

## 100 mA Ultra-low Supply Current (0.3 $\mu$ A) LDO Regulator with Battery Monitor

No. EA-503-191025

### OVERVIEW

The RP124x is an LDO regulator with a battery monitor (BM) featuring ultra-low supply current. The battery monitor has a function which divides the input voltage ( $V_{IN}$ ) into 1/3 or 1/4. The battery charge remaining can be monitored by MCU. The buffering output enables directly inputting a signal into the low voltage A/D converter (ADC) with built-in MCU.

### KEY BENEFITS

- Achieving Low Supply Current of 0.3  $\mu$ A, Longer Battery Life and Downsizing
- Requiring Only Three External Capacitors and Suitable for Space-saving Mounting for the Smaller Packages

### KEY SPECIFICATIONS

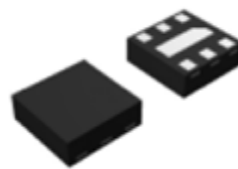
#### LDO Section

- Input Voltage Range: 1.7 V to 5.5 V
- Supply Current: Typ. 0.2  $\mu$ A
- Output Voltage Accuracy:  $\pm 0.8\%$
- Output Current: 100 mA
- Ceramic Capacitor Compatible: 1.0  $\mu$ F or more

#### BM Section

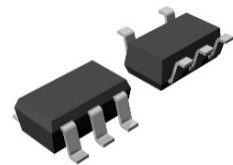
- Output Voltage:  $V_{IN}/3$  (RP124xxx3x)  
 $V_{IN}/4$  (RP124xxx4x)
- Supply Current: Typ. 0.1  $\mu$ A
- Ceramic Capacitor Compatible: 0.1  $\mu$ F to 0.22  $\mu$ F

### PACKAGES



DFN1212-6

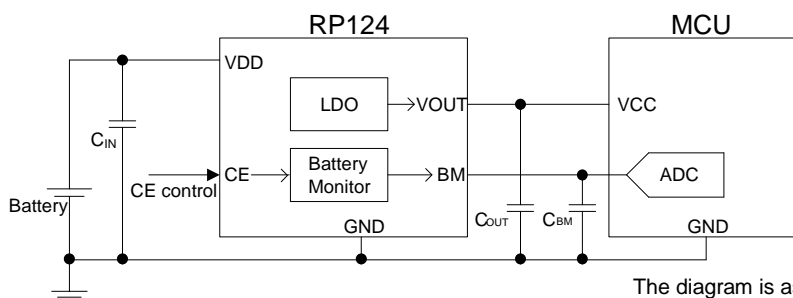
1.2 mm x 1.2 mm x 0.4 mm



SOT-23-5

2.9 mm x 2.8 mm x 1.1 mm

### TYPICAL APPLICATIONS



The diagram is assumed to be used for RP124xxxE.

### APPLICATIONS

- Battery powered IoT devices
- Energy harvesting devices
- Low power wireless communication modules including: *Bluetooth*<sup>®</sup> LE, Zigbee, and LPWA
- Low power consumption CPUs, memories, and sensors

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## RP124x

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### SELECTION GUIDE

The LDO set output voltage, the divided ratio of BM output voltage, the CE pin function and the auto-discharge function are user-selectable options.

#### Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP124Lxx#*-TR	DFN1212-6	5,000 pcs	Yes	Yes
RP124Nxx#*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: Specify the LDO set output voltage ( $V_{SET}$ ).

1.2 V (12) / 1.5 V (15) / 1.8 V (18) / 2.1 V (21) / 2.2 V (22) / 2.3 V (23) / 2.4 V (24) / 2.5 V (25) /  
2.7 V (27) / 2.8 V (28) / 3.0 V (30) / 3.1 V (31) / 3.3 V (33) / 3.6 V (36)

Contact Ricoh sales representatives for other voltages.

#: Specify the divided ratio of BM output voltage.

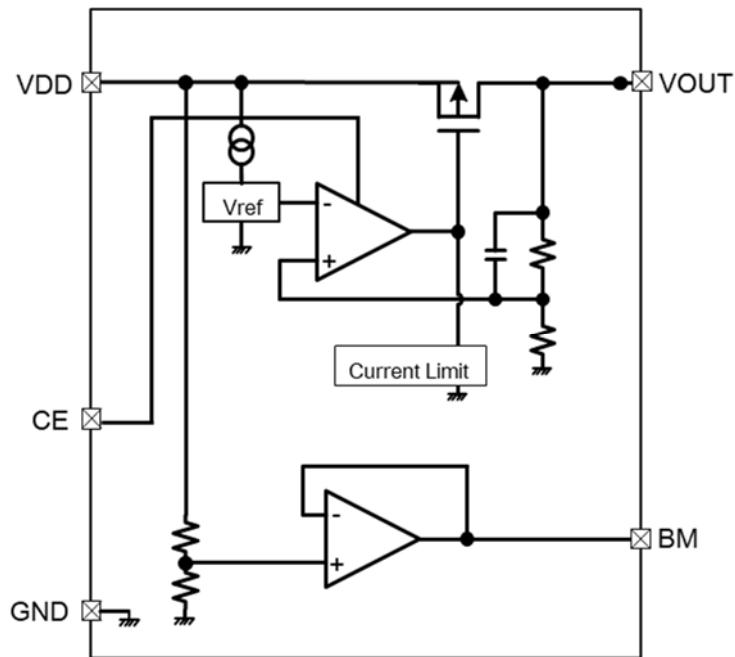
3:  $V_{IN}/3$

4:  $V_{IN}/4$

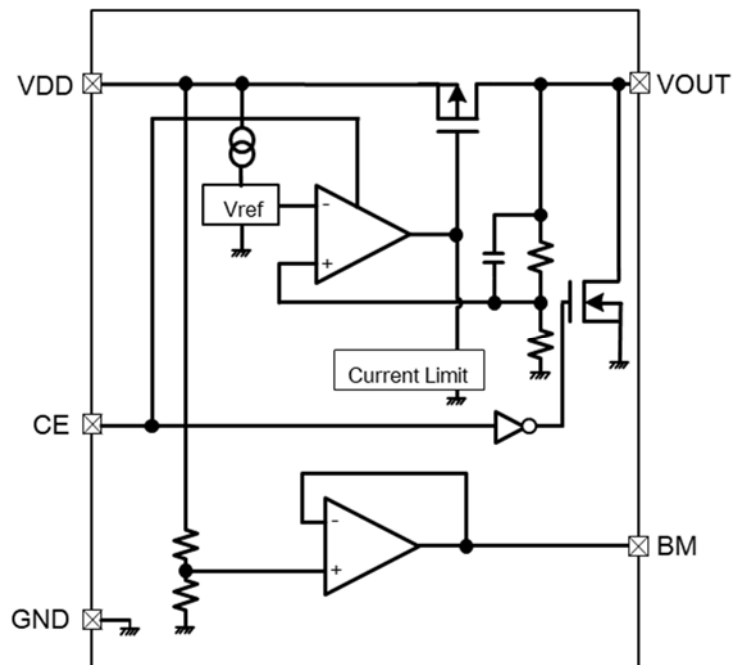
\*: Specify the CE pin and the auto-discharge option.

*	CE pin	Auto-discharge	
		LDO	No
B	Controlling LDO with the CE pin (Active-high)	BM	No
		LDO	Yes
D	Controlling LDO with the CE pin (Active-high)	BM	No
		LDO	No
E	Controlling BM with the CE pin (Active-high)	BM	Yes
		LDO	No

**BLOCK DIAGRAMS**



RP124xxxxB Block Diagram



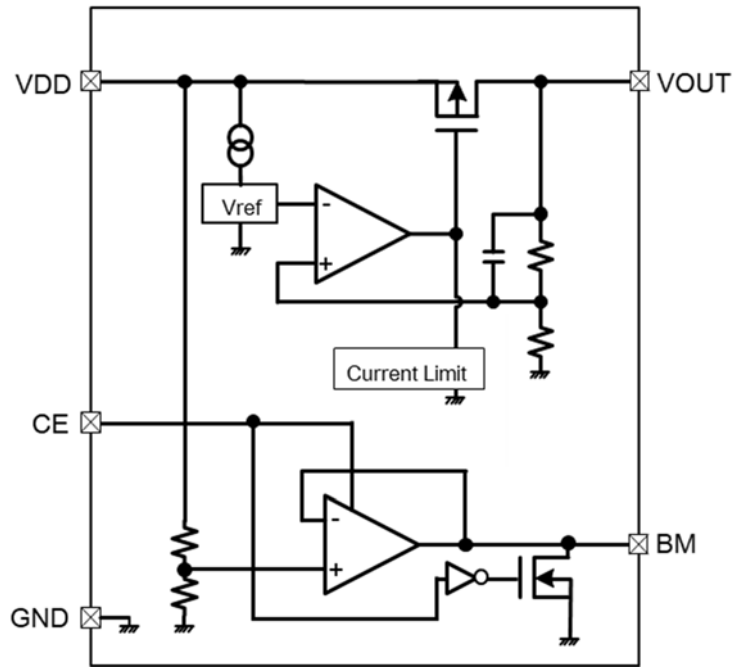
RP124xxxxD Block Diagram

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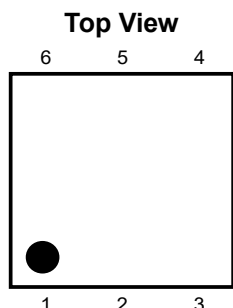
**RP124x**

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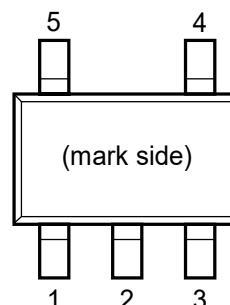
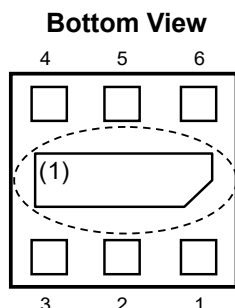
No. EA-503-191025

**RP124xxx E Block Diagram**

## PIN DESCRIPTIONS



RP124L (DFN1212-6) Pin Configuration



RP124N (SOT-23-5) Pin Configuration

### RP124L (DFN1212-6) Pin Description

Pin No.	Symbol	Description
1	VOUT	Output Pin
2	GND	Ground Pin
3	BM	Battery Monitoring Output Pin
4	CE	Chip Enable Pin, Active-high
5	NC	No Connection
6	VDD	Input Pin

### RP124N (SOT-23-5) Pin Description

Pin No.	Symbol	Description
1	VDD	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin, Active-high
4	BM	Battery Monitoring Output Pin
5	VOUT	Output Pin

<sup>(1)</sup> 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.

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## ABSOLUTE MAXIMUM RATINGS

### Absolute Maximum Ratings

Symbol	Item		Rating	Unit
$V_{IN}$	Input Voltage		-0.3 to 6.5	V
$V_{CE}$	CE Pin Voltage		-0.3 to 6.5	V
$V_{OUT}$	VOUT Pin Voltage		-0.3 to $V_{IN} + 0.3$	V
$V_{BM}$	BM Pin Voltage		-0.3 to $V_{IN} + 0.3$	V
$I_{OUT}$	Output Current		130	mA
$P_D$	Power Dissipation <sup>(1)</sup>	DFN1212-6 (JEDEC STD. 51-7 Test Land Pattern)	850	mW
		SOT-23-5 (JEDEC STD. 51-7 Test Land Pattern)	660	mW
$T_j$	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 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

### Recommended Operating Conditions

Symbol	Item		Rating	Unit
$V_{IN}$	Input Voltage	RP124xxx3x	1.7 to 5.5	V
		RP124xxx4x	2.4 to 5.5	
$T_a$	Operating Temperature		-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 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.

<sup>(1)</sup> Refer to *POWEWR DISSIPATION* for detailed information.

## ELECTRICAL CHARACTERISTICS

$V_{IN} = V_{SET} + 1.0 \text{ V}$ ,  $I_{OUT} = 1.5 \text{ mA}$ ,  $C_{IN} = C_{OUT} = 1.0 \mu\text{F}$ , unless otherwise noted.

The specifications surrounded by   are guaranteed by design engineering at  $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ .

### RP124x Electrical Characteristics: LDO Section

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

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit
$V_{OUT}$	Output Voltage	$V_{SET} > 2.0 \text{ V}$	x0.992		x1.008	V
			<span style="border: 1px solid black; padding: 0 2px;">x0.987</span>		<span style="border: 1px solid black; padding: 0 2px;">x1.013</span>	
		$V_{SET} \leq 2.0 \text{ V}$	-16		16	mV
			<span style="border: 1px solid black; padding: 0 2px;">-26</span>		<span style="border: 1px solid black; padding: 0 2px;">26</span>	
$I_{OUT}$	Output Current		<span style="border: 1px solid black; padding: 0 2px;">100</span>			mA
$\Delta V_{OUT}$	Output Voltage Deviation When Switching Mode	$1 \mu\text{A} \leq I_{OUT} \leq I_{OUTH}$	$V_{SET} > 2.0 \text{ V}$		<span style="border: 1px solid black; padding: 0 2px;">1</span>	%
			$V_{SET} \leq 2.0 \text{ V}$	<span style="border: 1px solid black; padding: 0 2px;">-20</span>		<span style="border: 1px solid black; padding: 0 2px;">20</span>
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$1.5 \text{ mA} \leq I_{OUT} \leq 100 \text{ mA}$	<span style="border: 1px solid black; padding: 0 2px;">-40</span>	2	<span style="border: 1px solid black; padding: 0 2px;">40</span>	mV
$V_{DIF}$	Dropout Voltage	$I_{OUT} = 100 \text{ mA}$	Refer to <i>Product-specific Electrical Characteristics</i>			
$I_{SS}$	Supply Current	$V_{CE} = V_{IN}$ , $I_{OUT} = 0 \text{ mA}$		0.2	0.42	$\mu\text{A}$
					<span style="border: 1px solid black; padding: 0 2px;">0.5</span>	$\mu\text{A}$
$I_{OUTH}$	Fast Mode Switching Current	$I_{OUT} = \text{From Light Load to Heavy Load}$ , $V_{IN} = 5.0 \text{ V}$		0.5		mA
$I_{OUTL}$	Low Power Mode Switching Current	$I_{OUT} = \text{From Heavy Load to Light Load}$ , $V_{IN} = 5.0 \text{ V}$	<span style="border: 1px solid black; padding: 0 2px;">0.08</span>			mA
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	$V_{SET} + 0.5 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$		0.02	<span style="border: 1px solid black; padding: 0 2px;">0.2</span>	%/V
$I_{SC}$	Short Current Limit	$V_{OUT} = 0 \text{ V}$		65		mA
$V_{CEH}$	CE Pin Input Voltage, high	RP124xxxxB/D	<span style="border: 1px solid black; padding: 0 2px;">1.0</span>			V
$V_{CEL}$	CE Pin Input Voltage, low	RP124xxxxB/D			<span style="border: 1px solid black; padding: 0 2px;">0.4</span>	V
$R_{DISN}$	Auto-discharge NMOS On-resistance	$V_{IN} = 4.0 \text{ V}$ , $V_{CE} = 0 \text{ V}$ , RP124xxxxD		50		$\Omega$

All test items listed under Electrical Characteristics are done under the pulse load condition  $T_j \approx T_a = 25^\circ\text{C}$ .

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**RP124x**

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**ELECTRICAL CHARACTERISTICS (continued)**The specifications surrounded by   are guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$ .**RP124x Product-specific Electrical Characteristics: LDO Section**

Product Name	$V_{\text{OUT}}$ [V]						$V_{\text{DIF}}$ [V]	
	$T_a = 25^{\circ}\text{C}$			$-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$				
	Min.	Typ.	Max.	Min.	Typ.	Max.	Typ.	Max.
RP124x12xx	1.184	1.200	1.216	<span style="border: 1px solid black; padding: 0 2px;">1.174</span>	1.200	<span style="border: 1px solid black; padding: 0 2px;">1.226</span>	0.640	<span style="border: 1px solid black; padding: 0 2px;">0.975</span>
RP124x15xx	1.484	1.500	1.516	<span style="border: 1px solid black; padding: 0 2px;">1.474</span>	1.500	<span style="border: 1px solid black; padding: 0 2px;">1.526</span>	0.410	<span style="border: 1px solid black; padding: 0 2px;">0.660</span>
RP124x18xx	1.784	1.800	1.816	<span style="border: 1px solid black; padding: 0 2px;">1.774</span>	1.800	<span style="border: 1px solid black; padding: 0 2px;">1.826</span>	0.230	<span style="border: 1px solid black; padding: 0 2px;">0.380</span>
RP124x21xx	2.084	2.100	2.116	<span style="border: 1px solid black; padding: 0 2px;">2.073</span>	2.100	<span style="border: 1px solid black; padding: 0 2px;">2.127</span>	0.150	<span style="border: 1px solid black; padding: 0 2px;">0.285</span>
RP124x22xx	2.183	2.200	2.217	<span style="border: 1px solid black; padding: 0 2px;">2.172</span>	2.200	<span style="border: 1px solid black; padding: 0 2px;">2.228</span>	0.130	<span style="border: 1px solid black; padding: 0 2px;">0.230</span>
RP124x23xx	2.282	2.300	2.318	<span style="border: 1px solid black; padding: 0 2px;">2.271</span>	2.300	<span style="border: 1px solid black; padding: 0 2px;">2.329</span>		
RP124x24xx	2.381	2.400	2.419	<span style="border: 1px solid black; padding: 0 2px;">2.369</span>	2.400	<span style="border: 1px solid black; padding: 0 2px;">2.431</span>	0.110	<span style="border: 1px solid black; padding: 0 2px;">0.180</span>
RP124x25xx	2.480	2.500	2.520	<span style="border: 1px solid black; padding: 0 2px;">2.468</span>	2.500	<span style="border: 1px solid black; padding: 0 2px;">2.532</span>		
RP124x27xx	2.679	2.700	2.721	<span style="border: 1px solid black; padding: 0 2px;">2.665</span>	2.700	<span style="border: 1px solid black; padding: 0 2px;">2.735</span>	0.100	<span style="border: 1px solid black; padding: 0 2px;">0.160</span>
RP124x28xx	2.778	2.800	2.822	<span style="border: 1px solid black; padding: 0 2px;">2.764</span>	2.800	<span style="border: 1px solid black; padding: 0 2px;">2.836</span>		
RP124x30xx	2.976	3.000	3.024	<span style="border: 1px solid black; padding: 0 2px;">2.961</span>	3.000	<span style="border: 1px solid black; padding: 0 2px;">3.039</span>	0.090	<span style="border: 1px solid black; padding: 0 2px;">0.145</span>
RP124x31xx	3.076	3.100	3.124	<span style="border: 1px solid black; padding: 0 2px;">3.060</span>	3.100	<span style="border: 1px solid black; padding: 0 2px;">3.140</span>		
RP124x33xx	3.274	3.300	3.326	<span style="border: 1px solid black; padding: 0 2px;">3.258</span>	3.300	<span style="border: 1px solid black; padding: 0 2px;">3.342</span>	0.090	<span style="border: 1px solid black; padding: 0 2px;">0.145</span>
RP124x36xx	3.572	3.600	3.628	<span style="border: 1px solid black; padding: 0 2px;">3.554</span>	3.600	<span style="border: 1px solid black; padding: 0 2px;">3.646</span>		



## ELECTRICAL CHARACTERISTICS (continued)

$C_{IN} = 1.0 \mu\text{F}$ ,  $C_{BM} = 0.22 \mu\text{F}$ , unless otherwise noted.

The specifications surrounded by   are guaranteed by design engineering at  $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ .

### RP124x Electrical Characteristics: Battery Monitor Section

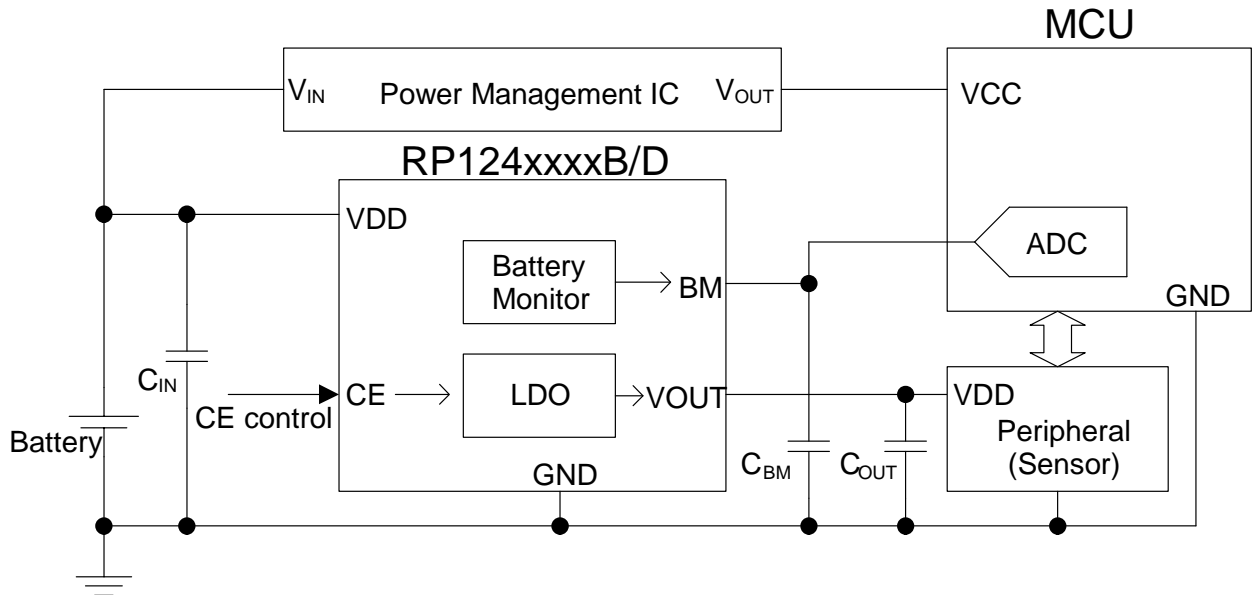
( $T_a = 25^\circ\text{C}$ )

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{BM}$	Output Voltage	$-10 \mu\text{A} \leq I_{BM} \leq 10 \mu\text{A}$	$1.7 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx3x	$V_{IN}/3-20$	$V_{IN}/3$	$V_{IN}/3+20$	mV
			<span style="border: 1px solid black; padding: 0 2px;"><math>V_{IN}/3-25</math></span>	$V_{IN}/3$	<span style="border: 1px solid black; padding: 0 2px;"><math>V_{IN}/3+25</math></span>		
			$2.4 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx4x	$V_{IN}/4-20$	$V_{IN}/4$	$V_{IN}/4+20$	
			<span style="border: 1px solid black; padding: 0 2px;"><math>V_{IN}/4-25</math></span>	$V_{IN}/4$	<span style="border: 1px solid black; padding: 0 2px;"><math>V_{IN}/4+25</math></span>		
$I_{BM}$	Output Current	$1.7 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx3x	<span style="border: 1px solid black; padding: 0 2px;">-10</span>		<span style="border: 1px solid black; padding: 0 2px;">10</span>	$\mu\text{A}$	
		$2.4 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx4x					
$I_{SSBM}$	Supply Current	$V_{IN} = V_{CE} = 3.6 \text{ V}$ , $I_{BM} = 0 \mu\text{A}$		0.1	0.2	$\mu\text{A}$	
$V_{CEHBM}$	CE Pin Input Voltage, high	$1.7 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx3E	<span style="border: 1px solid black; padding: 0 2px;">1.0</span>			V	
		$2.4 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx4E					
$V_{CELBM}$	CE Pin Input Voltage, low	$1.7 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx3E			<span style="border: 1px solid black; padding: 0 2px;">0.4</span>	V	
		$2.4 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}$ , RP124xxx4E					
$R_{DISNBM}$	Auto-discharge NMOS On-resistance	$V_{IN} = 4.0 \text{ V}$ , $V_{CE} = 0 \text{ V}$ , RP124xxxxE		50		$\Omega$	

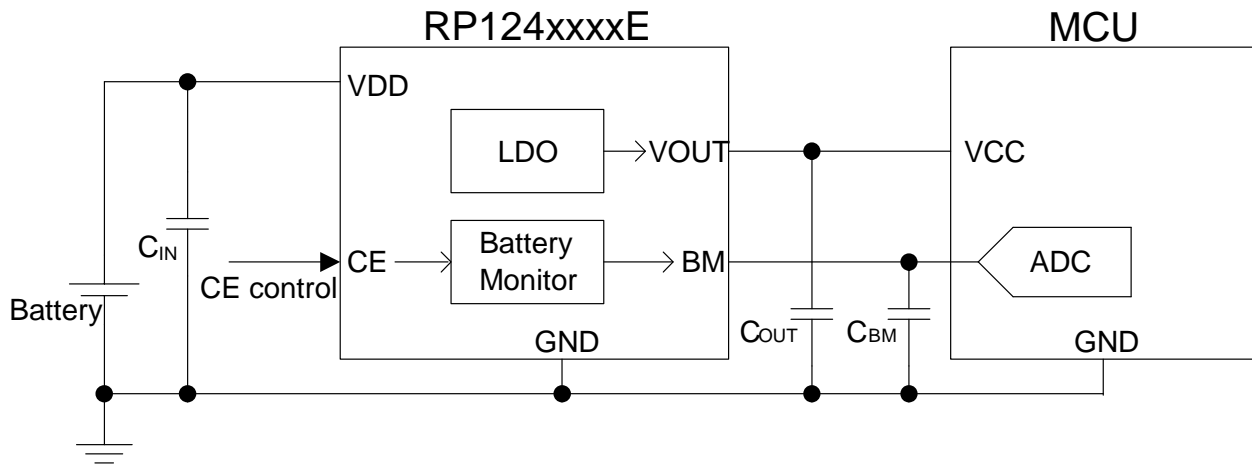
All test items listed under Electrical Characteristics are done under the pulse load condition  $T_J \approx T_a = 25^\circ\text{C}$ .

## APPLICATION INFORMATION

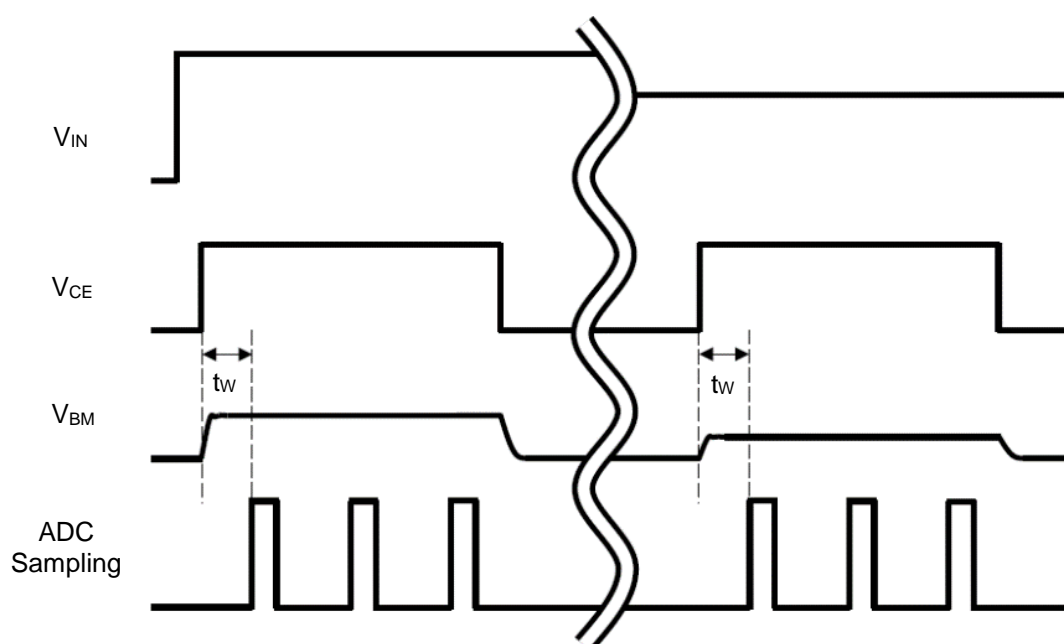
### TYPICAL APPLICATION



RP124xxxxB/D Typical Application Circuit



RP124xxxxE Typical Application Circuit



Timing Chart Example of RP124xxxxE Circuit

The above diagram shows the example of using the RP124xxxxE typical application circuit and its timing chart. Connecting BM pin and ADC input pin of MCU enables monitoring the battery voltage. Controlling the start-up and stop of Battery Monitor with CE pin by the timing based on the ADC sampling reduces power consumption of the entire system. When monitoring the battery voltage, set the waiting time ( $t_w$ ) in order to stabilize waveform after the CE input voltage is set to "H". It is recommended to set  $t_w \geq 10$  ms for this product.

#### Notes on External Components

- Phase compensation is provided to secure stable operation even when the load current is varied. For this purpose, use a 1.0- $\mu\text{F}$  or more output capacitor ( $C_{\text{OUT}}$ ) between the VOUT and GND pins, and a 0.1- $\mu\text{F}$  to 0.22- $\mu\text{F}$  capacitor ( $C_{\text{BM}}$ ) between the BM and GND pins with shortest-distance wiring. In case of using a tantalum type capacitor with a large ESR (Equivalent Series Resistance), the output might become unstable. Evaluate your circuit including consideration of frequency characteristics.
- Connect a 1.0- $\mu\text{F}$  or more input capacitor ( $C_{\text{IN}}$ ) between the VDD and GND pins with shortest-distance wiring.

## TECHNICAL NOTES

The performance of a power source circuit using this device is highly dependent on a peripheral circuit. A peripheral component or the device mounted on PCB should not exceed its rated voltage, rated current or rated power. When designing a peripheral circuit, please be fully aware of the following points.

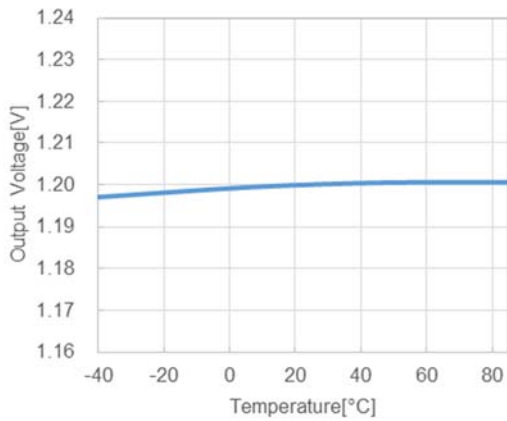
- The high impedance of the wirings may result in noise pickup and unstable operation of the device. Reduce the impedance of the VDD and GND wirings.
- When an intermediate voltage other than  $V_{IN}$  or GND is input to the CE pin, a supply current may be increased with a through current of a logic circuit in the IC. The CE pin is neither pulled up nor pulled down, therefore an operation is not stable at open.

## TYPICAL CHARACTERISTICS

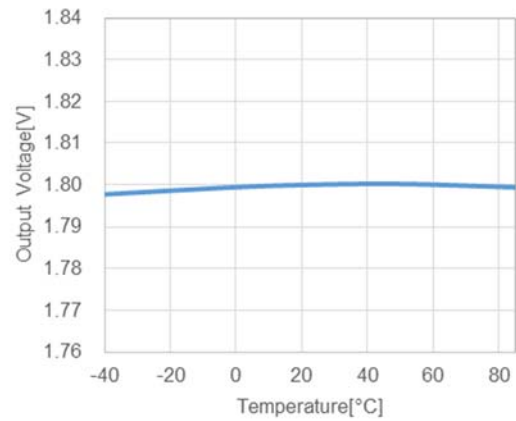
Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) LDO Output Voltage vs. Temperature ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F)

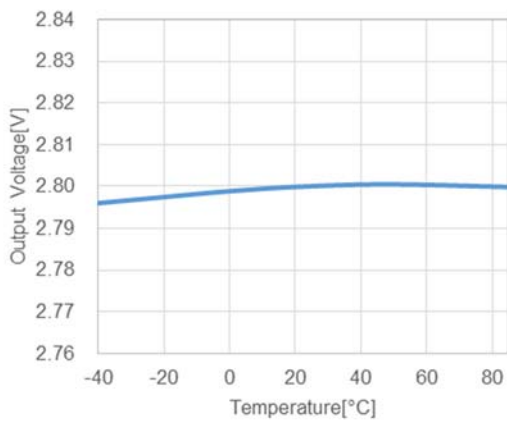
RP124x12xx,  $V_{IN}$  = 2.2 V,  $I_{OUT}$  = 1.5 mA



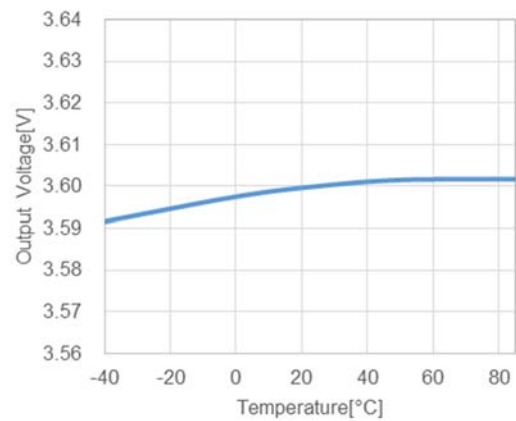
RP124x18xx,  $V_{IN}$  = 2.8 V,  $I_{OUT}$  = 1.5 mA



RP124x28xx,  $V_{IN}$  = 3.8 V,  $I_{OUT}$  = 1.5 mA

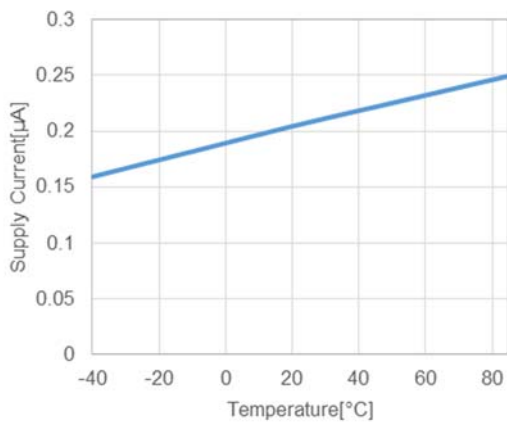


RP124x36xx,  $V_{IN}$  = 4.6 V,  $I_{OUT}$  = 1.5 mA

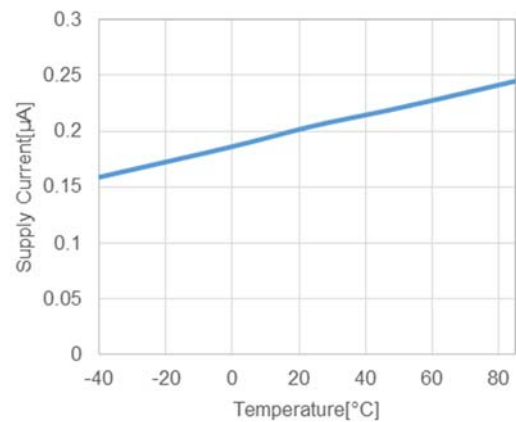


2) LDO Supply Current vs. Temperature ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F)

RP124x12xx,  $V_{IN}$  = 2.2 V



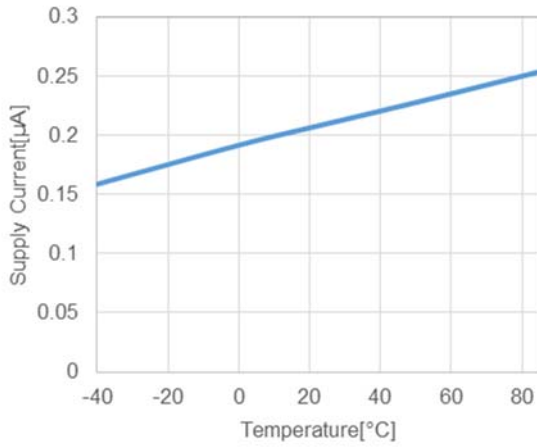
RP124x18xx,  $V_{IN}$  = 2.8 V



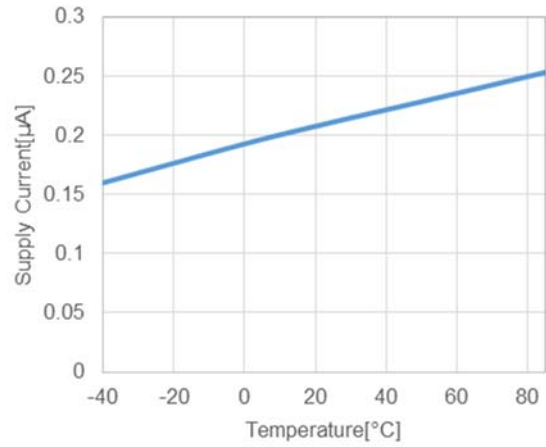
# RP124x

No. EA-503-191025

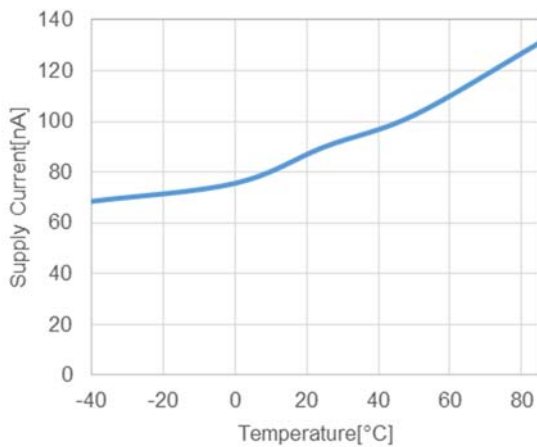
RP124x28xx,  $V_{IN} = 3.8\text{ V}$



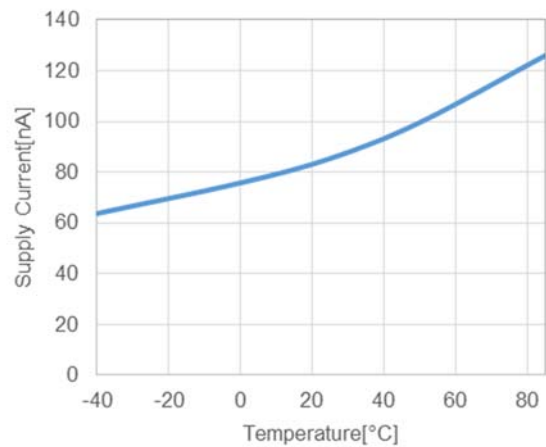
RP124x36xx,  $V_{IN} = 4.6\text{ V}$



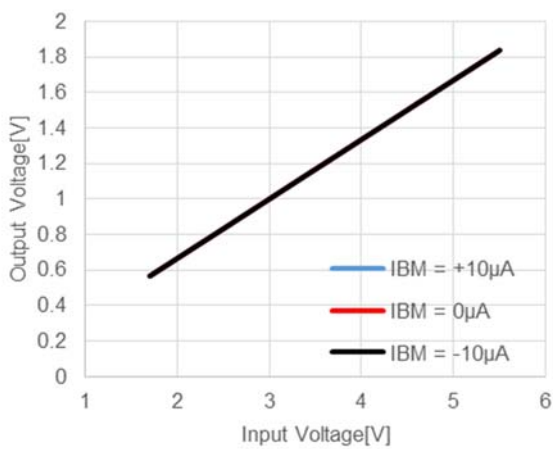
3) BM Supply Current vs. Temperature ( $C_{IN} = \text{Ceramic } 1.0\ \mu\text{F}$ ,  $C_{BM} = \text{Ceramic } 0.1\ \mu\text{F}$ )  
RP124xxx3x,  $V_{IN} = 3.6\text{ V}$



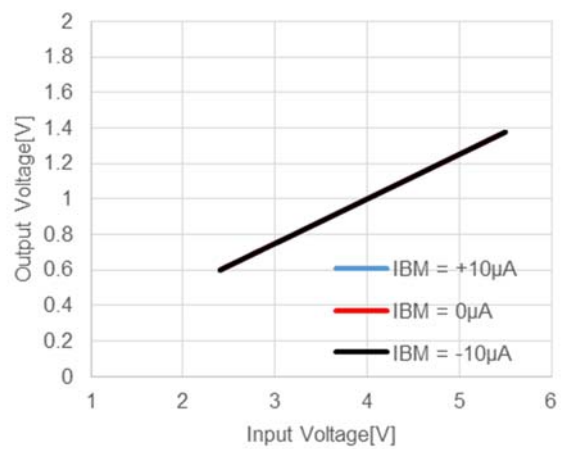
RP124xxx4x,  $V_{IN} = 3.6\text{ V}$



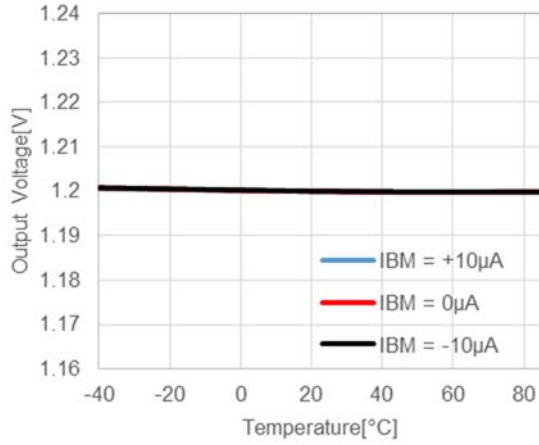
4) BM Output Voltage vs. Input Voltage ( $C_{IN} = \text{Ceramic } 1.0\ \mu\text{F}$ ,  $C_{BM} = \text{Ceramic } 0.1\ \mu\text{F}$ ,  $T_a = 25^{\circ}\text{C}$ )  
RP124xxx3x



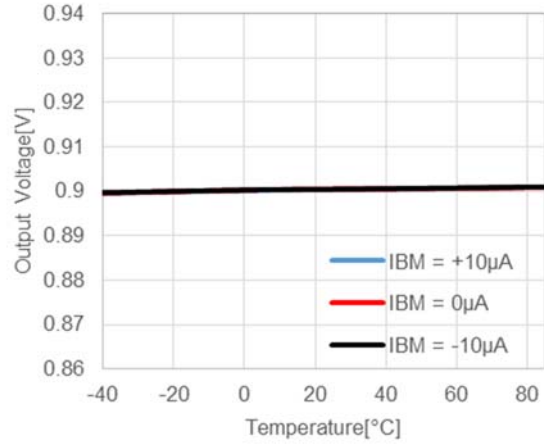
RP124xxx4x



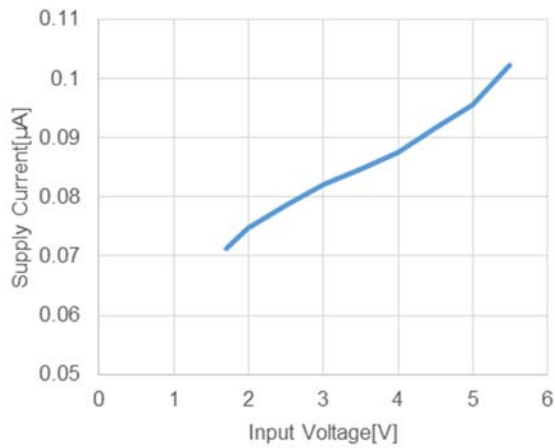
5) BM Output Voltage vs. Temperature ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{BM}$  = Ceramic 0.1  $\mu$ F)  
 RP124xxx3x,  $V_{IN}$  = 3.6 V



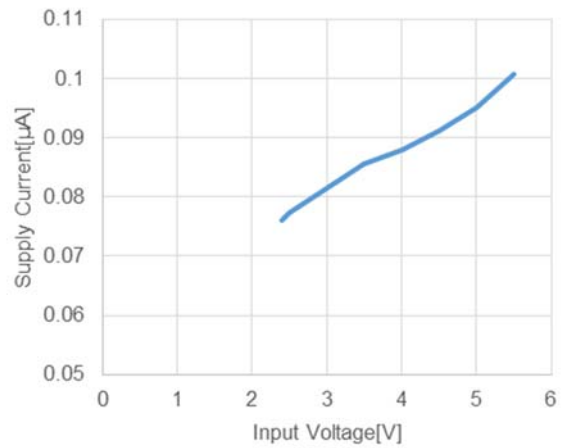
RP124xxx4x,  $V_{IN}$  = 3.6 V



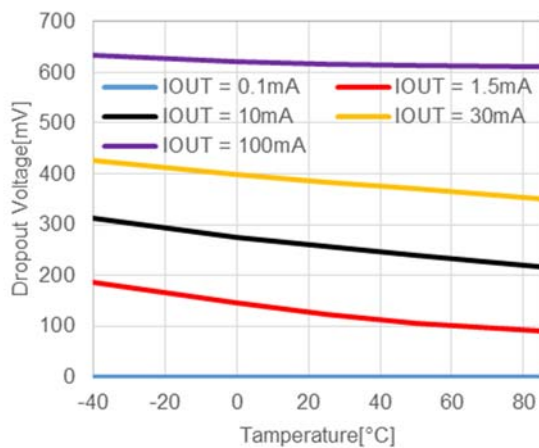
6) BM Supply Current vs. Input Voltage ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{BM}$  = Ceramic 0.1  $\mu$ F,  $T_a$  = 25°C)  
 RP124xxx3x



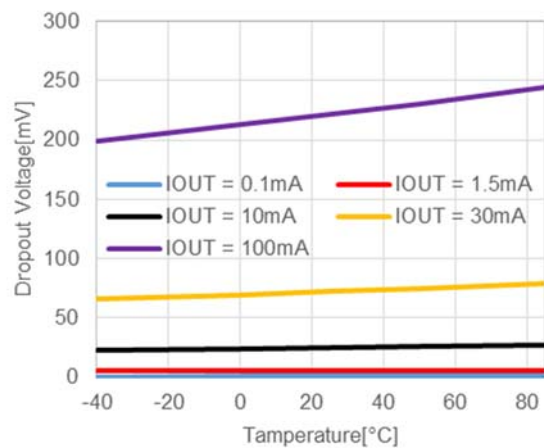
RP124xxx4x



7) LDO Dropout Voltage vs. Temperature ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F)  
 RP124x12xx



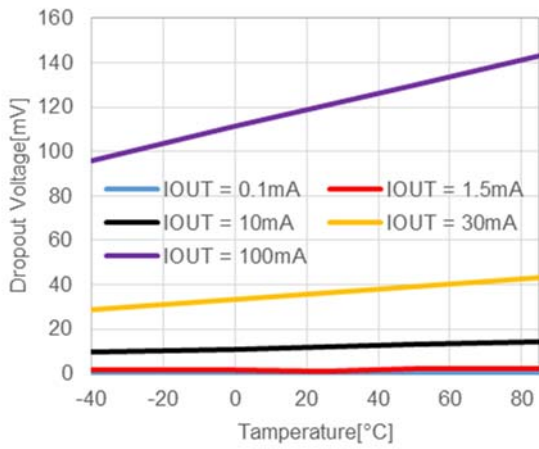
RP124x18xx



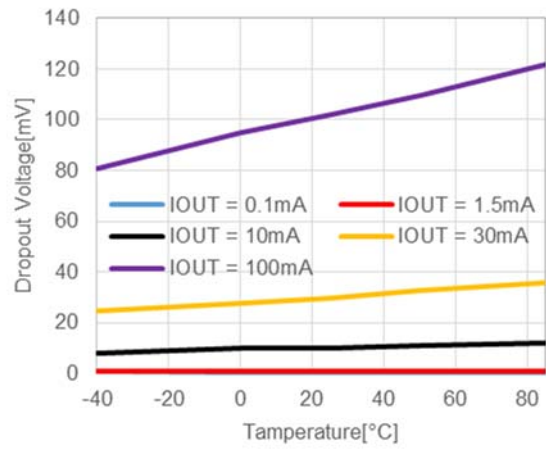
# RP124x

No. EA-503-191025

RP124x28xx

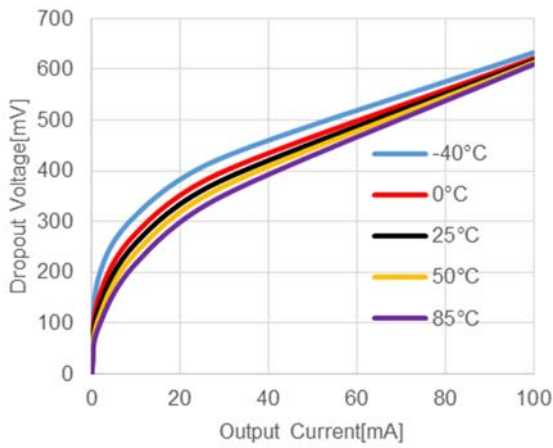


RP124x36xx

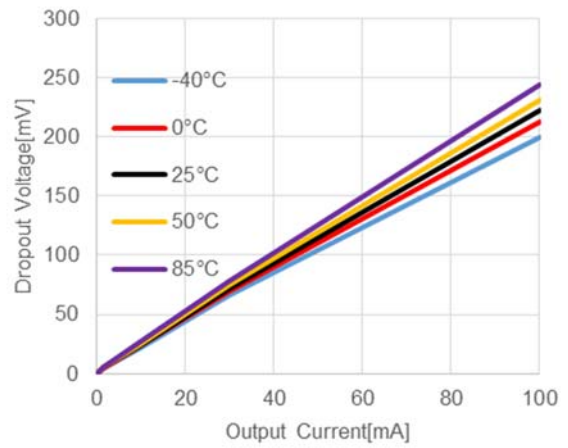


8) LDO Dropout Voltage vs. Output Current (C<sub>IN</sub> = Ceramic 1.0 μF, C<sub>OUT</sub> = Ceramic 1.0 μF)

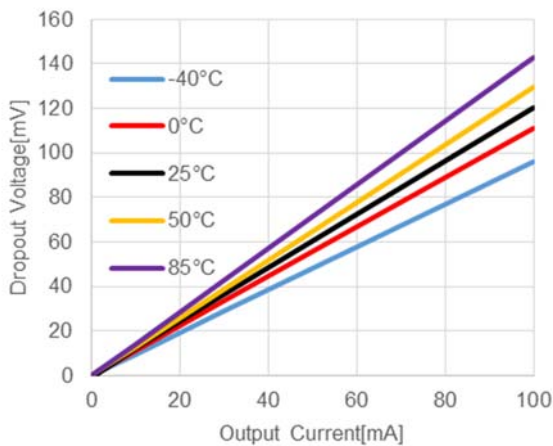
RP124x12xx



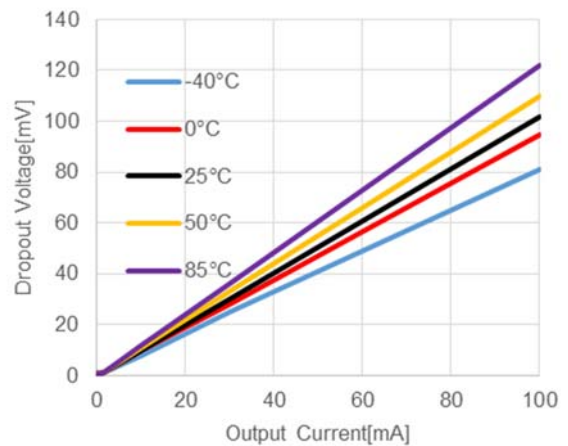
RP124x18xx



RP124x28xx

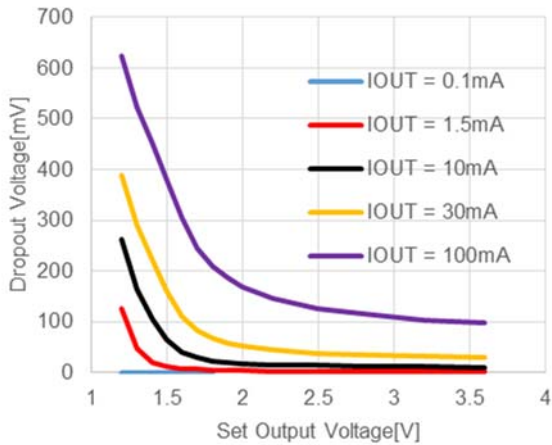


RP124x36xx



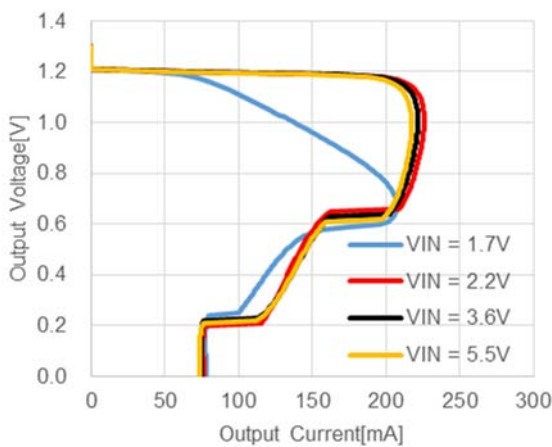


9) LDO Dropout Voltage vs. Set Output Voltage ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F,  $T_a$  = 25°C)

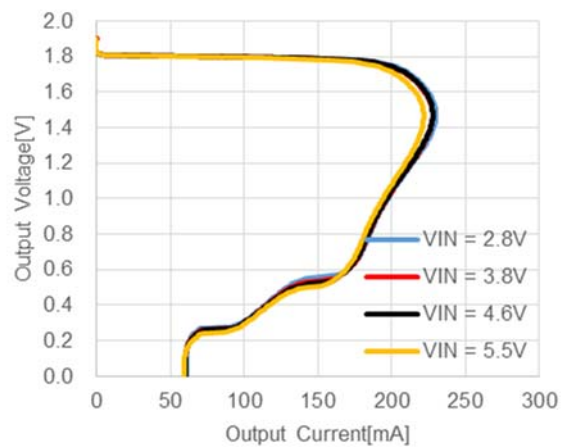


10) LDO Output Voltage vs. Output Current ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F,  $T_a$  = 25°C)

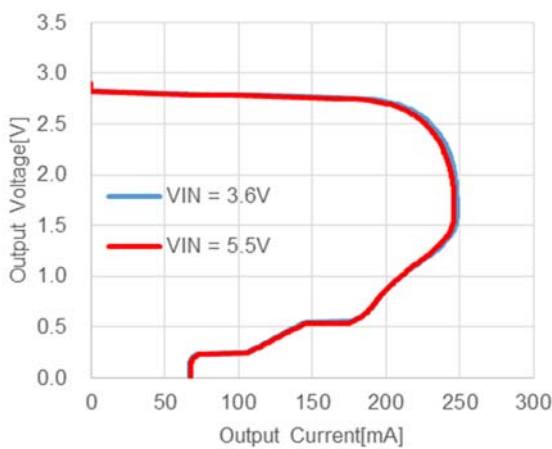
RP124x12xx



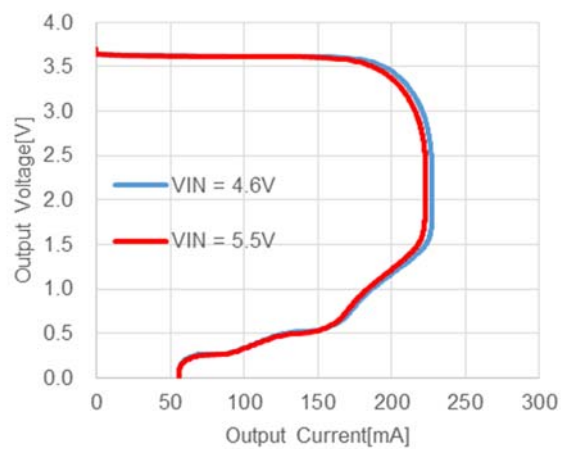
RP124x18xx



RP124x28xx



RP124x36xx

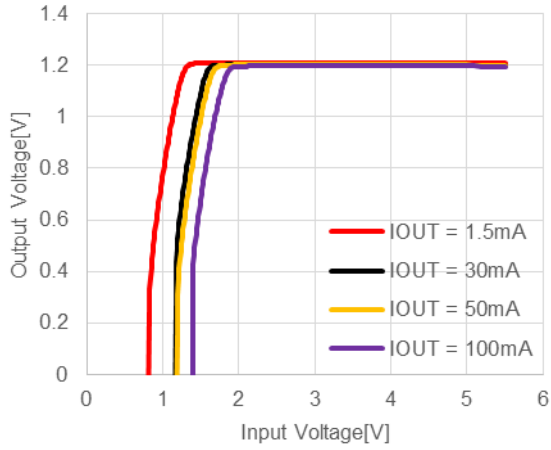


## RP124x

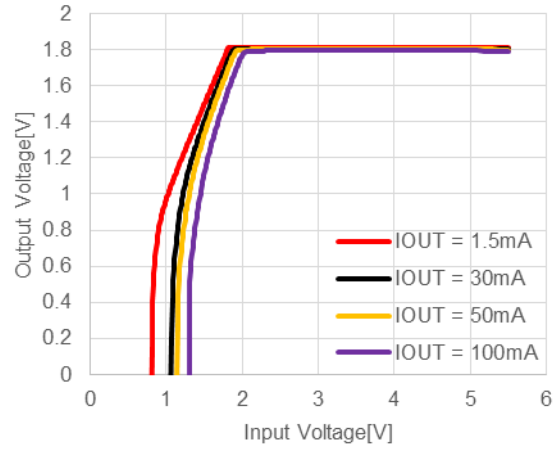
No. EA-503-191025

11) LDO Output Voltage vs. Input Voltage ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F,  $T_a$  = 25°C)

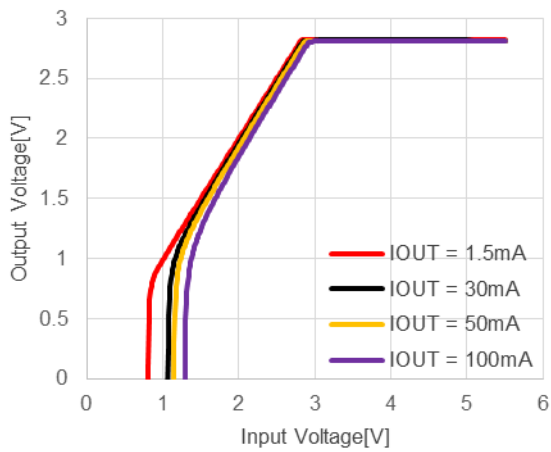
RP124x12xx



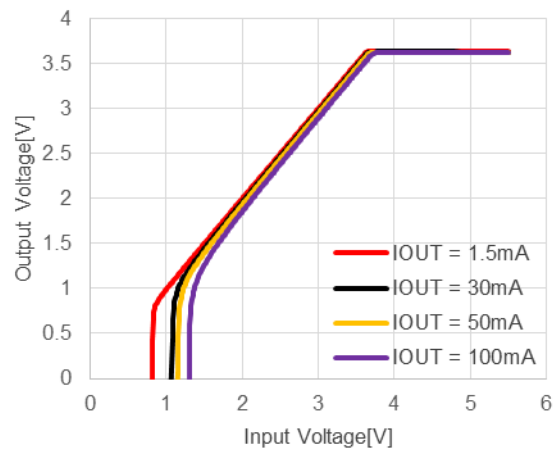
RP124x18xx



RP124x28xx

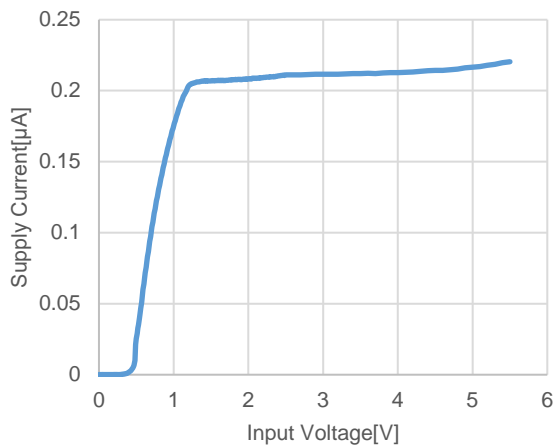


RP124x36xx

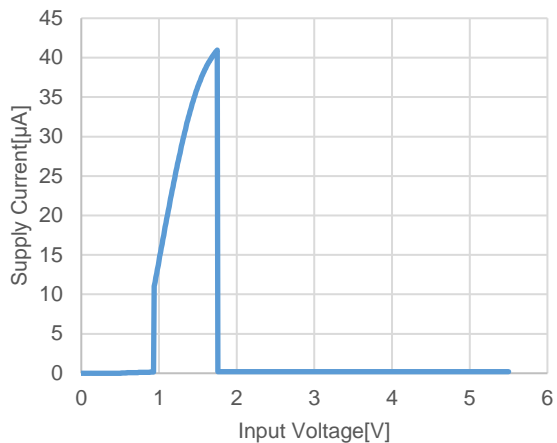


12) LDO Supply Current vs. Input Voltage ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F,  $T_a$  = 25°C)

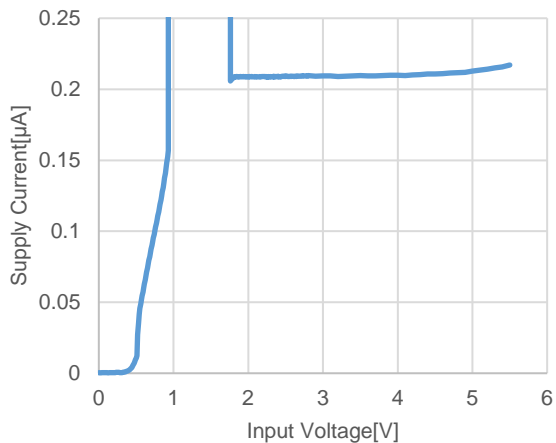
RP124x12xx



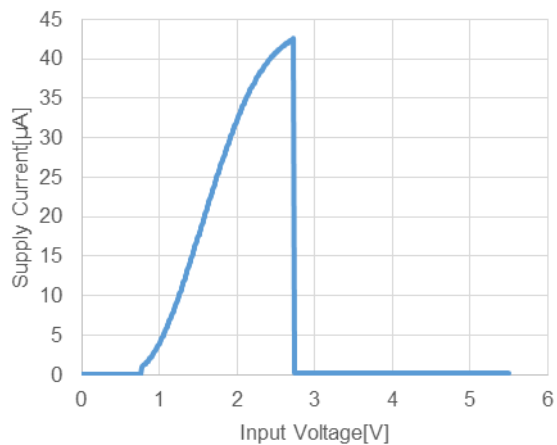
RP124x18xx (10 $\mu$ A/div)



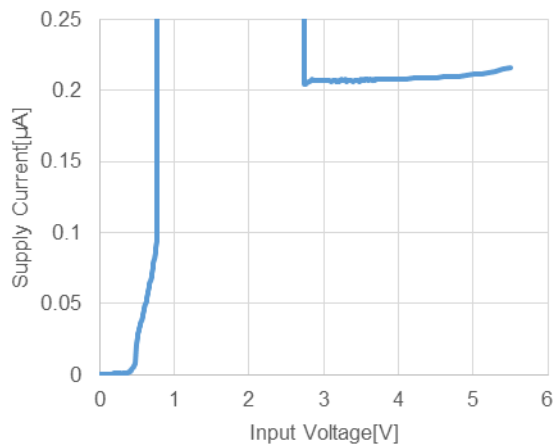
RP124x18xx (0.05 $\mu$ A/div)



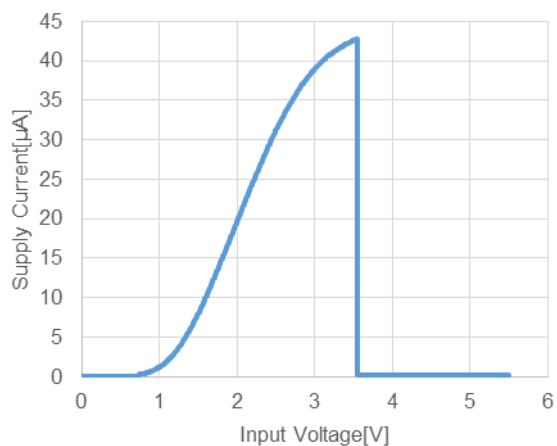
RP124x28xx (10 $\mu$ A/div)



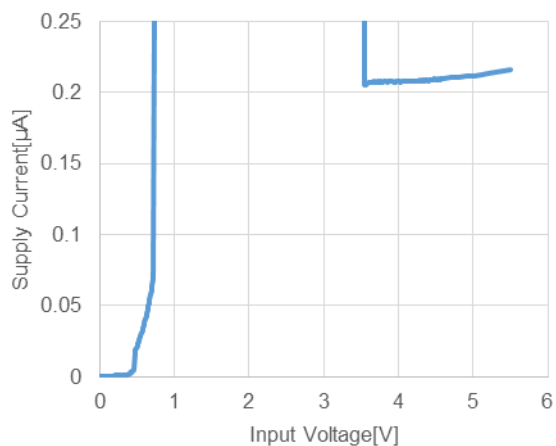
RP124x28xx (0.05 $\mu$ A/div)



RP124x36xx (10 $\mu$ A/div)



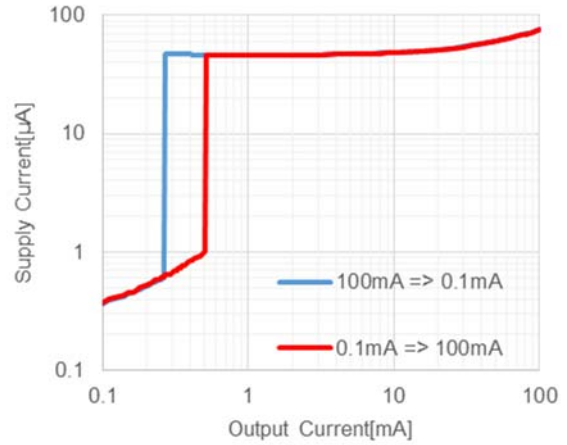
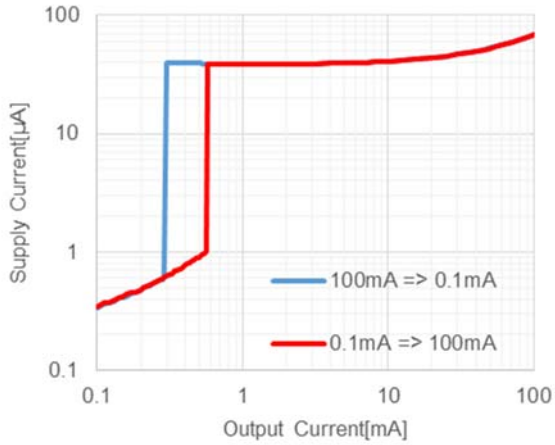
RP124x36xx (0.05 $\mu$ A/div)



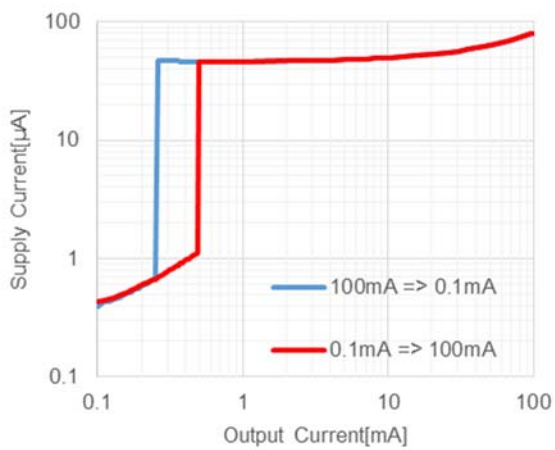
## RP124x

No. EA-503-191025

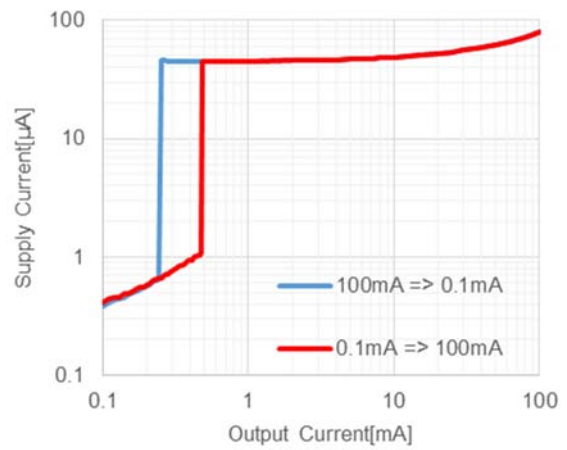
13) LDO Supply Current vs. Output Current ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F,  $T_a$  = 25°C)  
RP124x12xx RP124x18xx



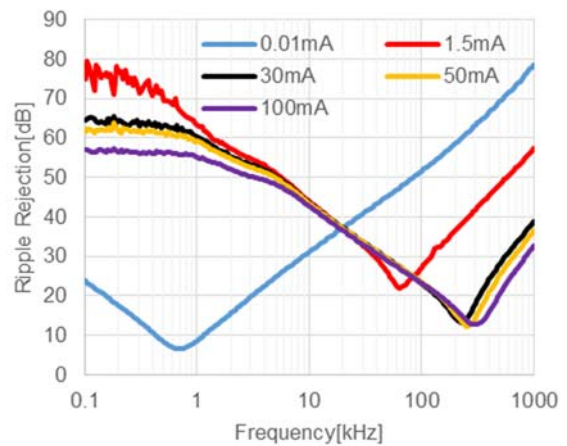
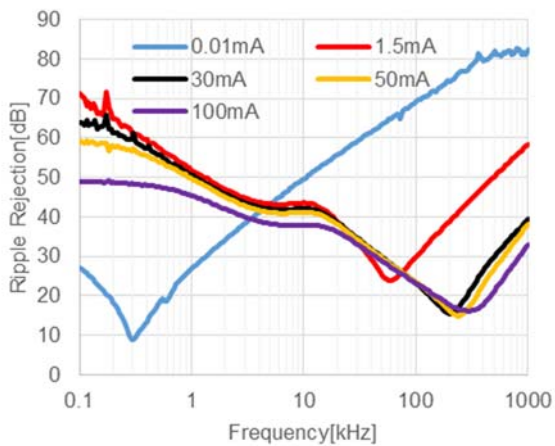
RP124x28xx



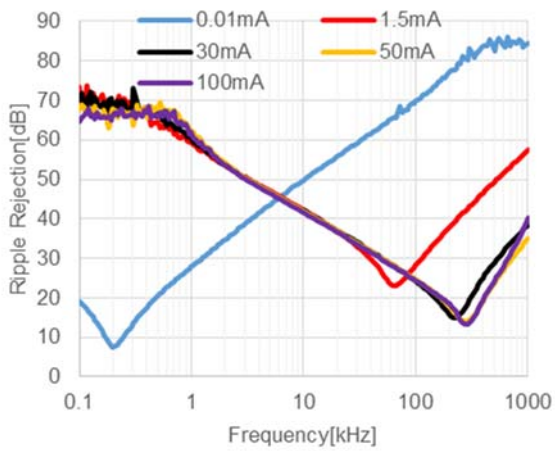
RP124x36xx



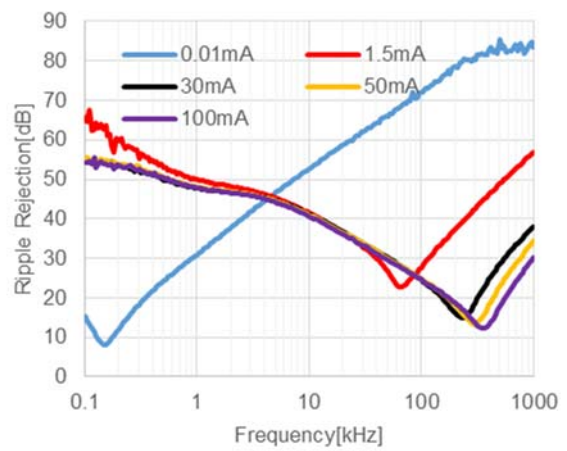
14) Ripple Rejection vs. Frequency ( $C_{IN}$  = none,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F,  $T_a$  = 25°C)  
RP124x12xx,  $V_{IN}$  = 2.2 V RP124x18xx,  $V_{IN}$  = 2.8 V



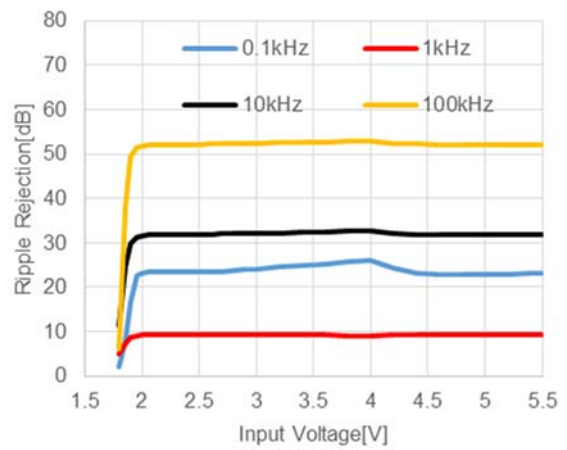
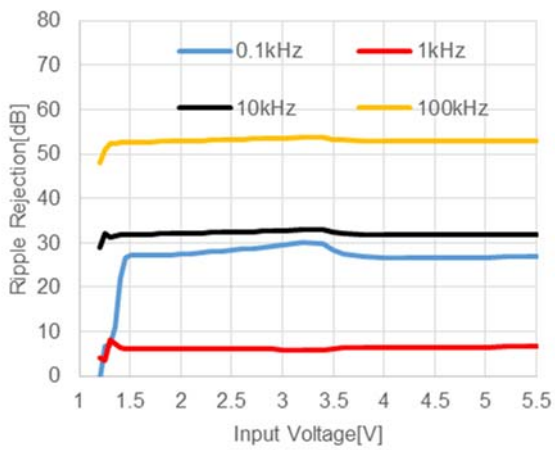
RP124x28xx,  $V_{IN} = 3.8V$



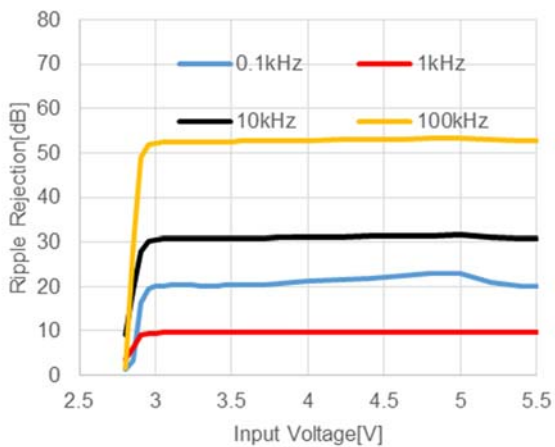
RP124x36xx,  $V_{IN} = 4.6V$



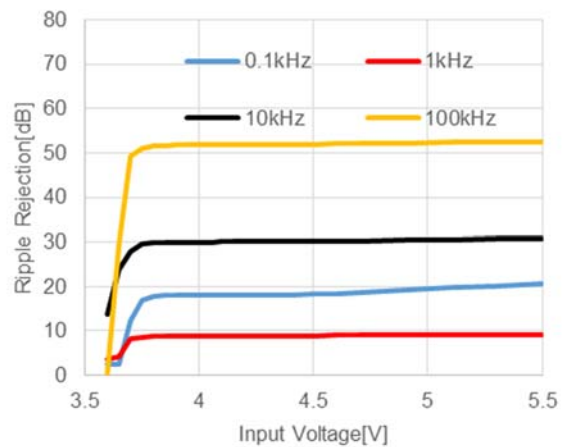
15) Ripple Rejection vs. Input Voltage ( $C_{IN} = \text{none}$ ,  $C_{OUT} = \text{Ceramic } 1.0 \mu F$ ,  $T_a = 25^\circ C$ )  
 RP124x12xx,  $I_{OUT} = 100 \mu A$       RP124x18xx,  $I_{OUT} = 100 \mu A$



RP124x28xx,  $I_{OUT} = 100 \mu A$



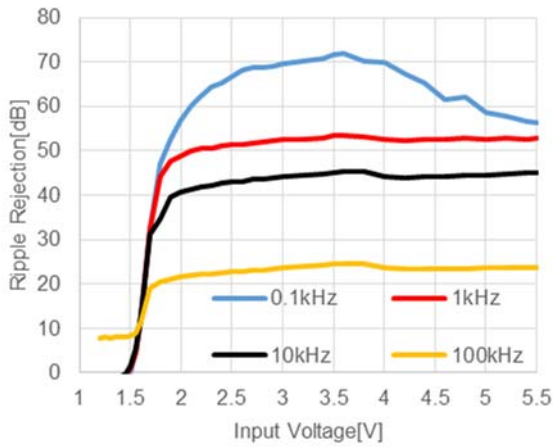
RP124x36xx,  $I_{OUT} = 100 \mu A$



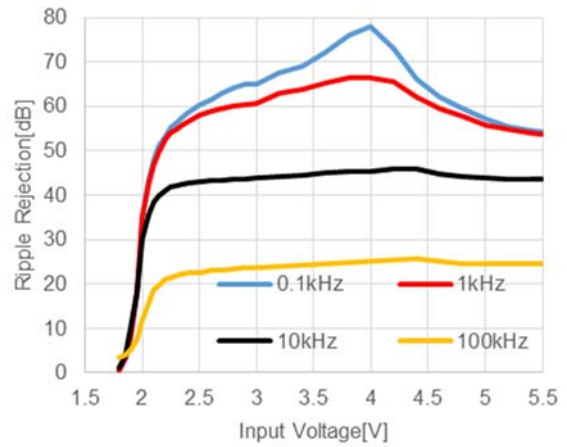
# RP124x

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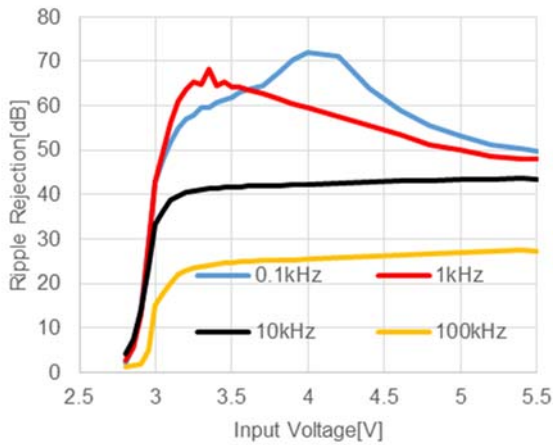
RP124x12xx,  $I_{OUT} = 30\text{mA}$



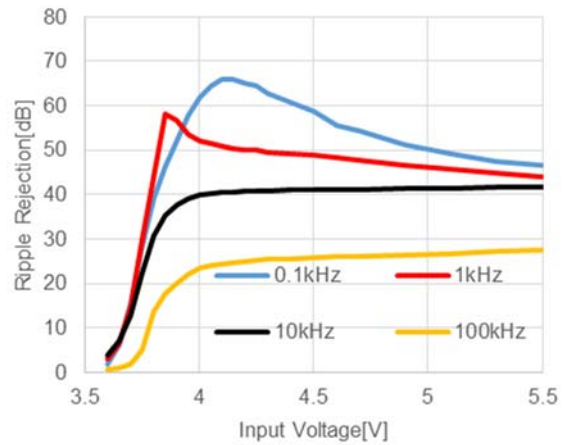
RP124x18xx,  $I_{OUT} = 30\text{mA}$



RP124x28xx,  $I_{OUT} = 30\text{mA}$

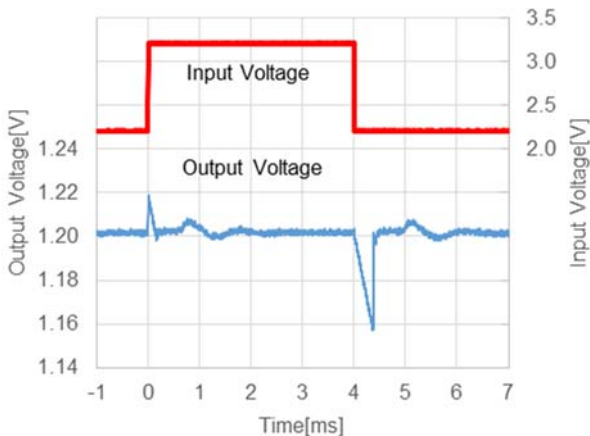


RP124x36xx,  $I_{OUT} = 30\text{mA}$

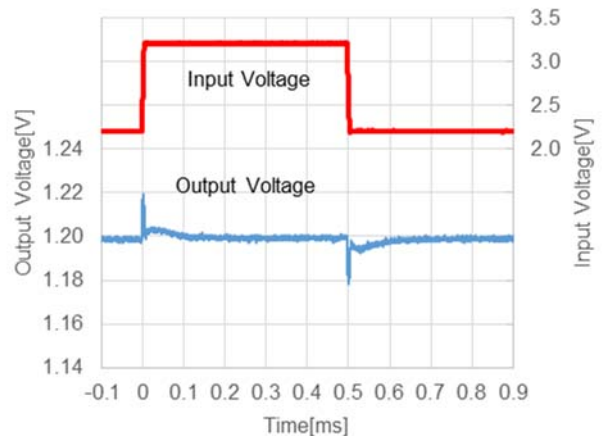


16) LDO Input Transient Response ( $C_{IN} = \text{Ceramic } 0.1 \mu\text{F}$ ,  $C_{OUT} = \text{Ceramic } 1.0 \mu\text{F}$ ,  $T_a = 25^\circ\text{C}$ )

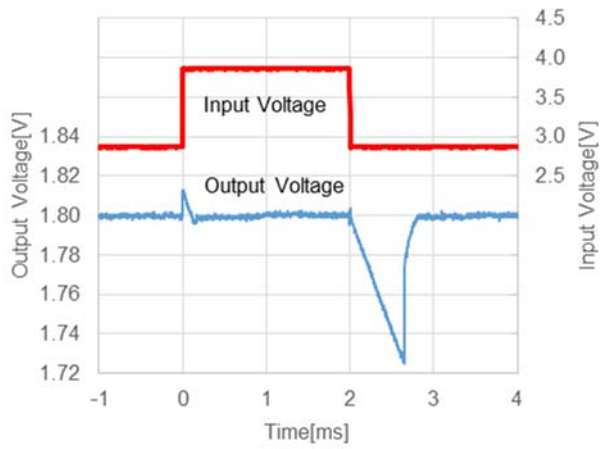
RP124x12xx,  $I_{OUT} = 100 \mu\text{A}$ ,  $t_R = t_F = 5 \mu\text{s}$



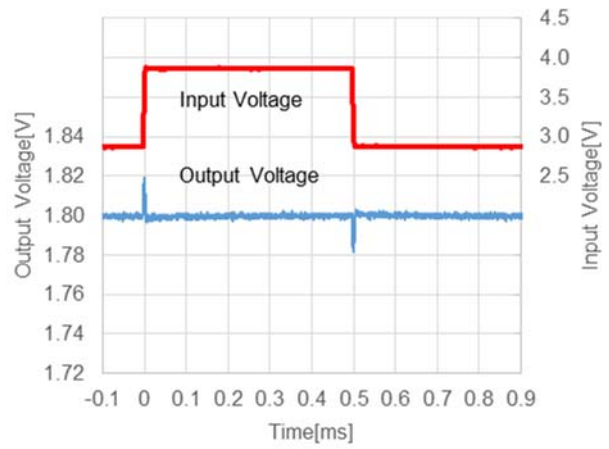
RP124x12xx,  $I_{OUT} = 30 \text{mA}$ ,  $t_R = t_F = 5 \mu\text{s}$



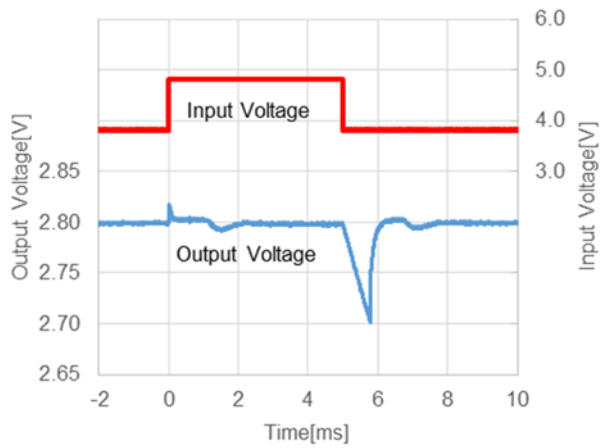
RP124x18xx,  $I_{OUT} = 100 \mu A$ ,  $t_R = t_F = 5 \mu s$



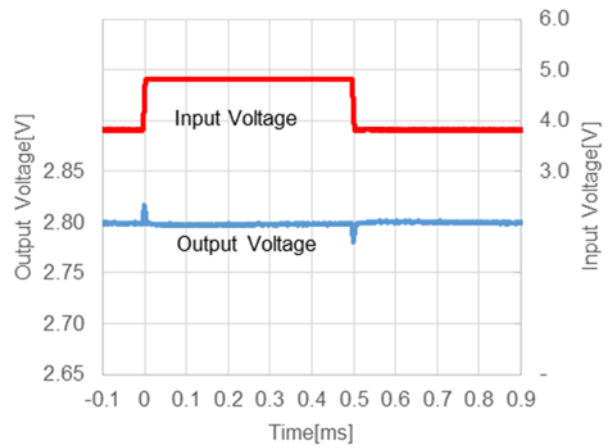
RP124x18xx,  $I_{OUT} = 30 mA$ ,  $t_R = t_F = 5 \mu s$



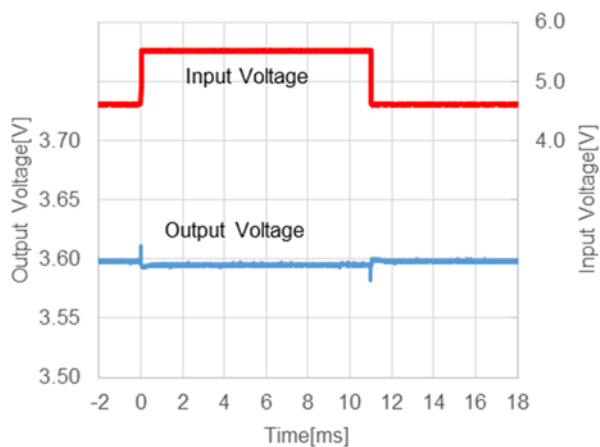
RP124x28xx,  $I_{OUT} = 100 \mu A$ ,  $t_R = t_F = 5 \mu s$



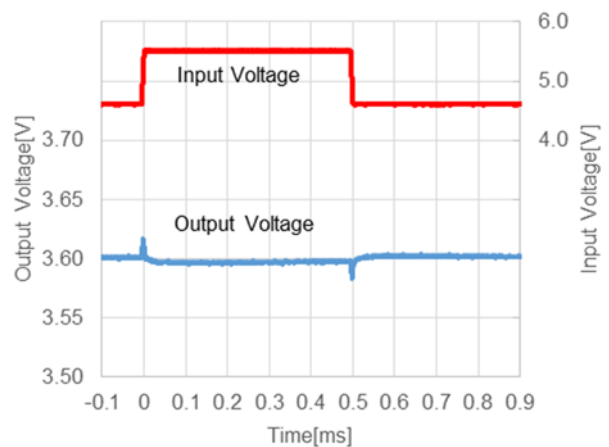
RP124x28xx,  $I_{OUT} = 30 mA$ ,  $t_R = t_F = 5 \mu s$



RP124x36xx,  $I_{OUT} = 100 \mu A$ ,  $t_R = t_F = 5 \mu s$



RP124x36xx,  $I_{OUT} = 30 mA$ ,  $t_R = t_F = 5 \mu s$





# RP124x

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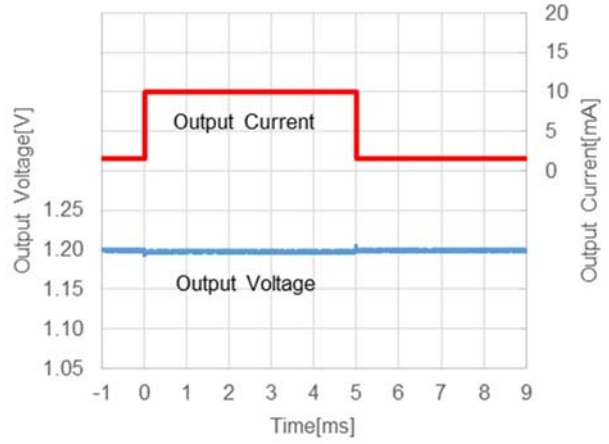
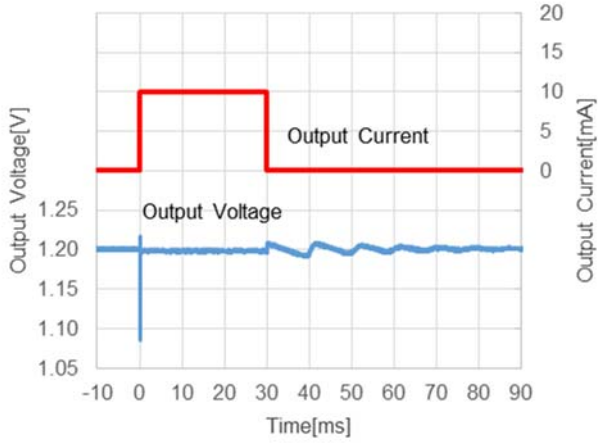
17) LDO Load Transient Response ( $C_{IN}$  = Ceramic 1.0  $\mu$ F,  $C_{OUT}$  = Ceramic 1.0  $\mu$ F,  $T_a$  = 25°C)

RP124x12xx

$V_{IN}$  = 2.2 V,  $I_{OUT}$  = 1  $\mu$ A  $\Leftrightarrow$  10 mA,  $t_R$  =  $t_F$  = 5  $\mu$ s

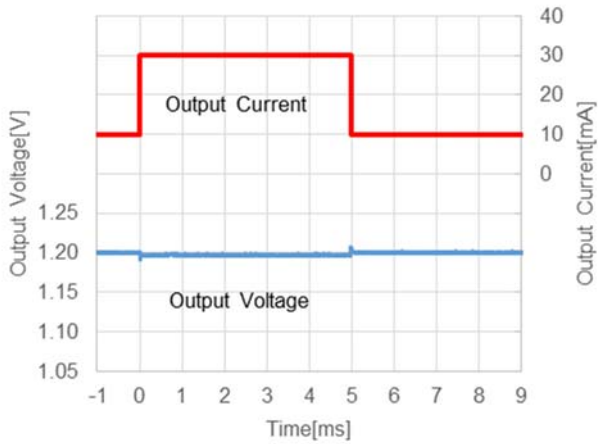
RP124x12xx

$V_{IN}$  = 2.2 V,  $I_{OUT}$  = 1.5 mA  $\Leftrightarrow$  10 mA,  $t_R$  =  $t_F$  = 5  $\mu$ s



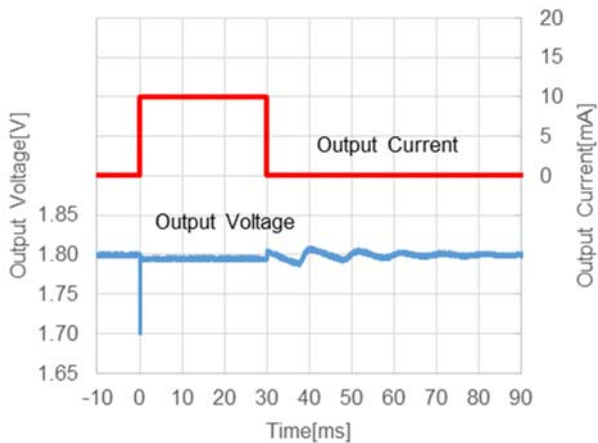
RP124x12xx

$V_{IN}$  = 2.2 V,  $I_{OUT}$  = 10 mA  $\Leftrightarrow$  30 mA,  $t_R$  =  $t_F$  = 5  $\mu$ s



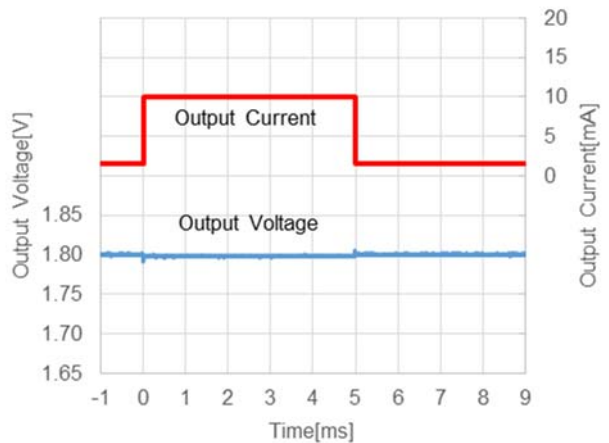
RP124x18xx

$V_{IN}$  = 2.8 V,  $I_{OUT}$  = 1  $\mu$ A  $\Leftrightarrow$  10 mA,  $t_R$  =  $t_F$  = 5  $\mu$ s



RP124x18xx

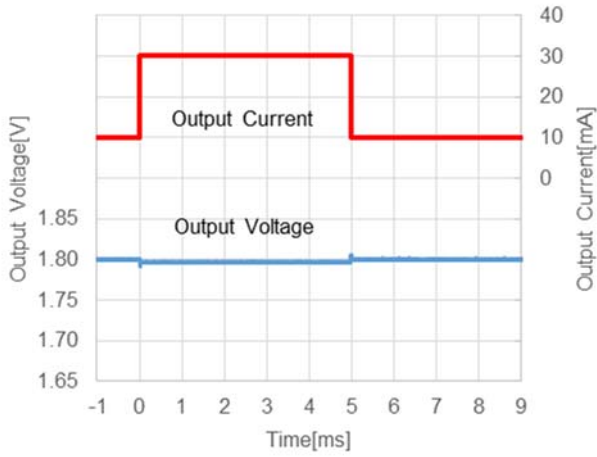
$V_{IN}$  = 2.8 V,  $I_{OUT}$  = 1.5 mA  $\Leftrightarrow$  10 mA,  $t_R$  =  $t_F$  = 5  $\mu$ s





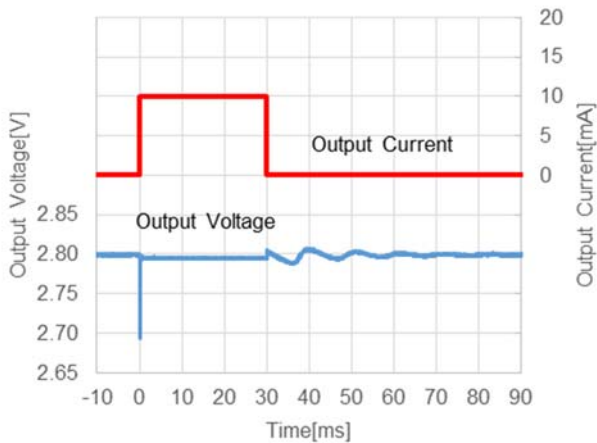
RP124x18xx

$V_{IN} = 2.8\text{ V}$ ,  $I_{OUT} = 10\text{ mA} \Leftrightarrow 30\text{ mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$



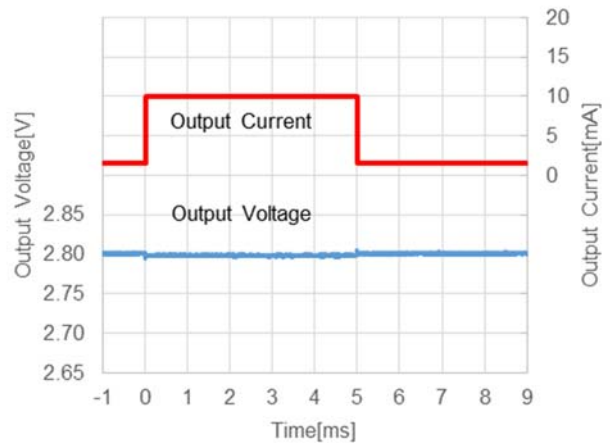
RP124x28xx

$V_{IN} = 3.8\text{ V}$ ,  $I_{OUT} = 1\ \mu\text{A} \Leftrightarrow 10\text{ mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$



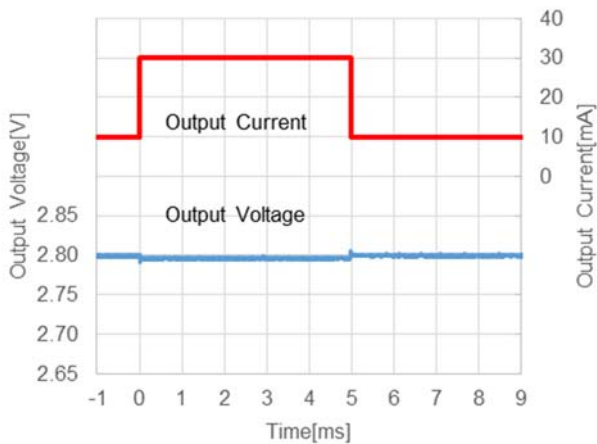
RP124x28xx

$V_{IN} = 3.8\text{ V}$ ,  $I_{OUT} = 1.5\text{ mA} \Leftrightarrow 10\text{ mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$



RP124x28xx

$V_{IN} = 3.8\text{ V}$ ,  $I_{OUT} = 10\text{ mA} \Leftrightarrow 30\text{ mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$

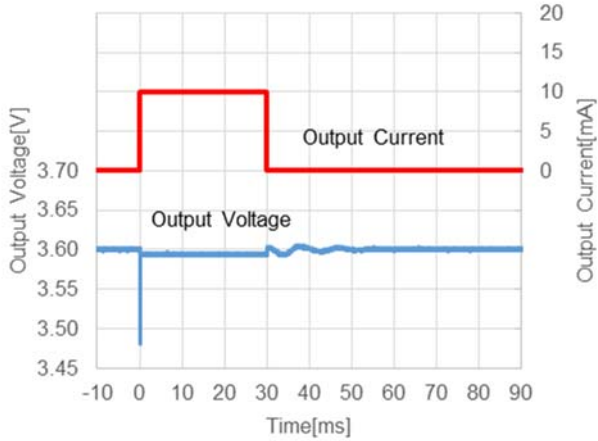


# RP124x

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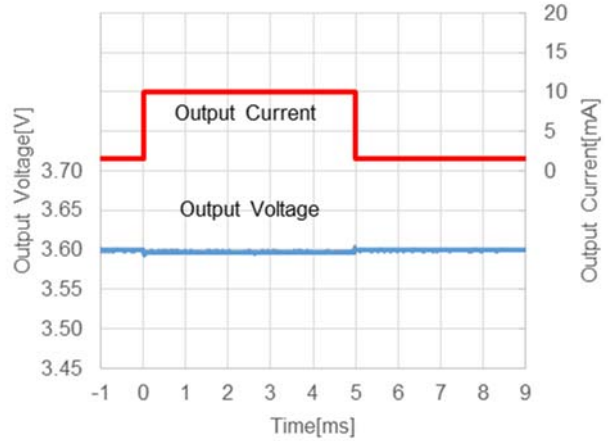
RP124x36xx

$V_{IN} = 4.6\text{ V}$ ,  $I_{OUT} = 1\ \mu\text{A} \Leftrightarrow 10\ \text{mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$



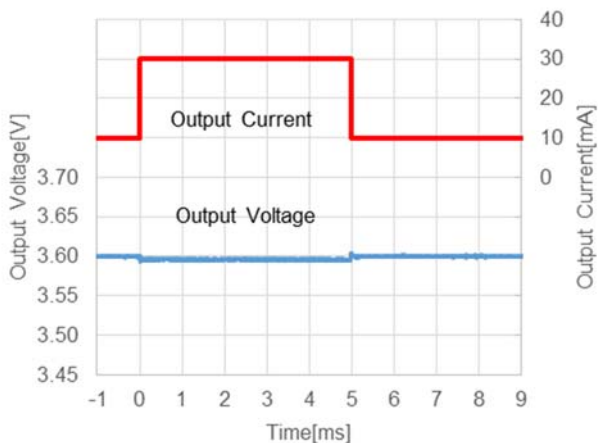
RP124x36xx

$V_{IN} = 4.6\text{ V}$ ,  $I_{OUT} = 1.5\ \text{mA} \Leftrightarrow 10\ \text{mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$



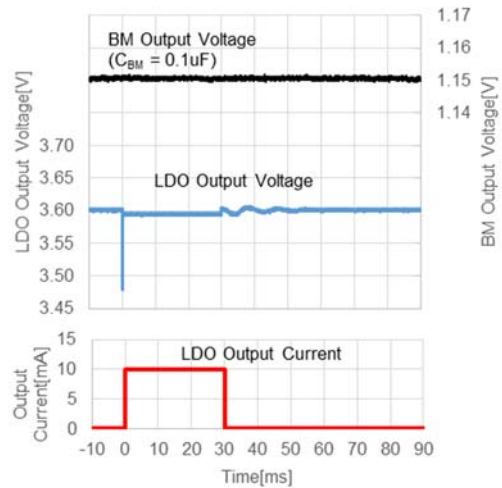
RP124x36xx

$V_{IN} = 4.6\text{ V}$ ,  $I_{OUT} = 10\ \text{mA} \Leftrightarrow 30\ \text{mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$



RP124x364x

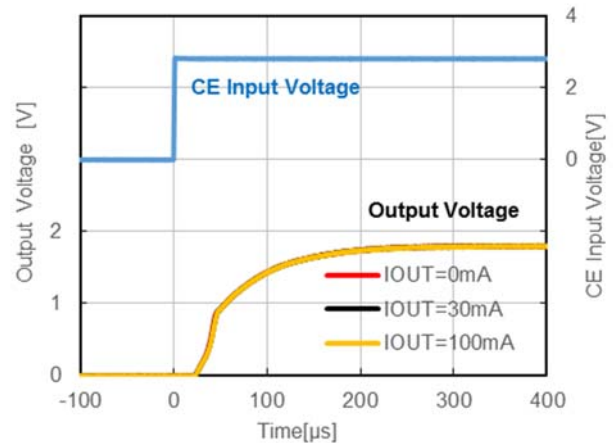
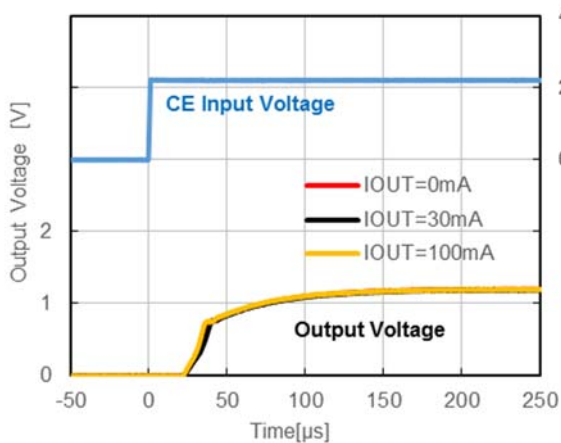
$V_{IN} = 4.6\text{ V}$ ,  $I_{OUT} = 1\ \mu\text{A} \Leftrightarrow 10\ \text{mA}$ ,  $t_R = t_F = 5\ \mu\text{s}$



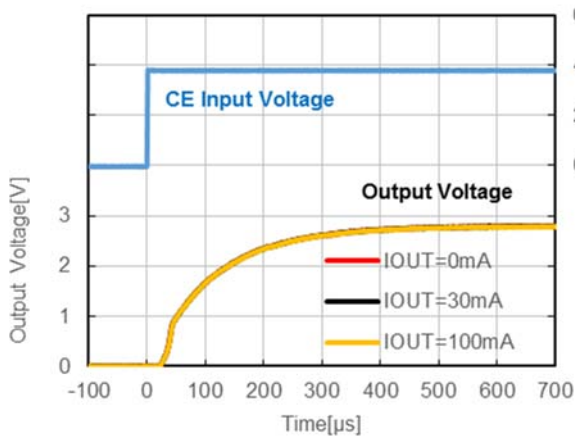
18) LDO Turning-on with CE Pin ( $C_{IN} = \text{Ceramic } 1.0\ \mu\text{F}$ ,  $C_{OUT} = \text{Ceramic } 1.0\ \mu\text{F}$ ,  $T_a = 25^\circ\text{C}$ )

RP124x12xD,  $V_{IN} = 2.2\ \text{V}$ ,  $V_{CE} = 0\ \text{V} \Rightarrow 2.2\ \text{V}$

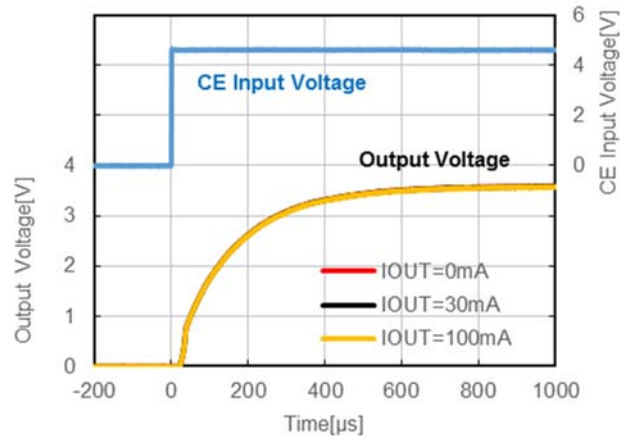
RP124x18xD,  $V_{IN} = 2.8\ \text{V}$ ,  $V_{CE} = 0\ \text{V} \Rightarrow 2.8\ \text{V}$



RP124x28xD,  $V_{IN} = 3.8\text{ V}$ ,  $V_{CE} = 0\text{ V} \Rightarrow 3.8\text{ V}$

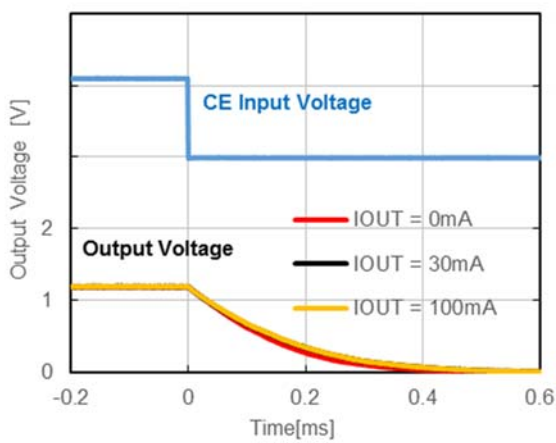


RP124x36xD,  $V_{IN} = 4.6\text{ V}$ ,  $V_{CE} = 0\text{ V} \Rightarrow 4.6\text{ V}$

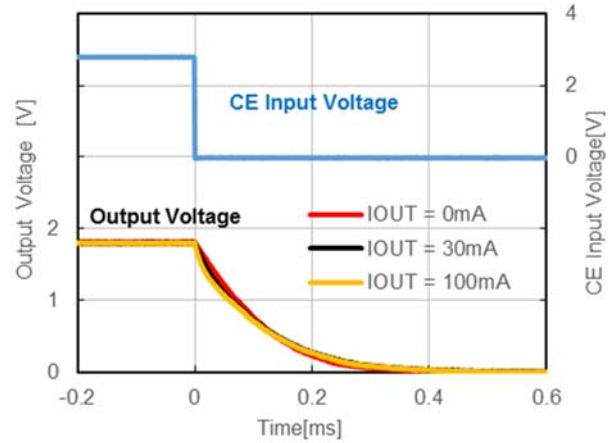


19) LDO Turning-off with CE Pin ( $C_{IN} = \text{Ceramic } 1.0\ \mu\text{F}$ ,  $C_{OUT} = \text{Ceramic } 1.0\ \mu\text{F}$ ,  $T_a = 25^\circ\text{C}$ )

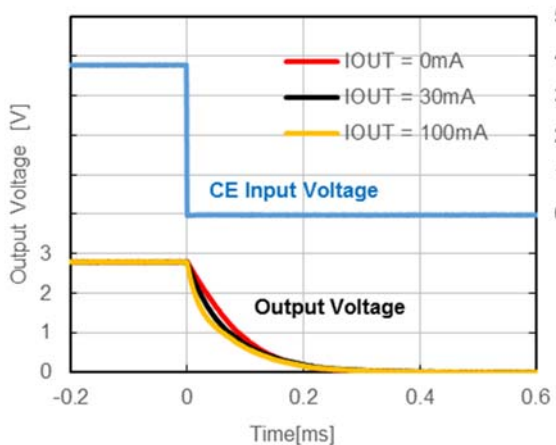
RP124x12xD,  $V_{IN} = 2.2\text{ V}$ ,  $V_{CE} = 2.2\text{ V} \Rightarrow 0\text{ V}$



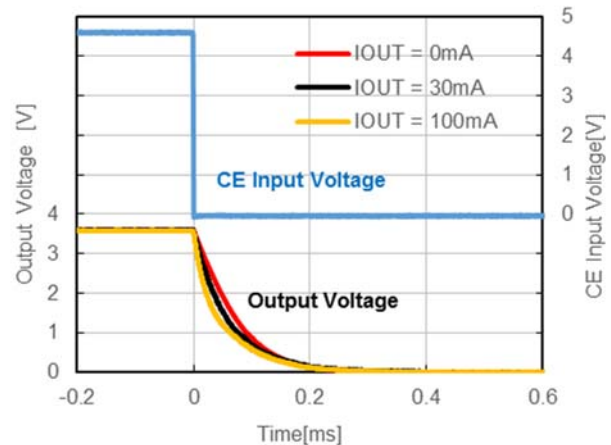
RP124x18xD,  $V_{IN} = 2.8\text{ V}$ ,  $V_{CE} = 2.8\text{ V} \Rightarrow 0\text{ V}$



RP124x28xD,  $V_{IN} = 3.8\text{ V}$ ,  $V_{CE} = 3.8\text{ V} \Rightarrow 0\text{ V}$



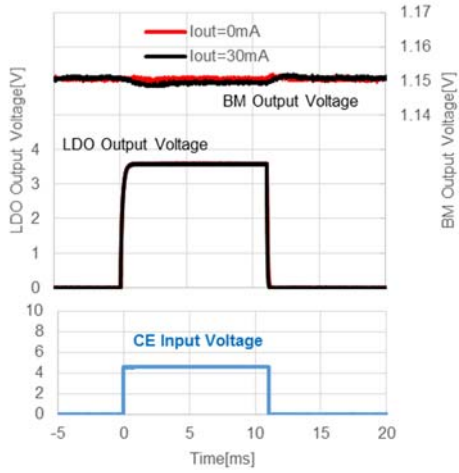
RP124x36xD,  $V_{IN} = 4.6\text{ V}$ ,  $V_{CE} = 4.6\text{ V} \Rightarrow 0\text{ V}$



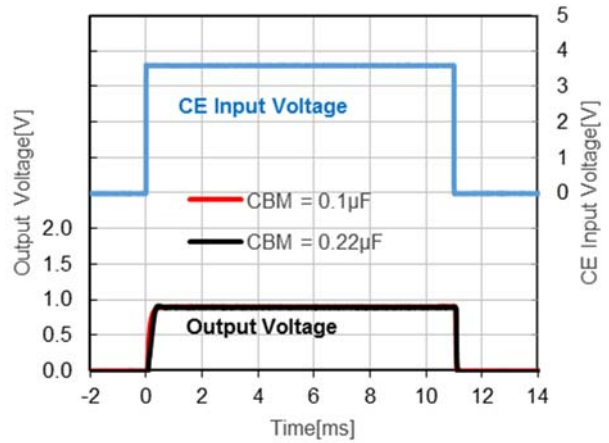
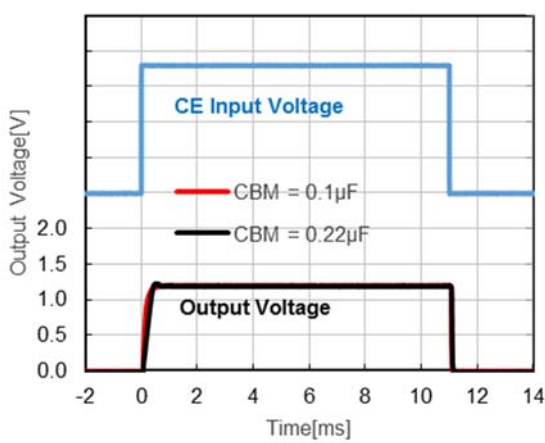
# RP124x

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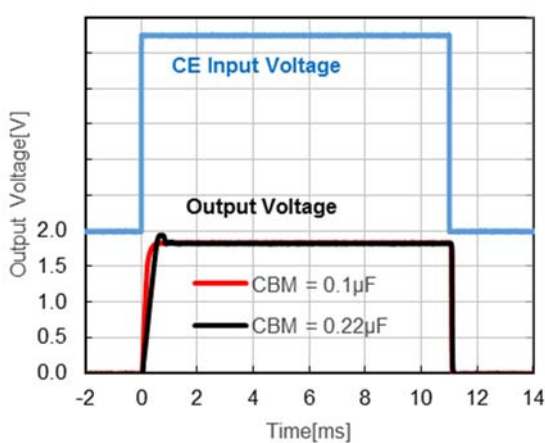
RP124x364D,  $V_{IN} = 4.6\text{ V}$ ,  $V_{CE} = 0\text{ V} \Leftrightarrow 4.6\text{ V}$



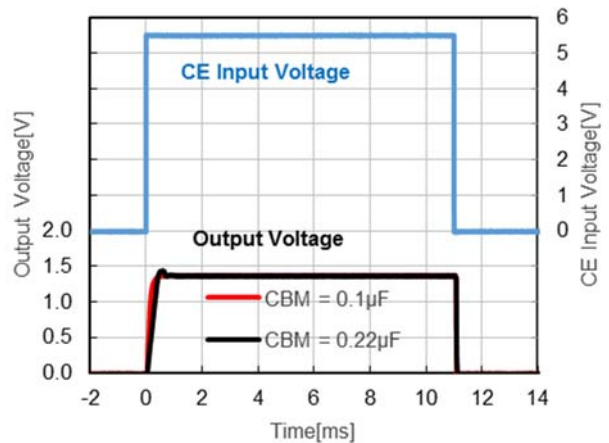
20) BM Turning-on/off with CE Pin ( $C_{IN} = \text{Ceramic } 1.0\ \mu\text{F}$ ,  $C_{BM} = \text{Ceramic } 0.1\ \mu\text{F}, 0.22\ \mu\text{F}$ ,  $T_a = 25^\circ\text{C}$ )  
RP124xxx3x,  $V_{IN} = 3.6\text{ V}$ ,  $V_{CE} = 0\text{ V} \Leftrightarrow 3.6\text{ V}$       RP124xxx4x,  $V_{IN} = 3.6\text{ V}$ ,  $V_{CE} = 0\text{ V} \Leftrightarrow 3.6\text{ V}$



RP124xxx3x,  $V_{IN} = 5.5\text{ V}$ ,  $V_{CE} = 0\text{ V} \Leftrightarrow 5.5\text{ V}$



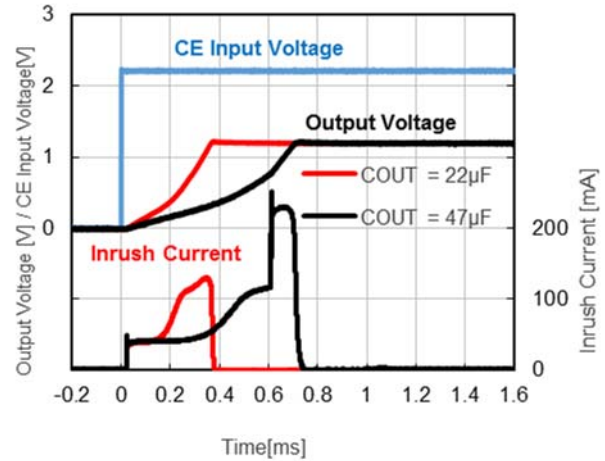
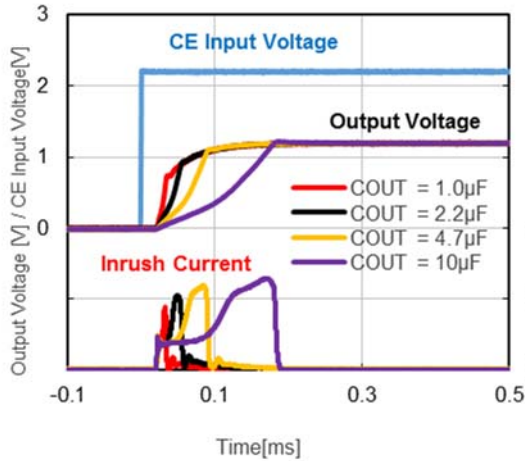
RP124xxx4x,  $V_{IN} = 5.5\text{ V}$ ,  $V_{CE} = 0\text{ V} \Leftrightarrow 5.5\text{ V}$



21) Inrush Current at CE Pin's Activation ( $C_{IN}$  = Ceramic 0.1  $\mu$ F,  $T_a$  = 25°C)

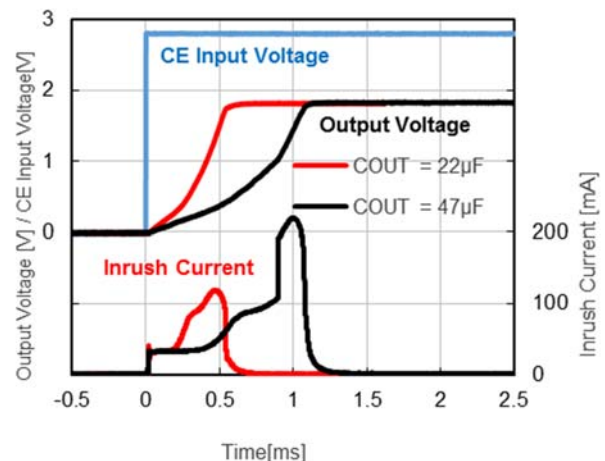
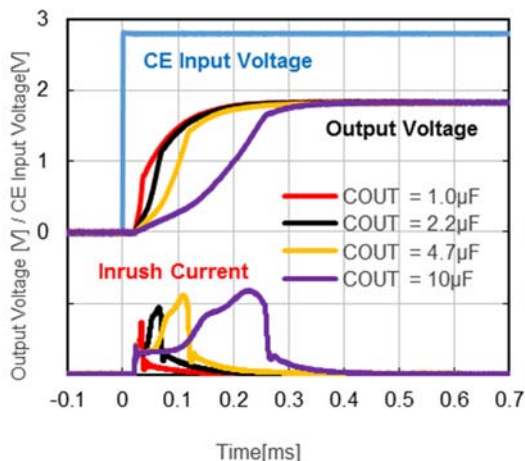
RP124x12xx,  $V_{IN}$  = 2.2 V,  $V_{CE}$  = 0 V => 2.2 V ①

RP124x12xx,  $V_{IN}$  = 2.2 V,  $V_{CE}$  = 0 V => 2.2 V ②



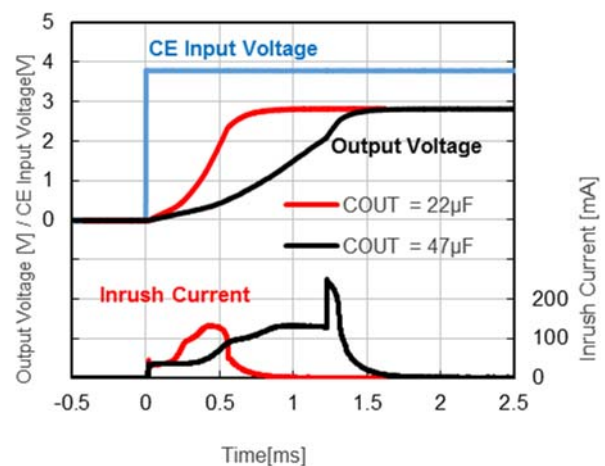
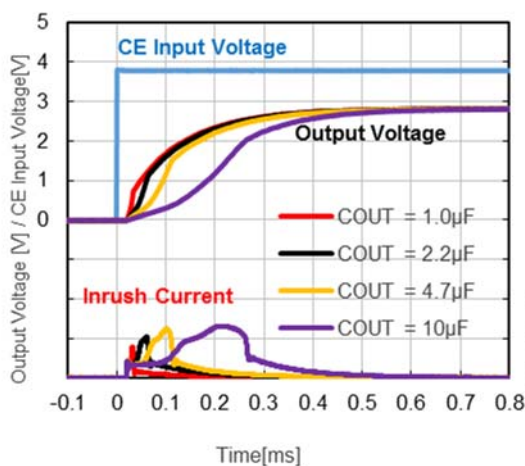
RP124x18xx,  $V_{IN}$  = 2.8 V,  $V_{CE}$  = 0 V => 2.8 V ①

RP124x18xx,  $V_{IN}$  = 2.8 V,  $V_{CE}$  = 0 V => 2.8 V ②



RP124x28xx,  $V_{IN}$  = 3.8 V,  $V_{CE}$  = 0 V => 3.8 V ①

RP124x28xx,  $V_{IN}$  = 3.8 V,  $V_{CE}$  = 0 V => 3.8 V ②

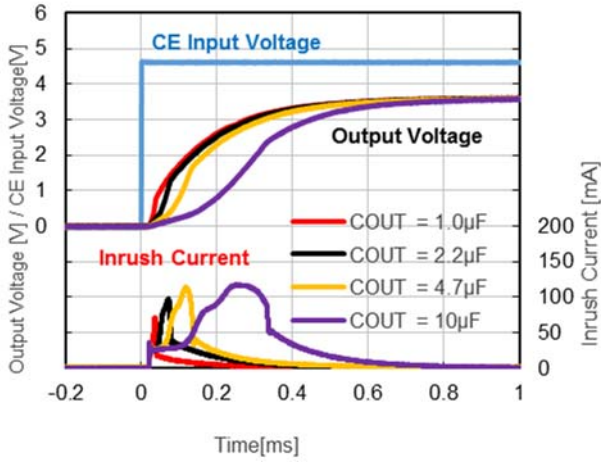




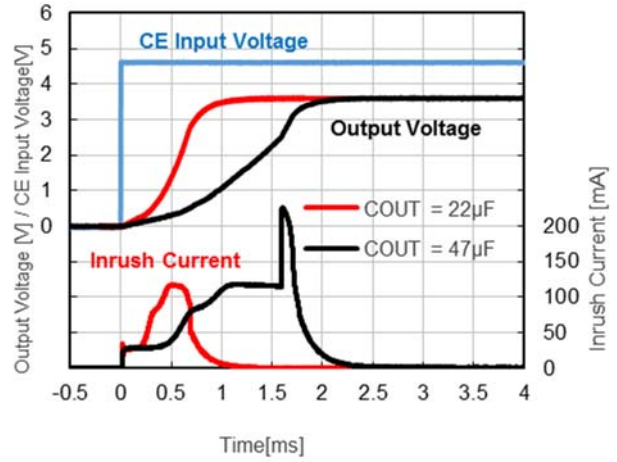
# RP124x

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RP124x36xx,  $V_{IN} = 4.6\text{ V}$ ,  $V_{CE} = 0\text{ V} \Rightarrow 4.6\text{ V}$  ①



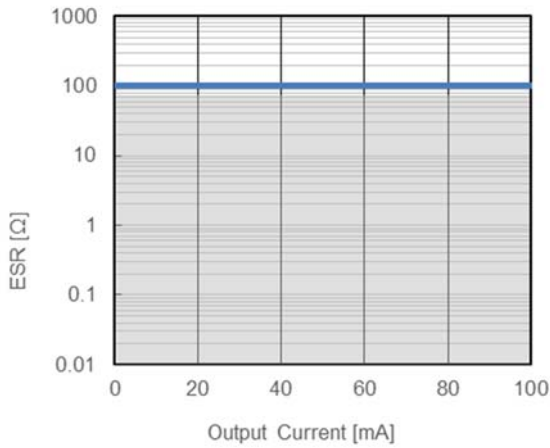
RP124x36xx,  $V_{IN} = 4.6\text{ V}$ ,  $V_{CE} = 0\text{ V} \Rightarrow 4.6\text{ V}$  ②



22) ESR vs. Output Current ( $C_{IN}$  = Ceramic  $1.0\mu\text{F}$ ,  $C_{OUT}$  = Ceramic  $1.0\mu\text{F}$ ,  $C_{BM}$  = Ceramic  $0.1\mu\text{F}$ )  
 Measuring Frequency : 10 Hz to 2 MHz、Ambient Temperature :  $-40^{\circ}\text{C}$  to  $5^{\circ}\text{C}$

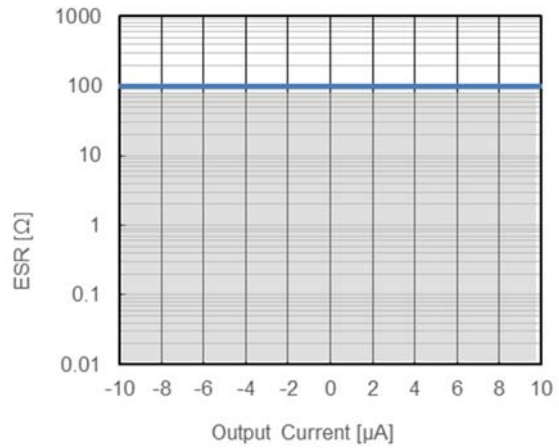
LDO

RP124x12xx,  $V_{IN} = 1.7\text{V}$  to  $5.5\text{V}$



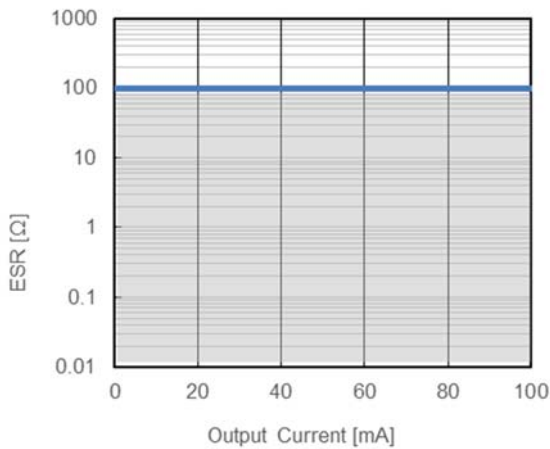
BM

RP124xxx3x,  $V_{IN} = 1.7\text{V}$  to  $5.5\text{V}$



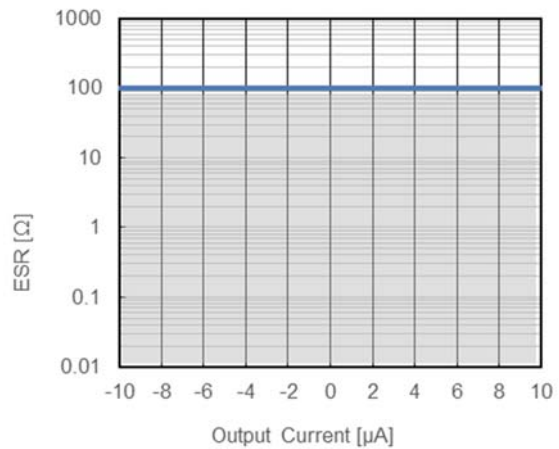
LDO

RP124x28xx,  $V_{IN} = 2.8\text{ V}$  to  $5.5\text{ V}$

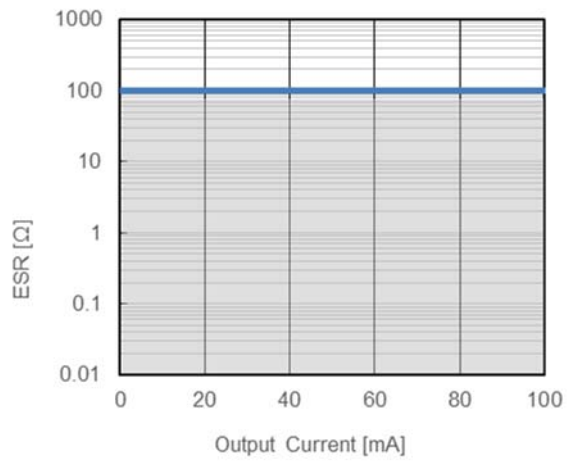


BM

RP124xxx4x,  $V_{IN} = 2.4\text{ V}$  to  $5.5\text{ V}$



LDO  
RP124x36xx,  $V_{IN} = 3.6\text{ V to }5.5\text{ V}$



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 × 14 pcs

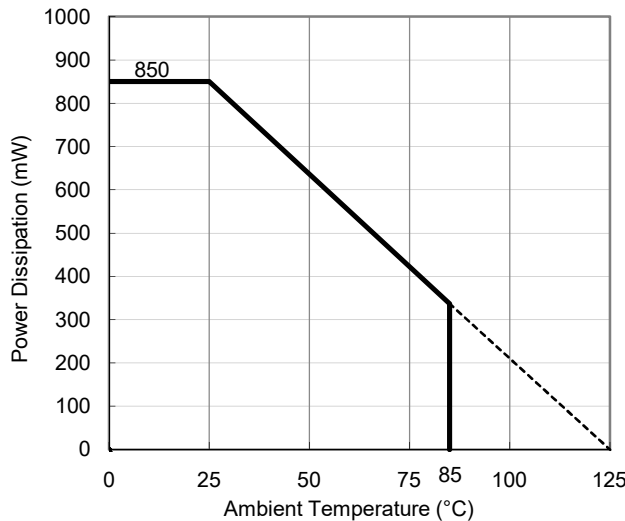
**Measurement Result**

(Ta = 25°C, Tjmax = 125°C)

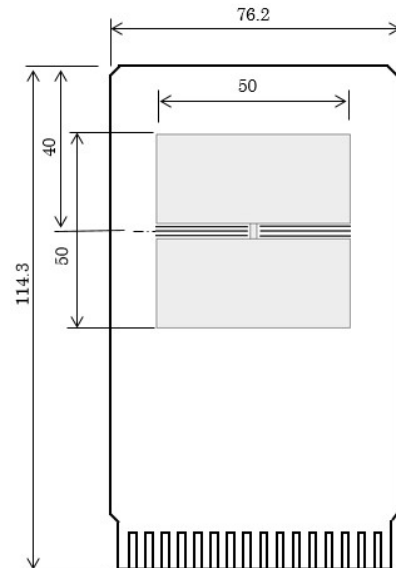
Item	Measurement Result
Power Dissipation	850 mW
Thermal Resistance (θja)	θja = 117°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 50°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter

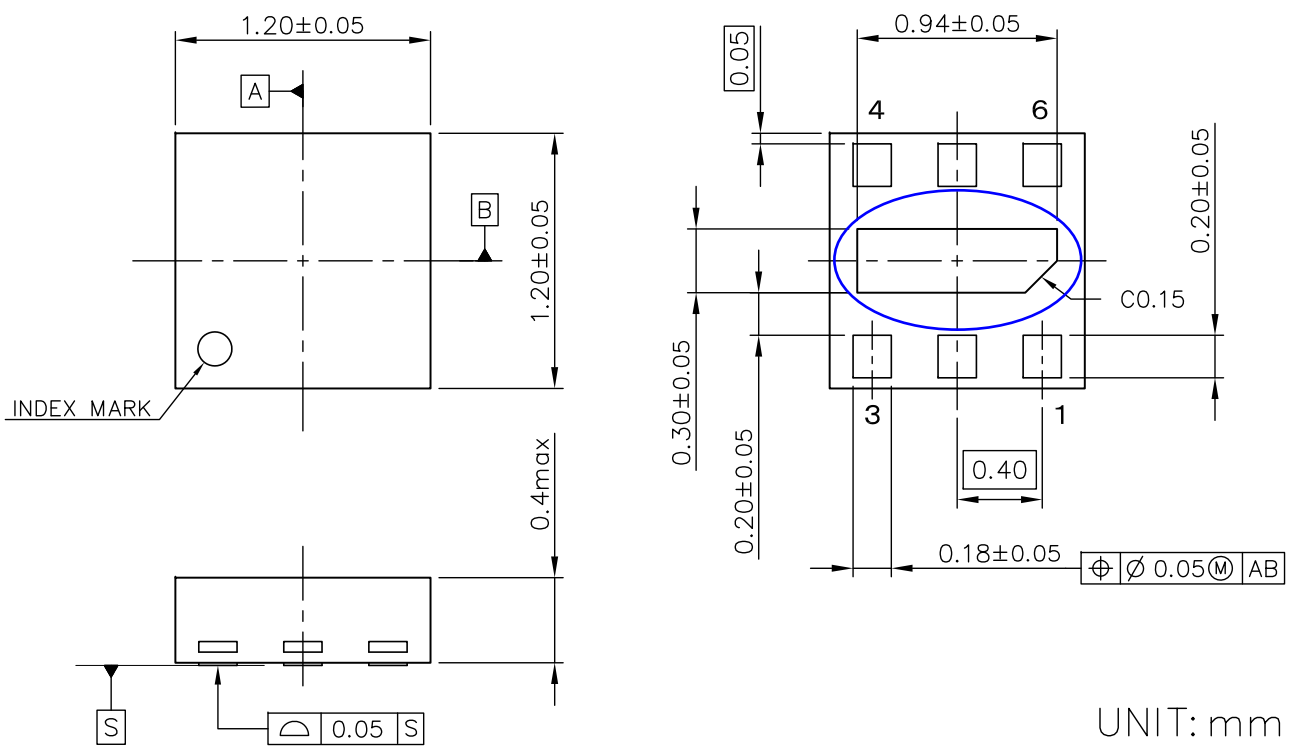


**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**





DFN1212-6 Package Dimensions

\* 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.

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 × 7 pcs

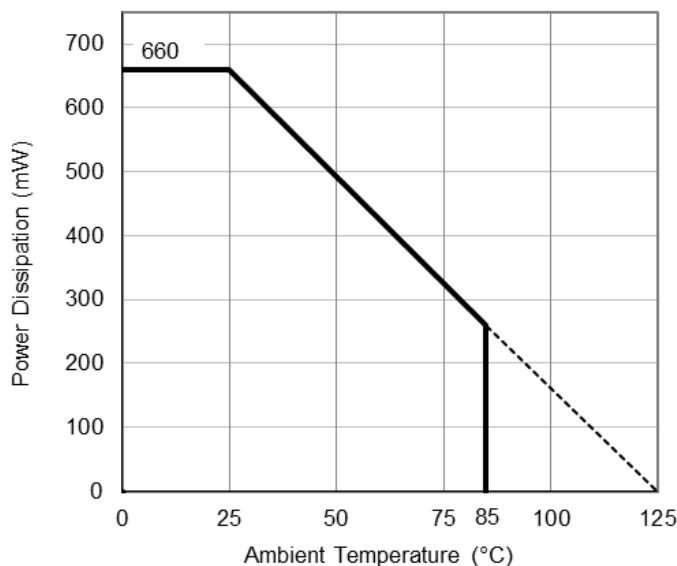
**Measurement Result**

(Ta = 25°C, Tjmax = 125°C)

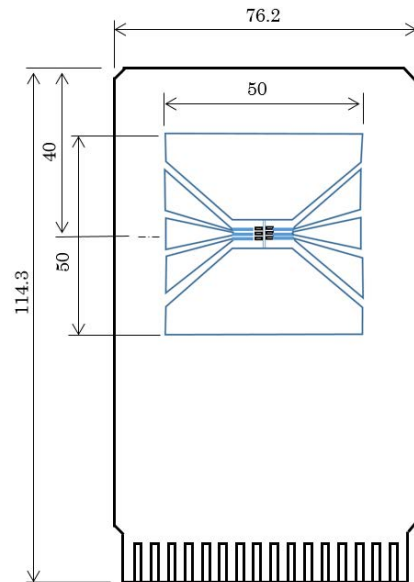
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

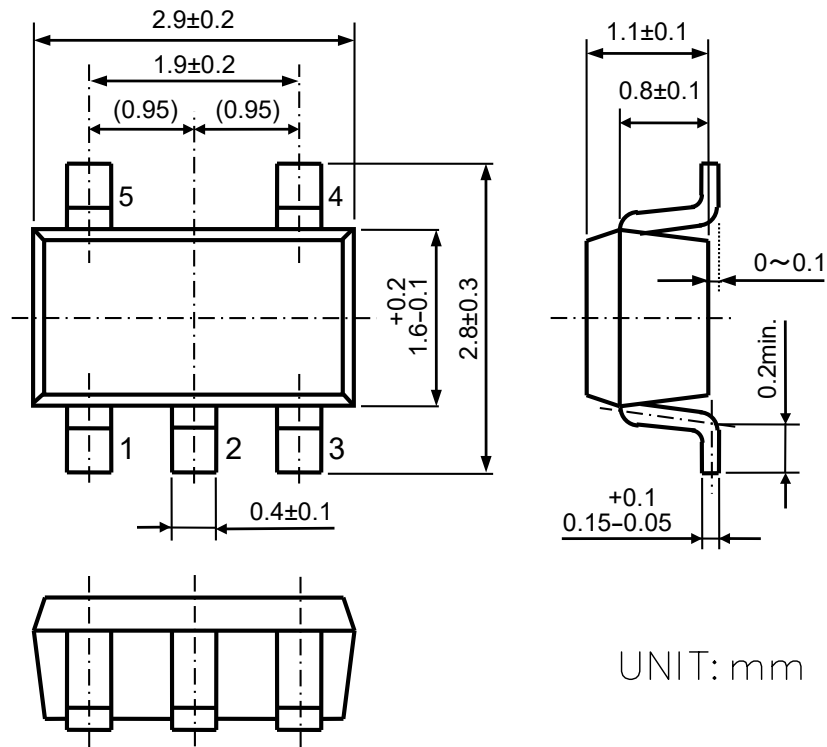
ψjt: Junction-to-Top Thermal Characterization Parameter



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



UNIT: mm

SOT-23-5 Package Dimensions



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