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## LOW NOISE 150mA LDO REGULATOR

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NO.EA-095-111027

### OUTLINE

The R1124N 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 R1124N 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 package for these ICs is SOT-23-5, high density mounting of the ICs on boards is possible.

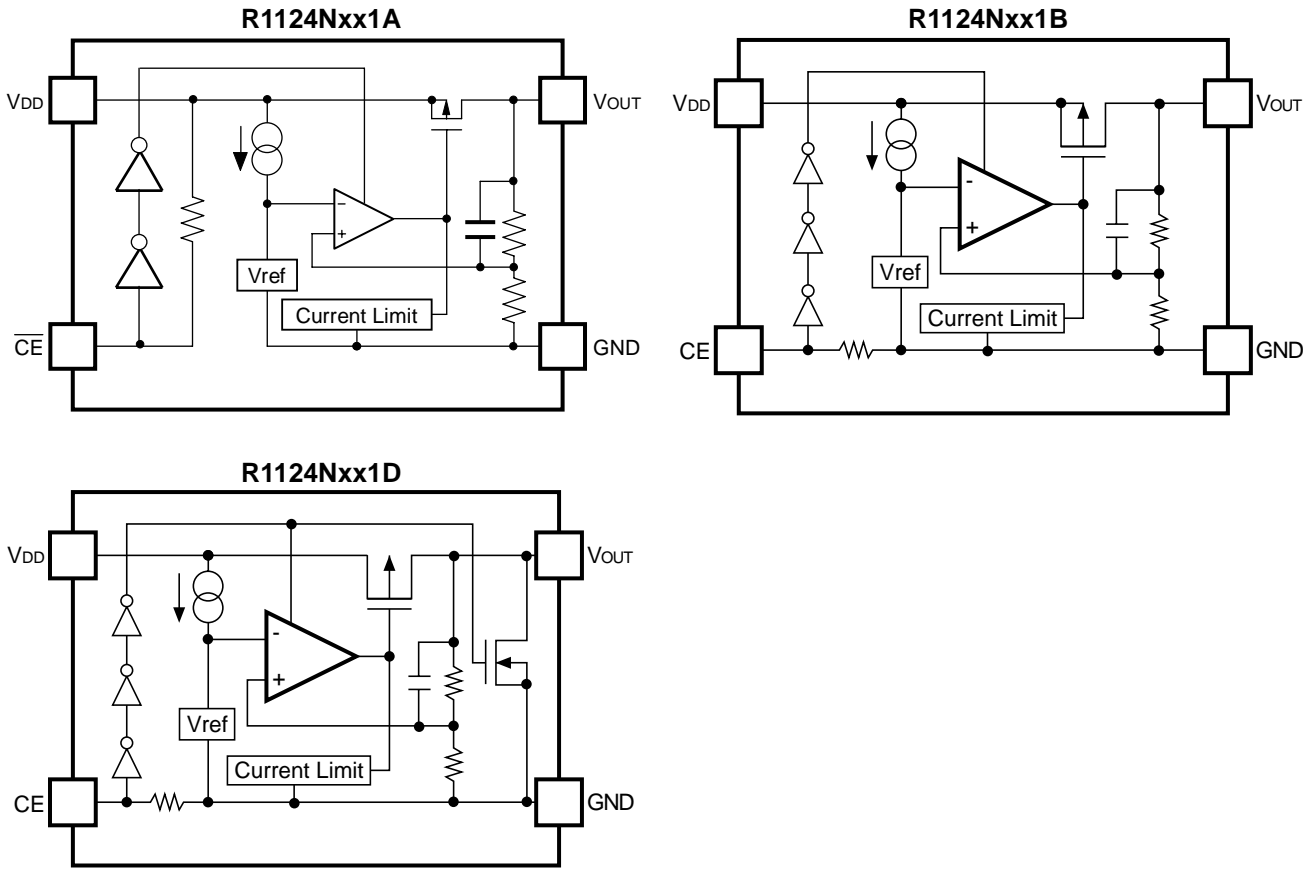
### FEATURES

- Supply Current ..... Typ. 75 $\mu$ A
- Standby Mode ..... Typ. 0.1 $\mu$ A
- Dropout Voltage ..... Typ. 0.22V ( $I_{OUT}=150\text{mA}$  3.0V Output type)
- Ripple Rejection ..... Typ. 70dB ( $f=1\text{kHz}$  3.0V Output type)  
Typ. 60dB ( $f=10\text{kHz}$ )
- Temperature-Drift Coefficient of Output Voltage ..... Typ.  $\pm 100\text{ppm}/^\circ\text{C}$
- Line Regulation ..... Typ. 0.02%/V
- Output Voltage Accuracy .....  $\pm 2.0\%$
- Output Voltage Range ..... 1.5V to 4.0V (0.1V steps)  
(For other voltages, please refer to MARK INFORMATIONS.)
- Package ..... SOT-23-5
- Built-in Fold Back Protection Circuit ..... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC ...  $C_{IN}=C_{OUT}=1\mu\text{F}$  ( $V_{OUT}<2.5\text{V}$ )  
 $C_{IN}=1\mu\text{F}$ ,  $C_{OUT}=0.47\mu\text{F}$  ( $V_{OUT} \geq 2.5\text{V}$ )

### 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, etc. for the ICs can be selected at the user's request.

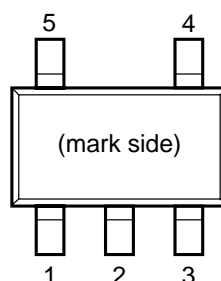
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1124Nxx1*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.5V(15) to 4.0V(40) 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 CONFIGURATION

SOT-23-5



## PIN DESCRIPTIONS

Pin No.	Symbol	Description
1	$V_{OUT}$	Output pin
2	GND	Ground Pin
3	$V_{DD}$	Input Pin
4	$\overline{CE}$ or CE	Chip Enable Pin
5	NC	No Connection

## ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
$V_{IN}$	Input Voltage	6.5	V
$V_{CE}$	Input Voltage ( $\overline{CE}$ or CE Pin)	6.5	V
$V_{OUT}$	Output Voltage	$-0.3 \sim V_{IN} + 0.3$	V
$I_{OUT}$	Output Current	200	mA
$P_D$	Power Dissipation (SOT-23-5) *	420	mW
$T_{opt}$	Operating Temperature Range	$-40 \sim 85$	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature Range	$-55 \sim 125$	$^{\circ}\text{C}$

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

### ABSOLUTE MAXIMUM RATINGS

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

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

## ELECTRICAL CHARACTERISTICS

## • R1124Nxx1A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 30mA	V <sub>OUT</sub> × 0.980		V <sub>OUT</sub> × 1.020	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> -V <sub>OUT</sub> = 1.0V	150			mA
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 150mA		22	40	mV
V <sub>DIF</sub>	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V, I <sub>OUT</sub> = 0mA		75	95	μA
I <sub>standby</sub>	Supply Current (Standby)	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V V <sub>CE</sub> = V <sub>DD</sub>		0.1	1.0	μA
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>OUT</sub> > 1.7V, Set V <sub>OUT</sub> +0.5V ≤ V <sub>IN</sub> ≤ 6.0V (V <sub>OUT</sub> ≤ 1.7V, 2.2V ≤ V <sub>IN</sub> ≤ 6.0V) I <sub>OUT</sub> = 30mA		0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz f=10kHz Ripple 0.5Vp-p V <sub>OUT</sub> > 1.7V, V <sub>IN</sub> -V <sub>OUT</sub> = 1.0V V <sub>OUT</sub> ≤ 1.7V, V <sub>IN</sub> -V <sub>OUT</sub> = 1.2V I <sub>OUT</sub> = 30mA		70 60		dB
V <sub>IN</sub>	Input Voltage		2.0		6.0	V
ΔV <sub>OUT</sub> /ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> = 30mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
I <sub>SC</sub>	Short Current Limit	V <sub>OUT</sub> = 0V		40		mA
R <sub>PU</sub>	$\overline{CE}$ Pull-up Resistance		0.7	2.0	8.0	MΩ
V <sub>CEH</sub>	$\overline{CE}$ Input Voltage "H"		1.5		6.0	V
V <sub>CEL</sub>	$\overline{CE}$ Input Voltage "L"		0.0		0.3	V
en	Output Noise	BW = 10Hz to 100kHz		30		μVrms

## 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.

● R1124Nxx1B/D

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 30mA	V <sub>OUT</sub> × 0.980		V <sub>OUT</sub> × 1.020	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> -V <sub>OUT</sub> = 1.0V	150			mA
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 150mA		22	40	mV
V <sub>DIF</sub>	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V, I <sub>OUT</sub> = 0mA		75	95	μA
I <sub>standby</sub>	Supply Current (Standby)	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V V <sub>CE</sub> = GND		0.1	1.0	μA
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>OUT</sub> > 1.7V, Set V <sub>OUT</sub> +0.5V ≤ V <sub>IN</sub> ≤ 6.0V (V <sub>OUT</sub> ≤ 1.7V, 2.2V ≤ V <sub>IN</sub> ≤ 6.0V) I <sub>OUT</sub> = 30mA		0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz f=10kHz Ripple 0.5Vp-p V <sub>OUT</sub> > 1.7V, V <sub>IN</sub> -V <sub>OUT</sub> = 1.0V V <sub>OUT</sub> ≤ 1.7, V <sub>IN</sub> -V <sub>OUT</sub> = 1.2V I <sub>OUT</sub> = 30mA		70 60		dB
V <sub>IN</sub>	Input Voltage		2.0		6.0	V
ΔV <sub>OUT</sub> / ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> = 30mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm /°C
I <sub>SC</sub>	Short Current Limit	V <sub>OUT</sub> = 0V		40		mA
R <sub>PD</sub>	$\overline{\text{CE}}$ Pull-down Resistance		0.7	2.0	8.0	MΩ
V <sub>CEH</sub>	$\overline{\text{CE}}$ Input Voltage "H"		1.5		6.0	V
V <sub>CEL</sub>	$\overline{\text{CE}}$ Input Voltage "L"		0.0		0.3	V
en	Output Noise	BW = 10Hz to 100kHz		30		μVrms
R <sub>LOW</sub>	On Resistance of Nch for auto-discharge (Only for D version)	V <sub>CE</sub> = 0V		60		Ω

**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 by OUTPUT VOLTAGE

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

Output Voltage $V_{OUT}$ (V)	Dropout Voltage		
	$V_{DIF}$ (V)		
	Condition	Typ.	Max.
$V_{OUT} = 1.5$	$I_{OUT} = 150\text{mA}$	0.38	0.70
$V_{OUT} = 1.6$		0.36	0.65
$V_{OUT} = 1.7$		0.34	0.60
$1.8 \leq V_{OUT} \leq 2.0$		0.32	0.55
$2.1 \leq V_{OUT} \leq 2.7$		0.28	0.50
$2.8 \leq V_{OUT} \leq 4.0$		0.22	0.35

## 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  $C_{OUT}$  with good frequency characteristics and ESR (Equivalent Series Resistance).

(Note: When the additional ceramic capacitors are connected 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 with a capacitance value as much as  $1.0\mu\text{F}$  or more between  $V_{DD}$  and GND pin, and as close as possible to the pins.

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

## TEST CIRCUITS

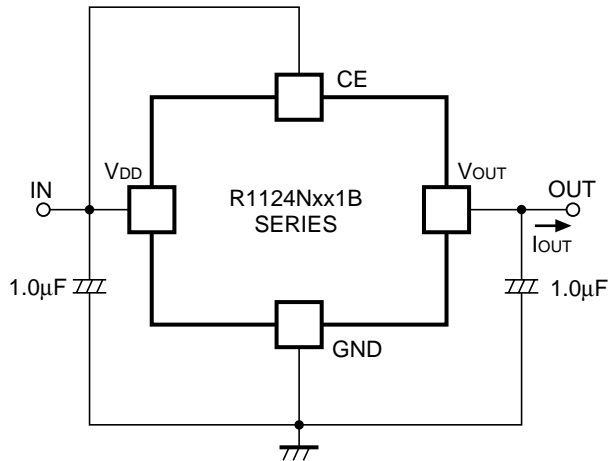


Fig.1 Standard test Circuit

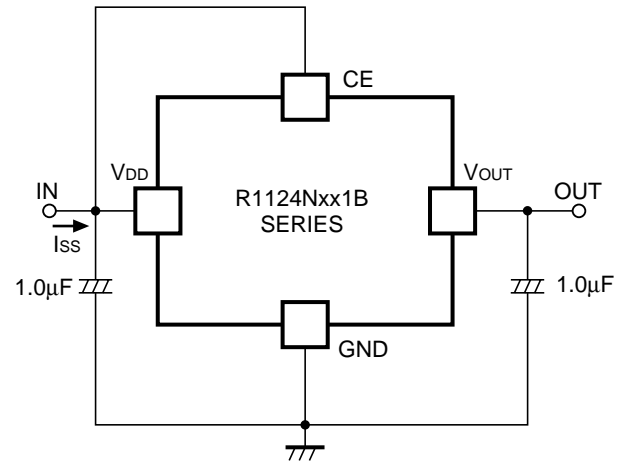


Fig.2 Supply Current Test Circuit

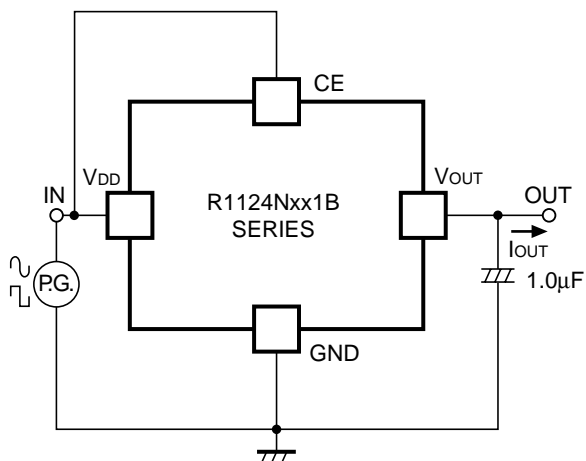


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

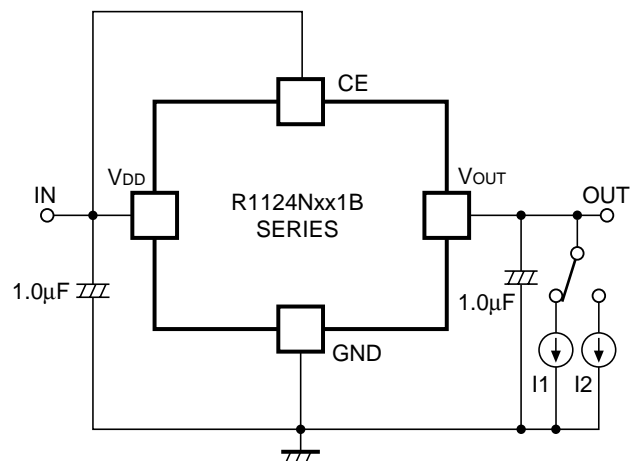
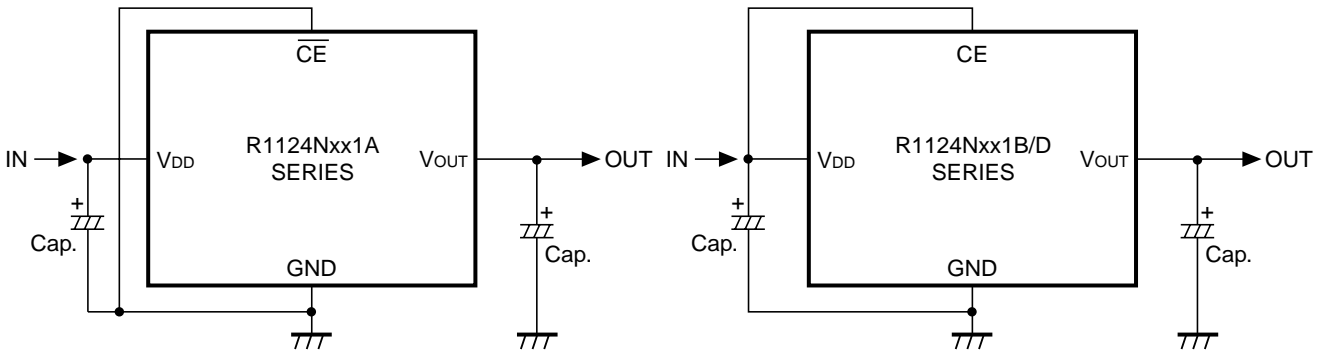


Fig.4 Load Transient Response Test Circuit

## TYPICAL APPLICATIONS



(External Components)

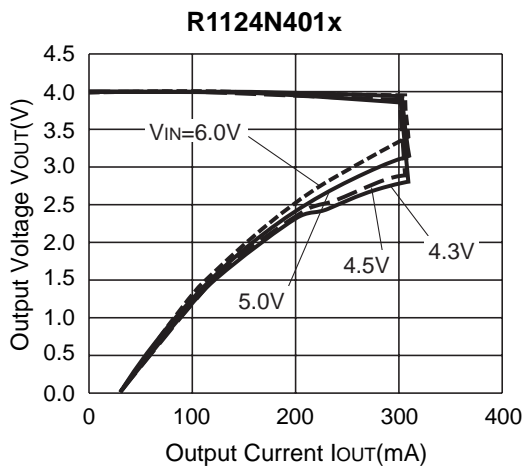
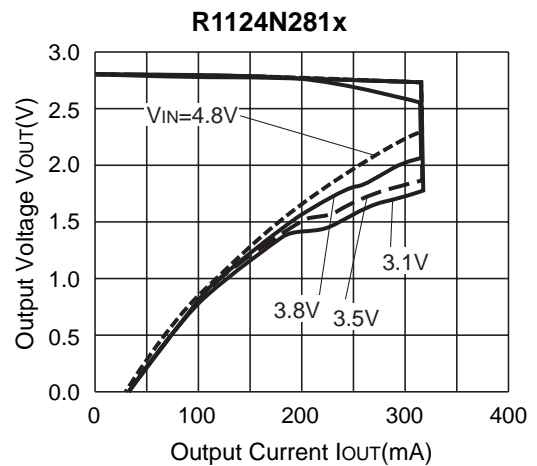
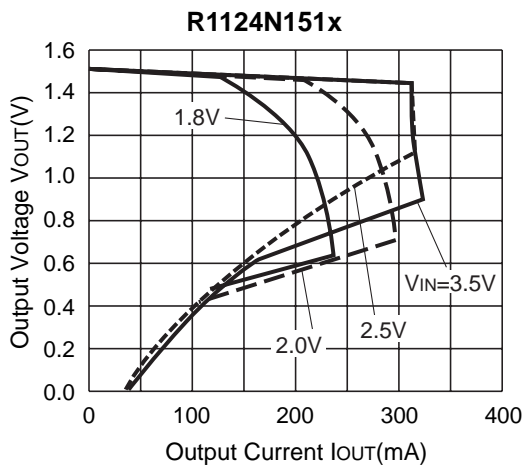
Output Capacitor; Ceramic 0.47 $\mu$ F (Set Output Voltage in the range from 2.5 to 5.0V)

Ceramic 1.0 $\mu$ F (Set Output Voltage in the range from 2.0 to 2.4V)

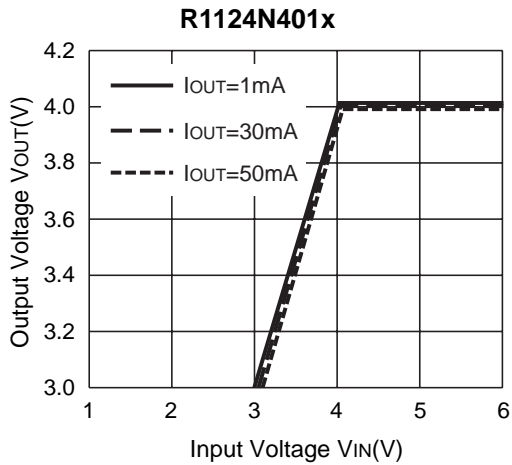
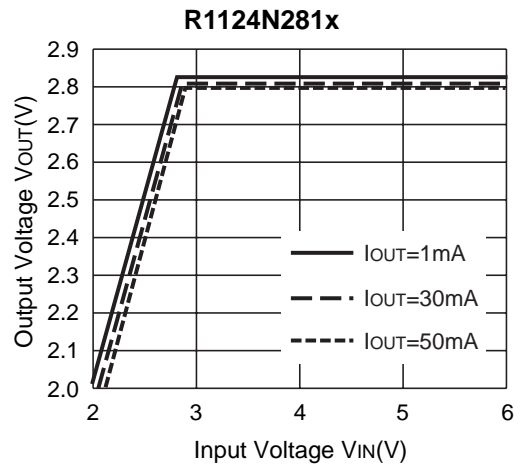
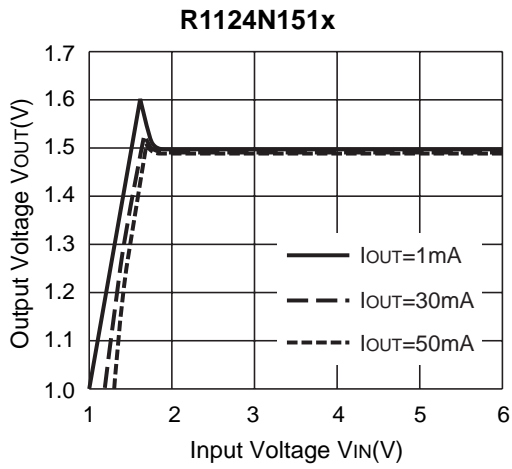
Input Capacitor; Ceramic 1.0 $\mu$ F

## TYPICAL CHARACTERISTICS

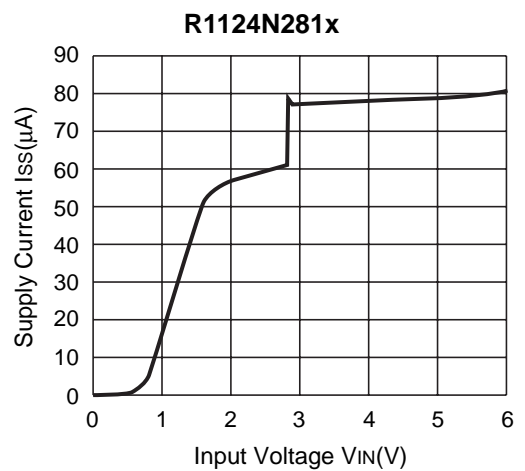
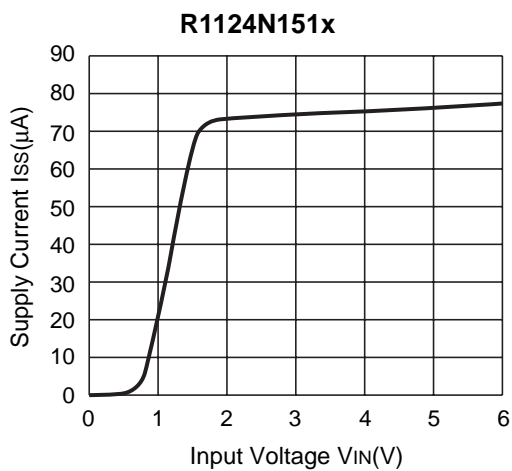
1) Output Voltage vs. Output Current (Topt=25°C)



2) Output Voltage vs. Input Voltage (T<sub>opt</sub>=25°C)



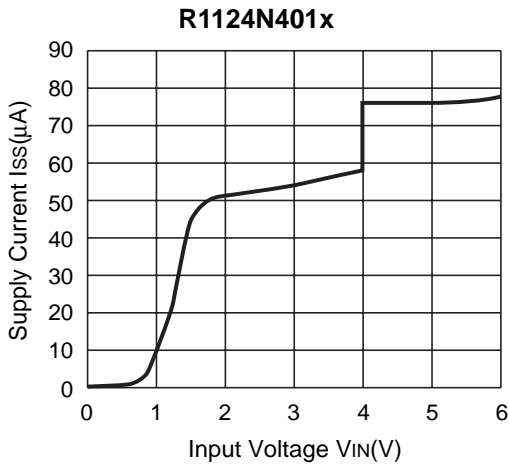
3) Supply Current vs. Input Voltage (T<sub>opt</sub>=25°C)



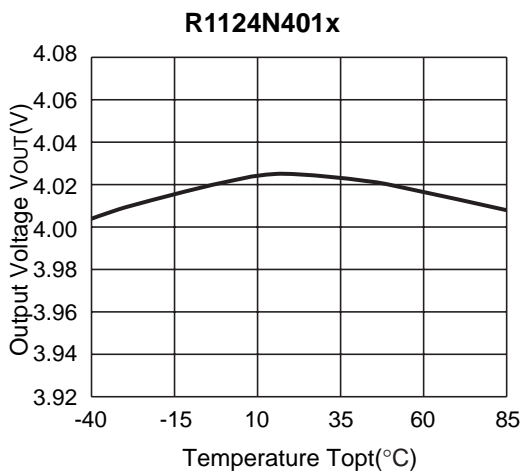
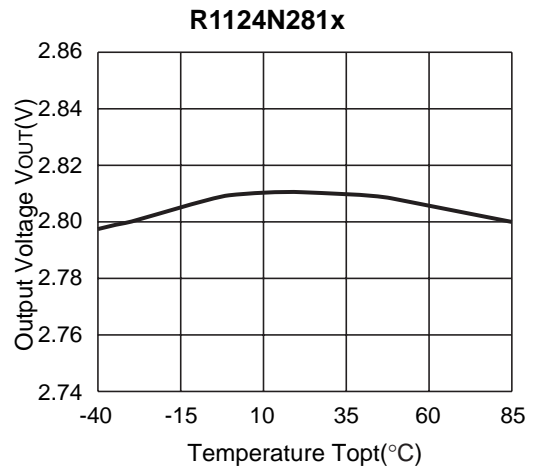
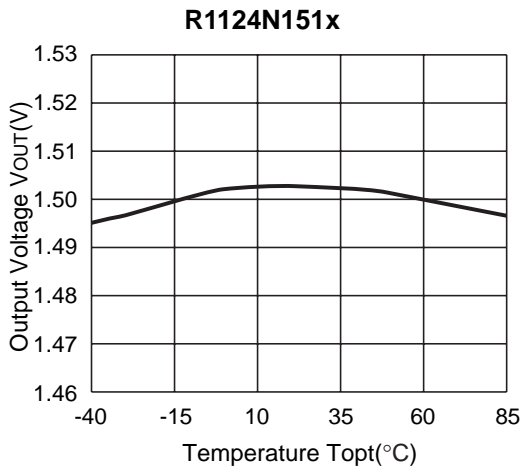
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## R1124N

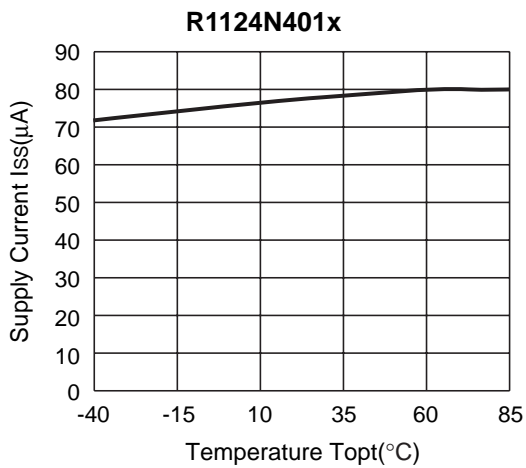
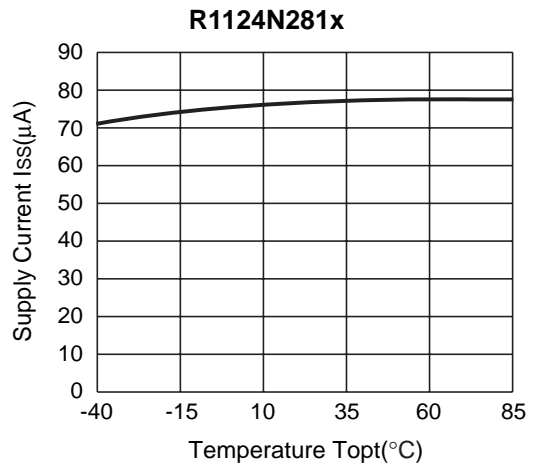
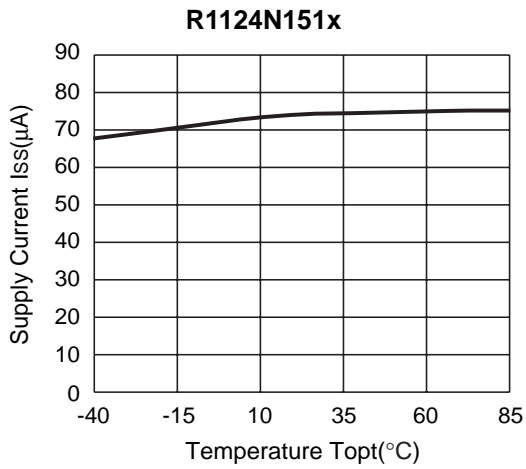
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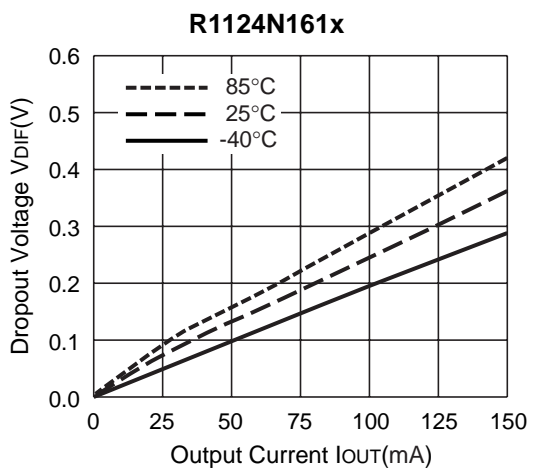
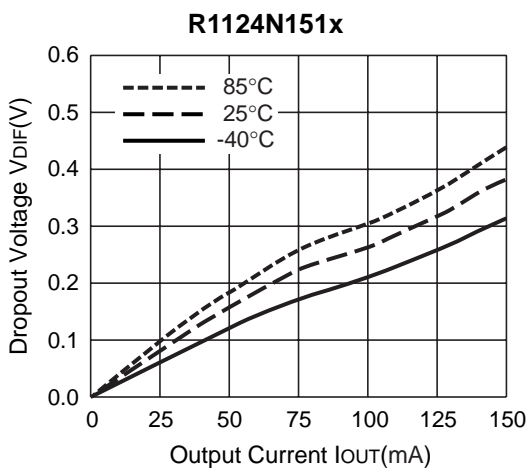
#### 4) Output Voltage vs. Temperature



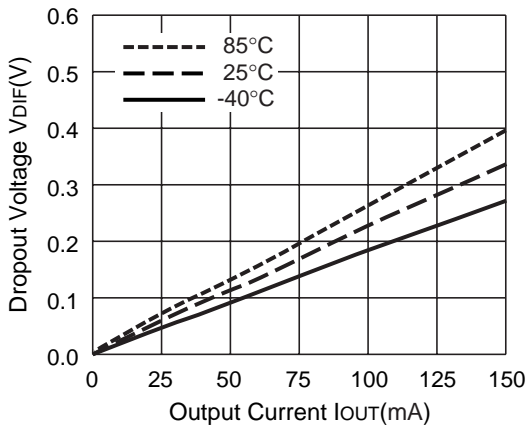
5) Supply Current vs. Temperature



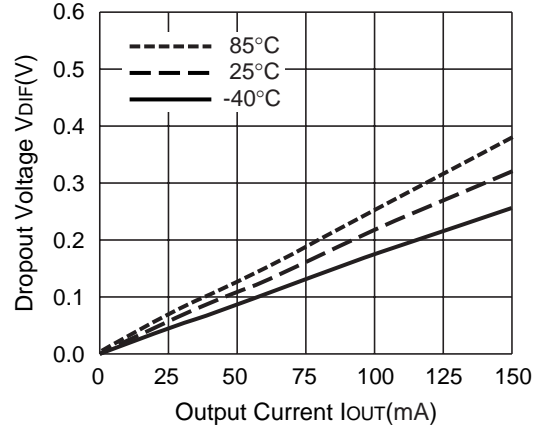
6) Dropout Voltage vs. Temperature



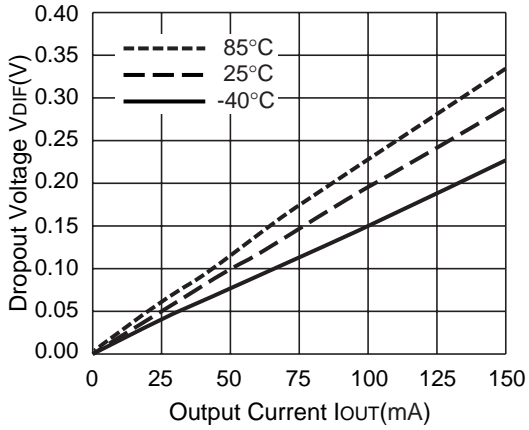
R1124N171x



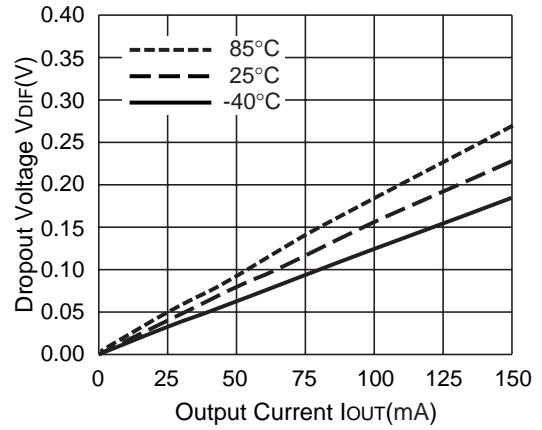
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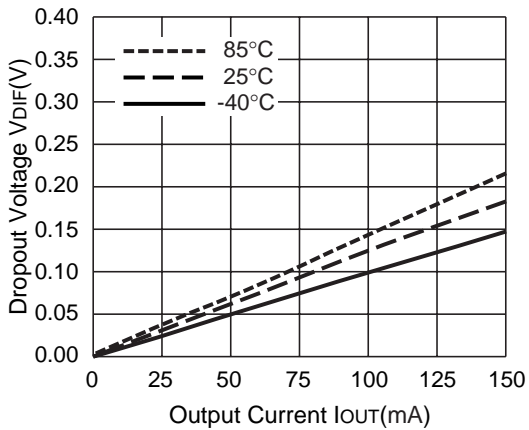
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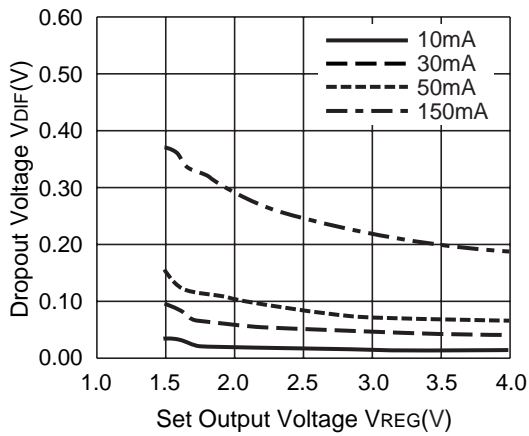
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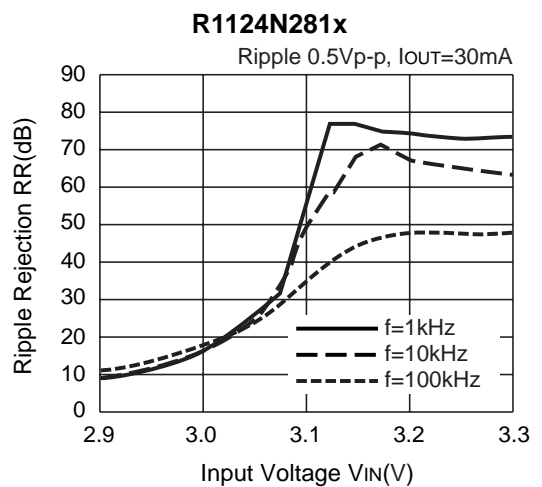
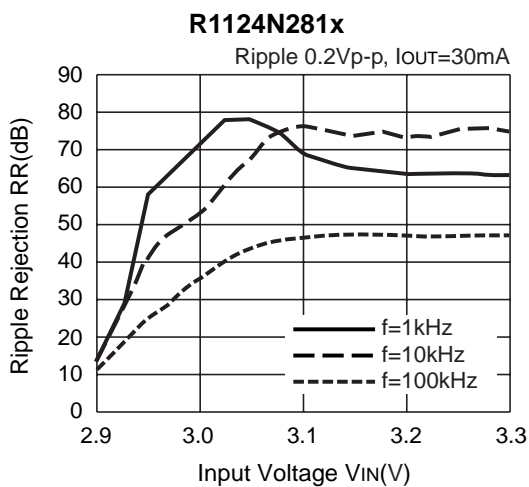
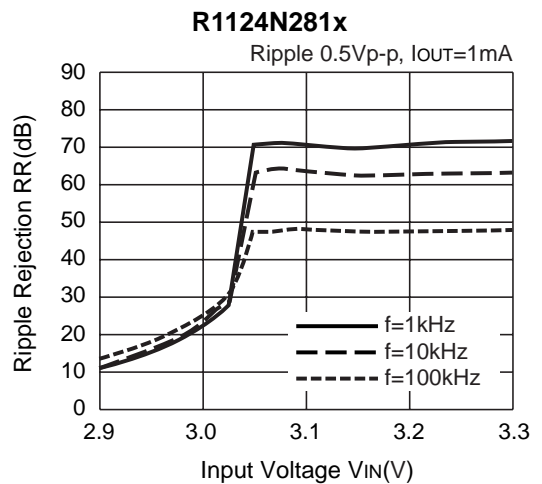
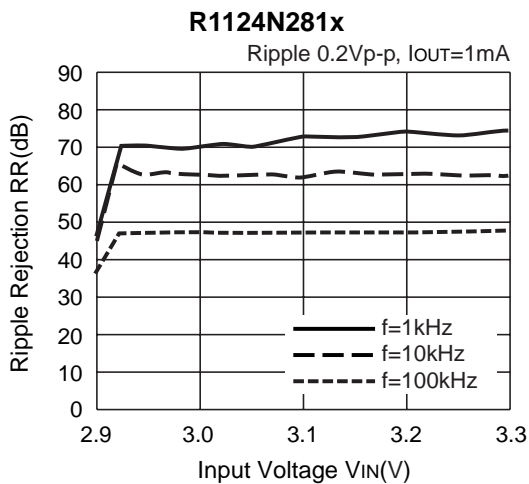
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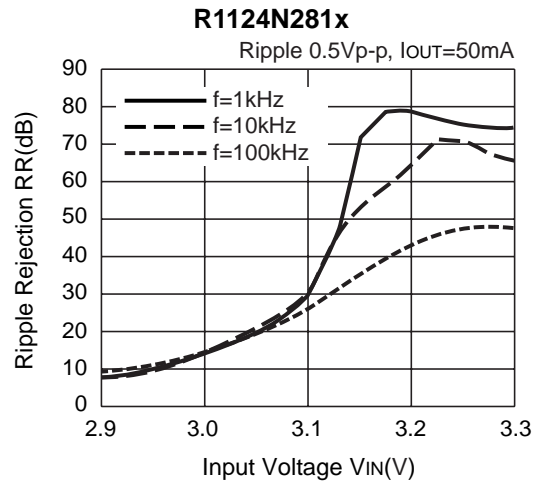
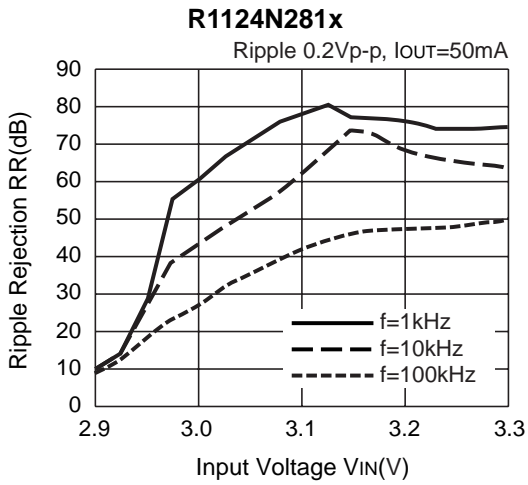


7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

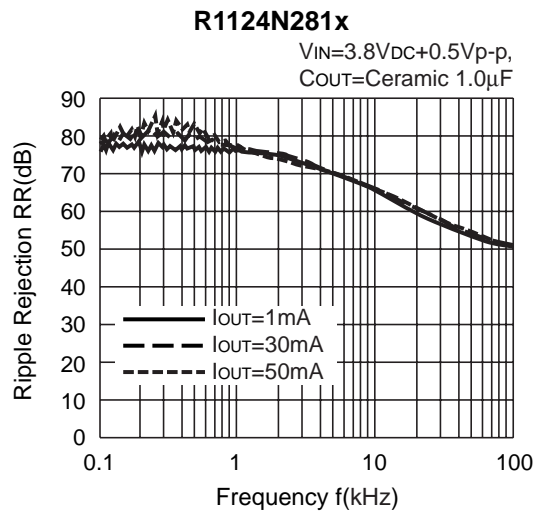
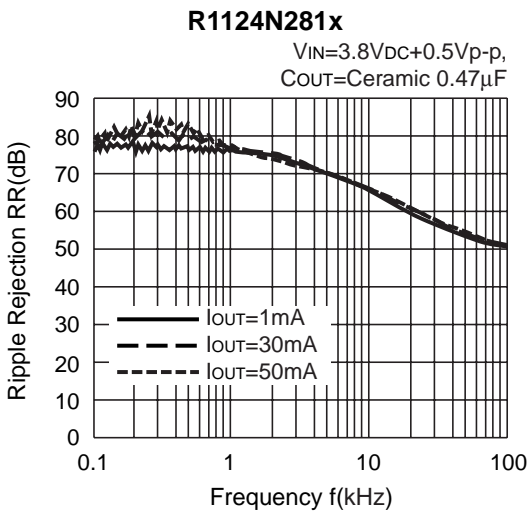
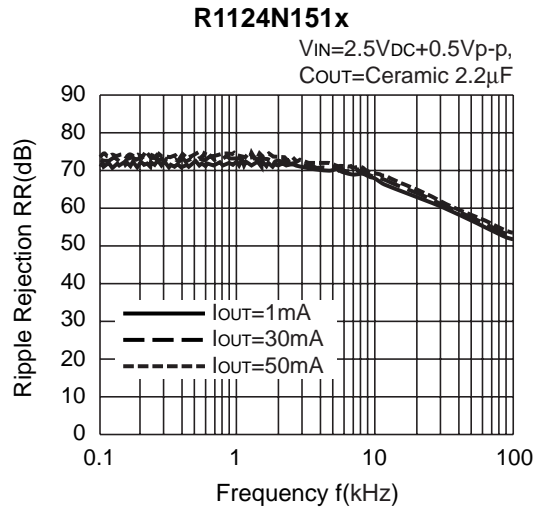
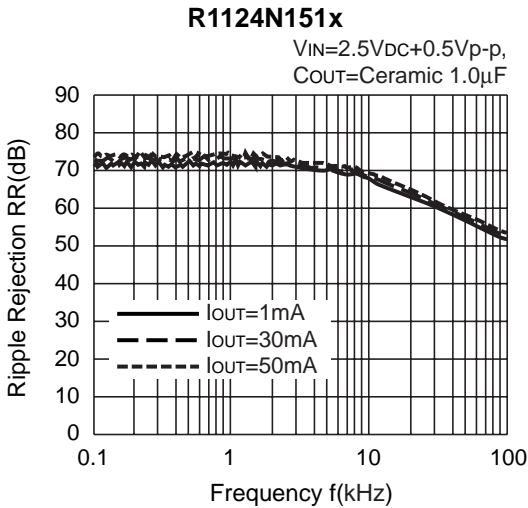


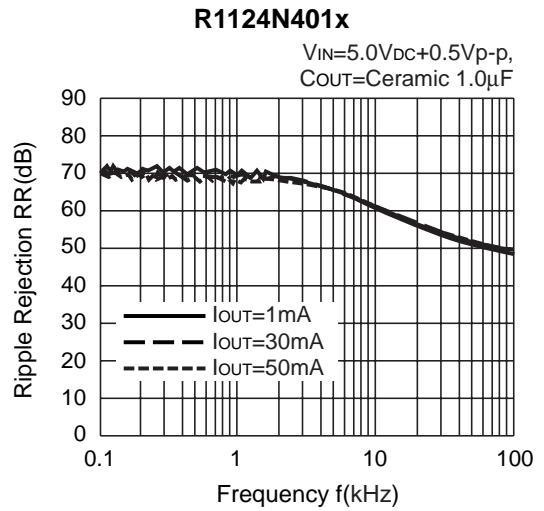
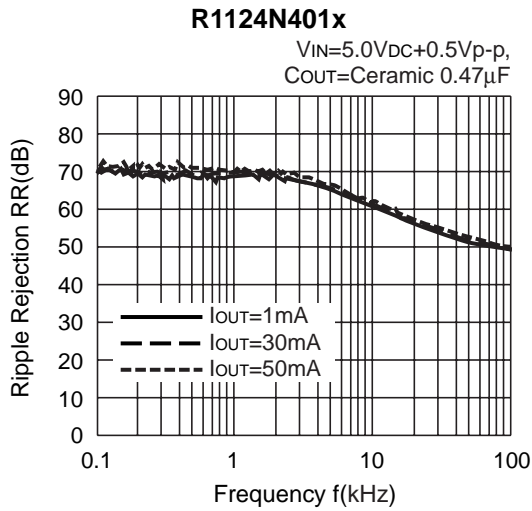
8) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, CIN=none, COUT=ceramic0.47μF)



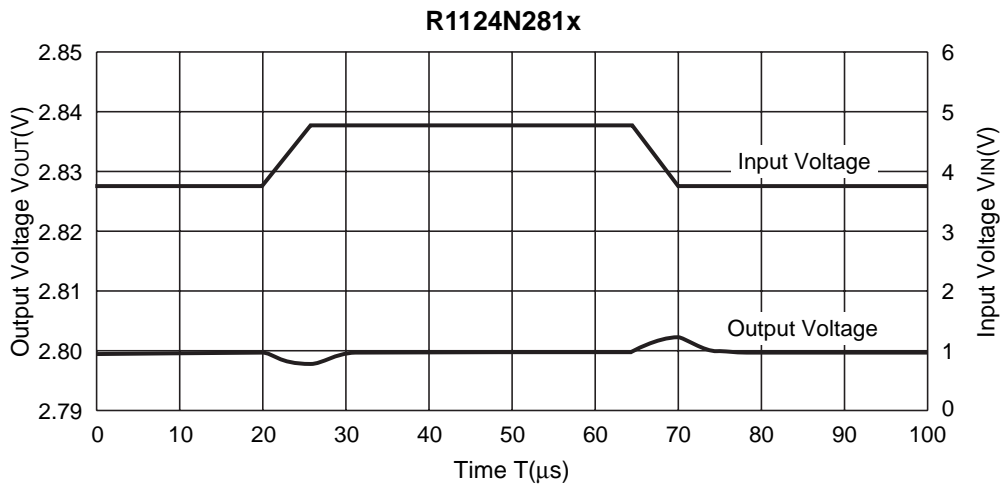
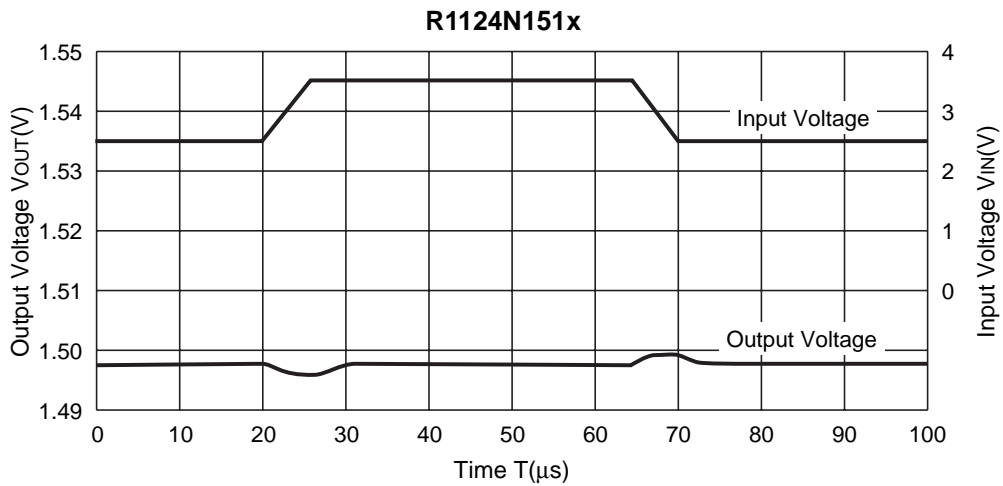


9) Ripple Rejection vs. Frequency ( $C_{IN}$ =none)

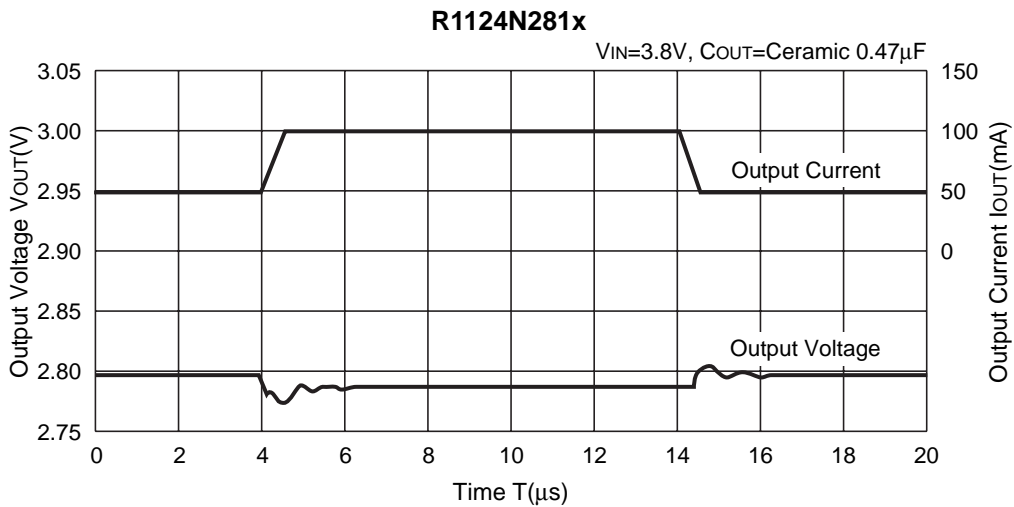
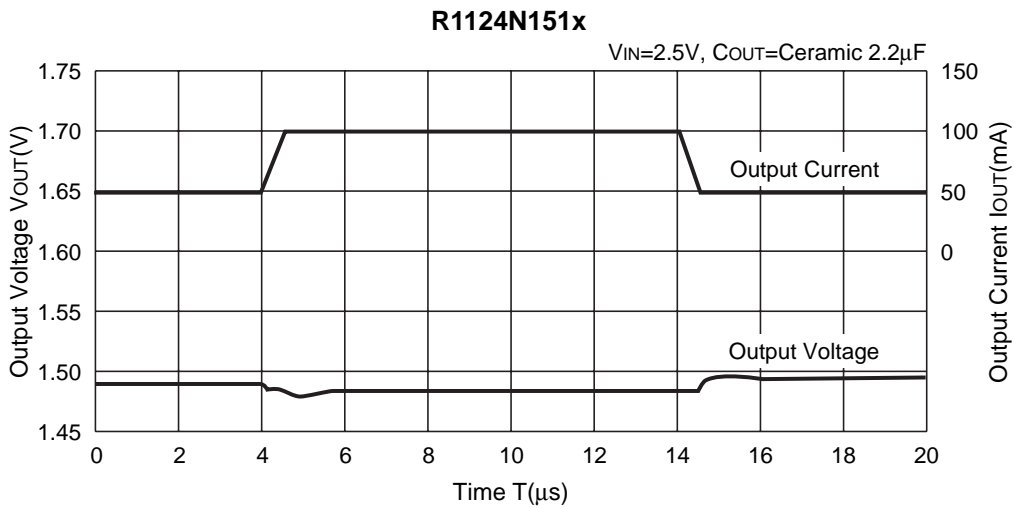
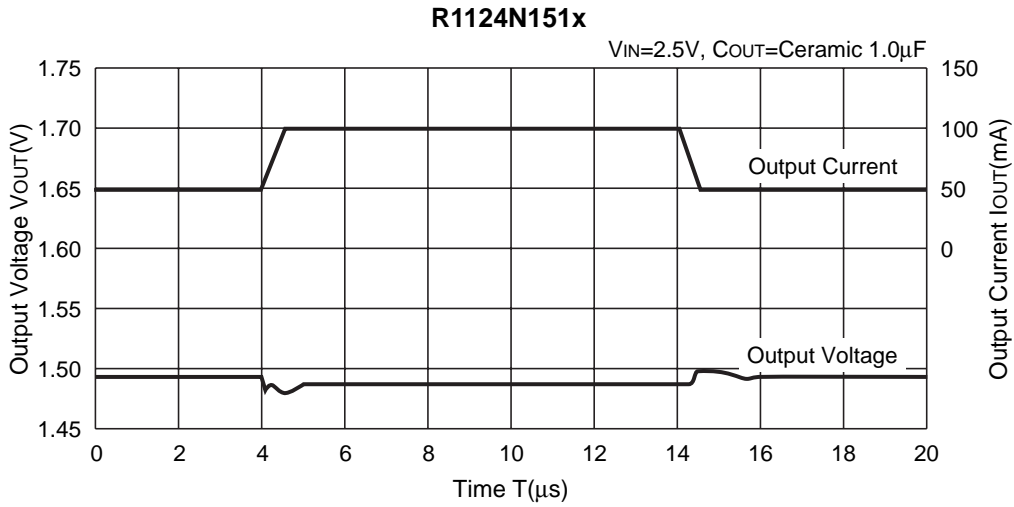


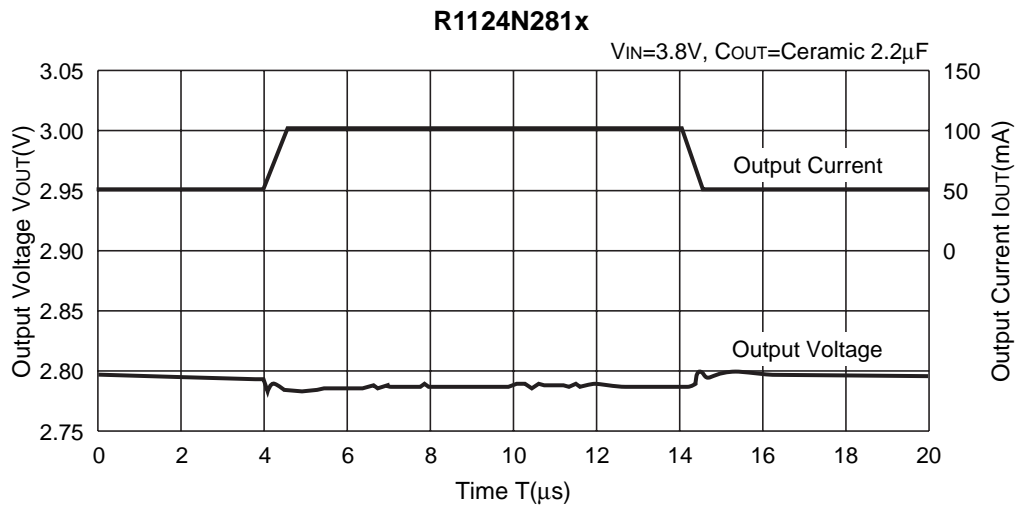
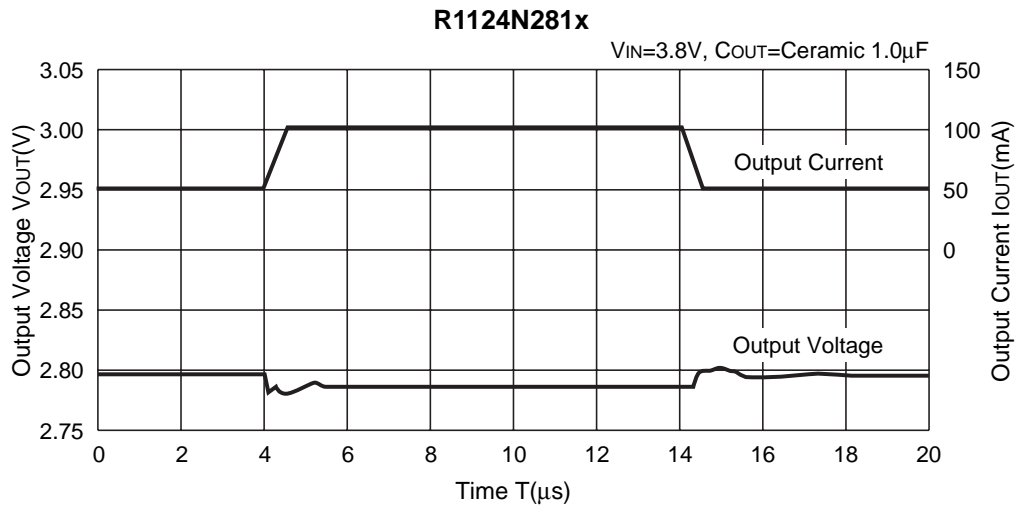


10) Input Transient Response ( $I_{OUT}=30\text{mA}$ ,  $C_{IN}=\text{none}$ ,  $t_r=t_f=5\mu s$ ,  $C_{OUT}=\text{Ceramic } 0.47\mu F$ )

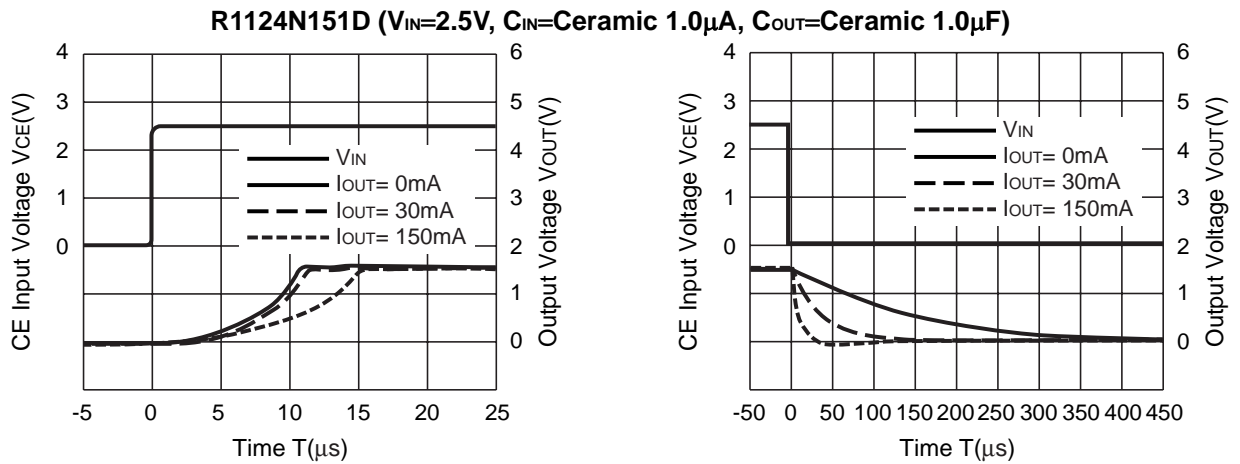


11) Load Transient Response ( $t_r=t_f=0.5\mu s$ ,  $C_{IN}=\text{Ceramic } 1.0\mu F$ )

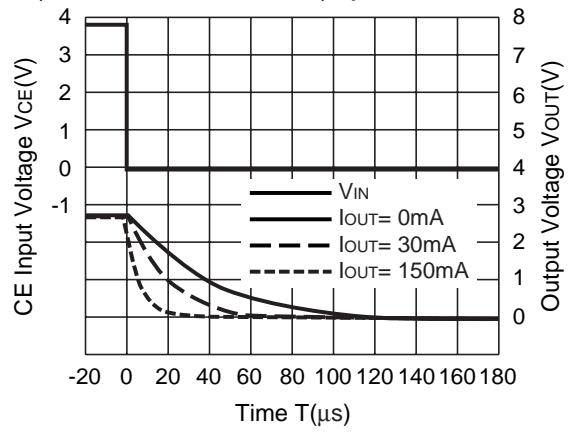
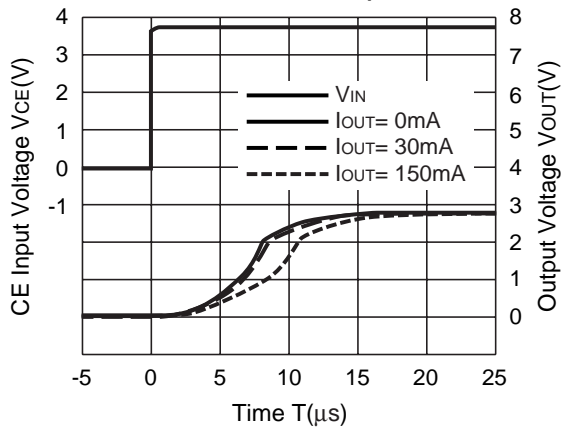




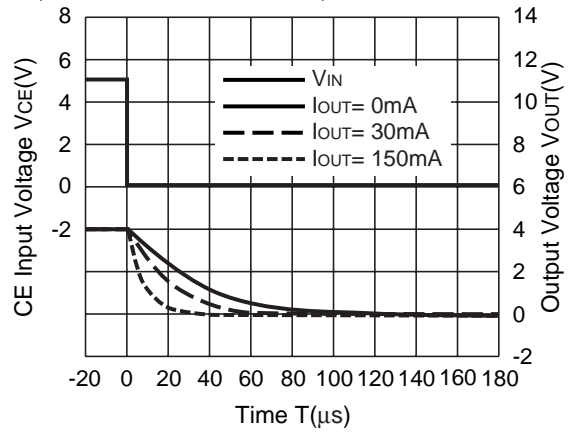
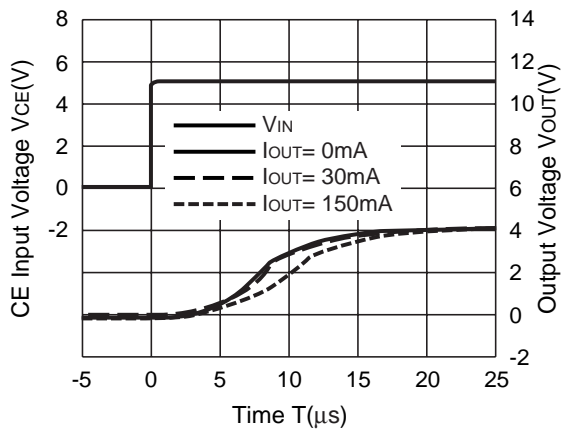
12) Turn-on/off speed with CE pin (D version)



R1124N281D ( $V_{IN}=3.8V$ ,  $C_{IN}=\text{Ceramic } 0.47\mu A$ ,  $C_{OUT}=\text{Ceramic } 0.47\mu F$ )



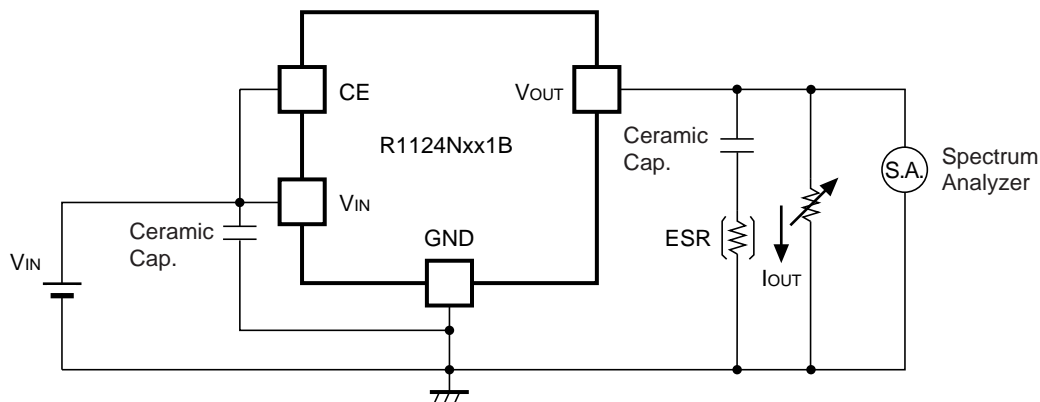
R1124N401D ( $V_{IN}=5.0V$ ,  $C_{IN}=\text{Ceramic } 0.47\mu A$ ,  $C_{OUT}=\text{Ceramic } 0.47\mu F$ )



## TECHNICAL NOTES

When using these ICs, consider the following points:

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor  $C_{OUT}$  with good frequency characteristics and ESR (Equivalent Series Resistance) of which is in the range described as follows:



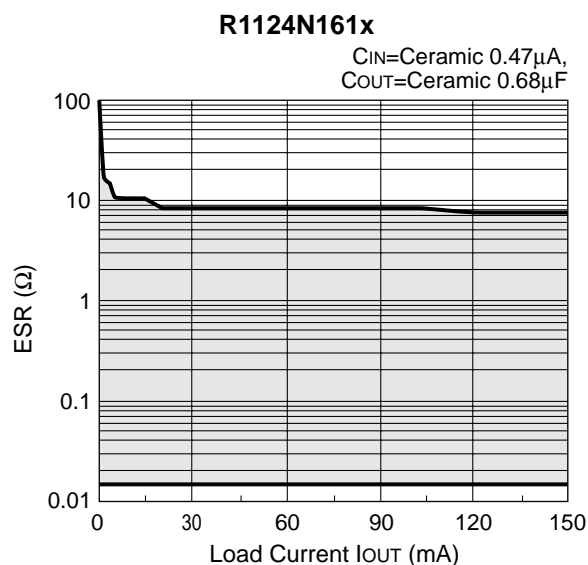
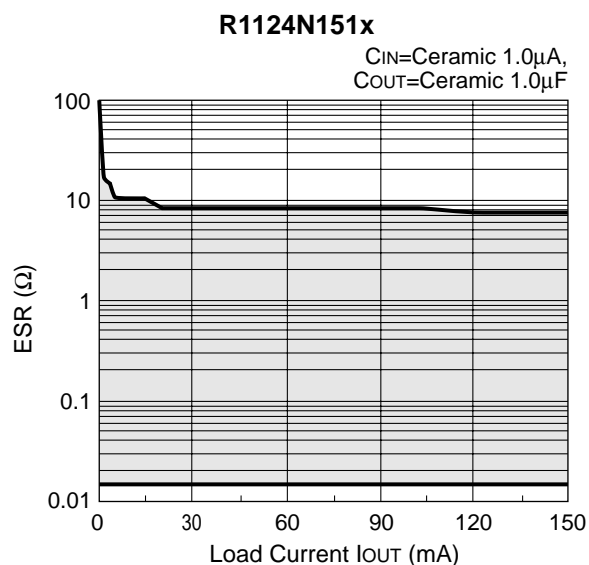
**Measuring Circuit for white noise; R1124Nxx1B**

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.

(Note: If additional ceramic capacitors are connected to the Output Pin with 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.)

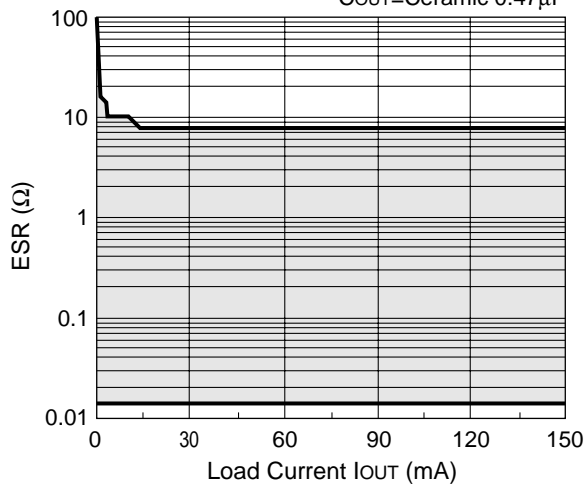
<Measurement conditions>

- (1)  $V_{IN} = V_{OUT} + 1\text{V}$
- (2) Frequency Band: 10Hz to 2MHz
- (3) Temperature:  $-40^\circ\text{C}$  to  $85^\circ\text{C}$



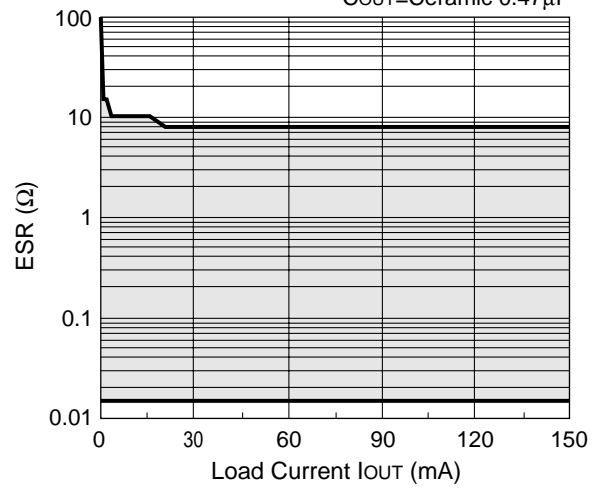
R1124N211x

C<sub>IN</sub>=Ceramic 0.47 $\mu$ A,  
C<sub>OUT</sub>=Ceramic 0.47 $\mu$ F



R1124N281x

C<sub>IN</sub>=Ceramic 0.47 $\mu$ A,  
C<sub>OUT</sub>=Ceramic 0.47 $\mu$ 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.