LOW NOISE 150mA LDO REGULATOR

R1113Z SERIES

NO. EA-101-0504

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-CSP4-P1 (Wafer Level CSP), high density mounting of the ICs on boards is possible.

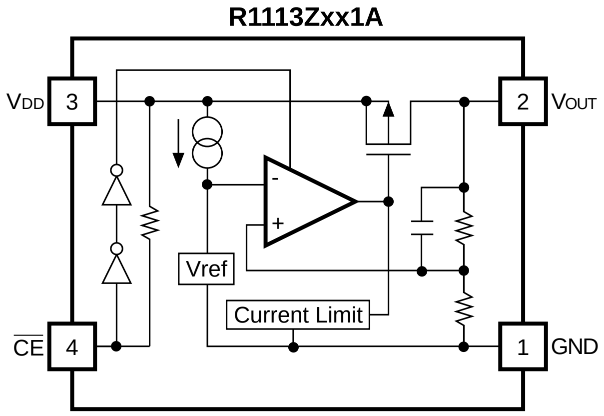
FEATURES

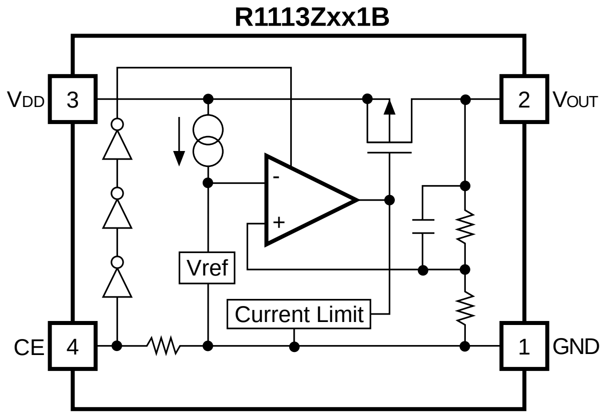
- Ultra-Low Supply Current..Typ. 100μA
- Standby Mode ....Typ. 0.1μA
- Low Dropout Voltage...Typ. 0.23V (I_{OUT}=100mA 3.0V Output type)
- High Ripple Rejection ....Typ. 80dB(f=1kHz 3.0V Output type)
- Low Temperature-Drift Coefficient of Output Voltage......Typ. ±100ppm/°C
- Excellent Line Regulation ....Typ. 0.05%/V
- High Output Voltage Accuracy ....±2.0%
- Excellent Dynamic Response
- Small Package ....WL-CSP4-P1 (Wafer Level CSP)
- Output Voltage ....Stepwise setting with a step of 0.1V in the range of 1.5V to5.0V 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





SELECTION GUIDE

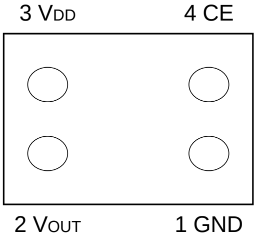
The output voltage, the active type, the packing type, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

R1113xxx1x-xx ←Part Number
↑↑ ↑ ↑
a b c d

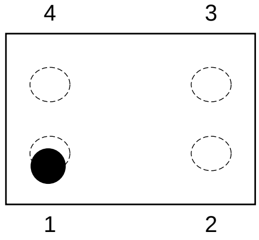
Code	Contents
a	Designation of Package Type : Z:WL-CSP4-P1 (Wafer Level CSP)
b	Setting Output Voltage (V_{OUT}) : Stepwise setting with a step of 0.1V in the range of 1.5V to 5.0V is possible.
c	Designation of Active Type : A : active low type B : active high type
d	Designation of Taping Type : Ex. TR, TL (refer to Taping Specifications; TR type is the standard direction.)

PIN CONFIGURATION

WL-CSP4-P1



Bottom View



Top View

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

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

Power Dissipation

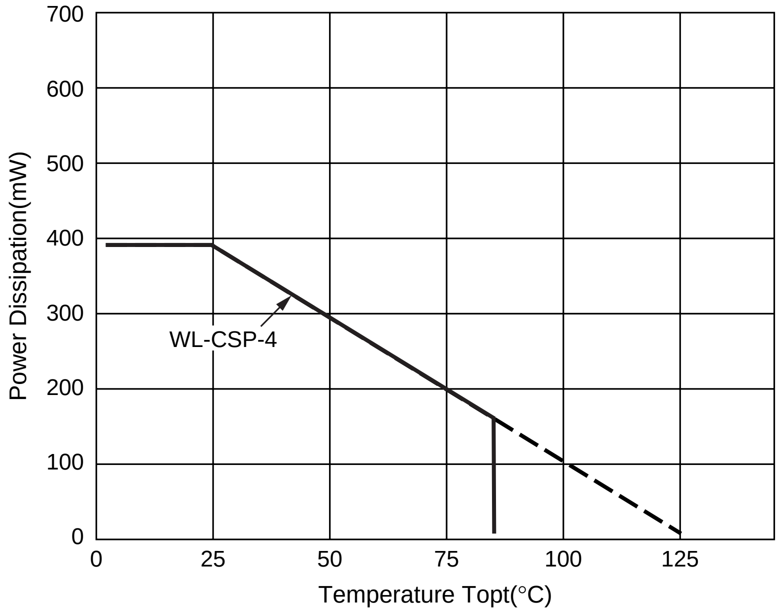
Typical Characteristics

∗Measurement Conditions

Mounted on board (Wind velocity=0m/s)
Board Material: FR-4 (Double-layer)
Board Size: 40mm×40mm×t1.6mm
Wiring area ratio against the board: 50%

∗Result

Power dissipation 465mW
Thermal Resistance 215°C/W



ELECTRICAL CHARACTERISTICS

• R1113Zxx1A

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}×0.98		V_{OUT}×1.02	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} ≦ 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
Istandby	Supply Current (Standby)	V_{IN} = V_{CE} = Set V_{OUT}+1V		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 6V 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
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA –40°C ≦ Topt ≦ 85°C		±100		ppm/°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V		30		mA
R_{PU}	$\overline{CE}$ Pull-up Resistance		2.5	5.0	10.0	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage “H”		1.5		V_{IN}	V
V_{CEL}	$\overline{CE}$ Input Voltage “L”		0.00		0.25	V
e_n	Output Noise	BW=10Hz to 100kHz		30		μVrms

• R1113Zxx1B

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}×0.98		V_{OUT}×1.02	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} ≦ 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
Istandby	Supply Current (Standby)	V_{IN} = V_{CE} = Set V_{OUT}+1V		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set VOUT+0.5V ≦ V_{IN} ≦ 6V 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
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA –40°C ≦ Topt ≦ 85°C		±100		ppm/°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V		30		mA
R_{PU}	CE Pull-up Resistance		2.5	5.0	10.0	MΩ
V_{CEH}	CE Input Voltage “H”		1.5		VIN	V
V_{CEL}	CE Input Voltage “L”		0.00		0.25	V
e_n	Output Noise	BW=10Hz to 100kHz		30		μVrms

ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

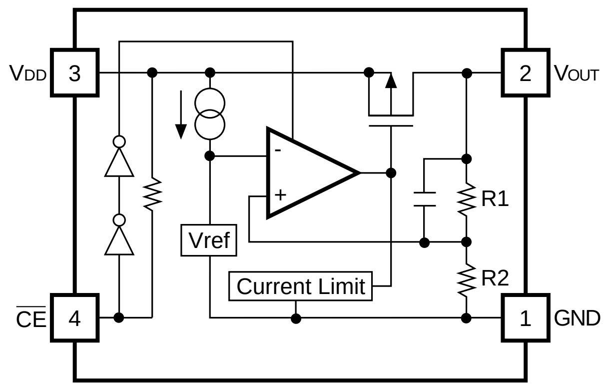
Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
1.5	I_{OUT} = 100mA	0.50	0.70
1.6		0.45	0.65
1.7		0.40	0.60
1.8		0.34	0.55
1.9		0.28	0.44
$2.0 \leqq V_{OUT} \leqq 2.3$		0.25	0.35
$2.4 \leqq V_{OUT} \leqq 2.7$		0.24	0.29
$2.8 \leqq V_{OUT} \leqq 5.0$		0.23	0.26

Topt = 25°C

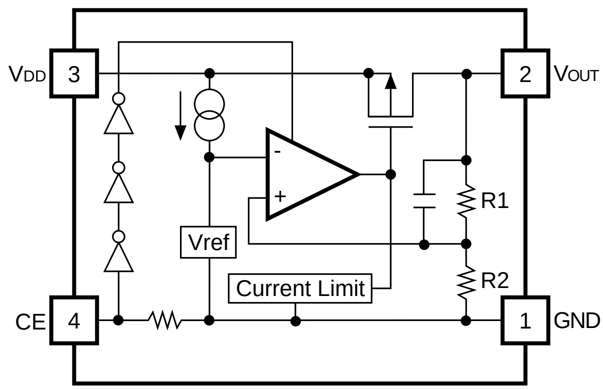
Output Voltage V_{OUT} (V)	Ripple Rejection RR (dB)		
	Condition	Typ.	Max.
$1.5 \leqq V_{OUT} \leqq 4.0$	f = 1kHz, Ripple 0.5Vp-p V_{IN} = Set V_{OUT} + 1V	80	
$4.1 \leqq V_{OUT} \leqq 5.0$		70	

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 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 2.2μF 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

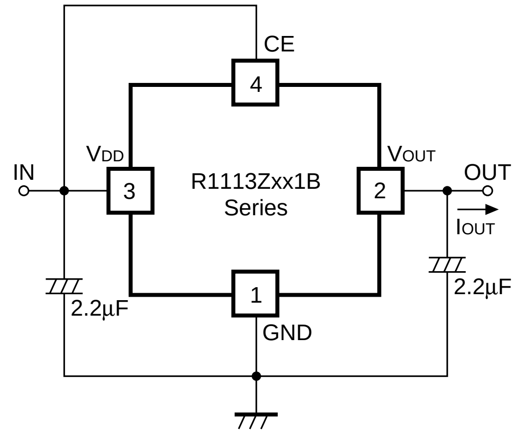


Fig.1 Standard test Circuit

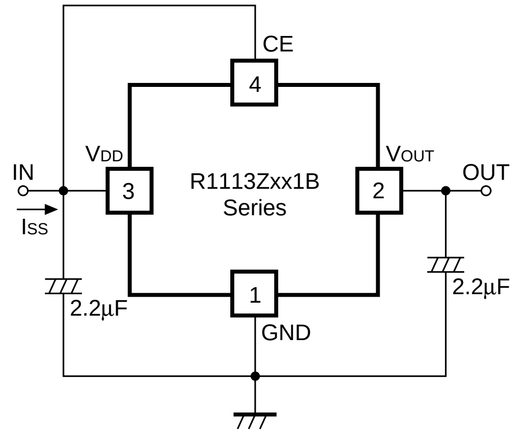


Fig.2 Supply Current Test Circuit

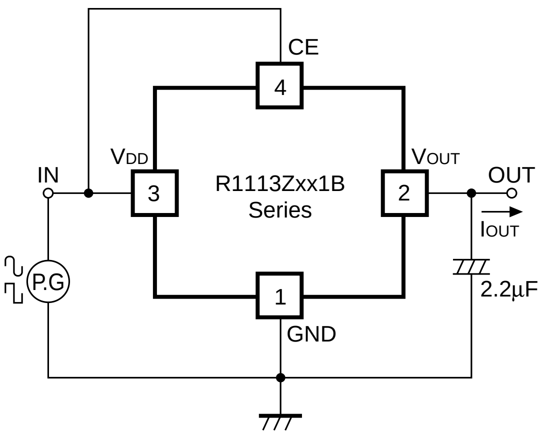


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

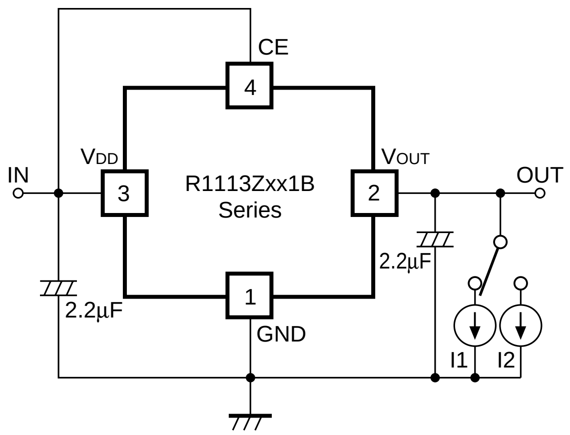
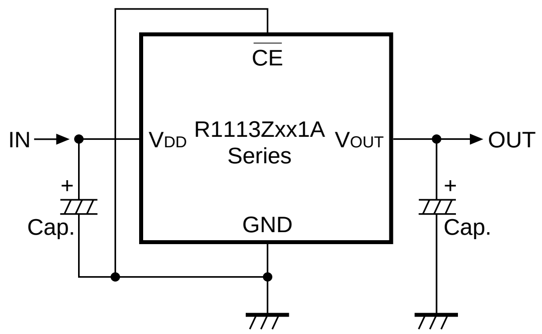
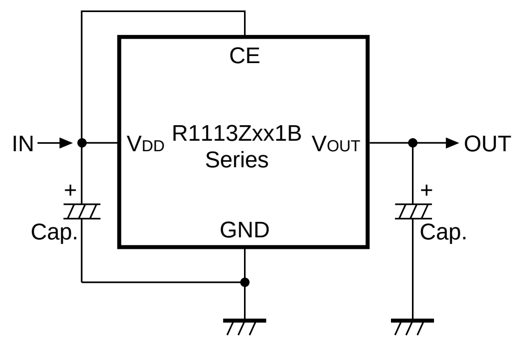


Fig.4 Load Transient Response Test Circuit

TYPICAL APPLICATION





(External Components)

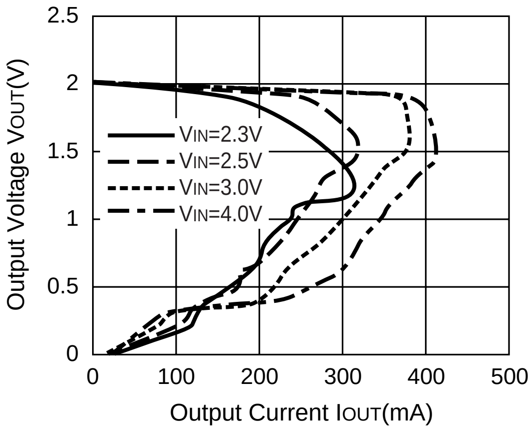
Output Capacitor ; Ceramic 2.2µF (Set Output Voltage in the range from 2.6 to 5.0V)
Ceramic 4.7µF (Set Output Voltage in the range from 1.5 to 2.5V)

Input Capacitor ; Ceramic 2.2µF

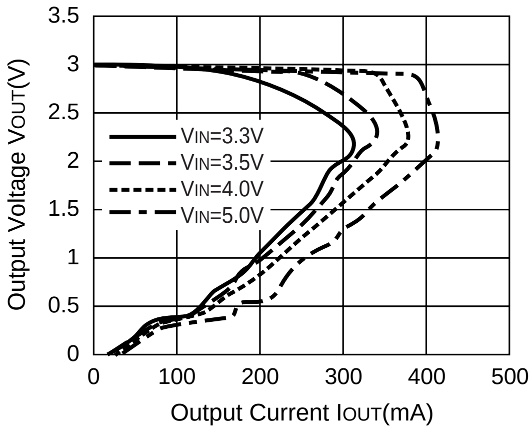
TYPICAL CHARACTERISTICS

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

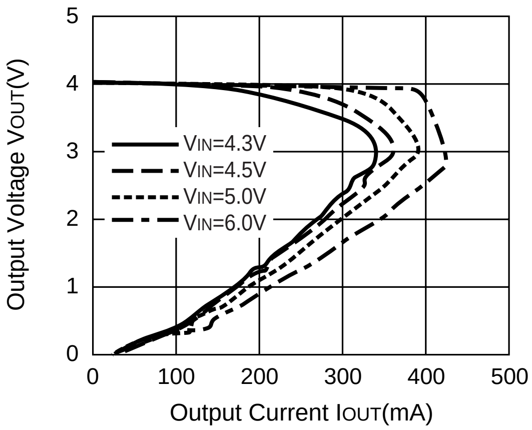
R1113Z201B



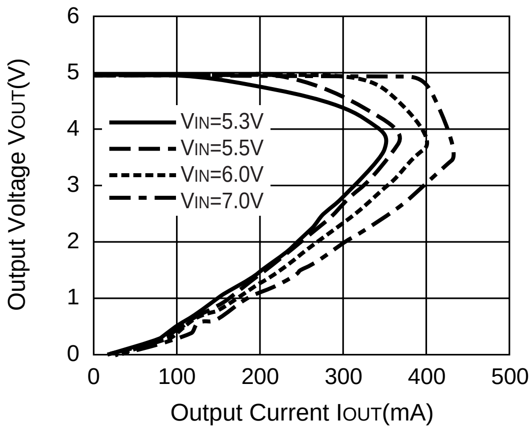
R1113Z301B



R1113Z401B

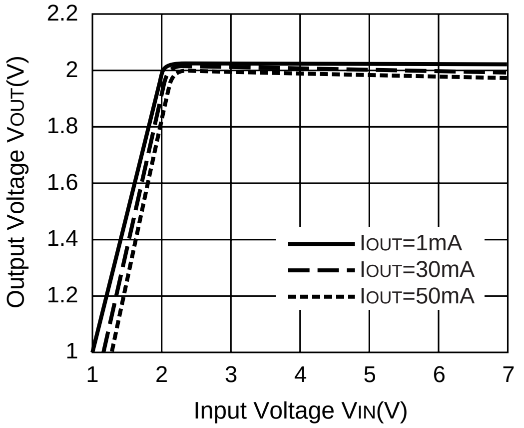


R1113Z501B



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

R1113Z201B



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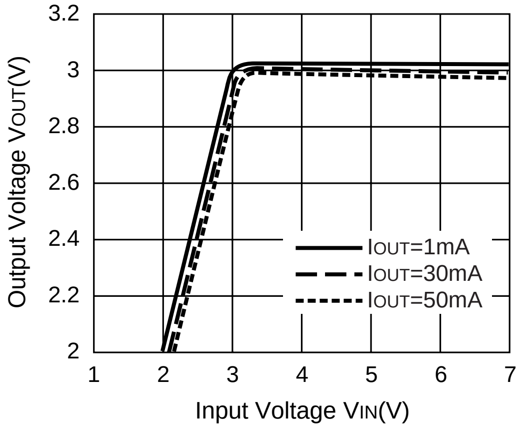
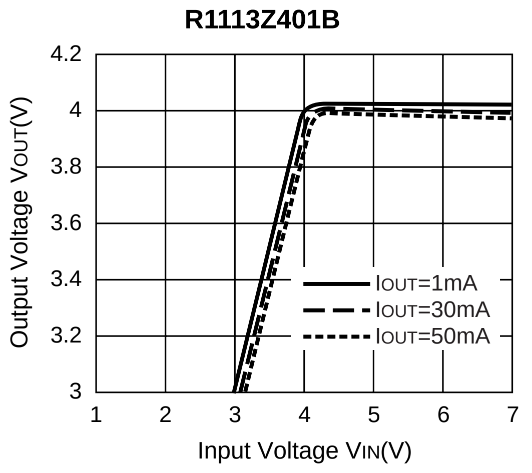
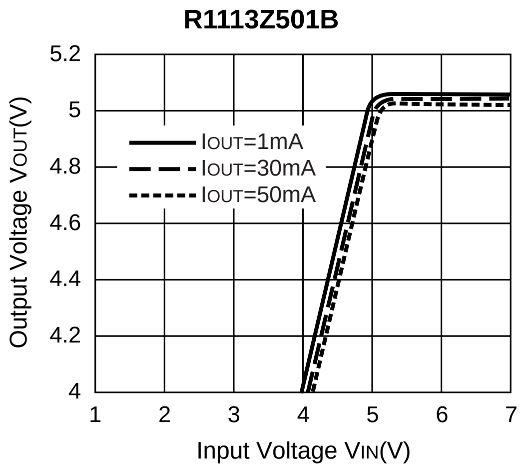
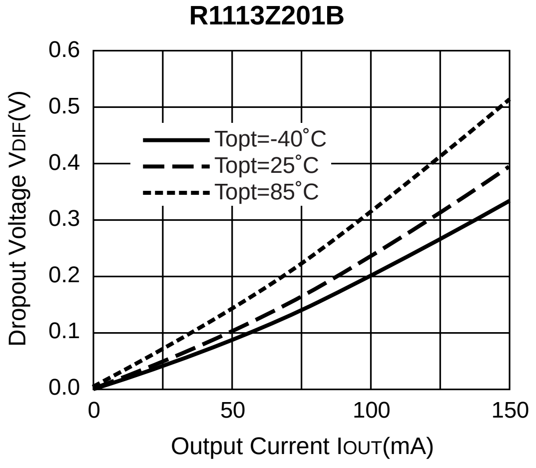
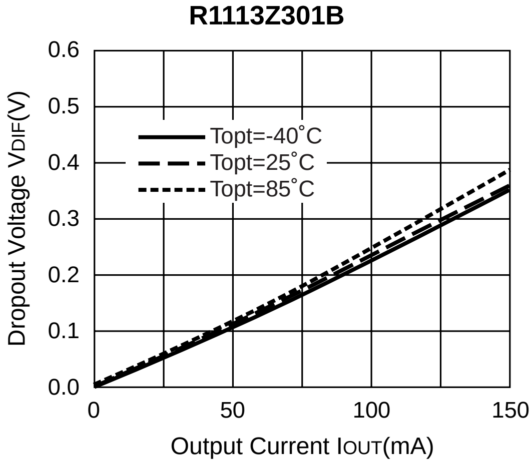


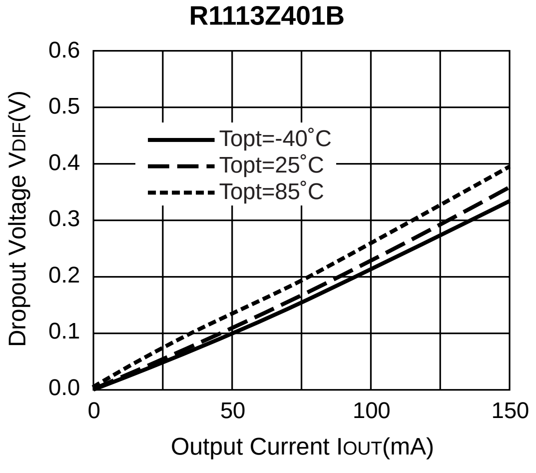


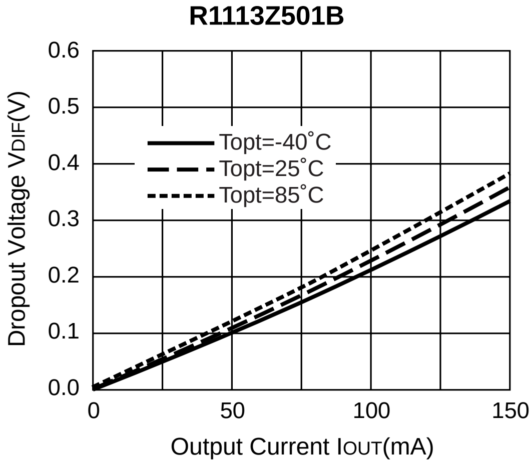


3) Dropout Voltage vs. Output Current





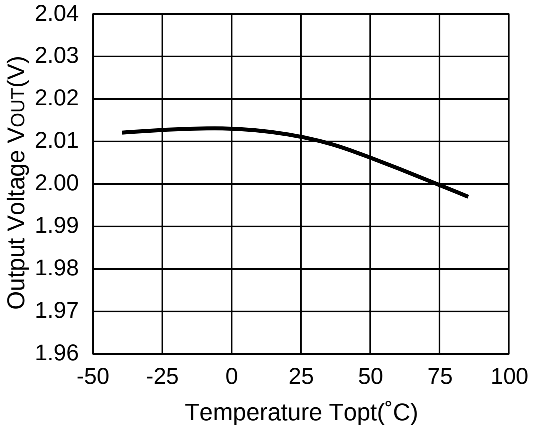




4) Output Voltage vs. Temperature

R1113Z201B

V_{IN}=3.0V, I_{OUT}=30mA



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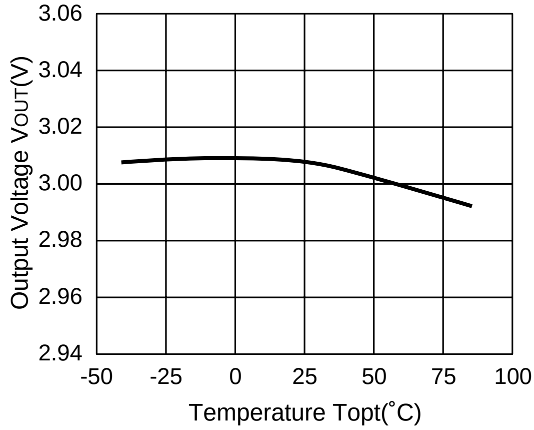
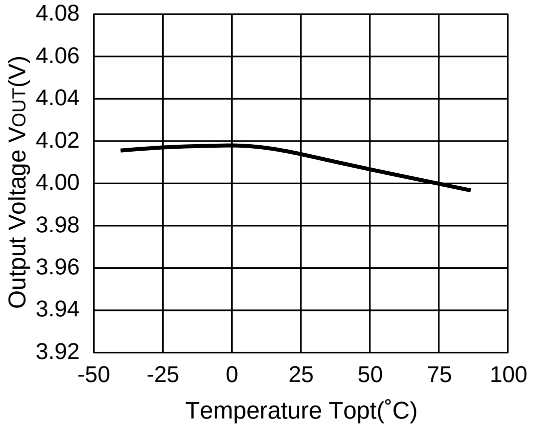
V_{IN}=4.0V, I_{OUT}=30mA



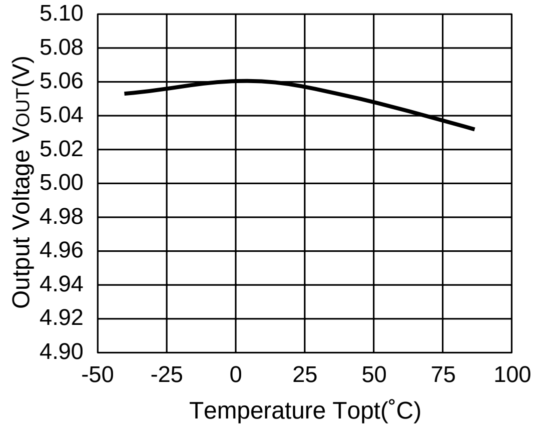
R1113Z401B

V_{IN}=5.0V, I_{OUT}=30mA



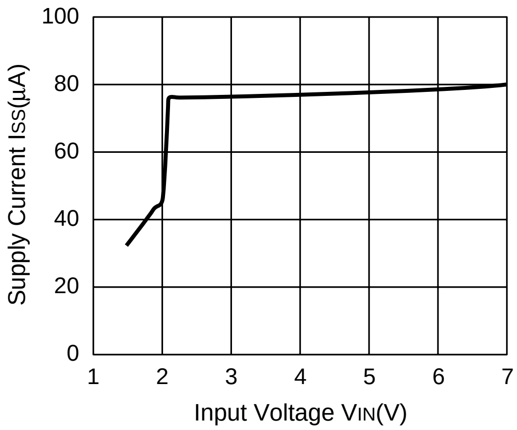
R1113Z501B

V_{IN}=6.0V, I_{OUT}=30mA



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

R1113Z201B



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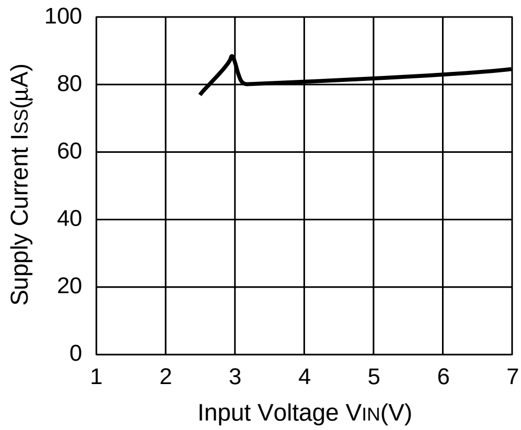

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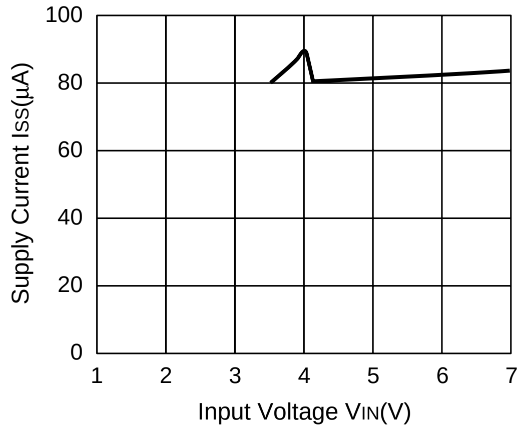

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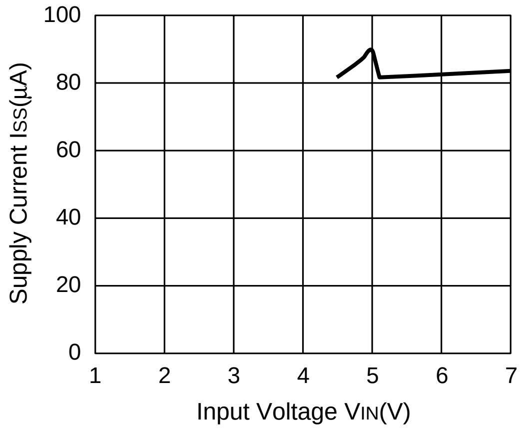
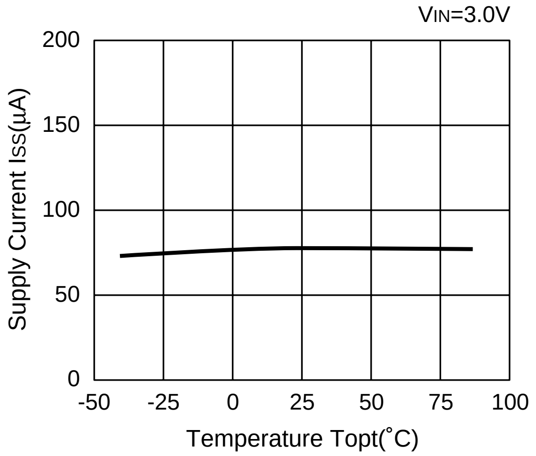


6) Supply Current vs. Temperature

R1113Z201B



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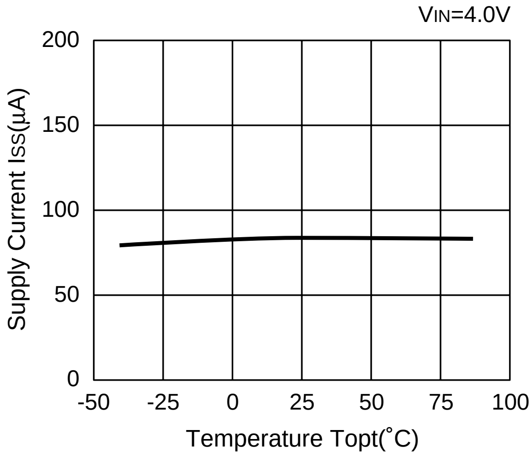

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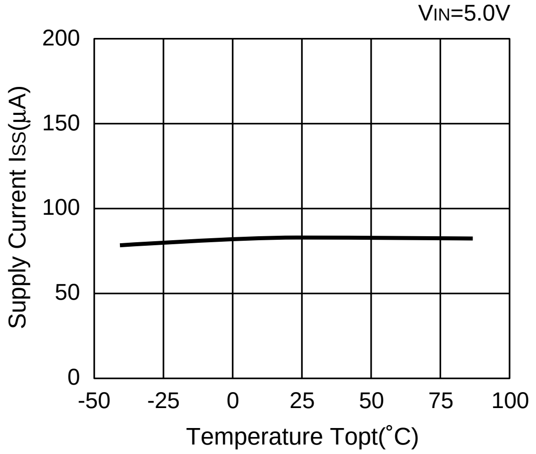

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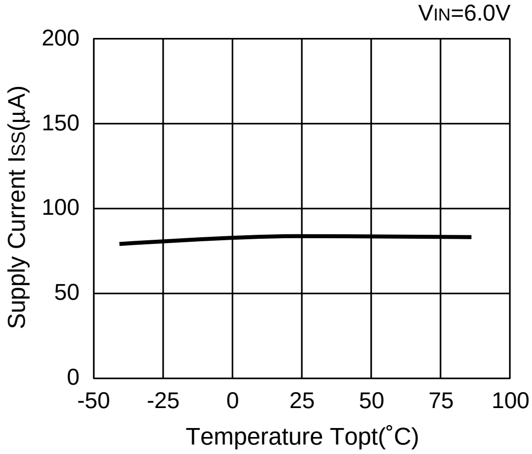
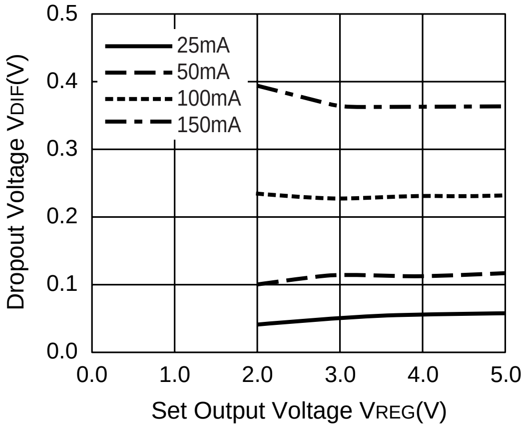


7) Dropout Voltage vs. Set Output Voltage

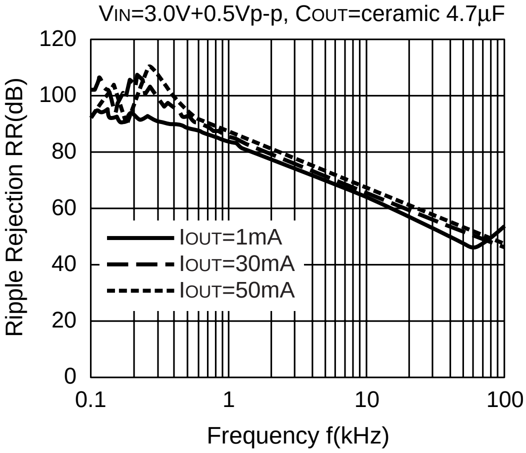
R1113Zxx1B



8) Ripple Rejection vs. Frequency

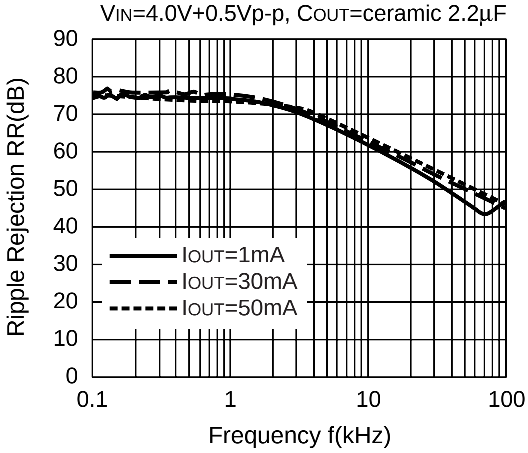
R1113Z201B

VIN=3.0V+0.5Vp-p, COUT=ceramic 4.7µF



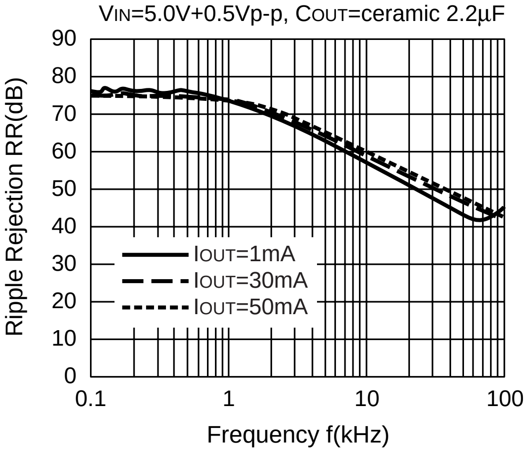
R1113Z301B

VIN=4.0V+0.5Vp-p, COUT=ceramic 2.2µF



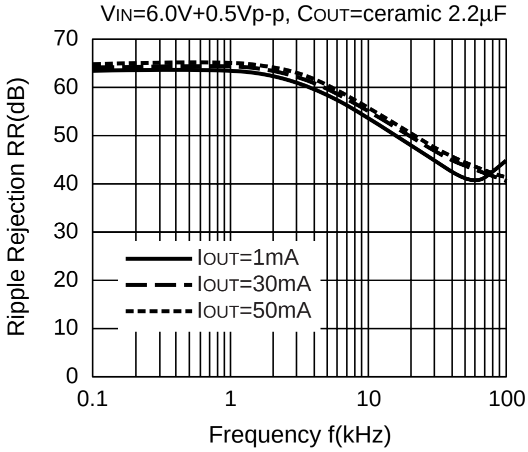
R1113Z401B

VIN=5.0V+0.5Vp-p, COUT=ceramic 2.2µF



R1113Z501B

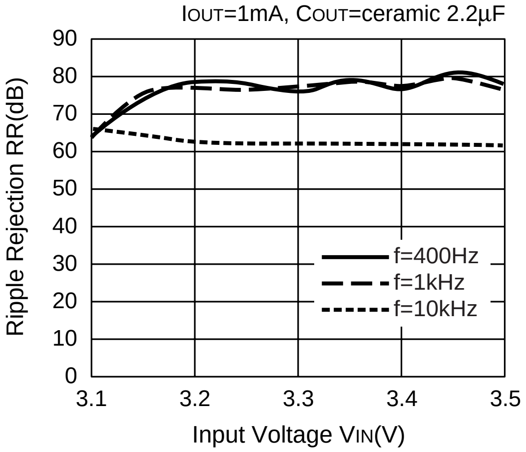
VIN=6.0V+0.5Vp-p, COUT=ceramic 2.2µF



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

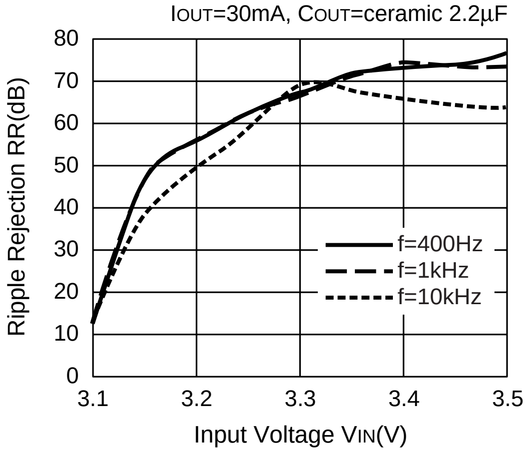
R1113Z301B

IOUT=1mA, COUT=ceramic 2.2µF



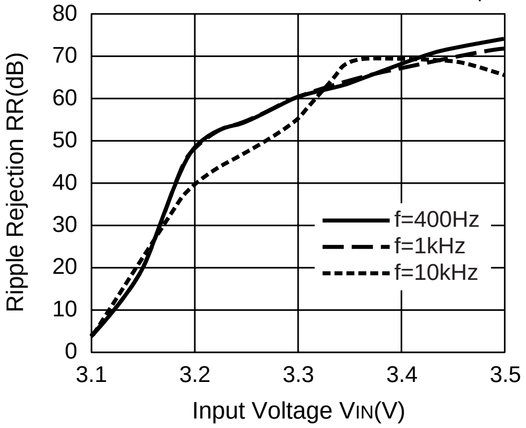
R1113Z301B

IOUT=30mA, COUT=ceramic 2.2µF



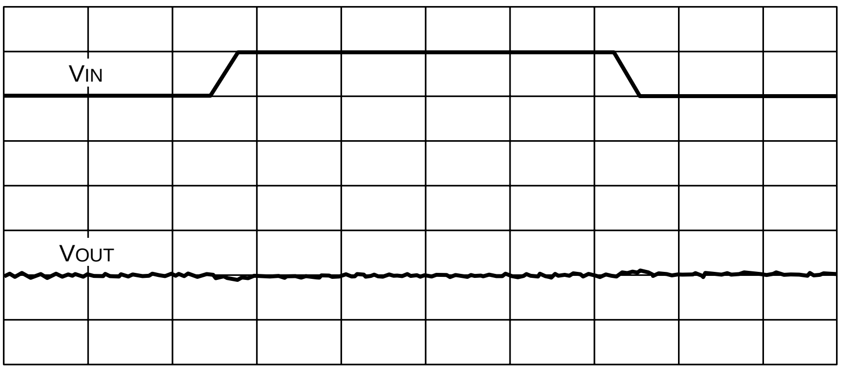
R1113Z301B

IOUT=50mA, COUT=ceramic 2.2µF



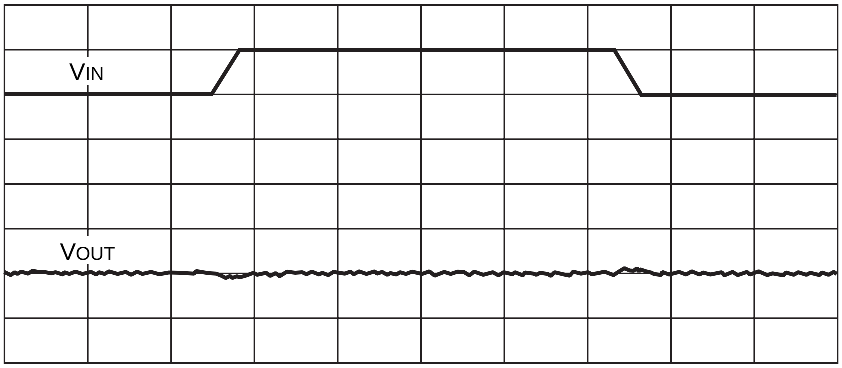
10) Input Transient Response

R1113Z201B Topt=25°C



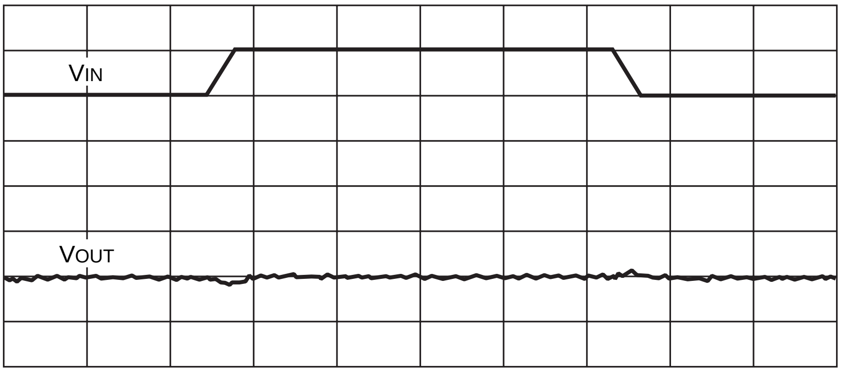
VIN=3.0V↔4.0V
IOUT=30mA
CIN =none
COUT=4.7µF
tr/tf=5µs

R1113Z301B Topt=25°C



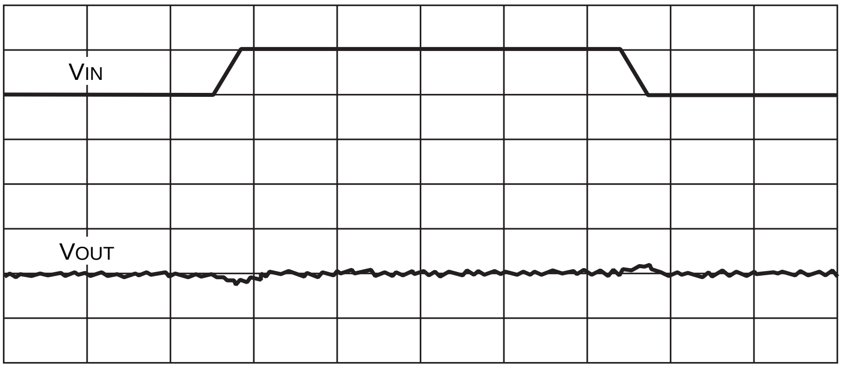
V_{IN}=4.0V↔5.0V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2μF
tr/tf=5μs

R1113Z401B Topt=25°C



V_{IN}=5.0V↔6.0V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2μF
tr/tf=5μs

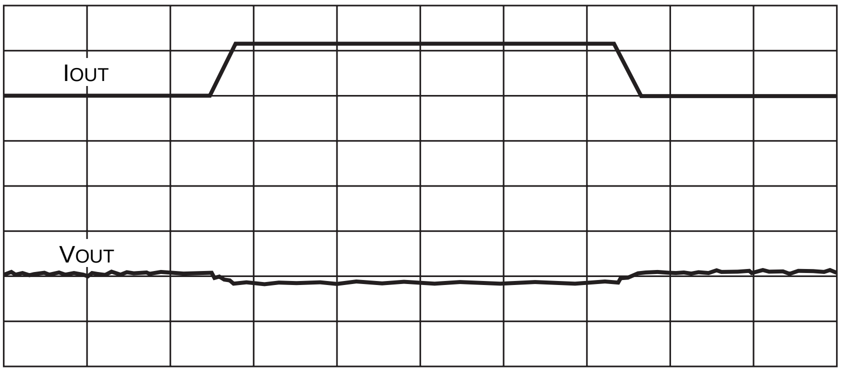
R1113Z501B Topt=25°C



V_{IN}=6.0V↔7.0V
I_{OUT}=30mA
C_{IN}=none
C_{OUT}=2.2μF
tr/tf=5μs

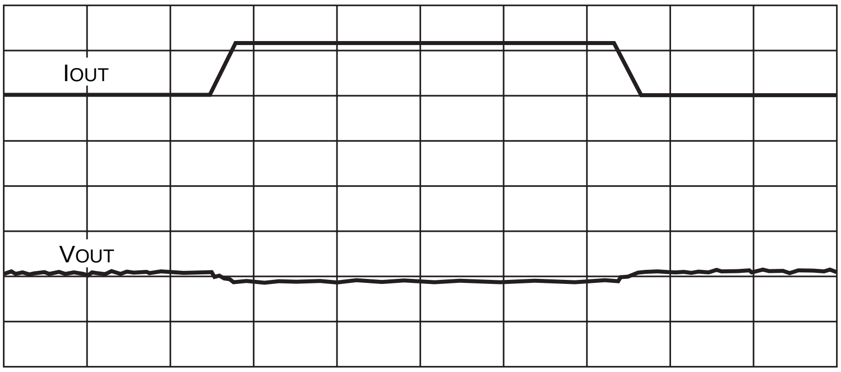
11) Load Transient Response

R1113Z201B Topt=25°C



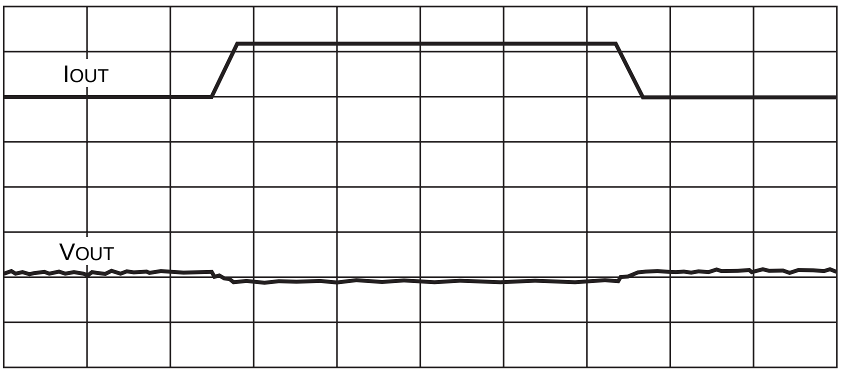
I_{OUT}=50mA↔100mA
V_{IN}=3.0V
C_{IN}=2.2μF
C_{OUT}=4.7μF
tr/tf=5μs

R1113Z301B Topt=25°C

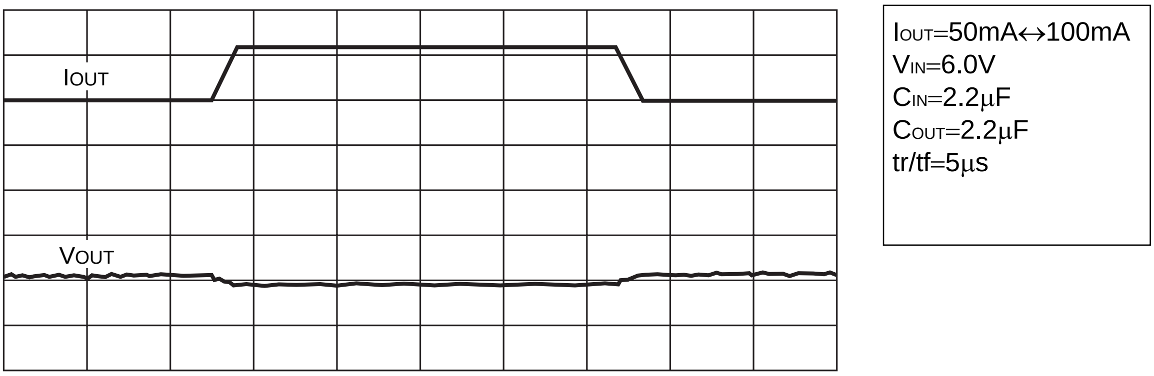


I_{OUT}=50mA↔100mA
V_{IN}=4.0V
C_{IN}=2.2μF
C_{OUT}=2.2μF
tr/tf=5μs

R1113Z401B Topt=25°C



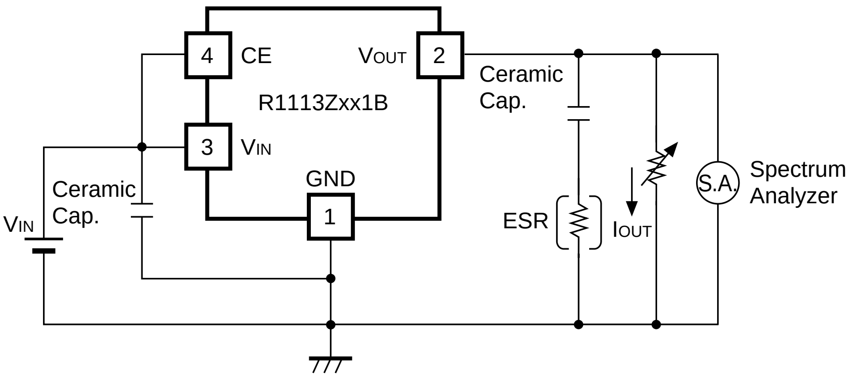
I_{OUT}=50mA↔100mA
V_{IN}=5.0V
C_{IN}=2.2μF
C_{OUT}=2.2μF
tr/tf=5μs



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 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.)

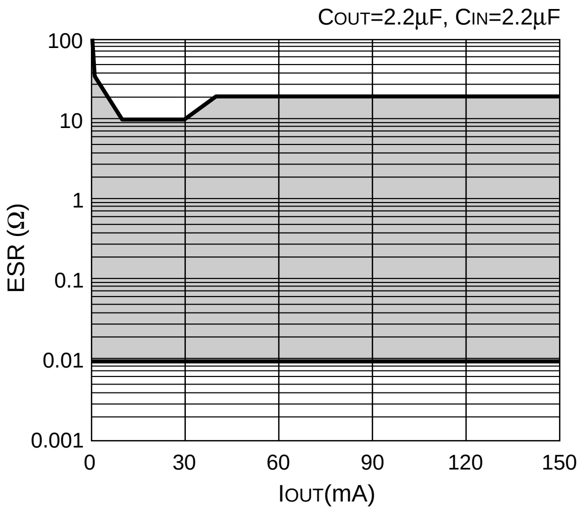
<Measurement conditions>

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

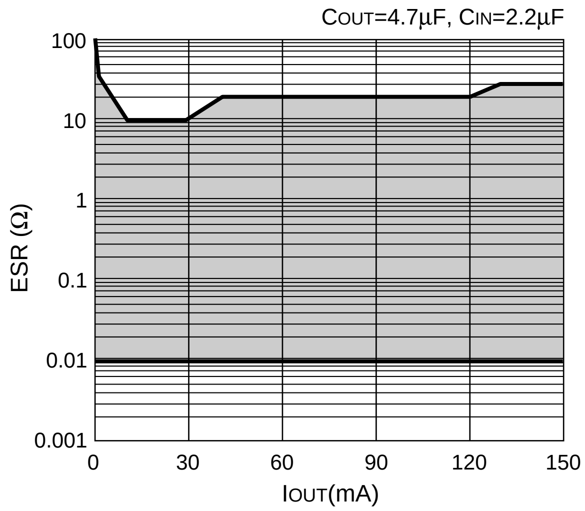
(2) Frequency Band: 10Hz to 1MHz

(3) Temperature: 25°C

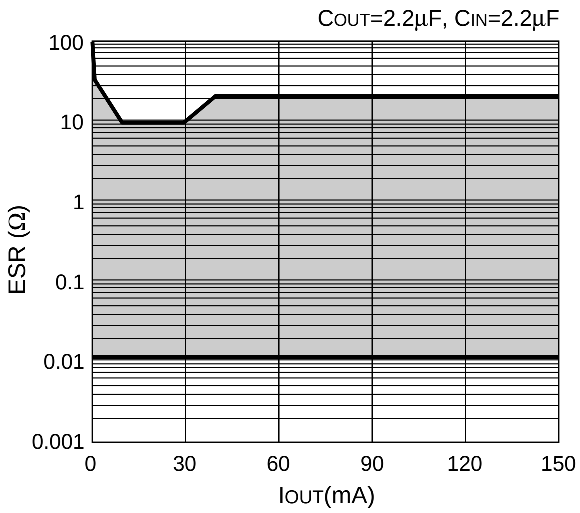
R1113Z201B



R1113Z201B



R1113Z301B



R1113Z301B