
LOW NOISE 150mA LDO REGULATOR

NO.EA-173-091109

OUTLINE

The RP130x Series are CMOS-based positive voltage regulator ICs with high ripple rejection, low dropout voltage, high output voltage accuracy and extremely low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, a resistor-net for voltage setting, a short current limit circuit and a chip enable circuit.

These ICs have an excellent low supply current performed by CMOS process, moreover they perform with low dropout voltage due to built-in low ON-resistance. A chip enable function prolongs the battery life.

The input transient response, the load transient response and the ripple rejection have been improved in the RP130x Series compared with the conventional products. Besides achieving low supply current (Typ.38 μ A).

The range of the operation voltage is capable from 1.7V to 6.5V and the range of the output voltage is capable from 1.2V to 5.0V for this product, which is wider range as our conventional product R1114x series.

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

FEATURES

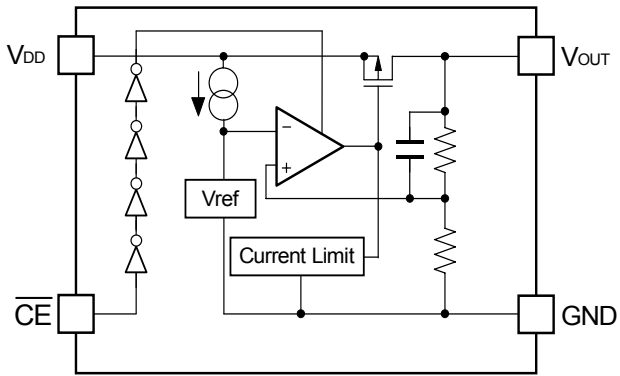
- Supply Current Typ. 38 μ A
- Supply Current (Standby Mode)..... Typ. 0.1 μ A
- Ripple Rejection Typ. 80dB (f=1kHz)
- Input Voltage Range 1.7V to 6.5V
- Output Voltage Range 1.2V to 5.0V
- Output Voltage Accuracy $\pm 1.0\%$ ($V_{OUT}>2.0V$, $T_{opt}=25^{\circ}C$)
- Temperature-Drift Coefficient of Output Voltage Typ. ± 20 ppm/ $^{\circ}C$
- Dropout Voltage..... Typ. 0.32V ($I_{OUT}=150mA$, $V_{OUT}=2.8V$)
- Line Regulation Typ. 0.02%/V
- Packages.....DFN(PLP)1010-4, SOT-23-5, SC-82AB
- Built-in Fold Back Protection Circuit..... Typ. 40mA
- Ceramic capacitors are recommended to be used with this IC 0.47 μ F or more

APPLICATIONS

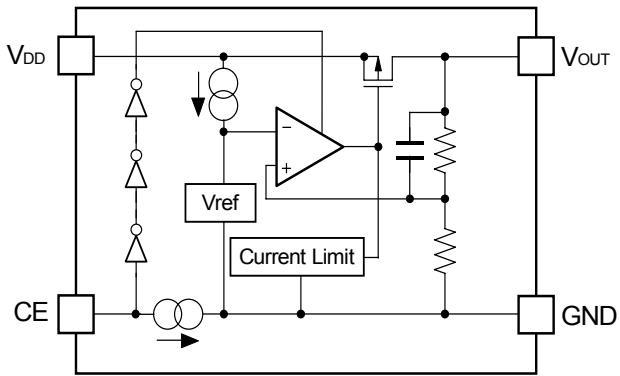
- Power source for battery-powered equipment.
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for high stable reference voltage.

BLOCK DIAGRAMS

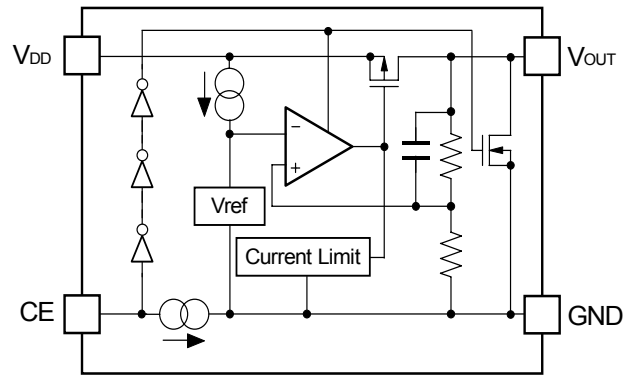
RP130xxx1A



RP130xxx1B



RP130xxx1D



SELECTION GUIDE

The output voltage, chip enable polarity, auto discharge function^{*}, and the taping type for the ICs can be selected at the user's request.

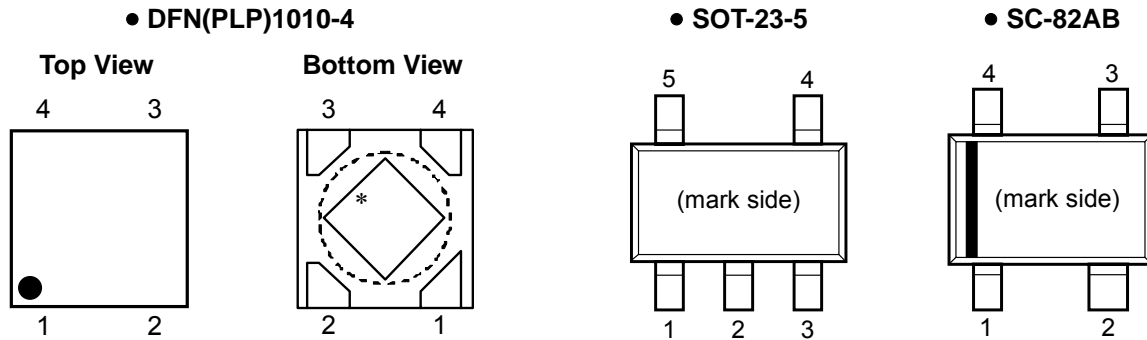
The selection can be made with designating the part number as shown below;

RP130xxx1x-xx-x ← Part Number
 ↑ ↑ ↑ ↑ ↑
 a b c d e

Code	Contents
a	Designation of Package Type: K: DFN(PLP)1010-4 N: SOT-23-5 Q: SC-82AB
b	Setting Output Voltage (V _{OUT}): 1.2V to 5.0V (For Standard Voltage, please refer to MARK INFORMATION.)
c	Designation of Mask Option A: active low, without auto discharge function [*] at OFF state. 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) 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



PIN DESCRIPTIONS

• DFN(PLP)1010-4

Pin No	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	\overline{CE} / 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.

• SOT-23-5

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

• SC-82AB

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	7.0	V
V_{CE}	Input Voltage (CE Pin)	-0.3 to 7.0	V
V_{OUT}	Output Voltage	-0.3 to $V_{IN}+0.3$	V
I_{OUT}	Output Current (DC)	200	mA
P_D	Power Dissipation (DFN(PLP)1010-4)*	400	mW
	Power Dissipation (SOT-23-5)*	420	
	Power Dissipation (SC-82AB)*	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.

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

V_{IN} =Set $V_{OUT}+1V$ for $V_{OUT}>1.5V$. $V_{IN}=2.5V$ for $V_{OUT} \leq 1.5V$. $I_{OUT}=1mA$, $C_{IN}=C_{OUT}=0.47\mu F$, unless otherwise noted.

The specification in is checked and guaranteed by design engineering at $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$, unless otherwise noted.

● **RP130xxx1A**

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

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{OUT}	Output Voltage	$T_{opt}=25^{\circ}C$	$V_{OUT}>2.0V$	$\times 0.99$		$\times 1.01$	V
			$V_{OUT} \leq 2.0V$	-20		20	mV
		$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	$V_{OUT}>2.0V$	×0.985		×1.015	V
			$V_{OUT} \leq 2.0V$	-30		30	mV
I_{OUT}	Output Current		150			mA	
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$1mA \leq I_{OUT} \leq 150mA$		10	30	mV	
V_{DIF}	Dropout Voltage	$I_{OUT}=150mA$	$1.2V \leq V_{OUT}<1.5V$		0.67	1.00	V
			$1.5V \leq V_{OUT}<1.7V$		0.54	0.81	
			$1.7V \leq V_{OUT}<2.0V$		0.46	0.68	
			$2.0V \leq V_{OUT}<2.5V$		0.41	0.60	
			$2.5V \leq V_{OUT}<4.0V$		0.32	0.51	
			$4.0V \leq V_{OUT}$		0.24	0.37	
I_{SS}	Supply Current	$I_{OUT}=0mA$		38	58	μA	
$I_{standby}$	Standby Current	$V_{CE}=V_{IN}$		0.1	1.0	μA	
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	Set $V_{OUT}+0.5V \leq V_{IN} \leq 5.0V$		0.02	0.10	%/V	
RR	Ripple Rejection	$f=1kHz$, Ripple 0.2Vp-p V_{IN} =Set $V_{OUT}+1.0V$, $I_{OUT}=30mA$ (In case that $V_{OUT} \leq 2.0V$, $V_{IN}=3.0V$)		80		dB	
V_{IN}	Input Voltage		1.7		6.5	V	
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		± 20		ppm/ $^{\circ}C$	
I_{lim}	Short Current Limit	$V_{OUT}=0V$		40		mA	
V_{CEH}	\overline{CE} Input Voltage "H"		1.0			V	
V_{CEL}	\overline{CE} Input Voltage "L"				0.4	V	
en	Output Noise	$BW=10Hz$ to $100kHz$, $I_{OUT}=30mA$		30		μV_{rms}	

All of units 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.

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.

● RP130xxx1B/D

T_{opt}=25°C

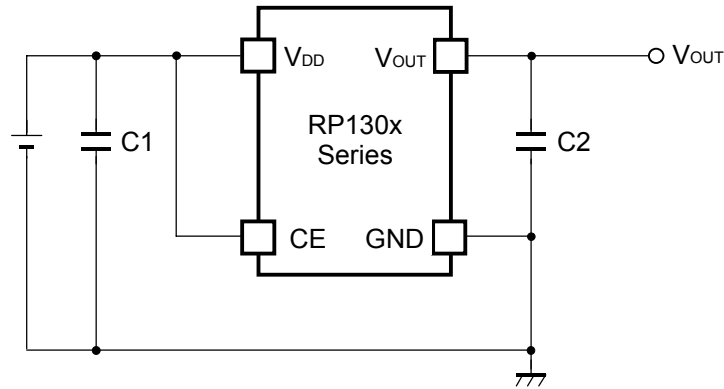
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V _{OUT}	Output Voltage	T _{opt} =25°C	V _{OUT} >2.0V	×0.99		×1.01	V
			V _{OUT} ≤ 2.0V	-20		20	mV
		-40°C ≤ T _{opt} ≤ 85°C	V _{OUT} >2.0V	×0.985		×1.015	V
			V _{OUT} ≤ 2.0V	-30		30	mV
I _{OUT}	Output Current		150			mA	
ΔV _{OUT} /ΔI _{OUT}	Load Regulation	1mA ≤ I _{OUT} ≤ 150mA		10	30	mV	
V _{DIF}	Dropout Voltage	I _{OUT} =150mA	1.2V ≤ V _{OUT} <1.5V	0.67	1.00	V	
			1.5V ≤ V _{OUT} <1.7V	0.54	0.81		
			1.7V ≤ V _{OUT} <2.0V	0.46	0.68		
			2.0V ≤ V _{OUT} <2.5V	0.41	0.60		
			2.5V ≤ V _{OUT} <4.0V	0.32	0.51		
			4.0V ≤ V _{OUT}	0.24	0.37		
I _{SS}	Supply Current	I _{OUT} =0mA		38	58	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} +1.0V, I _{OUT} =30mA (In case that V _{OUT} ≤ 2.0V, V _{IN} =3.0V)		80		dB	
V _{IN}	Input Voltage		1.7		6.5	V	
ΔV _{OUT} /ΔT _{opt}	Output Voltage Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±20		ppm/°C	
I _{lim}	Short Current Limit	V _{OUT} =0V		40		mA	
I _{PD}	CE Pull-down Current			0.4		μA	
V _{CEH}	CE Input Voltage "H"		1.0			V	
V _{CEL}	CE Input Voltage "L"				0.4	V	
e _n	Output Noise	BW=10Hz to 100kHz, I _{OUT} =30mA		30		μVrms	
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 T_j≈T_{opt}=25°C except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient.

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)

Ceramic Capacitor 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 0.47 μ F or more.

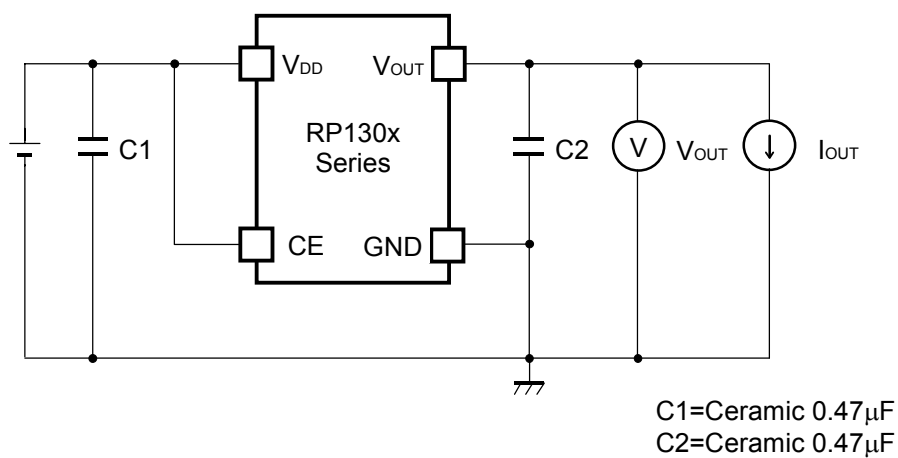
If a tantalum capacitor is used, and its ESR (Equivalent Series Resistance) of C2 is large, the loop oscillation may result. Because of this, select C2 carefully considering its frequency characteristics.

PCB Layout

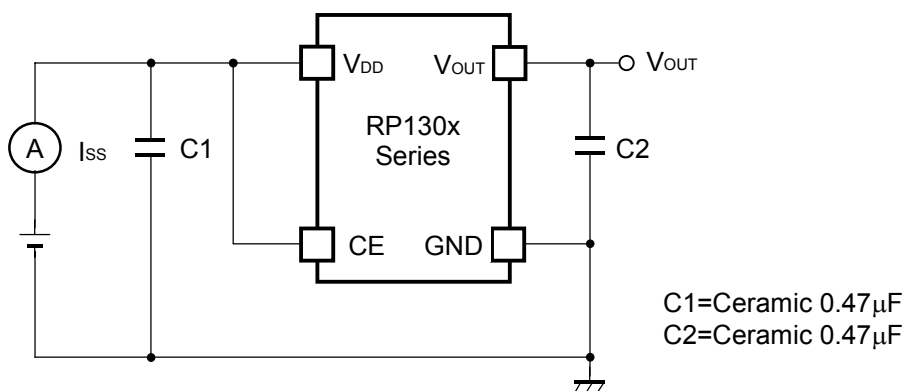
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 0.47 μ F or more between V_{DD} and GND pin, and as close as possible to the pins.

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

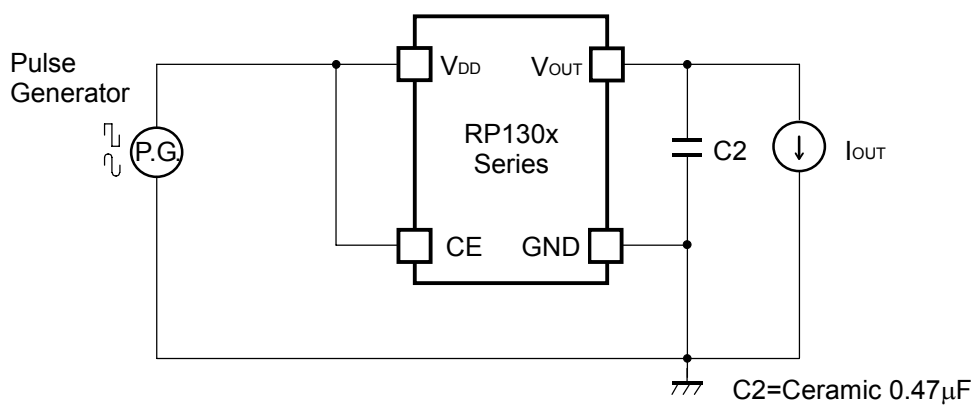
TEST CIRCUITS



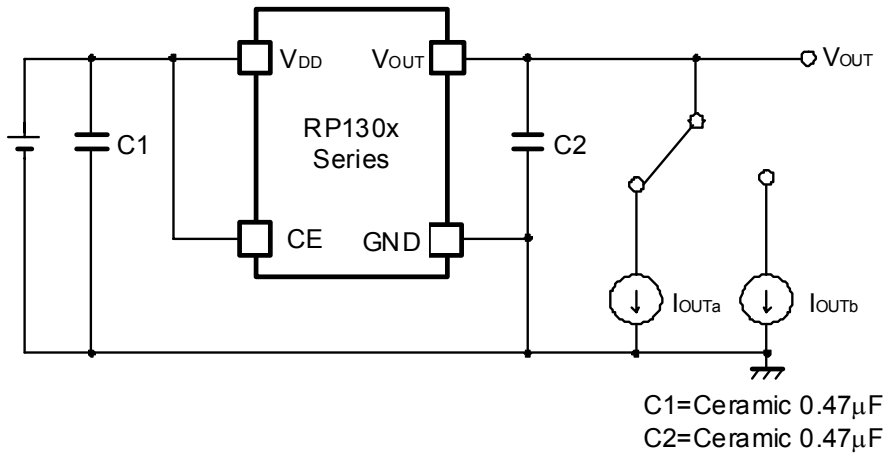
Basic Test Circuit



Supply Current Test Circuit



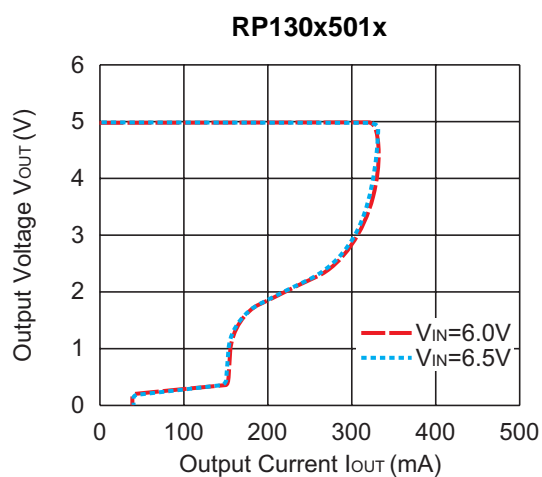
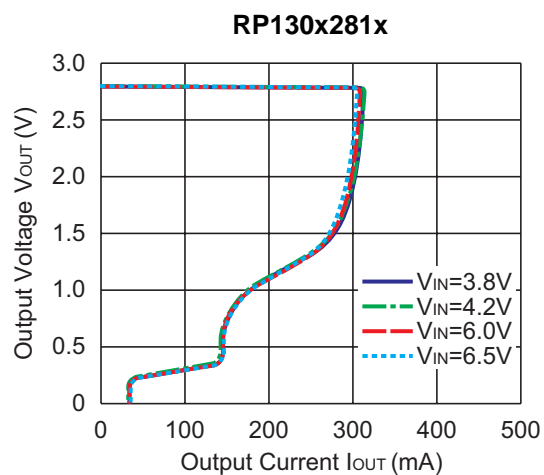
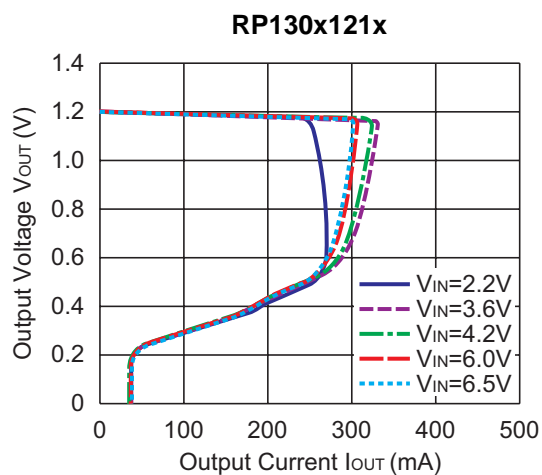
Ripple Rejection Test Circuit



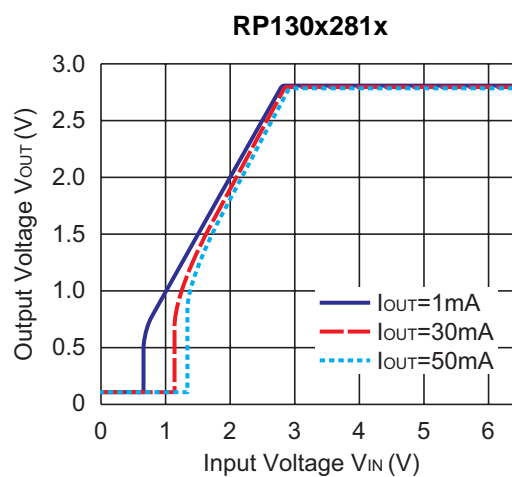
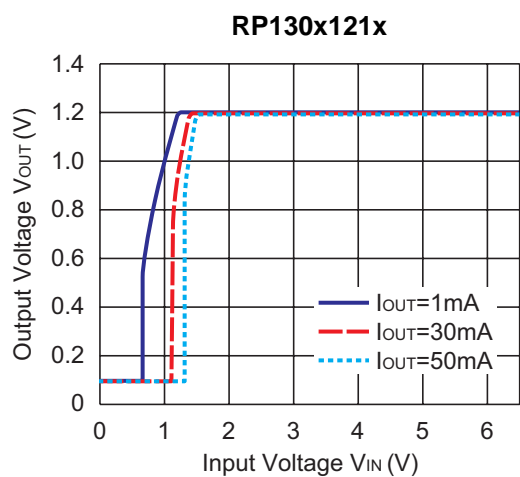
Load Transient Response Test Circuit

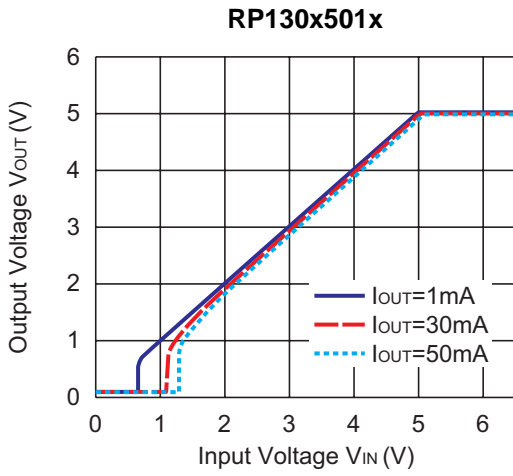
TYPICAL CHARACTERISTICS

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

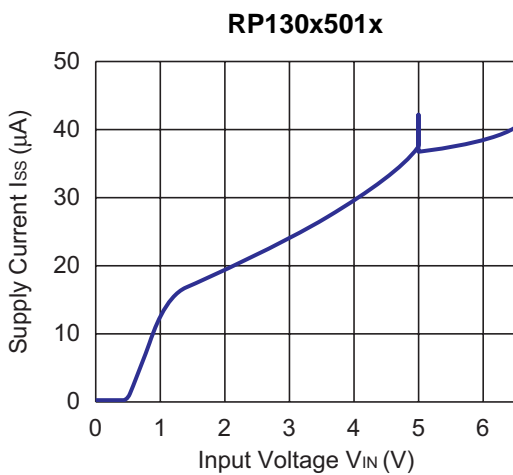
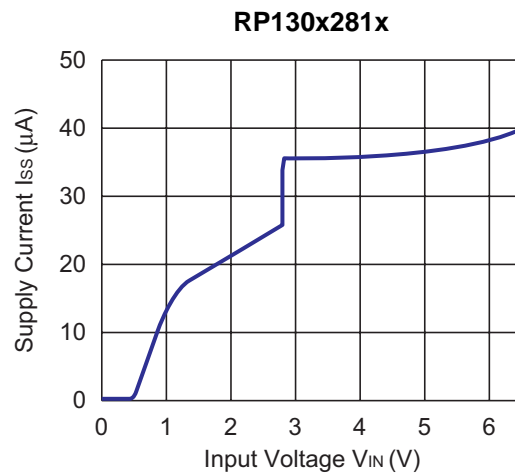
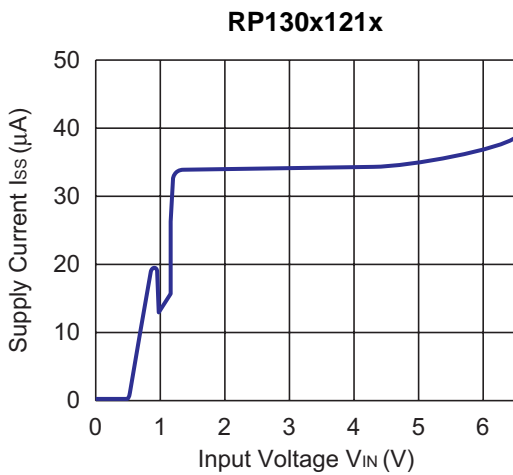


2) Output Voltage vs. Input Voltage ($C_1=0.47\mu\text{F}$, $C_2=0.47\mu\text{F}$, $T_{opt}=25^\circ\text{C}$)

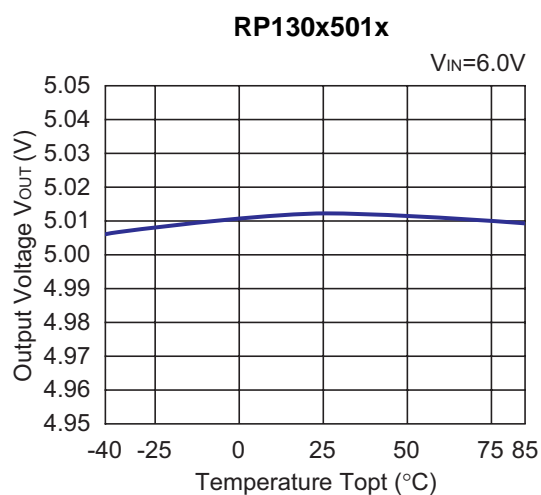
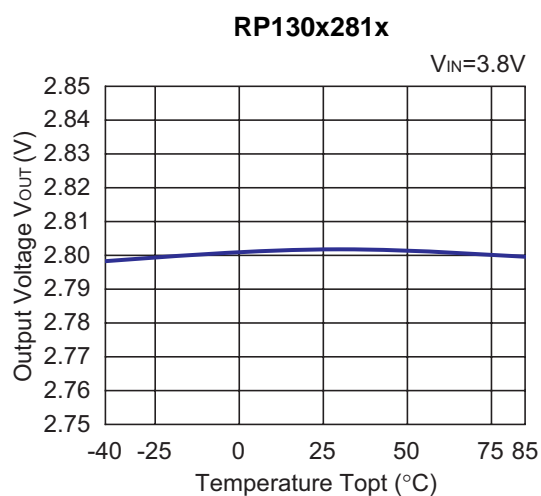
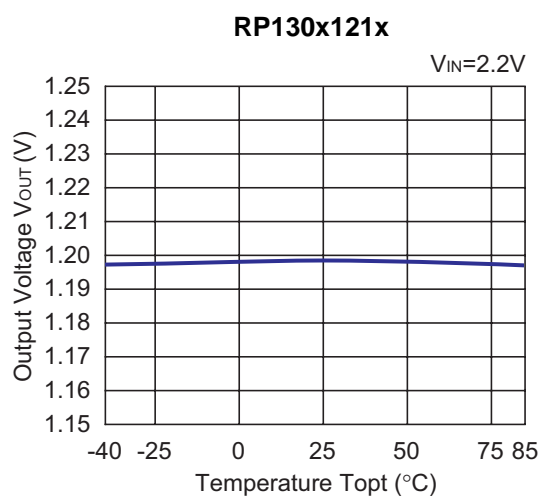




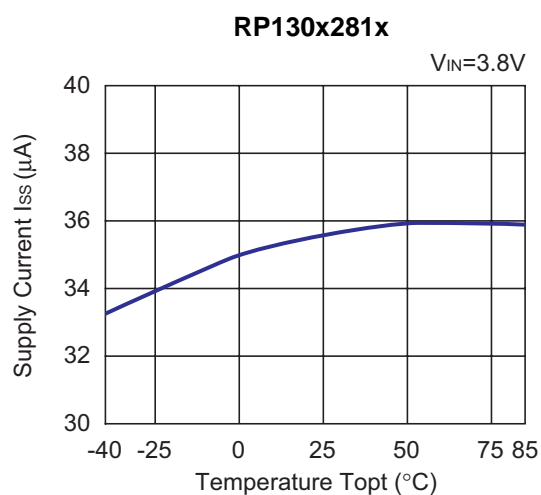
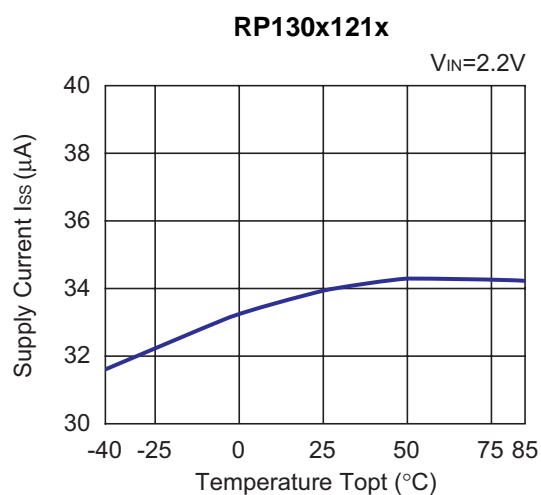
3) Supply Current vs. Input Voltage (C1=0.47 μ F, C2=0.47 μ F, Topt=25°C)



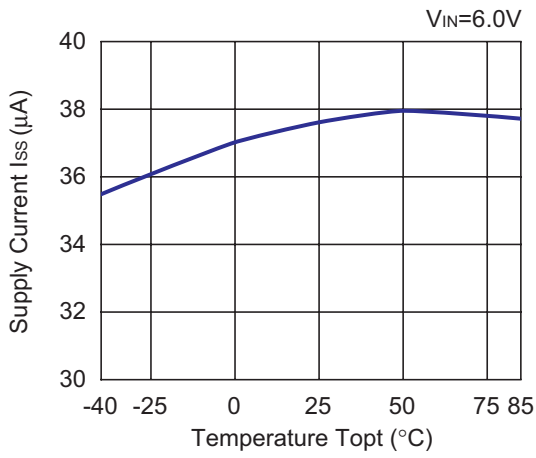
4) Output Voltage vs. Temperature ($I_{OUT}=1mA$, $C1=0.47\mu F$, $C2=0.47\mu F$)



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

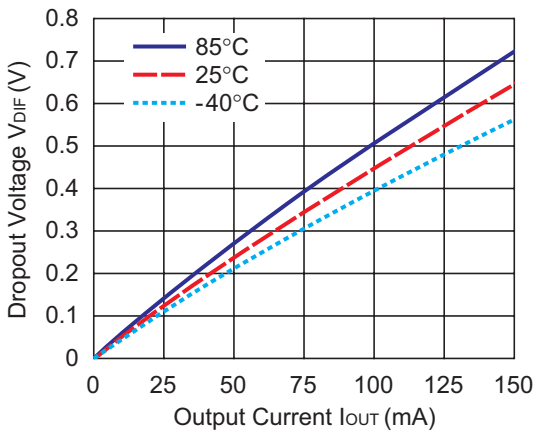


RP130x501x

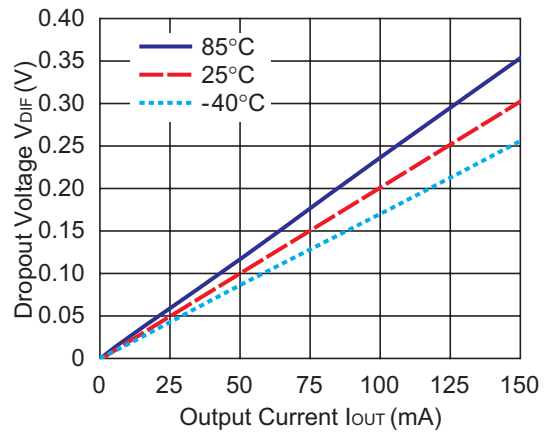


6) Dropout Voltage vs. Output Current ($C1=0.47\mu F$, $C2=0.47\mu F$)

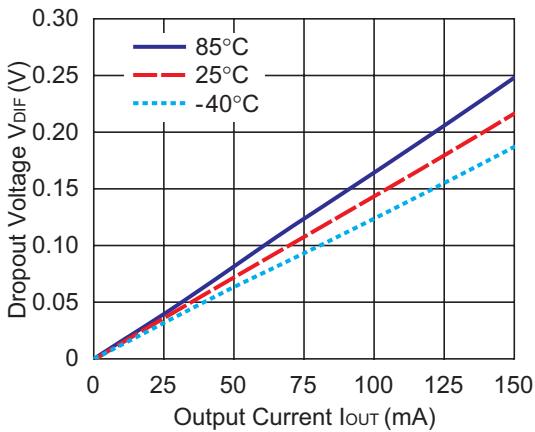
RP130x121x



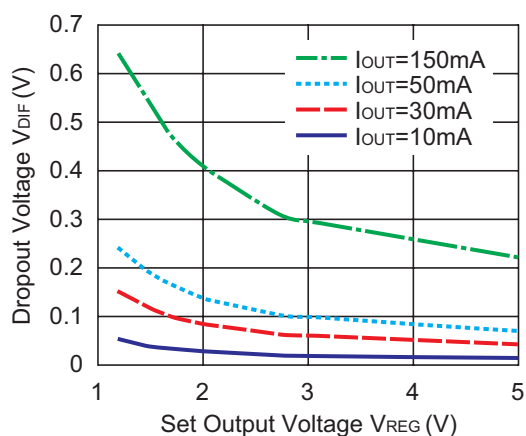
RP130x281x



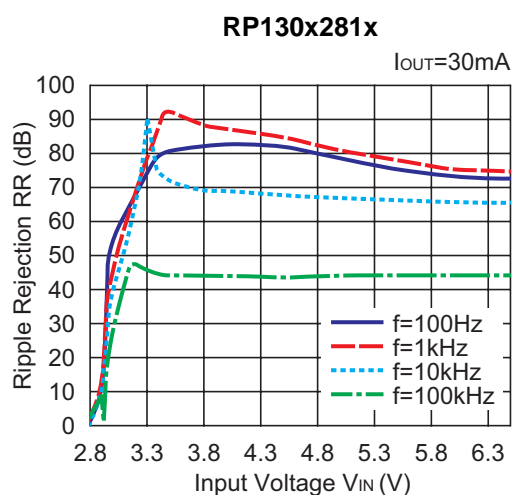
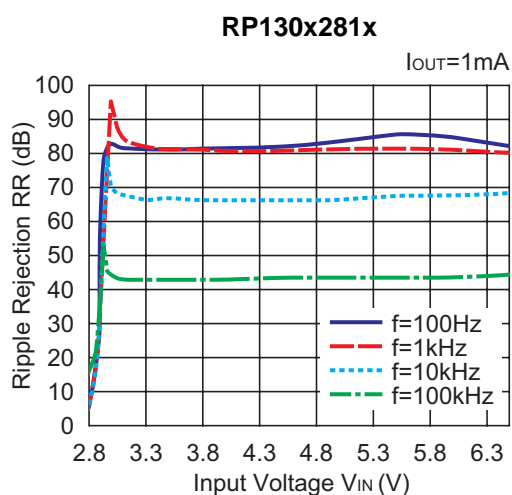
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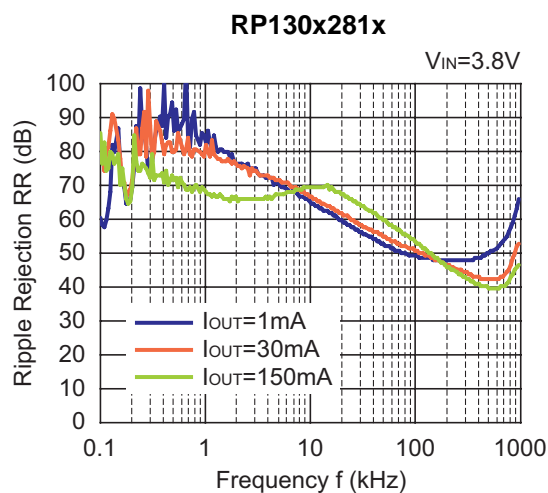
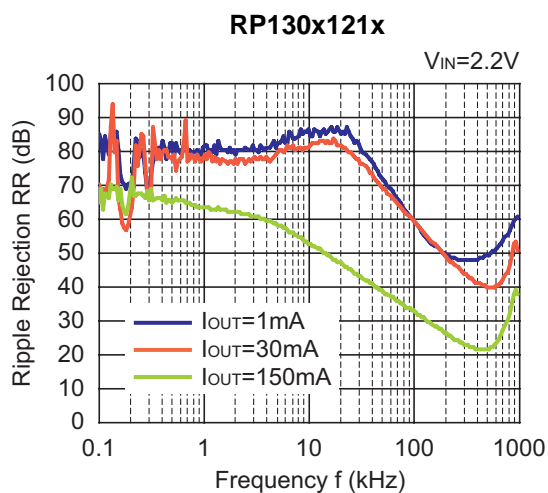
7) Dropout Voltage vs. Set Output Voltage (C1=0.47μF, C2=0.47μF)



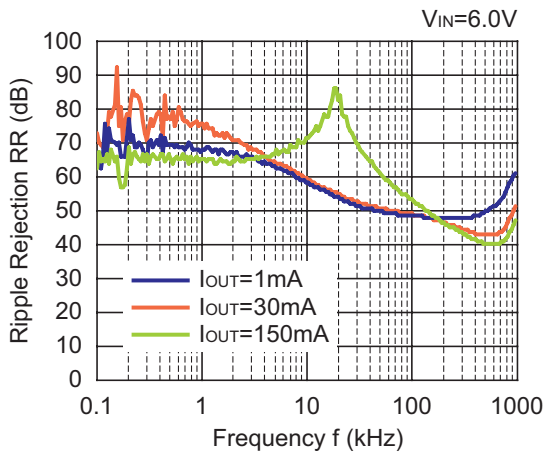
8) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=0.47μF, Ripple=0.2V_{p-p}, T_{opt}=25°C)



9) Ripple Rejection vs. Frequency (C1=none, C2=0.47μF, Ripple=0.2V_{p-p}, T_{opt}=25°C)

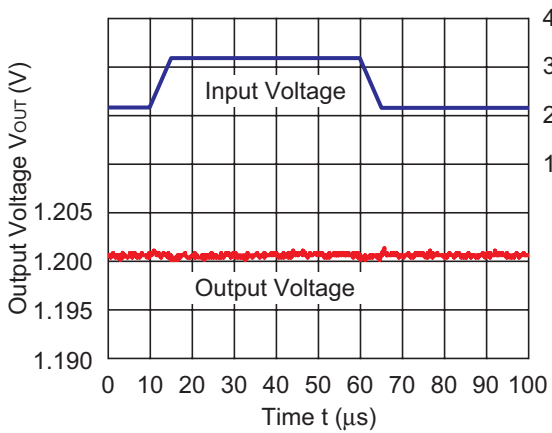


RP130x501x

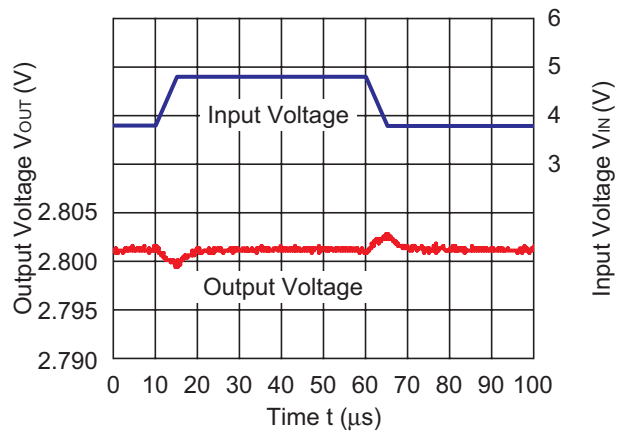


10) Input Transient Response ($I_{OUT}=30mA$, $t_r=t_f=5\mu s$, $C1=none$, $C2=0.47\mu F$, $T_{opt}=25^\circ C$)

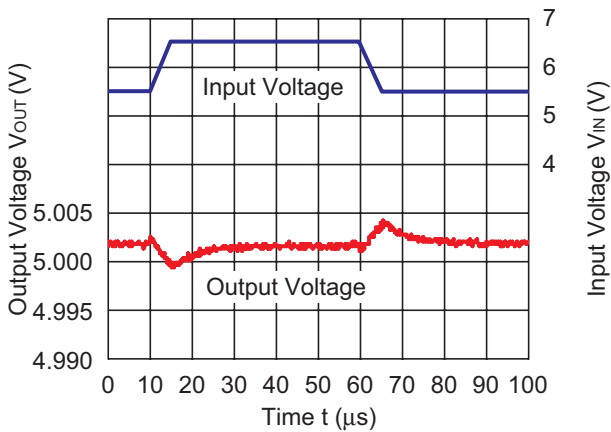
RP130x121x



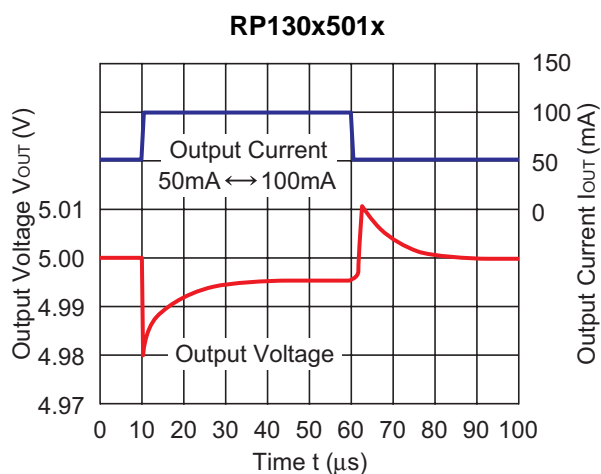
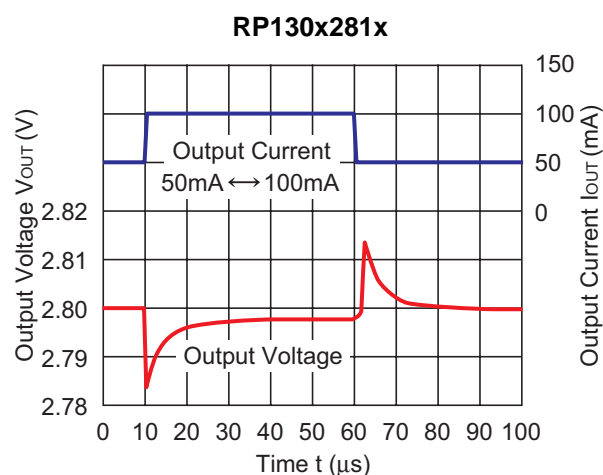
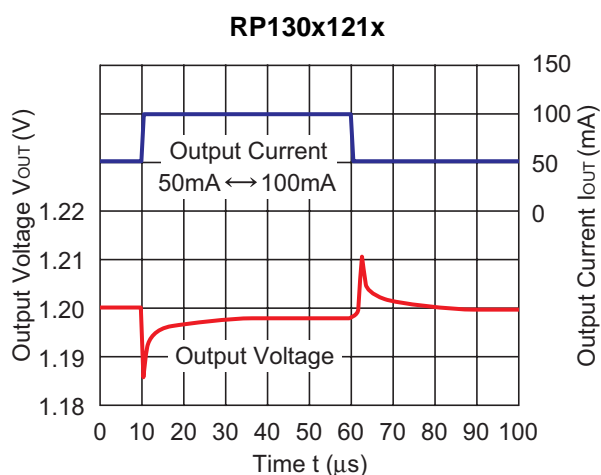
RP130x281x



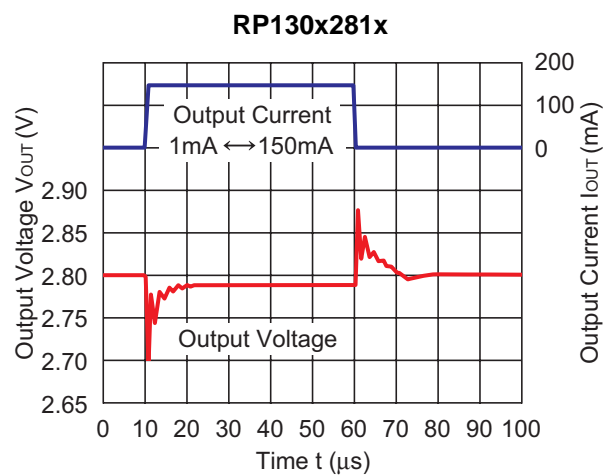
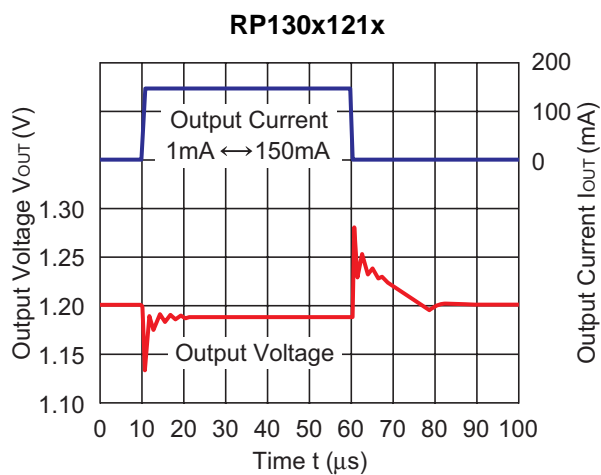
RP130x501x



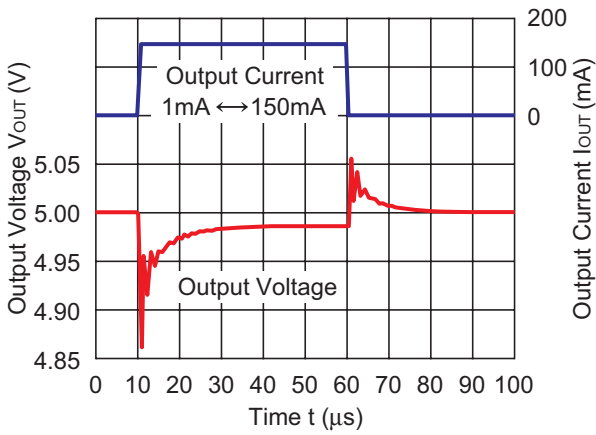
11) Load Transient Response ($t_r=t_f=0.5\mu s$, $C_1=0.47\mu F$, $C_2=0.47\mu F$, $I_{OUT}=50mA \leftrightarrow 100mA$, $T_{opt}=25^\circ C$)



12) Load Transient Response ($t_r=t_f=0.5\mu s$, $C_1=0.47\mu F$, $C_2=0.47\mu F$, $I_{OUT}=1mA \leftrightarrow 150mA$, $T_{opt}=25^\circ C$)

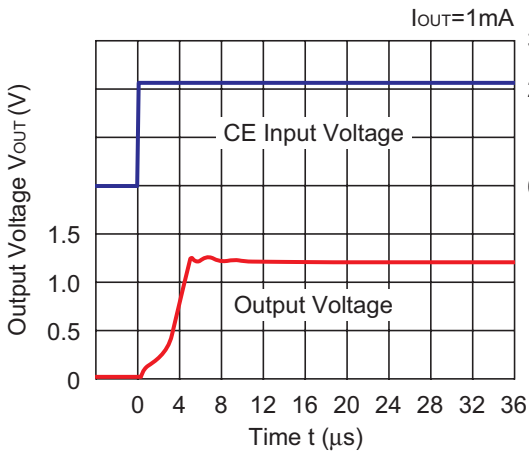


RP130x501x

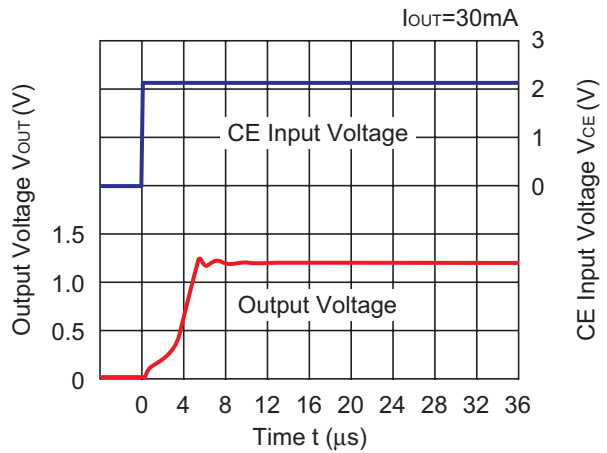


13) Turn On Speed with CE pin ($C1=0.47\mu F$, $C2=0.47\mu F$, $T_{opt}=25^{\circ}C$)

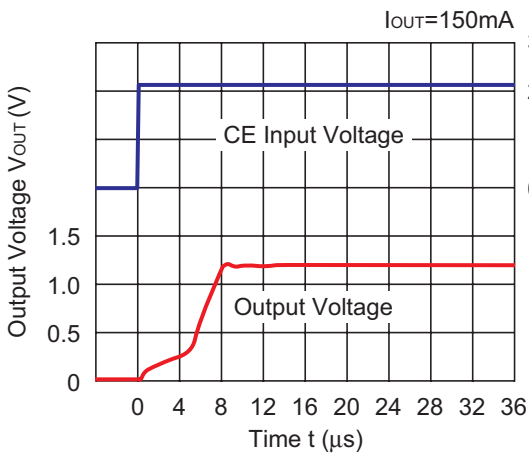
RP130x121x



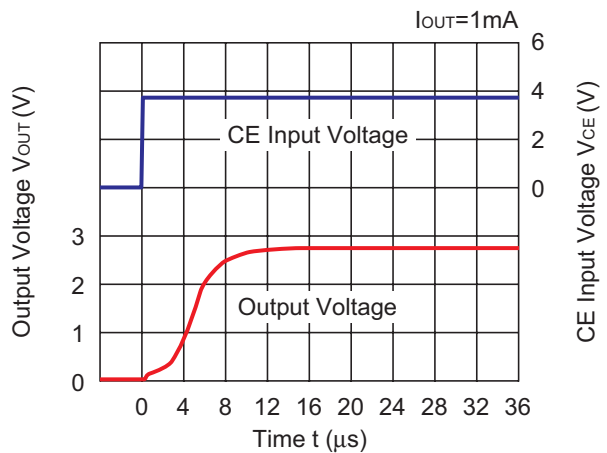
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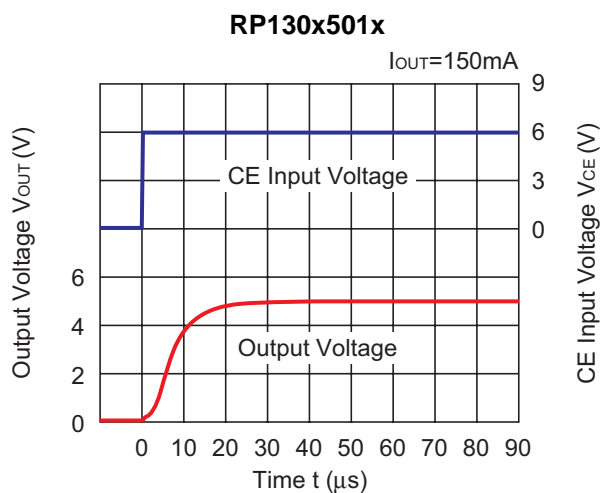
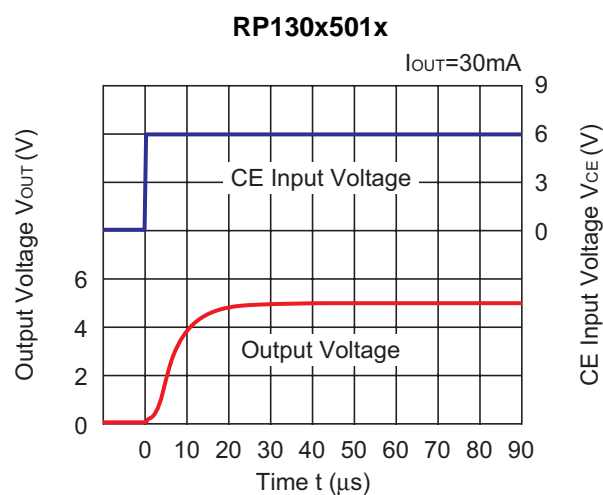
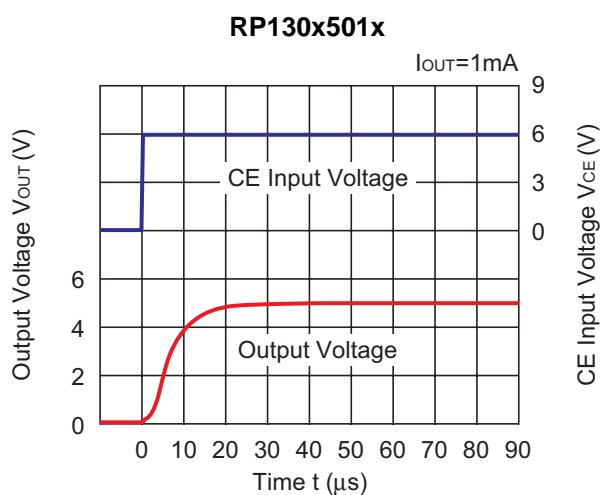
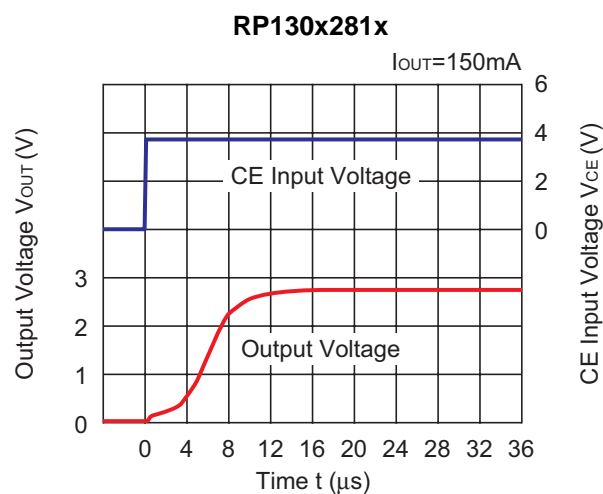
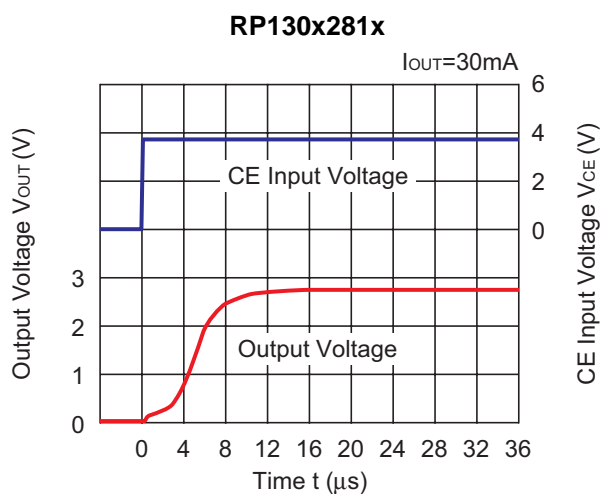


RP130x121x

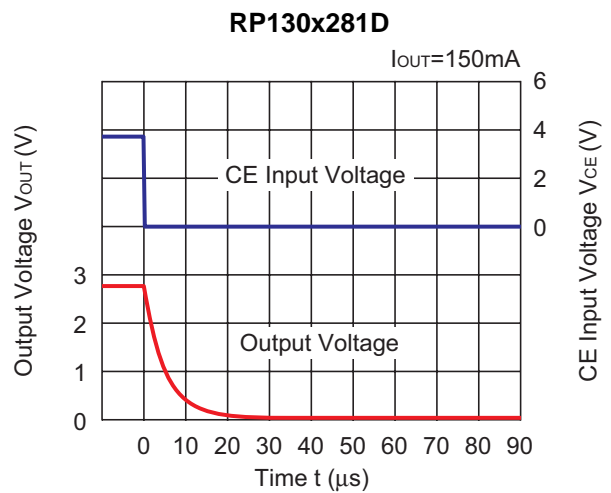
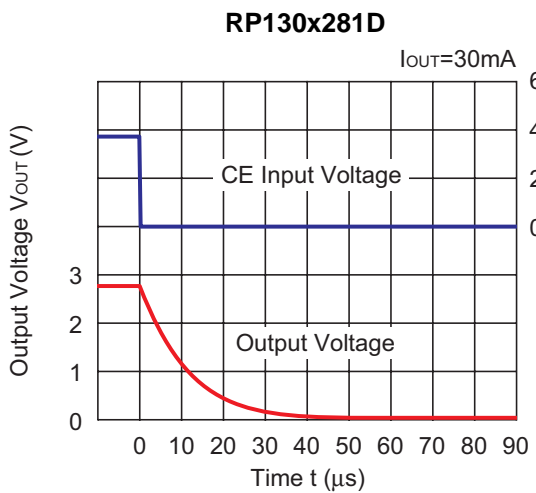
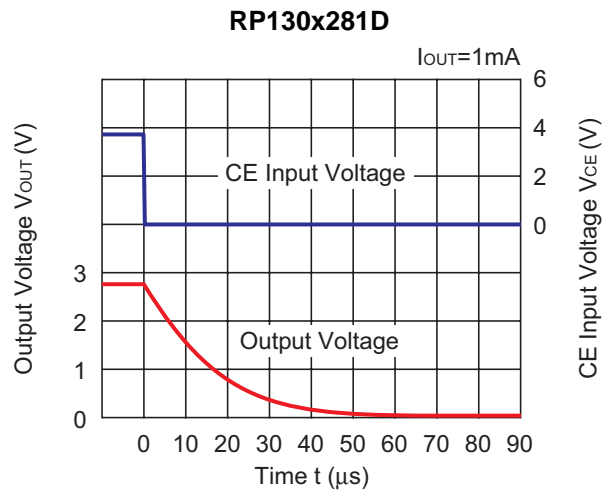
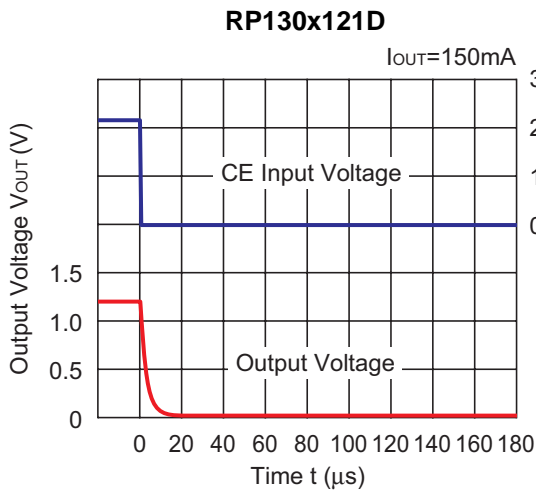
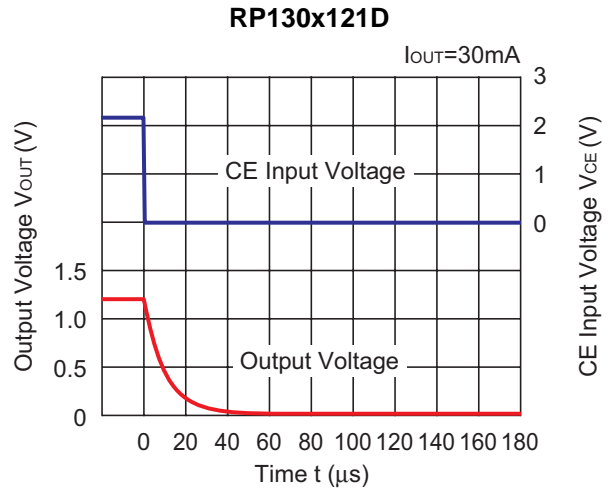
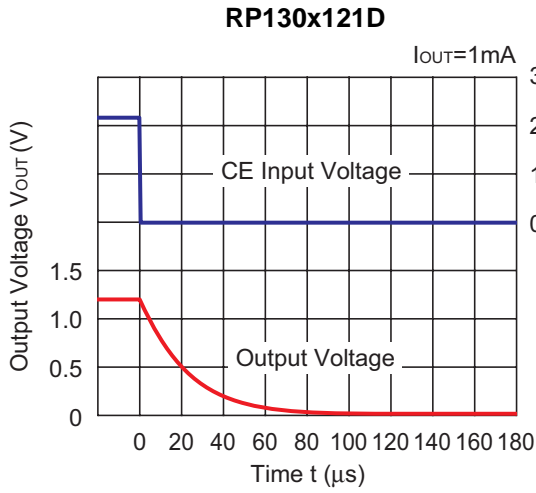


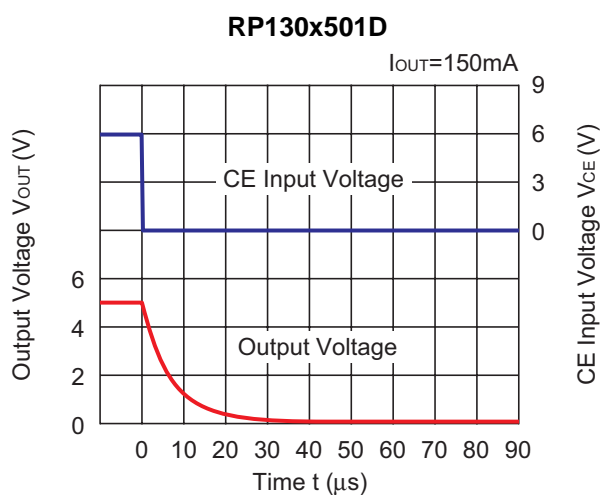
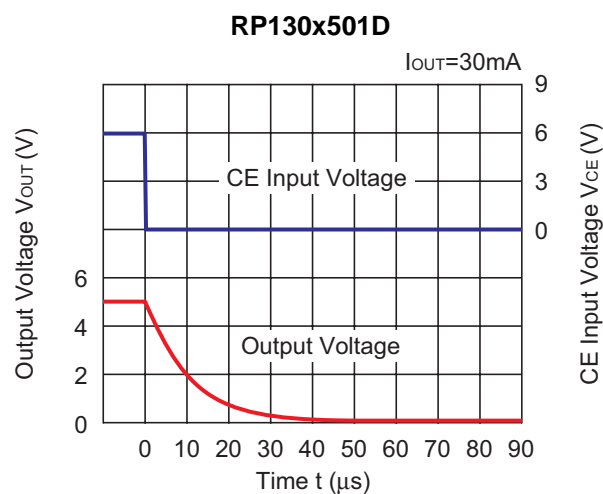
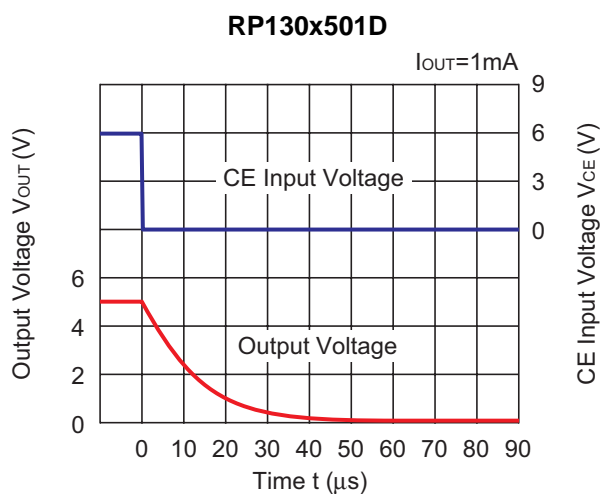
RP130x281x



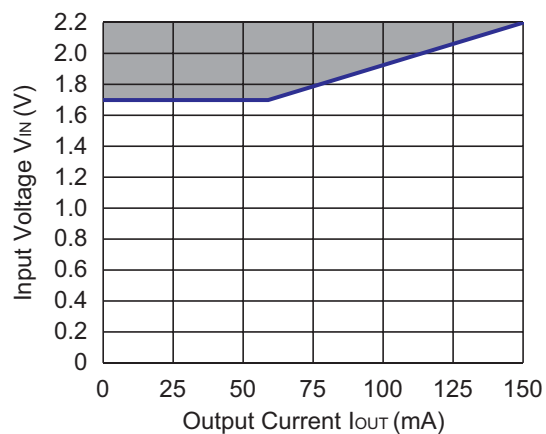


14) Turn Off Speed with CE pin (D Version) (C1=0.47μF, C2=0.47μF, Topt=25°C)





15) Minimum Operating Voltage ($C1=0.47\mu F$, $C2=0.47\mu F$)



Hatched area is available for 1.2V output.

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.

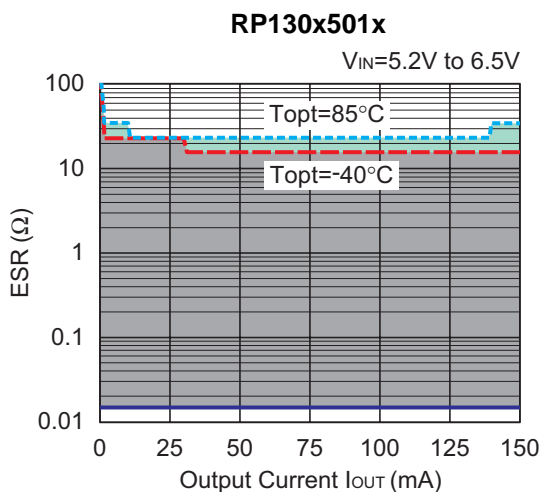
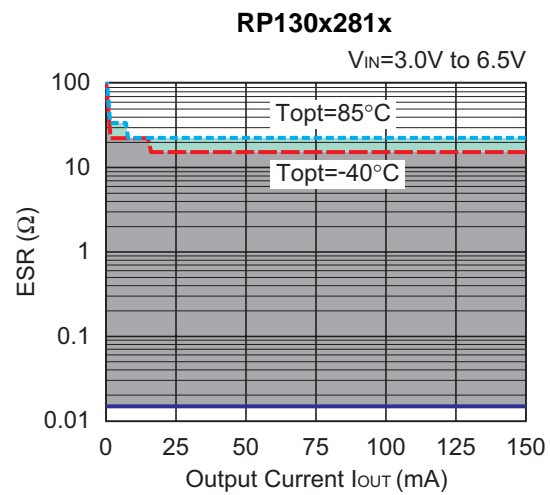
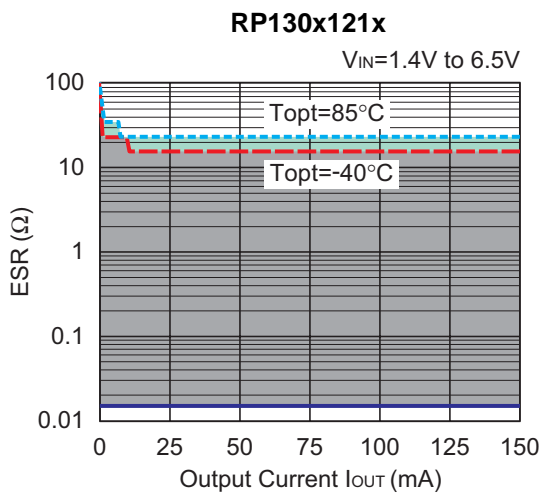
The conditions when the white noise level is under $40\mu\text{V}$ (Avg.) are marked as the hatched area in the graph.

Measurement conditions

Frequency Band : 10Hz to 3MHz

Temperature : -40°C to 85°C

C1, C2 : $0.47\mu\text{F}$





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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.