

## 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.

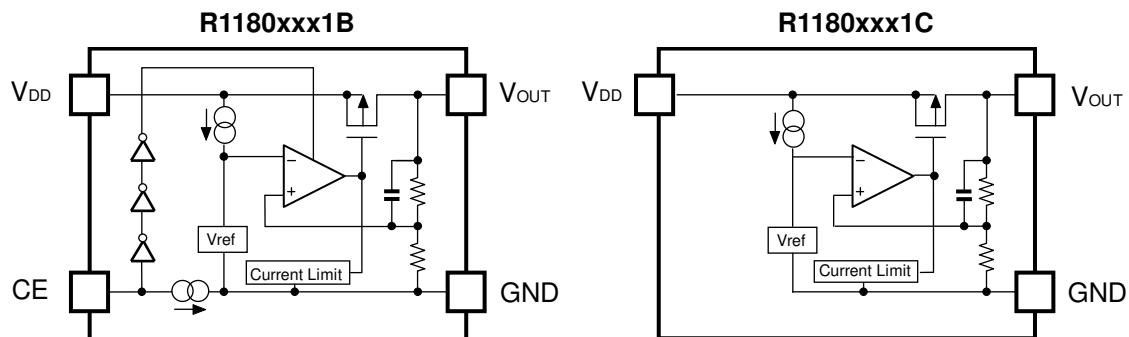
### FEATURES

- Supply Current ..... Typ. 1 $\mu$ A  
(Except the current through CE pull-down circuit)
- Standby Mode ..... Typ. 0.1 $\mu$ A
- Dropout Voltage ..... Typ. 0.25V ( $I_{OUT}=150mA$  3.0V Output type)
- Temperature-Drift Coefficient of Output Voltage ..... Typ.  $\pm 100ppm/\text{ }^{\circ}\text{C}$
- Line Regulation ..... Typ. 0.05%/V
- Output Voltage Accuracy .....  $\pm 2.0\%$
- 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 ..... 0.1 $\mu$ F

### APPLICATIONS

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

## BLOCK DIAGRAMS



## 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.

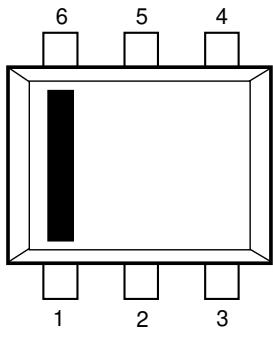
(For other voltages, please refer to MARK INFORMATIONS.)

\* : CE pin polarity are options as follows.

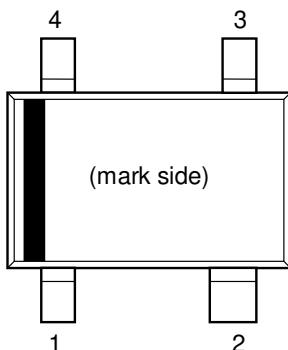
- (B) "H" Active
- (C) without CE pin

## PIN CONFIGURATION

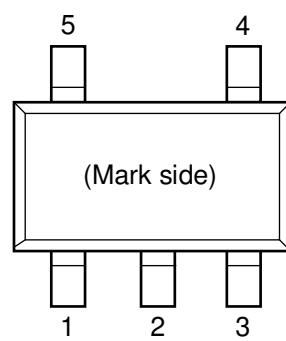
### • SON1612-6



### • 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	
$T_{opt}$	Operating Temperature Range	−40 to 85	°C
$T_{stg}$	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

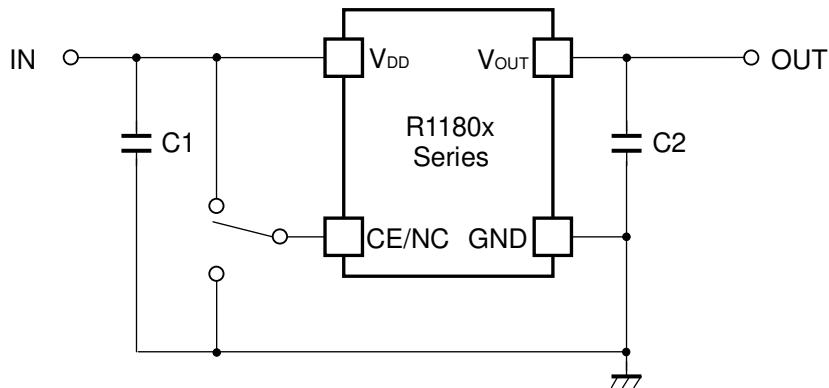
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =Set V <sub>OUT</sub> +1V 1μA ≤ I <sub>OUT</sub> ≤ 30mA	≥ 0.980		≤ 1.020	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V(V <sub>OUT</sub> ≥ 1.4V) V <sub>IN</sub> =2.4V(V <sub>OUT</sub>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

### • ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

Output Voltage V <sub>OUT</sub> (V)	Dropout Voltage V <sub>DIF</sub> (V)		
	Condition	Typ.	Max.
1.2 ≤ V <sub>OUT</sub> < 1.3	I <sub>OUT</sub> =150mA	0.85	1.20
1.3 ≤ V <sub>OUT</sub> < 1.4		0.75	1.10
1.4 ≤ V <sub>OUT</sub> < 1.5		0.65	1.00
1.5 ≤ V <sub>OUT</sub> < 1.7		0.60	0.90
1.7 ≤ V <sub>OUT</sub> < 1.9		0.50	0.75
1.9 ≤ V <sub>OUT</sub> < 2.1		0.40	0.65
2.1 ≤ V <sub>OUT</sub> < 2.8		0.35	0.55
2.8 ≤ V <sub>OUT</sub> ≤ 3.6		0.25	0.40

## TYPICAL APPLICATION



(External Components)

Output Capacitor

Ceramic Capacitor 0.1 $\mu$ F

## 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<sub>DD</sub> 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 0.1 $\mu$ F or more between V<sub>DD</sub> 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:

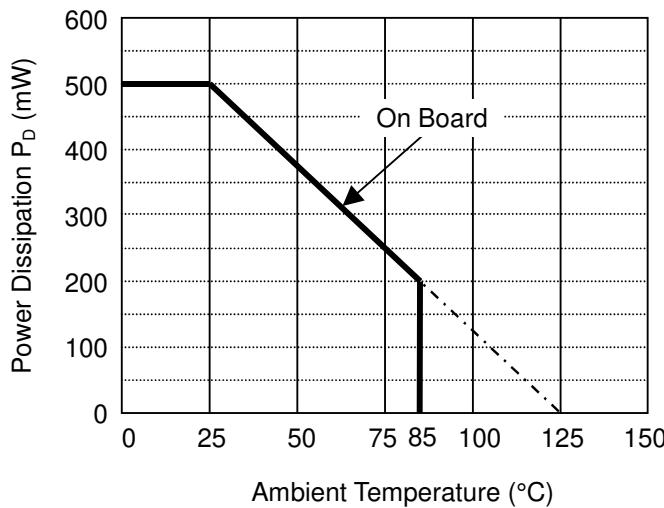
\* Measurement Conditions

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

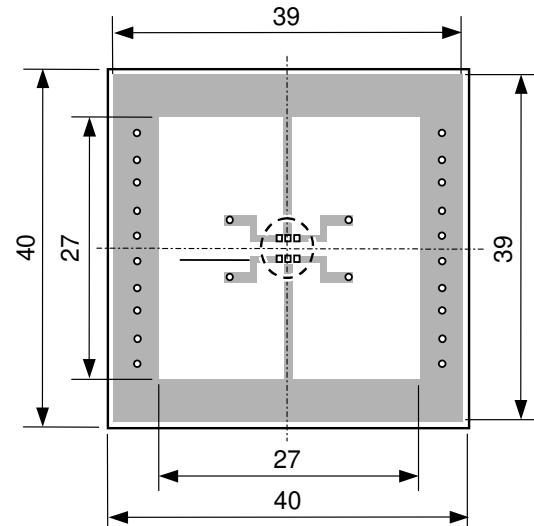
\* Measurement Results

( $T_a=25^{\circ}\text{C}$ ,  $T_{j\max}=125^{\circ}\text{C}$ )

Standard Land Pattern	
Power Dissipation	500mW
Thermal Resistance	$\theta_{ja} = (125-25^{\circ}\text{C}) / 0.5\text{W} = 200^{\circ}\text{C/W}$



Power Dissipation

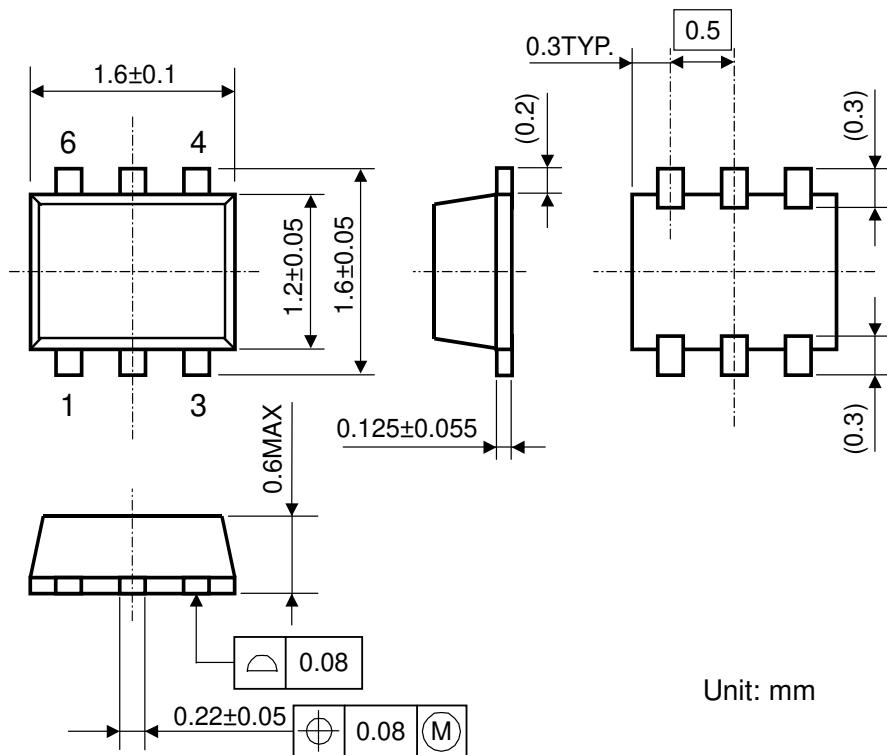


Measurement Board Pattern



IC Mount Area (Unit: mm)

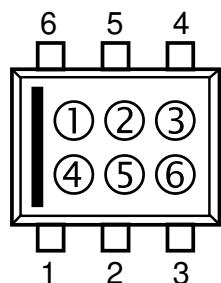
## PACKAGE DIMENSIONS (SON1612-6)



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

**R1180Dxx1C Series**

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

## POWER DISSIPATION (SC-82AB)

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

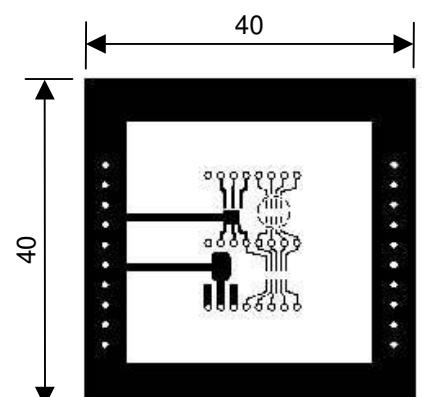
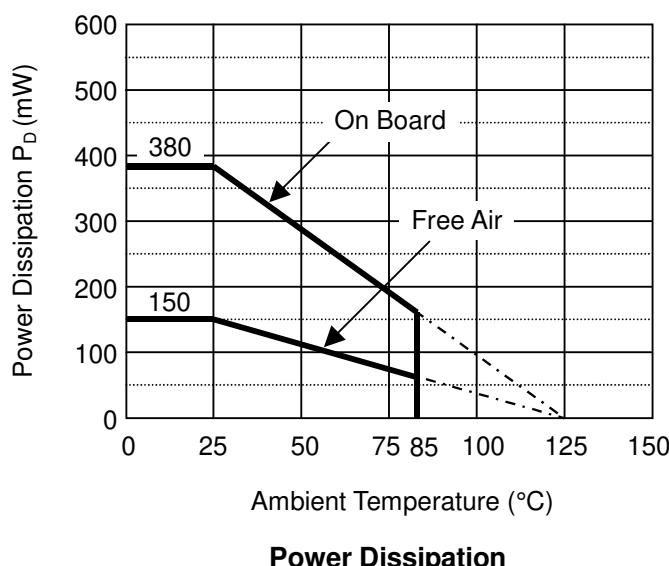
### Measurement Conditions

	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

( $T_a=25^{\circ}\text{C}$ ,  $T_{j\max}=125^{\circ}\text{C}$ )

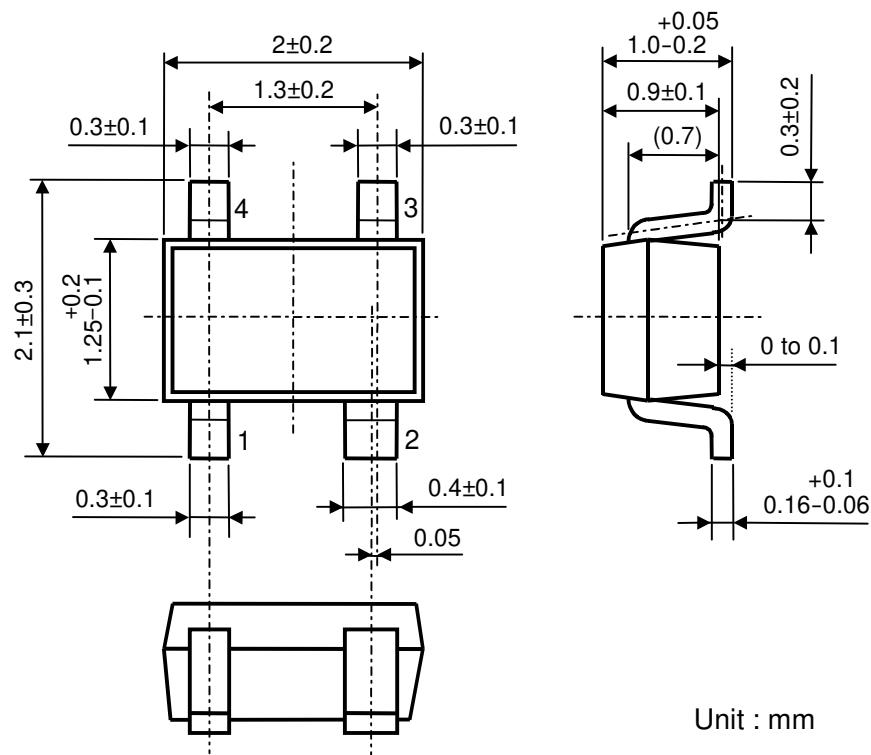
	Standard Land Pattern	Free Air
Power Dissipation	380mW	150mW
Thermal Resistance	$\theta_{ja} = (125-25^{\circ}\text{C})/0.38\text{W} = 263^{\circ}\text{C/W}$	667°C/W



Measurement Board Pattern

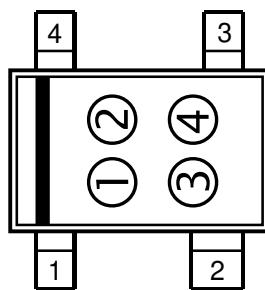
○ IC Mount Area (Unit : mm)

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

**R1180Qxx1C Series**

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

## 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.)

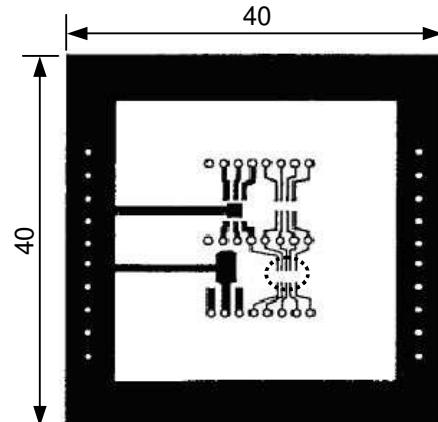
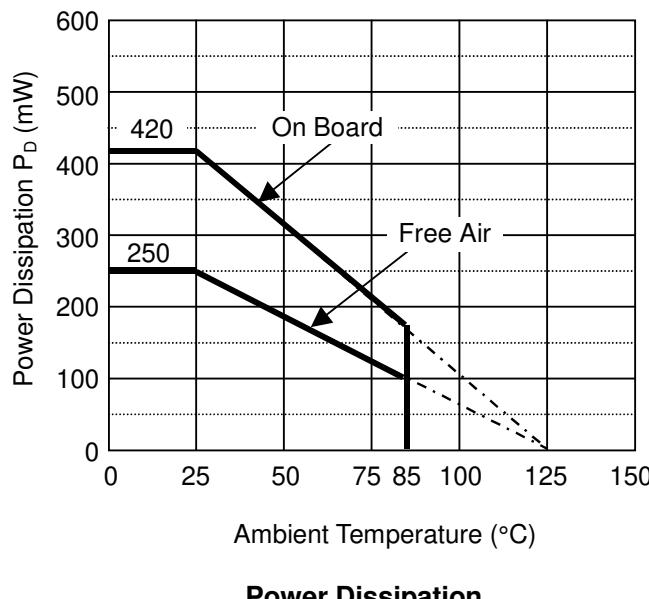
\* Measurement Conditions

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:

( $T_a=25^{\circ}\text{C}$ ,  $T_{j\max}=125^{\circ}\text{C}$ )

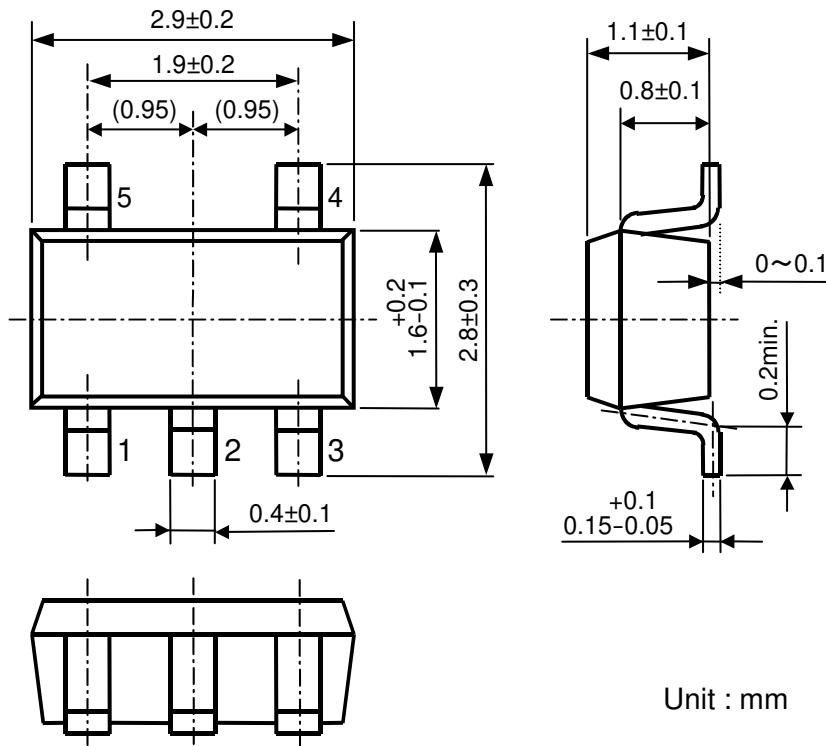
	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	$\theta_{ja} = (125-25^{\circ}\text{C})/0.42\text{W} = 238^{\circ}\text{C/W}$	400°C/W



Measurement Board Pattern

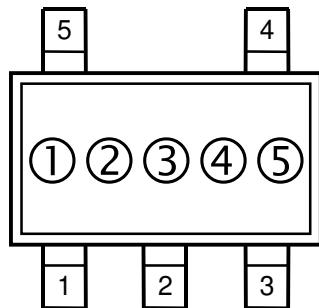
IC Mount Area (Unit: mm)

## PACKAGE DIMENSIONS (SOT-23-5)



## 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)

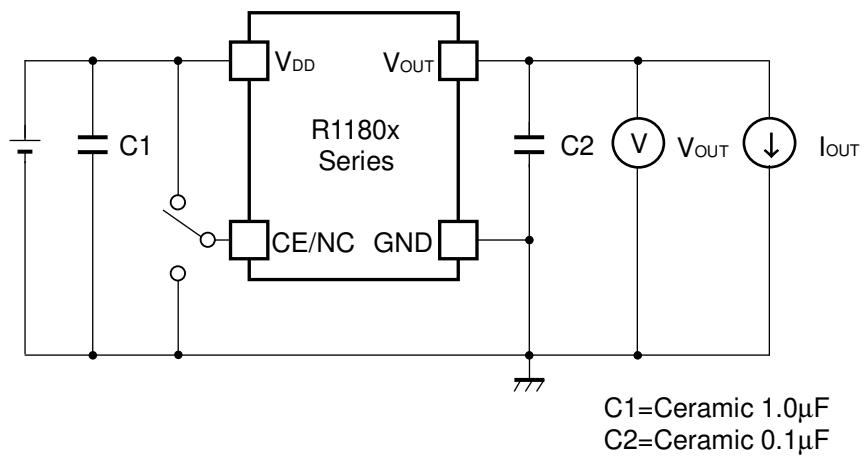
## R1180Nxx1B Series

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

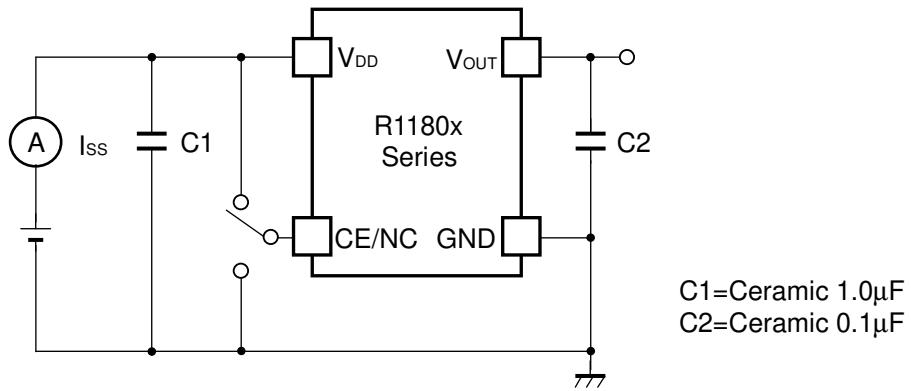
## R1180Nxx1C Series

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

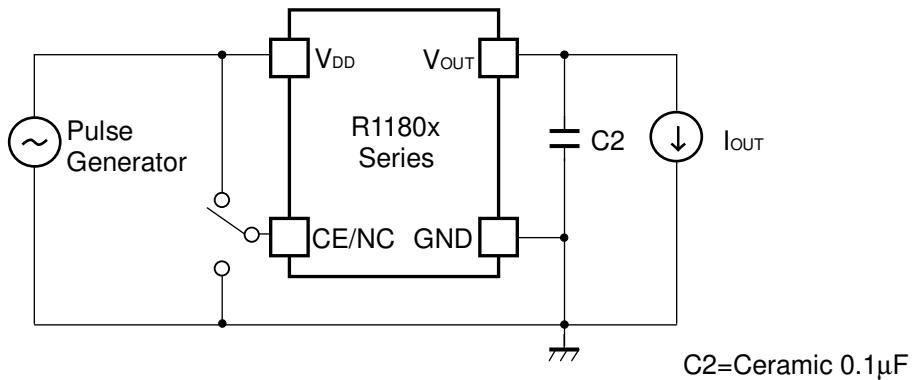
## TEST CIRCUITS



Standard test Circuit



Supply Current Test Circuit

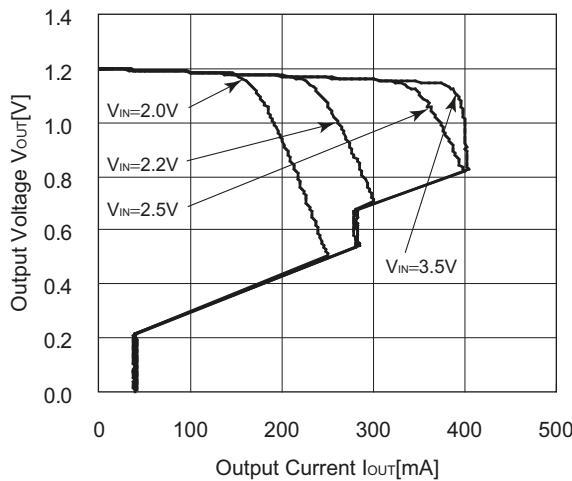


Ripple Rejection, Line Transient Response Test Circuit

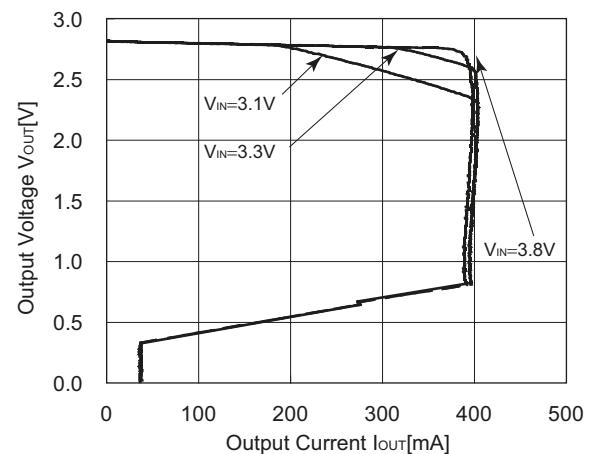
## TYPICAL CHARACTERISTICS

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

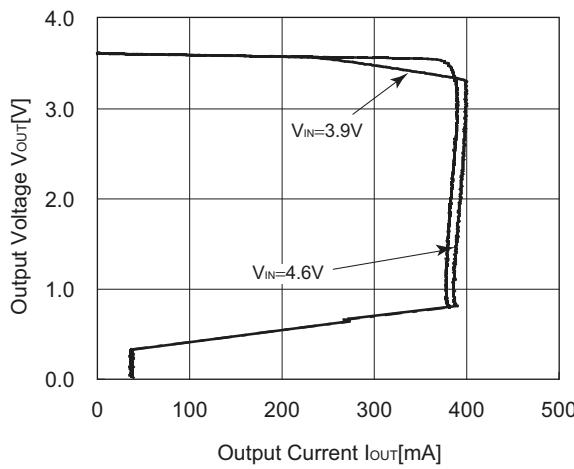
R1180x121x



R1180x281x

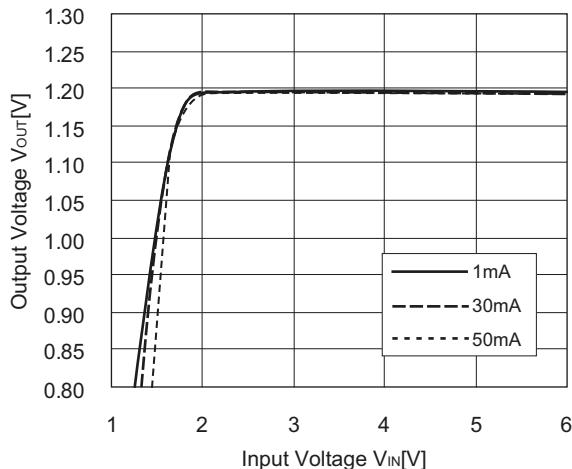


R1180x361x

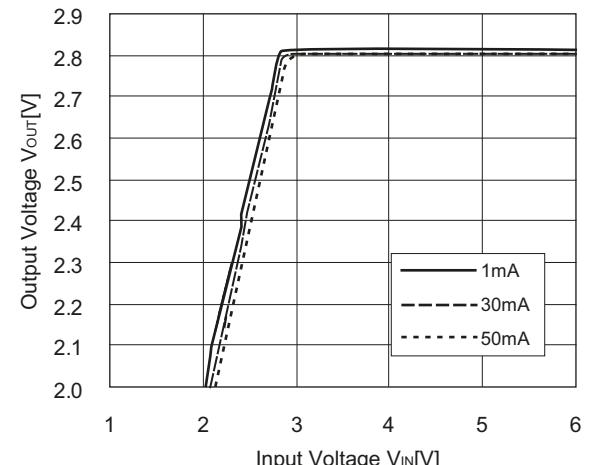


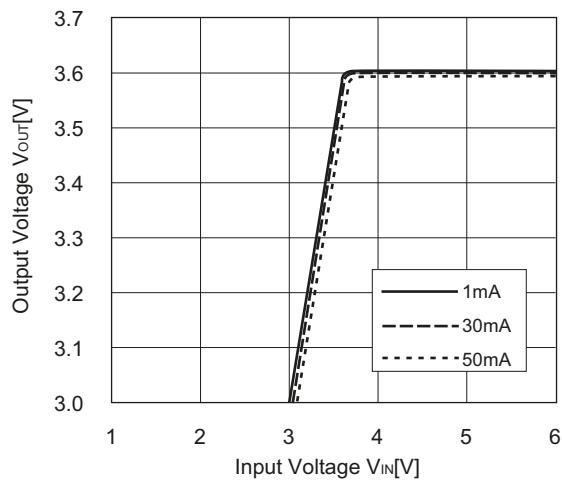
### 2) Output Voltage vs. Input Voltage (Topt=25°C)

R1180x121x

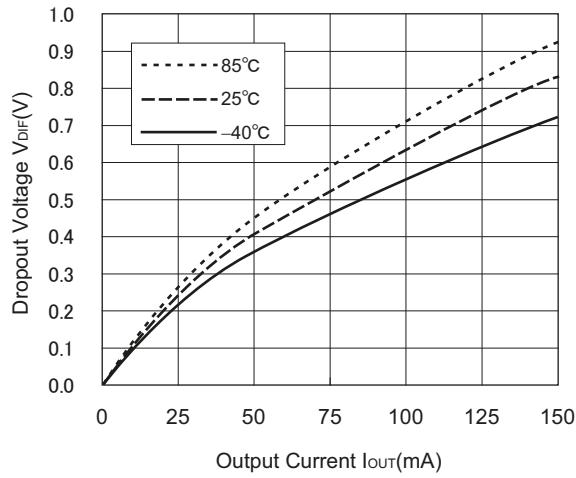
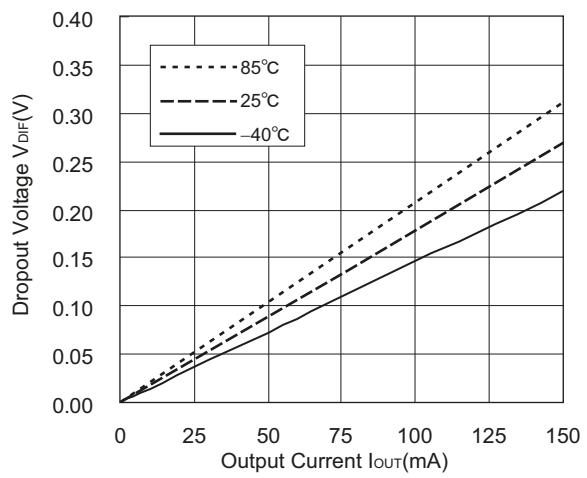
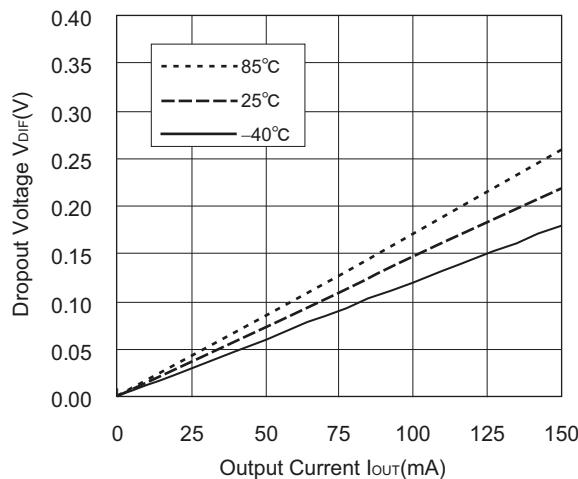


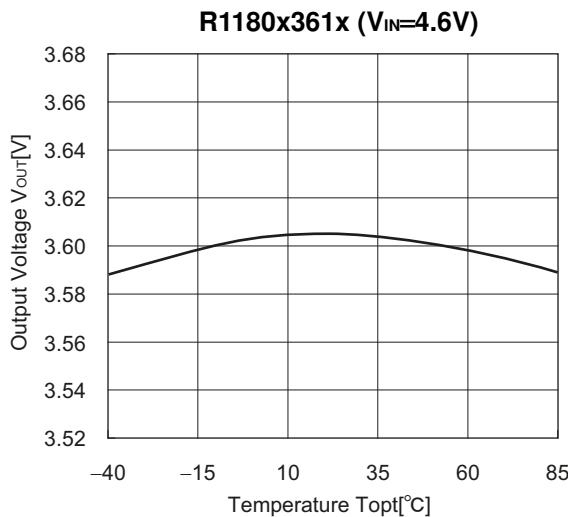
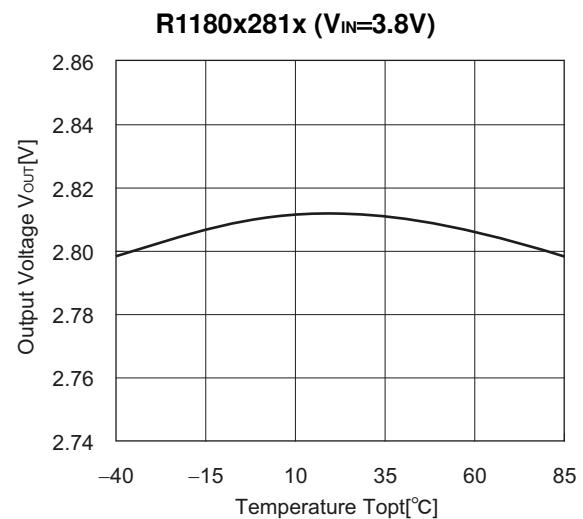
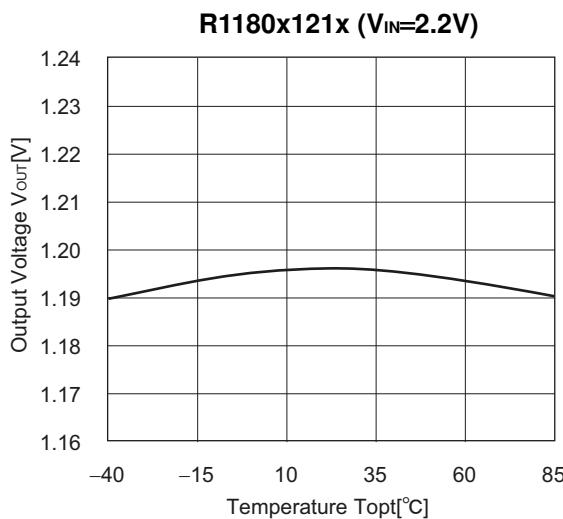
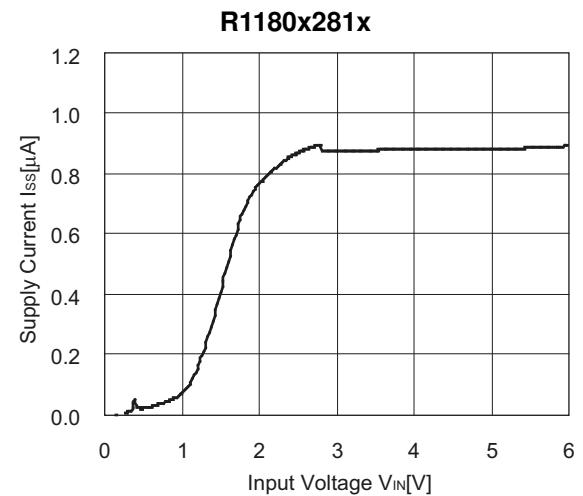
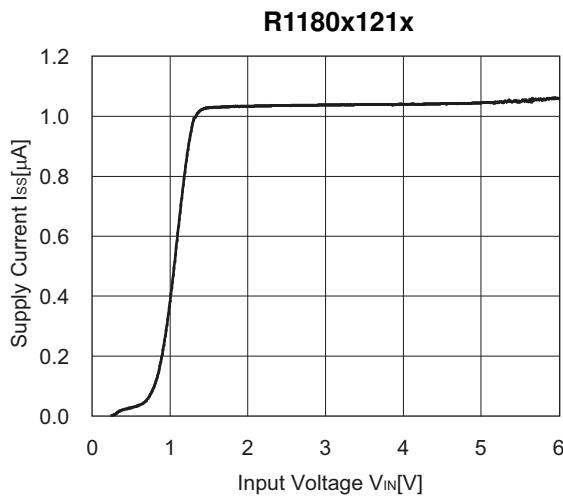
R1180x281x

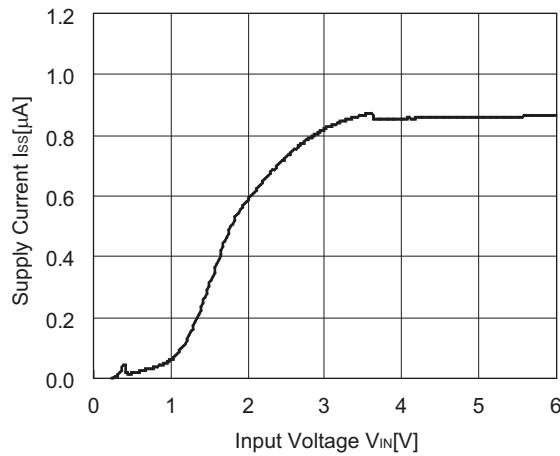


**R1180x361x**

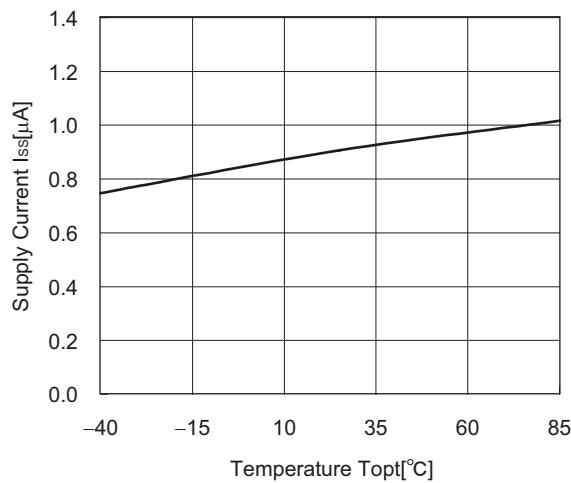
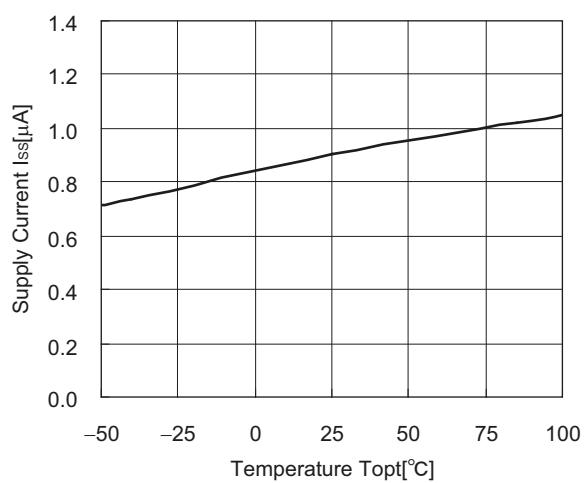
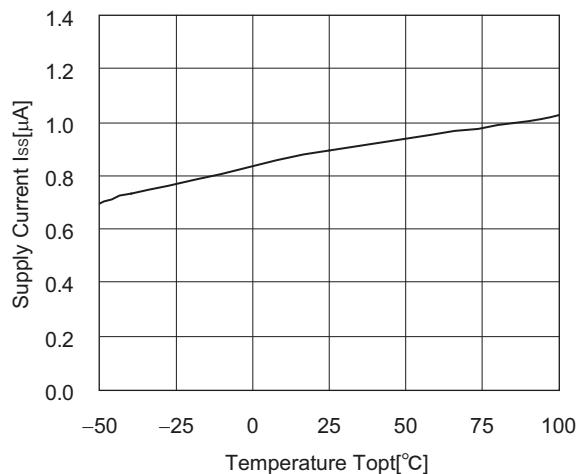
## 3) Dropout Voltage vs. Output Current

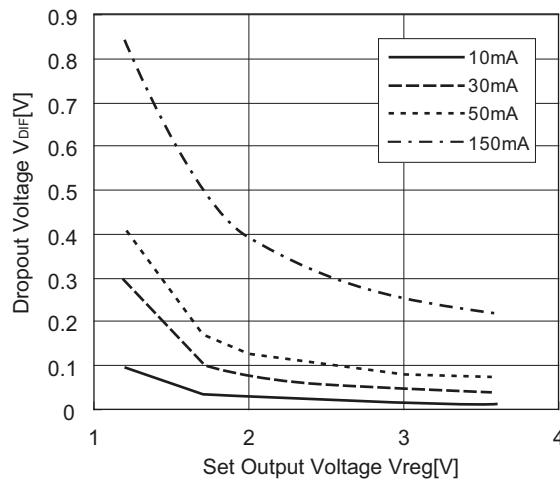
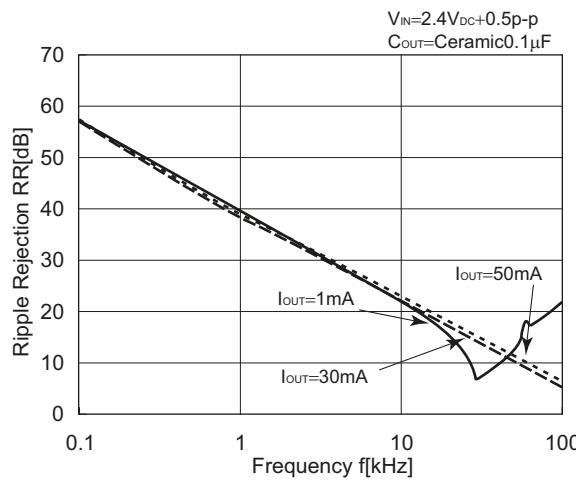
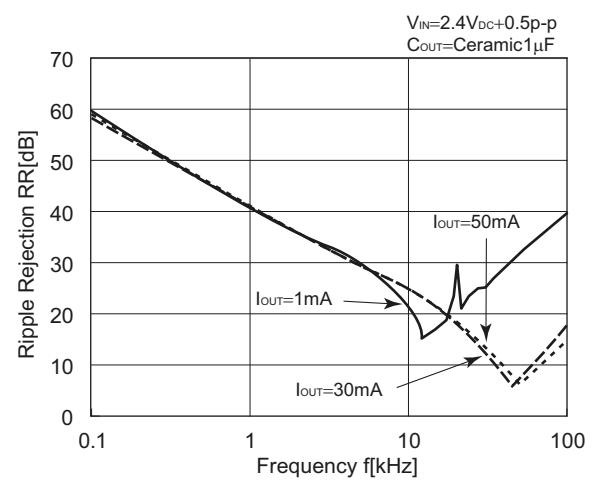
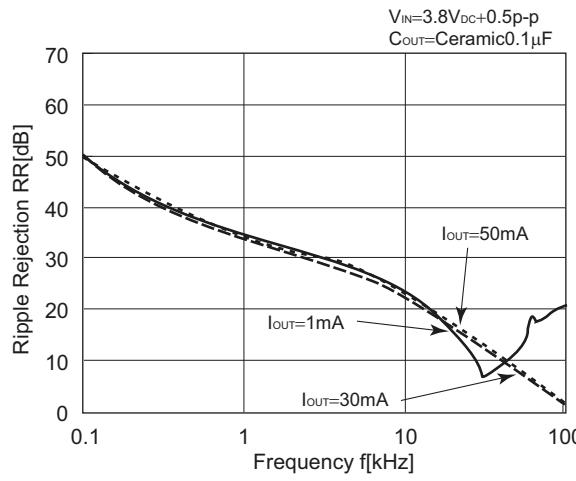
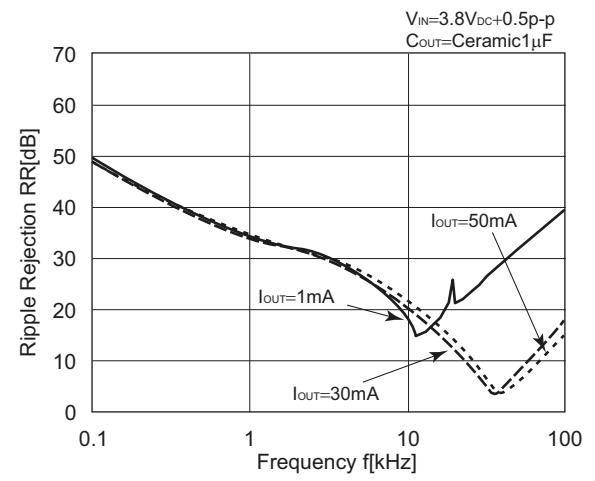
**R1180x121x****R1180x281x****R1180x361x**

4) Output Voltage vs. Temperature ( $I_{OUT}=30mA$ )5) Supply Current vs. Input Voltage ( $T_{opt}=25^{\circ}C$ )

**R1180x361x**

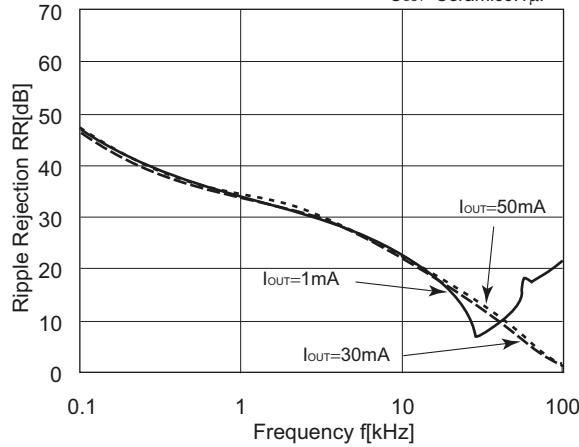
## 6) Supply Current vs. Temperature

**R1180x121x( $V_{IN}=2.2V$ )****R1180x281x( $V_{IN}=3.8V$ )****R1180x361x( $V_{IN}=4.6V$ )**

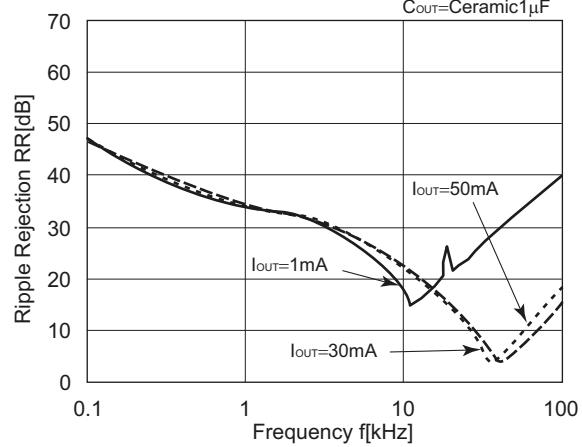
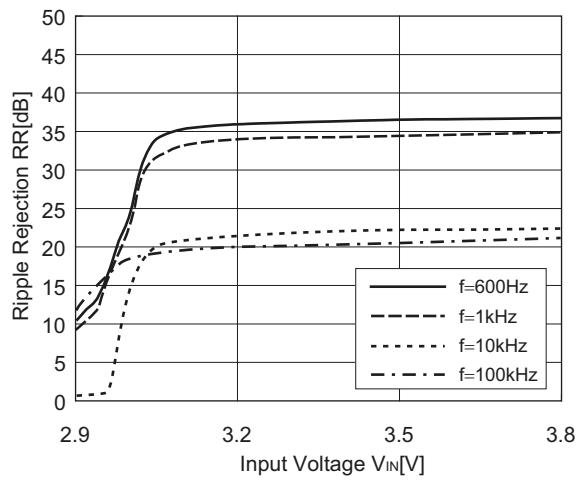
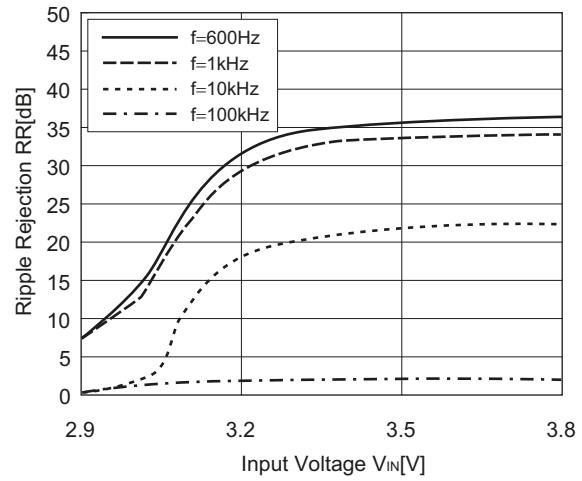
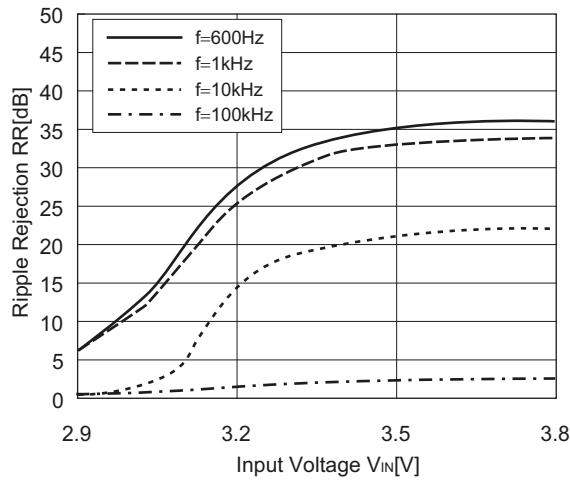
7) Dropout Voltage vs. Set Output Voltage ( $T_{opt}=25^{\circ}\text{C}$ )8) Ripple Rejection vs. Frequency ( $C_{in}=none$ )**R1180x121x****R1180x121x****R1180x281x****R1180x281x**

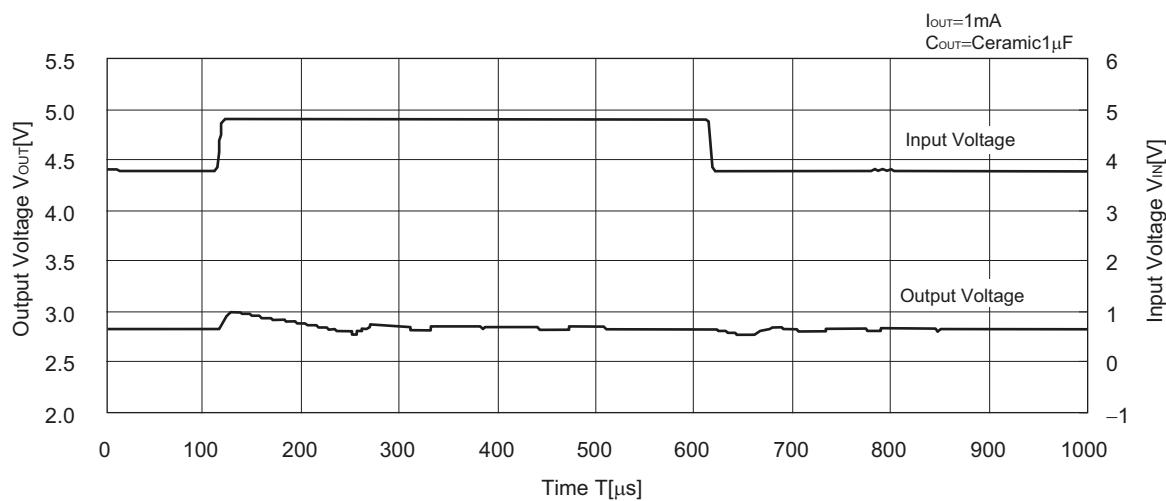
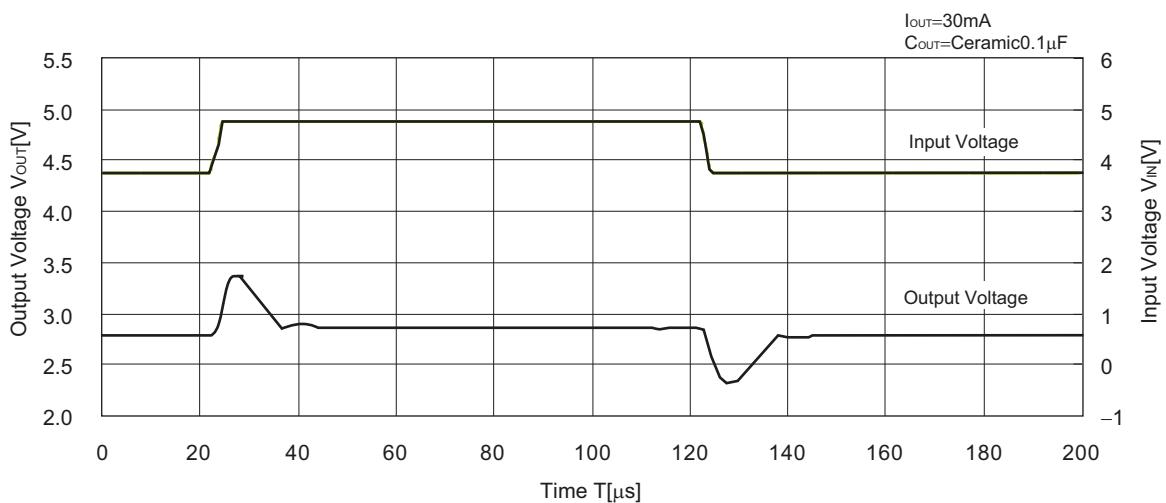
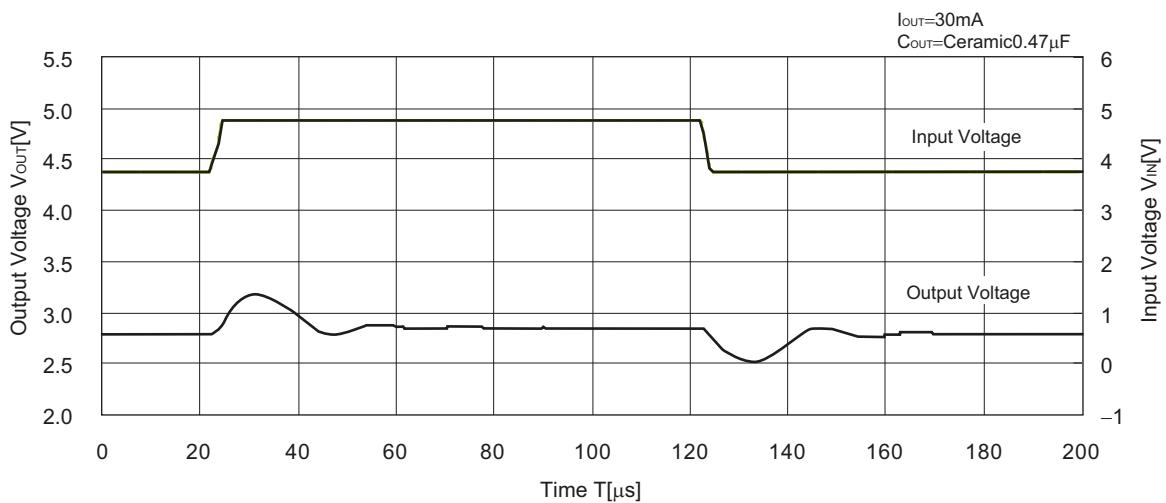
**R1180x361x**

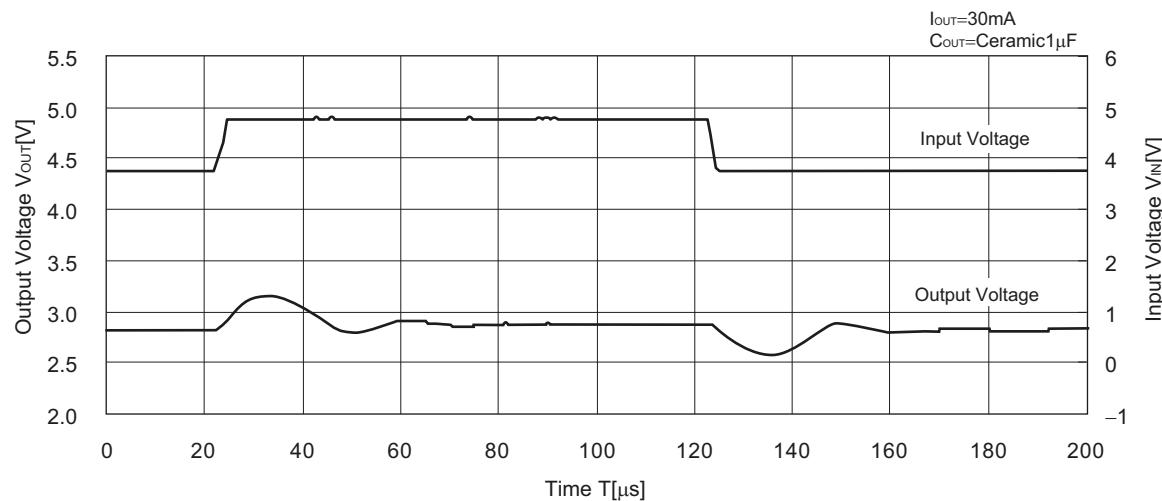
$V_{IN}=4.6V_{DC}+0.5p-p$   
 $C_{OUT}=\text{Ceramic}0.1\mu F$

**R1180x361x**

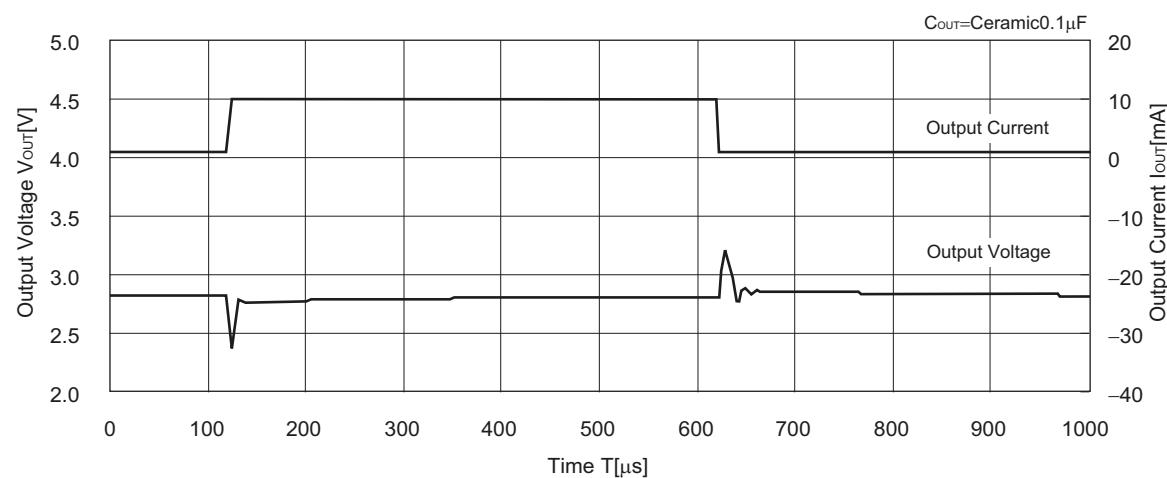
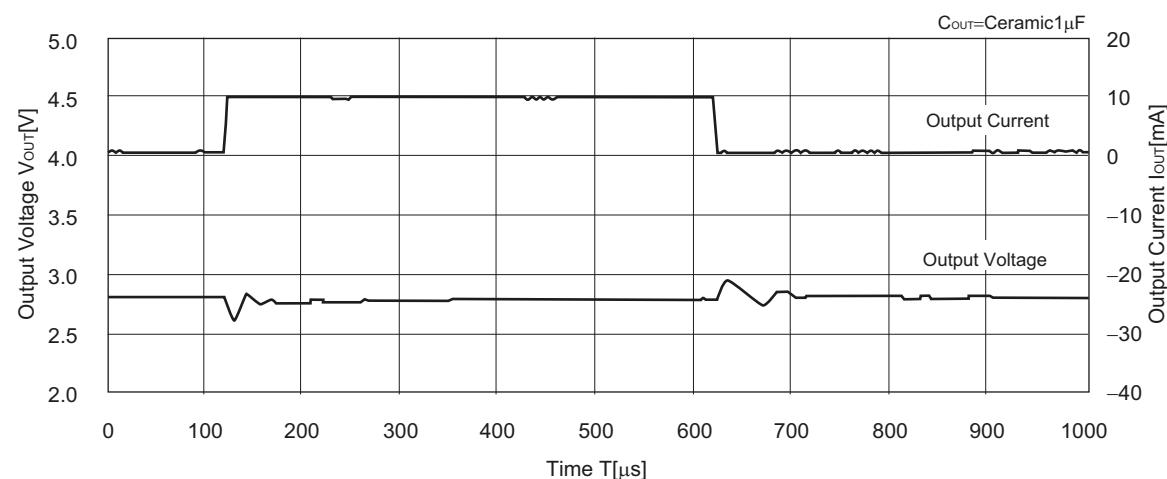
$V_{IN}=4.6V_{DC}+0.5p-p$   
 $C_{OUT}=\text{Ceramic}1\mu F$

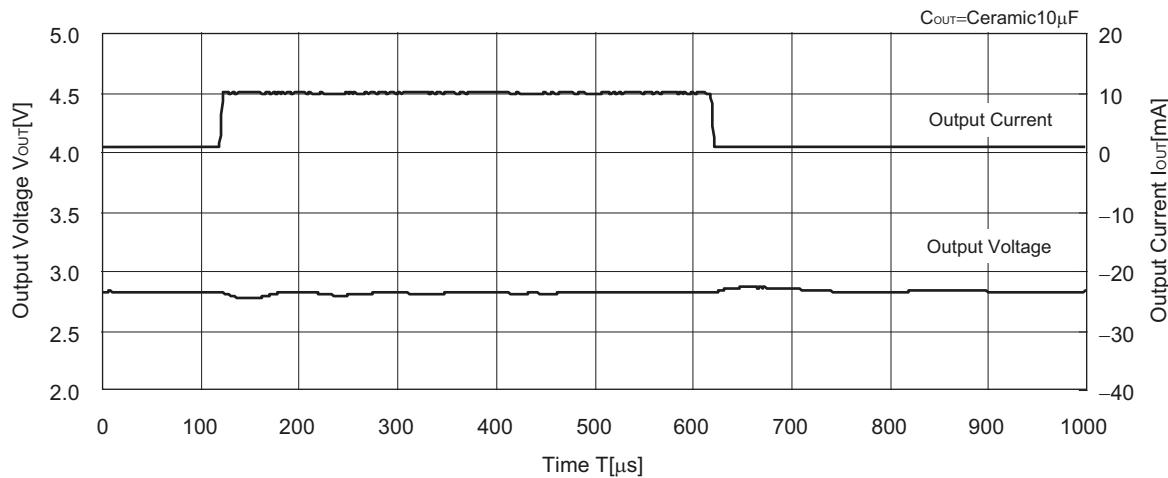
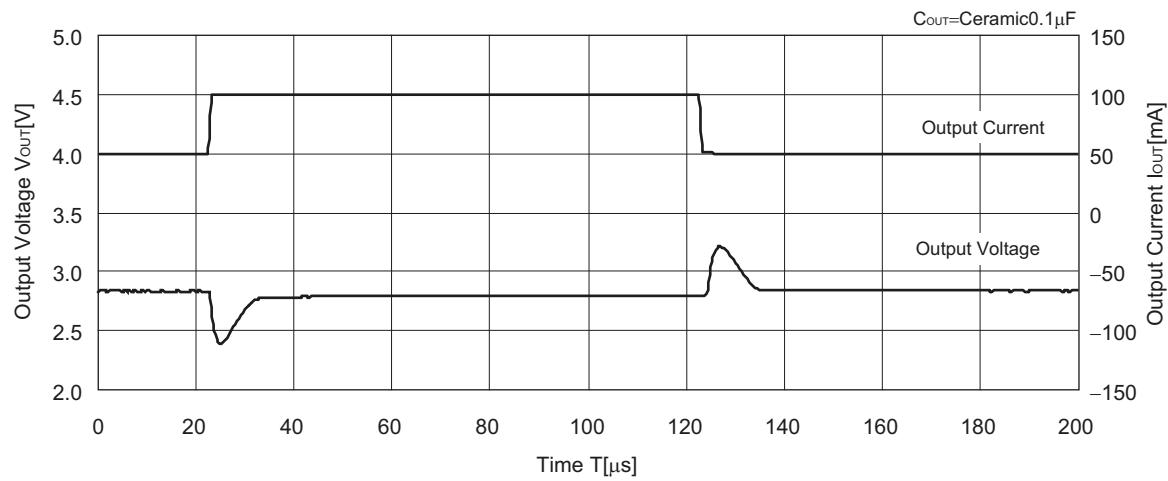
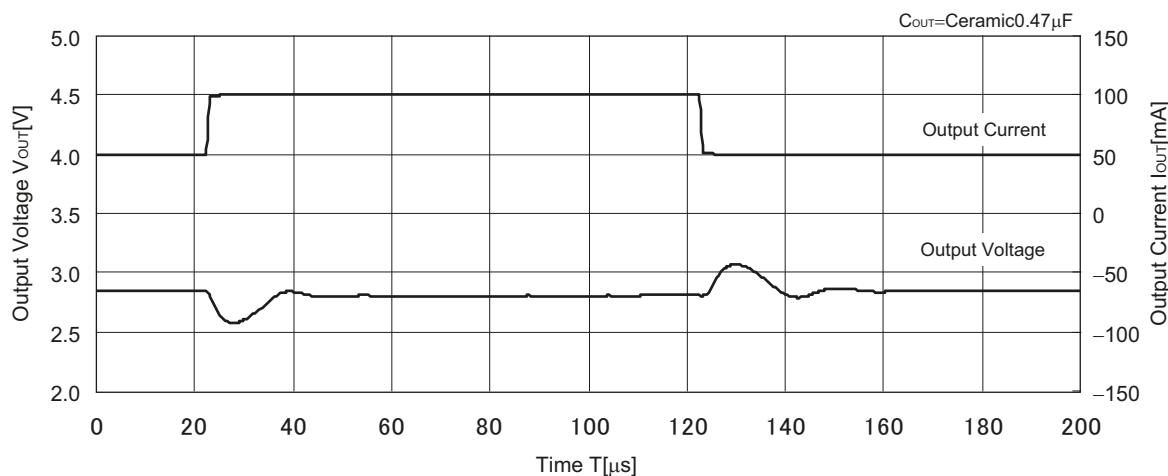
9) Ripple Rejection vs. Input Bias Voltage (Topt=25°C,  $C_{IN}=\text{none}$ ,  $C_{OUT}=\text{Ceramic}0.1\mu F$ )**R1180x281x( $I_{OUT}=1mA$ )****R1180x281x( $I_{OUT}=30mA$ )****R1180x281x( $I_{OUT}=50mA$ )**

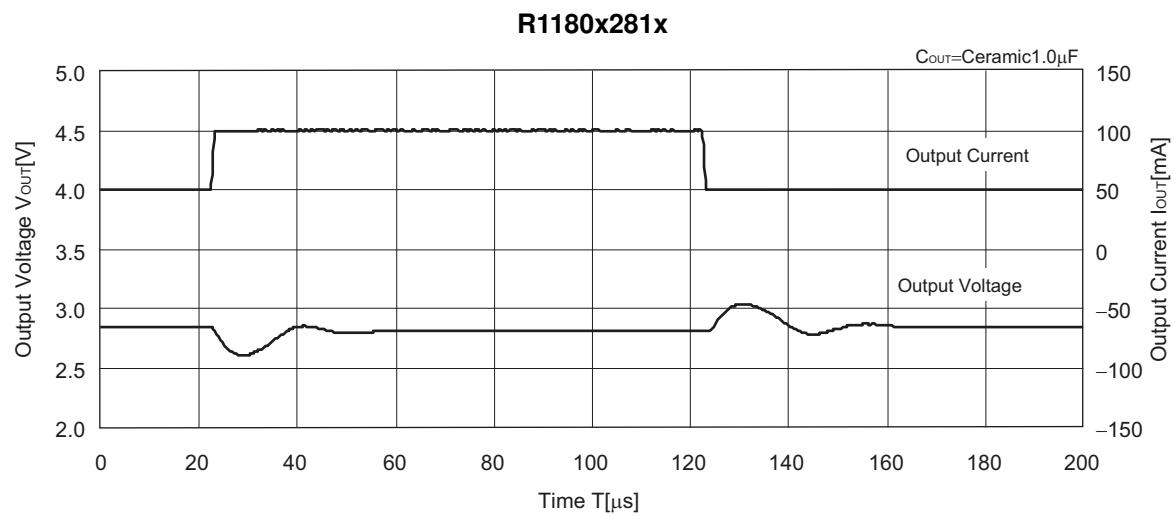
10) Input Transient Response ( $C_{IN}$ =none,  $tr=tf=5\mu s$ )**R1180x281x****R1180x281x****R1180x281x**

**R1180x281x**

11) Load Transient Response ( $tr=tf=0.5\mu s$   $V_{IN}=3.8V$ )

**R1180x281x****R1180x281x**

**R1180x281x****R1180x281x****R1180x281x**

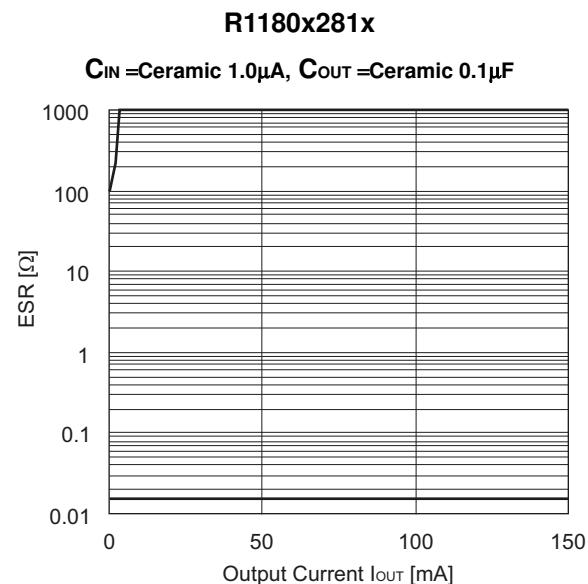
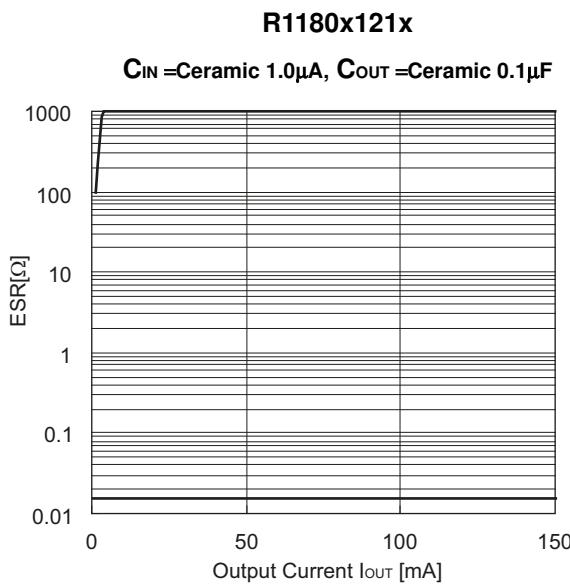


## ESR vs. Output Current

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  $40\mu\text{V}$  (Avg.) are marked as the hatched area in the graph.

<Measurement conditions>

- (1)  $V_{IN}=V_{OUT}+1\text{V}$
- (2) Frequency Band: 10Hz to 2MHz (BW=30Hz)
- (3) Temperature:  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$



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  - 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.

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