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## LOW NOISE 150mA LDO REGULATOR

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NO.EA-149-090330

### OUTLINE

The RP103x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, extremely low supply current, low ON-resistance, and high ripple rejection. 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 low dropout voltage and a chip enable function. The line transient response and load transient response of the RP103x Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The output voltage of these ICs is fixed with high accuracy. Since the packages for these ICs are DFN(PLP)1010-4, SOT23-5, SC82-AB, SC-88A, therefore high density mounting of the ICs on boards is possible.

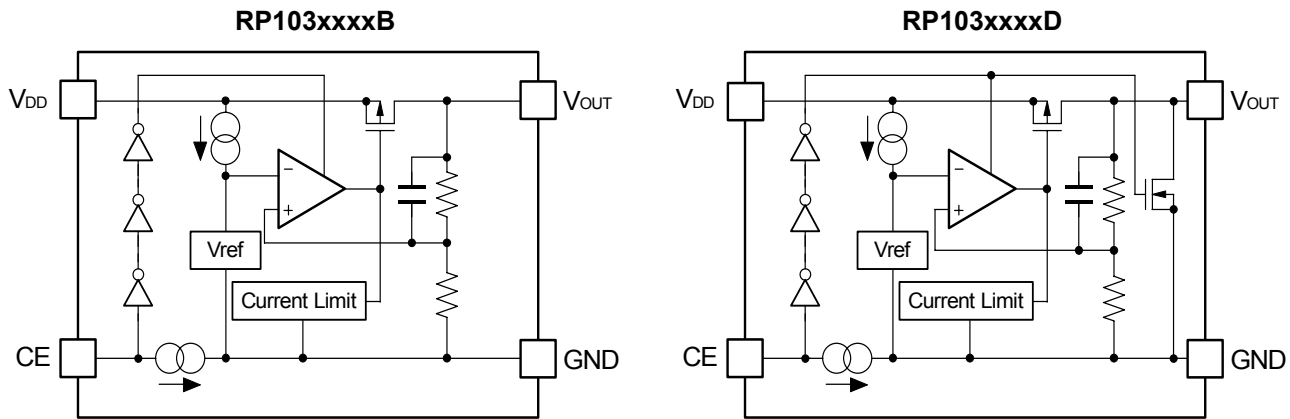
### FEATURES

- Supply Current ..... Typ. 36 $\mu$ A
- Standby Mode ..... Typ. 0.1 $\mu$ A
- Dropout Voltage..... Typ. 0.21V ( $I_{OUT}=150\text{mA}$ ,  $V_{OUT}=2.8\text{V}$ )
- Ripple Rejection ..... Typ. 75dB ( $f=1\text{kHz}$ )
- Temperature-Drift Coefficient of Output Voltage ..... Typ.  $\pm 30\text{ppm}/^\circ\text{C}$
- Line Regulation ..... Typ. 0.02%/V
- Output Voltage Accuracy .....  $\pm 1.0\%$
- Packages..... DFN(PLP)1010-4, SOT-23-5, SC-82AB, SC-88A
- Input Voltage Range..... 1.7V to 5.25V
- Output Voltage..... 1.2V to 3.3V (For Standard Voltage, please refer to MARK INFORMATIONs to be described.)
- Built-in Fold Back Protection Circuit..... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC .... 0.47 $\mu$ F 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.
- Power source for home appliances.

## BLOCK DIAGRAMS



## SELECTION GUIDE

The output voltage, auto discharge function\*, and the taping type for the ICs can be selected at the user's request.

The selection can be made with designating the part number as shown below;

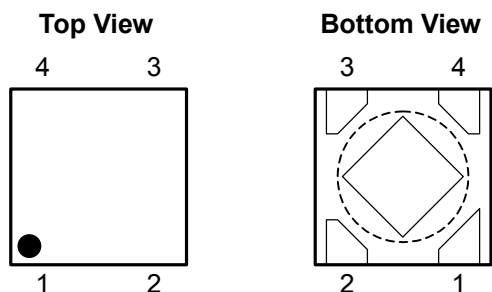
RP103xxxx-xx-X ← Part Number  
 ↑↑↑↑ ↑ ↑  
 a b a'c d e

Code	Contents
a, a'	Designation of Package Type; DFN(PLP)1010-4 : RP103Kxx1 SOT-23-5 : RP103Nxx1 SC-82AB : RP103Qxx1 SC-88A : RP103Qxx2
b	Setting Output Voltage (V <sub>OUT</sub> ): 1.2V to 3.3V (For Standard Voltage, please refer to MARK INFORMATIONs to be described.)
c	Designation of Mask Option B: active high, without auto discharge function* at OFF state. D: active high, with auto discharge function* at OFF state.
d	Designation of Taping Type: Ex. TR (Refer to Taping Specifications; TR type is the standard direction.)
e	Designation of composition of pin plating: -F : Lead free solder plating (SOT-23-5, SC-82AB, SC-88A) None: Au plating (DFN(PLP)1010-4)

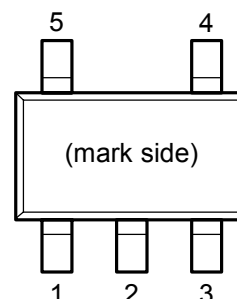
\*) When the mode is into standby with CE signal, auto discharge transistor turns on, and it makes the turn-off speed faster than normal type.

## PIN CONFIGURATIONS

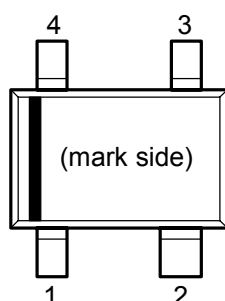
• DFN(PLP)1010-4\*



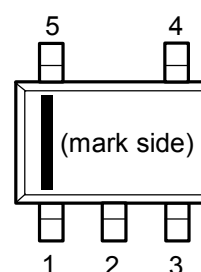
• SOT-23-5



• SC-82AB



• SC-88A



## PIN DESCRIPTIONS

• DFN(PLP)1010-4\*

Pin No.	Symbol	Description
1	V <sub>OUT</sub>	Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V <sub>DD</sub>	Input Pin

\*) Tab in the parts have GND level.  
 (They are connected to the back side of this IC.)  
 Do not connect to other wires or land patterns.

• SOT-23-5

Pin No.	Symbol	Description
1	V <sub>DD</sub>	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	NC	No Connection
5	V <sub>OUT</sub>	Output Pin

• SC-82AB

Pin No.	Symbol	Description
1	CE	Chip Enable Pin ("H" Active)
2	GND	Ground Pin
3	V <sub>OUT</sub>	Output Pin
4	V <sub>DD</sub>	Input Pin

• SC-88A

Pin No.	Symbol	Description
1	CE	Chip Enable Pin ("H" Active)
2	NC	No Connection
3	GND	Ground Pin
4	V <sub>OUT</sub>	Output Pin
5	V <sub>DD</sub>	Input 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	180	mA
$P_D$	Power Dissipation* (DFN(PLP)1010-4)	400	mW
	Power Dissipation* (SOT-23-5)	420	
	Power Dissipation* (SC-82AB)	380	
	Power Dissipation* (SC-88A)	380	
$T_{opt}$	Operating Temperature Range	-40 to 85	°C
$T_{stg}$	Storage Temperature Range	-55 to 125	°C

\*) For Power Dissipation, please refer to PACKAGE INFORMATION to be described.

### 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.

### 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

• RP103xxxxB/D

V<sub>IN</sub>=Set V<sub>OUT</sub>+1V for V<sub>OUT</sub> options greater than 1.5V. V<sub>IN</sub>=2.5V for V<sub>OUT</sub> ≤ 1.5V.

I<sub>OUT</sub>=1mA, C<sub>IN</sub>=C<sub>OUT</sub>=0.47μF, unless otherwise noted.

values indicate -40°C ≤ T<sub>opt</sub> ≤ 85°C, unless otherwise noted.

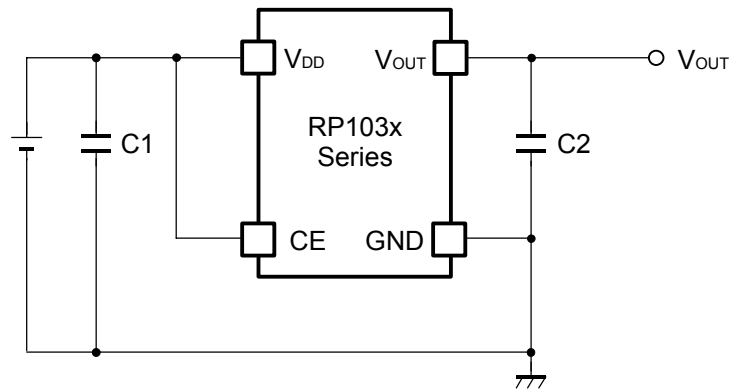
T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V <sub>OUT</sub>	Output Voltage	T <sub>opt</sub> =25°C	V <sub>OUT</sub> > 2.0V	×0.99		×1.01	V
			V <sub>OUT</sub> ≤ 2.0V	-20		+20	mV
		-40°C ≤ T <sub>opt</sub> ≤ 85°C	V <sub>OUT</sub> > 2.0V	<span style="border: 1px solid black; padding: 2px;">×0.985</span>		<span style="border: 1px solid black; padding: 2px;">×1.015</span>	V
			V <sub>OUT</sub> ≤ 2.0V	<span style="border: 1px solid black; padding: 2px;">-30</span>		<span style="border: 1px solid black; padding: 2px;">+30</span>	mV
I <sub>OUT</sub>	Output Current		<span style="border: 1px solid black; padding: 2px;">150</span>			mA	
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	1mA ≤ I <sub>OUT</sub> ≤ 150mA		10	<span style="border: 1px solid black; padding: 2px;">30</span>	mV	
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =150mA	1.2V ≤ V <sub>OUT</sub> < 1.5V		0.50	<span style="border: 1px solid black; padding: 2px;">0.62</span>	V
			1.5V ≤ V <sub>OUT</sub> < 1.7V		0.38	<span style="border: 1px solid black; padding: 2px;">0.47</span>	
			1.7V ≤ V <sub>OUT</sub> < 2.0V		0.34	<span style="border: 1px solid black; padding: 2px;">0.42</span>	
			2.0V ≤ V <sub>OUT</sub> < 2.5V		0.28	<span style="border: 1px solid black; padding: 2px;">0.36</span>	
			2.5V ≤ V <sub>OUT</sub> < 2.8V		0.22	<span style="border: 1px solid black; padding: 2px;">0.30</span>	
			2.8V ≤ V <sub>OUT</sub> ≤ 3.3V		0.21	<span style="border: 1px solid black; padding: 2px;">0.27</span>	
I <sub>SS</sub>	Supply Current	I <sub>OUT</sub> =0mA		36	<span style="border: 1px solid black; padding: 2px;">50</span>	μA	
I <sub>standby</sub>	Standby Current	V <sub>CE</sub> =0V		0.1	1.0	μA	
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	Set V <sub>OUT</sub> +0.5V ≤ V <sub>IN</sub> ≤ 5.0V		0.02	<span style="border: 1px solid black; padding: 2px;">0.10</span>	%/V	
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V <sub>IN</sub> =Set V <sub>OUT</sub> +1V, I <sub>OUT</sub> =30mA (In case that V <sub>OUT</sub> ≤ 2.0V, V <sub>IN</sub> =3.0V)		75		dB	
V <sub>IN</sub>	Input Voltage*		<span style="border: 1px solid black; padding: 2px;">1.7</span>		<span style="border: 1px solid black; padding: 2px;">5.25</span>	V	
ΔV <sub>OUT</sub> /ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	-40°C ≤ T <sub>opt</sub> ≤ 85°C		±30		ppm/°C	
I <sub>lim</sub>	Short Current Limit	V <sub>OUT</sub> =0V		40		mA	
I <sub>PD</sub>	CE Pull-down Current			0.3		μA	
V <sub>CEH</sub>	CE Input Voltage "H"		<span style="border: 1px solid black; padding: 2px;">1.1</span>			V	
V <sub>CEL</sub>	CE Input Voltage "L"				<span style="border: 1px solid black; padding: 2px;">0.3</span>	V	
en	Output Noise	BW=10Hz to 100kHz I <sub>OUT</sub> =30mA		60		μVrms	
R <sub>LOW</sub>	Low Output Nch Tr. ON Resistance (of D version)	V <sub>IN</sub> =4.0V V <sub>CE</sub> =0V		30		Ω	

\*) The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.

All of unit are tested and specified under load conditions such that T<sub>opt</sub>=25°C except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient.

## TYPICAL APPLICATION



(External Components)

C2 0.47 $\mu$ F MURATA: GRM155B30J474KE18B

## TECHNICAL NOTES

When using these ICs, consider the following points:

### Phase Compensation

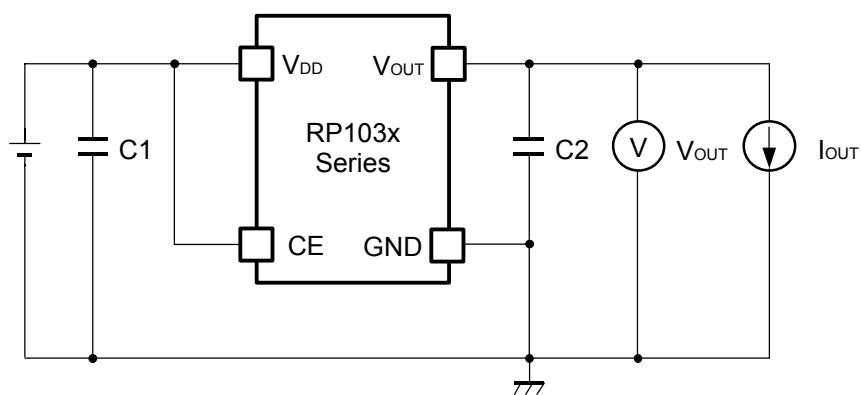
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output 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 0.47 $\mu$ F or more between  $V_{DD}$  and GND pin, and as close as possible to the pins.

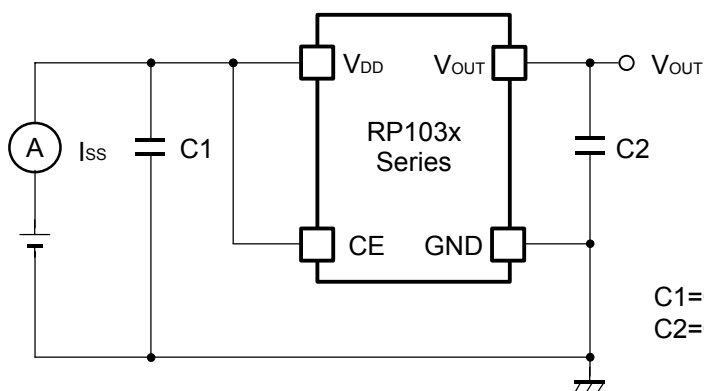
Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

## TEST CIRCUITS



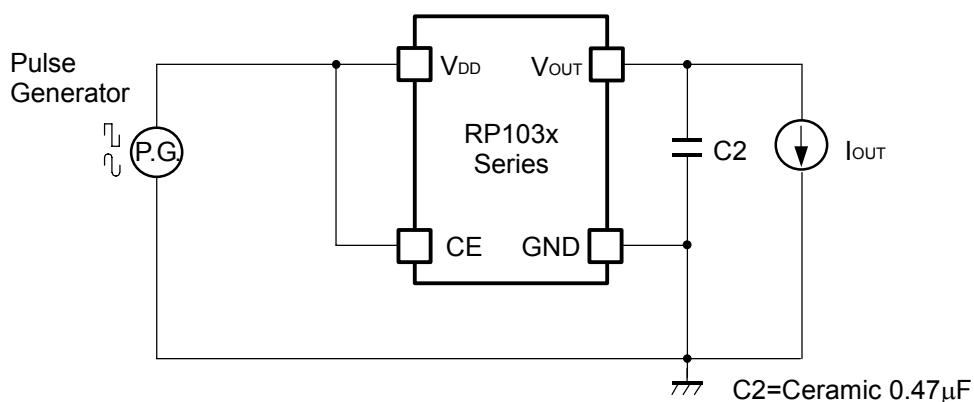
C1=Ceramic 0.47 $\mu$ F  
C2=Ceramic 0.47 $\mu$ F

**Basic Test Circuit**



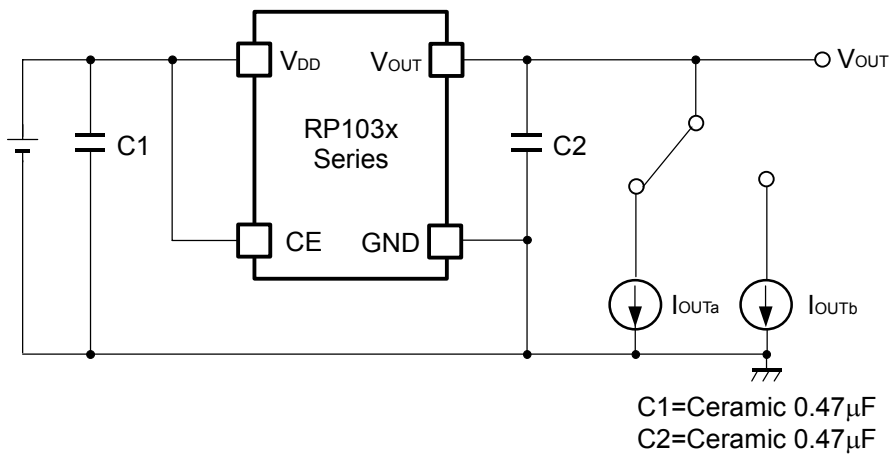
C1=Ceramic 0.47 $\mu$ F  
C2=Ceramic 0.47 $\mu$ F

**Test Circuit for Supply Current**



C2=Ceramic 0.47 $\mu$ F

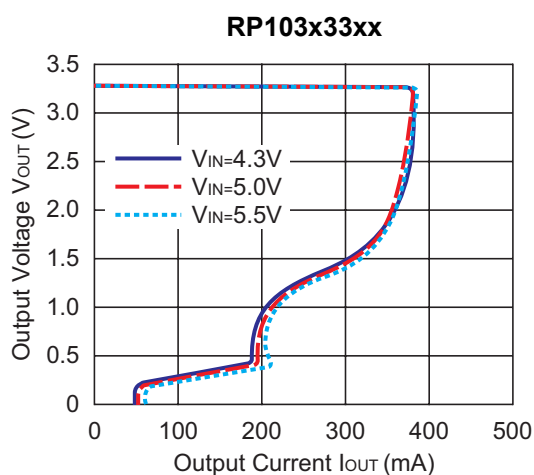
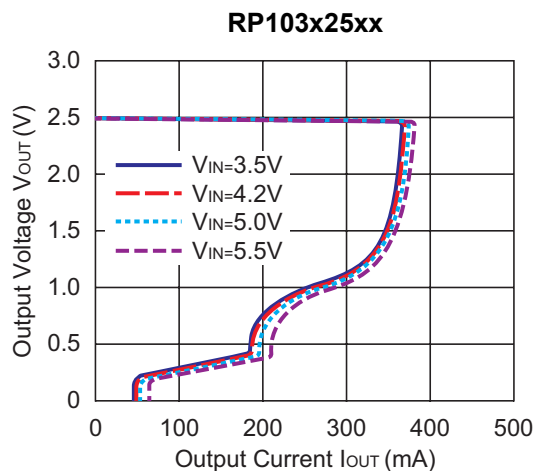
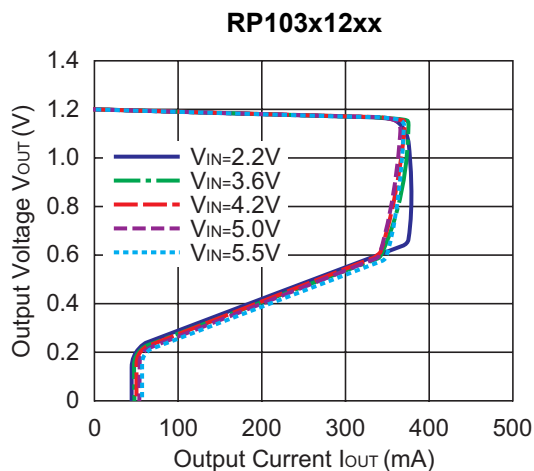
**Test Circuit for Ripple Rejection**



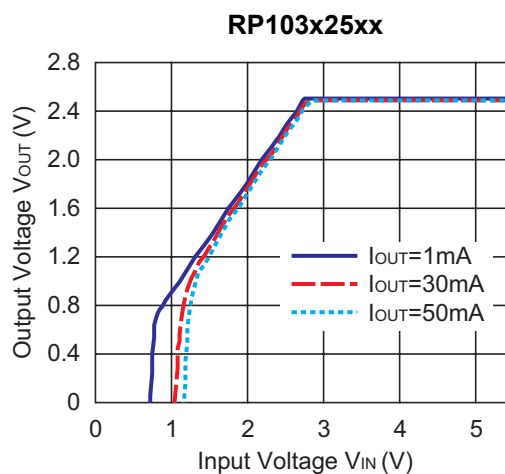
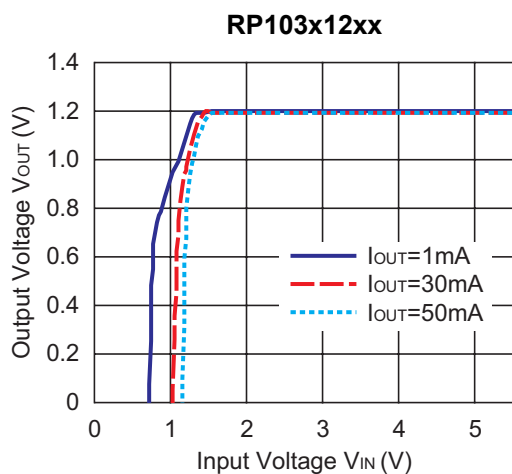
**Test Circuit for Load Transient Response**

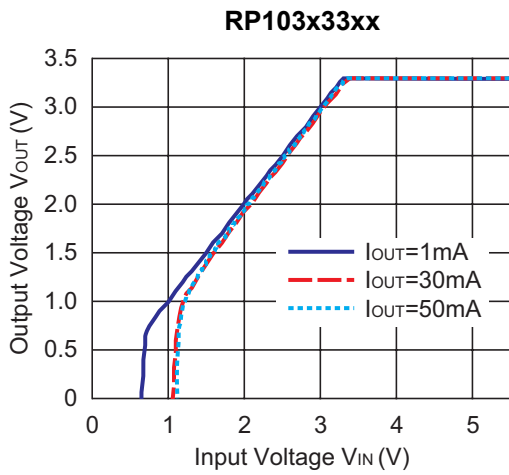
## TYPICAL CHARACTERISTICS

### 1) Output Voltage vs. Output Current ( $C_1=0.47\mu\text{F}$ , $C_2=0.47\mu\text{F}$ , $T_{opt}=25^\circ\text{C}$ )

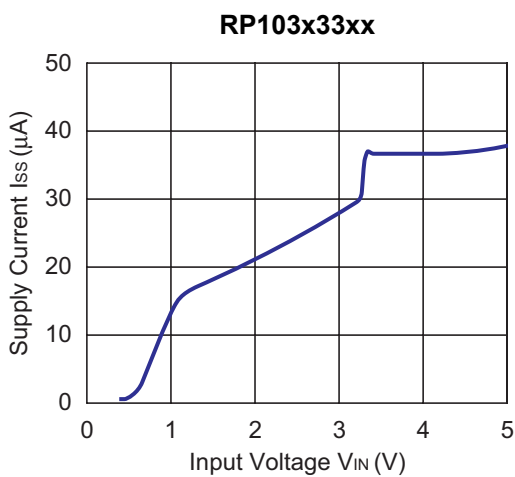
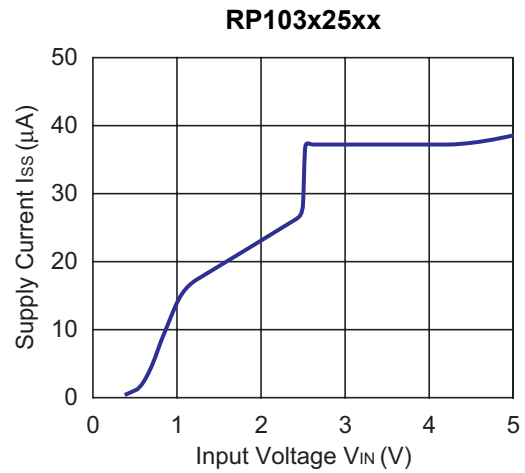
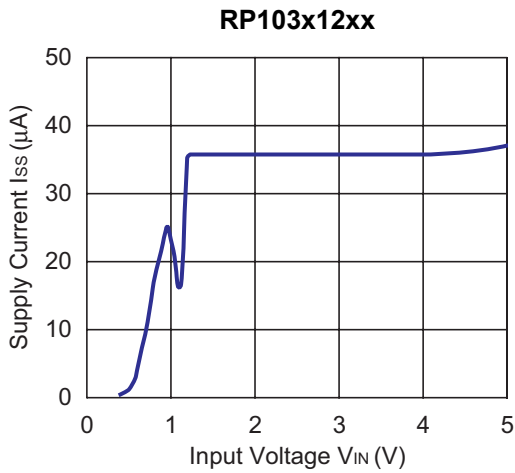


### 2) Output Voltage vs. Input Voltage ( $C_1=0.47\mu\text{F}$ , $C_2=0.47\mu\text{F}$ , $T_{opt}=25^\circ\text{C}$ )

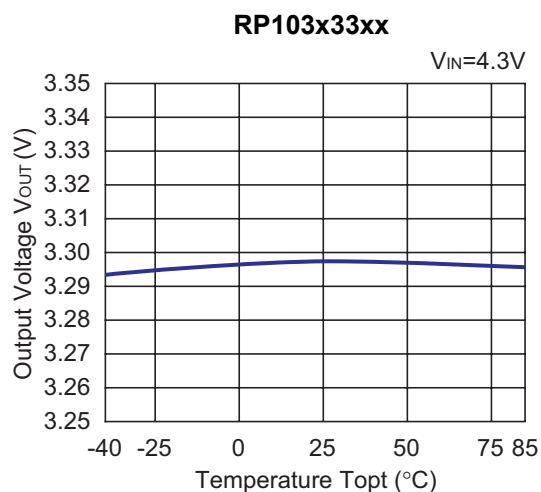
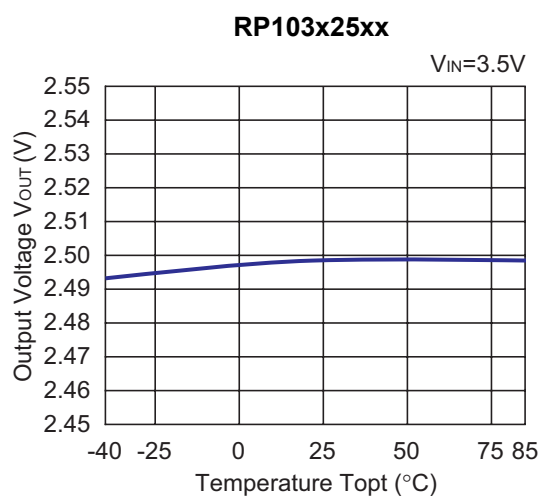
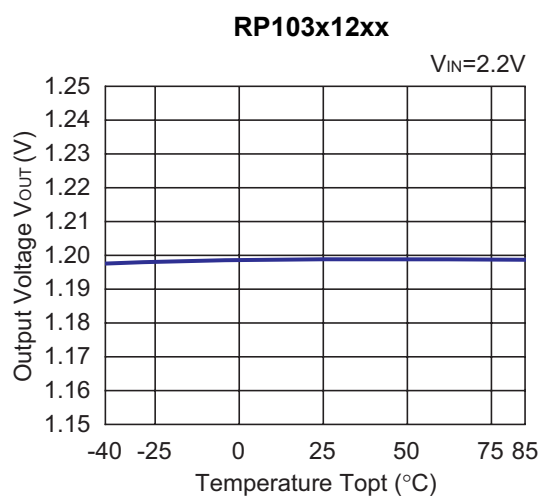




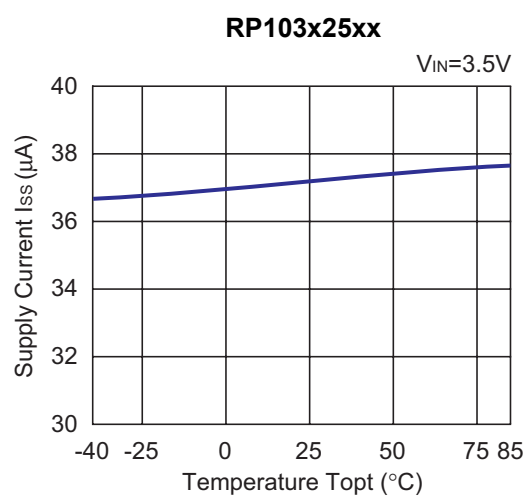
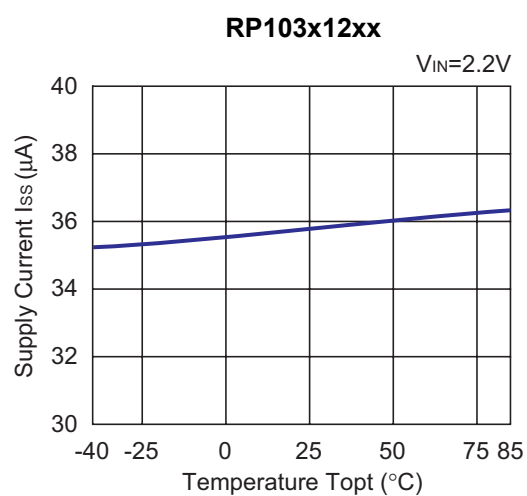
**3) Supply Current vs. Input Voltage ( $C1=0.47\mu F$ ,  $C2=0.47\mu F$ ,  $T_{opt}=25^{\circ}C$ )**



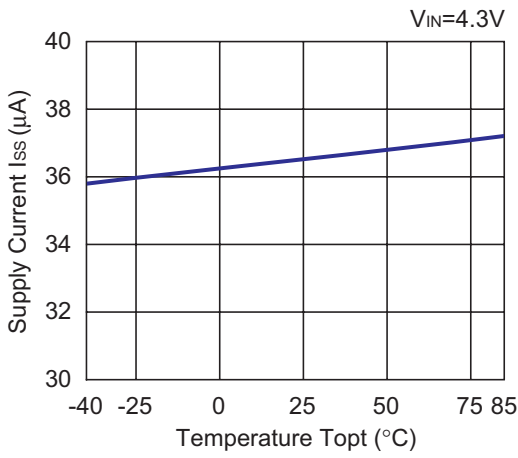
4) Output Voltage vs. Temperature (C1=0.47μF, C2=0.47μF, I<sub>OUT</sub>=1mA)



5) Supply Current vs. Temperature (C1=0.47μF, C2=0.47μF, I<sub>OUT</sub>=0mA)

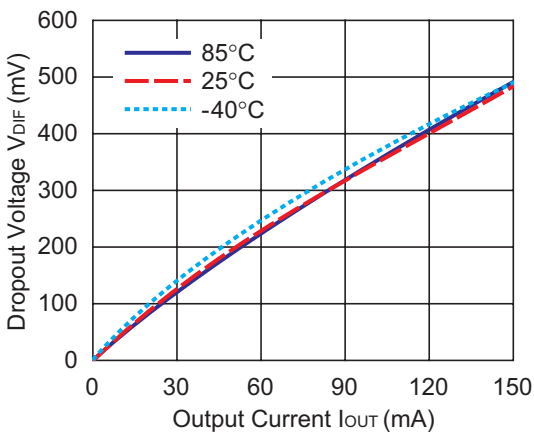


RP103x33xx

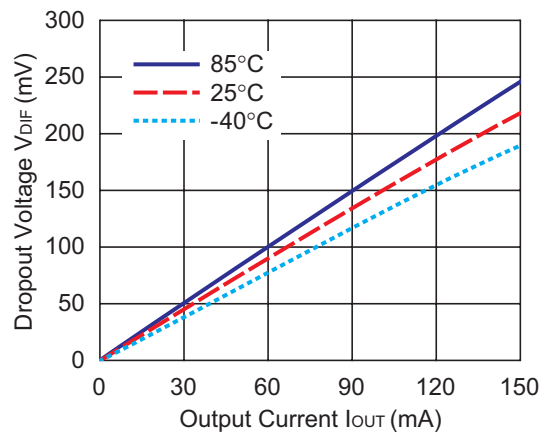


6) Dropout Voltage vs. Output Current ( $C1=0.47\mu F$ ,  $C2=0.47\mu F$ )

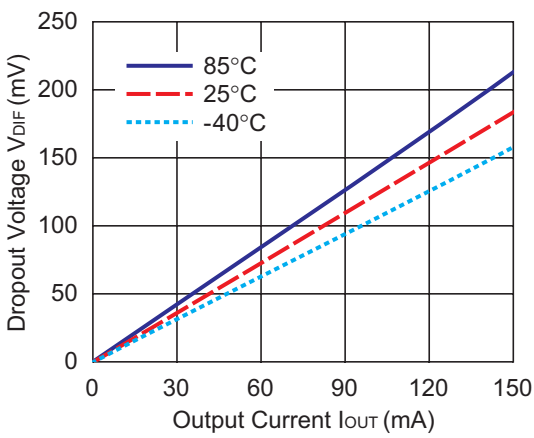
RP103x12xx



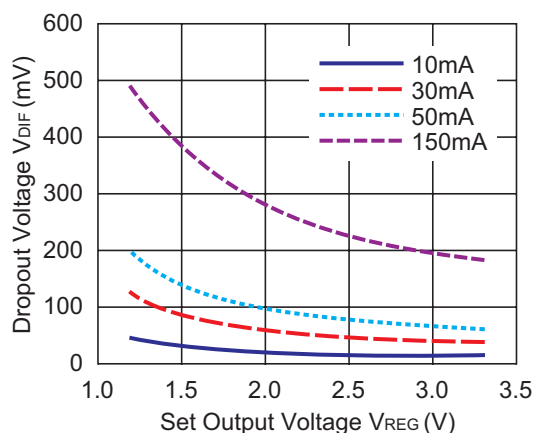
RP103x25xx



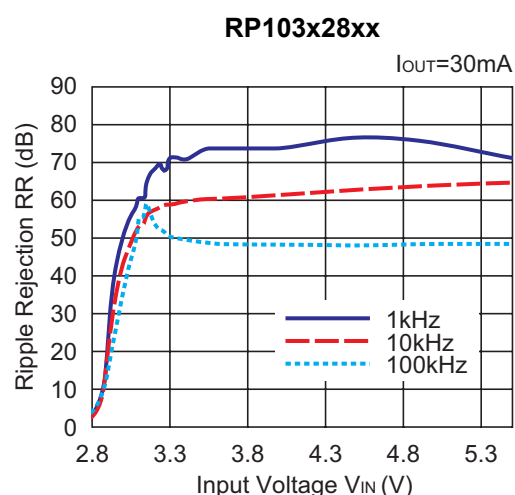
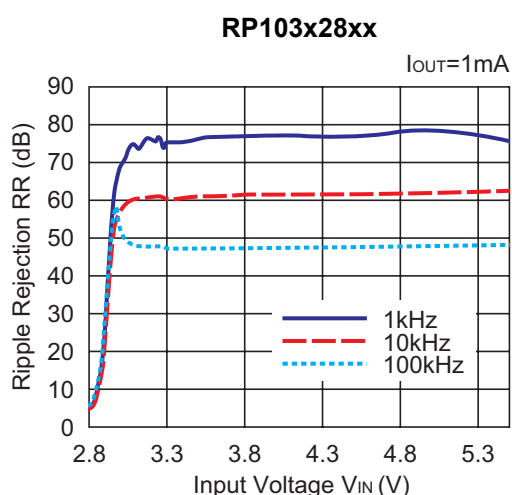
RP103x33xx



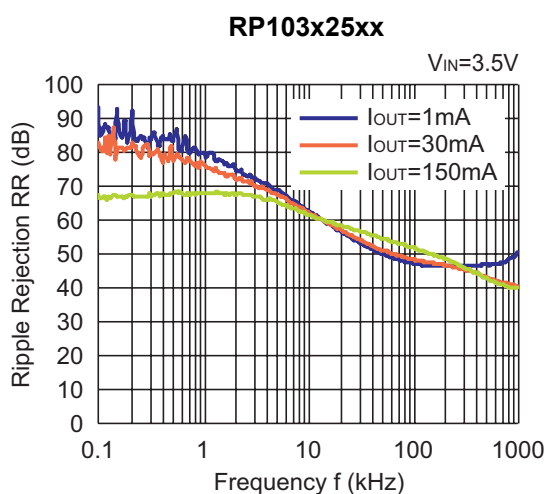
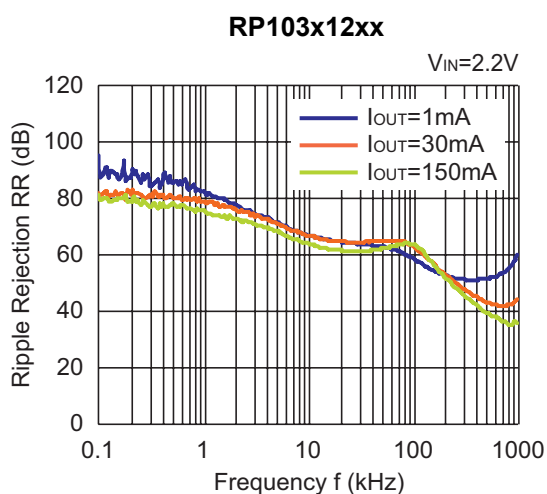
7) Dropout Voltage vs. Set Output Voltage ( $C1=0.47\mu\text{F}$ ,  $C2=0.47\mu\text{F}$ ,  $T_{opt}=25^\circ\text{C}$ )



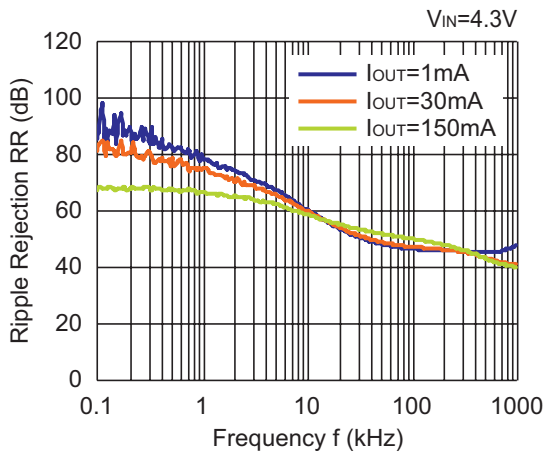
8) Ripple Rejection vs. Input Bias Voltage ( $C1=0.47\mu\text{F}$ ,  $C2=0.47\mu\text{F}$ , Ripple= $0.2V_{P-P}$ ,  $T_{opt}=25^\circ\text{C}$ )



9) Ripple Rejection vs. Frequency ( $C1=\text{none}$ ,  $C2=0.47\mu\text{F}$ , Ripple= $0.2V_{P-P}$ )

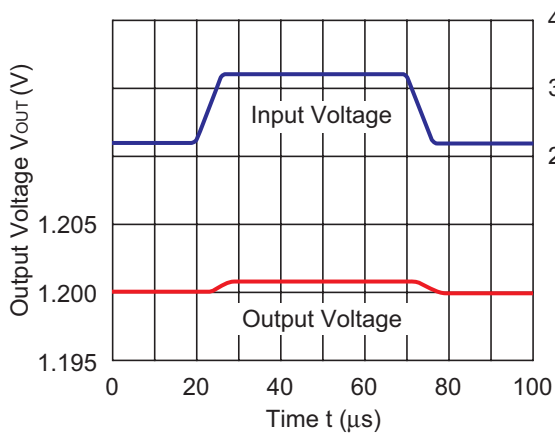


RP103x33xx

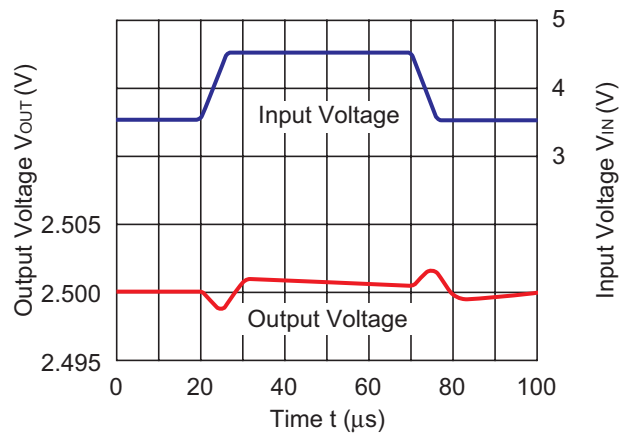


10) Input Transient Response ( $I_{OUT}=30mA$ ,  $t_r=t_f=5\mu s$ ,  $T_{opt}=25^\circ C$ )

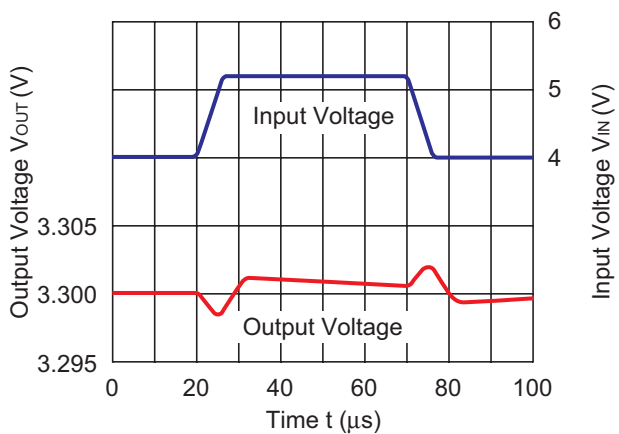
RP103x12xx



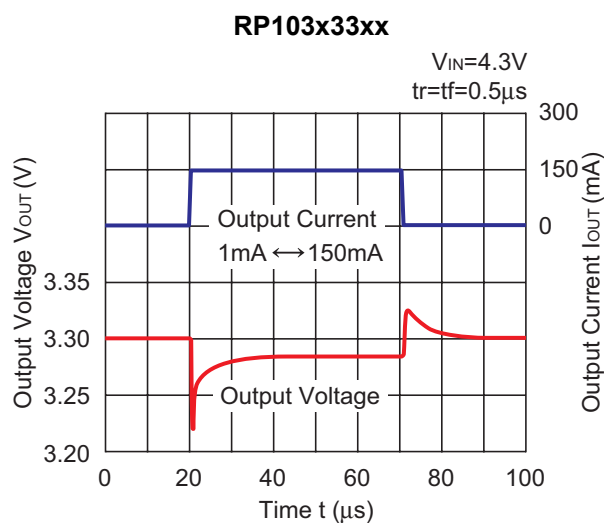
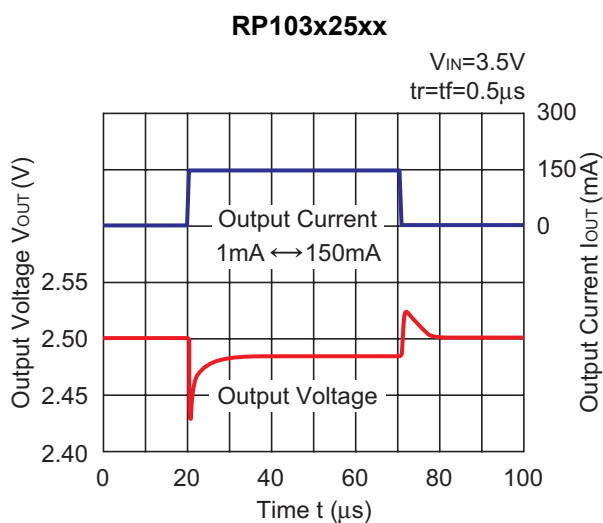
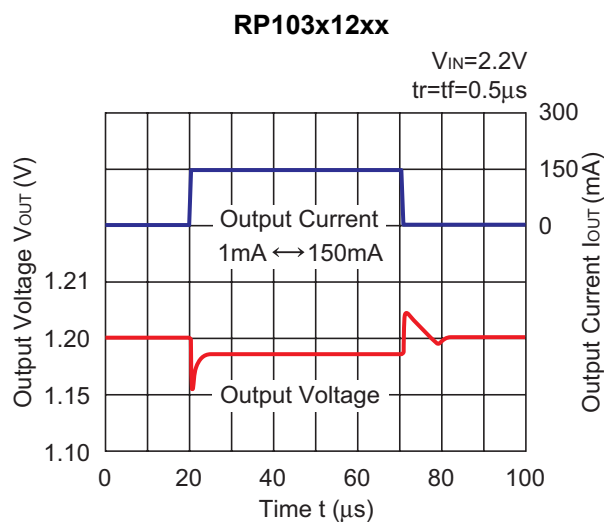
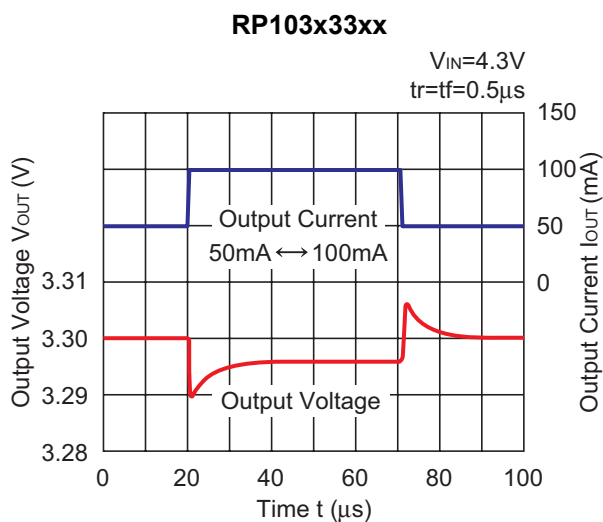
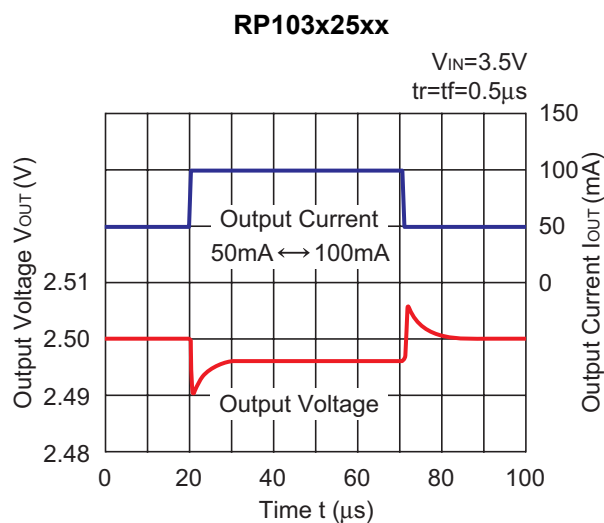
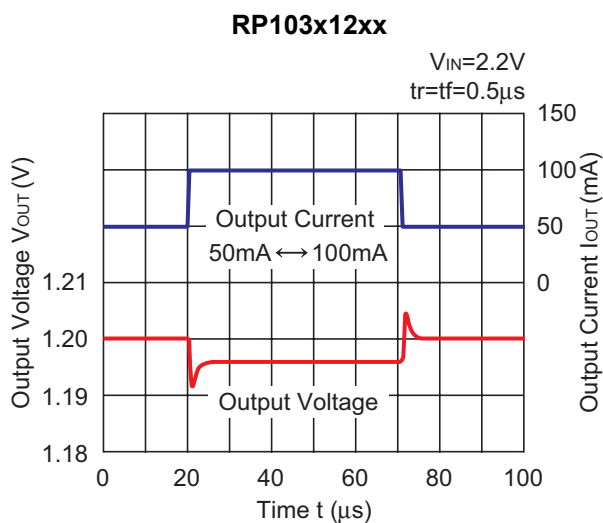
RP103x25xx



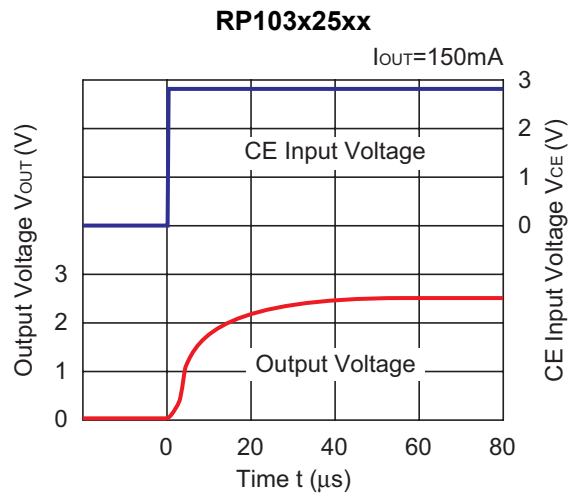
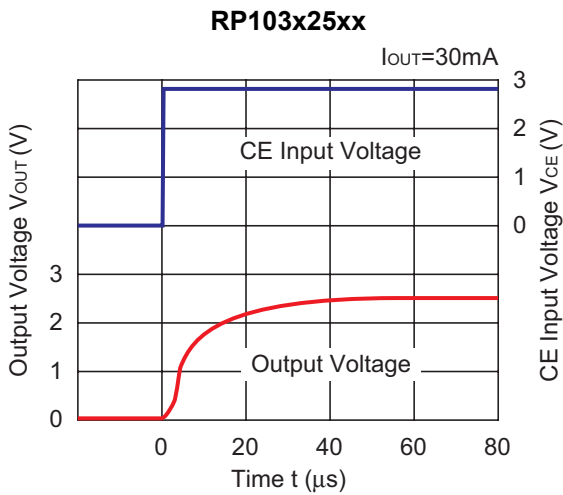
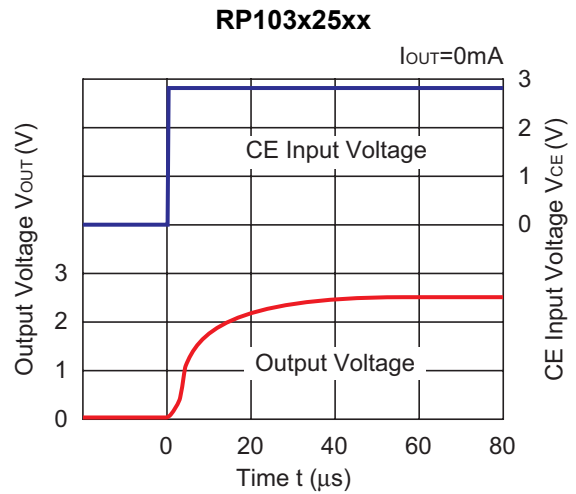
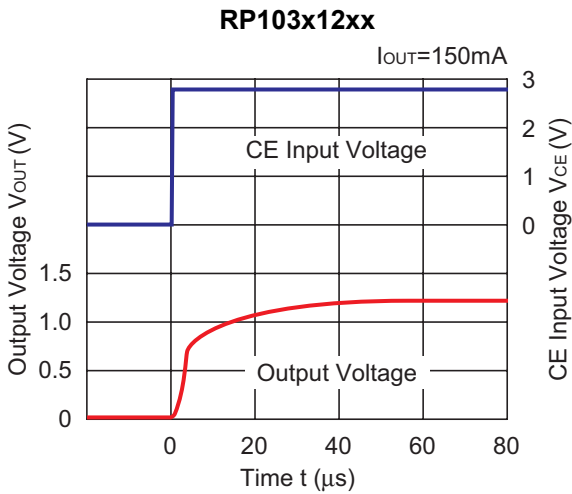
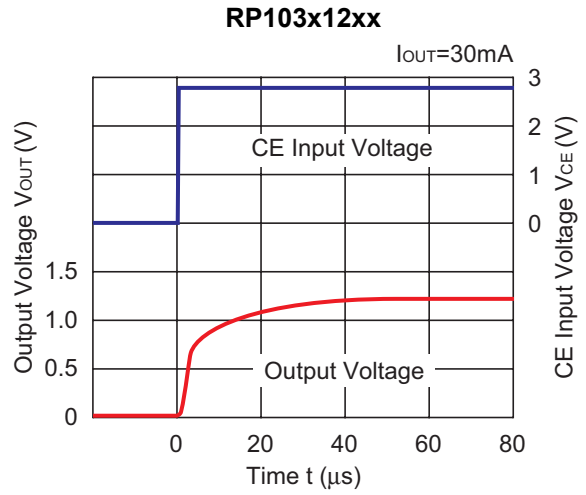
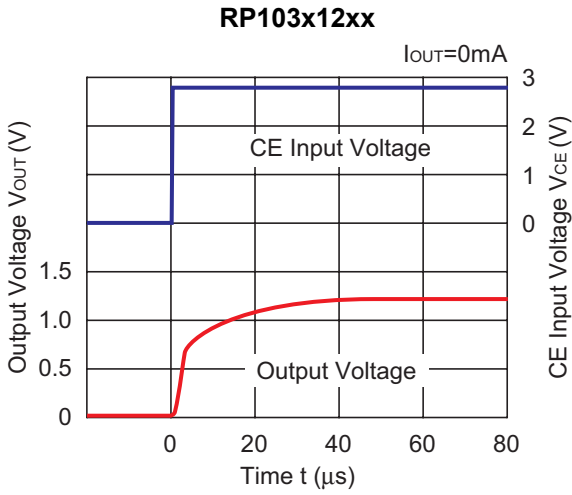
RP103x33xx

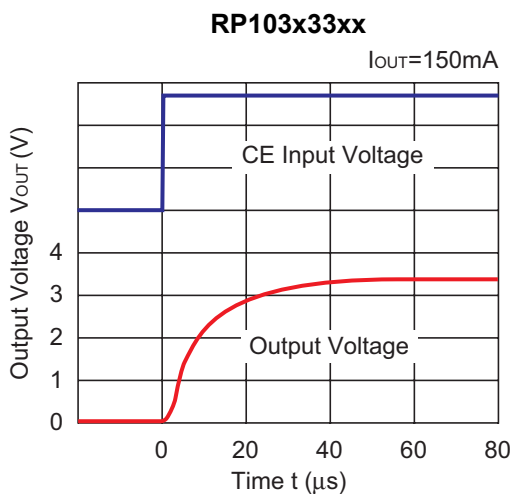
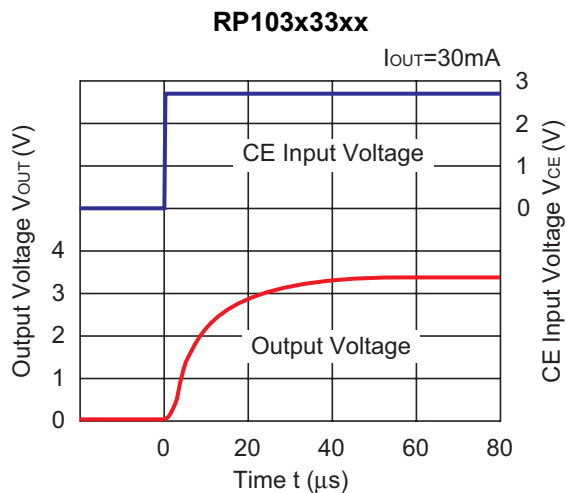
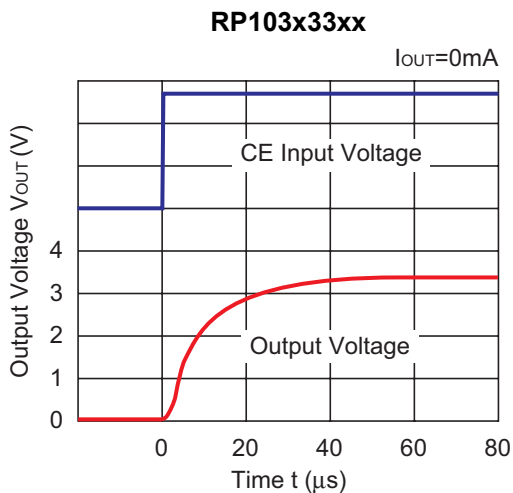


11) Load Transient Response ( $C1=0.47\mu\text{F}$ ,  $C2=0.47\mu\text{F}$ ,  $T_{\text{opt}}=25^\circ\text{C}$ )

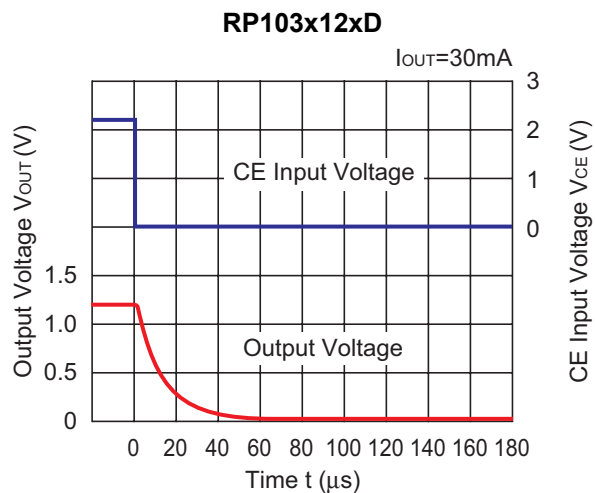
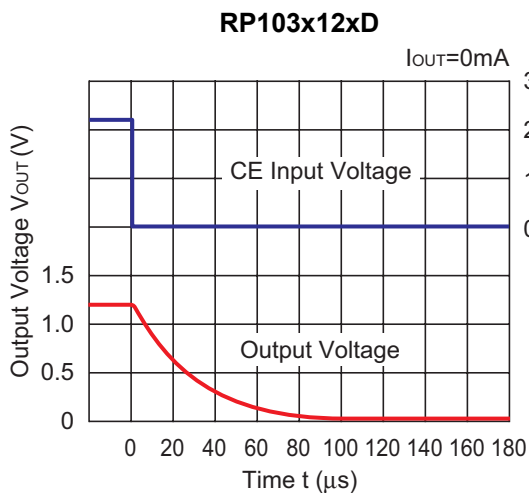


12) Turn On Speed with CE pin ( $C1=0.47\mu\text{F}$ ,  $C2=0.47\mu\text{F}$ ,  $T_{opt}=25^\circ\text{C}$ )

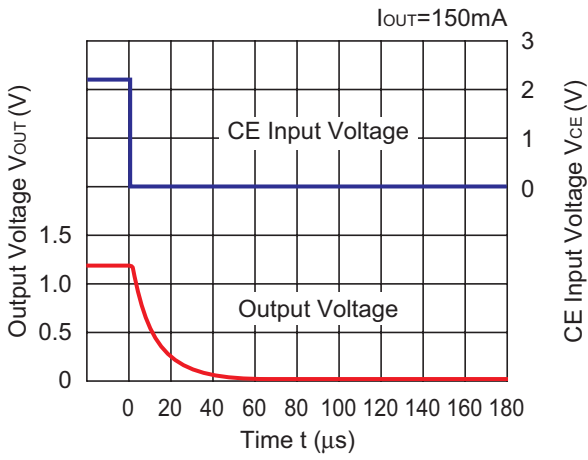




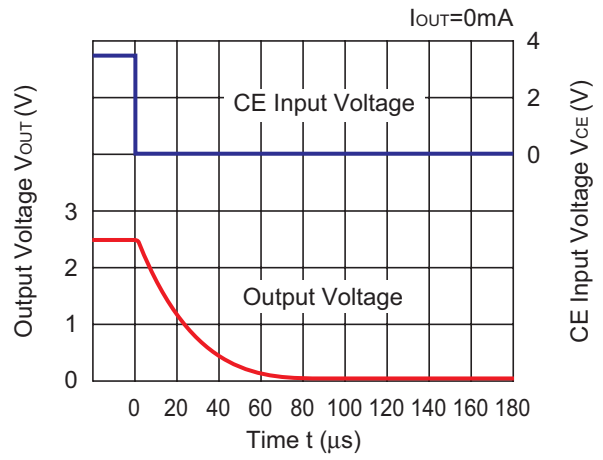
**13) Turn Off Speed with CE pin (D Version) ( $C1=0.47\mu F$ ,  $C2=0.47\mu F$ ,  $T_{opt}=25^{\circ}C$ )**



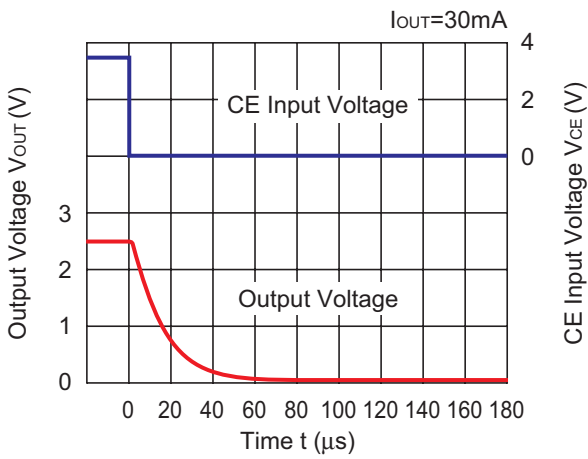
RP103x12xD



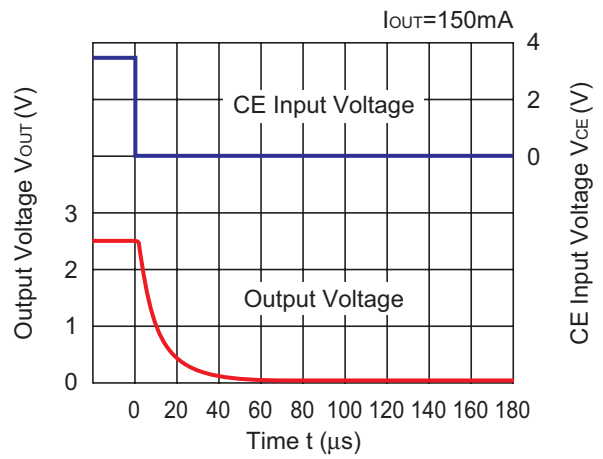
RP103x25xD



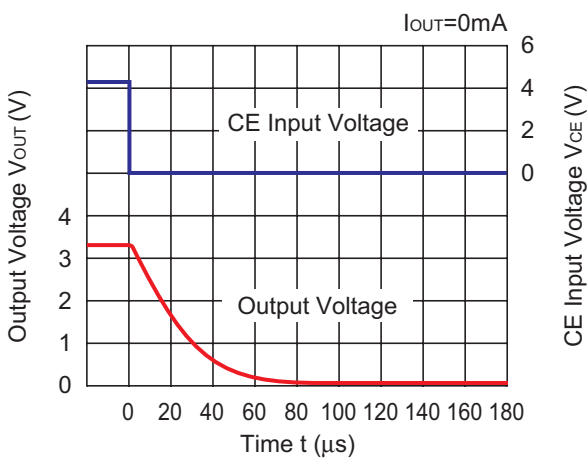
RP103x25xD



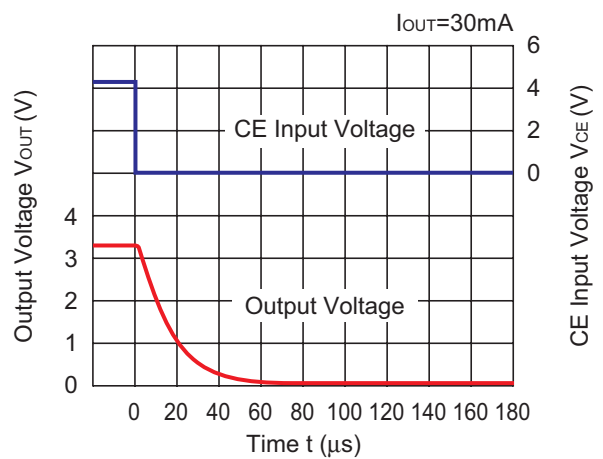
RP103x25xD

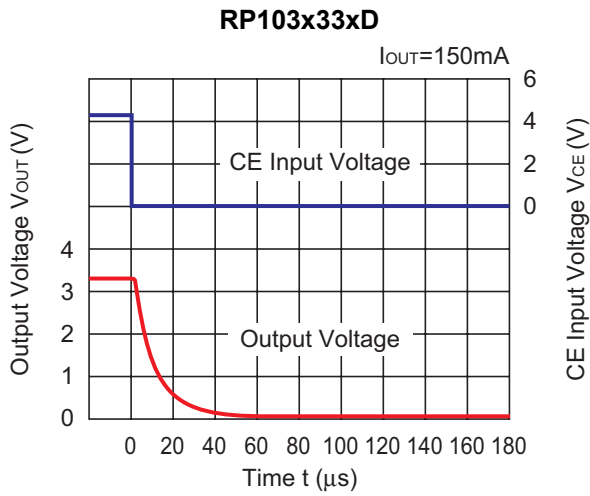


RP103x33xD

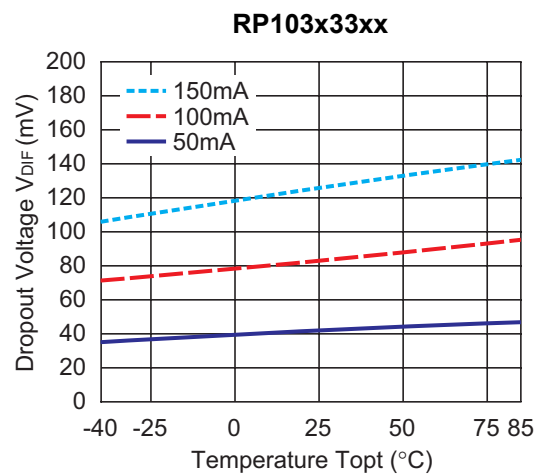
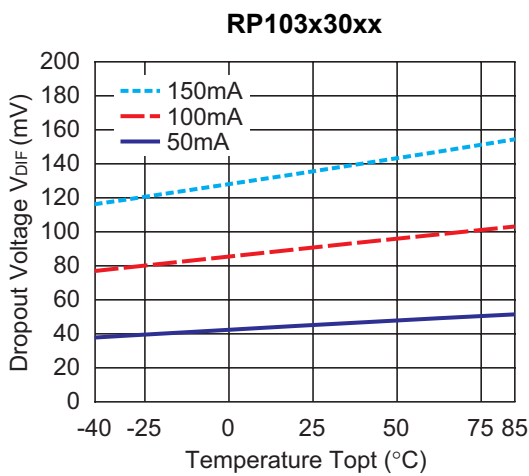
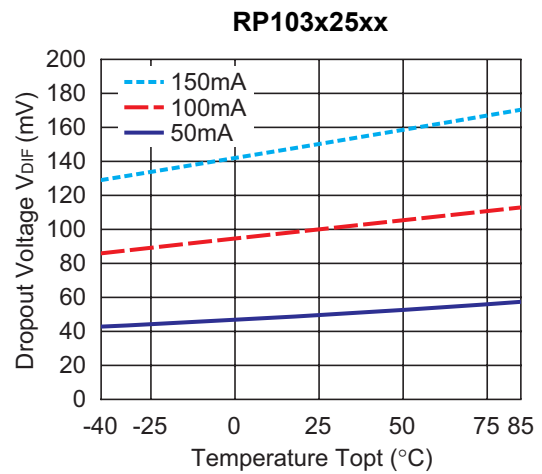
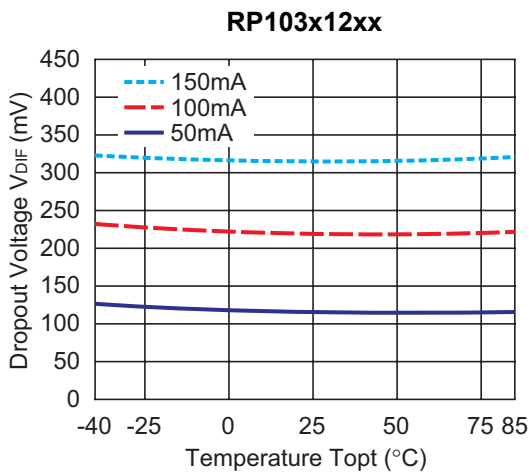


RP103x33xD





**14) Dropout Voltage vs. Temperature (C1=0.47μF, C2=0.47μF)**



## 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  $40\mu\text{V}$  (Avg.) are marked as the hatched area in the graph.

### Measurement conditions

Frequency Band : 10Hz to 2MHz

Temperature :  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

