LOW NOISE 150mA LDO REGULATOR

NO. EA-094-0209

R1114x SERIES

OUTLINE

The R1114x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, extremely low supply current, low ON-resistance, and high ripple rejection. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit, and a chip enable circuit.

These ICs perform with low dropout voltage and a chip enable function. The line transient response and load transient response of the R1114x 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 packages for these ICs are SOT-23-5 and SC-82AB, therefore high density mounting of the ICs on boards is possible.

FEATURES

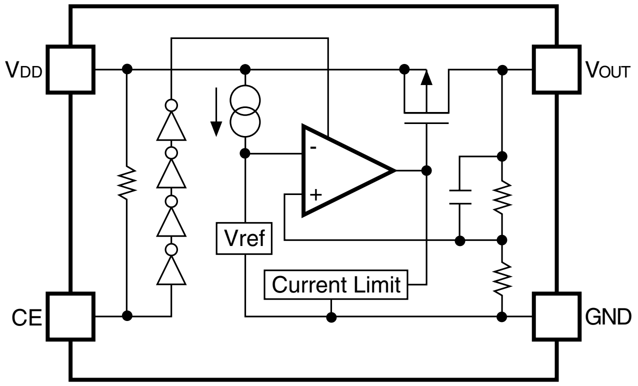
- Low Supply Current .... Typ. 75μA
- Standby Mode .... Typ. 0.1μA
- Low Dropout Voltage .... Typ. 0.22V (I_{OUT}=150mA 3.0V Output type)
- High Ripple Rejection .... Typ. 70dB (f=1kHz 3.0V Output type)
  Typ. 60dB (f=10kHz)
- Low Temperature-Drift Coefficient of Output Voltage .... Typ. ±100ppm/°C
- Excellent Line Regulation .... Typ. 0.02%/V
- High Output Voltage Accuracy .... ±2.0%
- Small Package SOT-23-5/SC-82AB
- Output Voltage .... Stepwise setting with a step of 0.1V in the range of 1.5V to 4.0V is possible
- Built-in Fold Back Protection Circuit .... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC .... $C_{IN}=C_{OUT}=1\mu F$ ($V_{OUT}<2.5V$)
  $C_{IN}=1\mu F$, $C_{OUT}=0.47\mu F$ ($V_{OUT}\geq 2.5V$)

APPLICATIONS

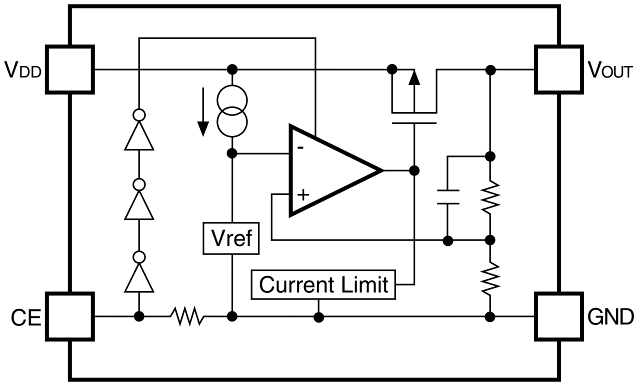
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

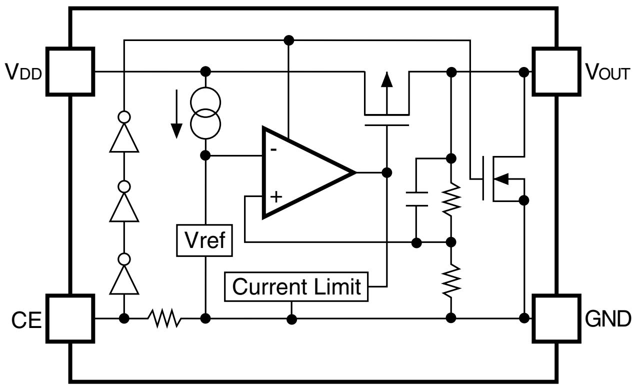
R1114xxx1A



R1114xxx1B



R1114xxx1D



RICOH

SELECTION GUIDE

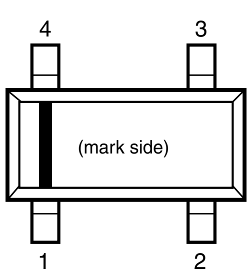
The output voltage, version, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

R1114xxx1x-xx ←Part Number
↑↑ ↑ ↑
a b c d

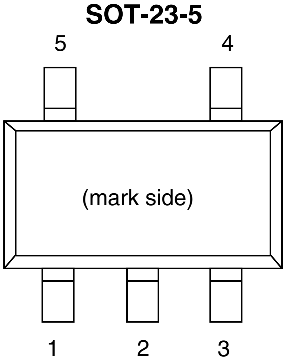
Code	Contents
a	Designation of Package Type: N: SOT-23-5 Q: SC-82AB
b	Setting Output Voltage (V_{OUT}): Stepwise setting with a step of 0.1V in the range of 1.5V to 4.0V is possible.
c	Designation of Active Type: A: active low type B: active high type D: active high, with auto discharge
d	Designation of Taping Type: Ex. TR (refer to Taping Specifications; TR type is the standard direction.)

PIN CONFIGURATION

SC-82AB



SOT-23-5



PIN DESCRIPTIONS

- **R1114Q**

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

- **R1114N**

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

- **R1114xxx1x**

Topt=25°C

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

- **ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE**

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
V_{OUT} = 1.5	I_{OUT} = 150mA	0.38	0.70
V_{OUT} = 1.6		0.36	0.65
V_{OUT} = 1.7		0.34	0.60
$1.8 \leq V_{OUT} \leq 2.0$		0.32	0.55
$2.1 \leq V_{OUT} \leq 2.7$		0.28	0.50
$2.8 \leq V_{OUT} \leq 4.0$		0.22	0.35

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance).
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 1.0µF or more between V_{DD} and GND pin, and as close as possible to the pins.

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

TEST CIRCUITS

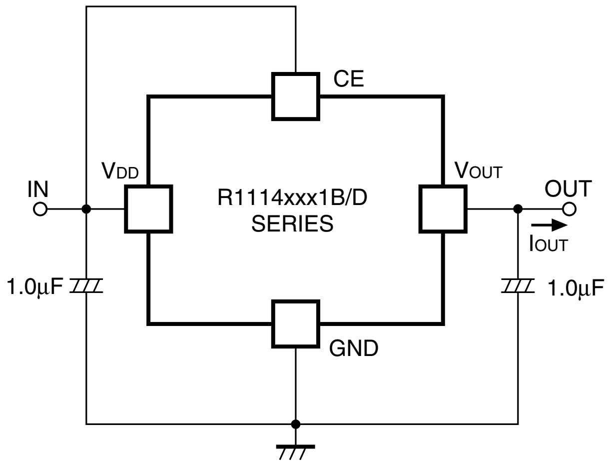


Fig.1 Standard test Circuit

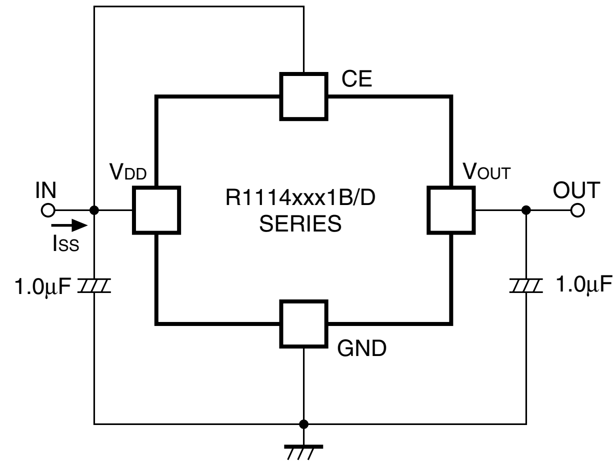


Fig.2 Supply Current Test Circuit

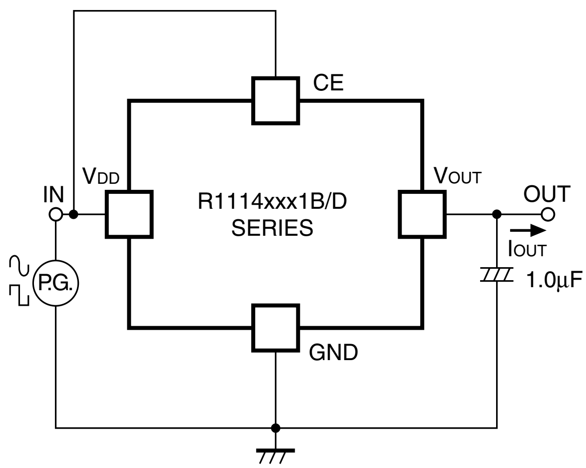


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

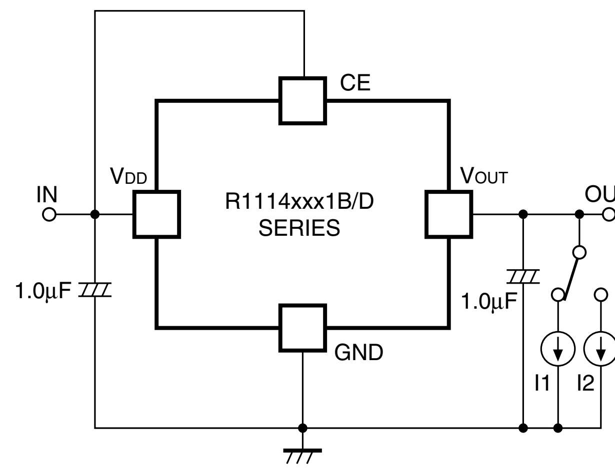
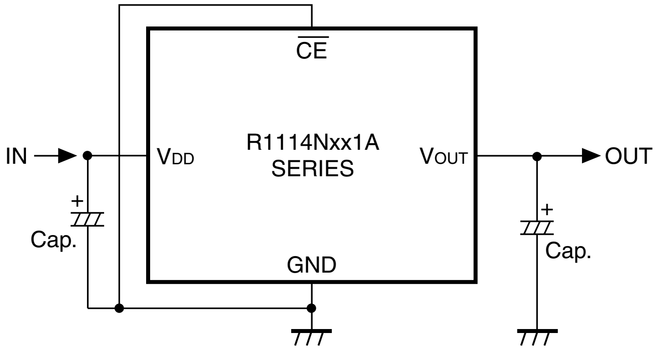
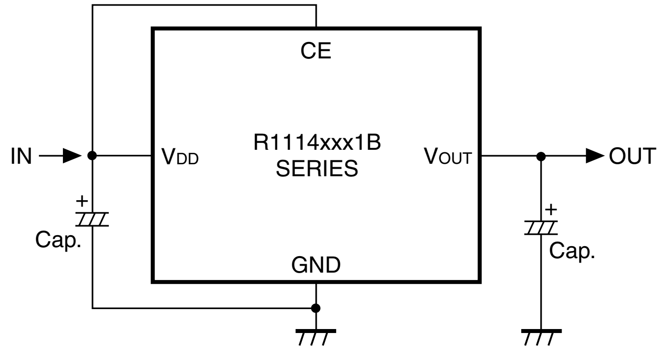


Fig.4 Load Transient Response Test Circuit

TYPICAL APPLICATIONS





(External Components)

Output Capacitor; Ceramic 0.47μF (Set Output Voltage in the range from 2.5 to 4.0V)

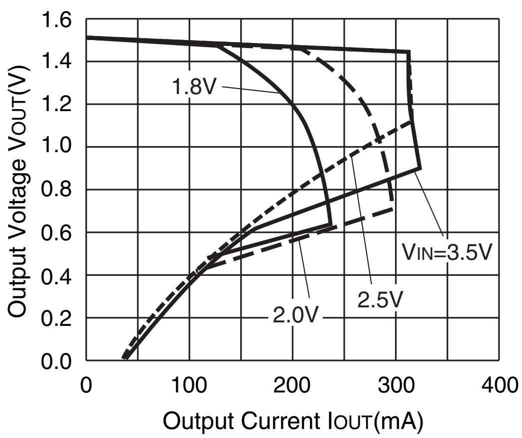
Ceramic 1.0μF (Set Output Voltage in the range from 1.5 to 2.4V)

Input Capacitor; Ceramic 1.0μF

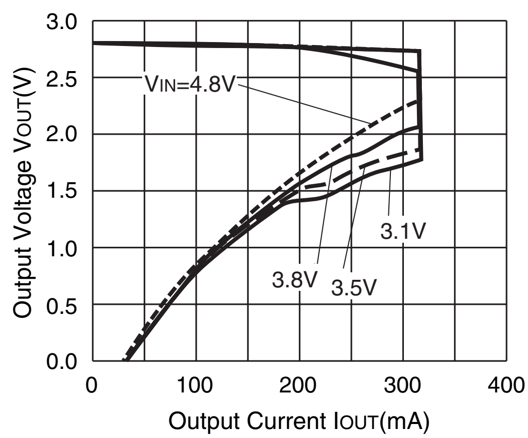
TYPICAL CHARACTERISTICS

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

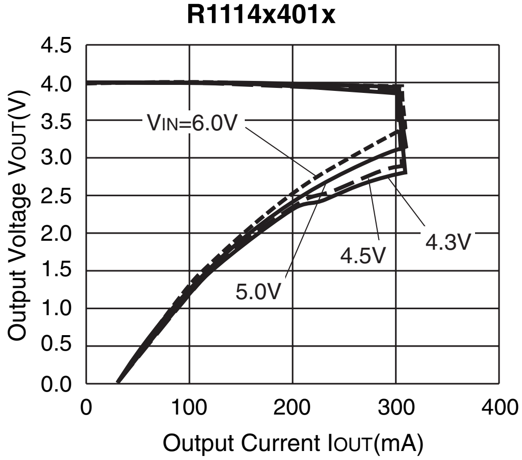
R1114x151x



R1114x281x

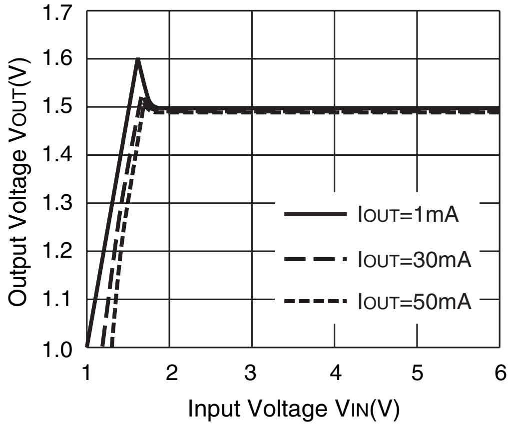


R1114x401x



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

R1114x151x



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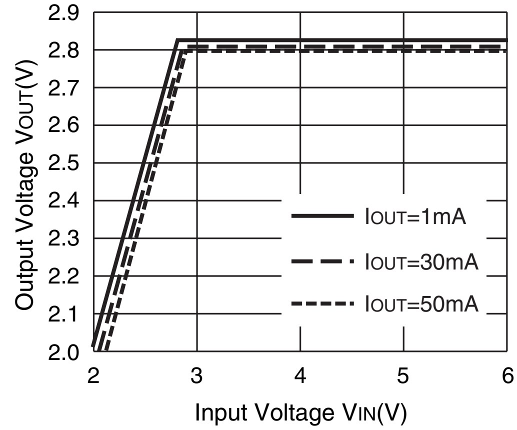
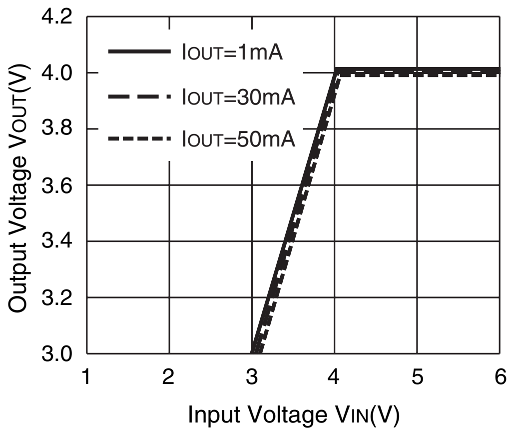
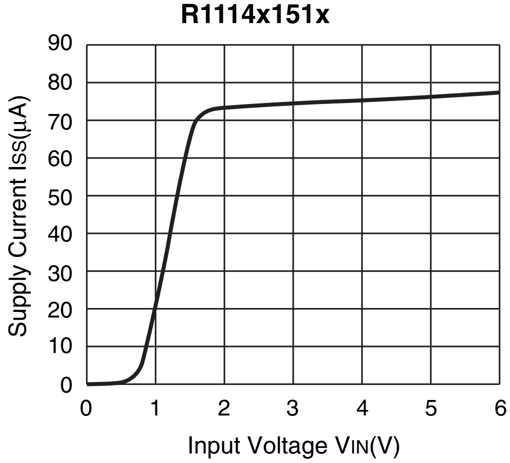


R1114x401x

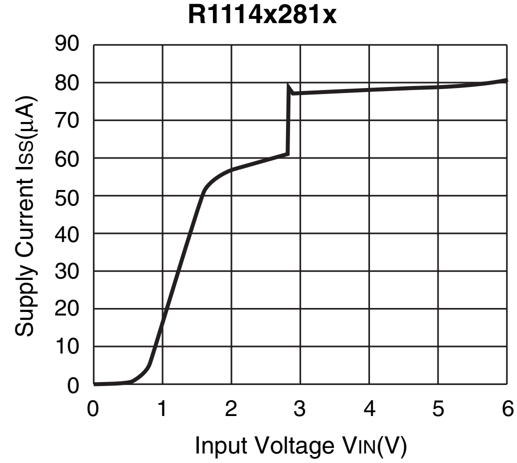


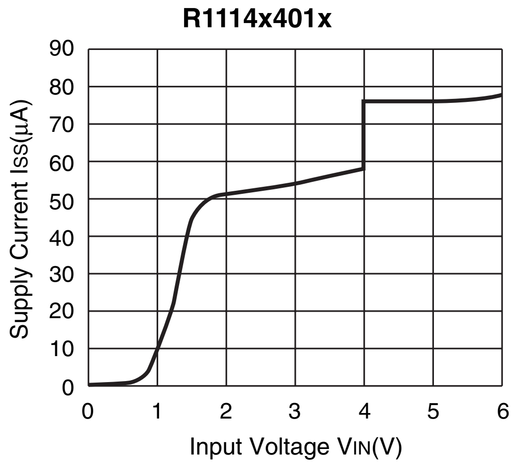
3) Supply Current vs. Input Voltage (Topt=25°C)

R1114x151x

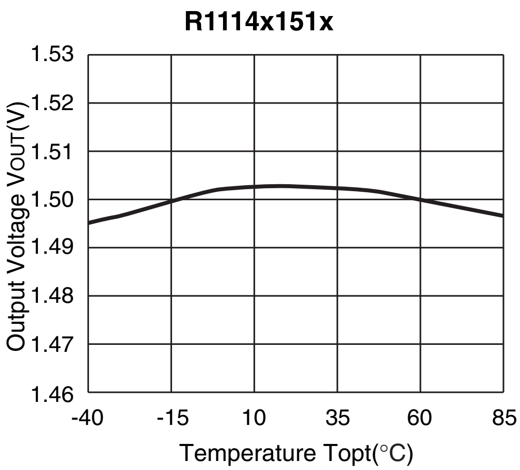


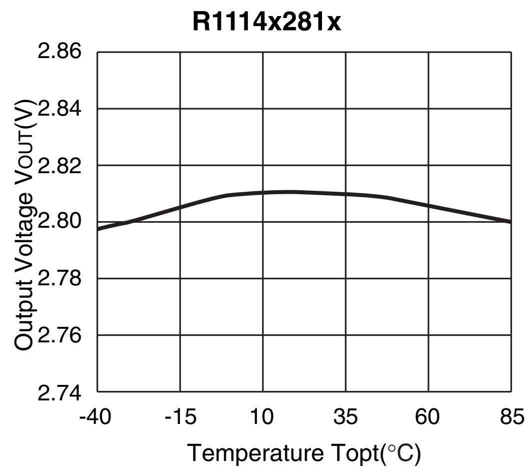
R1114x281x

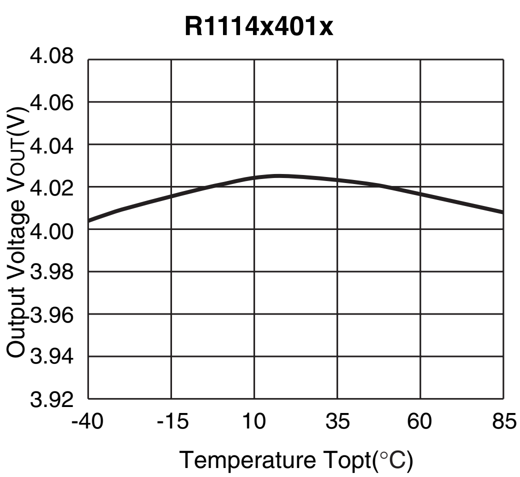




4) Output Voltage vs. Temperature

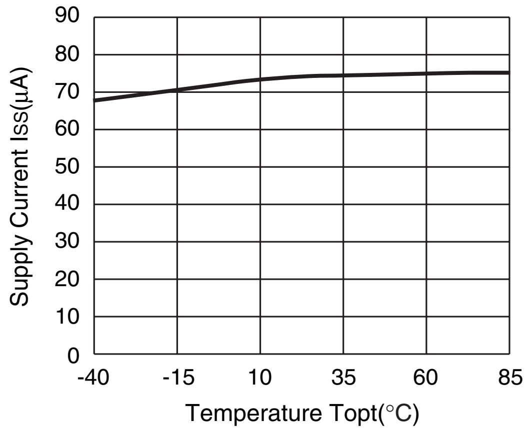




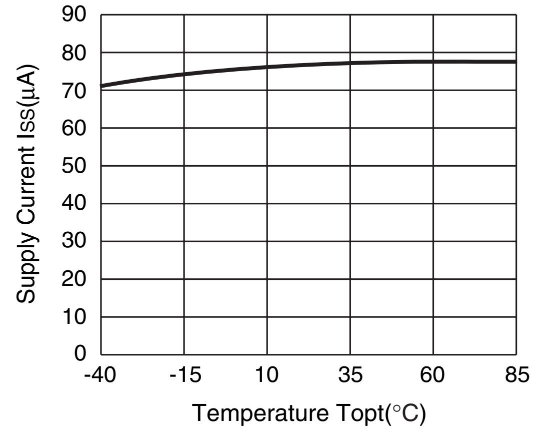


5) Supply Current vs. Temperature

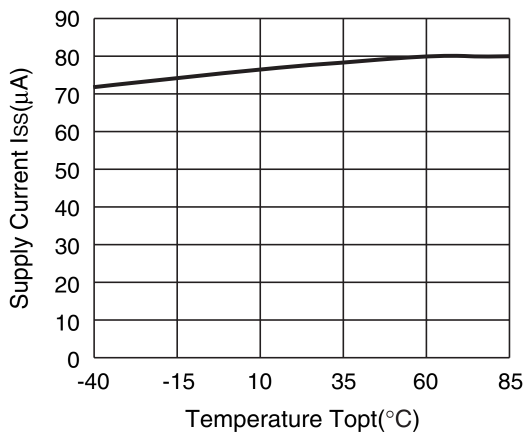
R1114x151x



R1114x281x

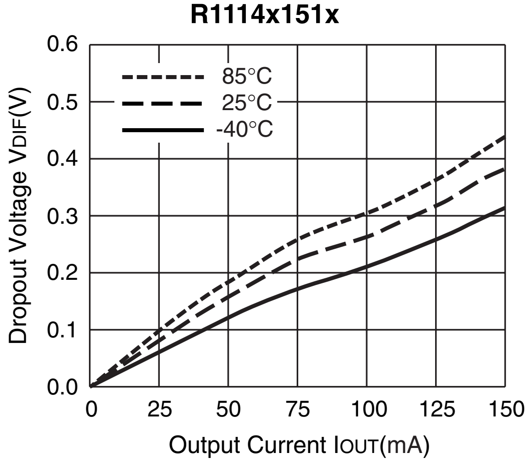


R1114x401x

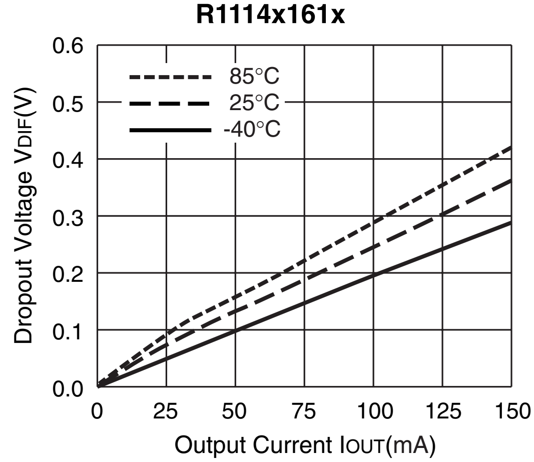


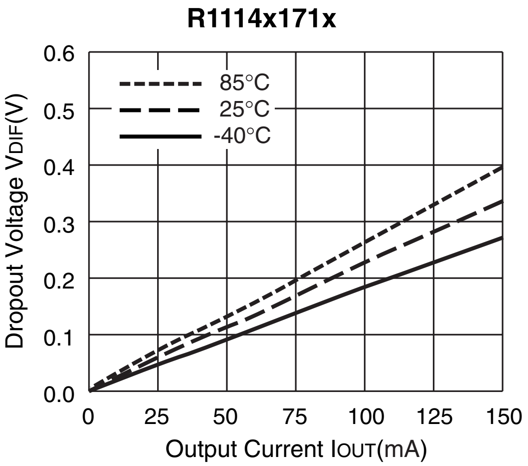
6) Dropout Voltage vs. Temperature

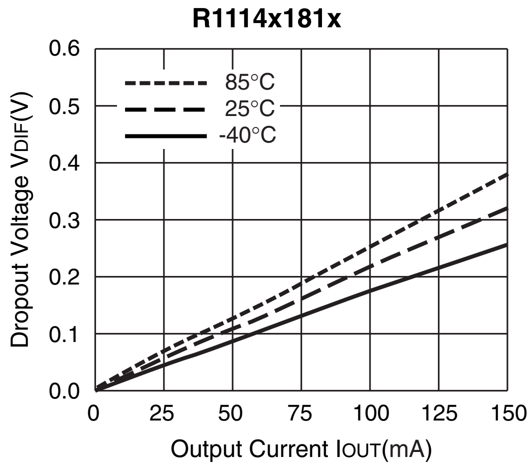
R1114x151x

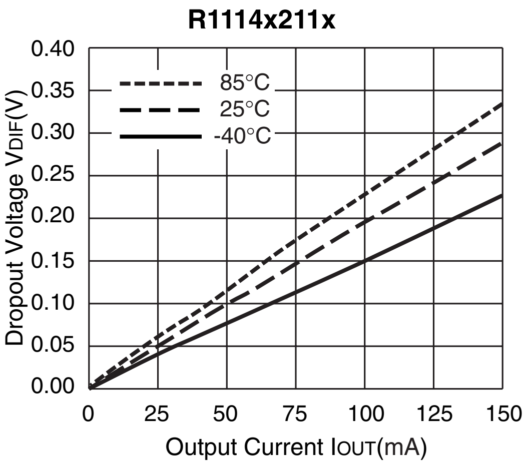


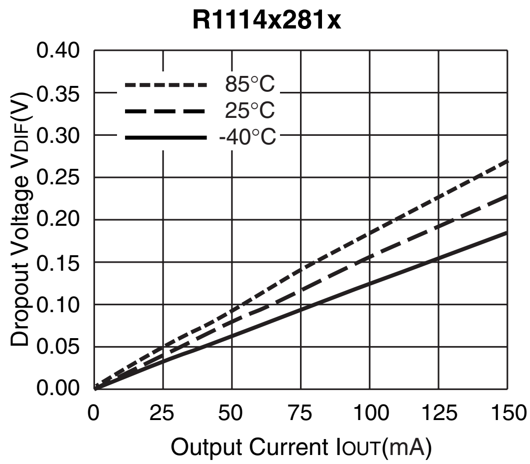
R1114x161x

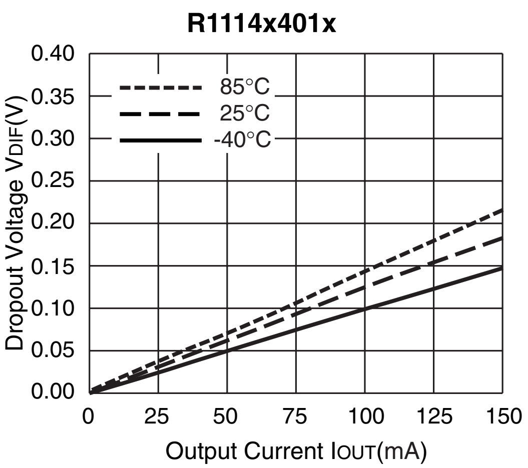



R1114x171x
85°C
25°C
-40°C
Dropout Voltage VDIF(V)
Output Current IOUT(mA)

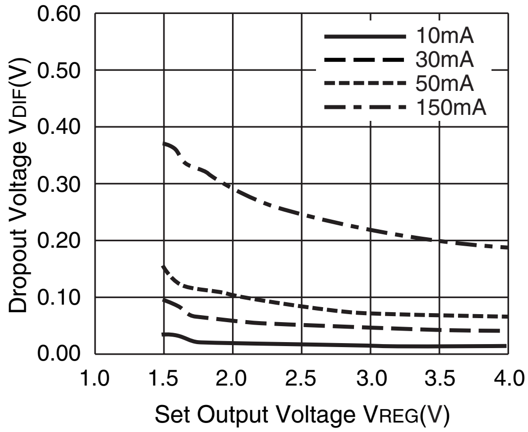

R1114x181x
85°C
25°C
-40°C
Dropout Voltage VDIF(V)
Output Current IOUT(mA)


R1114x211x
85°C
25°C
-40°C
Dropout Voltage VDIF(V)
Output Current IOUT(mA)


R1114x281x
85°C
25°C
-40°C
Dropout Voltage VDIF(V)
Output Current IOUT(mA)

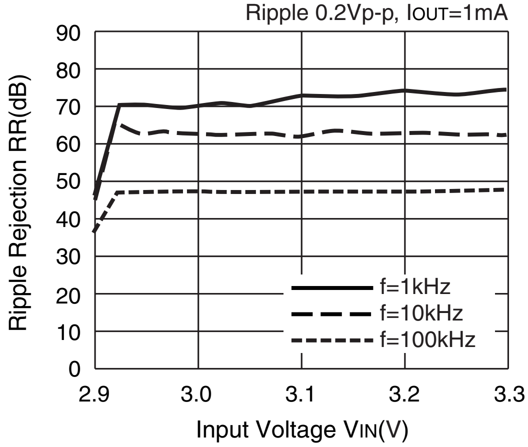

R1114x401x
85°C
25°C
-40°C
Dropout Voltage VDIF(V)
Output Current IOUT(mA)

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



8) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, C_{IN}=none, Cout=ceramic0.47μF)

R1114x281x



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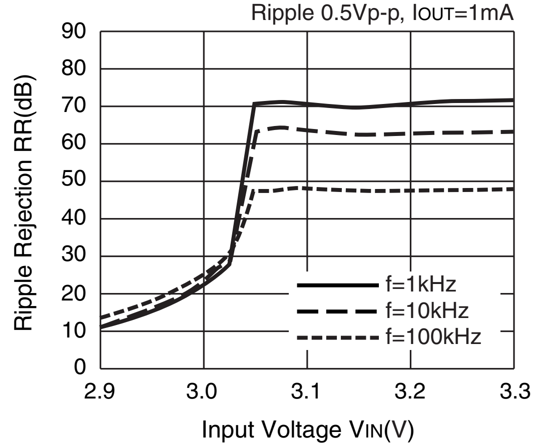

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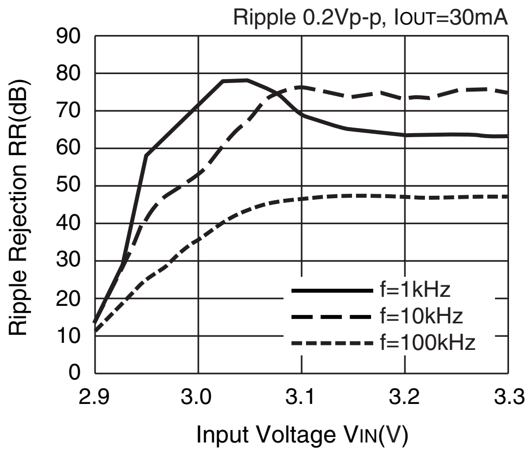
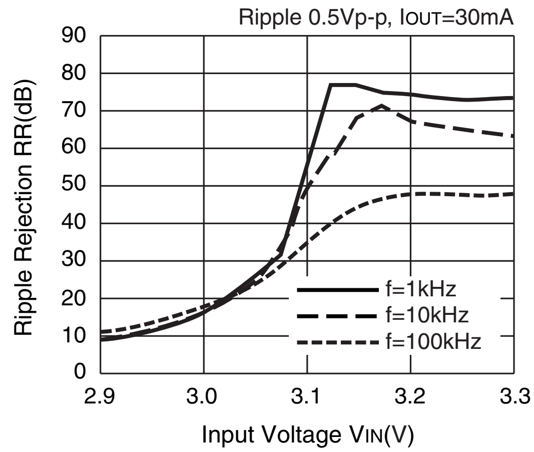
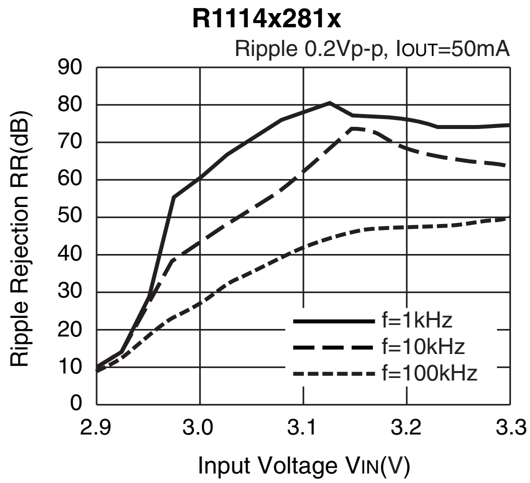
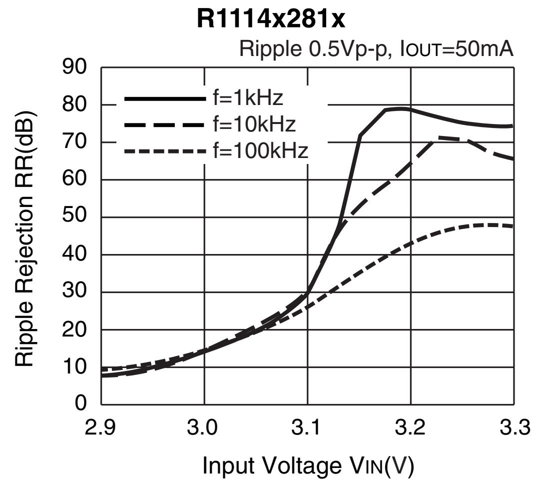


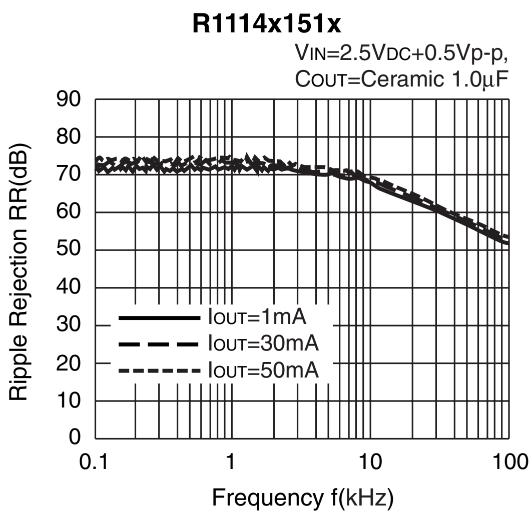
R1114x281x

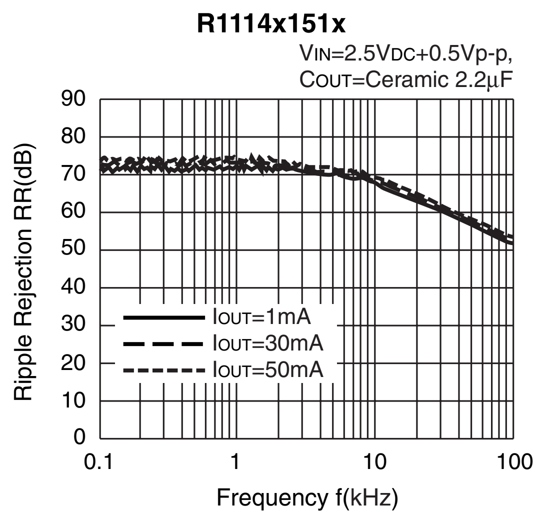


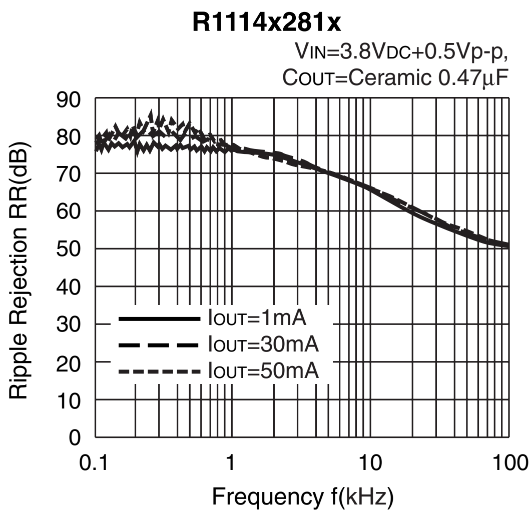


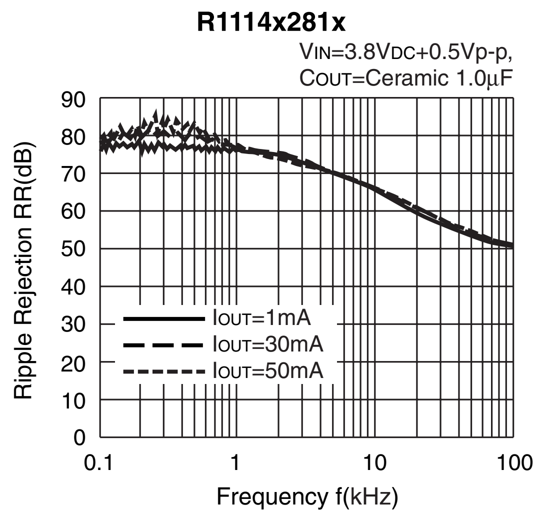


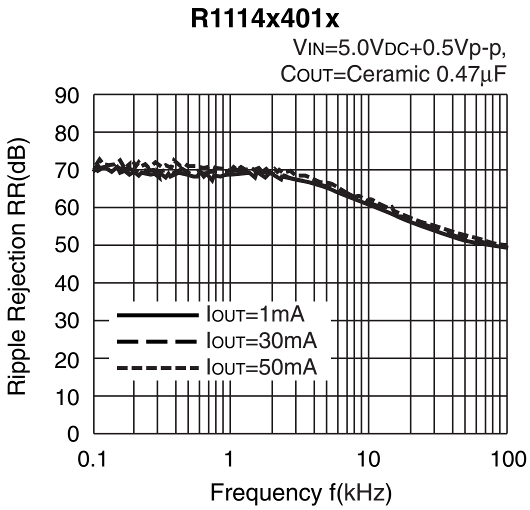
9) Ripple Rejection vs. Frequency (C_{IN}=none)

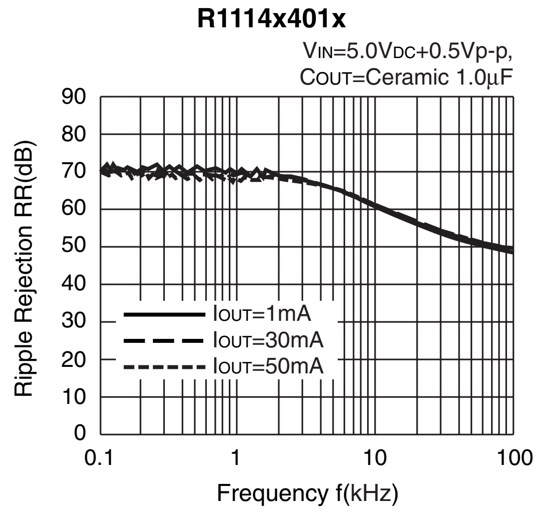




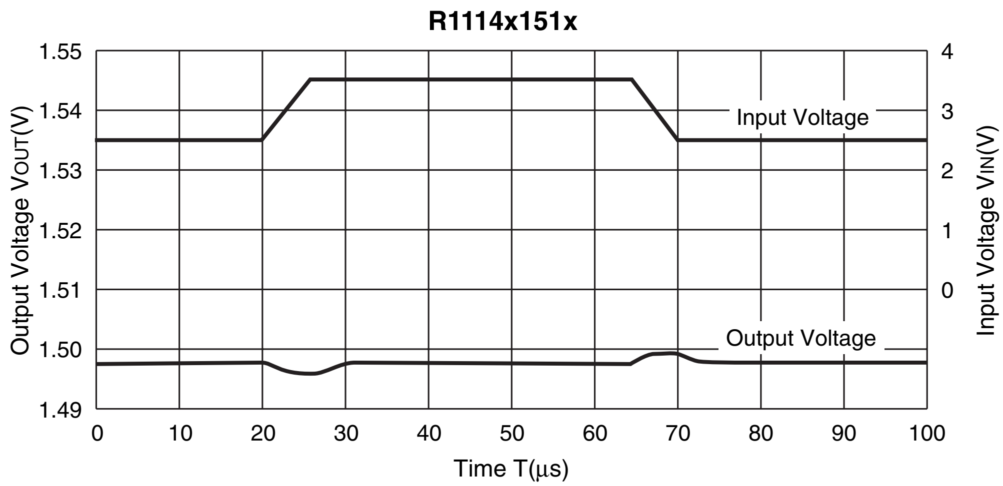


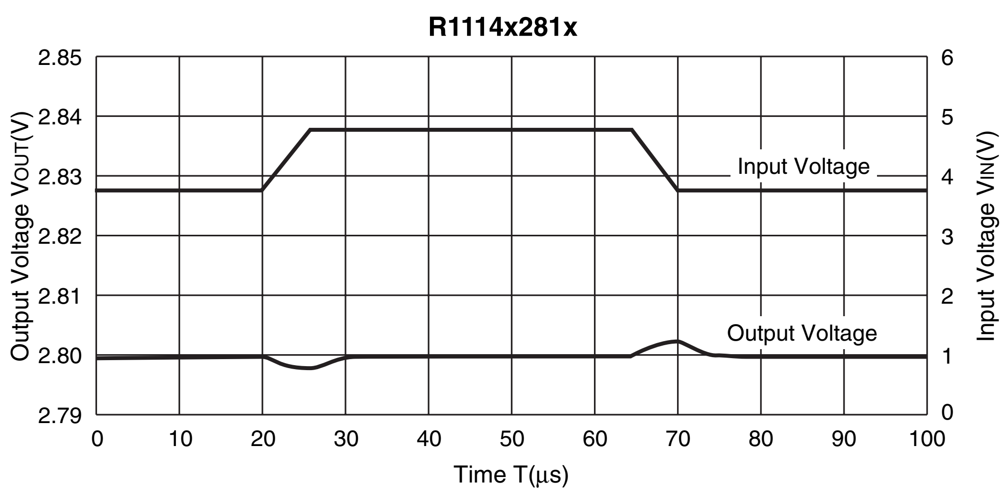




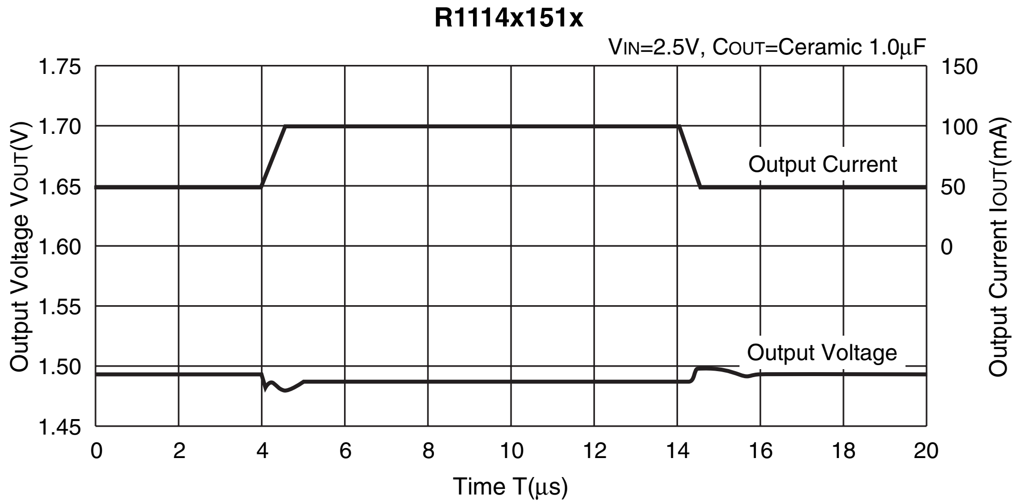


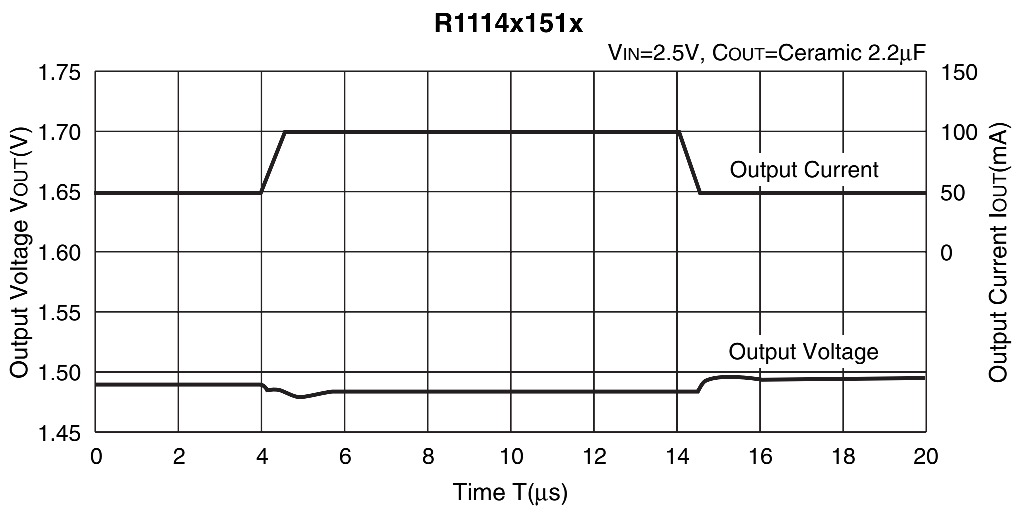
10) Input Transient Response (I_{OUT}=30mA, C_{IN}=none, tr=tf=5µs, C_{OUT}=Ceramic 0.47µF)

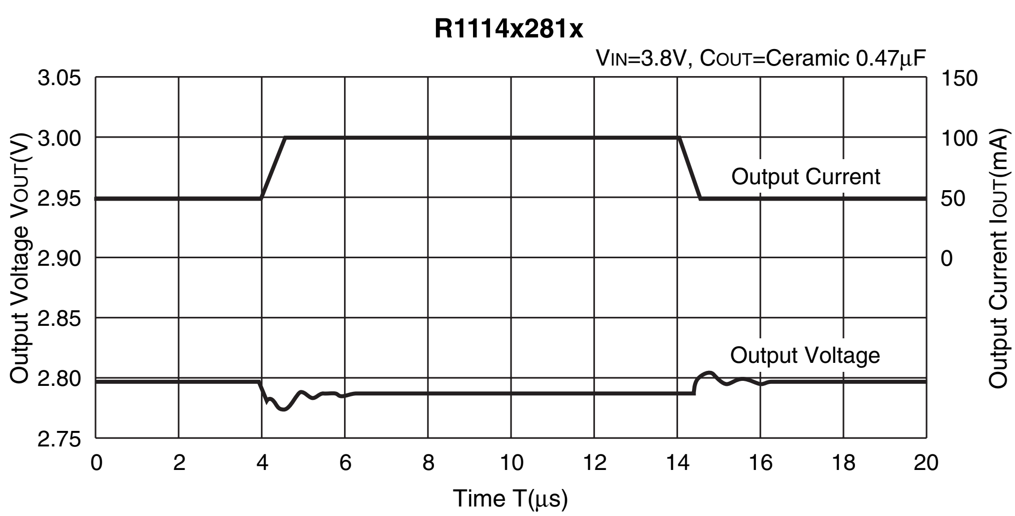




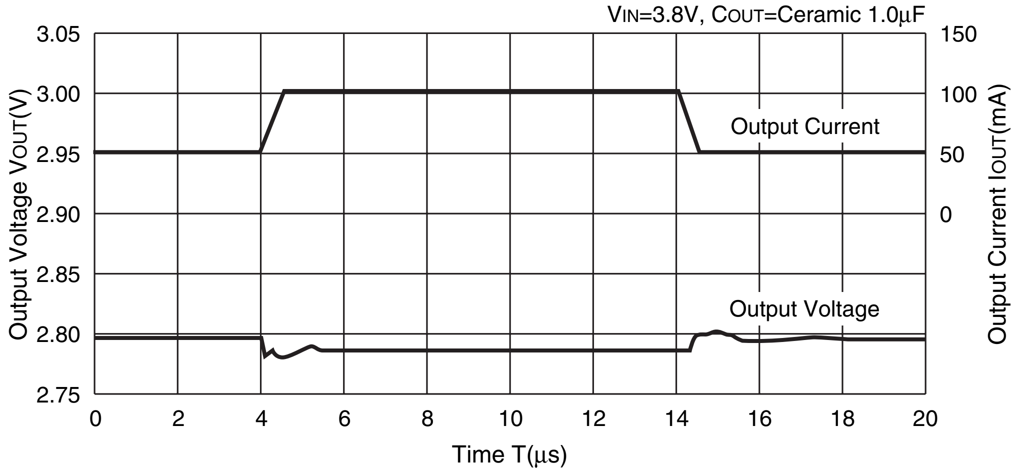
11) Load Transient Response (tr=tf=0.5μs, C_{IN}=Ceramic 1.0μF)



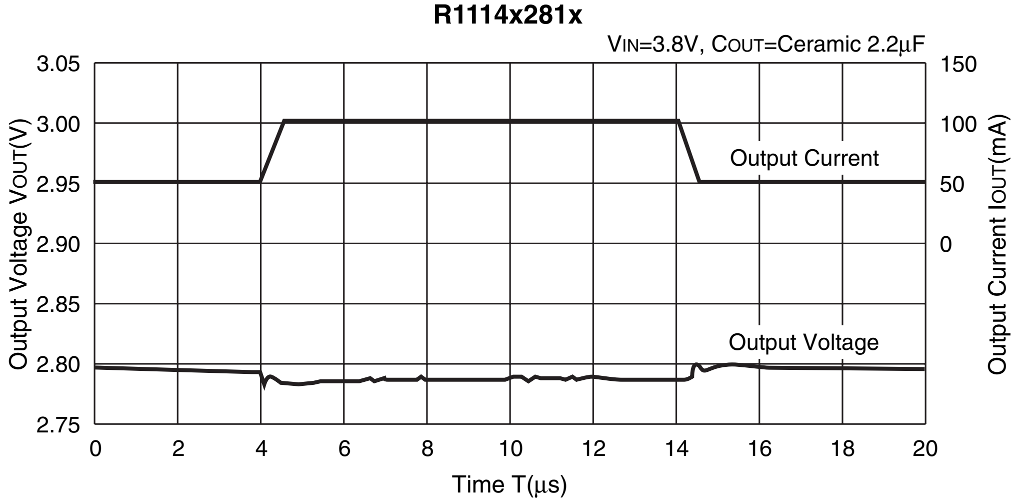




R1114x281x

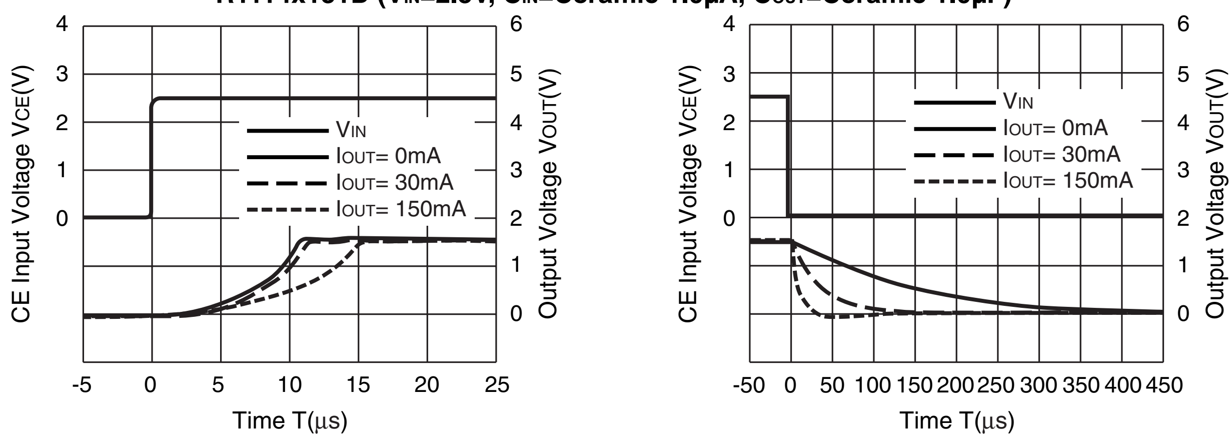


R1114x281x

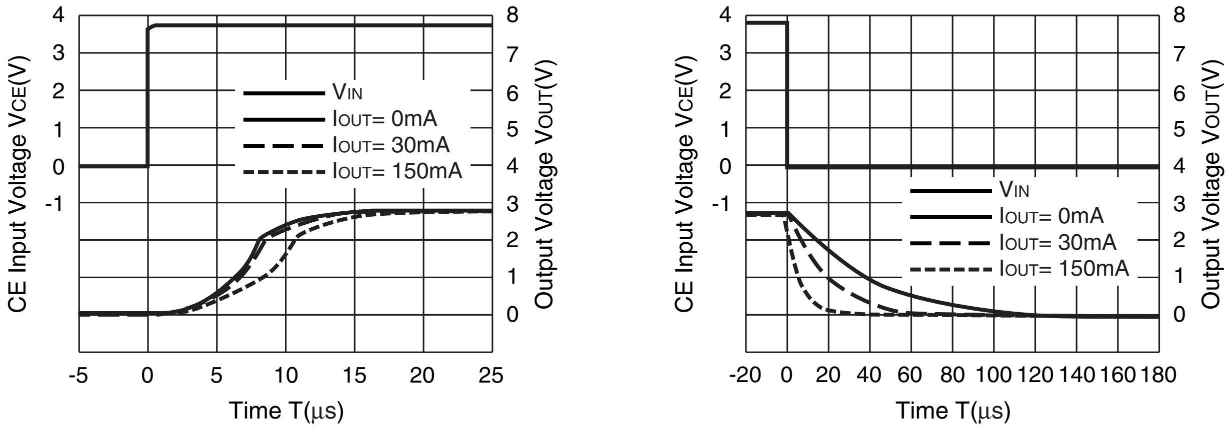


12) Turn-on/off speed with CE pin (D version)

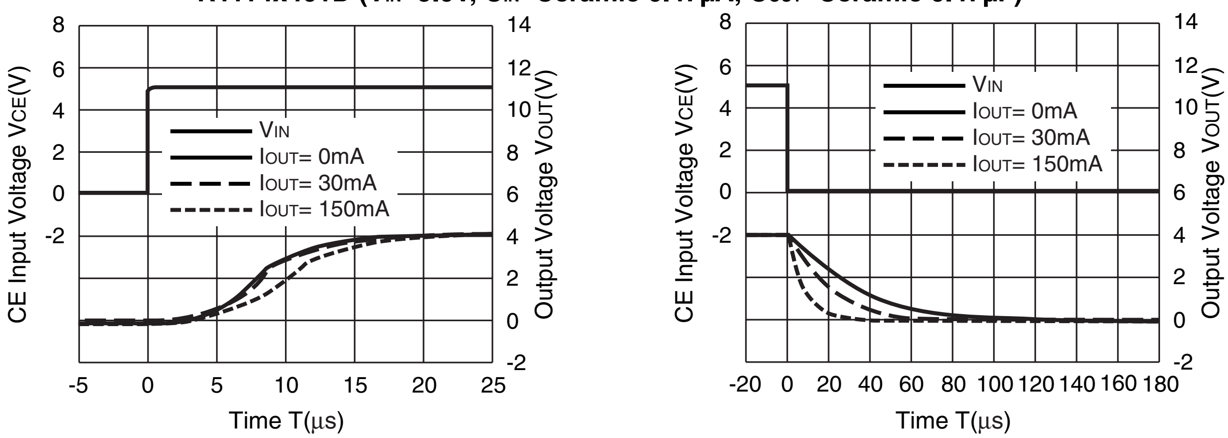
R1114x151D (VIN=2.5V, CIN=Ceramic 1.0μA, COUT=Ceramic 1.0μF)



R1114x281D (V_{IN}=3.8V, C_{IN}=Ceramic 0.47μA, C_{OUT}=Ceramic 0.47μF)



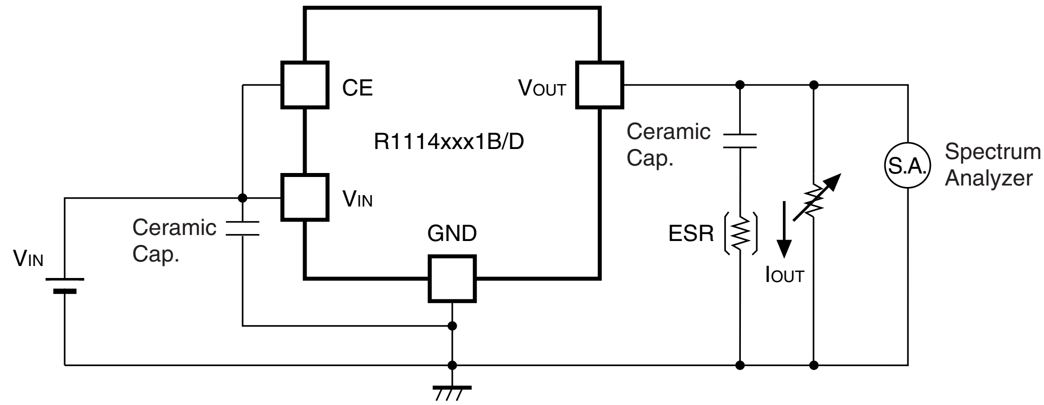
R1114x401D (V_{IN}=5.0V, C_{IN}=Ceramic 0.47μA, C_{OUT}=Ceramic 0.47μF)



TECHNICAL NOTES

When using these ICs, consider the following points:

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance) of which is in the range described as follows:



Measuring Circuit for white noise; R1114xxx1B/D

The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under 40μV (Avg.) are marked as the hatched area in the graph.
(Note: If additional ceramic capacitors are connected to the Output Pin with Output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

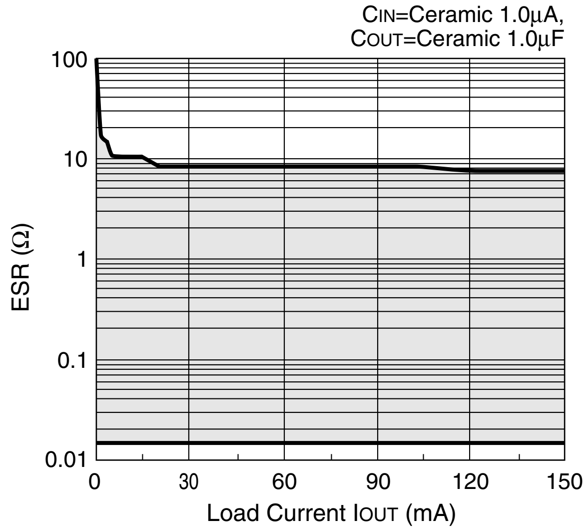
<Measurement conditions>

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

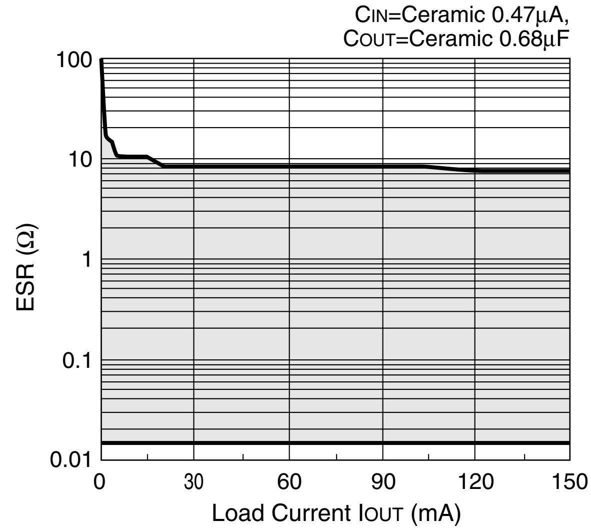
(2) Frequency Band: 10Hz to 2MHz

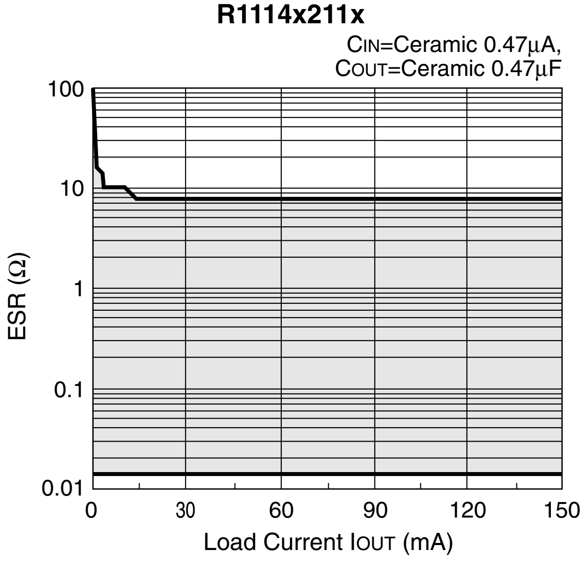
(3) Temperature: -40°C to 25°C

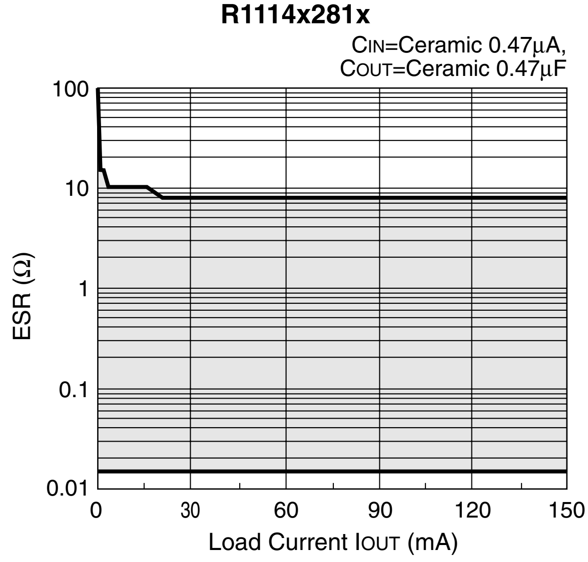
R1114x151x



R1114x161x




R1114x211x
CIN=Ceramic 0.47µA,
COUT=Ceramic 0.47µF
100
10
1
0.1
0.01
ESR (Ω)
0
30
60
90
120
150
Load Current IOUT (mA)


R1114x281x
CIN=Ceramic 0.47µA,
COUT=Ceramic 0.47µF
100
10
1
0.1
0.01
ESR (Ω)
0
30
60
90
120
150
Load Current IOUT (mA)