300mA Low Voltage LDO REGULATOR

R1131x SERIES

NO. EA-116-0503

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

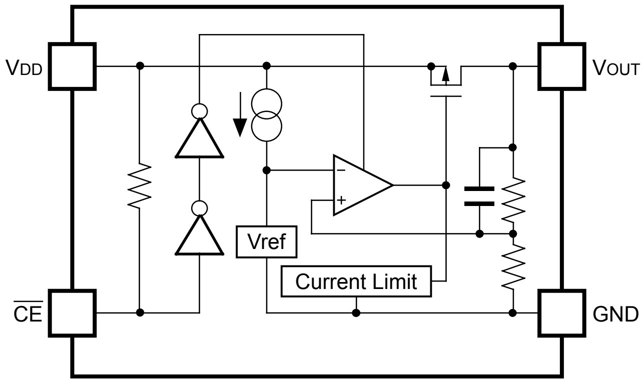
- Ultra-Low Supply Current ....Typ. 80μA (V_{OUT}<1.8V),
  Typ. 60μA ($V_{OUT} \geqq 1.8V$)
- Standby Mode ....Typ. 0.1μA
- Low Dropout Voltage..Typ. 0.48V(I_{OUT}=300mA Output Voltage=1.0V Type)
  Typ. 0.31V(I_{OUT}=300mA Output Voltage=1.5V Type)
  Typ. 0.23V(I_{OUT}=300mA Output Voltage=3.0V Type)
- High Ripple Rejection ....Typ. 65dB(f=1kHz)
- Low Temperature-Drift Coefficient of Output Voltage Typ. ±100ppm/°C
- Excellent Line Regulation ....Typ. 0.01%/V
- High Output Voltage Accuracy ....±2.0%
- Small Package ....SOT-23-5(Super Mini-mold), SON-6, HSON-6
- Output Voltage ....Stepwise setting with a step of 0.1V in the range of 0.8V to 3.3V is possible
- Input Voltage ....Min. 1.40V
- 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 ($V_{OUT} \geqq 1.0V$)

APPLICATIONS

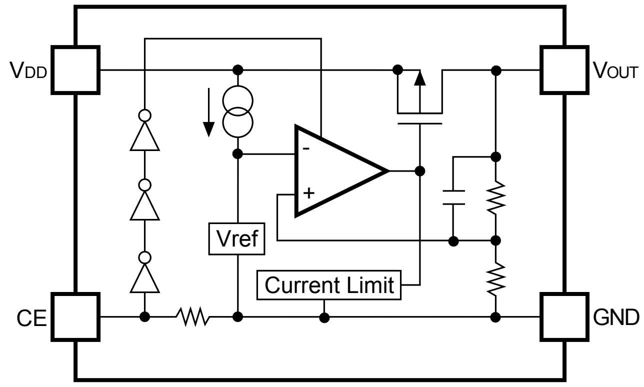
- Precision Voltage References.
- Power source for electrical appliances such as cameras, VCRs and hand-held communication equipment.
- Power source for battery-powered equipment.

BLOCK DIAGRAM

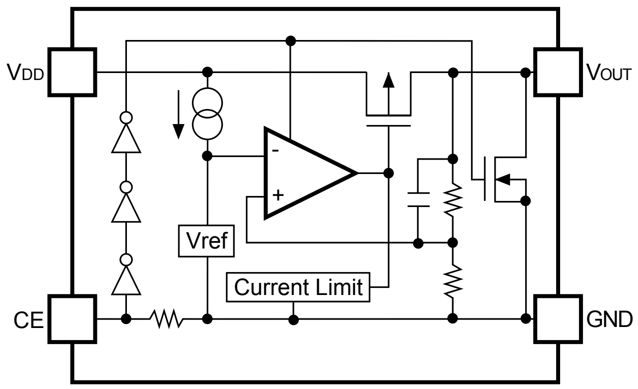
R1131xxxxA



R1131xxxxB



R1131xxxxD



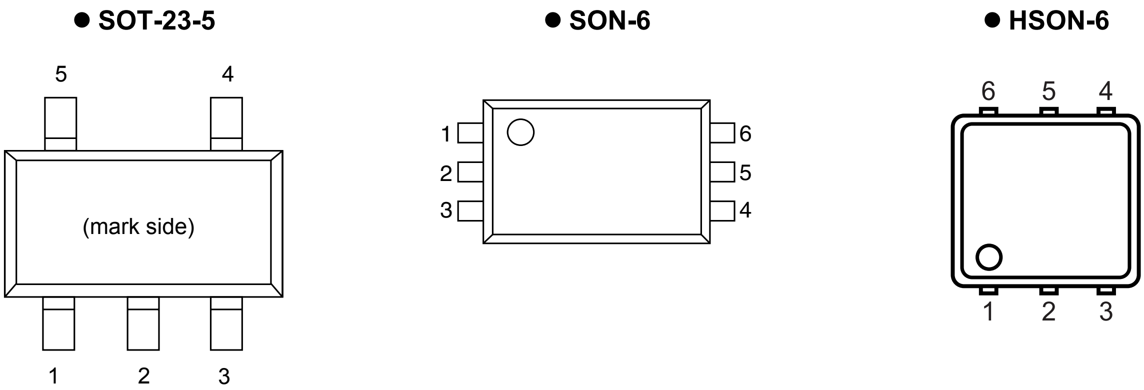
SELECTION GUIDE

The output voltage, the chip enable polarity, package type, and the taping type for the ICs can be selected at the user's request. The selection can be available by designating the part number as shown below;

R1131xxxxx-xx ←Part Number
↑ ↑ ↑↑ ↑
a b a'c d

Code	Contents
a, a'	Designation of Package Type : R1131Nxx1x-xx:SOT-23-5 (Mini-mold) R1131Dxx1x-xx:SON-6, R1131Dxx2x-xx:HSON-6
b	Setting Output Voltage (V_{OUT}):Stepwise setting with a step of 0.1V in the range of 0.8V to 3.3V is possible. If the output=1.85V, then the code is R1131x18xx5. If the output=2.85, then the code is R1131x28xx5.
c	Designation of Chip Enable Option : A:“L” active type. B:“H” active type. D:"H" active and with auto discharge function
d	Designation of Taping Type : TR Refer to Taping Specifications

PIN CONFIGURATIONS



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

∗ Tabs and tab suspension leads could be short to the GND level.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage($\overline{CE}$ /CE Pin)	–0.3 ~ 6.5	V
V_{OUT}	Output Voltage	–0.3 ~ V_{IN}+0.3	V
I_{OUT}	Output Current	350	mA
P_D	Power Dissipation(SOT23-5)	250	mW
	Power Dissipation(SON-6)		
	Power Dissipation(HSON-6)	400	
Topt	Operating Temperature Range	–40 ~ 85	°C
Tstg	Storage Temperature Range	–55 ~ 125	°C

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 Note 1	V_{OUT} ×0.98 (–30mV)		V_{OUT} ×1.02 (30mV)	V
I_{OUT}	Output Current	V_{IN} – V_{OUT} = 1.0V	300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = Set V_{OUT}+1V, 1mA ≦ I_{OUT} ≦ 300mA		40	70	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
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	Supply Current (Standby)	V_{IN} = V_{CE} = Set V_{OUT}+1V		0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V I_{OUT} = 30mA Set V_{OUT} < 0.9V: 1.4V ≦ V_{IN} ≦ 6.0V		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
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA –40°C ≦ Topt ≦ 85°C		±100		ppm /°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V		50		mA
R_{PU}	$\overline{CE}$ Pull-up Resistance		1.87	5.00	12.00	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage "H"		1.0		6.0	V
V_{CEL}	$\overline{CE}$ Input Voltage "L"		0.0		0.3	V
V_{EN}	Output Noise	BW = 10Hz to 100kHz		30		µVrms

Note1: ±30mV tolerance for V_{OUT} ≦ 1.5V.

- **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 Note 1	V_{OUT} ×0.98 (−30mV)		V_{OUT} ×1.02 (30mV)	V
I_{OUT}	Output Current	V_{IN} − V_{OUT} =1.0V	300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}=Set V_{OUT}+1V 1mA ≦ I_{OUT} ≦ 300mA		40	70	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
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	Supply Current (Standby)	V_{IN}=Set V_{OUT}+1V, VCE=GND		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V I_{OUT}=30mA Set V_{OUT}<0.9V: 1.4V ≦ V_{IN} ≦ 6.0V		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
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} =30mA −40°C ≦ Topt ≦ 85°C		±100		ppm /°C
I_{LIM}	Short Current Limit	V_{OUT} =0V		50		mA
R_{PDC}	CE Pull-down Resistance		1.87	5.00	12.00	MΩ
V_{CEH}	CE Input Voltage “H”		1.0		V_{IN}	V
V_{CEL}	CE Input Voltage “L”		0.0		0.3	V
V_{EN}	Output Noise	BW=10Hz to 100kHz		30		μVrms
R_{LOW}	Nch On Resistance for auto discharge (applied to D version only)	V_{CE} =0V		60		Ω

Note1: ±30mV tolerance for VOUT ≦ 1.5V.

ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	VDIF Typ.	VDIF Max.
0.8=V_{OUT}	I_{OUT} = 300mA	0.620	0.850
0.9=V_{OUT}		0.550	0.780
1.0 ≦ V_{OUT} ≦ 1.5		0.480	0.700
1.5 ≦ V_{OUT} ≦ 2.6		0.310	0.450
2.6 ≦ V_{OUT}		0.230	0.350

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.)

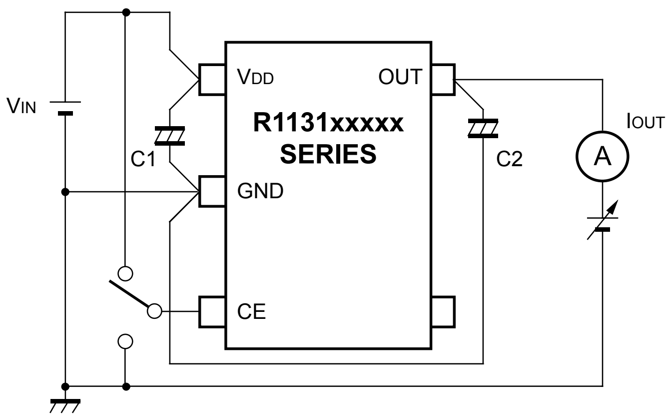
Chip capacitor characteristics of Bias dependence and Temperature characteristics may vary depending on its size, manufacturer, and part number.

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 1.0mF 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.

TYPICAL APPLICATION



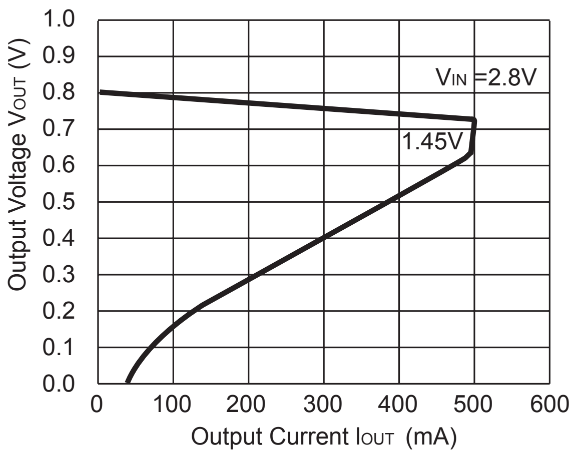
External Components examples:
CM05X5R105K06AB (Kyocera)
C1005JBOJ105K (TDK)
GRM155B30J105KE18B (Murata)

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

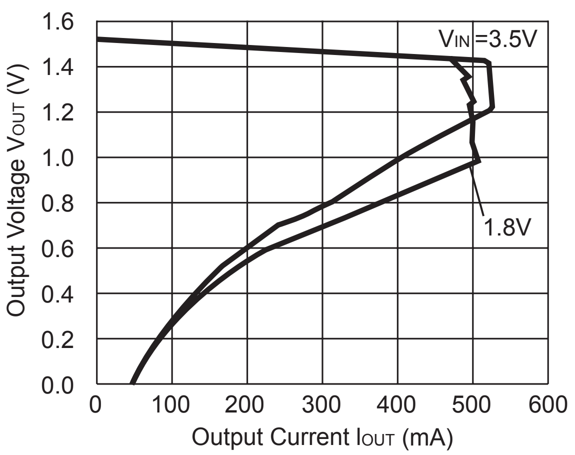
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

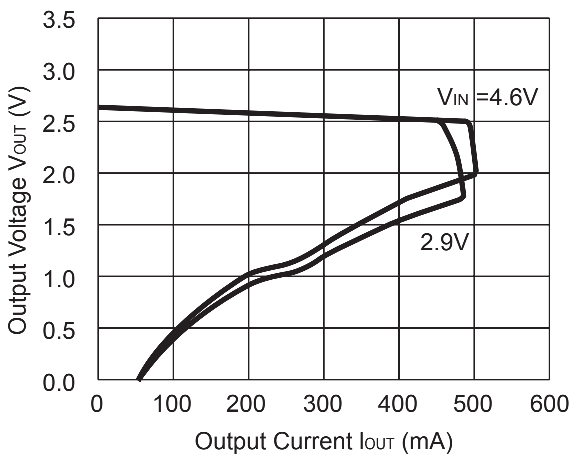
R1131x08xx



R1131x15xx



R1131x26xx



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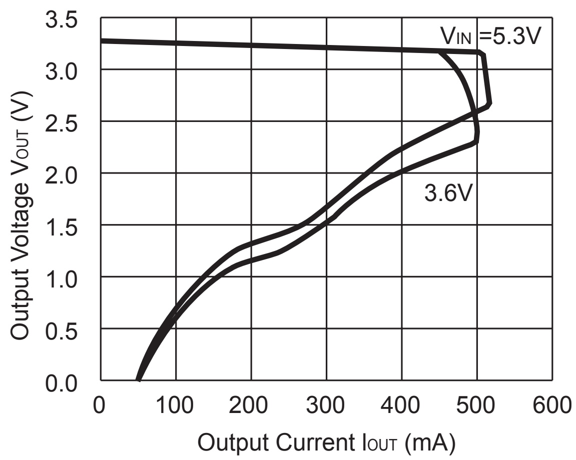
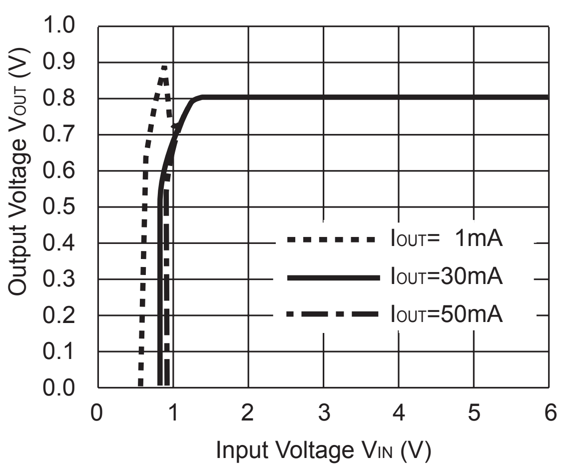


2) Output Voltage vs. Input Voltage

R1131x08xx



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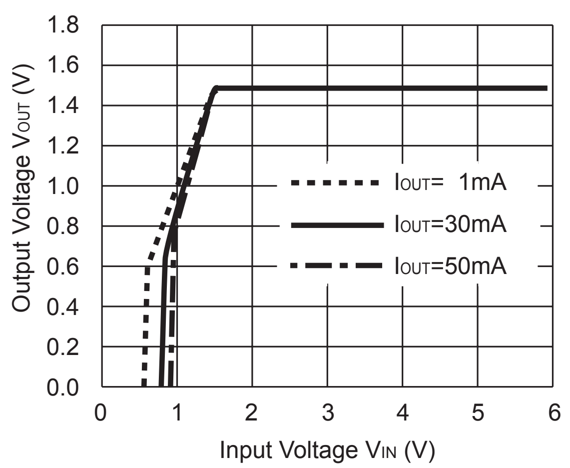
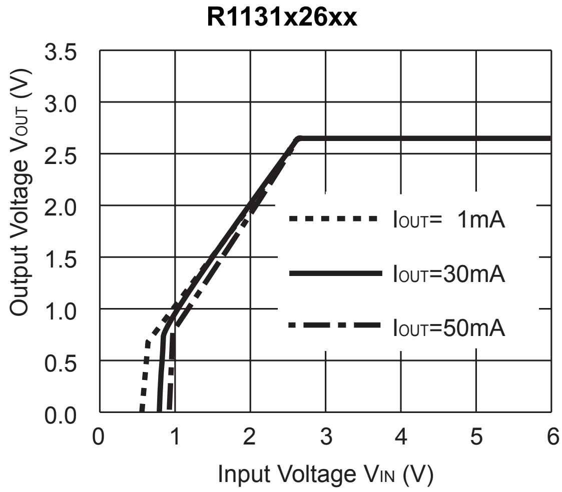
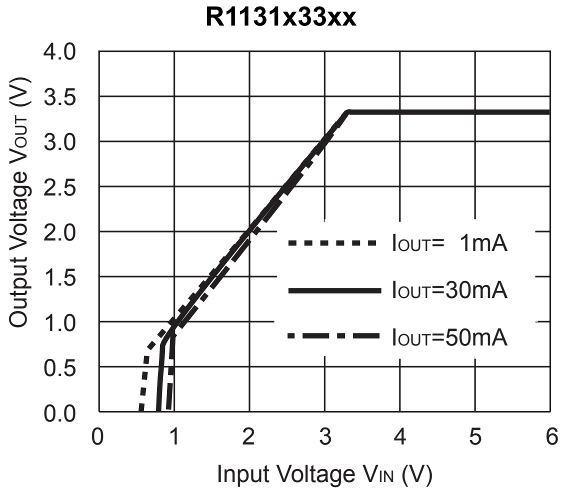
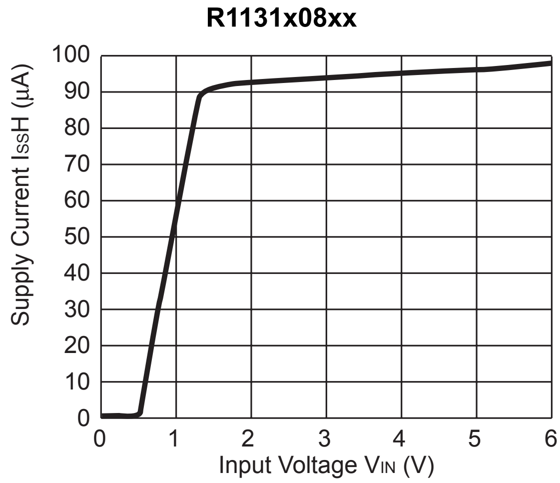
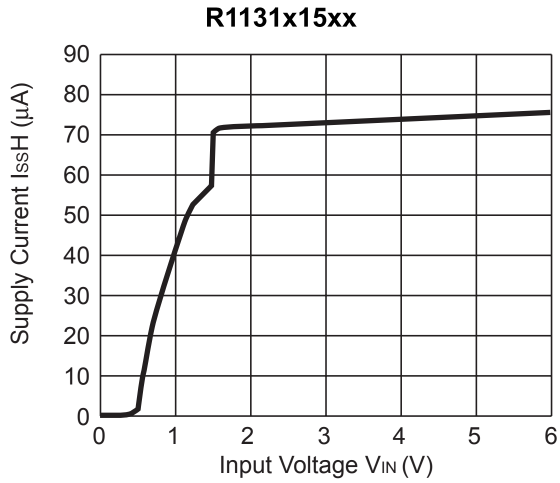


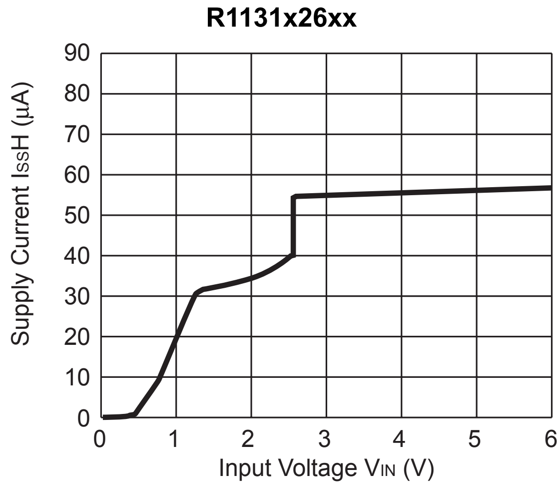


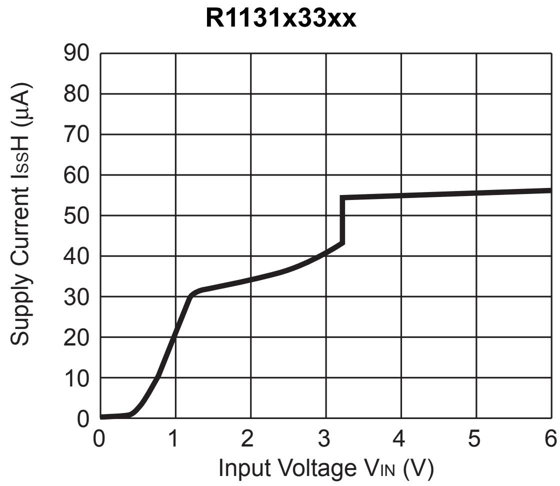


3) Supply Current vs. Input Voltage



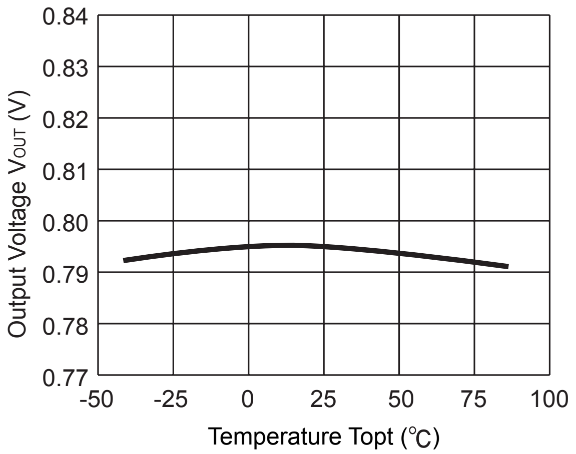






4) Output Voltage vs. Temperature

R1131x08xx



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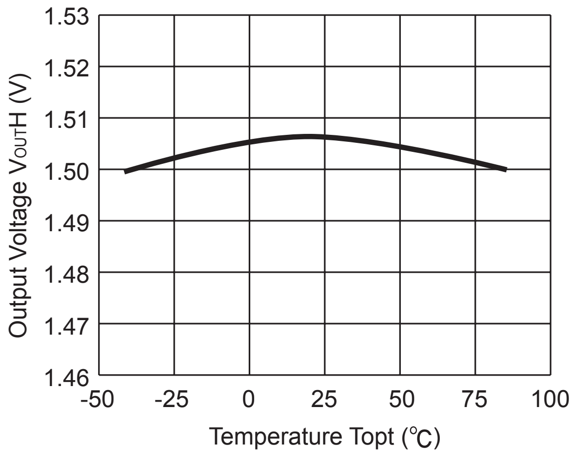

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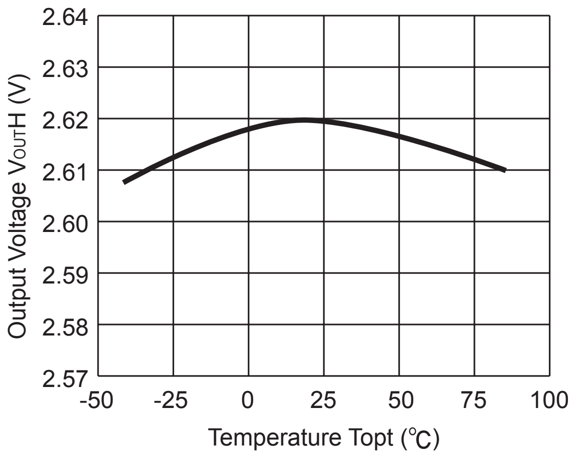
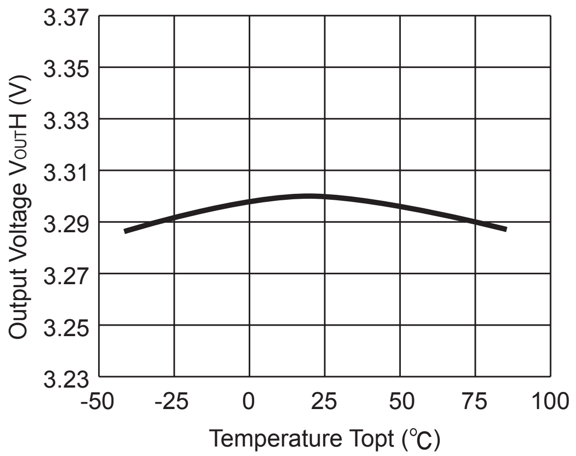
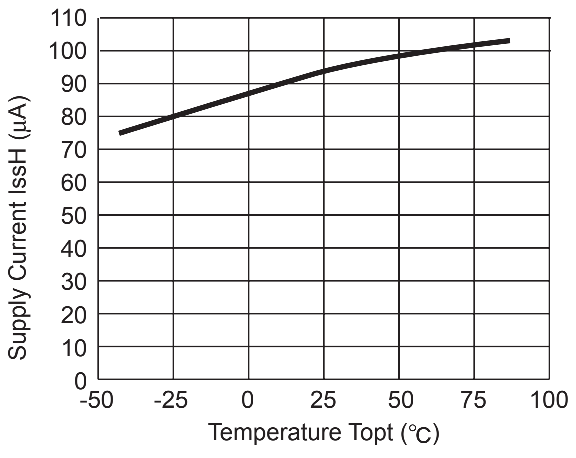


R1131x33xx



5) Supply Current vs. Temperature

R1131x08xx



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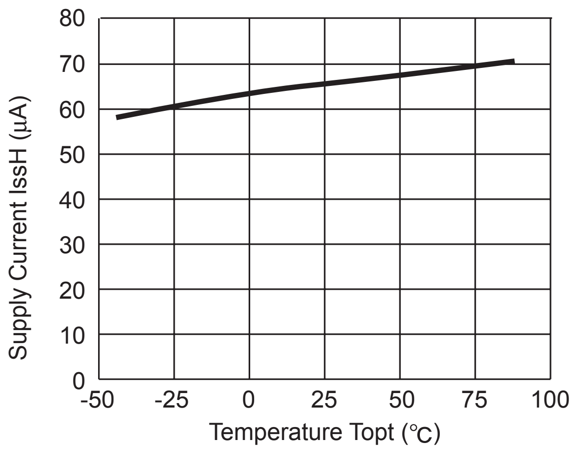
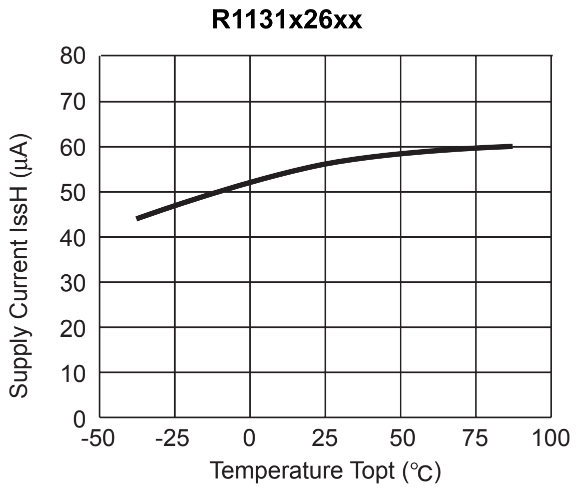
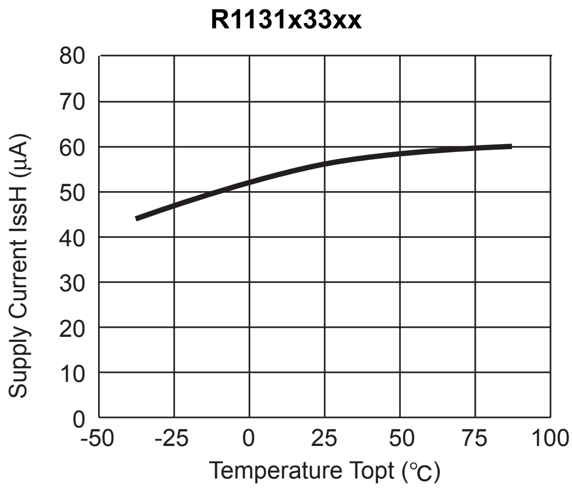
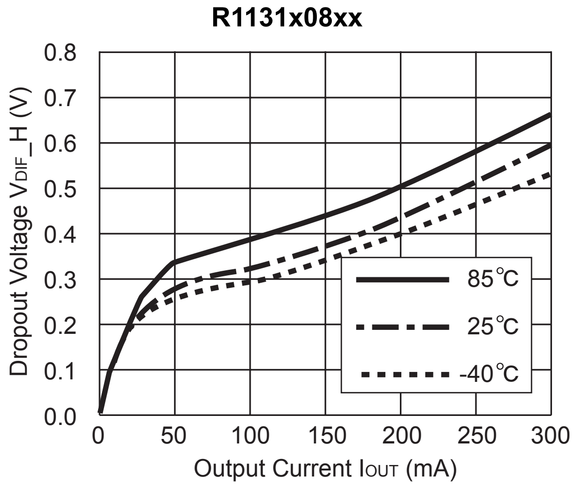
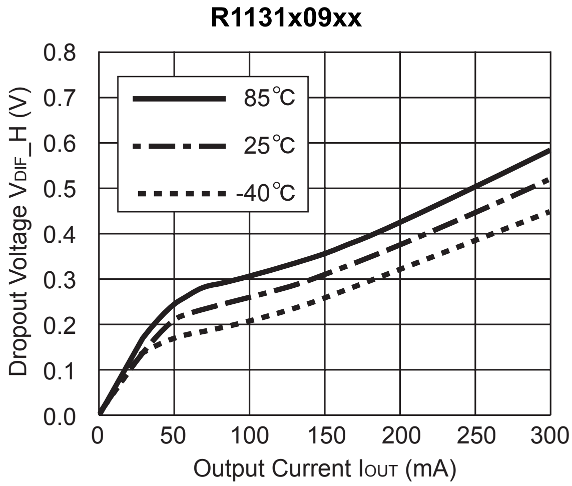


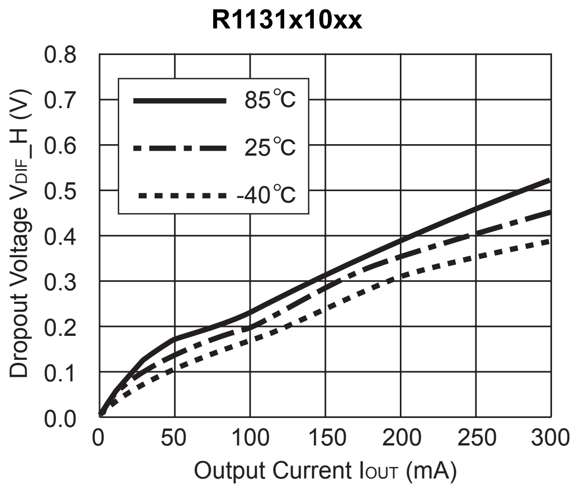


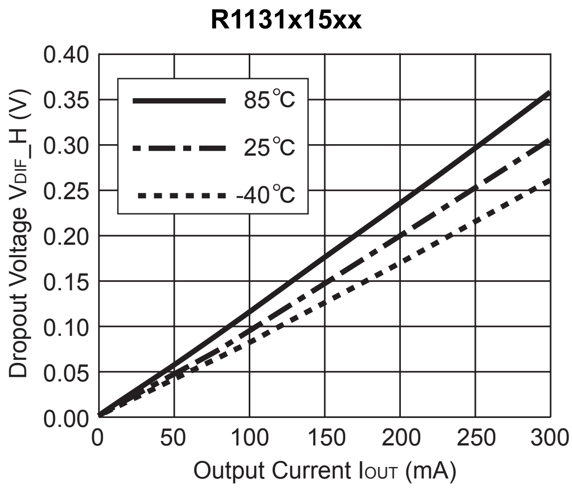


6) Dropout Voltage vs. Output Current









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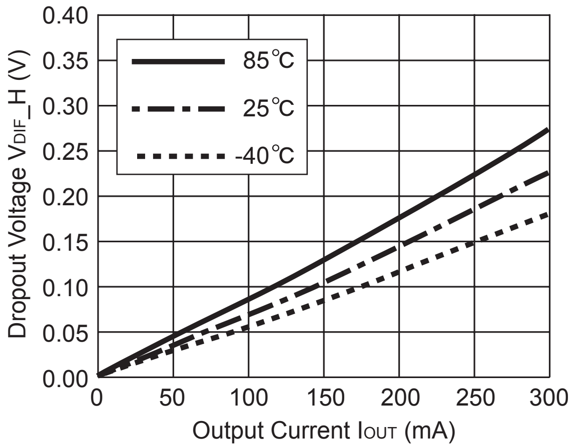

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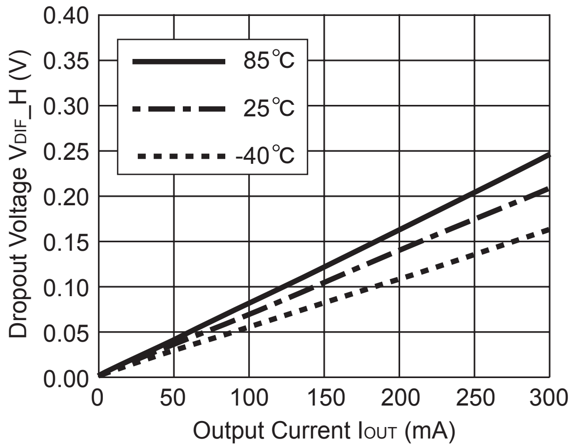
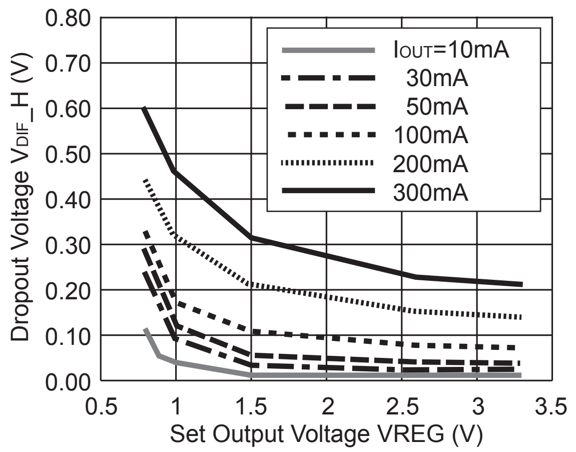


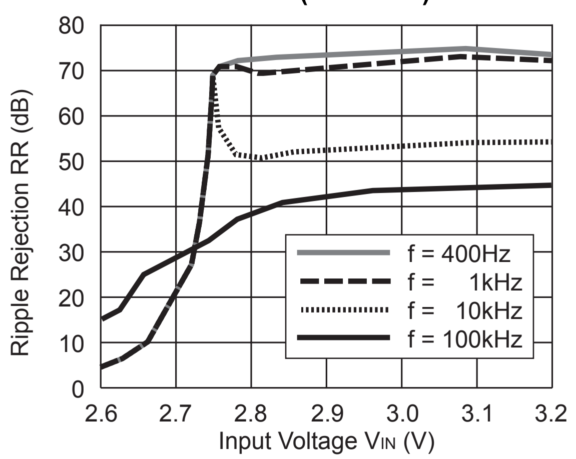
7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

R1131xxx1x

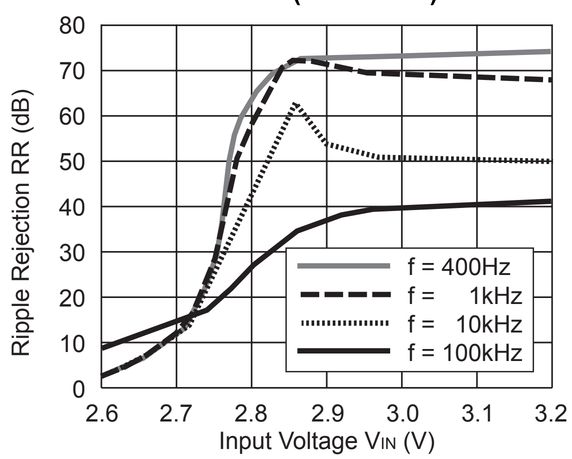


8) Ripple Rejection vs. Input Bias (Topt=25°C C_{IN}=none, C_{OUT}=Ceramic 1.0µF Ripple 0.2V_{P-P})

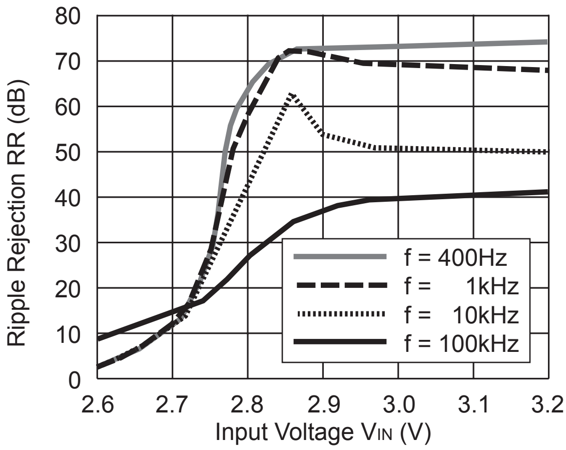
R1131x26xx (I_{OUT}=1mA)



R1131x26xx (I_{OUT}=30mA)



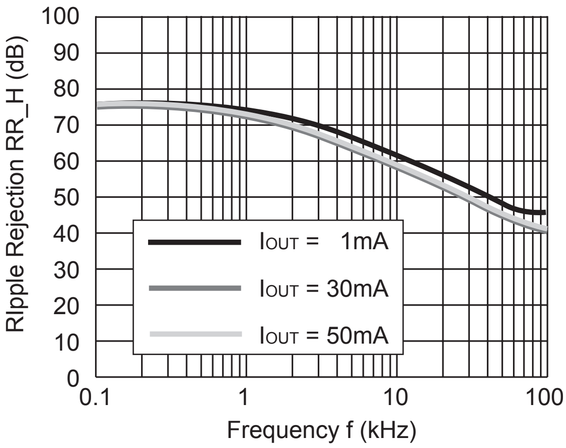
R1131x26xx (I_{OUT}=50mA)



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

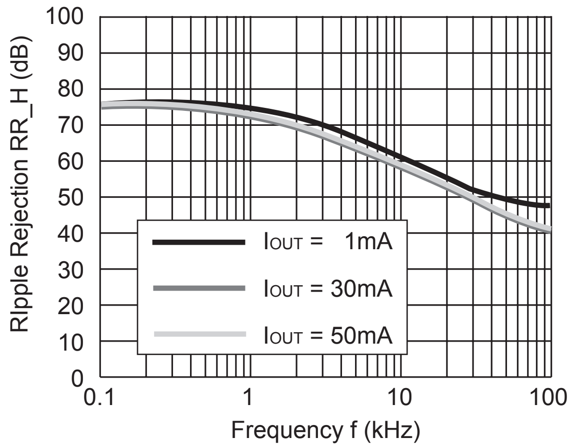
R1131x08xx

V_{IN}=1.8V_{DC}+0.2Vp-p,
C_{OUT}=Tantal 1.0μF



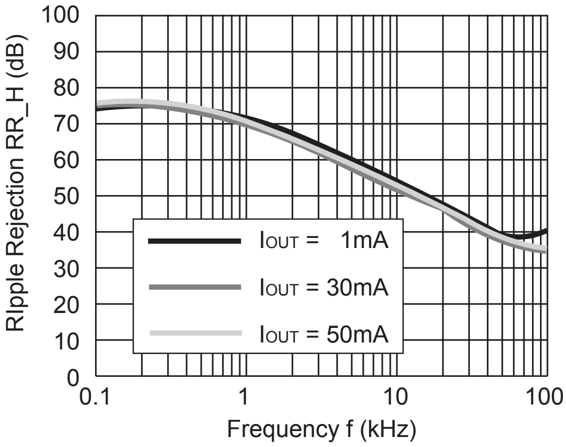
R1131x08xx

V_{IN}=1.8V_{DC}+0.2Vp-p,
C_{OUT}=Tantal 2.2μF



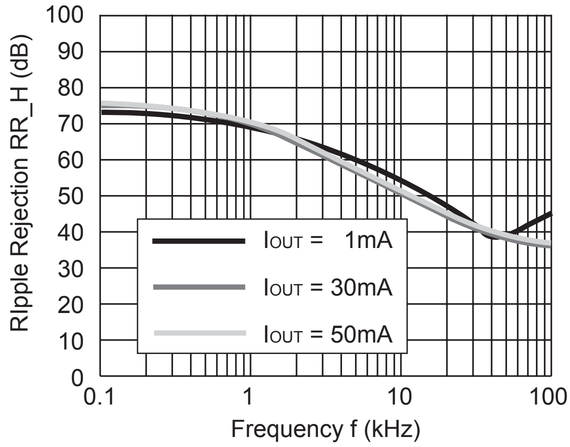
R1131x10xx

V_{IN}=2.0V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 1.0μF



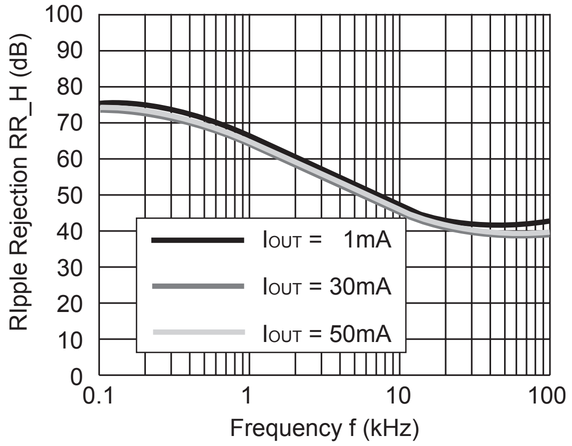
R1131x10xx

V_{IN}=2.0V_{DC}+0.2Vp-p,
C_{OUT}=Ceramic 2.2μF



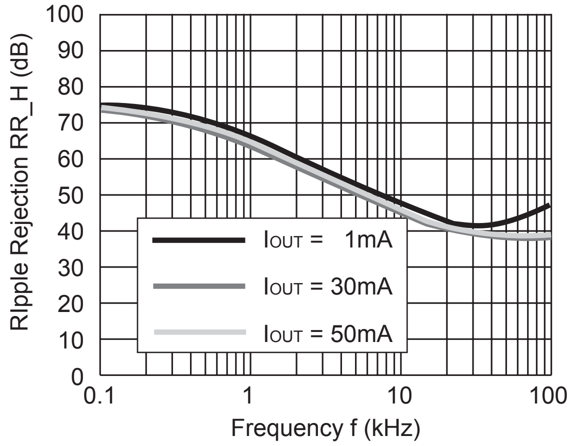
R1131x15xx

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



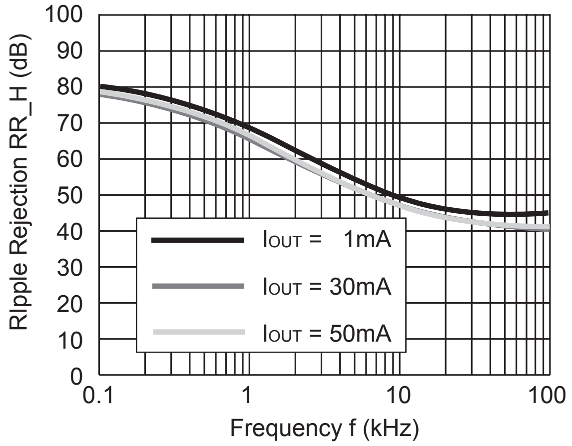
R1131x15xx

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



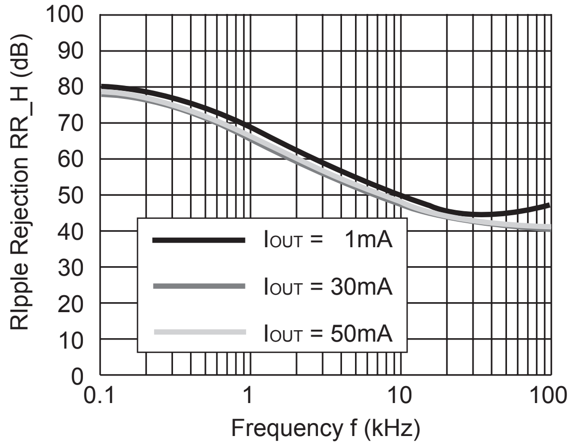
R1131x26xx

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



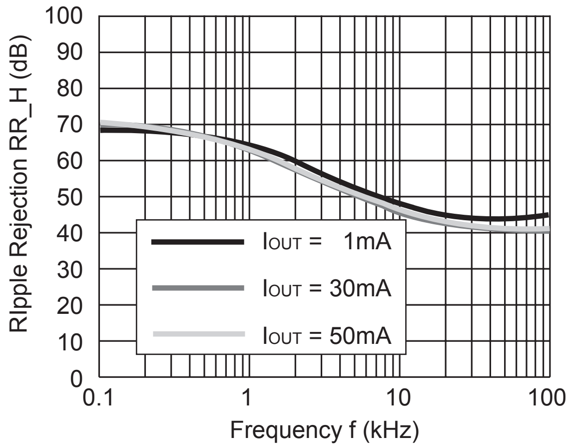
R1131x26xx

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



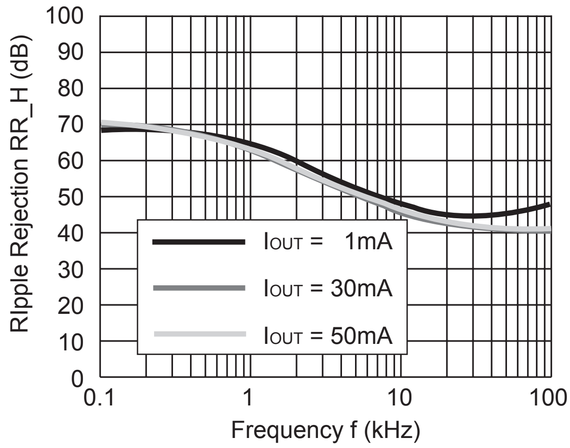
R1131x33xx

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



R1131x33xx

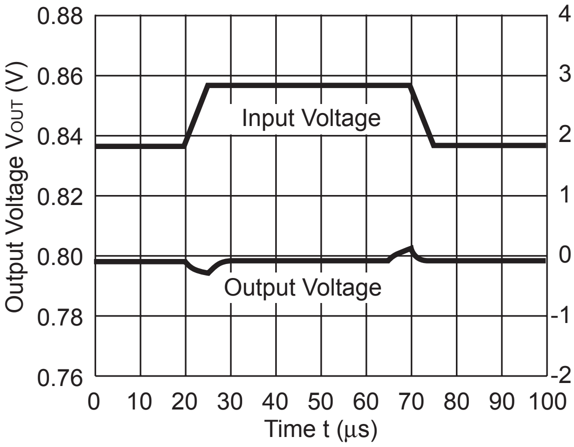
V_{IN}=4.3V_{DC}+0.2Vp-p,
C_{OUT}= Ceramic 2.2μF



10) Input Transient Response (CIN = none, tr=tf=5μs)

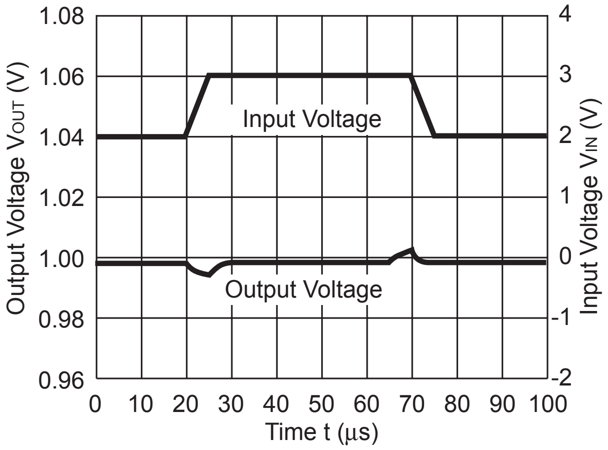
R1131x08xx

IOUT=30mA,
COUT = Tantalum 1.0μF



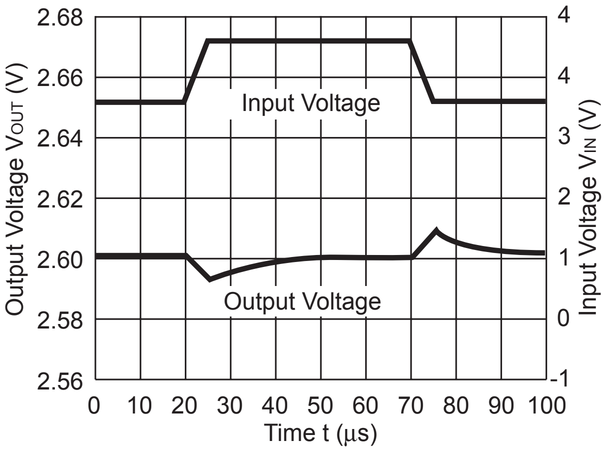
R1131x10x

IOUT=30mA,
COUT = Ceramic 1.0μF



R1131x26xx

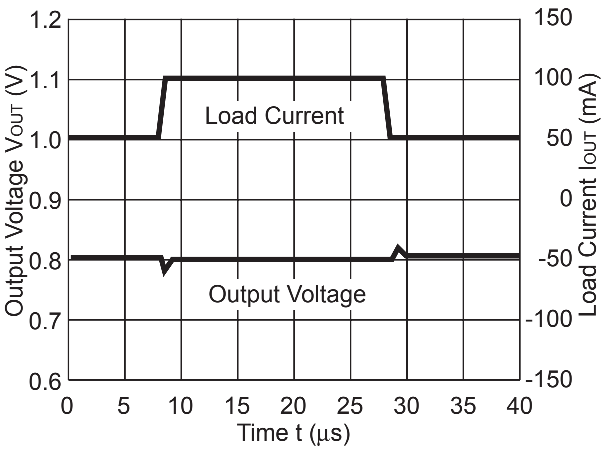
IOUT=30mA,
COUT= Ceramic 1.0μF



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

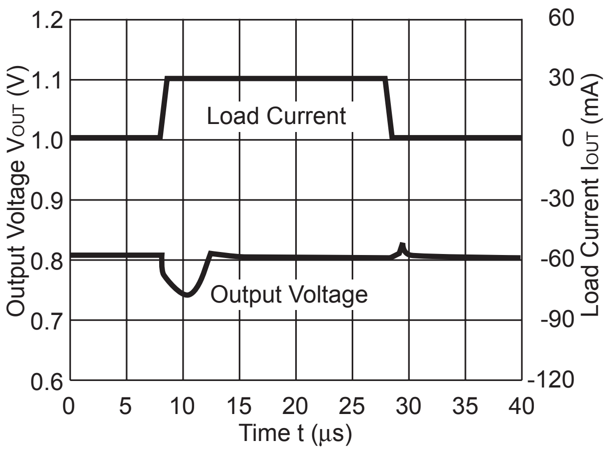
R1131x08xx

VIN=1.8V
CIN= tantalum 1.0μF,COUT = tantalum 1.0μF



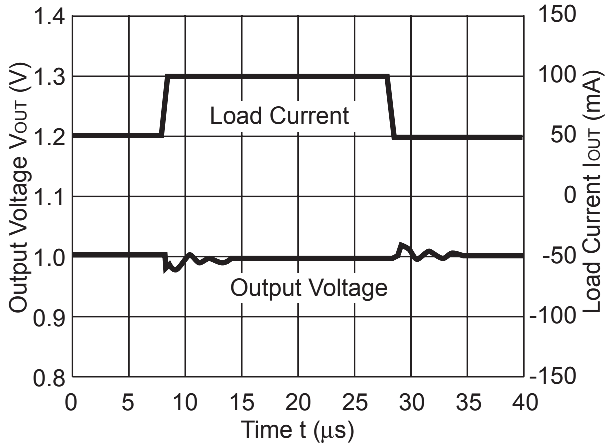
R1131x08xx

VIN=1.8V,
CIN = tantalum 1.0μF COUT = tantalum 2.2μF



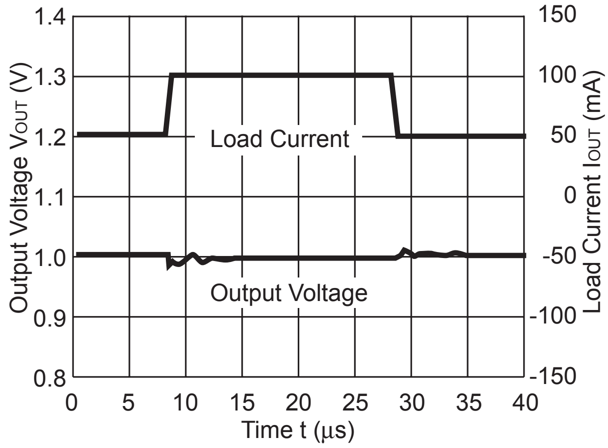
R1131x10xx

VIN=2.0V,
CIN = Ceramic 1.0μF COUT= Ceramic 1.0μF



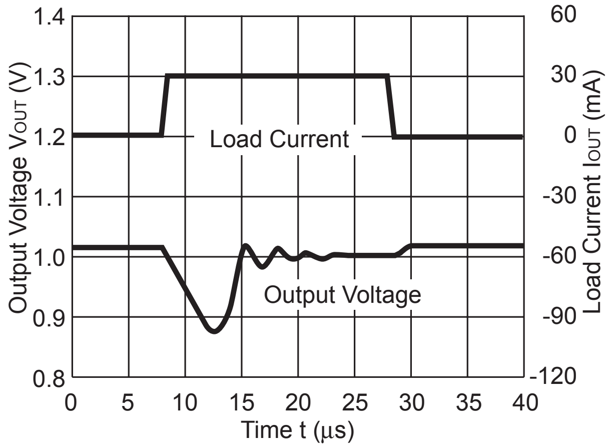
R1131x10xx

VIN=2.0V,
CIN= Ceramic 1.0μF, COUT = Ceramic 2.2μF



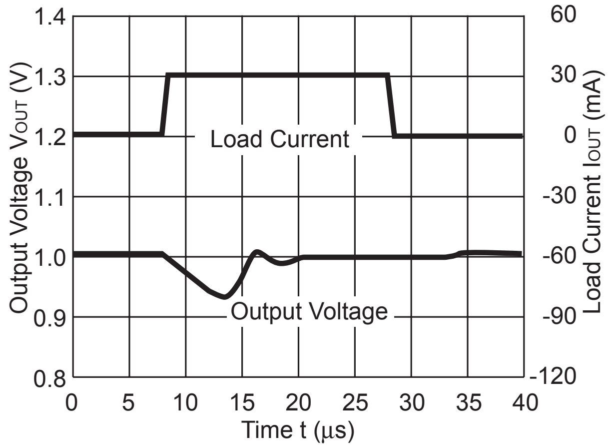
R1131x10xx

VIN=2.0V,
CIN = Ceramic 1.0μF COUT = Ceramic 1.0μF



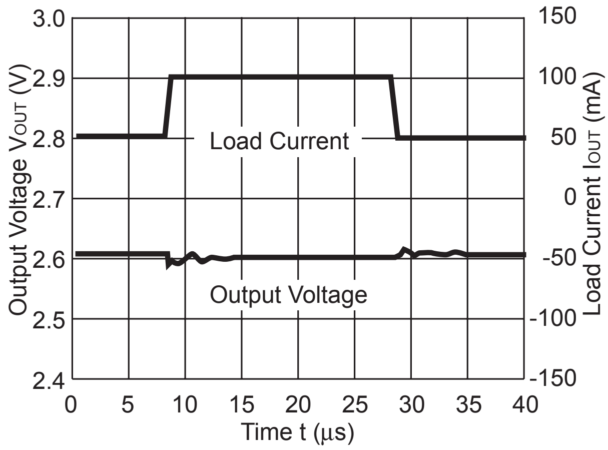
R1131x10xx

VIN=2.0V,
CIN = Ceramic 1.0μF COUT = Ceramic 2.2μF



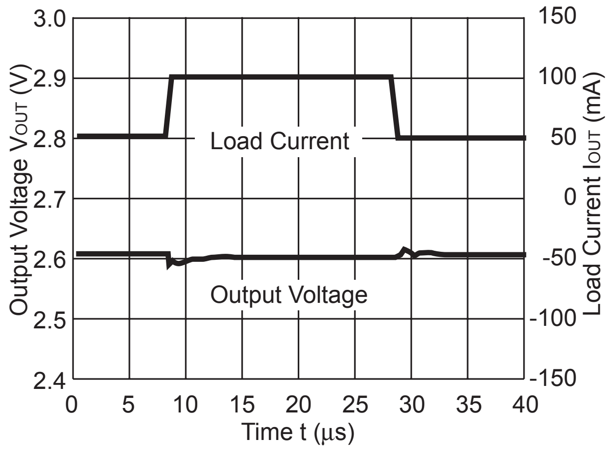
R1131x26xx

VIN=3.6V,
CIN = Ceramic 1.0μF COUT = Ceramic 1.0μF



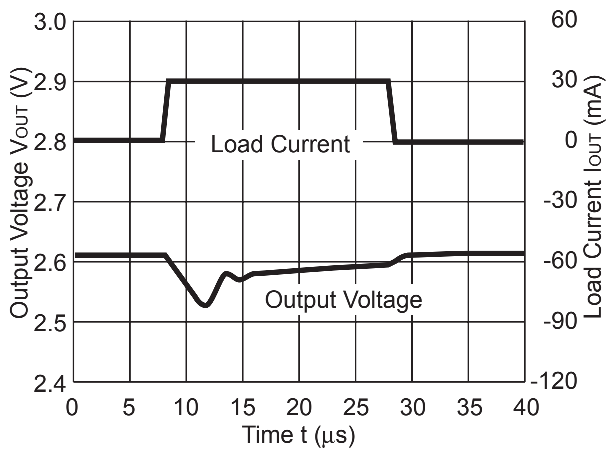
R1131x26xx

VIN=3.6V,
CIN = Ceramic 1.0μF COUT = Ceramic 2.2μF



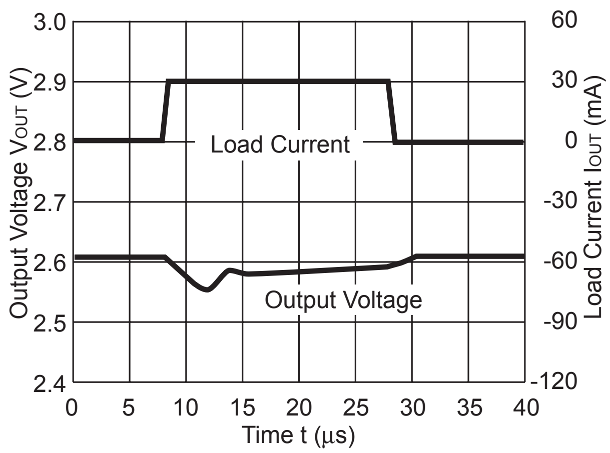
R1131x26xx

VIN=3.6V,
CIN = Ceramic 1.0µF COUT = Ceramic 1.0µF



R1131x26xx

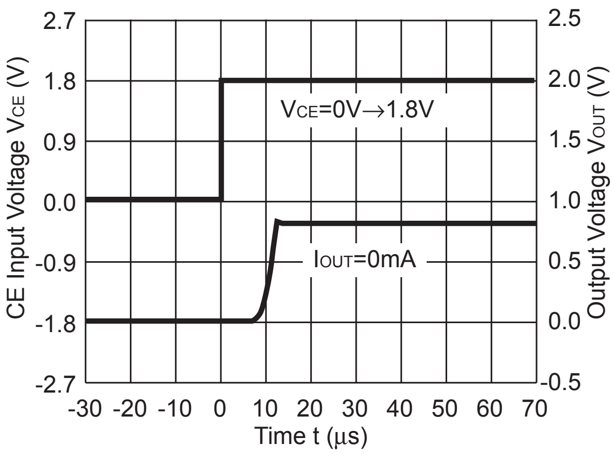
VIN=3.6V,
CIN = Ceramic 1.0µF COUT = Ceramic 2.2µF



12) Turn on speed with CE pin

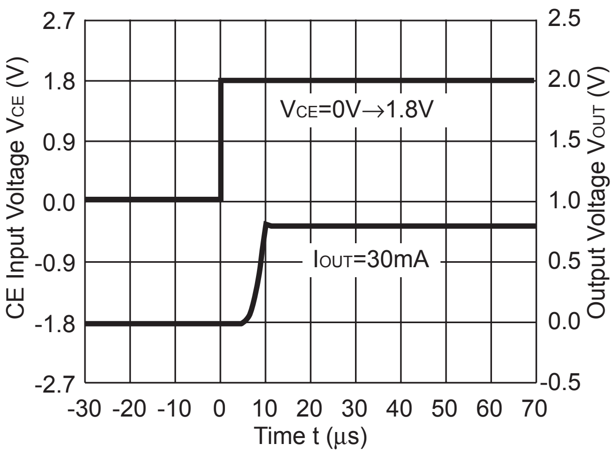
R1131x08xx

VIN=1.8V, CIN = Tantalum 1.0µF
COUT = Tantalum 1.0µF



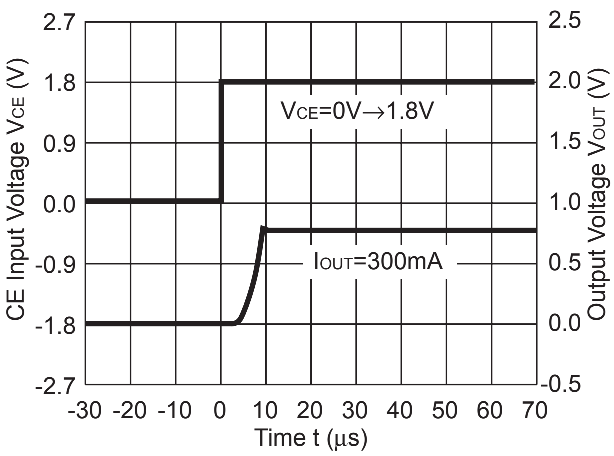
R1131x08xx

VIN=1.8V, CIN = Tantalum 1.0µF
COUT = Tantalum 1.0µF



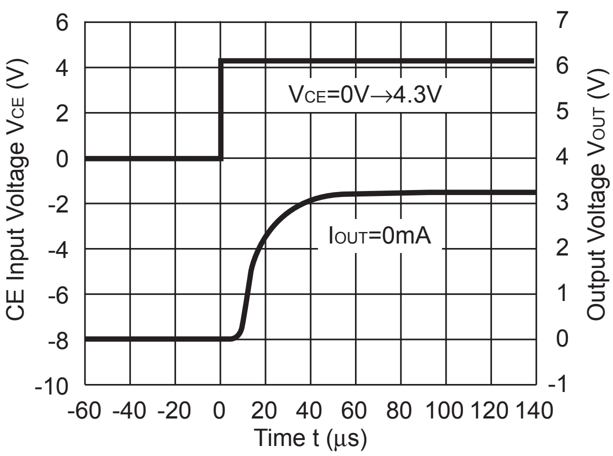
R1131x08xx

VIN=1.8V, CIN = Tantalum 1.0µF
COUT = Tantalum 1.0µF



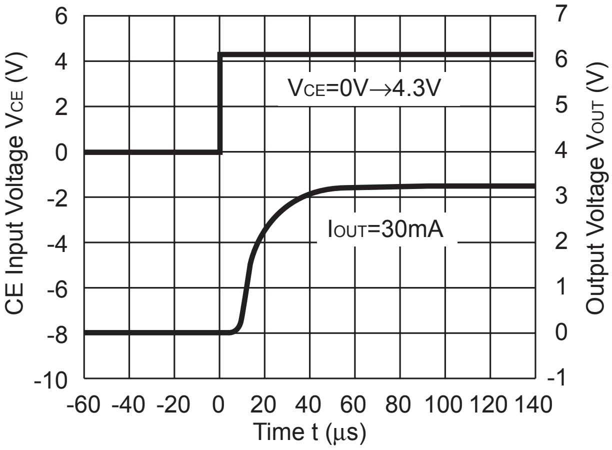
R1131x33xx

VIN=4.3V, CIN = Ceramic 1.0µF
COUT = Ceramic 1.0µF



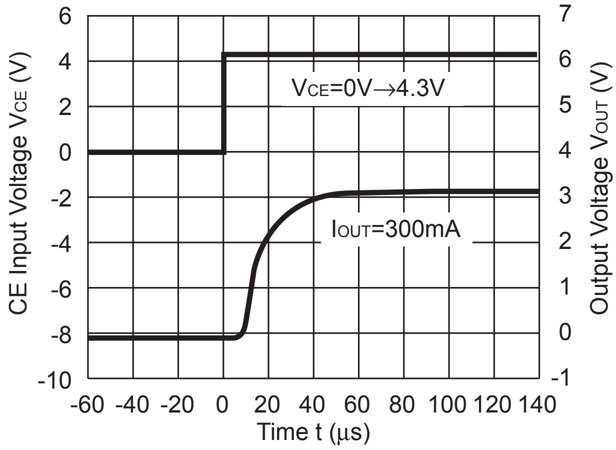
R1131x33xx (ECO=H)

VIN=4.3V, CIN = Ceramic 1.0μF
COUT = Ceramic 1.0μF



R1131x33xx (ECO=L)

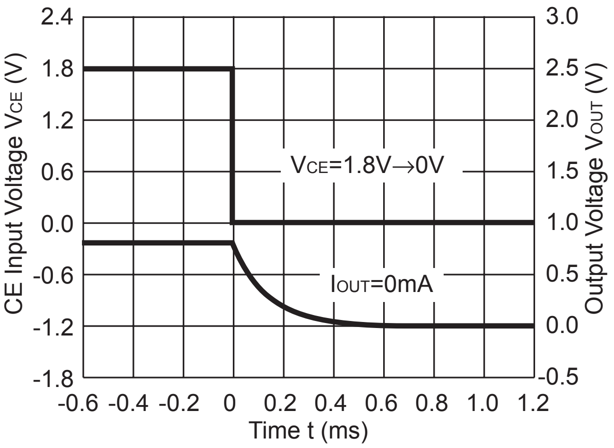
VIN=4.3V, CIN = Ceramic 1.0μF
COUT = Ceramic 1.0μF



13) Turn-off Speed with CE

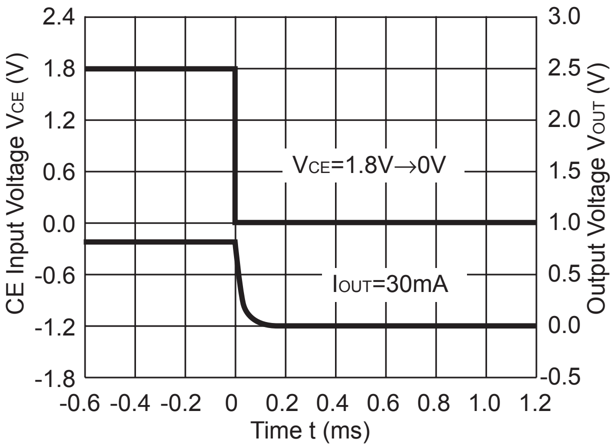
R1131x08xD

VIN=1.8V, CIN = Tantalum 1.0μF
COUT = Tantalum 1.0μF



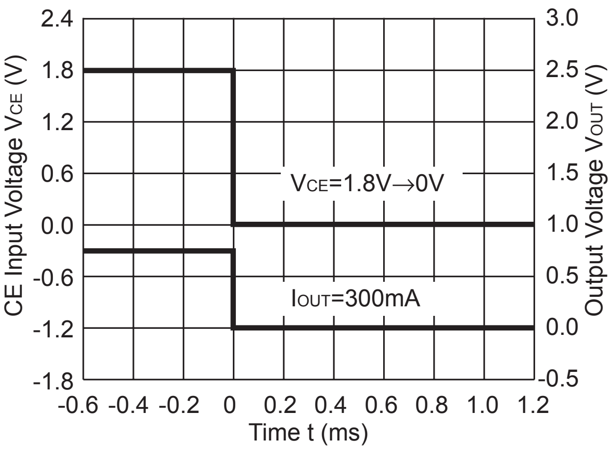
R1131x08xD

VIN=1.8V, CIN = Tantalum 1.0μF
COUT = Tantalum 1.0μF



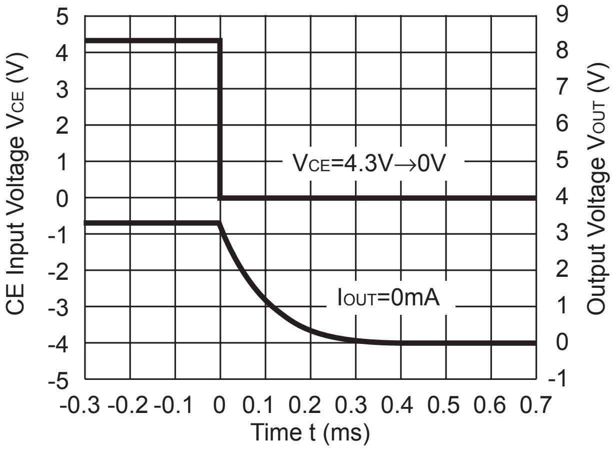
R1131x08xD

VIN=1.8V, CIN = Tantalum 1.0μF
COUT = Tantalum 1.0μF



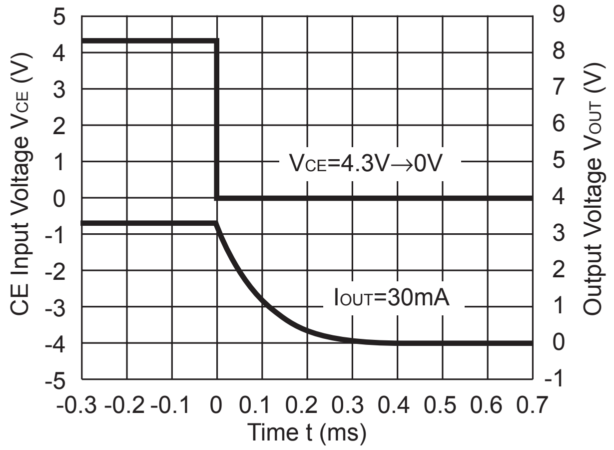
R1131x33xD

VIN=4.3V, CIN = Ceramic 1.0μF
COUT = Ceramic 1.0μF



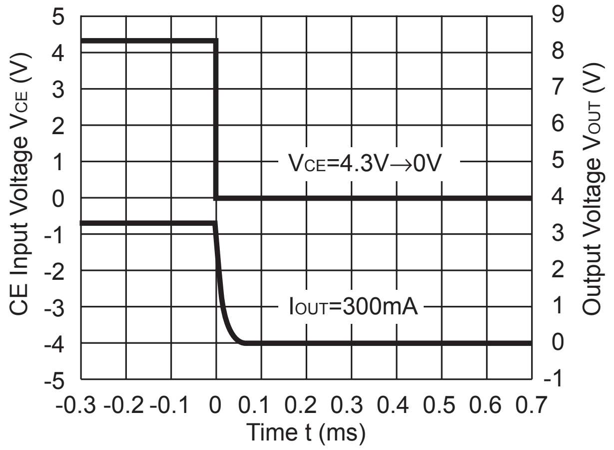
R1131x33xD

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



TECHNICAL NOTES

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:

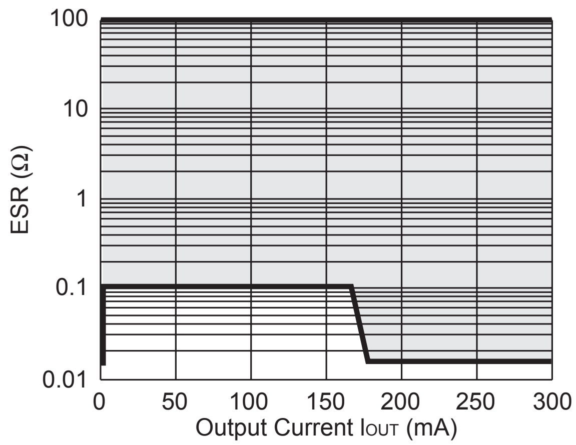
The relations between I_{OUT} (Output Current) and ESR of Output Capacitor are shown below. The conditions when the white noise level is under 40µV(Avg.) are marked as the hatched area in the graph.

<Test conditions>

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

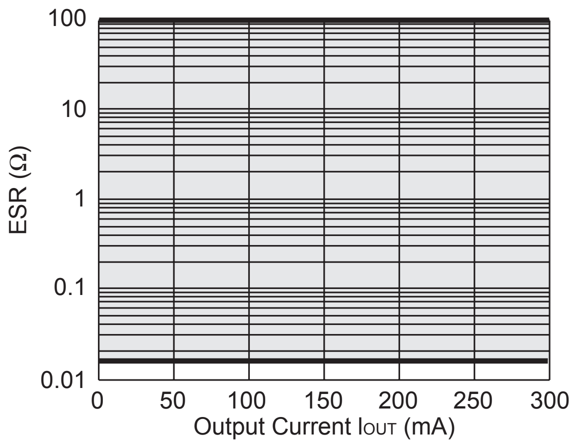
R1131x08xx

V_{IN}=1.4V to 6.0V,
C_{IN} = Ceramic 1.0µF C_{OUT} = Ceramic 1.0µF



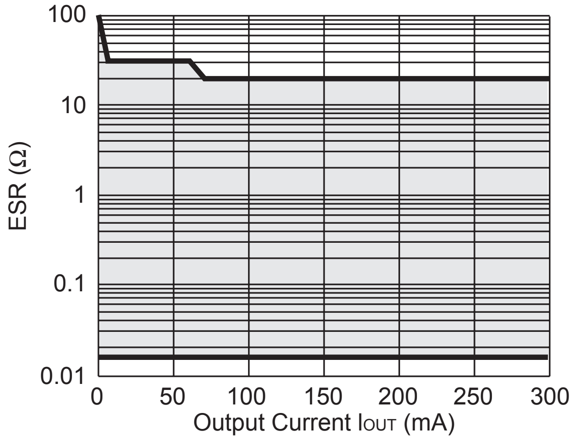
R1131x10xx

V_{IN}=1.4V to 6.0V,
C_{IN} = Ceramic 1.0µF C_{OUT} = Ceramic 1.0µF



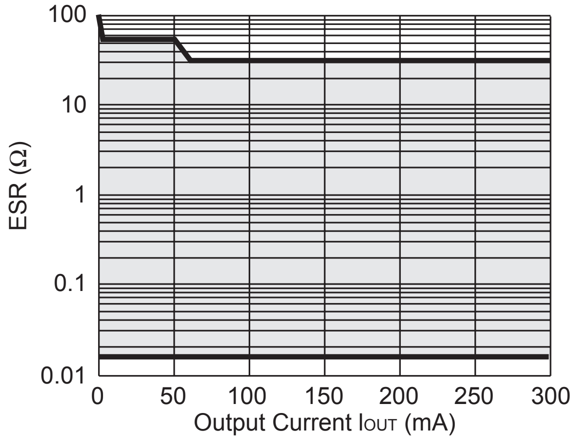
R1131x26xx

V_{IN}=3.0V to 6.0V,
C_{IN} = Ceramic 1.0μF C_{OUT} = Ceramic 1.0μF



R1131x15xx

V_{IN}=2.0V to 6.0V,
C_{IN} = Ceramic 1.0μF C_{OUT} = Ceramic 1.0μF



R1131x33xx

V_{IN}=3.6V to 6.0V,
C_{IN} = Ceramic 1.0μF C_{OUT} = Ceramic 1.0μF