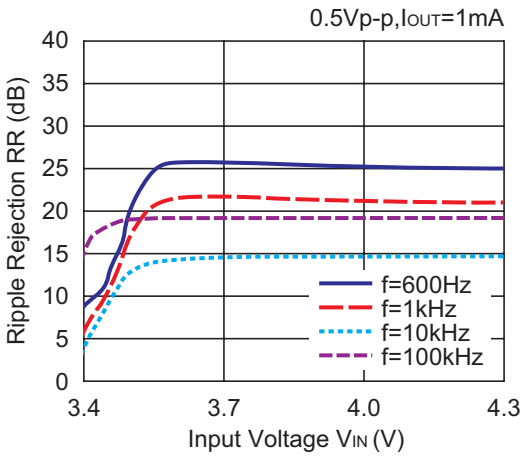


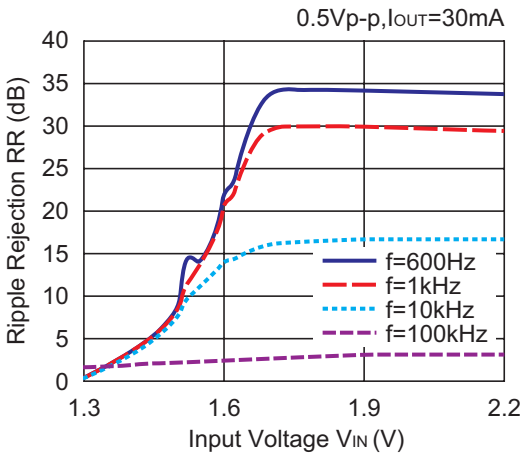
RP104x251x



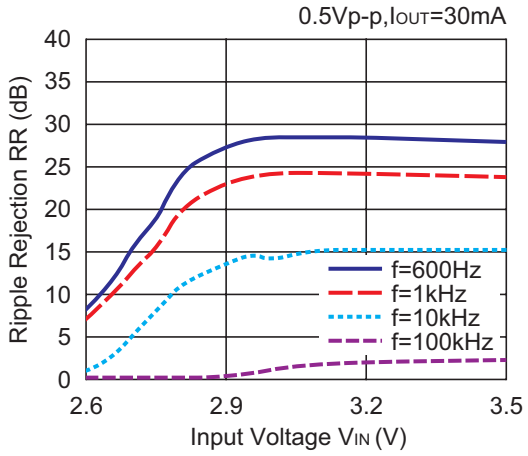
RP104x331x



RP104x121x



RP104x251x



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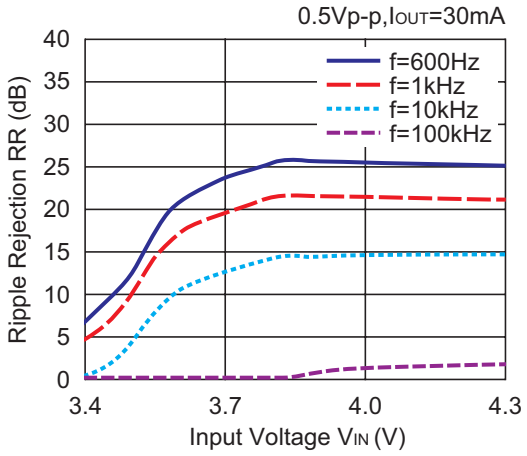
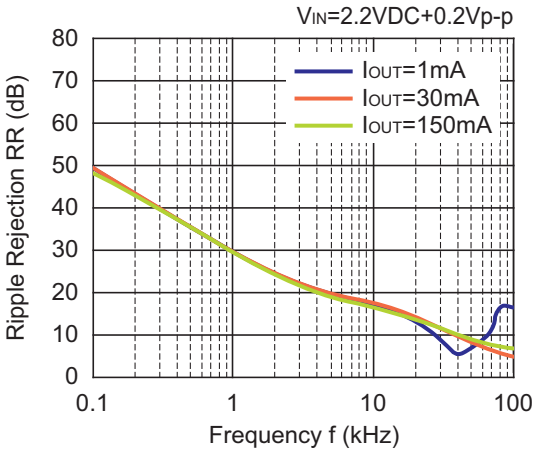
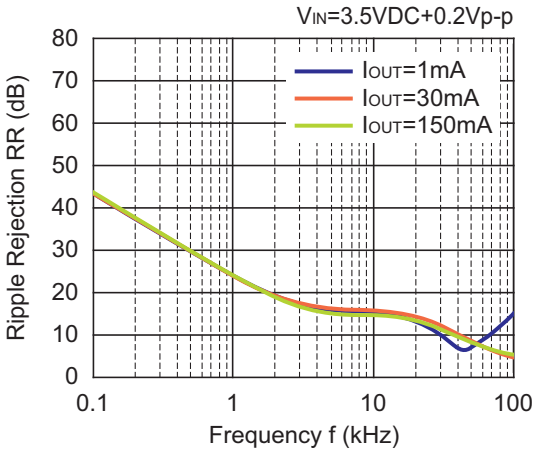


9) Ripple Rejection vs. Frequency (C1=none, C2=Ceramic 0.1μF, Topt=25°C)

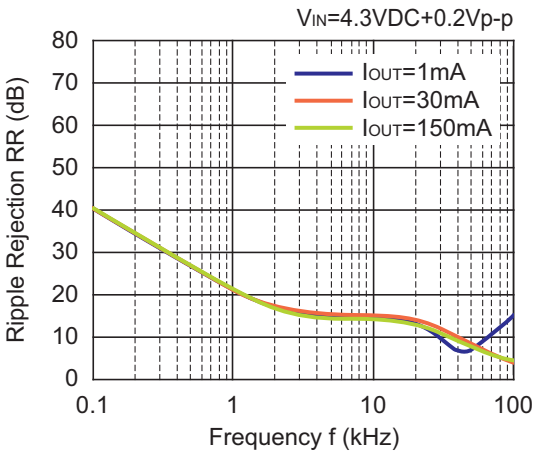
RP104x121x



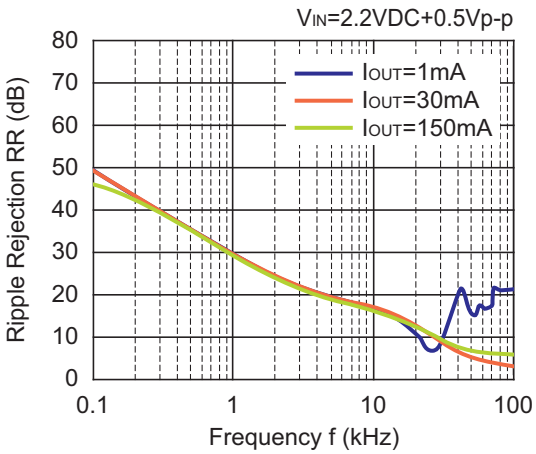
RP104x251x



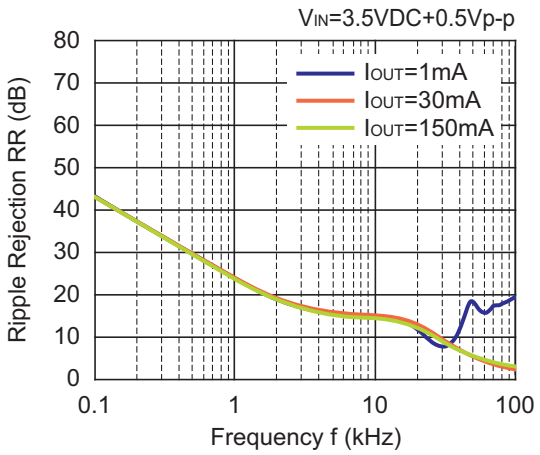
RP104x331x



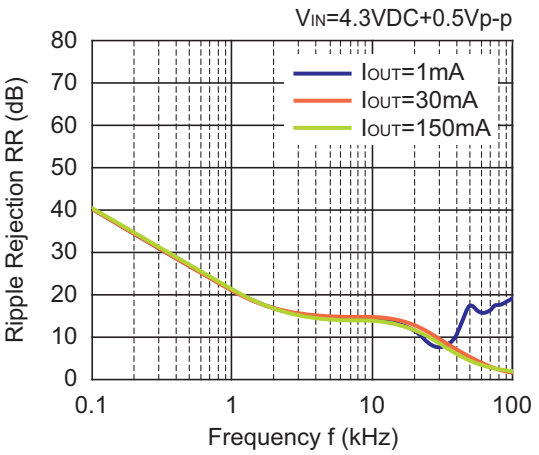
RP104x121x



RP104x251x

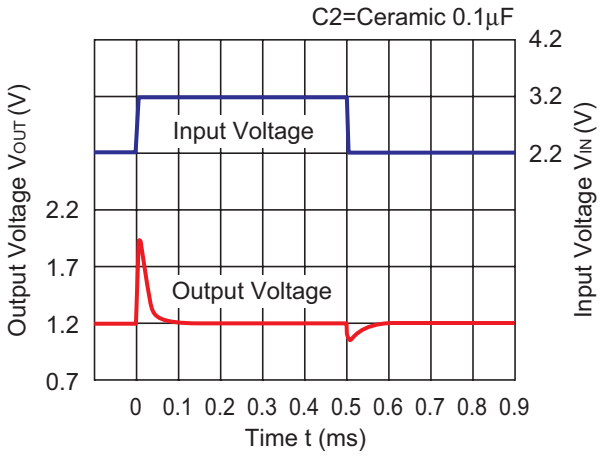


RP104x331x

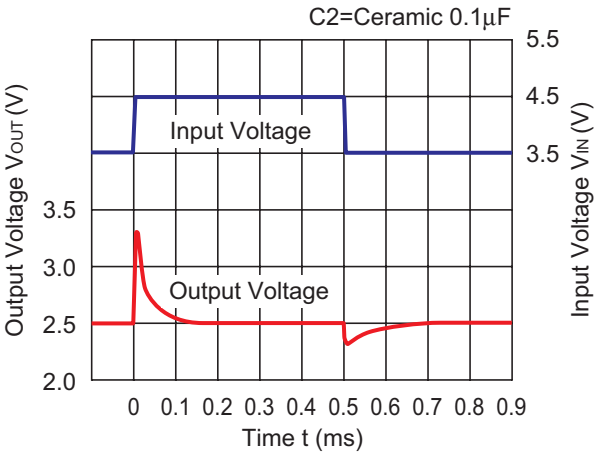


10) Input Transient Response (C1=none, I_{OUT}=30mA, T_{opt}=25°C)

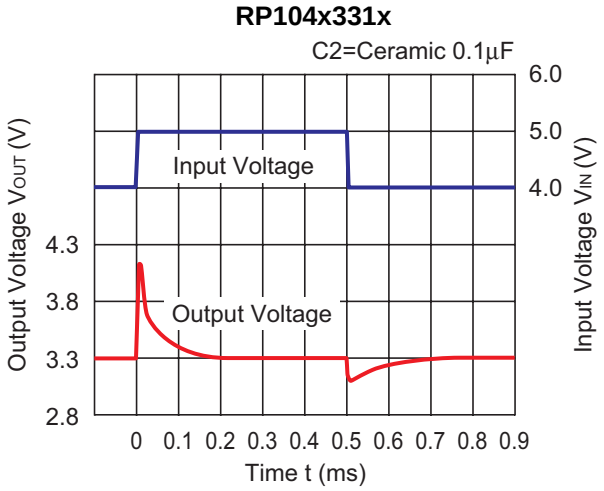
RP104x121x



RP104x251x



RP104x331x



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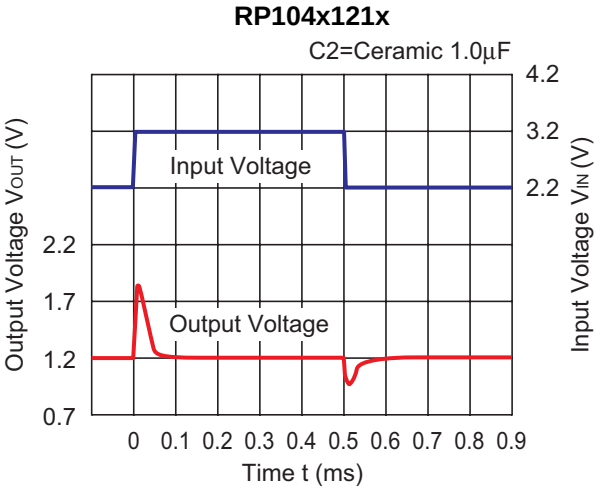

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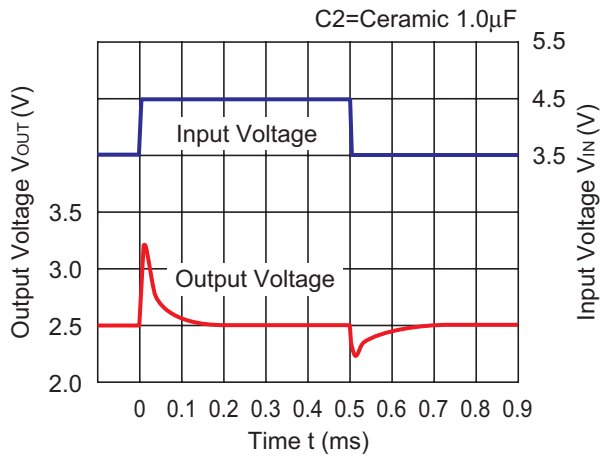
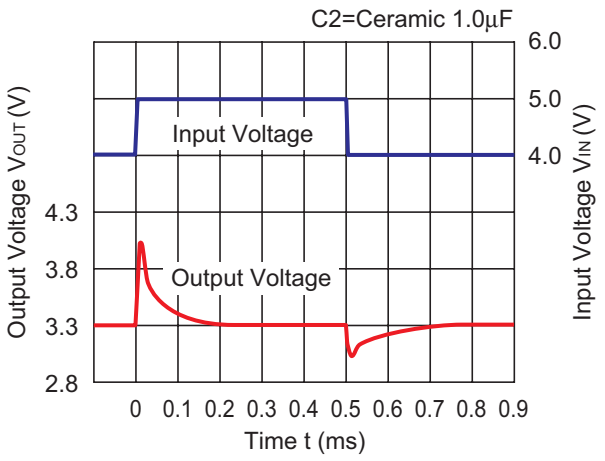
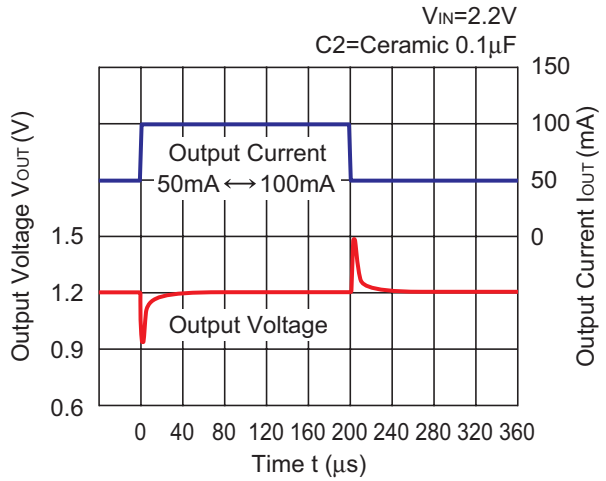


RP104x331x



11) Load Transient Response (C1=Ceramic 0.1µF, Topt=25°C)

RP104x121x



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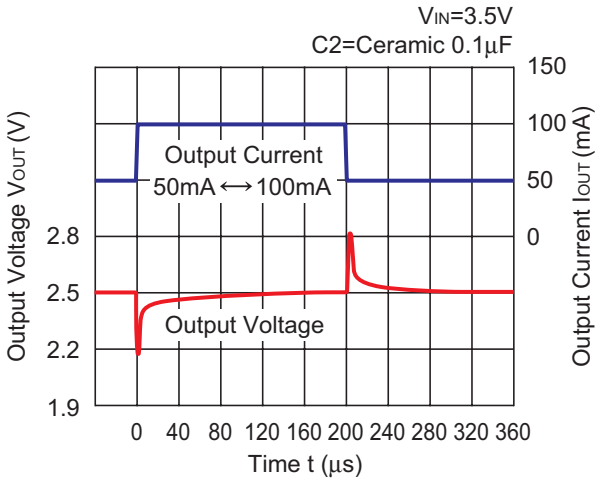

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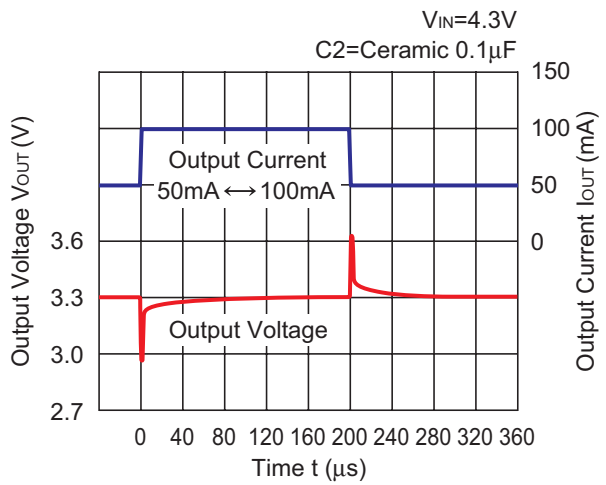
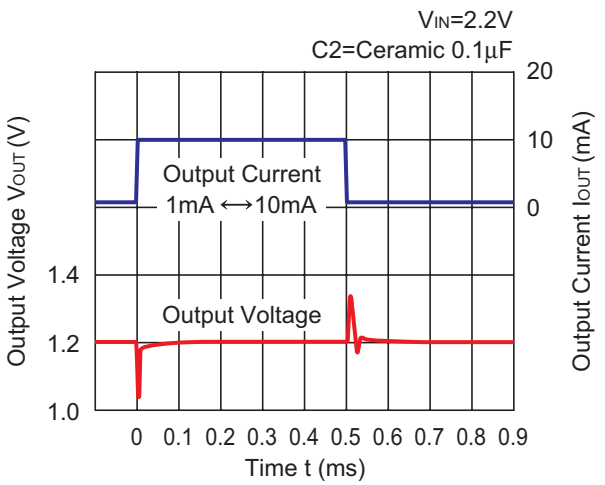
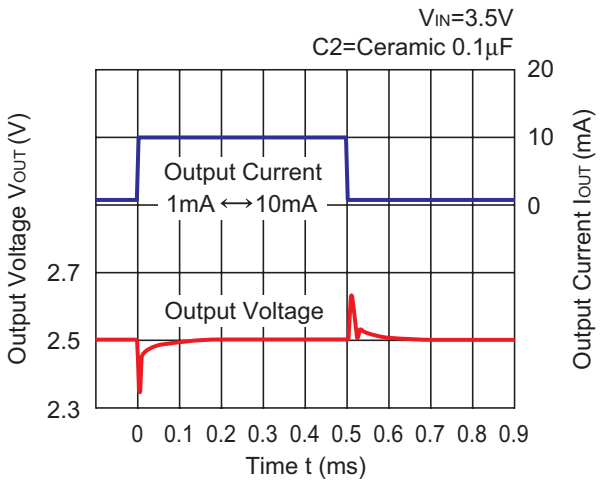


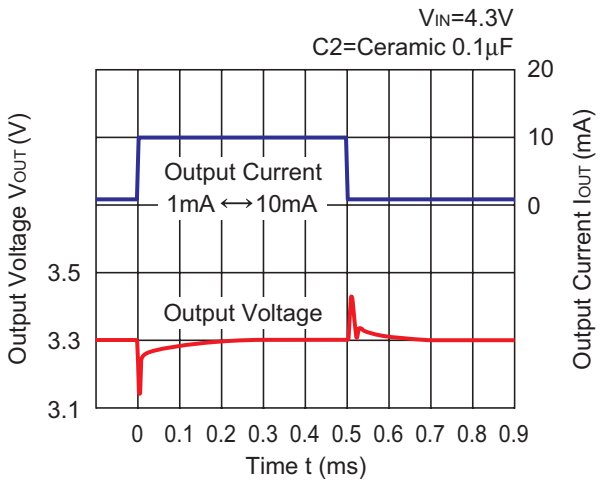
RP104x121x



RP104x251x



RP104x331x



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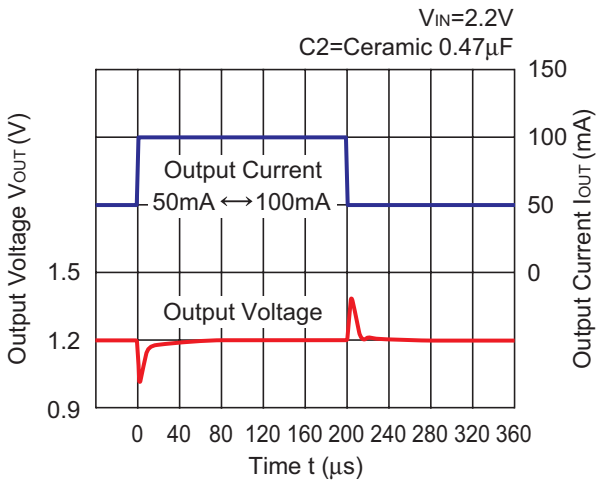

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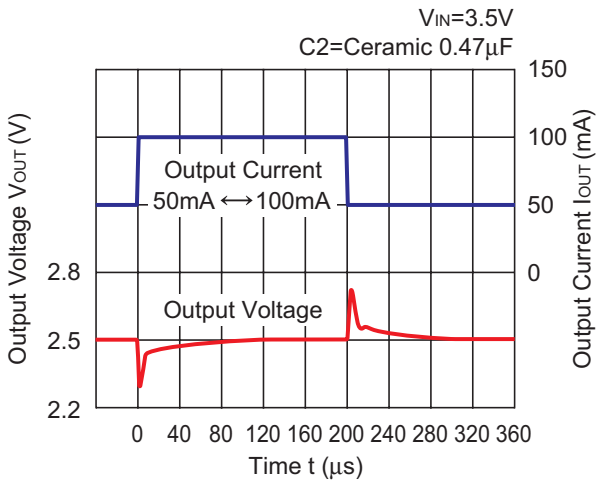

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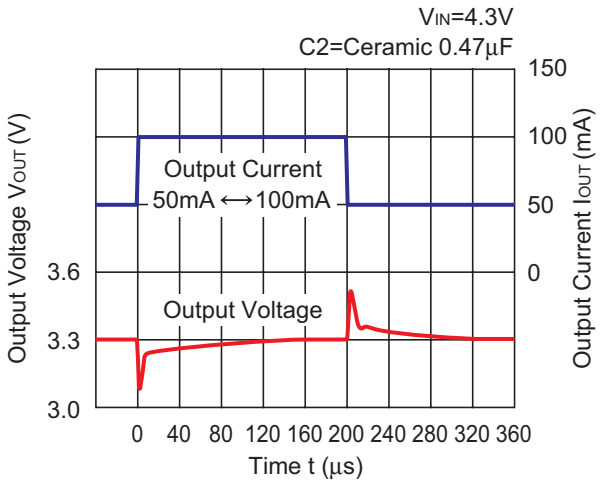

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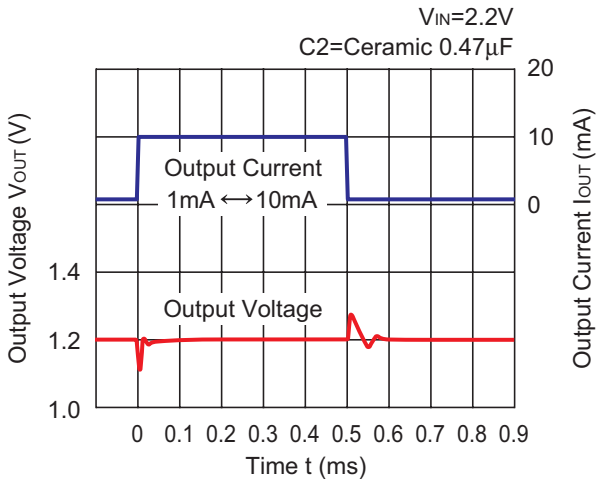

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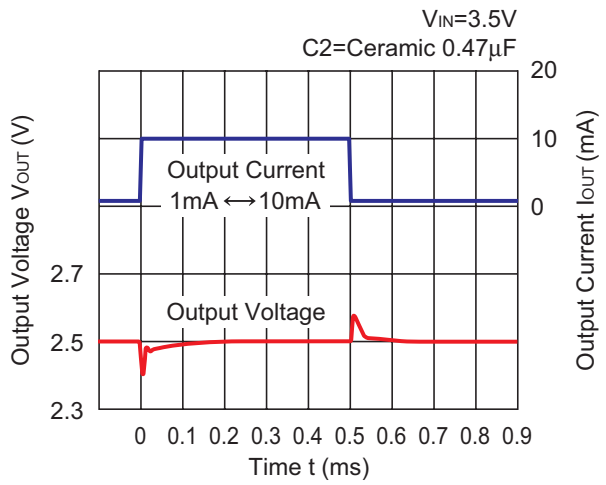

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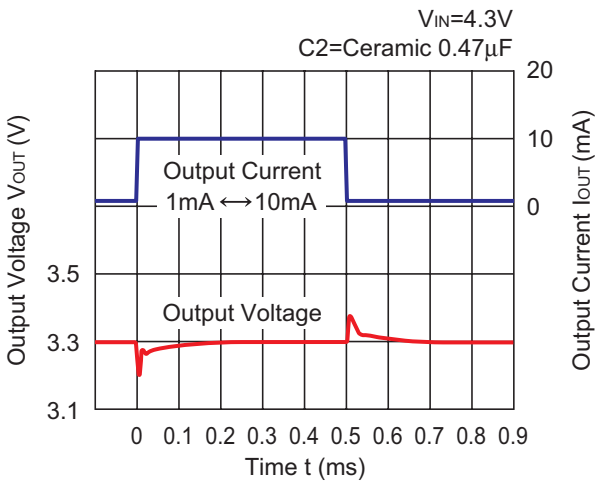
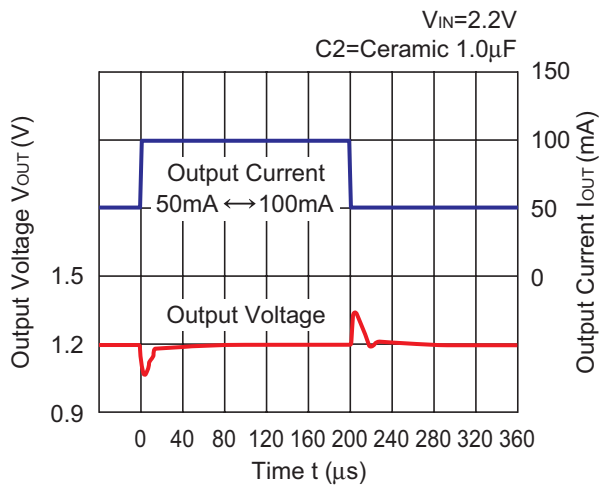
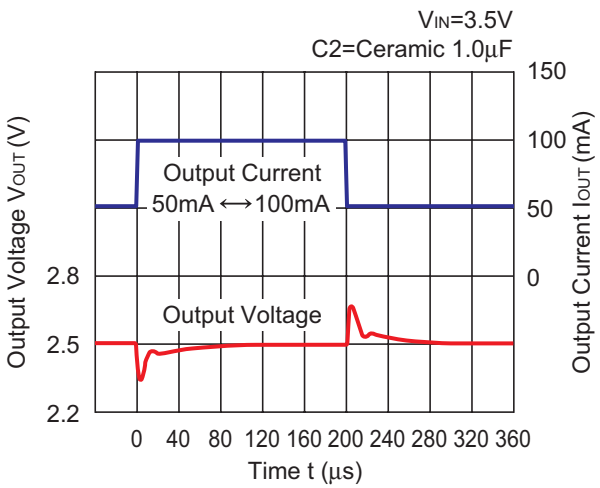


RP104x121x



RP104x251x



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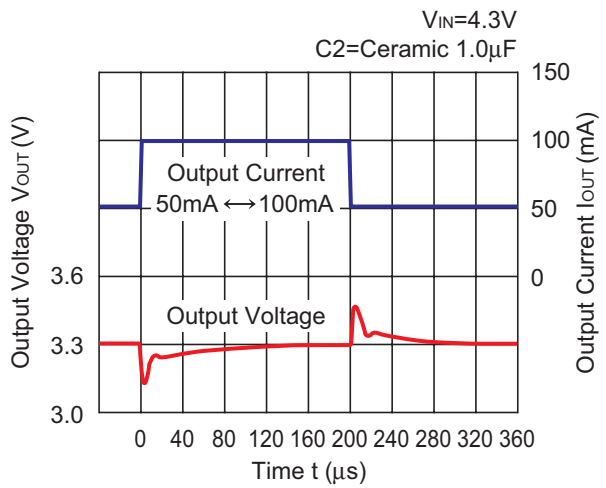

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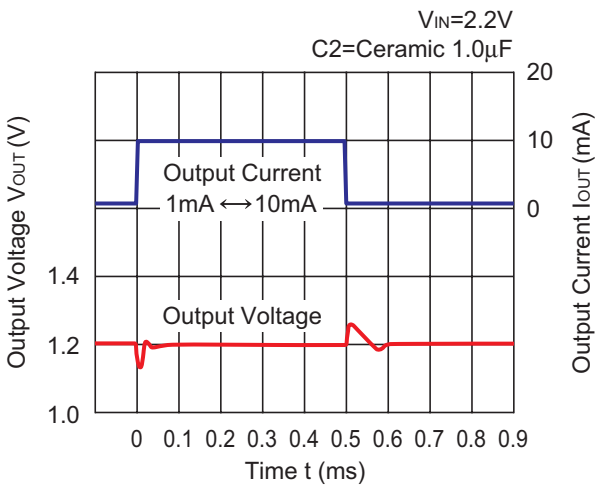

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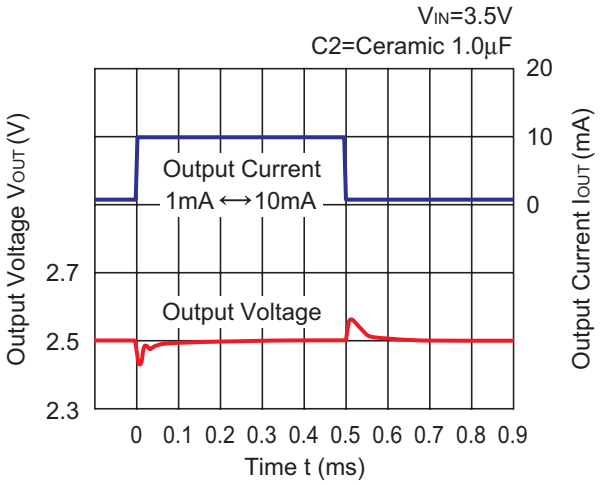

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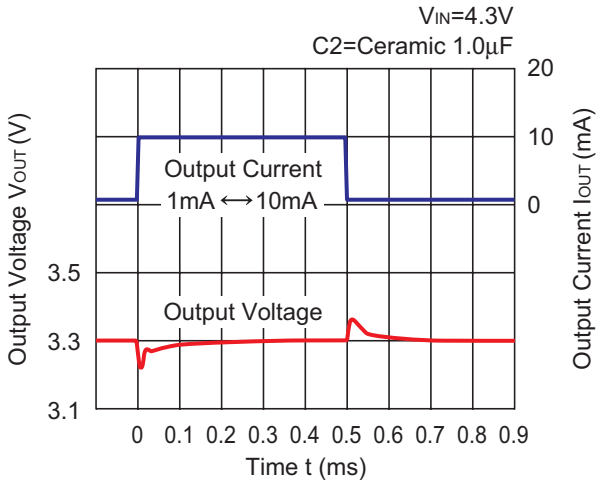
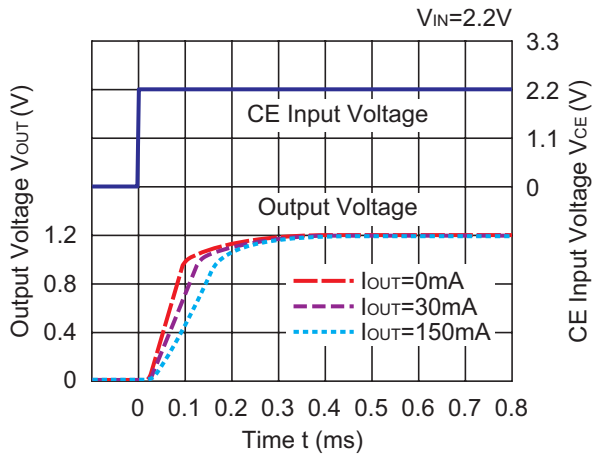
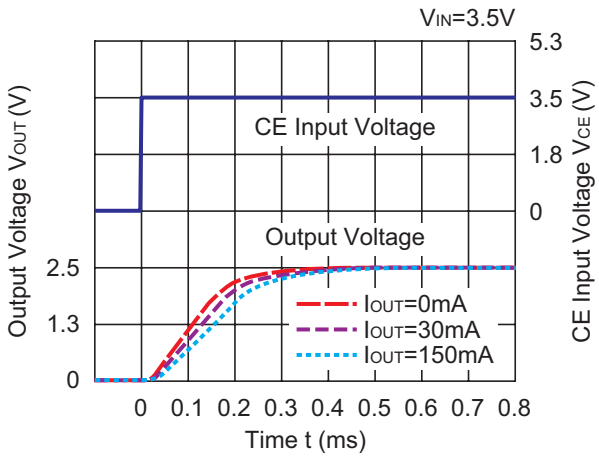


12) Turn On Speed with CE pin (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, Topt=25°C)

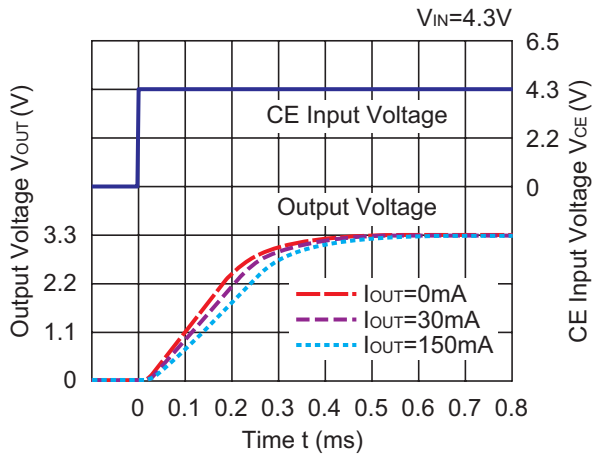
RP104x121B/D



RP104x251B/D

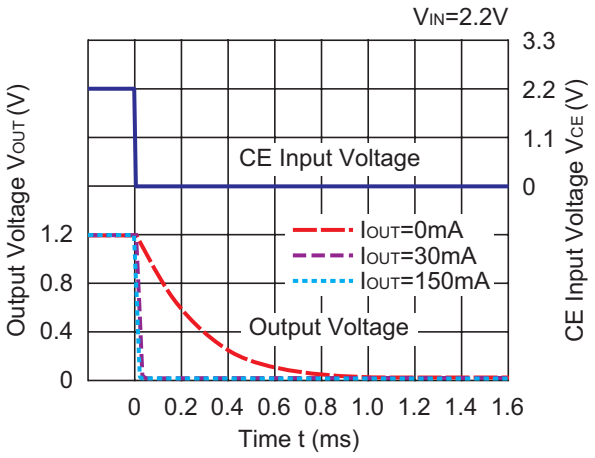


RP104x331B/D

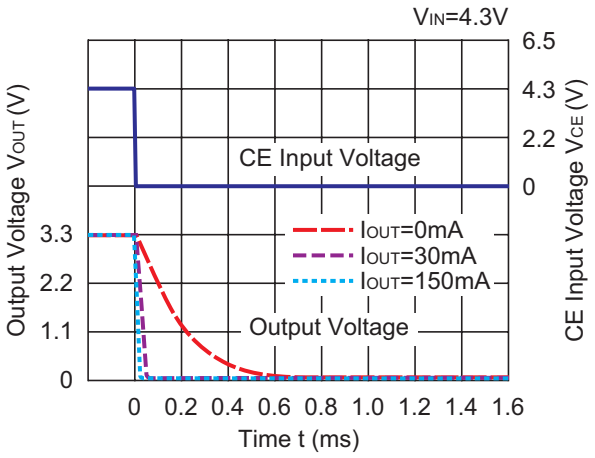


13) Turn Off Speed with CE pin (B Version) (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, Topt=25°C)

RP104x121B

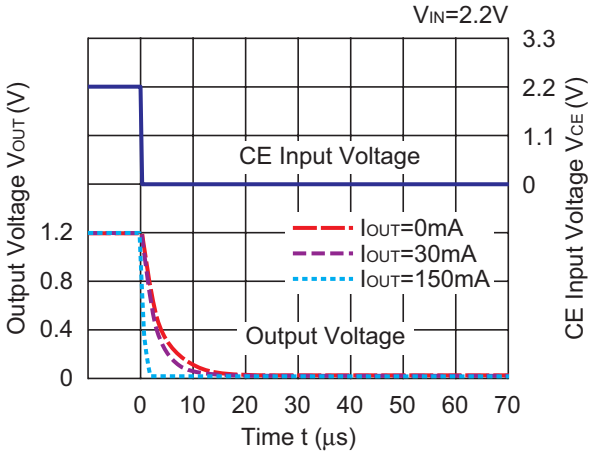


RP104x331B

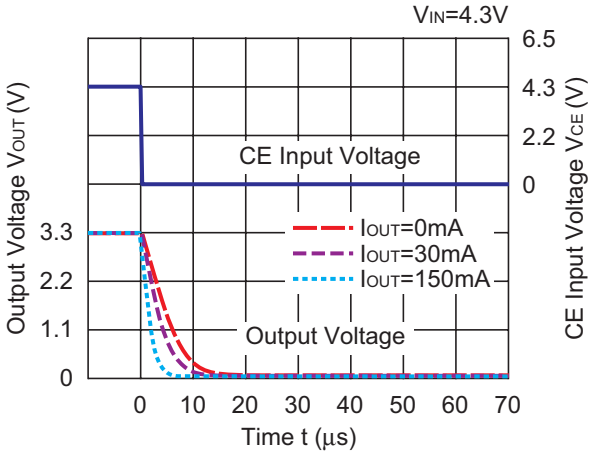


14) Turn Off Speed with CE pin (D Version) (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, Topt=25°C)

RP104x121D

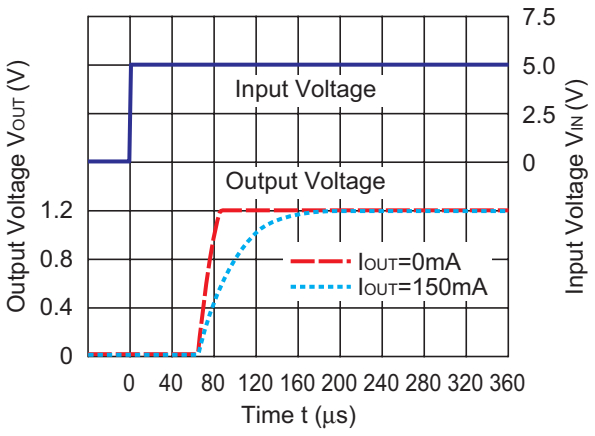


RP104x331D

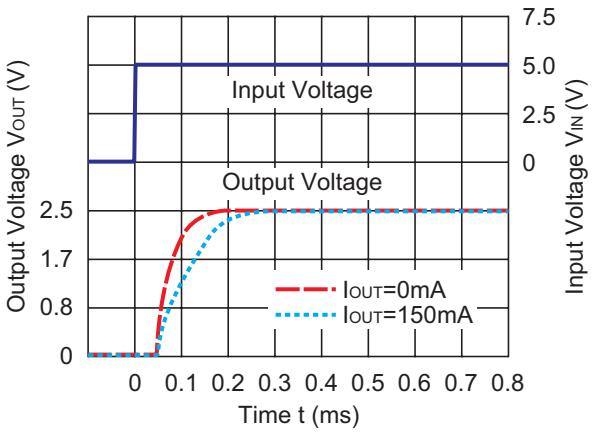


15) Turn On Speed of C Version (C1=Ceramic 0.1µF, C2=Ceramic 0.1µF, VIN=5.0V, Topt=25°C)

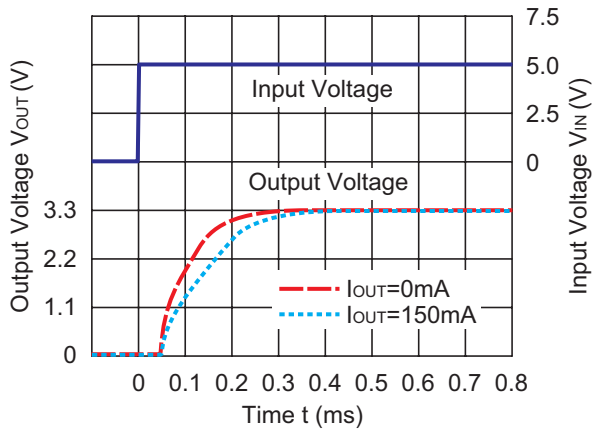
RP104x121C



RP104x251C



RP104x331C


Input Voltage
Output Voltage
IOUT=0mA
IOUT=150mA
Output Voltage VOUT (V)
Input Voltage VIN (V)
3.3
2.2
1.1
0
7.5
5.0
2.5
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
Time t (ms)

ESR vs. Output Current

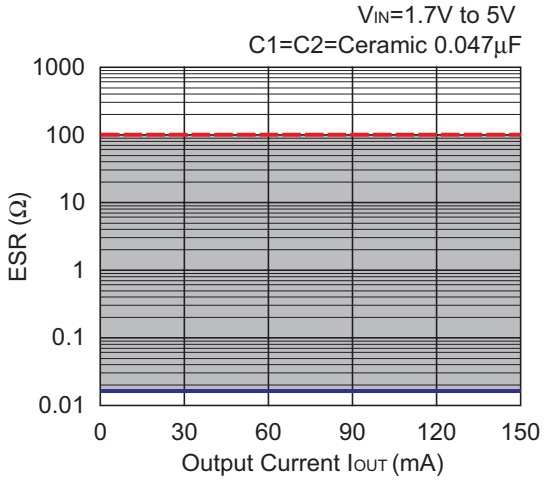
When using these ICs, consider the following points:

The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below.
The conditions when the white noise level is under 40μV (Avg.) are marked as the hatched area in the graph.

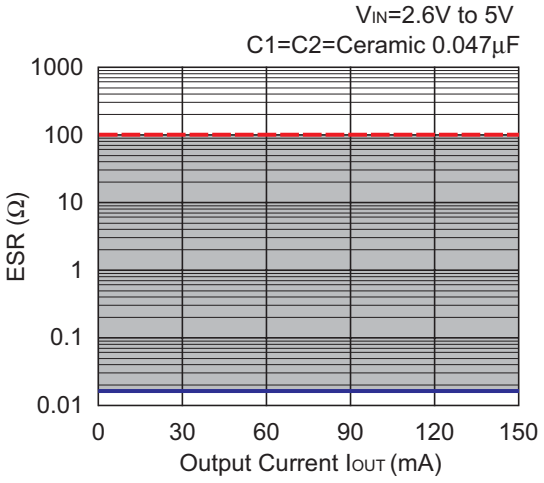
Measurement conditions

Frequency Band : 10Hz to 2MHz
Temperature : −40°C to 85°C

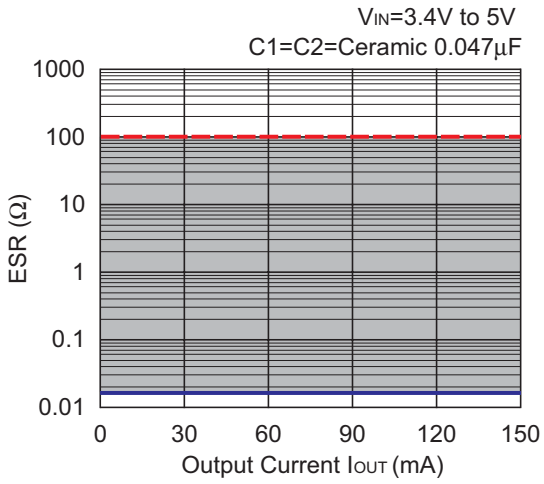
RP104x121x



RP104x251x



RP104x331x



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■Ricoh awarded ISO 14001 certification.
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

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Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.

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