300mA 10V INPUT LDO REGULATOR

NO.EA-205-100405

OUTLINE

The RP170x Series are CMOS-based LDO regulators featuring 300mA output current. Because of the 10V maximum input voltage, RP170x can be used in 2 cell lithium-ion battery powered portable appliances and besides a portable equipment. The supply current is Typ. 23μA though an excellent response characteristics.

The output voltage range from 1.2V is possible. The output voltage accuracy and temperature-drift coefficient of output voltage of the RP170x Series are excellent.

RP170x has a fold-back protection circuit and a thermal shutdown circuit. Moreover, a standby mode with ultra low supply current can be realized with the chip enable function.

SC-88A, SOT-23-5 and SOT-89-5 with high power dissipation packages are available.

FEATURES

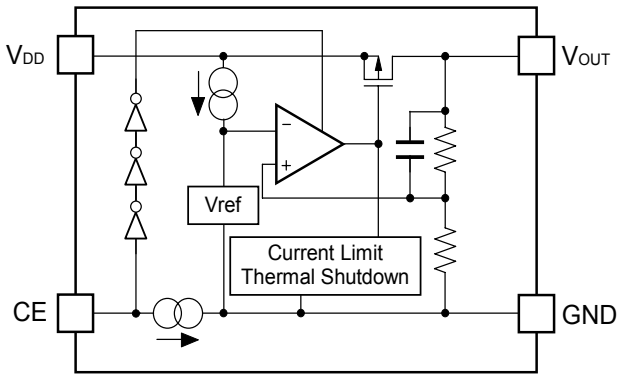
- Supply Current ..... Typ. 23μA
- Standby Mode ..... Typ. 0.1μA
- Dropout Voltage..... Typ. 0.20V (I_{OUT}=100mA, V_{OUT}=3.0V)
  Typ. 0.77V (I_{OUT}=300mA, V_{OUT}=2.8V)
- Ripple Rejection ..... Typ. 70dB (f=1kHz)
- Temperature-Drift Coefficient of Output Voltage ..... Typ. ±80ppm/°C
- Line Regulation ..... Typ. 0.02%/V
- Output Voltage Accuracy..... ±1.0%
- Packages..... SC-88A, SOT-23-5, SOT-89-5
- Input Voltage Range..... 2.6V to 10.0V
- Output Voltage Range..... 1.2V to 6.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Built-in Fold Back Protection Circuit..... Typ. 40mA (Current at short mode)
- Built-in Thermal Shutdown Circuit..... Shutdown Temperature at 165°C
- Ceramic capacitors are recommended to be used with this IC .... 1.0μF or more

APPLICATIONS

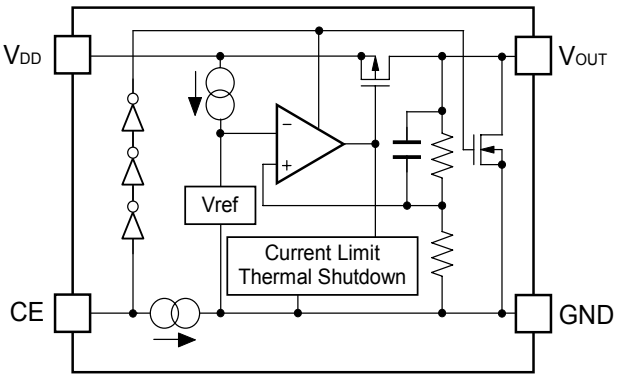
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.
- Power source for home appliances.

BLOCK DIAGRAMS

RP170xxxxB



RP170xxxxD



SELECTION GUIDE

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

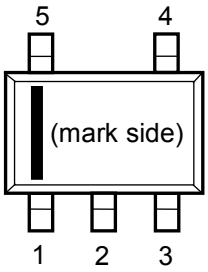
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP170Qxx2∗-TR-FE	SC-88A	3,000 pcs	Yes	Yes
RP170Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
RP170Hxx1∗-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.2V(12) to 6.0V(60) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

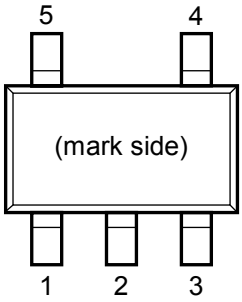
∗ : The auto discharge function at off state are options as follows.
(B) without auto discharge function at off state
(D) with auto discharge function at off state

PIN CONFIGURATIONS

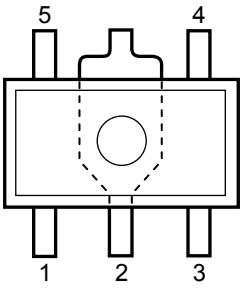
- **SC-88A**



- **SOT-23-5**



- **SOT-89-5**



PIN DESCRIPTIONS

- **SC-88A**

Pin No	Symbol	Pin 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

- **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

- **SOT-89-5**

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	12	V
V_{CE}	Input Voltage (CE Pin)	12	V
V_{OUT}	Output Voltage	−0.3 to V_{IN}+0.3	V
I_{OUT}	Output Current	330	mA
P_D	Power Dissipation* (SC-88A)	380	mW
	Power Dissipation* (SOT-23-5)	420	
	Power Dissipation* (SOT-89-5)	900	
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.

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.

ELECTRICAL CHARACTERISTICS

- **RP170xxxxB/D**

  V_{IN}=Set V_{OUT}+1V, I_{OUT}=1mA, unless otherwise noted.

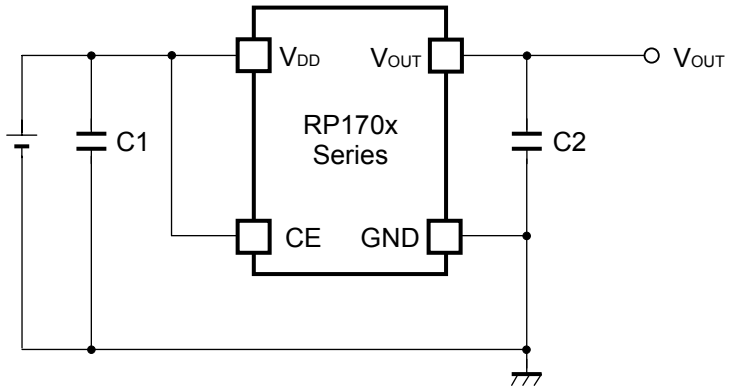
  ☐ values indicate −40°C ≤ Topt ≤ 85°C, unless otherwise noted.

  Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{OUT} > 1.5V	×0.99		×1.01	V
			V_{OUT} ≤ 1.5V	−15		+15	mV
		−40°C ≤ Topt ≤ 85°C	V_{OUT} > 1.5V	☐×0.974		☐×1.023	V
			V_{OUT} ≤ 1.5V	☐−40		☐+35	mV
I_{OUT}	Output Current			☐300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	0.1mA ≤ I_{OUT} ≤ 300mA			10	☐70	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	1.2V ≤ V_{OUT} < 1.3V		1.400	☐1.800	V
			1.3V ≤ V_{OUT} < 1.5V		1.350	☐1.750	
			1.5V ≤ V_{OUT} < 1.8V		1.200	☐1.550	
			1.8V ≤ V_{OUT} < 2.3V		0.980	☐1.300	
			2.3V ≤ V_{OUT} < 3.0V		0.770	☐1.080	
			3.0V ≤ V_{OUT} < 4.0V		0.600	☐0.850	
			4.0V ≤ V_{OUT} ≤ 6.0V		0.500	☐0.750	
I_{SS}	Supply Current	I_{OUT}=0mA			23	☐40	μA
Istandby	Standby Current	V_{IN}=10.0V, V_{CE}=GND			0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 10.0V (In case that V_{OUT} ≤ 2.1V, 2.6V ≤ V_{IN} ≤ 10.0V)			0.02	☐0.2	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p, I_{OUT}=30mA (In case that V_{OUT} < 2.0V, V_{IN}=3.0V)			70		dB
V_{IN}	Input Voltage			☐2.6		☐10	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	−40°C ≤ Topt ≤ 85°C			±80		ppm/°C
I_{SC}	Short Current Limit	V_{OUT}=0V			40		mA
I_{PD}	CE Pull-down Current				0.30		μA
V_{CEH}	CE Input Voltage "H"			☐1.7			V
V_{CEL}	CE Input Voltage "L"					☐0.8	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature			165		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			110		°C
en	Output Noise	BW=10Hz to 100kHz			100		μVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V_{IN}=7.0V V_{CE}=0V			250		Ω

All of unit are tested and specified under load conditions such that Tj≈Topt=25°C except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient and Thermal Shutdown.

TYPICAL APPLICATION



(External Components)
C2 1.0μF MURATA: GRM155B31A105KE15

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 with 1.0μF or more and good ESR (Equivalent Series Resistance).

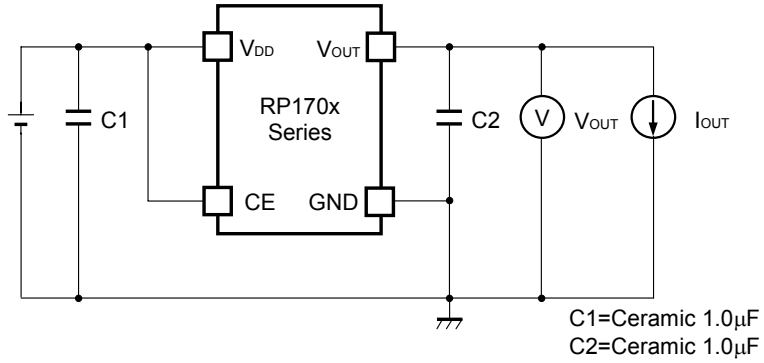
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

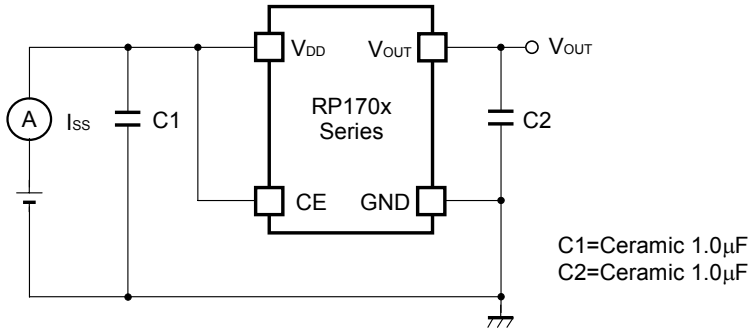
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0μF or more between V_{DD} and GND pin, and as close as possible to the pins.

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

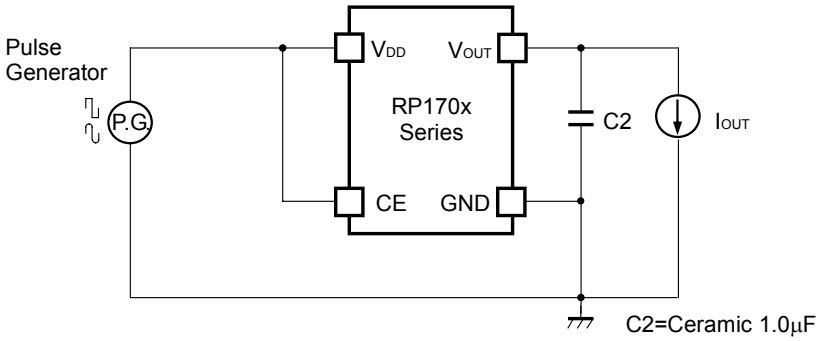
TEST CIRCUITS



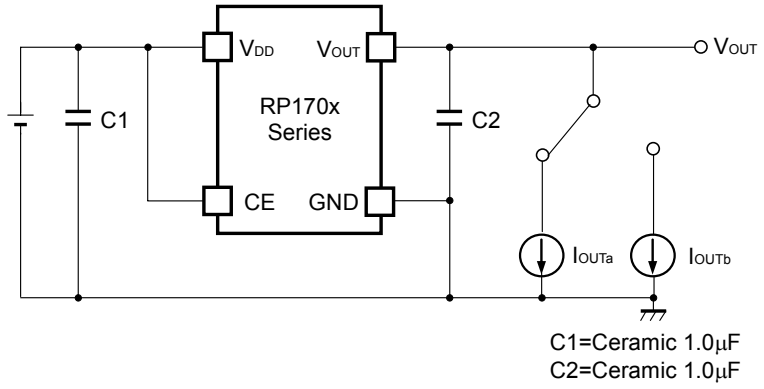
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection



Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

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

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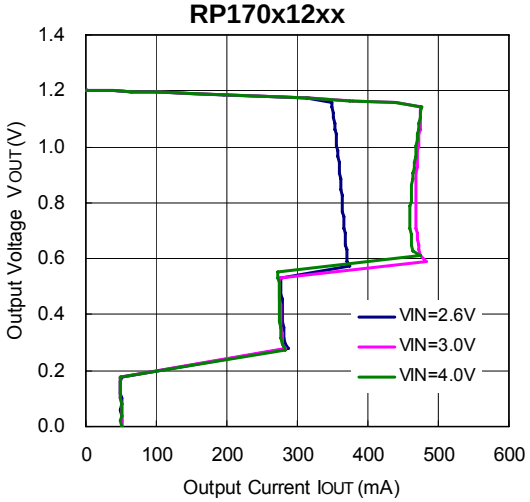

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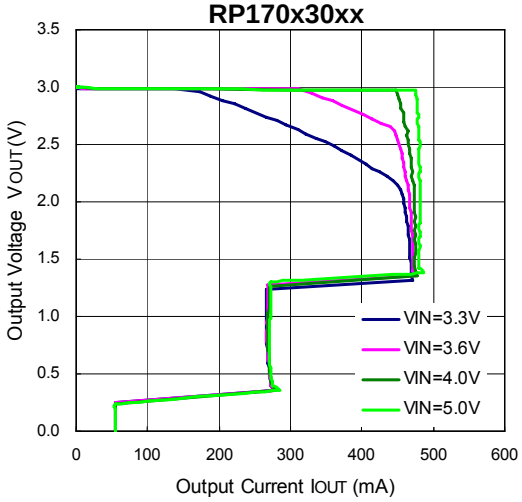

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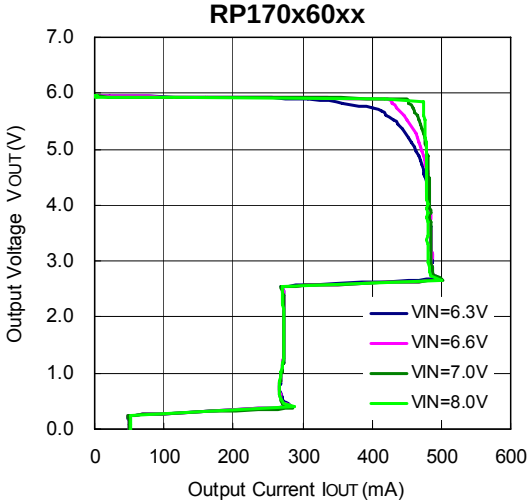
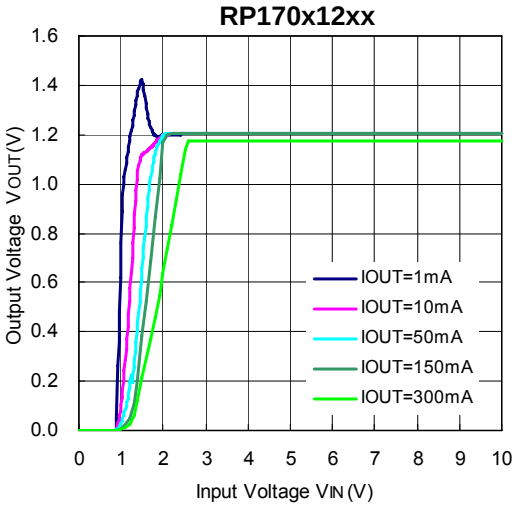


2) Output Voltage vs. Input Voltage (Topt=25°C)

RP170x12xx



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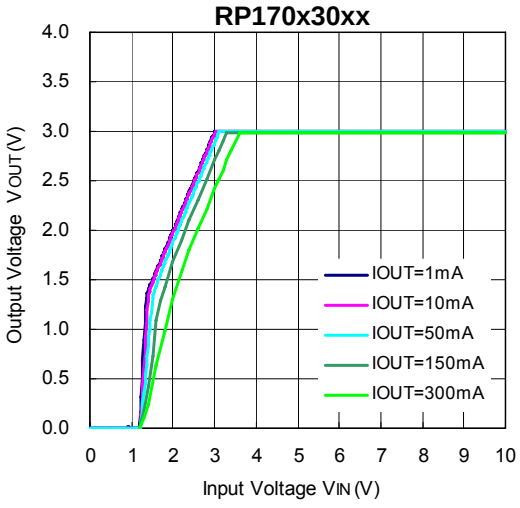

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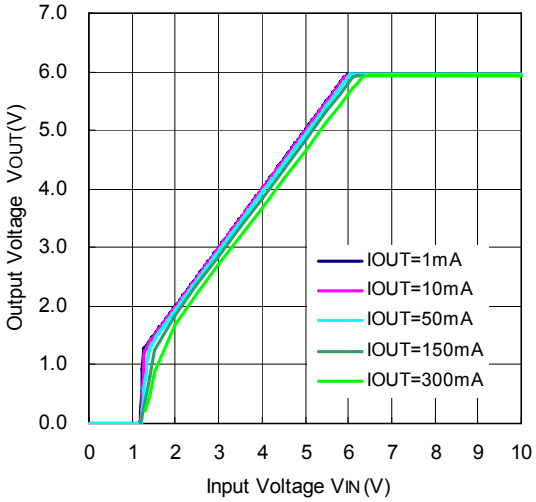
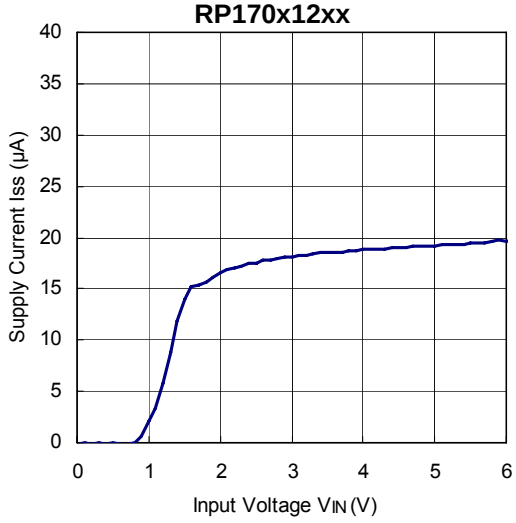


3) Supply Current vs. Input Voltage (T_{opt}=25°C)

RP170x12xx



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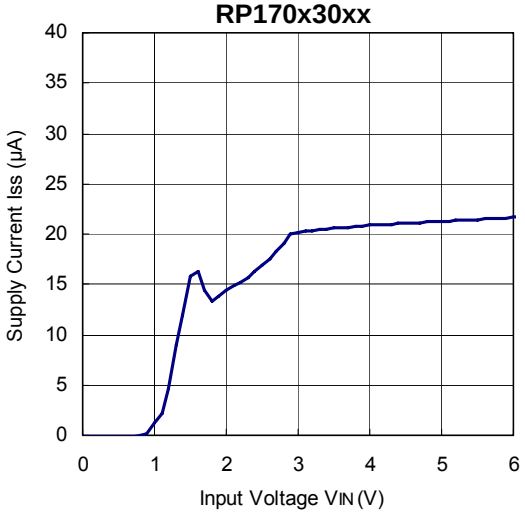

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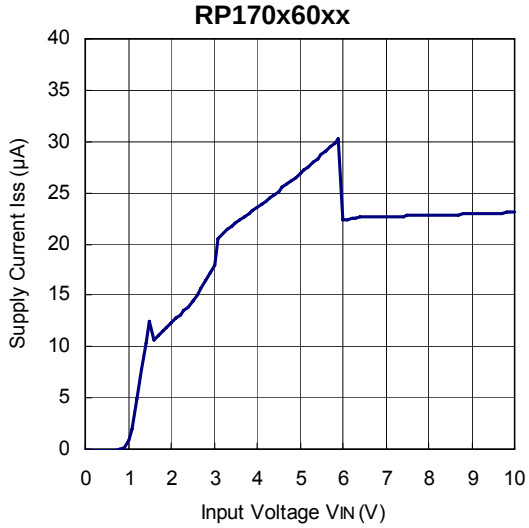
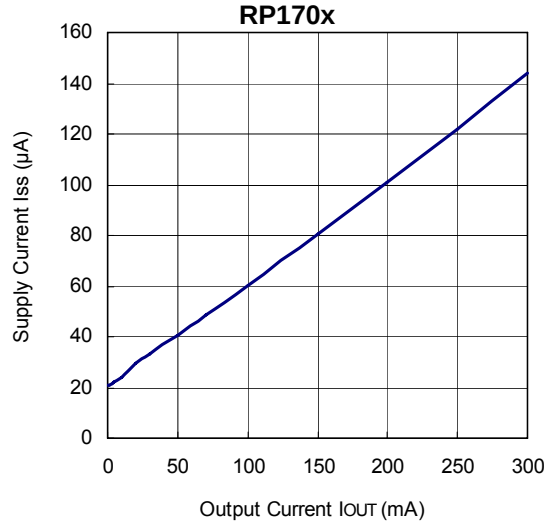
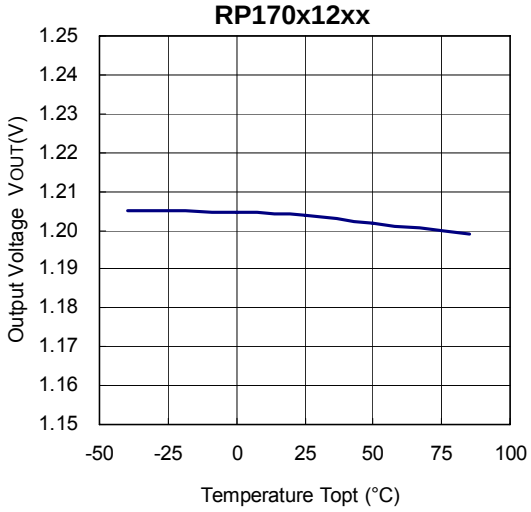
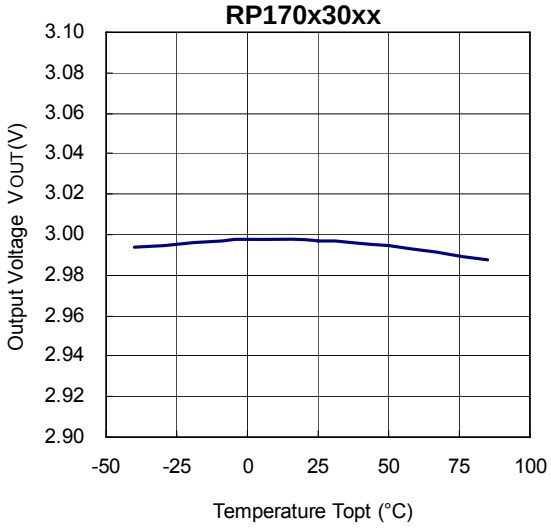


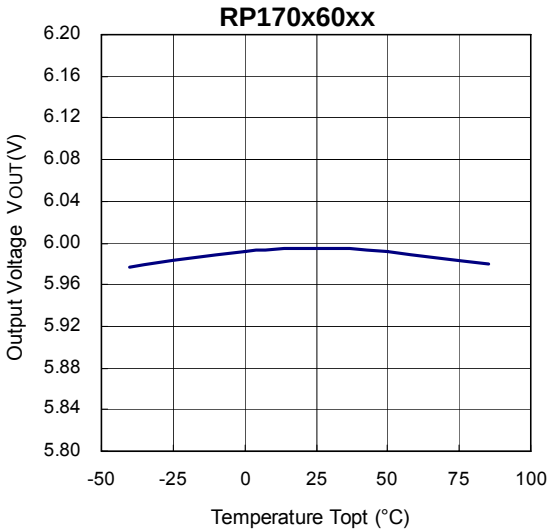
4) Supply Current vs. Output Current (T_{opt}=25°C)



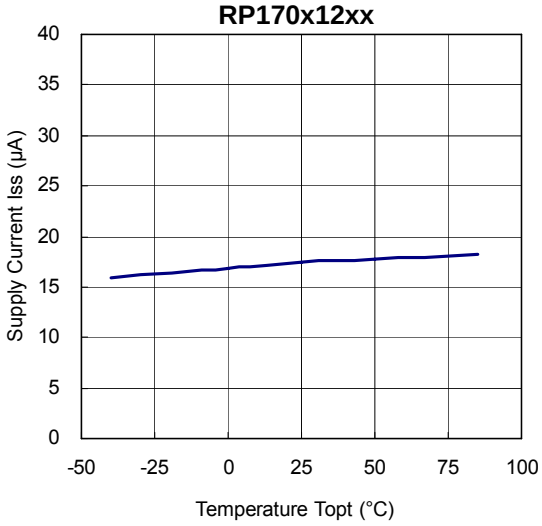
5) Output Voltage vs. Temperature

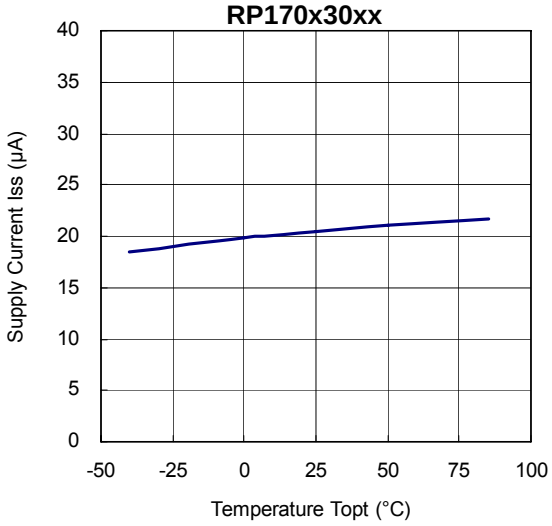


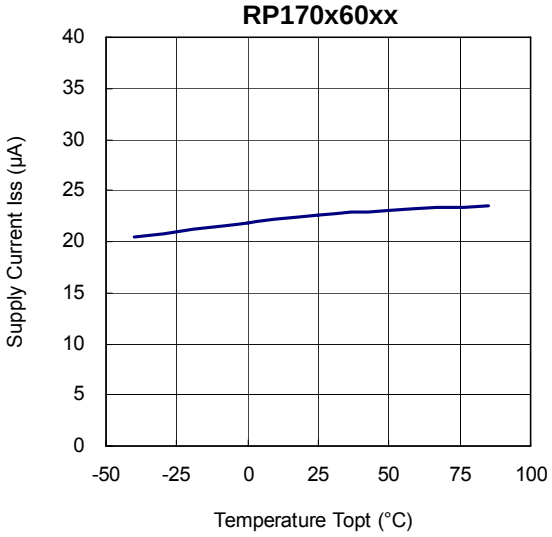




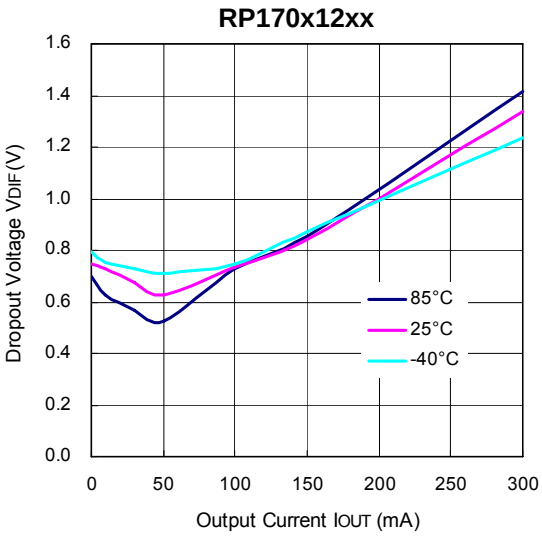
6) Supply Current vs. Temperature

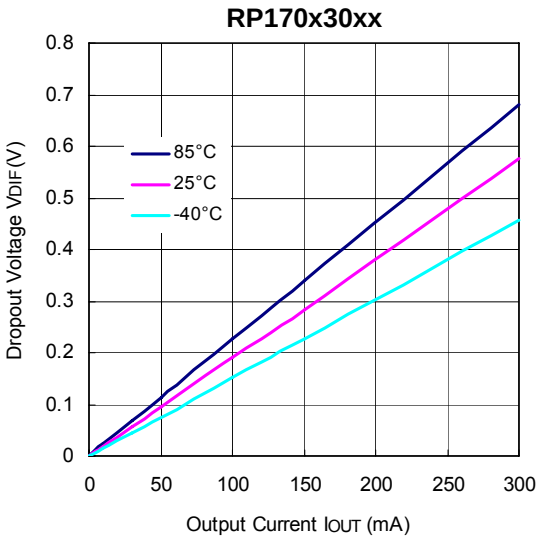


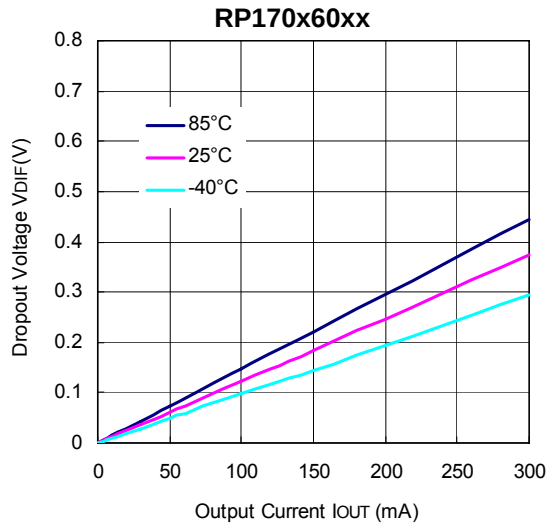




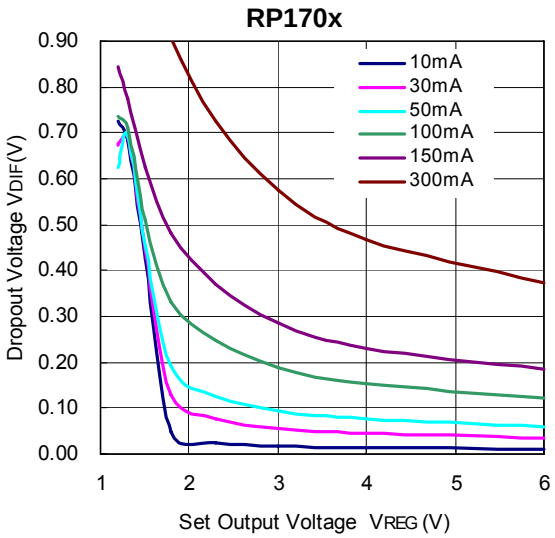
7) Dropout Voltage vs. Output Current



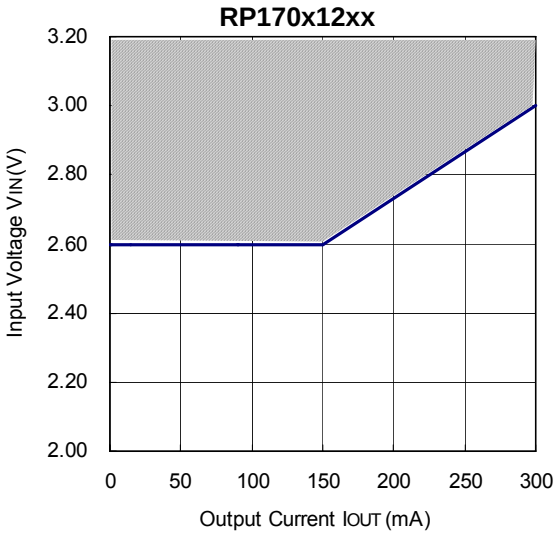




8) Dropout Voltage vs. Set Output Voltage (T_{opt}=25°C)

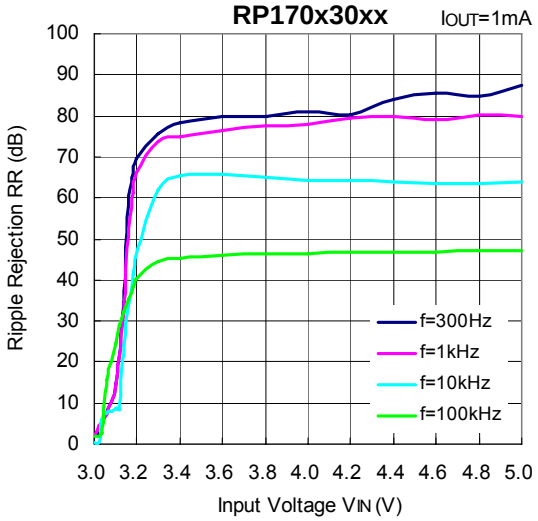


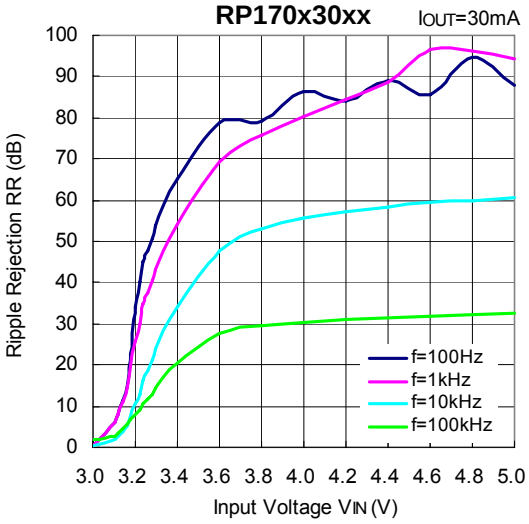
9) Minimum Operating Voltage

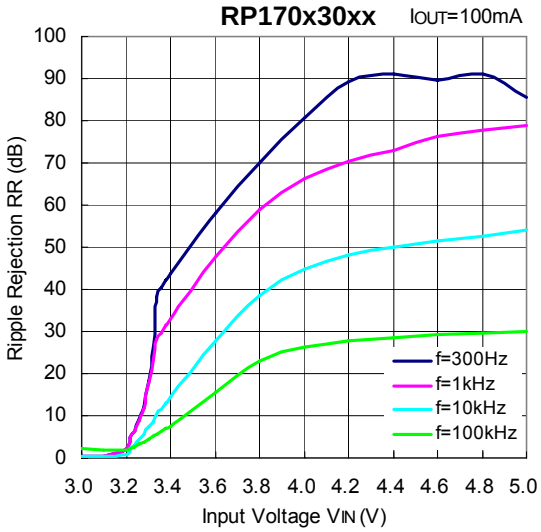


Hatched area is avaiable for 1.2V output

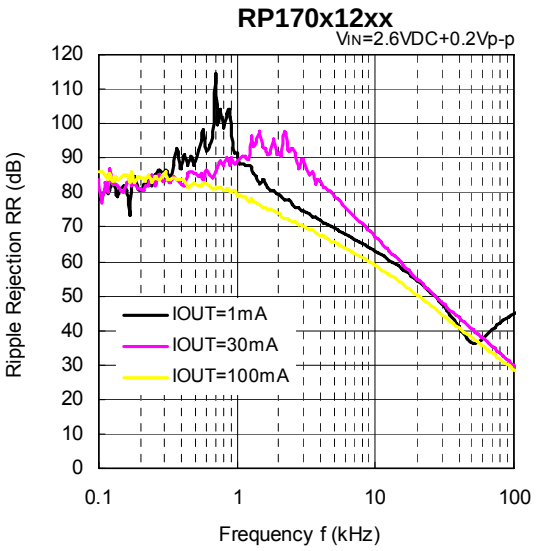
10) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=Ceramic 1.0µF, Ripple=0.2Vp-p, Topt=25°C)

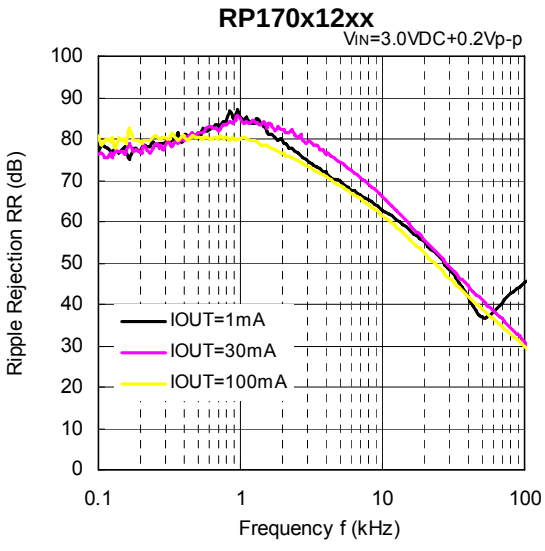






11) Ripple Rejection vs. Frequency (C1=none, C2=Ceramic 1.0µF, Topt=25°C)





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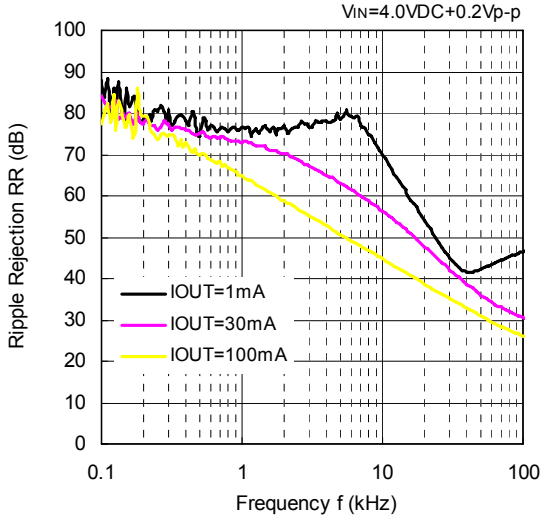

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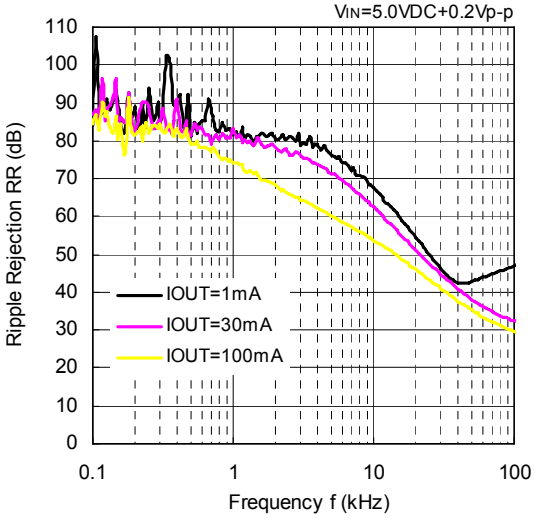

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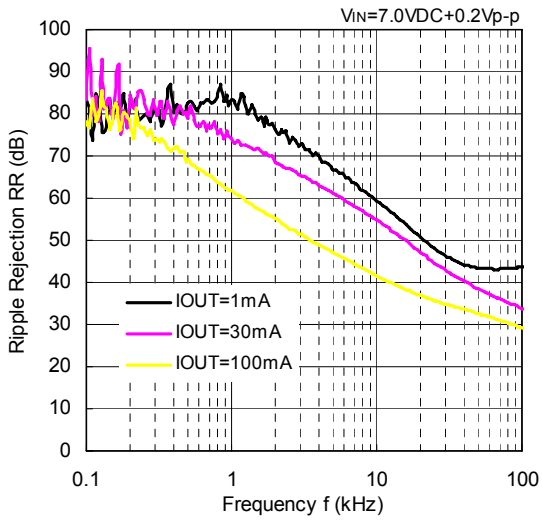
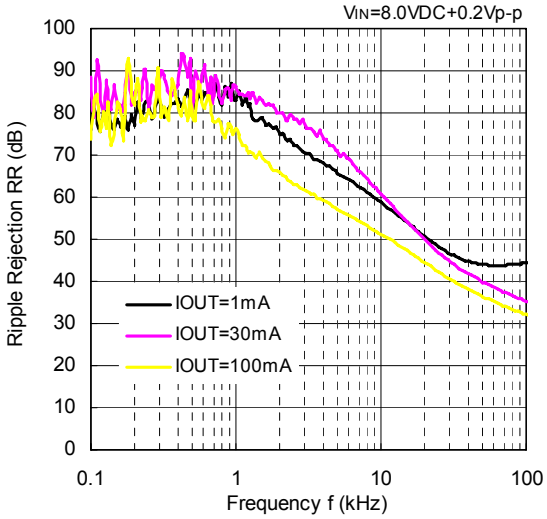
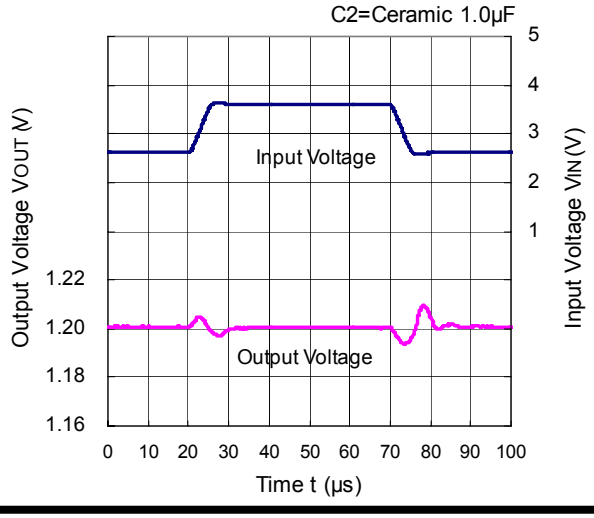


RP170x60xx



12) Input Transient Response (C1=none, I_{OUT}=30mA, tr=tf=5µs, T_{opt}=25°C)

RP170x12xx



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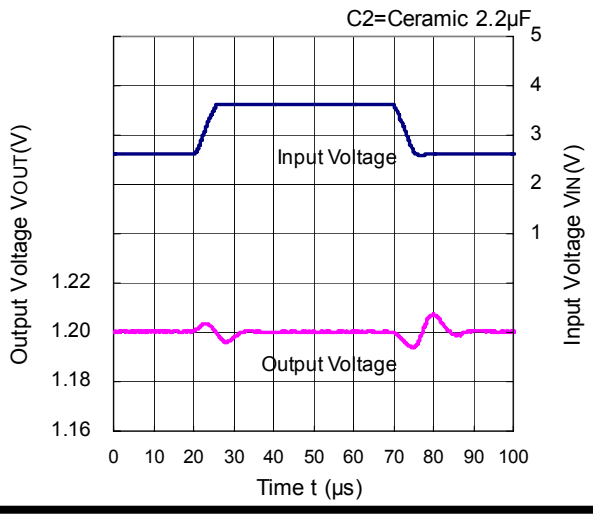
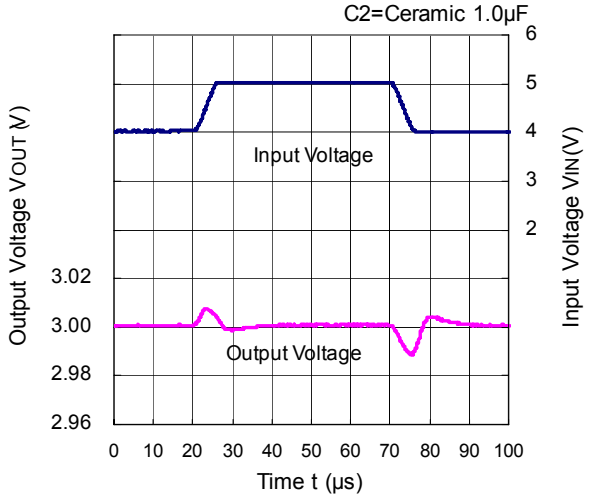


RP170x30xx



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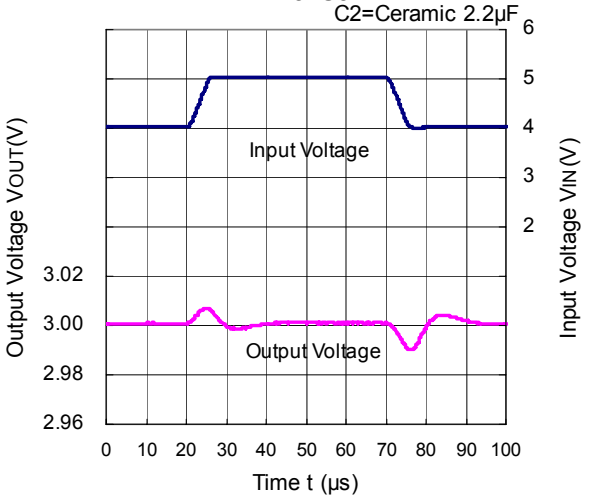

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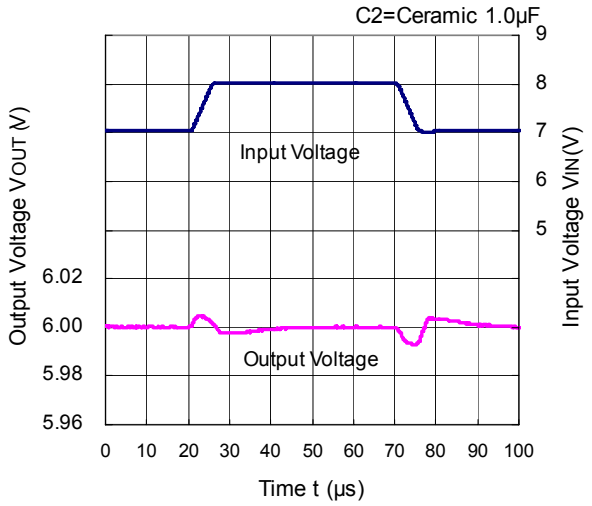

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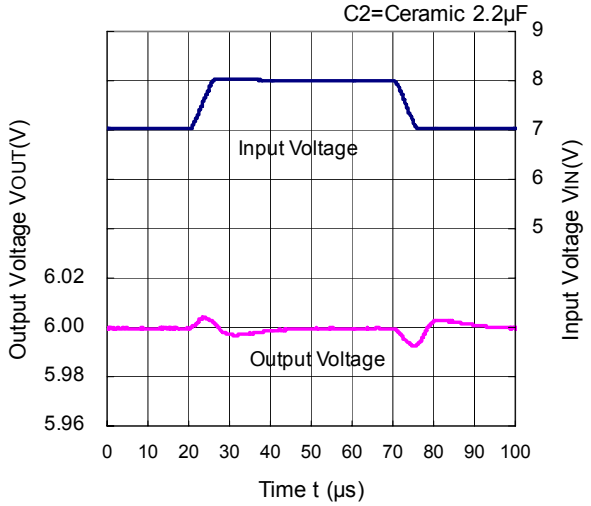
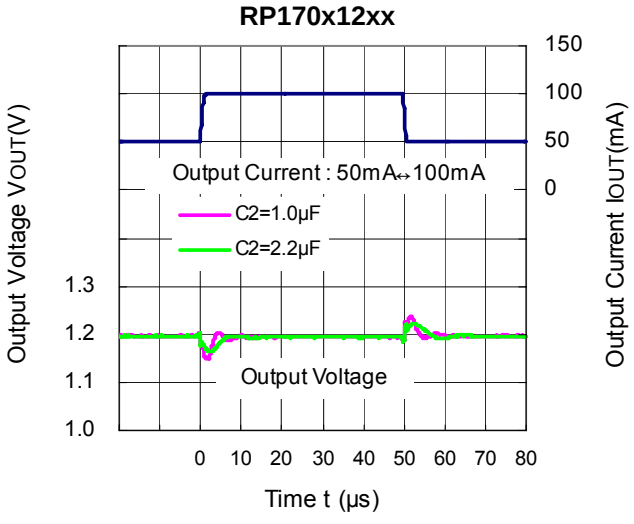


13) Load Transient Response (C1=Ceramic 1.0μF, tr=tf=500ns, Topt=25°C)

RP170x12xx



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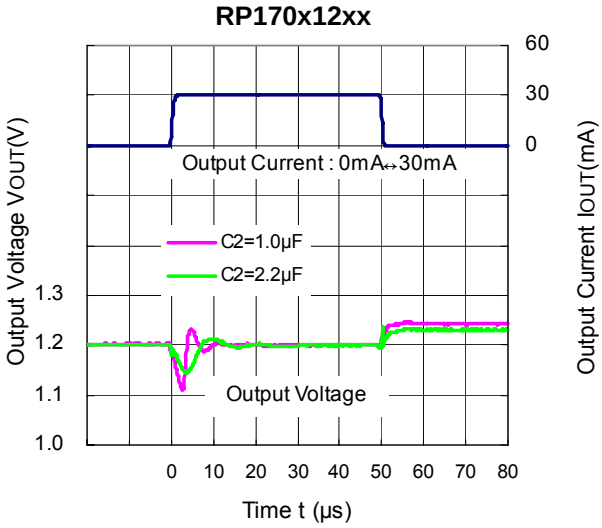

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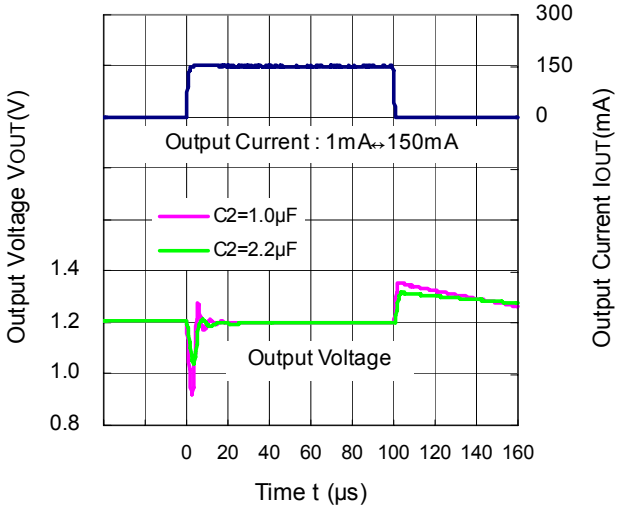

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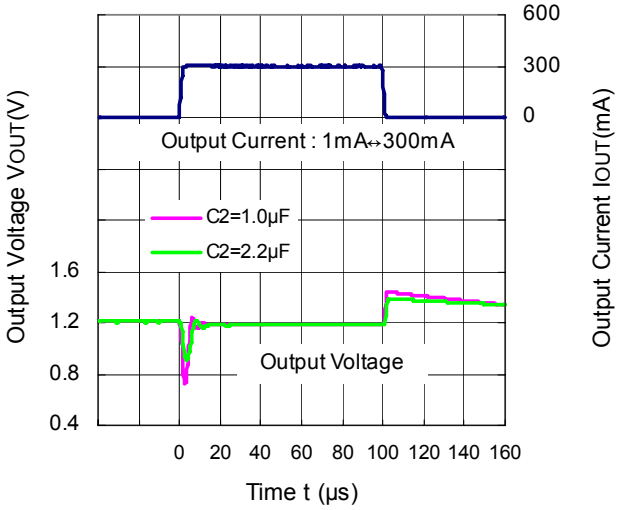

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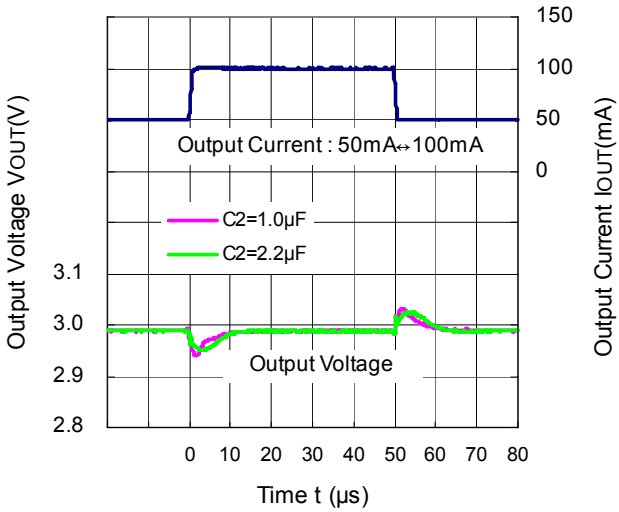

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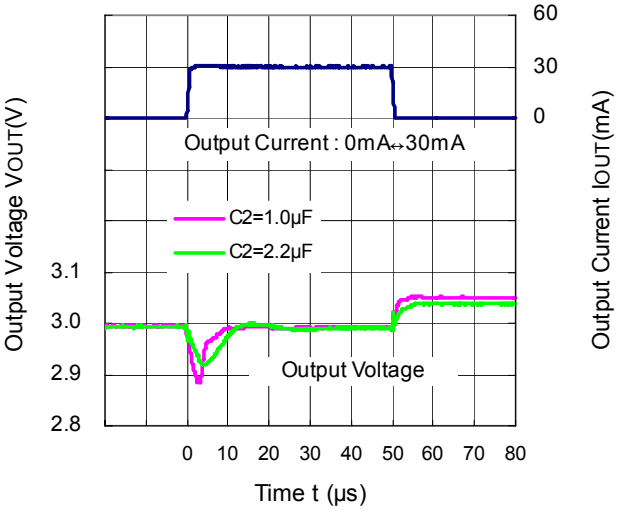

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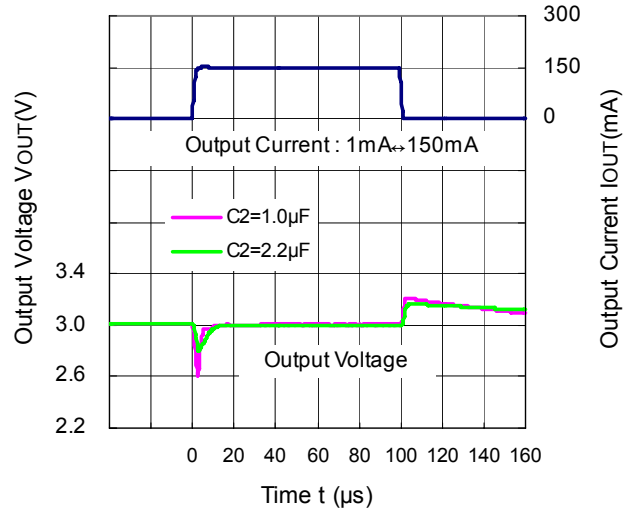

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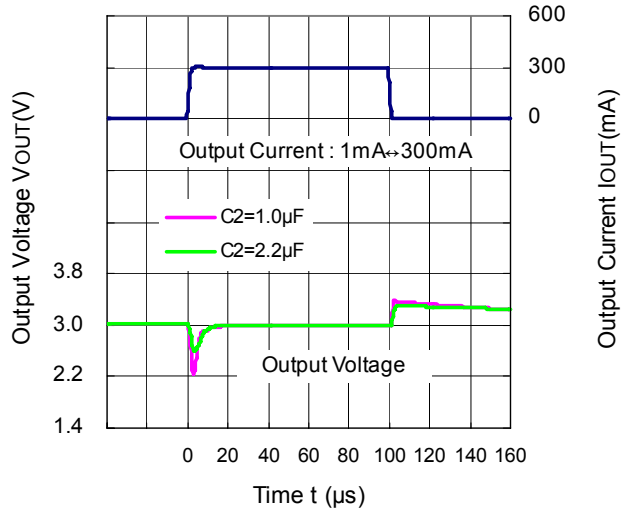

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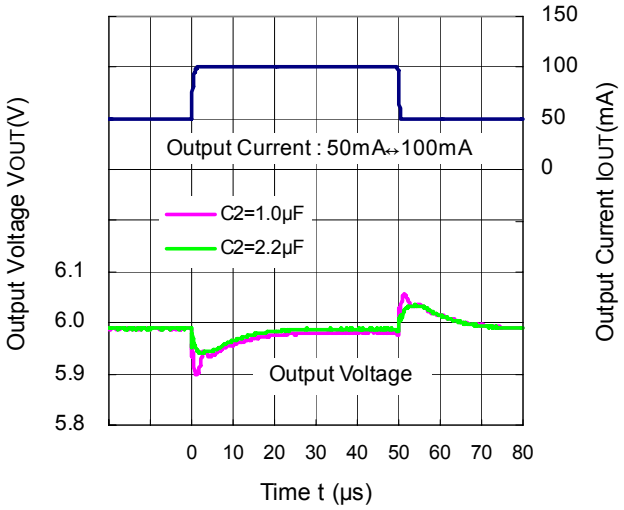

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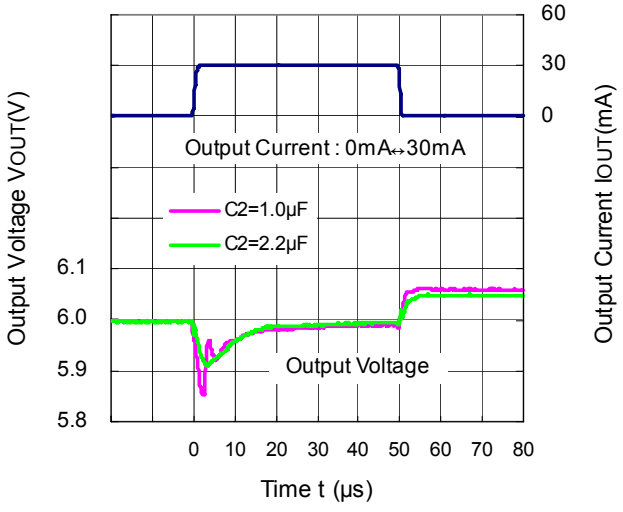

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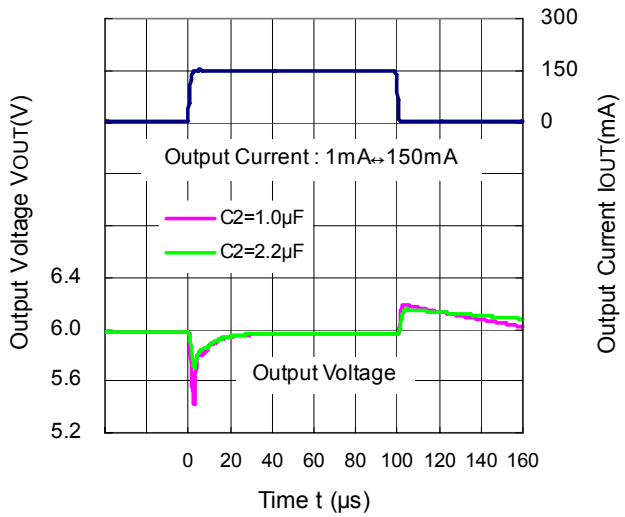

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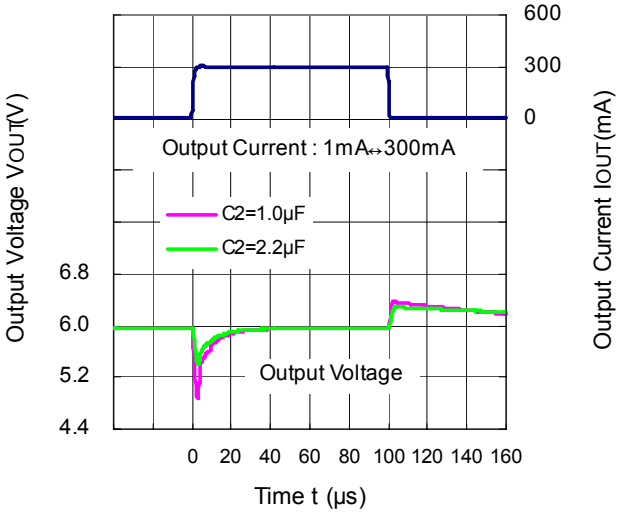
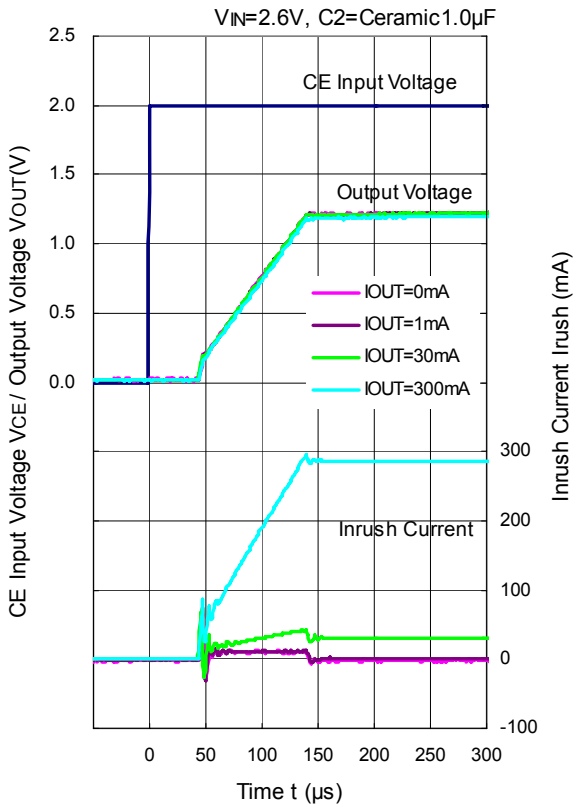


14) Turn On Speed with CE pin (C1=Ceramic 1.0µF, Topt=25°C)

RP170x12xx



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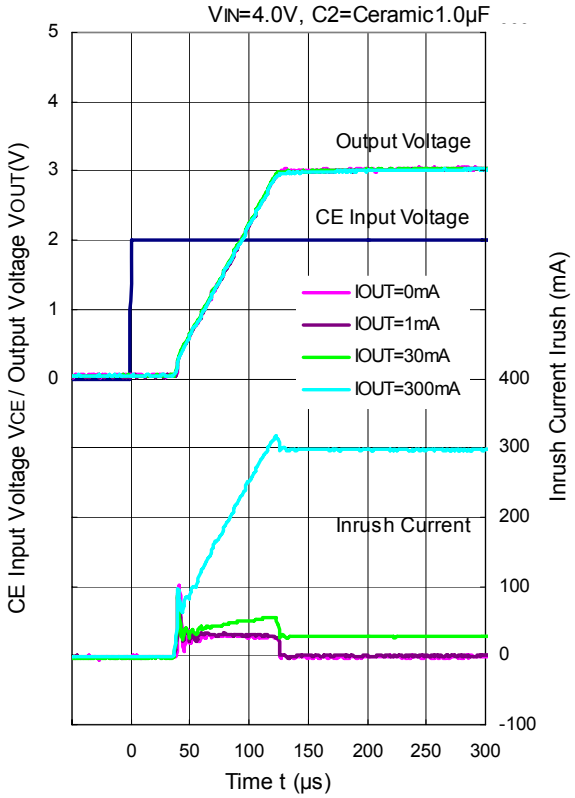

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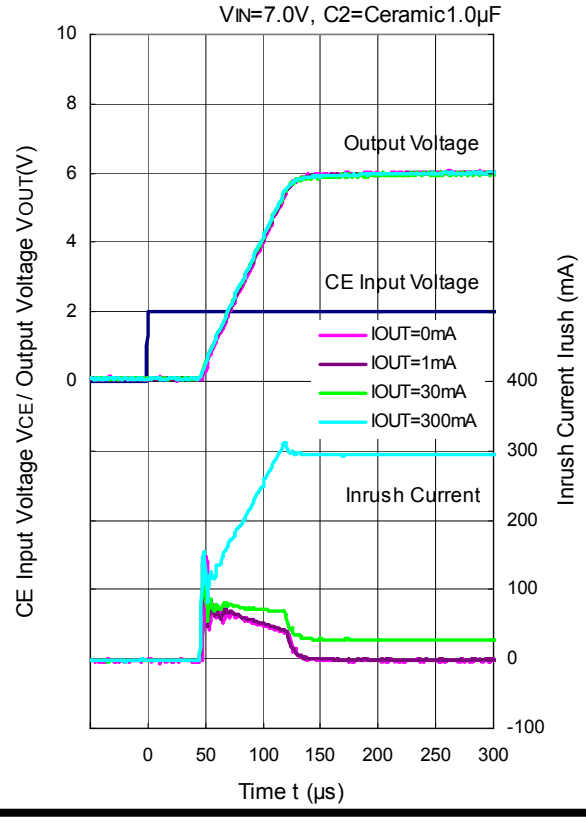

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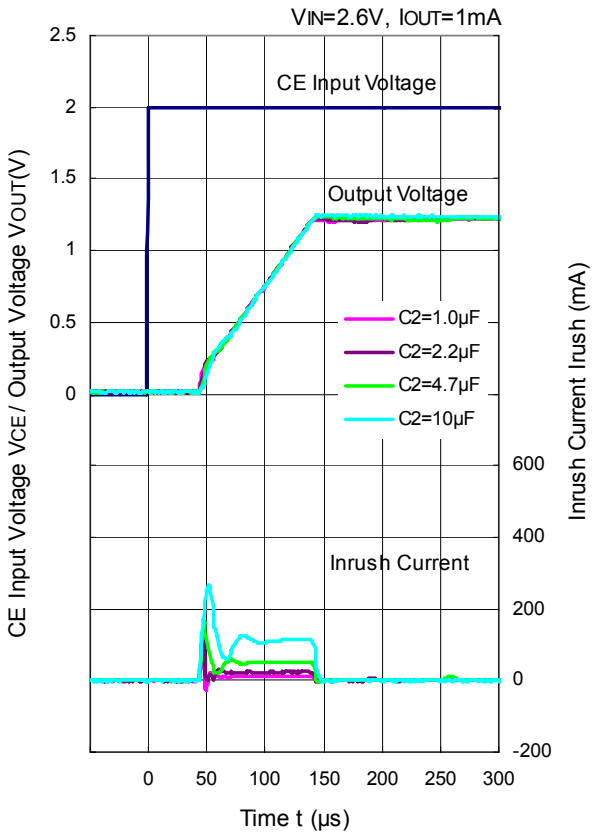
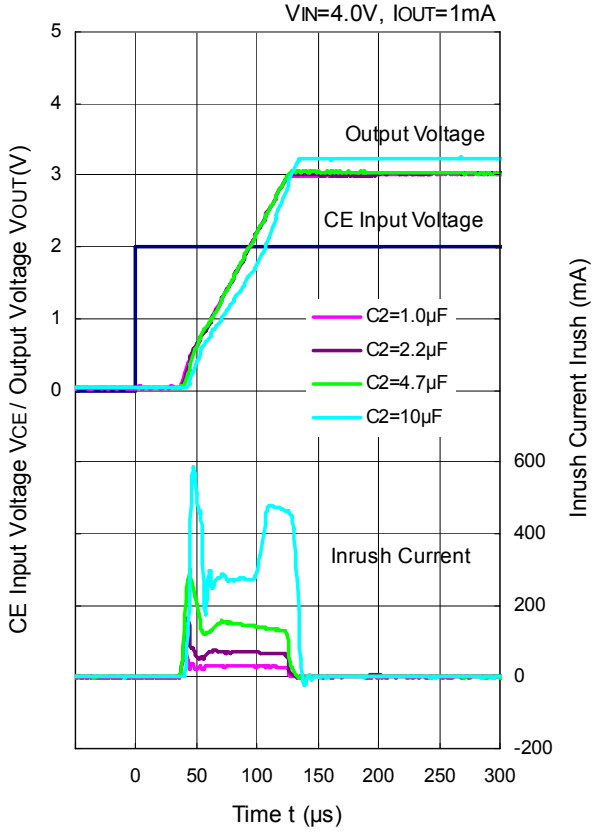


RP170x30xx



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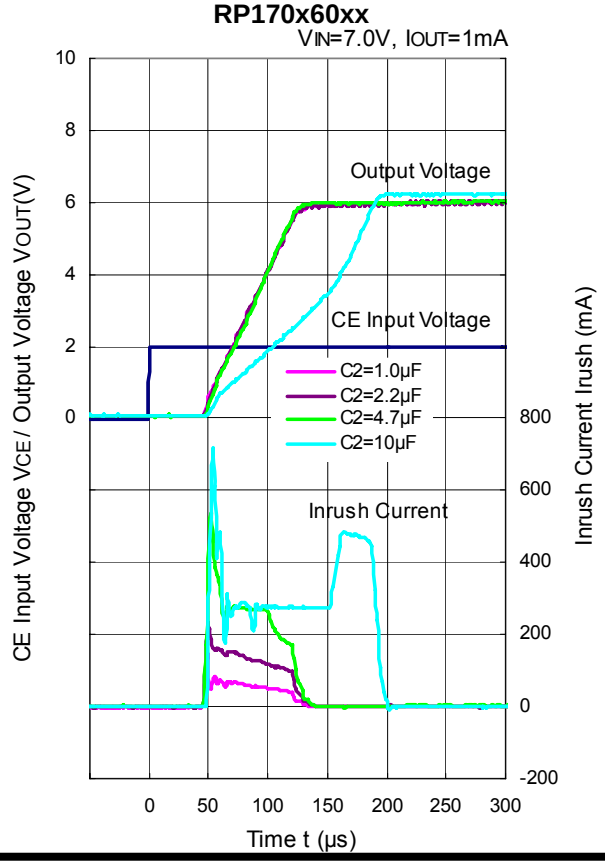
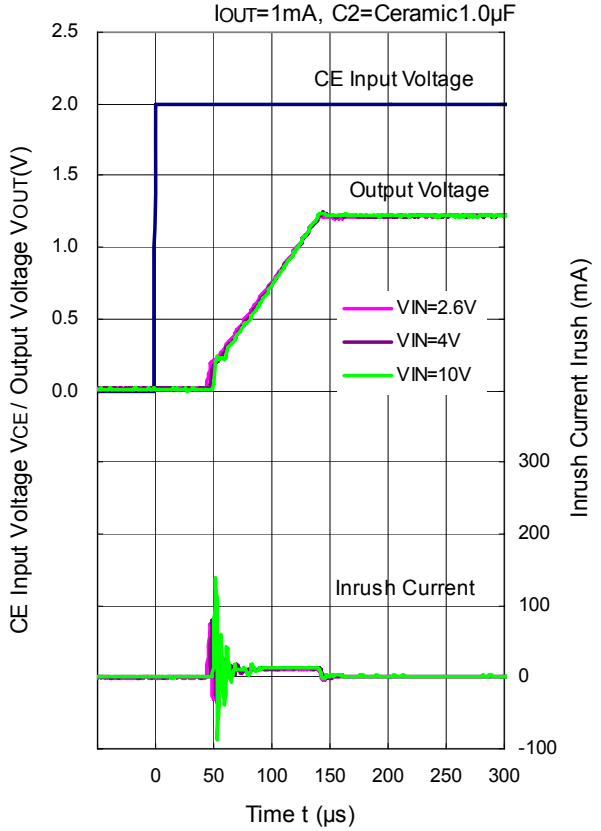


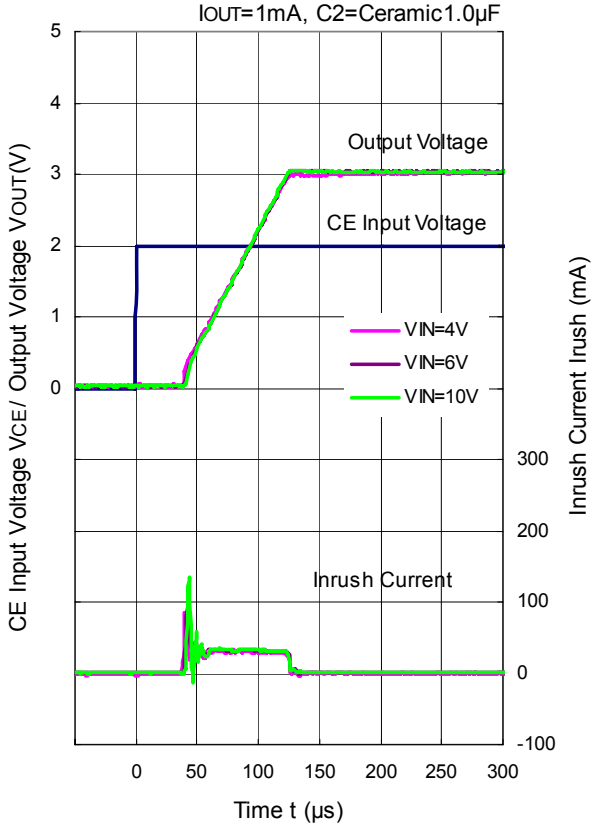
RP170x12xx

I_{OUT}=1mA, C2=Ceramic1.0μF



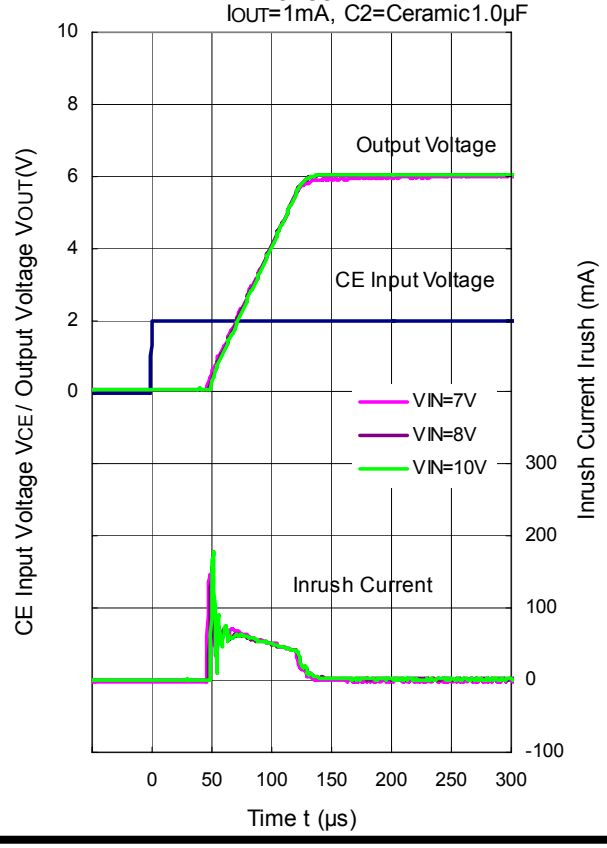
RP170x30xx

I_{OUT}=1mA, C2=Ceramic1.0μF



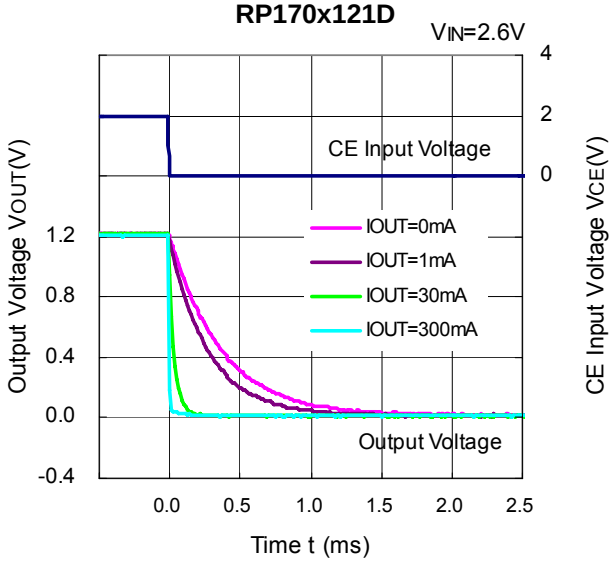
RP170x60xx

I_{OUT}=1mA, C2=Ceramic1.0μF

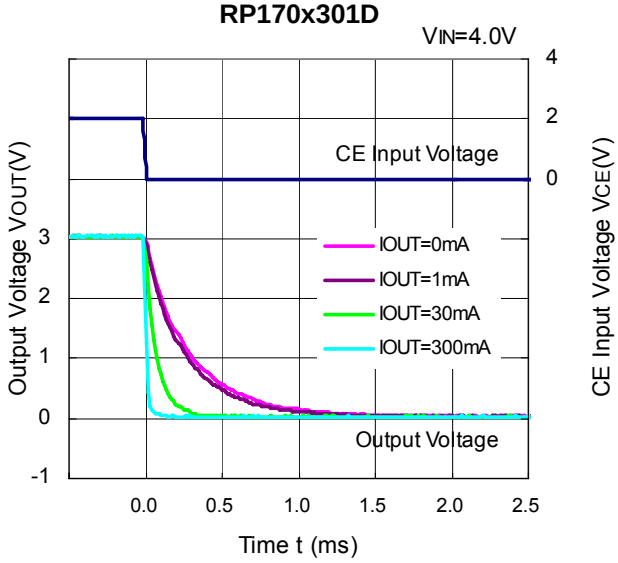


15) Turn Off Speed with CE pin (D Version) (C1=Ceramic 1.0μF, Topt=25°C)

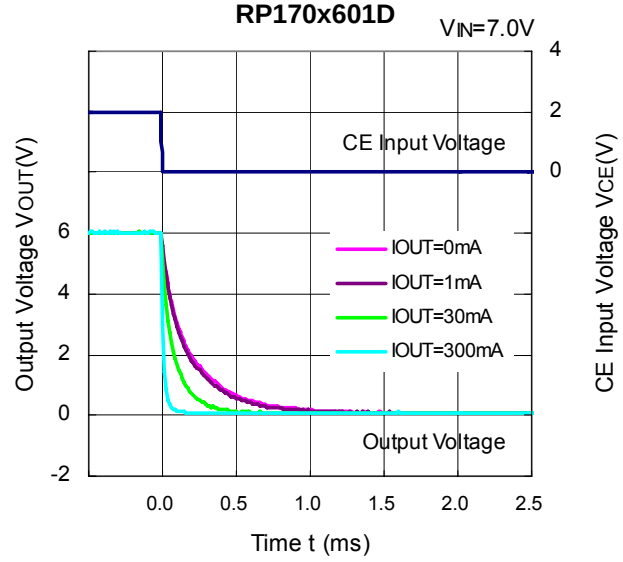
RP170x121D



RP170x301D



RP170x601D



ESR vs. Output Current

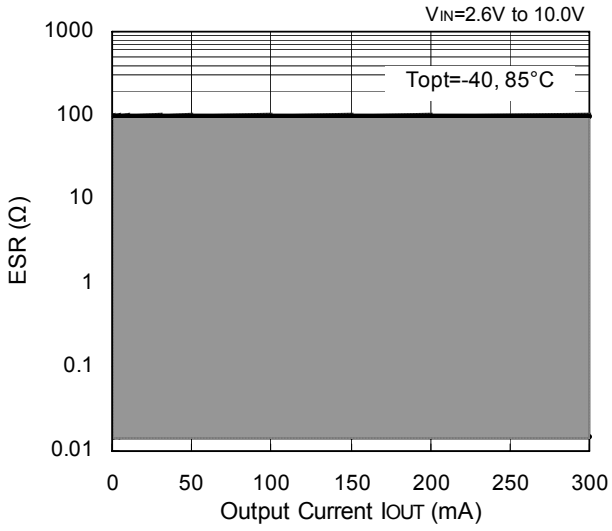
When using these ICs, consider the following points:

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.

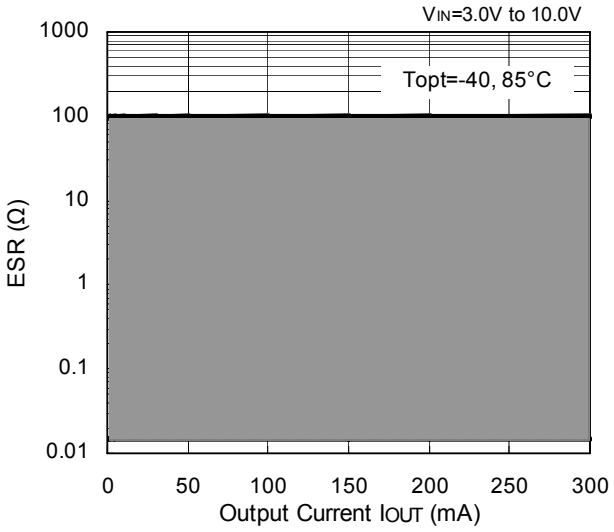
Measurement conditions

Frequency Band : 10Hz to 2MHz
Temperature : −40°C to 85°C
C1, C2 : Ceramic 1.0μF (Murata GRM155B31A105KE)

RP170x12xx



RP170x30xx



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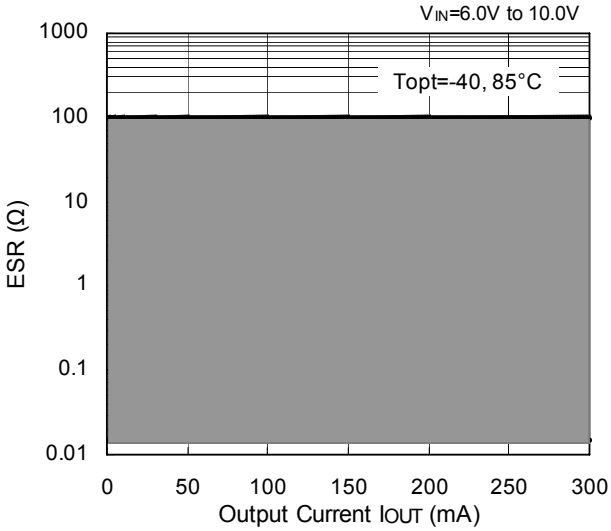

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The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our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

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