

## 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 and TO-92 package are available.

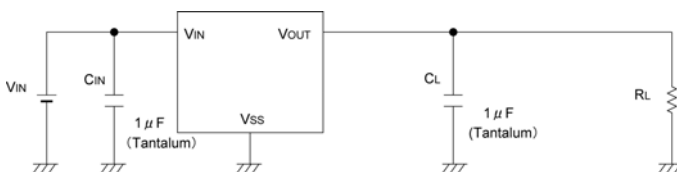
### ■ APPLICATIONS

- Battery powered equipment
- Reference voltage sources
- Cameras, video cameras
- CD-ROMs, DVDs
- Palmtops
- Portable audio video equipment

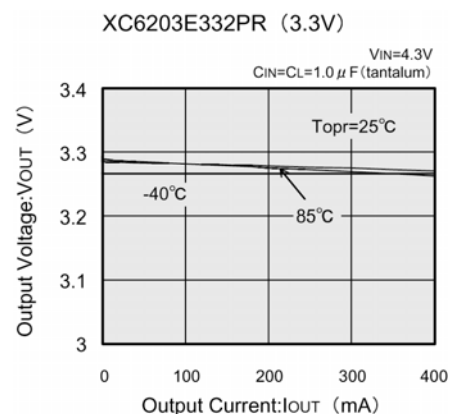
### ■ FEATURES

- 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, TO-92
- Environmentally Friendly** : EU RoHS Compliant, Pb Free

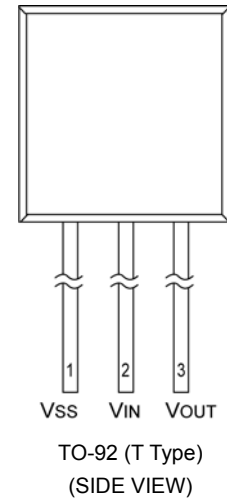
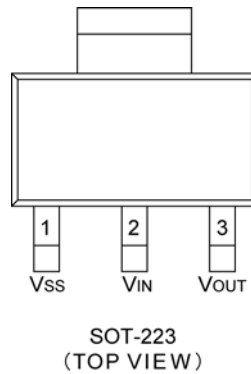
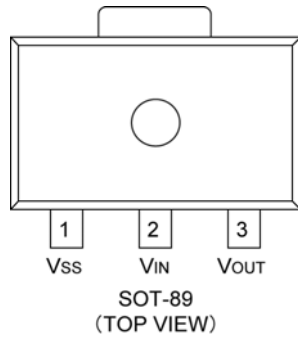
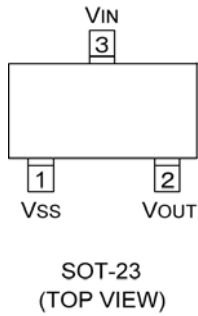
### ■ TYPICAL APPLICATION CIRCUIT



### ■ TYPICAL PERFORMANCE CHARACTERISTICS



## PIN CONFIGURATION



## PIN ASSIGNMENT

PIN NUMBER		PIN NAME	FUNCTION
SOT-23	SOT-89/SOT-223/TO-92		
1	1	VSS	Ground
3	2	VIN	Power Input
2	3	VOUT	Output

## PRODUCT CLASSIFICATION

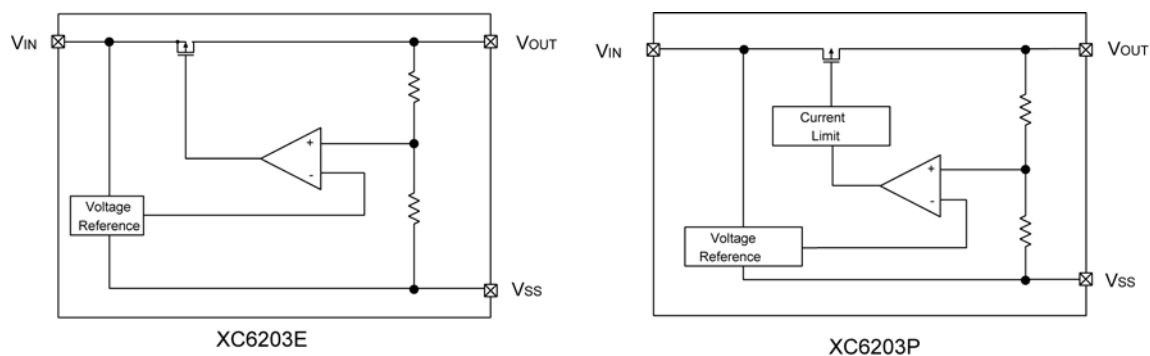
### Ordering Information

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
②③④	Output Voltage	180~600	e.g. 252:2.5V, Accuracy $\pm 2\%$
		28A	2.85V, Accuracy $\pm 2\%$ "A" indicates voltage of 50mV increments
⑤⑥-⑦ <sup>(*)</sup>	Packages (Order Unit)	MR	SOT-23 (3,000/Reel)
		MR-G	SOT-23 (3,000/Reel)
		PR	SOT-89 (1,000/Reel)
		PR-G	SOT-89 (1,000/Reel)
		FR	SOT-223 (1,000/Reel)
		FR-G	SOT-223 (1,000/Reel)
		TH	TO-92, Paper type (2,000/Tape)
		TH-G	TO-92, Paper type (2,000/Tape)
		TB	TO-92, Bag type (500/Bag)
		TB-G	TO-92, Bag type (500/Bag)

<sup>(\*)</sup> The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.

## ■ BLOCK DIAGRAMS



## ■ ABSOLUTE MAXIMUM RATINGS

Ta = 25°C

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage	V <sub>IN</sub>	12	V
Output Current	I <sub>OUT</sub>	500	mA
Output Voltage	V <sub>OUT</sub>	V <sub>SS</sub> -0.3~V <sub>IN</sub> +0.3	V
Power Dissipation	SOT-23	150	mW
	SOT-89	500	
	SOT-223	1,200 <sup>(*)</sup>	
	TO-92	300	
Operating Ambient Temperature	T <sub>opr</sub>	-40~+85	°C
Storage Temperature	T <sub>stg</sub>	-55~+125	°C

\*: Circuits board mounting: Double-sided board

## ELECTRICAL CHARACTERISTICS

XC6203X182

$V_{OUT(T)} = 1.8V$  (\*1)

$T_a = 25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	$V_{IN} = 2.8V$ $I_{OUT} = 40mA$	1.764	1.800	1.836	V
Maximum Output Current	$I_{OUTmax}$	$V_{IN} = 2.8V$ $V_{OUT} \geq V_{OUT(E)} \times 0.90$	400	-	-	mA
Load Regulation	$\Delta V_{OUT}$	$V_{IN} = 2.8V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	$V_{dif1}$	$I_{OUT} = 100mA$	-	200	300	mV
	$V_{dif2}$	$I_{OUT} = 200mA$	-	400	600	
Supply Current	$I_{SS}$	$V_{IN} = 2.8V$	-	8.0	16.0	$\mu A$
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $2.8V \leq V_{IN} \leq 8.0V$	-	0.2	0.3	%/V
Input Voltage	$V_{IN}$		-	-	8	V
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/ $^\circ C$
Short-Circuit Current (XC6203P Series Only)	$I_{LIM}$	$V_{IN} = 2.8V$ $V_{OUT} = 0V$	-	60	-	mA

### NOTE

\*1  $V_{OUT(T)}$  : Nominal output voltage.

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

(i.e. the output voltage when " $V_{OUT(T)} + 1.0V$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{OUT}$  value).

\*3  $V_{dif} = V_{IN1} - V_{OUT1}$

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

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

XC6203X252

$V_{OUT(T)} = 2.5V$  (\*1)

$T_a = 25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	$V_{IN} = 3.5V$ $I_{OUT} = 40mA$	2.450	2.500	2.550	V
Maximum Output Current	$I_{OUTmax}$	$V_{IN} = 3.5V$ $V_{OUT} \geq V_{OUT(E)} \times 0.93$	400	-	-	mA
Load Regulation	$\Delta V_{OUT}$	$V_{IN} = 3.5V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	$V_{dif1}$	$I_{OUT} = 100mA$	-	170	250	mV
	$V_{dif2}$	$I_{OUT} = 200mA$	-	320	500	
Supply Current	$I_{SS}$	$V_{IN} = 3.5V$	-	8.0	16.0	$\mu A$
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $3.5V \leq V_{IN} \leq 8.0V$	-	0.2	0.3	%/V
Input Voltage	$V_{IN}$		-	-	8	V
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/ $^\circ C$
Short-Circuit Current (XC6203P Series Only)	$I_{LIM}$	$V_{IN} = 3.5V$ $V_{OUT} = 0V$	-	60	-	mA

### NOTE

\*1  $V_{OUT(T)}$  : Nominal Specified output voltage.

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

(i.e. the output voltage when " $V_{OUT(T)} + 1.0V$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{OUT}$  value).

\*3  $V_{dif} = V_{IN1} - V_{OUT1}$

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

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

## ■ ELECTRICAL CHARACTERISTICS (Continued)

XC6203X302

$V_{OUT(T)} = 3.0V$  (\*1)

$T_a = 25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	$V_{IN} = 4V$ $I_{OUT} = 40mA$	2.940	3.000	3.060	V
Maximum Output Current	$I_{OUTmax}$	$V_{IN} = 4V$ $V_{OUT} \geq V_{OUT(E)} \times 0.96$	400	-	-	mA
Load Regulation	$\Delta V_{OUT}$	$V_{IN} = 4V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	Vdif1	$I_{OUT} = 100mA$	-	150	220	mV
	Vdif2	$I_{OUT} = 200mA$	-	300	420	
Supply Current	$I_{SS}$	$V_{IN} = 4V$	-	8.0	16.0	$\mu A$
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot \Delta V_{OUT}}$	$I_{OUT} = 40mA$ $4V \leq V_{IN} \leq 8.0V$	-	0.2	0.3	%/V
Input Voltage	$V_{IN}$		-	-	8.0	V
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
Short-Circuit Current (XC6203P Series Only)	$I_{LIM}$	$V_{IN} = 4V$ $V_{OUT} = 0V$	-	60	-	mA

**NOTE**

\*1  $V_{OUT(T)}$  : Nominal Specified output voltage.

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

(i.e. the output voltage when " $V_{OUT(T)} + 1.0V$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{OUT}$  value).

\*3  $V_{dif} = V_{IN1} - V_{OUT1}$

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

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

XC6203X332

$V_{OUT(T)} = 3.3V$  (\*1)

$T_a = 25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	$V_{IN} = 4.3V$ $I_{OUT} = 40mA$	2.940	3.300	3.366	V
Maximum Output Current	$I_{OUTmax}$	$V_{IN} = 4.3V$ $V_{OUT} \geq V_{OUT(E)} \times 0.96$	400	-	-	mA
Load Regulation	$\Delta V_{OUT}$	$V_{IN} = 4.3V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	Vdif1	$I_{OUT} = 100mA$	-	150	220	mV
	Vdif2	$I_{OUT} = 200mA$	-	300	420	
Supply Current	$I_{SS}$	$V_{IN} = 4.3V$	-	8.0	16.0	$\mu A$
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot \Delta V_{OUT}}$	$I_{OUT} = 40mA$ $4.3V \leq V_{IN} \leq 8.0V$	-	0.2	0.3	%/V
Input Voltage	$V_{IN}$		-	-	8	V
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
Short-Circuit Current (XC6203P Series Only)	$I_{LIM}$	$V_{IN} = 4.3V$ $V_{OUT} = 0V$	-	60	-	mA

**NOTE**

\*1  $V_{OUT(T)}$  : Nominal Specified output voltage.

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

(i.e. the output voltage when " $V_{OUT(T)} + 1.0V$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{OUT}$  value).

\*3  $V_{dif} = V_{IN1} - V_{OUT1}$

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

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

## ELECTRICAL CHARACTERISTICS (Continued)

XC6203X502

$V_{OUT(T)} = 5.0V$  (\*1)

$T_a = 25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	$V_{IN} = 6.0V$ $I_{OUT} = 40mA$	4.900	5.000	5.100	V
Maximum Output Current	$I_{OUTmax}$	$V_{IN} = 6.0V$ $V_{OUT} \geq V_{OUT(E)} \times 0.96$	400	-	-	mA
Load Regulation	$\Delta V_{OUT}$	$V_{IN} = 6.0V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	Vdif1	$I_{OUT} = 100mA$	-	100	180	mV
	Vdif2	$I_{OUT} = 200mA$	-	200	320	
Supply Current	$I_{SS}$	$V_{IN} = 6.0V$	-	10.0	20.0	$\mu A$
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $6.0V \leq V_{IN} \leq 8.0V$	-	0.2	0.3	%/V
Input Voltage	$V_{IN}$		-	-	8.0	V
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
Short-Circuit Current (XC6203P Series Only)	$I_{LIM}$	$V_{IN} = 6.0V$ $V_{OUT} = 0V$	-	60	-	mA

### NOTE

\*1  $V_{OUT(T)}$  : Nominal Specified output voltage.

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

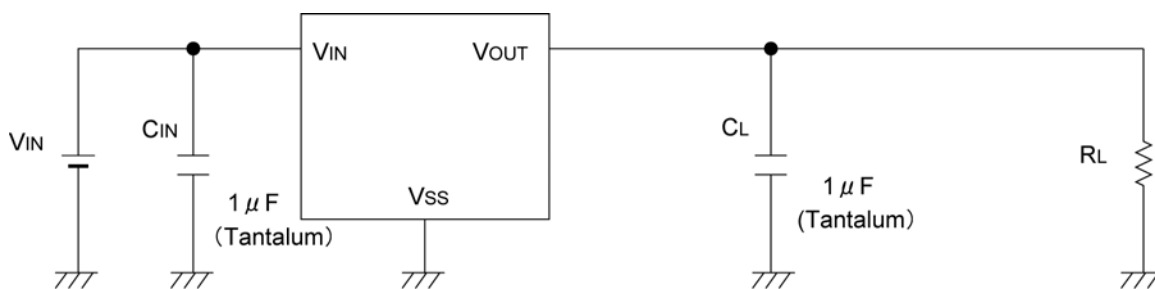
(i.e. the output voltage when " $V_{OUT(T)} + 1.0V$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{OUT}$  value).

\*3  $V_{dif} = V_{IN1} - V_{OUT1}$

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

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

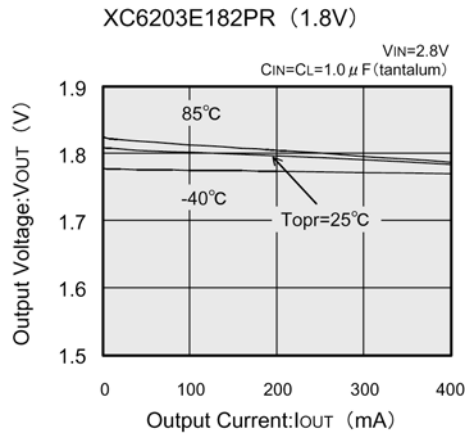
## TYPICAL APPLICATION CIRCUIT



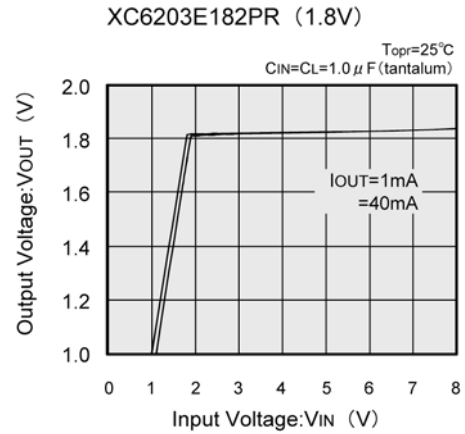
## ■ TYPICAL PERFORMANCE CHARACTERISTICS

### ● XC6203E182PR

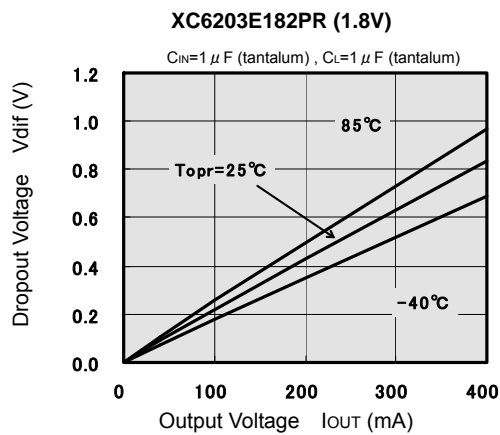
(1) Output Voltage vs. Output Current



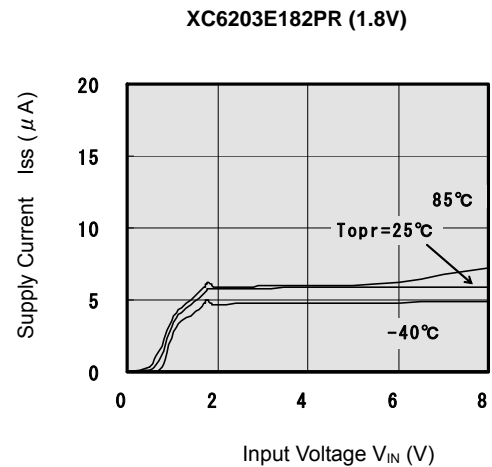
(2) Output Voltage vs. Input Voltage



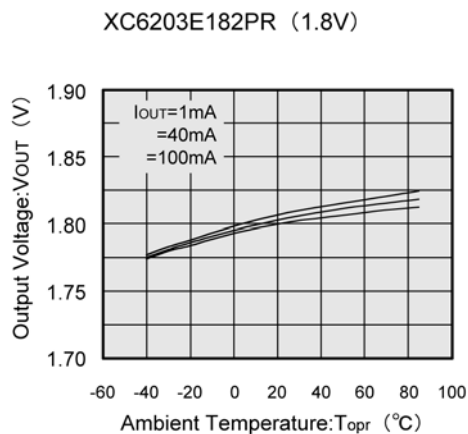
(3) Dropout Voltage vs. Output Current



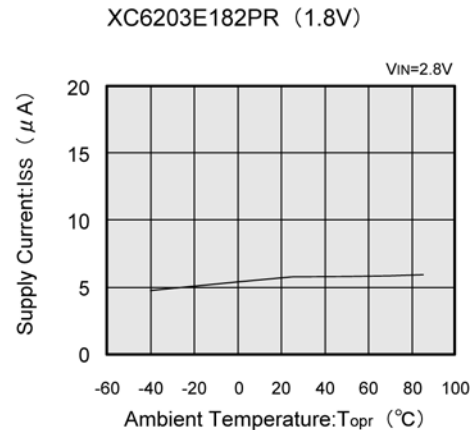
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



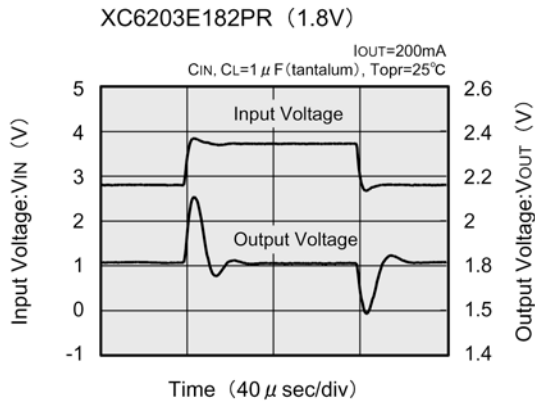
(6) Supply Current vs. Ambient Temperature



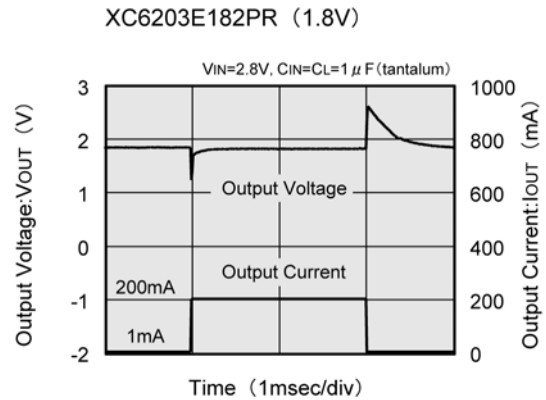
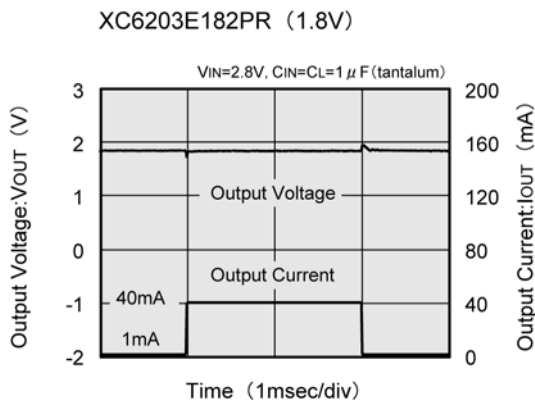
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ●XC6203E182PR (Continued)

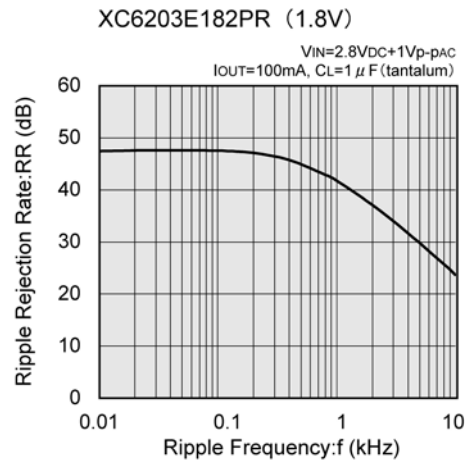
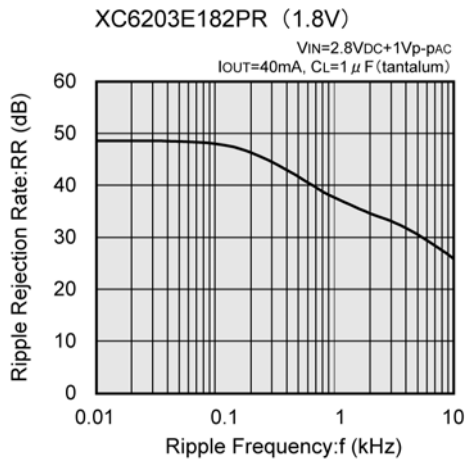
#### (7) Input Transient Response



#### (8) Load Transient Response



#### (9) Ripple Rejection Rate

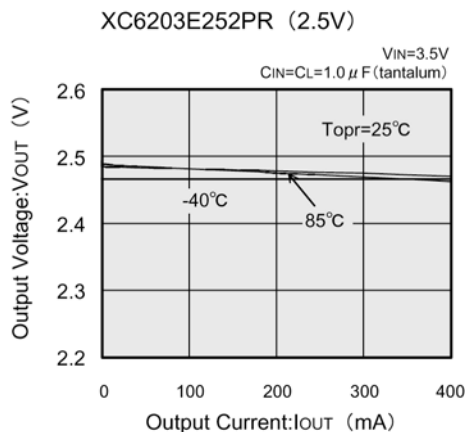




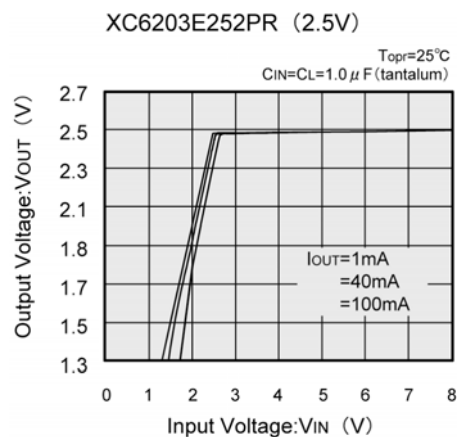
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E252PR

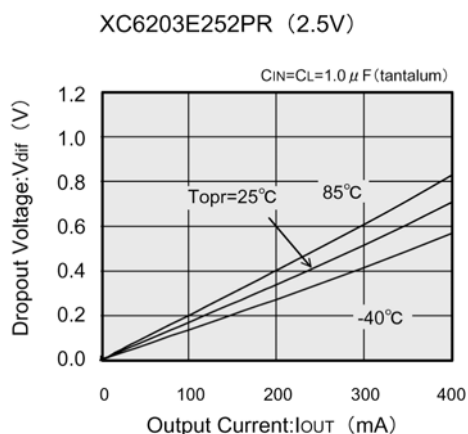
(1) Output Voltage vs. Output Current



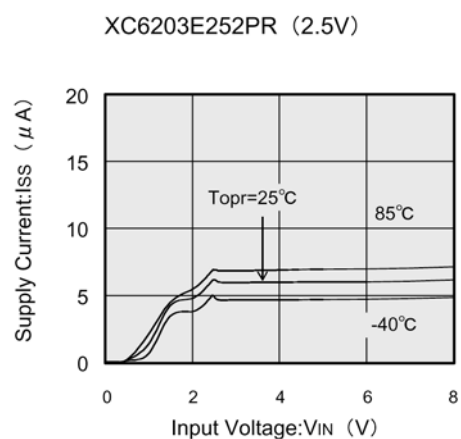
(2) Output Voltage vs. Input Voltage



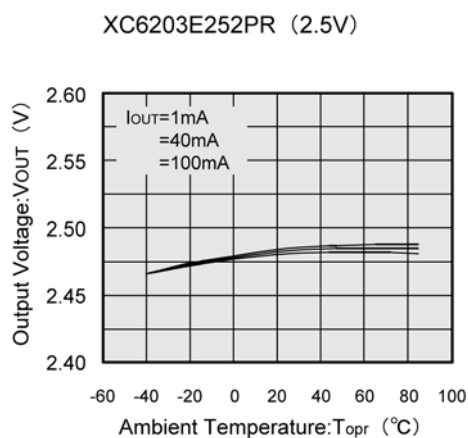
(3) Dropout Voltage vs. Output Current



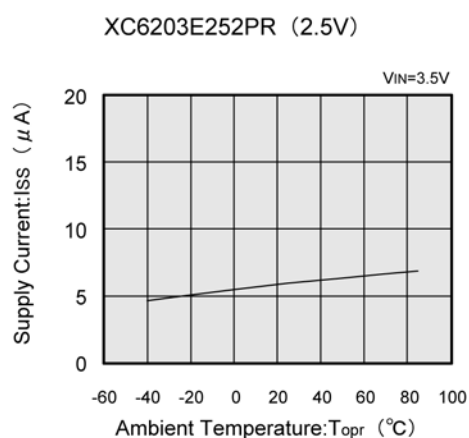
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



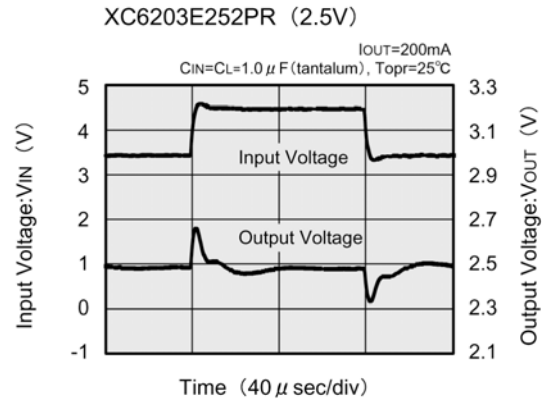
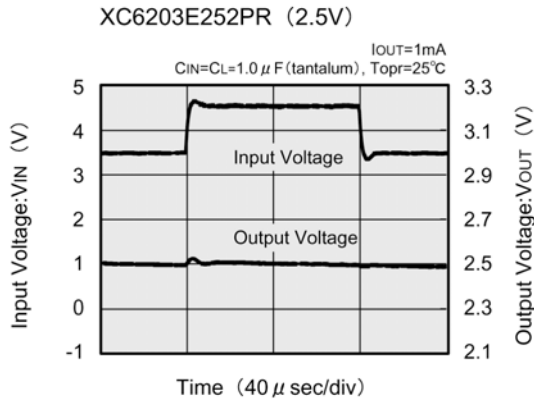
(6) Supply Current vs. Ambient Temperature



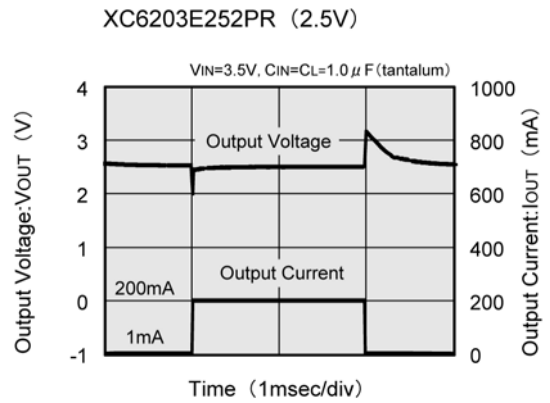
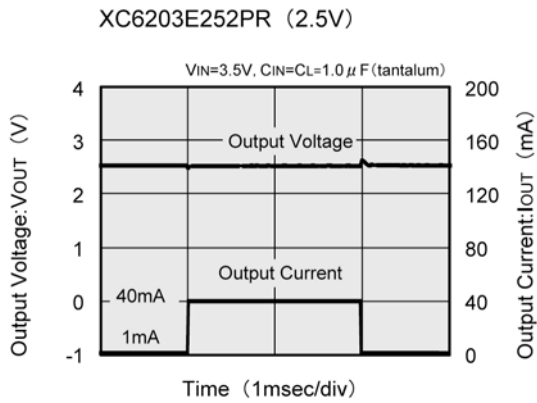
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ●XC6203E252PR (Continued)

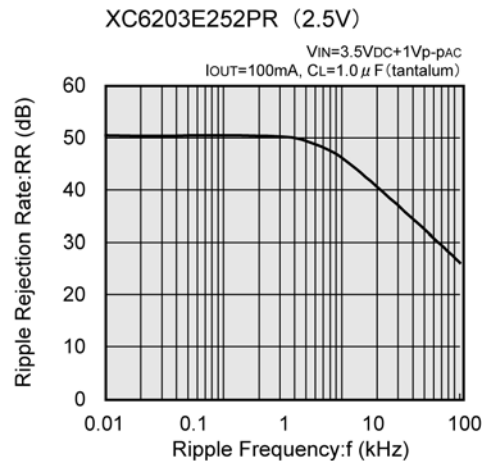
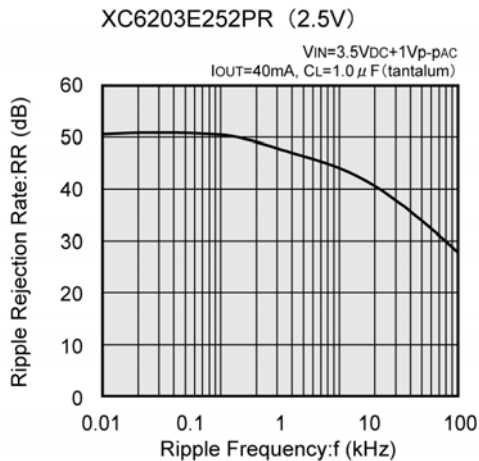
#### (7) Input Transient Response



#### (8) Load Transient Response



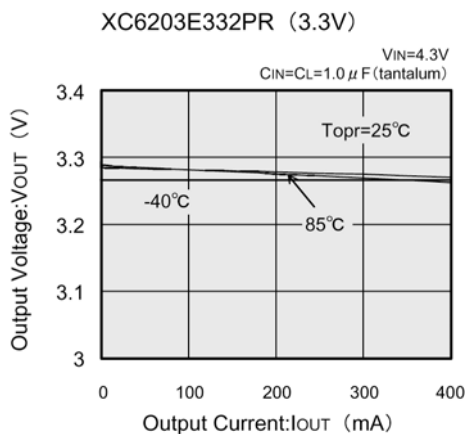
#### (9) Ripple Rejection Rate



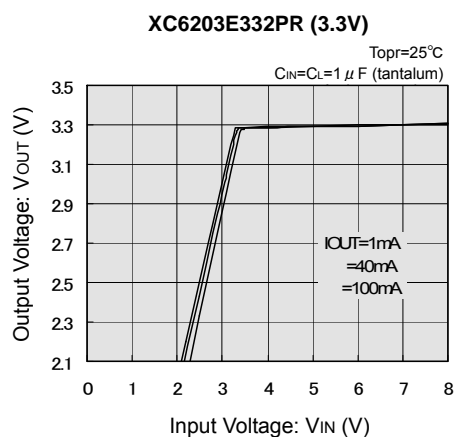
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E332PR

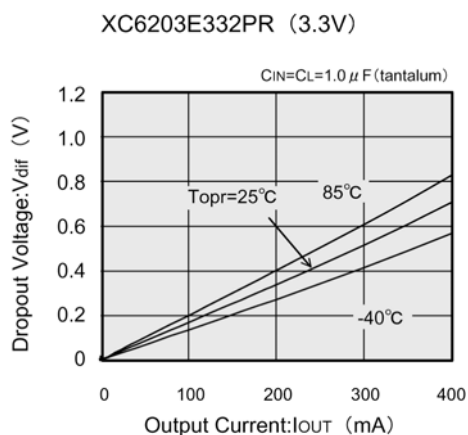
(1) Output Voltage vs. Output Current



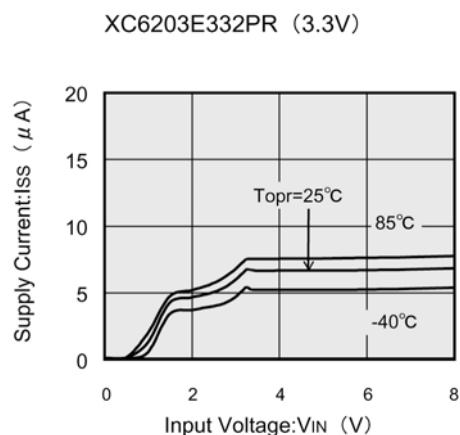
(2) Output Voltage vs. Input Voltage



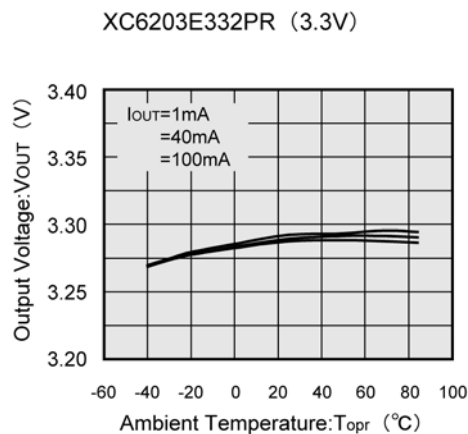
(3) Dropout Voltage vs. Output Current



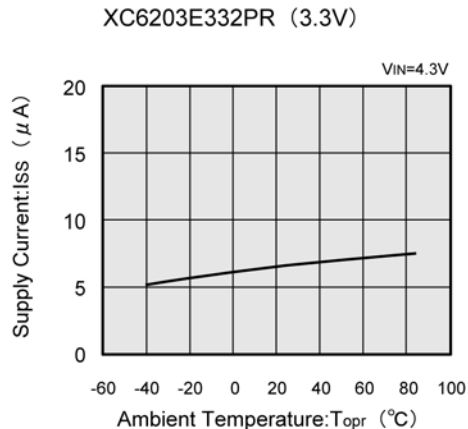
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



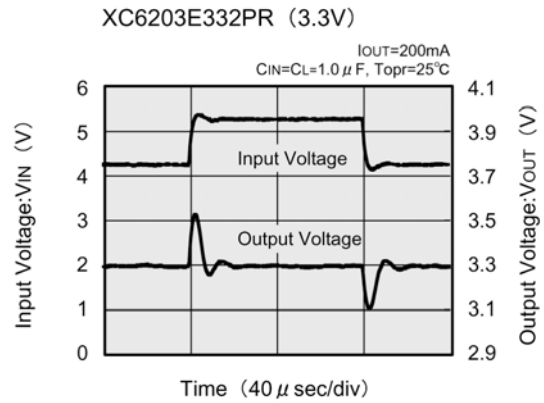
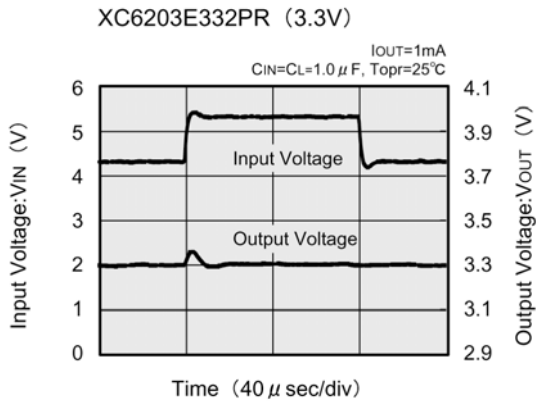
(6) Supply Current vs. Ambient Temperature



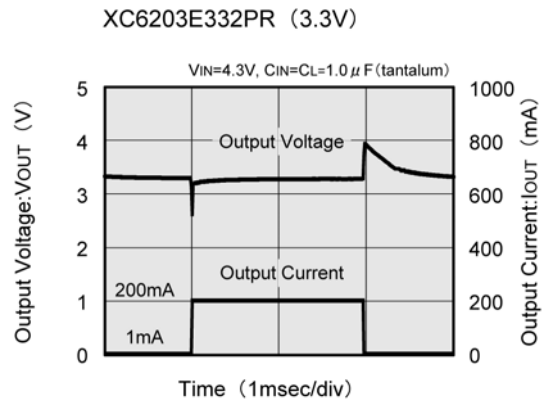
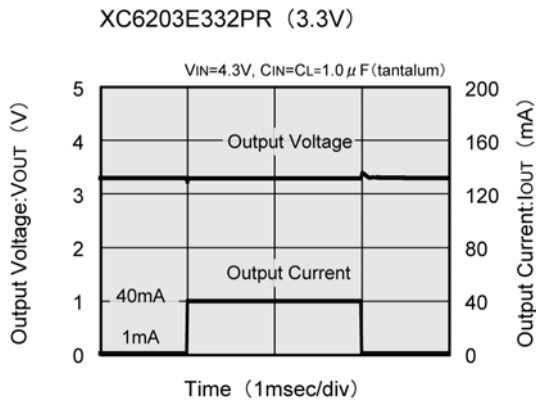
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ● XC6203E332PR (Continued)

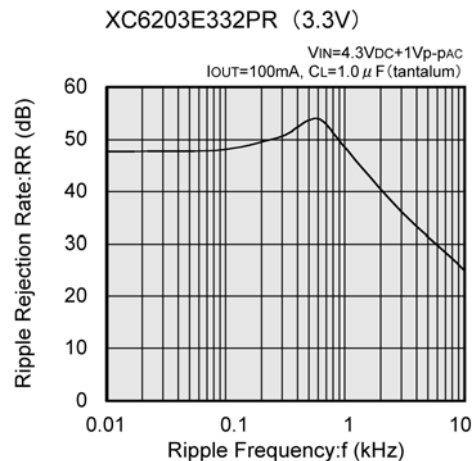
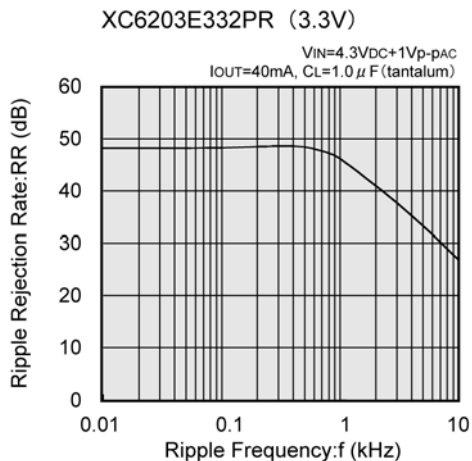
#### (7) Input Transient Response



#### (8) Load Transient Response



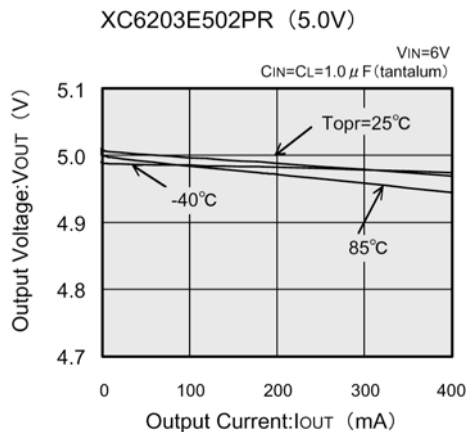
#### (9) Ripple Rejection Rate



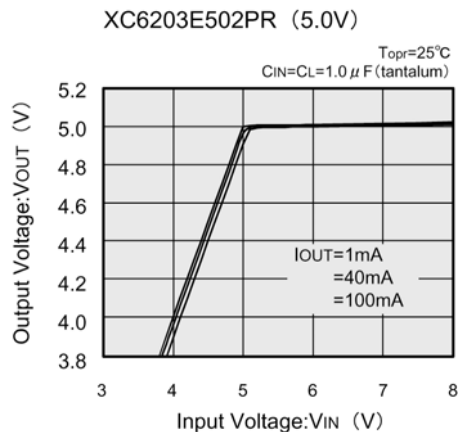
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E502PR

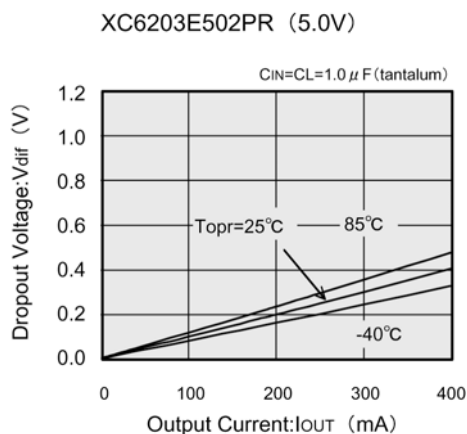
(1) Output Voltage vs. Output Current



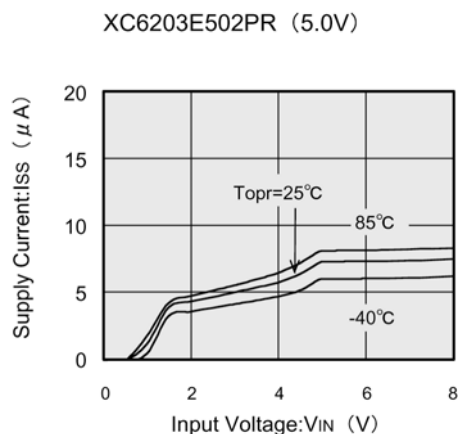
(2) Output Voltage vs. Input Voltage



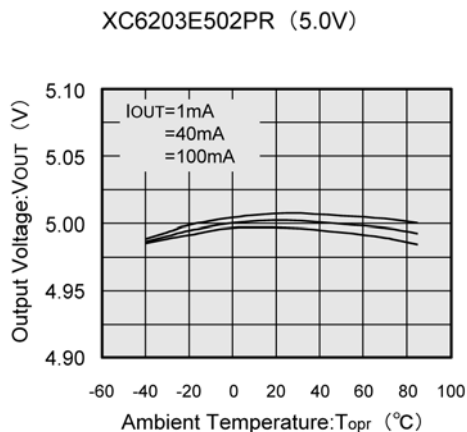
(3) Dropout Voltage vs. Output Current



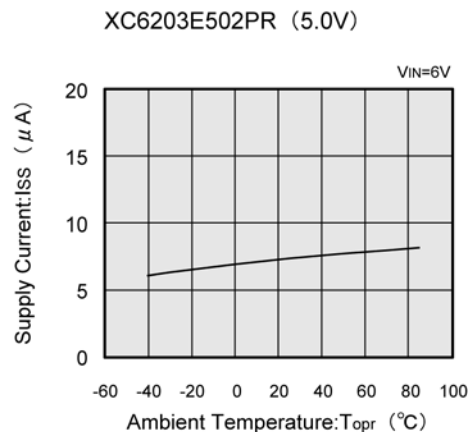
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



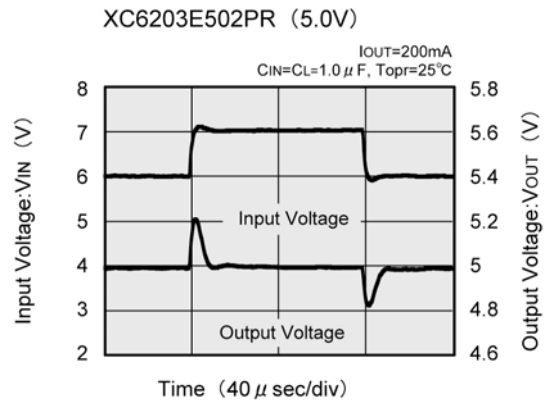
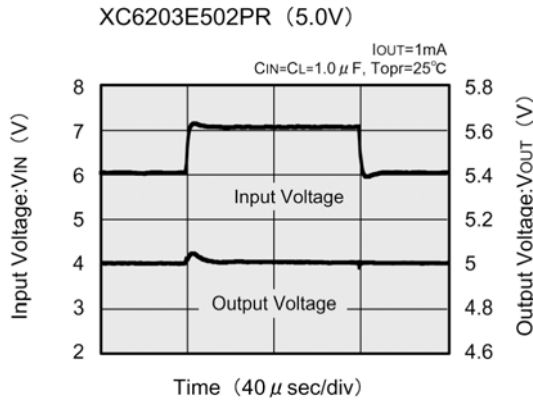
(6) Supply Current vs. Ambient Temperature



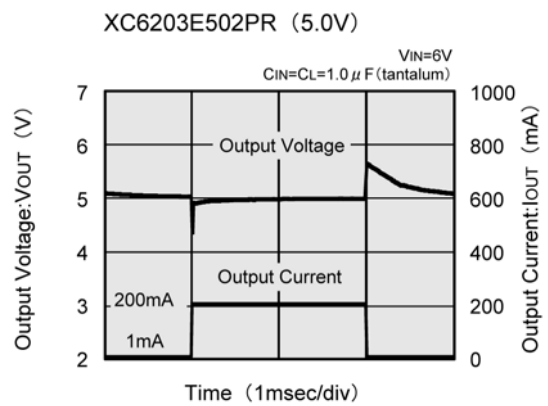
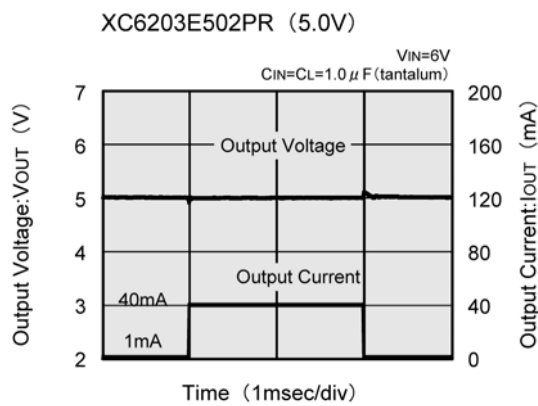
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ●XC6203E502PR (Continued)

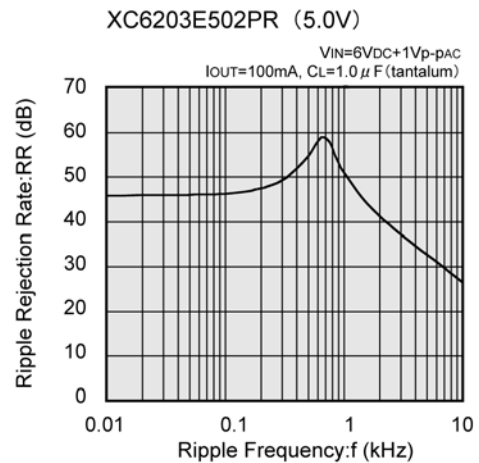
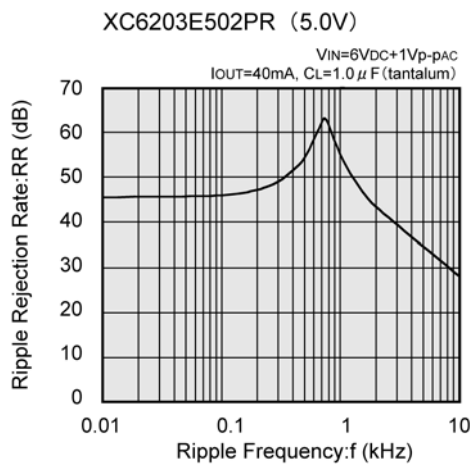
#### (7) Input Transient Response



#### (8) Load Transient Response



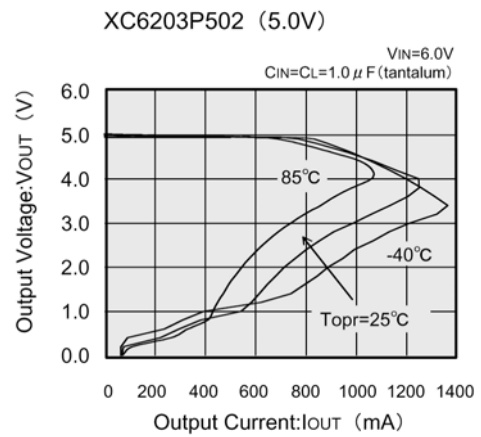
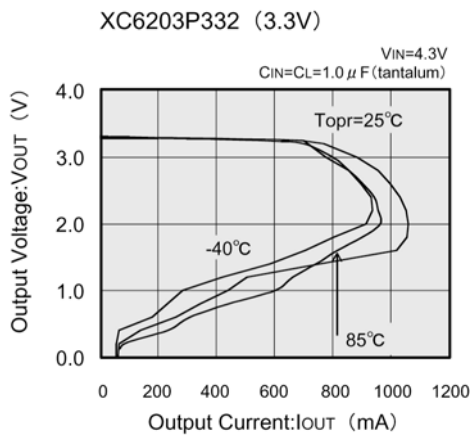
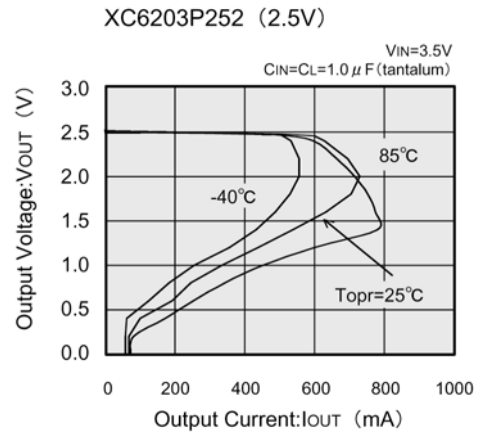
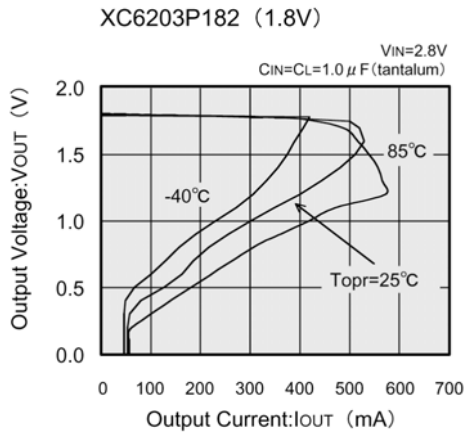
#### (9) Ripple Rejection Rate



■ **TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

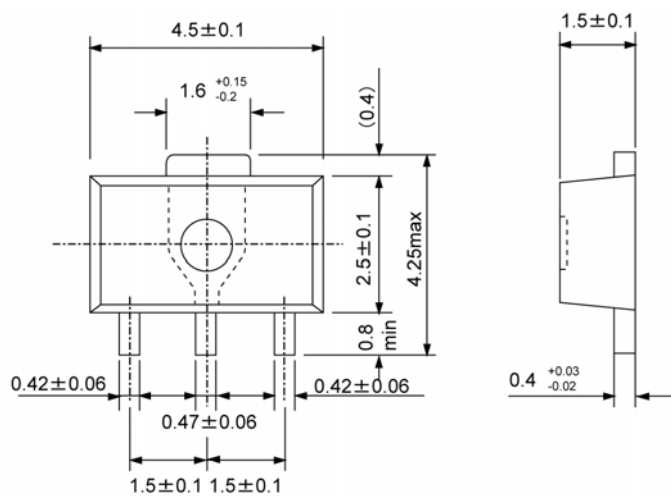
● **XC6203E502PR (Continued)**

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

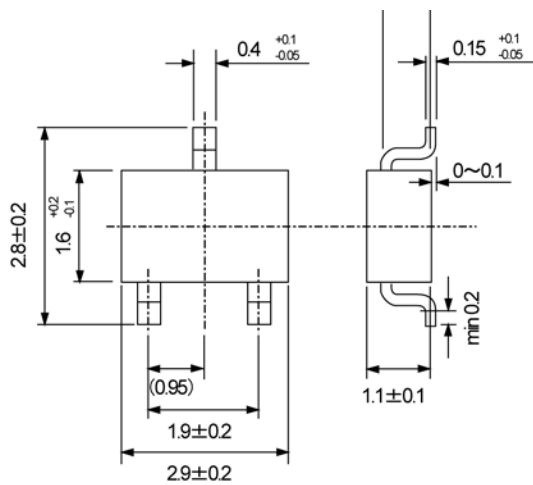


## PACKAGING INFORMATION

### ● SOT-89



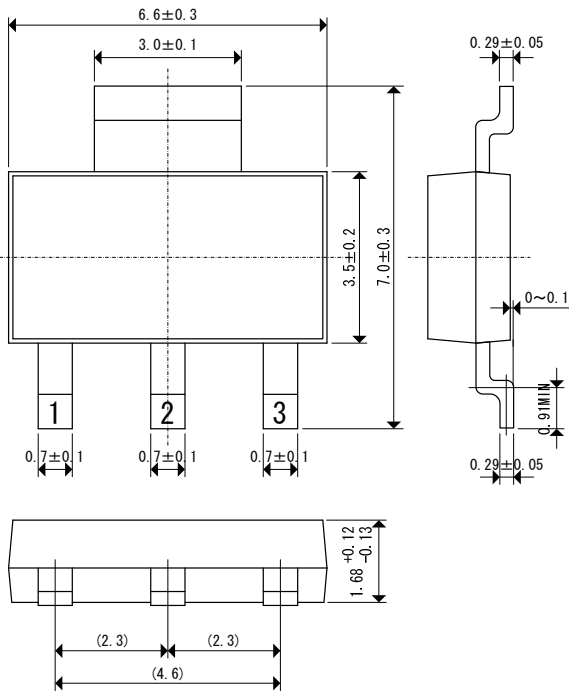
### ● SOT-23



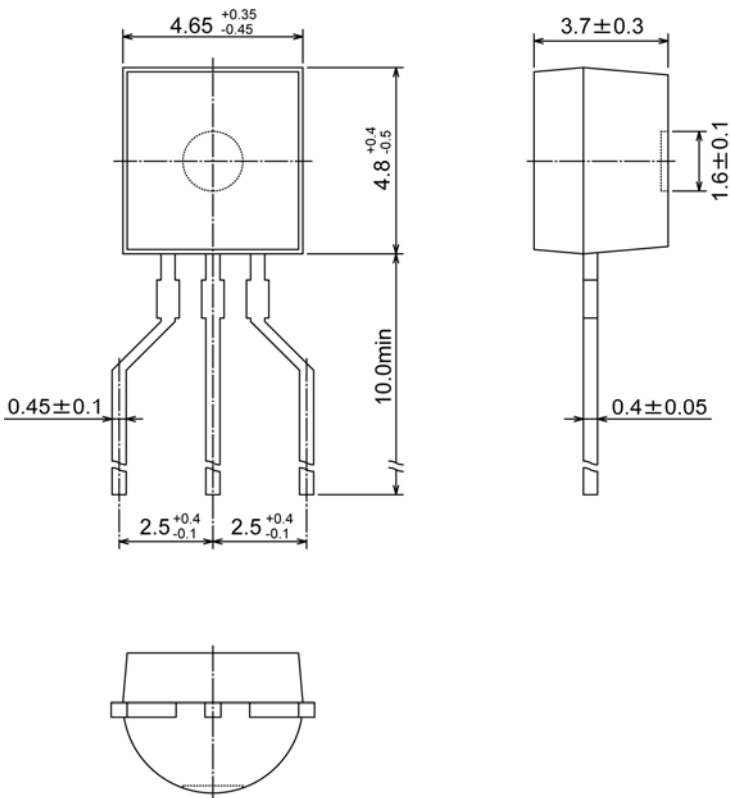


■ PACKAGING INFORMATION (Continued)

● SOT-223

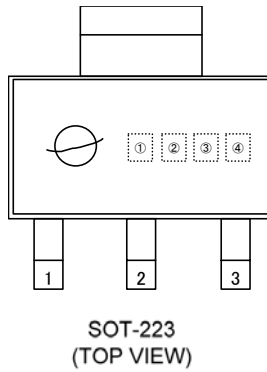
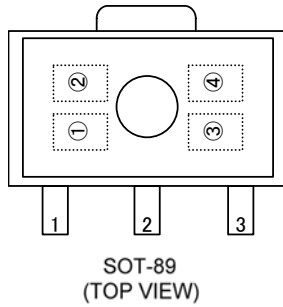
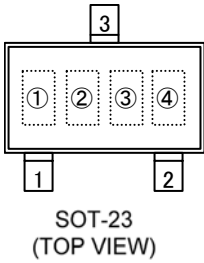


● TO-92



## MARKING RULE

● SOT-23, SOT-89, SOT-223



① represents product series

MARK	PRODUCT SERIES
3	XC6203xxxx

② represents type of regulator

MARK			PRODUCT SERIES
VOLTAGE=0.1~3.0V	VOLTAGE=3.1~6.0V	VOLTAGE=2.85V	
5	6	7	XC6203Pxxxx
2	3	4	XC6203Exxxxx

③ represents output voltage

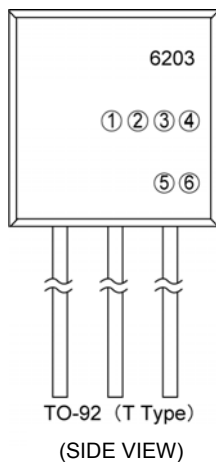
MARK	OUTPUT VOLTAGE (V)			MARK	OUTPUT VOLTAGE (V)		
0	—	3.1	—	F	—	4.6	—
1	—	3.2	—	H	—	4.7	—
2	—	3.3	—	K	1.8	4.8	—
3	—	3.4	—	L	1.9	4.9	—
4	—	3.5	—	M	2.0	5.0	—
5	—	3.6	—	N	2.1	5.1	—
6	—	3.7	—	P	2.2	5.2	—
7	—	3.8	—	R	2.3	5.3	—
8	—	3.9	—	S	2.4	5.4	—
9	—	4.0	—	T	2.5	5.5	—
A	—	4.1	—	U	2.6	5.6	—
B	—	4.2	—	V	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	—

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)

## MARKING RULE (Continued)

● TO-92



① represents type of regulator

MARK	PRODUCT SERIES
P	XC6203Pxxxxx
E	XC6203Exxxxx

②③④ represents output voltage and voltage accuracy

MARK			VOLTAGE (V)	VOLTAGE ACCURACY (%)	PRODUCT SERIES
②	③	④			
3	3	2	3.3	±2	XC6203x332xx
5	0	1	5.0	±1	XC6203x501xx
2	8	A	2.85	±2	XC6203x28Axx

⑤ represents least significant digit of the production year

MARK	PRODUCTION SERIES
3	2003
4	2004

⑥ represents production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

Note: No character inversion used

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