

LOW NOISE 150mA LDO REGULATOR R1113Z SERIES

■ OUTLINE

The R1113Z 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, 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 R1113Z 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 WL-CSP (Wafer Level CSP), high density mounting of the ICs on boards is possible.

■ FEATURES

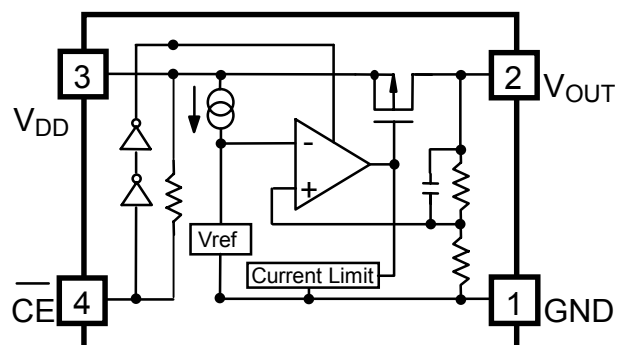
- Ultra-Low Supply Current..... Typ. 100 μ A
- Standby Mode Typ. 0.1 μ A
- Low Dropout Voltage Typ. 0.23V(I_{OUT} =100mA 3.0V Output type)
- High Ripple Rejection Typ. 80dB(f =1kHz 3.0V Output type)
- Low Temperature-Drift Coefficient of Output Voltage Typ. ± 100 ppm/ $^{\circ}$ C
- Excellent Line Regulation Typ. 0.05%/V
- High Output Voltage Accuracy..... $\pm 2.0\%$
- Excellent Dynamic Response
- Small Package WL-CSP(Wafer Level CSP)
- Output Voltage..... Stepwise setting with a step of 0.1V in the range of 2.0V to 5.0V is possible
- Built-in Chip Enable Circuit (2 types; A: active low , B: active high)
- Built-in Fold Back Protection Circuit.....Typ. 30mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC

■ APPLICATIONS

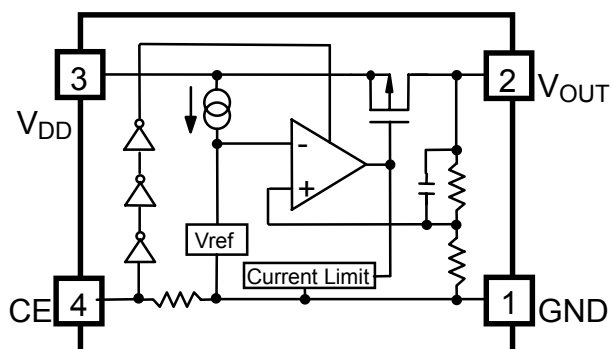
- Power source for cellular phones such as GSM, CDMA and various kinds of PCS.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

■ BLOCK DIAGRAM

R1113ZXX1A



R1113ZXX1B



SELECTION GUIDE

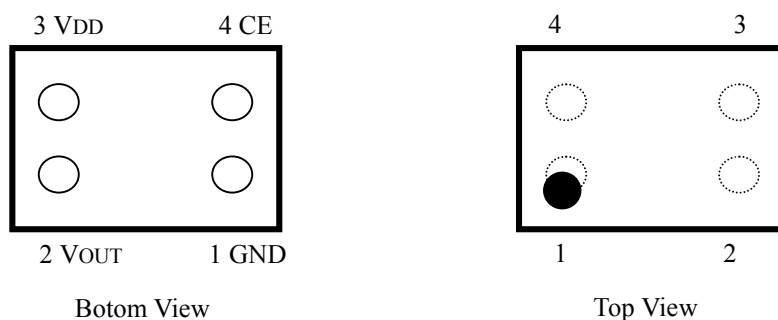
The output voltage, the active type, the packing type, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

R1113XXX1X-XX ←Part Number
 ↑ ↑ ↑ ↑
 a b c d

Code	Contents
a	Designation of Package Type : Z:WL-CSP(Wafer Level CSP)
b	Setting Output Voltage (V_{OUT}) : Stepwise setting with a step of 0.1V in the range of 2.0V to 5.0V is possible.
c	Designation of Active Type : A : active low type B : active high type
d	Designation of Taping Type : Ex. TR, TL (refer to Taping Specifications; TR type is the standard direction.)

PIN CONFIGURATION

WL-CSP 4Pin



PIN DESCRIPTION

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

■ ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Input Voltage	V_{IN}	7.0	V
Input Voltage($\overline{CE}$ or CE Pin)	V_{CE}	-0.3 ~ $V_{IN}+0.3$	V
Output Voltage	V_{OUT}	-0.3 ~ $V_{IN}+0.3$	V
Output Current	I_{OUT}	200	mA
Power Dissipation	P_D	190	mW
Operating Temperature Range	T_{opt}	-40 ~ 85	°C
Storage Temperature Range	T_{stg}	-55 ~ 125	°C

■ ELECTRICAL CHARACTERISTICS

● R1113ZXX1A

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

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	$V_{IN} = \text{Set } V_{OUT}+1\text{V}$ $1\text{mA} \leq I_{OUT} \leq 30\text{mA}$	V_{OUT} $\times 0.98$		V_{OUT} $\times 1.02$	V
I_{OUT}	Output Current	$V_{IN} - V_{OUT} = 1.0\text{V}$	150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN} = \text{Set } V_{OUT}+1\text{V}$ $1\text{mA} \leq I_{OUT} \leq 80\text{mA}$		20	45	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I_{SS}	Supply Current	$V_{IN} = \text{Set } V_{OUT}+1\text{V}$		100	170	μA
$I_{standby}$	Supply Current (Standby)	$V_{IN} = V_{CE} = \text{Set } V_{OUT}+1\text{V}$		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set $V_{OUT}+0.5\text{V} \leq V_{IN} \leq 8\text{V}$ $I_{OUT} = 30\text{mA}$		0.05	0.20	%/V
RR	Ripple Rejection	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
V_{IN}	Input Voltage		2.0		6.0	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	$I_{OUT} = 30\text{mA}$ $-40^{\circ}\text{C} \leq T_{opt} \leq 85^{\circ}\text{C}$		± 100		ppm/ °C
I_{lim}	Short Current Limit	$V_{OUT} = 0\text{V}$		30		mA
R_{PU}	$\overline{CE}$ Pull-up Resistance		2.5	5	10	M Ω
V_{CEH}	$\overline{CE}$ Input Voltage “H”		1.5		V_{IN}	V
V_{CEL}	$\overline{CE}$ Input Voltage “L”		0		0.25	V
e_n	Output Noise	BW=10Hz to 100kHz		30		μV_{rms}

● R1113ZXX1B

T_{opt}=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} - V _{OUT} = 1.0V	150			mA
ΔV _{OUT} /ΔI _{OUT}	Load Regulation	V _{IN} = Set V _{OUT} +1V 1mA ≤ I _{OUT} ≤ 80mA		20	45	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
I _{standby}	Supply Current (Standby)	V _{IN} = Set V _{OUT} +1V V _{CE} =GND		0.1	1.0	μA
ΔV _{OUT} /ΔV _{IN}	Line Regulation	Set V _{OUT} +0.5V ≤ V _{IN} ≤ 8V I _{OUT} = 30mA		0.05	0.20	%/V
RR	Ripple Rejection	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
V _{IN}	Input Voltage		2.0		6.0	V
ΔV _{OUT} /ΔT	Output Voltage Temperature Coefficient	I _{OUT} = 30mA -40°C ≤ T _{op} ≤ 85°C		±100		ppm /°C
I _{lim}	Short Current Limit	V _{OUT} = 0V		30		mA
R _{PD}	CE Pull-down Resistance		2.5	5	10	MΩ
V _{CEH}	CE Input Voltage "H"		1.5		V _{IN}	V
V _{CEL}	CE Input Voltage "L"		0		0.25	V
e _n	Output Noise	BW=10Hz to 100kHz		30		μVrms

● ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

T_{opt} = 25°C

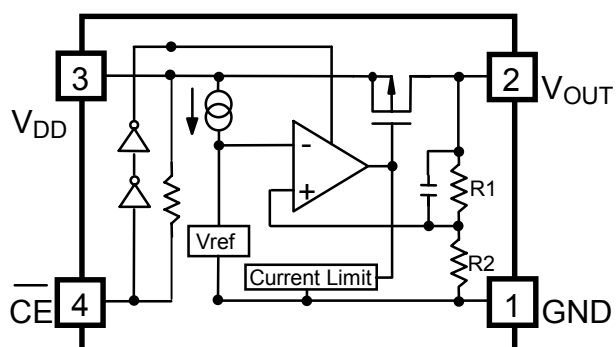
Output Voltage V _{OUT} (V)	Dropout Voltage		
	V _{DIF} (V)		
	Condition	TYP.	MAX.
2.0 ≤ V _{OUT} ≤ 2.3	I _{OUT} = 100mA	0.25	0.35
2.4 ≤ V _{OUT} ≤ 2.7		0.24	0.29
2.8 ≤ V _{OUT} ≤ 5.0		0.23	0.26

T_{opt} = 25°C

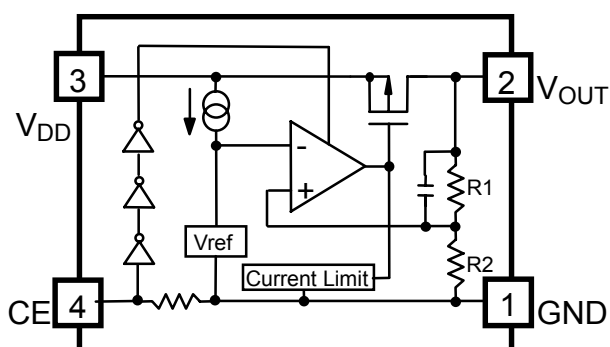
Output Voltage V _{OUT} (V)	Ripple Rejection		
	RR (dB)		
	Condition	TYP.	MAX.
2.0 ≤ V _{OUT} ≤ 4.0	f = 1kHz, Ripple 0.5Vp-p V _{IN} = Set V _{OUT} +1V	80	
4.1 ≤ V _{OUT} ≤ 5.0		70	

■ OPERATION

R1113ZXX1A



R1113ZXX1B



In these ICs, fluctuation of output voltage, V_{OUT} is detected by feedback 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, 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 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 VDD 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 2.2μF or more between VDD 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

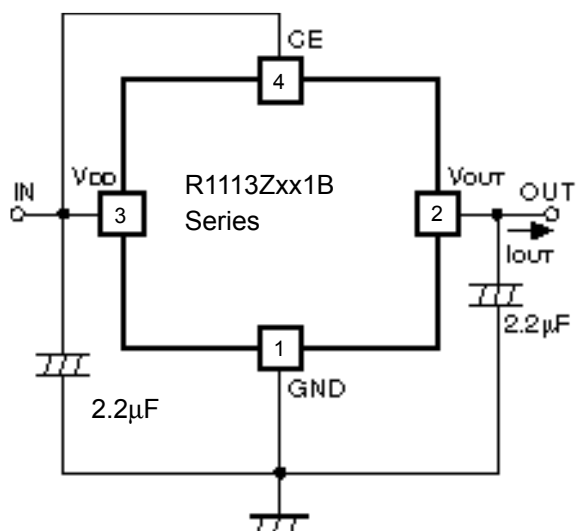


Fig.1 Standard test Circuit

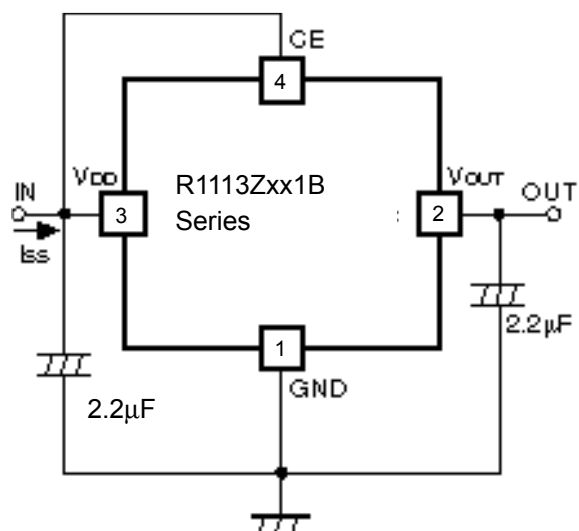


Fig.2 Supply Current Test Circuit

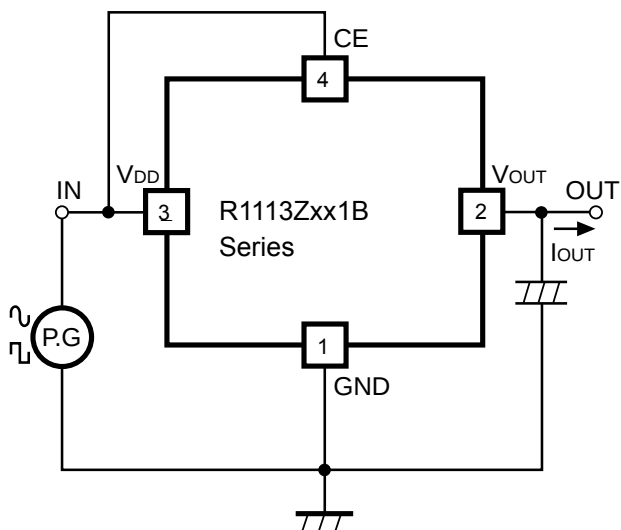


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

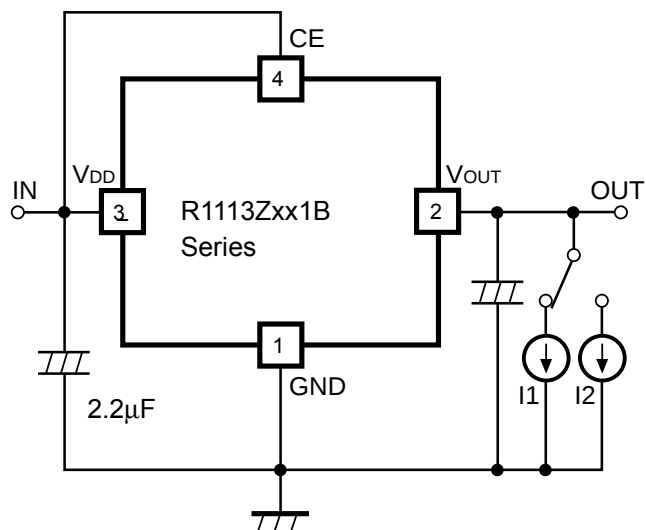
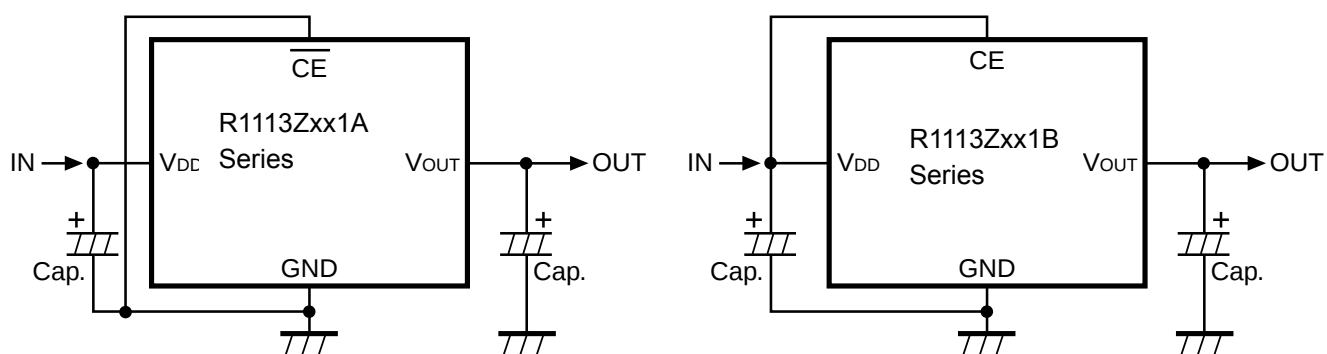


Fig.4 Load Transient Response Test Circuit

■ TYPICAL APPLICATION



(External Components)

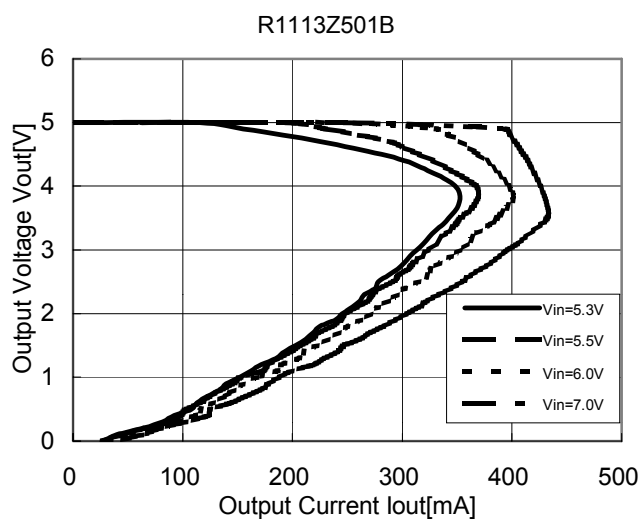
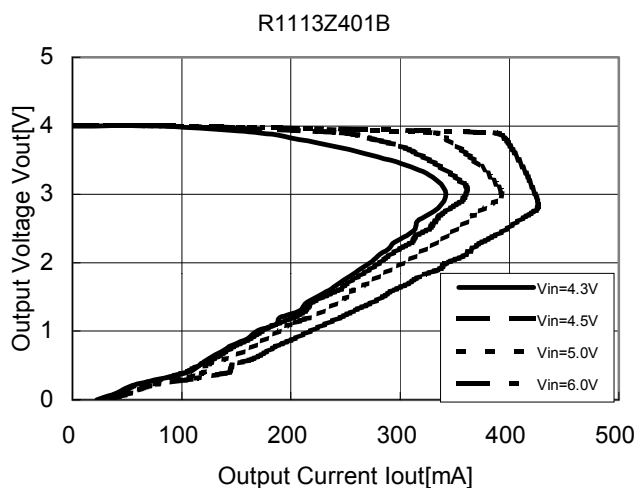
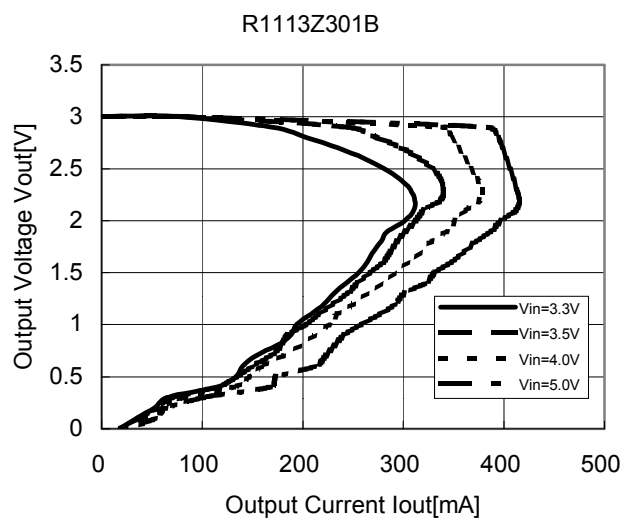
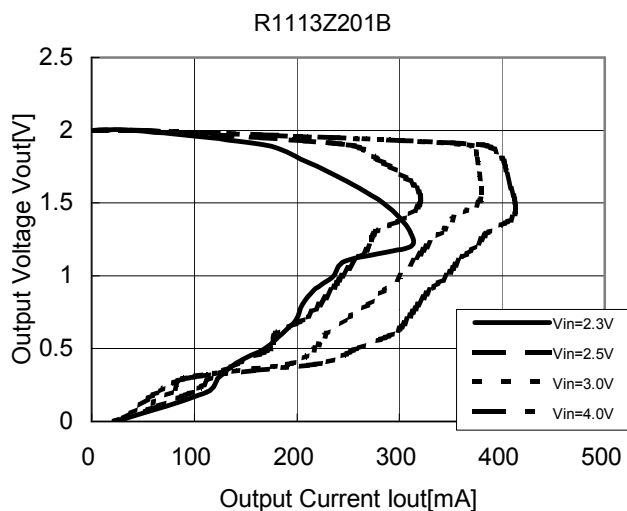
Output Capacitor; Ceramic 2.2 μ F (Set Output Voltage in the range from 2.6 to 5.0V)

Ceramic 4.7 μ F (Set Output Voltage in the range from 2.0 to 2.5V)

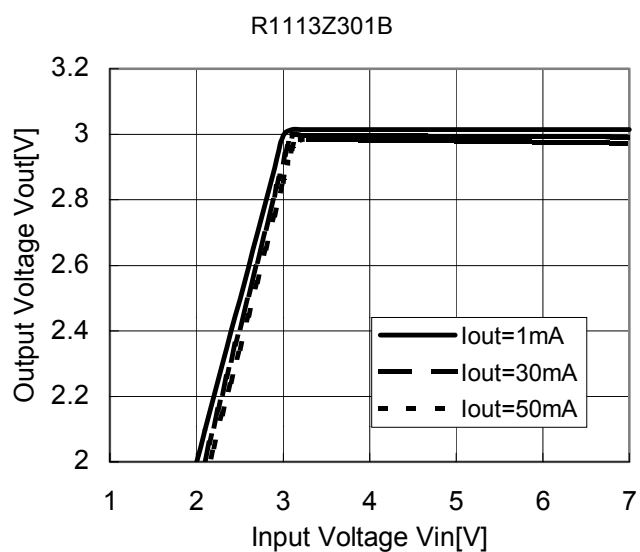
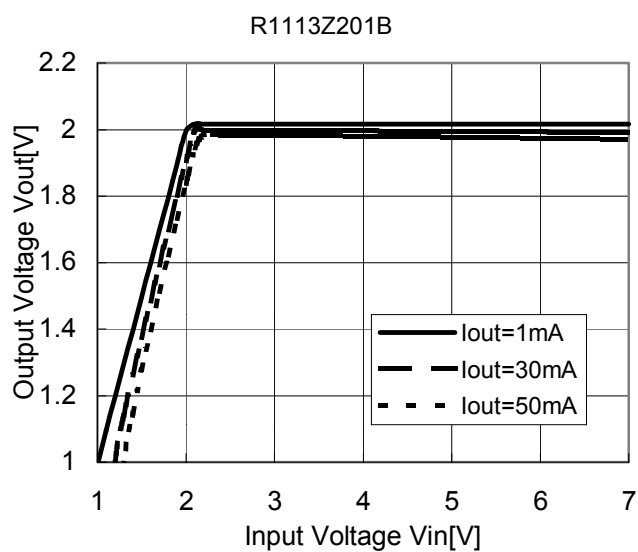
Input Capacitor; Ceramic 2.2 μ F

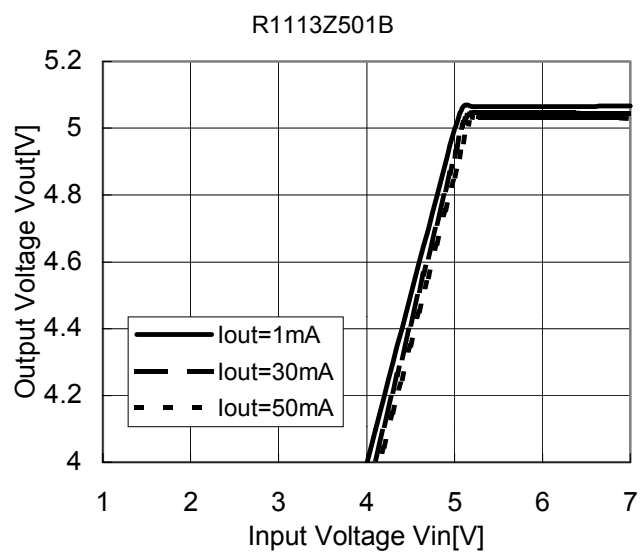
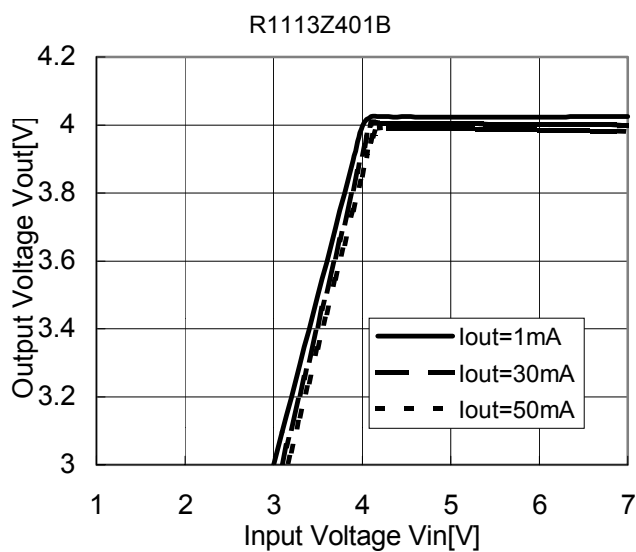
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current $T_{opt}=25^{\circ}\text{C}$

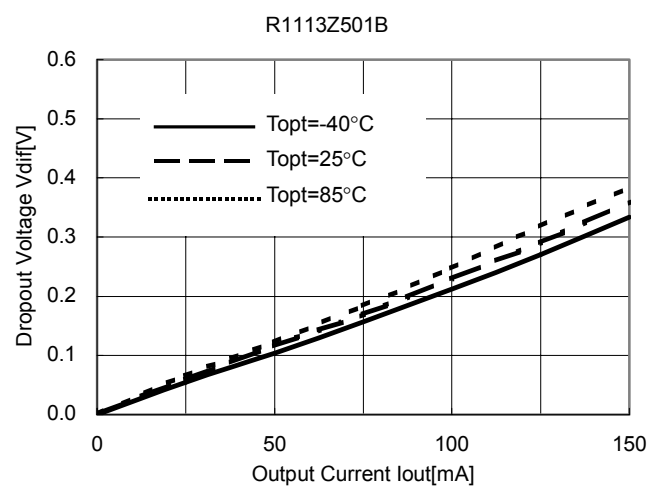
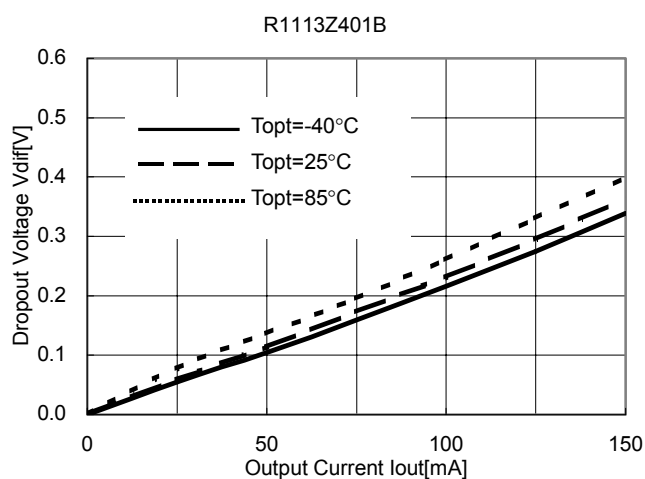
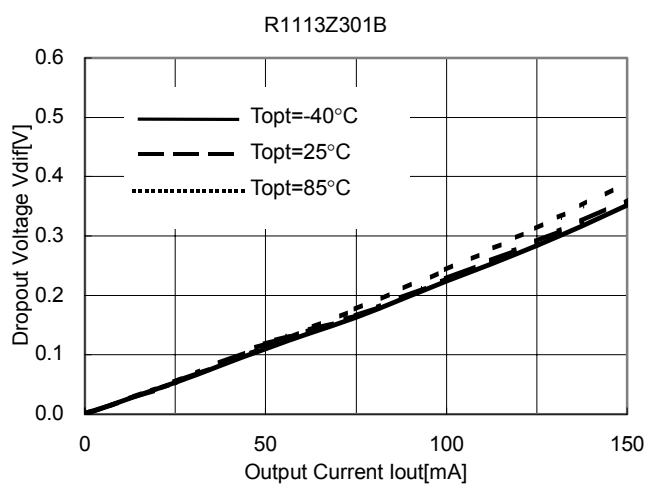
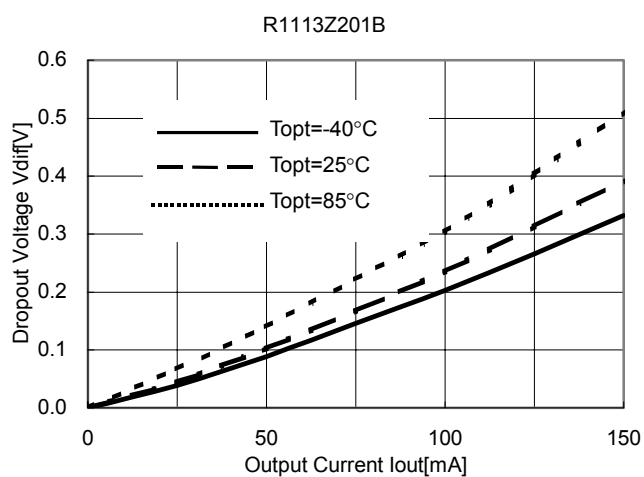


2) Output Voltage vs. Input Voltage $T_{opt}=25^{\circ}\text{C}$

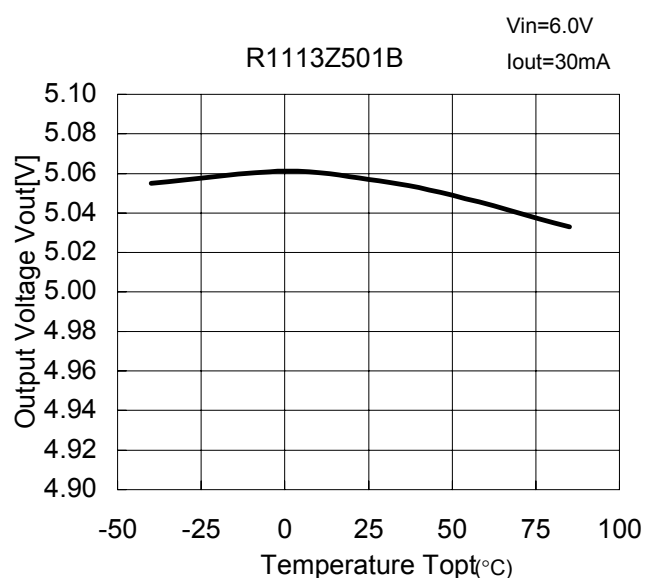
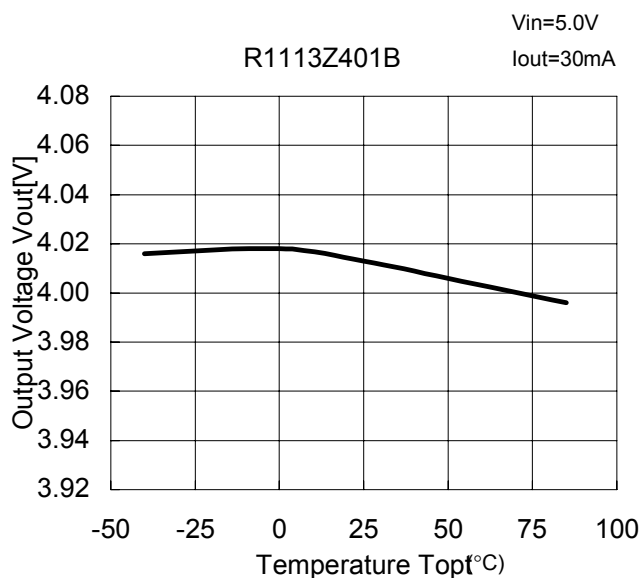
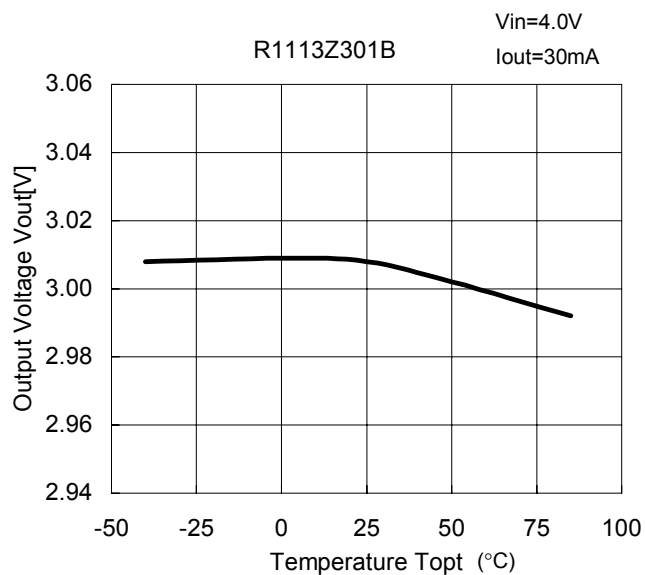
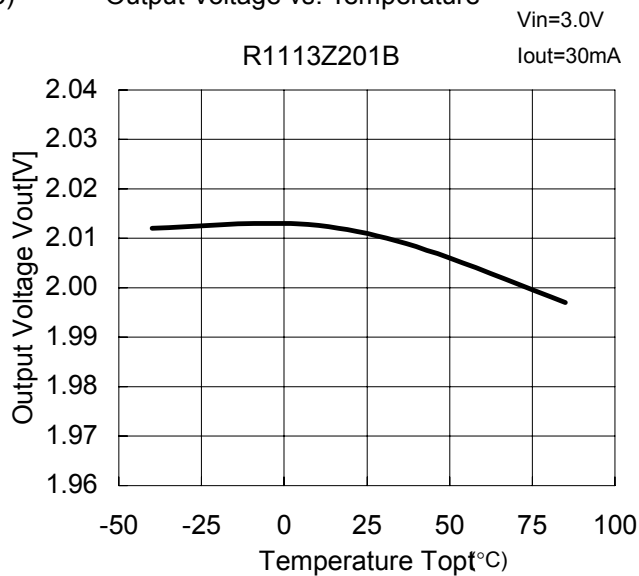




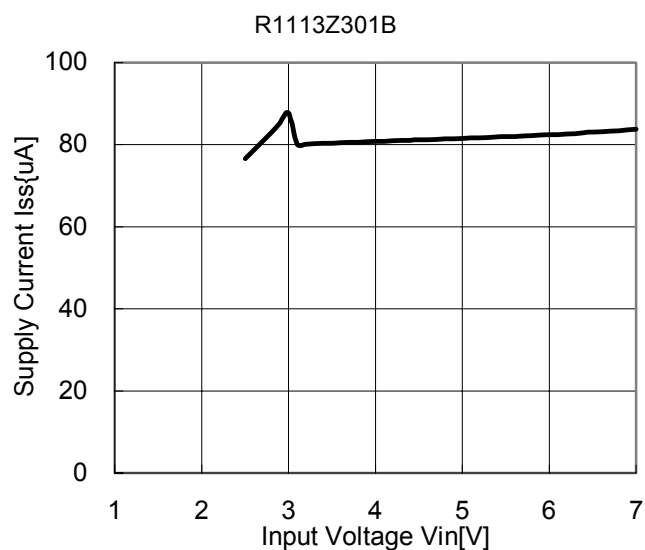
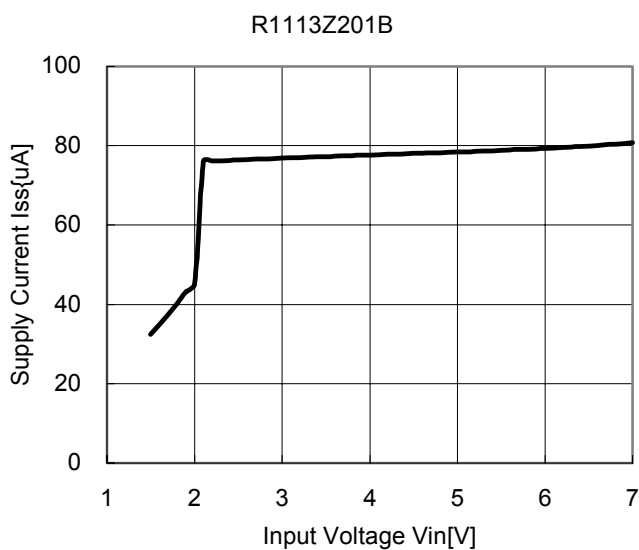
3) Dropout Voltage vs. Output Current

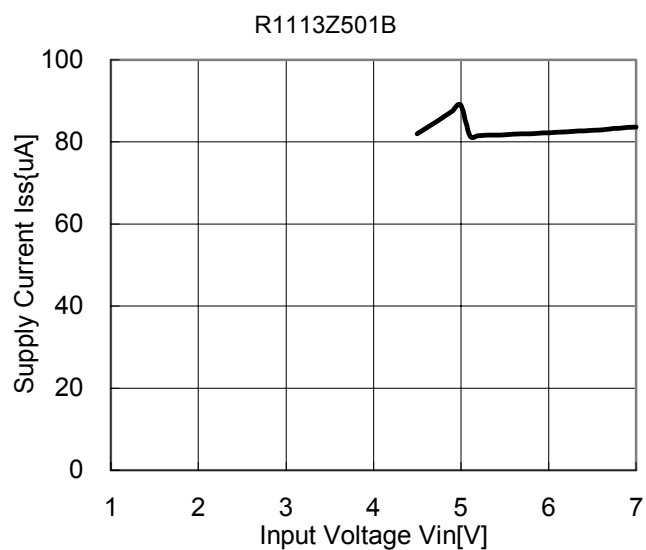
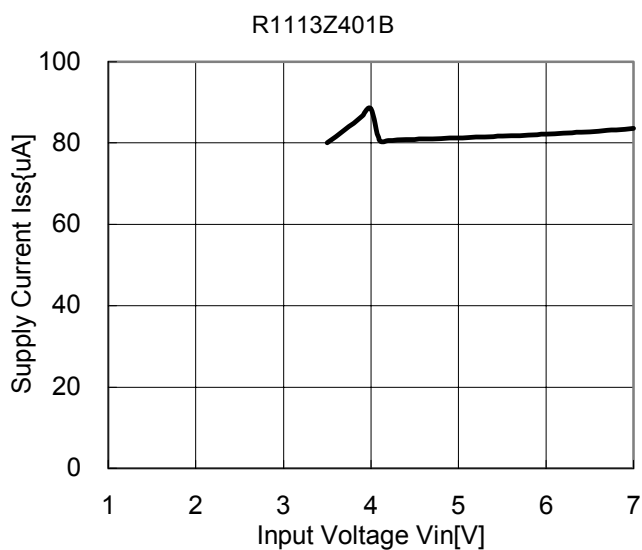


3) Output Voltage vs. Temperature

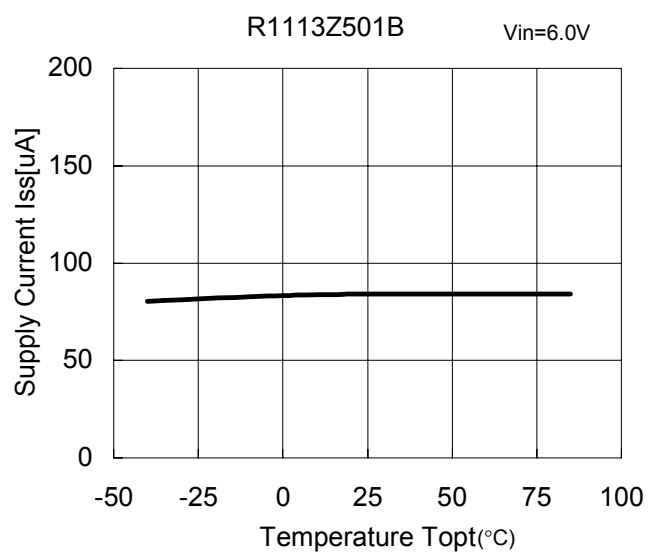
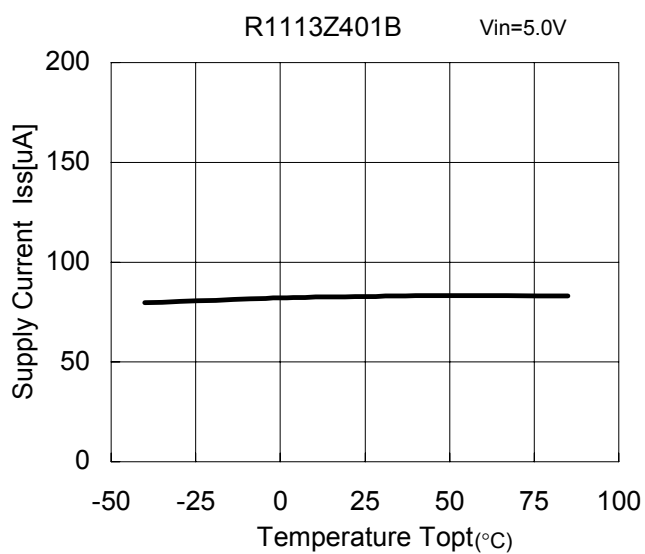
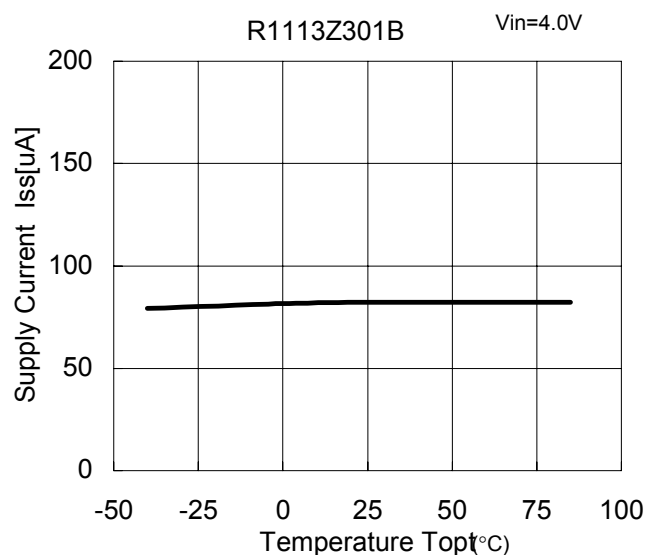
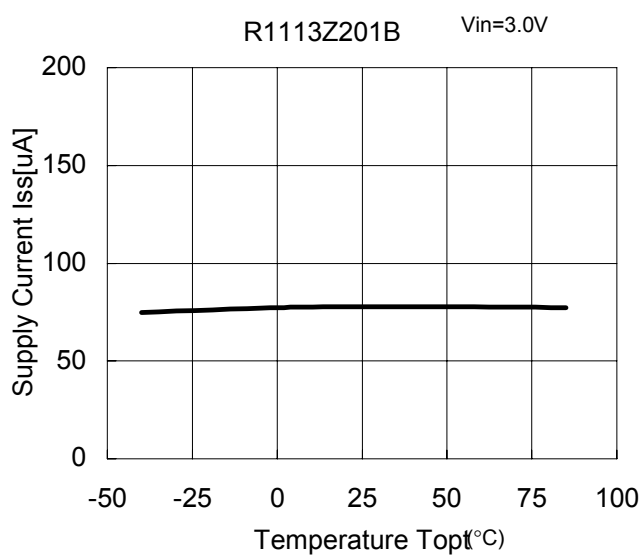


4) Supply Current vs. Input Voltage $T_{opt}=25^{\circ}C$

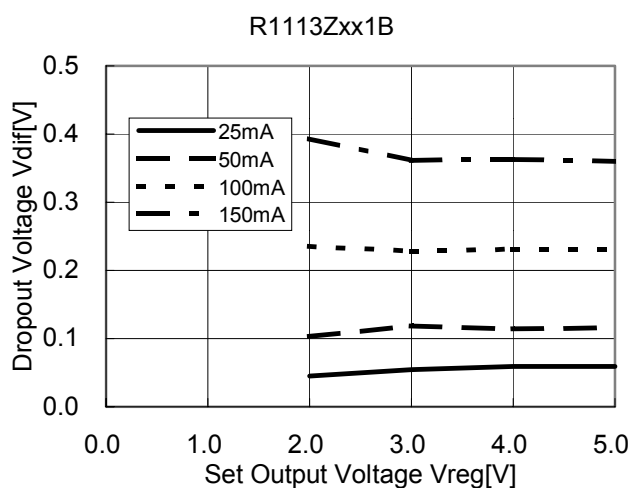




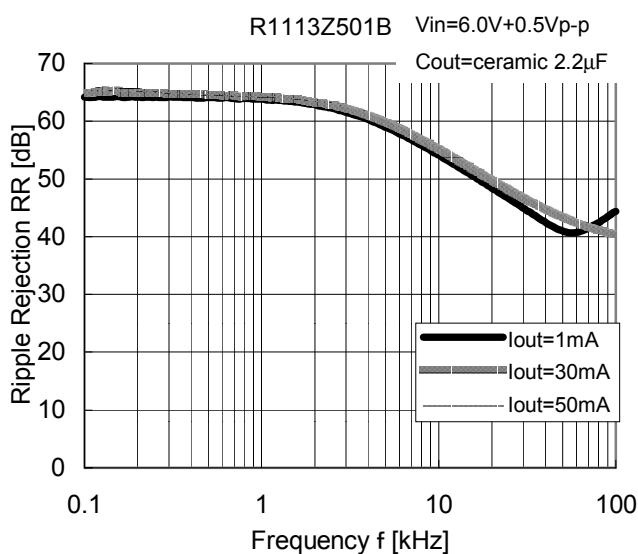
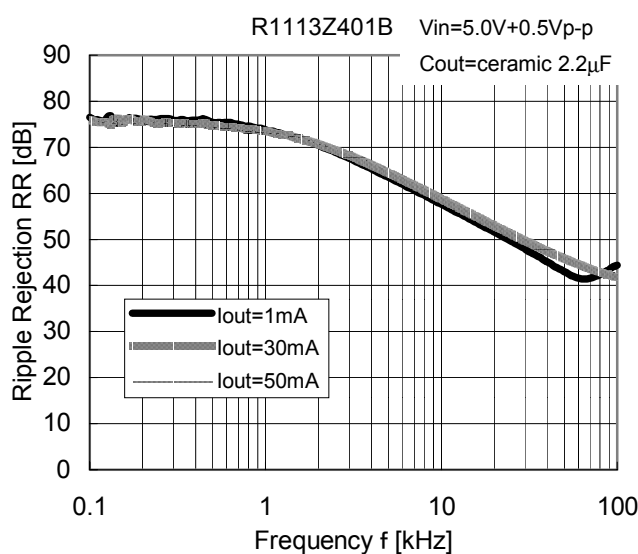
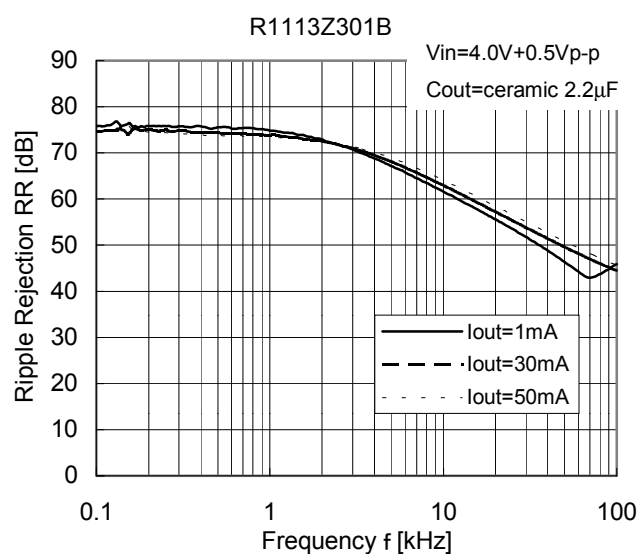
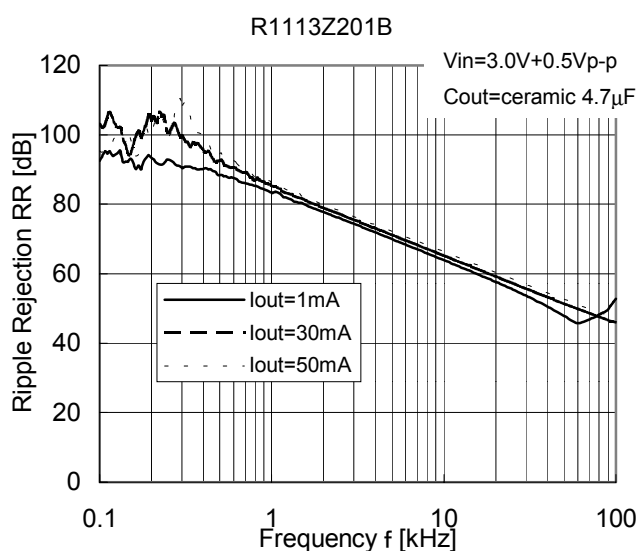
5) Supply Current vs. Temperature



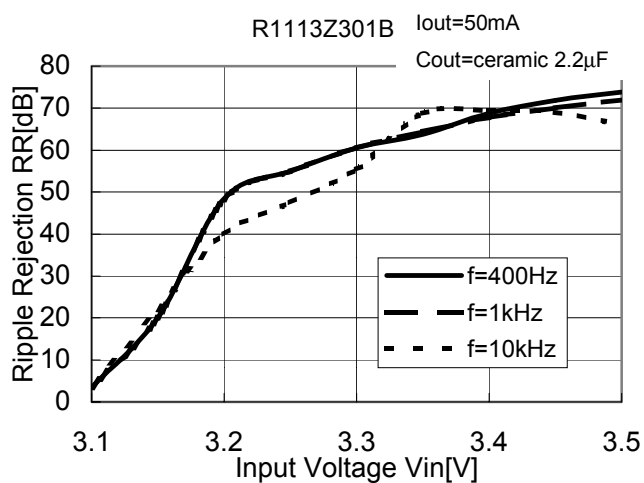
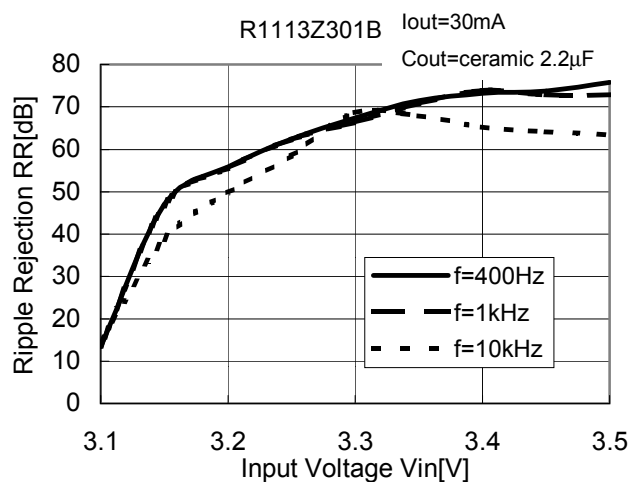
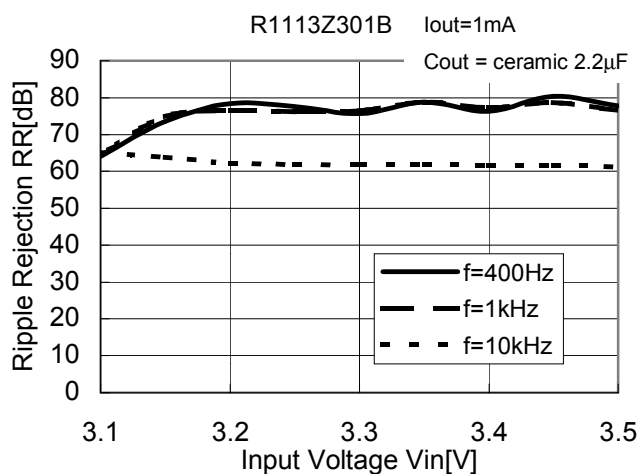
6) Dropout Voltage vs. Set Output Voltage



7) Ripple Rejection vs. Frequency



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

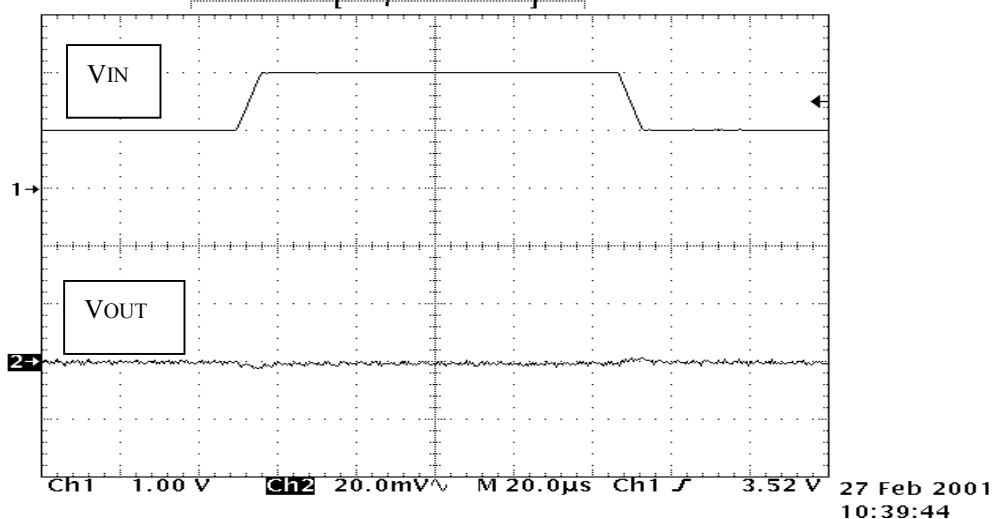


10) Input Transient Response

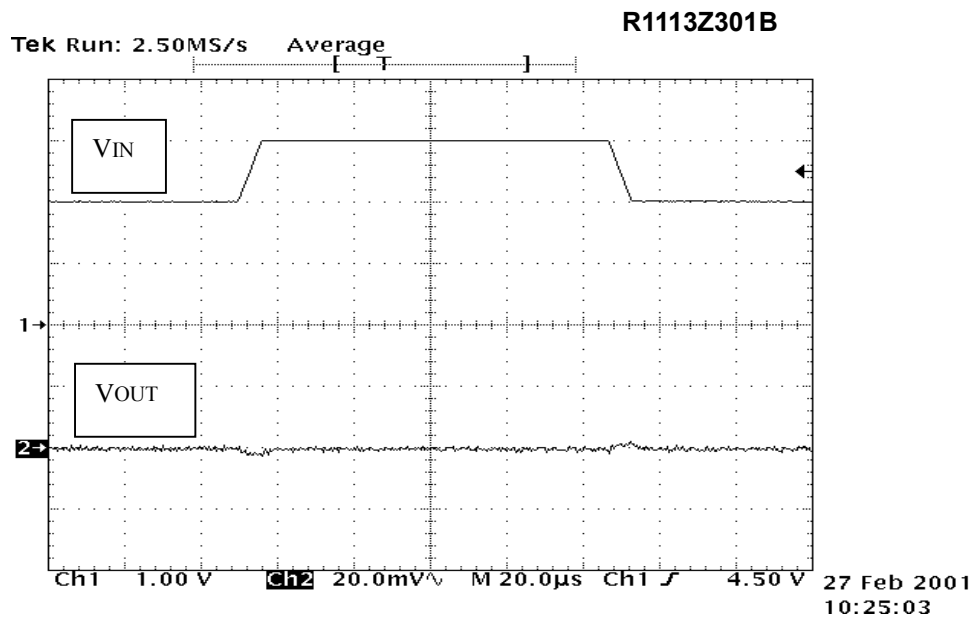
Tek Run: 2.50MS/s Average

R1113Z201B

Topt=25°C

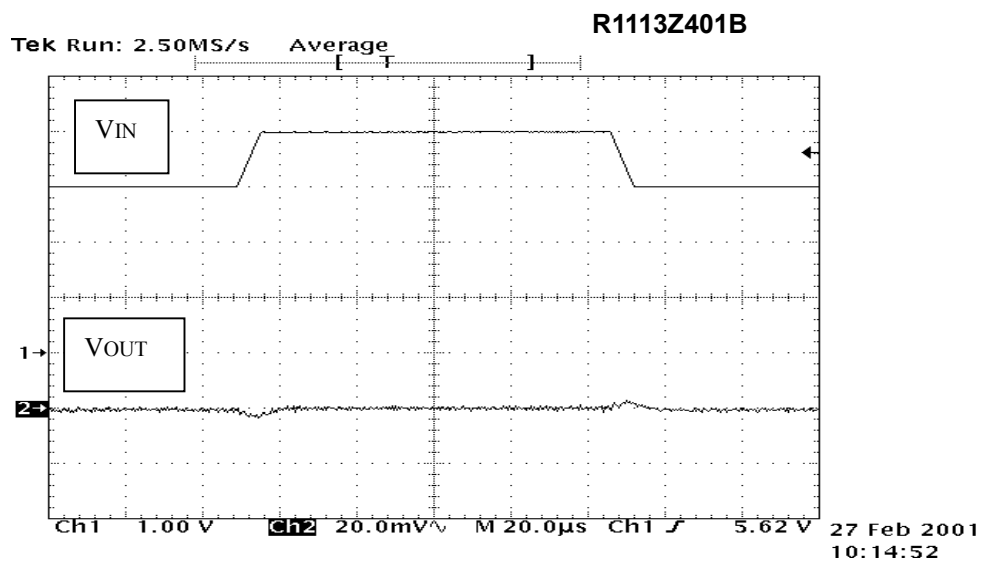


VIN=3.0V<-->4.0V
IOUT=30mA
CIN =none
COUT=4.7 μ F
tr/tf=5 μ s



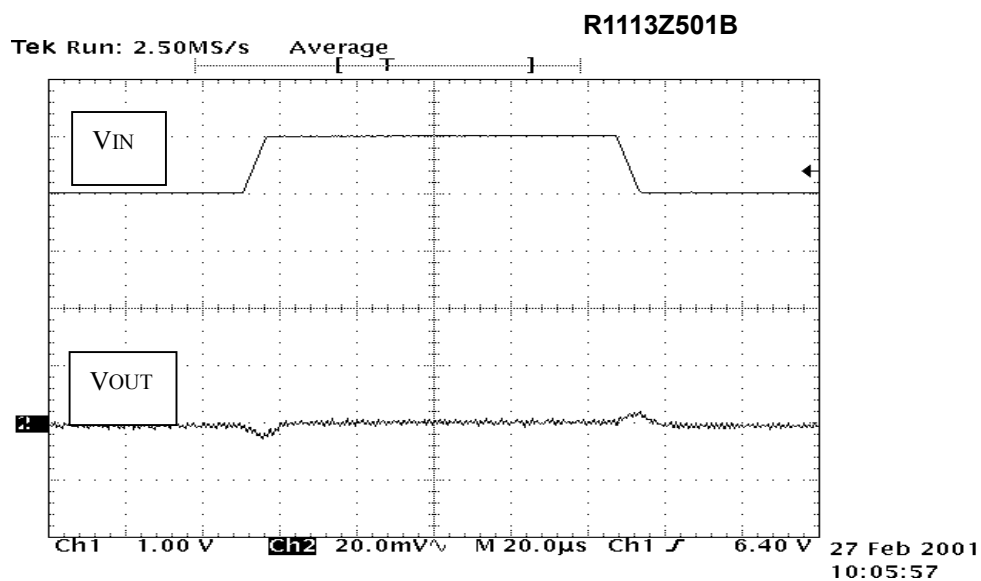
Topt=25°C

VIN=4.0V<-->5.0V
 IOUT=30mA
 CIN =none
 COUT=2.2µF
 tr/tf=5µs



Topt=25°C

VIN=5.0V<-->6.0V
 IOUT=30mA
 CIN =none
 COUT=2.2µF
 tr/tf=5µs



Topt=25°C

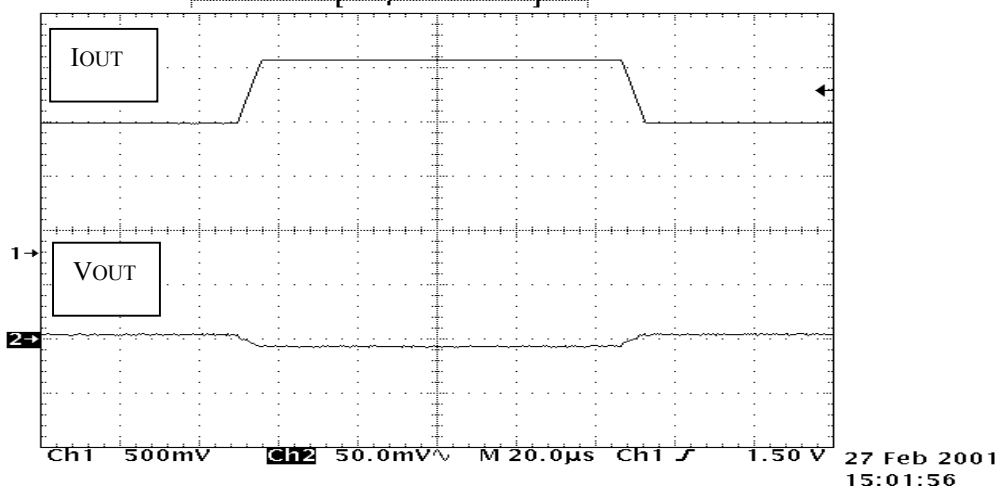
VIN=6.0V<-->7.0V
 IOUT=30mA
 CIN =none
 COUT=2.2µF
 tr/tf=5µs

11) Load Transient Response

R1113Z201B

T_{opt}=25°C

Tek Run: 2.50MS/s Average

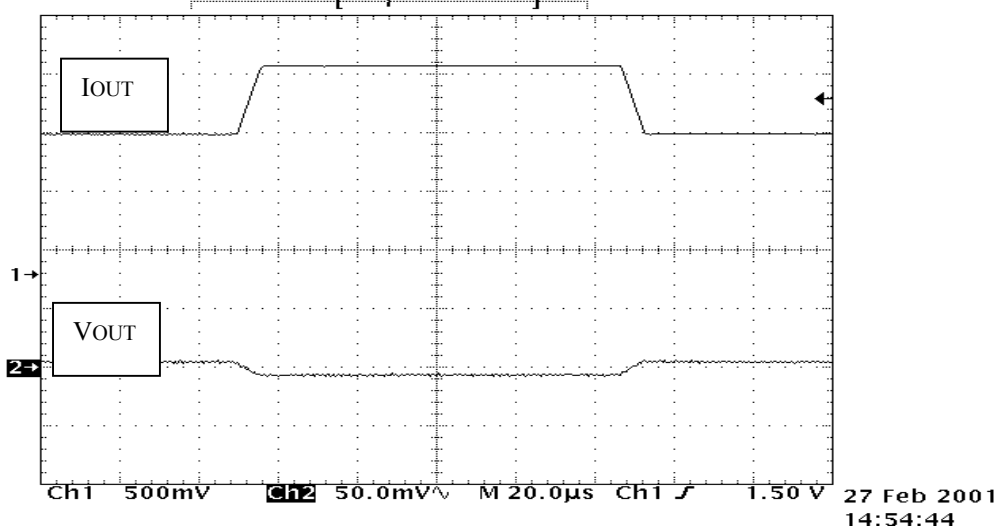


I_{OUT}=50mA<-->100mA
V_{IN}=3.0V
C_{IN}=2.2µF
C_{OUT}=4.7µF
tr/tf=5µs

R1113Z301B

T_{opt}=25°C

Tek Run: 2.50MS/s Average

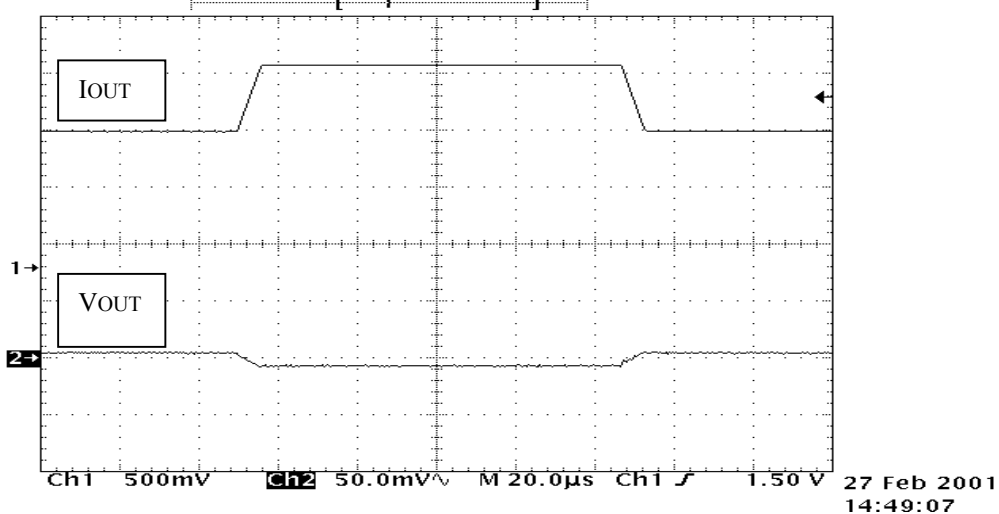


I_{OUT}=50mA<-->100mA
V_{IN}=4.0V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

R1113Z401B

T_{opt}=25°C

Tek Run: 2.50MS/s Average

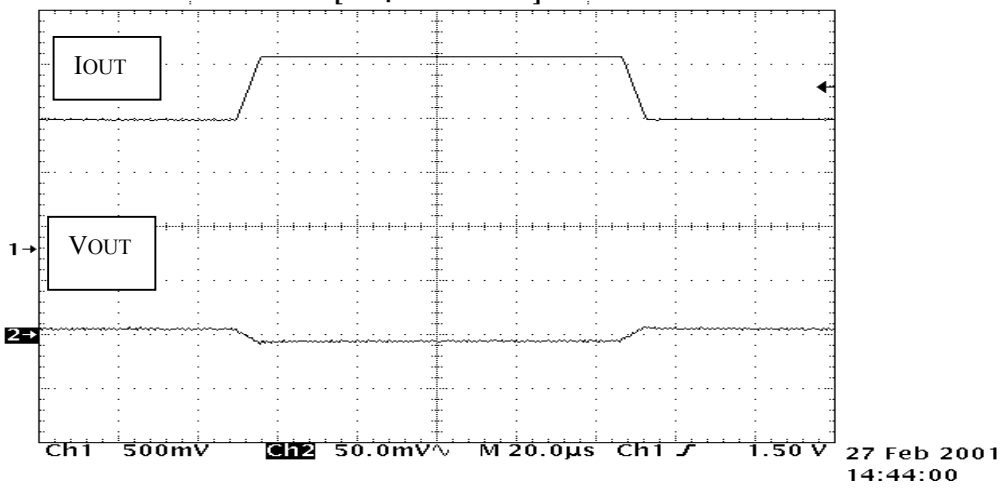


I_{OUT}=50mA<-->100mA
V_{IN}=5.0V
C_{IN}=2.2µF
C_{OUT}=2.2µF
tr/tf=5µs

R1113Z501B

Topt=25°C

Tek Run: 2.50MS/s Average

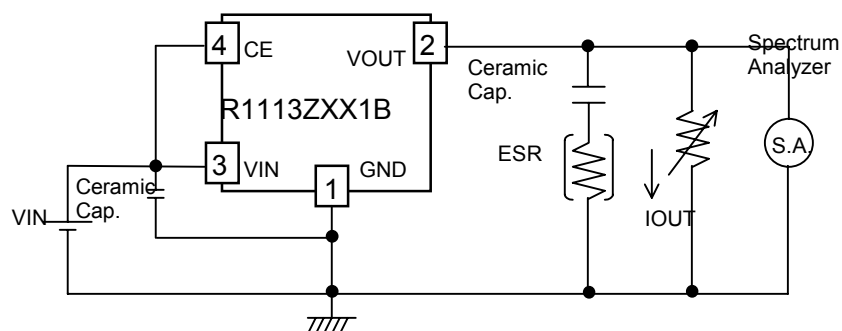


IOUT=50mA<-->100mA
VIN=6.0V
CIN=2.2µF
COUT=2.2µF
tr/td=5µs

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, 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; R1113ZXX1B

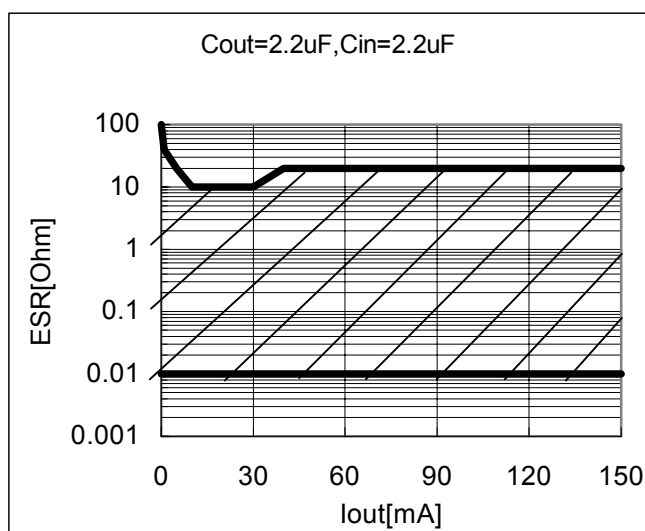
The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under $40\mu V$ (Avg.) are marked as the hatched area in the graph.

(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.)

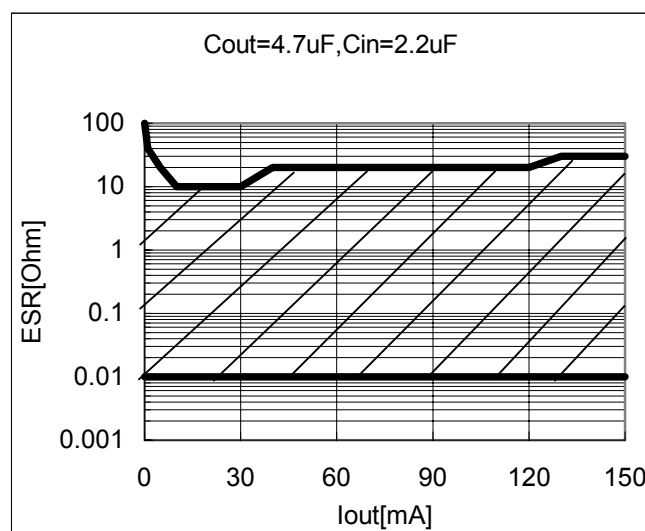
<Measurement conditions>

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

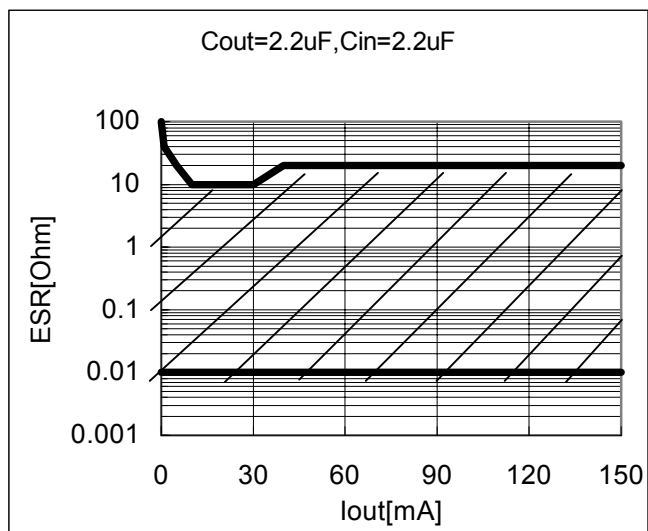
R1113Z201B



R1113Z201B



R1113Z301B



R1113Z301B

