

## Adjustable Voltage Output Multifunction 2A High Speed LDO Regulator

### ■ GENERAL DESCRIPTION

The XC6230 series are low on-resistance / low dropout voltage, highly precise, low noise, high PSRR, and large current High Speed LDO regulator IC. A built-in  $0.17\Omega$  low ON-resistance Pch driver transistor which can output up to a maximum output current 2.0A are also enclosed in a small surface-mount PKG, even in applications that input, and output voltage difference is you use a very small state, it is possible to use in the space-saving.

Then, the output voltage is possible to set the output voltage value to 1.2V ~ 5.0V by connecting the external resistors to  $V_{OFB}$  terminal.

The over current protection circuit will operate when the output current reaches its current limit. The thermal shutdown circuit will operate when the junction temperature reaches its limit temperature. The current limit is possible to arbitrarily set in a range of external resistor in 0.3A ~ 2.5A to  $I_{LIM}$  terminal. The inrush current prevention circuit perform the function of suppressing the variation of the  $V_{IN}$  line and it is possible to suppress the current (inrush current), which is charged in the output capacitor ( $C_L$ ) during IC start rising (when the IC control in CE).

In addition, the CE function enables the output to be turned off and the IC becomes a stand-by mode resulting in greatly reduced power consumption. The IC has further built-in reverse current prevention circuit, to prevent backflow current when the voltage state of more than input terminal ( $V_{IN}$ ) to the output terminal ( $V_{OUT}$ ).

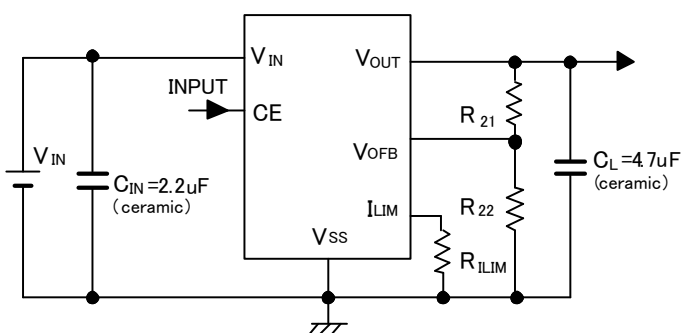
### ■ APPLICATIONS

- Industrial equipment
- Mobile modules
- Wireless modules

### ■ FEATURES

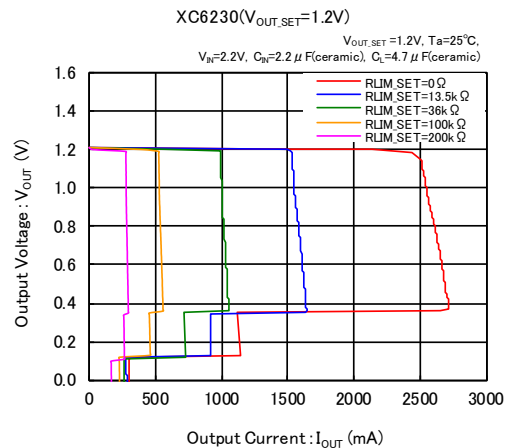
Output current	:	2.0A
Current Limit setting range	:	0.3A ~ 2.5A
Dropout Voltage (USP-6C)	:	0.17V @ $I_{OUT}=1.0A$ / $V_{OUT\_SET}=3.3V$
Dropout Voltage (SOP-8FD)	:	0.23V @ $I_{OUT}=1.0A$ / $V_{OUT\_SET}=3.3V$
Input voltage range	:	1.7V ~ 6.0V
Adjustable Output Voltage Accuracy	:	$1.2V \pm 1.0\%$
Output voltage setting range	:	1.2V ~ 5.0V
Supply current	:	45 $\mu$ A
Addition function	:	Reverse Current Protection Inrush Current Protection Output Voltage adjustable $C_L$ Discharge (A/H type) Current Limit adjustable
Protection function	:	Thermal shutdown (Detection Temp : 150°C Release Temp : 125°C) Current limit
Output capacitor	:	Ceramic capacitor (4.7 $\mu$ F)
Operating Ambient Temperature	:	-40°C ~ 105°C
Packages	:	USP-6C, SOP-8FD
Environment friendly features	:	EU RoHS Directive compliant, Pb free

### ■ TYPICAL APPLICATION CIRCUIT



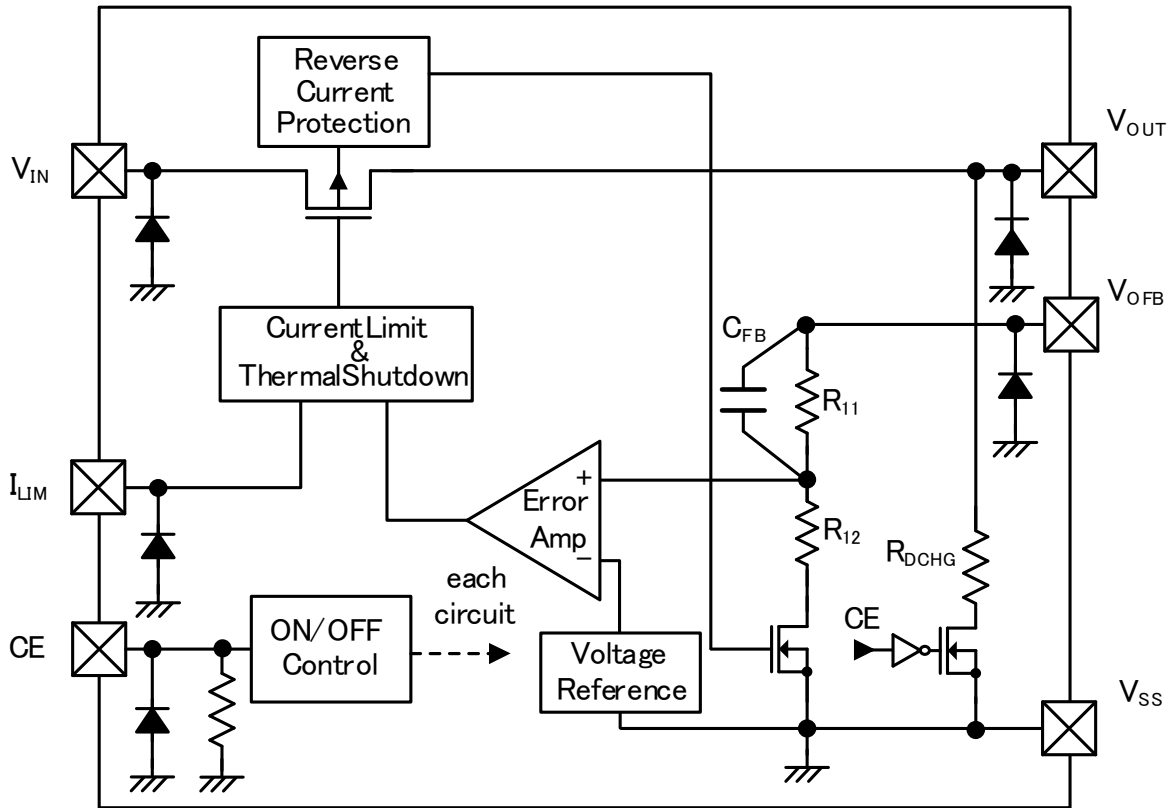
### ■ TYPICAL PERFORMANCE CHARACTERISTICS

Output Voltage vs. Output Current (Output current externally adjusted.)



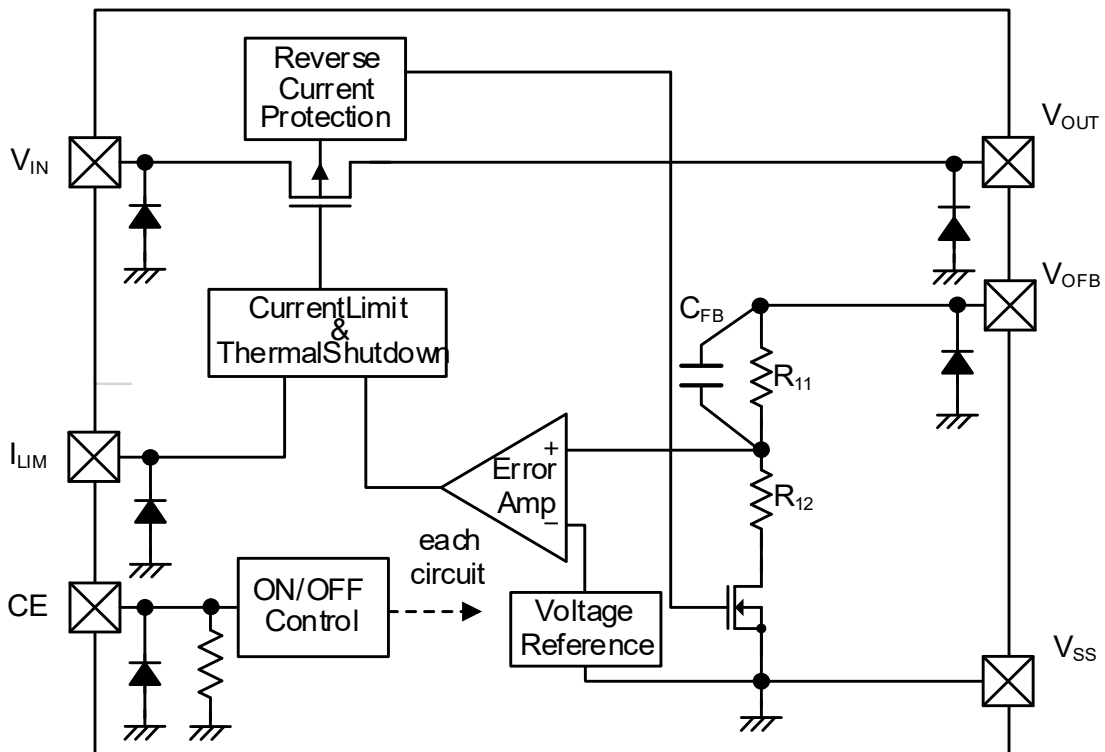
## ■ BLOCK DIAGRAMS

● Type A/H



\*Diodes inside the circuit are an ESD protection diodes.

● Type B/S



\*Diodes inside the circuit are an ESD protection diodes.

## ■ PRODUCT CLASSIFICATION

### ● Ordering Information

XC6230①②③④⑤⑥-⑦(\*1)

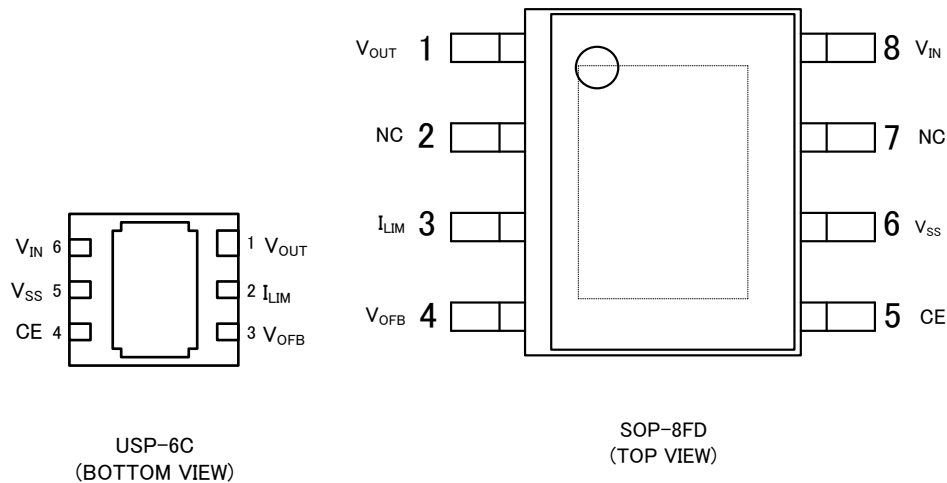
DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	Type	A	Refer to Selection Guide
		B	
		H	
		S	
②③	Output Voltage	00	Adjustable Output Voltage (V <sub>OFB</sub> =1.20V)
④	Adjustable Output Voltage Accuracy	1	±1%
⑤⑥-⑦(*1)	Packages (Order Unit)	ER-G	USP-6C (3,000pcs/Reel)
		QR-G	SOP-8FD (1,000pcs/Reel)

(\*1) The “-G” suffix denotes Halogen and Antimony free as well as being fully EU RoHS compliant.

### ● Selection Guide

FUNCTION	A/H TYPE	B/S TYPE
ADJUSTABLE OUTPUT VOLTAGE	Yes	Yes
CE PULL-DOWN RESISTOR	Yes	Yes
C <sub>L</sub> AUTO-DISCHARGE	Yes	-
INRUSH CURRENT PROTECTION	Yes	Yes
ADJUSTABLE CURRENT LIMITER	Yes	Yes
REVERSE CURRENT PROTECTION	Yes	Yes
THERMAL SHUTDOWN	Yes	Yes

## PIN CONFIGURATION



\* The dissipation pad for the USP-6C package and the SOP-8FD package should be solder-plate to enhance mounting strength and heat release. Please see the reference mount pattern and metal masking.

If the pad needs to be connected to other pins, it should be connected to the V<sub>SS</sub> (USP-6C: No. 5, SOP-8FD: No. 6) pin.

## PIN ASSIGNMENT

PIN NUMBER		PIN NAME	FUNCTIONS
USP-6C	SOP-8FD		
1	1	V <sub>OUT</sub>	Output
-	2, 7	NC	No Connection
2	3	I <sub>LIM</sub>	Current Limit Adjustment
3	4	V <sub>OFB</sub>	Output Voltage Adjustment
4	5	CE	ON/OFF Control
5	6	V <sub>SS</sub>	Ground
6	8	V <sub>IN</sub>	Power Input

## PIN FUNCTIOS ASSIGNMENT

PIN NAME	SIGNAL	STATUS
CE	H	Active
	L	Stand-by
	OPEN	Stand-by*

\* For CE pin voltage is fixed as L level because of internal pull-down resistor.

## ■ ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		$V_{IN}$	-0.3 ~ 7.0	V
Output Voltage		$V_{OUT}$	-0.3 ~ 7.0	V
CE Input Voltage		$V_{CE}$	-0.3 ~ 7.0	V
$V_{OFB}$ Pin Voltage		$V_{OFB}$	-0.3 ~ 6.0	V
$I_{LIM}$ Pin Voltage		$V_{LIM}$	-0.3 ~ 6.0	V
$I_{LIM}$ Pin Current		$I_{LIM}$	±1.0	mA
Power Dissipation ( $T_a=25^{\circ}C$ )	USP-6C	Pd	1000 (40mm x 40mm Standard board) <sup>(*)</sup>	mW
			1250 (JESD51-7 board) <sup>(*)</sup>	
	SOP-8FD		1500 (40mm x 40mm Standard board) <sup>(*)</sup>	
			2500 (JESD51-7 board) <sup>(*)</sup>	
Operating Ambient Temperature		$T_{opr}$	-40 ~ 105	°C
Storage Temperature		$T_{stg}$	-55 ~ 125	°C

All voltage ratings are relative to  $V_{SS}$ .

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

Please refer to PACKAGING INFORMATION for the mounting condition.

## ELECTRICAL CHARACTERISTICS

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Adjustable Output Voltage	V <sub>OFB</sub>	-	1.188	1.200	1.212	V	①
Output Voltage Setting Range	V <sub>OUT_SET</sub> <sup>(*)</sup>	-	1.2	-	5.0	V	①
Output Current	I <sub>OUTMAX</sub>	R <sub>LIM</sub> =0Ω	2000	-	-	mA	①
Input Voltage	V <sub>IN</sub>	-	1.7	-	6.0	V	①
Load Regulation1	ΔV <sub>OUT1</sub>	0.1mA ≤ I <sub>OUT</sub> ≤ 500mA	-	1	8	mV	①
Load Regulation2 <sup>(*)</sup>	ΔV <sub>OUT2</sub>	0.1mA ≤ I <sub>OUT</sub> ≤ 2000mA	-	1	14	mV	①
Dropout Voltage1 (Offset of Reverse Current Protection)	V <sub>dif1</sub> <sup>(*)</sup>	R <sub>21</sub> =33kΩ, R <sub>22</sub> =11kΩ I <sub>OUT</sub> =0mA	-	60	110	mV	①
Dropout Voltage2	V <sub>dif2</sub> <sup>(*)</sup>	【USP-6C】 R <sub>21</sub> =33kΩ, R <sub>22</sub> =11kΩ I <sub>OUT</sub> =1000mA	-	170	200	mV	①
		【SOP-8FD】 R <sub>21</sub> =33kΩ, R <sub>22</sub> =11kΩ I <sub>OUT</sub> =1000mA	-	230	260		
Dropout Voltage3	V <sub>dif3</sub> <sup>(*)</sup>	【USP-6C】 R <sub>21</sub> =33kΩ, R <sub>22</sub> =11kΩ I <sub>OUT</sub> =2000mA	-	350	410	mV	①
		【SOP-8FD】 R <sub>21</sub> =33kΩ, R <sub>22</sub> =11kΩ I <sub>OUT</sub> =2000mA	-	460	520		
Supply Current	I <sub>SS</sub>	V <sub>IN</sub> =6.0V, I <sub>OUT</sub> =0mA	-	45	83	μA	②
Stand-by Current	I <sub>STBY</sub>	V <sub>IN</sub> =6.0V, V <sub>CE</sub> =V <sub>SS</sub>	-	0.01	0.10	μA	②
Line Regulation	ΔV <sub>OUT</sub> / (ΔV <sub>IN</sub> · V <sub>OUT</sub> )	1.7V ≤ V <sub>IN</sub> ≤ 6.0V, I <sub>OUT</sub> =100mA	-	0.05	0.10	%/V	①
Output Voltage Temperature Characteristics	ΔV <sub>OUT</sub> / (ΔT <sub>opr</sub> · V <sub>OUT</sub> )	-40°C ≤ T <sub>opr</sub> ≤ 105°C	-	±100	-	ppm/°C	①
Power Supply Rejection Ratio	PSRR	V <sub>IN</sub> =V <sub>CE</sub> =2.2V+0.5Vp.p <sub>AC</sub> I <sub>OUT</sub> =30mA, f=1kHz	-	70	-	dB	③

Unless otherwise stated,

V<sub>IN</sub>=V<sub>CE</sub>=V<sub>OUT</sub>+1.0V, V<sub>OUT</sub>=V<sub>OFB</sub>, I<sub>OUT</sub>=10mA, C<sub>IN</sub>=2.2μF, C<sub>L</sub>=4.7μF, R<sub>LIM</sub>=0Ω

Parameter of electrical characteristics is applied when T<sub>J</sub>≒25°C become load conditions (pulse applied).

Unless ΔV<sub>OUT</sub> / (ΔT<sub>opr</sub> · V<sub>OUT</sub>), T<sub>TSD</sub> and T<sub>TSR</sub> conditions.

NOTE:

<sup>(\*)</sup>V<sub>OUT\_SET</sub>: Nominal output voltage. V<sub>OUT\_SET</sub> is adjustable with external resistors (R<sub>21</sub>, R<sub>22</sub>). V<sub>OUT\_SET</sub> is 1.2V, If V<sub>OUT</sub> = V<sub>OFB</sub>.

<sup>(\*)</sup>V<sub>dif</sub>={V<sub>IN1</sub>-V<sub>OUT1</sub>}

V<sub>IN</sub>: Gradually lower the input voltage, the input voltage when 3.3V is output.

V<sub>OUT</sub>: V<sub>OUT\_SET</sub> is set to more than 3.3V, it is confirmed that the 3.3V is output to V<sub>OUT</sub>.

<sup>(\*)</sup> Design reference value. This parameter is provided only for reference.

## ■ ELECTRICAL CHARACTERISTICS (Continued)

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Limit Current	I <sub>LIM</sub>	R <sub>LIM</sub> =0Ω	2250	2500	2750	mA	①
		R <sub>LIM</sub> =200kΩ, A/B Type	220	300	370		
		R <sub>LIM</sub> =200kΩ, H/S Type	240	300	370		
Short -Circuit Current	I <sub>SHORT</sub>	V <sub>OUT</sub> =V <sub>SS</sub>	-	320	-	mA	①
		V <sub>OUT</sub> =V <sub>SS</sub> , R <sub>LIM</sub> =200kΩ	-	180	-		
Input Impedance V <sub>OFB</sub>	R <sub>VOFB</sub>	V <sub>IN</sub> =V <sub>CE</sub> =6.0V, V <sub>OFB</sub> =5.5V	0.7	1.7	2.7	MΩ	①
CE "H" Level Voltage	V <sub>CEH</sub>	-	0.9	-	6.0	V	①
CE "L" Level Voltage	V <sub>CEL</sub>	-	V <sub>SS</sub>	-	0.4	V	①
CE "H" Level Current	I <sub>CEH</sub>	V <sub>IN</sub> =6.0V, V <sub>CE</sub> =6.0V	-	6.0	10.4	μA	①
CE "L" Level Current	I <sub>CEL</sub>	V <sub>IN</sub> =6.0V, V <sub>CE</sub> =V <sub>SS</sub>	-0.1	-	0.1	μA	①
Reverse Current	I <sub>REV</sub> <sup>(*)4</sup>	V <sub>IN</sub> =0V, V <sub>CE</sub> =2.0V, V <sub>OUT</sub> =6.0V	-	0.05	0.10	μA	①
V <sub>OUT</sub> Sink Current at Reverse condition	I <sub>REVS</sub> <sup>(*)5</sup>	V <sub>IN</sub> =V <sub>CE</sub> =5.0V, V <sub>OUT</sub> =6.0V	-	0.9	1.6	μA	①
Inrush Current	I <sub>RUSH</sub>	V <sub>IN</sub> =6.0V, V <sub>CE</sub> =0→6.0V	-	-	500	mA	①
Thermal Shutdown Detect Temperature	T <sub>TSD</sub>	Junction Temperature	-	150	-	°C	①
Thermal Shutdown Release Temperature	T <sub>TSR</sub>	Junction Temperature	-	125	-	°C	①
C <sub>L</sub> Discharge Resistance (A/H Type)	R <sub>DCHG</sub>	V <sub>IN</sub> =6.0V, V <sub>CE</sub> =V <sub>SS</sub> , V <sub>OUT</sub> =1.2V	-	35	-	Ω	①

Unless otherwise stated,

V<sub>IN</sub>=V<sub>CE</sub>=V<sub>OUT</sub>+1.0V, V<sub>OUT</sub>=V<sub>OFB</sub>, I<sub>OUT</sub>=10mA, C<sub>IN</sub>=2.2μF, C<sub>L</sub>=4.7μF, R<sub>LIM</sub>=0Ω

Parameter of electrical characteristics is applied when T<sub>j</sub>≒25°C become load conditions (pulse applied).

Unless ΔV<sub>OUT</sub>/ (ΔT<sub>opr</sub> · V<sub>OUT</sub>), T<sub>TSD</sub> and T<sub>TSR</sub> conditions.

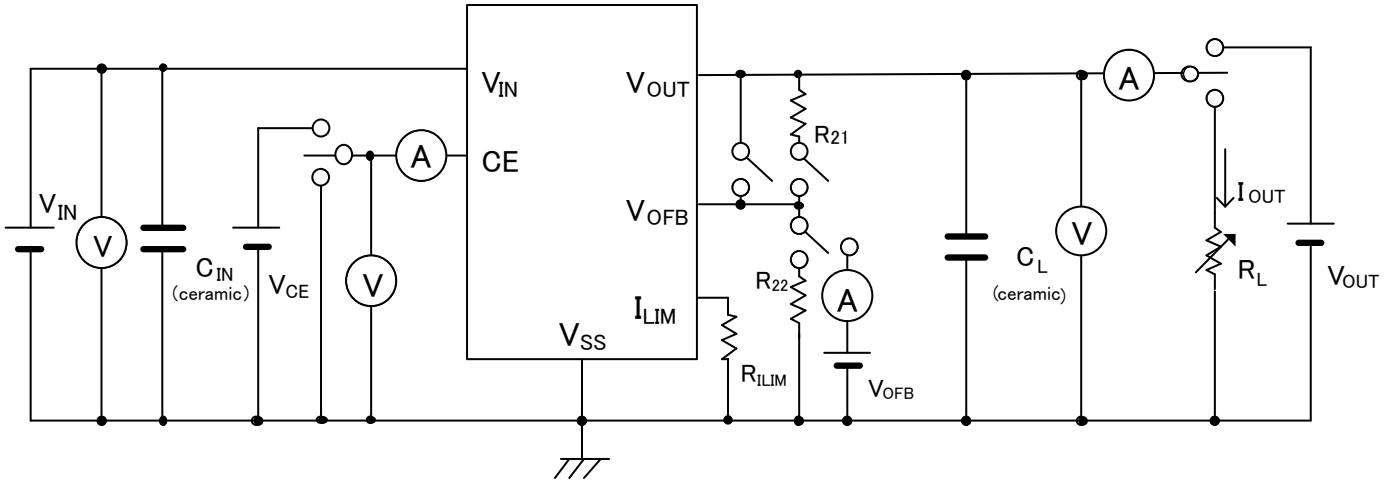
NOTE:

<sup>(\*)4</sup> reverse current (I<sub>REV</sub>) shows the current flowing from the V<sub>OUT</sub> terminal to V<sub>IN</sub> terminal.

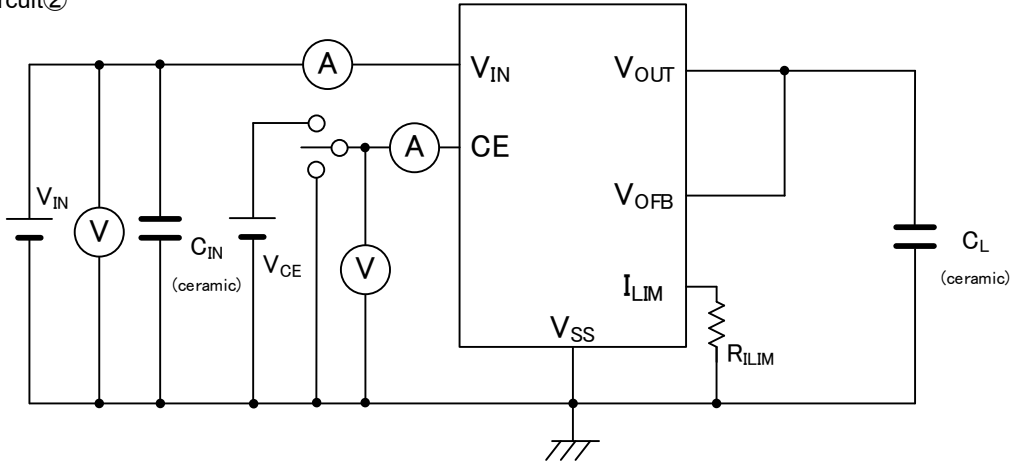
<sup>(\*)5</sup> reverse flow during the V<sub>OUT</sub> pin sink current (I<sub>REVS</sub>) shows the current flowing from the V<sub>OUT</sub> pin to the V<sub>SS</sub> terminal.

## TEST CIRCUITS

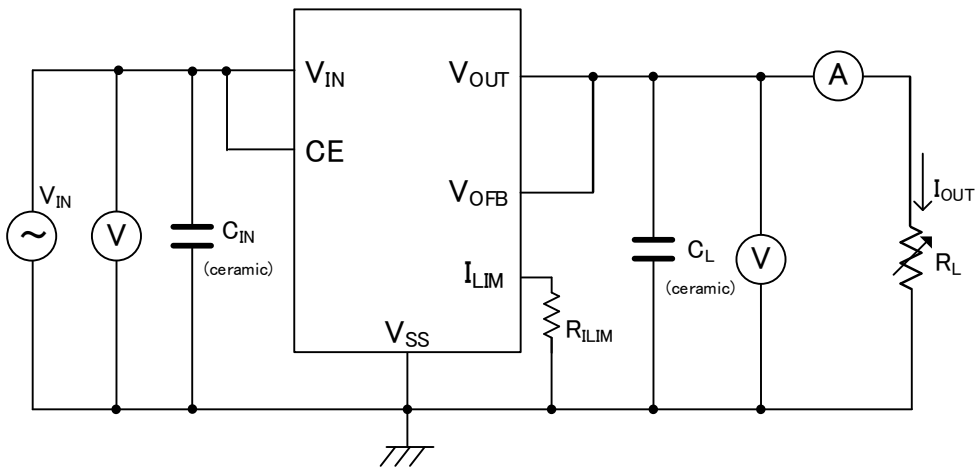
### ● Circuit①



### ● Circuit②



### ● Circuit③

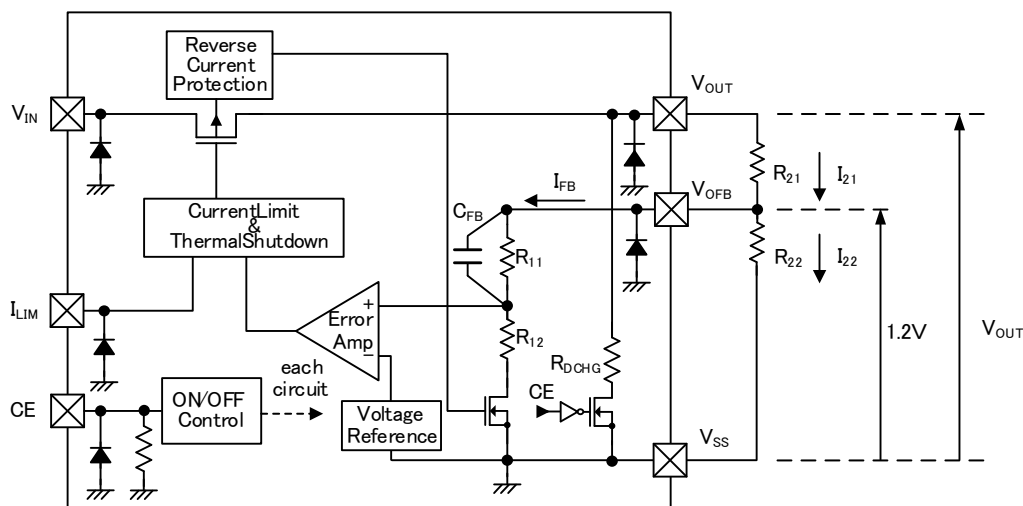




## ■ OPERATIONAL EXPLANATION

The XC6230 series controls the output voltage, divided by resistors  $R_{11}$  &  $R_{12}$  which are connected to the  $V_{OFB}$  pin is compared with the internal reference voltage by the error amplifier. The P-channel MOSFET connected to the  $V_{OUT}$  pin, is then driven by the subsequent output signal. The output voltage at the  $V_{OUT}$  pin is controlled & stabilized by negative feedback.

This IC the current limit circuit and short protect circuit operate in relation to the level of output current. The thermal protection operates in relation to the level of heat generation. The reverse current protection operates when  $V_{OUT}$  voltage is higher than  $V_{IN}$  voltage. Further, the IC's internal circuitry can be turned off via the CE pin's signal.



XC6230 Series, Type A/H.

### <Output voltage outside the adjustable function>

XC6230 series are possible to adjust the output voltage in the range of up to 1.2V~5.0V by the value of the external resistor divider  $R_{21}$  and  $R_{22}$ . The output voltage can be set externally by the following equation:

$$I_{21} = I_{FB} + I_{22} \quad (1)$$

$$I_{22} = V_{OFB} / R_{22} \quad (2)$$

Following (1), (2) 
$$I_{21} = I_{FB} + V_{OFB} / R_{22} \quad (3)$$

Setting output voltage " $V_{OUT\_SET}$ " is the sum of the voltage which is determined by the current flowing through the  $V_{OFB}$  voltage and resistance  $R_{21}$ .

$$V_{OUT\_SET} = V_{OFB} + R_{21} \times I_{21} \quad (4)$$

Substituting (3) in (4), 
$$V_{OUT\_SET} = V_{OFB} + R_{21} \times (I_{FB} + V_{OFB} / R_{22})$$
  

$$= V_{OFB} \times (R_{21} + R_{22}) / R_{22} + R_{21} \times I_{FB} \quad (5)$$

Following (5), can decide arbitrary setting voltage.

In this case, it becomes  $V_{OFB} = 1.200V$  (TYP.) from the electrical characteristics.

The second term of the equation (5),  $R_{21} \times I_{FB}$ , is the cause of the output voltage precision error.

The  $I_{FB}$  can be calculated by the following equation;

$$I_{FB} = V_{OFB} / (R_{11} + R_{12}) \quad (*1) \quad (6)$$

$$(*1): (R_{11} + R_{12}) = R_{V_{OFB}} \text{ (TYP. } 1.7M\Omega)$$

The cause of the output precision error,  $R_{21} \times I_{FB}$  can be calculated by the equation below;

$$R_{21} \times I_{FB} = R_{21} \times V_{OFB} / R_{V_{OFB}}$$
  

$$= V_{OFB} \times R_{21} / R_{V_{OFB}} \quad (7)$$

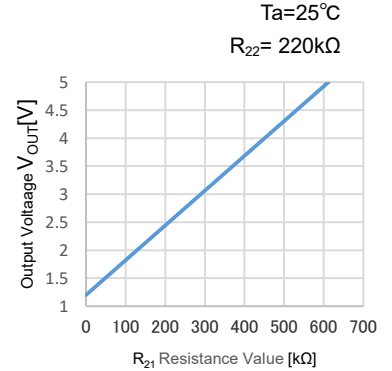
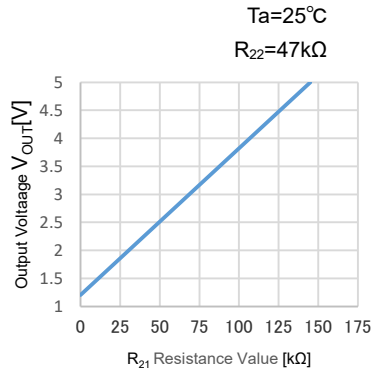
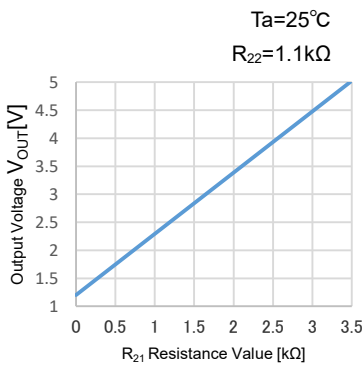
Accordingly, if  $R_{21} \ll R_{V_{OFB}}$ , Precision error of the output voltage setting, it can be made very small.

However, customers please would be selected on that was evaluated by your conditions of use. If the external resistance value is small, there is a trade-off between current consumption increases. The value of  $R_{22}$  is recommended 47k $\Omega$ .

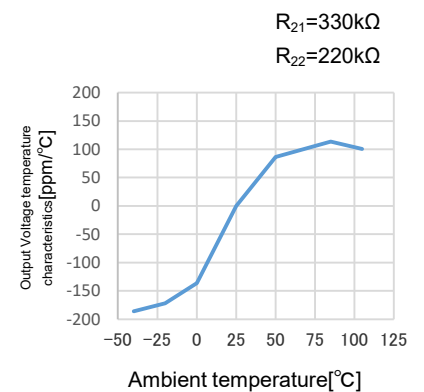
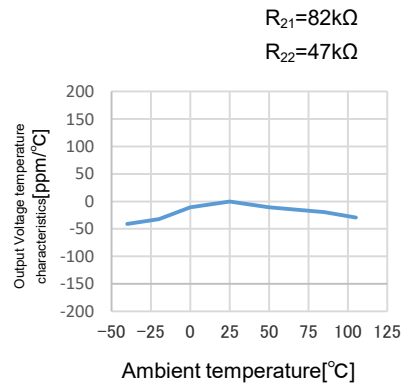
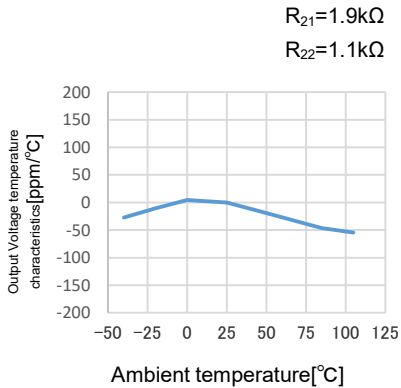
Please use by connecting the  $V_{OUT}$  pin and  $V_{OFB}$  terminal, when used as 1.2V set up.

## OPERATIONAL EXPLANATION (Continued)

### <Setting resistor dependence of output voltage>



### <Temperature characteristics of the output voltage>



Large external feedback resistor (R<sub>21</sub>, R<sub>22</sub>) can no longer be ignored I<sub>FB</sub> flowing into the IC, they will affect the set output voltage and the output voltage temperature characteristics.

Therefore, the feedback resistor should be chosen to be the R<sub>22</sub> ≤ 220kΩ.

### <Low ESR Capacitors>

The XC6230 series needs an output capacitor (C<sub>L</sub>) for phase compensation. In order to ensure the stable phase compensation, please place an output capacitor (C<sub>L</sub>) of 4.7μF or bigger at the V<sub>OUT</sub> pin and V<sub>SS</sub> pin as close as possible. For a stable power input, please connect an input capacitor (C<sub>IN</sub>) of 2.2μF between the input pin (V<sub>IN</sub>) and the ground pin (V<sub>SS</sub>).

Since Input capacitor (C<sub>IN</sub>), the output capacitor (C<sub>L</sub>) is bias dependence of the capacitor the influence of the missing capacity due to temperature characteristics, also there is a risk that cannot be stable phase compensation under the influence of the ESR. Please pay attention to the selection of the capacitor to be used.

## ■ OPERATIONAL EXPLANATION (Continued)

### <Current Limit, Short Current>

The IC has a built-in drooping current limiting circuit for overcurrent protection. When load current reaches the current limit level, the output voltage drops. Furthermore, when the output voltage drops to a specified value, the output current is throttled down. The output current finally falls at the level of 320mA (TYP.) when the output pin ( $V_{OUT}$ ) is short-circuited ( $R_{LIM}=0\Omega$ ).

### <Current limit external adjustment function>

By connecting a resistor to the current limit external adjustment pin ( $I_{LIM}$ ), the current limit can be set to any value. By the following each equation, the current limit value can be set to any value within a range of 300mA to 2500mA (TYP.).

Initial value of the current limit is set to 2500mA (TYP.) on IC inside. Please be sure to use the current limit external control terminal ( $I_{LIM}$ ) are connected by either  $0\Omega$  short to  $V_{SS}$  terminal on the substrate.

When the  $I_{LIM}$  pin is open, the switch transistor is forcibly turned off.

In case of  $300mA \leq I_{LIM(T)} \leq 500mA$  range,  $R_{LIM}[k\Omega] = 74300 / I_{LIM(T)}[mA] - 48.2[k\Omega] \dots\dots\dots(8)$

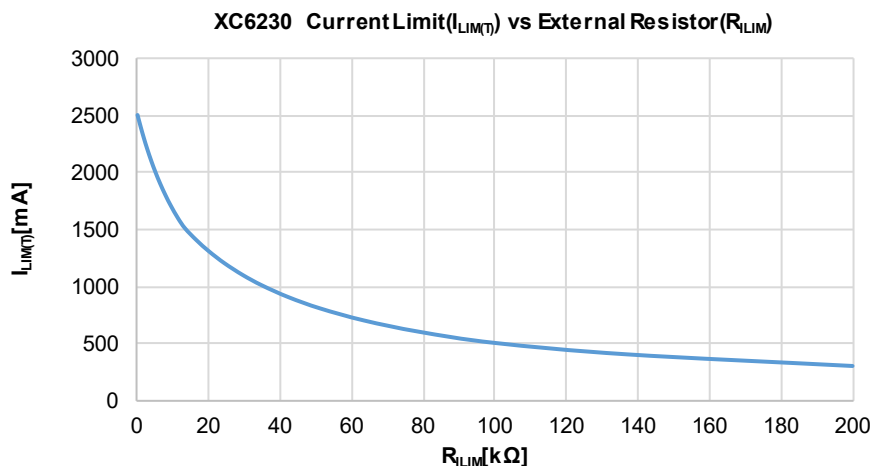
In case of  $500mA < I_{LIM(T)} \leq 1500mA$  range,  $R_{LIM}[k\Omega] = 65200 / I_{LIM(T)}[mA] - 30.0[k\Omega] \dots\dots\dots(9)$

In case of  $1500mA < I_{LIM(T)} < 2500mA$  range,  $R_{LIM}[k\Omega] = 49800 / I_{LIM(T)}[mA] - 19.9[k\Omega] \dots\dots\dots(10)$

$R_{LIM}$ : The external resistance value,  $I_{LIM(T)}$ : The current limit value

Table 1. Current Limit Setting List

$I_{LIM(T)}$ [mA]	$R_{LIM}$ [kΩ]	(E96) Resistor [kΩ]	Current Limit [mA] (TYP.)	$I_{LIM(T)}$ [mA]	$R_{LIM}$ [kΩ]	(E96) Resistor [kΩ]	Current Limit [mA] (TYP.)
300	199.5	200	299	1500	13.5	13.3	1506
400	137.6	137	401	1600	11.2	11.3	1596
500	100.4	100	501	1700	9.4	9.31	1705
600	78.7	78.7	600	1800	7.8	7.87	1793
700	63.1	63.4	698	1900	6.3	6.34	1898
800	51.5	51.1	804	2000	5.0	4.99	2001
900	42.4	42.2	903	2100	3.8	3.83	2099
1000	35.2	34.8	1006	2200	2.7	2.67	2206
1100	29.3	29.4	1098	2300	1.8	1.78	2297
1200	24.3	24.3	1201	2400	0.9	0.909	2393
1300	20.2	20	1304	2500	$I_{LIM}$ shorted to $V_{SS}$		2500
1400	16.6	16.5	1402				



## ■ OPERATIONAL EXPLANATION (Continued)

### <Thermal Shutdown>

When the junction temperature of the built-in driver transistor reaches the temperature limit, the thermal shutdown circuit operates, and the driver transistor will be set to OFF. The IC resumes its operation when the thermal shutdown function is released, and the IC's operation is automatically restored because the junction temperature drops to the level of the thermal shutdown release voltage.

### <CE Pin>

The IC's internal circuitry can be shutdown via the signal from the CE pin.

Since a pull-down resistor is connected to the CE pin, the "L" level is maintained even when the CE pin is open, but pull-down current to the CE pin is generated.

### <Inrush Current Protection>

The inrush current protection circuit is built in the IC.

When the IC starts to operate, the protection circuit limits the inrush current within 500mA (MAX.) from input pin ( $V_{IN}$ ) to output pin ( $V_{OUT}$ ) to charge  $C_L$  capacitor. However, the control of the internal IC cannot be supply more than 500mA (MAX.) for about 300 $\mu$ s.

### <Reverse Current Protection>

The XC6230 series includes reverse current protection to prevent the damage battery or the like which is connected to the  $V_{IN}$  pin to prevent the destruction as a result of backflow from  $V_{OUT}$  pin to the  $V_{IN}$  pin and  $V_{SS}$  pin when the power supply is connected to the  $V_{OUT}$  pin.

When  $V_{IN}$  is smaller than  $V_{OUT}$ , the reverse current protection works and suppress the reverse current to 0.1 $\mu$ A (MAX.). When  $V_{IN}$  is smaller than  $V_{OUT}$ , the  $V_{OUT}$  pin sink current  $I_{REVS}$  flowing from the  $V_{OUT}$  pin to the  $V_{SS}$  pin is 0.9 $\mu$ A (TYP.) as the IC operation current.

In addition, the reverse current protection function operates regardless of the CE pin voltage being "H" voltage or "L" voltage.

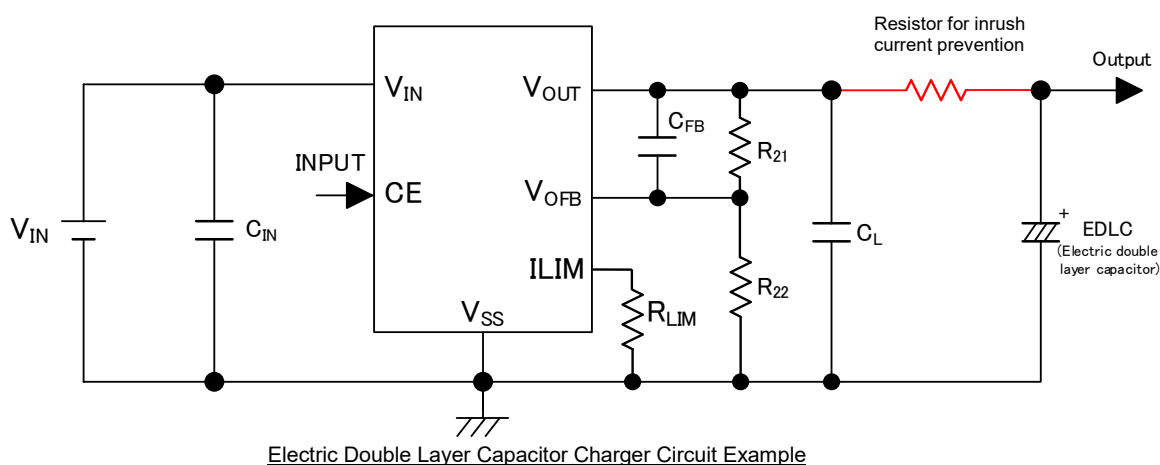
### < $C_L$ Auto-Discharge Function>

A/H type contains a  $C_L$  auto-discharge resistor and an N-channel transistor between the  $V_{OUT}$  pin and the  $V_{SS}$  pin. The device quickly discharges the electric charge in the output capacitor ( $C_L$ ) when a low signal to the CE pin is input to turn off a whole IC circuit. The  $C_L$  auto-discharge resistance is set at 35 $\Omega$  ( $V_{OUT}=1.2V$  TYP. @  $V_{IN}=6.0$ ).

Discharge time of the output capacitor ( $C_L$ ) is determined by a  $C_L$  auto-discharge resistor value ( $R_{DCHG}$ ) and an output capacitor value. Time constant  $\tau$  is defined as ( $\tau = C_L \times R_{DCHG}$ ). Output voltage after starting discharge can be calculated by the following formula.

## ■ NOTES ON USE

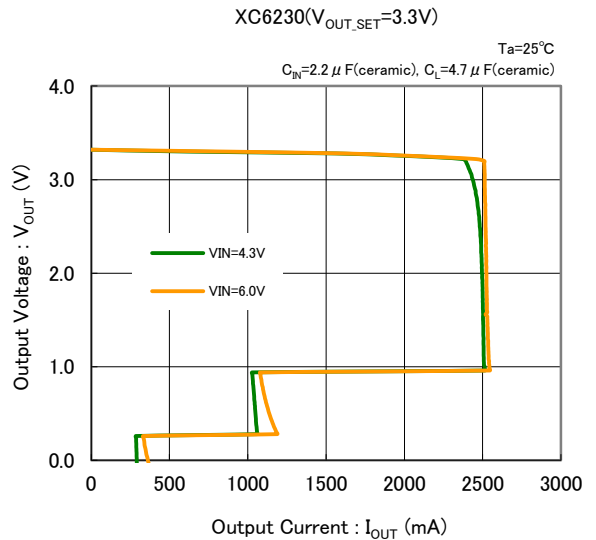
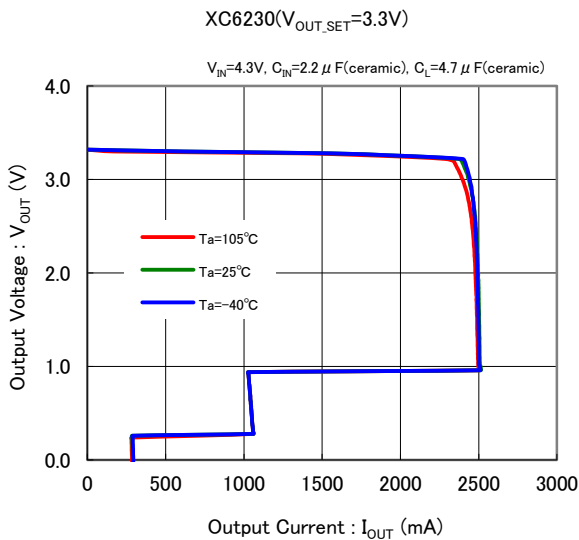
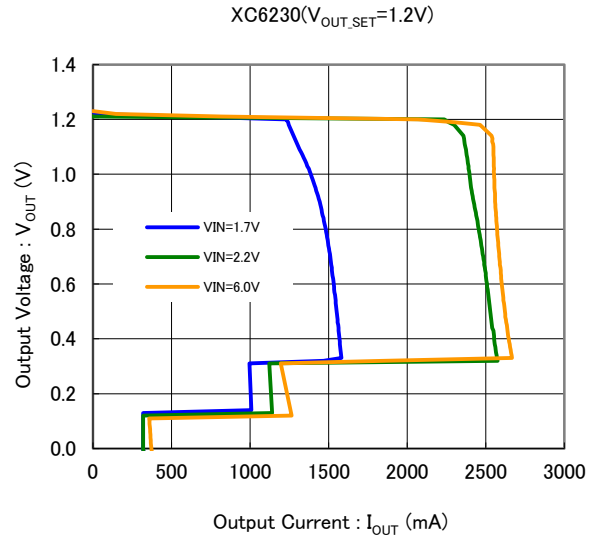
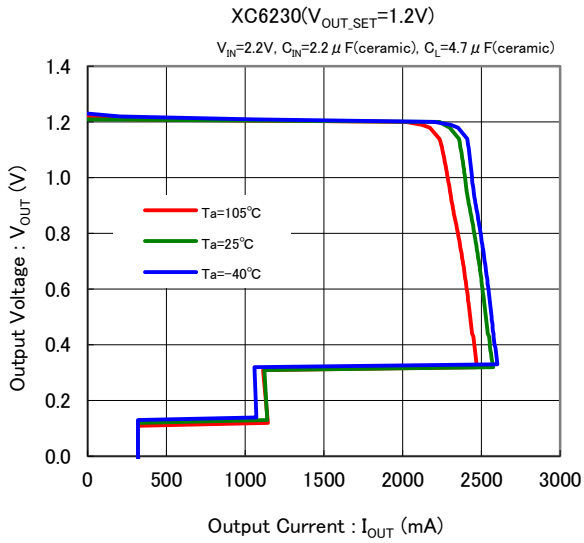
- For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
- Where wiring impedance is high, operations may become unstable due to the noise and/or phase lag depending on output current. Please strengthen  $V_{IN}$  and  $V_{SS}$  wiring in particular.
- The input capacitor ( $C_{IN}$ ) and the output capacitor ( $C_L$ ) should be placed to the as close as possible with a shorter wiring.
- This IC has output stabilized by negative feedback control so as to follow the output fluctuation.  
The negative feedback control because the response delay exists, for a change of steep load current, to compensate for the supply of the load current by the discharge of charge from the output capacitor ( $C_L$ ).  
However, since the electric charge discharge voltage temporarily drops, please use as large as possible a stabilization capacitance value of output capacitor ( $C_L$ ) you have our check the electrical characteristics If that can occur sudden input change and load change on the application.
- Torex recommend that the resistance tolerance and temperature coefficient of resistance (T.C.R) is selected the small parts in use, since the characteristics of the external resistor will affect the output voltage and current limit.
- If you are setting the current limit with an external resistor, please set the maximum output current, which is to use it as equal to or less than about 80% of the current limit setting value ( $I_{LIM(T)}$ ).
- In the case that high resistors value of the  $R_{21}$ ,  $R_{22}$  are used for B/S type and a voltage close to the input voltage level is applied to the output voltage Pin in the condition of CE="L", the output voltage may be maintained near the input voltage level.  
If it is necessary to reduce the output voltage to 0V under these conditions, please adjust the resistance of  $R_{21}$  and  $R_{22}$  and connect a load resistance so that a load current of 30 $\mu$ A or more can flow to the output side.
- Please use in the  $V_{IN}$ - $V_{OUT}$  difference and load current, in the range of heat loss does not exceed the allowable loss.  
For a change in the heat dissipation properties also by the substrate conditions, please design or select a good substrate of the heat dissipation efficiency.
- When adding a large capacitance or an electric double layer capacitor to the output line, overcurrent can flow momentarily at the current limit changing point in the low output voltage range.  
To prevent overcurrent, please use an output capacitor of 120  $\mu$ F or less. In addition, when using this IC to charge an electric double layer capacitor and the like, please put a resistor between an output capacitor ( $C_L$ ) and an electric double layer capacitor to prevent inrush current so that excessive overcurrent does not flow.



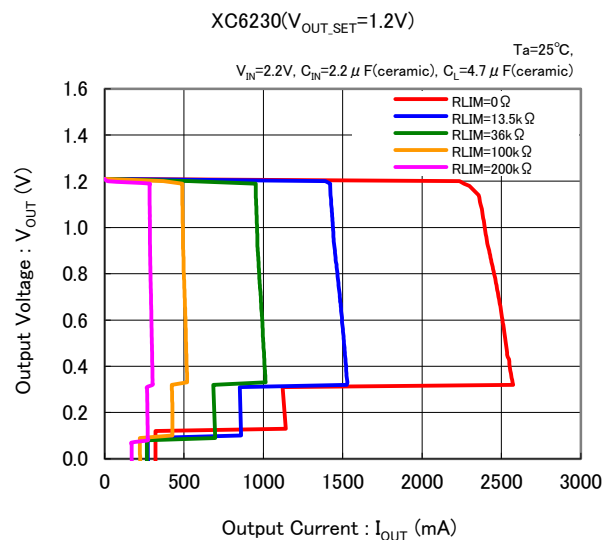
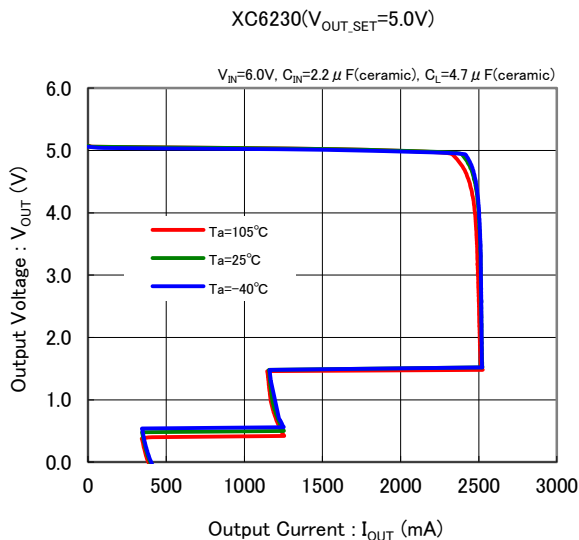
- Torex places an importance on improving our products and its reliability. However, by any possibility, we would request user fail-safe design and post-aging treatment on system or equipment.

## TYPICAL PERFORMANCE CHARACTERISTICS

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

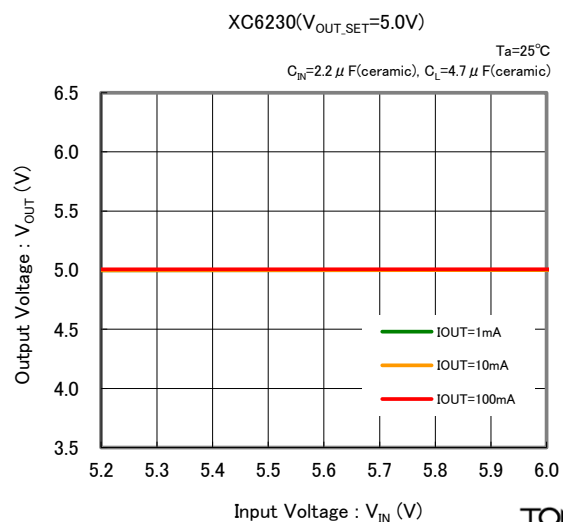
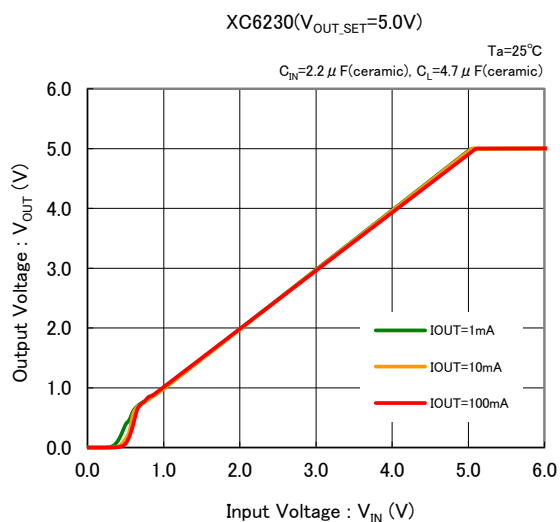
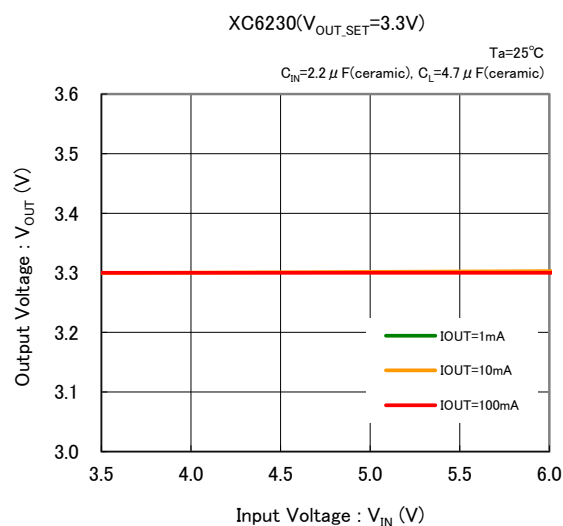
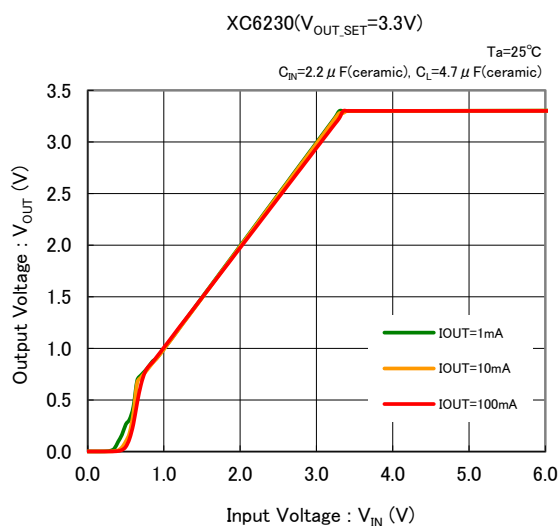
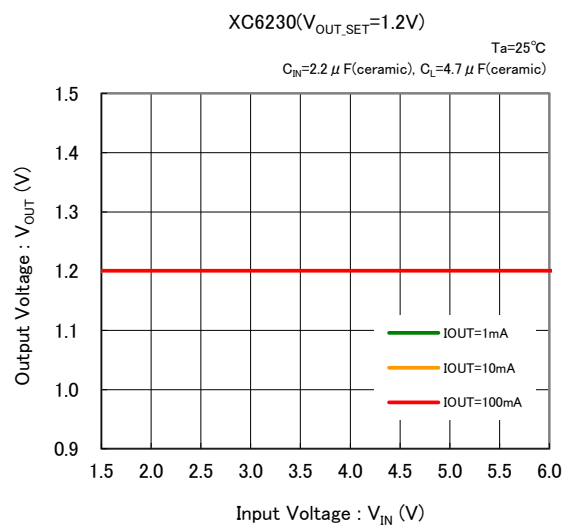
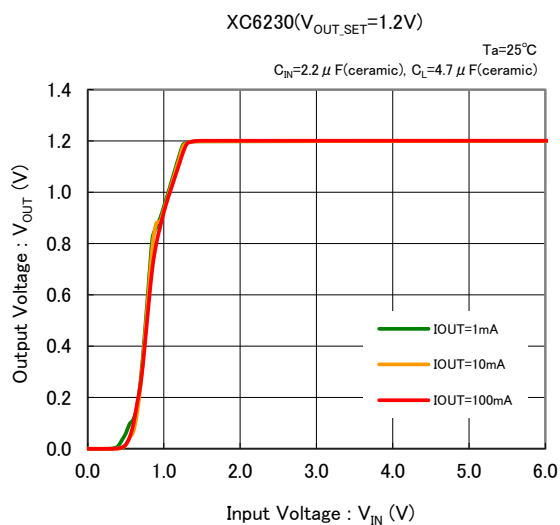


### (2) Output Voltage vs. Output Current (Output current externally adjusted.)



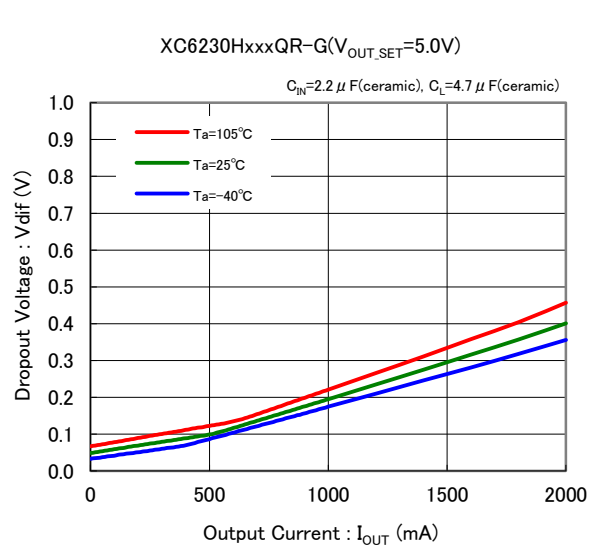
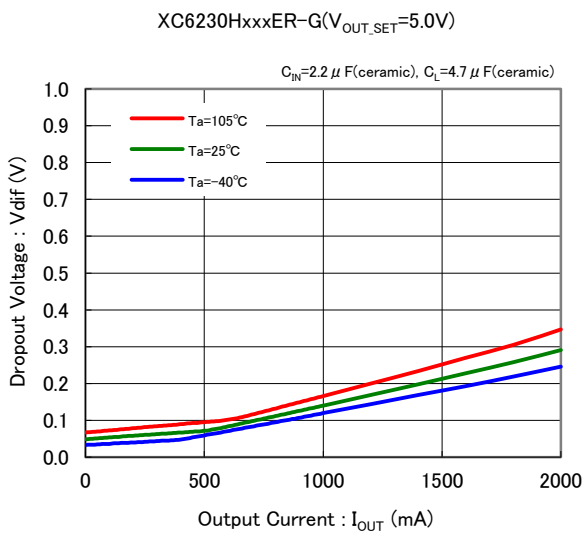
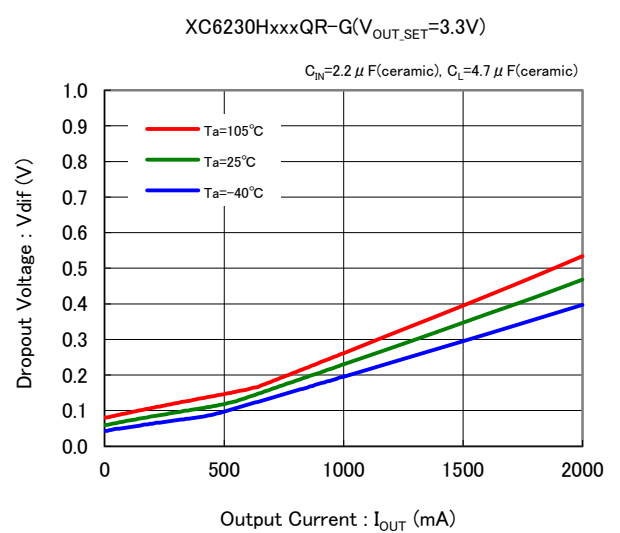
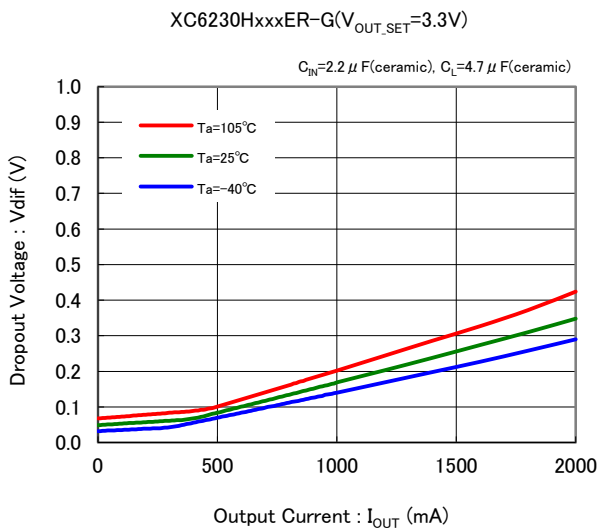
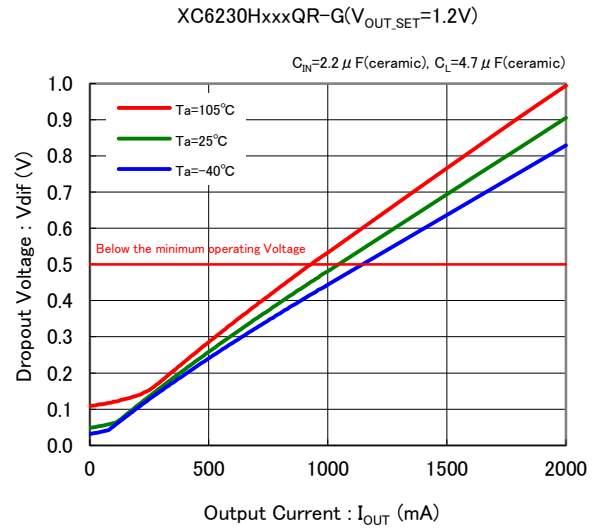
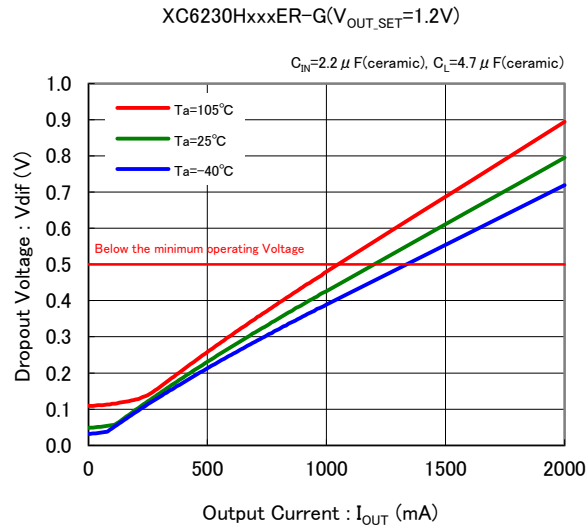
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

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



## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

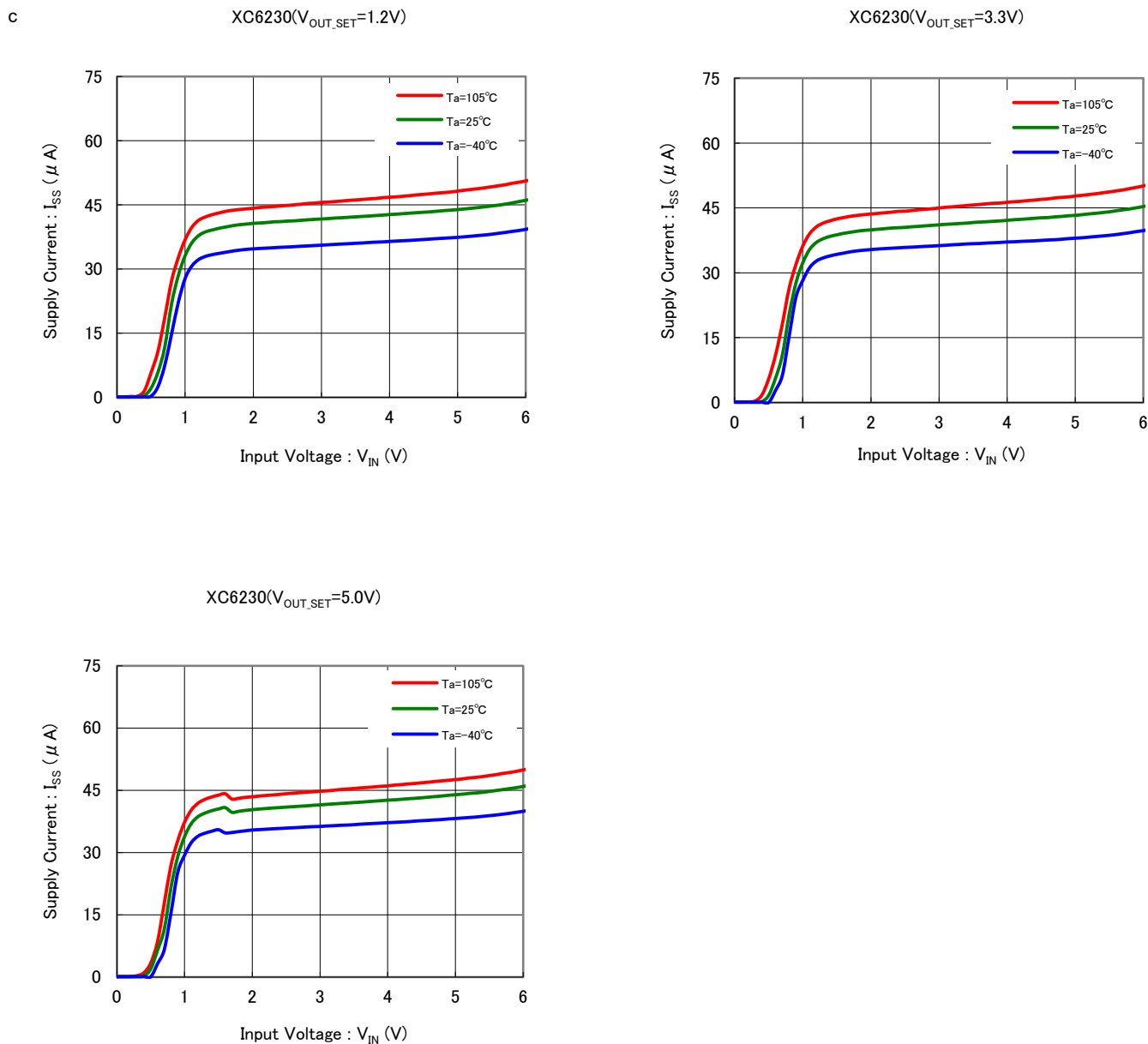
### (4) Dropout Voltage vs. Output Current



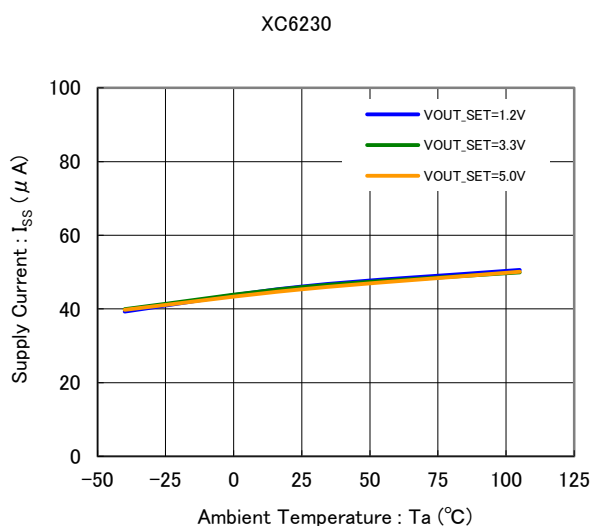


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

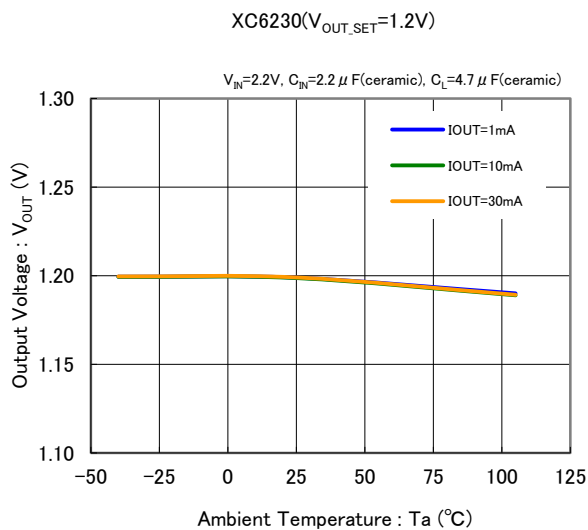
(5) Supply Current vs. Input Voltage



(6) Supply Current vs. Ambient Temperature

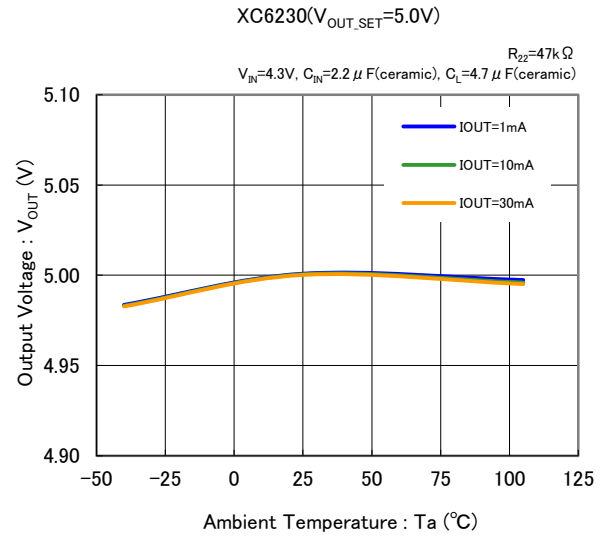
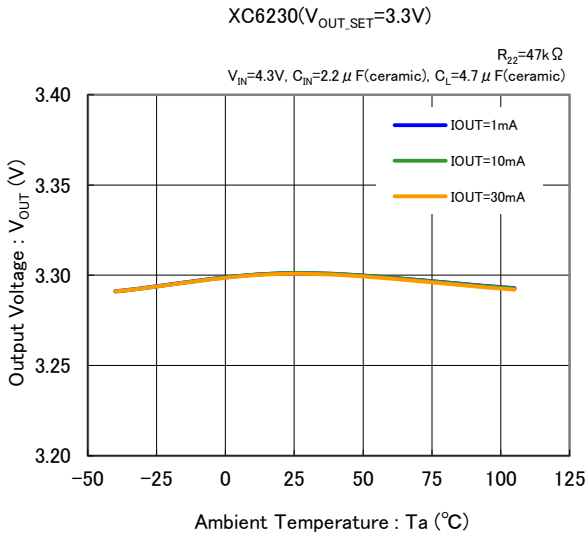


(7) Output Voltage vs. Ambient Temperature

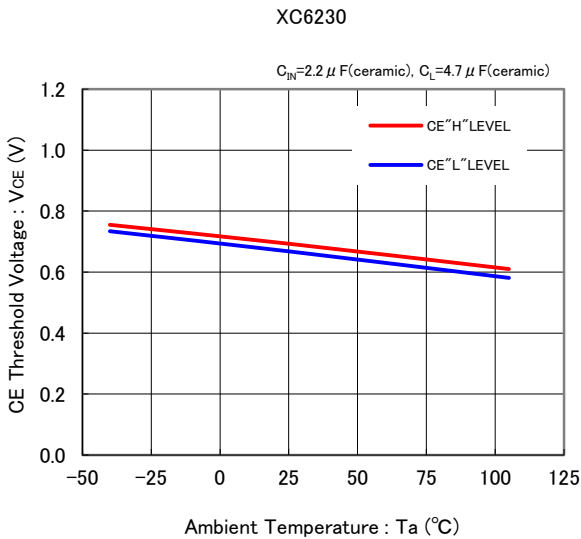


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

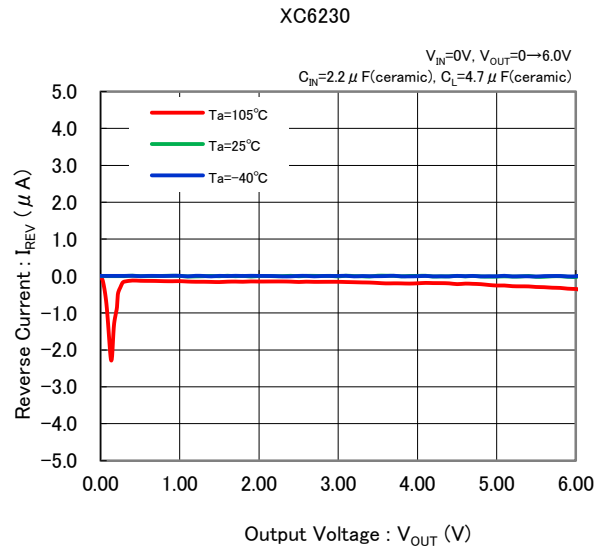
(7) Output Voltage vs. Ambient Temperature



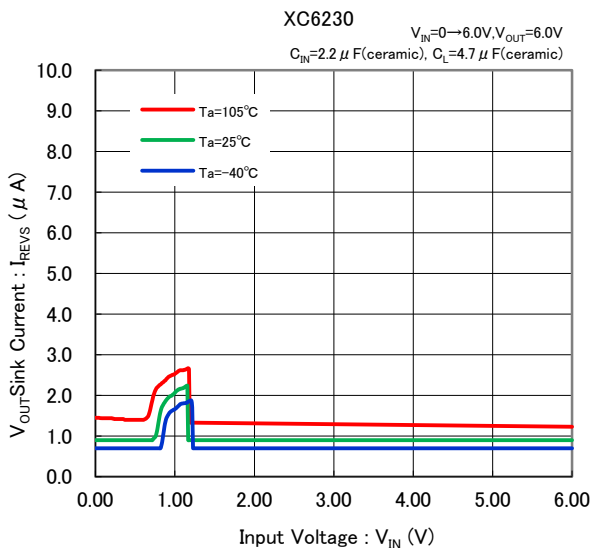
(8) CE Threshold Voltage vs. Ambient Temperature



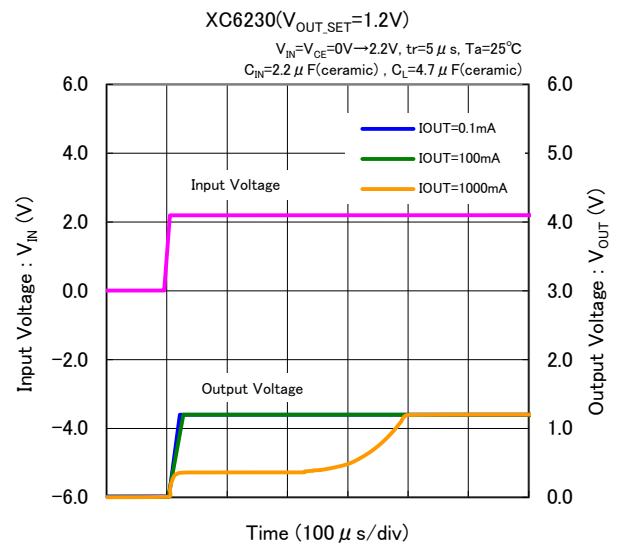
(9) Reverse Current vs. Output Voltage



(10)  $V_{OUT}$  Sink Current vs. Input Voltage

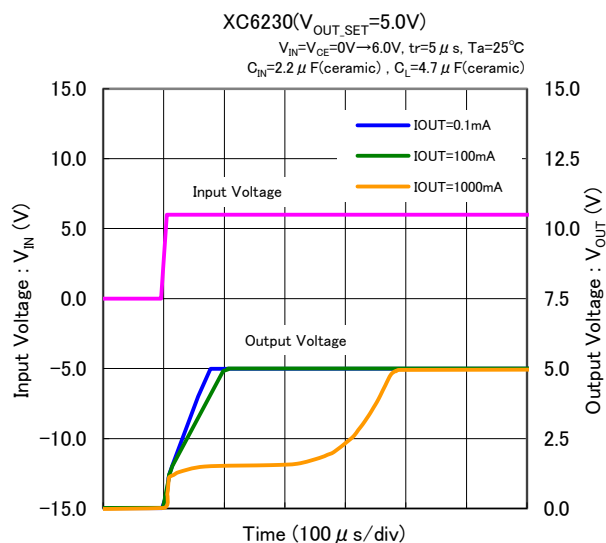
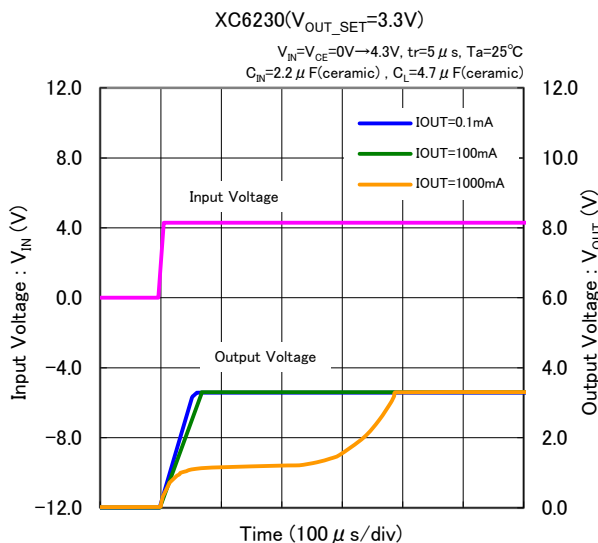


(11) Rising Response Time

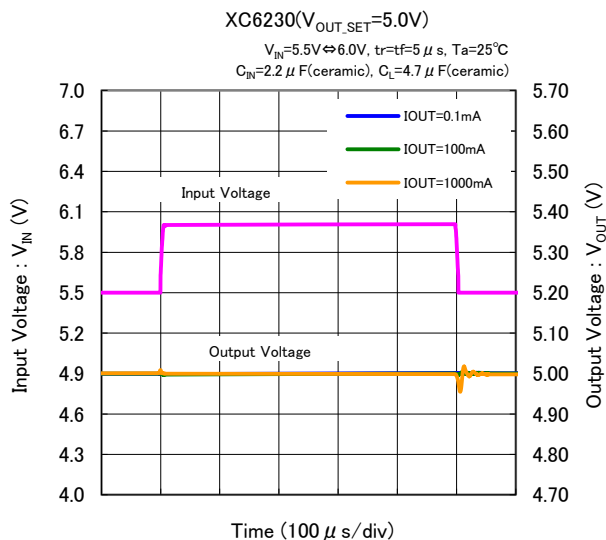
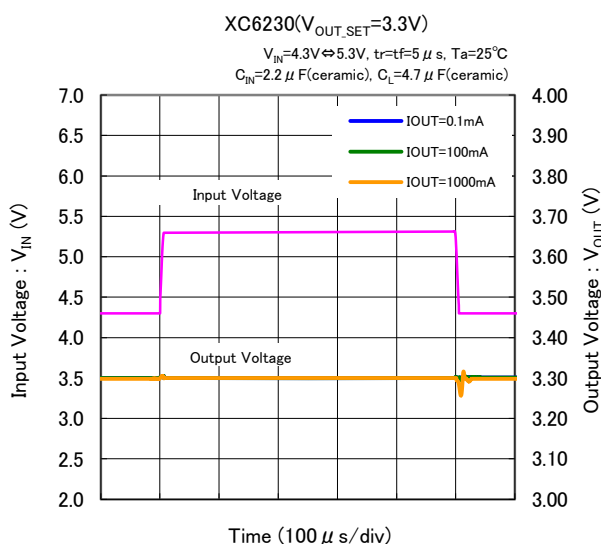
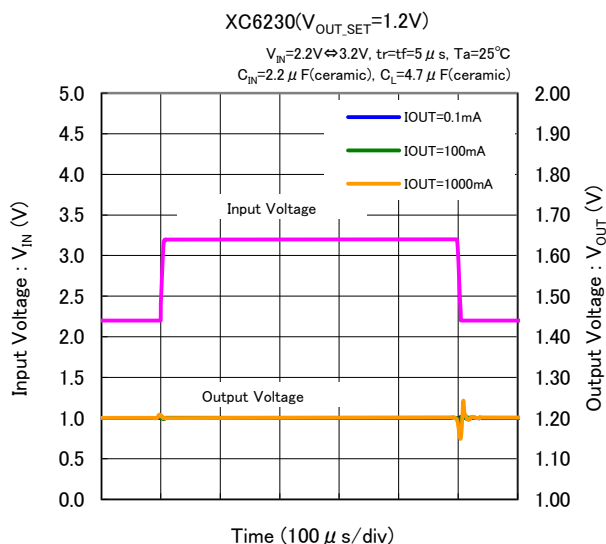


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (11) Rising Response Time

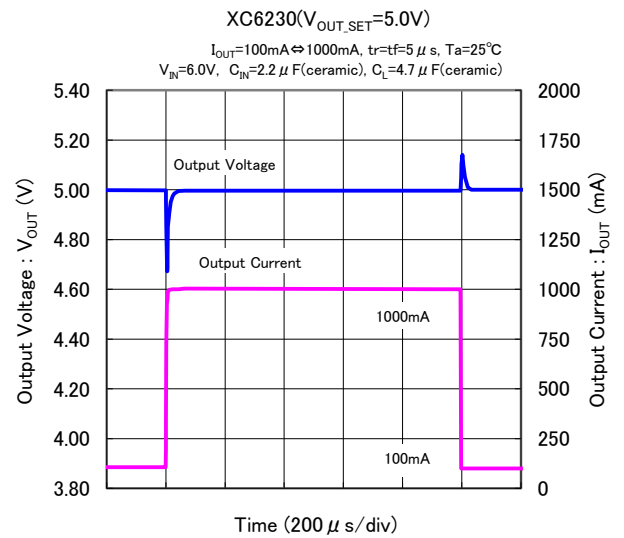
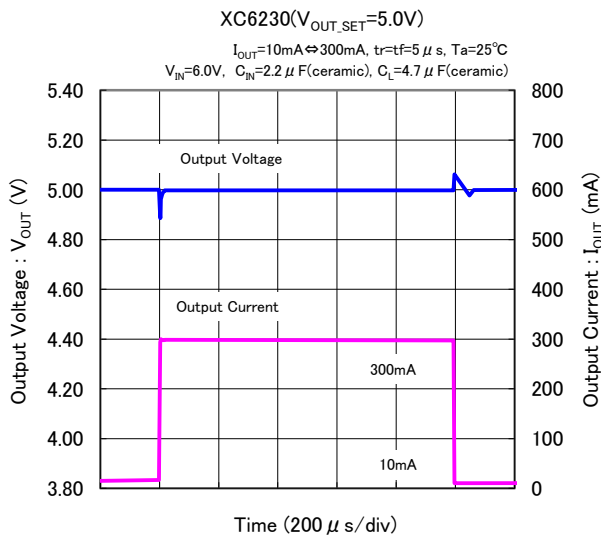
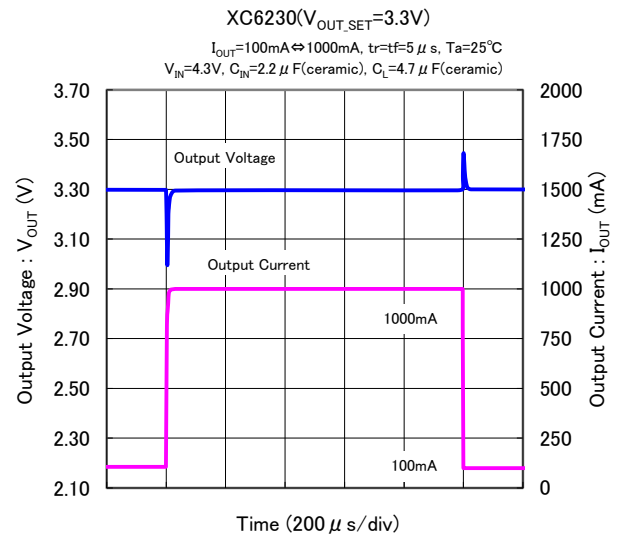
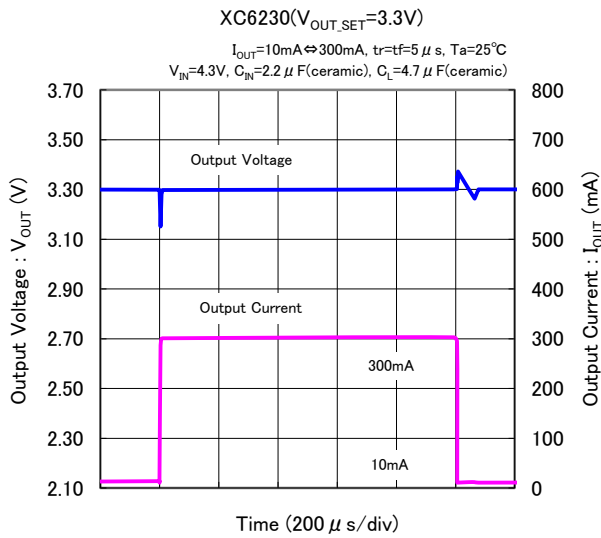
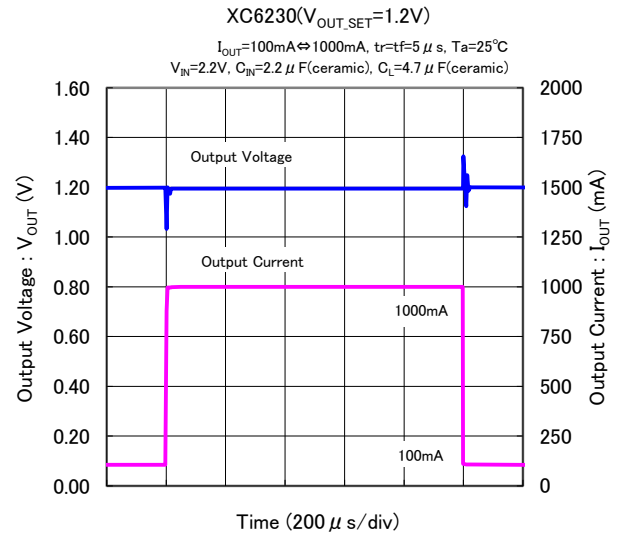
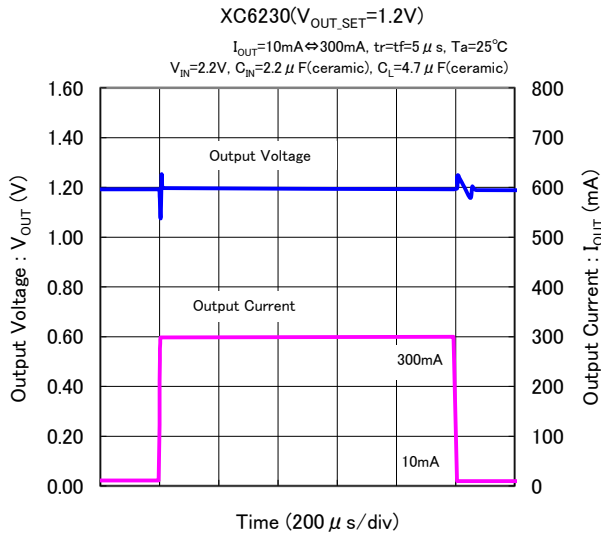


### (12) Input Transient Response



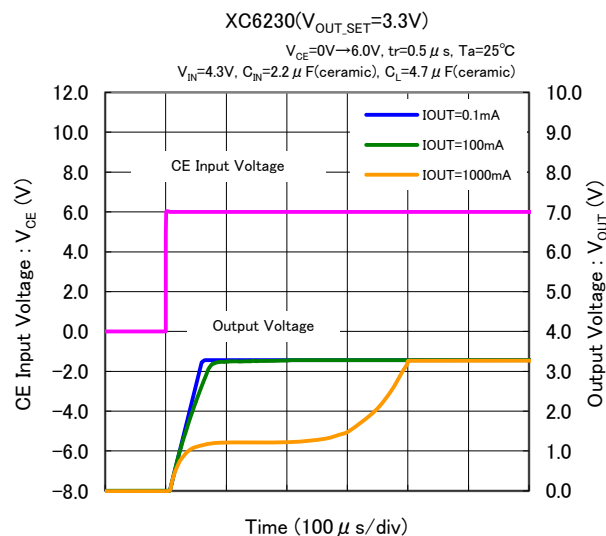
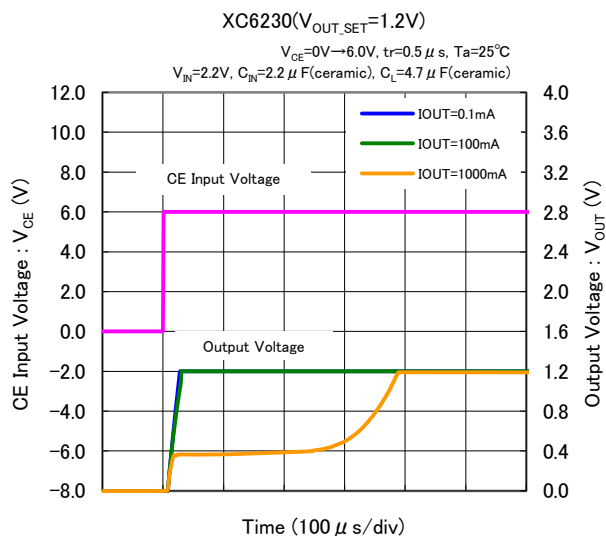
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (13) Load Transient Response

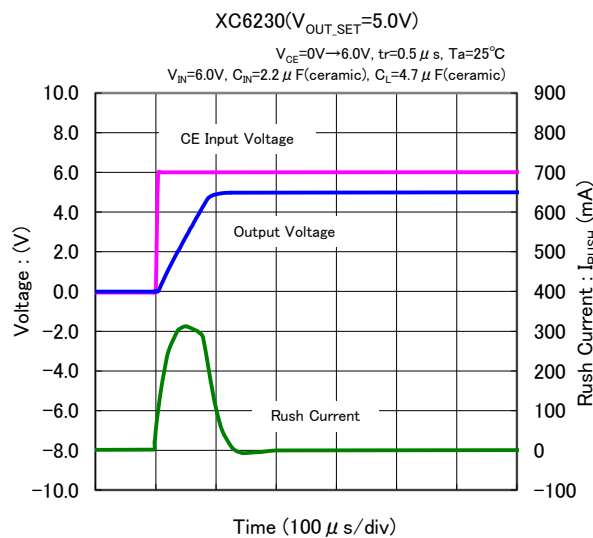
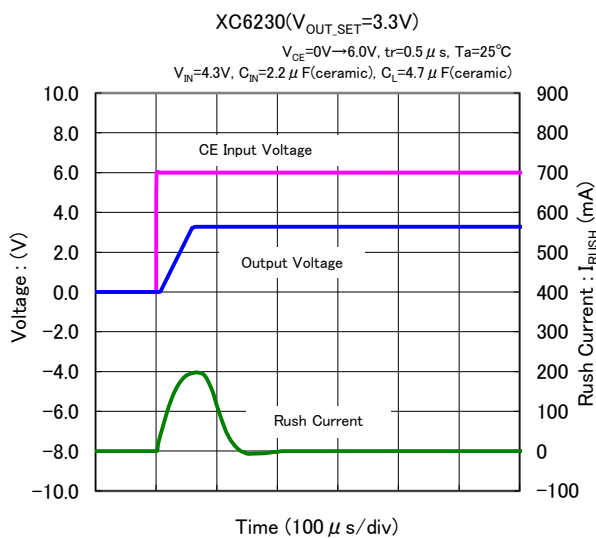
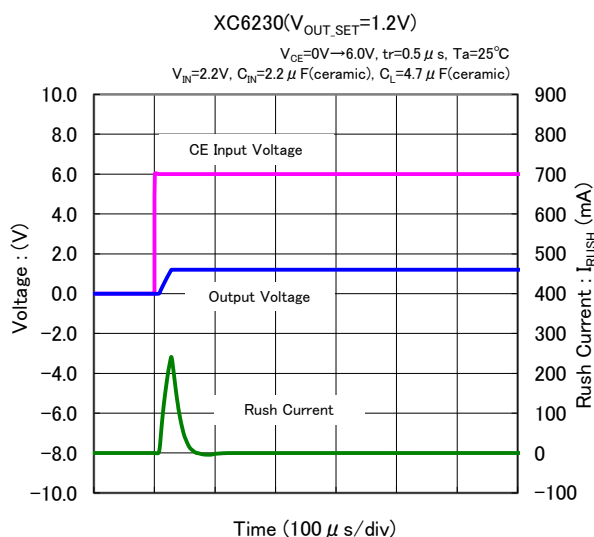
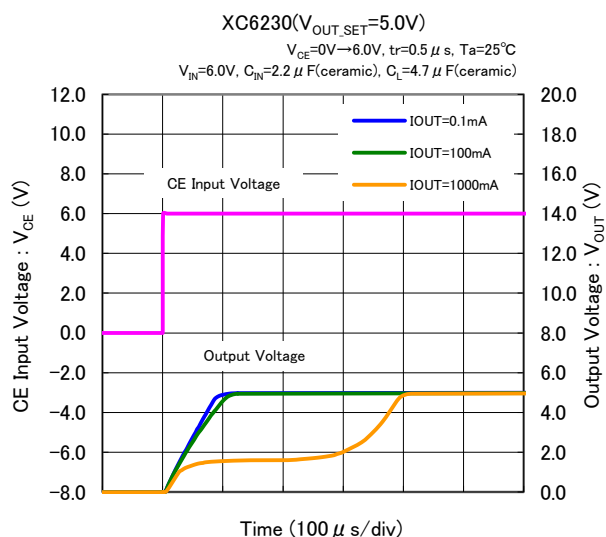


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(14) CE Rising Response Time

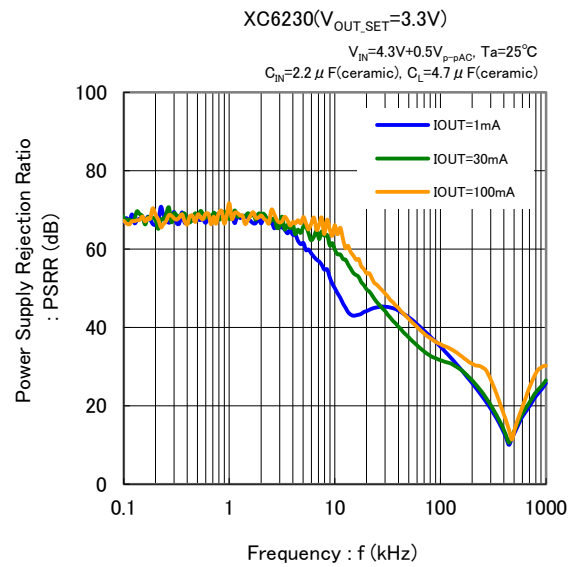
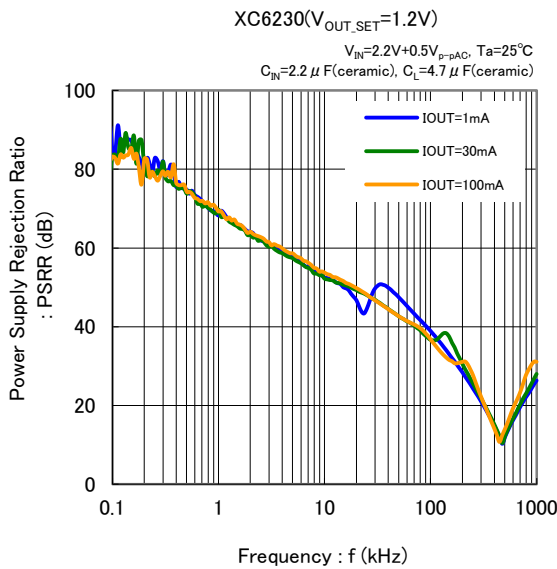
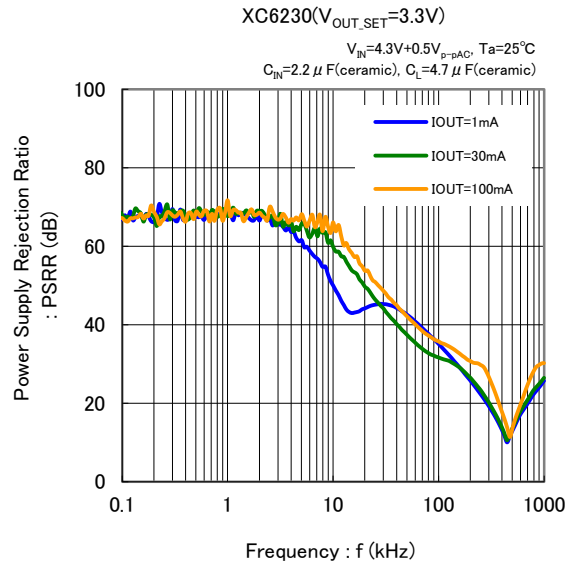
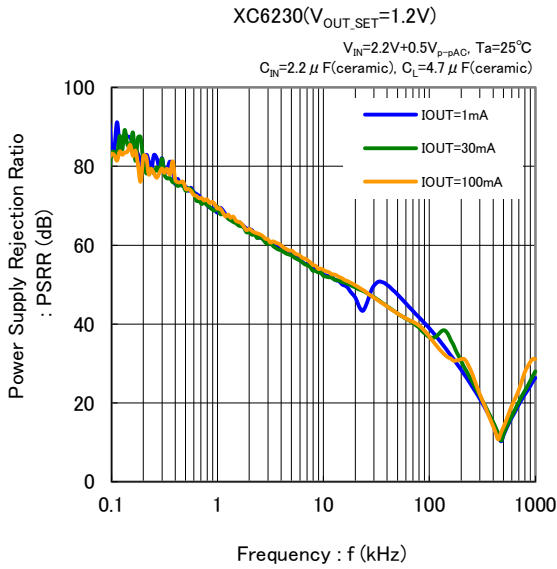


(15) Inrush Current Response

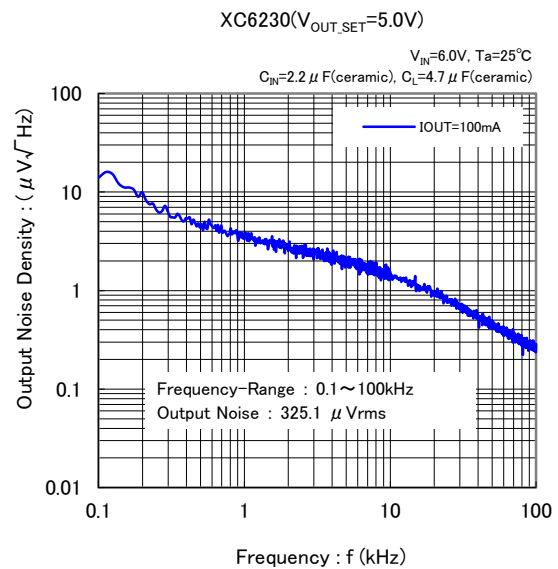
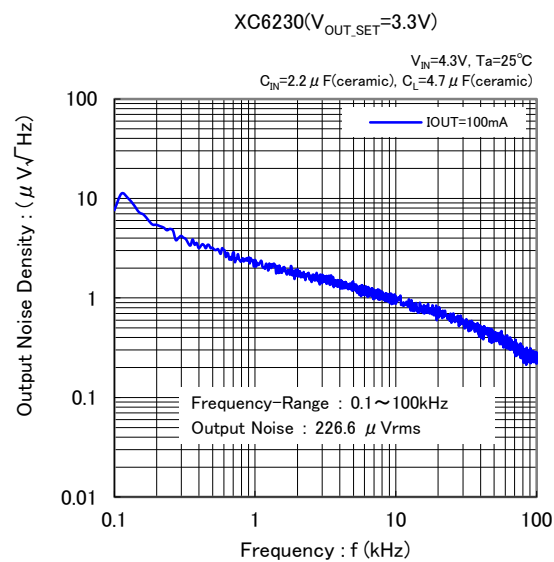


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (16) Power Supply Rejection Ratio



### (17) Output Noise Density



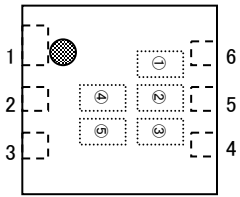
## ■ PACKAGING INFORMATION

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
SOP-8FD	<a href="#">SOP-8FD PKG</a>	<a href="#">SOP-8FD Power Dissipation</a>
USP-6C	<a href="#">USP-6C PKG</a>	<a href="#">USP-6C Power Dissipation</a>

## MARKING RULE

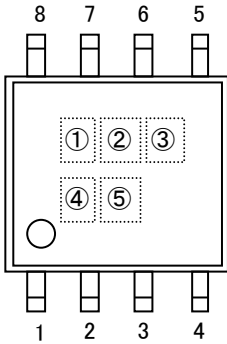
### ● USP-6C



①,②,③ represents product series

MARK	PRODUCT SERIES
0A1	XC6230H001**-G
0B1	XC6230S001**-G
0A2	XC6230A001**-G
0A3	XC6230B001**-G

### ● SOP-8FD



④,⑤ represents production lot number

01 to 09, 0A to 0Z, 11 to 9Z, A1 to A9, AA to AZ, B1 to ZZ repeated  
(G, I, J, O, Q, W excluded)

\*No character inversion used.



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[NCP4687DH15T1G](#) [NCV8703MX30TCG](#) [LP2951CN](#) [NCV4269CPD50R2G](#) [AP7315-25W5-7](#) [NCV47411PAAJR2G](#) [AP2111H-1.2TRG1](#)  
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[19214BC0A-E8T1U7\\*1](#) [S-19213B00A-V5T2U7](#) [S-19213B33A-V5T2U7](#) [S-19213BC0A-V5T2U7](#) [S-1313D18-N4T1U4](#)