RICOH

150mA Ultra Low Supply Current LDO REGULATOR

RP104 SERIES

NO.EA-150-070712

OUTLINE

The RP104 Series are CMOS-based voltage regulator ICs with high output voltage accuracy, extremely low supply current and low ON-resistance. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit and a chip enable circuit.

These ICs perform with ultra low supply current (Typ.1.0µA), which prolong the battery life.

Since the packages for these ICs are PLP1010-4, SOT-23-5 and SC-82AB, therefore high density mounting of the ICs on boards is possible.

FEATURES

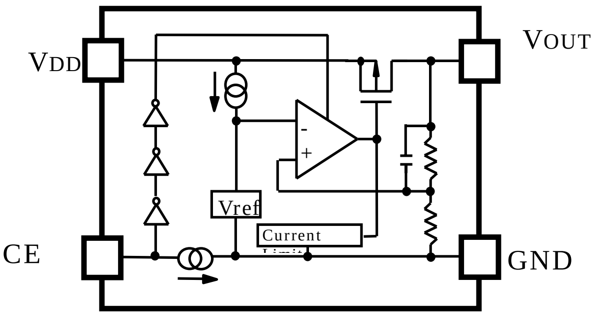
Low Supply Current	Typ. 1.0µA (Except the current through CE pull down circuit)
Standby Mode	Typ. 0.1µA
Low Dropout Voltage	Typ. 0.28V(I_{OUT}=150mA 2.5V Output type)
Low Temperature-Drift Coefficient of Output Voltage	Typ. ±40ppm/°C
Good Line Regulation	Typ. 0.02%/V
High Output Voltage Accuracy	±0.8%
Small Packages	PLP1010-4, SOT-23-5, SC-82AB
Output Voltage	1.2V, 1.3V, 1.5V, 1.8V, 1.85V, 1.9V, 2.0V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 2.9V, 3.0V, 3.2V, 3.3V
Built-in Fold Back Protection Circuit	Typ. 40mA (Current at short mode)
Ceramic capacitors are recommended to be used with this IC	C_{IN}=C_{OUT}=0.1µF or more

APPLICATIONS

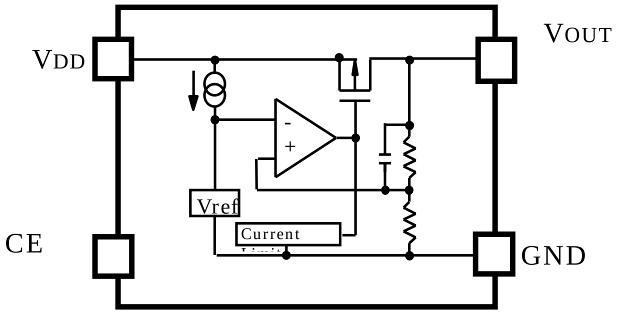
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

RP104xxx1B



RP104xxx1C



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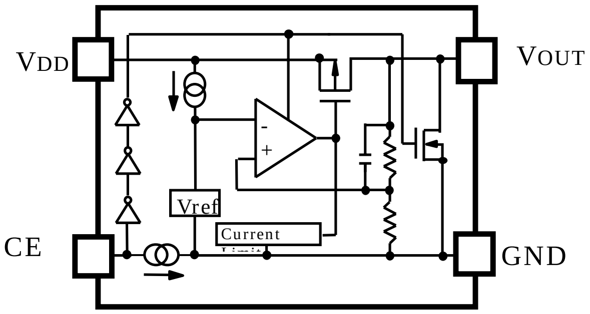


SELECTION GUIDE

The output voltage, version, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

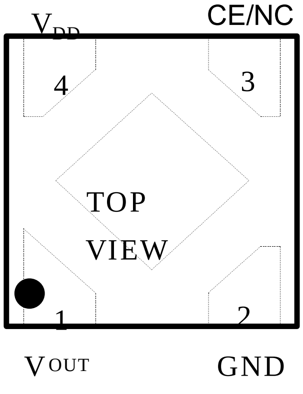
RP104xxx1x-xx ←Part Number
↑ ↑ ↑ ↑
a b c d

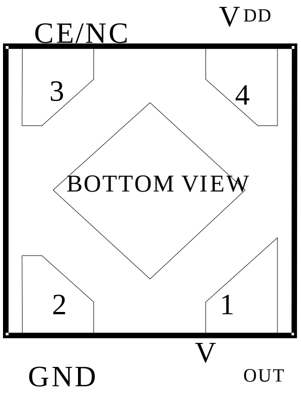
Code	Contents
a	Designation of Package Type: K: PLP1010-4 N: SOT-23-5 Q: SC82-AB
b	Setting Output Voltage (V_{OUT}): 1.2V, 1.3V, 1.5V, 1.8V, 1.85V, 1.9V, 2.0V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 2.9V, 3.0V, 3.2V, 3.3V Exception: 1.85V=RP104x181x5, 2.85V=RP104x281x5
c	Designation of Active Type: B: active high type* C: without chip enable circuit D: active high, with auto discharge*
d	Designation of Taping Type: Ex. TR (refer to Taping Specifications; TR type is the standard direction.)

*When the mode is into standby with CE signal, auto-discharge transistor turns on, and it makes the turn-off speed faster than normal type.

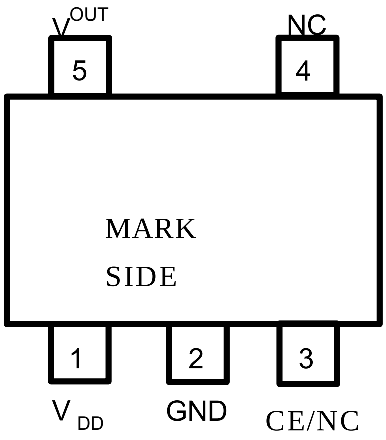
PIN CONFIGURATION

PLP1010-4

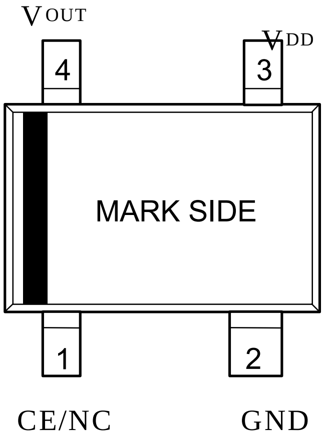




SOT-23-5



SC-82AB



■ PIN DESCRIPTIONS

- **RP104K**

Pin No.	Symbol	Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	CE or NC	Chip Enable Pin (“H” Active) or No Connection
4	V_{DD}	Input Pin

> Tab is GND level. (They are connected to the reverse side of this IC.)
> Do not connect to other wires or land patterns.

- **RP104N**

Pin No.	Symbol	Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE or NC	Chip Enable Pin (“H” Active) or No Connection
4	NC	No Connection
5	V_{OUT}	Output Pin

- **RP104Q**

Pin No.	Symbol	Description
1	CE or NC	Chip Enable Pin (“H” Active) or No Connection
2	GND	Ground Pin
3	V_{OUT}	Output Pin
4	V_{DD}	Input Pin

■ ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating		Unit
V_{IN}	Input Voltage	6.0		V
V_{CE}	Input Voltage (CE Pin)	6.0		V
V_{OUT}	Output Voltage	$- 0.3 \sim V_{IN} + 0.3$		V
I_{OUT}	Output Current	200		mA
P_D	Power Dissipation *	SOT-23-5	420	mW
		PLP1010-4	400	
		SC-82AB	380	
Ta	Ambience Temperature Range	- 40 ~ + 85		°C
Tstg	Storage Temperature Range	- 55 ~ + 125		°C

*For Power Dissipation, please refer to PACKAGE INFORMATION section

ELECTRICAL CHARACTERISTICS

RP104xxx
V_{IN} = Set V_{OUT} + 1V for V_{OUT} options greater than 1.5V. V_{IN}=2.5V for $V_{OUT} \leqq 1.5V$,
I_{OUT}=1mA, C_{IN} =C_{OUT}=0.1μF, unless otherwise noted.
Bold values indicate −40°C ≦ Ta ≦ 85°C, unless otherwise noted.

Ta=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	(*1)	V_{OUT} ×0.992 (-16mV) **V_{OUT}** **×0.985** **(-30mV)**		V_{OUT} ×1.008 (16mV) **V_{OUT}** **×1.015** **(30mV)**	V
I_{OUT}	Output Current		**150**			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≦ I_{OUT} ≦ 150mA		10	**20**	mV
V_{DIF}	Dropout Voltage	Please see the data on next page(p.8)				
I_{SS}	Supply Current	I_{OUT} = 0mA		1.0	**1.5**	μA
Istandby	Supply Current (Standby)	V_{CE} = 0V		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 5.0V		0.02	**0.10**	%/V
V_{IN}	Input Voltage	(*2)	**1.70**		**5.25**	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	− 40°C ≦ Ta ≦ 85°C		±40		ppm /°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V		40		mA
I_{PD}	CE Pull-down Current (D/B Version Only)			0.3		μA
V_{CEH}	CE Input Voltage "H" (D/B Version Only)		**1.5**			V
V_{CEL}	CE Input Voltage "L" (D/B Version Only)				**0.3**	V
R_{LOW}	Nch ON Resistance for Auto Discharge (D Version Only)	V_{IN}=4.0V, V_{CE}=0V		30		Ω

Dropout Voltage

V_{OUT} (V)	Dropout Voltage (V)		
	Condition	TYP.	MAX.
1.2V ≦ V_{OUT}< 1.5V	I_{OUT}=150mA	0.76	**1.05**
1.5V ≦ V_{OUT}< 1.7V		0.53	**0.80**
1.7V ≦ V_{OUT}< 2.0V		0.44	**0.65**
2.0V ≦ V_{OUT}< 2.5V		0.34	**0.50**
2.5V ≦ V_{OUT}< 2.8V		0.28	**0.40**
2.8V ≦ V_{OUT} ≦ 3.3V		0.24	**0.32**

The specification in **Bold** is checked and guaranteed by design engineering.

All of units are tested and specified under pulse load conditions such that Tj ≈ Ta =25°C except for Output Noise and Output Voltage Temperature Coefficient items.

(*1) $V_{OUT} \leqq 2.0V \pm 16mV$ accuracy(- 40°C ≦ Ta ≦ 85°C ±30mV accuracy)
(*2) If Input Voltage range is between 5.25V and 5.5V, the total operational time must be within 500hrs.

TECHNICAL NOTES

When using these ICs, consider the following points:

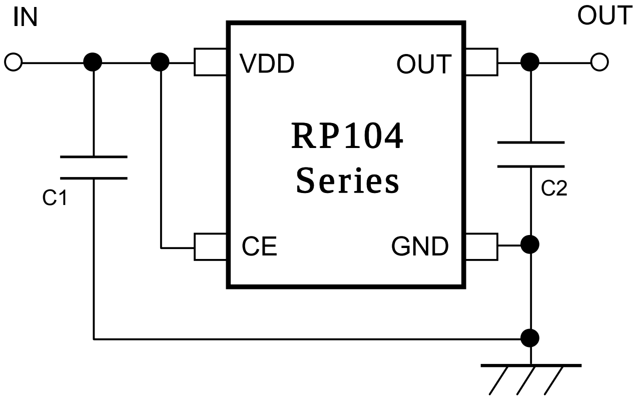
Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 0.1µF or more between V_{DD} and GND pin, and as close as possible to the pins.

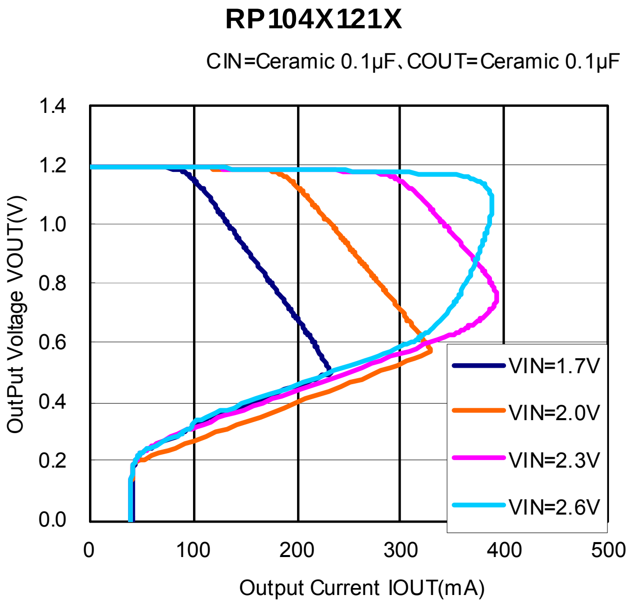
Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible.

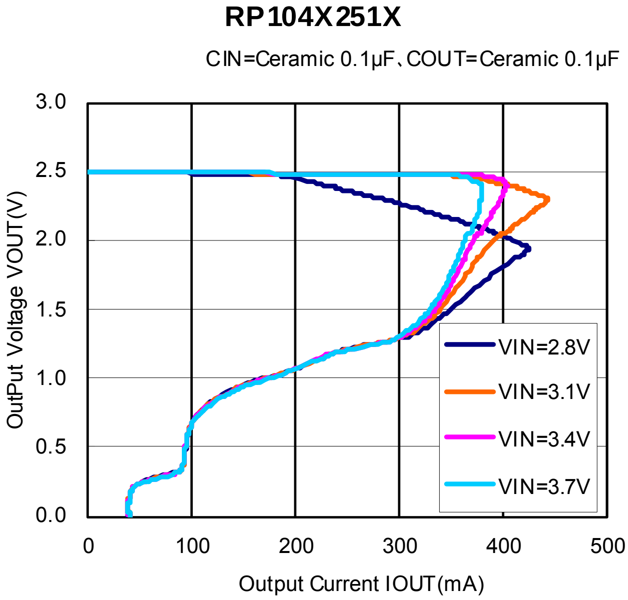


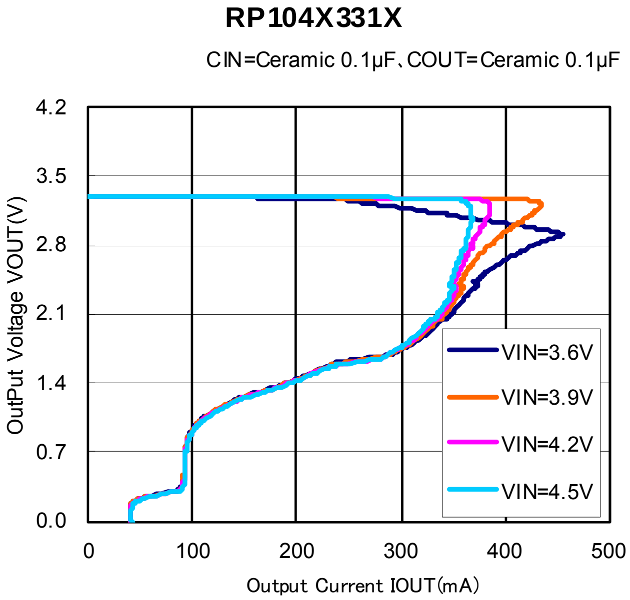
(External Components)
Output Capacitor 0.1µF MURATA : GRM155B31C104KA87B

TYPICAL CHARACTERISTICS

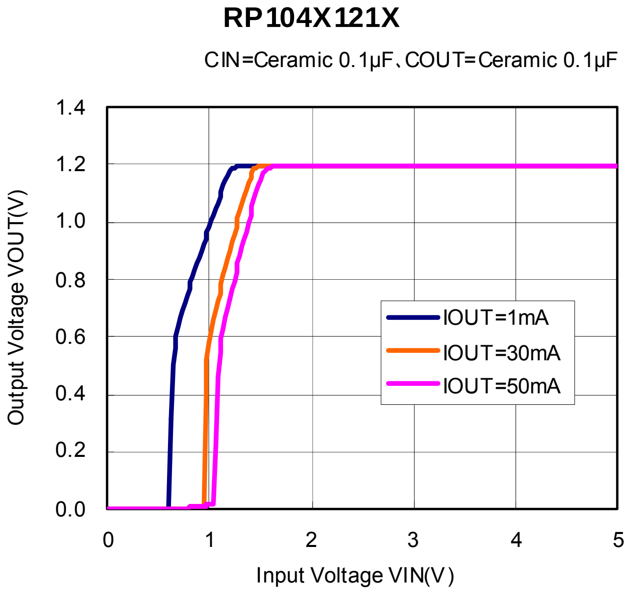
1. Output Voltage vs Output Current (Topt=25°C)

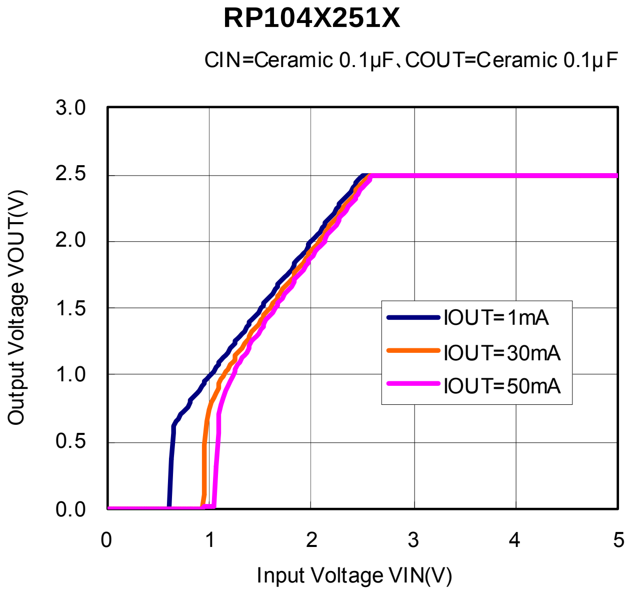


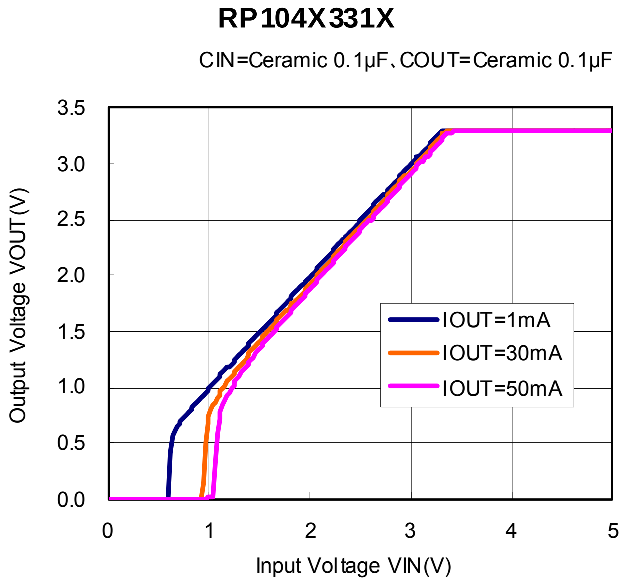




2. Output Voltage vs. Input Voltage

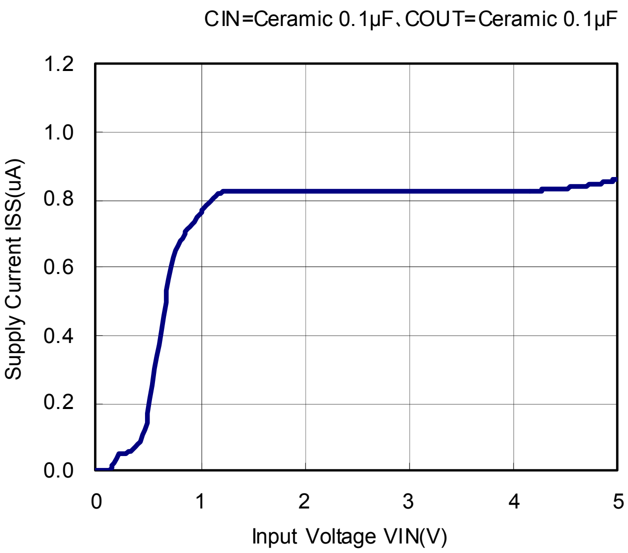




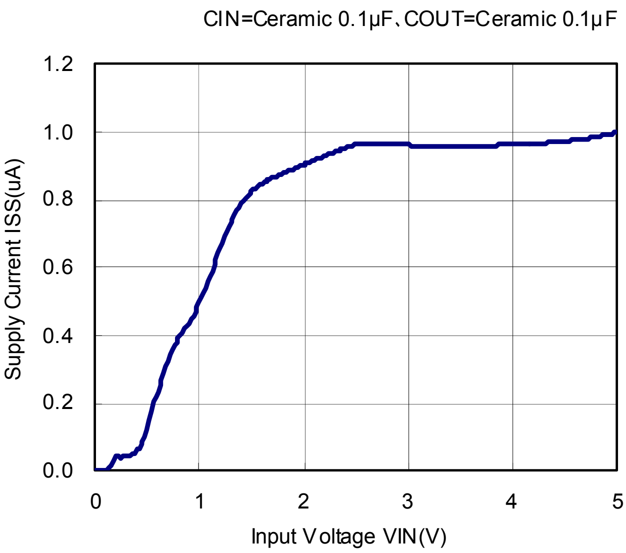


3. Supply Current vs. Input Voltage (Topt=25°C)

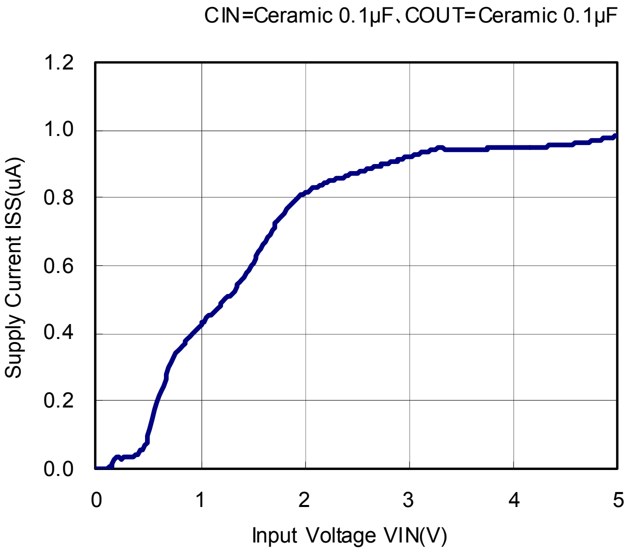
RP104X121X



RP104X251X



RP104X331X

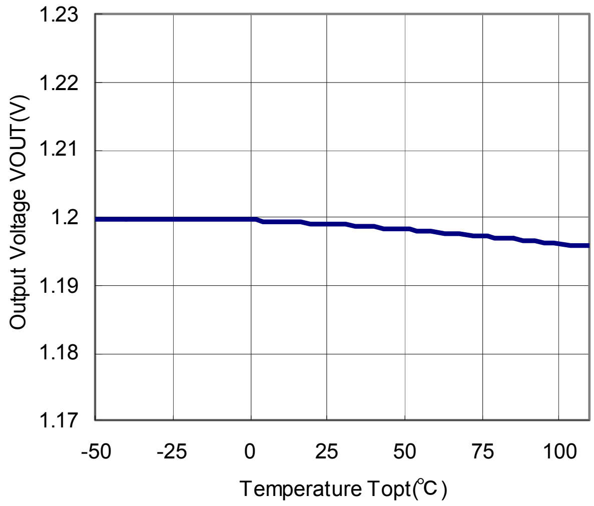


4. Output Voltage vs. Temperature

RP104X121X

VIN=2.2V

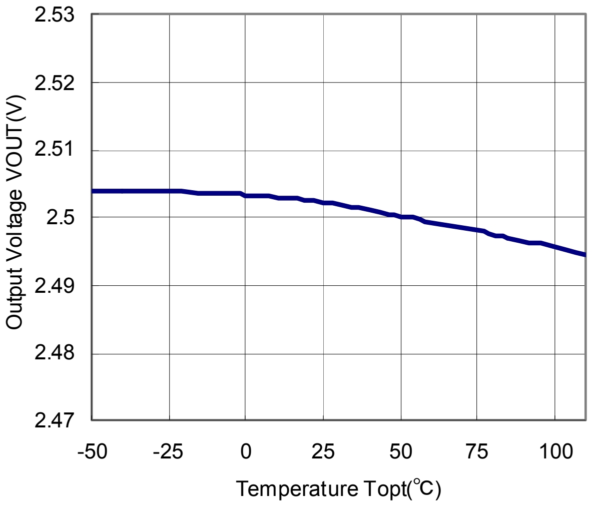
CIN=Ceramic 0.1µF、COUT=Ceramic 0.1µF



RP104X251X

VIN=3.5V

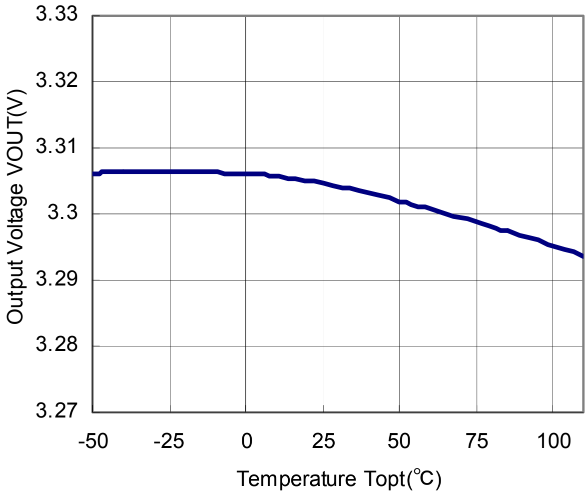
CIN=Ceramic 0.1µF、COUT=Ceramic 0.1µF



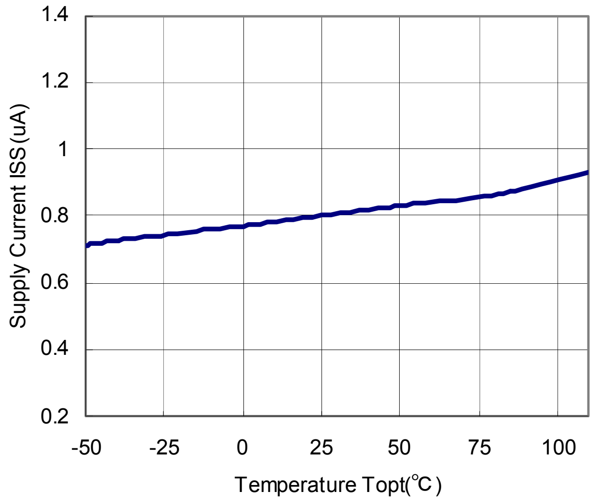
RP104X331X

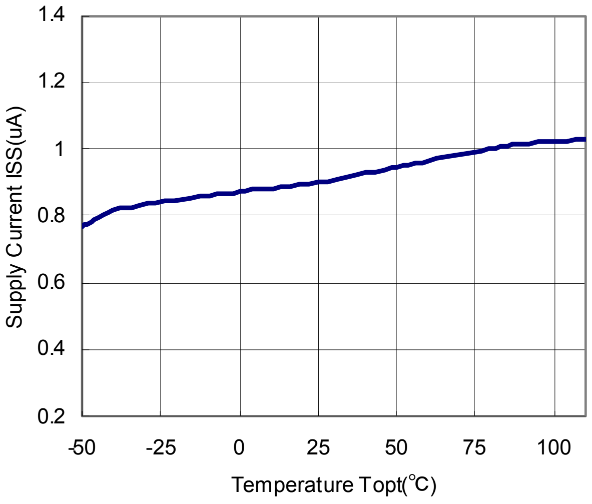
VIN=4.3V

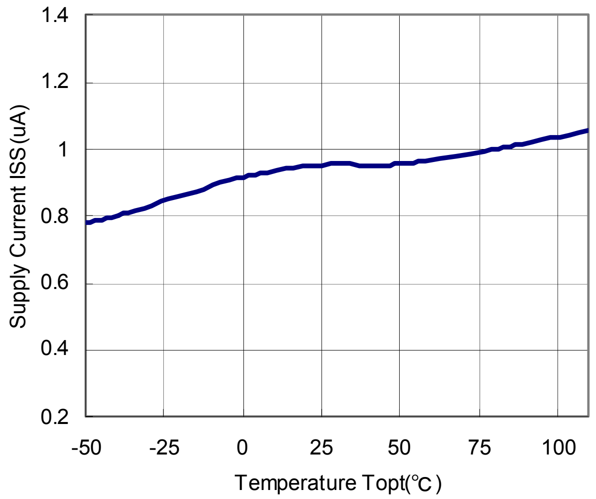
CIN=Ceramic 0.1µF、COUT=Ceramic 0.1µF



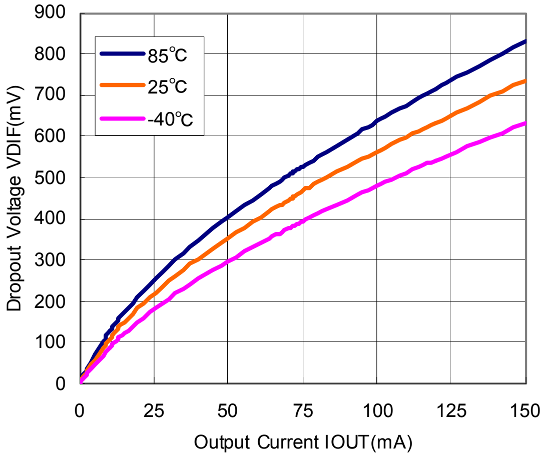
5. Supply Current vs. Temperature





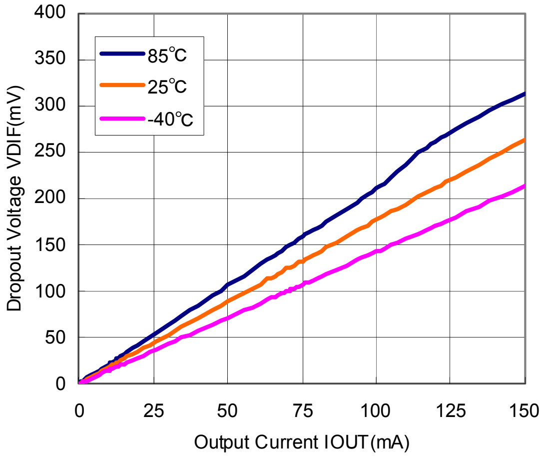


6. Dropout Voltage vs. Output Current (Topt=25°C)



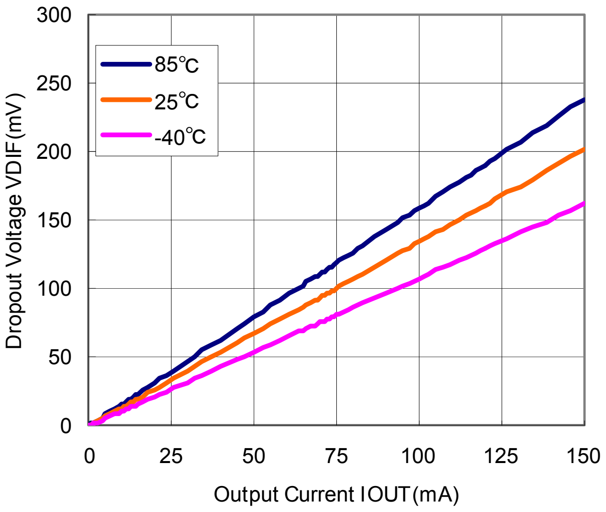
RP104X121X

CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF



RP104X251X

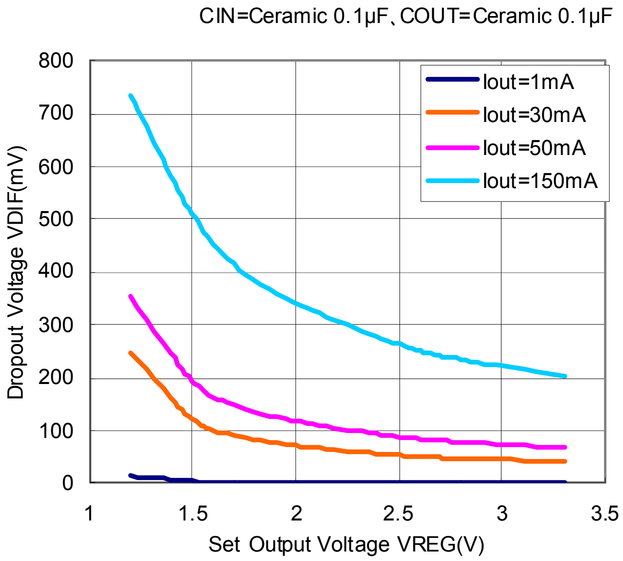
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF



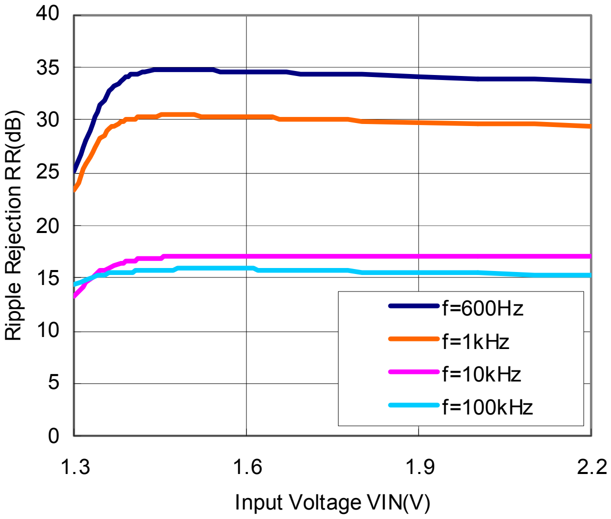
RP104X331X

CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF

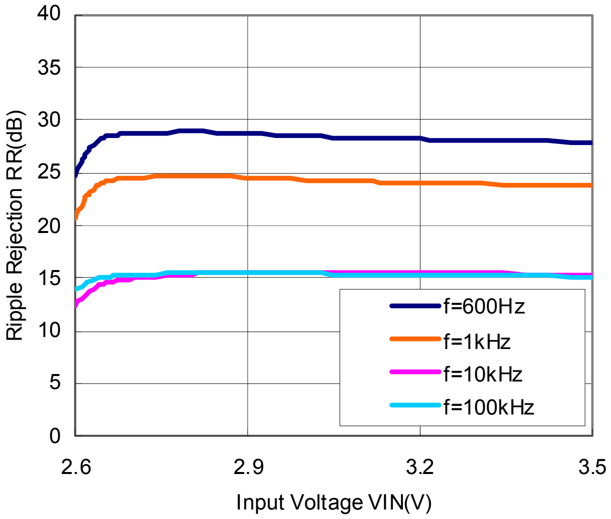
7. Dropout Voltage vs. Set Output Voltage(Topt=25°C)



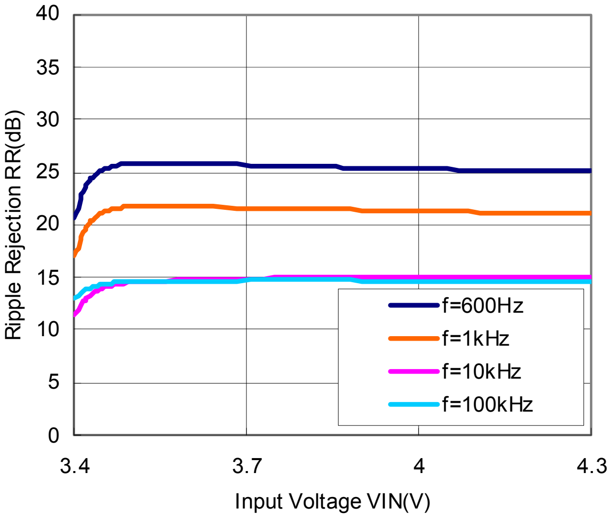
8) Ripple Rejection vs. Input Bias Voltage(Topt=25°C)



RP104X121X 0.2Vp-p、IOUT=1mA
CIN=none、COUT=Ceramic 0.1μF

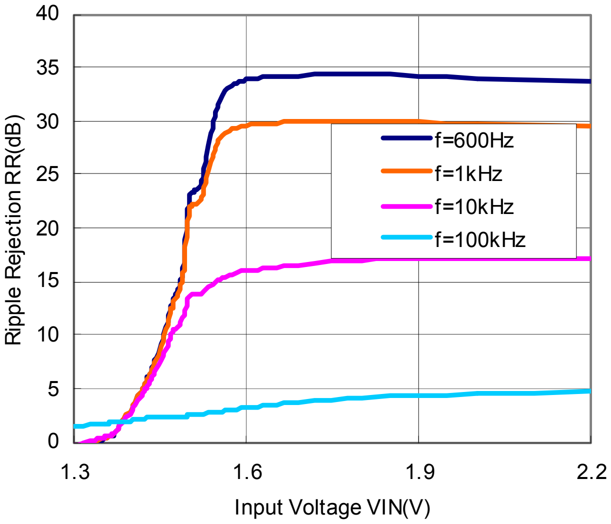


RP104X251X 0.2Vp-p、IOUT=1mA
CIN=none、COUT=Ceramic 0.1μF

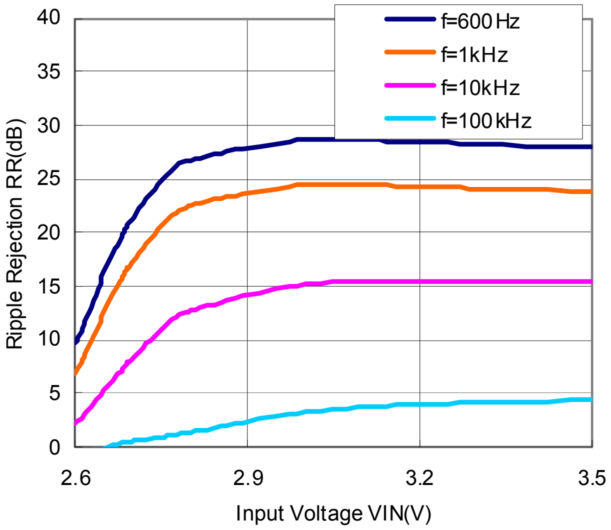


RP104X331X 0.2Vp-p、IOUT=1mA
CIN=none、COUT=Ceramic 0.1μF

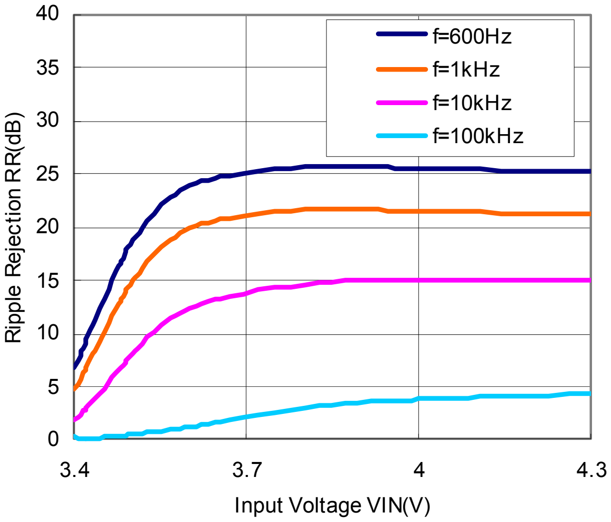
RP104X121X 0.2Vp-p、IOUT=30mA
CIN=none、COUT=Ceramic 0.1μF



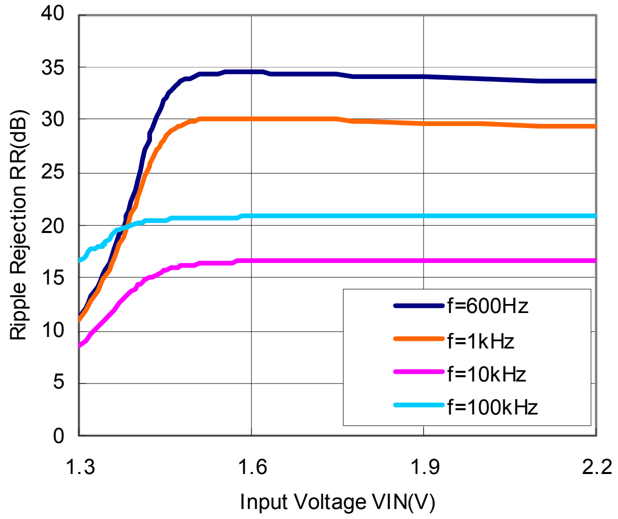
RP104X251X 0.2Vp-p、IOUT=30mA
CIN=none、COUT=Ceramic 0.1μF



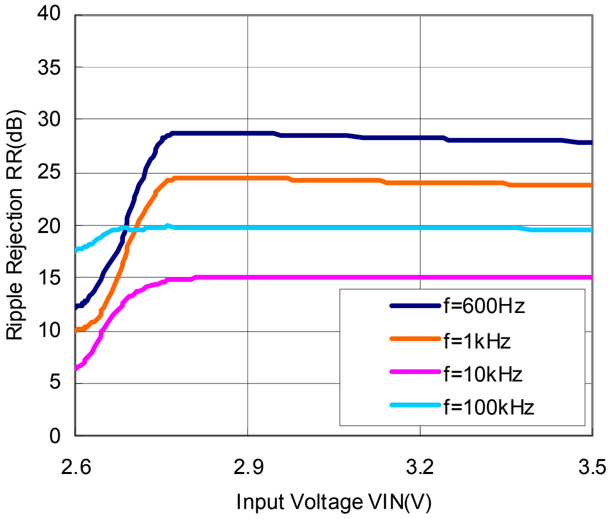
RP104X331X 0.2Vp-p、IOUT=30mA
CIN=none、COUT=Ceramic 0.1μF



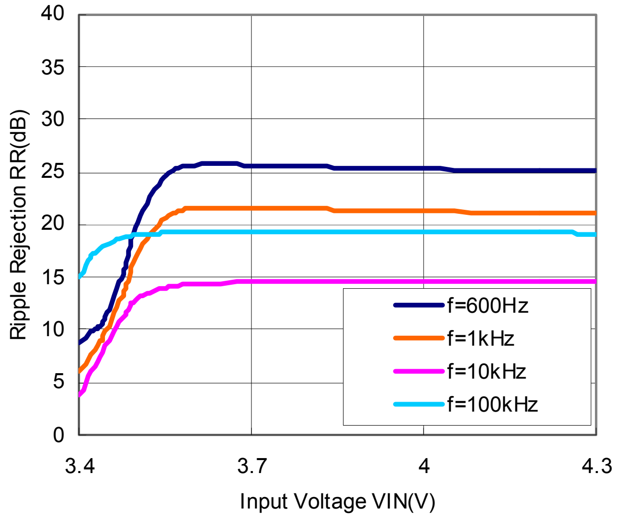
RP104X121X 0.5Vp-p、IOUT=1mA
CIN=none、COUT=Ceramic 0.1μF



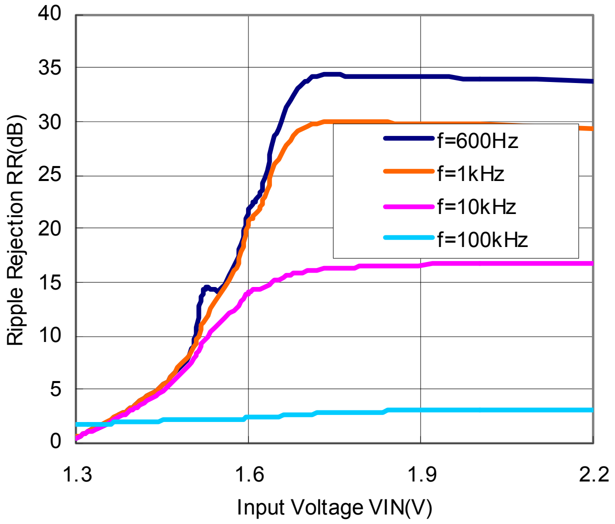
RP104X251X 0.5Vp-p、IOUT=1mA
CIN=none、COUT=Ceramic 0.1μF



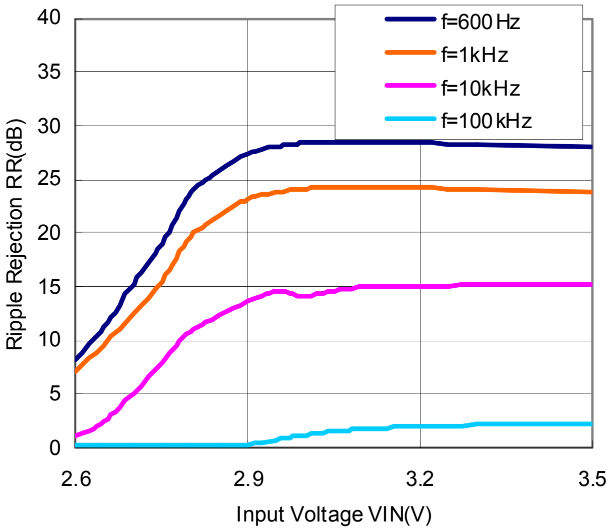
RP104X331X 0.5Vp-p、IOUT=1mA
CIN=none、COUT=Ceramic 0.1μF



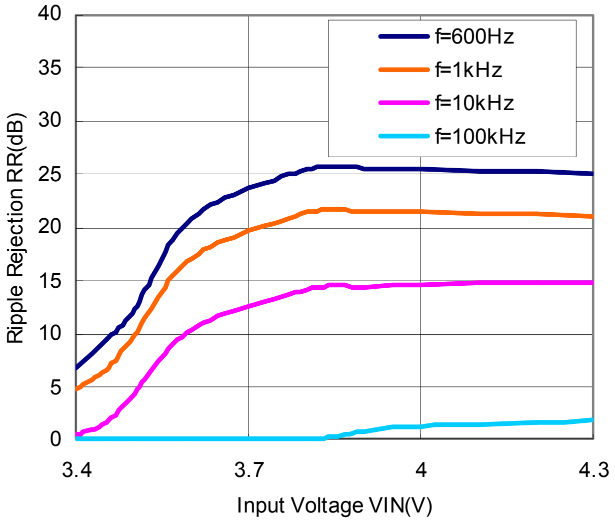
RP104X121X 0.5Vp-p、IOUT=30mA
CIN=none、COUT=Ceramic 0.1µF



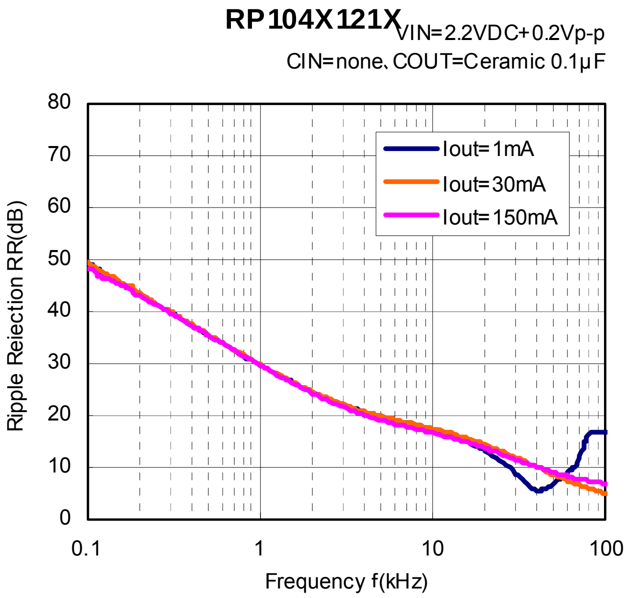
RP104X251X 0.5Vp-p、IOUT=30mA
CIN=none、COUT=Ceramic 0.1µF

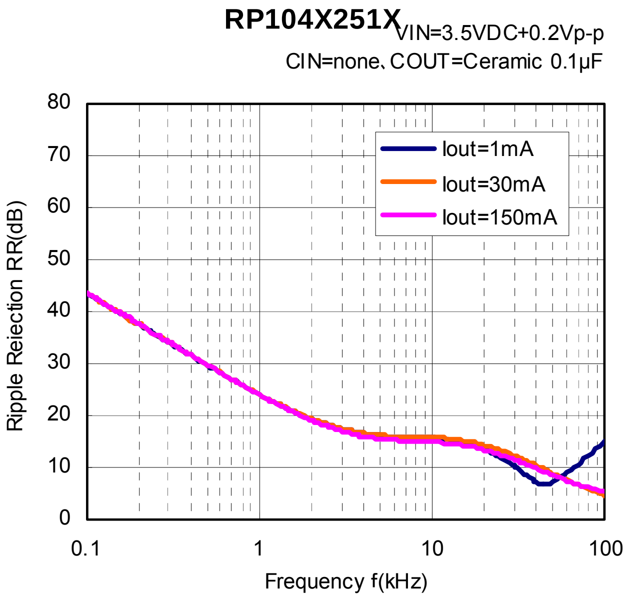


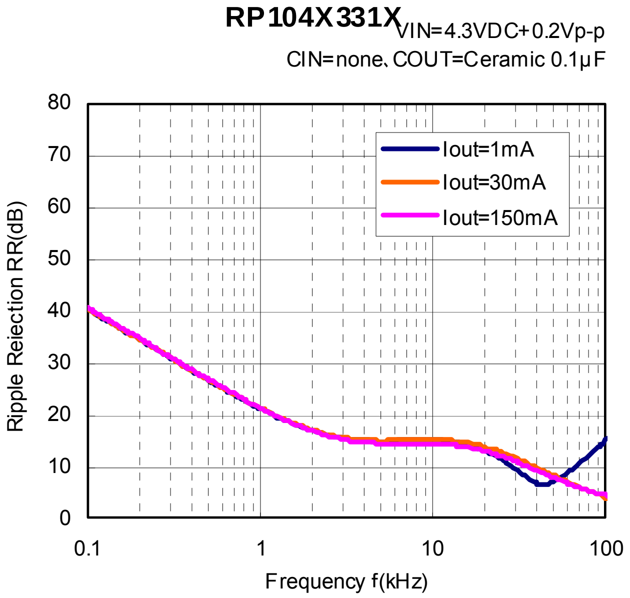
RP104X331X 0.5Vp-p、IOUT=30mA
CIN=none、COUT=Ceramic 0.1µF

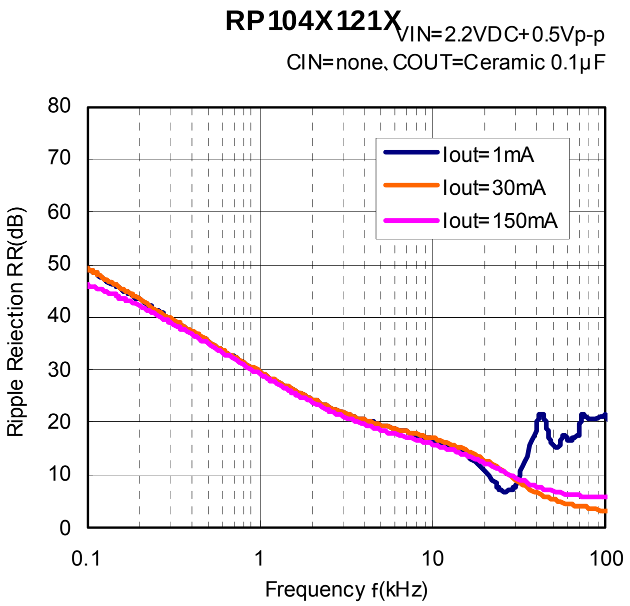


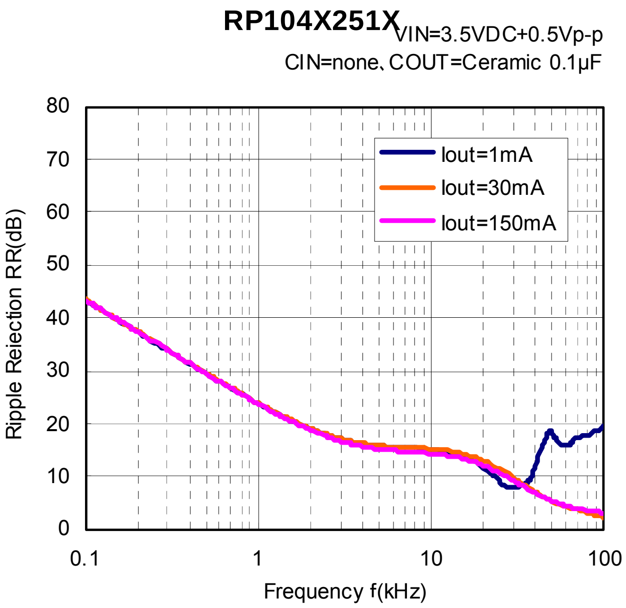
9) Ripple Rejection vs. Frequency (Topt=25°C)

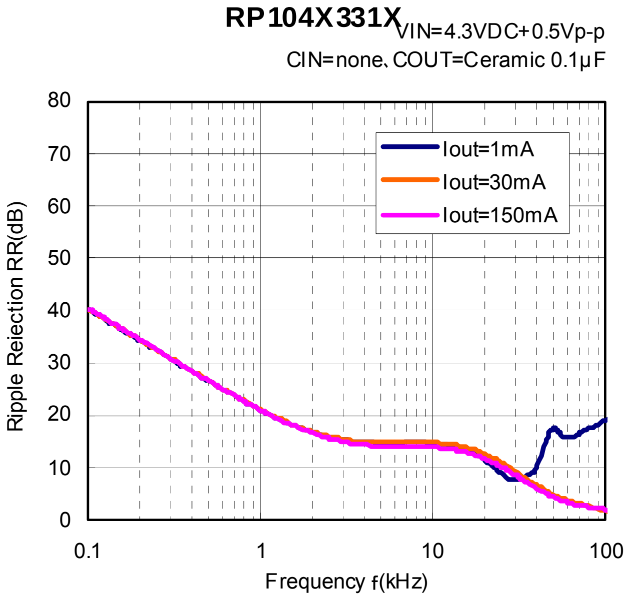




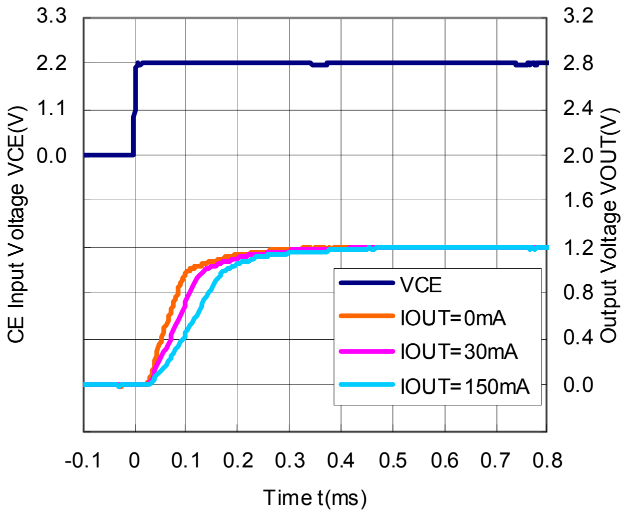



RP104X121X
VIN=2.2VDC+0.5Vp-p
CIN=none, COUT=Ceramic 0.1μF
Ripple Rejection RR(dB)
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Frequency f(kHz)
Iout=1mA
Iout=30mA
Iout=150mA


RP104X251X
VIN=3.5VDC+0.5Vp-p
CIN=none, COUT=Ceramic 0.1μF
Ripple Rejection RR(dB)
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Frequency f(kHz)
Iout=1mA
Iout=30mA
Iout=150mA

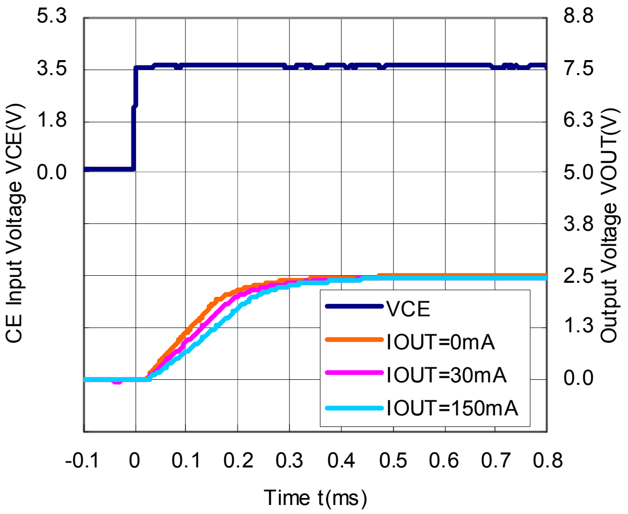

RP104X331X
VIN=4.3VDC+0.5Vp-p
CIN=none, COUT=Ceramic 0.1μF
Ripple Rejection RR(dB)
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Frequency f(kHz)
Iout=1mA
Iout=30mA
Iout=150mA

10) Turn on speed with CE pin (Topt=25°C)



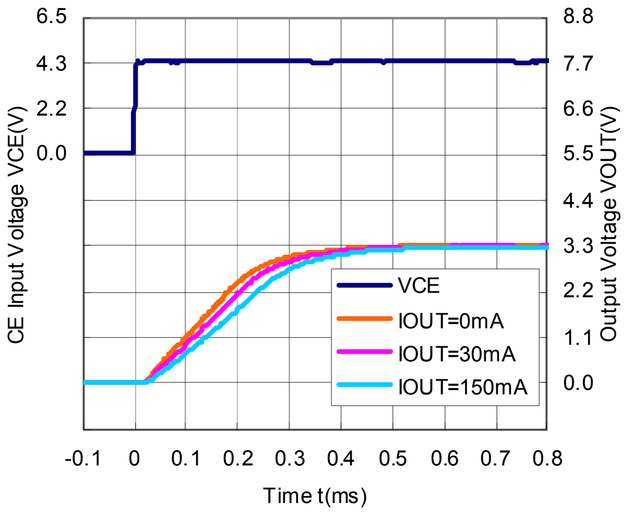
RP104X121X VIN=2.2V

CIN=Ceramic 0.1µF、COUT=Ceramic 0.1µF



RP104X251X VIN=3.5V

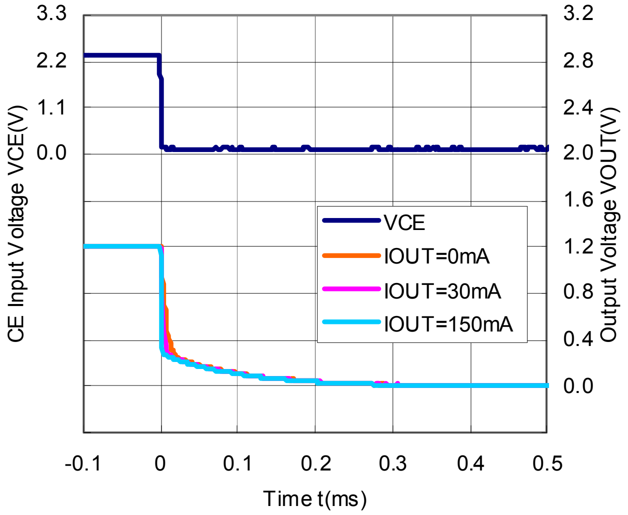
CIN=Ceramic 0.1µF、COUT=Ceramic 0.1µF

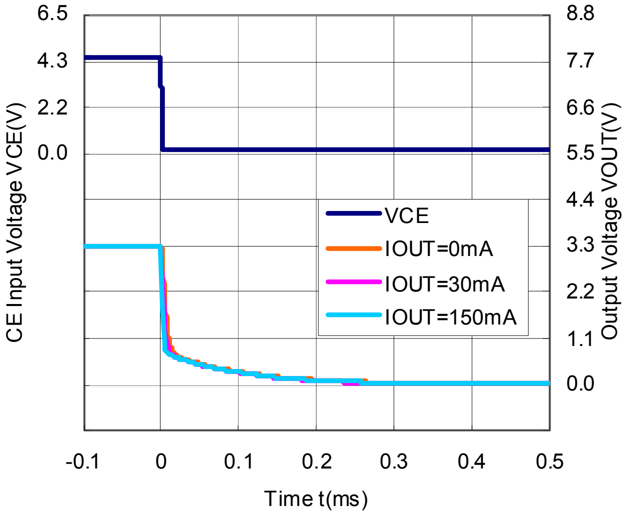


RP104X331X VIN=4.3V

CIN=Ceramic 0.1µF、COUT=Ceramic 0.1µF

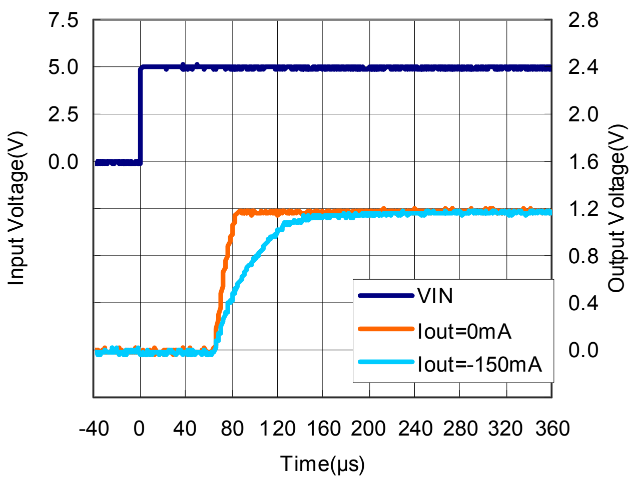
11) Turn off speed with CE pin (Topt=25°C)


RP104X121D
VIN=2.2V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF

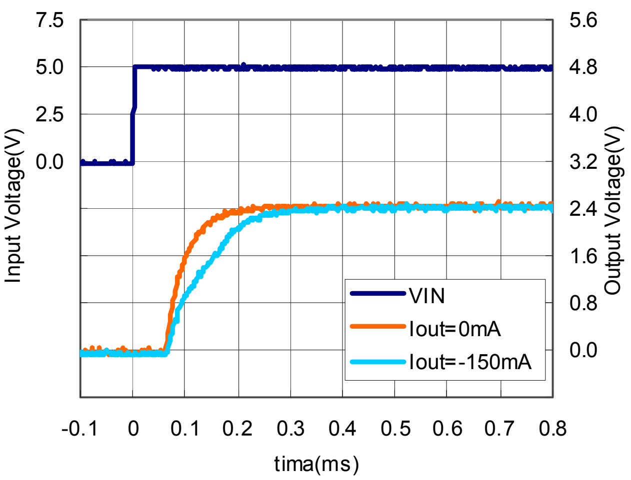

RP104X331D
VIN=4.3V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF

12. Turn on speed of C.version (Topt=25°C)

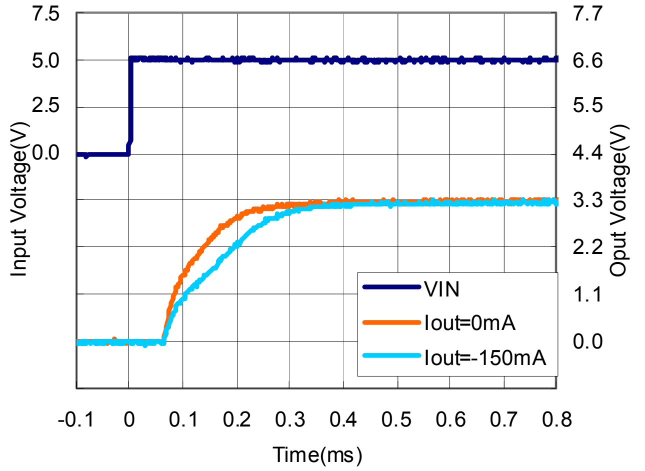
RP104X121C VIN=5.0V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF



RP104X251C VIN=5.0V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF

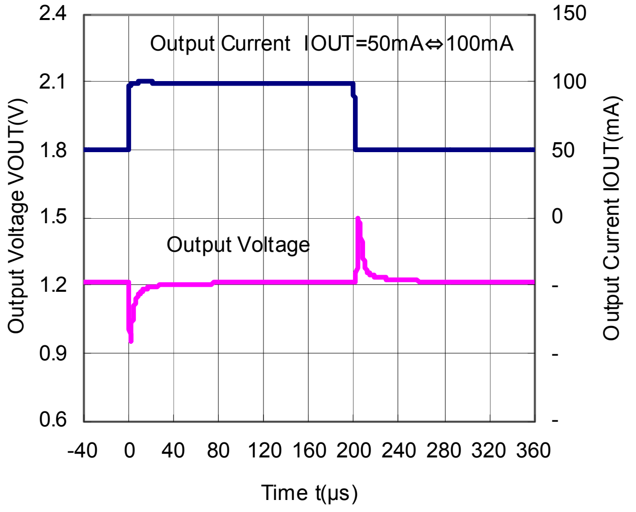


RP104X331C VIN=5.0V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF

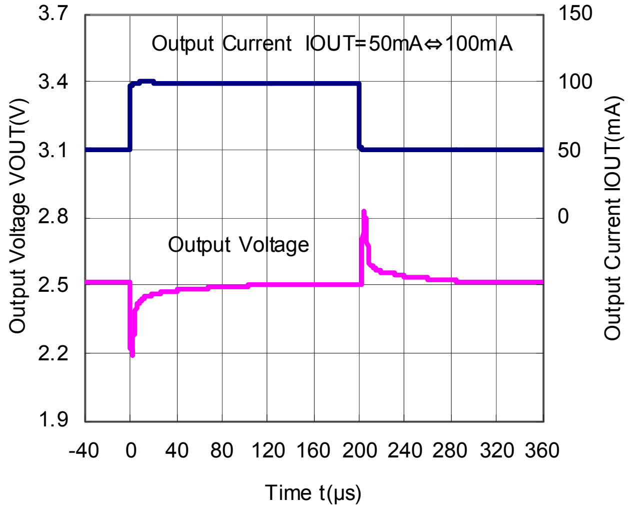


13) Load Transient Response (Topt=25°C)

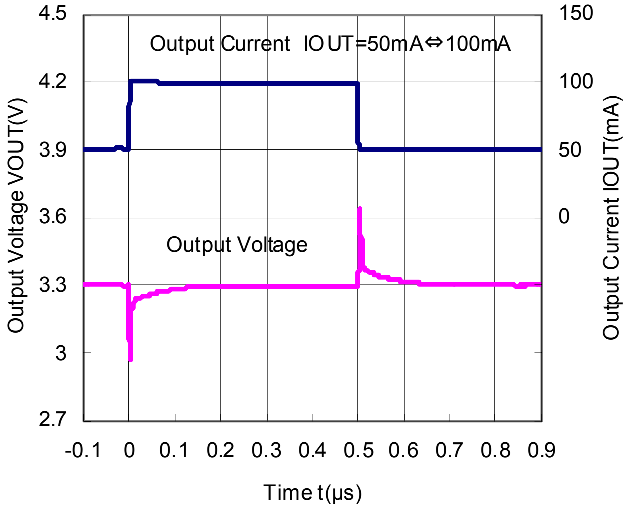
RP104X121X VIN=2.2V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF



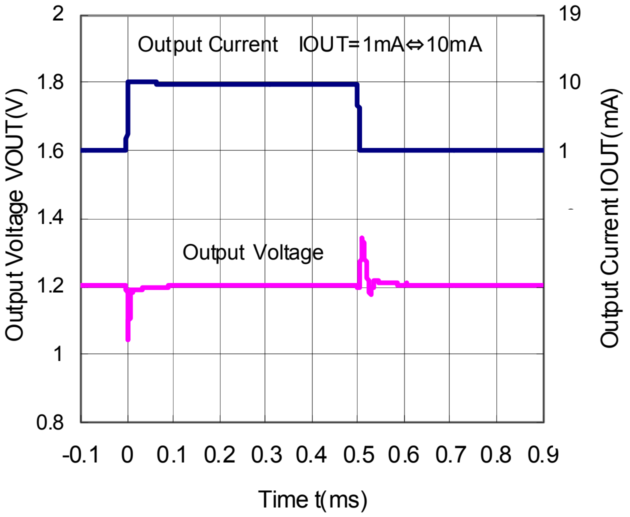
RP104X251X VIN=3.5V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF



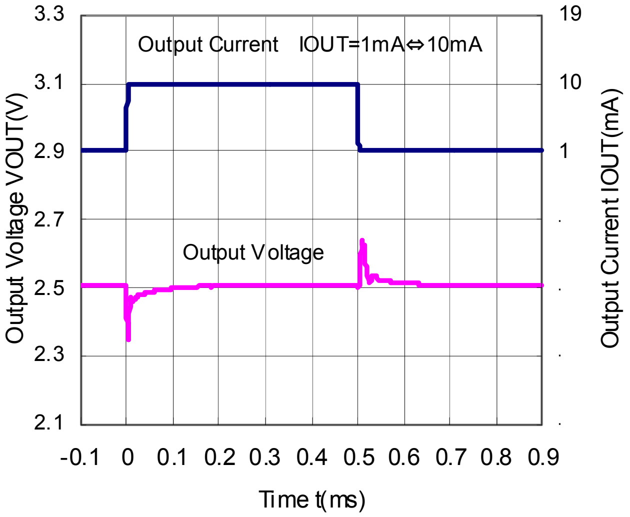
RP104X331X VIN=4.3V
CIN=Ceramic 0.1μF、COUT=Ceramic 0.1μF



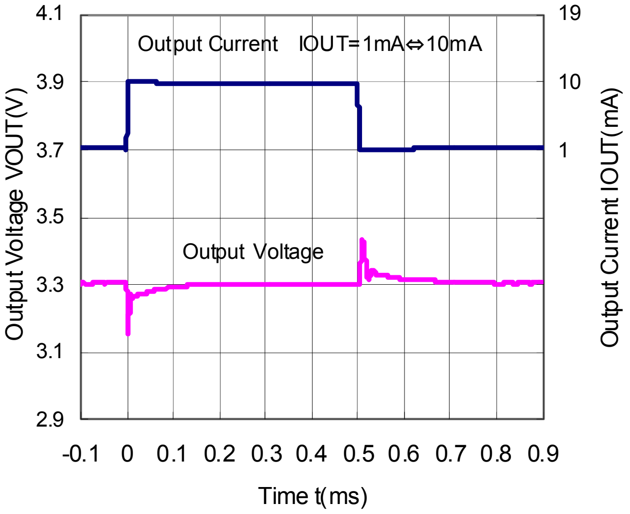
RP104X121X VIN=2.2V
CIN=Ceramic 0.1μF､COUT=Ceramic 0.1μF



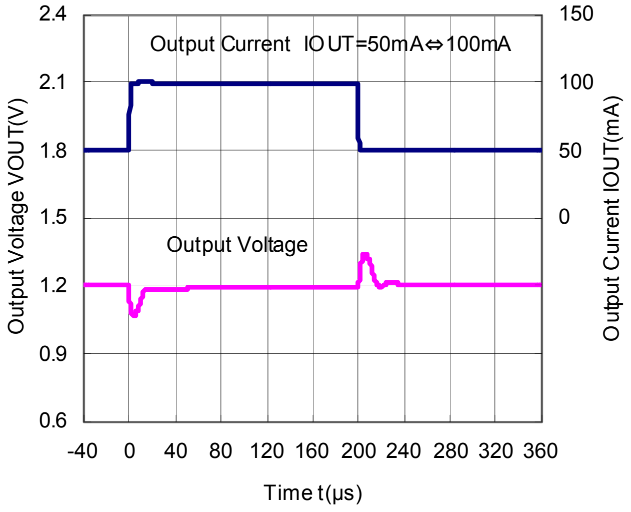
RP104X251X VIN=3.5V
CIN=Ceramic 0.1μF､COUT=Ceramic 0.1μF



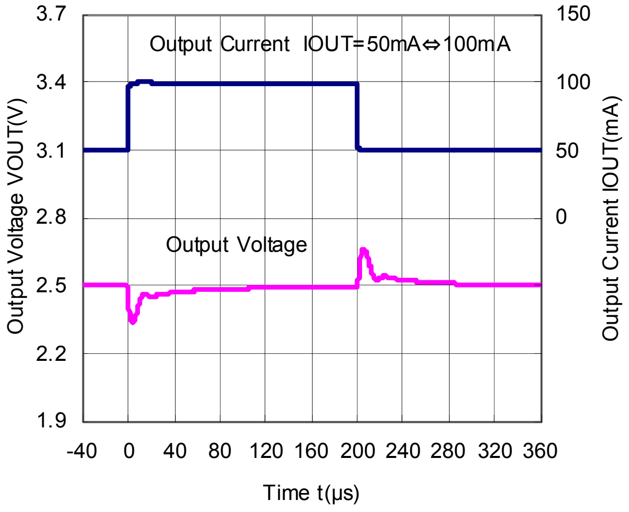
RP104X331X VIN=4.3V
CIN=Ceramic 0.1μF､COUT=Ceramic 0.1μF



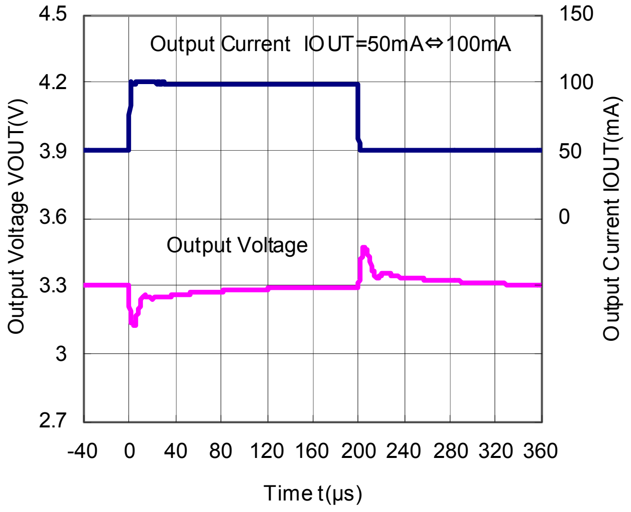
RP104X121X VIN=2.2V
CIN=Ceramic 0.1μF、COUT=Ceramic 1.0μF



RP104X251X VIN=3.5V
CIN=Ceramic 0.1μF、COUT=Ceramic 1.0μF

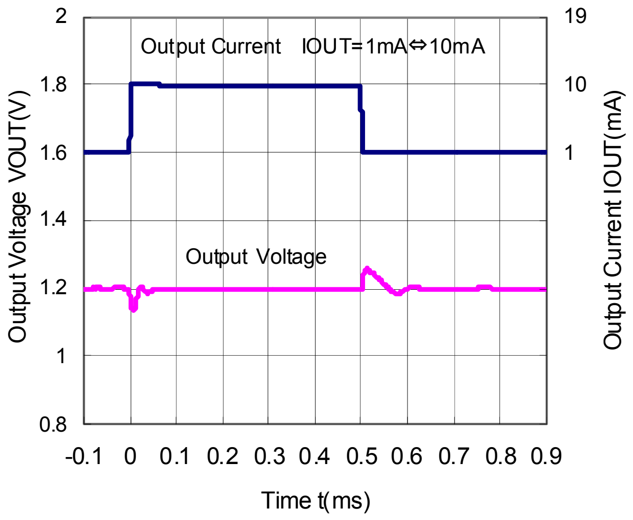


RP104X331X VIN=4.3V
CIN=Ceramic 0.1μF、COUT=Ceramic 1.0μF



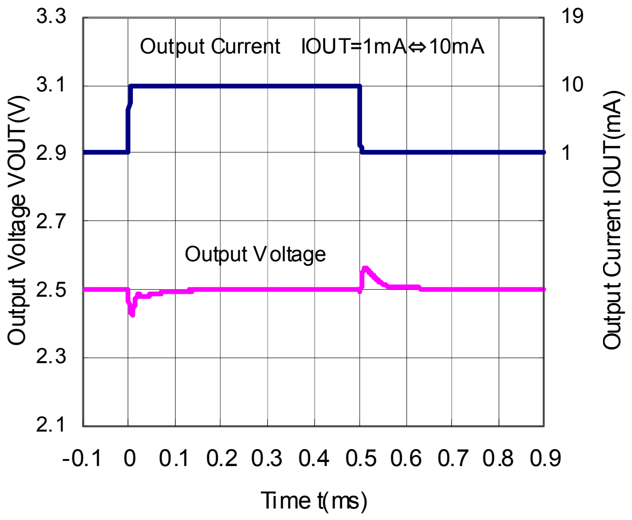
RP104X121X VIN=2.2V

CIN=Ceramic 0.1µF, COUT=Ceramic 1.0µF



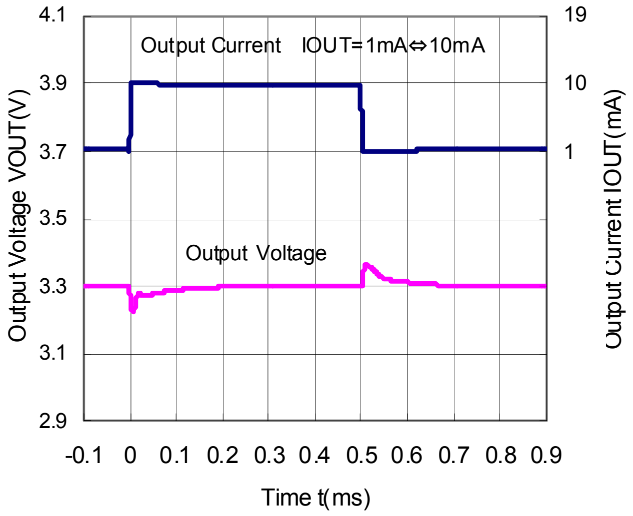
RP104X251X VIN=3.5V

CIN=Ceramic 0.1µF, COUT=Ceramic 1.0µF

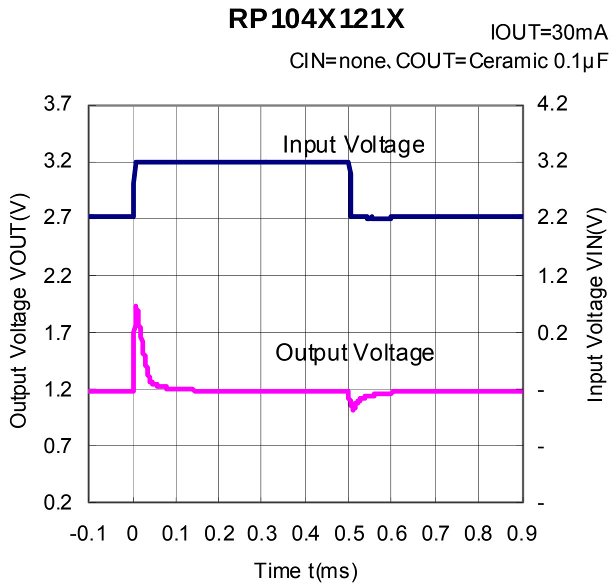


RP104X331X VIN=4.3V

CIN=Ceramic 0.1µF, COUT=Ceramic 1.0µF

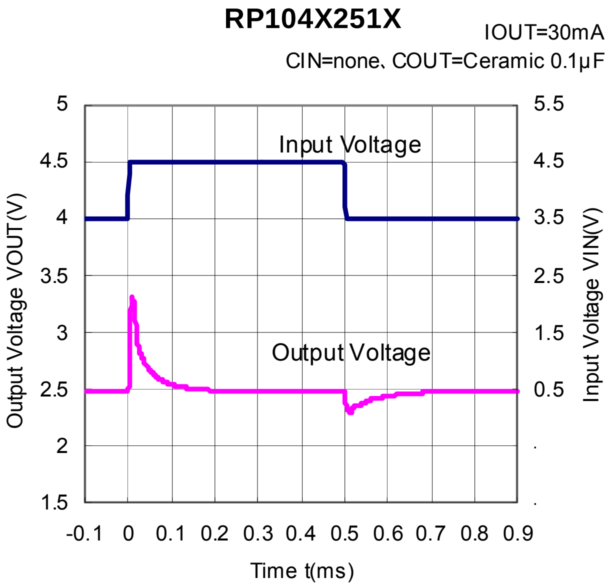


14. Input Transient Response (Topt=25°C)



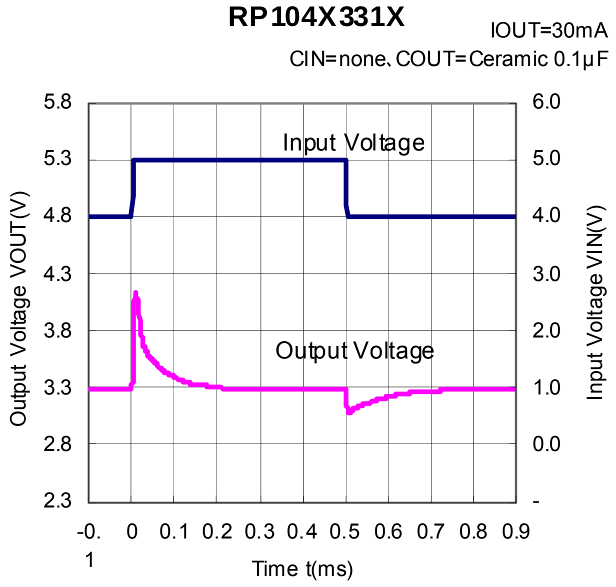
RP104X121X

IOUT=30mA
CIN=none, COUT=Ceramic 0.1μF



RP104X251X

IOUT=30mA
CIN=none, COUT=Ceramic 0.1μF

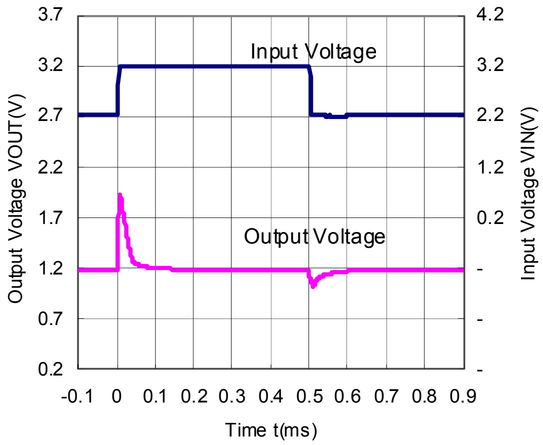


RP104X331X

IOUT=30mA
CIN=none, COUT=Ceramic 0.1μF

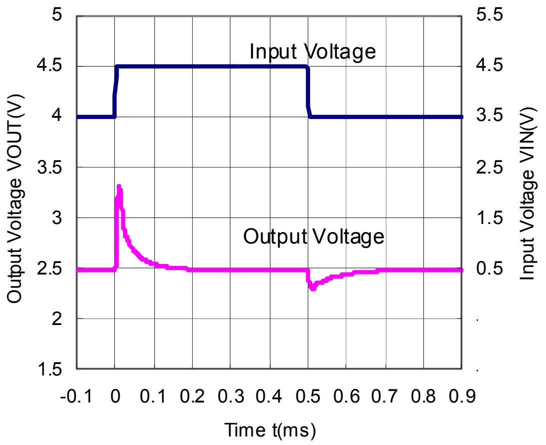
RP104X121X

IOUT=30mA
CIN=none, COUT=Ceramic 0.1μF



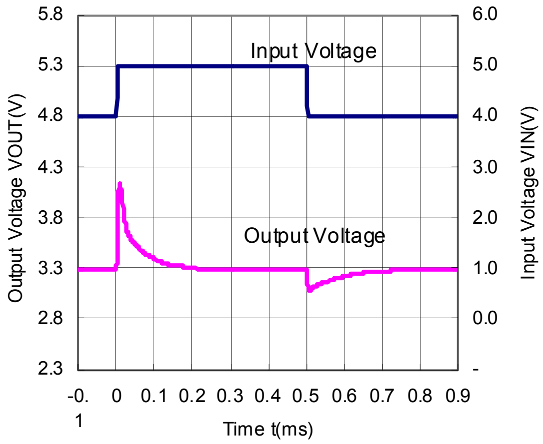
RP104X251X

IOUT=30mA
CIN=none, COUT=Ceramic 0.1μF



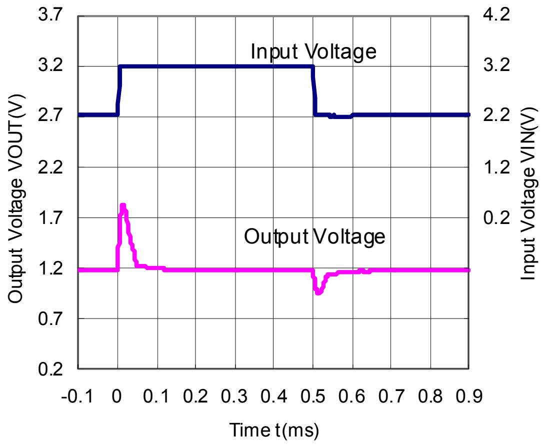
RP104X331X

IOUT=30mA
CIN=none, COUT=Ceramic 0.1μF



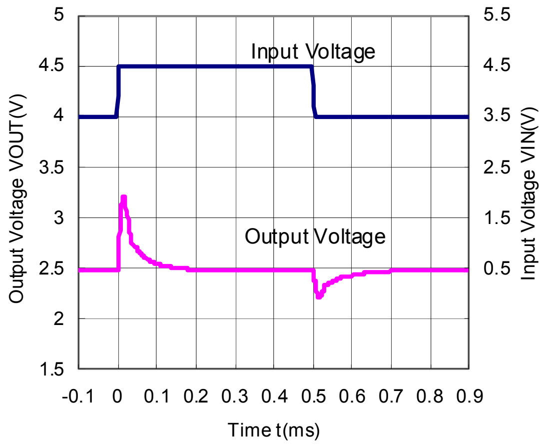
RP104X121X

IOUT=30mA
CIN=none, COUT=Ceramic 1.0μF



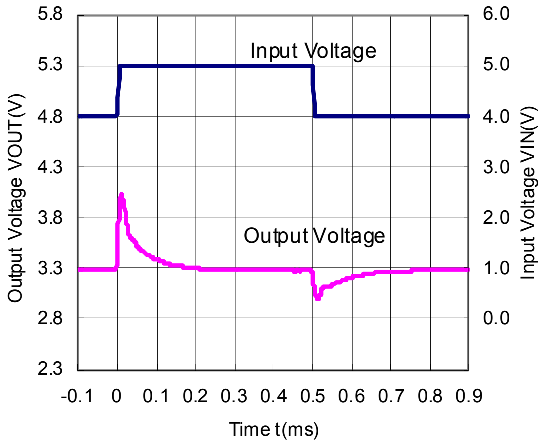
RP104X251X

IOUT=30mA
CIN=none, COUT=Ceramic 1.0μF

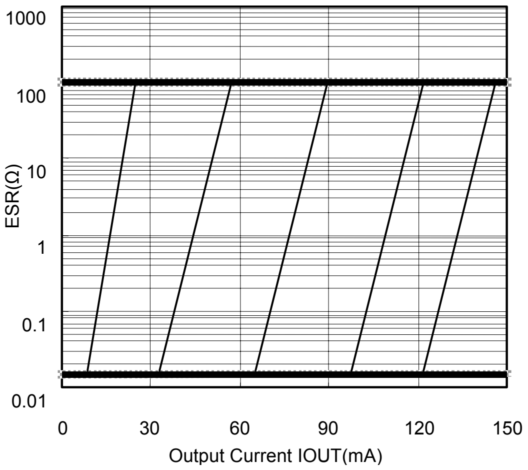


RP104X331X

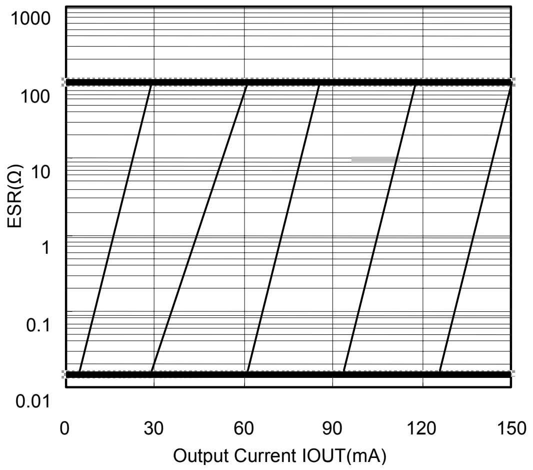
IOUT=30mA
CIN=none, COUT=Ceramic 1.0μF



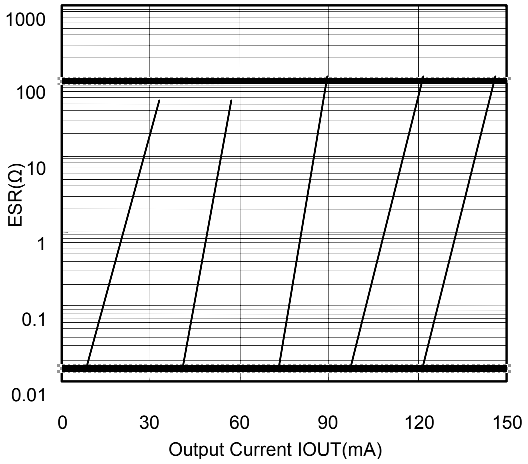
RP104X121X VIN=1.7V～5V
CIN=Ceramic 0.047μF、COUT=Ceramic 0.047



RP104X251X VIN=2.6V～5V
CIN=Ceramic 0.047μF、COUT=Ceramic 0.047



RP104X331X VIN=3.4V～5V
CIN=Ceramic 0.047μF、COUT=Ceramic 0.047



POWER DISSIPATION (SOT-23-5)

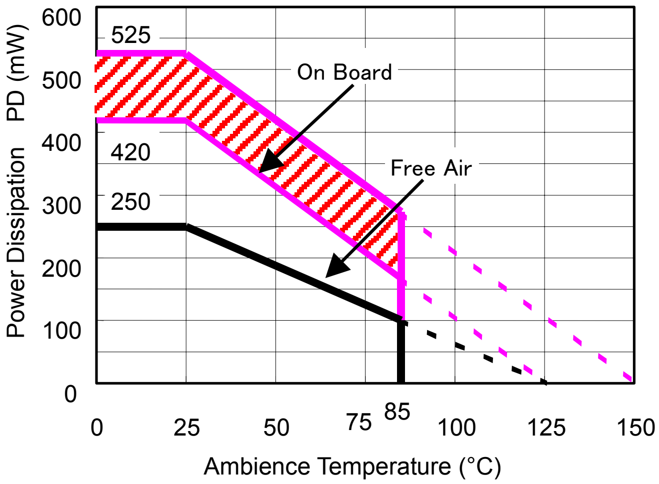
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

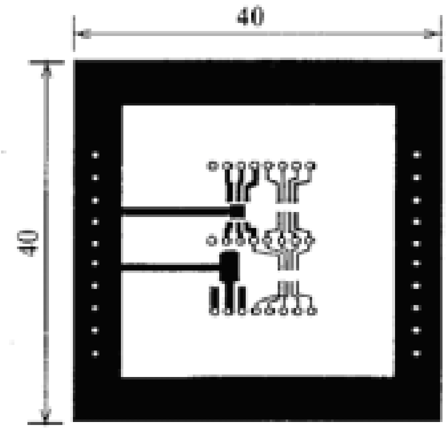
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm*40mm*1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.5mm * 44pcs

Measurement Result (Ta=25°C)

	Standard Test Land Pattern	Free Air
Power Dissipation	420mW(Tjmax=125°C) 525mW(Tjmax=150°C)	250mW(Tjmax=125°C)
Thermal Resistance	θja = (125-25°C)/0.42W= 263°C/W	400°C/W



Power Dissipation



Measurement Board Pattern

◌ IC Mount Area (Unit: mm)

- Use in the oblique-line-area might be influence the product-life cycle because of exceeding the absolutely maximum ratings 125°C of "Storage Temperature Range".
  Please suppress by 9,000 hours about use. 9,000 hours will correspond in six years when using it for four hours a day

POWER DISSIPATION (PLP1010-4)

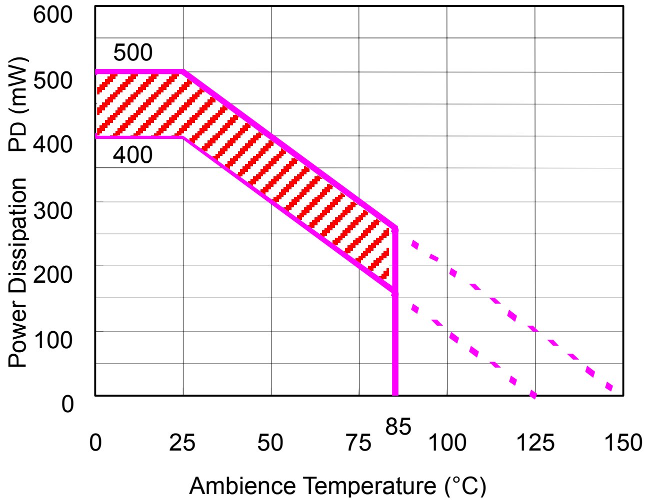
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

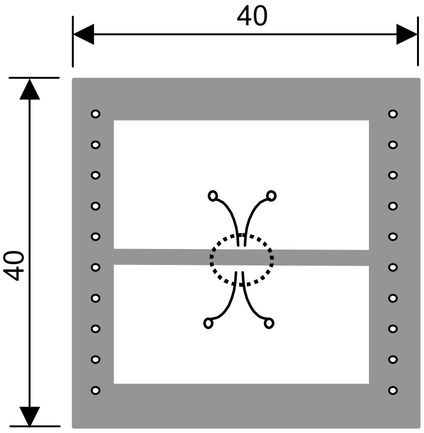
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm * 40mm * 1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.54mm * 24pcs

Measurement Result (Ta=25°C)

	Standard Test Land Pattern
Power Dissipation	400mW(Tjmax=125°C) 500mW(Tjmax=150°C)
Thermal Resistance	θja = (125-25°C)/0.4W= 250°C/W θjc = 67°C/W



Power Dissipation



Measurent Board Pattern
IC Mount Area

(Unit:mm)

-Use in the oblique-line-area might be influence the product-life cycle because of exceeding the absolutely maximum ratings 125°C of "Storage Temperature Range".
Please suppress by 13,000 hours about use. 13,000 hours will correspond in nine years when using it for four hours a day

POWER DISSIPATION (SC-82AB)

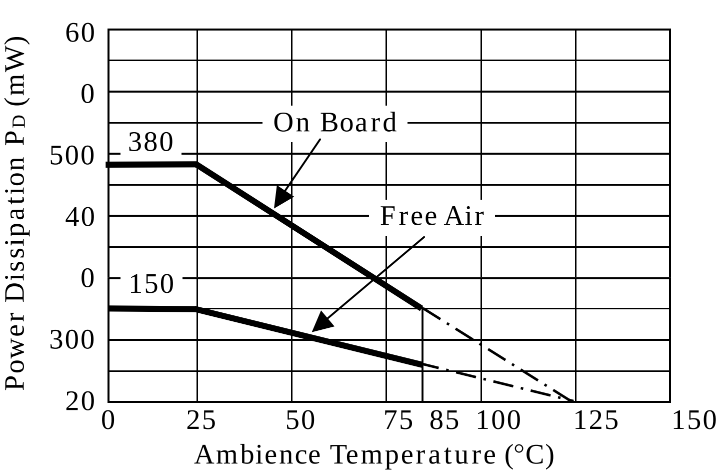
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below;

Measurement Conditions

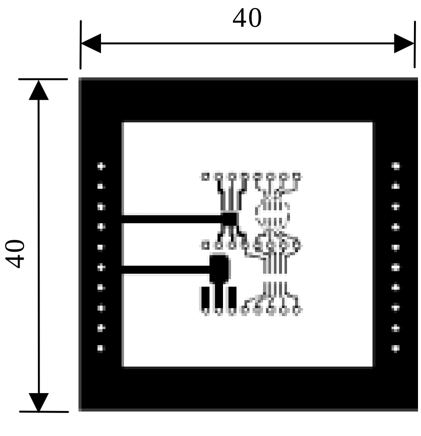
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double Layers)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-hole	ϕ0.5mm × 44pcs

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

	Standard Land Pattern	Free Air
Power Dissipation	**380mW**	150mW
Thermal Resistance	θja＝(125-25°C)/0.38W＝263°C/W	667°C/W



Power Dissipation



Measurment Board Pattern

◌ IC Mount Area (Unit : mm)