NISSHINBO

RP123x Series

250 mA Low Noise and Low Supply Current LDO Regulator

No.EA-508-230821

OVERVIEW

The RP123x is an LDO regulator that provides low output noise, high ripple rejection and fast response characteristics, achieved by low supply current. This device is suitable not only for noise-sensitive applications such as high-performance analog circuits, but also for various applications.

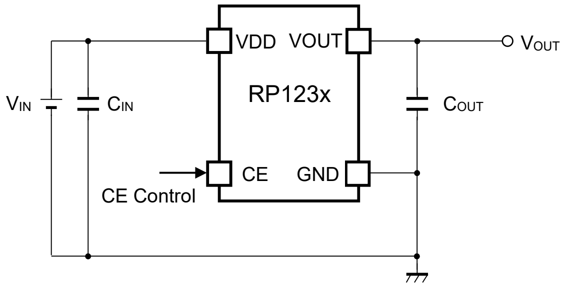
KEY BENEFITS

- Achieves Low Noise, High PSRR and Fast Response.
- Provides Saving Space by Adopting of 4-pin Small Package without Noise Bypass Capacitor.
- Provides Long-Duration of Operation for Battery-powered Equipment by Low Supply Current of 9.5 μA (Typ.), despite the low-noise LDO.

KEY SPECIFICATIONS

- Input Voltage Range (Max.Rating): 1.9 V to 5.5 V (6.0 V)
- Output Voltage Range: 1.2 V to 4.8 V (0.1 V step)
- Output Voltage Accuracy: ±0.8% (V_{SET} ≥ 1.8 V, Ta = 25°C)
- Supply Current: Typ. 9.5 μA
- Output Noise: Typ. 8 μVrms (I_{OUT} = 250 mA)
- Ripple Rejection: Typ. 90 dB (f = 1kHz)
  Typ. 85 dB (f = 10kHz)
  Typ. 65 dB (f = 100kHz)
- Dropout Voltage: Typ. 0.090 V (I_{OUT} = 250 mA, V_{SET} = 2.8 V, RP123Z)
  Typ. 0.105 V (I_{OUT} = 250 mA, V_{SET} = 2.8 V, RP123K/N)
- Protection Features: Thermal Shutdown Protection (Detection Temp. Typ.165°C)
  Inrush Current Limit at Typ.150 mA for appr.700μs period after startup
- Ceramic Capacitor (C_{IN}, C_{OUT}): 1.0 μF or more (No Need of Noise Bypass Capacitor)

TYPICAL APPLICATIONS



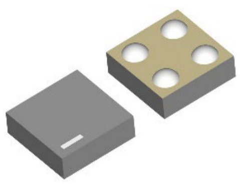
Without a bypass capacitor for noise

APPLICATIONS

- Mobile Phones and Tablets, Digital Cameras, Audio Devices, and Battery-powered Equipment
- RF Modules
- Clock Generator: VCO, PLL, etc.
- Noise-sensitive Devices: ADC, DAC

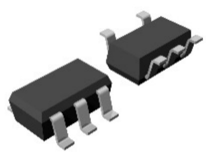
PACKAGE

WLCSP-4-P8
0.64 x 0.64 x 0.36 (mm)



WLCSP-4-P12
0.64 x 0.64 x 0.26 (mm)

DFN(PL)1010-4B
1.0 x 1.0 x 0.6 (mm)



SOT-23-5
2.9 x 2.8 x 1.1 (mm)

SELECTION GUIDE

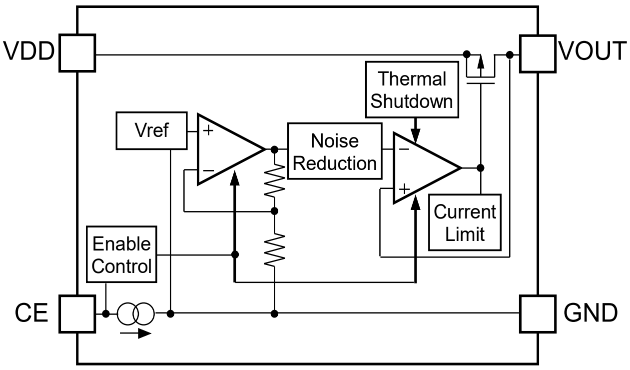
The set output voltage and the auto-discharge function[1] are user-selectable.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP123Zxx1∗-TR-F	WLCSP-4-P8	5,000 pcs	Yes	Yes
RP123Zxx3∗-TR-F	WLCSP-4-P12	10,000 pcs	Yes	Yes
RP123Kxx1∗-TR	DFN(PL)1010-4B	10,000 pcs	Yes	Yes
RP123Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

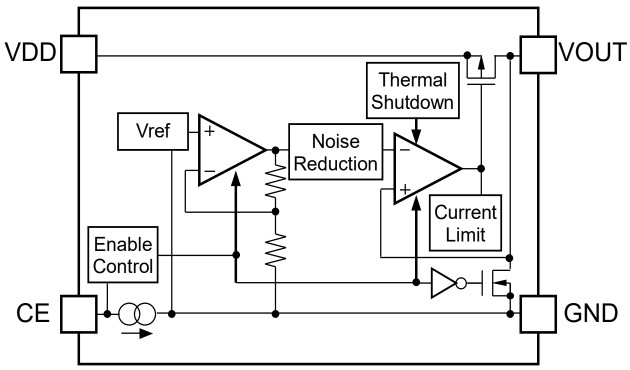
xx: Specify the set output voltage (V_{SET}) within the range of 1.2 V to 4.8 V in 0.1 V steps.
The voltage in 0.05 V step is shown as follows.
Ex. 1.85 V: RP123x18x∗5

∗ : Specify whether with the auto-discharge or not.
B: without the auto-discharge function
D: with the auto-discharge function

BLOCK DIAGRAMS



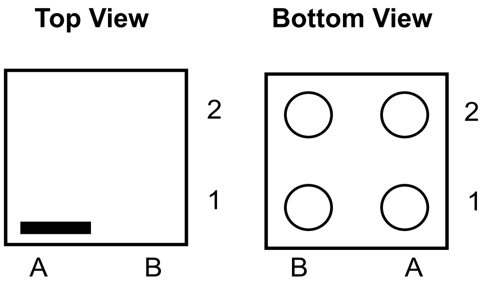
RP123xxxxB Block Diagram



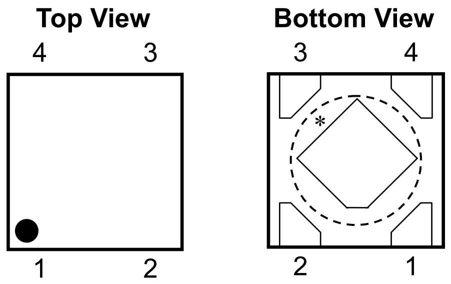
RP123xxxxD Block Diagram

[1] Auto-discharge function quickly lowers the output voltage to 0 V, 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.

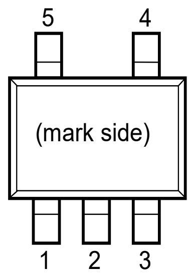
PIN DESCRIPTIONS



RP123Z (WLCSP-4-P8 / WLCSP-4-P12)
Pin Configuration



RP123K (DFN(PL)1010-4B)
Pin Configuration



RP123N (SOT-23-5)
Pin Configuration

RP123Zxx1x(WLCSP-4-P8), RP123Zxx3x(WLCSP-4-P12) Pin Description

Pin No.	Symbol	Description
A1	VDD	Input Pin
A2	VOUT	Output Pin
B1	CE	Chip Enable Pin, Active-high
B2	GND	Ground Pin

RP123K Pin Description

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

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

RP123N Pin Description

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	−0.3 to 6.0	V
V_{CE}	Input Voltage (CE pin)	−0.3 to 6.0	V
V_{OUT}	Output Voltage	−0.3 to V_{IN} + 0.3	V
I_{OUT}	Output Current	600	mA
P_D	Power Dissipation	Refer to Appendix "*POWER DISSIPATION*"	
Tj	Junction Temperature Range	−40 to 125	°C
Tstg	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 are not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	1.9 to 5.5	V
Ta	Operating Temperature Range	−40 to 85	°C

RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if they are used over such ratings by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

V_{IN} = V_{SET} + 1 V (V_{IN} = 5.5 V when V_{SET} ≥ 4.5 V), I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1µF, unless otherwise specified.
The specifications surrounded by ☐ are guaranteed by design engineering at -40°C ≤ Ta ≤ 85°C.

RP123xxxxx Electrical Characteristics (Ta = 25°C)

Symbol	Parameter		Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage		Ta = 25°C	V_{SET} ≥ 1.8V	x0.992		x1.008	V
				V_{SET} < 1.8V	−14		+14	mV
			−40°C ≤ Ta ≤ 85°C	V_{SET} ≥ 1.8V	x0.987		x1.012	V
				V_{SET} < 1.8V	Refer to *PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS*			
I_{OUT}	Output Current				250			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	RP123Z	1 mA ≤ I_{OUT} ≤ 250 mA V_{IN} = V_{SET} + 0.5 V, V_{IN} ≥ 1.9 V			2	15	mV
		RP123K/N	1 mA ≤ I_{OUT} ≤ 250 mA			8	25	
V_{DIF}	Dropout Voltage		I_{OUT} = 250 mA		Refer to *Dropout Voltage Characteristics*			
I_{SS}	Supply Current		I_{OUT} = 0 mA			9.5	25	µA
$I_{STANDBY}$	Standby Current		V_{IN} = V_{SET} = 5.5 V, V_{CE} = 0 V			0.01	0.3	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation		1.2V≤V_{SET}<1.4V	1.9V≤V_{IN}≤5.5V		0.02	0.10	%/V
			1.4V≤V_{SET}<4.3V	V_{SET}+0.5V≤V_{IN}≤5.5V				
			4.3V≤V_{SET}≤4.8V	V_{SET}+0.3V≤V_{IN}≤5.5V				
RR	Ripple Rejection		Ripple 0.2 Vp-p, I_{OUT} = 20 mA	f = 1 kHz		90		dB
				f = 10 kHz		85		
				f = 100 kHz		65		
I_{SC}	Short Current Limit		V_{OUT} = 0 V			45		mA
I_{PD}	CE Pull-down Current					0.25	0.50	µA
V_{CEH}	CE Input Voltage, high				1.0			V
V_{CEL}	CE Input Voltage, low						0.4	V
en	Output Noise		BW = 10Hz to 100kHz	I_{OUT} = 1 mA		12		µVrms
				I_{OUT} = 250 mA		8		
T_{TSD}	Thermal Shutdown Temperature, detection		Junction Temperature			165		ºC
T_{TSR}	Thermal Shutdown Temperature, released		Junction Temperature			110		ºC
R_{LOW}	Auto-discharge NMOS On-resistance (RP123xxxxD only)		V_{IN} = 5.0 V, CE = 0 V,			50		Ω

All test items listed under Electrical Characteristics are done under the pulse load condition (Tj ≈ Ta = 25°C) except Ripple Rejection and Output Noise.

ELECTRICAL CHARACTERISTICS

The specifications surrounded by ☐ are guaranteed by design engineering at -40°C ≤ Ta ≤ 85°C.

Dropout Voltage Characteristics (Ta = 25°C)

Symbol	Parameter		Conditions		Typ.	Max.	Unit
V_{DIF}	Dropout Voltage	RP123Z	I_{OUT}=250mA	1.2 ≤ V_{SET} < 1.6V	(1)	(1)	V
				1.6 ≤ V_{SET} < 1.7V	(1)	0.230 (2)	
				1.7 ≤ V_{SET} < 1.8V	0.140 (2)	0.220	
				1.8 ≤ V_{SET} < 1.9V	0.135	0.205	
				1.9 ≤ V_{SET} < 2.0V	0.125	0.190	
				2.0 ≤ V_{SET} < 2.1V	0.120	0.180	
				2.1 ≤ V_{SET} < 2.2V	0.115	0.170	
				2.2 ≤ V_{SET} < 2.5V	0.110	0.165	
				2.5 ≤ V_{SET} < 2.8V	0.100	0.150	
				2.8 ≤ V_{SET} < 3.3V	0.090	0.140	
				3.3 ≤ V_{SET} < 3.6V	0.080	0.130	
				3.6 ≤ V_{SET} < 4.0V	0.075	0.125	
				4.0 ≤ V_{SET} ≤ 4.8V	0.070	0.120	
		RP123K/N	I_{OUT}=250mA	1.2 ≤ V_{SET} < 1.6V	(1)	(1)	V
				1.6 ≤ V_{SET} < 1.7V	(1)	0.260 (2)	
				1.7 ≤ V_{SET} < 1.8V	0.160 (2)	0.245	
				1.8 ≤ V_{SET} < 1.9V	0.150	0.230	
				1.9 ≤ V_{SET} < 2.0V	0.140	0.215	
				2.0 ≤ V_{SET} < 2.1V	0.135	0.205	
				2.1 ≤ V_{SET} < 2.2V	0.130	0.195	
				2.2 ≤ V_{SET} < 2.5V	0.125	0.190	
				2.5 ≤ V_{SET} < 2.8V	0.115	0.175	
				2.8 ≤ V_{SET} < 3.3V	0.105	0.165	
				3.3 ≤ V_{SET} < 3.6V	0.095	0.155	
				3.6 ≤ V_{SET} < 4.0V	0.090	0.150	
				4.0 ≤ V_{SET} ≤ 4.8V	0.085	0.145	

(1) Input voltage must be equal or more than the minimum operating voltage of 1.9 V, and Dropout Voltage is calculated in the equation of 1.9 V – Output Voltage.
(2) When "Output voltage + Dropout Voltage" < 1.9 V, input voltage must be equal or more than the minimum operating voltage of 1.9 V.

The specifications surrounded by ☐ are guaranteed by design engineering at - 40°C ≤ Ta ≤ 85°C

RP123Z Product-specific Electrical Characteristics

Product Name	V_{OUT} [V]						V_{DIF} [V]	
	Ta = 25°C			−40°C ≤ Ta ≤ 85°C				
	Min.	Typ.	Max.	Min.	Typ.	Max.	Typ.	Max.
RP123Z12xx	1.186	1.200	1.214	1.180	1.200	1.218	(1)	(1)
RP123Z12xx5	1.236	1.250	1.264	1.230	1.250	1.268	(1)	(1)
RP123Z13xx	1.286	1.300	1.314	1.280	1.300	1.319	(1)	(1)
RP123Z14x	1.386	1.400	1.414	1.379	1.400	1.419	(1)	(1)
RP123Z15xx	1.486	1.500	1.514	1.479	1.500	1.519	(1)	(1)
RP123Z16xx	1.586	1.600	1.614	1.578	1.600	1.620	(1)	0.230 (2)
RP123Z17xx	1.686	1.700	1.714	1.678	1.700	1.720	0.140 (2)	0.220
RP123Z18xx	1.786	1.800	1.814	1.777	1.800	1.821	0.135	0.205
RP123Z18xx5	1.836	1.850	1.864	1.826	1.850	1.872	0.135	0.205
RP123Z19xx	1.885	1.900	1.915	1.876	1.900	1.922	0.125	0.190
RP123Z20xx	1.984	2.000	2.016	1.974	2.000	2.024	0.120	0.180
RP123Z21xx	2.084	2.100	2.116	2.073	2.100	2.125	0.115	0.170
RP123Z22xx	2.183	2.200	2.217	2.172	2.200	2.226	0.110	0.165
RP123Z23xx	2.282	2.300	2.318	2.271	2.300	2.327	0.110	0.165
RP123Z24xx	2.381	2.400	2.419	2.369	2.400	2.428	0.110	0.165
RP123Z25xx	2.480	2.500	2.520	2.468	2.500	2.530	0.100	0.150
RP123Z26xx	2.580	2.600	2.620	2.567	2.600	2.631	0.100	0.150
RP123Z27xx	2.679	2.700	2.721	2.665	2.700	2.732	0.100	0.150
RP123Z27xx5	2.728	2.750	2.772	2.715	2.750	2.783	0.100	0.150
RP123Z28xx	2.778	2.800	2.822	2.764	2.800	2.833	0.090	0.140
RP123Z28xx5	2.828	2.850	2.872	2.813	2.850	2.884	0.090	0.140
RP123Z29xx	2.877	2.900	2.923	2.863	2.900	2.934	0.090	0.140
RP123Z29xx5	2.927	2.950	2.973	2.912	2.950	2.985	0.090	0.140
RP123Z30xx	2.976	3.000	3.024	2.961	3.000	3.036	0.090	0.140
RP123Z31xx	3.076	3.100	3.124	3.060	3.100	3.137	0.090	0.140
RP123Z31xx5	3.125	3.150	3.175	3.110	3.150	3.187	0.090	0.140
RP123Z32xx	3.175	3.200	3.225	3.159	3.200	3.238	0.090	0.140
RP123Z33xx	3.274	3.300	3.326	3.258	3.300	3.339	0.080	0.130
RP123Z34xx	3.373	3.400	3.427	3.356	3.400	3.440	0.080	0.130
RP123Z35xx	3.472	3.500	3.528	3.455	3.500	3.542	0.080	0.130
RP123Z36xx	3.572	3.600	3.628	3.554	3.600	3.643	0.075	0.125
RP123Z37xx	3.671	3.700	3.729	3.652	3.700	3.744	0.075	0.125
RP123Z38xx	3.770	3.800	3.830	3.751	3.800	3.845	0.075	0.125
RP123Z39xx	3.869	3.900	3.931	3.850	3.900	3.946	0.075	0.125
RP123Z40xx	3.968	4.000	4.032	3.948	4.000	4.048	0.070	0.120
RP123Z41xx	4.068	4.100	4.132	4.047	4.100	4.149	0.070	0.120
RP123Z42xx	4.167	4.200	4.233	4.146	4.200	4.250	0.070	0.120
RP123Z43xx	4.266	4.300	4.334	4.245	4.300	4.351	0.070	0.120
RP123Z44xx	4.365	4.400	4.435	4.343	4.400	4.452	0.070	0.120
RP123Z45xx	4.464	4.500	4.536	4.442	4.500	4.554	0.070	0.120
RP123Z45xx5	4.514	4.550	4.586	4.491	4.550	4.604	0.070	0.120
RP123Z46xx	4.564	4.600	4.636	4.541	4.600	4.655	0.070	0.120
RP123Z47xx	4.663	4.700	4.737	4.639	4.700	4.756	0.070	0.120
RP123Z48xx	4.762	4.800	4.838	4.738	4.800	4.857	0.070	0.120

(1) Input voltage must be equal or more than the minimum operating voltage of 1.9 V, and Dropout Voltage is calculated in the equation of 1.9 V – Output Voltage.

(2) When "Output voltage + Dropout Voltage" < 1.9 V, input voltage must be equal or more than the minimum operating voltage of 1.9 V.

The specifications surrounded by ☐ are guaranteed by design engineering at - 40°C ≤ Ta ≤ 85°C

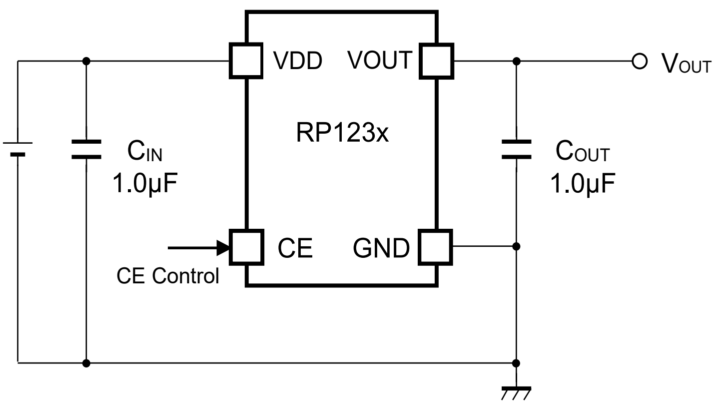
RP123K/Nxx1x Product-specific Electrical Characteristics

Product Name	V_{OUT} [V]						V_{DIF} [V]	
	Ta = 25°C			−40°C ≤ Ta ≤ 85°C				
	Min.	Typ.	Max.	Min.	Typ.	Max.	Typ.	Max.
RP123x121x	1.186	1.200	1.214	1.180	1.200	1.218	(1)	(1)
RP123x121x5	1.236	1.250	1.264	1.230	1.250	1.268	(1)	(1)
RP123x131x	1.286	1.300	1.314	1.280	1.300	1.319	(1)	(1)
RP123x141x	1.386	1.400	1.414	1.379	1.400	1.419	(1)	(1)
RP123x151x	1.486	1.500	1.514	1.479	1.500	1.519	(1)	(1)
RP123x161x	1.586	1.600	1.614	1.578	1.600	1.620	(1)	0.260 (2)
RP123x171x	1.686	1.700	1.714	1.678	1.700	1.720	0.160 (2)	0.245
RP123x181x	1.786	1.800	1.814	1.777	1.800	1.821	0.150	0.230
RP123x181x5	1.836	1.850	1.864	1.826	1.850	1.872	0.150	0.230
RP123x191x	1.885	1.900	1.915	1.876	1.900	1.922	0.140	0.215
RP123x201x	1.984	2.000	2.016	1.974	2.000	2.024	0.135	0.205
RP123x211x	2.084	2.100	2.116	2.073	2.100	2.125	0.130	0.195
RP123x221x	2.183	2.200	2.217	2.172	2.200	2.226	0.125	0.190
RP123x231x	2.282	2.300	2.318	2.271	2.300	2.327	0.125	0.190
RP123x241x	2.381	2.400	2.419	2.369	2.400	2.428	0.125	0.190
RP123x251x	2.480	2.500	2.520	2.468	2.500	2.530	0.115	0.175
RP123x261x	2.580	2.600	2.620	2.567	2.600	2.631	0.115	0.175
RP123x271x	2.679	2.700	2.721	2.665	2.700	2.732	0.115	0.175
RP123x271x5	2.728	2.750	2.772	2.715	2.750	2.783	0.115	0.175
RP123x281x	2.778	2.800	2.822	2.764	2.800	2.833	0.105	0.165
RP123x281x5	2.828	2.850	2.872	2.813	2.850	2.884	0.105	0.165
RP123x291x	2.877	2.900	2.923	2.863	2.900	2.934	0.105	0.165
RP123x291x5	2.927	2.950	2.973	2.912	2.950	2.985	0.105	0.165
RP123x301x	2.976	3.000	3.024	2.961	3.000	3.036	0.105	0.165
RP123x311x	3.076	3.100	3.124	3.060	3.100	3.137	0.105	0.165
RP123x311x5	3.125	3.150	3.175	3.110	3.150	3.187	0.105	0.165
RP123x321x	3.175	3.200	3.225	3.159	3.200	3.238	0.105	0.165
RP123x331x	3.274	3.300	3.326	3.258	3.300	3.339	0.095	0.155
RP123x341x	3.373	3.400	3.427	3.356	3.400	3.440	0.095	0.155
RP123x351x	3.472	3.500	3.528	3.455	3.500	3.542	0.095	0.155
RP123x361x	3.572	3.600	3.628	3.554	3.600	3.643	0.090	0.150
RP123x371x	3.671	3.700	3.729	3.652	3.700	3.744	0.090	0.150
RP123x381x	3.770	3.800	3.830	3.751	3.800	3.845	0.090	0.150
RP123x391x	3.869	3.900	3.931	3.850	3.900	3.946	0.090	0.150
RP123x401x	3.968	4.000	4.032	3.948	4.000	4.048	0.085	0.145
RP123x411x	4.068	4.100	4.132	4.047	4.100	4.149	0.085	0.145
RP123x421x	4.167	4.200	4.233	4.146	4.200	4.250	0.085	0.145
RP123x431x	4.266	4.300	4.334	4.245	4.300	4.351	0.085	0.145
RP123x441x	4.365	4.400	4.435	4.343	4.400	4.452	0.085	0.145
RP123x451x	4.464	4.500	4.536	4.442	4.500	4.554	0.085	0.145
RP123x451x5	4.514	4.550	4.586	4.491	4.550	4.604	0.085	0.145
RP123x461x	4.564	4.600	4.636	4.541	4.600	4.655	0.085	0.145
RP123x471x	4.663	4.700	4.737	4.639	4.700	4.756	0.085	0.145
RP123x481x	4.762	4.800	4.838	4.738	4.800	4.857	0.085	0.145

(1) Input voltage must be equal or more than the minimum operating voltage of 1.9 V, and Dropout Voltage is calculated in the equation of 1.9 V – Output Voltage.

(2) When "Output voltage + Dropout Voltage" < 1.9 V, input voltage must be equal or more than the minimum operating voltage of 1.9 V.

TYPICAL APPLICATION CIRCUIT



RP123x Typical Application Circuit

Technical Notes Related to External Components

- Ensure the VDD and GND lines are sufficiently robust. If their impedances are too high, noise pickup or unstable operation may result. Connect a 1.0 µF or more input capacitor (C_{IN}) between the VDD and GND pins with shortest-distance wiring. It is recommended to use a ceramic capacitor of 6.3 V and more such as the X7R and the X5R having small temperature dependence to ESR, ESL, and capacitance.
- Phase compensation is provided to secure stable operation even when the load current is varied. For this purpose, use a ceramic capacitor of 1.0 µF or more with ESR (Equivalent Series Resistance) of up to 300 mΩ to connect the output capacitor (C_{OUT}) between the VOUT and GND pins with shortest-distance wiring. Besides, set for the output capacitor to ensure the following effective capacitance in consideration of the dependence of temperature, DC bias, and package size.

Set Output Voltage (V_{SET})	Effective Capacitance
1.2 V ≤ V_{SET} < 2.0 V	0.75 µF and more
2.0 V ≤ V_{SET} < 3.4 V	0.70 µF and more
3.4 V ≤ V_{SET} ≤ 4.8 V	0.60 µF and more

In case of using a tantalum type capacitor with a large ESR, the output might become unstable. Evaluate your circuit including consideration of frequency characteristics with a parallel connection the above ceramic and the tantalum type capacitors.

THEORY OF OPERATION

Inrush Current Limit

The inrush current limit value at start-up increases in proportion to the capacitance of C_{OUT}. If not flow the load current (I_{LOAD}) except the charge current to C_{OUT}, the inrush current reaches 150 mA when the effective capacitance of C_{OUT} becomes approx. 3.6 µF or more, and the inrush current limit protection runs. During appr.700 µs after the CE pin becomes "H", the inrush current, which occurs at charging the capacitor of C_{OUT}, is limited at approx.150 mA. The power-on time (t_{ON}) can be calculated from the following equation. If the capacitance value of C_{OUT} is too much, the time-out occurs and the inrush current increases.

$$t_{ON} = t_D + C_{OUT} \cdot V_{SET} / I_{LIM\_START}$$

t_D : Delay Time at Start-up Typ.50 µs
V_{SET} : Set Output Voltage
I_{LIM_START}: Limit Current at Start-up Typ.150 mA

If flow the load current (I_{LOAD}) except the charge current to C_{OUT} during start-up, the start-up time becomes longer. The load current over I_{LIM_START} cannot be applied.

Minimum Operating Voltage

The RP123x does not include an UVLO circuit. To make the internal circuit operate normally and to ensure good output regulation, V_{IN} has to be: $V_{IN} \geq V_{SET} + V_{DIF}$ (Min.1.9 V). To bring out the best characteristics of the output noise voltage, the ripple rejection and the load transient response, V_{IN} has to be $V_{IN} = V_{SET} + 1.0$ V.

Thermal Shutdown Protection

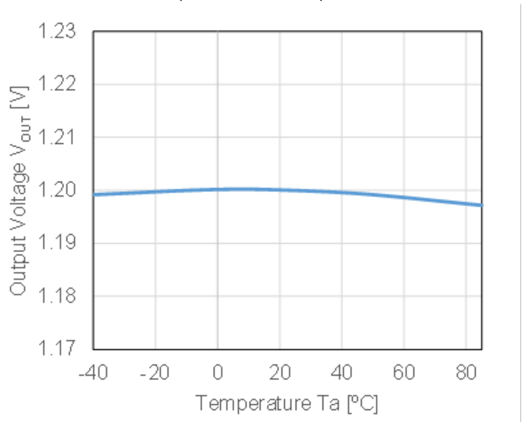
Thermal shutdown deactivates the circuit when the junction temperature exceeds the thermal shutdown threshold (T_{TSD}) of Typ. 165°C, and reactivates it when the junction temperature falls below the thermal shutdown release threshold (T_{TSR}) of Typ. 110°C. During the reactivation, the inrush current limit is in operation. Note that deactivation and activation cycle can be repeated due to load, heat dissipation and ambient temperature conditions. Thermal shutdown cannot be used for the purpose of heat sink, so the repetitive cycles of deactivation and activation may affect the reliability of the device.

TYPICAL CHARACTERISTICS

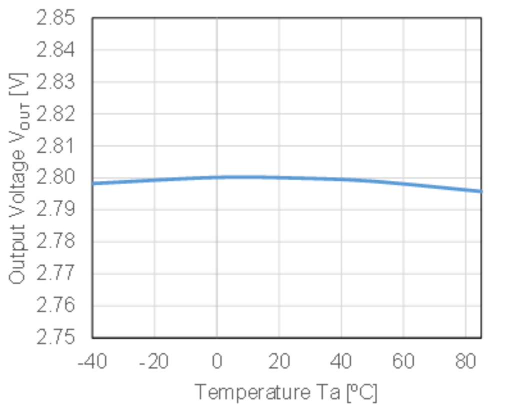
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Output Voltage vs Temperature (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF)

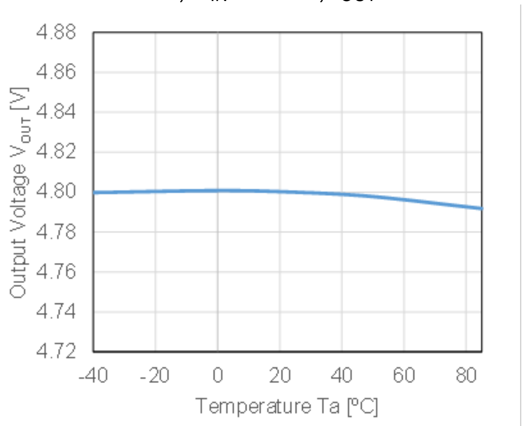
RP123x12xx, V_{IN} = 2.2 V, I_{OUT} = 1 mA



RP123x28xx, V_{IN} = 3.8 V, I_{OUT} = 1 mA

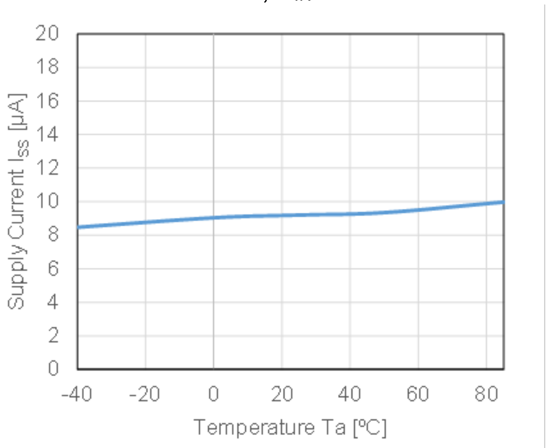


RP123x48xx, V_{IN} = 5.5 V, I_{OUT} = 1 mA

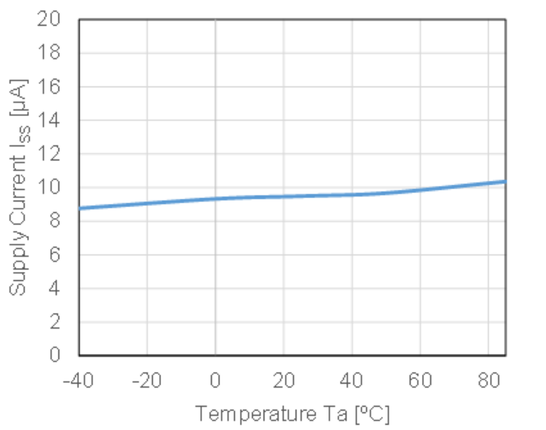


2) Supply Current vs Temperature (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF)

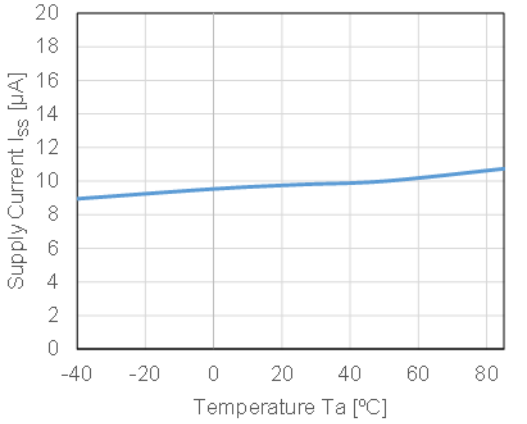
RP123x12xx, V_{IN} = 2.2 V



RP123x28xx, V_{IN} = 3.8 V

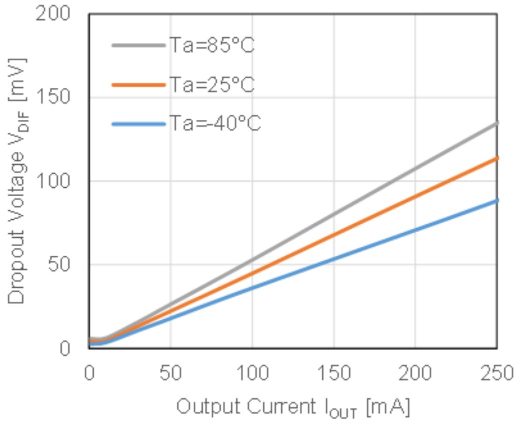


RP123x48xx, V_{IN} = 5.5 V

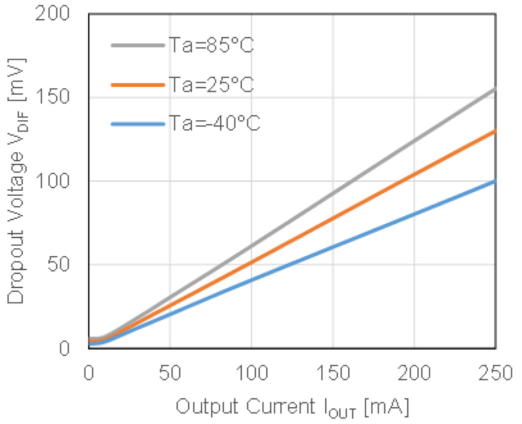


3) Dropout Voltage vs Output Current (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF)

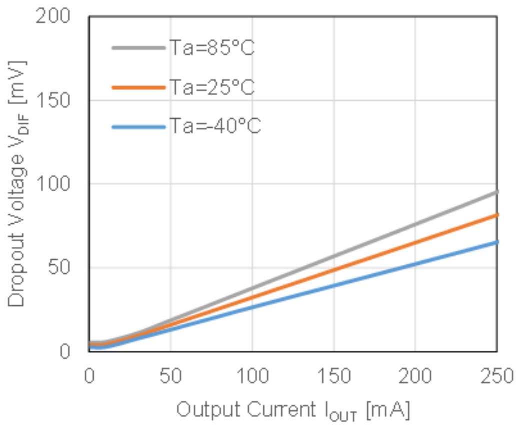
RP123Z18xx



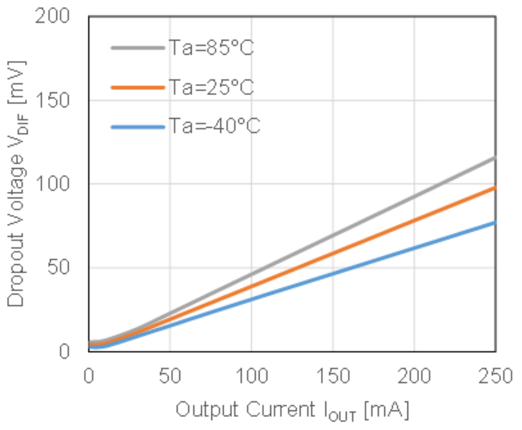
RP123K/N181x



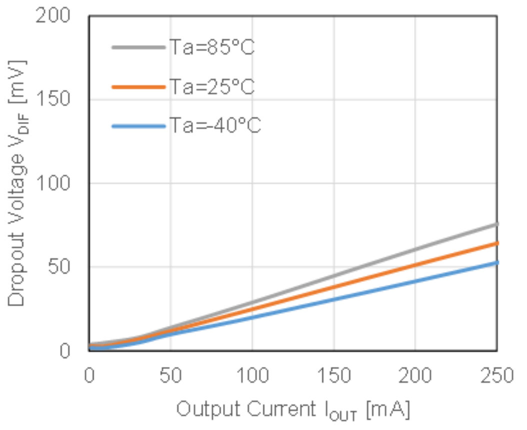
RP123Z28xx



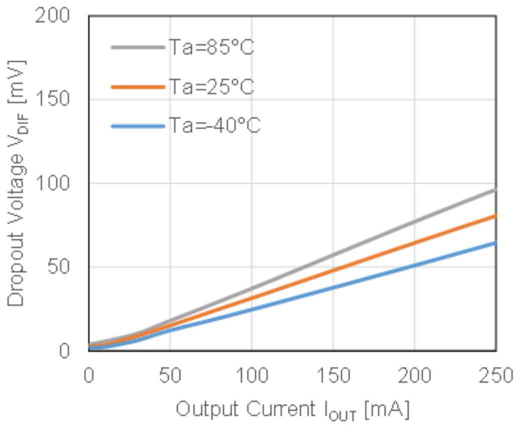
RP123K/N281x



RP123Z48xx

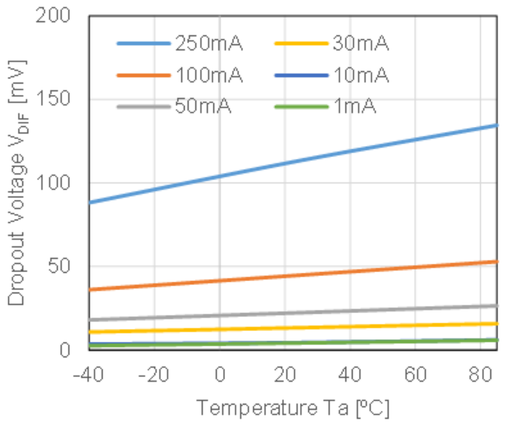


RP123K/N481x

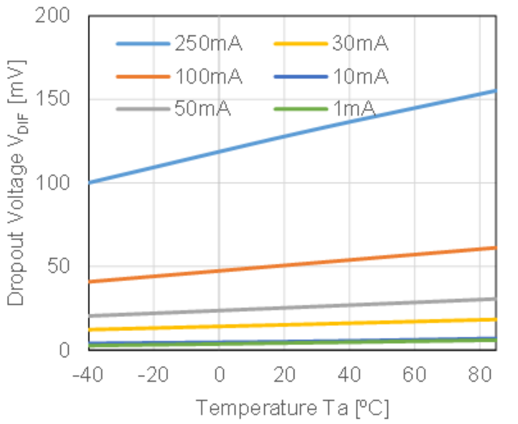


4) Dropout Voltage vs Temperature (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF)

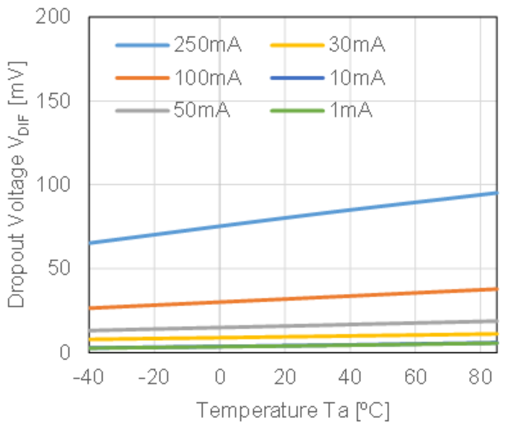
RP123Z18xx



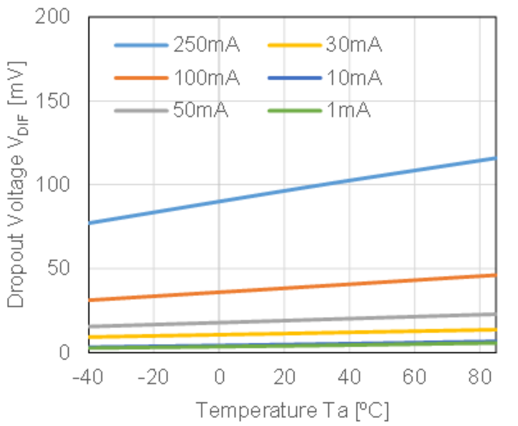
RP123K/N181x



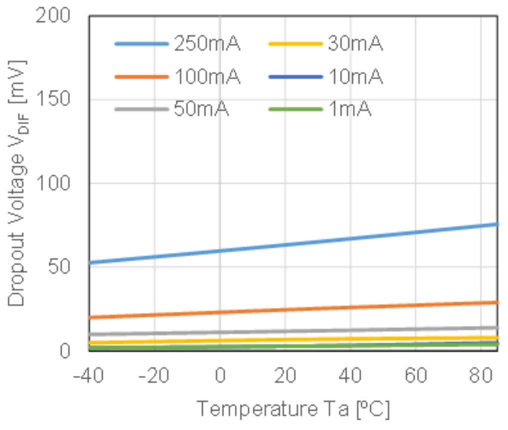
RP123Z28xx



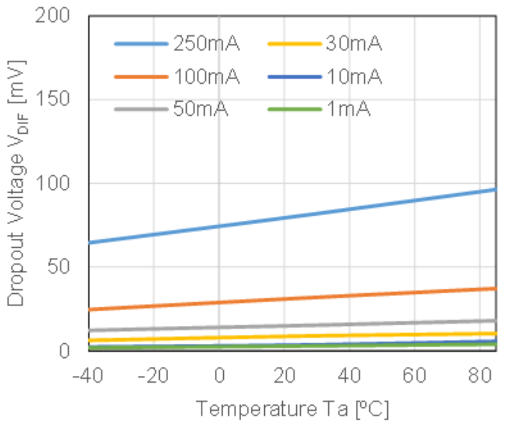
RP123K/N281x



RP123Z48xx

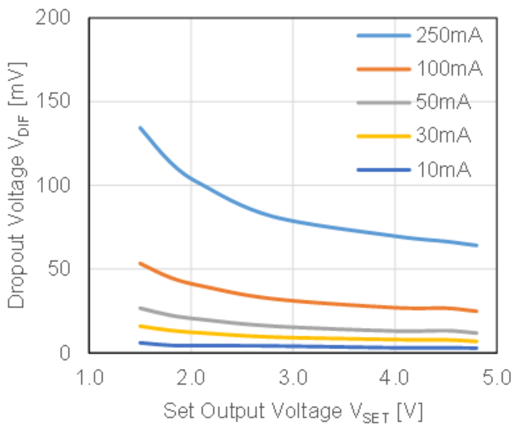


RP123K/N481x

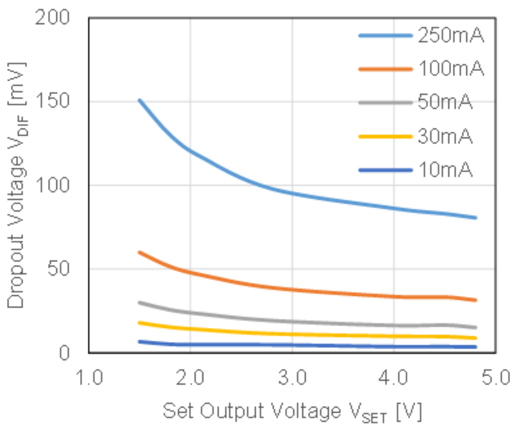


5) Dropout Voltage vs Set Output Voltage (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

RP123Zxxxx

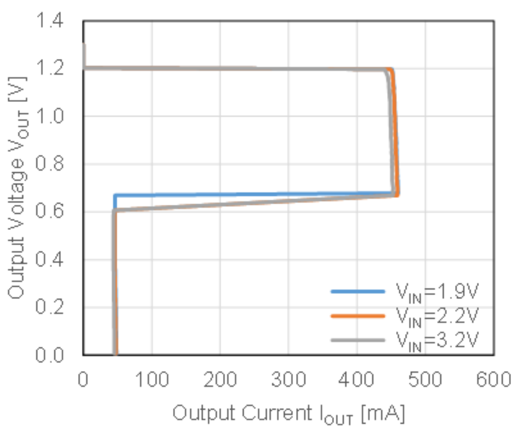


RP123K/Nxx1x

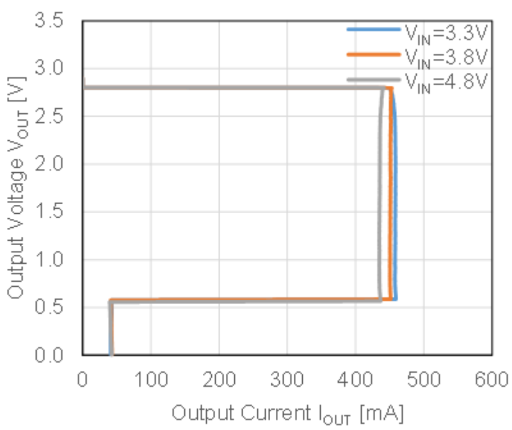


6) Output Voltage vs Output Current (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

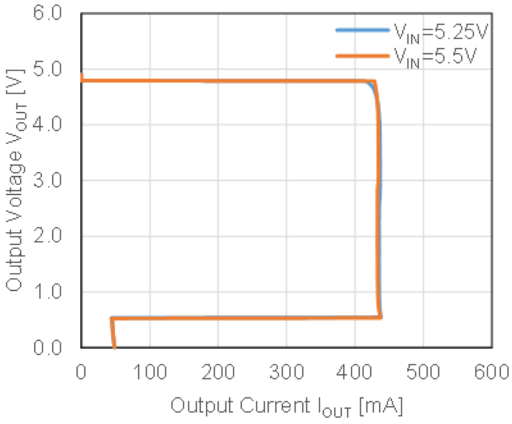
RP123x12xx



RP123x28xx

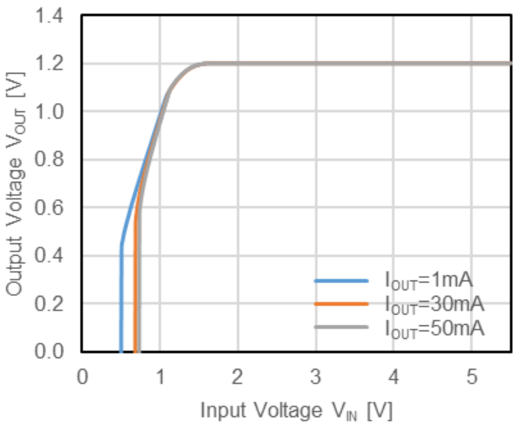


RP123x48xx

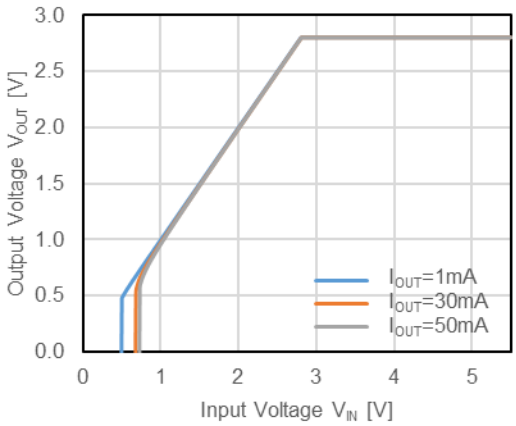


7) Output Voltage vs Input Voltage (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

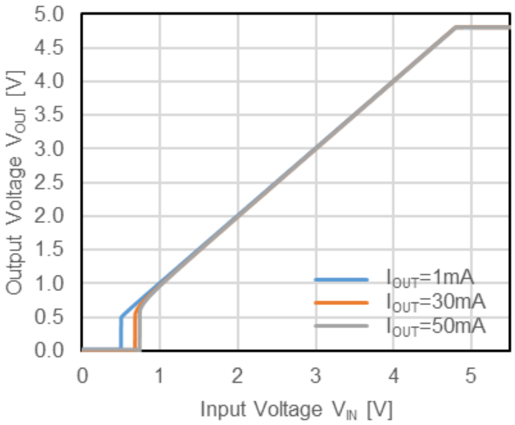
RP123x12xx



RP123x28xx

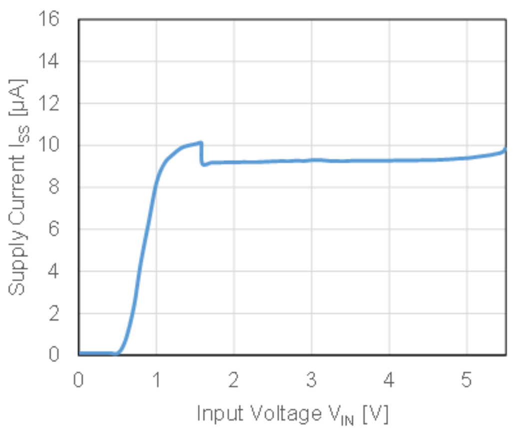


RP123x48xx

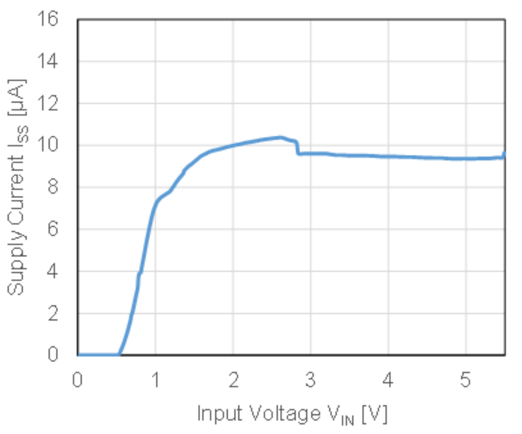


8) **Supply Current vs Input Voltage (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)**

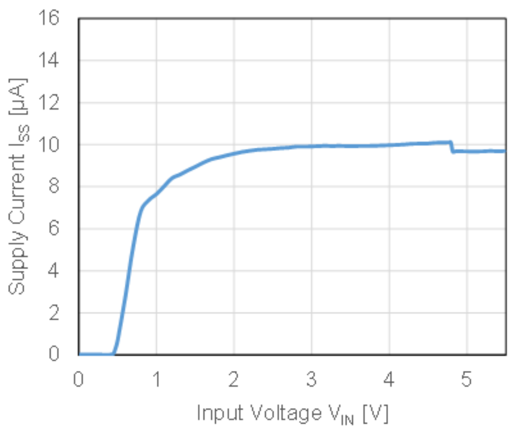
RP123x12xx



RP123x28xx

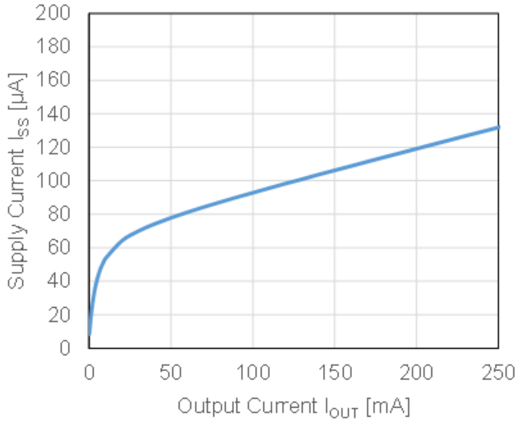


RP123x48xx

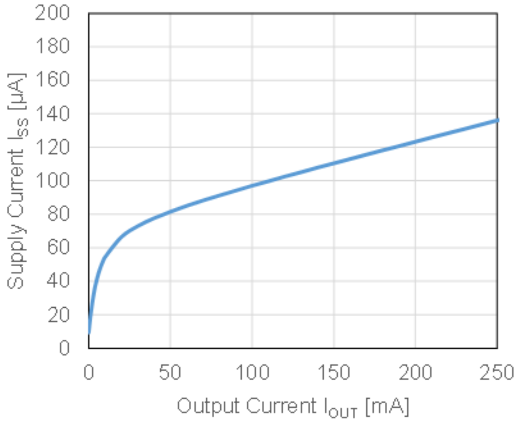


9) **Supply Current vs Output Current (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)**

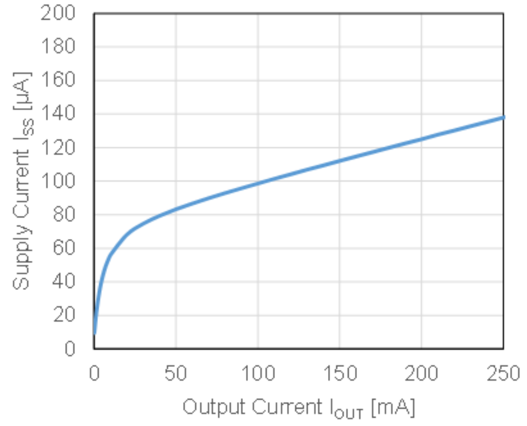
RP123x12xx, V_{IN} = 2.2 V



RP123x28xx, V_{IN} = 3.8 V

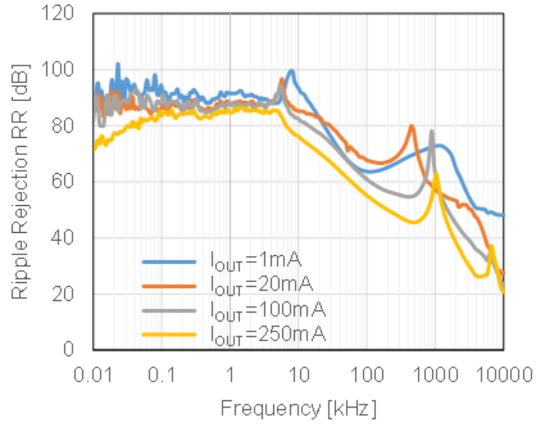


RP123x48xx, V_{IN} = 5.5 V

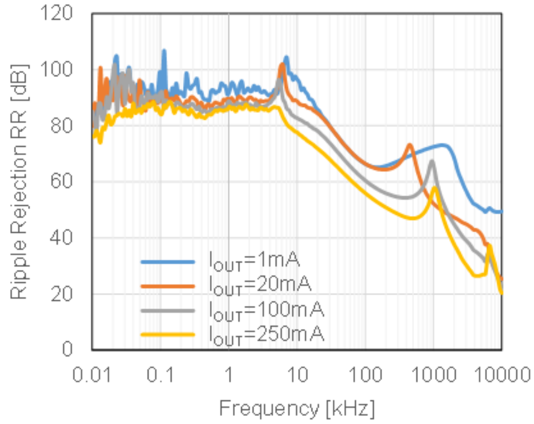


10) Ripple Rejection vs Frequency (C_{OUT} = Ceramic 1.0 µF, Ripple = 0.2 Vp-p, Ta = 25°C)

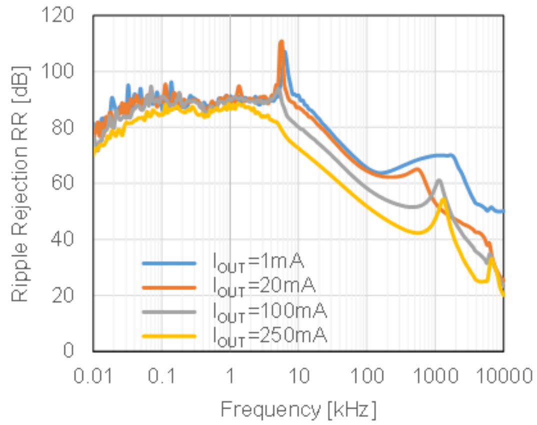
RP123x12xx, V_{IN} = 2.2 V



RP123x28xx, V_{IN} = 3.8 V

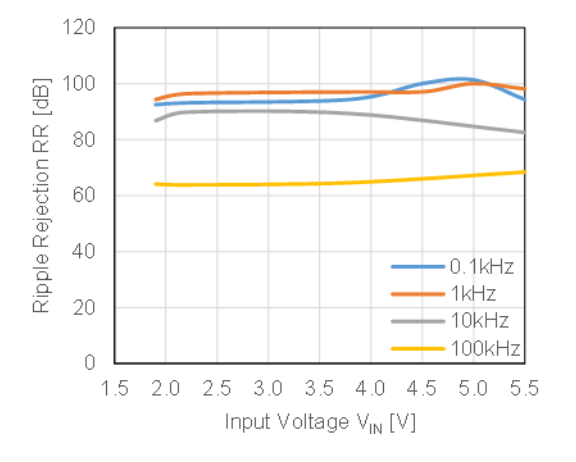


RP123x48xx, V_{IN} = 5.5 V

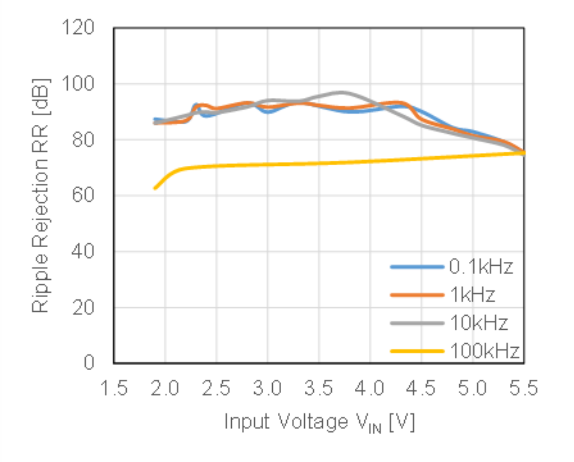


11) Ripple Rejection vs Input Bias Voltage (C_{OUT} = Ceramic 1.0 µF, Ripple = 0.2 Vp-p, Ta = 25°C)

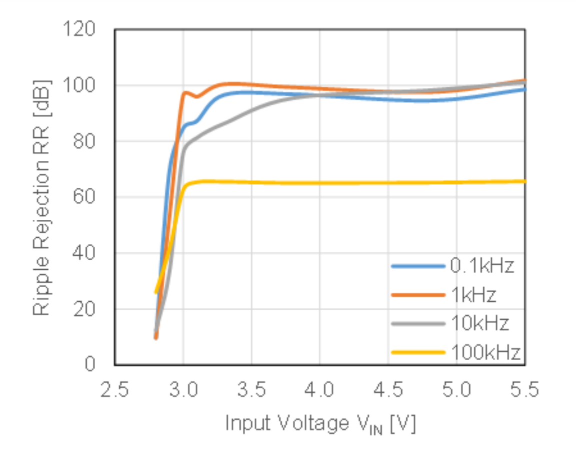
RP123x12xx, I_{OUT} = 1 mA



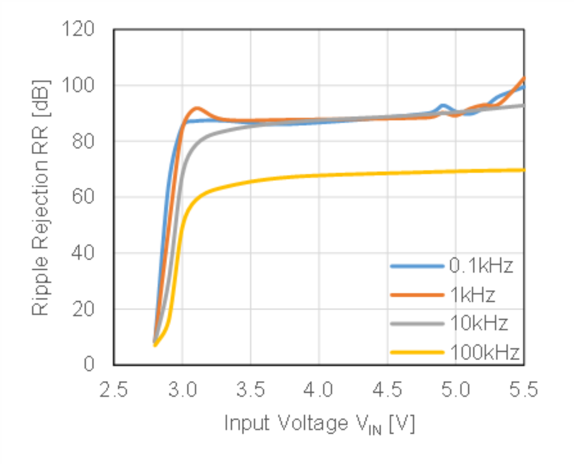
RP123x12xx, I_{OUT} = 20 mA



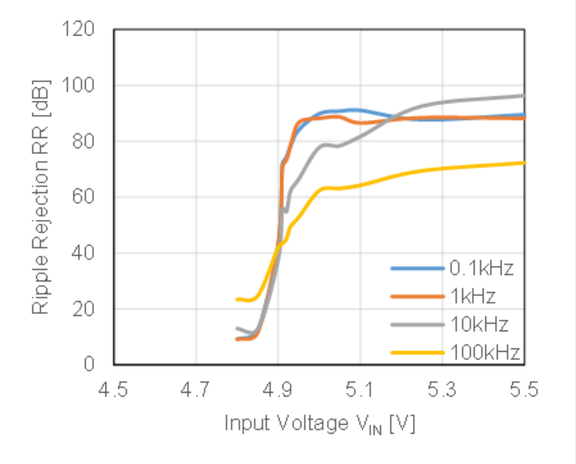
RP123x28xx, I_{OUT} = 1 mA



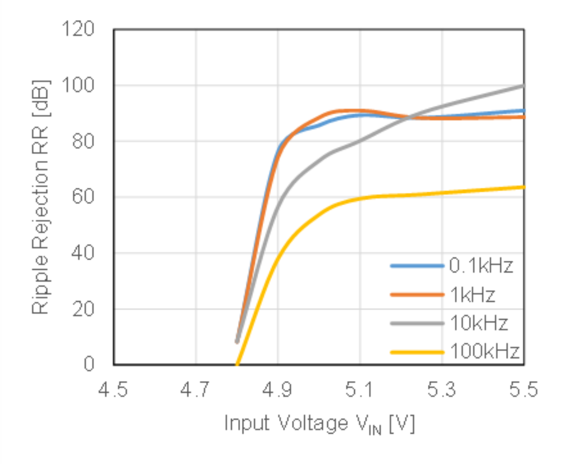
RP123x28xx, I_{OUT} = 20 mA



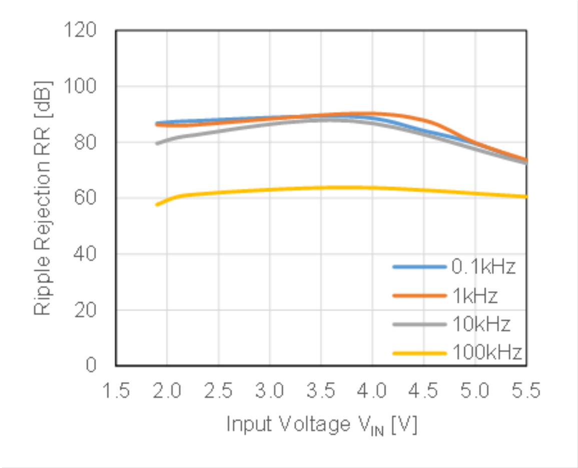
RP123x48xx, I_{OUT} = 1 mA



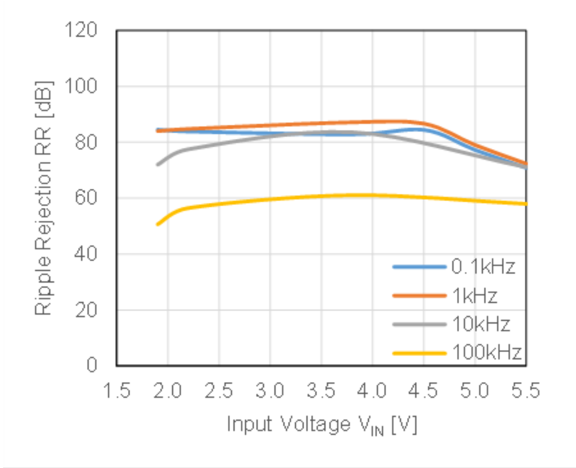
RP123x48xx, I_{OUT} = 20 mA



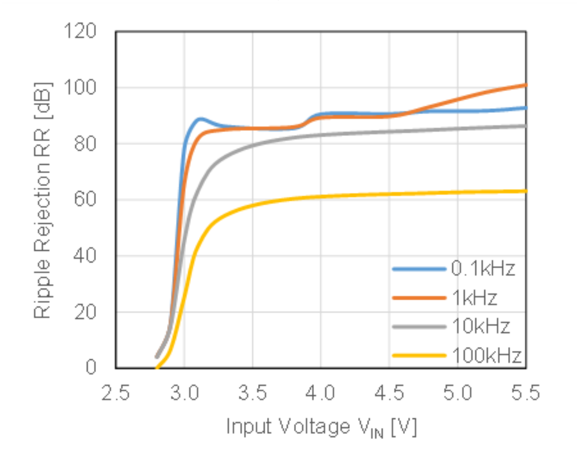
RP123x12xx, I_{OUT} = 100 mA



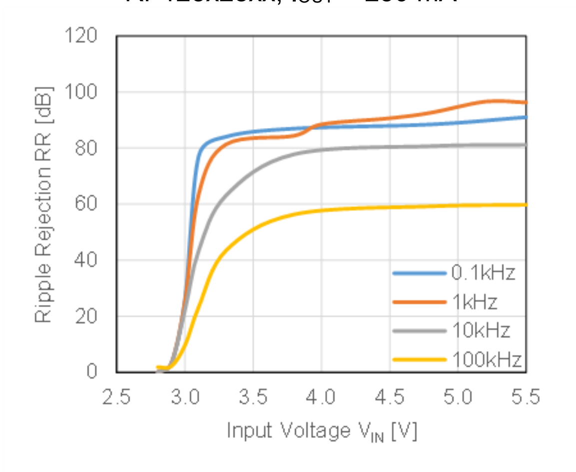
RP123x12xx, I_{OUT} = 250 mA



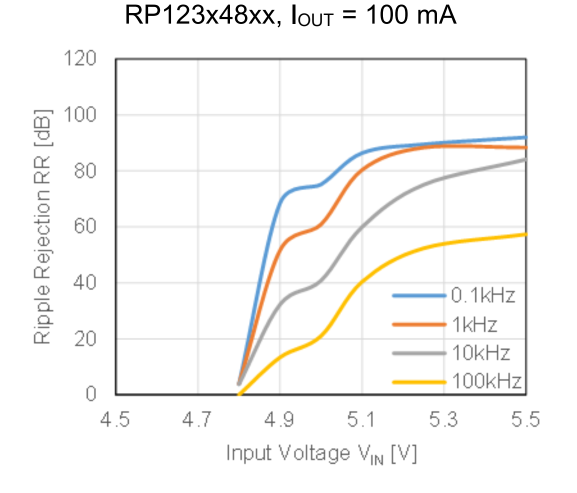
RP123x28xx, I_{OUT} = 100 mA



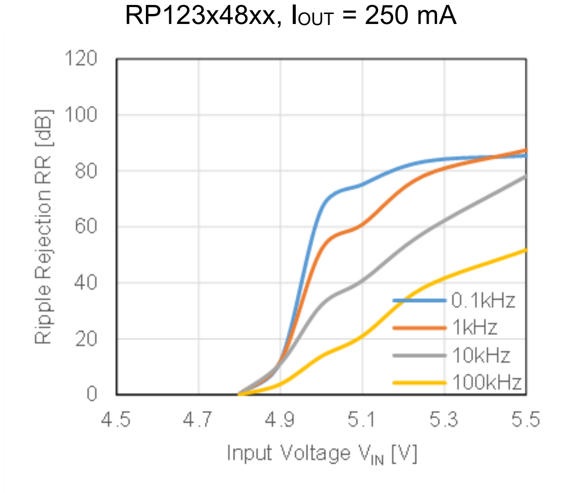
RP123x28xx, I_{OUT} = 250 mA



RP123x48xx, I_{OUT} = 100 mA

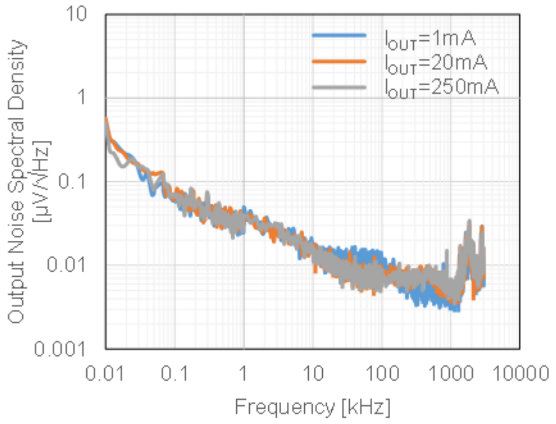


RP123x48xx, I_{OUT} = 250 mA

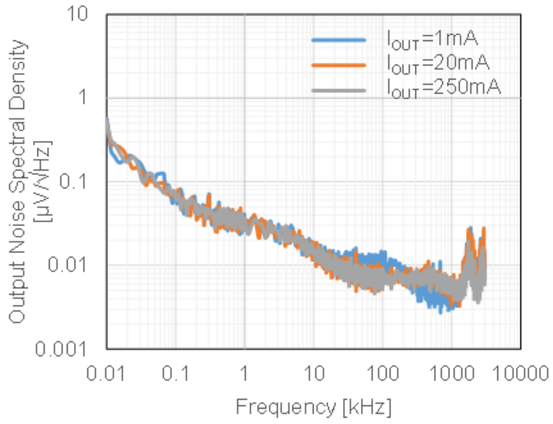


12) Output Noise Spectral Density vs Frequency (C_{IN}=Ceramic 1.0µF, C_{OUT}=Ceramic 1.0µF, Ta=25°C)

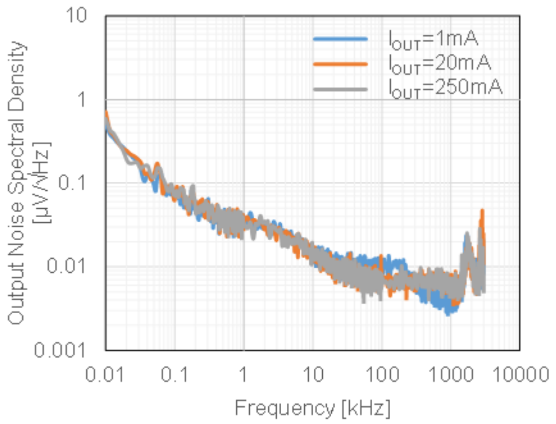
RP123x12xx, V_{IN} = 2.2 V



RP123x28xx, V_{IN} = 3.8 V

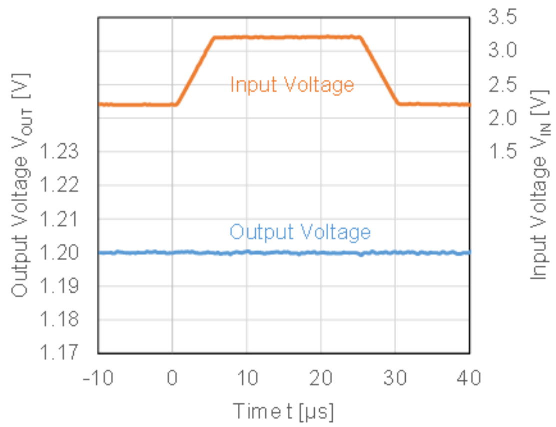


RP123x48xx, V_{IN} = 5.5 V

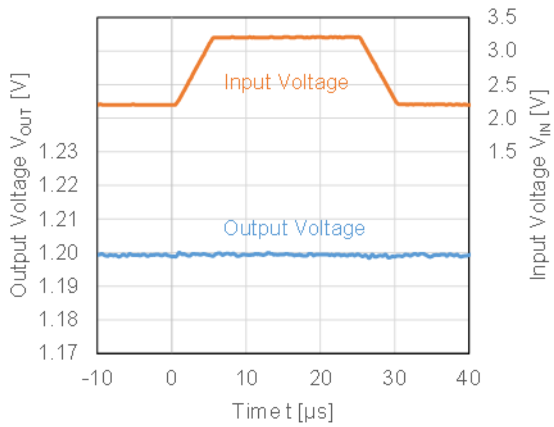


13) Input Transient Response (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, t_R = t_F = 5 µs, Ta = 25°C)

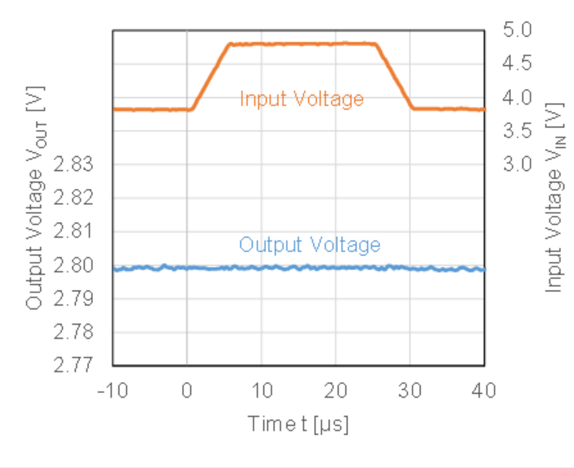
RP123x12xx, I_{OUT} = 1 mA



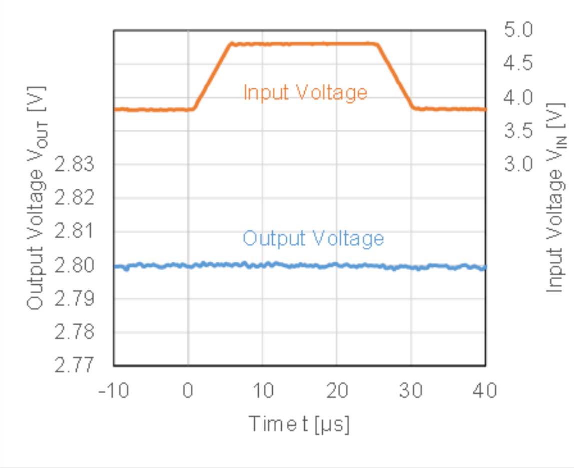
RP123x12xx, I_{OUT} = 20 mA



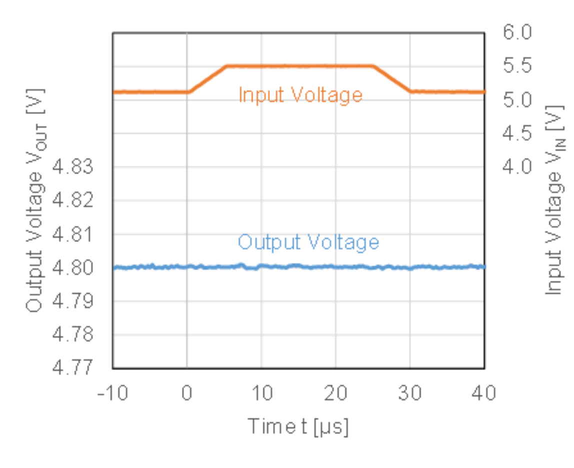
RP123x28xx, I_{OUT} = 1 mA



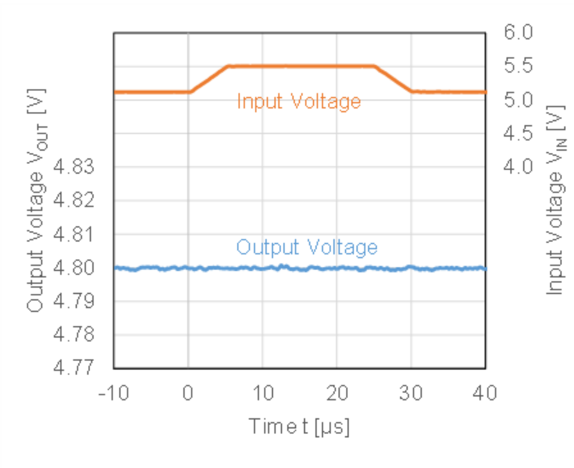
RP123x28xx, I_{OUT} = 20 mA



RP123x48xx, I_{OUT} = 1 mA

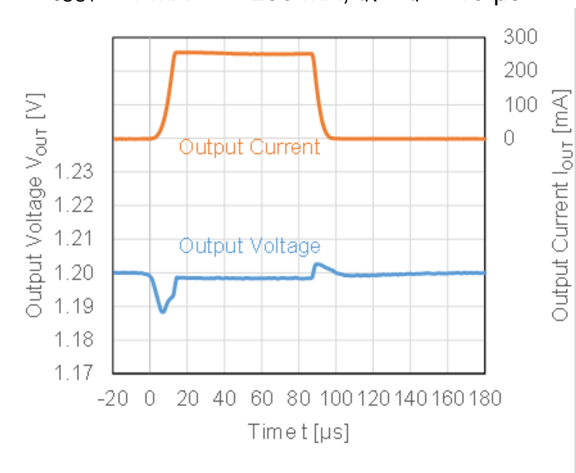


RP123x48xx, I_{OUT} = 20 mA

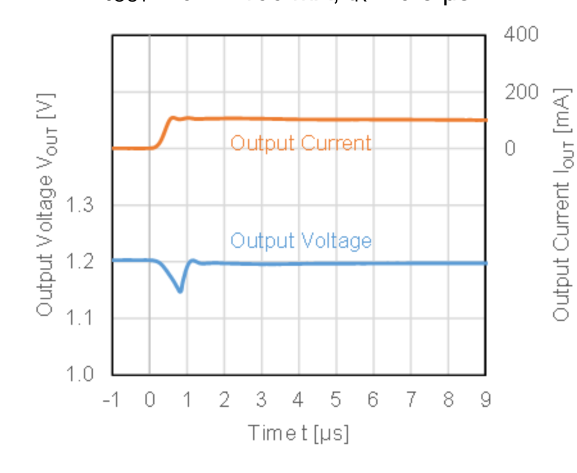


14) Load Transient Response (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

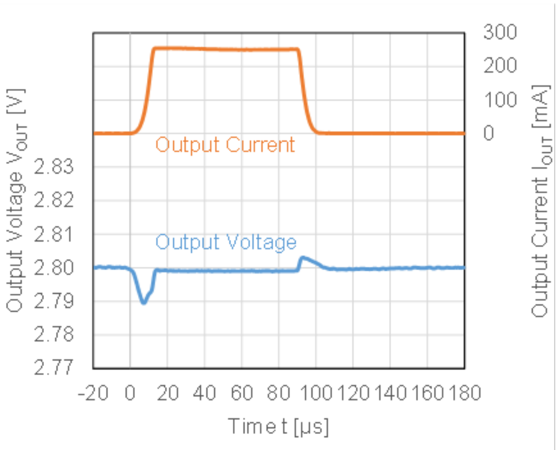
RP123x12xx, V_{IN} = 2.2 V,
I_{OUT} = 1 mA <=> 250 mA, t_R = t_F = 10 µs



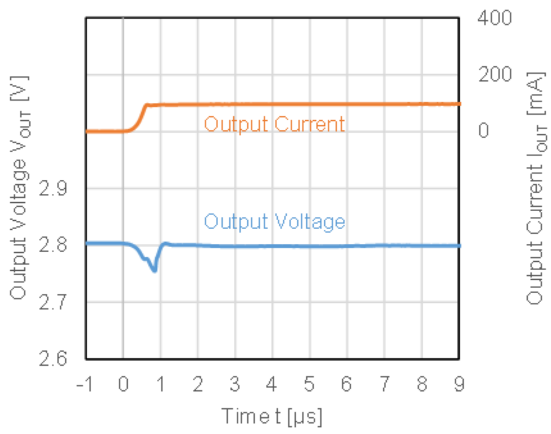
RP123x12xx, V_{IN} = 2.2 V,
I_{OUT} = 0 => 100 mA, t_R = 0.5 µs



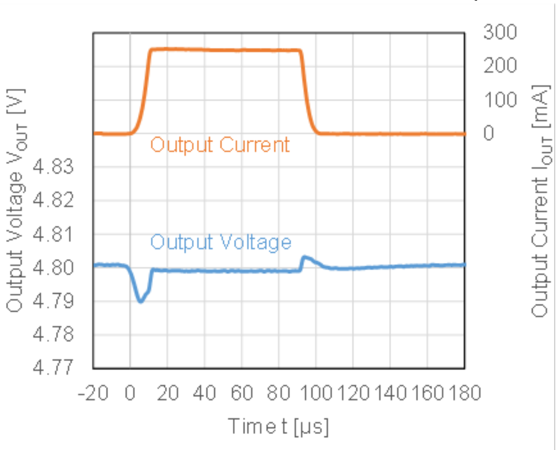
RP123x28xx, V_{IN} = 3.8 V,
I_{OUT} = 1 mA <=> 250 mA, t_R = t_F = 10 μs



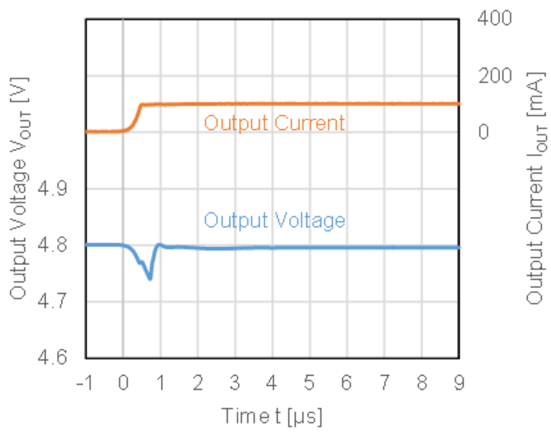
RP123x28xx, V_{IN} = 3.8 V,
I_{OUT} = 0 => 100 mA, t_R = 0.5 μs



RP123x48xx, V_{IN} = 5.5 V,
I_{OUT} = 1 mA <=> 250 mA, t_R = t_F = 10 μs

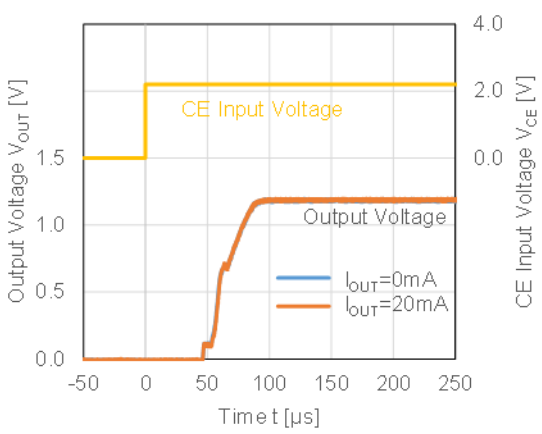


RP123x48xx, V_{IN} = 5.5 V,
I_{OUT} = 0 => 100 mA, t_R = 0.5 μs

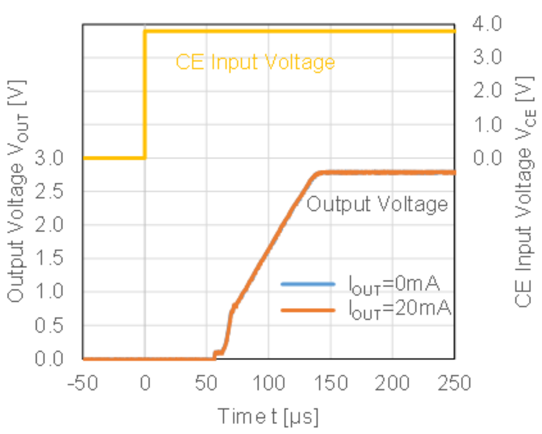


15) Turn On Speed with CE pin (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

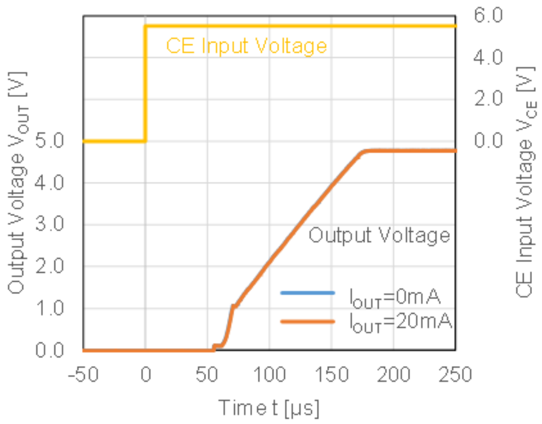
RP123x12xx, V_{IN} = 2.2 V



RP123x28xx, V_{IN} = 3.8 V

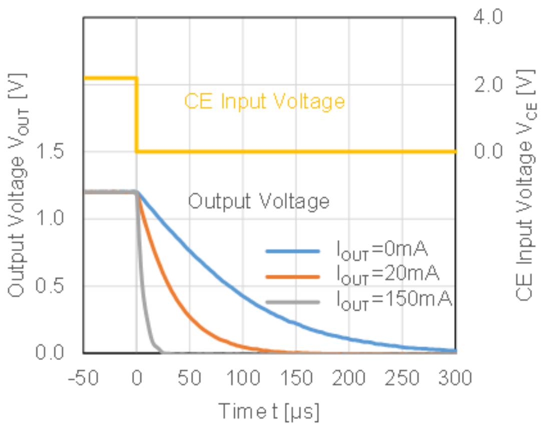


RP123x48xx, V_{IN} = 5.5V

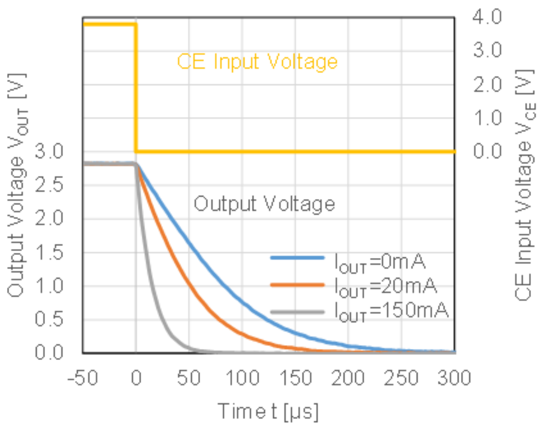


16) Turn Off Speed with CE pin (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

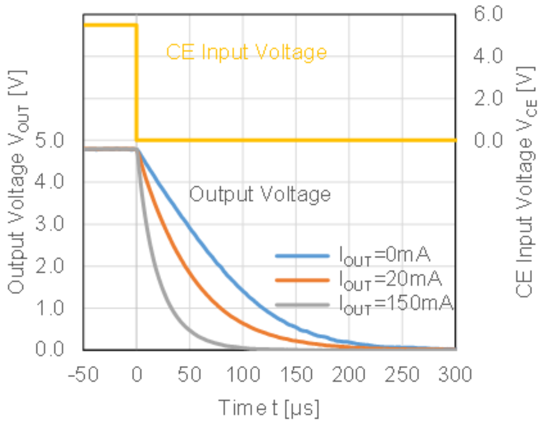
RP123x12xD, V_{IN} = 2.2 V



RP123x28xD, V_{IN} = 3.8 V

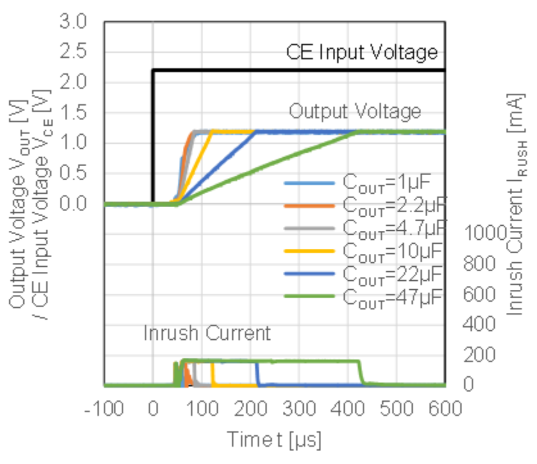


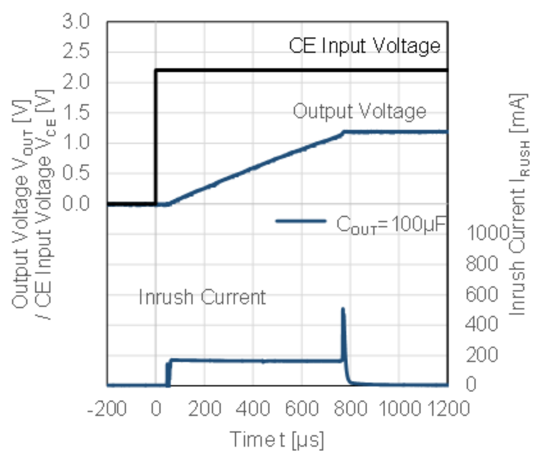
RP123x48xD, V_{IN} = 5.5V



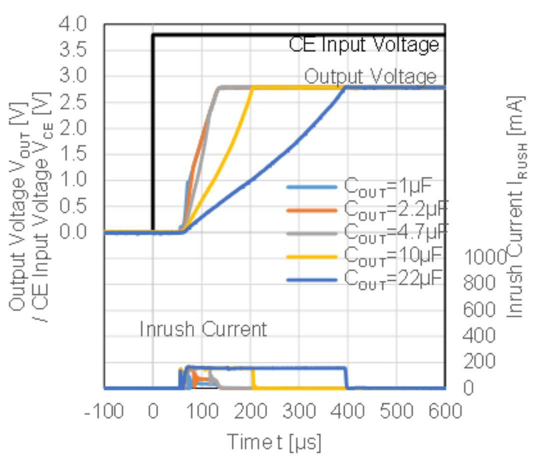
17) Inrush Current (C_{IN} = Ceramic 1.0 μF, I_{OUT} = 0 mA, Ta = 25°C)

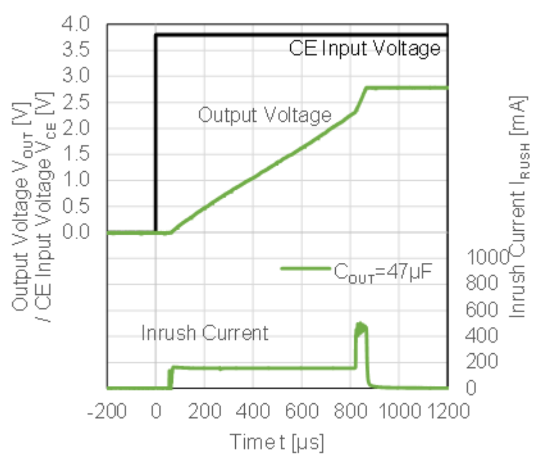
RP123x12xx, V_{IN} = 2.2 V



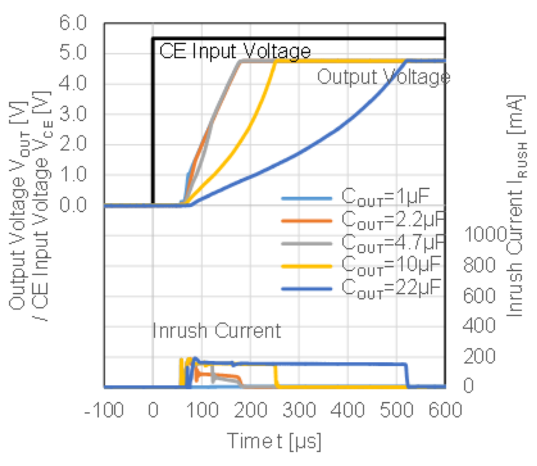


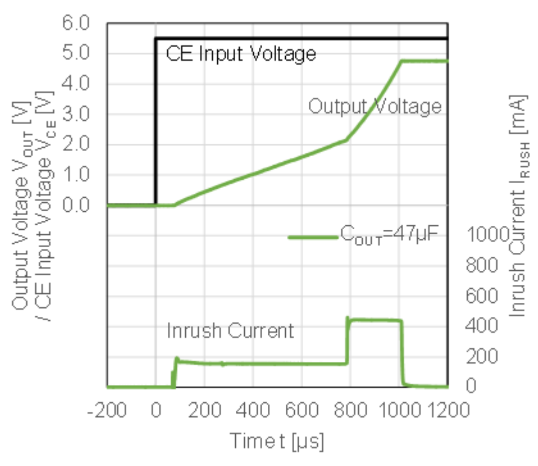
RP123x28xx, V_{IN} = 3.8 V



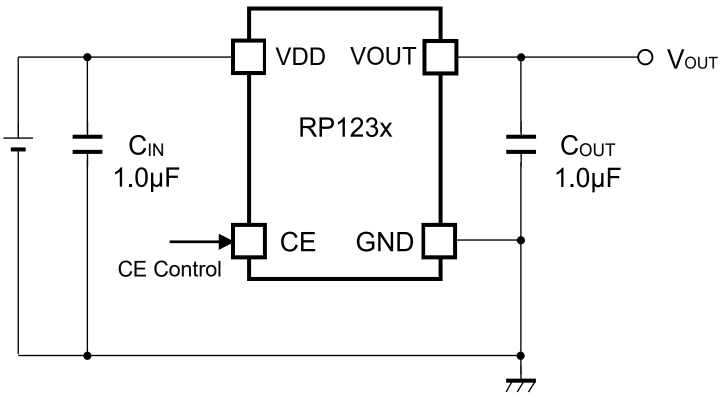


RP123x48xx, V_{IN} = 5.5 V





Test Circuit



Test Circuit of Typical Characteristics

Measurement Components of Typical Characteristics

Symbol	Capacitance	Manufacture	Parts Number
C_{IN}	1.0 µF	Murata	GRM155R61A105KE15
C_{OUT}	1.0 µF	Murata	GRM155R61A105KE15

PD-WLCSP-4-P8-RP122/RP123-JE-A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-9.

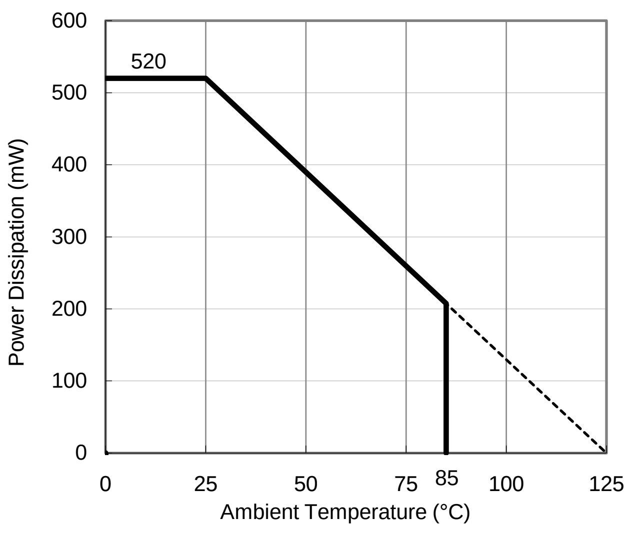
Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	101.5 mm x 114.5 mm x 1.6 mm
Copper Ratio	Outer Layer (First Layer): 60% Inner Layers (Second and Third Layers): 100% Outer Layer (Fourth Layer): 60%

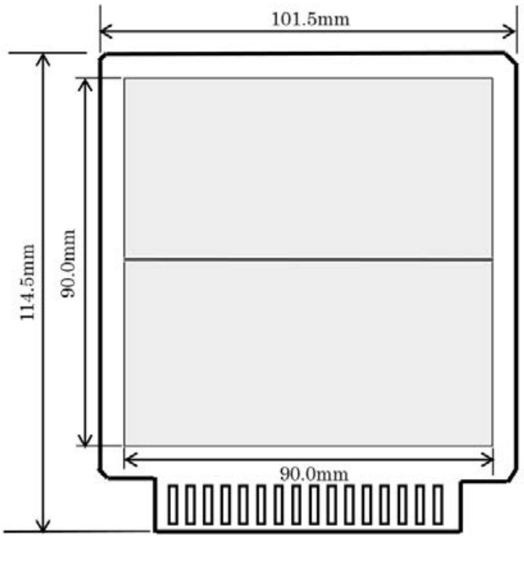
Measurement Result (Ta = 25°C, Tjmax = 125°C)

Item	Measurement Result
Power Dissipation	520 mW
Thermal Resistance (θja)	θja = 192°C/W

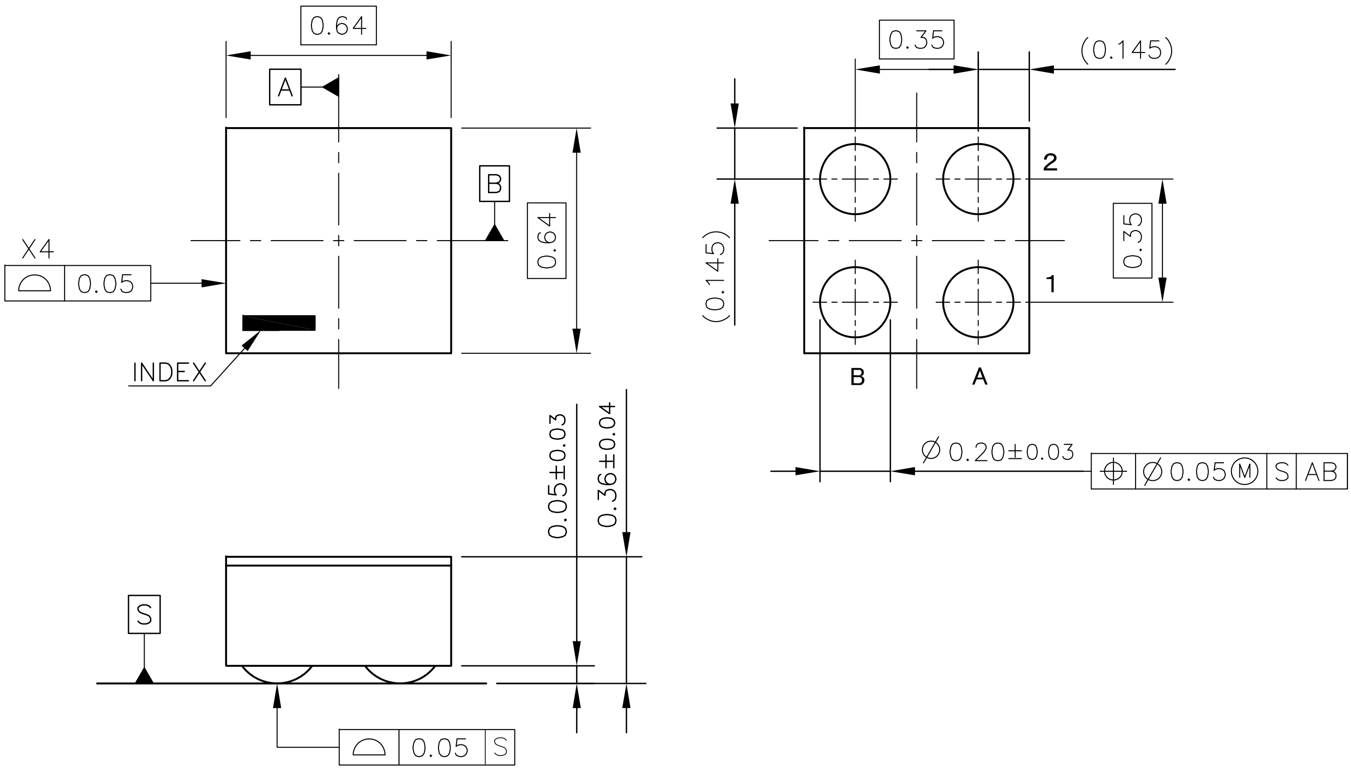
θja: Junction-to-Ambient Thermal Resistance



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern



WLCSP-4-P8 Package Dimensions (Unit: mm)

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.

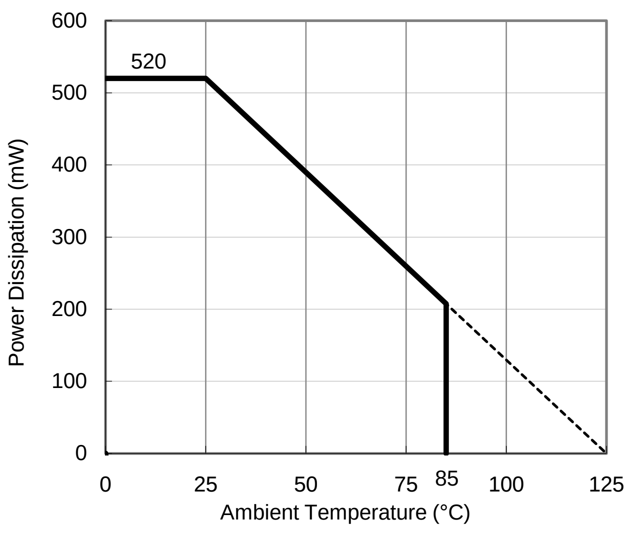
Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	101.5 mm x 114.5 mm x 1.6 mm
Copper Ratio	Outer Layer (First Layer): 60% Inner Layers (Second and Third Layers): 100% Outer Layer (Fourth Layer): 60%

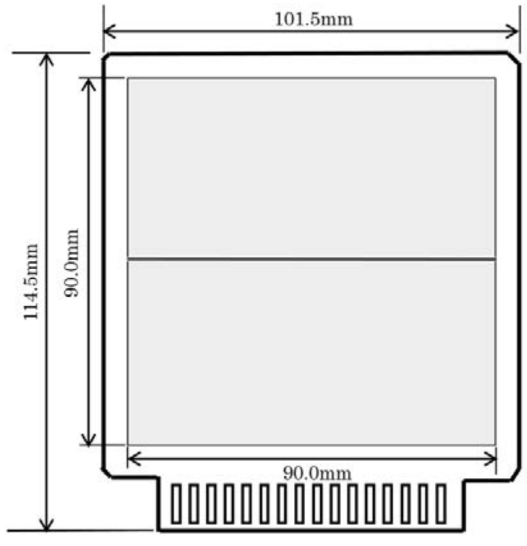
Measurement Result (Ta = 25°C, Tjmax = 125°C)

Item	Measurement Result
Power Dissipation	520 mW
Thermal Resistance (θja)	θja = 192°C/W

θja: Junction-to-Ambient Thermal Resistance

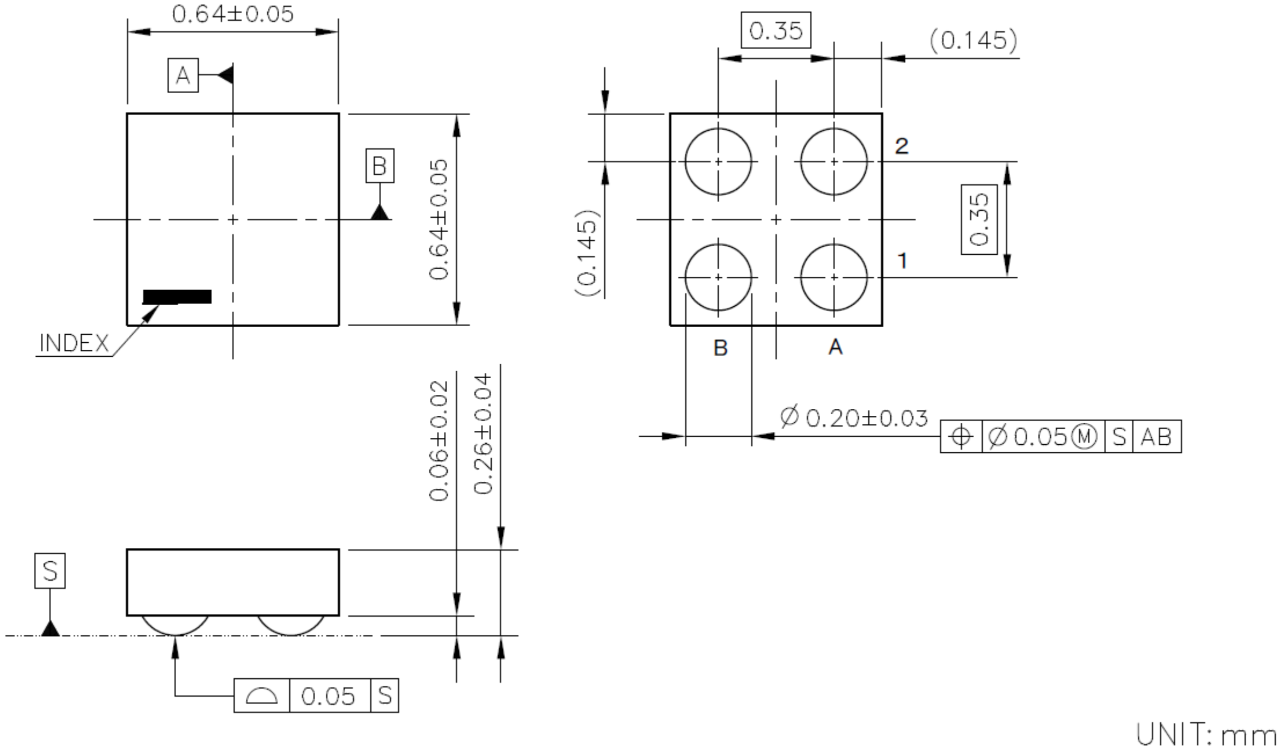


Power Dissipation vs. Ambient Temperature

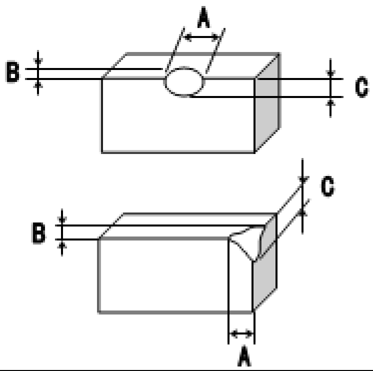


Measurement Board Pattern

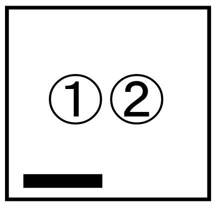
DM-WLCSP-4-P12-JE-A



WLCSP-4-P12 Package Dimensions

No.	Inspection Items	Inspection Criteria	Figure
1	Package chipping	A≥0.2mm is rejected B≥0.2mm is rejected C≥0.2mm is rejected And, Package chipping to Si surface and to bump is rejected.	
2	Si surface chipping	A≥0.2mm is rejected B≥0.2mm is rejected C≥0.2mm is rejected But, even if A≥0.2mm, B≤0.1mm is acceptable.	
3	No bump	No bump is rejected.	
4	Marking miss	To reject incorrect marking, such as another product name marking or another lot No. marking.	
5	No marking	To reject no marking on the package.	
6	Reverse direction of marking	To reject reverse direction of marking character.	
7	Defective marking	To reject unreadable marking. (Microscope: X15/ White LED/ Viewed from vertical direction)	
8	Scratch	To reject unreadable marking character by scratch. (Microscope: X15/ White LED/ Viewed from vertical direction)	
9	Stain and Foreign material	To reject unreadable marking character by stain and foreign material. (Microscope: X15/ White LED/ Viewed from vertical direction)	

①②: Lot Number ··· Alphanumeric Serial Number



RP123Z (WLCSP-4-P8 / WLCSP-4-P12) Part Markings

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.

MK-RP123Z-JAEA-C

RP123Z Part Marking List: RP123Zxx1x, RP123Zxx3x

Product Name	① ②	Product Name	① ②	Set Voltage
RP123Z12xB	Lot No.	RP123Z12xD	Lot No.	1.20 V
RP123Z13xB	Lot No.	RP123Z13xD	Lot No.	1.30 V
RP123Z14xB	Lot No.	RP123Z14xD	Lot No.	1.40 V
RP123Z15xB	Lot No.	RP123Z15xD	Lot No.	1.50 V
RP123Z16xB	Lot No.	RP123Z16xD	Lot No.	1.60 V
RP123Z17xB	Lot No.	RP123Z17xD	Lot No.	1.70 V
RP123Z18xB	Lot No.	RP123Z18xD	Lot No.	1.80 V
RP123Z19xB	Lot No.	RP123Z19xD	Lot No.	1.90 V
RP123Z20xB	Lot No.	RP123Z20xD	Lot No.	2.00 V
RP123Z21xB	Lot No.	RP123Z21xD	Lot No.	2.10 V
RP123Z22xB	Lot No.	RP123Z22xD	Lot No.	2.20 V
RP123Z23xB	Lot No.	RP123Z23xD	Lot No.	2.30 V
RP123Z24xB	Lot No.	RP123Z24xD	Lot No.	2.40 V
RP123Z25xB	Lot No.	RP123Z25xD	Lot No.	2.50 V
RP123Z26xB	Lot No.	RP123Z26xD	Lot No.	2.60 V
RP123Z27xB	Lot No.	RP123Z27xD	Lot No.	2.70 V
RP123Z28xB	Lot No.	RP123Z28xD	Lot No.	2.80 V
RP123Z29xB	Lot No.	RP123Z29xD	Lot No.	2.90 V
RP123Z30xB	Lot No.	RP123Z30xD	Lot No.	3.00 V
RP123Z31xB	Lot No.	RP123Z31xD	Lot No.	3.10 V
RP123Z32xB	Lot No.	RP123Z32xD	Lot No.	3.20 V
RP123Z33xB	Lot No.	RP123Z33xD	Lot No.	3.30 V
RP123Z34xB	Lot No.	RP123Z34xD	Lot No.	3.40 V
RP123Z35xB	Lot No.	RP123Z35xD	Lot No.	3.50 V
RP123Z36xB	Lot No.	RP123Z36xD	Lot No.	3.60 V
RP123Z37xB	Lot No.	RP123Z37xD	Lot No.	3.70 V
RP123Z38xB	Lot No.	RP123Z38xD	Lot No.	3.80 V
RP123Z39xB	Lot No.	RP123Z39xD	Lot No.	3.90 V
RP123Z40xB	Lot No.	RP123Z40xD	Lot No.	4.00 V
RP123Z41xB	Lot No.	RP123Z41xD	Lot No.	4.10 V
RP123Z42xB	Lot No.	RP123Z42xD	Lot No.	4.20 V
RP123Z43xB	Lot No.	RP123Z43xD	Lot No.	4.30 V
RP123Z44xB	Lot No.	RP123Z44xD	Lot No.	4.40 V
RP123Z45xB	Lot No.	RP123Z45xD	Lot No.	4.50 V
RP123Z46xB	Lot No.	RP123Z46xD	Lot No.	4.60 V
RP123Z47xB	Lot No.	RP123Z47xD	Lot No.	4.70 V
RP123Z48xB	Lot No.	RP123Z48xD	Lot No.	4.80 V
RP123Z12xB5	Lot No.	RP123Z12xD5	Lot No.	1.25 V
RP123Z18xB5	Lot No.	RP123Z18xD5	Lot No.	1.85 V
RP123Z28xB5	Lot No.	RP123Z28xD5	Lot No.	2.85 V
RP123Z45xB5	Lot No.	RP123Z45xD5	Lot No.	4.55 V
RP123Z29xB5	Lot No.	RP123Z29xD5	Lot No.	2.95 V
RP123Z31xB5	Lot No.	RP123Z31xD5	Lot No.	3.15 V
RP123Z27xB5	Lot No.	RP123Z27xD5	Lot No.	2.75 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

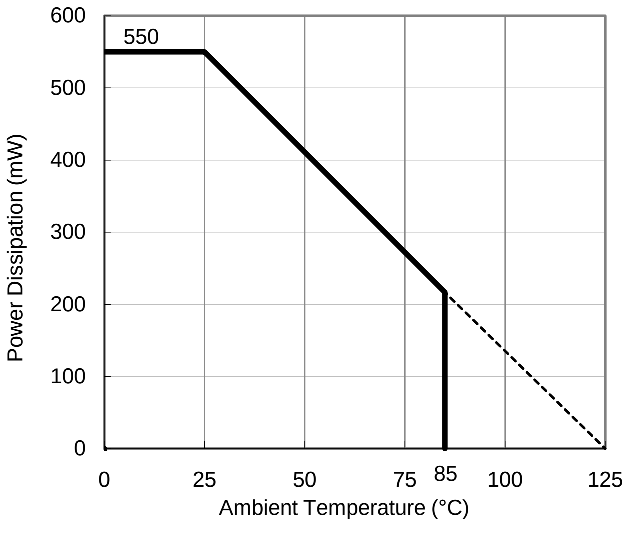
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.2 mm × 21 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

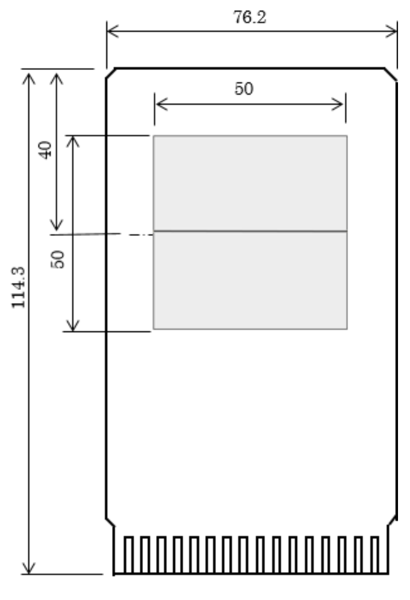
Item	Measurement Result
Power Dissipation	550 mW
Thermal Resistance (θja)	θja = 180°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 105°C/W

θja: Junction-to-Ambient Thermal Resistance

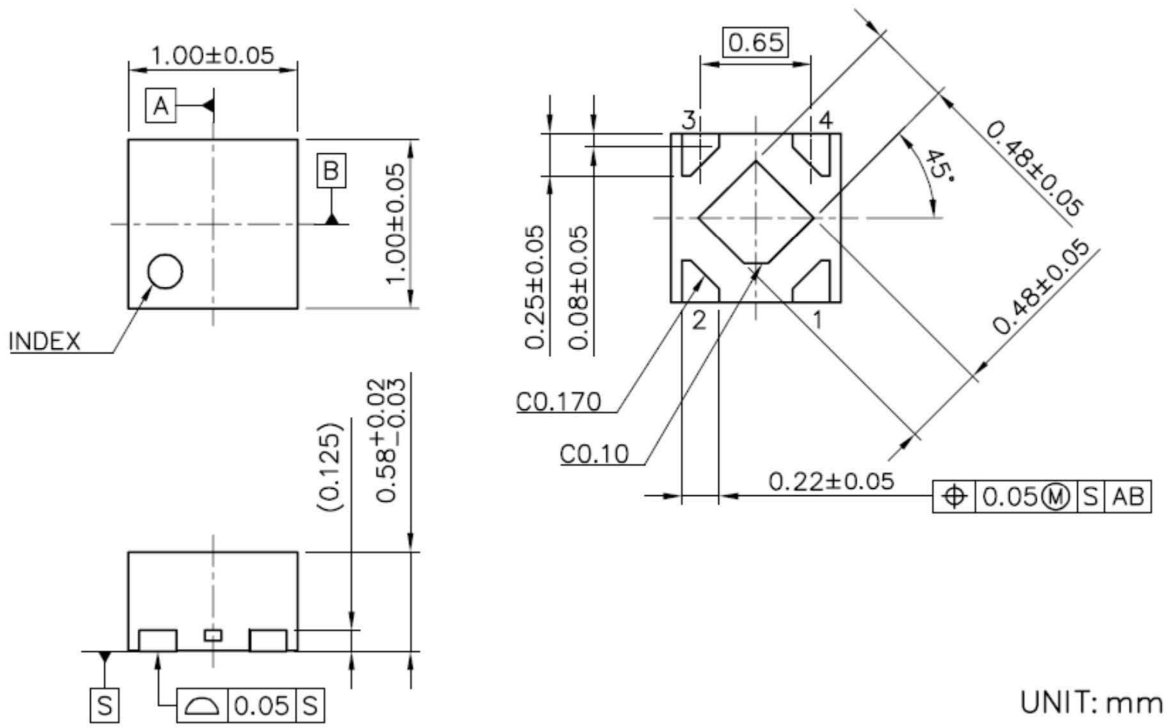
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature

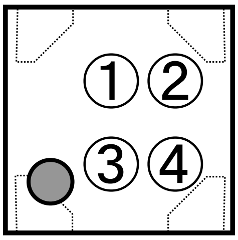


Measurement Board Pattern



DFN(PL)1010-4B Package Dimensions

①②: Product Code ··· Refer to *Part Marking List*
③④: Lot Number ··· Alphanumeric Serial Number



RP123K (DFN(PL)1010-4B) Part Markings

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

MK-RP123K-JAEA-C

RP123Kxx1x Part Marking List

Product Name	① ②	Product Name	① ②	V_{SET}
RP123K121B	9 A	RP123K121D	C A	1.20 V
RP123K131B	9 B	RP123K131D	C B	1.30 V
RP123K141B	9 C	RP123K141D	C C	1.40 V
RP123K151B	9 D	RP123K151D	C D	1.50 V
RP123K161B	9 E	RP123K161D	C E	1.60 V
RP123K171B	9 F	RP123K171D	C F	1.70 V
RP123K181B	9 G	RP123K181D	C G	1.80 V
RP123K191B	9 H	RP123K191D	C H	1.90 V
RP123K201B	9 J	RP123K201D	C J	2.00 V
RP123K211B	9 K	RP123K211D	C K	2.10 V
RP123K221B	9 L	RP123K221D	C L	2.20 V
RP123K231B	9 M	RP123K231D	C M	2.30 V
RP123K241B	9 N	RP123K241D	C N	2.40 V
RP123K251B	9 P	RP123K251D	C P	2.50 V
RP123K261B	9 R	RP123K261D	C R	2.60 V
RP123K271B	9 S	RP123K271D	C S	2.70 V
RP123K281B	9 T	RP123K281D	C T	2.80 V
RP123K291B	9 U	RP123K291D	C U	2.90 V
RP123K301B	9 V	RP123K301D	C V	3.00 V
RP123K311B	9 W	RP123K311D	C W	3.10 V
RP123K321B	9 X	RP123K321D	C X	3.20 V
RP123K331B	9 Y	RP123K331D	C Y	3.30 V
RP123K341B	9 Z	RP123K341D	C Z	3.40 V
RP123K351B	A A	RP123K351D	D A	3.50 V
RP123K361B	A B	RP123K361D	D B	3.60 V
RP123K371B	A C	RP123K371D	D C	3.70 V
RP123K381B	A D	RP123K381D	D D	3.80 V
RP123K391B	A E	RP123K391D	D E	3.90 V
RP123K401B	A F	RP123K401D	D F	4.00 V
RP123K411B	A G	RP123K411D	D G	4.10 V
RP123K421B	A H	RP123K421D	D H	4.20 V
RP123K431B	A J	RP123K431D	D J	4.30 V
RP123K441B	A K	RP123K441D	D K	4.40 V
RP123K451B	A L	RP123K451D	D L	4.50 V
RP123K461B	A M	RP123K461D	D M	4.60 V
RP123K471B	A N	RP123K471D	D N	4.70 V
RP123K481B	A P	RP123K481D	D P	4.80 V
RP123K121B5	A R	RP123K121D5	D R	1.25 V
RP123K181B5	A S	RP123K181D5	D S	1.85 V
RP123K281B5	A T	RP123K281D5	D T	2.85 V
RP123K451B5	A U	RP123K451D5	D U	4.55 V
RP123K291B5	A V	RP123K291D5	D V	2.95 V
RP123K311B5	A W	RP123K311D5	D W	3.15 V
RP123K271B5	A X	RP123K271D5	D X	2.75 V

PD-SOT-23-5-(85125)-JE-B

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

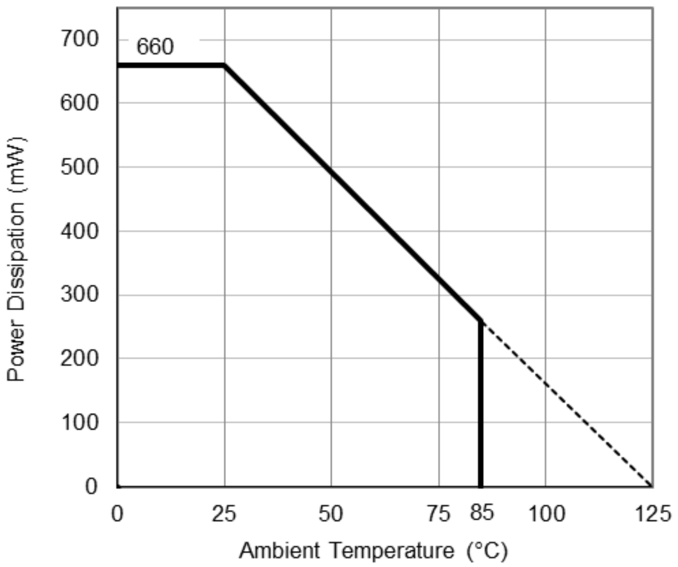
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx.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

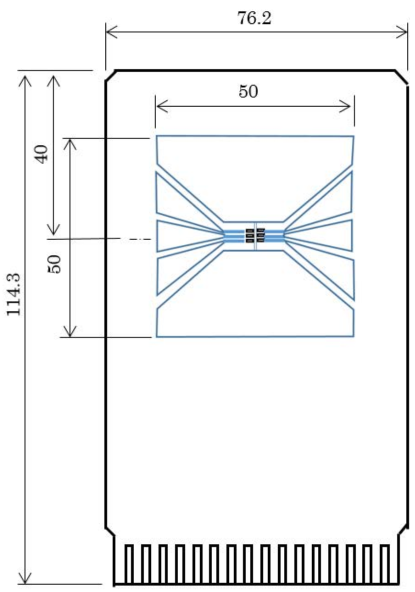
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



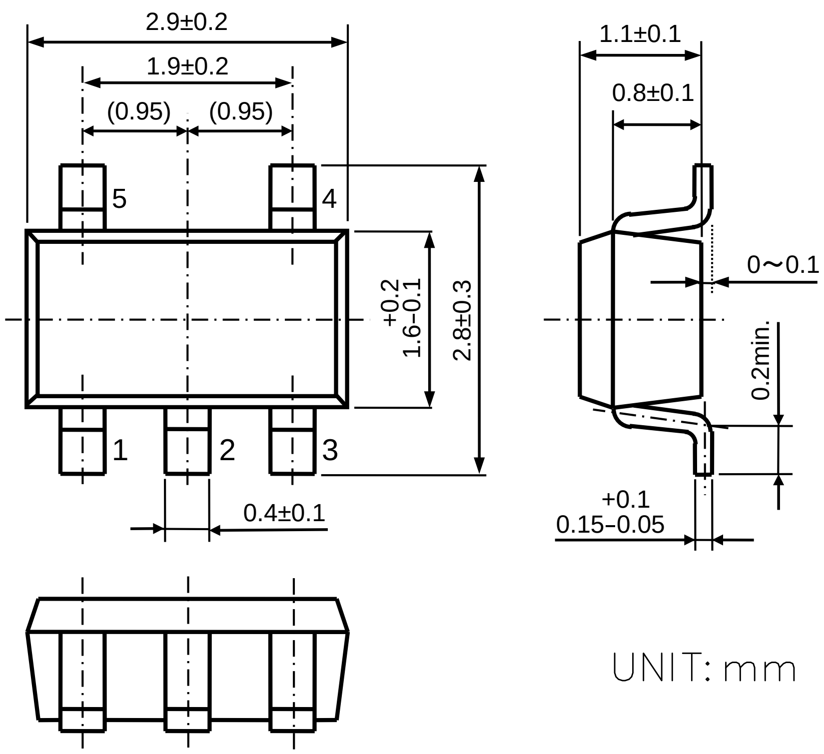
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

Nisshinbo Micro Devices Inc.

DM-SOT-23-5-JE-B

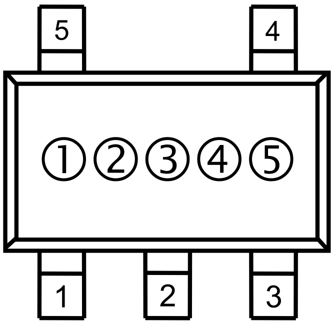


SOT-23-5 Package Dimensions

MK-RP123N-JAEA-A

①②③: Product Code ··· Refer to *Part Marking List*

④⑤: Lot Number ··· Alphanumeric Serial Number



RP123N (SOT-23-5) Part Markings

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.

MK-RP123N-JAEA-A

RP123Nxx1x Part Marking List

Product Name	① ② ③	Product Name	① ② ③	V_{SET}
RP123N121B	5 A 0	RP123N121D	7 A 0	1.20 V
RP123N131B	5 A 1	RP123N131D	7 A 1	1.30 V
RP123N141B	5 A 2	RP123N141D	7 A 2	1.40 V
RP123N151B	5 A 3	RP123N151D	7 A 3	1.50 V
RP123N161B	5 A 4	RP123N161D	7 A 4	1.60 V
RP123N171B	5 A 5	RP123N171D	7 A 5	1.70 V
RP123N181B	5 A 6	RP123N181D	7 A 6	1.80 V
RP123N191B	5 A 7	RP123N191D	7 A 7	1.90 V
RP123N201B	5 A 8	RP123N201D	7 A 8	2.00 V
RP123N211B	5 A 9	RP123N211D	7 A 9	2.10 V
RP123N221B	5 B 0	RP123N221D	7 B 0	2.20 V
RP123N231B	5 B 1	RP123N231D	7 B 1	2.30 V
RP123N241B	5 B 2	RP123N241D	7 B 2	2.40 V
RP123N251B	5 B 3	RP123N251D	7 B 3	2.50 V
RP123N261B	5 B 4	RP123N261D	7 B 4	2.60 V
RP123N271B	5 B 5	RP123N271D	7 B 5	2.70 V
RP123N281B	5 B 6	RP123N281D	7 B 6	2.80 V
RP123N291B	5 B 7	RP123N291D	7 B 7	2.90 V
RP123N301B	5 B 8	RP123N301D	7 B 8	3.00 V
RP123N311B	5 B 9	RP123N311D	7 B 9	3.10 V
RP123N321B	5 C 0	RP123N321D	7 C 0	3.20 V
RP123N331B	5 C 1	RP123N331D	7 C 1	3.30 V
RP123N341B	5 C 2	RP123N341D	7 C 2	3.40 V
RP123N351B	5 C 3	RP123N351D	7 C 3	3.50 V
RP123N361B	5 C 4	RP123N361D	7 C 4	3.60 V
RP123N371B	5 C 5	RP123N371D	7 C 5	3.70 V
RP123N381B	5 C 6	RP123N381D	7 C 6	3.80 V
RP123N391B	5 C 7	RP123N391D	7 C 7	3.90 V
RP123N401B	5 C 8	RP123N401D	7 C 8	4.00 V
RP123N411B	5 C 9	RP123N411D	7 C 9	4.10 V
RP123N421B	5 D 0	RP123N421D	7 D 0	4.20 V
RP123N431B	5 D 1	RP123N431D	7 D 1	4.30 V
RP123N441B	5 D 2	RP123N441D	7 D 2	4.40 V
RP123N451B	5 D 3	RP123N451D	7 D 3	4.50 V
RP123N461B	5 D 4	RP123N461D	7 D 4	4.60 V
RP123N471B	5 D 5	RP123N471D	7 D 5	4.70 V
RP123N481B	5 D 6	RP123N481D	7 D 6	4.80 V
RP123N121B5	6 A 0	RP123N121D5	8 A 0	1.25 V
RP123N181B5	6 A 1	RP123N181D5	8 A 1	1.85 V
RP123N281B5	6 A 2	RP123N281D5	8 A 2	2.85 V
RP123N451B5	6 A 3	RP123N451D5	8 A 3	4.55 V
RP123N291B5	6 A 4	RP123N291D5	8 A 4	2.95 V
RP123N311B5	6 A 5	RP123N311D5	8 A 5	3.15 V
RP123N271B5	6 A 6	RP123N271D5	8 A 6	2.75 V

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   - 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.
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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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