

## Low ESR Cap.Compatible Positive Voltage Regulators

## ■ GENERAL DESCRIPTION

The XC6206 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 XC6206 consists of a current limiter circuit, a driver transistor, a precision reference voltage and an error correction circuit. The series is compatible with low ESR ceramic capacitors. The current limiter's foldback circuit operates as a short circuit protection as well as the output current limiter for the output pin.

Output voltages are internally by laser trimming technologies. It is selectable in 0.1V increments within a range of 1.2V to 5.0V.

SOT-23, SOT-89, TO-92 and USP-6B packages are available.

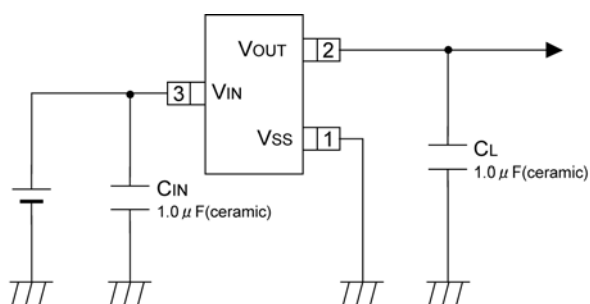
## ■ APPLICATIONS

- Smart phones / Mobile phones
- Portable game consoles
- Digital still cameras / Camcorders
- Digital audio equipments
- Reference voltage sources
- Multi-function power supplies

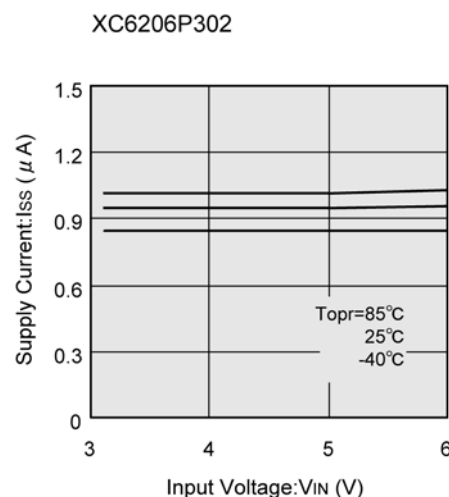
## ■ FEATURES

<b>Maximum Output Current</b>	: 200mA (3.0V type)
<b>Dropout Voltage</b>	: 250mV @ 100mA (3.0V type)
<b>Maximum Operating Voltage</b>	: 6.0V
<b>Output Voltage Range</b>	: 1.2V ~ 5.0V (0.1V increments)
<b>Highly Accurate</b>	: $\pm 2\%$ @ $V_{OUT} \geq 1.5V$ $+30mV$ @ $V_{OUT} < 1.5V$ $(\pm 1\% @ V_{OUT} \geq 2.0V)$
<b>Low Power Consumption</b>	: 1.0 $\mu$ A (TYP.)
<b>Low ESR Capacitor</b>	: Ceramic capacitor compatible
<b>Protection</b>	: Current Limit Circuit Built-in
<b>Operating Ambient Temperature</b>	: -40°C ~ +85°C
<b>Packages</b>	: SOT-23 SOT-89 TO-92 USP-6B
<b>Environmentally Friendly</b>	: EU RoHS Compliant, Pb Free

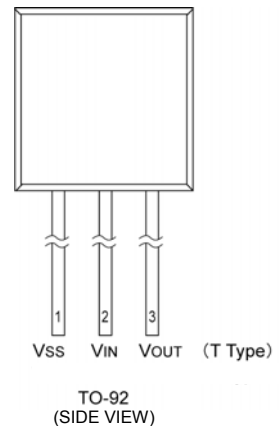
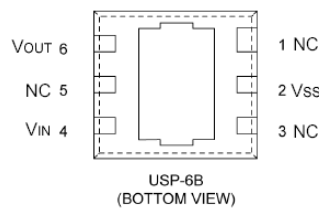
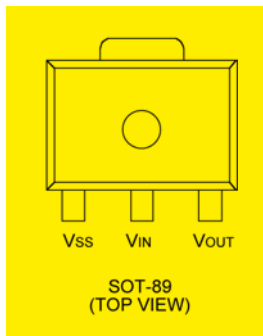
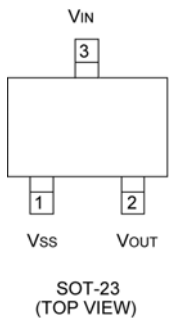
## ■ TYPICAL APPLICATION CIRCUIT



## ■ TYPICAL PERFORMANCE CHARACTERISTICS



## PIN CONFIGURATION



\*The dissipation pad for the USP-6B package should be solder-plated in recommended mount pattern and metal masking so as to enhance mounting strength and heat release. If the pad needs to be connected to other pins, it should be connected to the pin number 4 ( $V_{IN}$ ).

## PIN ASSIGNMENT

PIN NUMBER				PIN NAME	FUNCTIONS
SOT-23	SOT-89	USP-6B	TO-92		
1	1	2	1	Vss	Ground
3	2	4	2	VIN	Power Input
2	3	6	3	VOUT	Output
-	-	1, 3, 5	-	NC	No Connection

## PRODUCT CLASSIFICATION

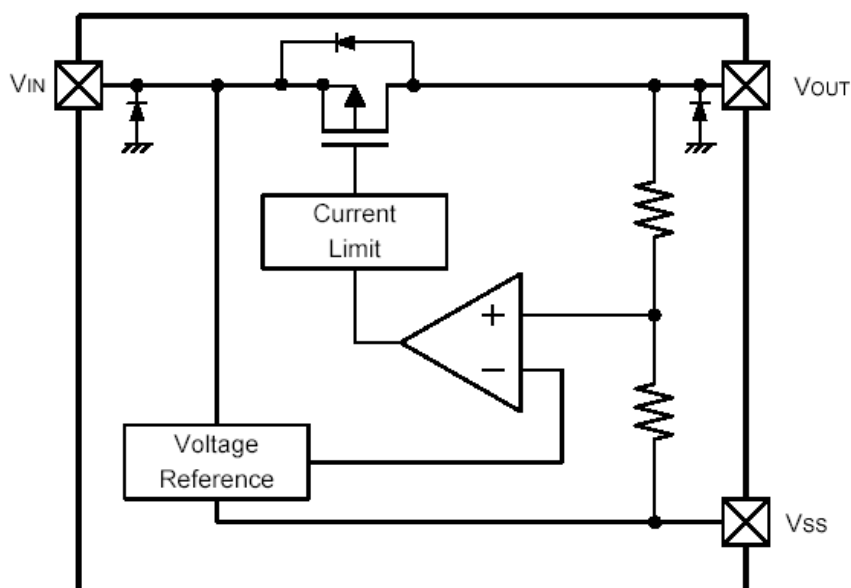
### Ordering Information

XC6206P ①②③④⑤-⑥<sup>(\*)</sup>

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①②	Output Voltage	12~50	e.g. Vout: 3.0V → ①=3, ②=0
③	Accuracy	2	$\pm 2\%$ ( $V_{OUT} \geq 1.5V$ ), $\pm 30mV$ ( $V_{OUT} < 1.5V$ )
		1	$\pm 1\%$ ( $V_{OUT} \geq 2.0V$ )
④⑤-⑥	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)
		DR	USP-6B (3,000/Reel)
		DR-G	USP-6B (3,000/Reel)
		TH	TO-92 (T type), Paper type (2,000/Tape)
		TH-G	TO-92 (T type), Paper type (2,000/Tape)
		TB	TO-92 (T type), Bag type (500/Bag)
TB-G	TO-92 (T type), Bag type (500/Bag)		

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

## ■ BLOCK DIAGRAM



\*Diodes inside the circuit are an ESD protection diode and a parasitic diode.

## ■ ABSOLUTE MAXIMUM RATINGS

Ta=25°C

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage	V <sub>IN</sub>	-0.3~+7.0	V
Output Current	I <sub>OUT</sub>	500 <sup>(*)</sup>	mA
Output Voltage	V <sub>OUT</sub>	-0.3 ~ V <sub>IN</sub> + 0.3	V
Power Dissipation	SOT-23	250	mW
		500(PCB mounted) <sup>(**)</sup>	
	SOT-89	500	
		1000(PCB mounted) <sup>(**)</sup>	
	USP-6B	120	
TO-92	300		
Operating Ambient Temperature	T <sub>opr</sub>	- 40 ~ + 85	°C
Storage Temperature	T <sub>stg</sub>	- 55 ~ + 125	°C

(\*)  $I_{OUT} \leq P_d / (V_{IN} - V_{OUT})$

(\*\*) This power dissipation figure shown is PCB mounted and is for reference only. Please refer to page 15~17 for details.

## ELECTRICAL CHARACTERISTICS

Ta=25 °C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT	
Output Voltage (Standard) <sup>(*2)</sup>	V <sub>OUT(E)</sub> <sup>(*3)</sup>	I <sub>OUT</sub> =30mA	V <sub>OUT(T)</sub> <1.5V	-0.03	V <sub>OUT(T)</sub> <sup>(*4)</sup>	+0.03	V	②
Output Voltage (High Accuracy) <sup>(*2)</sup>			V <sub>OUT(T)</sub> ≥1.5V	×0.98		×1.02		
		I <sub>OUT</sub> =30mA	V <sub>OUT(T)</sub> ≥2.0V	×0.99		×1.01		
Supply Current	I <sub>DD</sub>		-	1.0	3.0	μA	①	
Load Regulation	ΔV <sub>OUT</sub>	V <sub>OUT(T)</sub> ≤1.8V, 1mA≤I <sub>OUT</sub> ≤50mA		-	-	E-1 <sup>(*5)</sup>	mV	②
		V <sub>OUT(T)</sub> >1.8V, 1mA≤I <sub>OUT</sub> ≤100mA						
Dropout Voltage 1	V <sub>dif1</sub> <sup>(*6)</sup>	I <sub>OUT</sub> =30mA		-	E-2 <sup>(*5)</sup>		mV	②
Dropout Voltage 2	V <sub>dif2</sub> <sup>(*6)</sup>	V <sub>OUT(T)</sub> ≤1.8V, I <sub>OUT</sub> =60mA		-	E-3 <sup>(*5)</sup>			
		V <sub>OUT(T)</sub> >1.8V, I <sub>OUT</sub> =100mA						
Line Regulation	ΔV <sub>OUT</sub> / (ΔV <sub>IN</sub> · V <sub>OUT</sub> )	V <sub>OUT(T)</sub> <4.5V, V <sub>OUT(T)</sub> +1.0V≤V <sub>IN</sub> ≤6.0V, I <sub>OUT</sub> =30mA		-	0.05	0.25	%V	②
		V <sub>OUT(T)</sub> ≥4.5V, 5.5V≤V <sub>IN</sub> ≤6.0V, I <sub>OUT</sub> =30mA						
Maximum Output Current	I <sub>OUTMAX</sub>	V <sub>OUT</sub> ≥V <sub>OUT(E)</sub> ×0.9		E-4 <sup>(*5)</sup>	-	-	mA	②
Short Circuit Current	I <sub>SHORT</sub>	V <sub>OUT</sub> =V <sub>SS</sub>		-	E-5 <sup>(*5)</sup>	-	mA	②
Input Voltage	V <sub>IN</sub>			1.8	-	6.0	V	②
Output Voltage Temperature Characteristics	ΔV <sub>OUT</sub> / (ΔT <sub>opr</sub> · V <sub>OUT</sub> )	I <sub>OUT</sub> =30mA, -40°C≤T <sub>opr</sub> ≤85°C		-	±100	-	ppm/°C	②

\*1: Unless otherwise stated, V<sub>IN</sub> = V<sub>OUT(T)</sub> + 1.0V

\*2: (Standard): ±2% (1.5V≤V<sub>OUT(T)</sub>), ±0.03V (1.5V>V<sub>OUT(T)</sub>)  
(High Accuracy): ±1% (2.0V≤V<sub>OUT(T)</sub>)

\*3: V<sub>OUT(E)</sub>: Effective output voltage.

\*4: V<sub>OUT(T)</sub>: Nominal voltage

\*5: For E-1, E-2, E-3, E-4, E-5, Please refer to Electrical Characteristics Chart.

\*6: V<sub>dif</sub> = V<sub>IN1</sub> - V<sub>OUT1</sub>

V<sub>OUT1</sub>: A voltage equal to 98% of the output voltage whenever an amply stabilized {V<sub>OUT(T)</sub> + 1.0V} is input with each I<sub>OUT</sub>.

V<sub>IN1</sub>: The input voltage when V<sub>OUT1</sub> appears as input voltage is gradually decreased.

\*7: The low ESR capacitors use that is more than 1.0μF as C<sub>L</sub> is possible.

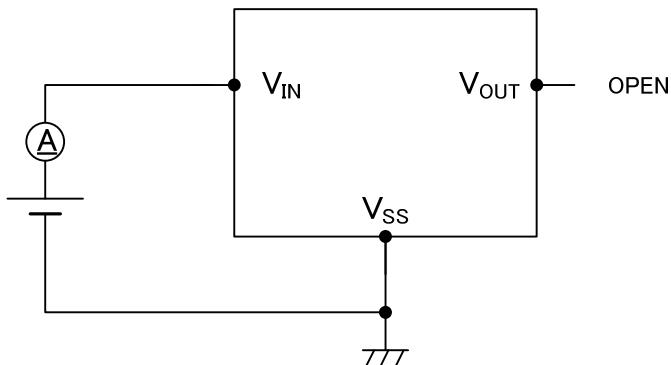
**■ ELECTRICAL CHARACTERISTICS (Continued)**

● Electrical Characteristics Chart

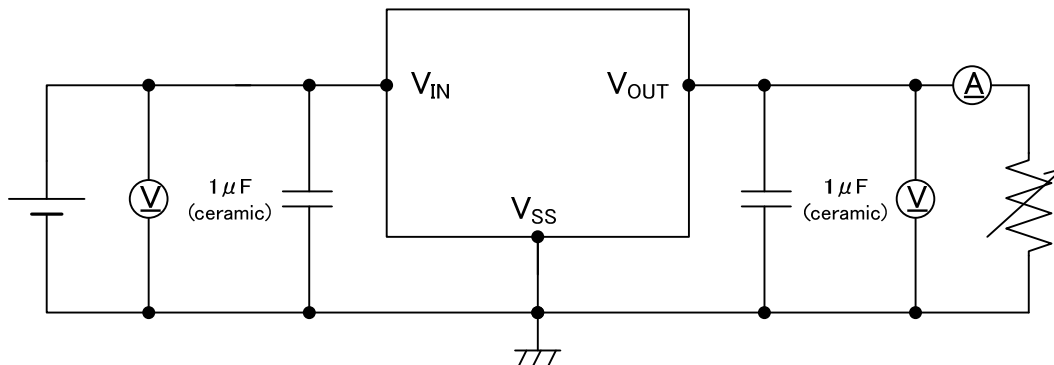
NOMINAL VOLTAGE	E-1	E-2		E-3		E-4	E-5
	LOAD REGULATION	DROPOUT VOLTAGE1		DROPOUT VOLTAGE2		MAX. OUTPUT CURRENT	SHORT CURRENT
	$\Delta V_{OUT}$ (mV)	$V_{dif1}$ (mV)		$V_{dif2}$ (mV)		$I_{OUTMAX}$ (mA)	$I_{SHORT}$ (mA)
$V_{OUT(T)}$	MAX.	TYP.	MAX.	TYP.	MAX.	MIN.	TYP.
1.2	40	460	760	700	960	60	180
1.3		400	650				
1.4		350	590	580	860		
1.5	45	300	510			450	810
1.6		250	450				
1.7		200	410				
1.8		150	390	780	80		
1.9	50	100	370			350	710
2.0							
2.1							
2.2							
2.3							
2.4	55	100	370	350	710	150	
2.5							
2.6							
2.7							
2.8							
2.9							
3.0	60	75	350	250	680	200	
3.1							
3.2							
3.3							
3.4	65	75	350	250	680	200	
3.5							
3.6							
3.7							
3.8							
3.9							
4.0	70	60	320	200	630	250	
4.1							
4.2							
4.3							
4.4							
4.5	75	60	320	200	630	250	
4.6							
4.7							
4.8							
4.9							
5.0	80	50	290	175	600		

## TEST CIRCUITS

Circuit ①



Circuit ②

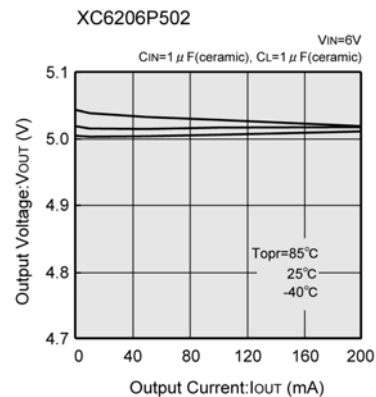
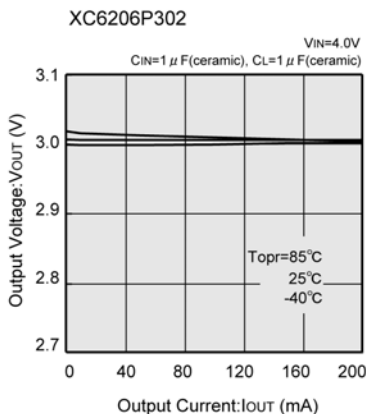
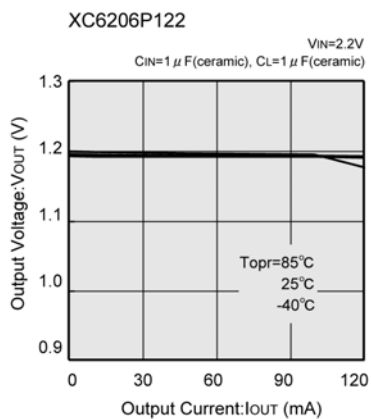


## NOTES ON USE

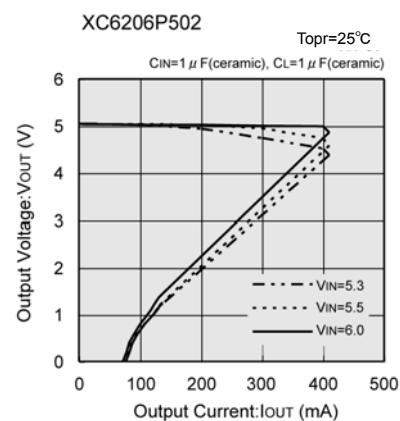
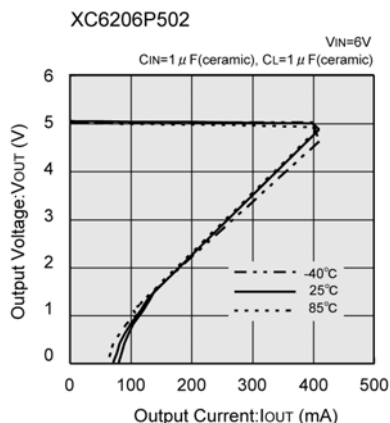
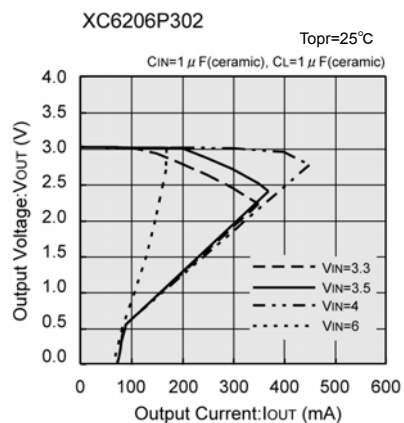
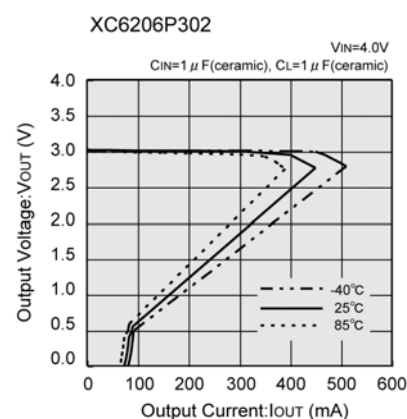
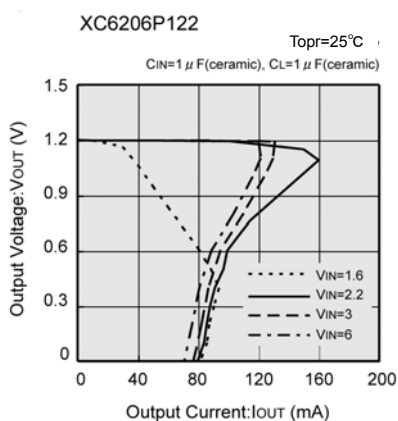
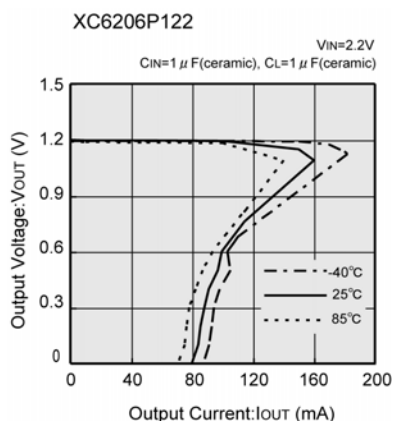
1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please strengthen  $V_{BIAS}$ ,  $V_{IN}$  and  $V_{SS}$  wiring in particular
3. Please wire the input capacitor ( $C_{IN}$ ) and the output capacitor ( $C_L$ ) 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

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

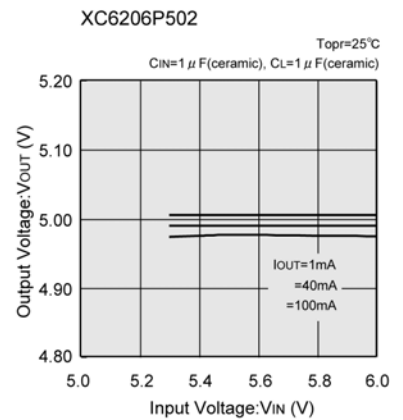
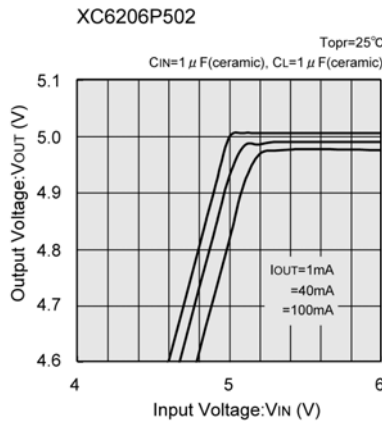
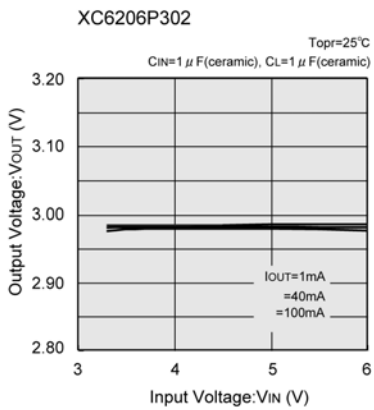
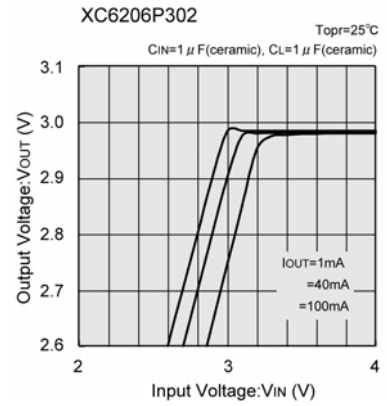
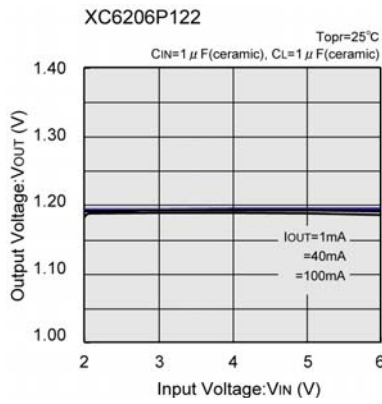
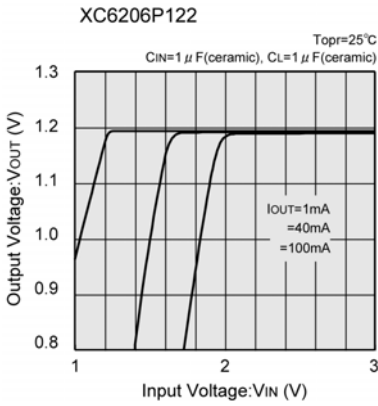


### (2) Current Limit

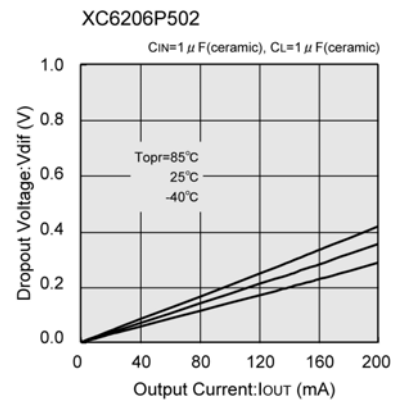
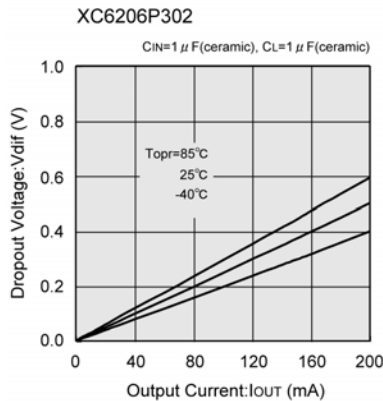
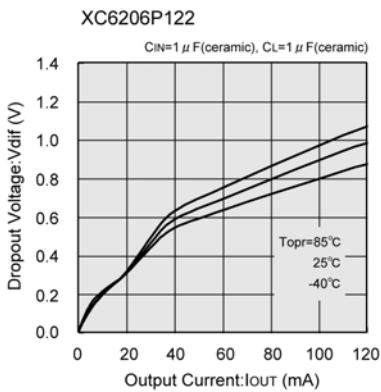


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (3) Output Voltage vs. Input Voltage



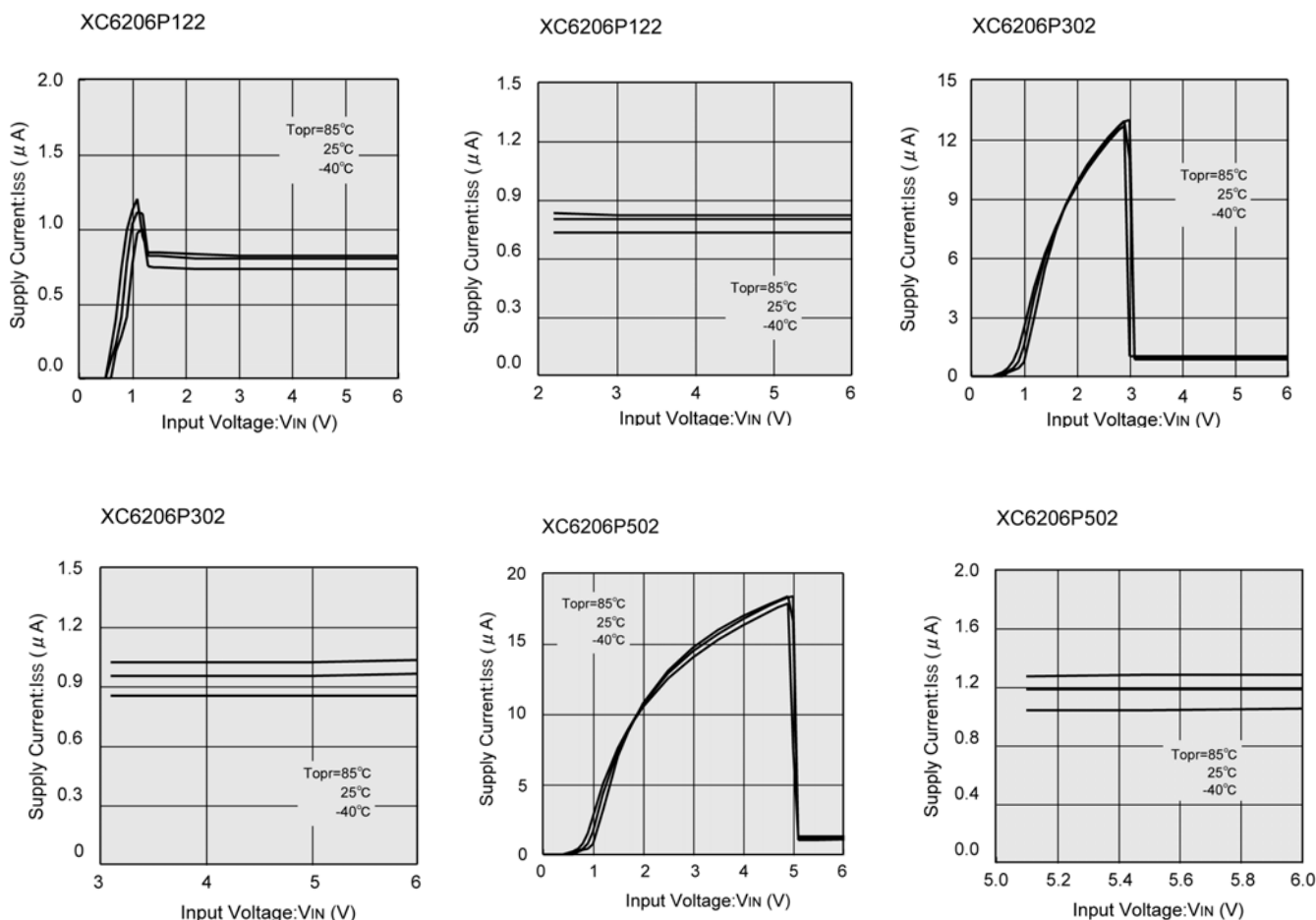
### (4) Dropout Voltage vs. Output Current



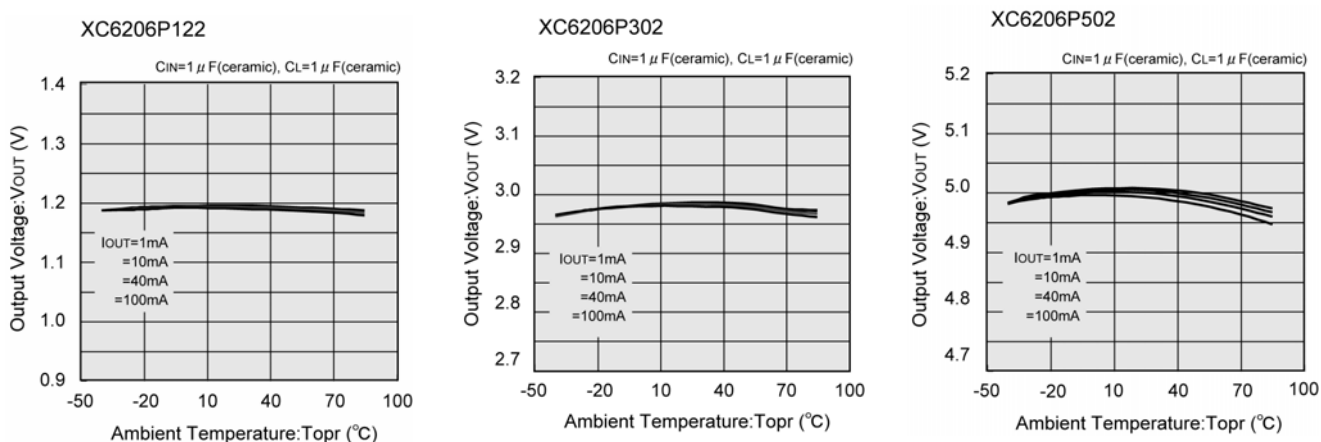


## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (5) Supply Current vs. Input Voltage

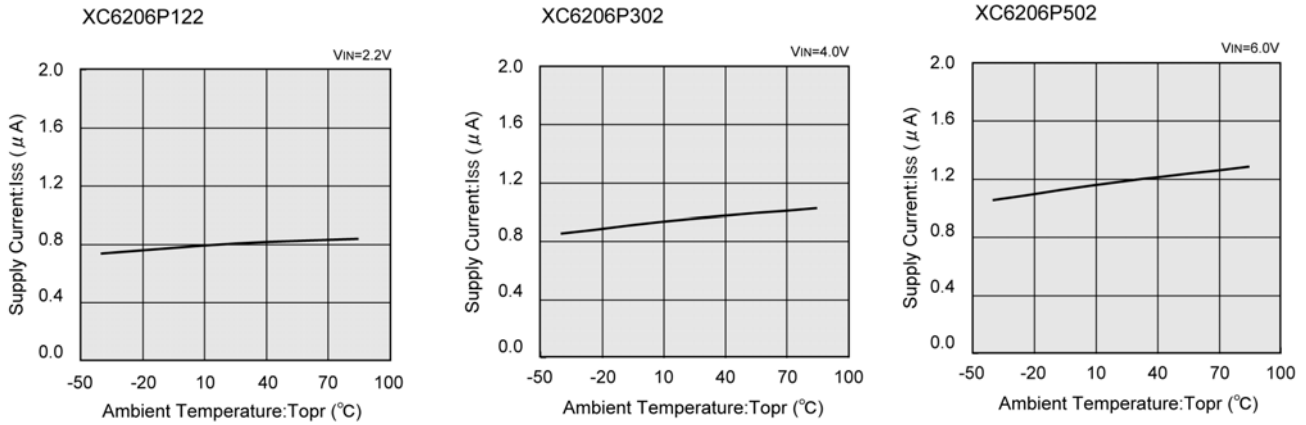


### (6) Output Voltage vs. Ambient Temperature

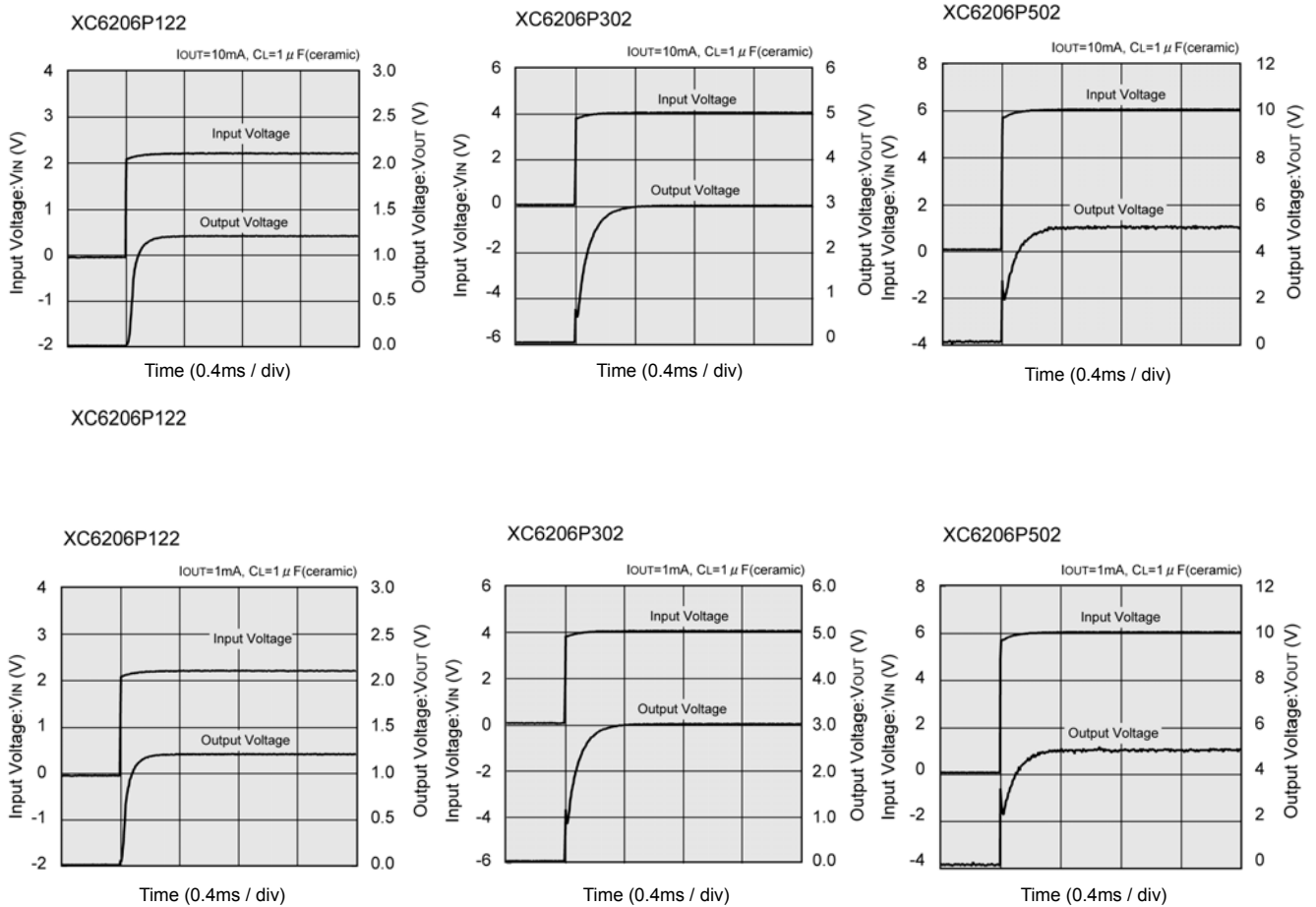


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (7) Output Voltage vs. Ambient Temperature

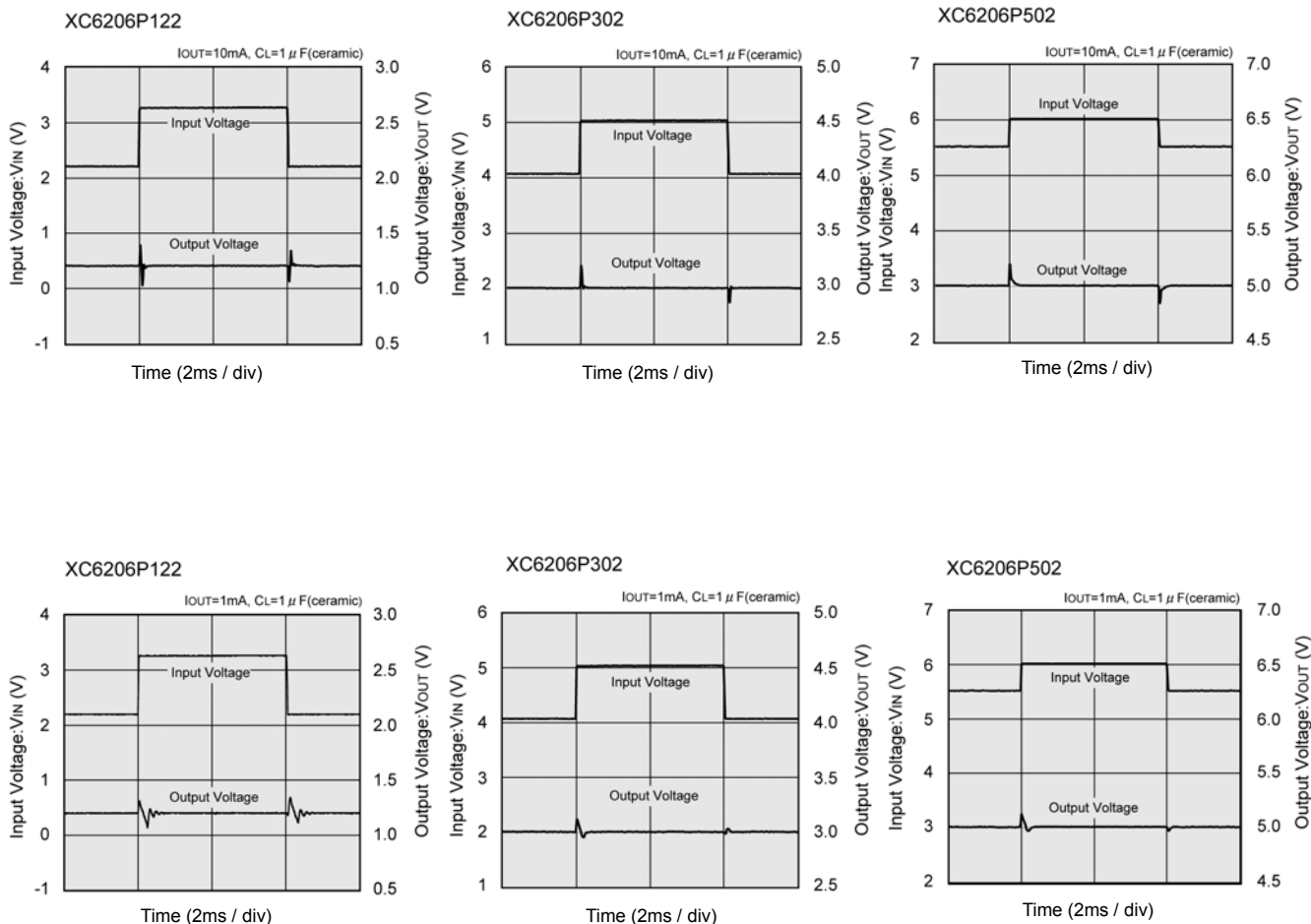


### (8) Input Transient Response 1

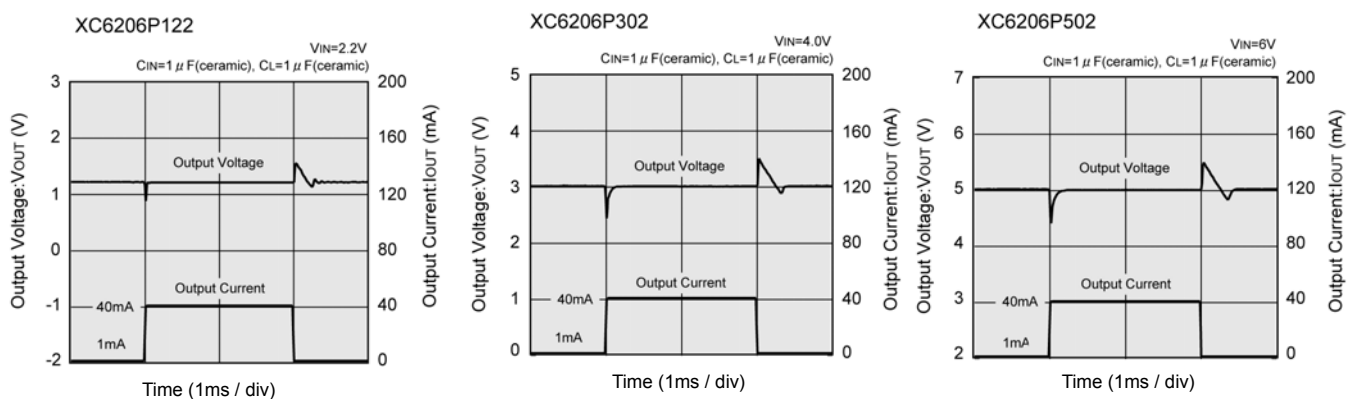


## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (9) Input Transient Response 2

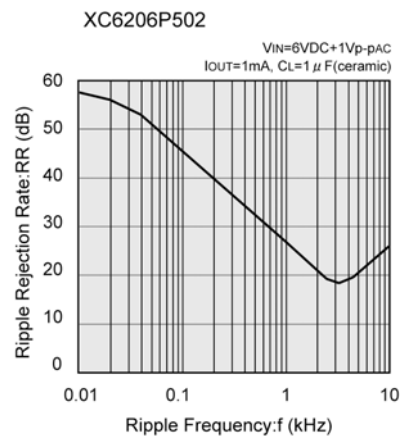
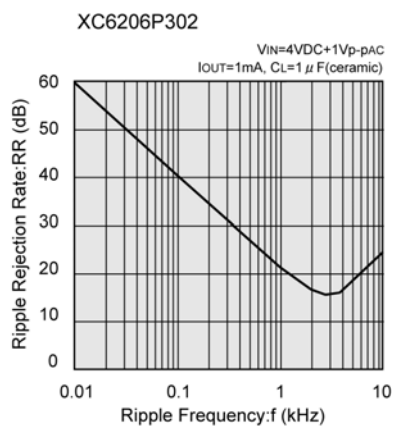
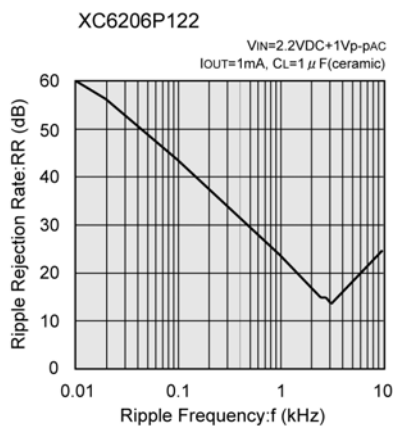
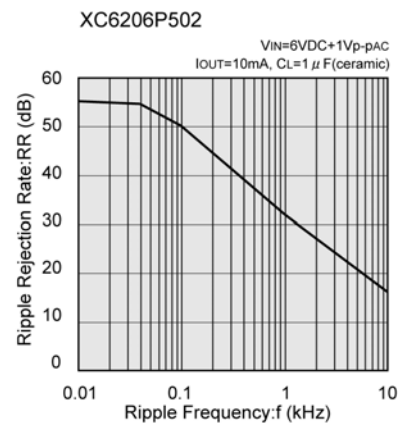
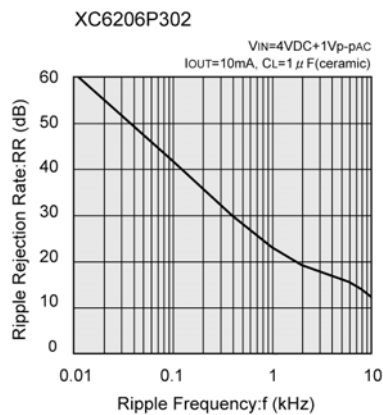
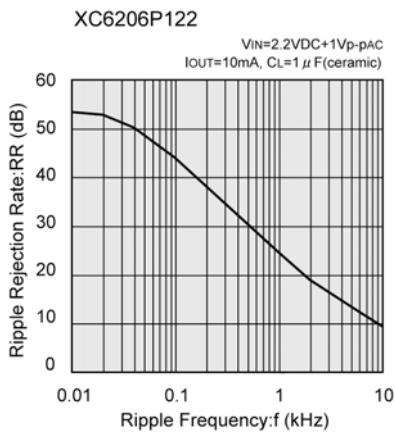


### (10) Load Transient Response



## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

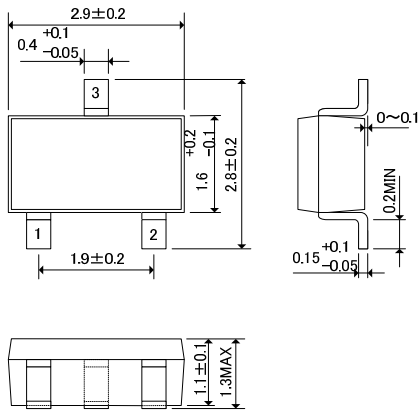
### (11) Ripple Rejection Rate



**PACKAGING INFORMATION**

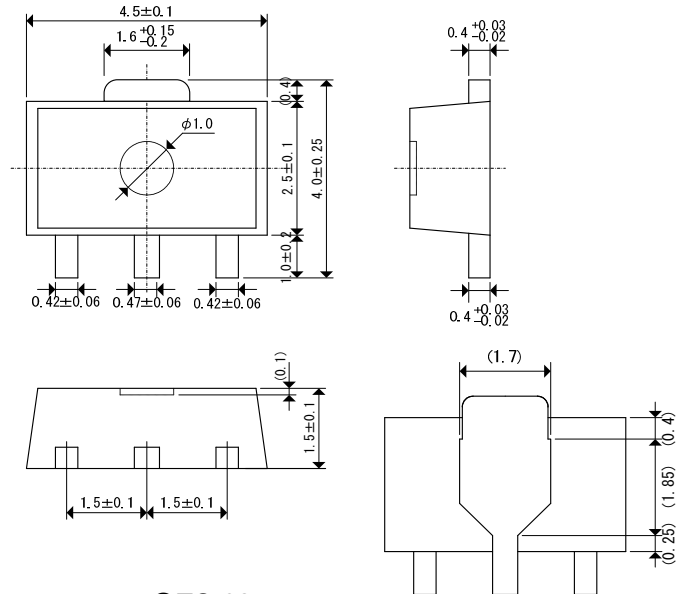
● SOT-23

Unit : mm



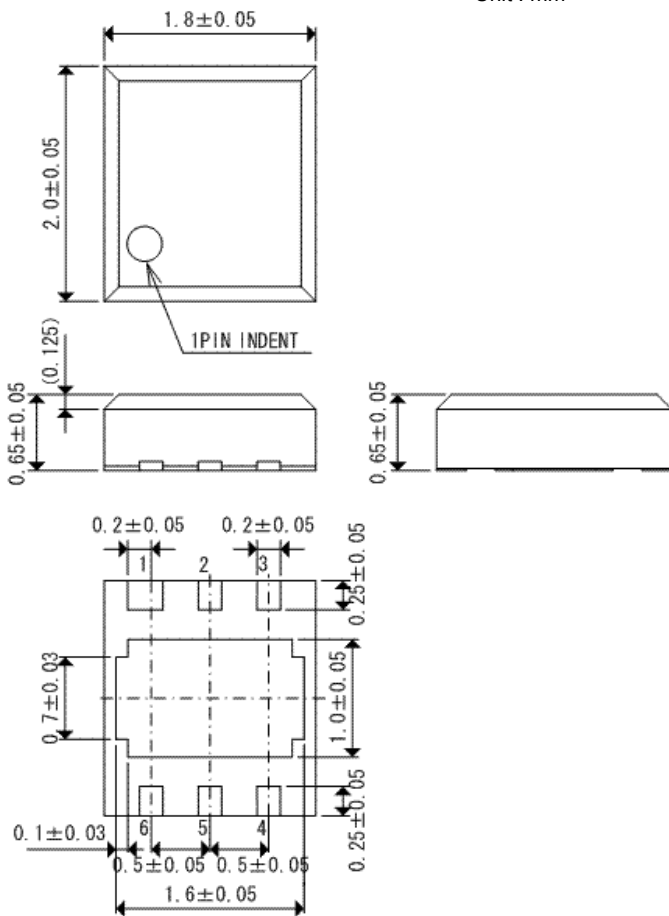
● SOT-89

Unit : mm



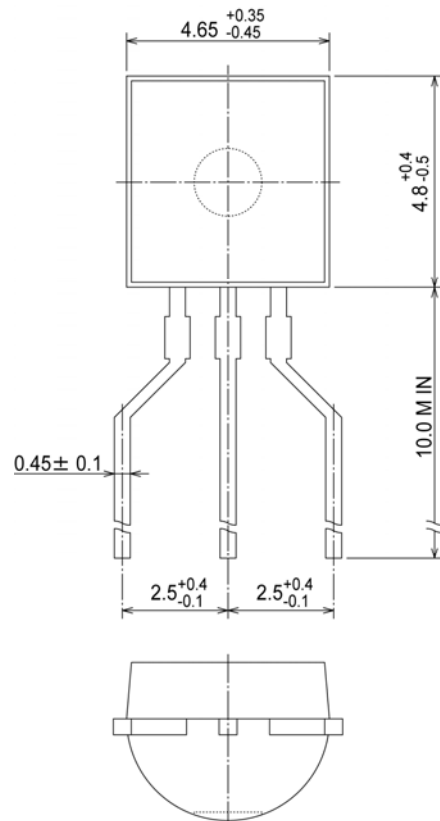
● USP-6B

Unit : mm



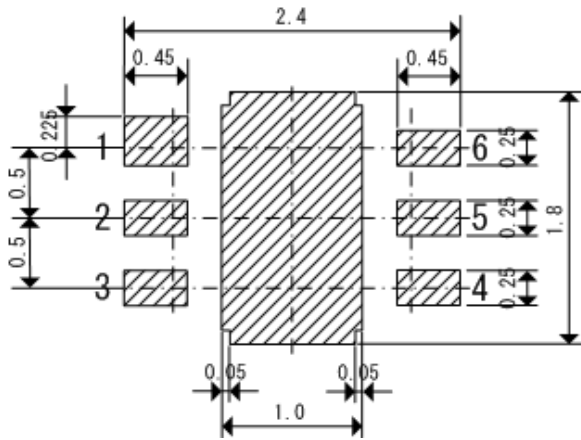
● TO-92

Unit : mm

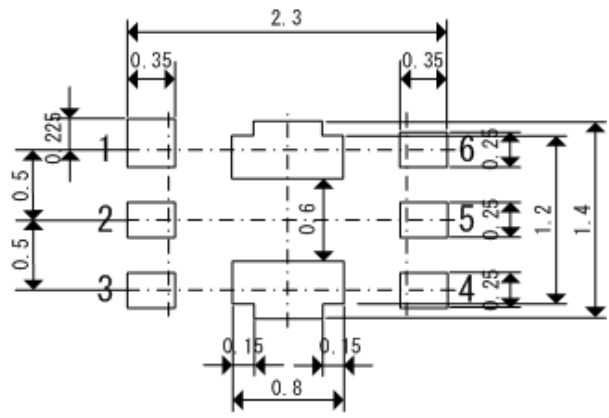


## PACKAGING INFORMATION (Continued)

● USP-6B Reference Pattern Layout



● USP-6B Reference Metal Mask Design



## ■ PACKAGING INFORMATION (Continued)

● SOT-23 Power Dissipation

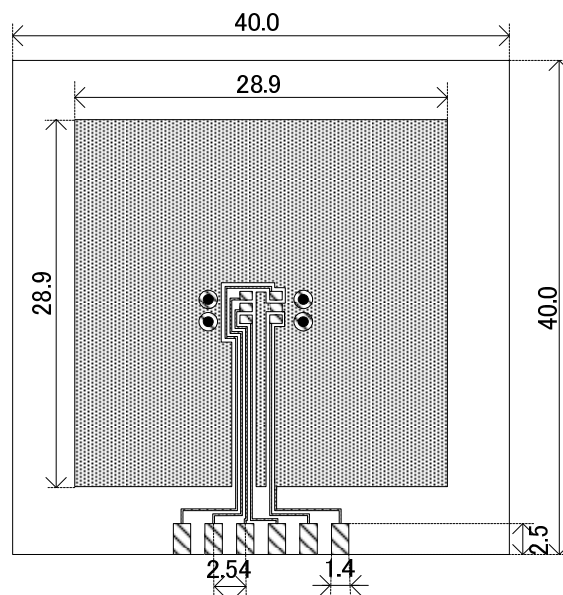
Power dissipation data for the SOT-23 is shown in this page.

The value of power dissipation varies with the mount board conditions.

Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)

- Condition: Mount on a board
- Ambient: Natural convection
- Soldering: Lead (Pb) free
- Board: Dimensions 40 x 40 mm (1600 mm<sup>2</sup> in one side)  
Copper (Cu) traces occupy 50% of the board area  
In top and back faces  
Package heat-sink is tied to the copper traces  
(Board of SOT-26 is used.)
- Material: Glass Epoxy (FR-4)
- Thickness: 1.6 mm
- Through-hole: 4 x 0.8 Diameter

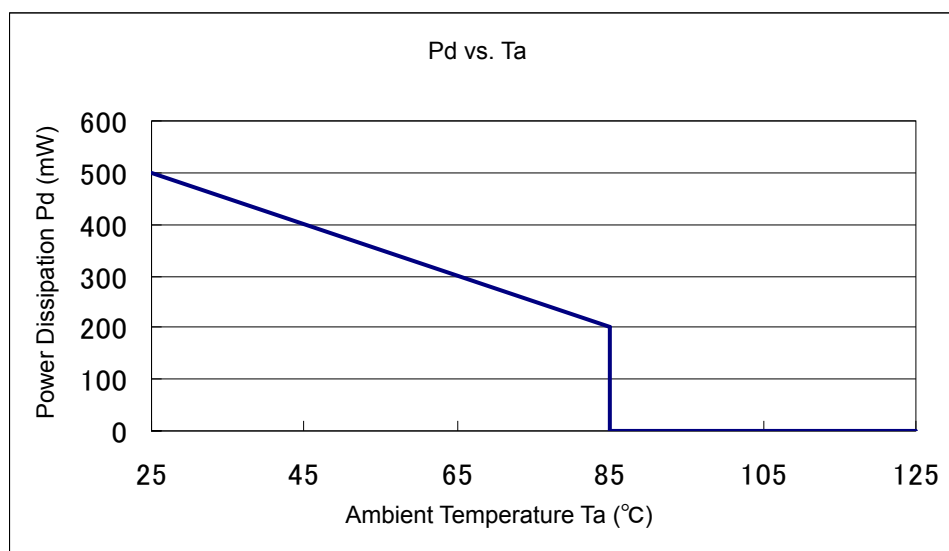


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient temperature

Board Mount ( $T_j \text{ max} = 125^\circ\text{C}$ )

Ambient Temperature ( $^\circ\text{C}$ )	Power Dissipation Pd (mW)	Thermal Resistance ( $^\circ\text{C/W}$ )
25	500	200.00
85	200	



## PACKAGING INFORMATION (Continued)

- SOT-89 Power Dissipation

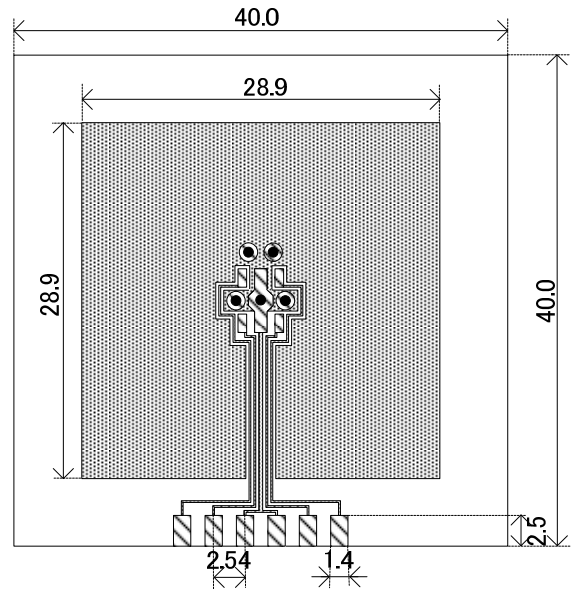
Power dissipation data for the SOT-89 is shown in this page.

The value of power dissipation varies with the mount board conditions.

Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)

- Condition: Mount on a board
- Ambient: Natural convection
- Soldering: Lead (Pb) free
- Board: Dimensions 40 x 40 mm (1600 mm<sup>2</sup> in one side)  
Copper (Cu) traces occupy 50% of the board area  
In top and back faces  
Package heat-sink is tied to the copper traces
- Material: Glass Epoxy (FR-4)
- Thickness: 1.6 mm
- Through-hole: 5 x 0.8 Diameter

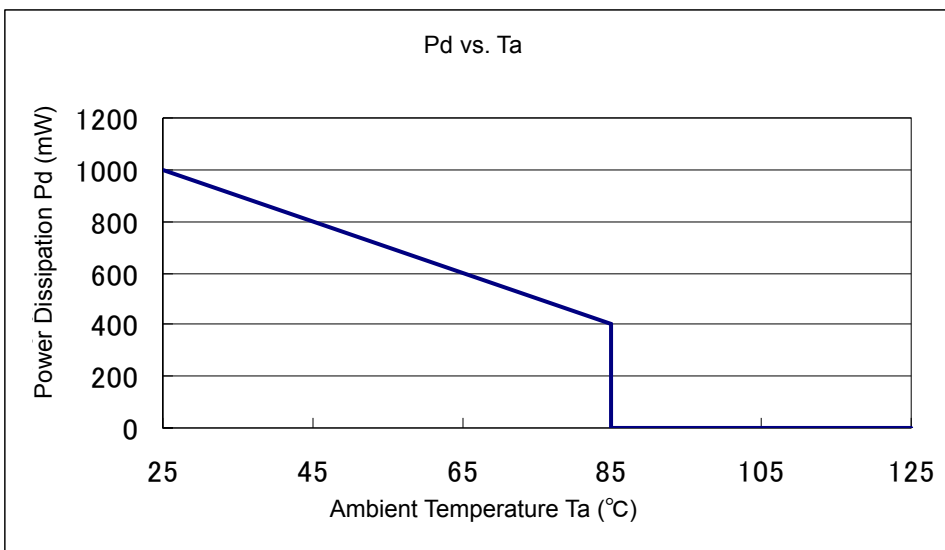


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient temperature

Board Mount ( $T_j \text{ max} = 125^\circ\text{C}$ )

Ambient Temperature ( $^\circ\text{C}$ )	Power Dissipation $P_d$ (mW)	Thermal Resistance ( $^\circ\text{C/W}$ )
25	1000	100.00
85	400	





## ■ PACKAGING INFORMATION (Continued)

● USP-6B Power Dissipation

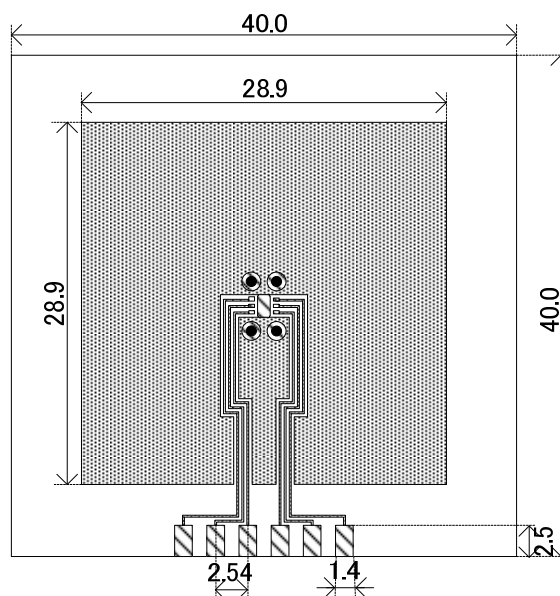
Power dissipation data for the USP-6B is shown in this page.

The value of power dissipation varies with the mount board conditions.

Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)

- Condition: Mount on a board
- Ambient: Natural convection
- Soldering: Lead (Pb) free
- Board: Dimensions 40 x 40 mm (1600 mm<sup>2</sup> in one side)  
Copper (Cu) traces occupy 50% of the board area  
In top and back faces  
Package heat-sink is tied to the copper traces
- Material: Glass Epoxy (FR-4)
- Thickness: 1.6 mm
- Through-hole: 4 x 0.8 Diameter

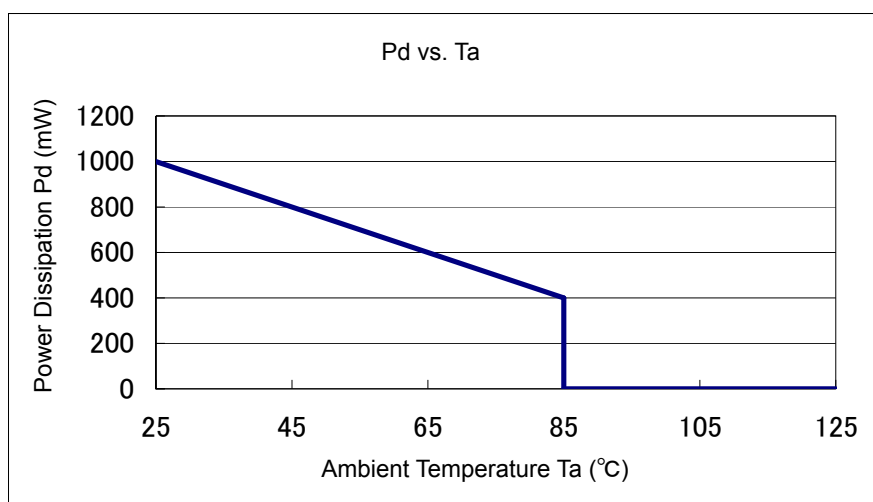


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient temperature

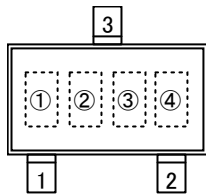
Board Mount ( $T_j \text{ max} = 125^\circ\text{C}$ )

Ambient Temperature ( $^\circ\text{C}$ )	Power Dissipation $P_d$ (mW)	Thermal Resistance ( $^\circ\text{C/W}$ )
25	1000	100.00
85	400	

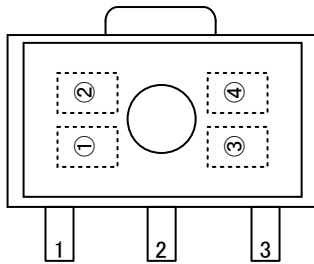


## MARKING RULE

●SOT-23, SOT-89



SOT-23  
(TOP VIEW)



SOT-89  
(TOP VIEW)

① represents product number

MARK	PRODUCT SERIES
6	XC6206P*****

② represents 3 pins regulator

MARK		PRODUCT SERIES
VOLTAGE=0.1 ~ 3.0V	VOLTAGE=3.1 ~ 6.0V	
5	6	XC6206P*****

③ represents output voltage

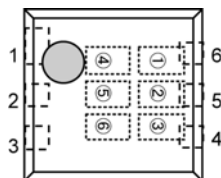
MARK	VOLTAGE (V)			MARK	OUTPUT VOLTAGE (V)		
0	-	3.1	-	F	1.6	4.6	-
1	-	3.2	-	H	1.7	4.7	-
2	-	3.3	-	K	1.8	4.8	-
3	-	3.4	-	L	1.9	4.9	-
4	-	3.5	-	M	2.0	5.0	-
5	-	3.6	-	N	2.1	-	-
6	-	3.7	-	P	2.2	-	-
7	-	3.8	-	R	2.3	-	-
8	-	3.9	-	S	2.4	-	-
9	-	4.0	-	T	2.5	-	-
A		4.1	-	U	2.6	-	-
B	1.2	4.2	-	V	2.7	-	-
C	1.3	4.3	-	X	2.8	-	-
D	1.4	4.4	-	Y	2.9	-	-
E	1.5	4.5	-	Z	3.0	-	-

④ represents production lot number

0 to 9, A to Z, and inverted 0 to 9, A to Z repeated. (G, I, J, O, Q, W excepted.)

## MARKING RULE (Continued)

### ● USP-6B



USP-6B  
(TOP VIEW)

①② represents product number

MARK		PRODUCT SERIES
①	②	
0	6	XC6206P***D*

③ represents 3 pins regulator

MARK	PRODUCT SERIES
P	XC6206P***D*

④⑤ represents output voltage

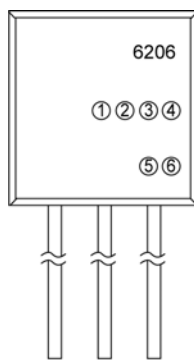
MARK		OUTPUT VOLTAGE(V)	PRODUCT SERIES
④	⑤		
3	3	3.3	XC6206P33*D*
5	0	5.0	XC6206P50*D*

⑥ represents production lot number

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

\*No character inversion used.

### ● TO-92



TO-92 (T Type)  
(SIDE VIEW)

① represents type of regulator

MARK	PRODUCT SERIES
P	XC6206P*****

②③ represents output voltage

MARK		VOLTAGE (V)	PRODUCT SERIES
②	③		
3	3	3.3	XC6206P33***
5	0	5	XC6206P50***

④ represents output voltage accuracy

MARK	OUTPUT VOLTAGE ACCURACY	PRODUCT SERIES
1	±1%	XC6206P**1**
2	±2%	XC6206P**2**

⑤ represents least significant digit of the production year

MARK	PRODUCTION YEAR
3	2003
4	2004

⑥ represents production lot number

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

\*No character inversion used.

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