RICOH

RP130x SERIES

LOW NOISE 150mA LDO REGULATOR

NO.EA-173-111020

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.38μA).

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 5.3V 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

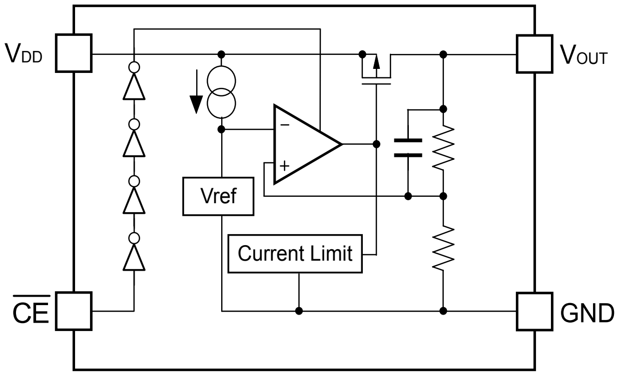
- Supply Current ....Typ. 38μA
- Supply Current (Standby Mode)...................................Typ. 0.1 μA
- Ripple Rejection ....Typ. 80dB (f=1kHz)
- Input Voltage Range...1.7V to 6.5V
- Output Voltage Range...1.2V to 5.3V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy..±1.0% (V_{OUT}>2.0V, T_{opt}=25°C)
- Temperature-Drift Coefficient of Output Voltage ....Typ. ±20ppm/°C
- Dropout Voltage..Typ. 0.32V (I_{OUT}=150mA, V_{OUT}=2.8V)
- Line Regulation ....Typ. 0.02%/V
- Packages...DFN(PLP)1010-4, SC-82AB, SOT-23-5
- Built-in Fold Back Protection Circuit.............................Typ. 40mA
- Ceramic capacitors are recommended to be used with this IC .... 0.47μF or more

APPLICATIONS

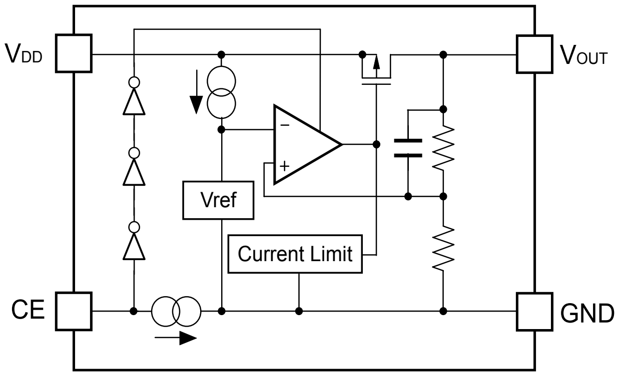
- Power source for battery-powered equipment.
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for high stable reference voltage.

BLOCK DIAGRAMS

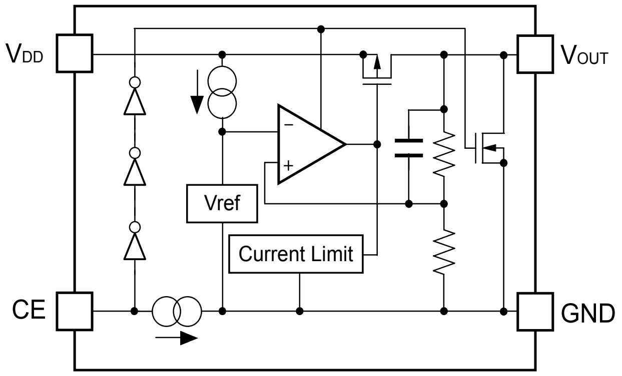
RP130xxx1A



RP130xxx1B



RP130xxx1D



SELECTION GUIDE

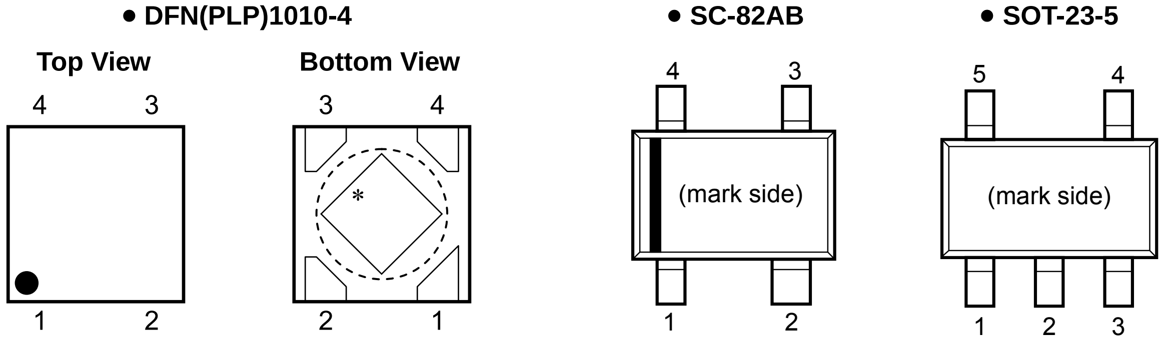
The output voltage, chip enable polarity, auto discharge function, and package, etc. for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP130Kxx1∗-TR	DFN(PLP)1010-4	10,000 pcs	Yes	Yes
RP130Qxx1∗-TR-FE	SC-82AB	3,000 pcs	Yes	Yes
RP130Nxx1∗-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 5.3V(53) 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.
(A) "L" active, without auto discharge function at off state
(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	$\overline{CE}$ / CE	Chip Enable Pin ("L" Active / "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	$\overline{CE}$ / CE	Chip Enable Pin ("L" Active / "H" Active)
2	GND	Ground Pin
3	V_{OUT}	Output Pin
4	V_{DD}	Input Pin

- **SOT-23-5**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	$\overline{CE}$ / CE	Chip Enable Pin ("L" Active / "H" Active)
4	NC	No Connection
5	V_{OUT}	Output 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	200	mA
P_D	Power Dissipation (DFN(PLP)1010-4)*	400	mW
	Power Dissipation (SC-82AB)*	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.

ELECTRICAL CHARACTERISTICS

V_{IN}=Set V_{OUT}+1V for V_{OUT}>1.5V. V_{IN}=2.5V for V_{OUT} ≤ 1.5V. I_{OUT}=1mA, C_{IN}=C_{OUT}=0.47µF, unless otherwise noted.
The specification in [ ] is checked and guaranteed by design engineering at −40°C ≤ Topt ≤ 85°C, unless otherwise noted.

- **RP130xxx1A**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{OUT}>2.0V	×0.99		×1.01	V
			V_{OUT} ≤ 2.0V	−20		20	mV
		−40°C ≤ Topt ≤ 85°C	V_{OUT}>2.0V	[×0.985]		[×1.015]	V
			V_{OUT} ≤ 2.0V	[−30]		[30]	mV
I_{OUT}	Output Current			[150]			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA			10	[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
Istandby	Standby Current	V_{CE}=V_{IN}			0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 6.5V			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
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	−40°C ≤ Topt ≤ 85°C			±20		ppm /°C
I_{SC}	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		µVrms

All of units are tested and specified under load conditions such that Tj≈Topt=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.

- **RP130xxx1B/D**

Topt=25°C

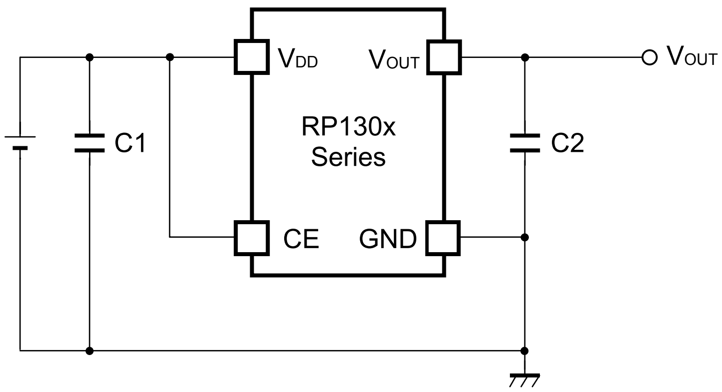
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{OUT}>2.0V	×0.99		×1.01	V
			V_{OUT} ≤ 2.0V	–20		20	mV
		–40°C ≤ Topt ≤ 85°C	V_{OUT}>2.0V	×0.985		×1.015	V
			V_{OUT} ≤ 2.0V	–30		30	mV
I_{OUT}	Output Current			150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA			10	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
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 6.5V			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
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	–40°C ≤ Topt ≤ 85°C			±20		ppm/°C
I_{SC}	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
en	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 Tj≈Topt=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 0.47µF 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 0.47µF or more.

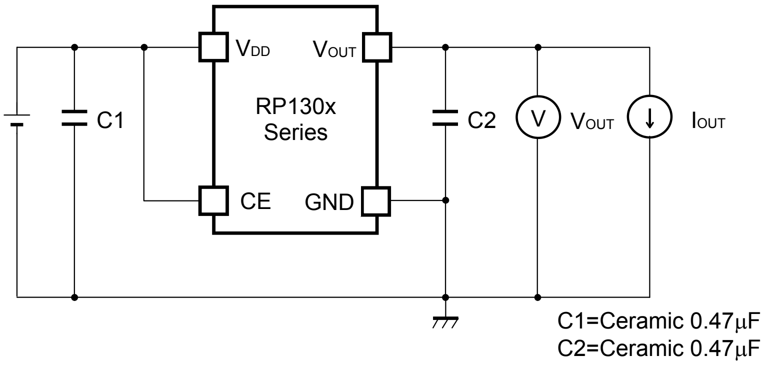
If a tantalum capacitor is used, and its ESR (Equivalent Series Resistance) of C2 is large, the loop oscillation may result. Because of this, select C2 carefully considering its frequency characteristics.

PCB Layout

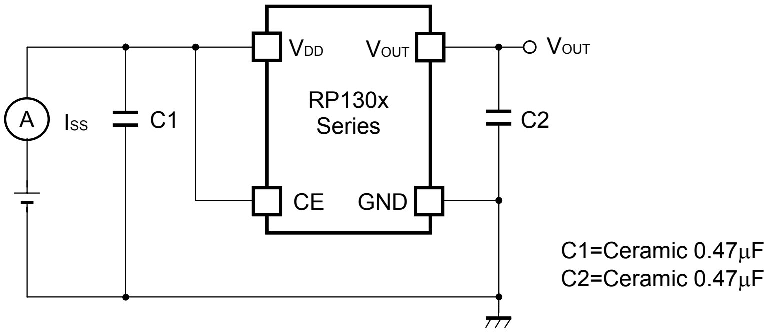
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 0.47µF or more between V_{DD} and GND pin, and as close as possible to the pins.

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

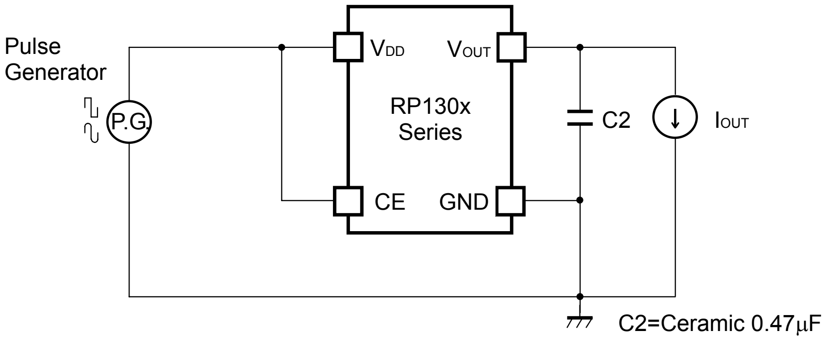
TEST CIRCUITS



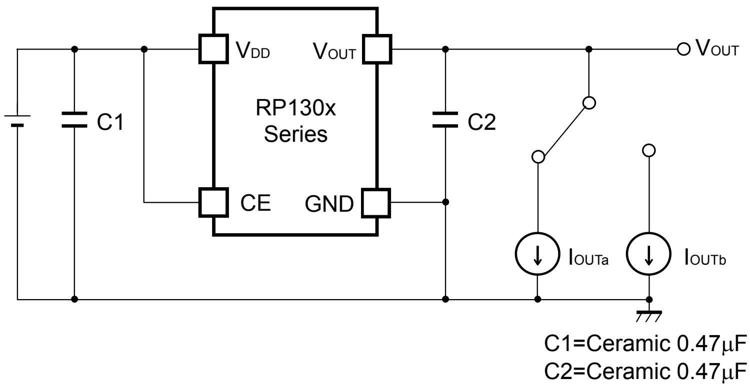
Basic Test Circuit



Supply Current Test Circuit



Ripple Rejection Test Circuit

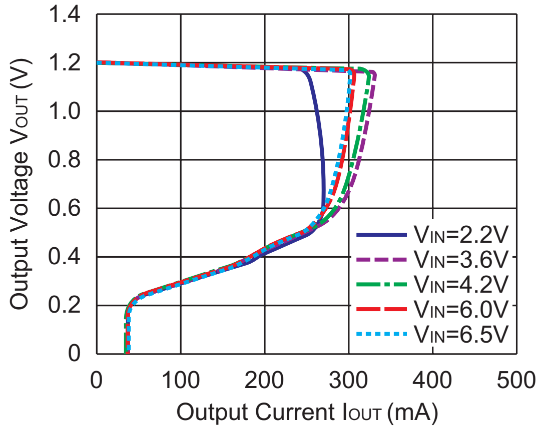


Load Transient Response Test Circuit

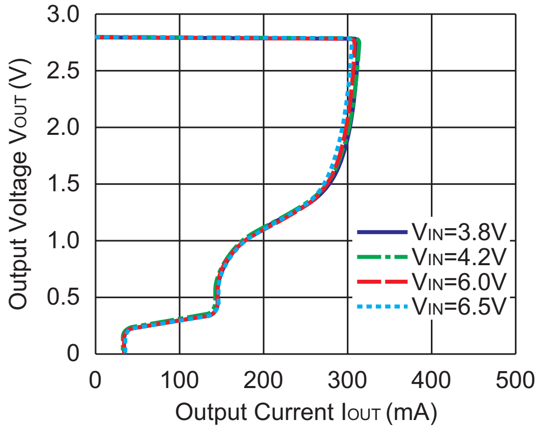
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C1=0.47μF, C2=0.47μF, Topt=25°C)

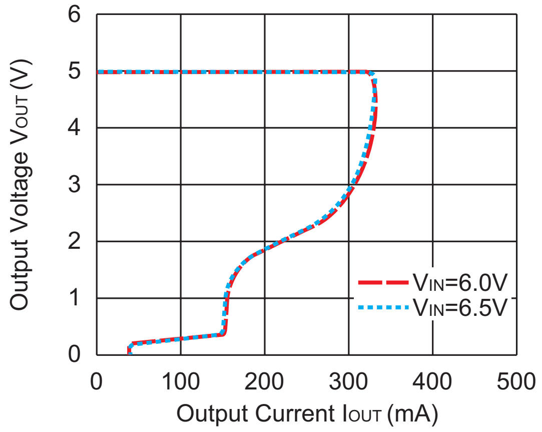
RP130x121x



RP130x281x

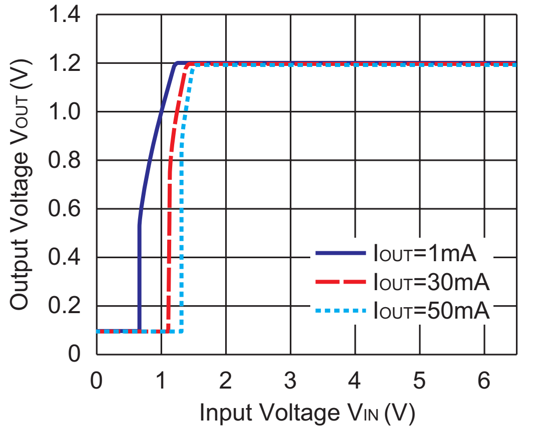


RP130x501x



2) Output Voltage vs. Input Voltage (C1=0.47μF, C2=0.47μF, Topt=25°C)

RP130x121x



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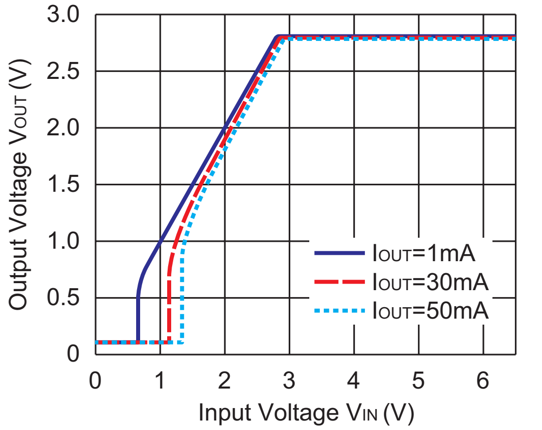

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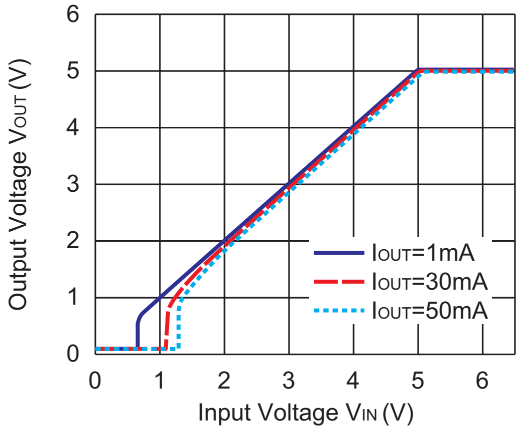
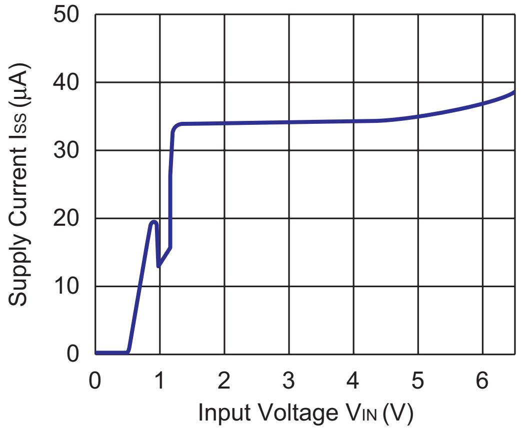


3) Supply Current vs. Input Voltage (C1=0.47μF, C2=0.47μF, Topt=25°C)

RP130x121x



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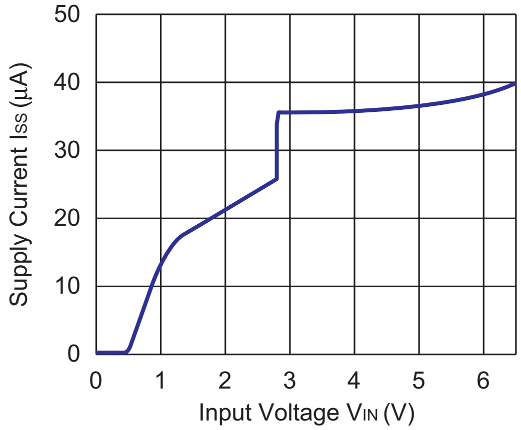

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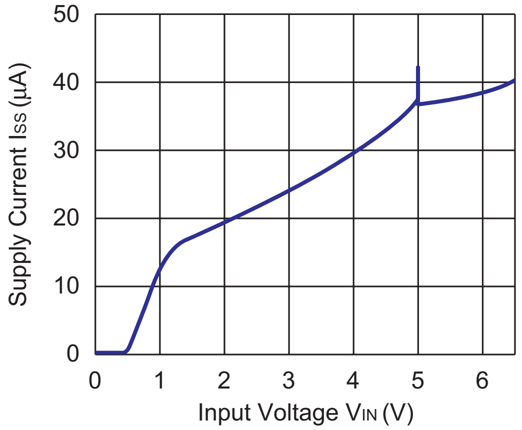
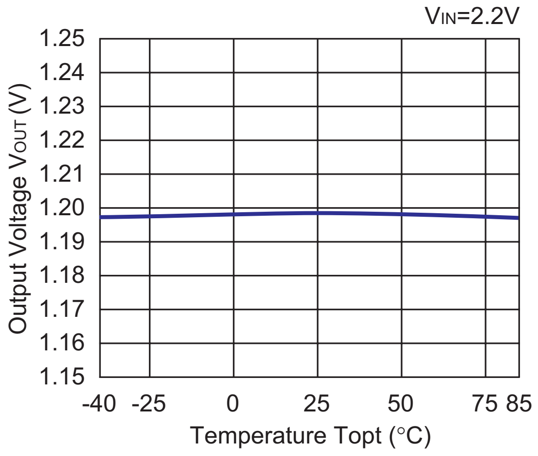


4) Output Voltage vs. Temperature (I_{OUT}=1mA, C1=0.47μF, C2=0.47μF)

RP130x121x



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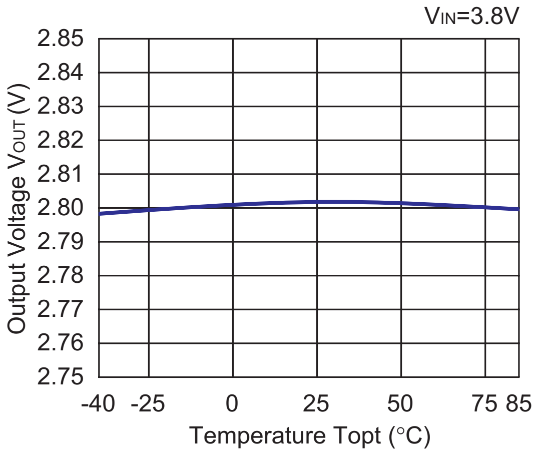

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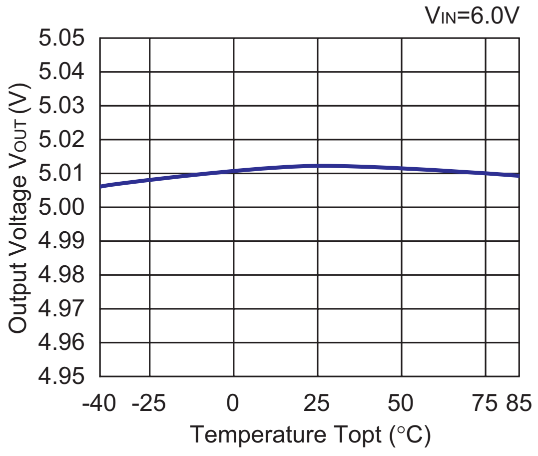
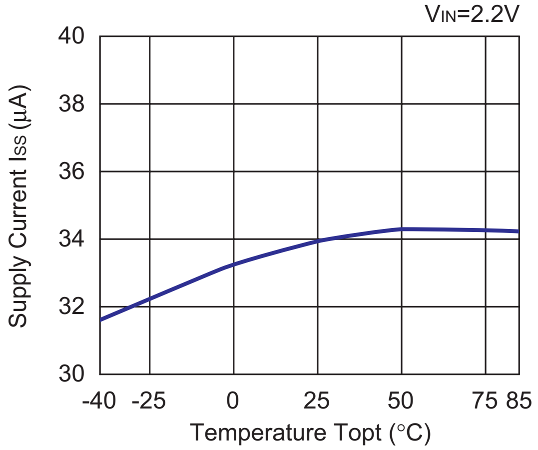


5) Supply Current vs. Temperature (I_{OUT}=0mA, C1=0.47μF, C2=0.47μF)

RP130x121x



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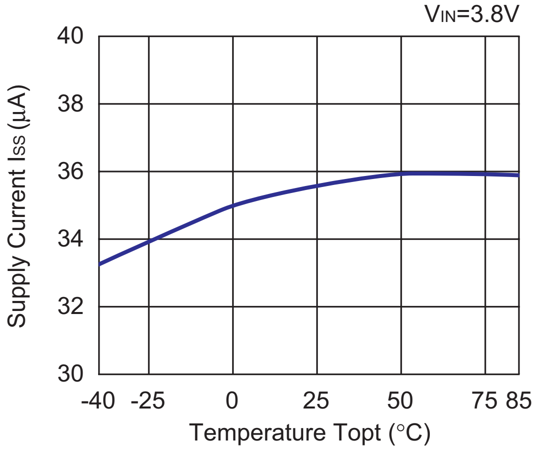
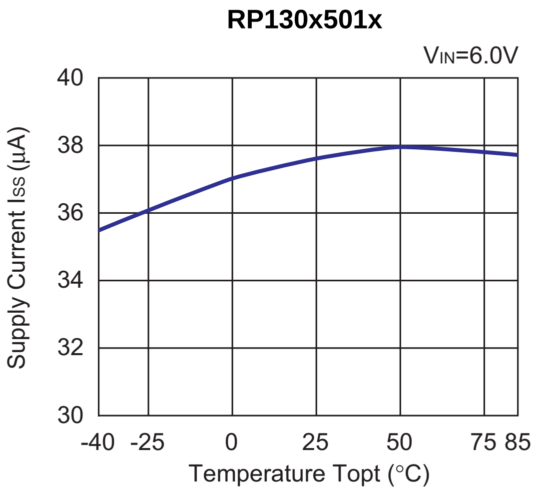
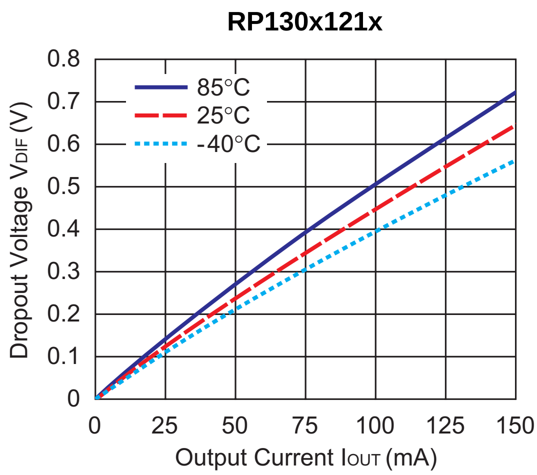
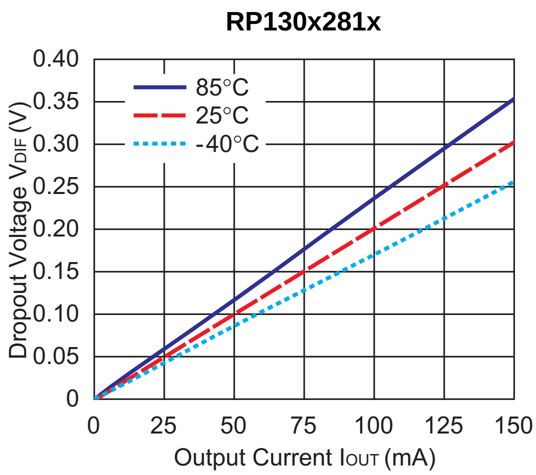
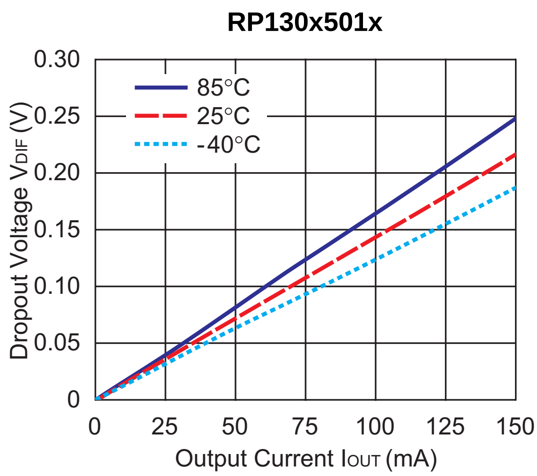




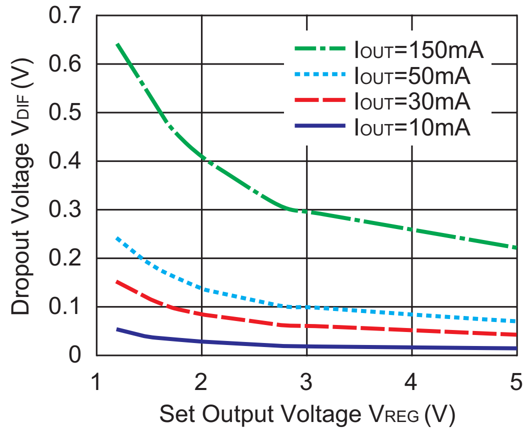
6) Dropout Voltage vs. Output Current (C1=0.47µF, C2=0.47µF)





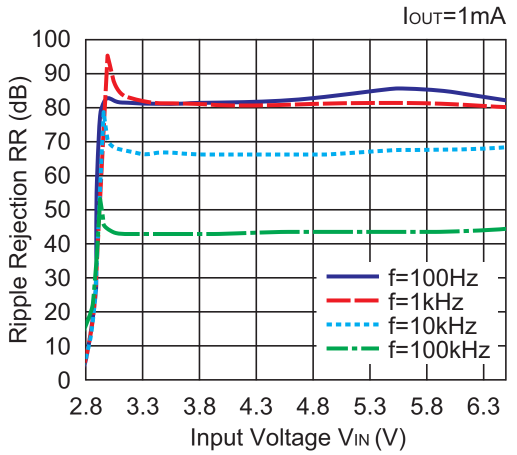


7) Dropout Voltage vs. Set Output Voltage (C1=0.47μF, C2=0.47μF)



8) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=0.47μF, Ripple=0.2Vp-p, Topt=25°C)

RP130x281x



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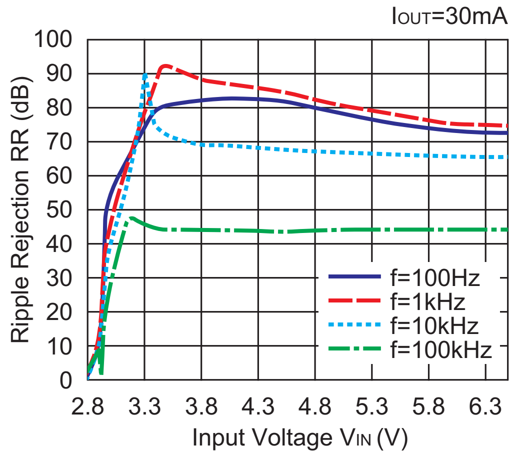
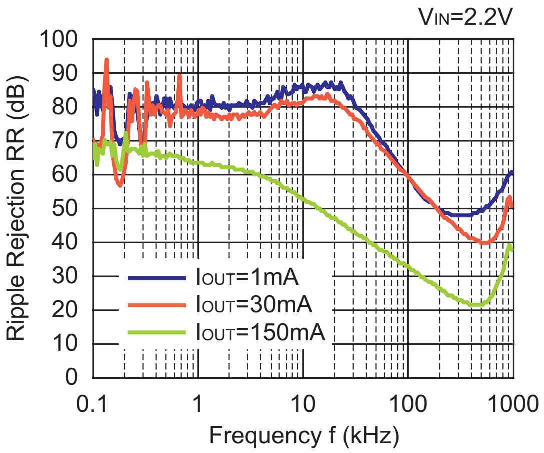
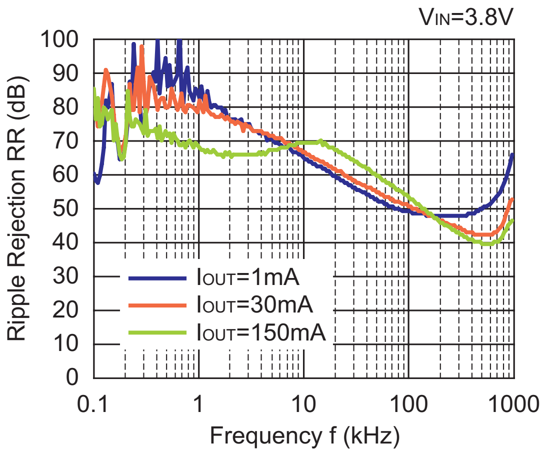


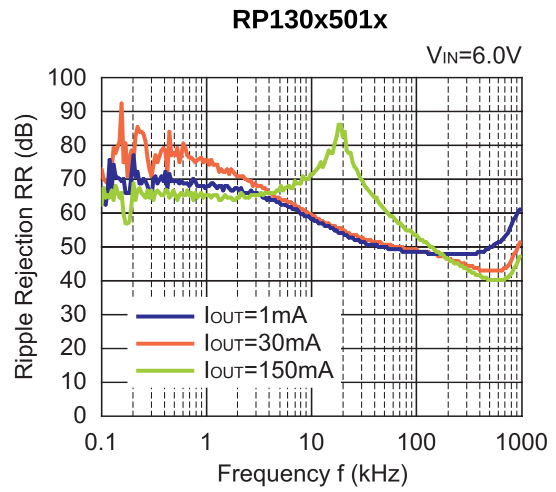
9) Ripple Rejection vs. Frequency (C1=none, C2=0.47μF, Ripple=0.2Vp-p, Topt=25°C)

RP130x121x

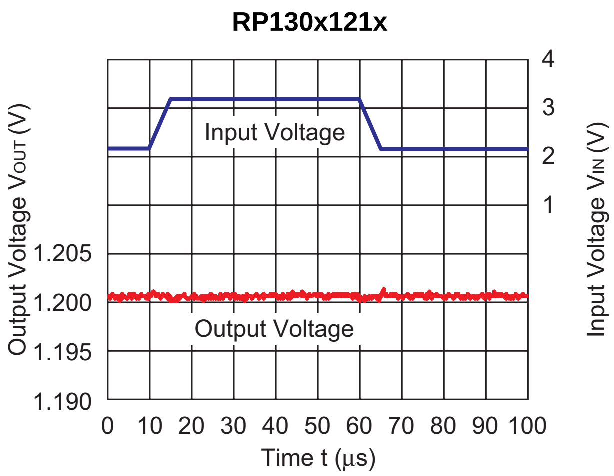


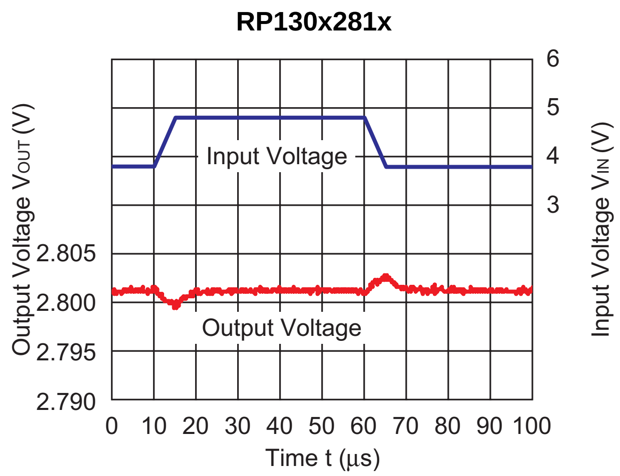
RP130x281x

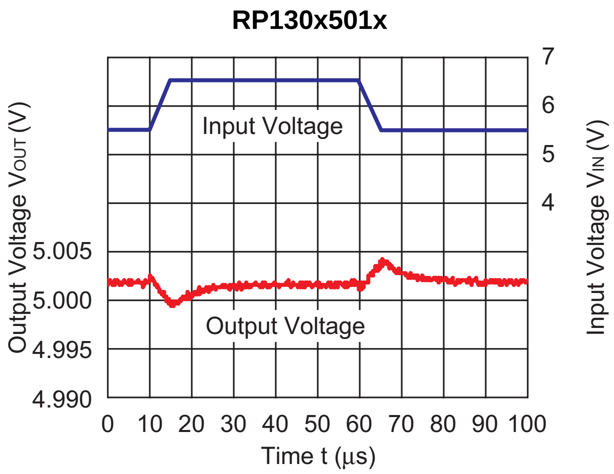




10) Input Transient Response (IOUT=30mA, tr=tf=5µs, C1=none, C2=0.47µF, Topt=25°C)

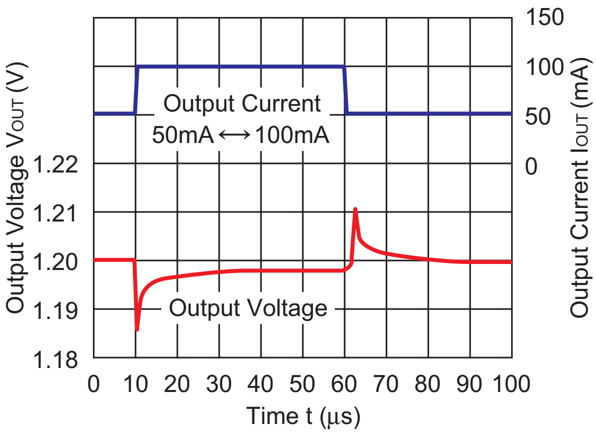




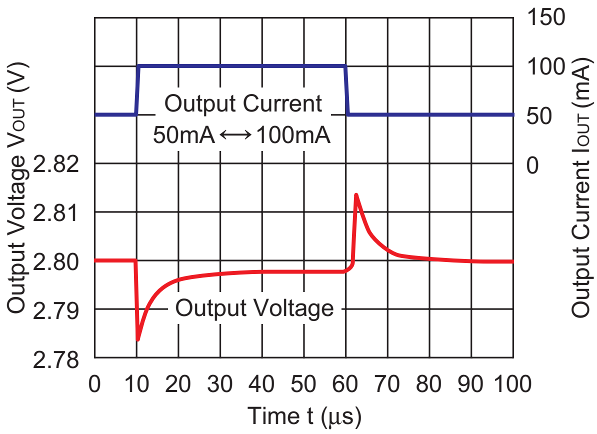


11) Load Transient Response (tr=tf=0.5μs, C1=0.47μF, C2=0.47μF, IOUT=50mA⇔100mA, Topt=25°C)

RP130x121x



RP130x281x



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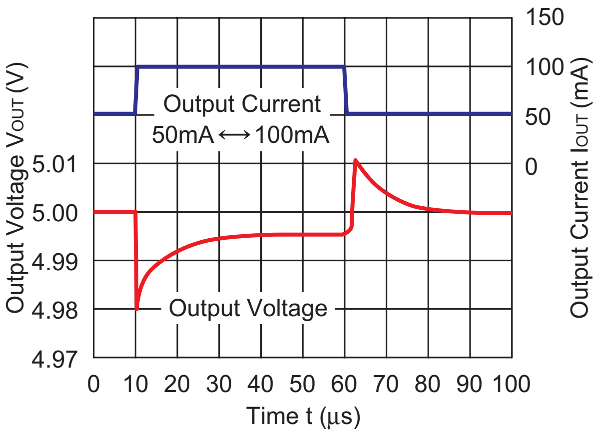
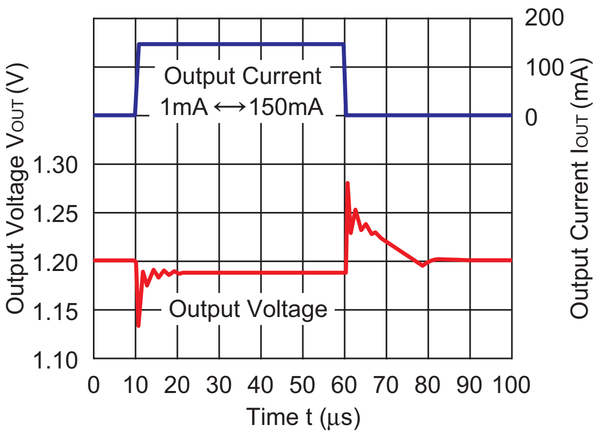


12) Load Transient Response (tr=tf=0.5μs, C1=0.47μF, C2=0.47μF, IOUT=1mA⇔150mA, Topt=25°C)

RP130x121x



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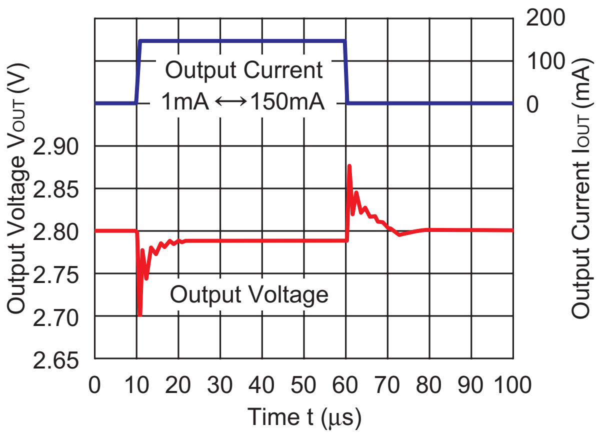
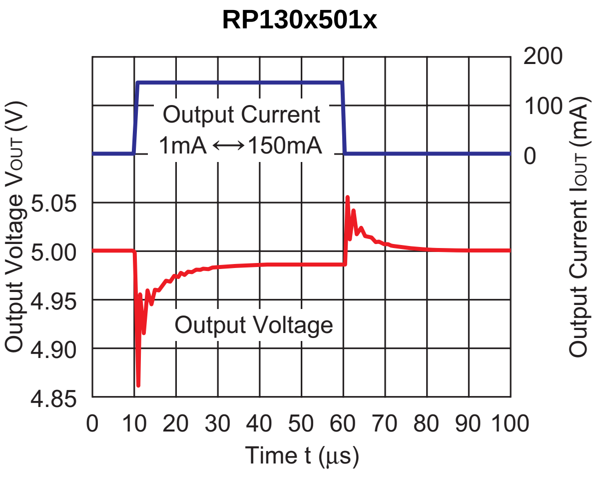
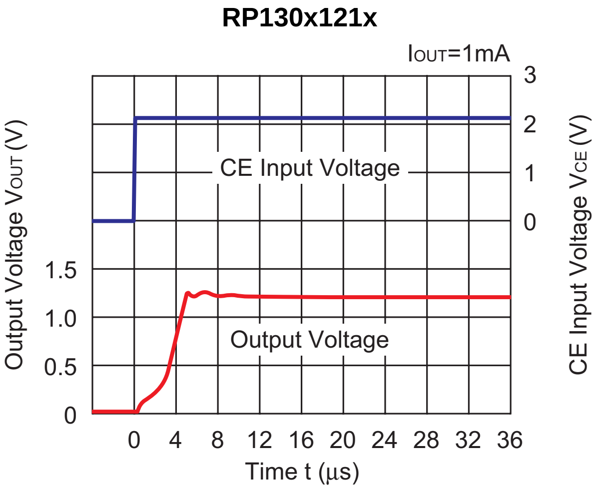
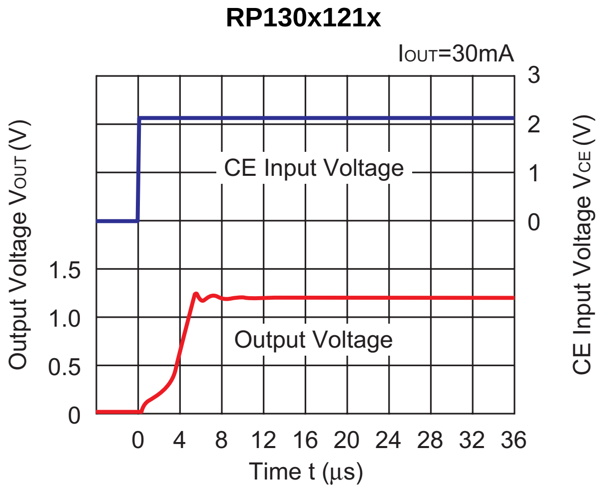


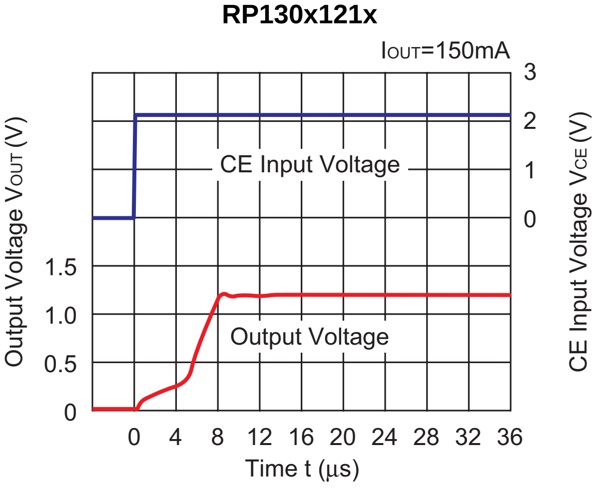
RICOH

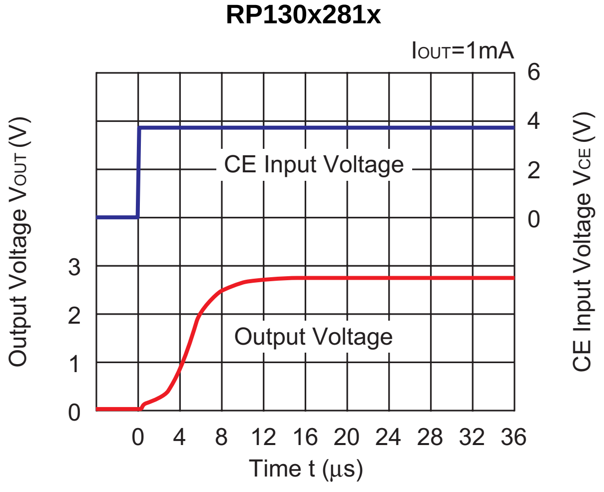


13) Turn On Speed with CE pin (C1=0.47µF, C2=0.47µF, Topt=25°C)









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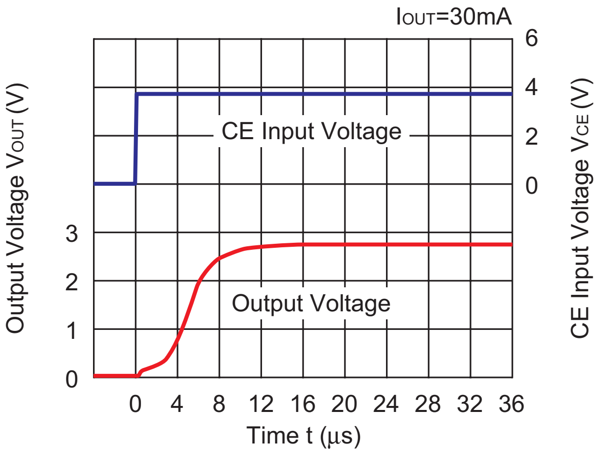

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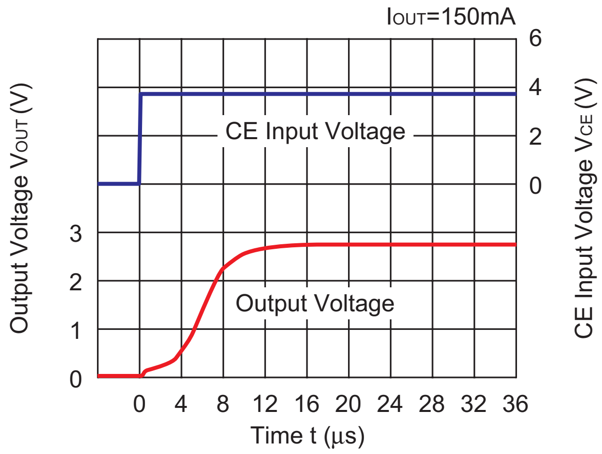

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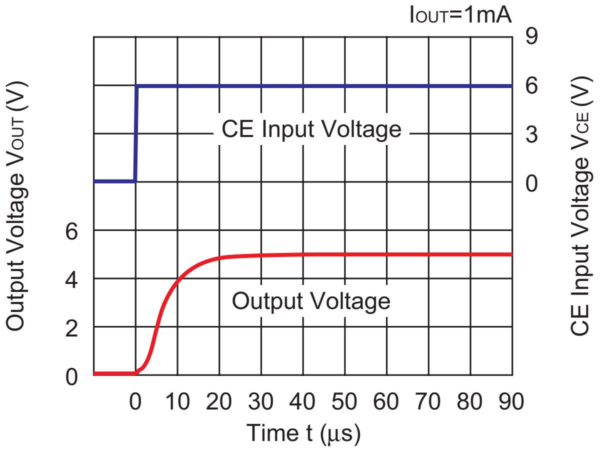

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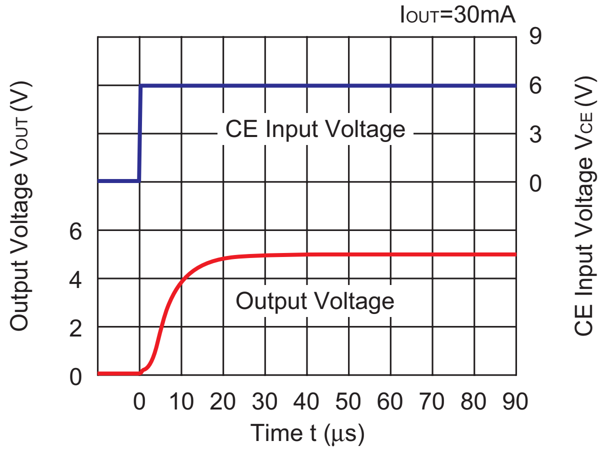

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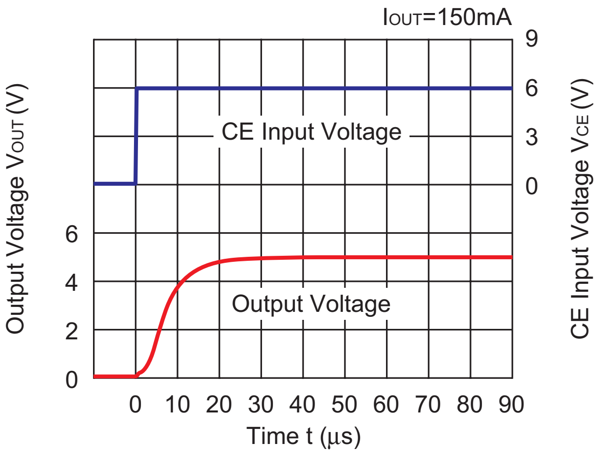
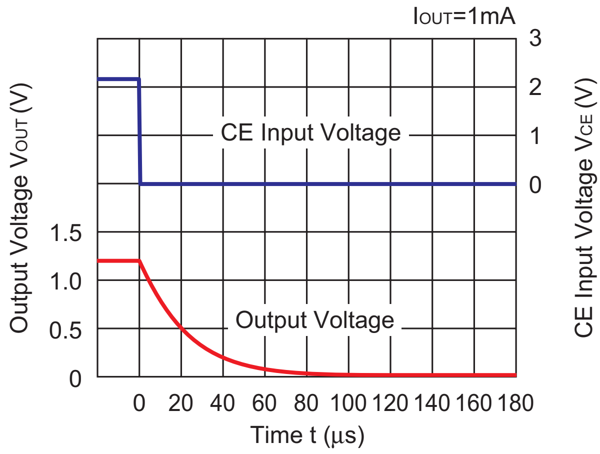


14) Turn Off Speed with CE pin (D Version) (C1=0.47µF, C2=0.47µF, Topt=25°C)

RP130x121D



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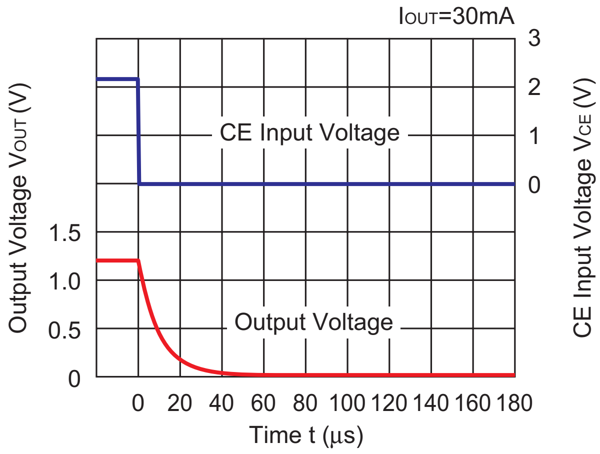

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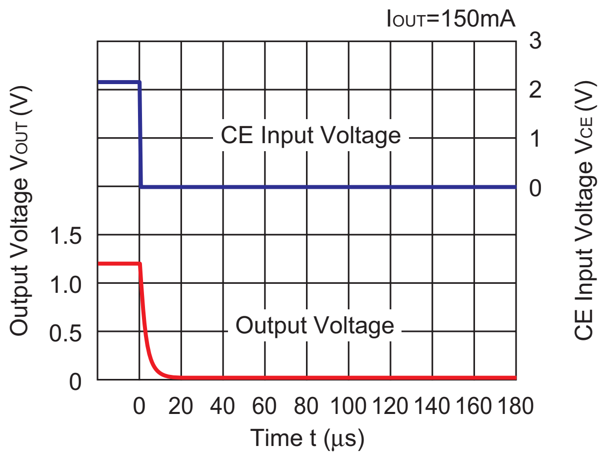

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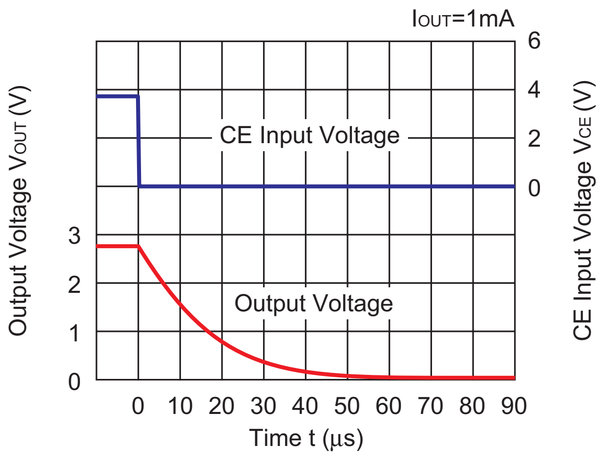

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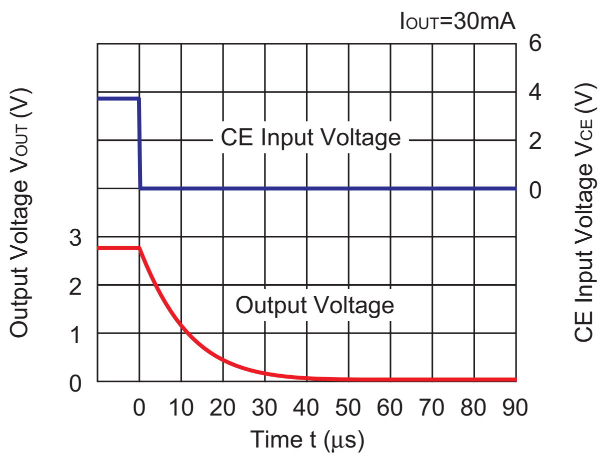

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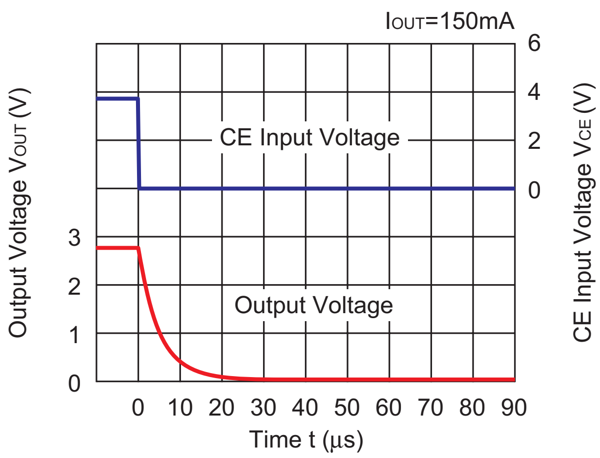
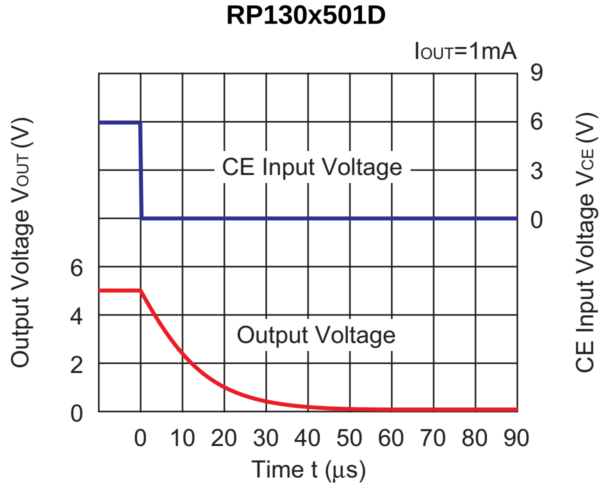
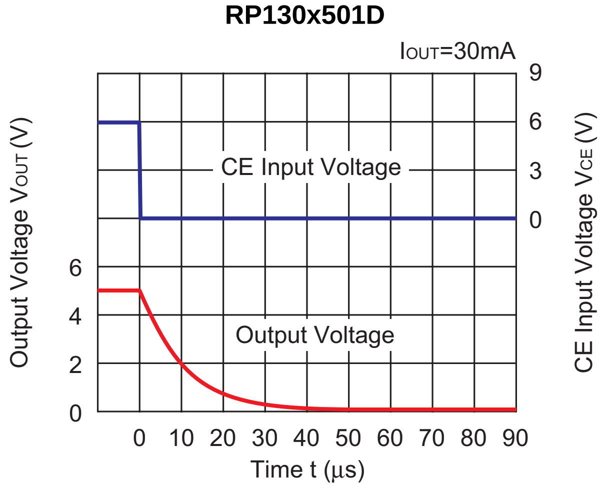
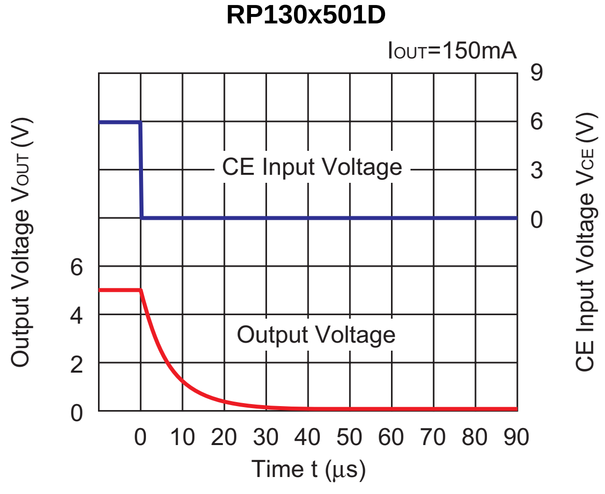
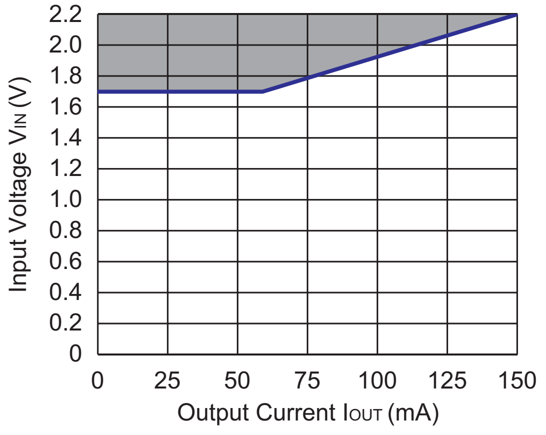








15) Minimum Operating Voltage (C1=0.47µF, C2=0.47µF)



Hatched area is available for 1.2V output.

ESR vs. Output Current

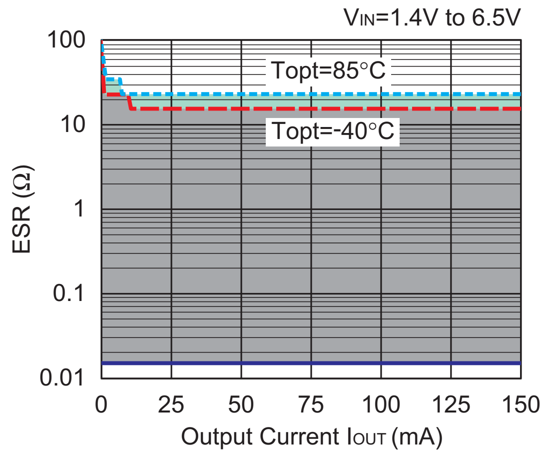
When using these ICs, consider the following points:

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 40μV (Avg.) are marked as the hatched area in the graph.

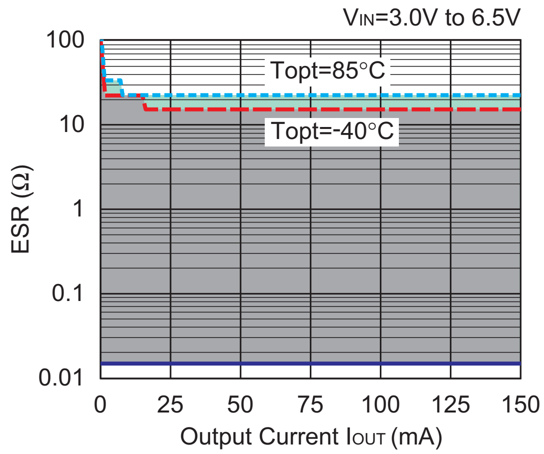
Measurement conditions

Frequency Band : 10Hz to 3MHz
Temperature : –40°C to 85°C
C1, C2 : 0.47μF

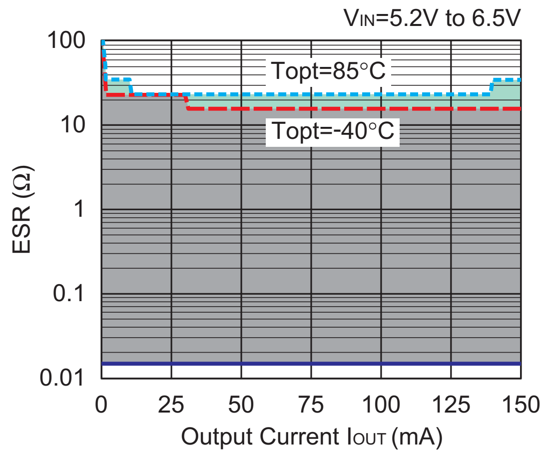
RP130x121x



RP130x281x



RP130x501x



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Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.

日本経営品質賞 1999年度受賞

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

RoHS Compliant

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

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