300 mA 10 V Input LDO Regulator for Industrial Applications

NO. EA-341-220928

OUTLINE

The RP170x Series are LDO regulators featuring 300 mA output current that are developed with CMOS process technology. Because of the 10 V maximum input voltage, RP170x can be used in the industrial equipments such as FAs and smart meters. The supply current is Typ. 23 μA though an excellent response characteristics. The output voltage range from 1.2 V is possible. The output voltage accuracy and temperature-drift coefficient of output voltage of the RP170x Series are excellent.

RP170x has a fold-back protection circuit and a thermal shutdown circuit. Moreover, a standby mode with ultra low supply current can be realized with the chip enable function.

SOT-23-5 and SOT-89-5 with high power dissipation packages are available.

This is a high-reliability semiconductor device for industrial applications (-Y) that has passed both the screening at high temperature and the reliability test with extended hours. This line of products operate in a wide temperature range from low temperature to high temperature to support harsh environment applications.

FEATURES

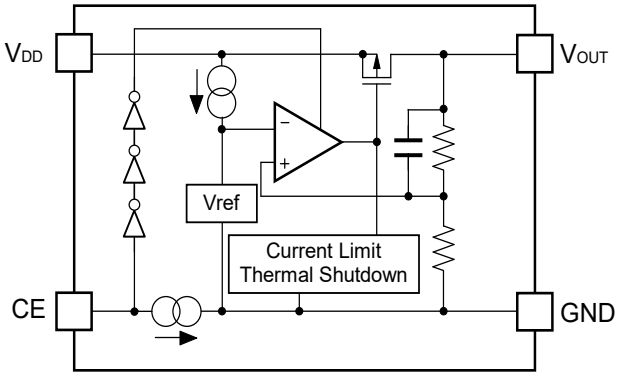
- Input Voltage Range (Maximum Rating) .....2.6 V to 10.0 V (12 V)
- Operating Temperature.....−50°C to 105°C
- Supply Current.....Typ. 23 μA
- Standby Mode .....Typ. 0.1 μA
- Dropout Voltage.....Typ. 0.20 V (I_{OUT} = 100 mA, V_{OUT} = 3.0 V)
  .....Typ. 0.77 V (I_{OUT} = 300 mA, V_{OUT} = 2.8 V)
- Ripple Rejection .....Typ. 70 dB (f = 1 kHz)
- Temperature-Drift Coefficient of Output Voltage .....Typ. ±80 ppm/°C
- Line Regulation.....Typ. 0.02%/V
- Output Voltage Accuracy .....±1.0%
- Packages.....SOT-23-5, SOT-89-5
- Output Voltage Range .....1.2 V/ 1.5 V/ 1.8 V/ 2.5 V/ 2.8 V/3.0 V/ 3.3 V/ 3.4 V/ 5.0 V/ 6.0 V
  Contact our sales representatives for other voltages.
- Built-in Fold Back Protection Circuit ..... Typ. 40mA (Current at short mode)
- Built-in Thermal Shutdown Circuit ..... Shutdown Temperature at 165°C
- Built-in Constant Slope Circuit (Soft-start Function)
- Ceramic capacitors are recommended to be used with this IC.....1.0 μF or more

APPLICATIONS

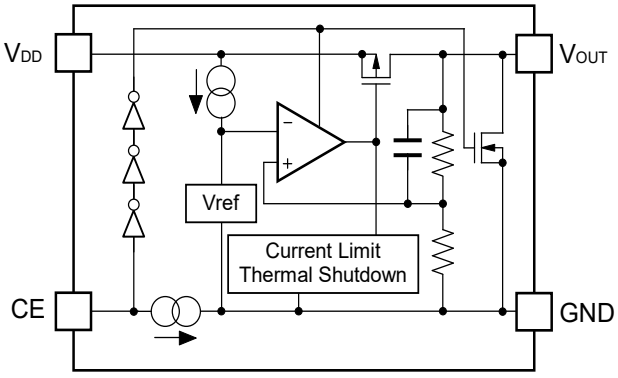
- Industrial equipments such as FAs and smart meters
- Equipments used under high-temperature conditions such as surveillance camera and vending machine
- Equipments accompanied by self-heating such as motor and lighting

BLOCK DIAGRAMS

RP170xxxxB



RP170xxxxD



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP170Nxx1∗-TR-YE	SOT-23-5	3,000 pcs	Yes	Yes
RP170Hxx1∗-T1-YE	SOT-89-5	1,000 pcs	Yes	Yes

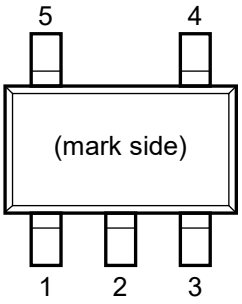
xx: Specify the set output voltage (V_{SET})
1.2 V (12) / 1.5 V (15) / 1.8 V (18) / 2.5 V (25) / 2.8 V (28) / 3.0 V (30) / 3.3 V (33) /
3.4 V (34) / 5.0 V (50) / 6.0 V (60)
Contact our sales representatives for other voltages.

∗ : The auto discharge functions at off state are as follows.
(B) without auto discharge function at off state
(D) with auto discharge function at off state

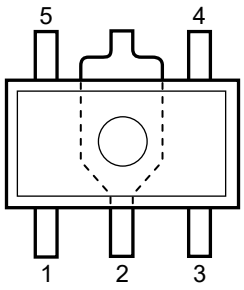
Auto-discharge function quickly lowers the output voltage to 0 V by releasing the electrical charge accumulated in the external capacitor when the chip enable signal is switched from the active mode to the standby mode.

PIN DESCRIPTIONS

● **SOT-23-5**



● **SOT-89-5**



● **SOT-23-5**

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

● **SOT-89-5**

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item		Rating	Unit
V_{IN}	Input Voltage		12	V
V_{CE}	Input Voltage (CE Pin)		12	V
V_{OUT}	Output Voltage		−0.3 to V_{IN} + 0.3	V
I_{OUT}	Output Current		330	mA
P_D	Power Dissipation* (JEDEC STD. 51-7)	SOT-23-5	830	mW
		SOT-89-5	3200	
Tj	Junction Temperature		−50 to 150	°C
Tstg	Storage Temperature Range		−55 to 150	°C

* Please refer to *PACKAGE INFORMATION* for detailed information.

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 is not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	2.6 to 10	V
Ta	Operating Temperature Range	−50 to 105	°C

RECOMMENDED OPERATING CONDITIONS

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

ELECTRICAL CHARACTERISTICS

V_{IN} = V_{SET} + 1 V, I_{OUT} = 1 mA, unless otherwise noted.
The specifications surrounded by [ ] are guaranteed by design engineering at –50°C ≤ Ta ≤ 105°C.

RP170xxxxB/D (Ta = 25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	1.5 V < V_{SET}	Ta = 25°C	V_{SET} x 0.99		V_{SET} x 1.01	V
			−50°C ≤ Ta ≤ 105°C	[V_{SET} x 0.965]		[V_{SET} x 1.03]	
		V_{SET} ≤ 1.5V	Ta = 25°C	−15		15	mV
			−50°C ≤ Ta ≤ 105°C	[–53]		[45]	
I_{OUT}	Output Current			[300]			mA
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	0.1 mA ≤ I_{OUT} ≤ 300 mA			10	[80]	mV
V_{DIF}	Dropout Voltage	I_{OUT} = 300 mA		Refer to the *Product-specific Electrical Characteristics*			
I_{SS}	Supply Current	I_{OUT} = 0 mA			23	[45]	µA
Istandby	Supply Current (Standby Mode)	V_{IN} = 10.0 V V_{CE} = GND			0.1	[1.2]	µA
ΔV_{OUT} /ΔV_{IN}	Line Regulation	V_{SET} + 0.5 V ≤ V_{IN} ≤ 10.0 V (When V_{SET} ≤ 2.1 V, 2.6 V ≤ V_{IN} ≤ 10.0 V)			±0.02	[±0.25]	%/V
I_{SC}	Short Current Limit	V_{OUT} = 0V			40		mA
I_{PD}	CE Pull-down Current				0.30		µA
V_{CEH}	CE Input Voltage “H”			[1.7]			V
V_{CEL}	CE Input Voltage “L”					[0.8]	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature			165		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			110		°C
R_{LOW}	Nch On Resistance for Auto Discharge (D Version Only)	V_{CE} = 0 V V_{IN} = 7.0 V			250		Ω

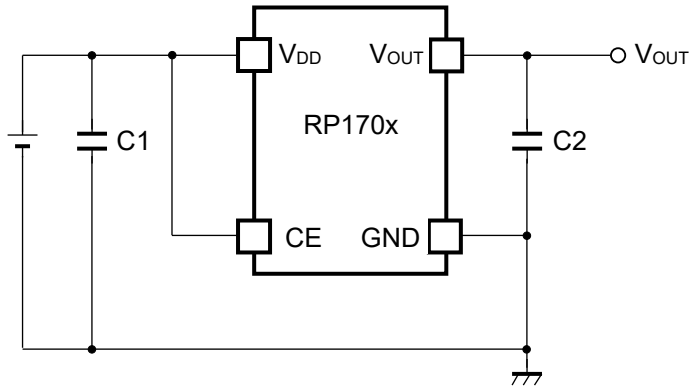
All test items listed under Electrical Characteristics are done under the pulse load condition (Tj ≈ Ta = 25°C).

V_{IN} = V_{SET} + 1 V, I_{OUT} = 1 mA, unless otherwise noted.
The specifications surrounded by ☐ are guaranteed by design engineering at –50°C ≤ Ta ≤ 105°C.

Product-specific Electrical Characteristics (Ta = 25°C)

Product Name	V_{OUT} [V] (Ta = 25°C)			V_{OUT} [V] (Ta = –50 to 105°C)			V_{DIF} [V]	
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	TYP.	MAX.
RP170x121x	1.185	1.200	1.215	1.147	1.200	1.245	1.400	1.925
RP170x151x	1.485	1.500	1.515	1.447	1.500	1.545	1.200	1.655
RP170x181x	1.782	1.800	1.818	1.737	1.800	1.854	0.980	1.305
RP170x251x	2.475	2.500	2.525	2.413	2.500	2.575	0.770	1.185
RP170x281x	2.772	2.800	2.828	2.702	2.800	2.884		
RP170x301x	2.970	3.000	3.030	2.895	3.000	3.090	0.600	0.995
RP170x331x	3.267	3.300	3.333	3.185	3.300	3.399		
RP170x341x	3.366	3.400	3.434	3.281	3.400	3.502		
RP170x501x	4.950	5.000	5.050	4.825	5.000	5.150	0.500	0.875
RP170x601x	5.940	6.000	6.060	5.790	6.000	6.180		

TYPICAL APPLICATION



External Components:

Symbol	Description
C2	Ceramic 1.0 µF (MURATA GRM155B31A105KE15)

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 C2 with 1.0 µF or more and good ESR (Equivalent Series Resistance).

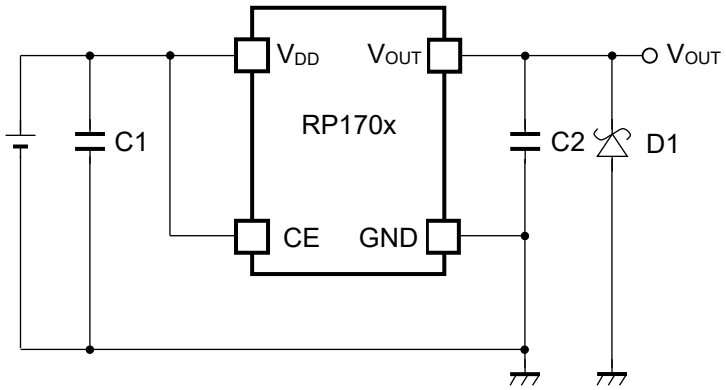
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0 µF or more between V_{DD} and GND, and as close as possible to the pins.

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

TYPICAL APPLICATION FOR IC CHIP BREAKDOWN PREVENTION



External Components:

Symbol	Description
C2	1.0 µF (Ceramic), MURATA, GRM155B31A105KE15

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

PACKAGE INFORMATION

POWER DISSIPATION (SOT-23-5)

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

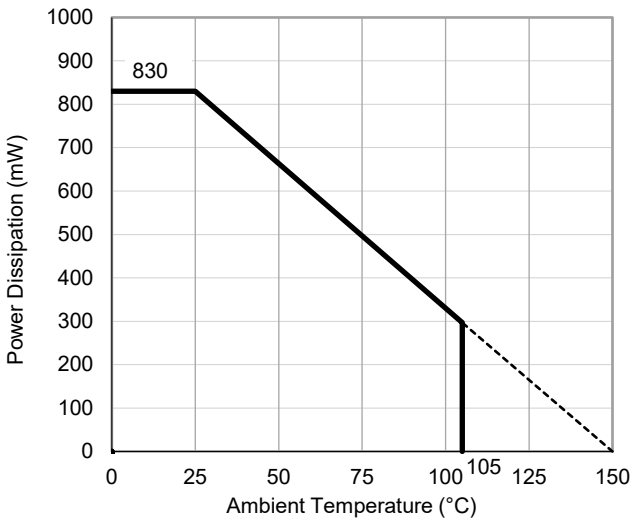
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 7 pcs

Measurement Result (Ta = 25°C, Tjmax = 150°C)

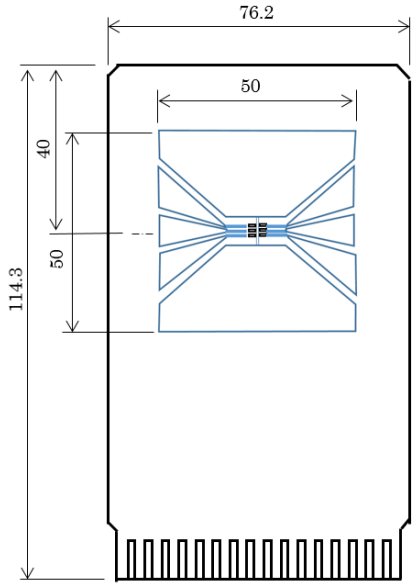
Item	Measurement Result
Power Dissipation	830 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter

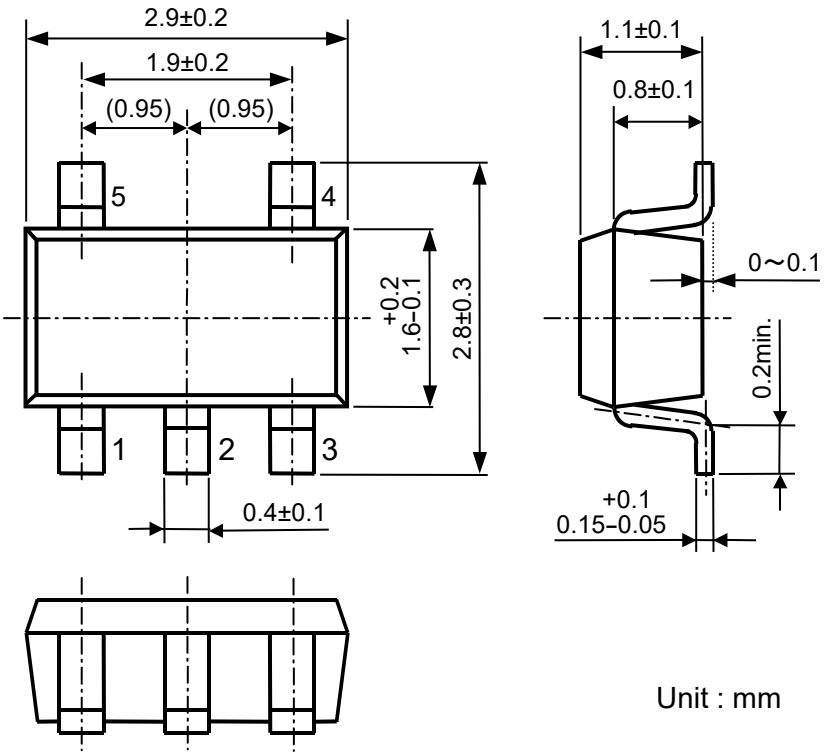


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (SOT-23-5)

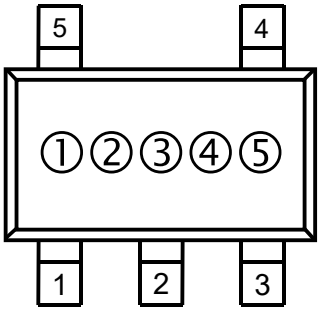


SOT-23-5 Package Dimensions

MARK SPECIFICATION (SOT-23-5)

①②③: Product Code … **Refer to *MARK SPECIFICATION TABLE (SOT-23-5).***

④⑤: Lot Number … Alphanumeric Serial Number



SOT-23-5 Mark Specification

MARK SPECIFICATION TABLE (SOT-23-5)

RP170Nxx1B

Product Name	①	②	③	V_{SET}
RP170N121B	F	A	A	1.2 V
RP170N151B	F	A	E	1.5 V
RP170N181B	F	A	H	1.8 V
RP170N251B	F	A	R	2.5 V
RP170N281B	F	A	U	2.8 V
RP170N301B	F	A	X	3.0 V
RP170N331B	G	A	A	3.3 V
RP170N341B	G	A	B	3.4 V
RP170N501B	G	A	T	5.0 V
RP170N601B	H	A	D	6.0 V

RP170Nxx1D

Product Name	①	②	③	V_{SET}
RP170N121D	F	B	A	1.2 V
RP170N151D	F	B	E	1.5 V
RP170N181D	F	B	H	1.8 V
RP170N251D	F	B	R	2.5 V
RP170N281D	F	B	U	2.8 V
RP170N301D	F	B	X	3.0 V
RP170N331D	G	B	A	3.3 V
RP170N341D	G	B	B	3.4 V
RP170N501D	G	B	T	5.0 V
RP170N601D	H	B	D	6.0 V

POWER DISSIPATION (SOT-89-5)

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

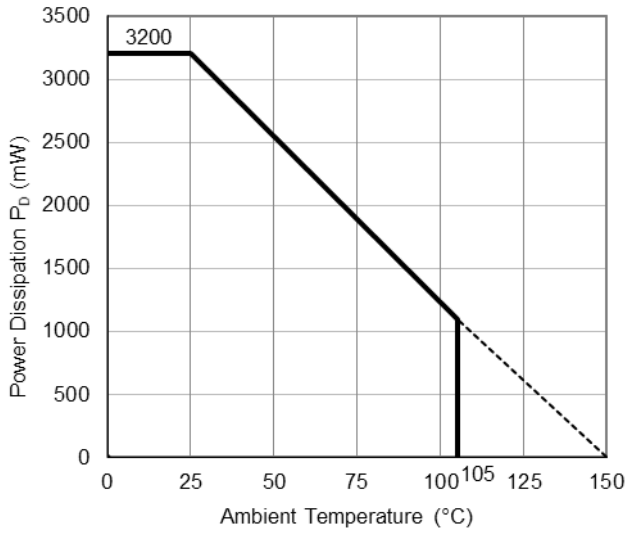
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 13 pcs

Measurement Result (Ta = 25°C, Tjmax = 150°C)

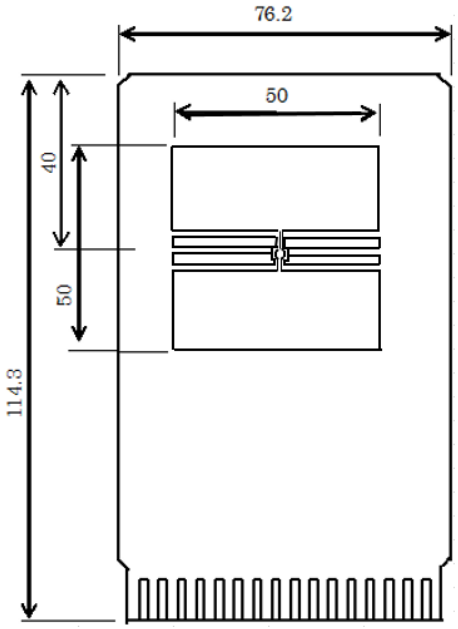
Item	Measurement Result
Power Dissipation	3200 mW
Thermal Resistance (θja)	θja = 38°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 13°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter

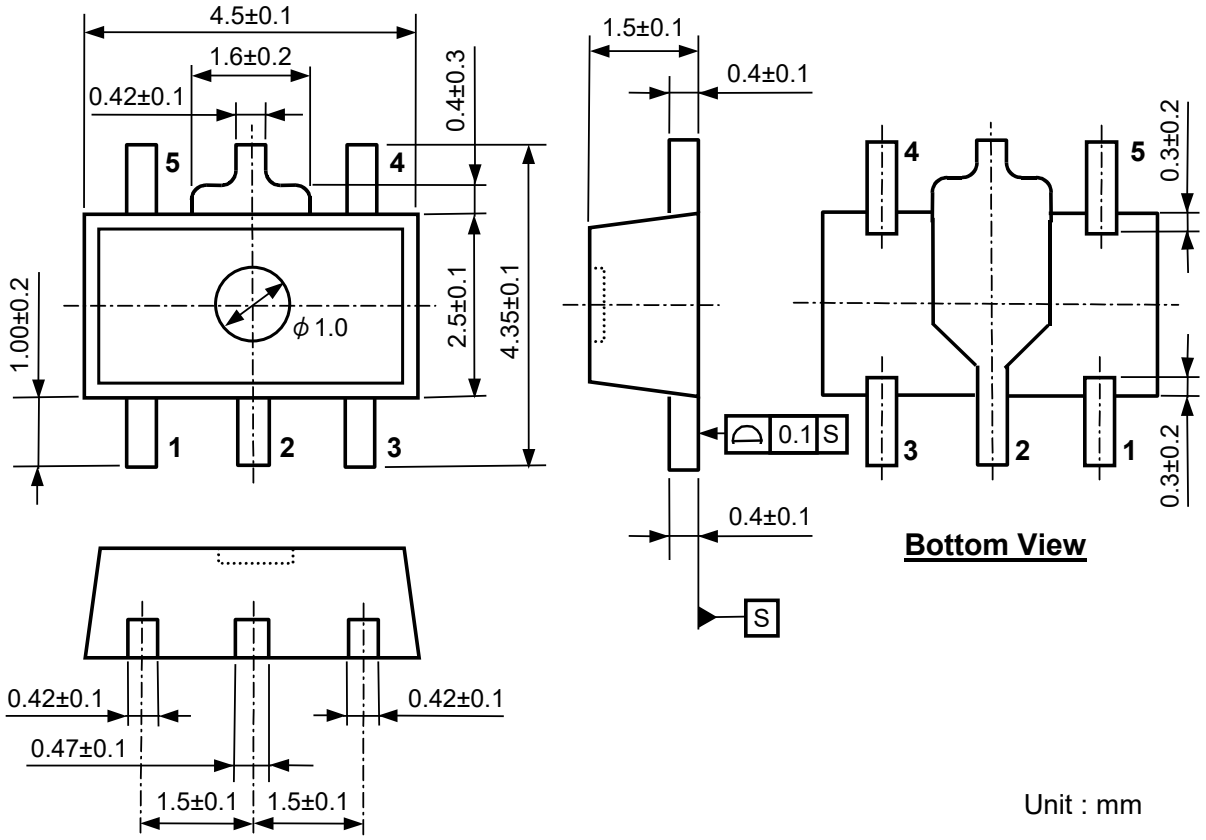


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (SOT-89-5)

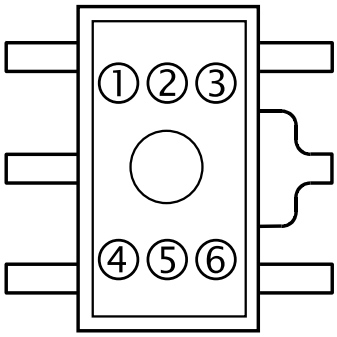


Unit : mm

MARK SPECIFICATION (SOT-89-5)

①②③④: Product Code … **Refer to *MARK SPECIFICATION TABLE (SOT-89-5)***

⑤⑥: Lot Number … Alphanumeric Serial Number



MARK SPECIFICATION TABLE (SOT-89-5)

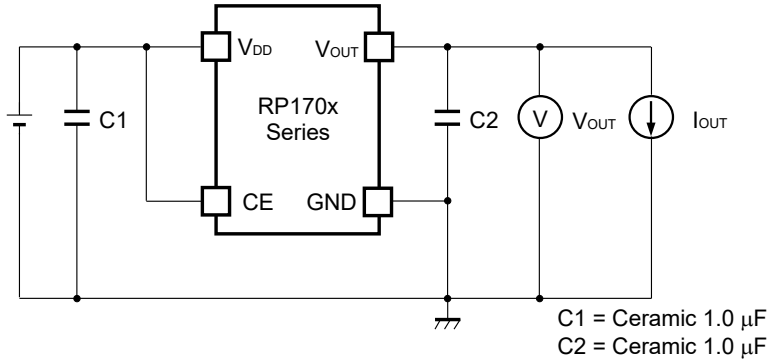
RP170Hxx1B

Product Name	①	②	③	④	V_{SET}
RP170H121B	Y	1	2	B	1.2 V
RP170H151B	Y	1	5	B	1.5 V
RP170H181B	Y	1	8	B	1.8 V
RP170H251B	Y	2	5	B	2.5 V
RP170H281B	Y	2	8	B	2.8 V
RP170H301B	Y	3	0	B	3.0 V
RP170H331B	Y	3	3	B	3.3 V
RP170H341B	Y	3	4	B	3.4 V
RP170H501B	Y	5	0	B	5.0 V
RP170H601B	Y	6	0	B	6.0 V

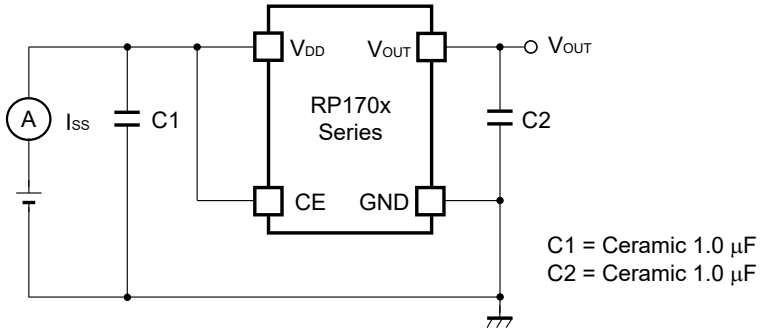
RP170Hxx1D

Product Name	①	②	③	④	V_{SET}
RP170H121D	Y	1	2	D	1.2 V
RP170H151D	Y	1	5	D	1.5 V
RP170H181D	Y	1	8	D	1.8 V
RP170H251D	Y	2	5	D	2.5 V
RP170H281D	Y	2	8	D	2.8 V
RP170H301D	Y	3	0	D	3.0 V
RP170H331D	Y	3	3	D	3.3 V
RP170H341D	Y	3	4	D	3.4 V
RP170H501D	Y	5	0	D	5.0 V
RP170H601D	Y	6	0	D	6.0 V

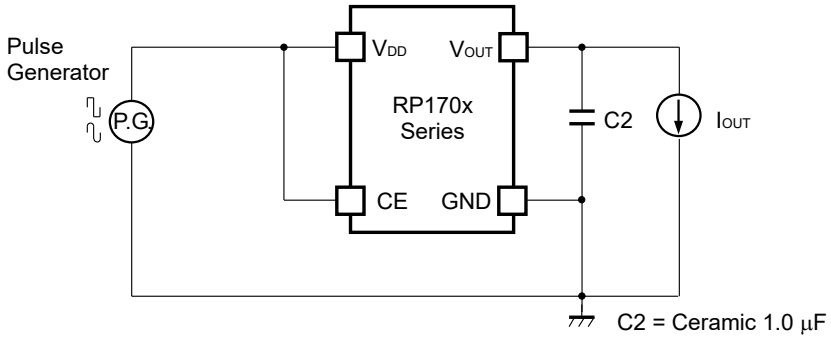
TEST CIRCUITS



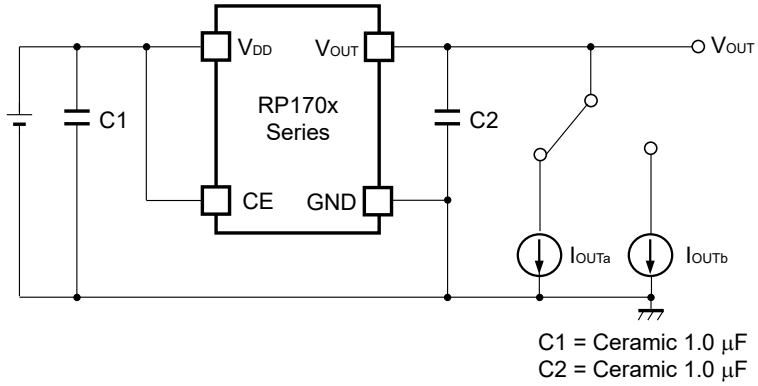
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

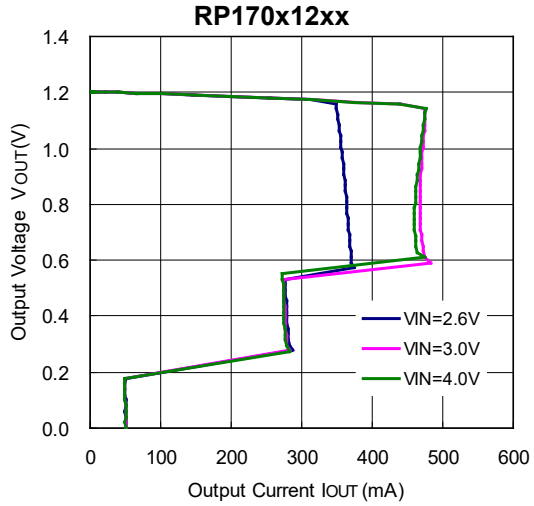


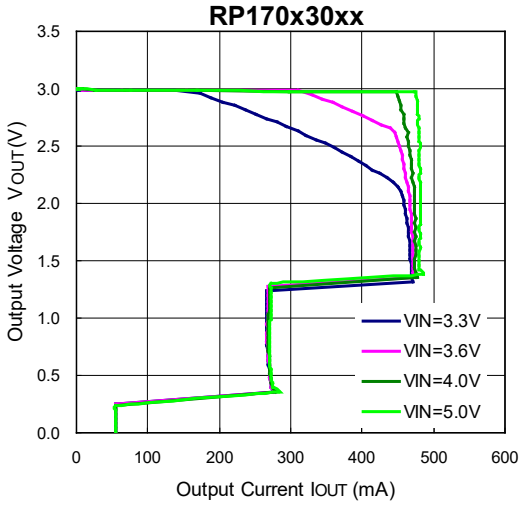
Test Circuit for Load Transient Response

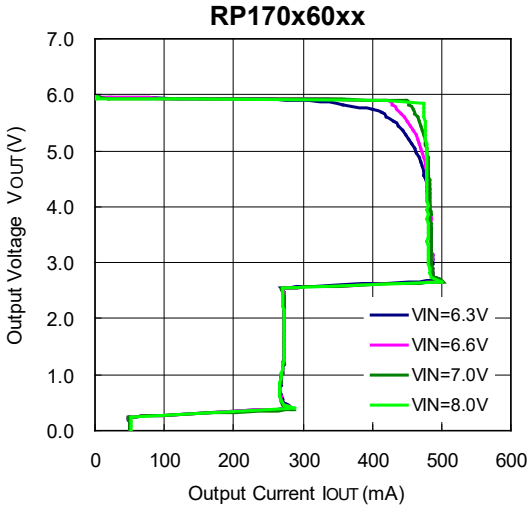
TYPICAL CHARACTERISTICS

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

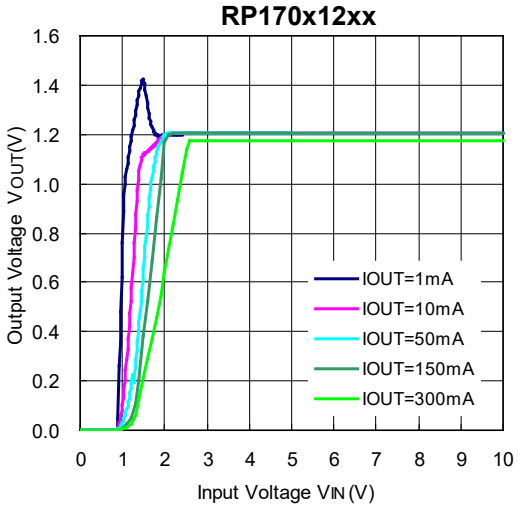
1) Output Voltage vs. Output Current (Ta = 25°C)

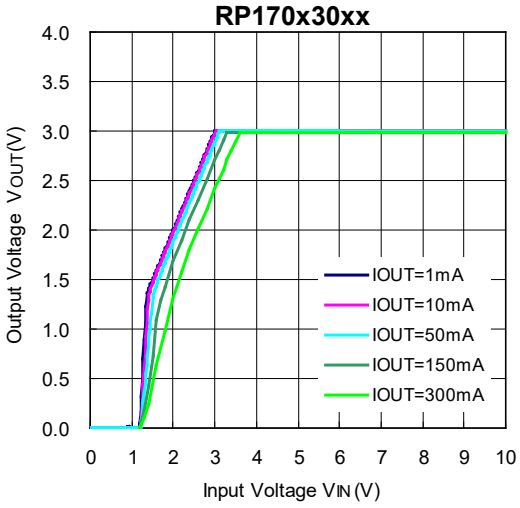




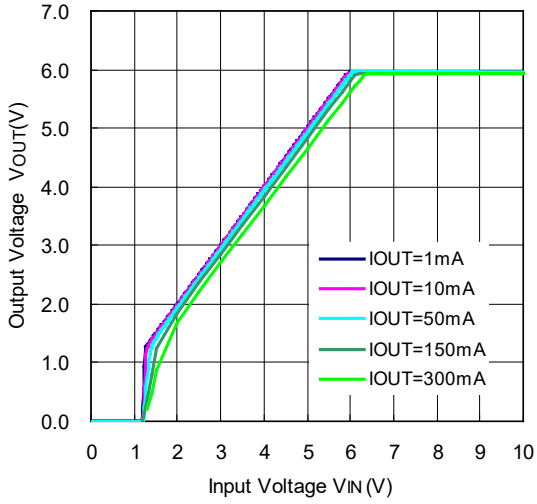


2) Output Voltage vs. Input Voltage (Ta = 25°C)



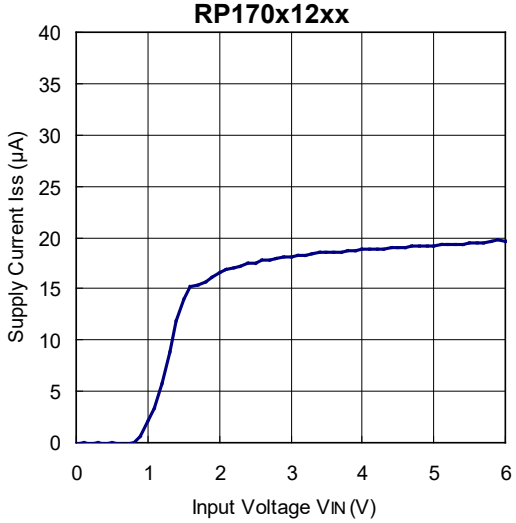


RP170x60xx

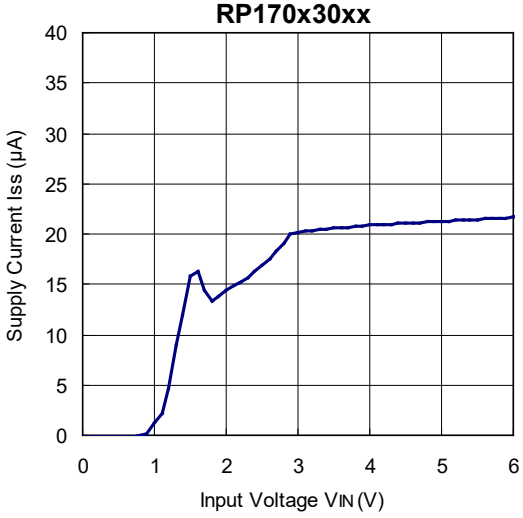


3) Supply Current vs. Input Voltage (Ta = 25°C)

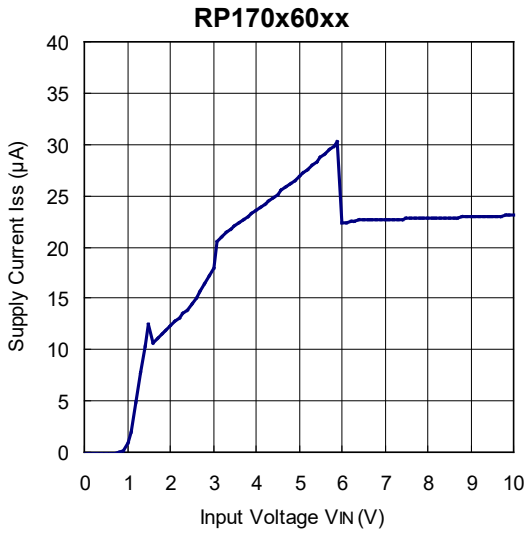
RP170x12xx



RP170x30xx

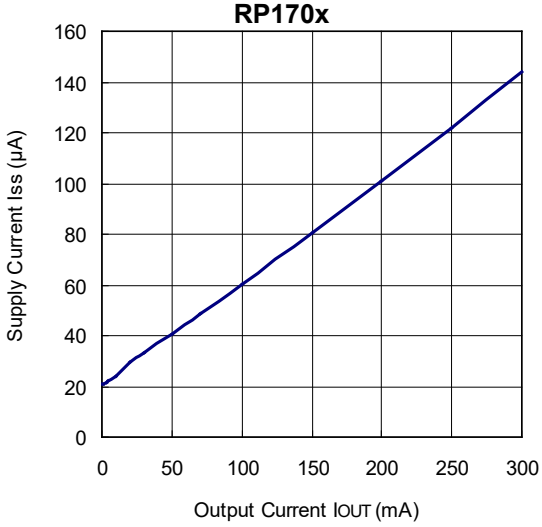


RP170x60xx



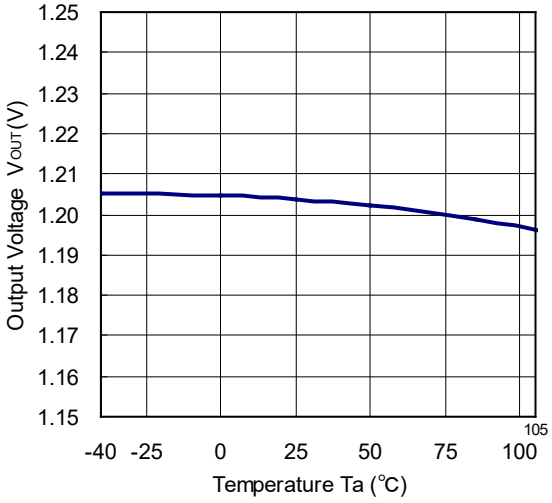
4) Supply Current vs. Output Current (Ta = 25°C)

RP170x

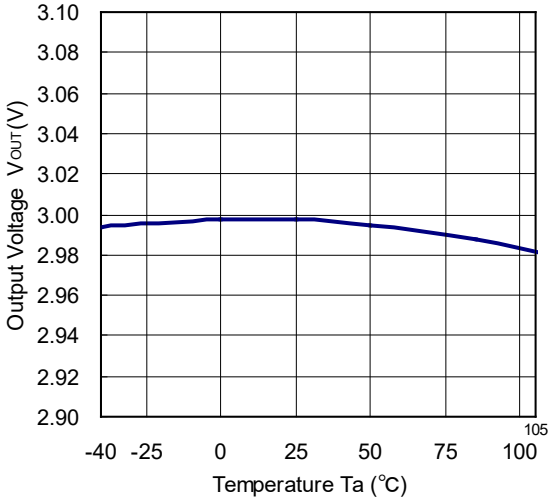


5) Output Voltage vs. Temperature

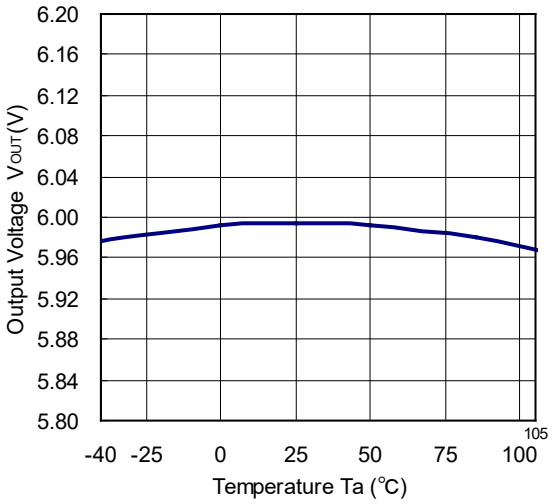
RP170x12xx



RP170x30xx

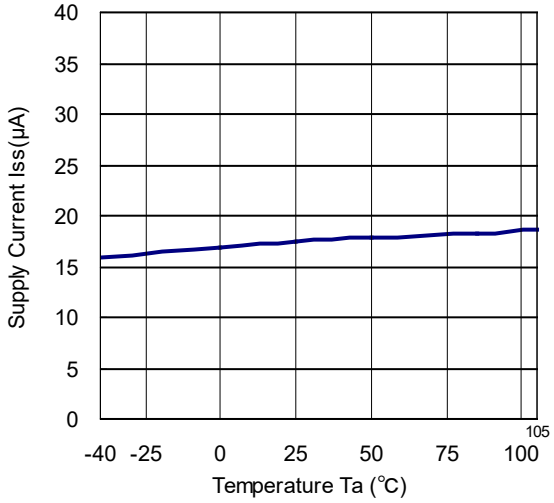


RP170x60xx

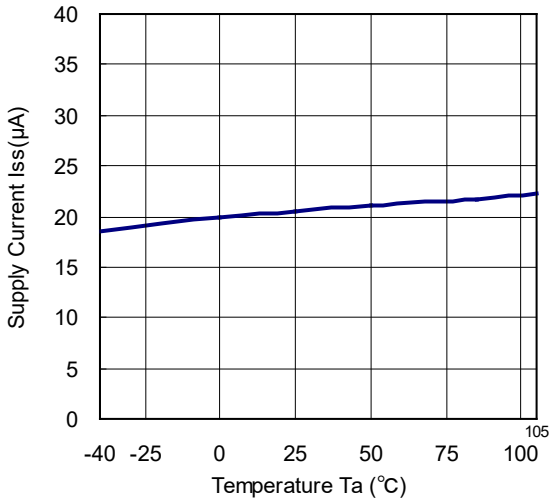


6) Supply Current vs. Temperature

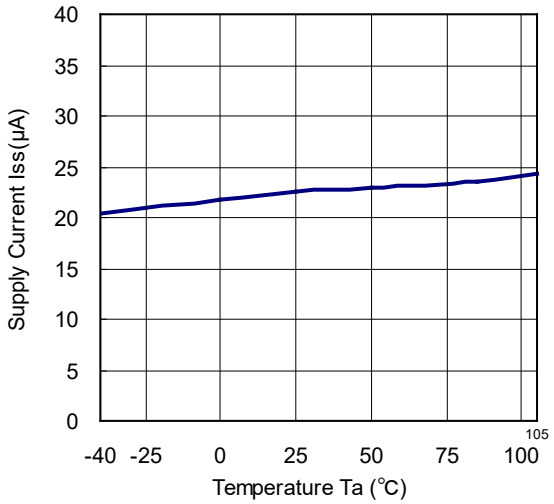
RP170x12xx



RP170x30xx

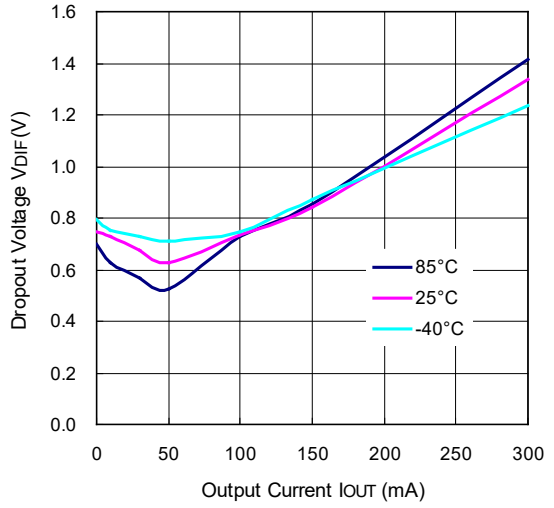


RP170x60xx

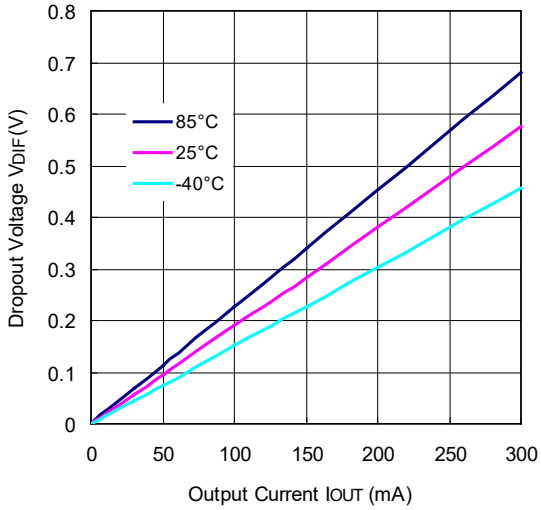


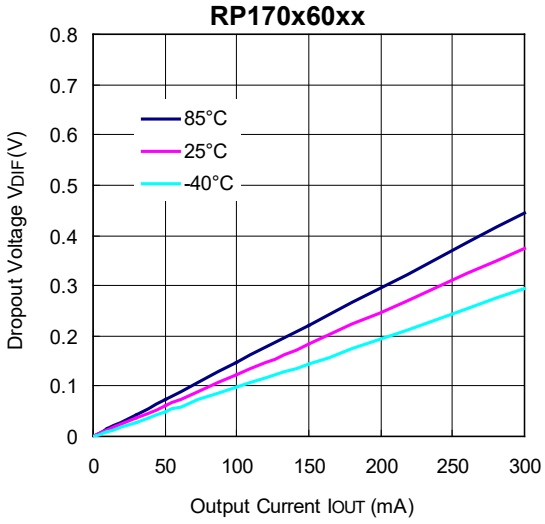
7) Dropout Voltage vs. Output Current

RP170x12xx

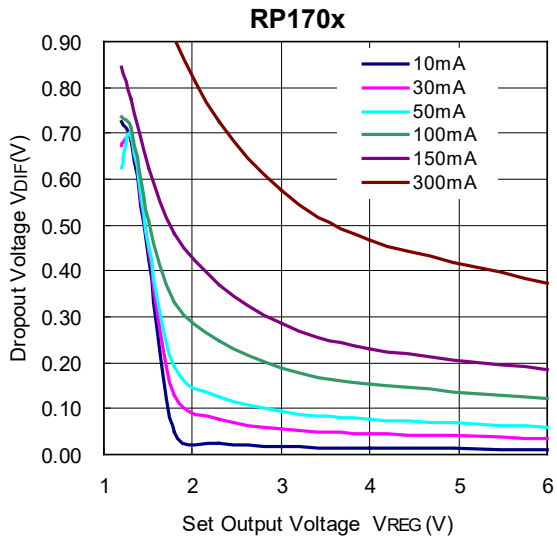


RP170x30xx

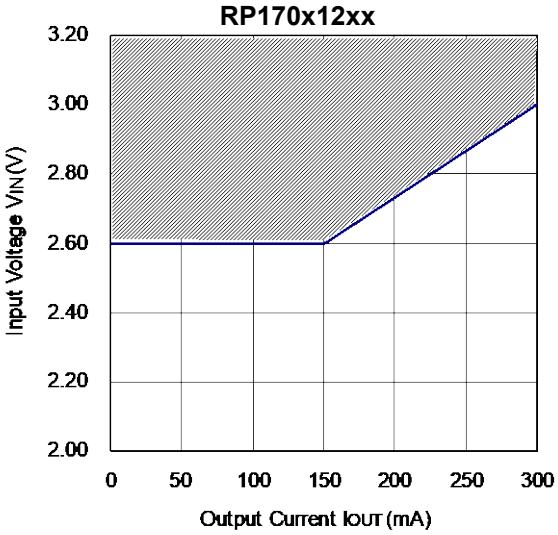




8) Dropout Voltage vs. Set Output Voltage (Ta = 25°C)

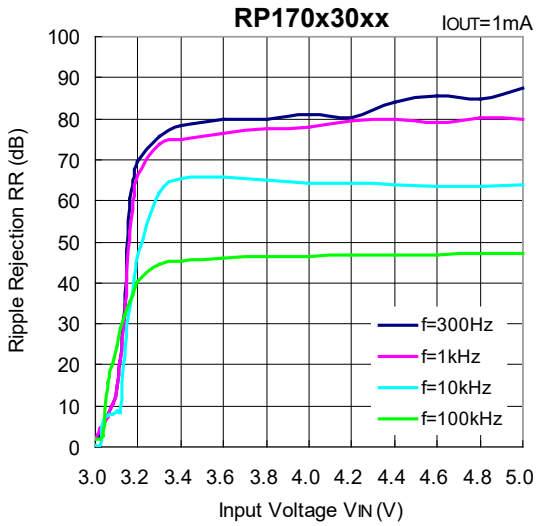


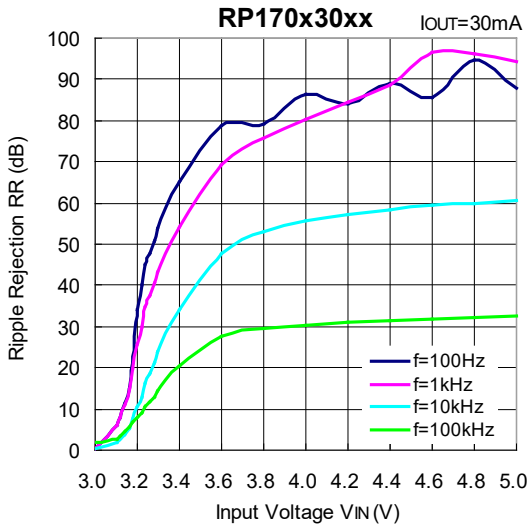
9) Minimum Operating Voltage

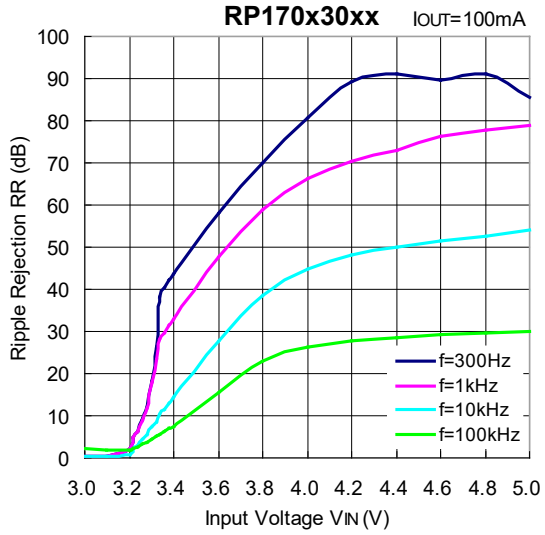


Hatched area is available for 1.2 V output

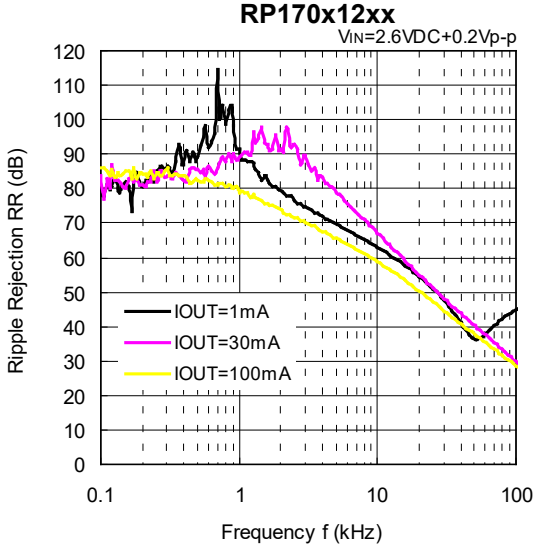
10) Ripple Rejection vs. Input Bias Voltage (C1 = none, C2 = Ceramic 1.0 µF, Ripple = 0.2 Vp-p, Ta = 25°C)

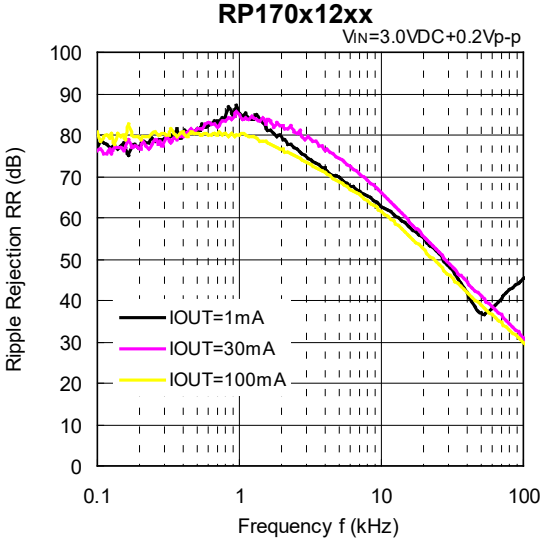


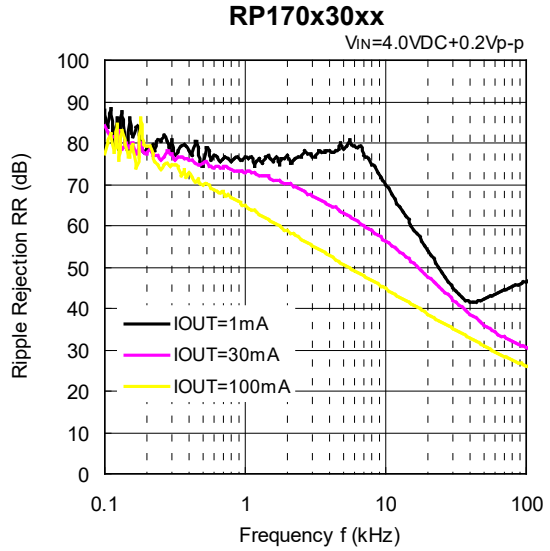


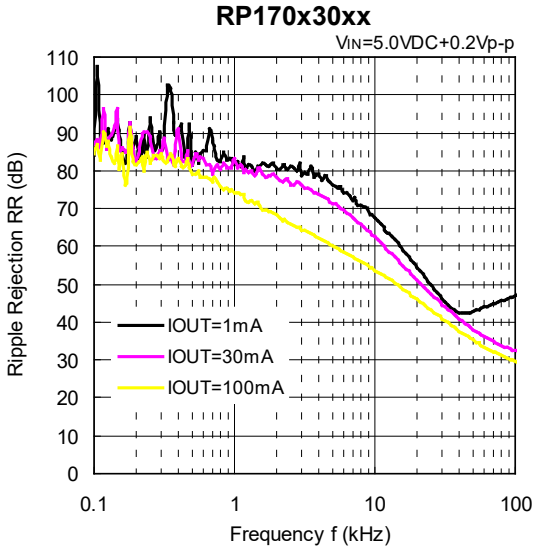


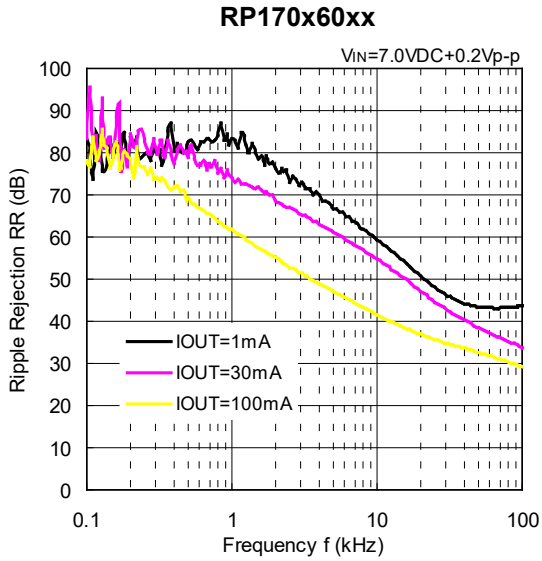
11) Ripple Rejection vs. Frequency (C1 = none, C2 = Ceramic 1.0 µF, Ta = 25°C)

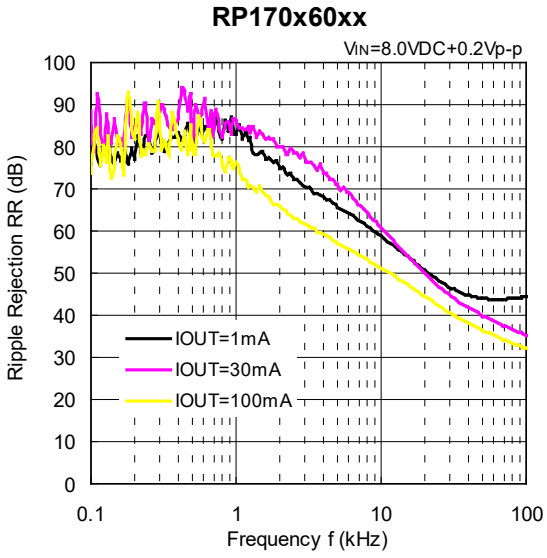




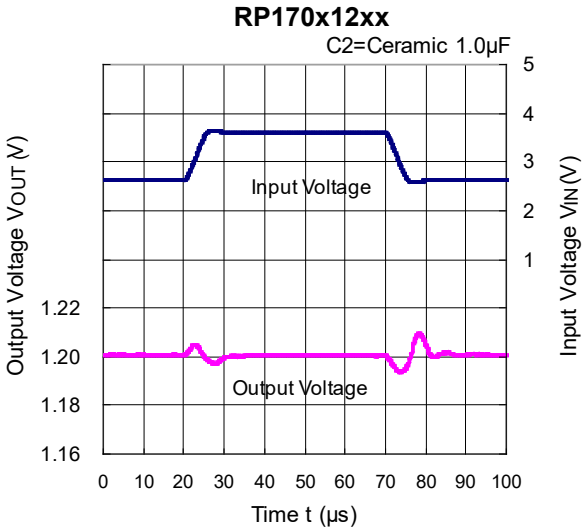


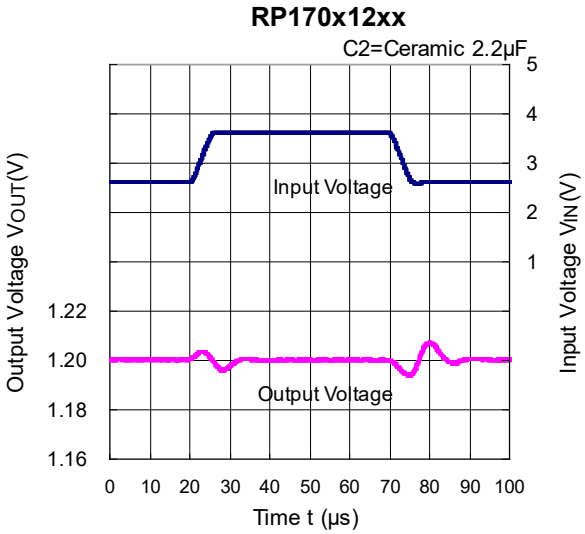


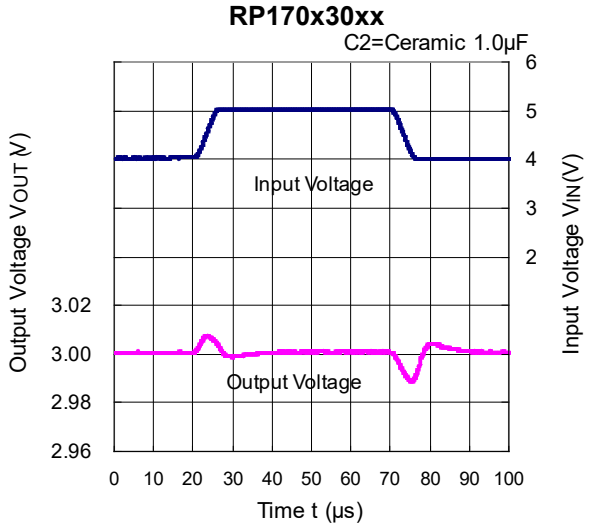


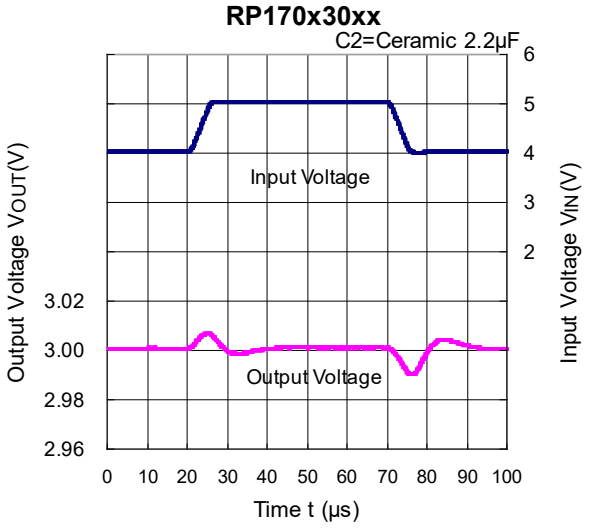


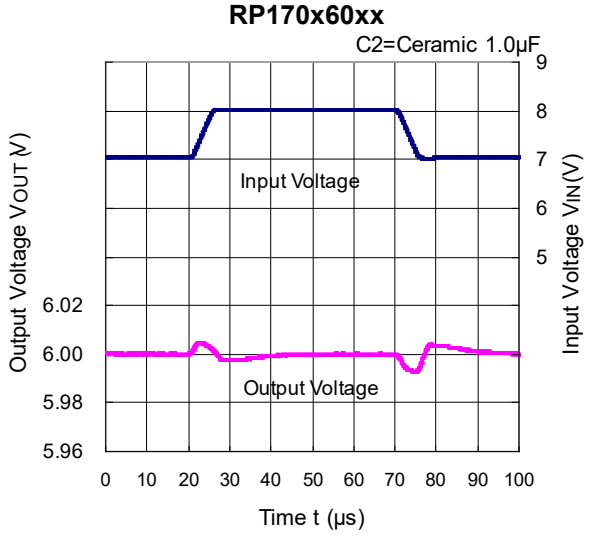
12) Input Transient Response (C1 = none, I_{OUT} = 30 mA, tr = tf = 5 µs, Ta = 25°C)

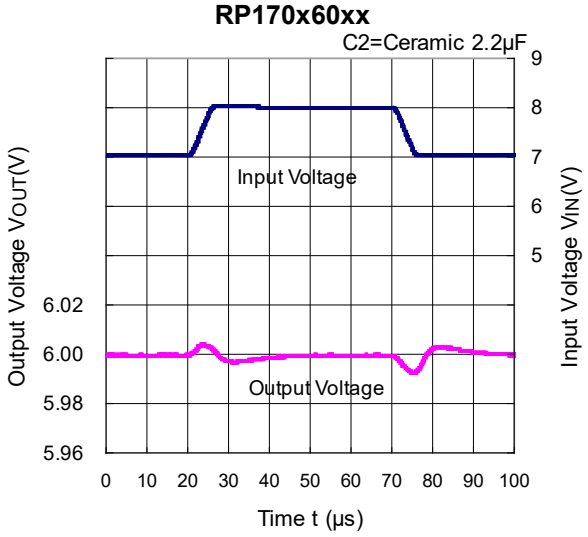




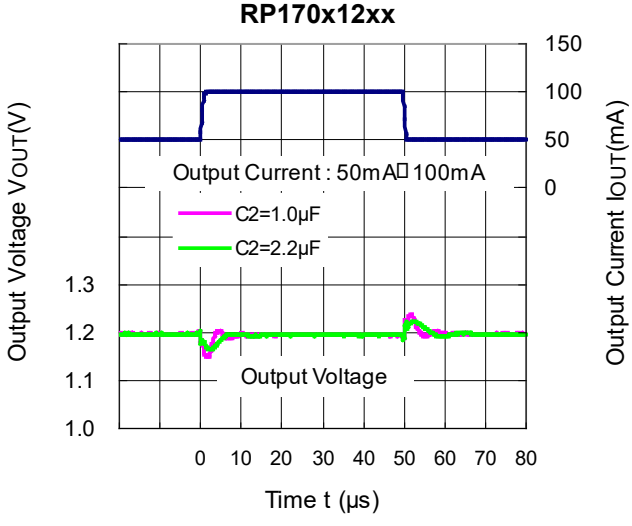


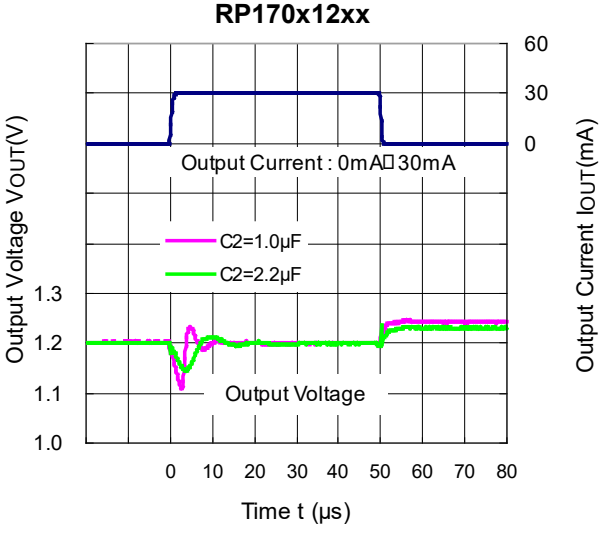




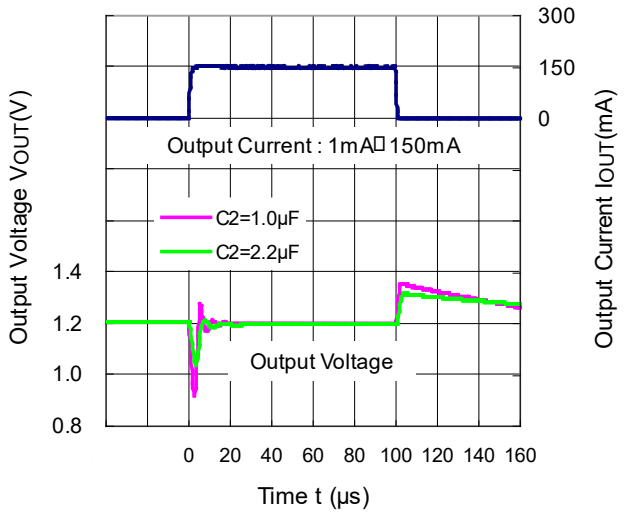


13) Load Transient Response (C1 = Ceramic 1.0 μF, tr = tf = 500 ns, Ta = 25°C)

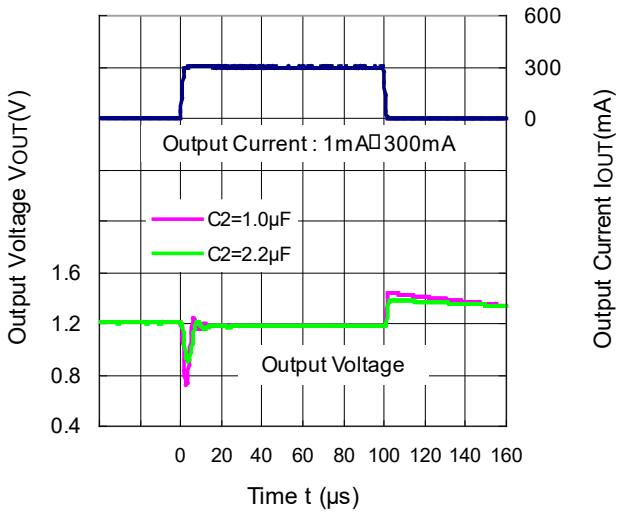




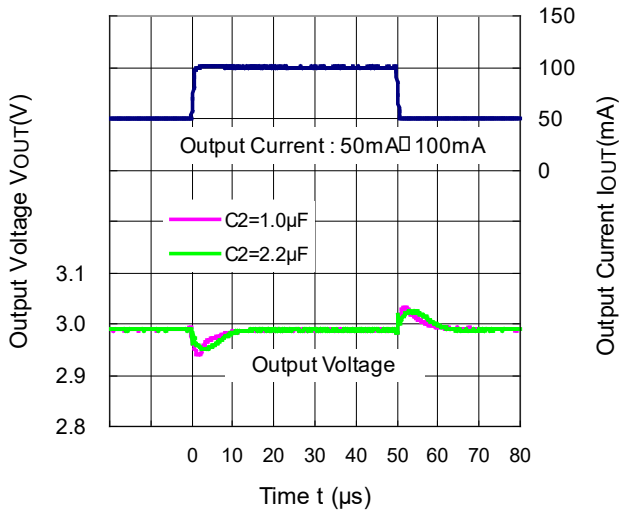
RP170x12xx



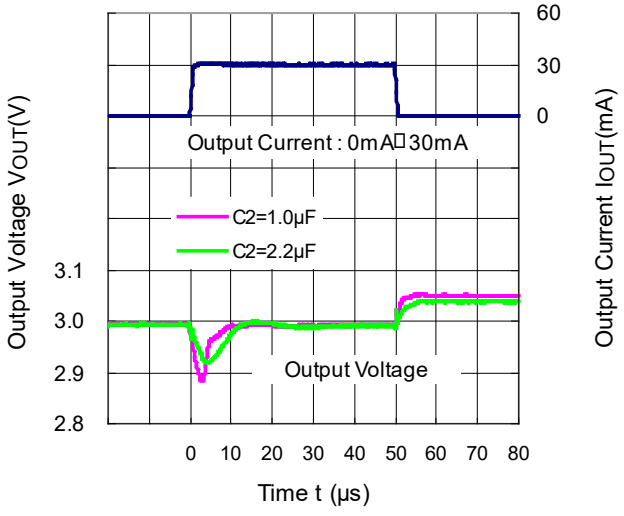
RP170x12xx



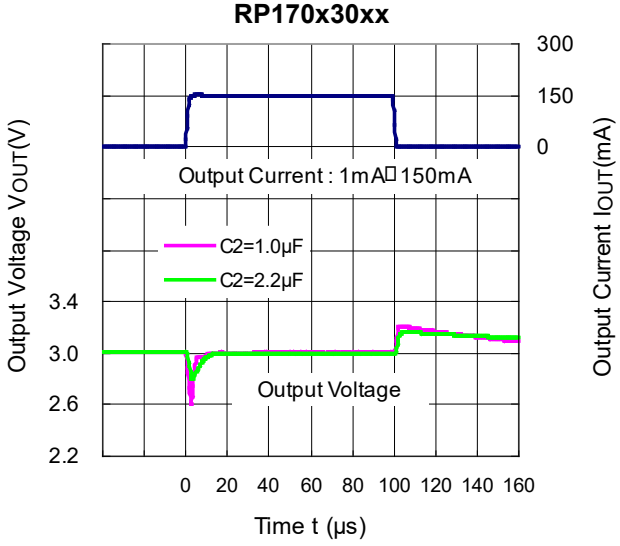
RP170x30xx



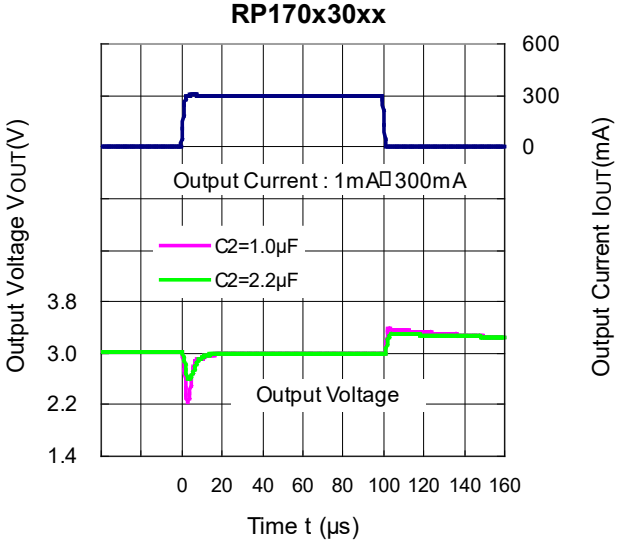
RP170x30xx



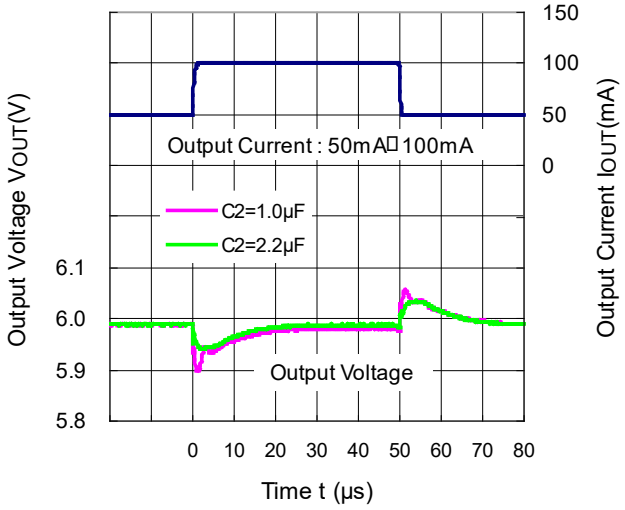
RP170x30xx



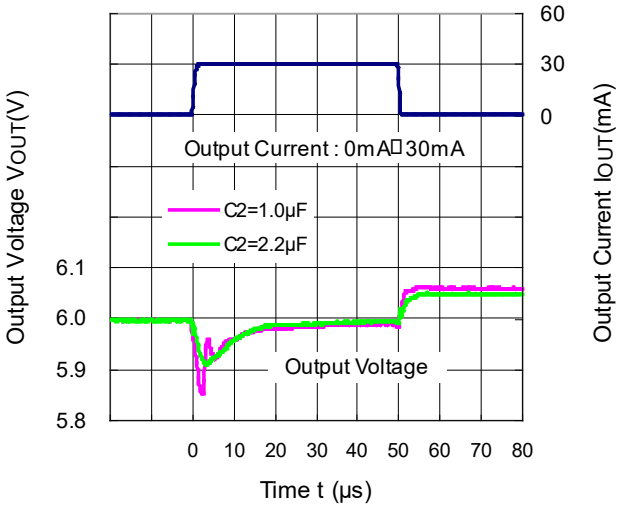
RP170x30xx



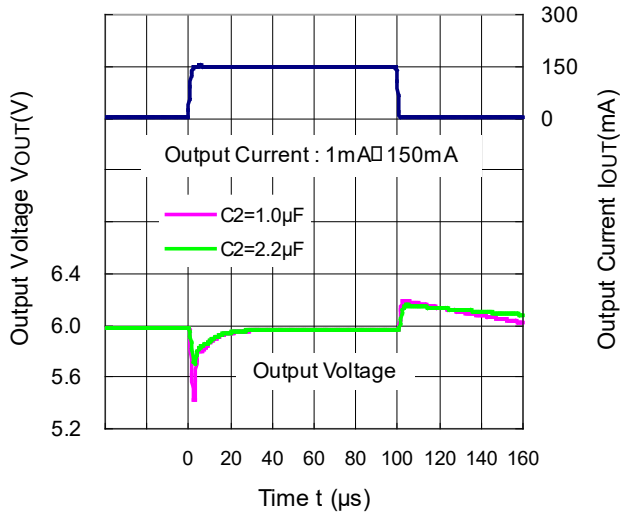
RP170x60xx



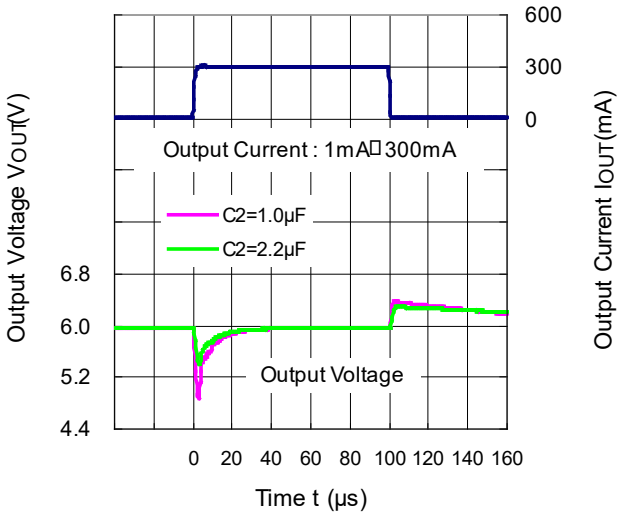
RP170x60xx



RP170x60xx

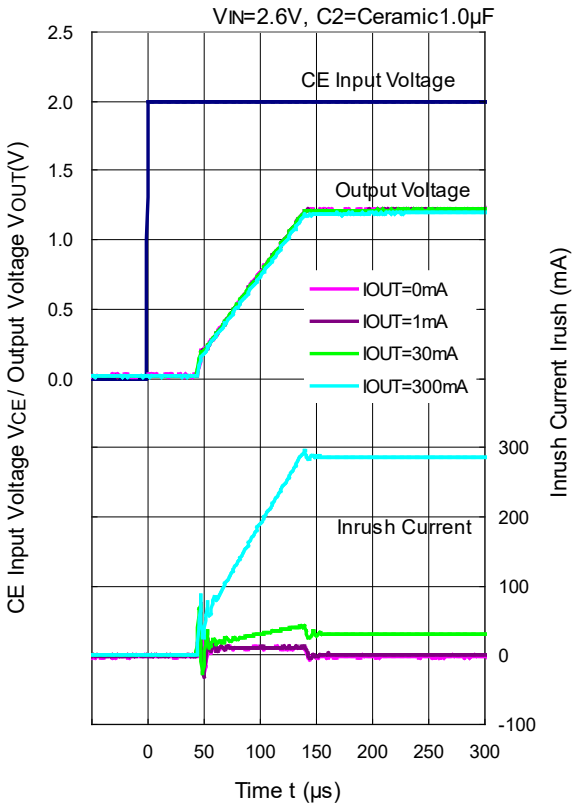


RP170x60xx

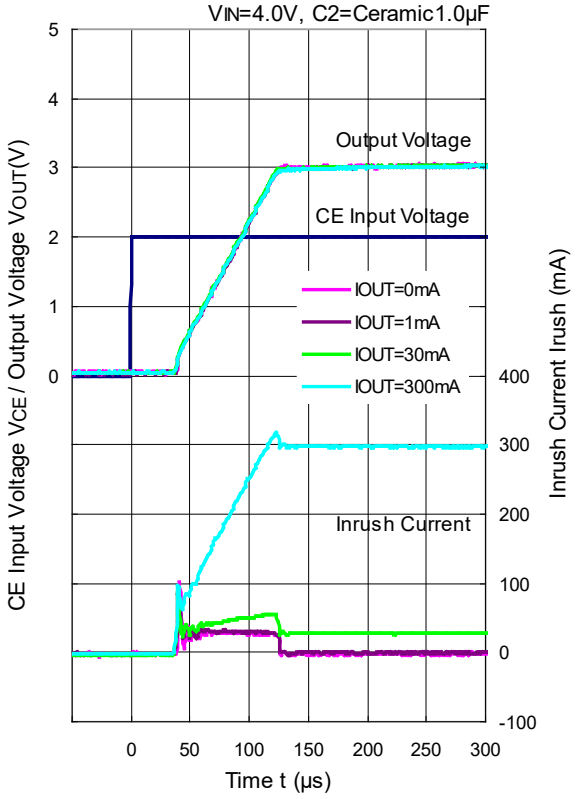


14) Turn On Speed with CE pin (C1 = Ceramic 1.0 µF, Ta = 25°C)

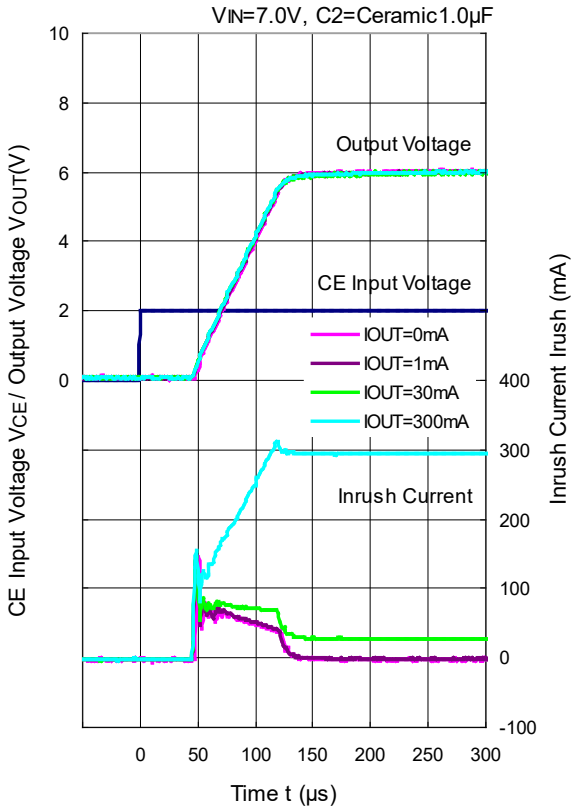
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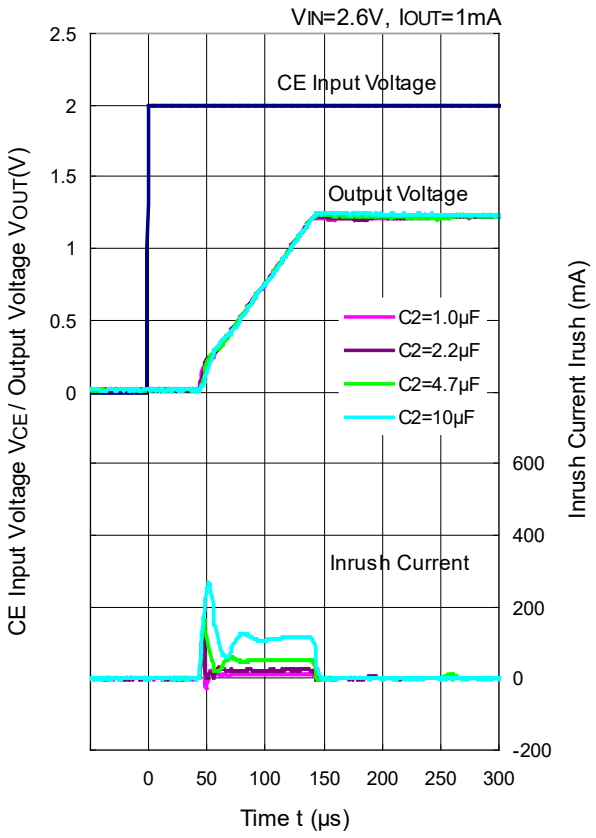
RP170x30xx



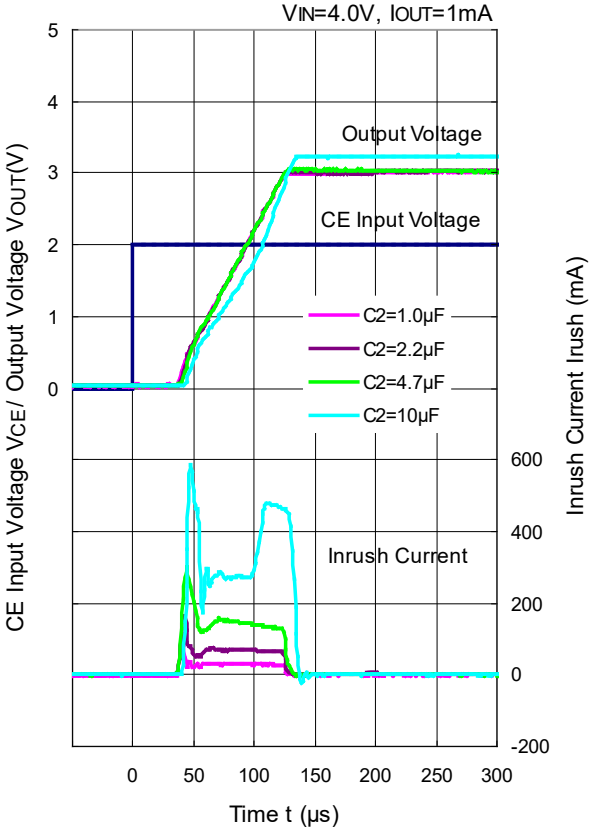
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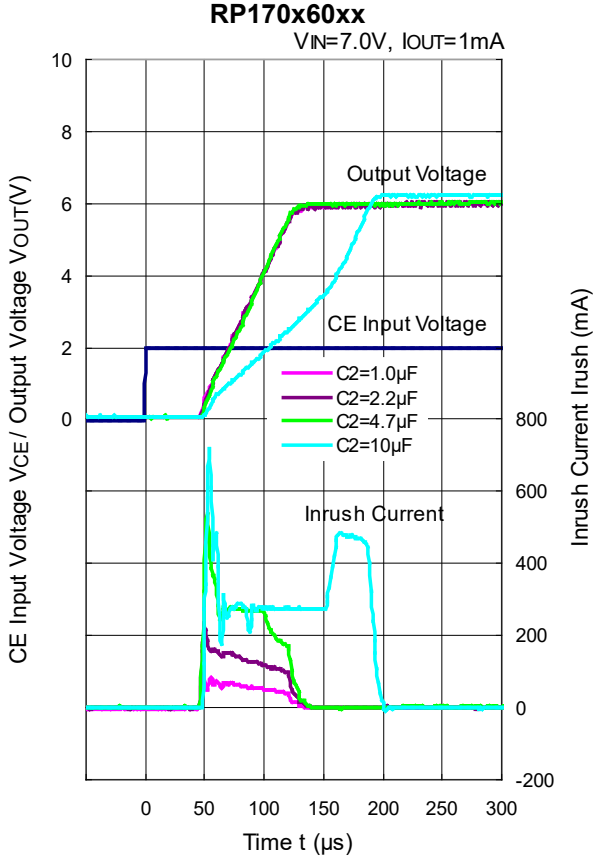
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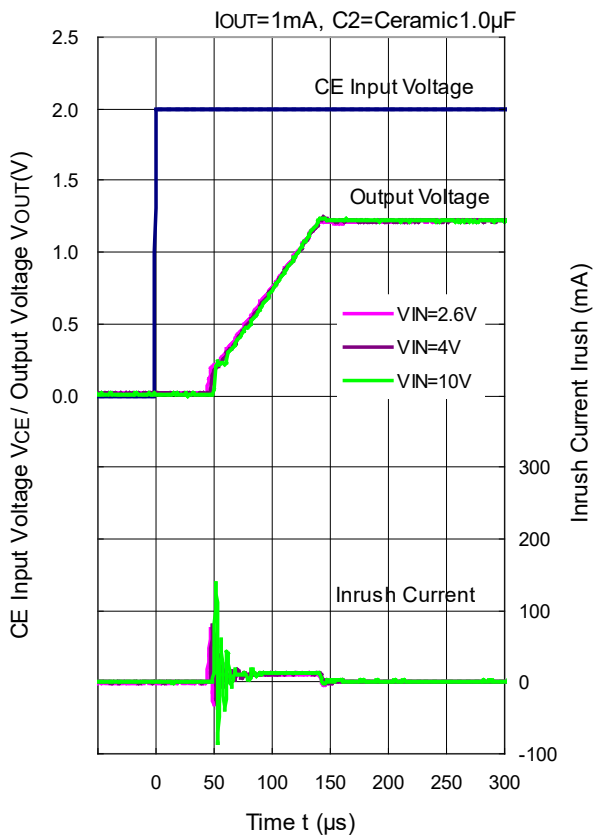
RP170x30xx



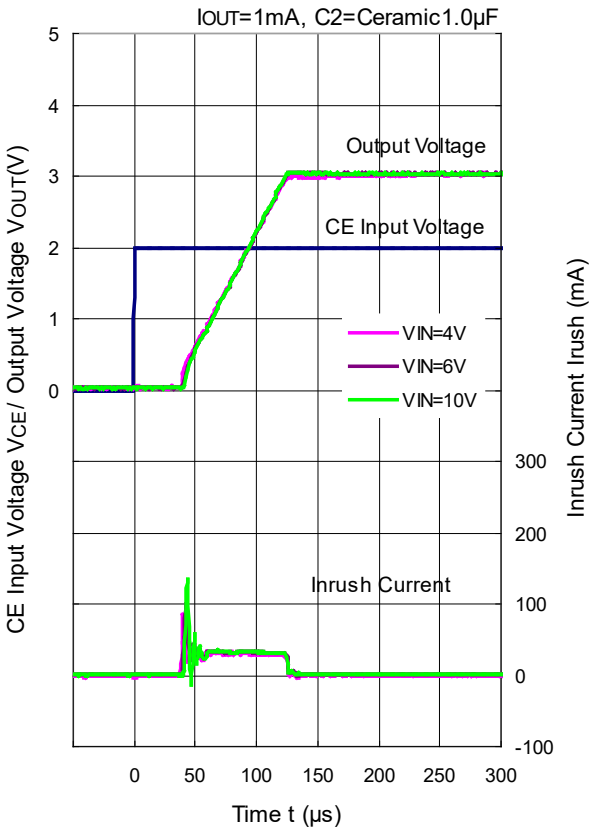
RP170x60xx



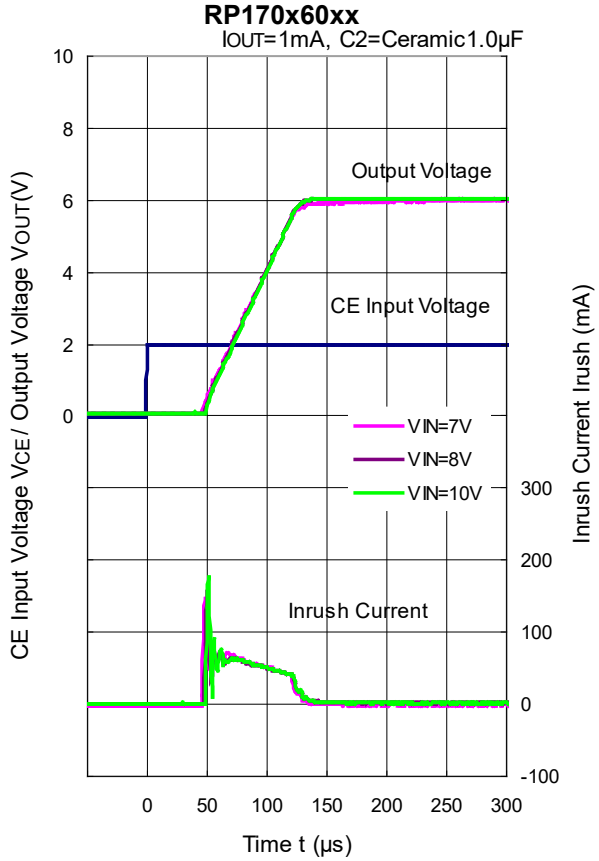
RP170x12xx



RP170x30xx

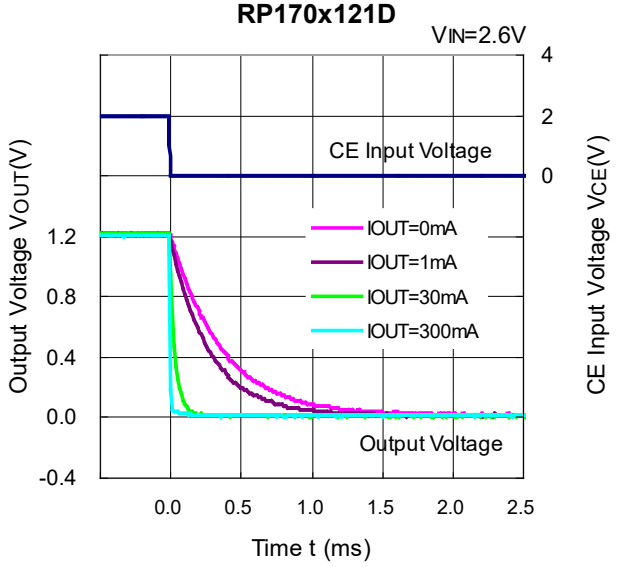


RP170x60xx

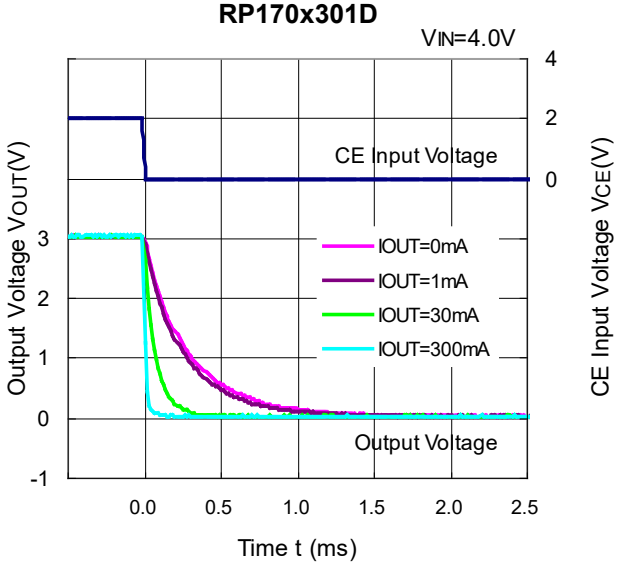


15) Turn Off Speed with CE pin (D Version) (C1 = Ceramic 1.0 μF, Ta = 25°C)

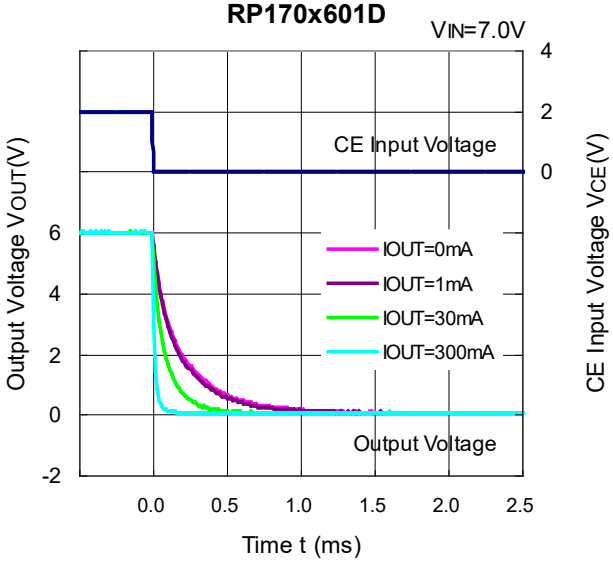
RP170x121D



RP170x301D



RP170x601D



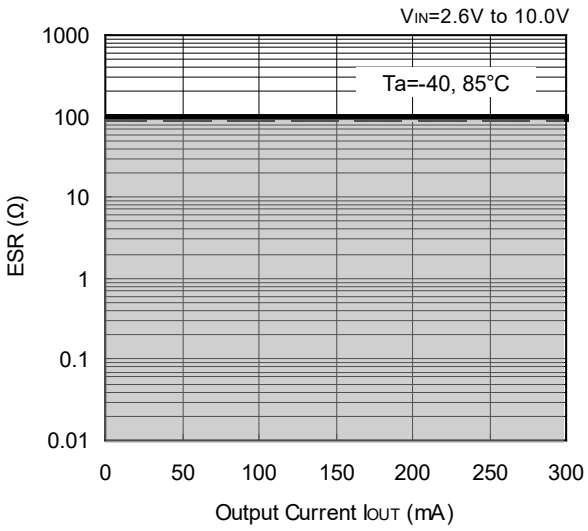
ESR vs. Output Current

Ceramic type output capacitor is recommended for this series; however, the other output capacitors with low ESR also can be used. The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under 40 μV (Avg.) are marked as the hatched area in the graph.

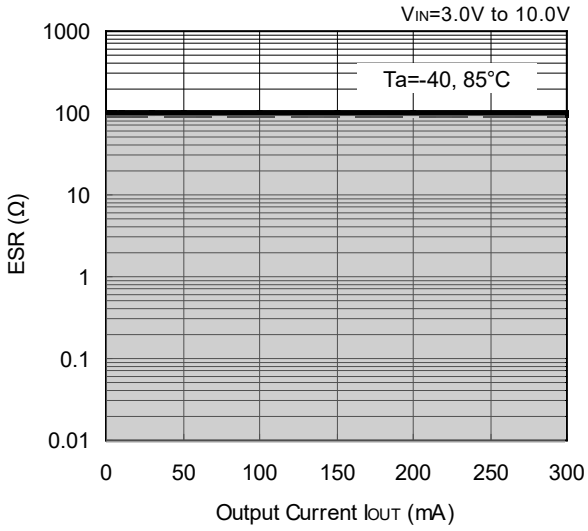
Measurement conditions

Frequency Band : 10 Hz to 2 MHz
Temperature : −40°C to 85°C
C1, C2 : Ceramic 1.0 μF (Murata GRM155B31A105KE)

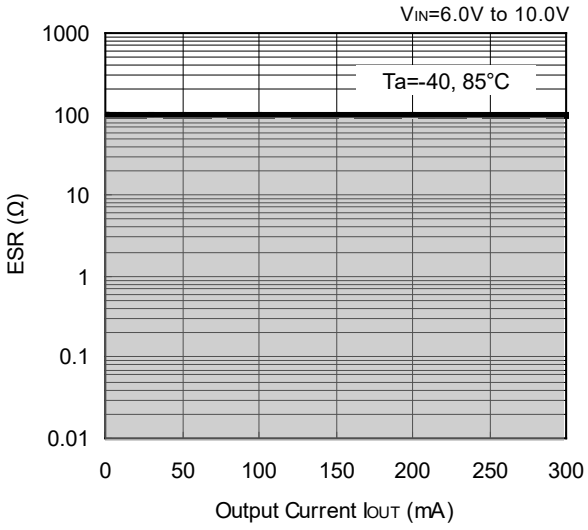
RP170x12xx



RP170x30xx



RP170x60xx



1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
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5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death should first contact us.
    - Aerospace Equipment
    - Equipment Used in the Deep Sea
    - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
    - Life Maintenance Medical Equipment
    - Fire Alarms / Intruder Detectors
    - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

    In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. Quality Warranty
    8-1. Quality Warranty Period
    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
    8-2. Quality Warranty Remedies
    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
    8-3. Remedies after Quality Warranty Period
    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

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Nisshinbo Micro Devices Inc.

Official website
https://www.nisshinbo-microdevices.co.jp/en/

Purchase information
https://www.nisshinbo-microdevices.co.jp/en/buy/

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Entegreci, Eskişehir merkezli, Türkiye geneline satış yapan bir elektronik komponent mağazasıdır. Entegreler (IC), mikrodenetleyiciler, transistörler, diyotlar, pasif elemanlar, konnektörler, modüller ve geliştirme kartları tek adetten seri üretim adetlerine kadar satılır. Ürün sayfalarında güncel stok durumunu, fiyatı ve datasheet bağlantısını bulabilirsiniz.

Parça koduyla arama

Üretici parça numarasını yazın; stok ve fiyatı hemen görün.

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Entegreden kapasitöre tüm elektronik komponent kategorileri.

Kategorilere göz atın

Üreticiler

Aradığınız üreticinin ürünlerini tek sayfada inceleyin.

Üreticileri görün

Toplu alım ve teklif

Listede olmayan ya da yüksek adetli parçalar için teklif isteyin.

Teklif isteyin

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