

Low Voltage 300mA LDO REGULATOR

NO.EA-116-090930

OUTLINE

The R1131x Series are CMOS-based low voltage regulator ICs with output voltage range from 0.8V to 3.3V. The minimum operating voltage is 1.4V. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a current limit circuit, and a chip enable circuit.

To prevent the destruction by over current, current limit circuit is included. Standby mode realizes ultra small consumption current.

The output voltage of these ICs is internally fixed with high accuracy. Since the packages for these ICs are SOT-23-5, SON-6, and HSON-6, high density mounting of the ICs on boards is possible.

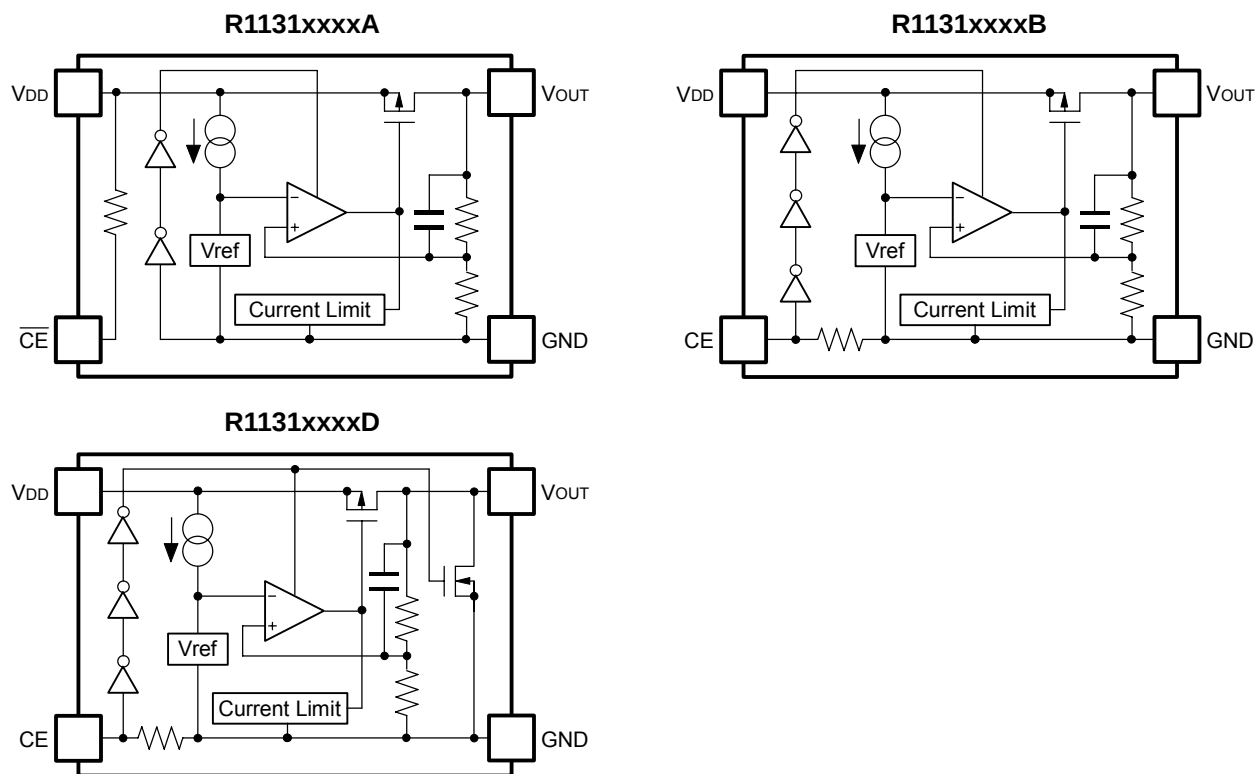
FEATURES

- Supply Current Typ. 80 μ A ($V_{OUT} < 1.8V$)
Typ. 60 μ A ($V_{OUT} \geq 1.8V$)
- Standby Mode Typ. 0.1 μ A
- Low Dropout Voltage Typ. 0.48V ($I_{OUT}=300mA$ Output Voltage=1.0V Type)
Typ. 0.31V ($I_{OUT}=300mA$ Output Voltage=1.5V Type)
Typ. 0.23V ($I_{OUT}=300mA$ Output Voltage=3.0V Type)
- Ripple Rejection Typ. 65dB ($f=1kHz$)
- Low Temperature-Drift Coefficient of Output Voltage Typ. $\pm 100ppm/^{\circ}C$
- Excellent Line Regulation Typ. 0.01%/V
- Output Voltage Accuracy $\pm 2.0\%$
- Packages SOT-23-5, SON-6, HSON-6
- Output Voltage Range 0.8V to 3.3V
- Input Voltage Range 1.4V to 6.0V
- Built-in fold-back protection circuit Typ. 50mA (Current at short mode)
- External Capacitors $C_{IN}=C_{OUT}$ =Tantalum 1.0 μ F ($V_{OUT} < 1.0V$)
 $C_{IN}=C_{OUT}$ =Ceramic 1.0 μ F ($V_{OUT} \geq 1.0V$)

APPLICATIONS

- Precision Voltage References.
- Power source for electrical appliances such as cameras, VCRs and hand-held communication equipment.
- Power source for battery-powered equipment.

BLOCK DIAGRAM



SELECTION GUIDE

The output voltage, the chip enable polarity, auto discharge function*, package type, 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;

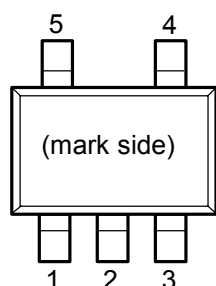
R1131xxxx-xx-x ←Part Number
 ↑↑↑↑↑
 a b a'c d e

Code	Contents
a, a'	Designation of Package Type: R1131Nxx1x-xx: SOT-23-5 R1131Dxx1x-xx: SON-6, R1131Dxx2x-xx: HSON-6
b	Setting Output Voltage (V _{OUT}): 0.8V to 3.3V (For Standard Voltage, please refer to MARK INFORMATION.)
c	Designation of Chip Enable Option: A: "L" active type, without auto discharge function*. B: "H" active type, without auto discharge function*. D: "H" active, with auto discharge function*
d	Designation of Taping Type: TR Refer to Taping Specifications
e	Designation of composition of plating: -F : Lead free solder plating (SOT-23-5, SON-6, HSON-6)

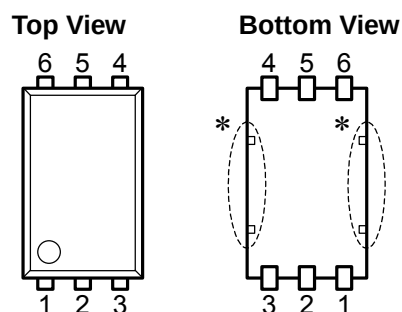
*) When the mode is into standby with CE signal, auto discharge transistor turns on, and it makes the turn-off speed faster than normal type.

PIN CONFIGURATIONS

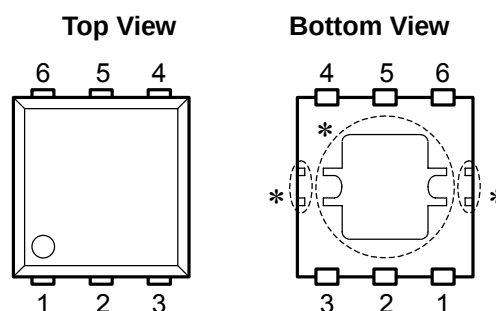
● SOT-23-5



● SON-6



● HSON-6



PIN DESCRIPTIONS

● SOT-23-5

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	$\overline{CE}$ or CE	Chip Enable Pin
4	NC	No Connection
5	V_{OUT}	Output pin

● SON-6, HSON-6

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	NC	No Connection
3	V_{OUT}	Output pin
4	NC	No Connection
5	GND	Ground Pin
6	$\overline{CE}$ or CE	Chip Enable Pin

*) Tab and tab suspension leads are 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.
 The tab suspension leads do not connect to other wires or land patterns.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage($\overline{CE}$ /CE Pin)	−0.3 to 6.5	V
V_{OUT}	Output Voltage	−0.3 to $V_{IN}+0.3$	V
I_{OUT}	Output Current	350	mA
P_D	Power Dissipation (SOT-23-5)*	420	mW
	Power Dissipation (SON-6)*	500	
	Power Dissipation (HSO-6)*	900	
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

• R1131xxxxA

T_{opt}=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V _{OUT}	Output Voltage	V _{IN} =Set V _{OUT} +1V 1μA ≤ I _{OUT} ≤ 30mA	V _{OUT} > 1.5V ×0.98		×1.02	V
			V _{OUT} ≤ 1.5V −30		+30	mV
I _{OUT}	Output Current	V _{IN} −V _{OUT} =1.0V	300			mA
ΔV _{OUT} / ΔI _{OUT}	Load Regulation	V _{IN} =Set V _{OUT} +1V, 1mA ≤ I _{OUT} ≤ 300mA		40	70	mV
V _{DIF}	Dropout Voltage	I _{OUT} =300mA	V _{OUT} =0.8V		620	850
			V _{OUT} =0.9V		550	780
			1.0V ≤ V _{OUT} < 1.5V		480	700
			1.5V ≤ V _{OUT} < 2.6V		310	450
			2.6V ≤ V _{OUT} ≤ 3.3V		230	350
I _{SS1}	Supply Current	V _{IN} =Set V _{OUT} +1V, V _{OUT} < 1.8V		80	111	μA
		V _{IN} =Set V _{OUT} +1V, V _{OUT} ≥ 1.8V		60	90	μA
I _{standby}	Standby Current	V _{IN} =V _{CE} =Set V _{OUT} +1V		0.1	1.0	μA
ΔV _{OUT} / ΔV _{IN}	Line Regulation	I _{OUT} =30mA V _{OUT} +0.5V ≤ V _{IN} ≤ 6.0V (V _{OUT} > 0.9V) 1.4V ≤ V _{IN} ≤ 6.0V (V _{OUT} ≤ 0.9V)		0.01	0.15	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V _{IN} =Set V _{OUT} +1V, I _{OUT} =30mA		65		dB
V _{IN}	Input Voltage		1.4		6.0	V
ΔV _{OUT} / ΔT _{opt}	Output Voltage Temperature Coefficient	I _{OUT} =30mA −40°C ≤ T _{opt} ≤ 85°C		±100		ppm /°C
I _{lim}	Short Current Limit	V _{OUT} =0V		50		mA
R _{PU}	$\overline{\text{CE}}$ Pull-up Resistance		1.87	5.0	12.0	MΩ
V _{CEH}	$\overline{\text{CE}}$ Input Voltage “H”		1.0		6.0	V
V _{CEL}	$\overline{\text{CE}}$ Input Voltage “L”		0		0.3	V
en	Output Noise	BW=10Hz to 100kHz		30		μVrms

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.

R1131x

• R1131xxxxB/D

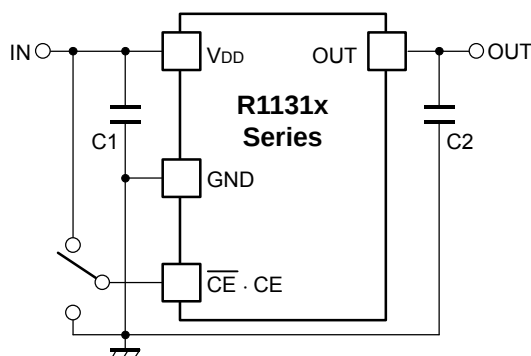
T_{opt}=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V _{OUT}	Output Voltage	V _{IN} =Set V _{OUT} +1V 1μA ≤ I _{OUT} ≤ 30mA	V _{OUT} > 1.5V ×0.98		×1.02	V
			V _{OUT} ≤ 1.5V −30		+30	mV
I _{OUT}	Output Current	V _{IN} −V _{OUT} =1.0V	300			mA
ΔV _{OUT} / ΔI _{OUT}	Load Regulation	V _{IN} =Set V _{OUT} +1V 1mA ≤ I _{OUT} ≤ 300mA		40	70	mV
V _{DIF}	Dropout Voltage	I _{OUT} =300mA	V _{OUT} =0.8V	620	850	mV
			V _{OUT} =0.9V	550	780	
			1.0V ≤ V _{OUT} < 1.5V	480	700	
			1.5V ≤ V _{OUT} < 2.6V	310	450	
			2.6V ≤ V _{OUT} ≤ 3.3V	230	350	
I _{SS1}	Supply Current	V _{IN} =Set V _{OUT} +1V, V _{OUT} < 1.8V		80	111	μA
		V _{IN} =Set V _{OUT} +1V, V _{OUT} ≥ 1.8V		60	90	μA
I _{standby}	Standby Current	V _{IN} =Set V _{OUT} +1V, V _{CE} =GND		0.1	1.0	μA
ΔV _{OUT} / ΔV _{IN}	Line Regulation	I _{OUT} =30mA V _{OUT} +0.5V ≤ V _{IN} ≤ 6.0V (V _{OUT} > 0.9V) 1.4V ≤ V _{IN} ≤ 6.0V (V _{OUT} ≤ 0.9V)		0.01	0.15	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V _{IN} =Set V _{OUT} +1V, I _{OUT} =30mA		65		dB
V _{IN}	Input Voltage		1.4		6.0	V
ΔV _{OUT} / ΔT _{opt}	Output Voltage Temperature Coefficient	I _{OUT} =30mA −40°C ≤ T _{opt} ≤ 85°C		±100		ppm /°C
I _{lim}	Short Current Limit	V _{OUT} =0V		50		mA
R _{PD}	CE Pull-down Resistance		1.87	5.0	12.0	MΩ
V _{CEH}	CE Input Voltage “H”		1.0		6.0	V
V _{CEL}	CE Input Voltage “L”		0		0.3	V
en	Output Noise	BW=10Hz to 100kHz		30		μVrms
R _{LOW}	Nch On Resistance for auto discharge (D version only)	V _{CE} =0V		60		Ω

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

TYPICAL APPLICATION



<External Components examples>

C2	1.0 μ F	CM05X5R105K06AB (Kyocera)
C2	1.0 μ F	C1005JBOJ105K (TDK)
C2	1.0 μ F	GRM155B30J105KE18B (Murata)

Output Capacitor; 1.0 μ F or more capacity ceramic Type

(If $V_{OUT} < 1.0V$, Tantalum Type is recommended)

Input Capacitor, 1.0 μ F or more capacity ceramic Type

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, be sure to use a 1.0 μ F or more capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance).

(Note: If a tantalum capacitor is connected to the Output pin for phase compensation, if the ESR value of the capacitor is too large, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

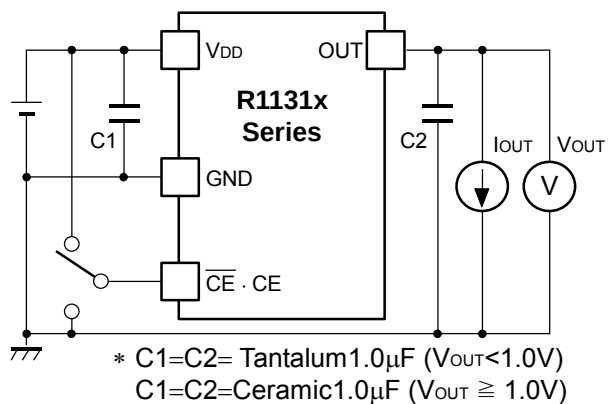
Chip capacitor characteristics of Bias dependence and Temperature characteristics may vary depending on its size, manufacturer, and part number.

PCB Layout

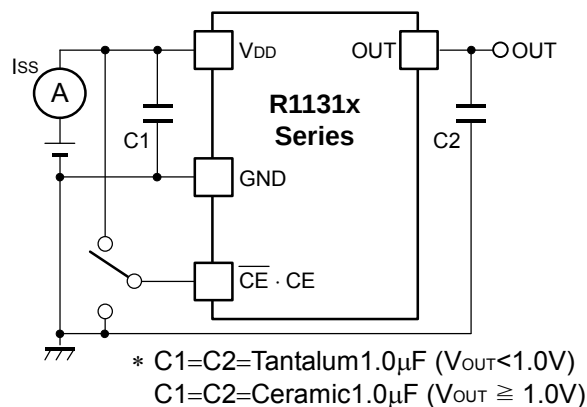
Make V_{DD} and GND lines sufficient. If their impedance is high, pick-up the noise or unstable operation may result. Connect a capacitor with as much as 1.0 μ F capacitor between V_{DD} and GND pin as close as possible.

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

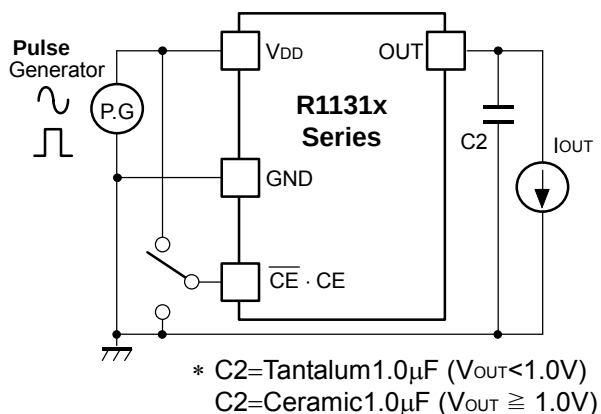
TEST CIRCUIT



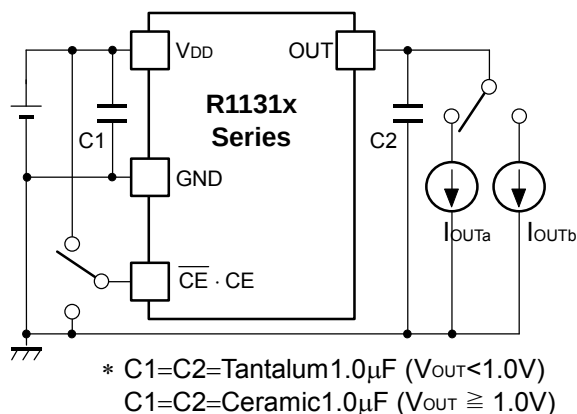
Standard Test Circuit



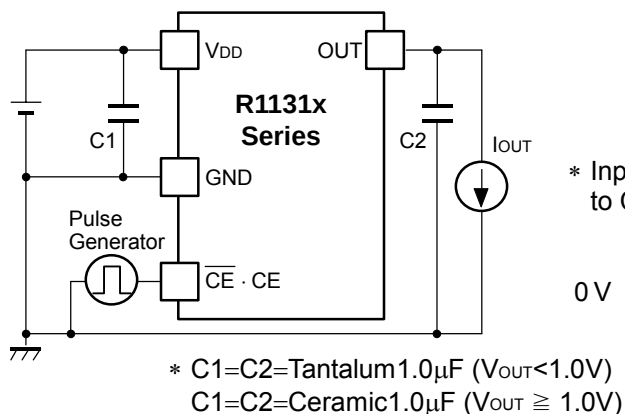
Supply Current Test Circuit



Ripple Rejection, Line Transient Response Test Circuit



Load Transient Response Test Circuit



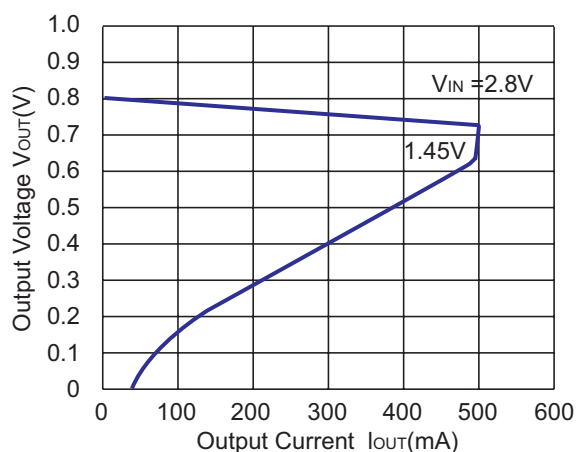
Turn on Speed with CE pin Test Circuit

* Input signal waveform to CE pin is shown below.
 Set V_{OUT}
 0V $\rightarrow$ +1.0V

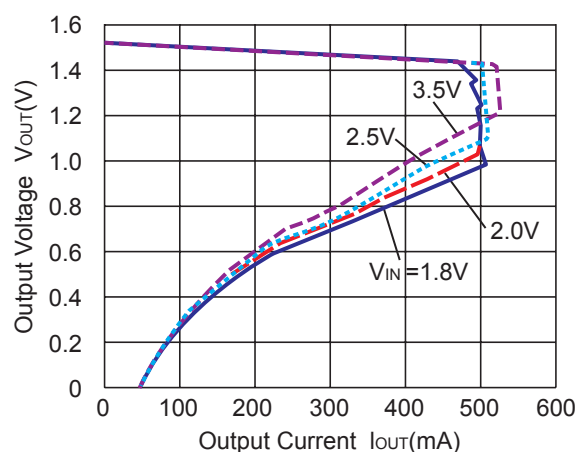
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

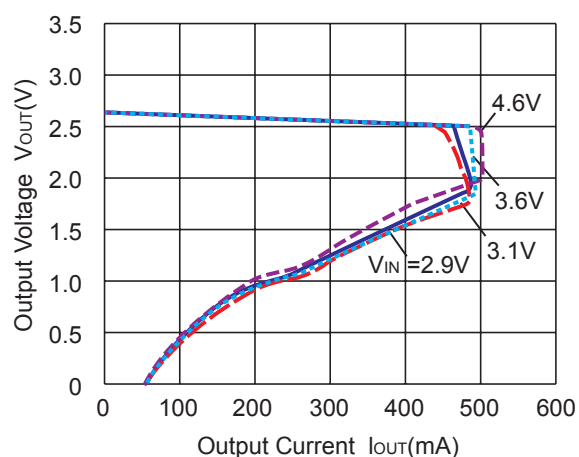
R1131x08xx



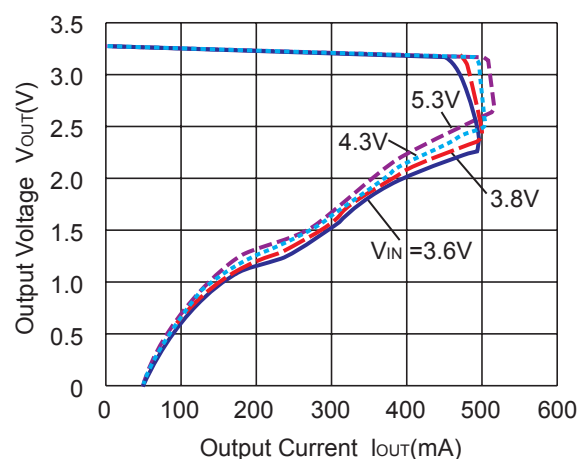
R1131x15xx



R1131x26xx

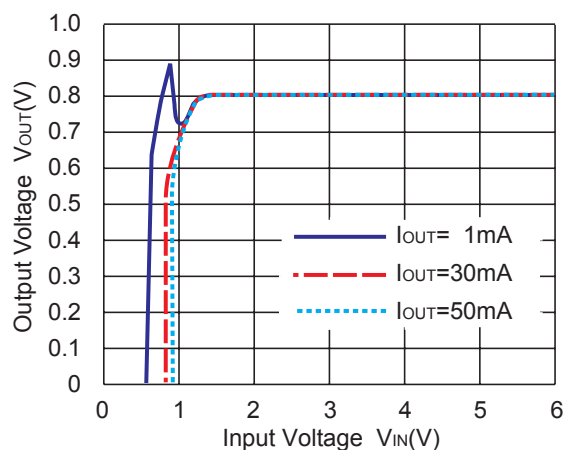


R1131x33xx

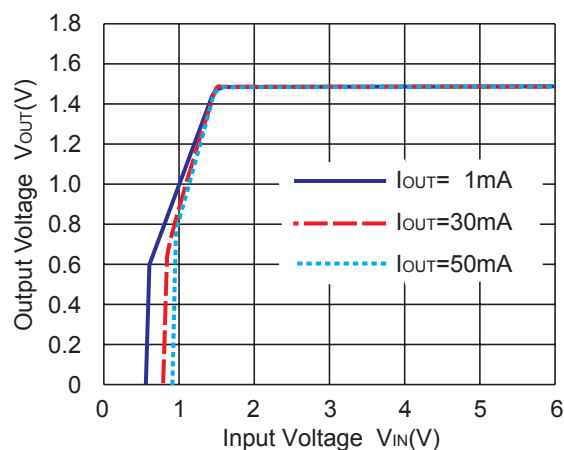


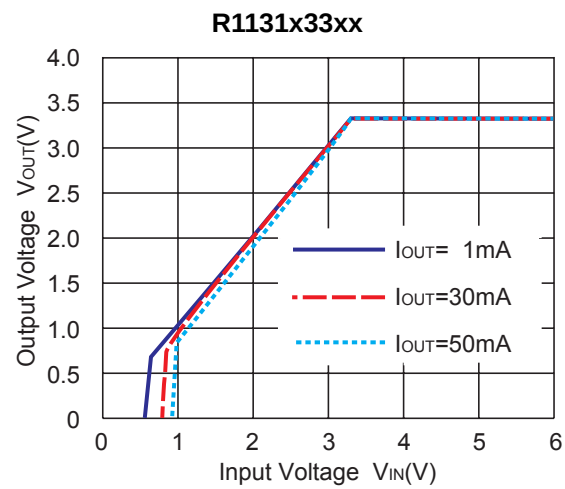
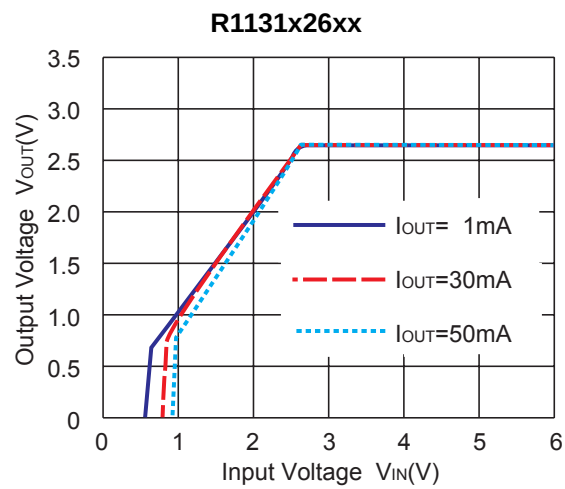
2) Output Voltage vs. Input Voltage

R1131x08xx

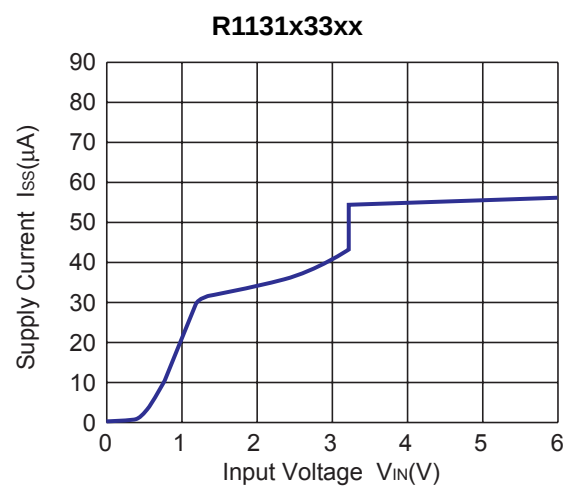
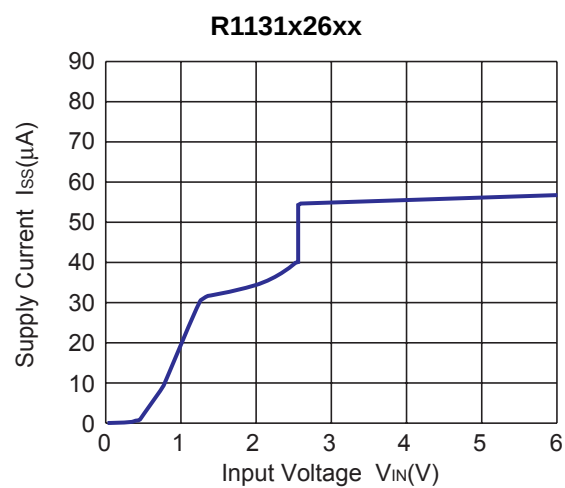
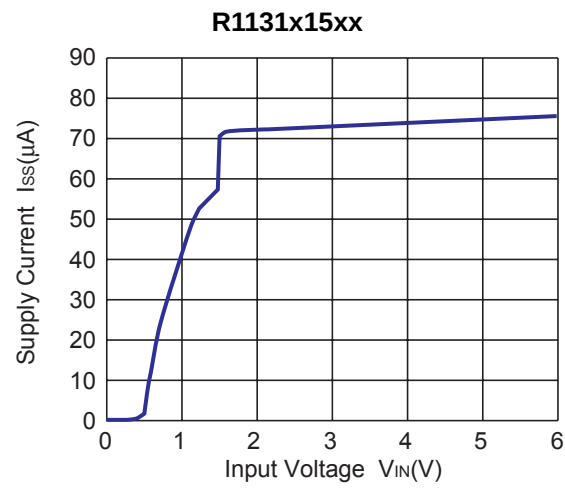
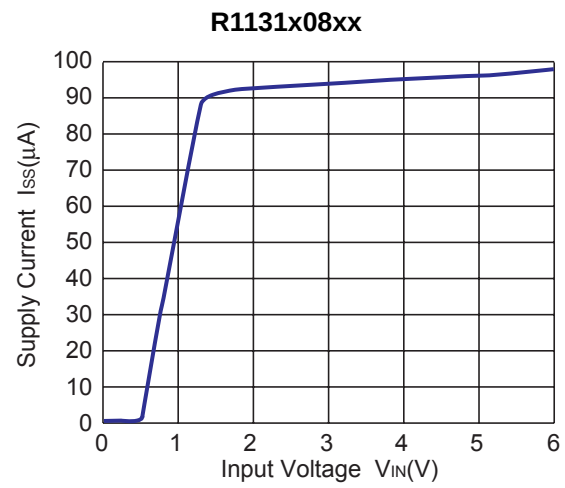


R1131x15xx



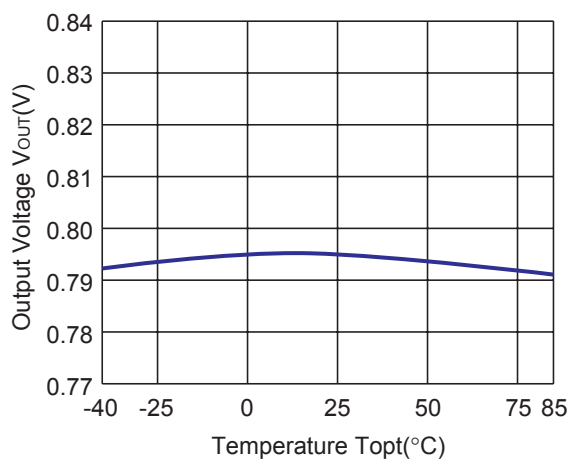


3) Supply Current vs. Input Voltage

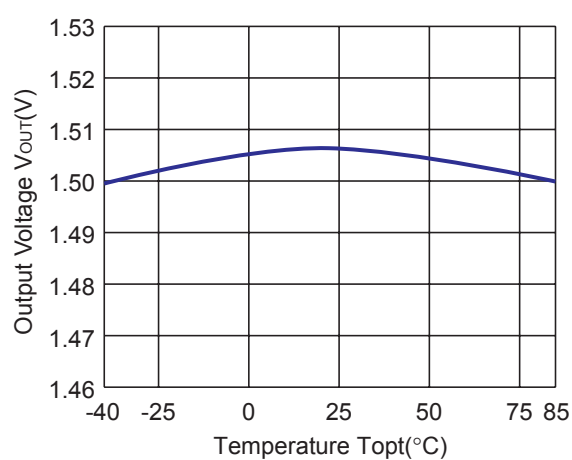


4) Output Voltage vs. Temperature

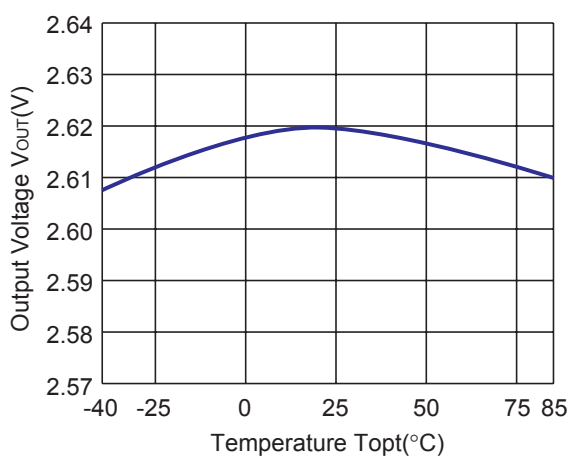
R1131x08xx



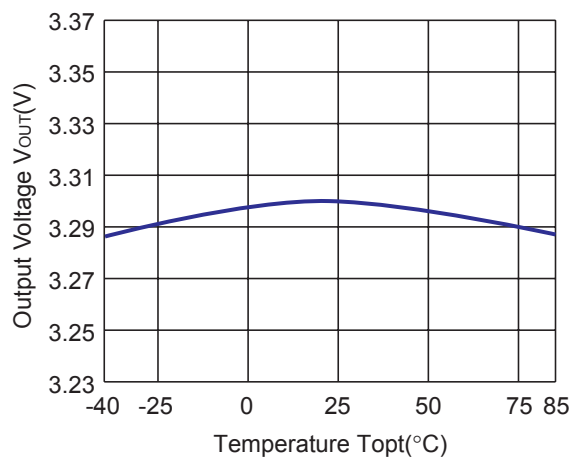
R1131x15xx



R1131x26xx

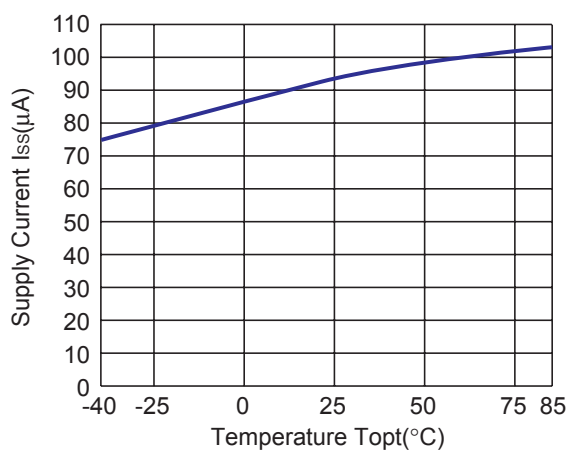


R1131x33xx

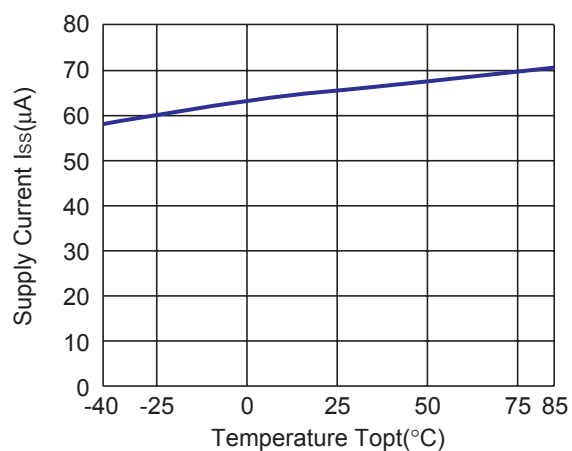


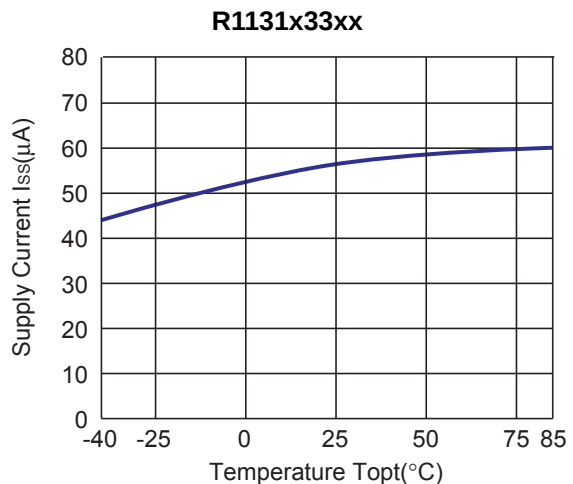
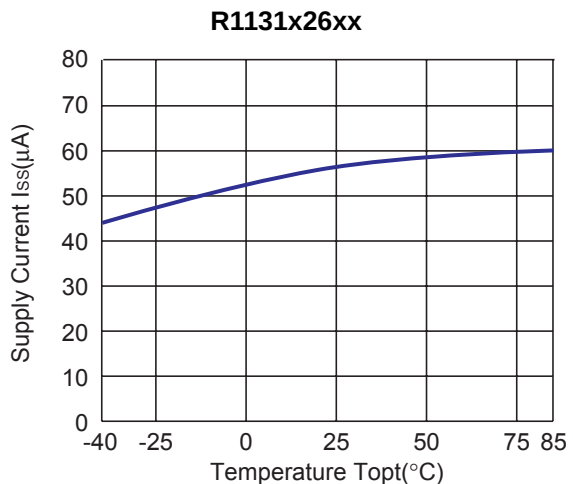
5) Supply Current vs. Temperature

R1131x08xx

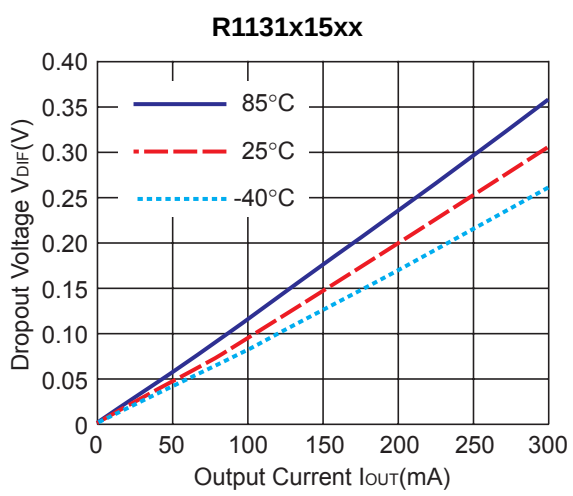
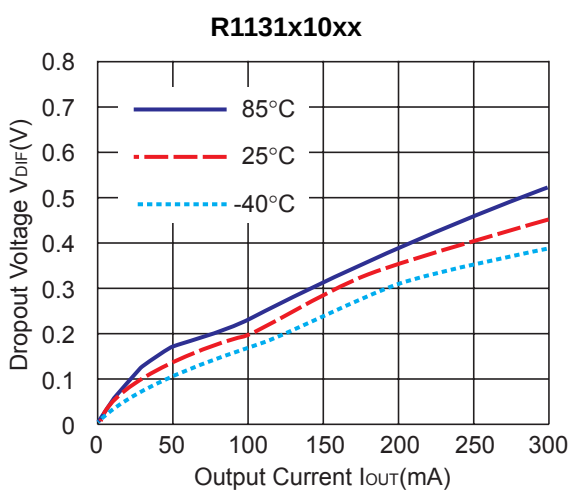
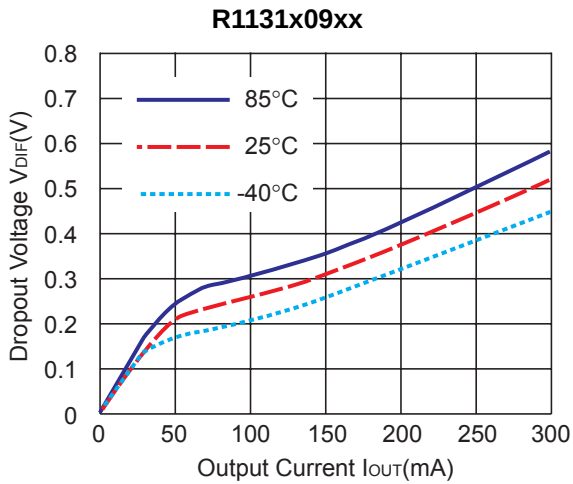
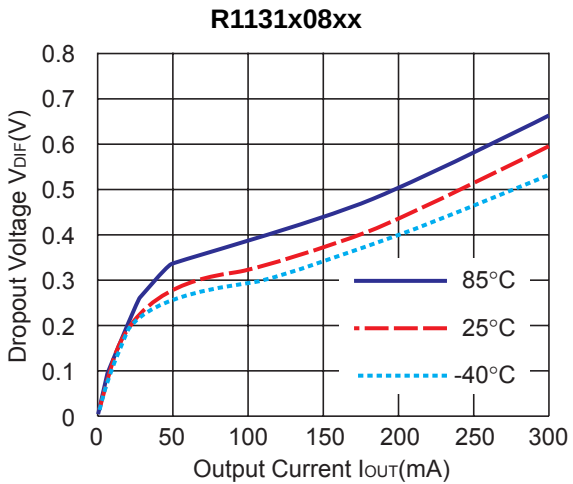


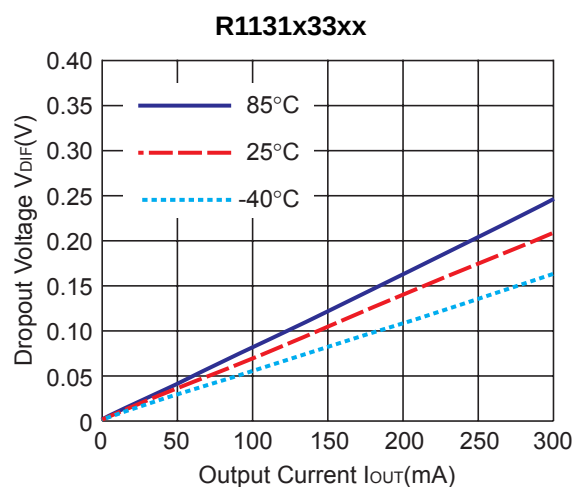
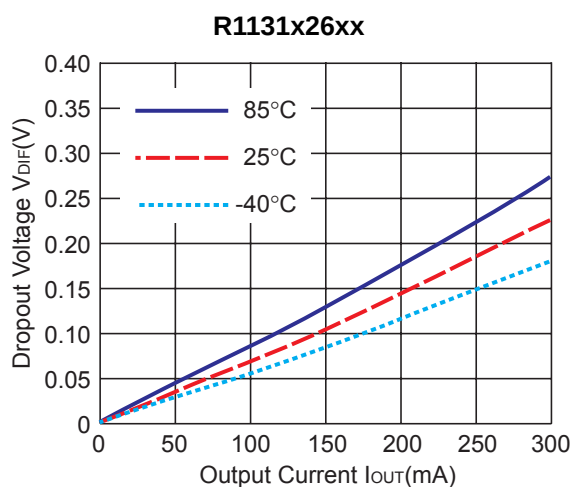
R1131x15xx



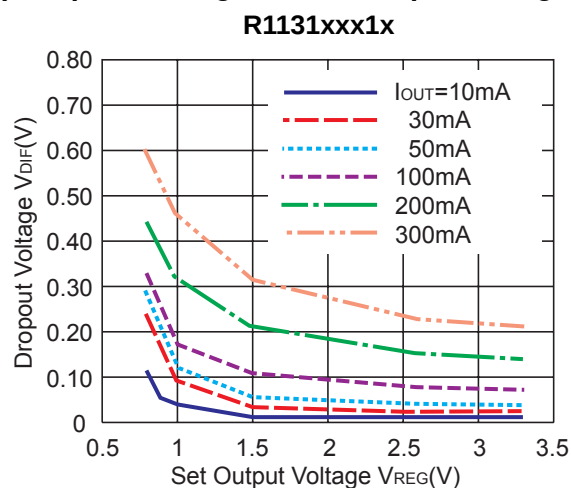


6) Dropout Voltage vs. Output Current

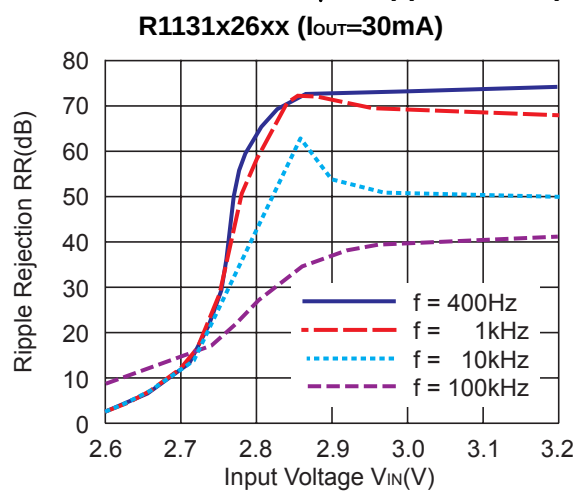
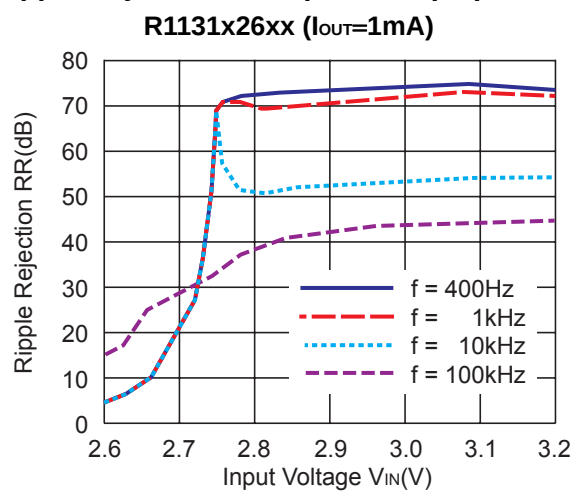


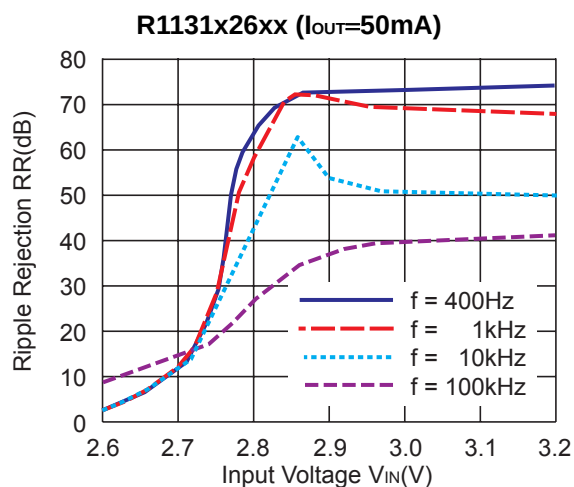


7) Dropout Voltage vs. Set Output Voltage (T_{opt}=25°C)

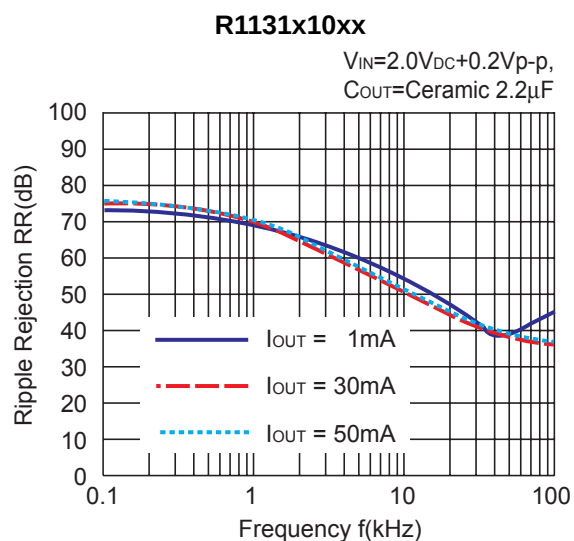
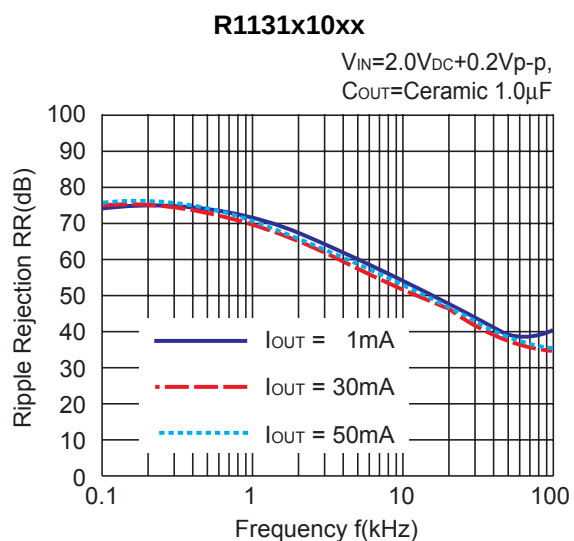
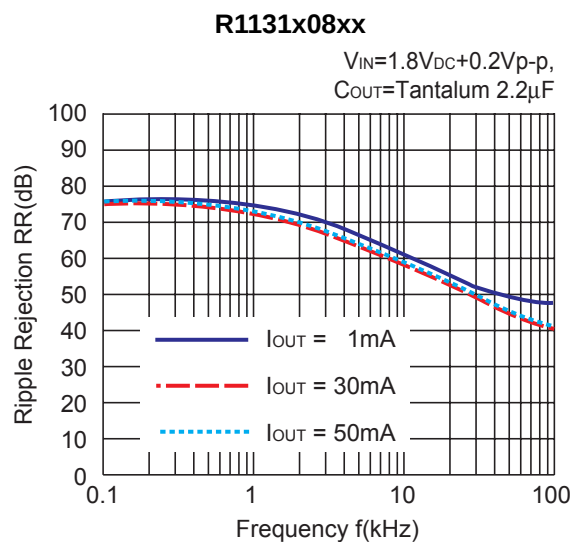
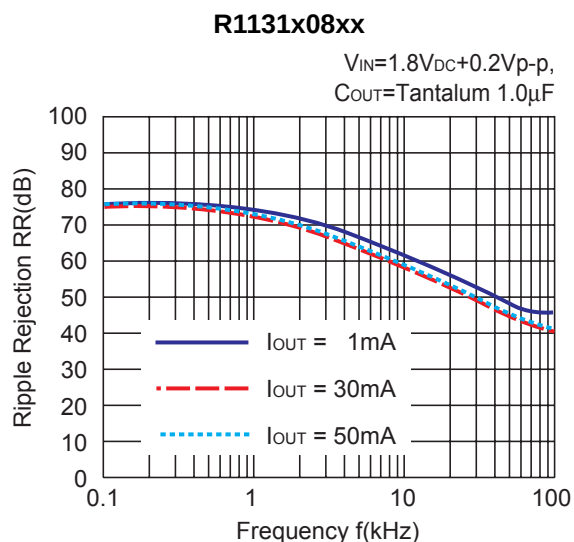


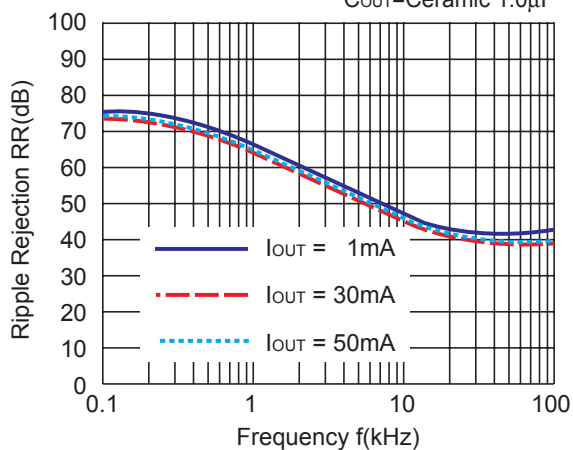
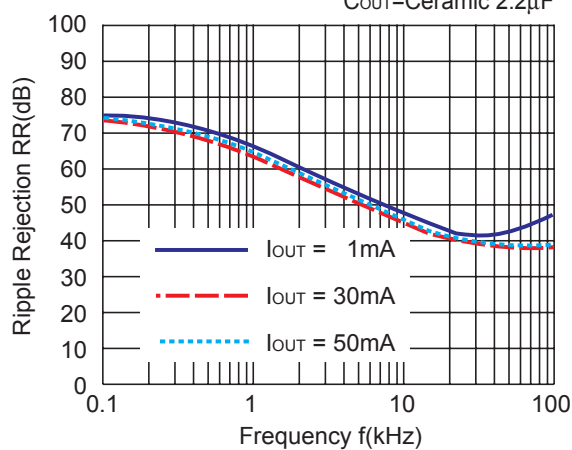
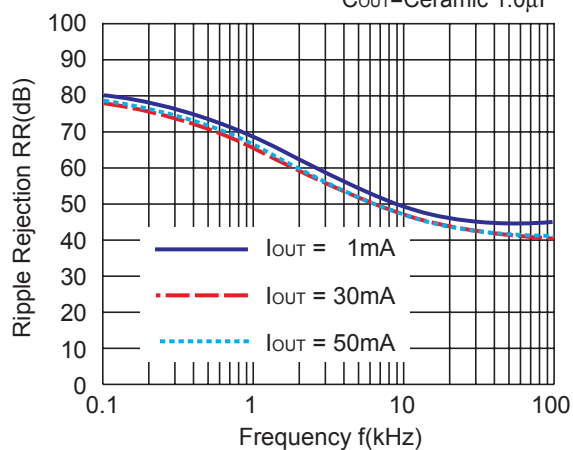
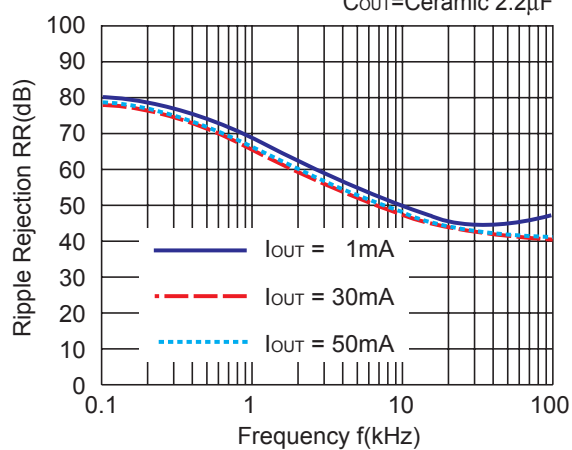
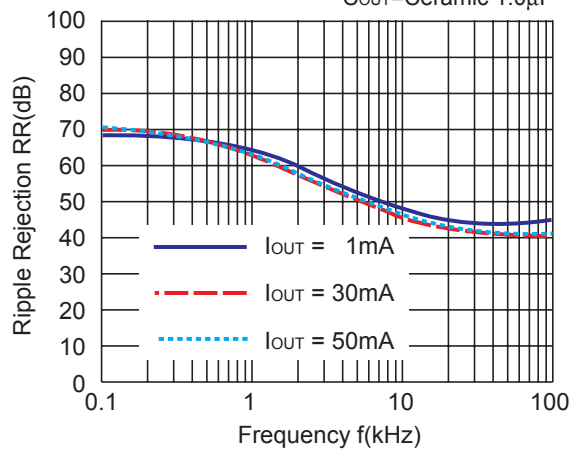
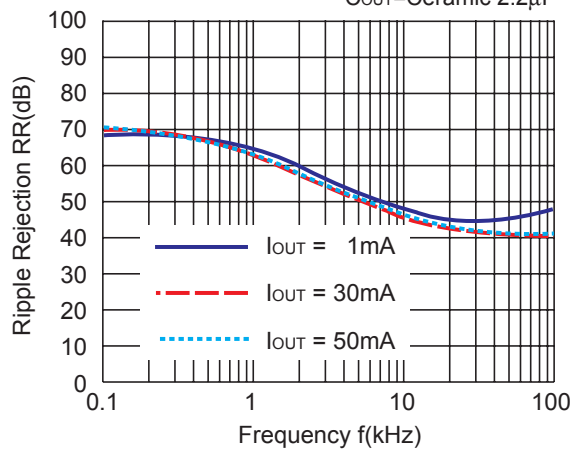
8) Ripple Rejection vs. Input Bias (T_{opt}=25°C C_{IN}=none, C_{OUT}=Ceramic 1.0μF Ripple 0.2V_{P-P})

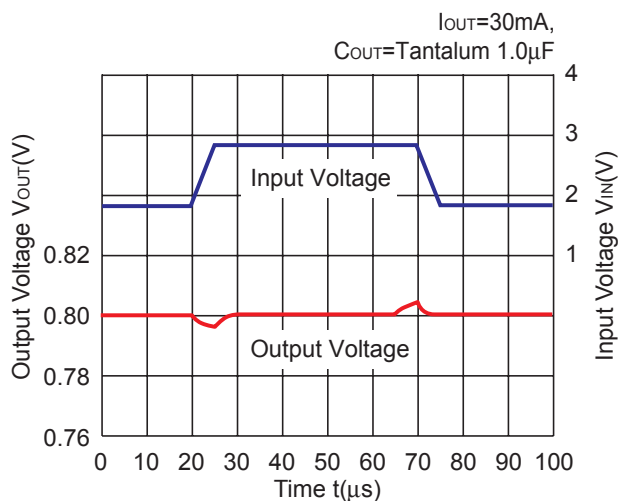
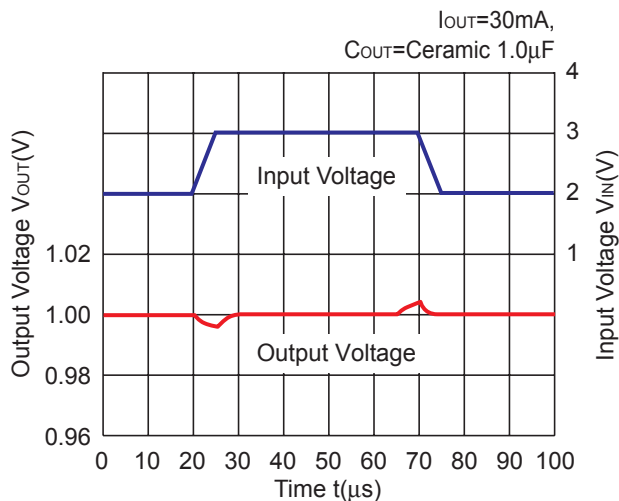
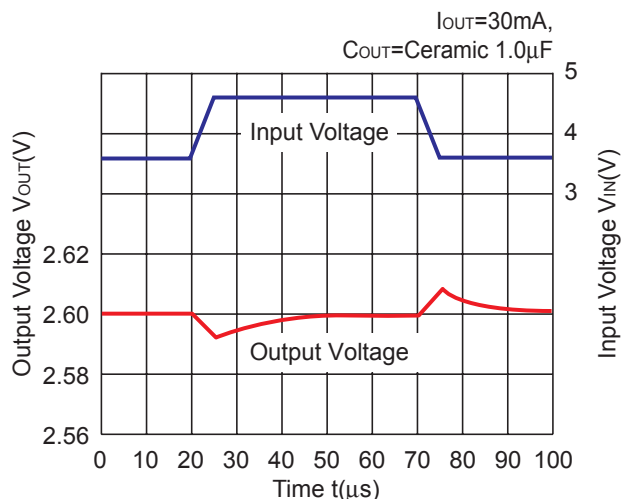




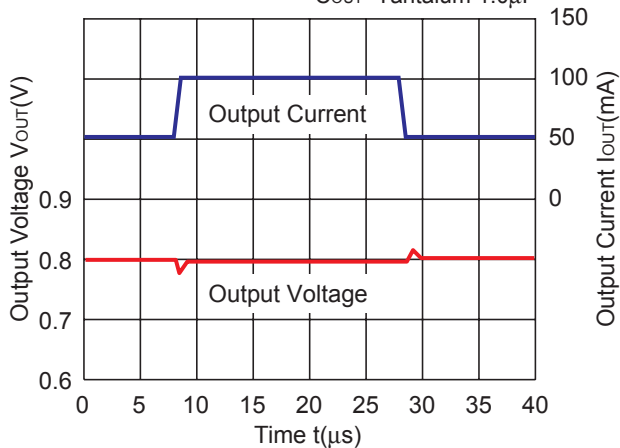
9) Ripple Rejection vs. Frequency ($C_{IN}=none$)



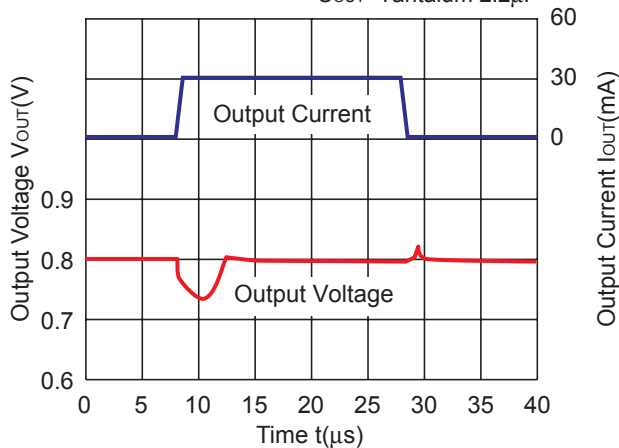
R1131x15xx
 $V_{IN}=2.5V_{DC}+0.2V_{p-p}$,
 $C_{OUT}=\text{Ceramic } 1.0\mu F$
**R1131x15xx**
 $V_{IN}=2.5V_{DC}+0.2V_{p-p}$,
 $C_{OUT}=\text{Ceramic } 2.2\mu F$
**R1131x26xx**
 $V_{IN}=3.6V_{DC}+0.2V_{p-p}$,
 $C_{OUT}=\text{Ceramic } 1.0\mu F$
**R1131x26xx**
 $V_{IN}=3.6V_{DC}+0.2V_{p-p}$,
 $C_{OUT}=\text{Ceramic } 2.2\mu F$
**R1131x33xx**
 $V_{IN}=4.3V_{DC}+0.2V_{p-p}$,
 $C_{OUT}=\text{Ceramic } 1.0\mu F$
**R1131x33xx**
 $V_{IN}=4.3V_{DC}+0.2V_{p-p}$,
 $C_{OUT}=\text{Ceramic } 2.2\mu F$


10) Input Transient Response ($C_{IN}=none$, $t_r=t_f=5\mu s$)
R1131x08xx

R1131x10x

R1131x26xx

11) Load Transient Response ($t_r=t_f=0.5\mu s$)
R1131x08xx

$V_{IN}=1.8V$ $C_{IN}=Tantalum\ 1.0\mu F$,
 $C_{OUT}=Tantalum\ 1.0\mu F$

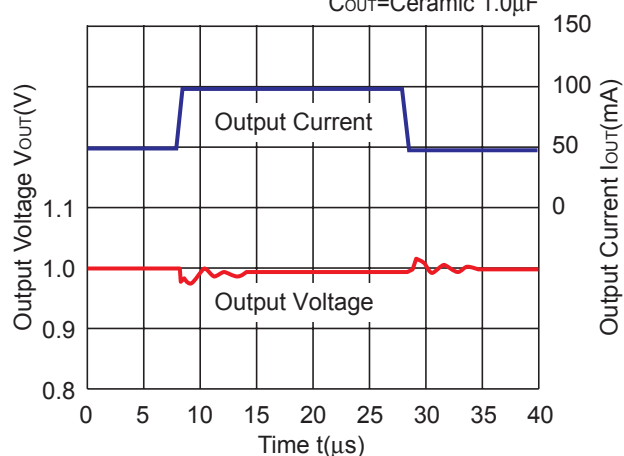

R1131x08xx

$V_{IN}=1.8V$ $C_{IN}=Tantalum\ 1.0\mu F$,
 $C_{OUT}=Tantalum\ 2.2\mu F$

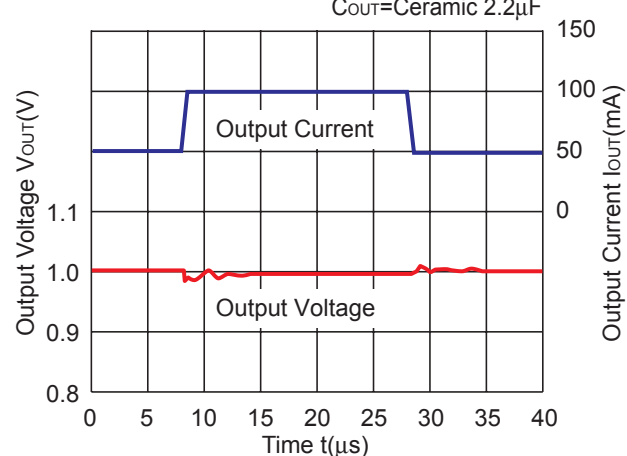


R1131x10xx

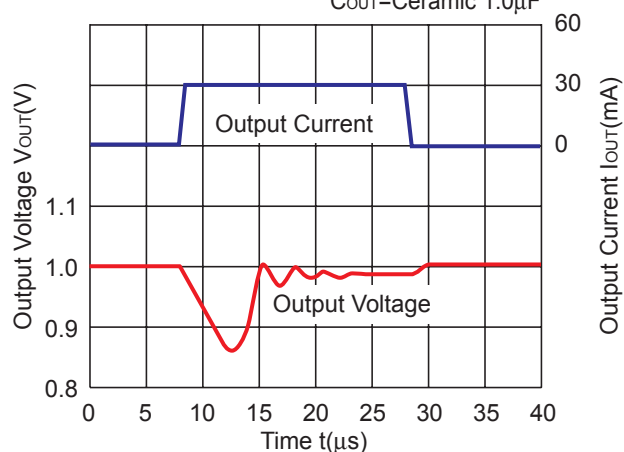
$V_{IN}=2.0V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$

**R1131x10xx**

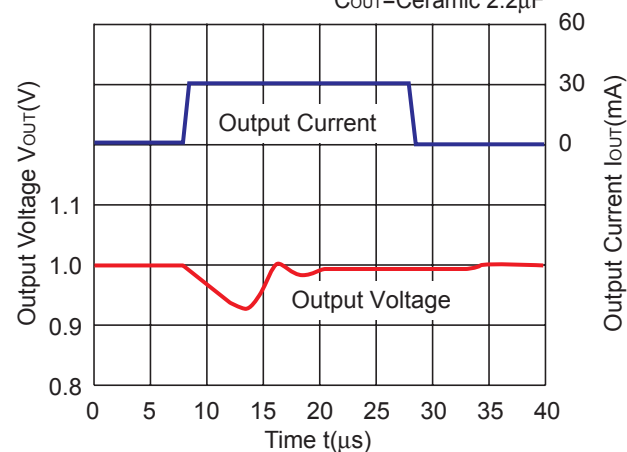
$V_{IN}=2.0V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $2.2\mu F$

**R1131x10xx**

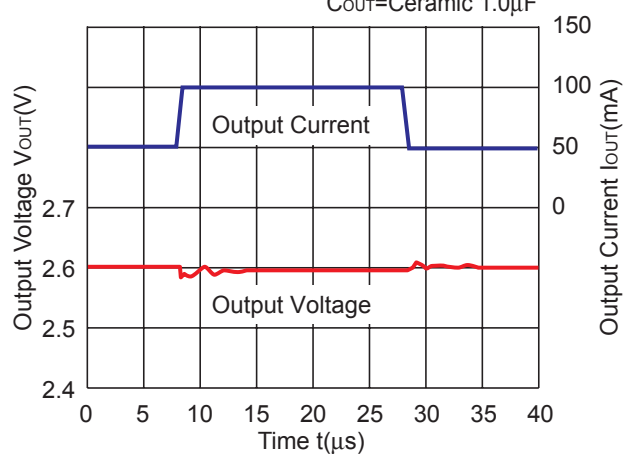
$V_{IN}=2.0V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$

**R1131x10xx**

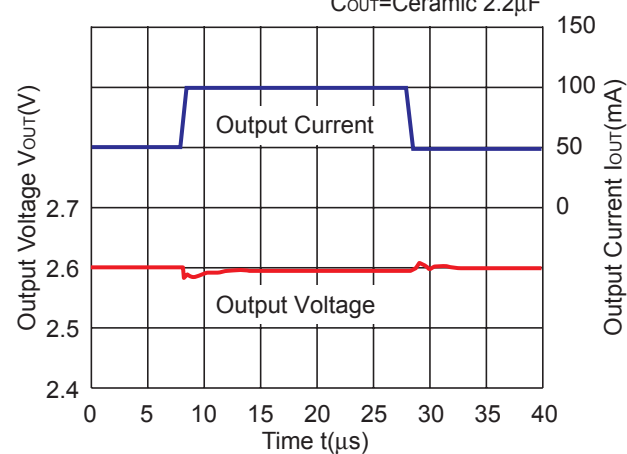
$V_{IN}=2.0V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $2.2\mu F$

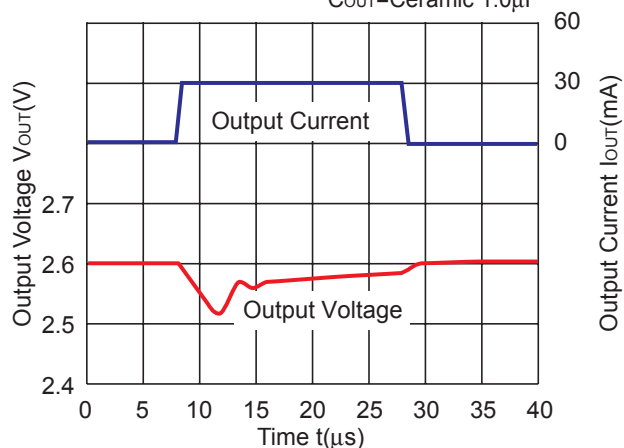
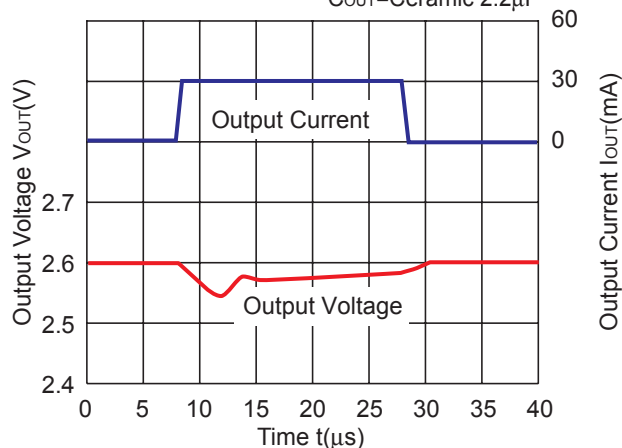
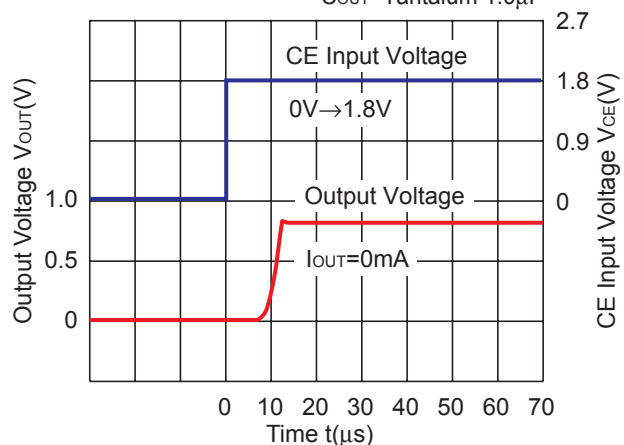
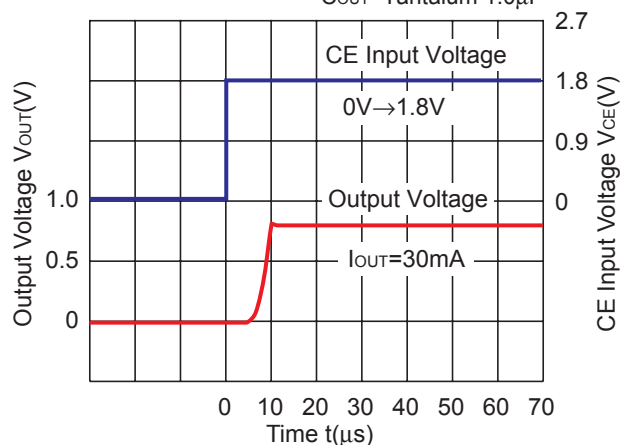
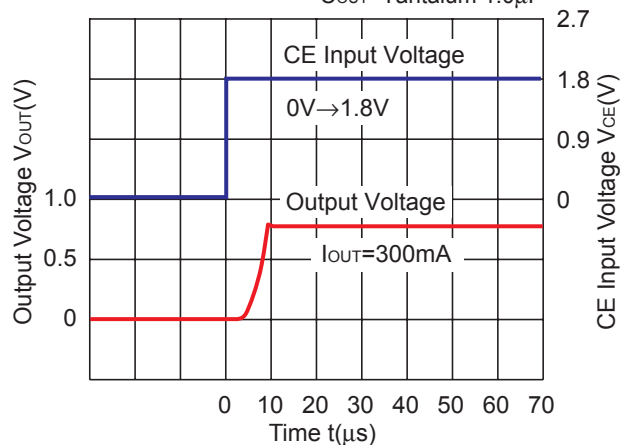
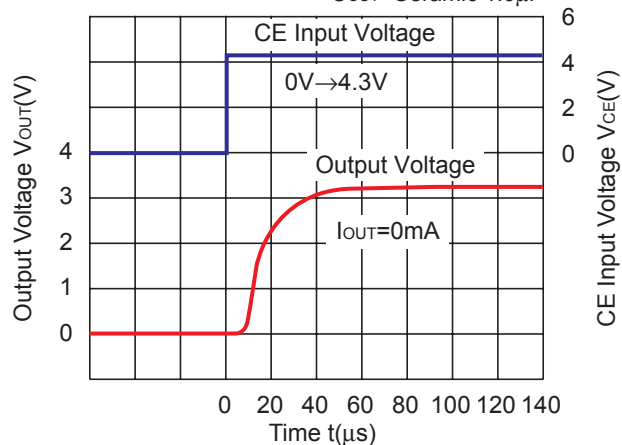
**R1131x26xx**

$V_{IN}=3.6V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$

**R1131x26xx**

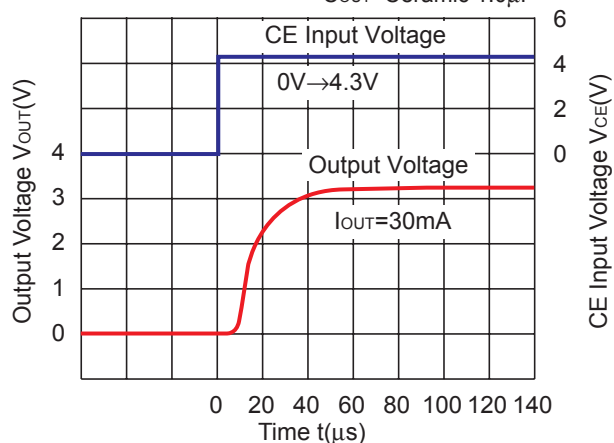
$V_{IN}=3.6V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $2.2\mu F$



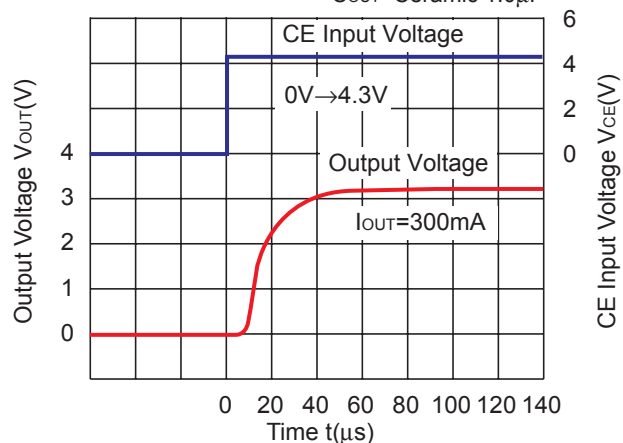
R1131x26xx
 $V_{IN}=3.6V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$

R1131x26xx
 $V_{IN}=3.6V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $2.2\mu F$

12) Turn on speed with CE pin
R1131x08xx
 $V_{IN}=1.8V$ C_{IN} =Tantalum $1.0\mu F$,
 C_{OUT} =Tantalum $1.0\mu F$

R1131x08xx
 $V_{IN}=1.8V$ C_{IN} =Tantalum $1.0\mu F$,
 C_{OUT} =Tantalum $1.0\mu F$

R1131x08xx
 $V_{IN}=1.8V$ C_{IN} =Tantalum $1.0\mu F$,
 C_{OUT} =Tantalum $1.0\mu F$

R1131x33xx
 $V_{IN}=4.3V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$


R1131x33xx (ECO=H)

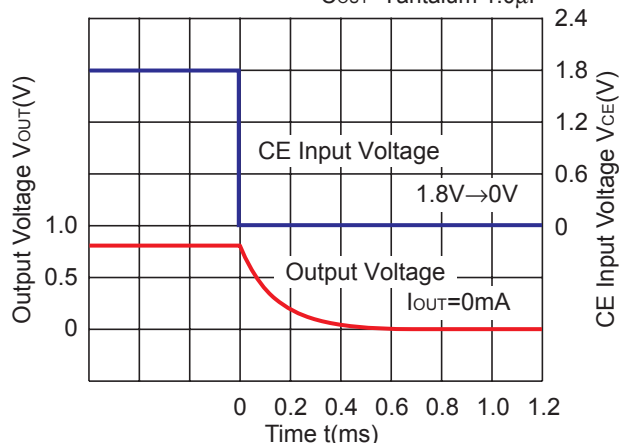
$V_{IN}=4.3V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$

**R1131x33xx (ECO=L)**

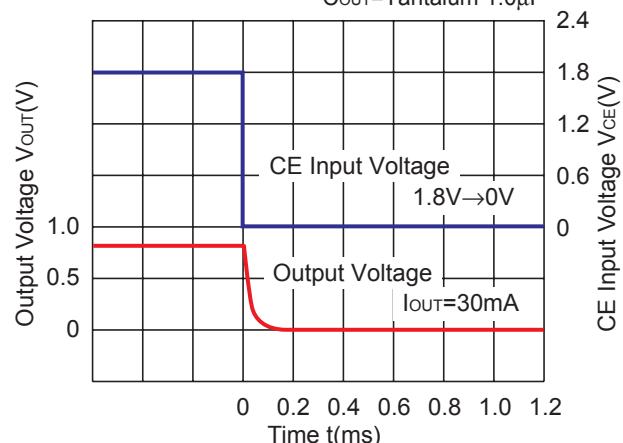
$V_{IN}=4.3V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$

**13) Turn-off Speed with CE****R1131x08xD**

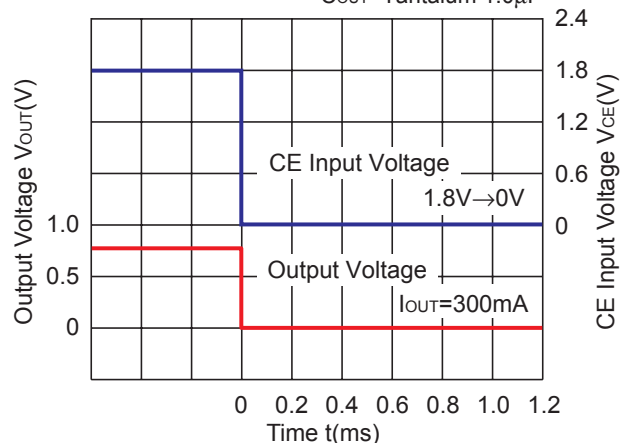
$V_{IN}=1.8V$ C_{IN} =Tantalum $1.0\mu F$,
 C_{OUT} =Tantalum $1.0\mu F$

**R1131x08xD**

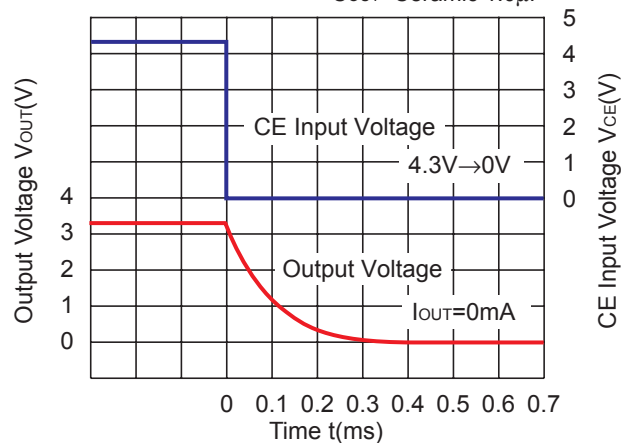
$V_{IN}=1.8V$ C_{IN} =Tantalum $1.0\mu F$,
 C_{OUT} =Tantalum $1.0\mu F$

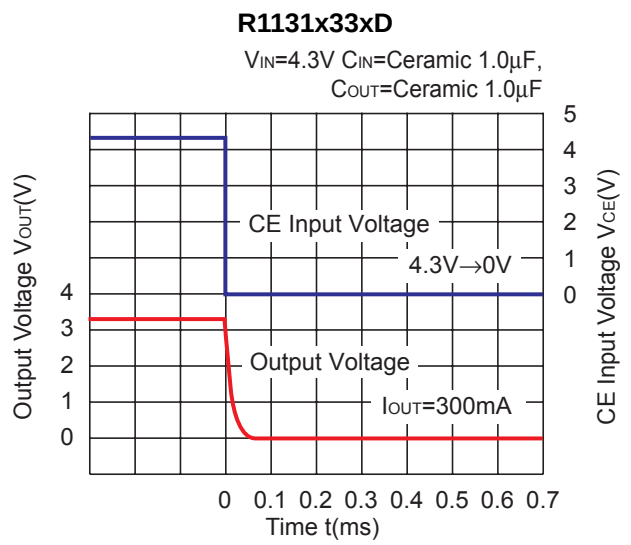
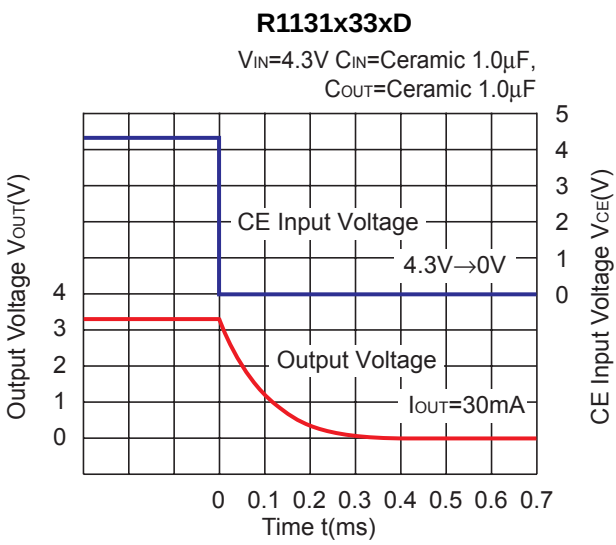
**R1131x08xD**

$V_{IN}=1.8V$ C_{IN} =Tantalum $1.0\mu F$,
 C_{OUT} =Tantalum $1.0\mu F$

**R1131x33xD**

$V_{IN}=4.3V$ C_{IN} =Ceramic $1.0\mu F$,
 C_{OUT} =Ceramic $1.0\mu F$





ESR vs. Output Current

When using these ICs, consider the following points:

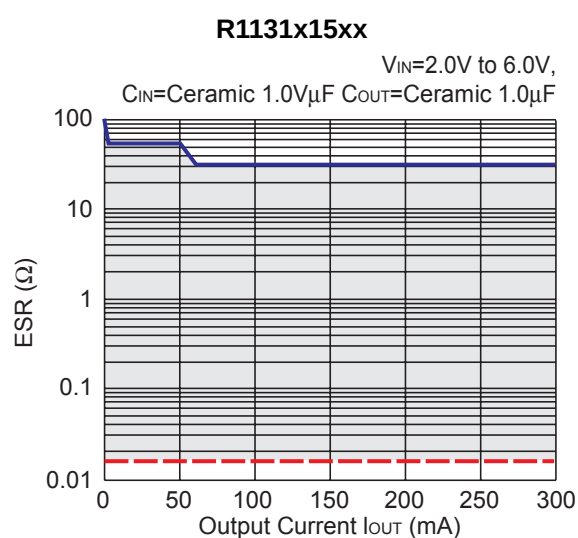
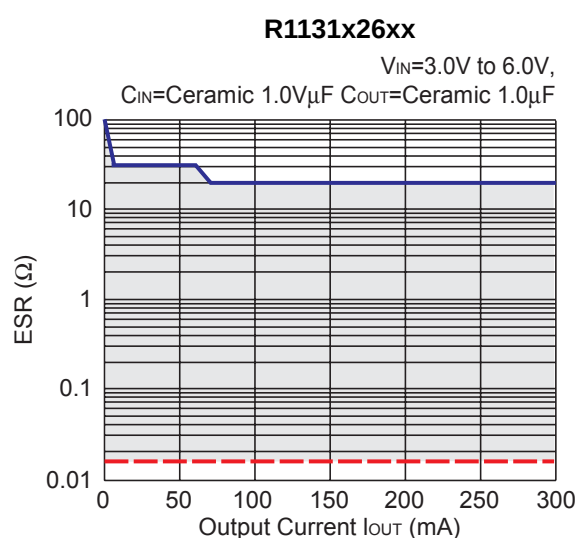
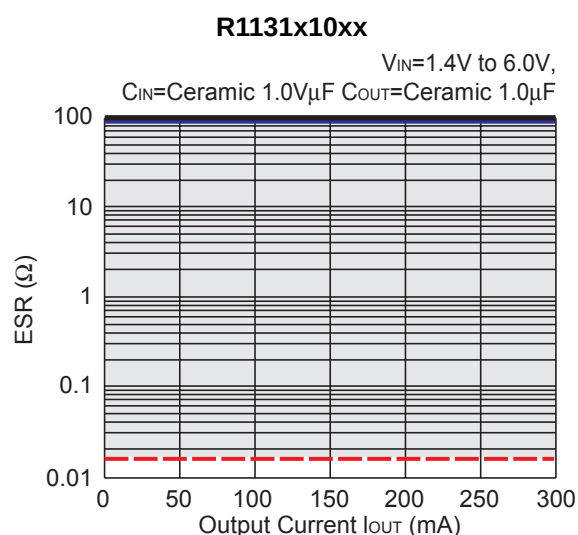
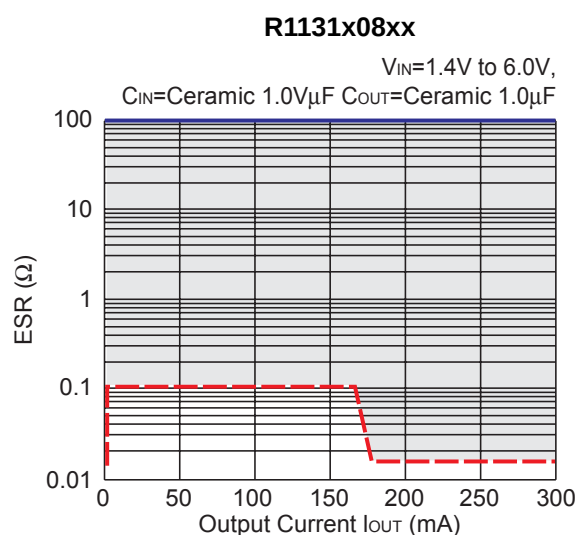
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, be sure to use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance) of which is in the range described as follows:

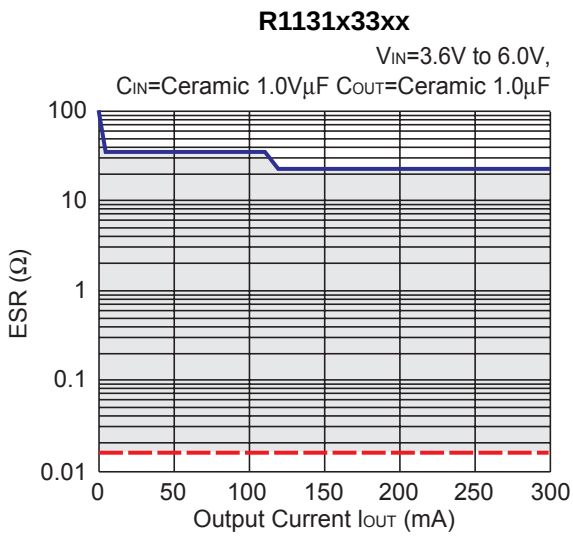
The relations between I_{OUT} (Output Current) and ESR of Output Capacitor are shown below.

The conditions when the white noise level is under $40\mu V(Avg.)$ are marked as the hatched area in the graph.

<Test conditions>

- (1) Frequency band: 10Hz to 2MHz
- (2) Temperature: 25°C







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