RICOH

RP107x SERIES

Capacitorless/ Low Voltage 200mA LDO REGULATOR

NO.EA-181-090417

OUTLINE

The RP107x Series are CMOS-based voltage regulator ICs with low input voltage acceptable (Vin minimum=1.4V), extremely low supply current (Typ. 9.5μA), the output capacitor free and the noise bypass capacitor free. Since the packages for these ICs are DFN (PLP)1212-6, WLCSP-4-P5, SOT23-5 and SC-88A, therefore extremely high density mounting of the ICs on boards is possible.

FEATURES

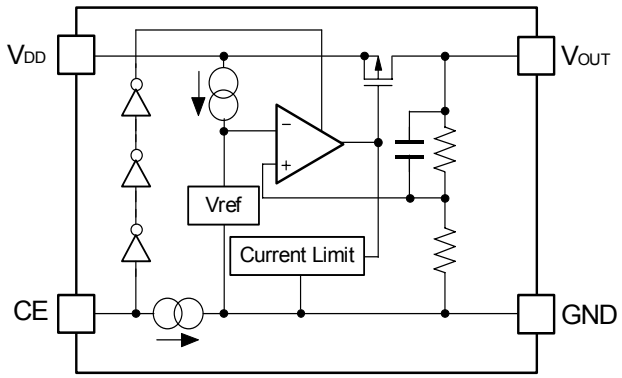
- Supply Current ..... Typ. 9.5μA (I_{OUT}=0mA)
- Standby Mode ..... Typ. 0.1μA
- Low Dropout Voltage ..... Typ. 0.27V (I_{OUT}=200mA, V_{OUT}=3.0V)
- Ripple Rejection ..... Typ. 70dB (f=1kHz, $V_{OUT} \leq$1.2V)
  ..... Typ. 65dB (f=1kHz, 1.2V<V_{OUT}< 2.2V)
  ..... Typ. 60dB (f=1kHz, $V_{OUT} \geq$ 2.2V)
- Line Regulation ..... Typ. 0.02%/V
- Output Voltage Accuracy ..... ± 1.0%
- Packages ..... DFN (PLP)1212-6, SOT-23-5, WLCSP-4-P5, SC-88A)
- Output Voltage ..... from 1.0V to 4.2V, 0.1V stepwise setting
- Built-in Fold Back Protection Circuit ..... Typ. 50mA (Current at short mode)
- Input Voltage Range ..... from 1.4V to 5.25V

APPLICATIONS

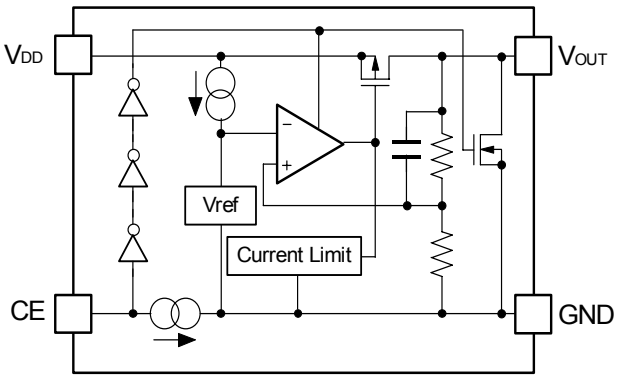
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

RP107xxx1B



RP107xxx1D



SELECTION GUIDE

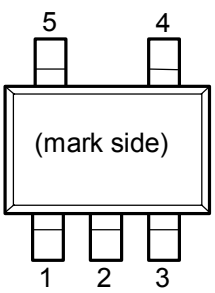
The output voltage, option, package, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

RP107xxxxx-xx-x ←Part Number
↑ ↑↑↑ ↑ ↑
a b a' c d e

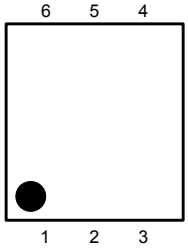
Code	Contents
a,a'	Designation of Package Type: a=K, a'=1: DFN(PLP)1212-6 a=N, a'=1: SOT-23-5 a=Z, a'=1: WLCSP-4-P5 a=Q, a'=2: SC-88A
b	Setting Output Voltage (V_{OUT}): 0.1V stepwise setting in the range from 1.0V to 4.2V
c	Designation of Mask Option B: active high, without auto discharge function at OFF state. D: active high, with auto discharge function at OFF state.
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 (SOT-23-5, SC-88A, WLCSP-4-P5) None: Au plating (DFN (PLP)1212-6)

PIN CONFIGURATIONS

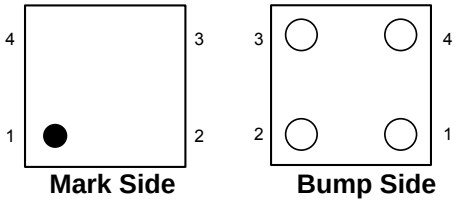
● **SOT-23-5**



● **DFN (PLP)1212-6**



WLCSP-4-P5



SC-88A

PIN DESCRIPTION

● **SOT-23-5**

Pin No.	Symbol	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

● **DFN(PLP)1212-6**

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

∗ Tab in the ◌ parts have GND level.
(They are connected to the reverse side of this IC.)
Do not connect to other wires or land patterns.

● **SC-88A**

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

● **WLCSP-4-P5**

Pin No.	Symbol	Description
1	V_{DD}	Input Pin
2	CE	Chip Enable Pin (”H” Active)
3	GND	Ground Pin
4	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	400	mA
P_D	Power Dissipation (SOT-23-5) *Note1	420	mW
	Power Dissipation (DFN(PLP)1212-6) *Note1	400	
	Power Dissipation (WLCSP-4-P5) *Note1	278	
	Power Dissipation (SC-88A) *Note1	380	
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	Storage Temperature Range	−55 to 125	°C

*Note1) For Power Dissipation please refer to PACKAGE INFORMATION to be described.

ELECTRICAL CHARACTERISTICS

- **RP107xxx1B/D**

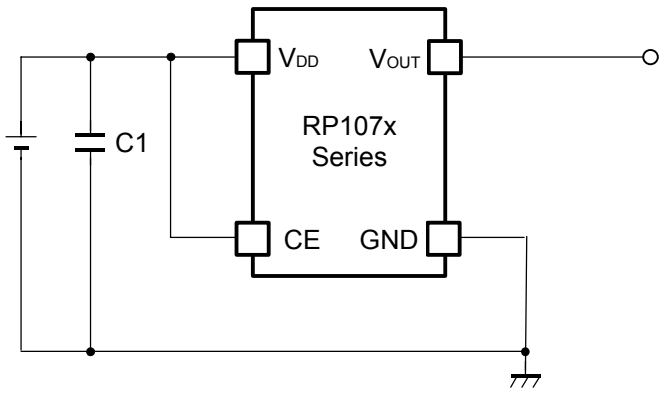
V_{IN}=Set V_{OUT}+ 1V, I_{OUT}=1mA, The value surrounded by [ ], guaranteed by design under the all operating temperature range, -40°C ≤Ta≤85°C

Ta=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}=Set V_{OUT}+1V		×0.99		×1.01	V
I_{OUT}	Output Current			[200]			mA
ΔV_{OUT}/ ΔI_{OUT}	Load Regulation	1mA ≦ I_{OUT} ≦ 200mA			25	[50]	mV
V_{DIF}	Dropout Voltage	I_{OUT}=200mA	1.0V ≦ V_{OUT}<1.1V		0.64	[0.92]	V
			1.1V ≦ V_{OUT}<1.2V		0.59	[0.84]	
			1.2V ≦ V_{OUT}<1.5V		0.55	[0.76]	
			1.5V ≦ V_{OUT}<2.0V		0.44	[0.60]	
			2.0V ≦ V_{OUT}<2.6V		0.35	[0.49]	
			2.6V ≦ V_{OUT}		0.27	[0.36]	
I_{SS}	Supply Current	I_{OUT}=0mA			9.5	[25]	μA
Istandby	Supply Current (Standby)	V_{CE}=0V			0.1	3.0	μA
ΔV_{OUT}/ ΔV_{IN}	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 5.0V			±0.02	[±0.20]	%/V
RR	Ripple Rejection	f=1kHz,Ripple 0.2Vp-p V_{IN}=Set V_{OUT}+1V, I_{OUT}=30mA V_{OUT} ≤1.2V 1.2V< V_{OUT} ≤2.2V V_{OUT} ≥ 2.2V			70 65 60		dB
V_{IN}	Input Voltage*[1]			[1.40]		[5.25]	V
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm /°C
I_{lim}	Short Current Limit	V_{OUT}=0V			50		mA
I_{PD}	CE Pull-down Current				0.1		μA
V_{CEH}	CE Input Voltage “H”			[1.0]			V
V_{CEL}	CE Input Voltage “L”					[0.4]	V
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V_{IN}=4.0,V_{CE}=0V			30		Ω

*1) Max. Input Voltage is 5.5V during 500hours

TYPICAL APPLICATION



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. If load variation is very large, it is better to attach the output capacitor in the range from 0.1μF to 10μF. If the tantalum capacitor is selected and the ESR (Equivalent Series Resistance) is high, the output may be unstable.

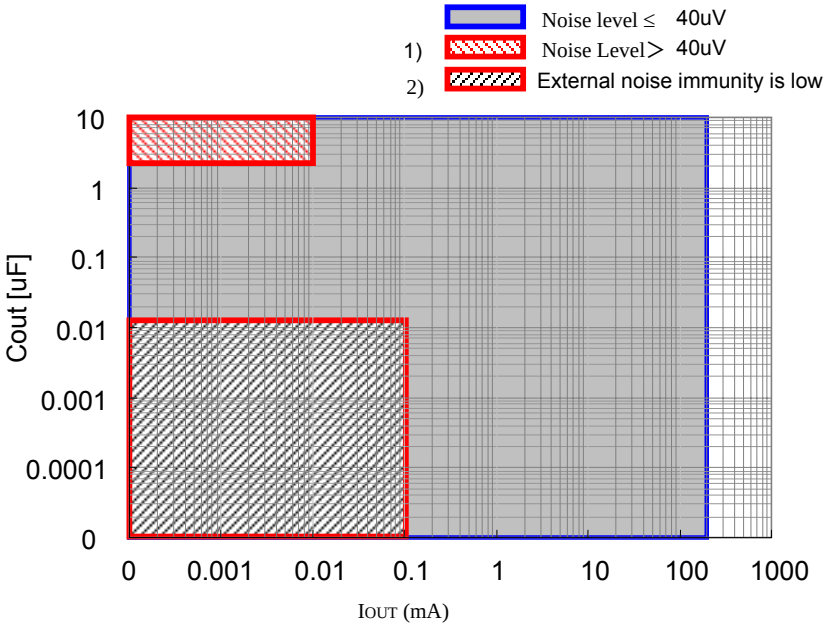
PCB Layout

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 0.1μF or more between V_{DD} and GND pin, and as close as possible to the pins.

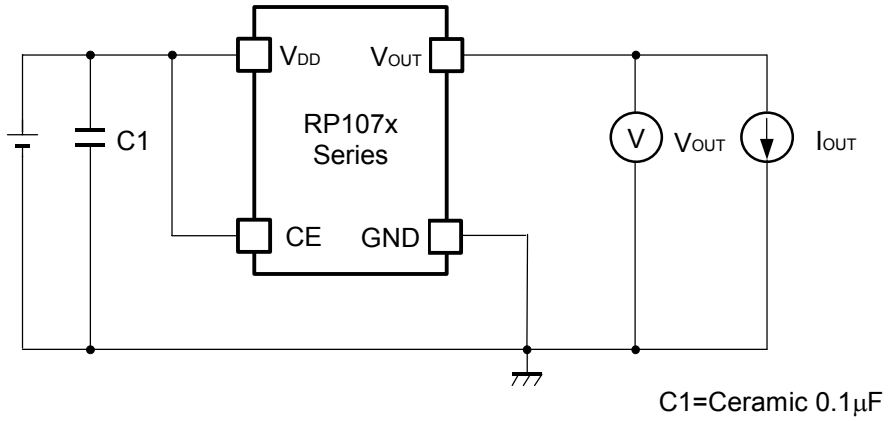
Notes: 1) If the output capacitor is set as equal or more than 2.2μF, output current is 0.01mA or lower than 0.01mA, noise level might be equal or more than 40μV. Considering frequency characteristics, fully evaluation is necessary.

2) If the output capacitor is set as equal or less than 0.01μF, and the output current is 0.1mA or less, external noise caused by other circuits may affect on the device. Enforce the GND or fully countermeasure is necessary.

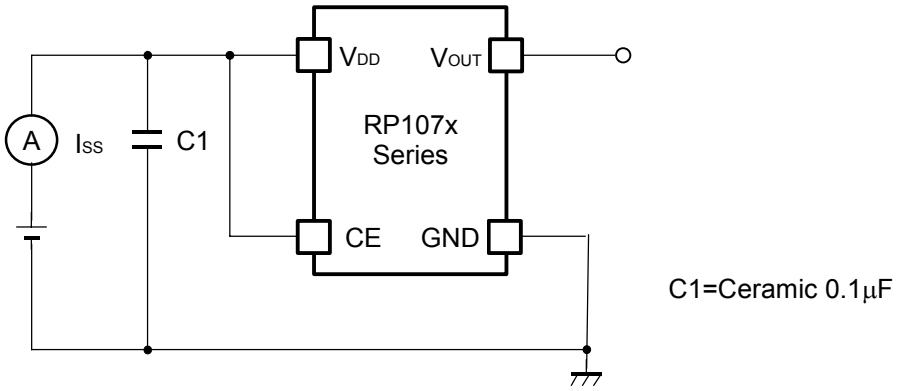
Please refer to the characteristics graph: external capacitor vs. output voltage.



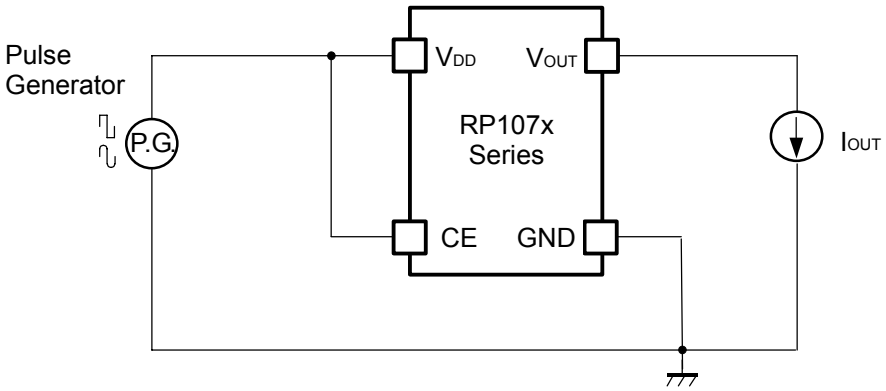
TEST CIRCUITS



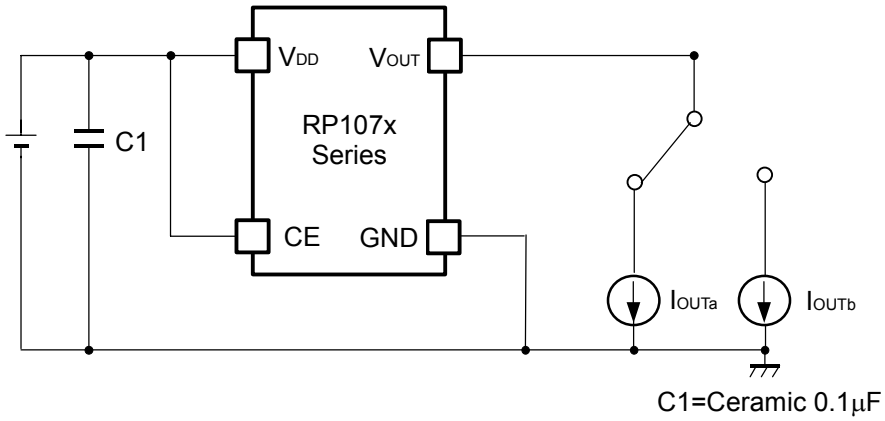
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

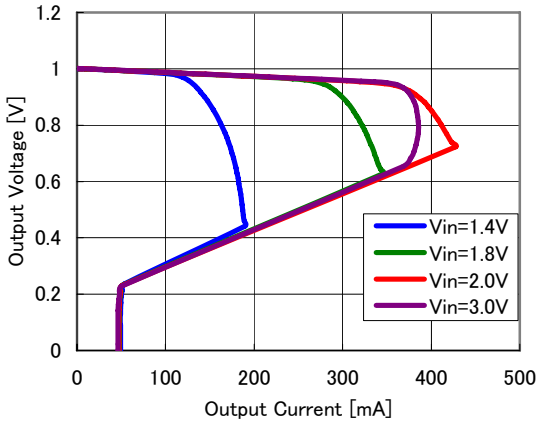


Test Circuit for Load Transient Response

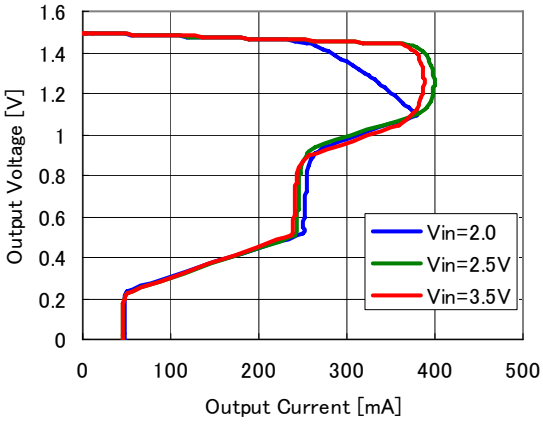
TYPICAL CHARACTERISTIC

1) Output Voltage vs. Output Current (C_{IN}=0.1μF, Topt=25°C)

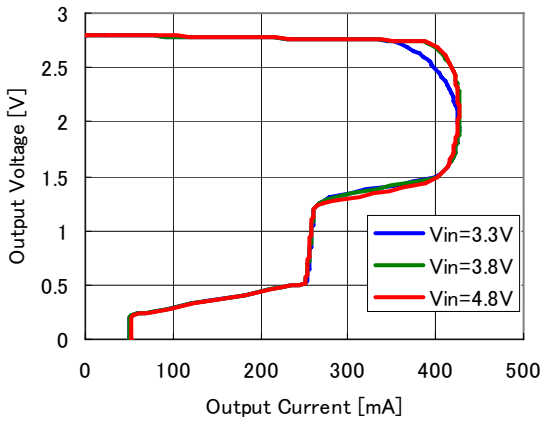
RP107x101x



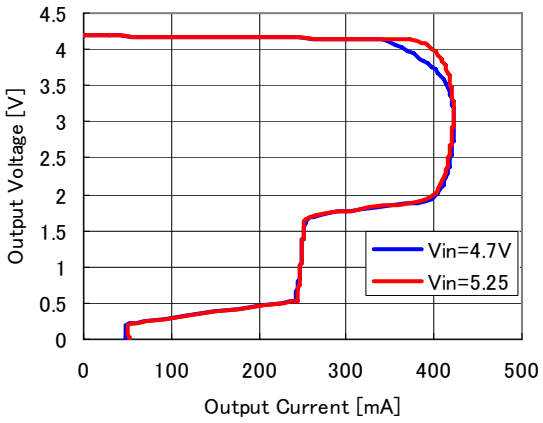
RP107x151x



RP107x281x

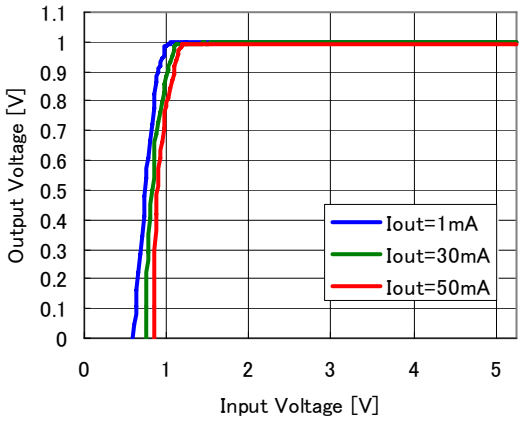


RP107x421x



2) Output Voltage vs. Input Voltage (Cin=0.1uF, Ta=25°C)

RP107x101x



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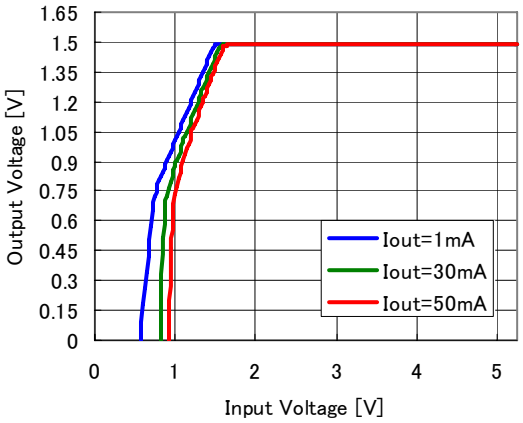

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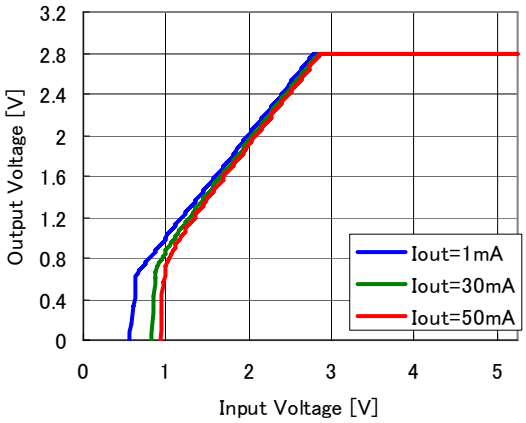
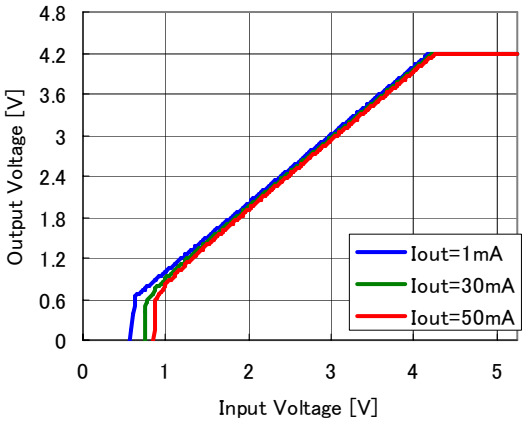
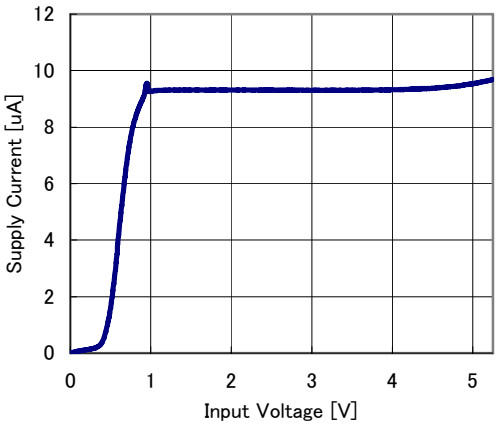


RP107x451x



3) Supply Current vs. Input Voltage(Cin=0.1uF, Ta=25°C)

RP107x101x



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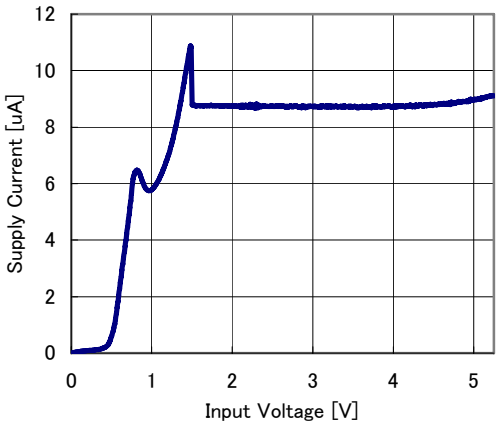

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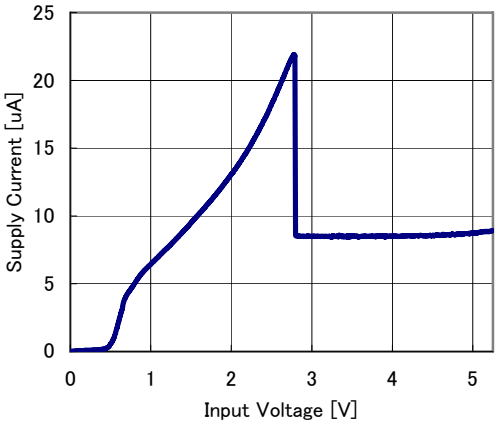

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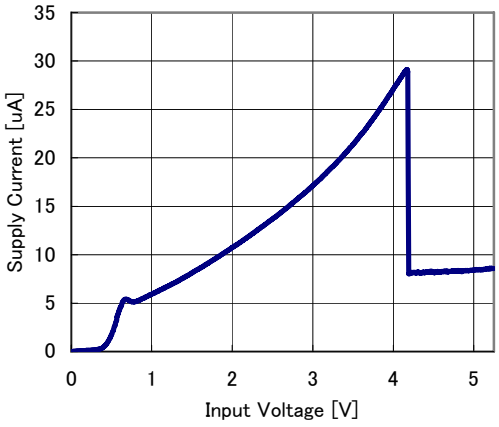
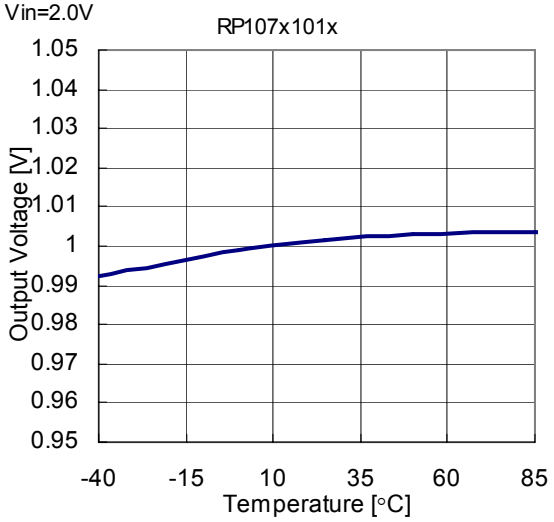
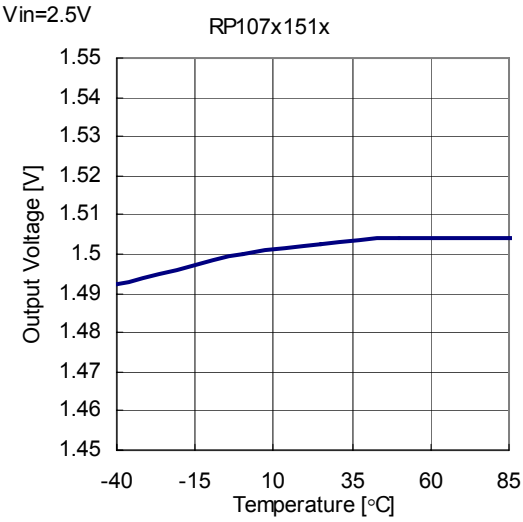


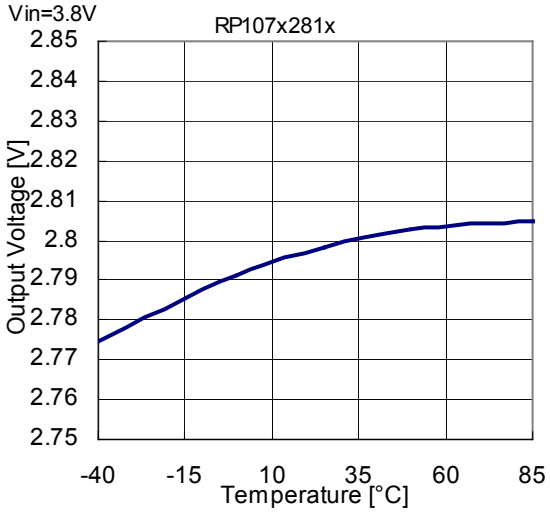
4) Output Voltage vs. Temperature (Cin=0.1uF, Iout=1mA)

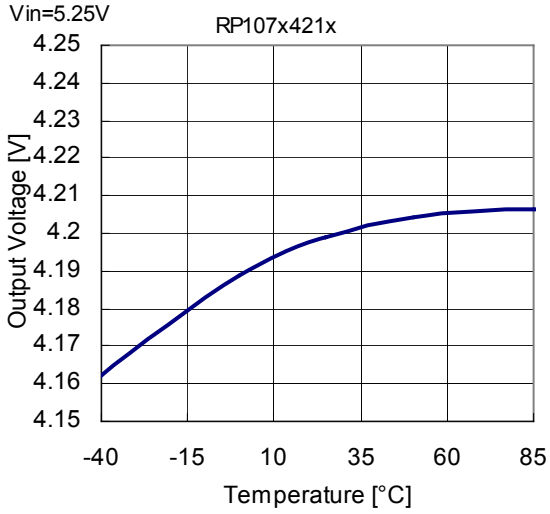
Vin=2.0V RP107x101x



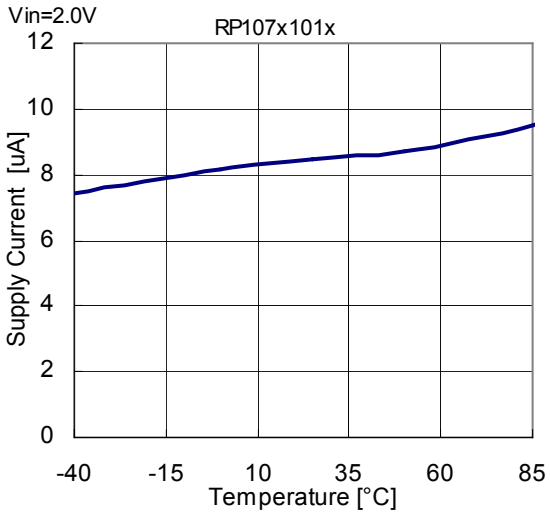
Vin=2.5V RP107x151x

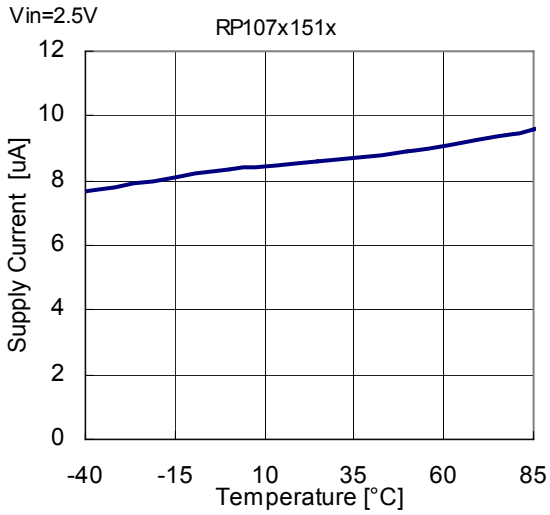


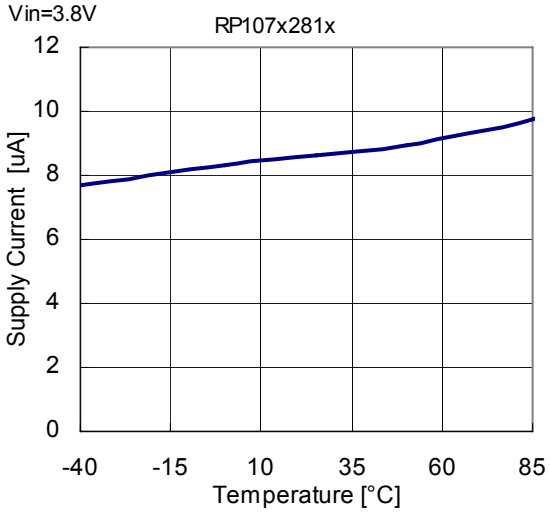


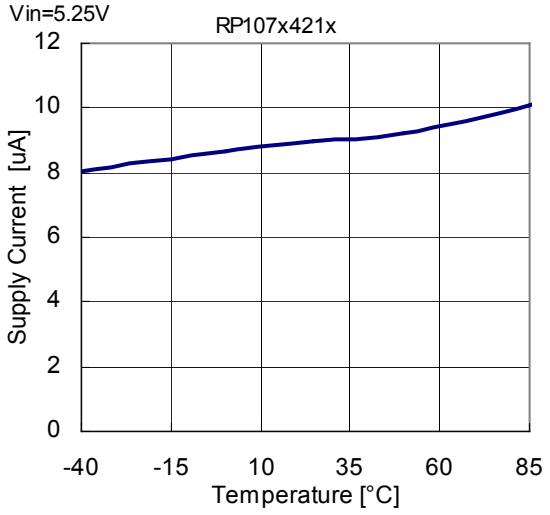


5) Supply Current vs. Temperature (Cin=0.1uF, Iout=0mA)



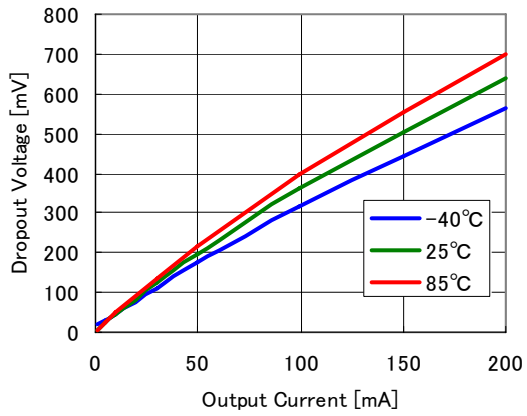




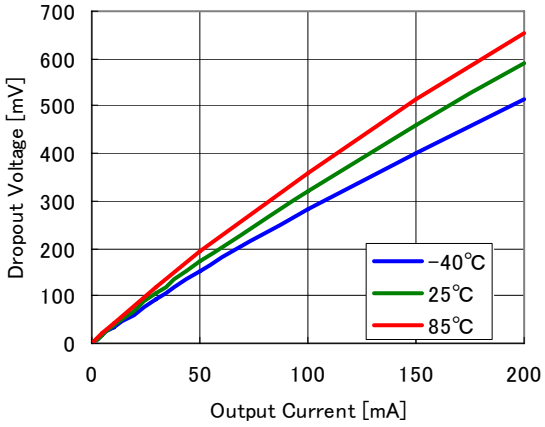


6) Dropout Voltage vs. Output Current (Cin=0.1uF)

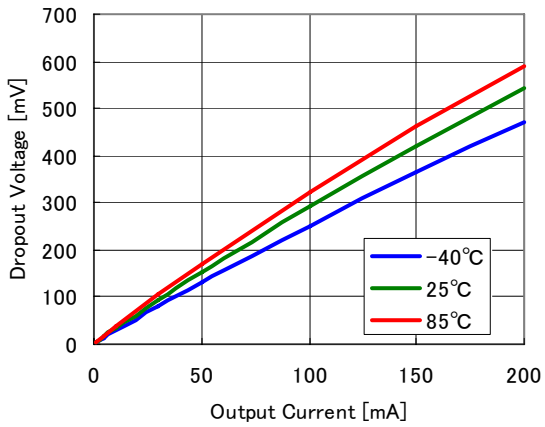
RP107x101x



RP107x111x



RP107x121x



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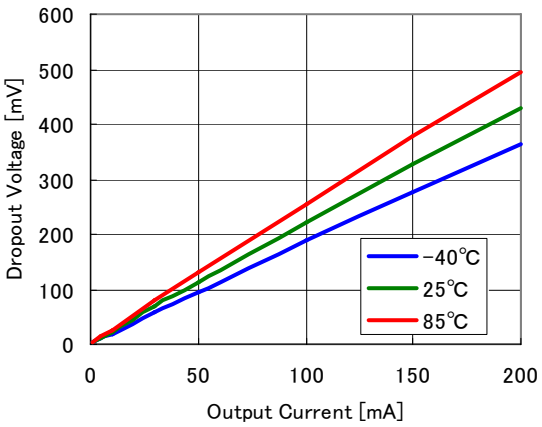
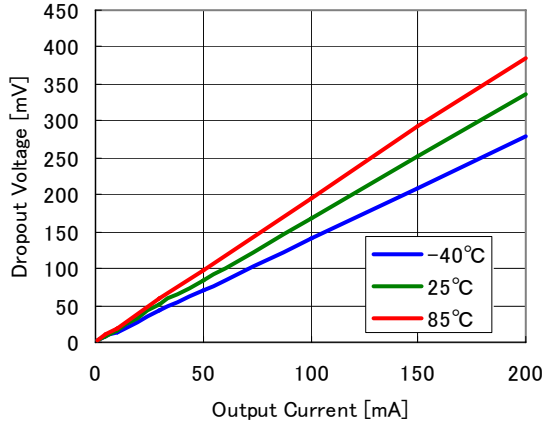
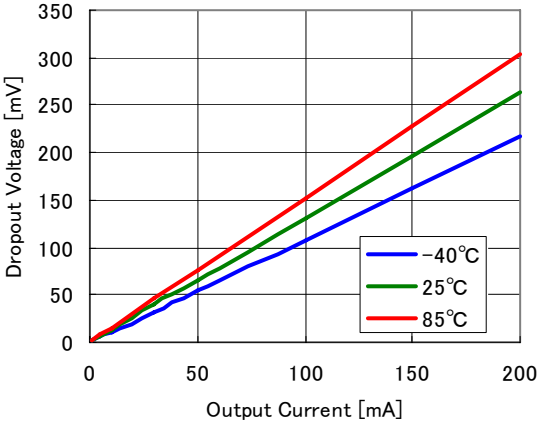


RP107x201x



RP107x301x



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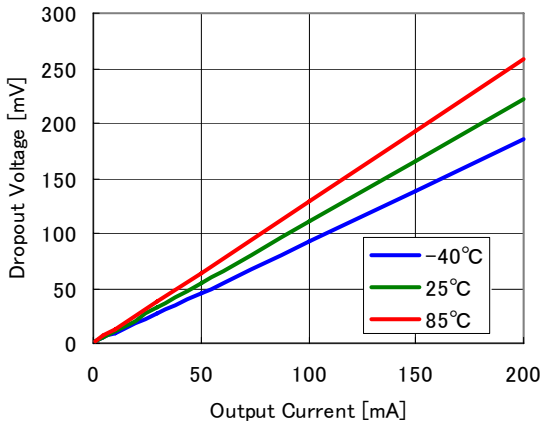
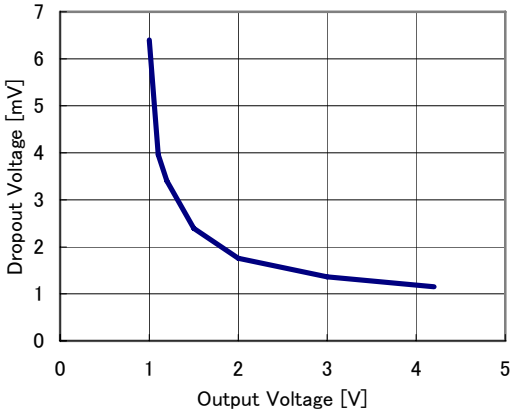
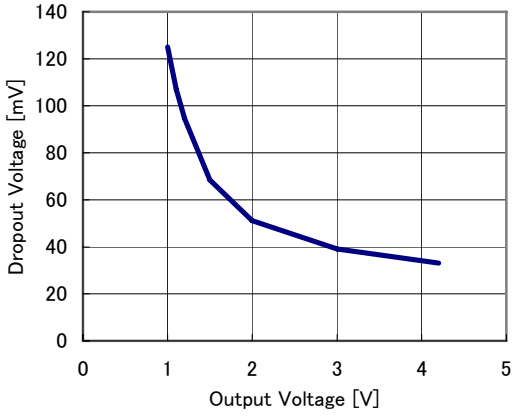


7) Dropout Voltage vs. Output Voltage (Cin=0.1uF)

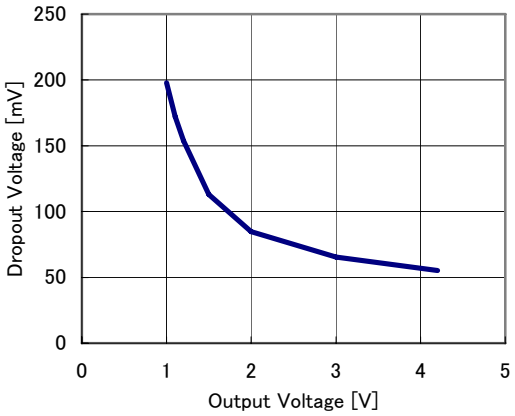
Iout=1mA RP107xxx1x



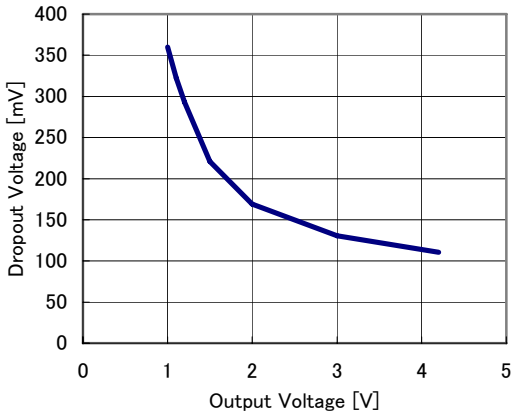
Iout=30mA RP107xxx1x



Iout=50mA RP107xxx1x

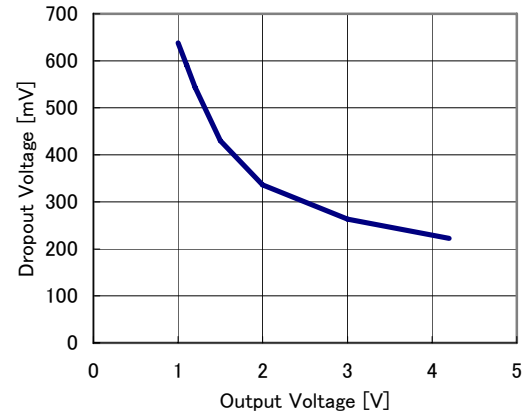


Iout=100mA RP107xxx1x



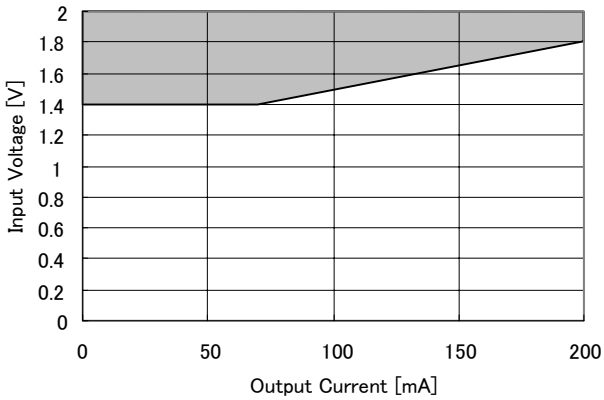
Iout=200mA

RP107xxx1x



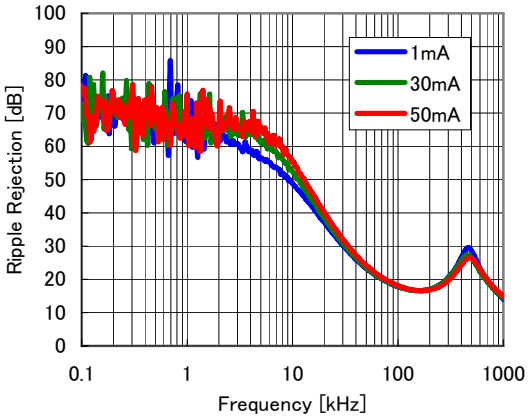
8) Minimum Operating Voltage (Cin=0.1uF)

RP107x101x

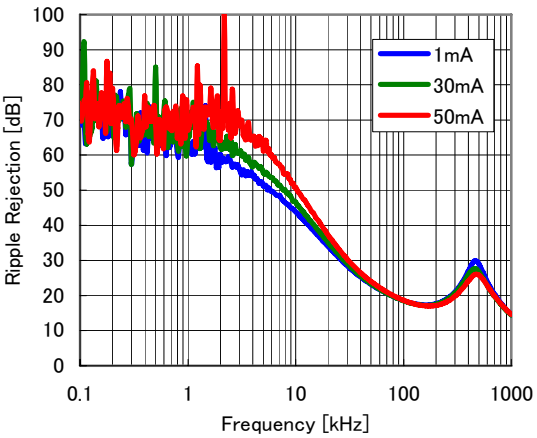


9) Ripple Rejection vs Frequency(Cin=none, Ta=25°C)

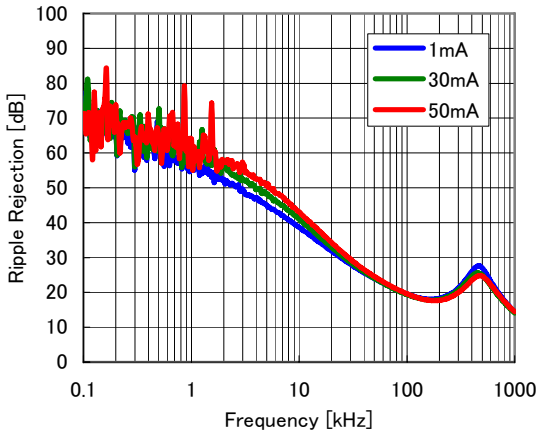
Vin=2.0V+0.2Vp-p R107x101x Cout=none



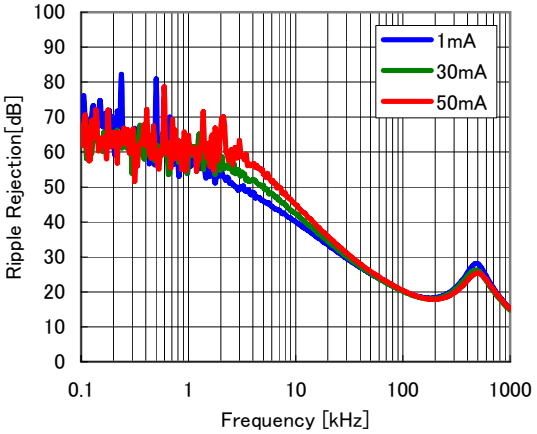
Vin=2.5V+0.2Vp-p RP107x151x Cout=none



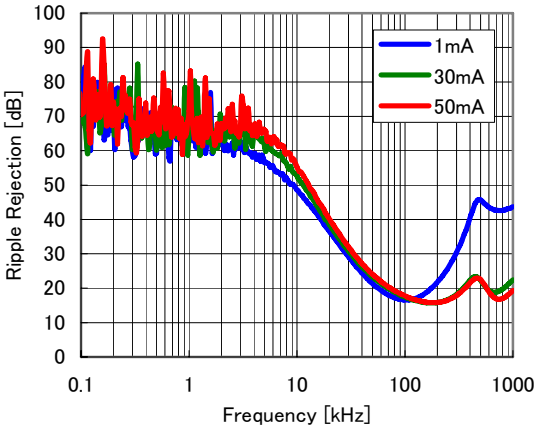
Vin=3.8V+0.2Vp-p RP107x281x Cout=none



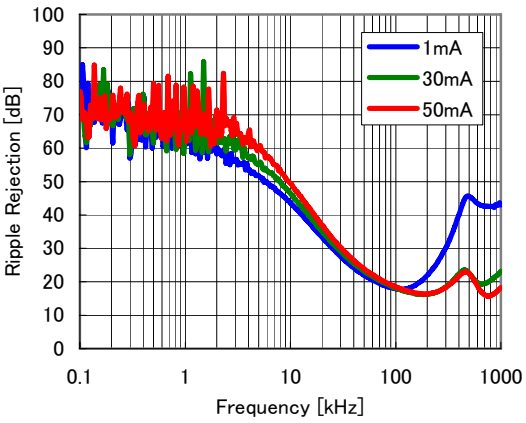
Vin=5.2V+0.2Vp-p RP107x421x Cout=none



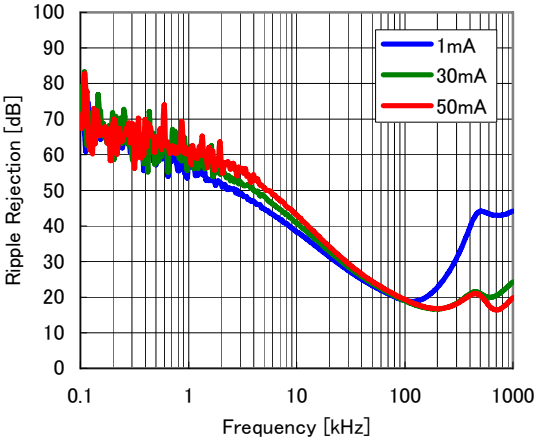
Vin=2.0V+0.2Vp-p R107x101x Cout=0.1uF



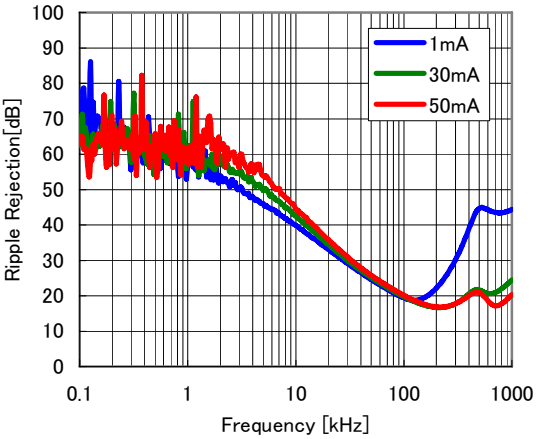
Vin=2.5V+0.2Vp-p RP107x151x Cout=0.1uF



Vin=3.8V+0.2Vp-p RP107x281x Cout=0.1uF

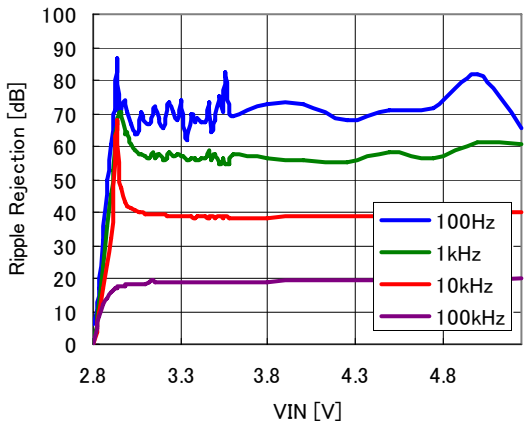


Vin=5.2V+0.2Vp-p RP107x421x Cout=0.1uF

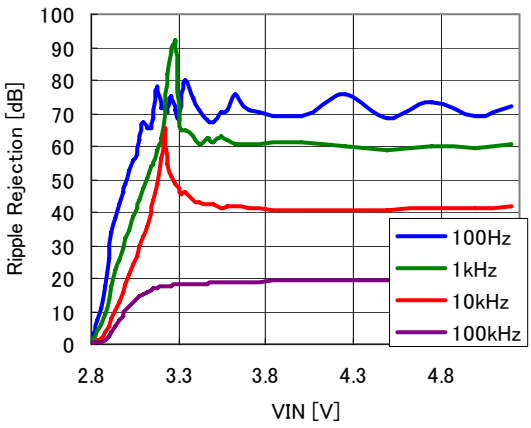


10) Ripple Rejection vs Input Bias(Vp-p=0.2V, Cout=0.1uF,Ta=25°C)

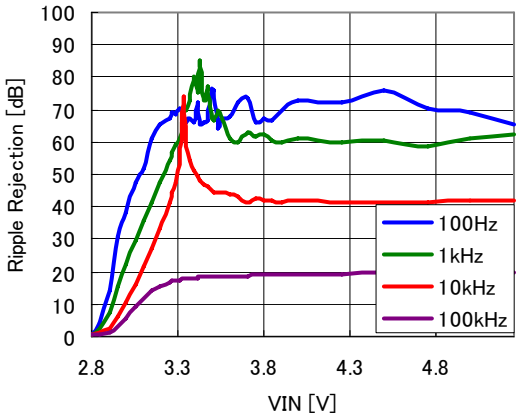
RP107x281x Iout=1mA



RP107x281x Iout=30mA

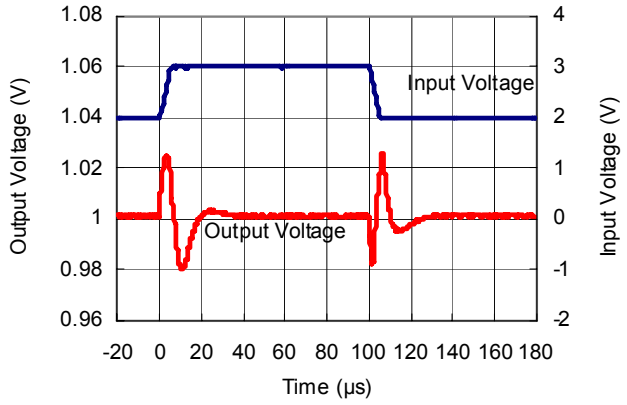


RP107x281x Iout=50mA

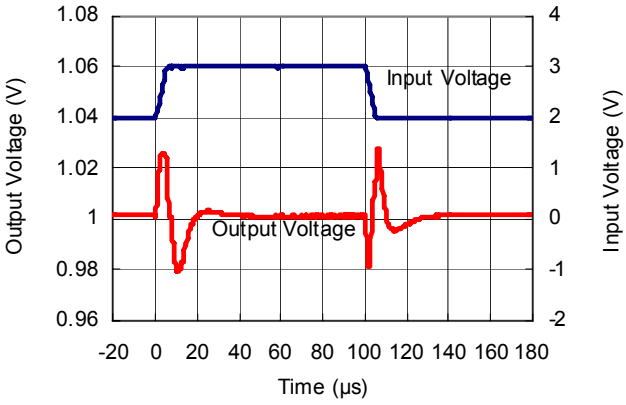


11) Line Transient Response (Iout=30mA, tr=tf=5us, Cin=none, Ta=25°C)

Vin:2V⇔3V RP107x101x Cout=none

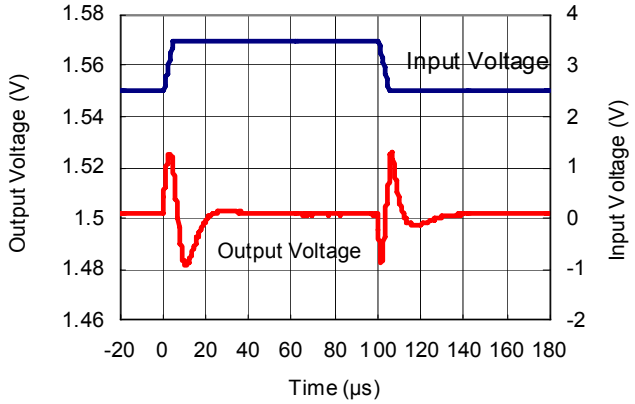


Vin:2V⇔3V RP107x101x Cout=Ceramic 0.1uF



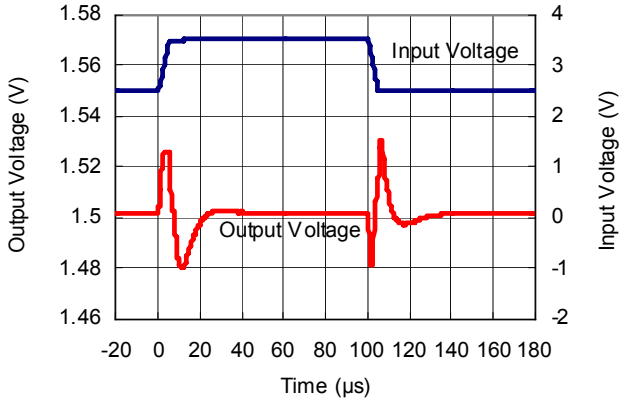
Vin:2.5V⇔3.5V Cout=none

RP107x151x



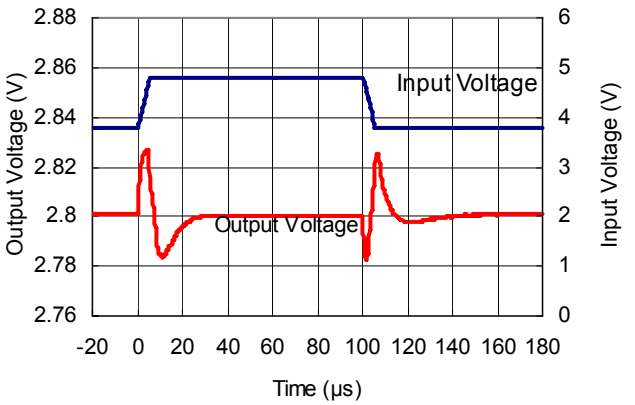
Vin:2.5V⇔3.5V Cout=Ceramic 0.1µF

RP107x151x



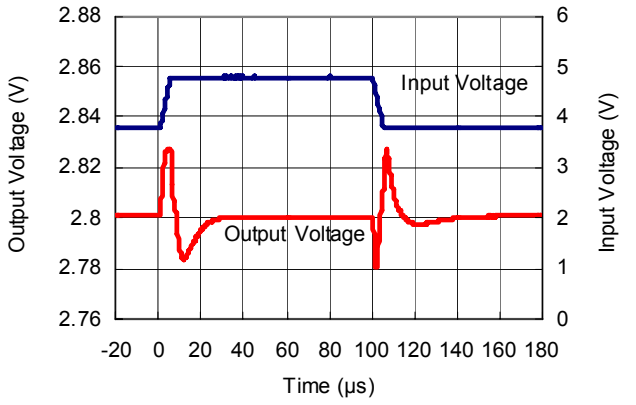
Vin:3.8V⇔4.8V Cout=none

RP107x281x



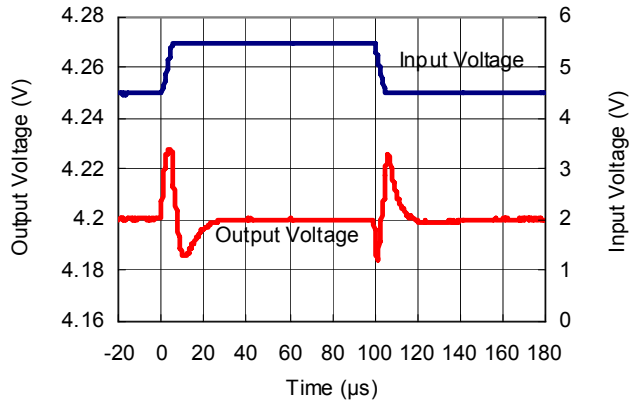
Vin:3.8V⇔4.8V Cout=Ceramic 0.1µF

RP107x281x



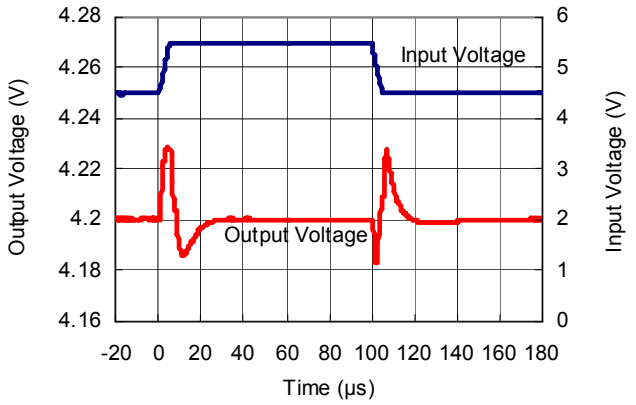
Vin:4.5V⇔5.5V Cout=none

RP107x421x



Vin:4.5V⇔5.5V Cout=Ceramic 0.1µF

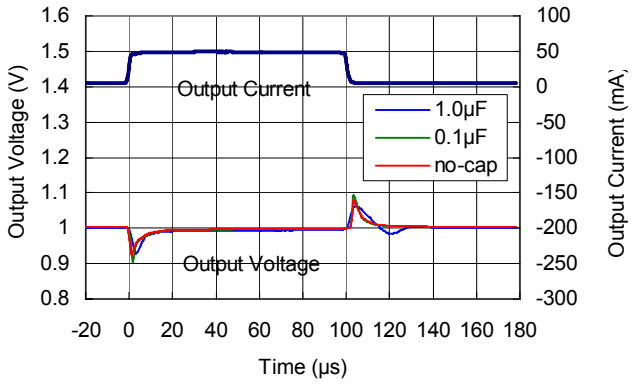
RP107x421x



12) Load Transient Response(Cin=0.1uF, Tr=Tf=0.5us, Ta=25°C)

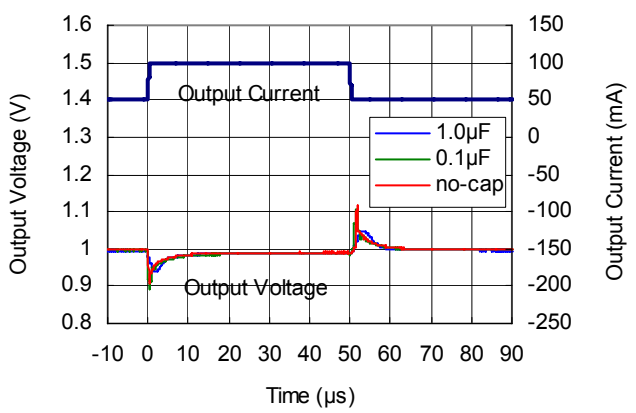
RP107x101x

Tr=Tf：2μs
Iout：5mA⇔50mA



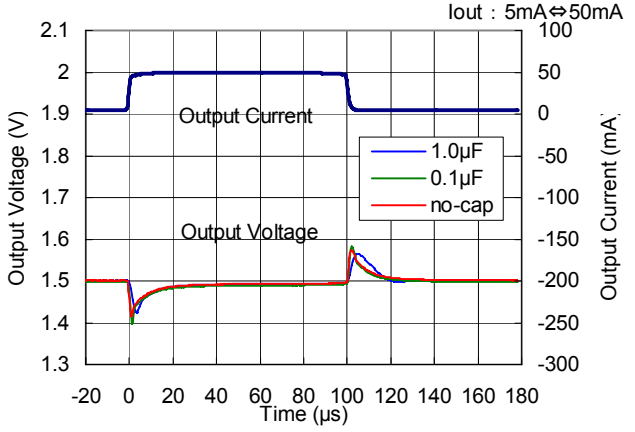
RP107x101x

Tr=Tf：0.5μs
Iout：50mA⇔100mA



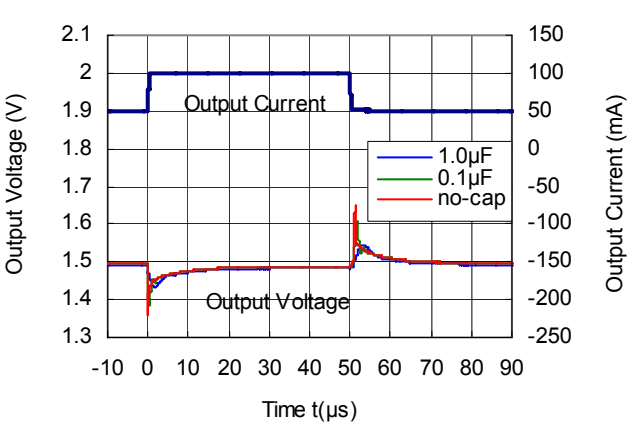
RP107x151x

Tr=Tf：2μs
Iout：5mA⇔50mA



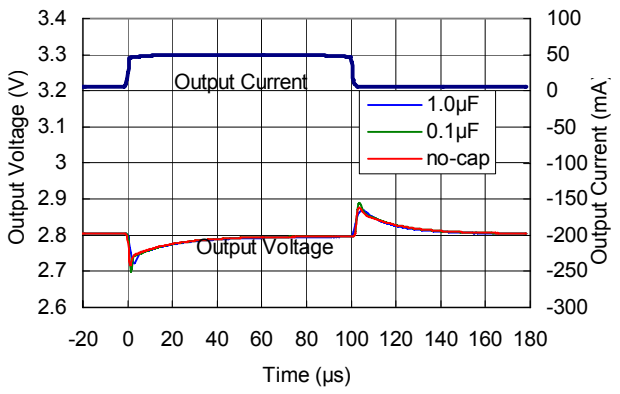
RP107x151x

Tr=Tf：0.5μs
Iout：50mA⇔100mA



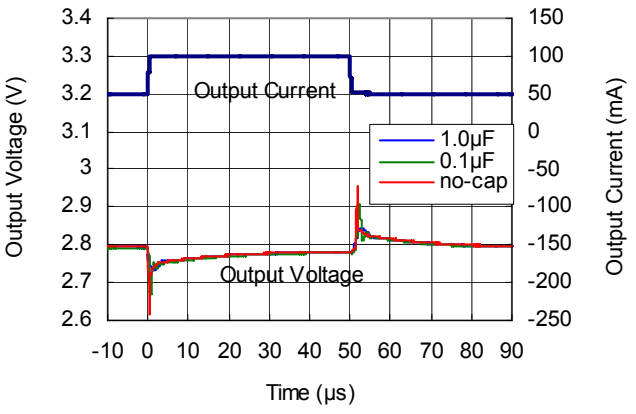
RP107x281x

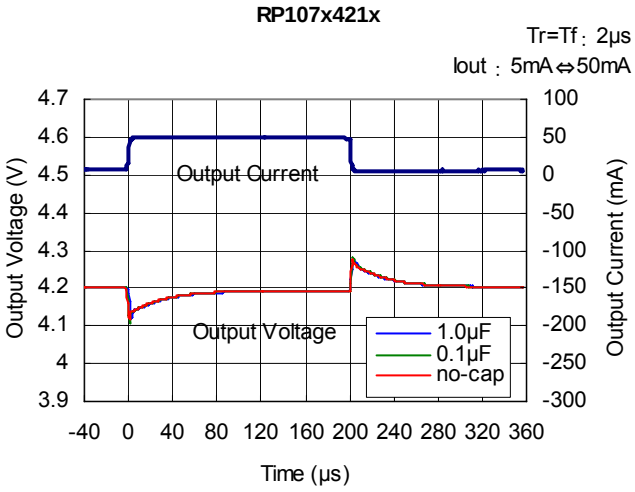
Tr=Tf：2μs
Iout：5mA⇔50mA

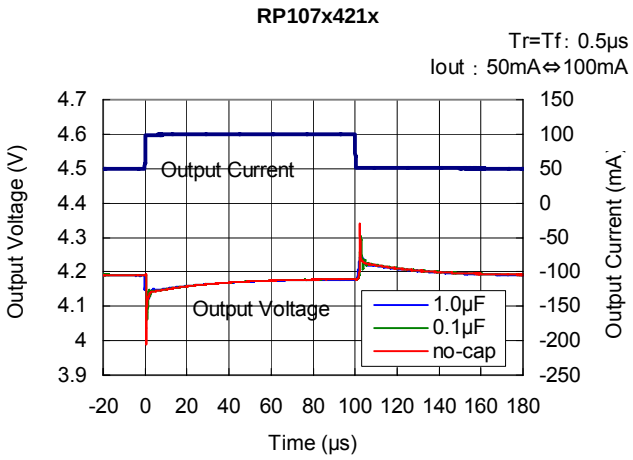


RP107x281x

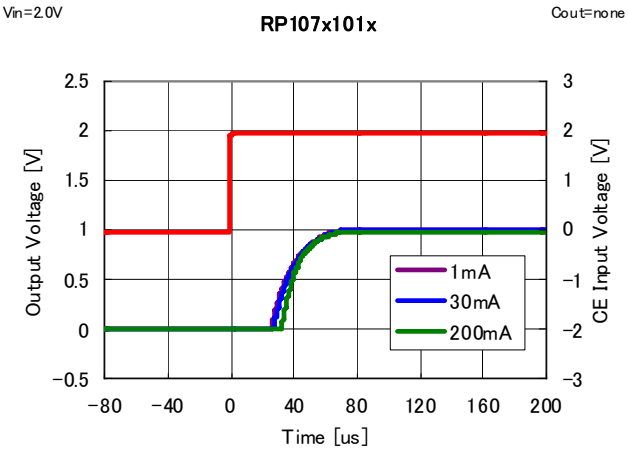
Tr=Tf：0.5μs
Iout：50mA⇔100mA

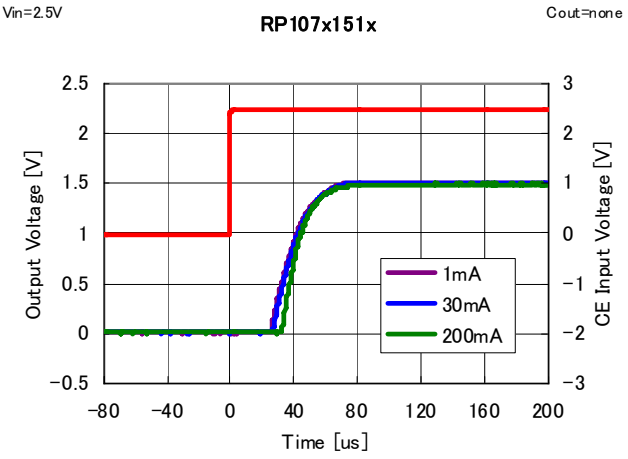


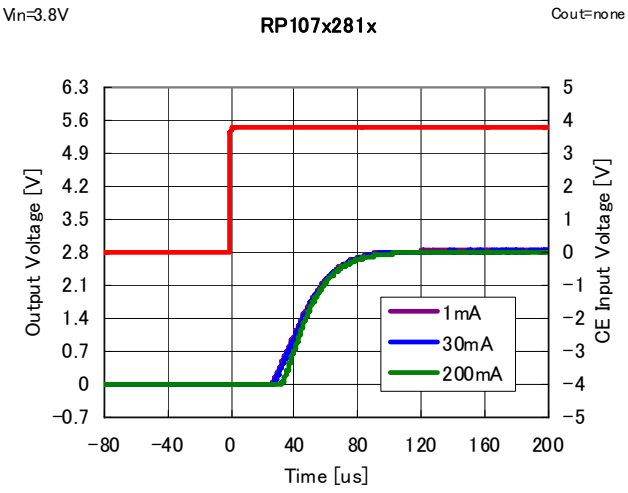


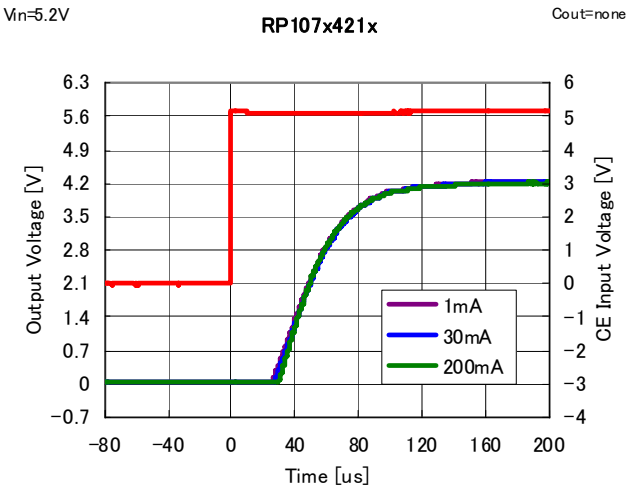


13) Turn On Speed with CE pin (Cin=0.1uF, Ta=25°C)

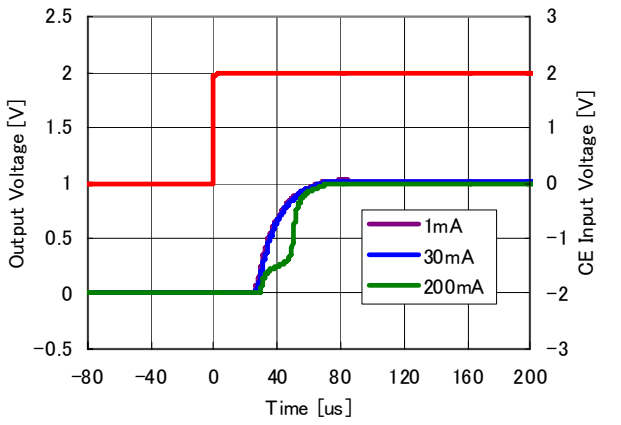




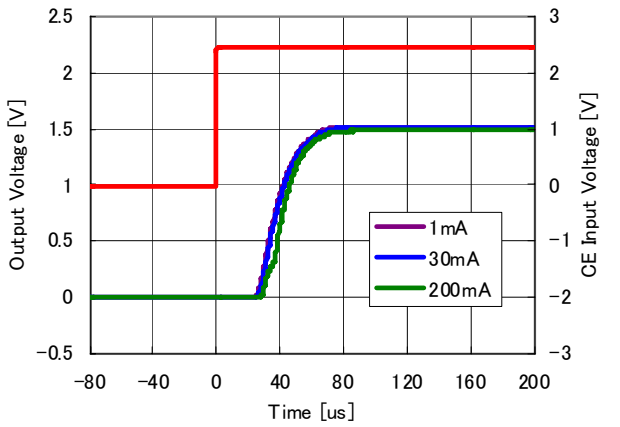




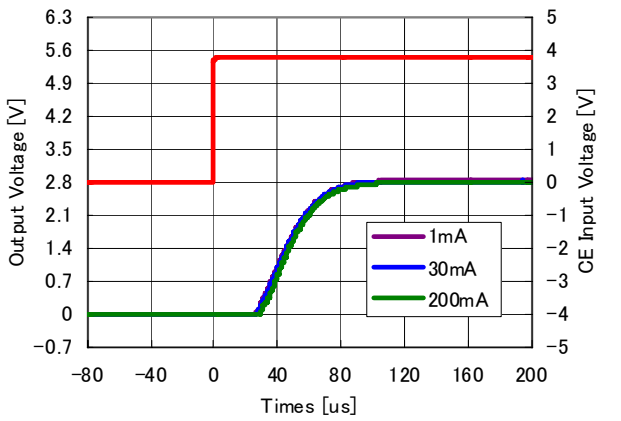
Vin=2.0V RP107x101x Cout=1uF



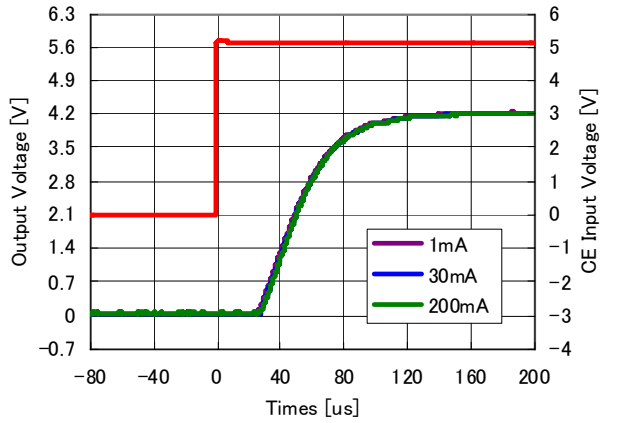
Vin=2.5V RP107x151x Cout=1uF



Vin=3.8V RP107x281x Cout=1uF

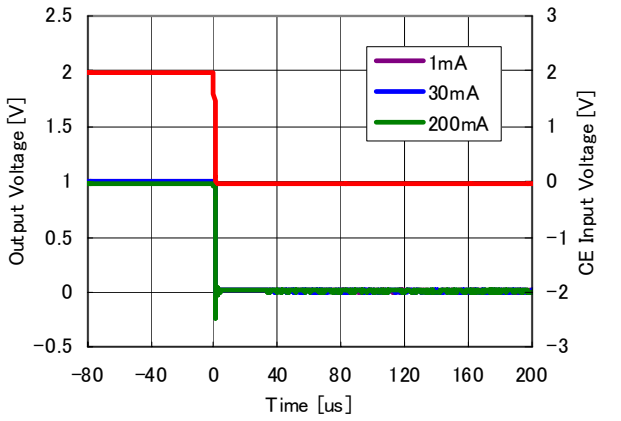


Vin=5.2V RP107x421x Cout=1uF

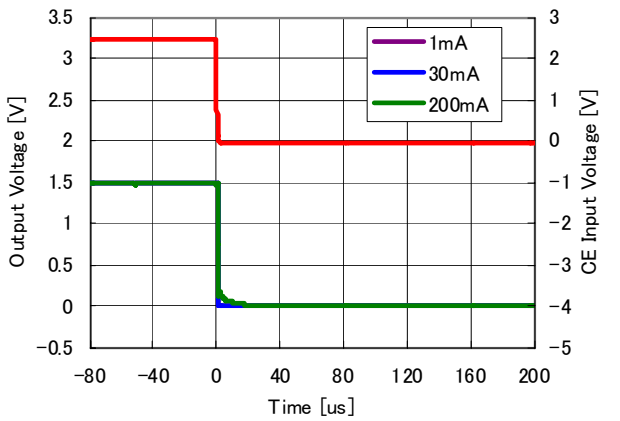


14)Turn Off Speed with CE pin (D Version) (Cin=0.1uF, Ta=25°C)

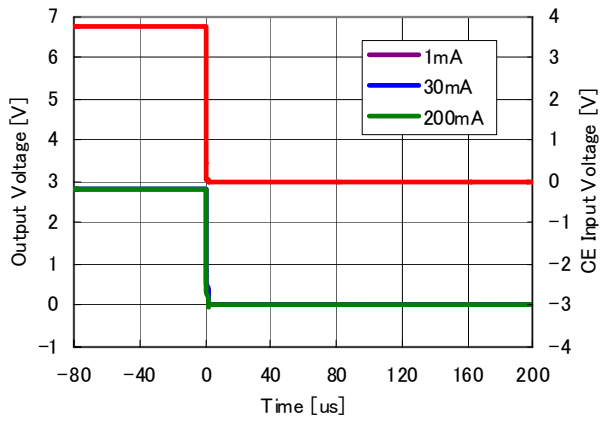
Vin=2.0V RP107x101x Cout=none



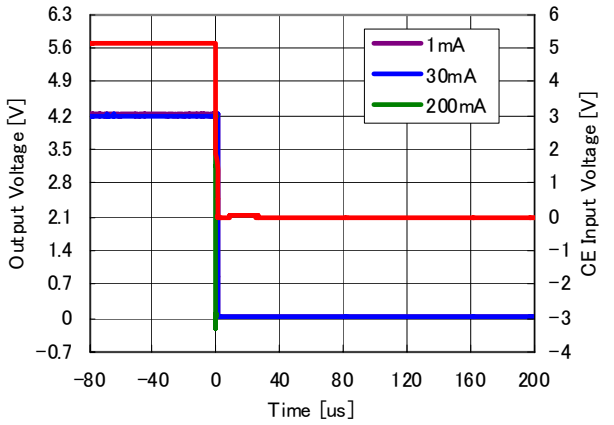
Vin=2.5V RP107x151x Cout=none



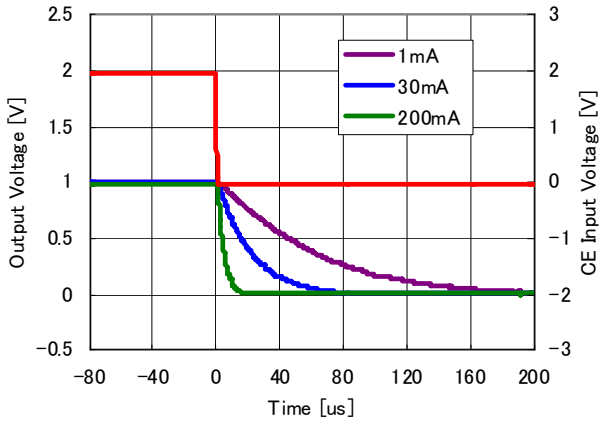
Vin=3.8V RP107x281x Cout=none



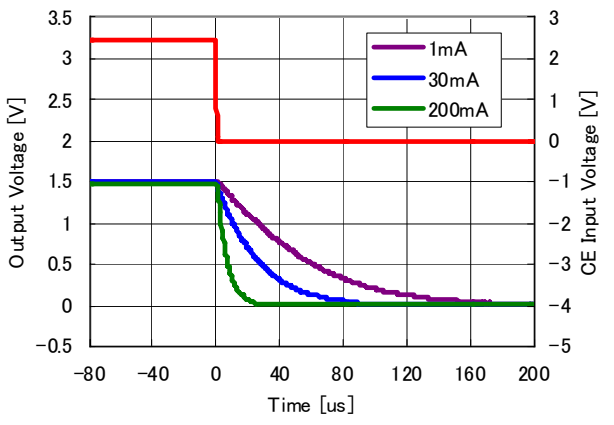
Vin=5.2V RP107x421x Cout=none



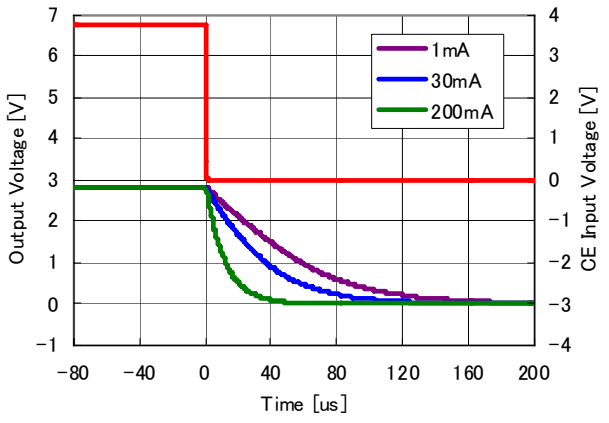
Vin=2.0V RP107x101x Cout=1uF



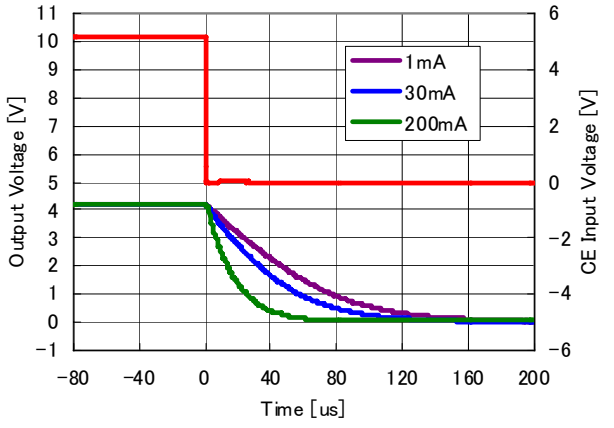
Vin=2.5V RP107x151x Cout=1uF



Vin=3.8V RP107x281x Cout=1uF

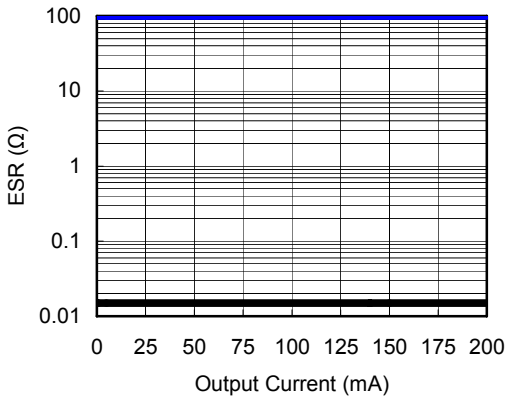


Vin=5.2V RP107x421x Cout=1uF

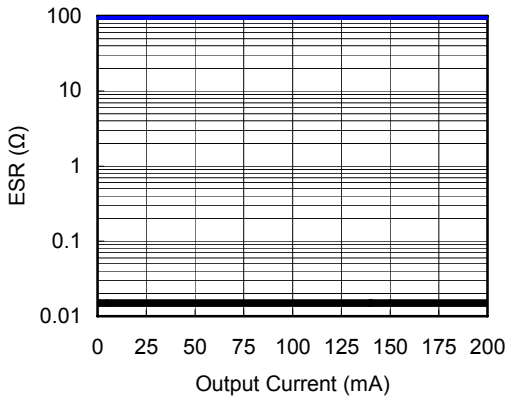


15) ESR vs. Iout (Cin=0.1uF, Cout=0.1uF)

RP107x101x Ta=-40～85℃ Vin=1.0V～5.25V



RP107x281x Ta=-40～85℃ Vin=1.0V～5.25V



RP107x421x Ta=-40～85℃ Vin=1.0V～5.25V