
LOW NOISE 300mA LDO REGULATOR

NO.EA-141-100114

OUTLINE

The RP102x 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, a resistor-net for voltage setting, a current limit circuit and a chip enable circuit.

These ICs perform with low dropout voltage and "chip enable" function. The line transient response and load transient response of the RP102x 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, DFN(PLP)1820-6, and WLCSP-4-P2, therefore high density mounting of the ICs on boards is possible.

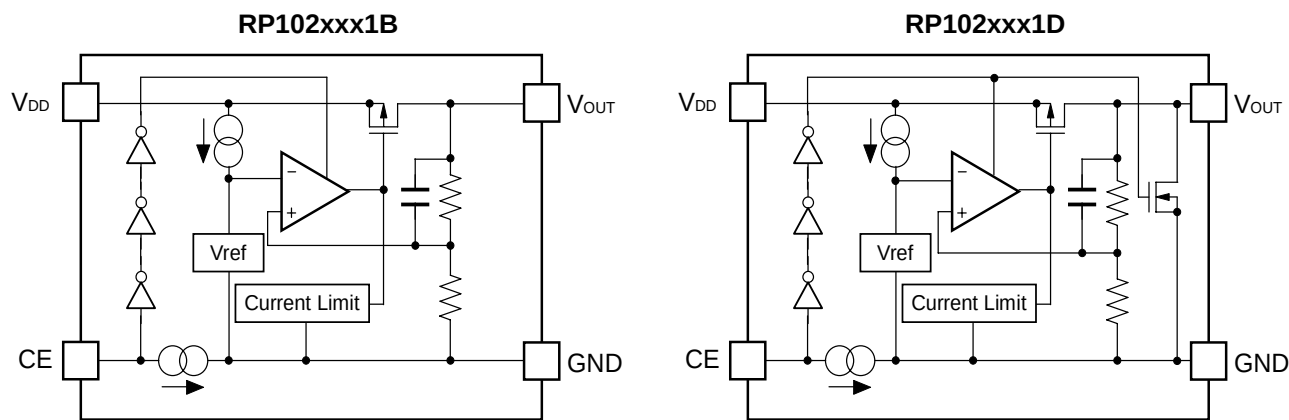
FEATURES

- Supply Current Typ. 50 μ A
- Standby Mode Typ. 0.1 μ A
- Dropout Voltage Typ. 0.12V ($I_{OUT}=300\text{mA}$, $V_{OUT}=2.8\text{V}$)
- Ripple Rejection Typ. 80dB ($f=1\text{kHz}$)
- Temperature-Drift Coefficient of Output Voltage ... Typ. $\pm 20\text{ppm}/^{\circ}\text{C}$
- Line Regulation Typ. 0.02%/V
- Output Voltage Accuracy $\pm 0.8\%$
- Packages WLCSP-4-P2, DFN(PLP)1820-6, 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. 50mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC $C_{IN}=C_{OUT}=1\mu\text{F}$ 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



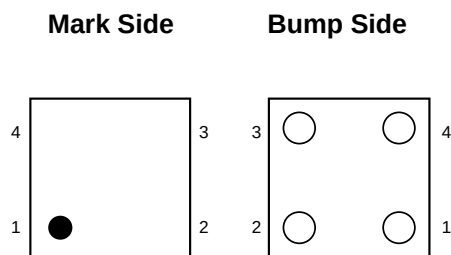
SELECTION GUIDE

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

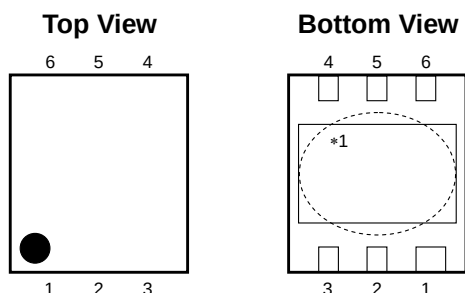
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP102Zxx1*-TR-F	WLCSP-4-P2	5,000 pcs	Yes	Yes
RP102Kxx1*-TR	DFN(PLP)1820-6	5,000 pcs	Yes	Yes
RP102Nxx1*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
xx: The output voltage can be designated in the range from 1.2V(12) to 3.3V(33) in 0.1V steps. (For other voltages, please refer to MARK INFORMATION.)				
* : 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

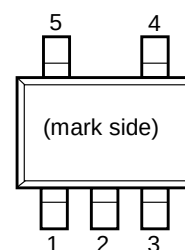
• WLCSP-4-P2



• DFN(PLP)1820-6



• SOT-23-5



PIN DESCRIPTION

• WLCSP-4-P2

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

• DFN(PLP)1820-6

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

*1) 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.

*2) No.1 pin and No.2 pin, No.5 pin and No.6 pin of DFN(PLP)1820-6 package must be wired when it is mounted on board.

• 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	400	mA
P_D	Power Dissipation (WLCSP-4-P2) *	530	mW
	Power Dissipation (SOT-23-5) *	420	
	Power Dissipation (DFN(PLP)1820-6) *	880	
T_{opt}	Operating Temperature Range	-40 to 85	°C
T_{stg}	Storage Temperature Range	-55 to 125	°C

*) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.

The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge.

And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

• RP102xxx1B/D

V_{IN} =Set $V_{OUT}+1V$ for V_{OUT} options grater than 1.5V. $V_{IN}=2.5V$ for $V_{OUT} \leq 1.5V$.

$I_{OUT}=1mA$, $C_{IN}=C_{OUT}=1\mu F$, unless otherwise noted.

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

Table 20

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V _{OUT}	Output Voltage	V _{IN} =Set V _{OUT} +1V	V _{OUT} > 2.0V	×0.992		×1.008	V
			V _{OUT} ≤ 2.0V	−16		+16	mV
I _{OUT}	Output Current			300			mA
ΔV _{OUT} / ΔI _{OUT}	Load Regulation	1mA ≤ I _{OUT} ≤ 150mA			10	20	mV
		1mA ≤ I _{OUT} ≤ 300mA			20	40	
V _{DIF}	Dropout Voltage	Refer to the following table					
I _{SS}	Supply Current	I _{OUT} =0mA			50	70	μA
I _{standby}	Supply Current (Standby)	V _{CE} =0V			0.1	2.0	μA
ΔV _{OUT} /ΔV _{IN}	Line Regulation	Set V _{OUT} +0.5V ≤ V _{IN} ≤ 5V			0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V _{IN} =Set V _{OUT} +1V, I _{OUT} =30mA (In case that V _{OUT} ≤ 2V, V _{IN} =3V)			80		dB
V _{IN}	Input Voltage*			1.7		5.25	V
ΔV _{OUT} /ΔT _{opt}	Output Voltage Temperature Coefficient	−40°C ≤ T _{opt} ≤ 85°C			±20		ppm /°C
I _{SC}	Short Current Limit	V _{OUT} =0V			50		mA
I _{PD}	CE Pull-down Current			0.05	0.3	0.6	μA
V _{CEH}	CE Input Voltage “H”			1.1			V
V _{CEL}	CE Input Voltage “L”					0.3	V
en	Output Noise	BW=10Hz to 100kHz, I _{OUT} =30mA			30		μVrms
R _{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V _{IN} =4V V _{CE} =0V			30		Ω

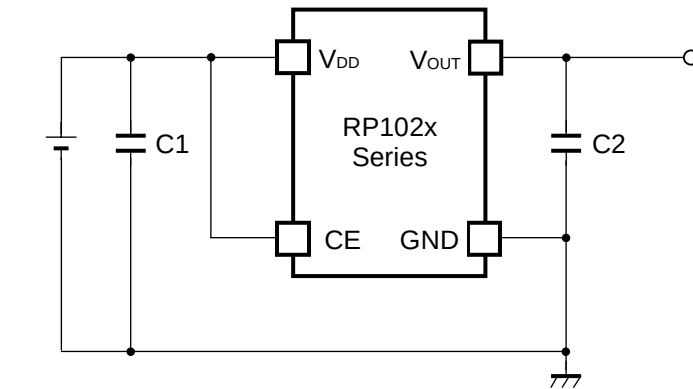
*) The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.

• Electrical Characteristics by Output Voltage

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

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)					
	Condition	Typ.	Max.	Condition	Typ.	Max.
$1.2V \leq V_{OUT} < 1.5V$	$I_{OUT}=150mA$	0.145	-	$I_{OUT}=300mA$	0.290	0.500
$1.5V \leq V_{OUT} < 1.7V$		0.110	0.160		0.220	0.320
$1.7V \leq V_{OUT} < 2.0V$		0.100	0.140		0.200	0.280
$2.0V \leq V_{OUT} < 2.5V$		0.085	0.120		0.170	0.240
$2.5V \leq V_{OUT} < 2.8V$		0.070	0.100		0.140	0.200
$2.8V \leq V_{OUT} \leq 3.3V$		0.060	0.095		0.120	0.190

TYPICAL APPLICATION



(External Components)

C2 1.0 μ F MURATA: GRM155B31A105KE15

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

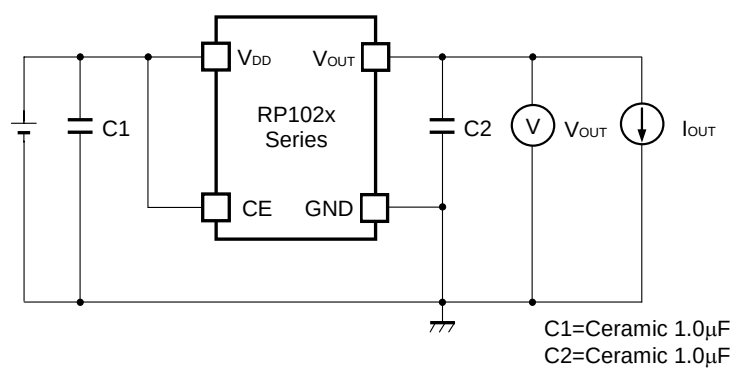
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

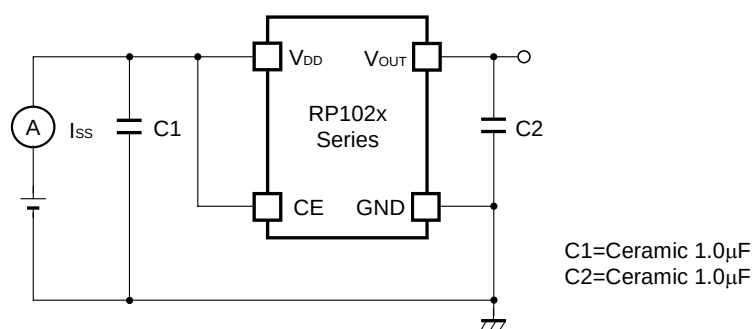
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0 μ F or more between V_{DD} and GND pin, and as close as possible to the pins.

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

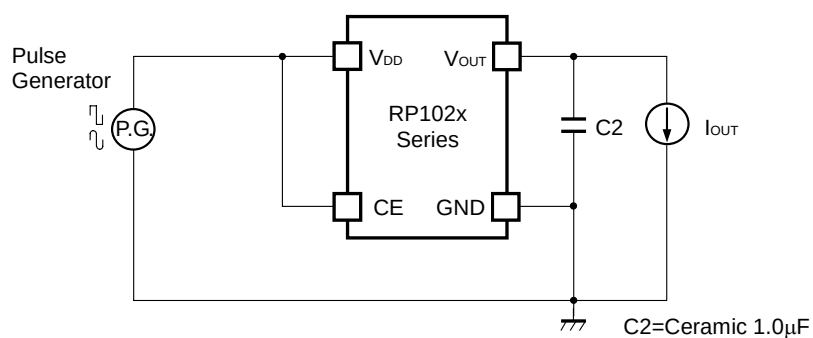
TEST CIRCUITS



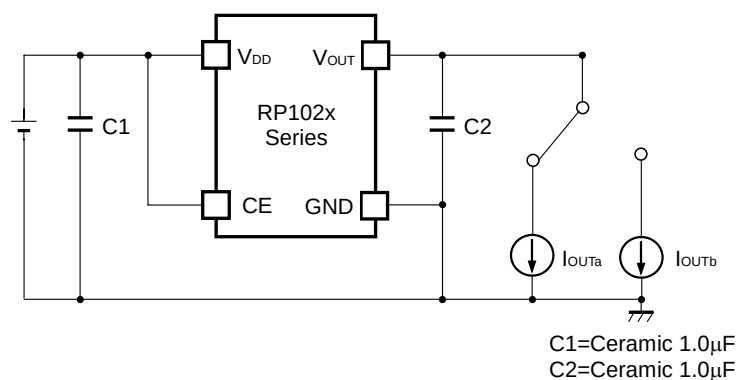
Basic Test Circuit



Test Circuit for Supply Current



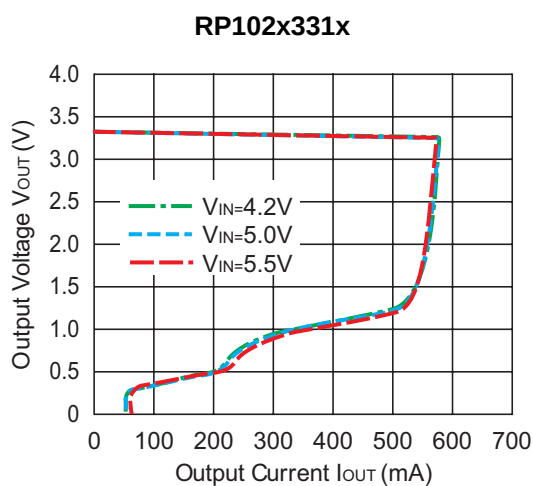
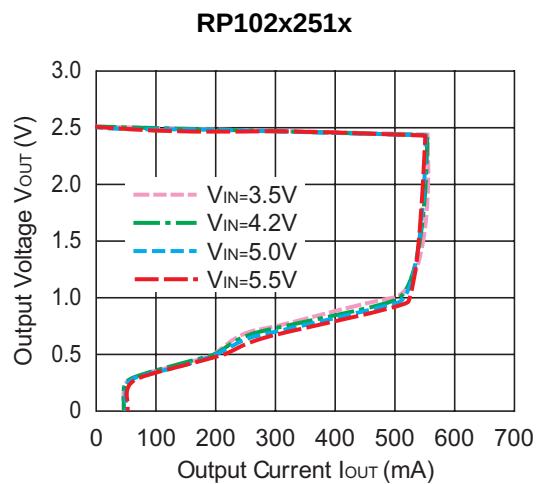
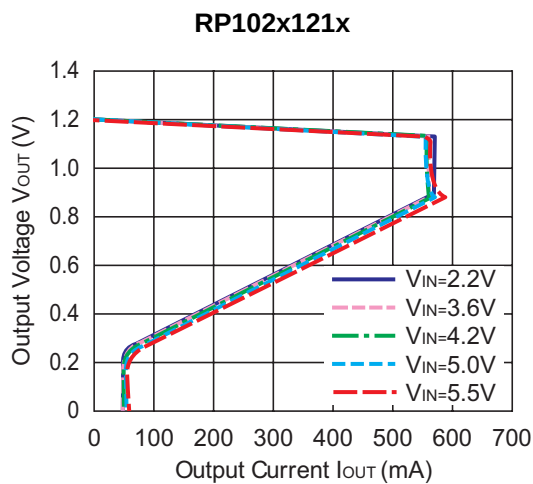
Test Circuit for Ripple Rejection



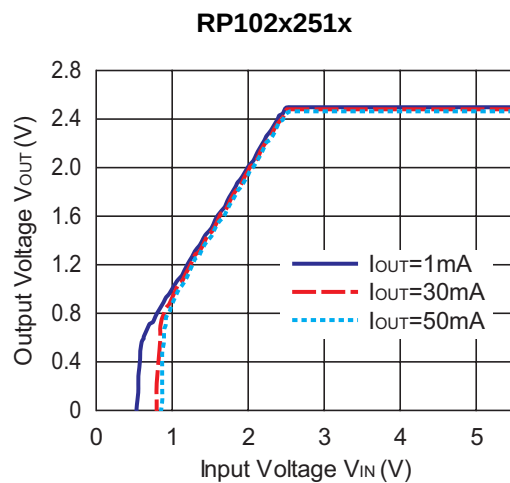
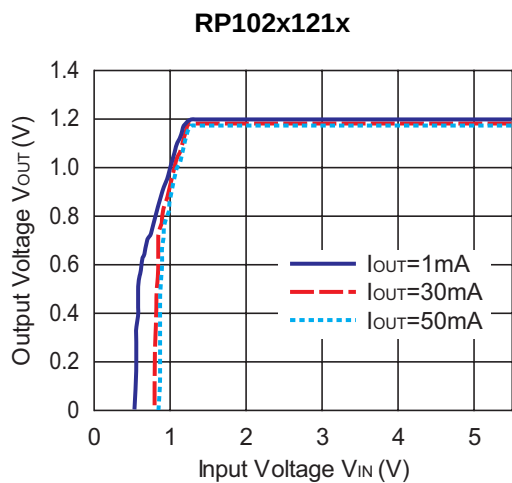
Test Circuit for Load Transient Response

TYPICAL CHARACTERISTIC

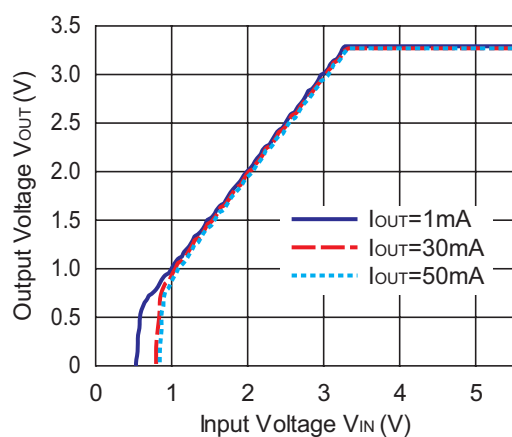
1) Output Voltage vs. Output Current ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $T_{opt}=25^{\circ}C$)



2) Output Voltage vs. Input Voltage ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $T_{opt}=25^{\circ}C$)

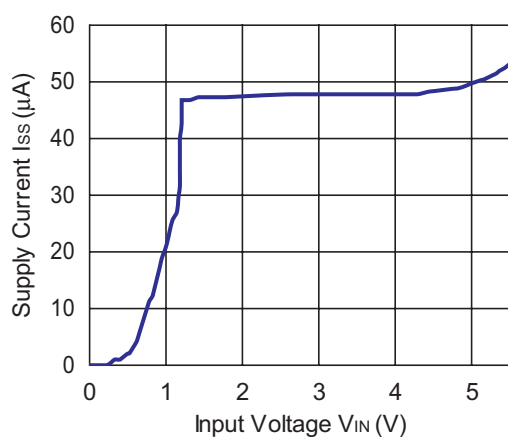


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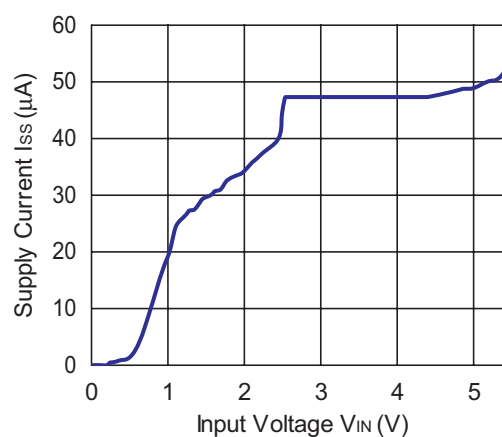


3) Supply Current vs. Input Voltage ($C_{IN}=1.0\mu\text{F}$, $C_{OUT}=1.0\mu\text{F}$, $T_{opt}=25^\circ\text{C}$)

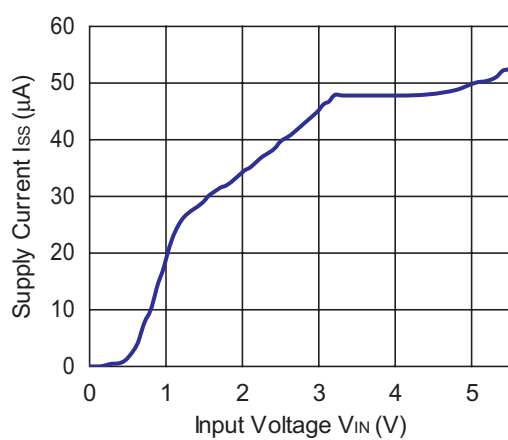
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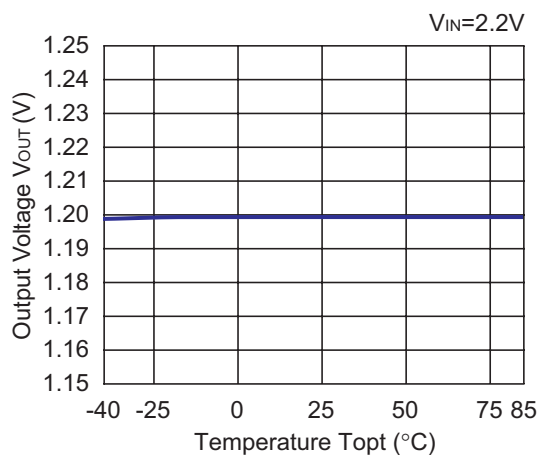
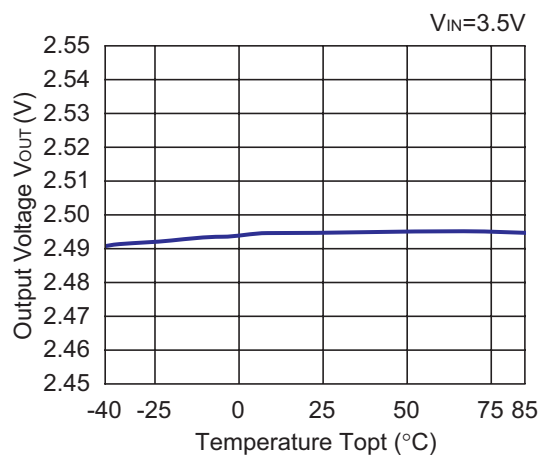
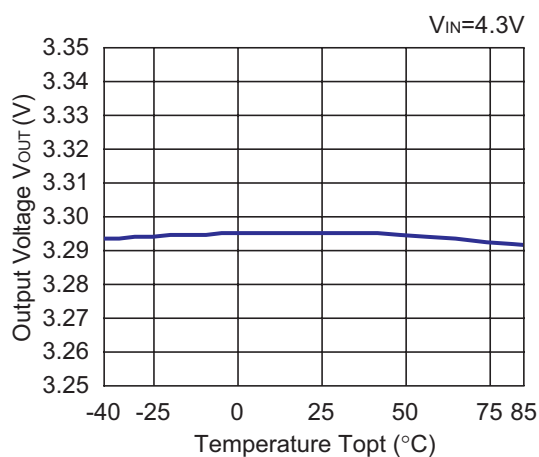
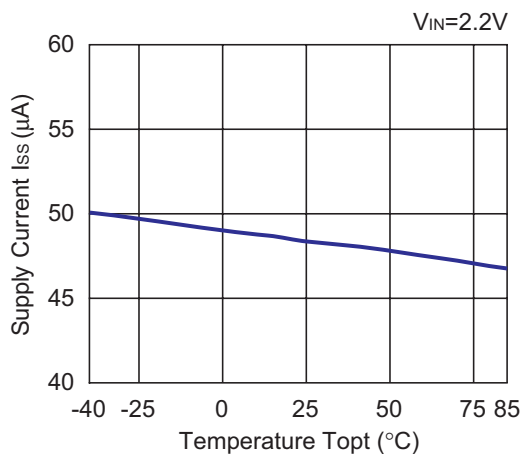
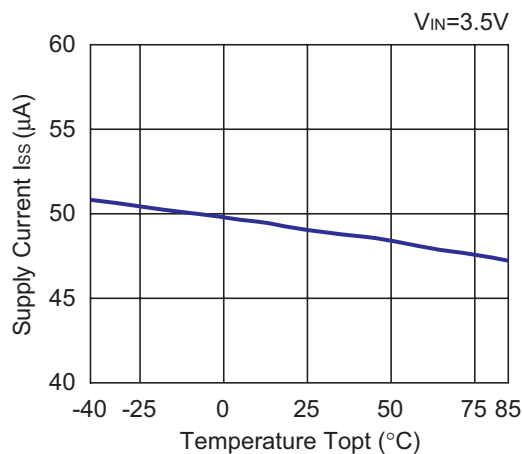


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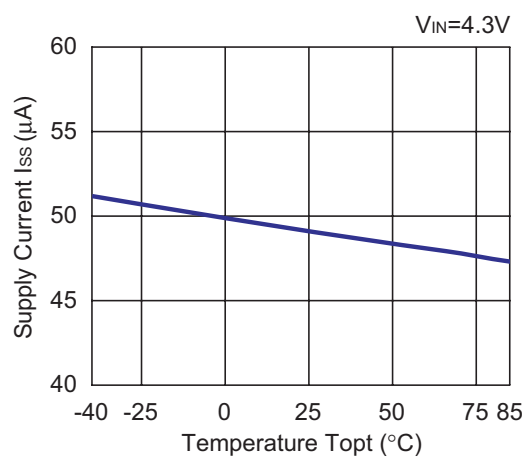


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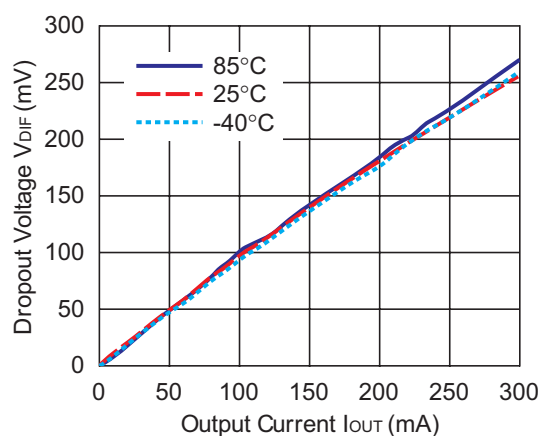
4) Output Voltage vs. Temperature ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $I_{OUT}=1mA$)
RP102x121x

RP102x251x

RP102x331x

5) Supply Current vs. Temperature ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $I_{OUT}=0mA$)
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RP102x251x


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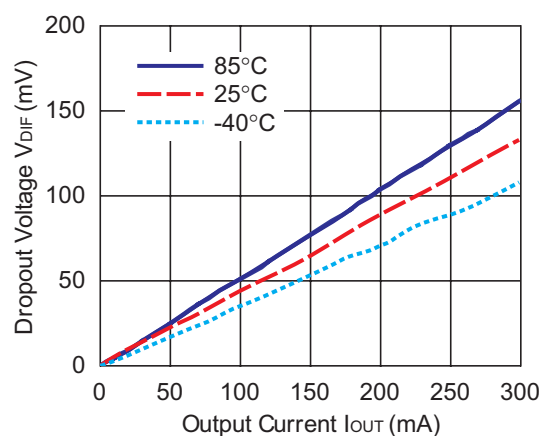


6) Dropout Voltage vs. Output Current ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$)

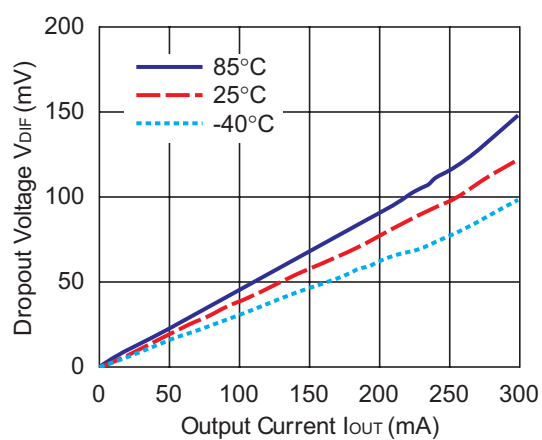
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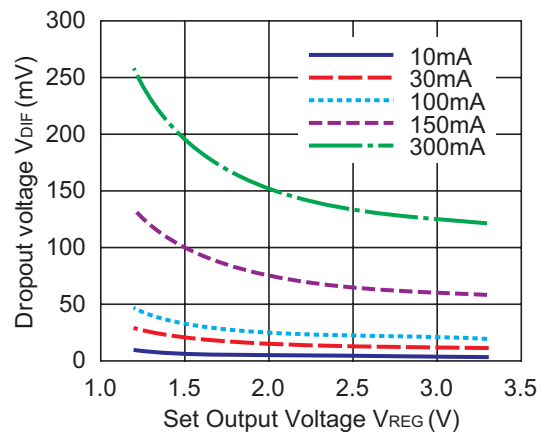
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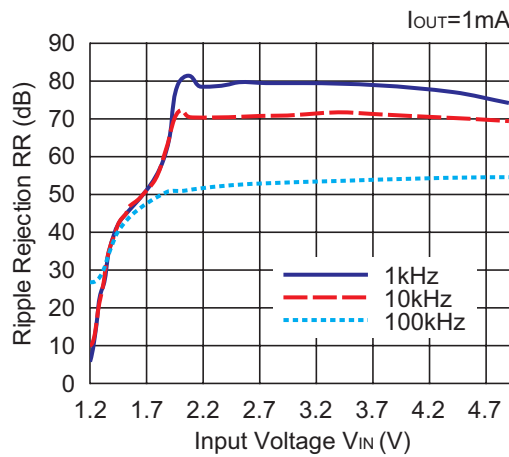


7) Dropout Voltage vs Set Output Voltage ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $T_{opt}=25^{\circ}C$)

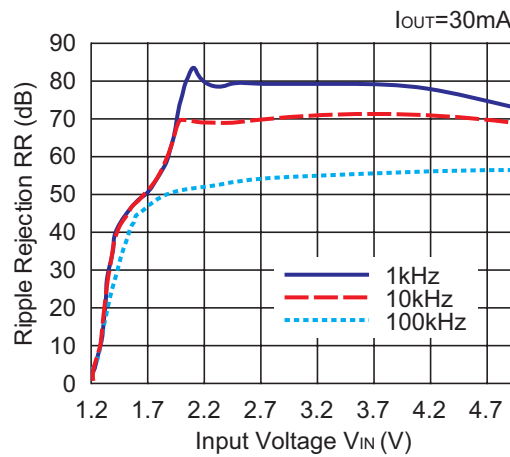


8) Ripple Rejection vs. Input Bias Voltage ($C_{IN}=none$, $C_{OUT}=1.0\mu F$, $Ripple=0.2Vp-p$, $T_{opt}=25^{\circ}C$)

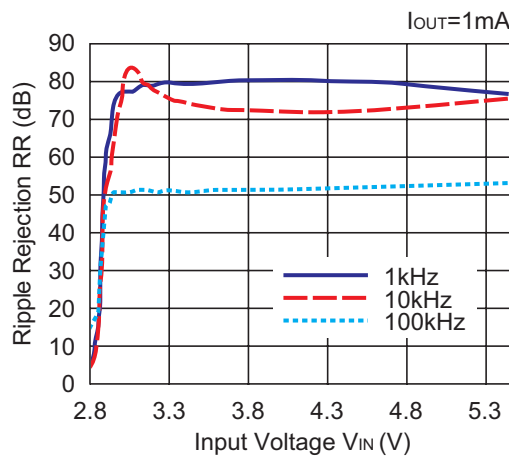
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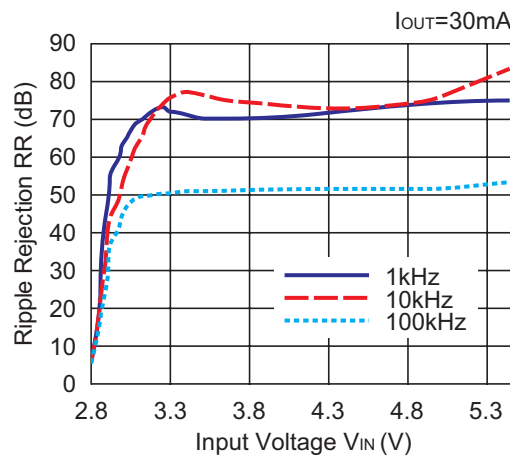
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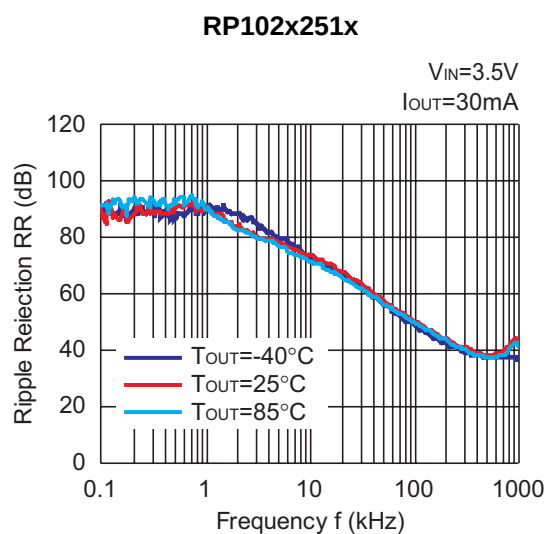
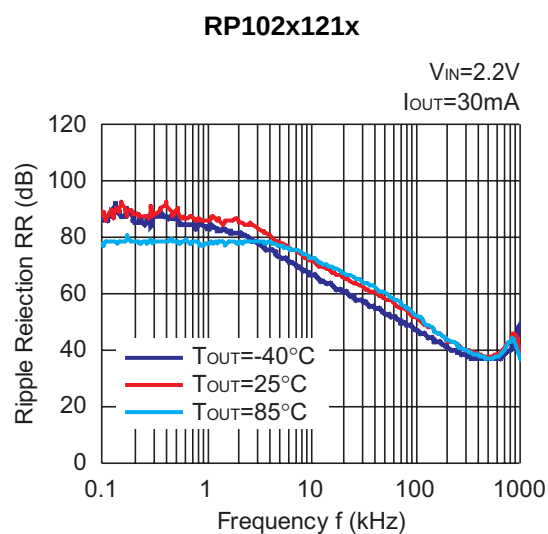
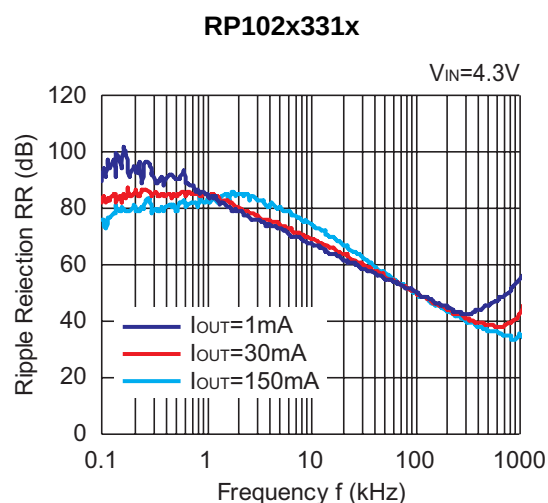
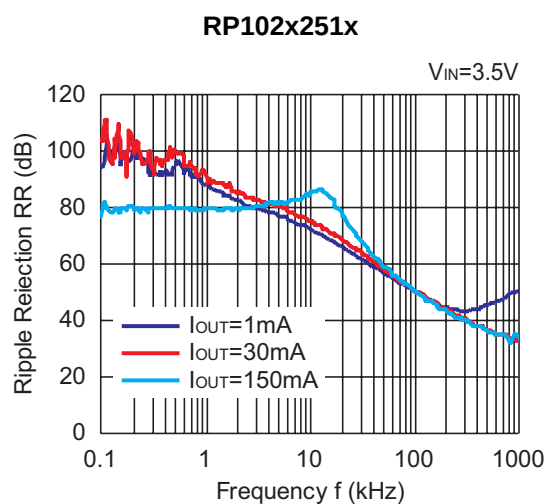
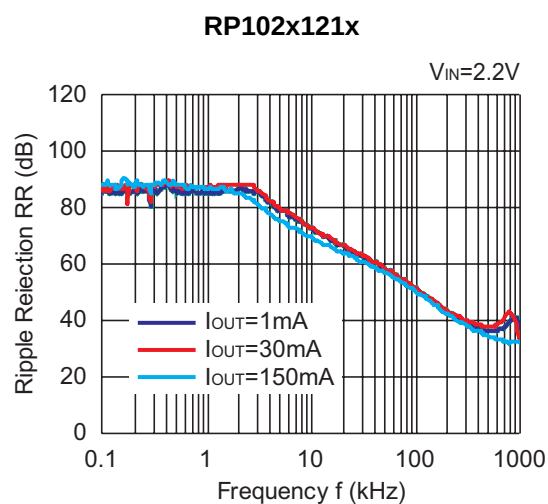
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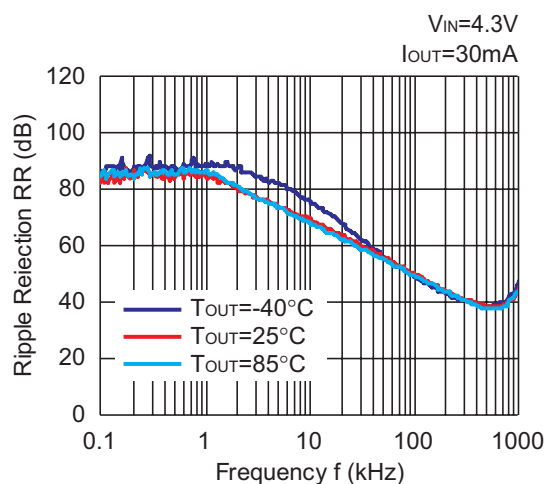
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9) Ripple Rejection vs. Frequency ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, Ripple=0.2Vp-p)

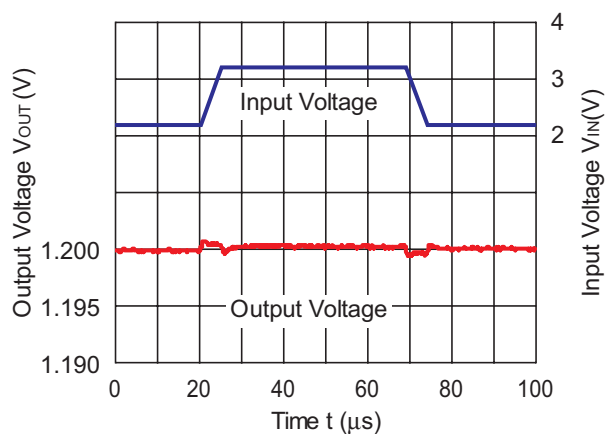


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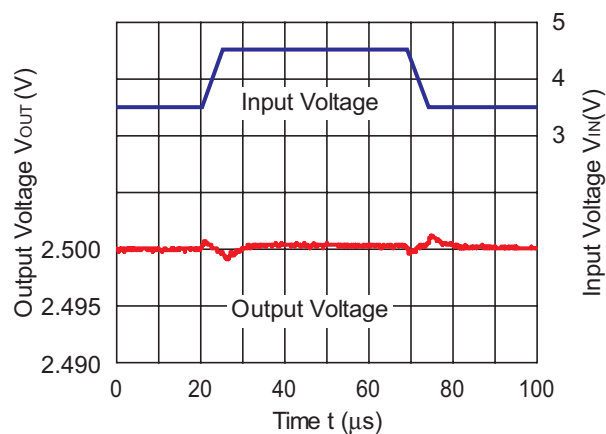


10) Input Transient Response ($C_{IN}=none$, $C_{OUT}=1.0\mu F$, $I_{OUT}=30mA$, $t_r=t_f=5\mu s$, $T_{opt}=25^{\circ}C$)

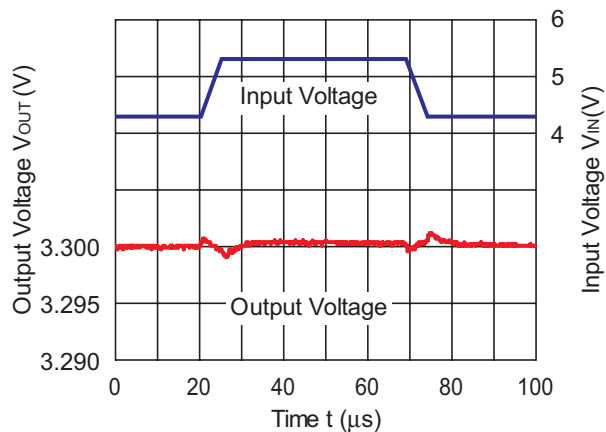
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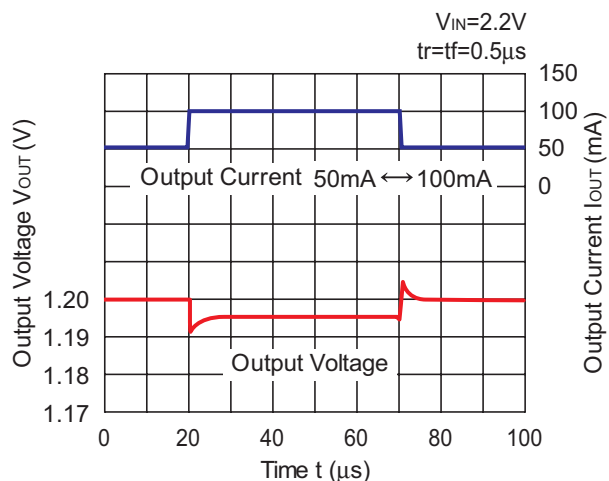


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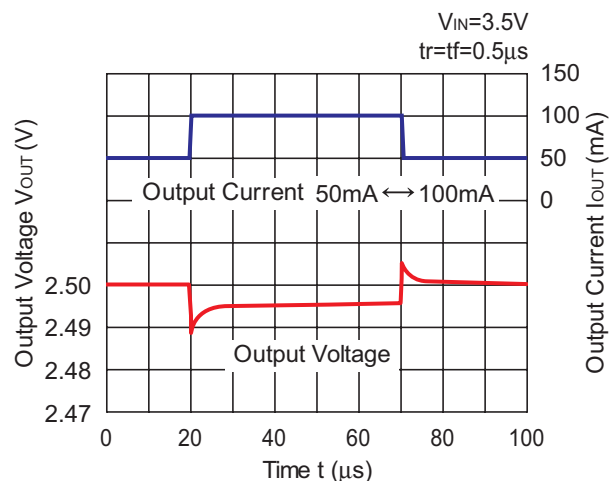


11) Load Transient Response ($C_{OUT}=1.0\mu F$, $T_{opt}=25^{\circ}C$)

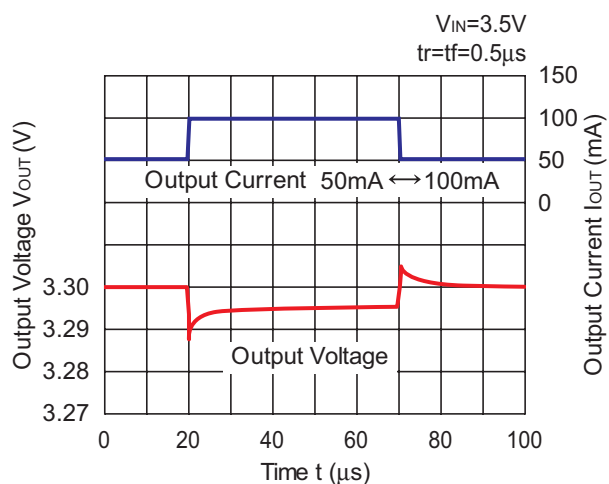
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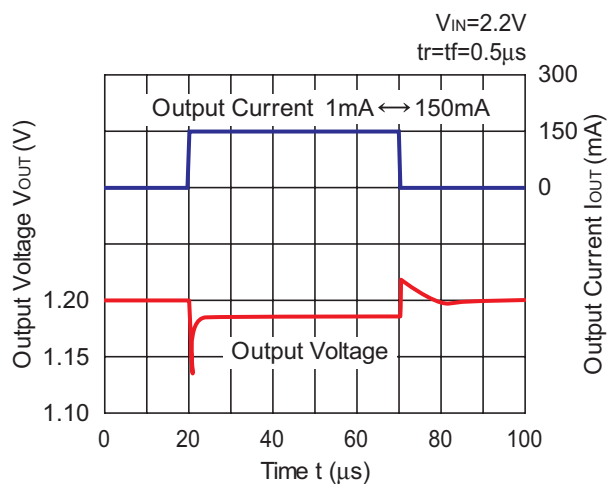
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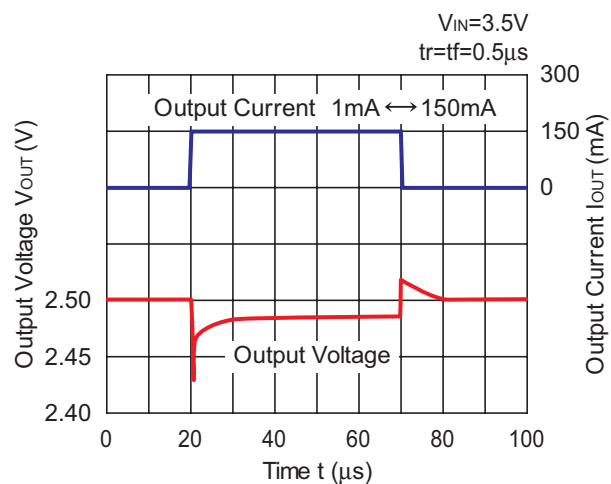
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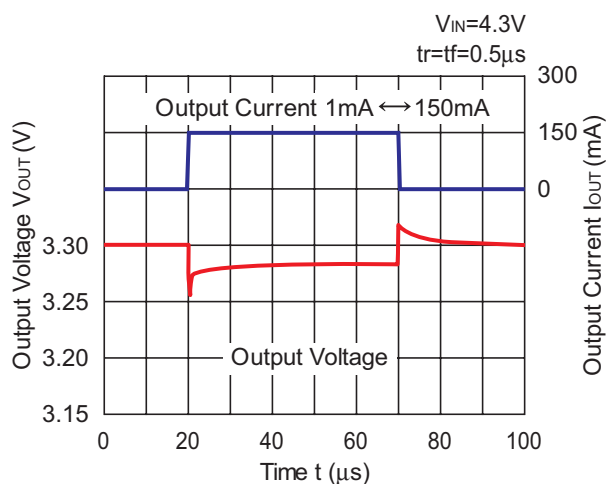
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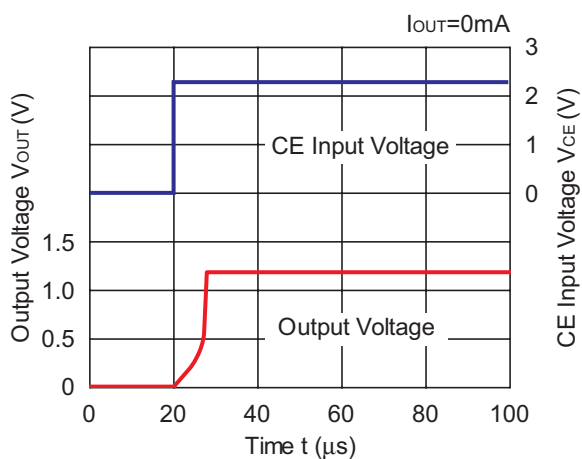


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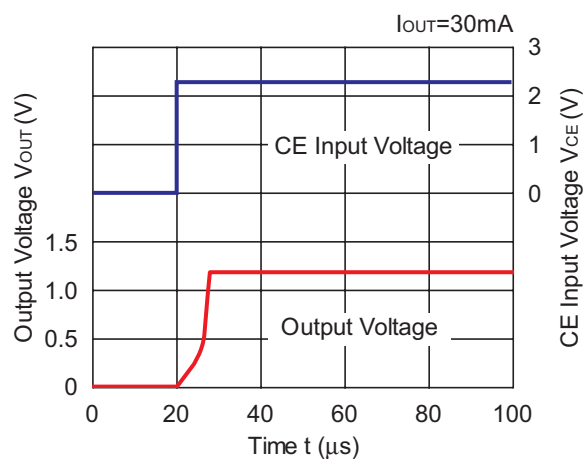


12) Turn On Speed with CE pin ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $T_{opt}=25^\circ C$)

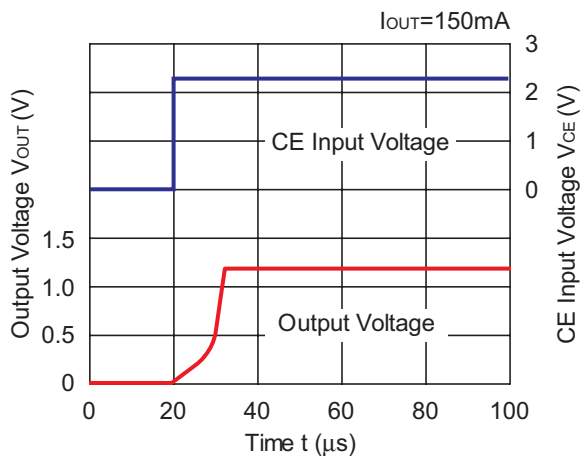
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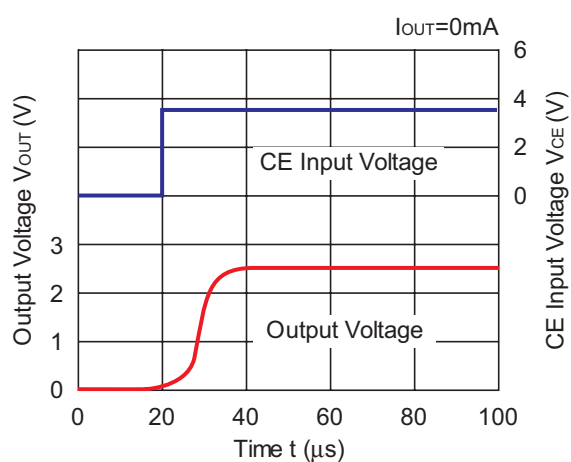
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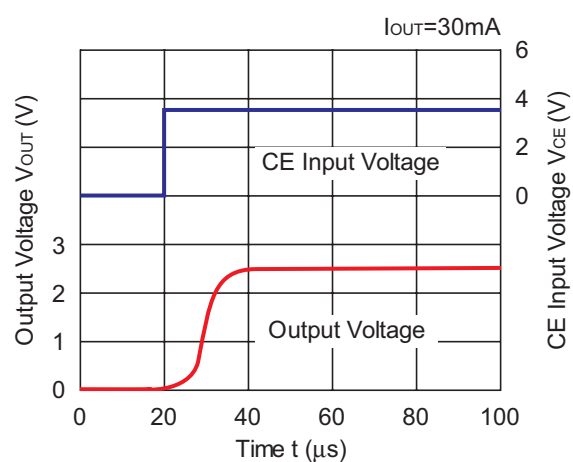
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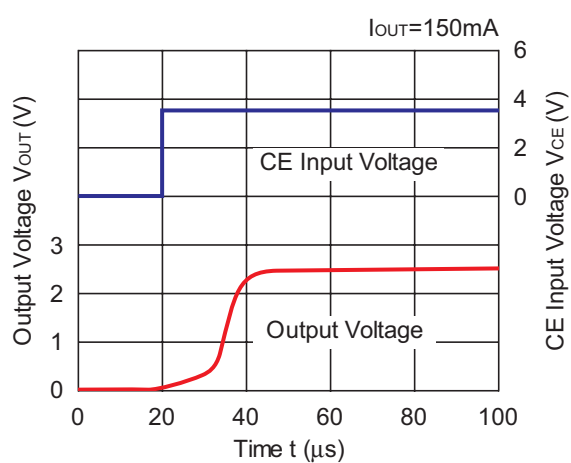
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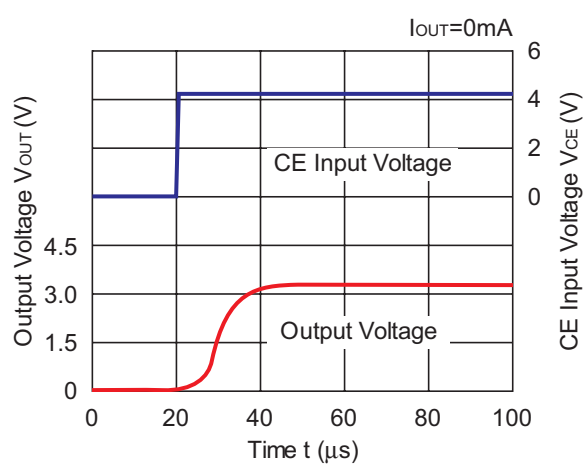
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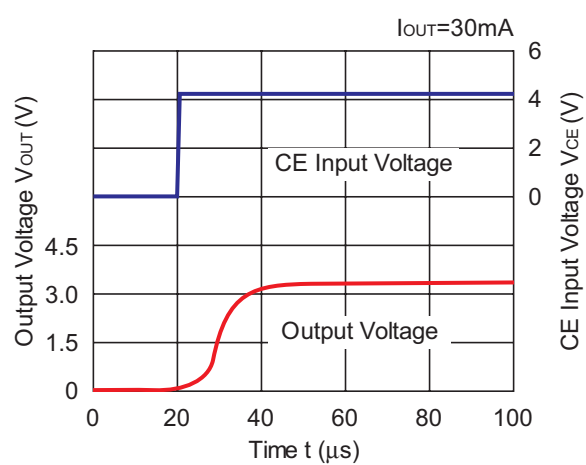
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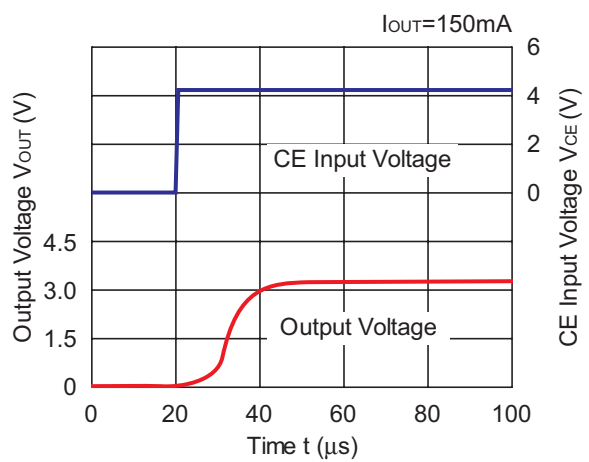
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RP102x331x

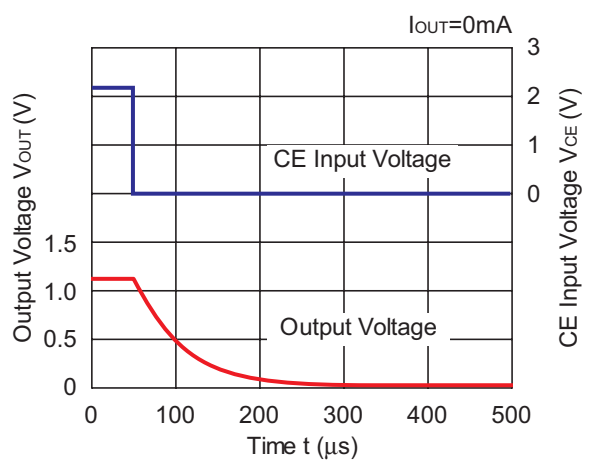


RP102x331x

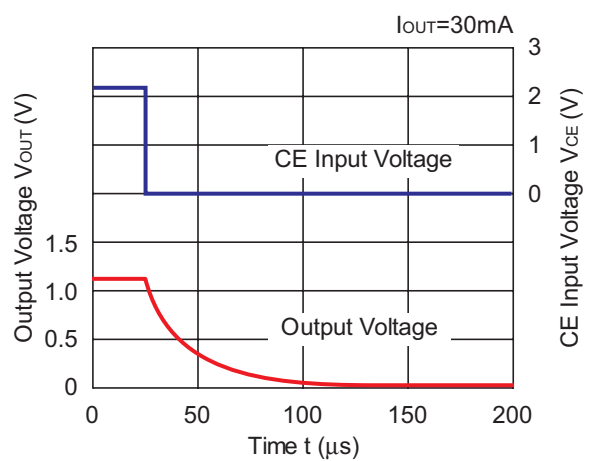


13) Turn OFF Speed with CE pin (D Version) ($C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $T_{opt}=25^{\circ}C$)

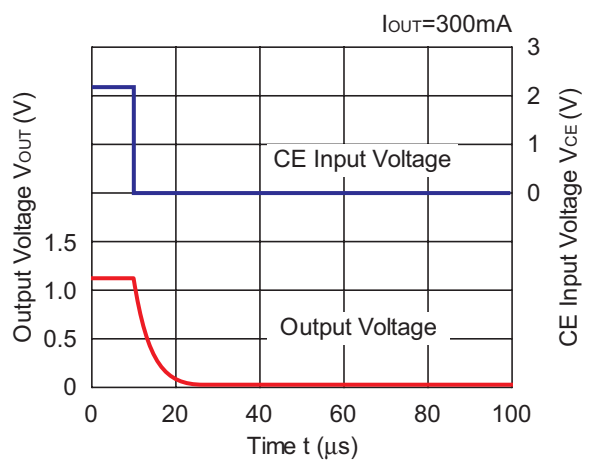
RP102x121D



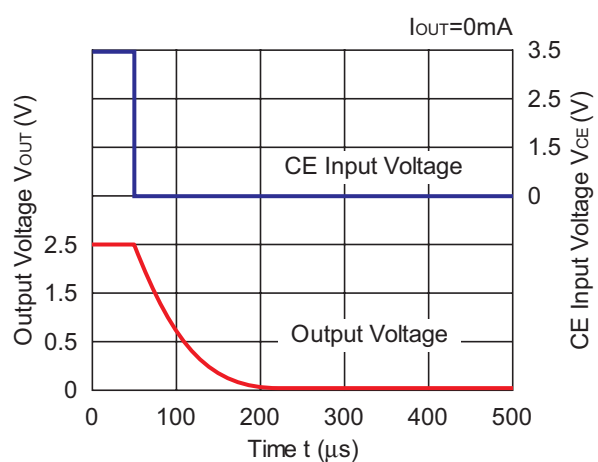
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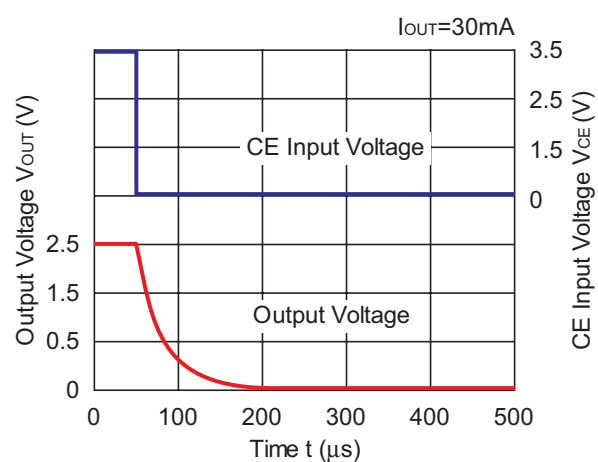
RP102x121D



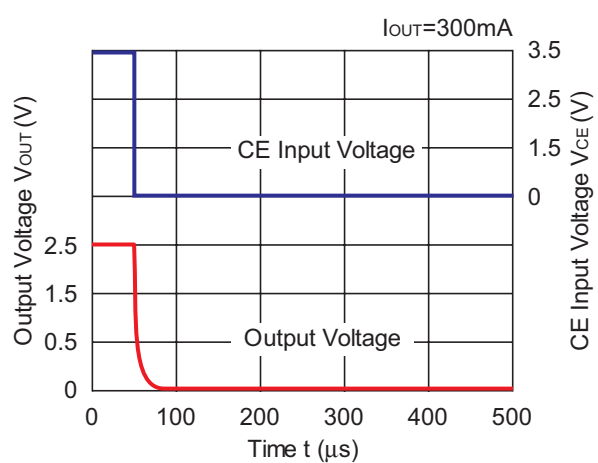
RP102x251x



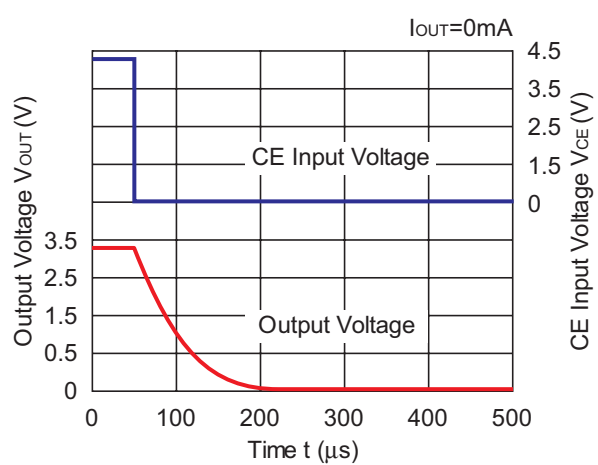
RP102x251x



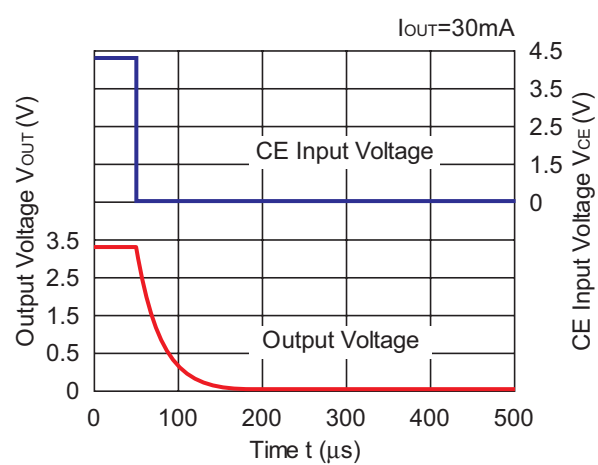
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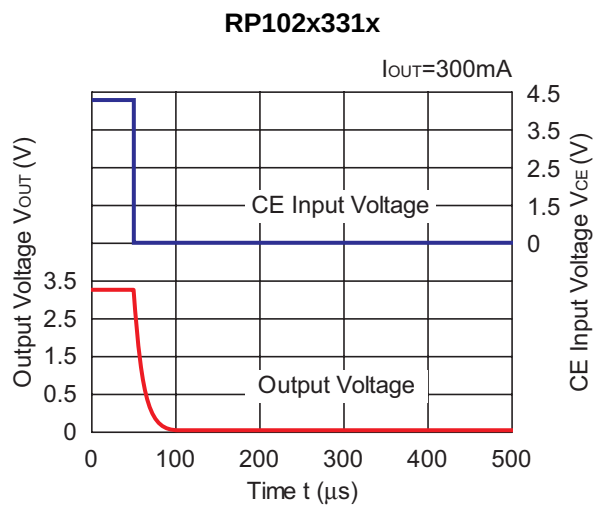


RP102x331x



RP102x331x





ESR vs. Output Current

When using these ICs, consider the following points:

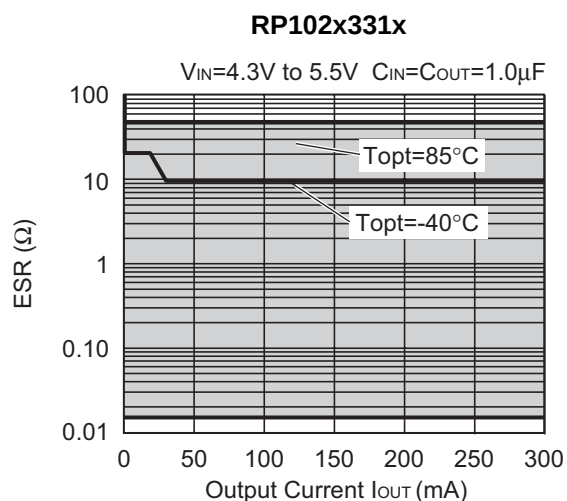
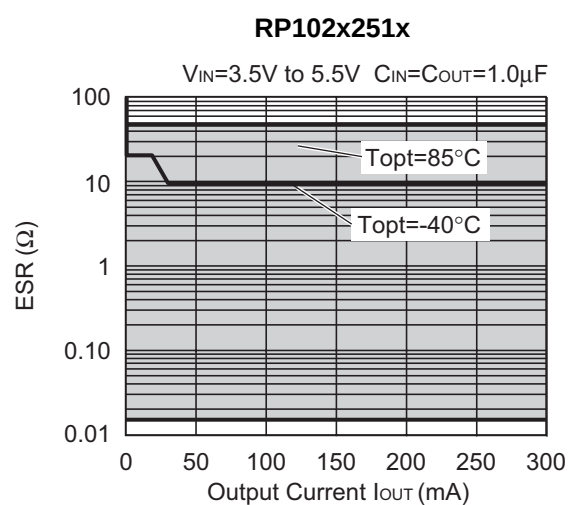
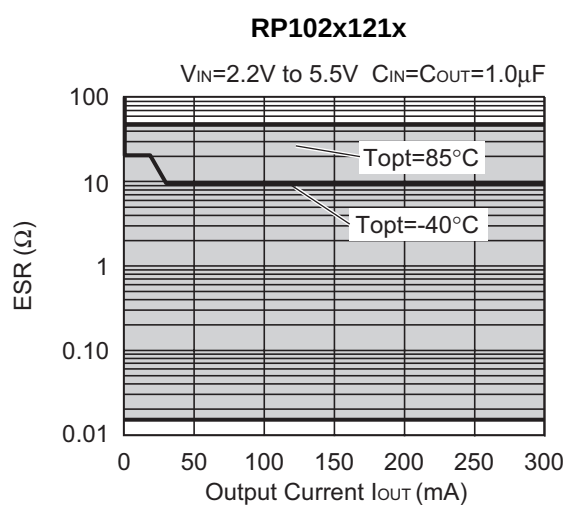
The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below.

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 $85^{\circ}C$





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RICOH COMPANY, LTD. Electronic Devices Company

● **Shin-Yokohama office (International Sales)**
3-2-3, Shin-Yokohama, Kohoku-ku, Yokohama City, Kanagawa 222-8530, Japan
Phone: +81-45-477-1697 Fax: +81-45-477-1698

RICOH EUROPE (NETHERLANDS) B.V.

● **Semiconductor Support Centre**
Prof. W.H.Keesomlaan 1, 1183 DL Amstelveen, The Netherlands
P.O.Box 114, 1180 AC Amstelveen
Phone: +31-20-5474-309 Fax: +31-20-5474-791

RICOH ELECTRONIC DEVICES KOREA Co., Ltd.

11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.

Room403, No.2 Building, 690#Bi Bo Road, Pu Dong New district, Shanghai 201203,
People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH COMPANY, LTD. Electronic Devices Company

● **Taipei office**
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623



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