300mA LDO REGULATOR

NO. EA-236-091020

OUTLINE

The RP114x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, low supply current, low dropout, and high ripple rejection. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a short current limit circuit, a chip enable circuit, and so on.

RP114x features a minimum input voltage from 1.4V and the output voltage, which can be set from 0.8V to 3.6V (in 0.1V step). The output voltage of these ICs is internally fixed.

These ICs perform with low dropout voltage due to built-in transistor with low ON resistance. Low supply current and a chip enable function prolong the battery life of each system. The ripple rejection, line transient response and load transient response of the RP114x Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

Since the packages for these ICs are DFN(PLP)1010-4, SC-88A, SOT-23-5, therefore high density mounting of the ICs on boards is possible.

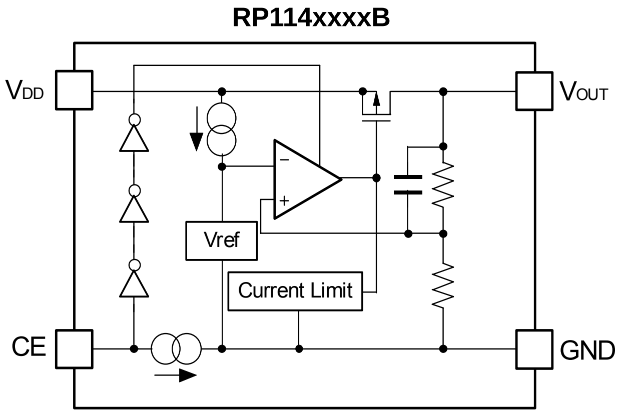
FEATURES

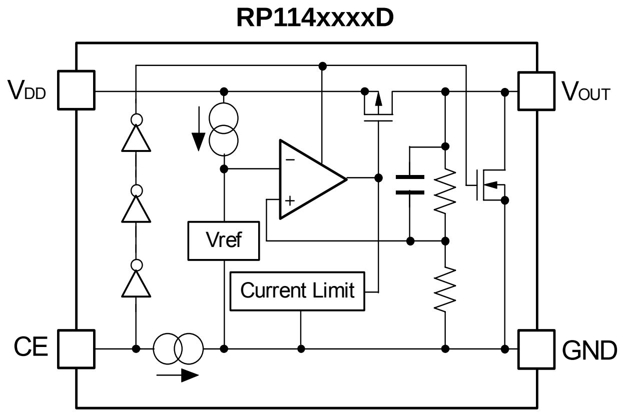
- Supply Current .... Typ. 50μA
- Standby Current .... Typ. 0.1μA
- Input Voltage Range.. 1.4V to 5.25V
- Output Voltage Range... 0.8V to 3.6V
- Output Voltage Accuracy.. ±1.0% (V_{OUT}>2.0V, T_{opt}=25°C)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±80ppm/°C
- Dropout Voltage.. Typ. 0.25V (I_{OUT}=300mA, V_{OUT}=2.8V)
- Ripple Rejection .... Typ. 70dB (f=1kHz)
- Line Regulation .... Typ. 0.02%/V
- Packages .... DFN(PLP)1010-4, SC-88A, SOT-23-5
- Built-in Fold Back Protection Circuit...................................... Typ. 60mA (Current at short mode)
- 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.

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;

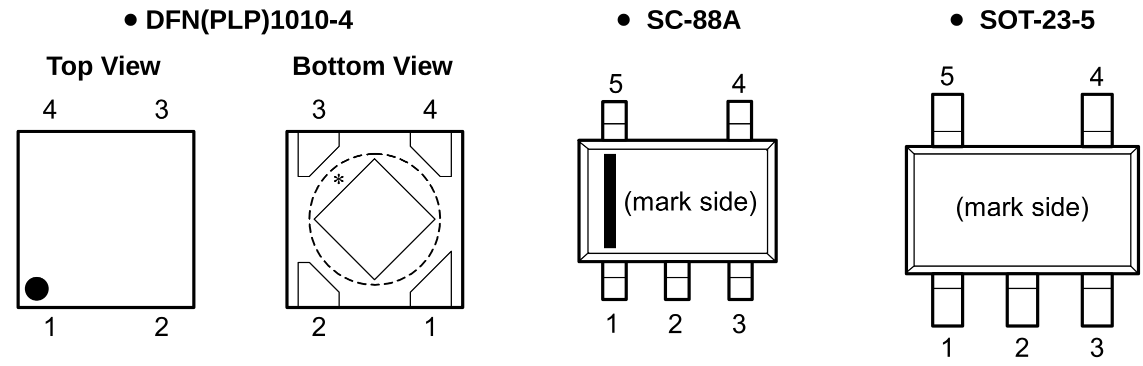
RP114xxxxx-xx-xx ←Part Number
↑ ↑ ↑↑ ↑ ↑
a b a'c d e

Code	Contents
a	Designation of Package Type: DFN(PLP)1010-4 : RP114Kxx1x-xx SC-88A : RP114Qxx2x-xx SOT-23-5 : RP114Nxx1x-xx
b	Setting Output Voltage (V_{OUT}): 0.8V to 3.6V (For Standard Voltage, please refer to MARK INFORMATIONS.)
c	Designation of Mask Option: B: without auto discharge function* at OFF state. D: with auto discharge function* at OFF state
d	Designation of Taping Type: TR (Refer to Taping Specifications; TR type is the standard direction.)
e	Designation of composition of pin plating: -FE : Pure Sn solder plating (Halogen free) (SC-88A, SOT-23-5) None: Au plating (Halogen free) (DFN(PLP)1010-4)

*) 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.

RICOH

PIN CONFIGURATIONS



PIN DESCRIPTIONS

- **DFN(PLP)1010-4**

Pin No	Symbol	Pin 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	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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	V
V_{CE}	Input Voltage (CE Pin)	–0.3 to 6.0	V
V_{OUT1}, V_{OUT2}	Output Voltage	–0.3 to V_{IN}+0.3	V
I_{OUT1}, I_{OUT2}	Output Current	400	mA
P_D	Power Dissipation (DFN(PLP)1010-4)*	400	mW
	Power Dissipation (SC-88A)*	380	
	Power Dissipation (SOT-23-5)*	420	
T_{opt}	Operating Temperature Range	–40 to 85	°C
T_{stg}	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

- **RP114x**

V_{IN}=Set V_{OUT}+1.0V (V_{OUT} > 1.5V), V_{IN}=2.5V ($V_{OUT} \leq$ 1.5V) , I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted.
The specification in $\boxed{}$ is checked and guaranteed by design engineering at –40°C ≤ Topt ≤ 85°C.

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{OUT} > 2.0V	×0.99		×1.01	V
			$V_{OUT} \leq$ 2.0V	–20		+20	mV
		–40°C ≤ Topt ≤ 85°C	V_{OUT} > 2.0V	$\boxed{\times 0.97}$		$\boxed{\times 1.03}$	V
			$V_{OUT} \leq$ 2.0V	$\boxed{-60}$		$\boxed{+60}$	mV
I_{OUT}	Output Current			$\boxed{300}$			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 300mA			15	$\boxed{40}$	mV
V_{DIF}	Dropout Voltage	Refer to the following table.					
I_{SS}	Supply Current	I_{OUT}=0mA			50	$\boxed{75}$	μA
$I_{standby}$	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			0.02	$\boxed{0.10}$	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V_{IN}=Set V_{OUT}+1V, I_{OUT}=30mA (In case that $V_{OUT} \leq$ 2.0V, V_{IN}=3V)			70		dB
V_{IN}	Input Voltage*			$\boxed{1.4}$		$\boxed{5.25}$	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	–40°C ≤ Topt ≤ 85°C			±80		ppm /°C
I_{lim}	Short Current Limit	V_{OUT}=0V			60		mA
I_{PD}	CE Pull-down Current				0.3		μA
V_{CEH}	CE Input Voltage "H"			$\boxed{1.0}$			V
V_{CEL}	CE Input Voltage "L"					$\boxed{0.4}$	V
en	Output Noise	BW=10Hz to 100kHz, I_{OUT}=30mA			75		μVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V_{IN}=4.0V, V_{CE}=0V			50		Ω

*) The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.
All of units are tested and specified under load conditions such that Tj≈Topt=25°C except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient.

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.

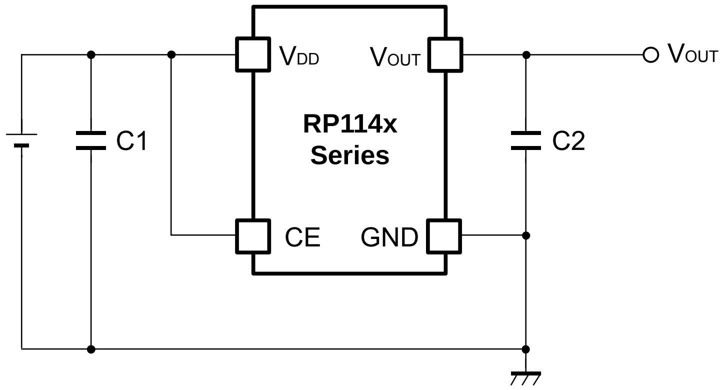
• Dropout Voltage by Output Voltage

Topt=25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
V_{OUT}=0.8	I_{OUT}=300mA	0.560	$\boxed{0.720}$
V_{OUT}=0.9		0.510	$\boxed{0.650}$
$1.0 \leq V_{OUT} < 1.2$		0.460	$\boxed{0.590}$
$1.2 \leq V_{OUT} < 1.4$		0.390	$\boxed{0.500}$
$1.4 \leq V_{OUT} < 1.7$		0.350	$\boxed{0.440}$
$1.7 \leq V_{OUT} < 2.1$		0.300	$\boxed{0.390}$
$2.1 \leq V_{OUT} < 2.5$		0.260	$\boxed{0.340}$
$2.5 \leq V_{OUT} < 3.0$		0.250	$\boxed{0.300}$
$3.0 \leq V_{OUT} \leq 3.6$		0.220	$\boxed{0.290}$

The specification in $\boxed{}$ is checked and guaranteed by design engineering at $-40°C \leq T_{opt} \leq 85°C$.

TYPICAL APPLICATIONS



(External Components)
C2 Ceramic 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).

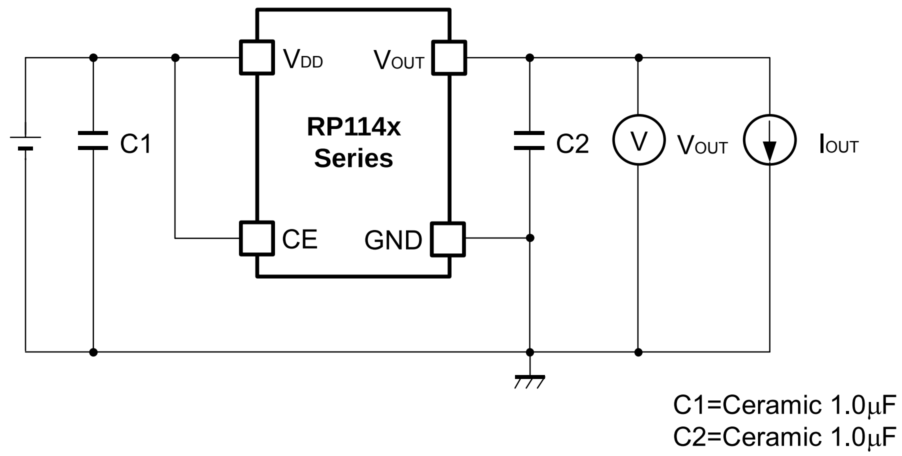
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

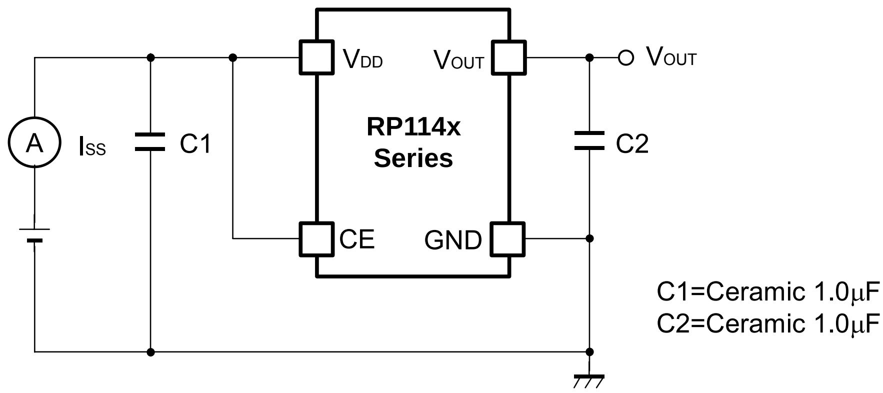
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0μF or more between V_{DD} and GND pin, and as close as possible to the pins.

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

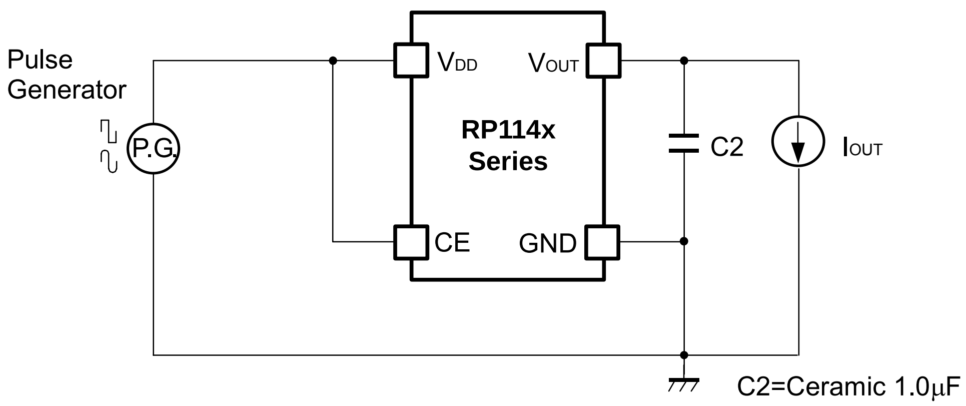
TEST CIRCUITS



Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

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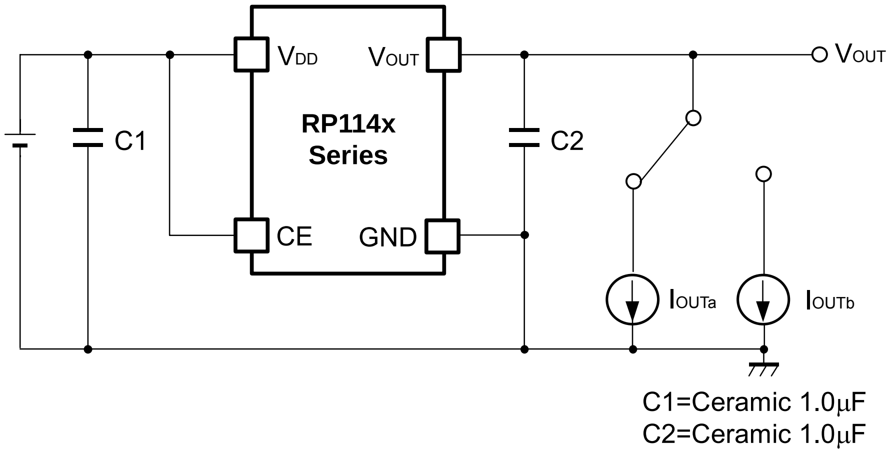
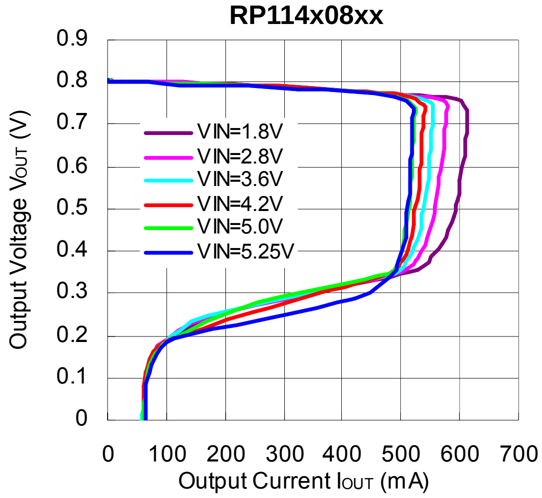
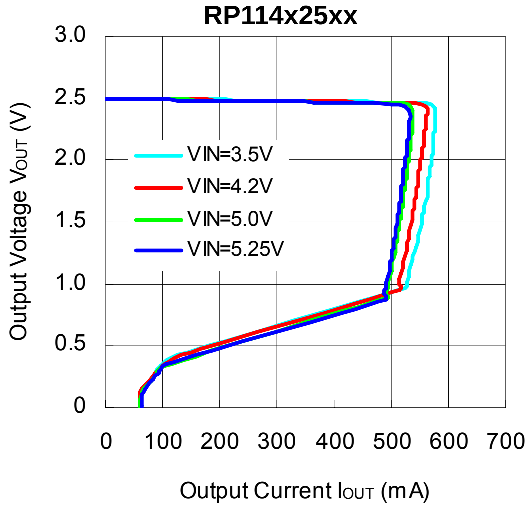


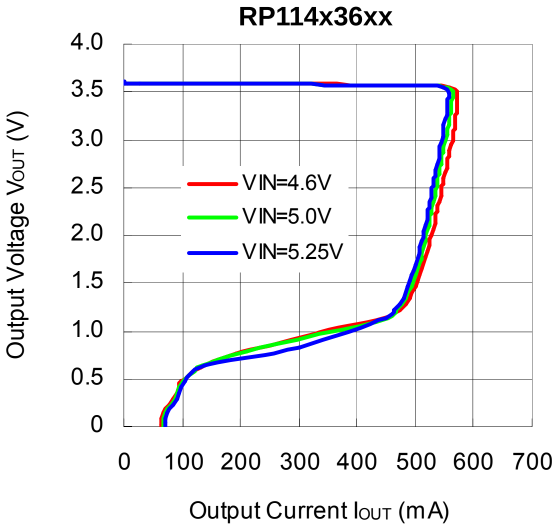
Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

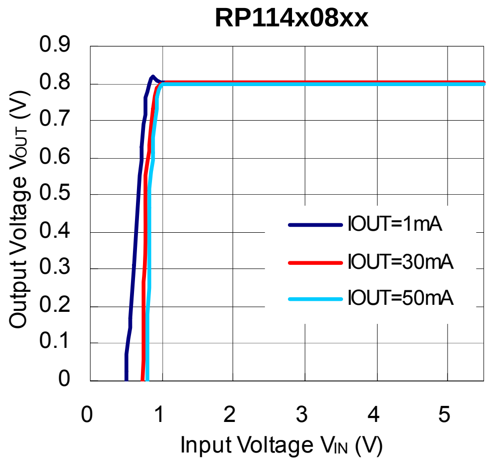
1) Output Voltage vs. Output Current (C1=1.0μF, C2=1.0μF, Topt=25°C)

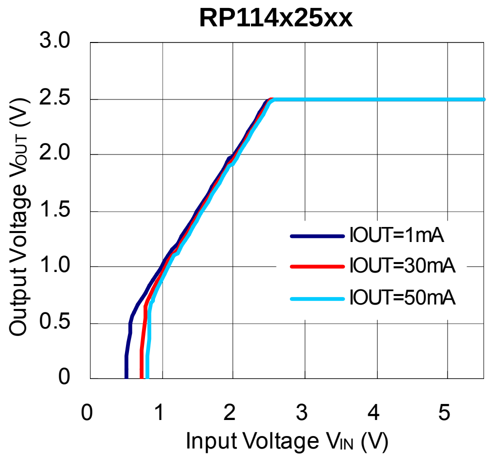


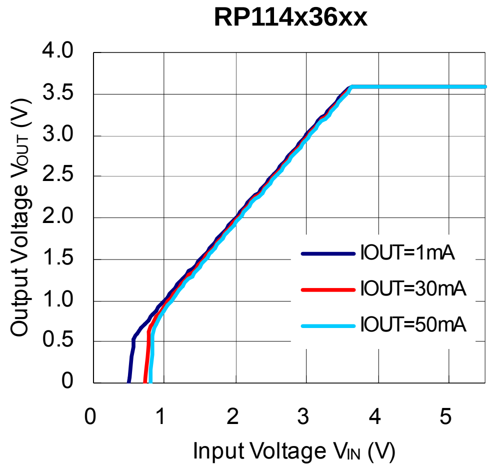




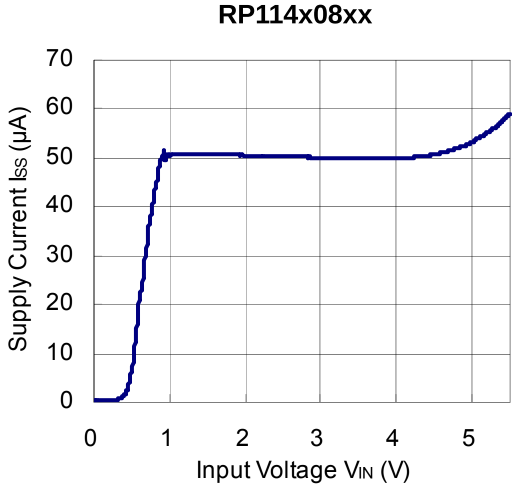
2) Output Voltage vs. Input Voltage (C1=1.0μF, C2=1.0μF, Topt=25°C)

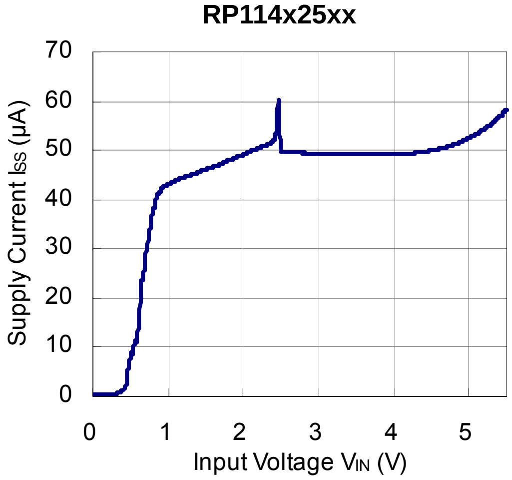


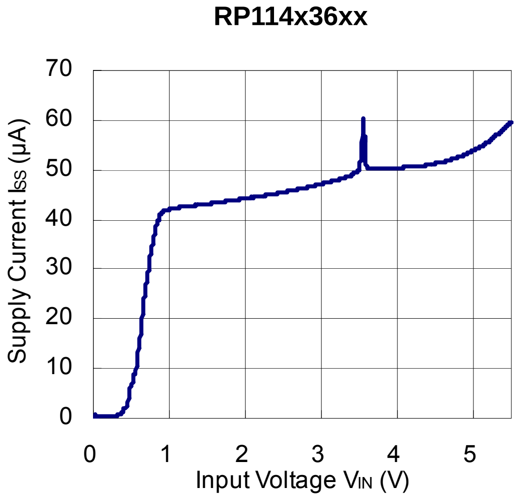




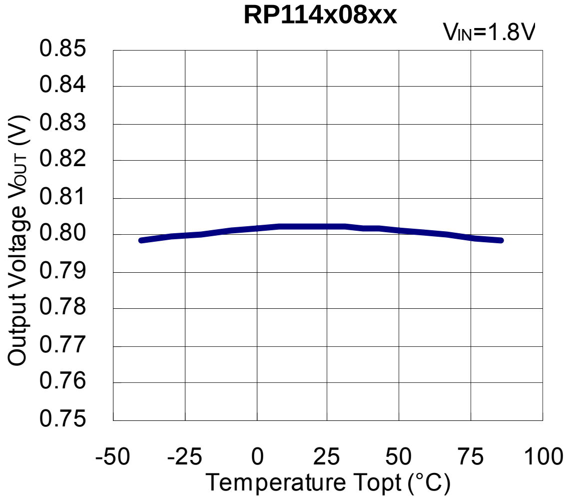
3) Supply Current vs. Input Voltage (C1=1.0µF, C2=1.0µF, Topt=25°C)

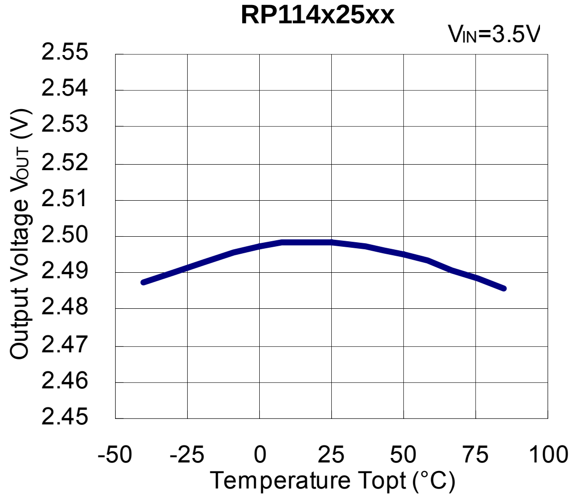


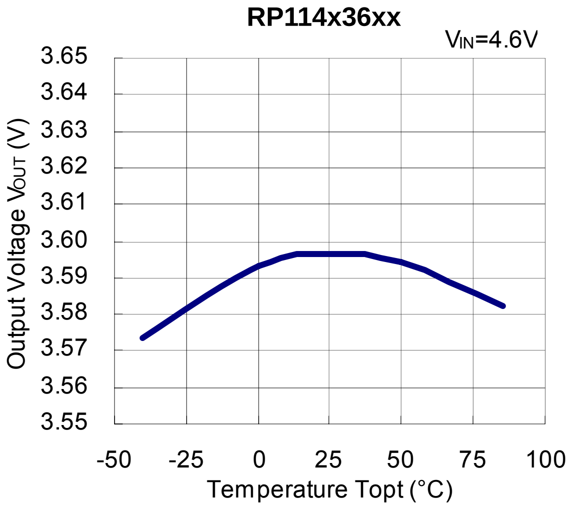




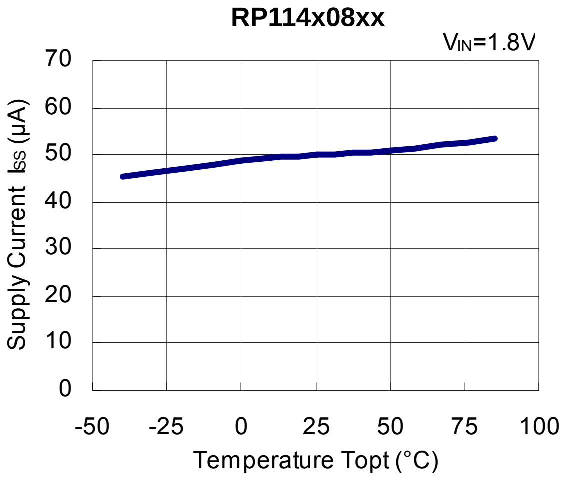
4) Output Voltage vs. Temperature (C1=1.0µF, C2=1.0µF, I_{OUT}=1mA)

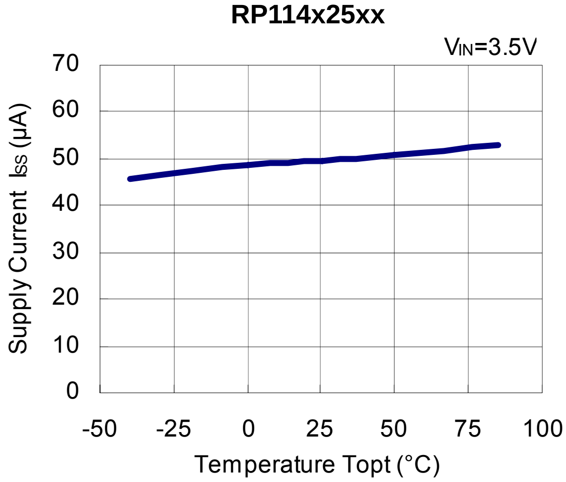


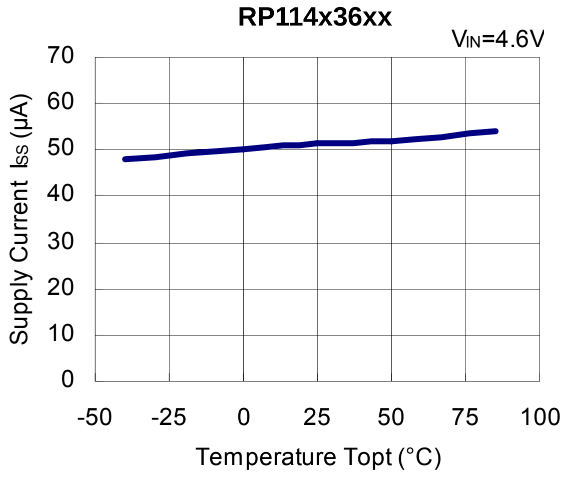




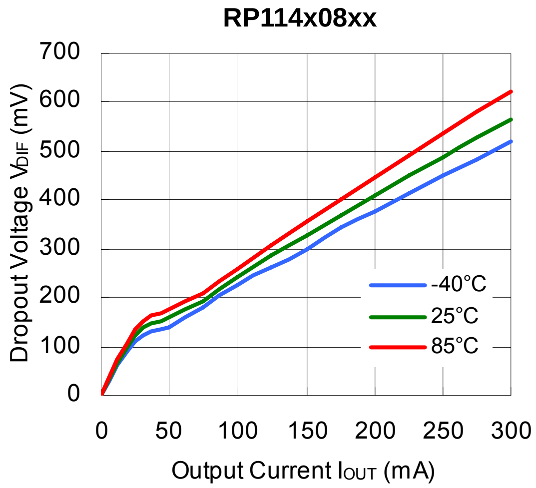
5) Supply Current vs. Temperature (C1=1.0µF, C2=1.0µF, I_{OUT}=0mA)

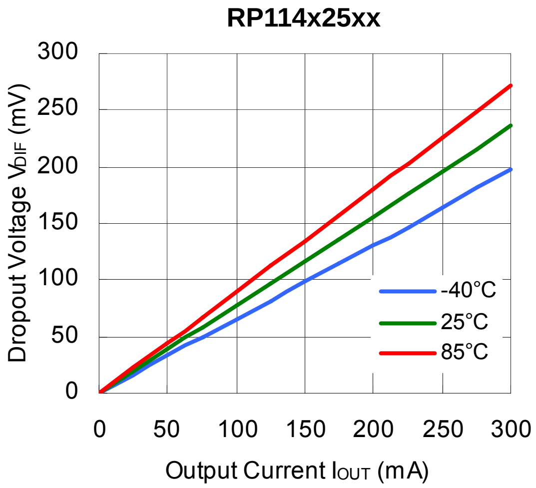


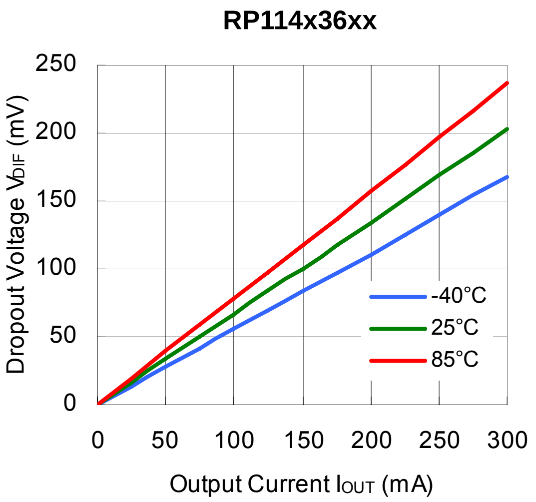




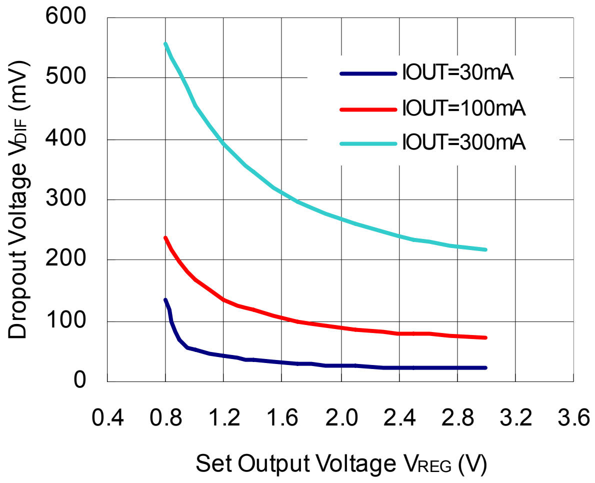
6) Dropout Voltage vs. Output Current (C1=1.0μF, C2=1.0μF)



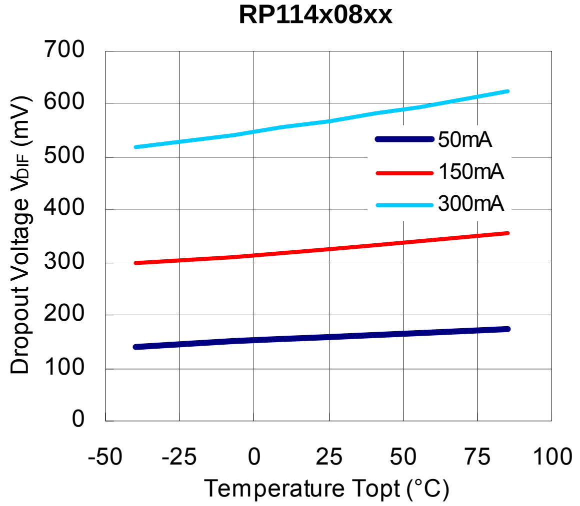


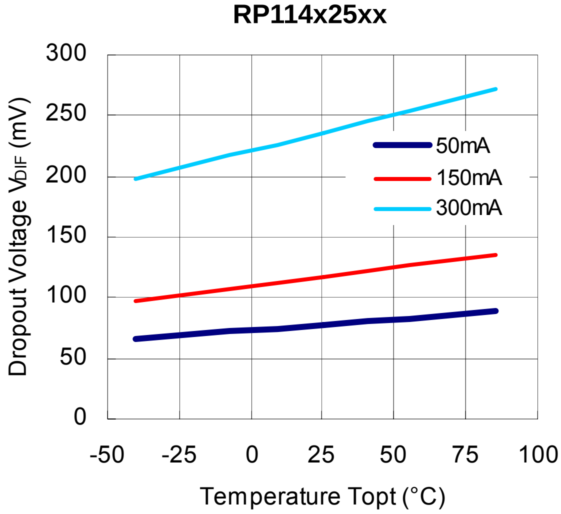


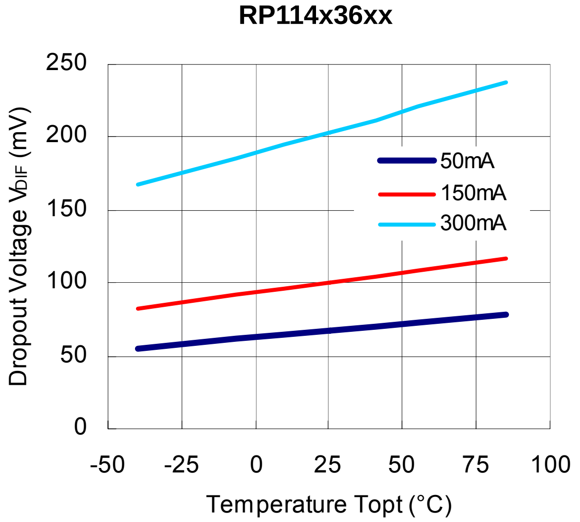
7) Dropout Voltage vs. Set Output Voltage (C1=1.0μF, C2=1.0μF, Topt=25°C)



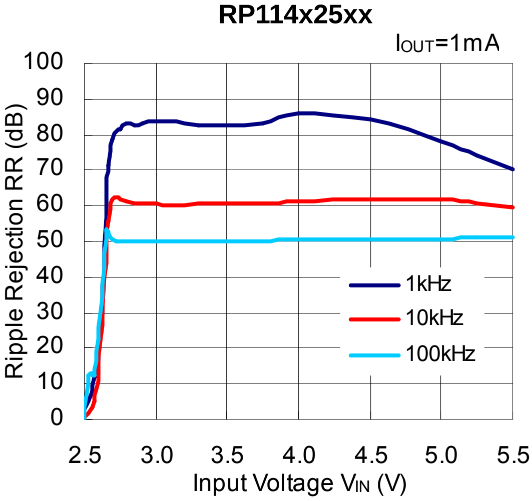
8) Dropout Voltage vs. Temperature (C1=none, C2=1.0μF)

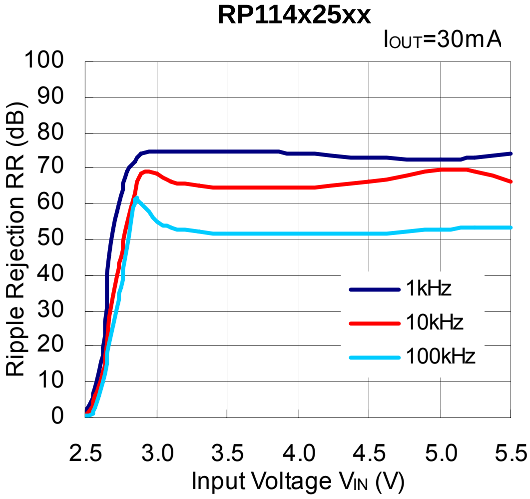




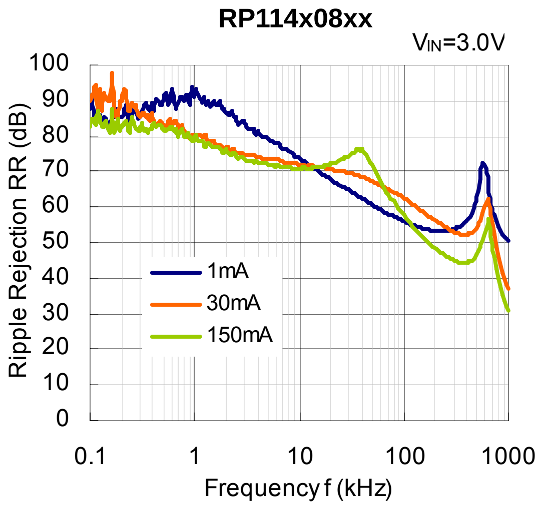


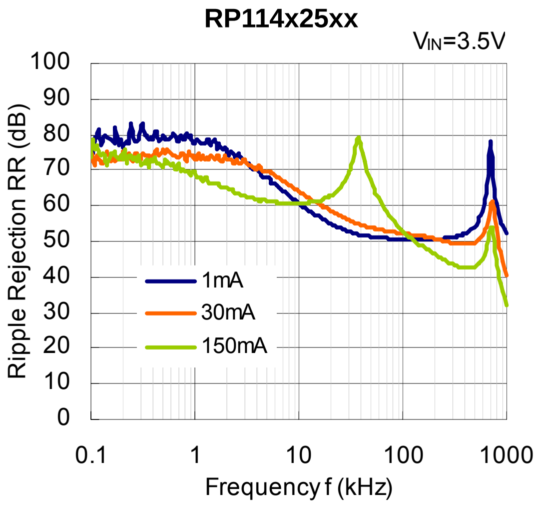
9) Ripple Rejection vs. Input Voltage (C1=none, C2=1.0µF, Ripple=0.2Vp-p, Topt=25°C)

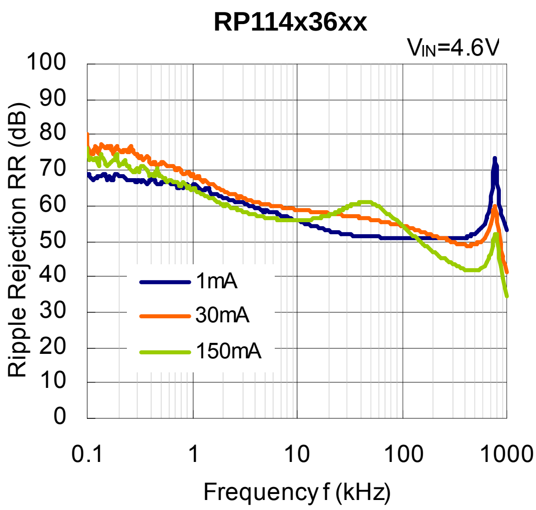




10) Ripple Rejection vs. Frequency (C1=none, C2=1.0µF, Topt=25°C)

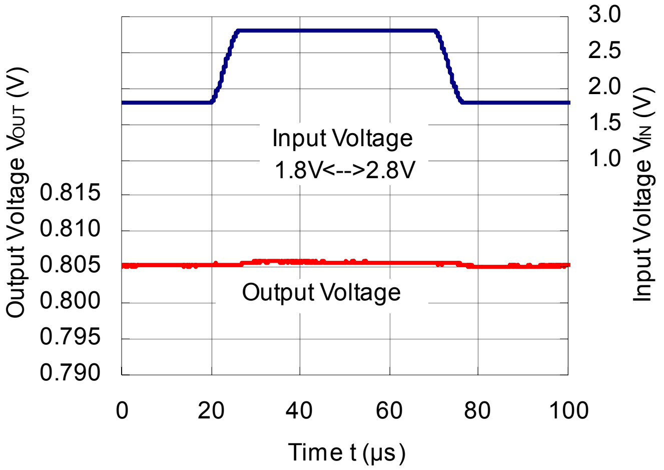




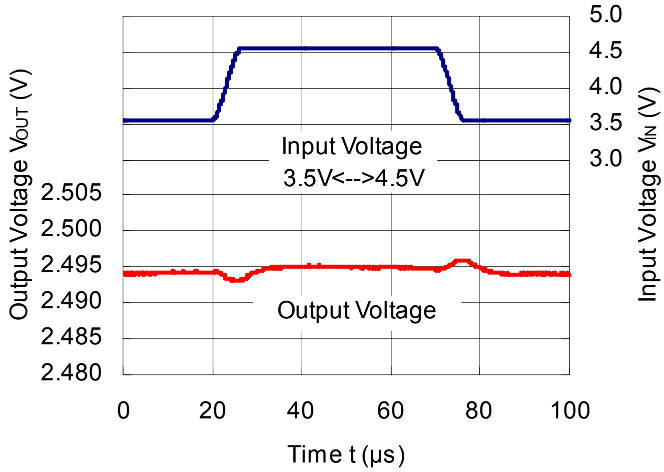


11) Input Transient Response (I_{OUT}=30mA, tr=tf=5μs, Topt=25°C)

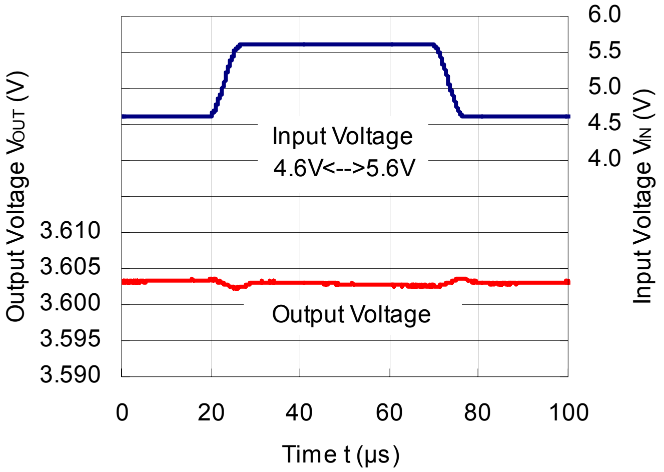
RP114x08xx



RP114x25xx

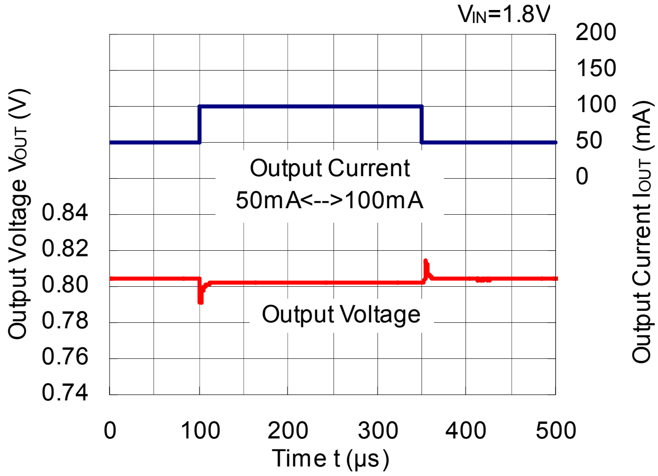


RP114x36xx

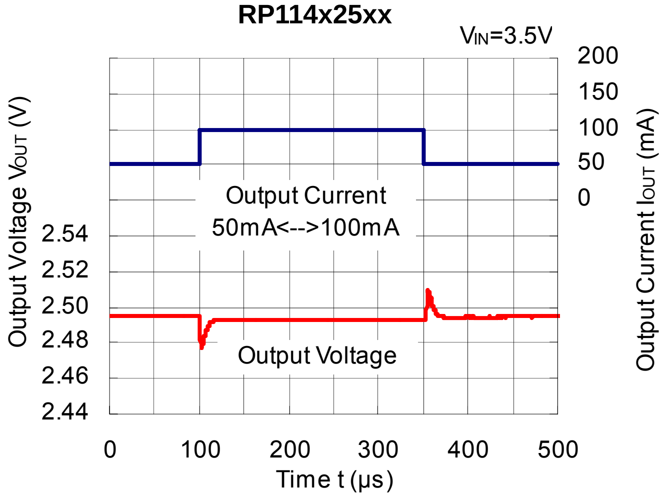


12) Load Transient Response (C1=1.0μF, C2=1.0μF, tr=tf=0.5μs, Topt=25°C)

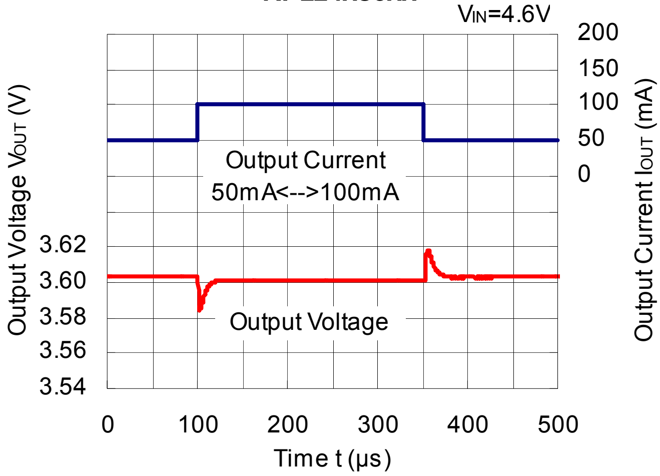
RP114x08xx



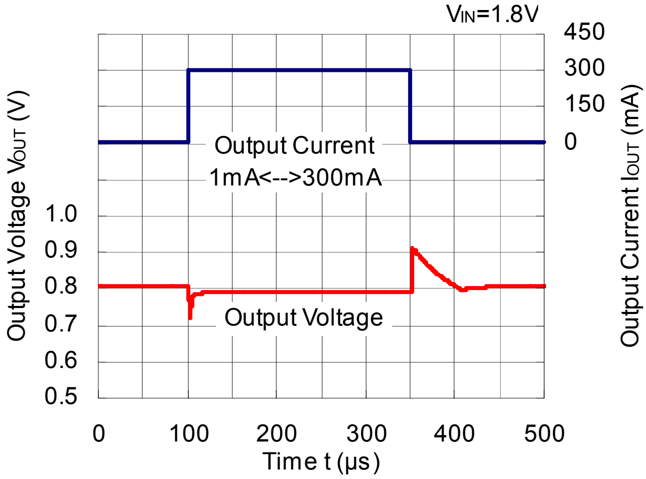
RP114x25xx



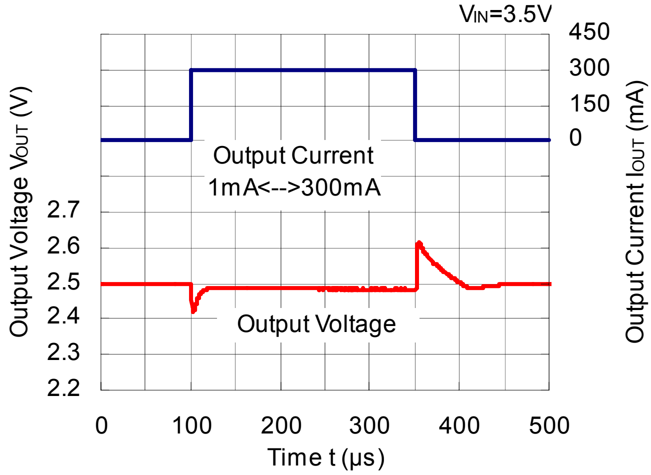
RP114x36xx



RP114x08xx



RP114x25xx



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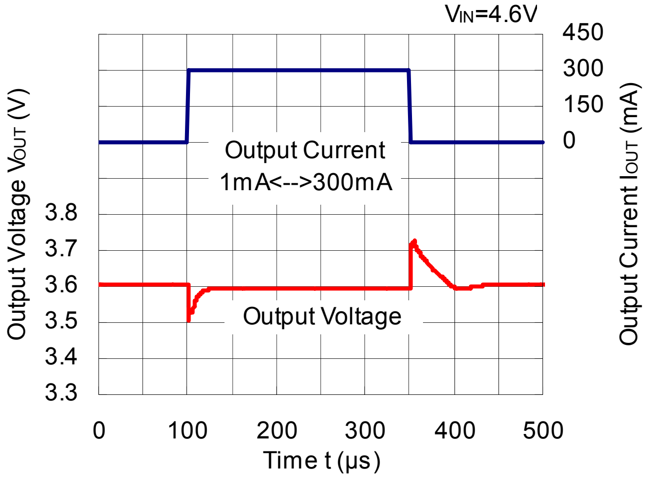
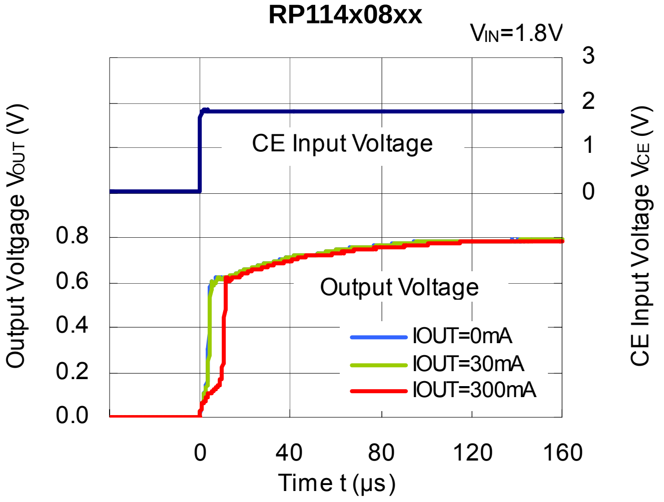
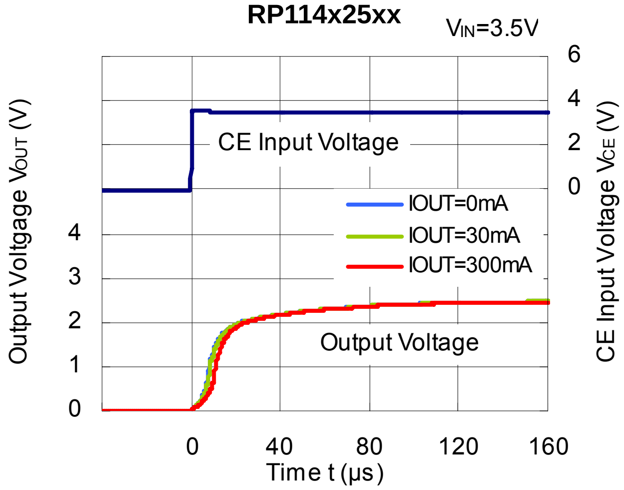
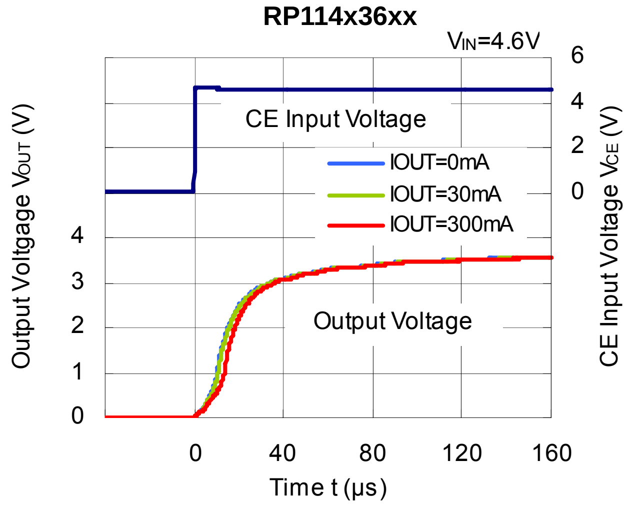


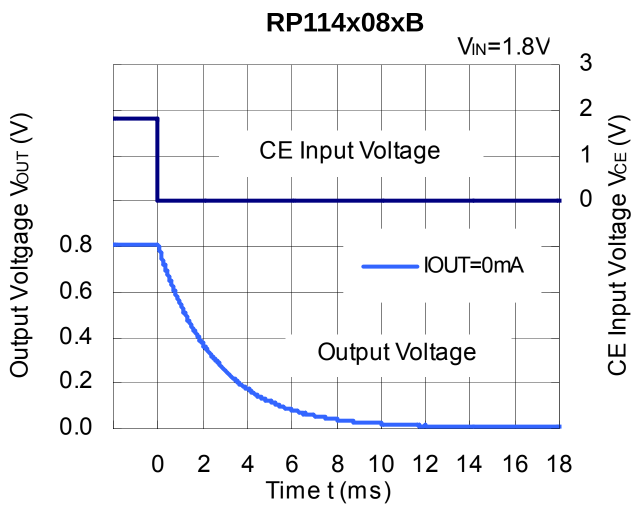
13) Turn On Speed with CE pin (C1=1.0µF, C2=1.0µF, Topt=25°C)

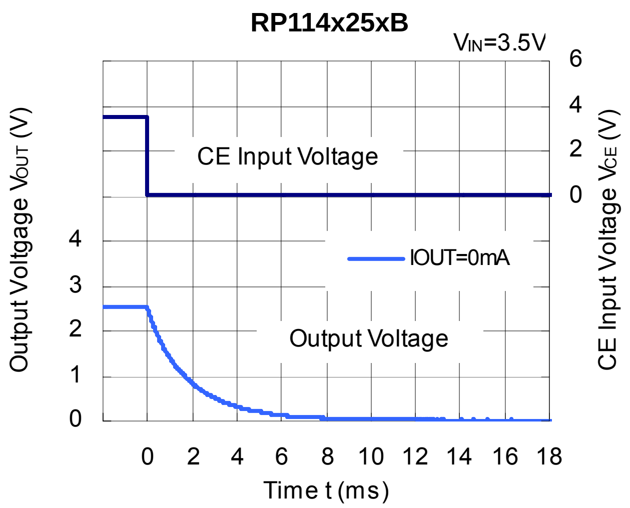


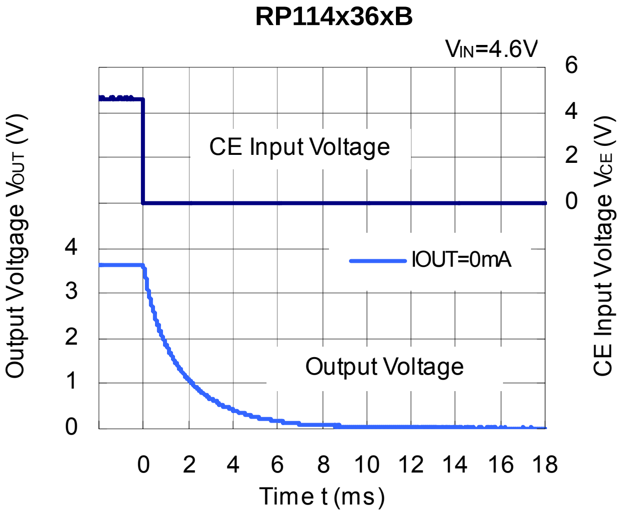




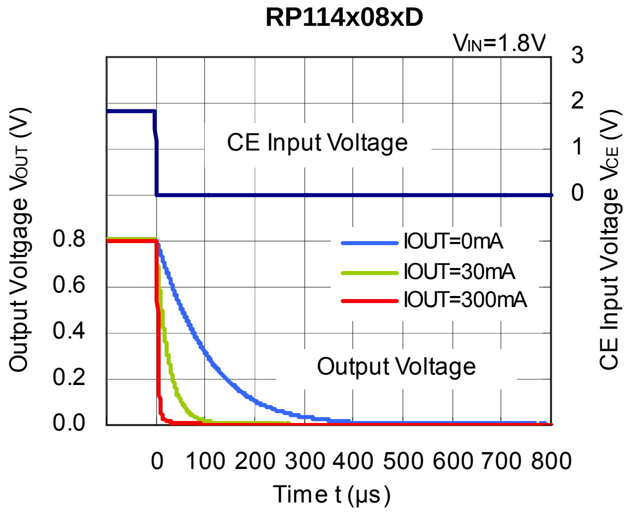
14) Turn Off Speed with CE pin (B version) (C1=1.0µF, C2=1.0µF, Topt=25°C)

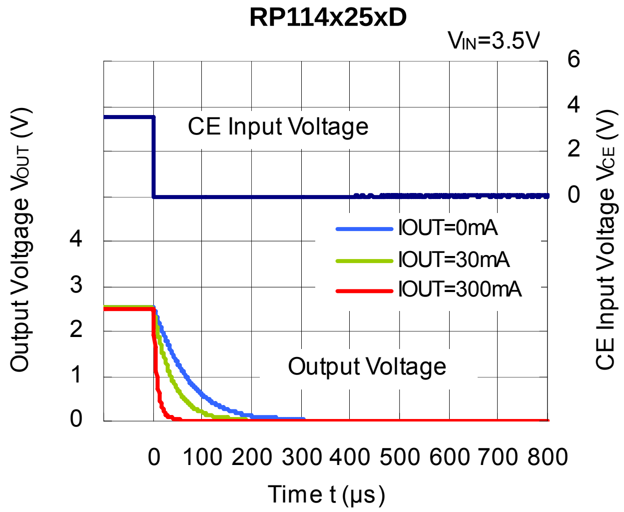


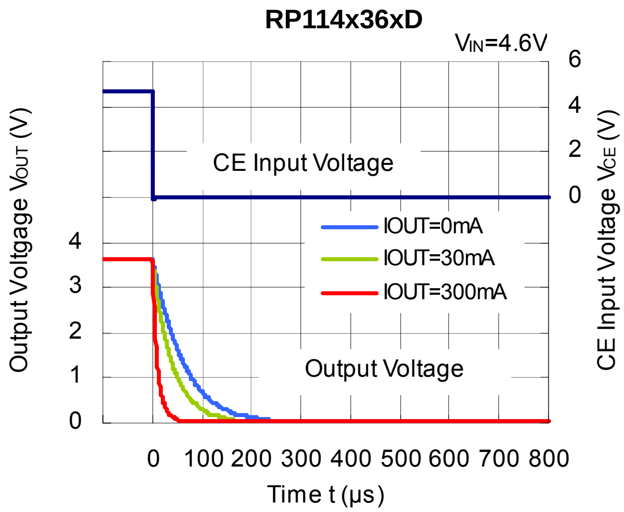




15) Turn Off Speed with CE pin (D version) (C1=1.0µF, C2=1.0µF, Topt=25°C)







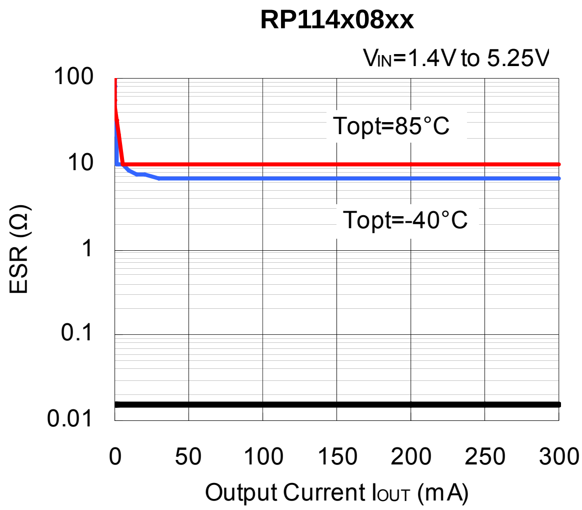
ESR vs. Output Current

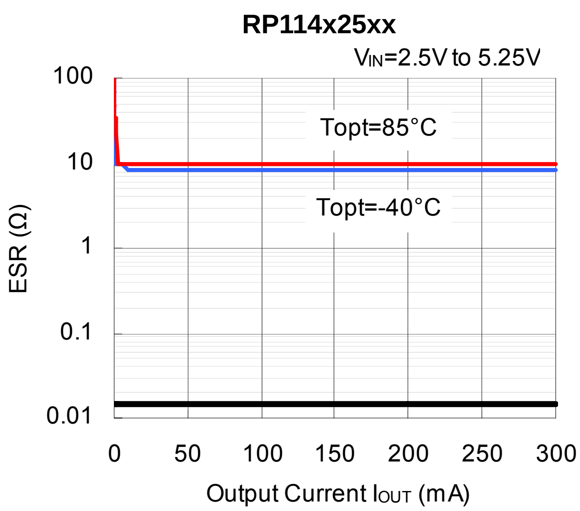
When using these ICs, consider the following points:

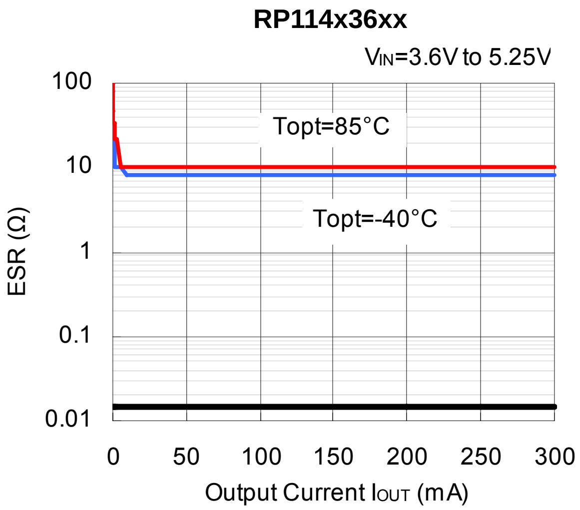
The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below.
The conditions when the white noise level is under 40μV (Avg.) are marked as the hatched area in the graph.

Measurement conditions

Frequency Band: 10Hz to 2MHz
Temperature : –40°C to 85°C
C1, C2 : 1.0μF







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■**Ricoh presented with the Japan Management Quality Award for 1999.**
Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.

■**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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