

## Large Current Positive Voltage Regulators

### ■ GENERAL DESCRIPTION

The XC6203 series are highly precise, low power consumption, 3 terminal positive voltage regulators manufactured using CMOS and laser trimming technologies.

The series provides large currents with a significantly small dropout voltage.

The XC6203P consists of a driver transistor, a current limiter, a precision reference voltage and an error amplifier. The XC6203E is also available but without the current limiter function. Output voltage is selectable in 0.1V increments between a voltage of 1.8V and 6.0V.

SOT-23, SOT-89, SOT-223 package are available.

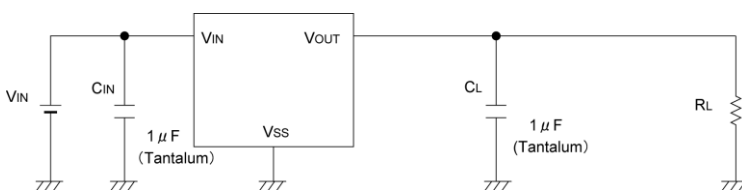
### ■ APPLICATIONS

- Magnetic disk drive
- Note PCs / Tablet PCs
- Digital still cameras / Camcorders
- Digital audio equipments
- Reference voltage sources
- Multi-function power supplies

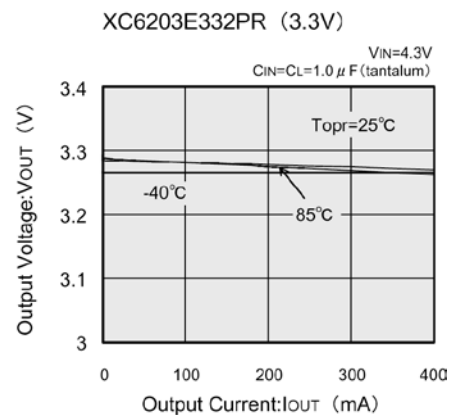
### ■ FEATURES

- Maximum Output Current** : 400mA (3.3V)
- Maximum Operating Voltage** : 8.0V
- Output Voltage Range** : 1.8V ~ 6.0V  
(Selectable in 0.1V increments)
- Highly Accurate** :  $\pm 2\%$
- Low Power Consumption** :  $8.0 \mu\text{A}$  (TYP.)
- Line Regulation** :  $0.2\% / \text{V}$  (TYP.)
- Output Voltage Temperature Characteristics**  
:  $\pm 100\text{ppm}/^\circ\text{C}$  (TYP.)
- Dropout Voltage** : 150mV @ 100mA,  
300mV @ 200mA
- Operating Ambient Temperature**:  $-40^\circ\text{C} \sim 85^\circ\text{C}$
- Packages** : SOT-23, SOT-89,  
SOT-223
- Environmentally Friendly** : EU RoHS Compliant, Pb Free

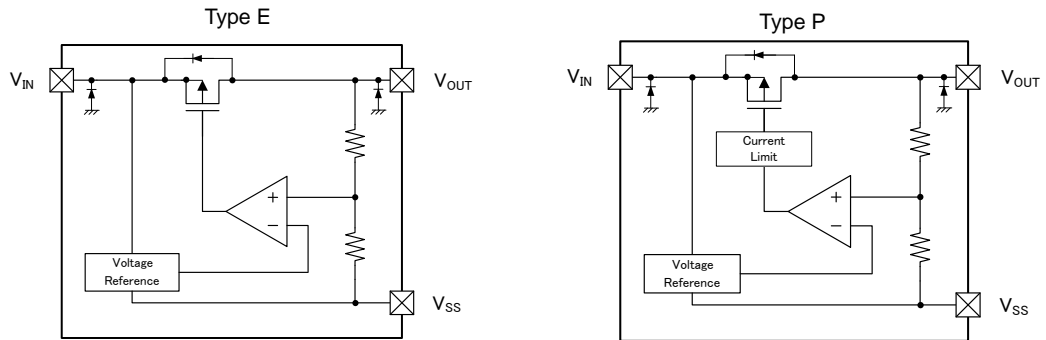
### ■ TYPICAL APPLICATION CIRCUIT



### ■ TYPICAL PERFORMANCE CHARACTERISTICS



## ■ BLOCK DIAGRAMS



\* Diodes inside the circuits are ESD protection diodes and parasitic diodes.

## ■ PRODUCT CLASSIFICATION

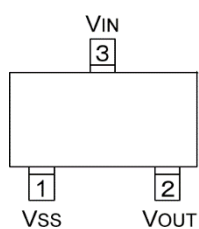
### ● Ordering Information

XC6203 ①②③④⑤⑥-⑦<sup>(\*)</sup>

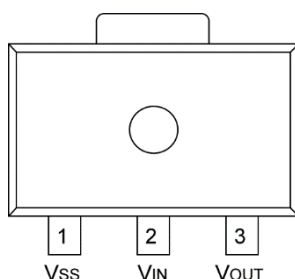
DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	Type of Regulator	P	Current limiter circuit built-in
		E	No current limiter circuit built-in
②③	Output Voltage	18~	e.g. 1.8V → ③=1, ④=8
④	Output Accuracy	2	±2% Output voltage is {x.x0V} (the 2 <sup>nd</sup> decimal place is "0")
		A	±2% Output voltage is {x.x5V} (the 2 <sup>nd</sup> decimal place is "5")
⑤⑥-⑦ <sup>(*)</sup>	Packages (Order Unit)	MR	SOT-23 (3,000pcs/Reel)
		MR-G	SOT-23 (3,000pcs/Reel)
		PR	SOT-89 (1,000pcs/Reel)
		PR-G	SOT-89 (1,000pcs/Reel)
		FR	SOT-223 (1,000pcs/Reel)
		FR-G	SOT-223 (1,000pcs/Reel)

<sup>(\*)</sup> The "-G" suffix denotes Halogen and Antimony free as well as being fully EU RoHS compliant.

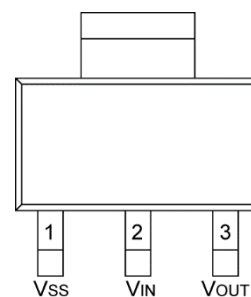
## ■ PIN CONFIGURATION



SOT-23  
(TOP VIEW)



SOT-89  
(TOP VIEW)



SOT-223  
(TOP VIEW)

## ■ PIN ASSIGNMENT

PIN NUMBER		PIN NAME	FUNCTIONS
SOT-23	SOT-89/SOT-223		
1	1	V <sub>SS</sub>	Ground
3	2	V <sub>IN</sub>	Power Input
2	3	V <sub>OUT</sub>	Output

## ■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage	V <sub>IN</sub>	-0.3 ~ 12.0	V
Output Voltage	V <sub>OUT</sub>	-0.3 ~ V <sub>IN</sub> + 0.3	V
Power Dissipation (T <sub>a</sub> =25°C)	Pd	250	mW
		500 (40mm x 40mm Standard board) <sup>(*)</sup>	
		500	
		1000 (40mm x 40mm Standard board) <sup>(*)</sup>	
		1500 (40mm x 40mm Standard board) <sup>(*)</sup>	
Operating Ambient Temperature	T <sub>opr</sub>	-40 ~ 85	°C
Storage Temperature	T <sub>stg</sub>	-55 ~ 125	°C

Note

<sup>(\*)</sup> This power dissipation figure shown is PCB mounted and is for reference only.

The mounting condition is please refer to PACKAGING INFORMATION.

## ELECTRICAL CHARACTERISTICS

XC6203 Series Type E

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Output Voltage	$V_{OUT(E)}$ <sup>(*2)</sup>	$I_{OUT}=40mA$ $1.8V \leq V_{OUT(T)}$	$\times 0.98$	$V_{OUT(T)}$ <sup>(*3)</sup>	$\times 1.02$	V	②
Maximum Output Current	$I_{OUTMAX}$	$V_{OUT} \geq E-1$ <sup>(*4)</sup>	$E-2$ <sup>(*4)</sup>	-	-	mA	②
Load Regulation	$\Delta V_{OUT}$	$1.8V \leq V_{OUT(T)}$ $1mA \leq I_{OUT} \leq 150mA$	-	40	100	mV	②
Dropout Voltage 1	$V_{dif1}$ <sup>(*5)</sup>	$I_{OUT}=100mA$	-	$E-3$ <sup>(*4)</sup>		mV	②
Dropout Voltage 2	$V_{dif2}$ <sup>(*5)</sup>	$I_{OUT}=200mA$	-	$E-4$ <sup>(*4)</sup>		mV	
Supply Current	$I_{DD}$		-	$E-5$ <sup>(*4)</sup>		$\mu A$	①
Line Regulation	$\frac{\Delta V_{OUT}}{(\Delta V_{IN} \cdot V_{OUT})}$	$1.8V \leq V_{OUT(T)}$ , $V_{OUT(T)}+1.0V \leq V_{IN} \leq 8.0V$ , $I_{OUT}=40mA$	-	0.2	0.3	%/V	②
Input Voltage	$V_{IN}$		-	-	8.0	V	②
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{(\Delta T_{opr} \cdot V_{OUT})}$	$I_{OUT}=40mA$ $-40^{\circ}C \leq T_{opr} \leq 85^{\circ}C$	-	$\pm 100$	-	ppm/°C	②

(\*1) Unless otherwise stated,  $V_{IN}=V_{OUT(T)}+1.0V$

(\*2)  $V_{OUT(E)}$ : Effective output voltage

(\*3)  $V_{OUT(T)}$ : Nominal output voltage.

(\*4) Please refer to the table E-1, E-2, E-3, E-4, E-5.

(\*5)  $V_{dif} = \{V_{IN1} - V_{OUT1}\}$

$V_{IN1}$ : The input voltage when  $V_{OUT1}$  appears as input voltage is gradually decreased.

$V_{OUT1}$ : A voltage equal to 98% of the output voltage when " $V_{OUT(T)} + 1.0V$ " is input.

## ■ ELECTRICAL CHARACTERISTICS (Continued)

XC6203 Series Type P

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Output Voltage	$V_{OUT(E)}^{(*)2}$	$I_{OUT}=40mA$   $1.8V \leq V_{OUT(T)}$	$\times 0.98$	$V_{OUT(T)}^{(*)3}$	$\times 1.02$	V	②
Maximum Output Current	$I_{OUTMAX}$	$V_{OUT} \geq E-1^{(*)4}$	$E-2^{(*)4}$	-	-	mA	②
Load Regulation	$\Delta V_{OUT}$	$1.8V \leq V_{OUT(T)}$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV	②
Dropout Voltage 1	$V_{dif1}^{(*)5}$	$I_{OUT}=100mA$	-	$E-3^{(*)4}$		mV	②
Dropout Voltage 2	$V_{dif2}^{(*)5}$	$I_{OUT}=200mA$	-	$E-4^{(*)4}$		mV	
Supply Current	$I_{DD}$		-	$E-5^{(*)4}$		$\mu A$	①
Line Regulation	$\frac{\Delta V_{OUT}}{(\Delta V_{IN} \cdot V_{OUT})}$	$1.8V \leq V_{OUT(T)}$ $V_{OUT(T)}+1.0V \leq V_{IN} \leq 8.0V$ $I_{OUT}=40mA$	-	0.2	0.3	%/V	②
Input Voltage	$V_{IN}$		-	-	8.0	V	②
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{(\Delta T_{opr} \cdot V_{OUT})}$	$I_{OUT}=40mA$ $-40^{\circ}C \leq T_{opr} \leq 85^{\circ}C$	-	$\pm 100$	-	ppm/°C	②
Short-Circuit Current	$I_{SHORT}$	$V_{OUT}=V_{SS}$	-	60	-	mA	②

(\*1) Unless otherwise stated,  $V_{IN}=V_{OUT(T)}+1.0V$

(\*2)  $V_{OUT(E)}$ : Effective output voltage

(\*3)  $V_{OUT(T)}$ : Nominal output voltage.

(\*4) Please refer to the table E-1, E-2, E-3, E-4, E-5.

(\*5)  $V_{dif} = \{V_{IN1} - V_{OUT1}\}$

$V_{IN1}$ : The input voltage when  $V_{OUT1}$  appears as input voltage is gradually decreased.

$V_{OUT1}$ : A voltage equal to 98% of the output voltage when " $V_{OUT(T)} + 1.0V$ " is input.

## ELECTRICAL CHARACTERISTICS (Continued)

NOMINAL OUTPUT VOLTAGE	E-1	E-2	E-3		E-4		E-5	
	MAXIMUM OUTPUT VOLTAGE		DROPOUT VOLTAGE1		DROPOUT VOLTAGE2		SUPPLY CURRENT	
	$V_{OUT2}$ (V)	$I_{OUTMAX}$ (mA)	$V_{dif1}$ (mV)		$V_{dif2}$ (mV)		$I_{SS}$ ( $\mu$ A)	
$V_{OUT(T)}$	-	MIN.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.
1.8	$V_{OUT(E)} \times 0.9$	400	200	300	400	600	8.0	16.0
1.9								
2.0								
2.1								
2.2								
2.3								
2.4	$V_{OUT(E)} \times 0.93$		170	250	320	500		
2.5								
2.6								
2.7								
2.8								
2.85								
2.9	$V_{OUT(E)} \times 0.96$	150	220	300	420	10.0	20.0	
3.0								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
3.7								
3.8								
3.9								
4.0								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
4.7								
4.8								
4.9								
5.0								
5.1								
5.2								
5.3								
5.4								
5.5								

\*) The symbol is as same as that in the chart of electrical characteristics.

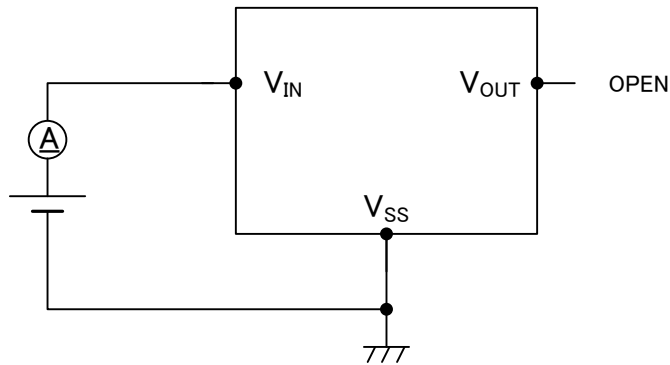
■ ELECTRICAL CHARACTERISTICS (Continued)

NOMINAL OUTPUT VOLTAGE	E-1	E-2	E-3		E-4		E-5	
	MAXIMUM OUTPUT VOLTAGE		DROPOUT VOLTAGE1		DROPOUT VOLTAGE2		SUPPLY CURRENT	
	$V_{OUT2}$ (V)	$I_{OUTMAX}$ (mA)	$V_{dif1}$ (mV)		$V_{dif2}$ (mV)		$I_{SS}$ (μA)	
$V_{OUT(T)}$	-	MIN.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.
5.6	$V_{OUT(E)} \times 0.96$	400	100	180	200	320	10.0	20.0
5.7								
5.8								
5.9								
6.0								

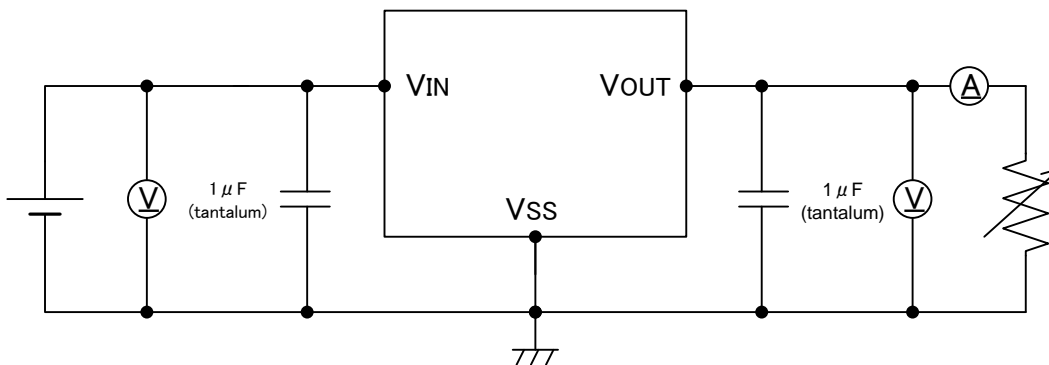
\*) The symbol is as same as that in the chart of electrical characteristics.

## TYPICAL APPLICATION CIRCUIT

1) CIRCUIT①



2) CIRCUIT②



## NOTES ON USE

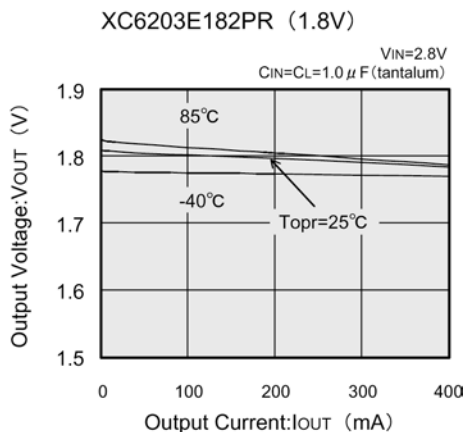
1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please keep the resistance low for the  $V_{BIAS}$ ,  $V_{IN}$  and  $V_{SS}$  wiring in particular.
3. Please wire the  $C_{IN}$  and  $C_L$  as close to the IC as possible.
4. Capacitances of these capacitors ( $C_{IN}$ ,  $C_L$ ) are decreased by the influences of bias voltage and ambient temperature. Care shall be taken for capacitor selection to ensure stability of phase compensation from the point of ESR influence.
5. When it is used in a quite small input / output dropout voltage, output may go into unstable operation. Please test it thoroughly before using it in production.
6. Torex places an importance on improving our products and their reliability. We request that users incorporate fail-safe designs and post-aging protection treatment when using Torex products in their systems.



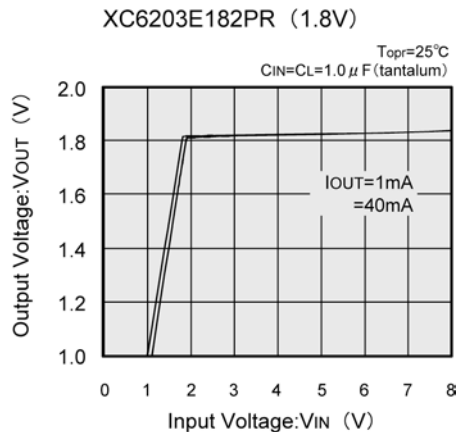
## ■ TYPICAL PERFORMANCE CHARACTERISTICS

### ● XC6203E182PR

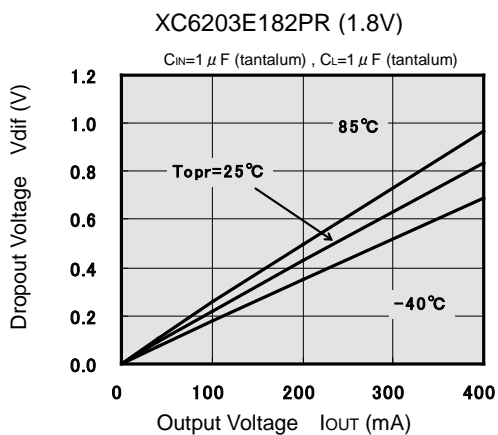
(1) Output Voltage vs. Output Current



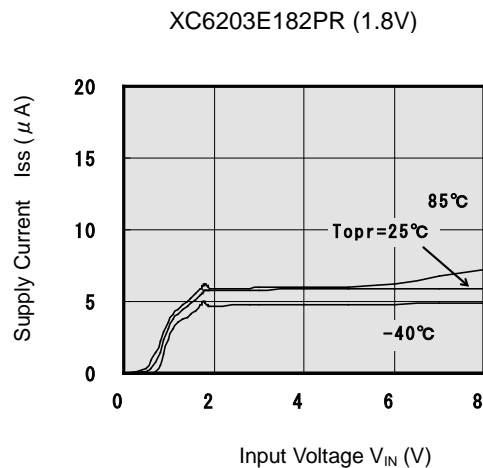
(2) Output Voltage vs. Input Voltage



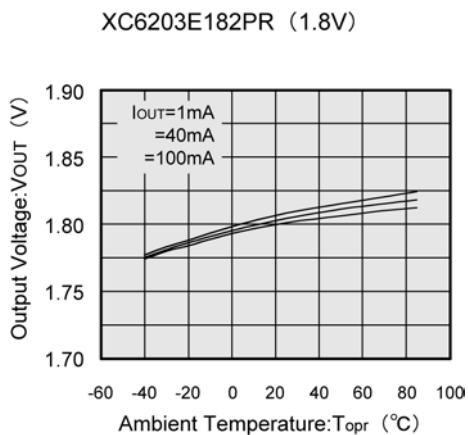
(3) Dropout Voltage vs. Output Current



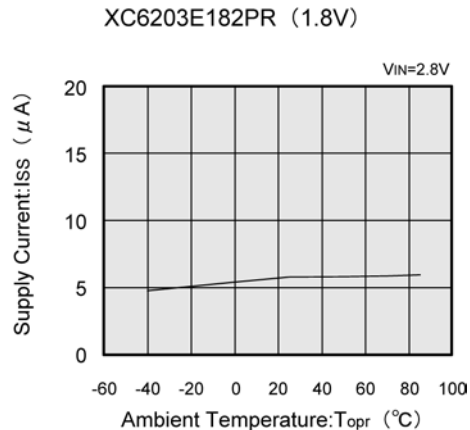
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



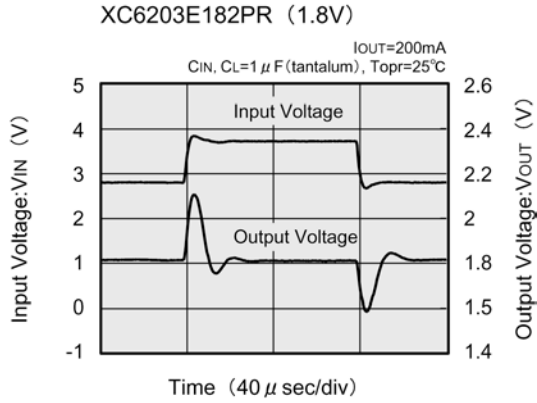
(6) Supply Current vs. Ambient Temperature



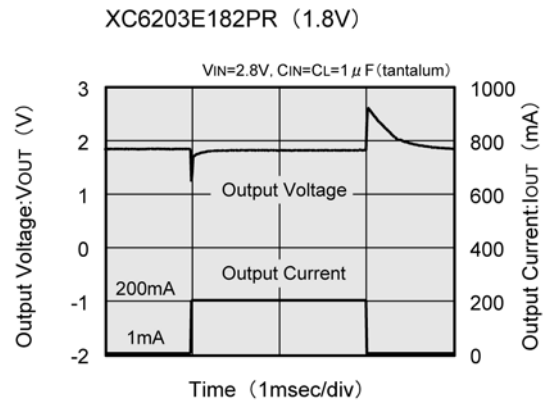
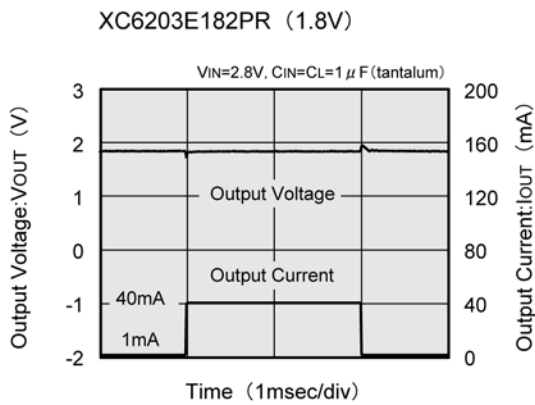
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ●XC6203E182PR (Continued)

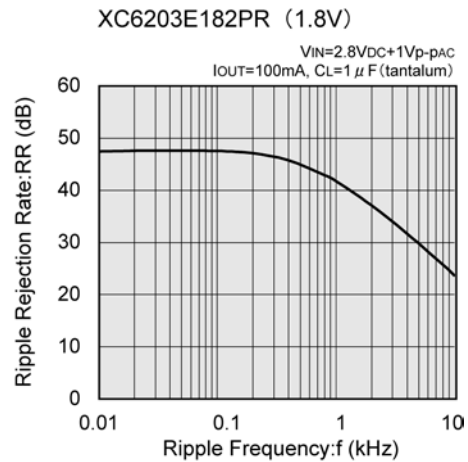
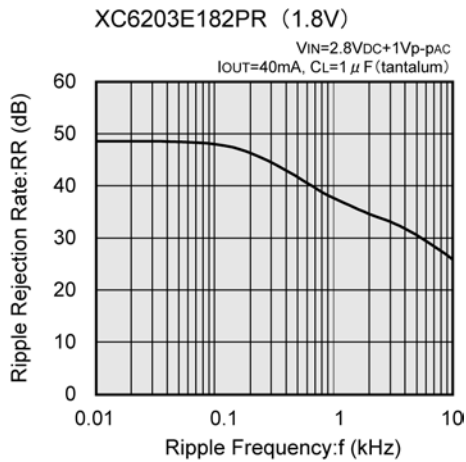
#### (7) Input Transient Response



#### (8) Load Transient Response



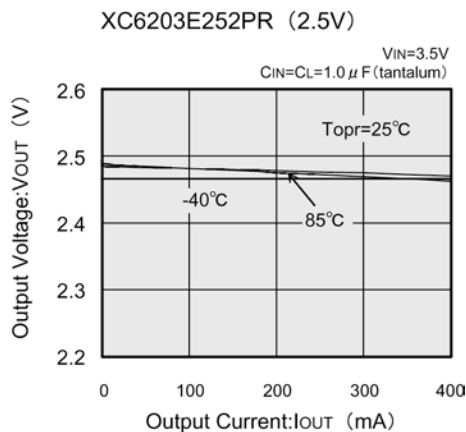
#### (9) Ripple Rejection Rate



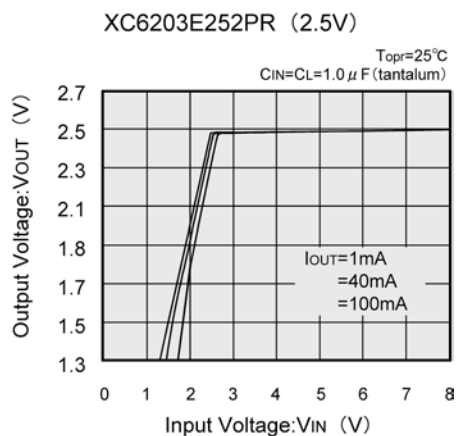
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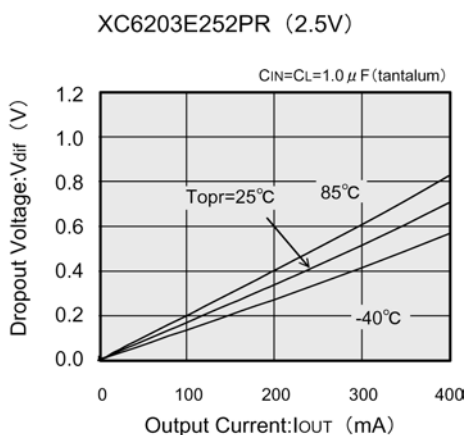
(1) Output Voltage vs. Output Current



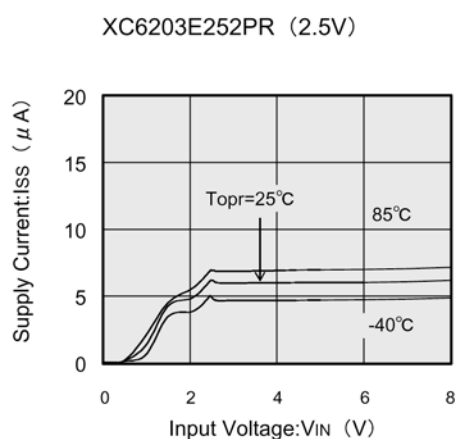
(2) Output Voltage vs. Input Voltage



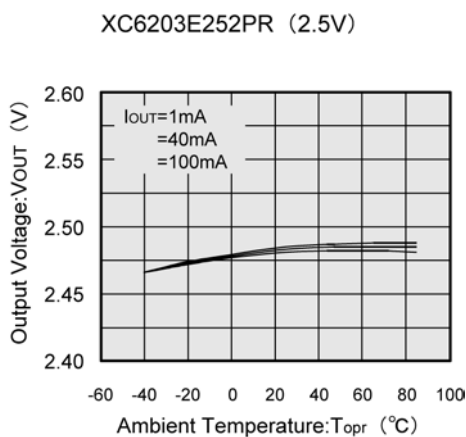
(3) Dropout Voltage vs. Output Current



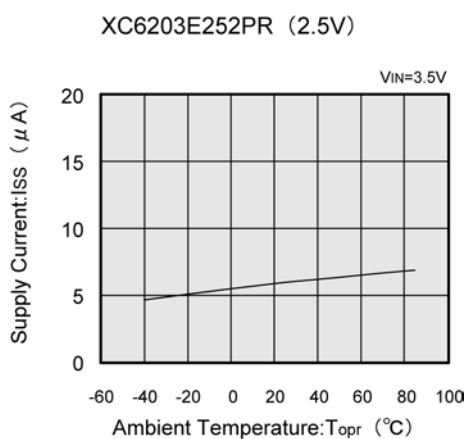
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



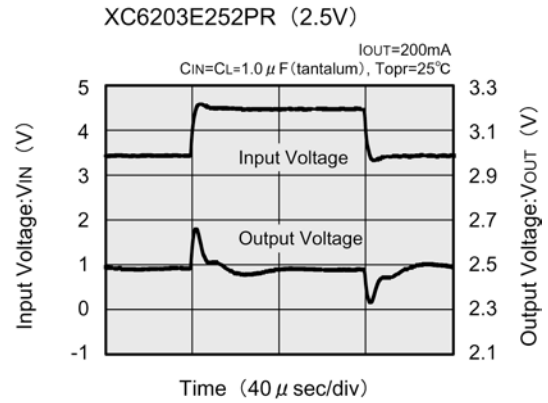
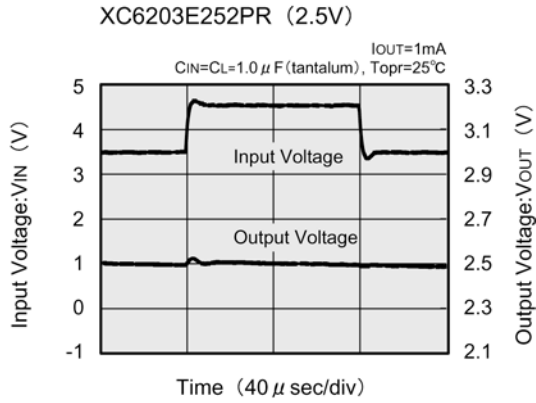
(6) Supply Current vs. Ambient Temperature



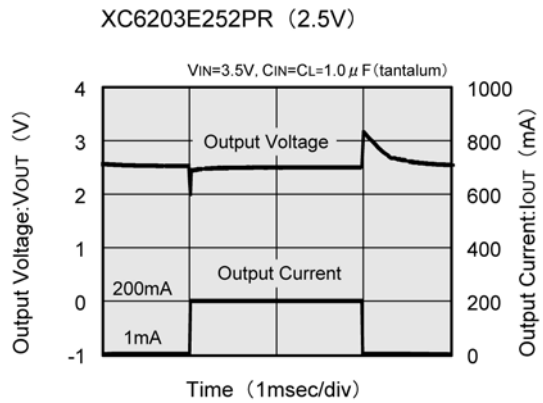
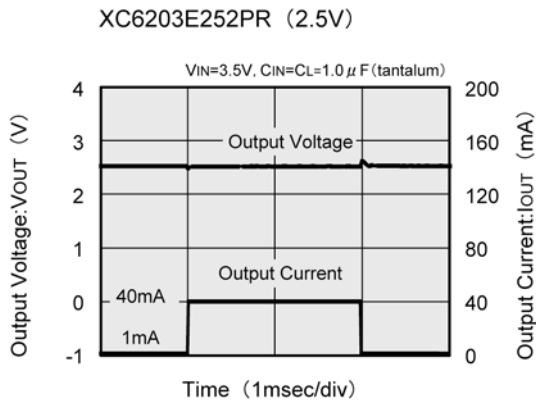
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

●XC6203E252PR (Continued)

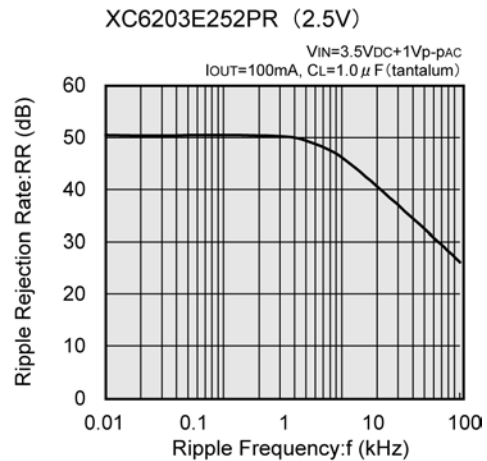
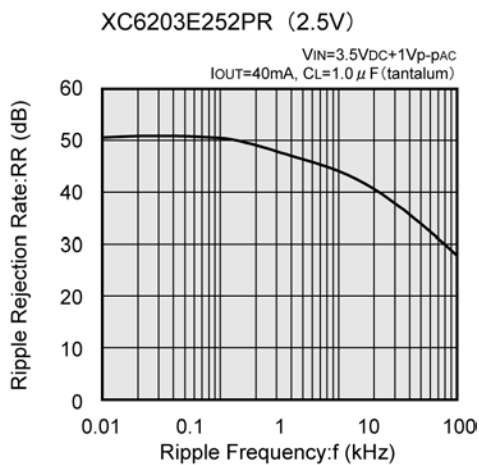
### (7) Input Transient Response



### (8) Load Transient Response



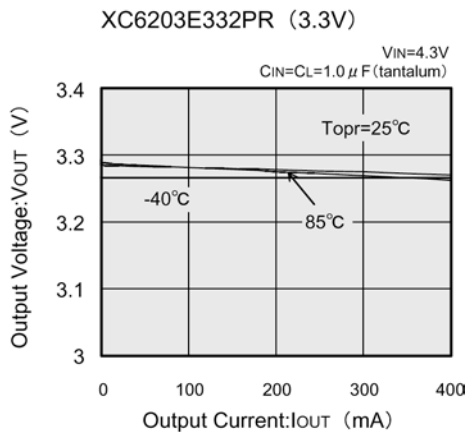
### (9) Ripple Rejection Rate



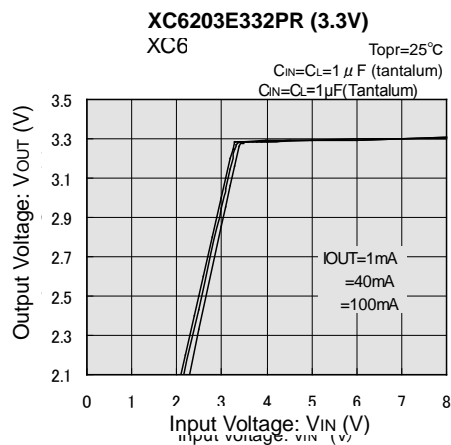
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E332PR

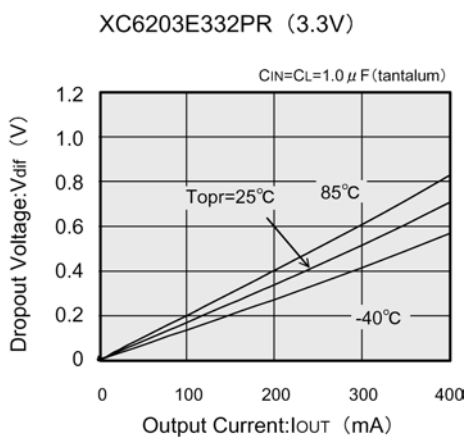
(1) Output Voltage vs. Output Current



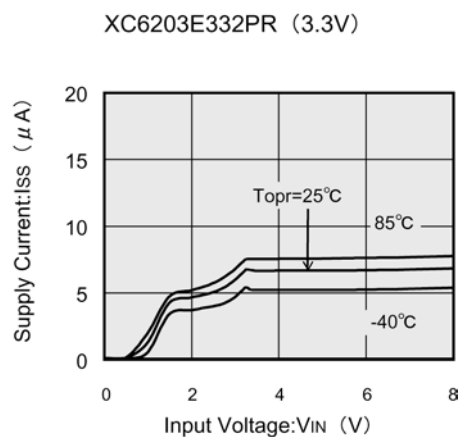
(2) Output Voltage vs. Input Voltage



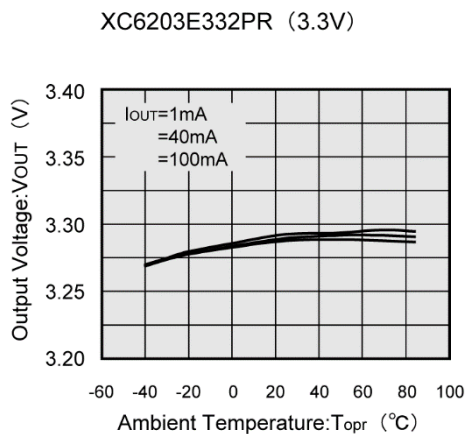
(3) Dropout Voltage vs. Output Current



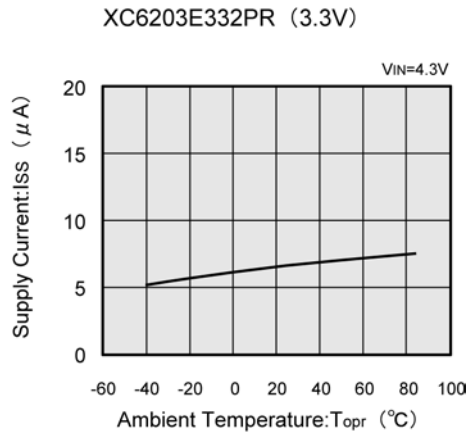
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



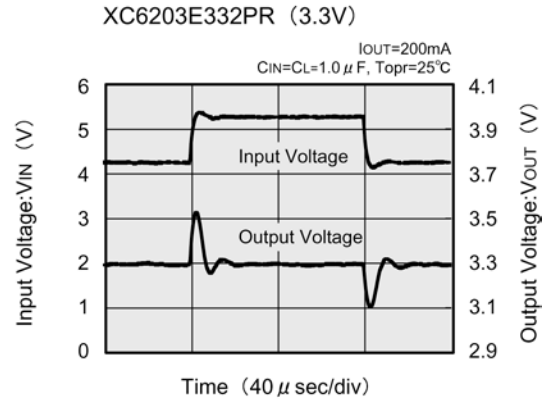
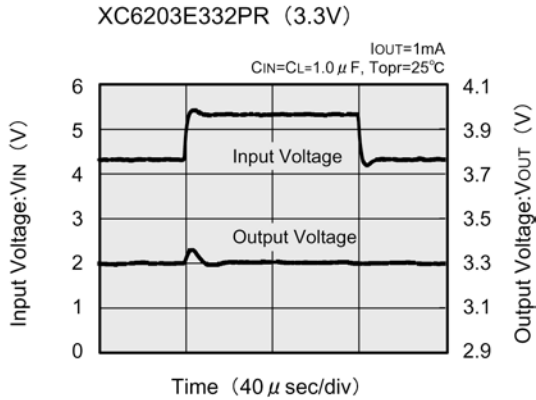
(6) Supply Current vs. Ambient Temperature



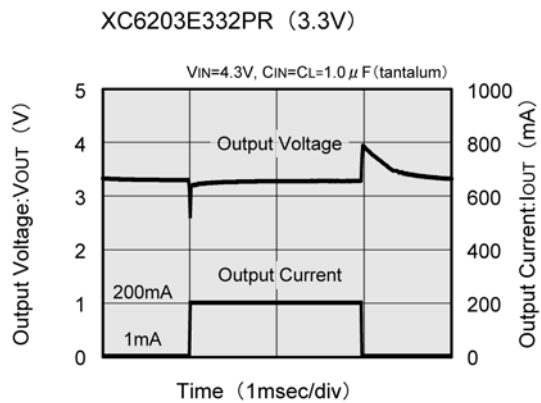
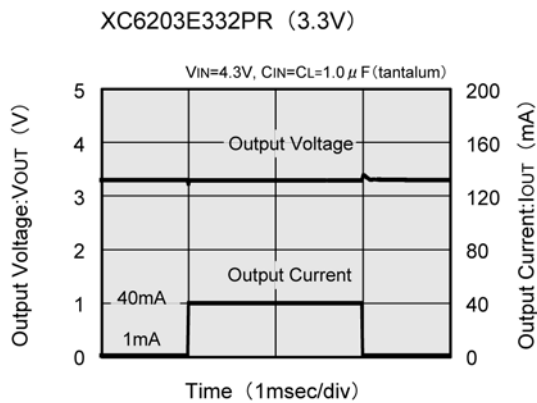
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ●XC6203E332PR (Continued)

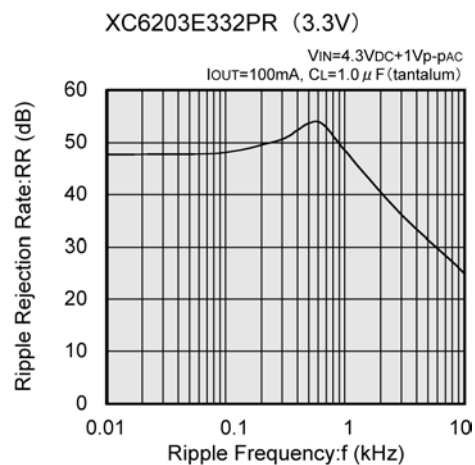
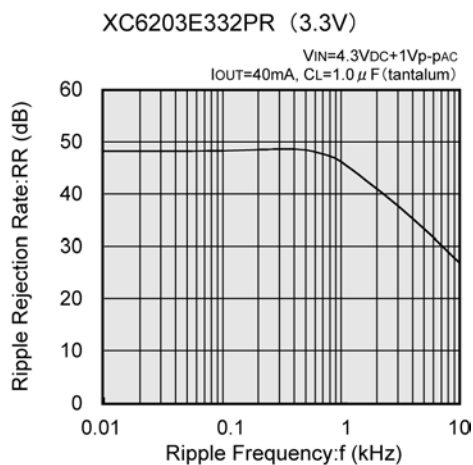
#### (7) Input Transient Response



#### (8) Load Transient Response



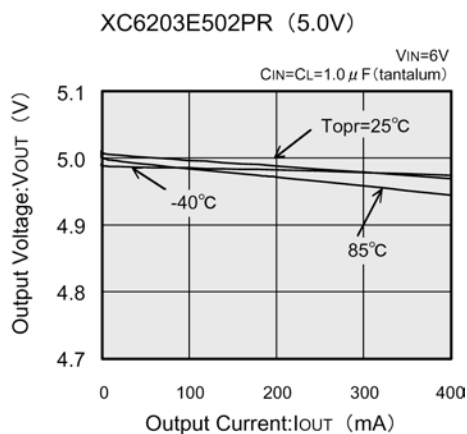
#### (9) Ripple Rejection Rate



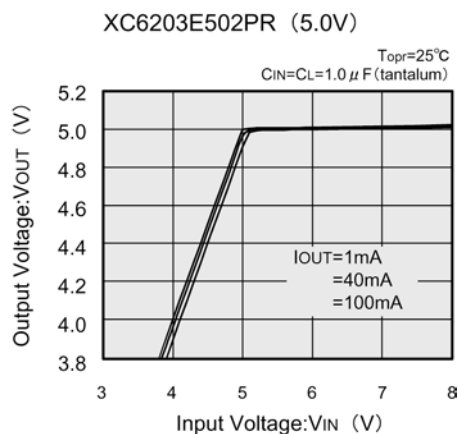
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E502PR

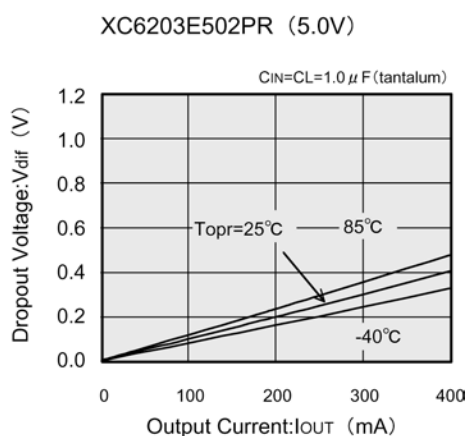
(1) Output Voltage vs. Output Current



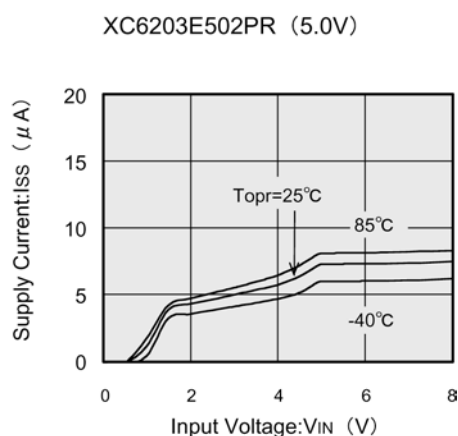
(2) Output Voltage vs. Input Voltage



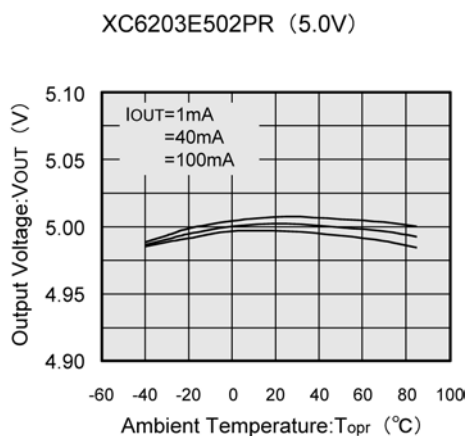
(3) Dropout Voltage vs. Output Current



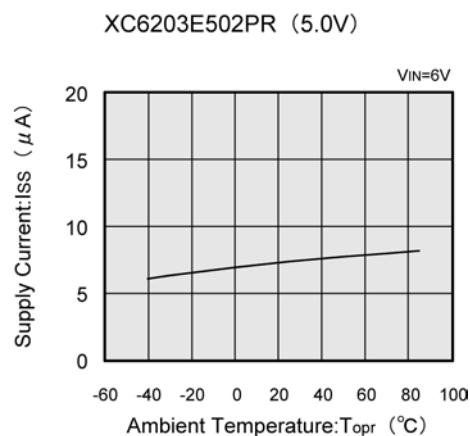
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



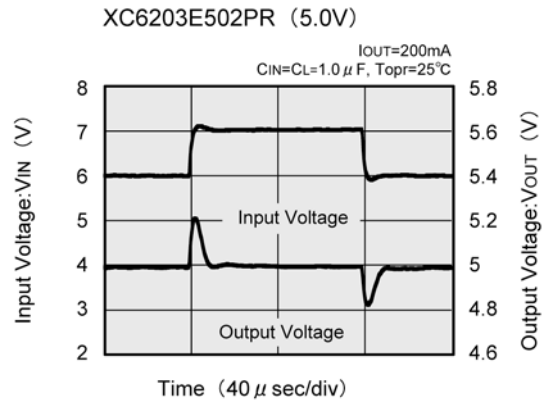
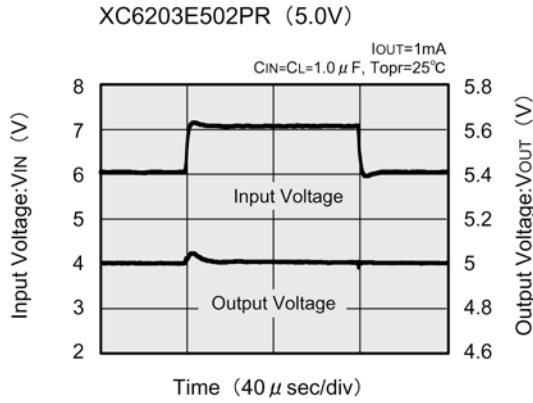
(6) Supply Current vs. Ambient Temperature



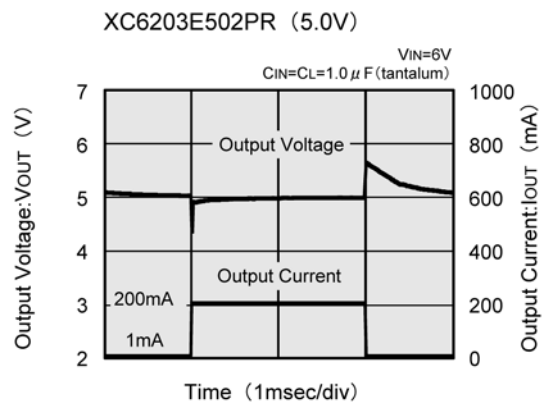
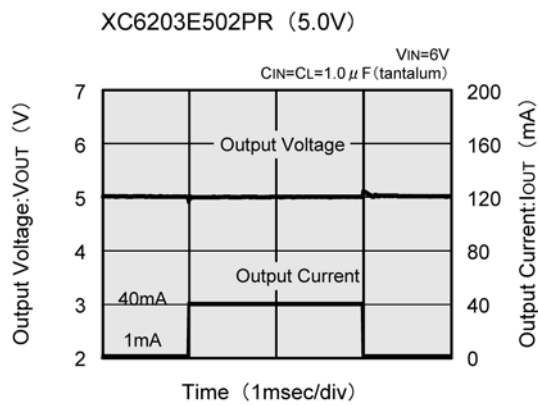
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ●XC6203E502PR (Continued)

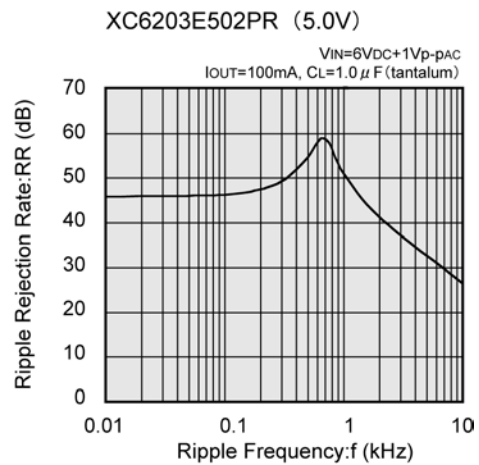
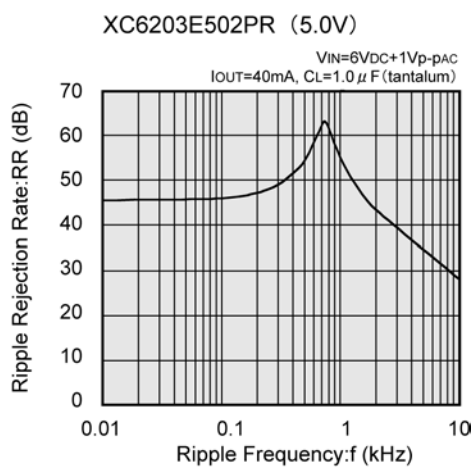
#### (7) Input Transient Response



#### (8) Load Transient Response



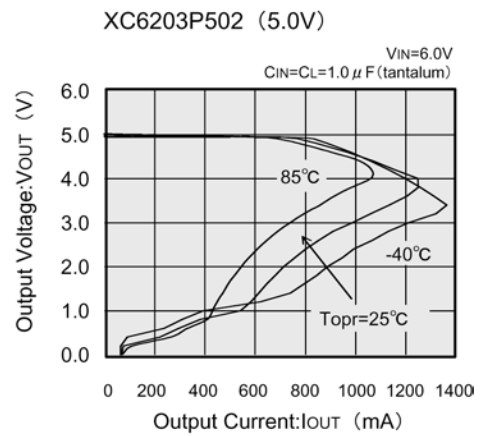
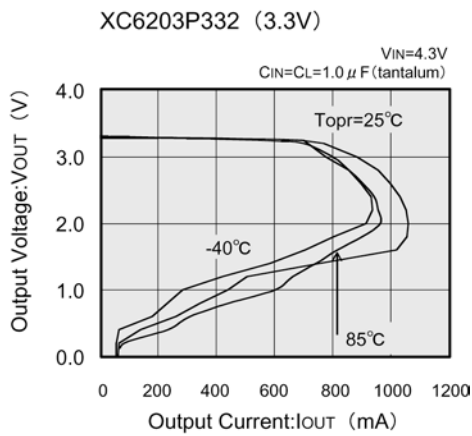
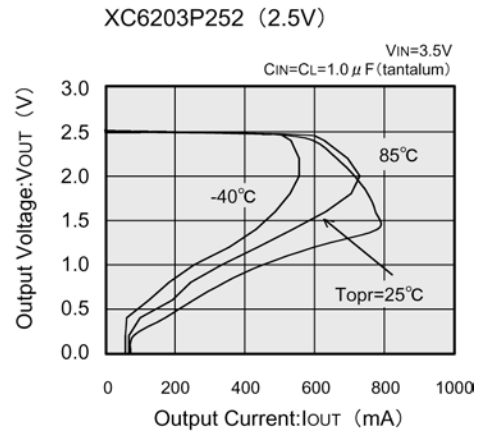
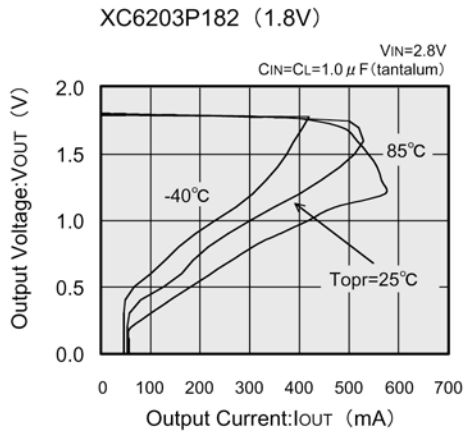
#### (9) Ripple Rejection Rate





## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (10) Output Voltage vs. Output Current



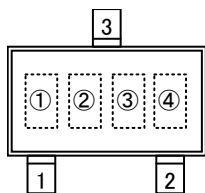
## ■ PACKAGING INFORMATION

For the latest package information go to, [www.torexsemi.com/technical-support/packages](http://www.torexsemi.com/technical-support/packages)

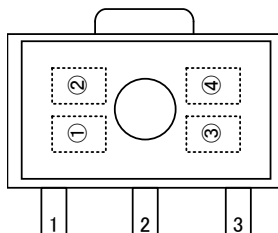
PACKAGE	OUTLINE / LAND PATTERN	THERMAL CHARACTERISTICS	
SOT-89	<a href="#">SOT-89 PKG</a>	Standard Board	<a href="#">SOT-89 Power Dissipation</a>
SOT-23	<a href="#">SOT-23 PKG</a>	Standard Board	<a href="#">SOT-23 Power Dissipation</a>
SOT-223	<a href="#">SOT-223 PKG</a>	Standard Board	<a href="#">SOT-223 Power Dissipation</a>

## MARKING RULE

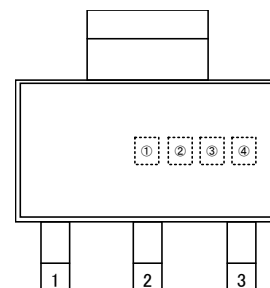
● SOT-23, SOT-89, SOT-223



SOT-23  
(TOP VIEW)



SOT-89  
(TOP VIEW)



SOT-223  
(TOP VIEW)

① represents product series

MARK	PRODUCT SERIES
3	XC6203xxxxx

② represents type of regulator

MARK	VOLTAGE	PRODUCT SERIES
2	0.1~3.0	XC6203E*****
3	3.1~6.0	
4	2.85	
5	0.1~3.0	XC6203P*****
6	3.1~6.0	
7	2.85	

③ represents output voltage

MARK	OUTPUT VOLTAGE (V)			MARK	OUTPUT VOLTAGE (V)		
0	—	3.1	—	F	—	4.6	—
1	—	3.2	—	H	—	4.7	—
2	—	3.3	—	K	1.8	4.8	—
3	—	3.4	—	L	1.9	4.9	—
4	—	3.5	—	M	2.0	5.0	—
5	—	3.6	—	N	2.1	5.1	—
6	—	3.7	—	P	2.2	5.2	—
7	—	3.8	—	R	2.3	5.3	—
8	—	3.9	—	S	2.4	5.4	—
9	—	4.0	—	T	2.5	5.5	—
A	—	4.1	—	U	2.6	5.6	—
B	—	4.2	—	V	2.7	5.7	—
C	—	4.3	—	X	2.8	5.8	2.85
D	—	4.4	—	Y	2.9	5.9	—
E	—	4.5	—	Z	3.0	6.0	—

\*IOUT MAX 450mA (XC6203E\*\*C\*\*)

e.g.

MARK			PRODUCT SERIES
①	②	③	
3	6	2	XC6203P332**
3	4	X	XC6203E28A**
3	2	Z	XC6203E30C**

④ represents production lot number

0~9, A to Z or inverted characters of 0 to 9 and A to Z repeated (G, I, J, O, Q, W excluded)