

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.

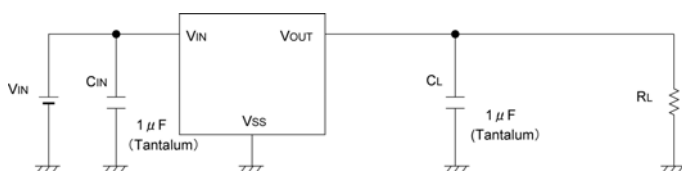
■ APPLICATIONS

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

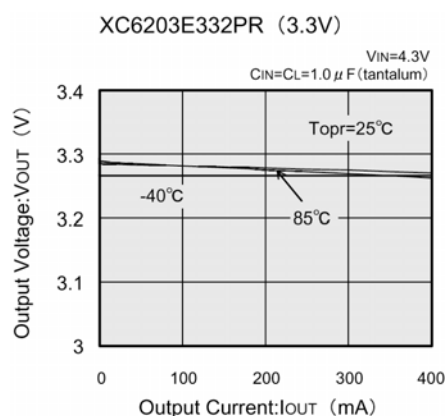
■ FEATURES

- 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** : $8.0 \mu A$ (TYP.)
- Line Regulation** : $0.2\% / V$ (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

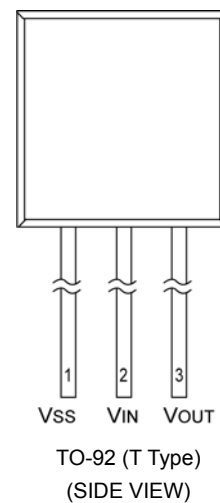
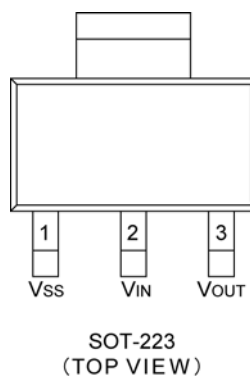
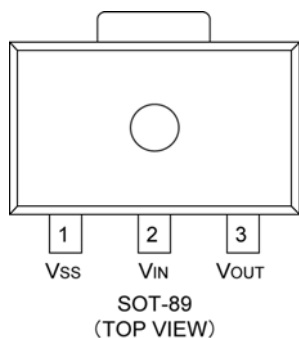
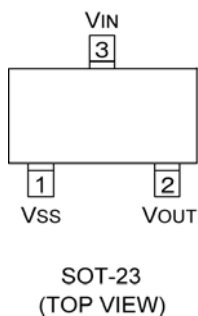
■ TYPICAL APPLICATION CIRCUIT



■ 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

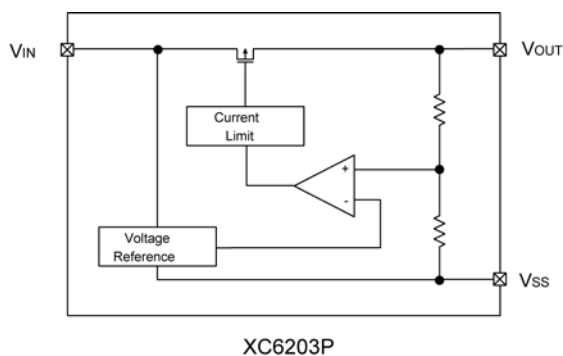
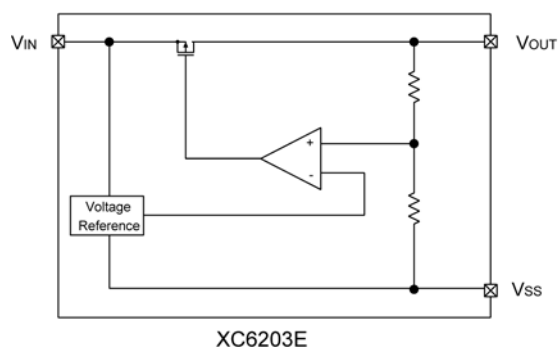
Ordering Information

XC6203 ①②③④⑤⑥-⑦^(*)

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 ^(*)	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)

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

■ BLOCK DIAGRAMS



■ ABSOLUTE MAXIMUM RATINGS

$T_a = 25^\circ\text{C}$

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	12	V
Output Current		I_{OUT}	500	mA
Output Voltage		V_{OUT}	$V_{SS}-0.3 \sim V_{IN}+0.3$	V
Power Dissipation	SOT-23	P_d	150	mW
	SOT-89		500	
	SOT-223		1,200 ^(*)	
	TO-92		300	
Operating Ambient Temperature		T_{opr}	$-40 \sim +85$	$^\circ\text{C}$
Storage Temperature		T_{stg}	$-55 \sim +125$	$^\circ\text{C}$

*: 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	ΔV_{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	μA
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot \Delta V_{OUT}}$	$I_{OUT} = 40mA$ $2.8V \leq V_{IN} \leq 8.0V$	-	0.2	0.3	%/V
Input Voltage	V_{IN}		-	-	8	V
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $-40^\circ C \leq T_{opr} \leq 85^\circ C$	-	± 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	ΔV_{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	μA
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot \Delta V_{OUT}}$	$I_{OUT} = 40mA$ $3.5V \leq V_{IN} \leq 8.0V$	-	0.2	0.3	%/V
Input Voltage	V_{IN}		-	-	8	V
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $-40^\circ C \leq T_{opr} \leq 85^\circ C$	-	± 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	ΔV_{OUT}	$V_{IN} = 4V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	V_{dif1}	$I_{OUT} = 100mA$	-	150	220	mV
	V_{dif2}	$I_{OUT} = 200mA$	-	300	420	
Supply Current	I_{SS}	$V_{IN} = 4V$	-	8.0	16.0	μA
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	$\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $-40^\circ C \leq T_{opr} \leq 85^\circ C$	-	± 100	-	ppm/ $^\circ C$
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	ΔV_{OUT}	$V_{IN} = 4.3V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	V_{dif1}	$I_{OUT} = 100mA$	-	150	220	mV
	V_{dif2}	$I_{OUT} = 200mA$	-	300	420	
Supply Current	I_{SS}	$V_{IN} = 4.3V$	-	8.0	16.0	μA
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	$\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $-40^\circ C \leq T_{opr} \leq 85^\circ C$	-	± 100	-	ppm/ $^\circ C$
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	ΔV_{OUT}	$V_{IN} = 6.0V$ $1mA \leq I_{OUT} \leq 200mA$	-	40	100	mV
Dropout Voltage (*3)	V_{dif1}	$I_{OUT} = 100mA$	-	100	180	mV
	V_{dif2}	$I_{OUT} = 200mA$	-	200	320	
Supply Current	I_{SS}	$V_{IN} = 6.0V$	-	10.0	20.0	μA
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	$\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$	$I_{OUT} = 40mA$ $-40^\circ C \leq T_{opr} \leq 85^\circ C$	-	± 100	-	ppm/ $^\circ C$
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

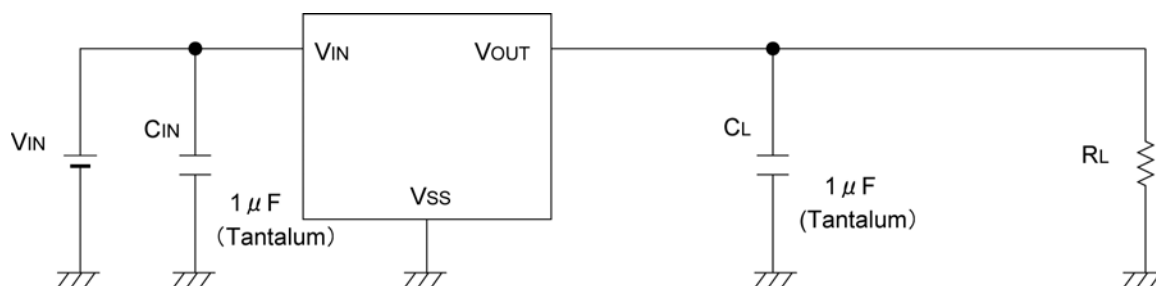
(i.e. the output voltage when " $V_{OUT(T)} + 1.0V$ " is provided at the V_{IN} pin while maintaining a certain I_{OUT} value).

*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.

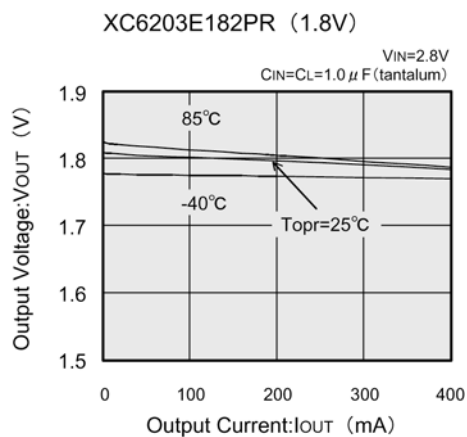
TYPICAL APPLICATION CIRCUIT



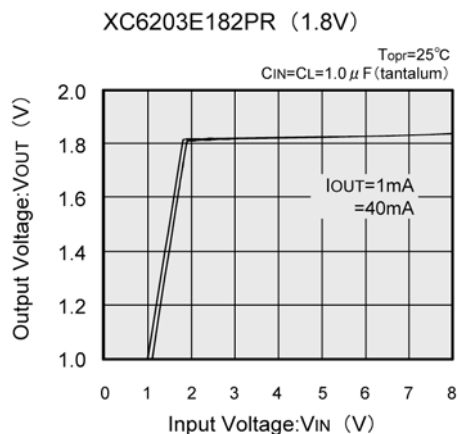
■ TYPICAL PERFORMANCE CHARACTERISTICS

● XC6203E182PR

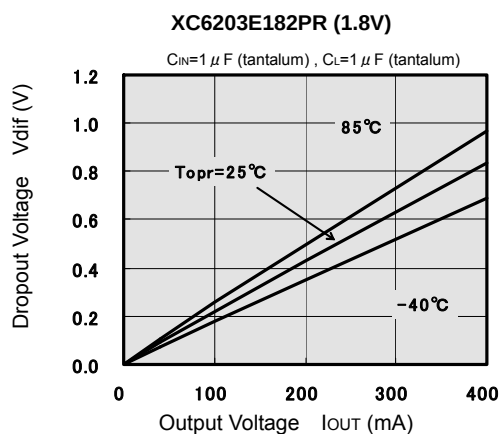
(1) Output Voltage vs. Output Current



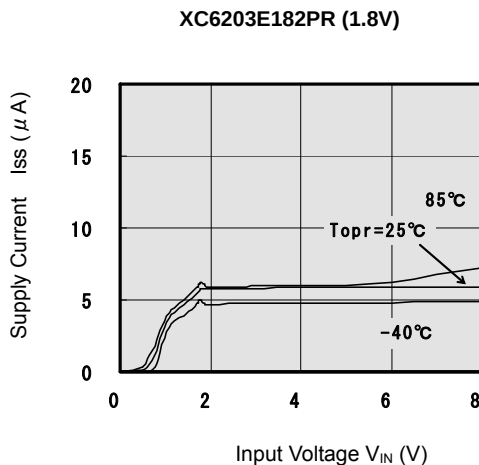
(2) Output Voltage vs. Input Voltage



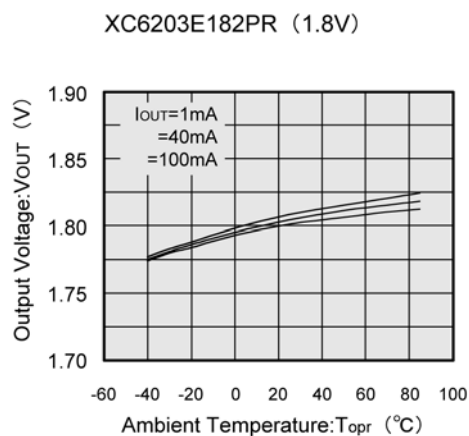
(3) Dropout Voltage vs. Output Current



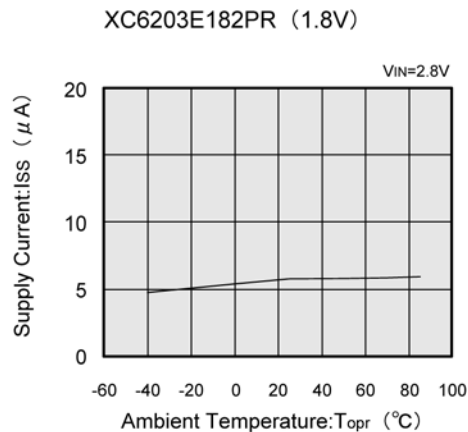
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



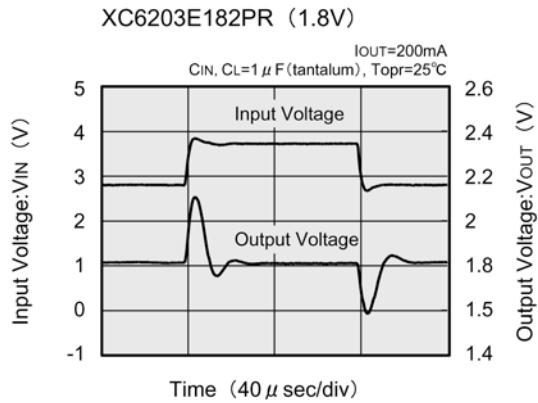
(6) Supply Current vs. Ambient Temperature



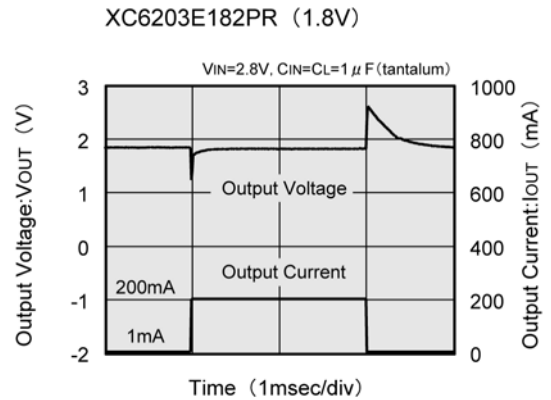
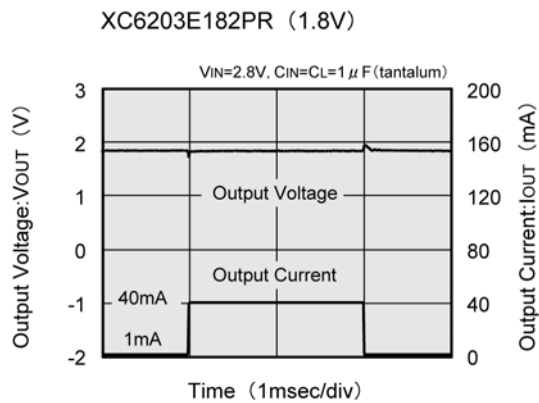
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

●XC6203E182PR (Continued)

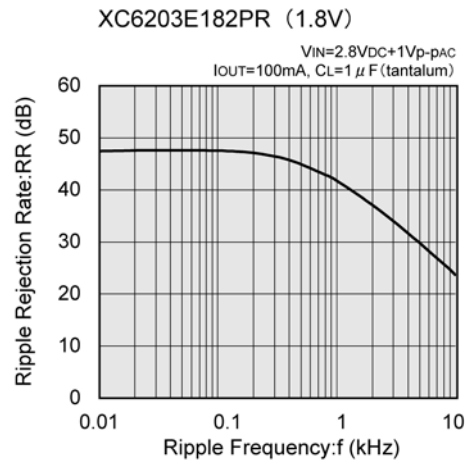
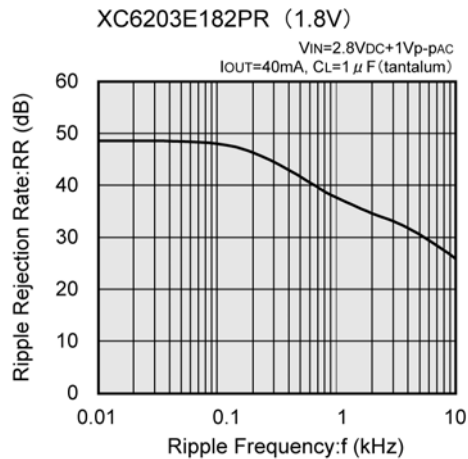
(7) Input Transient Response



(8) Load Transient Response



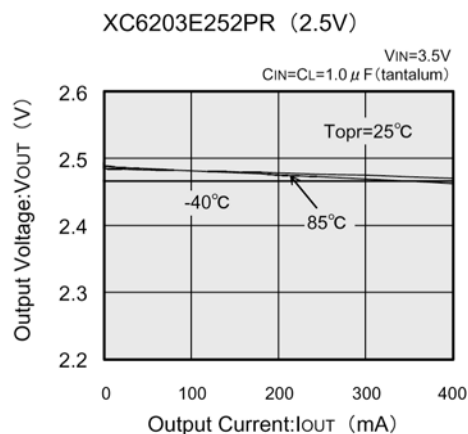
(9) Ripple Rejection Rate



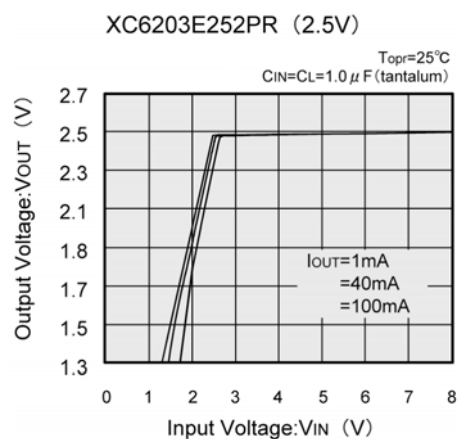
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E252PR

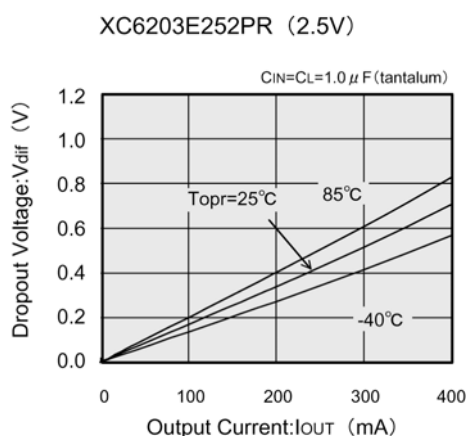
(1) Output Voltage vs. Output Current



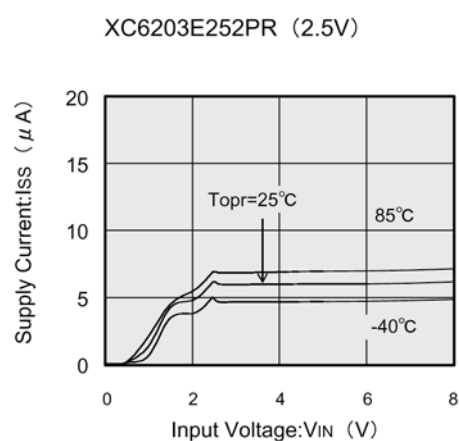
(2) Output Voltage vs. Input Voltage



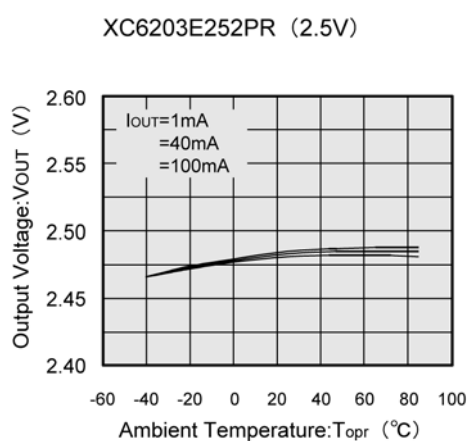
(3) Dropout Voltage vs. Output Current



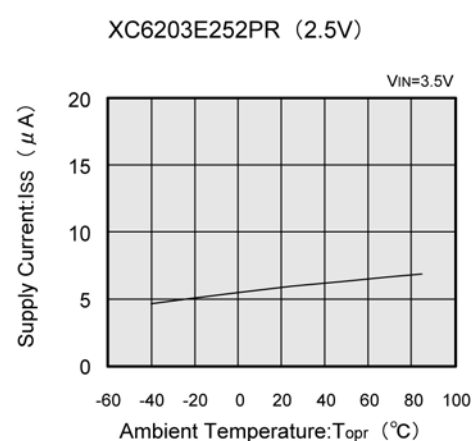
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



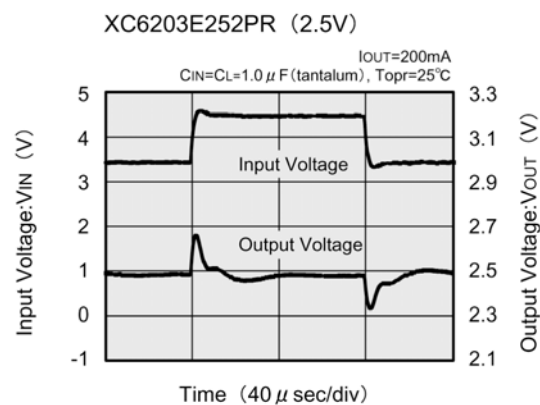
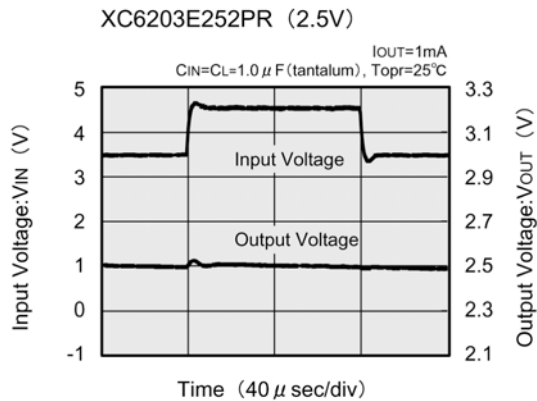
(6) Supply Current vs. Ambient Temperature



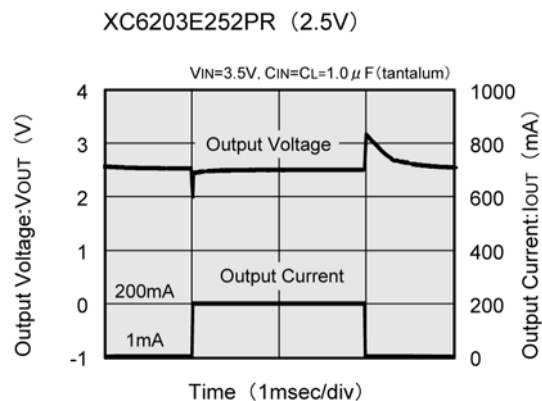
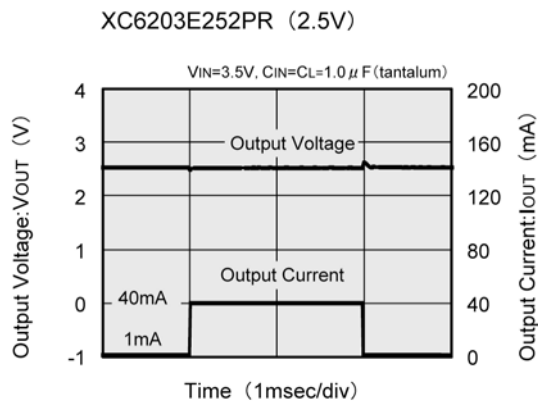
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

●XC6203E252PR (Continued)

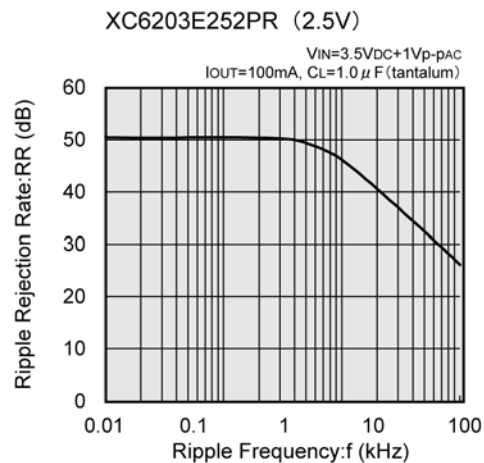
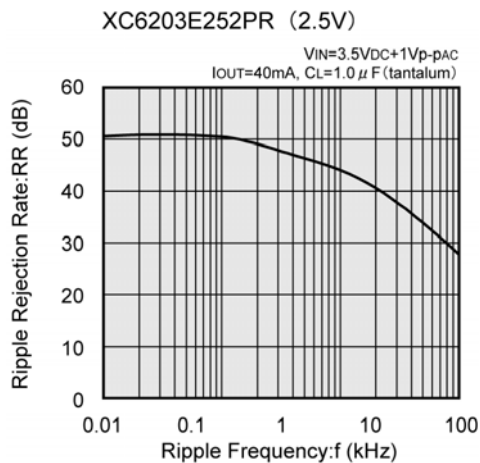
(7) Input Transient Response



(8) Load Transient Response



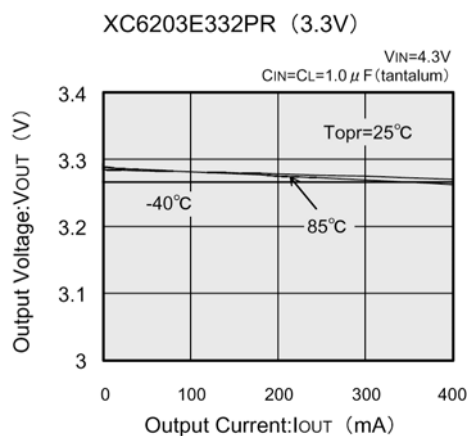
(9) Ripple Rejection Rate



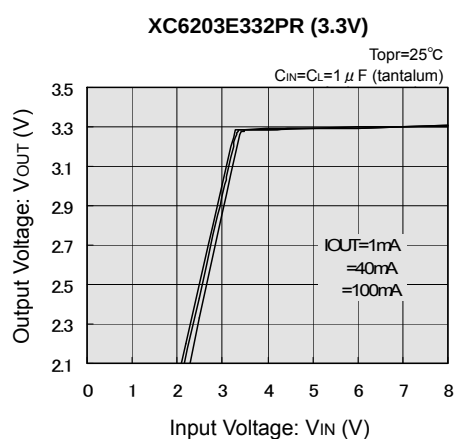
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E332PR

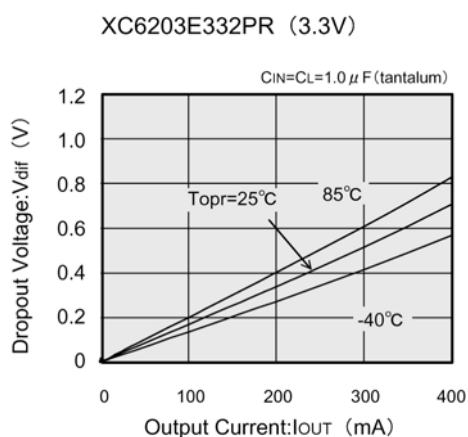
(1) Output Voltage vs. Output Current



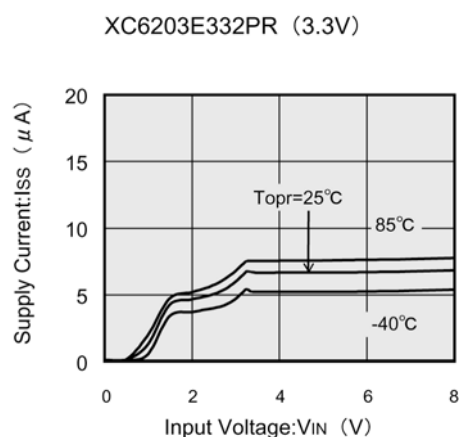
(2) Output Voltage vs. Input Voltage



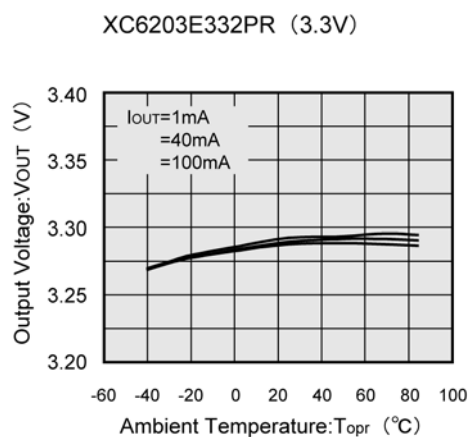
(3) Dropout Voltage vs. Output Current



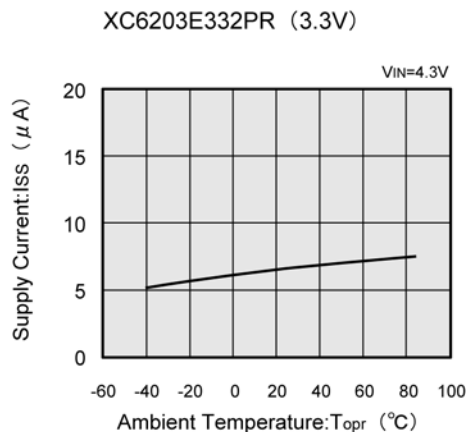
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



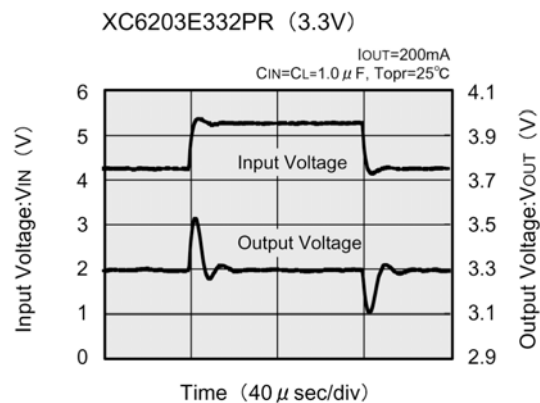
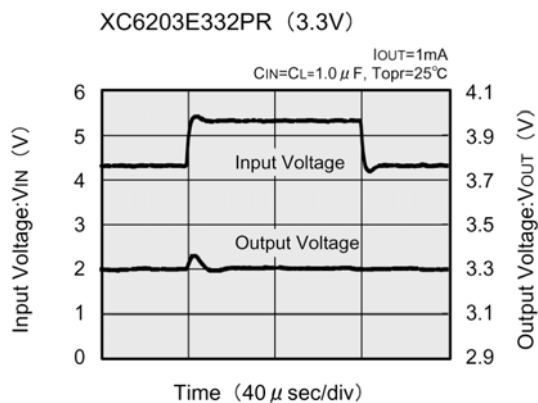
(6) Supply Current vs. Ambient Temperature



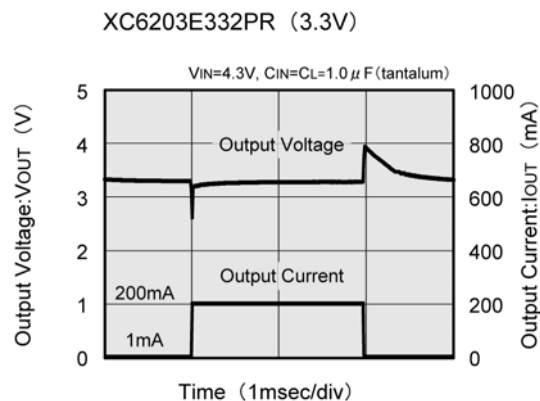
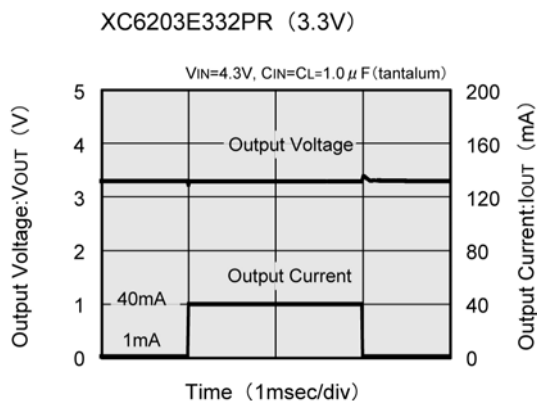
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E332PR (Continued)

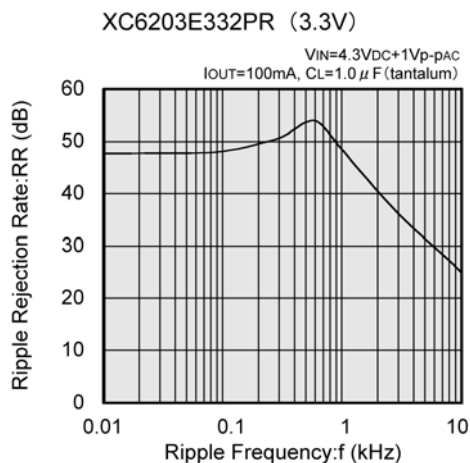
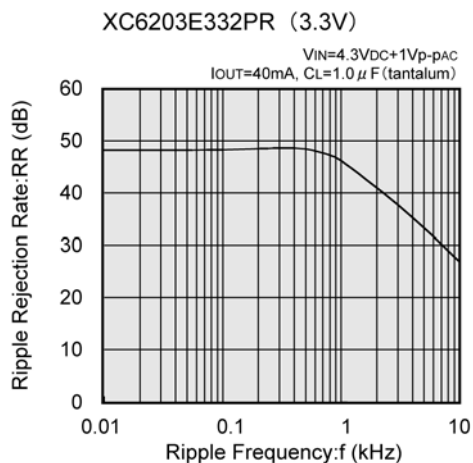
(7) Input Transient Response



(8) Load Transient Response



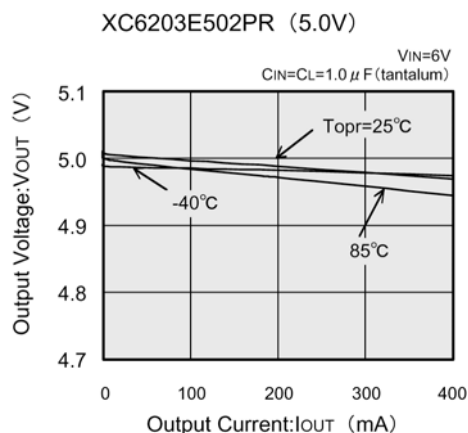
(9) Ripple Rejection Rate



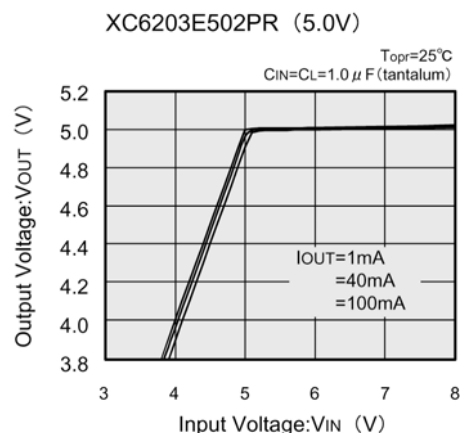
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC6203E502PR

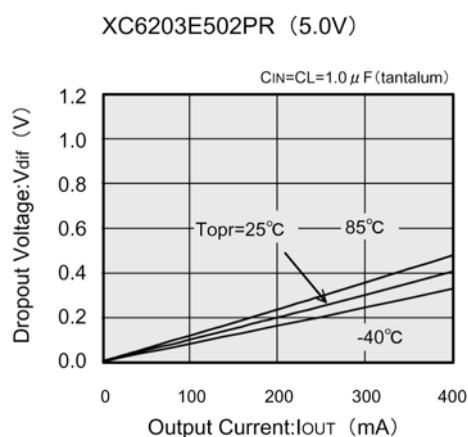
(1) Output Voltage vs. Output Current



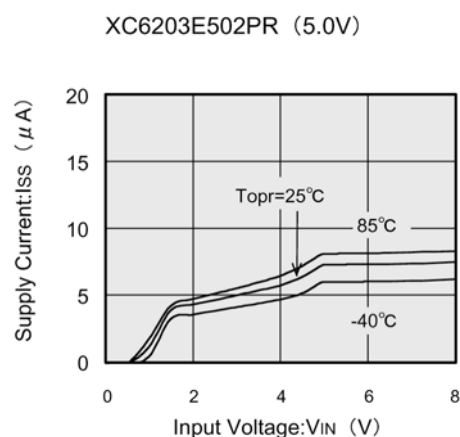
(2) Output Voltage vs. Input Voltage



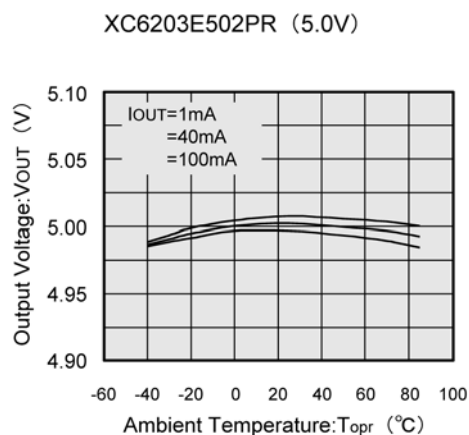
(3) Dropout Voltage vs. Output Current



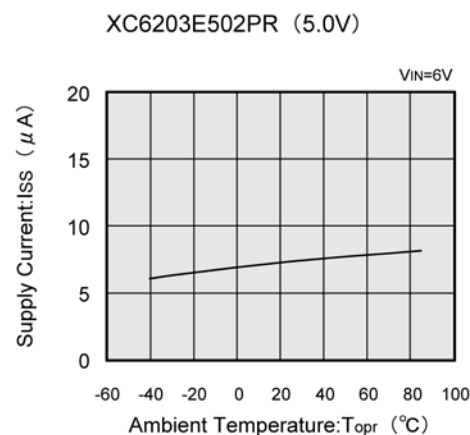
(4) Supply Current vs. Input Voltage



(5) Output Voltage vs. Ambient Temperature



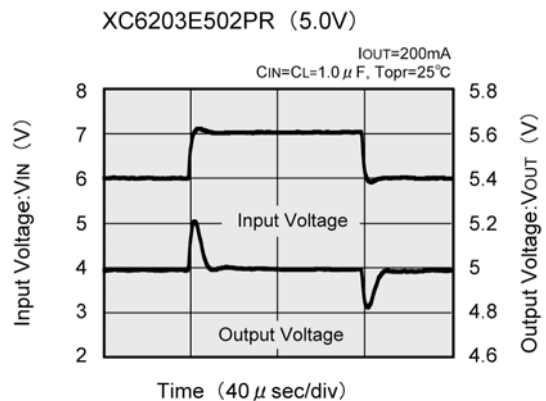
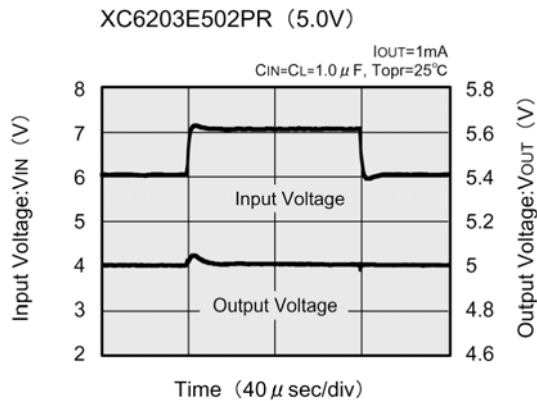
(6) Supply Current vs. Ambient Temperature



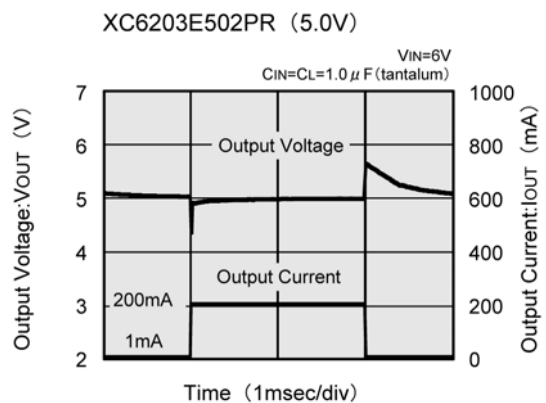
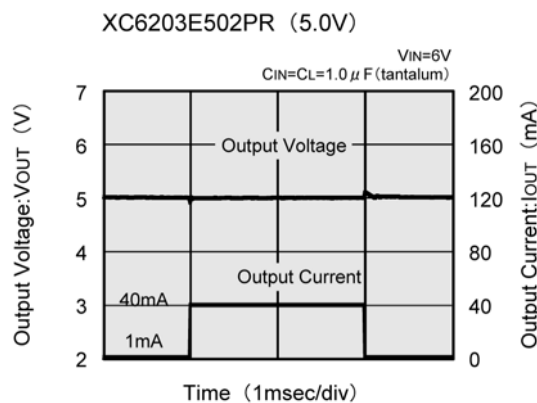
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

●XC6203E502PR (Continued)

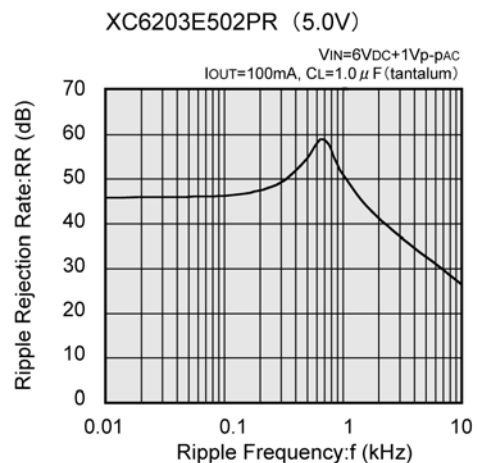
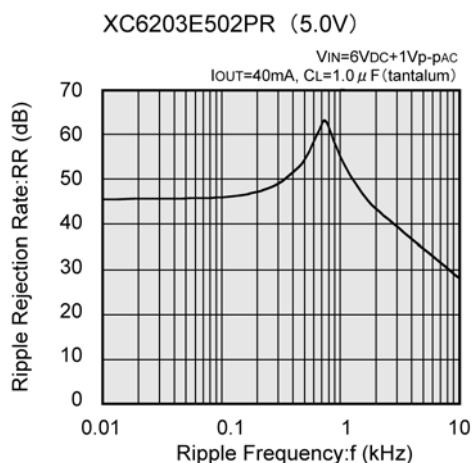
(7) Input Transient Response



(8) Load Transient Response



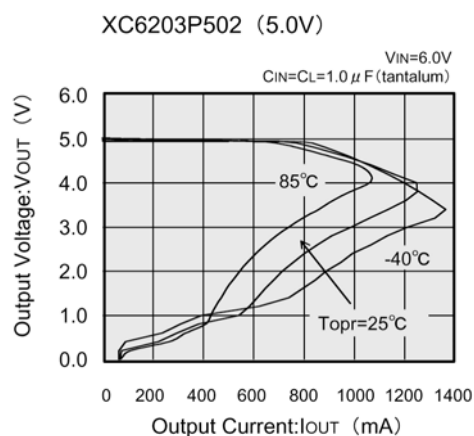
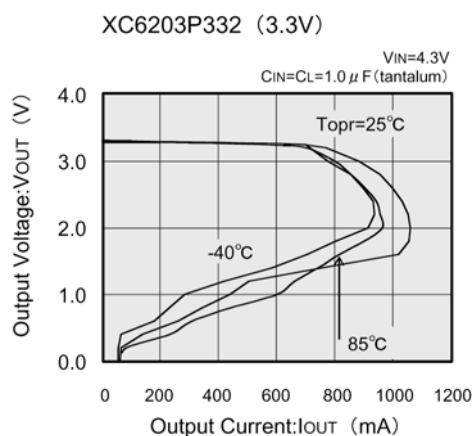
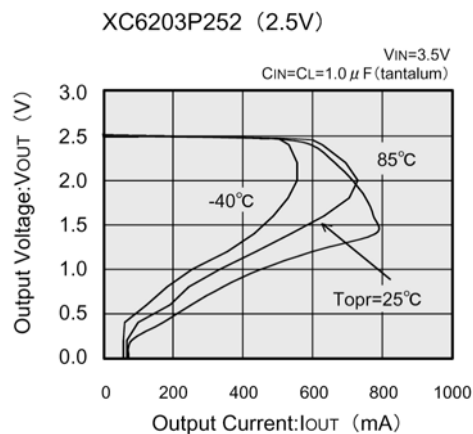
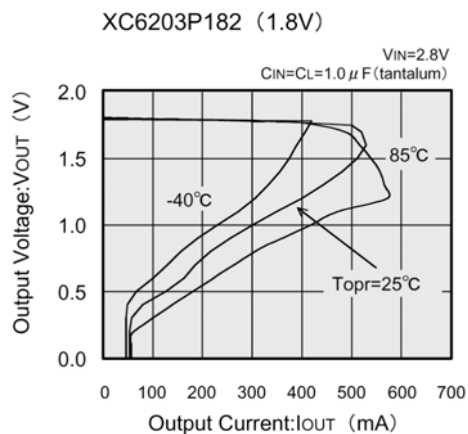
(9) Ripple Rejection Rate



■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

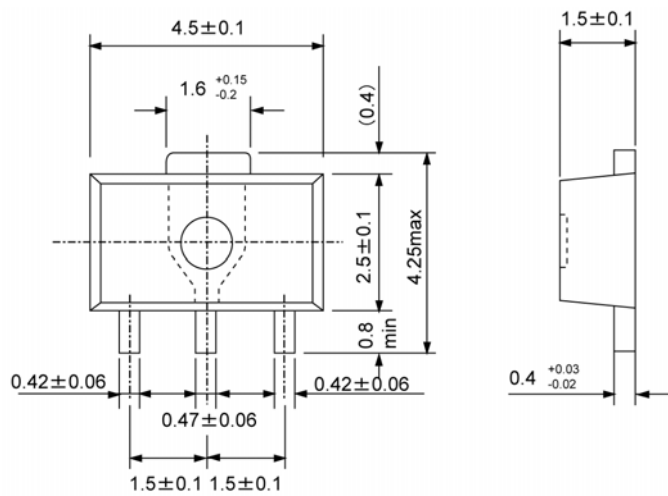
● XC6203E502PR (Continued)

(10) Output Voltage vs. Output Current

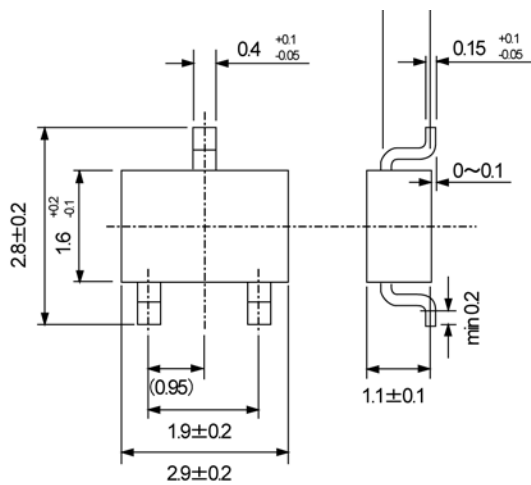


PACKAGING INFORMATION

● SOT-89

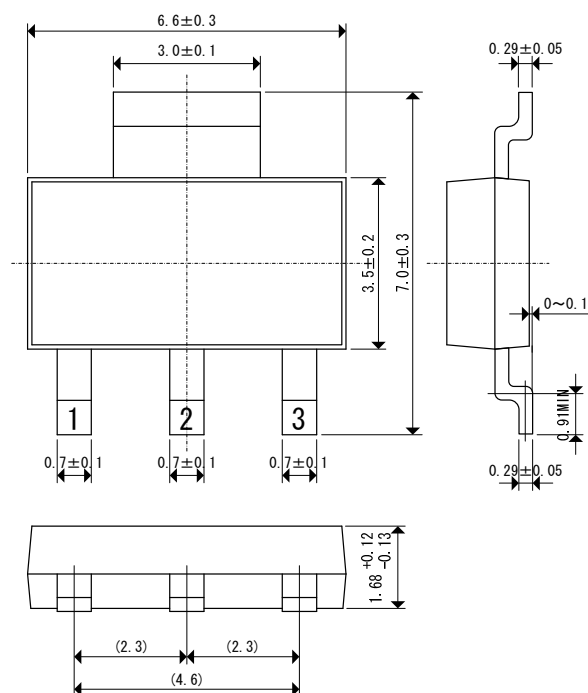


● SOT-23

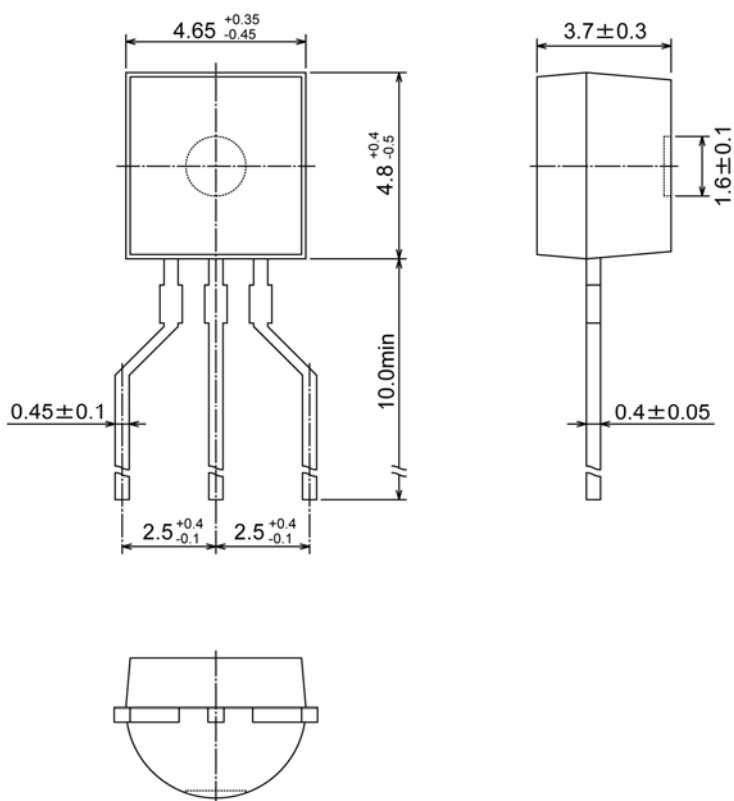


■ PACKAGING INFORMATION (Continued)

● SOT-223

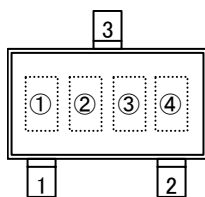


● TO-92

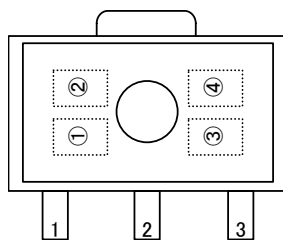


MARKING RULE

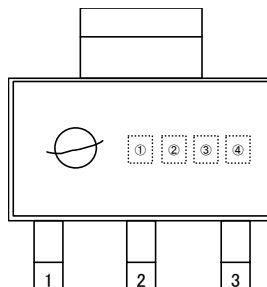
● SOT-23, SOT-89, SOT-223



SOT-23
(TOP VIEW)



SOT-89
(TOP VIEW)



SOT-223
(TOP VIEW)

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

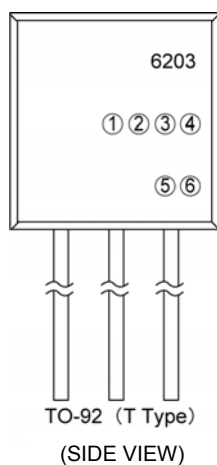
MARK	OUTPUT VOLTAGE (V)			MARK	OUTPUT VOLTAGE (V)		
0	—	3.1	—	F	—	4.6	—
1	—	3.2	—	H	—	4.7	—
2	—	3.3	—	K	1.8	4.8	—
3	—	3.4	—	L	1.9	4.9	—
4	—	3.5	—	M	2.0	5.0	—
5	—	3.6	—	N	2.1	5.1	—
6	—	3.7	—	P	2.2	5.2	—
7	—	3.8	—	R	2.3	5.3	—
8	—	3.9	—	S	2.4	5.4	—
9	—	4.0	—	T	2.5	5.5	—
A	—	4.1	—	U	2.6	5.6	—
B	—	4.2	—	V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