
LOW NOISE 150mA LDO REGULATOR

NO.EA-149-111020

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, SC-82AB, SC-88A, SOT-23-5, therefore high density mounting of the ICs on boards is possible.

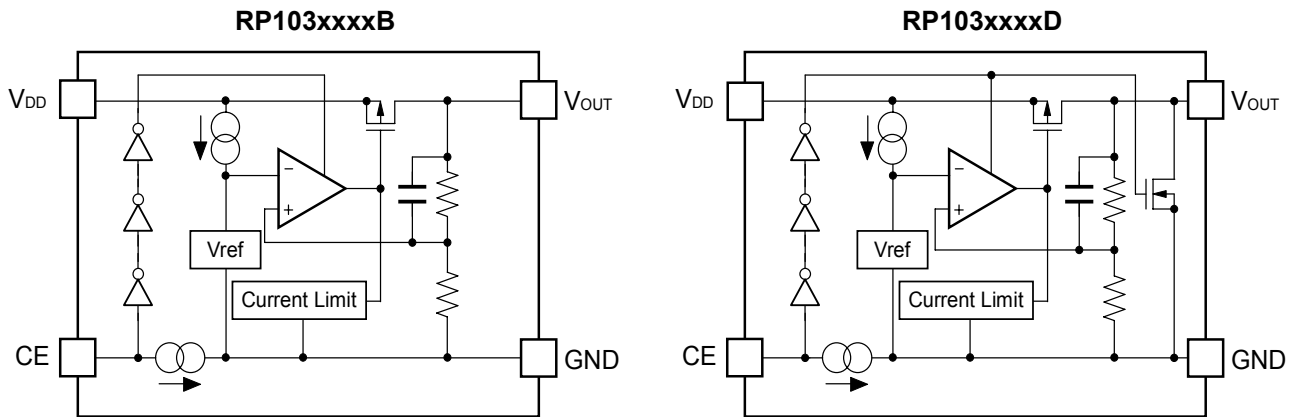
FEATURES

- Supply Current Typ. 36 μ A
- Standby Mode Typ. 0.1 μ 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, SC-82AB, SC-88A, 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 INFORMATION.)
- Built-in Fold Back Protection Circuit..... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC 0.47 μ 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

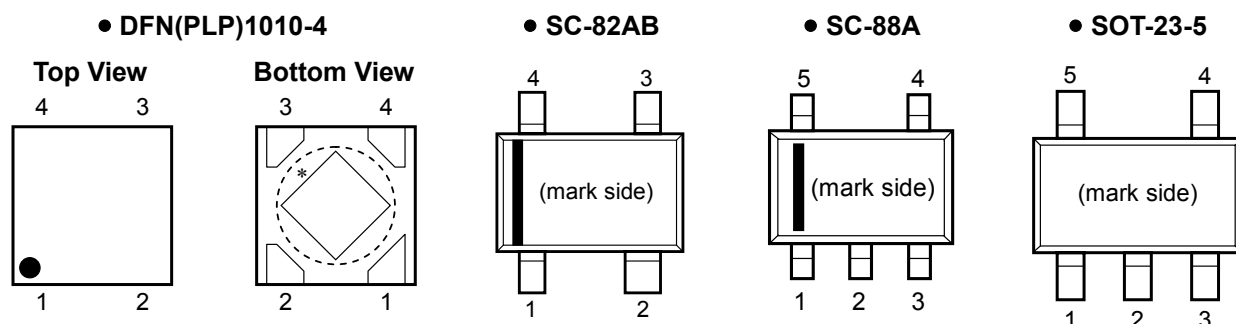
The output voltage, auto discharge function, package, and the taping type, etc. for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP103Kxx1*-TR	DFN(PLP)1010-4	10,000 pcs	Yes	Yes
RP103Qxx1*-TR-FE	SC-82AB	3,000 pcs	Yes	Yes
RP103Qxx2*-TR-FE	SC-88A	3,000 pcs	Yes	Yes
RP103Nxx1*-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
(D) "H" active, with auto discharge function at off state

PIN CONFIGURATIONS



PIN DESCRIPTIONS

• DFN(PLP)1010-4

Pin No	Symbol	Pin Description
1	V _{OUT}	Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
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

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active)
2	GND	Ground Pin
3	V _{OUT}	Output Pin
4	V _{DD}	Input Pin

• SC-88A

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

• SOT-23-5

Pin No	Symbol	Pin Description
1	V _{DD}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
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	180	mA
P_D	Power Dissipation* (DFN(PLP)1010-4)	400	mW
	Power Dissipation* (SC-82AB)	380	
	Power Dissipation* (SC-88A)	380	
	Power Dissipation* (SOT-23-5)	420	
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.

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_{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}=0.47μF, unless otherwise noted.

values indicate -40°C ≤ T_{opt} ≤ 85°C, unless otherwise noted.

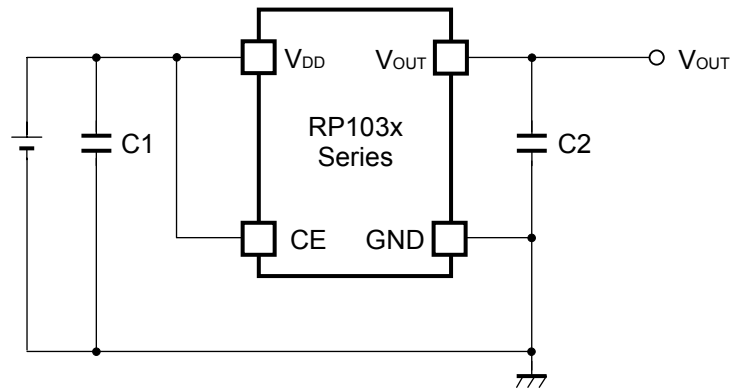
T_{opt}=25°C

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

TYPICAL APPLICATION



(External Components)

C2 0.47 μ F MURATA: GRM155B30J474KE18B

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

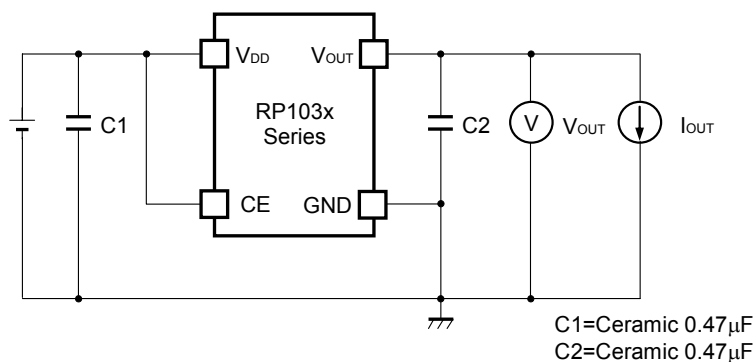
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output 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

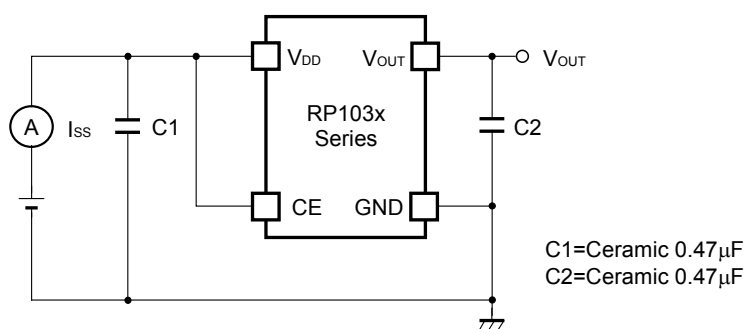
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 0.47 μ F or more between V_{DD} and GND pin, and as close as possible to the pins.

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

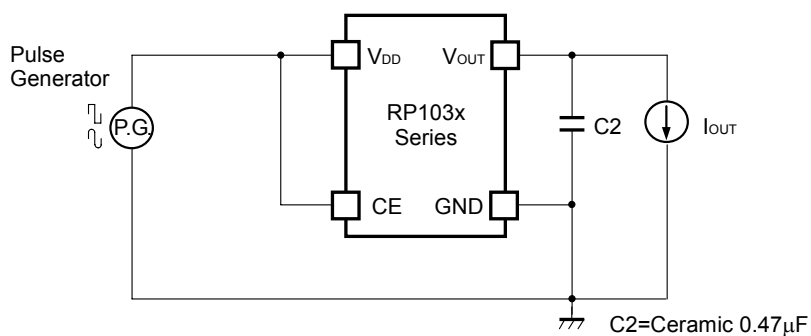
TEST CIRCUITS



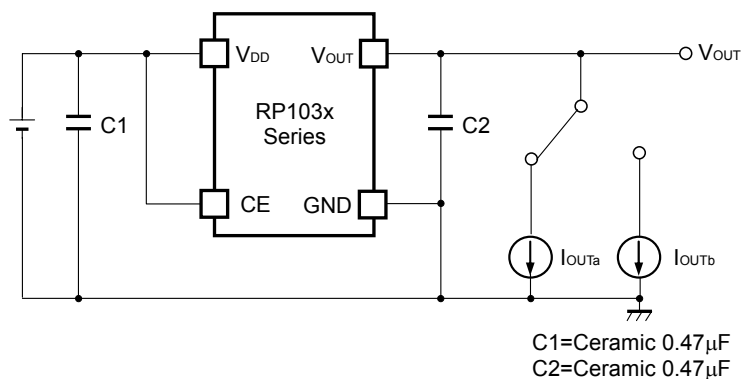
Basic Test Circuit



Test Circuit for Supply Current



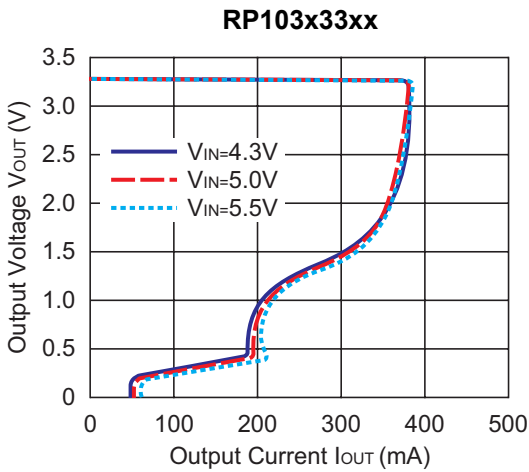
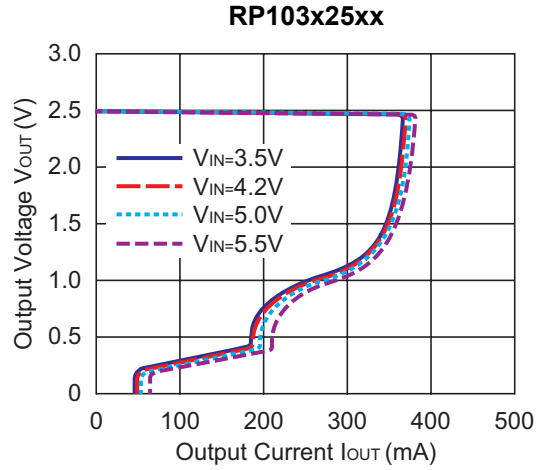
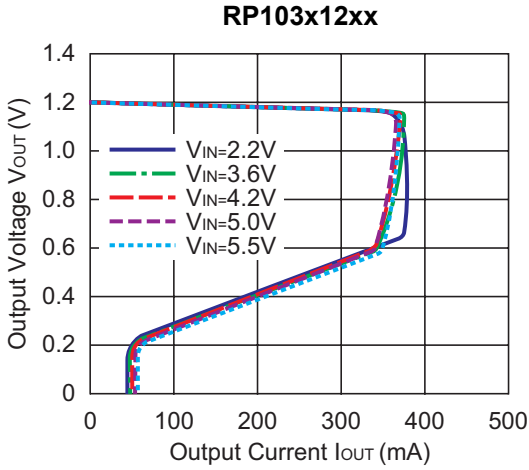
Test Circuit for Ripple Rejection



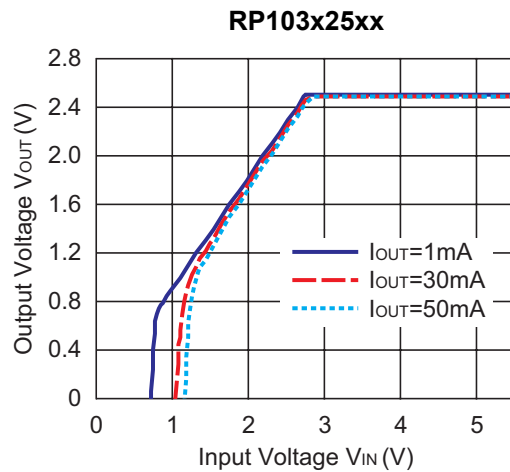
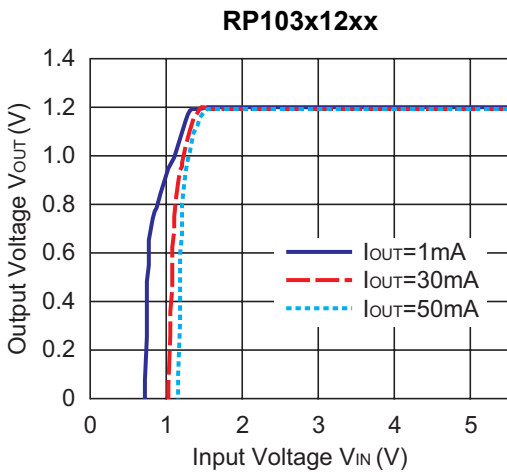
Test Circuit for Load Transient Response

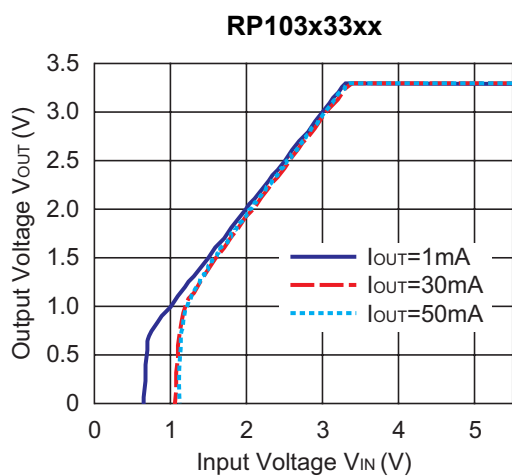
TYPICAL CHARACTERISTICS

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

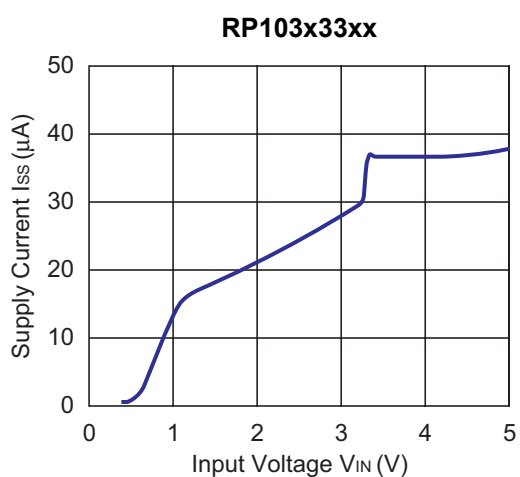
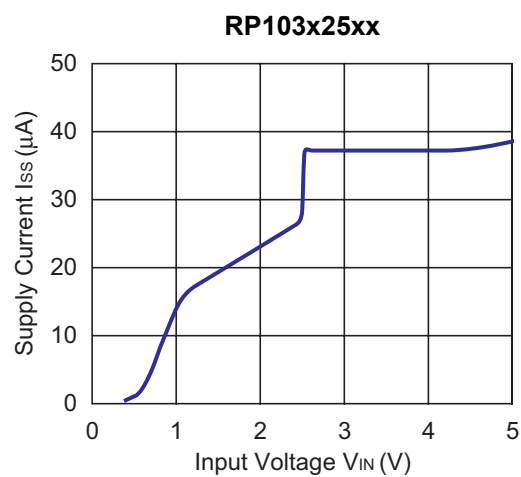
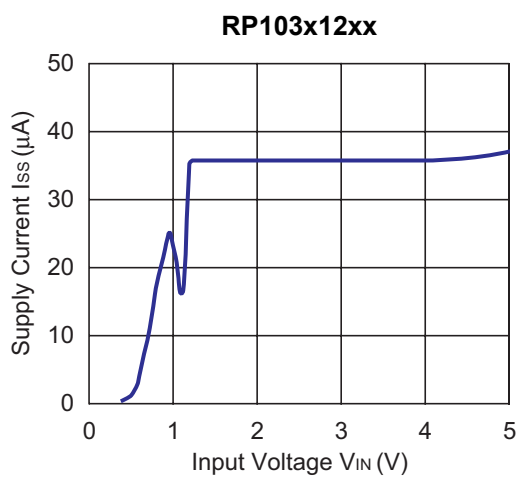


2) Output Voltage vs. Input Voltage ($C_1=0.47\mu\text{F}$, $C_2=0.47\mu\text{F}$, $T_{\text{opt}}=25^\circ\text{C}$)



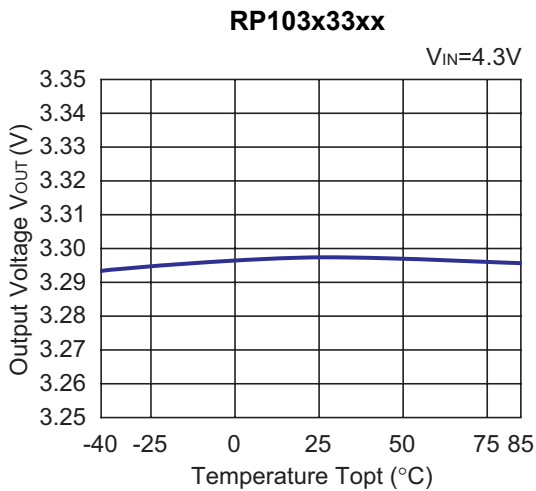
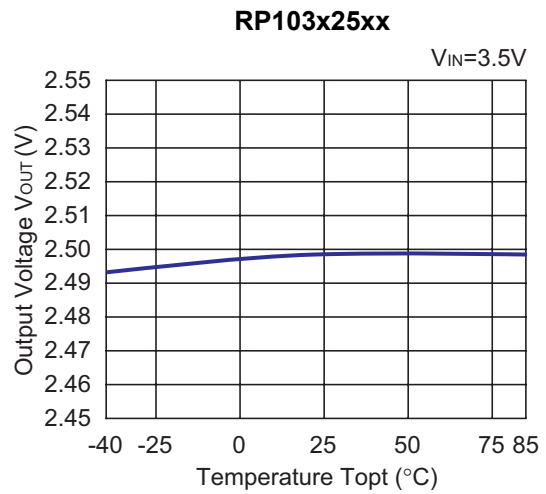
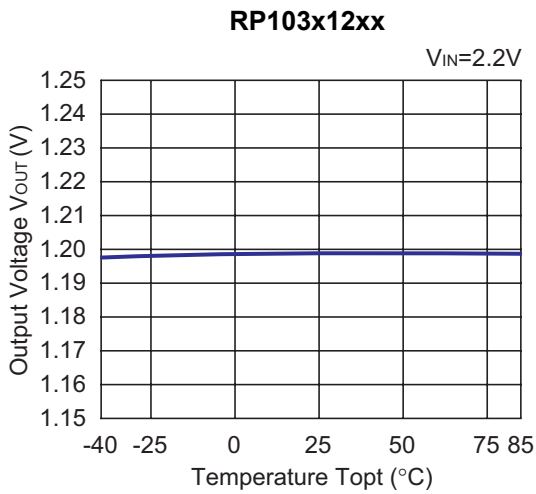


3) Supply Current vs. Input Voltage ($C1=0.47\mu F$, $C2=0.47\mu F$, $T_{opt}=25^{\circ}C$)

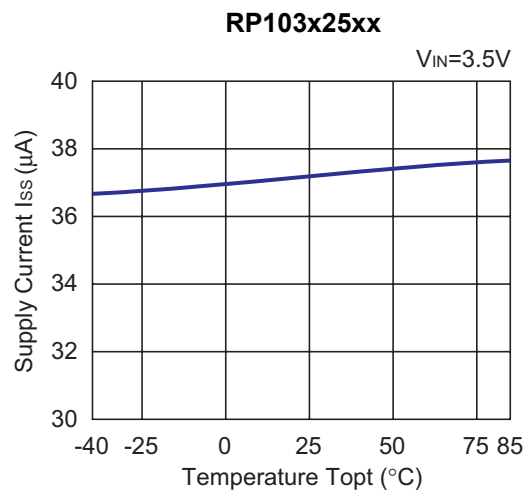
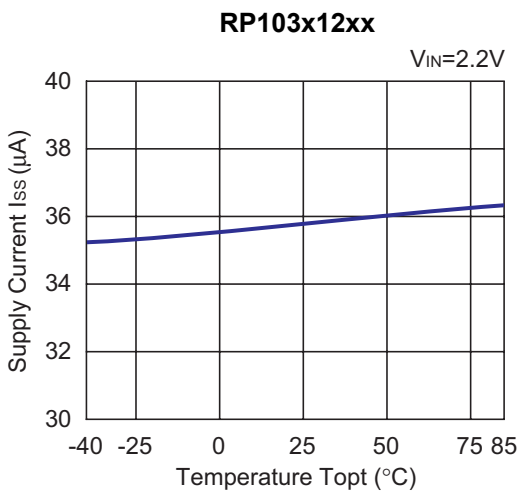


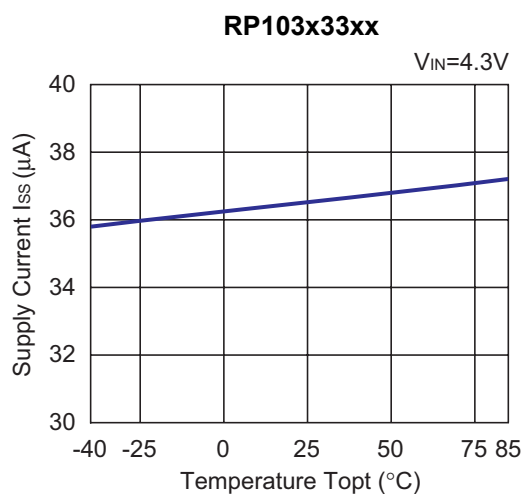
RP103x

4) Output Voltage vs. Temperature ($C1=0.47\mu\text{F}$, $C2=0.47\mu\text{F}$, $I_{\text{OUT}}=1\text{mA}$)

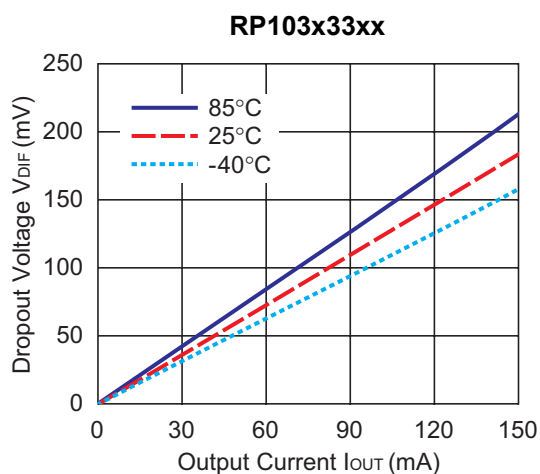
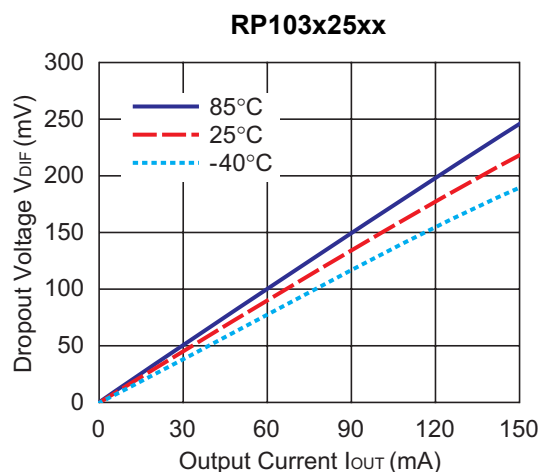
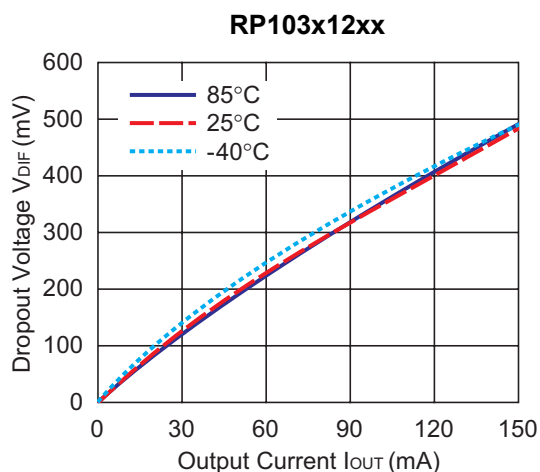


5) Supply Current vs. Temperature ($C1=0.47\mu\text{F}$, $C2=0.47\mu\text{F}$, $I_{\text{OUT}}=0\text{mA}$)

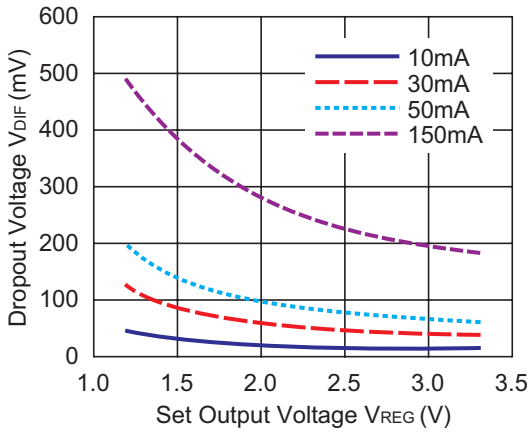




6) Dropout Voltage vs. Output Current ($C1=0.47\mu F$, $C2=0.47\mu F$)

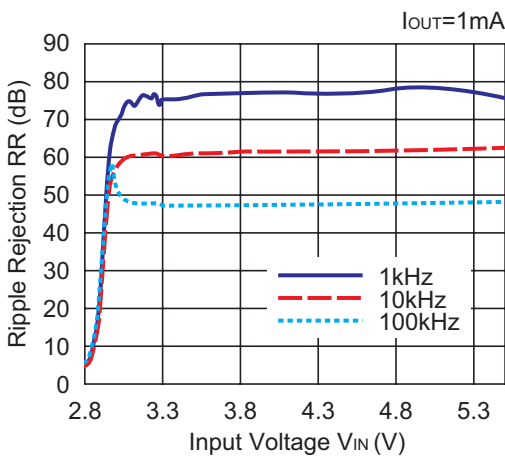


7) Dropout Voltage vs. Set Output Voltage (C1=0.47μF, C2=0.47μF, T_{opt}=25°C)

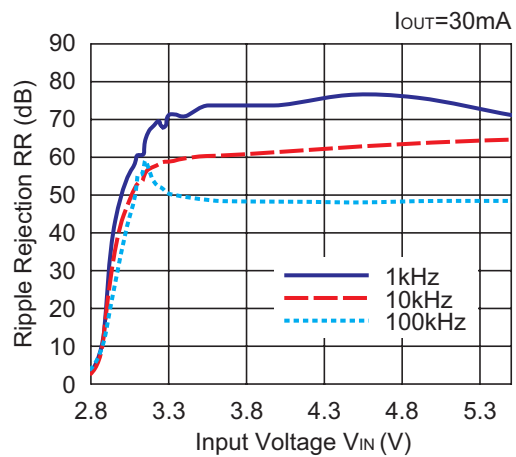


8) Ripple Rejection vs. Input Bias Voltage (C1=0.47μF, C2=0.47μF, Ripple=0.2V_{P-P}, T_{opt}=25°C)

RP103x28xx

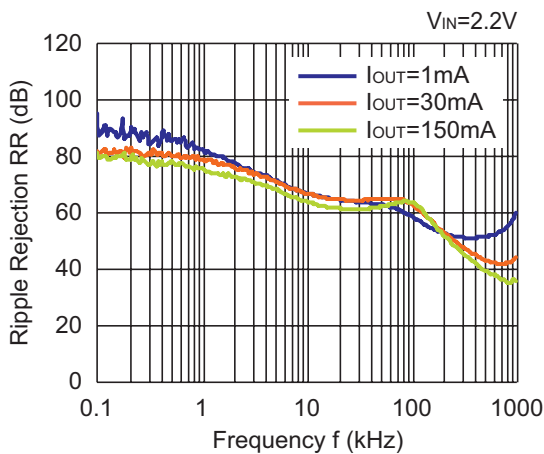


RP103x28xx

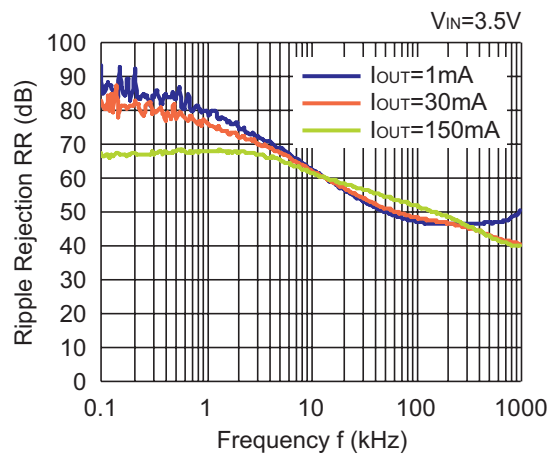


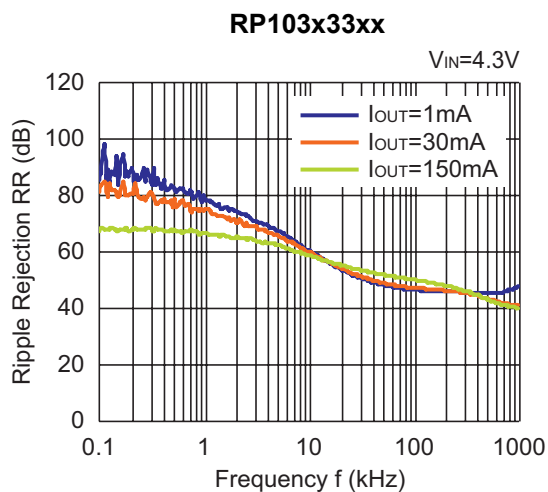
9) Ripple Rejection vs. Frequency (C1=none, C2=0.47μF, Ripple=0.2V_{P-P})

RP103x12xx

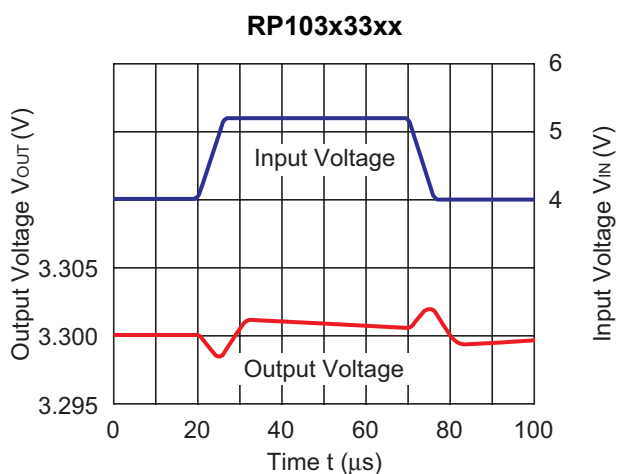
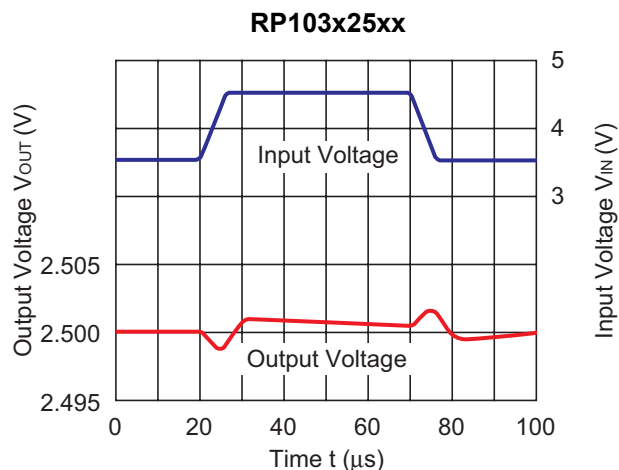
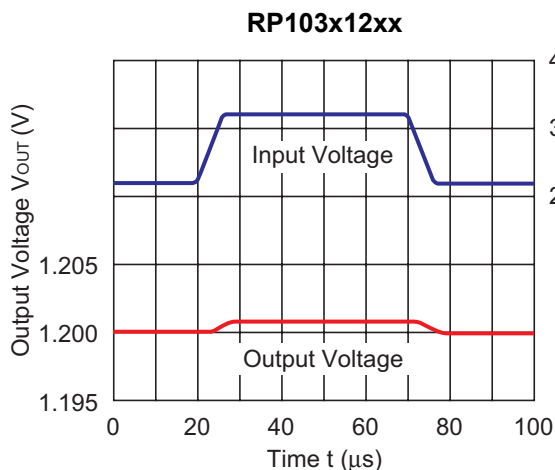


RP103x25xx

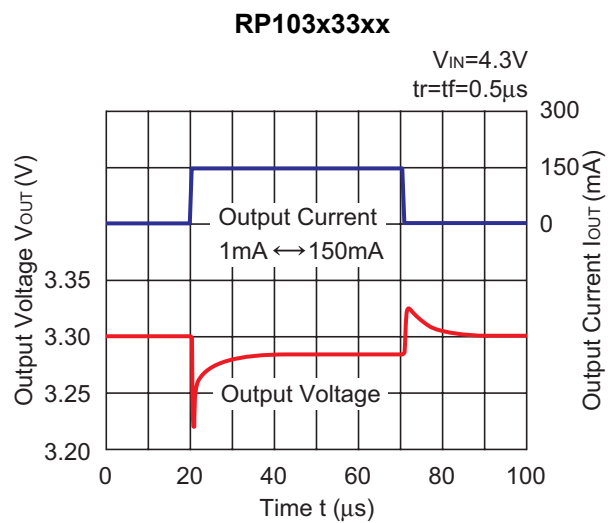
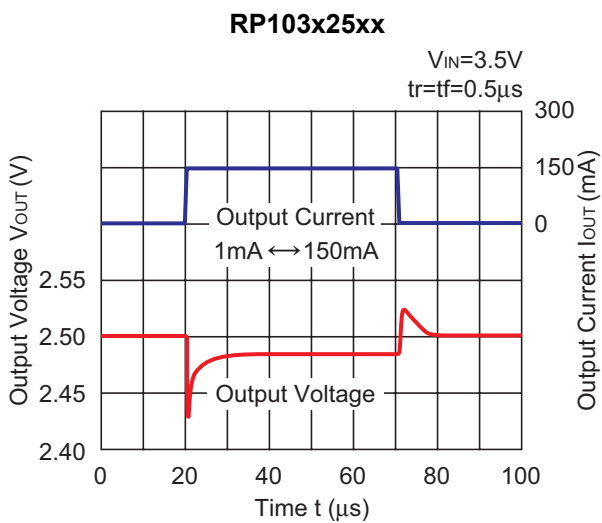
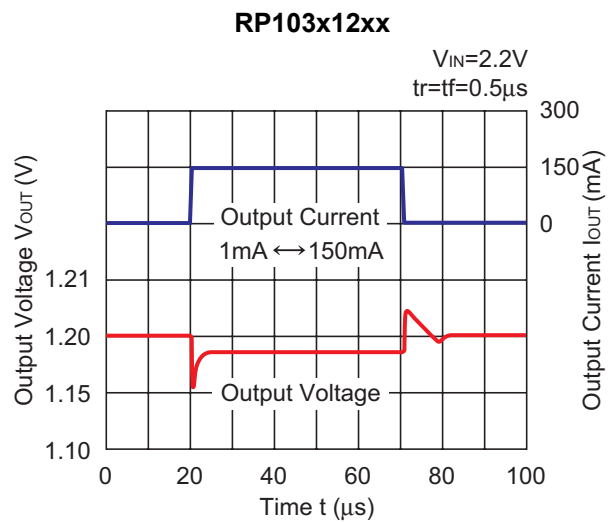
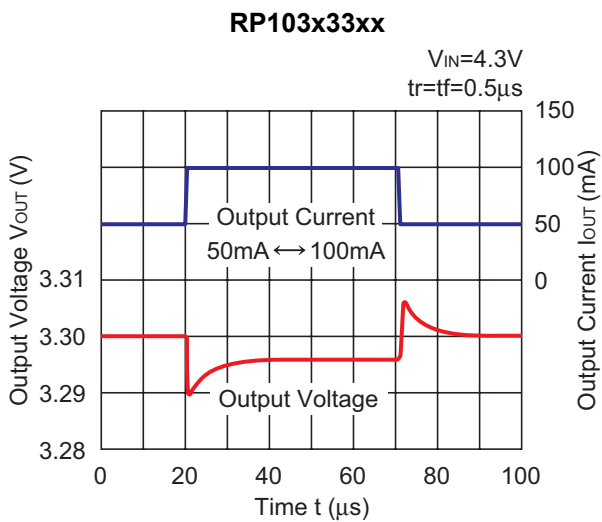
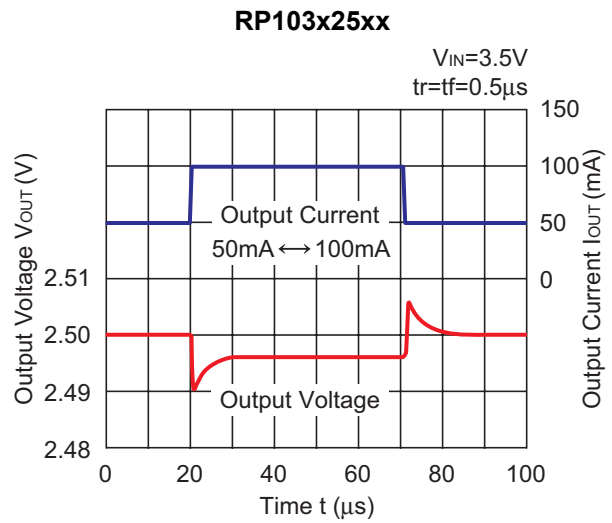
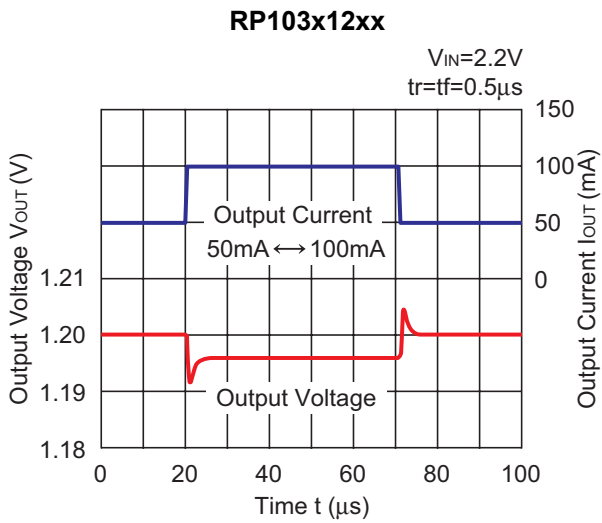




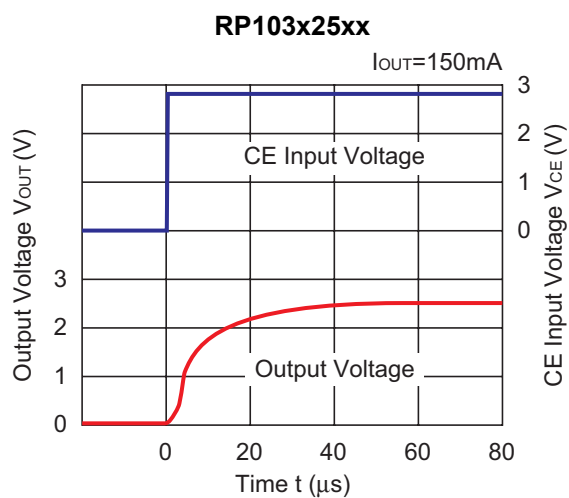
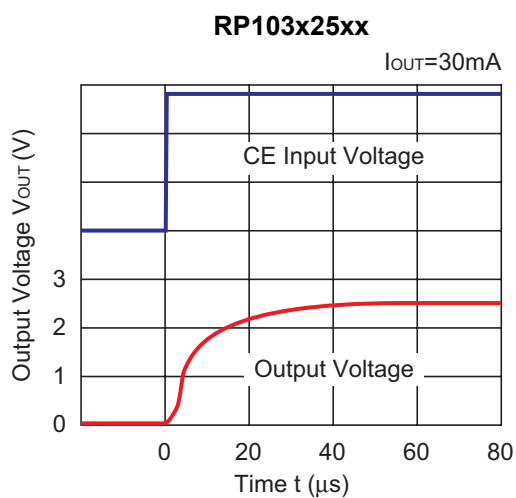
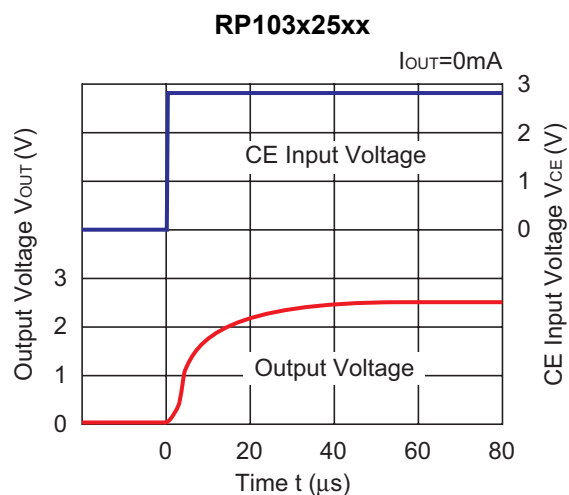
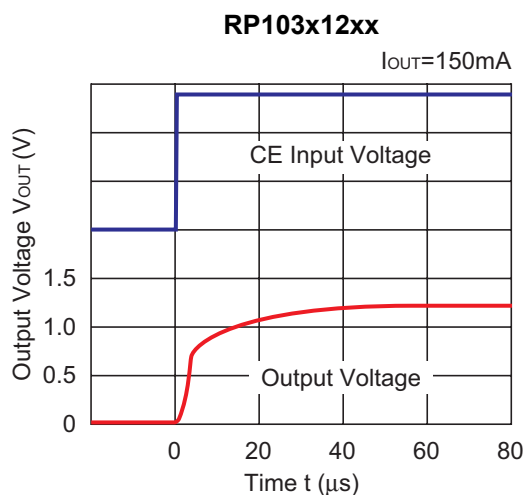
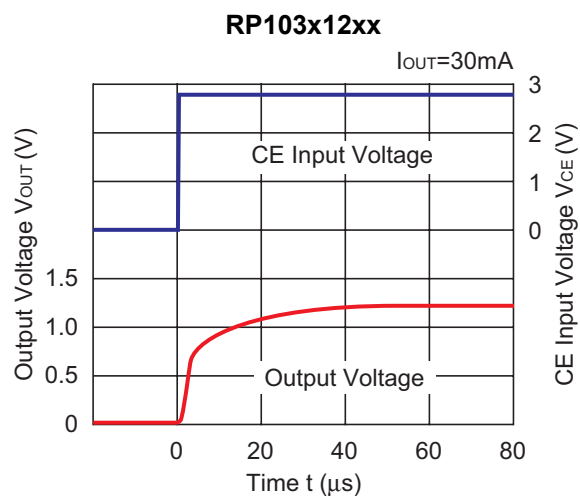
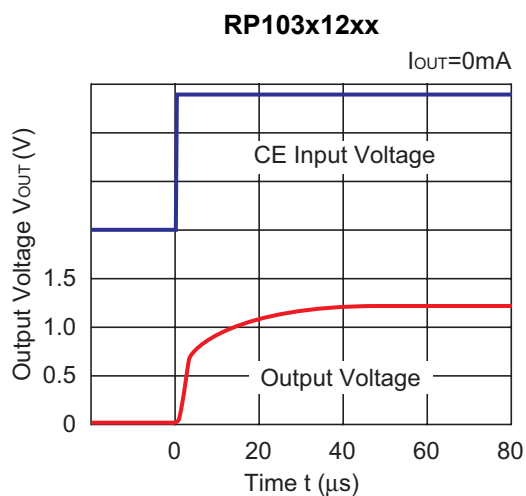
10) Input Transient Response ($I_{OUT}=30mA$, $t_r=t_f=5\mu s$, $T_{opt}=25^\circ C$)

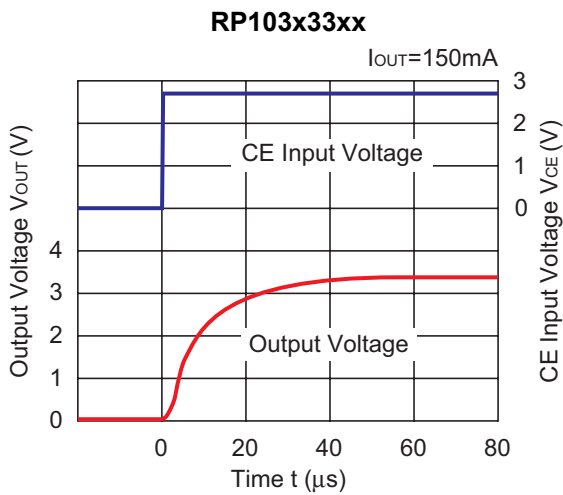
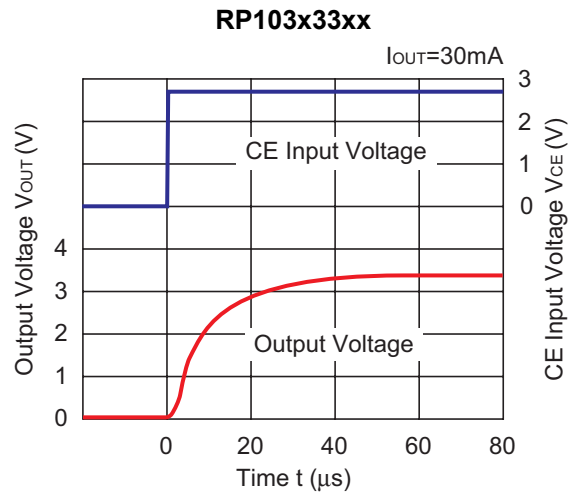
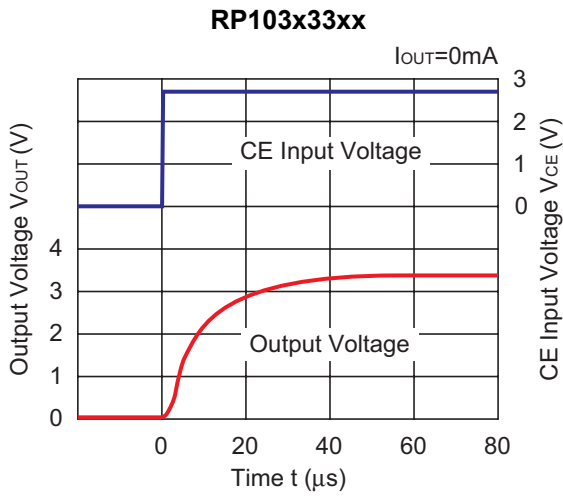


11) Load Transient Response ($C1=0.47\mu\text{F}$, $C2=0.47\mu\text{F}$, $T_{opt}=25^\circ\text{C}$)

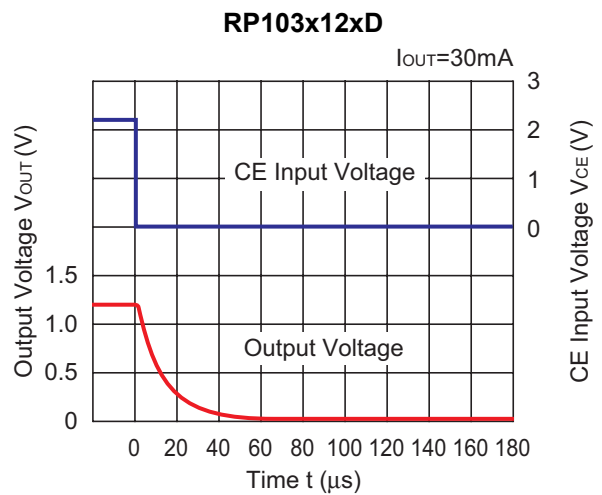
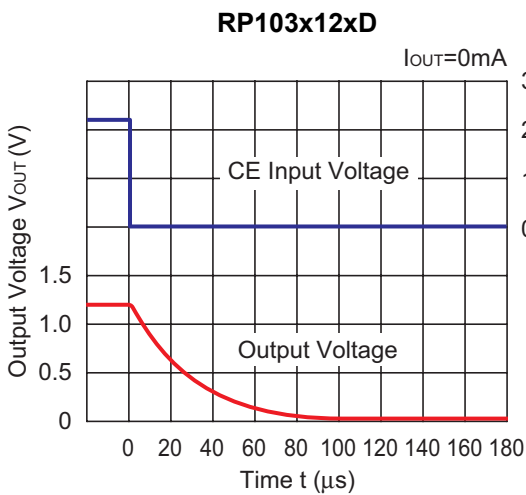


12) Turn On Speed with CE pin ($C1=0.47\mu\text{F}$, $C2=0.47\mu\text{F}$, $T_{\text{opt}}=25^{\circ}\text{C}$)

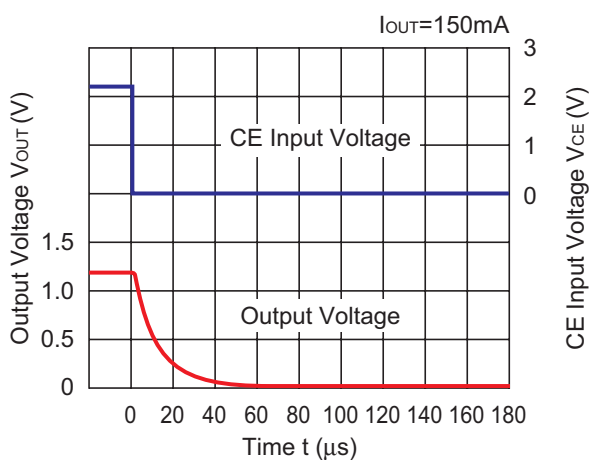




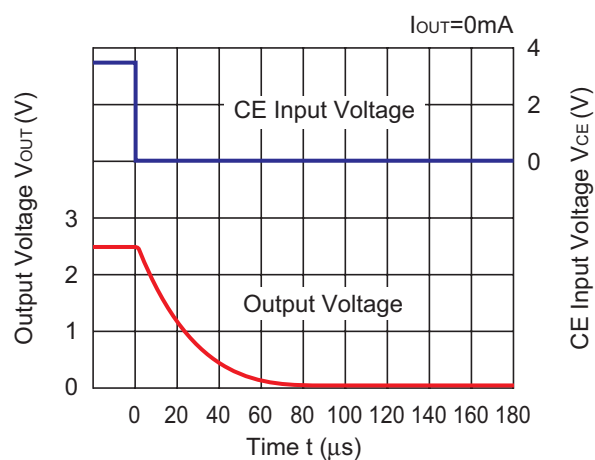
13) Turn Off Speed with CE pin (D Version) ($C1=0.47\mu F$, $C2=0.47\mu F$, $T_{opt}=25^{\circ}C$)



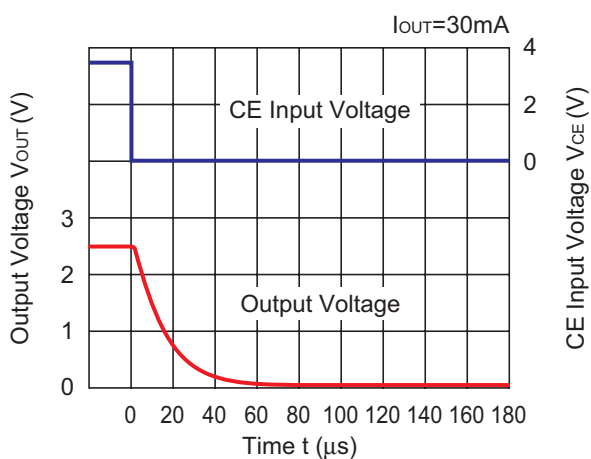
RP103x12xD



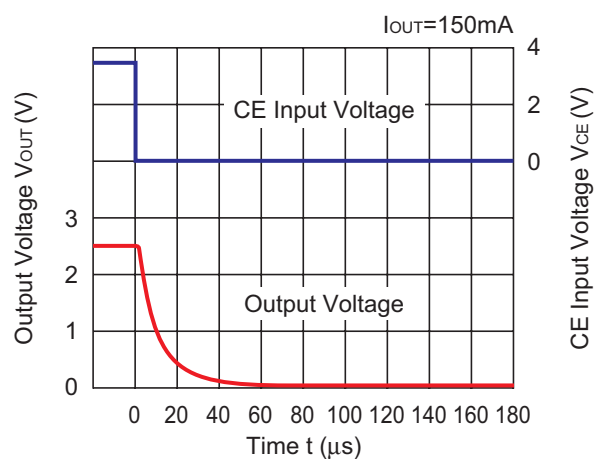
RP103x25xD



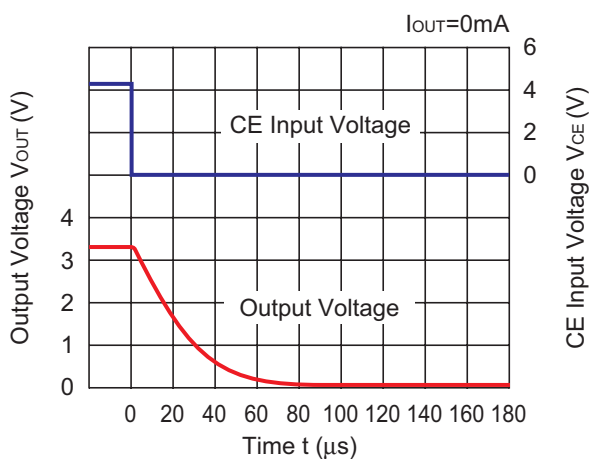
RP103x25xD



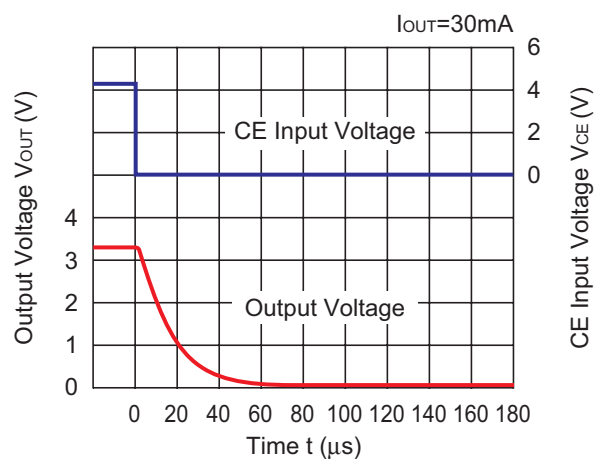
RP103x25xD



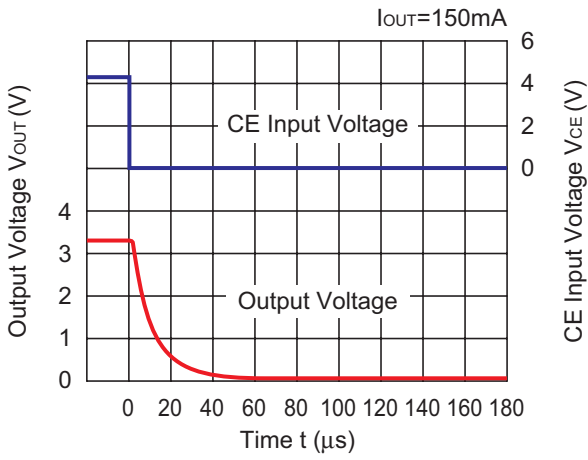
RP103x33xD



RP103x33xD

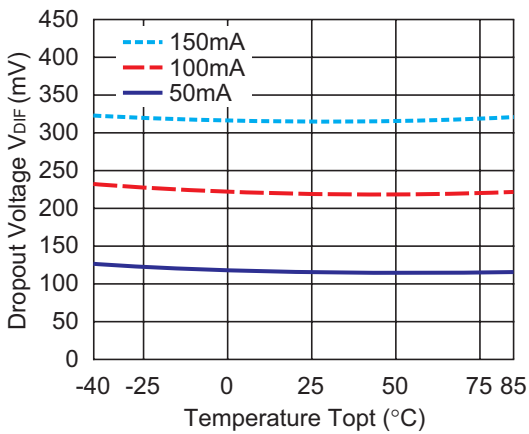


RP103x33xD

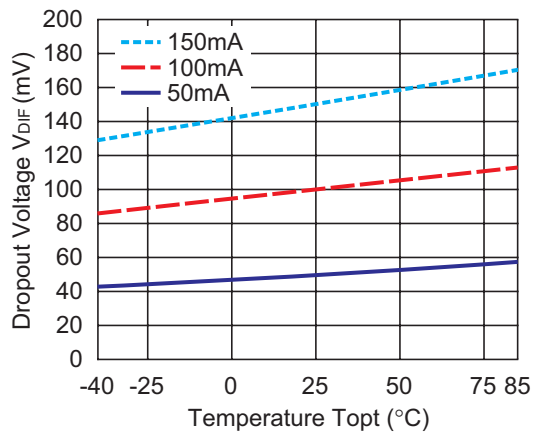


14) Dropout Voltage vs. Temperature ($C1=0.47\mu F$, $C2=0.47\mu F$)

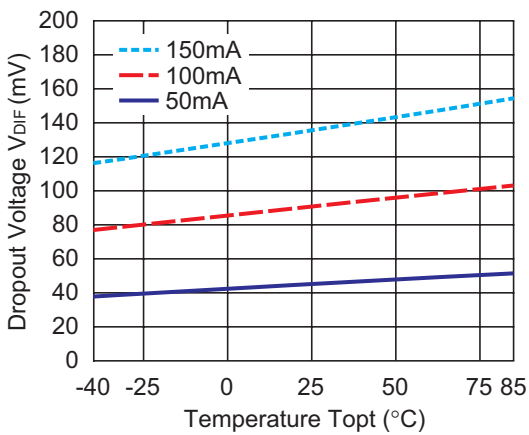
RP103x12xx



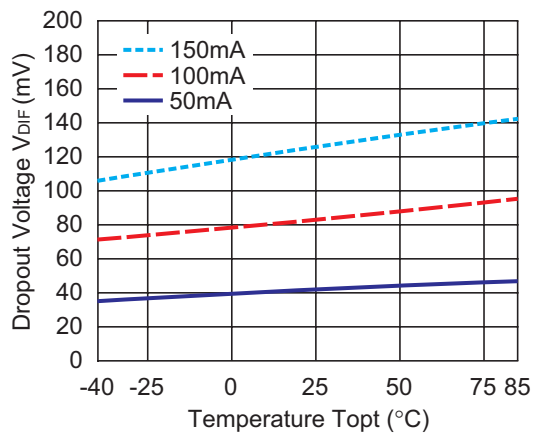
RP103x25xx



RP103x30xx



RP103x33xx



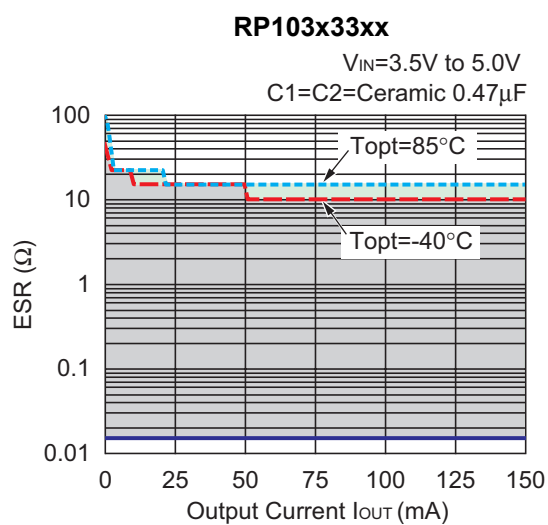
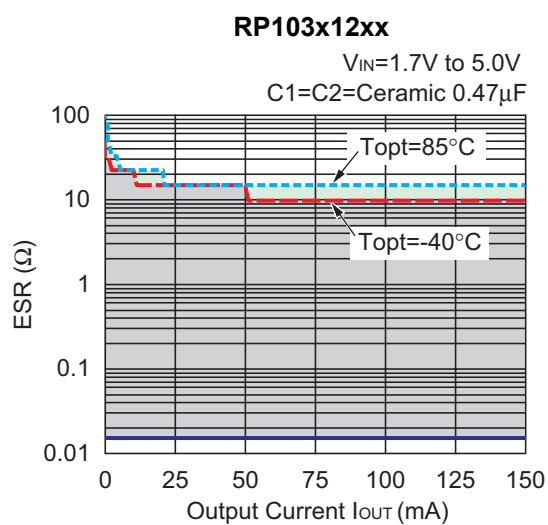
ESR vs. Output Current

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°C to 85°C





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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.