LOW NOISE 150mA LDO REGULATOR

NO.EA-094-111026

OUTLINE

The R1114x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, 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, SC-82AB, and SON1612-6 therefore high density mounting of the ICs on boards is possible.

FEATURES

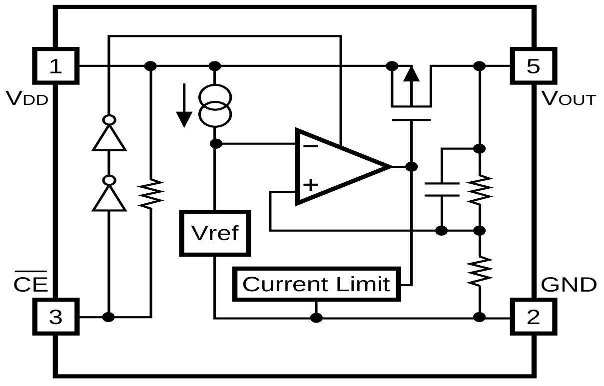
- Supply Current .... Typ. 75μA
- Standby Mode .... Typ. 0.1μA
- Dropout Voltage .... Typ. 0.22V (I_{OUT}=150mA 3.0V Output type)
- Ripple Rejection .... Typ. 70dB (f=1kHz 3.0V Output type)
  Typ. 60dB (f=10kHz)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.02%/V
- Output Voltage Range .... 1.5V to 4.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy .... ±2.0%
- Packages SON1612-6, SC-82AB, SOT-23-5
- Built-in Fold Back Protection Circuit .... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC ... $C_{IN}=C_{OUT}$=1μF (V_{OUT}<2.5V)
  C_{IN}=1μF, C_{OUT}=0.47μF ($V_{OUT} \geqq$ 2.5V)

APPLICATIONS

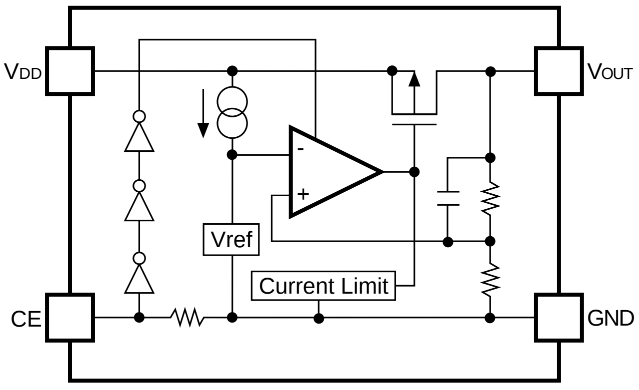
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

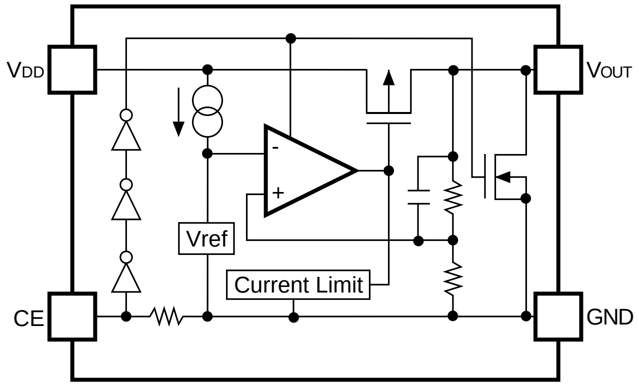
R1114xxx1A



R1114xxx1B



R1114xxx1D



SELECTION GUIDE

The output voltage, auto discharge function, package, and the taping type, etc. for the ICs can be selected at the user's request.

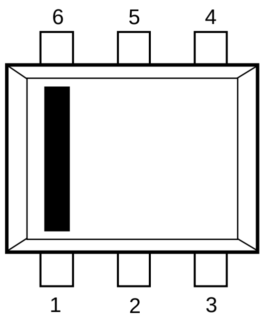
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1114Dxx1∗-TR-FE	SON1612-6	4,000 pcs	Yes	Yes
R1114Qxx1∗-TR-FE	SC-82AB	3,000 pcs	Yes	Yes
R1114Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.5V(15) to 4.0V(40) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

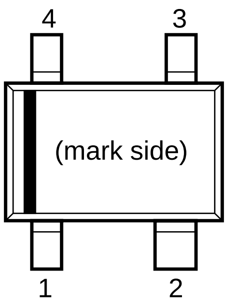
∗ : CE pin polarity and auto discharge function at off state are options as follows.
(A) "L" active, without auto discharge function at off state
(B) "H" active, without auto discharge function at off state
(D) "H" active, with auto discharge function at off state

PIN CONFIGURATION

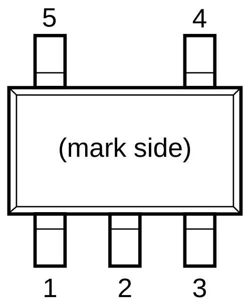
● **SON1612-6**



● **SC-82AB**



● **SOT-23-5**



PIN DESCRIPTIONS

● **R1114D**

Pin No.	Symbol	Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	V_{OUT}	Output pin
4	NC	No Connection
5	GND	Ground Pin
6	$\overline{CE}$ or CE	Chip Enable Pin

● **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)	6.5	V
V_{OUT}	Output Voltage	–0.3~V_{IN}+0.3	V
I_{OUT}	Output Current	200	mA
P_D	Power Dissipation (SON1612-6)*	500	mW
	Power Dissipation (SC-82AB)*	380	
	Power Dissipation (SOT-23-5)*	420	
Topt	Operating Temperature Range	–40~85	°C
Tstg	Storage Temperature Range	–55~125	°C

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

ABSOLUTE MAXIMUM RATINGS

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

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

- **R1114xxx1A**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN} = Set V_{OUT}+1V 1mA ≦ I_{OUT} ≦ 30mA	×0.980		×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} = V_{DD}		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
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA –40°C ≦ Topt ≦ 85°C		±100		ppm /°C
I_{SC}	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		6.0	V
V_{CEL}	$\overline{CE}$ Input Voltage "L"		0.0		0.3	V
en	Output Noise	BW = 10Hz to 100kHz		30		μVrms

- **R1114xxx1B/D**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN} = Set V_{OUT}+1V 1mA ≦ I_{OUT} ≦ 30mA	×0.980		×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		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
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA –40°C ≦ Topt ≦ 85°C		±100		ppm/°C
I_{SC}	Short Current Limit	V_{OUT} = 0V		40		mA
R_{PD}	CE Pull-down Resistance		0.7	2.0	8.0	MΩ
V_{CEH}	CE Input Voltage "H"		1.5		6.0	V
V_{CEL}	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 ≦ V_{OUT} ≦ 2.0		0.32	0.55
2.1 ≦ V_{OUT} ≦ 2.7		0.28	0.50
2.8 ≦ V_{OUT} ≦ 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

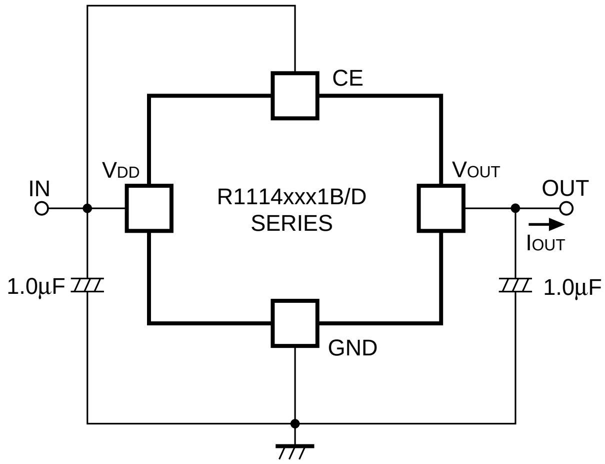


Fig.1 Standard test Circuit

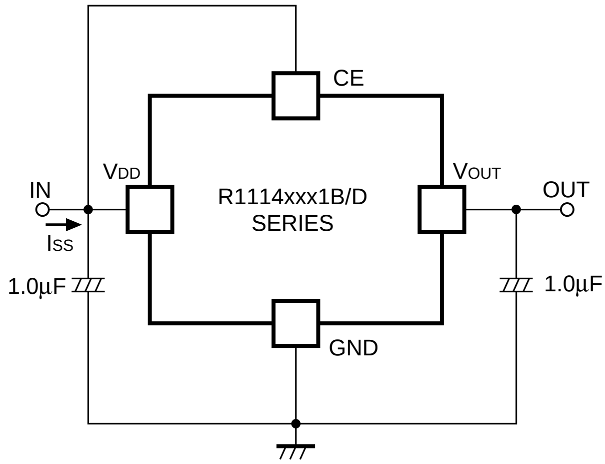


Fig.2 Supply Current Test Circuit

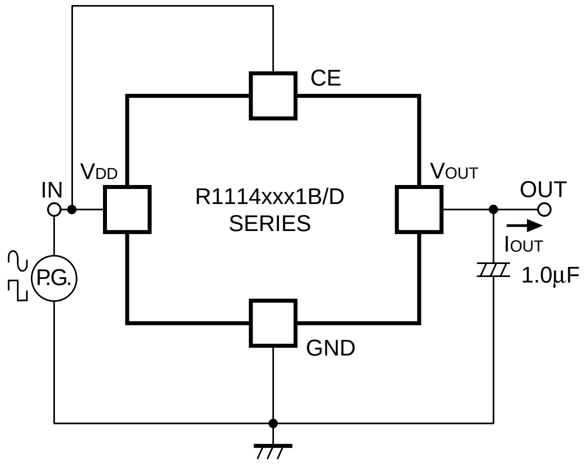


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

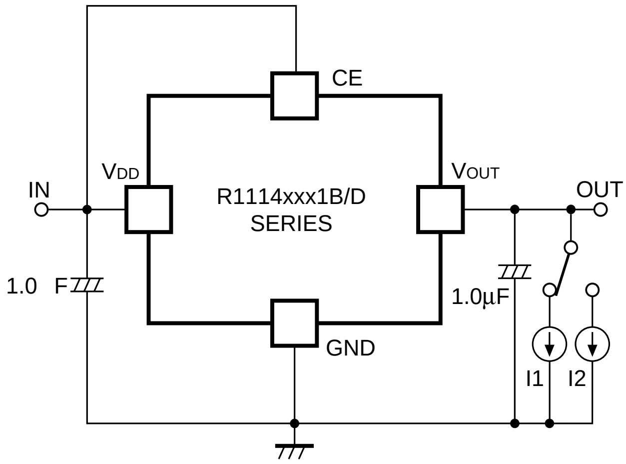
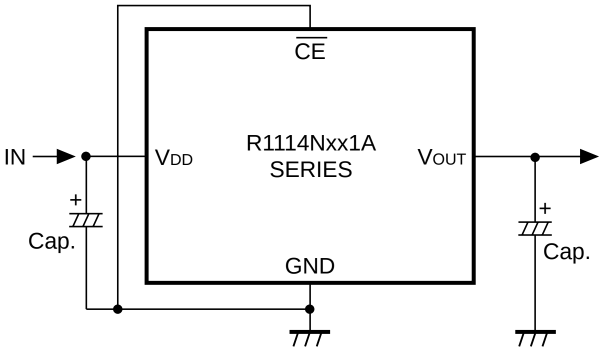
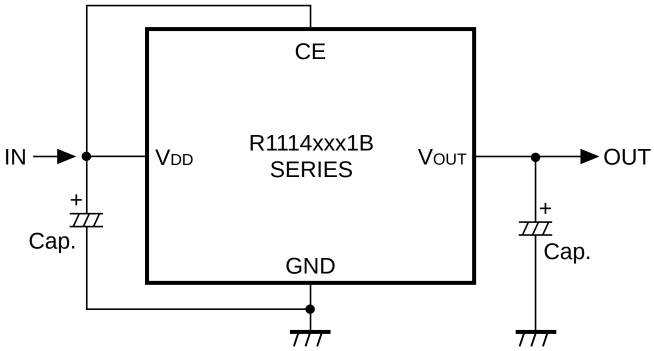


Fig.4 Load Transient Response Test Circuit

TYPICAL APPLICATIONS





(External Components)

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

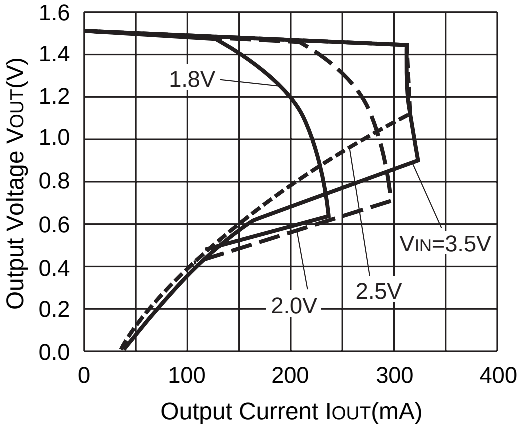
Ceramic 1.0μF (Set Output Voltage in the range from 1.5 to 2.4V)

Input Capacitor; Ceramic 1.0μF

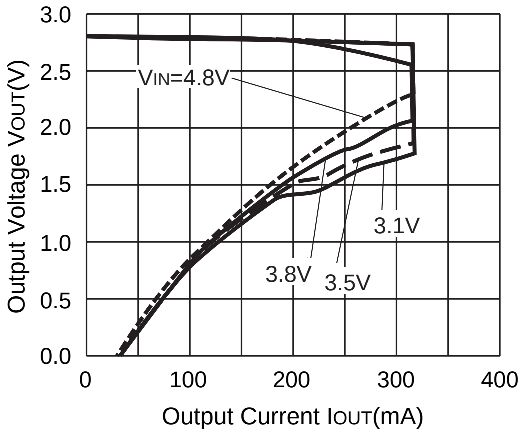
TYPICAL CHARACTERISTICS

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

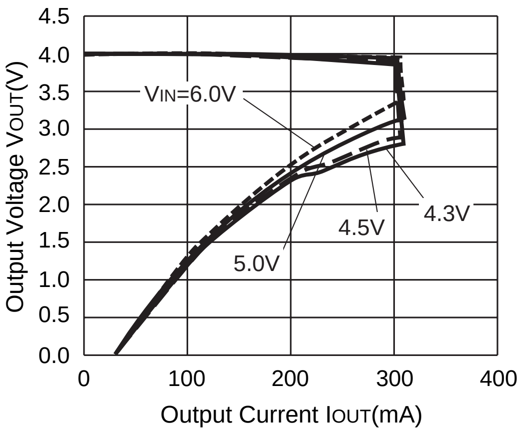
R1114x151x



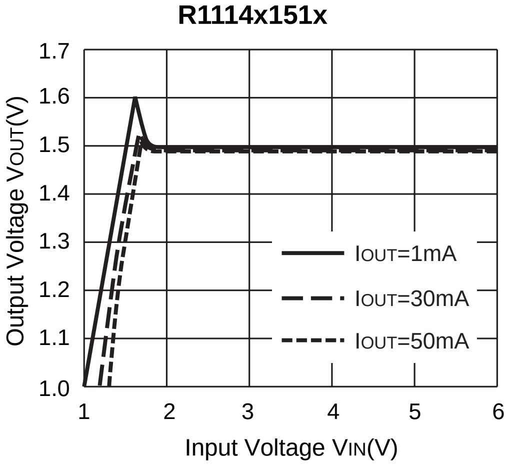
R1114x281x

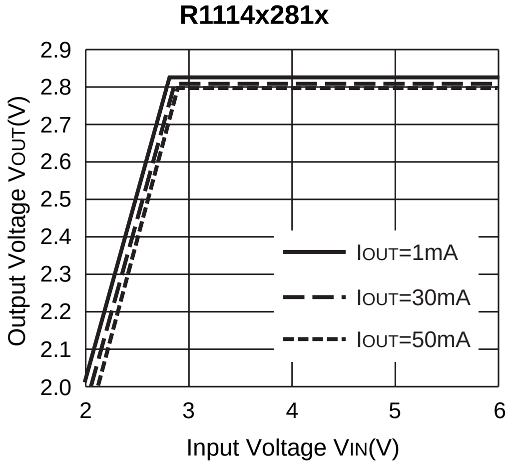


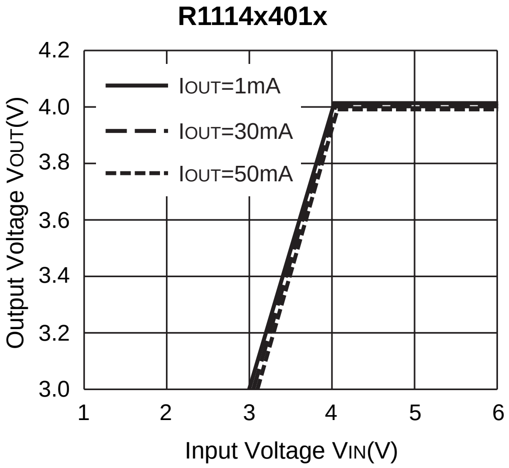
R1114x401x



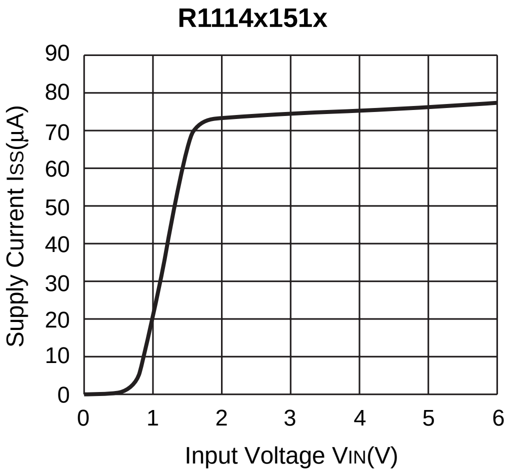
2) Output Voltage vs. Input Voltage (Topt=25°C)

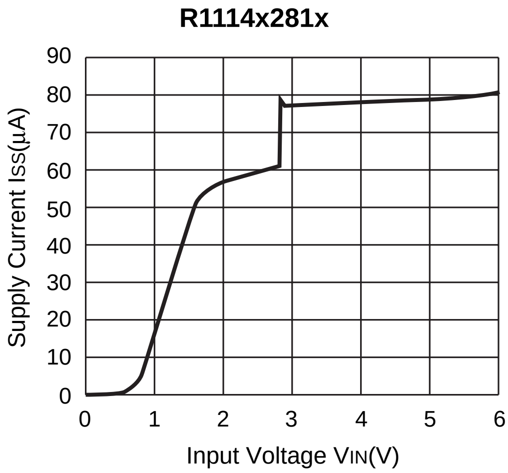


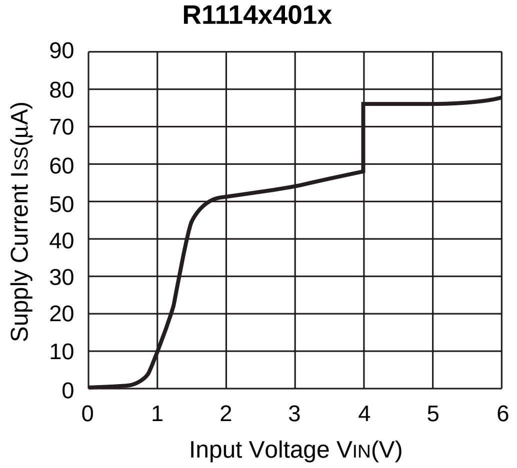




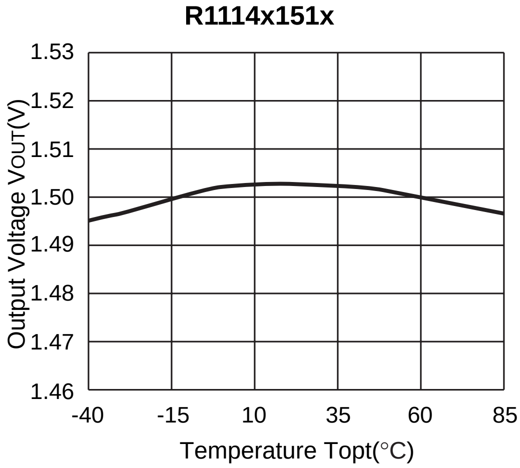
3) Supply Current vs. Input Voltage (Topt=25°C)

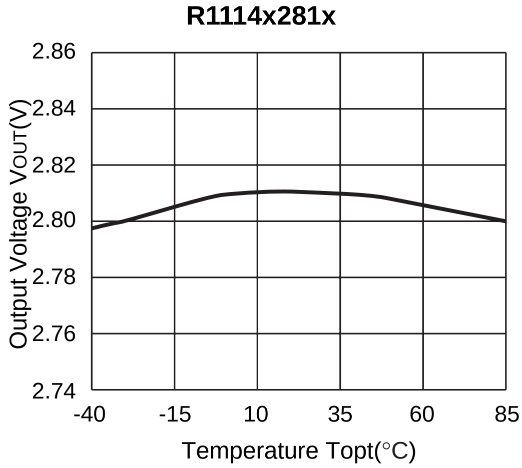


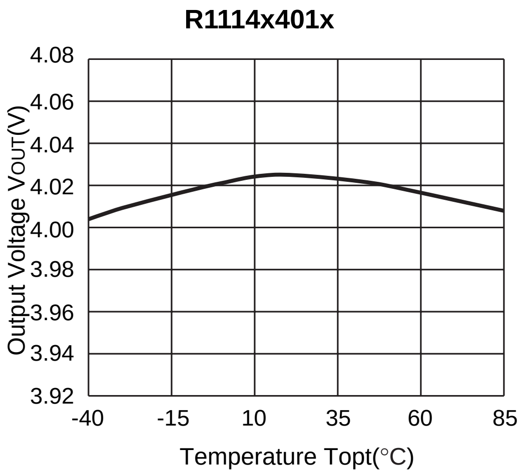




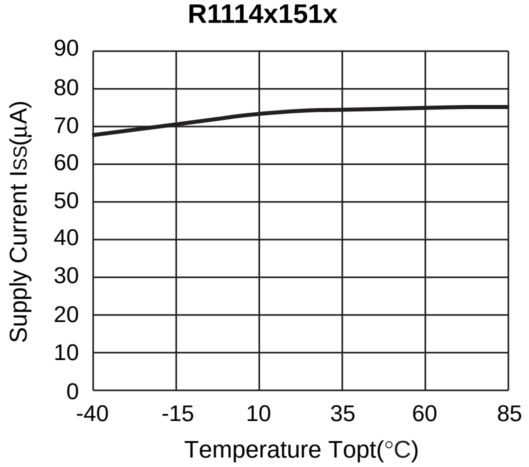
4) Output Voltage vs. Temperature

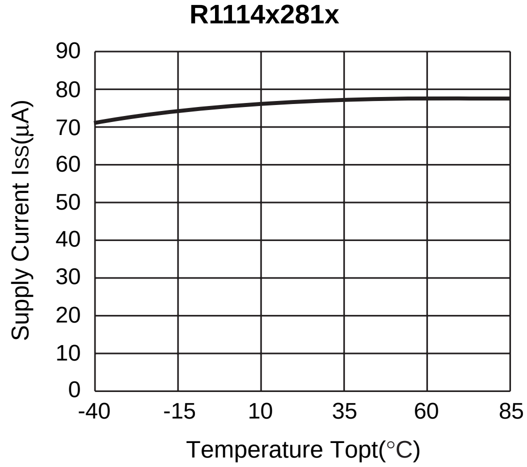


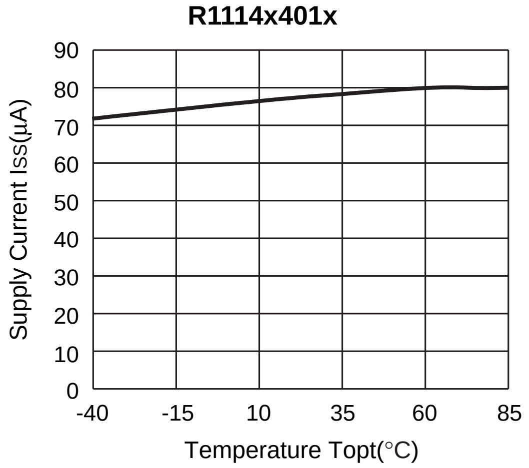




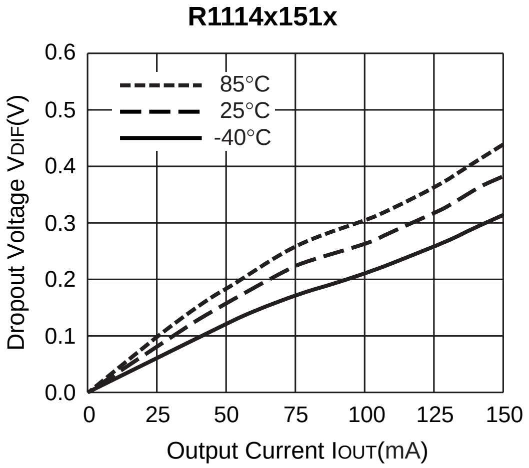
5) Supply Current vs. Temperature

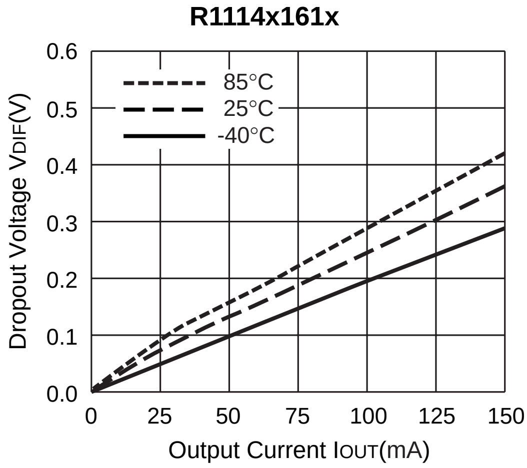


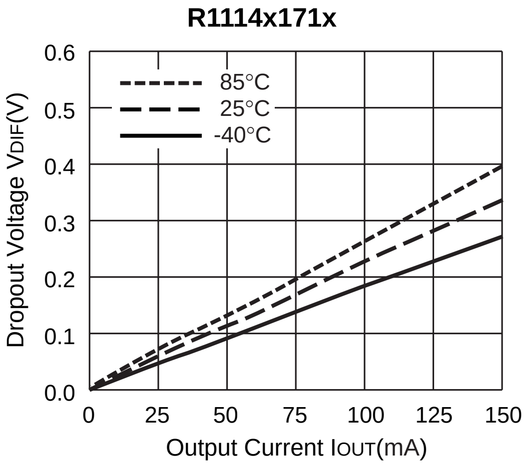


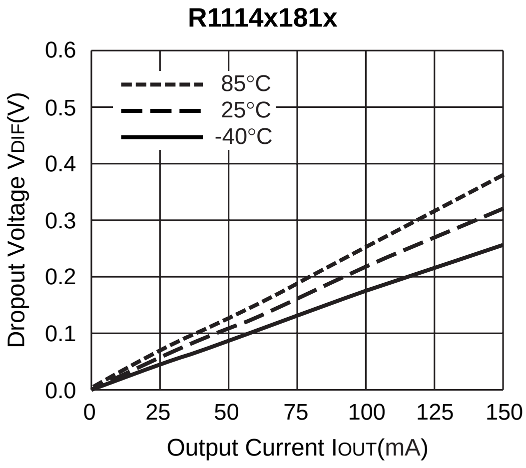


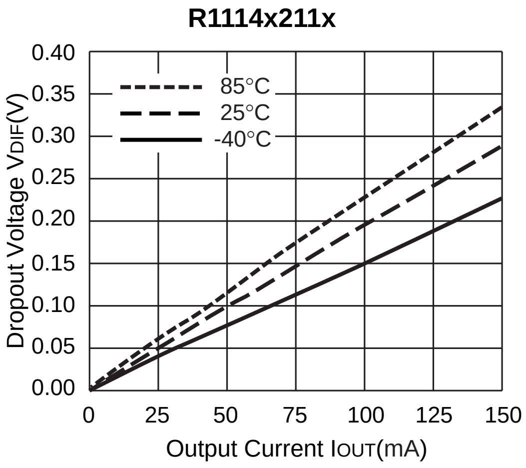
6) Dropout Voltage vs. Temperature

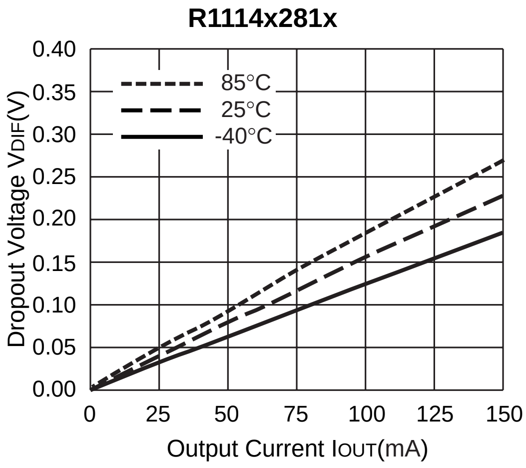


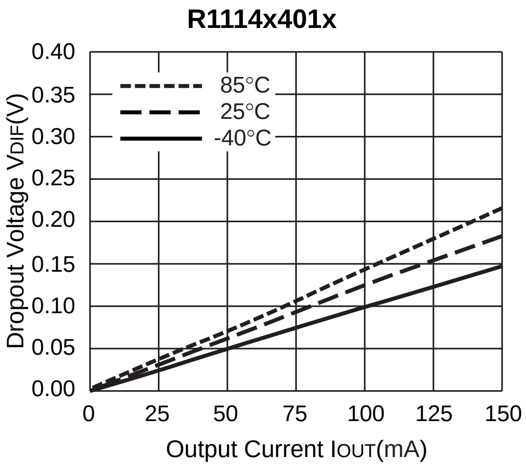



R1114x171x
Dropout Voltage VDIF(V)
Output Current IOUT(mA)
85°C
25°C
-40°C
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
25
50
75
100
125
150

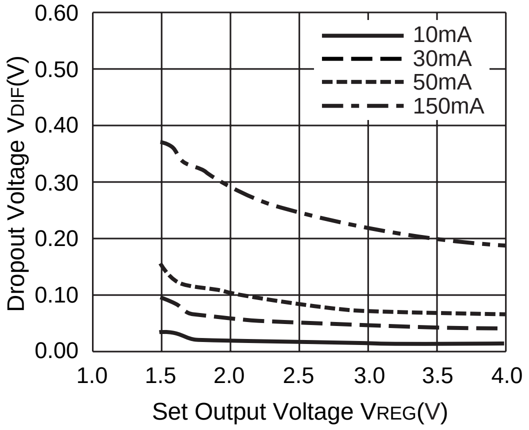

R1114x181x
Dropout Voltage VDIF(V)
Output Current IOUT(mA)
85°C
25°C
-40°C
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
25
50
75
100
125
150


R1114x211x
Dropout Voltage VDIF(V)
Output Current IOUT(mA)
85°C
25°C
-40°C
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0
25
50
75
100
125
150

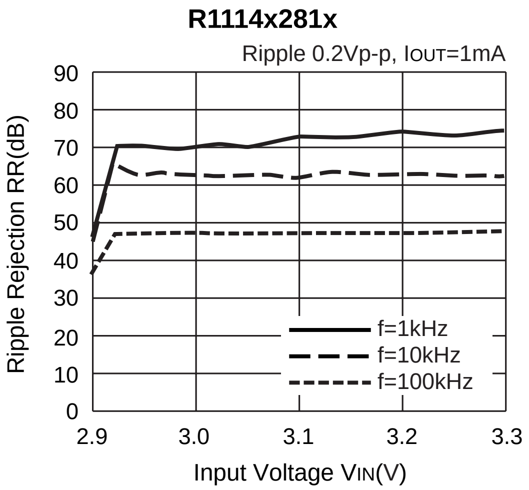

R1114x281x
Dropout Voltage VDIF(V)
Output Current IOUT(mA)
85°C
25°C
-40°C
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0
25
50
75
100
125
150

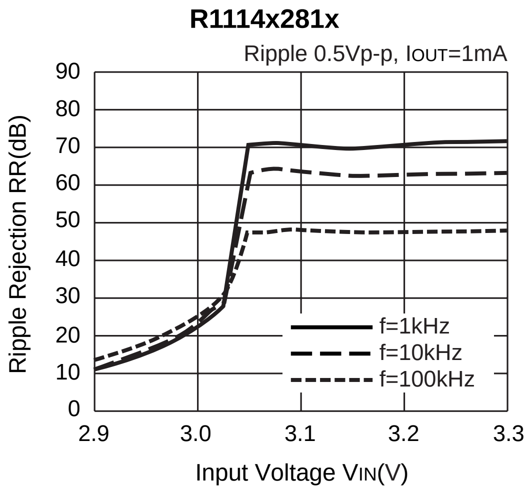

R1114x401x
Dropout Voltage VDIF(V)
Output Current IOUT(mA)
85°C
25°C
-40°C
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0
25
50
75
100
125
150

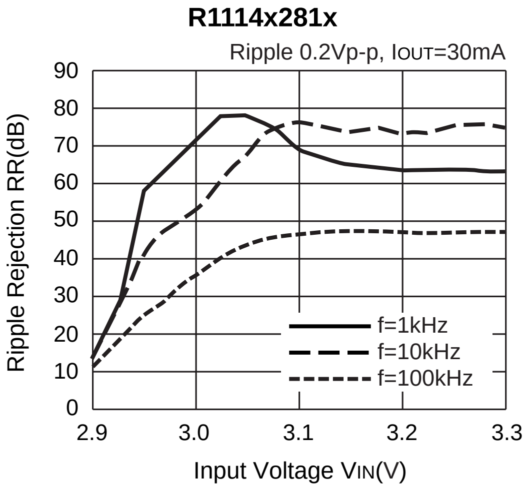
7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

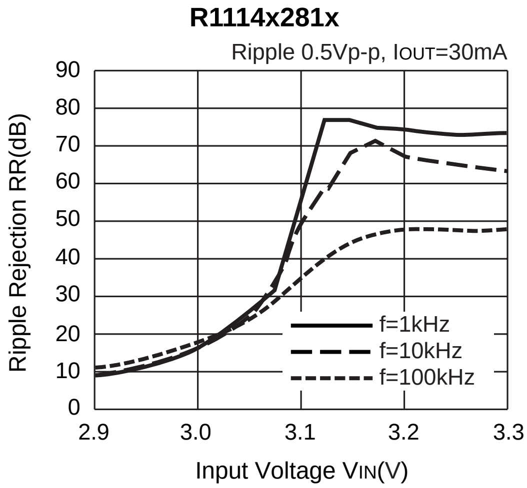


8) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, C_{IN}=none, C_{OUT}=ceramic0.47μF)

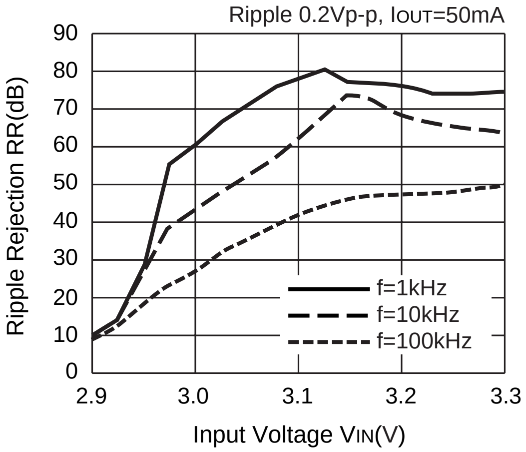




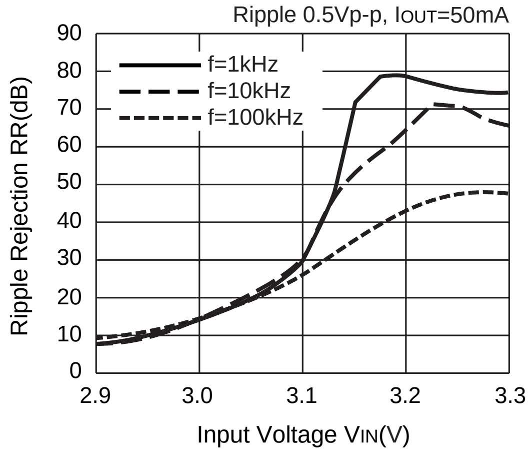




R1114x281x

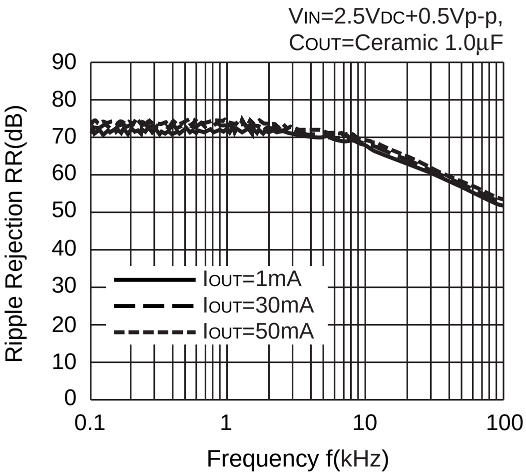


R1114x281x

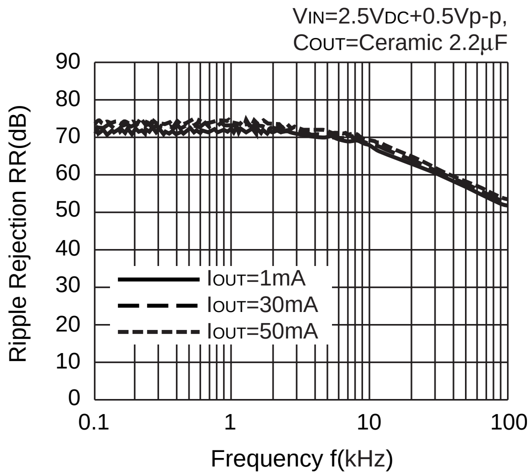


9) Ripple Rejection vs. Frequency (C_{IN}=none)

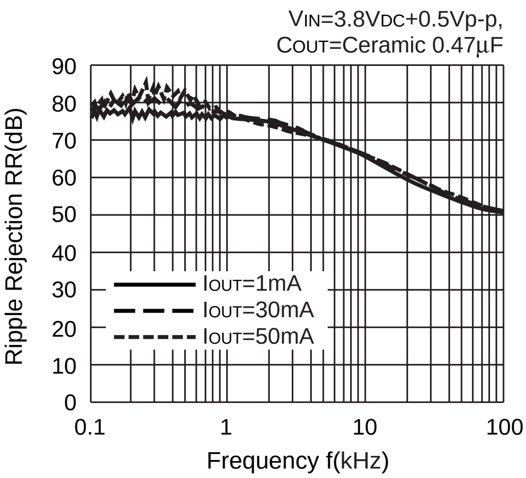
R1114x151x



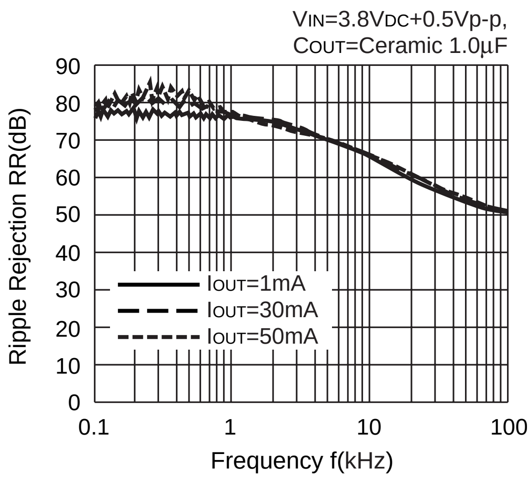
R1114x151x

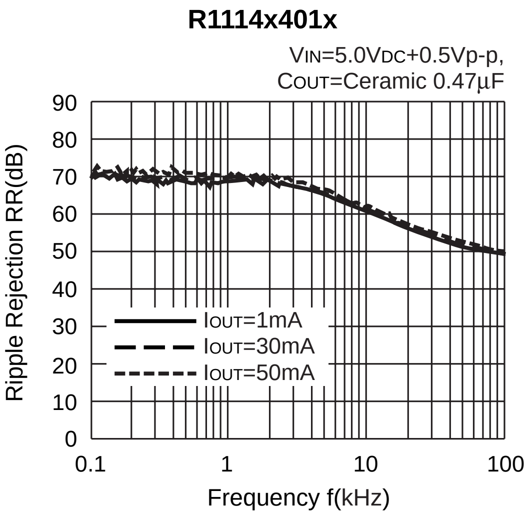


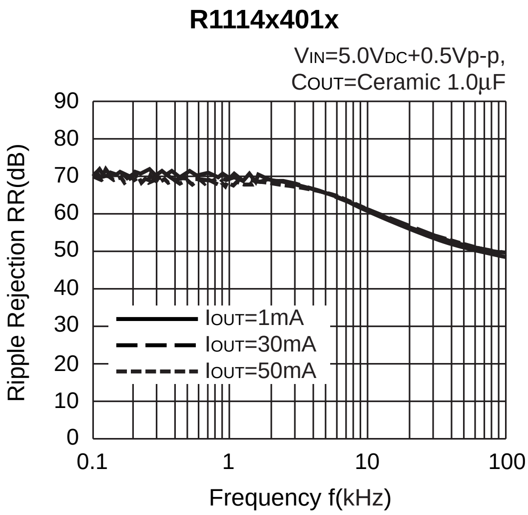
R1114x281x



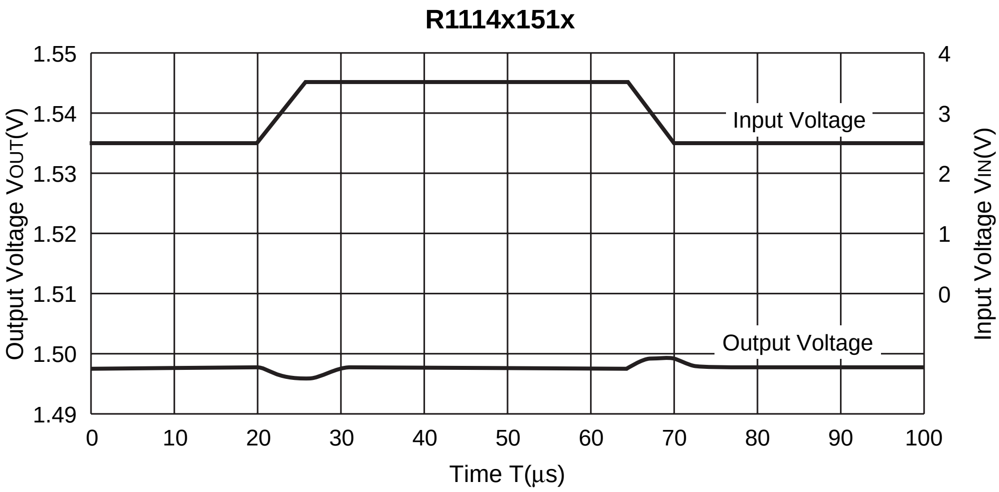
R1114x281x

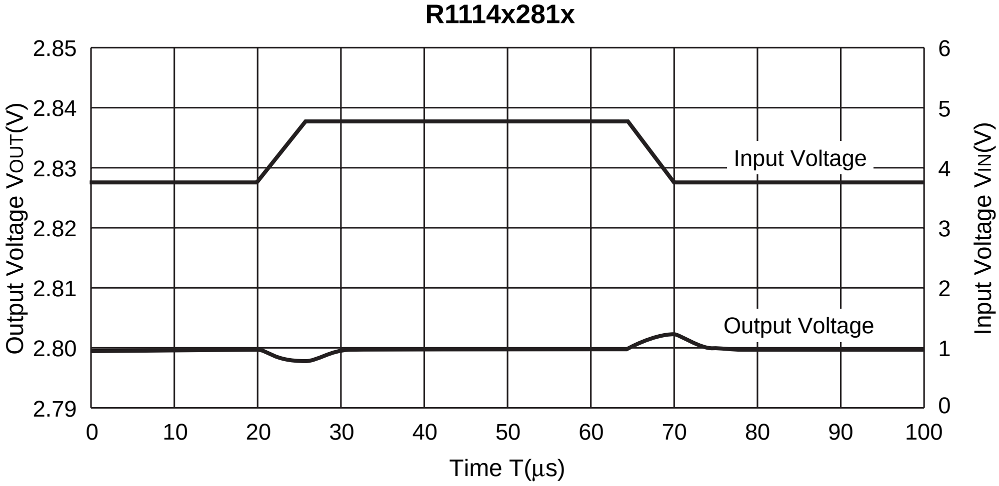




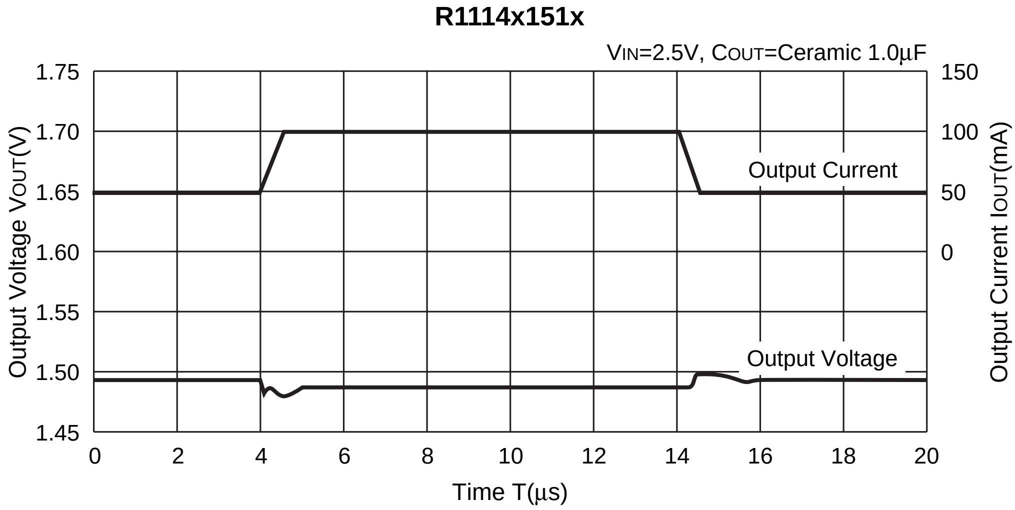


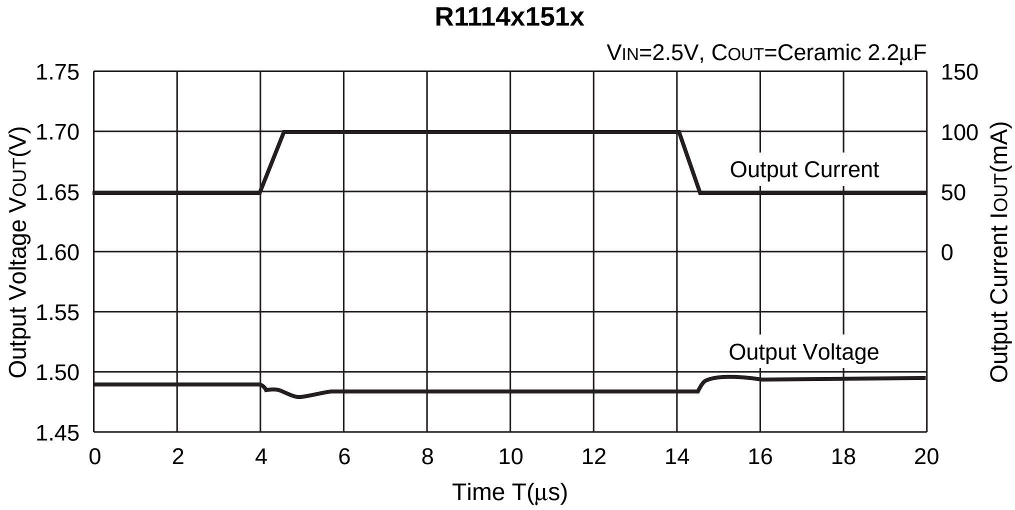
10) Input Transient Response (I_{OUT}=30mA, C_{IN}=none, tr=tf=5µs, C_{OUT}=Ceramic 0.47µF)

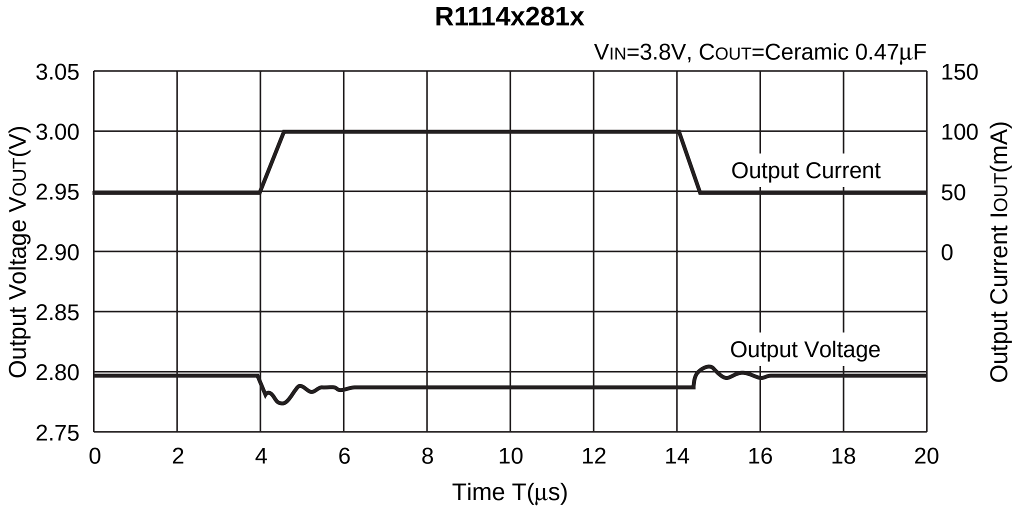




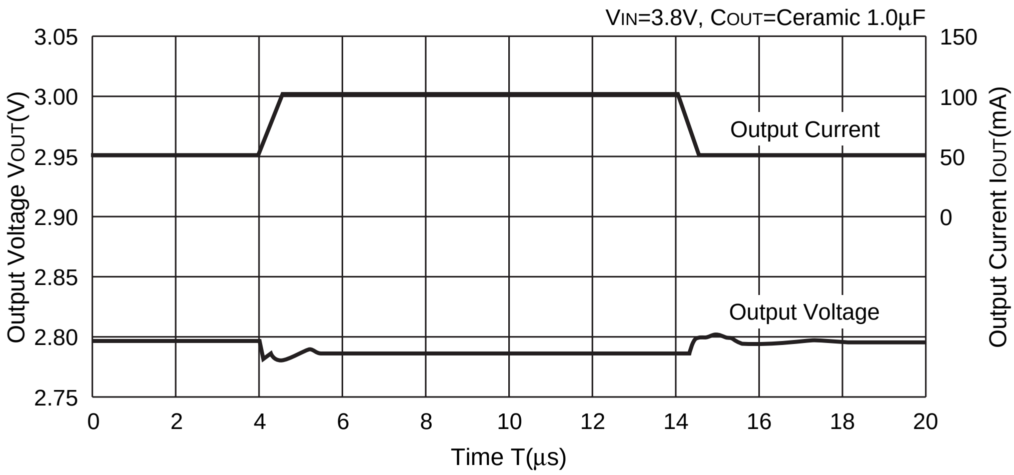
11) Load Transient Response (tr=tf=0.5μs, C_{IN}=Ceramic 1.0μF)



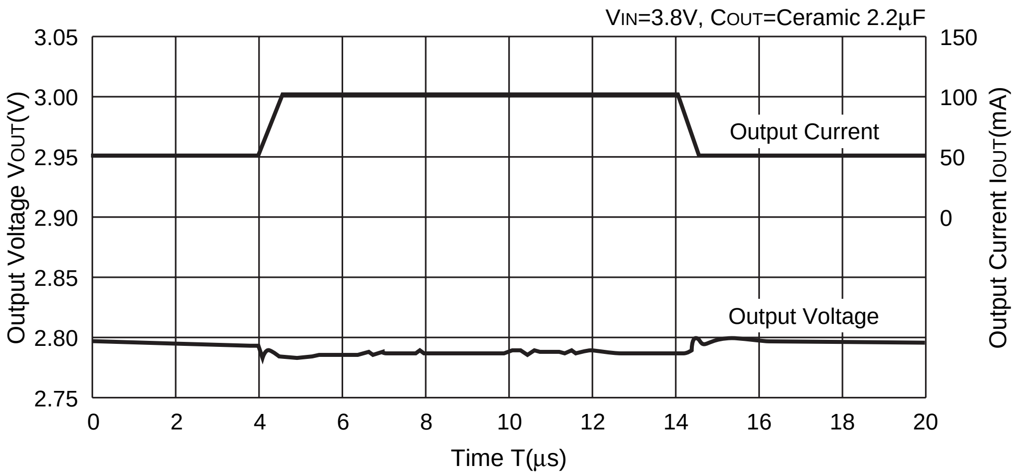




R1114x281x

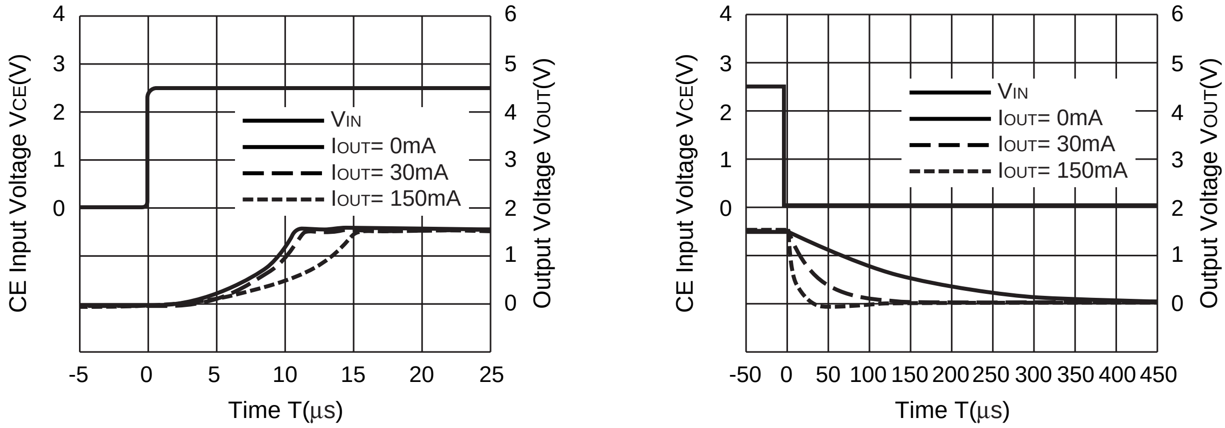


R1114x281x

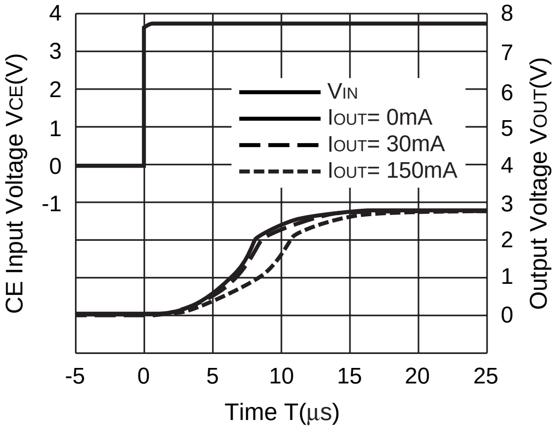


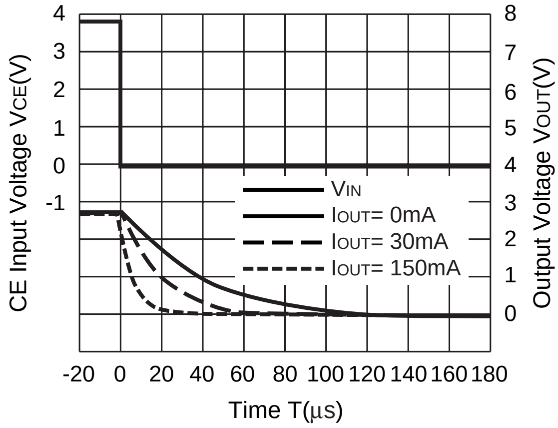
12) Turn-on/off speed with CE pin (D version)

R1114x151D (V_{IN}=2.5V, C_{IN}=Ceramic 1.0µF, C_{OUT}=Ceramic 1.0µF)

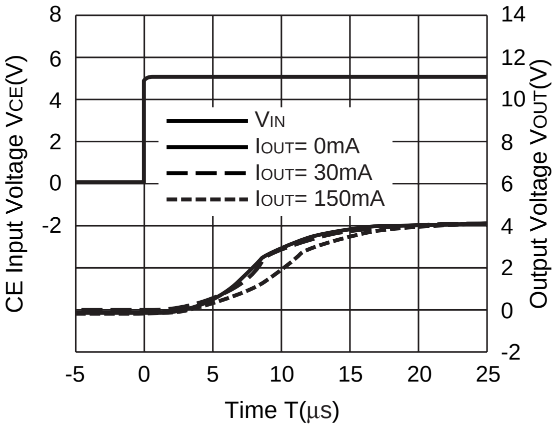


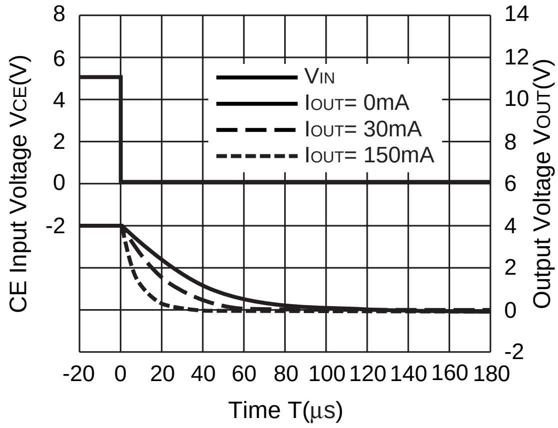
R1114x281D (V_{IN}=3.8V, C_{IN}=Ceramic 0.47µF, C_{OUT}=Ceramic 0.47µF)





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

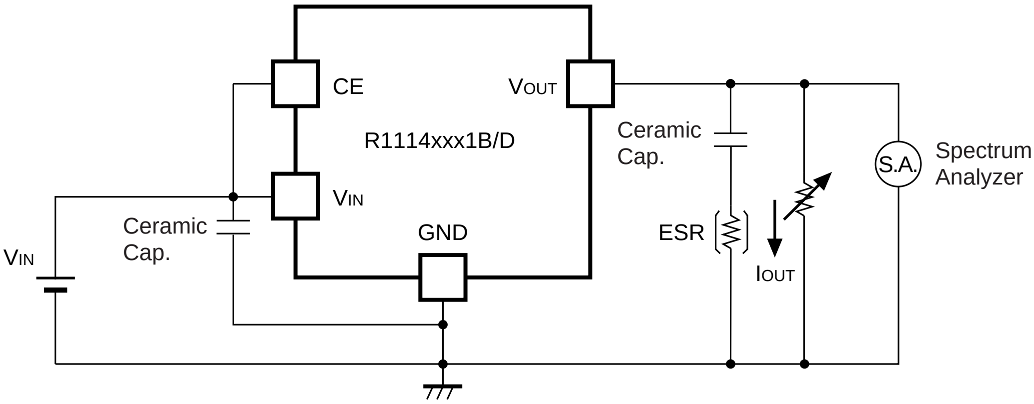




ESR vs. Output Current

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:

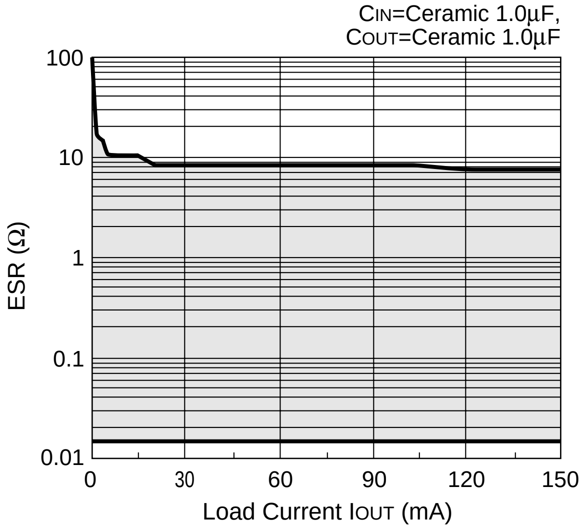


Measuring Circuit for white noise; R1114xxx1B/D

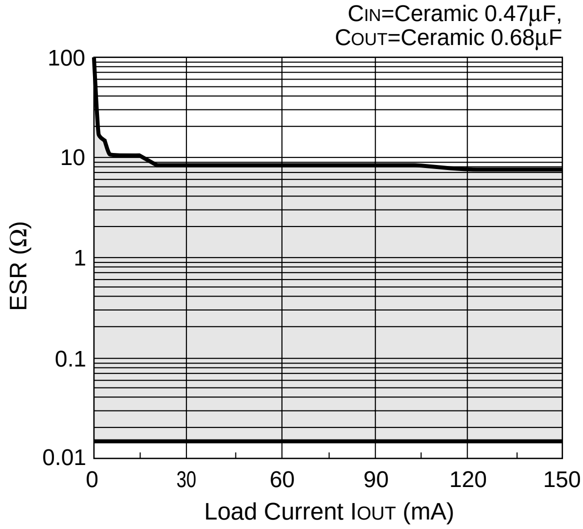
The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under 40µV (Avg.) are marked as the hatched area in the graph.
(Note: If additional ceramic capacitors are connected to the Output Pin with Output capacitor for 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.)

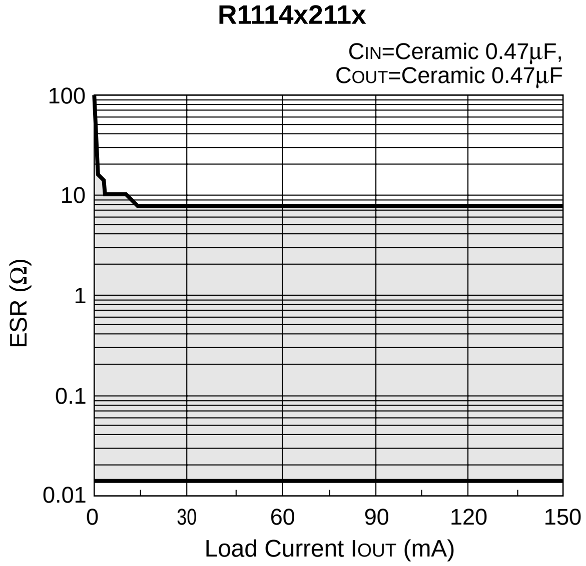
<Measurement conditions>
(1) $V_{IN}=V_{OUT}+1V$
(2) Frequency Band: 10Hz to 2MHz
(3) Temperature: –40°C to 25°C

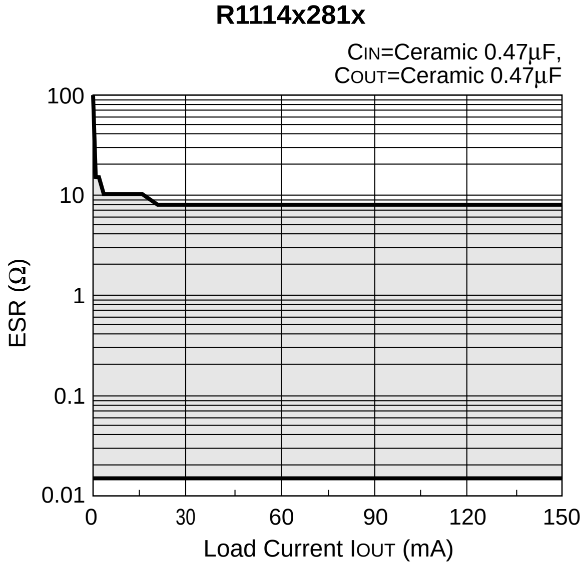
R1114x151x



R1114x161x




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

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8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.
11. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

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