RICOH

R1124N SERIES

LOW NOISE 150mA LDO REGULATOR

NO.EA-095-130411

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

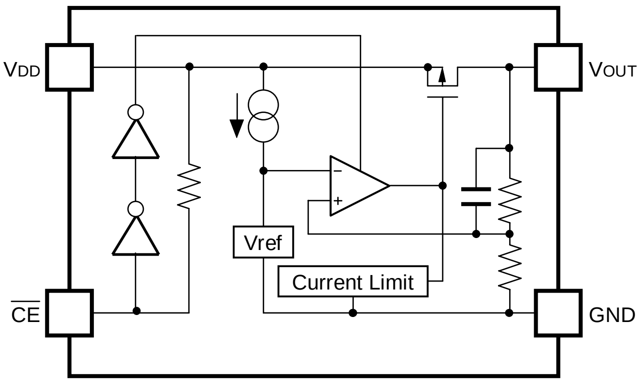
- Supply Current .... Typ. 75µA
- Standby Mode .... Typ. 0.1µA
- Dropout Voltage .... Typ. 0.22V (I_{OUT}=150mA 3.0V Output type)
- Ripple Rejection .... Typ. 70dB (f=1kHz 3.0V Output type)
  Typ. 60dB (f=10kHz)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.02%/V
- Output Voltage Accuracy .... ±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}=1µF (V_{OUT}<2.5V)
  C_{IN}=1µF, C_{OUT}=0.47µF (V_{OUT} ≧ 2.5V)

APPLICATIONS

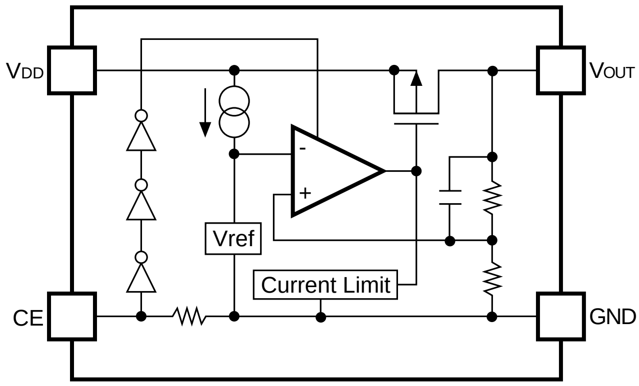
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

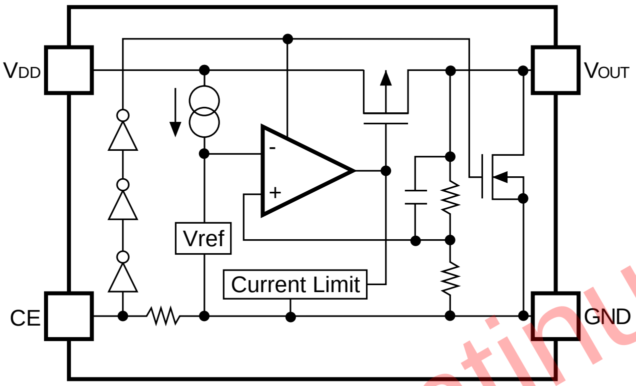
R1124Nxx1A



R1124Nxx1B



R1124Nxx1D



SELECTION GUIDE

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

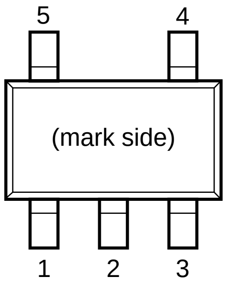
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1124Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

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
Topt	Operating Temperature Range	−40~85	°C
Tstg	Storage Temperature Range	−55~125	°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

- **R1124Nxx1A**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN} = Set V_{OUT}+1V 1mA ≦ I_{OUT} ≦ 30mA	V_{OUT}× 0.980		V_{OUT}× 1.020	V
I_{OUT}	Output Current	V_{IN}−V_{OUT} = 1.0V	150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = Set V_{OUT}+1V 1mA ≦ I_{OUT} ≦ 150mA		22	40	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I_{SS}	Supply Current	V_{IN} = Set V_{OUT}+1V, I_{OUT} = 0mA		75	95	μA
Istandby	Supply Current (Standby)	V_{IN} = Set V_{OUT}+1V V_{CE} = V_{DD}		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{OUT} > 1.7V, Set V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V (V_{OUT} ≦ 1.7V, 2.2V ≤ V_{IN} ≦ 6.0V) I_{OUT} = 30mA		0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz f=10kHz Ripple 0.5Vp−p V_{OUT} > 1.7V, V_{IN}−V_{OUT} = 1.0V V_{OUT} ≦ 1.7V, V_{IN}−V_{OUT} = 1.2V I_{OUT} = 30mA		70 60		dB
V_{IN}	Input Voltage		2.0		6.0	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA −40°C ≦ Topt ≦ 85°C		±100		ppm /°C
I_{SC}	Short Current Limit	V_{OUT} = 0V		40		mA
R_{PU}	$\overline{CE}$ Pull-up Resistance		0.7	2.0	8.0	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage "H"		1.5		6.0	V
V_{CEL}	$\overline{CE}$ 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**

Topt=25°C

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

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
V_{OUT} = 1.5	I_{OUT} = 150mA	0.38	0.70
V_{OUT} = 1.6		0.36	0.65
V_{OUT} = 1.7		0.34	0.60
1.8 ≦ V_{OUT} ≦ 2.0		0.32	0.55
2.1 ≦ V_{OUT} ≦ 2.7		0.28	0.50
2.8 ≦ V_{OUT} ≦ 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 1.0µF 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

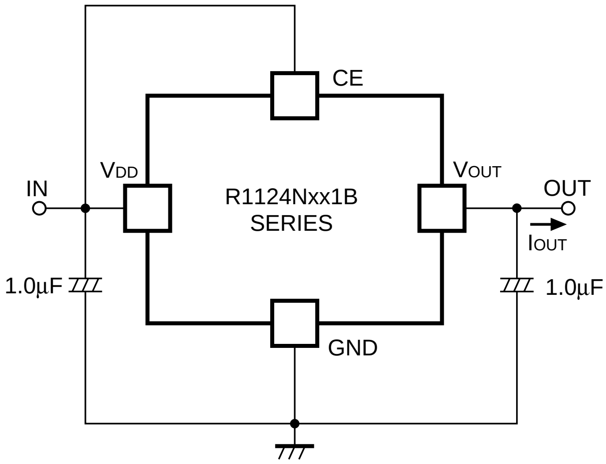


Fig.1 Standard test Circuit

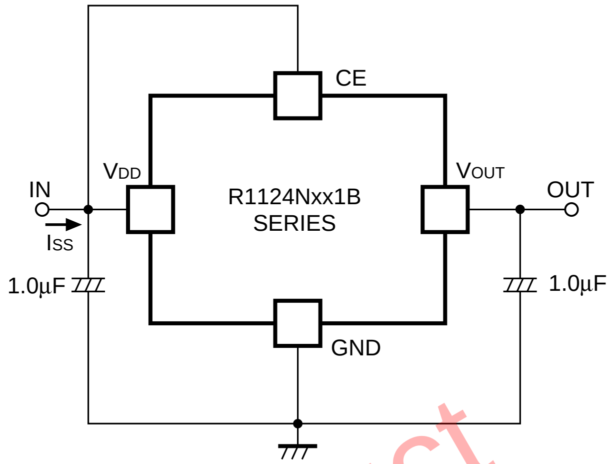


Fig.2 Supply Current Test Circuit

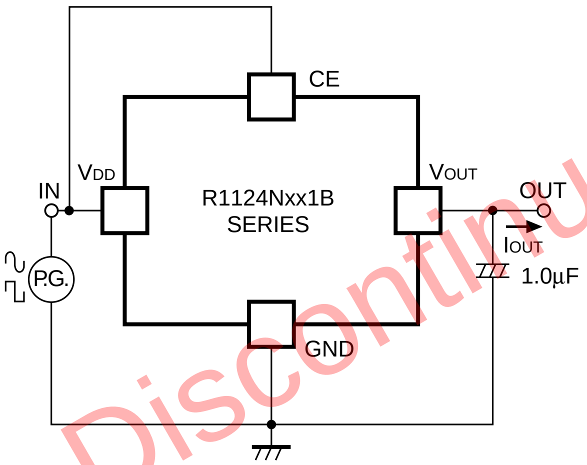


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

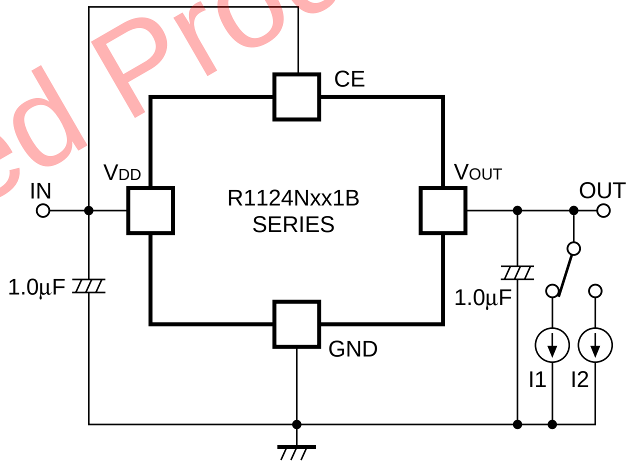
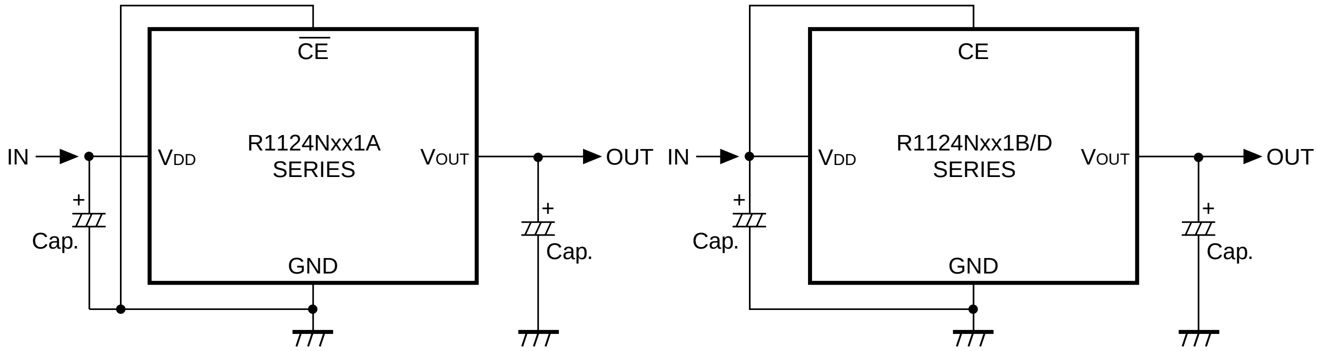


Fig.4 Load Transient Response Test Circuit

TYPICAL APPLICATIONS



(External Components)

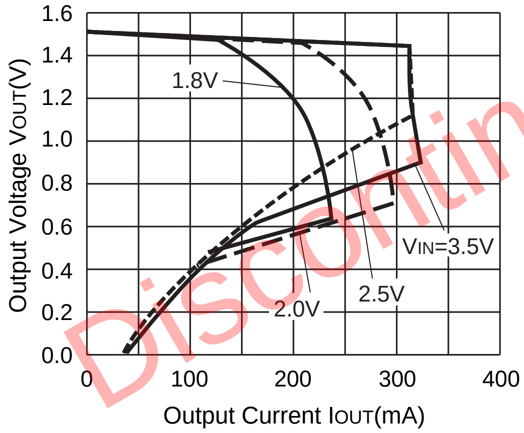
Output Capacitor; Ceramic 0.47µF (Set Output Voltage in the range from 2.5 to 5.0V)
Ceramic 1.0µF (Set Output Voltage in the range from 2.0 to 2.4V)

Input Capacitor; Ceramic 1.0µF

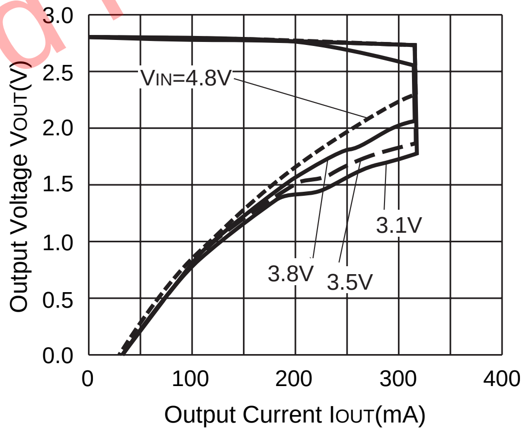
TYPICAL CHARACTERISTICS

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

R1124N151x



R1124N281x



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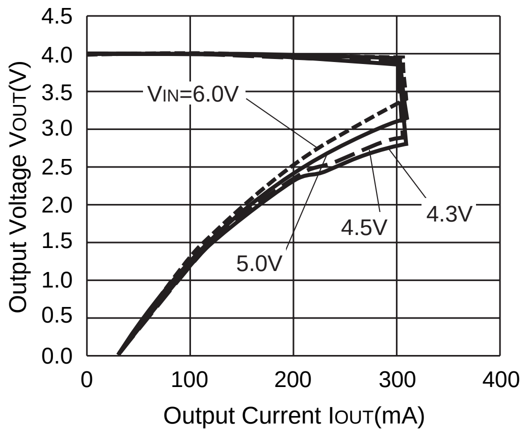
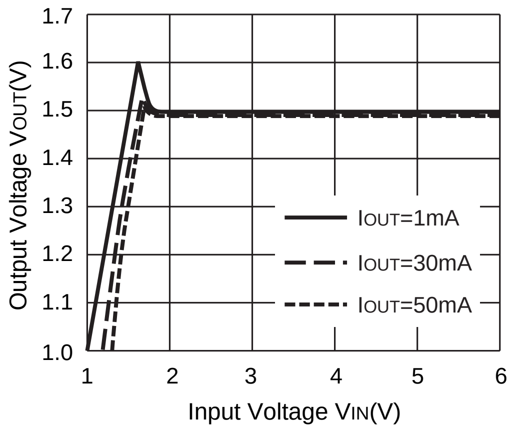
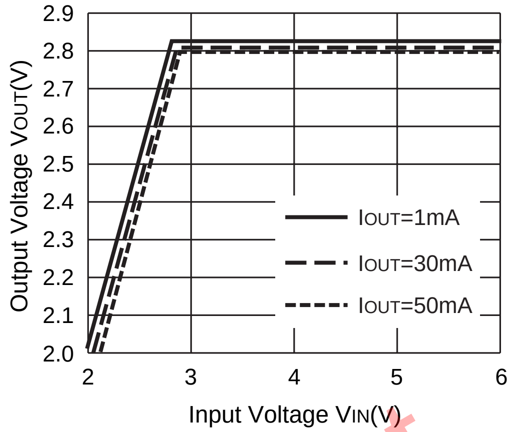


2) Output Voltage vs. Input Voltage (Topt=25°C)

R1124N151x



R1124N281x



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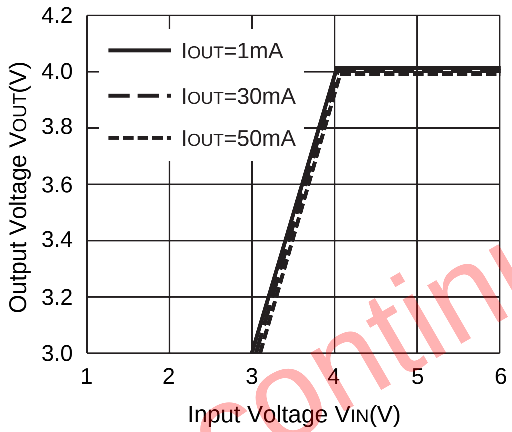
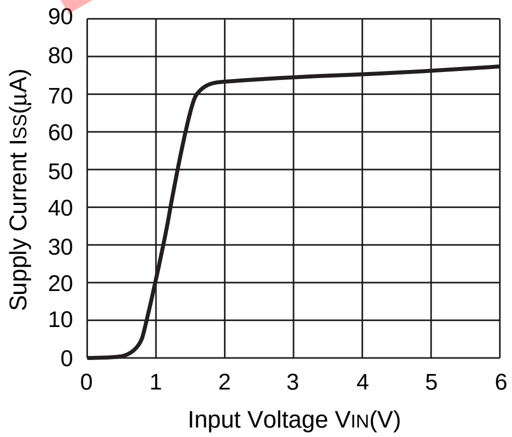


3) Supply Current vs. Input Voltage (Topt=25°C)

R1124N151x



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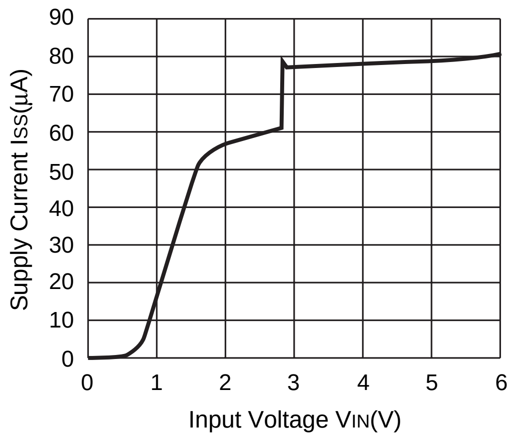
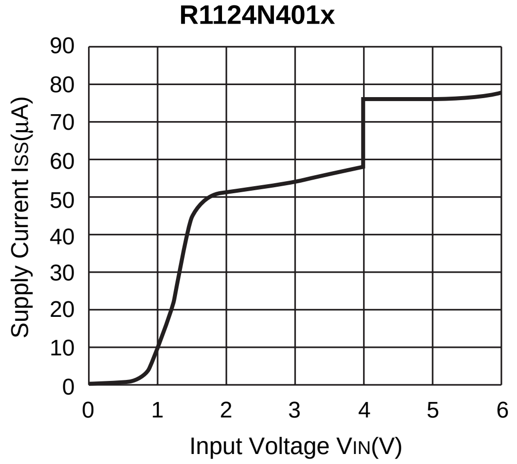
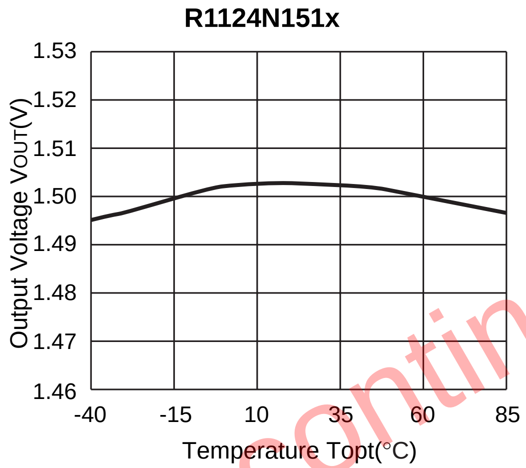
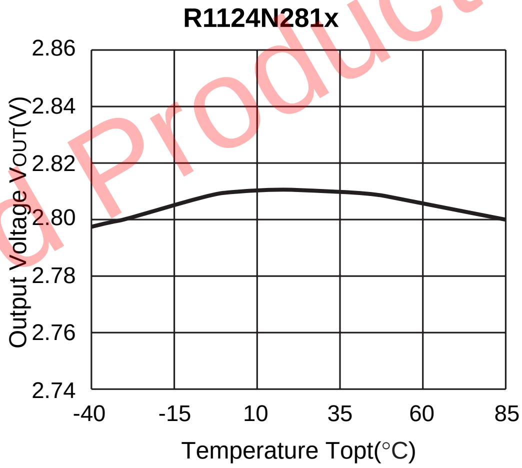
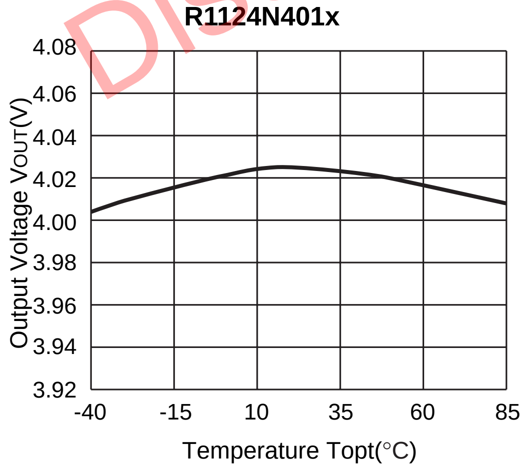




4) Output Voltage vs. Temperature

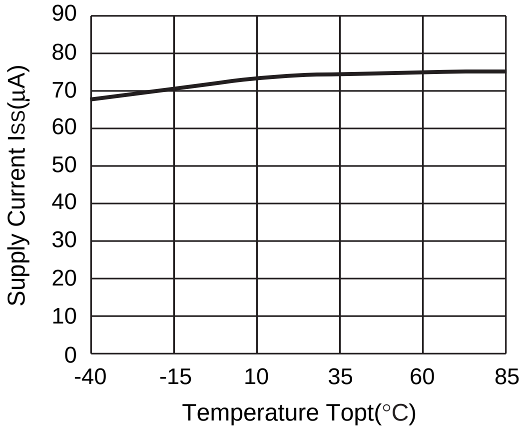






5) Supply Current vs. Temperature

R1124N151x



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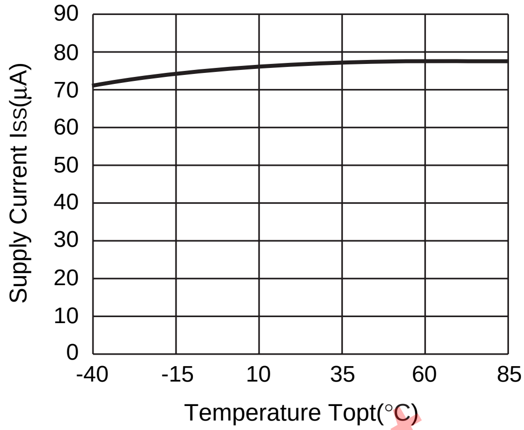

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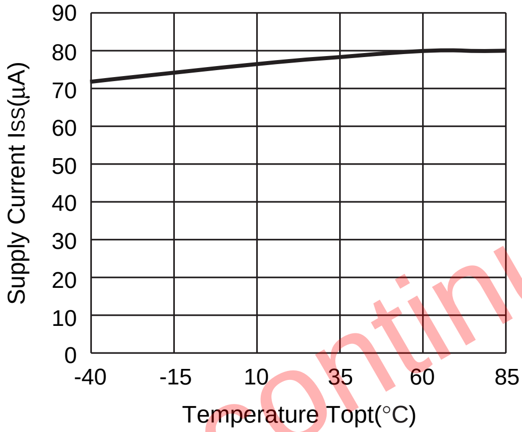
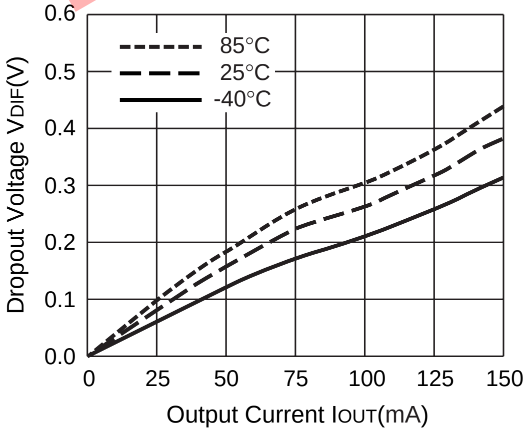
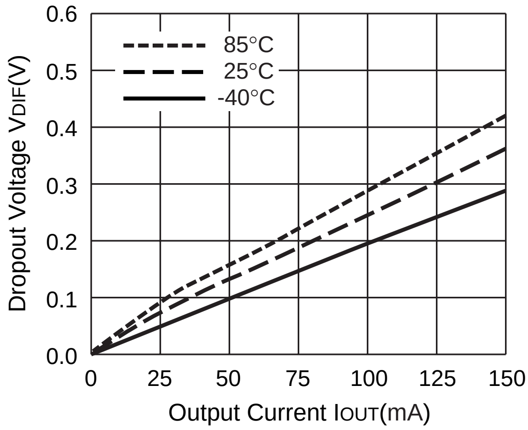


6) Dropout Voltage vs. Temperature

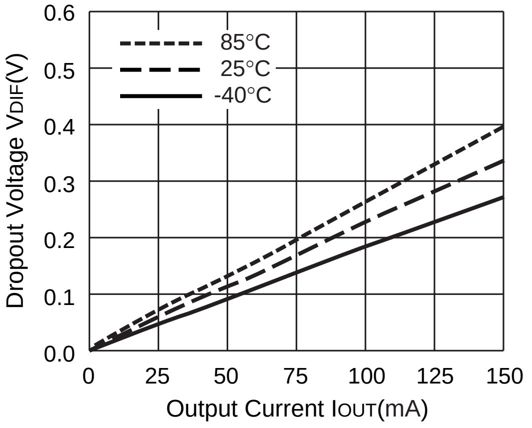
R1124N151x



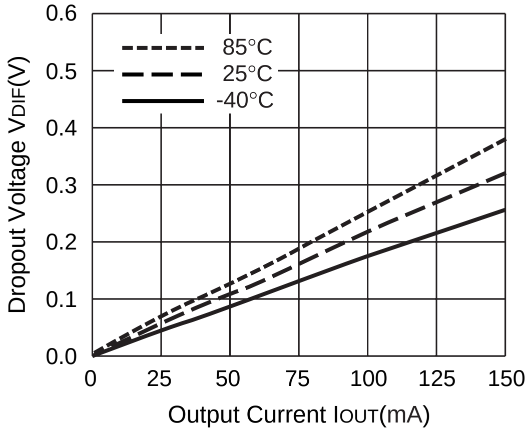
R1124N161x



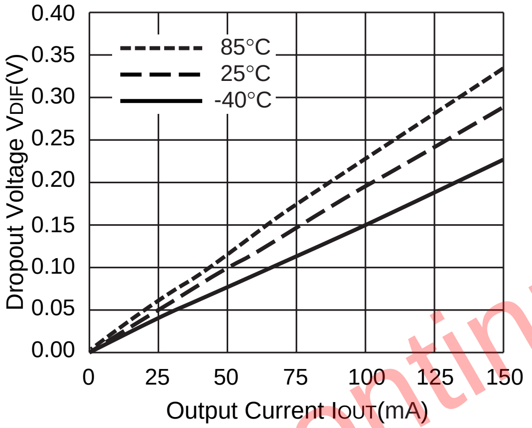
R1124N171x



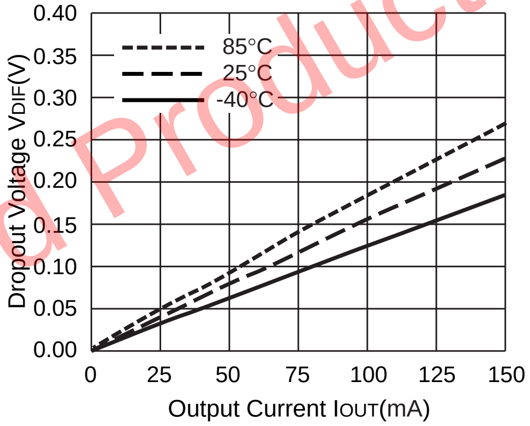
R1124N181x



R1124N211x



R1124N281x



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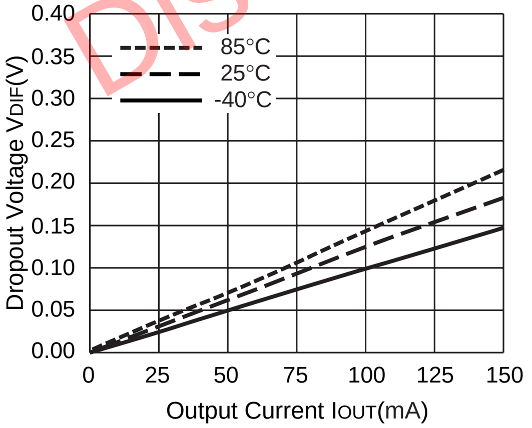
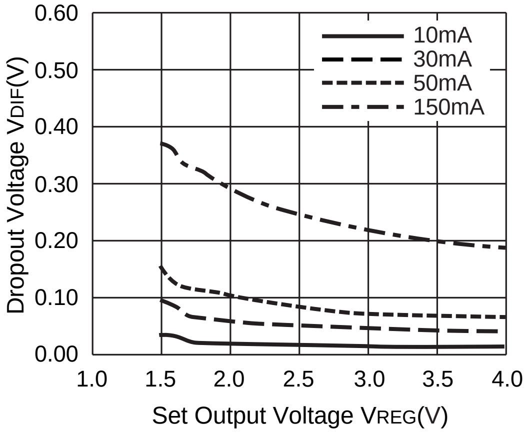
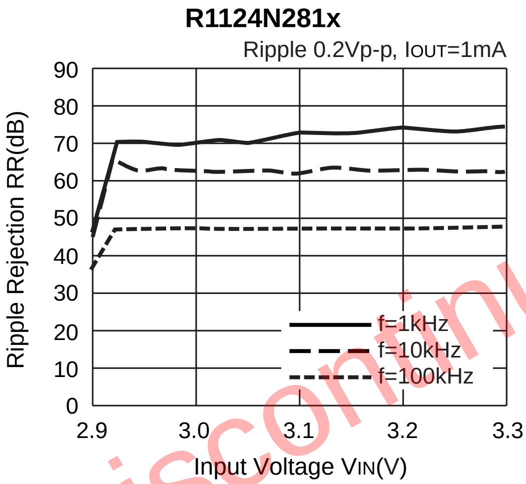
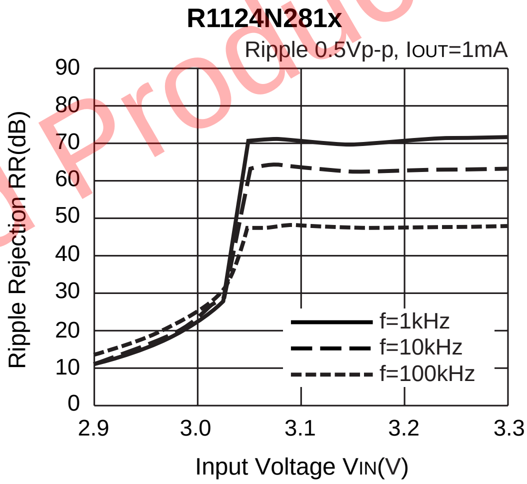


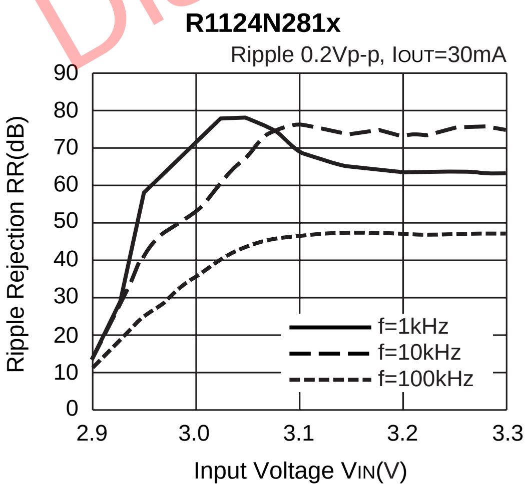
7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

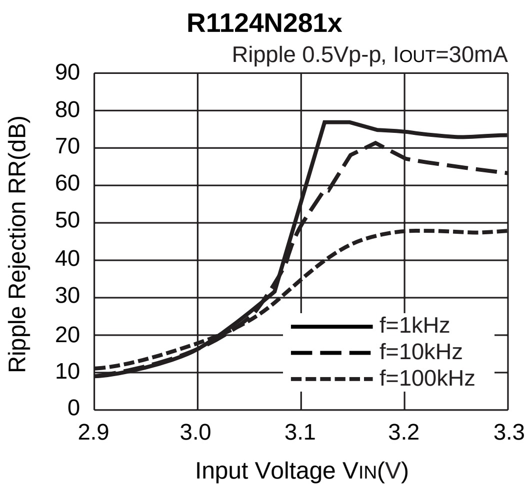


8) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, CIN=none, COUT=ceramic0.47µF)



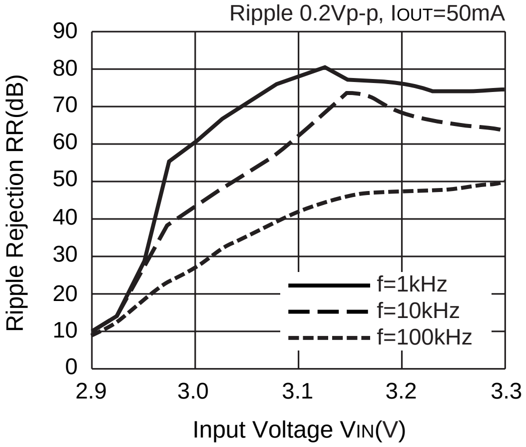






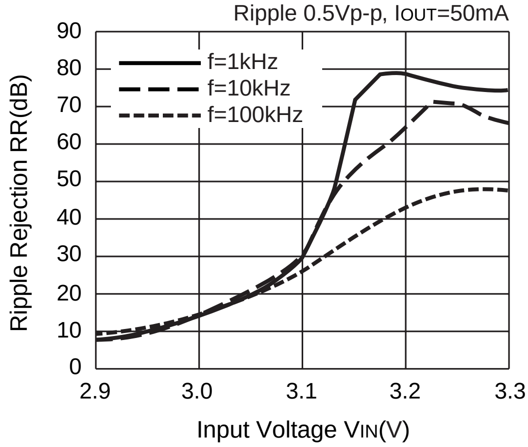
R1124N281x

Ripple 0.2Vp-p, IOUT=50mA



R1124N281x

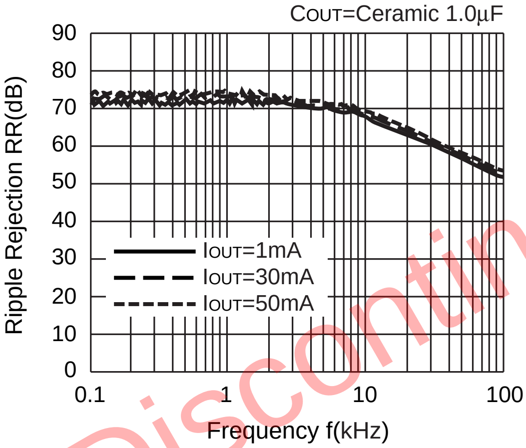
Ripple 0.5Vp-p, IOUT=50mA



9) Ripple Rejection vs. Frequency (CIN=none)

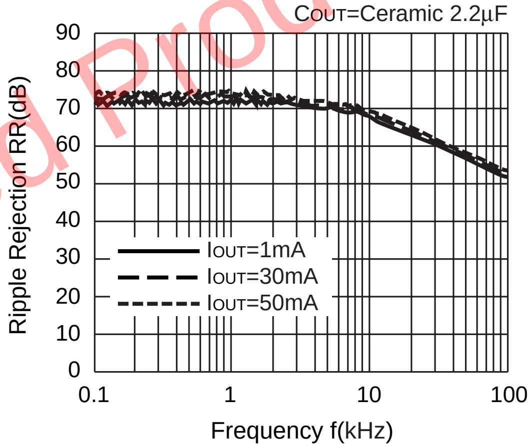
R1124N151x

VIN=2.5VDC+0.5Vp-p,
COUT=Ceramic 1.0µF



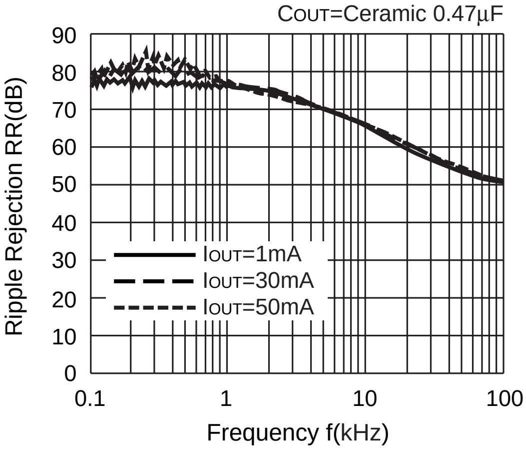
R1124N151x

VIN=2.5VDC+0.5Vp-p,
COUT=Ceramic 2.2µF



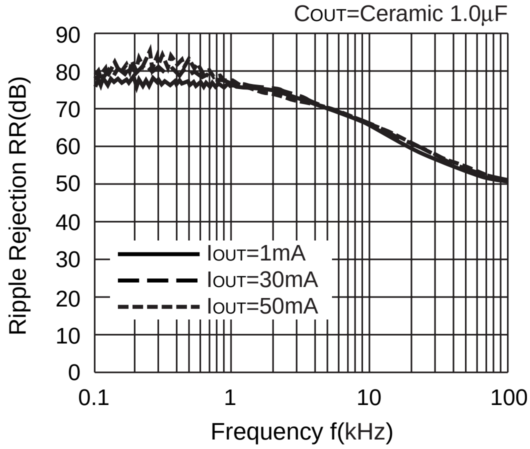
R1124N281x

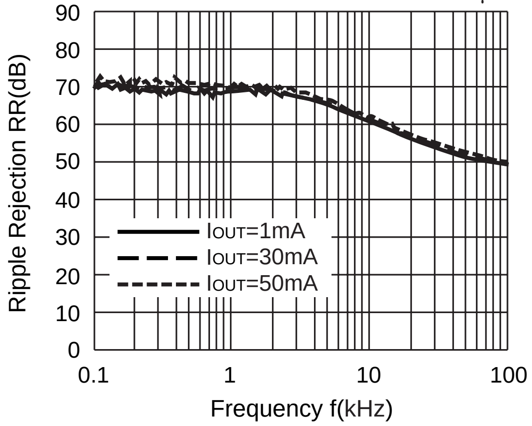
VIN=3.8VDC+0.5Vp-p,
COUT=Ceramic 0.47µF

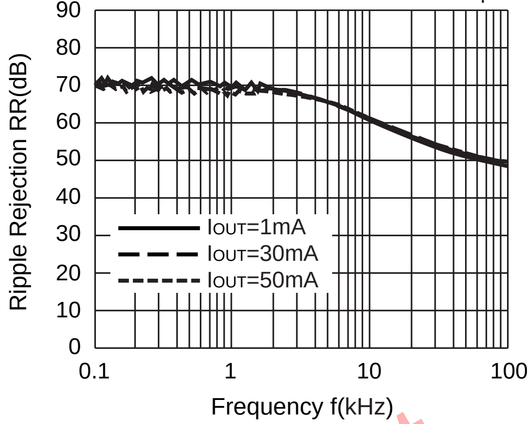


R1124N281x

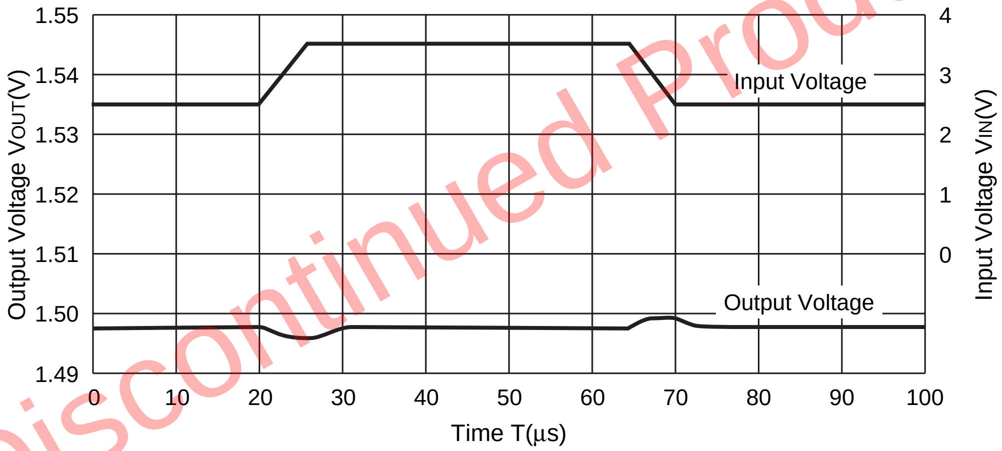
VIN=3.8VDC+0.5Vp-p,
COUT=Ceramic 1.0µF

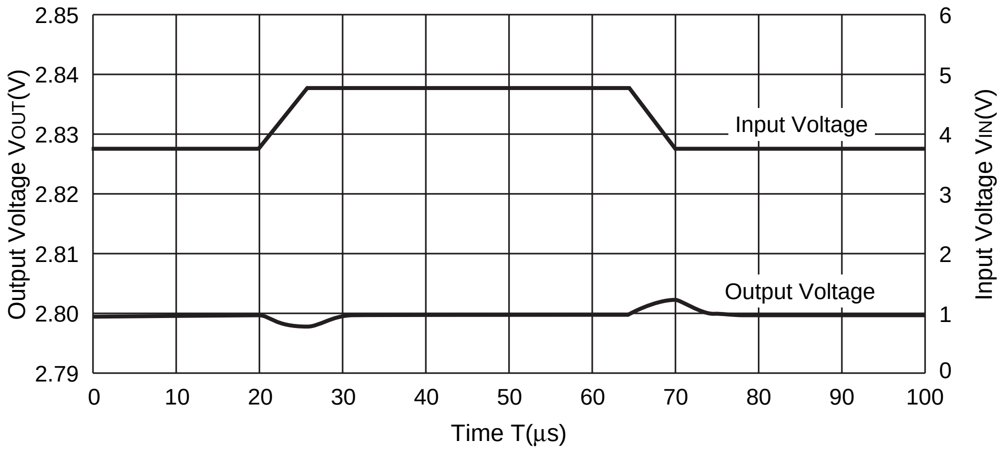




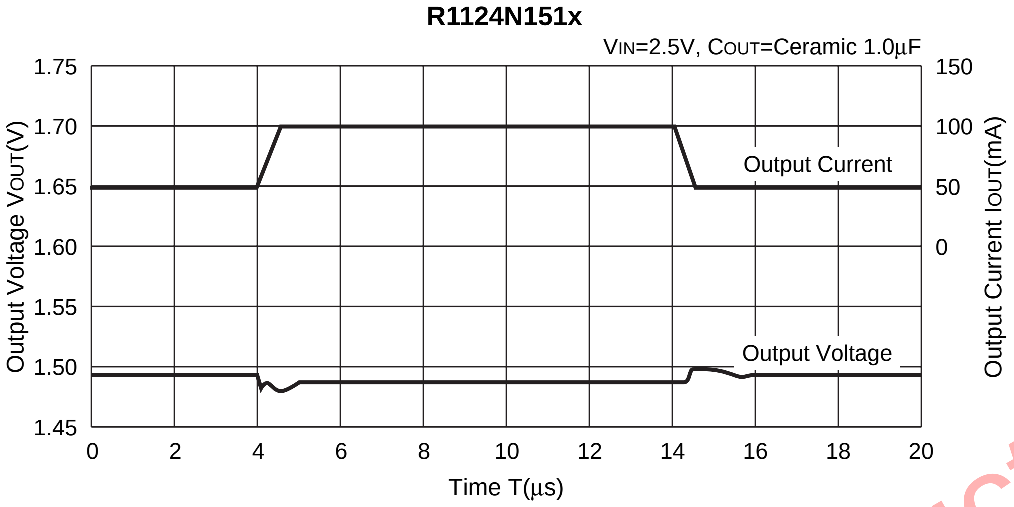


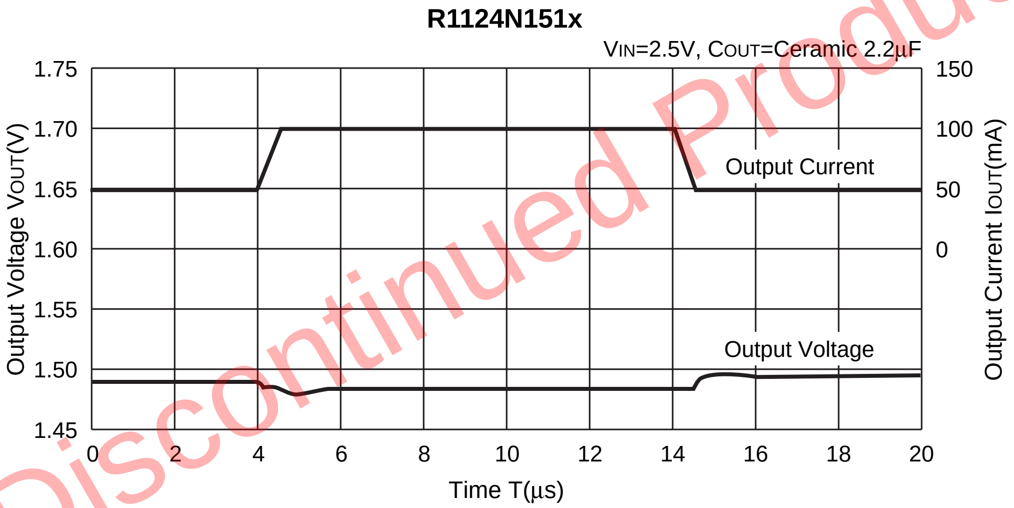
10) Input Transient Response (I_{OUT}=30mA, C_{IN}=none, tr=tf=5µs, C_{OUT}=Ceramic 0.47µF)

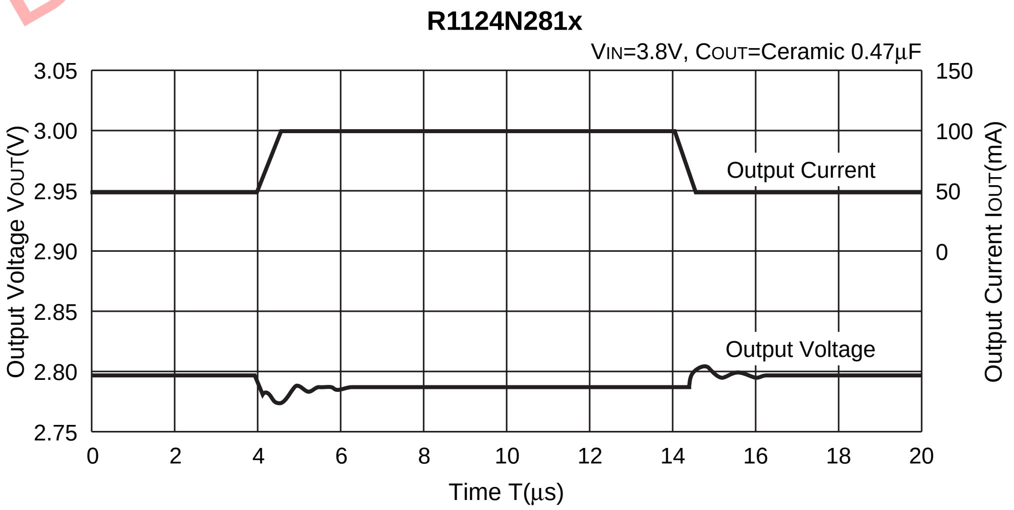




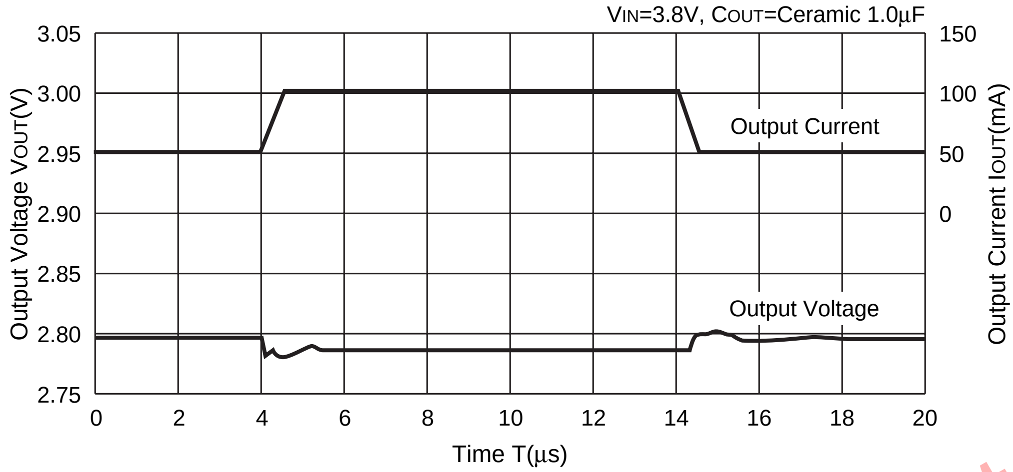
11) Load Transient Response (tr=tf=0.5μs, C_{IN}=Ceramic 1.0μF)



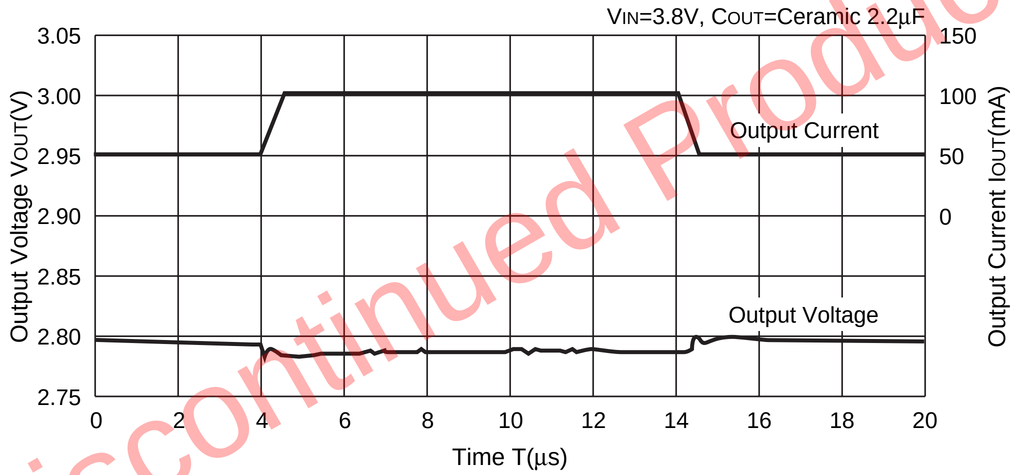




R1124N281x

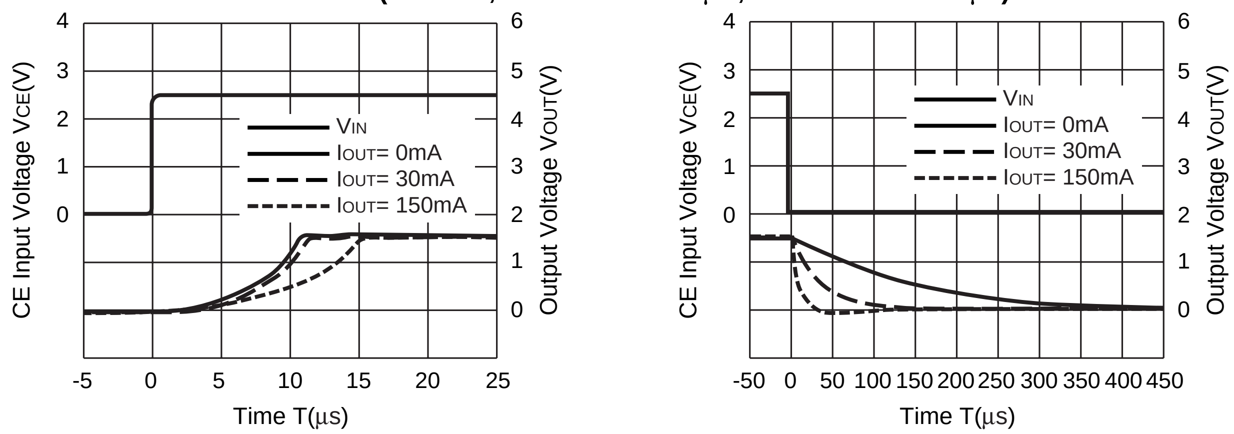


R1124N281x

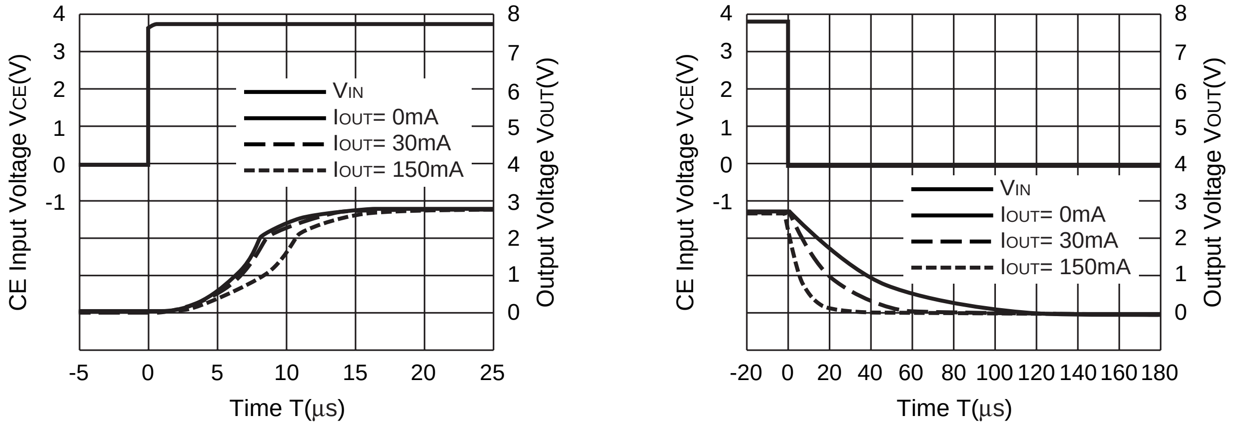


12) Turn-on/off speed with CE pin (D version)

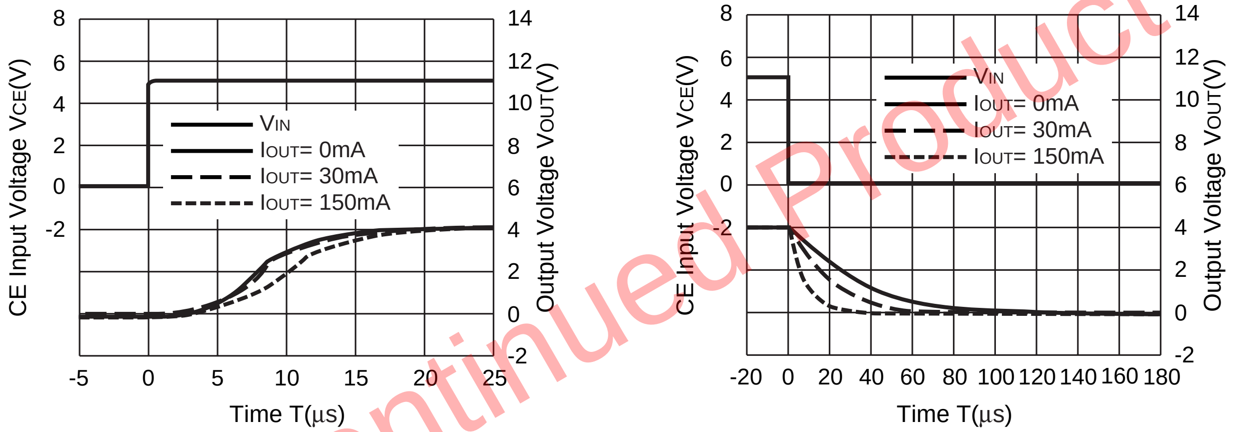
R1124N151D (VIN=2.5V, CIN=Ceramic 1.0µA, COUT=Ceramic 1.0µF)



R1124N281D (VIN=3.8V, CIN=Ceramic 0.47µA, COUT=Ceramic 0.47µF)



R1124N401D (VIN=5.0V, CIN=Ceramic 0.47µA, COUT=Ceramic 0.47µF)



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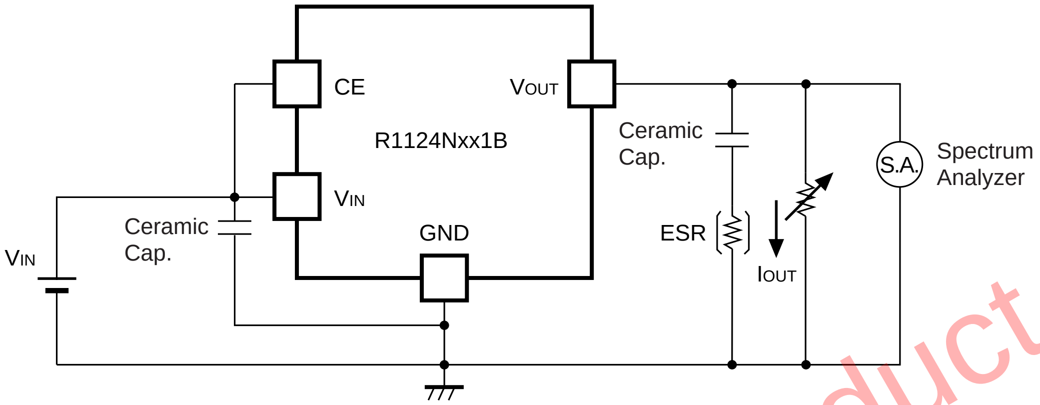
TECHNICAL NOTES

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 40µV (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>

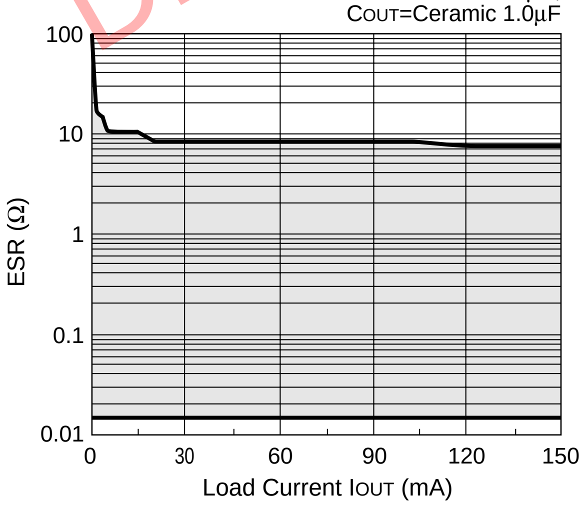
(1) $V_{IN}=V_{OUT}+1V$

(2) Frequency Band: 10Hz to 2MHz

(3) Temperature: −40°C to 85°C

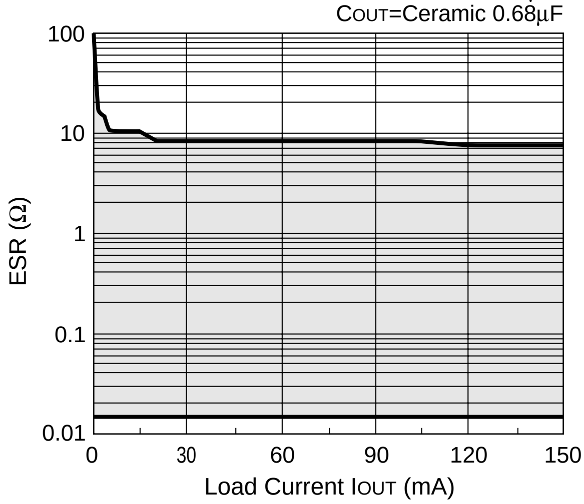
R1124N151x

CIN=Ceramic 1.0µA,
COUT=Ceramic 1.0µF

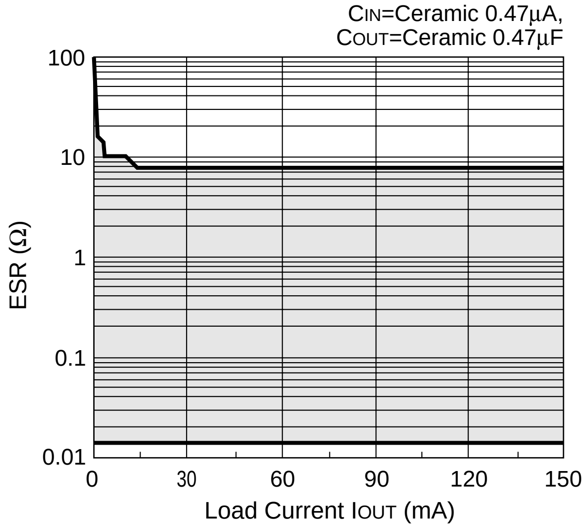


R1124N161x

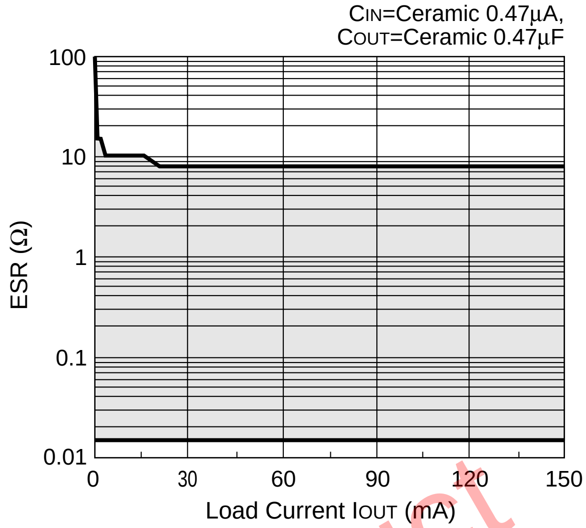
CIN=Ceramic 0.47µA,
COUT=Ceramic 0.68µF



R1124N211x



R1124N281x



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