XC6209/XC6212 Series

High Speed LDO Regulators Low ESR Cap.Compatible,Output ON/OFFControl

■GENERAL DESCRIPTION

The XC6209/XC6212 series are highly precise, low noise, positive voltage LDO regulators manufactured using CMOS processes. The series achieves high ripple rejection and low dropout and consists of a voltage reference, an error amplifier, a current limiter and a phase compensation circuit plus a driver transistor.

Output voltage is selectable in 50mV increments within a range of 0.9V ~ 6.0V.

The series is also compatible with low ESR ceramic capacitors which give added output stability. This stability can be maintained even during load fluctuations due to the excellent transient response of the series. The current limiter's foldback circuit also operates as a short protect for the output current limiter and the output pin.

The CE function enables the output to be turned off, resulting in greatly reduced power consumption.

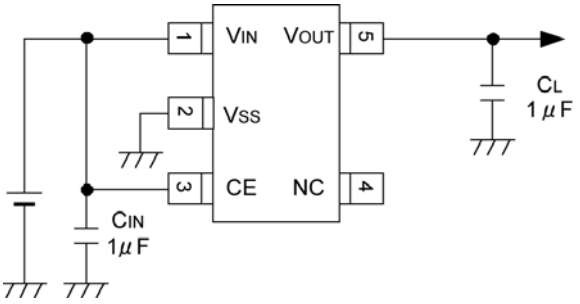
■APPLICATIONS

- ●Mobile phones, Cordless phones
- ●Wireless communication equipment
- ●Portable games
- ●Cameras, Video recorders
- ●Portable AV equipment
- ●Reference voltage
- ●Battery powered equipment

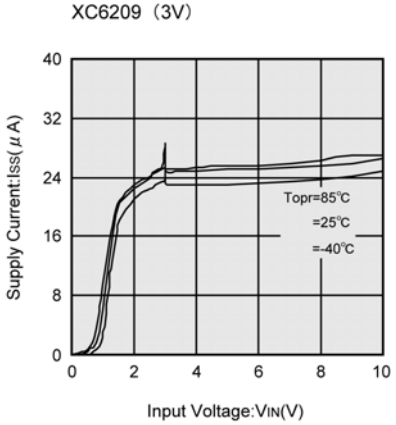
■FEATURES

Maximum Output Current	: 150mA (300mA=XC6209 E to H types)
Dropout Voltage	: 60mV @ 30mA : 200mV @ 100mA
Maximum Operating Voltage	: 2.0V ~ 10V
Output Voltage Range	: 0.9V ~ 6.0V(50mV Step)
Highly Accurate	: ±2% (VOUT>1.5V) ±30mV (VOUT≦1.5V)
Low Power Consumption	: 25μA (TYP.)
Standby Current	: Less than 0.1μA (TYP.)
High Ripple Rejection	: 70dB (10kHz)
Operating Temperature Range	: -40℃~ +85℃
Low ESR Capacitor Compatible	: Ceramic capacitor
Ultra Small Packages	: SOT-25 : USP-6B (XC6209) SOT-89-5 (XC6209)

■TYPICAL APPLICATION CIRCUIT

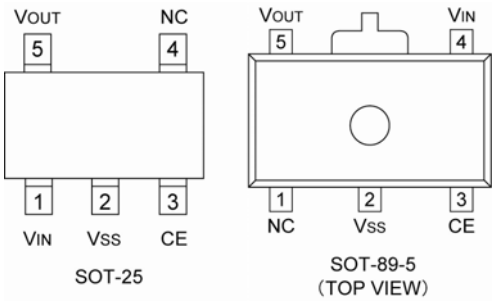


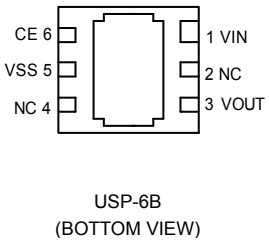
■TYPICAL PERFORMANCE CHARACTERISTICS



■PIN CONFIGURATION

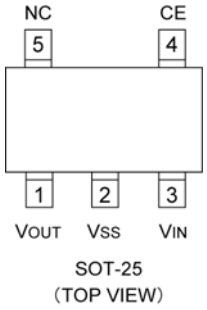
[XC6209]





*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 VSS pin.

[XC6212]



■PIN ASSIGNMENT

PIN NUMBER				PIN NAME	FUNCTION
XC6209			XC6212		
SOT-25	SOT-89-5	USP-6B	SOT-25		
1	4	1	3	VIN	Input
2	2	5	2	VSS	Ground
3	3	6	4	CE	ON/OFF Control
4	1	2,4	5	NC	No Connection
5	5	3	1	VOUT	Output

■FUNCTIONS

TYPE	CE	OPERATIONAL STATE
A, B, E, F Series	H	ON
	L	OFF
C, D, G, H Series	H	OFF
	L	ON

H=High Level
L=Low Level

■PRODUCT CLASSIFICATION

●Selection Guide

The following options for the CE pin logic and internal pull-up/down are available:

High Active + no pull-down resistor built-in (standard)
High Active+ 2MΩ pull-down resistor built-in <between CE-VSS> (semi-custom)
Low Active + no pull-up resistor built-in (semi-custom)
Low Active + 2MΩ pull-up resistor built-in <between VIN-CE> (semi-custom)

Note: *With the pull-up resistor or pull-down resistor built-in types, the supply current during operation will increase by VIN / 2MΩ (TYP.).

●Ordering Information

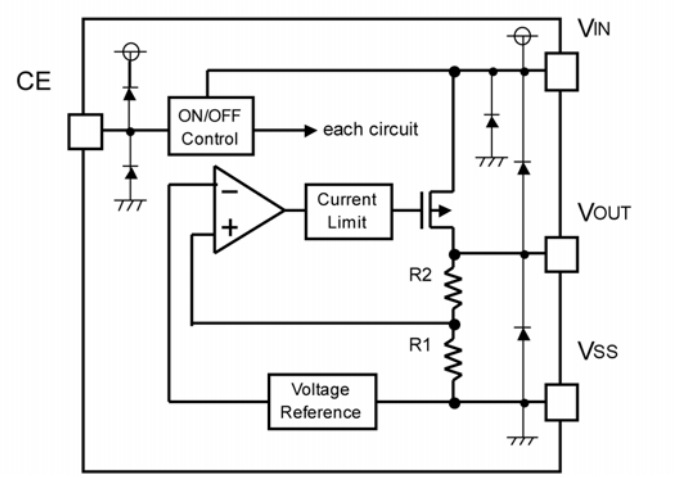
XC6209/12①②③④⑤⑥-⑦(*3)

DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION
① (*1)	Type of Regulator CE Pin Logic	A/E	: High Active (pull-down resistor built-in, semi-custom)
		B/F	: High Active (no pull-down resistor built-in, standard)
		C/G	: Low Active (pull-up resistor built-in, semi-custom)
		D/H	: Low Active (no pull-up resistor built-in, standard)
② ③	Output Voltage	09~60	: e.g. 20:2.0V, 30:3.0V,
④	Output Voltage Accuracy	2	: 100mV increments, ±2% accuracy (*2) e.g. ②=2, ③=8, ④=2 → 2.80V, ±2%
		1	: 100mV increments, ±1% accuracy (*2) e.g. ②=2, ③=8, ④=1 → 2.80V, ±1%
		A	: 50mV increments, ±2% accuracy (*2) e.g. ②=2, ③=8, ④=A → 2.85V, ±2%
		B	: 50mV increments, ±1% accuracy (*2) e.g. ②=2, ③=8, ④=B → 2.85V, ±1%
⑤⑥-⑦	Packages Taping Type (*4)	MR	: SOT-25 (SOT-23-5)
		MR-G	: SOT-25 (SOT-23-5) (Halogen & Antimony free)
		PR	: SOT-89-5 (for XC6209 only)
		PR-G	: SOT-89-5 (for XC6209 only) (Halogen & Antimony free)
		DR	: USP-6B (for XC6209 only)
		DR-G	: USP-6B (for XC6209 only) (Halogen & Antimony free)

(*1) Maximum output current of XC6209 E to H series depend on the setting voltage.
(*2) Within ±30mV (VOUT ≦ 1.5V)

(*3) The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.
(*4) The device orientation is fixed in its embossed tape pocket. For reverse orientation, please contact your local Torex sales office or representative. (Standard orientation: ⑤R-⑦, Reverse orientation: ⑤L-⑦)

■BLOCK DIAGRAM



■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		VIN	12.0	V
Output Current		IOUT	500	mA
Output Voltage		VOUT	VSS - 0.3 ~ VIN + 0.3	V
CE Input Voltage		VCE	VSS - 0.3 ~ VIN + 0.3	V
Power Dissipation	SOT-25	Pd	250	mW
	SOT-89-5		500	
	USP-6B		100	
Operating Temperature Range		Topr	-40 ~ +85	℃
Storage Temperature Range		Tstg	-55 ~ +125	℃

* Note: Within the range of $I_{OUT} = Pd/(V_{IN} - V_{OUT})$

■ELECTRICAL CHARACTERISTICS

XC6209/6212A, B Series

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Output Voltage	$V_{OUT(E)}$	I_{OUT}=30mA 2% accuracy (*7)	×0.98	$V_{OUT(T)}$	×1.02	V	1
		1% accuracy (*8)	×0.99	$V_{OUT(T)}$	×1.01		
Maximum Output Current	I_{OUTMAX}		150	-	-	mA	1
Load Regulation	△V_{OUT}	1mA≦ I_{OUT} ≦100mA	-	15	50	mV	1
Dropout Voltage (*4)	Vdif1	I_{OUT}=30mA	E-1			mV	1
	Vdif2	I_{OUT}=100mA	E-2				
Supply Current (A series)	I_{DD}	V_{IN}=V_{CE}= $V_{OUT(T)}$+1.0V (V_{OUT} ≦0.95V)=(V_{IN}=V_{CE}=2.0V)	-	28	55	μA	2
Supply Current (B series)		V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V (V_{OUT}≦0.95V)=(V_{IN}=V_{CE}=2.0V)		25	50		
Standby Current	Istby	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE} =V_{SS} (V_{OUT}≦0.95V)=(V_{IN}=2.0V)	-	0.01	0.10	μA	2
Line Regulation	△V_{OUT} / △V_{IN}・V_{OUT}	$V_{OUT(T)}$+1.0V≦V_{IN}≦10V (V_{OUT}≦0.95V)=(2.0V≦V_{IN}≦10V) I_{OUT}=30mA (V_{OUT}≦1.75V)=(I_{OUT}=10mA)	-	0.01	0.20	%/V	1
Input Voltage	V_{IN}		2	-	10	V	-
Output Voltage Temperature Characteristics	△V_{OUT} / △Topr・V_{OUT}	I_{OUT}=30mA -40℃≦Topr≦85℃	-	100	-	ppm /℃	1
Ripple Rejection Rate	PSRR	V_{IN}={$V_{OUT(T)}$+1.0}V+1.0Vp-pAC, (V_{OUT}≦1.5V)=(V_{IN}=2.5V+1.0Vp-pAC), I_{OUT}=50mA, f=10kHz	-	70	-	dB	4
Current Limiter	I_{lim}	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE}=V_{IN}, (V_{OUT}≦1.75V)=(V_{IN}=$V_{OUT(T)}$+2.0V)	-	300	-	mA	1
Short-circuit Current	Ishort	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE}=V_{IN}, (V_{OUT}≦1.75V)=(V_{IN}=$V_{OUT(T)}$+2.0V)	-	50	-	mA	1
CE "High" Voltage	V_{CEH}		1.6	-	V_{IN}	V	1
CE "Low" Voltage	V_{CEL}		-	-	0.25	V	2
CE "High" Current (A series)	I_{CEH}	V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V (V_{OUT}≦0.95V)=(V_{IN}=V_{CE}=2.0V)	0.60	-	5.0	μA	2
CE "High" Current (B series)	I_{CEH}	V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V (V_{OUT}≦0.95V)=(V_{IN}=V_{CE}=2.0V)	-0.10		0.10		
CE "Low" Current	I_{CEL}	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE}=V_{SS} (V_{OUT}≦0.95V)=(V_{IN}=2.0V)	-0.10	-	0.10	μA	2

NOTE :

* 1: Unless otherwise stated, V_{IN}=$V_{OUT(T)}$+1.0V. If V_{OUT} is less than 0.95V, V_{IN}= 2.0V.
* 2: $V_{OUT(T)}$=Specified output voltage
* 3: $V_{OUT(E)}$=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).
* 4: Vdif={$V_{IN1}^{(*6)}$-$V_{OUT1}^{(*5)}$}
* 5: V_{OUT1}=A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT} {$V_{OUT(T)}$+1.0V} is input.
* 6: V_{IN1}=The input voltage when V_{OUT1} appears as Input Voltage is gradually decreased.
* 7: If $V_{OUT(T)}$ is less than 1.45V, $V_{OUT(T)}$ -30mV (MIN.),
  $V_{OUT(T)}$ + 30mV (MAX.)
* 8: Only for the $V_{OUT(T)}$ more than 3.0V products.

■ELECTRICAL CHARACTERISTICS (Continued)

XC6209/6212E,F Series

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Output Voltage	$V_{OUT(E)}$	I_{OUT}=30mA 2% accuracy (*7)	×0.98	$V_{OUT(T)}$	×1.02	V	1
		1% accuracy (*8)	×0.99	$V_{OUT(T)}$	×1.01		
Maximum Output Current	I_{OUTMAX}	V_{IN}=E-4	E-3	-	-	mA	1
Load Regulation	△V_{OUT}	1mA≦ I_{OUT}≦100mA	-	15	50	mV	1
Load Regulation 2	△V_{OUT2}	1mA≦ I_{OUT}≦300mA	-	-	100	mV	1
Dropout Voltage (*4)	Vdif1	I_{OUT}=30mA	E-1			mV	1
	Vdif2	I_{OUT}=100mA	E-2				
Supply Current (E series)	I_{DD}	V_{IN}=V_{CE}= $V_{OUT(T)}$+1.0V	-	28	55	μA	2
Supply Current (F series)		V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V		25	50		
Standby Current	Istby	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE} =V_{SS}	-	0.01	0.10	μA	2
Line Regulation	$\frac{\triangle V_{OUT}}{\triangle V_{IN} \cdot V_{OUT}}$	$V_{OUT(T)}$+1.0V≦V_{IN}≦10V I_{OUT}=30mA (V_{OUT}≦1.75V)=(I_{OUT}=10mA)	-	0.01	0.20	%/V	1
Input Voltage	V_{IN}		2	-	10	V	-
Output Voltage Temperature Characteristics	$\frac{\triangle V_{OUT}}{\triangle Topr \cdot V_{OUT}}$	I_{OUT}=30mA -40℃≦Topr≦85℃	-	100	-	ppm /℃	1
Ripple Rejection Rate	PSRR	V_{IN}={$V_{OUT(T)}$+1.0}V+1.0Vp-pAC, (V_{OUT}≦1.5V)=V_{IN}=2.5V+1.0Vp-pAC , I_{OUT}=50mA, f=10kHz	-	70	-	dB	4
Current Limiter	I_{lim}	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE}=V_{IN}, (V_{OUT}≦1.75V)=V_{IN}=$V_{OUT(T)}$+2.0V	-	380	-	mA	1
Short-circuit Current	Ishort	V_{IN}= $V_{OUT(T)}$+1.0V, V_{CE}=V_{IN}, (V_{OUT}≦1.75V)=V_{IN}=$V_{OUT(T)}$+2.0V	-	50	-	mA	1
CE "High" Voltage	V_{CEH}		1.6	-	V_{IN}	V	1
CE "Low" Voltage	V_{CEL}		-	-	0.25	V	2
CE "High" Current (E series)	I_{CEH}	V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V	0.60	-	5.0	μA	2
CE "High" Current (F series)	I_{CEH}	V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V	-0.10		0.10	μA	2
CE "Low" Current	I_{CEL}	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE}=V_{SS}	-0.10	-	0.10	μA	2

NOTE :

* 1: Unless otherwise stated, V_{IN}=$V_{OUT(T)}$+1.0V. If V_{OUT} is less than 0.95V, V_{IN}= 2.0V.
* 2: $V_{OUT(T)}$=Specified output voltage
* 3: $V_{OUT(E)}$=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).
* 4: Vdif={V_{IN1}(*6)-V_{OUT1}(*5)}
* 5: V_{OUT1}=A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT} {$V_{OUT(T)}$+1.0V} is input.
* 6: V_{IN1}=The input voltage when V_{OUT1} appears as Input Voltage is gradually decreased.
* 7: If $V_{OUT(T)}$ is less than 1.45V, $V_{OUT(T)}$ -30mV (MIN.),
  $V_{OUT(T)}$ + 30mV (MAX.)
* 8: Only for the $V_{OUT(T)}$ more than 3.0V products.

■ELECTRICAL CHARACTERISTICS (Continued)

●Dropout Voltage

Voltage Accuracy 2% products

Ta=25°C

SYMBOL	E-0		E-1		E-2	
PARAMETER / SETTING OUTPUT VOLTAGE	OUTPUT VOLTAGE (V) (2%)		DROPOUT VOLTAGE 1 (mV) (IOUT=30mA)		DROPOUT VOLTAGE 2 (mV) (IOUT=100mA)	
	VOUT		Vdif1		Vdif2	
VOUT(T)	MIN	MAX	TYP	MAX	TYP	MAX
0.90	0.870	0.930	1100	1110	1150	1200
0.95	0.920	0.980				
1.00	0.970	1.030	1000	1010	1050	1100
1.05	1.020	1.080				
1.10	1.070	1.130	900	910	950	1000
1.15	1.120	1.180				
1.20	1.170	1.230	800	810	850	900
1.25	1.220	1.280				
1.30	1.270	1.330	700	710	750	800
1.35	1.320	1.380				
1.40	1.370	1.430	600	610	650	700
1.45	1.420	1.480				
1.50	1.470	1.530	500	510	550	600
1.55	1.519	1.581				
1.60	1.568	1.632	400	410	500	550
1.65	1.617	1.683				
1.70	1.666	1.734	300	310	400	450
1.75	1.715	1.785				
1.80	1.764	1.836	200	210	300	400
1.85	1.813	1.887				
1.90	1.862	1.938	120	150	280	380
1.95	1.911	1.989				
2.00	1.960	2.040	80	120	240	350
2.05	2.009	2.091				
2.10	2.058	2.142				330
2.15	2.107	2.193				
2.20	2.156	2.244				
2.25	2.205	2.295				
2.30	2.254	2.346				310
2.35	2.303	2.397				
2.40	2.352	2.448				
2.45	2.401	2.499				
2.50	2.450	2.550	70	100	220	290
2.55	2.499	2.601				
2.60	2.548	2.652				
2.65	2.597	2.703				
2.70	2.646	2.754				
2.75	2695	2.805				
2.80	2.744	2.856				270
2.85	2.793	2.907				
2.90	2.842	2.958				
2.95	2.891	3.009				
3.00	2.940	3.060	60	90	200	250
3.05	2.989	3.111				
3.10	3.038	3.162				
3.15	3.087	3.213				
3.20	3.136	3.264				
3.25	3.185	3.315				
3.30	3.234	3.366				
3.35	3.283	3.417				
3.40	3.332	3.468				
3.45	3.381	3.519				
3.50	3.430	3.570				
3.55	3.479	3.621				

■ELECTRICAL CHARACTERISTICS (Continued)

●Dropout Voltage (Continued)

Voltage Accuracy 2% products

Ta=25°C

SYMBOL	E-0		E-1		E-2	
PARAMETER / SETTING OUTPUT VOLTAGE	OUTPUT VOLTAGE (V) (2%)		DROPOUT VOLTAGE 1 (mV) (I_{OUT}=30mA)		DROPOUT VOLTAGE 2 (mV) (I_{OUT}=100mA)	
	V_{OUT}		Vdif1		Vdif2	
$V_{OUT(T)}$	MIN	MAX	TYP	MAX	TYP	MAX
3.60	3.528	3.672	60	90	200	250
3.65	3.577	3.723				
3.70	3.626	3.774				
3.75	3.675	3.825				
3.80	3.724	3.876				
3.85	3.773	3.927				
3.90	3.822	3.978				
3.95	3.871	4.029				
4.00	3.920	4.080		80	180	230
4.05	3.969	4.131				
4.10	4.018	4.182				
4.15	4.067	4.233				
4.20	4.116	4.284				
4.25	4.165	4.335				
4.30	4.214	4.386				
4.35	4.263	4.437				
4.40	4.312	4.488				
4.45	4.361	4.539				
4.50	4.410	4.590				
4.55	4.459	4.641				
4.60	4.508	4.692				
4.65	4.557	4.743				
4.70	4.606	4.794				
4.75	4.655	4.845				
4.80	4.704	4.896				
4.85	4.753	4.947				
4.90	4.802	4.998				
4.95	4.851	5.049				
5.00	4.900	5.100	50	70	160	210
5.05	4.949	5.151				
5.10	4.998	5.202				
5.15	5.047	5.253				
5.20	5.096	5.304				
5.25	5.145	5.355				
5.30	5.194	5.406				
5.35	5.243	5.457				
5.40	5.292	5.508				
5.45	5.341	5.559				
5.50	5.390	5.610				
5.55	5.439	5.661				
5.60	5.488	5.712				
5.65	5.537	5.763				
5.70	5.586	5.814				
5.75	5.635	5.865				
5.80	5.684	5.916				
5.85	5.733	5.967				
5.90	5.782	6.018				
5.95	5.831	6.069				
6.00	5.880	6.120				

*The input voltage 2.0V (MIN.) is needed to operate the series. When the output voltage is less than 2.0V, 2.0V-$V_{OUT(T)}$ of dropout voltage is needed at minimum.

■ELECTRICAL CHARACTERISTICS (Continued)

●Output Voltage

Voltage Accuracy 1% products

*Common values for A to H series, but available only for $V_{OUT} \geq 2.9V$ products.

SYMBOL	E-0	
PARAMETER / SETTING OUTPUT VOLTAGE	OUTPUT VOLTAGE (V) (1%)	
	VOUT	
VOUT(T)	MIN	MAX
3.00	2.970	3.030
3.05	3.020	3.081
3.10	3.069	3.131
3.15	3.119	3.182
3.20	3.168	3.232
3.25	3.218	3.283
3.30	3.267	3.333
3.35	3.317	3.384
3.40	3.366	3.434
3.45	3.416	3.485
3.50	3.465	3.535
3.55	3.515	3.586
3.60	3.564	3.636
3.65	3.614	3.687
3.70	3.663	3.737
3.75	3.713	3.788
3.80	3.762	3.838
3.85	3.812	3.889
3.90	3.861	3.939
3.95	3.911	3.990
4.00	3.960	4.040
4.05	4.010	4.091
4.10	4.059	4.141
4.15	4.109	4.192
4.20	4.158	4.242
4.25	4.208	4.293
4.30	4.257	4.343
4.35	4.307	4.394
4.40	4.356	4.444
4.45	4.405	4.494
4.50	4.455	4.545

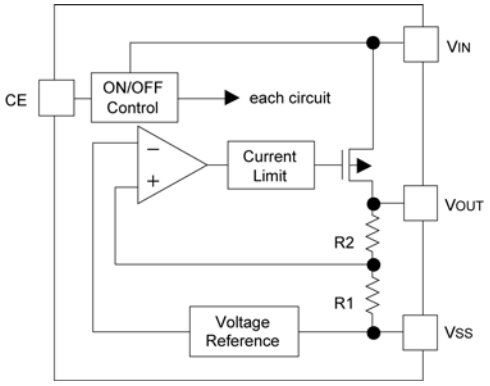
SYMBOL	E-0	
PARAMETER / SETTING OUTPUT VOLTAGE	OUTPUT VOLTAGE (V) (1%)	
	VOUT	
VOUT(T)	MIN	MAX
4.55	4.505	4.596
4.60	4.554	4.646
4.65	4.604	4.697
4.70	4.653	4.747
4.75	4.703	4.798
4.80	4.752	4.848
4.85	4.802	4.899
4.90	4.851	4.949
4.95	4.901	5.000
5.00	4.950	5.050
5.05	4.000	5.101
5.10	4.049	5.151
5.15	4.099	5.202
5.20	4.148	5.252
5.25	5.198	5.303
5.30	5.247	5.353
5.35	5.297	5.404
5.40	5.346	5.454
5.45	5.396	5.505
5.50	5.445	5.555
5.55	5.495	5.606
5.60	5.544	5.656
5.65	5.594	5.707
5.70	5.643	5.757
5.75	5.963	5.808
5.80	5.742	5.858
5.85	5.792	5.909
5.90	5.841	5.959
5.95	5.891	6.010
6.00	5.940	6.060

●Conditions

SYMBOL	E-4	E-3
CONDITIONS, SPEC. / SETTING OUTPUT VOLTAGE (V)	INPUT VOLTAGE (V)	MAXIMUM OUTPUT CURRENT (mA)
	VIN	MIN
0.90 ~ 0.95	2.5	260
1.00 ~ 1.05	2.5	260
1.10 ~ 1.15	2.6	270
1.20 ~ 1.25	2.7	290
1.30 ~ 1.35	2.8	300
1.40 ~ 1.45	2.9	
1.50 ~ 1.95	3.0	
2.00 ~ 6.00	VOUT(T) + 1.0	

* VOUT(T): Setting output voltage value

■OPERATIONAL EXPLANATION



Output voltage control with the XC6209/6212 series:

The voltage divided by resistors R1 & R2 is compared with the internal reference voltage by the error amplifier.

The P-channel MOSFET, which is connected to the VOUT pin, is then driven by the subsequent output signal. The output voltage at the VOUT pin is controlled & stabilized by a system of negative feedback.

The current limit circuit and short protect circuit operate in relation to the level of output current. Further, the IC's internal circuitry can be shutdown via the CE pin's signal.

<Low ESR Capacitors>
With the XC6209/6212 series, a stable output voltage is achievable even if used with low ESR capacitors as a phase compensation circuit is built-in. In order to ensure the effectiveness of the phase compensation, we suggest that an output capacitor (CL) is connected as close as possible to the output pin (VOUT) and the VSS pin. Please use an output capacitor with a capacitance value of at least 1μF. Also, please connect an input capacitor (CIN) of 0.1μF between the VIN pin and the VSS pin in order to ensure a stable power input.
Stable phase compensation may not be ensured if the capacitor runs out capacitance when depending on bias and temperature. In case the capacitor depends on the bias and temperature, please make sure the capacitor can ensure the actual capacitance.

<Current Limiter, Short-Circuit Protection>
The XC6209/6212 series includes a combination of a fixed current limiter circuit & a foldback circuit, which aid the operations of the current limiter and circuit protection. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, output voltage drops further and output current decreases. When the output pin is shorted, a current of about 50mA flows.

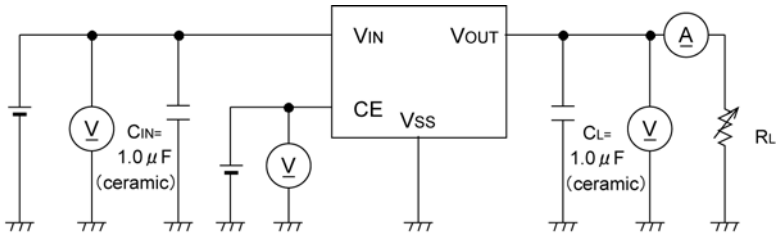
<CE Pin>
The IC's internal circuitry can be shutdown via the signal from the CE pin with the XC6209/6212 series. In shutdown mode, output at the VOUT pin will be pulled down to the VSS level via R1 & R2. The operational logic of the IC's CE pin is selectable (please refer to the selection guide). Note that as the standard XC6209/6212B type is ' High Active/No Pull Down', operations will become unstable with the CE pin open. Although the CE pin is equal to an inverter input with CMOS hysteresis, with either the pull-up or pull-down options, the CE pin input current will increase when the IC's in operation.
We suggest that you use this IC with either a VIN voltage or a VSS voltage input at the CE pin. If this IC is used with the correct specifications for the CE pin, the IC will operate normally. However, supply current may increase as a result of through current in the IC's internal circuitry

■NOTES ON USE

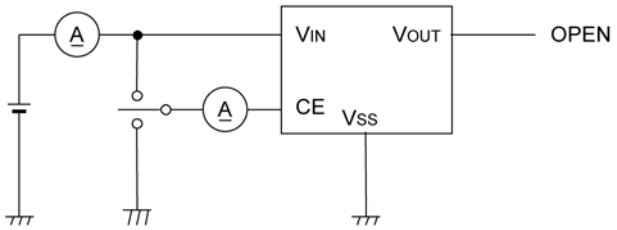
1 Please use this IC within the stated absolute maximum ratings.
The IC is liable to malfunction should the ratings be exceeded.
2 Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please strengthen VIN and VSS wiring in particular.
3 Please wire the input capacitor (CIN) and the output capacitor (CL) as close to the IC as possible.

■TEST CIRCUITS

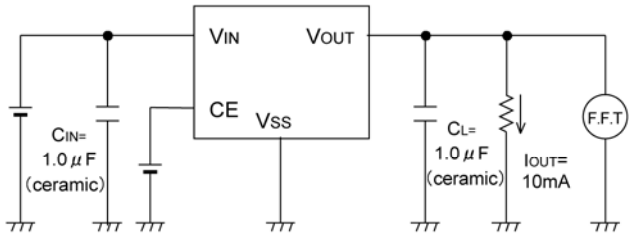
Circuit ①



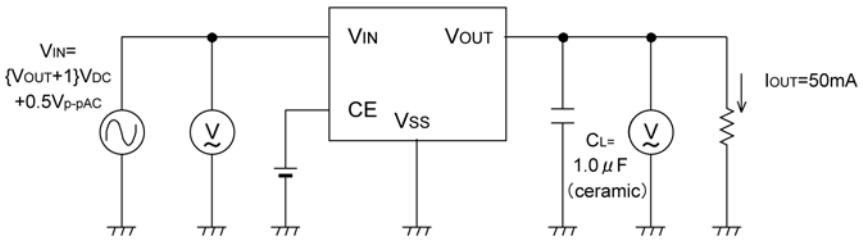
Circuit ②



Circuit ③



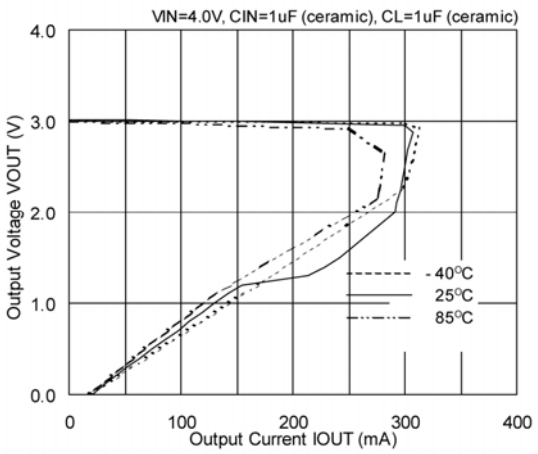
Circuit ④



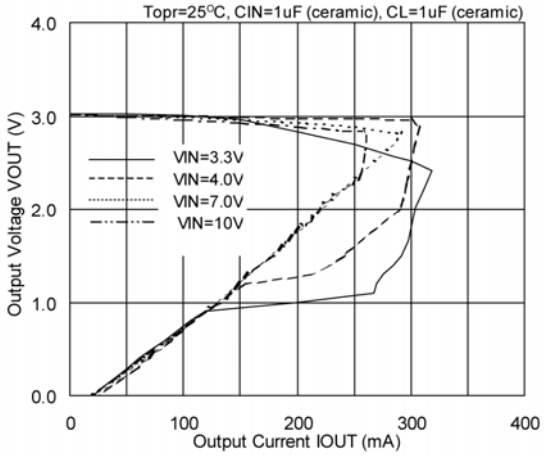
■TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

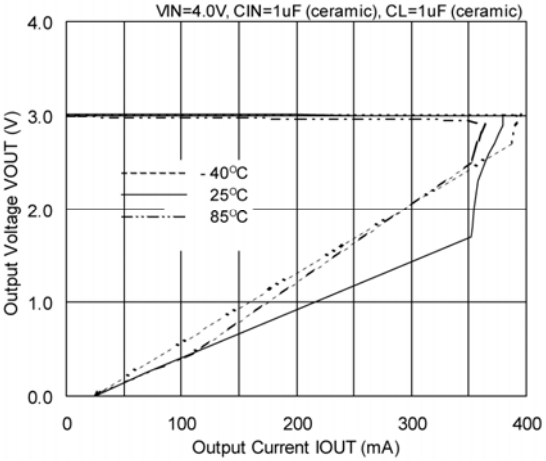
XC6209/12 B302



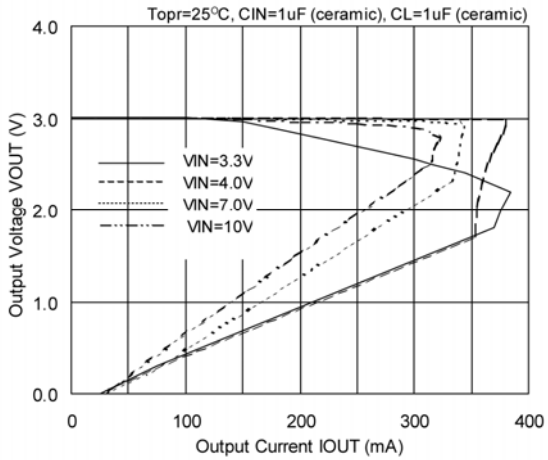
XC6209/12 B302



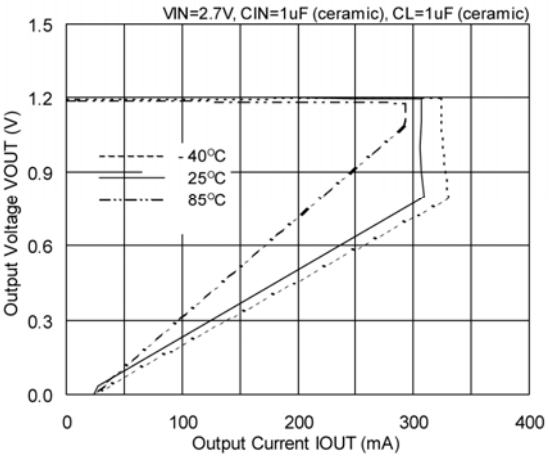
XC6209/12 F302



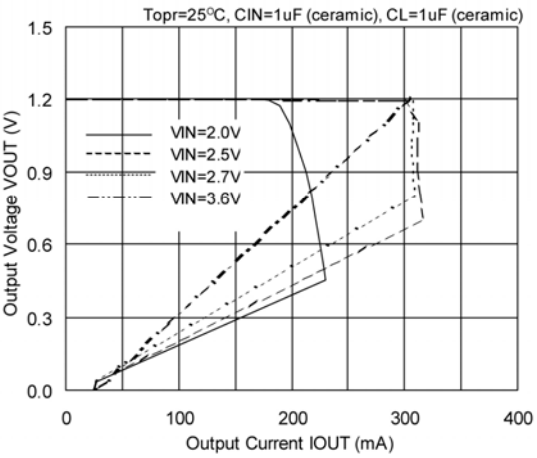
XC6209/12 F302



XC6209/12 B122



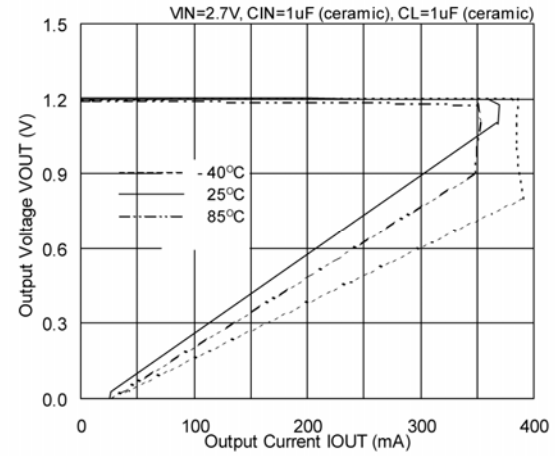
XC6209/12 B122



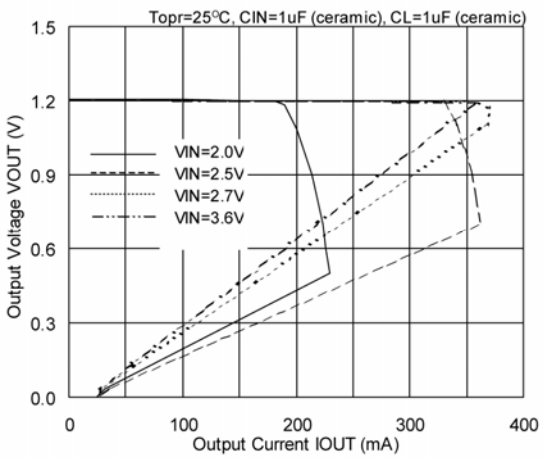
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

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

XC6209/12 F122

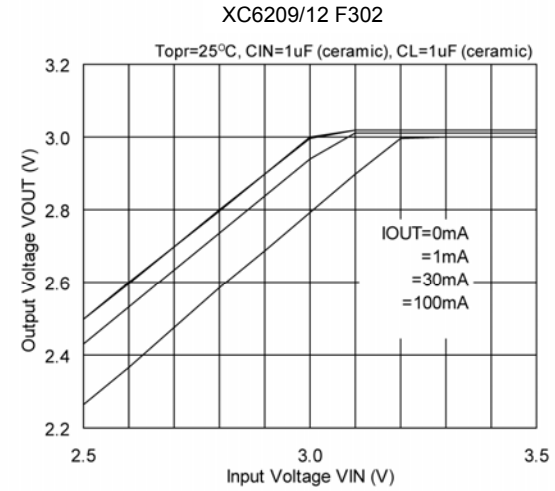


XC6209/12 F122

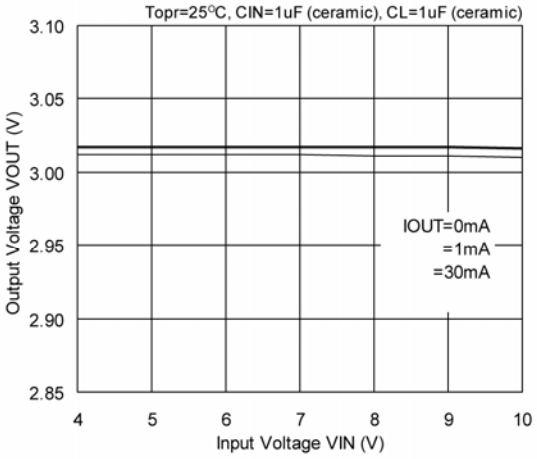


(2) Output Voltage vs. Input Voltage

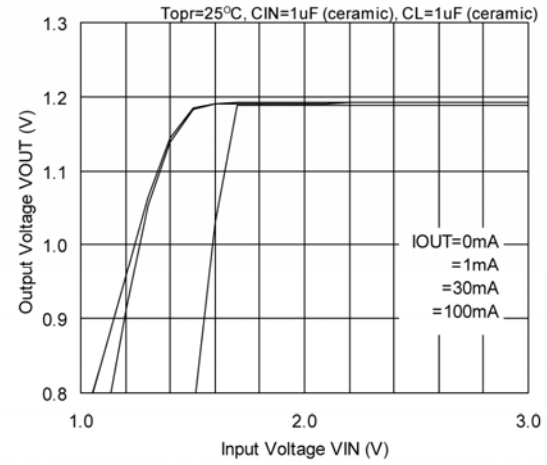
XC6209/12 F302



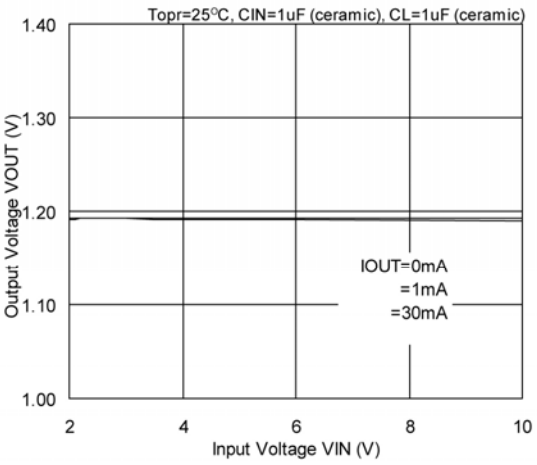
XC6209/12 F302



XC6209/12 F122



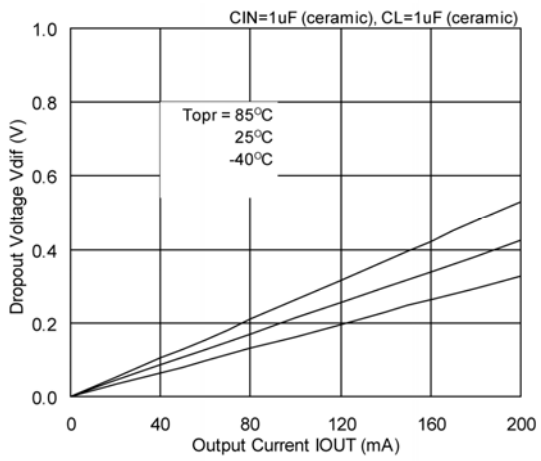
XC6209/12 F122



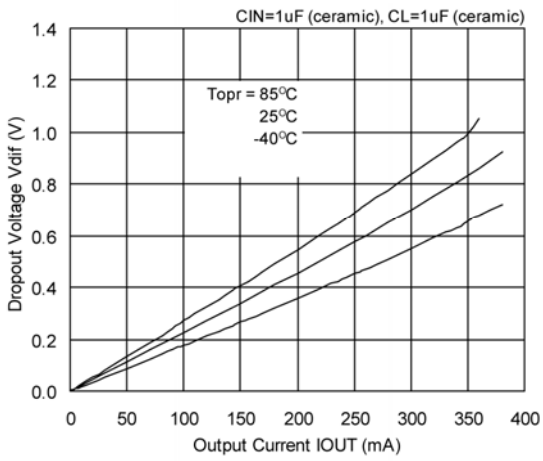
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

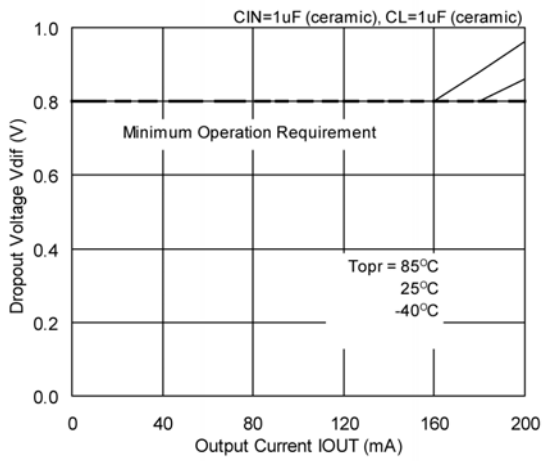
XC6209/12 B302



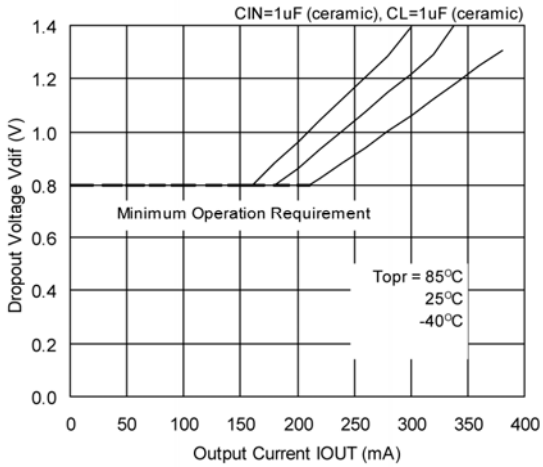
XC6209/12 F302



XC6209/12 B122

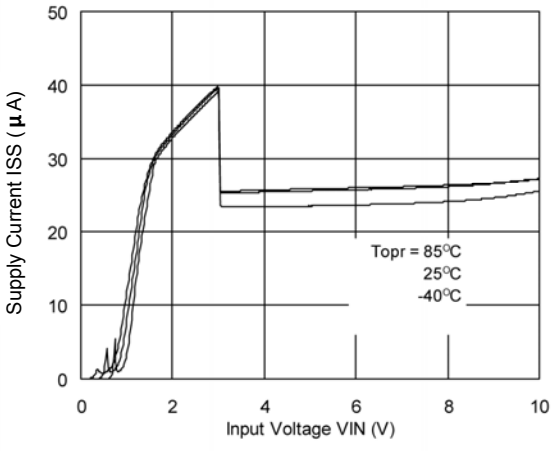


XC6209/12 F122

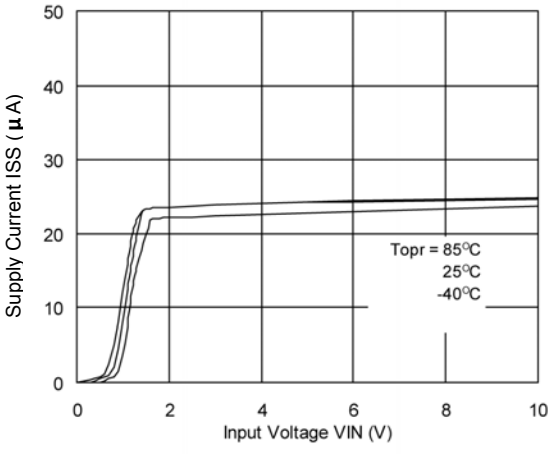


(4) Supply Current vs. Input Voltage

XC6209/12 F302

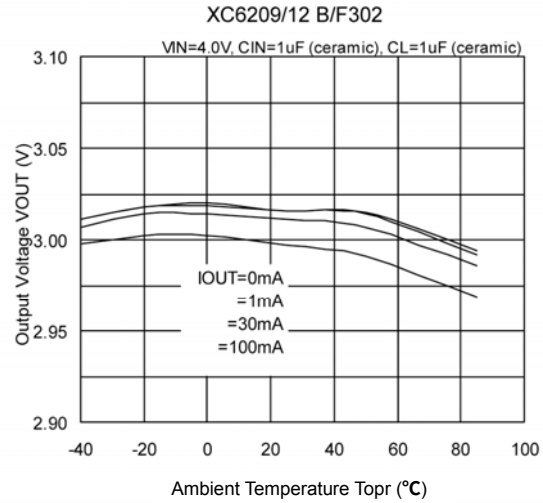


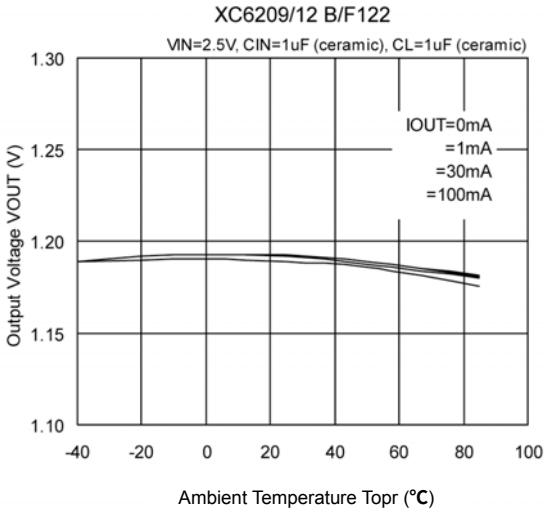
XC6209/12 F122



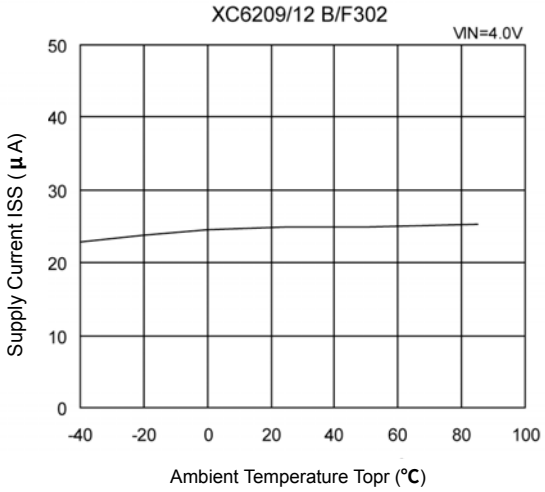
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

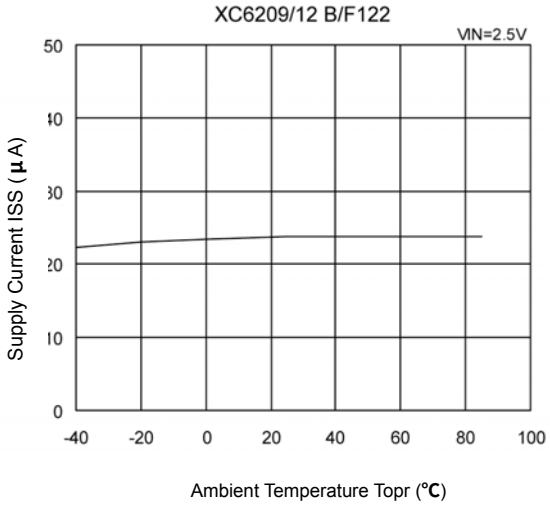
(5) Output Voltage vs. Ambient Temperature



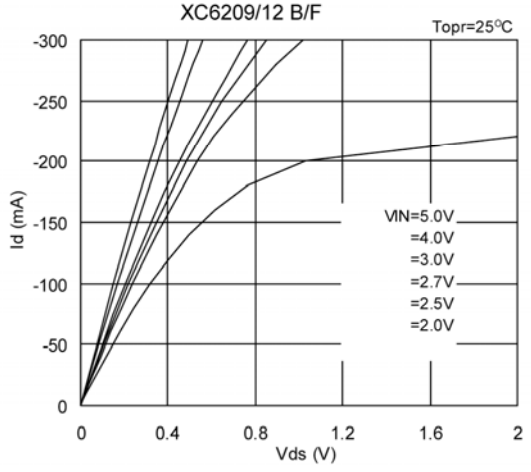


(6) Supply Current vs. Ambient Temperature



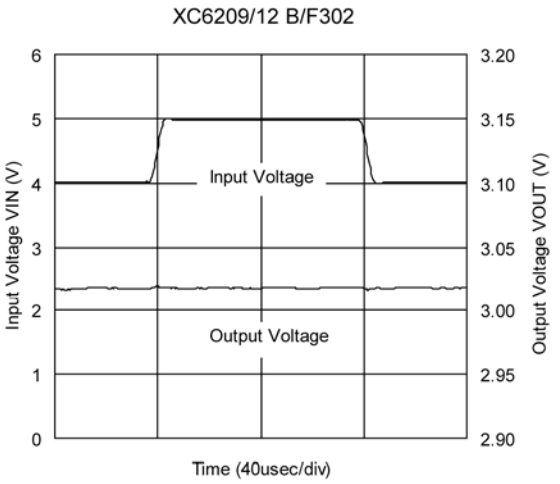


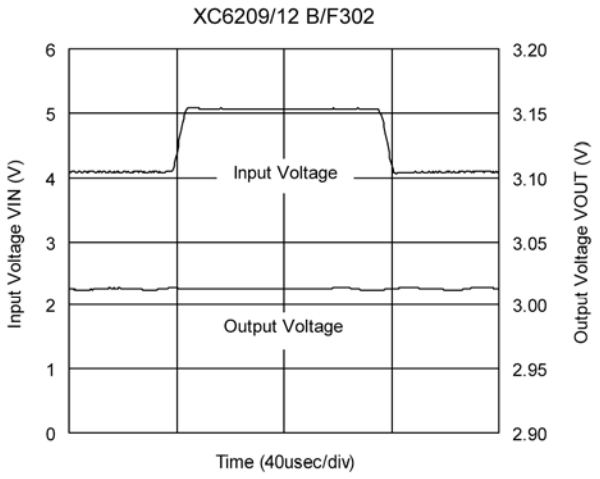
(7) P-ch Driver Transistor Characteristics

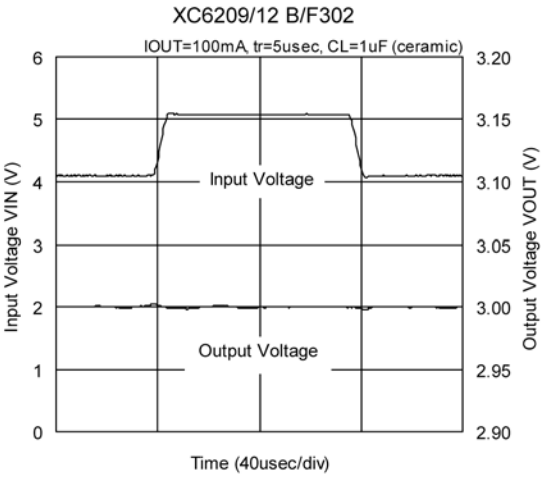


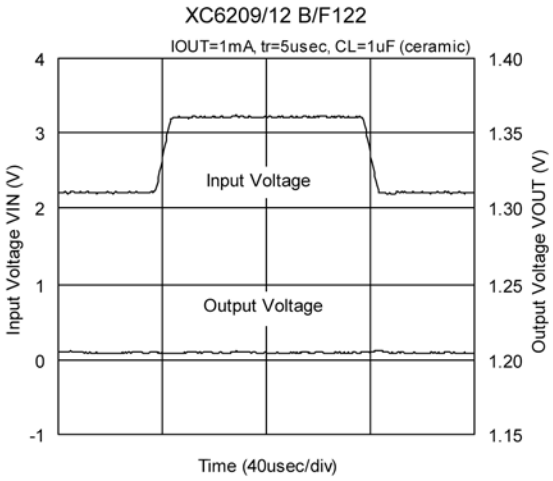
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

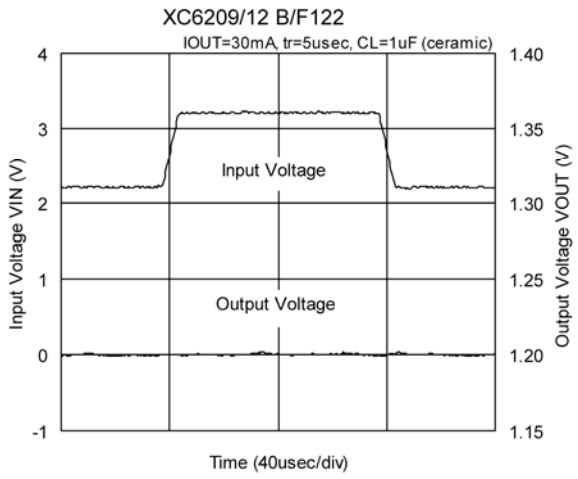
(8) Input Transient Response

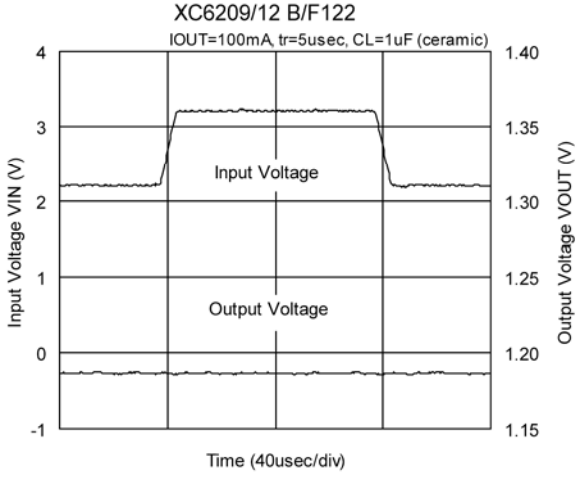






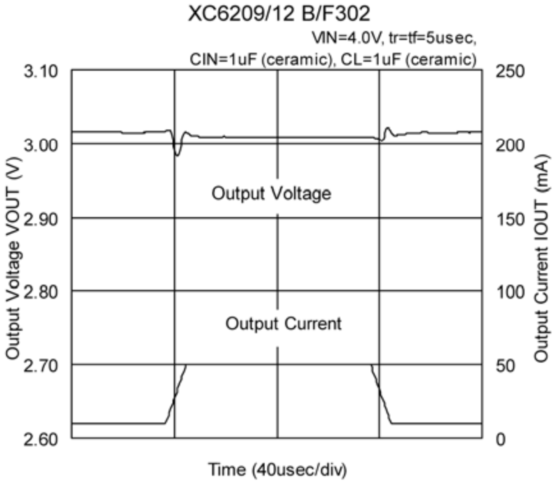


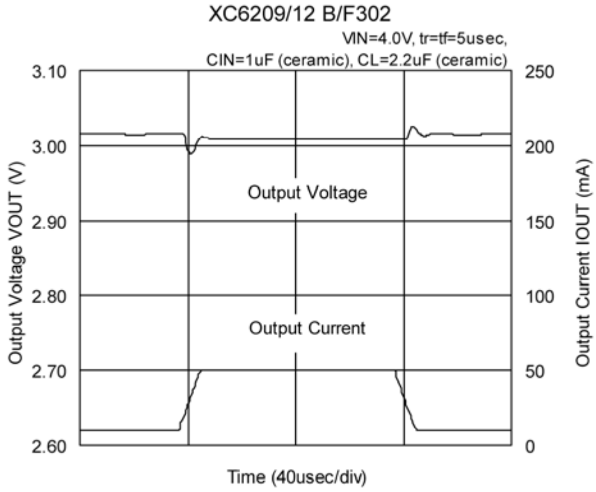


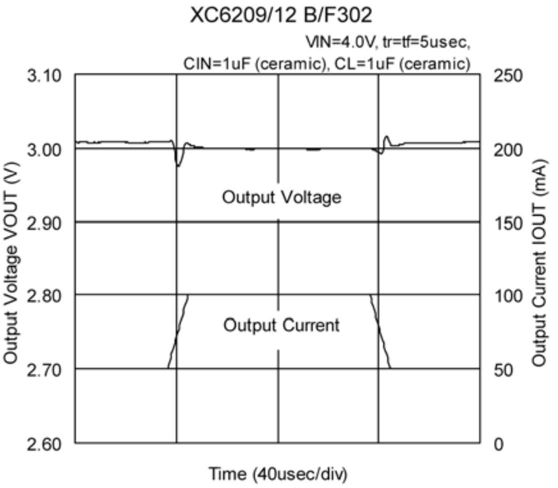


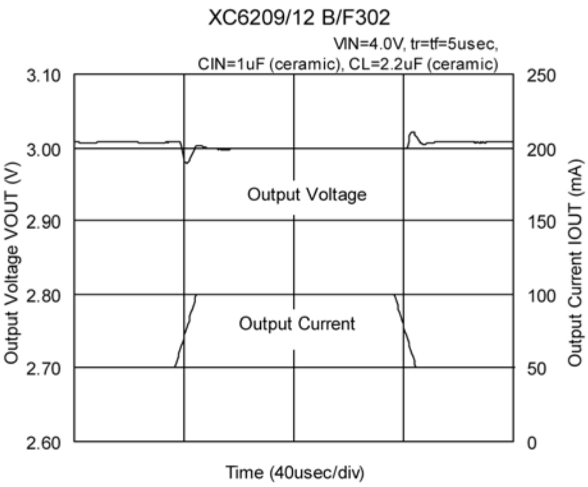
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

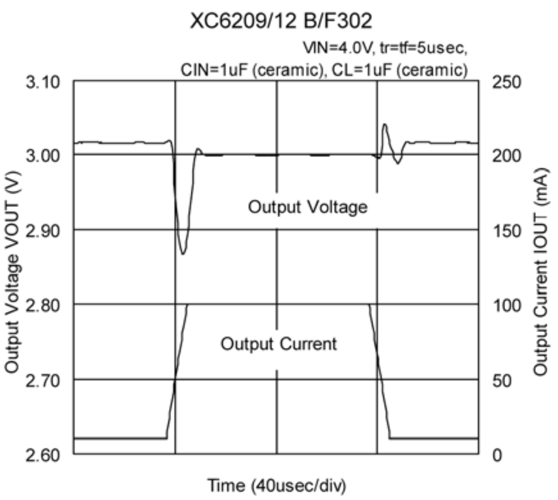
(9) Load Transient Response

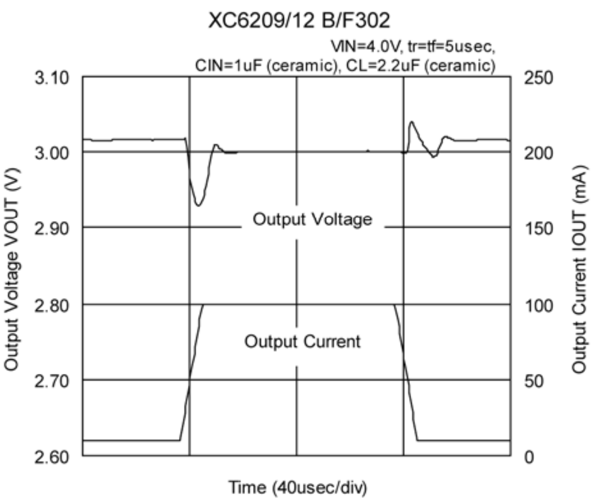








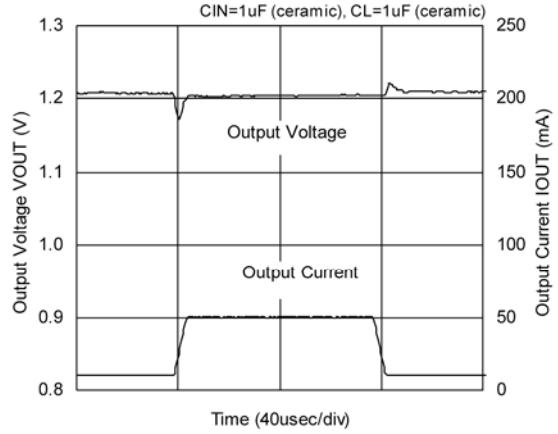




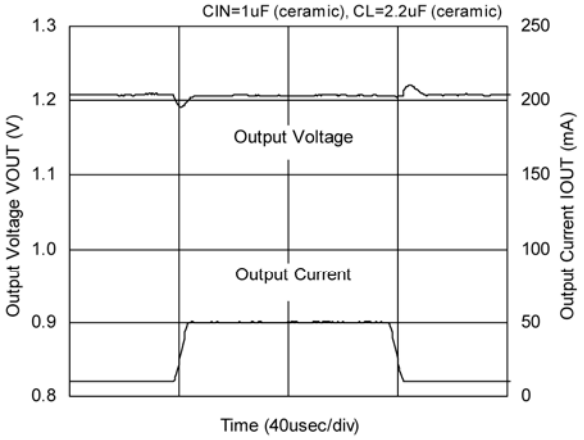
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) Load Transient Response (Continued)

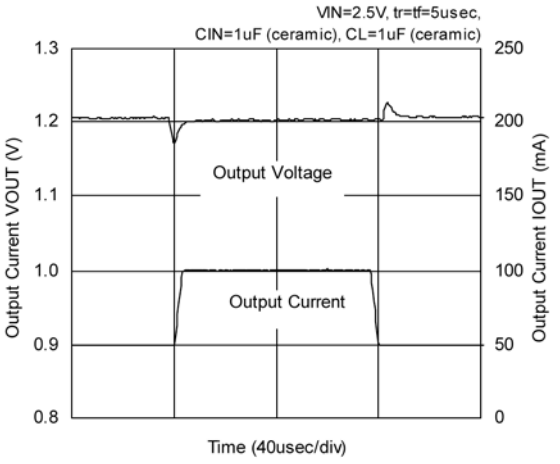
XC6209/12 B/F122
VIN=2.5V, tr=tf=5usec,
CIN=1uF (ceramic), CL=1uF (ceramic)



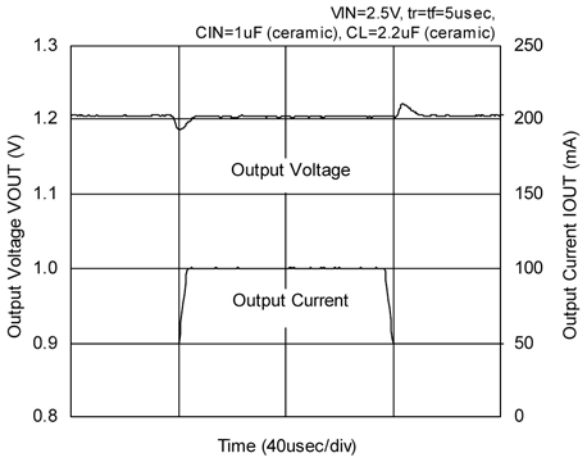
XC6209/12 B/F122
VIN=2.5V, tr=tf=5usec,
CIN=1uF (ceramic), CL=2.2uF (ceramic)



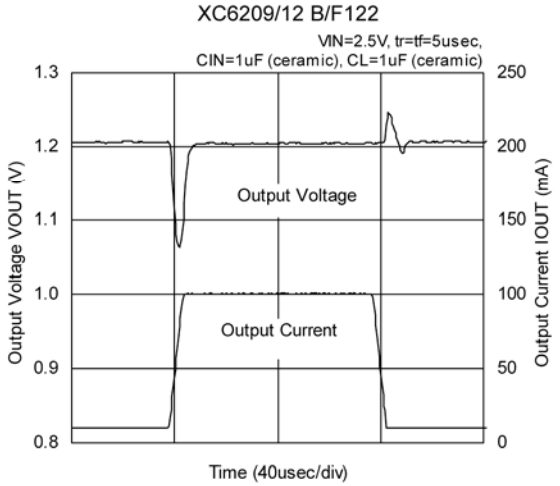
XC6209/12 B/F122
VIN=2.5V, tr=tf=5usec,
CIN=1uF (ceramic), CL=1uF (ceramic)



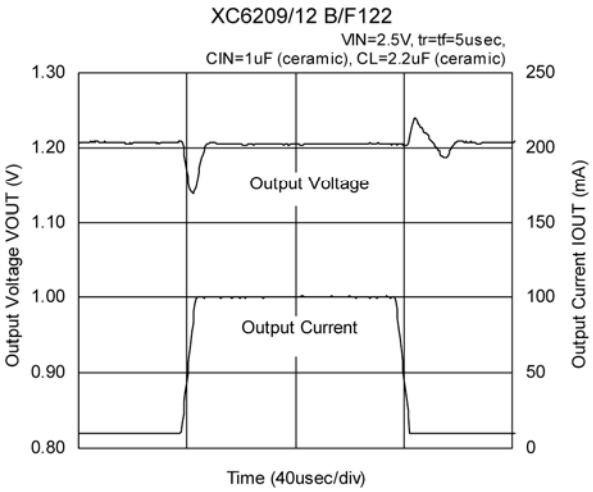
XC6209/12 B/F122
VIN=2.5V, tr=tf=5usec,
CIN=1uF (ceramic), CL=2.2uF (ceramic)



XC6209/12 B/F122
VIN=2.5V, tr=tf=5usec,
CIN=1uF (ceramic), CL=1uF (ceramic)



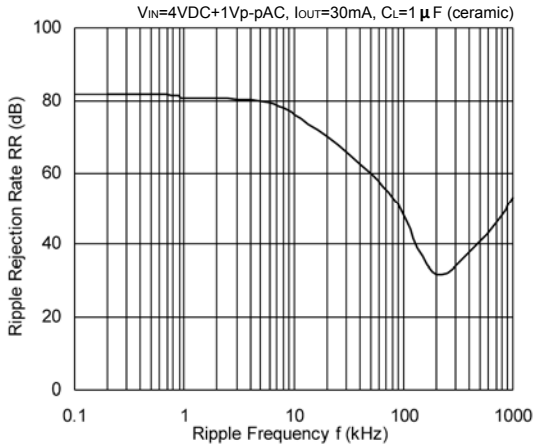
XC6209/12 B/F122
VIN=2.5V, tr=tf=5usec,
CIN=1uF (ceramic), CL=2.2uF (ceramic)



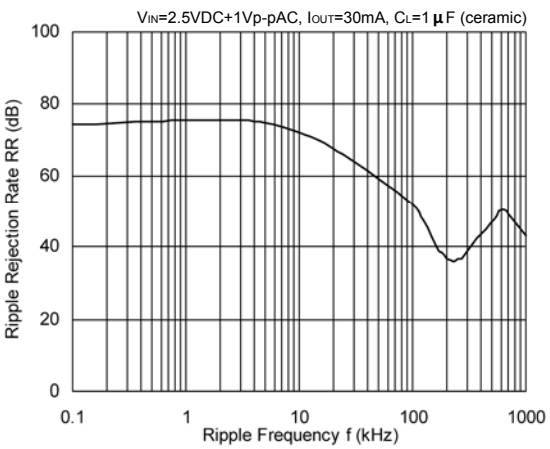
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(10) Ripple Rejection Rate

XC6209/12 B/F302

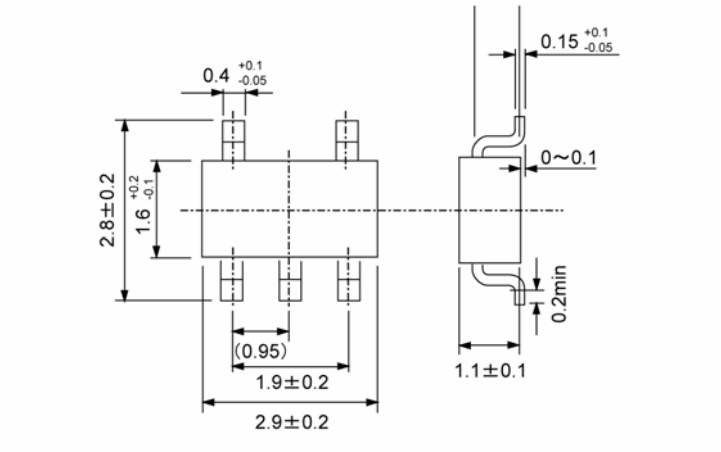


XC6209/12 B/F122

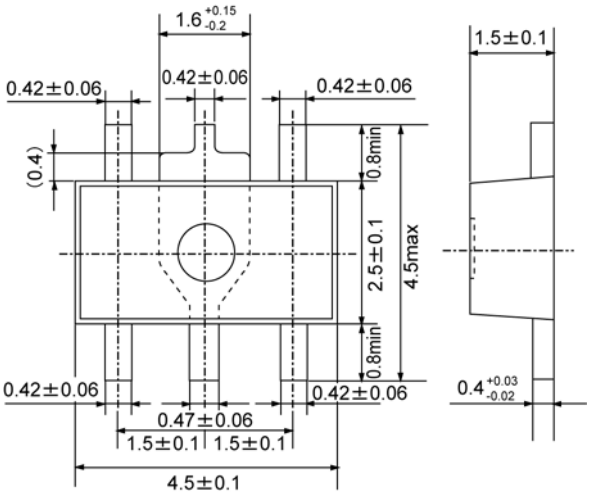


■PACKAGING INFORMATION

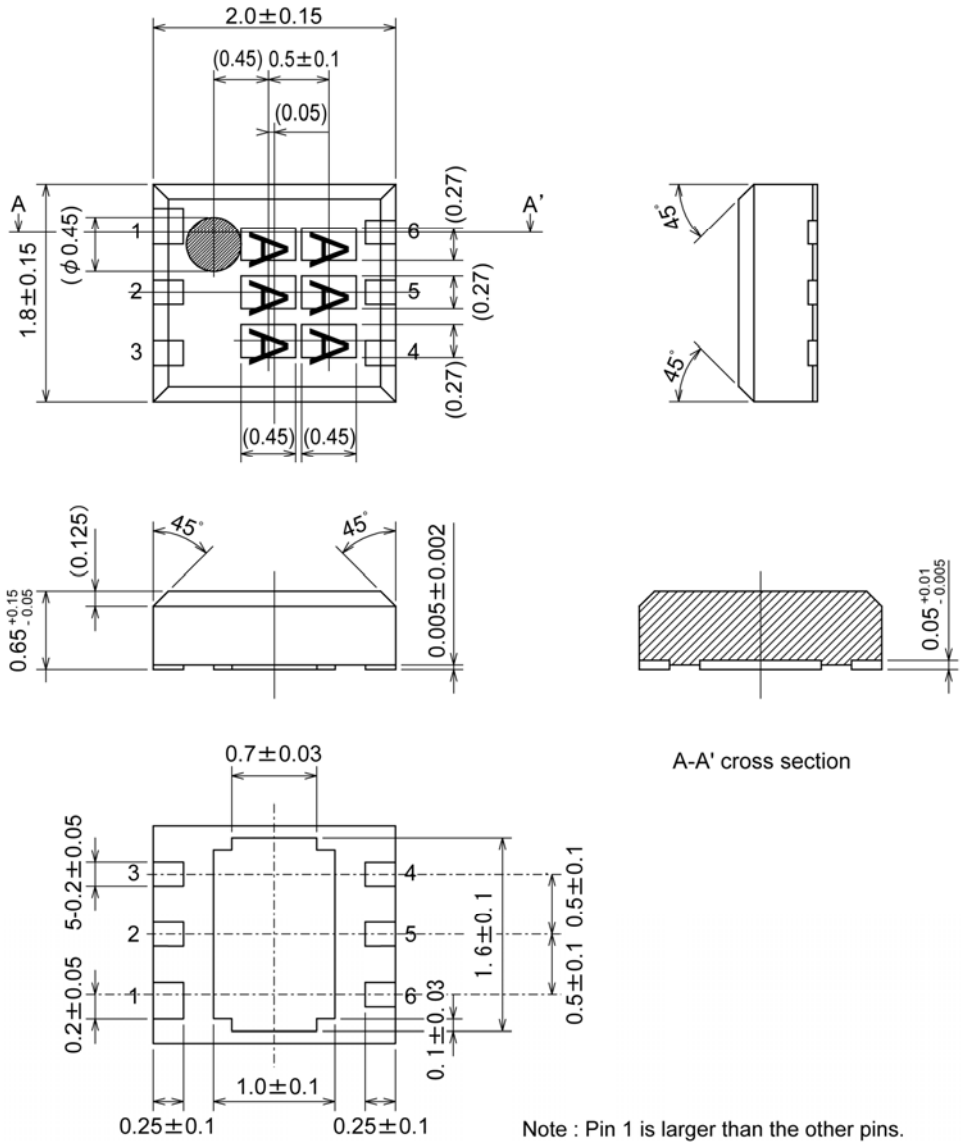
●SOT-25



●SOT-89-5



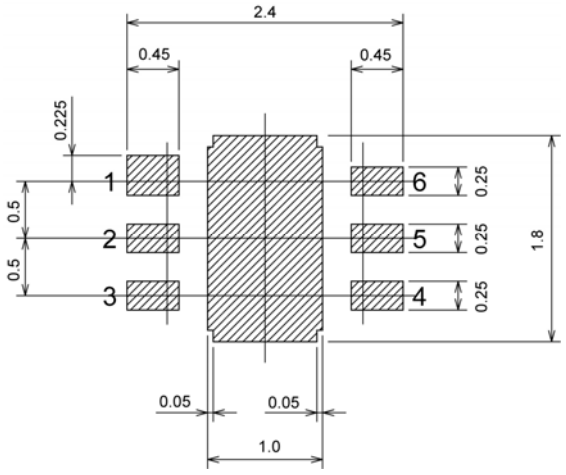
●USP-6B



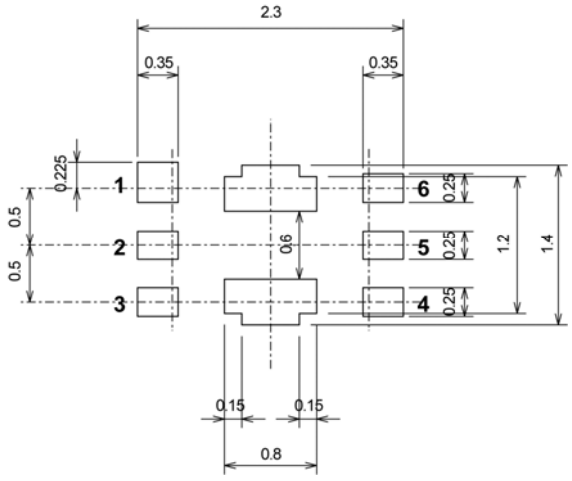
Note : Pin 1 is larger than the other pins.

■PACKAGING INFORMATION (Continued)

●USP-6B Recommended Pattern Layout



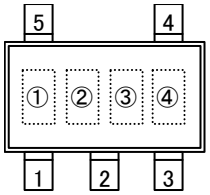
●USP-6B Recommended Metal Mask Design



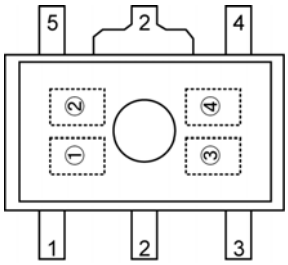
■MARKING RULE

[XC6209]

●SOT-25 & SOT-89-5



SOT-25
(TOP VIEW)



SOT-89-5
(TOP VIEW)

①Represents product series

MARK	PRODUCT SERIES
9	XC6209xxxxxx

②Represents type of regulator

MARK				PRODUCT SERIES
VOUT 100mV INCREMENTS		VOUT 50mV INCREMENTS		
VOLTAGE= 0.1～3.0V	VOLTAGE= 3.1～6.0V	VOLTAGE= 0.15～3.05V	VOLTAGE= 3.15～6.05V	
V	A	E	L	XC6209Axxxxx
X	B	F	M	XC6209Bxxxxx
Y	C	H	N	XC6209Cxxxxx
Z	D	K	P	XC6209Dxxxxx
V	A	E	L	XC6209Exxxxx
X	B	F	M	XC6209Fxxxxx
Y	C	H	N	XC6209Gxxxxx
Z	D	K	P	XC6209Hxxxxx

③Represents integer of the output voltage

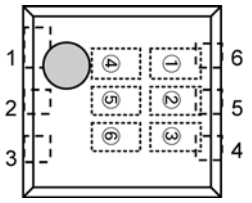
MARK	OUTPUT VOLTAGE (V)				MARK	OUTPUT VOLTAGE (V)			
0	-	3.1	-	3.15	F	1.6	4.6	1.65	4.65
1	-	3.2	-	3.25	H	1.7	4.7	1.75	4.75
2	-	3.3	-	3.35	K	1.8	4.8	1.85	4.85
3	-	3.4	-	3.45	L	1.9	4.9	1.95	4.95
4	-	3.5	-	3.55	M	2.0	5.0	2.05	5.05
5	-	3.6	-	3.65	N	2.1	5.1	2.15	5.15
6	-	3.7	-	.3.75	P	2.2	5.2	2.25	5.25
7	-	3.8	-	3.85	R	2.3	5.3	2.35	5.35
8	0.9	3.9	0.95	3.95	S	2.4	5.4	2.45	5.45
9	1.0	4.0	1.05	4.05	T	2.5	5.5	2.55	5.55
A	1.1	4.1	1.15	4.15	U	2.6	5.6	2.65	5.65
B	1.2	4.2	1.25	4.25	V	2.7	5.7	2.75	5.75
C	1.3	4.3	1.35	4.35	X	2.8	5.8	2.85	5.85
D	1.4	4.4	1.45	4.45	Y	2.9	5.9	2.95	5.95
E	1.5	4.5	1.55	4.55	Z	3.0	6.0	3.05	-

④Represents production lot number

0 to 9, A to Z reversed character of 0 to 9 and A to Z repeated
(G, I, J, O, Q, W excepted)

■MARKING RULE (Continued)

●USP-6B



USP-6B
(TOP VIEW)

①,②Represents product series

MARK		PRODUCT SERIES
①	②	
0	9	XC6209AxxxDx

③Represents type of regulator

MARK	TYPE	PRODUCT SERIES
A	CE pin, High Active pull-down resistor built in	XC6209AxxxDx
B	CE pin, High Active no pull-down resistor built in	XC6209BxxxDx
C	CE pin, Low Active pull-up resistor built in	XC6209CxxxDx
D	CE pin, Low Active no pull-up resistor built in	XC6209DxxxDx

④Represents integer of output voltage

MARK	VOLTAGE (V)	PRODUCT SERIES
3	3.X	XC6209x3xxDx
5	5.X	XC6209x5xxDx

⑤Represents decimal number of output voltage

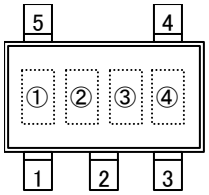
MARK	VOLTAGE (V)	PRODUCT SERIES	MARK	VOLTAGE (V)	PRODUCT SERIES
0	X.0	XC6209xx0xDx	A	X.05	XC6209xx0ADx
1	X.1	XC6209xx1xDx	B	X.15	XC6209xx1ADx
2	X.2	XC6209xx2xDx	C	X.25	XC6209xx2ADx
3	X.3	XC6209xx3xDx	D	X.35	XC6209xx3ADx
4	X.4	XC6209xx4xDx	E	X.45	XC6209xx4ADx
5	X.5	XC6209xx5xDx	F	X.55	XC6209xx5ADx
6	X.6	XC6209xx6xDx	H	X.65	XC6209xx6ADx
7	X.7	XC6209xx7xDx	K	X.75	XC6209xx7ADx
8	X.8	XC6209xx8xDx	L	X.85	XC6209xx8ADx
9	X.9	XC6209xx9xDx	M	X.95	XC6209xx9ADx

⑥Represents production lot number
0 to 9, A to Z repeated (G, I, J, O, Q, W excepted)
Note: No character inversion used.

■MARKING RULE (Continued)

[XC6212]

●SOT-25 (SOT-23-5)



SOT-25
(SOT-23-5)
(TOP VIEW)

①Represents product series

MARK	PRODUCT SERIES
9	XC6212xxxMx

②Represents type of regulator

MARK				PRODUCT SERIES
VOUT 100mV INCREMENTS		VOUT 50mV INCREMENTS		
VOUT=0.1~3.0V	VOUT=3.1~6.0V	VOUT=0.15~3.05V	VOUT=3.15~6.05V	
V	A	E	L	XC6209AxxxMx
X	B	F	M	XC6209BxxxMx
Y	C	H	N	XC6209CxxxMx
Z	D	K	P	XC6209DxxxMx

③Represents output voltage

MARK	OUTPUT VOLTAGE (V)				MARK	OUTPUT VOLTAGE (V)			
0	-	3.10	-	3.15	F	1.60	4.60	1.65	4.65
1	-	3.20	-	3.25	H	1.70	4.70	1.75	4.75
2	-	3.30	-	3.35	K	1.80	4.80	1.85	4.85
3	-	3.40	-	3.45	L	1.90	4.90	1.95	4.95
4	-	3.50	-	3.55	M	2.00	5.00	2.05	5.05
5	-	3.60	-	3.65	N	2.10	5.10	2.15	5.15
6	-	3.70	-	.3.75	P	2.20	5.20	2.25	5.25
7	-	3.80	-	3.85	R	2.30	5.30	2.35	5.35
8	0.90	3.90	0.95	3.95	S	2.40	5.40	2.45	5.45
9	1.00	4.00	1.05	4.05	T	2.50	5.50	2.55	5.55
A	1.10	4.10	1.15	4.15	U	2.60	5.60	2.65	5.65
B	1.20	4.20	1.25	4.25	V	2.70	5.70	2.75	5.75
C	1.30	4.30	1.35	4.35	X	2.80	5.80	2.85	5.85
D	1.40	4.40	1.45	4.45	Y	2.90	5.90	2.95	5.95
E	1.50	4.50	1.55	4.55	Z	3.00	6.00	3.05	-

④Represents production lot number

0 to 9, A to Z, reversed character of 0 to 9 and A to Z repeated (G, I, J, O, Q, W excepted)

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