RICOH

RP131x SERIES

LOW ON RESISTANCE / LOW VOLTAGE 1A LDO

NO.EA-174-111020

OUTLINE

The RP131x Series are voltage-regulators with a built-in low ON-resistance transistor and output current is 1A capability. These ICs are capable of the low input voltage (Min.1.6V) and also the minimum output voltage can be set from 0.8V. (The output voltage 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 chip enable circuit, current limit circuits for over-current and short, and a thermal-shutdown circuit.

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

The packages for these ICs are DFN1616-6B and DFN(PLP)1820-6 which are suitable for high density mounting of the ICs on boards. SOT-89-5, HSOP-6J and TO-252-5-P2 with high power dissipation are also available.

FEATURES

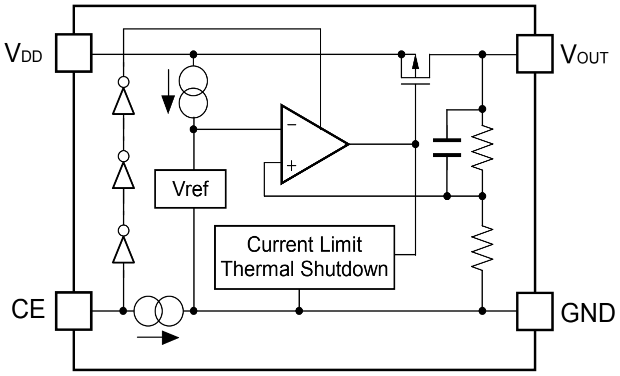
- Output Current .... Min. 1A
- Supply Current .... Typ. 65μA
- Standby Current .... Typ. 0.15μA
- Input Voltage Range .... 1.6V to 6.5V
- Output Voltage Range .... 0.8V to 5.5V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Dropout Voltage.. Typ. 0.5V (V_{OUT}=2.8V, I_{OUT}=1A)
- Ripple Rejection .... Typ. 70dB (f=1kHz, V_{OUT}=2.8V)
- Output Voltage Accuracy.. ±1.0%
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.05%/V
- Load Regulation .... Typ. 20mV at I_{OUT}=300mA, Typ. 80mV at I_{OUT}=1A
- Packages .... DFN1616-6B, DFN(PLP)1820-6, SOT-89-5, HSOP-6J, TO-252-5-P2
- Built-in Inrush current limit circuit .... Typ. 500mA
- Built-in Fold-Back Protection Circuit .... Typ. 250mA (Current at short mode)
- Built-in Thermal Shutdown Circuit .... Thermal Shutdown Temperature ; Typ. 165°C
  Released Temperature ; Typ. 135°C
- Built-in Auto Discharge Function .... D version
- Ceramic capacitors are recommended to be used with this IC .... 2.2μF or more (V_{OUT}≤3.6V)
  4.7μF or more (V_{OUT}>3.6V)

APPLICATIONS

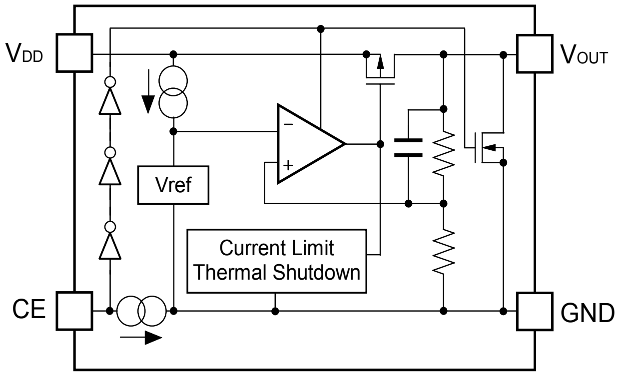
- Power source for battery-powered equipment.
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for Notebook PC.
- Power source for home appliances.

BLOCK DIAGRAMS

RP131xxx1B



RP131xxx1D



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP131Lxx1∗-TR	DFN1616-6B	5,000 pcs	Yes	Yes
RP131Kxx1∗-TR	DFN(PLP)1820-6	5,000 pcs	Yes	Yes
RP131Hxx1∗-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes
RP131Sxx1∗-E2-FE	HSOP-6J	1,000 pcs	Yes	Yes
RP131Jxx1∗-T1-FE	TO-252-5-P2	3,000 pcs	Yes	Yes

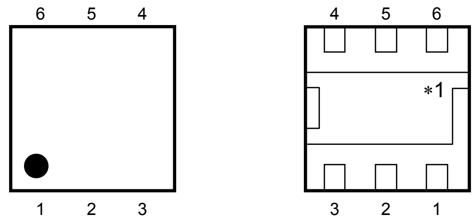
xx : The output voltage can be designated in the range from 0.8V(08) to 5.5V(55) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : The auto discharge function at off state are options as follows.
(B) without auto discharge function at off state
(D) with auto discharge function at off state

PIN CONFIGURATIONS

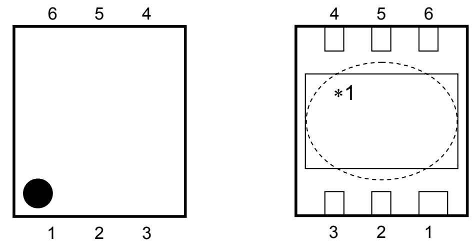
- **DFN1616-6B**

Top View **Bottom View**

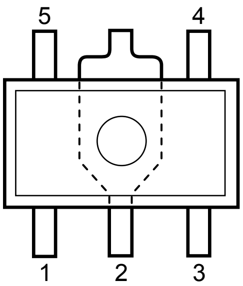


- **DFN(PLP)1820-6**

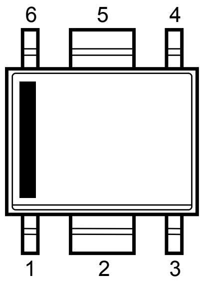
Top View **Bottom View**



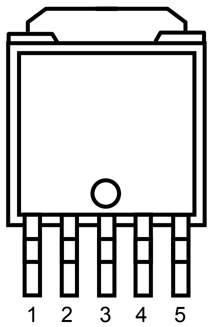
- **SOT-89-5**



- **HSON-6**



- **TO-252-5-P2**



PIN DESCRIPTIONS

- **DFN1616-6B**

Pin No.	Symbol	Pin Description
1	V_{OUT}	Output Pin*2
2	V_{OUT}	Output Pin*2
3	GND	Ground Pin
4	CE	Chip Enable Pin ("H" Active)
5	V_{DD}	Input Pin*2
6	V_{DD}	Input Pin*2

*1) 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.
*2) When you use this IC, please make sure be wired with 1pin with 2pin and 5pin with 6pin.

- **DFN(PLP)1820-6**

Pin No.	Symbol	Pin Description
1	V_{OUT}	Output Pin*2
2	V_{OUT}	Output Pin*2
3	GND	Ground Pin
4	CE	Chip Enable Pin ("H" Active)
5	V_{DD}	Input Pin*2
6	V_{DD}	Input Pin*2

*1) 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.
*2) When you use this IC, please make sure be wired with 1pin with 2pin and 5pin with 6pin.

- **SOT-89-5**

Pin No.	Symbol	Pin Description
1	NC	No Connection
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{DD}	Input Pin
5	V_{OUT}	Output Pin

- **HSOP-6J**

Pin No.	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin*3
3	NC	No Connection
4	CE	Chip Enable Pin ("H" Active)
5	GND	Ground Pin*3
6	V_{DD}	Input Pin

*3) When you use this IC, please make sure be wired with 2pin and 5pin.

- **TO-252-5-P2**

Pin No.	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin*4
3	GND	Ground Pin*4
4	CE	Chip Enable Pin ("H" Active)
5	V_{DD}	Input Pin

*4) When you use this IC, please make sure be wired with 2pin and 3pin.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	7.0	V
V_{CE}	Input Voltage (CE Pin)	−0.3 to 7.0	V
V_{OUT}	Output Voltage	−0.3 to V_{IN}+0.3	V
P_D	Power Dissipation (DFN1616-6B)*	640	mW
	Power Dissipation (DFN(PLP)1820-6)*	880	
	Power Dissipation (SOT-89-5)*	900	
	Power Dissipation (HSOP-6J)*	1700	
	Power Dissipation (TO-252-5-P2)*	1900	
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

V_{IN}=Set V_{OUT}+1V, I_{OUT}=1mA

The specification in ☐ is checked and guaranteed by design engineering at −40°C≤T_{opt}≤85°C, unless otherwise noted.

- **RP131xxx1B/D**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{OUT}>1.5V	×0.99		×1.01	V
			V_{OUT}≤1.5V	−15		15	mV
		−40°C≤Topt≤85°C	V_{OUT}>1.5V	×0.974		×1.018	V
			V_{OUT}≤1.5V	−40		27	mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	0.1mA≤I_{OUT}≤300mA			20	40	mV
		0.1mA≤I_{OUT}≤1A			80	120	
V_{DIF}	Dropout Voltage	Refer to the following table					
I_{SS}	Supply Current	I_{OUT}=0mA (V$_{IN}$=6.5V)			65	90	μA
Istandby	Standby Current	V_{CE}=0V, V_{IN}=6.5V			0.15	0.60	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V≤V_{IN}≤6.5V ∗However, V_{IN}≥1.6V			0.05	0.1	%/V
RR	Ripple Rejection	f=1kHz Ripple 0.2Vp-p I_{OUT}=100mA	V_{OUT}≤3.3V		70		dB
			V_{OUT}>3.3V		60		
V_{IN}	Input Voltage			1.6		6.5	V
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	−40°C≤Topt≤85°C			±100		ppm /°C
I_{LIM}	Output Current Limit			1			A
I_{SC}	Short Current Limit	V_{OUT}=0V			250		mA
I_{PD}	CE Pull-down Current				0.3		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, I_{OUT}=1mA			45		μVrms
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature			165		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			135		°C
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V_{IN}=4.0V, V_{CE}=0V			30		Ω

The specification in ☐ is checked and guaranteed by design engineering at −40°C≤T_{opt}≤85°C, unless otherwise noted.
All of unit are tested and specified under load conditions such that Tj≈T_{opt}=25°C except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient, Dropout Voltage at 1A Output Current and Thermal Shutdown items.

• Dropout Voltage by Output Voltage

Topt=25°C

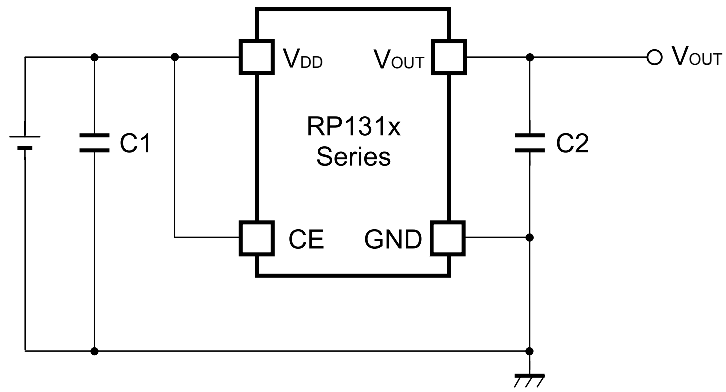
Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)					
	Condition	Typ.	Max.	Condition	Typ.	Max.
$0.8 \leq V_{OUT} < 0.9$	I_{OUT}=300mA	0.600	0.780	I_{OUT}=1A	1.100	1.650
$0.9 \leq V_{OUT} < 1.0$		0.550	0.690		1.050	1.500
$1.0 \leq V_{OUT} < 1.1$		0.450	0.610		1.000	1.450
$1.1 \leq V_{OUT} < 1.2$		0.340	0.540		0.930	1.420
$1.2 \leq V_{OUT} < 1.5$		0.290	0.500		0.900	1.380
$1.5 \leq V_{OUT} < 2.6$		0.230	0.310		0.700	1.100
$2.6 \leq V_{OUT} < 3.3$		0.150	0.180		0.500	0.750
$3.3 \leq V_{OUT} \leq 5.5$		0.140	0.170		0.450	0.650

The specification in ☐ is checked and guaranteed by design engineering at $-40°C \leq T_{opt} \leq 85°C$, unless otherwise noted.
All of unit are tested and specified under load conditions such that $Tj \approx T_{opt}=25°C$ except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient, Dropout Voltage at 1A Output Current and Thermal Shutdown items.

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



Recommendation value of the external capacitors

V_{OUT}	Capacitors	
$V_{OUT} \leq 3.6V$	C1	Kyocera 2.2μF (size:1005) [CM05X5R225M06AB]
	C2	Kyocera 2.2μF (size:1608) [CM105X5R225K06AB]
$V_{OUT} > 3.6V$	C1	Kyocera 2.2μF (size:1608) [CM105X5R225K06AB]
	C2	Kyocera 4.7μF (size:1608) [CM105X5R475M06AB]

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 good frequency characteristics and ESR (Equivalent Series Resistance).

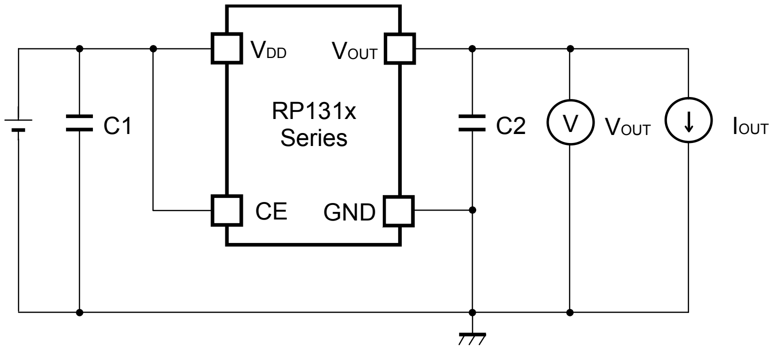
If a tantalum capacitor is used, and its ESR of C2 is large, the loop oscillation may result. Because of this, select C2 carefully considering its frequency characteristics.

PCB Layout

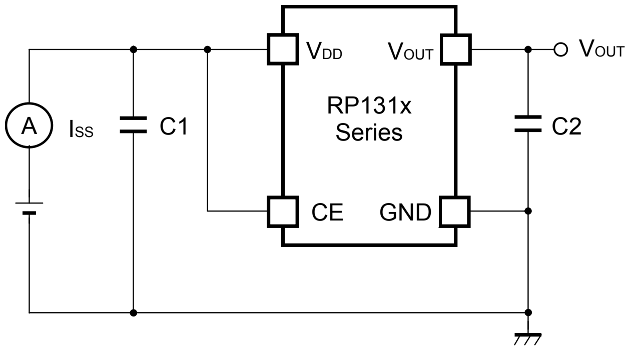
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 between V_{DD} and GND pin with a capacitance value as "Recommendation value of the external capacitors" above or more, and as close as possible to the pins.

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

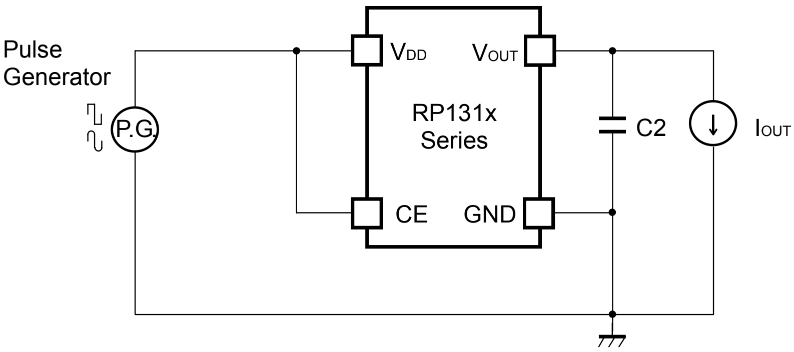
TEST CIRCUITS



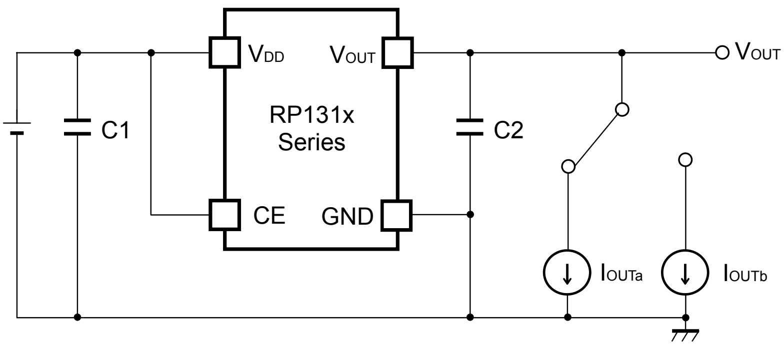
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

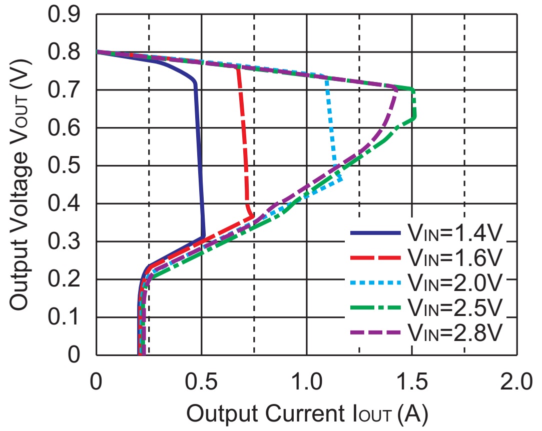


Test Circuit for Load Transient Response

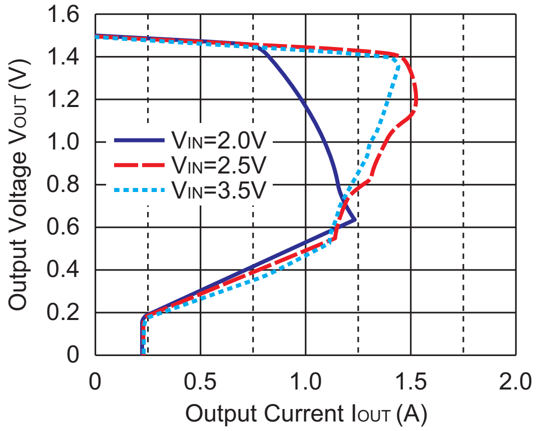
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25°C)

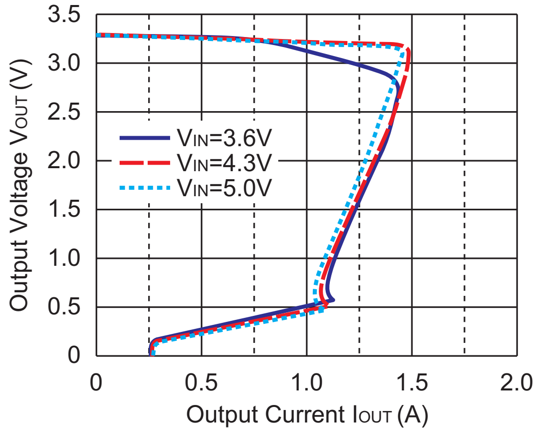
RP131x081x



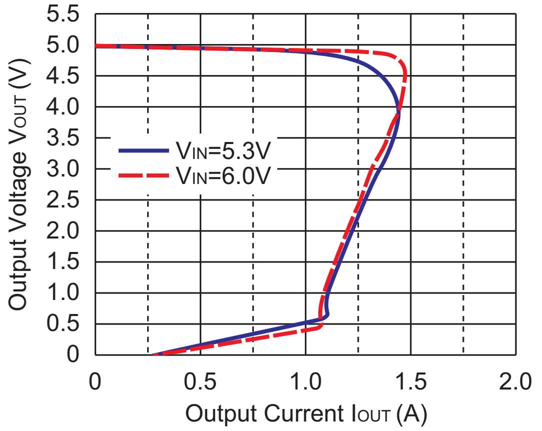
RP131x151x



RP131x331x

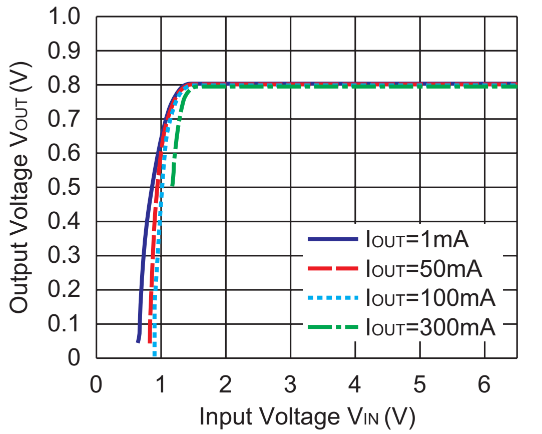


RP131x501x



2) Output Voltage vs. Input Voltage (Topt=25°C)

RP131x081x



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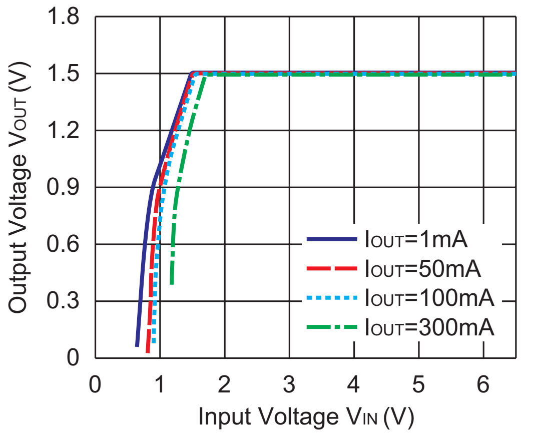

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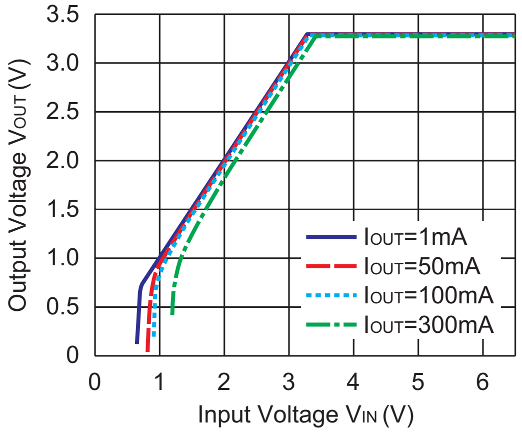
RP131x331x



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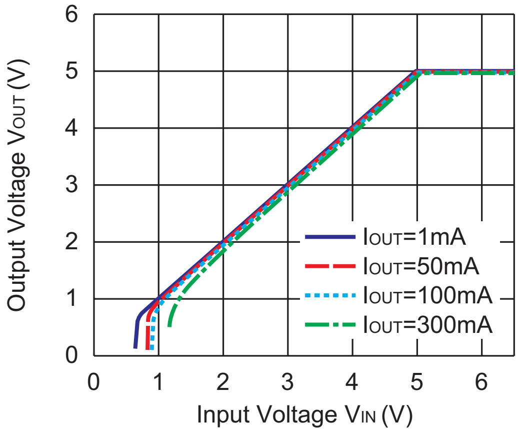
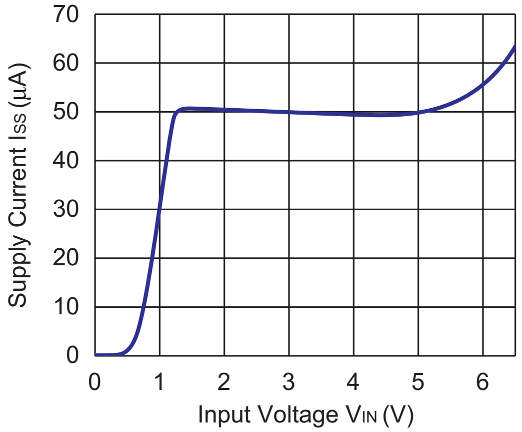


3) Supply Current vs. Input Voltage (Topt=25°C)

RP131x081x



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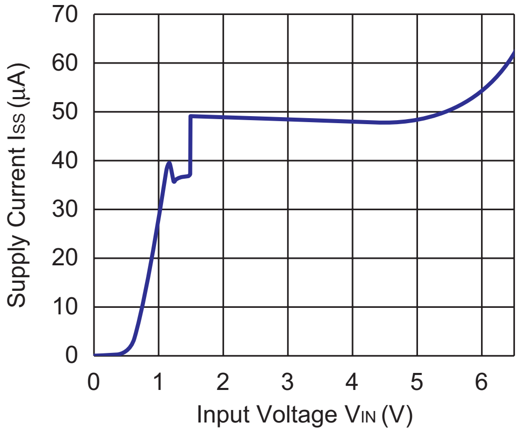

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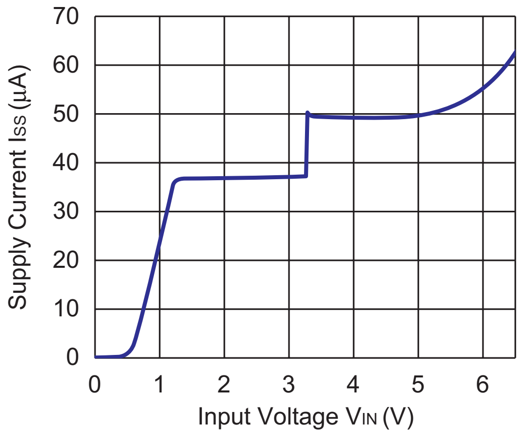

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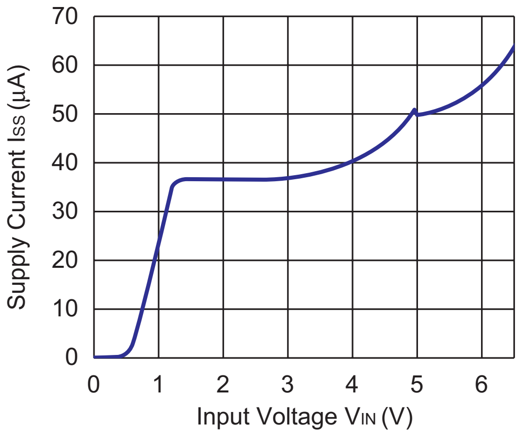
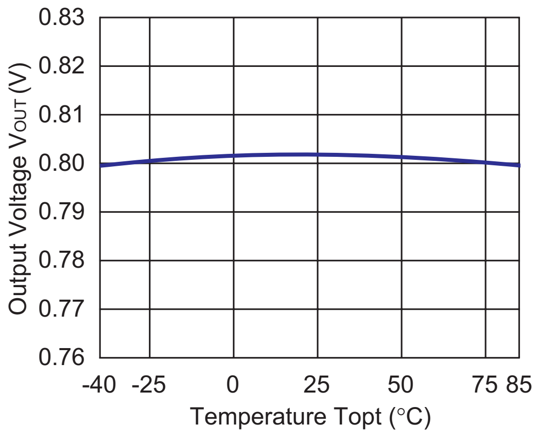
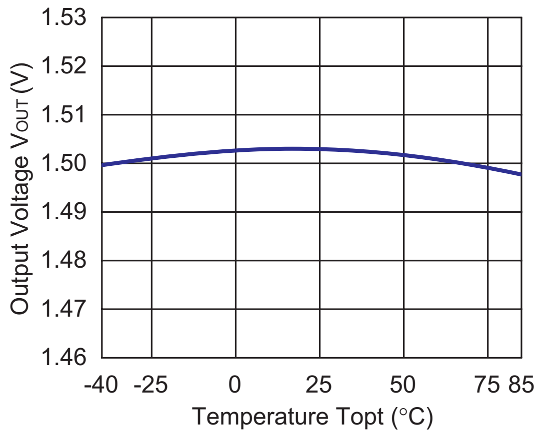


4) Output Voltage vs. Temperature

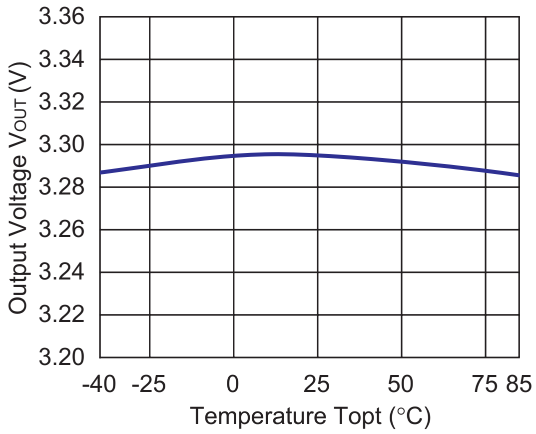
RP131x081x



RP131x281x



RP131x331x



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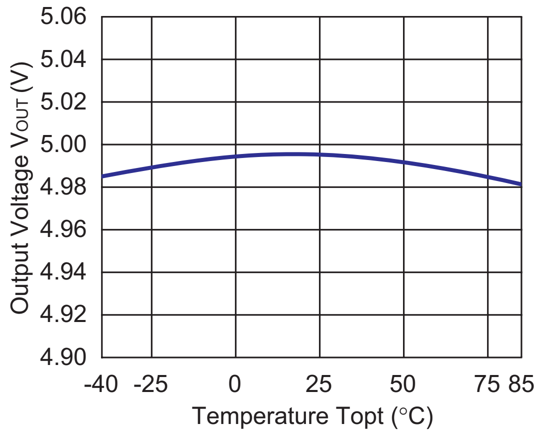
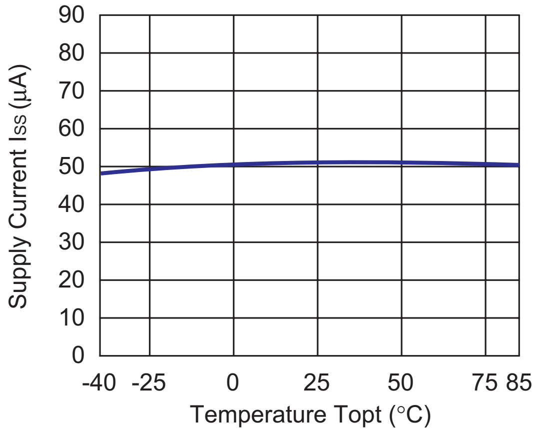


5) Supply Current vs. Temperature

RP131x081x



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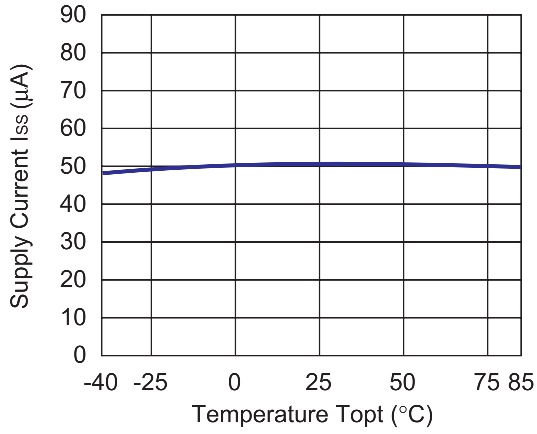

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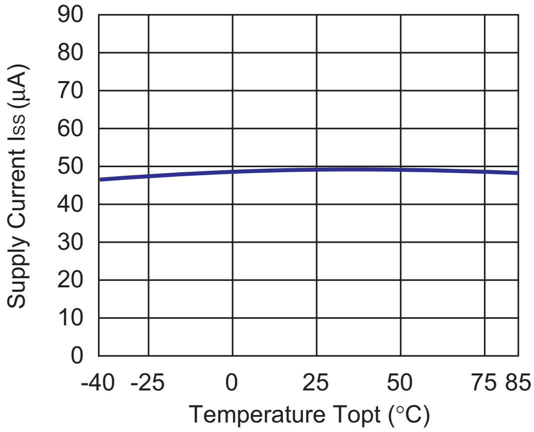
RP131x331x



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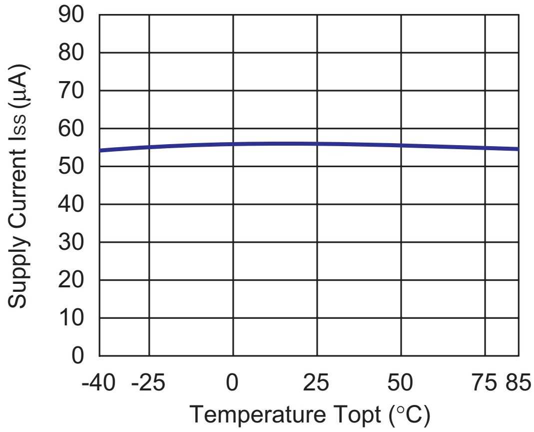
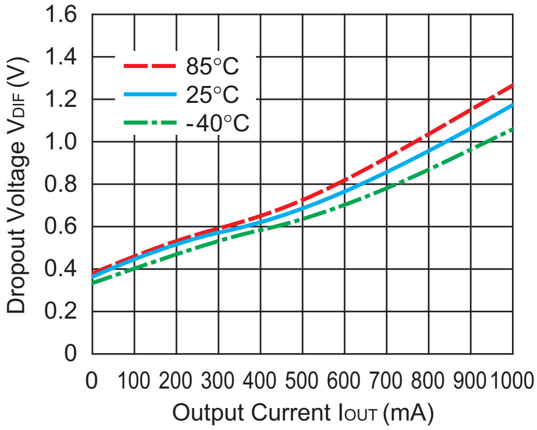
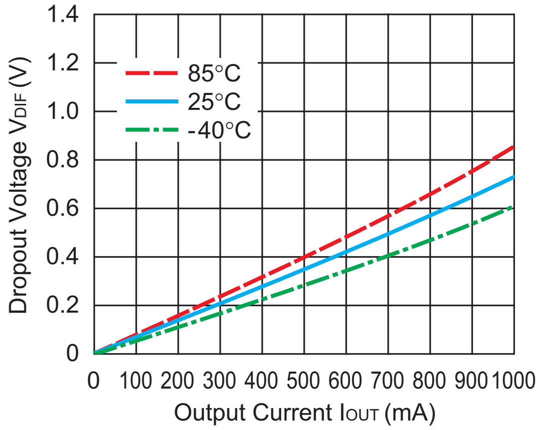


6) Dropout Voltage vs. Output Current

RP131x081x



RP131x151x



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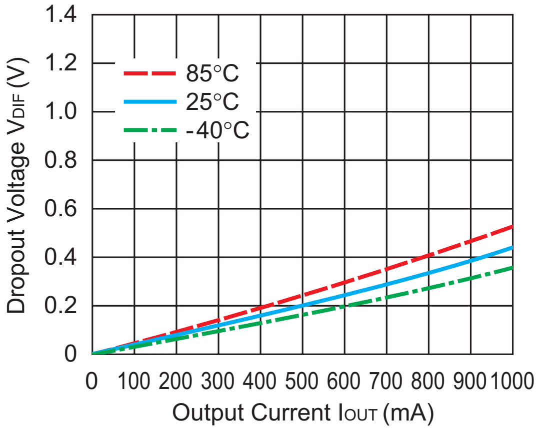

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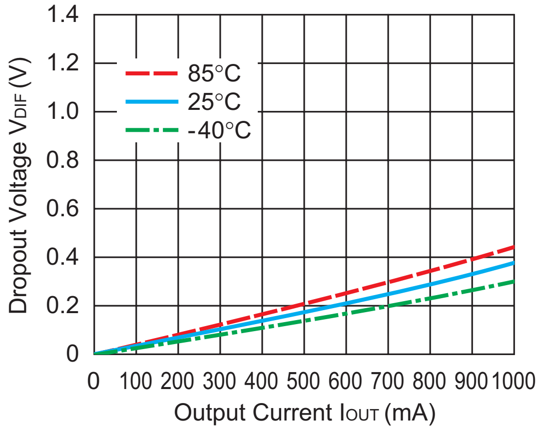
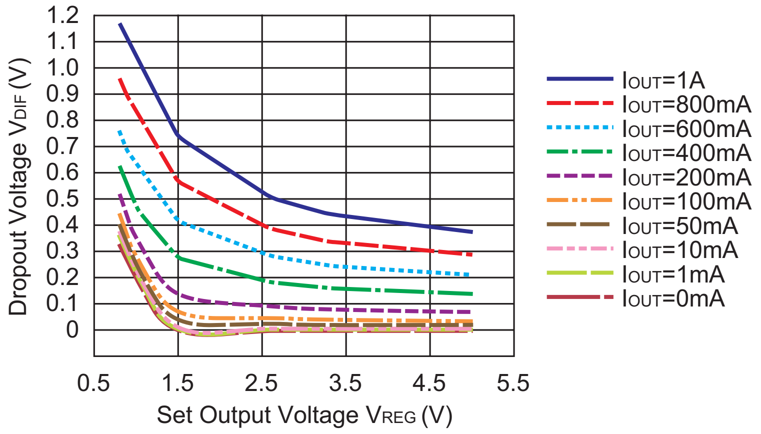
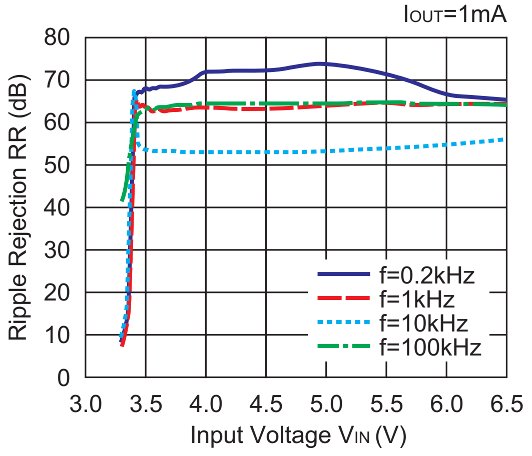


7) Dropout Voltage vs. Set Output Voltage

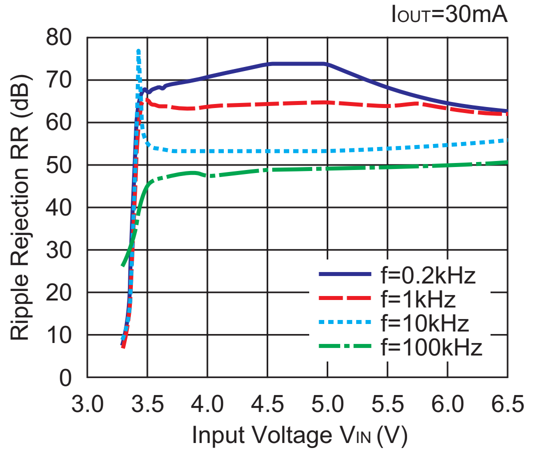


8) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=Ceramic 1.0μF, Ripple=0.2Vp-p, Topt=25°C)

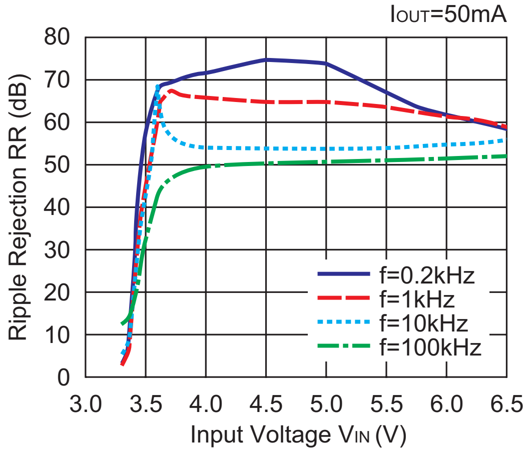
RP131x331x



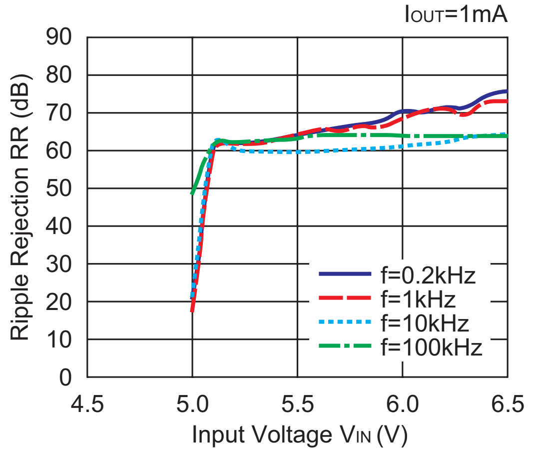
RP131x331x



RP131x331x



RP131x501x



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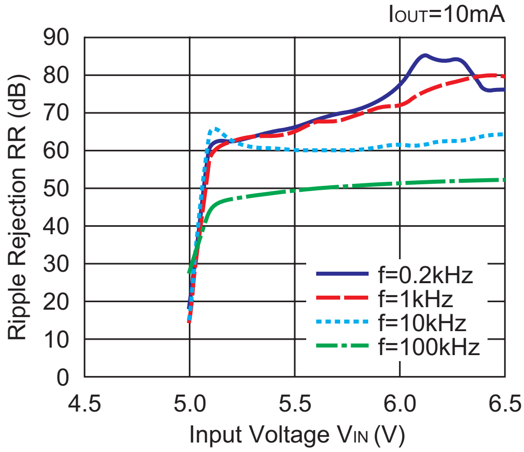

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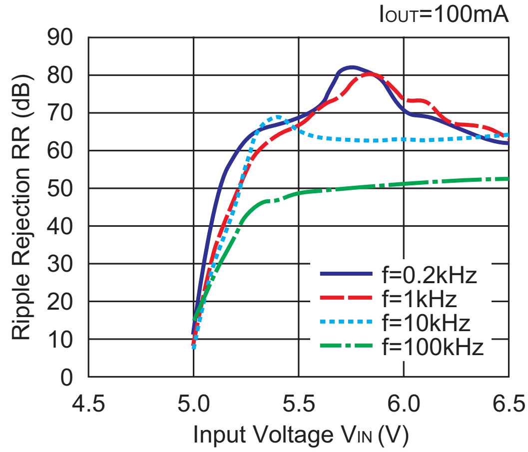
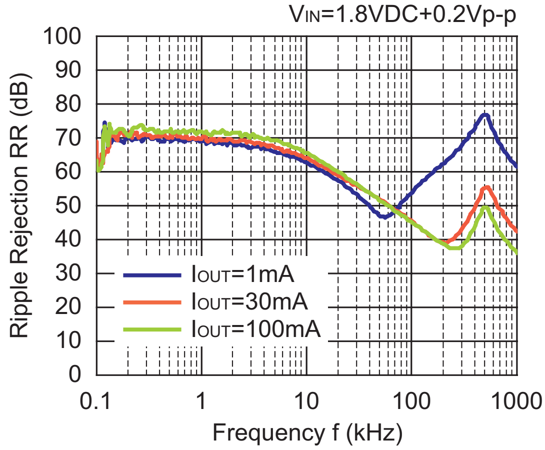
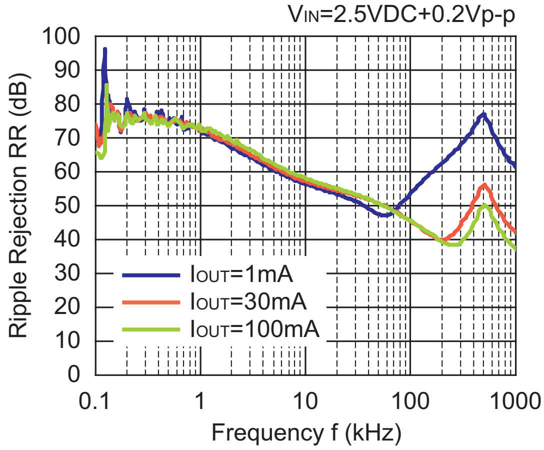


9) Ripple Rejection vs. Frequency (C1=none, C2=Ceramic 4.7µF, Topt=25°C)

RP131x081x



RP131x151x



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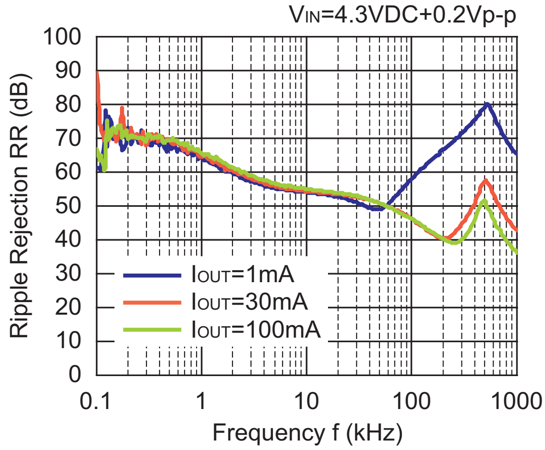

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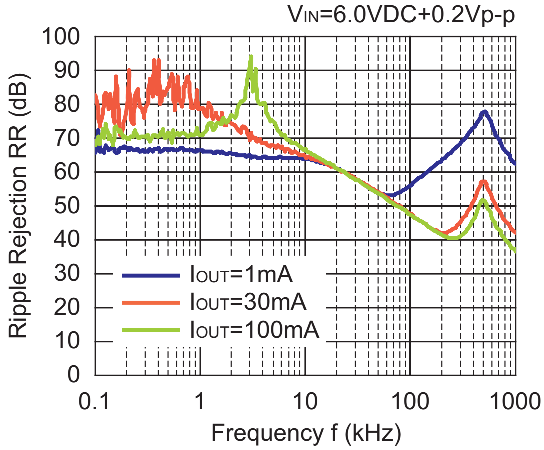
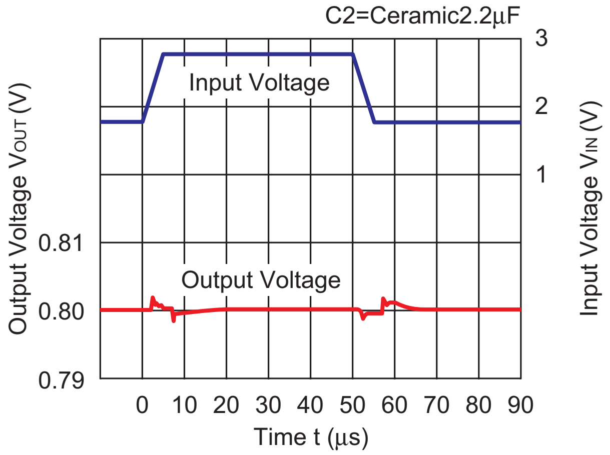
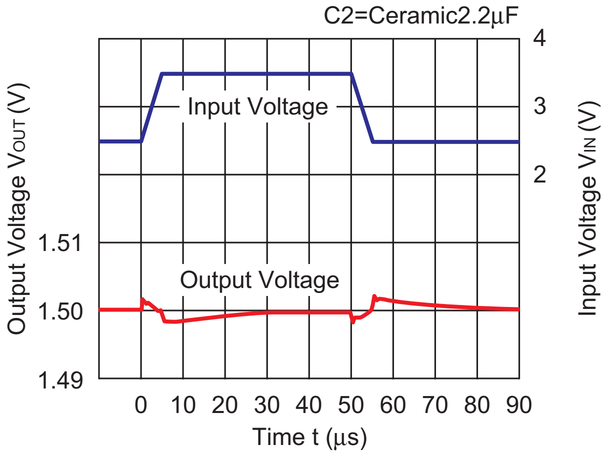


10) Input Transient Response (I_{OUT}=100mA, tr=tf=5µs, C1=none, Topt=25°C)

RP131x081x



RP131x151x



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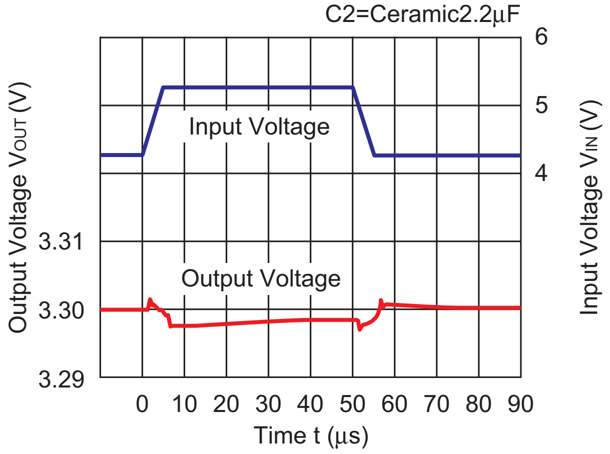
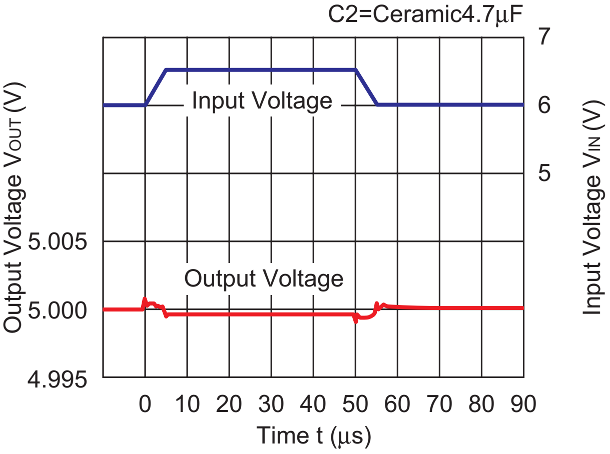
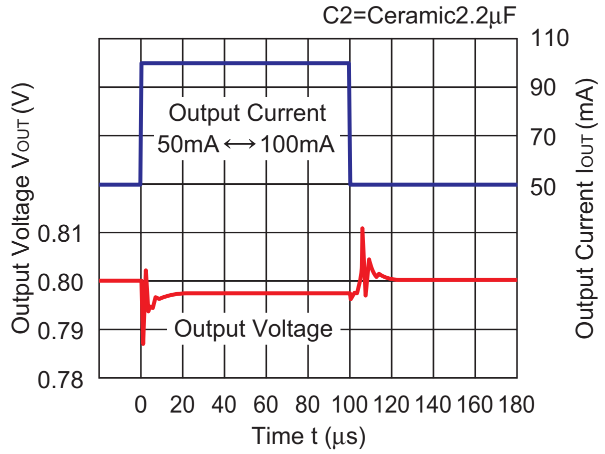


RP131x501x

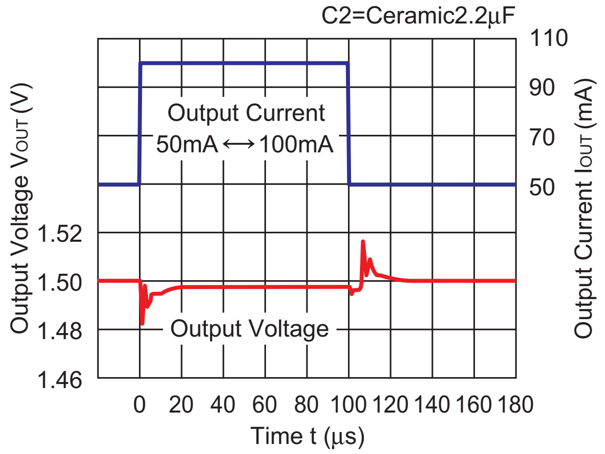


11) Load Transient Response (tr=tf=0.5µs, C1=Ceramic 2.2µF, V_{IN}=V_{OUT}+1.0V, Topt=25°C)

RP131x081x



RP131x151x



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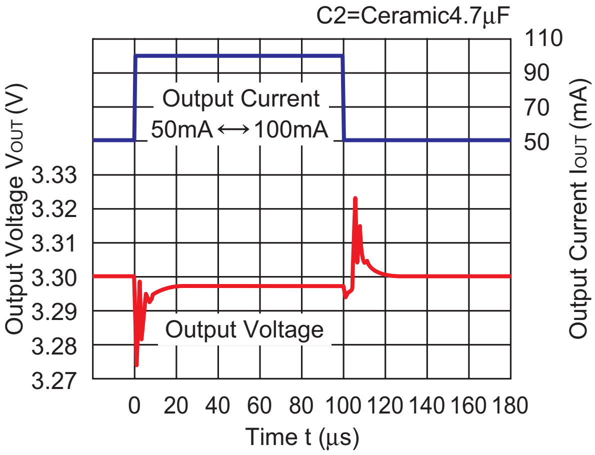
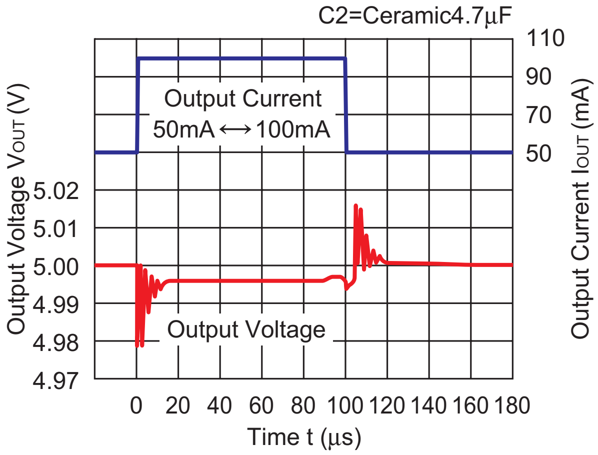
RP131x331x



RP131x501x



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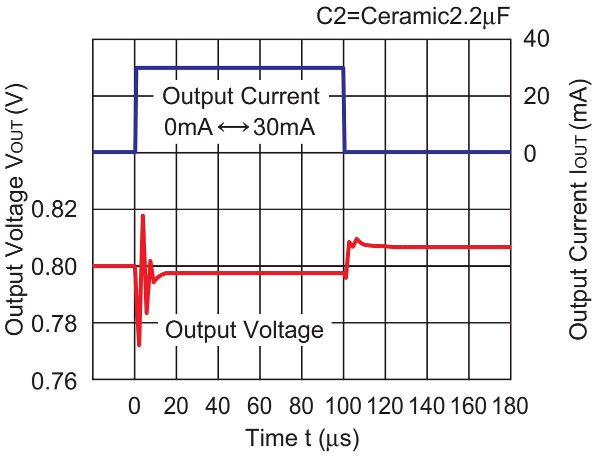

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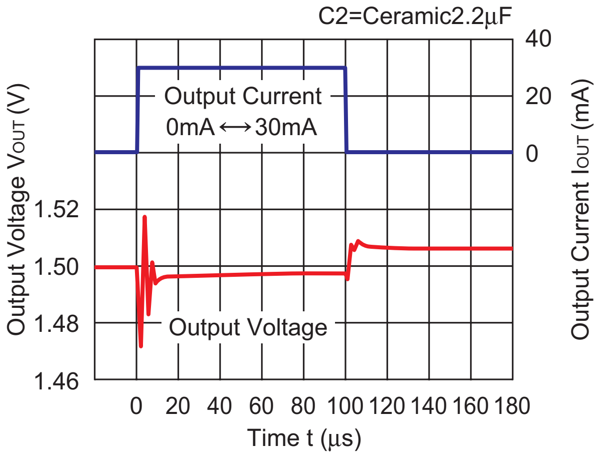

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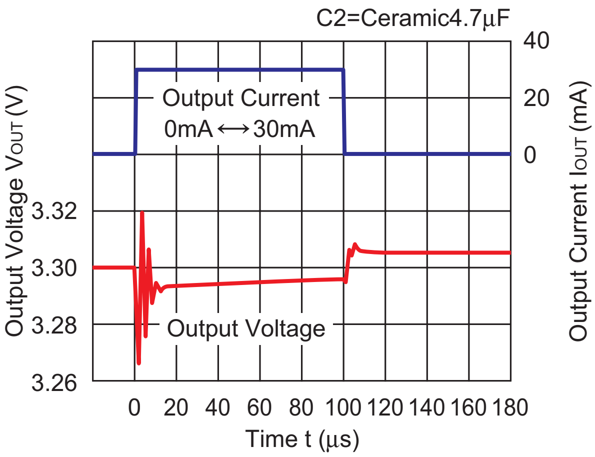

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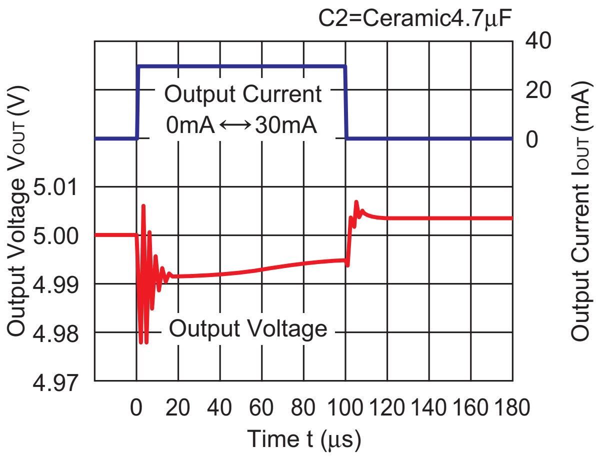

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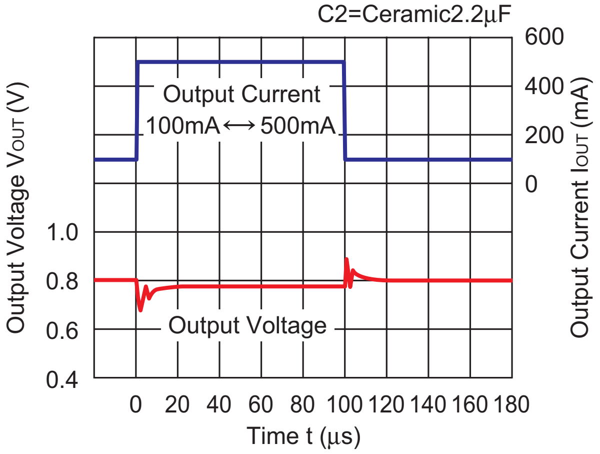

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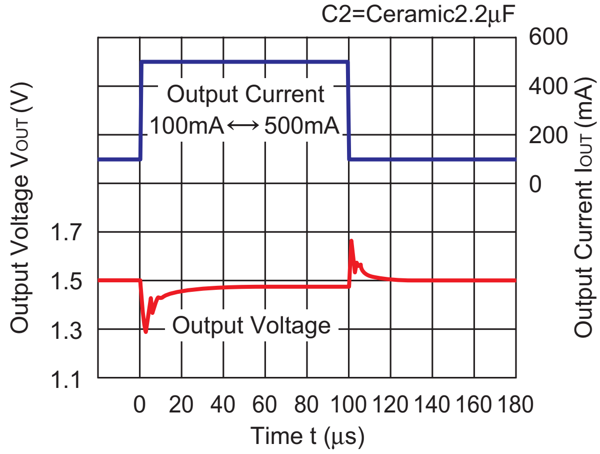

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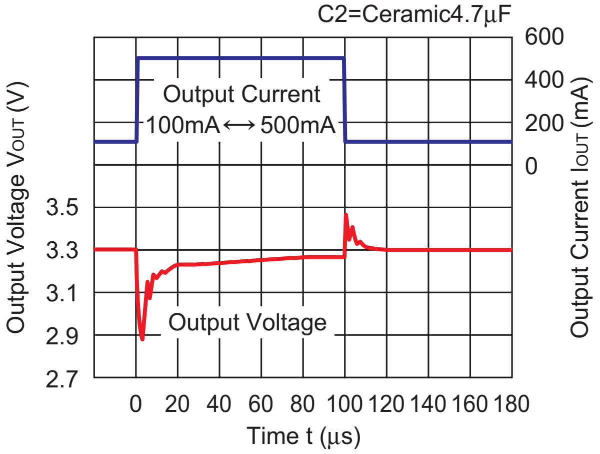

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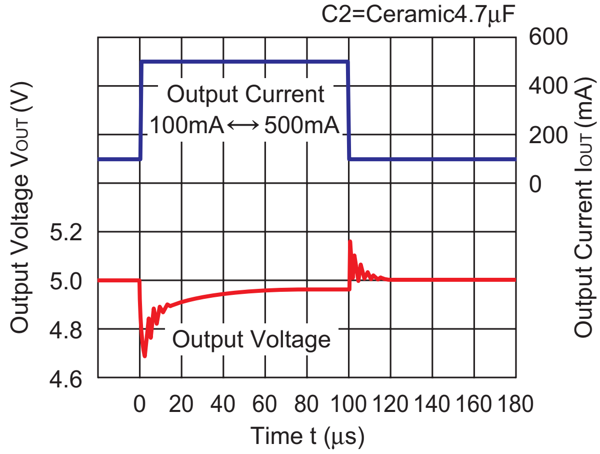
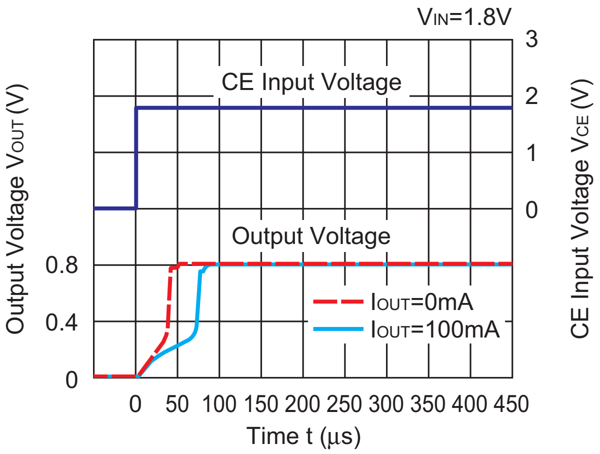
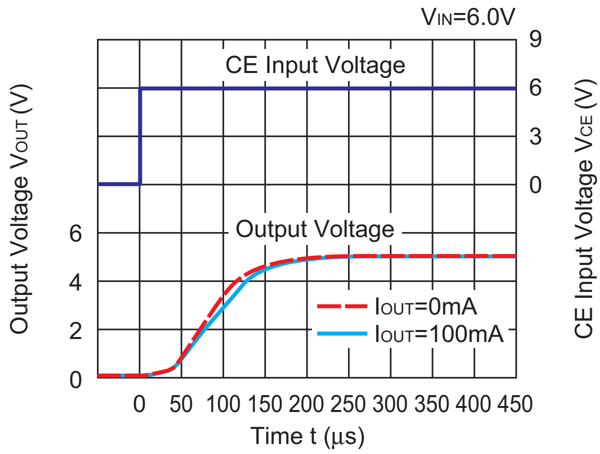


12) Turn On Speed with CE pin (C1=Ceramic 2.2μF, C2=Ceramic 4.7μF, Topt=25°C)

RP131x081x

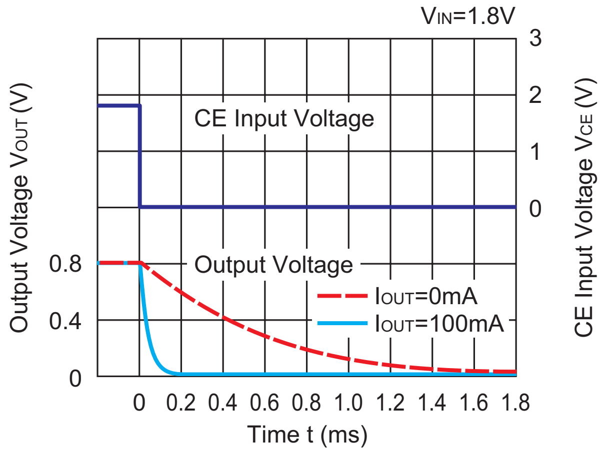


RP131x501x

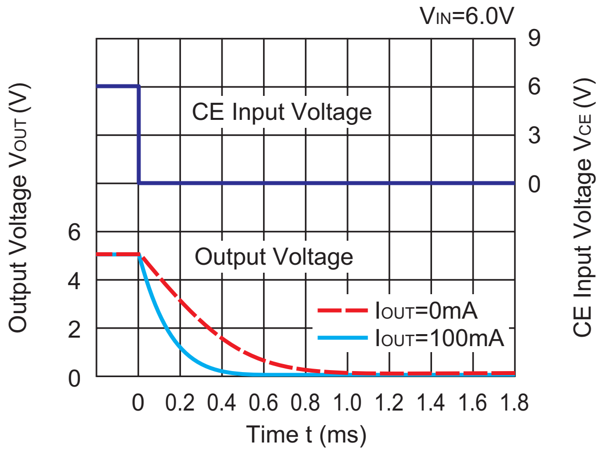


13) Turn Off Speed with CE pin (D Version) (C1=Ceramic 2.2µF, C2=Ceramic 4.7µF, Topt=25°C)

RP131x081D

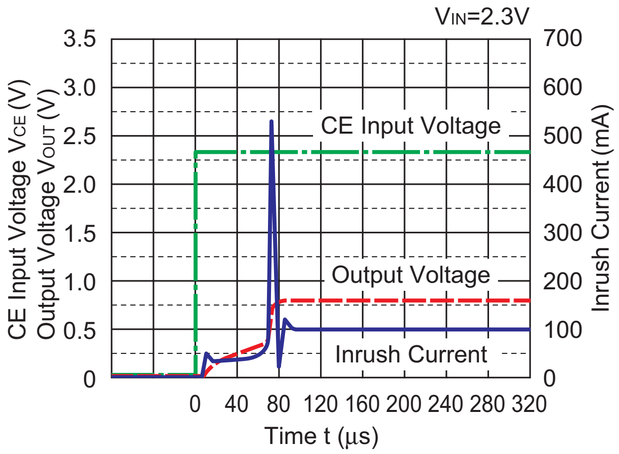


RP131x501D

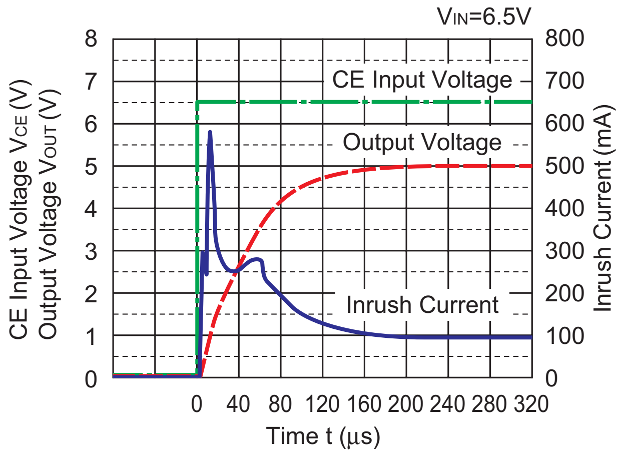


14) Inrush Current at turning on (C1=Ceramic 2.2µF, C2=Ceramic 4.7µF, Topt=25°C)

RP131x081x

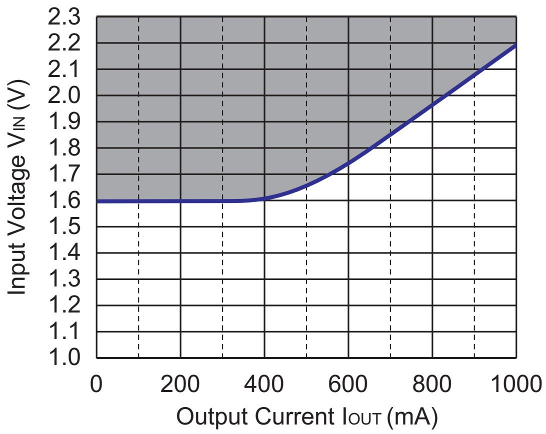


RP131x501x



15) Minimum Operating Voltage

RP131x081x



Hatched area is available for 0.8V output.

ESR vs. Output Current

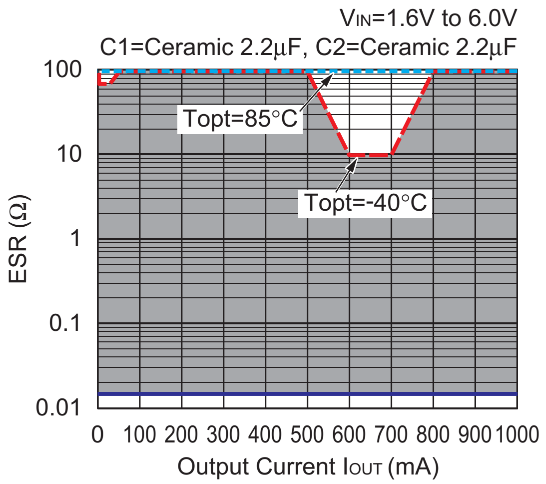
When using these ICs, consider the following points:

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

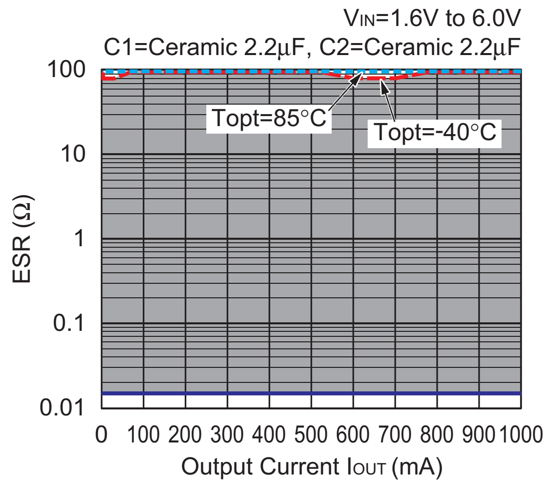
Measurement conditions

Frequency Band : 10Hz to 3MHz
Temperature : –40°C to 85°C
C1 : 2.2µF (Kyocera, CM05X5R225M04AD)
C2 : 2.2µF (Kyocera, CM105X5R225K06AE)
4.7µF (Kyocera, CM105X5R475M06AB)

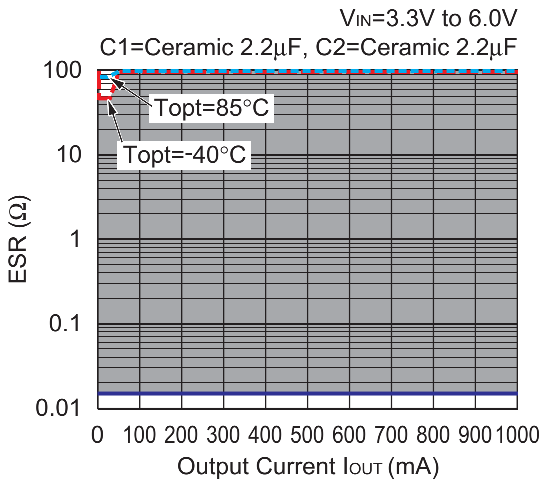
RP131x081x



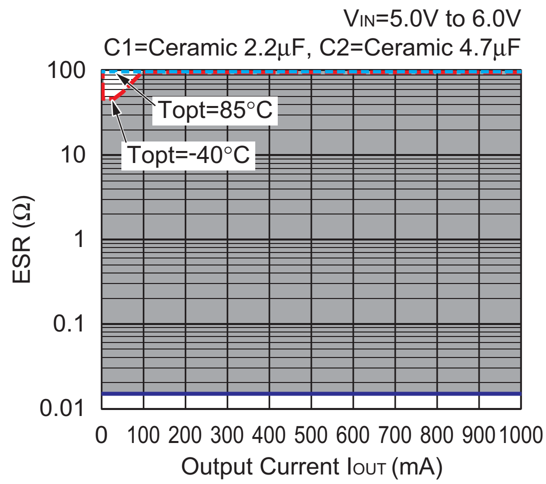
RP131x151x



RP131x331x



RP131x501x



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

■Ricoh awarded ISO 14001 certification.
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

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