LOW NOISE 150mA LDO REGULATOR

R1112N SERIES

APPLICATION MANUAL

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R1112N SERIES

OUTLINE

The R1112N Series are voltage regulator ICs with high output voltage accuracy, extremely low supply current, low ON-resistance, and high ripple rejection by CMOS process. 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 R1112N 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 are SOT-23-5 (Mini-mold) package , high density mounting of the ICs on boards is possible.

FEATURES

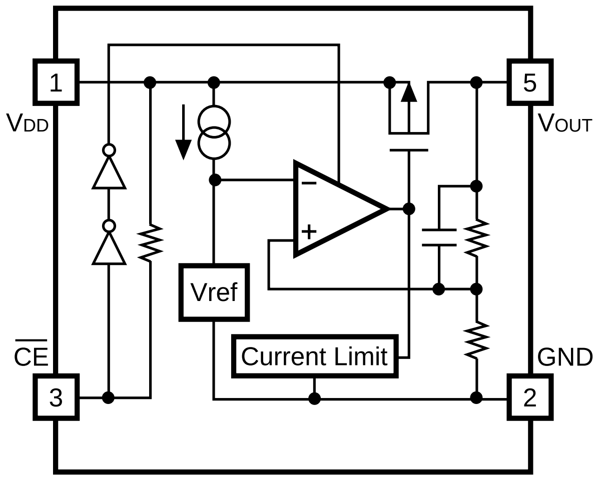
- Ultra-Low Supply Current .... TYP. 100µA
- Standby Mode Current.. TYP. 0.1µA
- Low Dropout Voltage .... TYP. 0.19V (I_{OUT}=100mA 3.0V Output type)
- High Ripple Rejection .... TYP. 80dB(f=1kHz)
- Low Temperature-Drift Coefficient of Output Voltage TYP. ±100ppm/°C
- Excellent Line Regulation.. TYP. 0.05%/V
- High Output Voltage Accuracy .... ±2.0%
- Excellent Dynamic Response
- Small Package .... SOT-23-5 (Mini-mold)
- Output Voltage... Stepwise setting with a step of 0.1V in the range of 1.5V to 5.0V is possible
- Built-in chip enable circuit (2 types; A: active low, B: active high)
- Pin-out... Similar to the LP2980/LP2985
- Built-in fold-back protection circuit.................................... TYP. 30mA (Current at short mode)
- Ceramic capacitors recommended to be used with this IC

APPLICATIONS

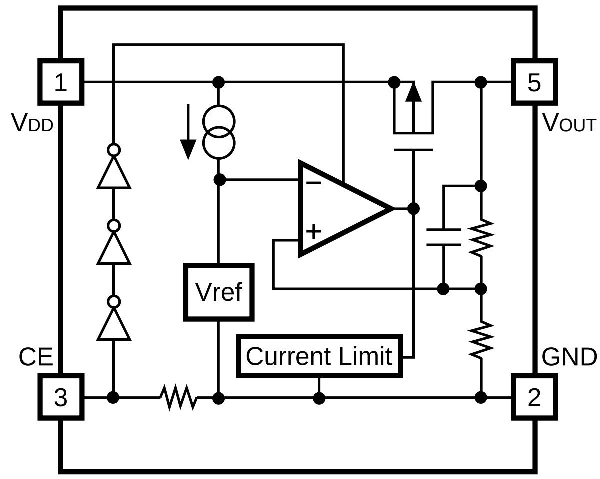
- Power source for cellular phones such as GSM, CDMA and various kind of PCSs.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAM

R1112NXX1A



R1112NXX1B



SELECTION GUIDE

The output voltage, the active type, the packing type, and the taping type for the ICs can be selected at the user's request. The selection can be made by designating the part number as shown below:

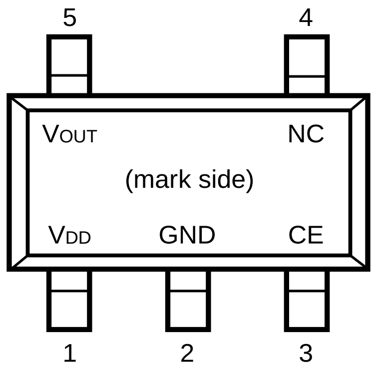
R1112XXX1X-XX ←Part Number
↑ ↑ ↑ ↑
a b c d

Code	Contents
a	Designation of Package Type: N: SOT-23-5 (Mini-mold)
b	Setting Output Voltage (V_{OUT}): Stepwise setting with a step of 0.1V in the range of 1.5V to 5.0V is possible.
c	Designation of Active Type: A: active low type B: active high type
d	Designation of Taping Type: Ex. TR, TL (refer to Taping Specifications; TR type is the standard direction.)

RICOH

PIN CONFIGURATION

SOT-23-5



PIN DESCRIPTION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	7.0	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	250	mW
Topt	Operating Temperature Range	-40 ~ 85	°C
Tstg	Storage Temperature Range	-55 ~ 125	°C

ELECTRICAL CHARACTERISTICS

- **R1112NXX1A**

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	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} ≤ 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		100	170	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} ≤ 8V I_{OUT} = 30mA		0.05	0.20	%/V
RR	Ripple Rejection	f = 1kHz, Ripple 0.5Vp-p V_{IN} = Set V_{OUT}+1V		80		dB
V_{IN}	Input Voltage		2.0		6.0	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA -40°C ≤ Topt ≤ 85°C		±100		ppm /°C
Ilim	Short Current Limit	V_{OUT} = 0V		30		mA
R_{PU}	$\overline{CE}$ Pull-up Resistance		2.5	5	10	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage “H”		1.5		V_{IN}	V
V_{CEL}	$\overline{CE}$ Input Voltage “L”		0		0.25	V
e_n	Output Noise	BW=10Hz to 100kHz		30		µVrms

- **R1112NXX1B**

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	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} ≤ 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		100	170	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} ≤ 8V I_{OUT} = 30mA		0.05	0.20	%/V
RR	Ripple Rejection	f = 1kHz, Ripple 0.5Vp-p V_{IN} = Set V_{OUT}+1V		80		dB
V_{IN}	Input Voltage		2.0		6.0	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA -40°C ≤ Top t ≤ 85°C		±100		ppm /°C
Ilim	Short Current Limit	V_{OUT} = 0V		30		mA
R_{PD}	CE Pull-down Resistance		2.5	5	10	MΩ
V_{CEH}	CE Input Voltage "H"		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"		0		0.25	V
e_n	Output Noise	BW=10Hz to 100kHz		30		µVrms

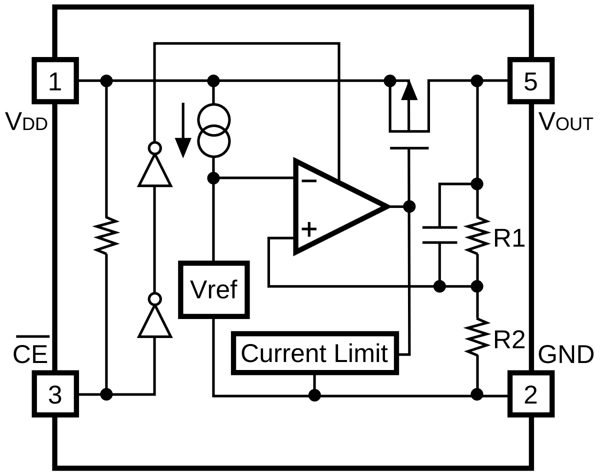
- **ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE**

Topt = 25°C

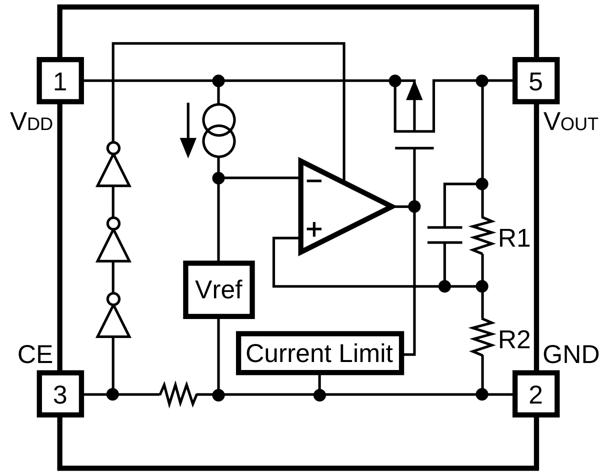
Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	TYP.	MAX.
1.5 ≤ V_{OUT} ≤ 1.6	I_{OUT} = 100mA	0.32	0.55
1.7 ≤ V_{OUT} ≤ 1.8		0.28	0.47
1.9 ≤ V_{OUT} ≤ 2.3		0.25	0.35
2.4 ≤ V_{OUT} ≤ 2.7		0.20	0.29
2.8 ≤ V_{OUT} ≤ 5.0		0.19	0.26

OPERATION

R1112NXX1A



R1112NXX1B



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 Error Amplifier, so that a constant voltage is output. A current limit circuit for protection at short mode and a chip enable circuit are included.

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, be sure to use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance). We use Ceramic Capacitors for evaluation of these ICs.

Recommended Capacitors; GRM40X5R225K6.3 (Murata)
GRM40-034X5R335K6.3 (Murata)
GRM40-034X5R475K6.3 (Murata)

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

PCB Layout

Make V_{DD} and GND line sufficient. When the impedance of these is high, it would be a cause of picking up the noise or unstable operation. Connect a capacitor with a capacitance value of 2.2µF or more between V_{DD} and GND pin as close as possible.

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

TEST CIRCUITS

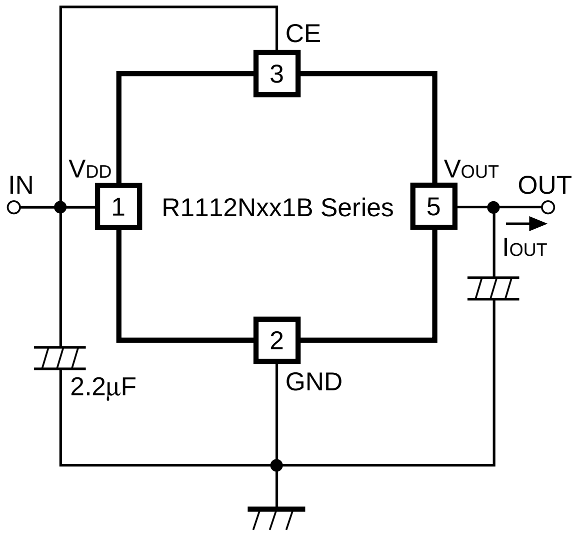


Fig.1 Standard test Circuit

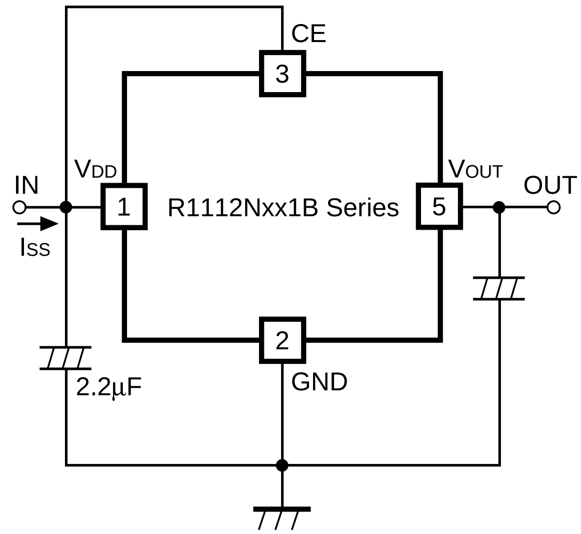


Fig.2 Supply Current Test Circuit

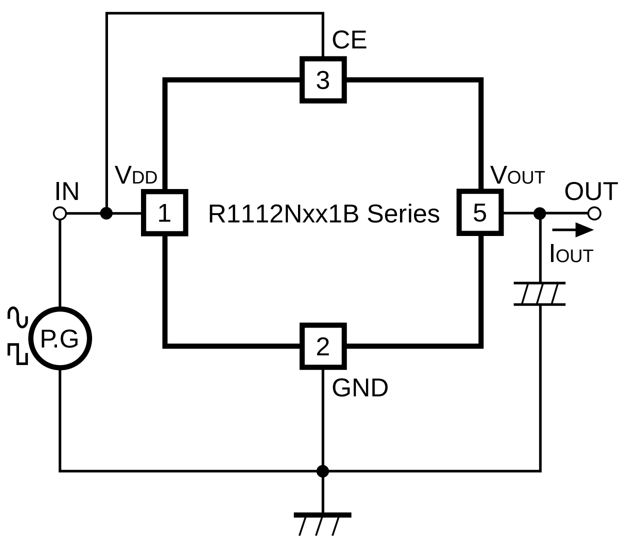


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

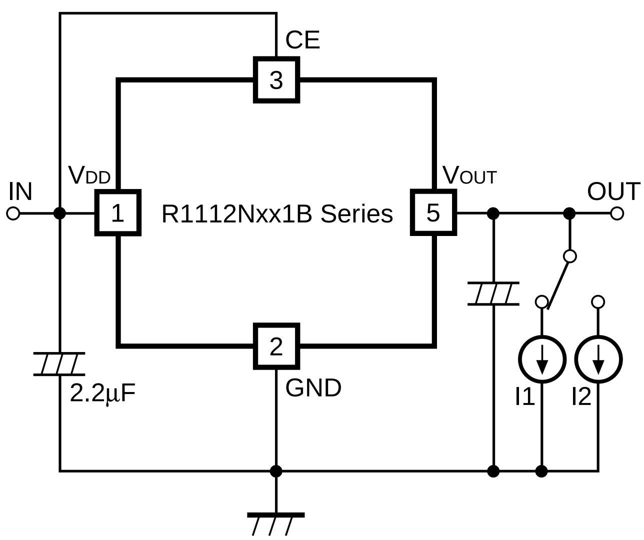
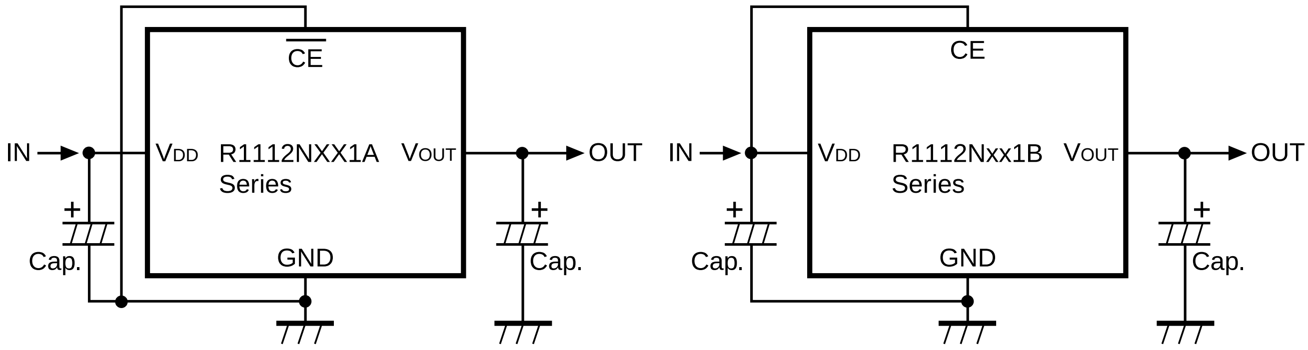


Fig.4 Load Transient Response Test Circuit

TYPICAL APPLICATION



(External Components)

Output Capacitor; Ceramic 2.2μF(Set Output Voltage in the range from 2.5 to 5.0V)

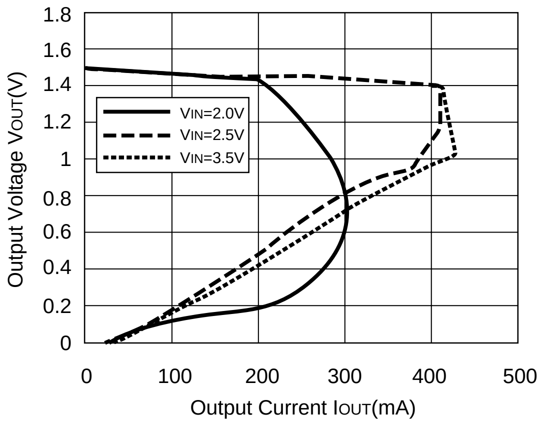
Ceramic 4.7μF (Set Output Voltage in the range from 1.5 to 2.5V)

Input Capacitor; Ceramic 2.2μF

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

R11x2N151B



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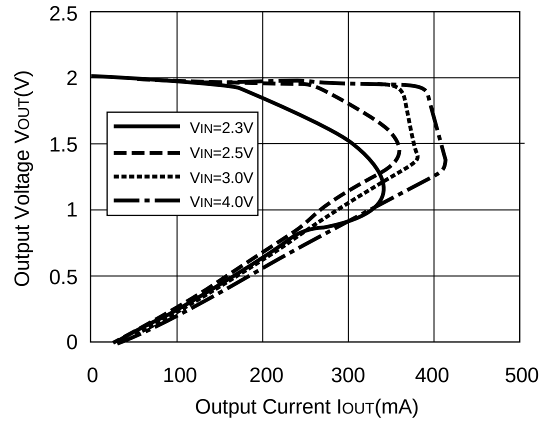
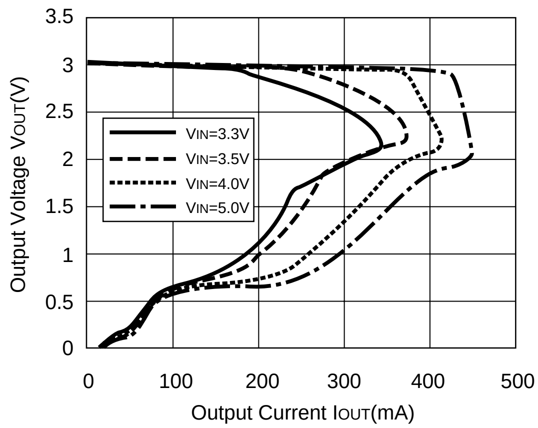


R11x2N301B



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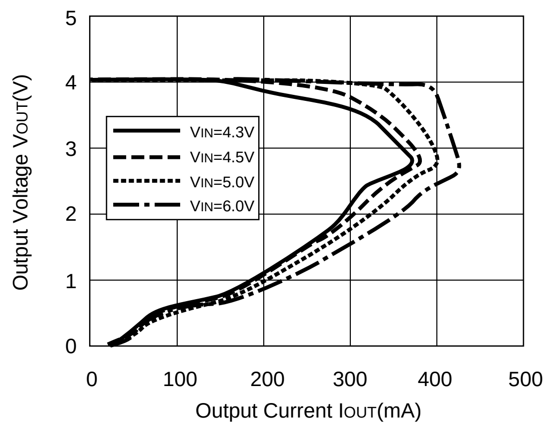

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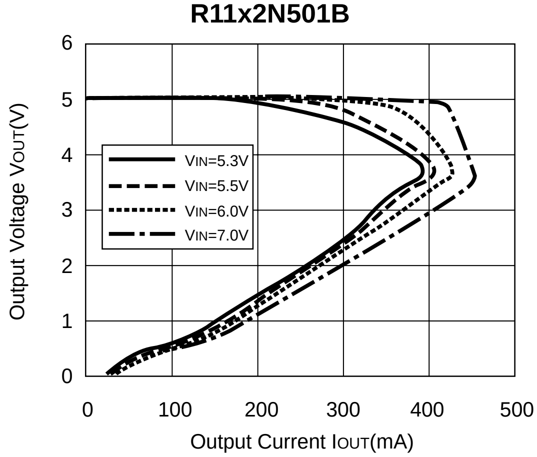
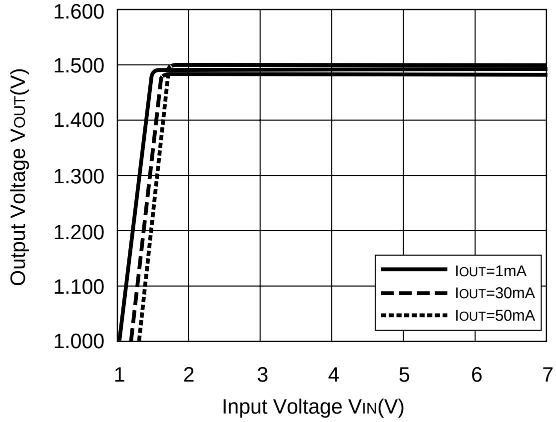


2) Output Voltage vs. Input Voltage

R11x2N151B



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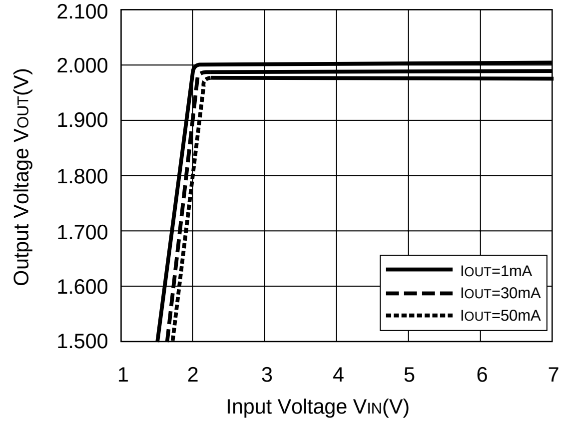

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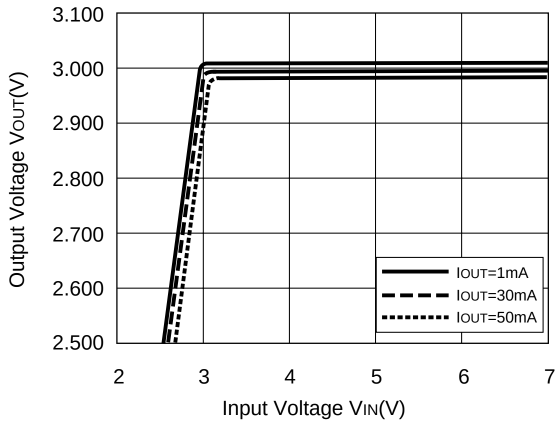

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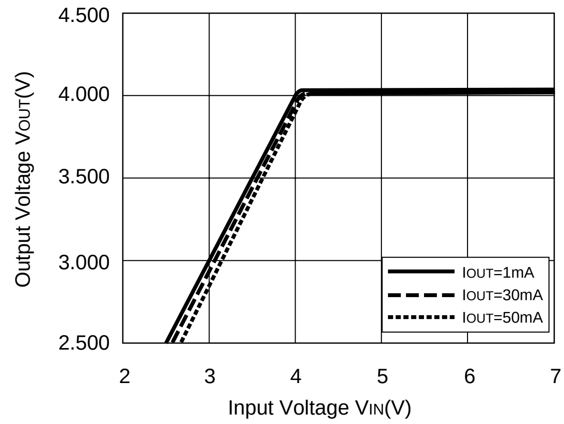

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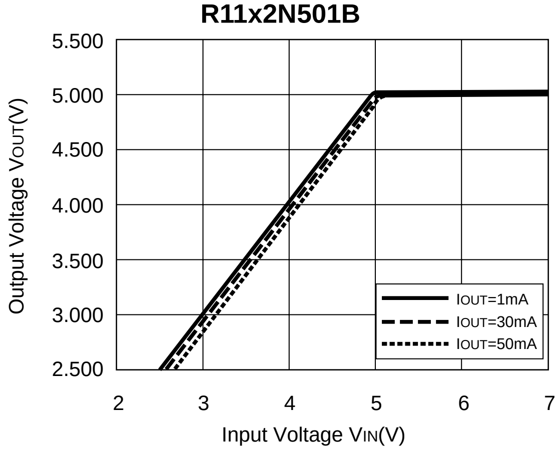
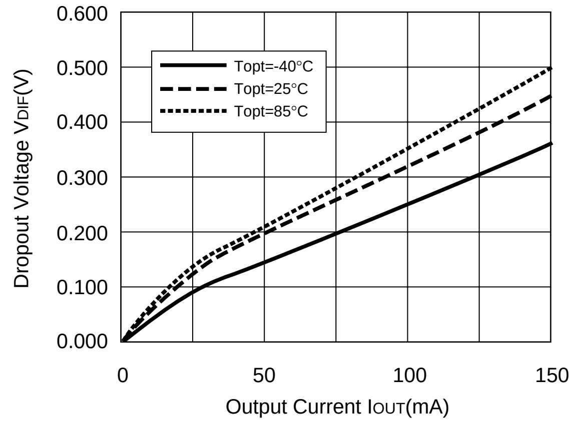


3) Dropout Voltage vs. Output Current

R11x2N151B



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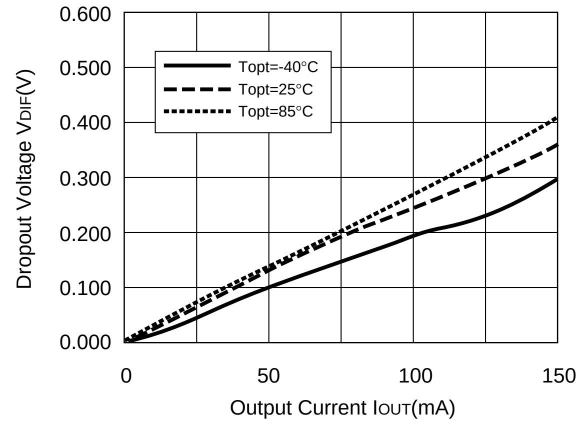

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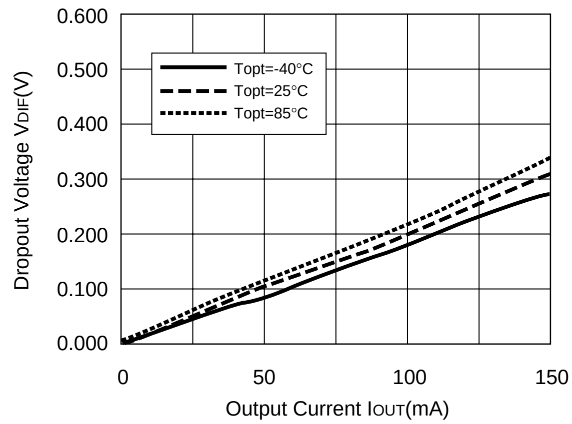

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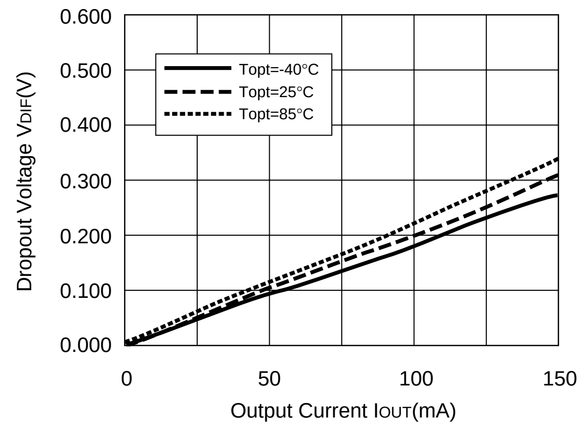

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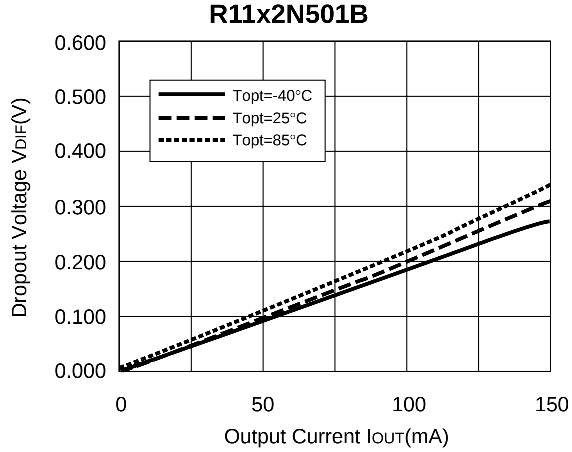
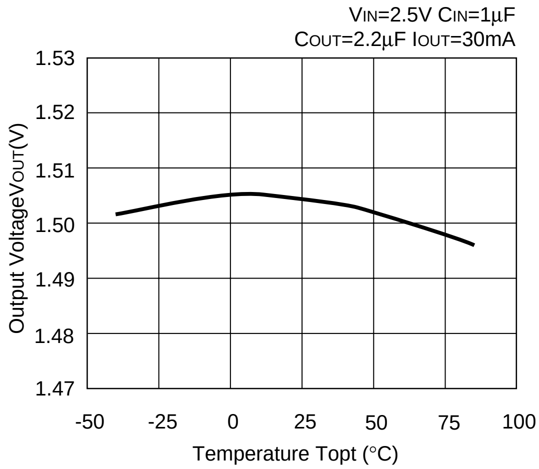


4) Output Voltage vs. Temperature

R11x2N151A/B



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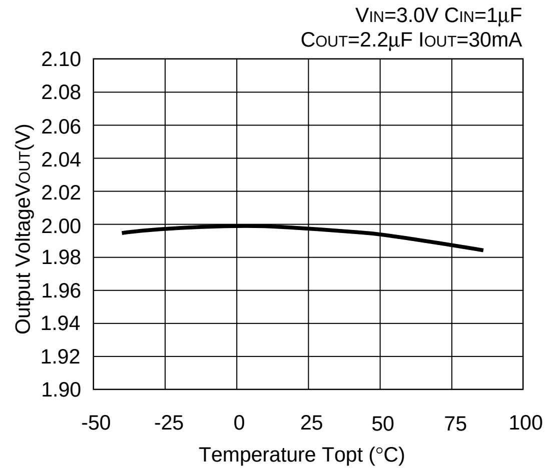

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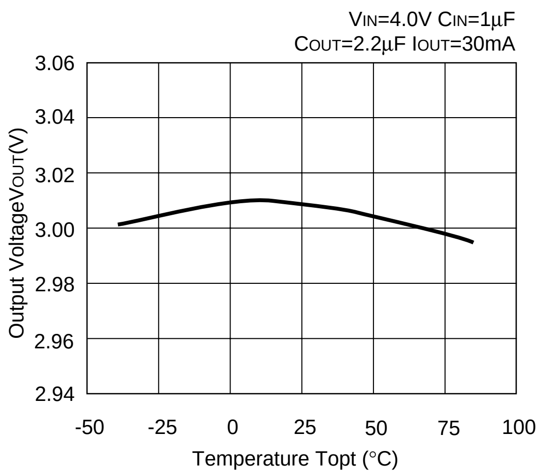

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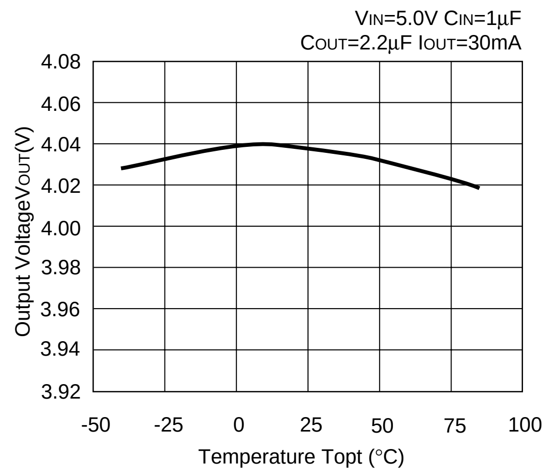

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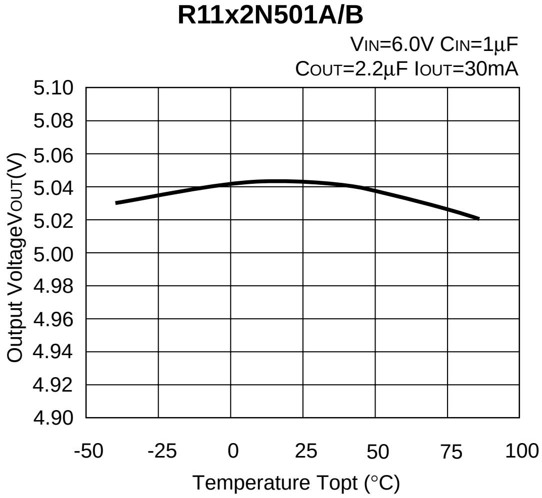
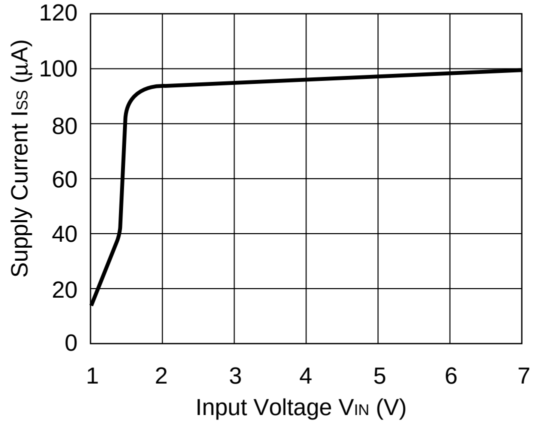


5) Supply Current vs. Input Voltage

R11x2N151B



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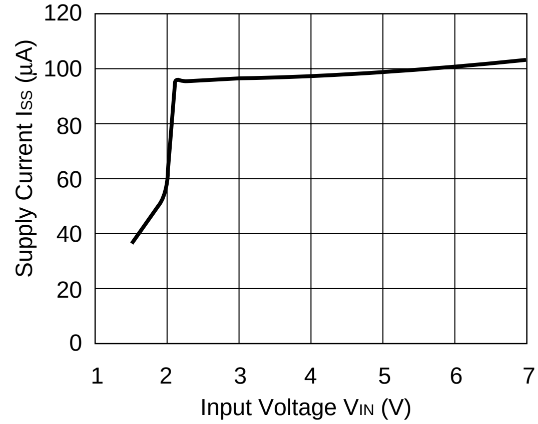

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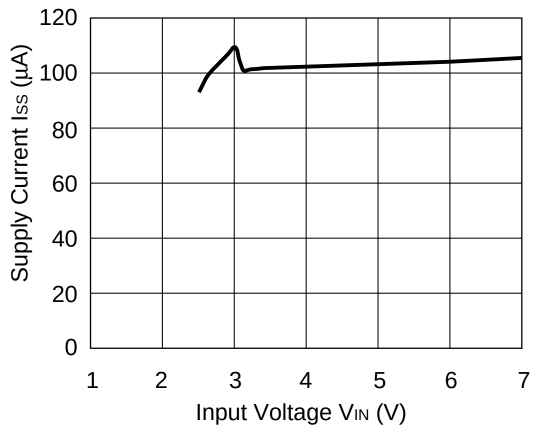

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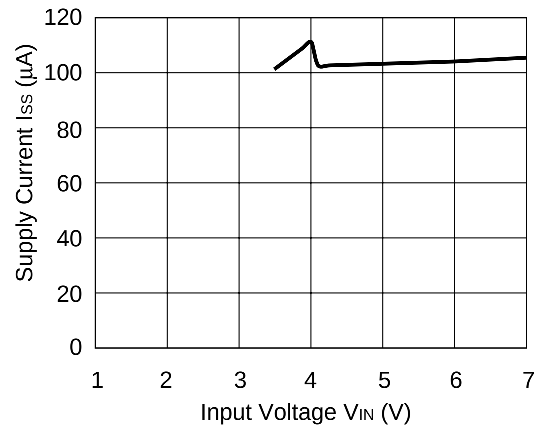

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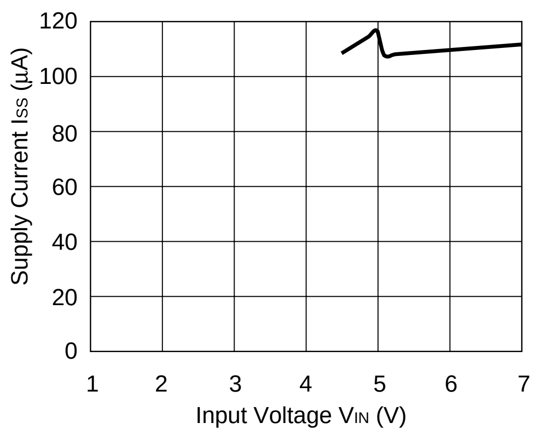
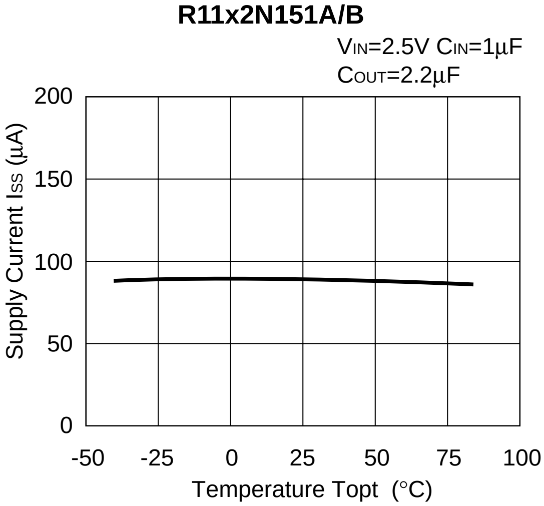
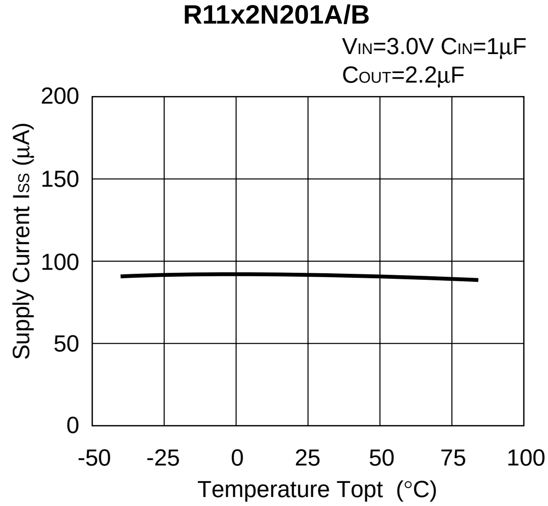
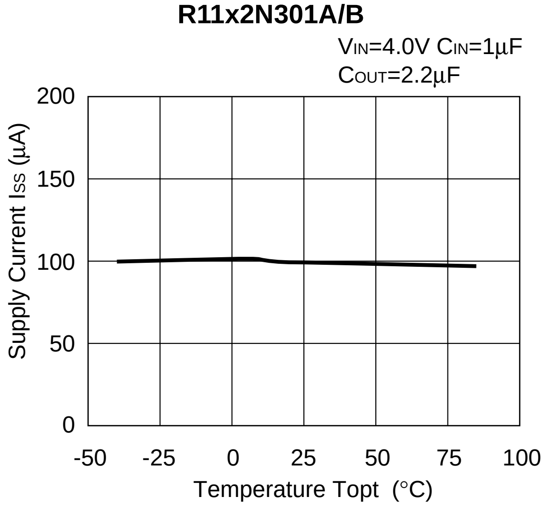
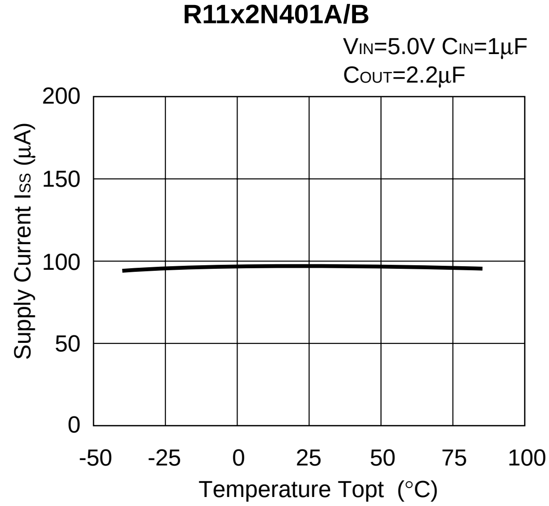


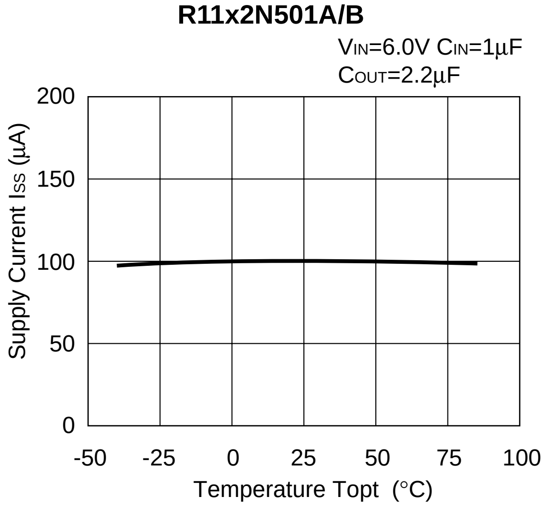
6) Supply Current vs. Temperature







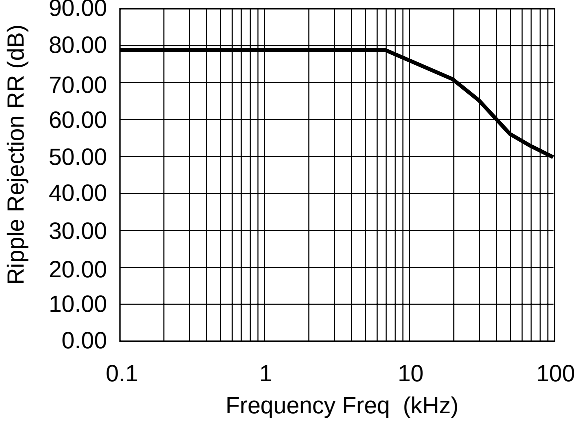




7) Ripple Rejection vs. Frequency

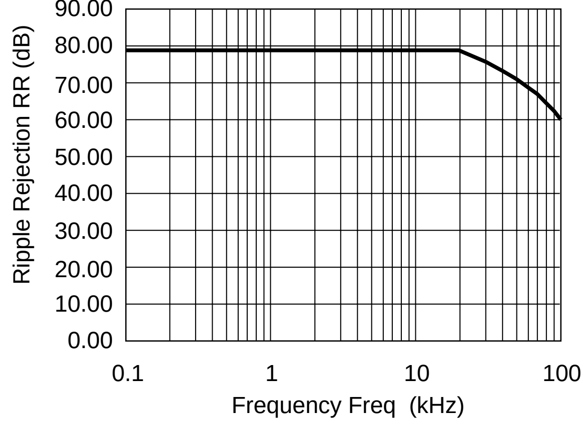
R11x2N151A/B

V_{IN}=2.5V+0.5Vp-p
C_{OUT}=2.2µF I_{OUT}=30mA



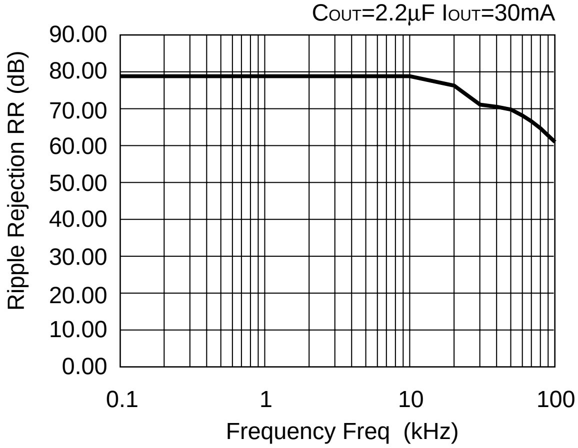
R11x2N201A/B

V_{IN}=3.0V+0.5Vp-p
C_{OUT}=2.2µF I_{OUT}=30mA



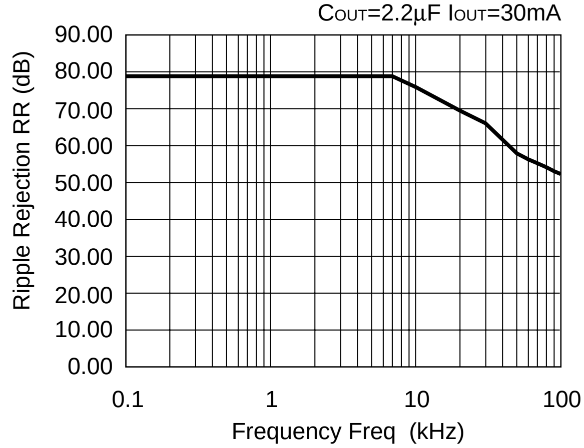
R11x2N301A/B

V_{IN}=4.0V+0.5Vp-p
C_{OUT}=2.2µF I_{OUT}=30mA



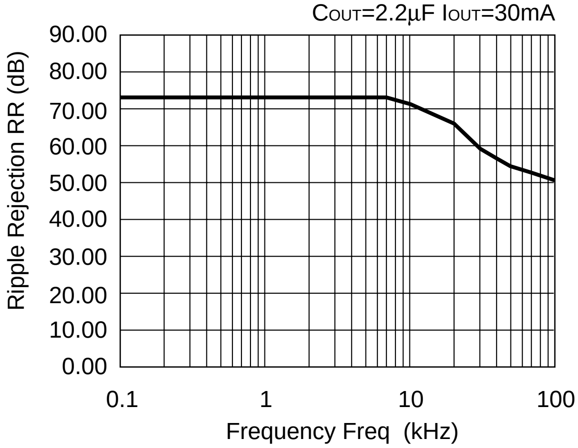
R11x2N401A/B

V_{IN}=5.0V+0.5Vp-p
C_{OUT}=2.2µF I_{OUT}=30mA



R11x2N501A/B

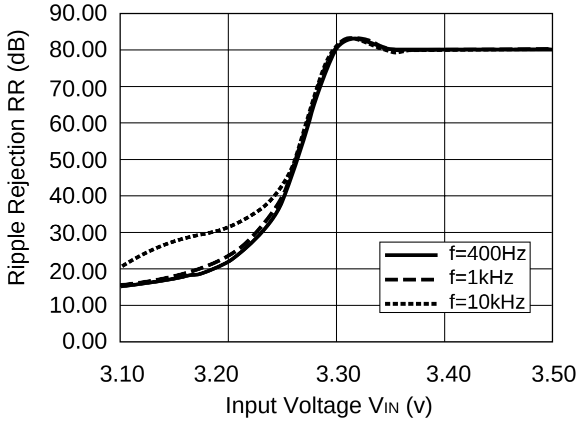
V_{IN}=6.0V+0.5Vp-p
C_{OUT}=2.2µF I_{OUT}=30mA



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

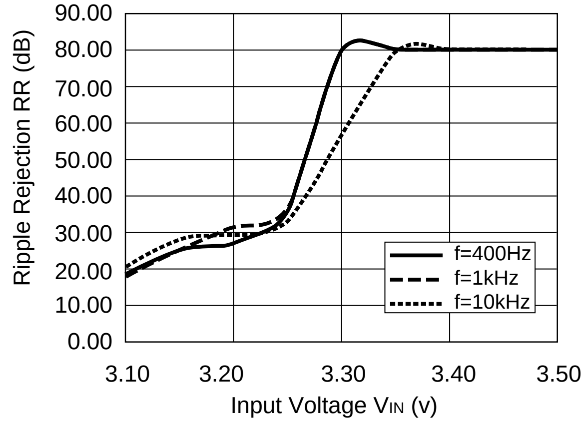
R11x2N301B

C_{OUT}=Ceramic 2.2µF
I_{OUT}=1mA



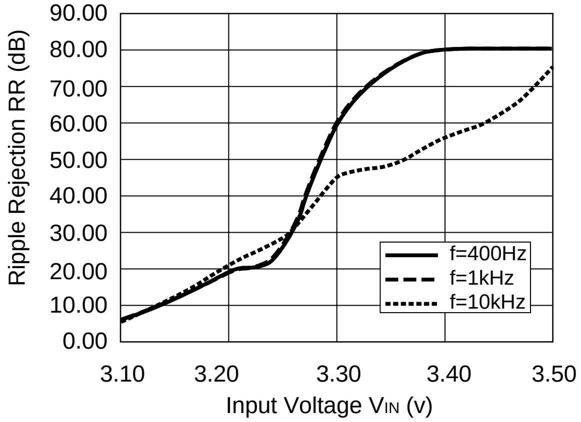
R11x2N301B

C_{OUT}=Ceramic 2.2µF
I_{OUT}=10mA



R11x2N301B

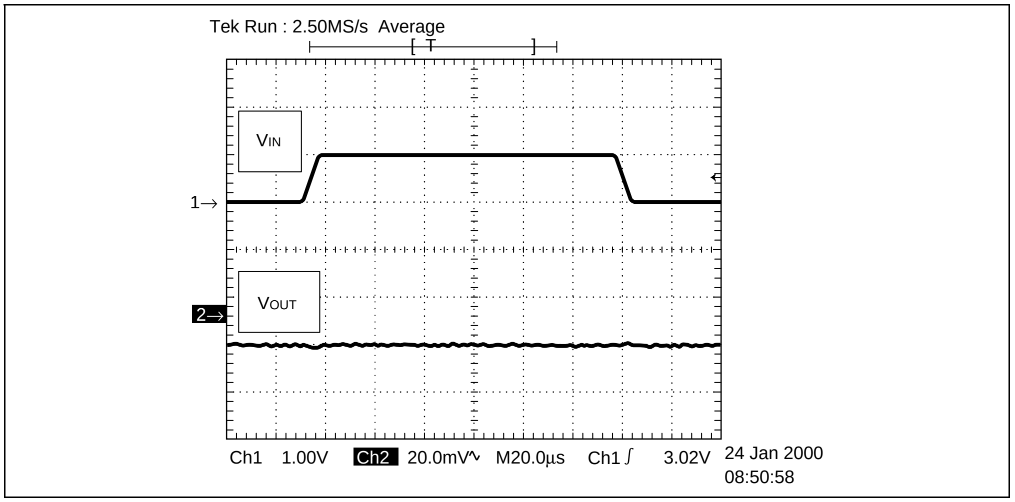
C_{OUT}=Ceramic 2.2µF
I_{OUT}=50mA



9) Input Transient Response

R11X2N151B

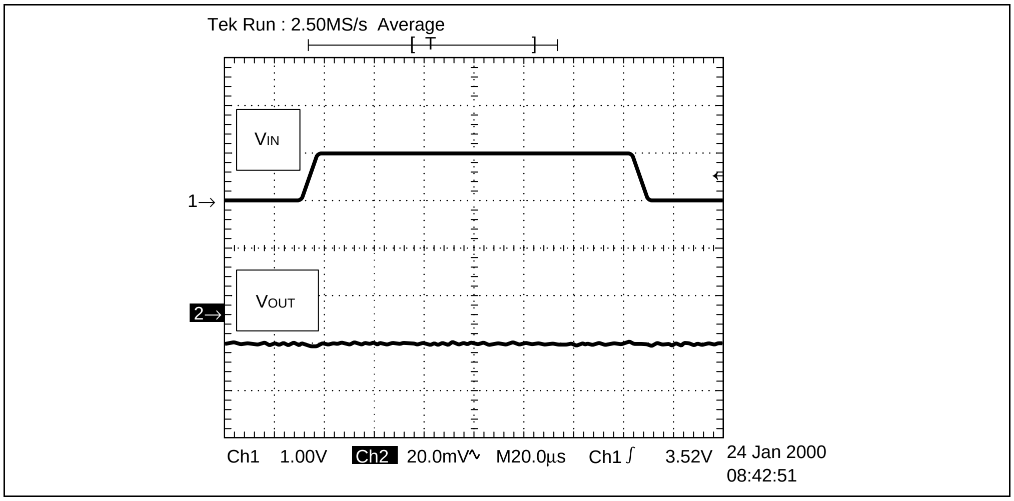
Topt=25°C



V_{IN}=2.5V↔3.5V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N201B

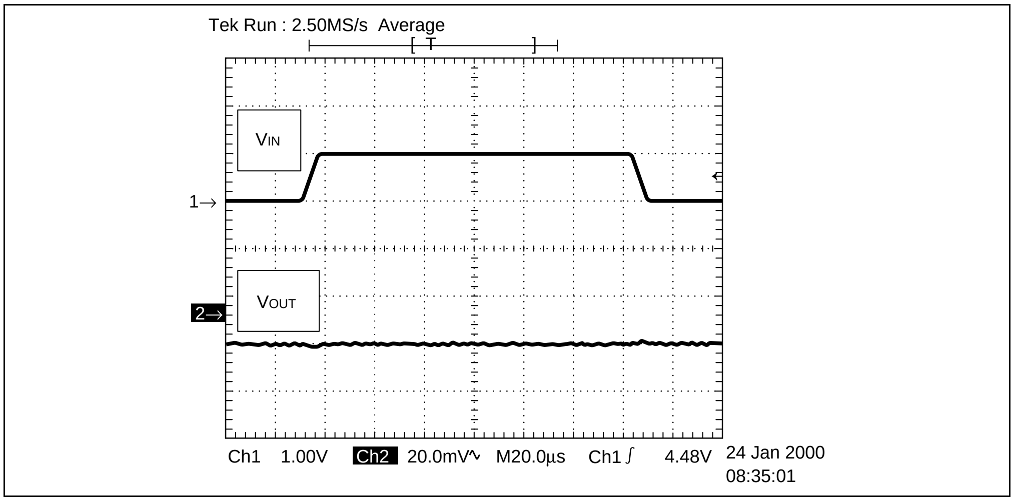
Topt=25°C



V_{IN}=3.0V↔4.0V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N301B

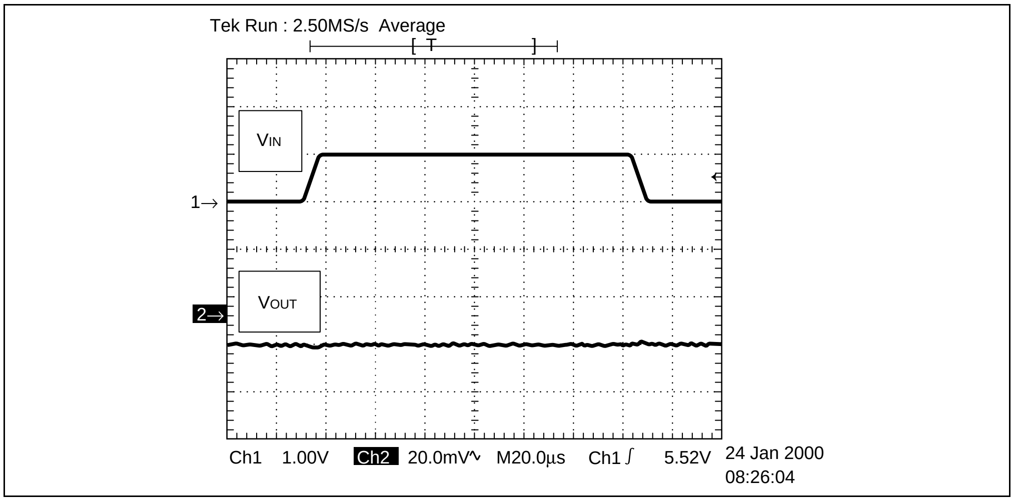
Topt=25°C



V_{IN}=4.0V↔5.0V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N401B

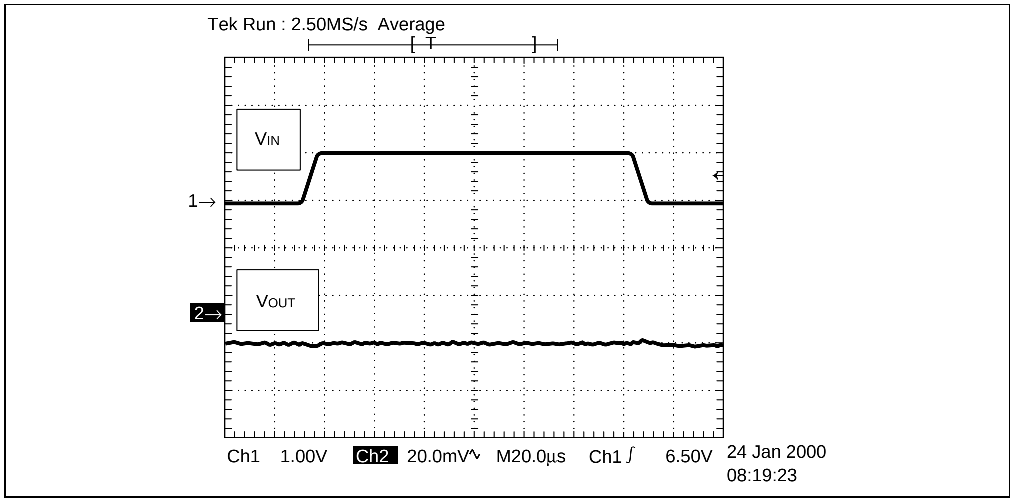
Topt=25°C



V_{IN}=5.0V↔6.0V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N501B

Topt=25°C

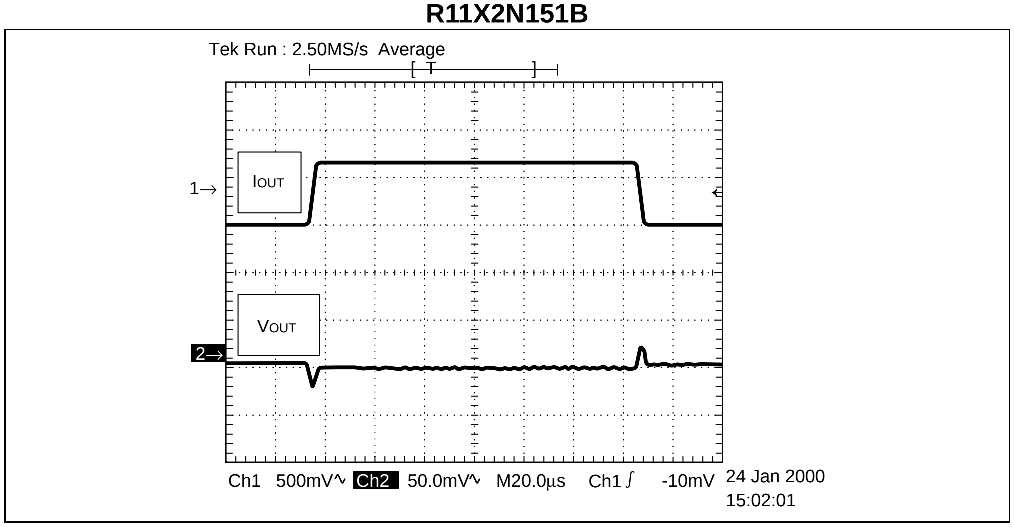


V_{IN}=6.0V↔7.0V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2µF
tr/tf=5µs

10) Load Transient Response

R11X2N151B

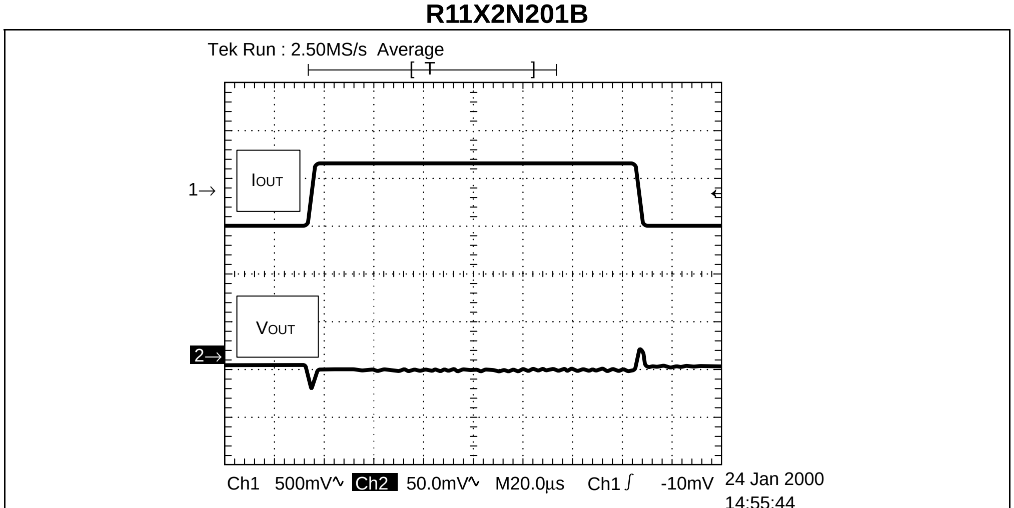
Topt=25°C



I_{OUT}=50mA↔100mA
V_{IN}=2.5V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N201B

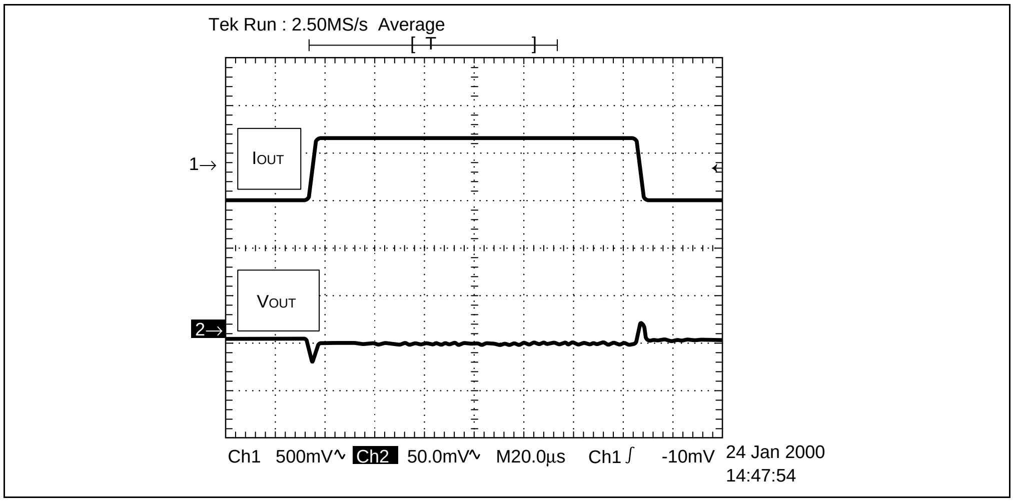
Topt=25°C



I_{OUT}=50mA↔100mA
V_{IN}=3.0V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N301B

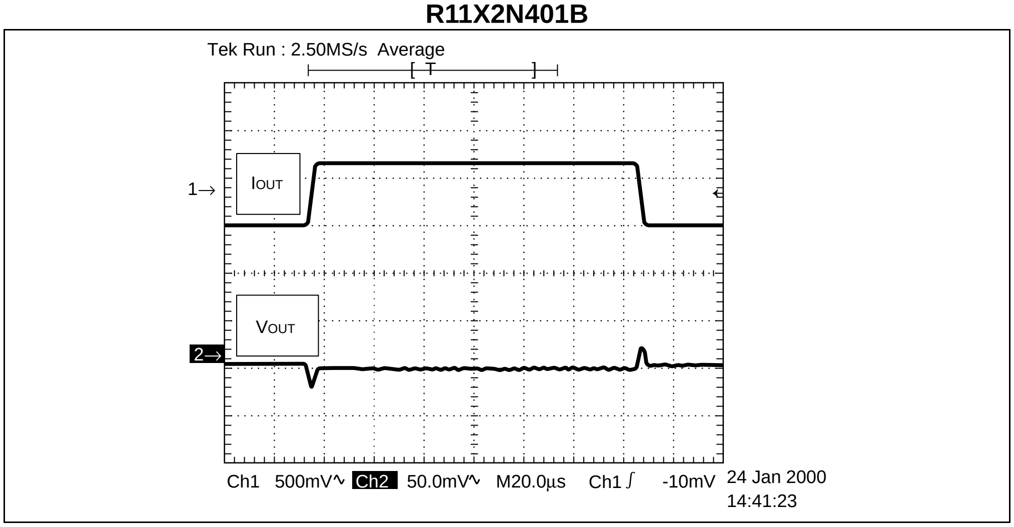
Topt=25°C



I_{OUT}=50mA↔100mA
V_{IN}=4.0V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N401B

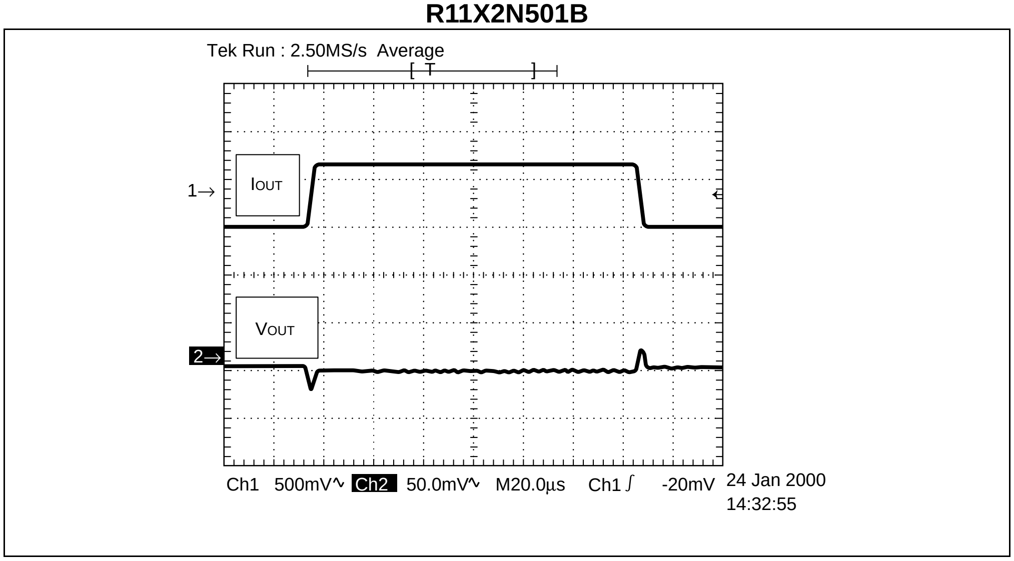
Topt=25°C



I_{OUT}=50mA↔100mA
V_{IN}=5.0V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

R11X2N501B

Topt=25°C

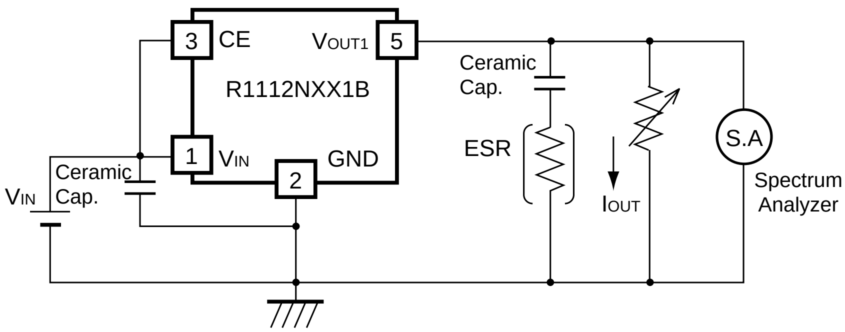


I_{OUT}=50mA↔100mA
V_{IN}=6.0V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

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, be sure to 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; R1112NXX1B

The relations between I_{OUT} (Output Current) and ESR of 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: 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 same external components as ones to be used on the PCB.)

<measuring conditions>

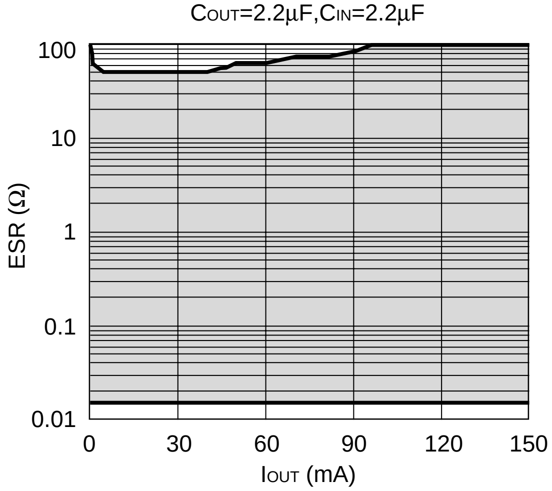
(1) $V_{IN}=V_{OUT}+1V$

(2) Frequency band: 10Hz to 1MHz

(3) Temperature: 25°C

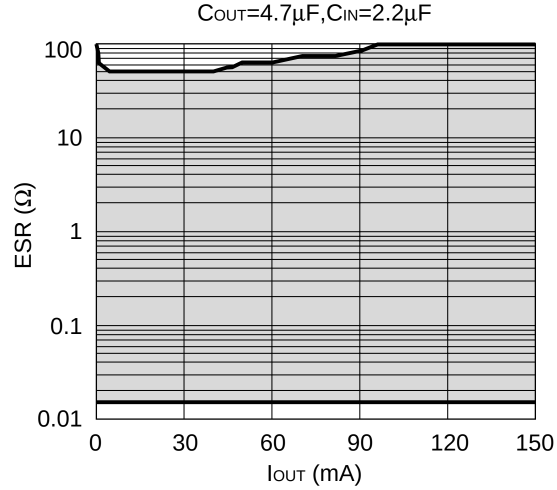
R11X2N151B

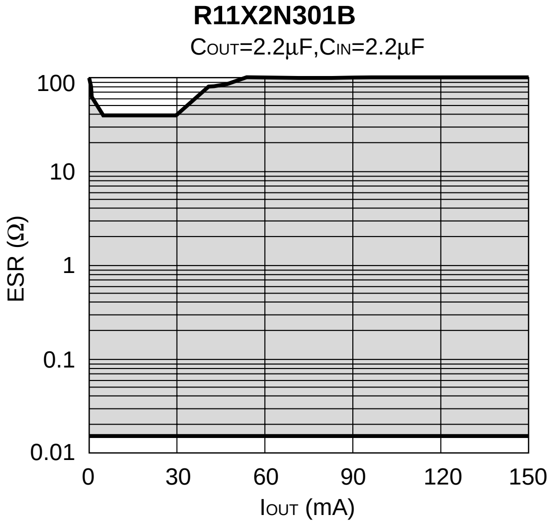
C_{OUT}=2.2µF,C_{IN}=2.2µF

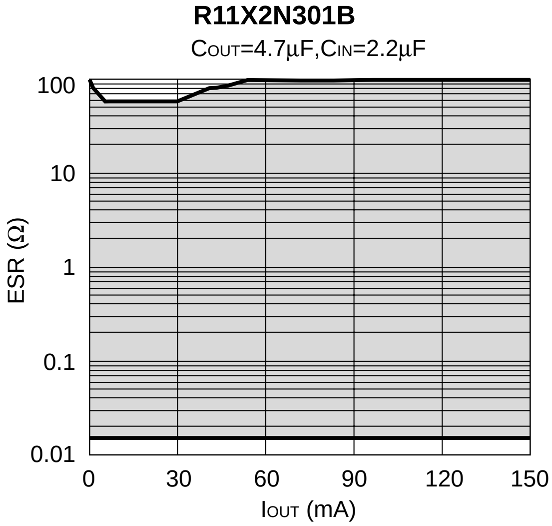


R11X2N151B

C_{OUT}=4.7µF,C_{IN}=2.2µF







- Make V_{DD} and GND line sufficient. When the impedance of these is high, the noise might be picked up or not work correctly.
- Connect the capacitor with a capacitance of 2.2µF or more between V_{DD} and GND as close as possible.
- Set external components, especially Output Capacitor, as close as possible to the ICs and make wiring shortest.