LOW NOISE 150mA L.D.O REGULATOR

R1120N SERIES

APPLICATION MANUAL

RICOH

ELECTRONIC DEVICES DIVISION

NO. EA-047-9803

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7. Anti-radiation design is not implemented in the products described in this application manual.

8. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

June 1995

R1120N SERIES

APPLICATION MANUAL

CONTENTS

OUTLINE ····· 1
FEATURES ····· 1
APPLICATIONS ····· 1
BLOCK DIAGRAM ····· 2
SELECTION GUIDE ····· 2
PIN CONFIGURATION ····· 3
PIN DESCRIPTION ····· 3
ABSOLUTE MAXIMUM RATINGS ····· 4
ELECTRICAL CHARACTERISTICS ····· 5
OPERATION ····· 7
TEST CIRCUITS ····· 8
TYPICAL CHARACTERISTICS ····· 9
1) Output Voltage vs. Output Current ····· 9
2) Output Voltage vs. Input Voltage ····· 9
3) Dropout Voltage vs. Output Current ····· 10
4) Output Voltage vs. Temperature ····· 11
5) Supply Current vs. Input Voltage ····· 11
6) Supply Current vs. Temperature ····· 12
7) Dropout Voltage vs. Set Output Voltage ····· 13
8) Ripple Rejection vs. Frequency ····· 13
9) Ripple Rejection vs. Input Voltage (DC bias) ····· 15
10) Line Transient Response ····· 15
11) Load Transient Response ····· 16
TYPICAL APPLICATION ····· 19
PACKAGE DIMENSION ····· 19
TAPING SPECIFICATION ····· 20

LOW NOISE 150mA L.D.O REGULATOR

R1120N SERIES

OUTLINE

The R1120N Series are voltage regulator ICs with high output voltage accuracy, lowest 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 Dynamic Response to line and load is fast, so these ICs are very suitable for the power supply for handheld 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

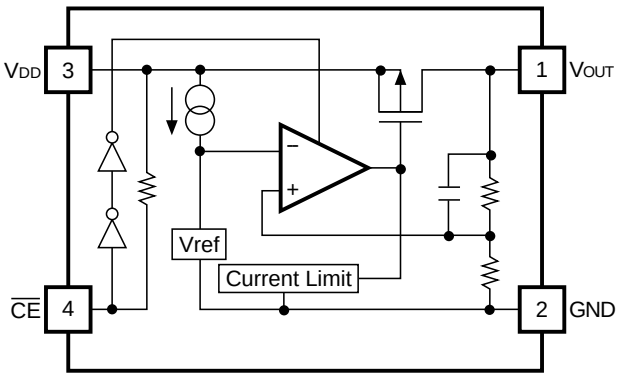
- Ultra-Low Supply Current ·····TYP. 35µA
- Standby Current ·····TYP. 0.1µA
- Dropout Voltage ·····TYP. 0.2V (I_{OUT}=100mA)
- High Ripple Rejection ·····TYP. 70dB (f=1kHz)
- High Accuracy Output Voltage ·····±2.0%
- Low Temperature-Drift Coefficient of Output Voltage ·····TYP. ±100ppm/°C
- Excellent Line Regulation ·····TYP. 0.05%/V
- Pinout·····Similar to the TK112
- Small Package·····SOT-23-5 (Mini-mold)

APPLICATIONS

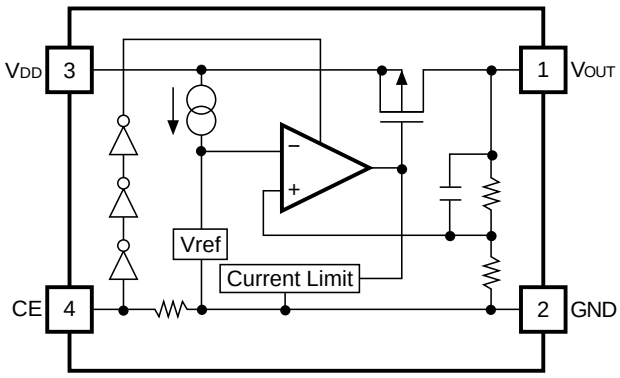
- Power source for portable communication tools, cameras and VCRs.
- Power source for battery-powered equipment.
- Power source for domestic appliances.

BLOCK DIAGRAM

R1120N××1A



R1120N××1B



SELECTION GUIDE

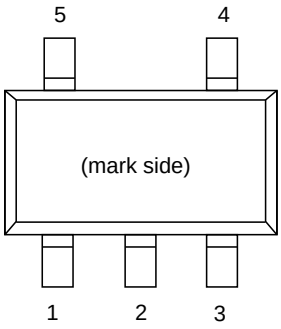
The output voltage, the active type, the packing type and the taping type for the ICs can be selected at the user's request. The selection can be made by designating the part number as shown below:

R1120N ××1×–×× ← Part Number
a b c

Code	Contents
a	Setting Output Voltage (VOUT) : Stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible.
b	Designation of Chip enable Active Type : A : "L" active type B : "H" active type
c	Designation of Taping Type : Ex. TR, TL (refer to Taping Specifications, TR type is prescribed as a standard.)

PIN CONFIGURATION

• **SOT-23-5**



PIN DESCRIPTION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	9	V
V_{CE}	Input Voltage for CE/$\overline{CE}$ 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
Topt	Operating Temperature Range	–40 to 85	°C
Tstg	Storage Temperature Range	–55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum ratings are threshold limit values that must not be exceeded even for an instant under any conditions. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

ELECTRICAL CHARACTERISTICS

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}–setV_{OUT}=1.0V 1mA≤I_{OUT}≤30mA	×0.98		×1.02	V
I_{OUT}	Output Current	V_{IN}–setV_{OUT}=1.0V when V_{OUT}=setV_{OUT}–0.1V	150			mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V_{IN}–setV_{OUT}=1.0V 1mA≤I_{OUT}≤80mA		12	40	mV
V_{DIF}	Dropout Voltage	refer to the ELECTICAL CHARACTERISTICS by OUTPUT VOLTAGE				
Iss	Supply Current	V_{IN}–setV_{OUT}=1.0V		35	70	µA
Istandby	Standby Current	V_{IN}–setV_{OUT}=1.0V, V_{CE}=V_{IN}		0.1	1.0	µA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	refer to the ELECTICAL CHARACTERISTICS by OUTPUT VOLTAGE				
RR	Ripple Rejection	f=1kHz, Ripple 0.5Vp-p V_{IN}–setV_{OUT}=1.0V		70		dB
V_{IN}	Input Voltage		2.7		8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=30mA –40°C≤Topt≤85°C		±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V		50		mA
R_{PU}	Pull up resistance for $\overline{CE}$ pin		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
en	Output Noise	BW=10Hz to 100kHz		60		µVrms

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}–setV_{OUT}=1.0V 1mA≤I_{OUT}≤30mA	×0.98		×1.02	V
I_{OUT}	Output Current	V_{IN}–setV_{OUT}=1.0V when V_{OUT}=setV_{OUT} – 0.1V	150			mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	V_{IN}–setV_{OUT}=1.0V 1mA≤I_{OUT}≤80mA		12	40	mV
V_{DIF}	Dropout Voltage	refer to the ELECTICAL CHARACTERISTICS by OUTPUT VOLTAGE				
Iss	Supply Current	V_{IN}–setV_{OUT}=1.0V		35	70	µA
Istandby	Standby Current	V_{IN}–setV_{OUT}=1.0V, V_{CE}=GND		0.1	1.0	µA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	refer to the ELECTICAL CHARACTERISTICS by OUTPUT VOLTAGE				
RR	Ripple Rejection	f=1kHz, Ripple 0.5Vp-p V_{IN}–setV_{OUT}=1.0V		70		dB
V_{IN}	Input Voltage		2.7		8	V
$\frac{\Delta V_{OUT}}{\Delta Topt}$	Output Voltage Temperature Coefficient	I_{OUT}=30mA –40°C≤Topt≤85°C		±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V		50		mA
R_{PD}	Pull down resistance for $\overline{CE}$ pin		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
en	Output Noise	BW=10Hz to 100kHz		60		µVrms

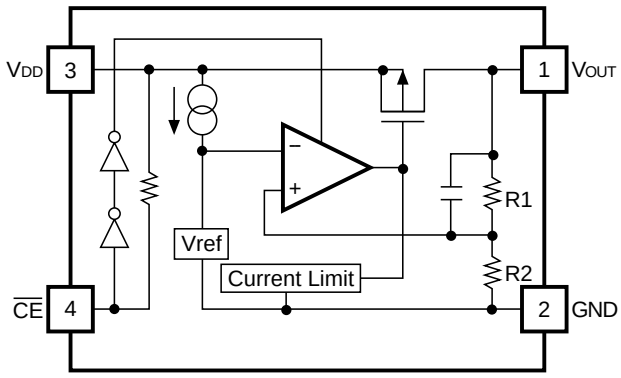
• ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt=25°C

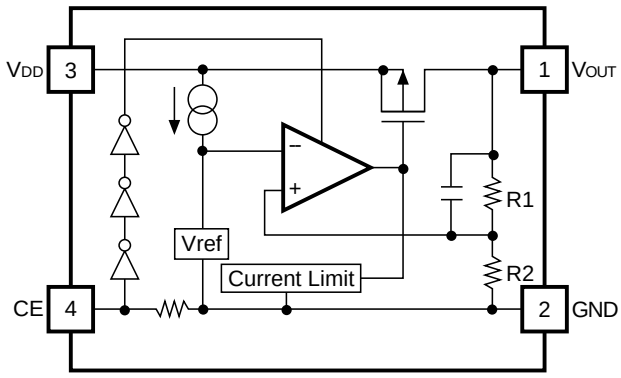
Output Voltage V_{OUT}(V)	Dropout Voltage			Line Regection		
	V_{DIF}(V)			$\Delta V_{OUT}/\Delta V_{IN}$(%/V)		
	Conditions	TYP.	MAX.	Conditions	TYP.	MAX.
2.0≤V_{OUT}≤2.4	I_{OUT}=100mA	0.30	0.70	I_{OUT}=30mA setV_{OUT}+0.7V≤V_{IN}≤8V	0.05	0.20
2.5≤V_{OUT}≤2.7		0.24	0.35	I_{OUT}=30mA setV_{OUT}+0.5V≤V_{IN}≤8V		
2.8≤V_{OUT}≤3.3		0.20	0.30			
3.4≤V_{OUT}≤6.0		0.17	0.26			

OPERATION

R1120N××1A

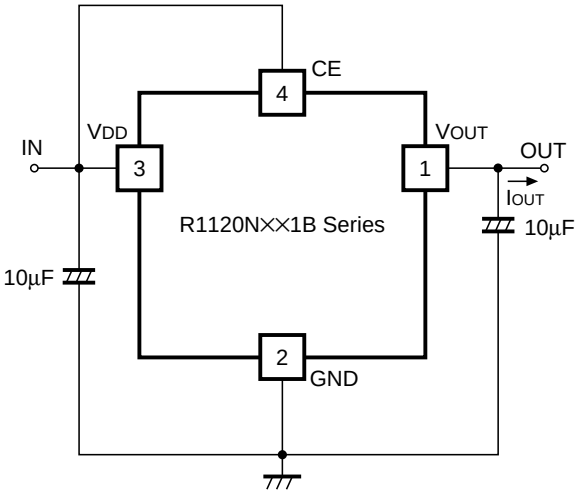


R1120N××1B

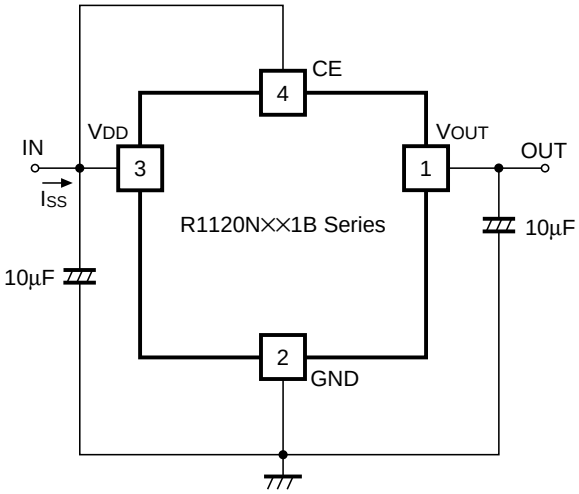


In these ICs, fluctuation in Output Voltage VOUT is detected by Feed-back Registers R1, R2, and the result is compare with a reference voltage by Error Amplifier, so that a constant voltage is output.
A current limit circuit working for Short Protect and a chip enable circuit are included.

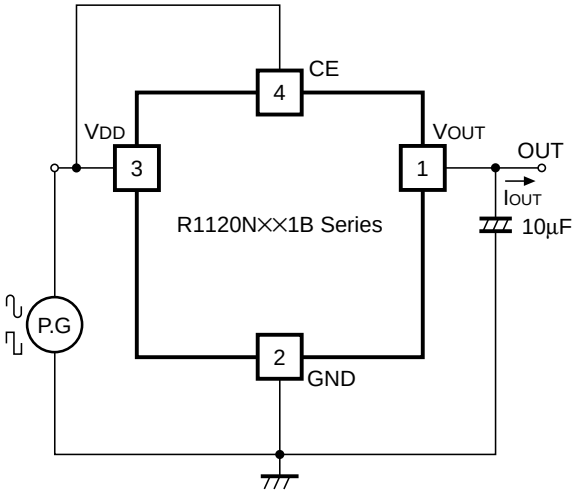
TEST CIRCUITS



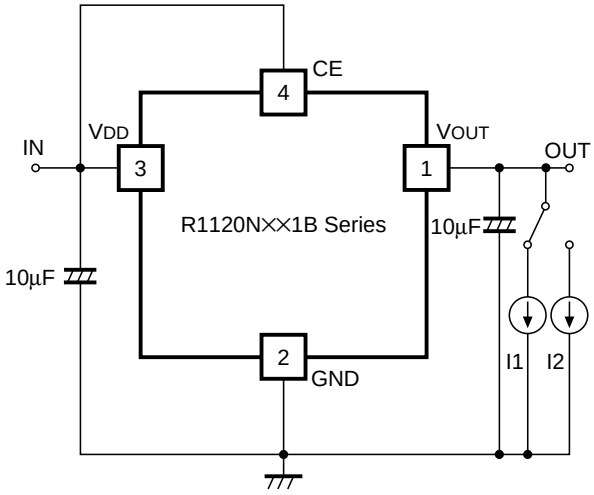
Standard Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection and Line Transient Response

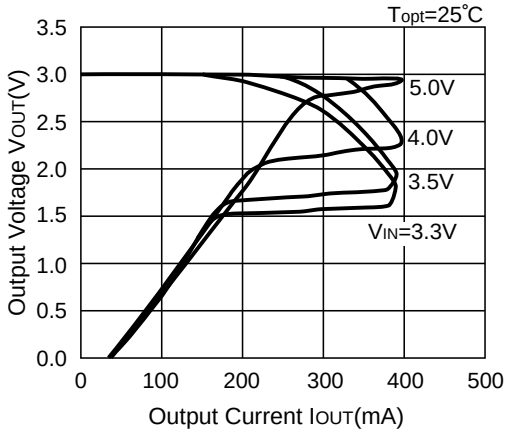


Test Circuit for Load Transient Response

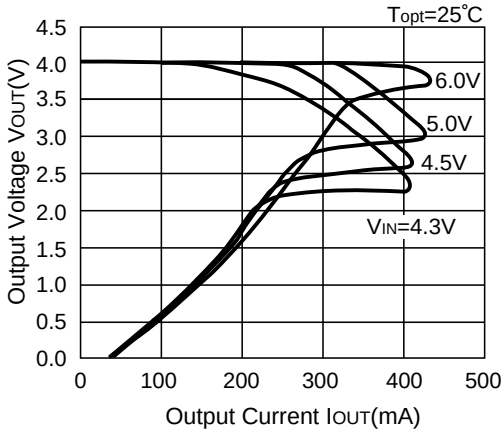
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

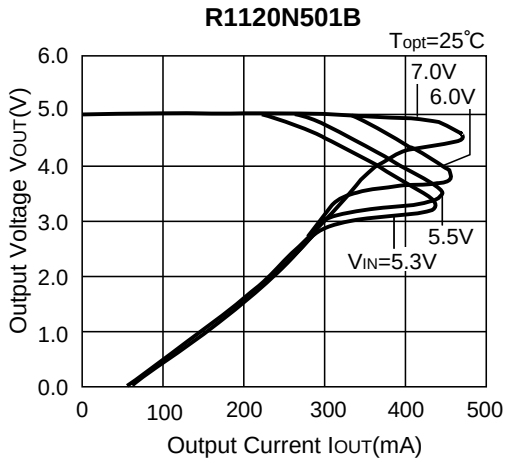
R1120N301B



R1120N401B

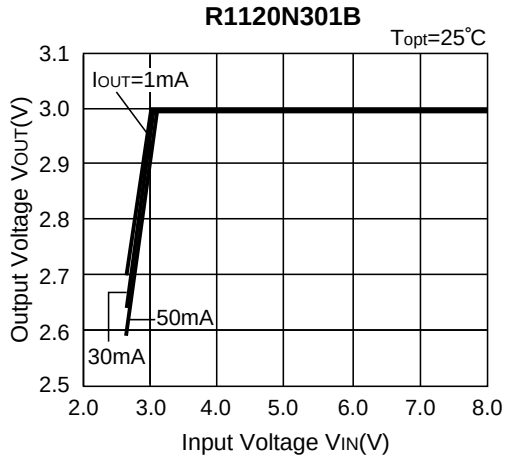


R1120N501B

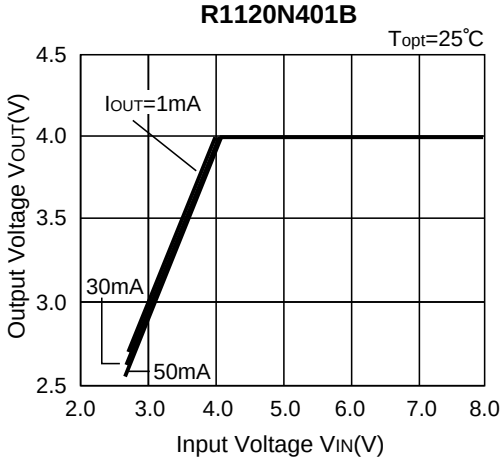


2) Output Voltage vs. Input Voltage

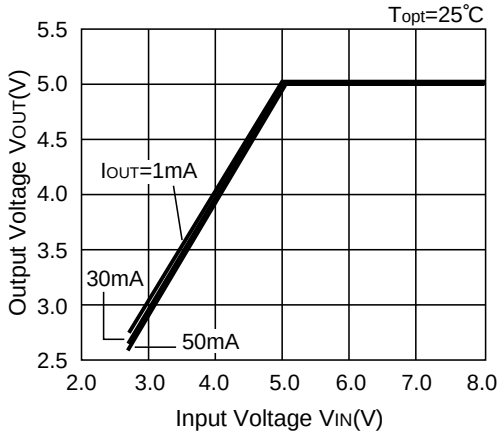
R1120N301B



R1120N401B

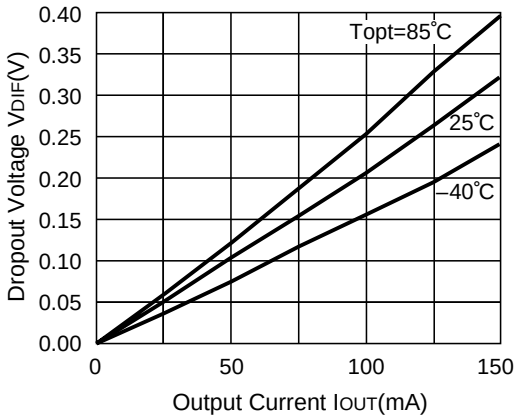


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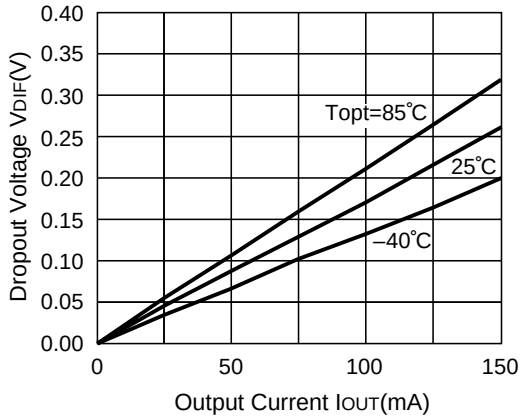


3) Dropout Voltage vs. Output Current

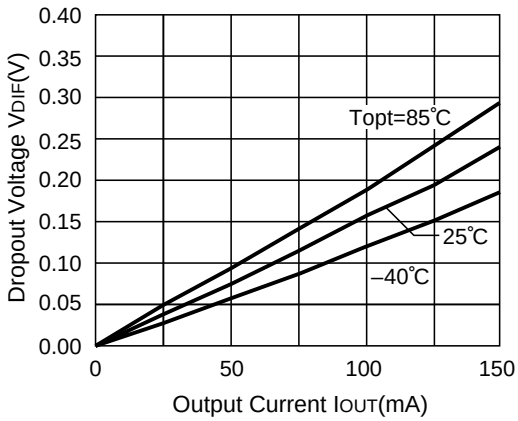
R1120N301B



R1120N401B

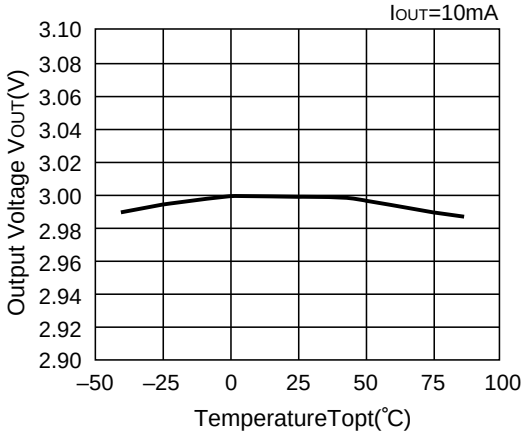


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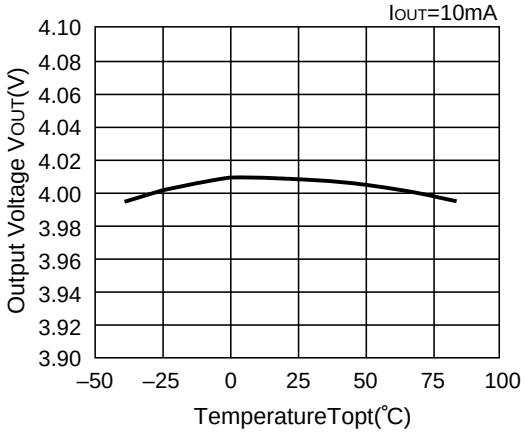


4) Output Voltage vs. Temperature

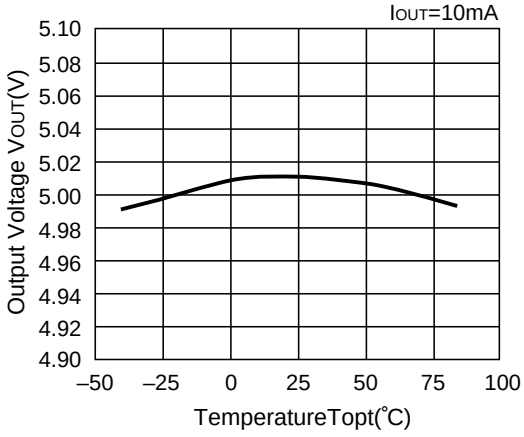
R1120N301B V_{IN}=4V I_{OUT}=10mA



R1120N401B V_{IN}=5V I_{OUT}=10mA

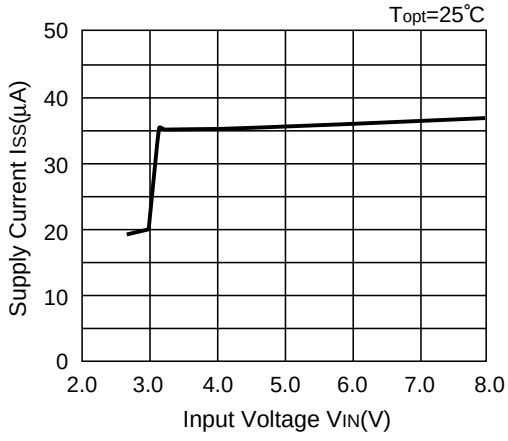


R1120N501B V_{IN}=6V I_{OUT}=10mA

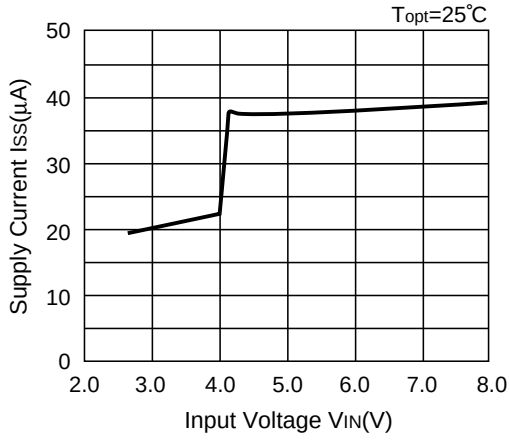


5) Supply Current vs. Input Voltage

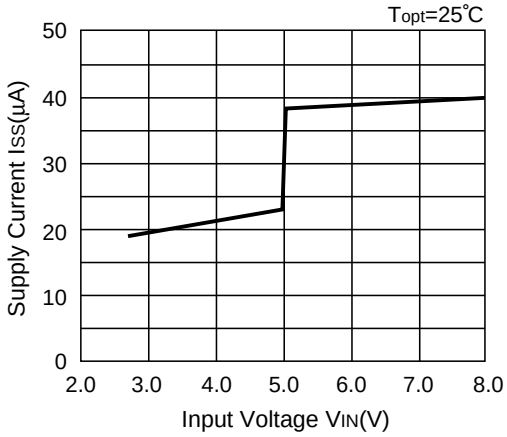
R1120N301B T_{opt}=25˚C



R1120N401B T_{opt}=25˚C

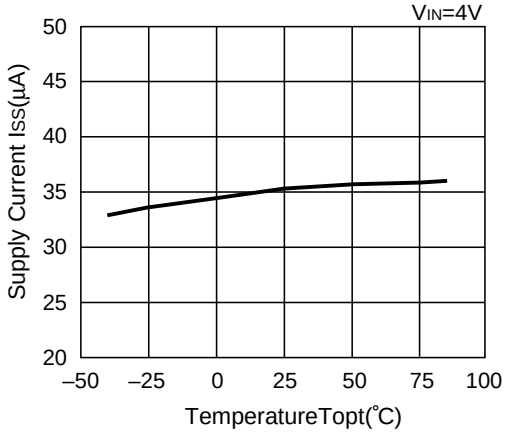


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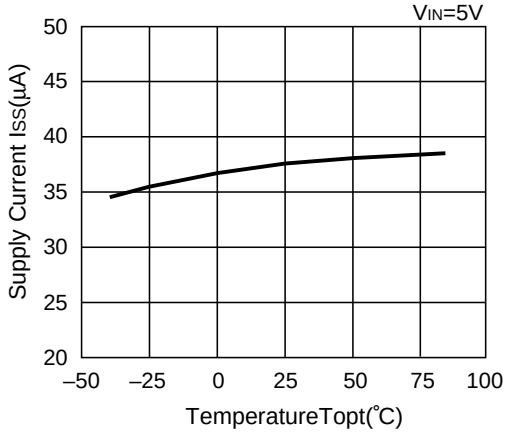


6) Supply Current vs. Temperature

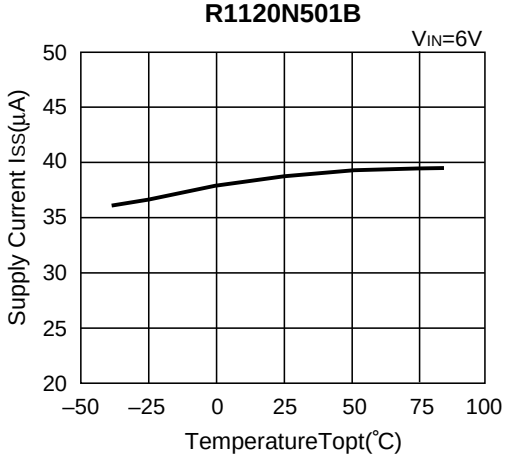
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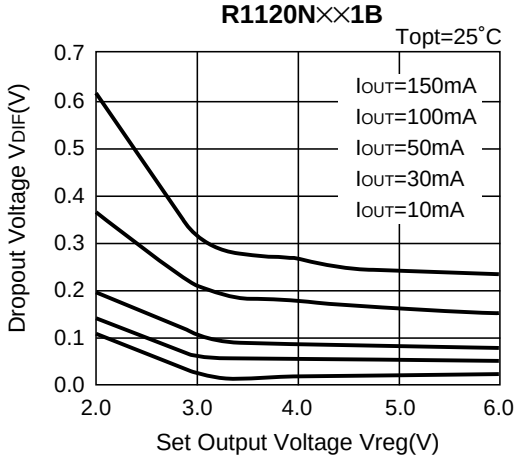
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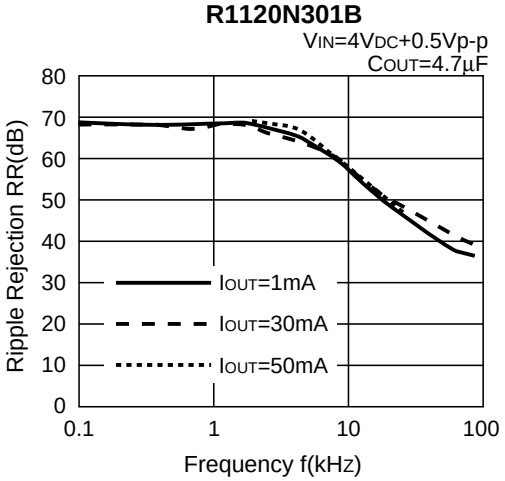
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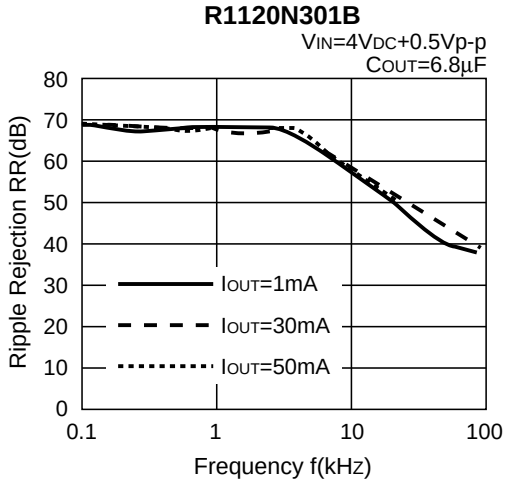


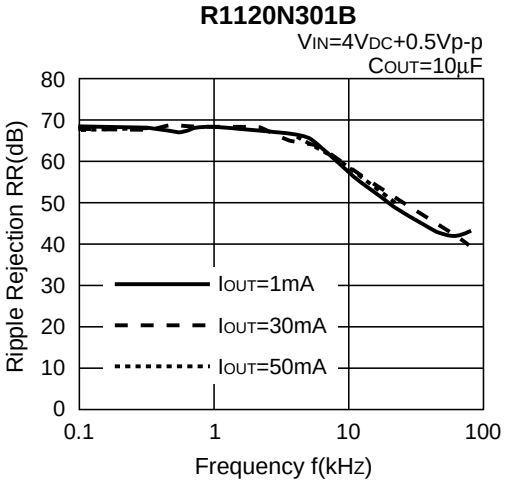
7) Dropout Voltage vs. Set Output Voltage

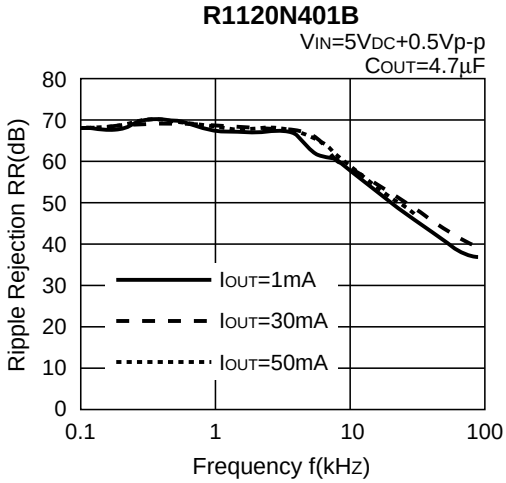


8) Ripple Rejection vs. Frequency



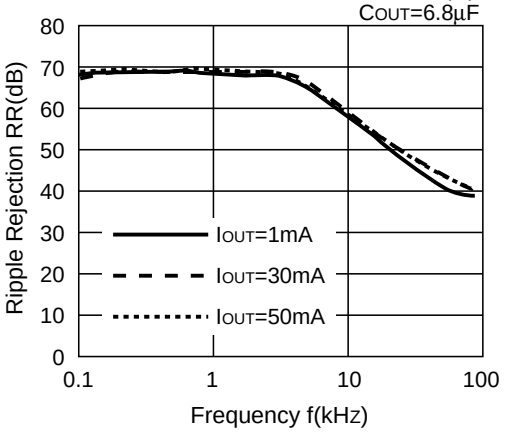






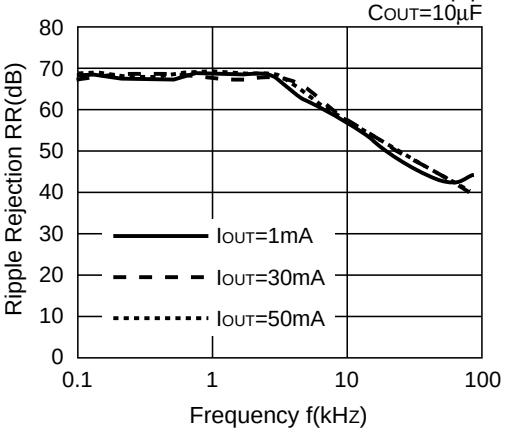
R1120N401B

V_{IN}=5V_{DC}+0.5Vp-p
C_{OUT}=6.8µF



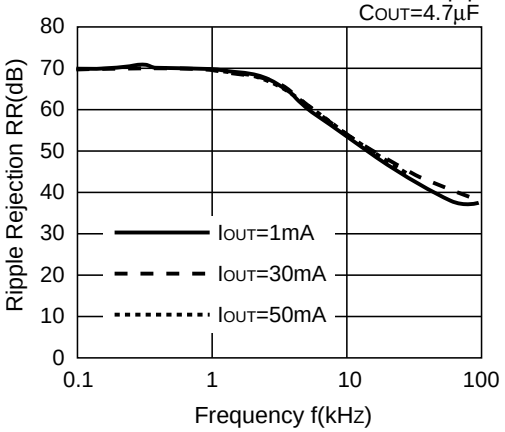
R1120N401B

V_{IN}=5V_{DC}+0.5Vp-p
C_{OUT}=10µF



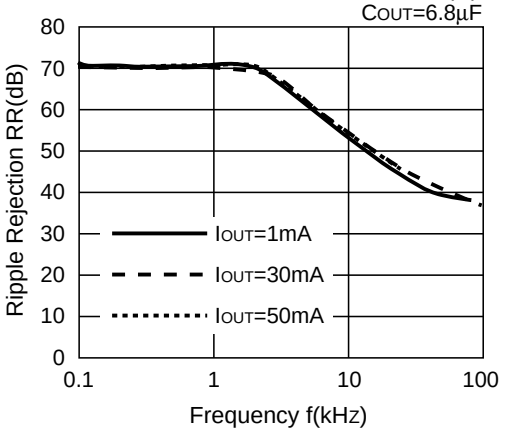
R1120N501B

V_{IN}=6V_{DC}+0.5Vp-p
C_{OUT}=4.7µF



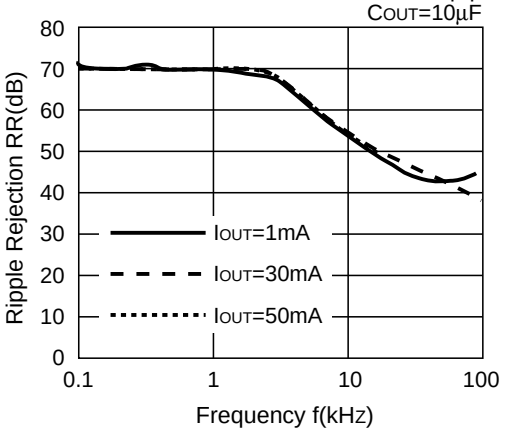
R1120N501B

V_{IN}=6V_{DC}+0.5Vp-p
C_{OUT}=6.8µF

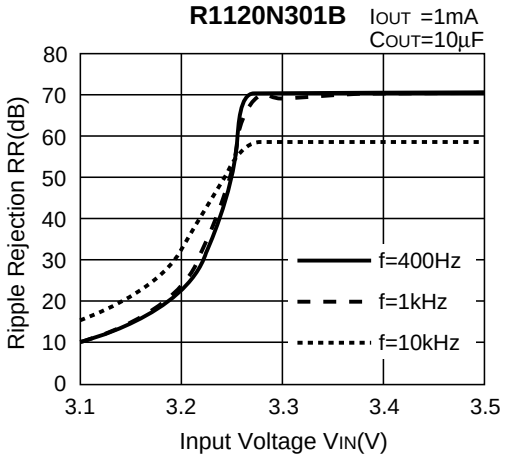


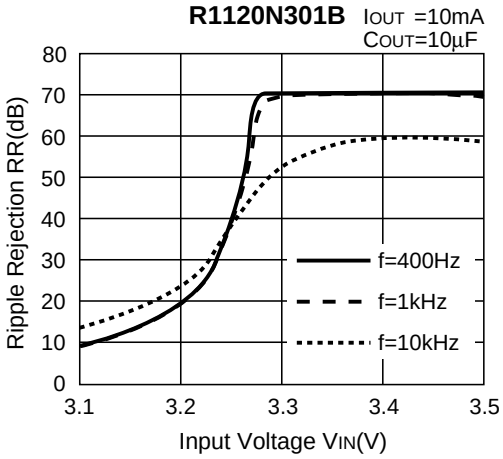
R1120N501B

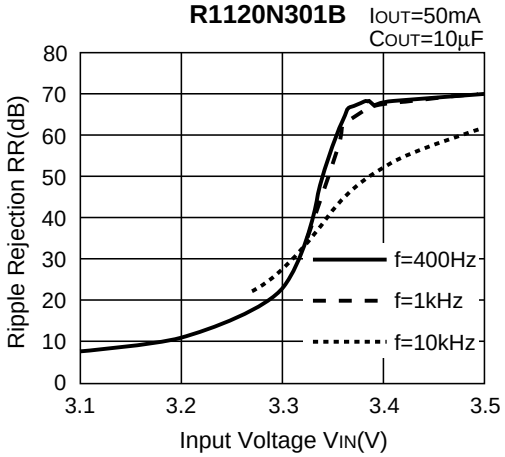
V_{IN}=6V_{DC}+0.5Vp-p
C_{OUT}=10µF



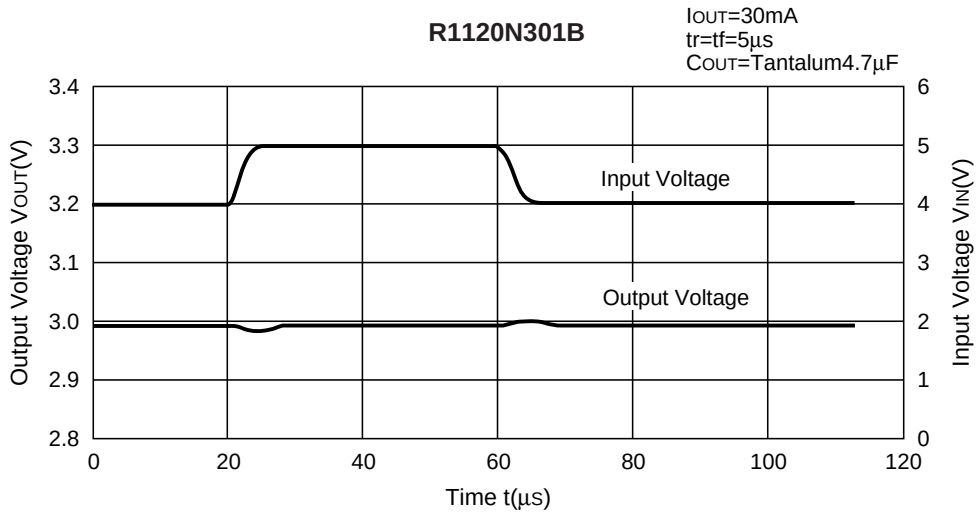
9) Ripple Rejection vs. Input Voltage (DC bias)

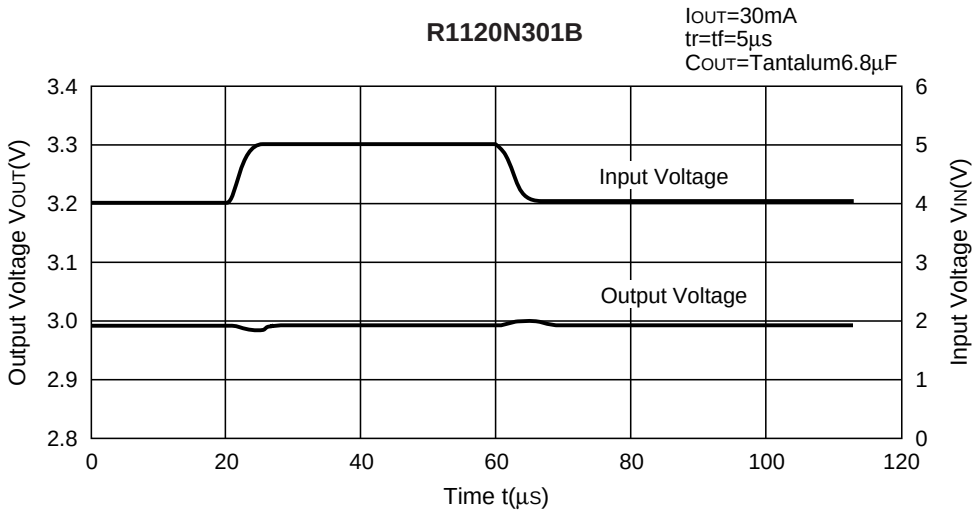


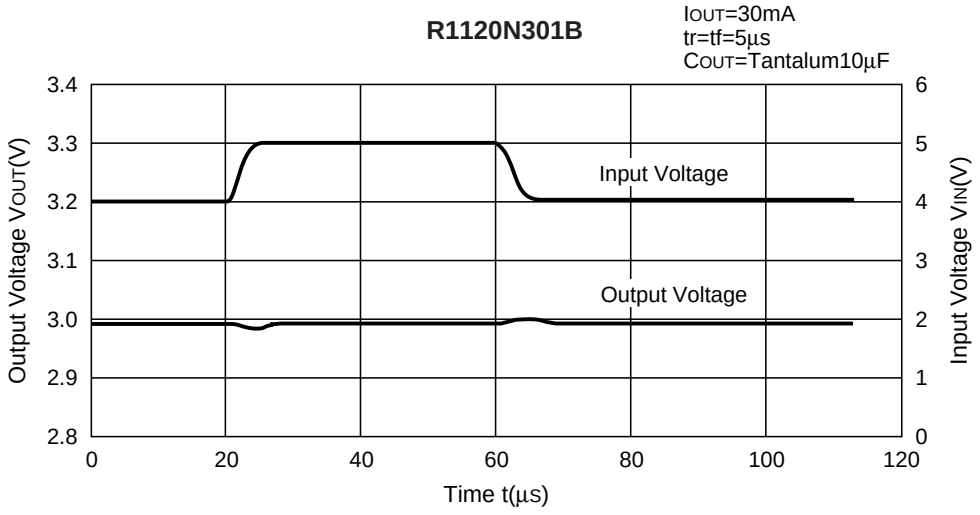




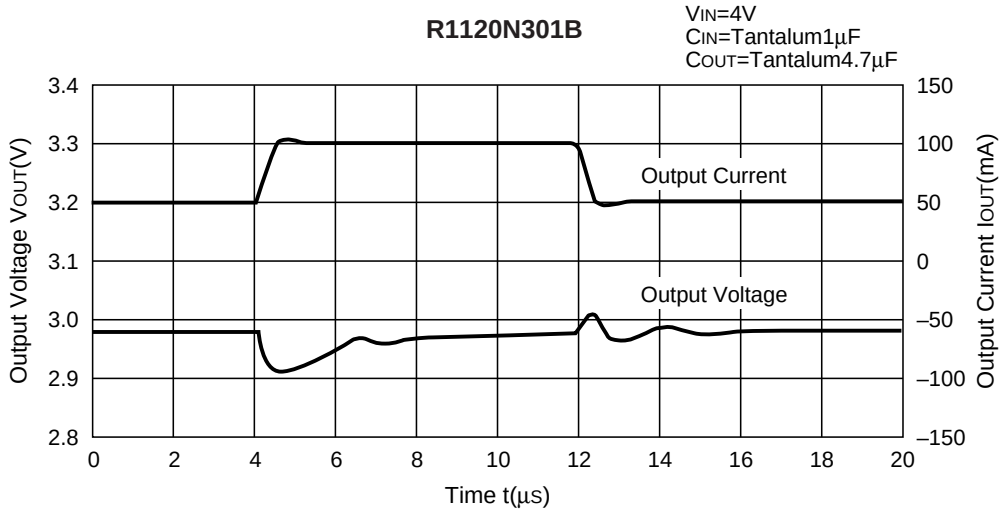
10) Line Transient Response

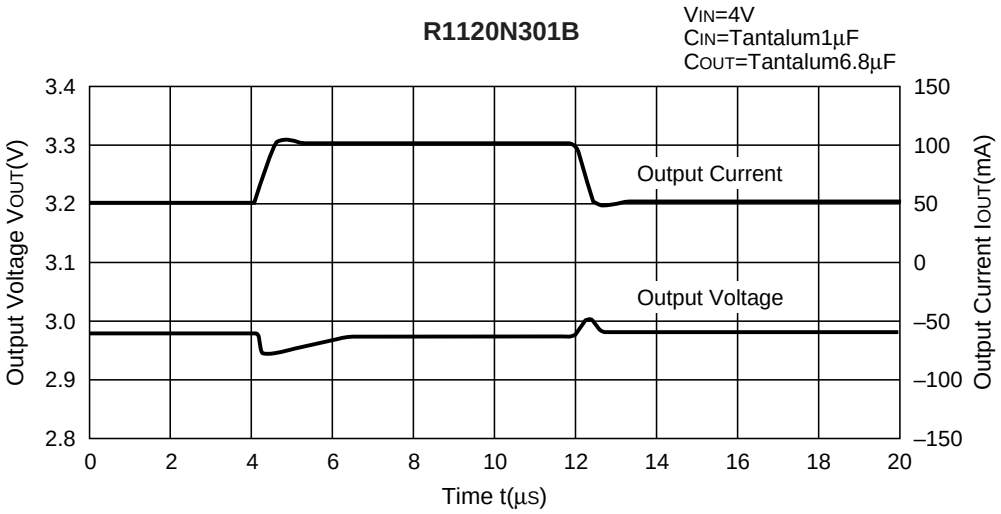


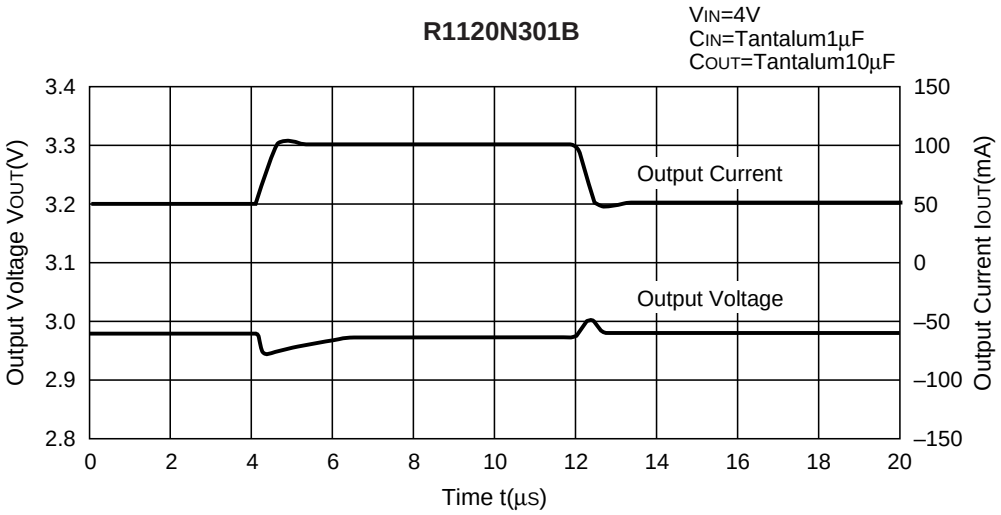




11) Load Transient Response




R1120N301B
VIN=4V
CIN=Tantalum1µF
COUT=Tantalum6.8µF
Output Current
Output Voltage
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time t(µs)
3.4
3.3
3.2
3.1
3.0
2.9
2.8
150
100
50
0
–50
–100
–150
0
2
4
6
8
10
12
14
16
18
20


R1120N301B
VIN=4V
CIN=Tantalum1µF
COUT=Tantalum10µF
Output Current
Output Voltage
Output Voltage VOUT(V)
Output Current IOUT(mA)
Time t(µs)
3.4
3.3
3.2
3.1
3.0
2.9
2.8
150
100
50
0
–50
–100
–150
0
2
4
6
8
10
12
14
16
18
20

APPLICATION HINTS

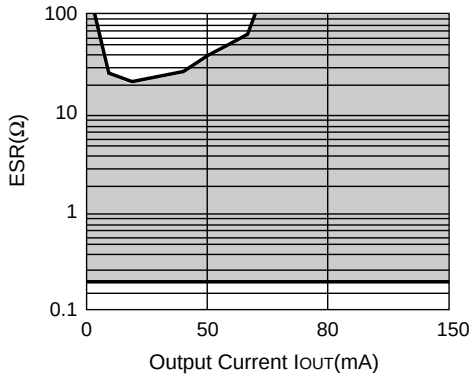
When using these ICs, be sure to take care of following points :

- 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 :
  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, there are possibilities that the operation will be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

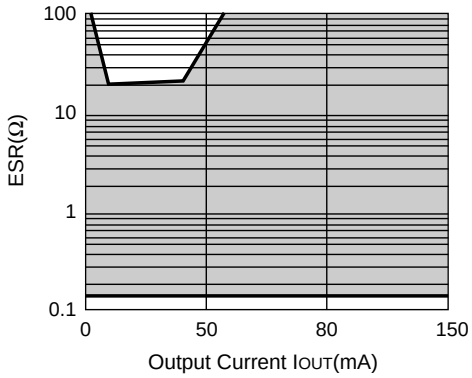
  < measuring conditions >
  V_{IN}=4V
  Freqency band : 10Hz to 1MHz Temperature : 25°C

- Make V_{DD} and GND line sufficient. When the impedance of these is high, there is a case to pick up the noise or not to work correctly.
- Connect the capacitor with a capacitance of 1μF 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.

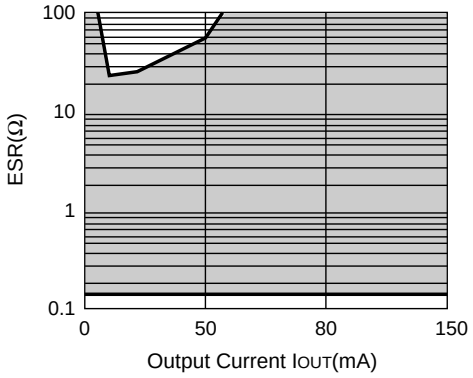
Ceramic Capacitor 4.7μF



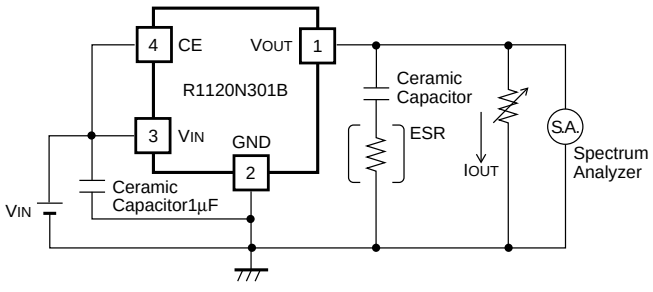
Ceramic Capacitor 6.8μF



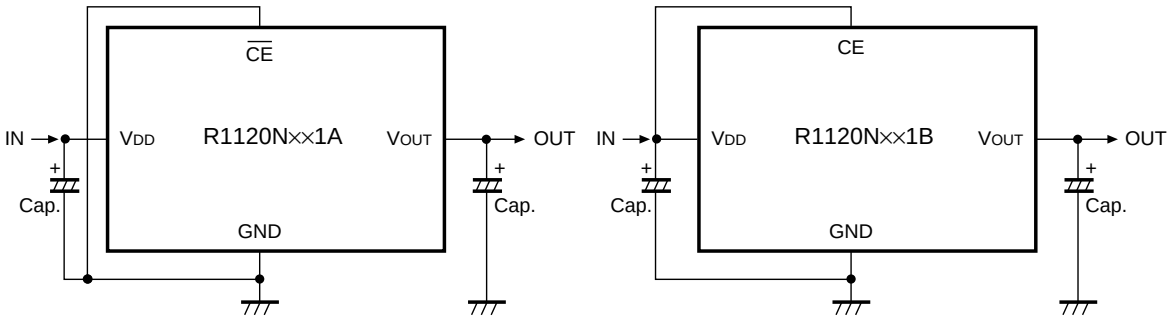
Ceramic Capacitor 10μF



• Measuring Circuit for white noise ; R1120N301B

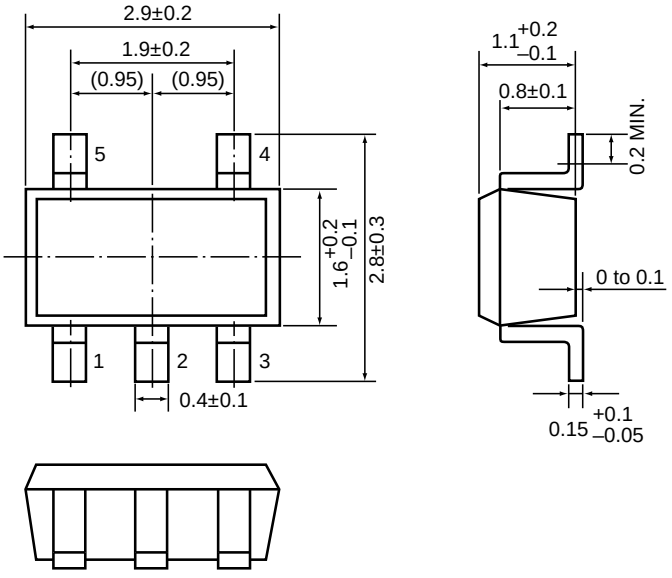


TYPICAL APPLICATION



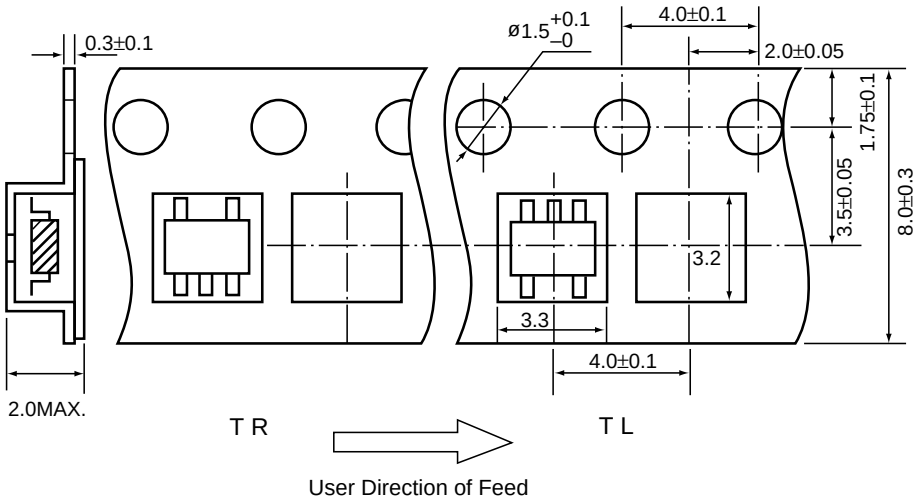
PACKAGE DIMENSION (Unit : mm)

• SOT-23-5



TAPING SPECIFICATION (Unit : mm)

• SOT-23-5





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