

## LOW NOISE 150mA LDO REGULATOR

NO.EA-094-0512

### 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

- Low Supply Current ..... Typ. 75 $\mu$ A
- Standby Mode ..... Typ. 0.1 $\mu$ A
- Low Dropout Voltage..... Typ. 0.22V ( $I_{OUT}=150\text{mA}$  3.0V Output type)
- High Ripple Rejection ..... Typ. 70dB ( $f=1\text{kHz}$  3.0V Output type)  
..... Typ. 60dB ( $f=10\text{kHz}$ )
- Low Temperature-Drift Coefficient of Output Voltage..... Typ.  $\pm 100\text{ppm}/^\circ\text{C}$
- Excellent Line Regulation ..... Typ. 0.02%/V
- High Output Voltage Accuracy .....  $\pm 2.0\%$
- Small Packages ..... SOT-23-5/SC-82AB/SON1612-6
- 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 ...  $C_{IN}=C_{OUT}=1\mu\text{F}$  ( $V_{OUT}<2.5\text{V}$ )  
 $C_{IN}=1\mu\text{F}$ ,  $C_{OUT}=0.47\mu\text{F}$  ( $V_{OUT} \geq 2.5\text{V}$ )

### 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**



## 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 D: SON1612-6 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



## 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

### • 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

## 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	$-0.3 \sim V_{IN} + 0.3$	V
$I_{OUT}$	Output Current	200	mA
$P_D$	Power Dissipation (SOT-23-5) *1	420	mW
	Power Dissipation (SC82-AB) *1	380	
	Power Dissipation (SON1612-6) *1	500	
$T_{opt}$	Operating Temperature Range	$-40 \sim 85$	$^{\circ}C$
$T_{stg}$	Storage Temperature Range	$-55 \sim 125$	$^{\circ}C$

\*1 For Power Dissipation, please refer to PACKAGE INFORMATION to be described.

## ELECTRICAL CHARACTERISTICS

### • R1114xxx1A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 30mA	×0.980		×1.020	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> -V <sub>OUT</sub> = 1.0V	150			mA
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 150mA		22	40	mV
V <sub>DIF</sub>	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V, I <sub>OUT</sub> = 0mA		75	95	μA
I <sub>standby</sub>	Supply Current (Standby)	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V V <sub>CE</sub> = V <sub>DD</sub>		0.1	1.0	μA
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>OUT</sub> > 1.7V, Set V <sub>OUT</sub> +0.5V ≤ V <sub>IN</sub> ≤ 6.0V (V <sub>OUT</sub> ≤ 1.7V, 2.2V ≤ V <sub>IN</sub> ≤ 6.0V) I <sub>OUT</sub> = 30mA		0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz f=10kHz Ripple 0.5Vp-p V <sub>OUT</sub> > 1.7V, V <sub>IN</sub> -V <sub>OUT</sub> = 1.0V V <sub>OUT</sub> ≤ 1.7, V <sub>IN</sub> -V <sub>OUT</sub> = 1.2V I <sub>OUT</sub> = 30mA		70 60		dB
V <sub>IN</sub>	Input Voltage		2.0		6.0	V
ΔV <sub>OUT</sub> /ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> = 30mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
I <sub>lim</sub>	Short Current Limit	V <sub>OUT</sub> = 0V		40		mA
R <sub>PU</sub>	$\overline{\text{CE}}$ Pull-up Resistance		0.7	2.0	8.0	MΩ
V <sub>CEH</sub>	$\overline{\text{CE}}$ Input Voltage "H"		1.5		6.0	V
V <sub>CEL</sub>	$\overline{\text{CE}}$ Input Voltage "L"		0.0		0.3	V
en	Output Noise	BW = 10Hz to 100kHz		30		μVrms

## • R1114xxx1B/D

T<sub>opt</sub>=25°C

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

• ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

$T_{opt} = 25^{\circ}\text{C}$

Output Voltage $V_{OUT}$ (V)	Dropout Voltage		
	$V_{DIF}$ (V)		
	Condition	Typ.	Max.
$V_{OUT} = 1.5$	$I_{OUT} = 150\text{mA}$	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  $1.0\mu\text{F}$  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 0.47 $\mu$ F (Set Output Voltage in the range from 2.5 to 4.0V)

Ceramic 1.0 $\mu$ F (Set Output Voltage in the range from 1.5 to 2.4V)

Input Capacitor; Ceramic 1.0 $\mu$ F

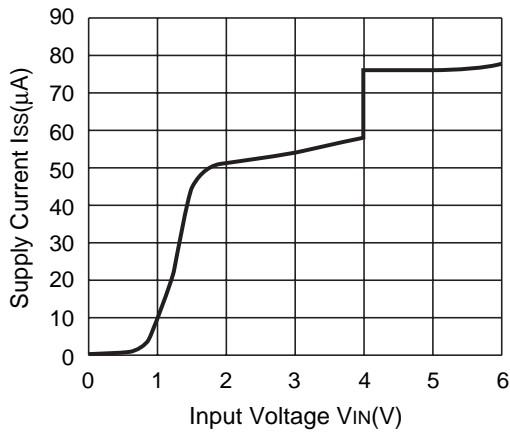
## TYPICAL CHARACTERISTICS

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



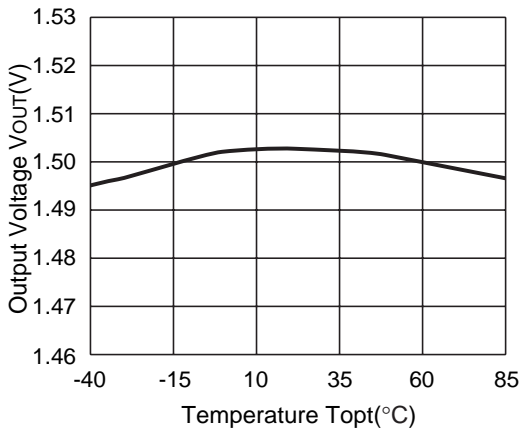
2) Output Voltage vs. Input Voltage ( $T_{opt}=25^{\circ}\text{C}$ )3) Supply Current vs. Input Voltage ( $T_{opt}=25^{\circ}\text{C}$ )

R1114x401x

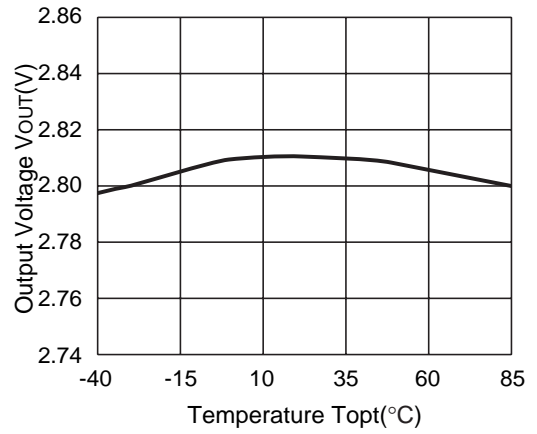


4) Output Voltage vs. Temperature

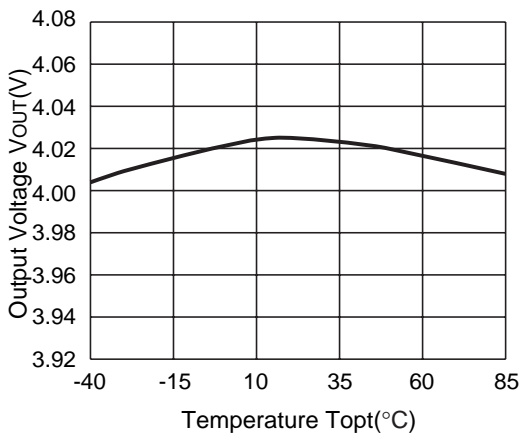
R1114x151x



R1114x281x



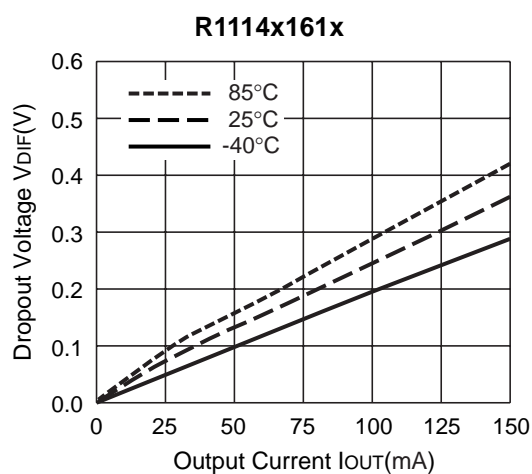
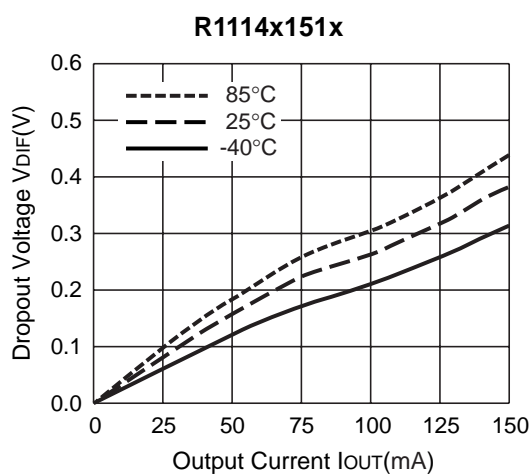
R1114x401x



5) Supply Current vs. Temperature



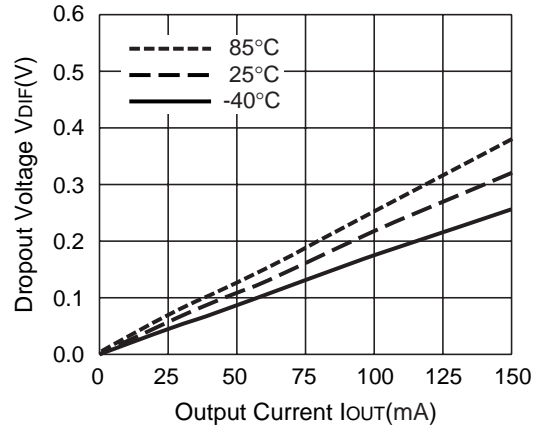
6) Dropout Voltage vs. Temperature



R1114x171x



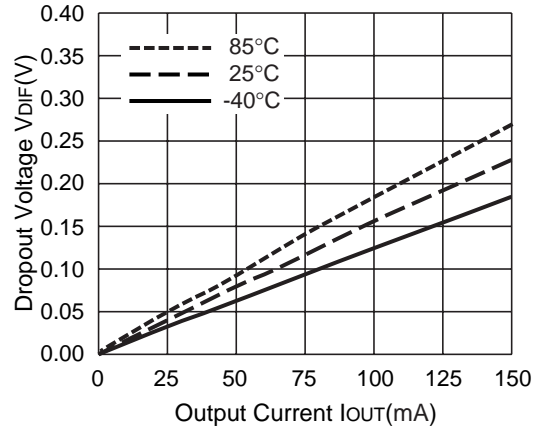
R1114x181x



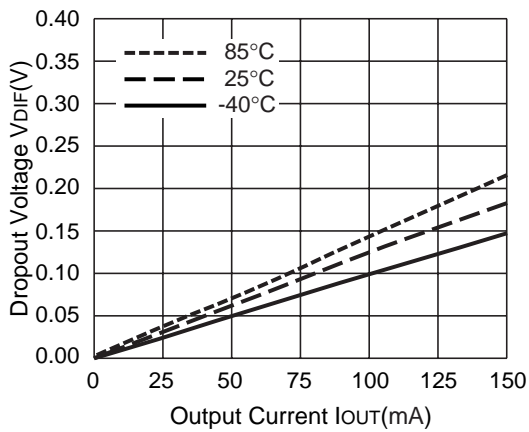
R1114x211x



R1114x281x



R1114x401x



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



8) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, CIN=none, COUT=ceramic0.47μF)





9) Ripple Rejection vs. Frequency (C<sub>IN</sub>=none)







10) Input Transient Response ( $I_{OUT}=30\text{mA}$ ,  $C_{IN}=\text{none}$ ,  $t_r=t_f=5\mu s$ ,  $C_{OUT}=\text{Ceramic } 0.47\mu F$ )



11) Load Transient Response ( $t_r=t_f=0.5\mu s$ ,  $C_{IN}=\text{Ceramic } 1.0\mu F$ )

R1114x151x



R1114x151x



R1114x281x



R1114x281x



R1114x281x



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

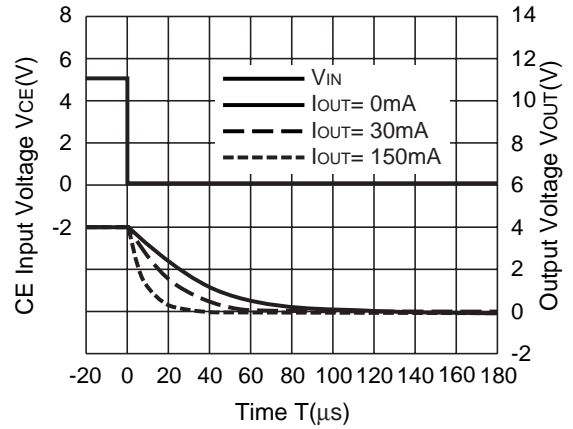
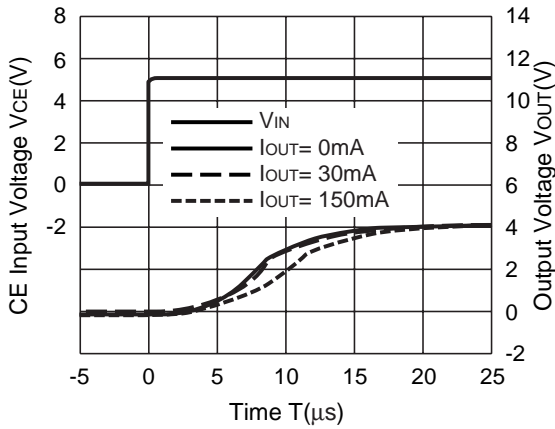
R1114x151D ( $V_{IN}=2.5V$ ,  $C_{IN}=\text{Ceramic } 1.0\mu F$ ,  $C_{OUT}=\text{Ceramic } 1.0\mu F$ )



R1114x281D ( $V_{IN}=3.8V$ ,  $C_{IN}=\text{Ceramic } 0.47\mu F$ ,  $C_{OUT}=\text{Ceramic } 0.47\mu F$ )



R1114x401D ( $V_{IN}=5.0V$ ,  $C_{IN}=\text{Ceramic } 0.47\mu F$ ,  $C_{OUT}=\text{Ceramic } 0.47\mu F$ )



## 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  $40\mu\text{V}$  (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.)

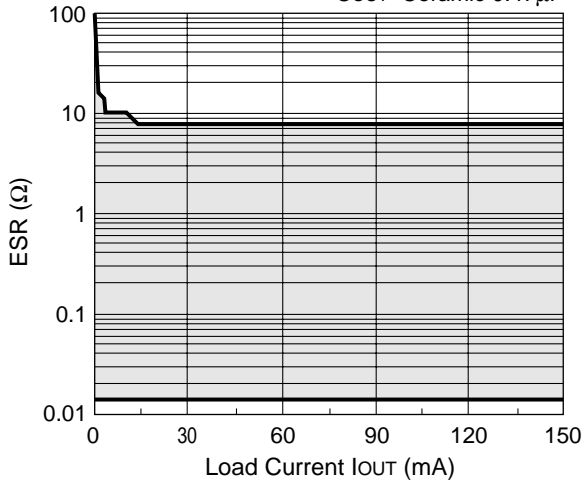
<Measurement conditions>

- (1)  $V_{IN} = V_{OUT} + 1\text{V}$
- (2) Frequency Band: 10Hz to 2MHz
- (3) Temperature:  $-40^{\circ}\text{C}$  to  $25^{\circ}\text{C}$



R1114x211x

C<sub>IN</sub>=Ceramic 0.47μF,  
C<sub>OUT</sub>=Ceramic 0.47μF



R1114x281x

C<sub>IN</sub>=Ceramic 0.47μF,  
C<sub>OUT</sub>=Ceramic 0.47μF

