

300mA 10V INPUT LDO REGULATOR

NO.EA-205-120404

OUTLINE

The RP170x Series are CMOS-based LDO regulators featuring 300mA output current. Because of the 10V maximum input voltage, RP170x can be used in 2 cell lithium-ion battery powered portable appliances and besides a portable equipment. The supply current is Typ. 23 μ A though an excellent response characteristics.

The output voltage range from 1.2V is possible. The output voltage accuracy and temperature-drift coefficient of output voltage of the RP170x Series are excellent.

RP170x has a fold-back protection circuit and a thermal shutdown circuit. Moreover, a standby mode with ultra low supply current can be realized with the chip enable function.

SC-88A (**Limited**), SOT-23-5 and SOT-89-5 with high power dissipation packages are available.

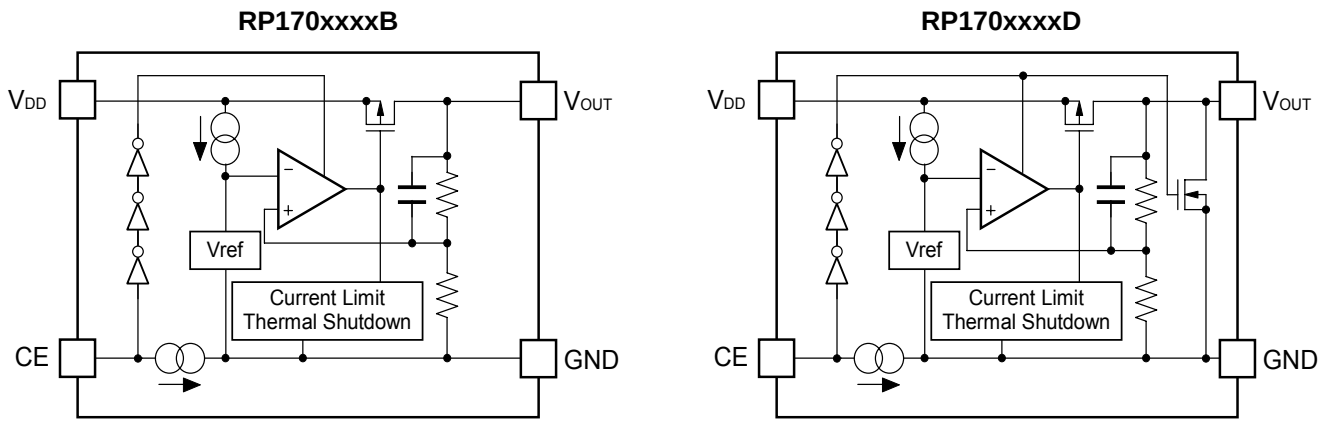
FEATURES

- Supply Current Typ. 23 μ A
- Standby Mode Typ. 0.1 μ A
- Dropout Voltage..... Typ. 0.20V ($I_{OUT}=100mA$, $V_{OUT}=3.0V$)
Typ. 0.77V ($I_{OUT}=300mA$, $V_{OUT}=2.8V$)
- Ripple Rejection Typ. 70dB ($f=1kHz$)
- Temperature-Drift Coefficient of Output Voltage Typ. $\pm 80ppm/^{\circ}C$
- Line Regulation Typ. 0.02%/V
- Output Voltage Accuracy $\pm 1.0\%$
- Packages..... SC-88A (**Limited**), SOT-23-5, SOT-89-5
- Input Voltage Range..... 2.6V to 10.0V
- Output Voltage Range 1.2V to 6.0V (0.1V steps)
(For other voltages, please refer to MARK INFORMATION.)
- Built-in Fold Back Protection Circuit..... Typ. 40mA (Current at short mode)
- Built-in Thermal Shutdown Circuit..... Shutdown Temperature at 165 $^{\circ}C$
- Ceramic capacitors are recommended to be used with this IC 1.0 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



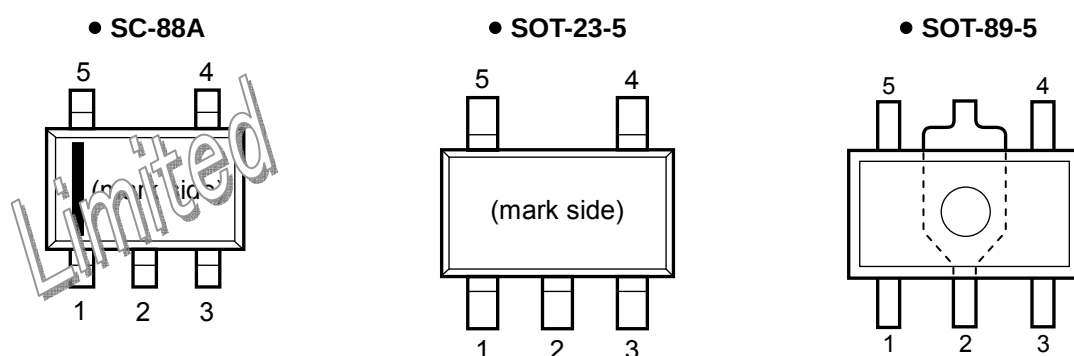
SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP170Qxx2*-TR-FE	SC-88A (Limited)	3,000 pcs	Yes	Yes
RP170Nxx1*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
RP170Hxx1*-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes
xx: The output voltage can be designated in the range from 1.2V(12) to 6.0V(60) in 0.1V steps. (For other voltages, please refer to MARK INFORMATION.)				
* : The auto discharge function at off state are options as follows. (B) without auto discharge function at off state (D) 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



PIN DESCRIPTIONS

• SC-88A (Limited)

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

• SOT-89-5

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	12	V
V_{CE}	Input Voltage (CE Pin)	12	V
V_{OUT}	Output Voltage	-0.3 to $V_{IN}+0.3$	V
I_{OUT}	Output Current	330	mA
P_D	Power Dissipation* (SC-88A) (Limited)	380	mW
	Power Dissipation* (SOT-23-5)	420	
	Power Dissipation* (SOT-89-5)	900	
T_{opt}	Operating Temperature Range	-40 to 85	$^{\circ}\text{C}$
T_{stg}	Storage Temperature Range	-55 to 125	$^{\circ}\text{C}$

*) 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

• RP170xxxxB/D

V_{IN} =Set $V_{OUT}+1V$, $I_{OUT}=1mA$, unless otherwise noted.

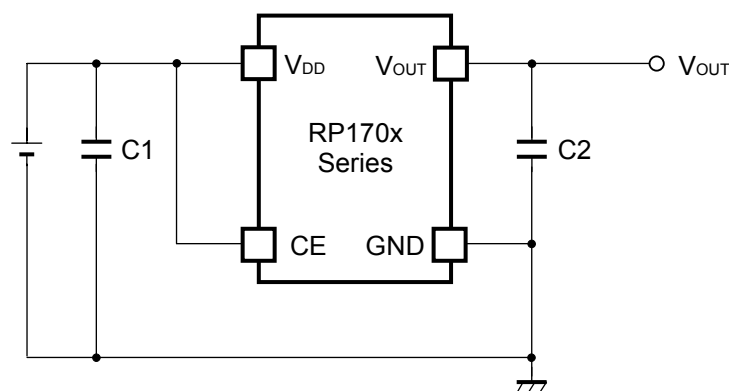
 values indicate $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$, unless otherwise noted.

$T_{opt}=25^{\circ}C$

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$T_{opt}=25^{\circ}C$	$V_{OUT} > 1.5V$	$\times 0.99$	$\times 1.01$	V
			$V_{OUT} \leq 1.5V$	-15	+15	mV
		$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	$V_{OUT} > 1.5V$	$\times 0.974$	$\times 1.023$	V
			$V_{OUT} \leq 1.5V$	-40	+35	mV
I_{OUT}	Output Current		300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$0.1mA \leq I_{OUT} \leq 300mA$		10	70	mV
V_{DIF}	Dropout Voltage	$I_{OUT}=300mA$	$1.2V \leq V_{OUT} < 1.3V$	1.400	1.800	V
			$1.3V \leq V_{OUT} < 1.5V$	1.350	1.750	
			$1.5V \leq V_{OUT} < 1.8V$	1.200	1.550	
			$1.8V \leq V_{OUT} < 2.3V$	0.980	1.300	
			$2.3V \leq V_{OUT} < 3.0V$	0.770	1.080	
			$3.0V \leq V_{OUT} < 4.0V$	0.600	0.850	
			$4.0V \leq V_{OUT} \leq 6.0V$	0.500	0.750	
I_{SS}	Supply Current	$I_{OUT}=0mA$		23	40	μA
$I_{standby}$	Standby Current	$V_{IN}=10.0V$, $V_{CE}=GND$		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set $V_{OUT}+0.5V \leq V_{IN} \leq 10.0V$ (In case that $V_{OUT} \leq 2.1V$, $2.6V \leq V_{IN} \leq 10.0V$)		0.02	0.2	%/V
RR	Ripple Rejection	$f=1kHz$, Ripple 0.2Vp-p, $I_{OUT}=30mA$ (In case that $V_{OUT} < 2.0V$, $V_{IN}=3.0V$)		70		dB
V_{IN}	Input Voltage		2.6		10	V
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		± 80		ppm/ $^{\circ}C$
I_{SC}	Short Current Limit	$V_{OUT}=0V$		40		mA
I_{PD}	CE Pull-down Current			0.30		μA
V_{CEH}	CE Input Voltage "H"		1.7			V
V_{CEL}	CE Input Voltage "L"				0.8	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		165		$^{\circ}C$
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		110		$^{\circ}C$
en	Output Noise	BW=10Hz to 100kHz		100		μV_{rms}
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	$V_{IN}=7.0V$ $V_{CE}=0V$		250		Ω

All of unit are tested and specified under load conditions such that $T_j \approx T_{opt}=25^{\circ}C$ except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient and Thermal Shutdown.

TYPICAL APPLICATION



(External Components)

C2 1.0 μ F MURATA: GRM155B31A105KE15

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 1.0 μ F or more and good ESR (Equivalent Series Resistance).

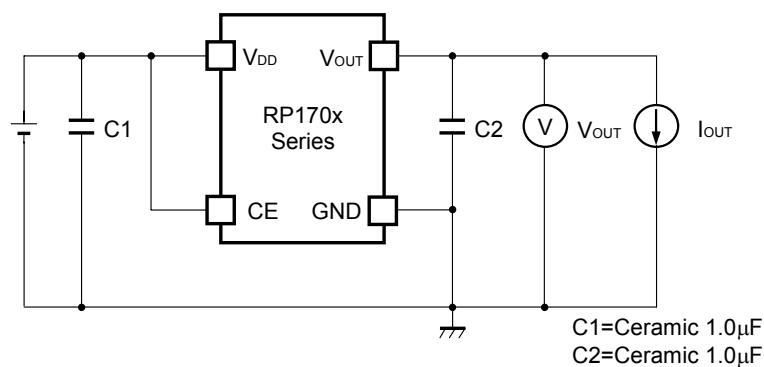
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

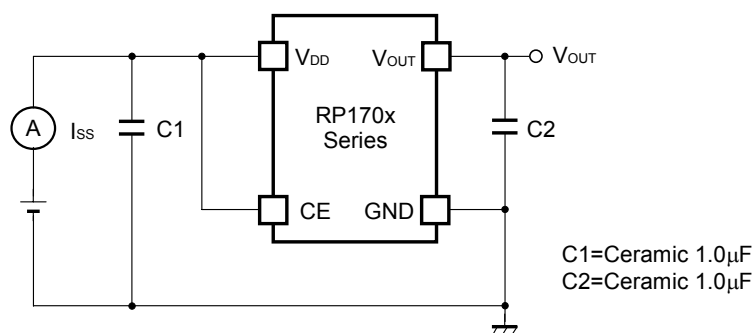
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0 μ F or more between V_{DD} and GND pin, and as close as possible to the pins.

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

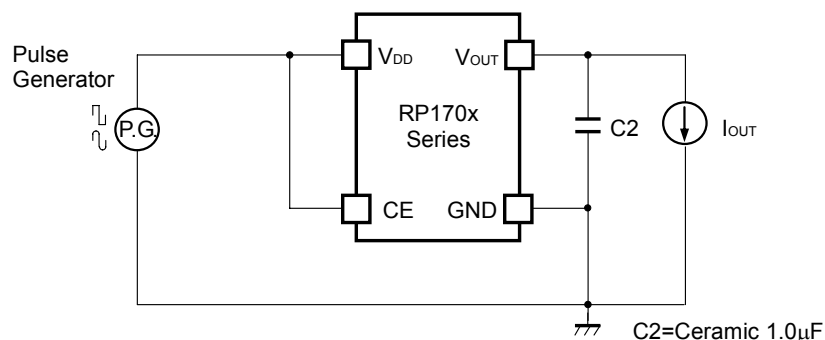
TEST CIRCUITS



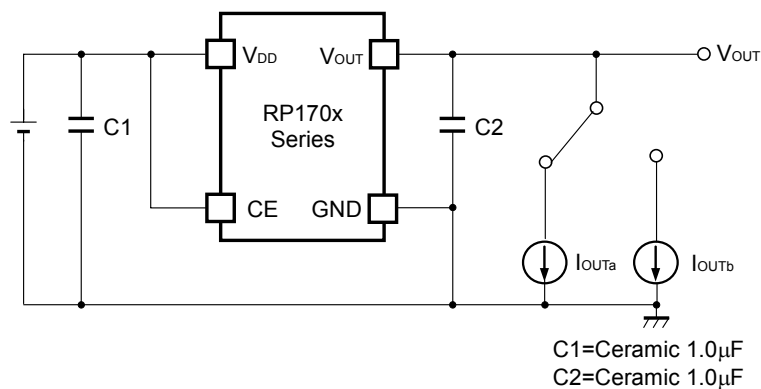
Basic Test Circuit



Test Circuit for Supply Current



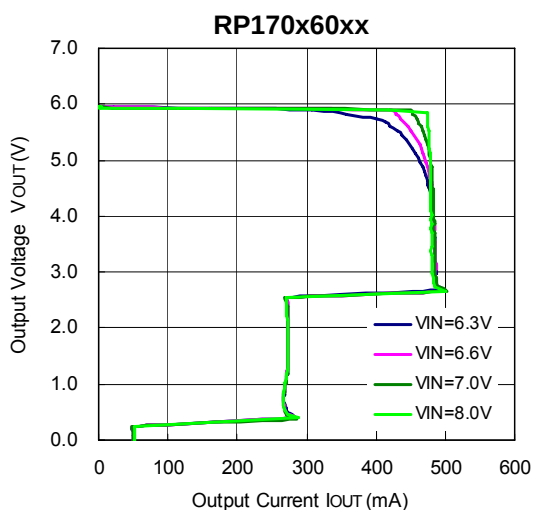
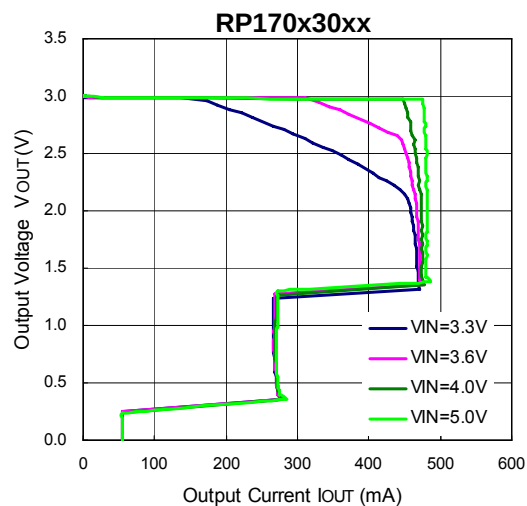
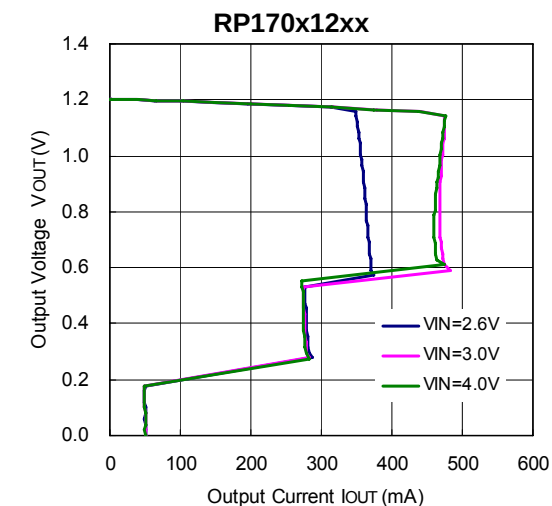
Test Circuit for Ripple Rejection



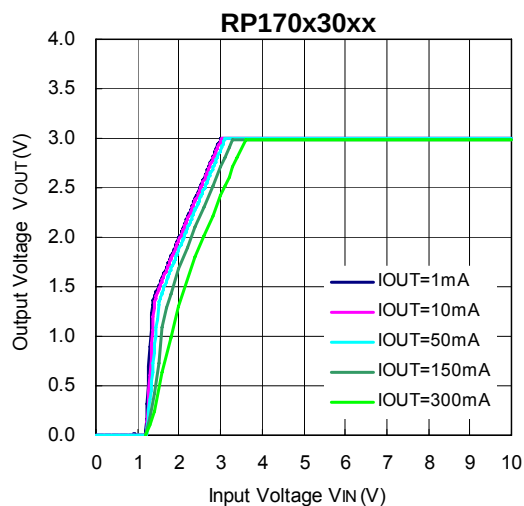
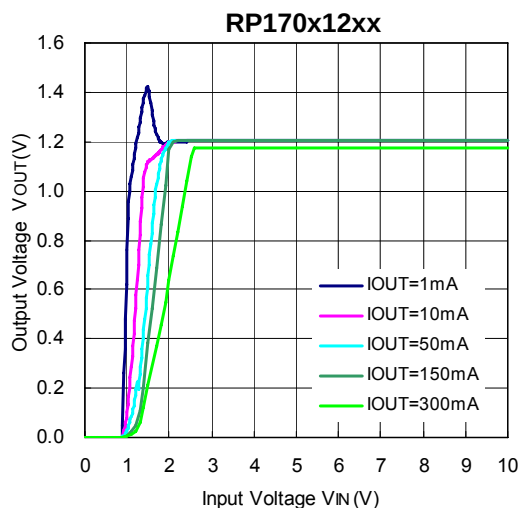
Test Circuit for Load Transient Response

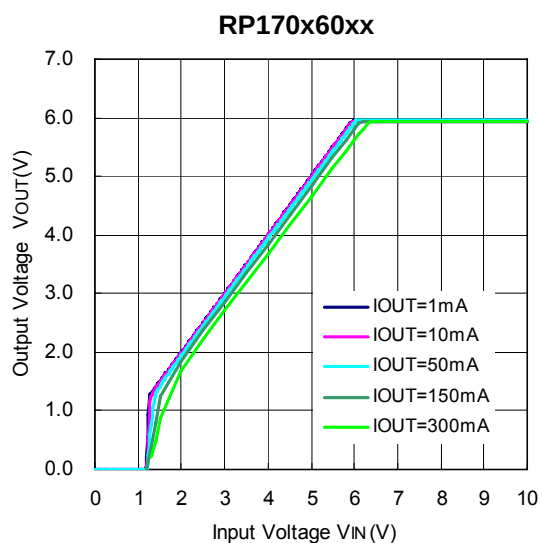
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current ($T_{opt}=25^{\circ}\text{C}$)

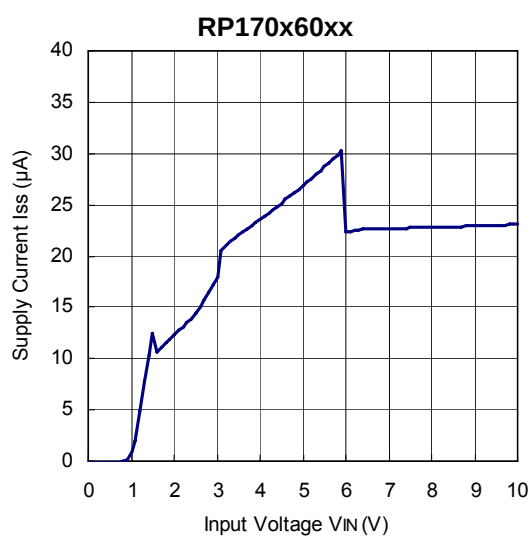
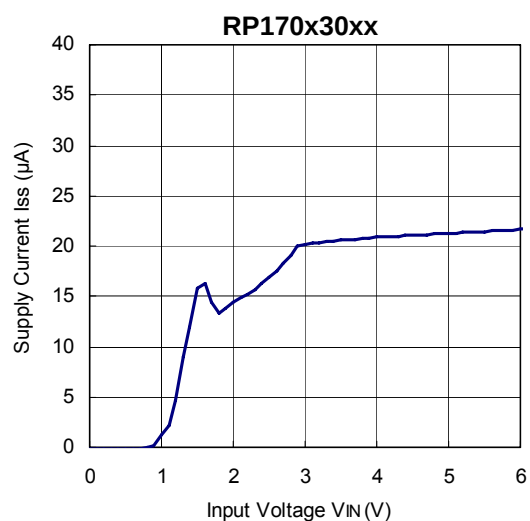
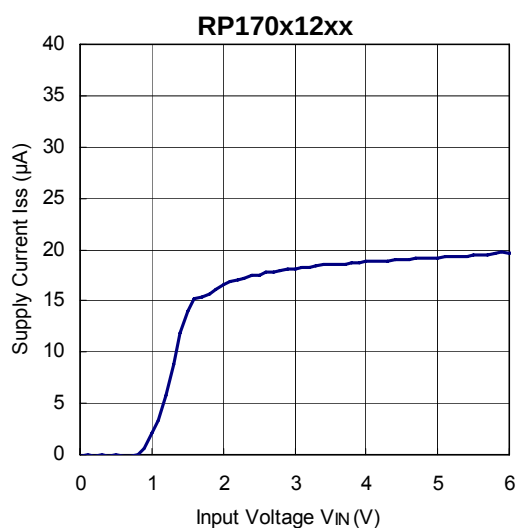


2) Output Voltage vs. Input Voltage ($T_{opt}=25^{\circ}\text{C}$)

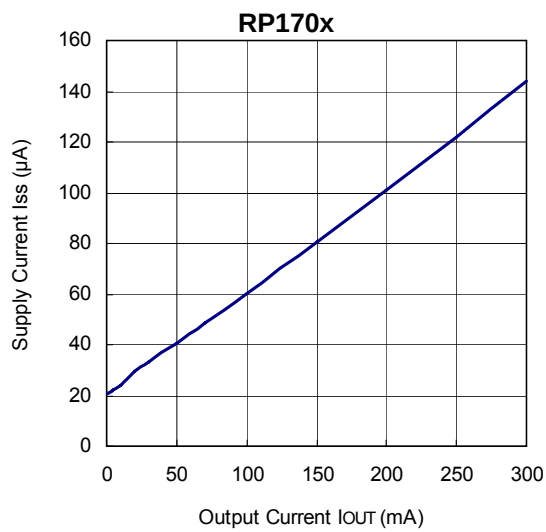




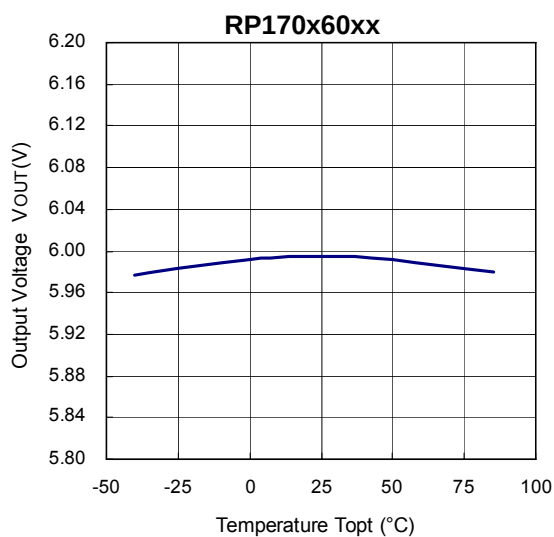
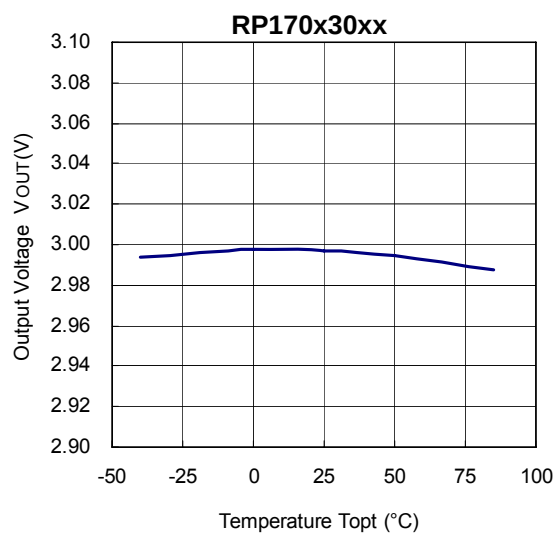
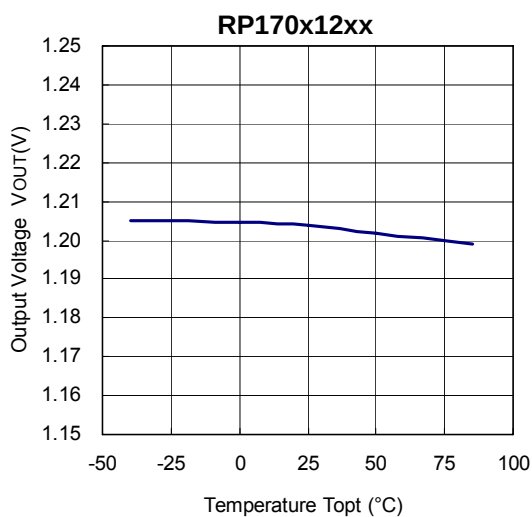
3) Supply Current vs. Input Voltage ($T_{opt}=25^{\circ}\text{C}$)



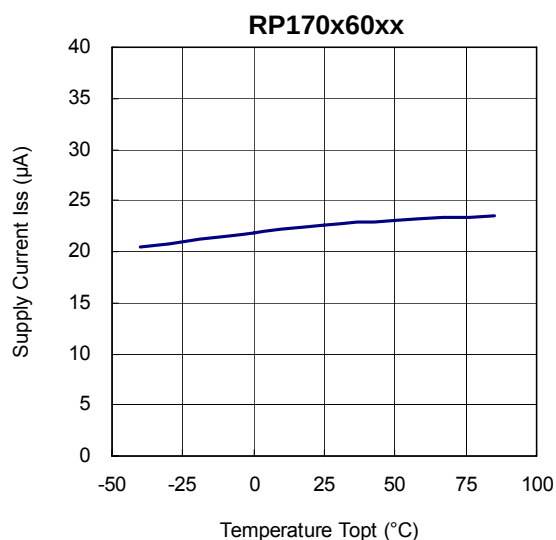
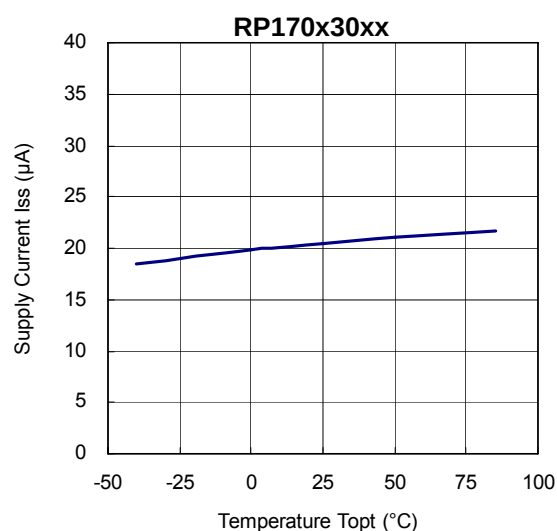
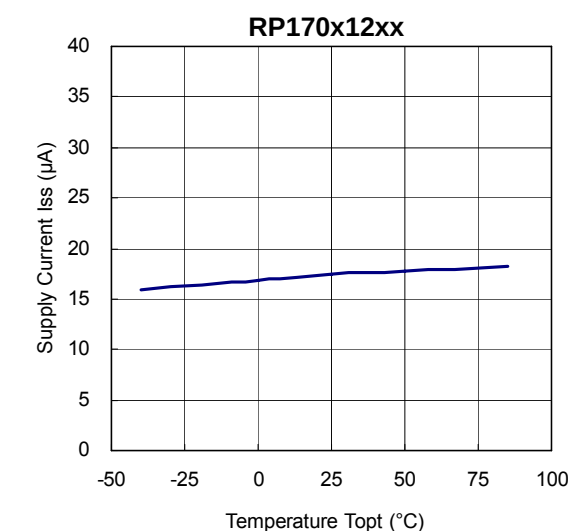
4) Supply Current vs. Output Current (T_{opt}=25°C)



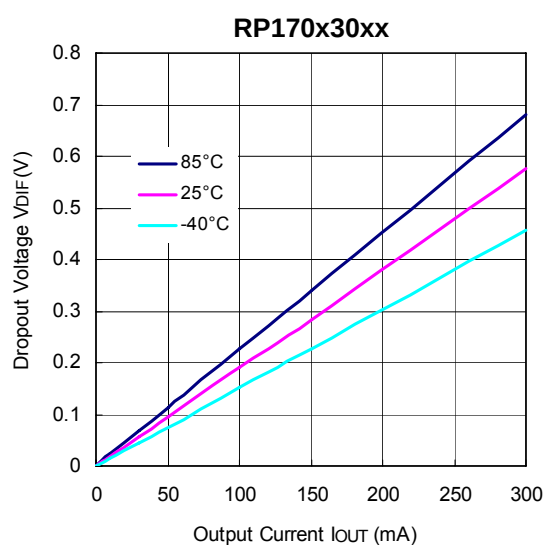
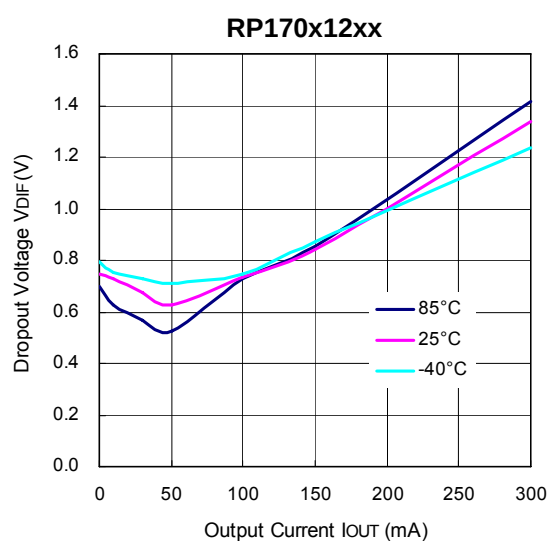
5) Output Voltage vs. Temperature

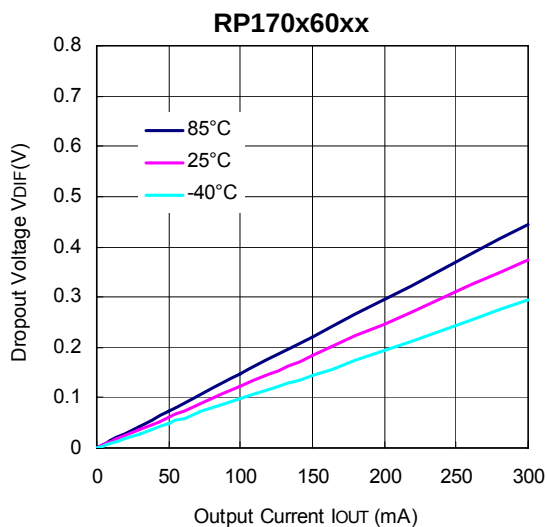


6) Supply Current vs. Temperature

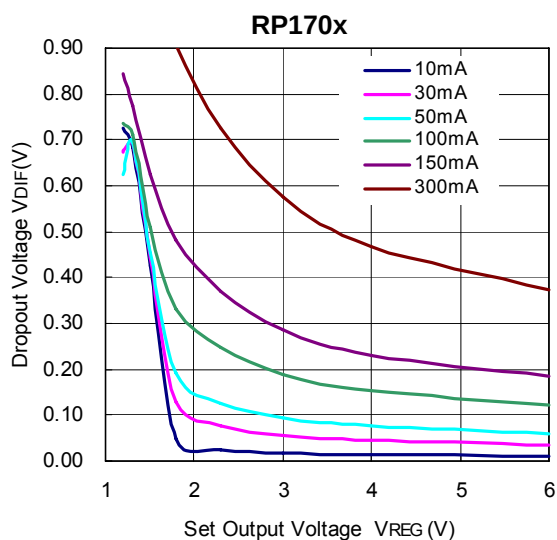


7) Dropout Voltage vs. Output Current

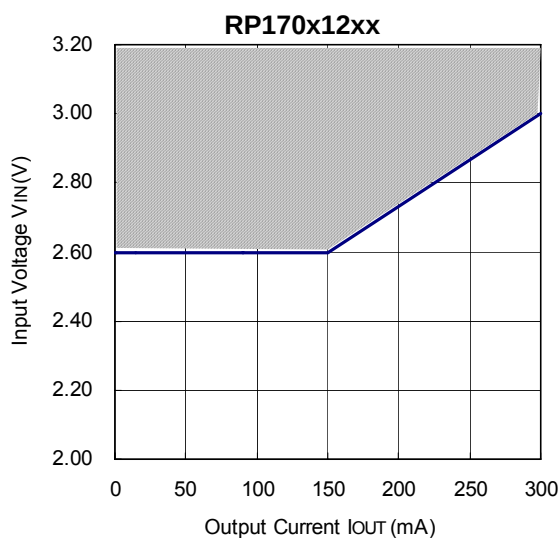




8) Dropout Voltage vs. Set Output Voltage ($T_{opt}=25^{\circ}\text{C}$)

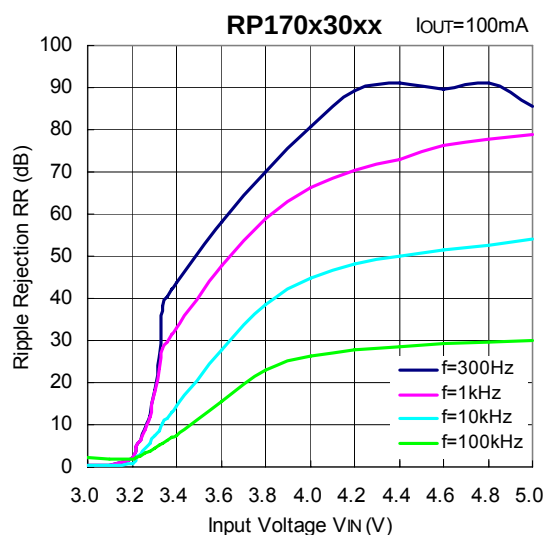
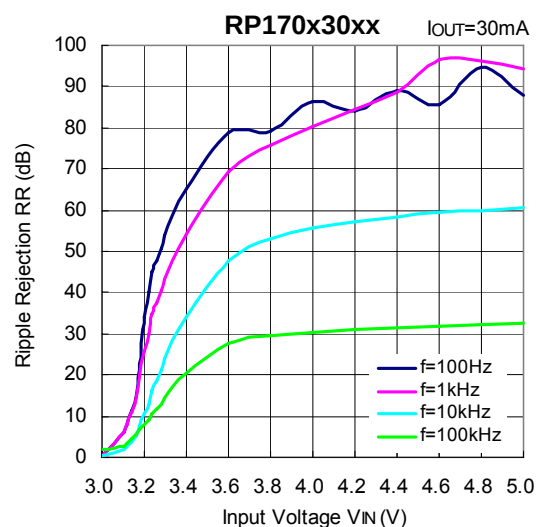
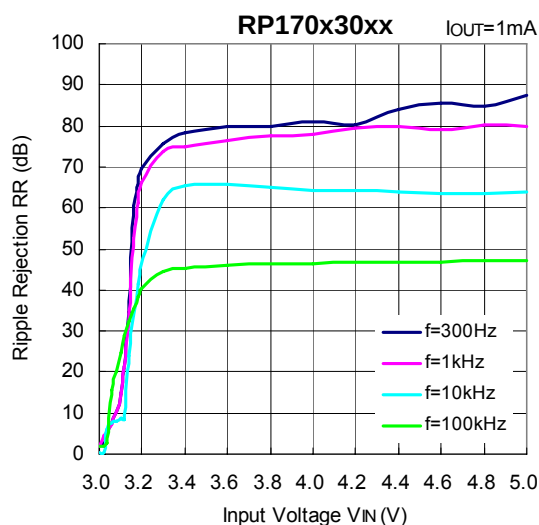


9) Minimum Operating Voltage

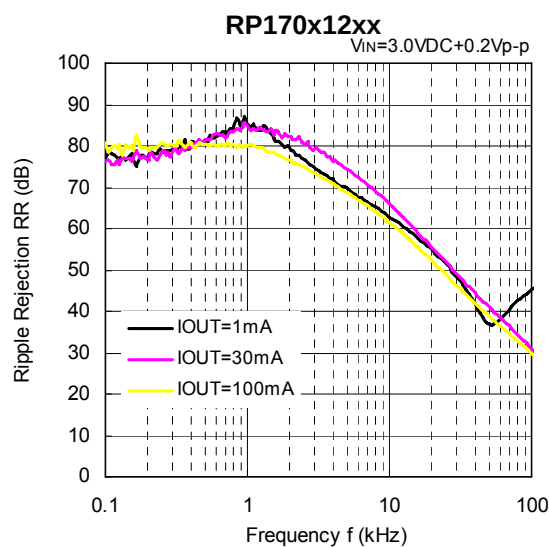
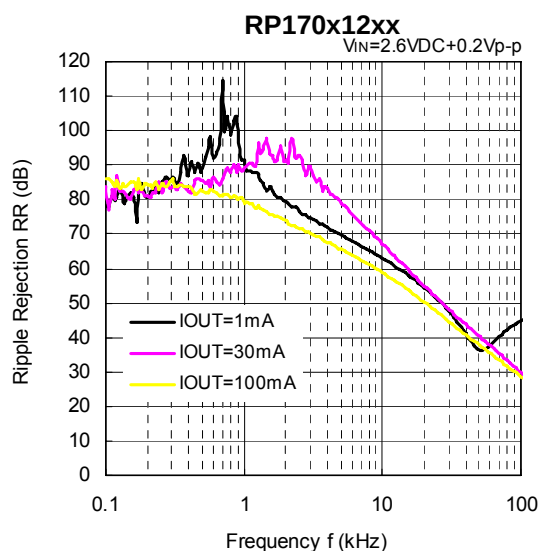


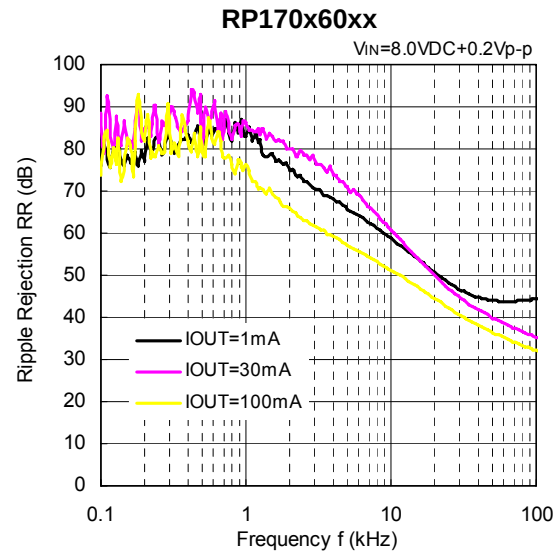
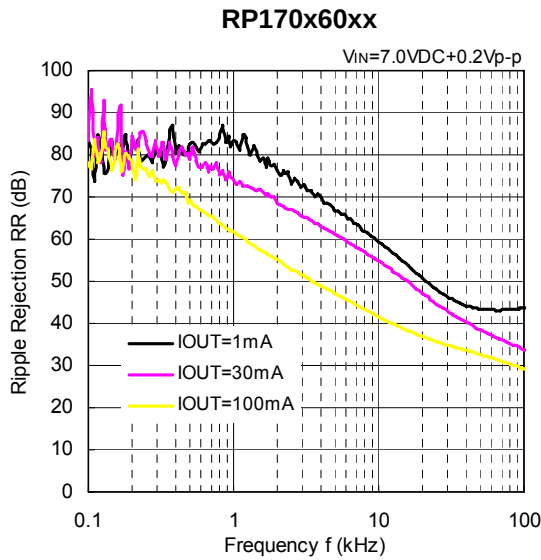
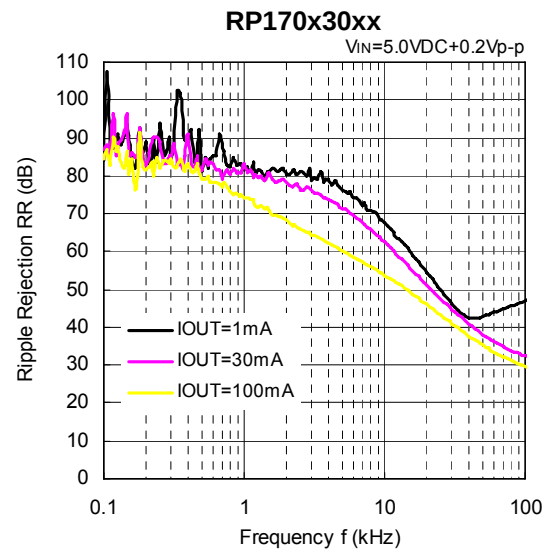
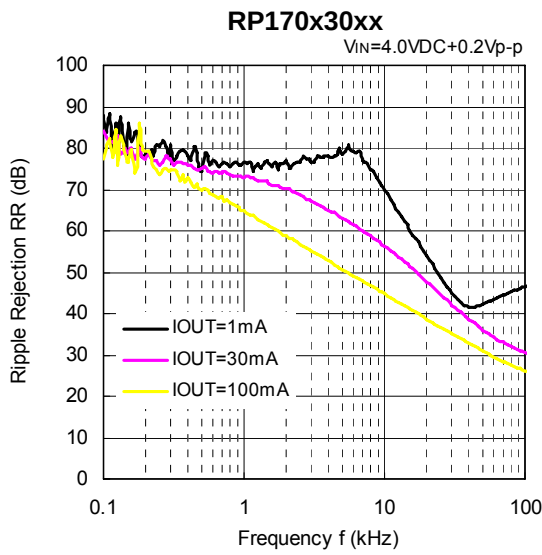
Hatched area is available for 1.2V output

10) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=Ceramic 1.0μF, Ripple=0.2Vp-p, T_{opt}=25°C)

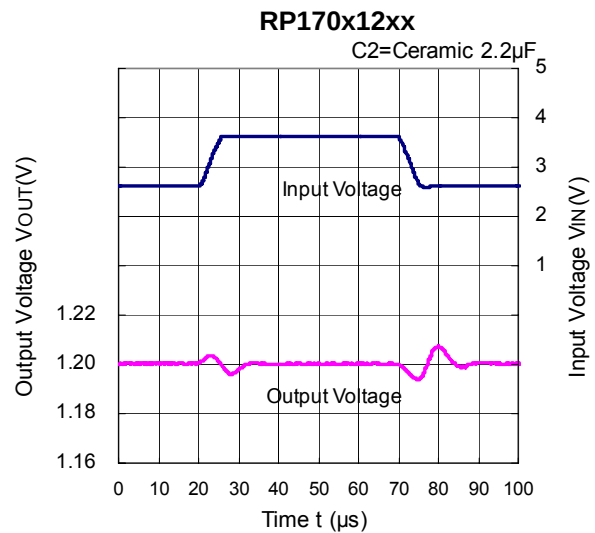
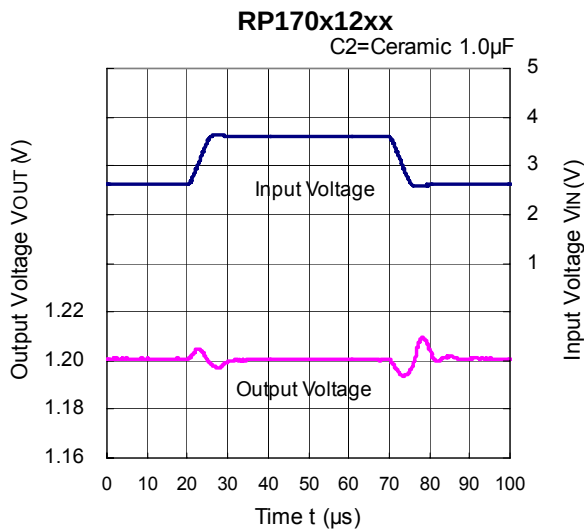


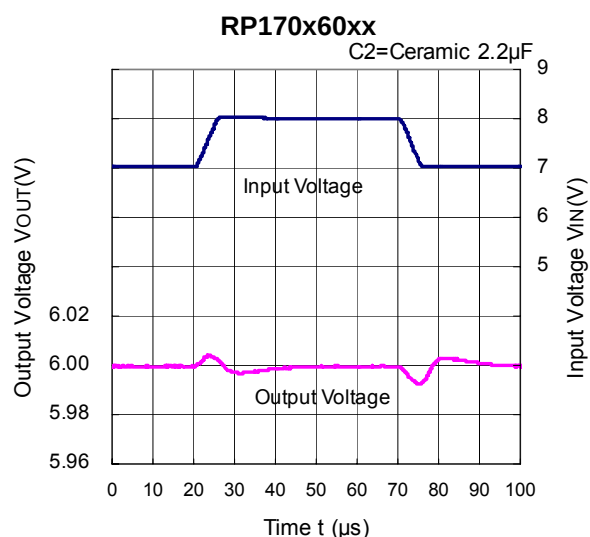
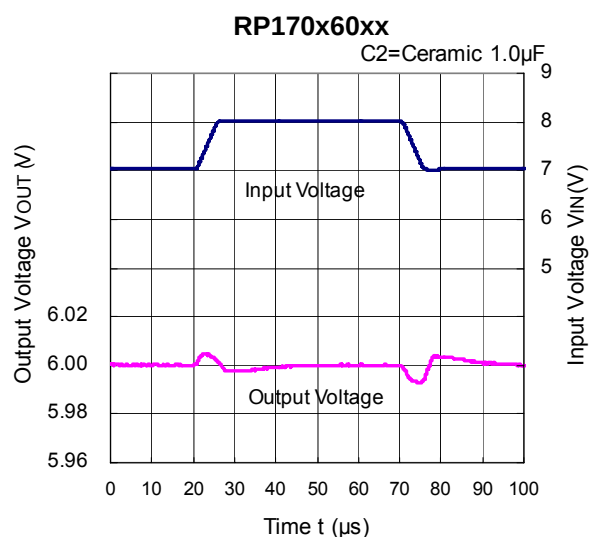
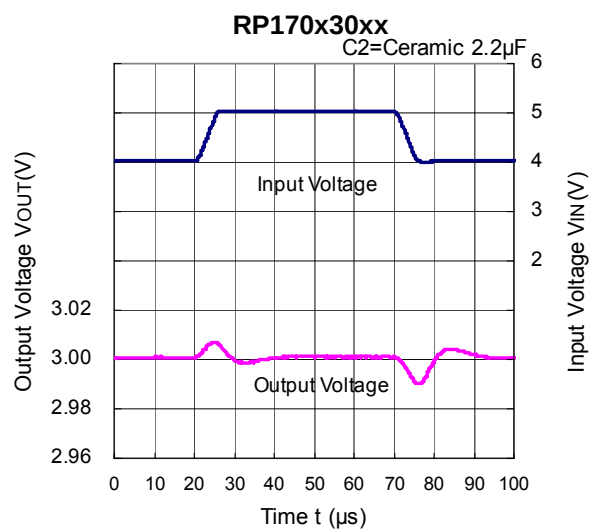
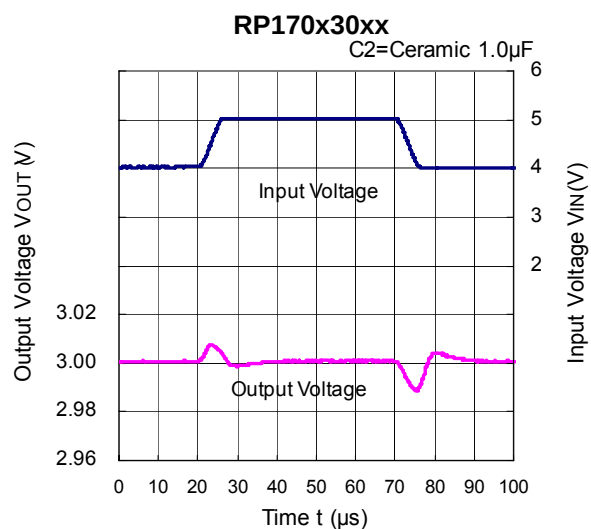
11) Ripple Rejection vs. Frequency (C1=none, C2=Ceramic 1.0μF, T_{opt}=25°C)



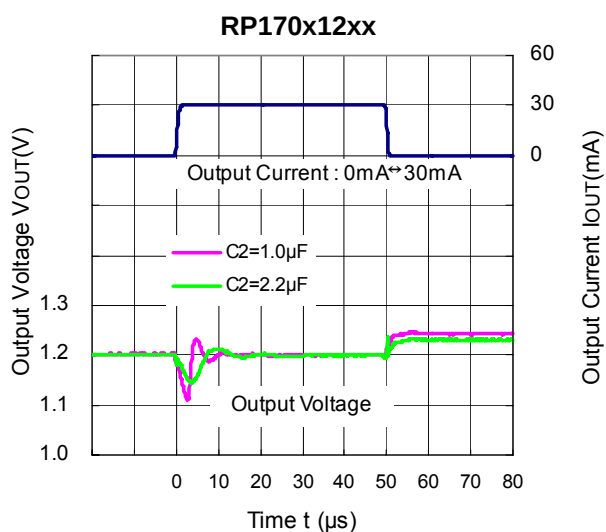
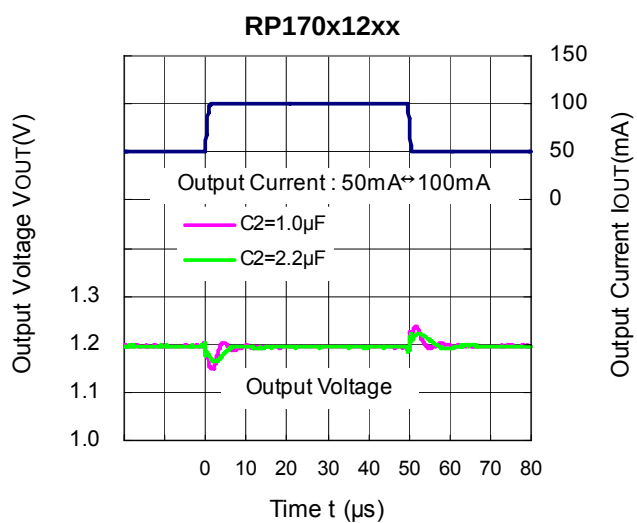


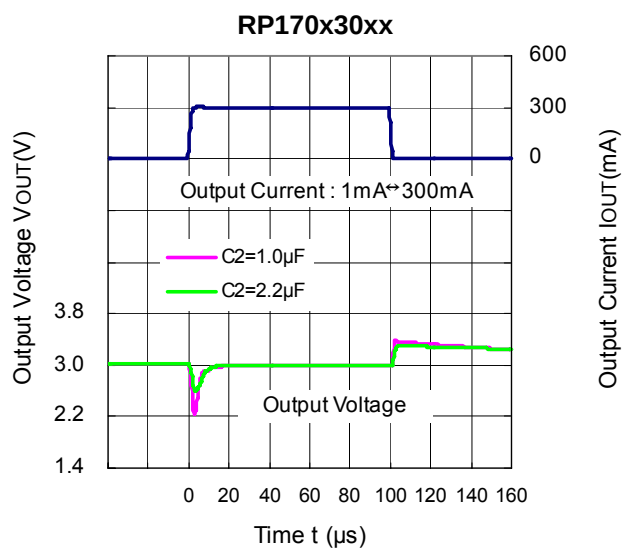
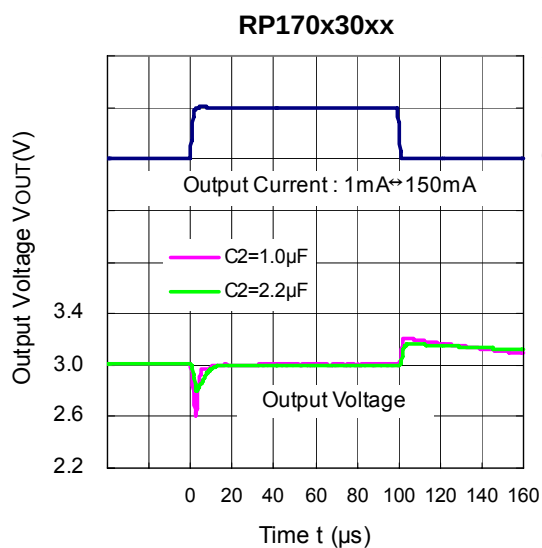
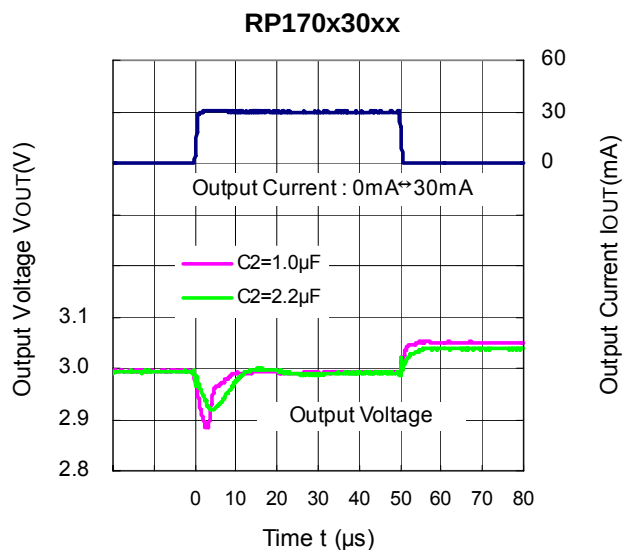
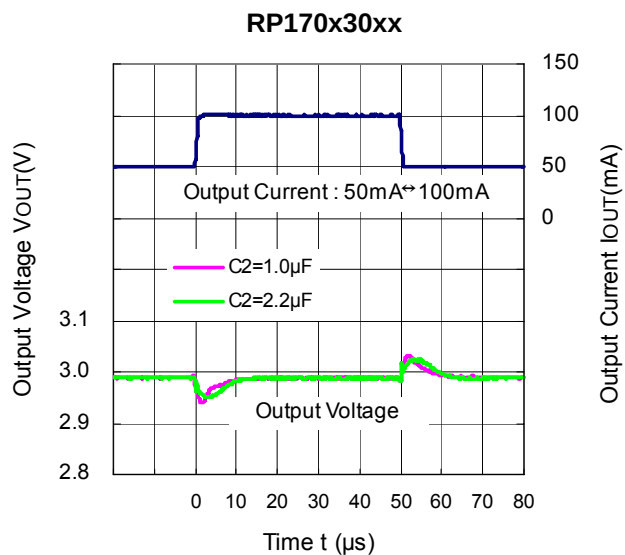
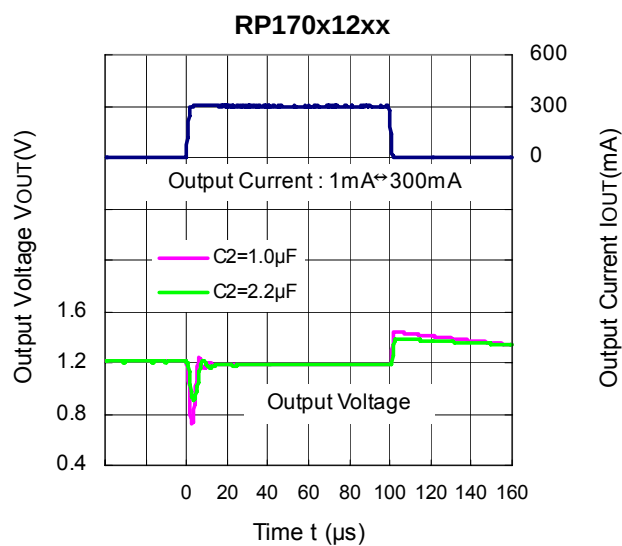
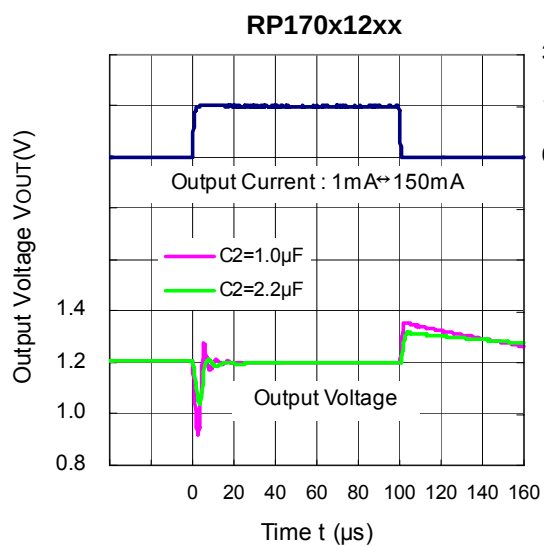
12) Input Transient Response ($C1=\text{none}$, $I_{OUT}=30mA$, $t_r=t_f=5\mu s$, $T_{opt}=25^\circ C$)

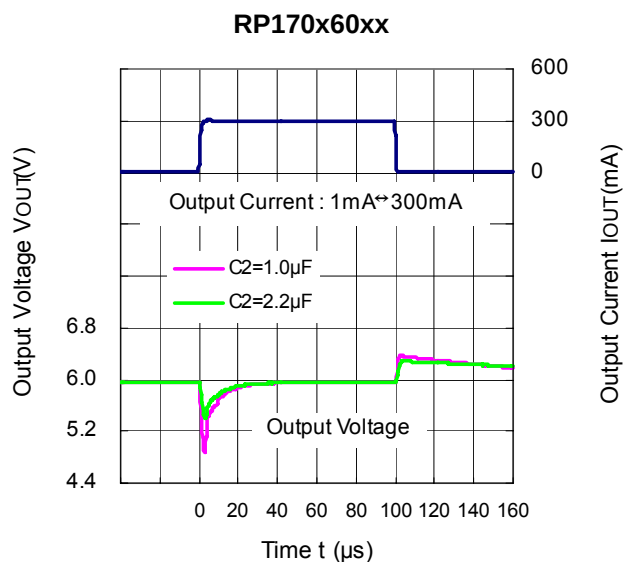
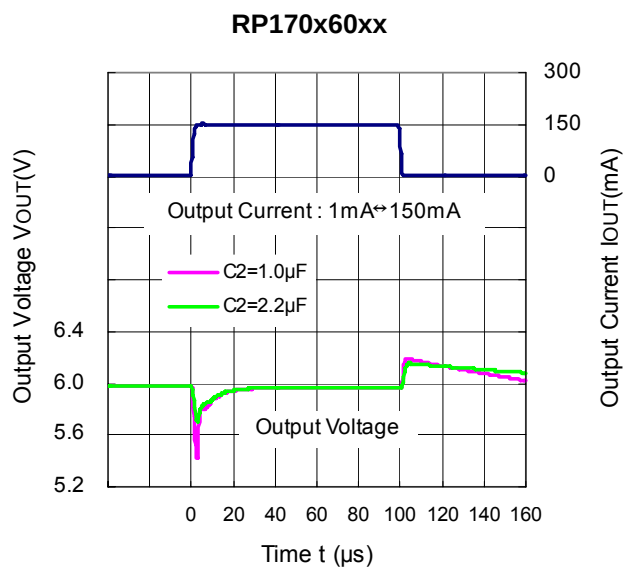
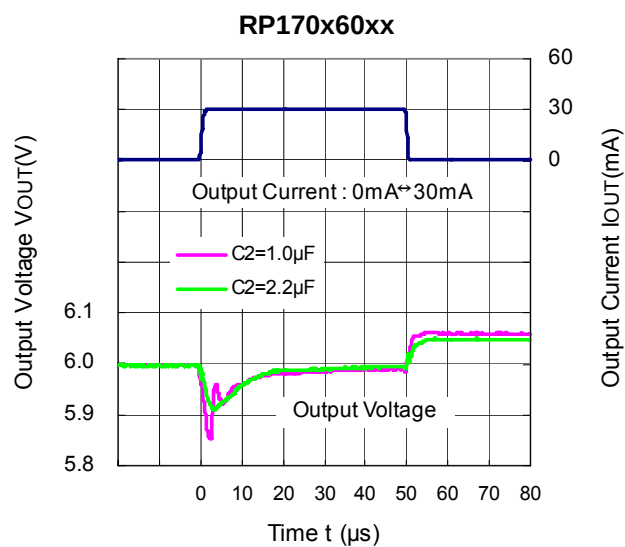
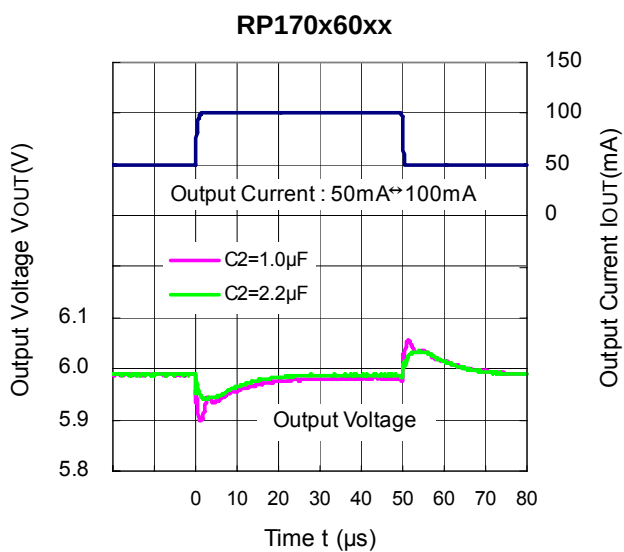




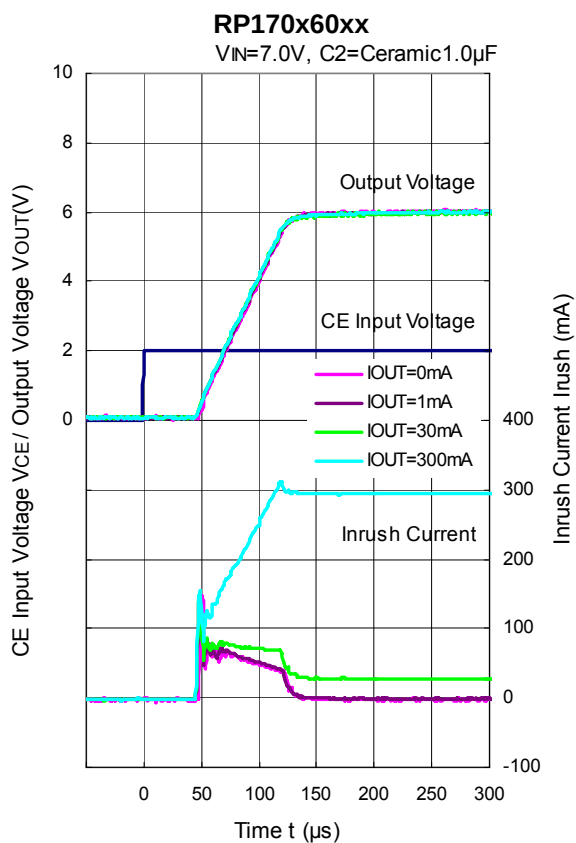
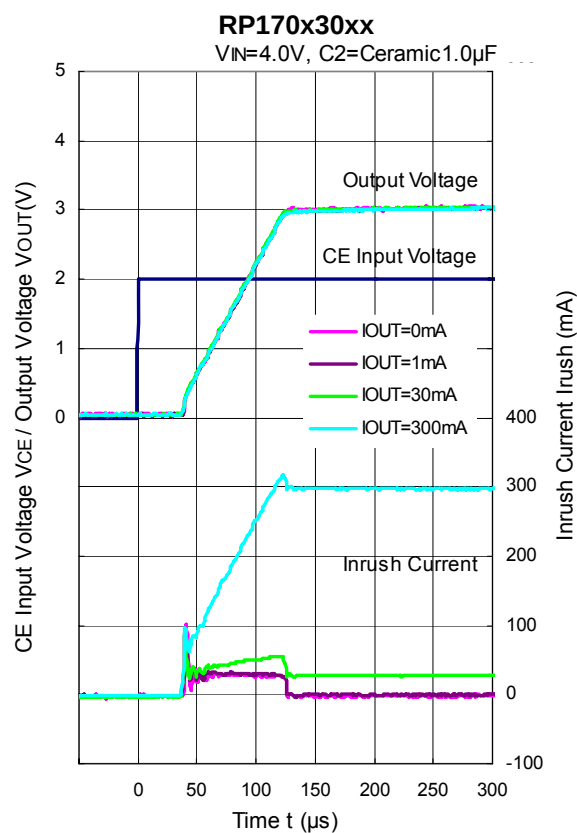
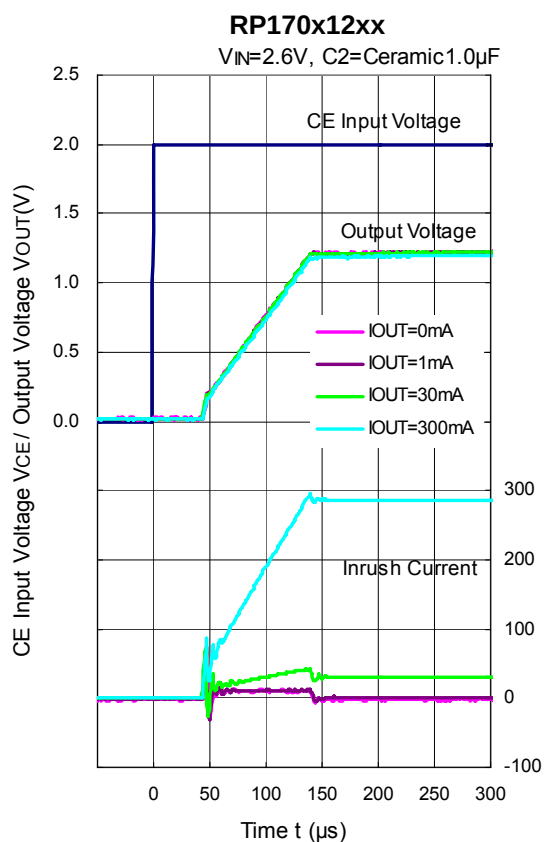
13) Load Transient Response (C1=Ceramic 1.0 μ F, $t_r=t_f=500$ ns, $T_{opt}=25^{\circ}$ C)

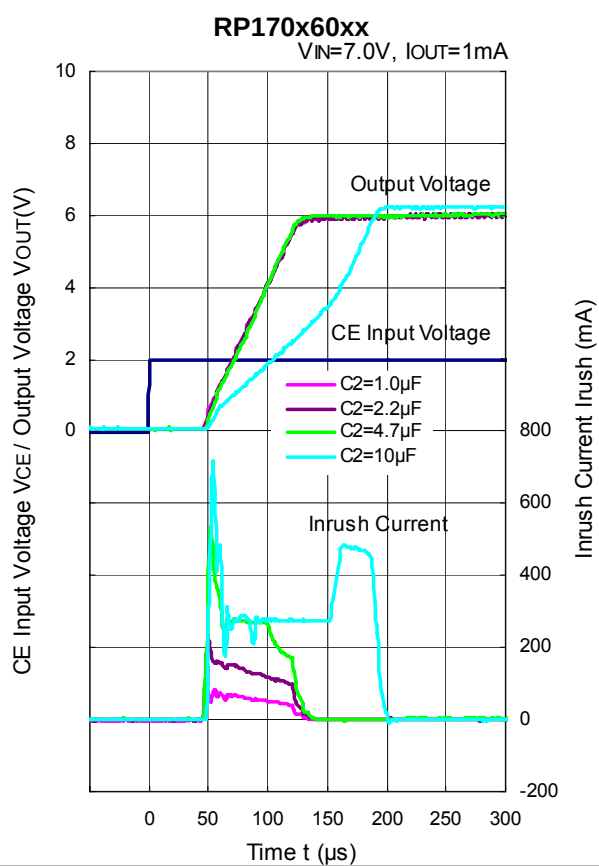
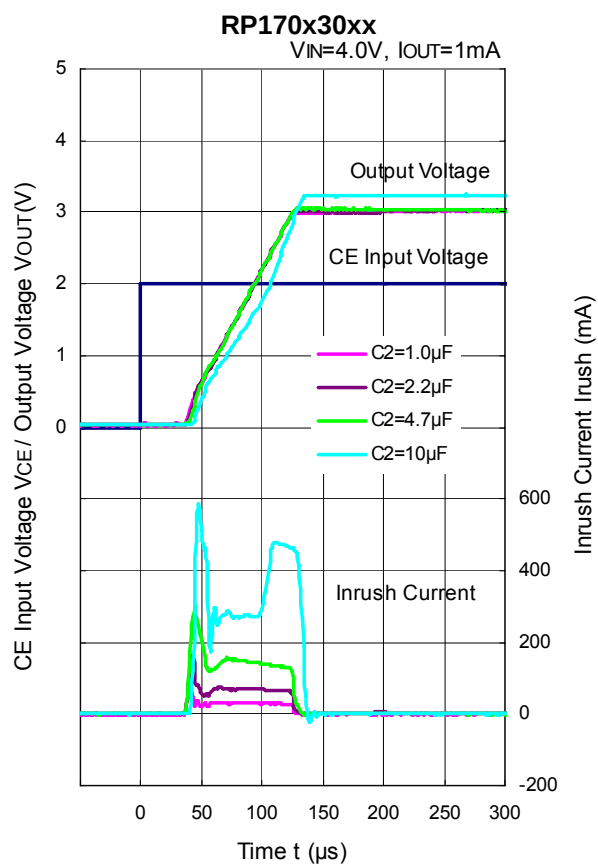
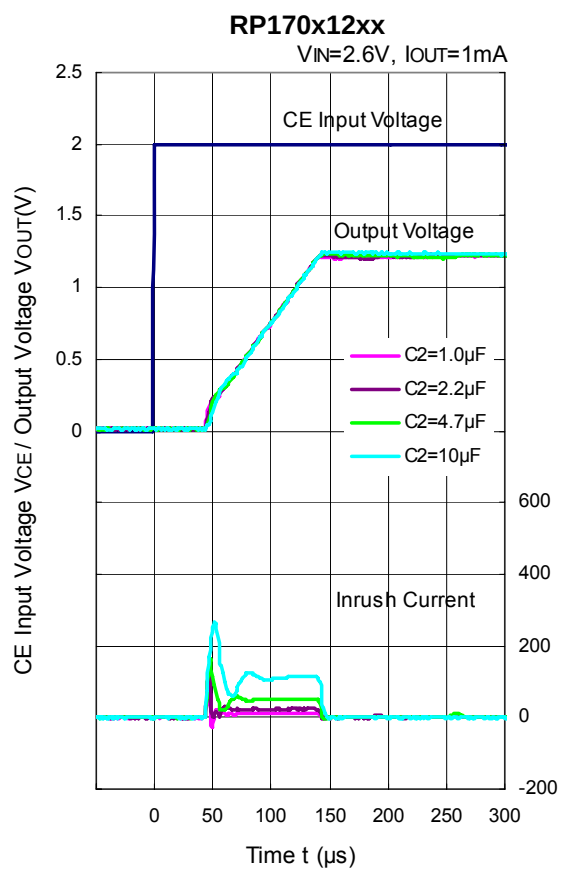


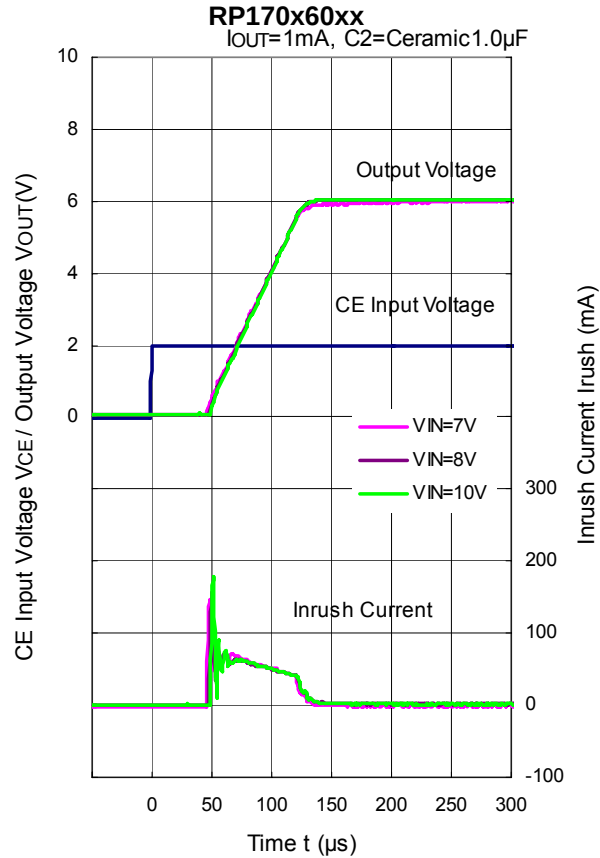
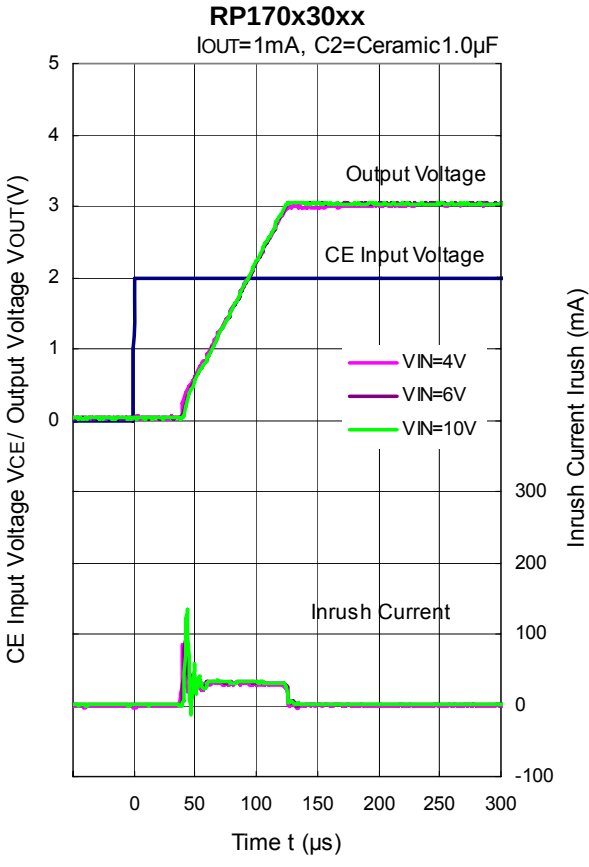
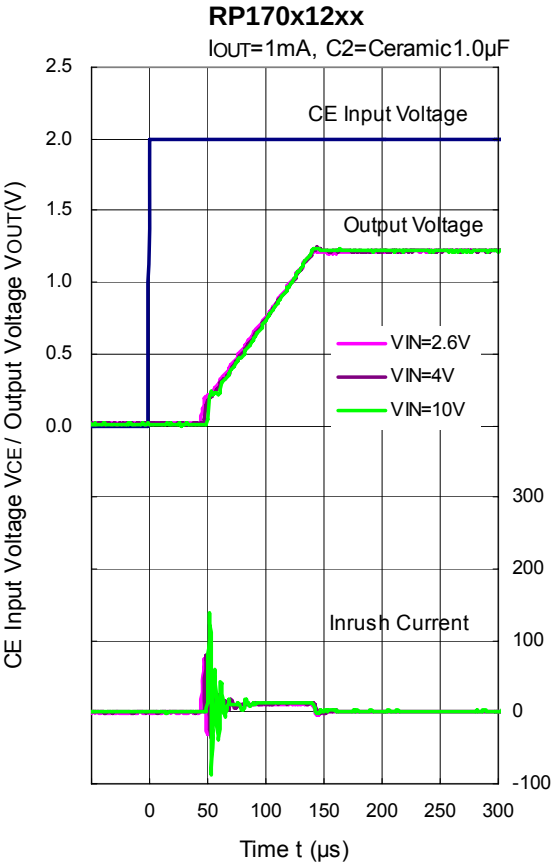




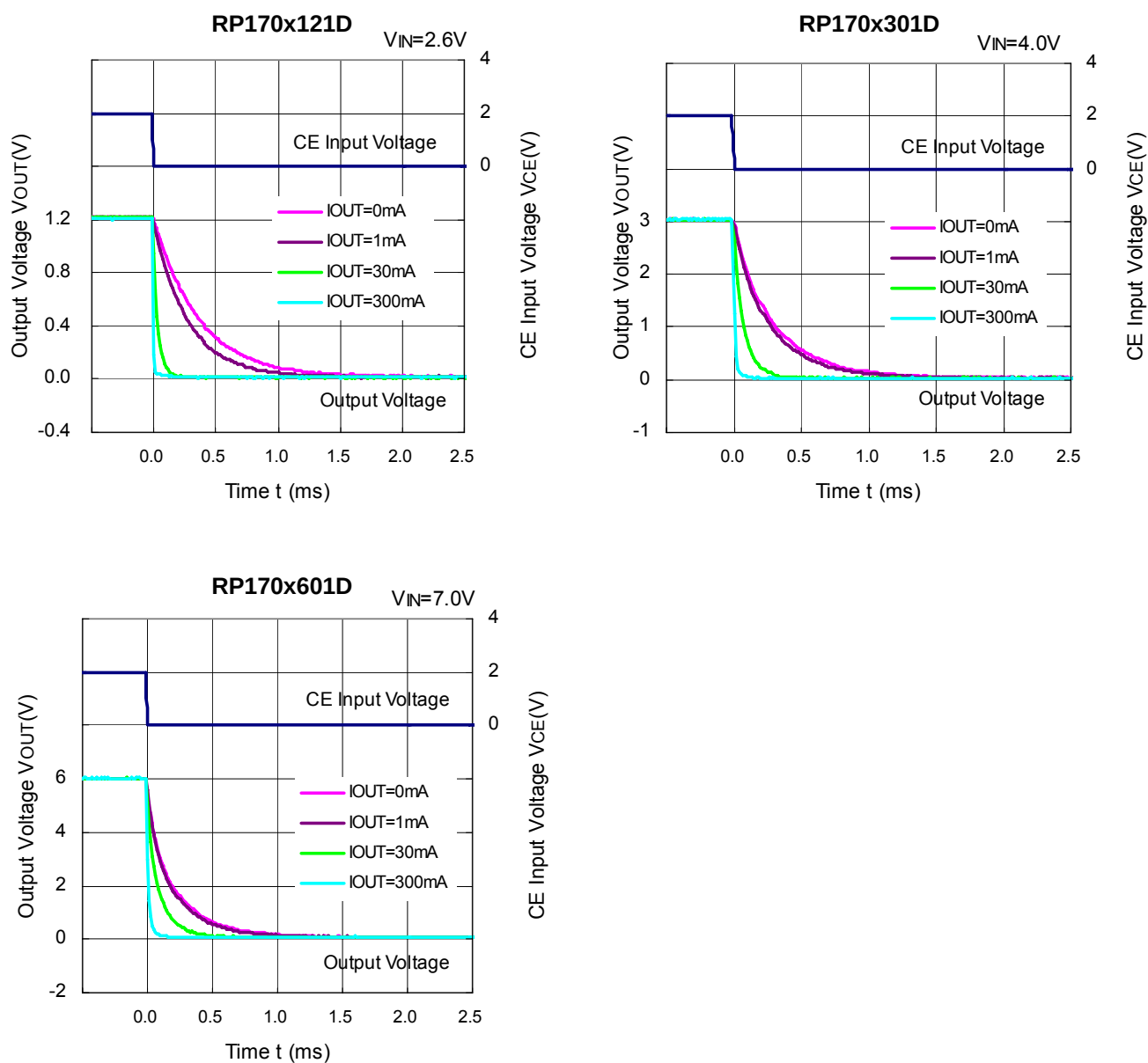
14) Turn On Speed with CE pin (C1=Ceramic 1.0 μ F, T_{opt}=25°C)







15) Turn Off Speed with CE pin (D Version) (C1=Ceramic 1.0 μ F, T_{opt}=25°C)



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.

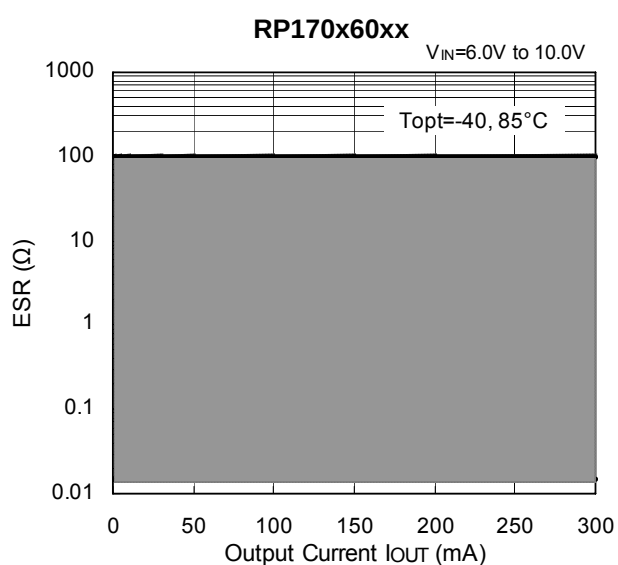
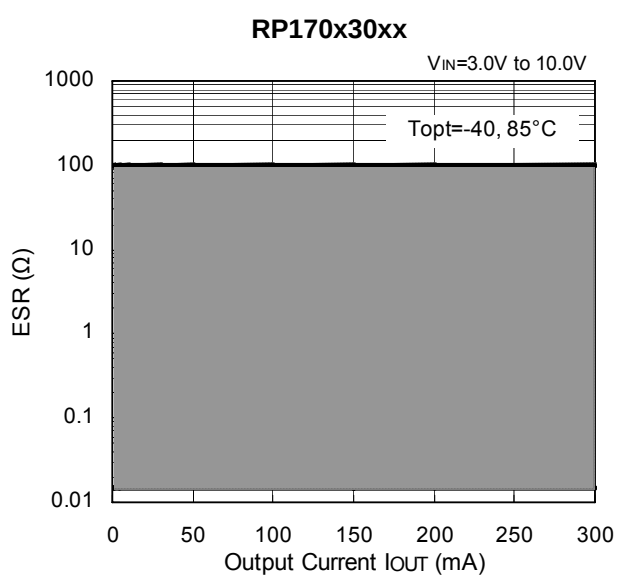
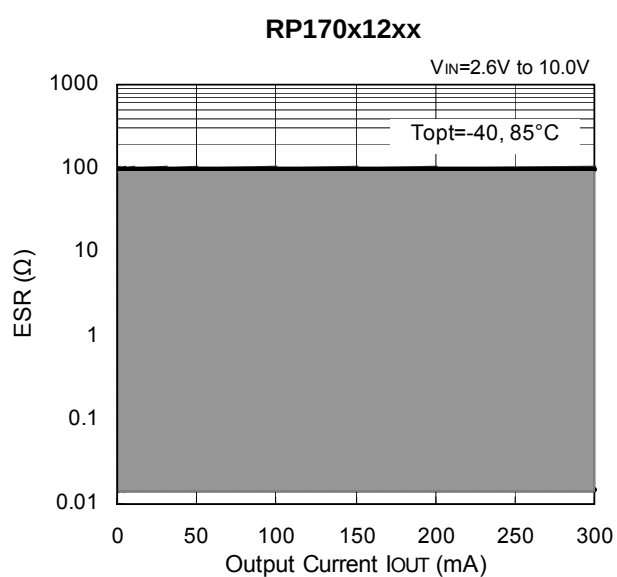
The conditions when the white noise level is under $40\mu V$ (Avg.) are marked as the hatched area in the graph.

Measurement conditions

Frequency Band : 10Hz to 2MHz

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

C1, C2 : Ceramic $1.0\mu F$ (Murata GRM155B31A105KE)





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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.