RICOH

RP112x SERIES

Low Noise 150mA LDO REGULATOR

NO.EA-258-110203

OUTLINE

The RP112x Series are CMOS-based voltage regulator (LDO) ICs, which have been developed using the CMOS process technology, with high output voltage accuracy, low-supply current, low On-resistance transistor, low noise output voltage and high ripple rejection. Each of the ICs is composed of the followings: a voltage reference unit, an error amplifier, a resistor-net for output voltage setting, a current limit circuit, and a chip enable circuit.

The RP112x features ultra low noise and its Ripple Rejection is as low as 80dB at f=1kHz, 75dB at f=10kHz and 65dB at f=100kHz. The Output Noise is also as low as Typ. 10μVrms. It is kept the low level at any Output Voltage. RP112x is suitable for the power source for the portable music player and RF module that demands for higher level of noise reduction. SOT-23-5 and SC-88A packages, a 1mm square DFN(PLP)1010-4 package are available.

FEATURES

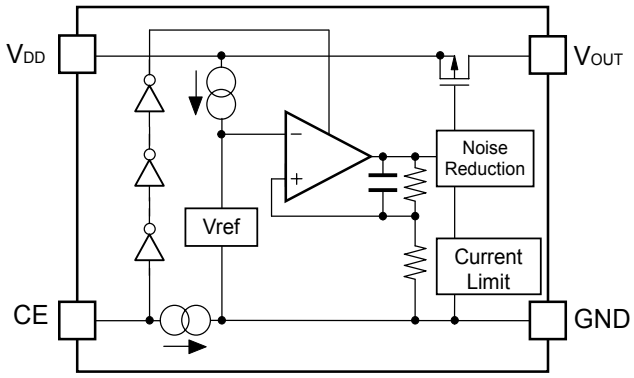
- Supply Current ..... Typ. 75μA
- Standby Current ..... Typ. 0.1μA
- Dropout Voltage ..... Typ. 0.20V (I_{OUT}=150mA, V_{OUT}=2.8V)
- Ripple Rejection ..... Typ. 80dB (f=1kHz)
  Typ. 75dB (f=10kHz)
  Typ. 65dB (f=100kHz)
- Output Voltage Accuracy ..... ±1.0%
- Output Voltage Temperature Coefficient ..... Typ. ±30ppm/°C
- Line Regulation ..... Typ. 0.02%/V
- Packages ..... DFN(PLP)1010-4, SC-88A, SOT-23-5
- Input Voltage Range ..... 2.0V to 5.25V
- Output Voltage Range ..... 1.2V to 4.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Short Current Limit ..... Typ. 40mA
- Built-in Foldback Protection Circuit
- Output Noise ..... Typ. 10μVrms
- Ceramic capacitors are recommended to be used with this IC ..... 1.0μF or more

APPLICATIONS

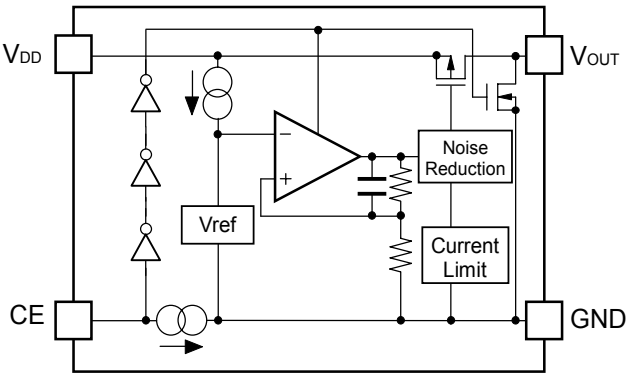
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras,VCRs and camcorders.
- Power source for battery-powered equipments.
- Power source for electrical home appliances.
- Power source for the portable music player
- Power source for RF module

BLOCK DIAGRAMS

RP112xxxxB



RP112xxxxD



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP112Kxx1∗-TR	DFN(PLP)1010-4	10,000 pcs	Yes	Yes
RP112Qxx2∗-TR-FE	SC-88A	3,000 pcs	Yes	Yes
RP112Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

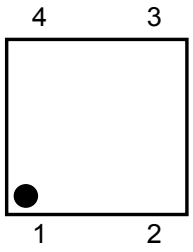
xx : The output voltage can be designated in the range of 1.2V(12)to 4.0V(40)in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : Auto discharge function at off state are options as follows.
(B) "H" active, without auto discharge function at off state
(D) "H" active, with auto discharge function at off state

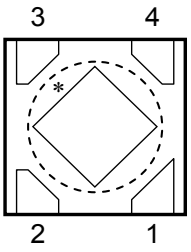
PIN CONFIGURATIONS

● **DFN(PLP)1010-4**

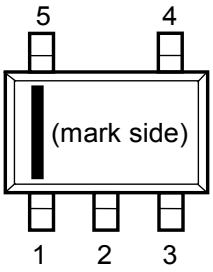
Top View



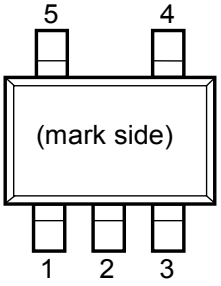
Bottom View



● **SC-88A**



● **SOT-23-5**



PIN DESCRIPTIONS

● **DFN(PLP)1010-4**

Pin No.	Symbol	Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{DD}	Input Pin

∗) Tab is GND level. (They are connected to the reverse side of this IC.)
The tab is better to be connected to the GND, but leaving it open is also acceptable.

● **SC-88A**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	NC	No Connection
5	V_{OUT}	Output Pin

● **SOT-23-5**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	NC	No Connection
5	V_{OUT}	Output Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	V
V_{CE}	Input Voltage (CE Pin)	6.0	V
V_{OUT}	Output Voltage	−0.3 to V_{IN} + 0.3	V
I_{OUT}	Output Current	180	mA
P_D	Power Dissipation (DFN(PLP)1010-4)*	400	mW
	Power Dissipation (SC-88A)*	380	
	Power Dissipation (SOT-23-5)*	420	
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	Storage Temperature Range	−55 to 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.

ELECTRICAL CHARACTERISTICS

Unless otherwise noted, V_{IN}=Set V_{OUT} +1.0V(V_{OUT} >1.5), V_{IN}=2.5V($V_{OUT} \leq$ 1.5V), I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0µF.
The values in [ ] are applicable under the condition of −40°C ≤ Topt ≤ 85°C.

- **RP112xxxxB/D**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	$V_{OUT} \geq$ 2.0V	×0.99		×1.01	V
			V_{OUT} < 2.0V	−20		20	mV
		-40°C ≤ Topt ≤ 85°C	$V_{OUT} \geq$ 2.0V	[×0.985]		[×1.015]	V
			V_{OUT} < 2.0V	[−30]		[30]	mV
I_{OUT}	Output Current			[150]			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA		[-14]	0	[14]	mV
V_{DIF}	Dropout Voltage	Please refer to “Dropout Voltage”.					
I_{SS}	Supply Current	I_{OUT}=0mA			75	[100]	µA
Istandby	Standby Current	V_{CE}=0V			0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 5.0V	$V_{OUT} \geq$ 1.7V		0.02	[0.10]	%/V
		2.2V <V_{IN} < 5.0V	V_{OUT} < 1.7V				
RR	Ripple Rejection	Ripple 0.2Vp-p, V_{IN}=Set V_{OUT}+1.0V, I_{OUT}=30mA	f =1kHz		80		dB
			f =10kHz		75		
			f =100kHz		65		
V_{IN}	Input Voltage*			[2.0]		[5.25]	V
$\Delta V_{OUT}/\Delta$Topt	Output Voltage Temperature Coefficient	40°C ≤ Topt ≤ 85°C			±30		ppm /°C
I_{SC}	Short Current Limit	V_{OUT}=0V			40		mA
I_{PD}	CE Pull-down Current				0.3	[0.6]	µA
V_{CEH}	CE Input Voltage "H"			[1.0]			V
V_{CEL}	CE Input Voltage "L"					[0.4]	V
en	Output Noise	BW=10Hz~100kHz I_{OUT}=30mA			10		µVrms
R_{LOW}	Auto-discharge Nch Tr. ON Resistance (D version)	V_{IN}=4.0V, V_{CE}=0V			60		Ω

The values in [ ] have been tested and guaranteed by Design Engineering.
All test categories were tested on the products under the pulse load condition (Tj≈Topt=25°C) except for Output Voltage Temperature Coefficient,Output Noise and Ripple Rejection.
*) When Input Voltage is 5.5V, the total operational time must be within 500hrs.

- **Dropout Voltage**

Topt=25°C

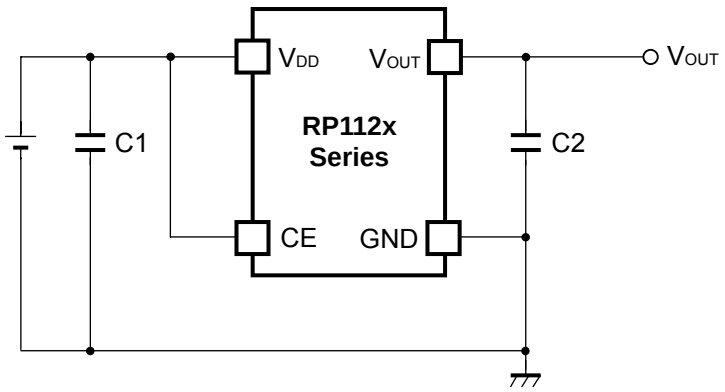
Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
1.2V ≤ V_{OUT} < 1.3V	I_{OUT}=150mA	0.39	0.80
1.3V ≤ V_{OUT} < 1.4V		0.37	0.70
1.4V ≤ V_{OUT} < 1.5V		0.34	0.60
1.5V ≤ V_{OUT} < 1.7V		0.32	0.50
1.7V ≤ V_{OUT} < 2.0V		0.29	0.41
2.0V ≤ V_{OUT} < 2.5V		0.25	0.36
2.5V ≤ V_{OUT} < 2.8V		0.22	0.31
2.8V ≤ V_{OUT} < 4.0V		0.20	0.28

The values in [ ] have been tested and guaranteed by Design Engineering

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.

TYPICAL APPLICATIONS



External Parts Example:
C1, C2: Ceramic Capacitor 1.0µF, Murata, GRM155B31A105KE15

TECHNICAL NOTES

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 1.0µF or more capacitor C2.

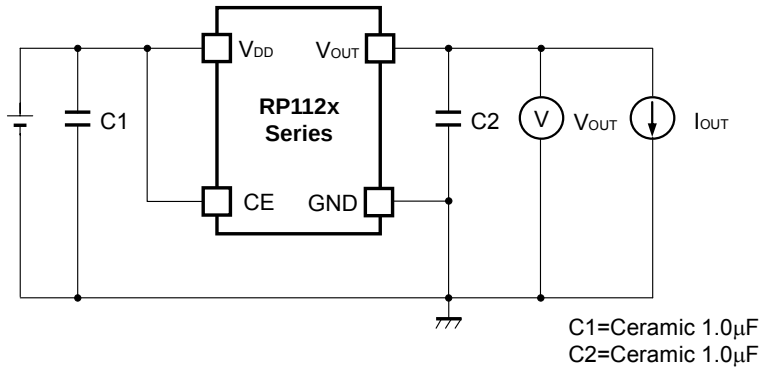
In case of using a tantalum capacitor, the output may be unstable due to inappropriate ESR. Therefore, the full range of operating conditions for the capacitor in the application should be considered.

PCB Layout

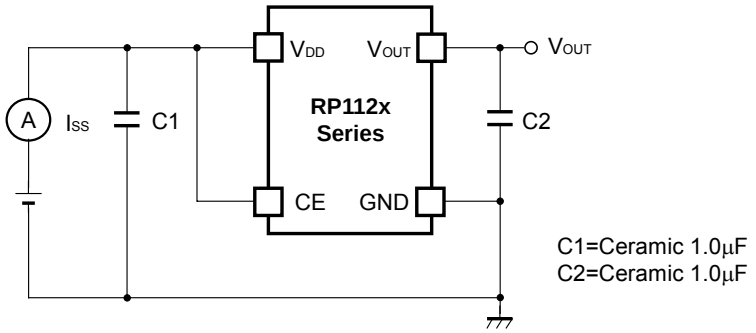
The high impedances of V_{DD} and GND could be a reason for the noise pickup and unstable operation. Therefore, it is imperative that the impedances of V_{DD} and GND be the lowest possible. Also, place a 1.0µF or more capacitor (C1) between V_{DD} pin and GND pin as close as possible to each other.

As for C2 output capacitor that is used for phase compensation, place it between V_{OUT} pin and GND as close as possible to each other (Refer to TYPICAL APPLICATIONS).

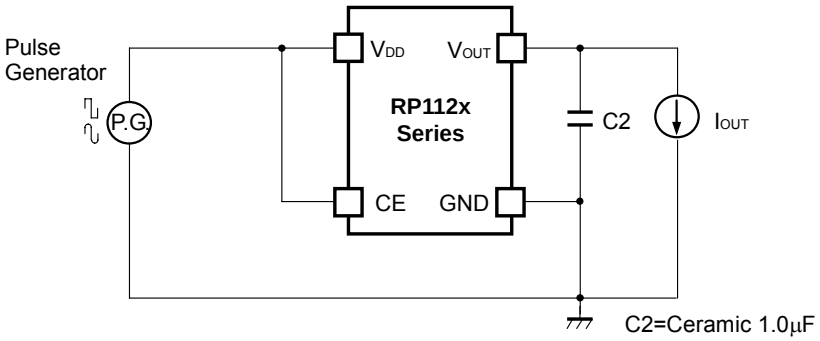
TEST CIRCUIT



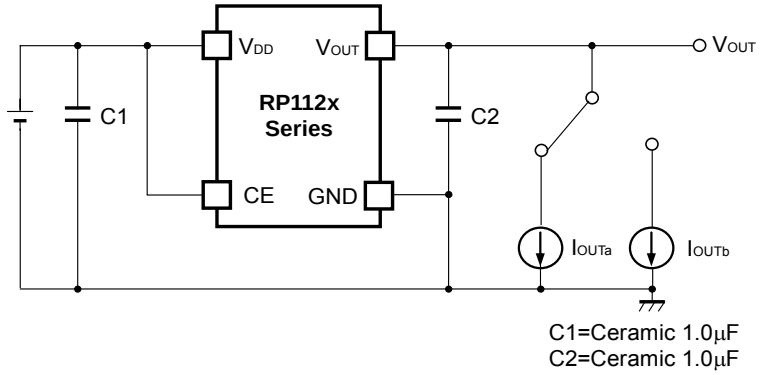
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection



Test Circuit for Load Transient Response

Typical Characterics

1) Output Voltage vs. Output Current (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

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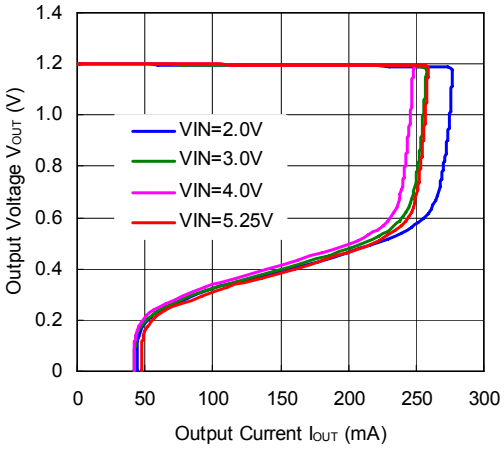

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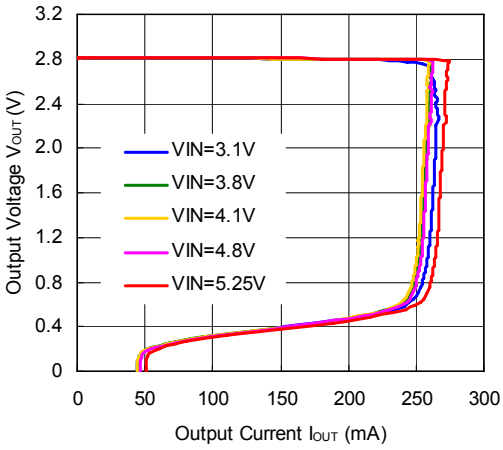

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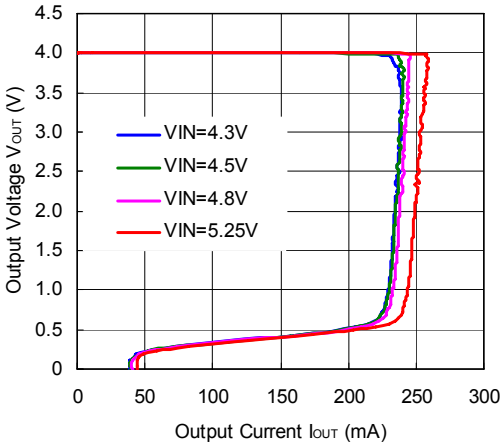
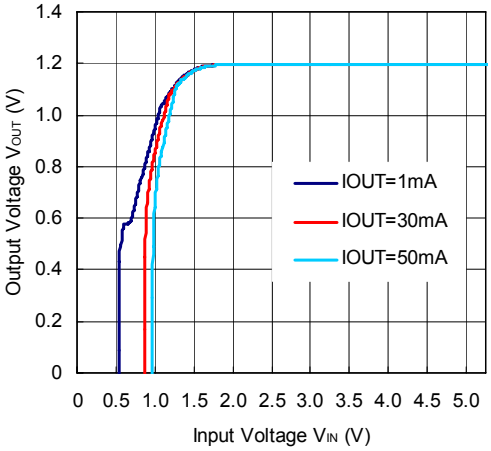


2) Output Voltage vs. Input Voltage (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

RP112x12xx



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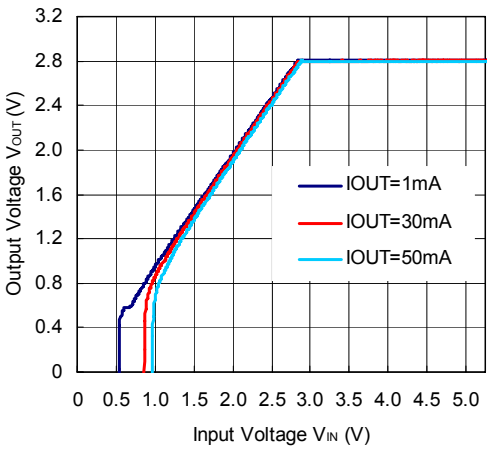

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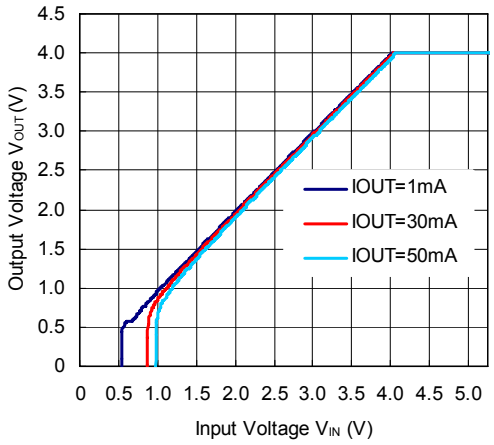
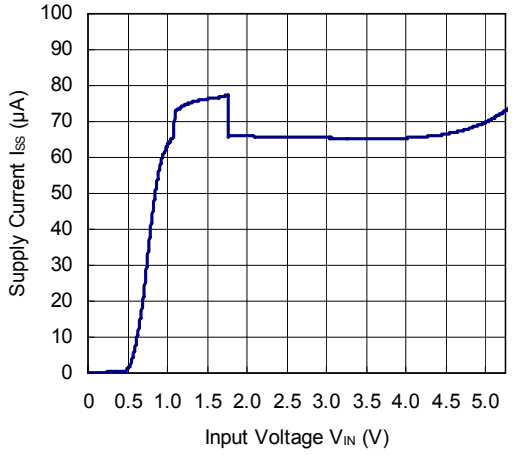


3) Supply Currnet vs. Input Voltage (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

RP112x12xx



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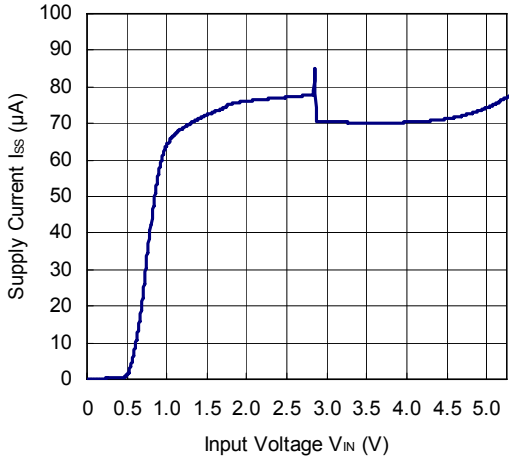

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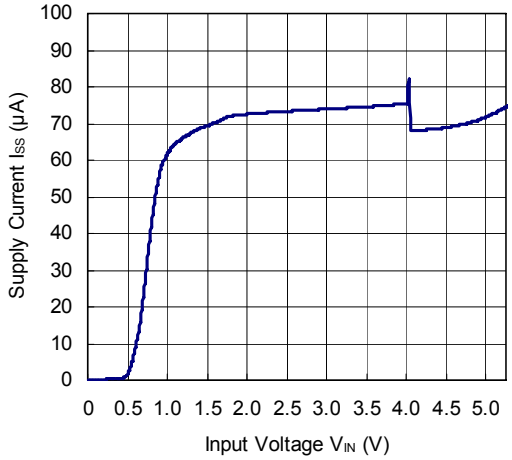
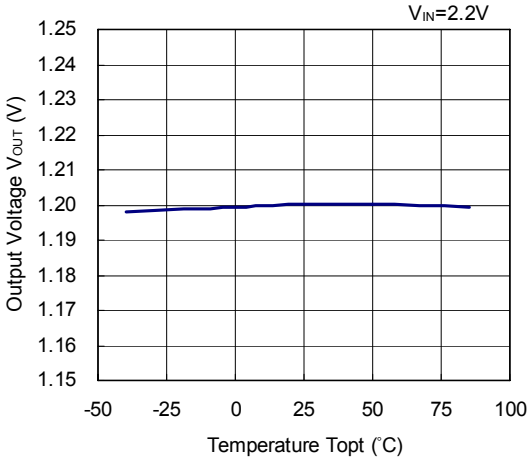


4) Output Voltage vs.Temperature (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, I_{OUT}=1mA)

RP112x12xx



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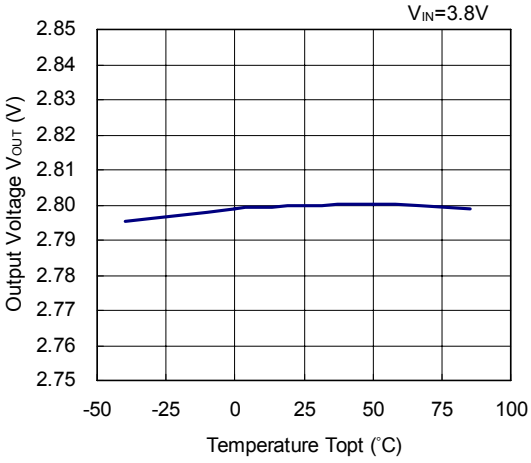

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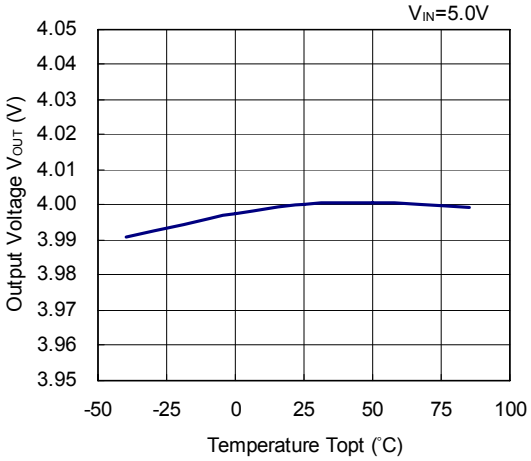
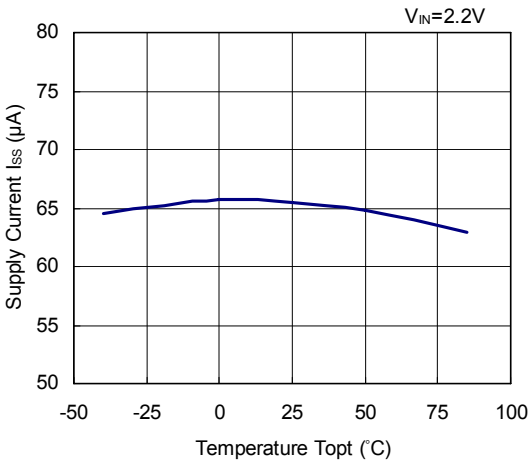


5) Supply Current vs.Temperature (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF,I_{OUT}=0mA)

RP112x12xx



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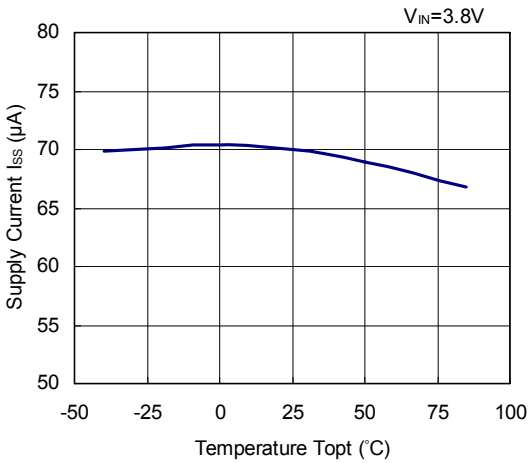

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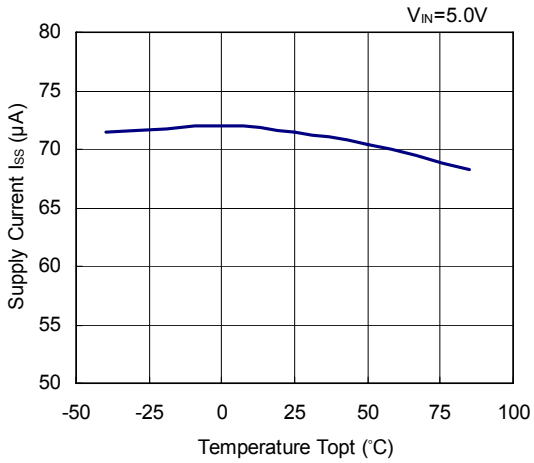
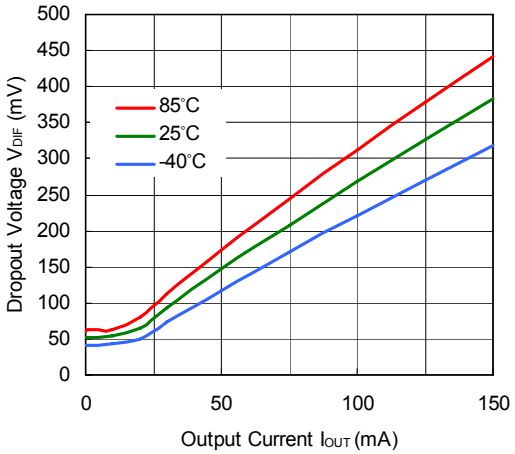


6) Droplut Voltage vs.Output Current (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF)

RP112x12xx



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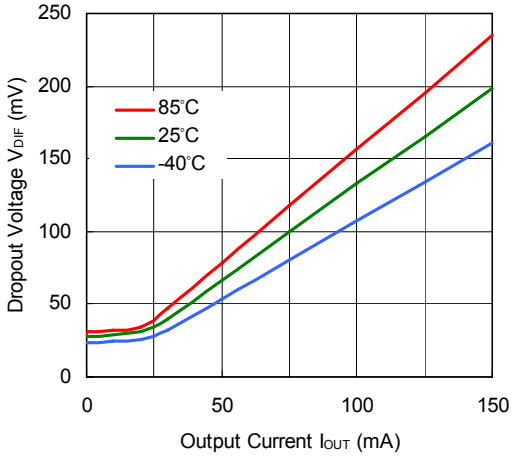

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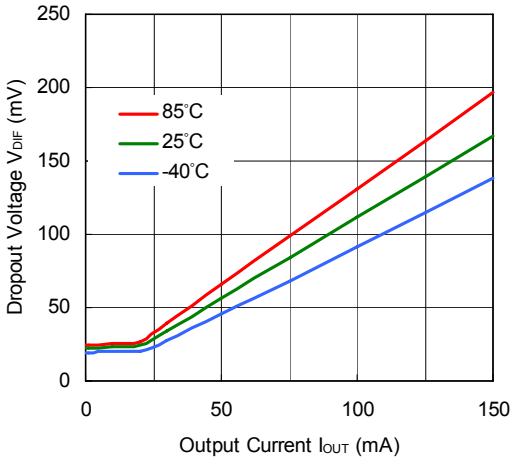
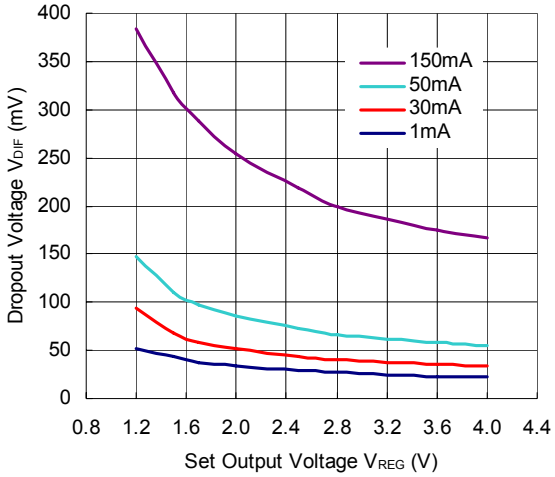
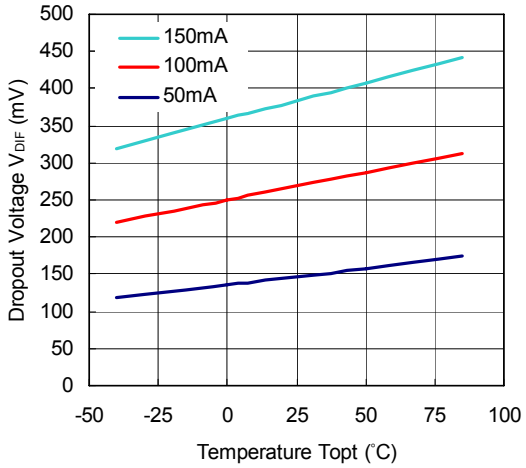


7) Dropout Voltage vs. Set Output Voltage (C1=Ceramic 1.0μF, C2=Ceramic 1.0μF, Topt=25°C)

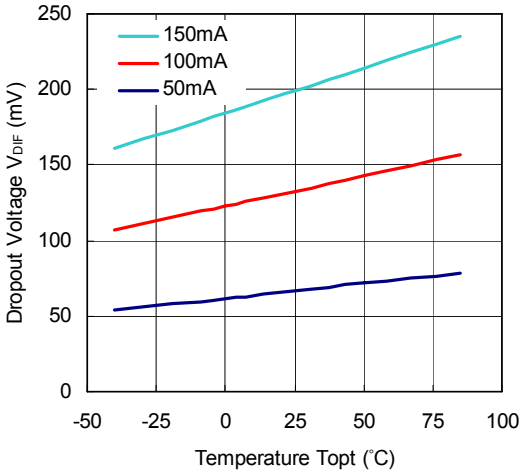


8) Dropout Voltage vs. Temperature (C1=Ceramic 1.0μF, C2=Ceramic 1.0μF)

RP112x12xx



RP112x28xx



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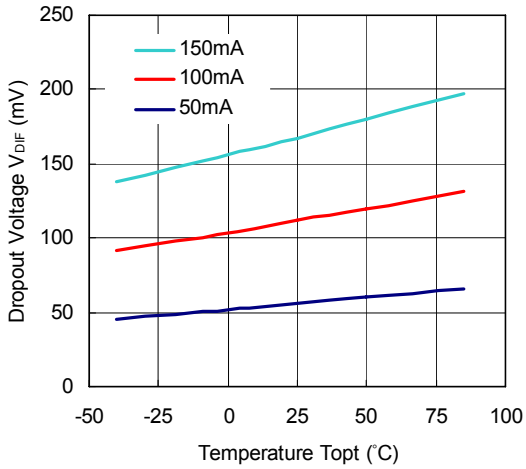
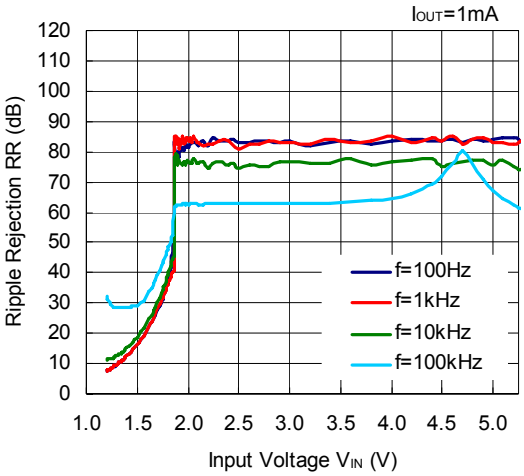


9) Ripple Rejection vs. Input Voltage (C1=none, C2=Ceramic 1.0µF, Ripple=0.2Vp-p, Topt=25°C)

RP112x12xx



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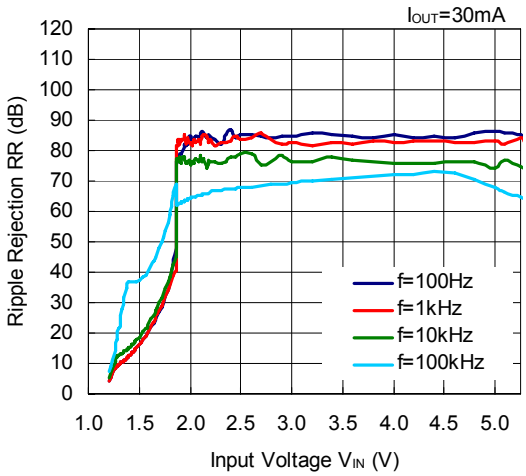
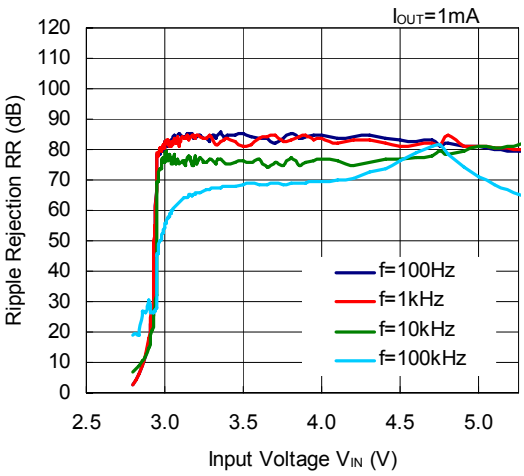
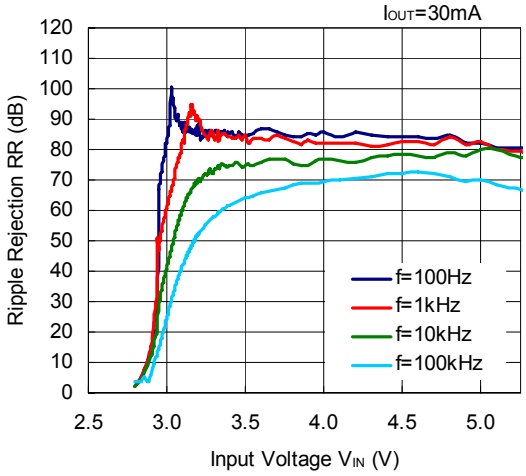


RP112x28xx



RP112x28xx



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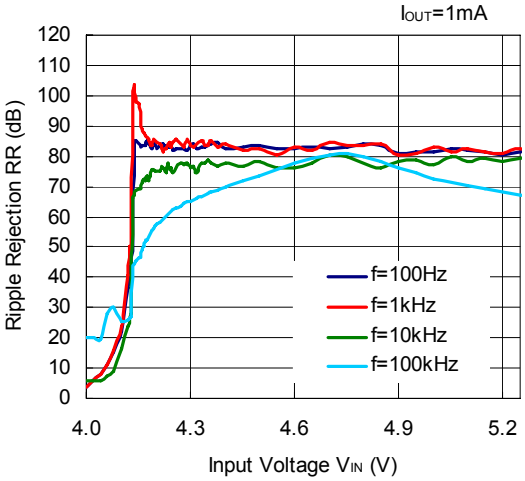
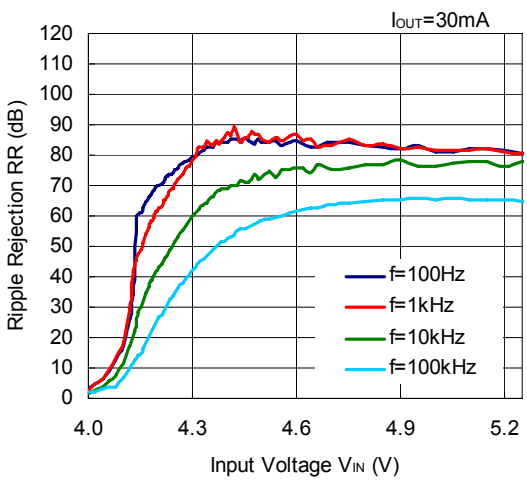
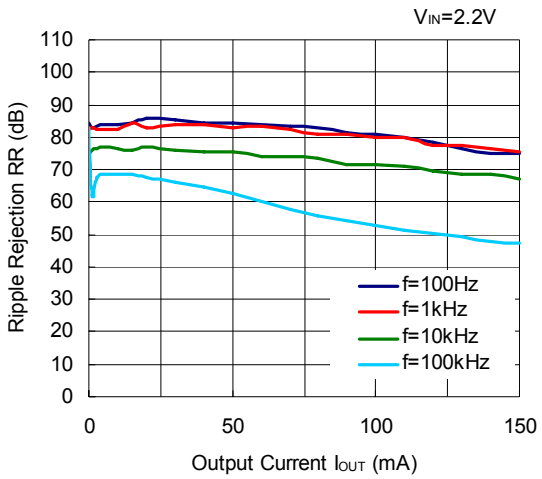


RP112x40xx

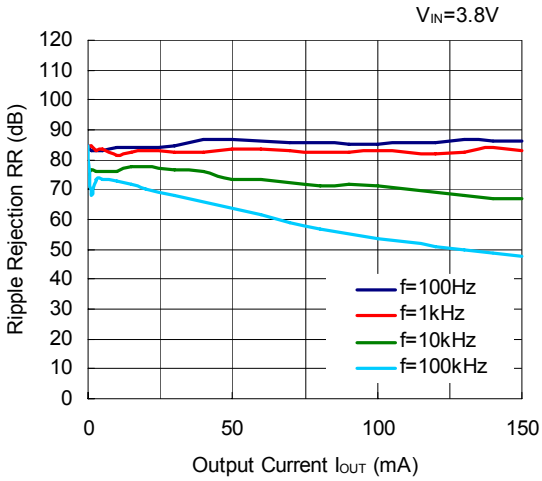


10) Ripple Rejection vs. Output Current (C1=none, C2=Ceramic 1.0µF, Ripple=0.2Vp-p, Topt=25°C)

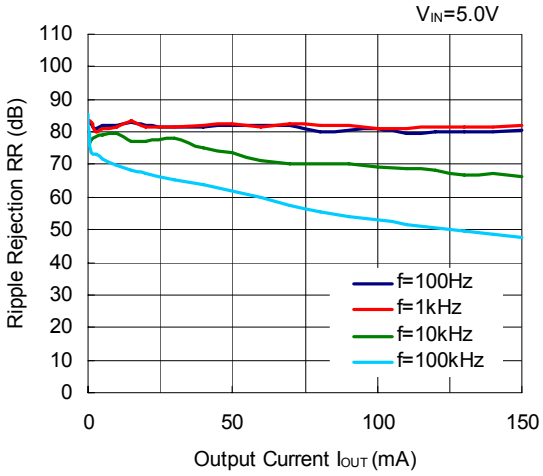
RP112x12xx



RP112x28xx

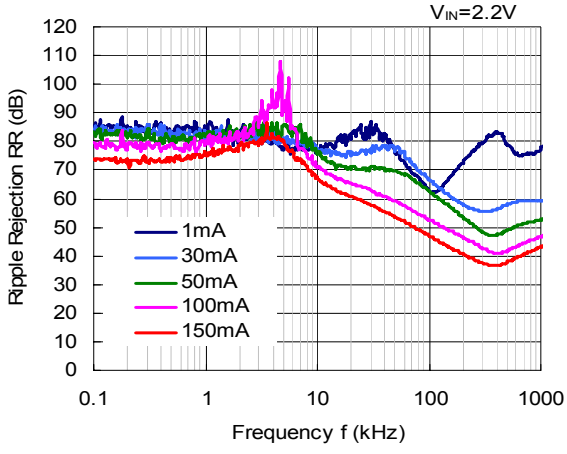


RP112x40xx

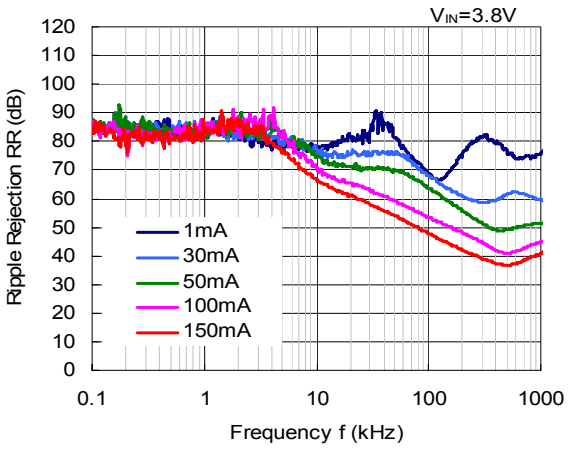


11) Ropple Rejection vs. Frequency (C1=none, C2=Ceramic 1.0µF, Ripple=0.2Vp-p, Topt=25°C)

RP112x12xx



RP112x28xx



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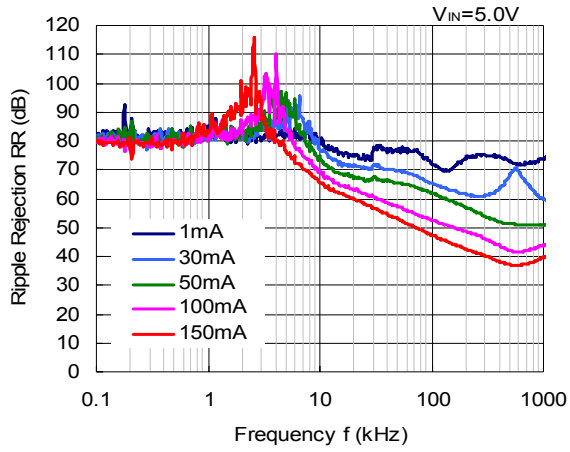
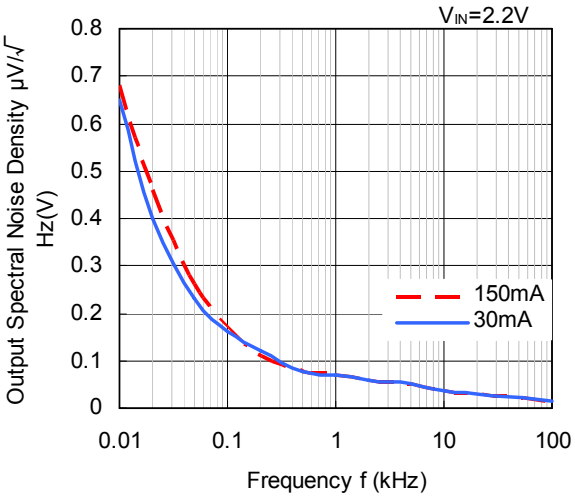
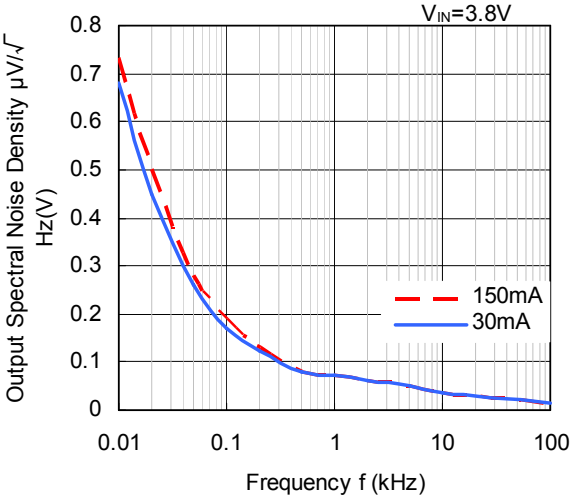


12) Output Spectral Noise Density vs.Frequancy (C1=none, C2=Ceramic 1.0µF, Topt=25°C)

RP112x12xx



RP112x28xx



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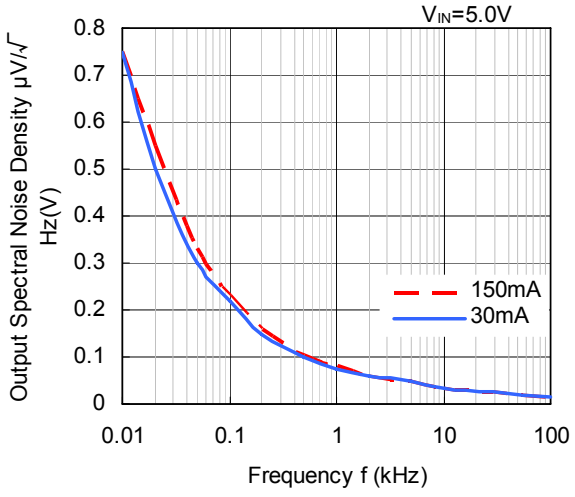
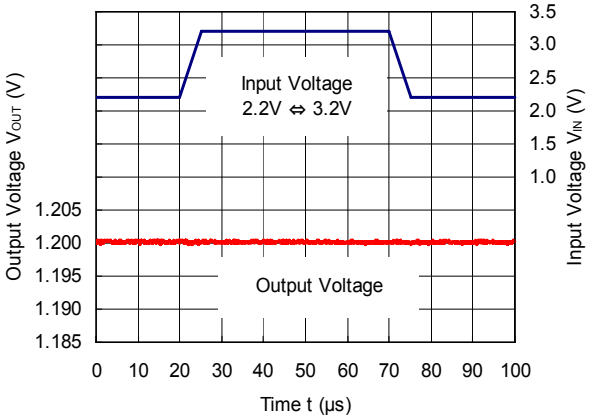
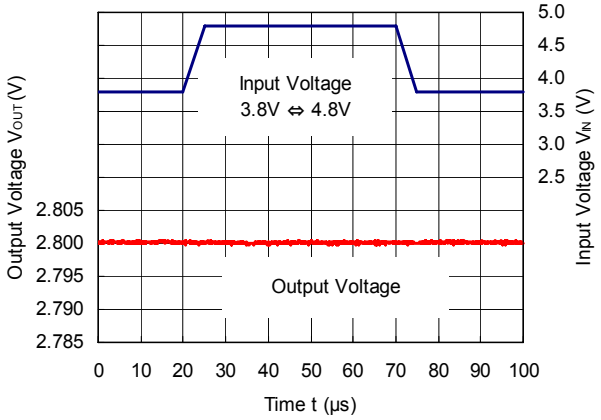


13) Input Transient Response (C1=none, C2=Ceramic 1.0µF, I_{OUT}=30mA, tr=tf=5.0µs, Topt=25°C)

RP112x12xx



RP112x28xx



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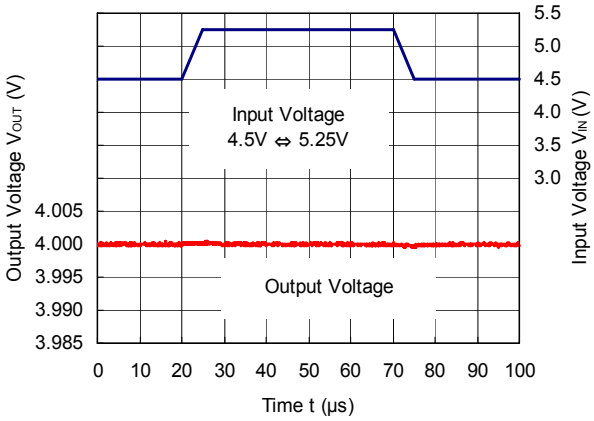
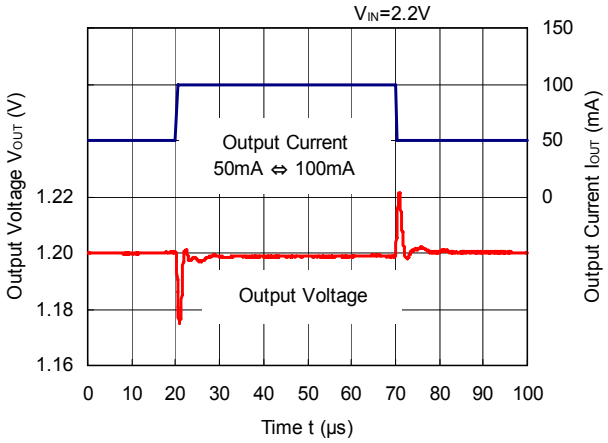


14) Load Transient Response (C1=Ceramic 1.0µF,C2=Ceramic 1.0µF, tr=tf=0.5µs,Topt=25°C)

RP112x12xx



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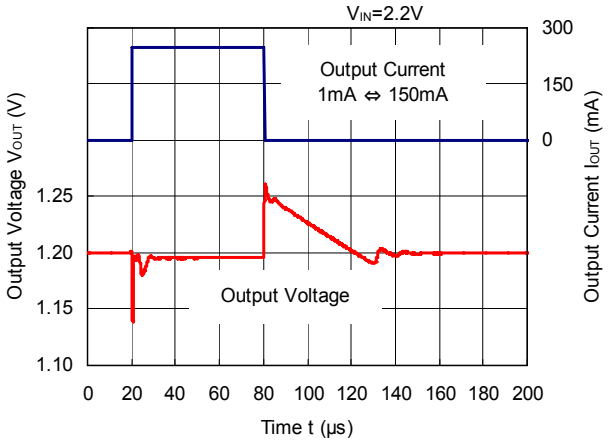

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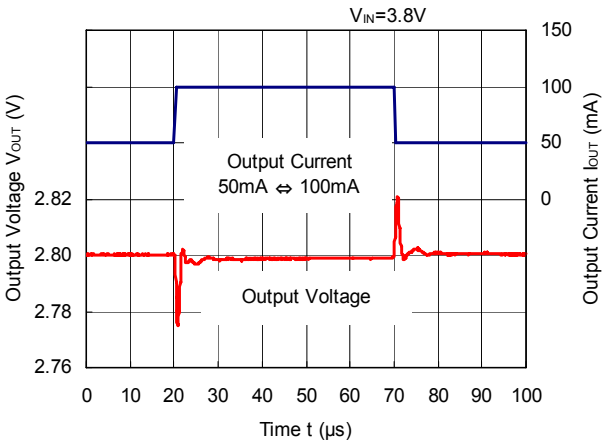

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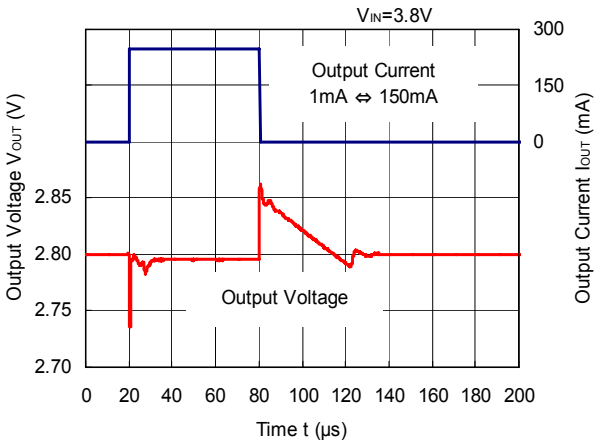

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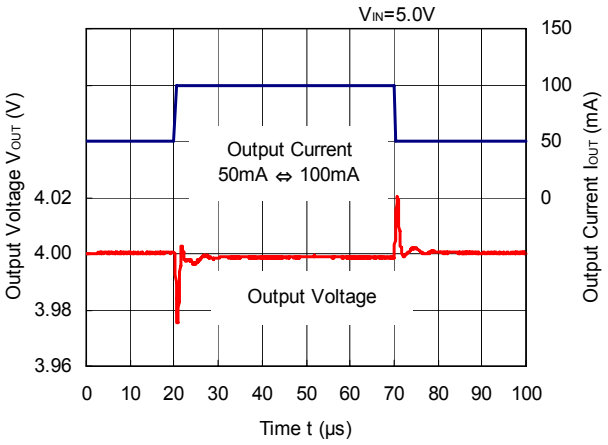
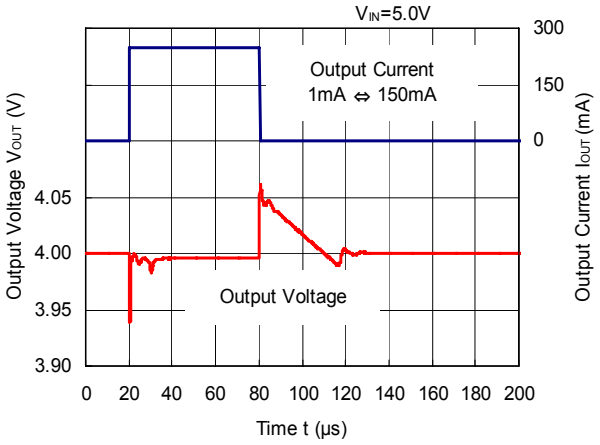
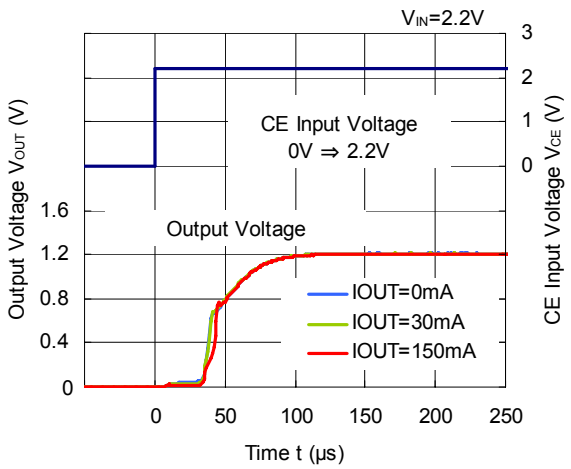


RP112x40xx



15) Turn on Speed with CE pin (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

RP112x12xx



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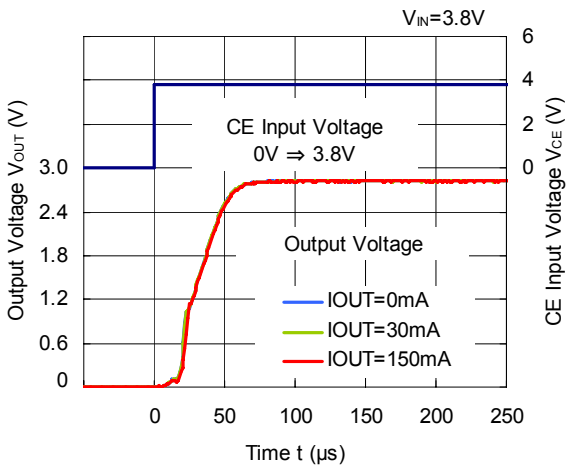
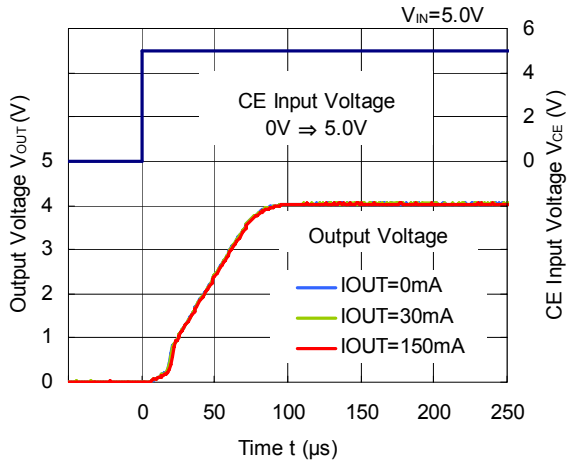
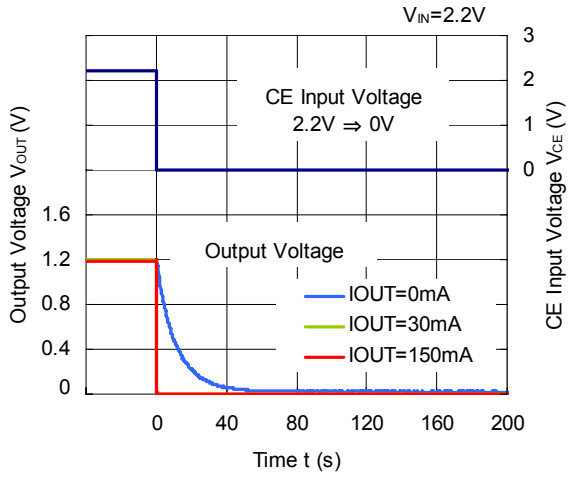


RP112x40xx

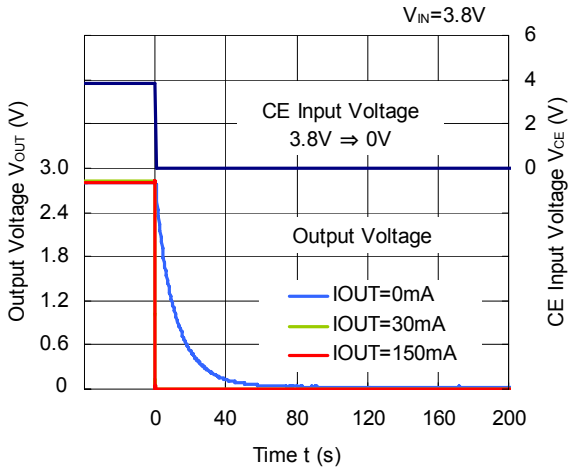


16) Turn off Speed with CE pin (B Version) (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

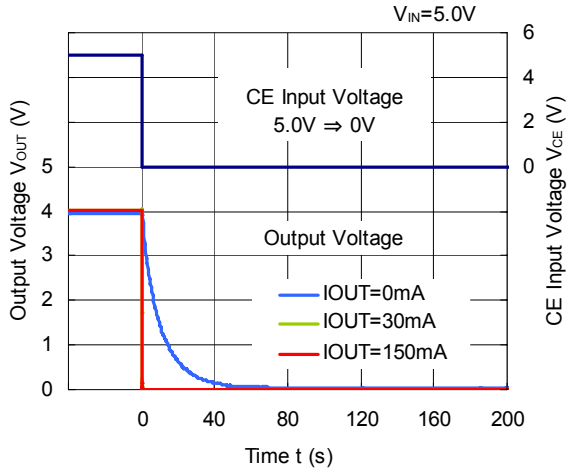
RP112x12xx



RP112x28xx

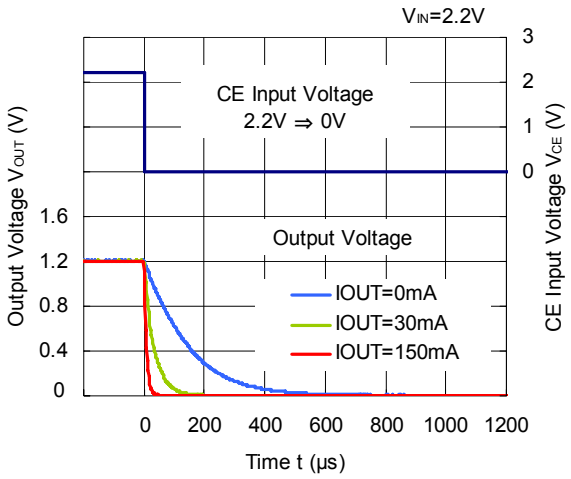


RP112x40xB

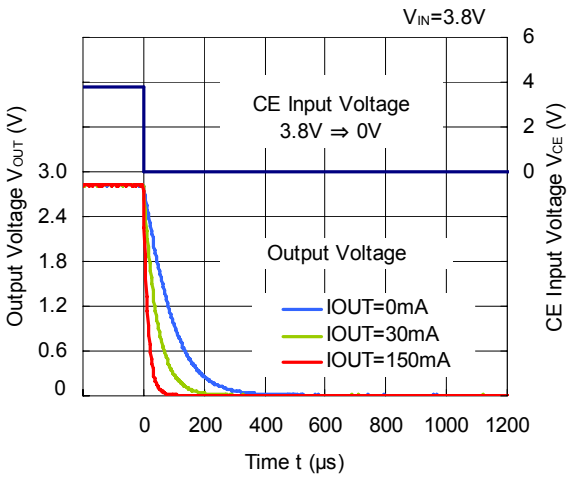


17) Turn off Speed with CE pin (D Version) (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

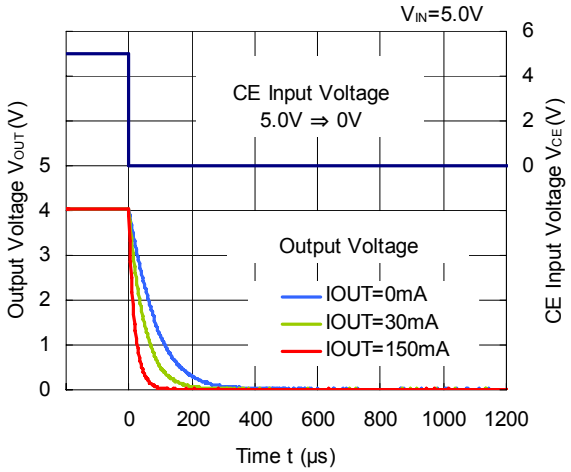
RP112x12xD



RP112x28xD

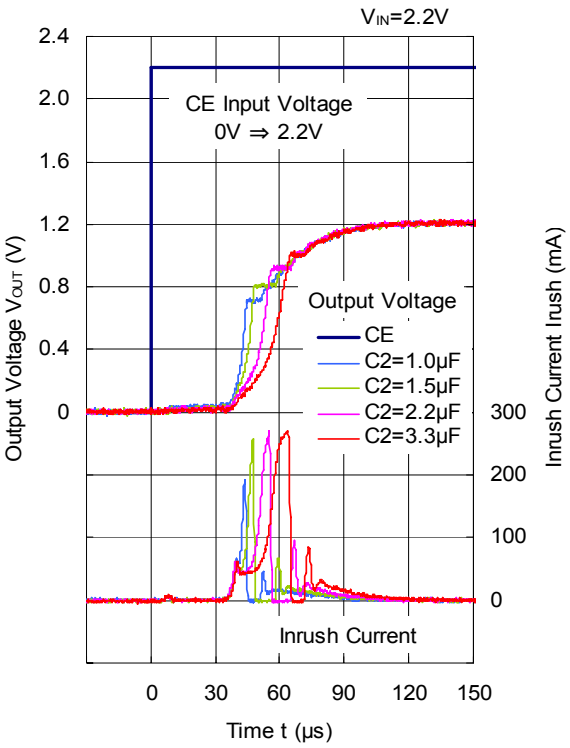


RP112x40xD

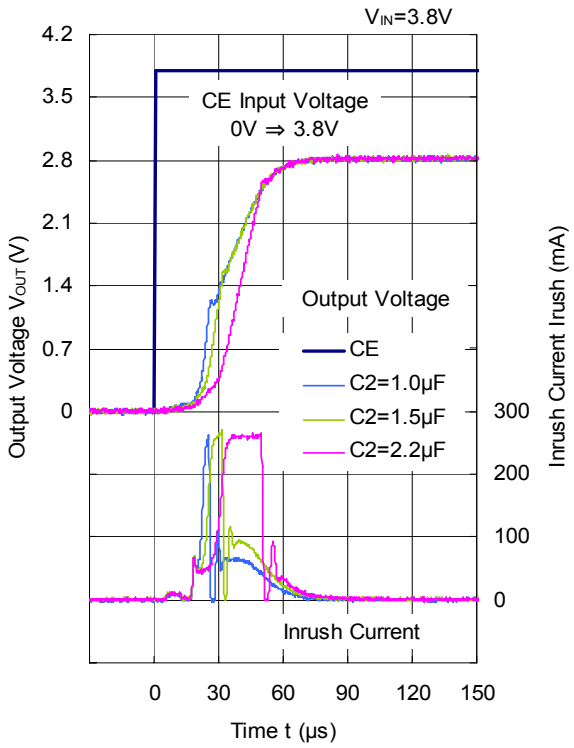


18) Inrush Current (C1=Ceramic 1.0µF, I_{OUT}=0mA, Topt=25°C)

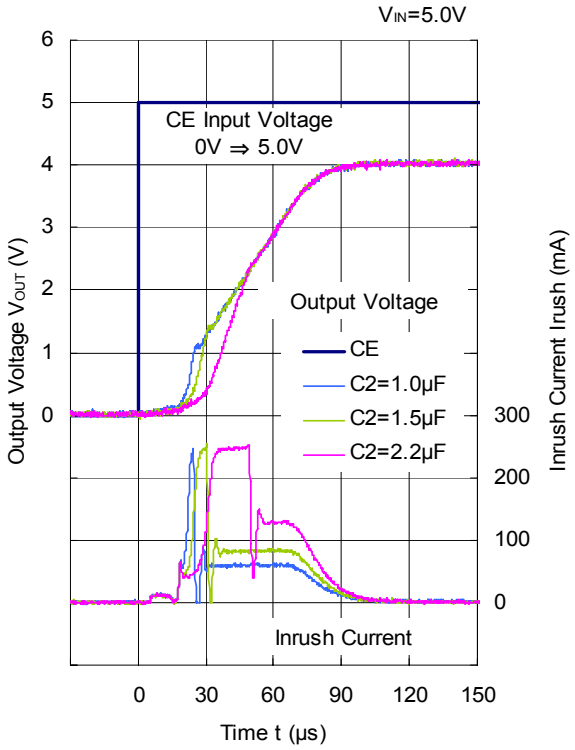
RP112x12xx



RP112x28xx



RP112x40xx



ESR vs.Ooutput Current

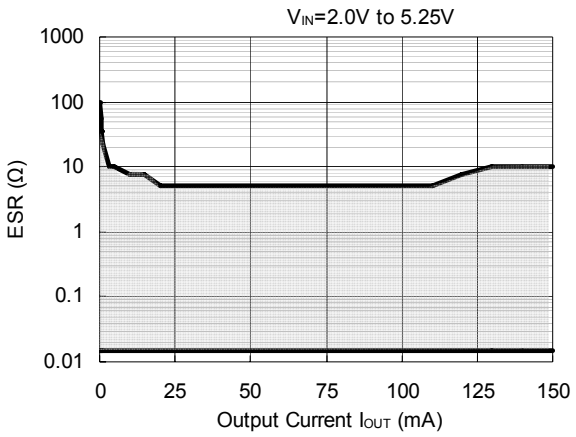
When using these ICs, consider the following points:

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.

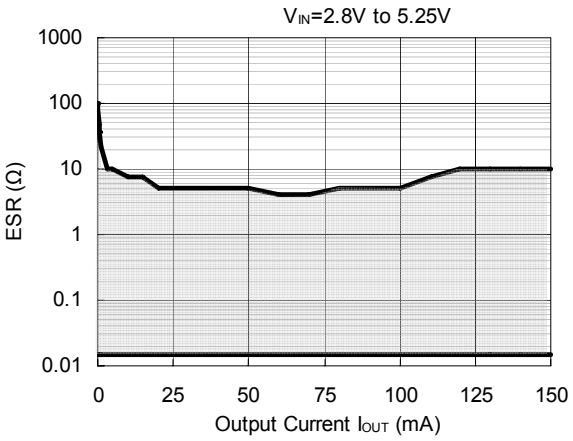
Measurement Conditions

Frequency Band : 10Hz to 2MHz
Temperature : −40˚ C to 85˚ C
Hatched Area : Noise level is under 40μV(Avg.)
C1,C2 : 1.0μF or more

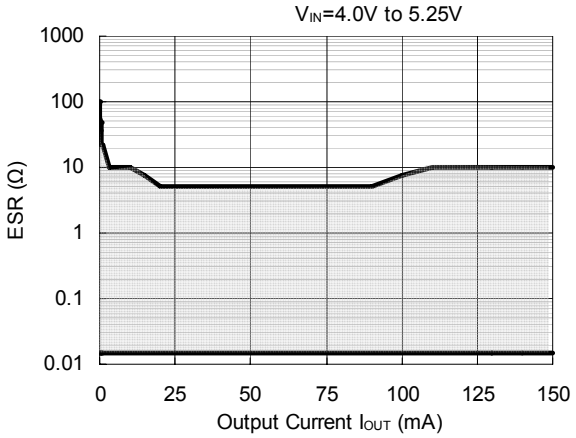
RP112x12xx



RP112x28xx



RP112x40xx



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■Ricoh awarded ISO 14001 certification.
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

RoHS Compliant
Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.

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