XC8101 Series

ETR2501-007

High Side Load Switch with Low Supply Current

■ GENERAL DESCRIPTION

The XC8101 series is a low supply current load switch IC with ON/OFF control and output current protection which integrates P-channel MOSFET. The XC8101 is suited for power distribution switch. With connecting to the output pin of step-down DC/DC converters, the CE pin controls ON/OFF for each distribution switch to deliver power per requirements and maximize total power efficiency. As result, the XC8101 helps extend battery life and product operation time. The XC8101 is available in an ultra small package USP-4 and does not require any external capacitors so that it can provide small power unit design and board space saving. When low signal is input to the CE pin, the XC8101 enters stand-by mode. Even where a load capacitor is connected to the output pin during in the stand-by mode, the internal switch between the V_{OUT} and V_{SS} of the XC8101 enables the electric charge in the load capacitor to be discharged. Because of this discharge function, the V_{OUT} pin voltage falls quickly to V_{SS} level.

The XC8101 contains an over current protection with foldback current circuitry which operates as over current protection and short circuit protection for the output pin.

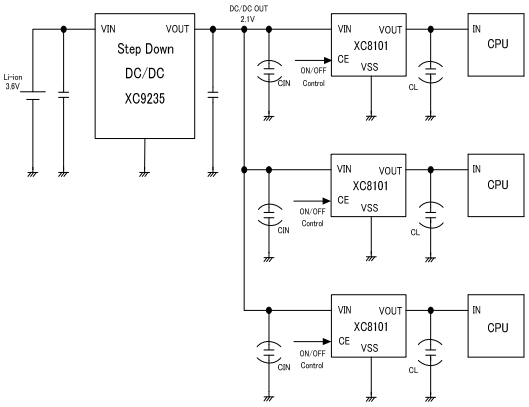
■APPLICATIONS

- Mobile phones, Smart phones
- Digital still cameras, Digital video cameras
- Portable games
- Portable equipment

■FEATURES

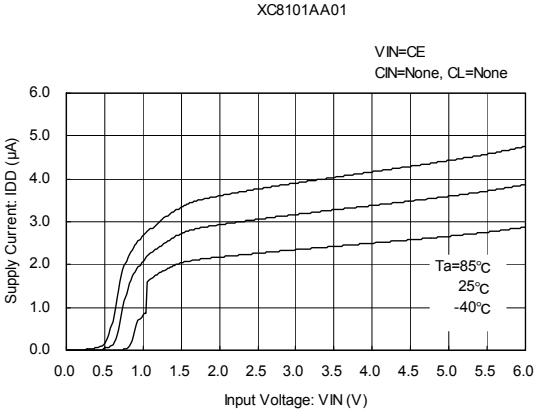
On Resistance	: 0.75Ω@ V_{IN}=2.9V (TYP.)
	: 1.15Ω@ V_{IN}=1.8V (TYP.)
Output Current	: 200mA <Current Limit =300mA (TYP.)>
Input Voltage Range	: 1.8V～6.0V
Power Consumption	: 3.0μA@ V_{IN}=1.8V
Stand-by Current	: 0.1μA
Protection Circuit	: Current limit, 300mA (TYP.)
	: Short-circuit Protection, Short current= 30mA (TYP.)
ON/OFF Function	: High Active Enable
High-Speed Discharge Function	
Operating Temperature Range	: -40℃～85℃
Packages	: USP-4, SSOT-24, SOT-25
Environmentally Friendly	: EU RoHS Compliant, Pb Free

■TYPICAL APPLICATION CIRCUIT

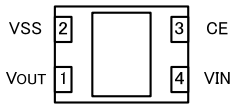


■ TYPICAL PERFORMANCE CHARACTERISTICS

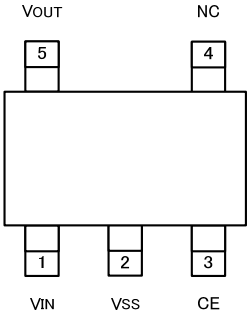
●Supply Current vs. Input Voltage



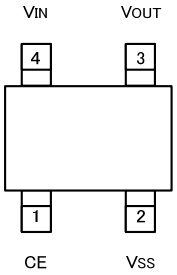
■PIN CONFIGURATION



USP-4
(BOTTOM VIEW)



SOT-25
(TOP VIEW)



SSOT-24
(TOP VIEW)

*The heat dissipation pad of the USP-4 package is recommended to solder as shown in the recommended mount pattern and metal mask pattern for mounting strength. The heat dissipation pad should be electrically opened or connected to the V_{SS} (No. 2) pin.

■PIN ASSIGNMENT

PIN NUMBER			PIN NAME	FUNCTIONS
USP-4	SOT-25	SSOT-24		
4	1	4	V_{IN}	Power Input
1	5	3	V_{OUT}	Output
2	2	2	V_{SS}	Ground
3	3	1	CE	ON/OFF Control
-	4	-	NC	No Connection

■PRODUCT CLASSIFICATION

●Ordering Information

XC8101①②③④⑤⑥−⑦(*1)

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	CE pin logic	A	High active enable
②	C_L Discharge Function	A	Output capacitor (C_L) auto-discharge function integrated
③④	Internal Standard Number	01	Fixed
⑤⑥−⑦(*1)	Packages (Order Unit)	GR-G	USP-4 (3,000/Reel)
		MR-G	SOT-25 (3,000/Reel)
		NR-G	SSOT-24 (3,000/Reel)

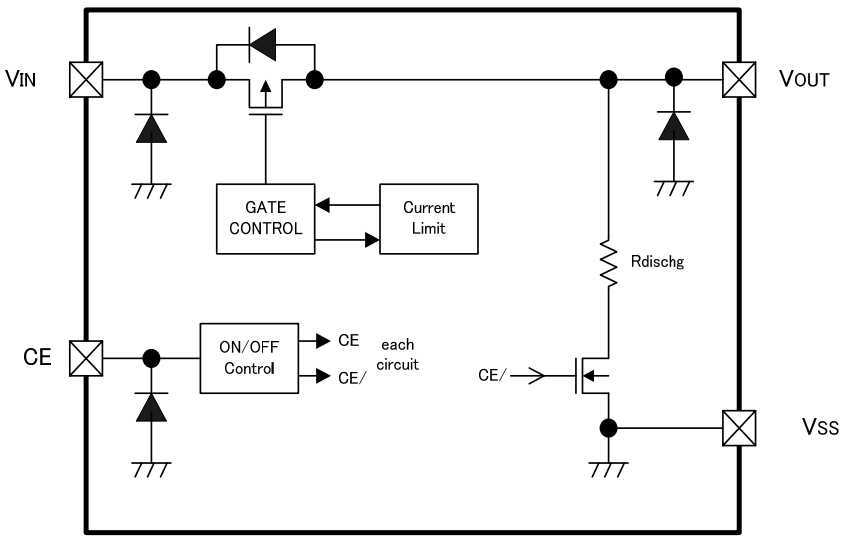
(*1) The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.

■FUNCTION CHART

SERIES	CE	IC OPERATIONAL STATUS ON/OFF
XC8101AA01	High	ON
	Low	OFF

■BLOCK DIAGRAM

●XC8101AA Series



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

■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	V_{SS}-0.3～+6.5	V
Output Current		I_{OUT}	450 *	mA
Output Voltage		V_{OUT}	V_{SS}-0.3～V_{IN}	V
CE Input Voltage		V_{CE}	V_{SS}-0.3～+6.5	V
Power Dissipation	USP-4	Pd	120	mW
	SOT-25		250	
	SSOT-24		150	
Operating Temperature Range		Topr	-40～+85	°C
Storage Temperature Range		Tstg	-55～+125	°C

* Please make sure that I_{OUT} is less than Pd/(V_{IN}-V_{OUT}).

■ELECTRICAL CHARACTERISTICS

●XC8101AA Series

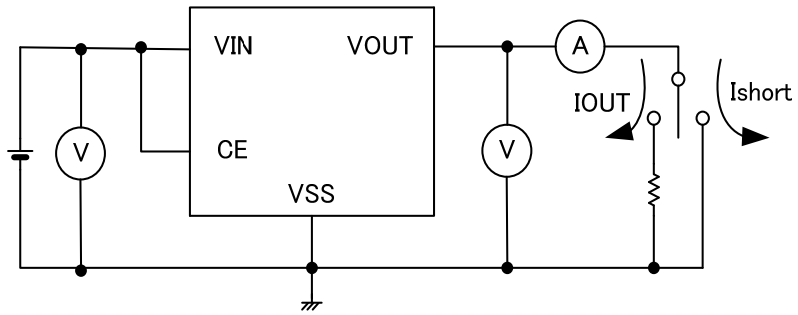
Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Input Voltage	V_{IN}		1.8	-	6.0	V	-
On Resistance (SSOT-24 / USP-4)	R_{ON}	V_{IN}=6.0V, V_{CE}=V_{IN}	-	0.55	0.90	Ω	①
		V_{IN}=4.0V, V_{CE}=V_{IN}	-	0.65	1.00		
		V_{IN}=2.9V, V_{CE}=V_{IN}	-	0.75	1.10		
		V_{IN}=1.8V, V_{CE}=V_{IN}	-	1.15	1.50		
On Resistance (SOT-25)	R_{ON}	V_{IN}=6.0V, V_{CE}=V_{IN}	-	0.65	1.00	Ω	①
		V_{IN}=4.0V, V_{CE}=V_{IN}	-	0.75	1.10		
		V_{IN}=2.9V, V_{CE}=V_{IN}	-	0.85	1.20		
		V_{IN}=1.8V, V_{CE}=V_{IN}	-	1.25	1.60		
Supply Current	I_{DD}	V_{IN}=6.0V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	2.7	8.2	μA	②
		V_{IN}=4.0V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	2.3	7.3		
		V_{IN}=2.9V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	2.2	6.9		
		V_{IN}=1.8V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	2.0	6.2		
Stand-by Current	I_{STBY}	V_{IN}=6.0V, V_{CE}=V_{SS}, V_{OUT}=OPEN	-	0.01	0.10	μA	②
Switch Leakage Current	I_{LEAK}	V_{IN}=6.0V, V_{CE}=V_{OUT}=V_{SS}	-	0.01	0.10	μA	②
Current Limit	I_{LIM}	V_{CE}=V_{IN}, V_{OUT}= V_{IN} - 1.0V	200	300	-	mA	①
Short Circuit Current	I_{SHORT}	V_{CE}=V_{IN}, V_{OUT}=0V	-	30	-	mA	①
CE High Level Voltage	V_{CEH}		1.2	-	6.0	V	③
CE Low Level Voltage	V_{CEL}		-	-	0.3	V	③
CE High Level Current	I_{CEH}	V_{CE}=V_{IN}	-0.1	-	0.1	μA	③
CE Low Level Current	I_{CEL}	V_{CE}=V_{SS}	-0.1	-	0.1	μA	③
C_L Auto-Discharge Resistance	R_{DCHG}	V_{IN}=4.0V, V_{OUT}=4.0V, V_{CE}=V_{SS}	650	900	1100	Ω	④
Turn On Time (*1)	$t_{DLY(ON)}$	V_{IN}=4.0V, V_{CE}=0.3V→1.2V, R_L=80Ω, without C_{IN},C_L	-	6	13	μs	⑤
Turn Off Time (*2)	$t_{DLY(OFF)}$	V_{IN}=4.0V, V_{CE}=1.2V→0.3V, R_L=80Ω, without C_{IN},C_L	-	2.0	4.0	μs	⑤

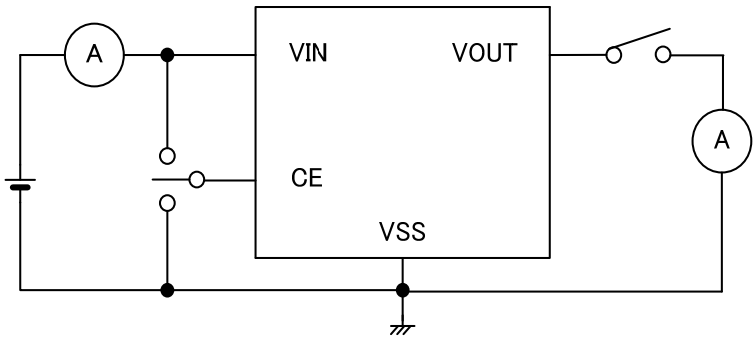
NOTE:
*1: Time to reach 90% of V_{OUT} after V_{CE} entering the V_{CEH} threshold.
*2: Time to fall to 10% of V_{OUT} after V_{CE} entering the V_{CEL} threshold.

■TEST CIRCUITS

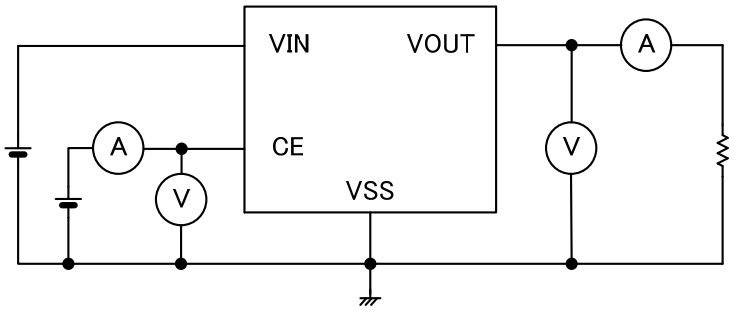
Circuit ①



Circuit ②

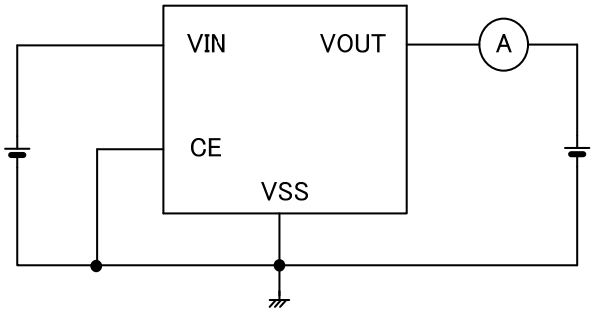


Circuit ③

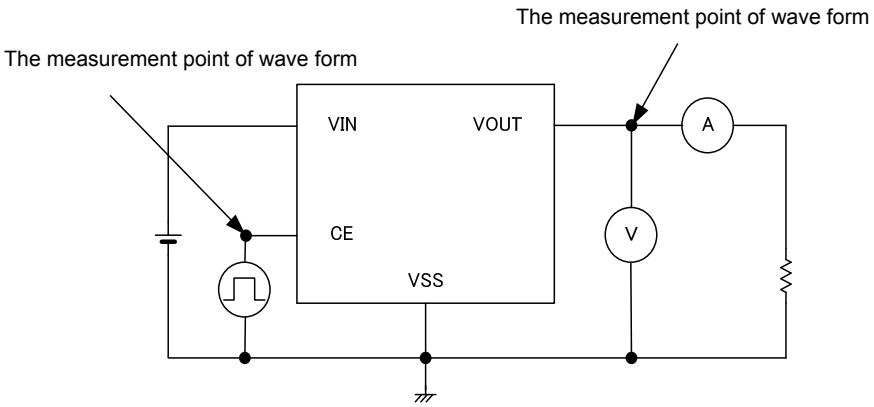


■TEST CIRCUITS (Continued)

Circuit ④



Circuit ⑤



■OPERATIONAL EXPLANATION

<CE Pin>
The XC8101 enables an output P-channel MOSFET switch and the IC internal circuitry to turn off by the signal to the CE pin. In the shutdown mode, the V_{OUT} pin will be pulled down to the V_{SS} by the C_L auto-discharge function.
The output voltage becomes unstable when the CE pin is opened. If the input voltage to the CE pin is within the specified threshold voltages, the logic is fixed and the XC8101 will operate normally. However, supply current may increase as a result of the shoot-through current of internal circuitry when the medium level voltage is input to the CE pin.

＜Input Capacitor＞
The XC8101 works well without an output capacitor（C_L）. However, an output capacitor such as a bypass capacitor is tied up to the output side of the IC, input voltage ringing may occur when the IC is turned on. In order to reduce the ringing, an input capacitor with the value of 1μF or more is requested to attach between V_{IN} pin and V_{SS} pin. The capacitor should be tied and placed as close as the IC.

<CL Auto-Discharge Function>
The XC8101A contains a C_L auto-discharge resistor and an N-channel transistor between the V_{OUT} pin and the V_{SS} pin. The XC8101A quickly discharge 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 900Ω (V_{OUT}=4.0V TYP. @ V_{IN}=4.0). Discharge time of the output capacitor (C_L) is determined by a CL auto-discharge resistor value (R_{DCHG}) and an output capacitor value. Time constant τ is defined as ($\tau = C \times R_{DCHG}$). Output voltage after starting discharge can be calculated by the following formula.

$$V = V_{OUT} \times e^{-t/\tau}, \quad \text{or} \quad t = \tau \ln (V_{OUT} / V)$$

V: Output voltage after starting discharge
V_{OUT}: Output voltage
t: Discharge time
τ : Output discharge resistor value Rdischg × Output capacitor (C_L) value C

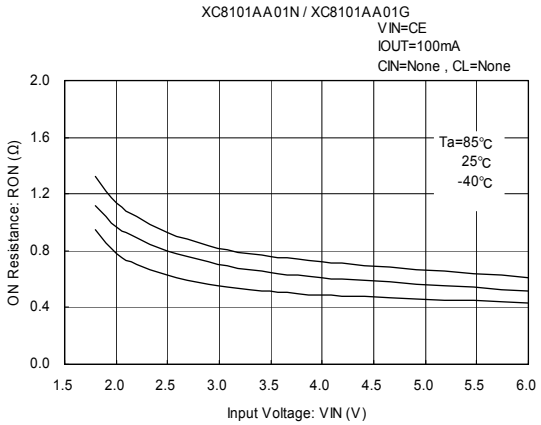
<Current Limiter, Short-Circuit Protection>
The XC8101 series contains a constant current limiter and foldback current circuitry. The constant current limiter operates to limit output current and the foldback current circuitry operates as short circuit protection for the output pin.
When the load current reaches the limit current, the constant current limiter operates and the output voltage drops. The output voltage further, then the foldback current circuitry operates to decrease the output current. When the output pin is short-circuited to the ground, the output current drops and maintains a flow about 30mA.

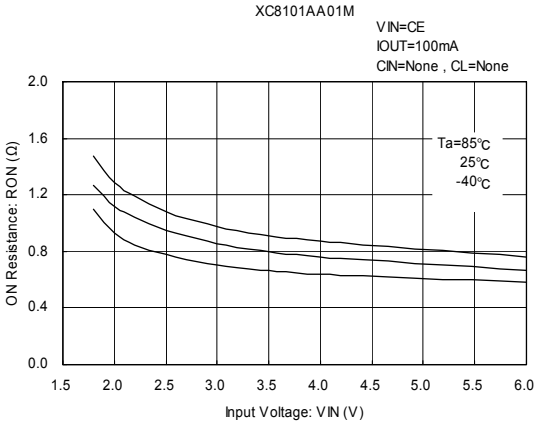
■NOTES ON USE

1. Please use this IC within the stated absolute maximum ratings. Operation beyond these limits may cause degrading or permanent damage to the device.
2. The X8101 goes into an undefined operation when the CE pin is left open. The CE pin shall be tied to low or high level.
3. V_{OUT} pin voltage should not be applied beyond the V_{IN} pin voltage. The IC may get damage due to the reverse current toward the V_{IN} pin.

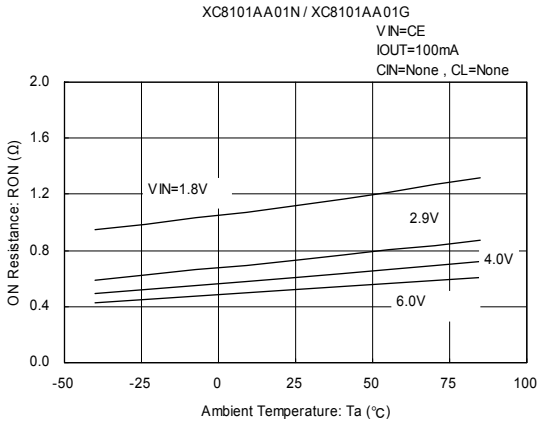
■TYPICAL PERFORMANCE CHARACTERISTICS

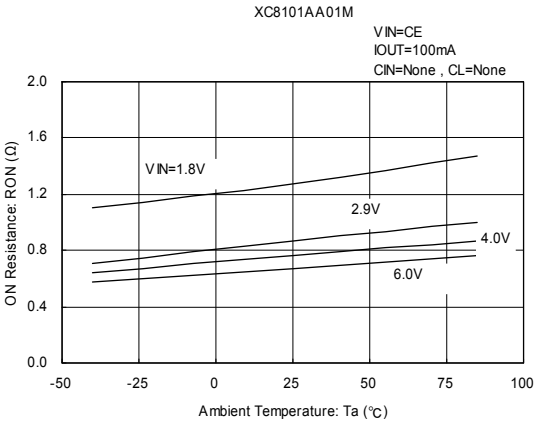
(1) ON Resistance vs. Input Voltage



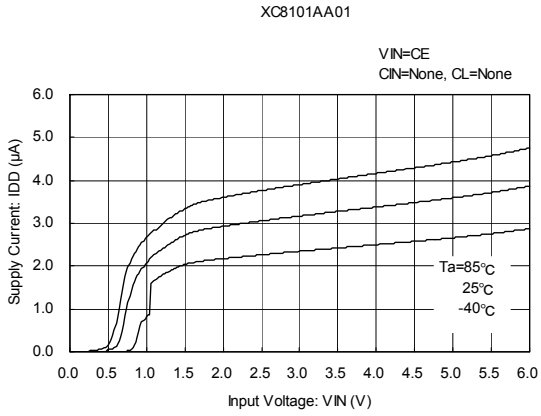


(2) ON Resistance vs. Ambient Temperature

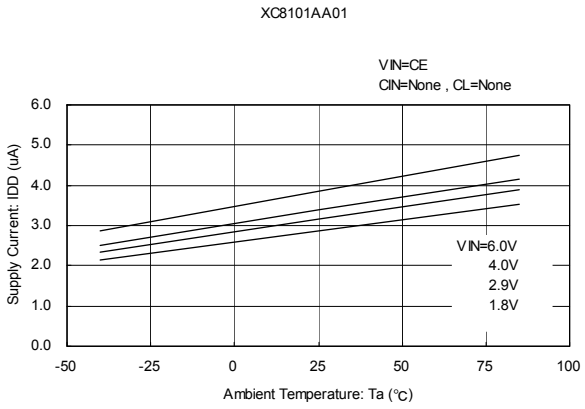




(3) Supply Current vs. Input Voltage



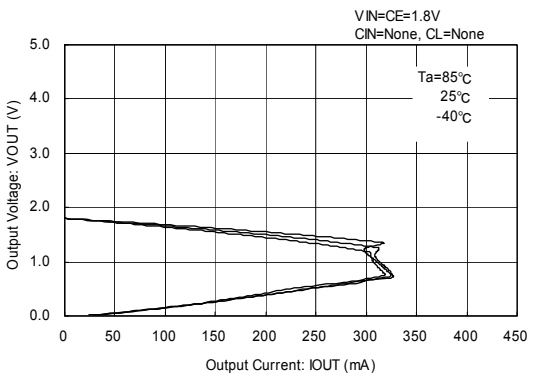
(4) Supply Current vs. Ambient Temperature



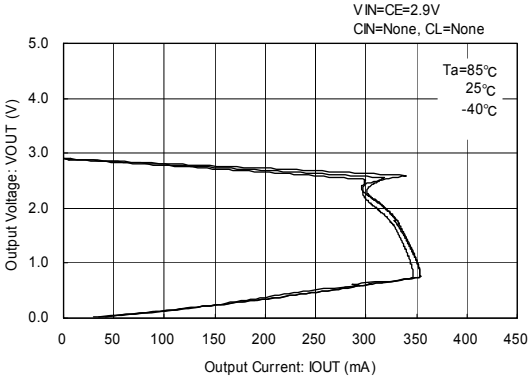
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(5) Output Voltage vs. Output Current

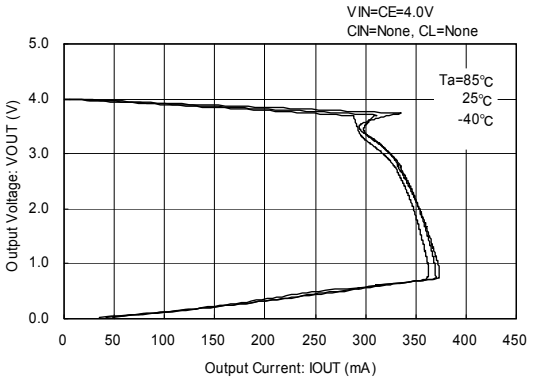
XC8101AA01N / XC8101AA01G



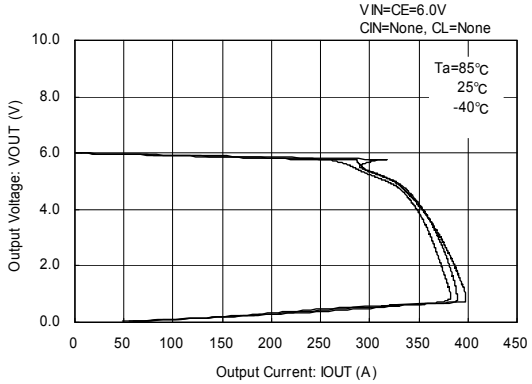
XC8101AA01N / XC8101AA01G



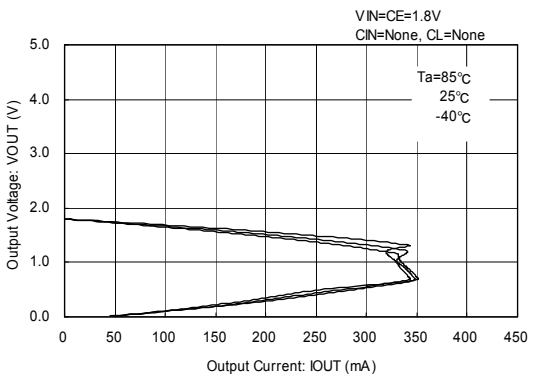
XC8101AA01N / XC8101AA01G



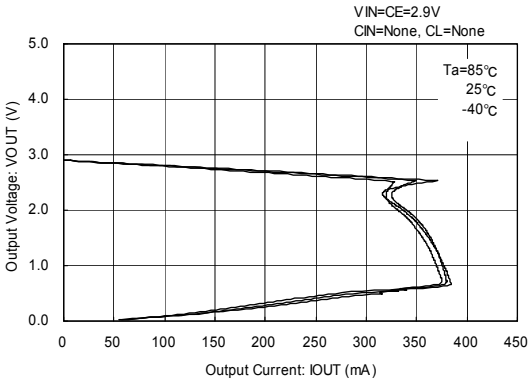
XC8101AA01N / XC8101AA01G



XC8101AA01M

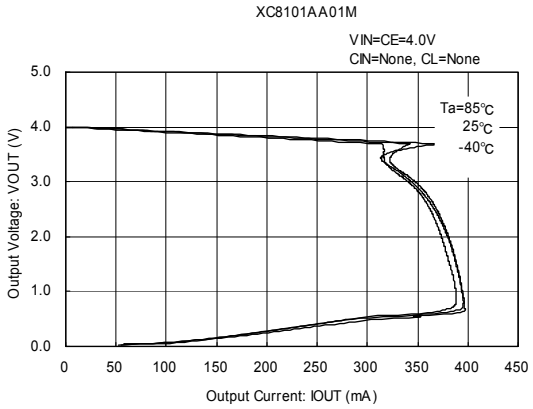


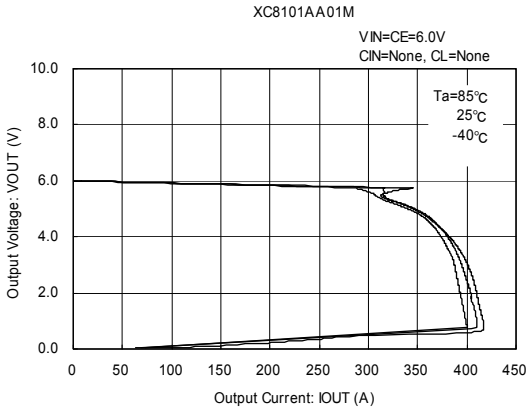
XC8101AA01M



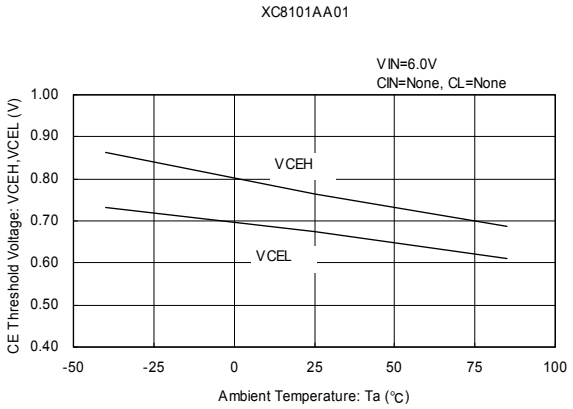
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

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

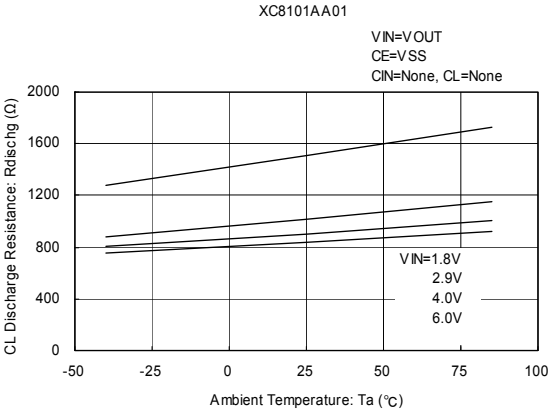




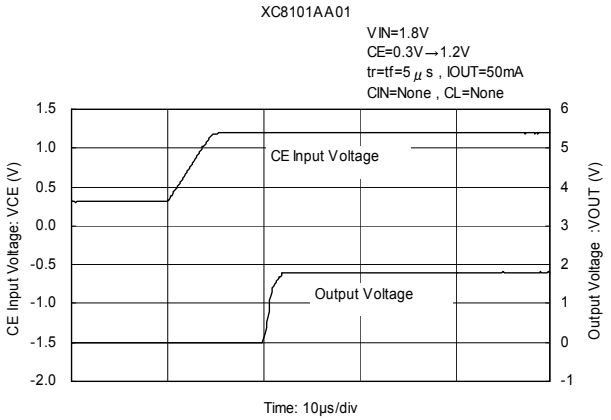
(6) CE Threshold Voltage vs. Ambient Temperature

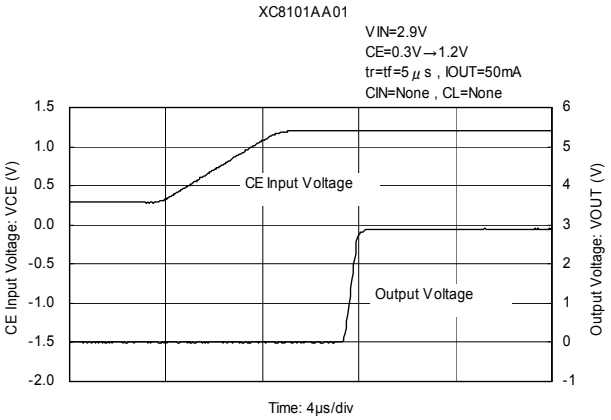


(7) CL Discharge Resistance vs. Ambient Temperature



(8) Output Turn-on Time with CE

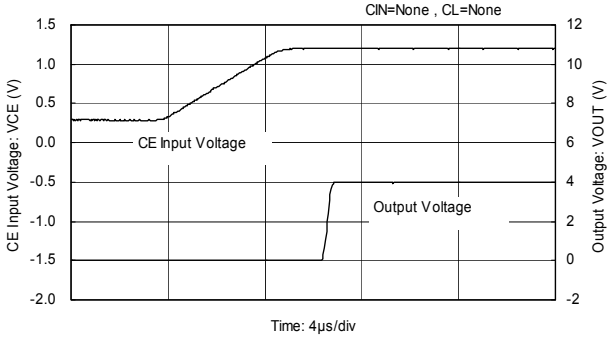




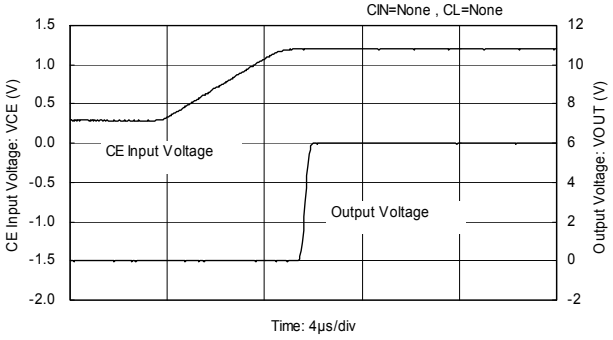
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Output Turn-on Time with CE (Continued)

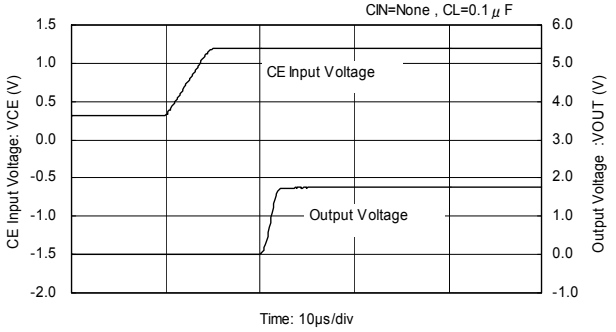
XC8101AA01
VIN=4.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=None , CL=None



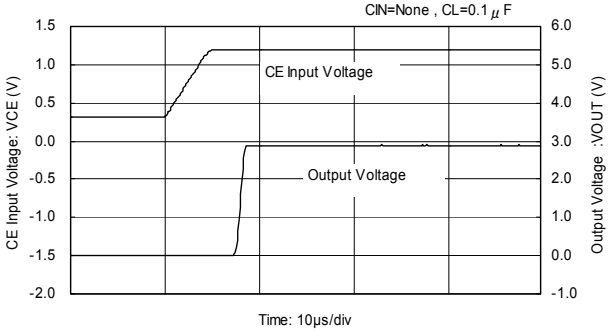
XC8101AA01
VIN=6.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=None , CL=None



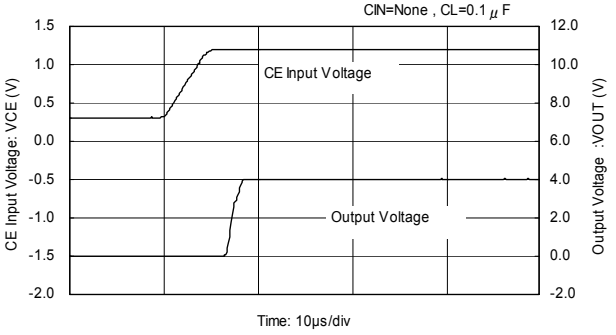
XC8101AA01
VIN=1.8V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=None , CL=0.1μF



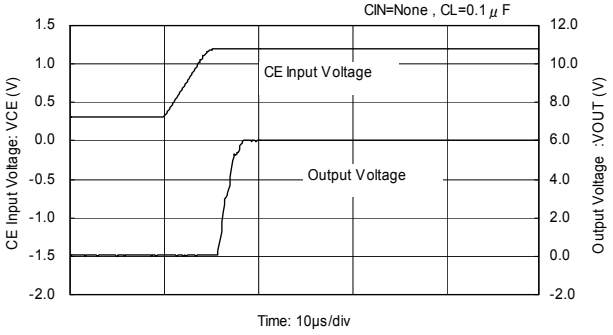
XC8101AA01
VIN=2.9V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=None , CL=0.1μF



XC8101AA01
VIN=4.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=None , CL=0.1μF

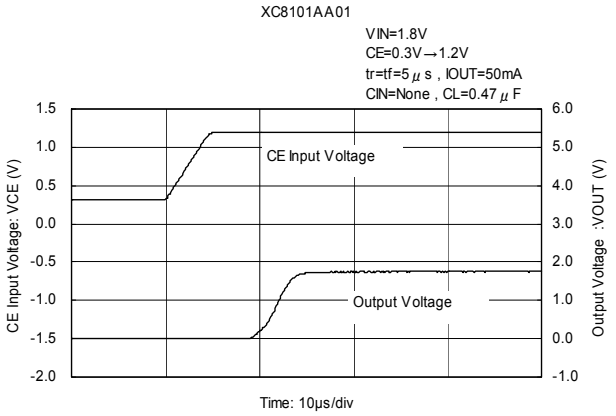


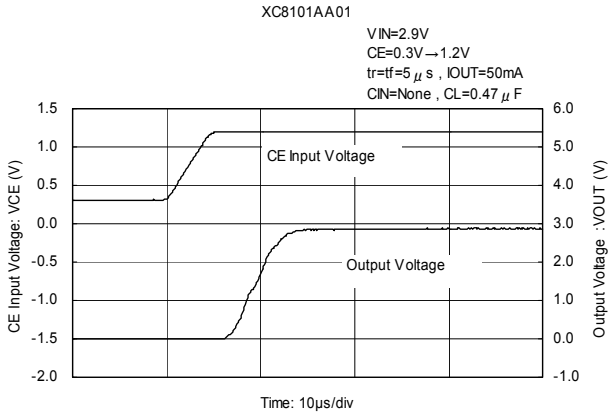
XC8101AA01
VIN=6.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=None , CL=0.1μF

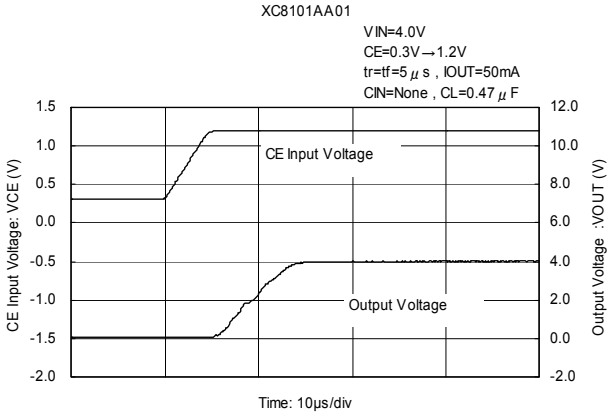


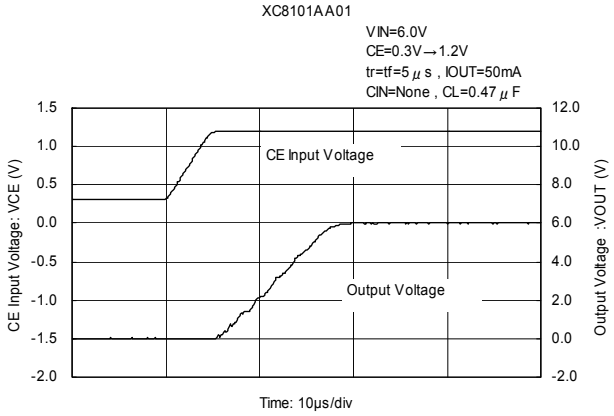
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

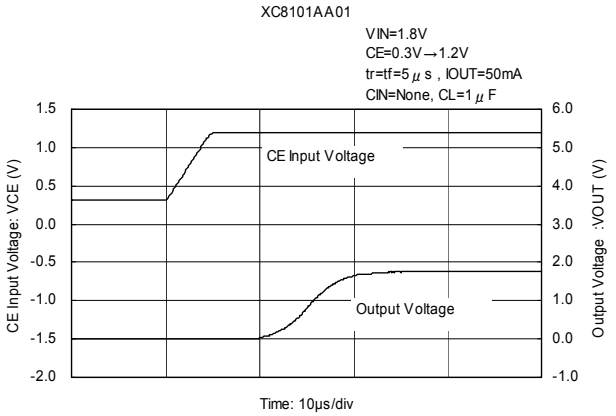
(8) Output Turn-on Time with CE (Continued)

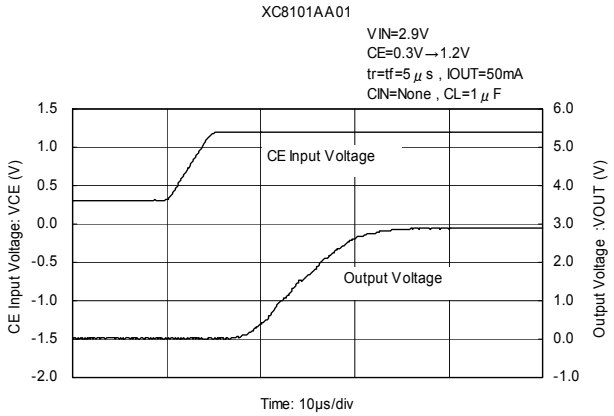






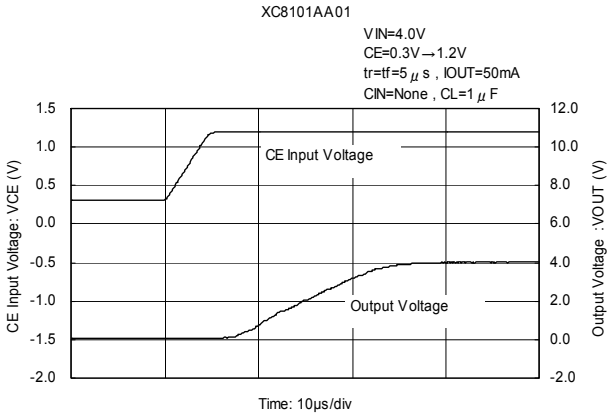


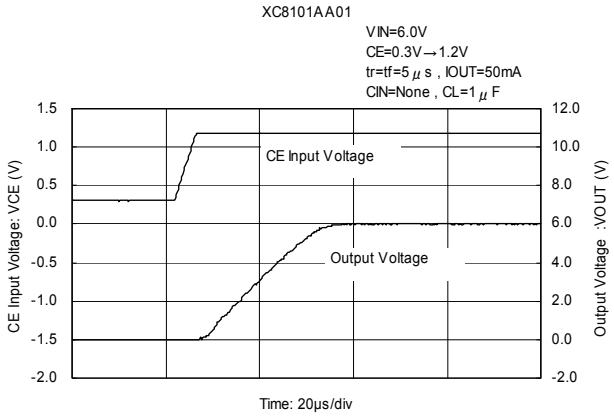


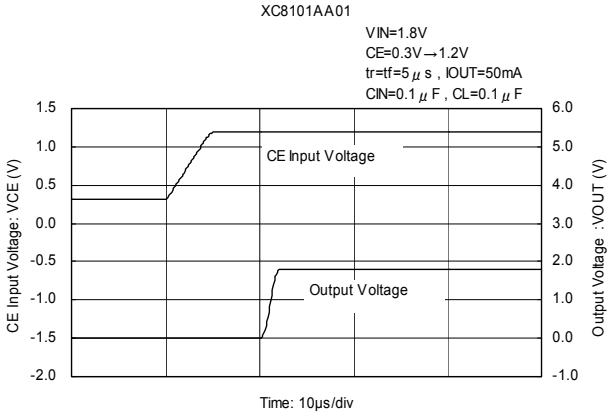


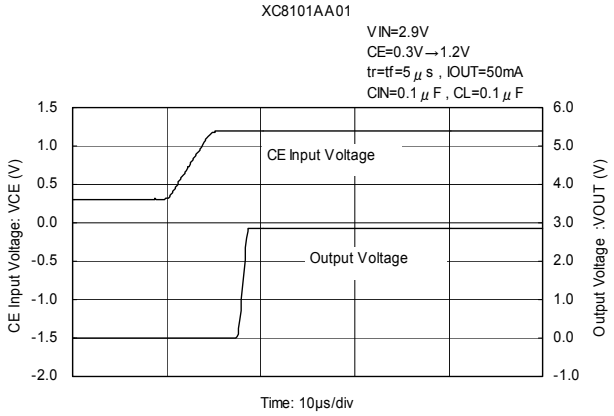
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

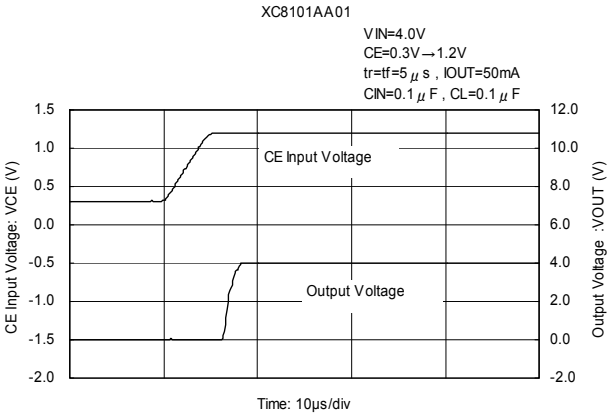
(8) Output Turn-on Time with CE (Continued)

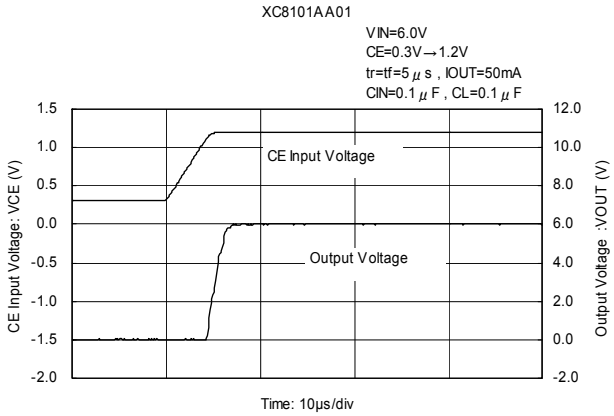






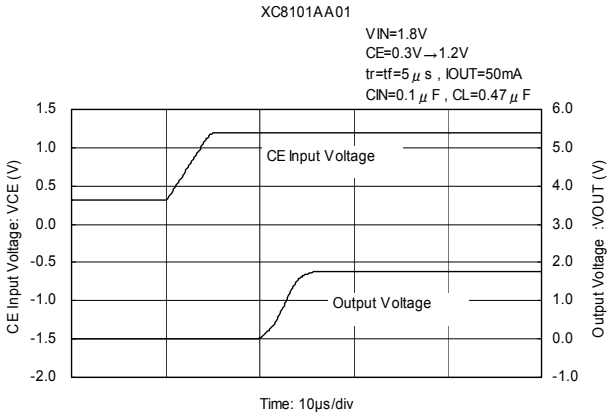


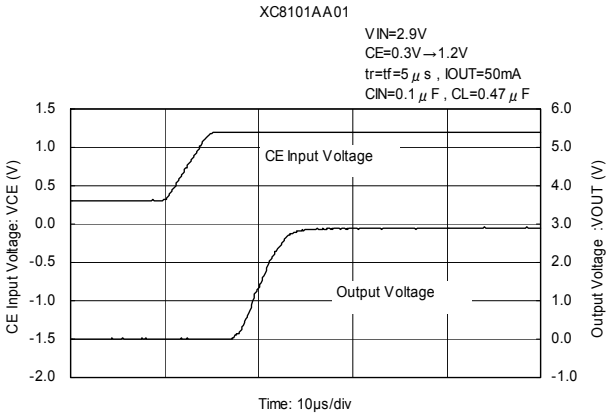


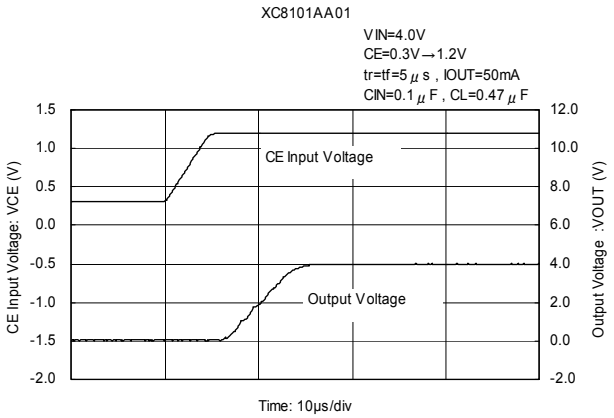


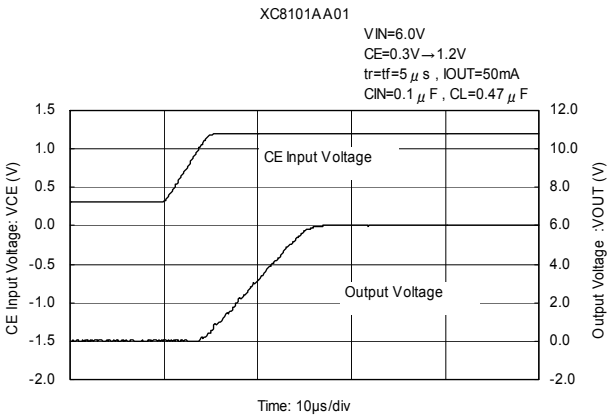
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

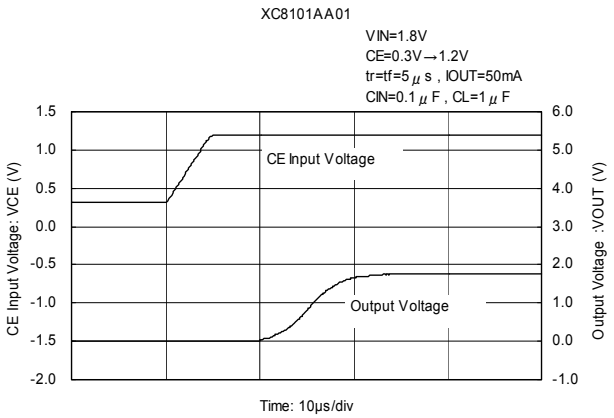
(8) Output Turn-on Time with CE (Continued)

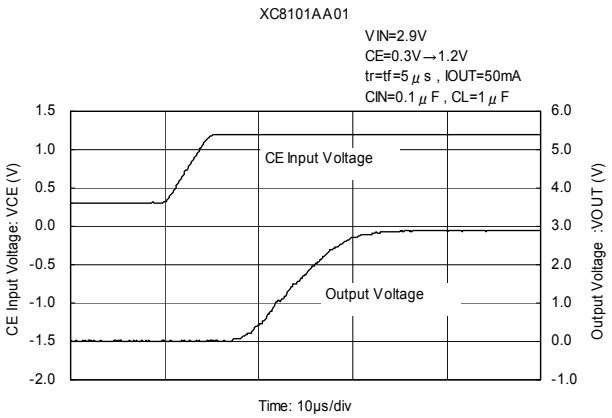








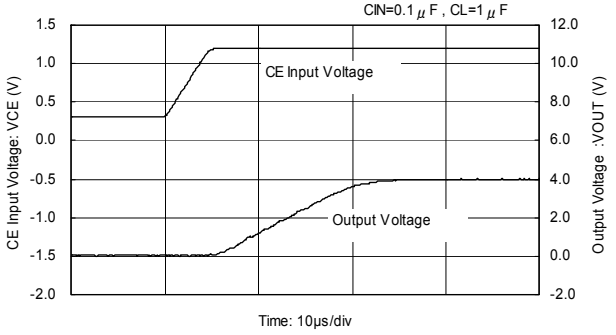




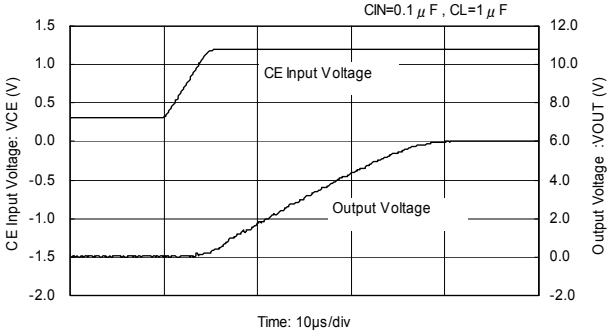
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Output Turn-on Time with CE (Continued)

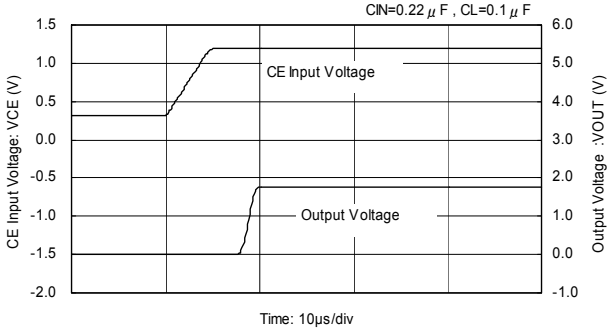
XC8101AA01
VIN=4.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=0.1μF , CL=1μF



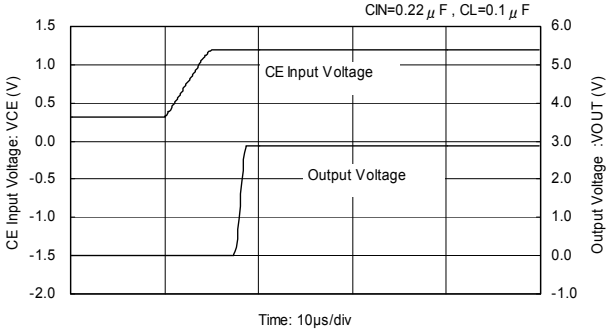
XC8101AA01
VIN=6.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=0.1μF , CL=1μF



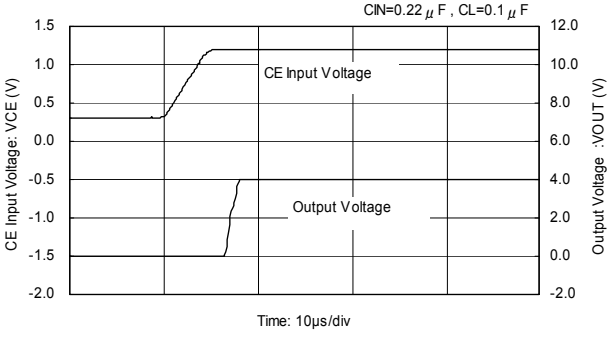
XC8101AA01
VIN=1.8V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=0.22μF , CL=0.1μF



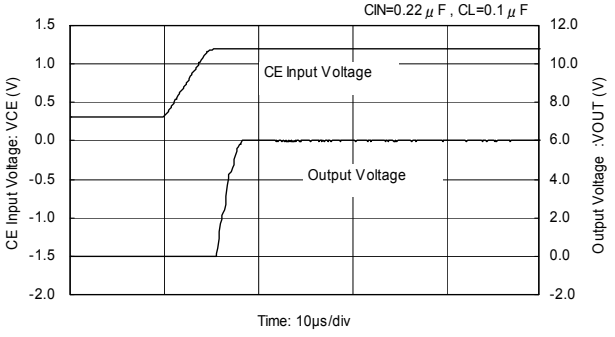
XC8101AA01
VIN=2.9V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=0.22μF , CL=0.1μF



XC8101AA01
VIN=4.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=0.22μF , CL=0.1μF

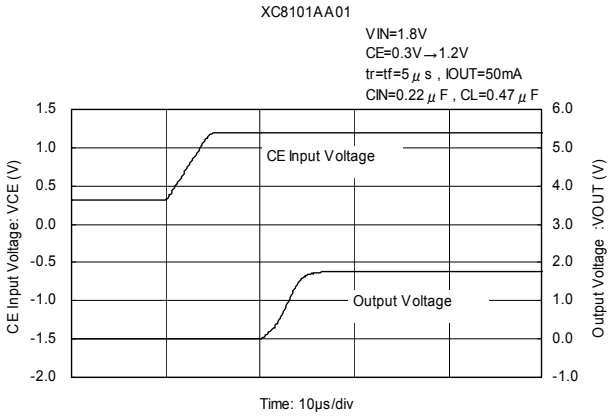


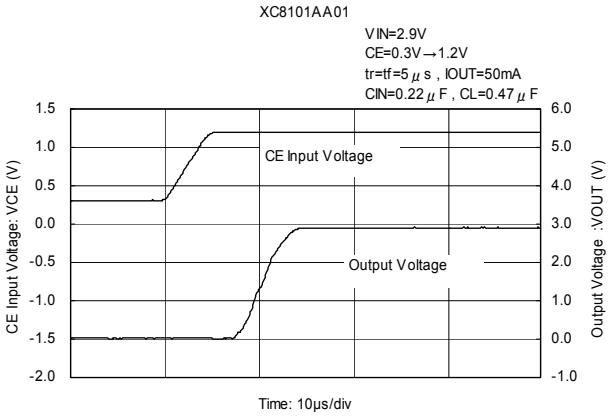
XC8101AA01
VIN=6.0V
CE=0.3V→1.2V
tr=tf=5μs , IOUT=50mA
CIN=0.22μF , CL=0.1μF

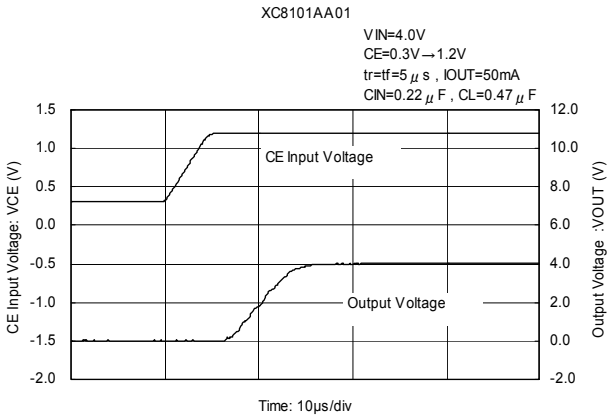


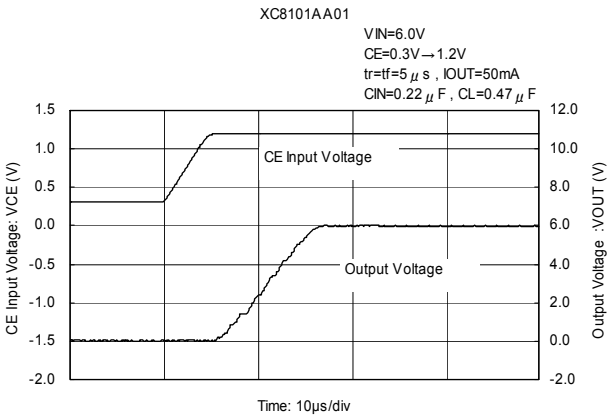
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

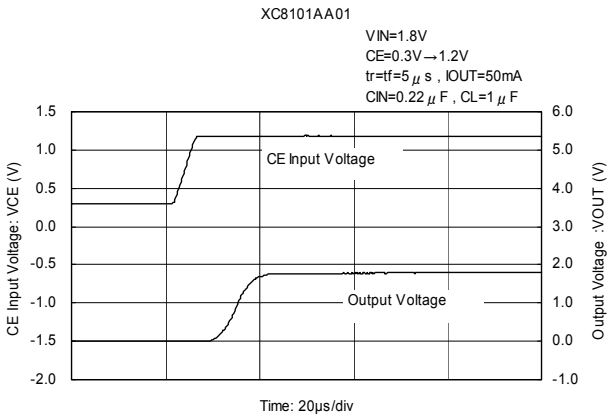
(8) Output Turn-on Time with CE (Continued)

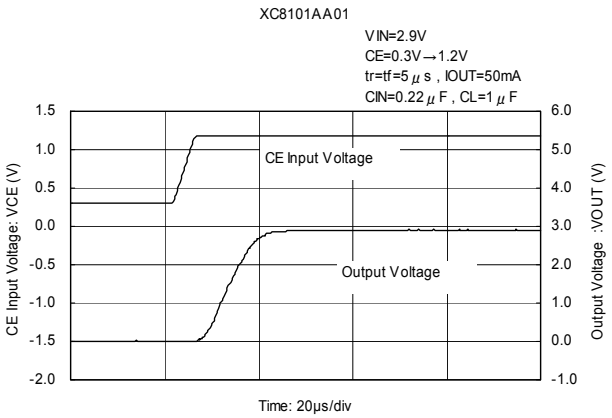






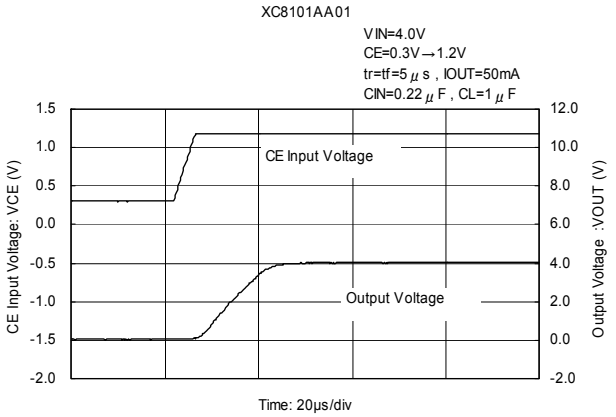


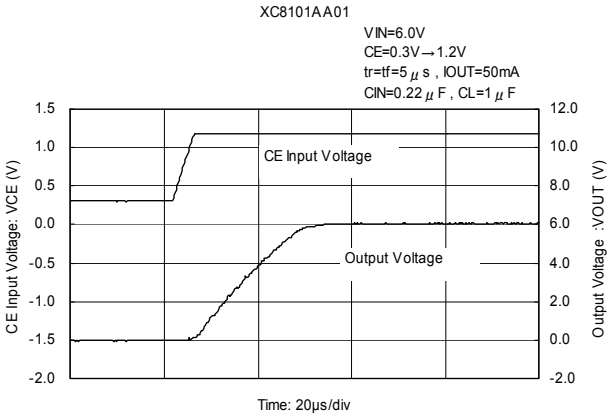


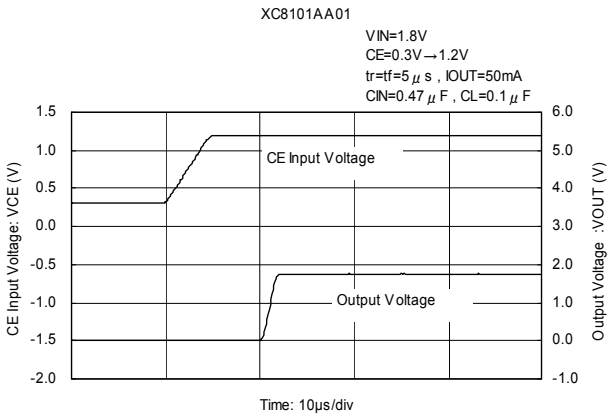


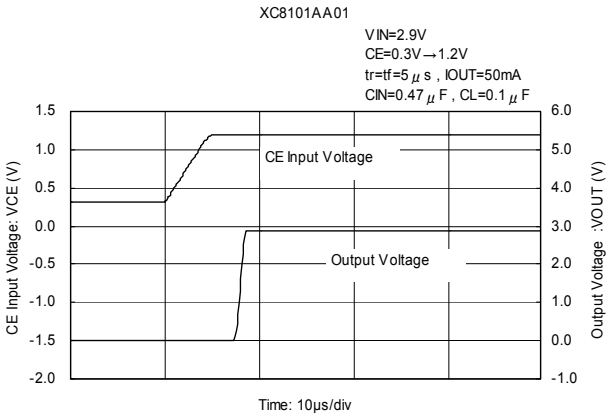
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

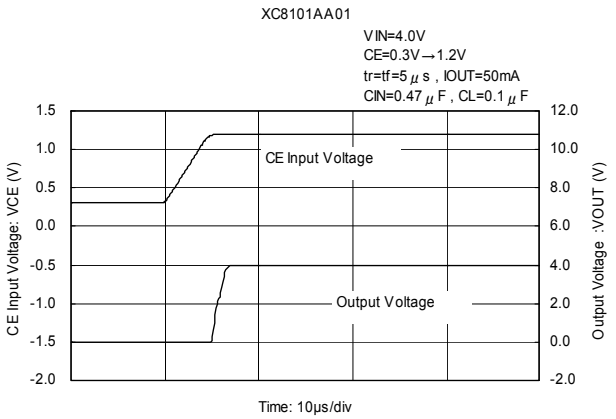
(8) Output Turn-on Time with CE (Continued)

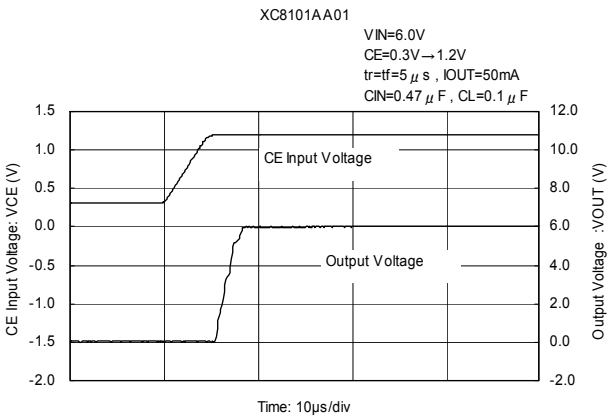






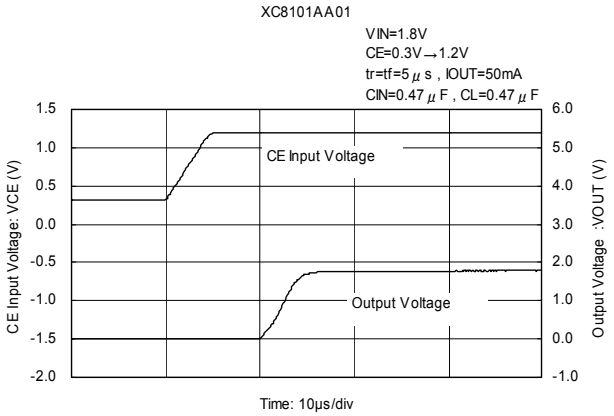


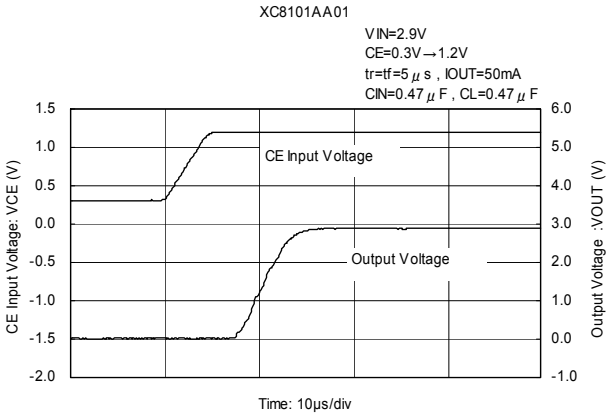


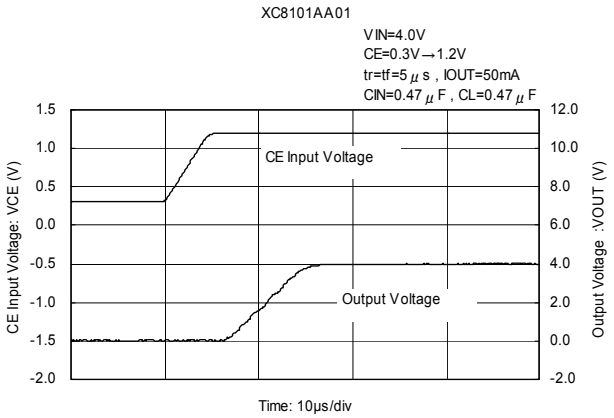


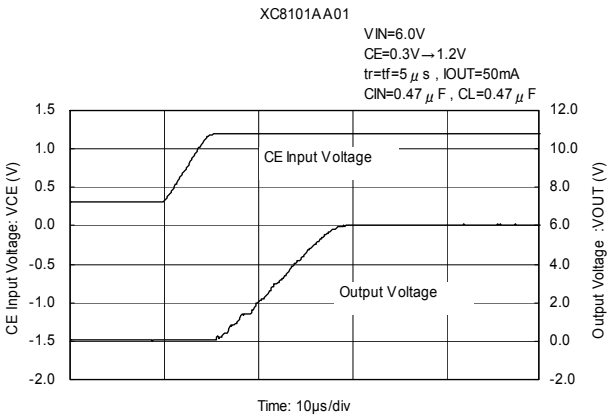
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

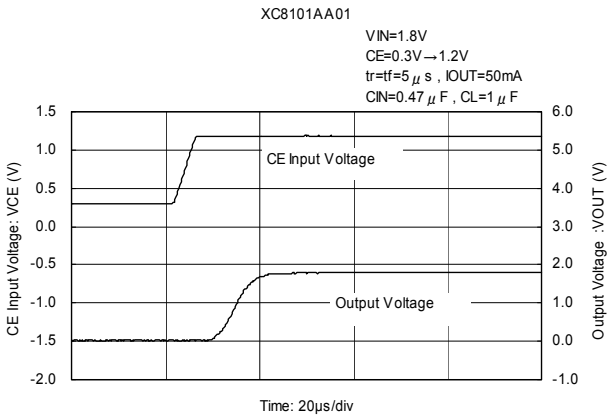
(8) Output Turn-on Time with CE (Continued)

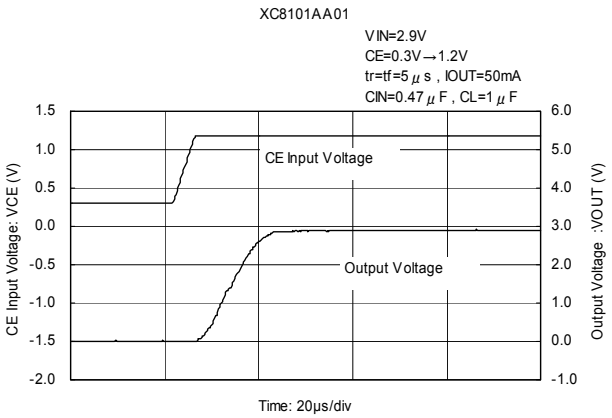






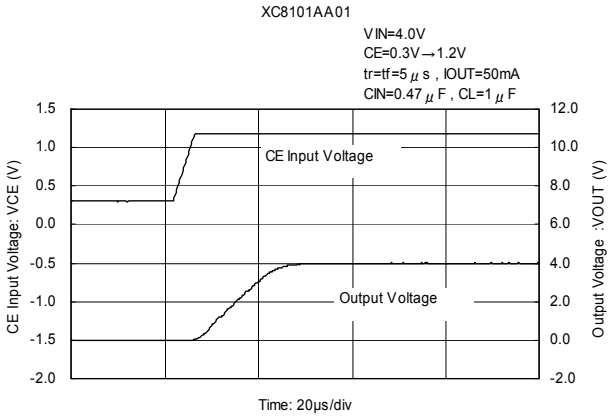


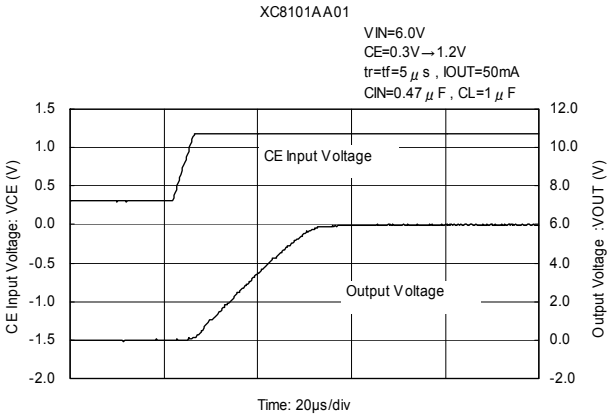


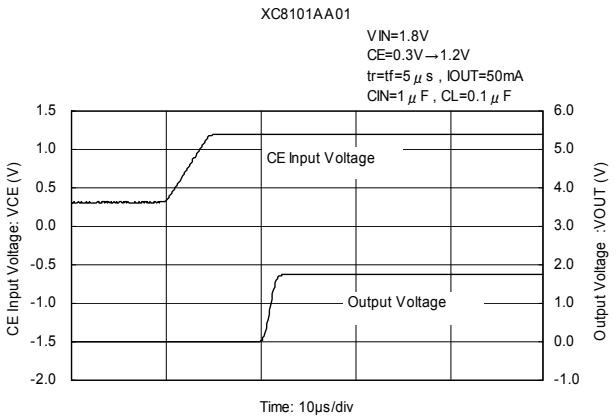


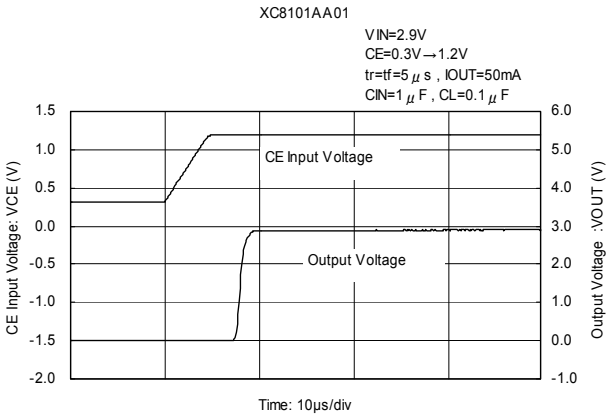
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

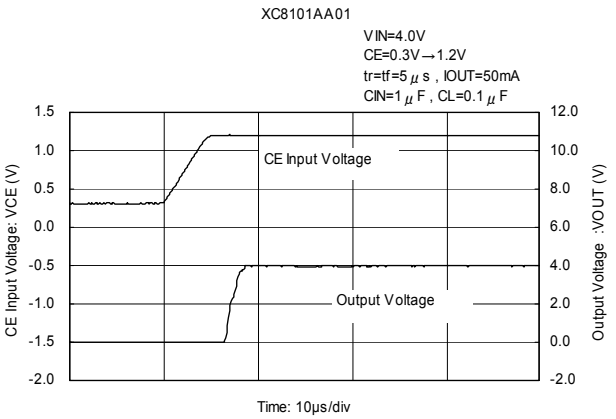
(8) Output Turn-on Time with CE (Continued)

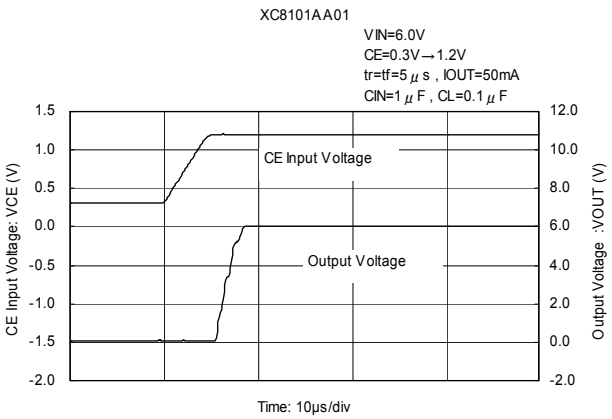






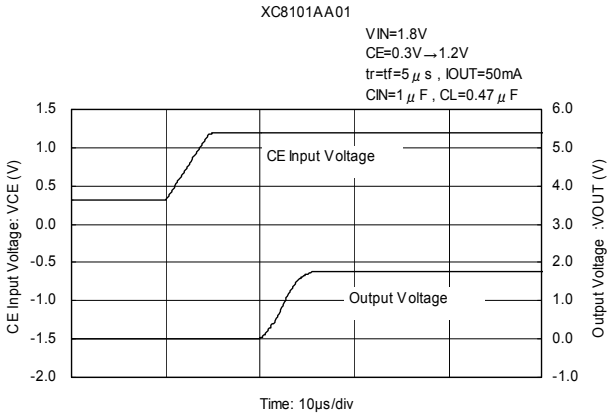


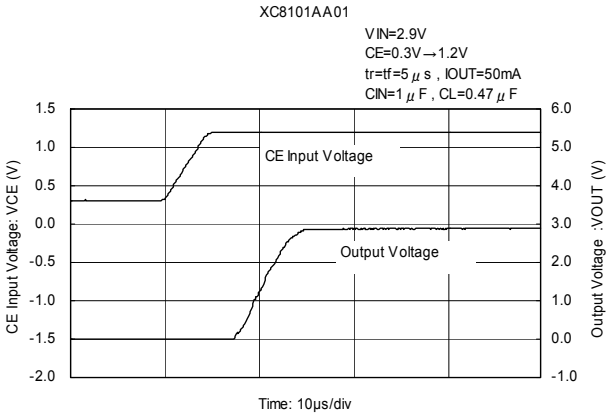


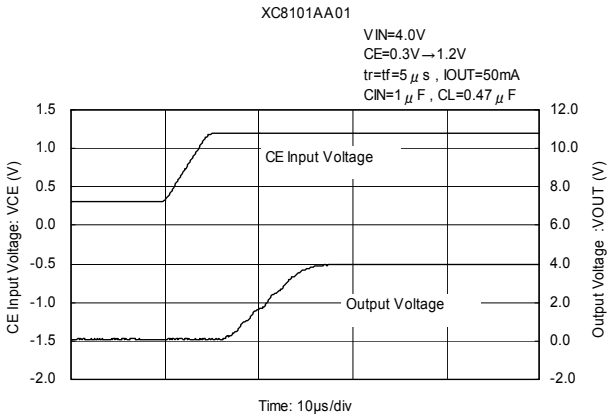


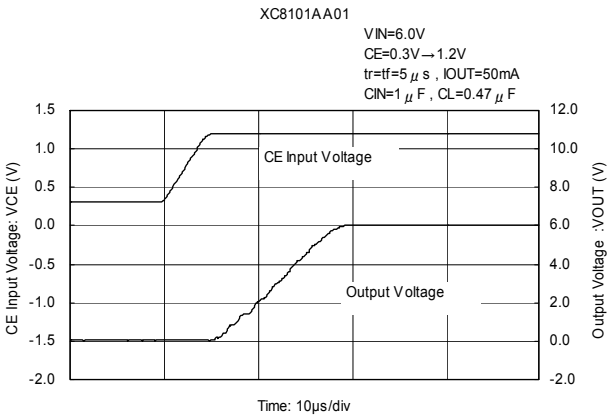
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

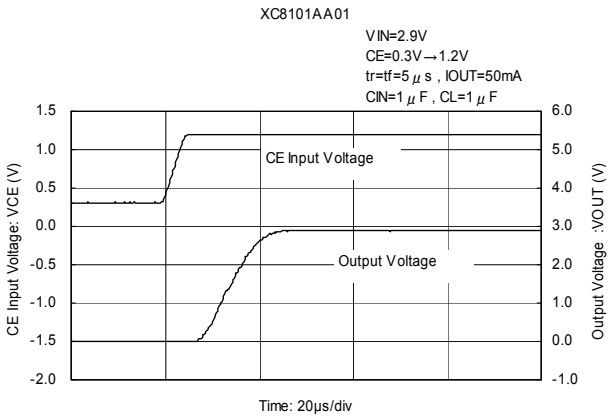
(8) Output Turn-on Time with CE (Continued)

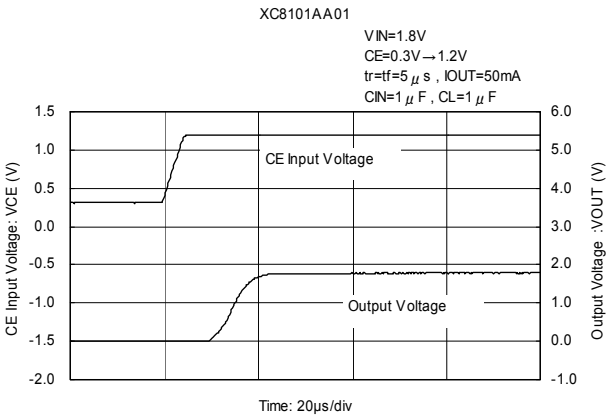






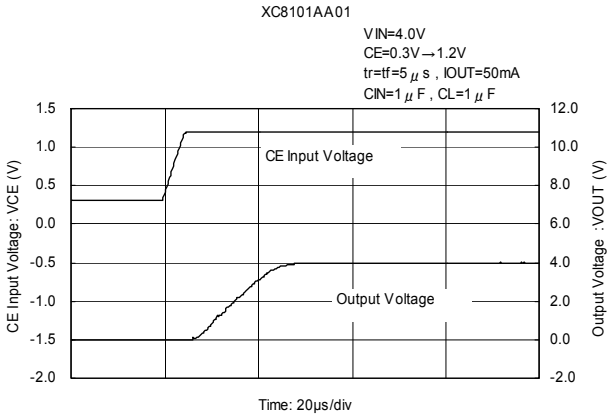


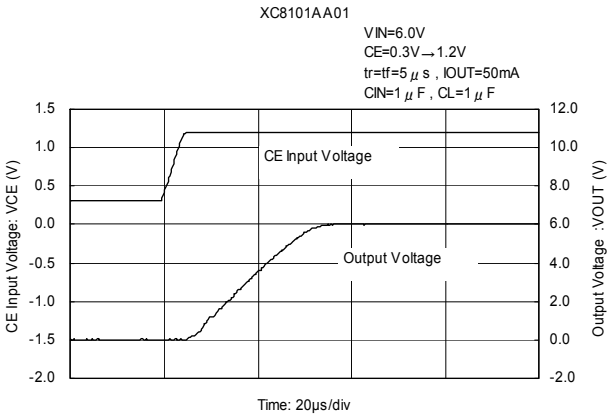




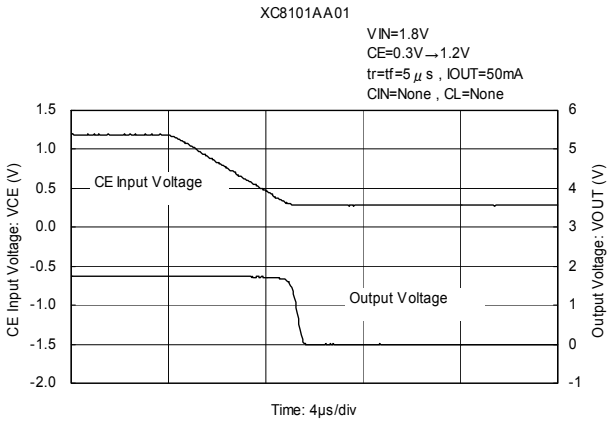
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

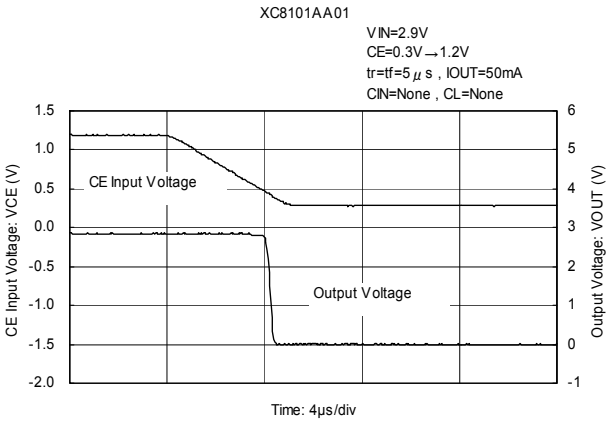
(8) Output Turn-on Time with CE (Continued)

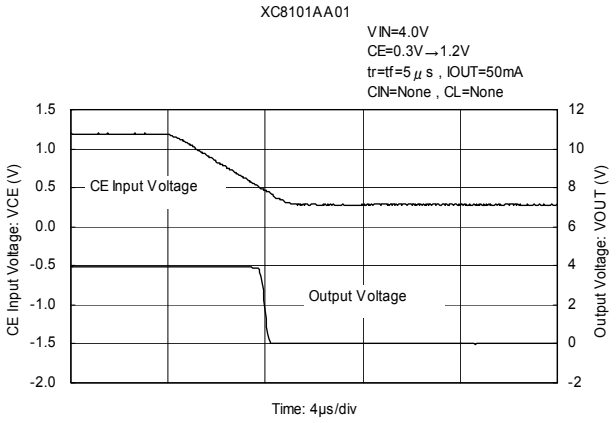


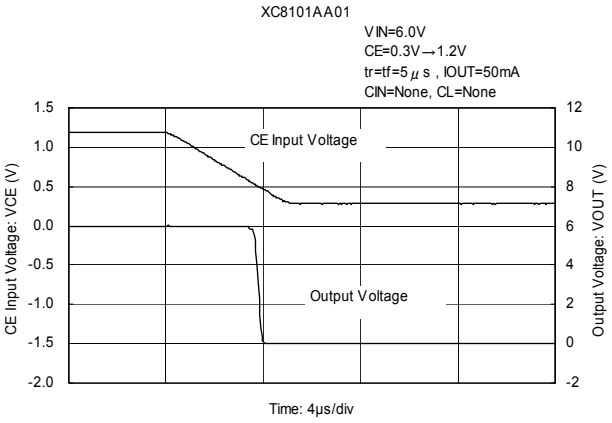


(9) Output Turn-off Time with CE



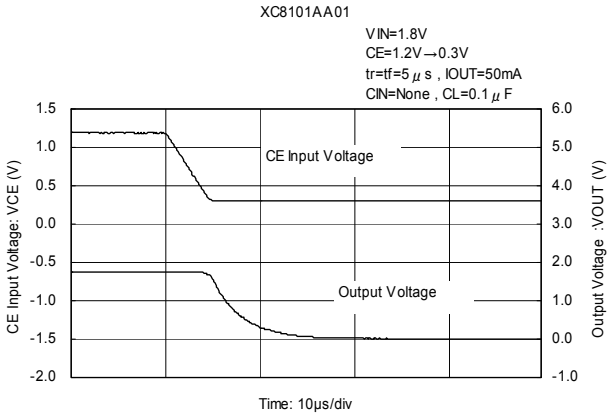


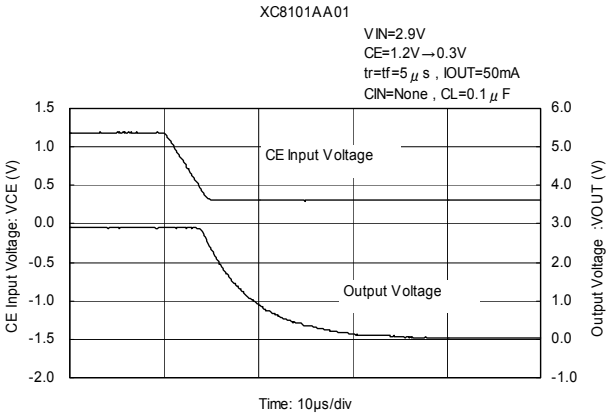


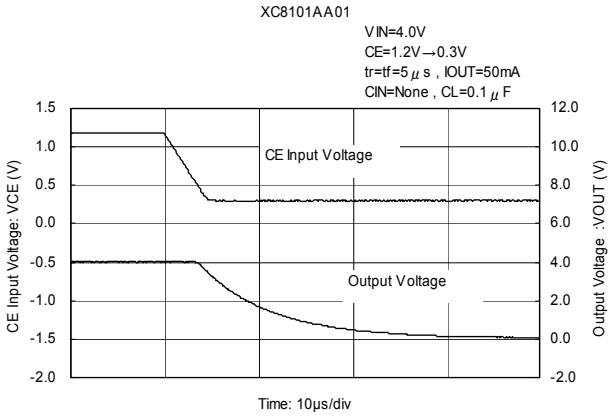


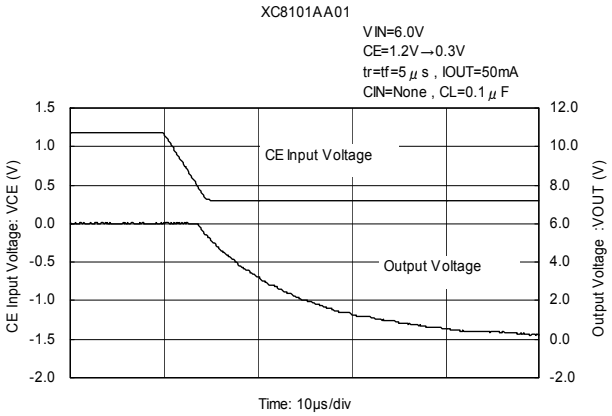
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

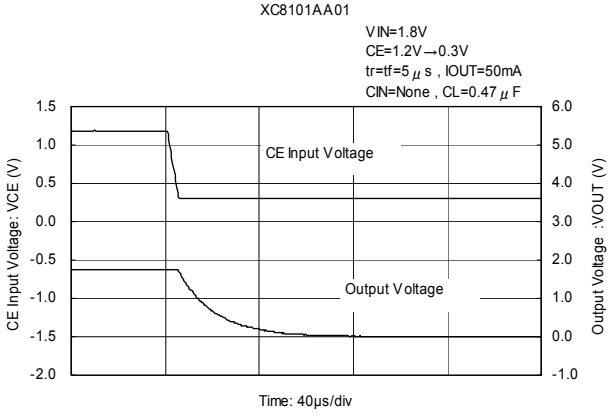
(9) Output Turn-off Time with CE (Continued)

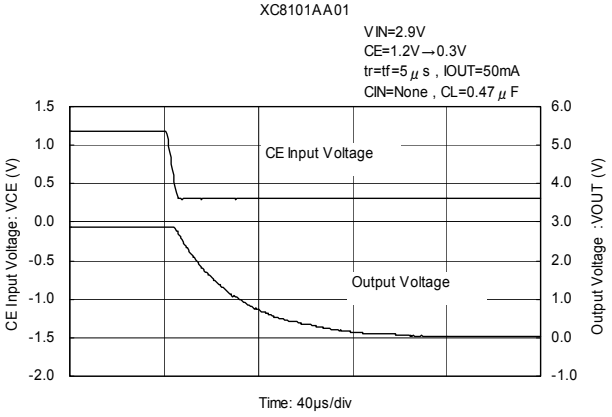






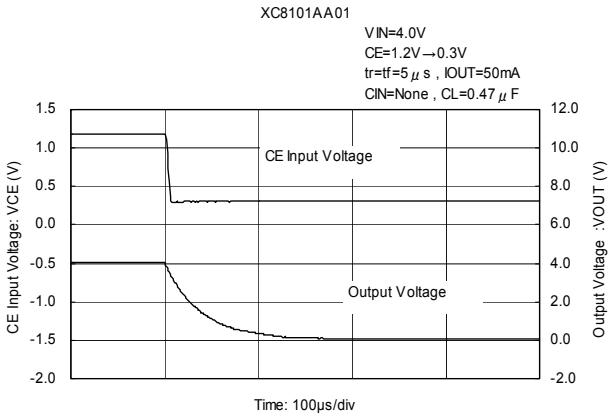


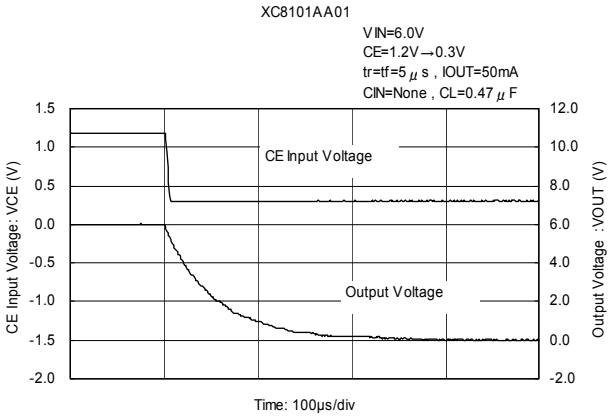


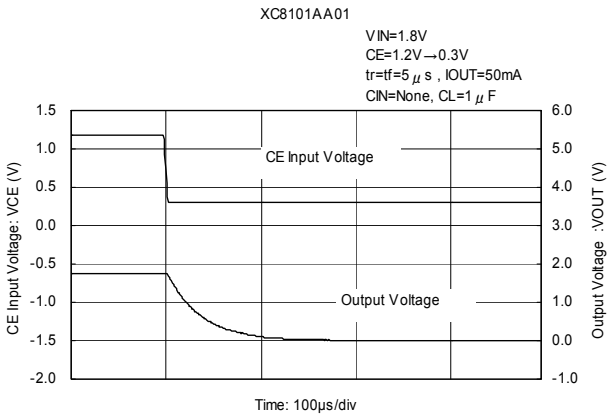


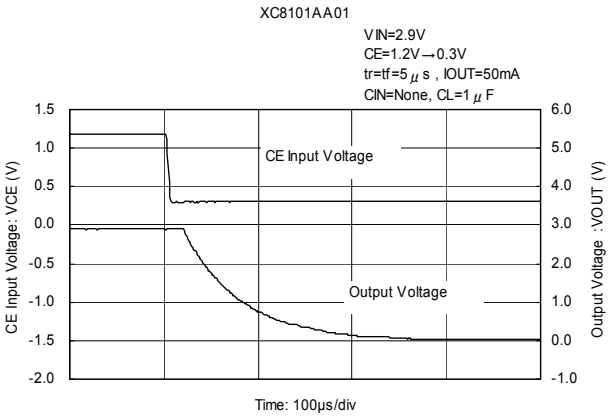
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

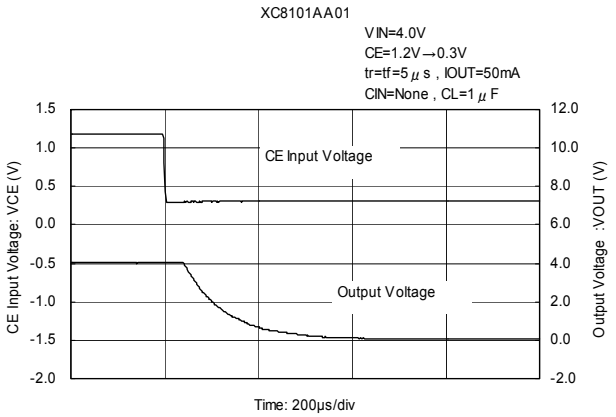
(9) Output Turn-off Time with CE (Continued)

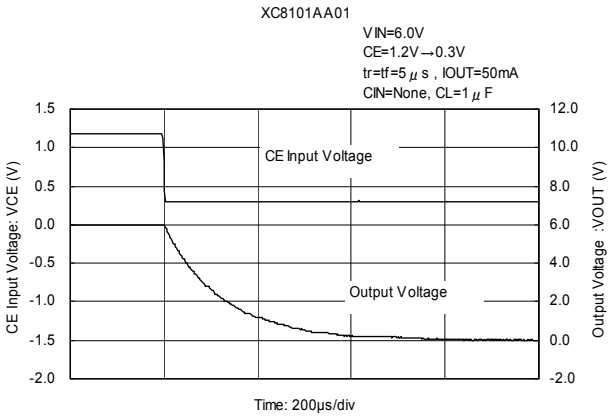






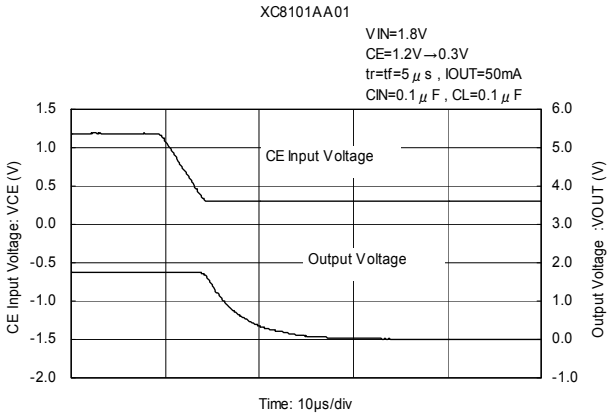


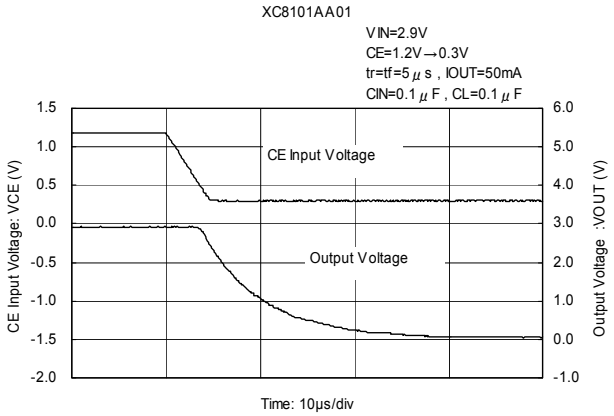


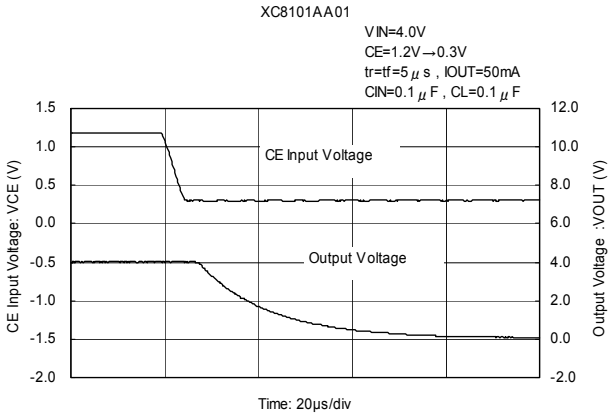


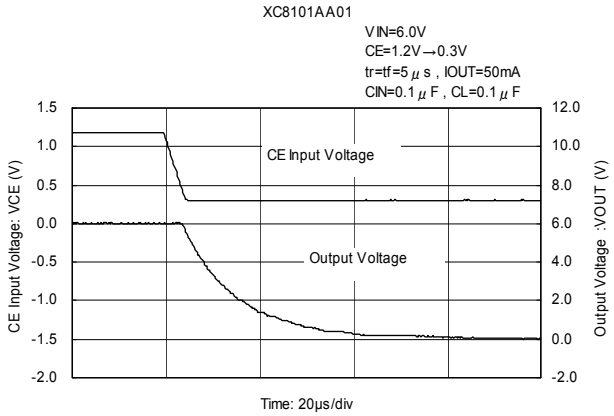
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

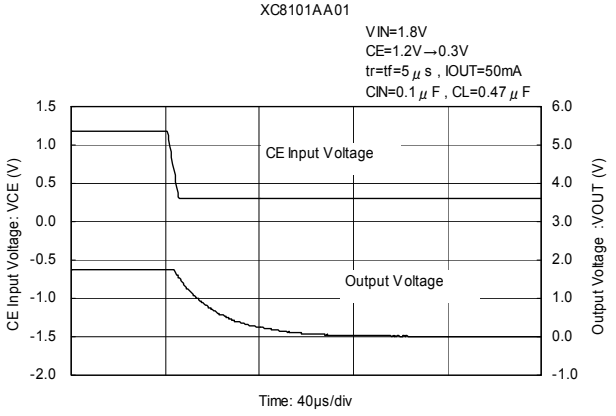
(9) Output Turn-off Time with CE (Continued)

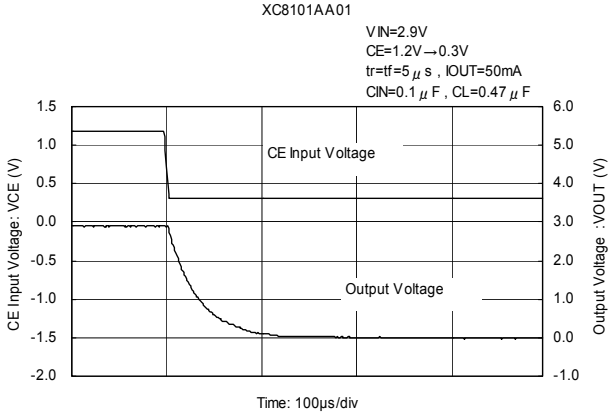






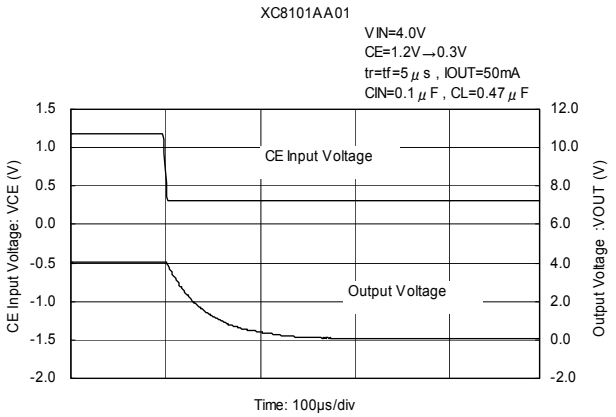


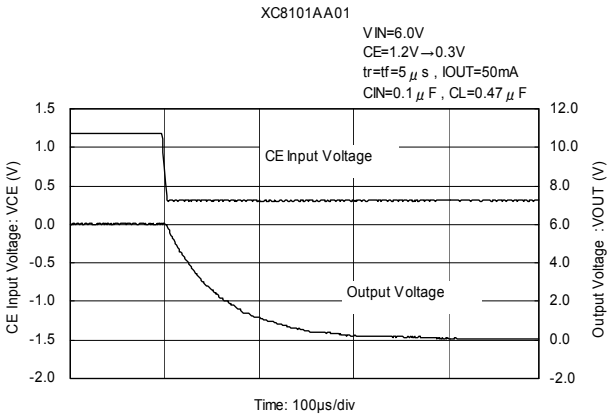


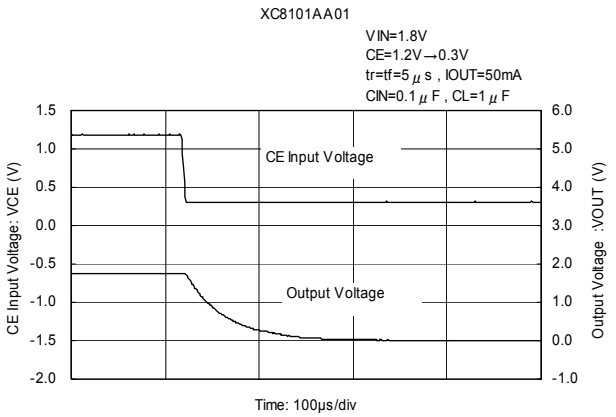


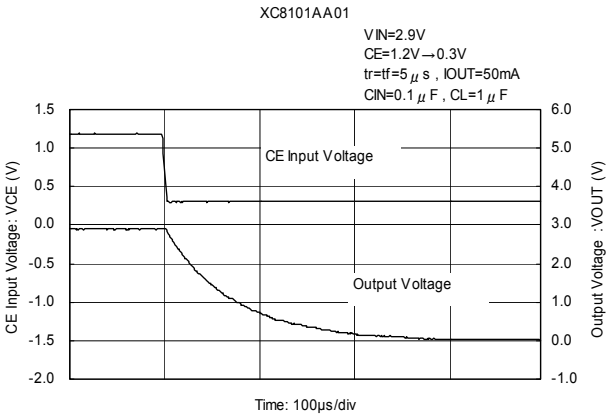
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

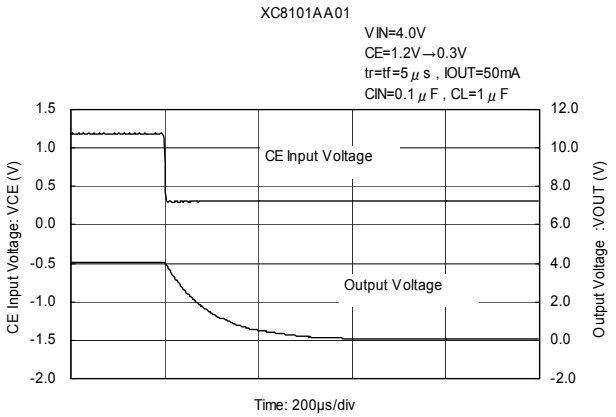
(9) Output Turn-off Time with CE (Continued)

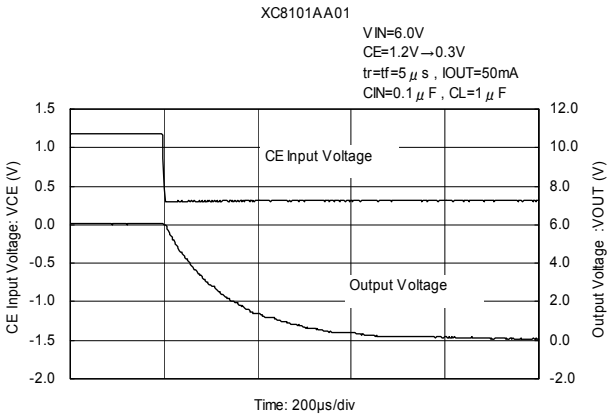






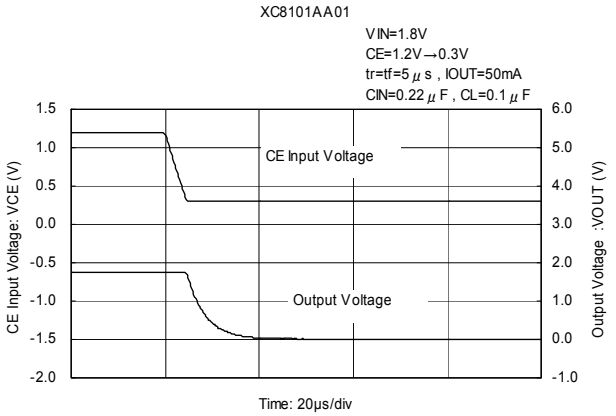


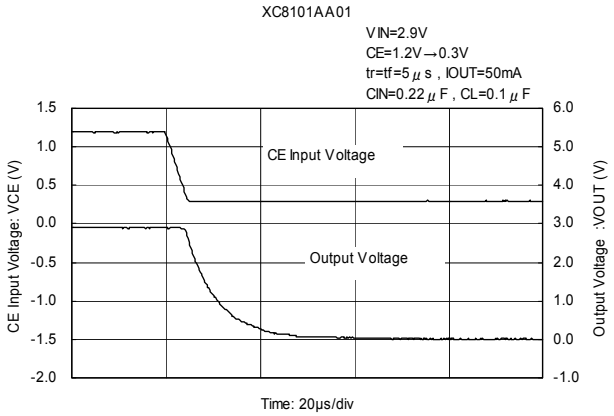


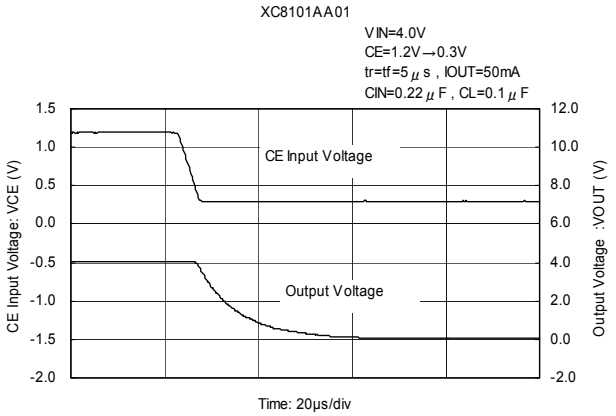


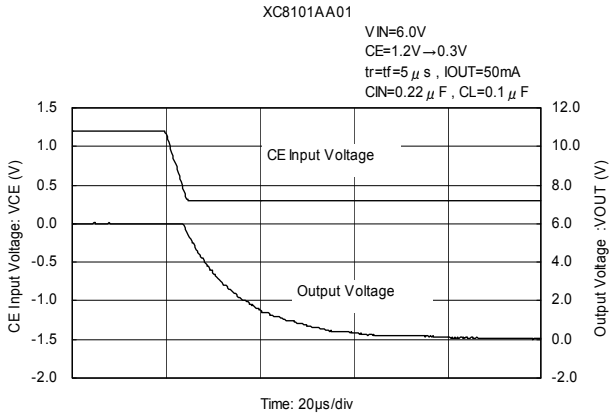
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

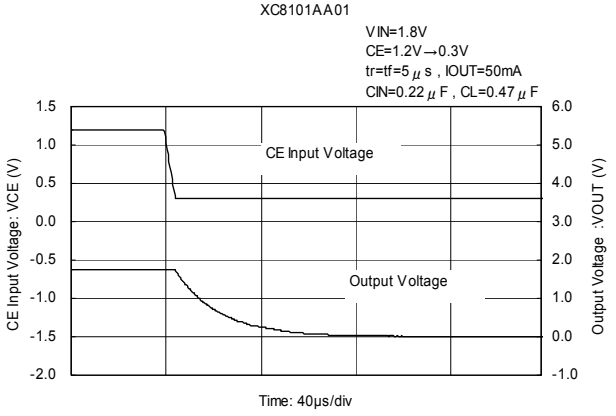
(9) Output Turn-off Time with CE (Continued)

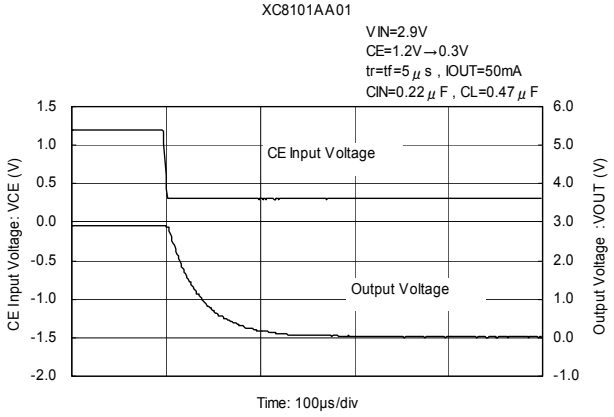






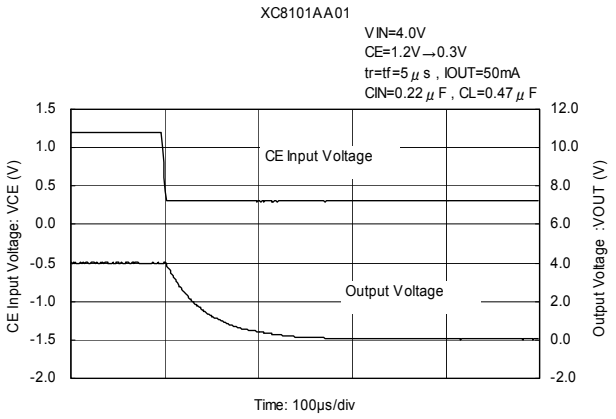


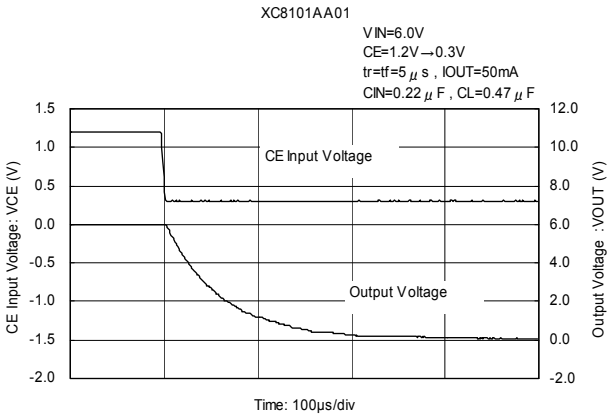


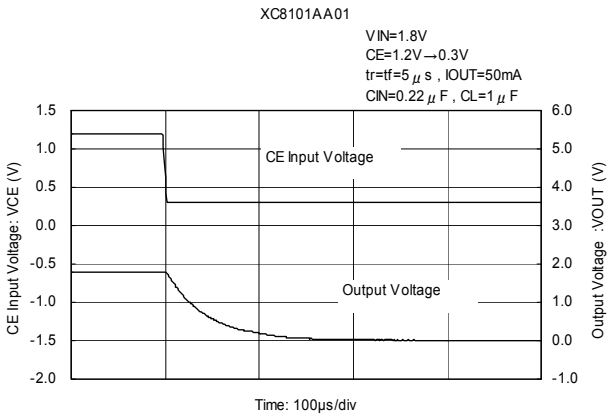


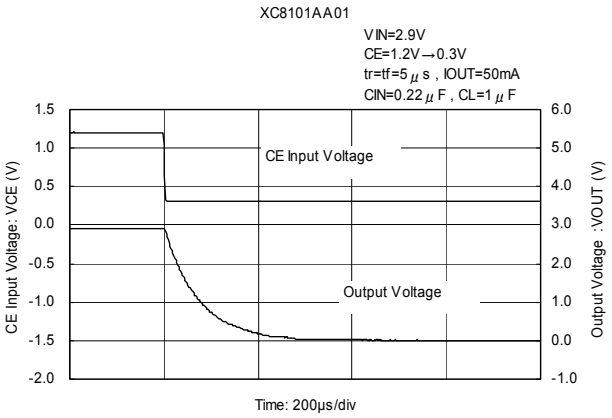
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

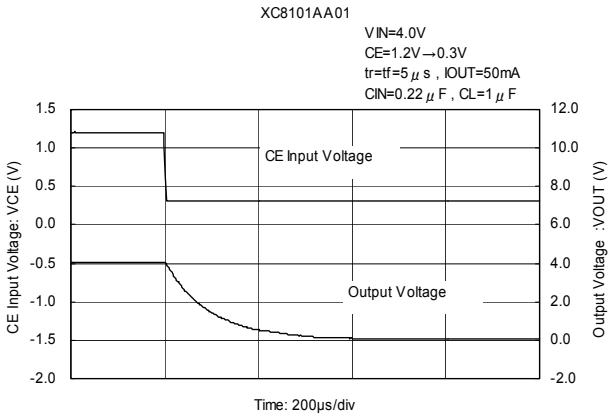
(9) Output Turn-off Time with CE (Continued)

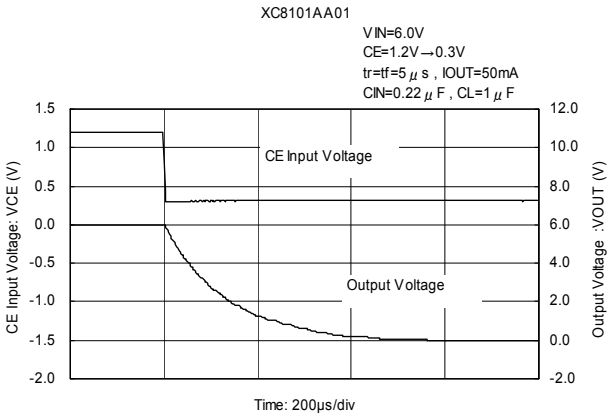






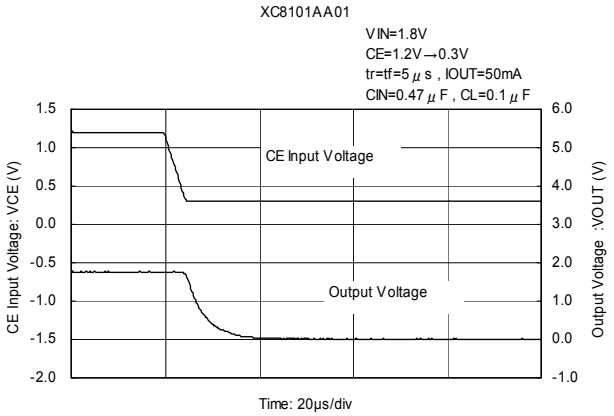


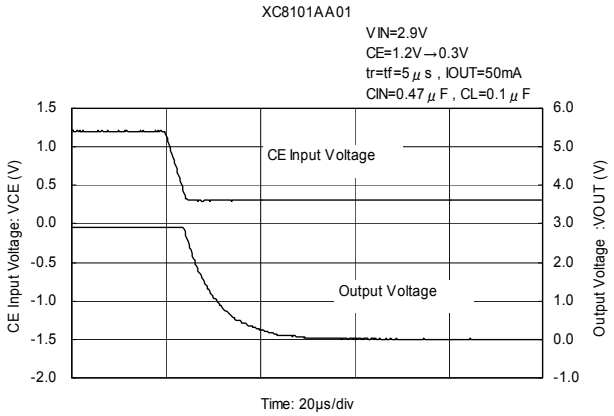


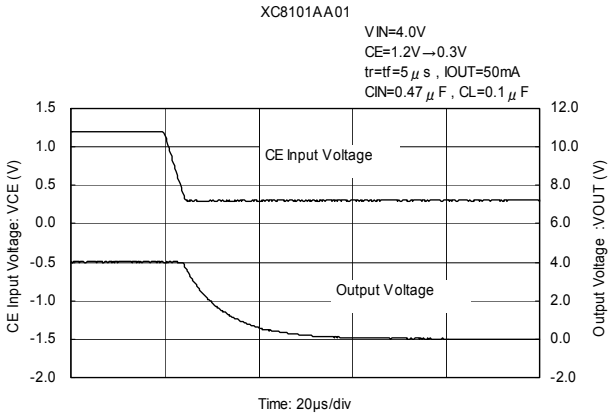


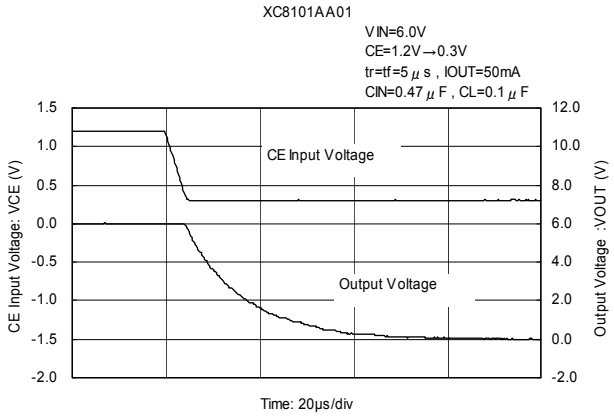
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

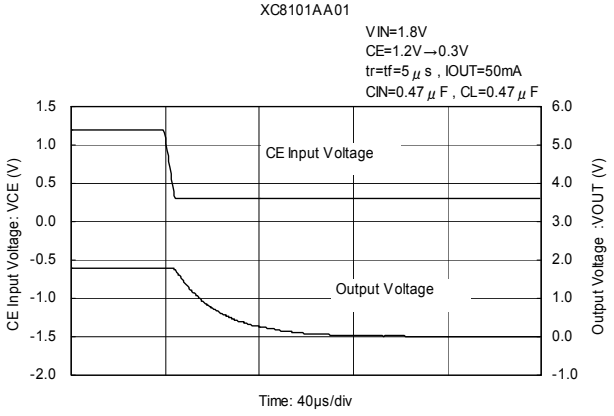
(9) Output Turn-off Time with CE (Continued)

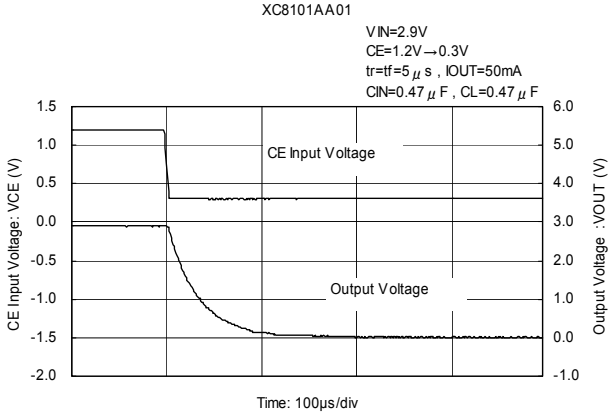






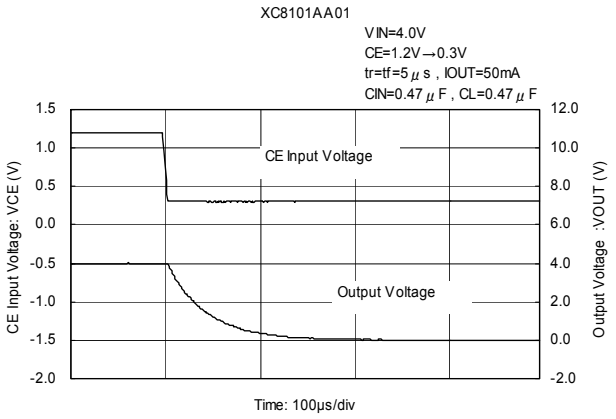


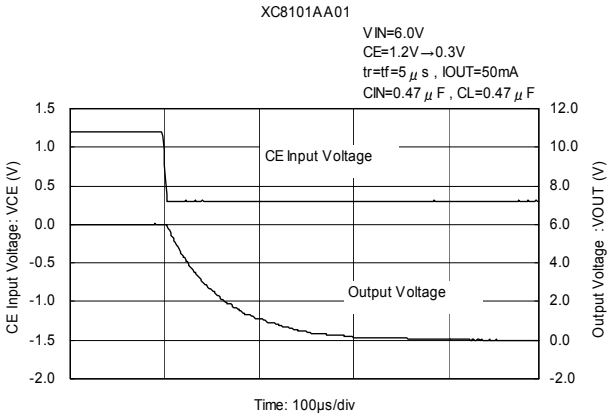


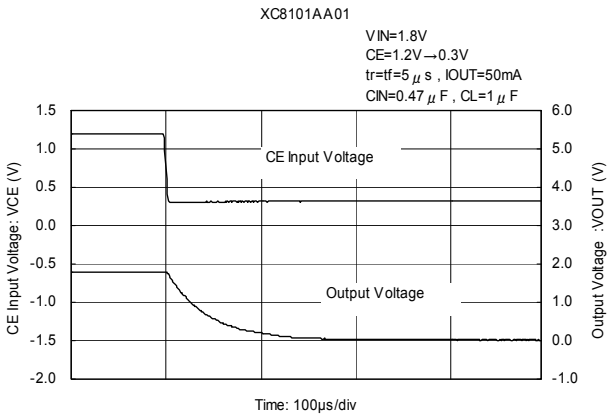


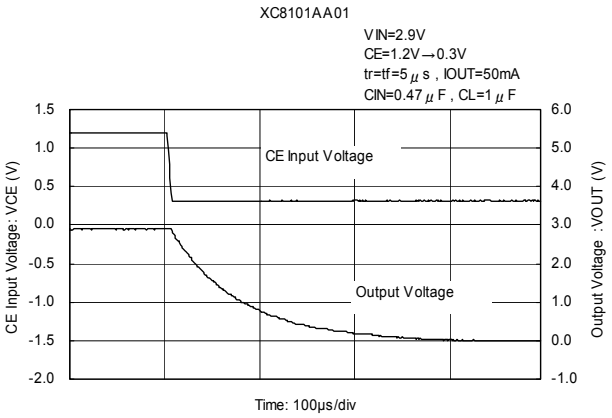
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

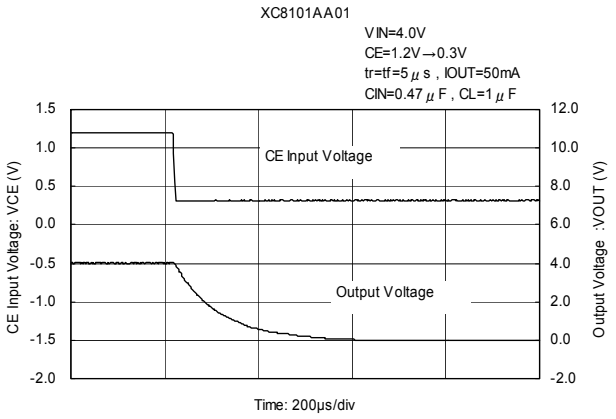
(9) Output Turn-off Time with CE (Continued)

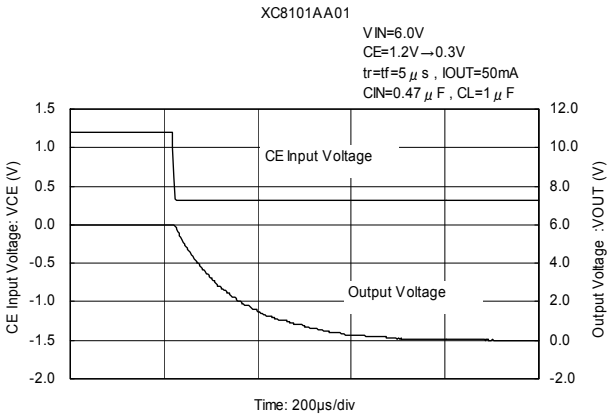






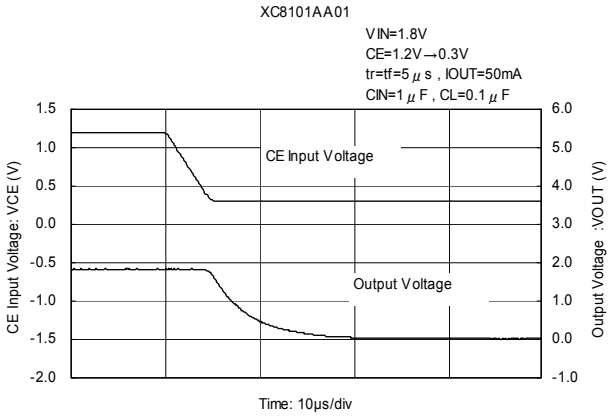


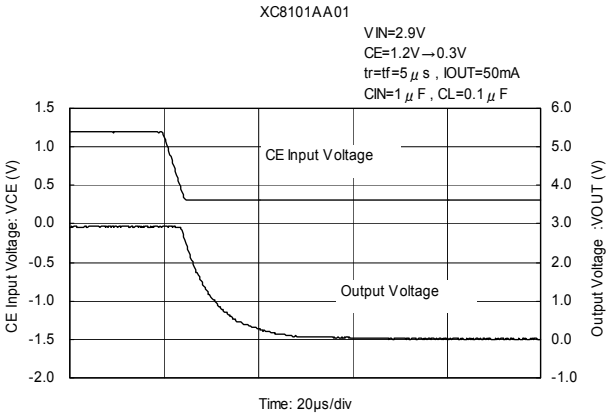


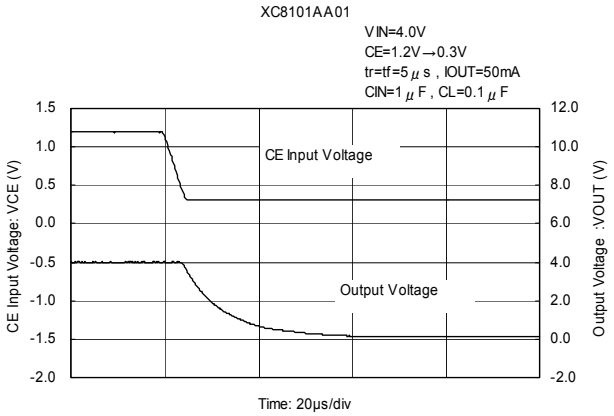


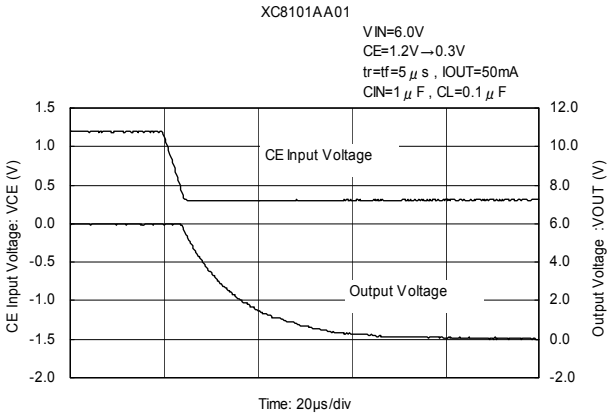
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

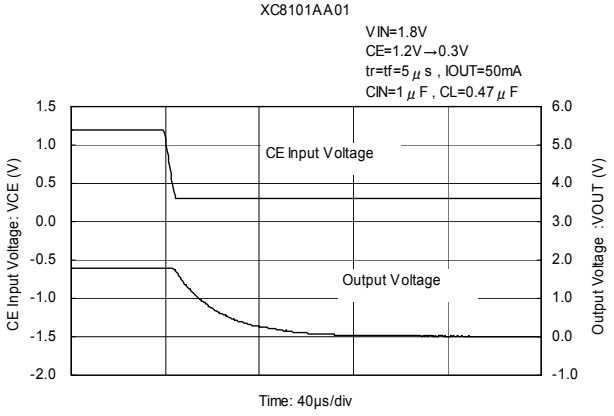
(9) Output Turn-off Time with CE (Continued)

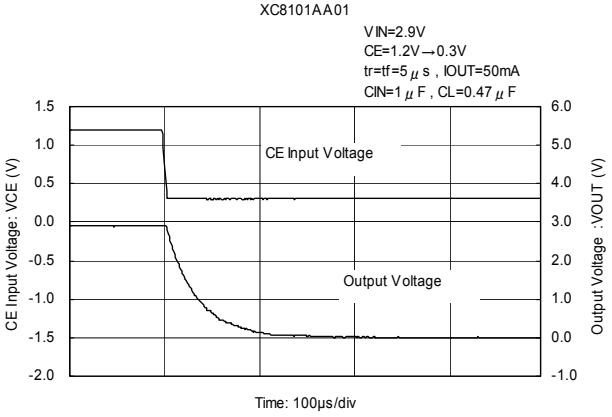






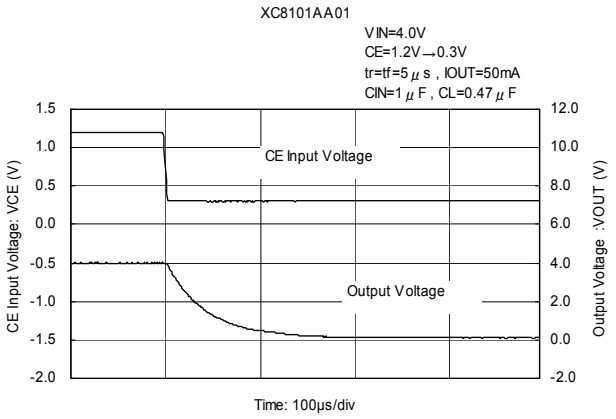


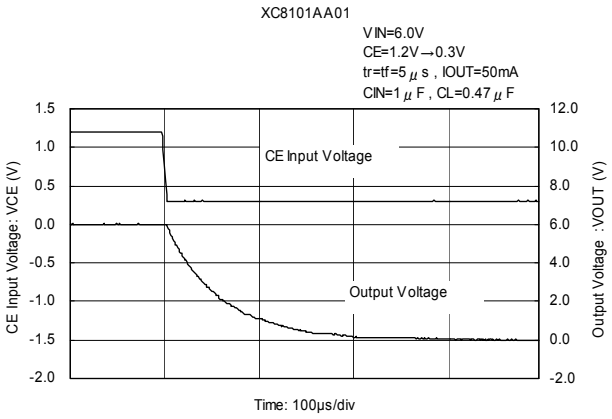


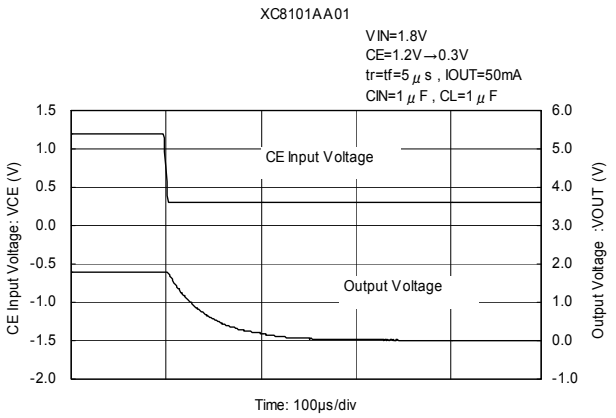


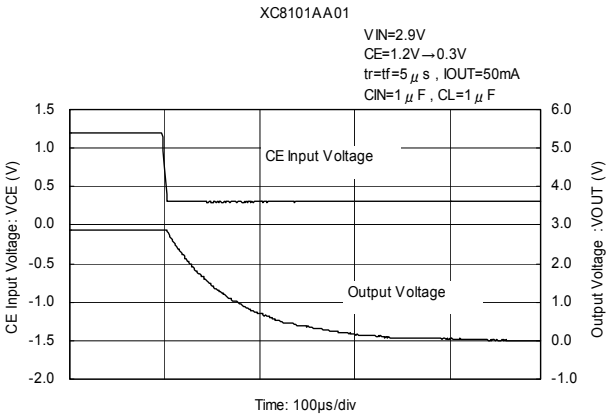
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

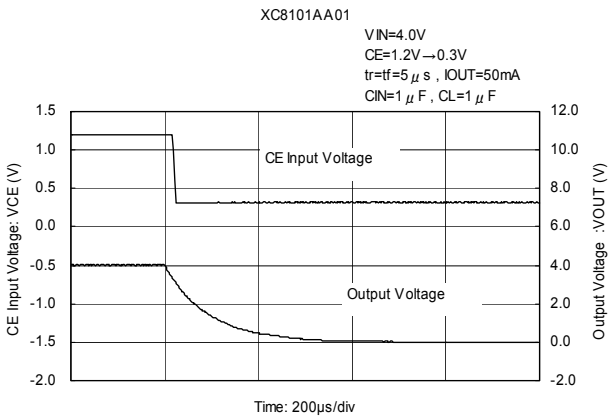
(9) Output Turn-off Time with CE (Continued)

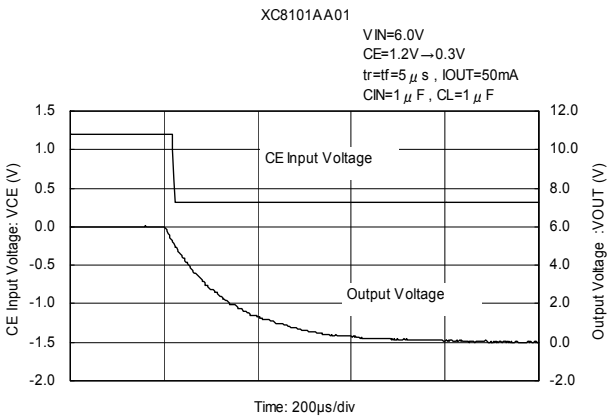






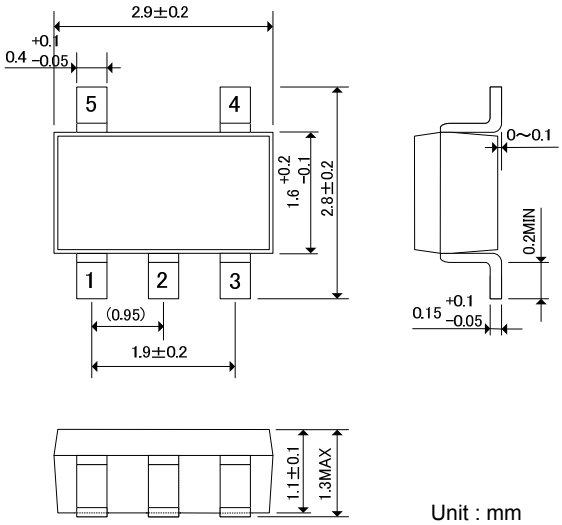






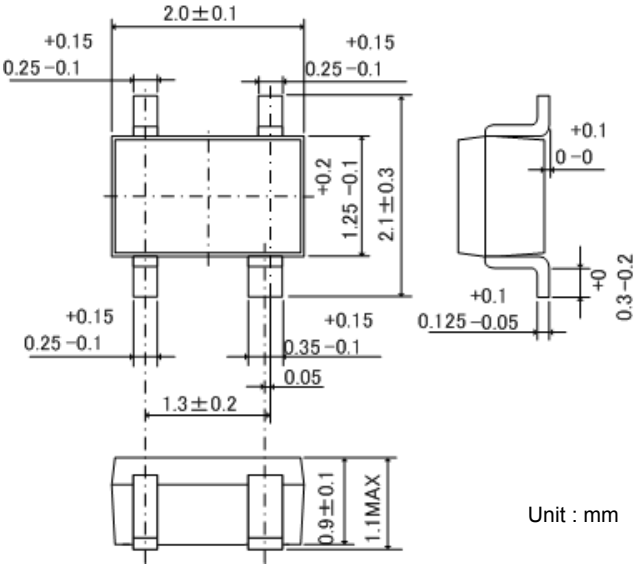
■PACKAGING INFORMATION

●SOT-25



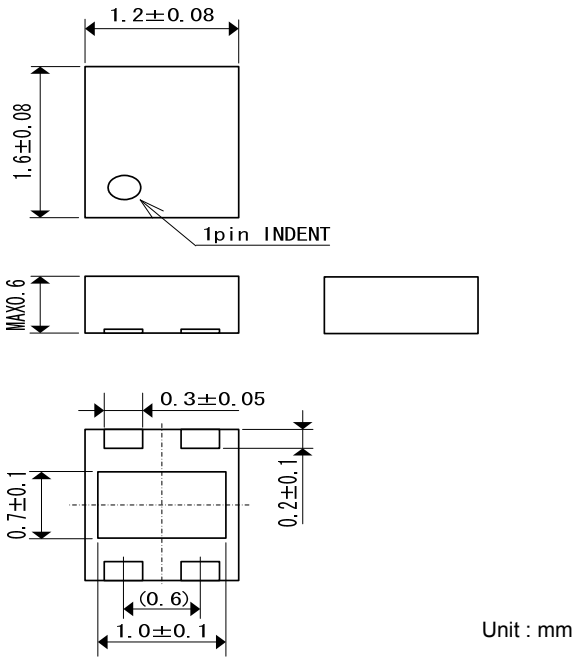
Unit : mm

●SSOT-24



Unit : mm

●USP-4



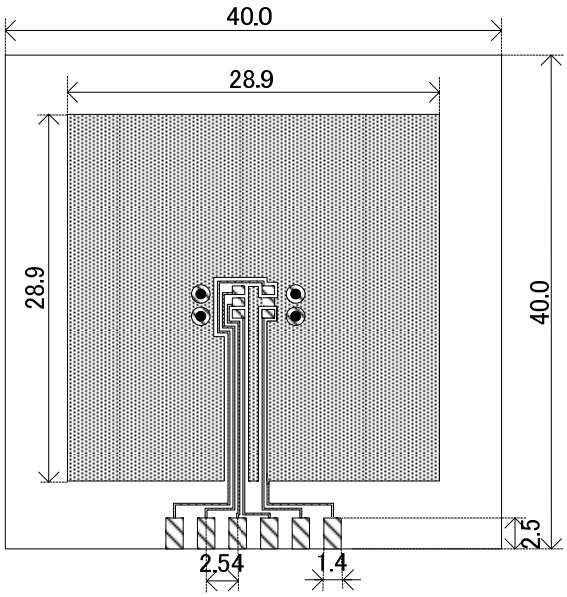
Unit : mm

■PACKAGING INFORMATION (Continued)

● SOT-25 Power Dissipation

Power dissipation data for the SOT-25 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as one of reference data taken in the described condition.

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

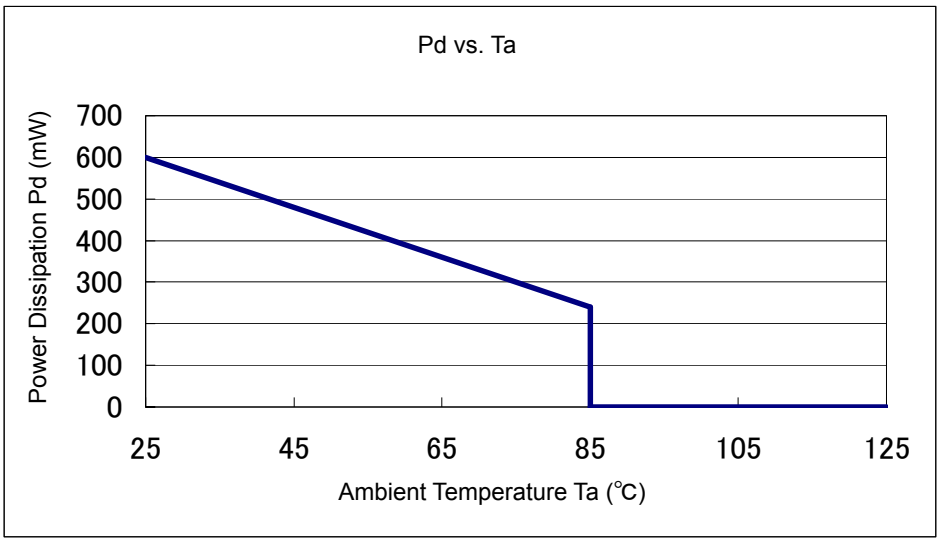


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	600	166.67
85	240	

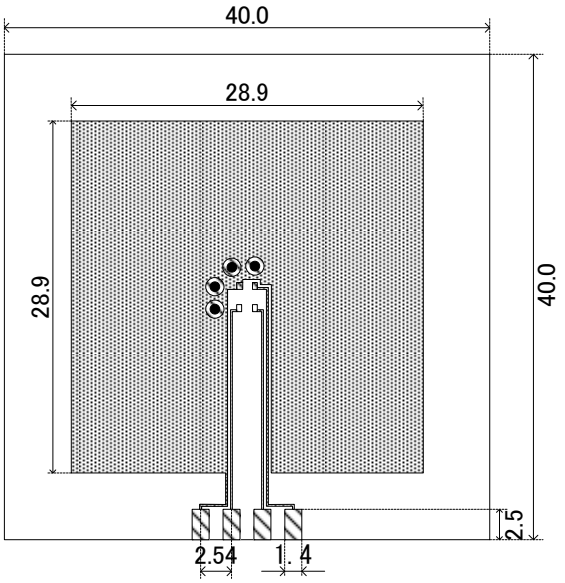


■PACKAGING INFORMATION (Continued)

● SSOT-24 Power Dissipation

Power dissipation data for the SSOT-24 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as one of reference data taken in the described condition.

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

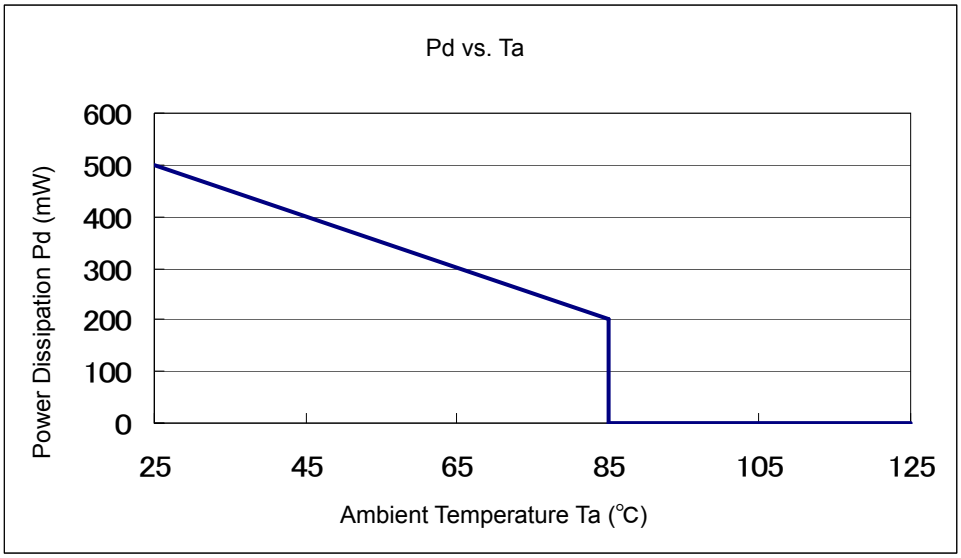


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	500	200.00
85	200	

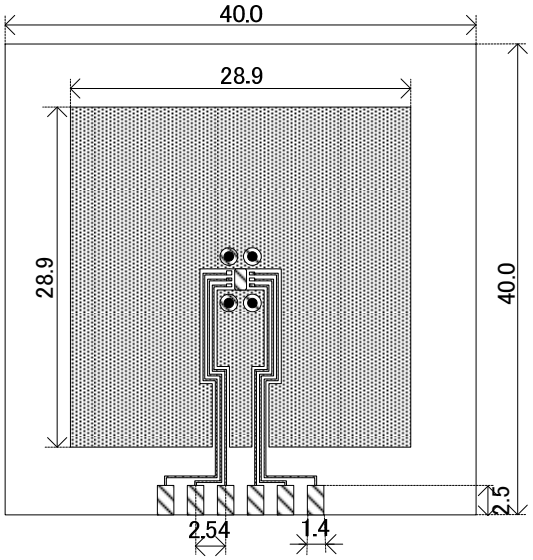


■PACKAGING INFORMATION (Continued)

● USP-4 Power Dissipation

Power dissipation data for the USP-4 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as one of reference data taken in the described condition.

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

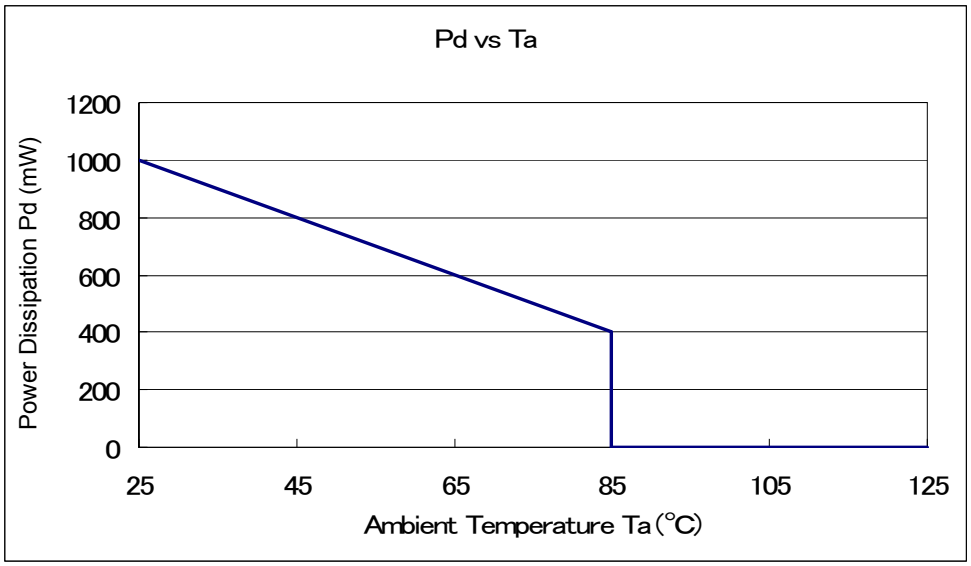


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	1000	100.00
85	400	



■MARKING RULE

●SOT-25、USP-4

① represents product series

MARK	PRODUCT SERIES
U	XC8101******

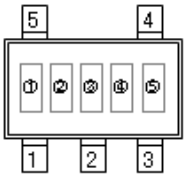
② represents CE pin logic

MARK	PRODUCT SERIES
F	XC8101A*****

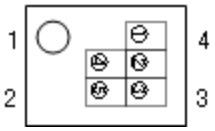
③ represents C_L Discharge Function

MARK	PRODUCT SERIES
C	XC8101AA****

④⑤ represents production lot number
01, …,09, 0A, …,0Z, 11,…,9Z, A1, …, A9, AA, …, Z9, ZA,…,ZZ repeated.
(G, I, J, O, Q, W excluded)
*No character inversion used.



SOT-25
(TOP VIEW)



USP-4
(TOP VIEW)

●SSOT-24

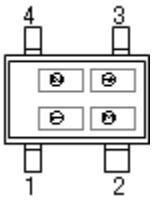
① represents product series

MARK	PRODUCT SERIES
U	XC8101******

② represents CE pin logic

MARK	PRODUCT SERIES
F	XC8101A*****

③④ represents production lot number
01, …,09, 0A, …,0Z, 11,…,9Z, A1, …, A9, AA, …, Z9, ZA,…,ZZ repeated.
(G, I, J, O, Q, W excluded)
*No character inversion used.



SSOT-24
(TOP VIEW)

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