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## 0.6% ACCURACY LOW NOISE 200mA LDO REGULATOR

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NO.EA-140-111020

### OUTLINE

The RP100x 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 RP100x 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 SOT-23-5 and DFN(PLP)1612-4, therefore high density mounting of the ICs on boards is possible.

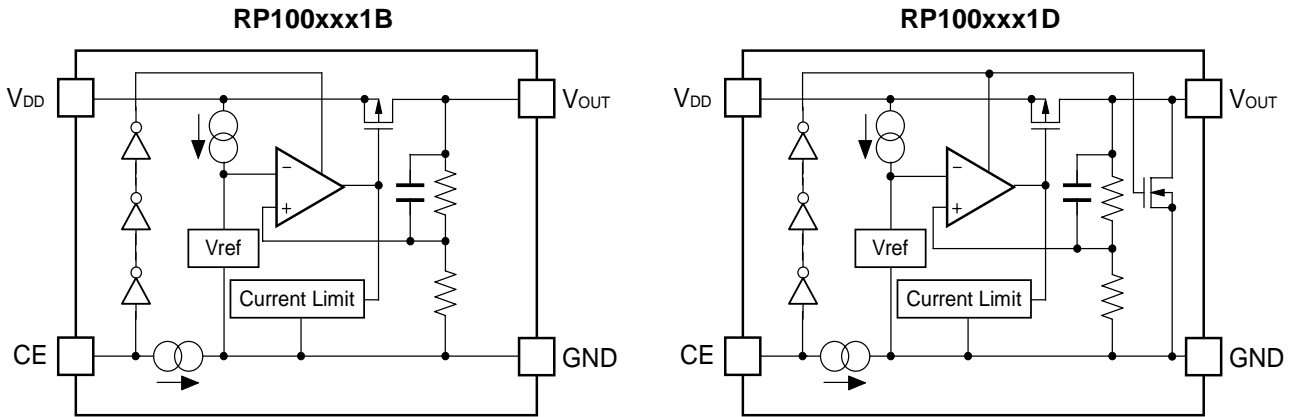
### FEATURES

- Supply Current ..... Typ. 18 $\mu$ A
- Standby Current ..... Typ. 0.1 $\mu$ A
- Dropout Voltage ..... Typ. 0.13V ( $I_{OUT}=150\text{mA}$ ,  $V_{OUT}=2.8\text{V}$ )
- 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 .....  $\pm 0.6\%$
- Packages ..... DFN(PLP)1612-4, 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 ..... 1.0 $\mu$ F or more

### APPLICATIONS

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

## 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
RP100Kxx1*-TR	DFN(PLP)1612-4	5,000 pcs	Yes	Yes
RP100Nxx1*-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.)

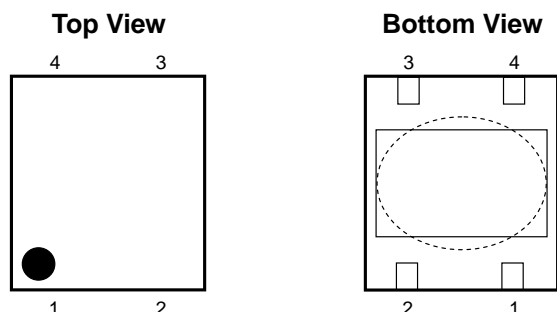
\* : CE pin polarity and auto discharge function at off state are options as follows.

(B) "H" active, without auto discharge function at off state

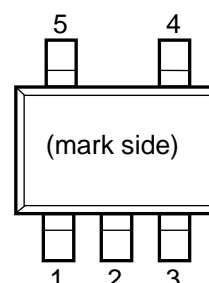
(D) "H" active, with auto discharge function at off state

## PIN CONFIGURATIONS

• DFN(PLP)1612-4



• SOT-23-5



## PIN DESCRIPTIONS

• DFN(PLP)1612-4

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.

• 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	300	mA
$P_D$	Power Dissipation (SOT-23-5)*	420	mW
	Power Dissipation (DFN(PLP)1612-4)*	610	
$T_{opt}$	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

### • RP100xxx1B/D

$V_{IN} = \text{Set } V_{OUT} + 1V$ ,  $I_{OUT} = 1mA$ ,  $C_{IN} = C_{OUT} = 1\mu F$ , unless otherwise noted.

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

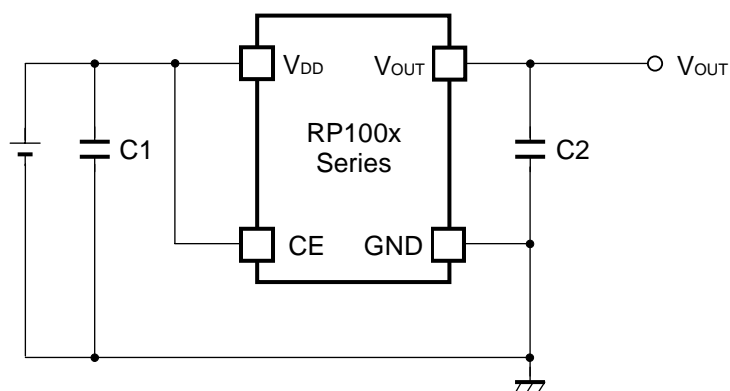
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
$V_{OUT}$	Output Voltage	$V_{OUT} > 2.0V$	$\times 0.994$		$\times 1.006$	V	
		$V_{OUT} \leq 2.0V$	-12		+12	mV	
$I_{OUT}$	Output Current		200			mA	
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$1mA \leq I_{OUT} \leq 150mA$		20	40	mV	
$V_{DIF}$	Dropout Voltage	$I_{OUT} = 150mA$	$1.2V \leq V_{OUT} < 1.5V$		0.40	0.50	V
			$1.5V \leq V_{OUT} < 1.7V$		0.24	0.38	
			$1.7V \leq V_{OUT} < 2.0V$		0.21	0.34	
			$2.0V \leq V_{OUT} < 2.5V$		0.17	0.30	
			$2.5V \leq V_{OUT} < 2.8V$		0.14	0.25	
			$2.8V \leq V_{OUT} \leq 3.3V$		0.13	0.23	
$I_{SS}$	Supply Current	$I_{OUT} = 0mA$		18	25	$\mu A$	
$I_{standby}$	Standby Current	$V_{CE} = 0V$		0.1	2.0	$\mu A$	
$\Delta V_{OUT}/\Delta V_{IN}$	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 $V_{IN} = \text{Set } V_{OUT} + 1V$ , $I_{OUT} = 30mA$ (In case that $V_{OUT} \leq 2.0V$ , $V_{IN} = 3V$ )		75		dB	
$V_{IN}$	Input Voltage*		1.7		5.25	V	
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		$\pm 30$		ppm/ $^{\circ}C$	
$I_{SC}$	Short Current Limit	$V_{OUT} = 0V$		40		mA	
$I_{PD}$	CE Pull-down Current			0.3		$\mu A$	
$V_{CEH}$	CE Input Voltage "H"		1.1			V	
$V_{CEL}$	CE Input Voltage "L"				0.3	V	
en	Output Noise	BW=10Hz to 100kHz $I_{OUT} = 30mA$		30		$\mu V_{rms}$	
$R_{LOW}$	Low Output Nch Tr. ON Resistance (of D version)	$V_{IN} = 4.0V$ , $V_{CE} = 0V$		30		$\Omega$	

\*) 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.

#### 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)

C2 1.0 $\mu$ 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 good frequency characteristics and ESR (Equivalent Series Resistance).

Ceramic capacitors have different temperature characteristics and bias characteristics depending on their dimensions and manufacturers. If the setting voltage is 2.5V or more and the capacitor's dimensions for  $V_{OUT}$  equal to 1.0mm by 0.5mm or smaller than that, the capacitance value might be extremely low. As a result, the capacitance might be much less than expected value. In such cases, the operation might be unstable at low temperature. ( $-20^{\circ}\text{C}$  or less) In that case, use a larger capacity, or a large dimensions' capacitor. (For example 1.6mm by 0.8mm)

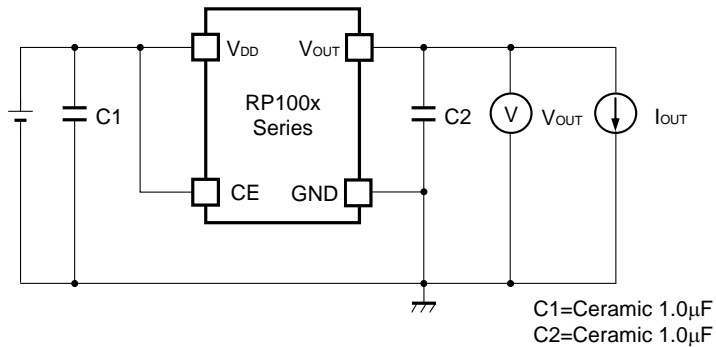
If a tantalum capacitor is selected as an output capacitor, large ESR may be a cause of unstable operation. Evaluate the operation of PCB with considerable frequency characteristics.

### PCB Layout

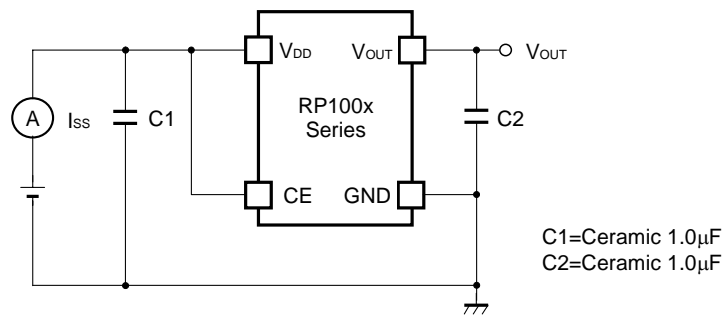
Make  $V_{DD}$  and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0 $\mu$ F or more between  $V_{DD}$  and GND pin, and as close as possible to the pins.

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

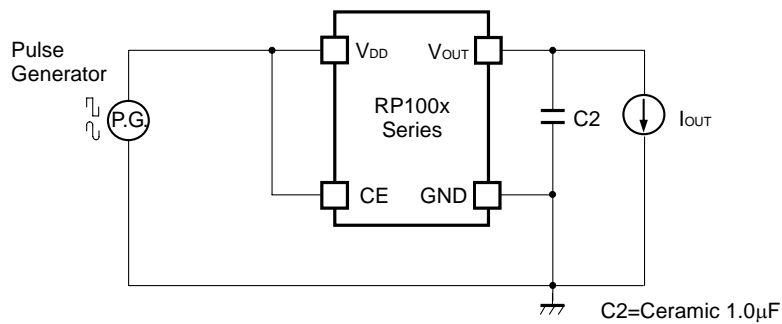
TEST CIRCUITS



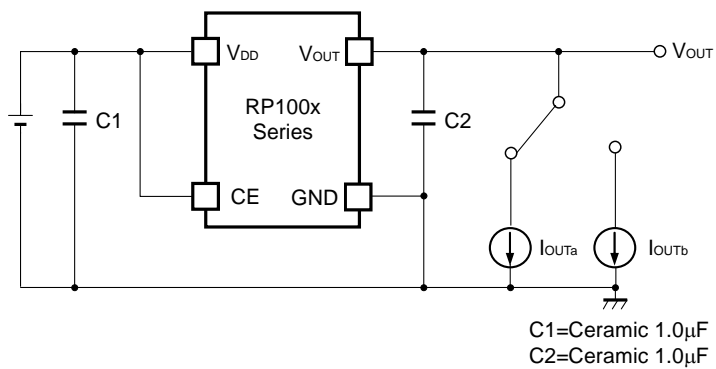
Basic Test Circuit



Test Circuit for Supply Current



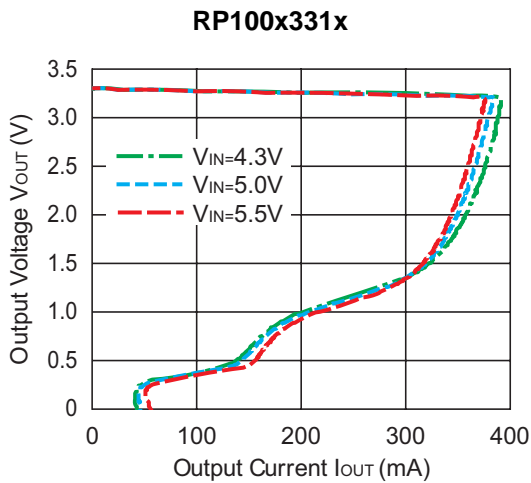
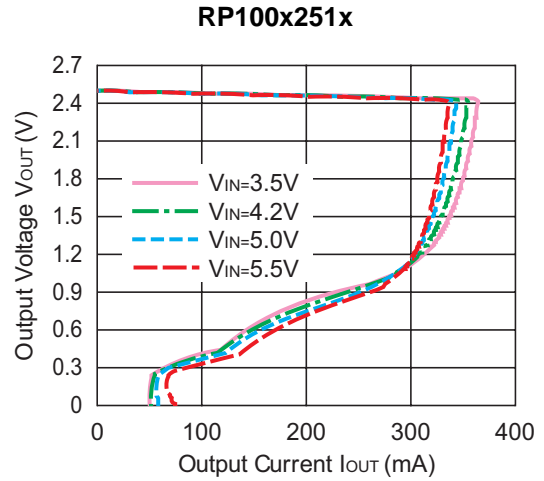
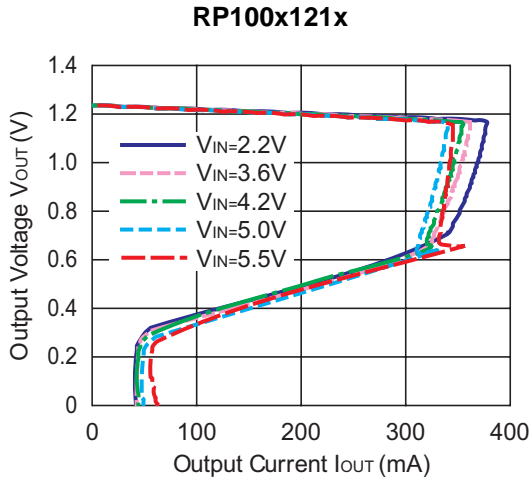
Test Circuit for Ripple Rejection



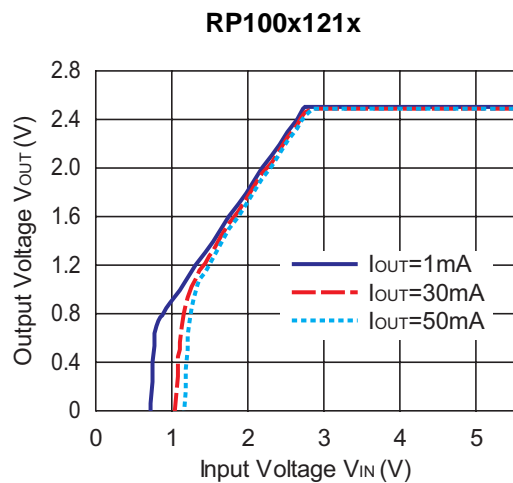
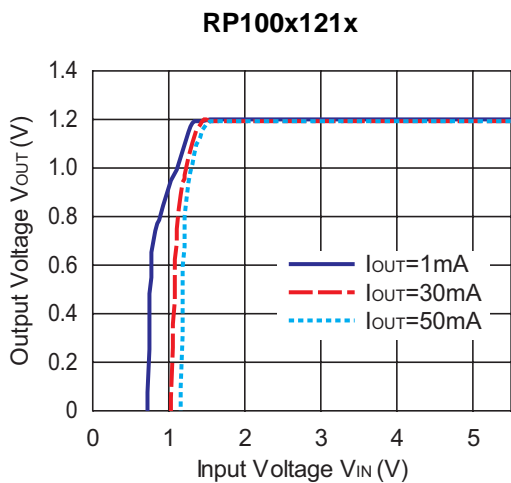
Test Circuit for Load Transient Response

## TYPICAL CHARACTERISTICS

### 1) Output Voltage vs. Output Current ( $C_1=1.0\mu\text{F}$ , $C_2=1.0\mu\text{F}$ , $T_{opt}=25^\circ\text{C}$ )

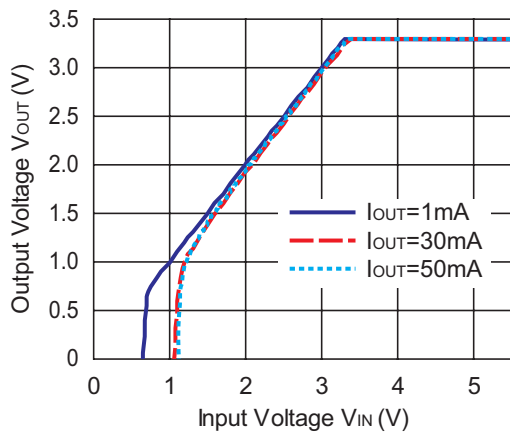


### 2) Output Voltage vs. Input Voltage ( $C_1=1.0\mu\text{F}$ , $C_2=1.0\mu\text{F}$ , $T_{opt}=25^\circ\text{C}$ )



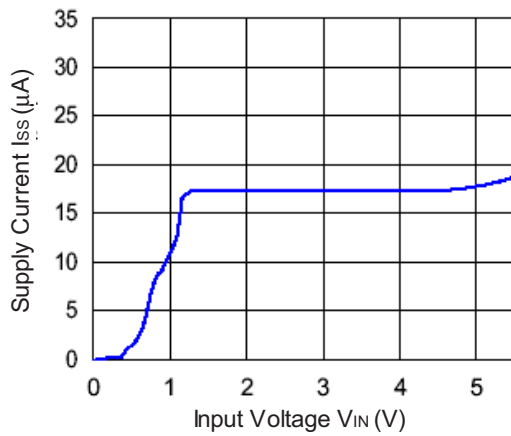


RP100x121x

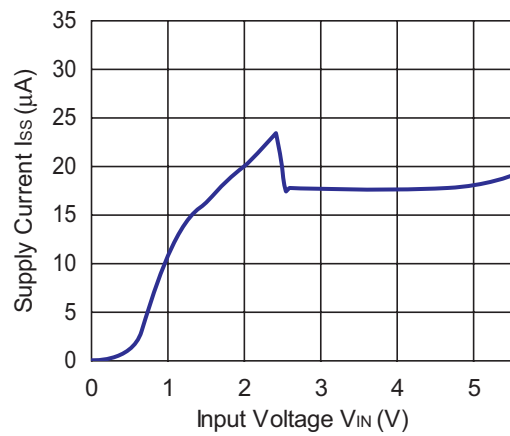


3) Supply Current vs. Input Voltage ( $C1=1.0\mu F$ ,  $C2=1.0\mu F$ ,  $T_{opt}=25^{\circ}C$ )

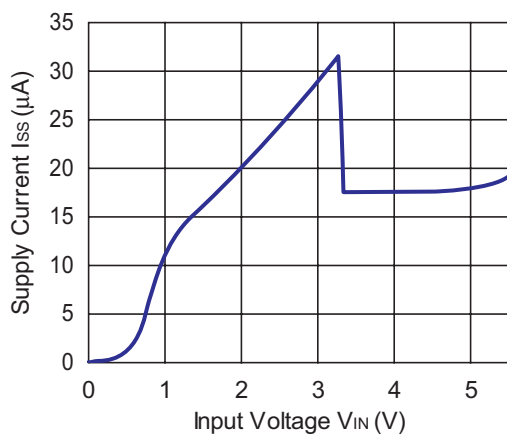
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RP100x251x

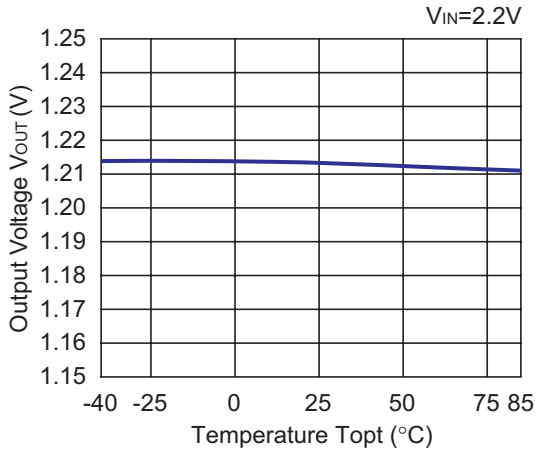


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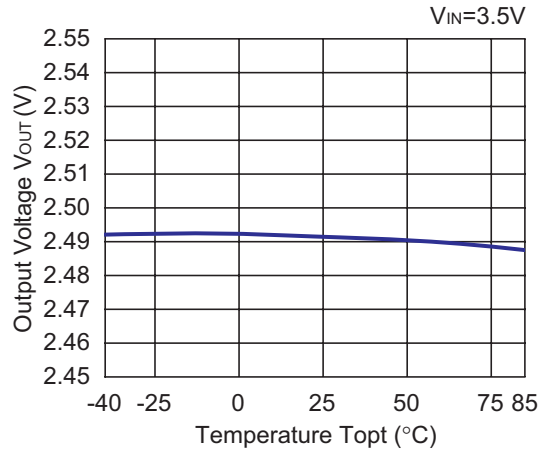


4) Output Voltage vs. Temperature (C1=1.0μF, C2=1.0μF, I<sub>OUT</sub>=1mA)

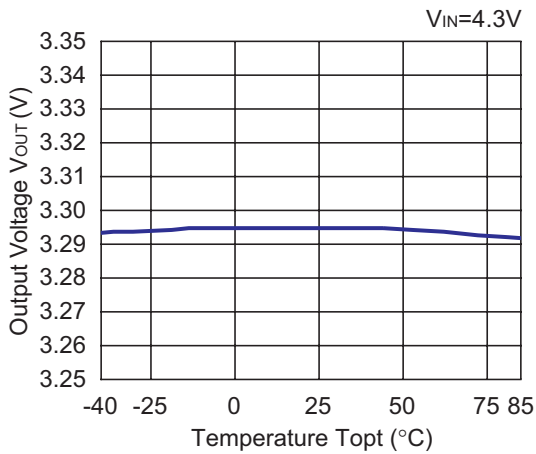
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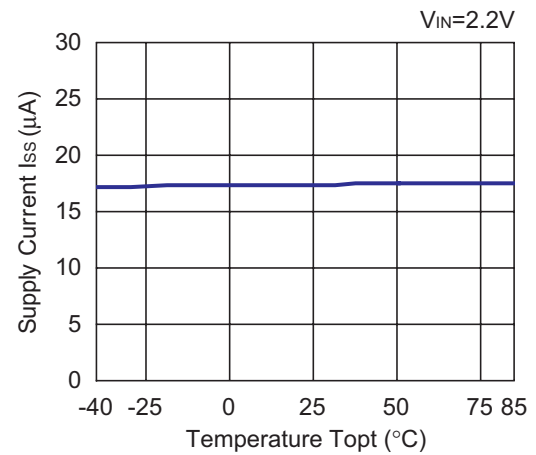


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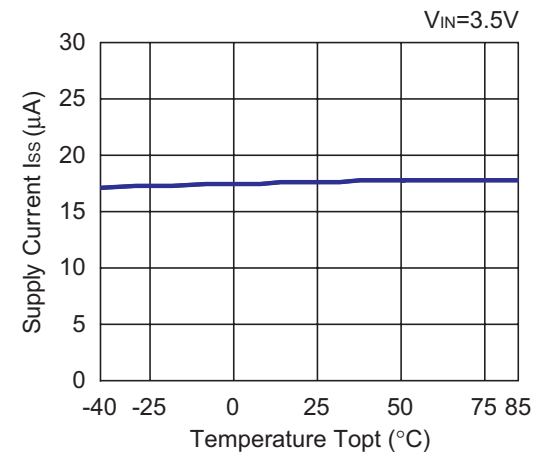


5) Supply Current vs. Temperature (C1=1.0μF, C2=1.0μF, I<sub>OUT</sub>=0mA)

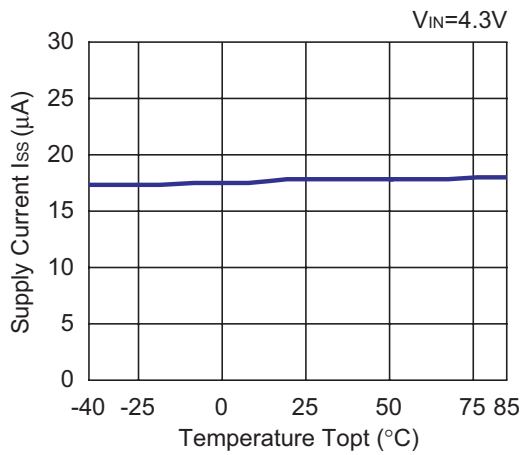
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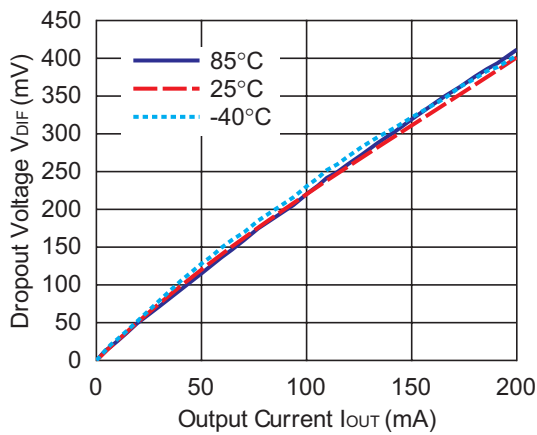


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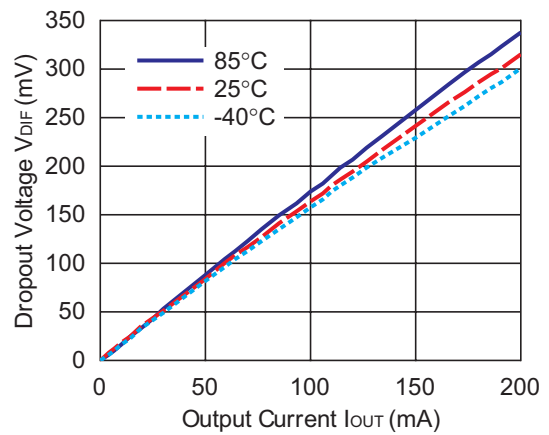


**6) Dropout Voltage vs. Output Current (C1=1.0µF,C2=1.0µF)**

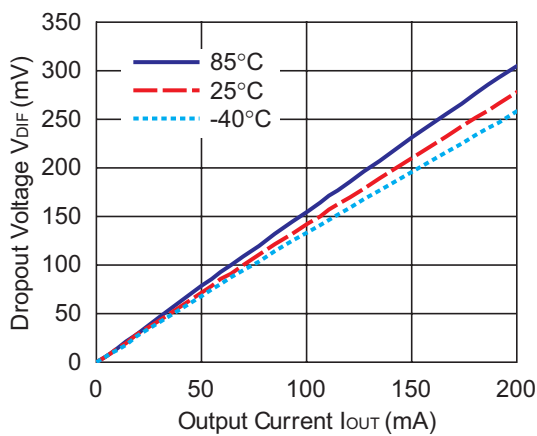
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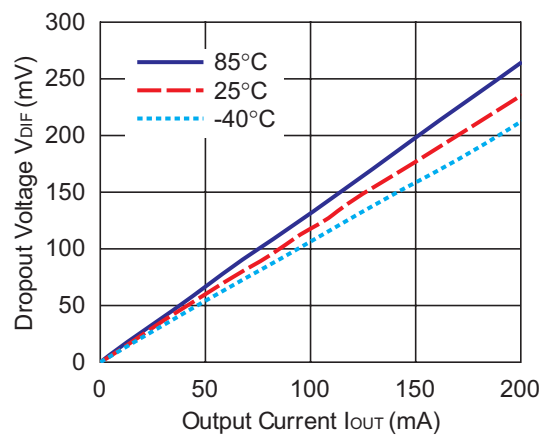
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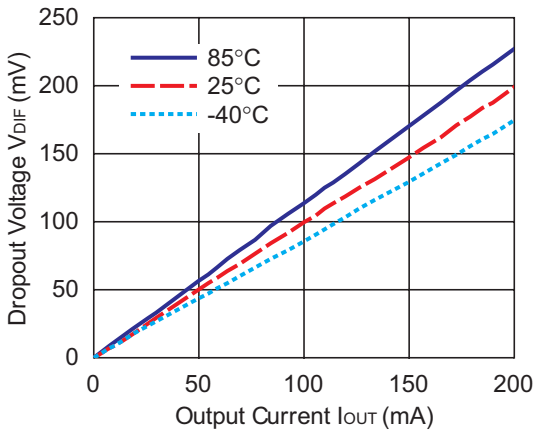
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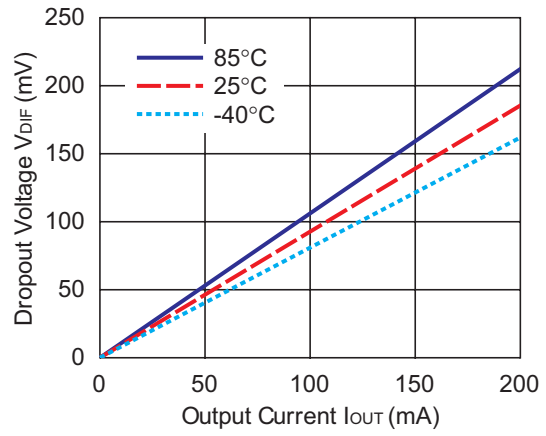
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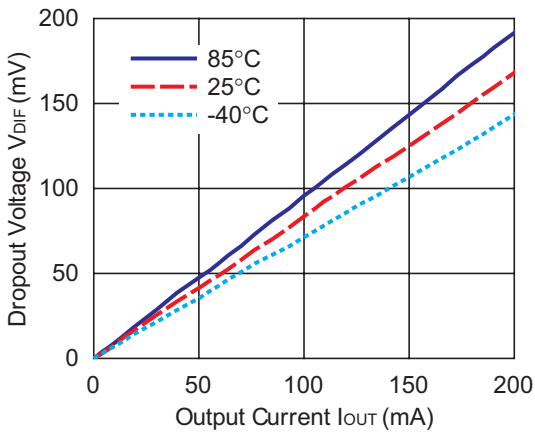
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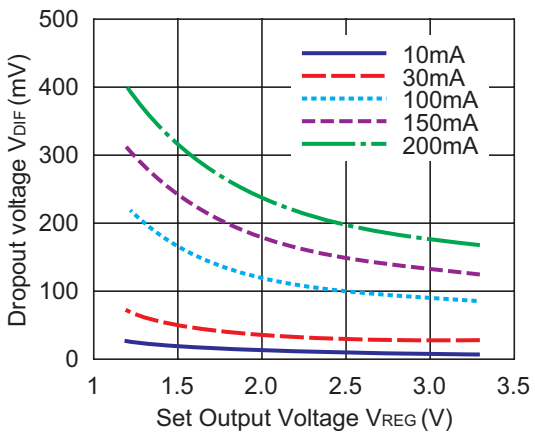
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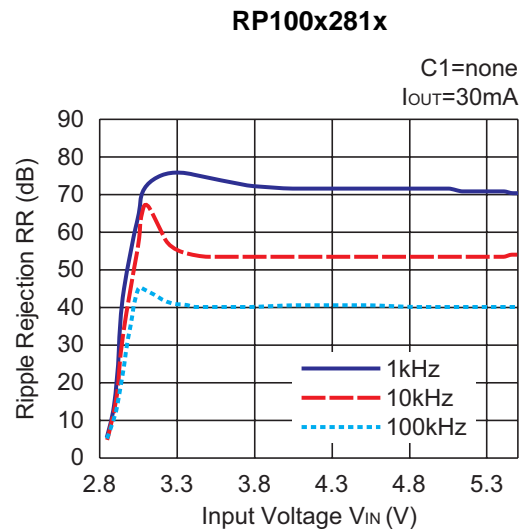
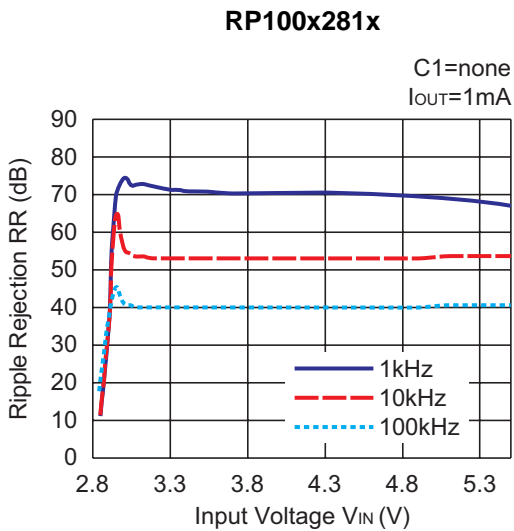
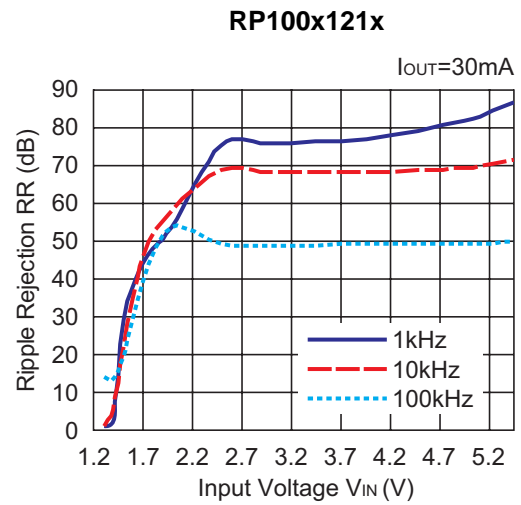
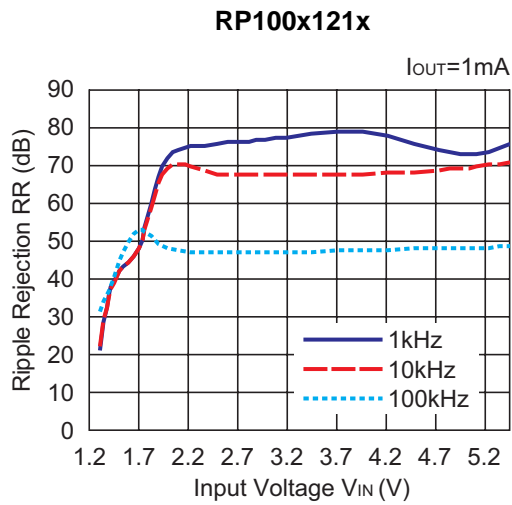
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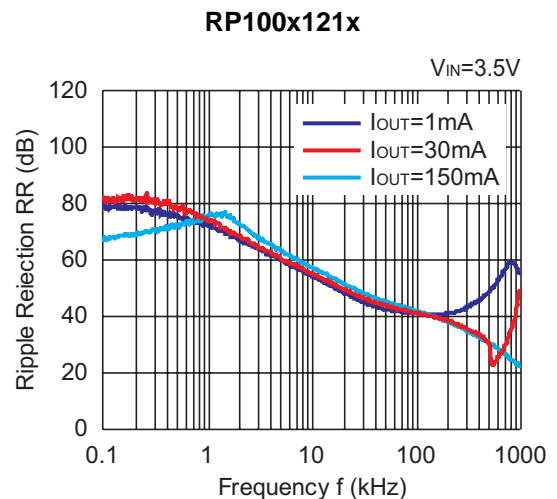
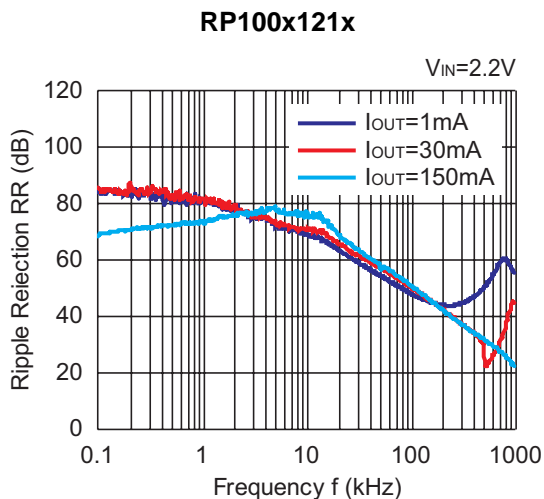
7) Dropout Voltage vs Set Output Voltage ( $C1=1.0\mu F$ ,  $C2=1.0\mu F$ ,  $T_{opt}=25^\circ C$ )



8) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=1.0μF, Ripple=0.2Vp-p, T<sub>opt</sub>=25°C)

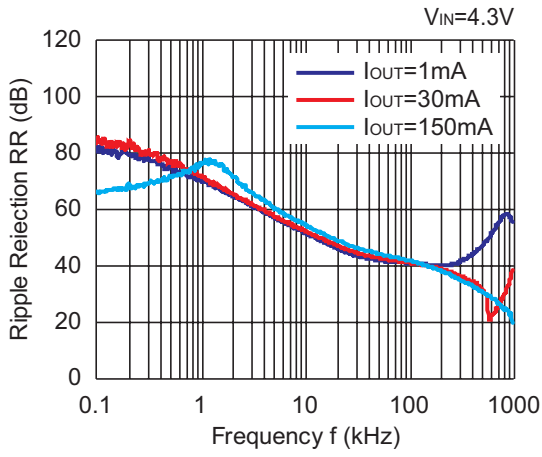


9) Ripple Rejection vs. Frequency (C1=none, C2=1.0μF, Ripple=0.2Vp-p)

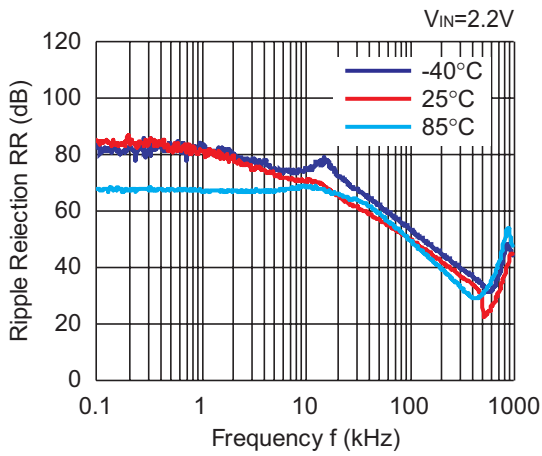


# RP100x

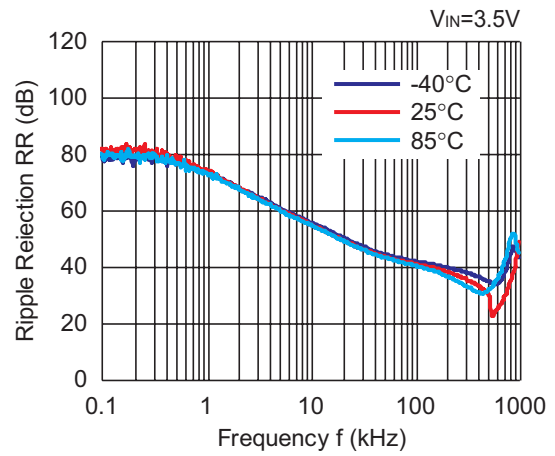
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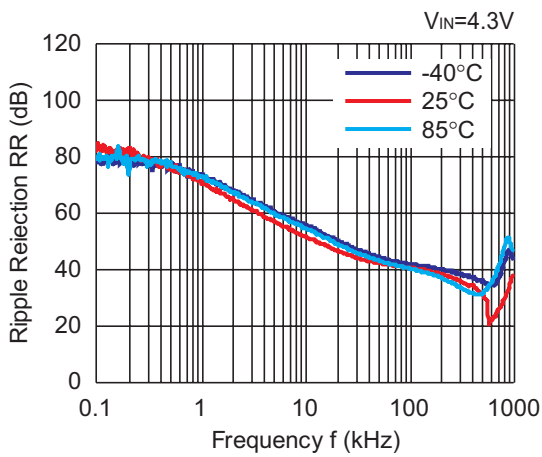
### RP100x121x



### RP100x251x

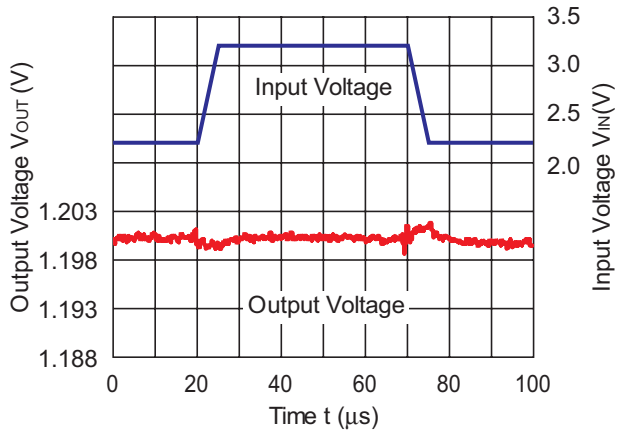


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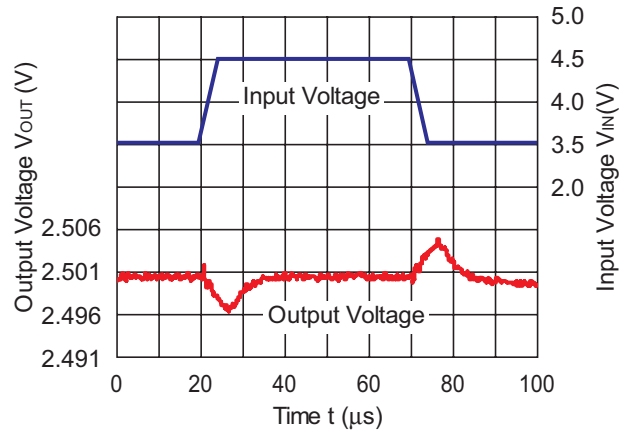


10) Input Transient Response ( $I_{OUT}=30mA$ ,  $t_r=t_f=5\mu s$ ,  $T_{opt}=25^\circ C$ )

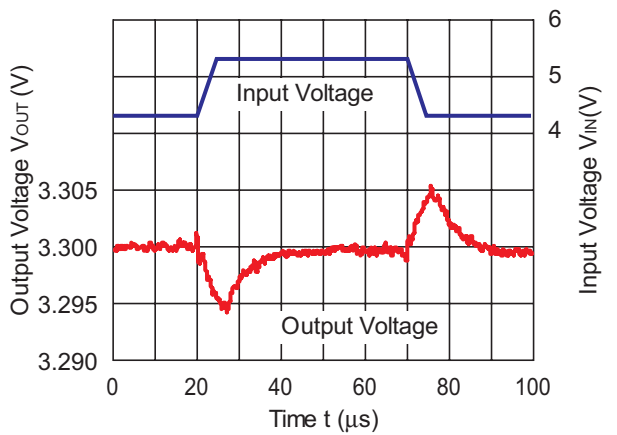
RP100x121x



RP100x251x

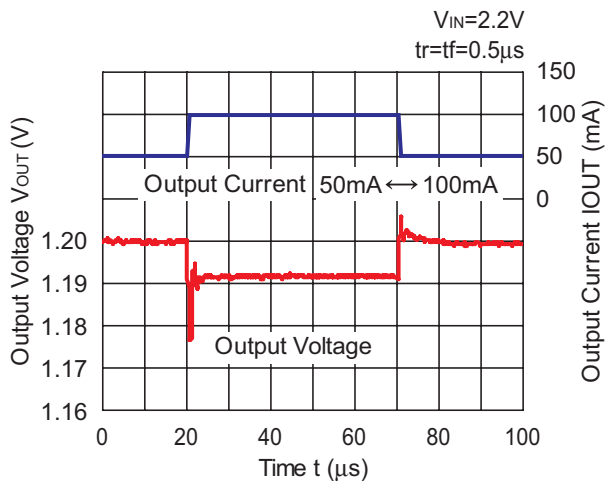


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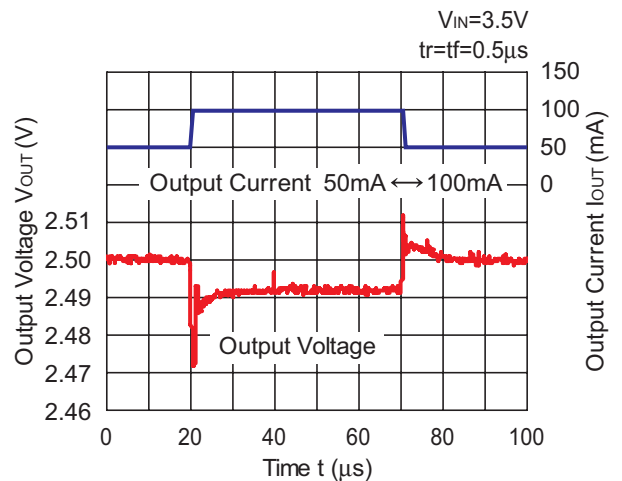


11) Load Transient Response ( $C_2=1.0\mu F$ ,  $T_{opt}=25^\circ C$ )

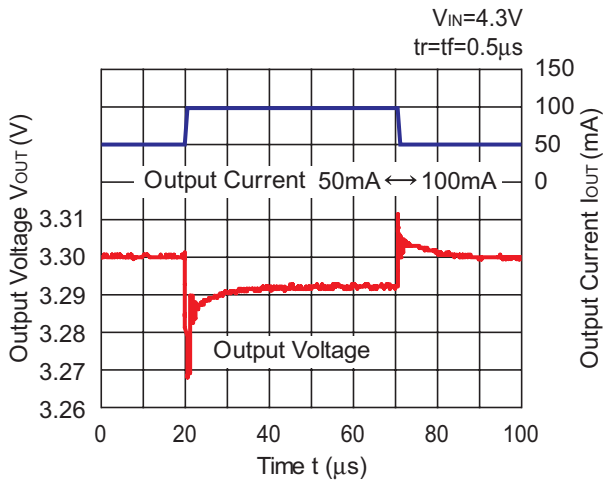
RP100x121x



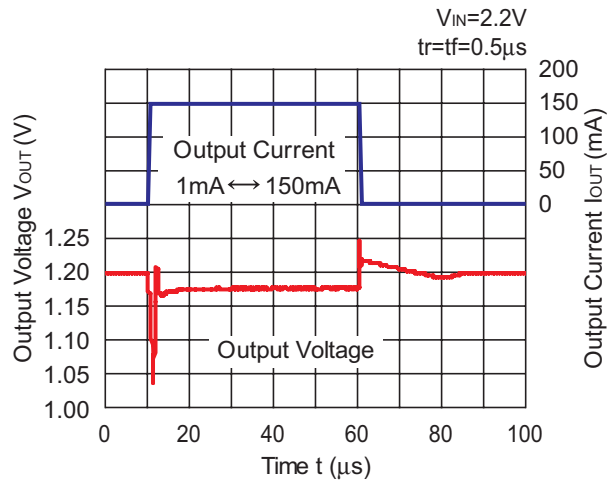
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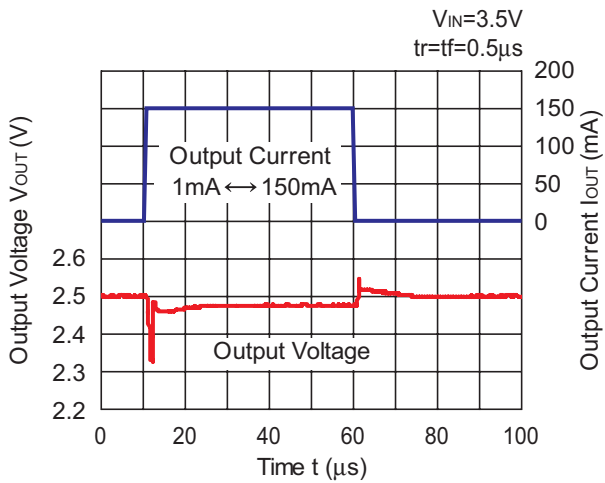
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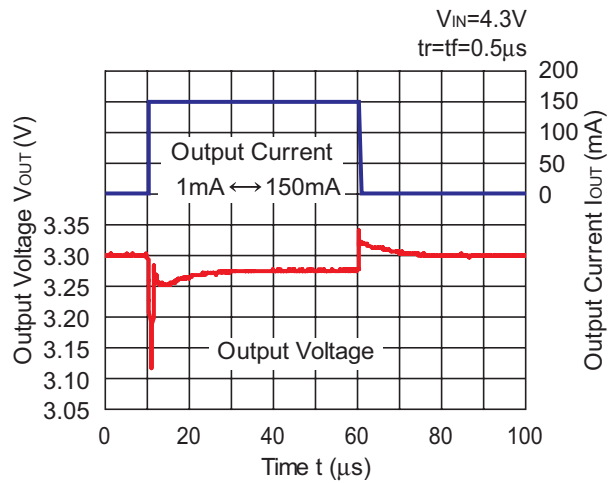
RP100x121x



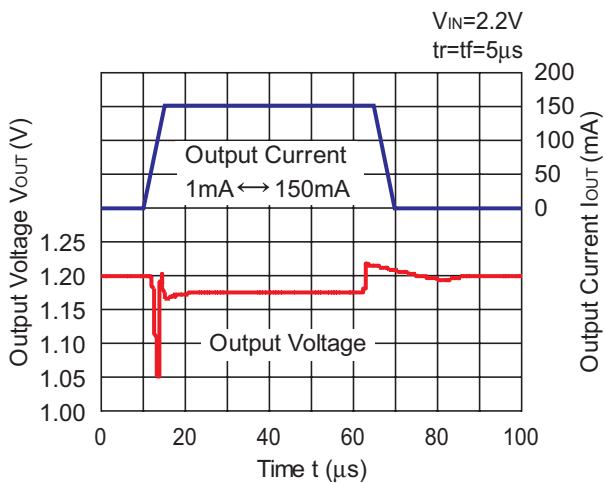
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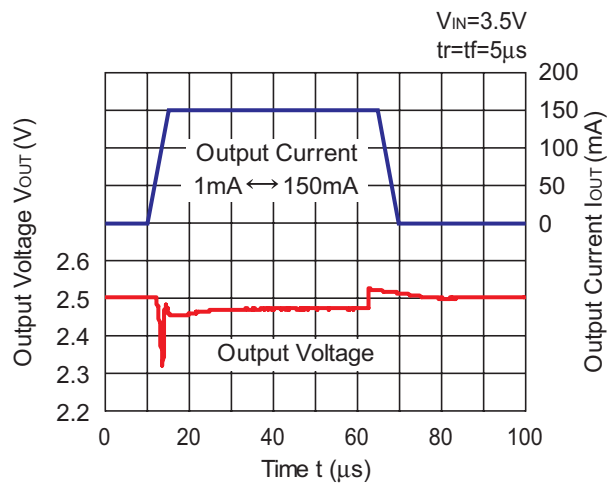
RP100x331x



RP100x121x

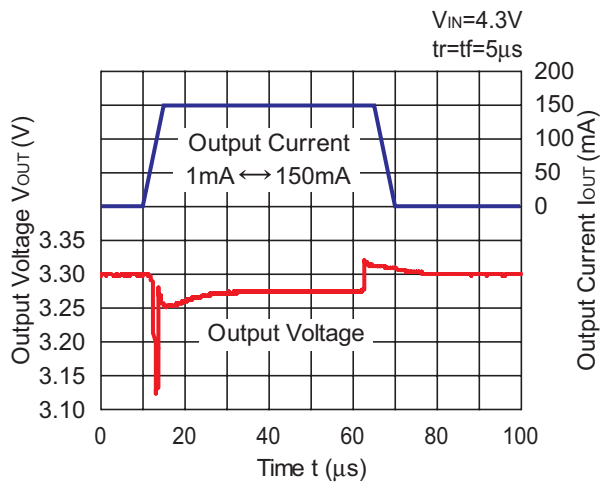


RP100x251x



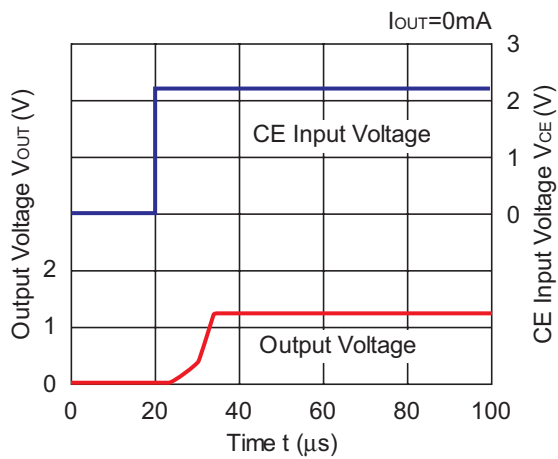


RP100x331x

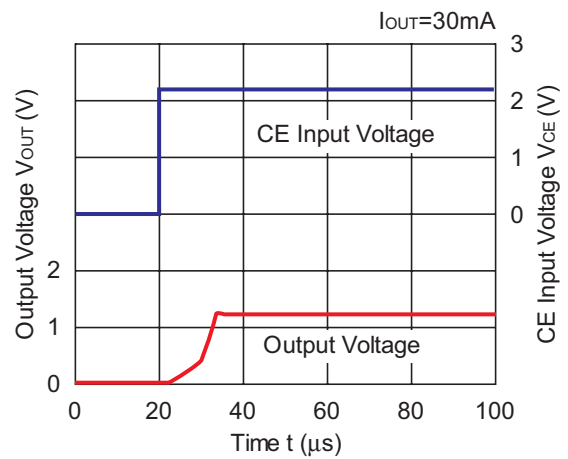


12) Turn On Speed with CE pin ( $C1=1.0\mu F$ ,  $C2=1.0\mu F$ ,  $T_{opt}=25^{\circ}C$ )

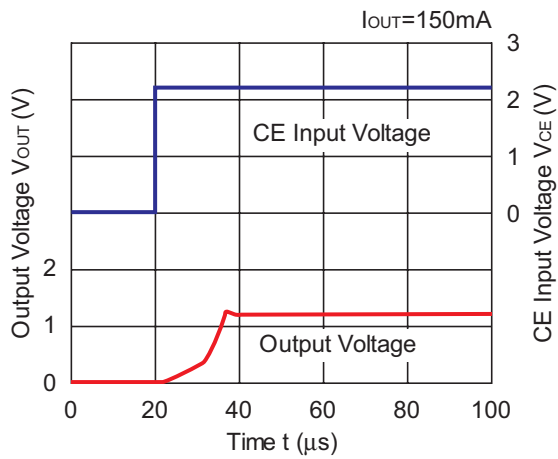
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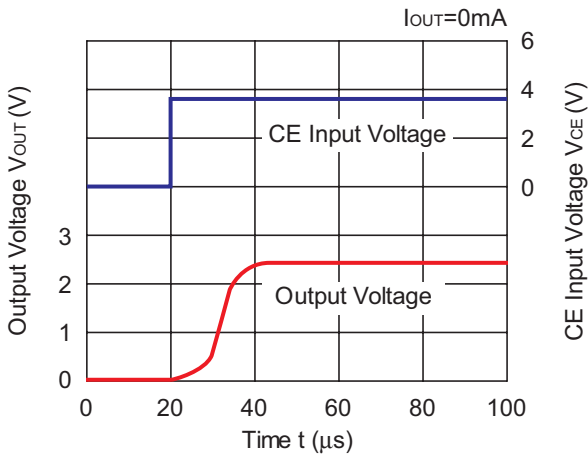
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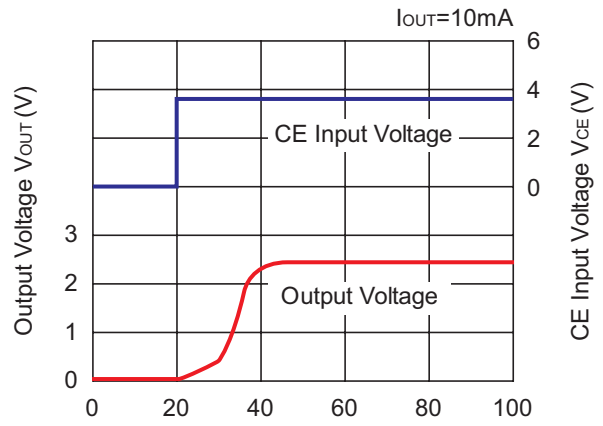
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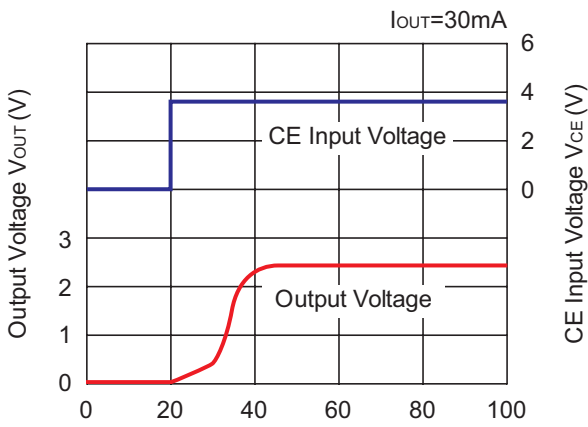
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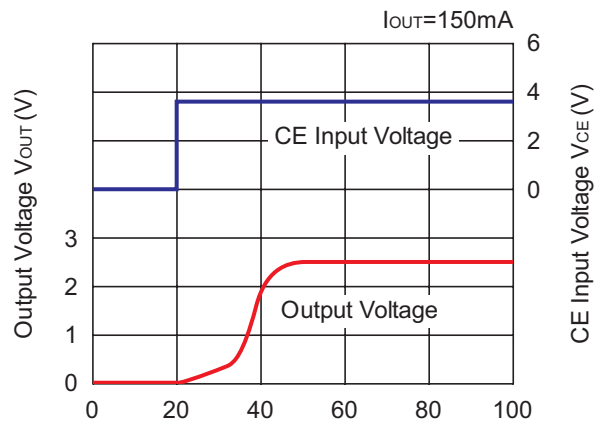
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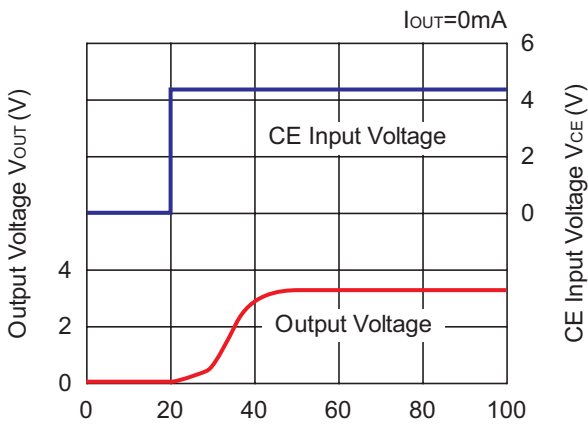
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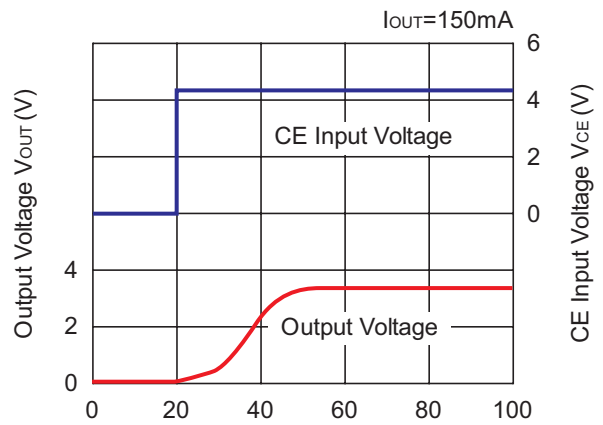
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RP100x331x

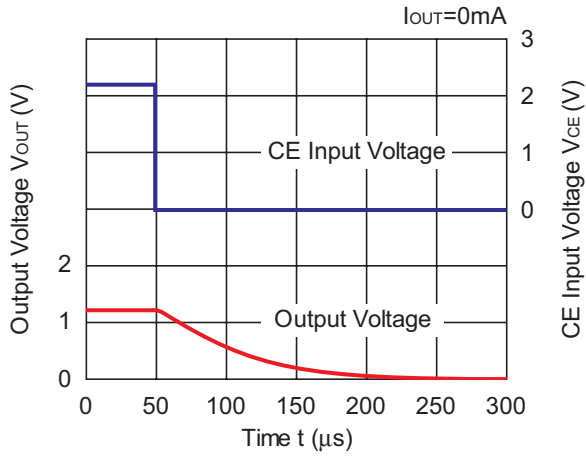


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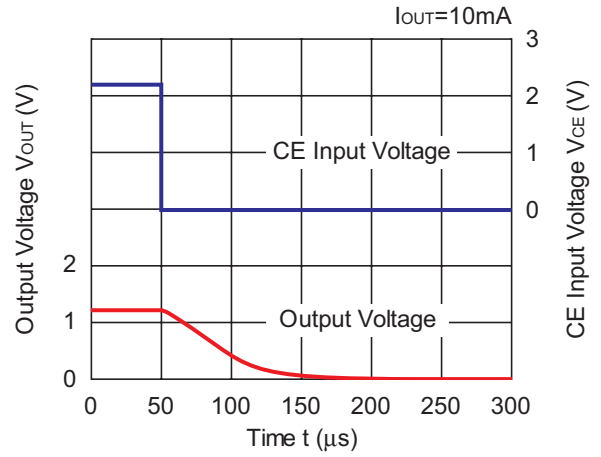


13) Turn Off Speed with CE pin (D Version) (C1=1.0μF, C2=1.0μF, T<sub>opt</sub>=25°C)

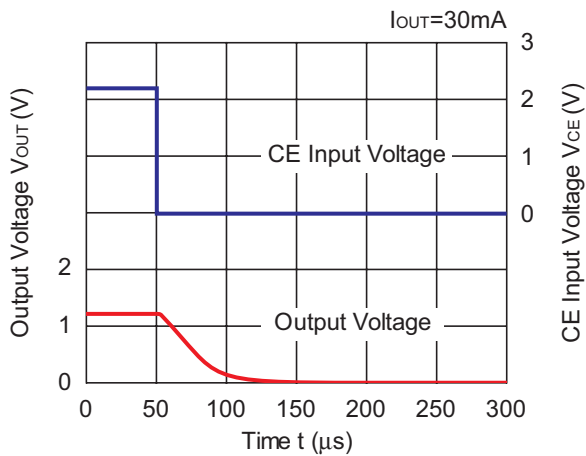
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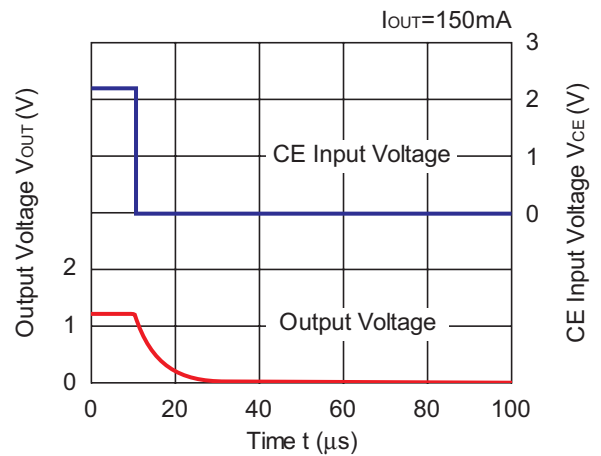
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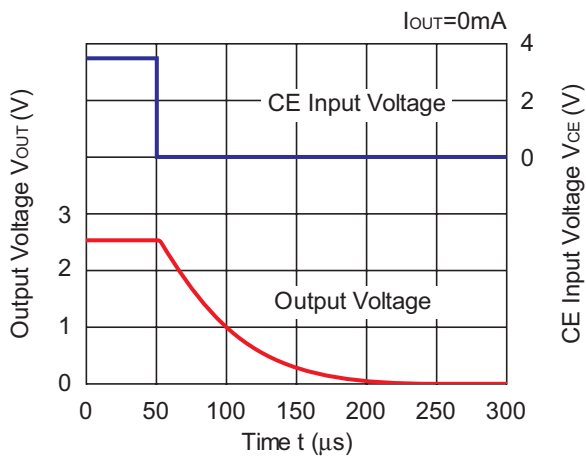
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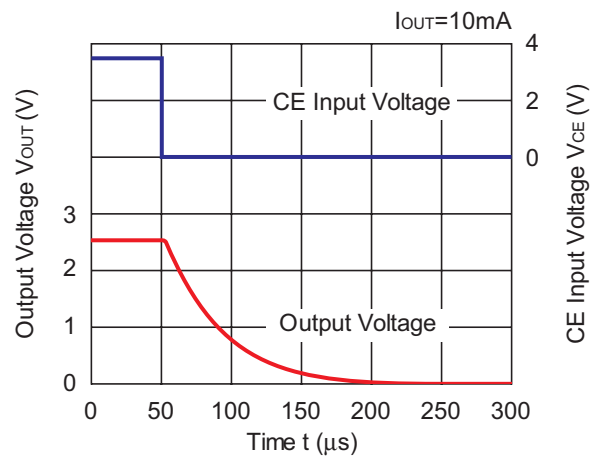
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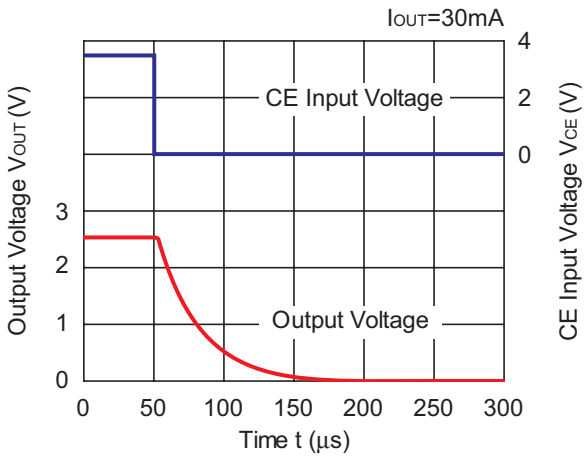
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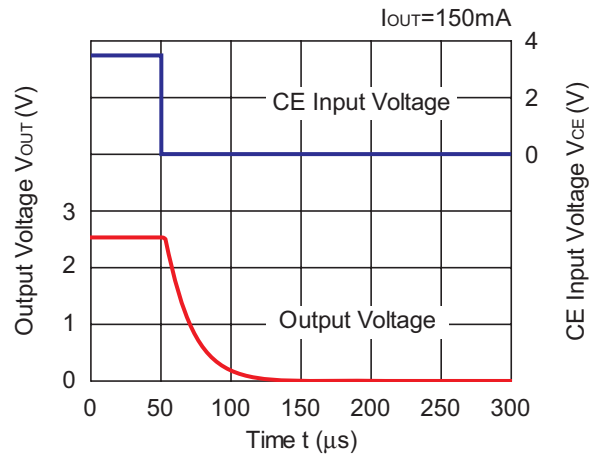
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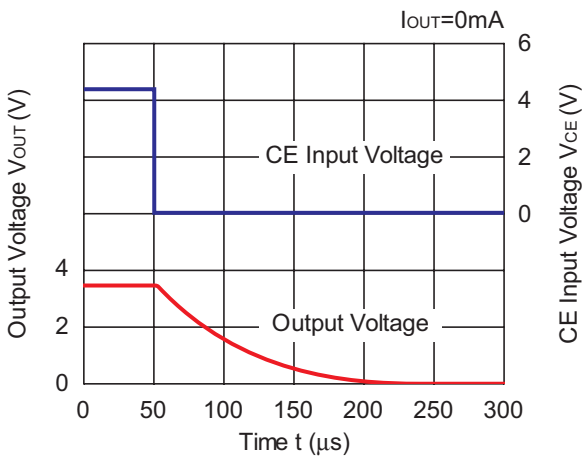
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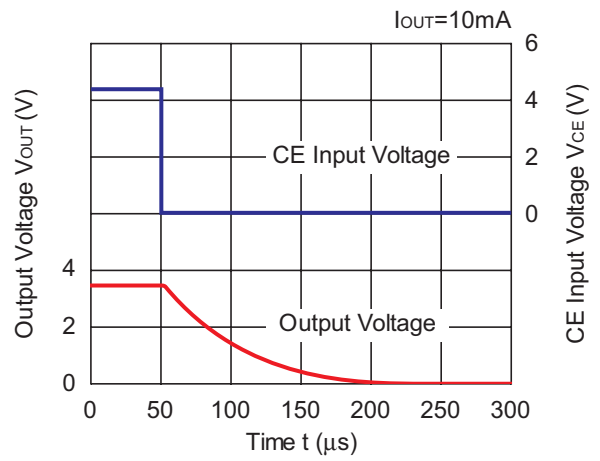
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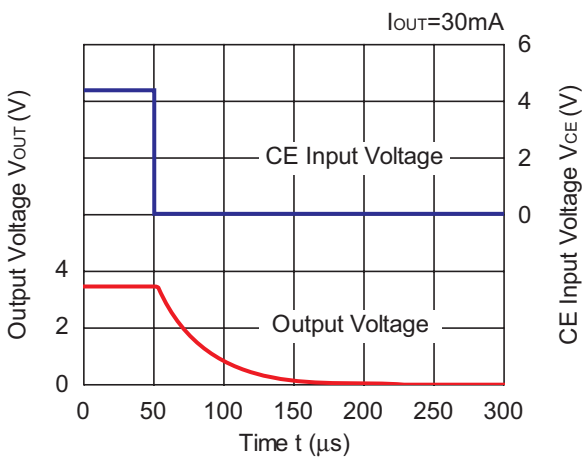
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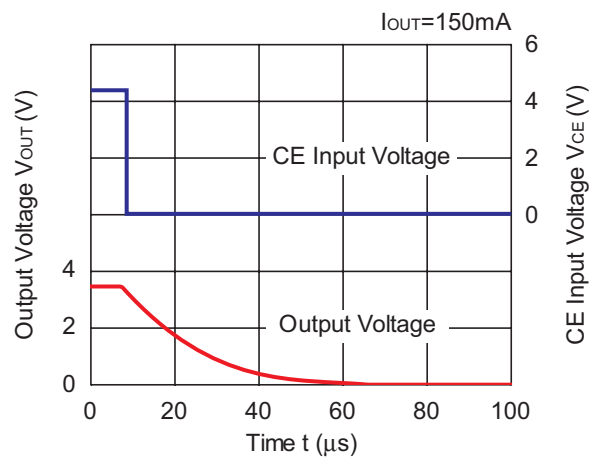
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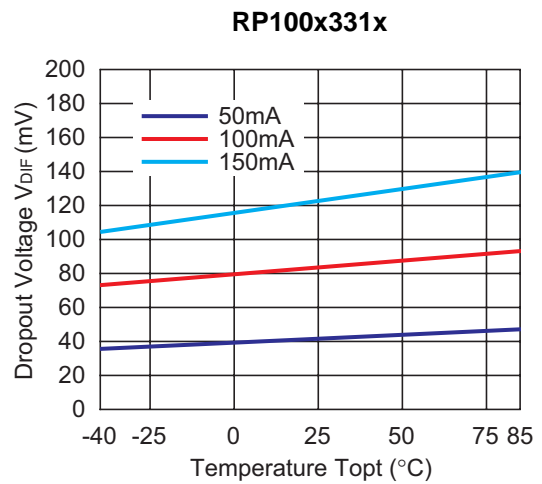
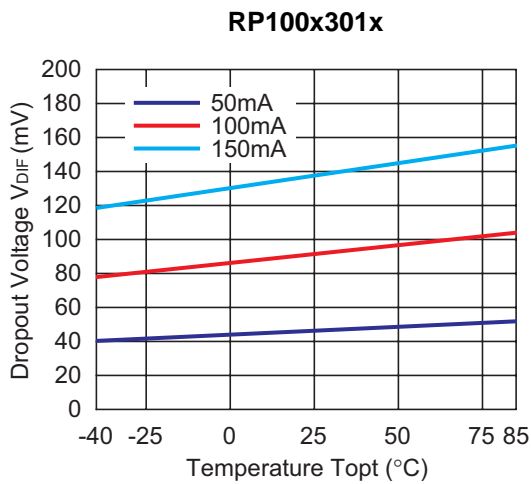
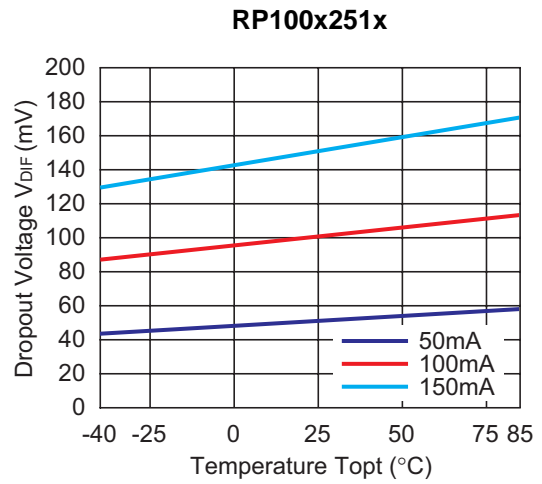
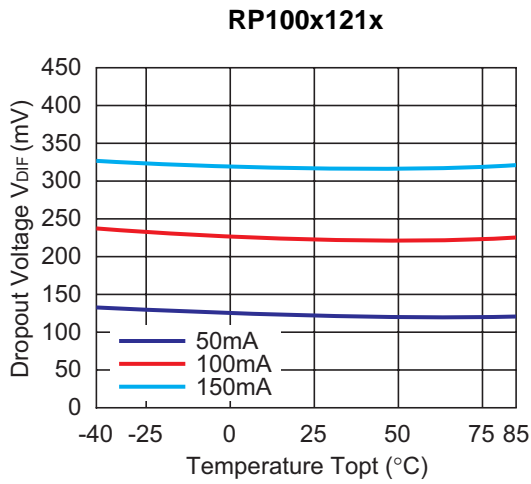
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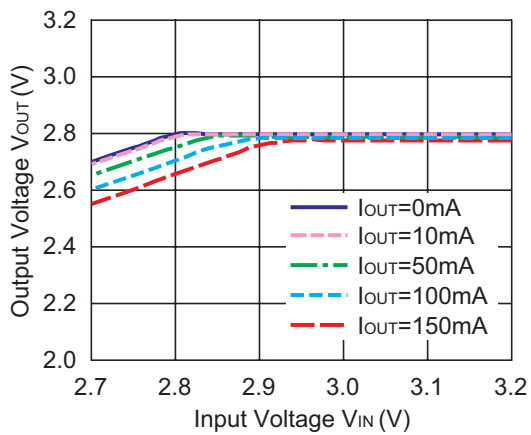
RP100x331Dx



14) Dropout Voltage vs Temperature (C1=1.0μF, C2=1.0μF)



15) Output Voltage vs. Input Voltage (C1=1.0μF, C2=1.0μF)



## ESR vs. Output Current

When using these ICs, consider the following points:

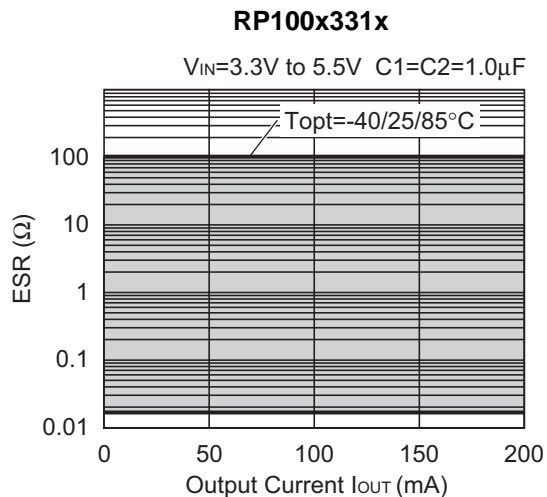
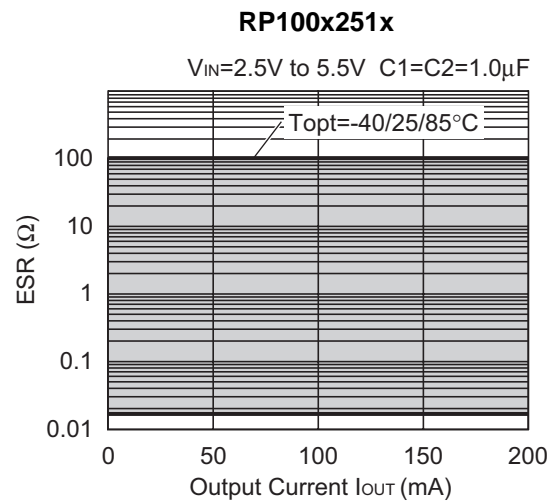
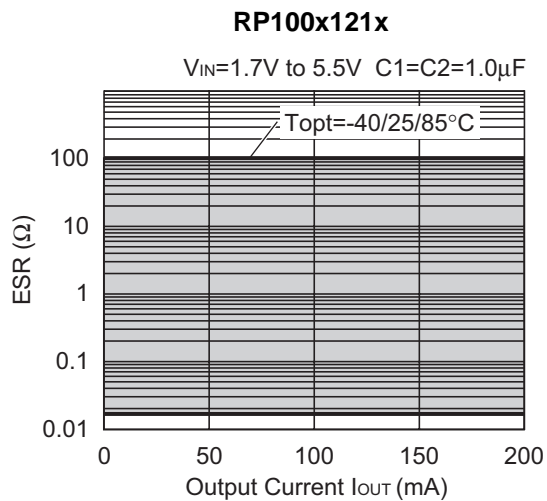
The relations between  $I_{OUT}$  (Output Current) and ESR of an output capacitor are shown below.

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

### Measurement conditions

Frequency Band: 10Hz to 2MHz

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





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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.



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