RICOH

R1180x-Y Series

150 mA LDO Regulator for Industrial Applications

NO.EA-340-210820

OUTLINE

The R1180x is a CMOS-based voltage regulator IC with high output voltage accuracy, extremely low supply current, and low ON-resistance. This IC 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 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.

The R1180x is available in SOT-23-5 and SON1612-6 package which is possible to mount at high density.

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

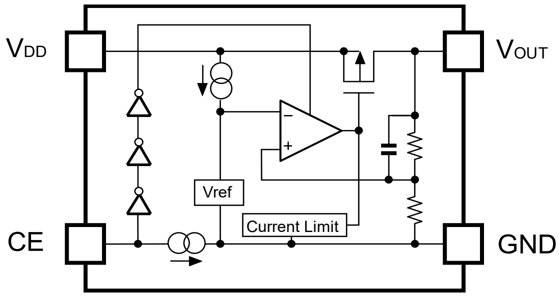
- Input Voltage (Maximum Rating)............................. 1.7V to 6.0V (6.5V)
- Operating Temperature Range .... −50°C to 105°C
- Supply Current .... Typ. 1.0μA
  (Except the current through CE pull-down circuit)
- Standby Mode .... Typ. 0.1μA
- Dropout Voltage .... Typ. 0.25V (I_{OUT}=150mA 3.0V Output type)
- Temperature-Drift Coefficient of Output Voltage ...... Typ. ±100ppm/°C
- Line Regulation .... Typ. 0.05%/V
- Output Voltage Accuracy.. ±2.0%
- Output Voltage Range... 1.2V, 1.5V, 1.8V, 1.85V, 2.0V, 2.3V, 2.5V, 2.8V, 3.0V, 3.3V, 3.4V
  Contact our sales representatives for other voltages.
- Package SOT-23-5, SON1612-6
- Built-in Fold Back Protection Circuit .... Typ. 40mA (Current at short mode)
- Recommended Ceramic Capacitor to IC ....0.1μF or more

APPLICATIONS

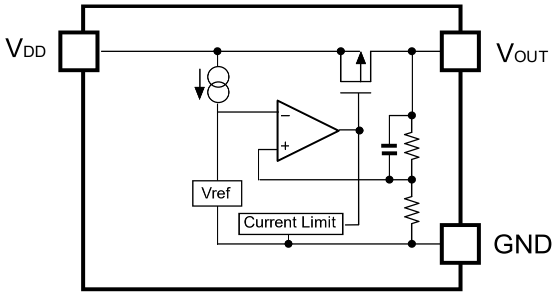
- Industrial equipments such as FAs and smart meters
- Equipments used under high-temperature conditions such as surveillance camera and vending machine
- Equipments accompanied by self-heating such as motor and lighting

BLOCK DIAGRAMS

R1180xxx1B



R1180xxx1C



SELECTION GUIDE

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

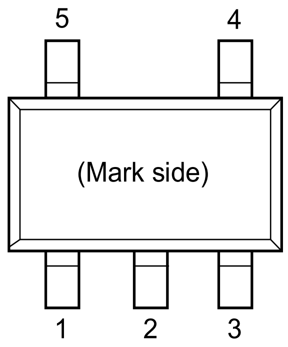
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1180Nxx1∗-TR-YE	SOT-23-5	3,000 pcs	Yes	Yes
R1180Dxx1∗-TR-YE	SON1612-6	4,000 pcs	Yes	Yes

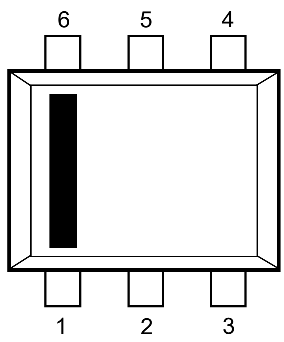
xx: The set output voltage (V_{SET}) can be designated by 1.2V (12), 1.5V (15), 1.8V (18), 1.85V (181∗5), 2.0V (20), 2.3V (23), 2.5V (25), 2.8V (28), 3.0V (30), 3.3V (33), and 3.4V (34).

* Contact our sales representatives for other voltages.

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

PIN DESCRIPTIONS





● **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

● **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

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*1	SOT-23-5	Standard Land Pattern	525	mW
		SON1612-6	Standard Land Pattern	625	
Tj	Junction Temperature		−50 to 150		°C
Tstg	Storage Temperature Range		−55 to 150		°C

*1 For Power Dissipation, please refer to *PACKAGE INFORMATION*.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage 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 rating is not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	1.7 to 6.0	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 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

$V_{IN}=V_{SET}+1.0V$, $C_{IN}=1.0\mu F$, $C_{OUT}=0.1\mu F$, unless otherwise noted.
The specifications surrounded by [ ] are guaranteed by design engineering at −50°C ≤ Ta ≤ 105°C.

- **R1180xxx1B/C** (Ta=25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	1μA≤I_{OUT}≤30mA	Ta=25°C	×0.980		×1.020	V
			−50°C≤Ta≤105°C	[×0.965]		[×1.035]	
I_{OUT}	Output Current	$V_{IN}=V_{SET}+1.0V$(V_{SET}≥1.5V) V_{IN}=2.4V(V_{SET}<1.5V)		[150]			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}=V_{SET}+1.0V$(V_{SET}≥1.5V) V_{IN}=2.4V(V_{SET}<1.5V) 1μA≤I_{OUT}≤150mA			20	[50]	mV
V_{DIF}	Dropout Voltage	I_{OUT}=150mA		Refer to the *Product-specific Electrical Characteristics*			
I_{SS}	Supply Current	I_{OUT}=0mA			1.0	[1.85]	μA
Istandby	Supply Current (Standby)	V_{CE}=GND			0.1	[1.0]	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=30mA V_{SET}+0.5V≤V_{IN}≤6.0V (V_{SET}≥1.5V) 2.0V≤V_{IN}≤6.0V (1.2V≤V_{SET}≤1.4V)			0.05	[0.20]	%/V
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	V
V_{CEL}	CE Input Voltage "L"	(R1180xxx1B)		0		[0.3]	V

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

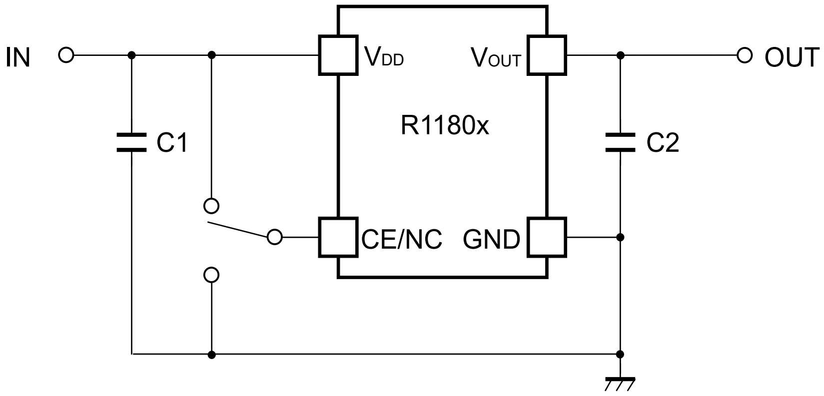
Product-specific Electrical Characteristics

The specifications surrounded by [ ] are guaranteed by design engineering at −50°C ≤ Ta ≤ 105°C.

(Ta = 25°C)

Product Name	V_{OUT} [V]					V_{DIF} [V]	
	(Ta = 25°C)			(−50°C ≤ Ta ≤ 105°C)			
	MIN.	TYP.	MAX.	MIN.	MAX.	TYP.	MAX.
R1180x121x	1.176	1.200	1.224	1.158	1.242	0.85	1.20
R1180x151x	1.470	1.500	1.530	1.448	1.553	0.60	0.90
R1180x181x	1.764	1.800	1.836	1.737	1.863	0.50	0.75
R1180x181x5	1.813	1.850	1.887	1.786	1.914	0.50	0.75
R1180x201x	1.960	2.000	2.040	1.930	2.070	0.40	0.65
R1180x231x	2.254	2.300	2.346	2.220	2.380	0.35	0.55
R1180x251x	2.450	2.500	2.550	2.413	2.588		
R1180x281x	2.744	2.800	2.856	2.702	2.898	0.25	0.40
R1180x301x	2.940	3.000	3.060	2.895	3.105		
R1180x331x	3.234	3.300	3.366	3.185	3.416		
R1180x341x	3.332	3.400	3.468	3.281	3.519		

TYPICAL APPLICATION



External Parts Example:

C1	1.0µF (Ceramic)
C2	0.1µF (Ceramic)

TECHNICAL NOTES

When using these ICs, consider the following points:

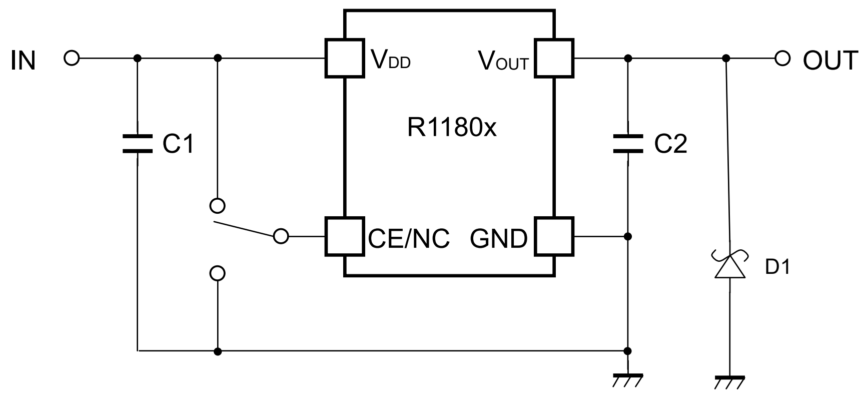
Phase Compensation

In this device, 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 this device with as same external components as ones to be used on the PCB.)

PCB Layout

Ensure the V_{DD} and GND lines are sufficiently robust. If their impedance is too high, noise pickup or unstable operation may result. Connect a 1.0µF input capacitor (C1) between the V_{DD} and GND pins, and as close as possible to the pins. Connect C2 as close as possible to the IC to make the wiring as short as possible. Please refer to the Basic Circuit Diagram as above.

TYPICAL APPLICATION FOR IC CHIP BREAKDOWN PREVENTION



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)

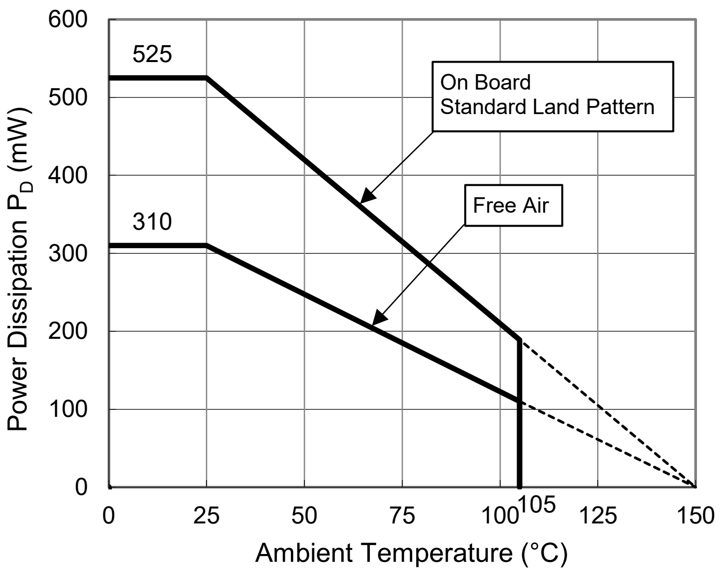
The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

Measurement Conditions

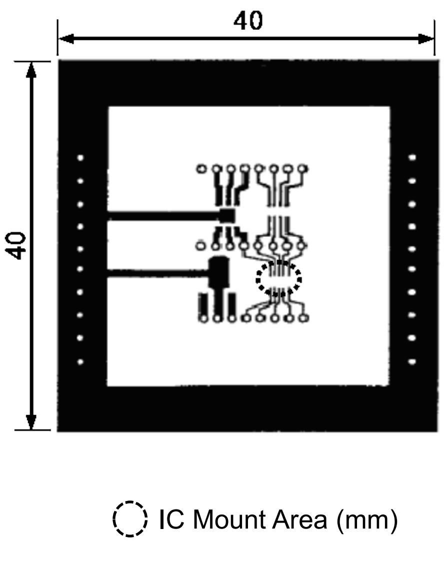
	Standard Test Land Pattern
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-Sided Board)
Board Dimensions	40 mm × 40 mm × 1.6 mm
Copper Ratio	Top Side: Approx. 50% Bottom Side: Approx. 50%
Through-holes	ϕ 0.5 mm × 44 pcs

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

	Standard Test Land Pattern	Free Air
Power Dissipation	525 mW	310 mW
Thermal Resistance	θja = (150 − 25°C) / 0.525 W = 238°C/W	400°C/W

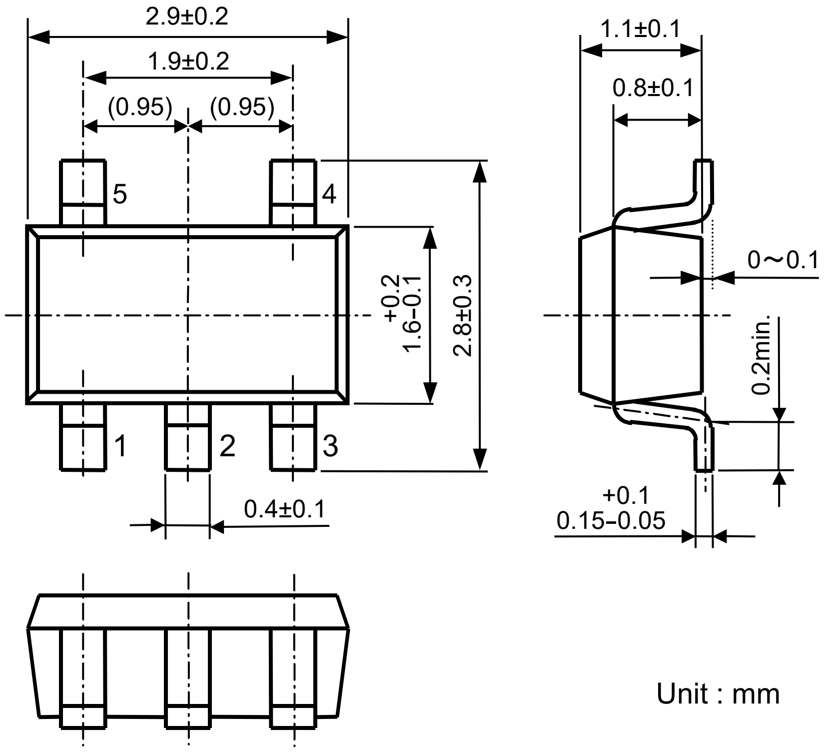


Power Dissipation vs. Ambient Temperature



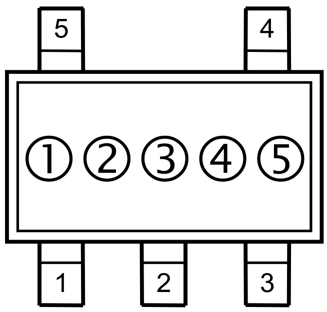
Measurement Board Pattern

PACKAGE DIMENSIONS (SOT-23-5)



MARK SPECIFICATION (SOT-23-5)

①②③: Product Code ··· Refer to *R1180N MARK SPECIFICATION TABLE*
④⑤: Lot Number ··· Alphanumeric Serial Number



R1180N MARK SPECIFICATION TABLE (SOT-23-5)

Product Name	① ② ③	V_{SET}
R1180N121B	C 1 2	1.2 V
R1180N151B	C 1 5	1.5 V
R1180N181B	C 1 8	1.8 V
R1180N181B5	C 3 7	1.85 V
R1180N201B	C 2 0	2.0 V
R1180N231B	C 2 3	2.3 V
R1180N251B	C 2 5	2.5 V
R1180N281B	C 2 8	2.8 V
R1180N301B	C 3 0	3.0 V
R1180N331B	C 3 3	3.3 V
R1180N341B	C 3 4	3.4 V

Product Name	① ② ③	V_{SET}
R1180N121C	D 1 2	1.2 V
R1180N151C	D 1 5	1.5 V
R1180N181C	D 1 8	1.8 V
R1180N181C5	D 3 7	1.85V
R1180N201C	D 2 0	2.0 V
R1180N231C	D 2 3	2.3 V
R1180N251C	D 2 5	2.5 V
R1180N281C	D 2 8	2.8 V
R1180N301C	D 3 0	3.0 V
R1180N331C	D 3 3	3.3 V
R1180N341C	D 3 4	3.4 V

POWER DISSIPATION (SON1612-6)

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

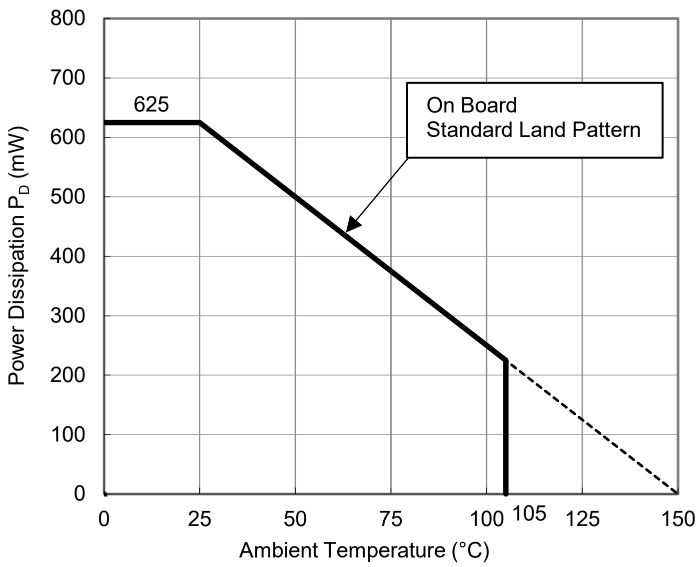
Measurement Conditions

	Standard Test Land Pattern
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-Sided Board)
Board Dimensions	40 mm × 40 mm × 1.6 mm
Copper Ratio	Top Side: Approx. 50% Bottom Side: Approx. 50%
Through-holes	ϕ 0.5 mm × 24 pcs

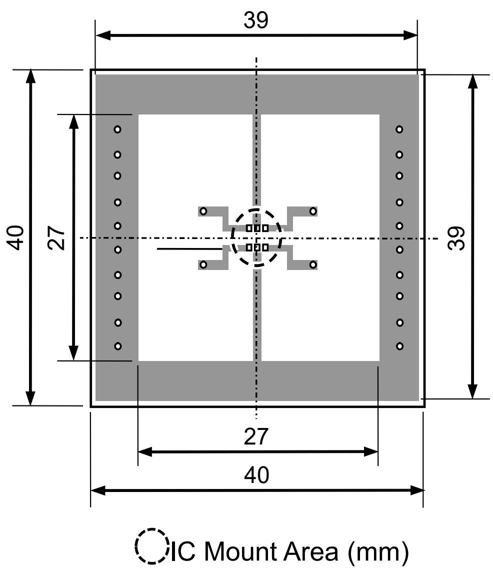
Measurement Result

(Ta = 25°C, Tjmax = 150°C)

	Standard Test Land Pattern
Power Dissipation	625 mW
Thermal Resistance	θja = (150 − 25°C) / 0.625 W = 200°C/W

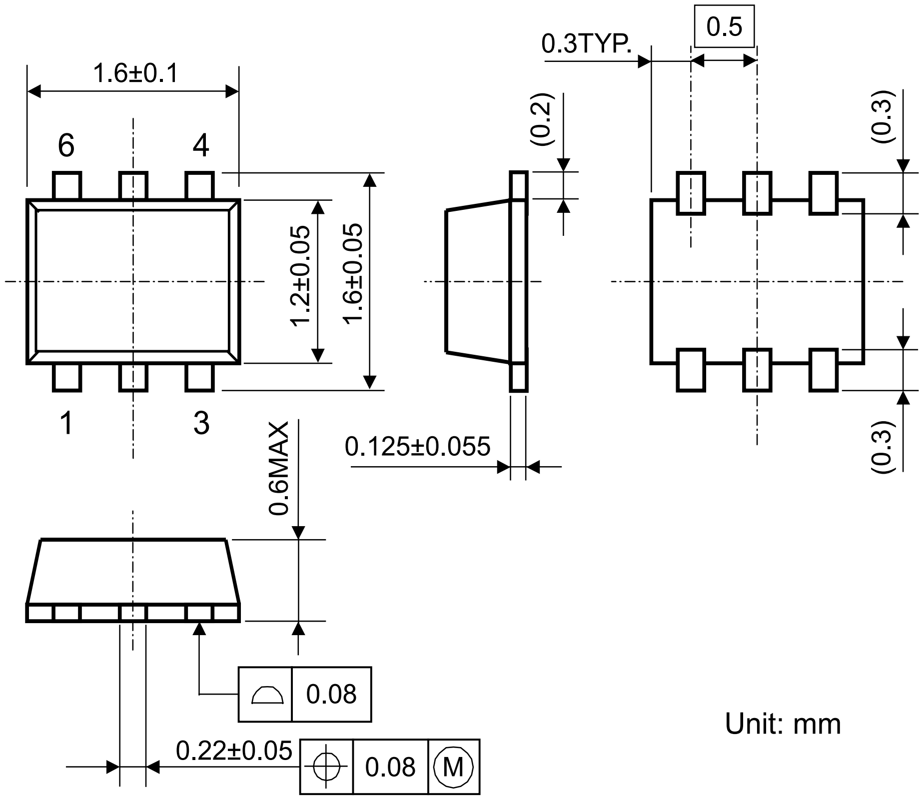


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

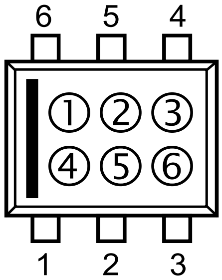
PACKAGE DIMENSIONS (SON1612-6)



Unit: mm

MARK SPECIFICATION (SON1612-6)

①②③④: Product Code ··· Refer to *R1180D MARK SPECIFICATION TABLE*
⑤⑥: Lot Number ··· Alphanumeric Serial Number



R1180D MARK SPECIFICATION TABLE (SON1612-6)

Product Name	① ② ③ ④	V_{SET}
R1180D121B	G 1 2 B	1.2 V
R1180D151B	G 1 5 B	1.5 V
R1180D181B	G 1 8 B	1.8 V
R1180D181B5	G 0 0 B	1.85 V
R1180D201B	G 2 0 B	2.0 V
R1180D231B	G 2 3 B	2.3 V
R1180D251B	G 2 5 B	2.5 V
R1180D281B	G 2 8 B	2.8 V
R1180D301B	G 3 0 B	3.0 V
R1180D331B	G 3 3 B	3.3 V
R1180D341B	G 3 4 B	3.4 V

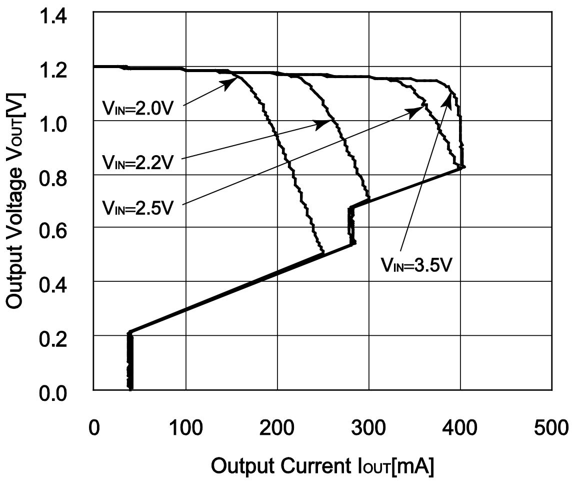
Product Name	① ② ③ ④	V_{SET}
R1180D121C	G 1 2 C	1.2 V
R1180D151C	G 1 5 C	1.5 V
R1180D181C	G 1 8 C	1.8 V
R1180D181C5	G 0 0 C	1.85 V
R1180D201C	G 2 0 C	2.0 V
R1180D231C	G 2 3 C	2.3 V
R1180D251C	G 2 5 C	2.5 V
R1180D281C	G 2 8 C	2.8 V
R1180D301C	G 3 0 C	3.0 V
R1180D331C	G 3 3 C	3.3 V
R1180D341C	G 3 4 C	3.4 V

TYPICAL CHARACTERISTICS

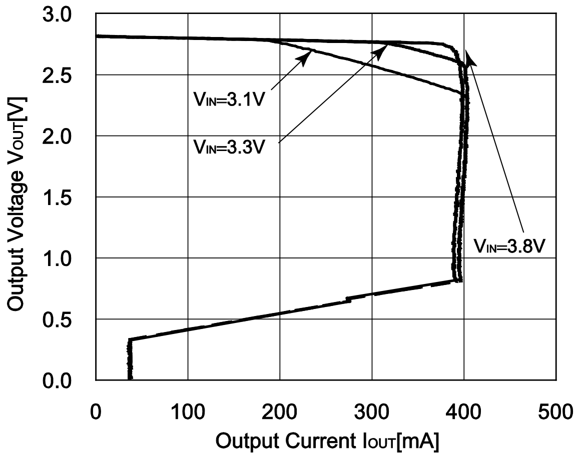
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

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

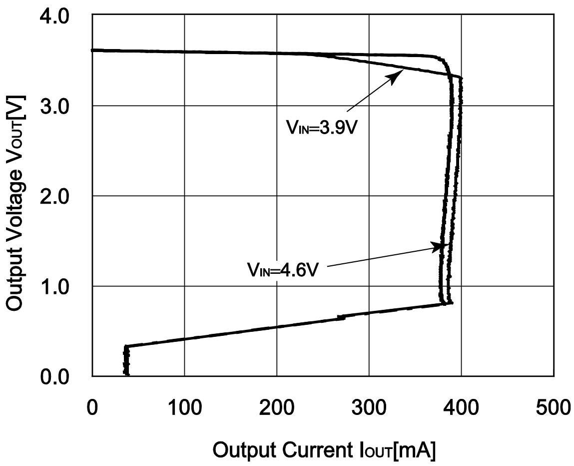
R1180x121x



R1180x281x

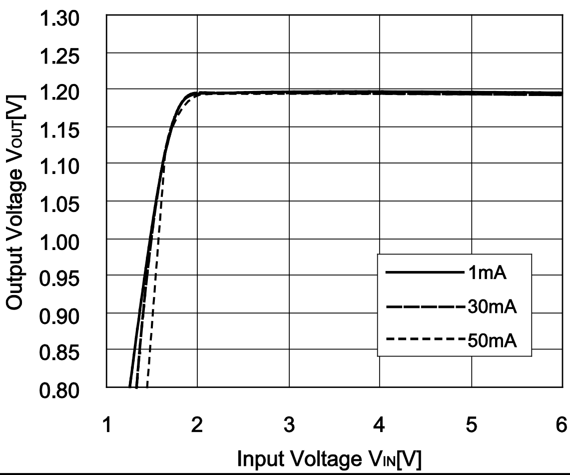


R1180x361x

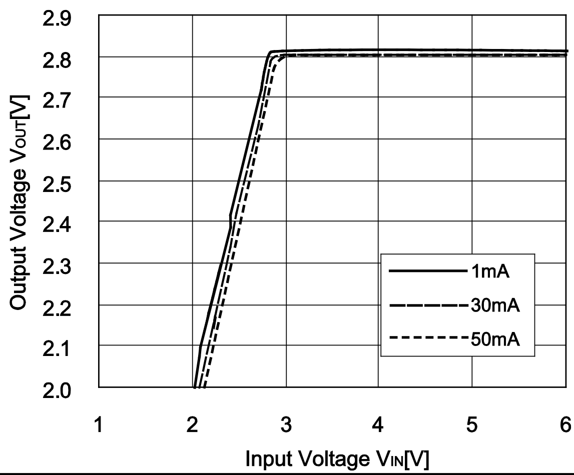


2) Output Voltage vs. Input Voltage (Ta=25°C)

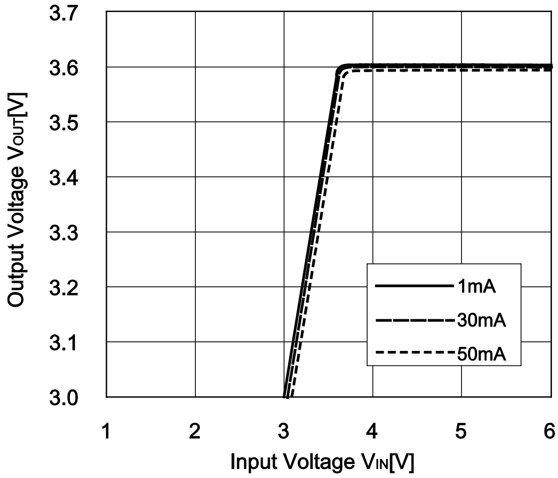
R1180x121x



R1180x281x

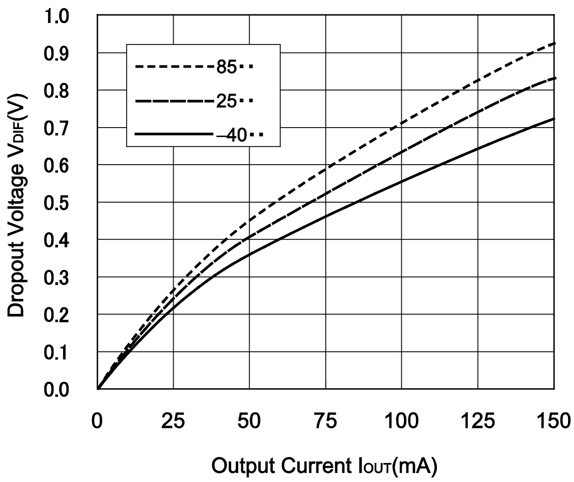


R1180x361x

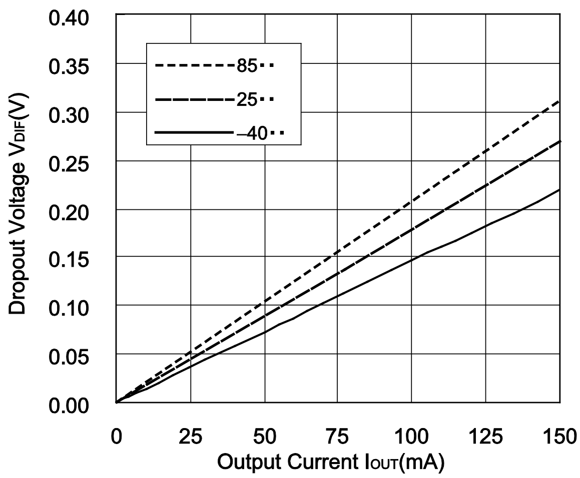


3) Dropout Voltage vs. Output Current

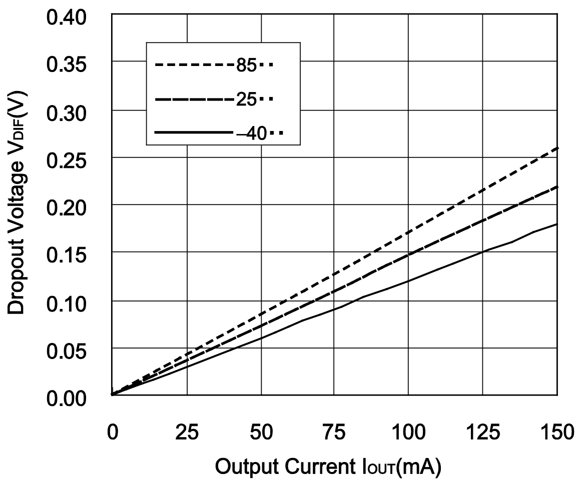
R1180x121x



R1180x281x

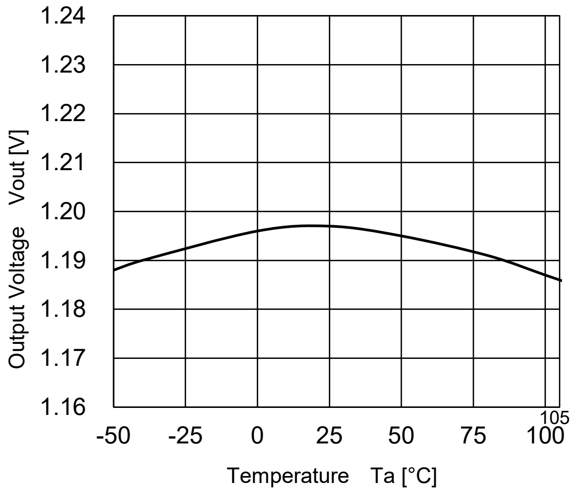


R1180x361x

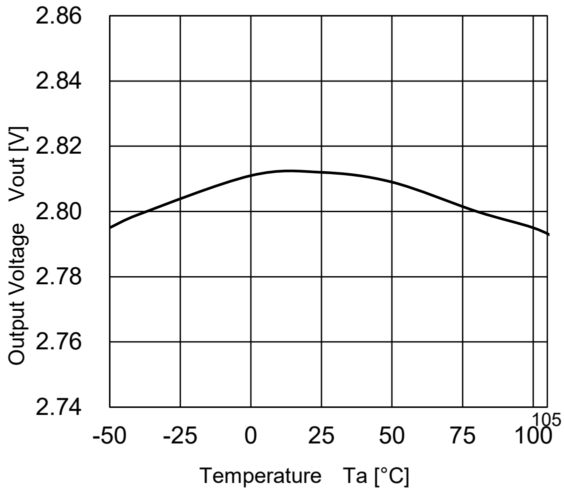


4) Output Voltage vs. Temperature (I_{OUT}=30mA)

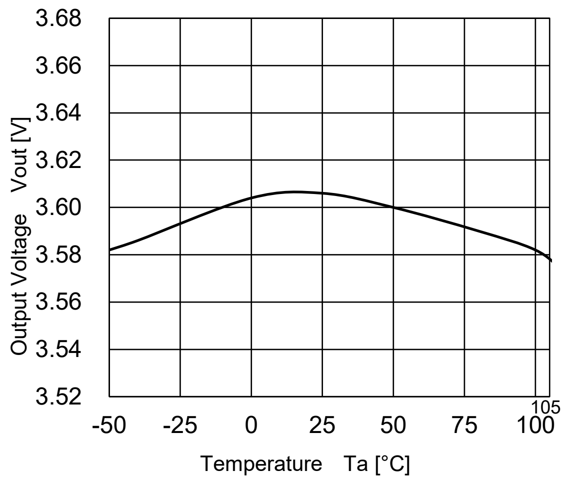
R1180x121x (V_{IN}=2.2V)



R1180x281x (V_{IN}=3.8V)

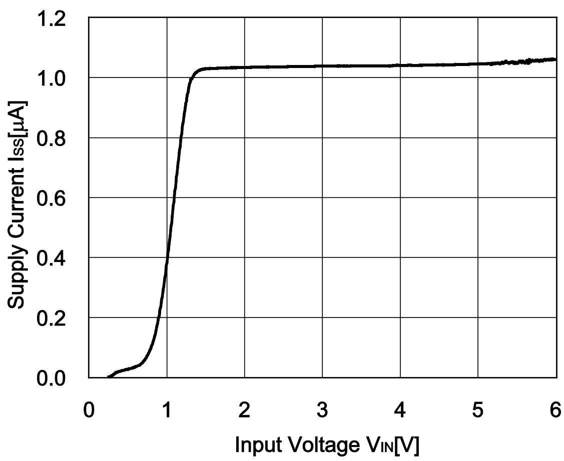


R1180x361x (V_{IN}=4.6V)

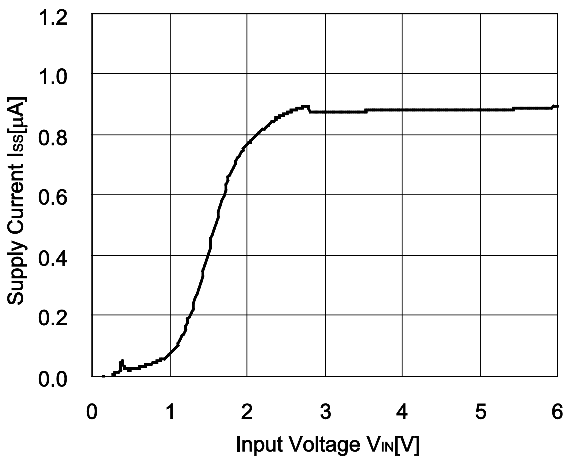


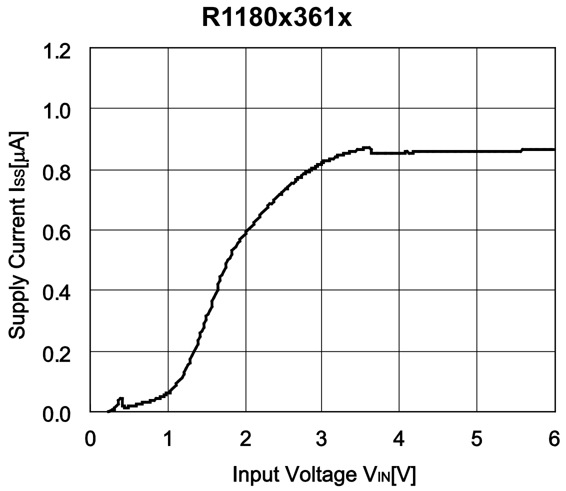
5) Supply Current vs. Input Voltage (Ta=25°C)

R1180x121x

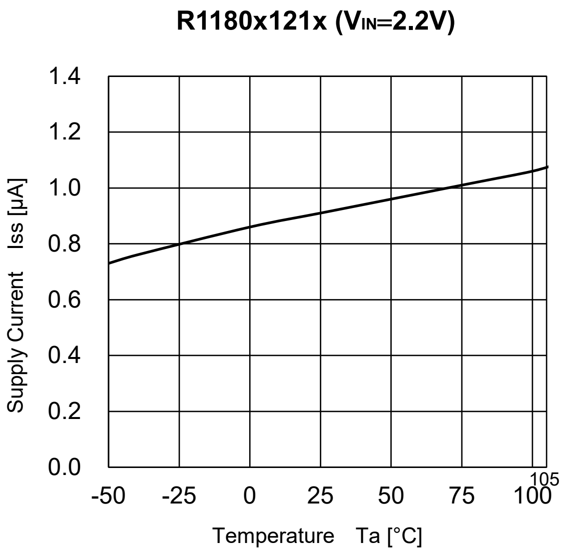


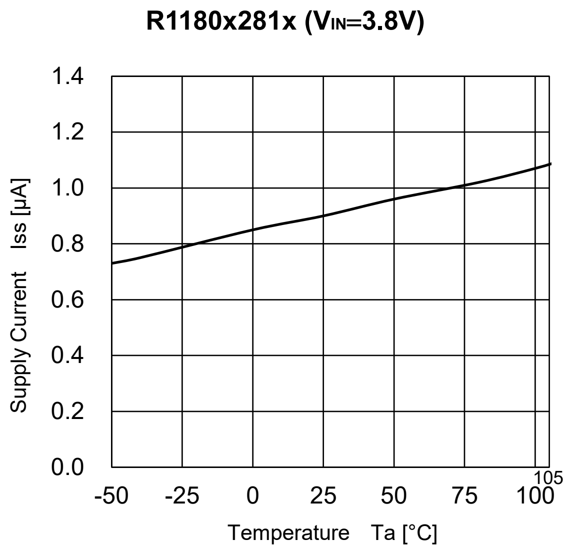
R1180x281x

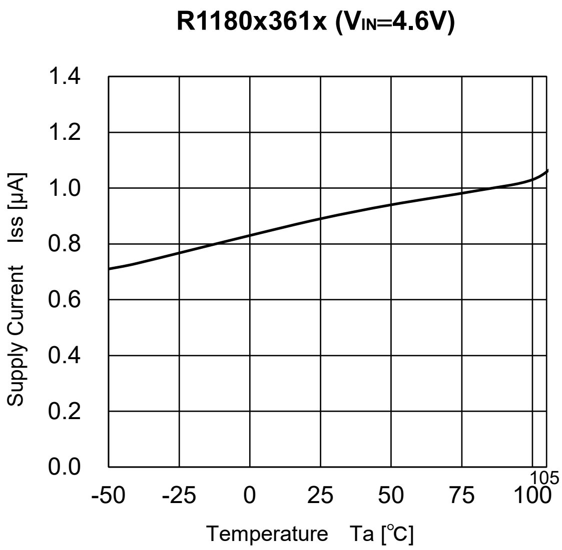




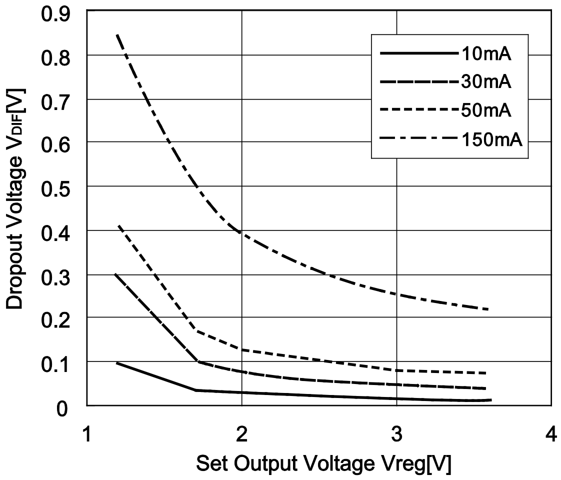
6) Supply Current vs. Temperature



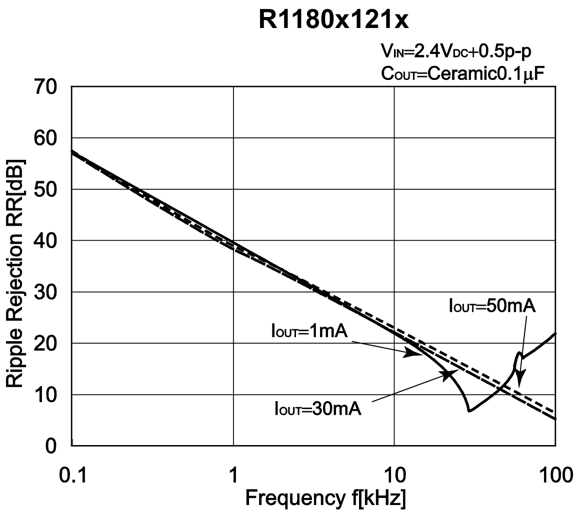


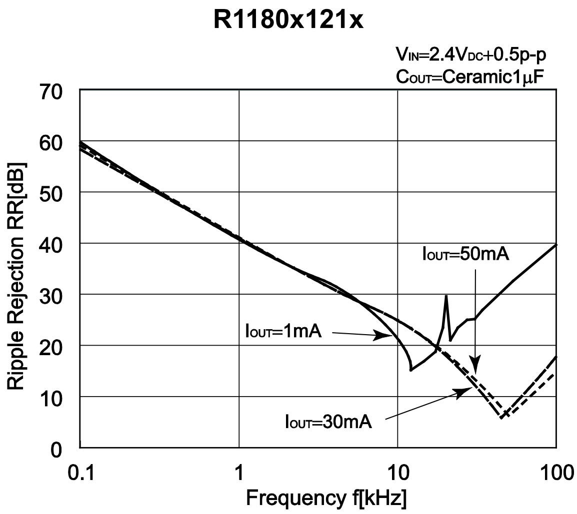


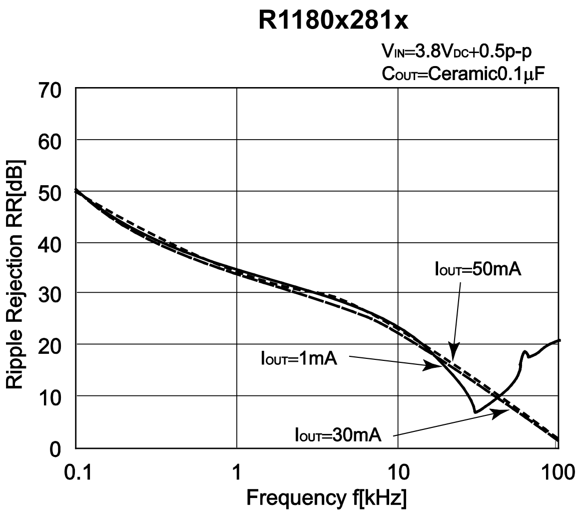
7) Dropout Voltage vs. Set Output Voltage (Ta=25°C)

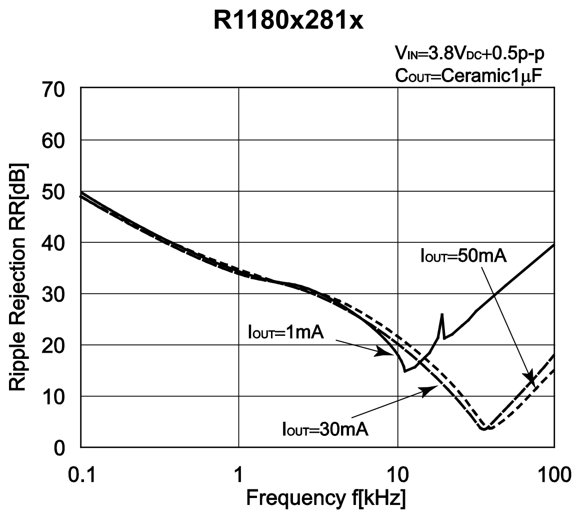


8) Ripple Rejection vs. Frequency (C1=none)

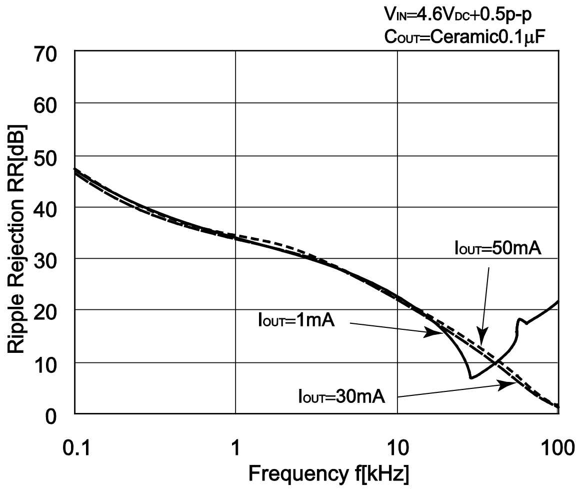




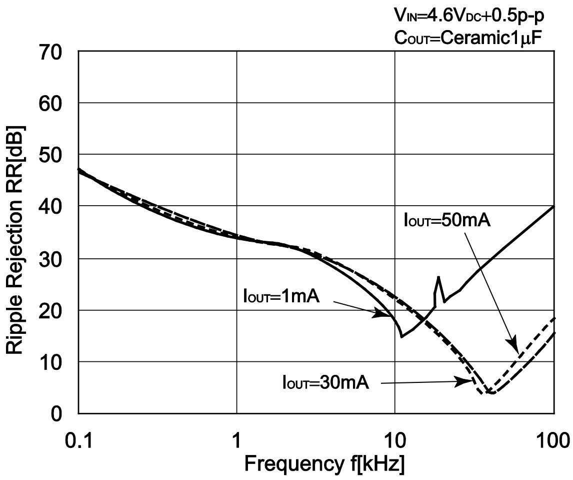




R1180x361x

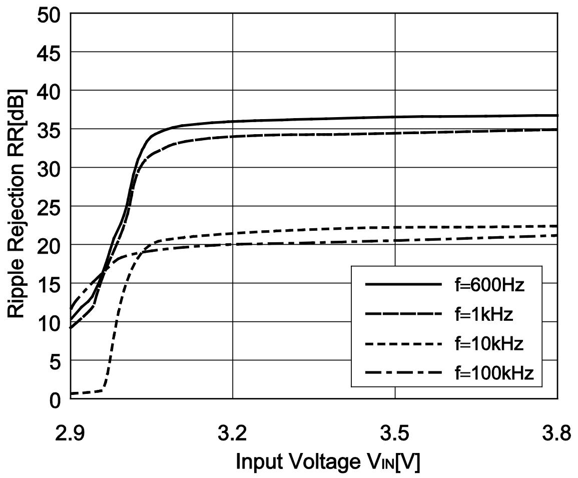


R1180x361x

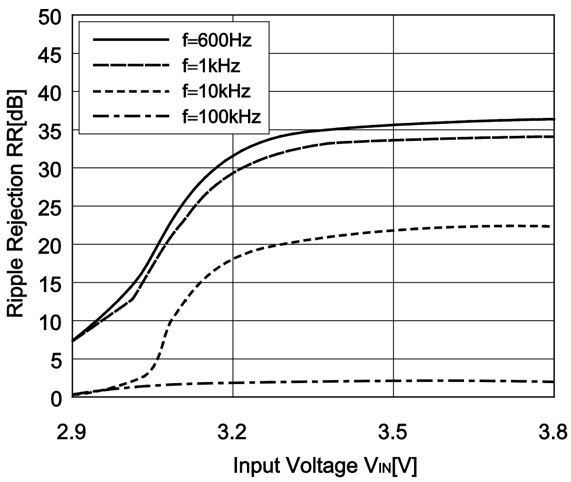


9) Ripple Rejection vs. Input Bias Voltage (Ta=25°C, C1=none, C2=Ceramic0.1μF)

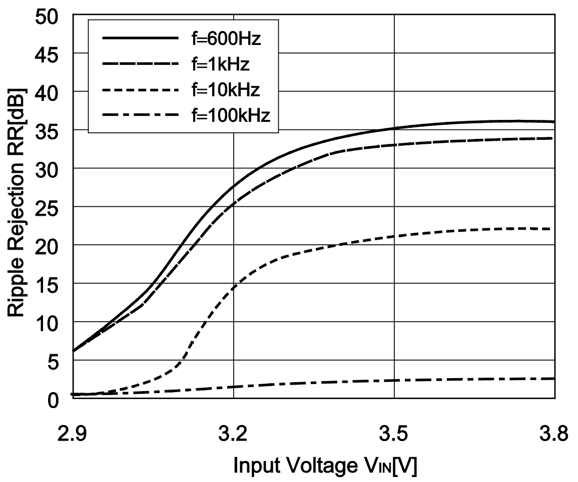
R1180x281x (IOUT=1mA)



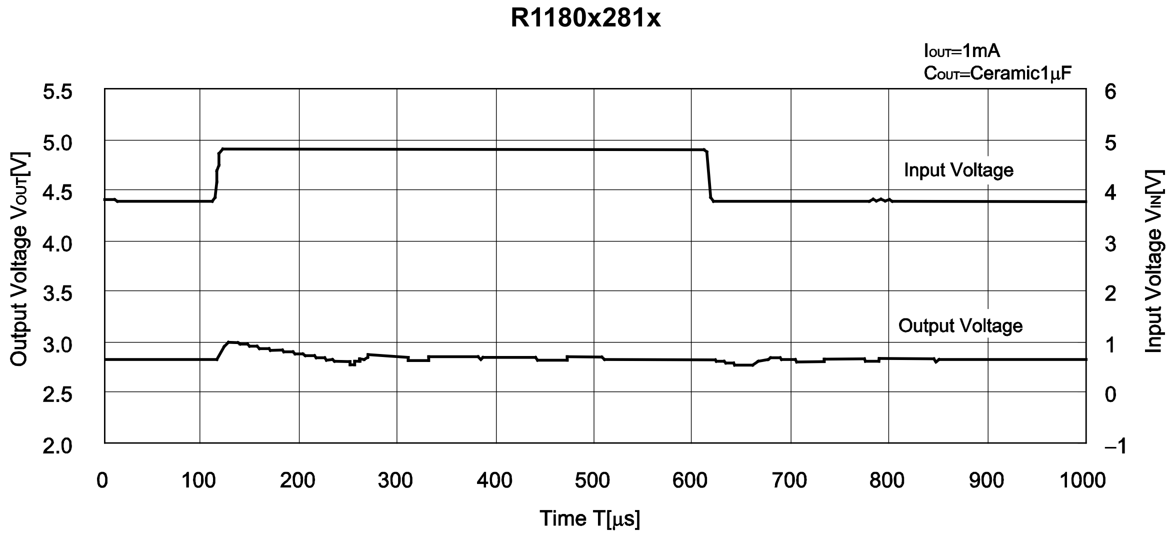
R1180x281x (IOUT=30mA)

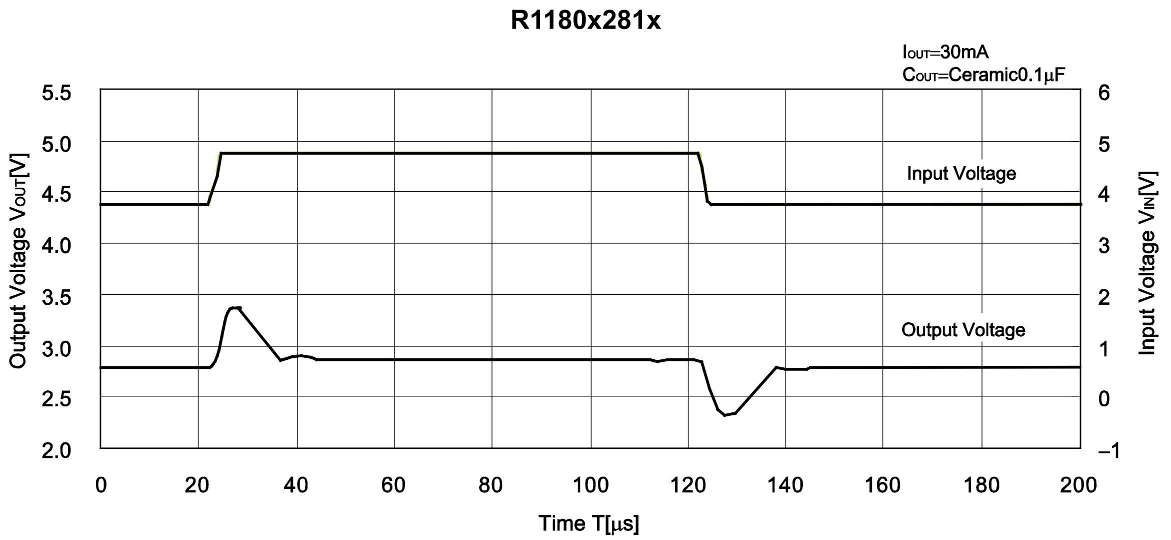


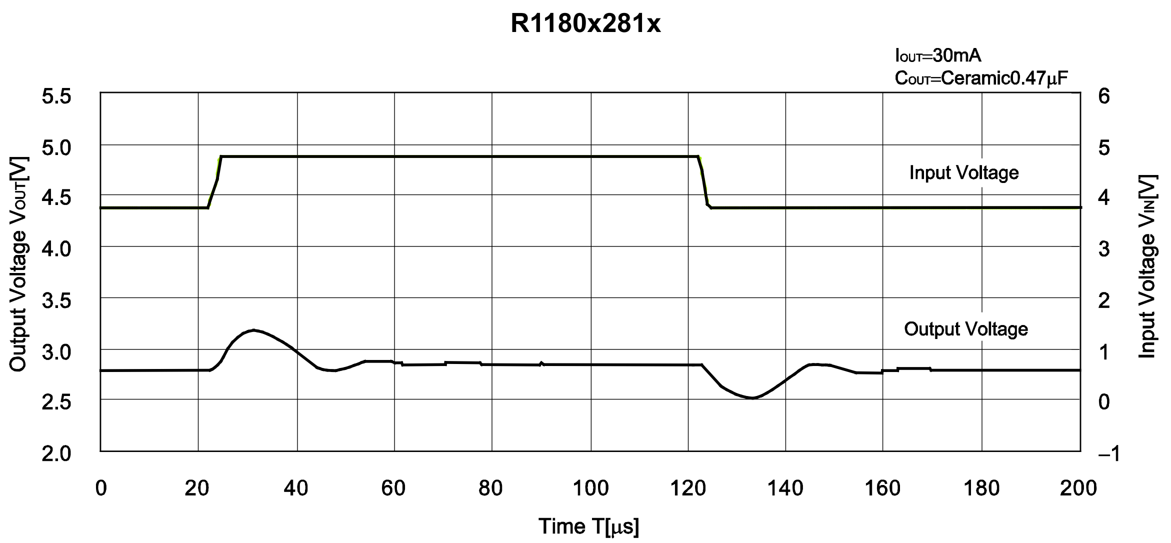
R1180x281x (IOUT=50mA)

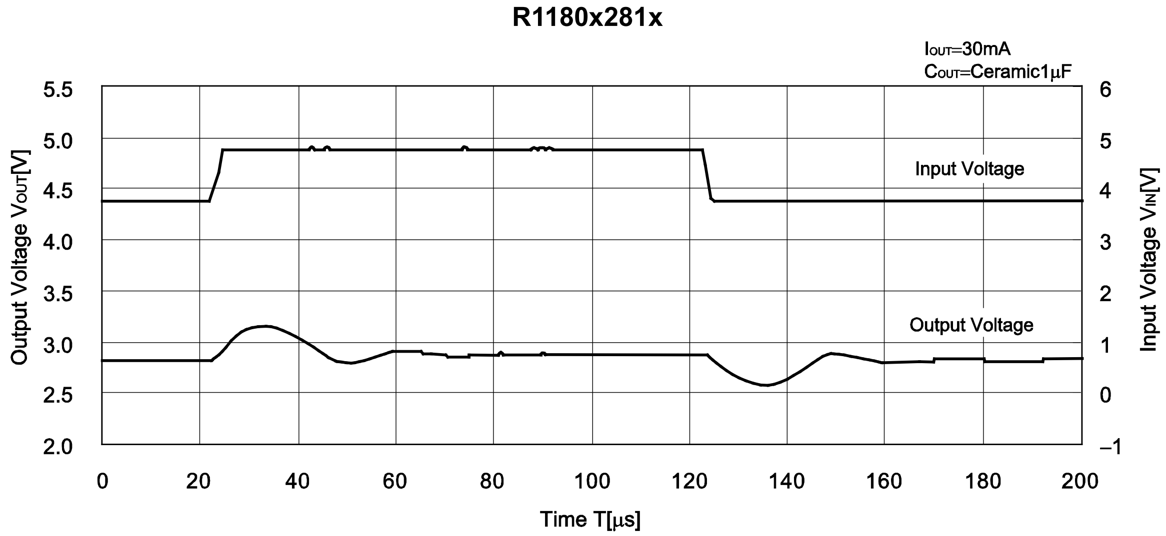


10) Input Transient Response (C1=none, tr=tf=5μs)

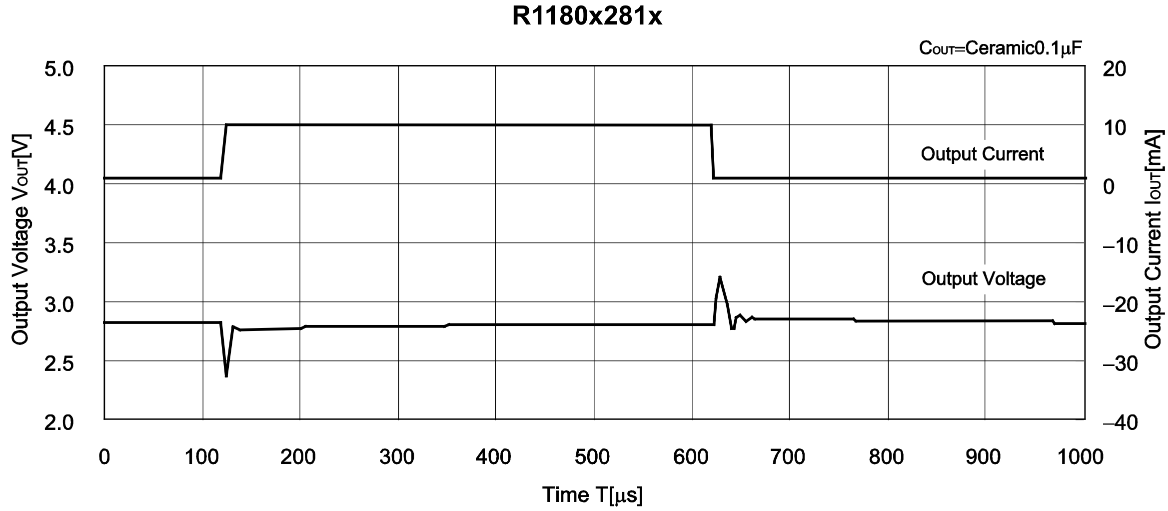


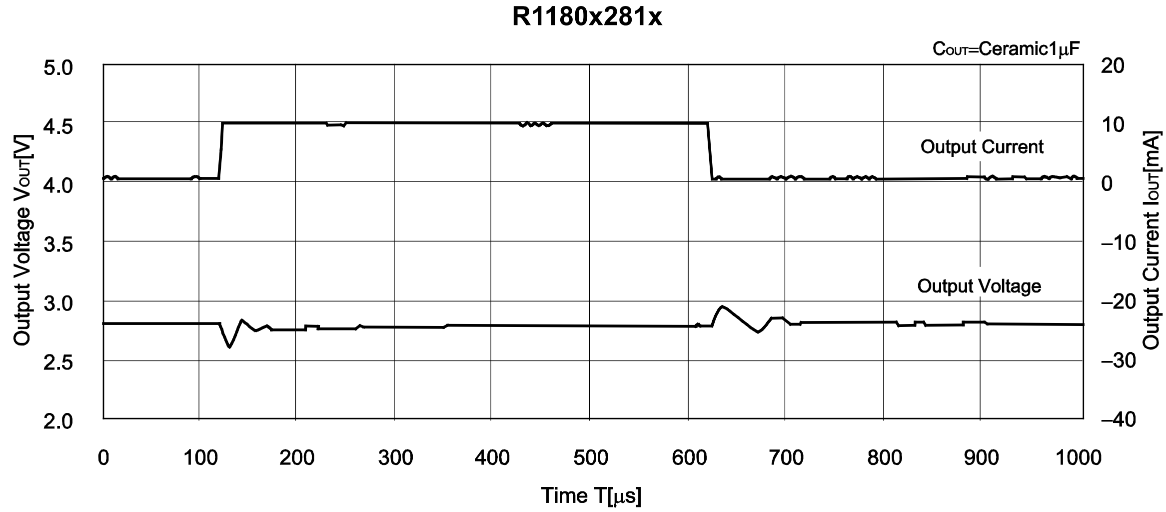




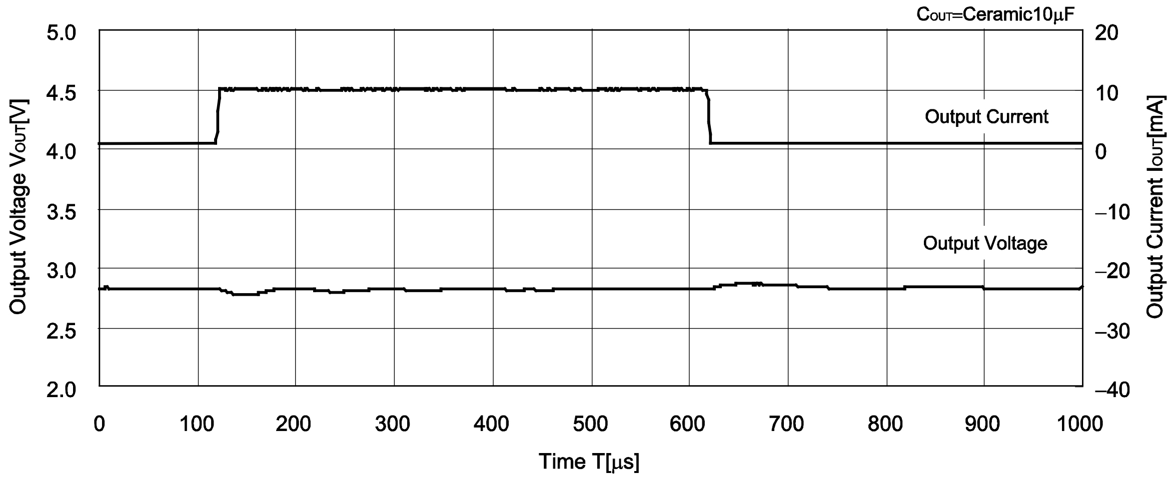


11) Load Transient Response (tr=tf=0.5μs V_{IN}=3.8V)

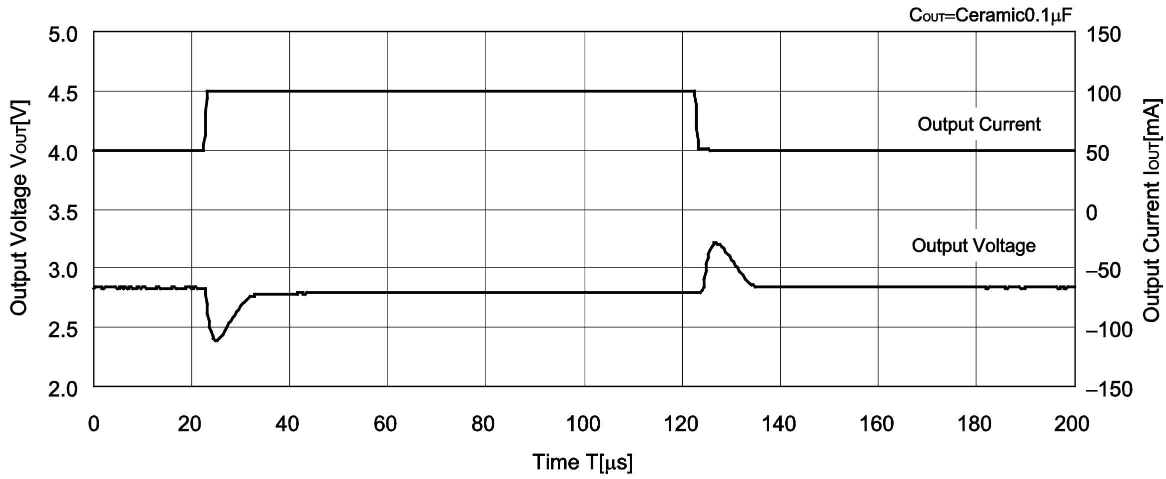




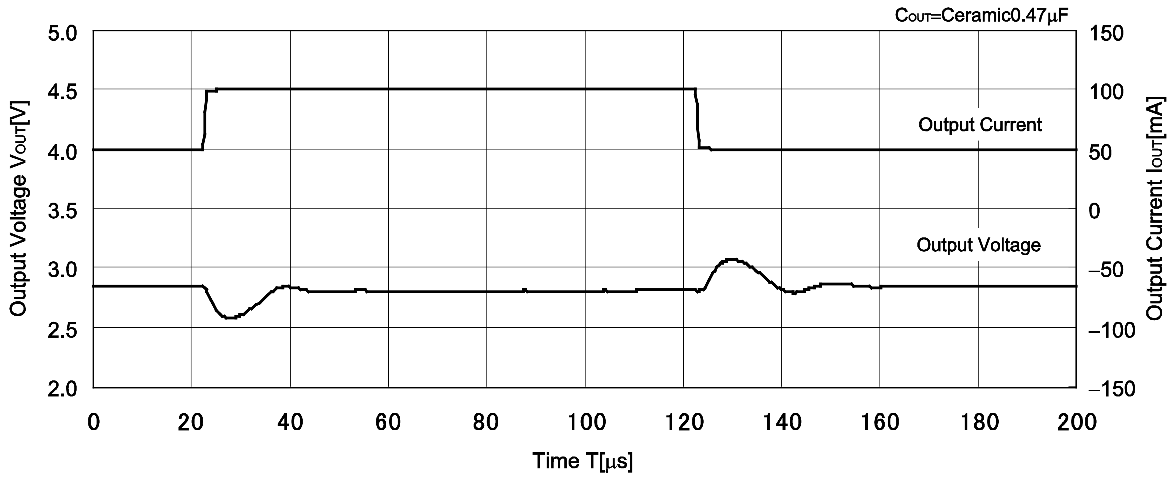
R1180x281x

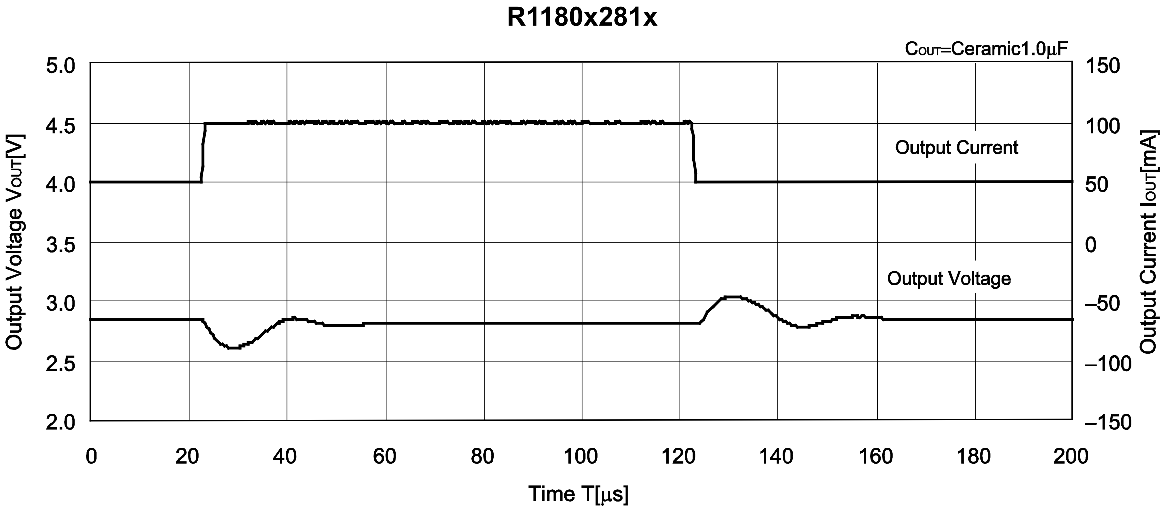


R1180x281x



R1180x281x




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

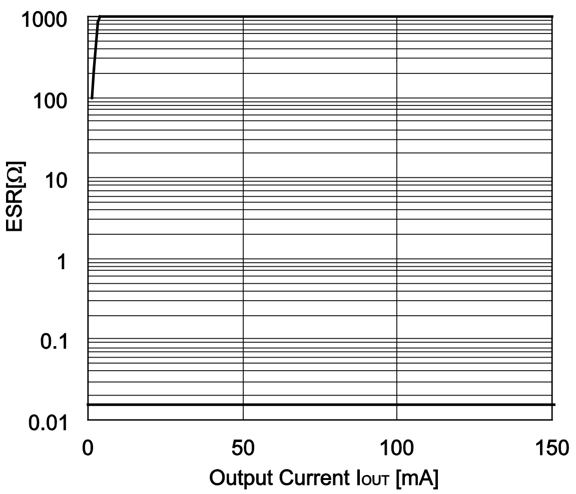
ESR vs. Output Current

The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below. 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

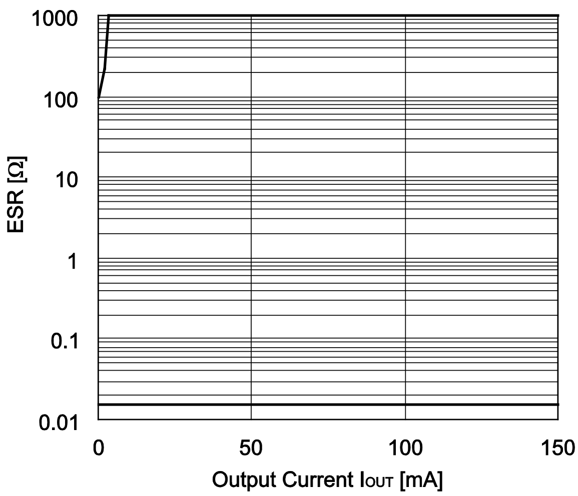
R1180x121x

C1 = Ceramic 1.0μA, C2 = Ceramic 0.1μF



R1180x281x

C1 = Ceramic 1.0μA, C2 = Ceramic 0.1μF



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