

LOW ON RESISTANCE / LOW VOLTAGE 1A LDO

NO.EA-174-180711

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. 65 μ A
- Standby Current Typ. 0.15 μ A
- Input Voltage Range 1.6V to 6.5V
- Output Voltage Range 0.8V to 5.5V ⁽¹⁾(0.1V steps)
- 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 $\pm 1.0\%$
- Temperature-Drift Coefficient of Output Voltage Typ. $\pm 100ppm/^{\circ}C$
- 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 $^{\circ}C$
Released Temperature ; Typ. 135 $^{\circ}C$
- Built-in Auto Discharge Function D version
- Ceramic capacitors are recommended to be used with this IC 2.2 μ F or more ($V_{OUT}\leq 3.6V$)
4.7 μ F 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.

⁽¹⁾ For other voltages, please refer to MARK INFORMATIONS.

RP131x

NO.EA-174-180711

SELECTION GUIDE

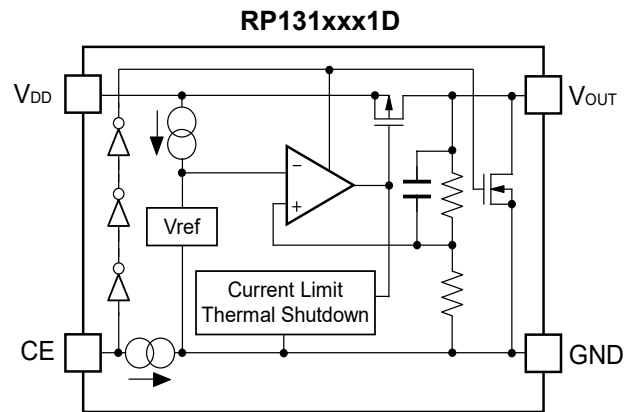
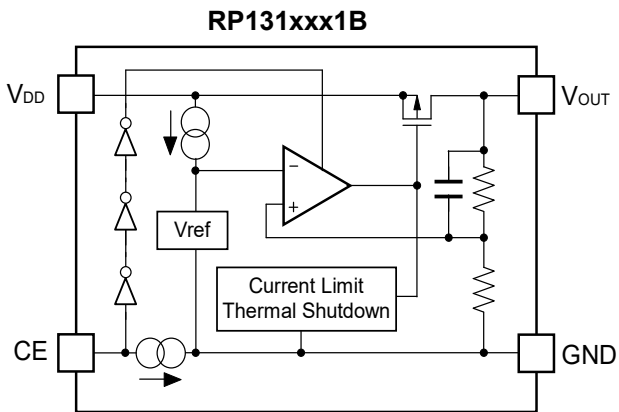
The output voltage, auto discharge function, package for the ICs can be selected at the user's request.

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 INFORMATION.)

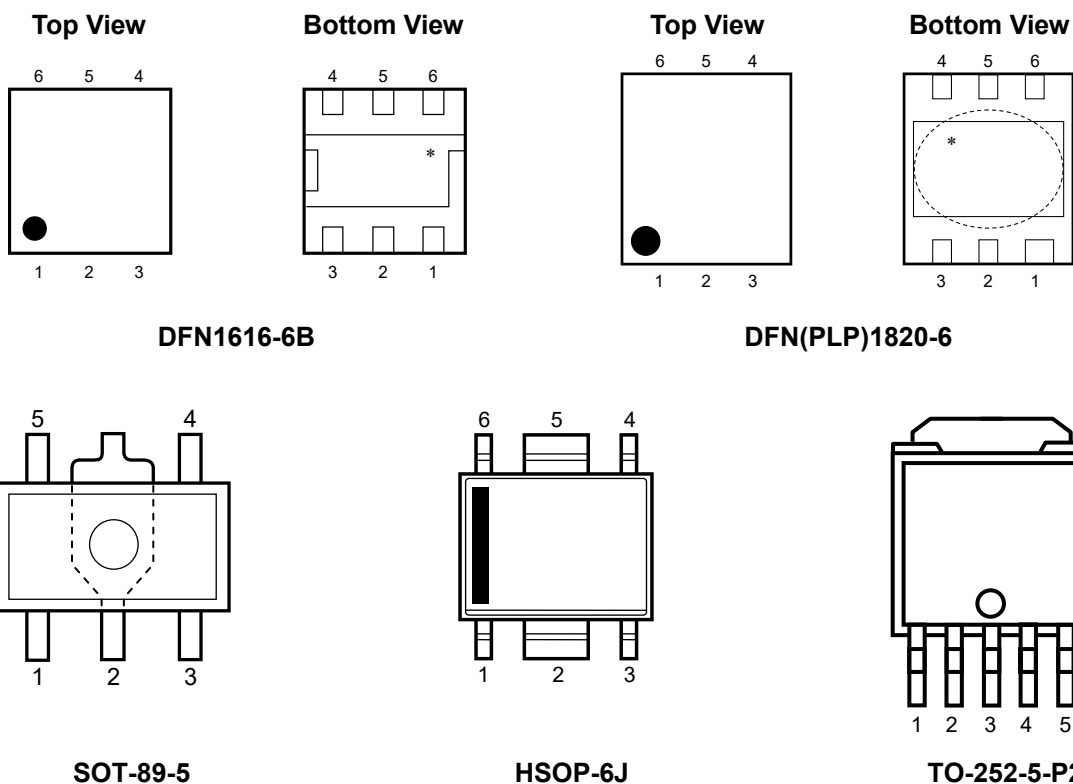
- * : The auto discharge function at off state are options as follows.⁽¹⁾
(B) without auto discharge function at off state
(D) with auto discharge function at off state

BLOCK DIAGRAMS



⁽¹⁾ Auto-discharge function quickly lowers the output voltage to 0V, when the chip enable signal is switched from the active mode to the standby mode, by releasing the electrical charge accumulated in the external capacitor

PIN DESCRIPTIONS



*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.

RP131L (DFN1616-6B) Pin Description

Pin No.	Symbol	Pin Description
1	VOUT	Output Pin ⁽¹⁾
2	VOUt	Output Pin ⁽¹⁾
3	GND	Ground Pin
4	CE	Chip Enable Pin ("H" Active)
5	VDD	Input Pin ⁽¹⁾
6	VDD	Input Pin ⁽¹⁾

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

RP131x

NO.EA-174-180711

RP131K (DFN(PLP)1820-6) Pin Description

Pin No.	Symbol	Pin Description
1	VOUT	Output Pin ⁽¹⁾
2	VOUT	Output Pin ⁽¹⁾
3	GND	Ground Pin
4	CE	Chip Enable Pin ("H" Active)
5	VDD	Input Pin ⁽¹⁾
6	VDD	Input Pin ⁽¹⁾

RP131H (SOT-89-5) Pin Description

Pin No.	Symbol	Pin Description
1	NC	No Connection
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	VDD	Input Pin
5	VOUT	Output Pin

RP131S (HSOP-6J) Pin Description

Pin No.	Symbol	Pin Description
1	VOUT	Output Pin
2	GND	Ground Pin ⁽²⁾
3	NC	No Connection
4	CE	Chip Enable Pin ("H" Active)
5	GND	Ground Pin ⁽²⁾
6	VDD	Input Pin

RP131J (TO-252-5-P2) Pin Description

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

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

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

⁽³⁾ 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 ⁽¹⁾	DFN1616-6B, JEDEC STD.51-7	2400	mW
		DFN(PLP)1820-6, JEDEC STD.51-7	2200	
		SOT-89-5, JEDEC STD.51-7	2600	
		HSOP-6J, JEDEC STD.51-7	2700	
		TO-252-5-P2, JEDEC STD.51-7	3800	
T_j	Junction Temperature Range	-40 to 125	°C	
T_{stg}	Storage Temperature Range	-55 to 125	°C	

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	1.6 to 6.5	V
T_a	Operating Temperature Range	-40 to 85	°C

RECOMMENDED OPERATING CONDITIONS

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 ratings by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

⁽¹⁾ Refer to POWER DISSIPATION for detailed information.

RP131x

NO.EA-174-180711

ELECTRICAL CHARACTERISTICS $V_{IN} = \text{Set } V_{OUT} + 1V, I_{OUT} = 1mA$ The specification in is checked and guaranteed by design engineering at $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$, unless otherwise noted.**RP131xxx1B/D** $(T_a = 25^{\circ}\text{C})$

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{OUT}	Output Voltage	$T_a = 25^{\circ}\text{C}$	$V_{OUT} > 1.5V$	$\times 0.99$		$\times 1.01$	V
			$V_{OUT} \leq 1.5V$	-15		15	mV
		$-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$	$V_{OUT} > 1.5V$	$\times 0.974$		$\times 1.018$	V
			$V_{OUT} \leq 1.5V$	-40		27	mV
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$0.1mA \leq I_{OUT} \leq 300mA$		20	40	mV	
		$0.1mA \leq I_{OUT} \leq 1A$		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	
$I_{standby}$	Standby Current	$V_{CE} = 0V, V_{IN} = 6.5V$		0.15	0.60	μA	
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	Set $V_{OUT} + 0.5V \leq V_{IN} \leq 6.5V$ *However, $V_{IN} \geq 1.6V$		0.05	0.1	%/V	
RR	Ripple Rejection	$f = 1kHz$ Ripple 0.2Vp-p $I_{OUT} = 100mA$	$V_{OUT} \leq 3.3V$		70	dB	
			$V_{OUT} > 3.3V$		60		
V_{IN}	Input Voltage		1.6		6.5	V	
I_{LIM}	Output Current Limit		1			A	
$\frac{\Delta V_{OUT}}{\Delta T_a}$	Output Voltage Temperature Coefficient	$-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$		± 100		ppm/ $^{\circ}\text{C}$	
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	
e_n	Output Noise	$BW = 10Hz \text{ to } 100kHz, I_{OUT} = 1mA$		45		μV_{rms}	
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		165		$^{\circ}\text{C}$	
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		135		$^{\circ}\text{C}$	
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	$V_{IN} = 4.0V, V_{CE} = 0V$		30		Ω	

All test items listed under Electrical Characteristics are done under the pulse load condition ($T_j \approx T_a = 25^{\circ}\text{C}$) except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient, Dropout Voltage at 1A Output Current and Thermal Shutdown items.

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

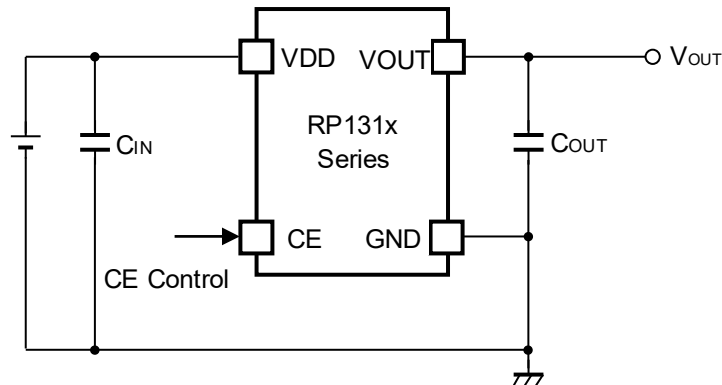
Dropout Voltage

($T_a = 25^{\circ}\text{C}$)

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

APPLICATION INFORMATION

Typical Application Circuits



Recommendation value of the external capacitors

V_{OUT}	Capacitors	
$V_{OUT} \leq 3.6V$	C_{IN}	Kyocera 2.2 μ F (size:1005) [CM05X5R225M06AB]
	C_{OUT}	Kyocera 2.2 μ F (size:1608) [CM105X5R225K06AB]
$V_{OUT} > 3.6V$	C_{IN}	Kyocera 2.2 μ F (size:1608) [CM105X5R225K06AB]
	C_{OUT}	Kyocera 4.7 μ F (size:1608) [CM105X5R475M06AB]

Technical Notes on the External Components

When using this IC, consider 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 C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance).

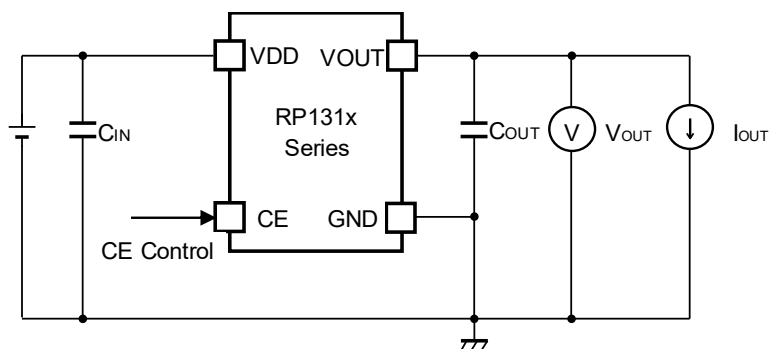
If a tantalum capacitor is used, and its ESR of C_{OUT} is large, the loop oscillation may result. Because of this, select C_{OUT} carefully considering its frequency characteristics.

PCB Layout

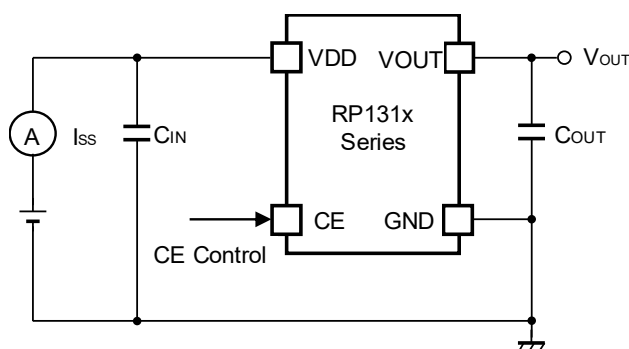
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C_{IN} between V_{DD} and GND pin with a capacitance value as "Recommendation value of the external capacitors" above or more, and as close as possible to the pins.

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

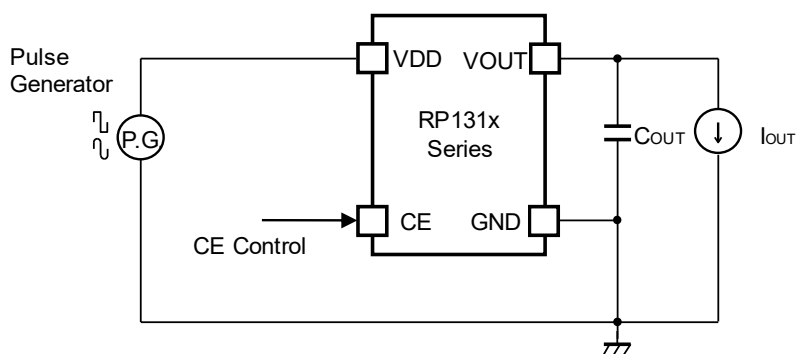
TEST CIRCUITS



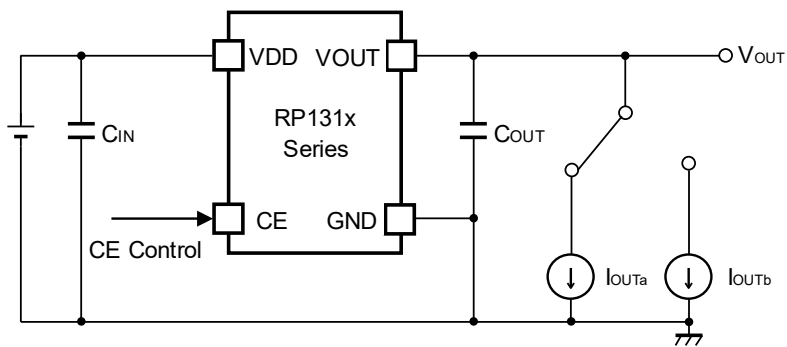
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection



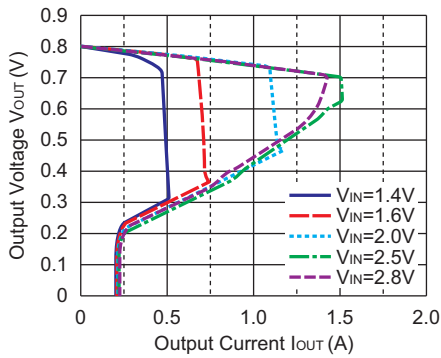
Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

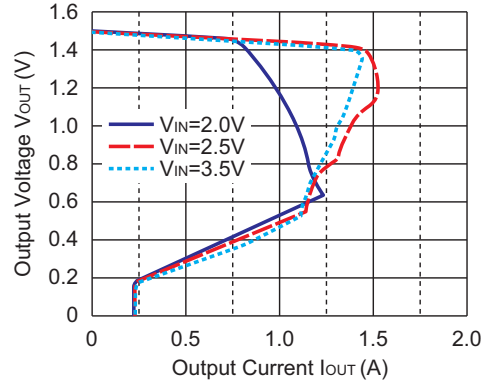
Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Output Voltage vs. Output Current ($T_a = 25^\circ\text{C}$)

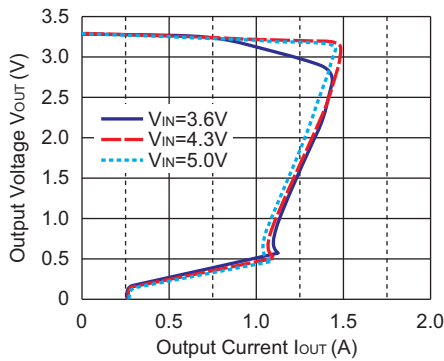
RP131x081x



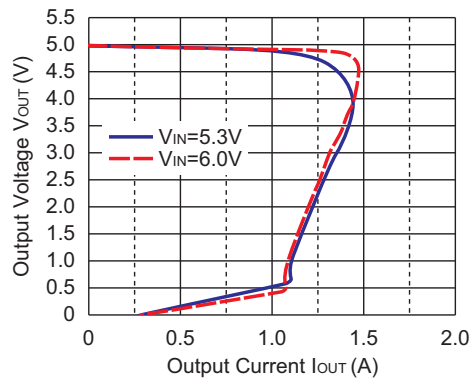
RP131x151x



RP131x331x

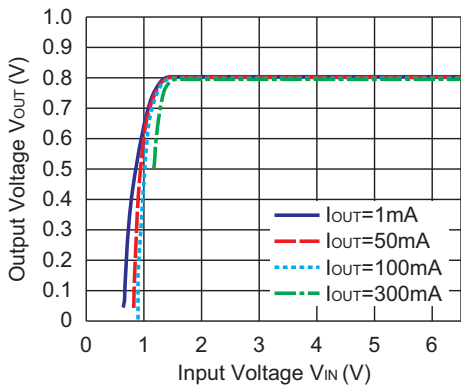


RP131x501x

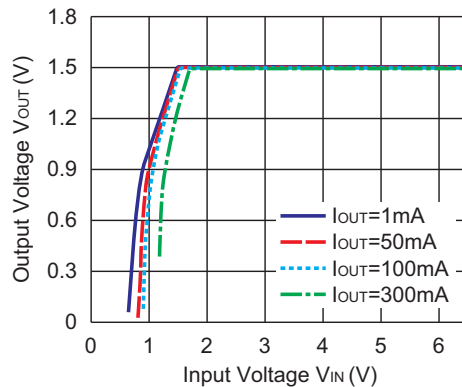


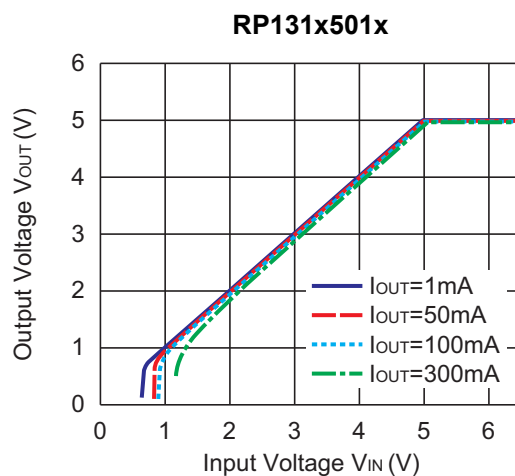
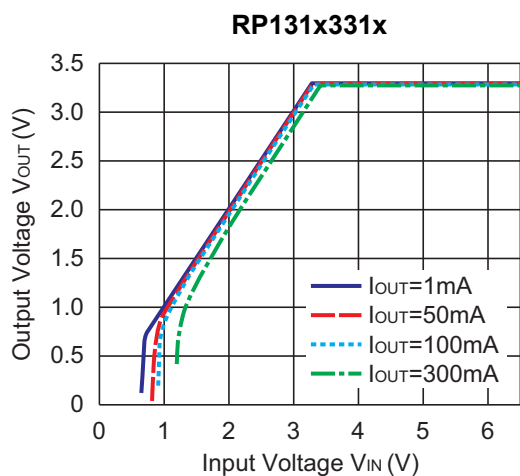
2) Output Voltage vs. Input Voltage ($T_a = 25^\circ\text{C}$)

RP131x081x

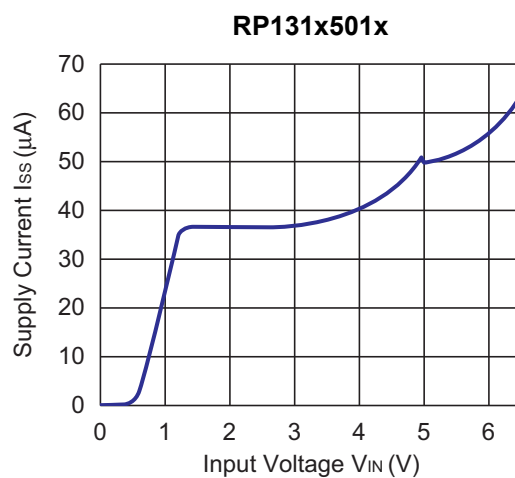
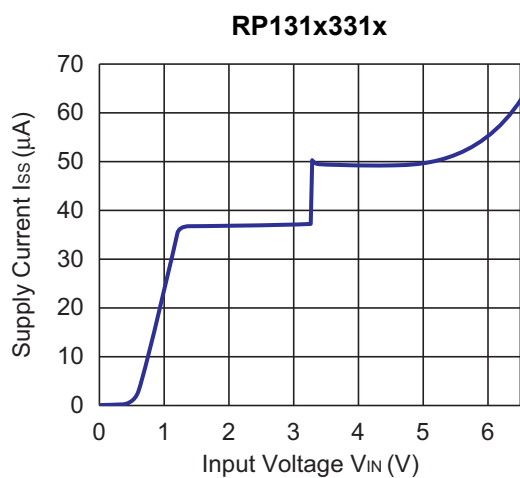
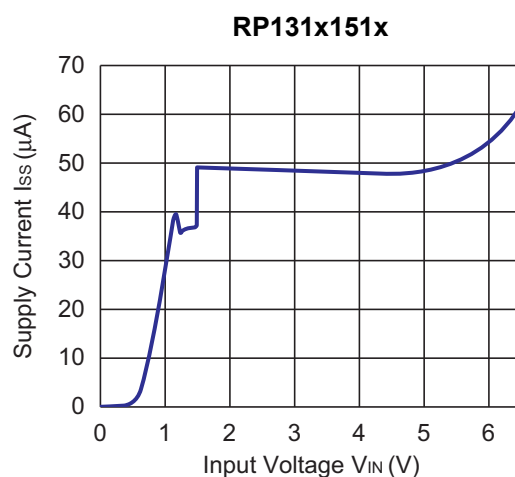
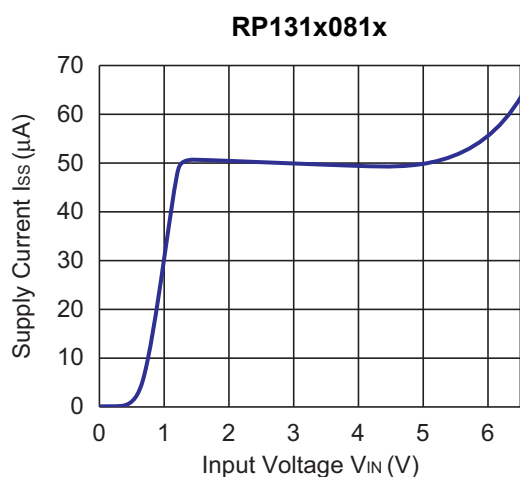


RP131x151x

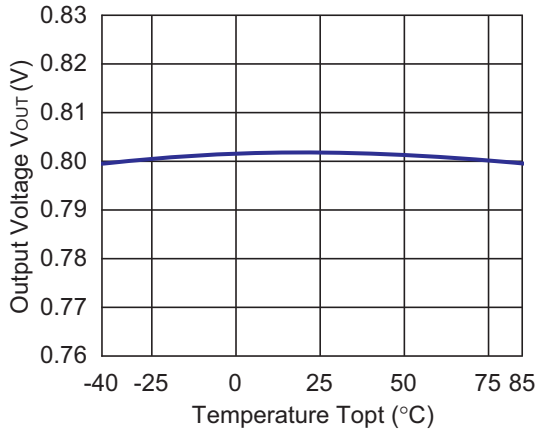
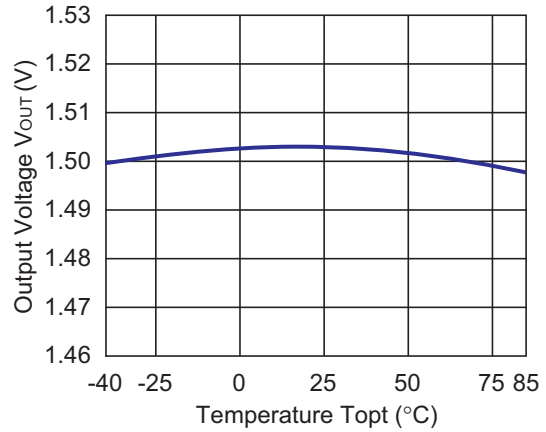
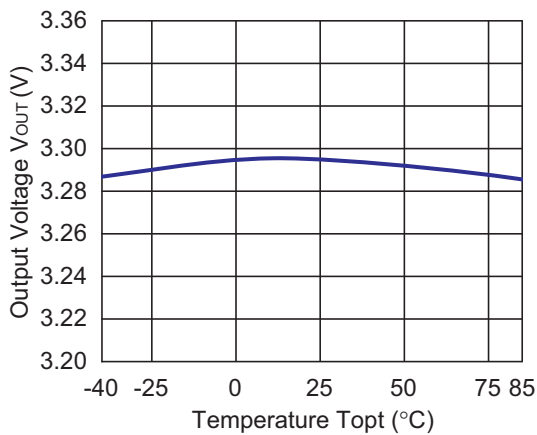
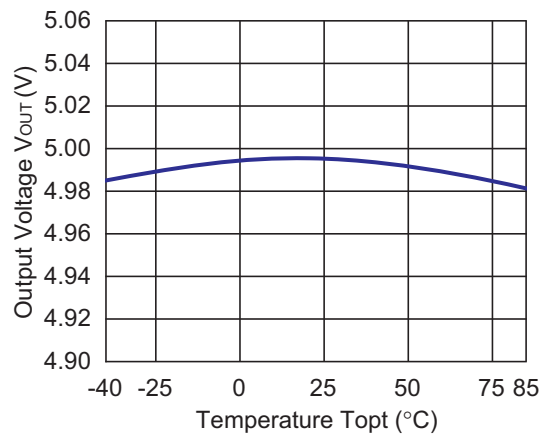
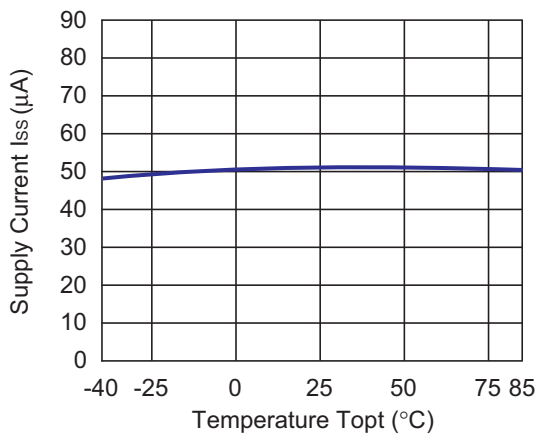
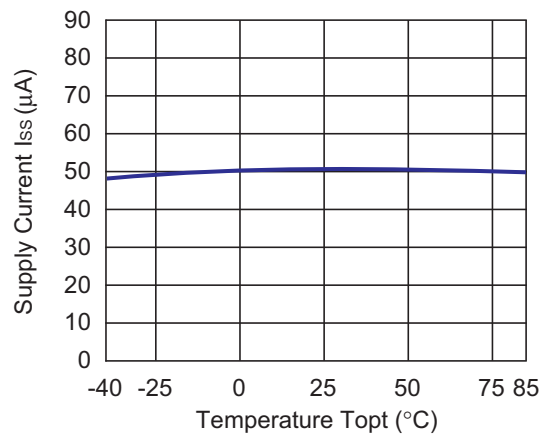




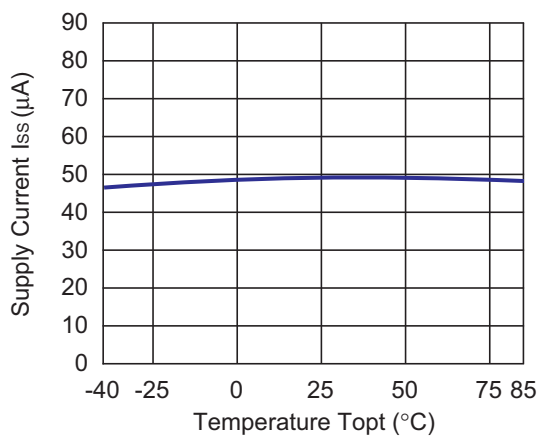
3) Supply Current vs. Input Voltage (Ta=25°C)



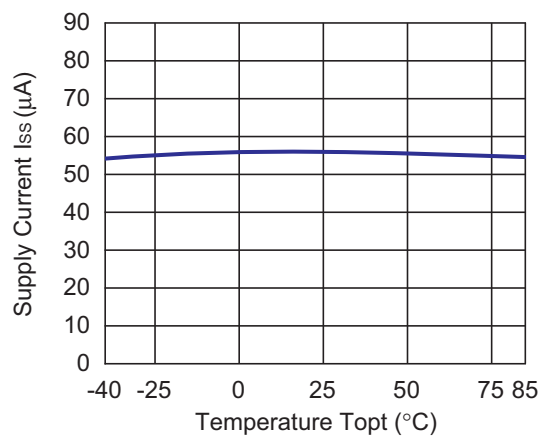
RP131xNO.EA-174-180711

4) Output Voltage vs. Temperature**RP131x081x****RP131x281x****RP131x331x****RP131x501x****5) Supply Current vs. Temperature****RP131x081x****RP131x151x**

RP131x331x

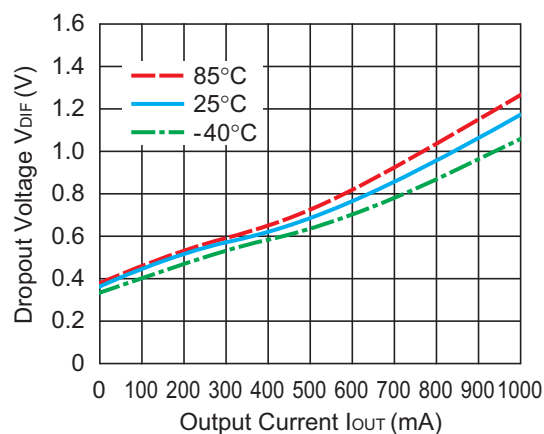


RP131x501x

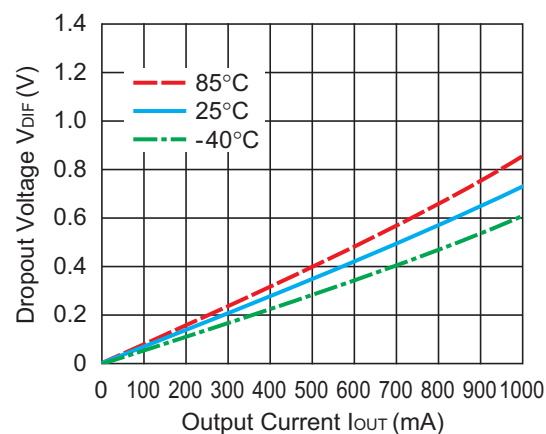


6) Dropout Voltage vs. Output Current

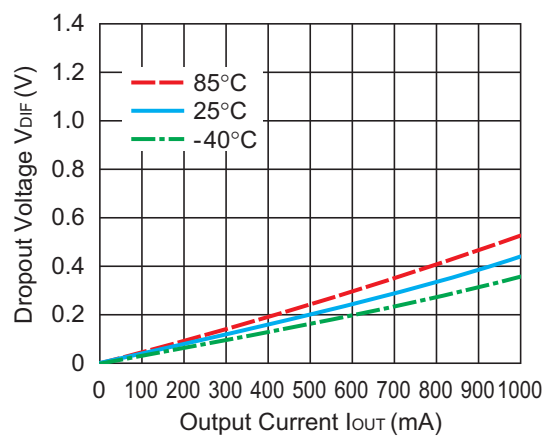
RP131x081x



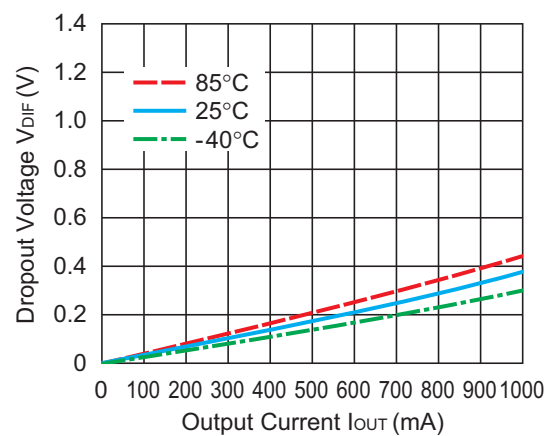
RP131x151x



RP131x331x



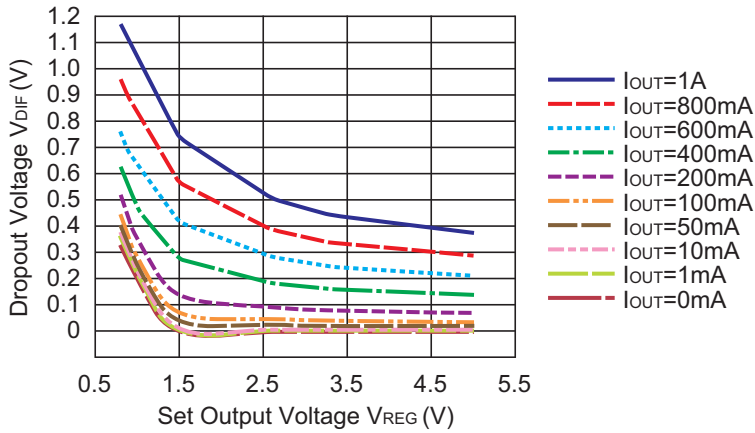
RP131x501x



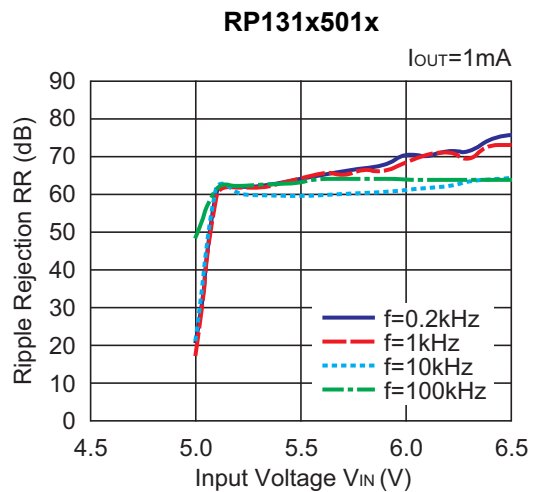
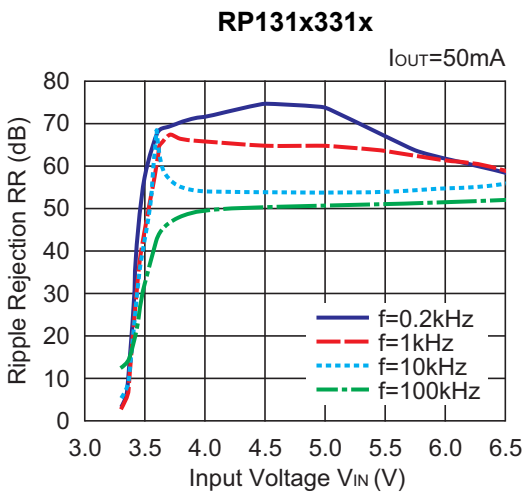
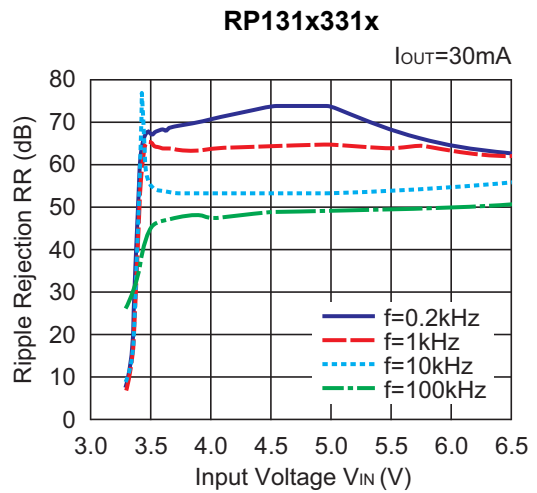
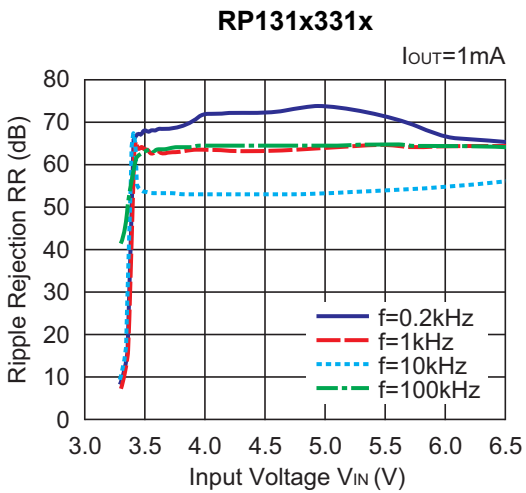
RP131x

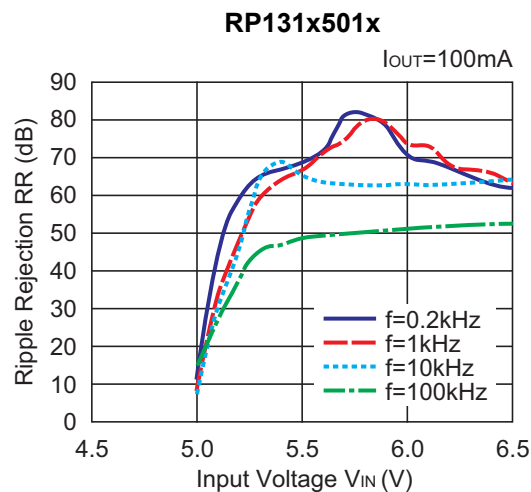
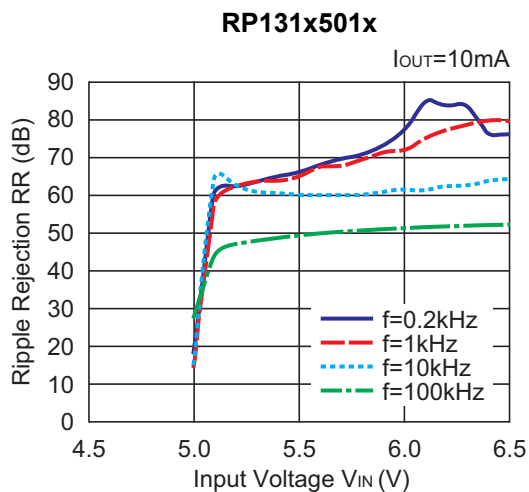
NO.EA-174-180711

7) Dropout Voltage vs. Set Output Voltage

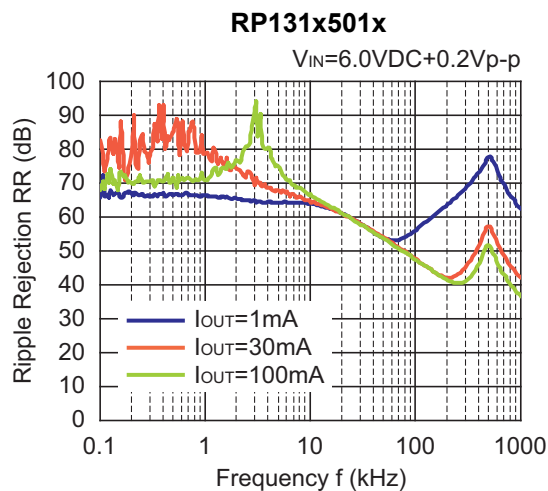
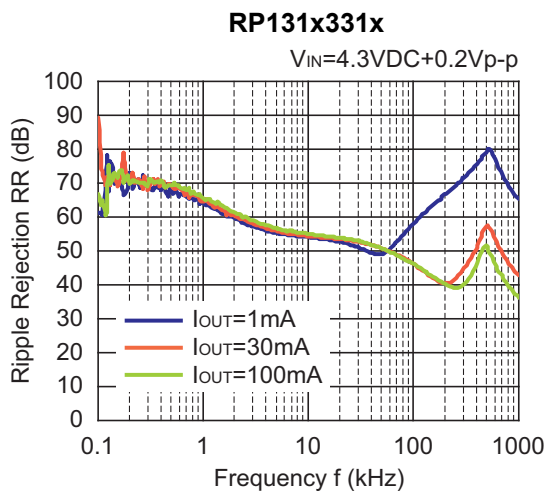
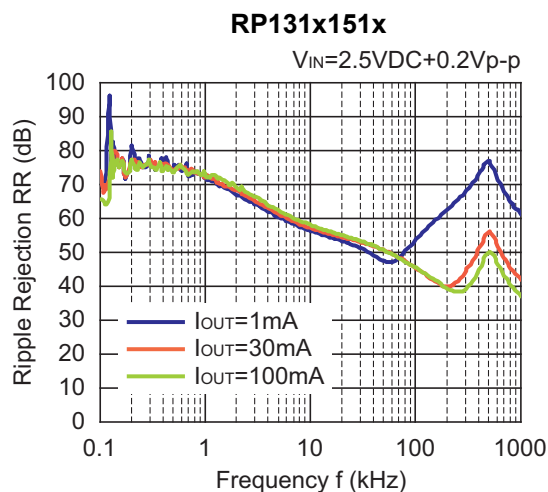
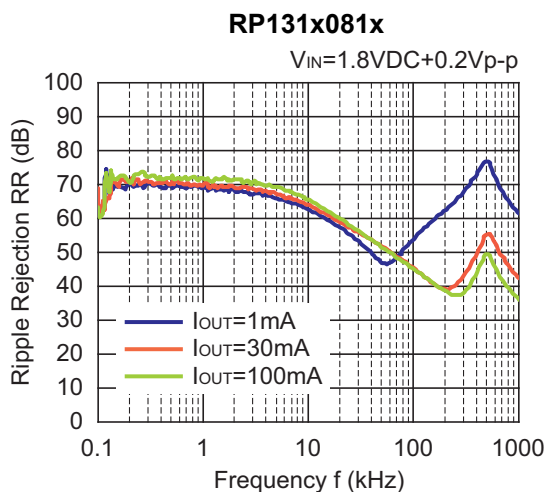


8) Ripple Rejection vs. Input Bias Voltage ($C1=none$, $C2=Ceramic\ 1.0\mu F$, Ripple= $0.2V_{pp}$, $T_a=25^\circ C$)





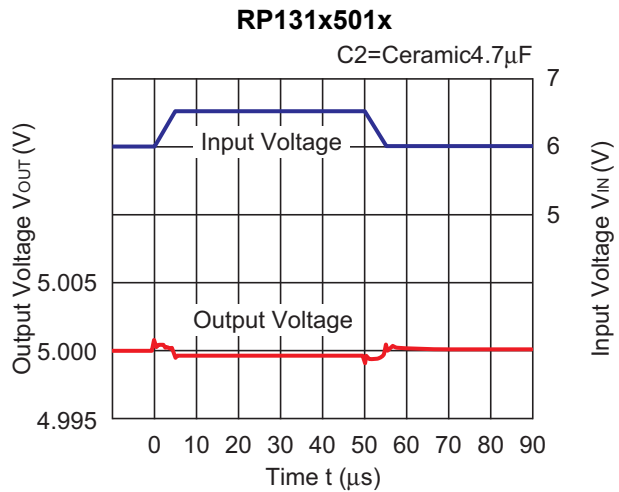
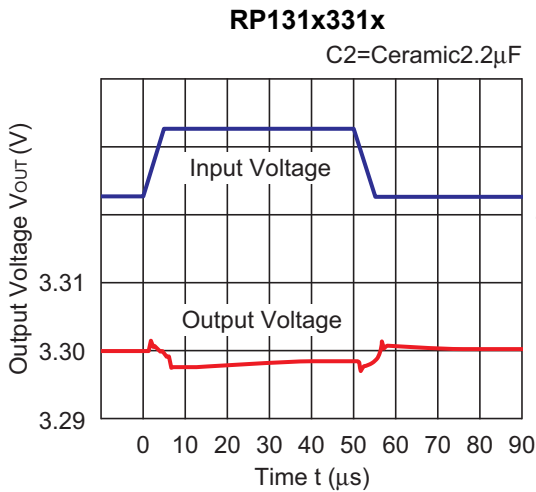
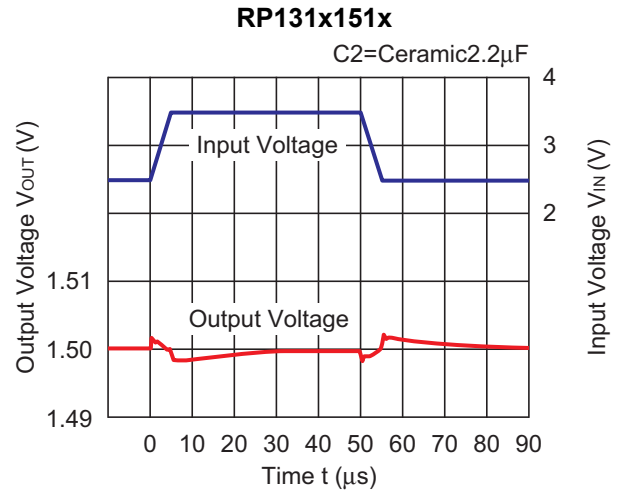
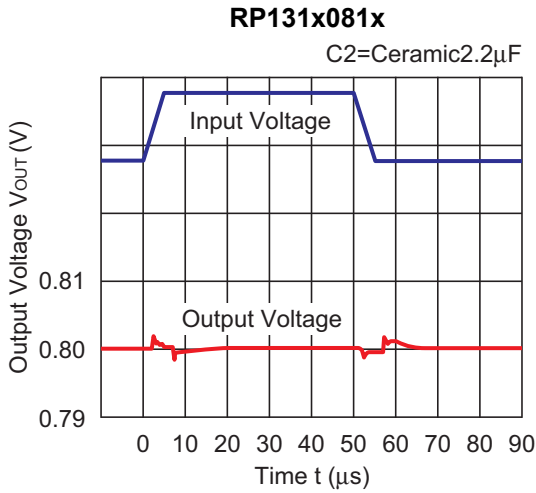
9) Ripple Rejection vs. Frequency ($C1=none$, $C2=Ceramic\ 4.7\mu F$, $T_a=25^{\circ}C$)



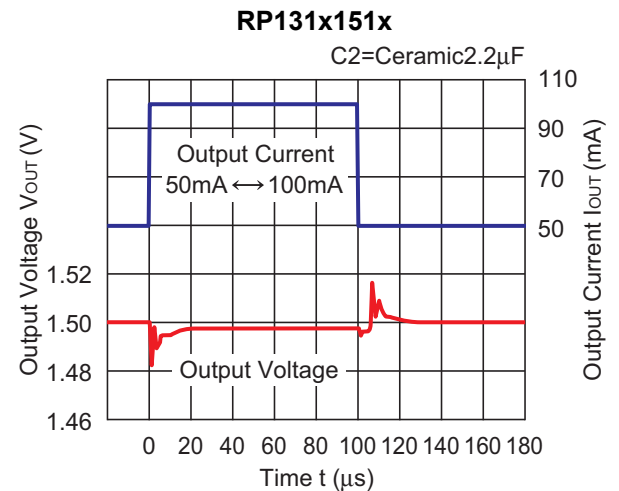
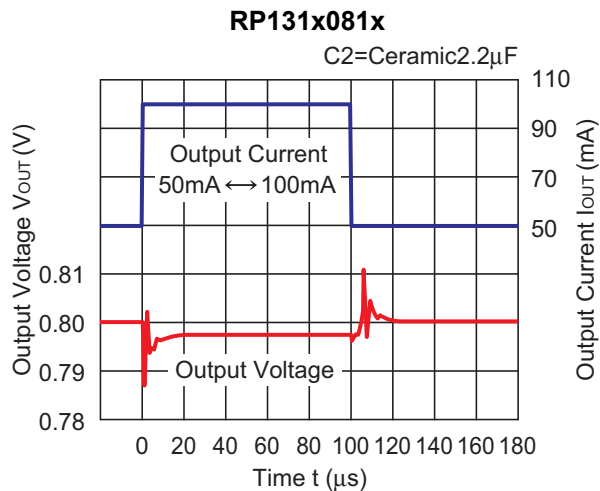
RP131x

NO.EA-174-180711

10) Input Transient Response ($I_{OUT}=100\text{mA}$, $t_r=t_f=5\mu\text{s}$, $C_1=\text{none}$, $T_a=25^\circ\text{C}$)

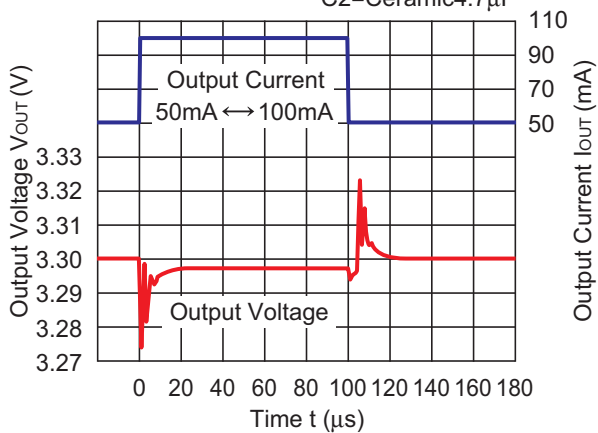


11) Load Transient Response ($t_r=t_f=0.5\mu\text{s}$, $C_1=\text{Ceramic } 2.2\mu\text{F}$, $V_{IN}=V_{OUT}+1.0\text{V}$, $T_{opt}=25^\circ\text{C}$)



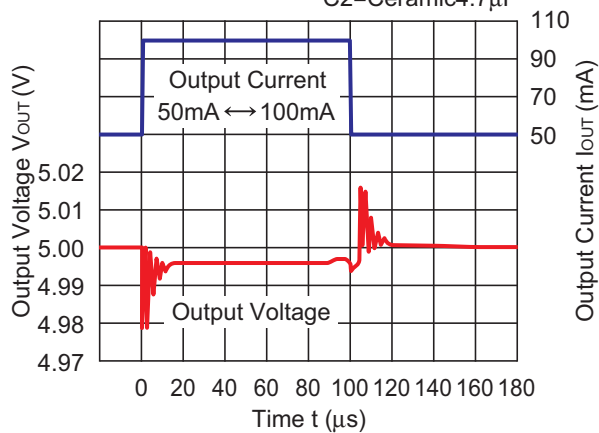
RP131x331x

C2=Ceramic4.7 μ F



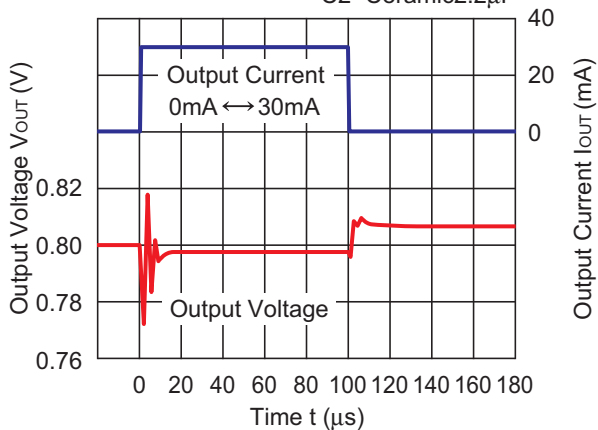
RP131x501x

C2=Ceramic4.7 μ F



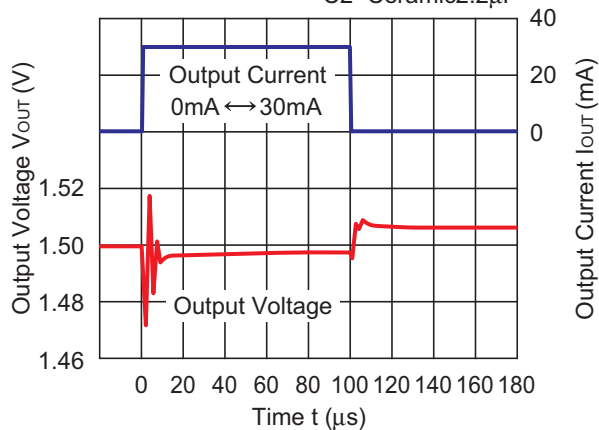
RP131x081x

C2=Ceramic2.2 μ F



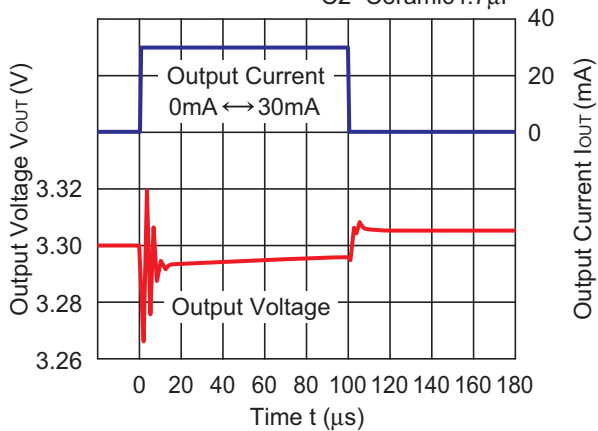
RP131x151x

C2=Ceramic2.2 μ F



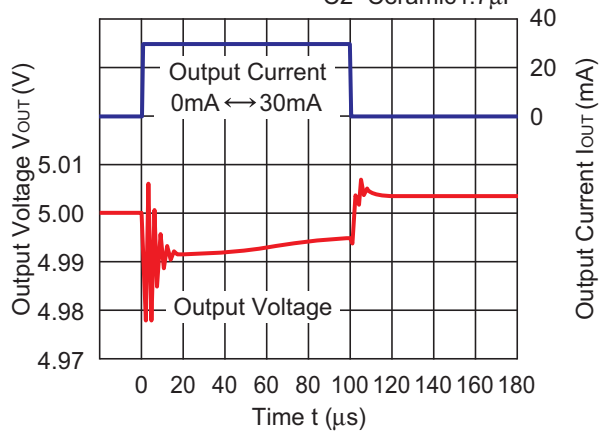
RP131x331x

C2=Ceramic4.7 μ F



RP131x501x

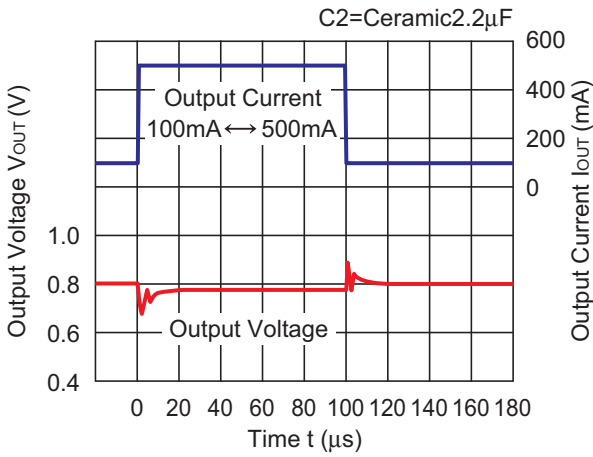
C2=Ceramic4.7 μ F



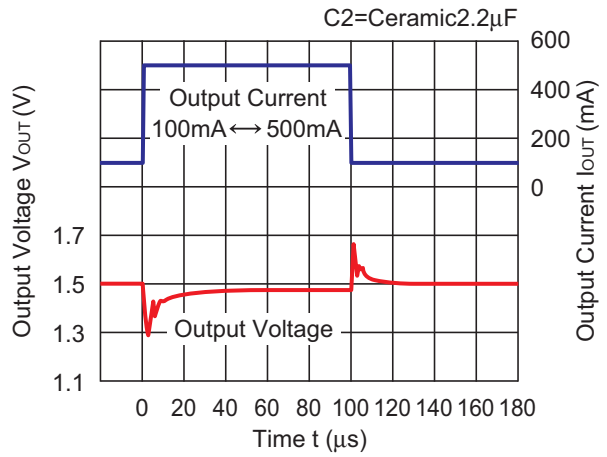
RP131x

NO.EA-174-180711

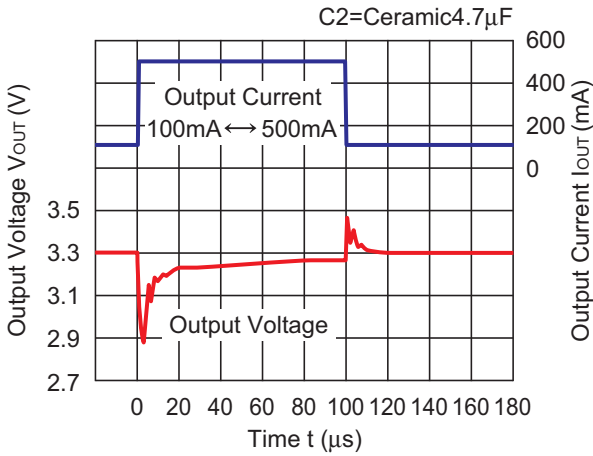
RP131x081x



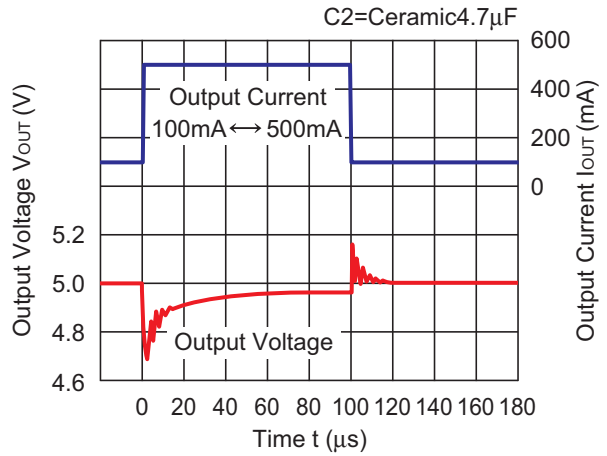
RP131x151x



RP131x331x

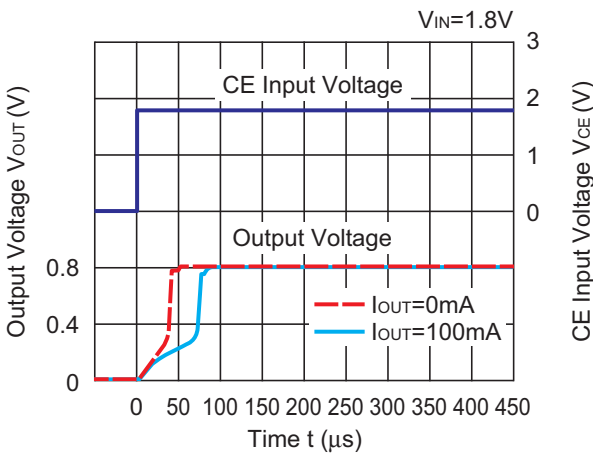


RP131x501x

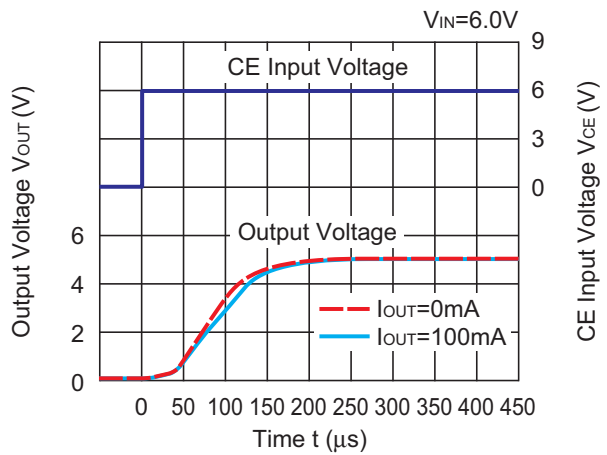


12) Turn On Speed with CE pin (C1=Ceramic 2.2 μ F, C2=Ceramic 4.7 μ F, T_{opt} =25 $^{\circ}$ C)

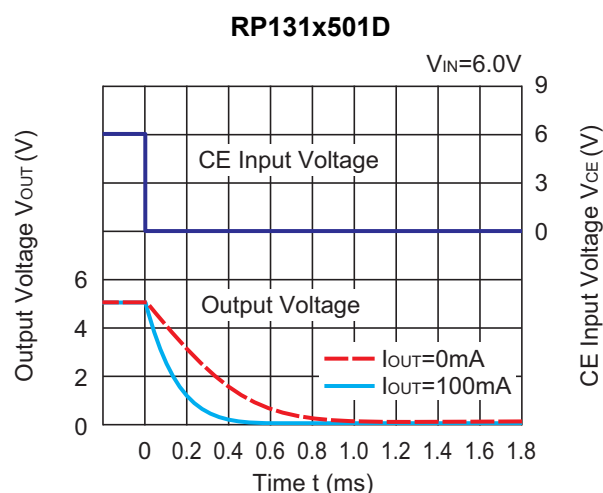
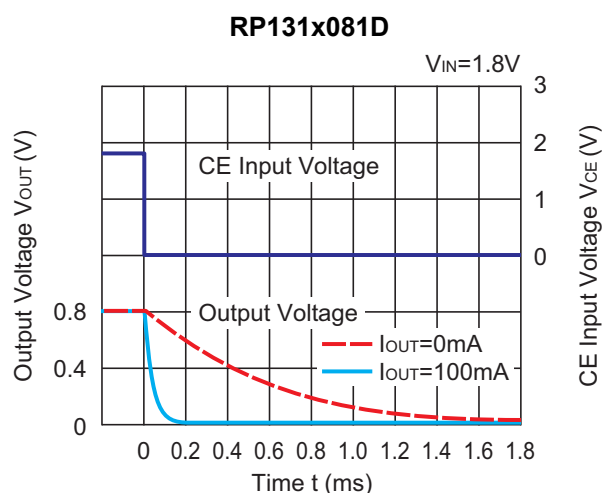
RP131x081x



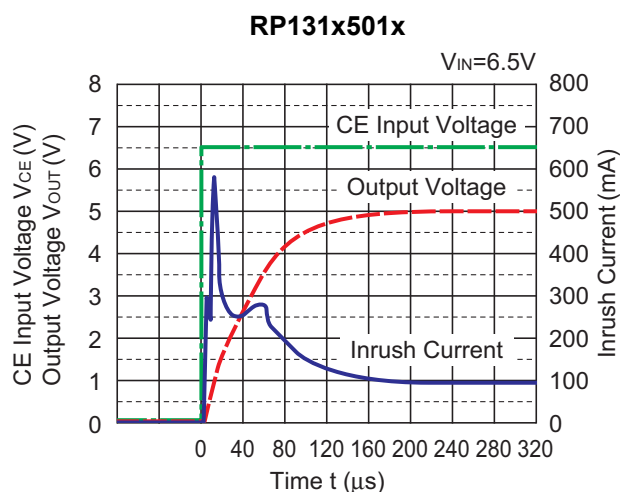
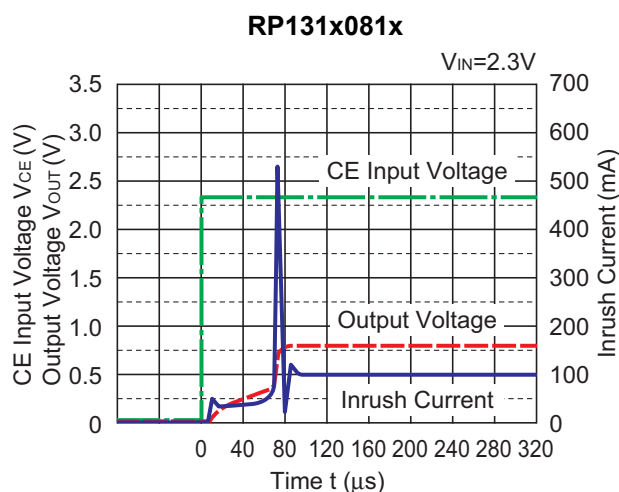
RP131x501x



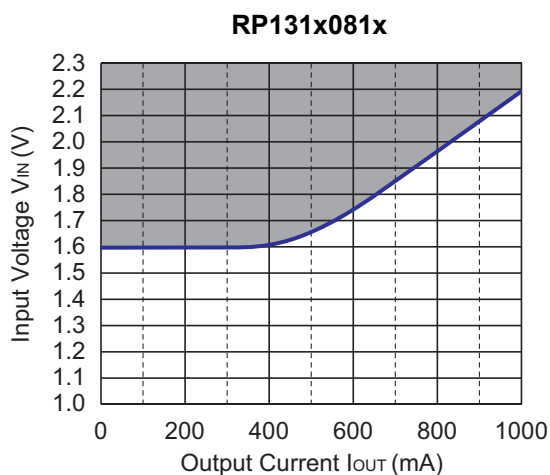
13) Turn Off Speed with CE pin (D Version) (C1=Ceramic 2.2μF, C2=Ceramic 4.7μF, Ta=25°C)



14) Inrush Current at turning on (C1=Ceramic 2.2μF, C2=Ceramic 4.7μF, T_{opt}=25°C)



15) Minimum Operating Voltage



Hatched area is available for 0.8V output.

RP131x

NO.EA-174-180711

ESR vs. Output Current

When using these ICs, consider the following points:

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

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

Measurement conditions

Frequency Band : 10Hz to 3MHz

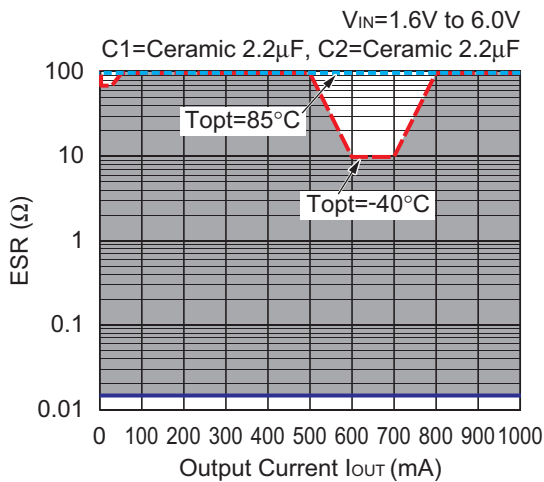
Temperature : -40°C to 85°C

C1 : $2.2\mu\text{F}$ (Kyocera, CM05X5R225M04AD)

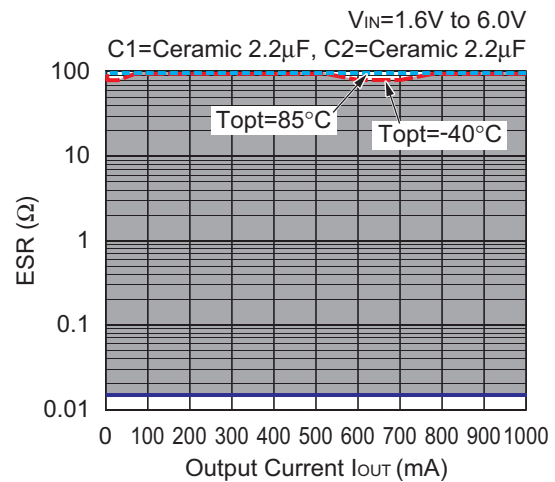
C2 : $2.2\mu\text{F}$ (Kyocera, CM105X5R225K06AE)

$4.7\mu\text{F}$ (Kyocera, CM105X5R475M06AB)

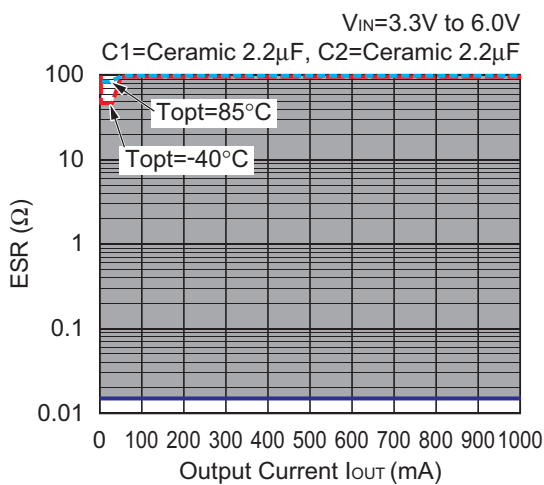
RP131x081x



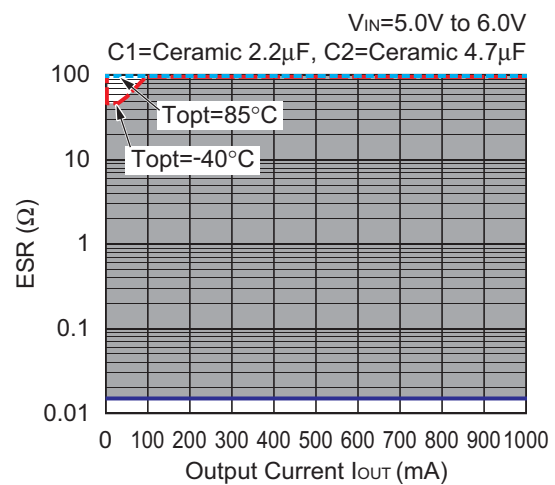
RP131x151x



RP131x331x



RP131x501x



改訂履歴

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.2 mm × 15 pcs

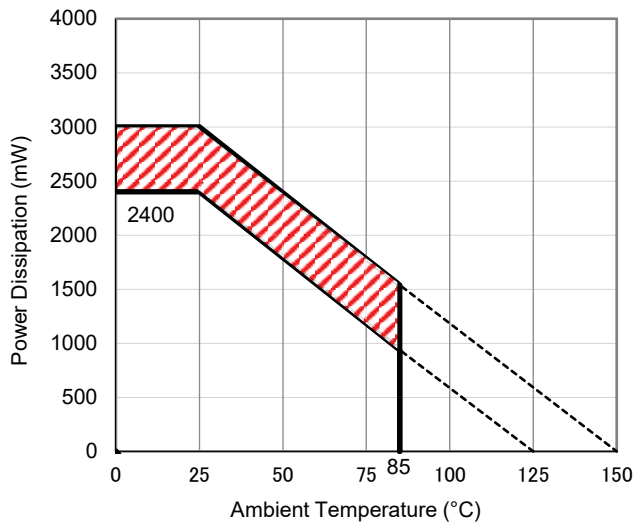
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

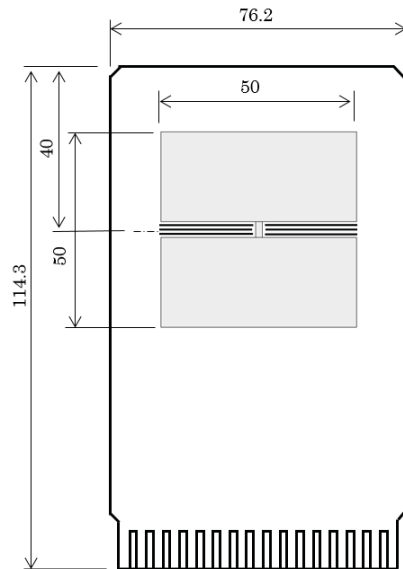
Item	Measurement Result
Power Dissipation	2400 mW
Thermal Resistance (θja)	θja = 41°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 11°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



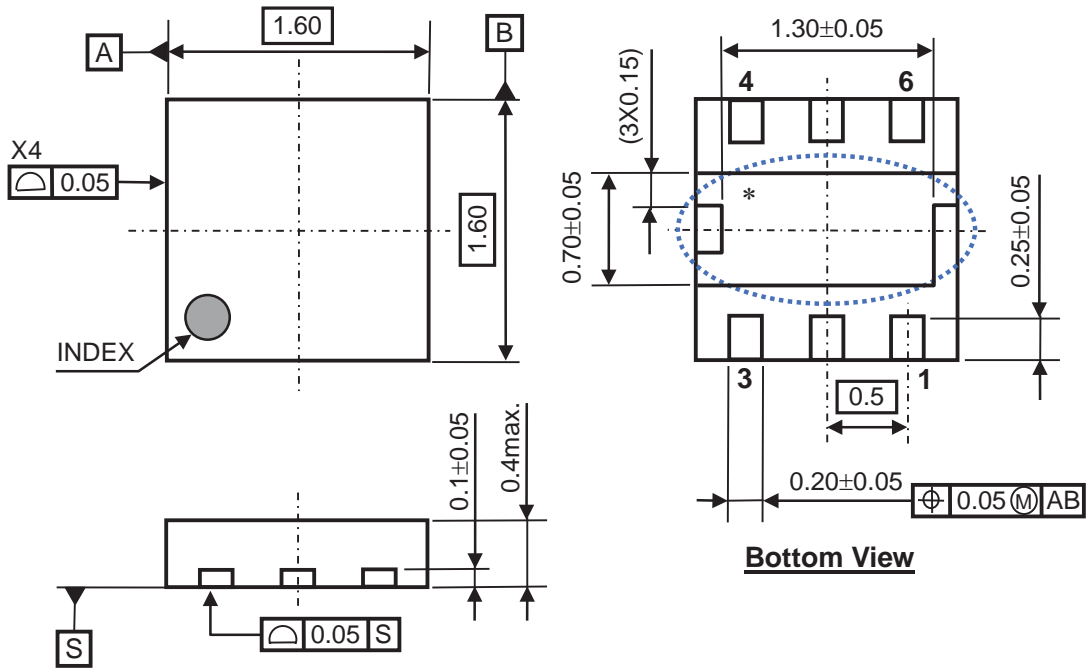
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years



DFN1616-6B Package Dimensions (Unit: mm)

* The tab on the bottom of the package shown by blue circle is a substrate potential (GND). It is recommended that this tab be connected to the ground plane pin on the board but it is possible to leave the tab floating.

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.2 mm × 34 pcs

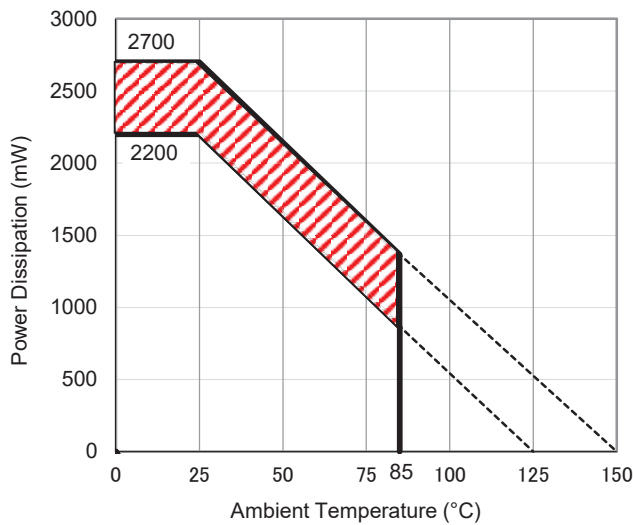
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

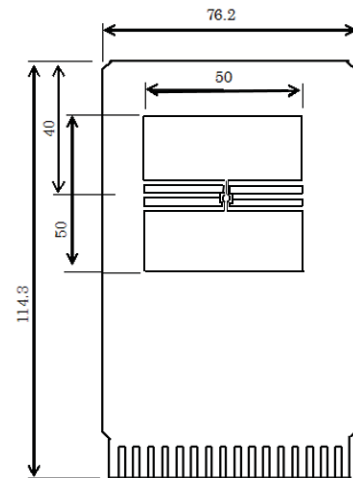
Item	Measurement Result
Power Dissipation	2200 mW
Thermal Resistance (θja)	θja = 45°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 18°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



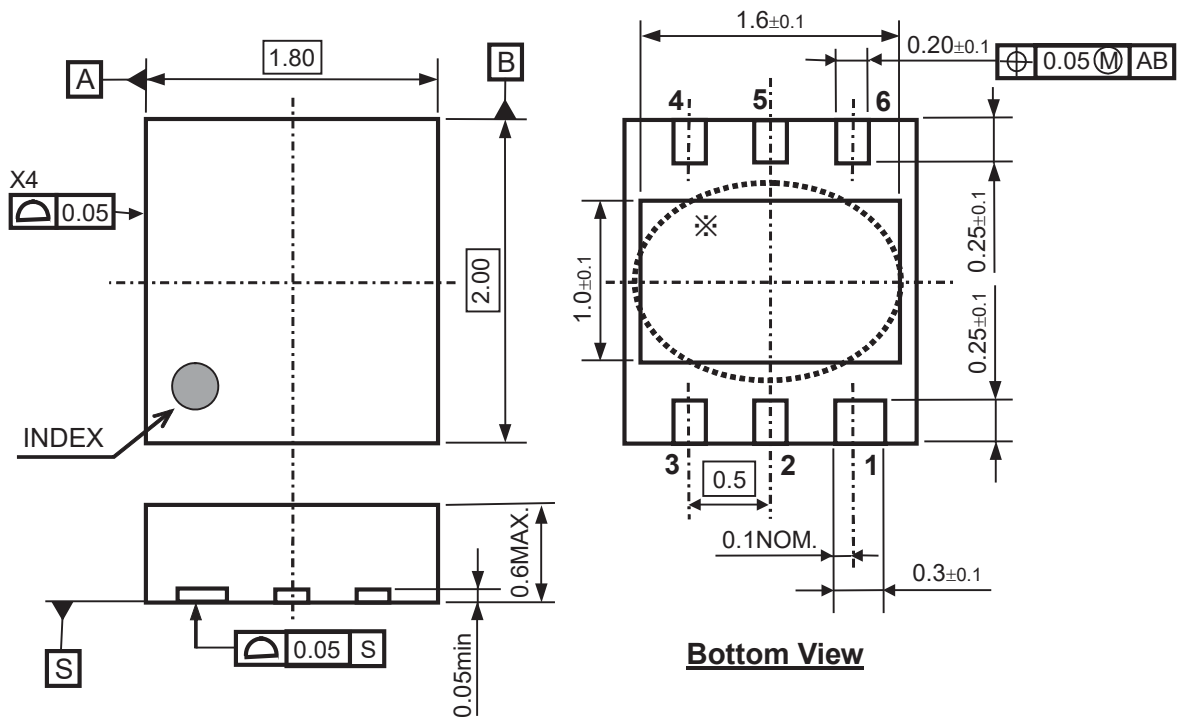
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

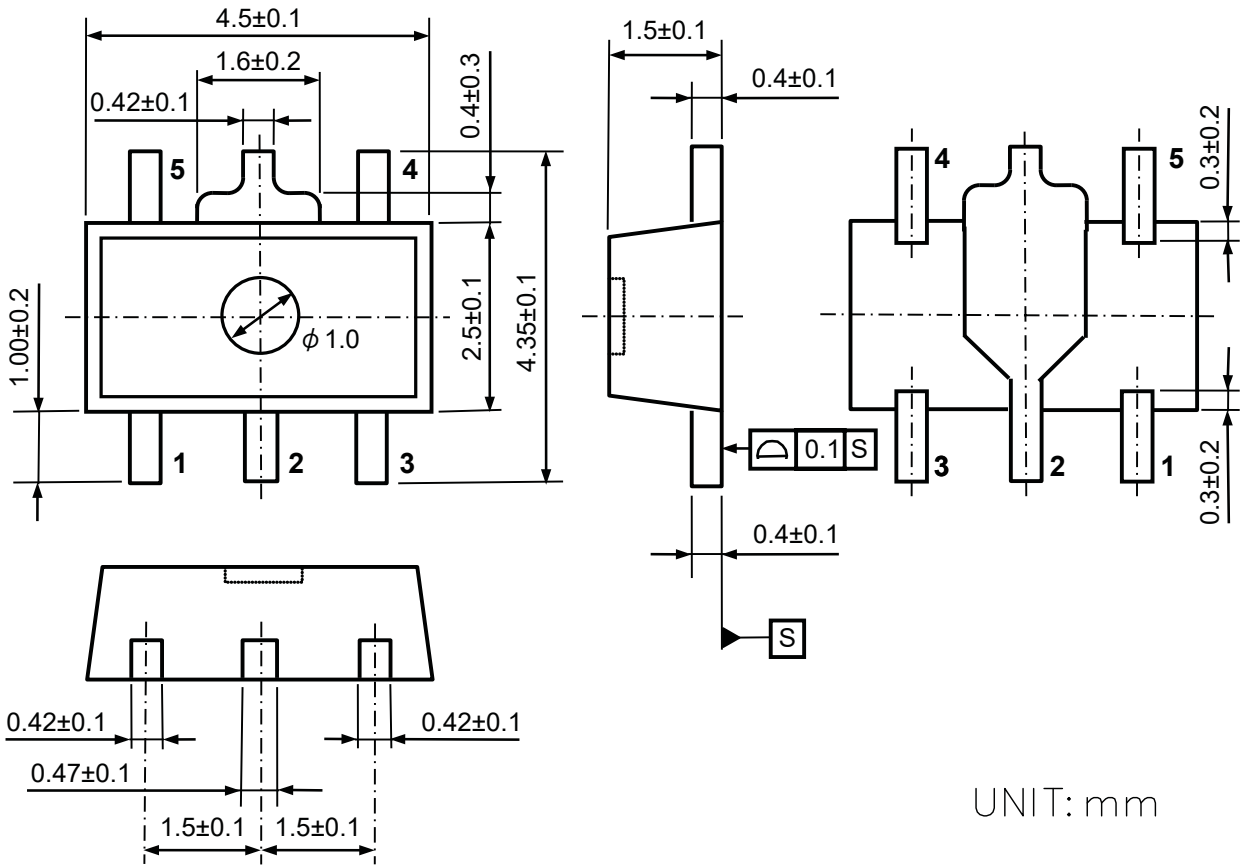
The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years



DFN(PLP)1820-6 Package Dimensions (Unit: mm)

* The tab on the bottom of the package is substrate level (GND). It is recommended that the tab be connected to the ground plane on the board, or otherwise be left floating.



SOT-89-5 Package Dimensions

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.3 mm × 13 pcs

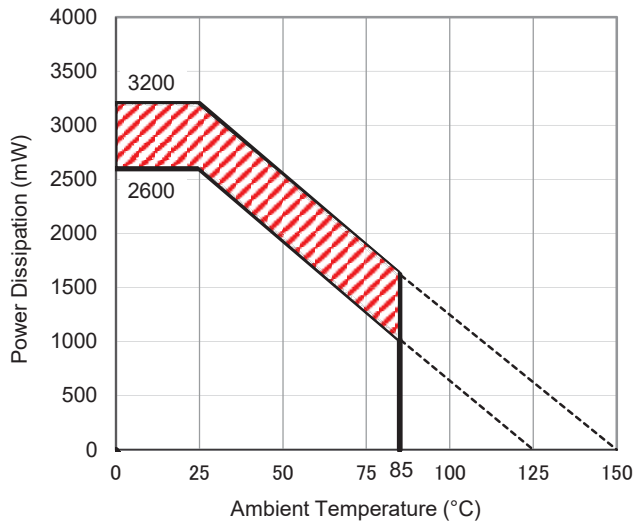
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

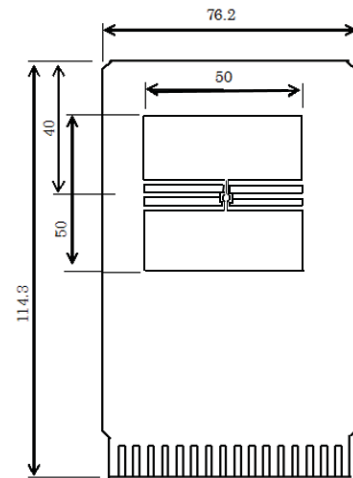
Item	Measurement Result
Power Dissipation	2600 mW
Thermal Resistance (θja)	θja = 38°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 13°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.3 mm × 28 pcs

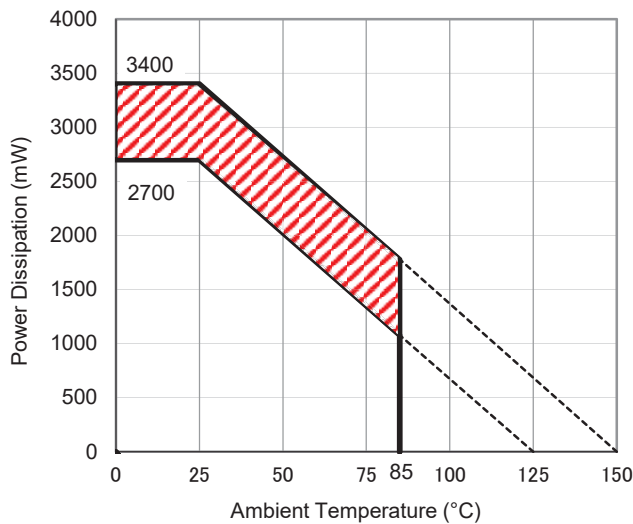
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

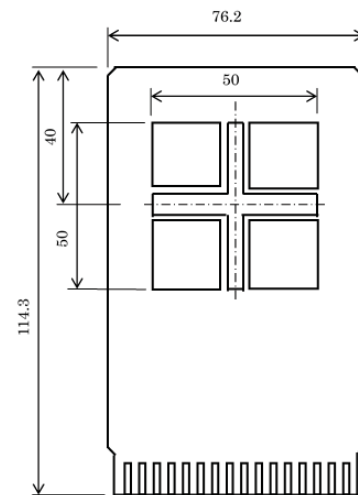
Item	Measurement Result
Power Dissipation	2700 mW
Thermal Resistance (θja)	θja = 37°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 7°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



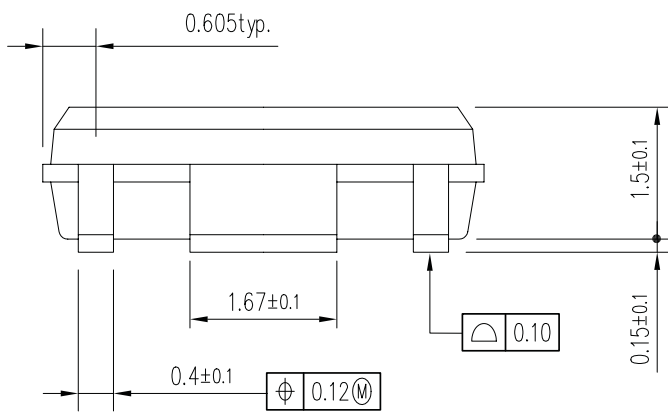
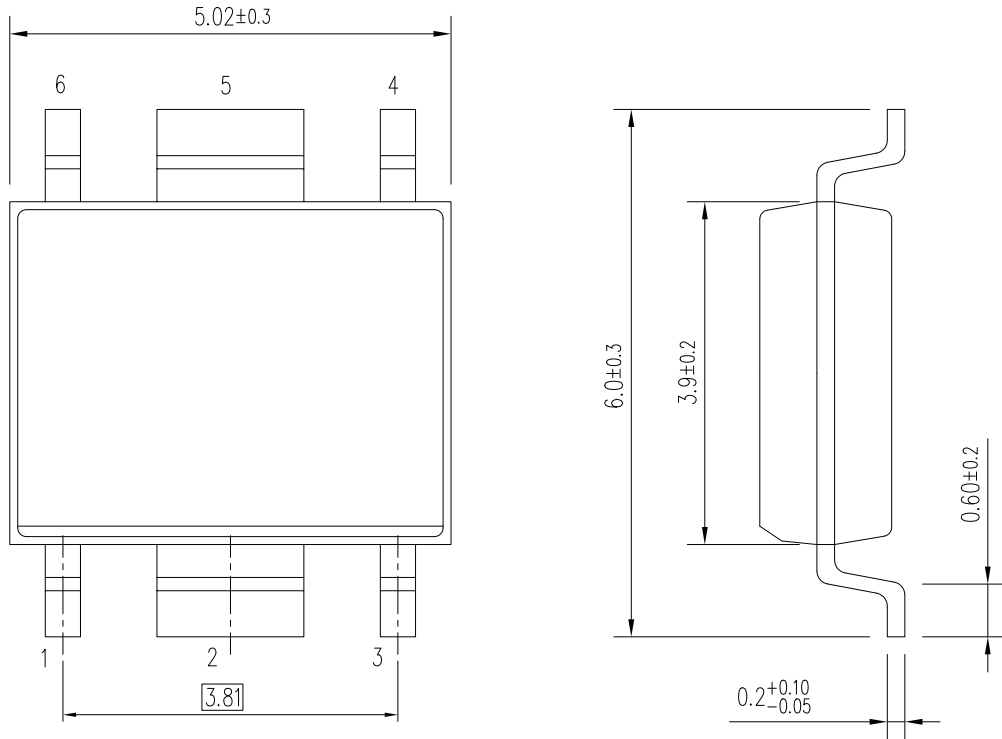
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years



UNIT: mm

HSOP-6J Package Dimensions

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

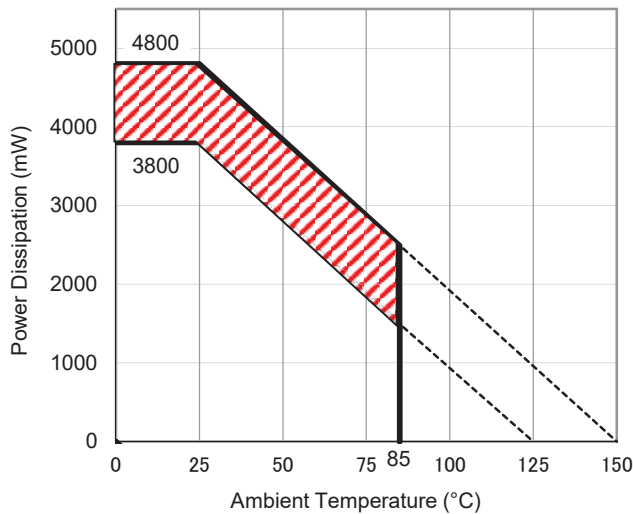
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.3 mm × 21 pcs

Measurement Result

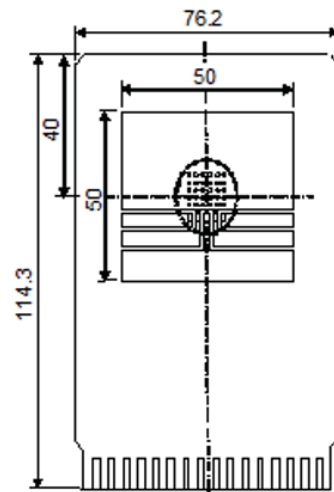
(Ta = 25°C, Tjmax = 125°C)

Item	Measurement Result
Power Dissipation	3800 mW
Thermal Resistance (θja)	θja = 26°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 7°C/W

θja: Junction-to-Ambient Thermal Resistance
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

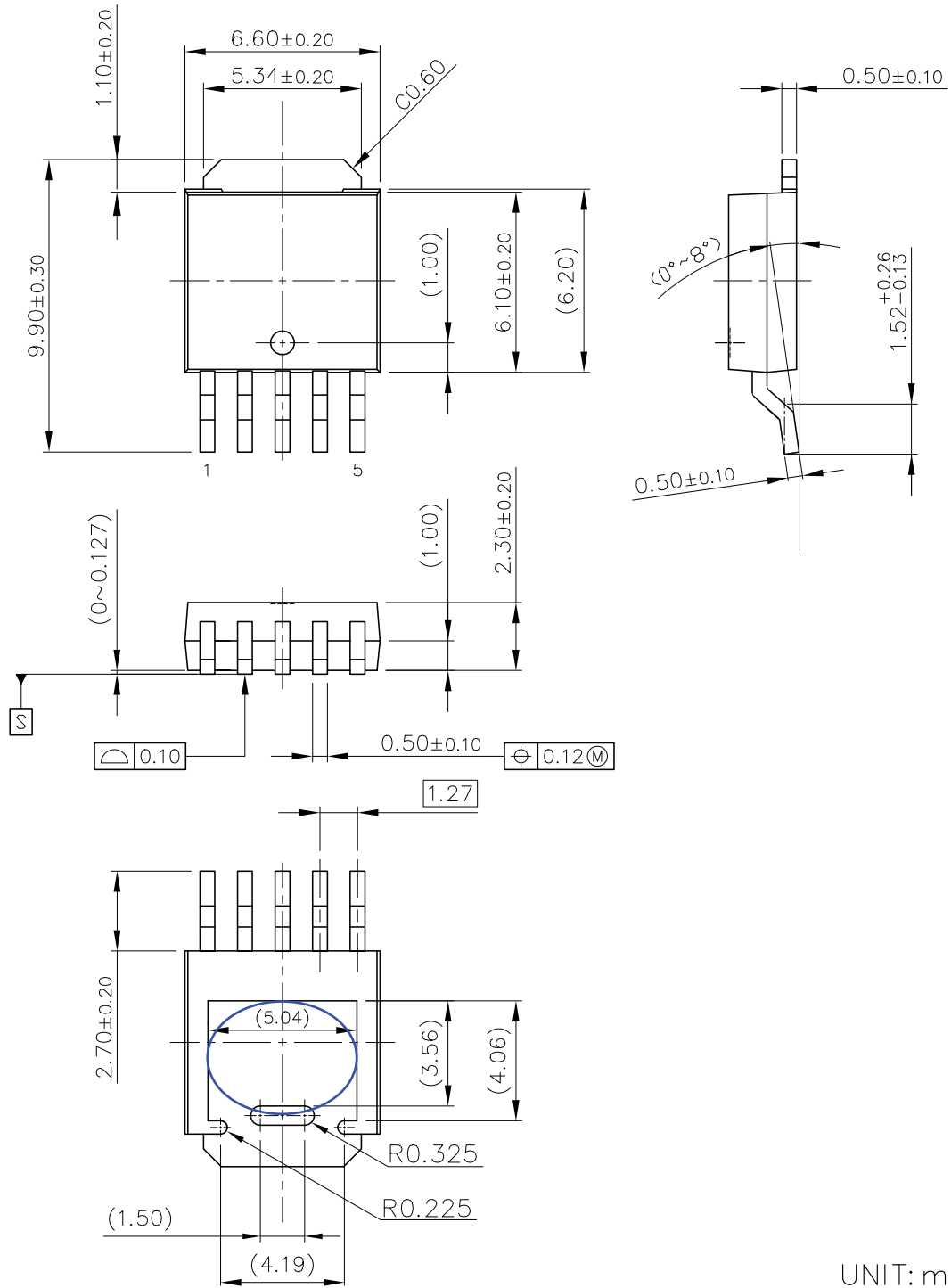
The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years

PACKAGE DIMENSIONS

TO-252-5-P2

Ver. A



UNIT: mm

TO-252-5-P2 Package Dimensions

* The tab on the bottom of the package shown by blue circle is a substrate potential (GND). It is recommended that this tab be connected to the ground plane on the board but it is possible to leave the tab floating.



1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact Ricoh sales or our distributor before attempting to use AOI.
11. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.



Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

RICOH RICOH ELECTRONIC DEVICES CO., LTD.

<https://www.e-devices.ricoh.co.jp/en/>

Sales & Support Offices

Ricoh Electronic Devices Co., Ltd.

Shin-Yokohama Office (International Sales)

2-3, Shin-Yokohama 3-chome, Kohoku-ku, Yokohama-shi, Kanagawa, 222-8530, Japan
Phone: +81-50-3814-7687 Fax: +81-45-474-0074

Ricoh Americas Holdings, Inc.

675 Campbell Technology Parkway, Suite 200 Campbell, CA 95008, U.S.A.
Phone: +1-408-610-3105

Ricoh Europe (Netherlands) B.V.

Semiconductor Support Centre

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

Ricoh International B.V. - German Branch

Semiconductor Sales and Support Centre

Oberrather Strasse 6, 40472 Düsseldorf, Germany
Phone: +49-211-6546-0

Ricoh Electronic Devices Korea Co., Ltd.

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

Ricoh Electronic Devices Shanghai Co., Ltd.

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

Ricoh Electronic Devices Shanghai Co., Ltd.

Shenzhen Branch

1205, Block D (Jinlong Building), Kingkey 100, Hongbao Road, Luohu District,
Shenzhen, China
Phone: +86-755-8348-7600 Ext 225

Ricoh Electronic Devices Co., Ltd.

Taipei office

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

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Ricoh Electronics:

[RP131H101D-T1-FE](#) [RP131S331D-E2-FE](#) [RP131S331B-E2-FE](#) [RP131H181D-T1-FE](#) [RP131H181B-T1-FE](#)
[RP131H501B-T1-FE](#) [RP131S151B-E2-FE](#) [RP131S101B-E2-FE](#) [RP131S301D-E2-FE](#) [RP131J151D-T1-FE](#)
[RP131H451D-T1-FE](#) [RP131H251B-T1-FE](#) [RP131S281D-E2-FE](#) [RP131S251D-E2-FE](#) [RP131S151D-E2-FE](#)
[RP131J121D-T1-FE](#) [RP131H251D-T1-FE](#) [RP131S501D-E2-FE](#) [RP131S451D-E2-FE](#) [RP131H151D-T1-FE](#)
[RP131H331B-T1-FE](#) [RP131H121D-T1-FE](#) [RP131S101D-E2-FE](#) [RP131S121B-E2-FE](#) [RP131H121B-T1-FE](#)
[RP131H301D-T1-FE](#) [RP131S121D-E2-FE](#) [RP131H151B-T1-FE](#) [RP131H501D-T1-FE](#) [RP131H331D-T1-FE](#)
[RP131S501B-E2-FE](#) [RP131S181B-E2-FE](#) [RP131S251B-E2-FE](#) [RP131S181D-E2-FE](#) [RP131K431B-TR](#)
[RP131K251D-TR](#) [RP131K441D-TR](#) [RP131K101B-TR](#) [RP131K081B-TR](#) [RP131K101D-TR](#) [RP131K081D-TR](#)
[RP131K121D-TR](#) [RP131K331D-TR](#) [RP131K151D-TR](#) [RP131K181D-TR](#) [RP131K501B-TR](#) [RP131K501D-TR](#)
[RP131K121B-TR](#) [RP131K251B-TR](#) [RP131K411B-TR](#) [RP131K341D-TR](#) [RP131H111D-T1-FE](#) [RP131H131D-T1-FE](#)
[RP131H141D-T1-FE](#) [RP131H181D5-T1-FE](#) [RP131H211D-T1-FE](#) [RP131H281B-T1-FE](#) [RP131S291D-E2-FE](#)
[RP131S301B-E2-FE](#) [RP131S351D-E2-FE](#) [RP131S361D-E2-FE](#) [RP131S401D-E2-FE](#) [RP131S421D-E2-FE](#)
[RP131S131B-E2-FE](#) [RP131S131D-E2-FE](#) [RP131S181D5-E2-FE](#) [RP131S261B-E2-FE](#) [RP131S261D-E2-FE](#)
[RP131S281B-E2-FE](#) [RP131S081D-E2-FE](#) [RP131S091B-E2-FE](#) [RP131S091D-E2-FE](#) [RP131S111B-E2-FE](#)
[RP131S111D-E2-FE](#) [RP131S121D5-E2-FE](#) [RP131L181D-TR](#) [RP131L251D-TR](#) [RP131L331D-TR](#) [RP131L471D-TR](#)
[RP131L501D-TR](#) [RP131S081B-E2-FE](#) [RP131K461D-TR](#) [RP131K511B-TR](#) [RP131K511D-TR](#) [RP131K551B-TR](#)
[RP131L121D-TR](#) [RP131L131D-TR](#) [RP131K401B-TR](#) [RP131K401D-TR](#) [RP131K421B-TR](#) [RP131K421D-TR](#)
[RP131K431D-TR](#) [RP131K451D-TR](#) [RP131K301D-TR](#) [RP131K311D-TR](#) [RP131K321B-TR](#) [RP131K321D-TR](#)
[RP131K331B-TR](#) [RP131K361D-TR](#) [RP131K271D-TR](#)