RICOH

R1112N SERIES

LOW NOISE 150mA LDO REGULATOR

NO.EA-059-130409

OUTLINE

The R1112N 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 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 is SOT-23-5 (Mini-mold) package, high density mounting of the ICs on boards is possible.

FEATURES

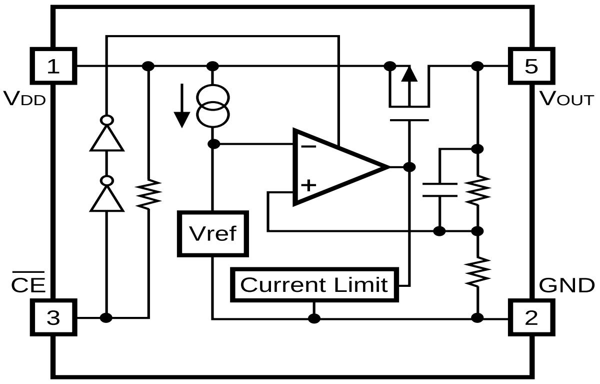
- Supply Current .... Typ. 100μA
- Standby Current .... Typ. 0.1μA
- Dropout Voltage .... Typ. 0.19V (I_{OUT}=100mA 3.0V Output type)
- Ripple Rejection .... Typ. 80dB(f=1kHz)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.05%/V
- Output Voltage Accuracy .... ±2.0%
- Excellent Dynamic Response
- Package .... SOT-23-5(Mini-mold)
- Output Voltage .... 1.5V to 5.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- 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

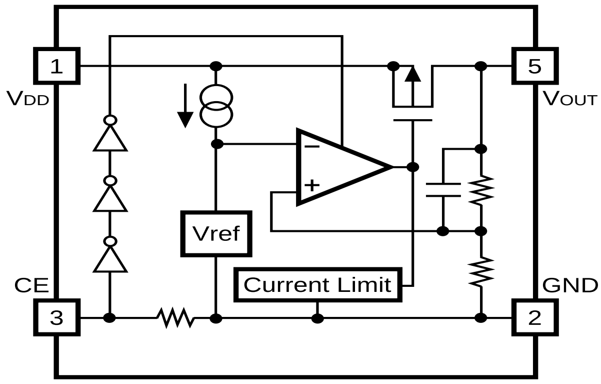
- Power source for cellular phones such as GSM, CDMA and various kinds of PCSs.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAM

R1112Nxx1A



R1112Nxx1B



SELECTION GUIDE

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

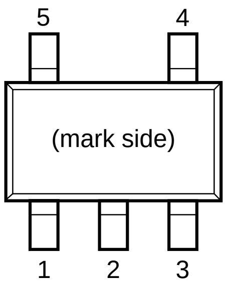
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1112Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

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 type
(B) "H" active type

PIN CONFIGURATION

SOT-23-5



PIN DESCRIPTION

Pin No	Symbol	Pin 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 to V_{IN}+0.3	V
V_{OUT}	Output Voltage	-0.3 to V_{IN}+0.3	V
I_{OUT}	Output Current	200	mA
P_D	Power Dissipation	250	mW
T_{opt}	Operating Temperature Range	-40 to 85	°C
T_{stg}	Storage Temperature Range	-55 to 125	°C

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

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.
The functional operation at or over these absolute maximum ratings is not assured.

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}− Set 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} ≤ 6.0V 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				6.0	V
$\Delta V_{OUT}/$ ΔT_{opt}	Output Voltage Temperature Coefficient	I_{OUT} = 30mA −40°C ≤ Topt ≤ 85°C		±100		ppm/°C
I_{SC}	Short Current Limit	V_{OUT} = 0V		30		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		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.

- **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}− Set 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} ≤ 6.0V 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				6.0	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA −40°C ≤ Topt ≤ 85°C		±100		ppm/°C
I_{SC}	Short Current Limit	V_{OUT} = 0V		30		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		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.

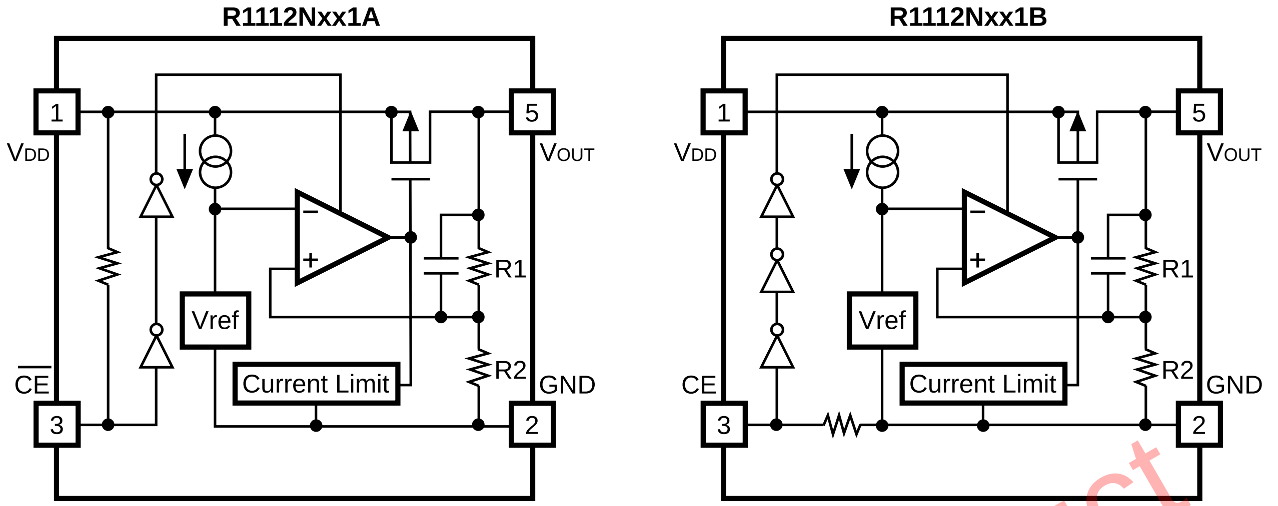
ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

Output Voltage V_{OUT} (V)	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

∗) The products of the Set Vout ≤ 1.8V, the operation may become unstable in case of V_{IN} ≤ 2.0V, so please use the products on condition that V_{IN} ≥ 2.0V.

OPERATION



In these ICs, fluctuation of the 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.

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 lines sufficient. If their impedance is high, picking up the noise or unstable operation may result. 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 as short as possible.

TEST CIRCUITS

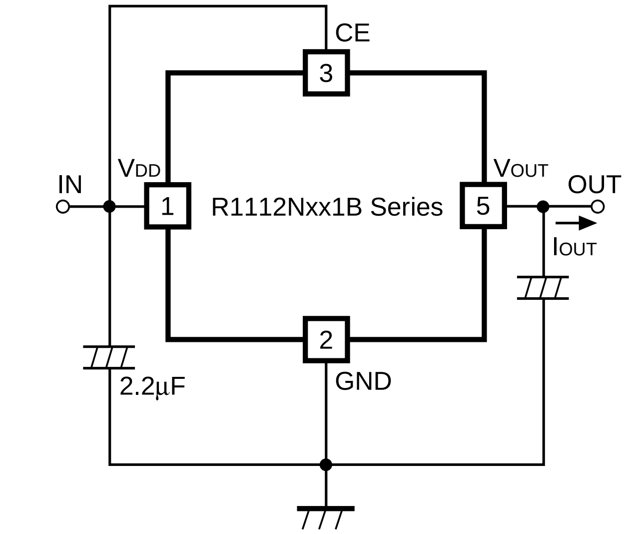


Fig.1 Standard test Circuit

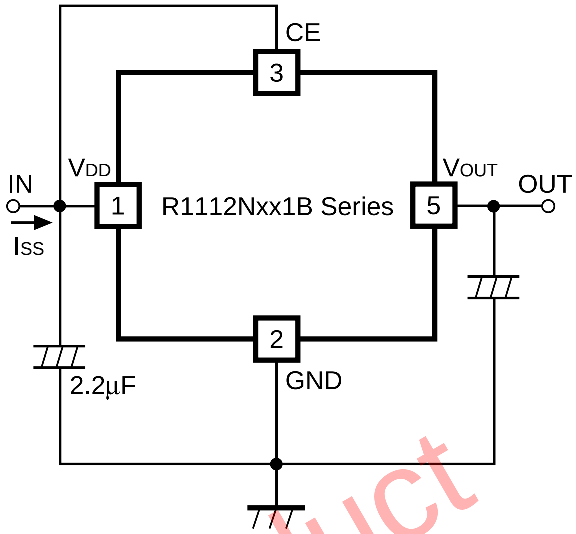


Fig.2 Supply Current Test Circuit

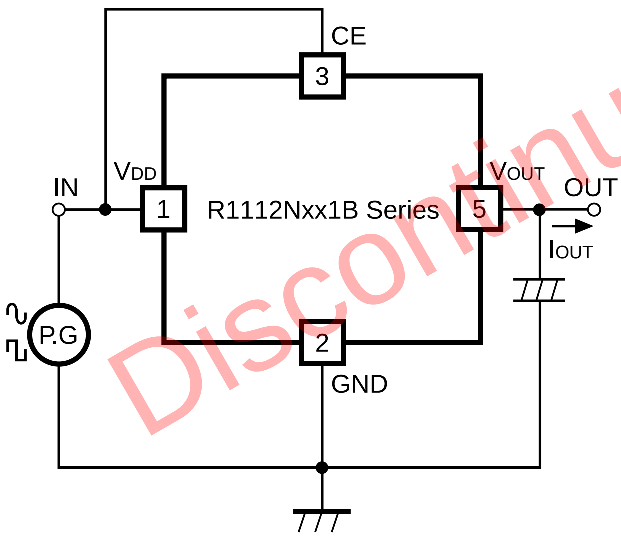


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

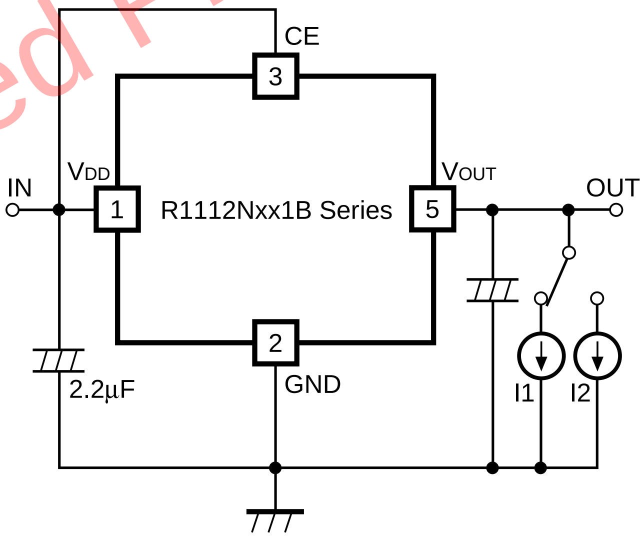
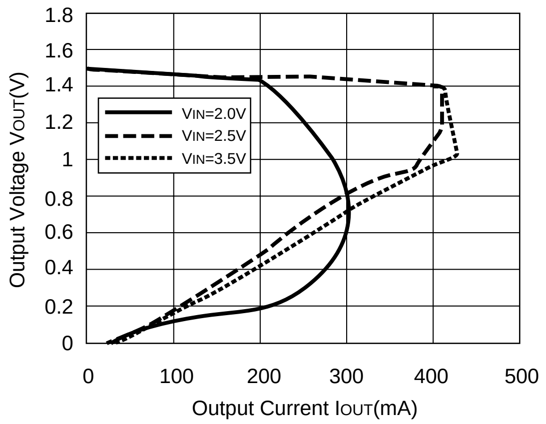


Fig.4 Load Transient Response Test Circuit

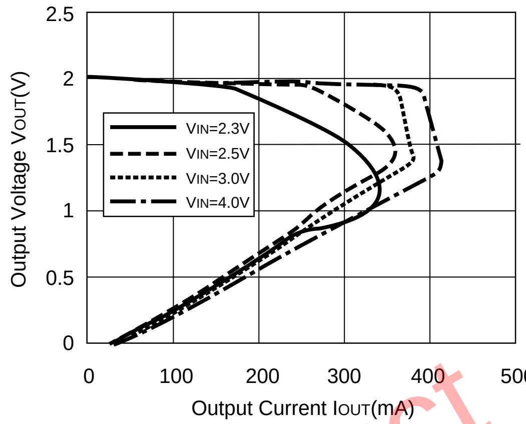
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

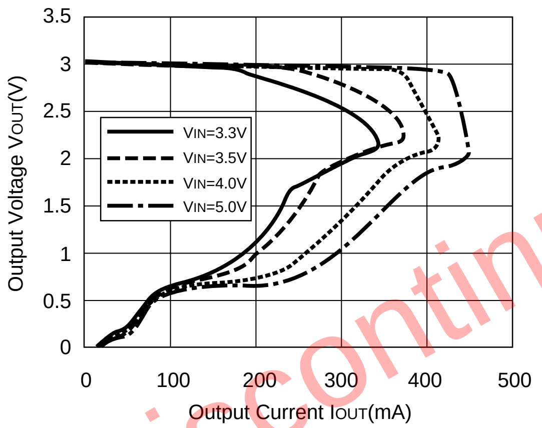
R1112N151B



R1112N201B



R1112N301B



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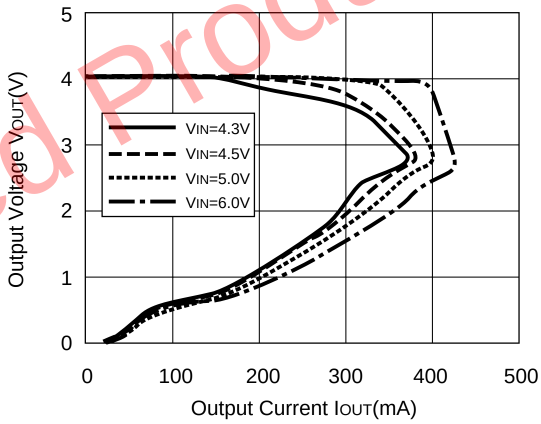

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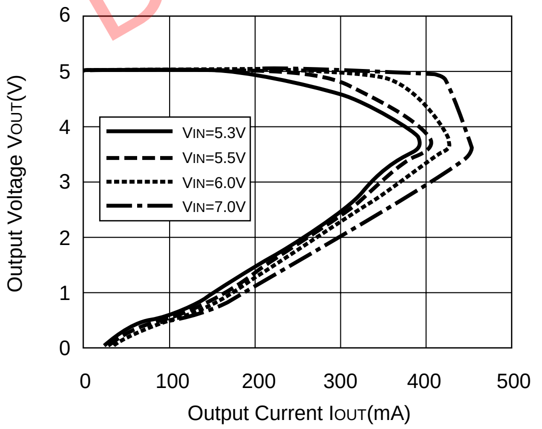

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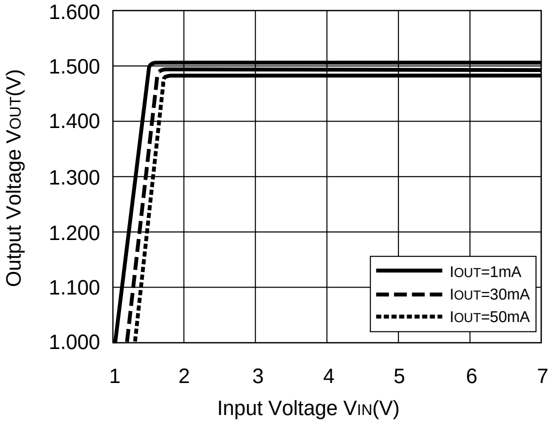
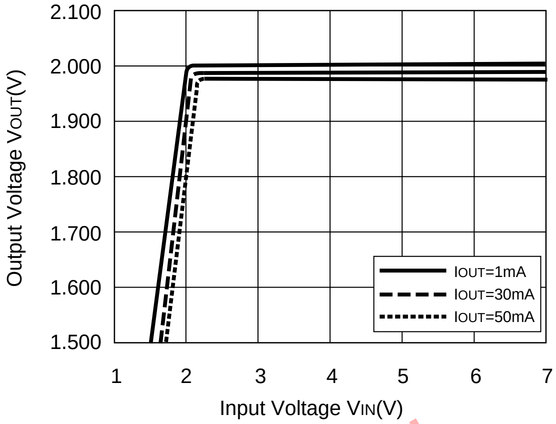
2) Output Voltage vs. Input Voltage

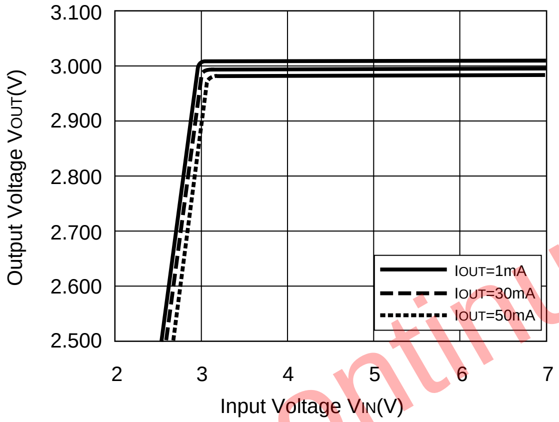
R1112N151B



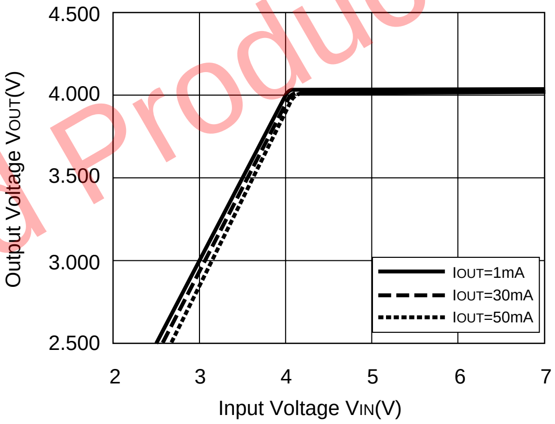
R1112N201B



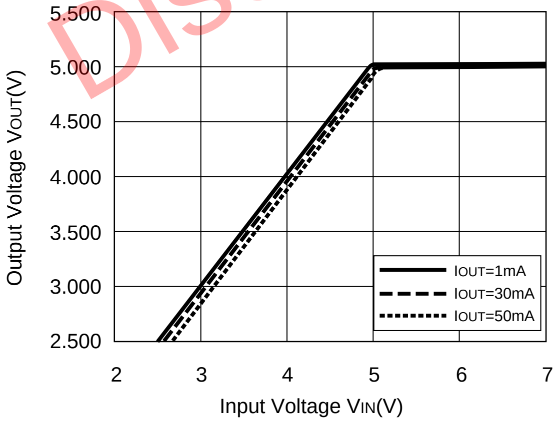
R1112N301B



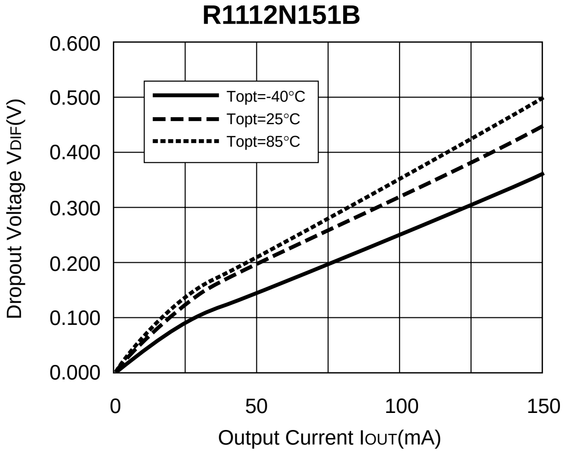
R1112N401B

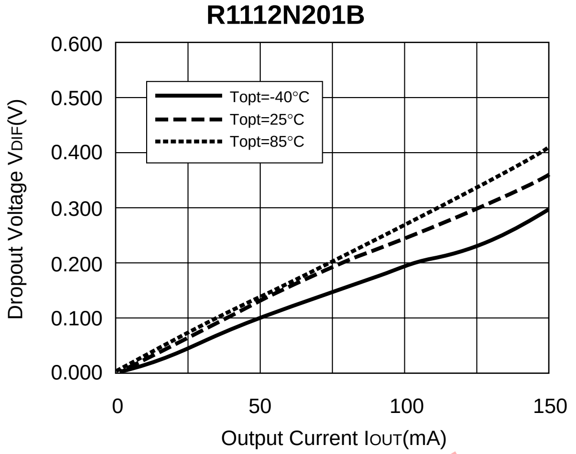


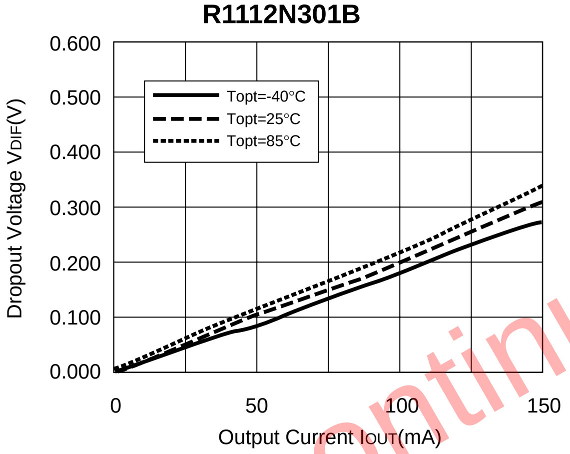
R1112N501B

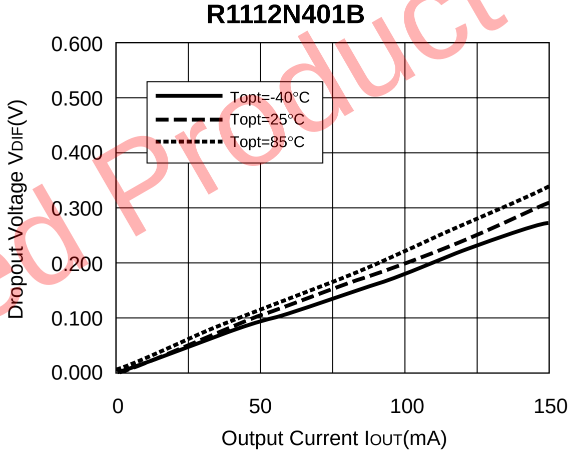


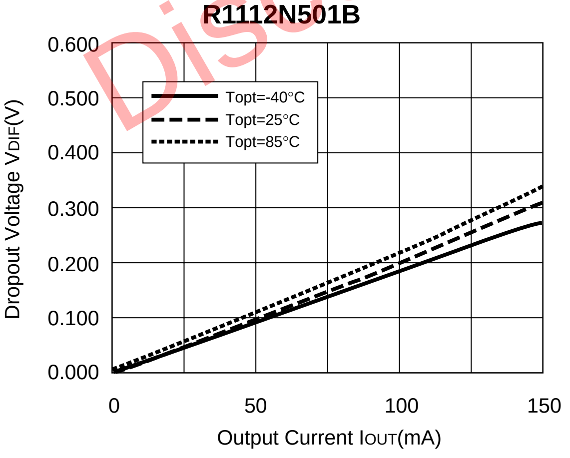
3) Dropout Voltage vs. Output Current







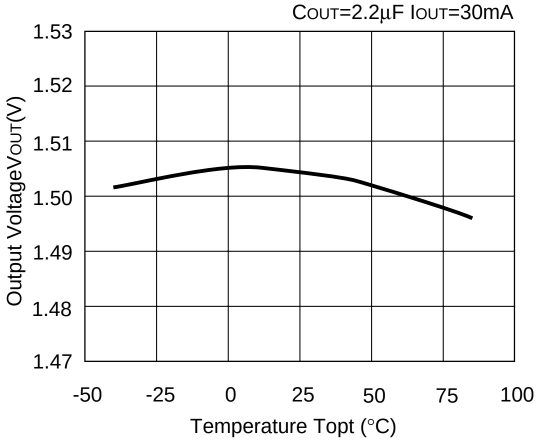




4) Output Voltage vs. Temperature

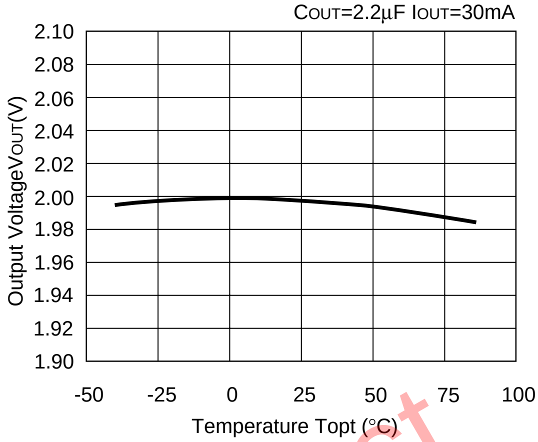
R1112N151A/B

VIN=2.5V CIN=1µF
COUT=2.2µF IOUT=30mA



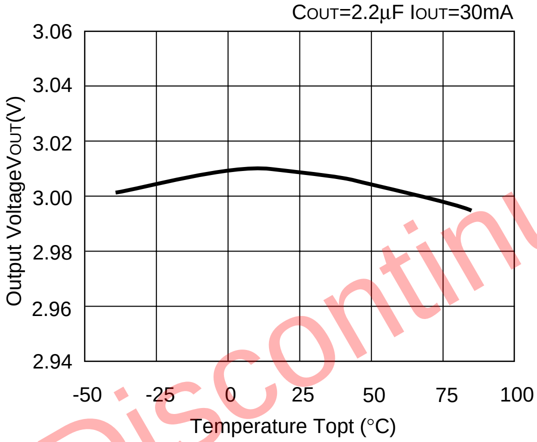
R1112N201A/B

VIN=3.0V CIN=1µF
COUT=2.2µF IOUT=30mA



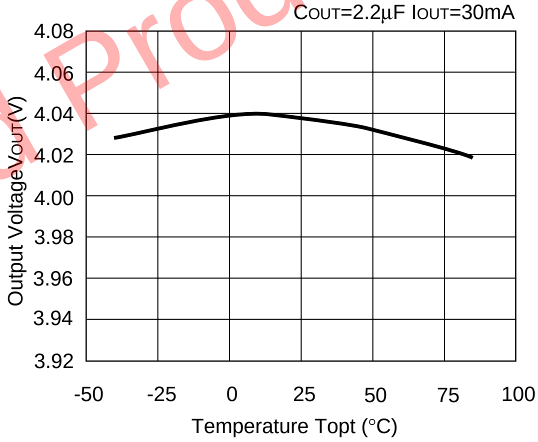
R1112N301A/B

VIN=4.0V CIN=1µF
COUT=2.2µF IOUT=30mA



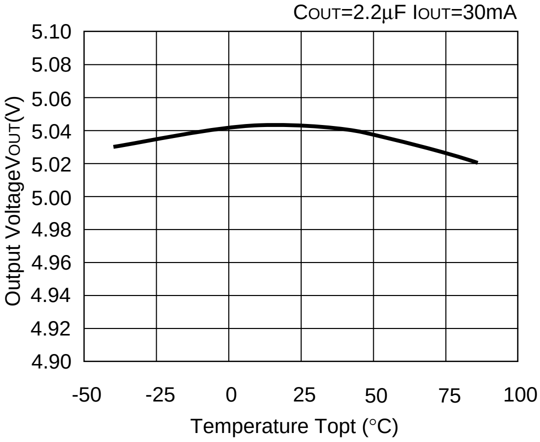
R1112N401A/B

VIN=5.0V CIN=1µF
COUT=2.2µF IOUT=30mA

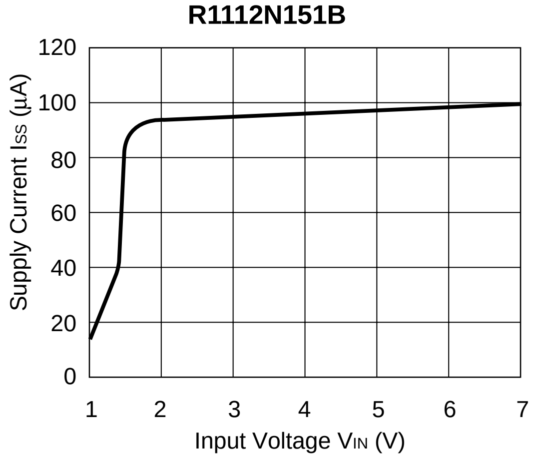


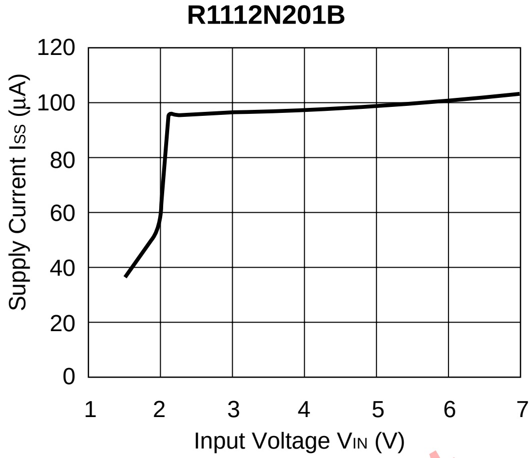
R1112N501A/B

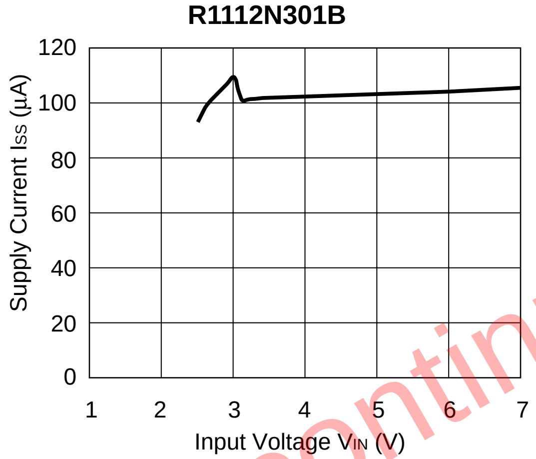
VIN=6.0V CIN=1µF
COUT=2.2µF IOUT=30mA

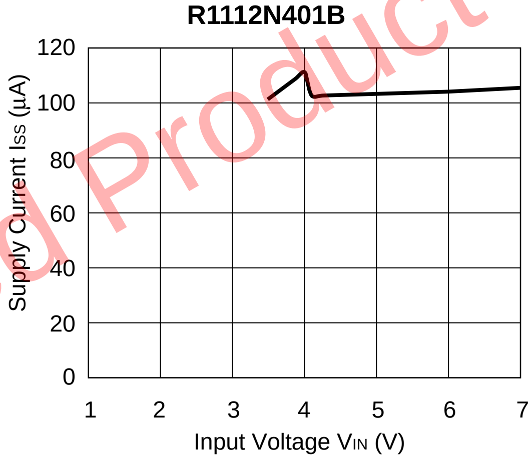


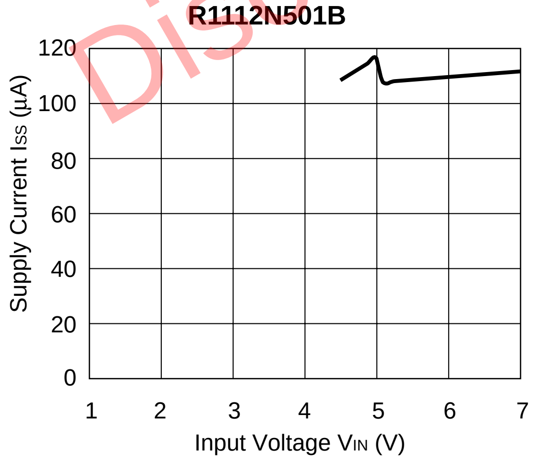
5) Supply Current vs. Input Voltage







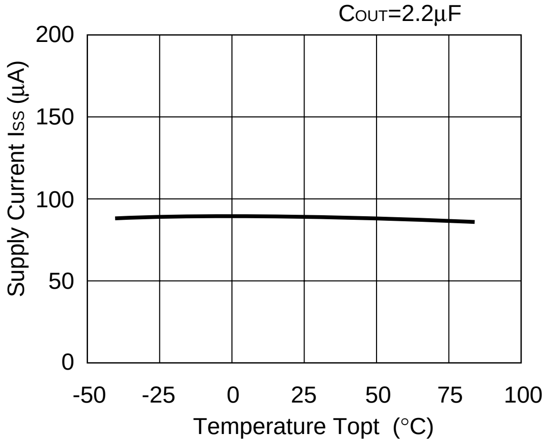




6) Supply Current vs. Temperature

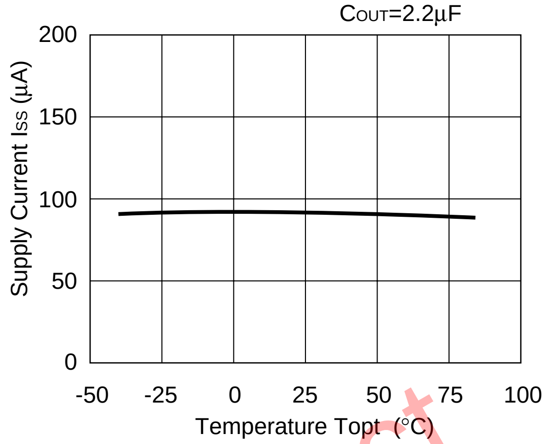
R1112N151A/B

VIN=2.5V CIN=1µF
COUT=2.2µF



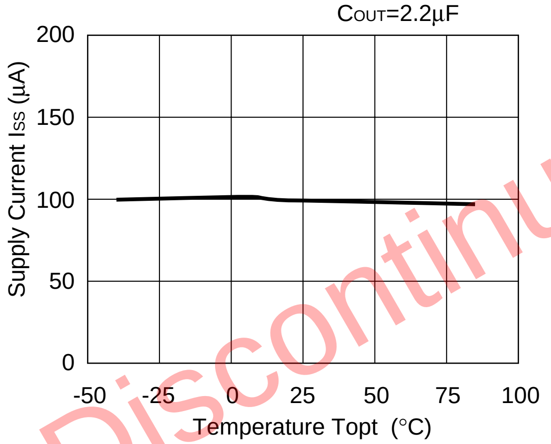
R1112N201A/B

VIN=3.0V CIN=1µF
COUT=2.2µF



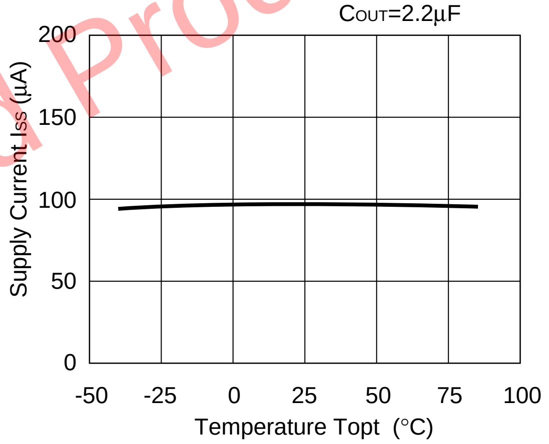
R1112N301A/B

VIN=4.0V CIN=1µF
COUT=2.2µF



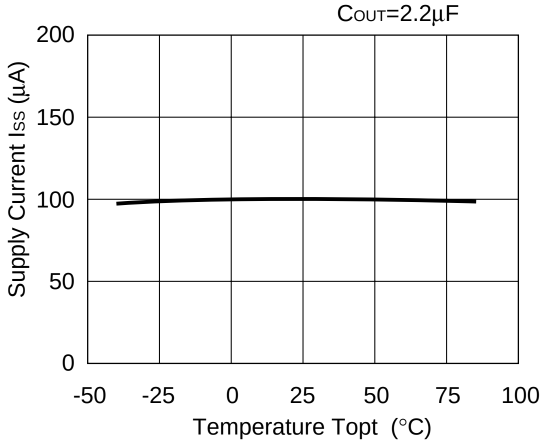
R1112N401A/B

VIN=5.0V CIN=1µF
COUT=2.2µF

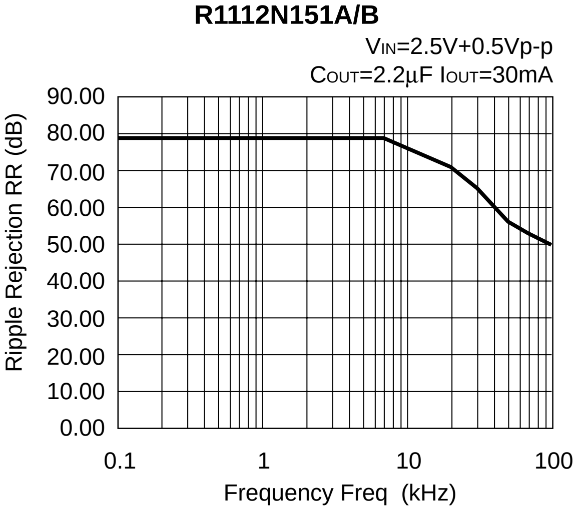


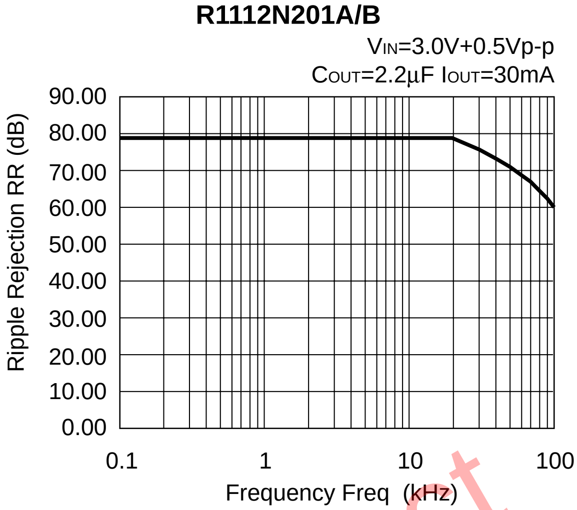
R1112N501A/B

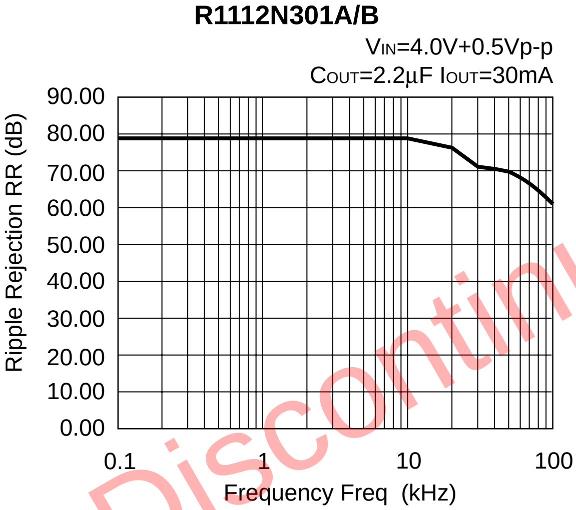
VIN=6.0V CIN=1µF
COUT=2.2µF

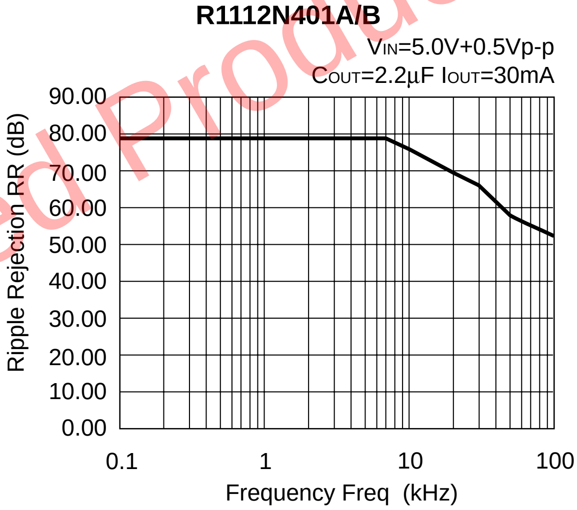


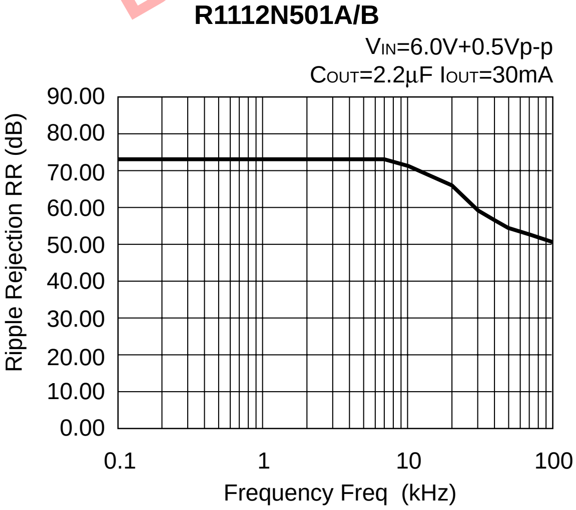
7) Ripple Rejection vs. Frequency







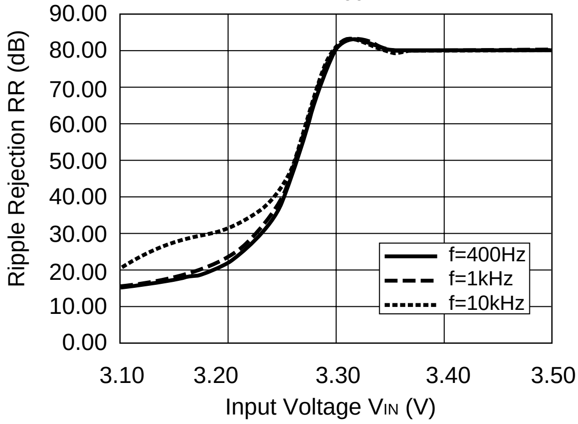




8) Ripple Rejection vs. Input Voltage (DC bias)

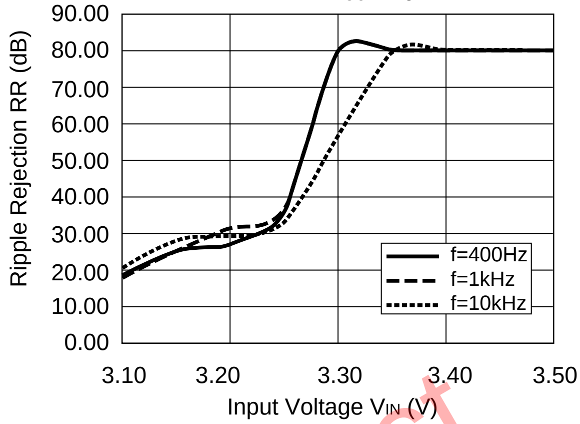
R1112N301B

C_{OUT}=Ceramic 2.2µF
I_{OUT}=1mA



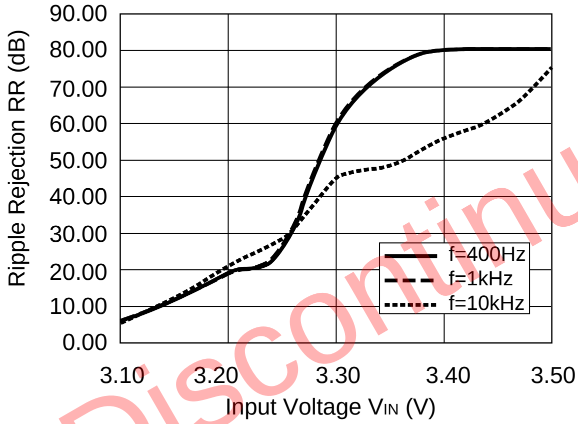
R1112N301B

C_{OUT}=Ceramic 2.2µF
I_{OUT}=10mA



R1112N301B

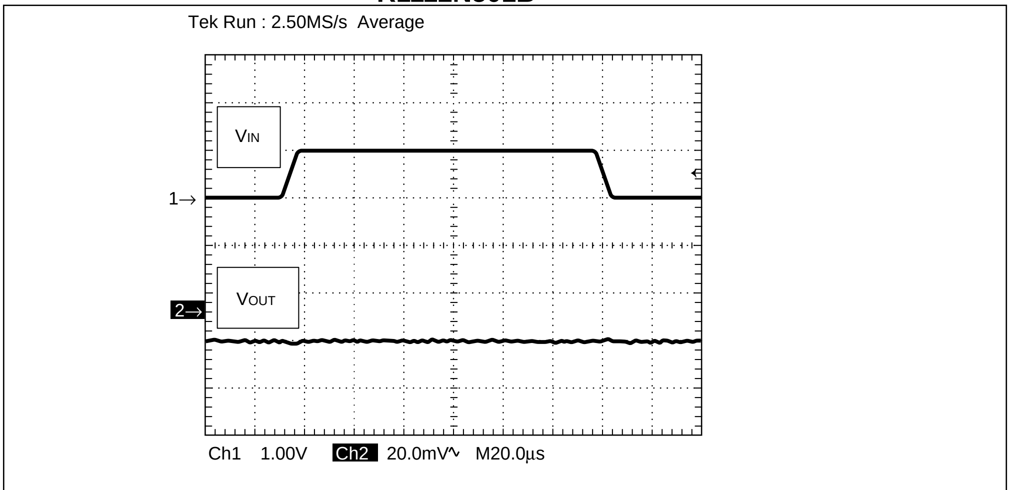
C_{OUT}=Ceramic 2.2µF
I_{OUT}=50mA



9) Input Transient Response

R1112N501B

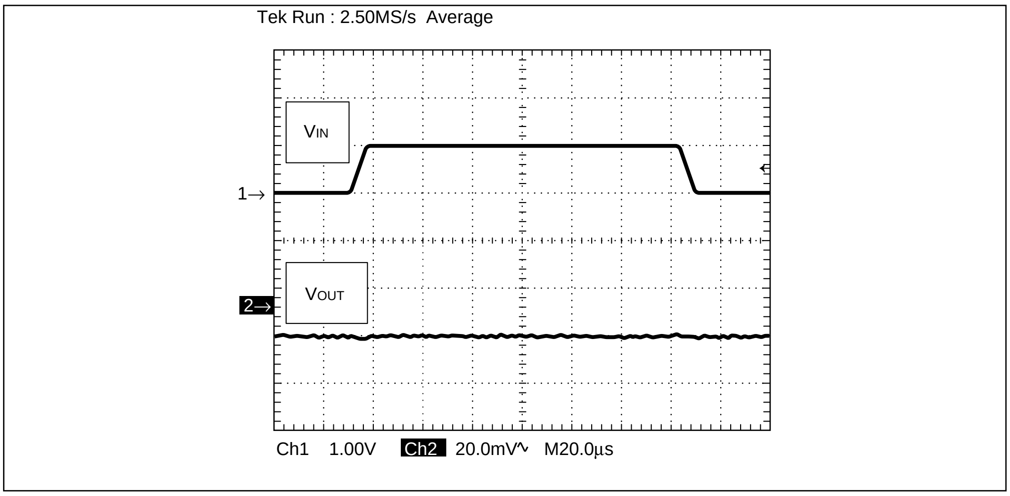
Topt=25°C



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

R1112N201B

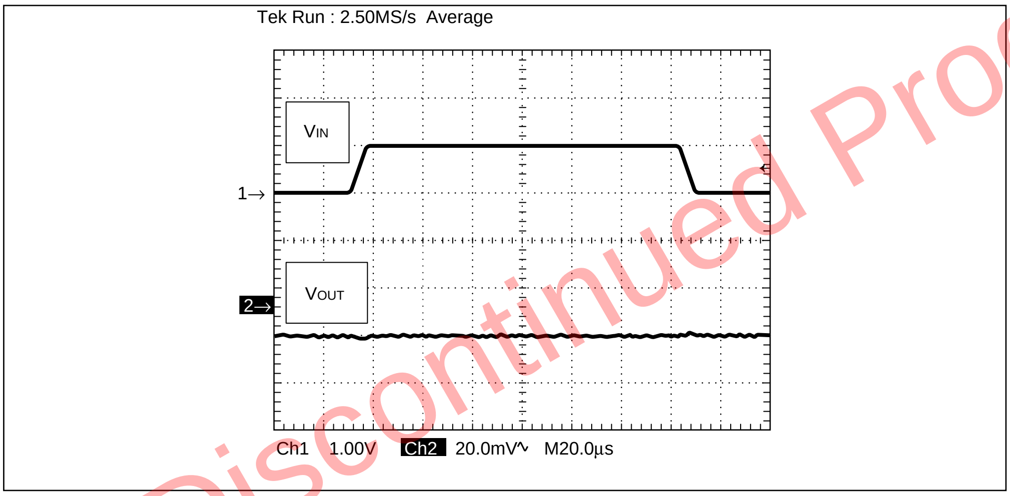
Topt=25°C



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

R1112N301B

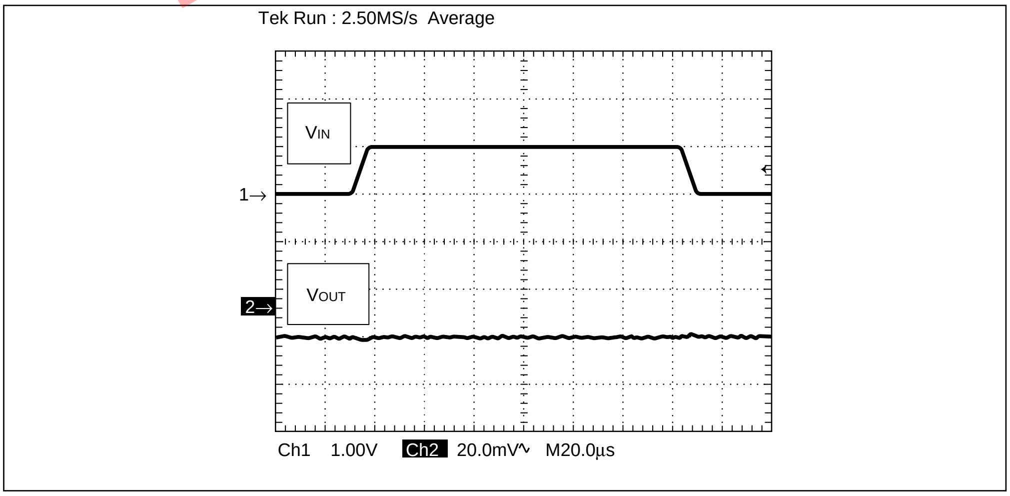
Topt=25°C



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

R1112N401B

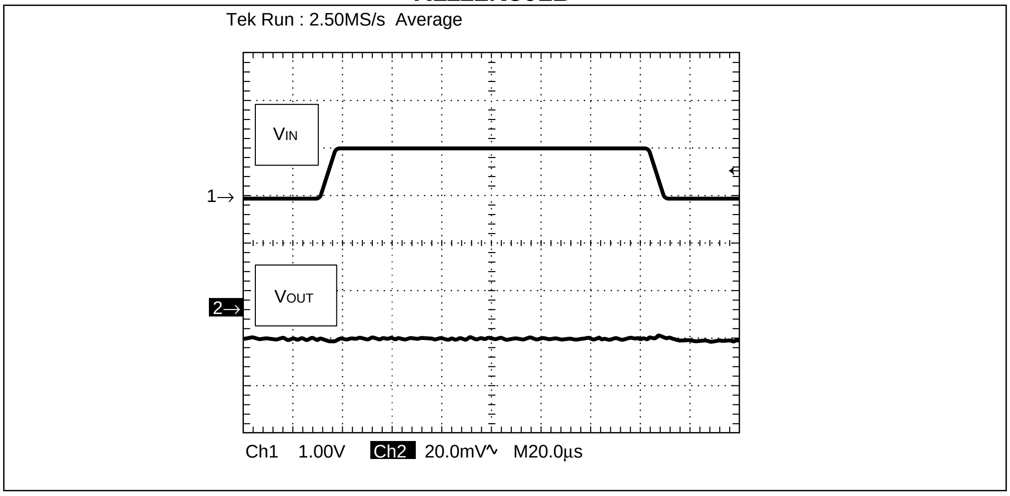
Topt=25°C



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

R1112N501B

Topt=25°C

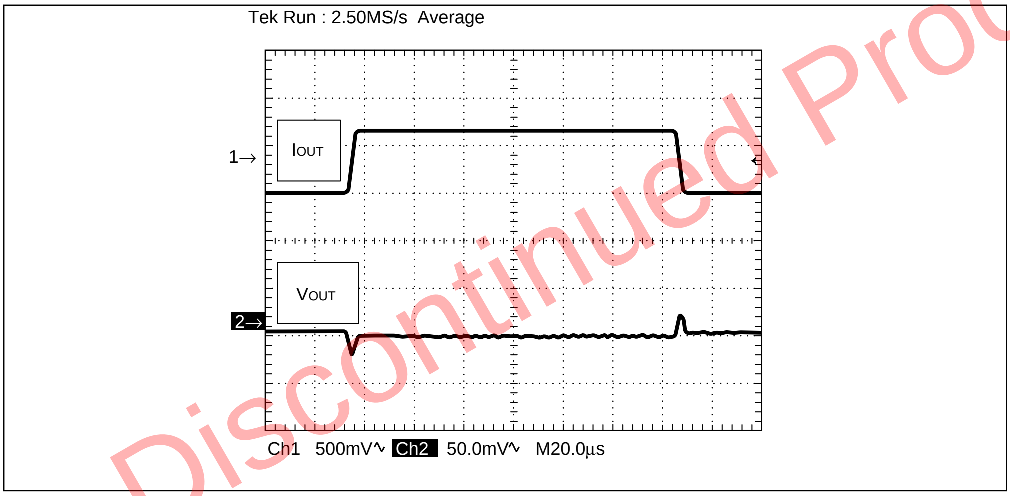


VIN=6.0V↔7.0V
IOUT=30mA
CIN=none
COUT=2.2µF
tr/tf=5µs

10) Load Transient Response

R1112N151B

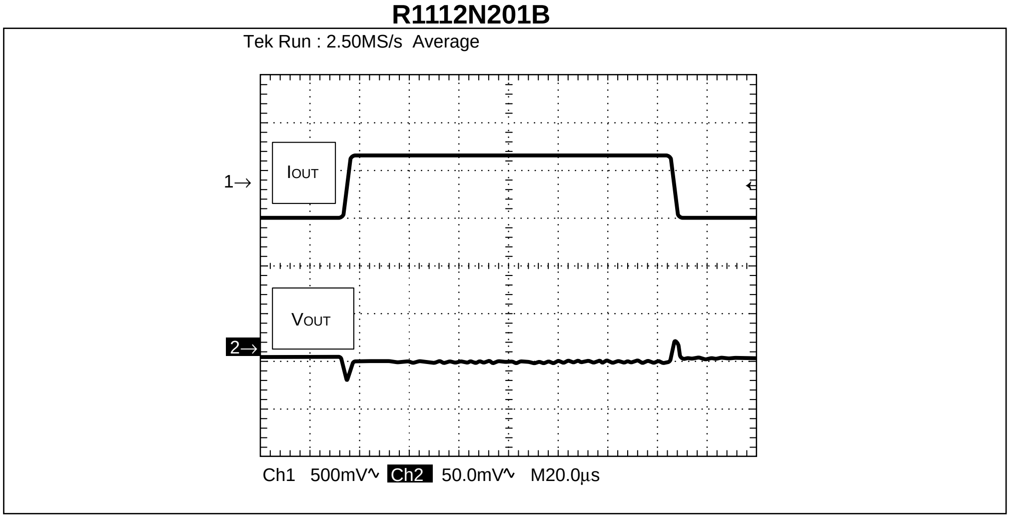
Topt=25°C



IOUT=50mA↔100mA
VIN=2.5V
CIN=2.2µF
COUT=2.2µF
tr/tf=5µs

R1112N201B

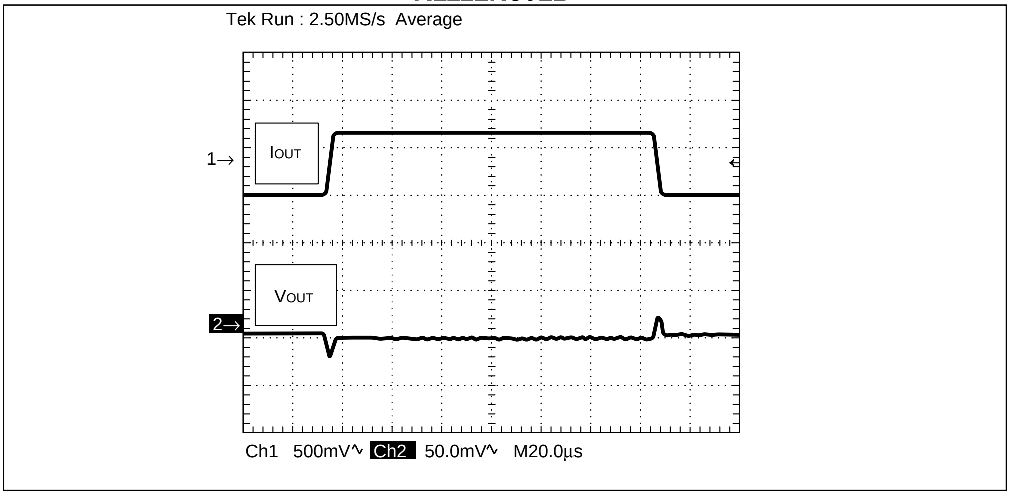
Topt=25°C



IOUT=50mA↔100mA
VIN=3.0V
CIN=2.2µF
COUT=2.2µF
tr/tf=5µs

R1112N301B

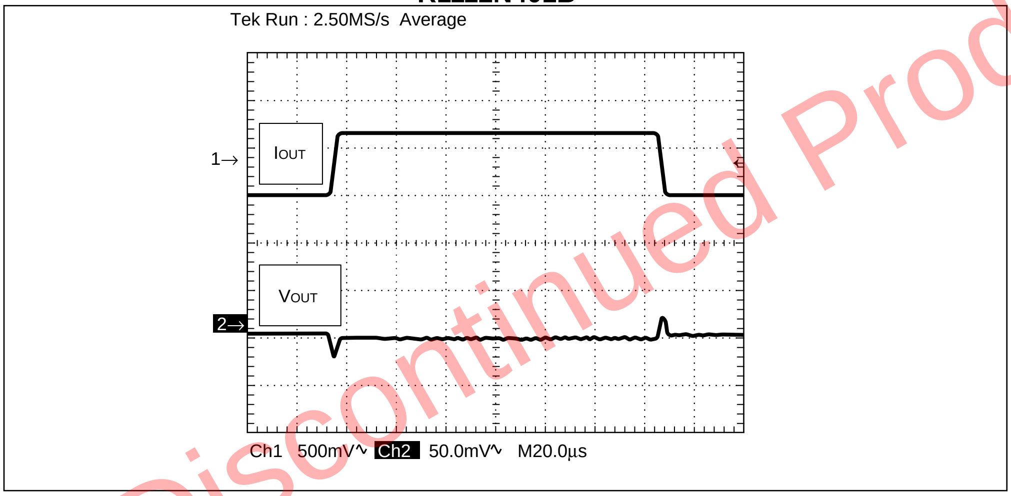
Topt=25°C



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

R1112N401B

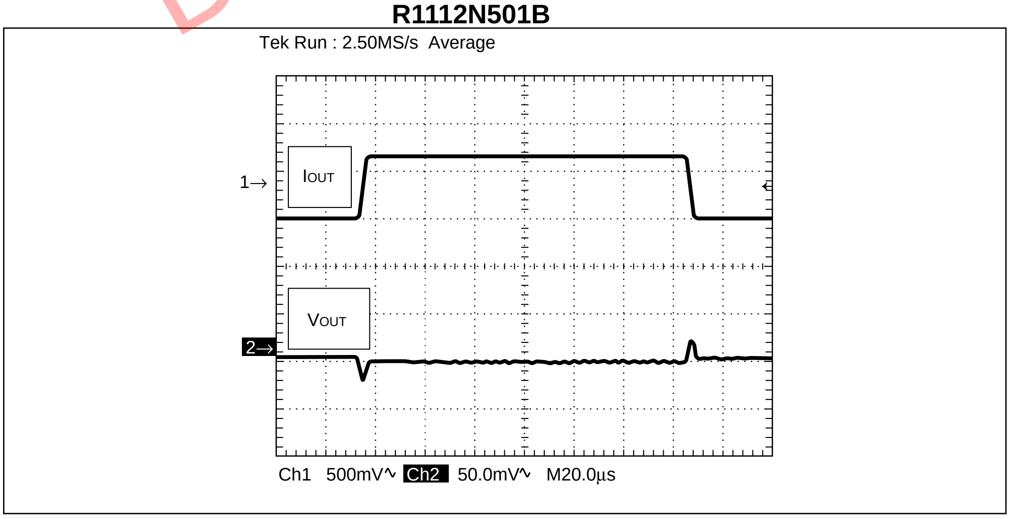
Topt=25°C



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

R1112N501B

Topt=25°C

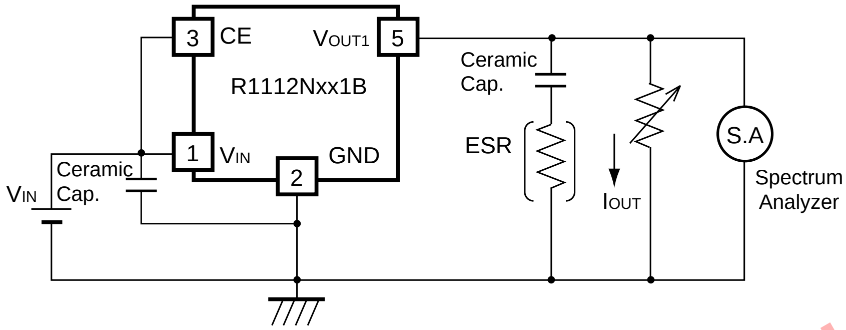


I_{OUT}=50mA↔100mA
V_{IN}=6.0V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

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:

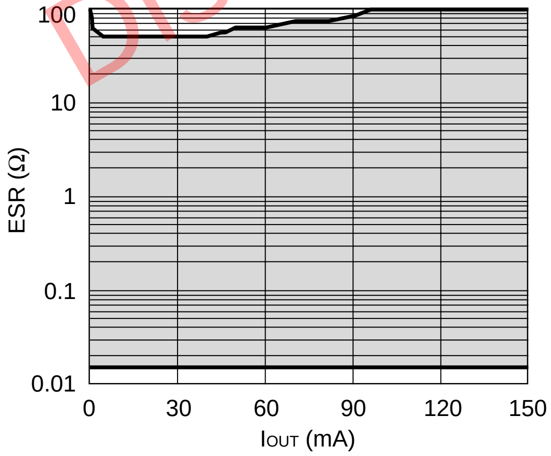


Measuring Circuit for white noise; R1112N301B

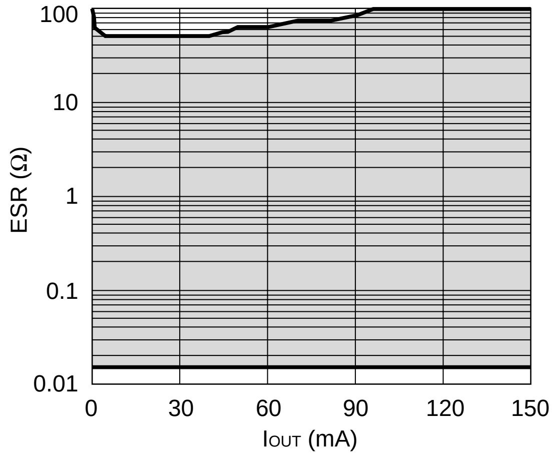
The relationship between I_{OUT} (the output current) and ESR of the output capacitor is shown in the graphs below. The conditions when the white noise level is under 40µV (Avg.) are indicated by the hatched area in the graph.
(Note: When additional ceramic capacitors are connected to the output pin with the output capacitor for phase compensation, operation might be unstable. Because of this, test these ICs with the same external components as the 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

R1112N151B
C_{OUT}=2.2µF,C_{IN}=2.2µF

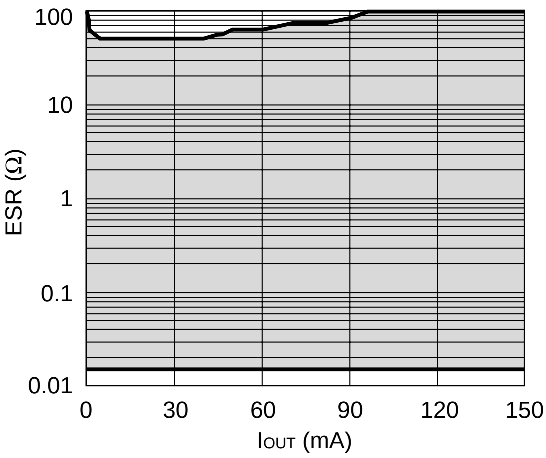


R1112N151B
C_{OUT}=4.7µF,C_{IN}=2.2µF



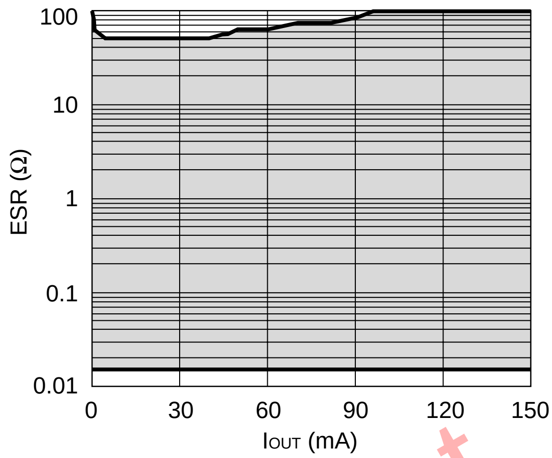
R1112N301B

C_{OUT}=2.2µF,C_{IN}=2.2µF

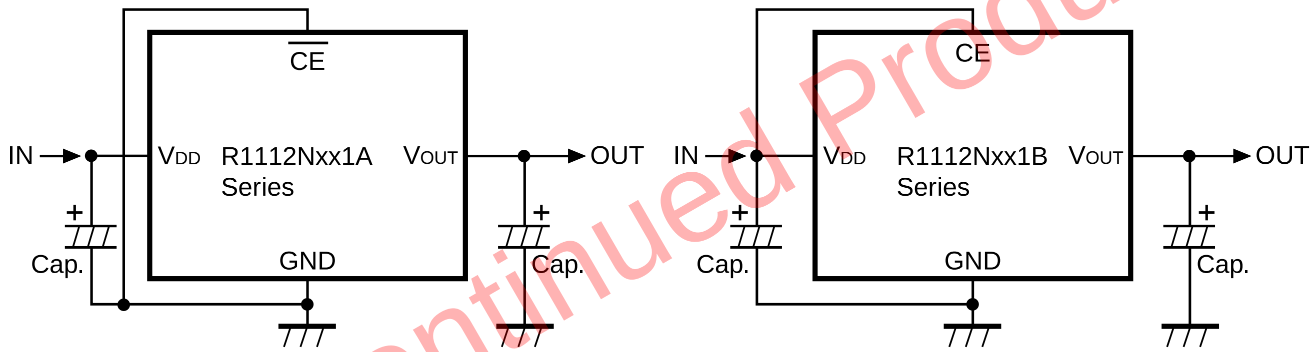


R1112N301B

C_{OUT}=4.7µF,C_{IN}=2.2µF



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

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