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R1115Z SERIES

LOW NOISE 150mA LDO Regulator

NO.EA-107-070910

OUTLINE

The R1115Z Series are CMOS-based voltage regulator ICs with 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 R1115Z 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 WLCSP-4-P4, therefore high density mounting of the ICs on boards is possible.

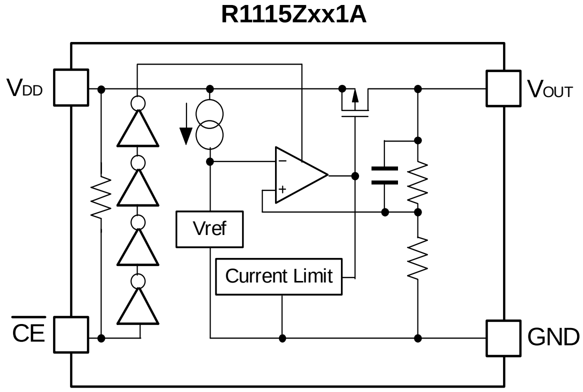
FEATURES

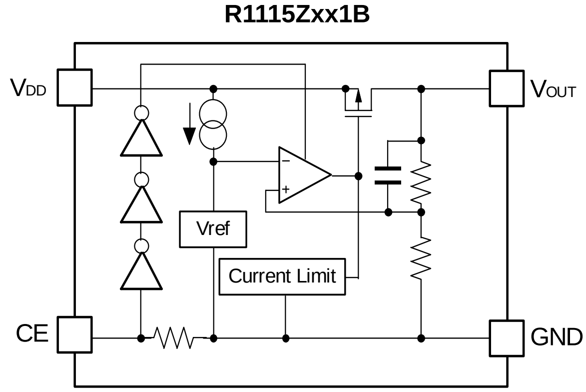
- Supply Current .... Typ. 75µA
- Standby Current .... Typ. 0.1µA
- Output Voltage .... 1.5V to 4.0V
- Dropout Voltage .... Typ. 0.22V (I_{OUT}=150mA, V_{OUT}=3.0V)
- Ripple Rejection .... Typ. 70dB (f=1kHz)
  Typ. 60dB (f=10kHz)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.02%/V
- Output Voltage Accuracy .... ±2.0%
- Packages WLCSP-4-P4
- 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} ≧ 2.5V)

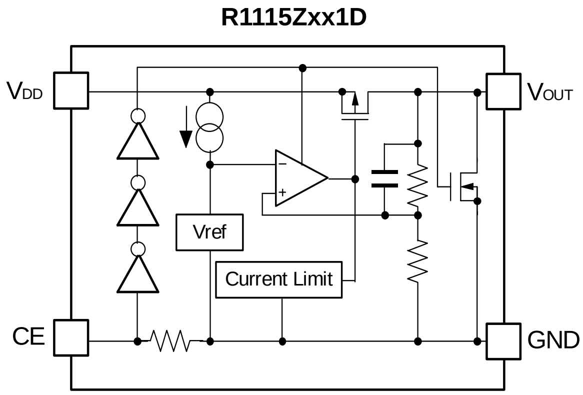
APPLICATIONS

- 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







SELECTION GUIDE

The output voltage, auto discharge function*, 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;

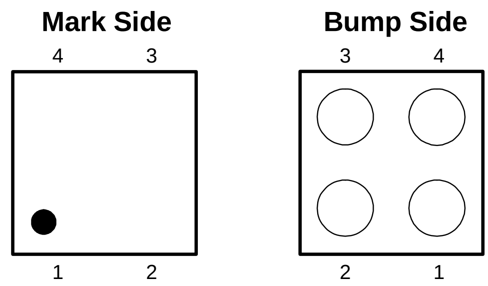
R1115Zxx1x-xx-x ←Part Number
↑ ↑ ↑ ↑ ↑
a b c d e

Code	Contents
a	Designation of Package Type: Z: WLCSP-4-P4
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: with $\overline{CE}$ (active low type) B: with CE (active high type) D: with CE (active high with auto discharge function*)
d	Designation of Taping Type: Ex. TR (refer to Taping Specifications; TR type is the standard direction.)
e	Designation of composition of pin plating: -F: Lead free plating

*) When the mode is into standby with CE signal, auto discharge transistor turns on, and it makes the turn-off speed faster than normal type.

PIN CONFIGURATION

- **WLCSP-4-P4**



PIN DESCRIPTION

- **R1115Z**

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

ABSOLUTE MAXIMUM RATING

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 to V_{IN}+0.3	V
I_{OUT}	Output Current	200	mA
P_D	Power Dissipation*	600	mW
Topt	Operating Temperature Range	–40 to 85	°C
Tstg	Storage Temperature Range	–55 to 125	°C

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

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ELECTRICAL CHARACTERISTICS

- **R1115Zxx1A**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}=Set V_{OUT}+1V 1mA ≦ I_{OUT} ≦ 30mA		×0.98		×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} ≦ 150mA			22	40	mV
V_{DIF}	Dropout Voltage	I_{OUT}=150mA	V_{OUT} = 1.5V		0.38	0.70	V
			V_{OUT} = 1.6V		0.36	0.65	
			V_{OUT} = 1.7V		0.34	0.60	
			1.8V ≦ V_{OUT} ≦ 2.0V		0.32	0.55	
			2.1V ≦ V_{OUT} ≦ 2.7V		0.28	0.50	
			2.8V ≦ V_{OUT} ≦ 4.0V		0.22	0.35	
I_{SS}	Supply Current	V_{IN}=Set V_{OUT}+1V, I_{OUT}=0mA			75	95	µA
$I_{standby}$	Standby Current	V_{IN}=Set V_{OUT}+1V V_{CE}=V_{DD}			0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=30mA V_{OUT} > 1.6V, Set V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V (V_{OUT} ≦ 1.6V, 2.2V ≤ V_{IN} ≦ 6.0V)			0.02	0.10	%/V
RR	Ripple Rejection	Ripple 0.5Vp–p I_{OUT}=30mA V_{OUT}>1.7V, V_{IN}–V_{OUT}=1.0V (V_{OUT} ≦ 1.7V, V_{IN}–V_{OUT}=1.2V)	f=1kHz		70		dB
			f=10kHz		60		
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_{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		6.0	V
V_{CEL}	$\overline{CE}$ Input Voltage "L"			0		0.3	V
en	Output Noise	BW =10Hz to 100kHz			30		µVrms

- **R1115Zxx1B/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	×0.98		×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} ≦ 150mA		22	40	mV
V_{DIF}	Dropout Voltage	I_{OUT}=150mA, V_{OUT} = 1.5V		0.38	0.70	V
		I_{OUT}=150mA, V_{OUT} = 1.6V		0.36	0.65	V
		I_{OUT}=150mA, V_{OUT} = 1.7V		0.34	0.60	V
		I_{OUT}=150mA, 1.8V ≦ V_{OUT} ≦ 2.0V		0.32	0.55	V
		I_{OUT}=150mA, 2.1V ≦ V_{OUT} ≦ 2.7V		0.28	0.50	V
		I_{OUT}=150mA, 2.8V ≦ V_{OUT} ≦ 4.0V		0.22	0.35	V
I_{SS}	Supply Current	V_{IN}=Set V_{OUT}+1V, I_{OUT}=0mA		75	95	μA
$I_{standby}$	Standby Current	V_{IN}=Set V_{OUT}+1V, V_{CE}=GND		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=30mA V_{OUT}>1.6V, Set V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V (V_{OUT} ≦ 1.6V, 2.2V ≦ V_{IN} ≦ 6.0V)		0.02	0.10	%/V
RR	Ripple Rejection	Ripple 0.5Vp–p I_{OUT}=30mA V_{OUT}>1.7V, $V_{IN}-V_{OUT}$=1.0V (V_{OUT} ≦ 1.7V, $V_{IN}-V_{OUT}$=1.2V) f=1kHz		70		dB
		f=10kHz		60		dB
V_{IN}	Input Voltage		2.0		6.0	V
$\Delta V_{OUT}/\Delta T_{opt}$	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_{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		0.3	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

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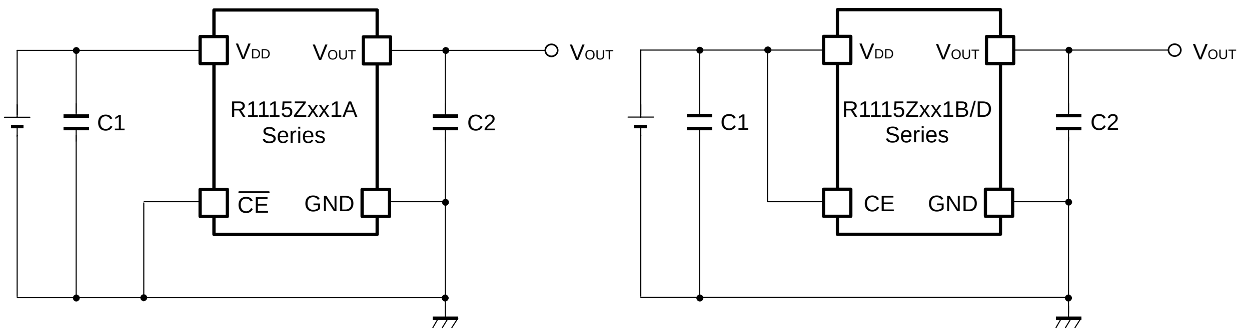
TYPICAL APPLICATIONS



(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

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 C2. Recommendation value is as follows:

If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable. Evaluate your circuit with considering frequency characteristics.

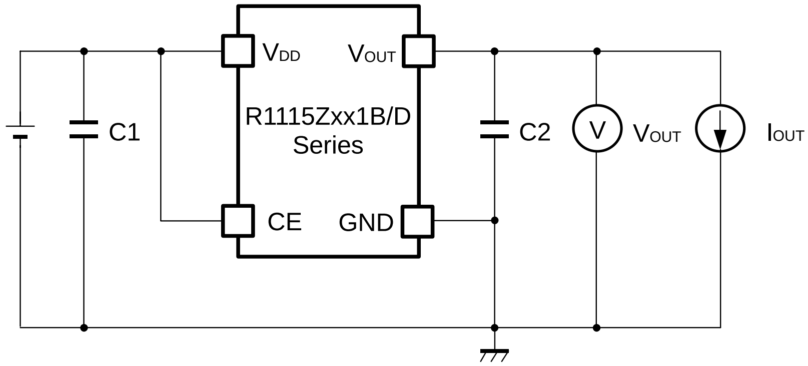
Output Voltage	C2 recommendation value
$V_{OUT} \leqq 2.4V$	1.0μF or more
$2.5 \leqq V_{OUT}$	0.47μF or more

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1μF or more between V_{DD} and GND pin, and as close as possible to the pins.

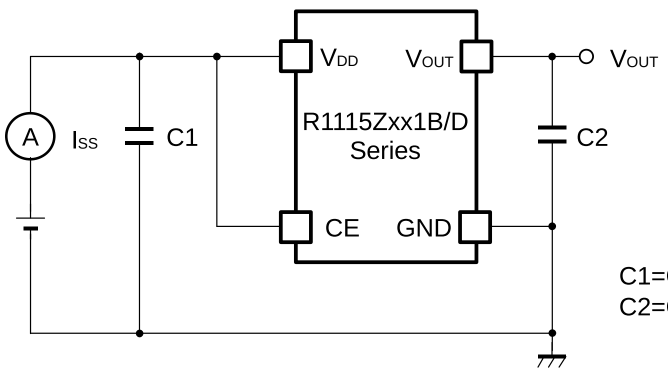
Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

TEST CIRCUITS



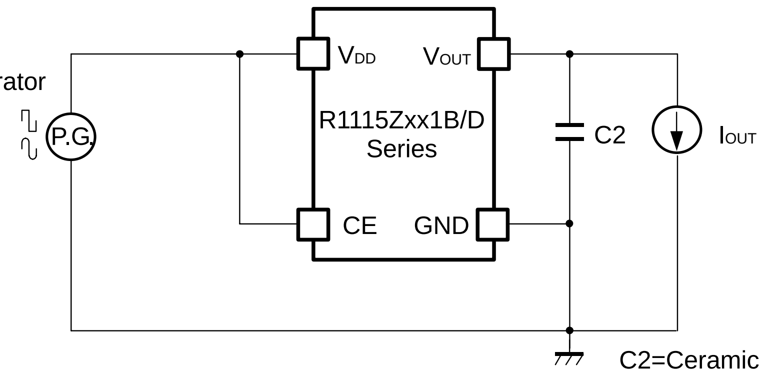
C1=Ceramic 1.0μF
C2=Ceramic 1.0μF

Fig.1 Standard test Circuit



C1=Ceramic 1.0μF
C2=Ceramic 1.0μF

Fig.2 Supply Current Test Circuit



C2=Ceramic 1.0μF

Fig.3 Ripple Rejection, Line Transient Response Test Circuit

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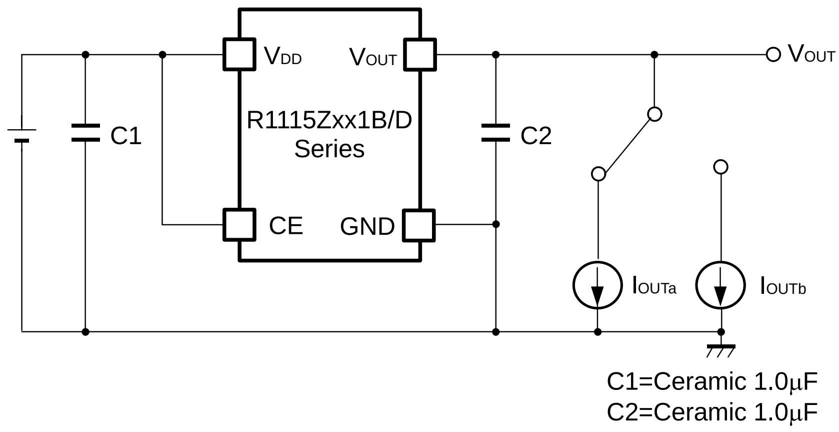

Fig.4 Load Transient Response Test Circuit

TYPICAL CHARACTERISTICS

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

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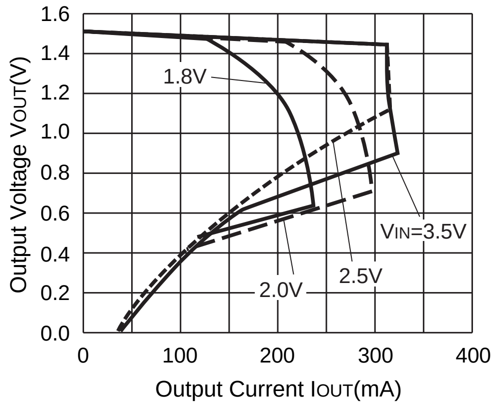

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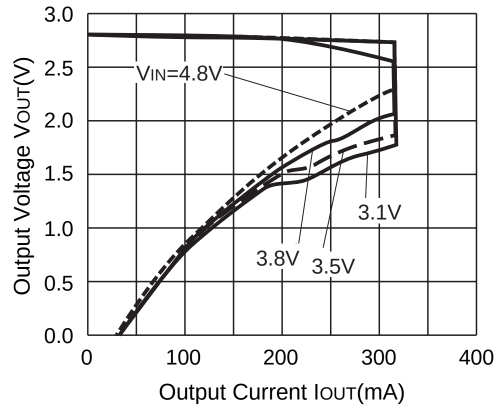

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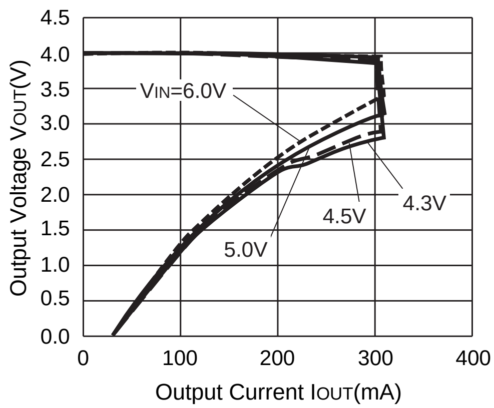
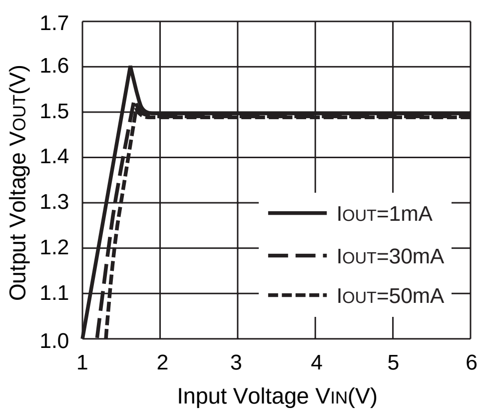


2) Output Voltage vs. Input Voltage (Topt=25°C)

R1115Z151x



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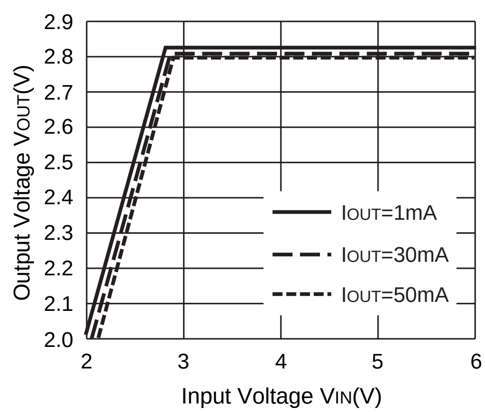

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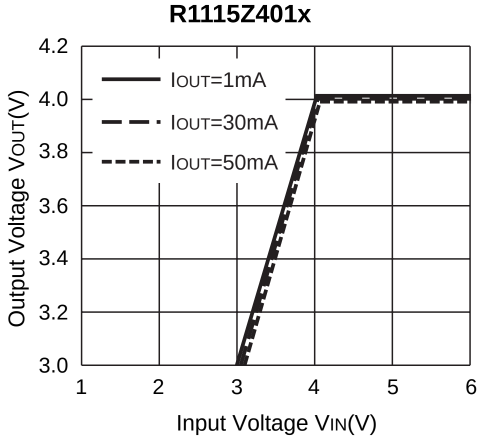
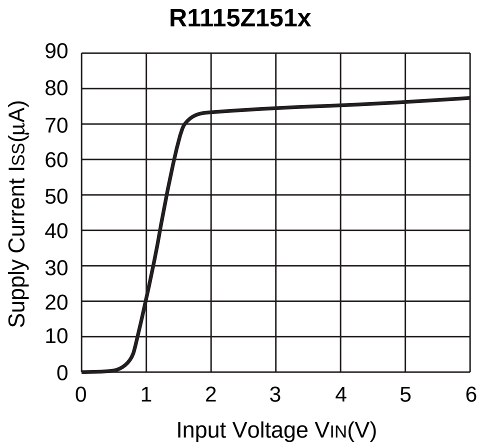
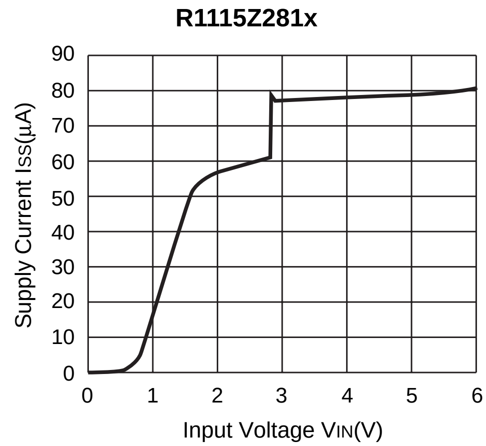
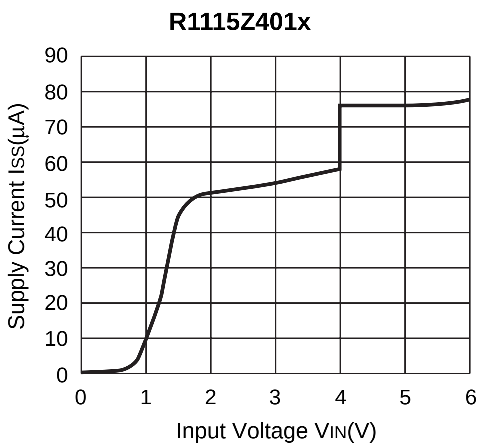


3) Supply Current vs. Input Voltage (Topt=25°C)







4) Output Voltage vs. Temperature

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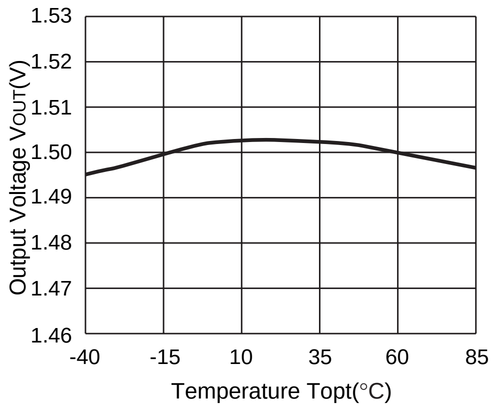

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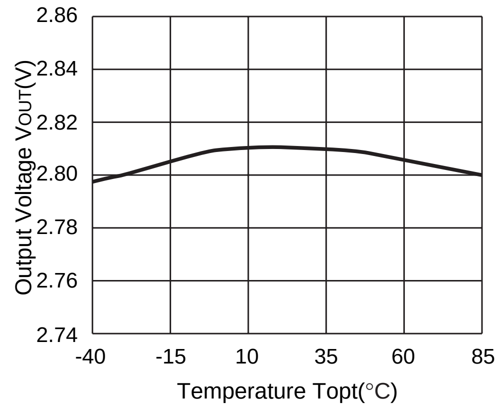

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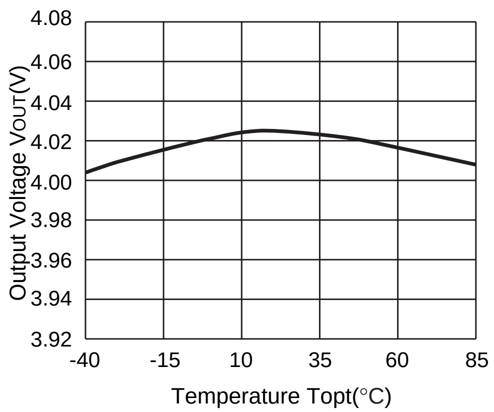
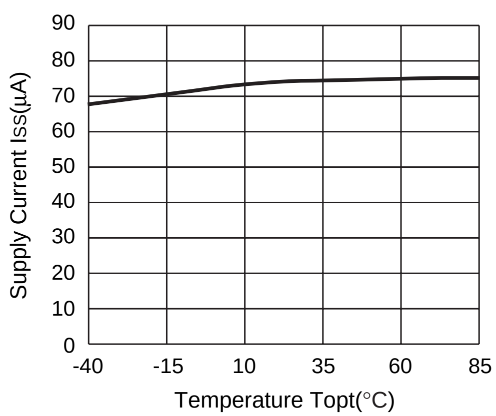


5) Supply Current vs. Temperature

R1115Z151x



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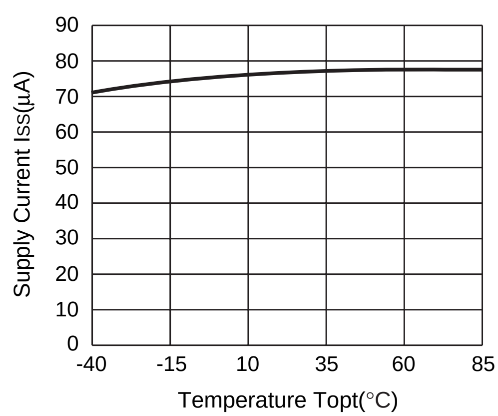

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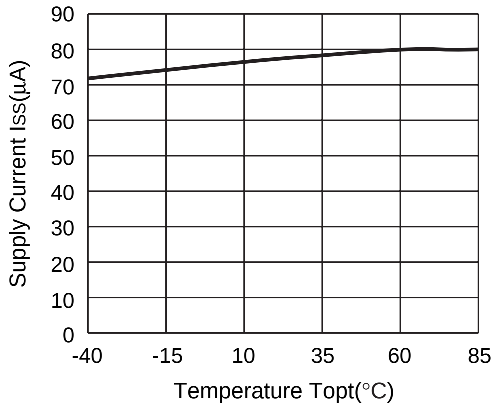

6) Dropout Voltage vs. Output Current

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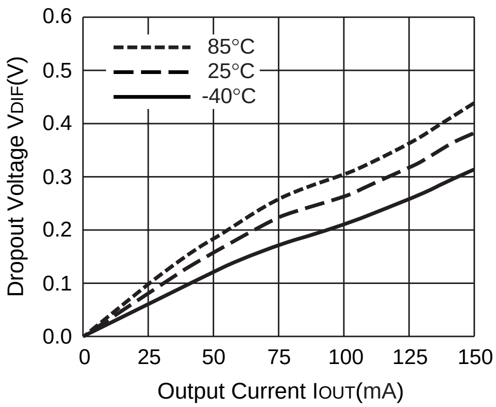

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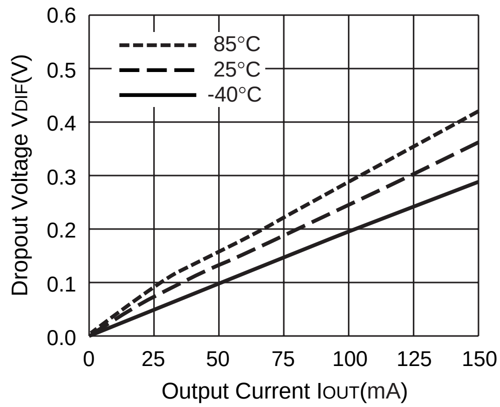

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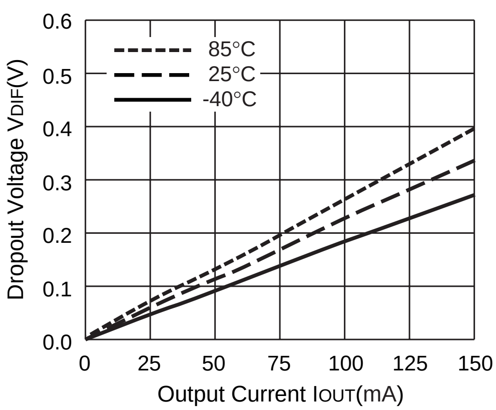

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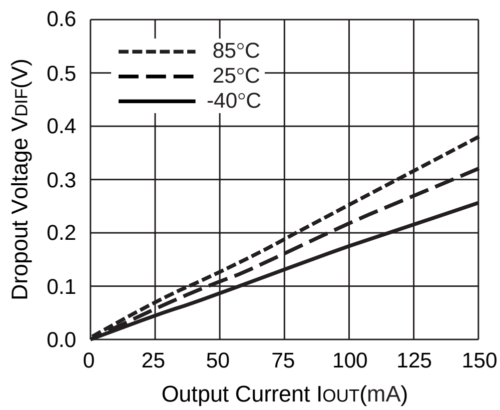

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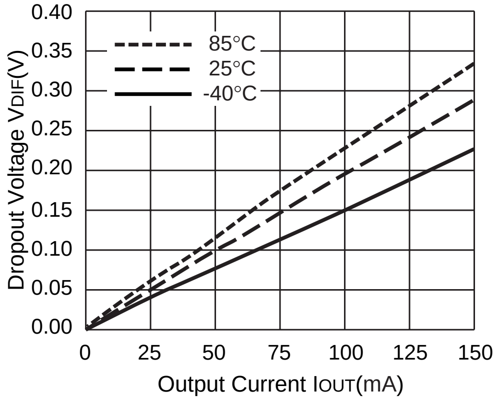

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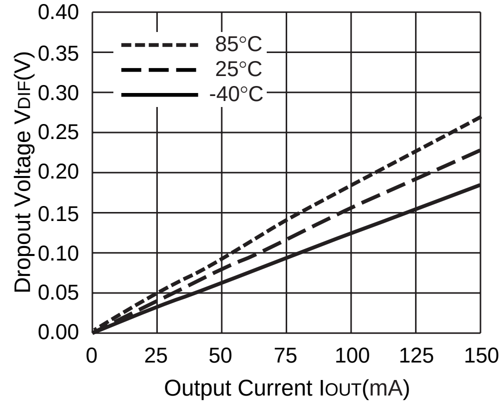

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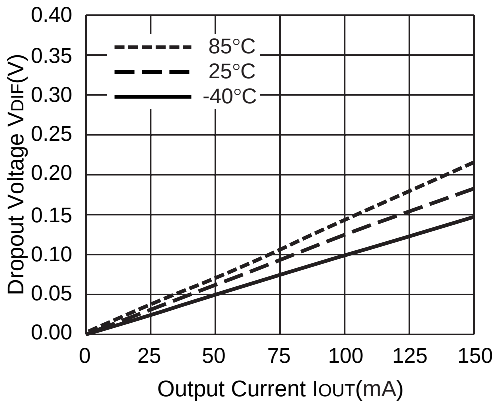
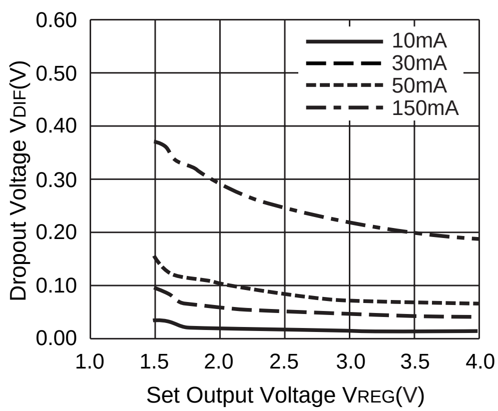


7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)



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8) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, C_{IN}=none, C_{OUT}=ceramic 0.47µF)

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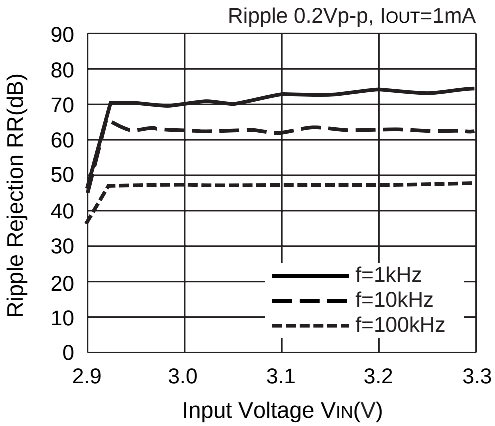

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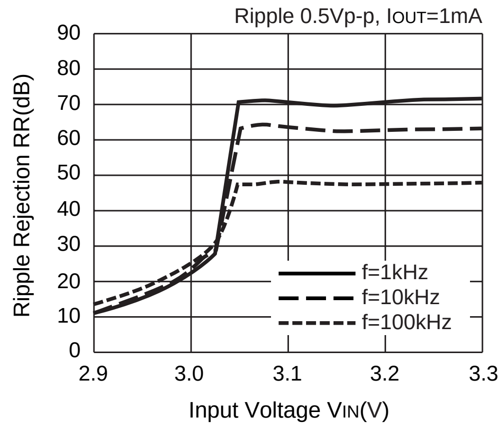

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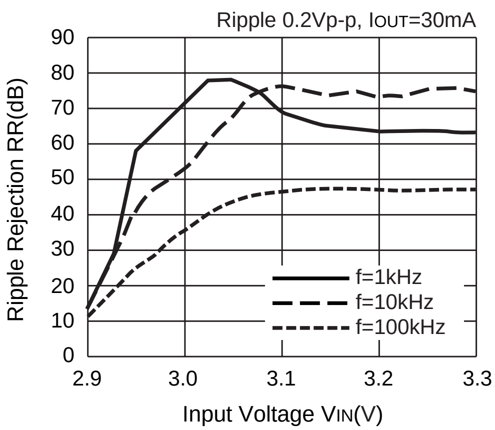

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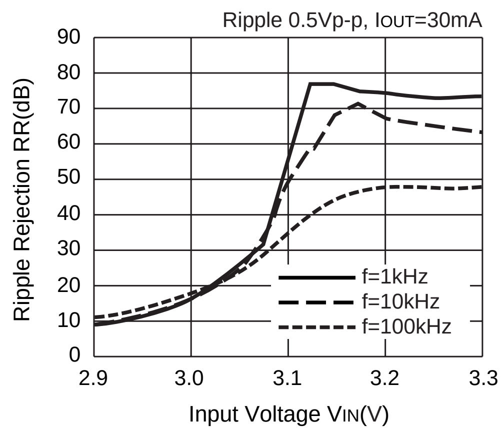

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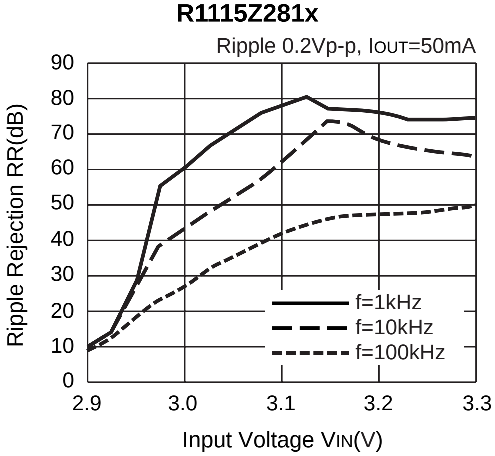

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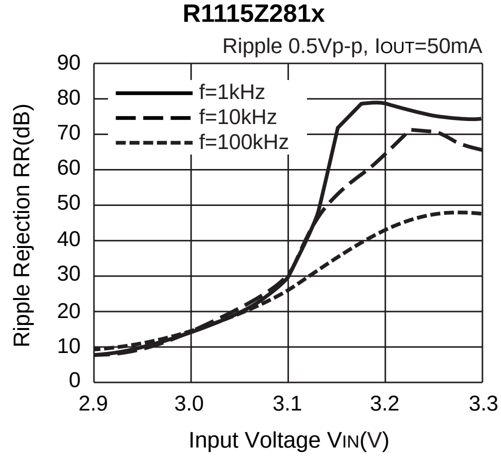
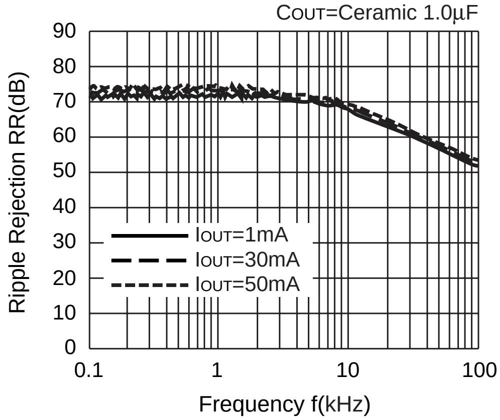


9) Ripple Rejection vs. Frequency (CIN=none)

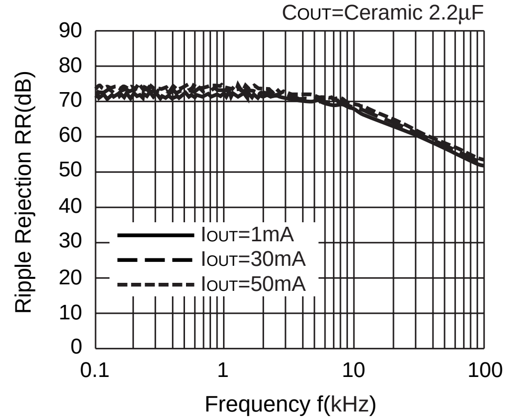
R1115Z151x

VIN=2.5VDC+0.5Vp-p,
COUT=Ceramic 1.0µF



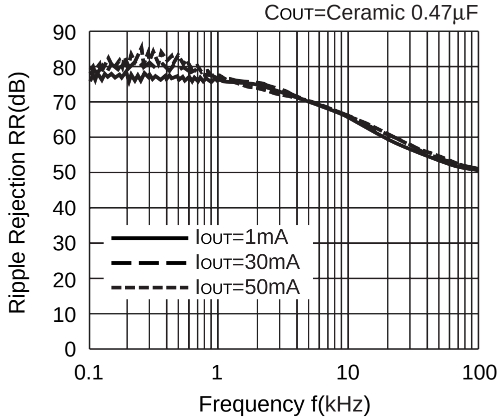
R1115Z151x

VIN=2.5VDC+0.5Vp-p,
COUT=Ceramic 2.2µF



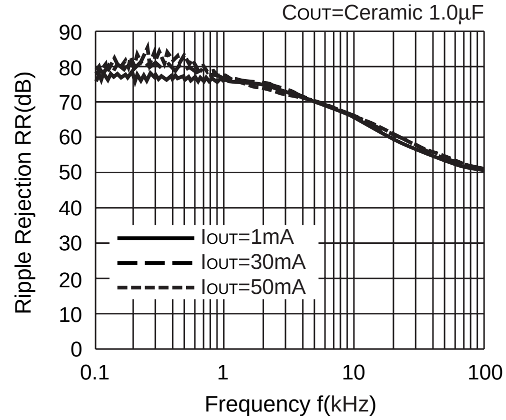
R1115Z281x

VIN=3.8VDC+0.5Vp-p,
COUT=Ceramic 0.47µF



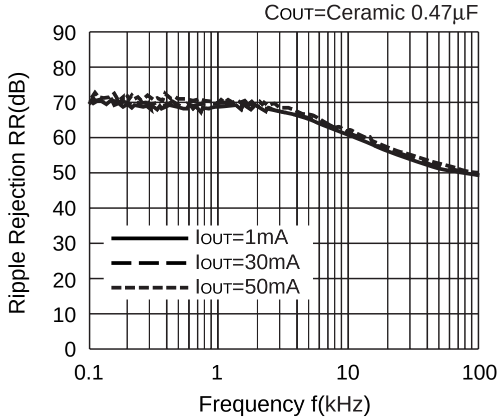
R1115Z281x

VIN=3.8VDC+0.5Vp-p,
COUT=Ceramic 1.0µF



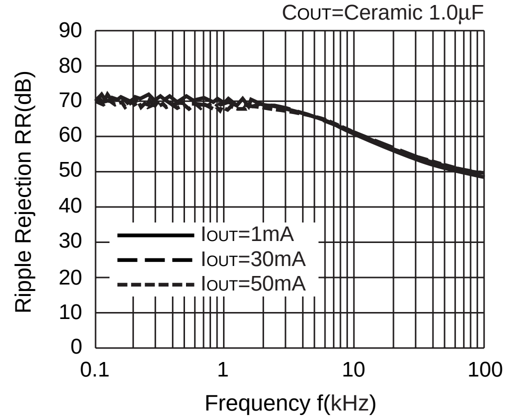
R1115Z401x

VIN=5.0VDC+0.5Vp-p,
COUT=Ceramic 0.47µF



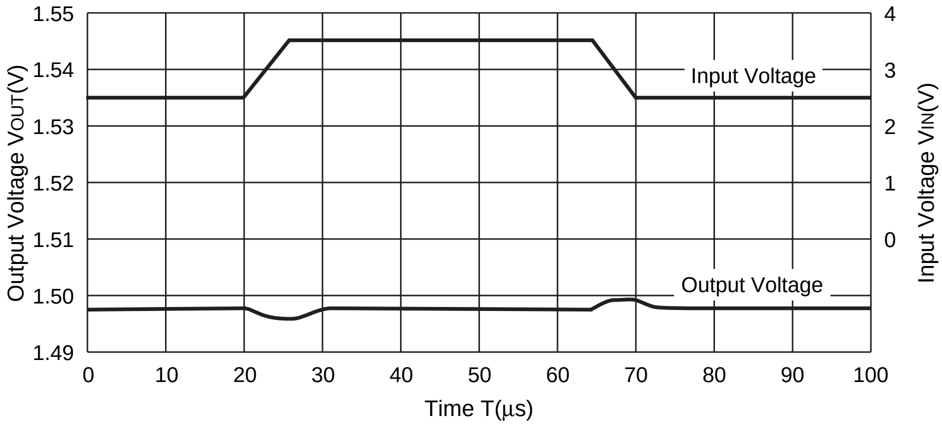
R1115Z401x

VIN=5.0VDC+0.5Vp-p,
COUT=Ceramic 1.0µF

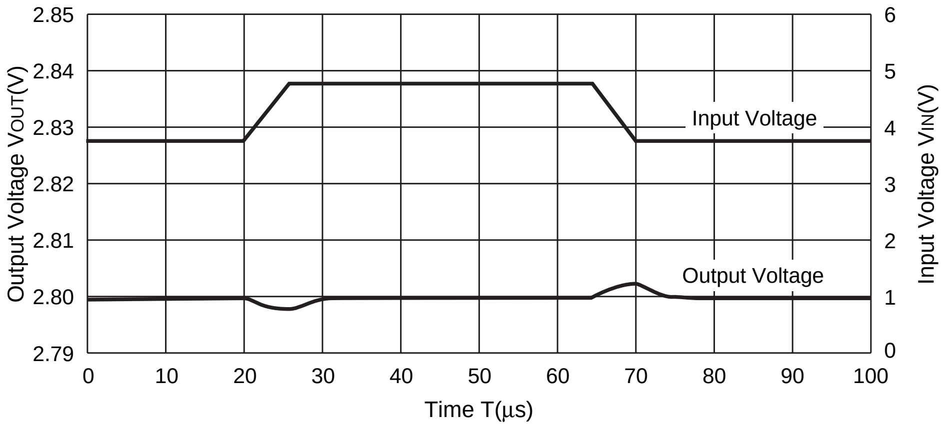


10) Input Transient Response (I_{OUT}=30mA, C_{IN}=none, tr=tf=5µs, C_{OUT}=Ceramic 0.47µF)

R1115Z151x

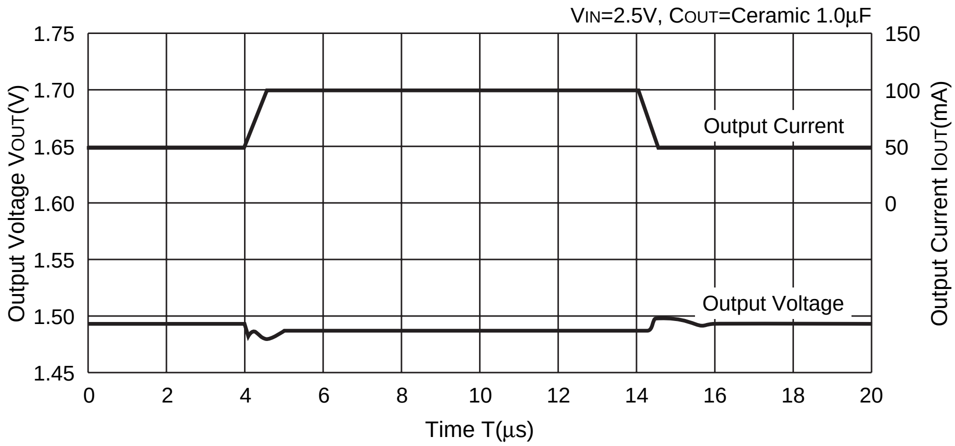


R1115Z281x

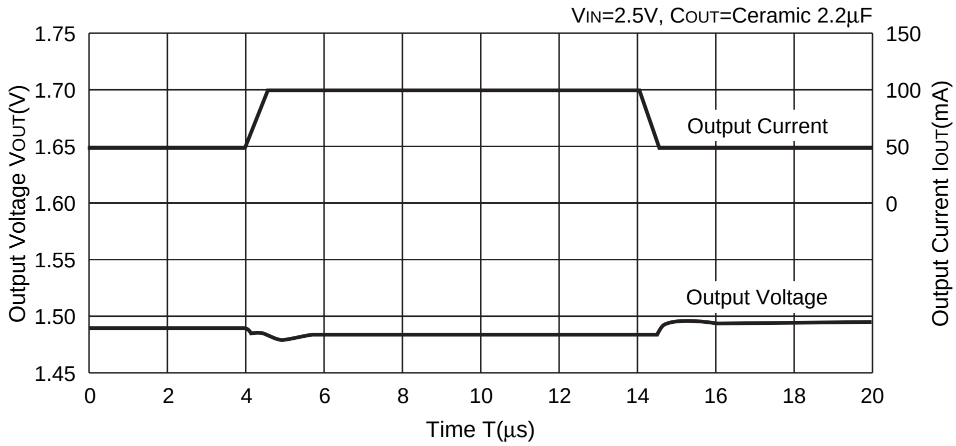


11) Load Transient Response (tr=tf=0.5µs, C_{IN}=Ceramic 1.0µF)

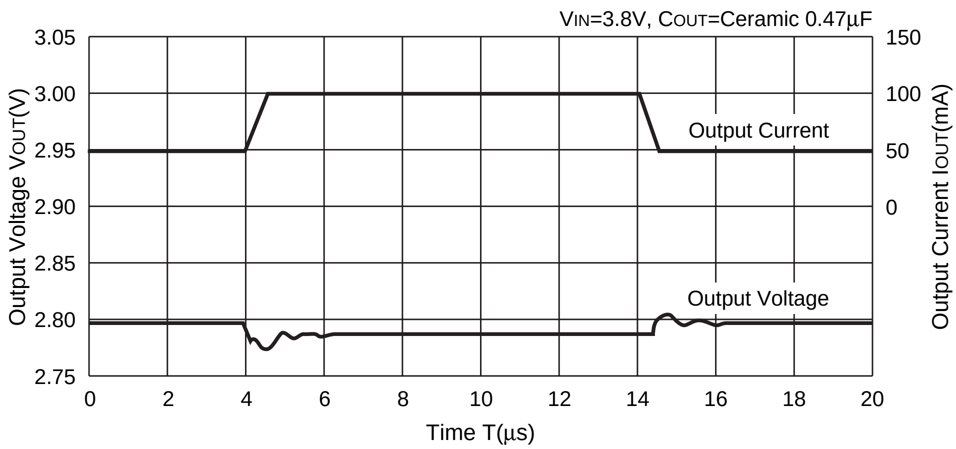
R1115Z151x



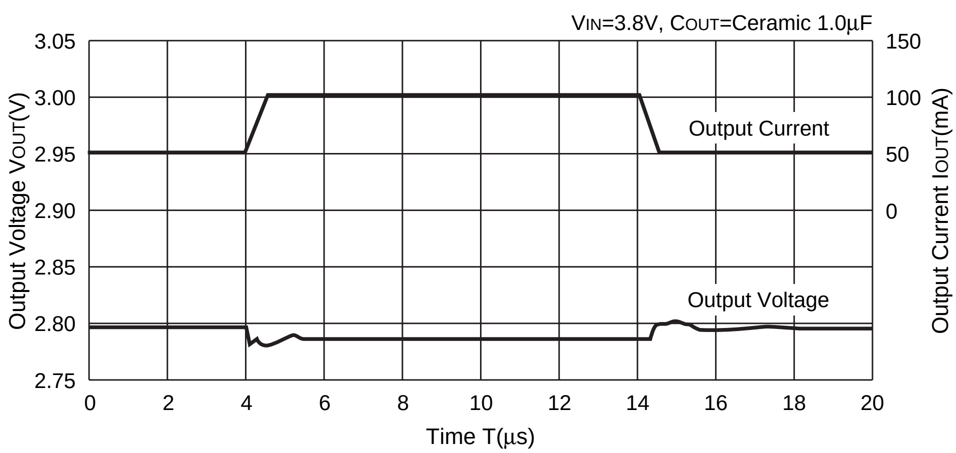
R1115Z151x



R1115Z281x

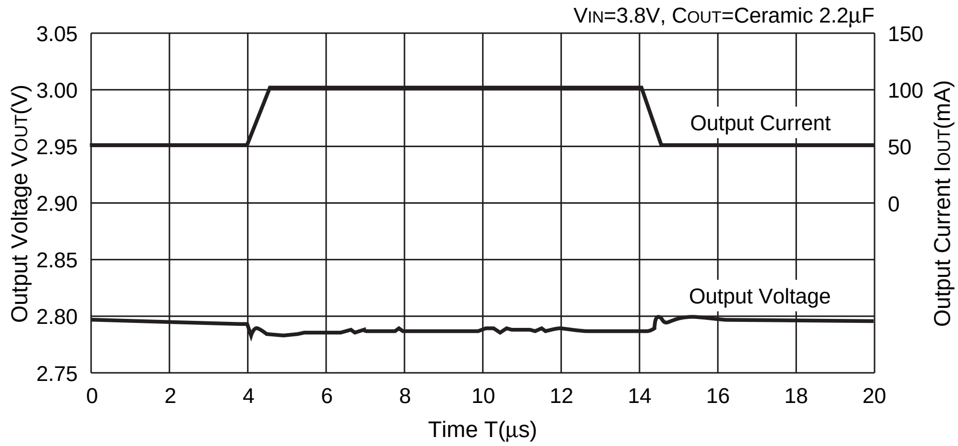


R1115Z281x



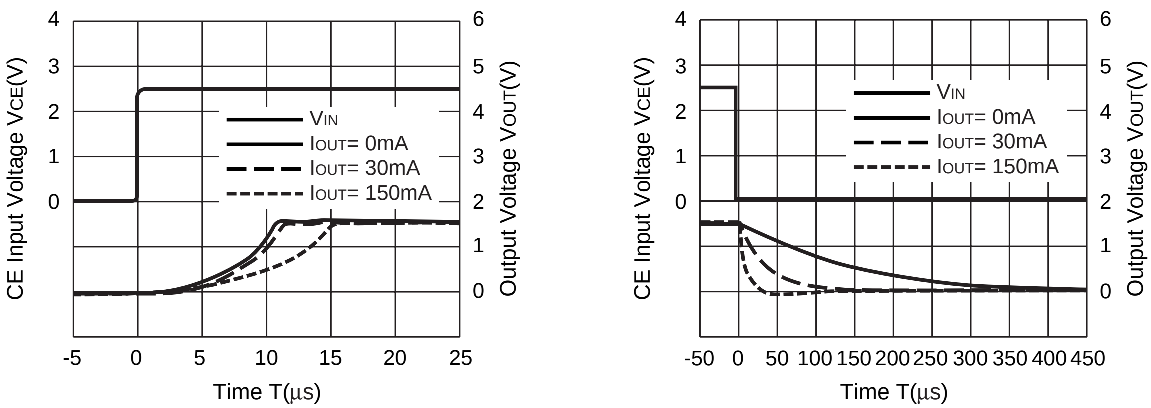
RICOH

R1115Z281x

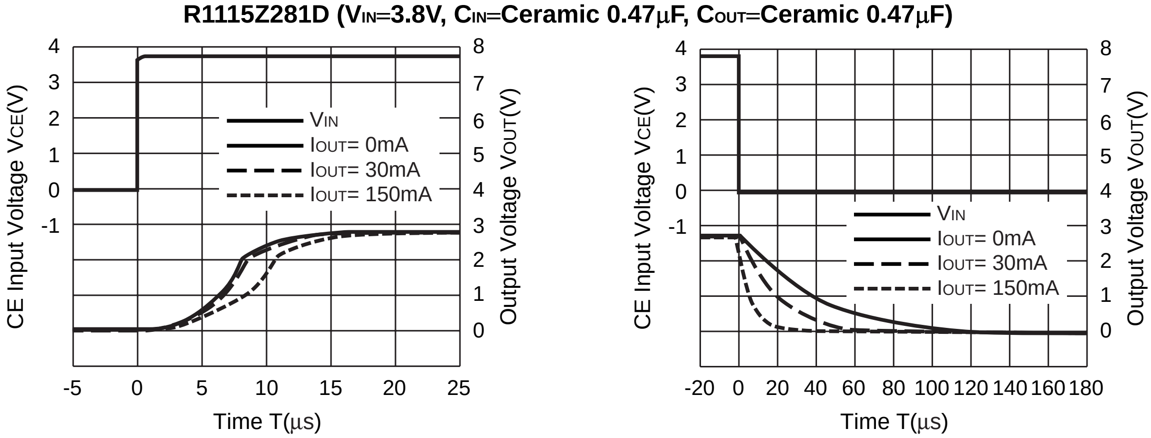


12) Turn-on/off speed with CE pin (D version)

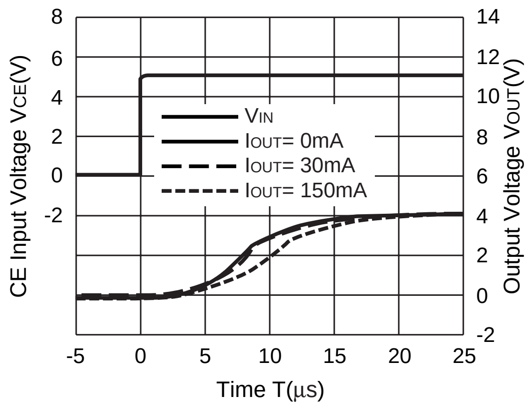
R1115Z151D (VIN=2.5V, CIN=Ceramic 1.0µF, COUT=Ceramic 1.0µF)

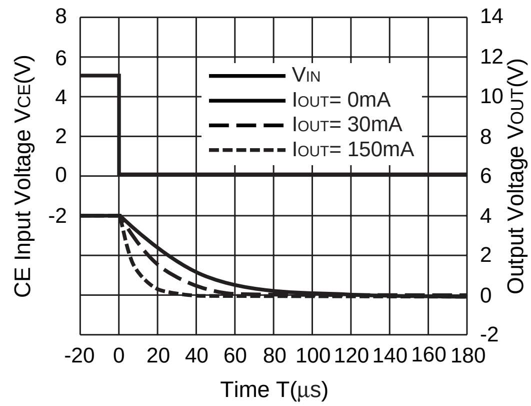


R1115Z281D (VIN=3.8V, CIN=Ceramic 0.47µF, COUT=Ceramic 0.47µF)



R1115Z401D (V_{IN}=5.0V, C_{IN}=Ceramic 0.47μF, C_{OUT}=Ceramic 0.47μF)



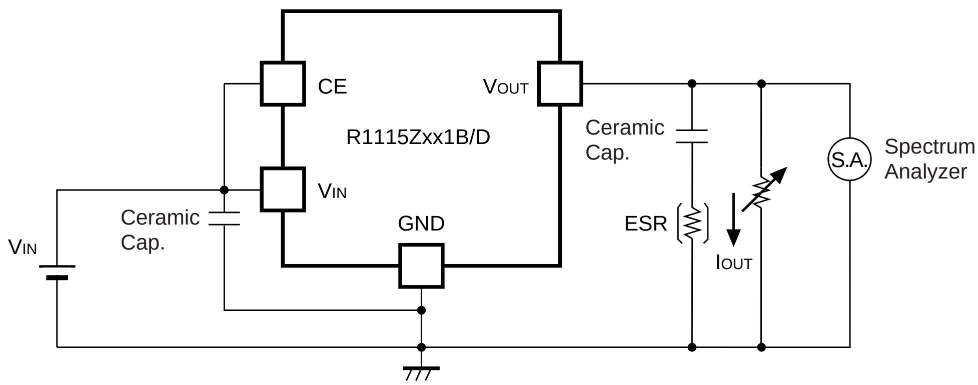


RICOH

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; R1115Zxx1B/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.)

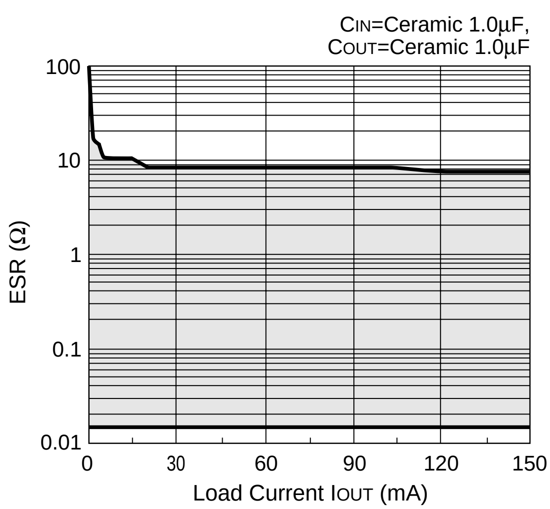
<Measurement conditions>

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

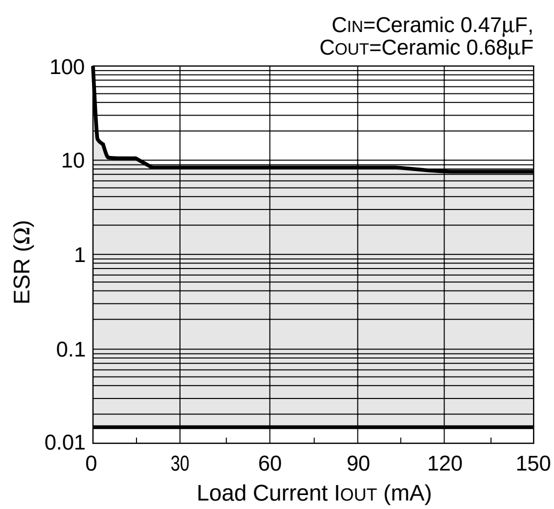
(2) Frequency Band: 10Hz to 2MHz

(3) Temperature: –40°C to 25°C

R1115Z151x

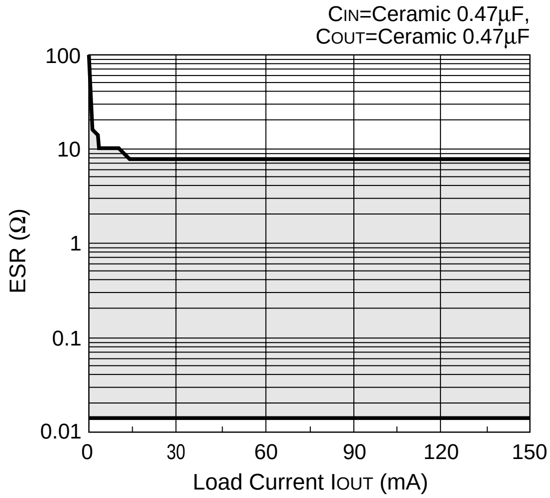


R1115Z161x

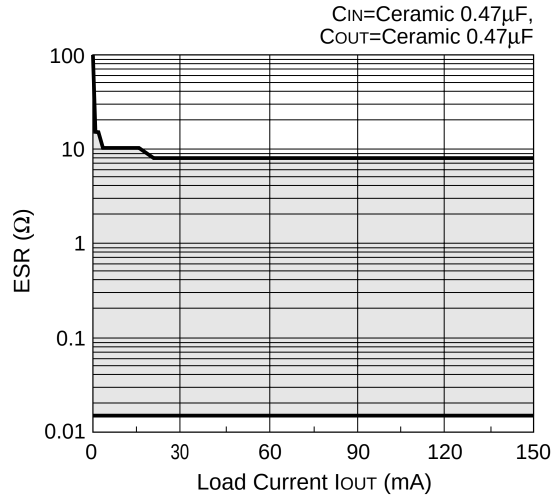


RICOH

R1115Z211x



R1115Z281x

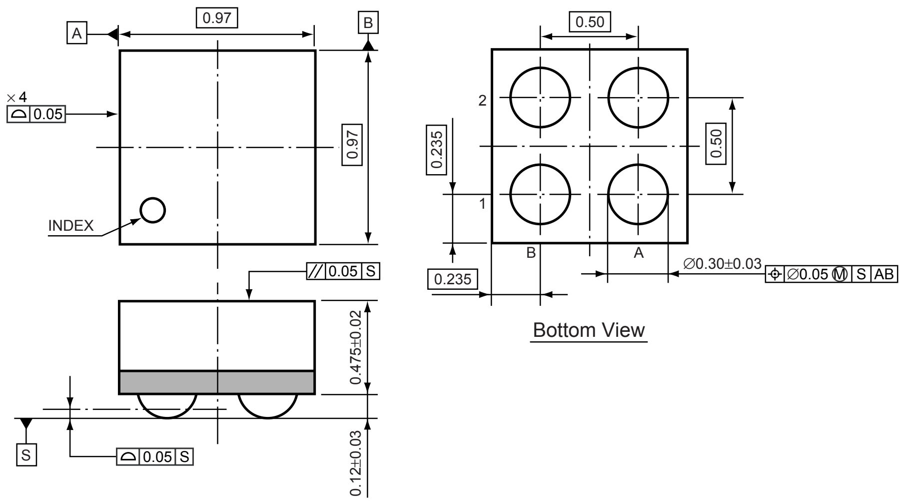


RICOH

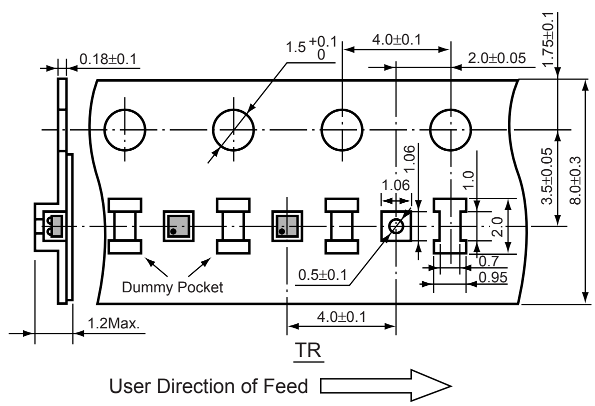
- **WLCSP-4-P4**

Unit: mm

PACKAGE DIMENSIONS

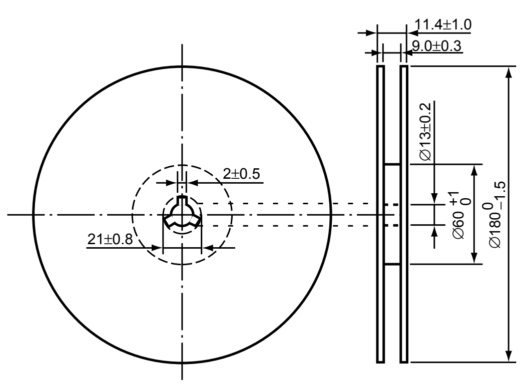


TAPING SPECIFICATION



TAPING REEL DIMENSIONS　REUSE REEL (EIAJ-RRM-08Bc)

(1reel=3000pcs)



POWER DISSIPATION (WLCSP-4-P4)

This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

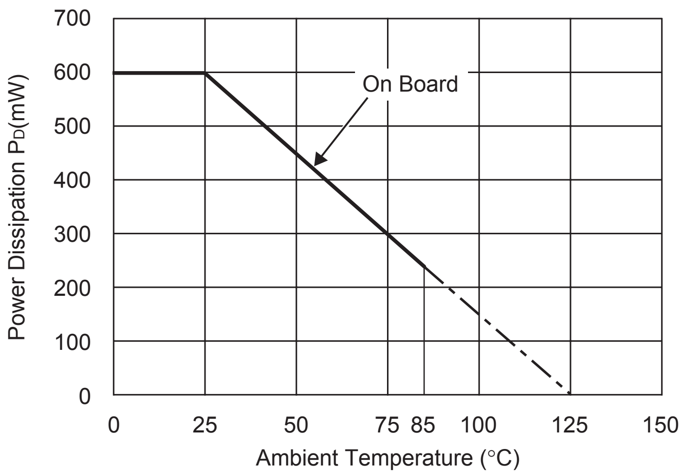
Measurement Conditions

	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plactic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	–

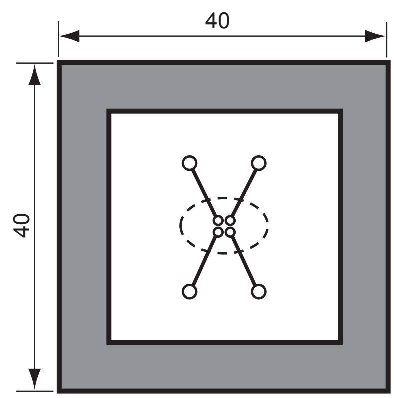
Measurement Result

(Topt=25°C,Tjmax=125°C)

	Standard Land Pattern
Power Dissipation	600mW
Thermal Resistance	θja=(125−25°C)/0.60W=167°C/W



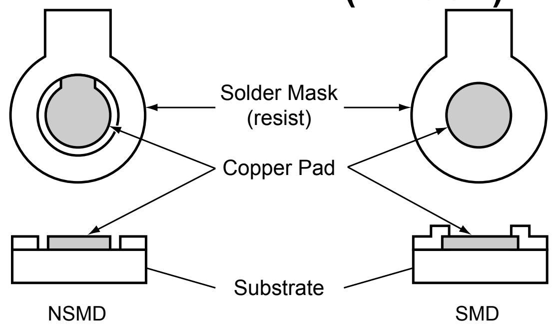
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

RECOMMENDED LAND PATTERN (WLCSP)



(Unit : mm)

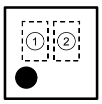
NSMD and SMD Pad Definition

Pad definition	Copper Pad	Solder Mask Opening
NSMD (Non-Solder Mask defined)	0.30mm	Min. 0.40mm
SMD (Solder Mask defined)	Min. 0.40mm	0.30mm

- * Pad layout and size can be modified by customers material, equipment, method.
- * Please adjust pad layout according to your conditions.
- * Recommended Stencil Aperture Size....ø0.3mm
- * Since lead free WLCSP components are not compatible with the tin/lead solder process, you shall not mount lead free WLCSP components using the tin/lead solder paste.

R1115Z SERIES MARK SPECIFICATION

- **WLCSP-4-P4**



①, ② : Lot Number