

High Current High Speed Dual LDO Regulator

GENERAL DESCRIPTION

The XCM406 series is a high current, dual LDO regulator in an ultra small USP-12B01 package which measures just 2.8mm x 2.8mm. The IC is basically two XC6210 high speed CMOS LDOs which are precise, low noise, high current, regulators consisting of a voltage reference, an error amplifier, a current limiter and phase compensation circuit plus a driver transistor. The low ON resistance of the built-in driver transistor means that batteries can be used to a minimal input-output voltage differential and can therefore be used for a longer time. The series can be used with low ESR ceramic capacitors and output voltages are selectable in 0.1V increments within a range of 0.8V to 5.0V per channel. The fold-back current limit circuit also operates as the output current limiter and the output pin protector.

The IC can be placed in stand-by mode via the CE function so that power consumption is greatly reduced.

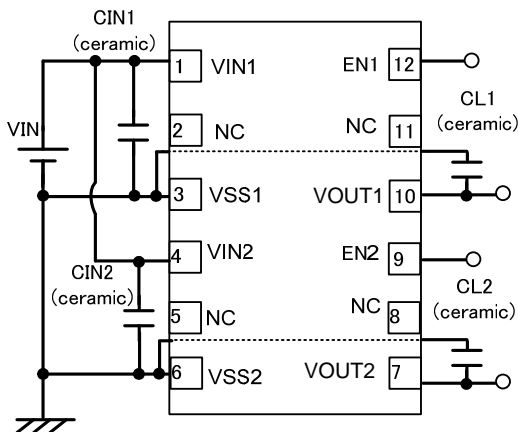
APPLICATIONS

- Mobile phone
- Bluetooth equipment
- Portable AV equipment
- Portable gaming equipment

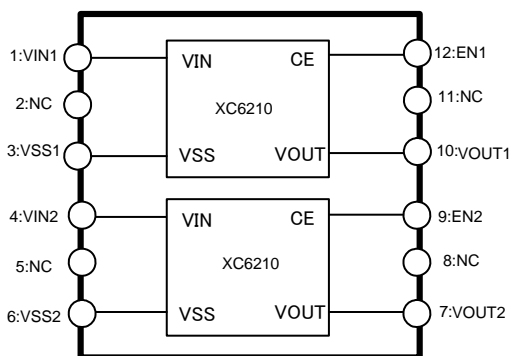
FEATURES

Maximum Output Current	: 700mA (TYP.: 800mA limit) ($1.6V \leq V_{OUT(T)} \leq 5.0V$)
Dropout Voltage	: 50mV @ $I_{OUT}=100mA$
Operating Voltage Range	: 1.5V ~ 6.0V
Output Voltage Setting Range	: 0.8V ~ 5.0V (0.1V increments)
Accuracy	: $\pm 2\%$
Low Power Consumption	: 35 μA (TYP.)
High Ripple Rejection	: 60dB @ 1kHz
Operating Temperature Range	: - 40 °C ~ 85 °C
Package	: USP-12B01

TYPICAL APPLICATION CIRCUIT

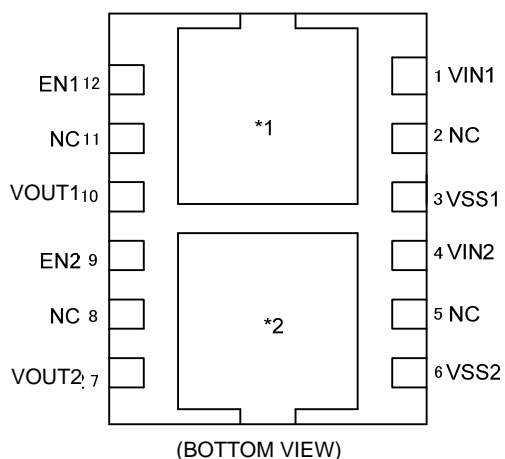


* The dotted lines in the circuit indicates the connection using through-holes at the backside of the PC board



(TOP VIEW)

PIN CONFIGURATION



* A dissipation pad on the reverse side of the package should be electrically isolated.

*1: Electrical potential of the XC6210 series' dissipation pad should be the Vss level.

*2: Electrical potential of the XC6210 series' dissipation pad should be the Vss level.

Care must be taken for an electrical potential of each dissipation pad so as to enhance mounting strength and heat release when the pad needs to be connected to the circuit.

PIN ASSIGNMENT

PIN NUMBER	PIN NAME			FUNCTION
	XCM406	XC6210	XC6210	
1	VIN1	VIN	-	VR1 Power Input
2	NC	-	-	No Connection
3	VSS1	Vss	-	VR1 Ground
4	VIN2	-	VIN	VR2 Power Input
5	NC	-	-	No Connection
6	VSS2	-	Vss	VR2 Ground
7	VOUT2	-	VOUT	VR2 Output
8	NC	-	-	No Connection
9	EN2	-	CE	VR2 ON/OFF Control
10	VOUT1	VOUT	-	VR1 Output
11	NC	-	-	No Connection
12	EN1	CE	-	VR1 ON/OFF Control

PRODUCT CLASSIFICATION

Ordering Information

XCM406 _____

DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION
	Combination of the Series and Options Output Voltage	AA	: XC6210Bxx2 + XC6210Bxx2 (High Active, Without Pull-down resistor)
		AB	: XC6210Axx2 + XC6210Axx2 (High Active, With Pull-down resistor)
	Output Voltages	01 ~	: Internally set sequential number relating to output voltage V _{OUT1} selection output voltage range : 0.8V ~ 5.0V (0.1V increments) V _{OUT2} selection output voltage range : 0.8V ~ 5.0V (0.1V increments)
	Device Orientation	D	: USP-12B01
		R	: Embossed tape, standard feed

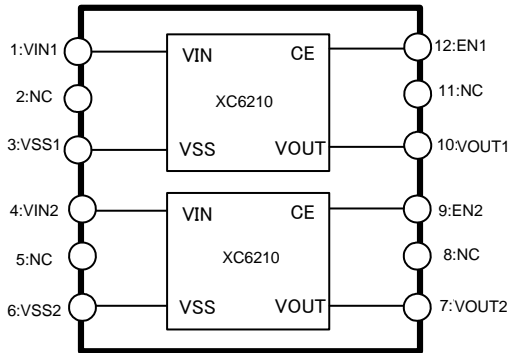
DESIGNATOR (Output Voltage)

	VOUT1	VOUT2
01	1.3	1.5
02	1.8	3.3
03	2.5	3.3
04	3.3	1.5

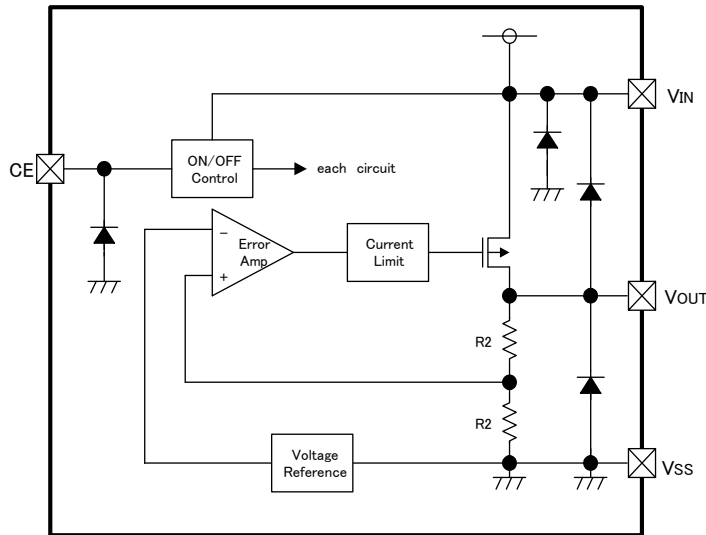
The XCM406 series are semi-custom products. For other combinations, output voltages and etc., please ask your sales contacts.

BLOCK DIAGRAMS

XCM406



XC6210



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

ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V _{IN}	6.5	V
Output Current *		I _{OUT}	900	mA
Output Voltage		V _{OUT}	V _{SS} - 0.3 ~ V _{IN} + 0.3	V
CE Voltage		V _{CE}	V _{SS} - 0.3 ~ 6.5	V
Power Dissipation	USP-12B01	P _d	150	mW
Junction Temperature		T _J	125	
Ambient Temperature Range		T _{opr}	- 40 ~ + 85	
Storage Temperature Range		T _{stg}	- 55 ~ + 125	

ELECTRICAL CHARACTERISTICS

VR Block (XC6210 Series)

Ta=25

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Output Voltage (*2), (*3)	VOUT(E)	VIN=VOUT(T)+1.0V, IOUT=30mA VCE=ON(VIN or VSS)	× 0.98	VOUT(T)	× 1.02	V	
		VOUT(T) 1.5V, IOUT=30mA VCE=ON(VIN or VSS)	(-30mV)	VOUT(T)	(+30mV)		
Maximum Output Current VOUT(E) > 1.6V	IOUTMAX	VIN=VOUT(T)+1.0V, VCE=ON(VIN or VSS)	700	-	-	mA	
Maximum Output Current VOUT(E) 1.5V	IOUTMAX	VIN=VOUT(T)+1.0V, VCE=ON(VIN or VSS)	500	-	-	mA	
Load Regulation	VOUT	1mA IOUT 100mA, VCE=ON(VIN or VSS)	-	15	60	mV	
Dropout Voltage (*4)	Vdif1	IROUT=30mA, VCE=ON(VIN or VSS)	E-1			mV	
	Vdif2	IROUT=100mA, VCE=ON(VIN or VSS)	E-2			mV	
Supply Current (A type)	IDD	VIN=VCE=VOUT(T)+1.0V	E-3			μA	
Supply Current (B type)		VIN=VCE=VOUT(T)+1.0V	-	35	55		
Stand-by Current	ISTBY	VIN=6.0V, CE=OFF(VIN or VSS)	-0.10	-	0.10	μA	
Line Regulation	$\frac{V_{OUT}}{V_{OUT} - V_{OUT}} \cdot \frac{V_{OUT}}{V_{OUT}}$	VOUT(T)+1.0V VIN 6.0V VOUT(T) 4.5V, 5.5V VIN 6.0V VCE=ON(VIN or VSS), IOUT=30mA	-	0.01	0.20	% / V	
Input Voltage	VIN		1.5	-	6.0	V	-
Output Voltage Temperature Characteristics	$\frac{V_{OUT}}{V_{OUT} - V_{OUT}} \cdot \frac{V_{OUT}}{V_{OUT}}$	IOUT=30mA, VCE=ON(VIN or VSS) -40 Topr 85	-	± 100	-	ppm /	
Ripple Rejection Rate	PSRR	VIN=[VOUT(T)+1.0]VDC+0.5Vp-pAC VOUT(T) 4.75V VIN=5.75VDC+0.5Vp-pAC VCE=ON(VIN or VSS), IOUT=30mA, f=1kHz	-	60	-	dB	
Current Limiter VOUT(E) > 1.6V	Ilim	VIN=VOUT(T)+1.0V, VCE=ON(VIN or VSS)	700	800	-	mA	
Current Limiter VOUT(E) 1.5V	Ilim	VIN=VOUT(T)+1.0V, VCE=ON(VIN or VSS)	-	800	-	mA	
Short-Circuit Current	Ishort	VIN=VOUT(T)+1.0V, VCE=ON(VIN or VSS)	-	50	-	mA	
CE "High" Level Voltage	VCEH		1.3	-	6.0	V	
CE "Low" Level Voltage	VCEL		-	-	0.25	V	
CE "High" Level Current (A type)	ICEH	VCE=VIN=VOUT(T)+1.0V	E-4			μA	
CE "High" Level Current (B type)	ICEH		-0.10	-	0.10	μA	
CE "Low" Level Current (A·B type)	ICEL	VIN=VOUT(T)+1.0V, VCE=VSS	-0.10	-	0.10	μA	

NOTE:

*1: Unless otherwise stated, VIN=VOUT(T)+1.0V

*2: VOUT(T)=Specified output voltage

*3: VOUT(E)=Effective output voltage

(i.e. the output voltage when " VOUT(T)+1.0V" is provided while maintaining a certain IOUT value).

*4: Vdif = {VIN1⁽⁶⁾ - VOUT1⁽⁵⁾ }

*5: A voltage equal to 98% of the output voltage whenever a stabilized VOUT1=IOUT{VOUT(T)+1.0V} is input.

*6: VIN1= the input voltage when VOUT1, which appears as input voltage is gradually decreased.

*7: VOUT(T)≤1.50V MIN. : VOUT(T) - 30mV, MAX. : VOUT(T) +30mV

*8: CE conditions: XC6210A / B type: ON=VIN, OFF=VSS

VOLTAGE CHART

XC6210 Series Dropout Voltage, Supply Current, CE"H / L" Level Current Table

PARAMETER SPECIFIED OUTPUT VOLTAGE	E-0		E-1		E-2		E-3		E-4																	
	OUTPUT VOLTAGE (V)		DROPOUT VOLTAGE 1 (mV) ($I_{OUT}=30mA$)		DROPOUT VOLTAGE 2 (mV) ($I_{OUT}=100mA$)		SUPPLY CURRENT (μA)		CE "H" LEVEL CURRENT (μA)																	
			Ta=25		Ta=25		Ta=25		Ta=25																	
	$V_{OUT(T)}$		V_{dif1}		V_{dif2}		I_{DD}		ICEH																	
	MIN	MAX	TYP	MAX	TYP	MAX	TYP	MAX	MIN	MAX																
0.80	0.770	.0830	100	700	250	800	38.0	60.0	1.50	5.00																
0.85	0.820	0.880		600		700																				
0.90	0.870	0.930		50		500					150	600	38.5	61.5	2.00	6.50										
0.95	0.920	0.980				400						500														
1.00	0.970	1.030	30		300	100	400	39.0	63.0	2.50		8.00														
1.05	1.020	1.080			200		300																			
1.10	1.070	1.130		27	100		90				400		39.5	64.5	3.00	9.50										
1.15	1.120	1.180			41						120															
1.20	1.170	1.230	25		37	80		135	39.5	64.5	3.00	9.50														
1.25	1.220	1.280			200			120																		
1.30	1.270	1.330		18	28		60	90					40.0	66.0	3.50	11.00										
1.35	1.320	1.380			25			37									80	120	39.5	64.5	3.00	9.50				
1.40	1.370	1.430	30			100			100	250	38.5	61.5											2.00	6.50		
1.45	1.420	1.480																							50	500
1.50	1.470	1.530		100			700						250	800	38.0	60.0										
1.55	1.519	1.581			27			41									90	135	39.0	63.0	2.50	8.00				
1.60	1.568	1.632	25			37			80	120	39.5	64.5											3.00	9.50		
1.65	1.617	1.683																							18	28
1.70	1.666	1.734		25			37						80	120	39.5	64.5										
1.75	1.715	1.785			30			100									100	250	38.5	61.5	2.00	6.50				
1.80	1.764	1.836	50			500			150	600	38.0	60.0											1.50	5.00		
1.85	1.813	1.887																							100	700
1.90	1.862	1.938		27			41						90	135	39.0	63.0										
1.95	1.911	1.989			25			37									80	120	39.5	64.5	3.00	9.50				
2.00	1.960	2.040	18			28			60	90	40.0	66.0											3.50	11.00		
2.05	2.009	2.091																							25	37
2.10	2.058	2.142		30			100						100	250	38.5	61.5										
2.15	2.107	2.193			50			500									150	600	38.0	60.0	1.50	5.00				
2.20	2.156	2.244	100			700			250	800	38.0	60.0											1.50	5.00		
2.25	2.205	2.295																							27	41
2.30	2.254	2.346		25			37						80	120	39.5	64.5										
2.35	2.303	2.397			18			28									60	90	40.0	66.0	3.50	11.00				
2.40	2.352	2.448	25			37			80	120	39.5	64.5											3.00	9.50		
2.45	2.401	2.499																							30	100
2.50	2.450	2.550		50			500						150	600	38.0	60.0										
2.55	2.499	2.601			100			700									250	800	38.0	60.0	1.50	5.00				
2.60	2.548	2.652	27			41			90	135	39.0	63.0											2.50	8.00		
2.65	2.597	2.703																							25	37
2.70	2.646	2.754		18			28						60	90	40.0	66.0										
2.75	2.695	2.805			25			37									80	120	39.5	64.5	3.00	9.50				
2.80	2.744	2.856	30			100			100	250	38.5	61.5											2.00	6.50		
2.85	2.793	2.907																							50	500
2.90	2.842	2.958		100			700						250	800	38.0	60.0										
2.95	2.891	3.009			27			41									90	135	39.0	63.0	2.50	8.00				

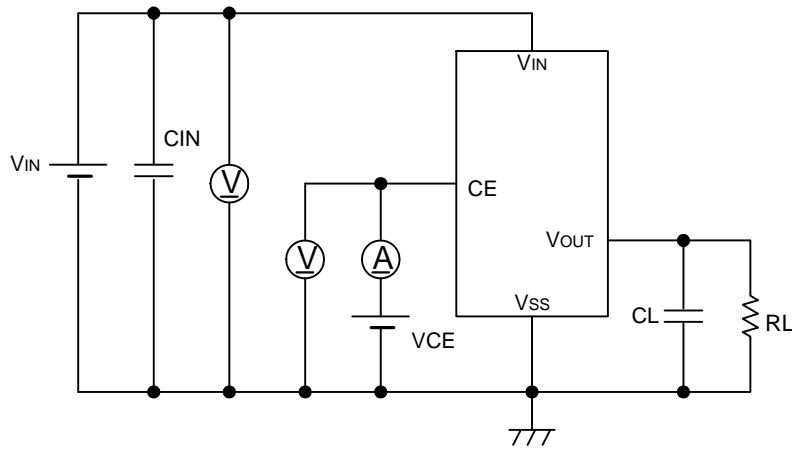
VOLTAGE CHART (Continued)

XC6210 Series Voltage Table 2

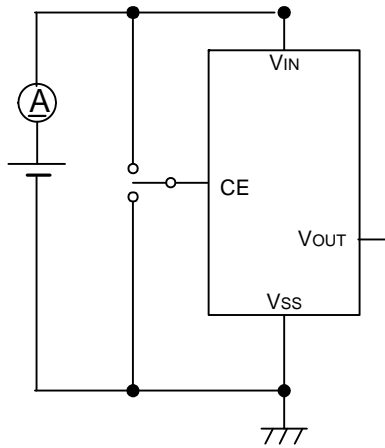
PARAMETER SPECIFIED OUTPUT VOLTAGE	E-0		E-1		E-2		E-3		E-4	
	OUTPUT VOLTAGE (V)		DROPOUT VOLTAGE 1 (mV) (I _{OUT} =30mA)		DROPOUT VOLTAGE 2 (mV) (I _{OUT} =100mA)		SUPPLY CURRENT (μA)		CE "H" LEVEL CURRENT (μA)	
	V _{OUT(T)}		V _{dif1}		V _{dif2}		I _{DD}		ICEH	
	MIN	MAX	TYP	MAX	TYP	MAX	TYP	MAX	MIN	MAX
3.00	2.940	3.060	15	23	50	75	40.5	67.5	4.00	12.50
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								
3.60	3.528	3.672								
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	15	23	50	75	41.5	70.5	4.85	15.50
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								

TEST CIRCUITS

Circuit

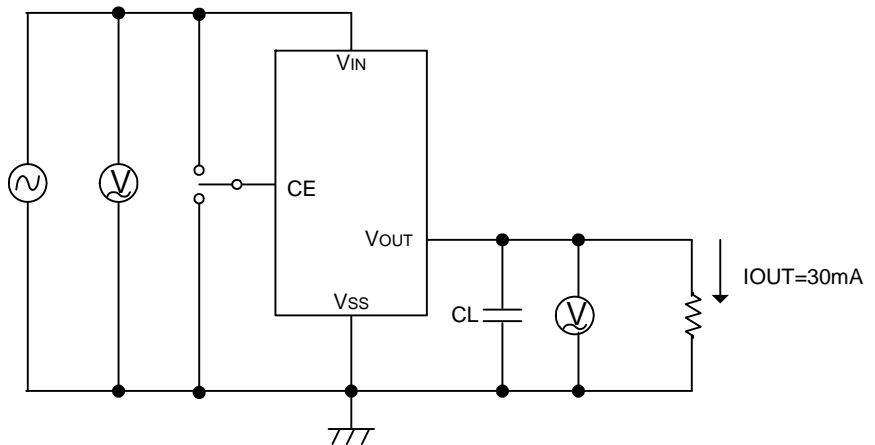


Circuit



Circuit

$V_{IN} = \{V_{OUT} + 1.0V\}V_{DC} + 0.5V_{p-pAC}$
 $V_{OUT} = 4.75V$
 $V_{IN} = 5.75V_{DC} + 0.5V_{p-pAC}$



VR	OUTPUT VOLTAGE	0.8V~1.45V	1.5V ~ 1.75V	1.8V ~ 5.0V
	CL	6.8 μF	4.7 μF	1.0 μF

OPERATIONAL EXPLANATION

<Output Voltage Regulator Control>

The voltage, divided by resistors R1 & R2, which are connected to the VOUT pin is compared with the internal reference voltage by the error amplifier. The P-channel MOSFET connected to the VOUT pin is then driven by the subsequent output signal. The output voltage at the VOUT pin is controlled and stabilized by negative feedback. The constant current limit circuit and short circuit protection operate in relation to the level of output current.

<Low ESR Capacitor>

With the XC6210 series regulator, a stable output voltage is achievable even if low ESR capacitors are used, as a phase compensation circuit is built into the regulator. In order to ensure the effectiveness of the phase compensation, we suggest that an output capacitor (CL) will be connected as close as possible between the output pin (VOUT) and the VSS pin. Please use an output capacitor (CL) with a capacitance based on the chart below. We also suggest an input capacitor (CIN) of 1 μ F. This should be connected between VIN and VSS in order to stabilize input power source.

Output Capacitor Corresponding Table

VOUT	0.8V ~ 1.45V	1.5V ~ 1.75V	1.8V ~ 5.0V
CL	6.8 μ F	4.7 μ F	1.0 μ F

<Current Limiter, Short-Circuit Protection>

The XC6210 series regulator offers a combination of current limit and short circuit protection by means of a built-in fixed current limiter circuit and a foldback circuit. 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, the output voltage drops further and output current decreases. When the output pin is shorted, a current of about 50mA flows.

<CE Pin>

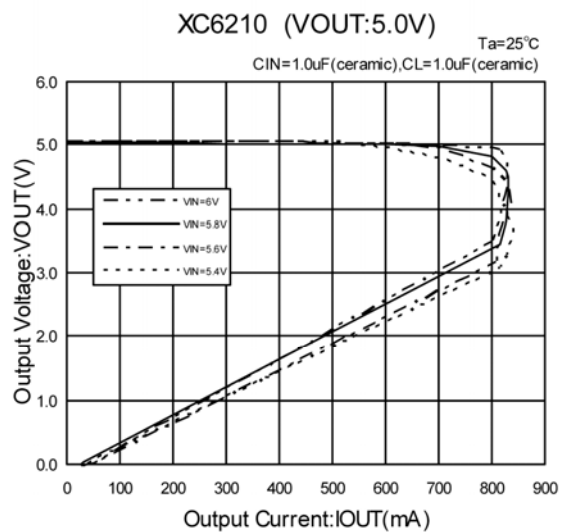
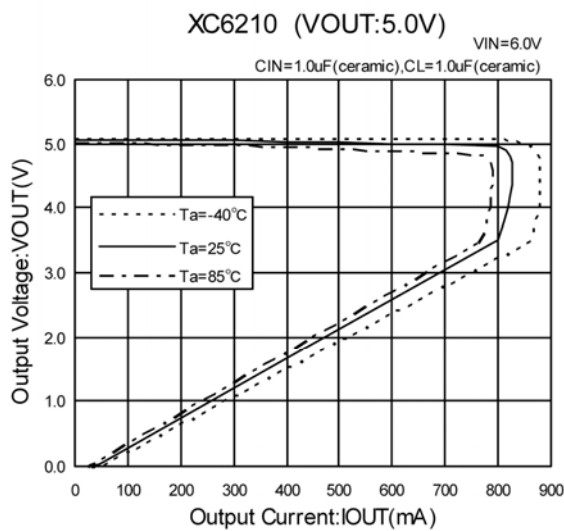
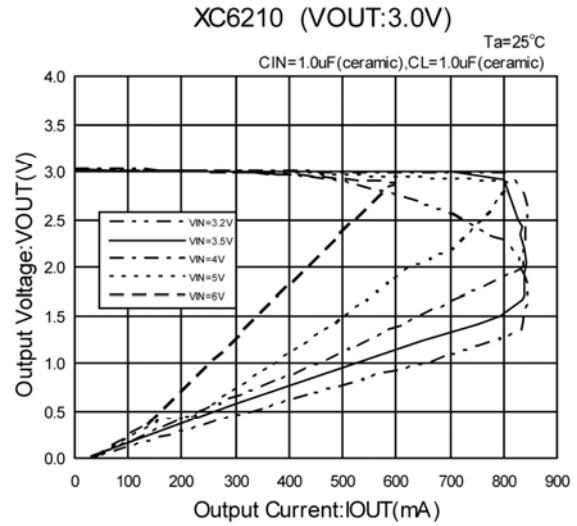
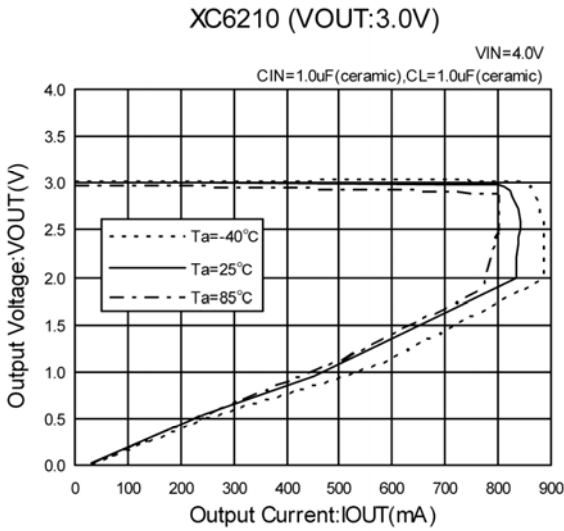
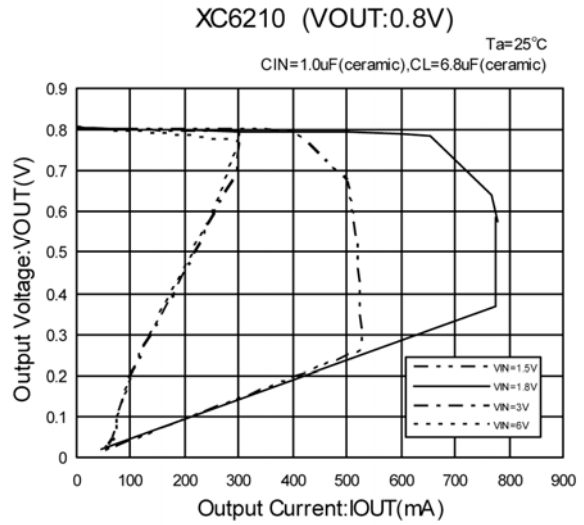
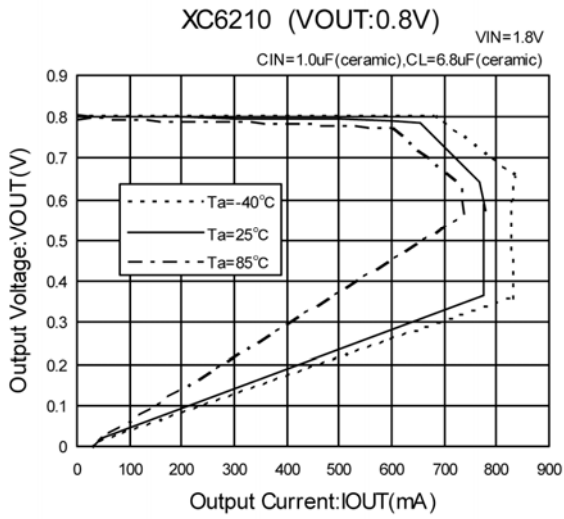
The IC's internal regulator circuitry can be shut down via the signal from the CE pin with the XC6210 series. In shutdown mode, output at the VOUT pin will be pulled down to the VSS level via R1 & R2. Options are available for the CE pin logic (See the product classification). Note that as the XC6210B types are '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 is 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 if a voltage other than VIN or VSS is applied.

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. When rapid input fluctuation or load fluctuation occurs, please increase the capacitor value such as CIN or CL to stabilize the operation.

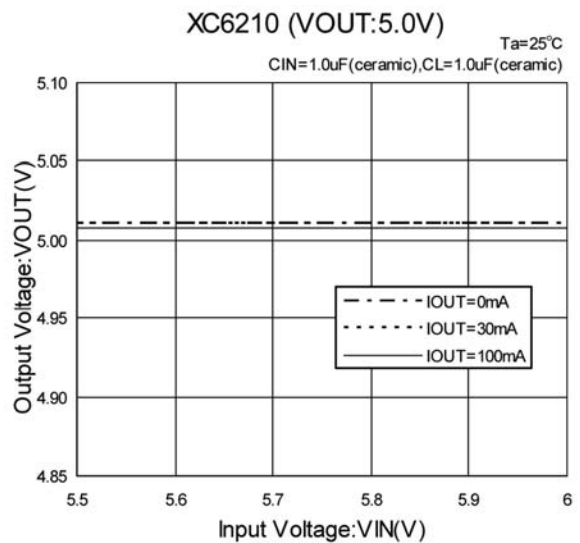
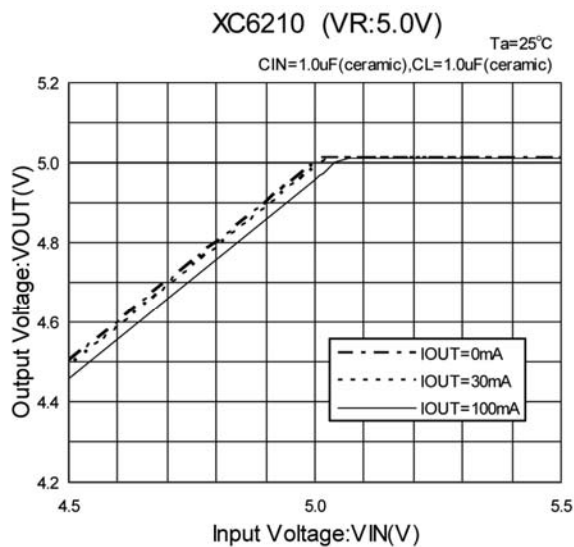
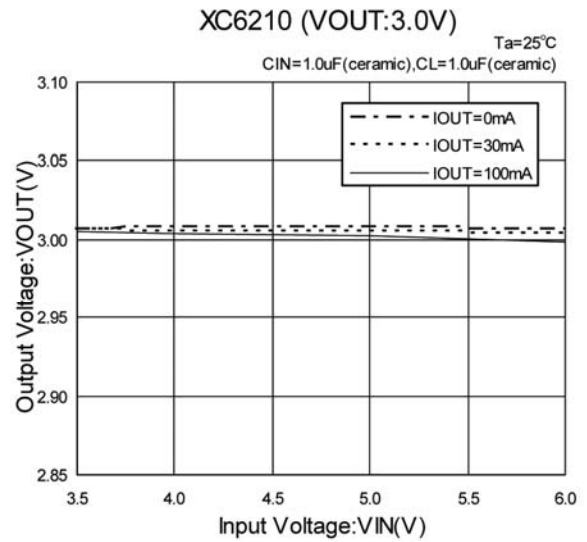
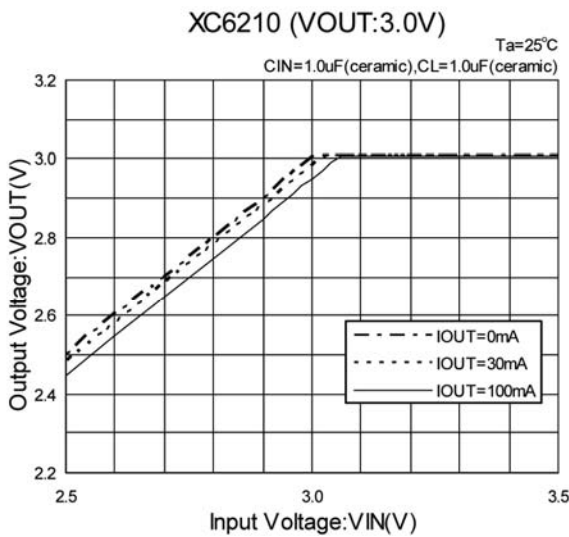
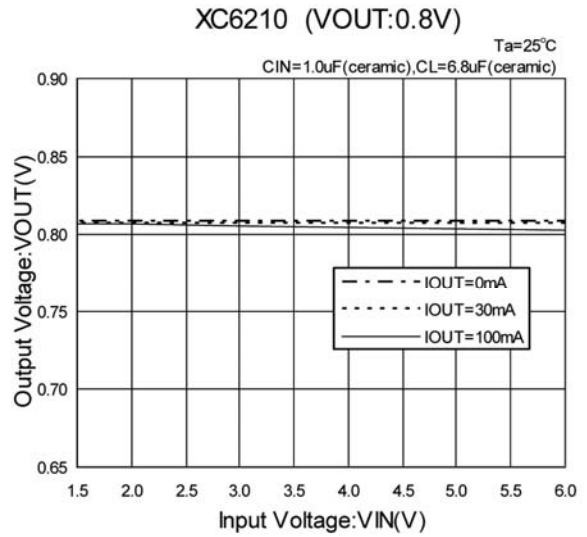
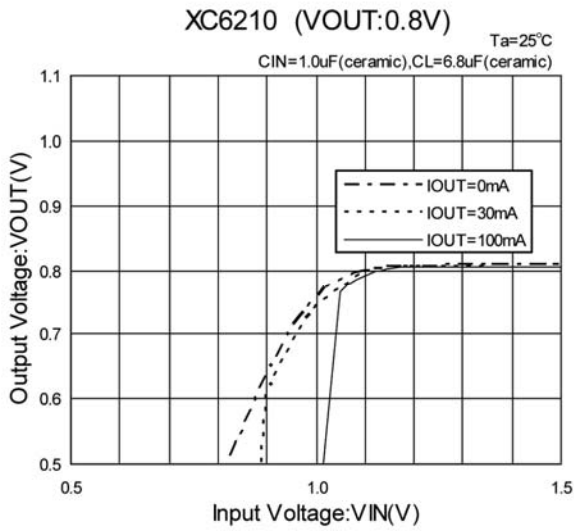
TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current



TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

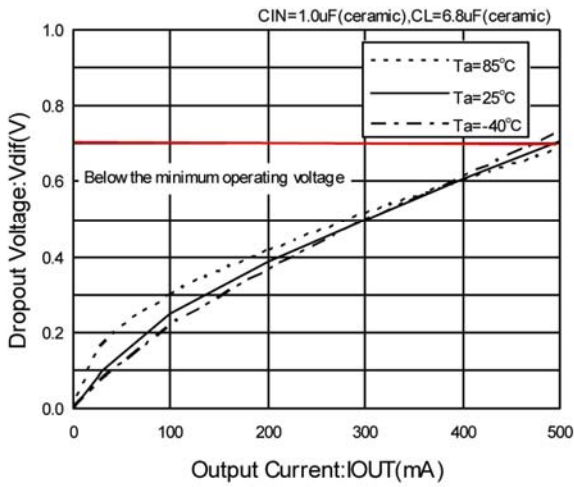
(2) Output Voltage vs. Input Voltage



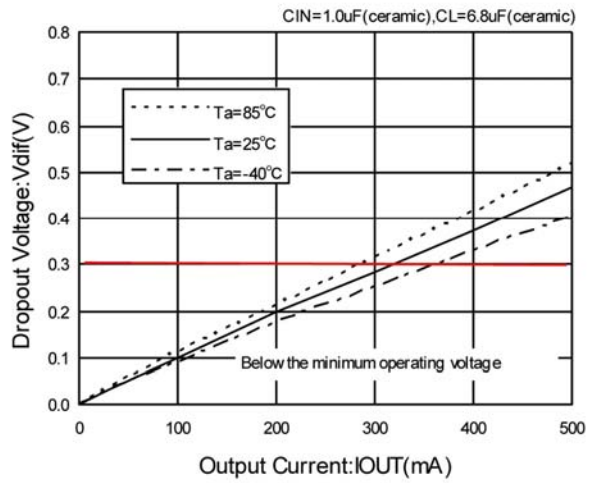
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

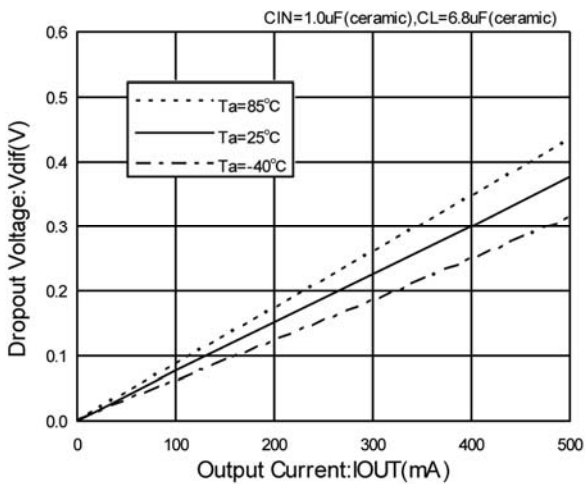
XC6210 (VOUT:0.8V)



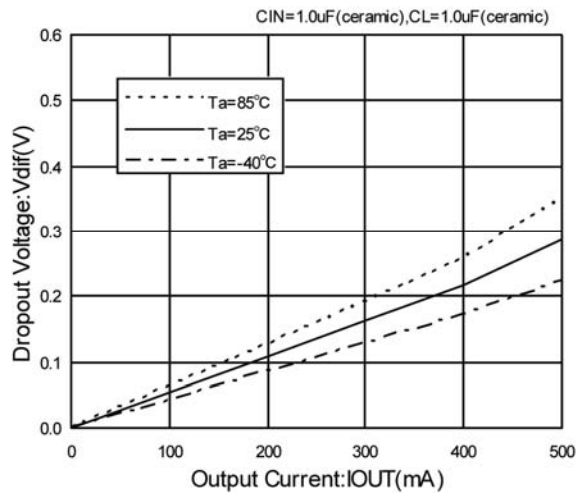
XC6210 (VOUT:1.2V)



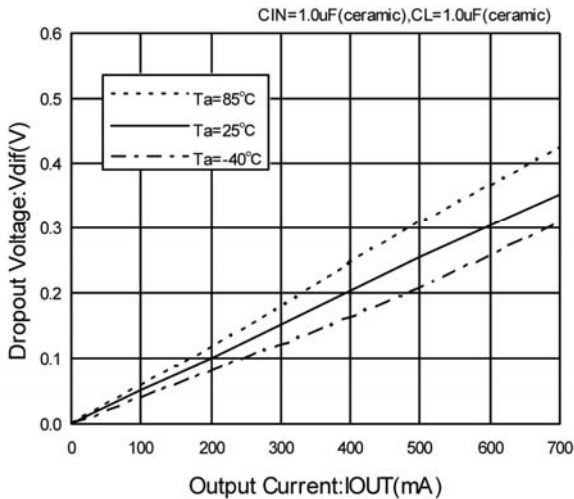
XC6210 (VOUT:1.5V)



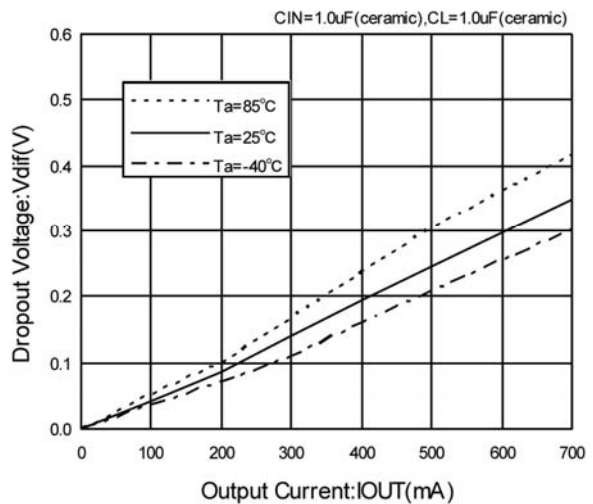
XC6210 (VOUT:2.5V)



XC6210 (VOUT:3.0V)

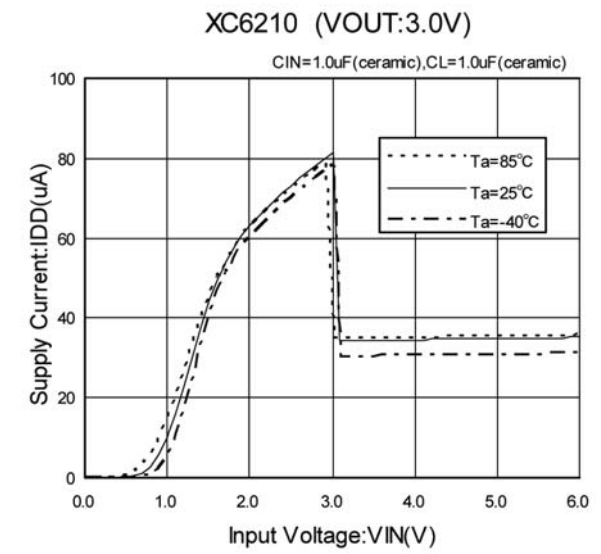
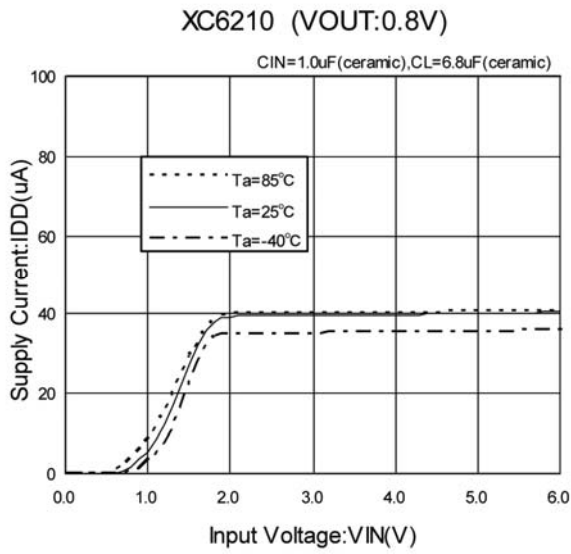


XC6210 (VOUT:5.0V)

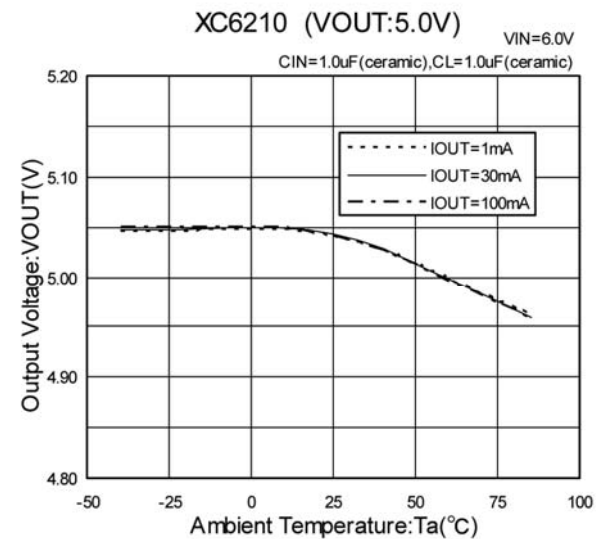
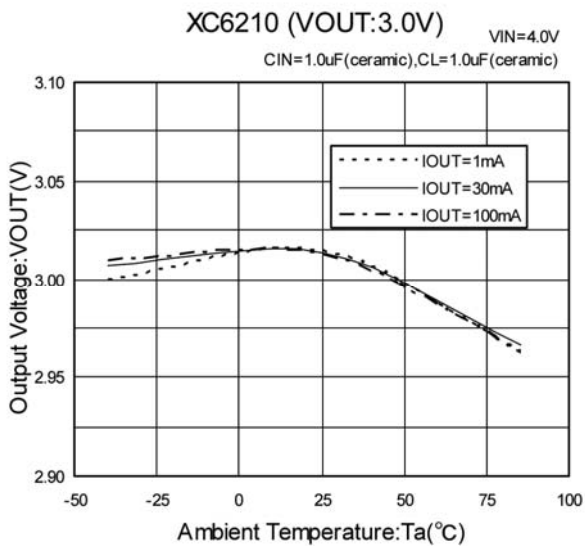
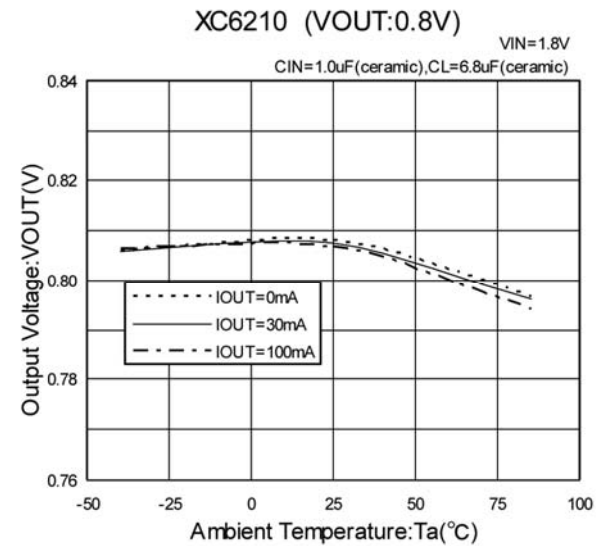
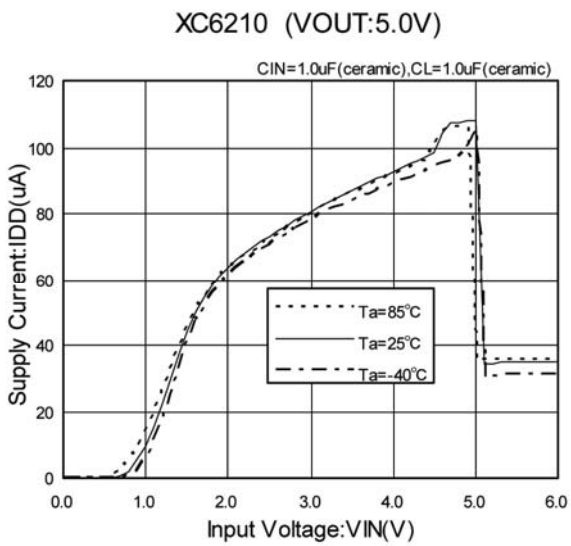


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(4) Supply Current vs. Input Voltage

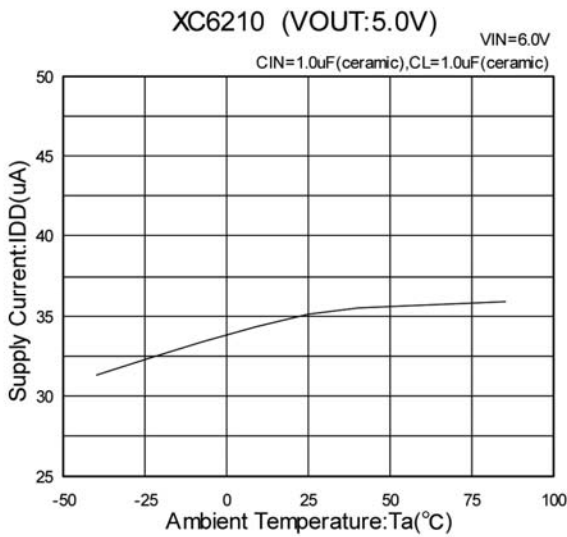
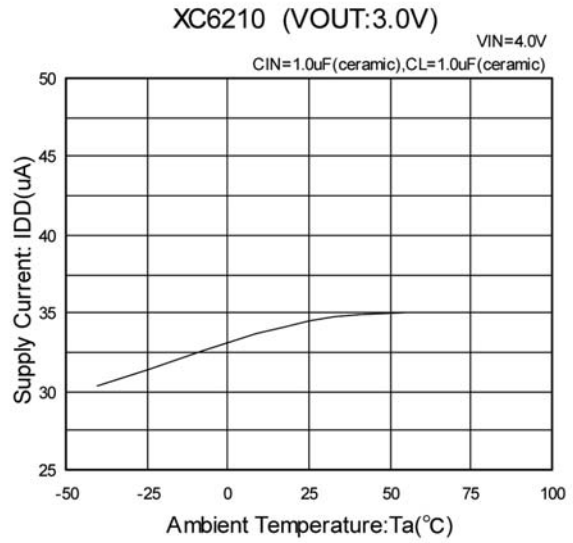
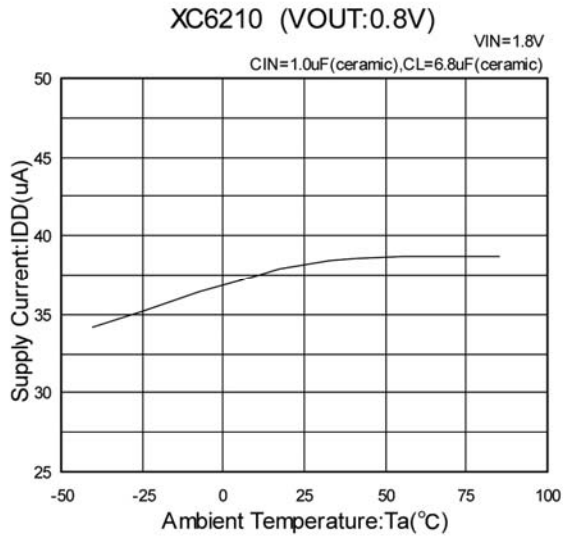


(5) Output Voltage vs. Ambient Temperature

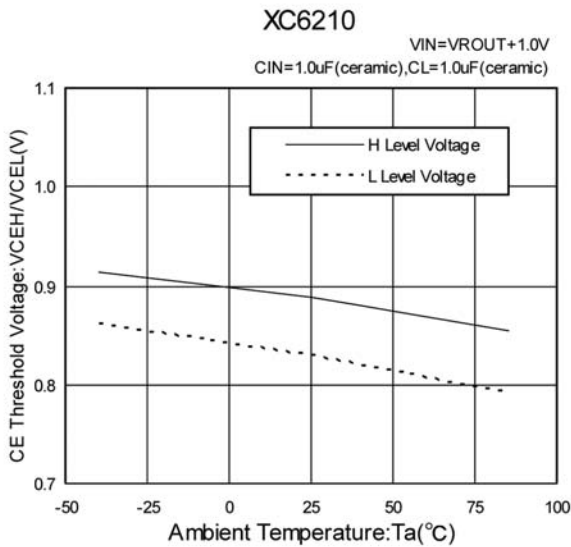


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(6) Supply Current vs. Ambient Temperature

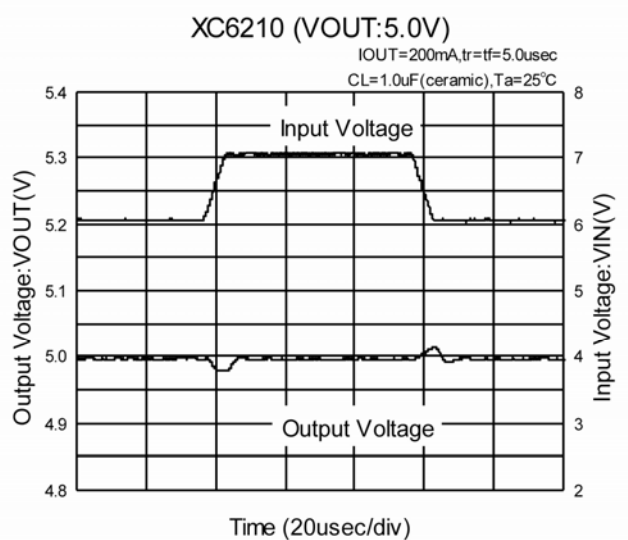
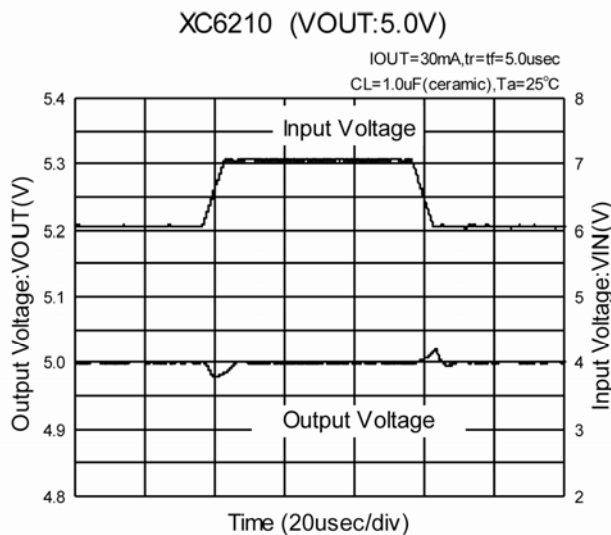
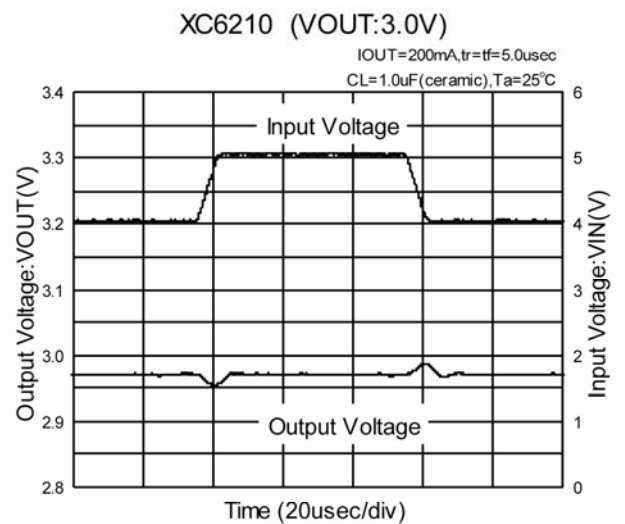
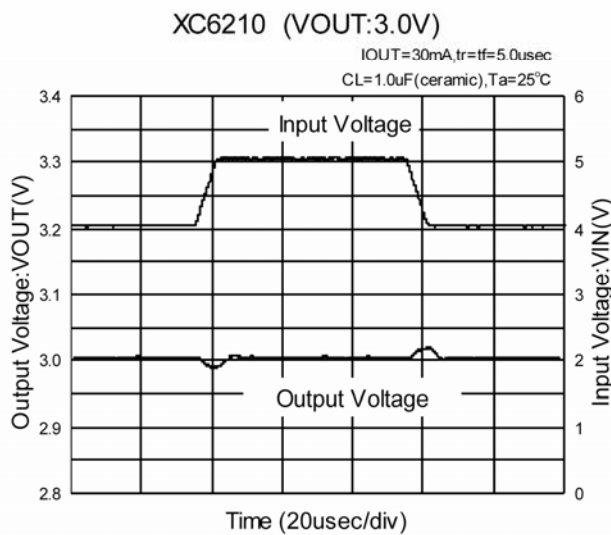
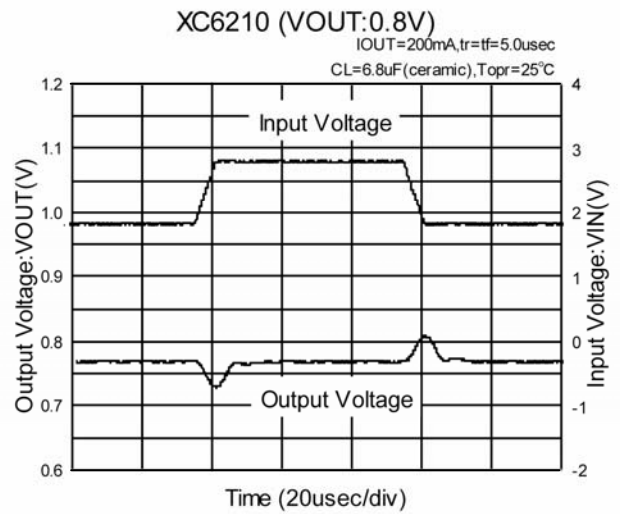
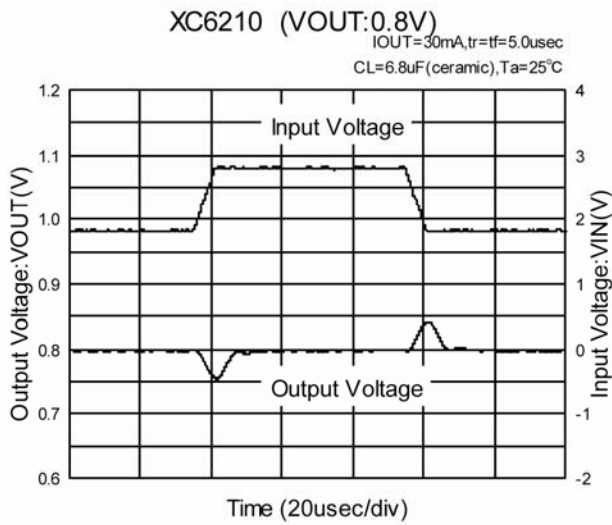


(7) CE Pin Threshold Voltage vs. Ambient Temperature



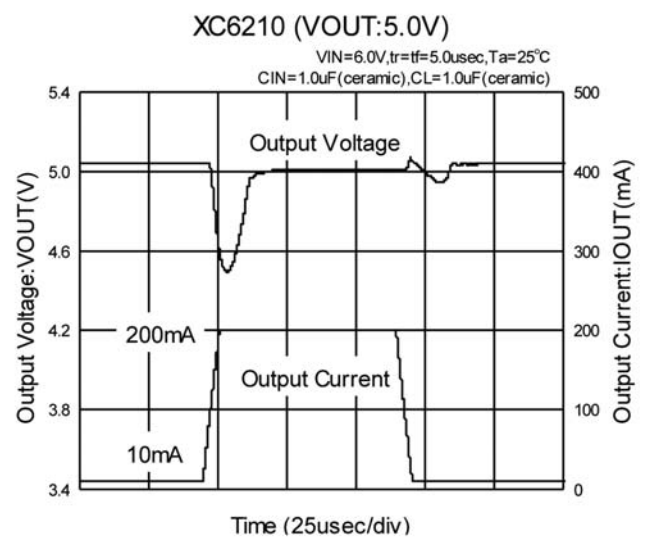
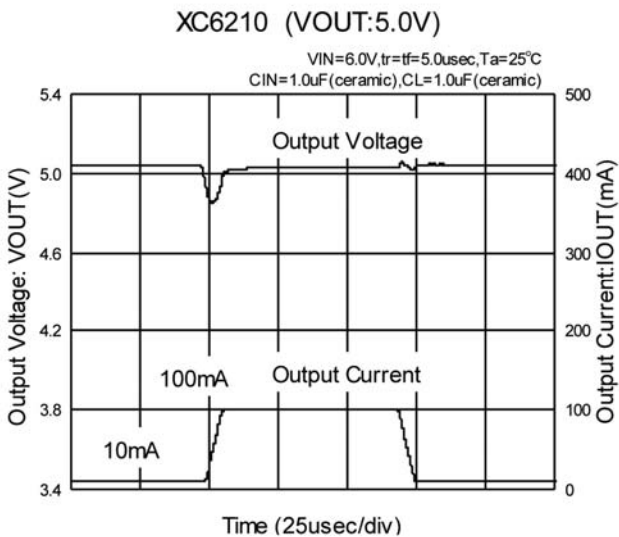
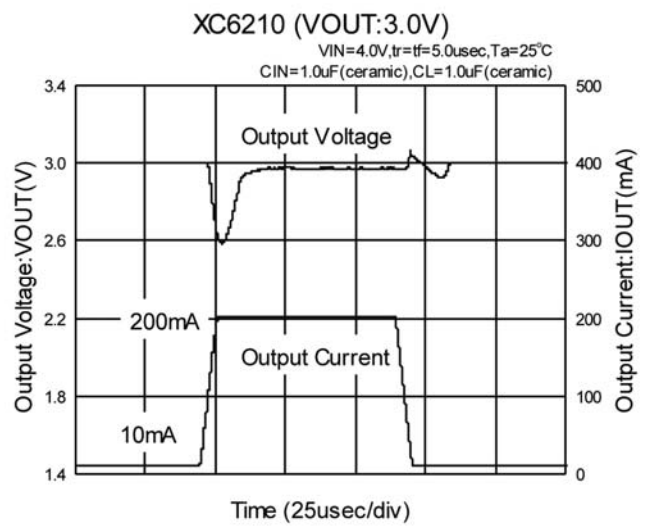
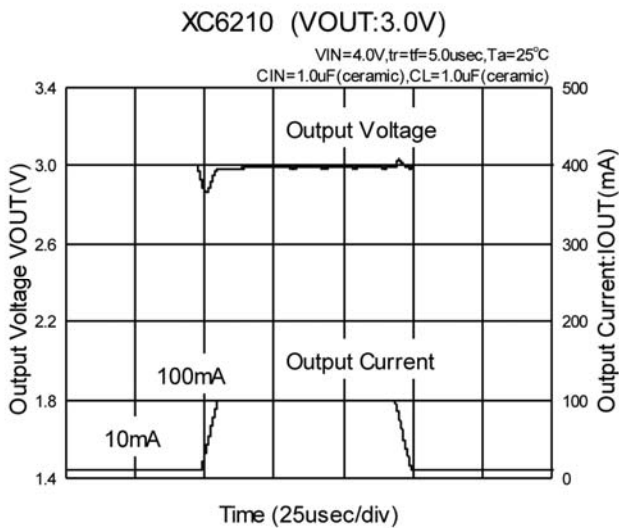
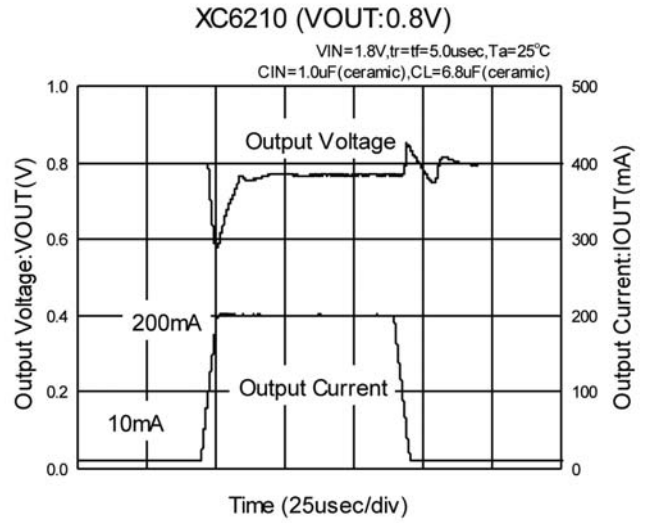
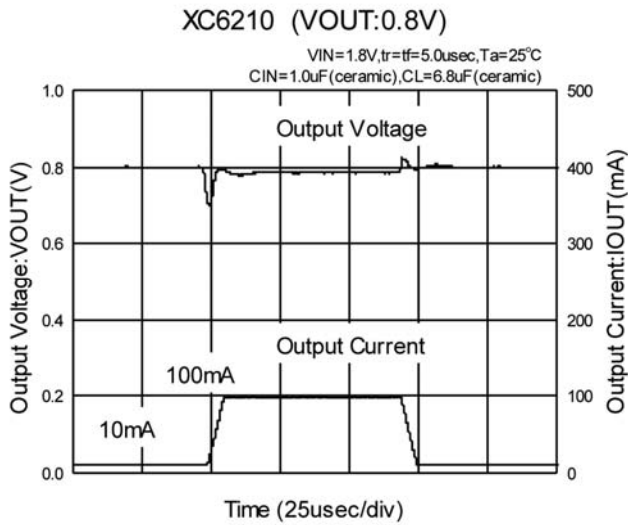
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Input Transient Response



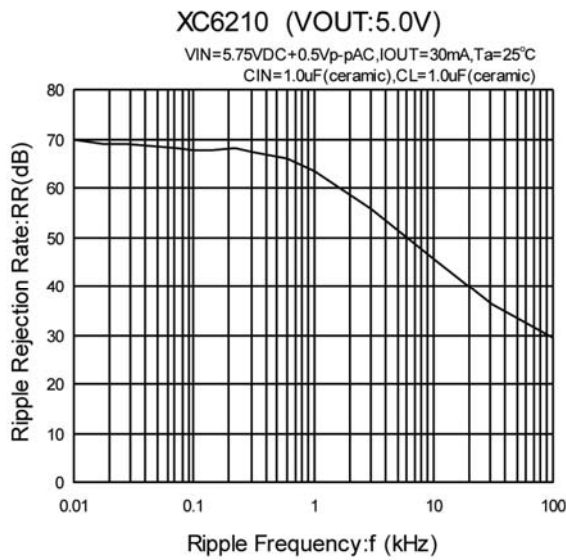
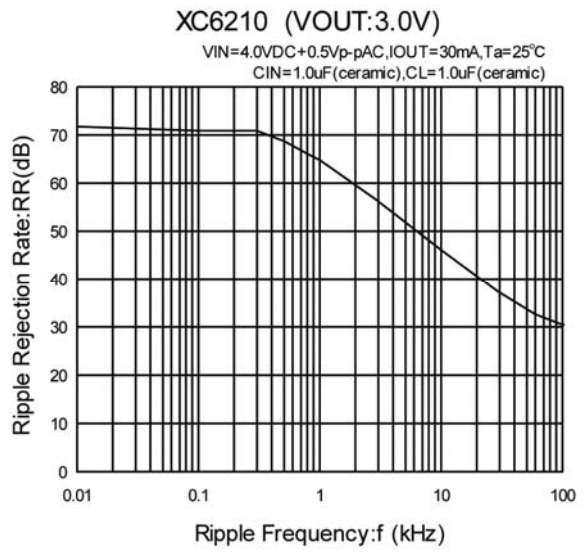
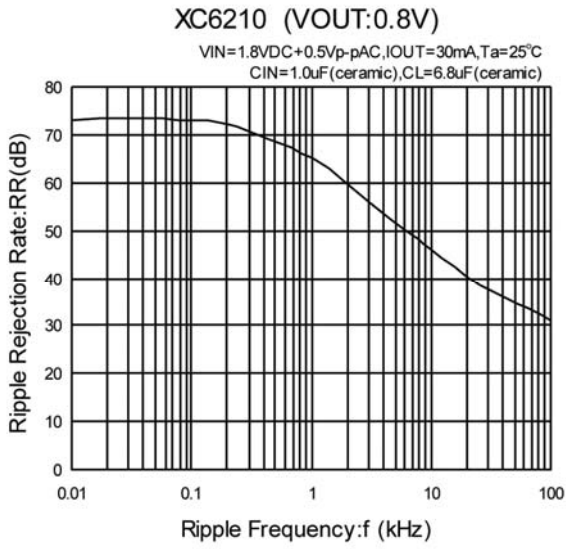
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) Output Transient Response



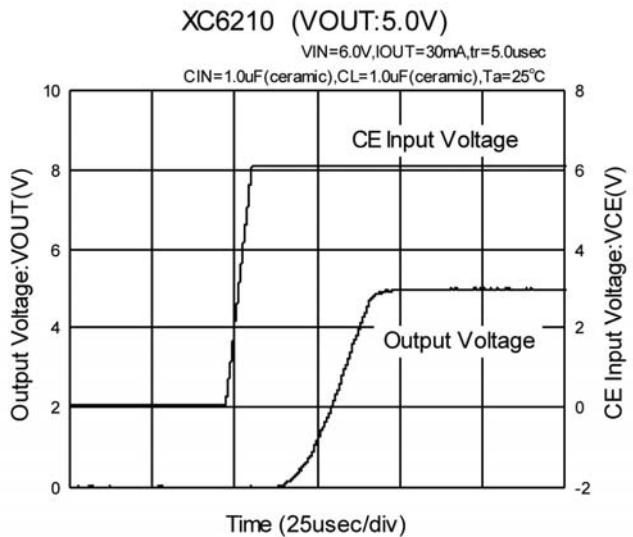
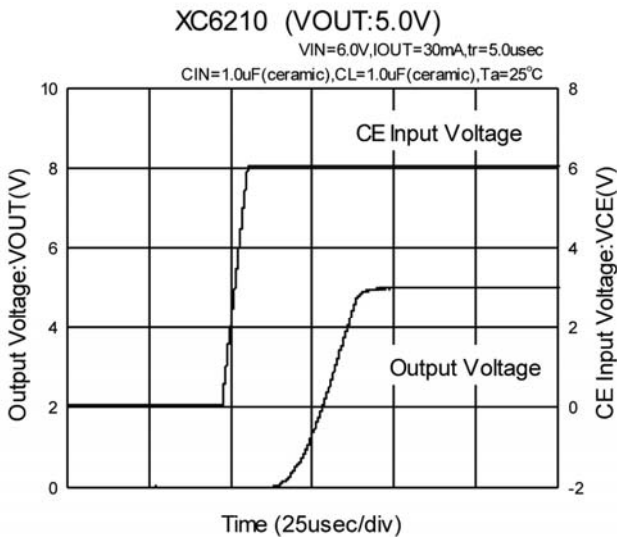
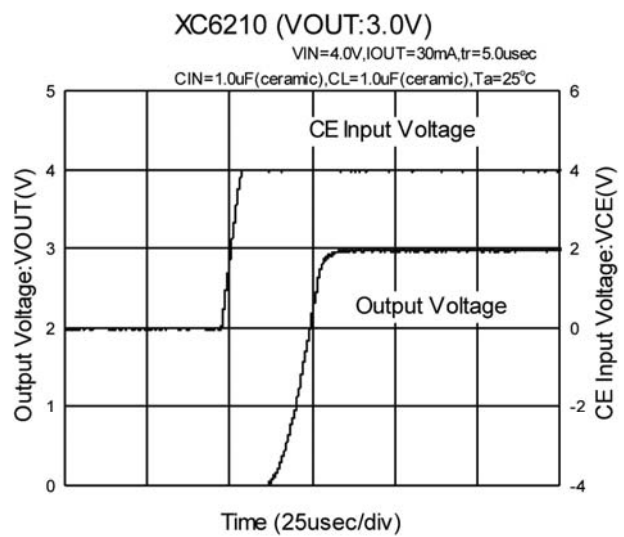
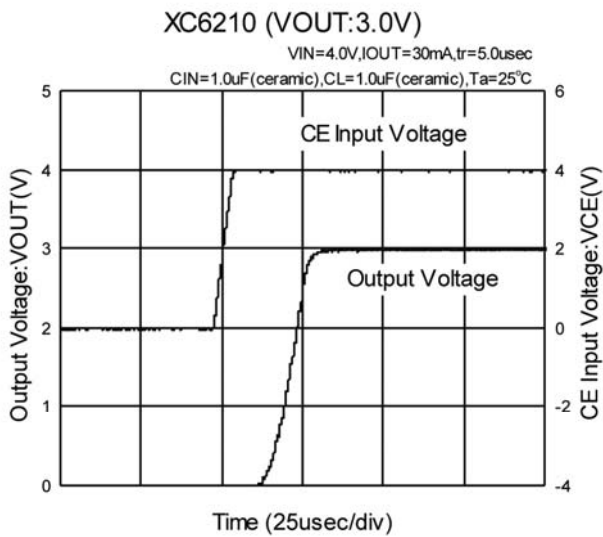
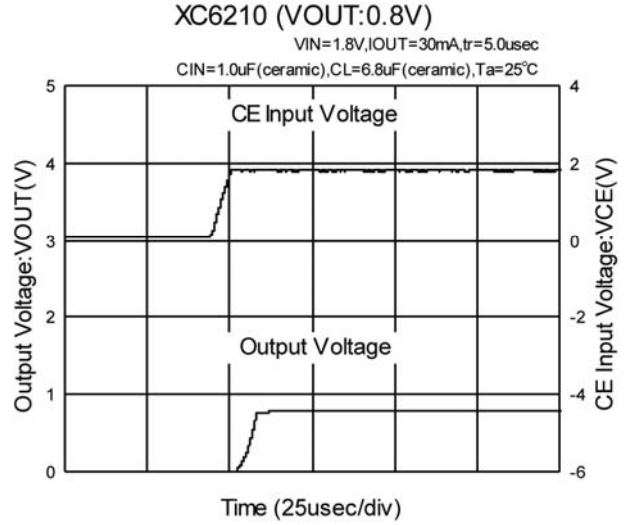
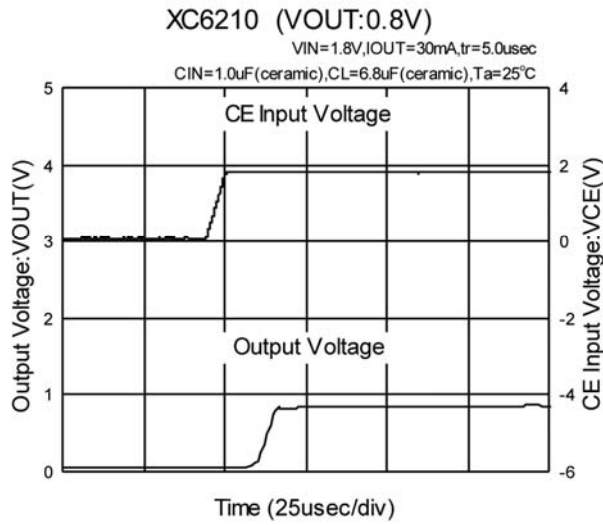
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(10) Ripple Rejection Rate



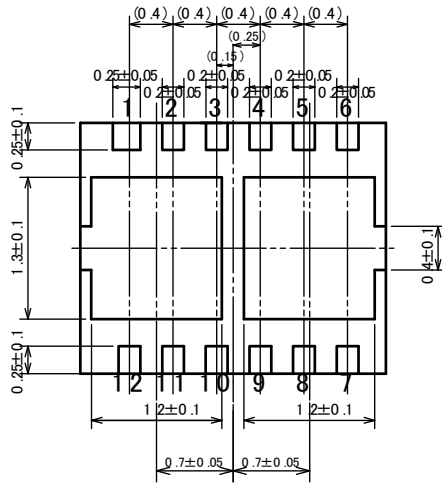
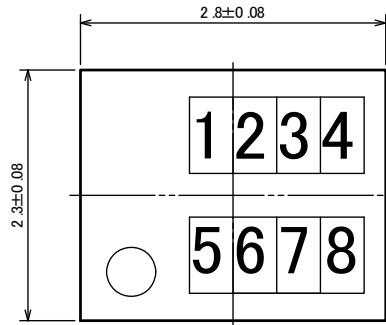
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(11) CE Rise Time



PACKAGING INFORMATION

USP-12B01



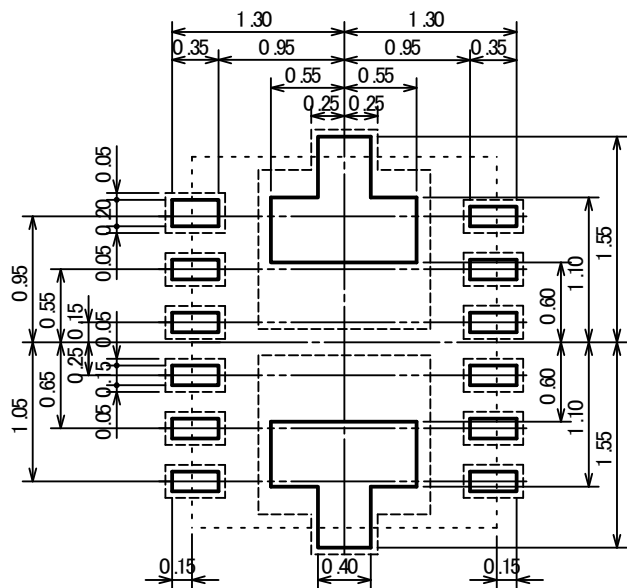
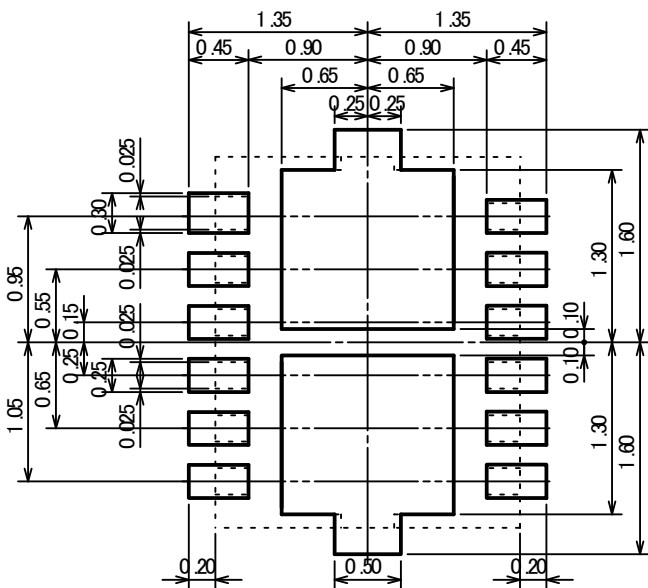
Lead Treatment: Au 0.3 μm Min.

- *1: Soldering fillet surface is not formed because the sides of the pins are not plated.
- *2: Pin No. 1 is wider than the other pins.

20/1 Unit : mm

USP-12B01 Reference Pattern Layout

USP-12B01 Reference Metal Mask Design



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