400 mA Low Noise and Low Supply Current LDO Regulator

NO.EA-403-180206

OVERVIEW

The RP122x is a 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.

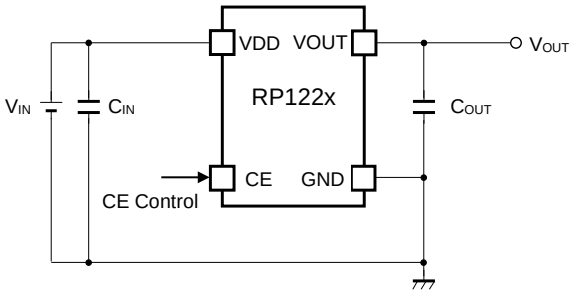
KEY BENEFITS

- 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): 1.7 V to 5.25 V (6.0 V)
- Output Voltage Range: 1.2 V to 4.8 V (0.1 V step)
- 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. 0.17 V (I_{OUT} = 400 mA, V_{SET} = 2.8 V, RP122K)
- Protection Features: Thermal Shutdown Protection (Detection Temp. Typ.165°C)
  Inrush Current Limit at Typ. 250 mA for appr.700 µs period after start-up
- Ceramic Capacitor (C_{IN}, C_{OUT}): 1.0 µF or more (No Need of Noise Bypass Capacitor)

TYPICAL APPLICATIONS



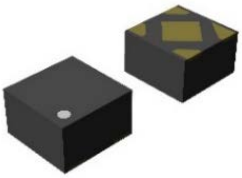
Without a bypass capacitor for noise

PACKAGE

[Under Development]

WLCSP-4-P8

0.64 mm x 0.64 mm,
t = 0.36 mm (Max.)



DFN(PLP)1010-4

1.0 mm x 1.0 mm,
t = 0.6 mm (Max.)

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

SELECTION GUIDE

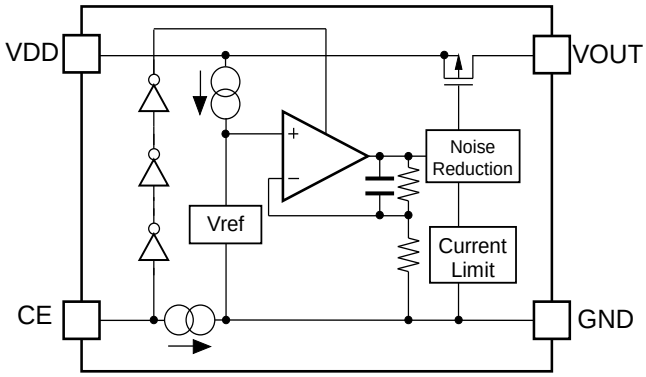
The set output voltage and the auto-discharge function(1) are user-selectable.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
[Under Development] RP122Zxx1∗-TR-F	WLCSP-4-P8	5,000 pcs	Yes	Yes
RP122Kxx1∗-TR	DFN(PLP)1010-4	10,000 pcs	Yes	Yes

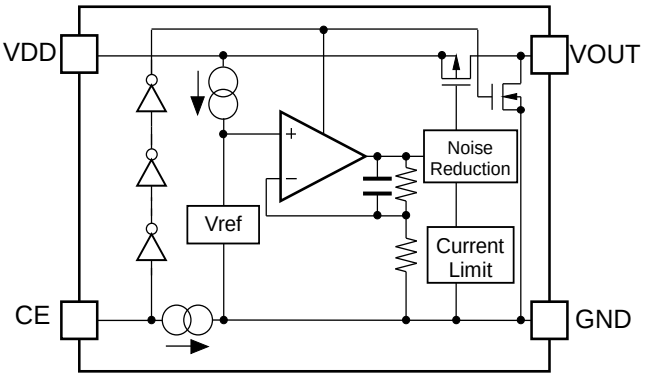
xx: Specify the set output voltage (V_{SET}) within the range of 1.2 V to 4.8 V in 0.1 V steps.
The voltage in 0.05 V step is shown as follows.
Ex. 1.85 V: RP122K181∗5

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

BLOCK DIAGRAMS



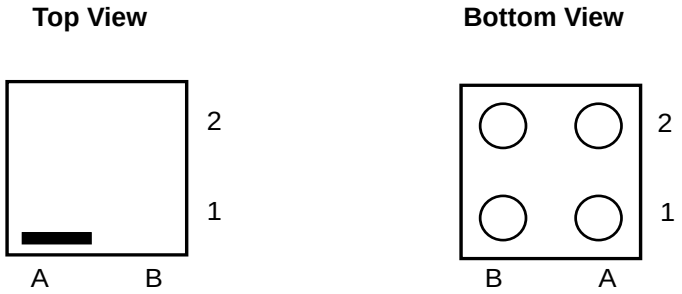
RP122xxx1B Block Diagram



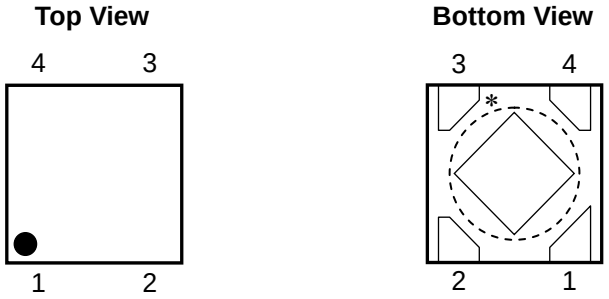
RP122xxx1D Block Diagram

(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



[Under Development] RP122Z (WLCSP-4-P8) Pin Configuration



RP122K (DFN(PLP)1010-4) Pin Configuration

[Under Development] RP122Z 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

RP122K 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 must be electrically connected to GND (substrate level) when mounted on the board.

ABSOLUTE MASIMUM 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(1)	WLCSP-4-P8, JEDEC STD.51-9	470	mW
		DFN(PLP) 1010-4, JEDEC STD.51-7	800	mW
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 the permanent damages and may degrade the life time and safety for both device and system using the device in the field.
The functional operation at or over these absolute maximum ratings are not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	1.9 to 5.25 (2)	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 when they are used over such ratings by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

(1) Refer to *POWER DISSIPATION* for detailed information.

(2) If the input voltage exceeds the maximum value of 5.25 V for some reasons, the operational accumulated time becomes up to 500 hours at 5.5V.

ELECTRICAL CHARACTERISTICS

V_{IN} = V_{SET} + 1 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.

RP122Kxx1x Electrical Characteristics (Ta = 25°C)

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Ta = 25°C	V_{SET} ≥ 1.8V	x0.99		x1.01	V
			V_{SET} < 1.8V	−18		+18	mV
		−40°C ≤ Ta ≤ 85°C	V_{SET} ≥ 1.8V	[x0.985]		[x1.015]	V
			V_{SET} < 1.8V	[−27]		[+27]	mV
I_{OUT}	Output Current			400			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1 mA ≤ I_{OUT} ≤ 400 mA			13	[40]	mV
V_{DIF}	Dropout Voltage	I_{OUT} = 400 mA		Refer to *PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS*			
I_{SS}	Supply Current	I_{OUT} = 0 mA			9.5	[25]	µA
$I_{STANDBY}$	Standby Current	V_{CE} = 0 V			0.01	0.3	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{SET} +0.5 V ≤ V_{IN} ≤ 5.25 V, V_{IN} ≥ 1.9 V			0.02	[0.10]	%/V
R_R	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			70		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 = 10 Hz ~ 100 kHz	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 (RP122Kxx1D 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.

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

RP122Kxx1x 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.
RP122K121x	1.182	1.200	1.218	1.173	1.200	1.227	(1)	(1)
RP122K121x5	1.232	1.250	1.268	1.223	1.250	1.277	(1)	(1)
RP122K131x	1.282	1.300	1.318	1.273	1.300	1.327	(1)	(1)
RP122K141x	1.382	1.400	1.418	1.373	1.400	1.427	(1)	(1)
RP122K151x	1.482	1.500	1.518	1.473	1.500	1.527	(1)	0.470
RP122K161x	1.582	1.600	1.618	1.573	1.600	1.627	(1)	0.425
RP122K171x	1.682	1.700	1.718	1.673	1.700	1.727	0.260	0.390
RP122K181x	1.782	1.800	1.818	1.773	1.800	1.827	0.240	0.365
RP122K181x5	1.831	1.850	1.869	1.822	1.850	1.878	0.240	0.365
RP122K191x	1.881	1.900	1.919	1.871	1.900	1.929	0.225	0.345
RP122K201x	1.980	2.000	2.020	1.970	2.000	2.030	0.215	0.330
RP122K211x	2.079	2.100	2.121	2.068	2.100	2.132	0.205	0.310
RP122K221x	2.178	2.200	2.222	2.167	2.200	2.233	0.195	0.300
RP122K231x	2.277	2.300	2.323	2.265	2.300	2.335	0.195	0.300
RP122K241x	2.376	2.400	2.424	2.364	2.400	2.436	0.195	0.300
RP122K251x	2.475	2.500	2.525	2.462	2.500	2.538	0.180	0.280
RP122K261x	2.574	2.600	2.626	2.561	2.600	2.639	0.180	0.280
RP122K271x	2.673	2.700	2.727	2.659	2.700	2.741	0.180	0.280
RP122K281x	2.772	2.800	2.828	2.758	2.800	2.842	0.170	0.265
RP122K281x5	2.821	2.850	2.879	2.807	2.850	2.893	0.170	0.265
RP122K291x	2.871	2.900	2.929	2.856	2.900	2.944	0.170	0.265
RP122K301x	2.970	3.000	3.030	2.955	3.000	3.045	0.170	0.265
RP122K311x	3.069	3.100	3.131	3.053	3.100	3.147	0.170	0.265
RP122K321x	3.168	3.200	3.232	3.152	3.200	3.248	0.170	0.265
RP122K331x	3.267	3.300	3.333	3.250	3.300	3.350	0.155	0.245
RP122K341x	3.366	3.400	3.434	3.349	3.400	3.451	0.155	0.245
RP122K351x	3.465	3.500	3.535	3.447	3.500	3.553	0.155	0.245
RP122K361x	3.564	3.600	3.636	3.546	3.600	3.654	0.145	0.235
RP122K371x	3.663	3.700	3.737	3.644	3.700	3.756	0.145	0.235
RP122K381x	3.762	3.800	3.838	3.743	3.800	3.857	0.145	0.235
RP122K391x	3.861	3.900	3.939	3.841	3.900	3.959	0.145	0.235
RP122K401x	3.960	4.000	4.040	3.940	4.000	4.060	0.140	0.225
RP122K411x	4.059	4.100	4.141	4.038	4.100	4.162	0.140	0.225
RP122K421x	4.158	4.200	4.242	4.137	4.200	4.263	0.140	0.225
RP122K431x	4.257	4.300	4.343	4.235	4.300	4.365	0.140	0.225
RP122K441x	4.356	4.400	4.444	4.334	4.400	4.466	0.140	0.225
RP122K451x	4.455	4.500	4.545	4.432	4.500	4.568	0.140	0.225
RP122K461x	4.554	4.600	4.646	4.531	4.600	4.669	0.140	0.225
RP122K471x	4.653	4.700	4.747	4.629	4.700	4.771	0.140	0.225
RP122K481x	4.752	4.800	4.848	4.728	4.800	4.872	0.140	0.225

(1) Input voltage should be equal or more than the minimum operating voltage of 1.9 V.

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 250mA when the effective capacitance of C_{OUT} becomes appr.6.0 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 appr.250 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.250 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

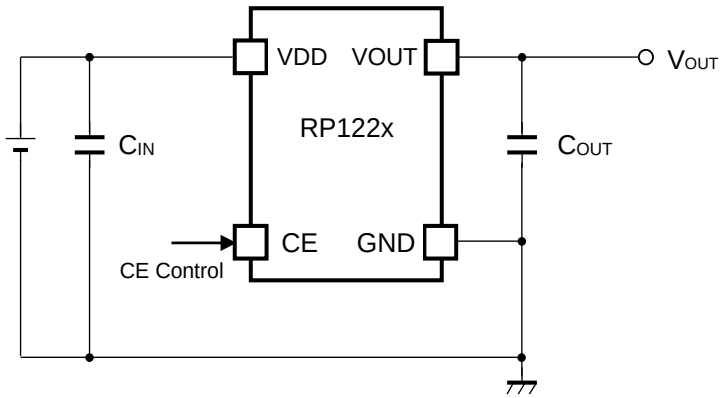
The RP122x does not include an UVLO circuit. To make the internal circuit operate normally and to ensure good output regulation, V_{IN} has to be: $V_{IN} \geq V_{SET} + V_{DIF}$ (Min.1.9 V). To bring out the best characteristics of the output noise voltage, the ripple rejection and the load transient response, V_{IN} has to be $V_{IN} = V_{SET} + 1.0$ V.

Thermal Shutdown Protection

Thermal shutdown deactivates a 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.

APPLICATION INFORMATION

Typical Application Circuit



RP122x Typical Application Circuit

External Components

Symbol	Description
C_{IN}	Ceramic Capacitor, 1.0 µF, Murata, GRM155R61A105KE15
C_{OUT}	Ceramic Capacitor, 1.0 µF, Murata, GRM155R61A105KE15

Technical Notes Related to External Components

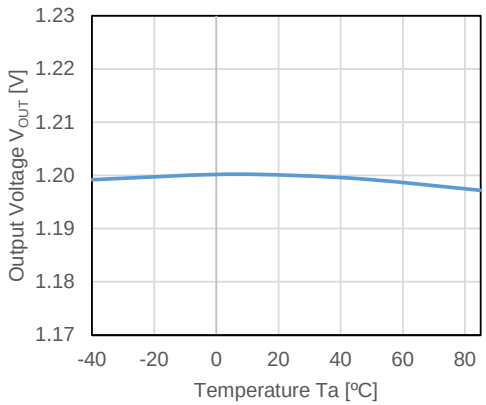
- Ensure the VDD and GND lines are sufficiently robust. If their impedances are too high, noise pickup or unstable operation may result. Connect a 1.0 µF or more input capacitor (C_{IN}) between the VDD and GND pins with shortest-distance wiring.
- Phase compensation is provided to secure stable operation 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 an output capacitor (C_{OUT}) between the VOUT and GND pins with shortest-distance wiring. 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.

TYPICAL CHARACTERISTICS

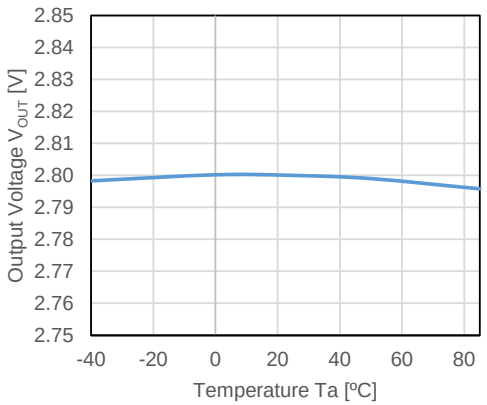
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

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

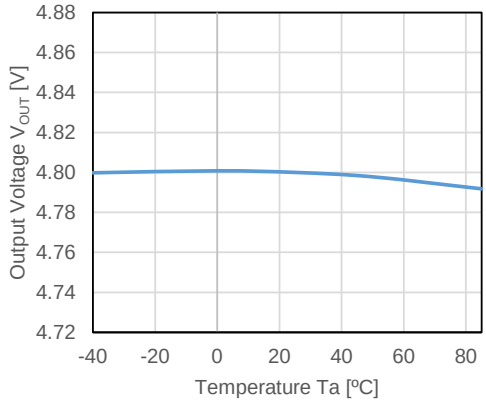
RP122x121x, V_{IN} = 2.2 V, I_{OUT} = 1 mA



RP122x281x, V_{IN} = 3.8 V, I_{OUT} = 1 mA

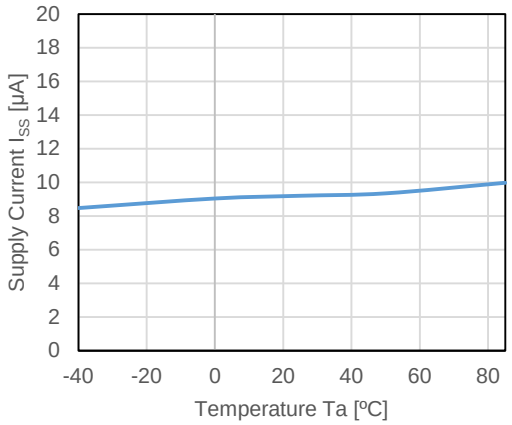


RP122x481x, V_{IN} = 5.25 V, I_{OUT} = 1 mA

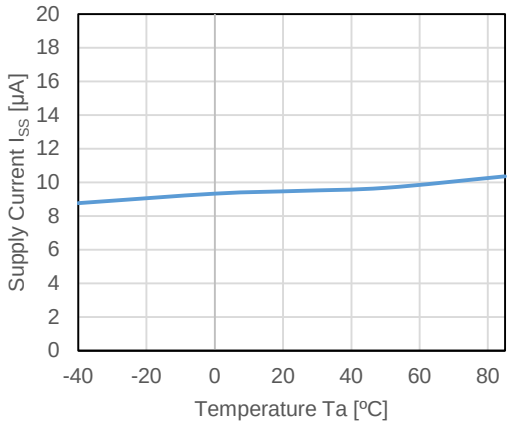


2) Supply Current vs. Temperature (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF)

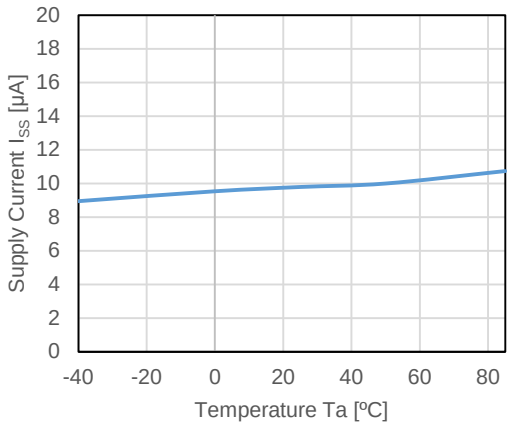
RP122x121x, V_{IN} = 2.2 V



RP122x281x, V_{IN} = 3.8 V

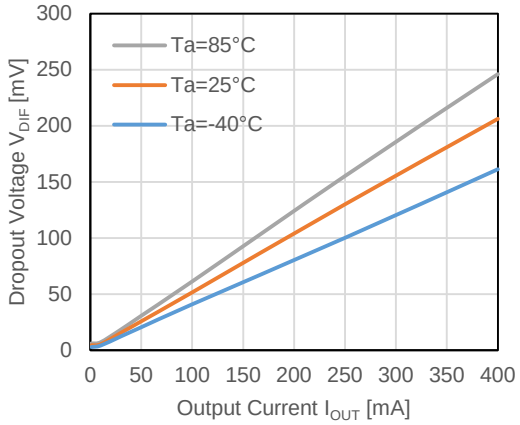


RP122x481x, V_{IN} = 5.25 V

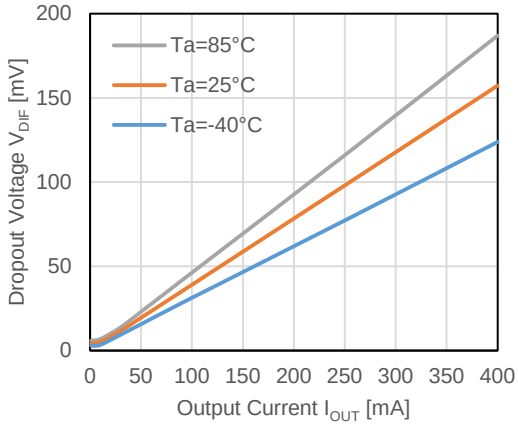


3) Dropout Voltage vs. Output Current (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF)

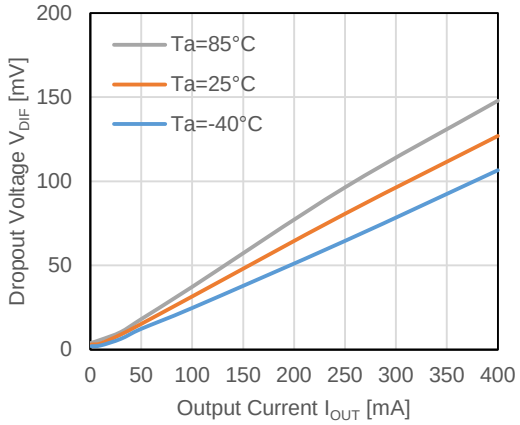
RP122K181x



RP122K281x

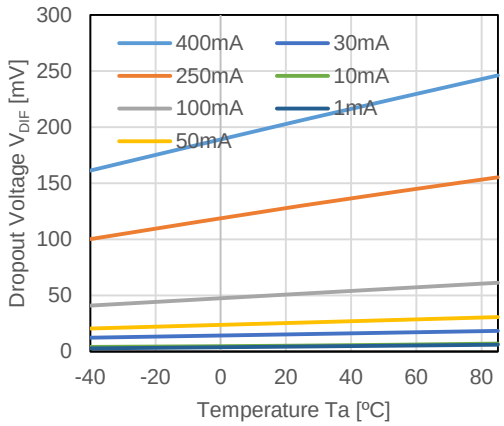


RP122K481x

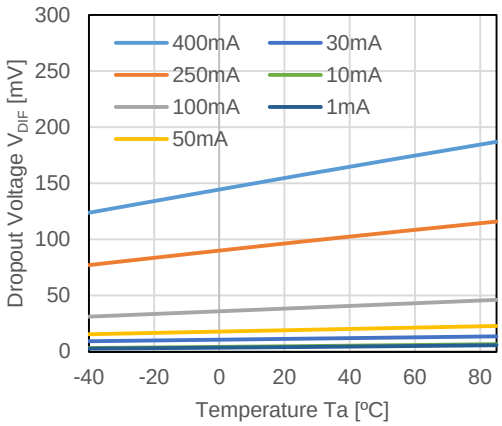


4) Dropout Voltage vs. Temperature (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF)

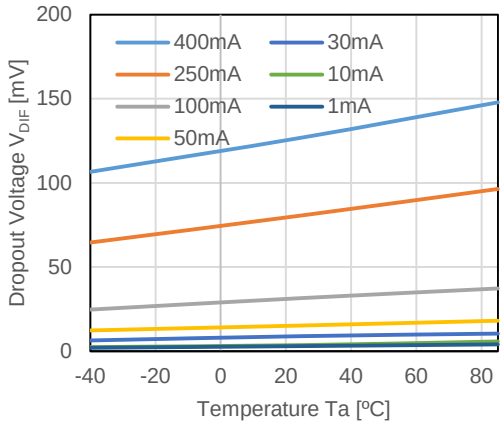
RP122K181x



RP122K281x

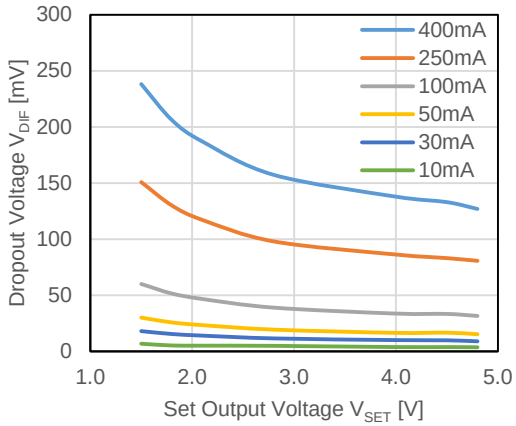


RP122K481x



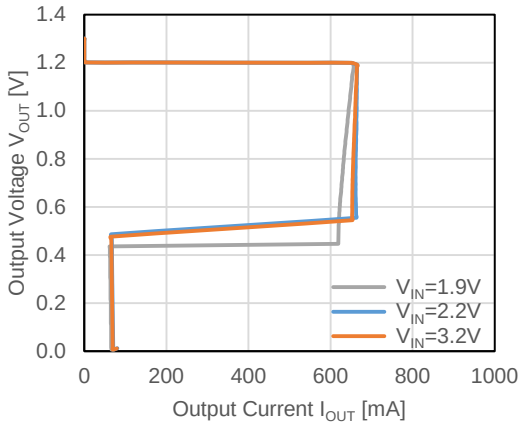
5) Dropout Voltage vs. Set Output Voltage (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

RP122Kxx1x

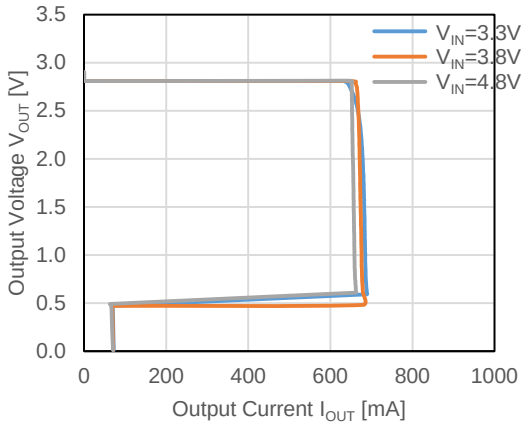


6) Output Voltage vs. Output Current (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

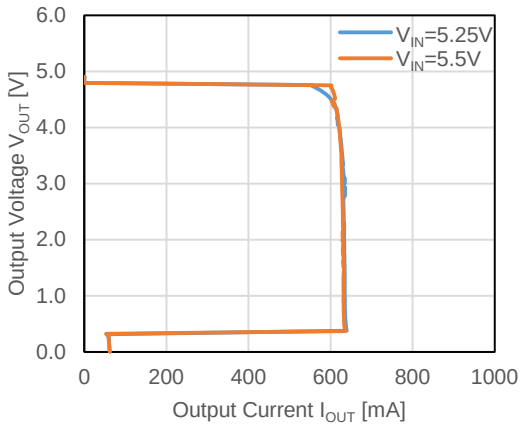
RP122x121x



RP122x281x

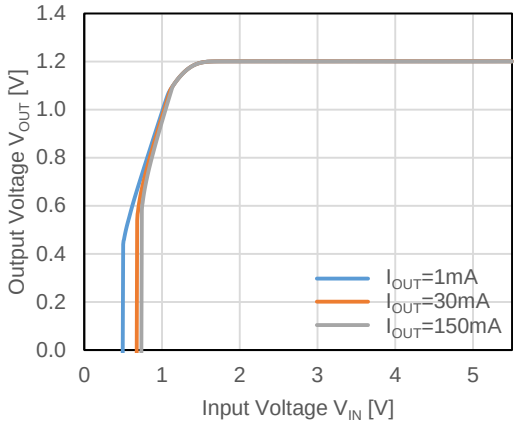


RP122x481x

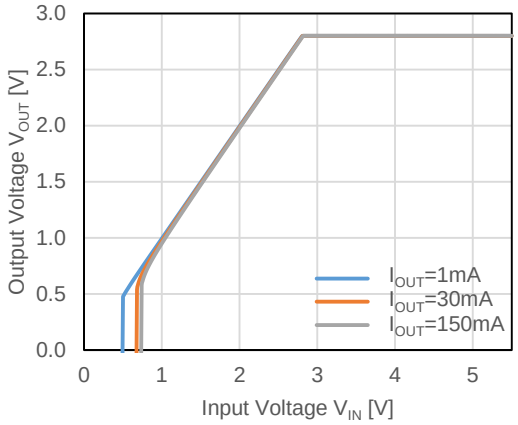


7) Output Voltage vs. Input Voltage (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

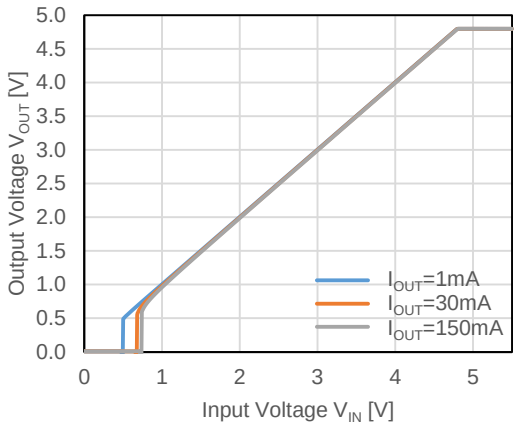
RP122x121x



RP122x281x

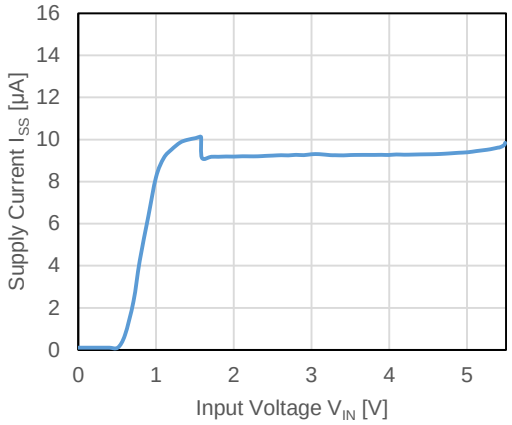


RP122x481x

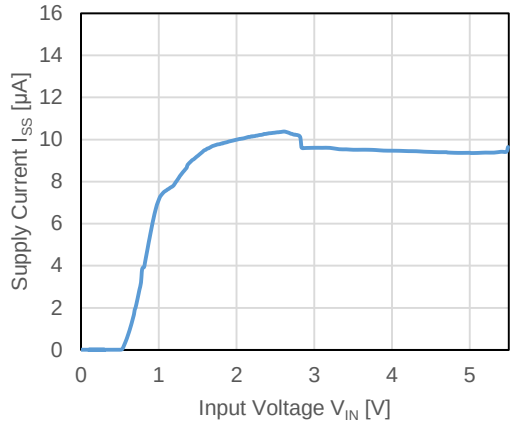


8) Supply Current vs. Input Voltage (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

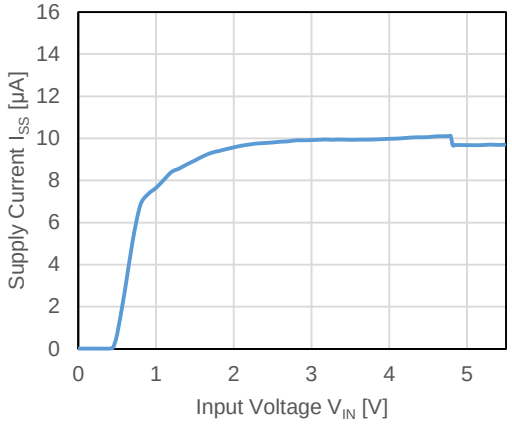
RP122x121x



RP122x281x

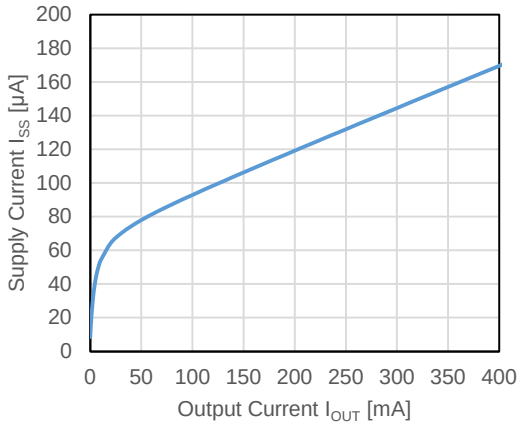


RP122x481x

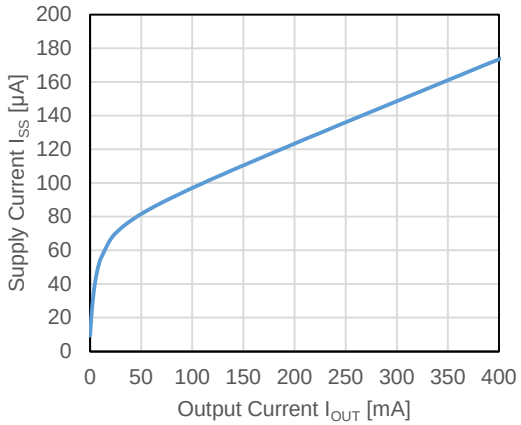


9) Supply Current vs. Output Current (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

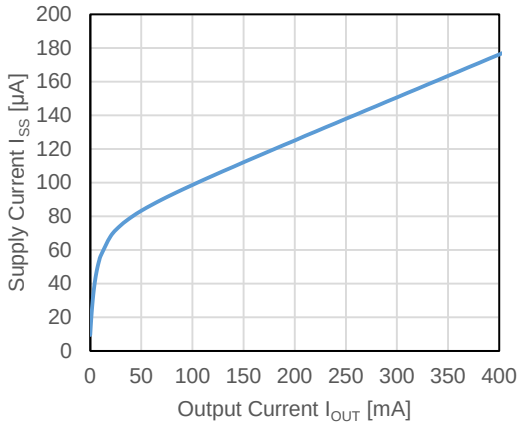
RP122x121x, V_{IN} = 2.2 V



RP122x281x, V_{IN} = 3.8 V

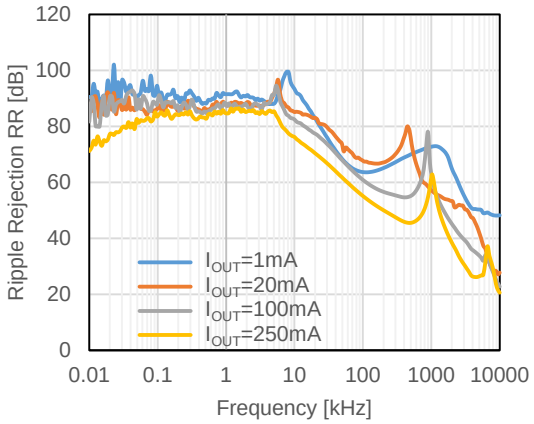


RP122x481x, V_{IN} = 5.25 V

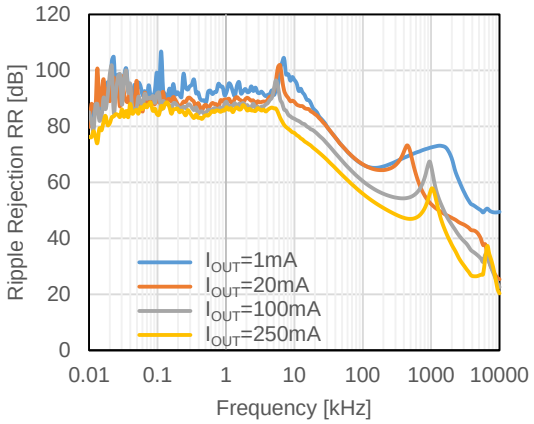


10) Ripple Rejection vs. Frequency (C_{OUT} = Ceramic 1.0 µF, Ripple = 0.2 Vp-p, Ta = 25°C)

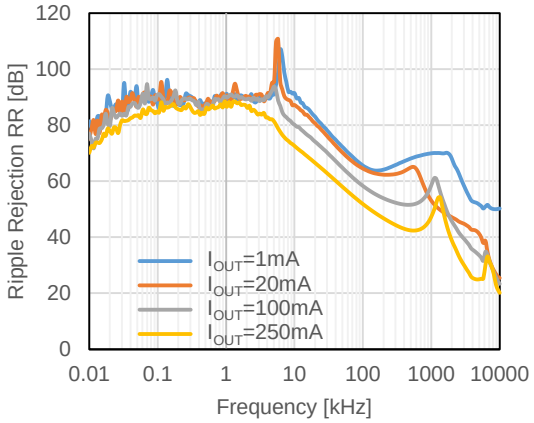
RP122x121x, V_{IN} = 2.2 V



RP122x281x, V_{IN} = 3.8 V

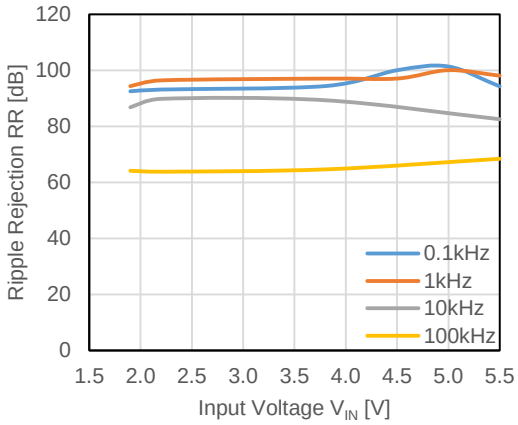


RP122x481x, V_{IN} = 5.25 V

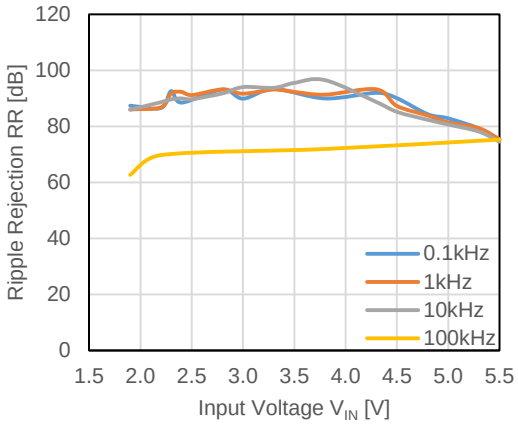


11) Ripple Rejection vs. Input Voltage (C_{OUT} = Ceramic 1.0 µF, Ripple = 0.2 Vp-p, Ta = 25°C)

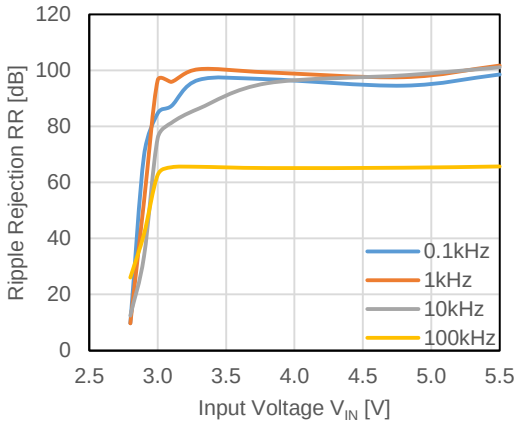
RP122x121x, I_{OUT} = 1 mA



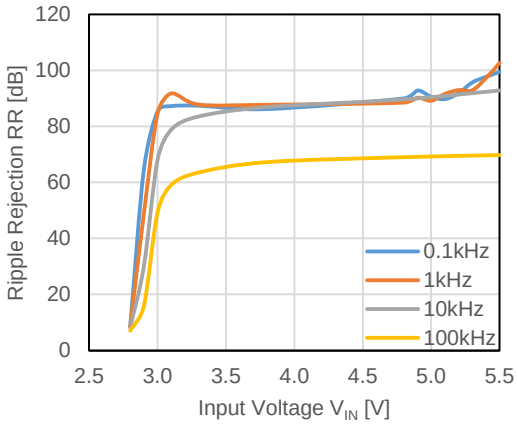
RP122x121x, I_{OUT} = 20 mA



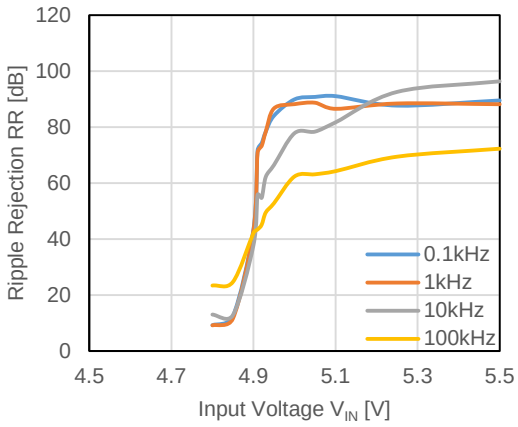
RP122x281x, I_{OUT} = 1 mA



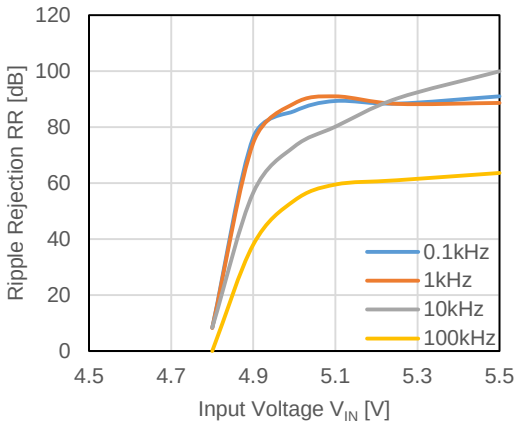
RP122x281x, I_{OUT} = 20 mA



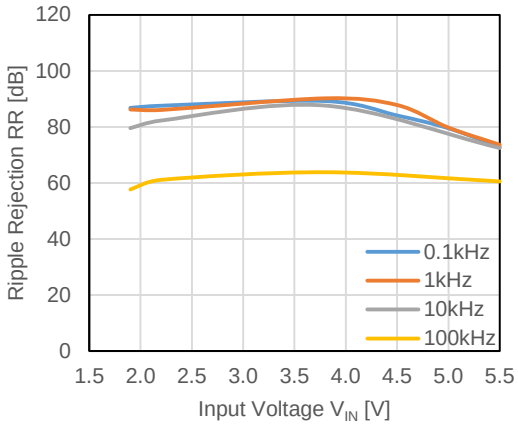
RP122x481x, I_{OUT} = 1 mA



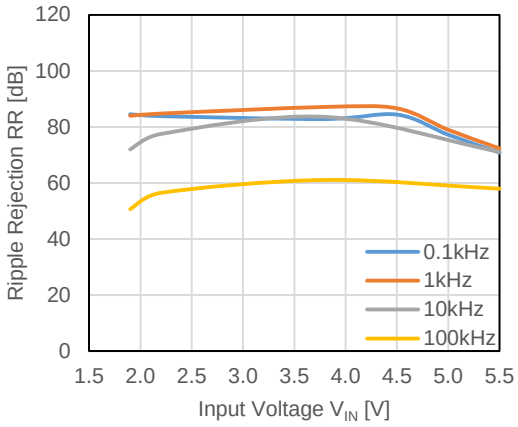
RP122x481x, I_{OUT} = 20 mA



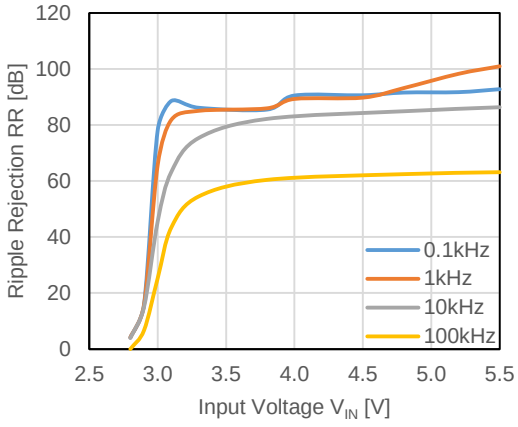
RP122x121x, I_{OUT} = 100 mA



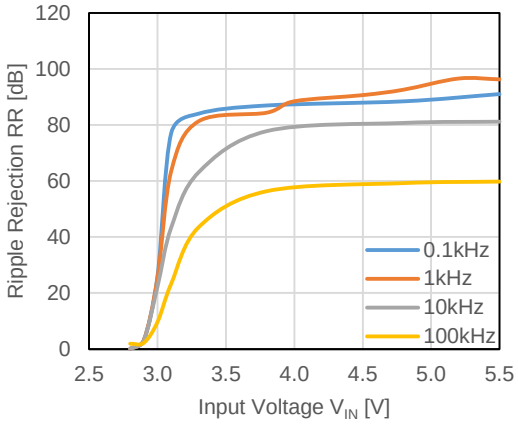
RP122x121x, I_{OUT} = 250 mA



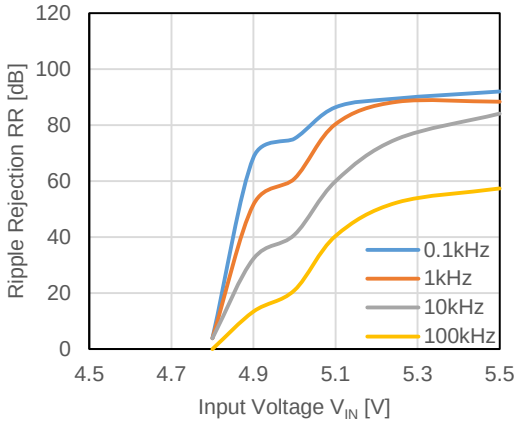
RP122x281x, I_{OUT} = 100 mA



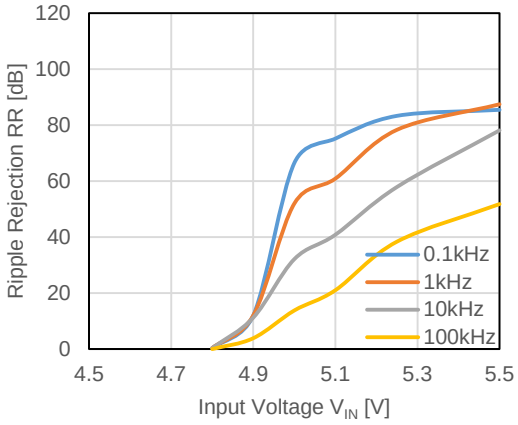
RP122x281x, I_{OUT} = 250 mA



RP122x481x, I_{OUT} = 100 mA

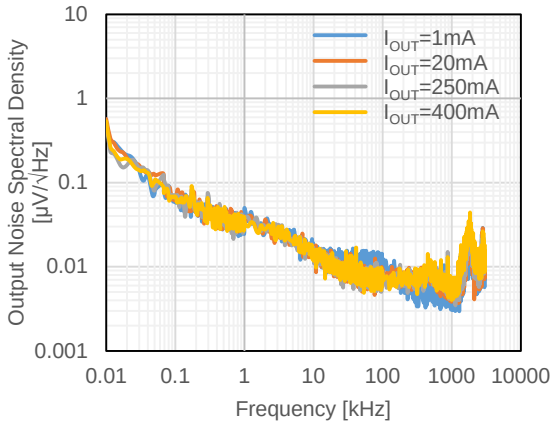


RP122x481x, I_{OUT} = 250 mA

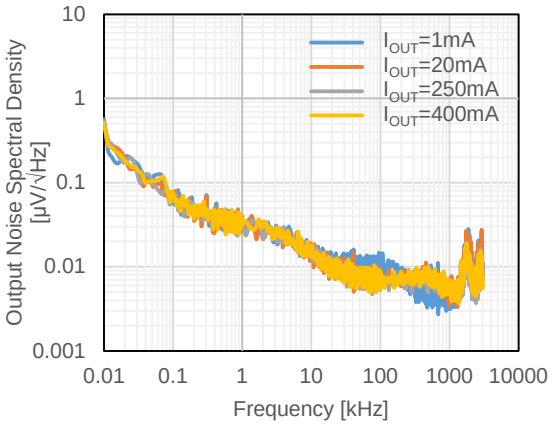


12) Output Noise Spectral Density vs. Frequency (C_{IN}=Ceramic 1.0 µF, C_{OUT}=Ceramic 1.0 µF, Ta=25°C)

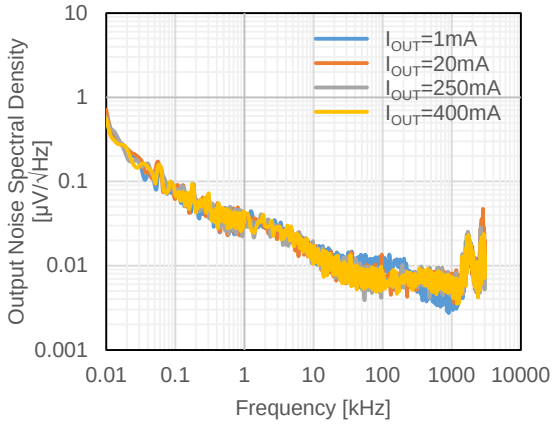
RP122x121x, V_{IN} = 2.2 V



RP122x281x, V_{IN} = 3.8 V

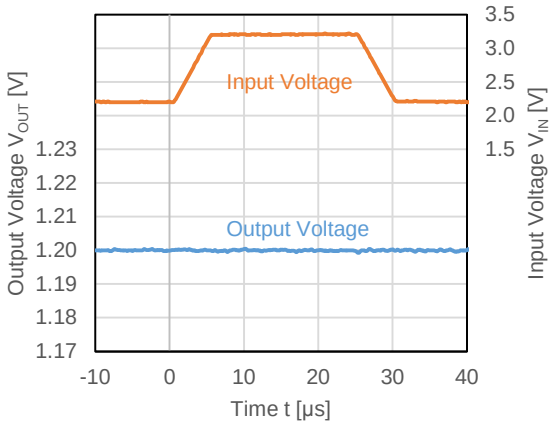


RP122x481x, V_{IN} = 5.25 V

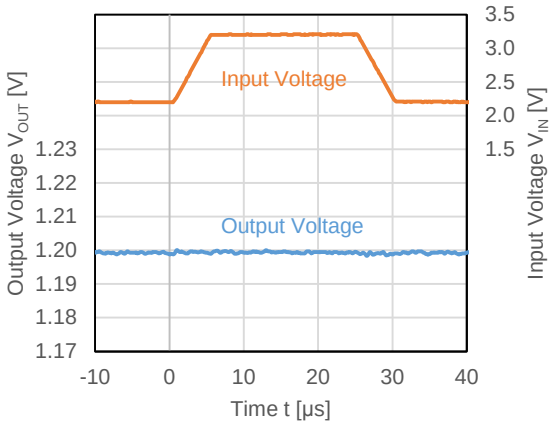


13) Input Transient Response (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, t_R = t_F = 5 µs, Ta = 25°C)

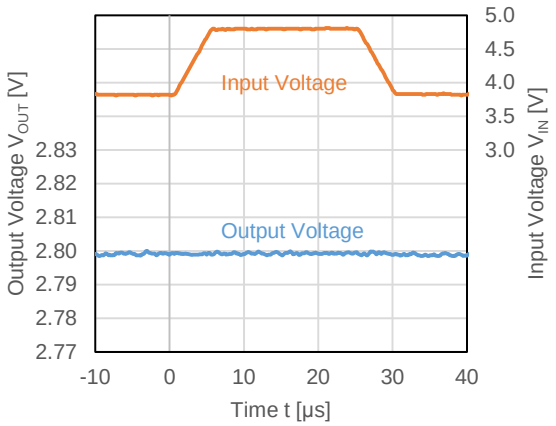
RP122x121x, I_{OUT} = 1 mA



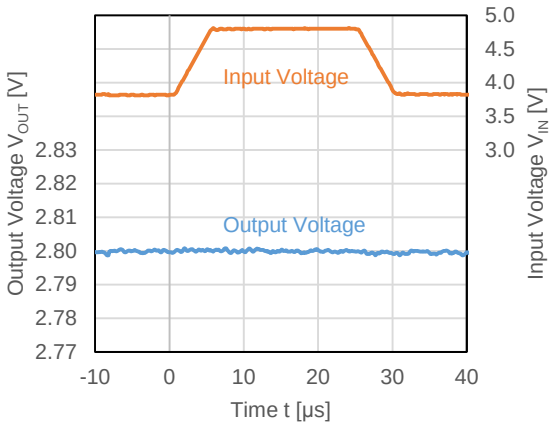
RP122x121x, I_{OUT} = 20 mA



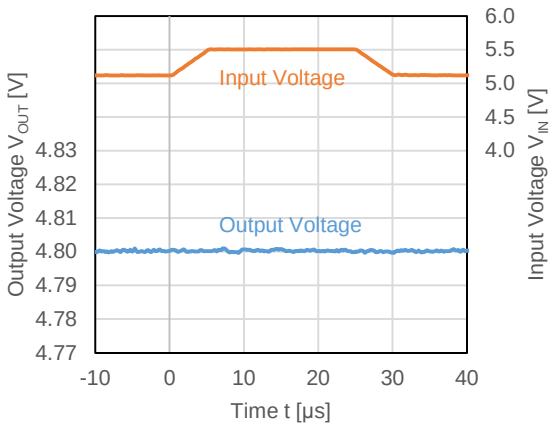
RP122x281x, I_{OUT} = 1 mA



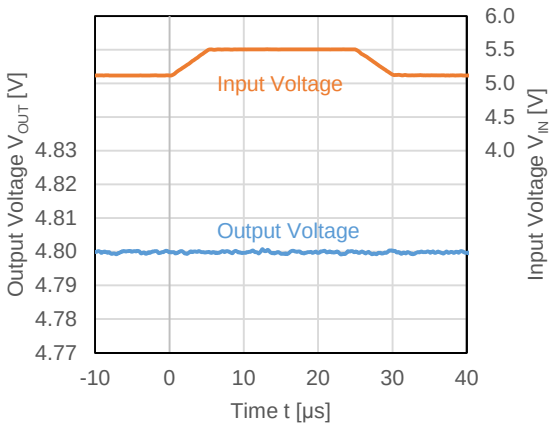
RP122x281x, I_{OUT} = 20 mA



RP122x481x, I_{OUT} = 1 mA

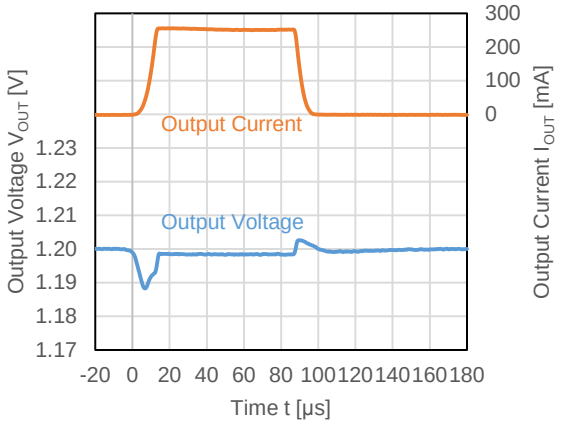


RP122x481x, I_{OUT} = 20 mA

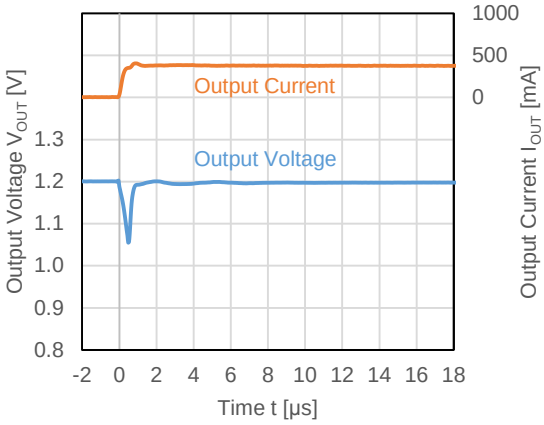


14) Load transient Response (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

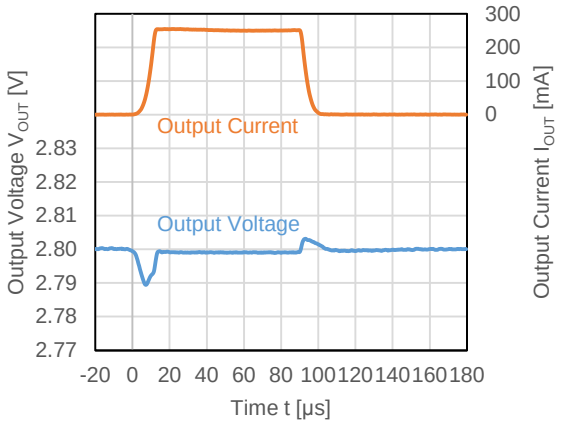
RP122x121x, V_{IN} = 2.2 V,
I_{OUT} = 1 mA <=> 250 mA, t_R = t_F = 10 µs



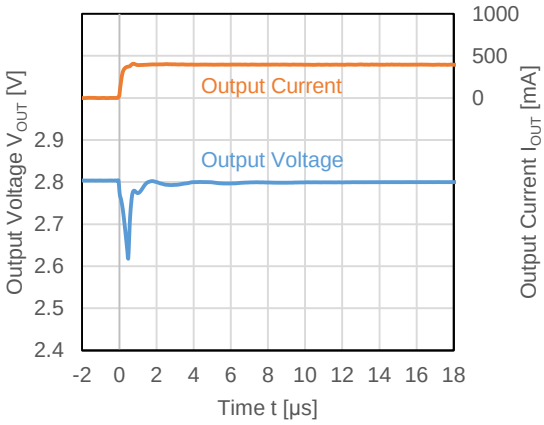
RP122x121x, V_{IN} = 2.2 V,
I_{OUT} = 0 => 400 mA, t_R = 0.5 µs



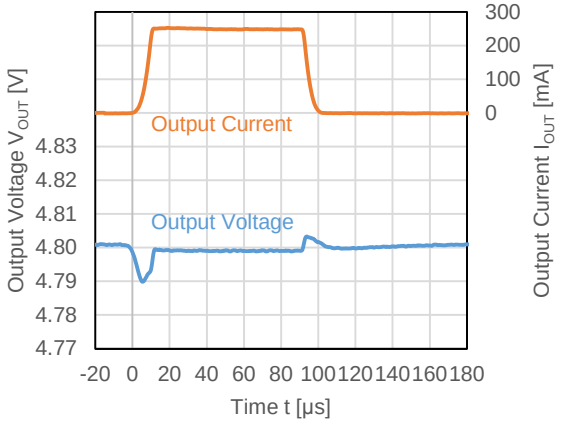
RP122x281x, V_{IN} = 3.8 V,
I_{OUT} = 1 mA <=> 250 mA, t_R = t_F = 10 µs



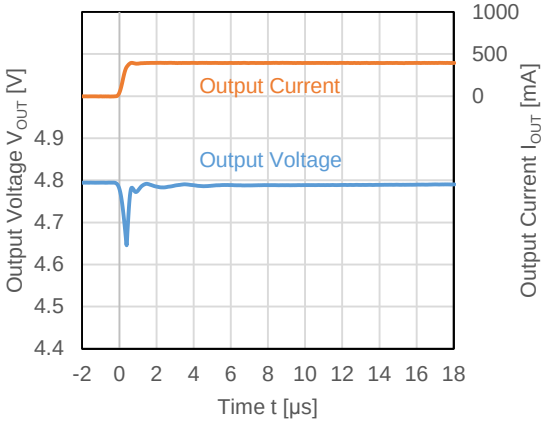
RP122x281x, V_{IN} = 3.8 V,
I_{OUT} = 0 => 400 mA, t_R = 0.5 µs



RP122x481x, V_{IN} = 5.25 V,
I_{OUT} = 1 mA <=> 250 mA, t_R = t_F = 10 µs

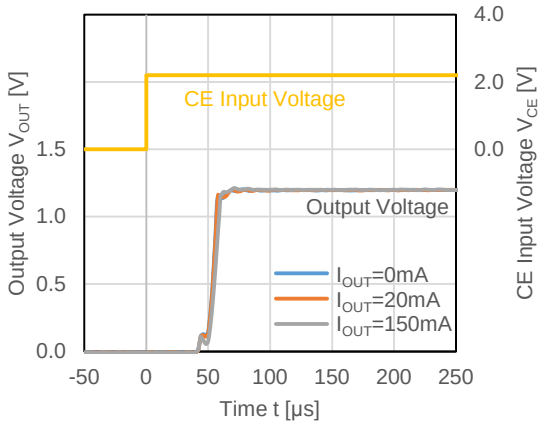


RP122x481x, V_{IN} = 5.25 V,
I_{OUT} = 0 => 400 mA, t_R = 0.5 µs

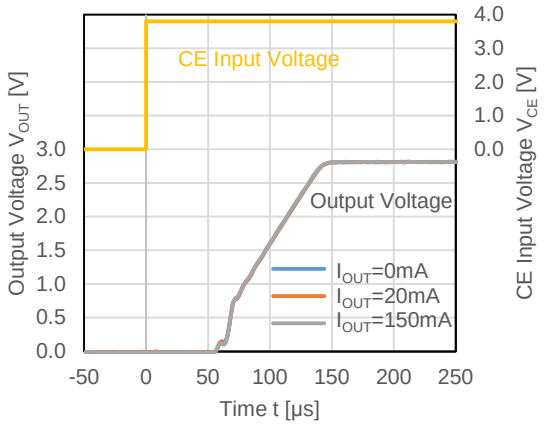


15) Turn On Speed with CE Pin (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

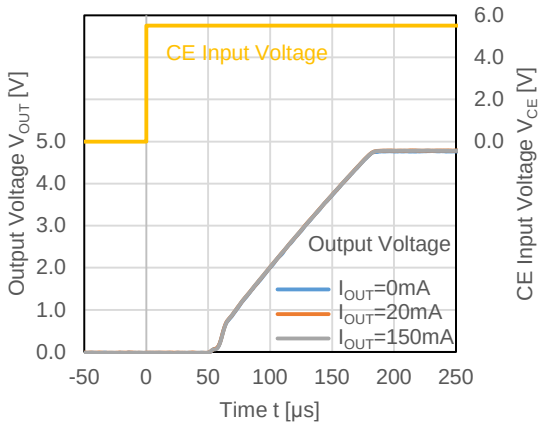
RP122x121x, V_{IN} = 2.2 V



RP122x281x, V_{IN} = 3.8 V

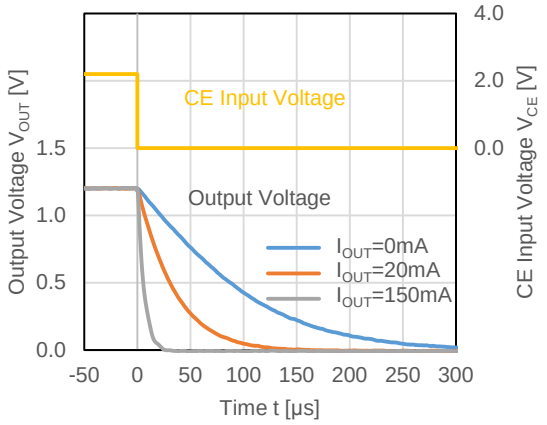


RP122x481x, V_{IN} = 5.25V

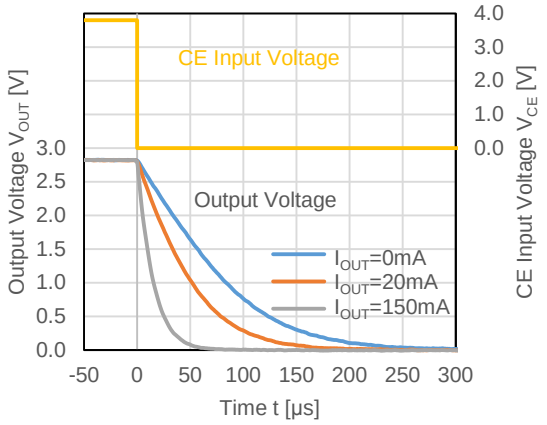


16) Turn Off Speed with CE Pin (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

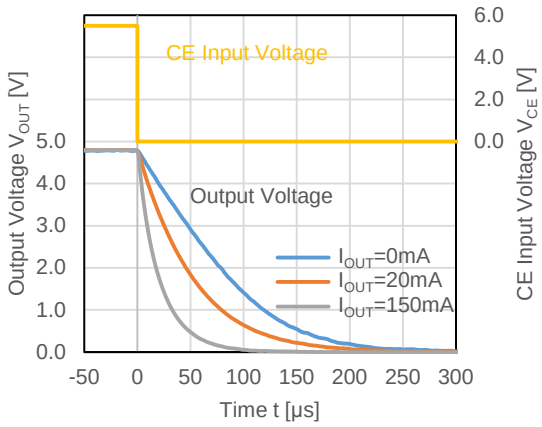
RP122x121D, V_{IN} = 2.2 V



RP122x281D, V_{IN} = 3.8 V

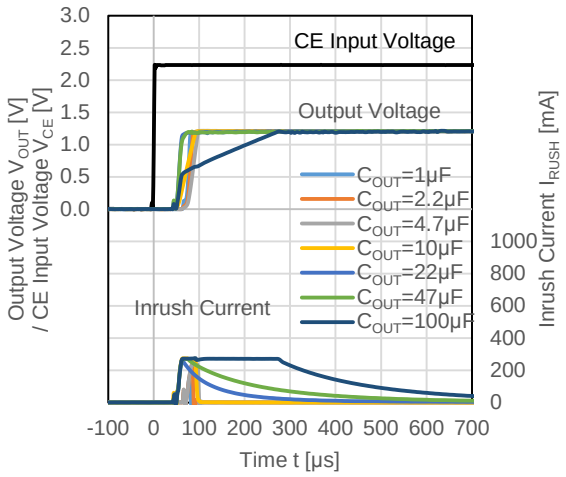


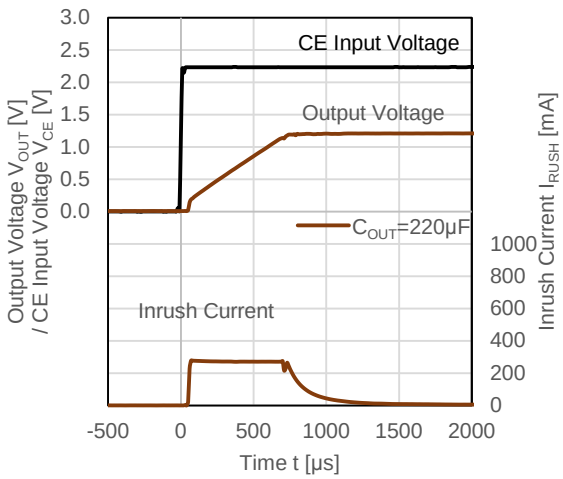
RP122x481D, V_{IN} = 5.25V



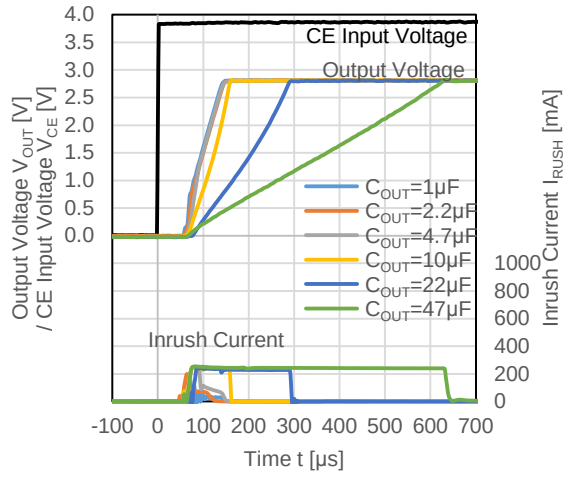
17) Inrush Current (C_{IN} = Ceramic 1.0 µF, I_{OUT} = 0 mA, Ta = 25°C)

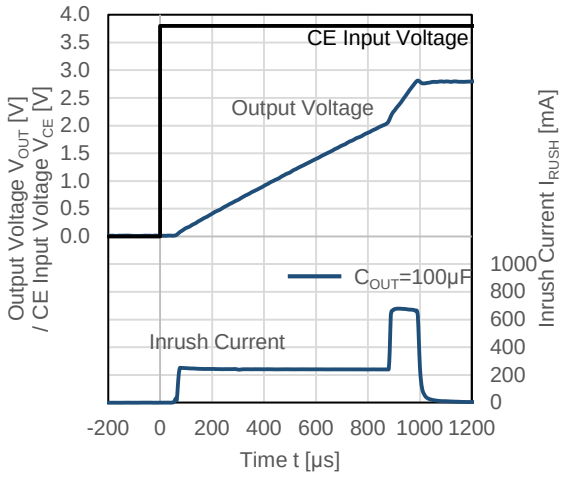
RP122x121x, V_{IN} = 2.2 V



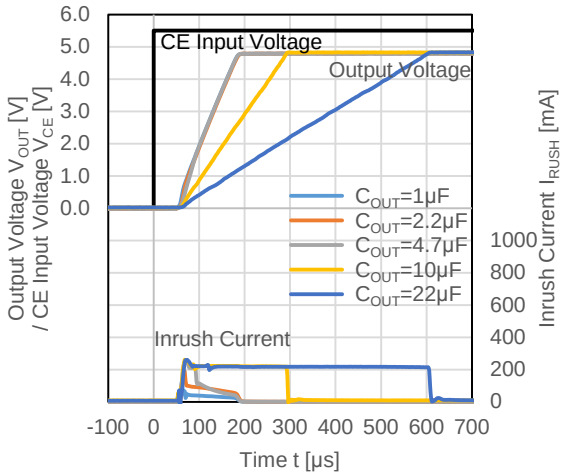


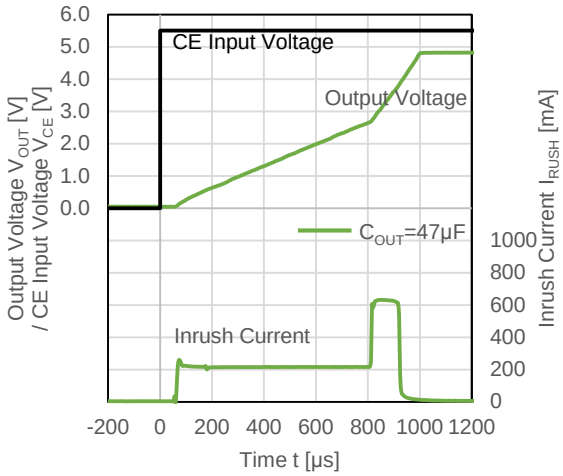
RP122x281x, V_{IN} = 3.8 V





RP122x481x, V_{IN} = 5.25 V





Ver. 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. 51-7.

Measurement Conditions

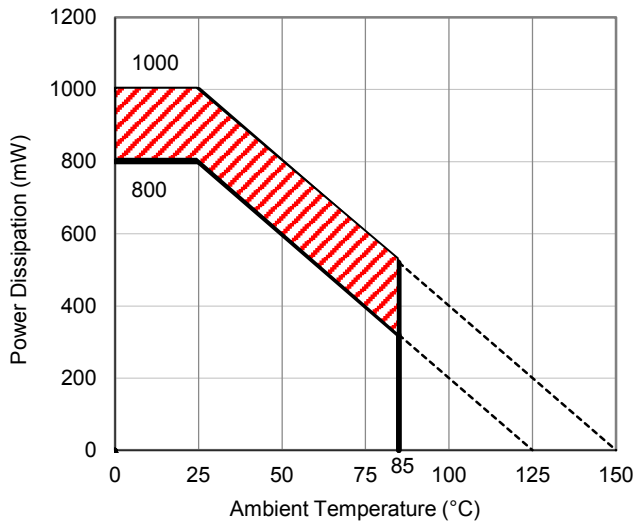
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.2 mm × 11 pcs

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

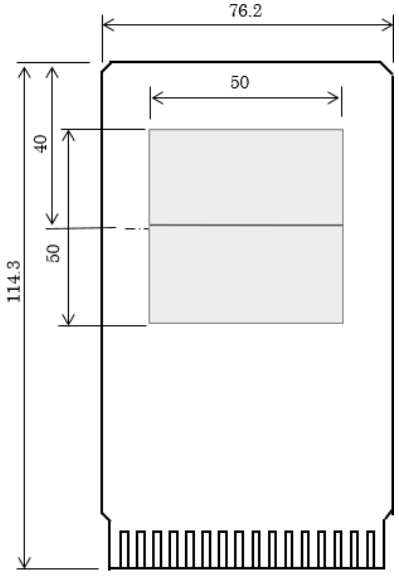
Item	Measurement Result
Power Dissipation	800 mW
Thermal Resistance (θja)	θja = 125°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 58°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature

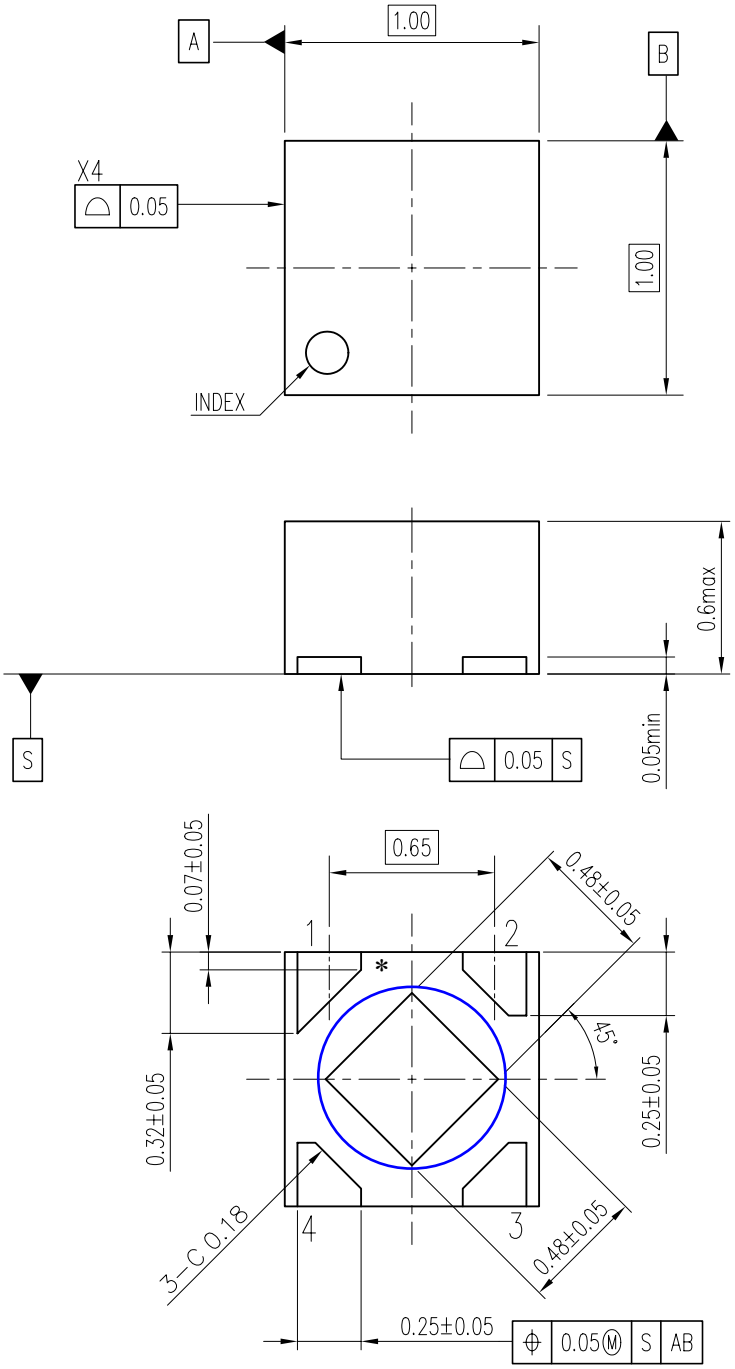


Measurement Board Pattern

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

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

Ver. A



DFN(PLP)1010-4 Package Dimensions (Unit: mm)

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

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