RICOH

R1131x SERIES

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

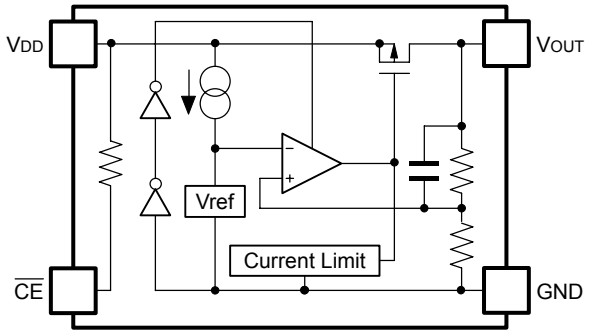
- Supply Current ..... Typ. 80μA (V_{OUT} < 1.8V)
  Typ. 60μA (V_{OUT} ≥ 1.8V)
- Standby Mode ..... Typ. 0.1μA
- Low Dropout Voltage ..... Typ. 0.48V(I_{OUT}=300mA Output Voltage=1.0V Type)
  Typ. 0.31V(I_{OUT}=300mA Output Voltage=1.5V Type)
  Typ. 0.23V(I_{OUT}=300mA Output Voltage=3.0V Type)
- Ripple Rejection ..... Typ. 65dB(f=1kHz)
- Low Temperature-Drift Coefficient of Output Voltage Typ. ±100ppm/°C
- Excellent Line Regulation ..... Typ. 0.01%/V
- Output Voltage Accuracy ..... ±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 1.0μF (V_{OUT} < 1.0V)
  C_{IN}=C_{OUT}=Ceramic 1.0μF (V_{OUT} ≥ 1.0V)

APPLICATIONS

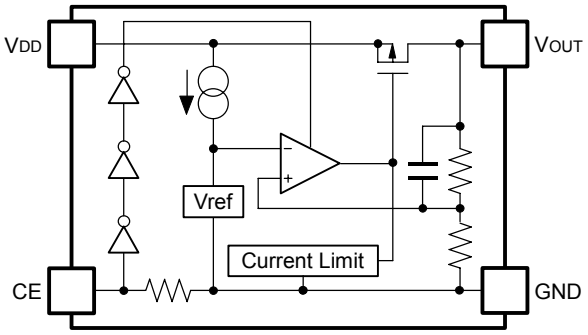
- Precision Voltage References.
- Power source for electrical appliances such as cameras, VCRs and hand-held communication equipment.
- Power source for battery-powered equipment.

BLOCK DIAGRAM

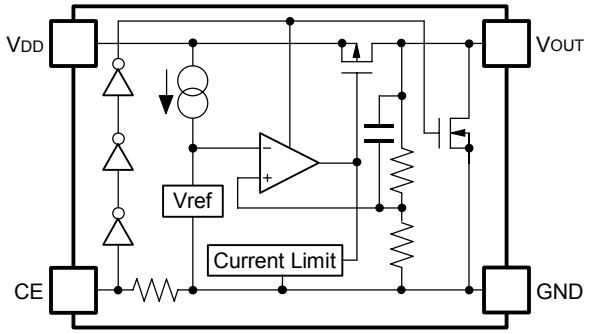
R1131xxxxA



R1131xxxxB



R1131xxxxD



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;

R1131x**XXXX**X-**XX**-**X** ←Part Number

↑ ↑ ↑ ↑ ↑ ↑ ↑

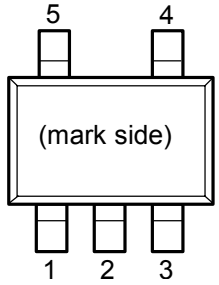
a b a'c d e

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 INFORMATIONS.)
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.

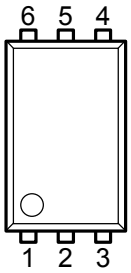
PIN CONFIGURATIONS

● **SOT-23-5**

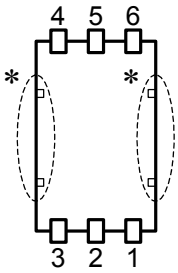


● **SON-6**

Top View

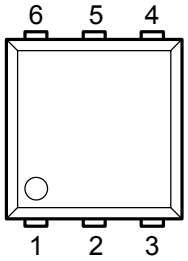


Bottom View

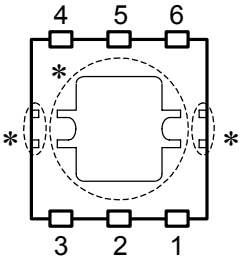


● **HSON-6**

Top View



Bottom View



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 be 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 (HSON-6)*	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.

ELECTRICAL CHARACTERISTICS

- **R1131xxxxA**

Topt=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
Istandby	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}/ ΔTopt	Output Voltage Temperature Coefficient	I_{OUT}=30mA −40°C ≤ Topt ≤ 85°C			±100		ppm /°C
Ilim	Short Current Limit	V_{OUT}=0V			50		mA
R_{PU}	$\overline{CE}$ Pull-up Resistance			1.87	5.0	12.0	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage “H”			1.0		6.0	V
V_{CEL}	$\overline{CE}$ 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.

- **R1131xxxxB/D**

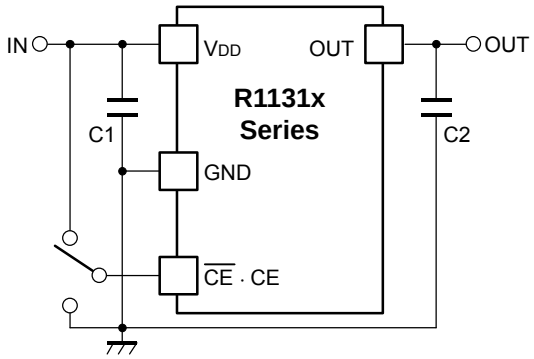
Topt=25°C

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
Istandby	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}/ ΔTopt	Output Voltage Temperature Coefficient	I_{OUT}=30mA −40°C ≤ Topt ≤ 85°C			±100		ppm /°C
Ilim	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 1.0μF CM05X5R105K06AB (Kyocera)
C2 1.0μF C1005JBOJ105K (TDK)
C2 1.0μF GRM155B30J105KE18B (Murata)

Output Capacitor; 1.0μF or more capacity ceramic Type
(If V_{OUT} < 1.0V, Tantalum Type is recommended)
Input Capacitor, 1.0μF 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 1.0μF 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.)

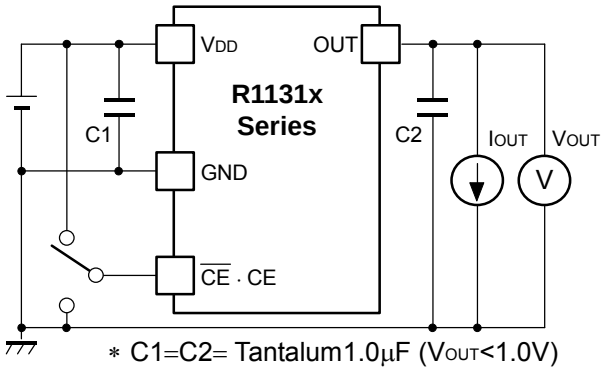
Chip capacitor characteristics of Bias dependence and Temperature characteristics may vary depending on its size, manufacturer, and part number.

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 1.0μF capacitor between V_{DD} and GND pin as close as possible.

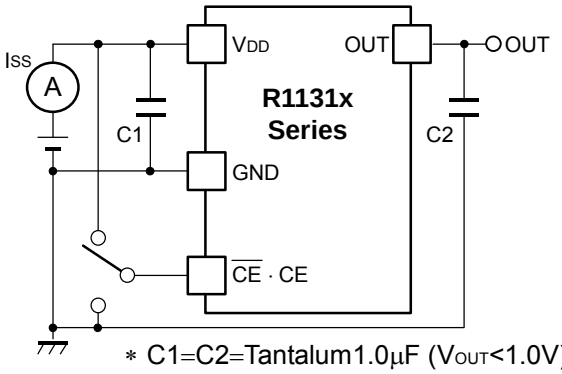
Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible.

TEST CIRCUIT



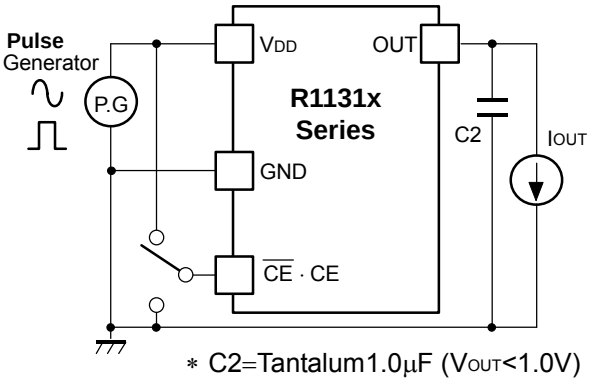
∗ C1=C2= Tantalum1.0μF (V_{OUT}<1.0V)
C1=C2=Ceramic1.0μF (V_{OUT} ≧ 1.0V)

Standard Test Circuit



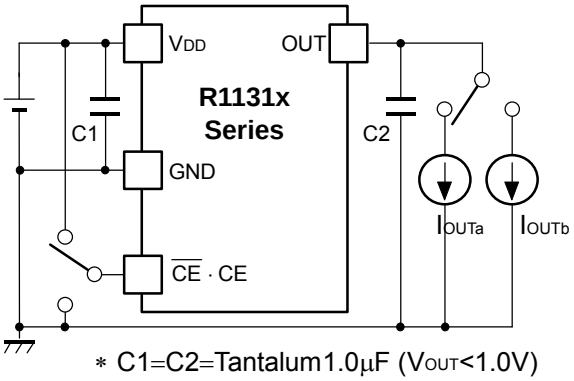
∗ C1=C2=Tantalum1.0μF (V_{OUT}<1.0V)
C1=C2=Ceramic1.0μF (V_{OUT} ≧ 1.0V)

Supply Current Test Circuit



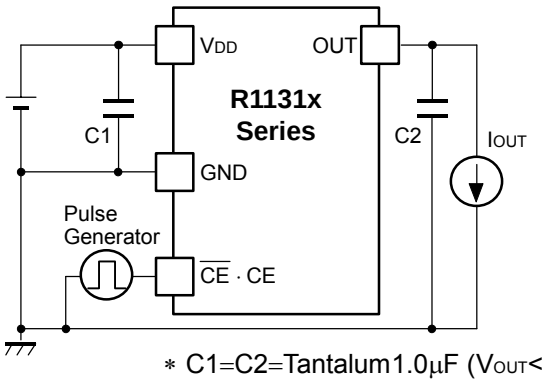
∗ C2=Tantalum1.0μF (V_{OUT}<1.0V)
C2=Ceramic1.0μF (V_{OUT} ≧ 1.0V)

Ripple Rejection, Line Transient Response Test Circuit

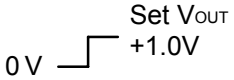


∗ C1=C2=Tantalum1.0μF (V_{OUT}<1.0V)
C1=C2=Ceramic1.0μF (V_{OUT} ≧ 1.0V)

Load Transient Response Test Circuit



∗ Input signal waveform to CE pin is shown below.



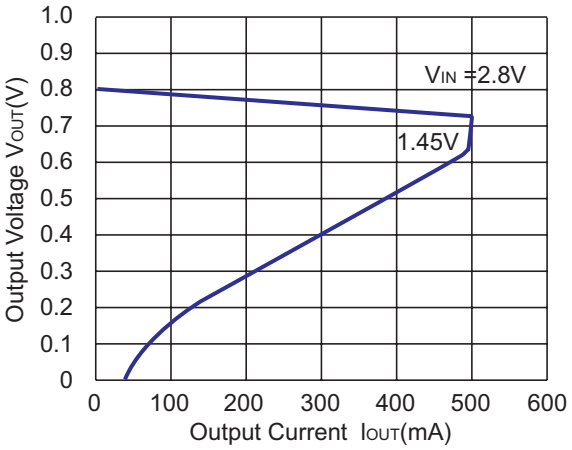
∗ C1=C2=Tantalum1.0μF (V_{OUT}<1.0V)
C1=C2=Ceramic1.0μF (V_{OUT} ≧ 1.0V)

Turn on Speed with CE pin Test Circuit

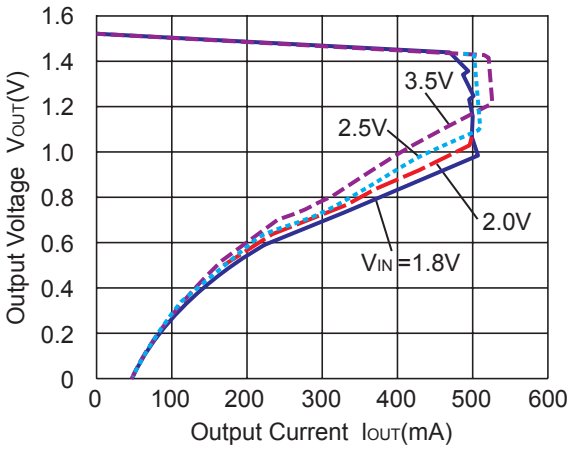
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

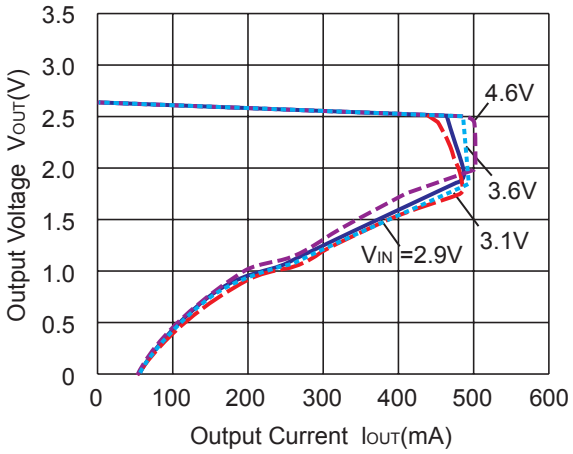
R1131x08xx



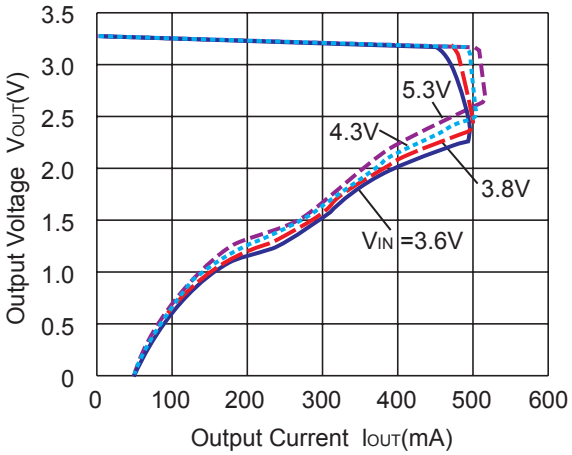
R1131x15xx



R1131x26xx

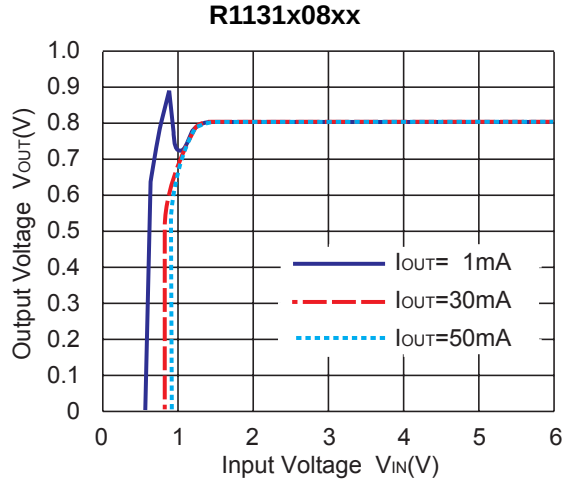


R1131x33xx



2) Output Voltage vs. Input Voltage

R1131x08xx



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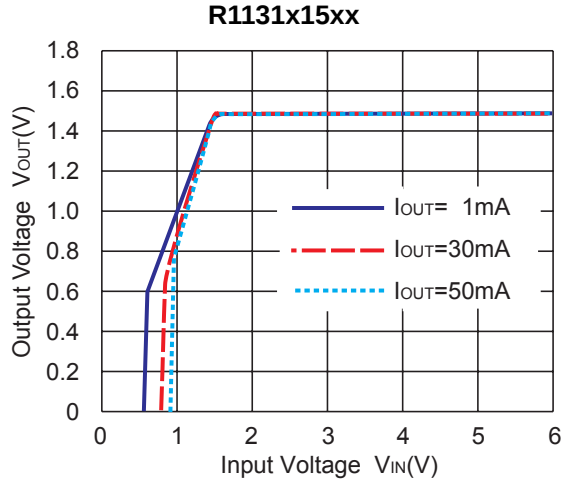
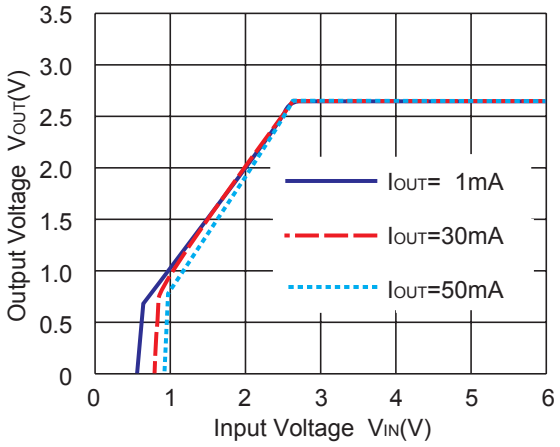
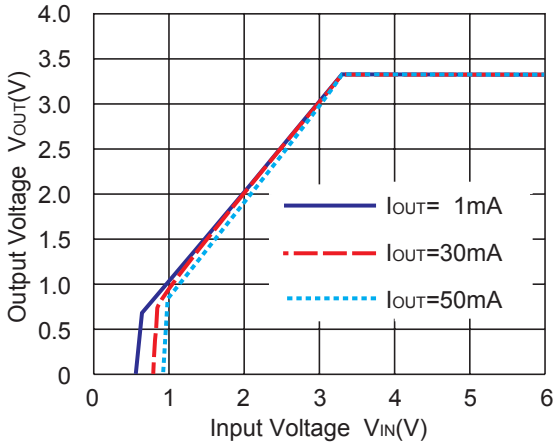


R1131x26xx

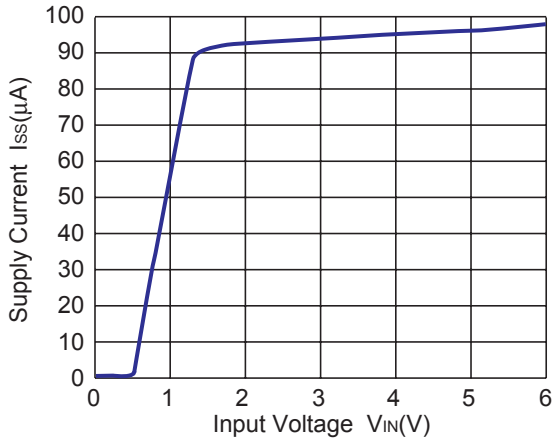


R1131x33xx

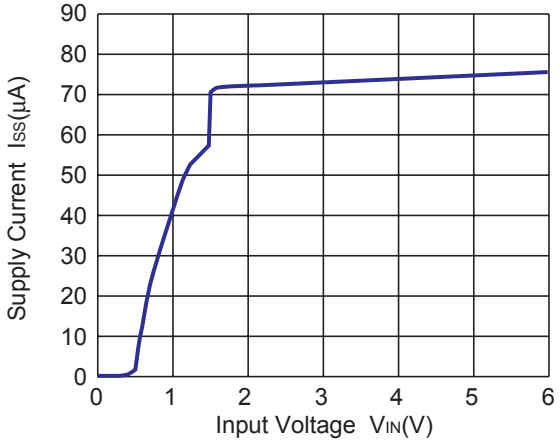


3) Supply Current vs. Input Voltage

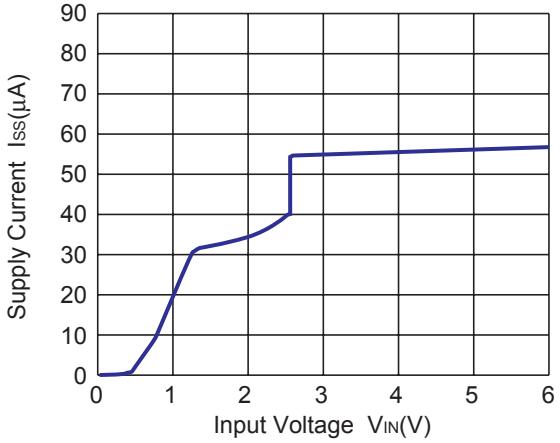
R1131x08xx



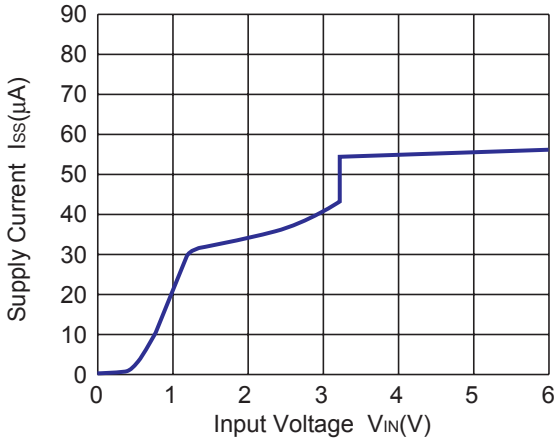
R1131x15xx



R1131x26xx

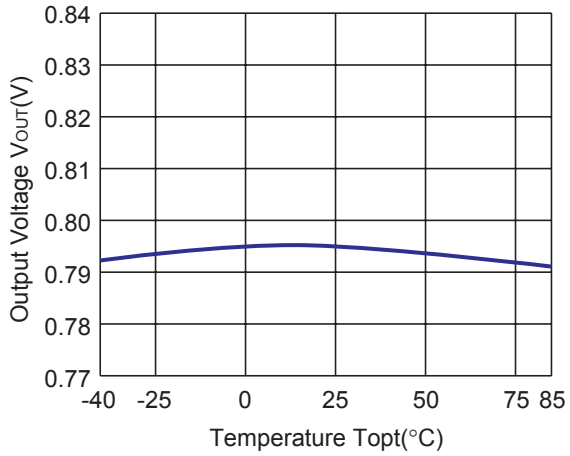


R1131x33xx

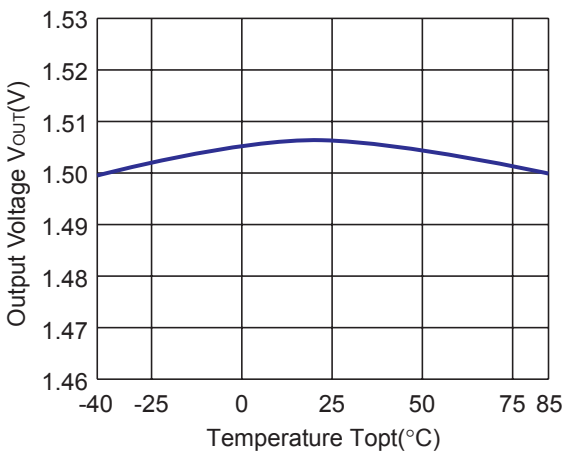


4) Output Voltage vs. Temperature

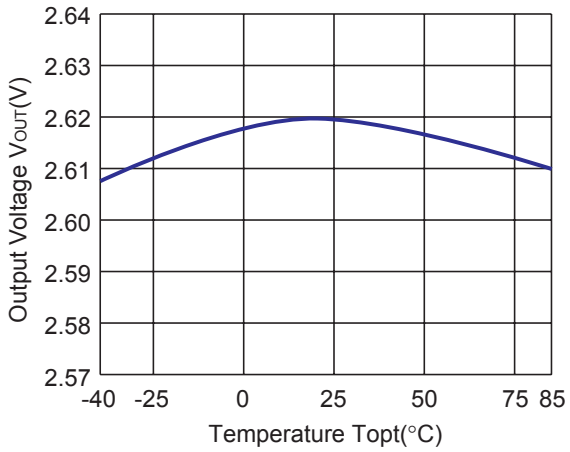
R1131x08xx



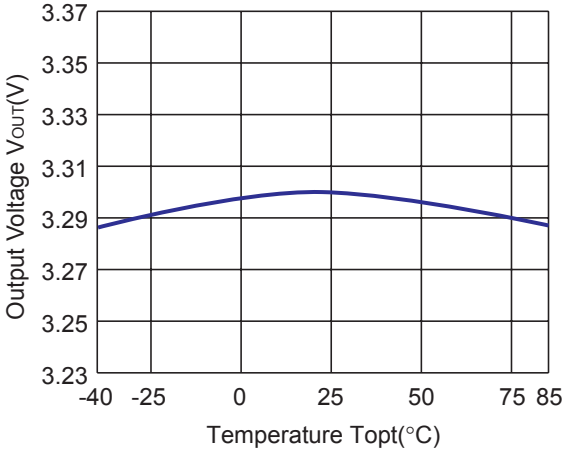
R1131x15xx



R1131x26xx

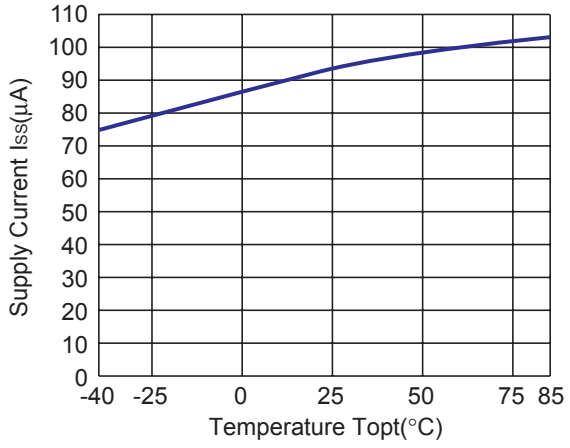


R1131x33xx

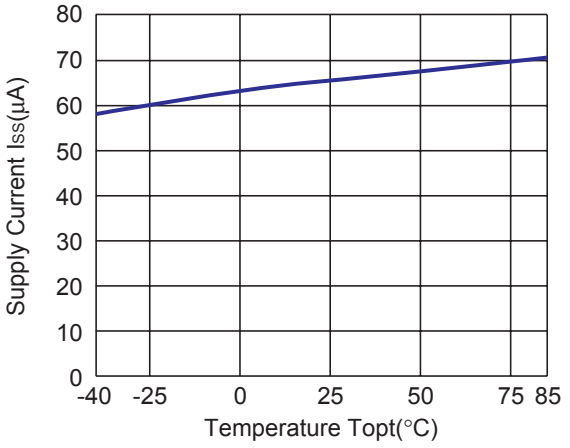


5) Supply Current vs. Temperature

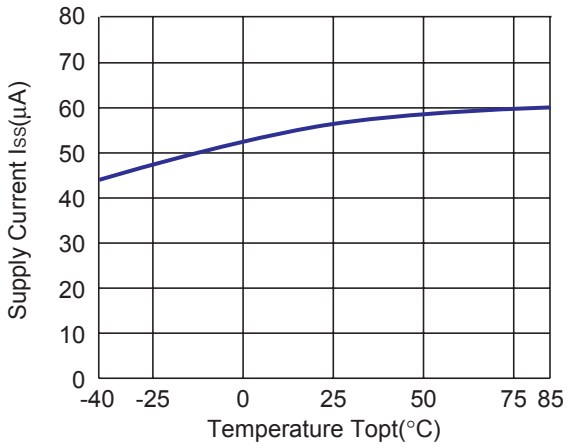
R1131x08xx



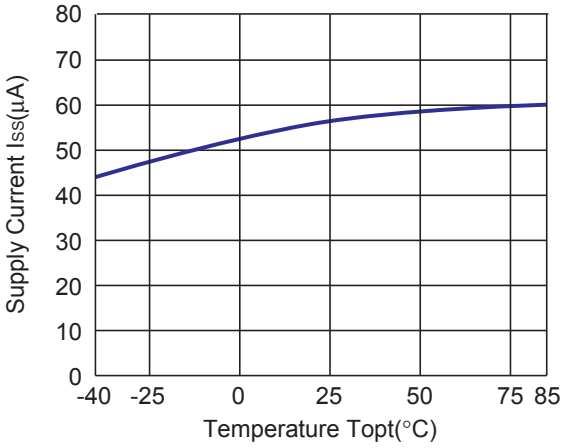
R1131x15xx



R1131x26xx

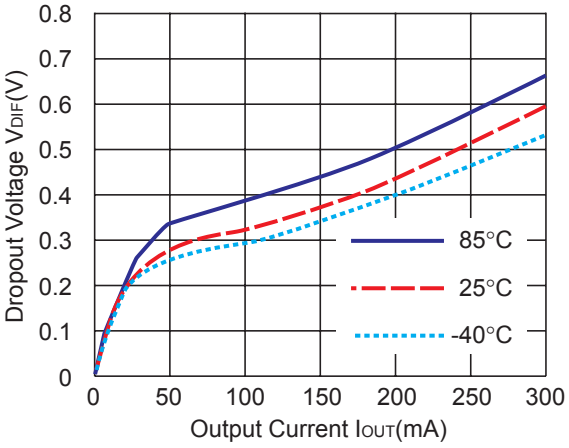


R1131x33xx

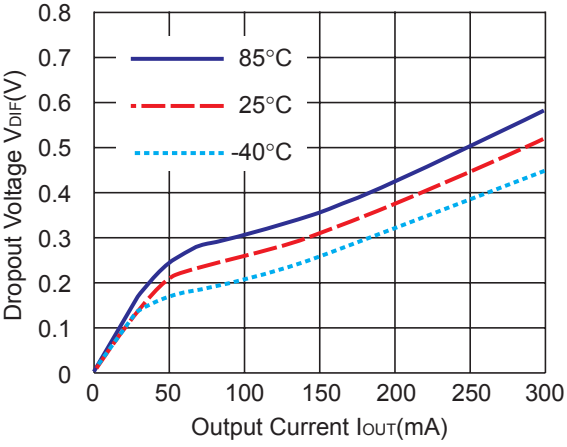


6) Dropout Voltage vs. Output Current

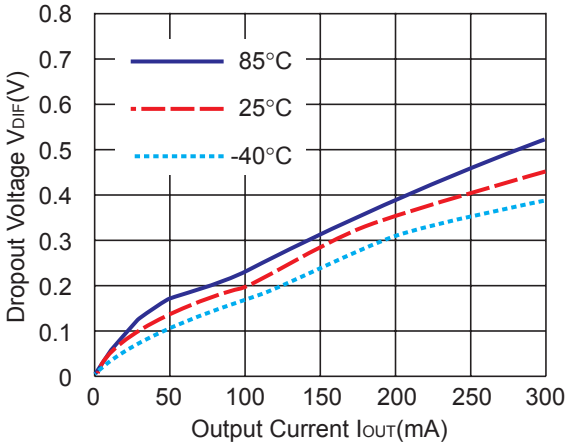
R1131x08xx



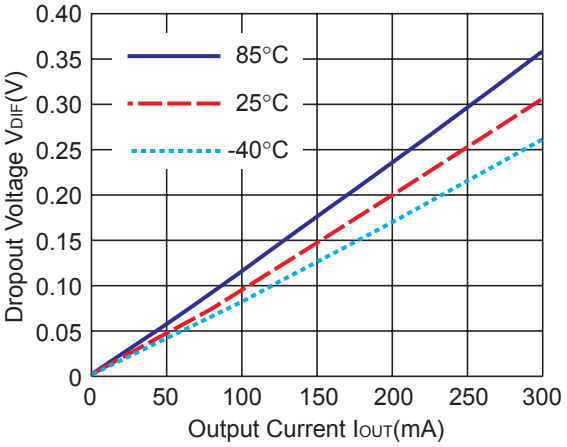
R1131x09xx



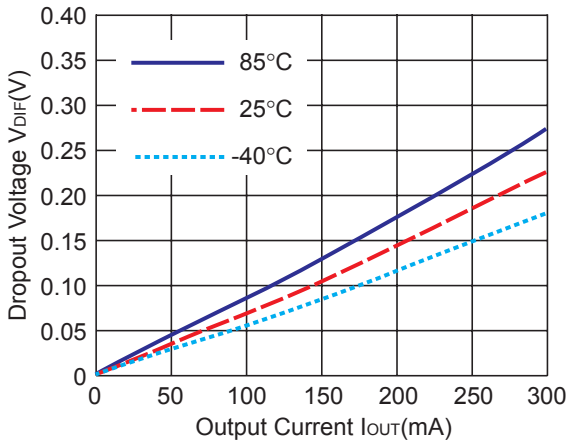
R1131x10xx



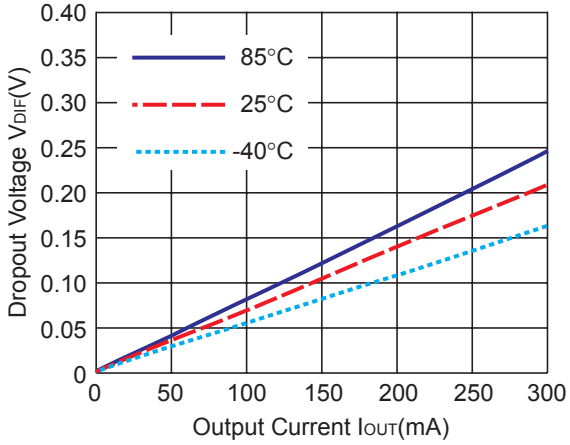
R1131x15xx



R1131x26xx

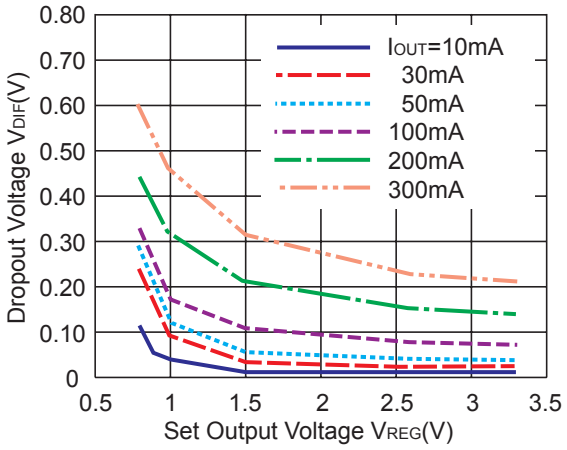


R1131x33xx



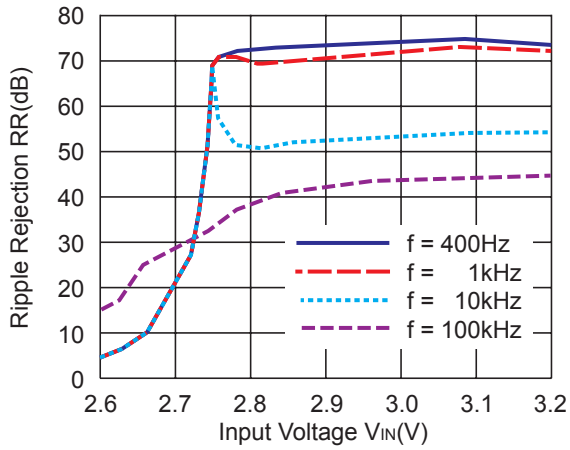
7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

R1131xxx1x

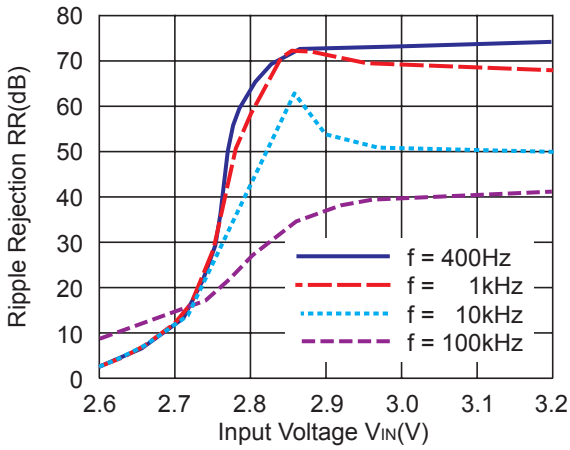


8) Ripple Rejection vs. Input Bias (Topt=25°C CIN=none, COUT=Ceramic 1.0µF Ripple 0.2VP-P)

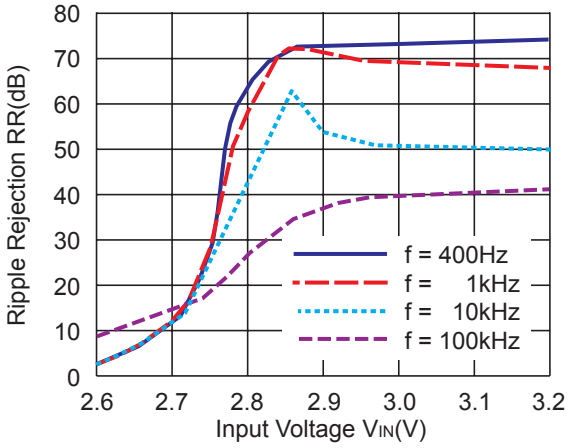
R1131x26xx (IOUT=1mA)



R1131x26xx (IOUT=30mA)

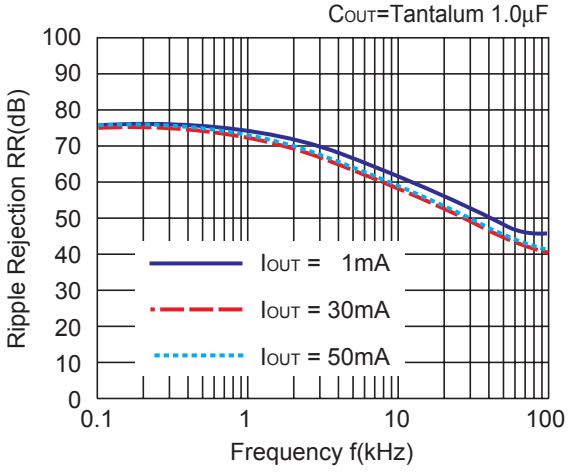


R1131x26xx (I_{OUT}=50mA)

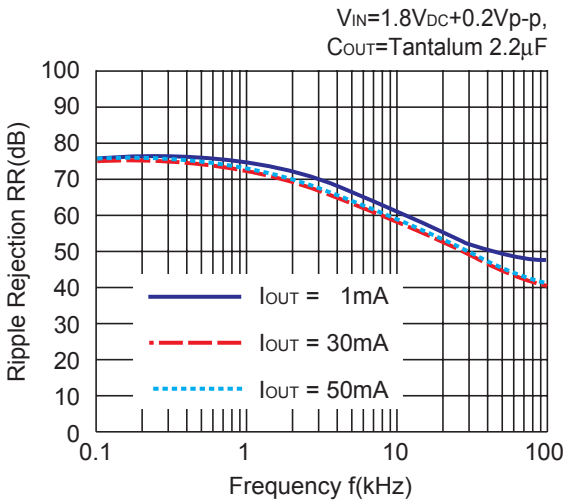


9) Ripple Rejection vs. Frequency (C_{IN}=none)

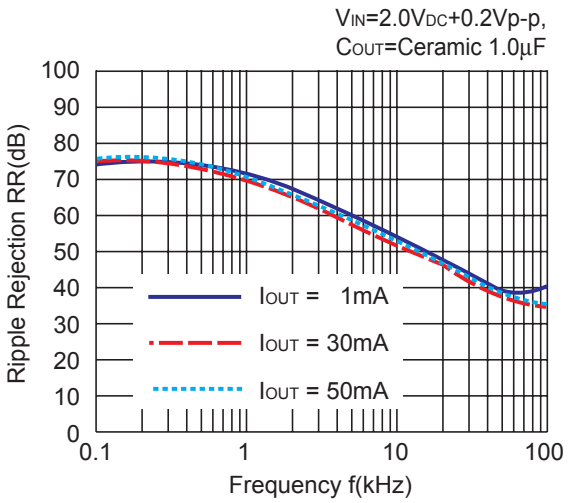
R1131x08xx



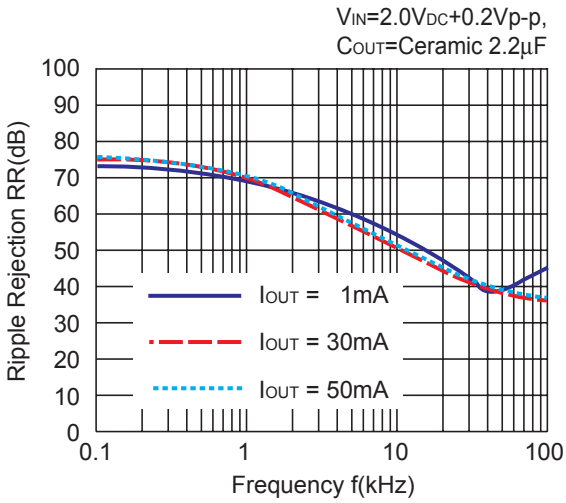
R1131x08xx



R1131x10xx

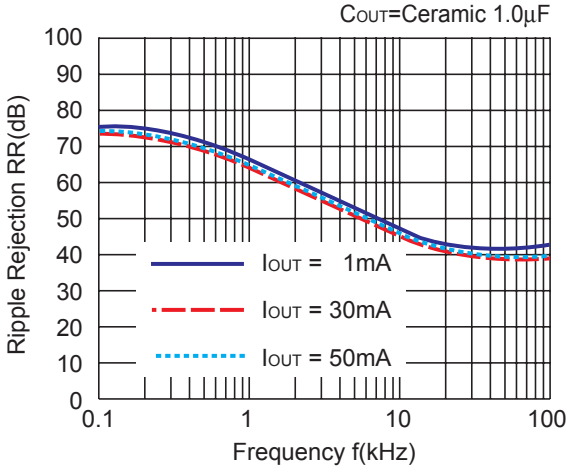


R1131x10xx



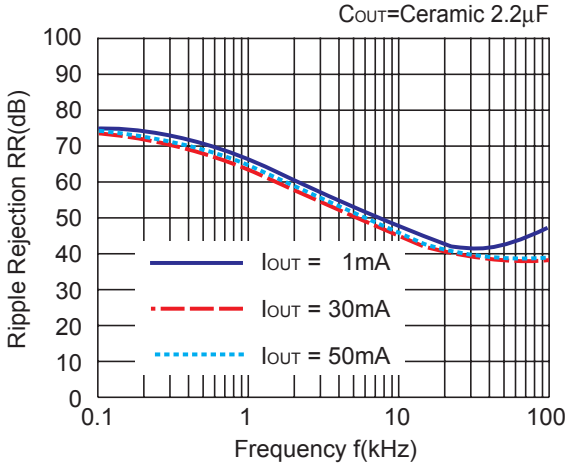
R1131x15xx

V_{IN}=2.5V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 1.0µF



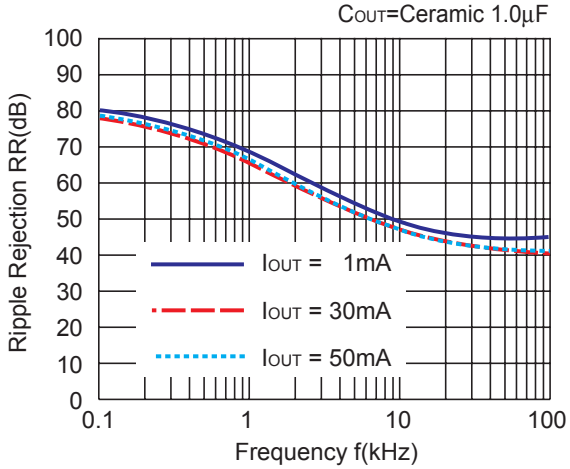
R1131x15xx

V_{IN}=2.5V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 2.2µF



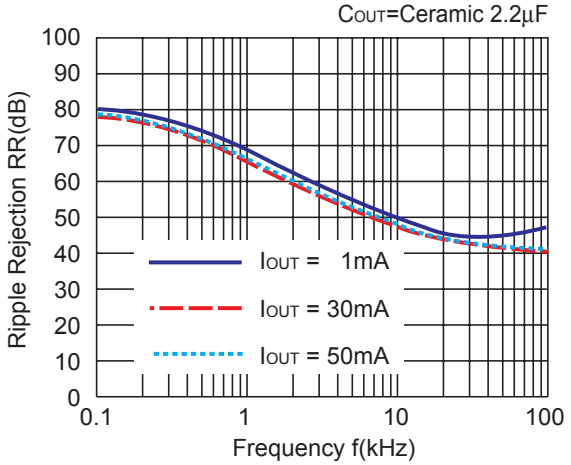
R1131x26xx

V_{IN}=3.6V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 1.0µF



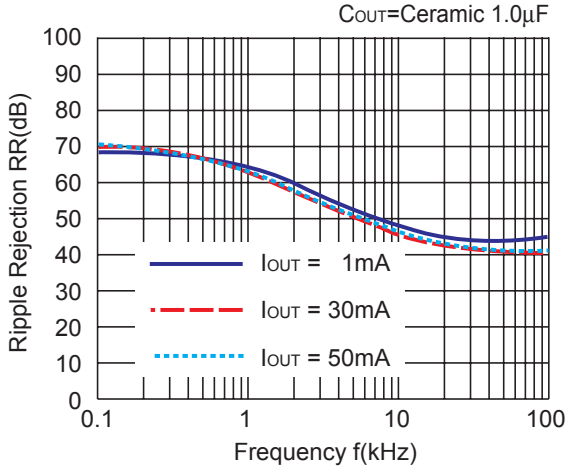
R1131x26xx

V_{IN}=3.6V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 2.2µF



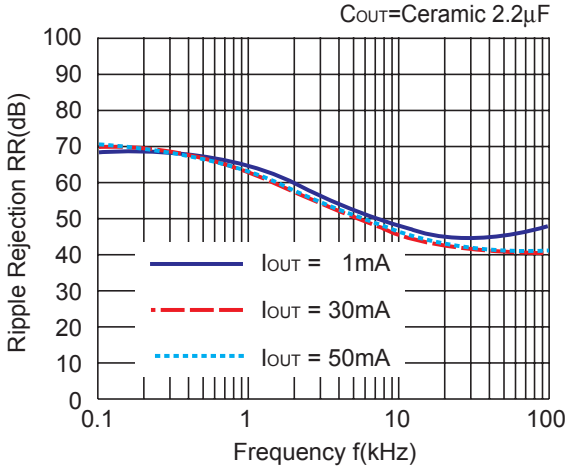
R1131x33xx

V_{IN}=4.3V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 1.0µF



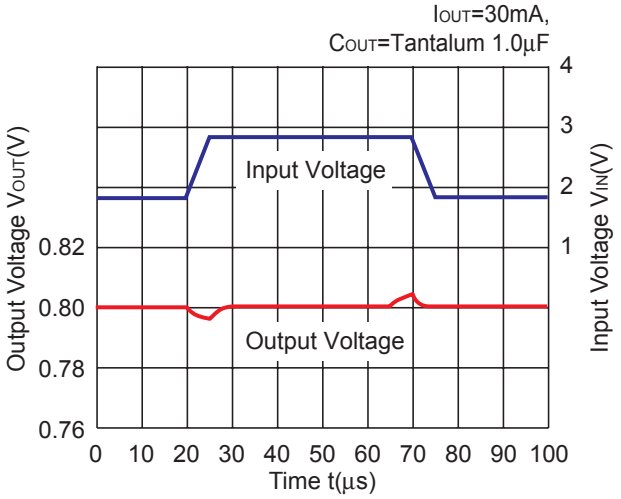
R1131x33xx

V_{IN}=4.3V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 2.2µF

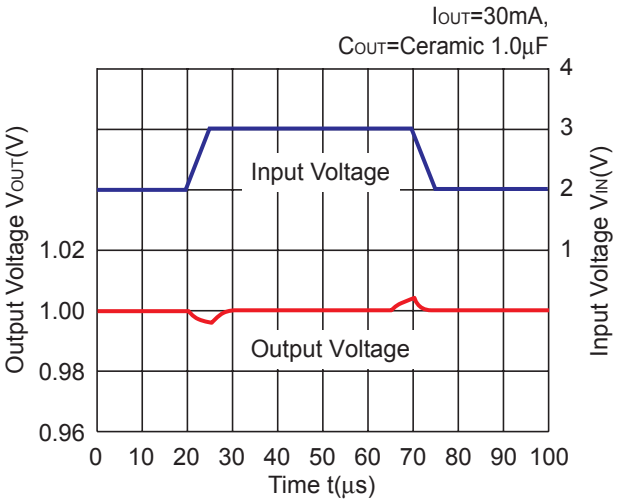


10) Input Transient Response (C_{IN}=none, tr=tf=5µs)

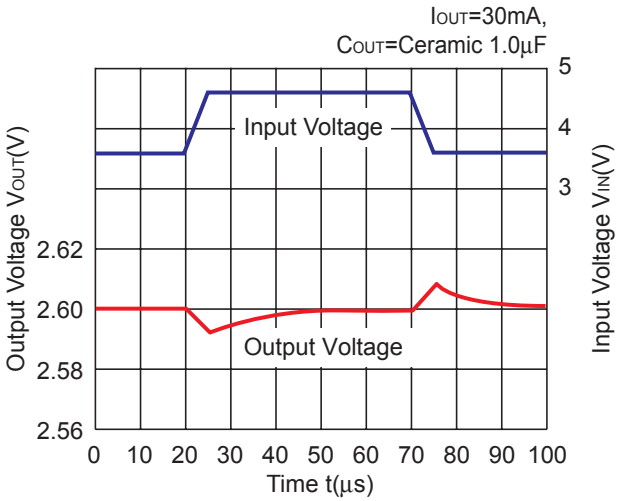
R1131x08xx



R1131x10x

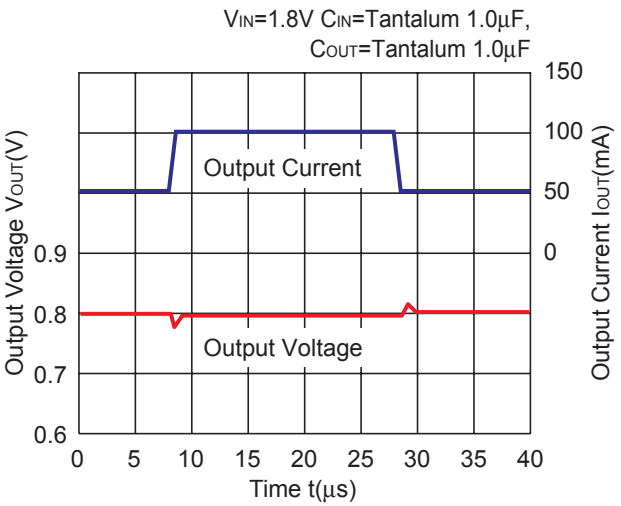


R1131x26xx

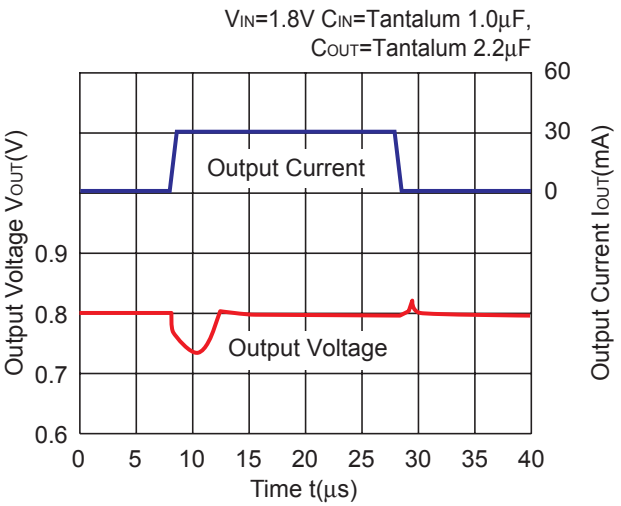


11) Load Transient Response (tr=tf=0.5µs)

R1131x08xx

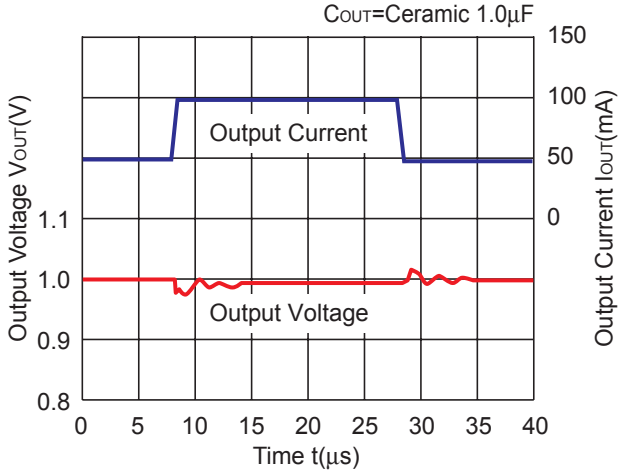


R1131x08xx



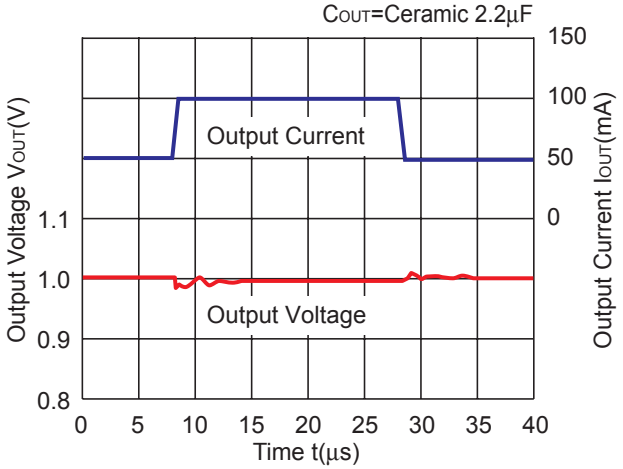
R1131x10xx

V_{IN}=2.0V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 1.0µF



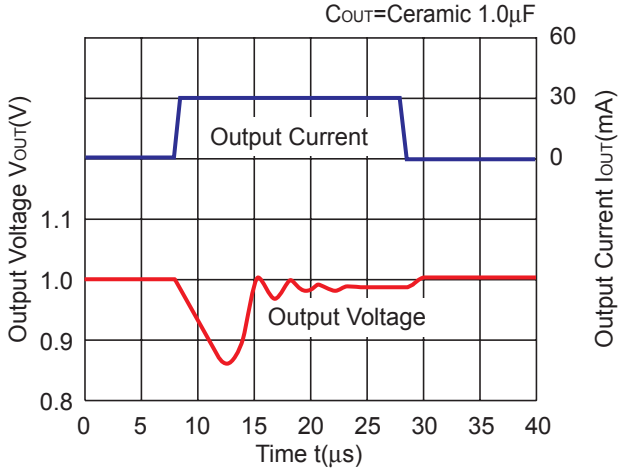
R1131x10xx

V_{IN}=2.0V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 2.2µF



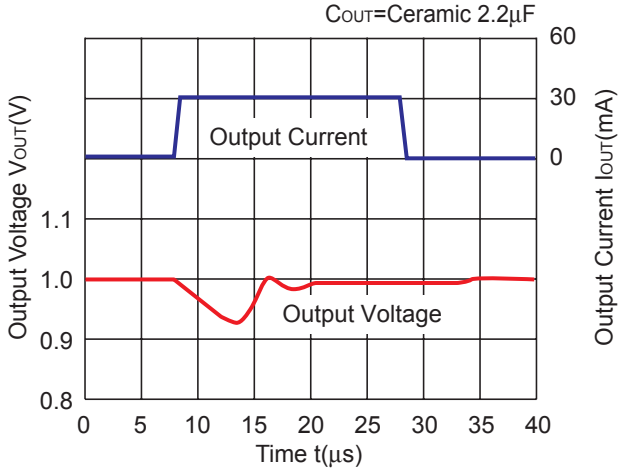
R1131x10xx

V_{IN}=2.0V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 1.0µF



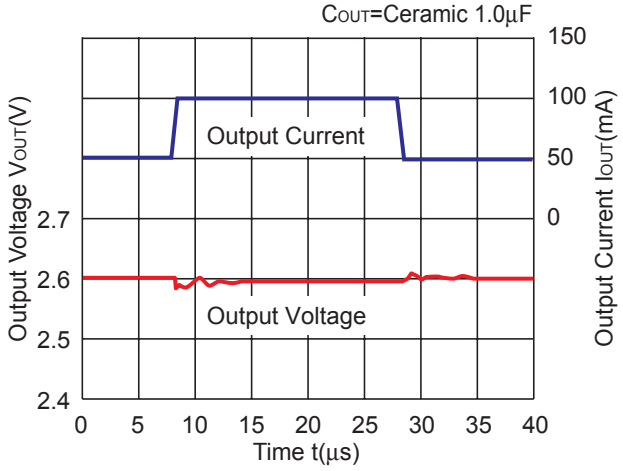
R1131x10xx

V_{IN}=2.0V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 2.2µF



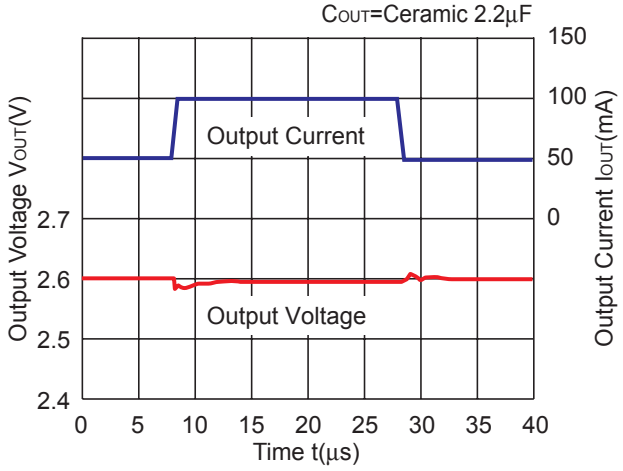
R1131x26xx

V_{IN}=3.6V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 1.0µF



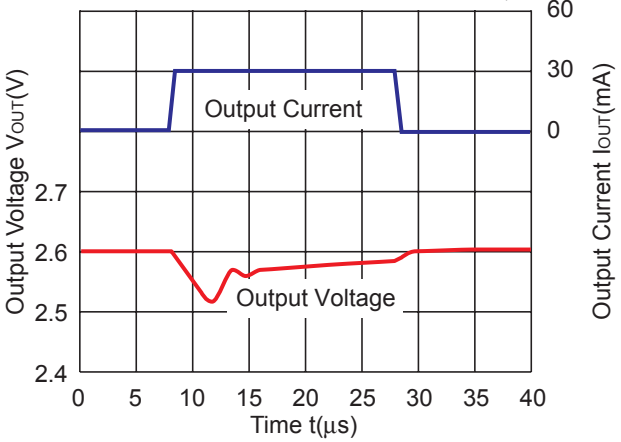
R1131x26xx

V_{IN}=3.6V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 2.2µF



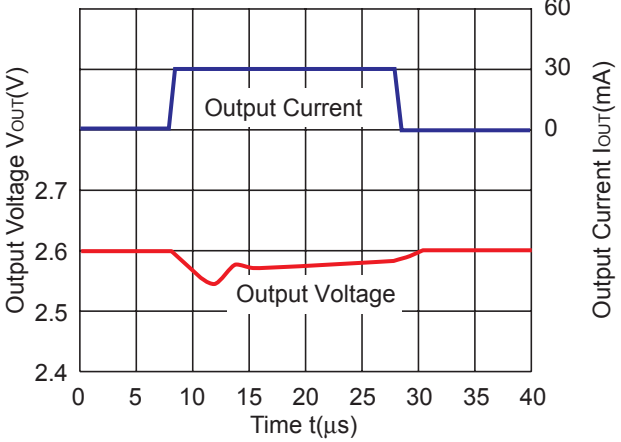
R1131x26xx

V_{IN}=3.6V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 1.0µF



R1131x26xx

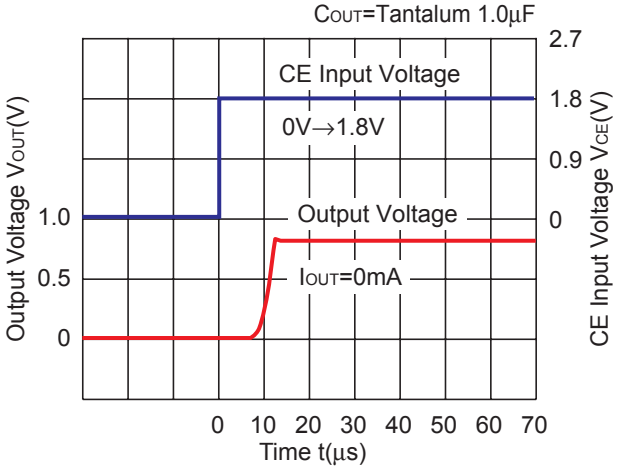
V_{IN}=3.6V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 2.2µF



12) Turn on speed with CE pin

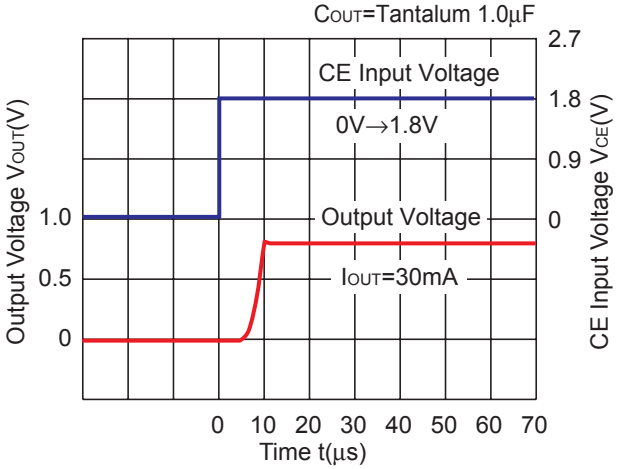
R1131x08xx

V_{IN}=1.8V C_{IN}=Tantalum 1.0µF,
C_{OUT}=Tantalum 1.0µF



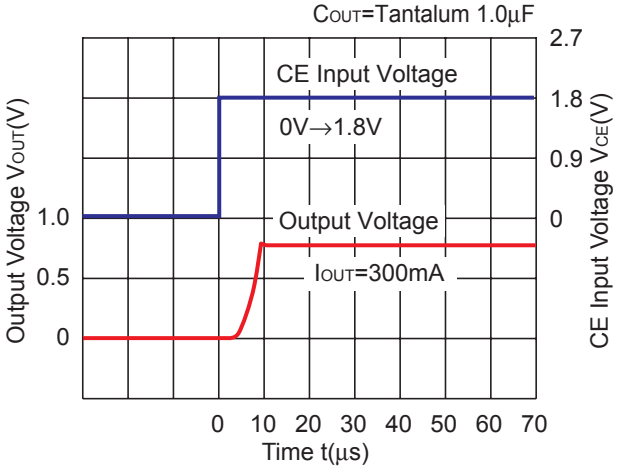
R1131x08xx

V_{IN}=1.8V C_{IN}=Tantalum 1.0µF,
C_{OUT}=Tantalum 1.0µF



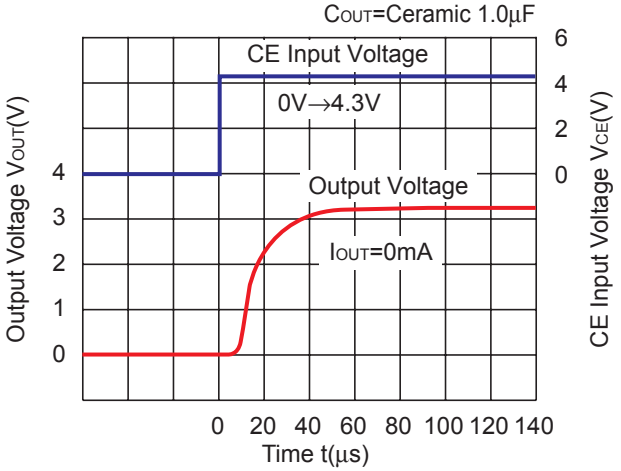
R1131x08xx

V_{IN}=1.8V C_{IN}=Tantalum 1.0µF,
C_{OUT}=Tantalum 1.0µF

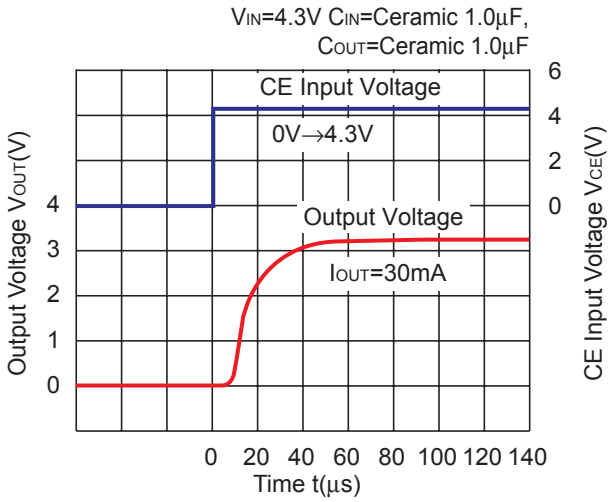


R1131x33xx

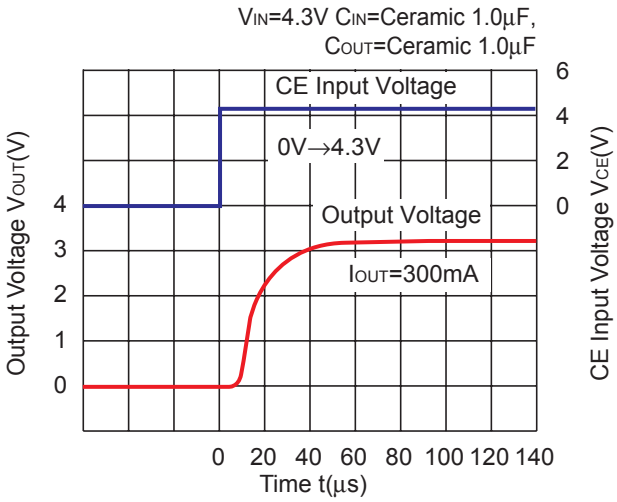
V_{IN}=4.3V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 1.0µF



R1131x33xx (ECO=H)

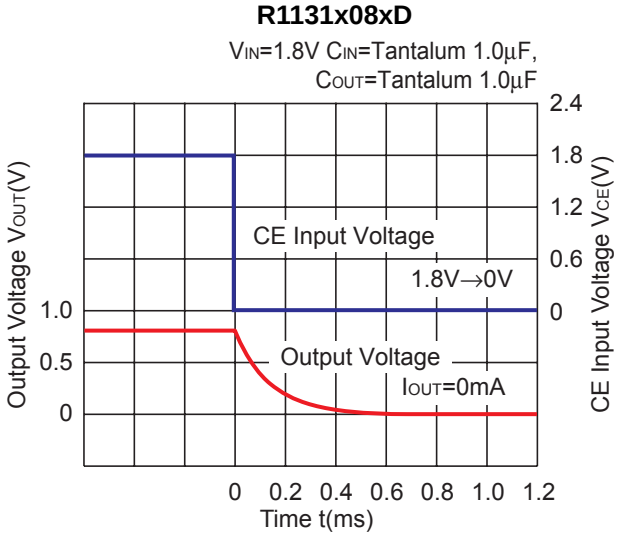


R1131x33xx (ECO=L)

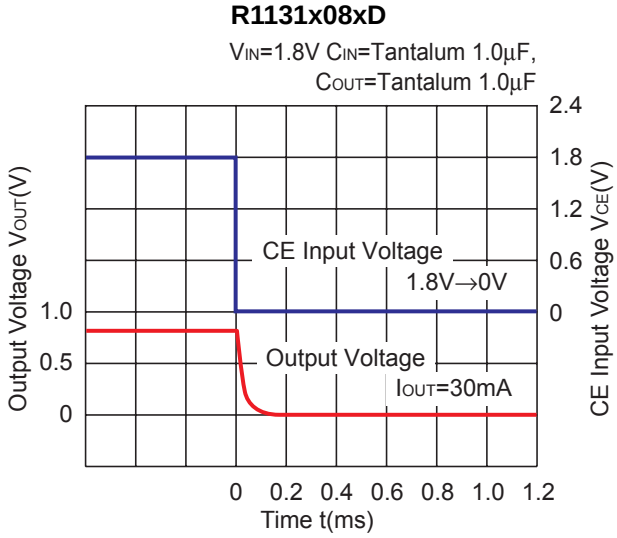


13) Turn-off Speed with CE

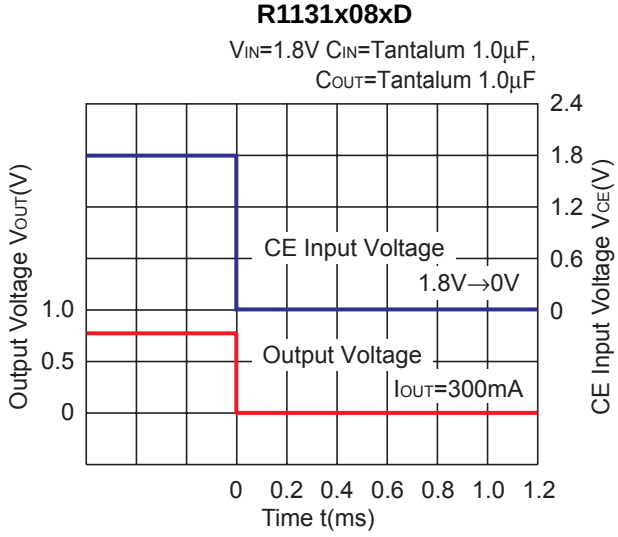
R1131x08xD



R1131x08xD



R1131x08xD



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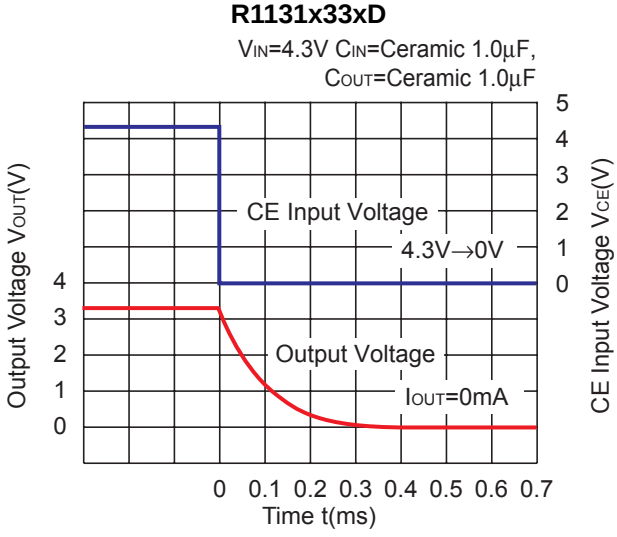
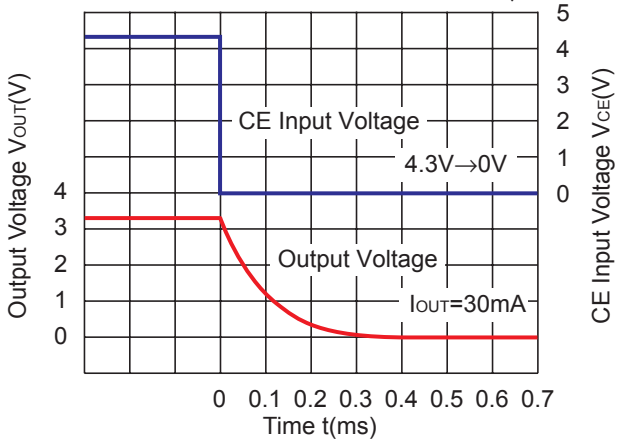


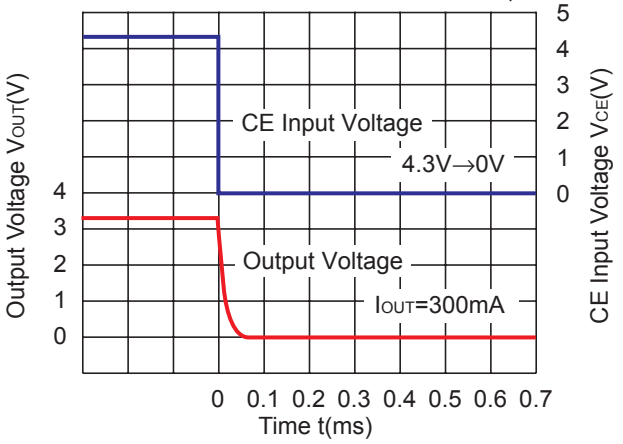
R1131x33xD

V_{IN}=4.3V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 1.0µF



R1131x33xD

V_{IN}=4.3V C_{IN}=Ceramic 1.0µF,
C_{OUT}=Ceramic 1.0µF



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.

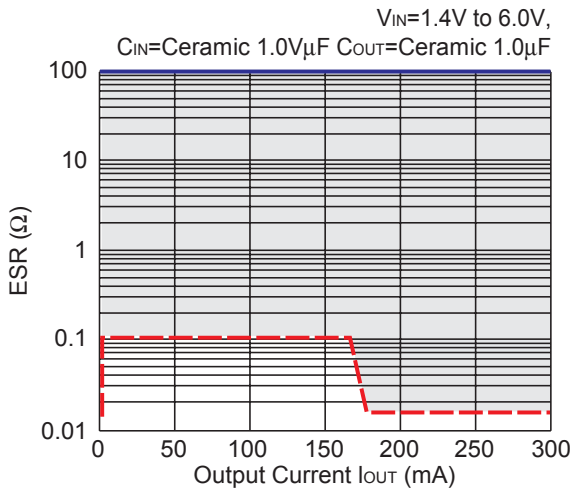
The conditions when the white noise level is under 40μV(Avg.) are marked as the hatched area in the graph.

<Test conditions>

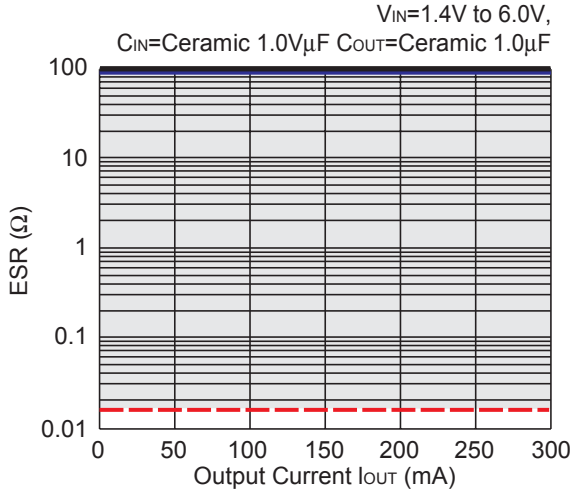
(1) Frequency band: 10Hz to 2MHz

(2) Temperature: 25°C

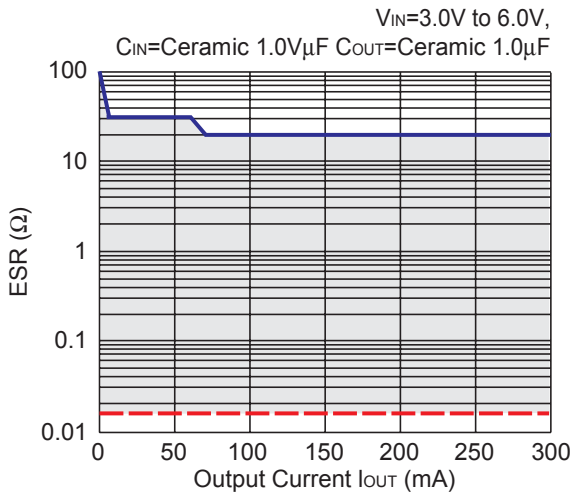
R1131x08xx



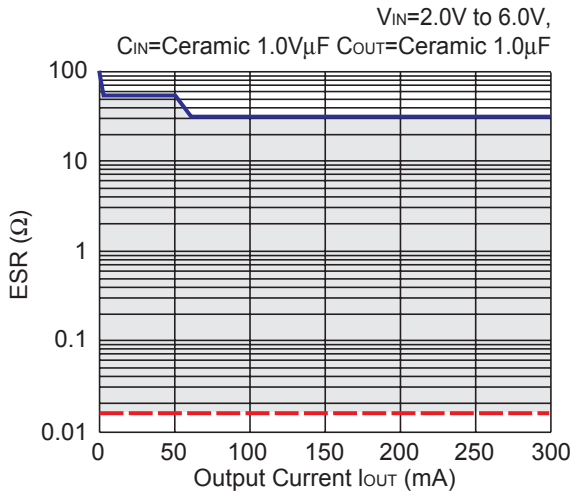
R1131x10xx



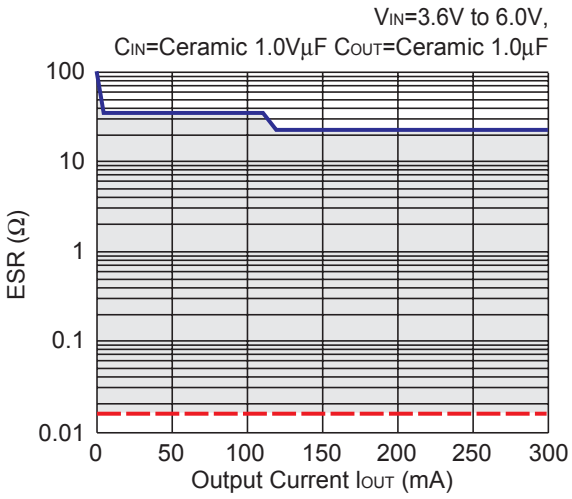
R1131x26xx



R1131x15xx



R1131x33xx


VIN=3.6V to 6.0V,
CIN=Ceramic 1.0VµF COUT=Ceramic 1.0µF
100
10
1
0.1
0.01
ESR (Ω)
0
50
100
150
200
250
300
Output Current IOUT (mA)

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RICOH COMPANY, LTD.
Electronic Devices Company
● Shin-Yokohama office (International Sales)
3-2-3, Shin-Yokohama, Kohoku-ku, Yokohama City, Kanagawa 222-8530, Japan
Phone: +81-45-477-1697 Fax: +81-45-477-1698

RICOH EUROPE (NETHERLANDS) B.V.
● Semiconductor Support Centre
Prof. W.H.Keesomlaan 1, 1183 DL Amstelveen, The Netherlands
P.O.Box 114, 1180 AC Amstelveen
Phone: +31-20-5474-309 Fax: +31-20-5474-791

RICOH ELECTRONIC DEVICES KOREA Co., Ltd.
11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.
Room403, No.2 Building, 690#Bi Bo Road, Pu Dong New district, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH COMPANY, LTD.
Electronic Devices Company
● Taipei office
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623