LOW NOISE 150mA LDO REGULATOR

NO.EA-058-111026

OUTLINE

The R1121N 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 voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors, 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 R1121N 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 (Mini-mold) package , high density mounting of the ICs on boards is possible.

FEATURES

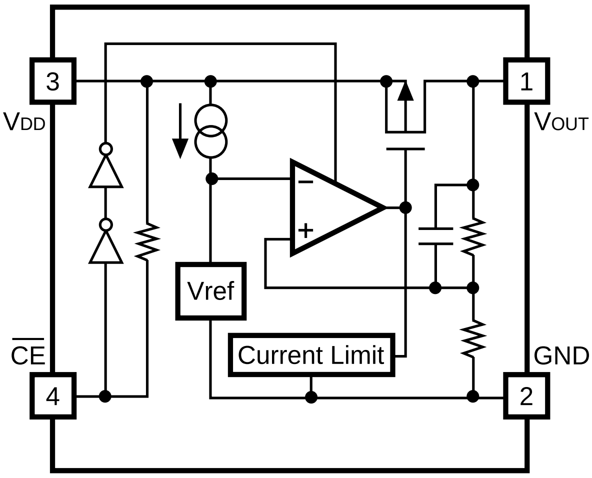
- Supply Current .... Typ. 35μA
- Standby Mode .... Typ. 0.1μA
- Dropout Voltage .... Typ. 0.2V (I_{OUT}=100mA)
- Ripple Rejection .... Typ. 70dB(f=1kHz)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.05%/V
- Output Voltage Accuracy .... ±2.0%
- Output Voltage Range .... 1.5V to 5.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Package .... SOT-23-5 (Mini-mold)
- Built-in chip enable circuit (2 types; A: active “L”, B: active “H”)
- Pin-out .... Similar to the TK112,TK111

APPLICATIONS

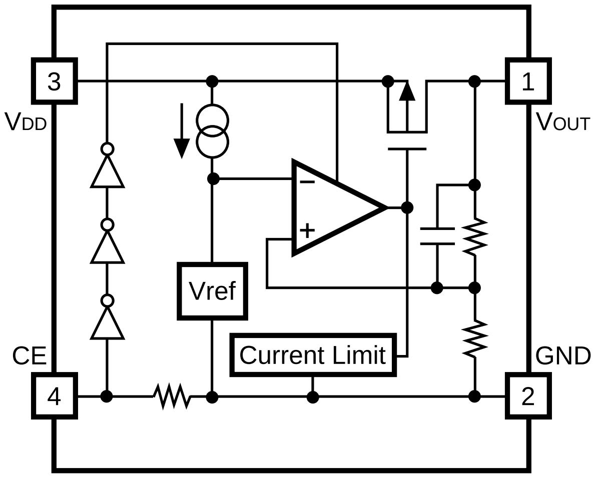
- Power source for cellular phones such as GSM, CDMA and various kinds of PCSs.
- Power source for domestic appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAM

R1121Nxx1A



R1121Nxx1B



SELECTION GUIDE

The output voltage, the active type for the ICs can be selected at the user's request.

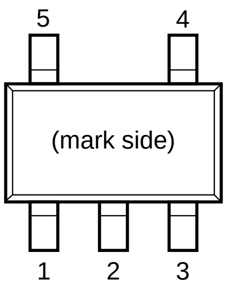
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1121Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.5V(15) to 5.0V(50) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : Designation of Active Type.
(A) "L" active
(B) "H" active

PIN CONFIGURATION

SOT-23-5



PIN DESCRIPTION

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	9.0	V
V_{CE}	Input Voltage($\overline{CE}$ or CE Pin)	-0.3 ~ V_{IN}+0.3	V
V_{OUT}	Output Voltage	-0.3 ~ 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

- **R1121Nxx1A**

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} ×0.98		V_{OUT} ×1.02	V
I_{OUT}	Output Current	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = Set V_{OUT} + 1V 1mA ≦ I_{OUT} ≦ 80mA		12	40	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I_{SS}	Supply Current	V_{IN} = Set V_{OUT} + 1V		35	70	μA
Istandby	Supply Current (Standby)	V_{IN} = V_{CE} = Set V_{OUT} + 1V		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 8.0V I_{OUT} = 30mA		0.05	0.20	%/V
RR	Ripple Rejection	f = 1kHz, Ripple 0.5Vp-p V_{IN} = Set V_{OUT} + 1V		70		dB
V_{IN}	Input Voltage		2.0		8.0	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		50		mA
R_{PU}	$\overline{CE}$ Pull-up Resistance		2.5	5.0	10.0	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage “H”		1.5		V_{IN}	V
V_{CEL}	$\overline{CE}$ Input Voltage “L”		0.00		0.25	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.

- **R1121Nxx1B**

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} ×0.98		V_{OUT} ×1.02	V
I_{OUT}	Output Current	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = Set V_{OUT} + 1V 1mA ≦ I_{OUT} ≦ 80mA		12	40	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I_{SS}	Supply Current	V_{IN} = Set V_{OUT} + 1V		35	70	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	Set V_{OUT} + 0.5V ≦ V_{IN} ≦ 8.0V I_{OUT} = 30mA		0.05	0.20	%/V
RR	Ripple Rejection	f = 1kHz, Ripple 0.5Vp-p V_{IN} = Set V_{OUT} + 1V		70		dB
V_{IN}	Input Voltage		2.0		8.0	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		50		mA
R_{PD}	CE Pull-down Resistance		2.5	5.0	10.0	MΩ
V_{CEH}	CE Input Voltage "H"		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"		0.00		0.25	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.

ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

Output Voltage V_{OUT} (V)	Output Current I_{OUT} (mA)	
	Condition	Min.
$1.5 \leqq V_{OUT} \leqq 1.7$	$V_{IN} - V_{OUT} = 1.0V$	100
$1.8 \leqq V_{OUT} \leqq 5.0$		150

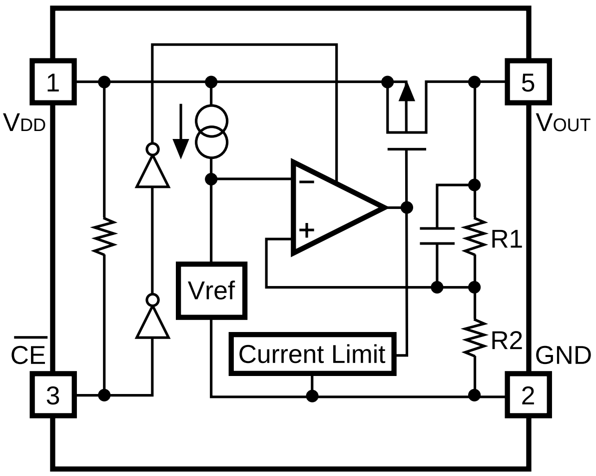
Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)			
	Condition	Min.	Typ.	Max.
1.5	$I_{OUT} = 100mA$	0.50		
1.6		0.40		
1.7		0.30		
$1.8 \leqq V_{OUT} \leqq 1.9$			0.60	1.40
$2.0 \leqq V_{OUT} \leqq 2.4$			0.35	0.70
$2.5 \leqq V_{OUT} \leqq 2.7$			0.24	0.35
$2.8 \leqq V_{OUT} \leqq 3.3$			0.20	0.30
$3.4 \leqq V_{OUT} \leqq 5.0$			0.17	0.26

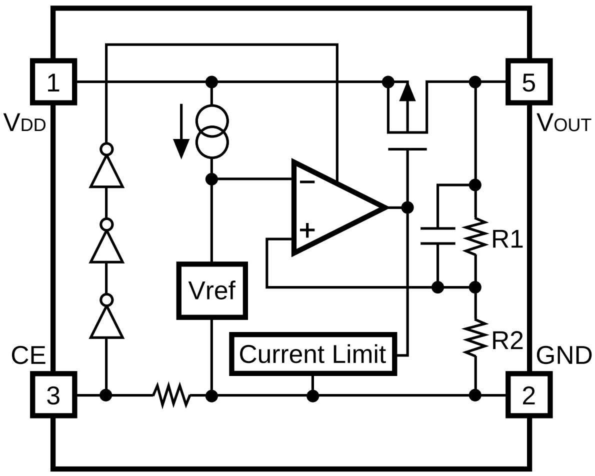
Note : When set Output Voltage is equal or less than 2.0V,
V_{IN} should be equal or more than 2.0V.

OPERATION

R1121Nxx1A



R1121Nxx1B



In these ICs, fluctuation of output voltage, V_{OUT} is detected by feed-back registers R1, R2, and the result is compared with a reference voltage by the error amplifier, so that a constant voltage is output.

A current limit circuit for protection in short mode and a chip enable circuit, are included.

TEST CIRCUITS

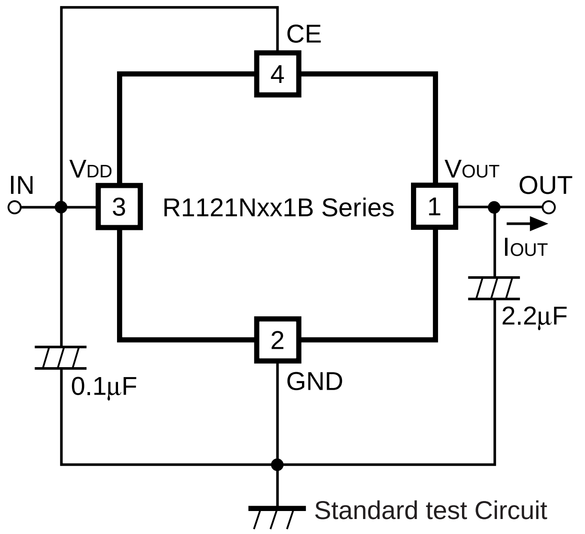


Fig.1 Standard test Circuit

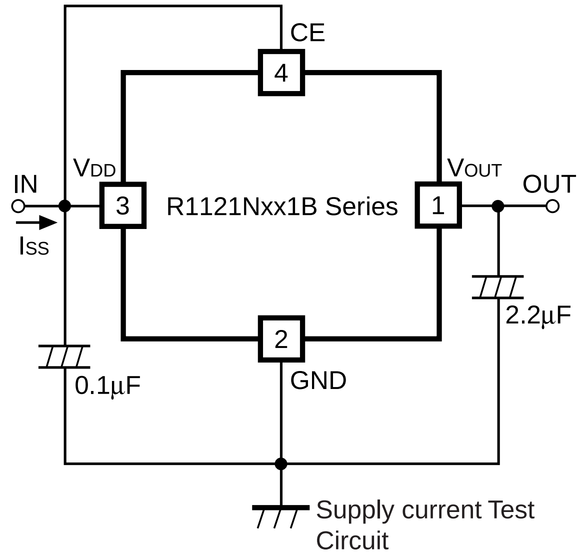


Fig.2 Supply Current Test Circuit

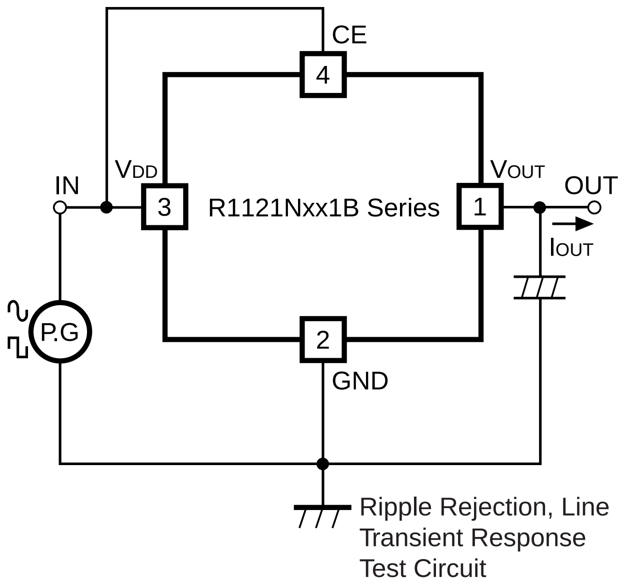


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

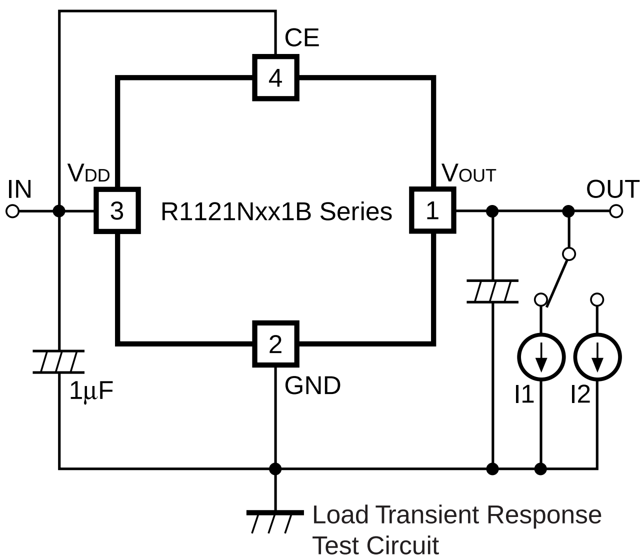
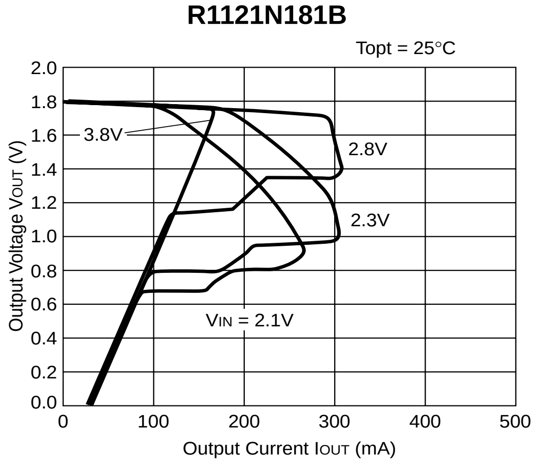
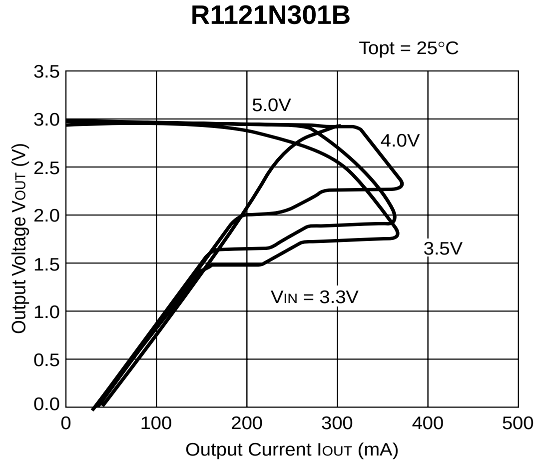


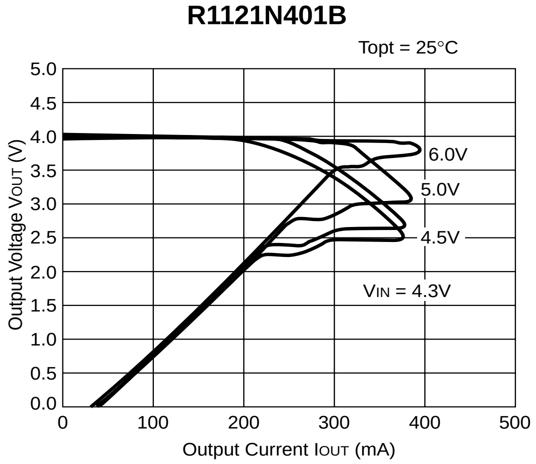
Fig.4 Load Transient Response Test Circuit

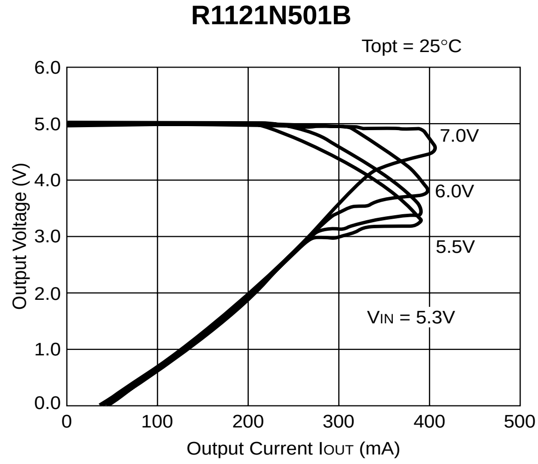
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

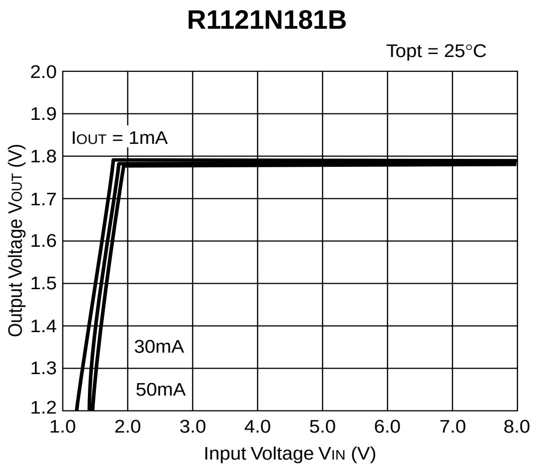


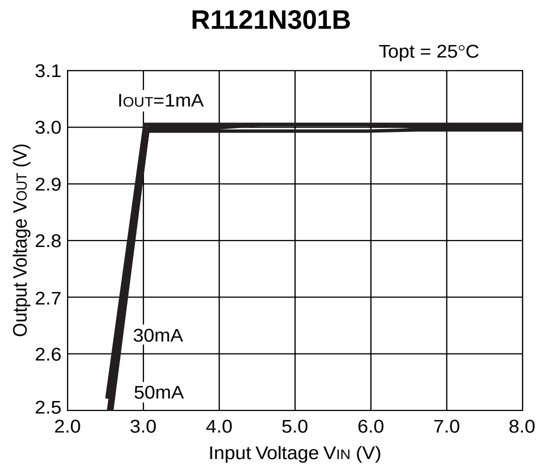






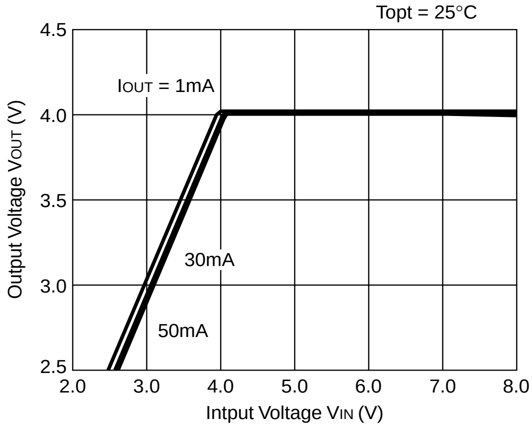
2) Output Voltage vs. Input Voltage



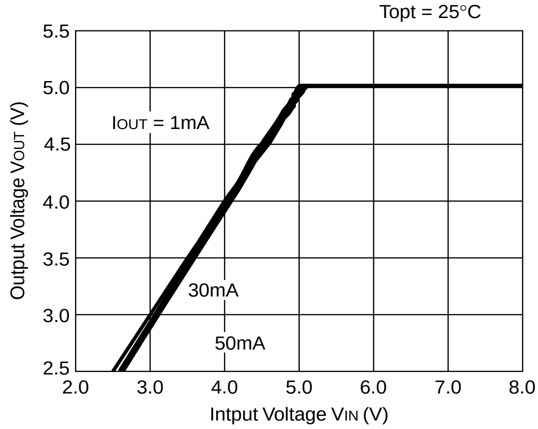


RICOH

R1121N401B

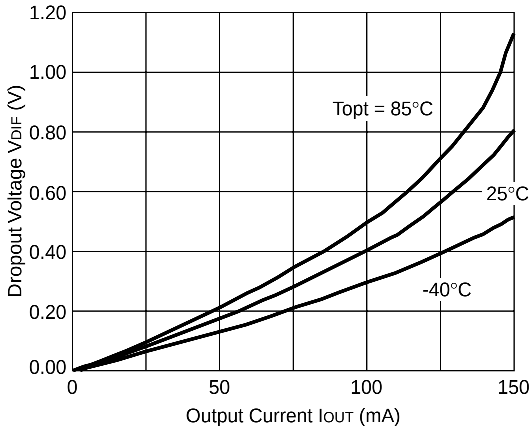


R1121N501B

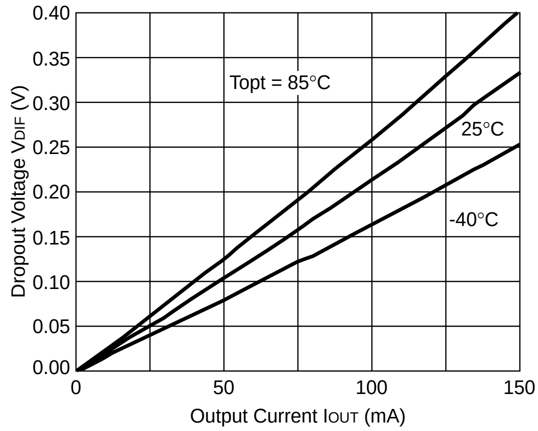


3) Dropout Voltage vs. Output Current

R1121N181B



R1121N301B



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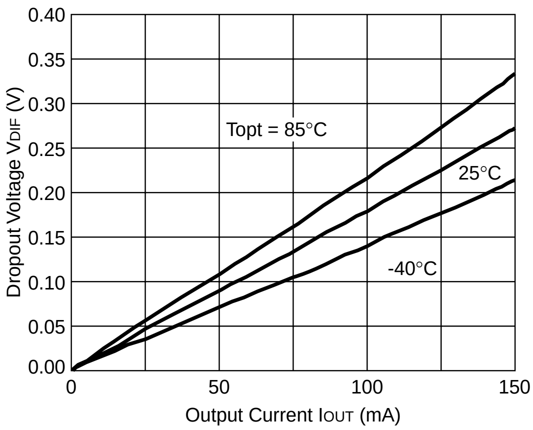

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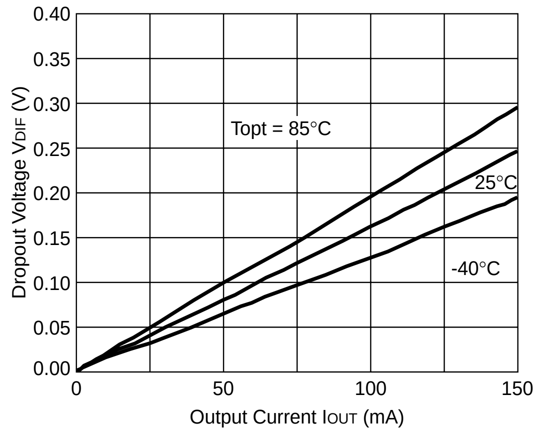
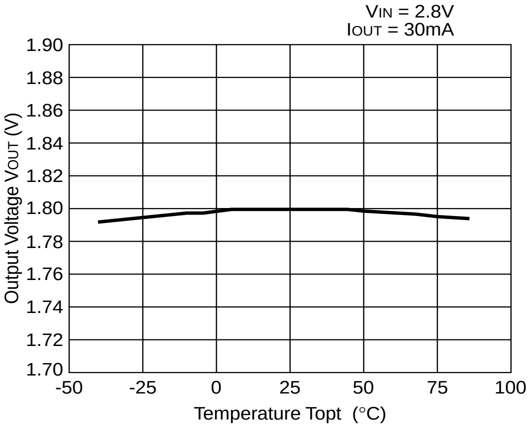


4) Output Voltage vs. Temperature

R1121N181B



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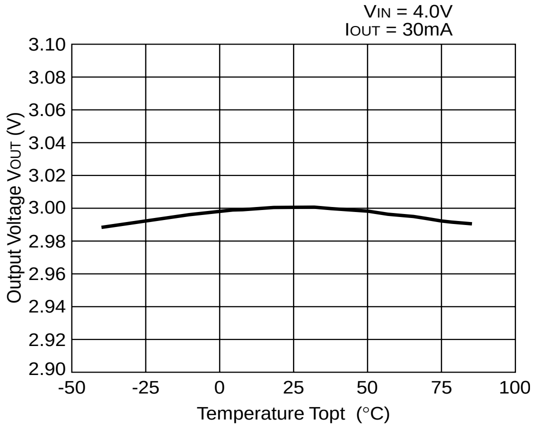

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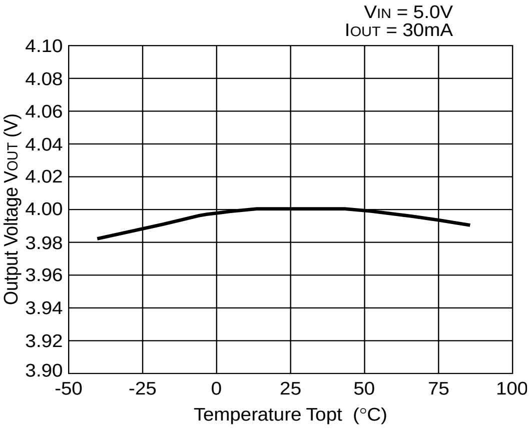

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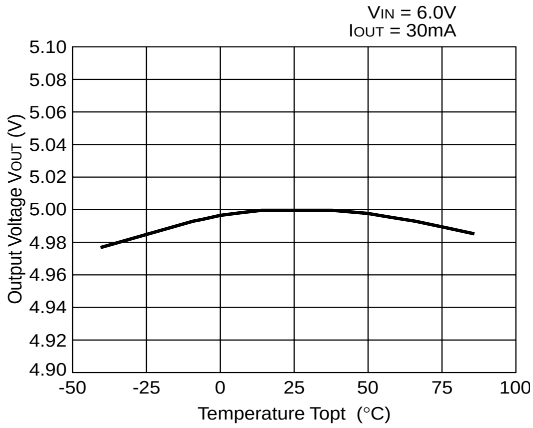
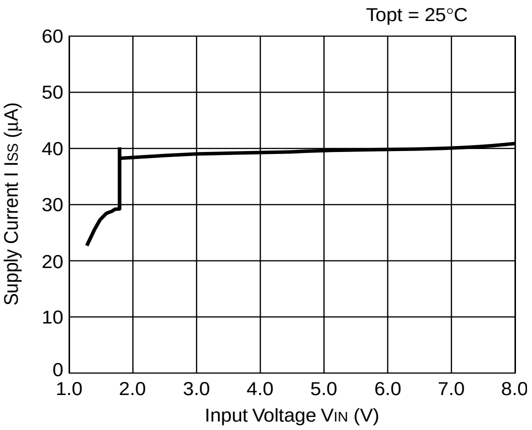


5) Supply Current vs. Input Voltage

R1121N181B



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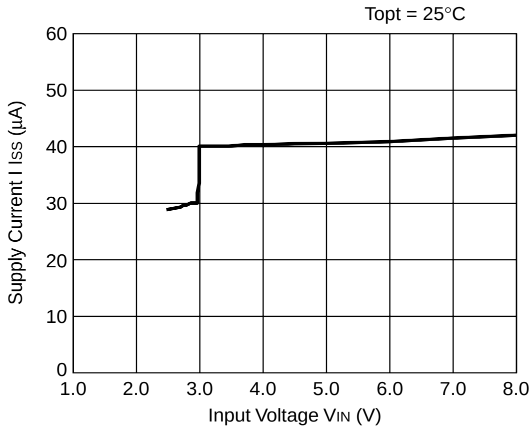
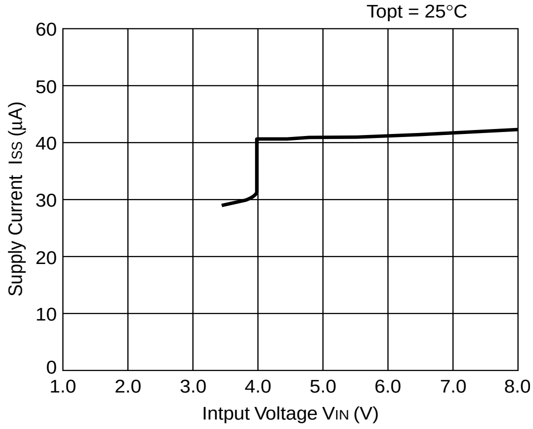


RICOH

R1121N401B



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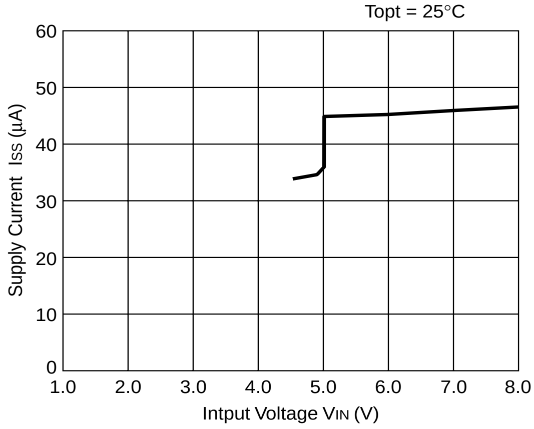
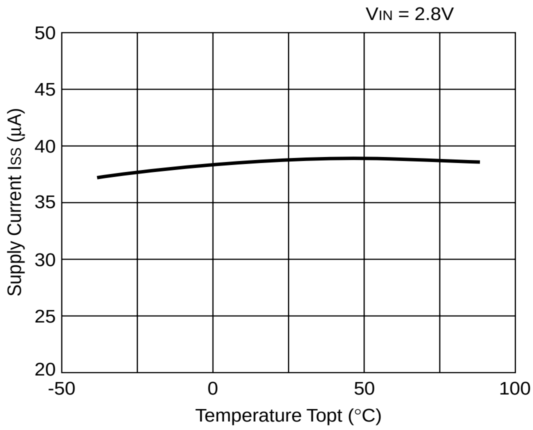


6) Supply Current vs. Temperature

R1121N181B



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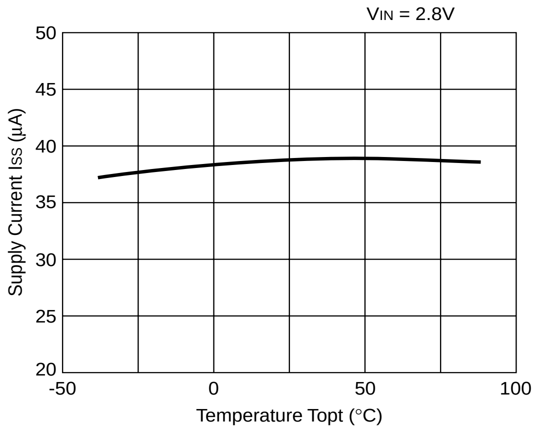

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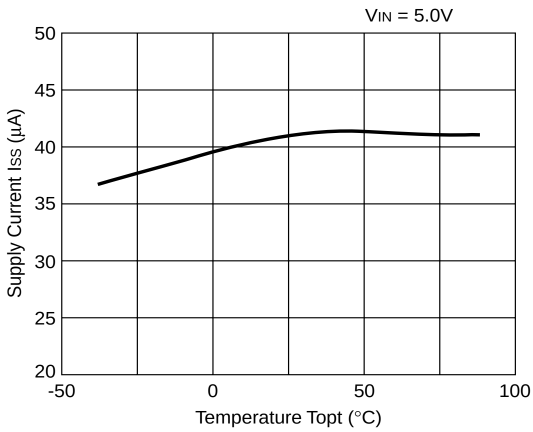

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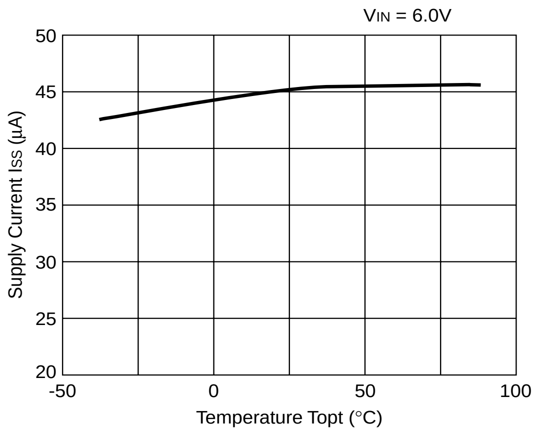
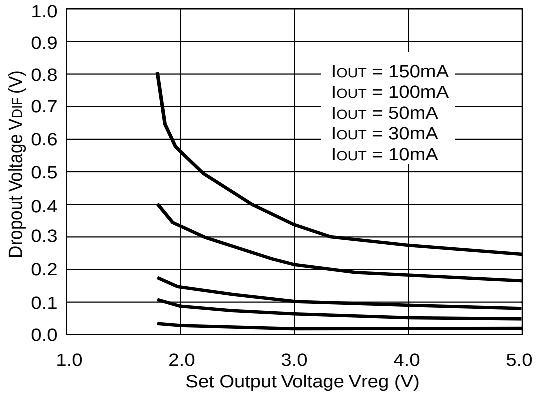


7) Dropout Voltage vs. Set Output Voltage

R1121Nxx1B

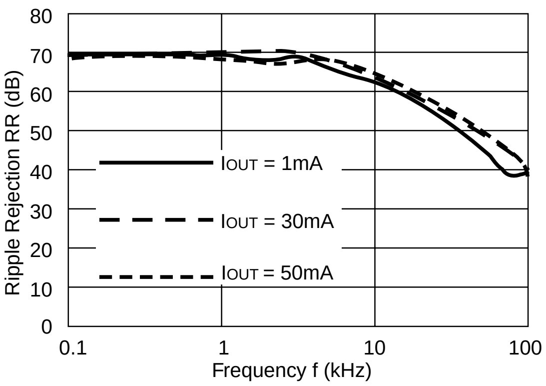
Topt = 25°C



8) Ripple Rejection vs. Frequency

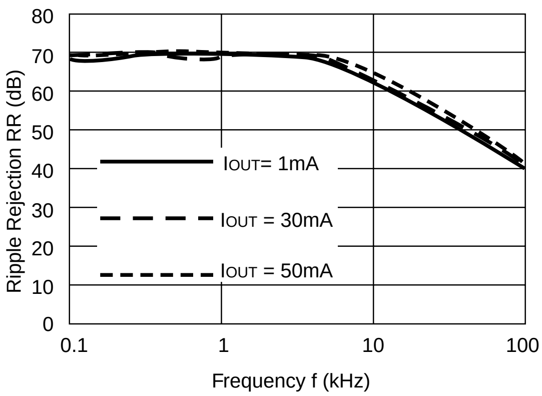
R1121N181B

VIN = 2.8VDC + 0.5Vp-p
COUT = tantal 1.0µF



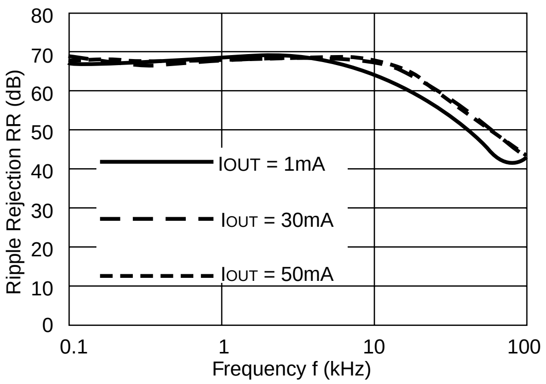
R1121N181B

VIN = 2.8VDC + 0.5Vp-p
COUT = tantal 2.2µF



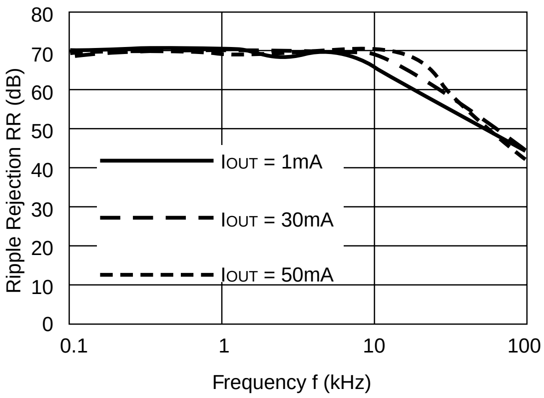
R1121N301B

VIN = 4.0VDC + 0.5Vp-p
COUT = tantal 1.0µF



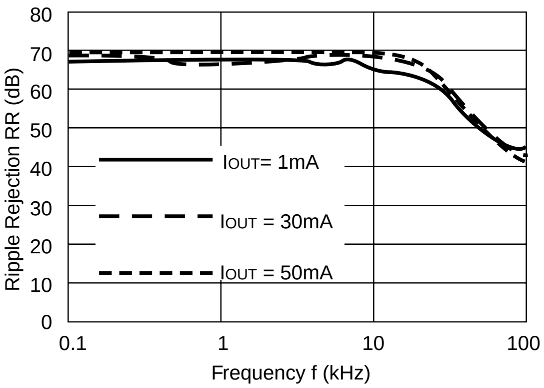
R1121N301B

VIN = 4.0VDC + 0.5Vp-p
COUT = tantal 2.2µF



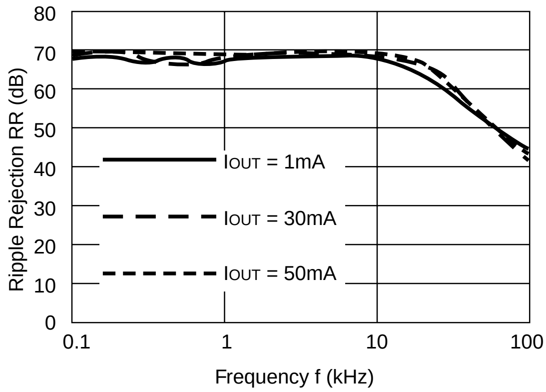
R1121N401B

V_{IN} = 5.0V_{DC} + 0.5Vp-p
C_{OUT} = tantal 1.0µF



R1121N401B

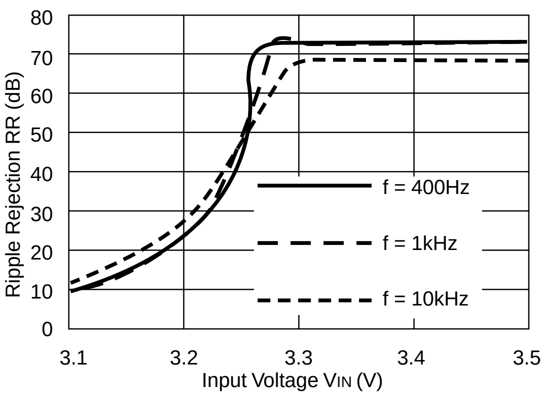
V_{IN} = 5.0V_{DC} + 0.5Vp-p
C_{OUT} = tantal 2.2µF



9) Ripple Rejection vs. Input Voltage (DC bias)

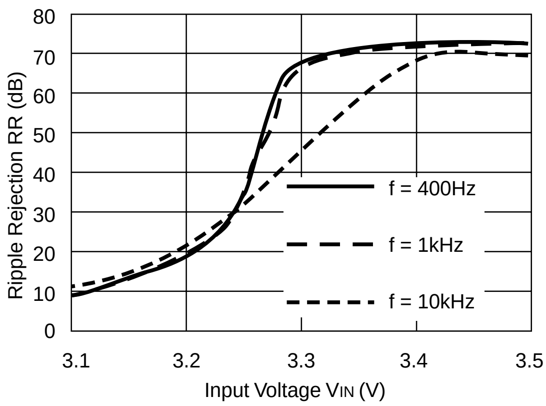
R1121N301B

I_{OUT} = 1mA
C_{OUT} = 2.2µF



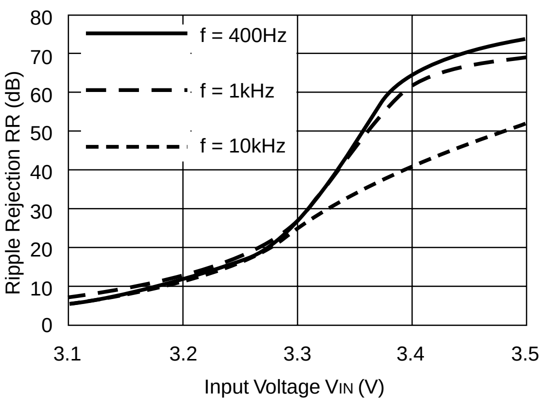
R1121N301B

I_{OUT} = 10mA
C_{OUT} = 2.2µF

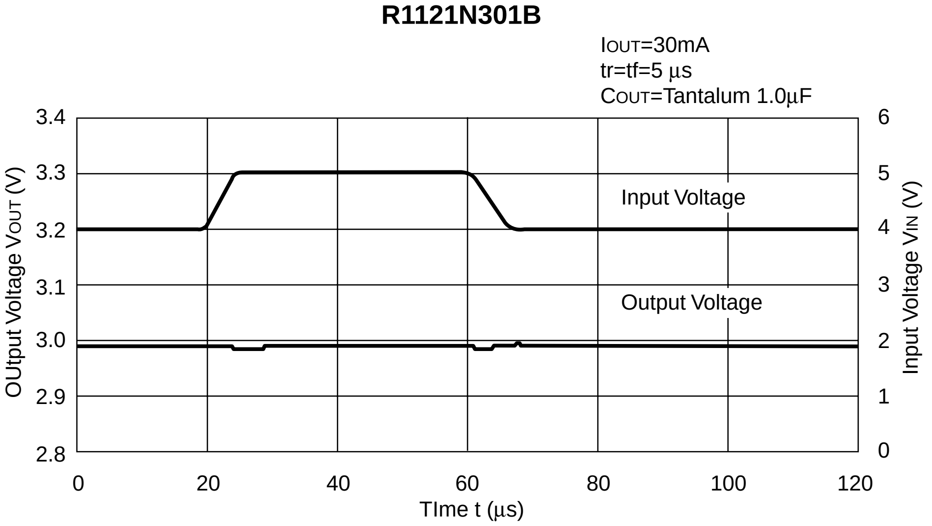


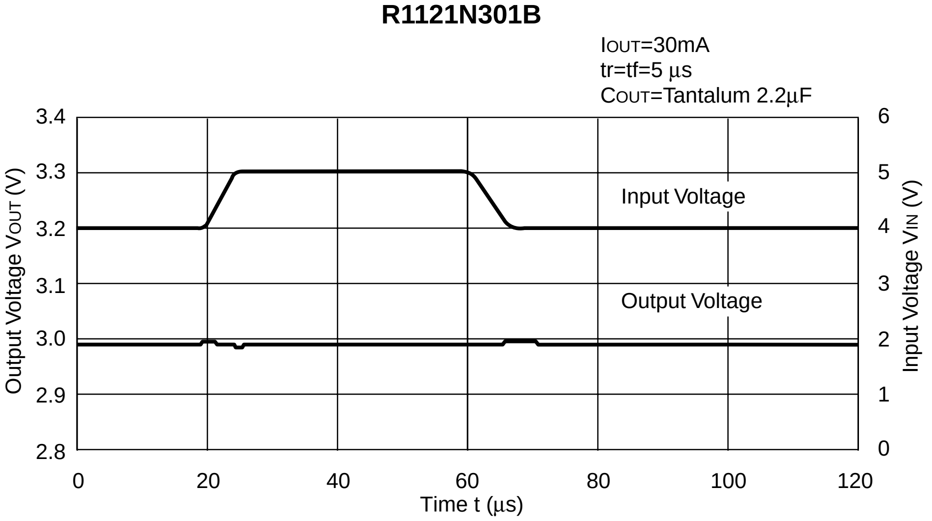
R1121N301B

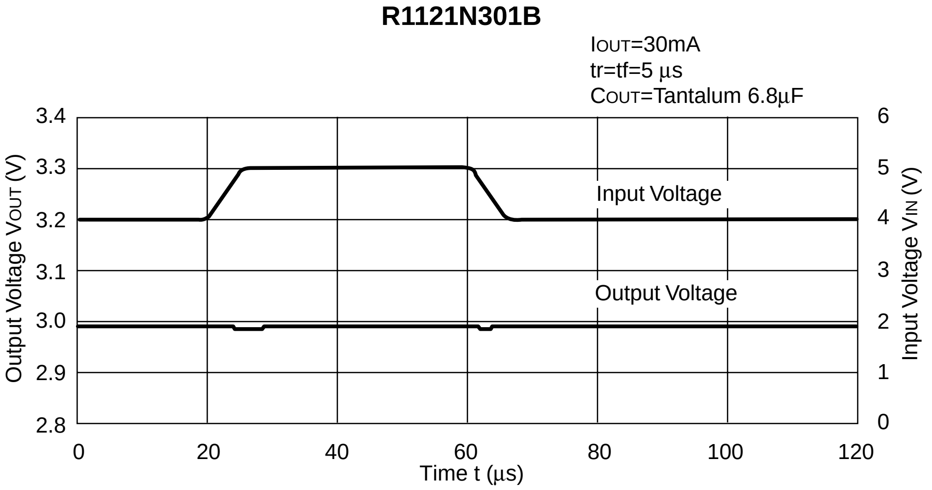
I_{OUT} = 50mA
C_{OUT} = 2.2µF



10) LineTransient Response



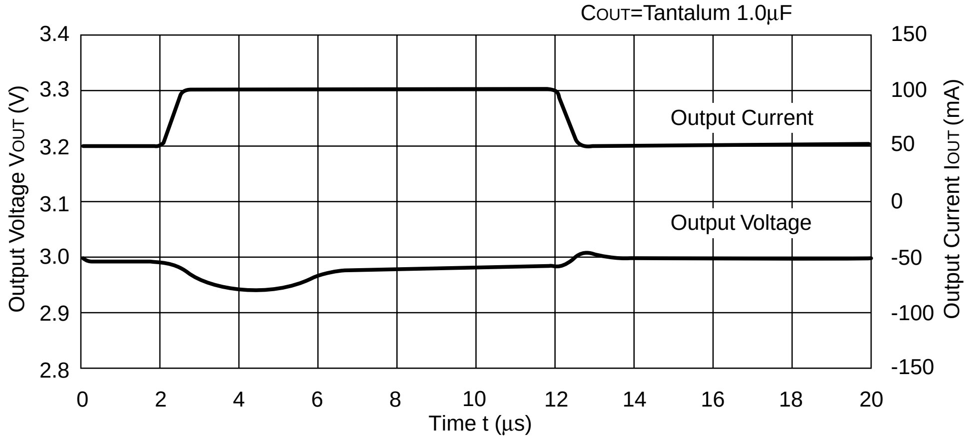




11) Load Transient Response

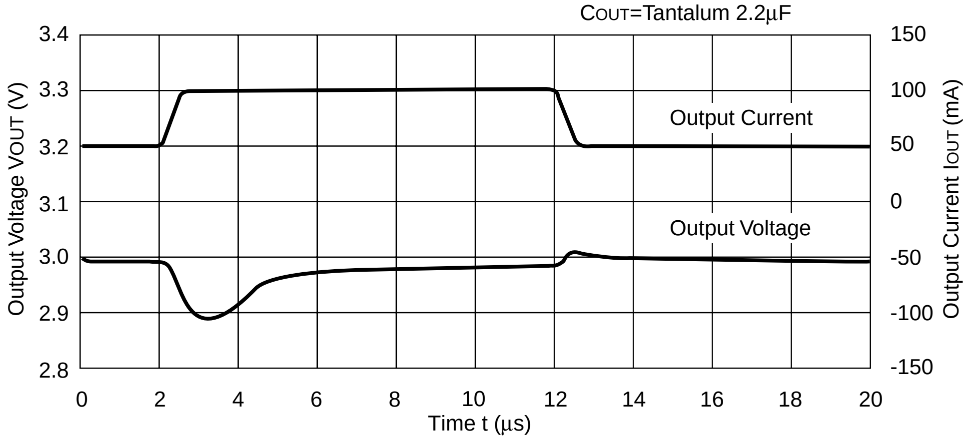
R1121N301B

V_{IN}=4V
C_{IN}=Tantalum 1µF
C_{OUT}=Tantalum 1.0µF



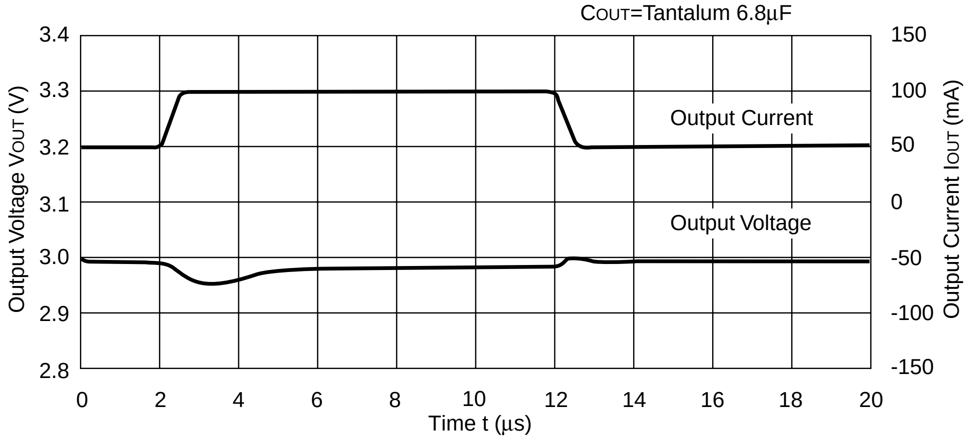
R1121N301B

V_{IN}=4V
C_{IN}=Tantalum 1µF
C_{OUT}=Tantalum 2.2µF



R1121N301B

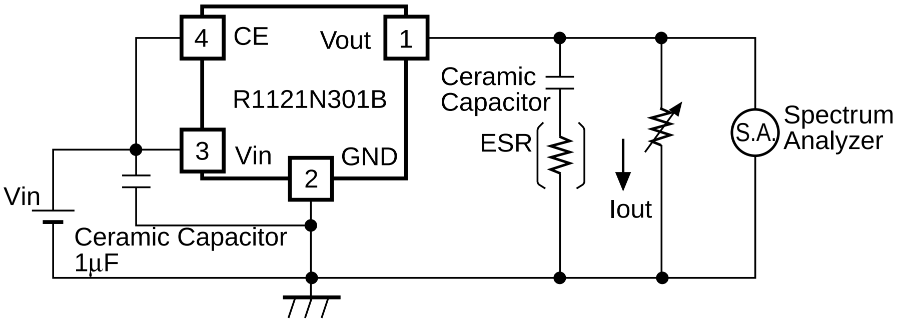
V_{IN}=4V
C_{IN}=Tantalum 1µF
C_{OUT}=Tantalum 6.8µF



TECHNICAL NOTES

When using these ICs, be sure to 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, be sure to use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance) in the range described as follows:



Measuring Circuit for white noise; R1121N301B

The relationship between I_{OUT} (output current) and ESR of output capacitor is shown in the graphs below. The conditions when the white noise level is under 40mV (Avg.) are indicated by the hatched area in the graph.

(note: When the 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 the same external components as the ones to be used on the PCB.)

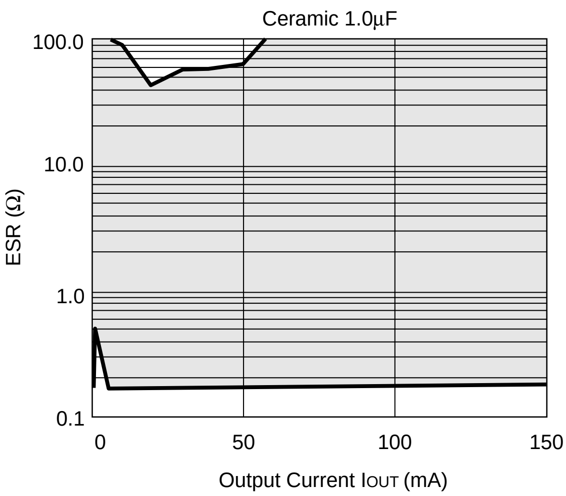
<Measurement conditions>

(1) V_{IN}=4V

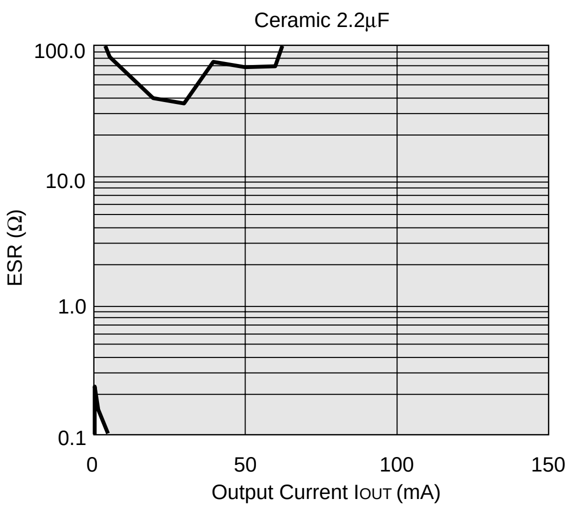
(2) Frequency Band: 10Hz to 1MHz

(3) Temperature: 25°C

R1121N301B



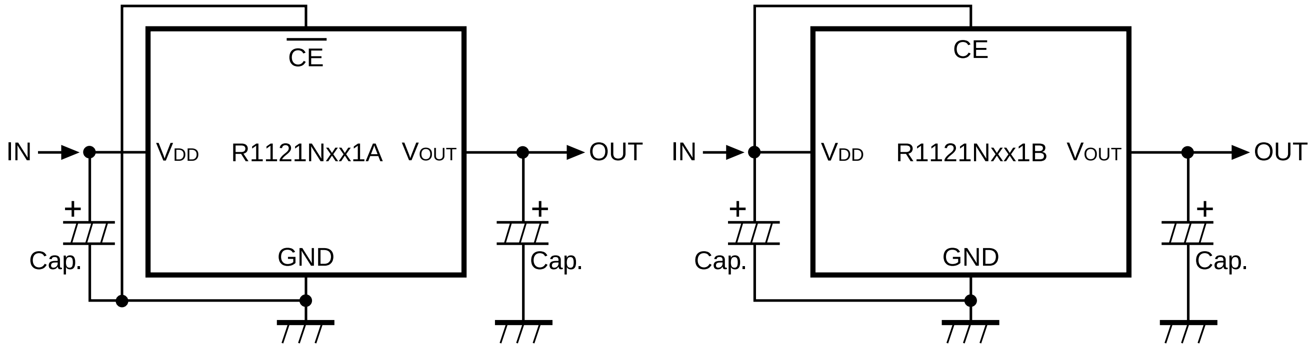
R1121N301B



RICOH

· Make V_{DD} and GND lines sufficient. If their impedance is high, noise pick up or incorrect operation may result.
· Connect the capacitor with a capacitance of 1μF or more between V_{DD} and GND as close as possible.
· Set external components, especially the output capacitor, as close as possible to the ICs and make wiring as short as possible.

TYPICAL APPLICATION



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