150mA LDO REGULATOR

NO.EA-105-220531

OUTLINE

The R1180x 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 which prevents the destruction by excess current, and so on. The output voltage of these ICs is fixed with high accuracy. B version has a chip enable pin, therefore ultra-low consumption current standby mode can be realized with the pin.

Since the packages for these ICs are SOT-23-5 (R1180N Series), SC-82AB (R1180Q Series), and SON1612-6 (R1180D Series), therefore high density mounting of the ICs on boards is possible.

FEATURES

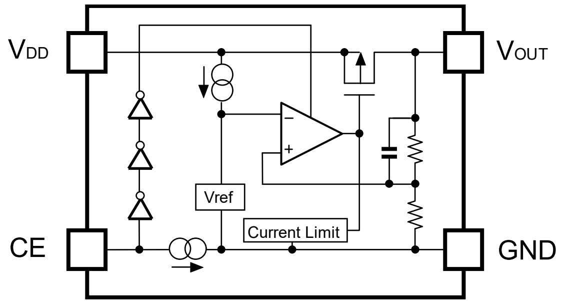
- Supply Current .... Typ. 1μA
  (Except the current through CE pull-down circuit)
- Standby Mode.. Typ. 0.1μA
- Dropout Voltage .... Typ. 0.25V (I_{OUT}=150mA 3.0V Output type)
- Temperature-Drift Coefficient of Output Voltage ...... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.05%/V
- Output Voltage Accuracy.. ±2.0%
- Packages SON1612-6, SC-82AB, SOT-23-5
- Output Voltage Range.. 1.2V to 3.6V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Built-in Fold Back Protection Circuit .... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC 0.1μF

APPLICATIONS

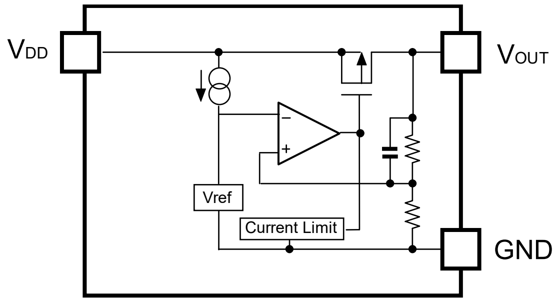
- Stable voltage reference.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

R1180xxx1B



R1180xxx1C



SELECTION GUIDE

The output voltage, CE pin polarity, package, etc. for the ICs can be selected at the user's request.

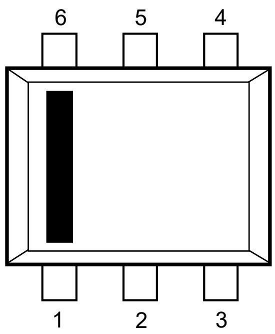
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1180Dxx1∗-TR-FE	SON1612-6	4,000 pcs	Yes	Yes
R1180Qxx1∗-TR-FE	SC-82AB	3,000 pcs	Yes	Yes
R1180Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.2V(12) to 3.6V(36) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

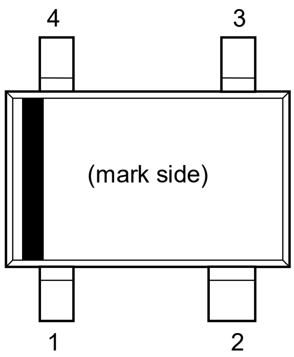
∗ : CE pin polarity are options as follows.
(B) "H" Active
(C) without CE pin

PIN CONFIGURATION

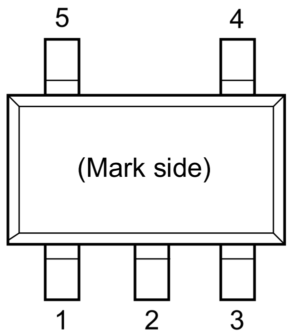
● SON1612-6



● SC-82AB



● SOT-23-5



PIN DESCRIPTIONS

● **SON1612-6**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	V_{OUT}	Output pin
4	NC	No Connection
5	GND	Ground Pin
6	CE or NC	Chip Enable Pin or No Connection

● **SC-82AB**

Pin No	Symbol	Pin Description
1	CE or NC	Chip Enable Pin or No Connection
2	GND	Ground Pin
3	V_{OUT}	Output pin
4	V_{DD}	Input Pin

● **SOT-23-5**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE or NC	Chip Enable Pin or No Connection
4	NC	No Connection
5	V_{OUT}	Output pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage (CE Pin)	6.5	V
V_{OUT}	Output Voltage	-0.3 to $V_{IN}+0.3$	V
I_{OUT}	Output Current	180	mA
P_D	Power Dissipation (SON1612-6)*	500	mW
	Power Dissipation (SC-82AB)*	380	
	Power Dissipation (SOT-23-5)*	420	
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	Storage Temperature Range	−55 to 125	°C

*) For Power Dissipation, please refer to PACKAGE 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 (ELECTRICAL CHARACTERISTICS)

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

- **R1180xxx1B/C**

Topt=25°C

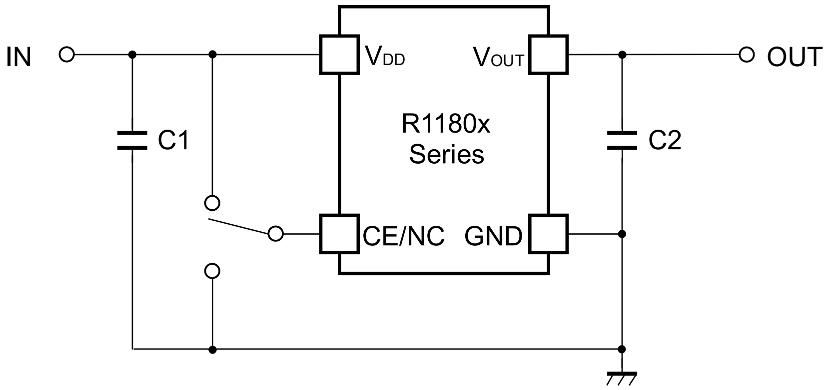
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}=Set V_{OUT}+1V 1μA ≤ I_{OUT} ≤ 30mA	×0.980		×1.020	V
I_{OUT}	Output Current	V_{IN}–V_{OUT}=1.0V(V_{OUT} ≥ 1.4V) V_{IN}=2.4V(V_{OUT}<1.4V)	150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}–V_{OUT}=1.0V(V_{OUT} ≥ 1.4V) V_{IN}=2.4V(V_{OUT}<1.4V) 1μA ≤ I_{OUT} ≤ 150mA		20	40	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I_{SS}	Supply Current	V_{IN}–V_{OUT}=1.0V,I_{OUT}=0mA		1.0	1.5	μA
Istandby	Supply Current (Standby)	V_{IN}–V_{OUT}=1.0V,V_{CE}=GND		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=30mA V_{OUT}+0.5V ≤ V_{IN} ≤ 6.0V (V_{OUT} ≥ 1.5V) 2.0V ≤ V_{IN} ≤ 6.0V (1.2V ≤ V_{OUT} ≤ 1.4V)		0.05	0.20	%/V
V_{IN}	Input Voltage		1.7		6.0	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=30mA –40°C ≤ Topt ≤ 85°C		±100		ppm /°C
I_{SC}	Short Current Limit	V_{OUT}=0V		40		mA
I_{PD}	CE Pull-down Constant Current	(R1180xxx1B)		0.35		μA
V_{CEH}	CE Input Voltage "H"	(R1180xxx1B)	1.2		6.0	V
V_{CEL}	CE Input Voltage "L"	(R1180xxx1B)	0.0		0.3	V

- **ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE**

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
1.2 ≦ V_{OUT} < 1.3	I_{OUT}=150mA	0.85	1.20
1.3 ≦ V_{OUT} < 1.4		0.75	1.10
1.4 ≦ V_{OUT} < 1.5		0.65	1.00
1.5 ≦ V_{OUT} < 1.7		0.60	0.90
1.7 ≦ V_{OUT} < 1.9		0.50	0.75
1.9 ≦ V_{OUT} < 2.1		0.40	0.65
2.1 ≦ V_{OUT} < 2.8		0.35	0.55
2.8 ≦ V_{OUT} ≦ 3.6		0.25	0.40

TYPICAL APPLICATION



(External Components)
Output Capacitor
Ceramic Capacitor 0.1μF

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 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 C1 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 C2, as close as possible to the ICs, and make wiring as short as possible.

PACKAGE INFORMATION

POWER DISSIPATION (SON1612-6)

Power Dissipation (P_D) depends on conditions of mounting on board.

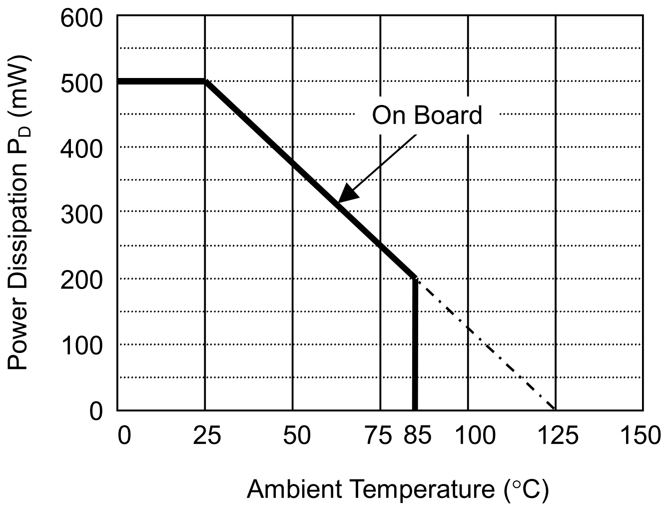
This specification is based on the measurement at the condition below:

* Measurement Conditions

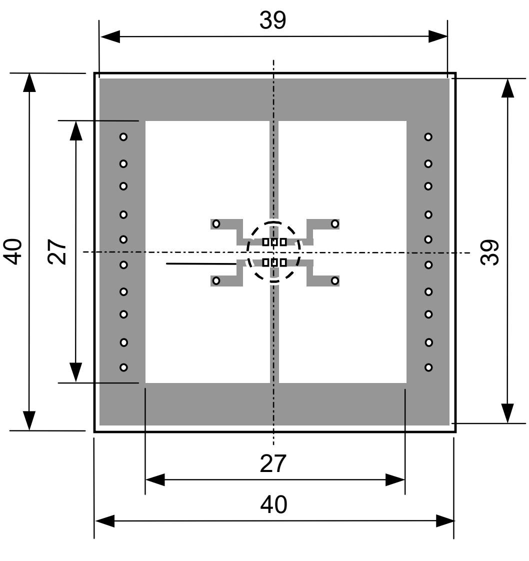
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity 0m/s)
Board Material	Glass cloth epoxy plastic (Double layers)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through - hole	φ 0.5mm × 24pcs

* Measurement Results (Ta=25°C, Tjmax=125°C)

	Standard Land Pattern
Power Dissipation	500mW
Thermal Resistance	θja = (125-25°C)/ 0.5W = 200°C/W



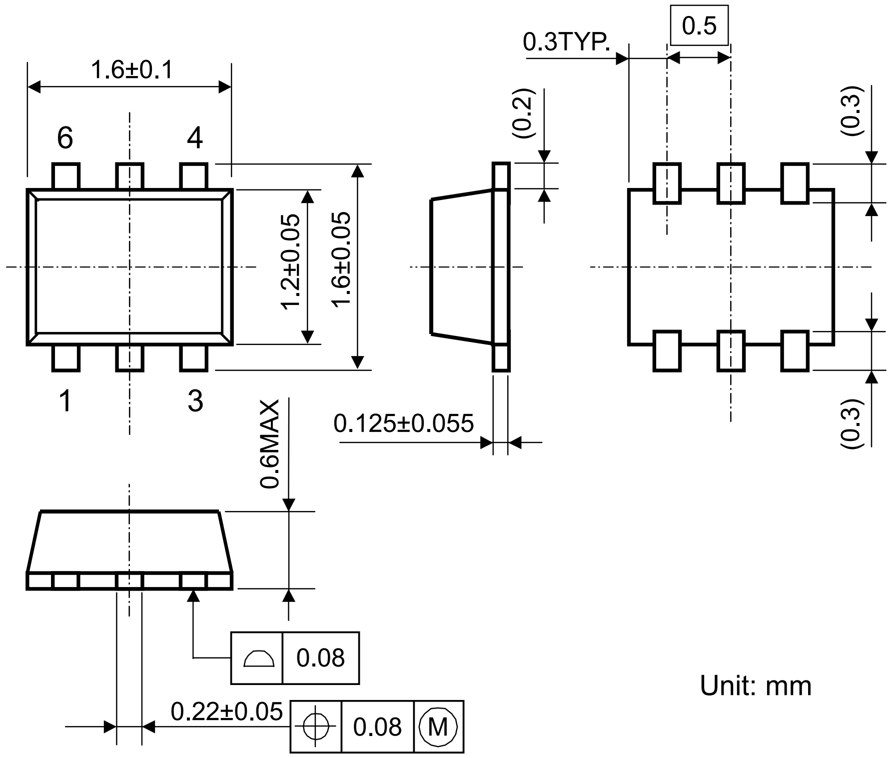
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit: mm)

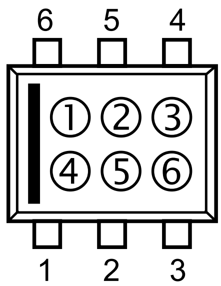
PACKAGE DIMENSIONS (SON1612-6)



MARK SPECIFICATION (SON1612-6)

①②③④ : Product Code … **Refer to R1180D Series Mark Specification Table**

⑤⑥ : Lot Number … Alphanumeric Serial Number



R1180D MARK SPECIFICATION TABLE (SON1612-6)

R1180Dxx1B Series

Product Name	①②③④
R1180D121B	**G12B**
R1180D131B	**G13B**
R1180D141B	**G14B**
R1180D151B	**G15B**
R1180D161B	**G16B**
R1180D171B	**G17B**
R1180D181B	**G18B**
R1180D191B	**G19B**
R1180D201B	**G20B**
R1180D211B	**G21B**
R1180D221B	**G22B**
R1180D231B	**G23B**
R1180D241B	**G24B**
R1180D251B	**G25B**
R1180D261B	**G26B**
R1180D271B	**G27B**
R1180D281B	**G28B**
R1180D291B	**G29B**
R1180D301B	**G30B**
R1180D311B	**G31B**
R1180D321B	**G32B**
R1180D331B	**G33B**
R1180D341B	**G34B**
R1180D351B	**G35B**
R1180D361B	**G36B**
R1180D181B5	**G00B**
R1180D261B5	**G01B**

R1180Dxx1C Series

Product Name	①②③④
R1180D121C	**G12C**
R1180D131C	**G13C**
R1180D141C	**G14C**
R1180D151C	**G15C**
R1180D161C	**G16C**
R1180D171C	**G17C**
R1180D181C	**G18C**
R1180D191C	**G19C**
R1180D201C	**G20C**
R1180D211C	**G21C**
R1180D221C	**G22C**
R1180D231C	**G23C**
R1180D241C	**G24C**
R1180D251C	**G25C**
R1180D261C	**G26C**
R1180D271C	**G27C**
R1180D281C	**G28C**
R1180D291C	**G29C**
R1180D301C	**G30C**
R1180D311C	**G31C**
R1180D321C	**G32C**
R1180D331C	**G33C**
R1180D341C	**G34C**
R1180D351C	**G35C**
R1180D361C	**G36C**
R1180D181C5	**G00C**
R1180D261C5	**G01C**

POWER DISSIPATION (SC-82AB)

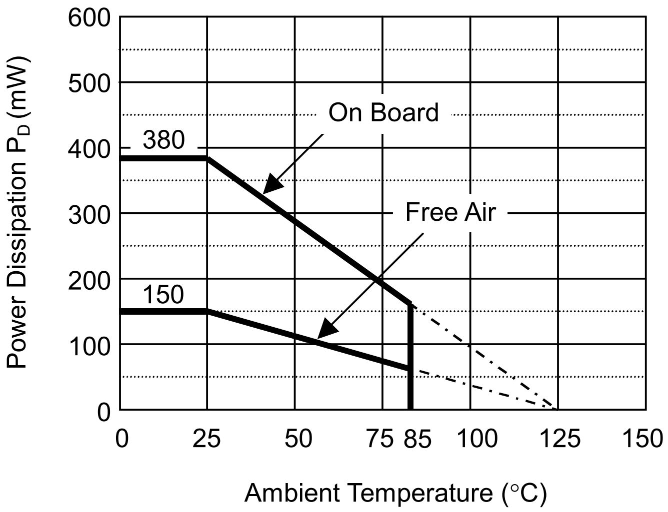
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the Measurement Conditions below.

Measurement Conditions

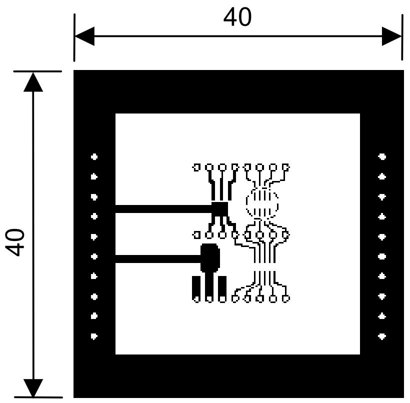
	Standard Land Pattern
Environment	Mounting on Board (Wind Velocity=0m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-layers)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Topside: Approx. 50%, Backside: Approx. 50%
Through-hole	φ0.5mm × 44pcs

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



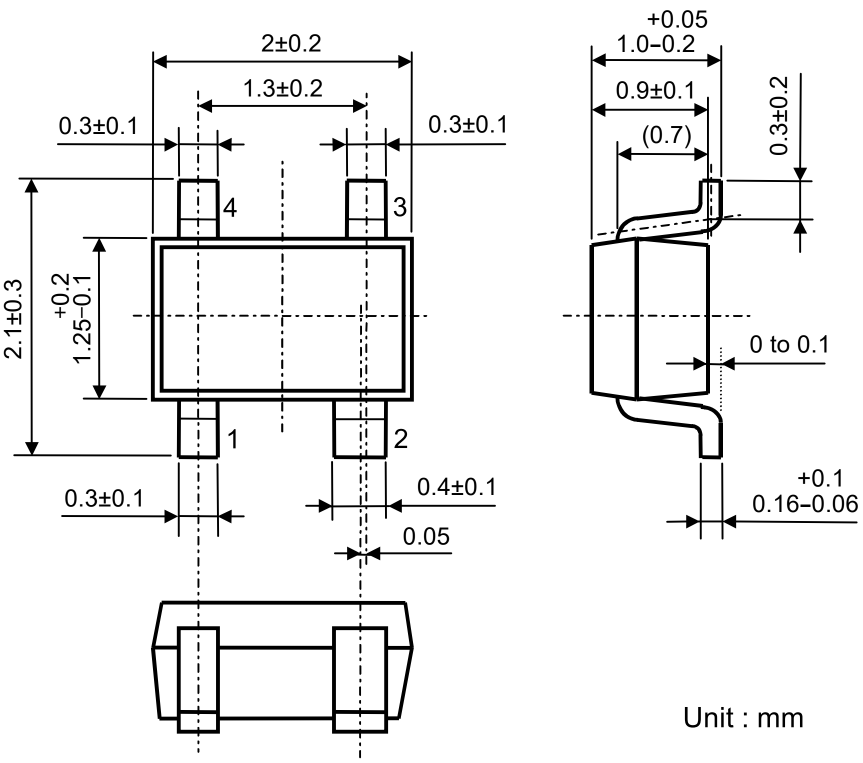
Power Dissipation



Measurement Board Pattern

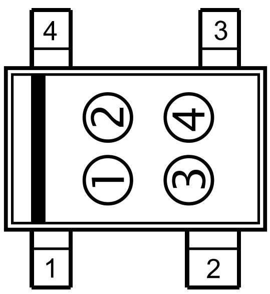
IC Mount Area (Unit : mm)

PACKAGE DIMENSIONS (SC-82AB)



MARK SPECIFICATION (SC-82AB)

①②: Product Code … **Refer to R1180Q Series Mark Specification Table**
③④: Lot Number … Alphanumeric Serial Number



R1180Q MARK SPECIFICATION TABLE (SC-82AB)

R1180Qxx1B Series

Product Name	①②
R1180Q121B	**A2**
R1180Q131B	**A3**
R1180Q141B	**A4**
R1180Q151B	**A5**
R1180Q161B	**A6**
R1180Q171B	**A7**
R1180Q181B	**A8**
R1180Q191B	**A9**
R1180Q201B	**B0**
R1180Q211B	**B1**
R1180Q221B	**B2**
R1180Q231B	**B3**
R1180Q241B	**B4**
R1180Q251B	**B5**
R1180Q261B	**B6**
R1180Q271B	**B7**
R1180Q281B	**B8**
R1180Q291B	**B9**
R1180Q301B	**C0**
R1180Q311B	**C1**
R1180Q321B	**C2**
R1180Q331B	**C3**
R1180Q341B	**C4**
R1180Q351B	**C5**
R1180Q361B	**C6**
R1180Q181B5	**C7**
R1180Q261B5	**C8**

R1180Qxx1C Series

Product Name	①②
R1180Q121C	**D2**
R1180Q131C	**D3**
R1180Q141C	**D4**
R1180Q151C	**D5**
R1180Q161C	**D6**
R1180Q171C	**D7**
R1180Q181C	**D8**
R1180Q191C	**D9**
R1180Q201C	**E0**
R1180Q211C	**E1**
R1180Q221C	**E2**
R1180Q231C	**E3**
R1180Q241C	**E4**
R1180Q251C	**E5**
R1180Q261C	**E6**
R1180Q271C	**E7**
R1180Q281C	**E8**
R1180Q291C	**E9**
R1180Q301C	**F0**
R1180Q311C	**F1**
R1180Q321C	**F2**
R1180Q331C	**F3**
R1180Q341C	**F4**
R1180Q351C	**F5**
R1180Q361C	**F6**
R1180Q181C5	**F7**
R1180Q261C5	**F8**

POWER DISSIPATION (SOT-23-5)

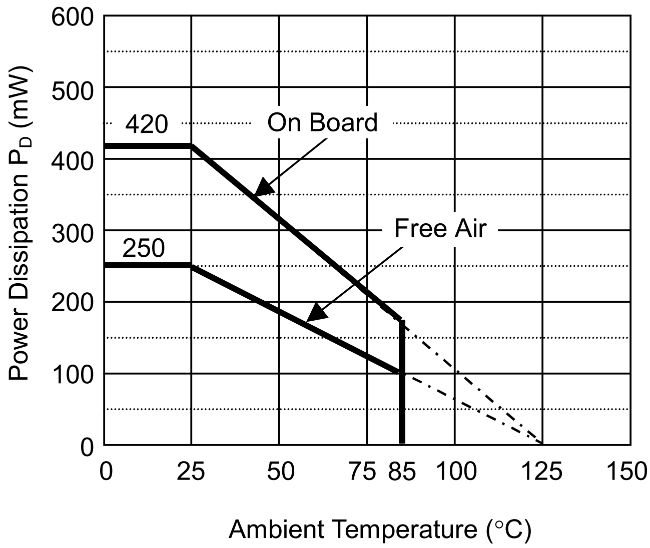
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

* Measurement Conditions

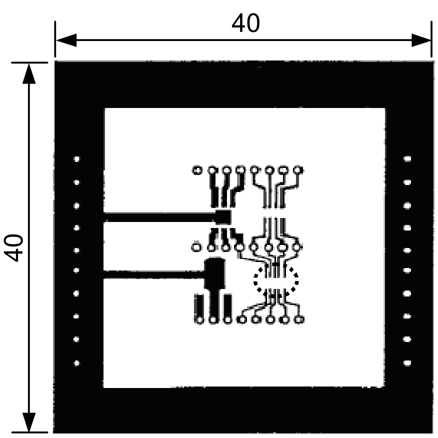
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm*40mm*1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.5mm * 44pcs

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

	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	θja = (125-25°C)/0.42W= 238°C/W	400°C/W



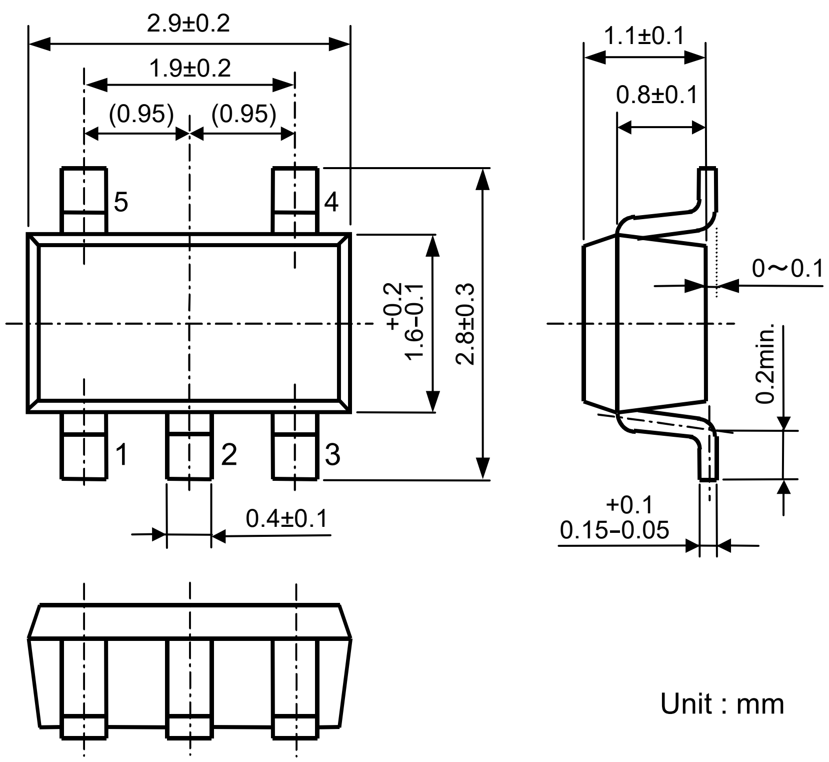
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit: mm)

PACKAGE DIMENSIONS (**SOT-23-5**)

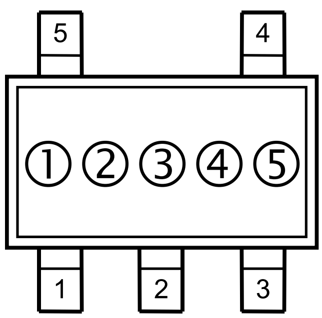


Unit : mm

MARK SPECIFICATION (**SOT-23-5**)

①②③ : Product Code … **Refer to R1180N Series Mark Specification Table**

④⑤ : Lot Number … Alphanumeric Serial Number



R1180N MARK SPECIFICATION TABLE (SOT-23-5)

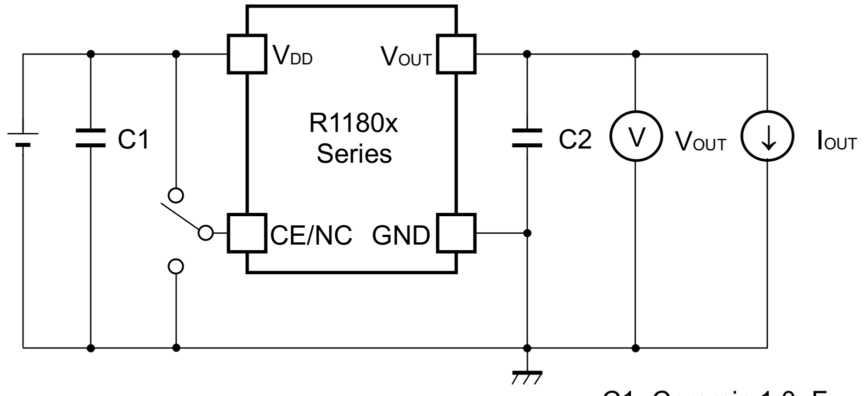
R1180Nxx1B Series

Product Name	①②③
R1180N121B	**C12**
R1180N131B	**C13**
R1180N141B	**C14**
R1180N151B	**C15**
R1180N161B	**C16**
R1180N171B	**C17**
R1180N181B	**C18**
R1180N191B	**C19**
R1180N201B	**C20**
R1180N211B	**C21**
R1180N221B	**C22**
R1180N231B	**C23**
R1180N241B	**C24**
R1180N251B	**C25**
R1180N261B	**C26**
R1180N271B	**C27**
R1180N281B	**C28**
R1180N291B	**C29**
R1180N301B	**C30**
R1180N311B	**C31**
R1180N321B	**C32**
R1180N331B	**C33**
R1180N341B	**C34**
R1180N351B	**C35**
R1180N361B	**C36**
R1180N181B5	**C37**
R1180N261B5	**C38**

R1180Nxx1C Series

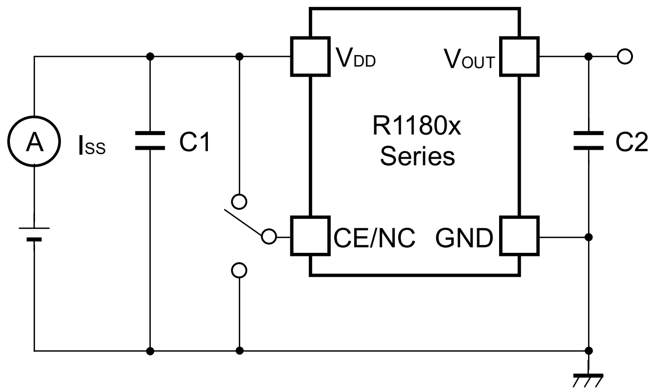
Product Name	①②③
R1180N121C	**D12**
R1180N131C	**D13**
R1180N141C	**D14**
R1180N151C	**D15**
R1180N161C	**D16**
R1180N171C	**D17**
R1180N181C	**D18**
R1180N191C	**D19**
R1180N201C	**D20**
R1180N211C	**D21**
R1180N221C	**D22**
R1180N231C	**D23**
R1180N241C	**D24**
R1180N251C	**D25**
R1180N261C	**D26**
R1180N271C	**D27**
R1180N281C	**D28**
R1180N291C	**D29**
R1180N301C	**D30**
R1180N311C	**D31**
R1180N321C	**D32**
R1180N331C	**D33**
R1180N341C	**D34**
R1180N351C	**D35**
R1180N361C	**D36**
R1180N181C5	**D37**
R1180N261C5	**D38**

TEST CIRCUITS



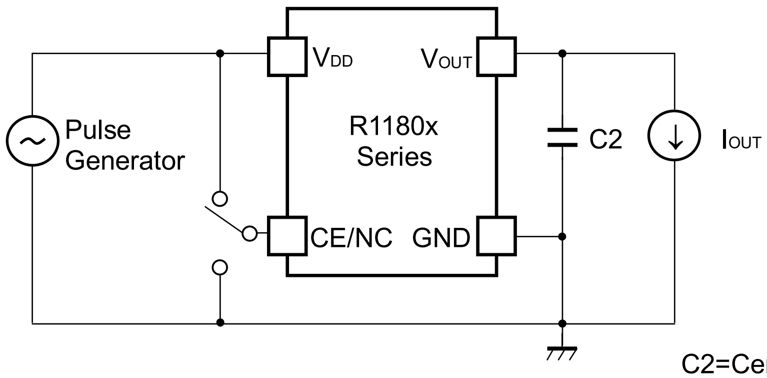
C1=Ceramic 1.0μF
C2=Ceramic 0.1μF

Standard test Circuit



C1=Ceramic 1.0μF
C2=Ceramic 0.1μF

Supply Current Test Circuit



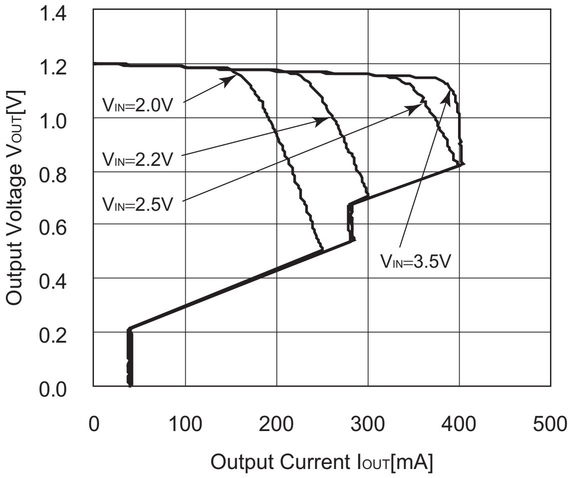
C2=Ceramic 0.1μF

Ripple Rejection, Line Transient Response Test Circuit

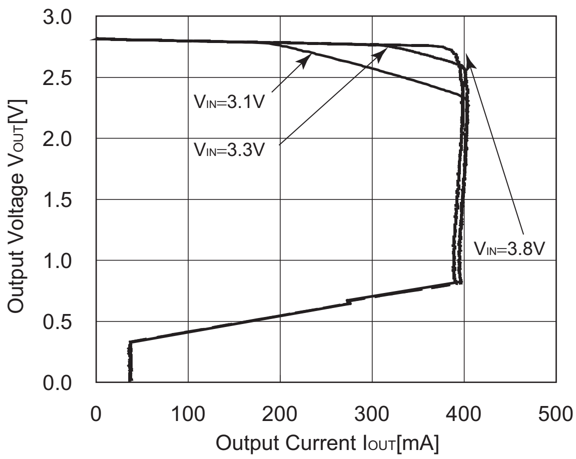
TYPICAL CHARACTERISTICS

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

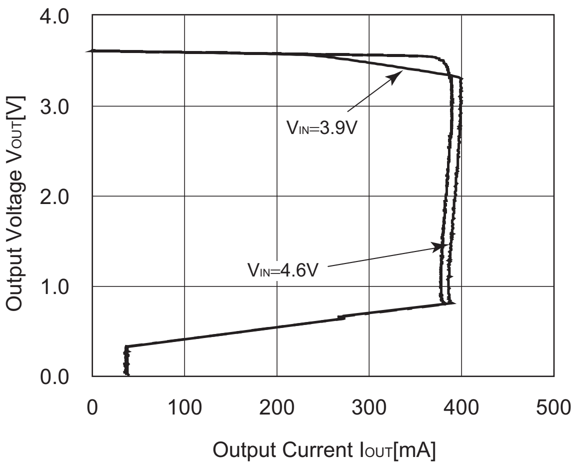
R1180x121x



R1180x281x

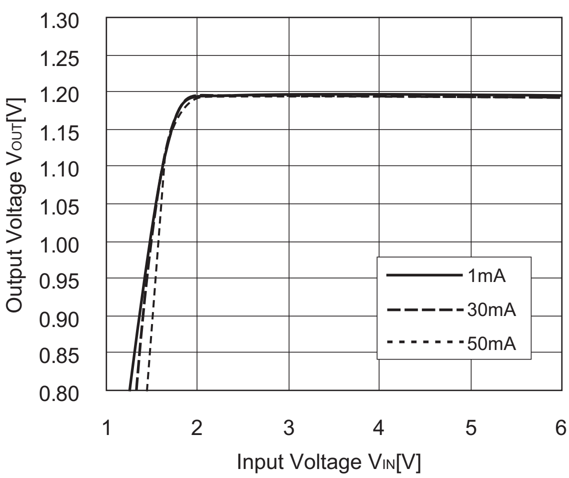


R1180x361x

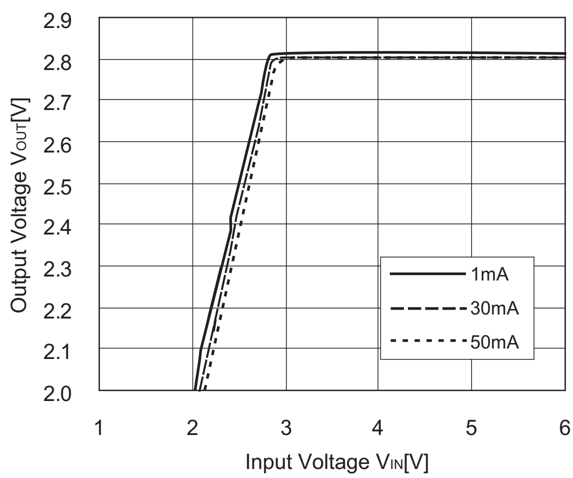


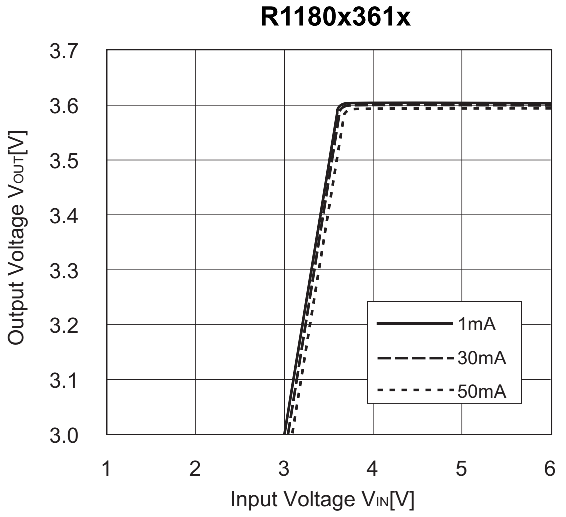
2) Output Voltage vs. Input Voltage (Topt=25°C)

R1180x121x

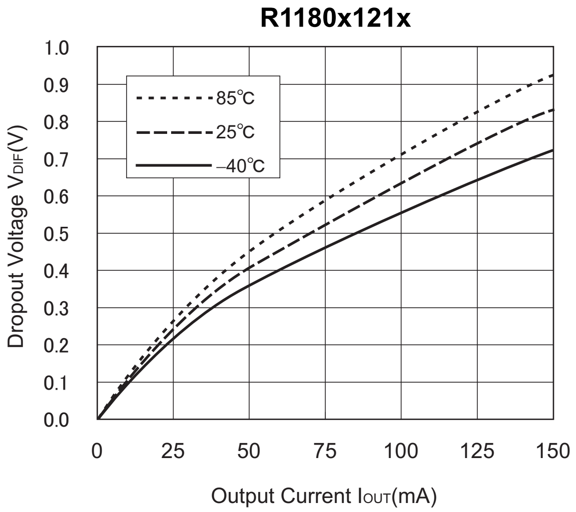


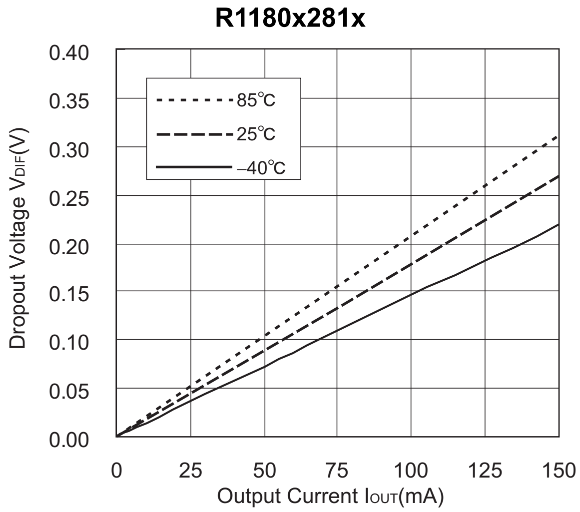
R1180x281x

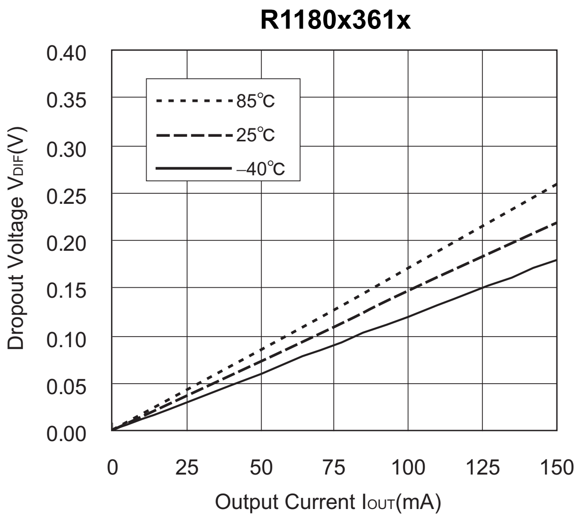




3) Dropout Voltage vs. Output Current

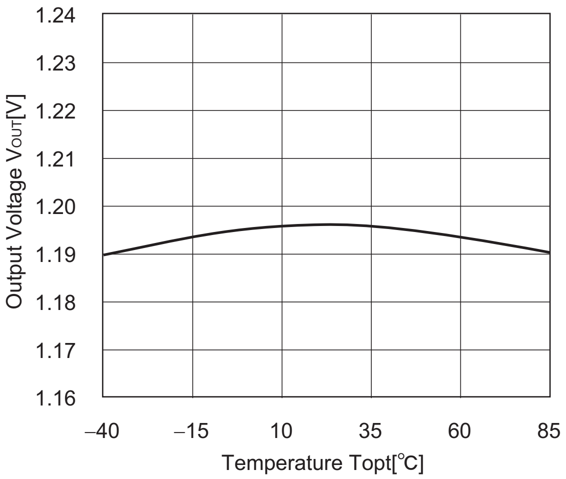




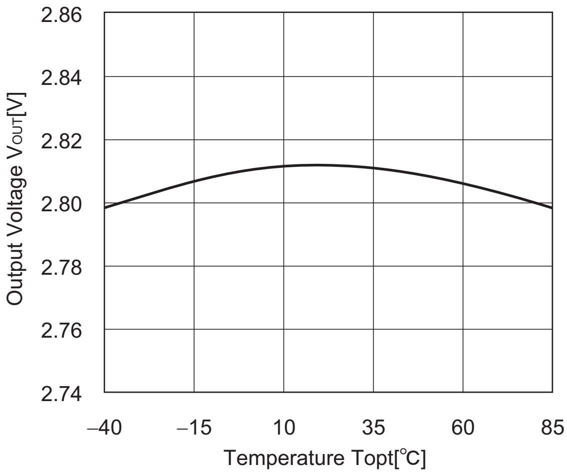


4) Output Voltage vs. Temperature (I_{OUT}=30mA)

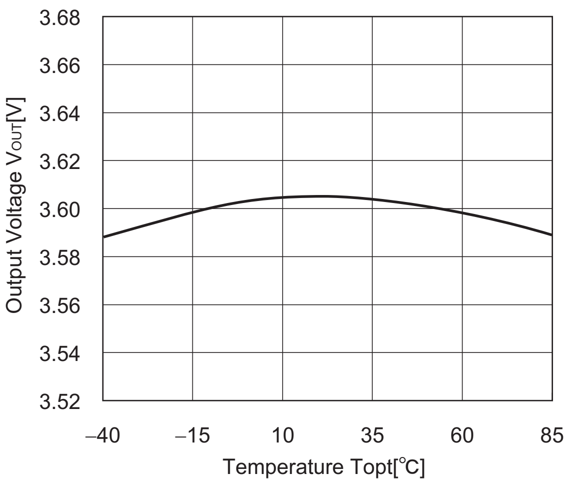
R1180x121x (V_{IN}=2.2V)



R1180x281x (V_{IN}=3.8V)

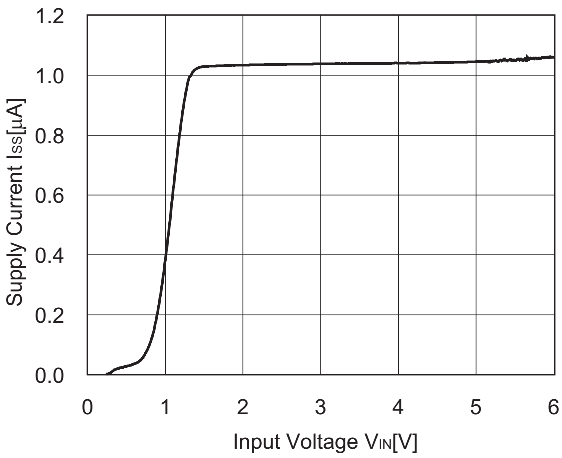


R1180x361x (V_{IN}=4.6V)

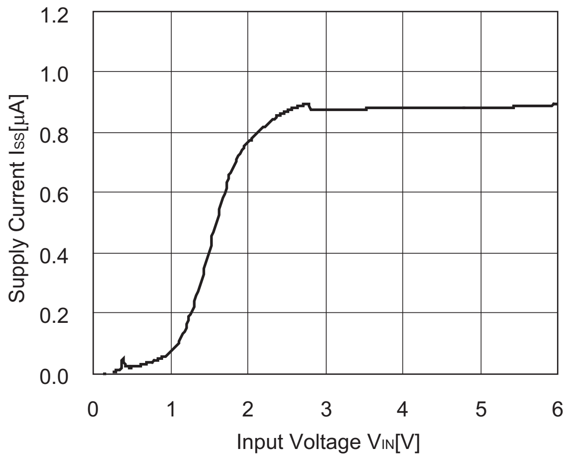


5) Supply Current vs. Input Voltage (Topt=25°C)

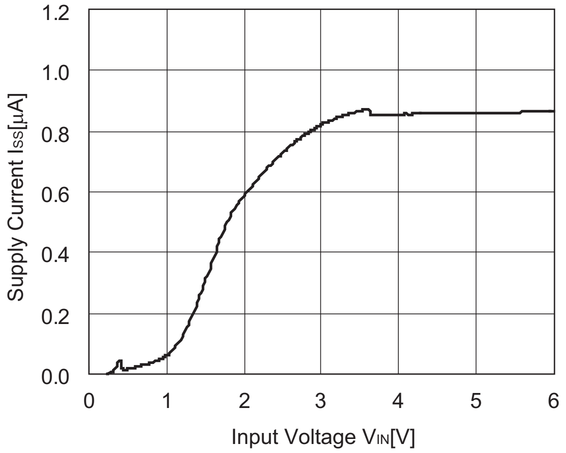
R1180x121x



R1180x281x

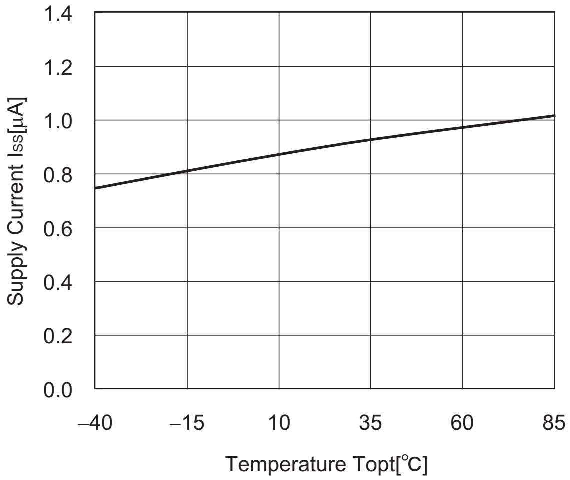


R1180x361x

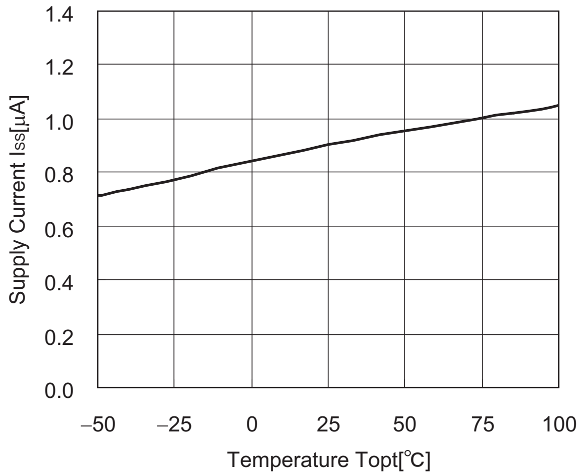


6) Supply Current vs. Temperature

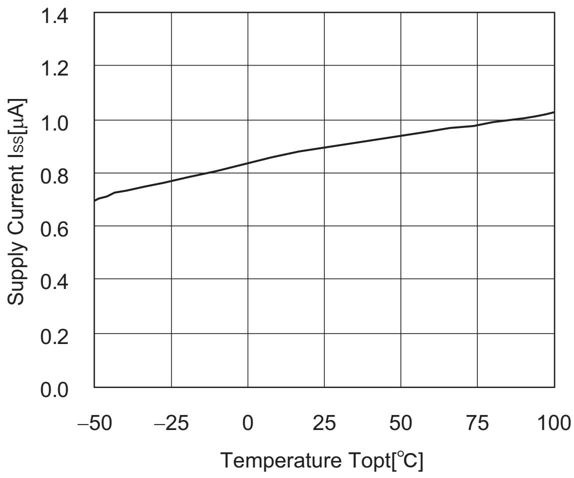
R1180x121x(VIN=2.2V)



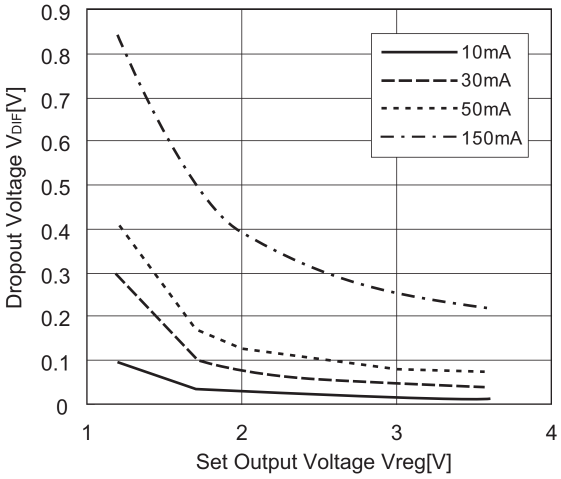
R1180x281x(VIN=3.8V)



R1180x361x(VIN=4.6V)

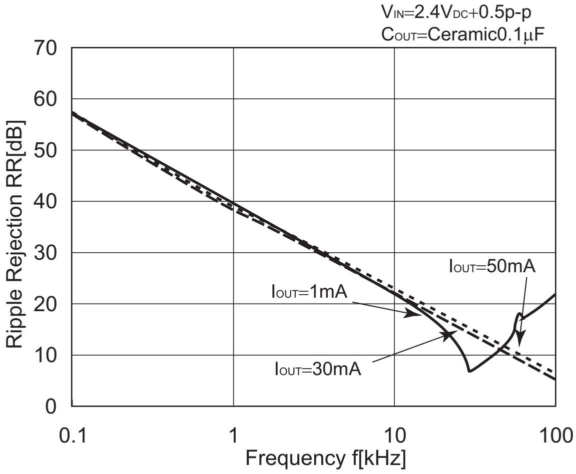


7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

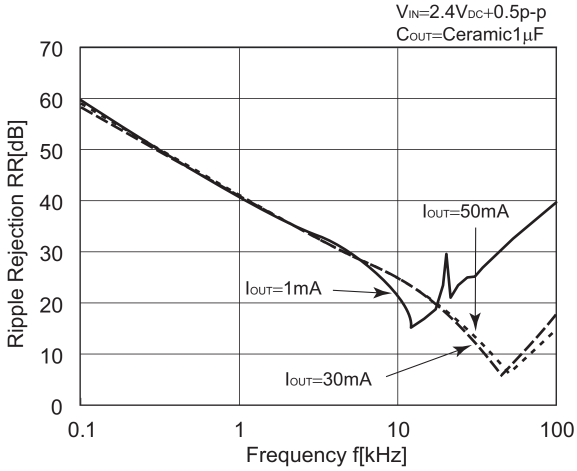


8) Ripple Rejection vs. Frequency (CIN=none)

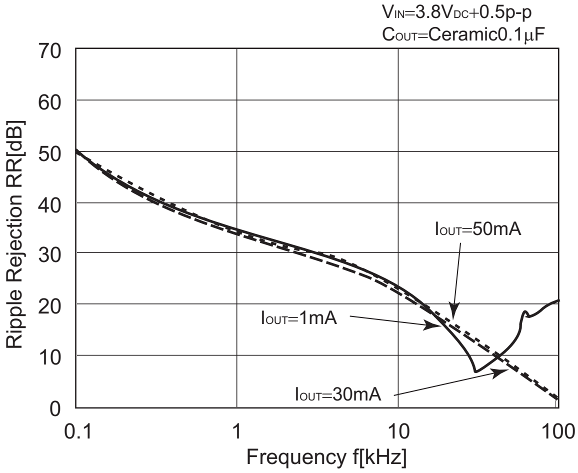
R1180x121x



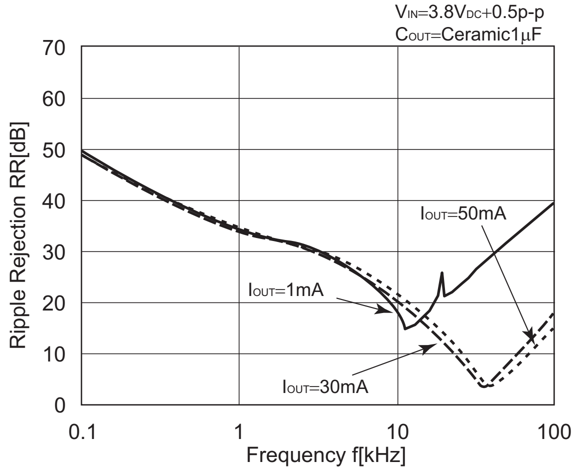
R1180x121x



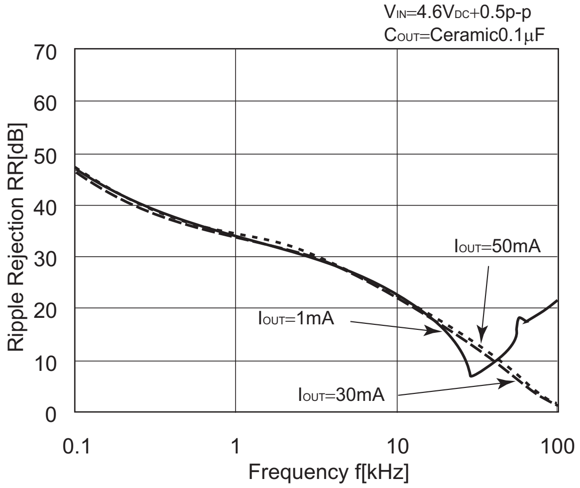
R1180x281x



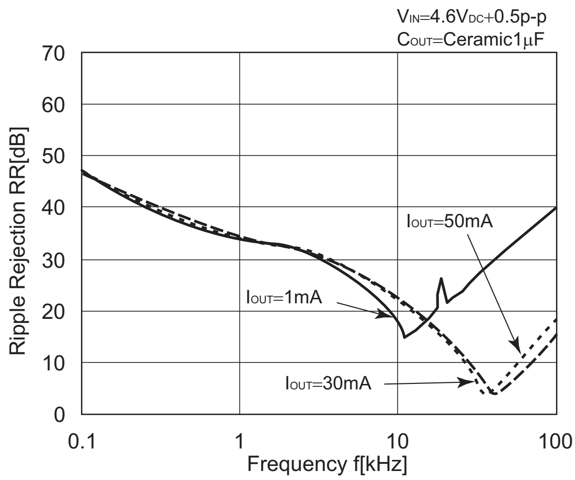
R1180x281x



R1180x361x

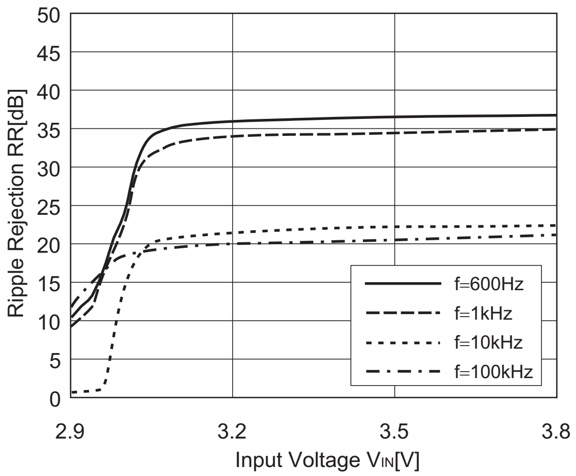


R1180x361x

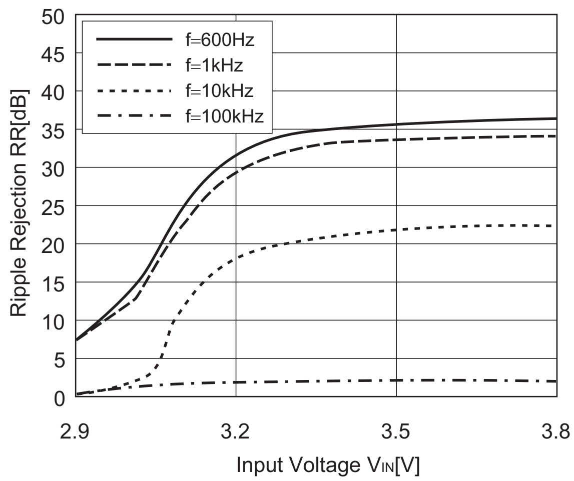


9) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, C_{IN}=none, C_{OUT}=Ceramic0.1μF)

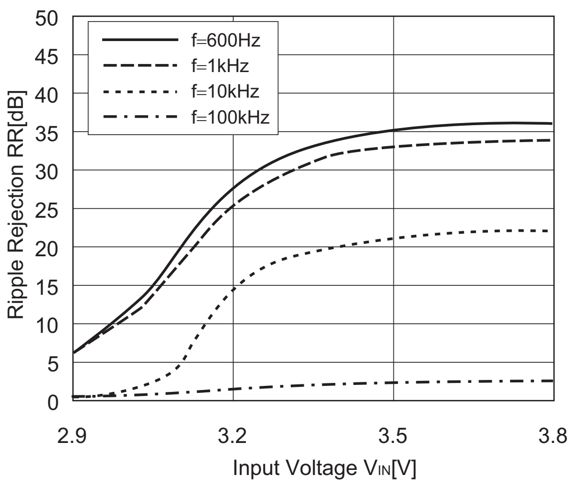
R1180x281x(I_{OUT}=1mA)



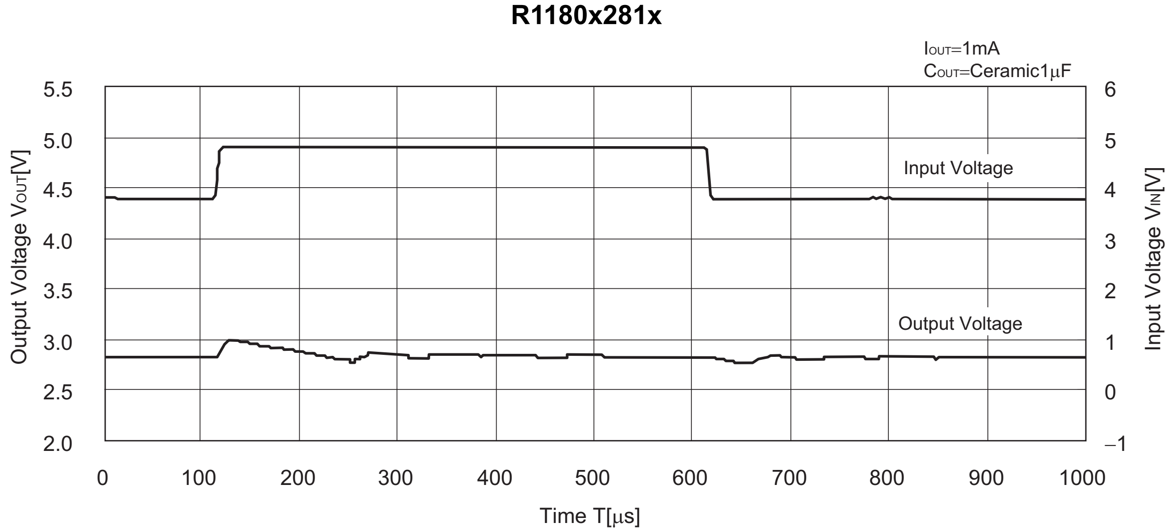
R1180x281x(I_{OUT}=30mA)

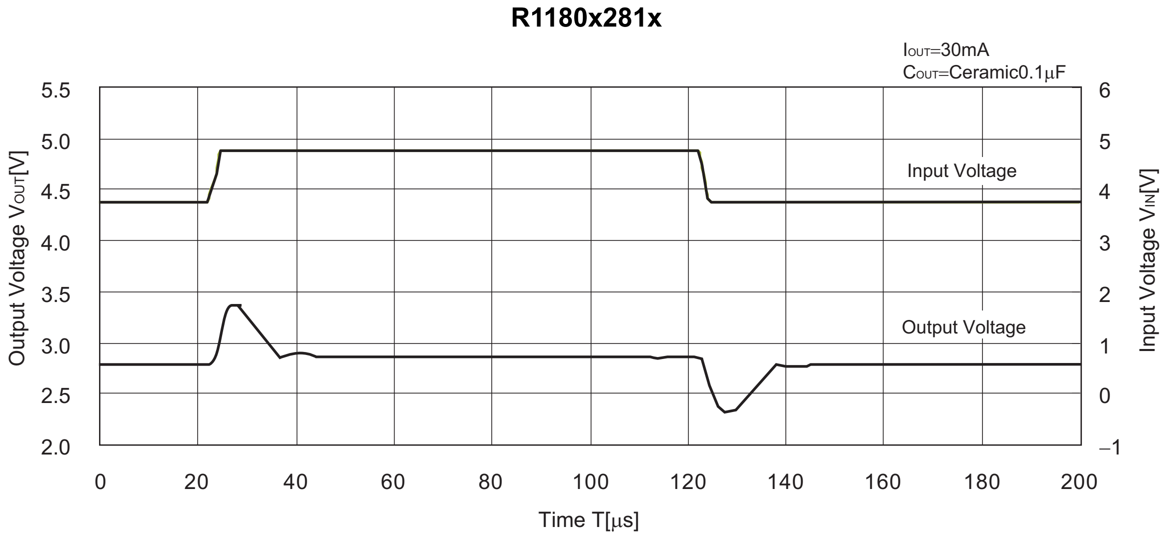


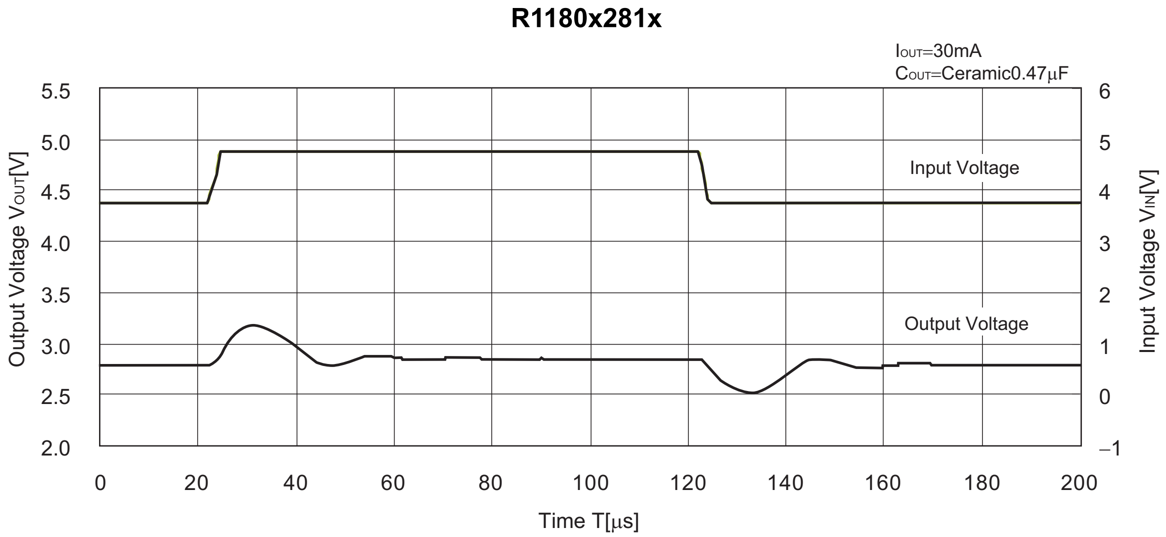
R1180x281x(I_{OUT}=50mA)

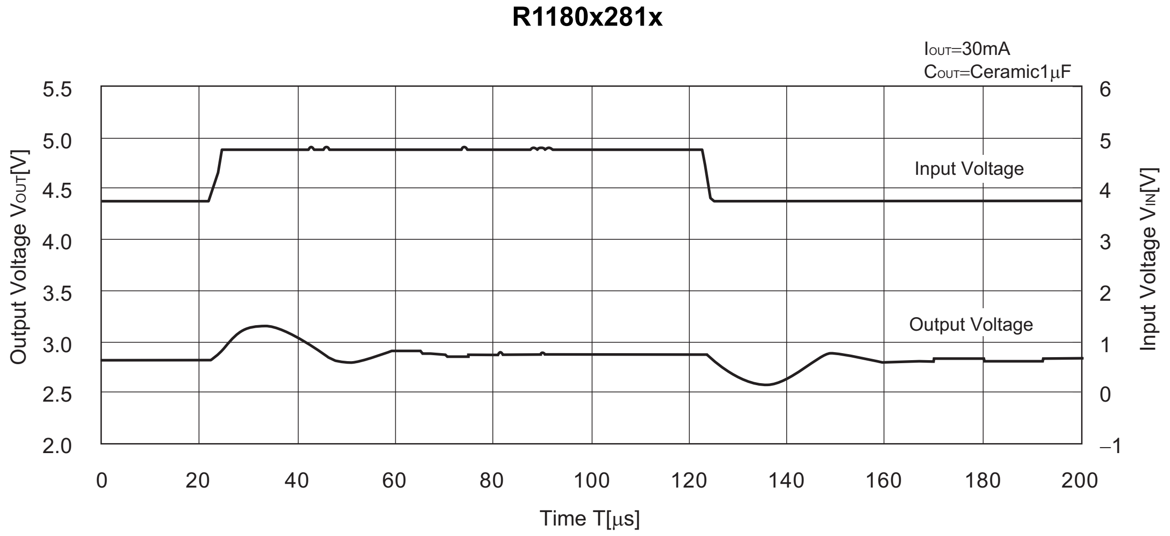


10) Input Transient Response (C_{IN}=none, tr=tf=5μs)

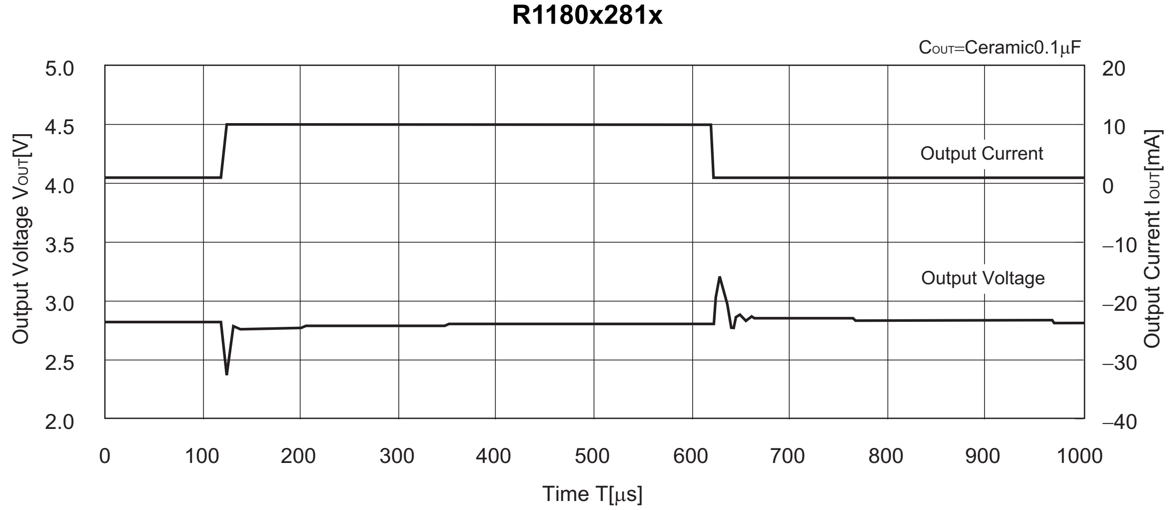


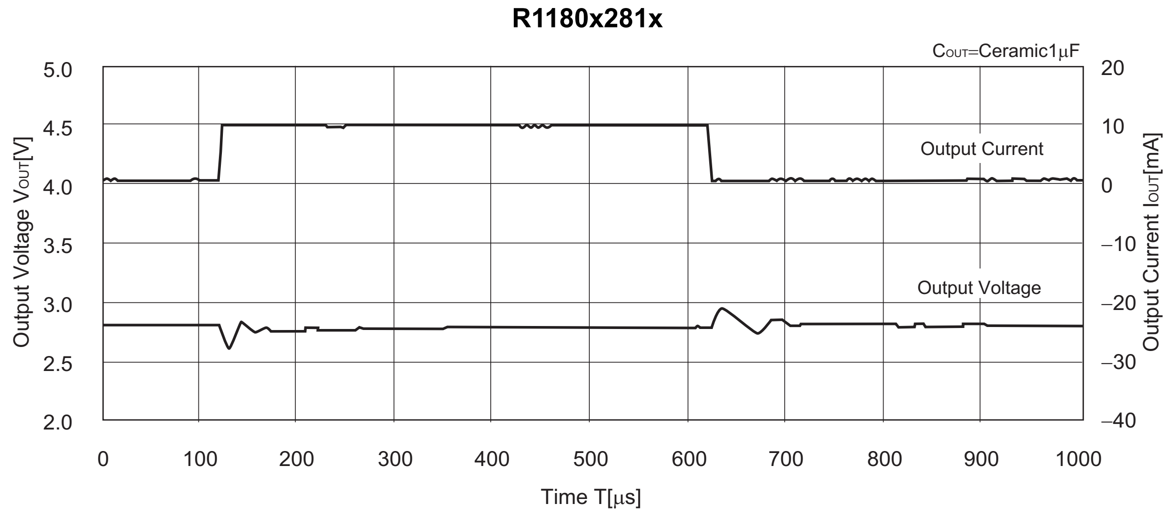


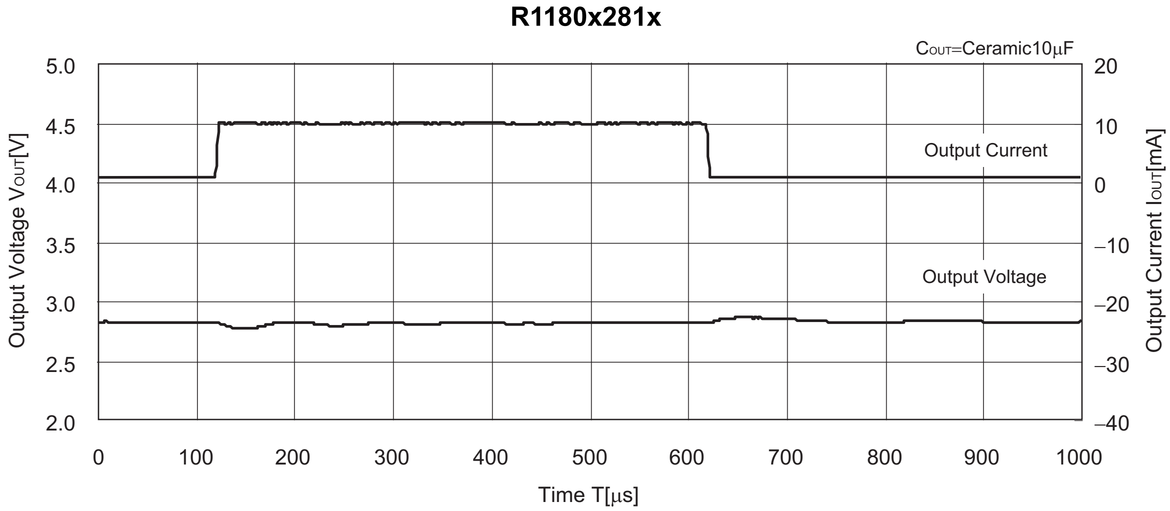


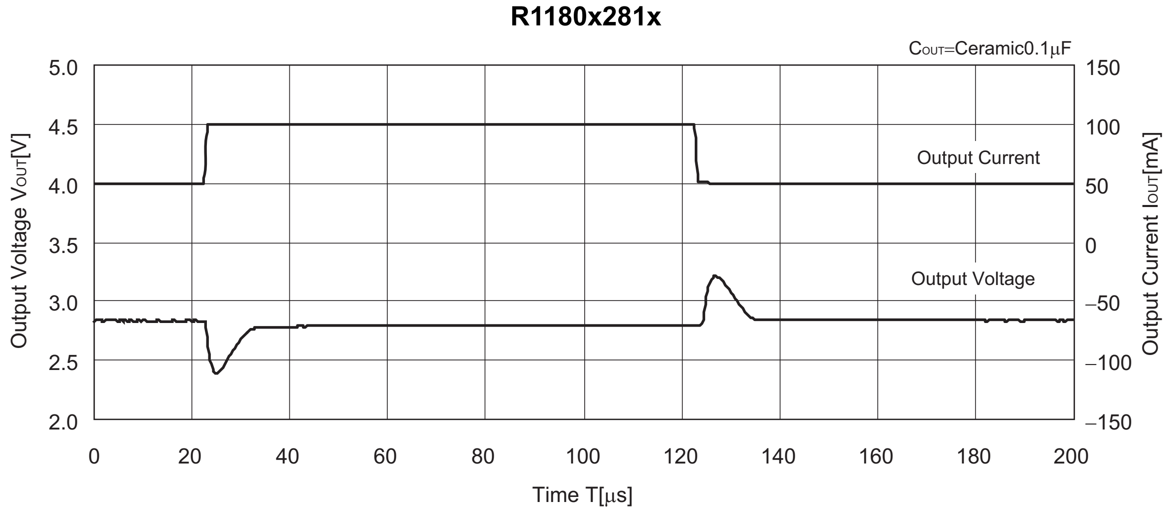


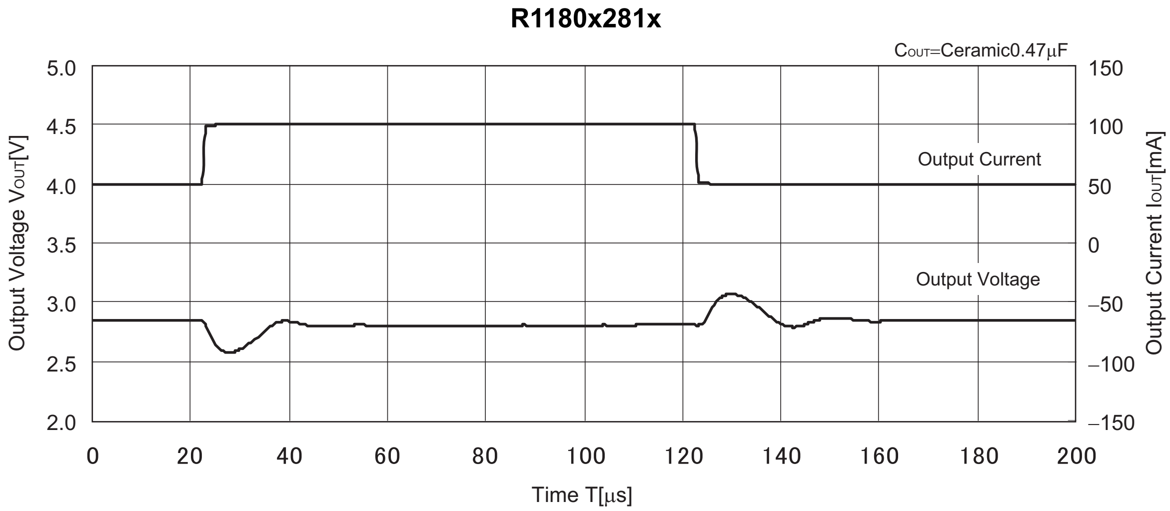
11) Load Transient Response (tr=tf=0.5μs V_{IN}=3.8V)

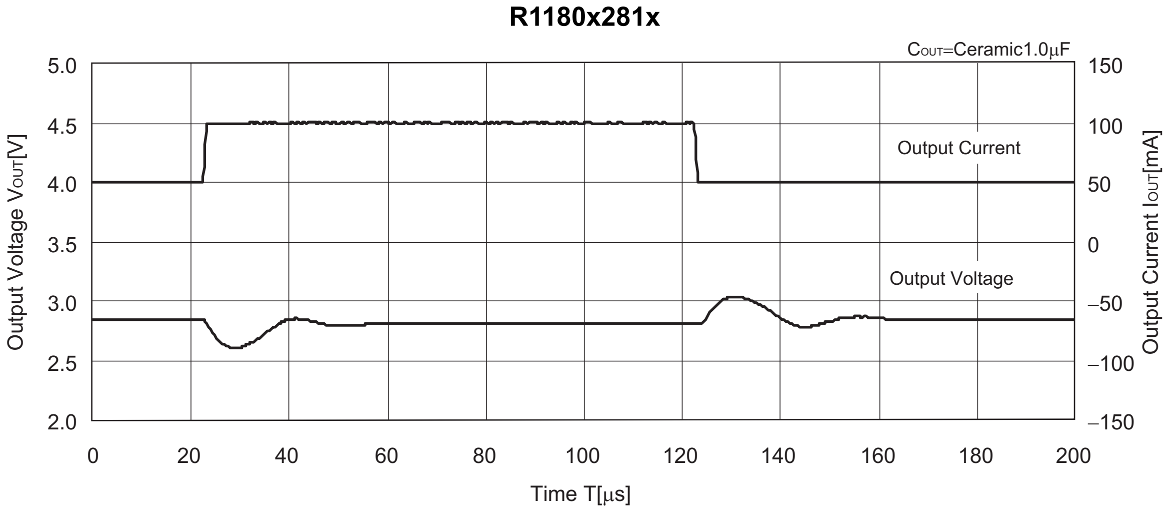





R1180x281x
COUT=Ceramic10μF
Output Current
Output Voltage
Output Voltage VOUT[V]
Output Current IOUT[mA]
Time T[μs]
5.0
4.5
4.0
3.5
3.0
2.5
2.0
20
10
0
−10
−20
−30
−40
0
100
200
300
400
500
600
700
800
900
1000


R1180x281x
COUT=Ceramic0.1μF
Output Current
Output Voltage
Output Voltage VOUT[V]
Output Current IOUT[mA]
Time T[μs]
5.0
4.5
4.0
3.5
3.0
2.5
2.0
150
100
50
0
−50
−100
−150
0
20
40
60
80
100
120
140
160
180
200


R1180x281x
COUT=Ceramic0.47μF
Output Current
Output Voltage
Output Voltage VOUT[V]
Output Current IOUT[mA]
Time T[μs]
5.0
4.5
4.0
3.5
3.0
2.5
2.0
150
100
50
0
−50
−100
−150
0
20
40
60
80
100
120
140
160
180
200


R1180x281x
COUT=Ceramic1.0μF
Output Current
Output Voltage
Output Voltage VOUT[V]
Output Current IOUT[mA]
Time T[μs]
5.0
4.5
4.0
3.5
3.0
2.5
2.0
150
100
50
0
−50
−100
−150
0
20
40
60
80
100
120
140
160
180
200

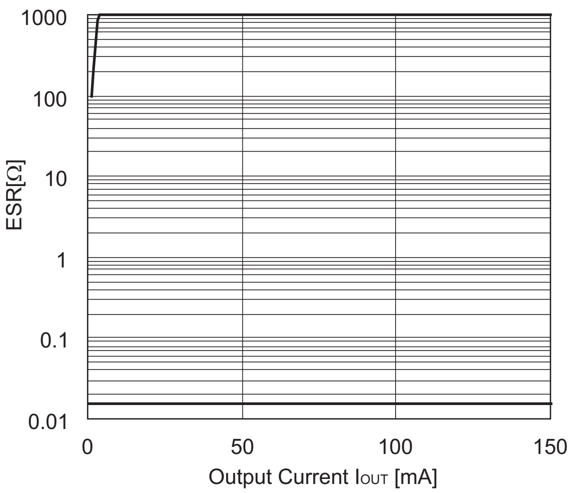
ESR vs. Output Current

The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown above. The conditions when the white noise level is under 40µV (Avg.) are marked as the hatched area in the graph.

<Measurement conditions>
(1) $V_{IN}=V_{OUT}+1V$
(2) Frequency Band: 10Hz to 2MHz (BW=30Hz)
(3) Temperature: –40°C to 85°C

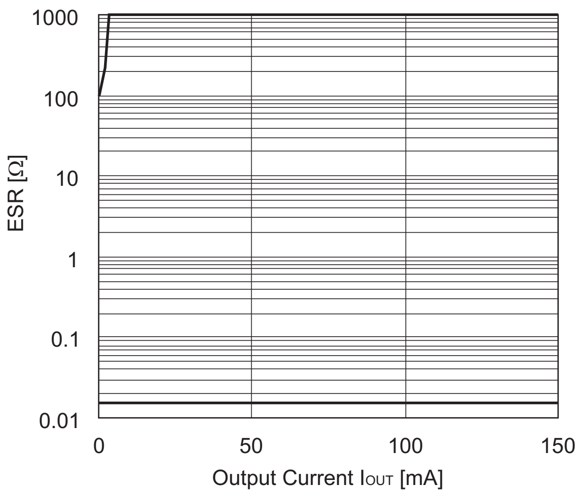
R1180x121x

C_{IN} =Ceramic 1.0µA, C_{OUT} =Ceramic 0.1µF



R1180x281x

C_{IN} =Ceramic 1.0µA, C_{OUT} =Ceramic 0.1µF



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    - 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

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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.
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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.