

Low on Resistance / Low Voltage 1 A LDO for High Temperature Applications

NO.EA-343-230714

OUTLINE

The RP132x Series are voltage-regulators with a built-in low ON-resistance transistor and output current is 1A capability. These ICs have two versions: fixed output voltage type and externally adjustable output voltage type. The externally adjustable output voltage type is adjustable between 0.8V and 5.5V. The minimum input voltage can be set from 1.4V. Otherwise, the load regulation of RP132x has much improved when compared with conventional regulators. It is Typ.5mV at $I_{OUT}=0.1\text{mA}$ to 1A.

Each of these ICs consists of a voltage reference unit, an error amplifier, a resistor net for setting output voltage, current limit circuits to prevent over-current 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 DFN(PL)1820-6, SOT-89-5, HSOP-6J, and TO-252-5-P2. They range from high-density mounting to ultra high wattage.

FEATURES

- Input Voltage Range (Maximum Rating) 1.4V to 6.5V (7 V)
- Operating Temperature Range -40°C to 105°C (※)
- Output Current Min. 1A
- Supply Current Typ. $65\mu\text{A}$
- Standby Current Typ. $0.15\mu\text{A}$
- Output Voltage Range Fixed Output Voltage Type:
0.8V, 1.05V, 1.2V, 1.5V, 1.8V, 2.5V, 3.0V, 3.3V, 4.0V, 5.0V
Contact our sales representatives for other voltages.
Adjustable Output Voltage Type: 0.8V to 5.5V
- Dropout Voltage Typ. 0.52V ($V_{SET}=3.0\text{V}$, $I_{OUT}=1\text{A}$)
- Ripple Rejection Typ. 70dB ($f=1\text{kHz}$, $V_{SET}=3.0\text{V}$)
- Output Voltage Accuracy $\pm 1.0\%$
- Output Voltage Temperature-Drift Coefficient Typ. $\pm 60\text{ppm}/^{\circ}\text{C}$
- Line Regulation Typ. 0.052%/V
- Load Regulation Typ. 3mV at $I_{OUT}=300\text{mA}$, Typ. 5mV at $I_{OUT}=1\text{A}$
- Packages DFN(PL)1820-6, SOT-89-5, HSOP-6J, TO-252-5-P2
- Inrush Current Limit Circuit Typ. 500mA
B/D version: Inrush current limit time is 500 μs .
- Fold-Back Protection Circuit Typ. 250mA (Current at short mode)
- Thermal Shutdown Circuit Thermal Shutdown Temperature: Typ. 165°C
Released Temperature: Typ. 95°C
- Auto Discharge Function D version
- Ceramic capacitors are recommended to be used with this IC 2.2 μF or more ($V_{SET} \leq 3.6\text{V}$)
4.7 μF or more ($V_{SET} > 3.6\text{V}$)

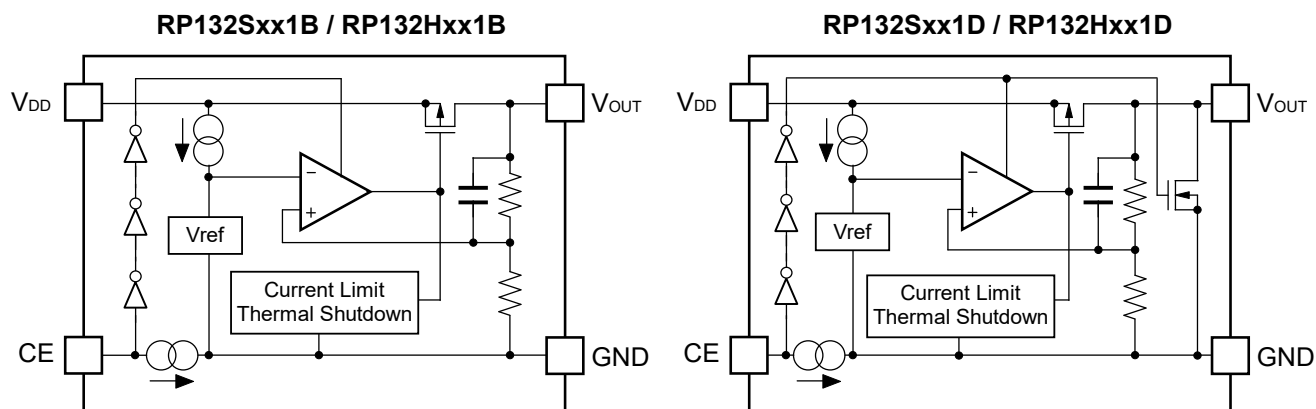
※ This product is usable for the high-temperature applications since have passed a test at the high temperature. In addition, this product has a high-reliability since having passed our rigorous quality standards. To distinguish from the consumer products, “-Yx” is added at the end of the product name.

APPLICATIONS

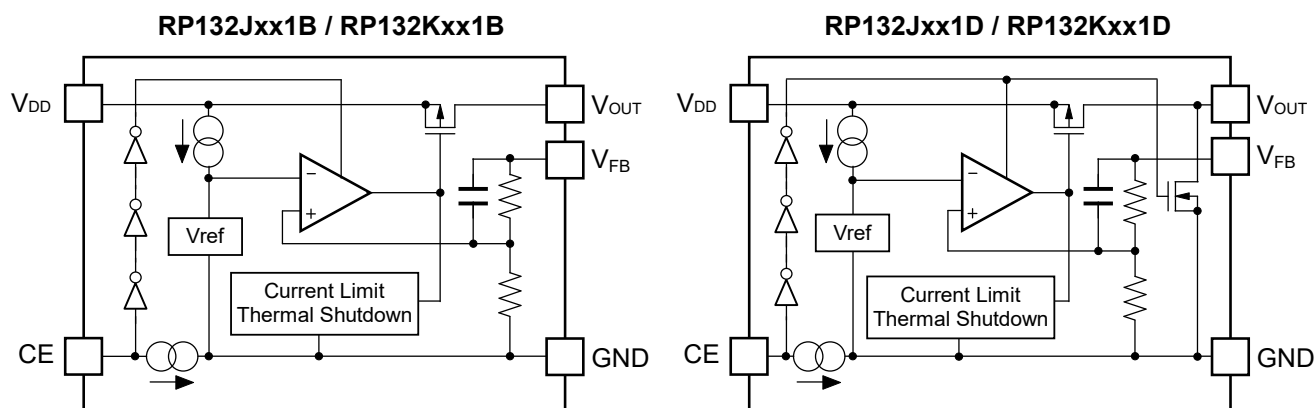
- Industrial equipments such as FAs and smart meters
 - Equipments used under high-temperature conditions
- Equipments accompanied by self-heating

BLOCK DIAGRAMS

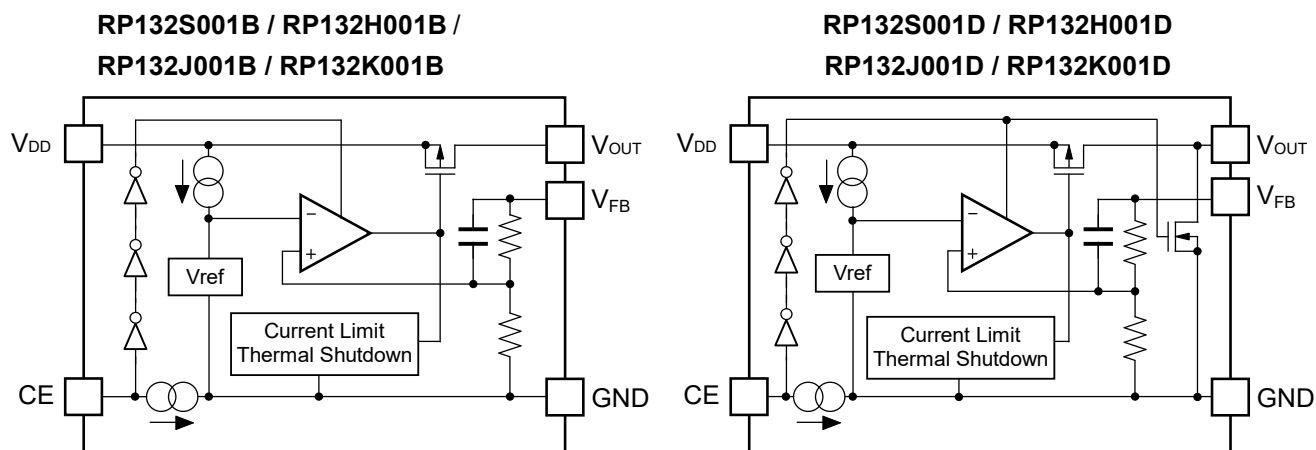
• Fixed Output Voltage Type (HSOP-6J / SOT89-5)



• Fixed Output Voltage Type (TO-252-5-P2 / DFN(PL)1820-6)



• Adjustable Output Voltage Type (HSOP-6J / SOT-89-5 / TO-252-5-P2 / DFN(PL)1820-6)



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP132K001*-TR-Y	DFN(PL)1820-6	5,000 pcs	Yes	Yes
RP132Kxx1*-TR-Y				
RP132H001*-T1-YE	SOT-89-5	1,000 pcs	Yes	Yes
RP132Hxx1*-T1-YE				
RP132S001*-E2-YE	HSOP-6J	1,000 pcs	Yes	Yes
RP132Sxx1*-E2-YE				
RP132J001*-T1-YE	TO-252-5-P2	3,000 pcs	Yes	Yes
RP132Jxx1*-T1-YE				

RP132x001x is the adjustable output voltage type.

xx: Specify the set output voltage (V_{SET}) of the fixed output voltage type.

0.8V(08), 1.2V(12), 1.5V(15), 1.8V(18), 2.5V(25), 3.0V(30), 3.3V(33), 4.0V(40), 5.0V(50)

1.05V(RP132x101x5)

Contact our sales representatives for other voltages.

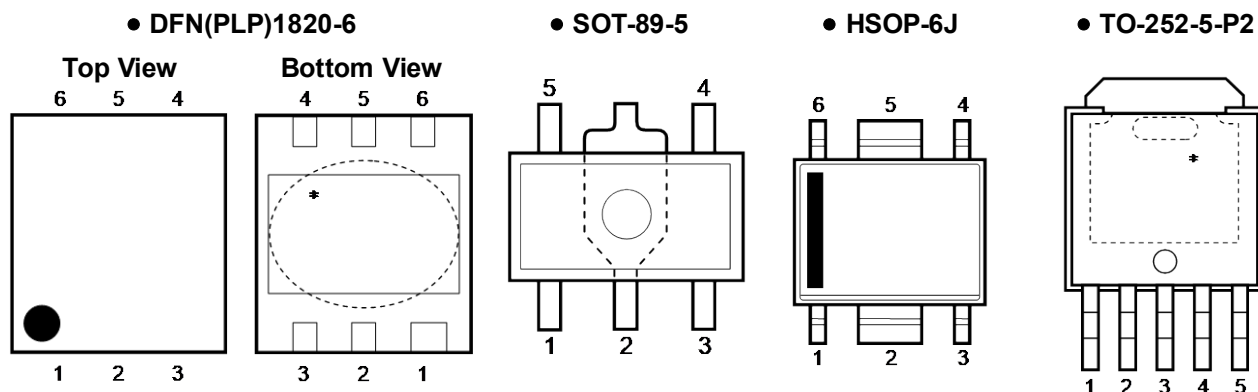
*: The auto discharge function at off state options are as follows.

(B) without auto discharge function* at off state

(D) with auto discharge function* at off state

* 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



• DFN(PL)1820-6

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

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

When using Fixed Output Voltage Type (RP132Kxx1x), V_{OUT} pin and V_{FB} pin should be connected. When using Adjustable Output Voltage Type (RP132K001x), please follow *Notes on the Adjustable Output Voltage Type Settings*.

• SOT-89-5

Pin No.	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active) (RP132Hxx1B/D)
	V_{FB}	Feed Back Pin (RP132H001B/D)
2	GND	Ground Pin
3	NC	No Connection (RP132Hxx1B/D)
	CE	Chip Enable Pin ("H" Active) (RP132H001B/D)
4	V_{DD}	Input Pin
5	V_{OUT}	Output Pin

When using Adjustable Output Voltage Type (RP132H001x), please follow *Notes on Adjustable Output Voltage Type Settings*.

● HSOP-6J

Pin No.	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	NC	No Connection (RP132Sxx1B/D)
	V_{FB}	Feed Back Pin (RP132S001B/D)
4	CE	Chip Enable Pin ("H" Active)
5	GND	Ground Pin
6	V_{DD}	Input Pin

No. 2 pin and No .5 pin must be wired each other when mounted on boards. When using Adjustable Output Voltage Type (RP132S001x), please follow *Notes on Adjustable Output Voltage Type Settings*.

● TO-252-5-P2

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

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

When using Fixed Output Voltage Type (RP132Jxx1x), V_{OUT} pin and V_{FB} pin should be connected. When using Adjustable Output Voltage Type (RP132J001x), please follow *Notes on the Adjustable Output Voltage Type Settings*.

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_{FB}	Input Voltage (V_{FB} Pin)			-0.3 to 7.0	V
V_{OUT}	Output Voltage			-0.3 to $V_{IN}+0.3$	V
P_D	Power Dissipation*	DFN(PL)1820-6	JEDEC STD. 51	2200	mW
		SOT-89-5	JEDEC STD. 51	2600	
		HSOP-6J	JEDEC STD. 51	2700	
		TO-252-5-P2	JEDEC STD. 51	3800	
T_j	Junction Temperature			-40 to 125	°C
T_{stg}	Storage Temperature Range			-55 to 125	°C

*) Refer to *PACKAGE INFORMATION* for detailed information.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage 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	1.4 to 6.5	V
T_a	Operating Temperature Range	-40 to 105	°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 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.

ELECTRICAL CHARACTERISTICS

$V_{IN}=V_{SET}+1.0V$, $I_{OUT}=1mA$, $C_{IN}=2.2\mu F$, $C_{OUT}=2.2\mu F$ ($V_{SET} \leq 3.6V$), $4.7\mu F$ ($V_{SET} > 3.6V$), unless otherwise noted.

The specifications surrounded by are guaranteed by design engineering at $-40^{\circ}C \leq T_a \leq 105^{\circ}C$.

• RP132xxxxB/D (Fixed Output Voltage Type)

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

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V _{OUT}	Output Voltage	Ta=25°C	V _{SET} > 1.5V	×0.99		×1.01	V
			V _{SET} ≤ 1.5V	−15		15	mV
		−40°C ≤ Ta ≤ 105°C	V _{SET} > 1.5V	×0.981		×1.019	V
			V _{SET} ≤ 1.5V	−29		29	mV
I _{LIM}	Output Current Limit			1			A
ΔV _{OUT} /ΔI _{OUT}	Load Regulation	0.1mA ≤ I _{OUT} ≤ 300mA			3	20	mV
		0.1mA ≤ I _{OUT} ≤ 1A			5	60	
V _{DIF}	Dropout Voltage	Refer to the <i>Product-specific Electrical Characteristics</i>					
I _{SS}	Supply Current	I _{OUT} =0mA (V _{IN} =6.5V)			65	85	μA
I _{standby}	Standby Current	V _{CE} =0V, V _{IN} =6.5V			0.15	0.6	μA
ΔV _{OUT} /ΔV _{IN}	Line Regulation	V _{SET} +0.5V ≤ V _{IN} ≤ 6.5V * However, V _{IN} ≥ 1.6V			0.05	0.10	%/V
I _{SC}	Short Current Limit	V _{OUT} =0V			250		mA
I _{PD}	CE Pull-down Current				0.3	0.7	μA
V _{CEH}	CE Input Voltage "H"			1.0			V
V _{CEL}	CE Input Voltage "L"					0.4	V
T _{TSD}	Thermal Shutdown Detection Temperature	Junction Temperature			165		°C
T _{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			95		°C
R _{LOW}	Low Output Nch Tr. ON Resistance (D version)	V _{IN} =4.0V, V _{CE} =0V			50		Ω

All test items listed under Electrical Characteristics are done under the pulse load condition ($T_j=T_a=25^{\circ}C$) except for Dropout Voltage at 1A Output Current and Load Regulation.

The specifications surrounded by are guaranteed by design engineering at $-40^{\circ}\text{C} \leq T_a \leq 105^{\circ}\text{C}$.

RP132xxxxB/D (Fixed Output Voltage Type) Product-specific Electrical Characteristics ($T_a = 25^{\circ}\text{C}$)

Product Name	V_{OUT} [V] ($T_a = 25^{\circ}\text{C}$)			V_{OUT} [V] ($T_a = -40$ to 105°C)			V_{DIF} [V] ($I_{\text{OUT}} = 300$ mA)		V_{DIF} [V] ($I_{\text{OUT}} = 1$ A)	
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.
RP132x08xx	0.785	0.800	0.815	0.771	0.800	0.829	0.670	0.890	1.200	1.540
RP132x12xx	1.185	1.200	1.215	1.171	1.200	1.229	0.360	0.540	0.900	1.230
RP132x15xx	1.485	1.500	1.515	1.471	1.500	1.529	0.240	0.330	0.780	1.050
RP132x18xx	1.782	1.800	1.818	1.766	1.800	1.834				
RP132x25xx	2.475	2.500	2.525	2.453	2.500	2.548				
RP132x30xx	2.970	3.000	3.030	2.943	3.000	3.057	0.150	0.210	0.520	0.720
RP132x33xx	3.267	3.300	3.333	3.237	3.300	3.363	0.130	0.180	0.460	0.680
RP132x40xx	3.960	4.000	4.040	3.924	4.000	4.076				
RP132x50xx	4.950	5.000	5.050	4.905	5.000	5.095				
RP132x10xx5	1.035	1.050	1.065	1.021	1.050	1.079	0.51	0.73	1.05	1.39

$V_{IN} = V_{SET} + 1.0V$, $I_{OUT} = 1mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 2.2\mu F (V_{SET} \leq 3.6V)$, $4.7\mu F (V_{SET} > 3.6V)$, unless otherwise noted.

The specifications surrounded by are guaranteed by design engineering at $-40^{\circ}C \leq T_a \leq 105^{\circ}C$

● **RP132x001B/D (Adjustable Output Voltage Type)**

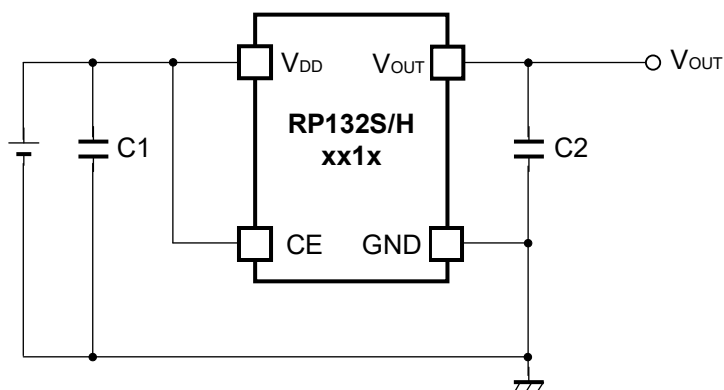
($T_a = 25^{\circ}C$)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V _{FB}	Feedback Voltage	Ta=25°C	V _{OUT} =V _{FB}	0.785	0.800	0.815	V
		−40°C ≤ Ta ≤ 105°C		0.771		0.829	
V _{OUT}	Output Voltage Adjusting Range			0.8		5.5	V
I _{LIM}	Output Current Limit	V _{OUT} =V _{FB}		1			A
ΔV _{OUT} / ΔI _{OUT}	Load Regulation	0.1mA ≤ I _{OUT} ≤ 300mA			3	20	mV
		0.1mA ≤ I _{OUT} ≤ 1A			5	60	
V _{DIF}	Dropout Voltage	V _{OUT} =V _{FB}	I _{OUT} =300mA		0.67	0.89	V
			I _{OUT} =1A		1.20	1.54	
I _{SS}	Supply Current	V _{OUT} =V _{FB} , I _{OUT} =0mA (V _{IN} =6.5V)			65	85	μA
Istandby	Standby Current	V _{CE} =0V, V _{IN} =6.5V			0.15	0.6	μA
ΔV _{OUT} / ΔV _{IN}	Line Regulation	V _{OUT} =V _{FB} , 1.6V ≤ V _{IN} ≤ 6.5V			0.05	0.10	%/V
I _{SC}	Short Current Limit	V _{OUT} =V _{FB} =0V			250		mA
I _{PD}	CE Pull-down Current				0.3	0.7	μA
V _{CEH}	CE Input Voltage "H"			1.0			V
V _{CEL}	CE Input Voltage "L"					0.4	V
T _{TSD}	Thermal Shutdown Detection Temperature	Junction Temperature			165		°C
T _{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			95		°C
R _{LOW}	Low Output Nch Tr. ON Resistance (D version)	V _{IN} =4.0V, V _{CE} =0V			50		Ω

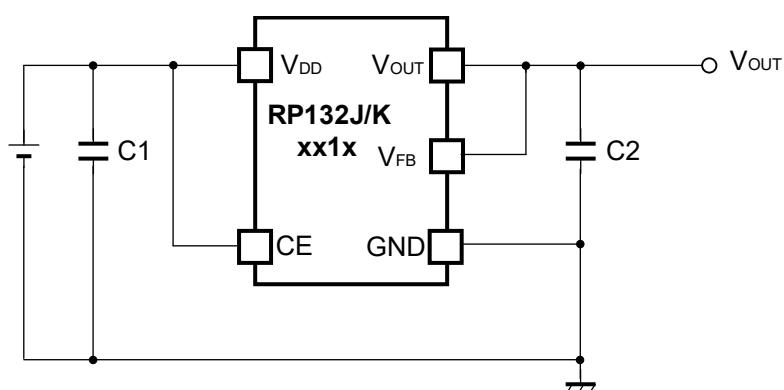
All test items listed under Electrical Characteristics are done under the pulse load condition ($T_j \approx T_a = 25^{\circ}C$) except for Dropout Voltage at 1A Output Current and Load Regulation.

TYPICAL APPLICATION

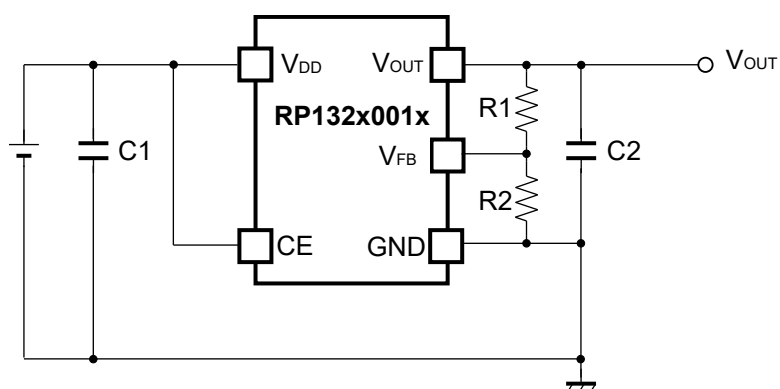
Fixed Output Voltage Type (HSOP-6J/ SOT89-5)



Fixed Output Voltage Type (TO-252-5-P2 / DFN(PL)1820-6)



Adjustable Output Voltage Type (HSOP-6J / SOT89-5/ TO-252-5-P2 / DFN(PL)1820-6)



TECHNICAL NOTES

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.

Recommended value of the external capacitors

V_{OUT}	Capacitors	
$V_{SET} \leq 3.6V$	C1	2.2 μ F
	C2	2.2 μ F
$V_{SET} > 3.6V$	C1	2.2 μ F
	C2	4.7 μ F

Please refer to *Technical Notes on Adjustable Output Voltage Type* when using R1 and R2 as output capacitors.

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.

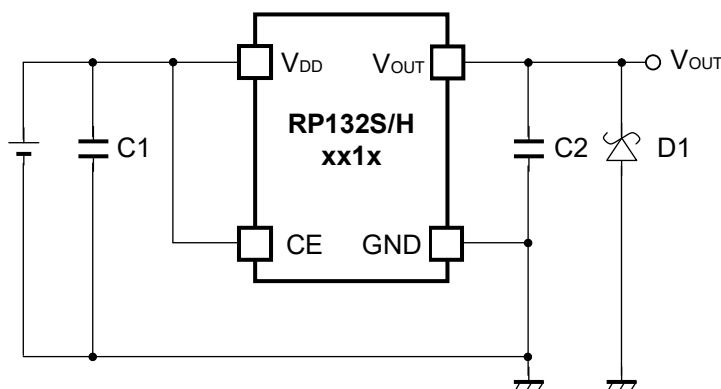
Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

Transient Response

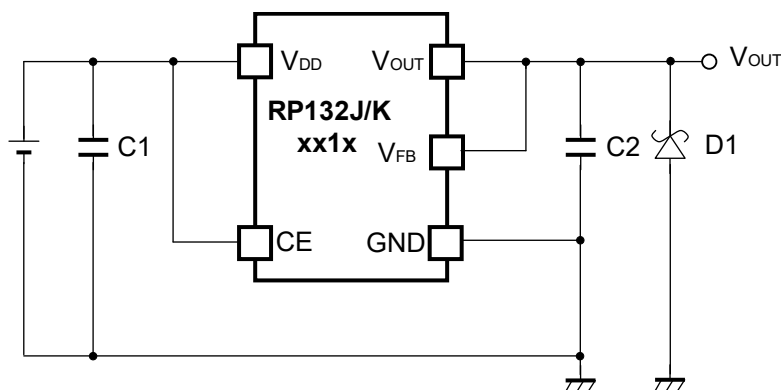
When using the Adjustable Output Voltage Type, the transient response could be affected by the external resistors. Evaluate the circuit taking the actual conditions of use into account.

TYPICAL APPLICATION FOR IC CHIP BREAKDOWN PREVENTION

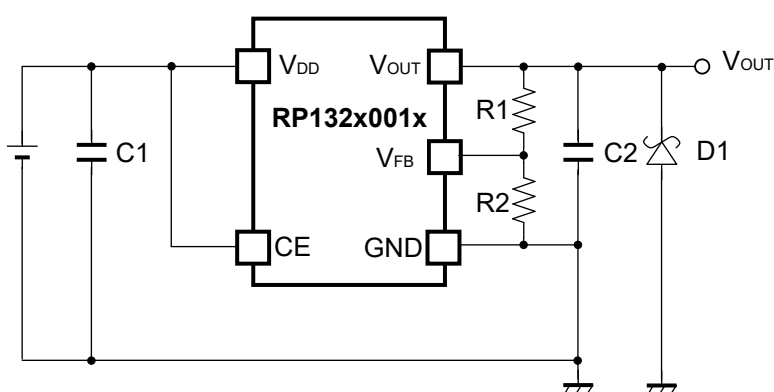
Fixed Output Voltage Type (HSOP-6J / SOT89-5)



Fixed Output Voltage Type (TO-252-5-P2 / DFN(PL)1820-6)



Adjustable Output Voltage Type (HSOP-6J / SOT89-5 / TO-252-5-P2 / DFN(PL)1820-6)



When a sudden surge of electrical current travels along the V_{OUT} pin and GND due to a short-circuit, electrical resonance of a circuit involving an output capacitor (C2) and a short circuit inductor generates a negative voltage and may damage the device or the load devices. Connecting a schottky diode (D1) between the V_{OUT} pin and GND has the effect of preventing damage to them.

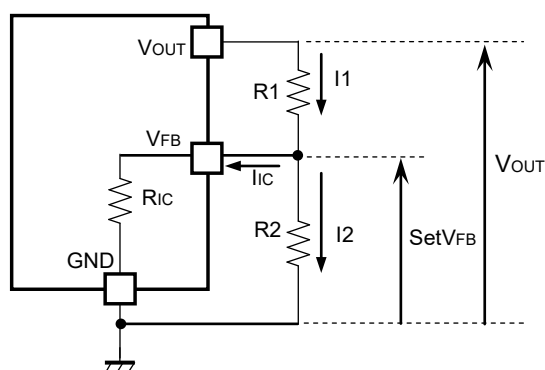
Adjustable Output Voltage Type Settings

Output Voltage Setting Method

Adjustable Output Voltage Type can be adjusted the output voltage up to 5.5V by using the external divider resistors. Also, please use 16kΩ or less for R2 resistor.

If the V_{FB} voltage is described as $setV_{FB}$, the output voltage can be set by using the following equations

$setV_{FB}$ is equal to 0.8V. The V_{OUT} pin of Adjustable Output Voltage Type should be connected to the V_{FB} pin.



$$I1 = I_{IC} + I2 \dots\dots\dots (1)$$

$$I2 = setV_{FB} / R2 \dots\dots\dots (2)$$

Thus,

$$I1 = I_{IC} + setV_{FB} / R2 \dots\dots\dots (3)$$

Therefore,

$$V_{OUT} = setV_{FB} \times R1 \times I1 \dots\dots\dots (4)$$

Put Equation (3) into Equation (4), then

$$\begin{aligned} V_{OUT} &= setV_{FB} \times R1 \times (I_{IC} + setV_{FB} / R2) \\ &= setV_{FB} \times (1 + R1 / R2) + R1 \times I_{IC} \dots\dots\dots (5) \end{aligned}$$

In Equation (5), $R1 \times I_{IC}$ is the error-causing factor in V_{OUT} .

As for I_{IC} ,

$$I_{IC} = setV_{FB} / R_{IC} \dots\dots\dots (6)$$

Therefore, the error-causing factor $R1 \times I_{IC}$ can be described as follows.

$$\begin{aligned} R1 \times I_{IC} &= R1 \times setV_{FB} / R_{IC} \\ &= setV_{FB} \times R1 / R_{IC} \dots\dots\dots (7) \end{aligned}$$

For better accuracy, choosing $R1 (<< R_{IC})$ reduces this error.

Without the error-causing factor $R1 \times I_{IC}$, the output voltage can be calculated by the following equation

$$V_{OUT} = setV_{FB} \times ((R1 + R2) / R2) \dots\dots\dots (8)$$

R_{IC} of RP132x is approximately Typ.1.3MΩ ($T_a=25^\circ\text{C}$, this value is guaranteed by design).

The value could be affected by the temperature, therefore evaluate the circuit taking the actual conditions of use into account.

Inrush Current Limit Time Settings

The RP132x Series include the circuit which can limit the inrush current at start-up to 500mA or less. The current limit time of B/D version is fixed internally as approximately Typ.500 μ s.

Please note that during the inrush current limit time, the load current cannot be more than the limited current.

PACKAGE INFORMATION

POWER DISSIPATION (DFN(PL)1820-6)

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 × 36 pcs

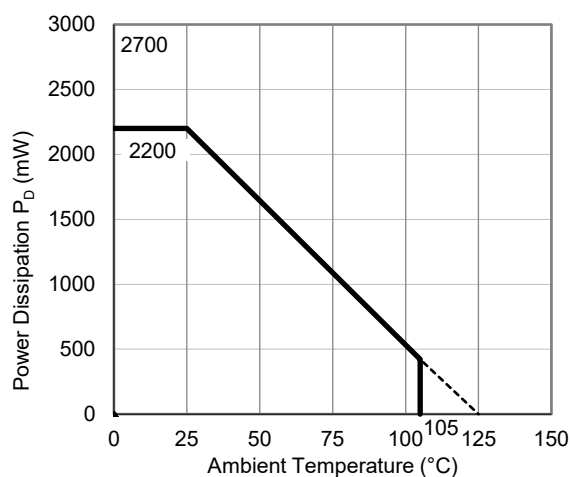
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

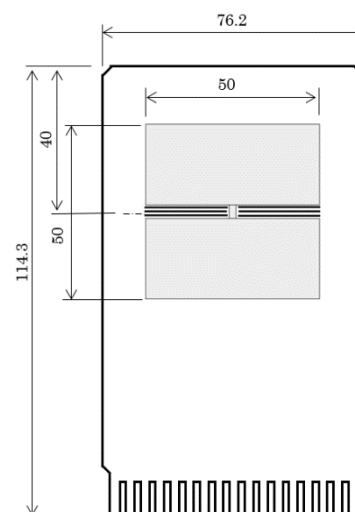
Item	Measurement Result
Power Dissipation	2200 mW
Thermal Resistance (θ_{ja})	$\theta_{ja} = 45^{\circ}\text{C/W}$
Thermal Characterization Parameter (ψ_{jt})	$\psi_{jt} = 18^{\circ}\text{C/W}$

θ_{ja} : Junction-to-ambient thermal resistance.

ψ_{jt} : Junction-to-top of package thermal characterization parameter.



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

POWER DISSIPATION (SOT-89-5)

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

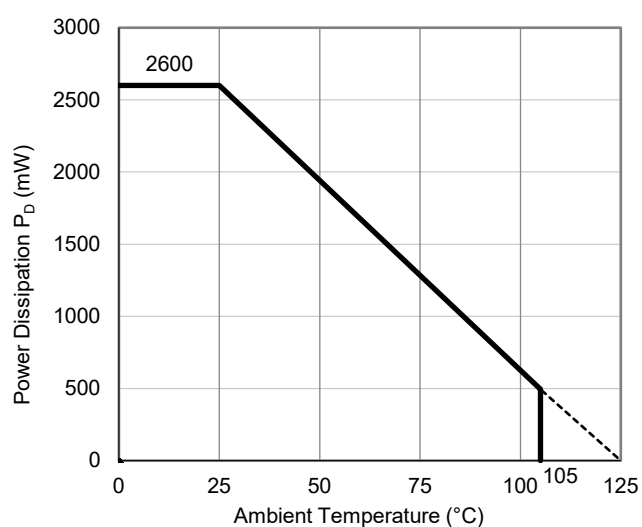
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

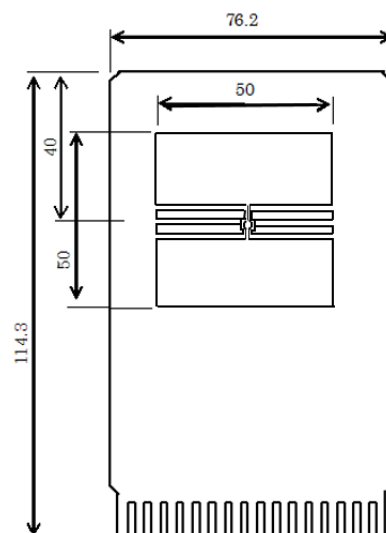
Item	Measurement Result
Power Dissipation	2600 mW
Thermal Resistance (θ_{ja})	$\theta_{ja} = 38^{\circ}\text{C/W}$
Thermal Characterization Parameter (ψ_{jt})	$\psi_{jt} = 13^{\circ}\text{C/W}$

θ_{ja} : Junction-to-Ambient Thermal Resistance

ψ_{jt} : Junction-to-Top Thermal Characterization Parameter

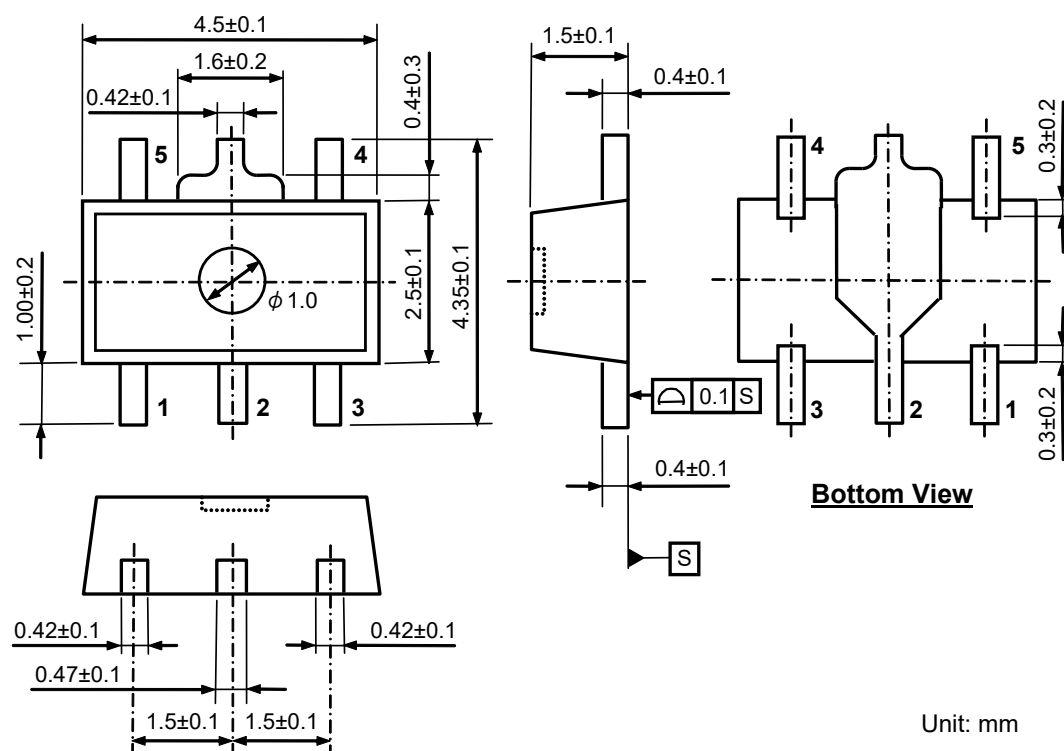


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (SOT-89-5)



SOT-89-5 Package Dimensions

POWER DISSIPATION (HSOP-6J)

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

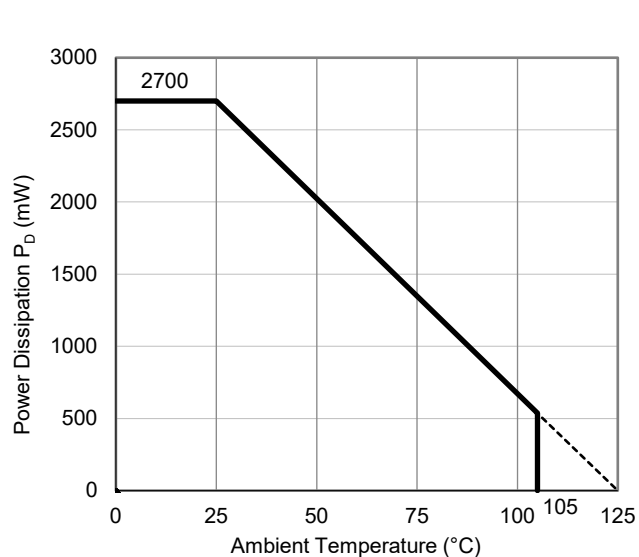
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

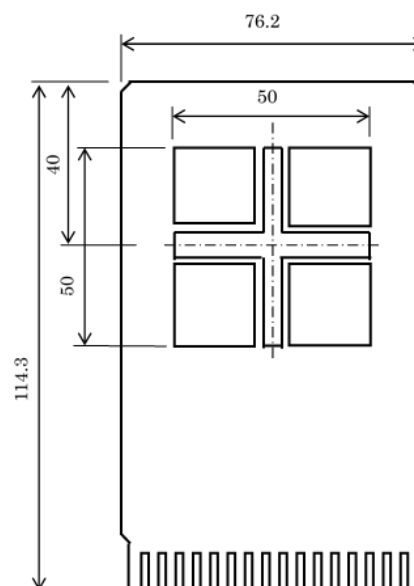
Item	Measurement Result
Power Dissipation	2700 mW
Thermal Resistance (θ_{ja})	$\theta_{ja} = 37^{\circ}\text{C/W}$
Thermal Characterization Parameter (ψ_{jt})	$\psi_{jt} = 7^{\circ}\text{C/W}$

θ_{ja} : Junction-to-Ambient Thermal Resistance

ψ_{jt} : Junction-to-Top Thermal Characterization Parameter

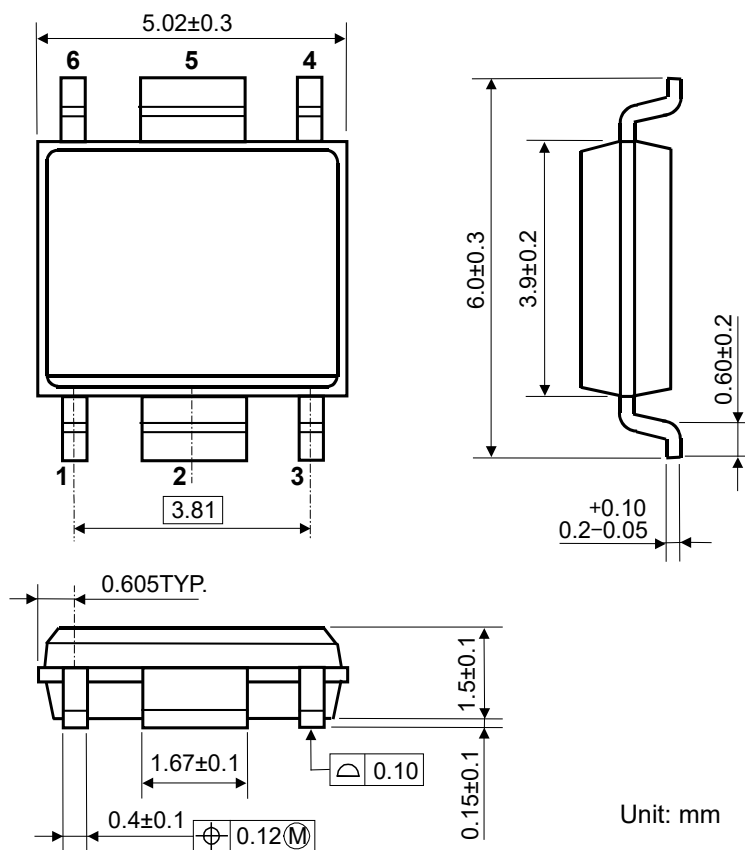


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (HSOP-6J)



Unit: mm

HSOP-6J Package Dimensions

POWER DISSIPATION (TO-252-5-P2)

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

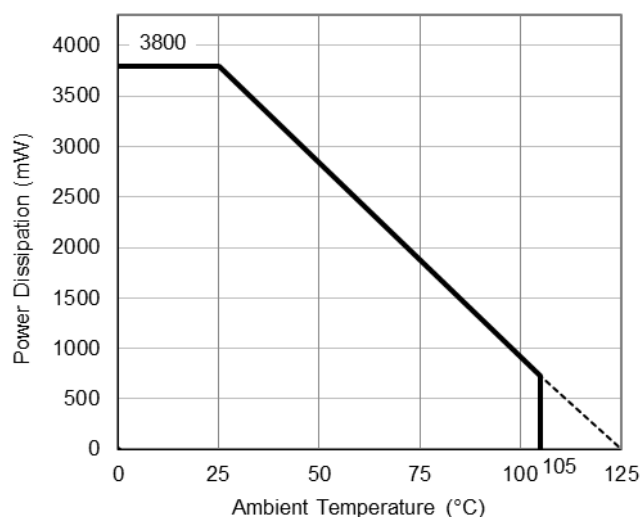
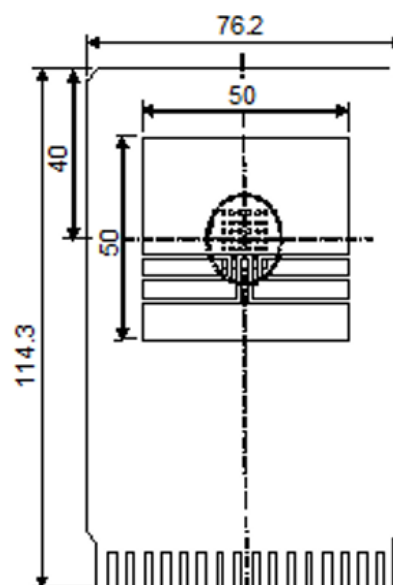
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

Item	Measurement Result
Power Dissipation	3800 mW
Thermal Resistance (θ_{ja})	$\theta_{ja} = 26^{\circ}\text{C/W}$
Thermal Characterization Parameter (ψ_{jt})	$\psi_{jt} = 7^{\circ}\text{C/W}$

θ_{ja} : Junction-to-Ambient Thermal Resistance

ψ_{jt} : Junction-to-Top Thermal Characterization Parameter

**Power Dissipation vs. Ambient Temperature****Measurement Board Pattern**

Technical drawing of the SMD package showing top, side, and bottom views with dimensions in mm.

Top View Dimensions:

- Overall width: 6.60 ± 0.20
- Pin pitch (between pins 1 and 5): 5.34 ± 0.20
- Pin 1 to center line: 1.10 ± 0.20
- Pin 5 to center line: 1.10 ± 0.20
- Pin 1 to pin 5: 2.30 ± 0.20
- Pin 1 to center line (alternative): 0.50 ± 0.10
- Pin 5 to center line (alternative): 0.50 ± 0.10
- Pin 1 to pin 5 (alternative): 1.27
- Pin 1 to center line (alternative): 0.10
- Pin 5 to center line (alternative): 0.12
- Pin 1 to center line (alternative): 0.12
- Pin 5 to center line (alternative): 0.12

Side View Dimensions:

- Overall height: 9.90 ± 0.30
- Pin height: 1.10 ± 0.20
- Pin 1 to center line: 1.10 ± 0.20
- Pin 5 to center line: 1.10 ± 0.20
- Pin 1 to pin 5: 2.30 ± 0.20
- Pin 1 to center line (alternative): 0.50 ± 0.10
- Pin 5 to center line (alternative): 0.50 ± 0.10
- Pin 1 to pin 5 (alternative): 1.27
- Pin 1 to center line (alternative): 0.10
- Pin 5 to center line (alternative): 0.12
- Pin 1 to center line (alternative): 0.12
- Pin 5 to center line (alternative): 0.12

Bottom View Dimensions:

- Overall width: 6.60 ± 0.20
- Pin pitch (between pins 1 and 5): 5.34 ± 0.20
- Pin 1 to center line: 1.10 ± 0.20
- Pin 5 to center line: 1.10 ± 0.20
- Pin 1 to pin 5: 2.30 ± 0.20
- Pin 1 to center line (alternative): 0.50 ± 0.10
- Pin 5 to center line (alternative): 0.50 ± 0.10
- Pin 1 to pin 5 (alternative): 1.27
- Pin 1 to center line (alternative): 0.10
- Pin 5 to center line (alternative): 0.12
- Pin 1 to center line (alternative): 0.12
- Pin 5 to center line (alternative): 0.12

Notes:

- *) The tab on the b enhances thermal electrically connected level). It is recommended connected to the g board, or otherwise

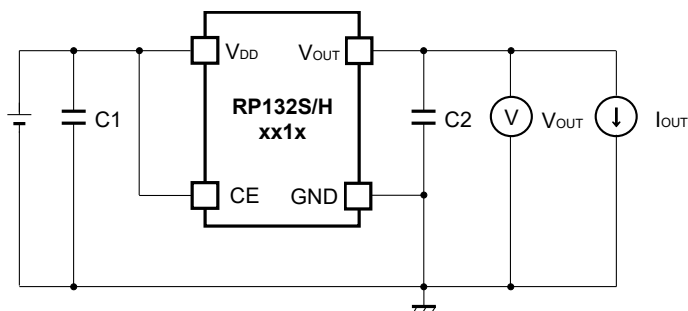
(Unit : mm)

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

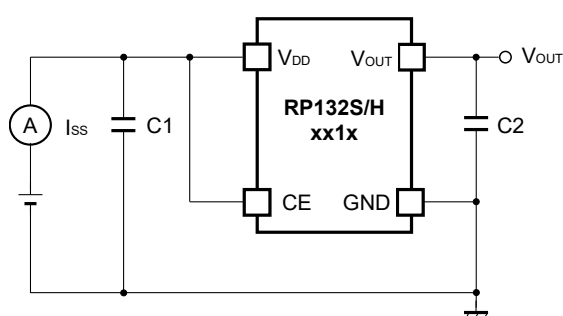
(Unit : mm)

TEST CIRCUITS

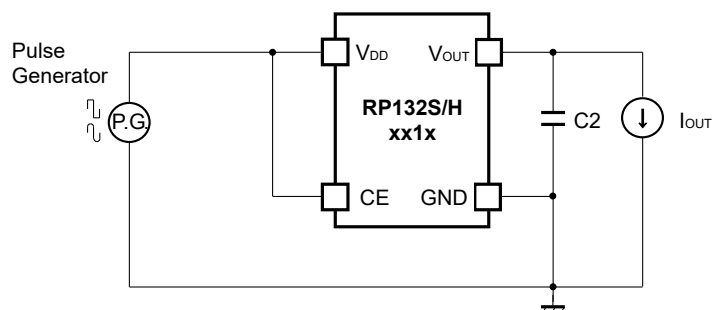
- Fixed Output Voltage Type (HSOP-6J / SOT89-5)



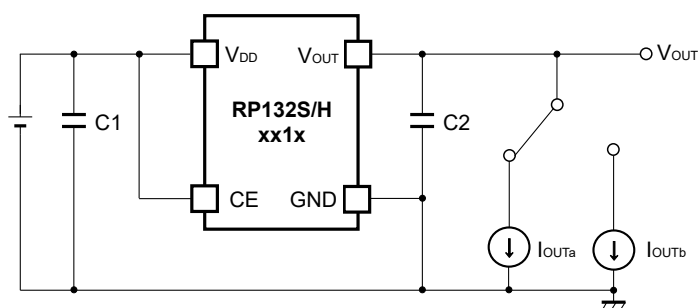
Basic Test Circuit



Test Circuit for Supply Current

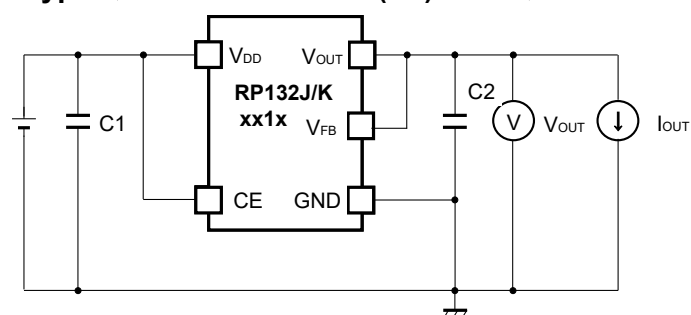


Test Circuit for Ripple Rejection

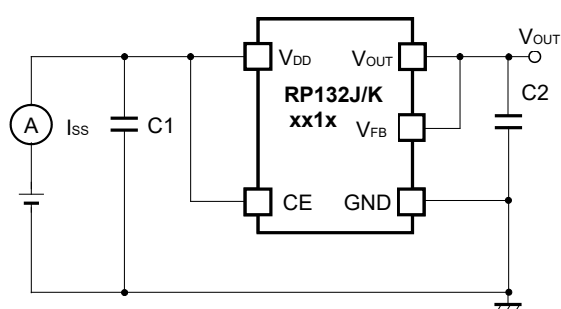


Test Circuit for Load Transient Response

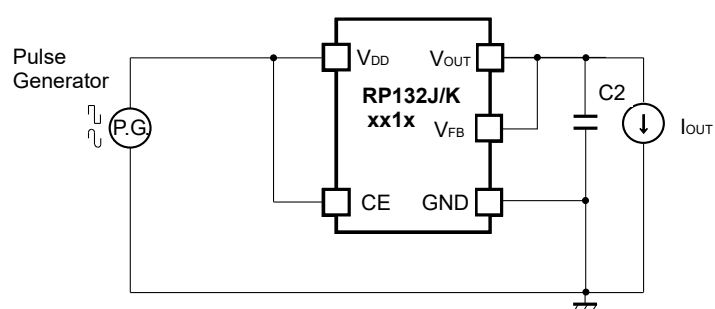
• **Fixed Output Voltage Type (TO-252-5-P2 / DFN(PL)1820-6)**



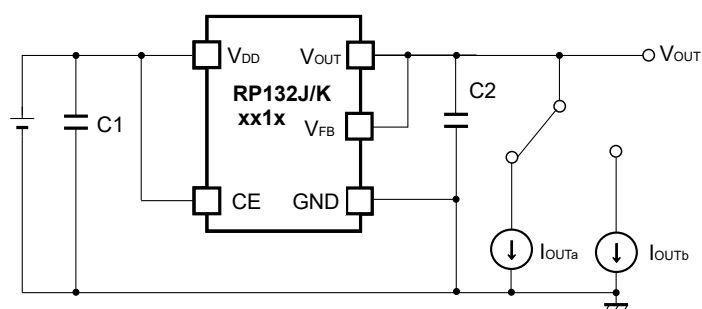
Basic Test Circuit



Test Circuit for Supply Current

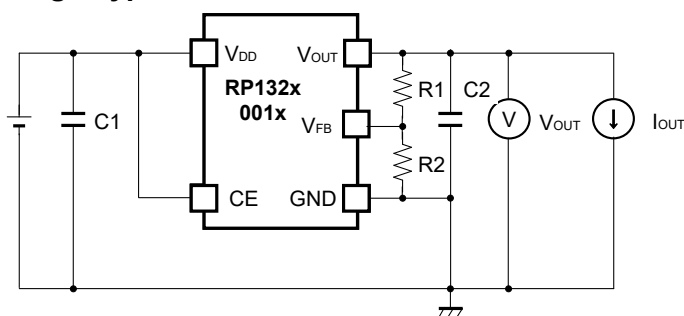


Test Circuit for Ripple Rejection

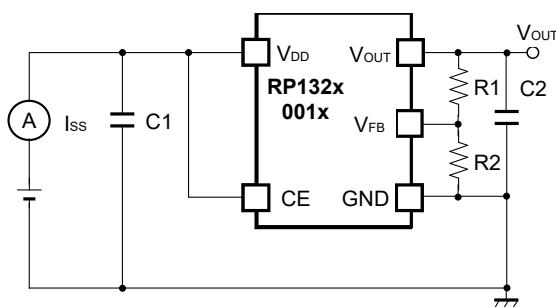


Test Circuit for Load Transient Response

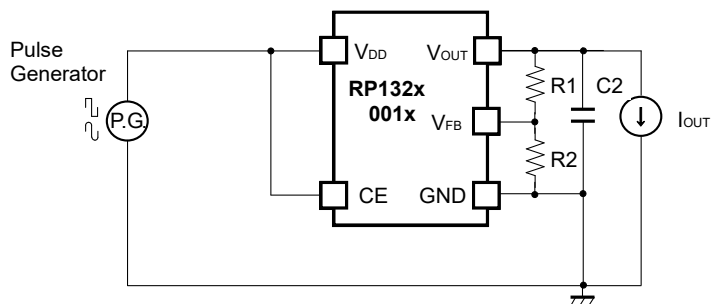
• Adjustable Output Voltage Type (HSOP-6J / SOT89-5/ TO-252-5-P2 / DFN(PL)1820-6)



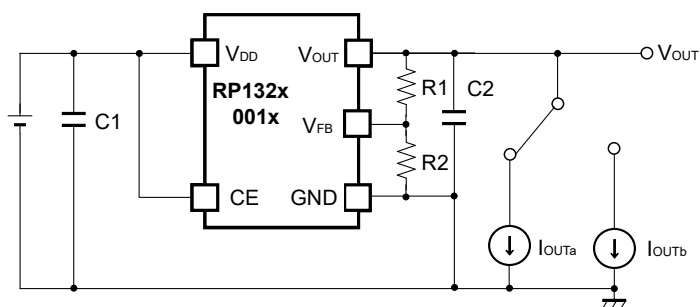
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection



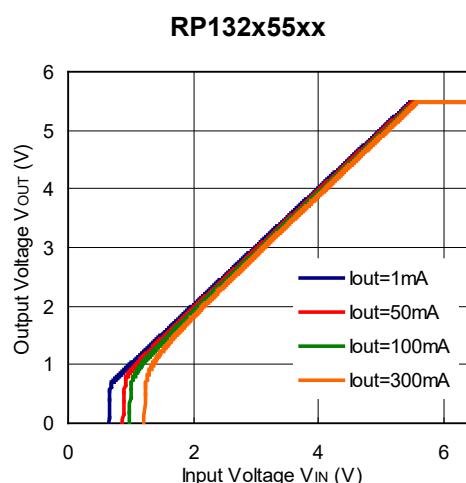
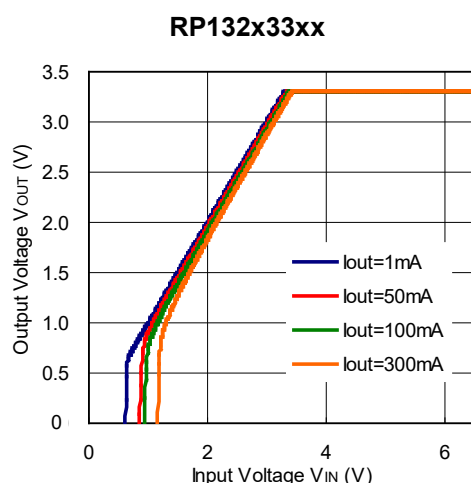
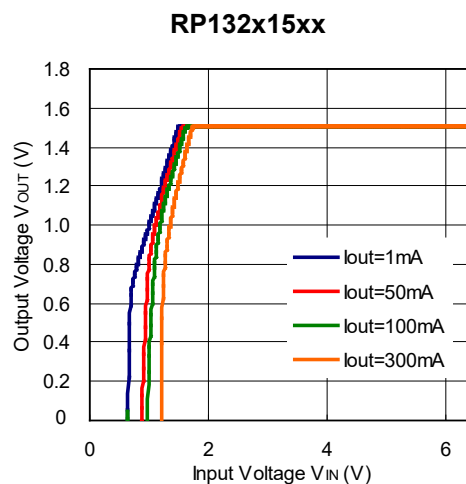
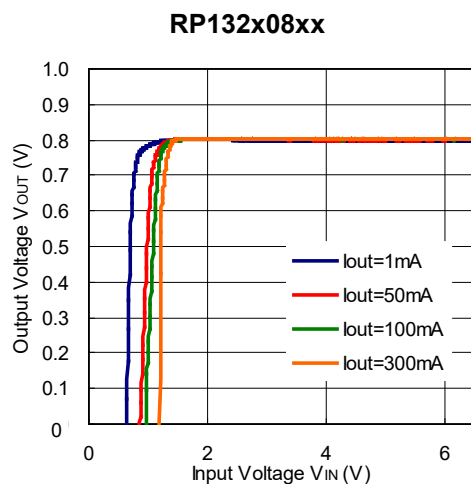
Test Circuit for Load Transient Response

Please refer to "Adjustable Output Voltage Type Settings" when using R1 and R2 as output capacitors.

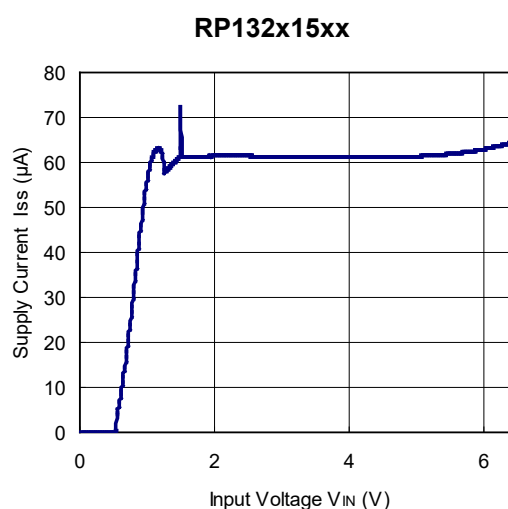
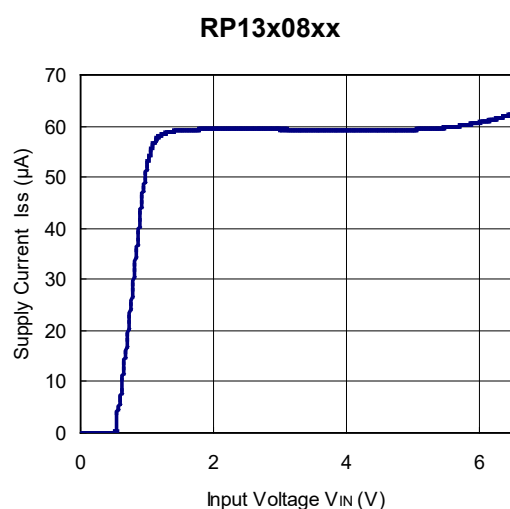
TYPICAL CHARACTERISTICS

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

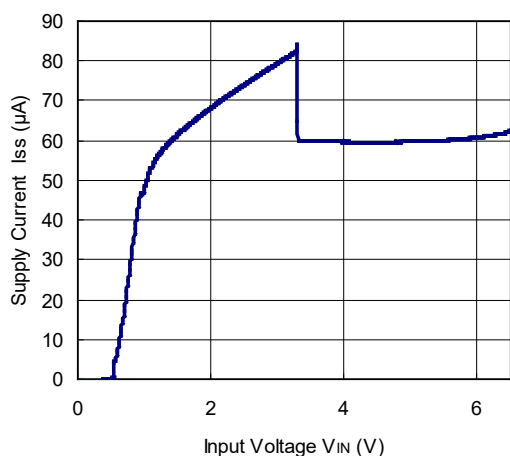
1) Output Voltage vs. Input Voltage ($T_a=25^\circ\text{C}$)



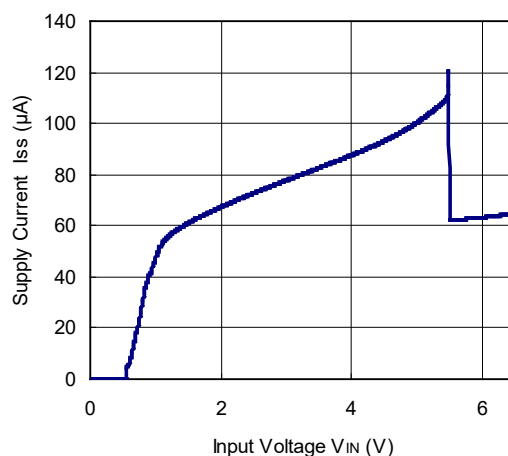
2) Supply Current vs. Input Voltage ($T_a=25^\circ\text{C}$)



RP132x33xx

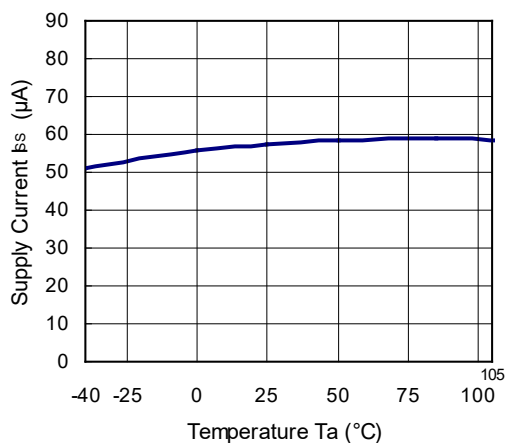


RP132x55xx

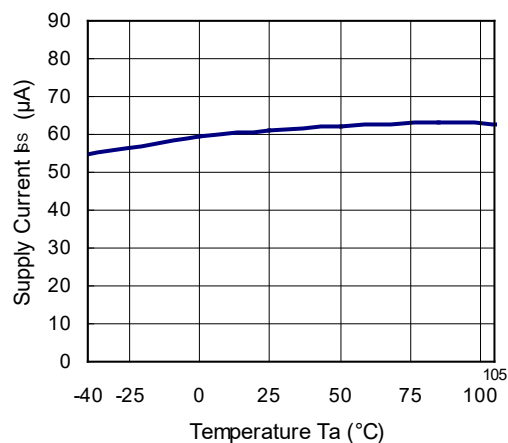


3) Supply Current vs. Temperature

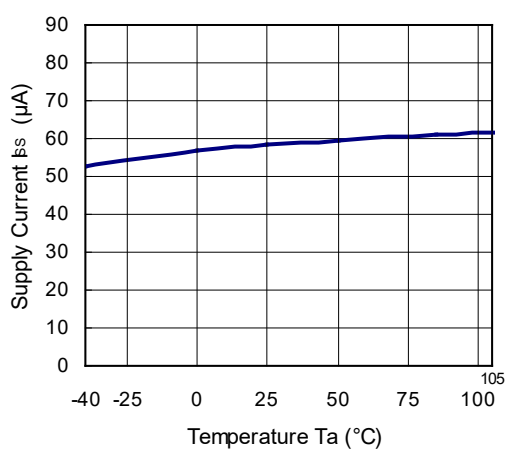
RP132x08xx



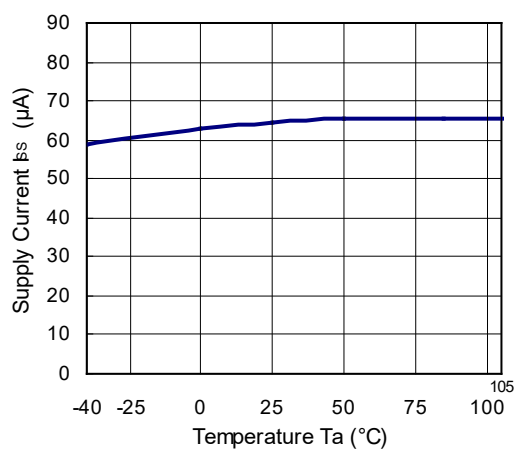
RP132x15xx



RP132x33xx

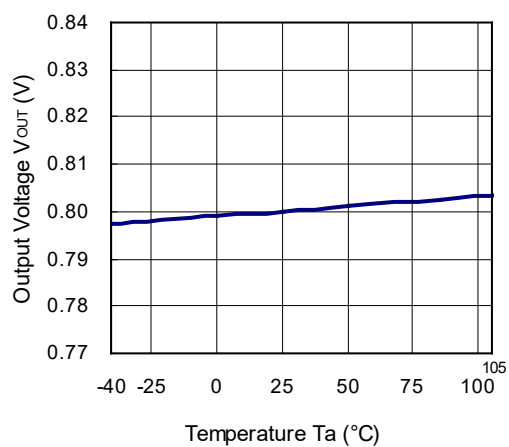


RP132x55xx

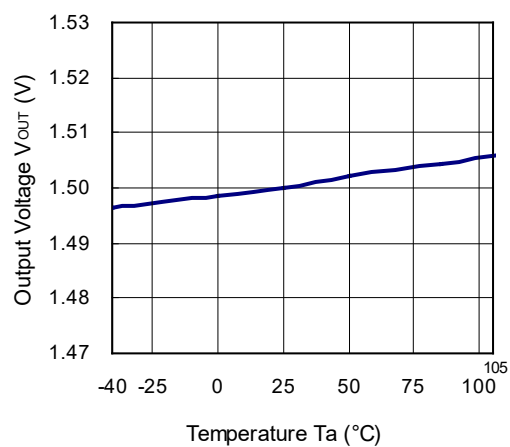


4) Output Voltage vs. Temperature

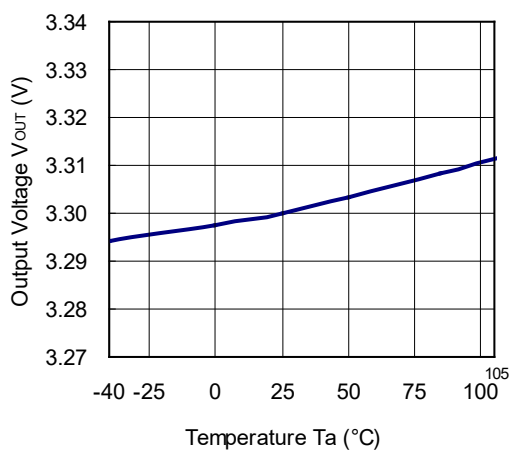
RP132x08xx



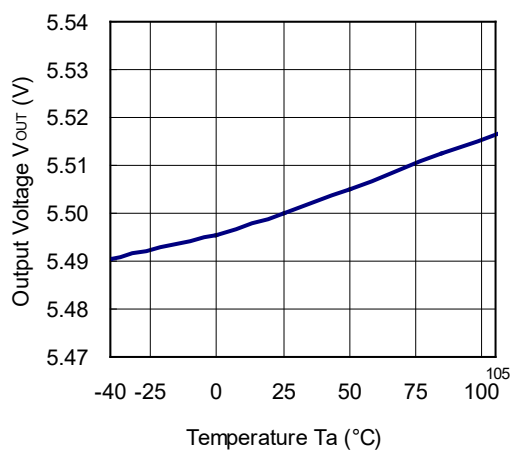
RP132x15xx



RP132x33xx

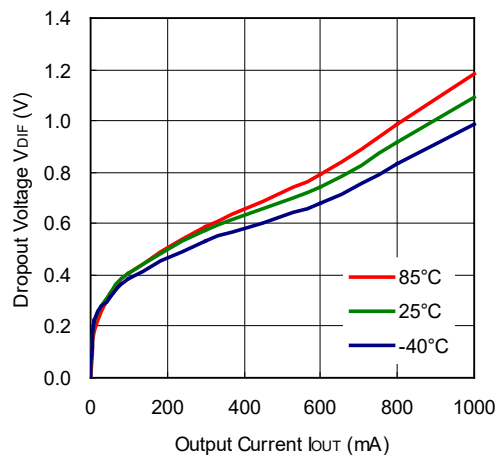


RP132x55xx

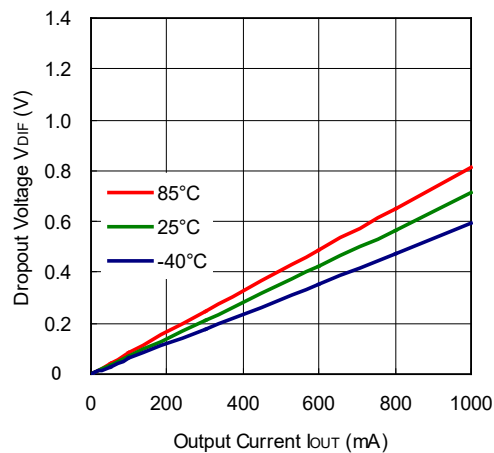


5) Dropout Voltage vs. Output Current

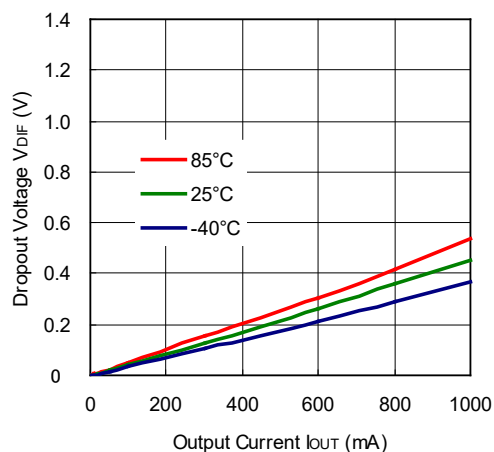
RP132x08xx



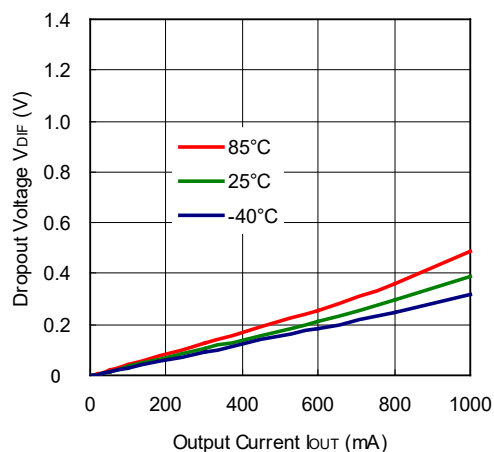
RP132x15xx



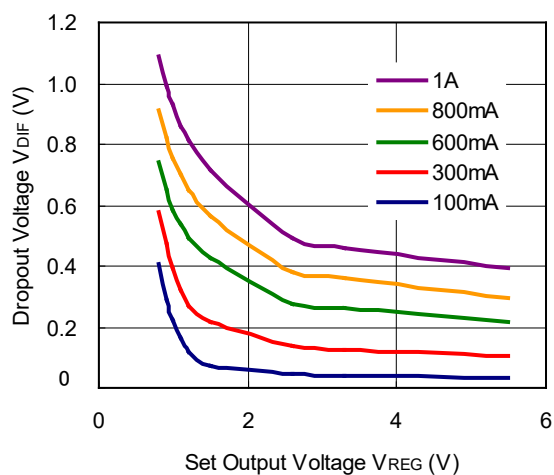
RP132x33xx



RP132x55xx



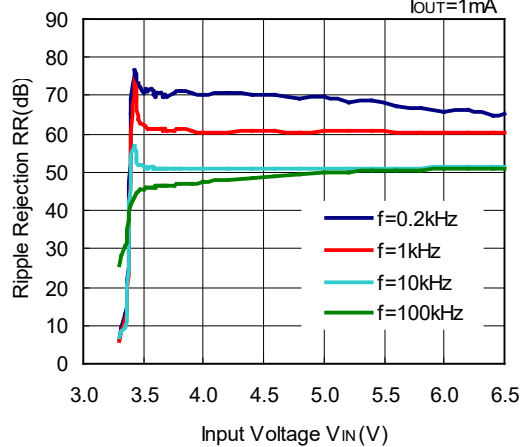
6) Dropout Voltage vs. Set Output Voltage



7) Ripple Rejection vs. Input Voltage (C1=none, Ripple=0.2Vp-p, $T_a=25^\circ\text{C}$)

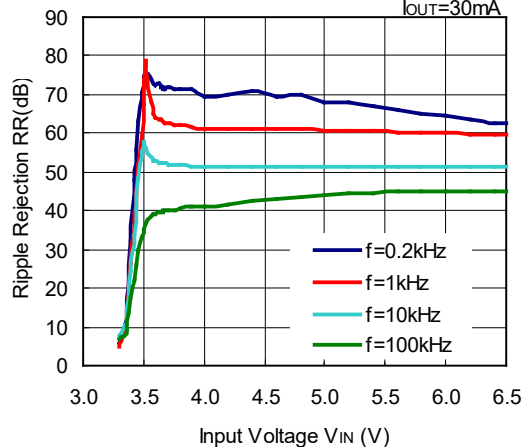
RP132x33xx

C2=Ceramic 2.2 μF
 $I_{OUT}=1\text{mA}$

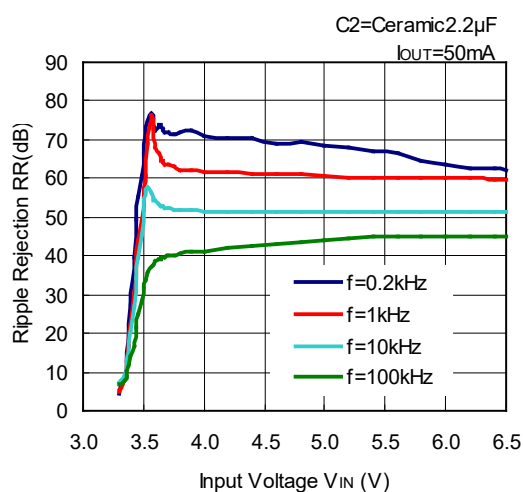


RP132x33xx

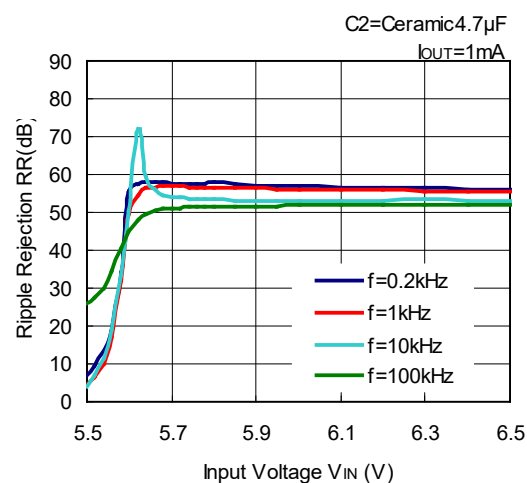
C2=Ceramic 2.2 μF
 $I_{OUT}=30\text{mA}$



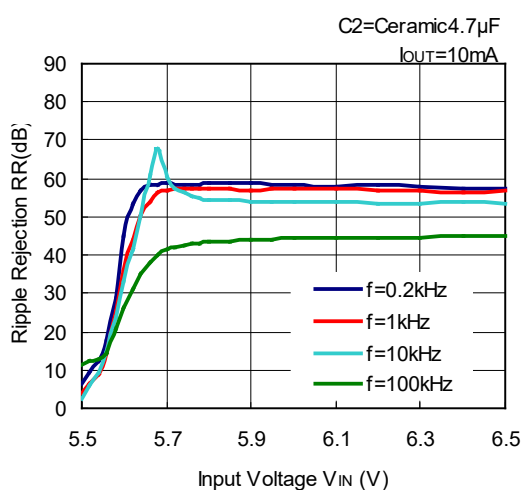
RP132x33xx



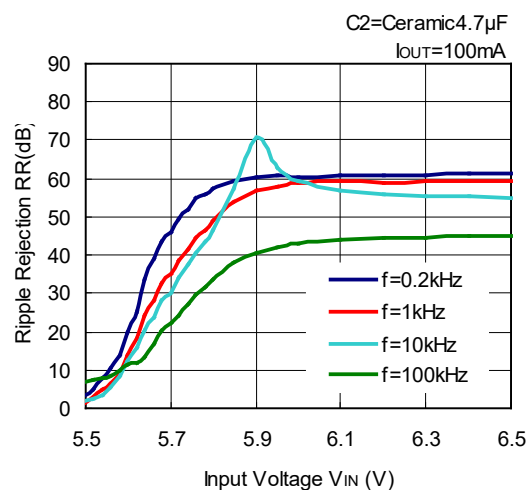
RP131x55xx



RP132x55xx

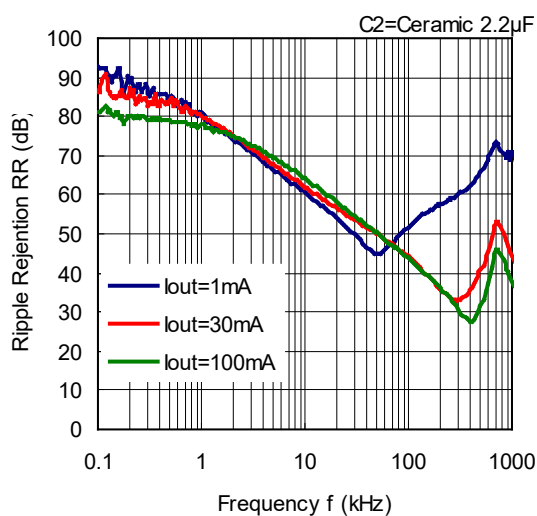


RP132x55xx

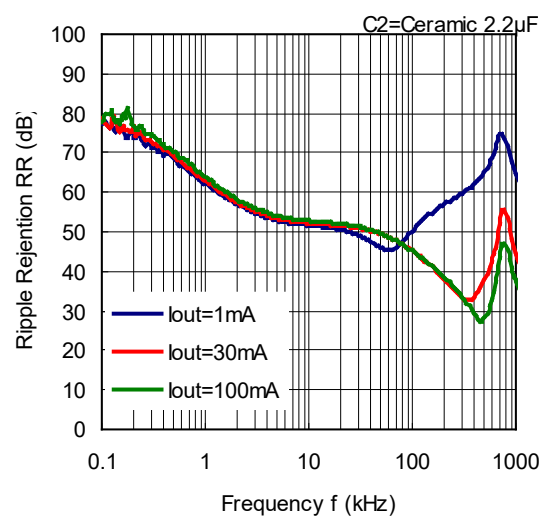


8) Ripple Rejection vs. Frequency (C1=none, $V_{IN}=V_{SET}+1.0V+0.2Vp-p$, $T_a=25^\circ\text{C}$)

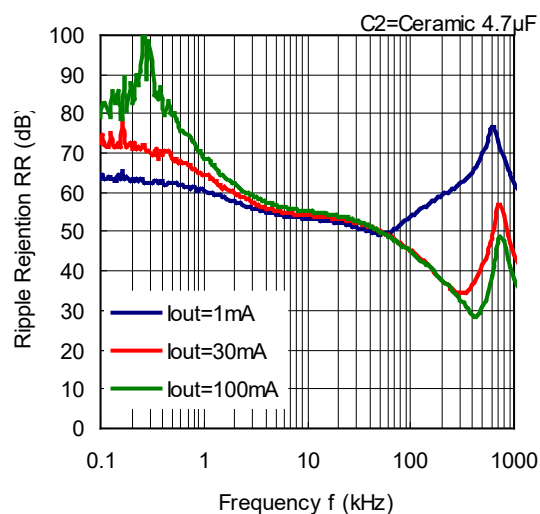
RP132x08xx



RP132x33xx

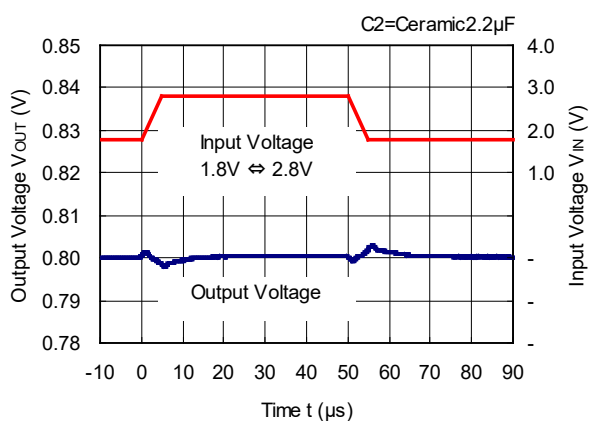


RP132x55xx

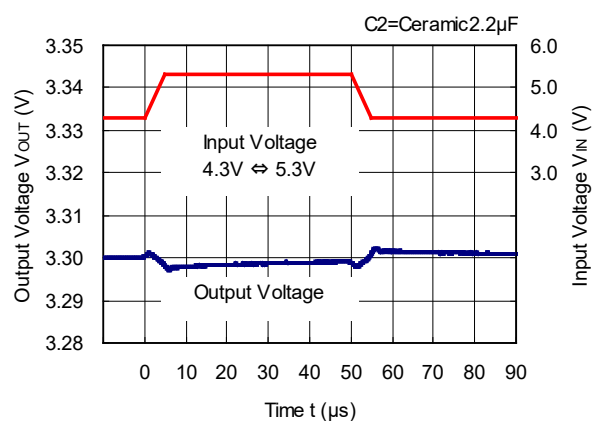


9) Input Transient Response (C1=none, I_{OUT}=100mA, tr=tf=5 μ s, Ta=25°C)

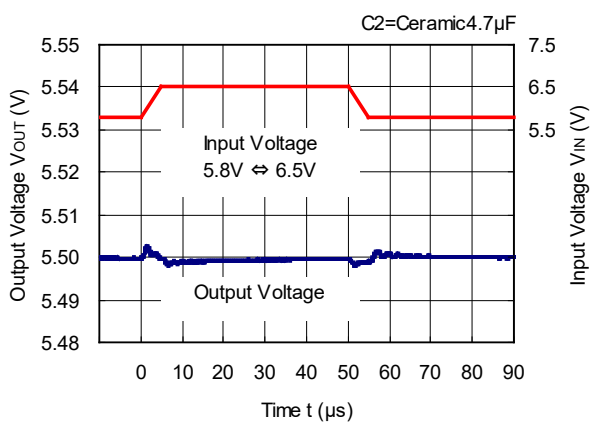
RP132x08xx



RP132x33xx

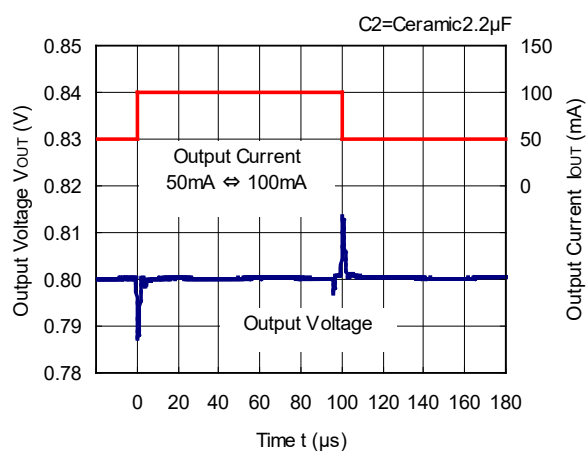


RP132x55xx

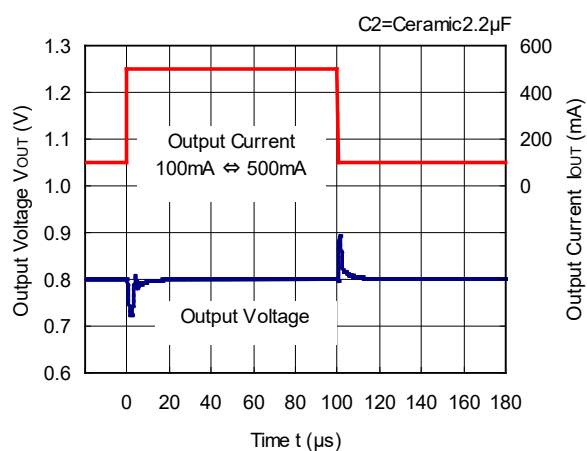


10) Load Transient Response ($V_{IN}=V_{OUT}+1.0V$, $C1=Ceramic\ 2.2\mu F$, $t_r=t_f=0.5\mu s$, $T_a=25^{\circ}C$)

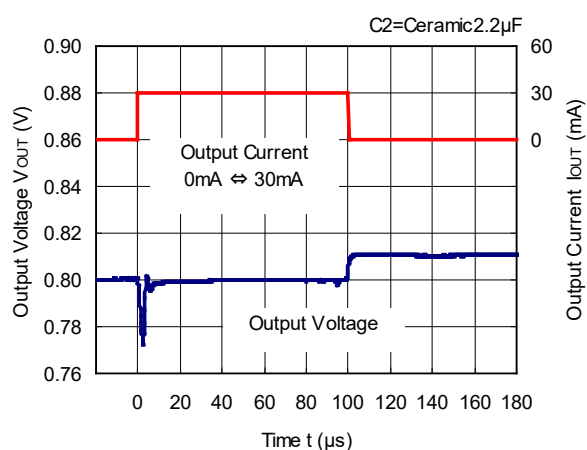
RP132x08xx



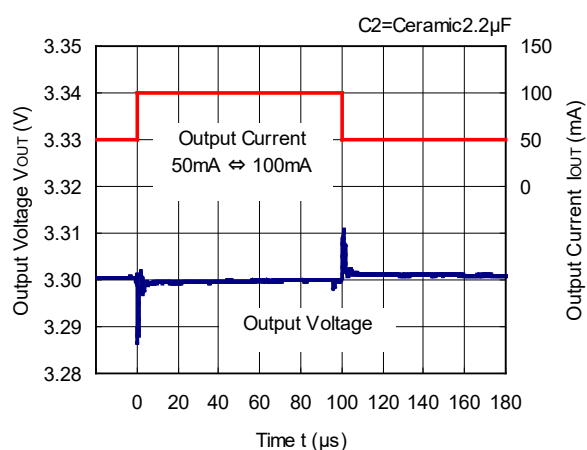
RP132x08xx



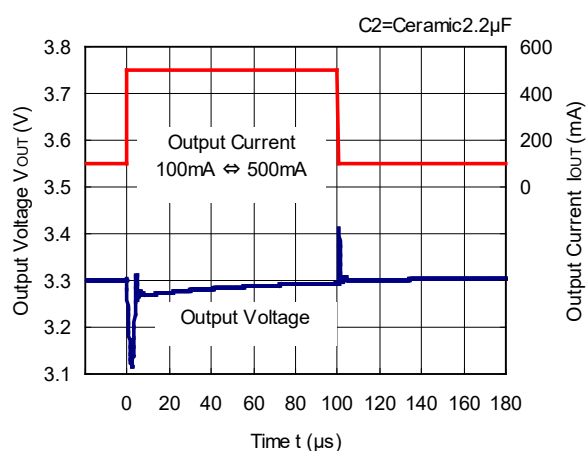
RP132x08xx



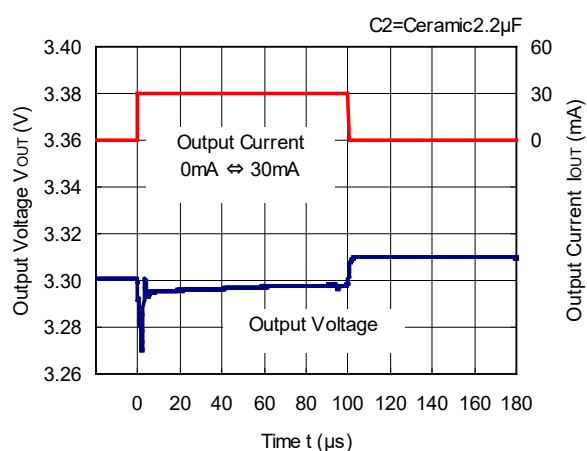
RP132x33xx



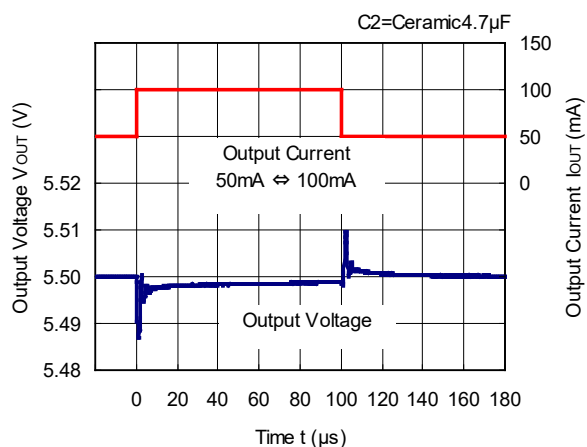
RP132x33xx



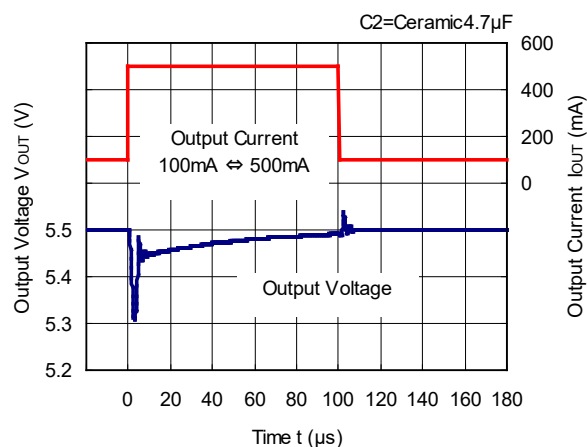
RP132x33xx



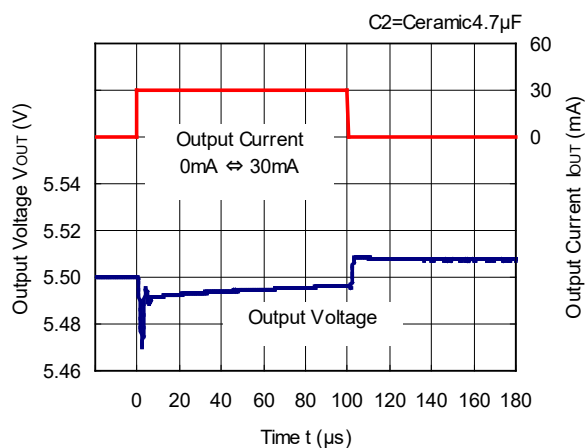
RP132x55xx



RP132x55xx

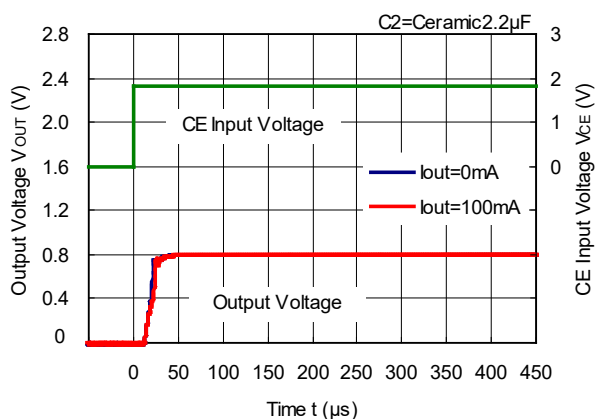


RP132x55xx

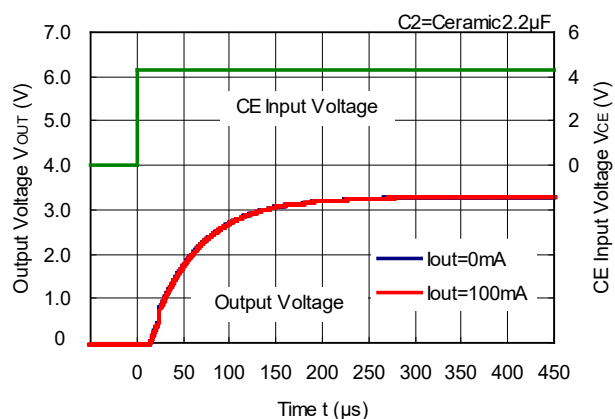


11) Turn on Speed with CE pin (($V_{IN}=V_{SET}+1.0V$, $C1$ =Ceramic 2.2 μ F, $T_a=25^{\circ}C$)

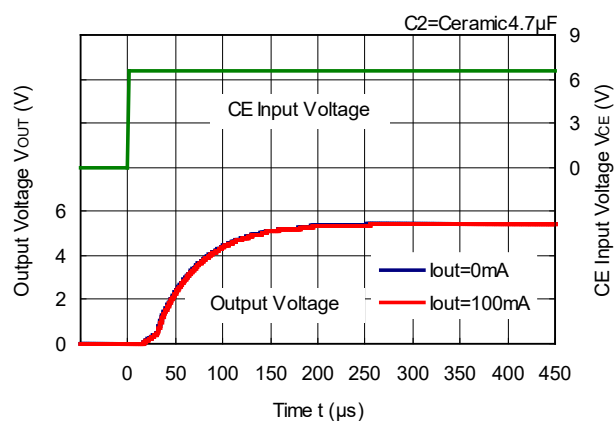
RP132x08xx



RP132x33xx

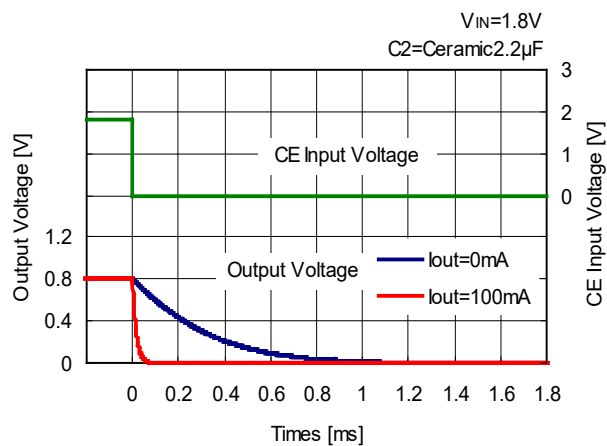


RP132x55xx

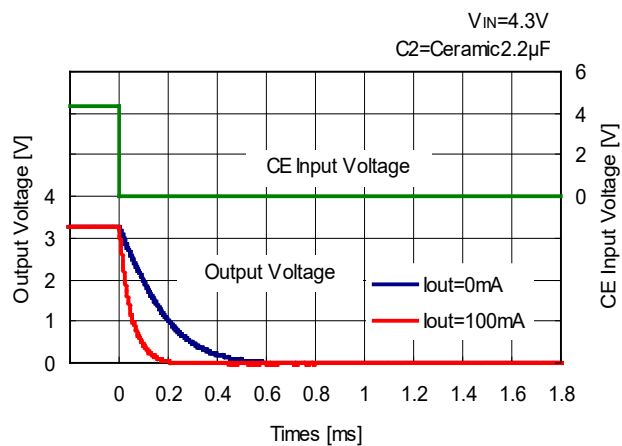


12) Turn off Speed with CE pin (D version) (C1=Ceramic 2.2 μ F, $T_a=25^\circ C$)

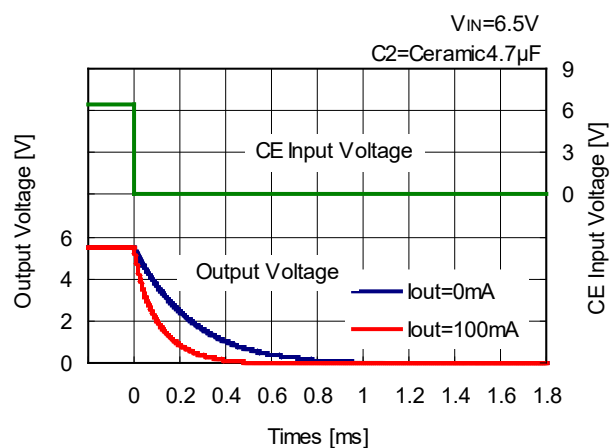
RP132x08xD



RP132x33xD

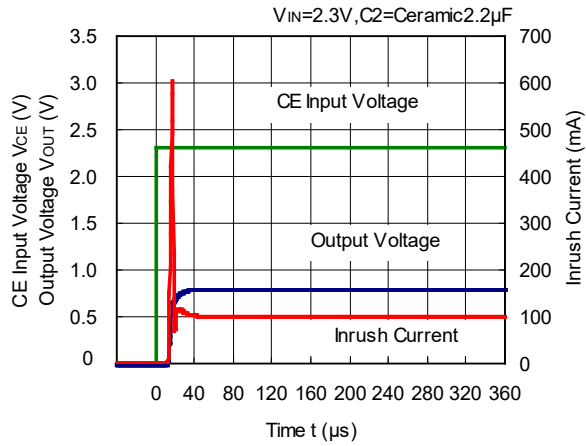


RP132x55xD

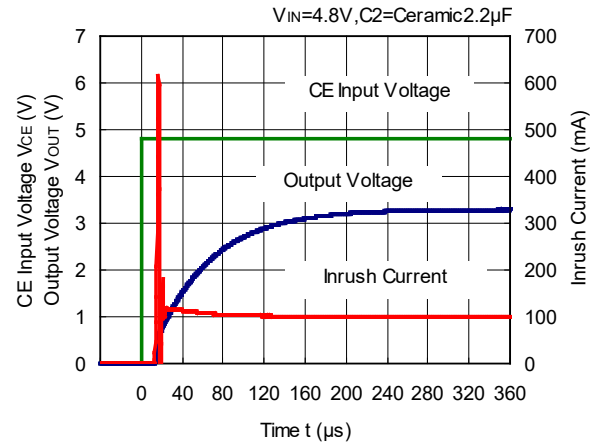


13) Inrush Current (C1=Ceramic 2.2 μ F, I_{OUT}=100mA, Ta=25°C)

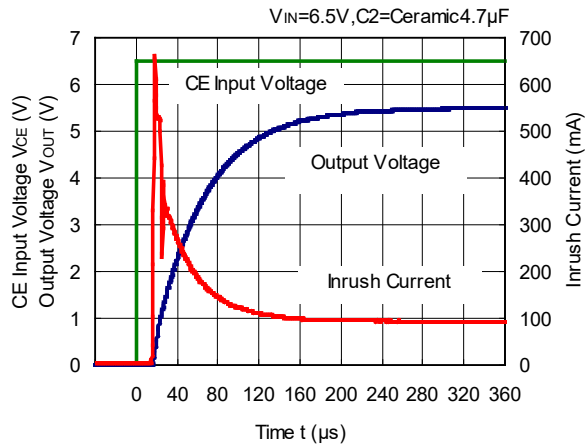
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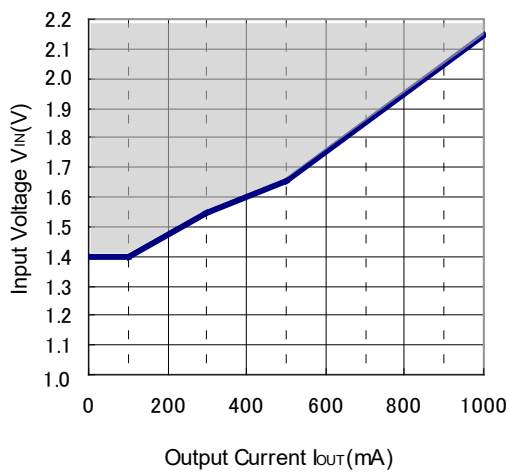


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14) Minimum Operating Voltage

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The operation range that can output 0.8V is shown by the hatched area in the graph.

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 $40\mu V$ (Avg.) are marked as the hatched area in the graph.

Measurement Conditions

Frequency Band : 10Hz to 2MHz

Temperature : $-40^{\circ}C$ to $85^{\circ}C$

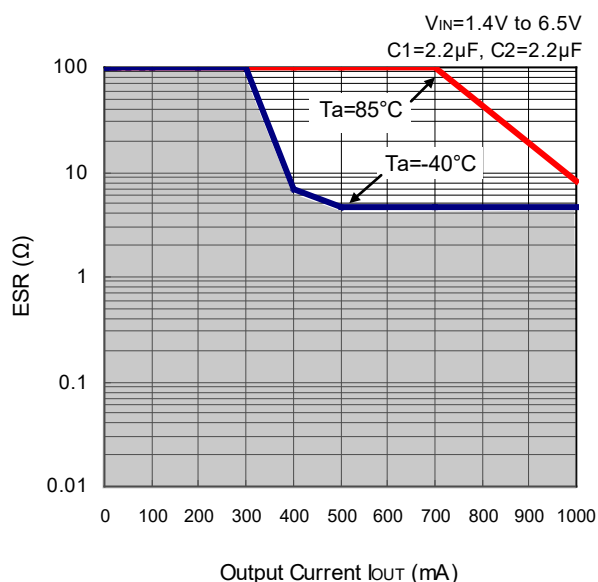
Hatched Area : Noise level is under $40\mu V_{rms}$ (Avg.)

C1 : $2.2\mu F$ (Kyocera CM05X5R225M06A)

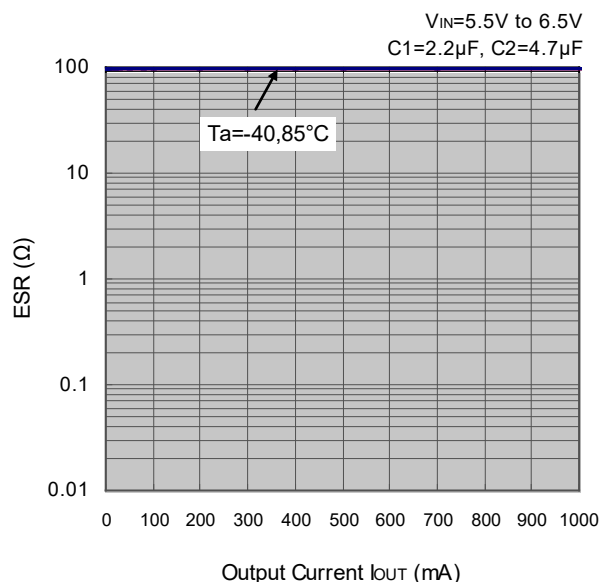
C2 : $2.2\mu F$ ($V_{OUT} = 0.8V$, Kyocera CM105X5R225K06AB)

$4.7\mu F$ ($V_{OUT} = 5.5V$, Kyocera CM105X5R475M06AB)

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 - Aerospace Equipment
 - Equipment Used in the Deep Sea
 - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
 - Life Maintenance Medical Equipment
 - Fire Alarms / Intruder Detectors
 - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
 - Various Safety Devices
 - Traffic control system
 - Combustion equipment

In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.

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. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. **Quality Warranty**
 - 8-1. **Quality Warranty Period**

In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
 - 8-2. **Quality Warranty Remedies**

When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.

Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
 - 8-3. **Remedies after Quality Warranty Period**

With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.



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