

RICOH

R1118x SERIES

AUTOMATIC MODE SHIFT / 150mA LOW VOLTAGE REGULATOR

NO.EA-175-140530

OUTLINE

R1118x Series are CMOS-based voltage regulator ICs with ultra low supply current (Typ.5.5 μ A), and remarkable improved transient response compared with the conventional low supply current voltage regulator. The supply current of these ICs is automatically shifts between fast mode and low power mode, it depending on the load current. The current threshold is fixed internally. R1118x shifts from low power mode to fast response mode at $I_{OUT}=7\text{mA}$ (Typ.) and shifts fast response mode to low power mode at $I_{OUT}=2\text{mA}$ (Typ.).

These ICs are capable of the low input voltage (Min.1.4V) and the output voltage range from 0.8V is possible. The output voltage of R1118x is fixed in the IC.

Each of these ICs consists of a voltage reference unit, an error amplifier, a resistor net for setting output voltage, a current limit circuits for over-current.

A standby mode with ultra low supply current can be realized with the chip enable function.

Since the packages for these ICs are SOT-23-5 and DFN(PLP)1612-4B, therefore high density mounting of the ICs on boards is possible.

FEATURES

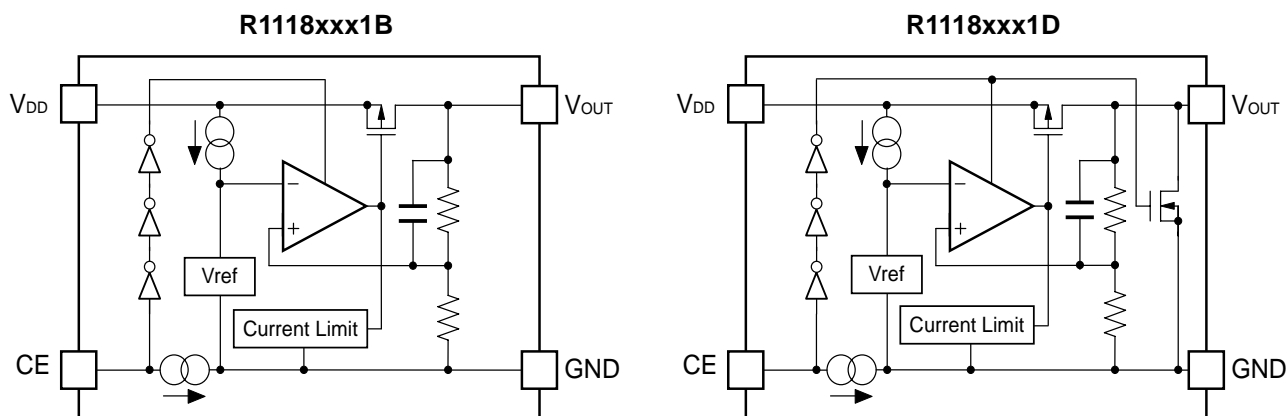
- Supply Current (Low power Mode)Typ. 5.5 μ A ($I_{OUT}=0\text{mA}$)
- Supply Current (Fast Mode)Typ. 50 μ A ($I_{OUT}=11\text{mA}$)
- Supply Current (Standby Mode)Typ. 0.1 μ A
- Ripple RejectionTyp. 70dB ($f=1\text{kHz}$)
Typ. 60dB ($f=10\text{kHz}$)
- Input Voltage Range1.4V to 6.0V
- Output Voltage Range0.8V to 4.2V (0.1V steps)
(For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy $\pm 1.0\%$ ($1.5\text{V} < V_{OUT} \leq 3.5\text{V}$, $T_{opt}=25^{\circ}\text{C}$)
- Temperature-Drift Coefficient of Output VoltageTyp. $\pm 100\text{ppm}/^{\circ}\text{C}$
- Dropout VoltageTyp. 0.27V ($I_{OUT}=150\text{mA}$, $V_{OUT}=2.8\text{V}$)
- Line RegulationTyp. 0.02%/V
- PackagesDFN(PLP)1612-4B, SOT-23-5
- Built-in Fold Back Protection CircuitTyp. 40mA
- Ceramic capacitors are recommended to be used with this IC 1.0 μ F

APPLICATIONS

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

R1118x

BLOCK DIAGRAMS



SELECTION GUIDE

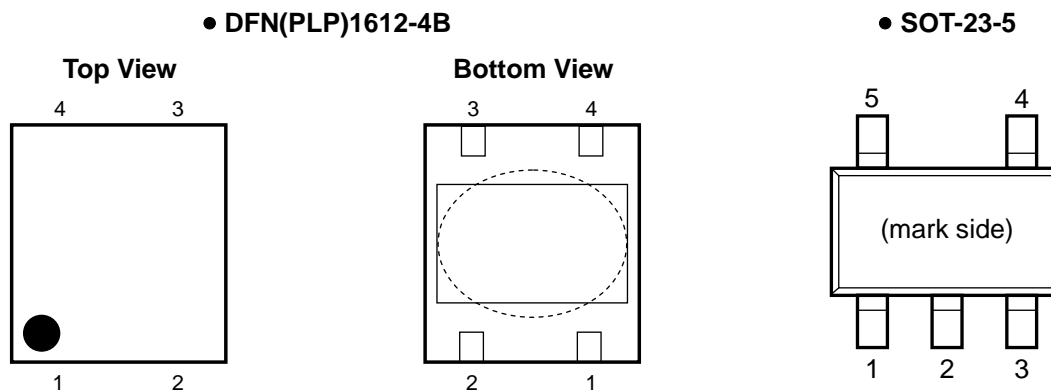
The output voltage, auto discharge function, package, and the taping type, etc. for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1118Kxx1*-TR	DFN(PLP)1612-4B	5,000 pcs	Yes	Yes
R1118Nxx1*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 0.8V(08) to 4.2V(42) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

* : CE pin polarity and 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



PIN DESCRIPTIONS

• DFN(PLP)1612-4B

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.

• 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

R1118x

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage (CE Pin)	-0.3 to 6.5	V
V_{OUT}	Output Voltage	-0.3 to $V_{IN}+0.3$	V
I_{OUT}	Output Current (DC)	180	mA
P_D	Power Dissipation (DFN(PLP)1612-4B)*	580	mW
	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.

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

• R1118xxx1B/D

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

The specification in is checked and guaranteed by design engineering at $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$, unless otherwise noted.

$T_{opt}=25^{\circ}C$

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{OUT}	Output Voltage	$T_{opt}=25^{\circ}C$	$V_{OUT} \leq 1.5V$	-15		15	mV
			$1.5V < V_{OUT} \leq 3.5V$	$\times 0.99$		$\times 1.01$	V
			$3.5V < V_{OUT}$	$\times 0.985$		$\times 1.015$	V
		$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	$V_{OUT} \leq 1.5V$	-40		30	mV
			$1.5V < V_{OUT} \leq 3.5V$	$\times 0.973$		$\times 1.02$	V
			$3.5V < V_{OUT}$	$\times 0.968$		$\times 1.025$	V
I_{OUT}	Output Current		150			mA	
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$1mA \leq I_{OUT} \leq 150mA$			80	mV	
V_{DIF}	Dropout Voltage	Refer to the following table					
I_{SS1}	Supply Current (Low Power Mode)	$I_{OUT}=0mA$		5.5	16	μA	
I_{SS2}	Supply Current (Fast Mode)	$I_{OUT}=11mA$		50	105	μA	
$I_{standby}$	Standby Current	$V_{IN}=6.0V, V_{CE}=GND$		0.1	1.0	μA	
I_{OUTH}	Fast Mode Current Threshold	$I_{OUT}=1\mu A \rightarrow 30mA$		7	12	mA	
I_{OUTL}	Low Power Mode Current Threshold	$I_{OUT}=30mA \rightarrow 1\mu A$	1	2		mA	
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	Set $V_{OUT}+0.5V \leq V_{IN} \leq 6.0V$ (In case that $V_{OUT} \leq 0.9V, V_{IN} \geq 1.4V$)		± 0.02	± 0.2	%/V	
RR	Ripple Rejection	Ripple 0.2Vp-p $I_{OUT}=30mA$ (In case that $V_{OUT}<1.5V, V_{IN}=\text{Set } V_{OUT}+1.5V$)	$f=1kHz$		70	dB	
			$f=10kHz$		60		
V_{IN}	Input Voltage		1.4		6.0	V	
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		± 100		ppm/ $^{\circ}C$	
I_{sc}	Short Current Limit	$V_{OUT}=0V$		40		mA	
I_{PD}	CE Pull-down Current		0.01	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 to 100kHz		100		μV_{rms}	
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	$V_{CE}=0V$		40		Ω	

All of unit are tested and specified under load conditions such that $T_j \approx T_{opt}=25^{\circ}C$ except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient items.

R1118x

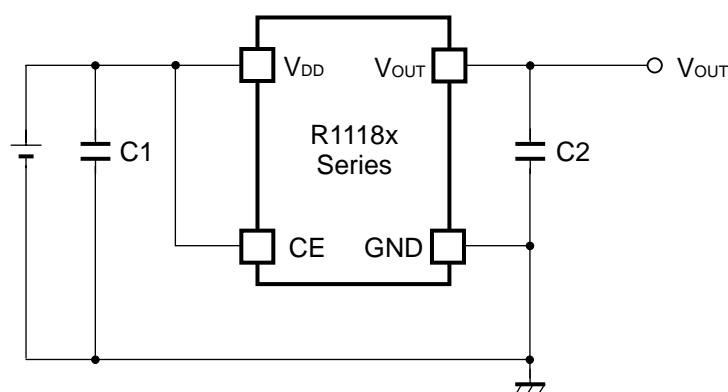
• Dropout Voltage by Output Voltage

$T_{opt}=25^{\circ}\text{C}$

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
$0.8 \leq V_{OUT} < 0.9$	$I_{OUT}=150\text{mA}$	0.82	1.06
$0.9 \leq V_{OUT} < 1.0$		0.74	0.98
$1.0 \leq V_{OUT} < 1.2$		0.66	0.90
$1.2 \leq V_{OUT} < 1.5$		0.54	0.77
$1.5 \leq V_{OUT} < 2.0$		0.45	0.64
$2.0 \leq V_{OUT} < 2.8$		0.34	0.49
$2.8 \leq V_{OUT}$		0.27	0.37

The specification in is checked and guaranteed by design engineering at $-40^{\circ}\text{C} \leq T_{opt} \leq 85^{\circ}\text{C}$, unless otherwise noted.

TYPICAL APPLICATION



(External Components)

Ceramic Capacitor C2 1.0 μF TDK C1005JB0J105K
Kyocera CM05X5R105K06AB

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 1.0 μF or more.

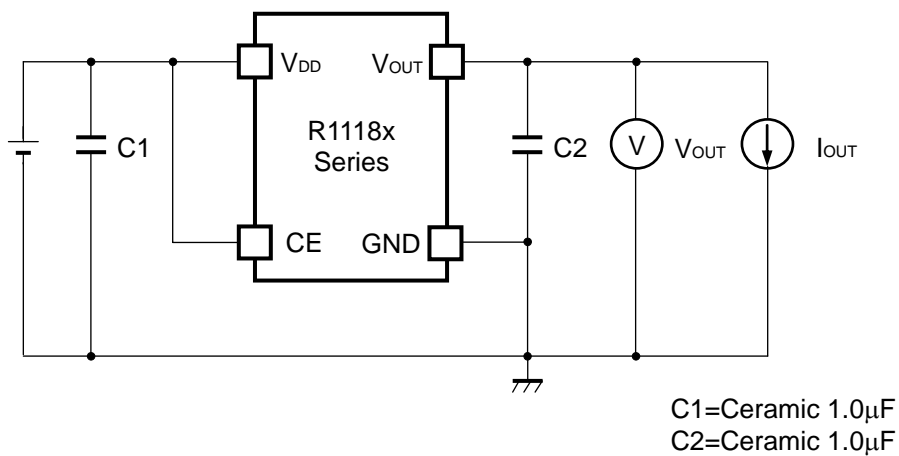
If a tantalum capacitor is used, and its ESR (Equivalent Series Resistance) of C2 is large, the loop oscillation may result. Because of this, select C2 carefully considering its frequency characteristics.

PCB Layout

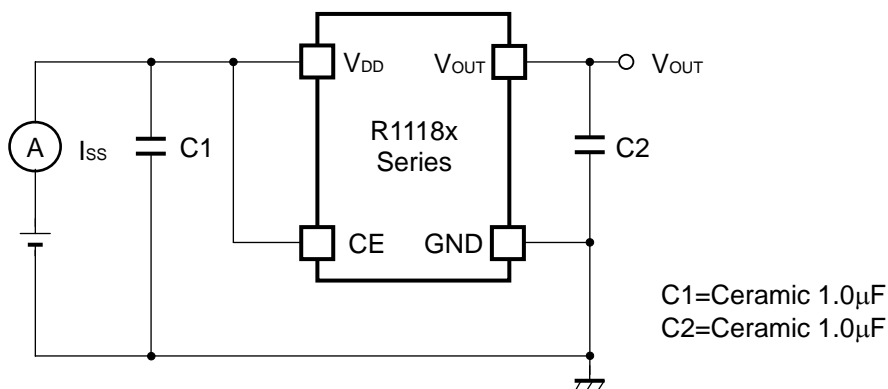
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0 μF or more between V_{DD} and GND pin, and as close as possible to the pins.

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

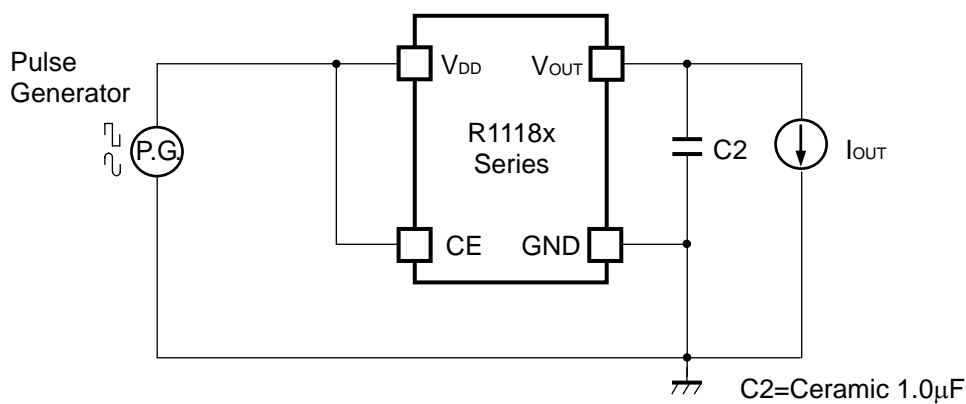
TEST CIRCUITS



Basic Test Circuit



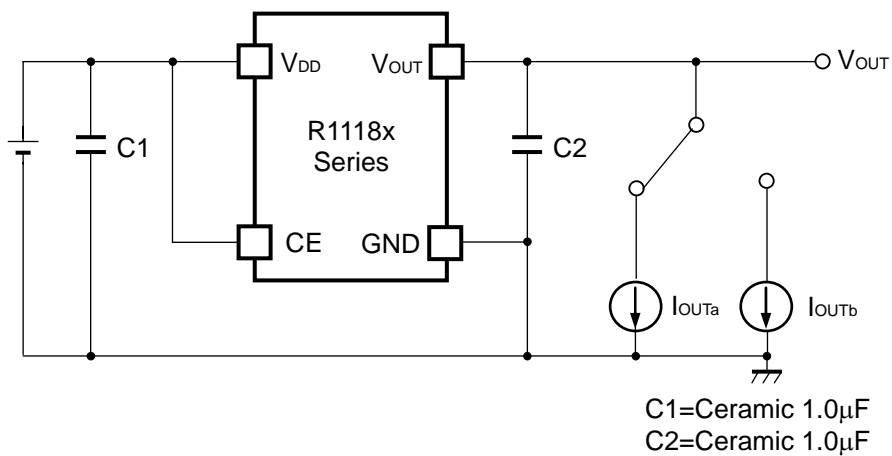
Test Circuit for Supply Current



Test Circuit for Ripple Rejection

* R1118N (SOT-23-5) is the discontinued product and the R1118K (DFN(PLP)1612-4B) is the non-promotion product.
As of March in 2015.

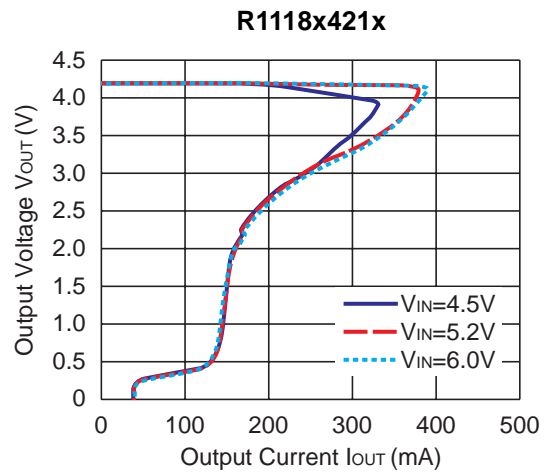
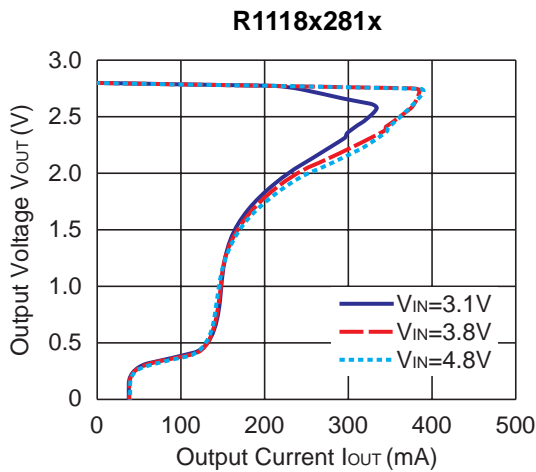
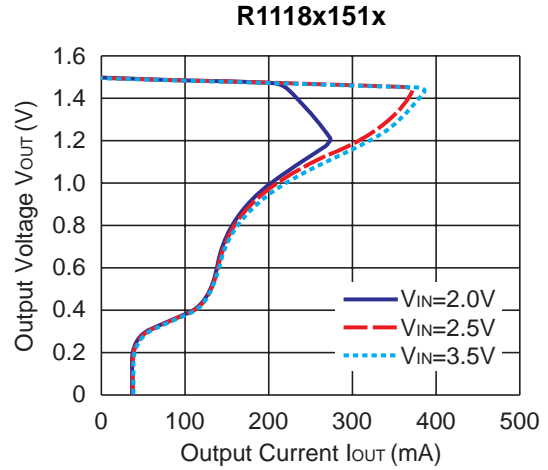
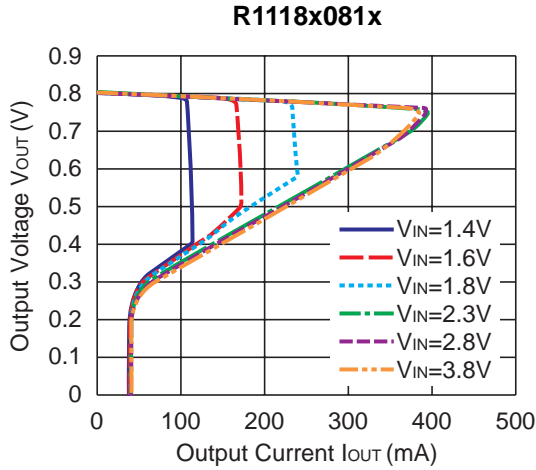
R1118x



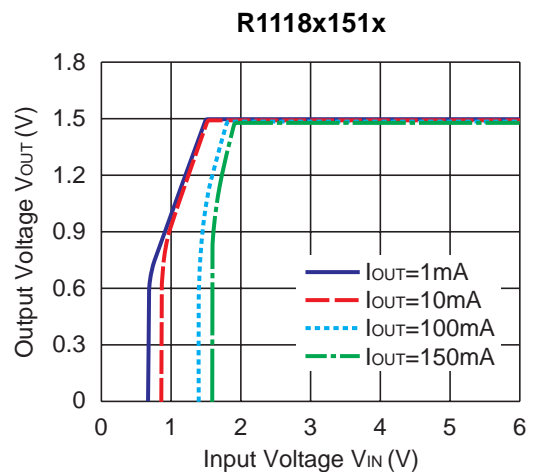
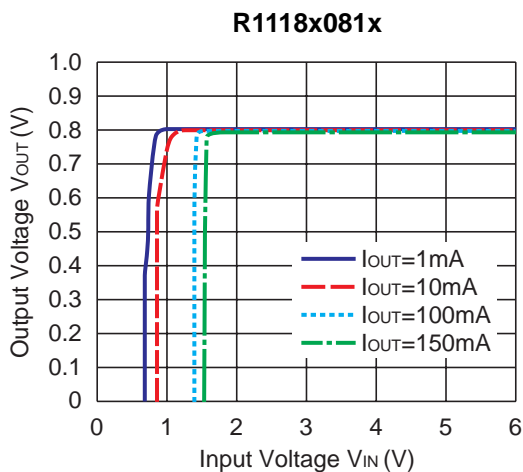
Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

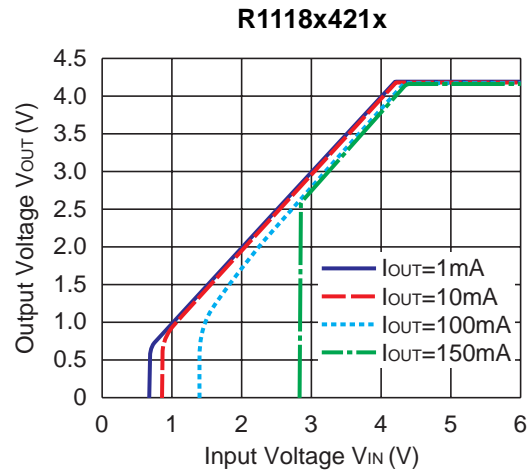
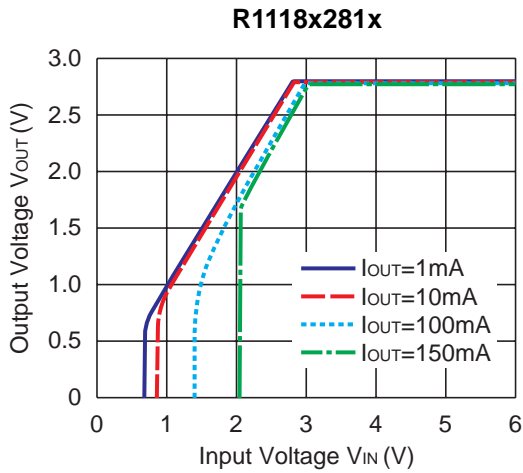
1) Output Voltage vs. Output Current (T_{opt}=25°C)



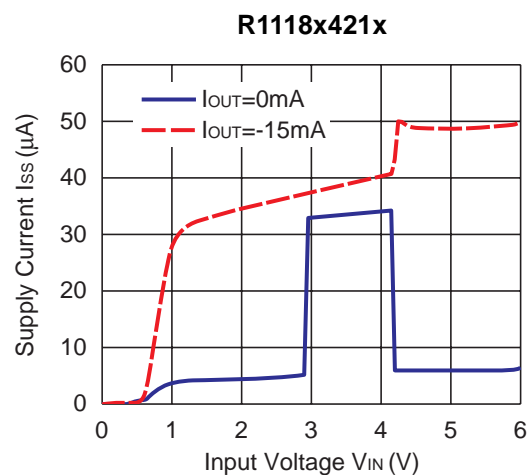
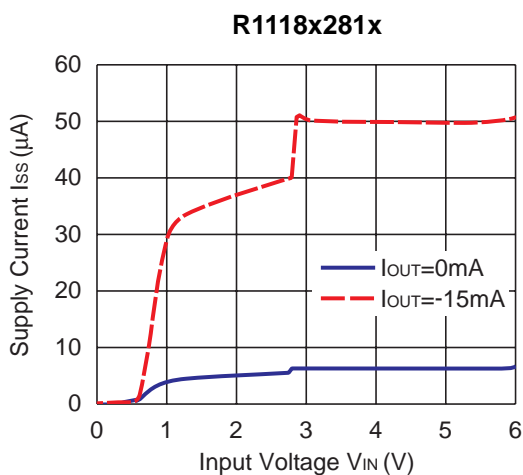
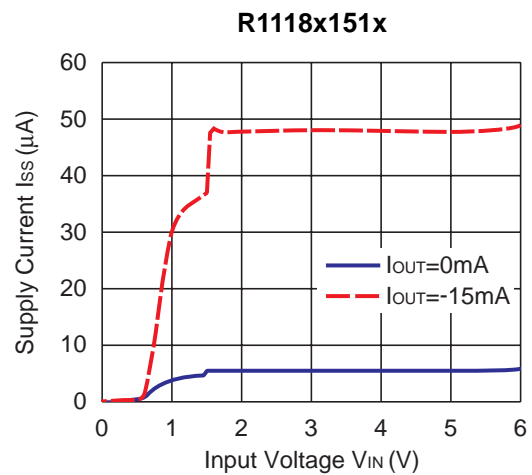
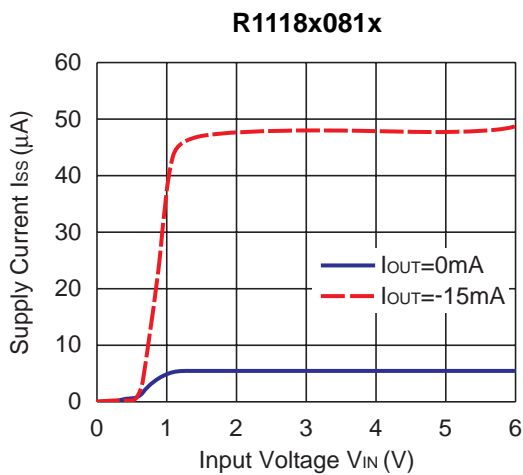
2) Output Voltage vs. Input Voltage (T_{opt}=25°C)



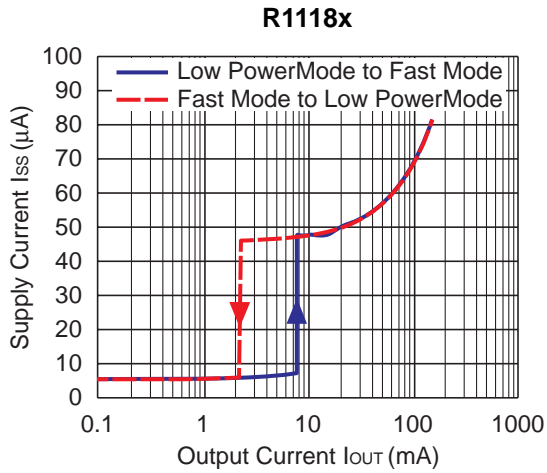
R1118x



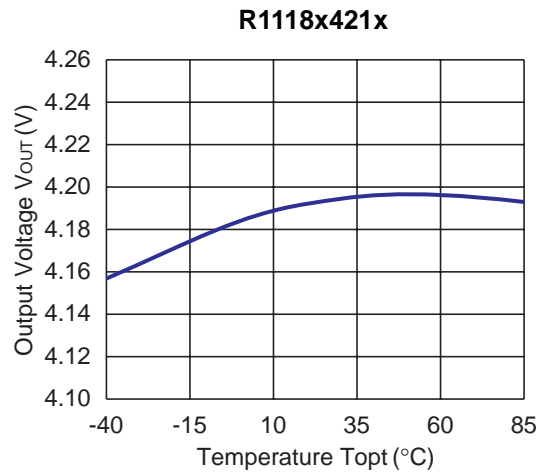
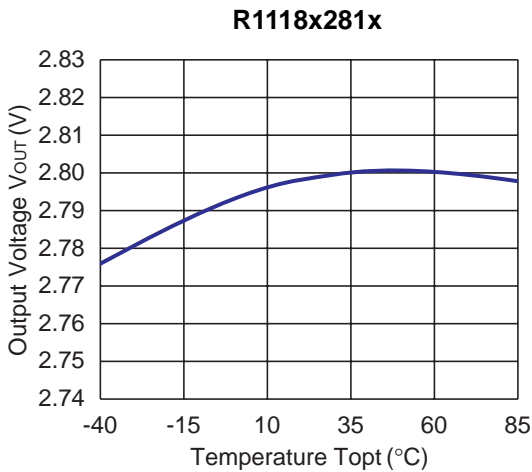
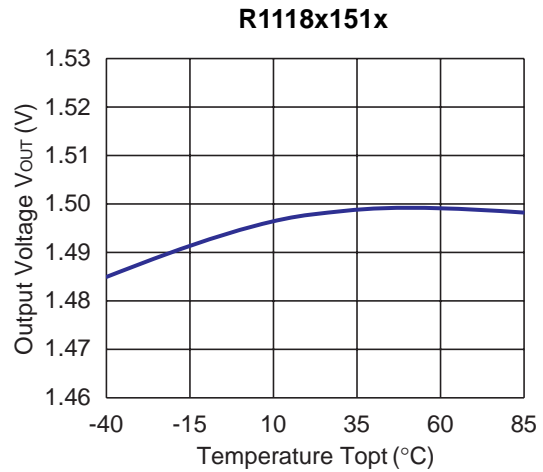
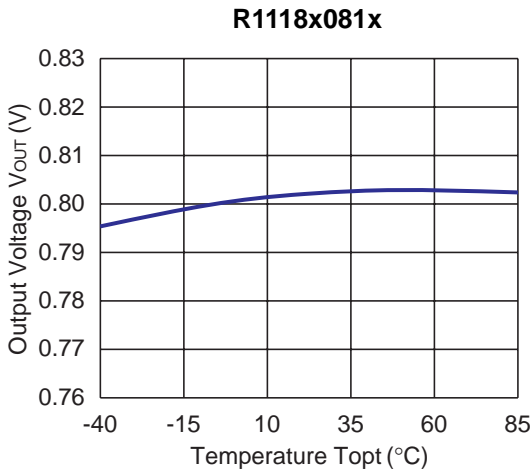
3) Supply Current vs. Input Voltage ($T_{opt}=25^{\circ}\text{C}$)



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



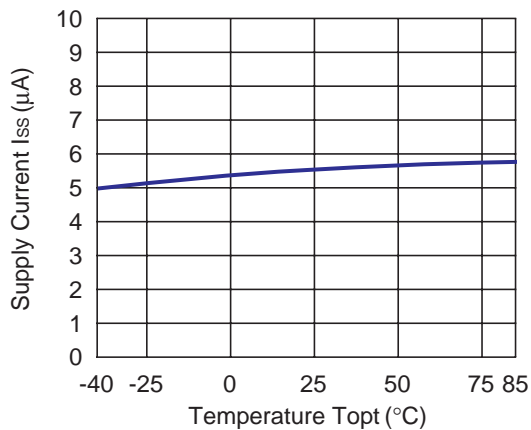
5) Output Voltage vs. Temperature



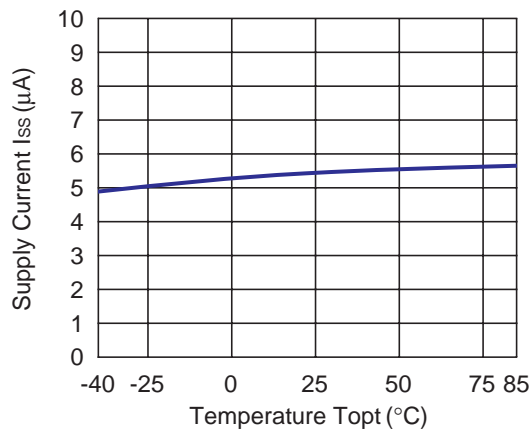
R1118x

6) Supply Current vs. Temperature

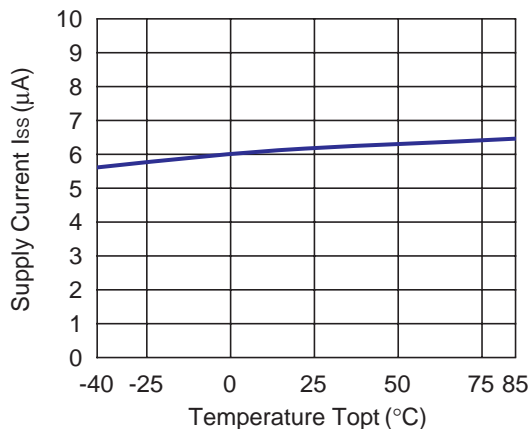
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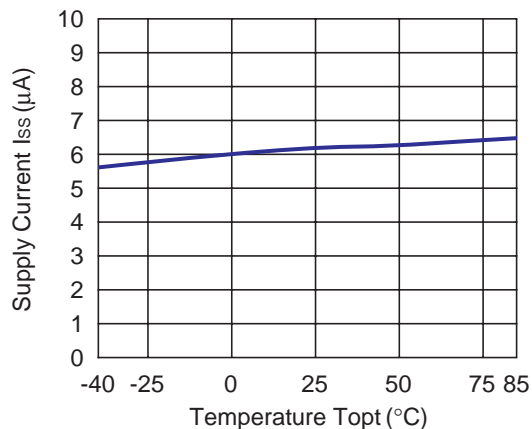
R1118x151x



R1118x281x

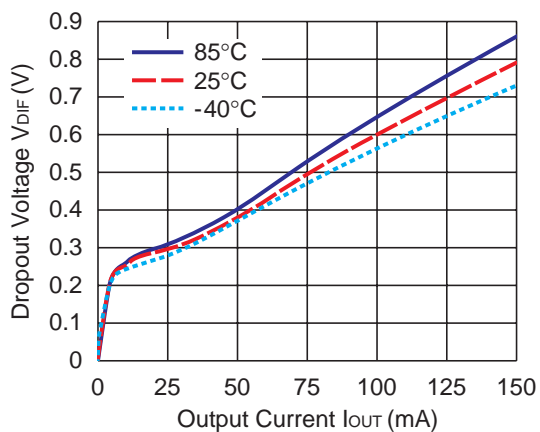


R1118x421x

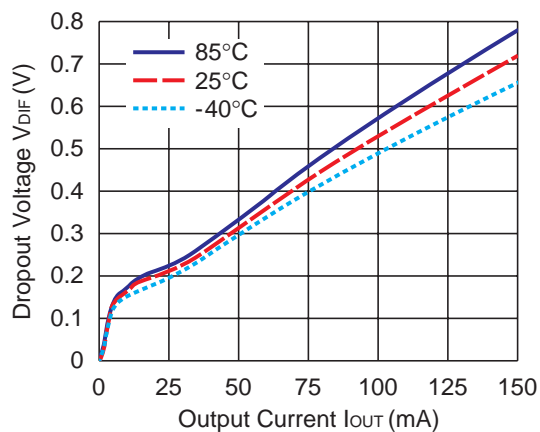


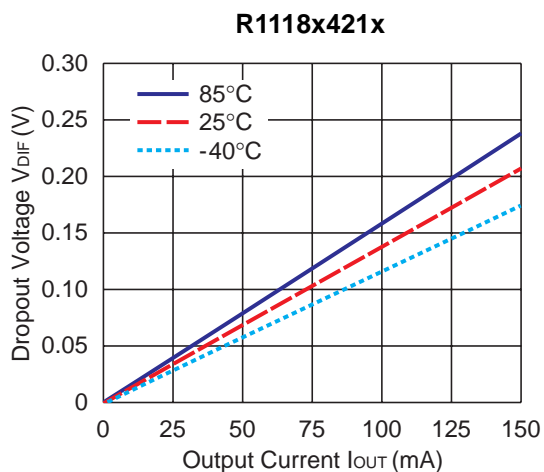
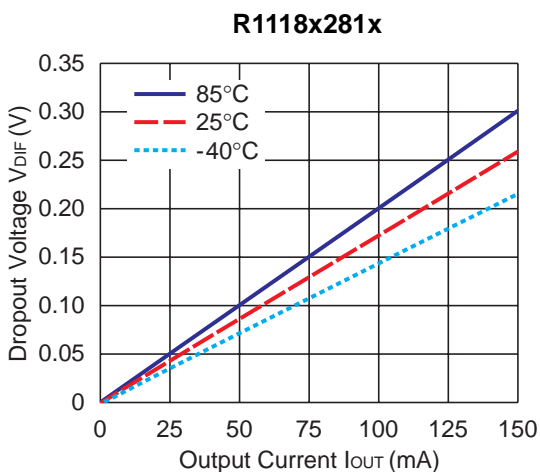
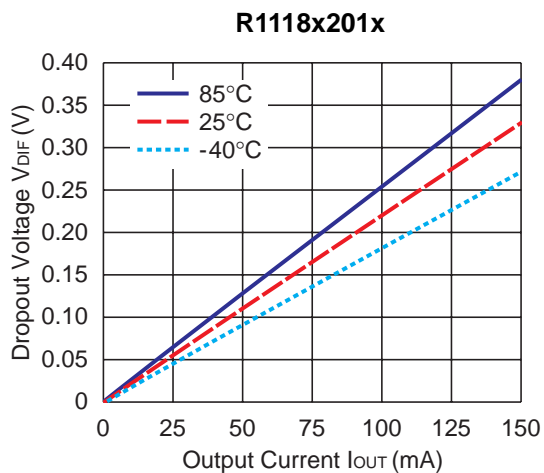
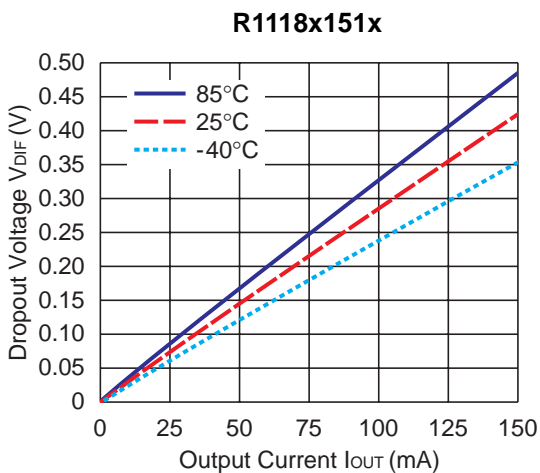
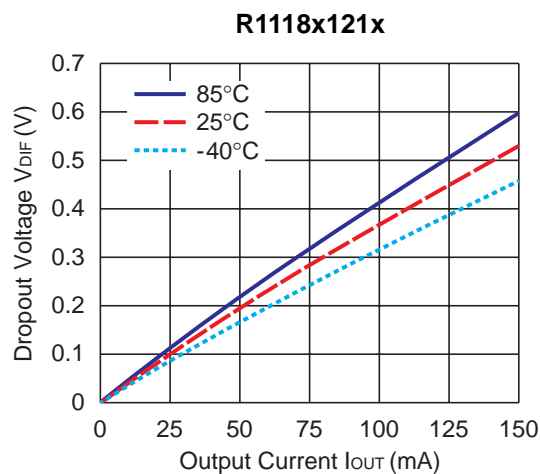
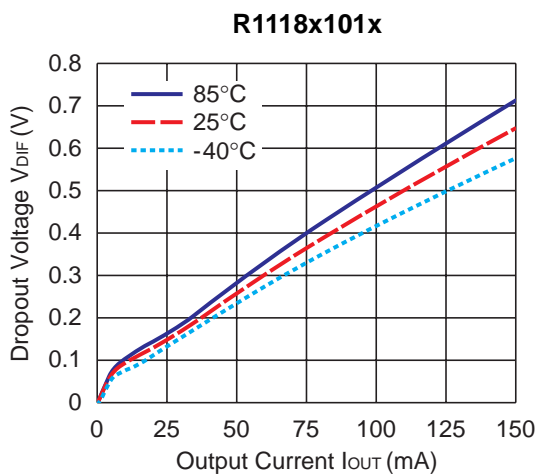
7) Dropout Voltage vs. Output Current

R1118x081x



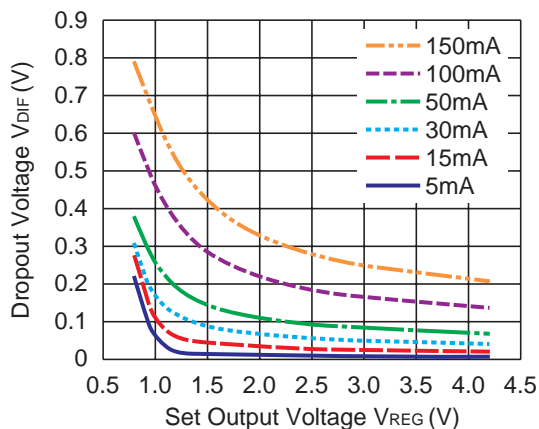
R1118x091x





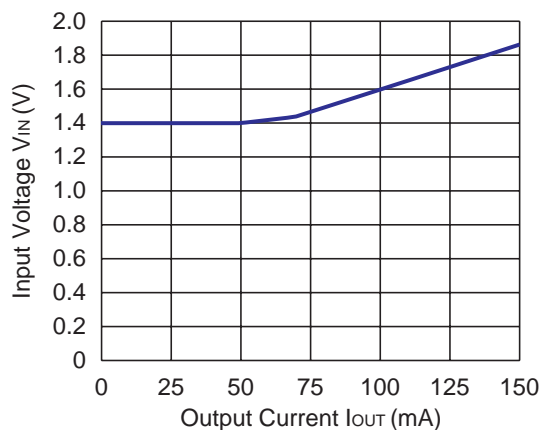
R1118x

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



9) Minimum Operating Voltage

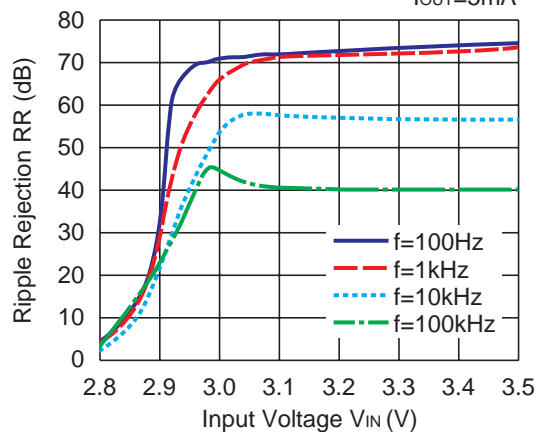
R1118x081x



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

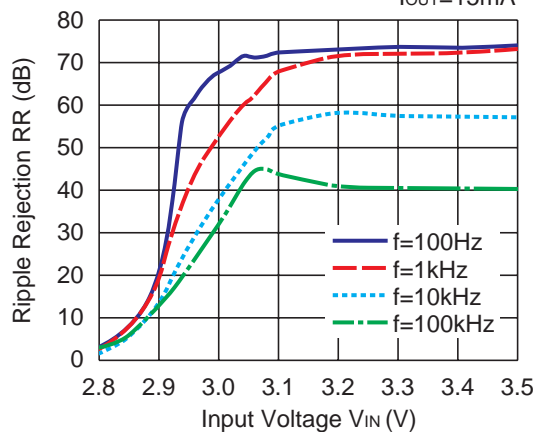
R1118x281x

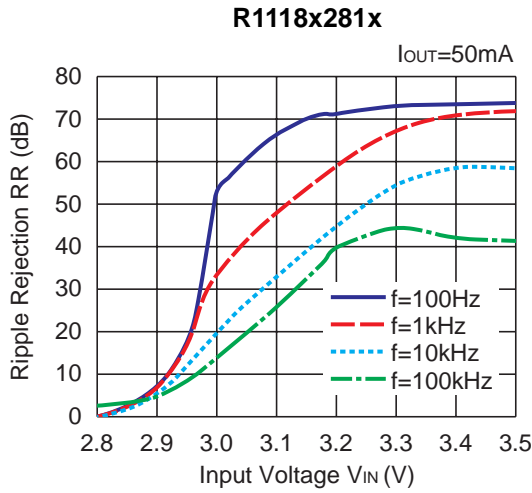
$I_{OUT}=5mA$



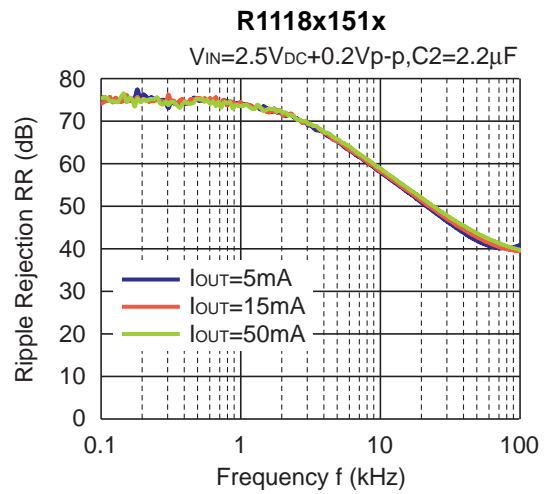
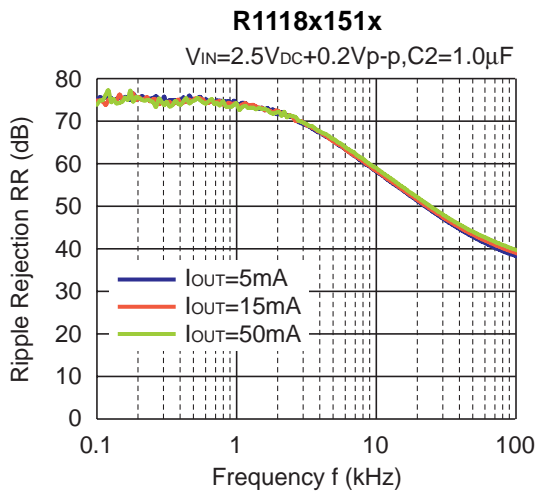
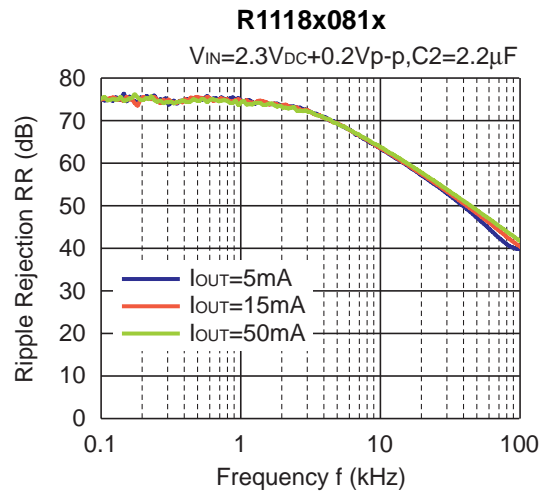
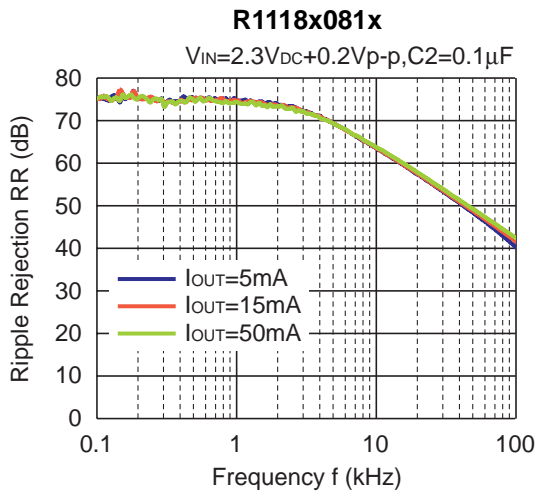
R1118x281x

$I_{OUT}=15mA$



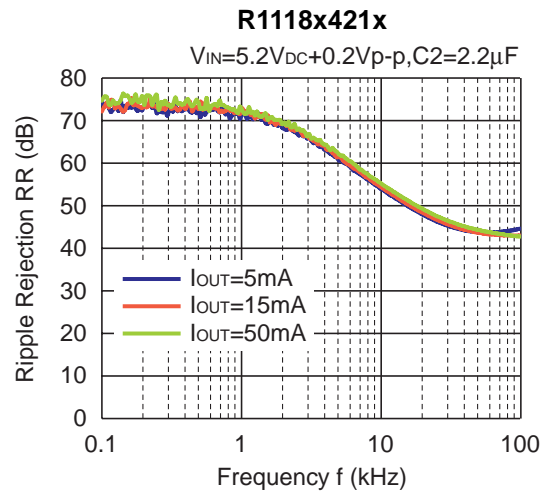
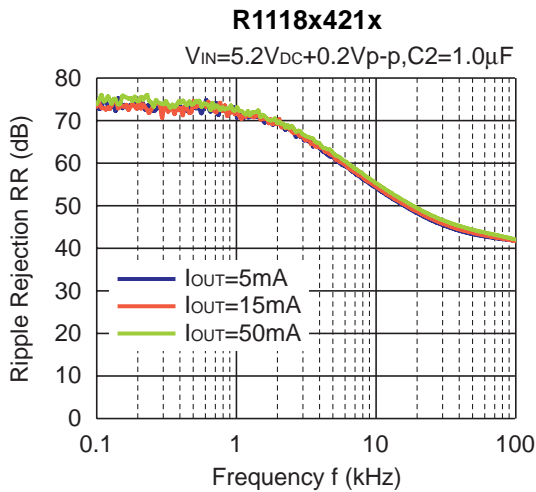
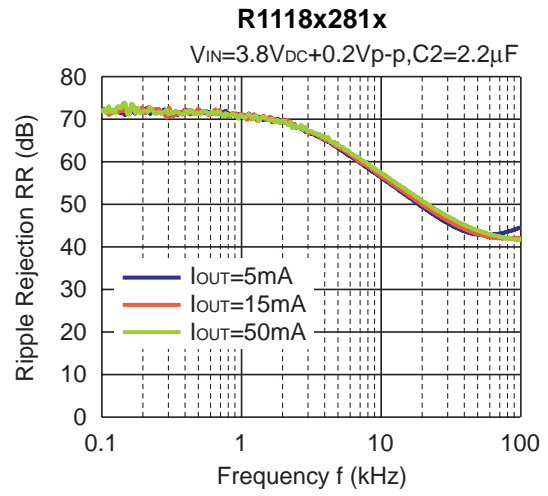
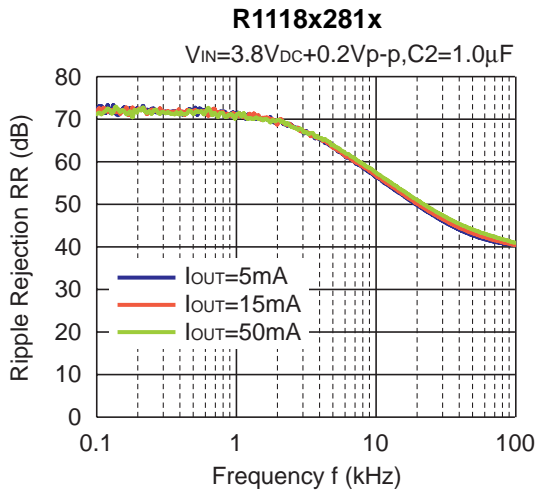


11) Ripple Rejection vs. Frequency ($C1=none$, $T_{opt}=25^{\circ}C$)

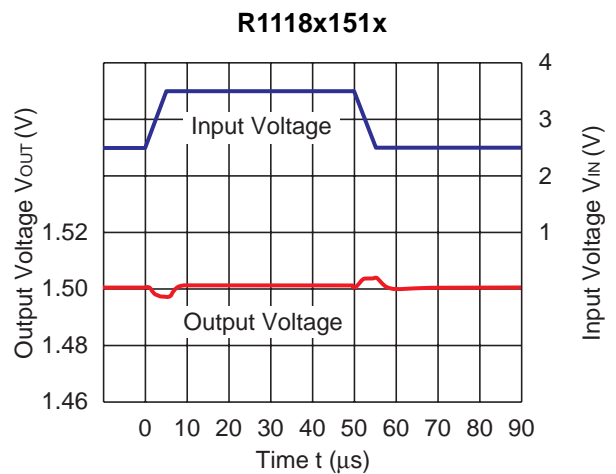
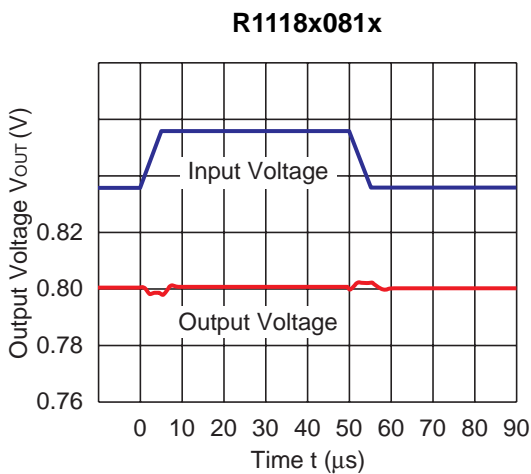


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As of March in 2015.

R1118x

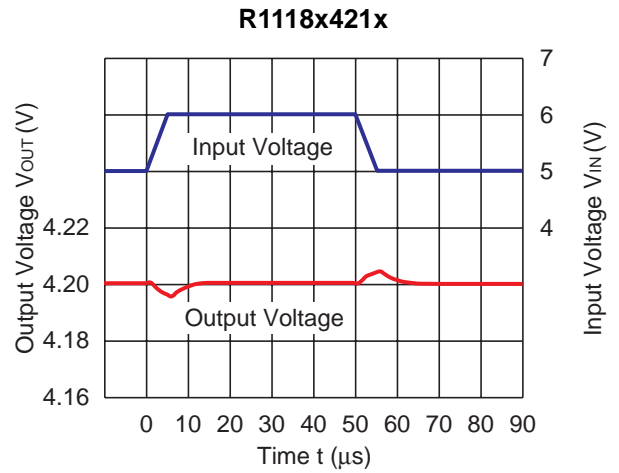
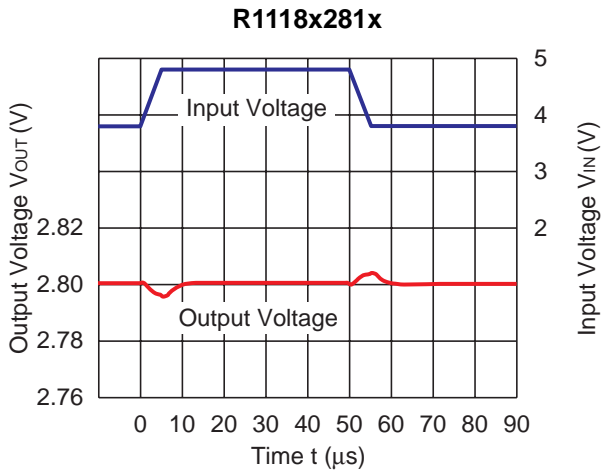


12) Input Transient Response ($I_{OUT}=30mA$, $t_r=t_f=5\mu s$, $C_1=none$, $C_2=1\mu F$, $T_{opt}=25^\circ C$)

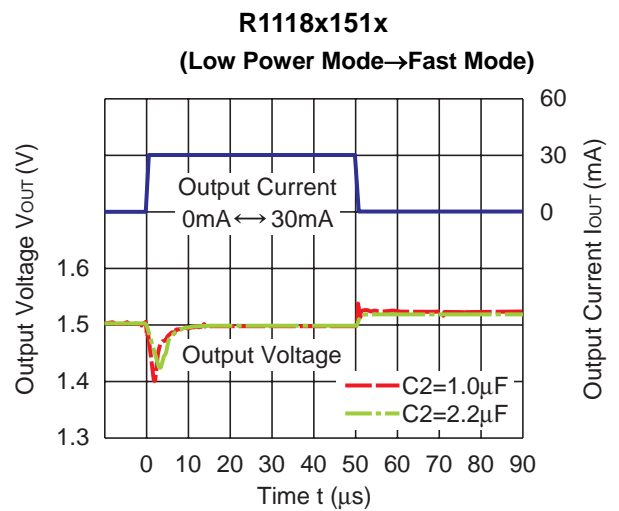
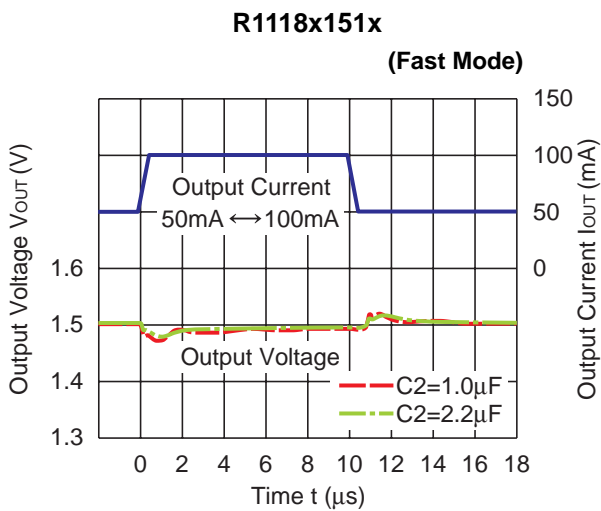
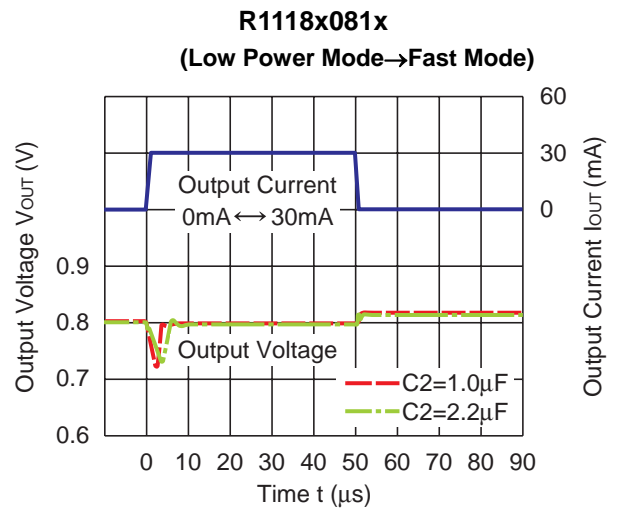
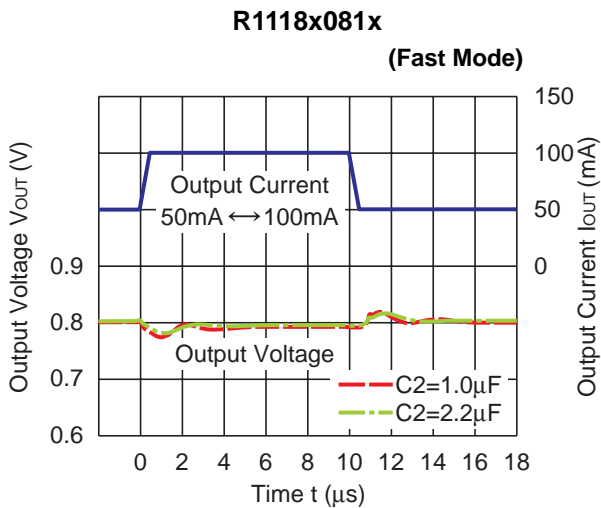


* R1118N (SOT-23-5) is the discontinued product and the R1118K (DFN(PLP)1612-4B) is the non-promotion product.
As of March in 2015.

R1118x

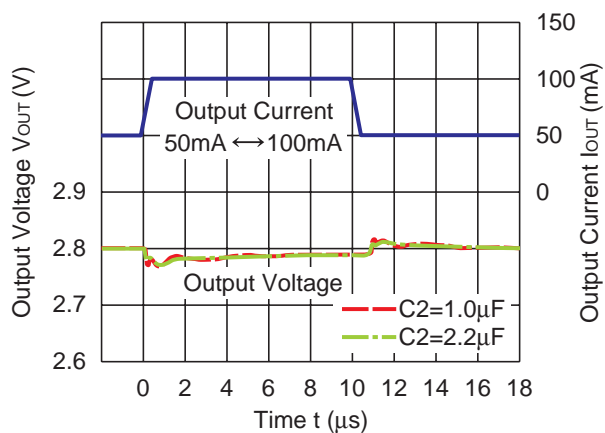


13) Load Transient Response ($t_r=t_f=500\text{ns}$, $C_1=1.0\mu\text{F}$, $T_{opt}=25^\circ\text{C}$)

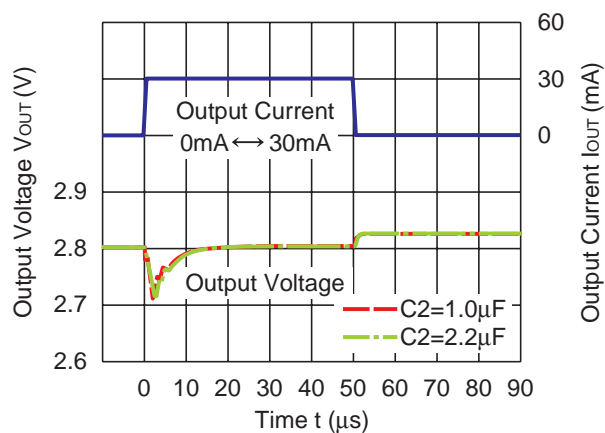


R1118x

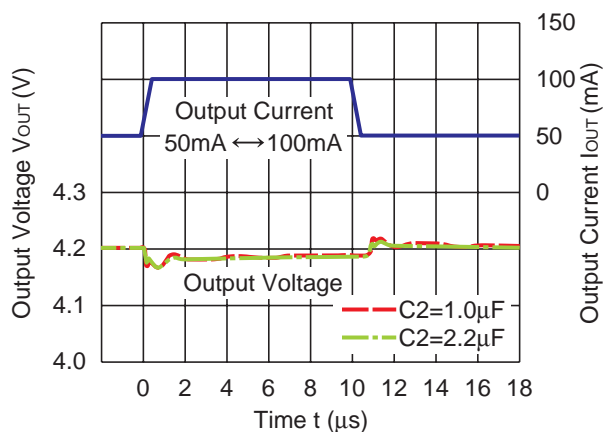
R1118x281x
(Fast Mode)



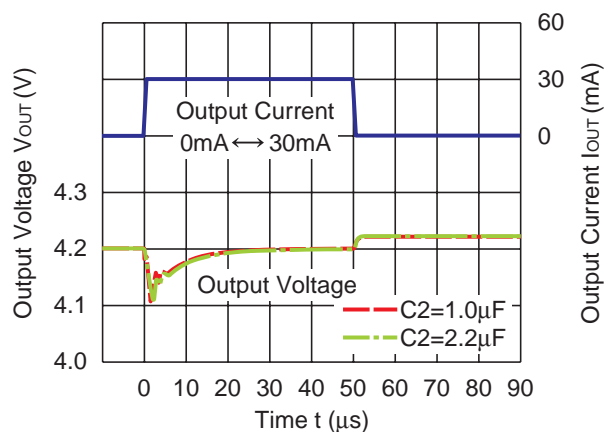
R1118x281x
(Low Power Mode \rightarrow Fast Mode)



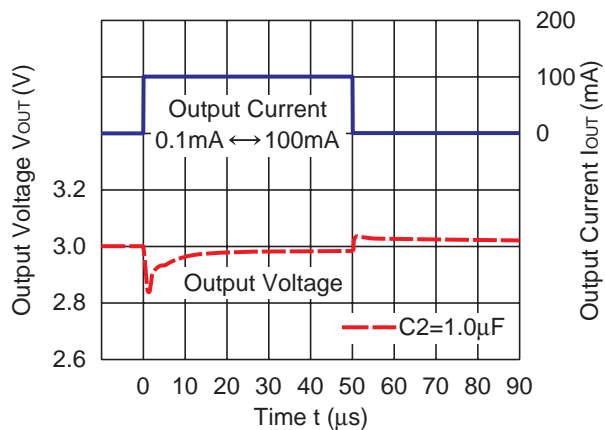
R1118x421x
(Fast Mode)



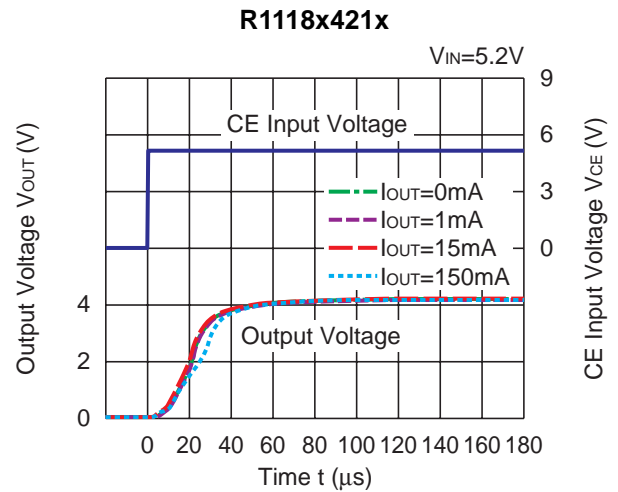
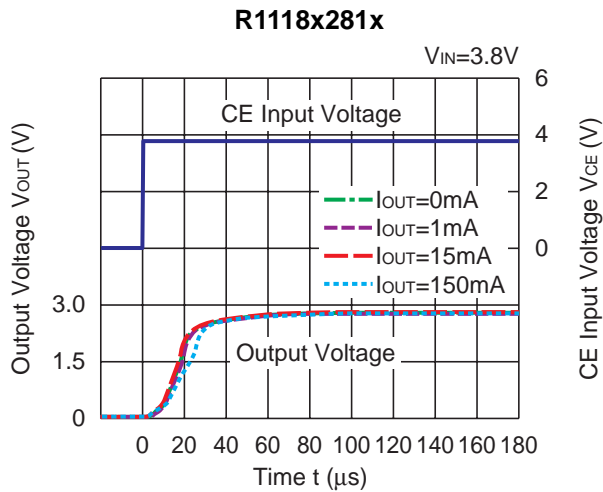
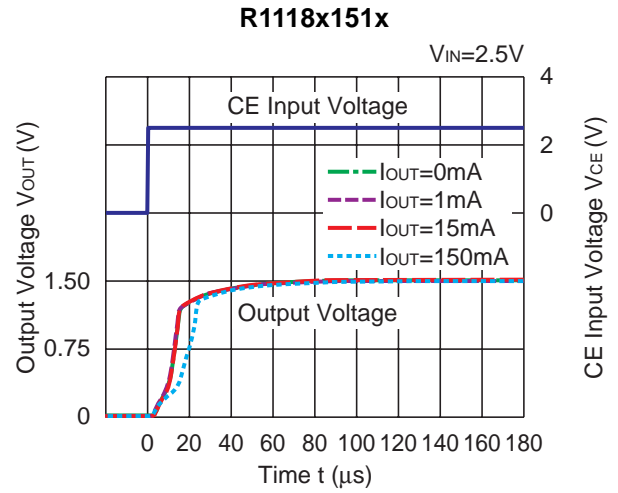
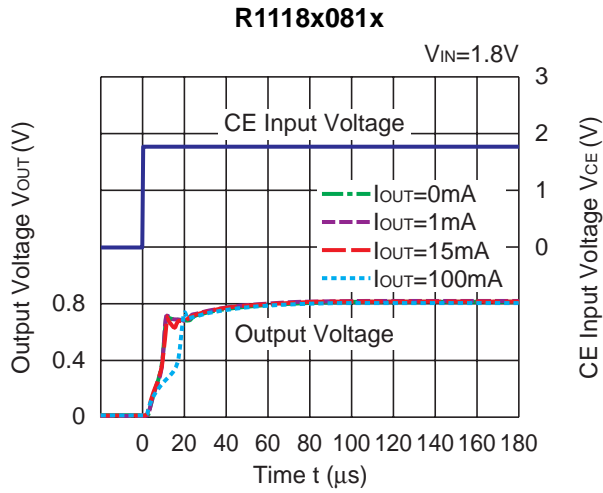
R1118x421x
(Low Power Mode \rightarrow Fast Mode)



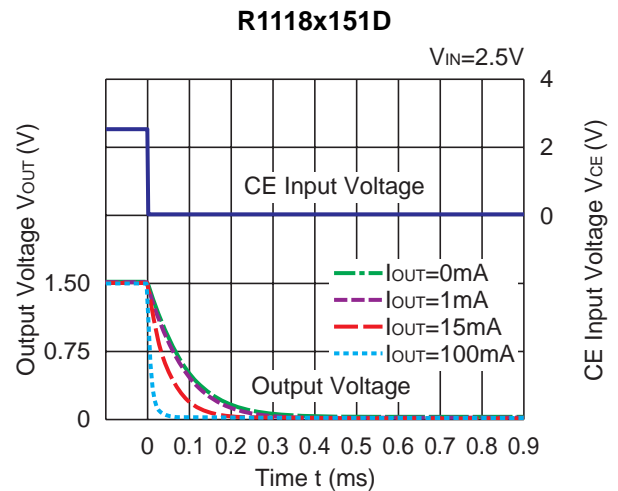
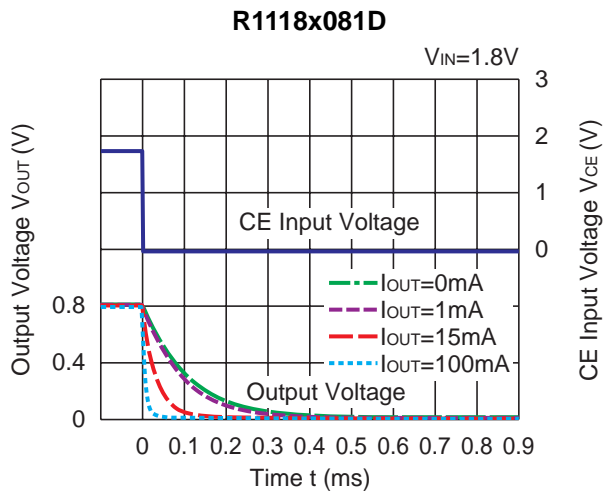
R1118x301x
(Low Power Mode \rightarrow Fast Mode)



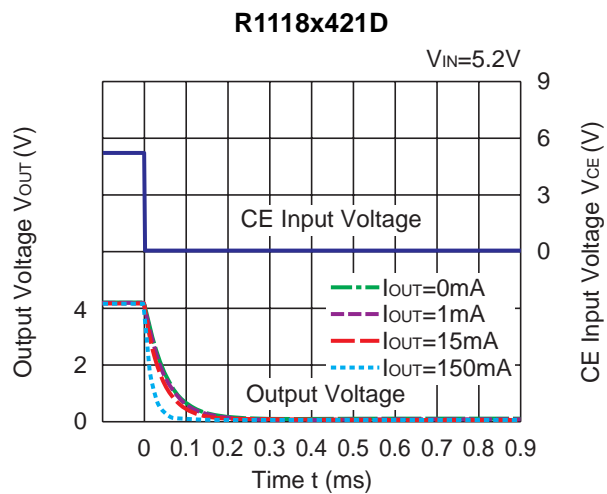
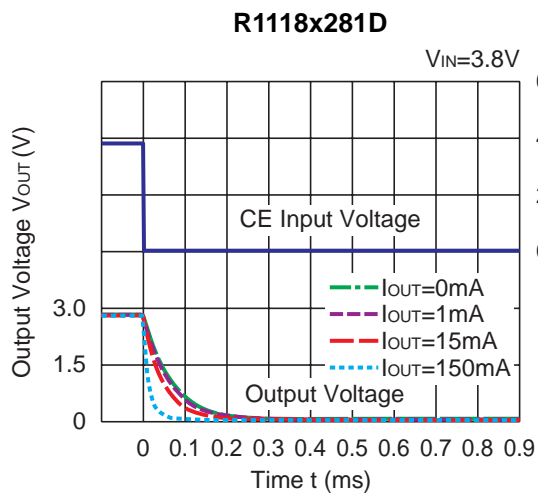
14) Turn On Speed with CE pin (C1=Ceramic 1.0 μ F, C2=Ceramic 1.0 μ F, T_{opt}=25°C)



15) Turn Off Speed with CE pin (D Version) (C1=Ceramic 1.0 μ F, C2=Ceramic 1.0 μ F, T_{opt}=25°C)



R1118x



ESR vs. Output Current

When using these ICs, consider the following points:

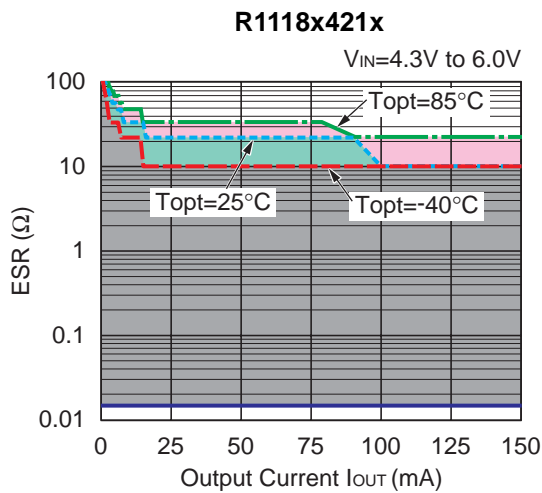
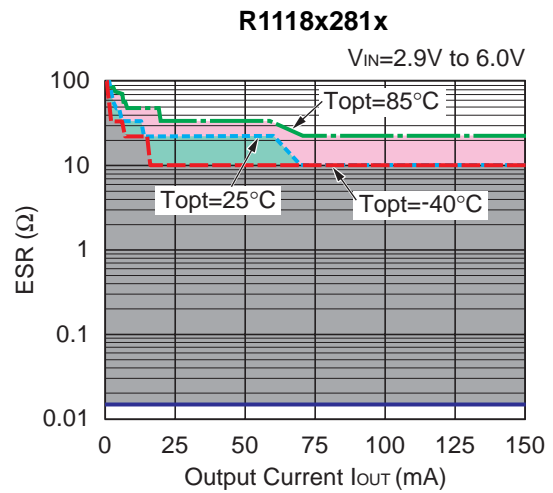
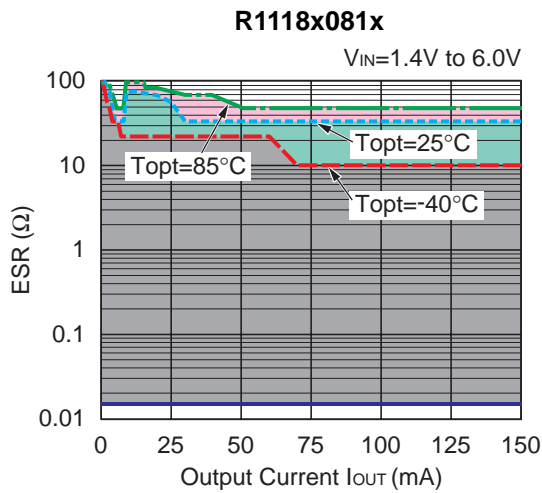
The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below.
The conditions when the white noise level is under $40\mu\text{V}$ (Avg.) are marked as the hatched area in the graph.

Measurement conditions

Frequency Band : 10Hz to 2MHz

Temperature : -40°C to 85°C

C1, C2 : $1.0\mu\text{F}$ (Murata, GRM155B31A105KE)





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RICOH RICOH ELECTRONIC DEVICES CO., LTD.

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Sales & Support Offices

RICOH ELECTRONIC DEVICES CO., LTD.

Higashi-Shinagawa Office (International Sales)
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.

Semiconductor Support Centre
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands
Phone: +31-20-5474-309

RICOH INTERNATIONAL B.V. - German Branch

Semiconductor Sales and Support Centre
Oberrather Strasse 6, 40472 Düsseldorf, Germany
Phone: +49-211-6546-0

RICOH ELECTRONIC DEVICES KOREA CO., LTD.

3F, Haesung Bldg, 504, Teheran-ro, Gangnam-gu, Seoul, 135-725, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2051-5713

RICOH ELECTRONIC DEVICES SHANGHAI CO., LTD.

Room 403, No.2 Building, No.690 Bibo Road, Pu Dong New District, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH ELECTRONIC DEVICES CO., LTD.

Taipei office
Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623