XC6224 Series

TOREX

1.2V Low Voltage Operation,150mA High Speed LDO Voltage Regulator

GENERAL DESCRIPTION

The XC6224 series is a high speed LDO regulator that features high accurate, low noise, high ripple rejection, low dropout and low power consumption. The series consists of a voltage reference, an error amplifier, a driver transistor, a current limiter, and a phase compensation circuit.

This IC is suitable for a local power supply placed in adjacent to the system logic LSI or others, because of low input voltage operation, using an ultra small package USPN-4B02 (0.75mm x 0.95mm) and stable operation with a small phase compensation capacitor (C_L) 0.47µ F.

Also, this IC has fast transient response and high ripple rejection (70dB @ 1kHz).

The CE function enables the circuit to be in stand-by mode by inputting low level signal. In the stand-by mode, the series enables the electric charge at the output capacitor C_L to be discharged via the internal switch, and as a result the V_{OUT} pin quickly returns to the V_{SS} level.

The over current protection circuit is integrated and operates when the output current reaches current limit level.
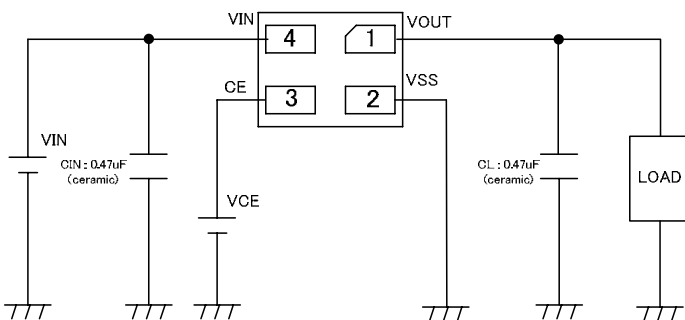
APPLICATIONS

Smart phones / Mobile phones
Digital still cameras
Mobile devices / terminals
Bluetooth
Wireless LAN
Digital TV tuners

FEATURES

Maximum Output Current	: 150mA
Operating Voltage Range	: 1.2V 3.6V
High Accuracy	: ±1.5 (V_{OUT} =1.25V 3.0V)
	±20mV (V_{OUT} = 0.8V 1.20V)
Low Power Consumption	: 33µ A (TYP.)
Stand-by Current	: 0.1µ A
High Ripple Rejection	: 70dB@1kHz
Dropout Voltage	: 210mV 150mA (V_{OUT}=2.8V)
Protection Circuits	: Current Limiter
	Short Circuit Protection
ON/OFF Control	: Active High
	C_L Auto Discharge Function
Output Capacitor	: Low ESR Capacitor
Operating Ambient Temperature	: -40 +85
Packages	: USPN-4B02
	SSOT-24
	SOT-25
Environmentally Friendly	: EU RoHS Compliant, Pb Free

TYPICAL APPLICATION CIRCUIT
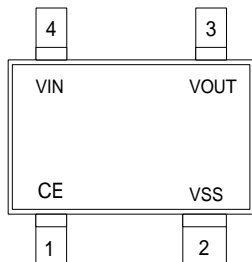

USPN−4B02 0.75mm × 0.95mm size
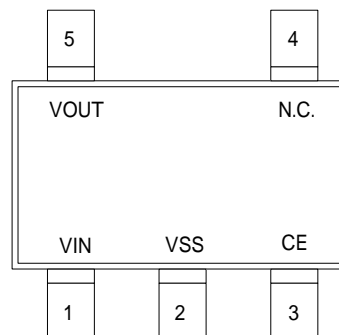(BOTTOM VIEW)

TYPICAL PERFORMANCE CHARACTERISTICS

XC6224x181

I_{OUT} = 1mA   150mA, tr=tf=0.5µ s,
V_{IN} = 2.80V, Ta=25 , C_{IN}=C_L=0.47µ F
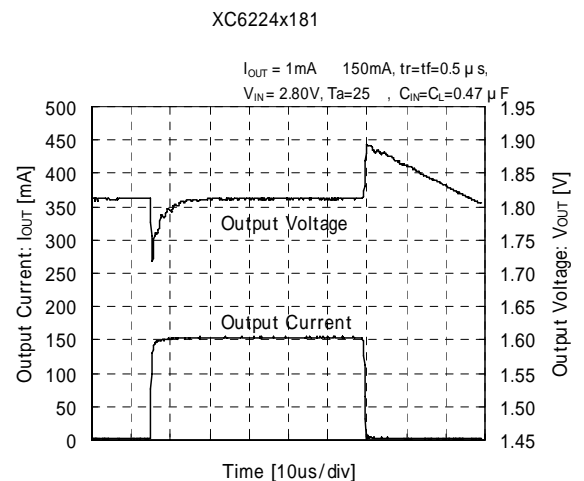
PIN CONFIGURATION
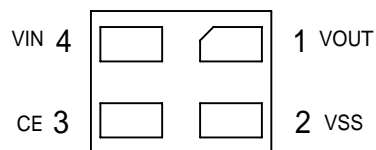
USPN-4B02
(BOTTOM VIEW)

SSOT-24
(TOP VIEW)

SOT-25
(TOP VIEW)

PIN ASSIGNMENT

PIN NUMBER			PIN NAME	FUNCTIONS
USPN-4B02	SSOT-24	SOT-25		
4	4	1	V_{IN}	Power Input
1	3	5	V_{OUT}	Output
2	2	2	V_{SS}	Ground
3	1	3	CE	ON/OFF Control
-	-	4	NC	No Connection

PIN LOGIC CONDITION

PIN NAME	DESIGNATOR	CONDITIONS
CE	L	$0V \le V_{CE} \le 0.3V$
	H	$1.0V \le V_{CE} \le 3.6V$
	OPEN	V_{CE}=OPEN

FUNCTION CHART FOR CE PIN

DESIGNATOR	IC OPERATION
H	ON
L	OFF Stand-by
OPEN	Undefined state in XC6224A
	OFF(Stand-by) in XC6224B*

H=High Level
L=Low Level
*An internal pull-down resister maintains the CE pin voltage to be low.
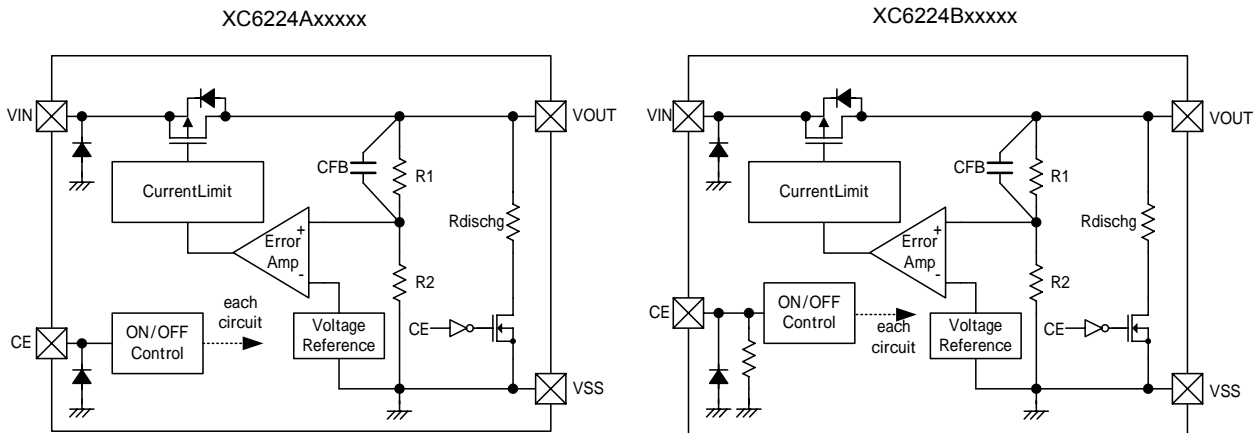
PRODUCT CLASSIFICATION

Ordering Information

XC6224   -   (*1)

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
	Type of Regulator	A	CE Active High, Without CE pull-down, with C_L Discharge
		B	CE Active High, With CE pull-down, with C_L Discharge
	Output Voltage	08　30	ex.) 2.5V　　=2,　=5
	Output Voltage (The 2nd Decimal Place)	1	{x.x0V} (the 2nd decimal place is "0")
		B	{x.x5V} (the 2nd decimal place is "5")
-	Packages (Order Unit)	7R-G	USPN-4B02 (5,000/Reel)
		MR-G	SOT-25 (3,000/Reel)
		NR-G	SSOT-24 (3,000/Reel)

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

BLOCK DIAGRAMS

XC6224Axxxxx

VIN — CurrentLimit — CFB — R1 — Error Amp — Rdischg — VOUT

ON/OFF Control — each circuit — Voltage Reference — R2 — CE

CE — VSS

XC6224Bxxxxx

VIN — CurrentLimit — CFB — R1 — Error Amp — Rdischg — VOUT

CE — ON/OFF Control — each circuit — Voltage Reference — R2 — CE

VSS

ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	$V_{SS}-0.3$ ~ +4.6	V
Output Current		I_{OUT}	180 [*1]	mA
Output Voltage		V_{OUT}	$V_{SS}-0.3$ ~ $V_{IN}+0.3$	V
CE Input Voltage		V_{CE}	$V_{SS}-0.3$ ~ 4.6	V
Power Dissipation	USPN-4B02	Pd	100	mW
			550 (PCB mounted) [*2]	
	SSOT24		150	
			500 (PCB mounted) [*2]	
	SOT-25		250	
			600 (PCB mounted) [*2]	
Operating Ambient Temperature		Topr	-40 ~ +85	
Storage Temperature		Tstg	-55 ~ +125	

*1: Please use within the range of I_{OUT} ≤ Pd ÷ (V_{IN} ＝ V_{OUT})

*2: This is a reference data taken by using the test board.　Please refer to page 21 ~ 23 for details.

ELECTRICAL CHARACTERISTICS

XC6224Axxxxx   Ta=25

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CURCUITS
Output Voltage	$V_{OUT(E)}$ *3	$V_{OUT\ T}$ 1.25V $V_{CE}=V_{IN}$, I_{OUT}=10mA	$V_{OUT(T)}$×0.985 [*2]	$V_{OUT(T)}$ [*2]	$V_{OUT(T)}$×1.015 [*2]	V	
		$V_{OUT\ T}$ 1.2V $V_{CE}=V_{IN}$, I_{OUT}=10mA	-20mV [*7]	$V_{OUT(T)}$ [*2]	+20mV [*7]		
Maximum Output Current	I_{OUTMAX}	$V_{CE}=V_{IN}$	150	-	-	mA	
Load Regulation	ΔV_{OUT}	$V_{CE}=V_{IN}$ 0.1mA I_{OUT} 150mA	-	5	20	mV	
Dropout Voltage [*4]	Vdif	I_{OUT}=150mA $V_{CE}=V_{IN}$, $V_{IN}=V_{OUT(E)}$×0.98 [*3]	E-1			mV	
Supply Current	I_{DD}	$V_{CE}=V_{IN}$, I_{OUT}=0mA	-	33	77	μA	
Stand-by Current	I_{STBY}	$V_{CE}=V_{SS}$		0.01	0.4	μA	
Line Regulation	$\Delta V_{OUT}/$ $\Delta V_{IN}\ V_{OUT}$	$V_{OUT\ T}$ 1.10V $V_{OUT(T)}$+0.5V V_{IN} 3.6V $V_{CE}=V_{IN}$, I_{OUT}=10mA [*2]	-	0.04	0.37	%/V	
		$V_{OUT\ T}$ 1.05V 1.6V V_{IN} 3.6V $V_{CE}=V_{IN}$, I_{OUT}=10mA [*2]					
Input Voltage	V_{IN}		1.2	-	3.6	V	
Output Voltage Temperature Characteristics	$\Delta V_{OUT}/$ $\Delta Ta\ V_{OUT}$	$V_{CE}=V_{IN}$, I_{OUT}=30mA [*1] -40 Ta 85	-	± 100	-	ppm/	
Power Supply Rejection Ratio	PSRR	$V_{CE}=V_{IN}$ When 0.80V $V_{OUT\ T}$ 2.60V, V_{IN}=3.0V 0.5Vp-pAC 2.65V $V_{OUT\ T}$ 3.00V V_{IN}=3.3V+0.25Vp-pAC I_{OUT}=30mA, f=1kHz [*2]	-	70	-	dB	
Current Limit	I_{LIM}	$V_{CE}=V_{IN}$	150	250	-	mA	
Short Current	I_{SHORT}	$V_{CE}=V_{IN}$, V_{OUT} is connected to V_{SS}	-	35	-	mA	
CE High Level Voltage	V_{CEH}		1.0	-	3.6	V	
CE Low Level Voltage	V_{CEL}		-	-	0.3	V	
CE High Level Current	I_{CEH}	$V_{CE}=V_{IN}$ A Type	-0.1	0	0.1	μA	
CE High Level Current	I_{CEL}	$V_{CE}=V_{SS}$	-0.1	0	0.1	μA	
C_L Discharge Resistance	R_{DCHG}	V_{IN}=3.6V, $V_{CE}=V_{SS}$	-	450	-	Ω	

NOTE:

*1: Unless otherwise specified, input voltage conditions are;

      0.80V $V_{OUT(T)}$ 2.60V   {$V_{IN}=V_{OUT(T)}$+1.0V}

      2.65V $V_{OUT(T)}$ 2.80V   {V_{IN}=3.3V}

      2.85V $V_{OUT(T)}$ 3.00V   {V_{IN}=3.5V}

*2: $V_{OUT(T)}$: Nominal output voltage

*3: $V_{OUT(E)}$: Effective output voltage

   This output voltages are measured at the constant current when the input voltages are stable as Note 1.

*4: Vdif {V_{IN1} [*5] V_{OUT1} [*6]}

*5: V_{IN1}=The input voltage when V_{OUT1} appears as input voltage is gradually decreased.

*6: V_{OUT1}=A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT} {$V_{OUT(T)}$+1.0V} is input

*7: $V_{OUT(T)}$ ±20mV is the specification value of output voltage where $V_{OUT(T)}$ 1.20V

TOIREX

ELECTRICAL CHARACTERISTICS (Continued)

XC6224Bxxxxx   Ta=25

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CURCUITS
Output Voltage	$V_{OUT(E)}$ *3	$V_{OUT\ T}$ 1.25V $V_{CE}=V_{IN}$, $I_{OUT}=10mA$	$V_{OUT(T)}\times0.985$ [*2]	$V_{OUT(T)}$ [*2]	$V_{OUT(T)}\times1.015$ [*2]	V	
		$V_{OUT\ T}$ 1.2V, $V_{IN}=2.5V$ $V_{CE}=V_{IN}$, $I_{OUT}=10mA$	-20mV [*7]	$V_{OUT(T)}$ [*2]	+20mV [*7]		
Maximum Output Current	I_{OUTMAX}	$V_{CE}=V_{IN}$ [*1]	150	-	-	mA	
Load Regulation	ΔV_{OUT}	$V_{CE}=V_{IN}$ [*1] 0.1mA I_{OUT} 150mA	-	5	20	mV	
Dropout Voltage (*4)	Vdif	$I_{OUT}=150mA$, $V_{CE}=V_{IN}$ $V_{IN}=V_{OUT(E)}\times0.98$ [*3]	E-1			mV	
Supply Current	I_{DD}	$V_{CE}=V_{IN}$ [*1] $I_{OUT}=0mA$	-	33	77	μ A	
Stand-by Current	I_{STBY}	$V_{CE}=V_{SS}$	-	0.01	0.4	μ A	
Line Regulation	$\Delta V_{OUT}/$ $\Delta V_{IN}\ V_{OUT}$	$V_{OUT\ T}$ 1.10V $V_{OUT(T)}+0.5V$ V_{IN} 3.6V $V_{CE}=V_{IN}$ $I_{OUT}=10mA$ [*2] $V_{OUT\ T}$ 1.05V 1.6V V_{IN} 3.6V $V_{CE}=V_{IN}$ $I_{OUT}=10mA$ [*2]	-	0.04	0.37	%/V	
Input Voltage	V_{IN}		1.2	-	3.6	V	
Output Voltage Temperature Characteristics	$\Delta V_{OUT}/$ $\Delta Ta\ V_{OUT}$	$V_{CE}=V_{IN}$, $I_{OUT}=30mA$ [*1] -40 Ta 85	-	± 100	-	ppm/	
Power Supply Rejection Ratio	PSRR	$V_{CE}=V_{IN}$ When 0.80V $V_{OUT\ T}$ 2.60V $V_{IN}=3.0V$ 0.5Vp-pAC 2.65V $V_{OUT\ T}$ 3.00V $V_{IN}=3.3V+0.25Vp-pAC$ $I_{OUT}=30mA$ f=1kHz [*2]	-	70	-	dB	
Current Limit	I_{LIM}	$V_{CE}=V_{IN}$	150	250	-	mA	
Short Current	I_{SHORT}	$V_{CE}=V_{IN}$, V_{OUT} is connected to V_{SS}	-	35	-	mA	
CE High Level Voltage	V_{CEH}		1.0	-	3.6	V	
CE Low Level Voltage	V_{CEL}		-	-	0.3	V	
CE High Level Current	I_{CEH}	$V_{CE}=V_{IN}$ B Type	-	5.5	13.0	μ A	
CE High Level Current	I_{CEL}	$V_{CE}=V_{SS}$	-0.1	0	0.1	μ A	
C_L Discharge Resistance	R_{DCHG}	$V_{IN}=3.6V$, $V_{CE}=V_{SS}$	-	450	-	Ω	

NOTE:

*1: Unless otherwise specified, input voltage conditions are;

      0.80V $V_{OUT(T)}$ 2.60V   {$V_{IN}=V_{OUT(T)}+1.0V$}
      2.65V $V_{OUT(T)}$ 2.80V   {$V_{IN}=3.3V$}
      2.85V $V_{OUT(T)}$ 3.00V   {$V_{IN}=3.5V$}

*2: $V_{OUT(T)}$: Nominal output voltage

*3: $V_{OUT(E)}$: Effective output voltage

   This output voltages are measured at the constant current when the input voltages are stable as Note 1.

*4: Vdif {V_{IN1} [*5] V_{OUT1} [*6]}

*5: V_{IN1}=The input voltage when V_{OUT1} appears as input voltage is gradually decreased.

*6: V_{OUT1}=A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT} {$V_{OUT(T)}+1.0V$} is input

*7: $V_{OUT(T)}$ ±20mV is the specification value of output voltage where $V_{OUT(T)}$ 1.20V.

ELECTRICAL CHARACTERISTICS (Continued)

Voltage Table

NOMINAL OUTPUT VOLTAGE (V)	OUTPUT VOLTAGE [*1] (V)		DROPOUT VOLTAGE E-1 (mV)	
	$V_{OUT(E)}$		Vdif	
$V_{OUT(T)}$	MIN.	MAX.	TYP.	MAX.
0.80	0.7800	0.8200	-	-
0.85	0.8300	0.8700	-	-
0.90	0.8800	0.9200	-	-
0.95	0.9300	0.9700	-	-
1.00	0.9800	1.0200	-	-
1.05	1.0300	1.0700	-	-
1.10	1.0800	1.1200	-	-
1.15	1.1300	1.1700	-	-
1.20	1.1800	1.2200	400	500
1.25	1.2313	1.2687		
1.30	1.2805	1.3195		
1.35	1.3298	1.3702		
1.40	1.3790	1.4210		
1.45	1.4283	1.4717		
1.50	1.4775	1.5225		
1.55	1.5268	1.5732		
1.60	1.5760	1.6240		
1.65	1.6253	1.6747		
1.70	1.6745	1.7255		
1.75	1.7238	1.7762		
1.80	1.7730	1.8270	300	430
1.85	1.8223	1.8777		
1.90	1.8715	1.9285		
1.95	1.9208	1.9792		
2.00	1.9700	2.0300		
2.05	2.0193	2.0807		
2.10	2.0685	2.1315		
2.15	2.1178	2.1822		
2.20	2.1670	2.2330		
2.25	2.2163	2.2837		
2.30	2.2655	2.3345		
2.35	2.3148	2.3852		
2.40	2.3640	2.4360		
2.45	2.4133	2.4867		
2.50	2.4625	2.5375	210	410
2.55	2.5118	2.5882		
2.60	2.5610	2.6390		
2.65	2.6103	2.6897		
2.70	2.6595	2.7405		
2.75	2.7088	2.7912		
2.80	2.7580	2.8420		
2.85	2.8073	2.8927		
2.90	2.8565	2.9435		
2.95	2.9058	2.9942		
3.00	2.9550	3.0450		

(*1) When $V_{OUT(T)}$ 1.20V, the output voltage accuracy is ±20mV.
    When $V_{OUT(T)}$ 1.25V, the output voltage accuracy is ±1.5%.

OPERATIONAL EXPLANATION

XC6224Axxxxx

XC6224Bxxxxx
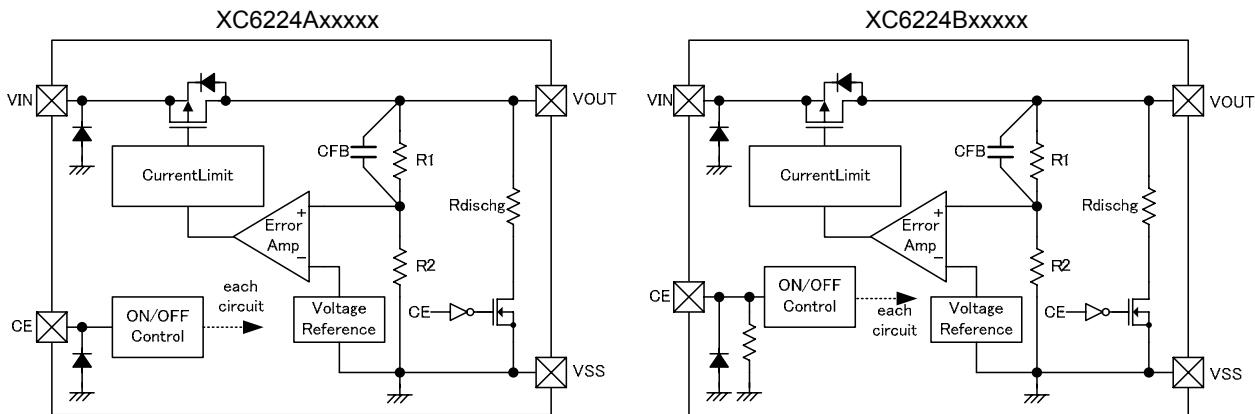
The voltage divided by resistors R1 & R2 is compared with the internal reference voltage by the error amplifier. The P-channel MOSFET which is connected to the V_{OUT} pin is then driven by the subsequent output signal. The output voltage at the V_{OUT} pin is controlled and stabilized by a system of negative feedback. The current limit circuit and short circuit protection operate in relation to the level of output current. Further, the IC's internal circuitry can be shutdown via the CE pin signal.

<Low ESR Capacitor>

The XC6224 needs an output capacitor C_L and a built-in phase compensation circuit for phase compensation. In order to ensure the stable phase compensation, please place an output capacitor C_L of 0.47μ F or bigger at the V_{OUT} pin as close as possible. For a stable power input, please connect an input capacitor C_{IN} of 0.47μ F between the V_{IN} pin and the V_{SS} pin.

<Current Limiter, Short-Circuit Protection>

The protection circuit operates as a combination of an output current limiter and fold-back short circuit protection. When load current reaches the current limit level, the output voltage drops. As a result, the load current starts to reduce with showing fold-back curve. The output current finally falls at the level of 35mA when the output pin is short-circuited.

<CE Pin>

The IC's internal circuitry can be shutdown via the signal from the CE pin. In shutdown mode, output at the V_{OUT} pin will be pulled down to the V_{SS} level in the XC6224B series. When the CE pin is open, the output voltage becomes undefined state in the XC6224A series because of a high active and no pull-down. Although the CE pin is equal to CMOS input configuration, the CE pin input current which flows into a pull-down resistor will increase in the XC6224B series

NOTES ON USE

1   For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2.   Torex places an importance on improving our products and its reliability.
     However, by any possibility, we would request user fail-safe design and post-aging treatment on system or equipment.
3.   Where wiring impedance is high, operations may become unstable due to the noise and/or phase lag depending on output current. Please strengthen V_{IN} and V_{SS} wiring in particular.
4.   The input capacitor C_{IN} and the output capacitor C_L should be placed to the IC as close as possible with a shorter wiring.
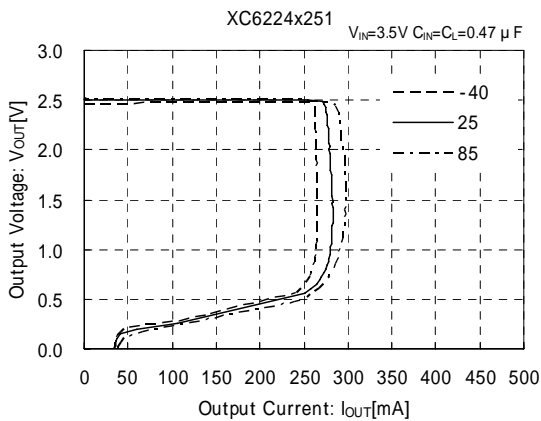
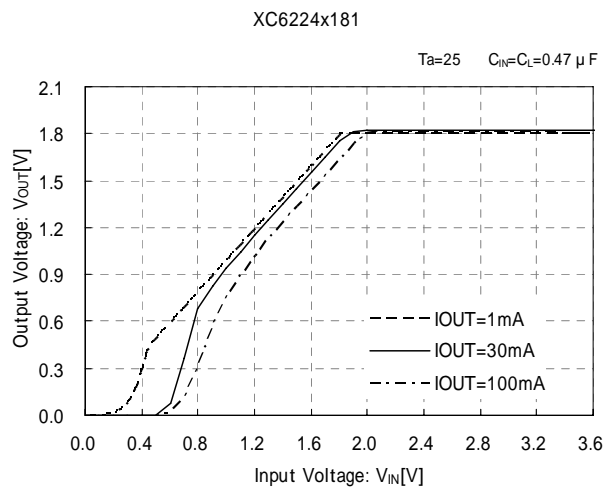# TEST CIRCUITS

Circuit
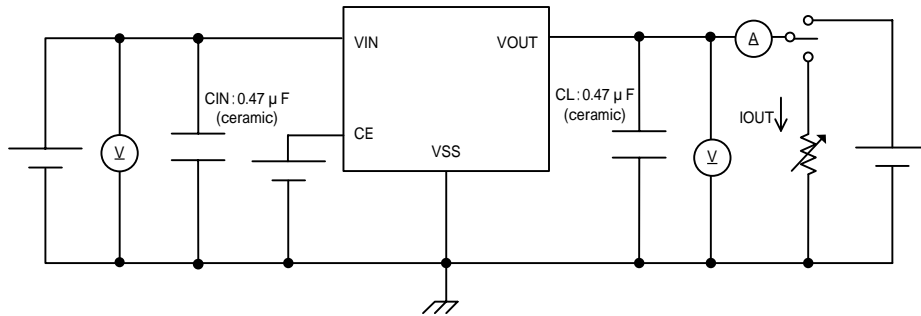
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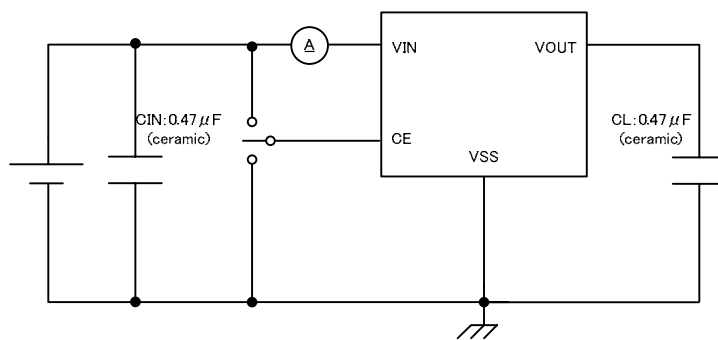
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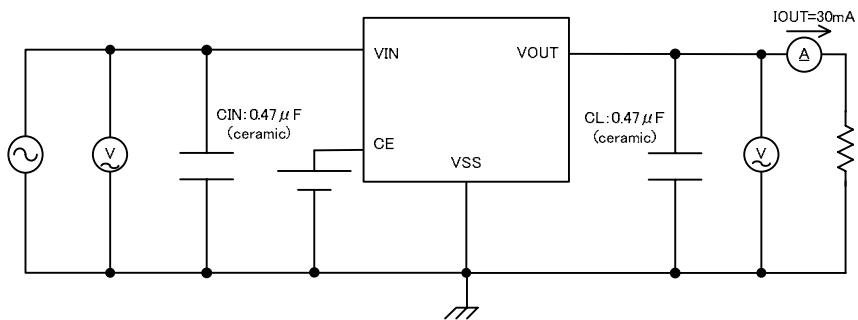
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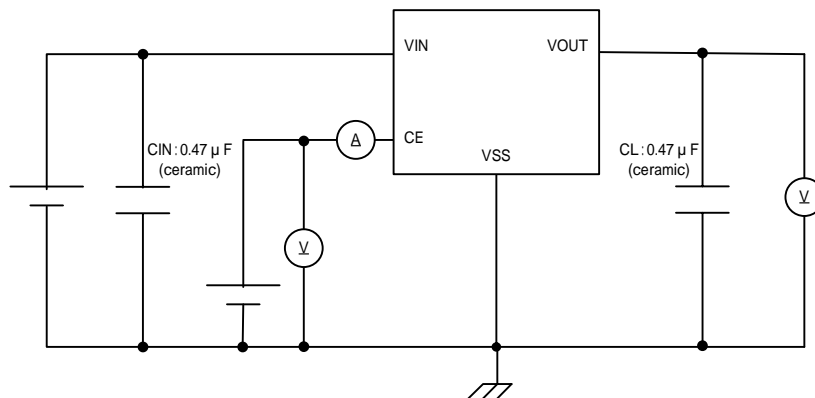
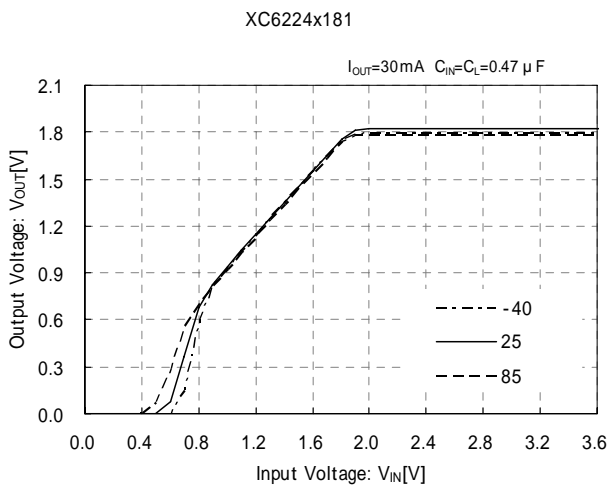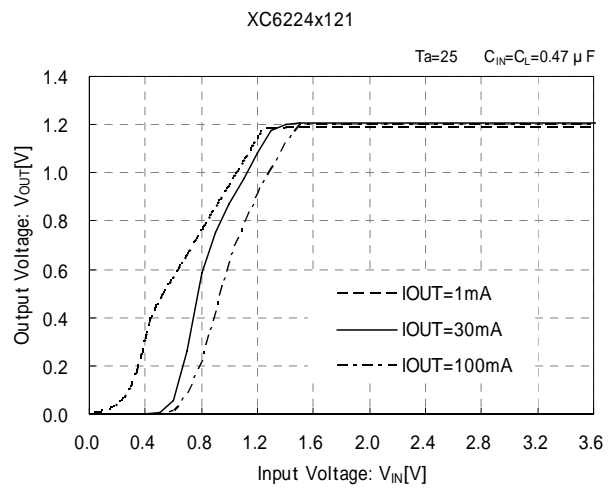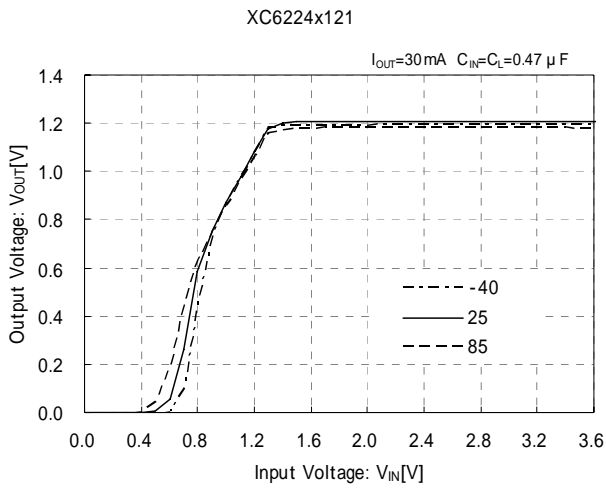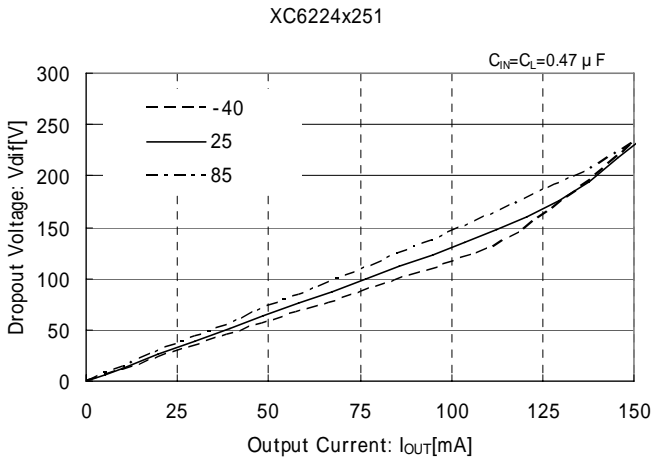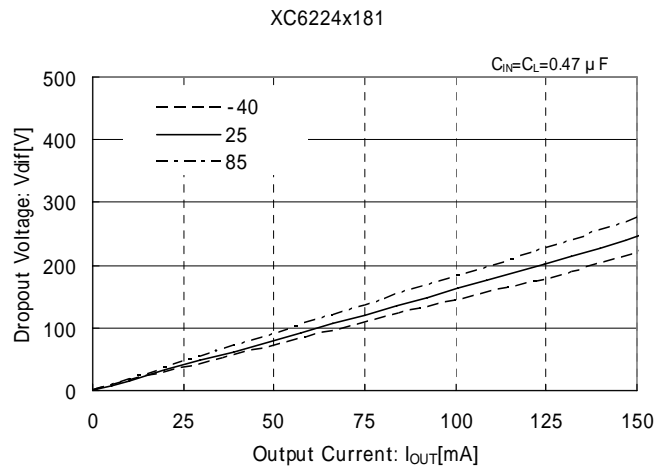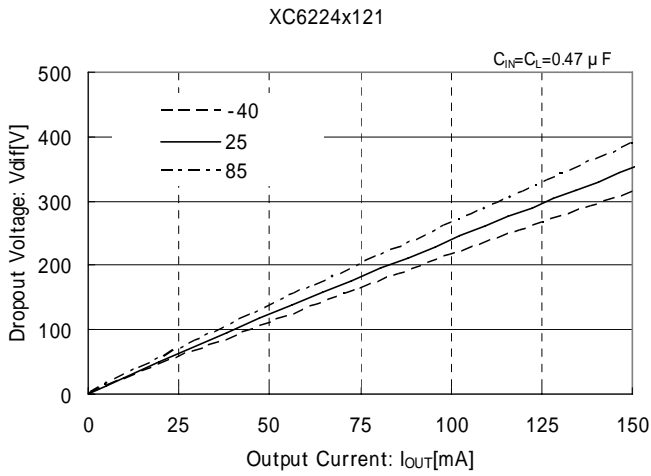## TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

XC6224x121
V_{IN}=2.2V C_{IN}=C_L=0.47μ F

XC6224x121
Ta=25 C_{IN}=C_L=0.47μ F

XC6224x181
V_{IN}=2.8V C_{IN}=C_L=0.47μ

XC6224x181
Ta=25 C_{IN}=C_L=0.47μ F

XC6224x251
V_{IN}=3.5V C_{IN}=C_L=0.47μ F

XC6224x251
Ta=25 C_{IN}=C_L=0.47μ F
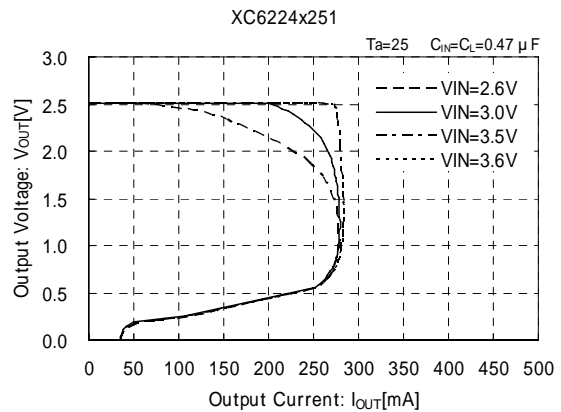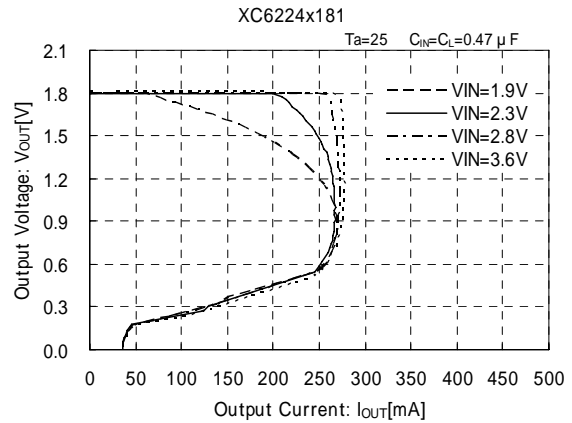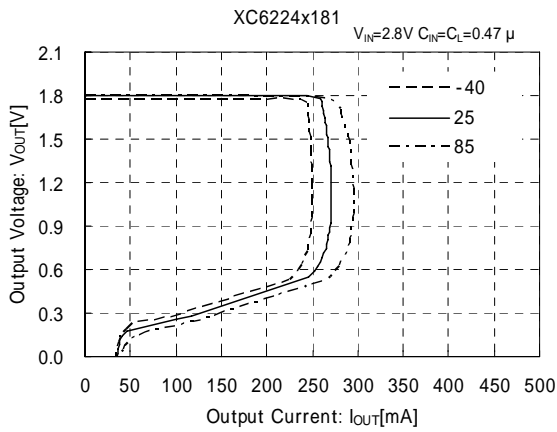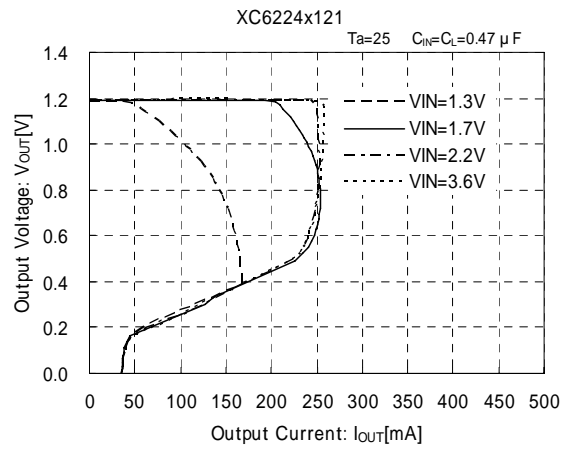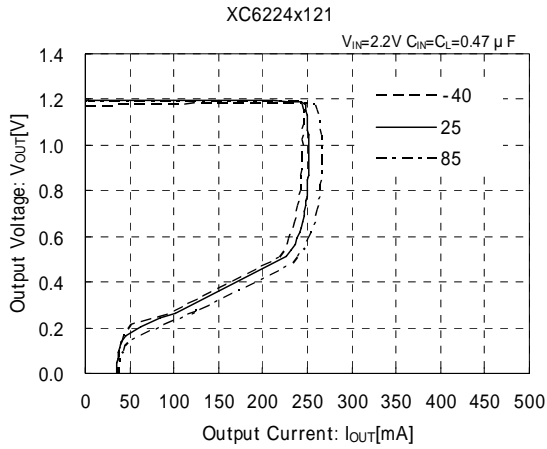
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) Output Voltage vs. Input Voltage

XC6224x121

$I_{OUT}=30$ A $C_{IN}=C_L=0.47\mu$ F

- ·—· 40
- —— 25
- --- 85

XC6224x121

Ta=25 $C_{IN}=C_L=0.47\mu$ F

- --- IOUT =1mA
- —— IOUT =30mA
- ·—· IOUT =100mA

XC6224x181

$I_{OUT}=30$ A $C_{IN}=C_L=0.47\mu$ F

- ·—· 40
- —— 25
- --- 85

XC6224x181

Ta=25 $C_{IN}=C_L=0.47\mu$ F

- --- IOUT =1mA
- —— IOUT =30mA
- ·—· IOUT =100mA

XC6224x251

$I_{OUT}=30$ A $C_{IN}=C_L=0.47\mu$ F

- ·—· 40
- —— 25
- --- 85

XC6224x251

Ta=25 $C_{IN}=C_L=0.47\mu$ F

- --- IOUT =1mA
- —— IOUT =30mA
- ·—· IOUT =100mA
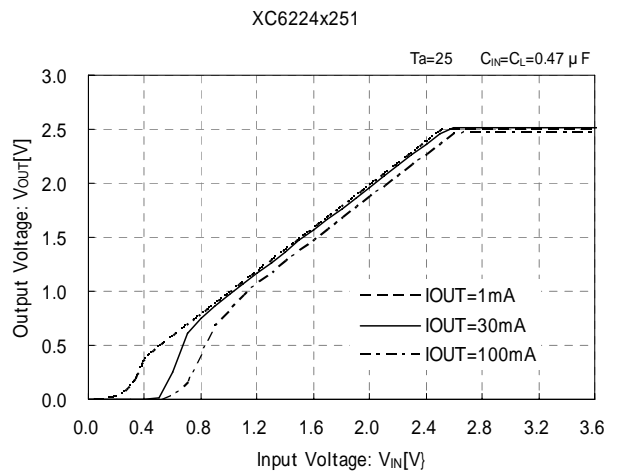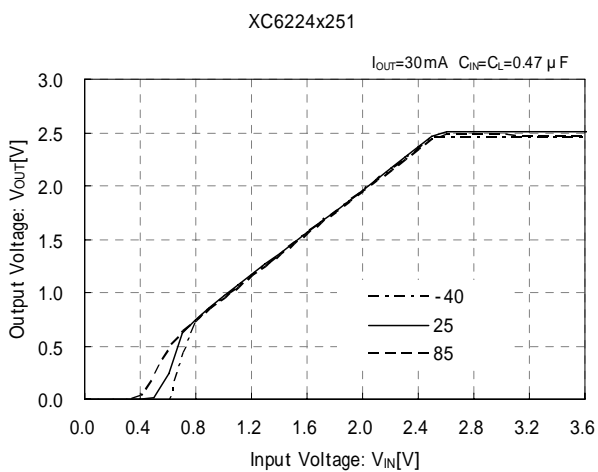
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

XC6224x121

$C_{IN}=C_L=0.47\mu\ F$

XC6224x181

$C_{IN}=C_L=0.47\mu\ F$

XC6224x251

$C_{IN}=C_L=0.47\mu\ F$

(4) Supply Current vs. Input Voltage

XC6224x121

$I_{OUT}=O\ A\ C_{IN}=C_L=0.47\mu\ F$
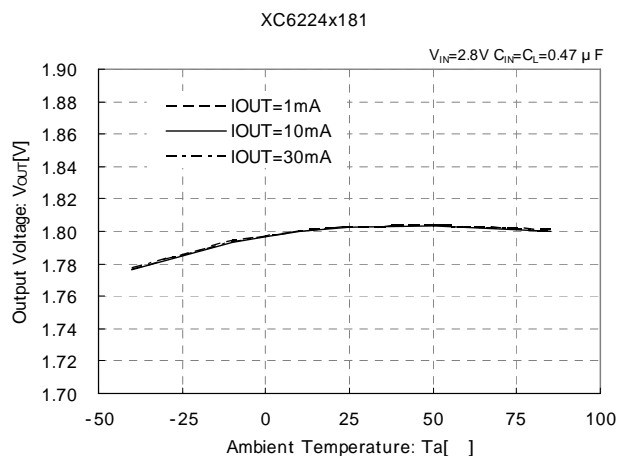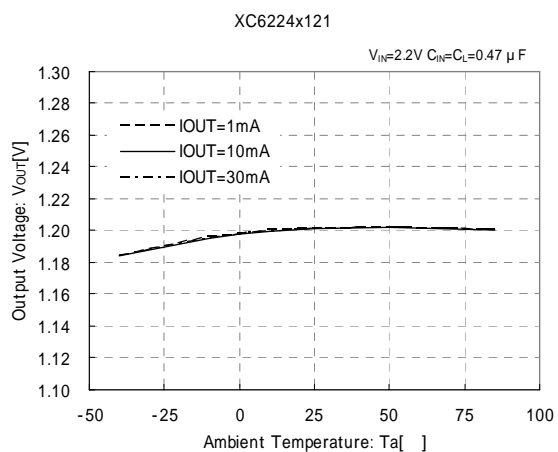
XC6224x181

$I_{OUT}=O\ A\ C_{IN}=C_L=0.47\mu\ F$
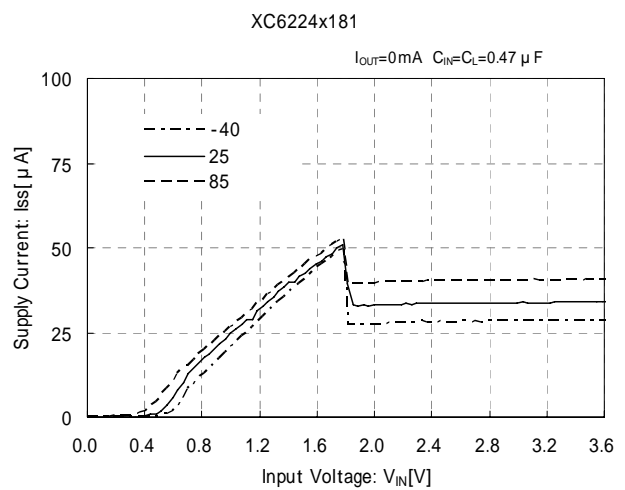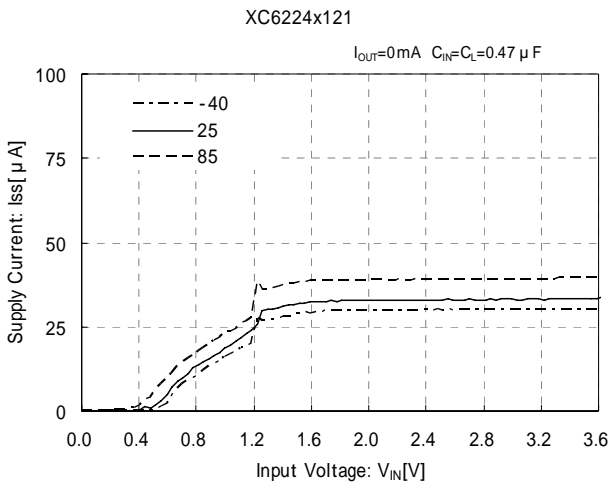
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(4) Supply Current vs. Input Voltage (Continued)

XC6224x251

$I_{OUT}=0$ A $C_{IN}=C_L=0.47\mu$ F
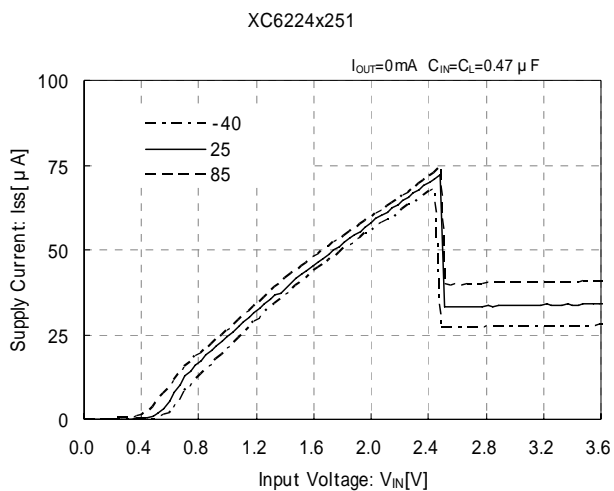
(5) Output Voltage vs. Ambient Temperature

XC6224x121

$V_{IN}=2.2V$ $C_{IN}=C_L=0.47\mu$ F

XC6224x181

$V_{IN}=2.8V$ $C_{IN}=C_L=0.47\mu$ F

XC6224x251

$V_{IN}=3.5V$ $C_{IN}=C_L=0.47\mu$ F
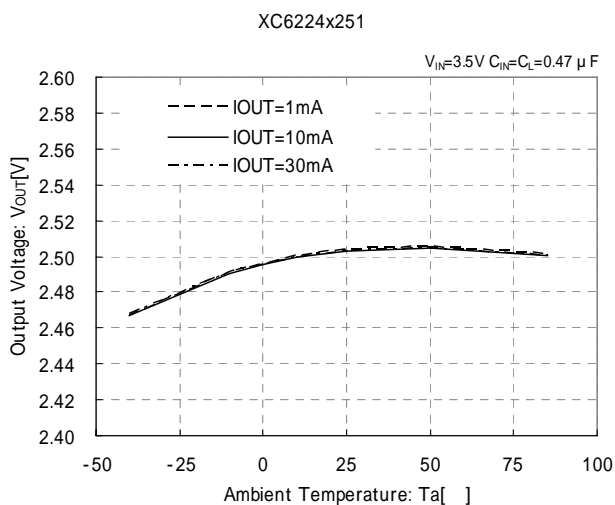
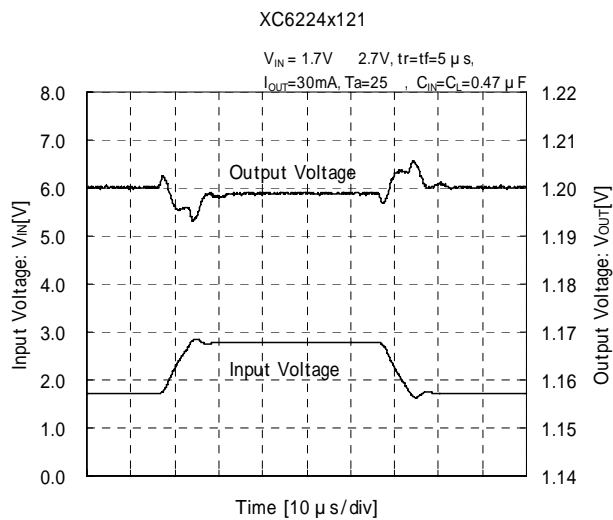## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(6) Rising Response Time

XC6224x121

tr=5μs, Ta=25 , C$_{IN}$=C$_L$=0.47μF

XC6224x181
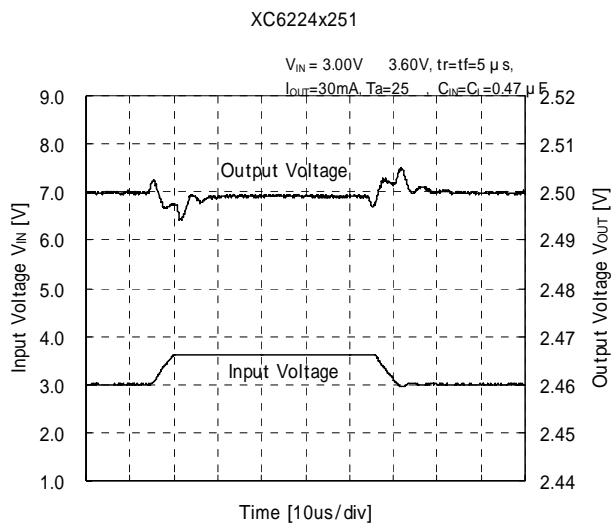
tr=5μs, Ta=25 , C$_{IN}$=C$_L$=0.47μF

XC6224x251

tr=5μs, Ta=25 , C$_{IN}$=C$_L$=0.47μF

(7) Input Transient Response

XC6224x121

V$_{IN}$ = 1.7V 2.7V, tr=tf=5μs,
I$_{OUT}$=30mA, Ta=25 , C$_{IN}$=C$_L$=0.47μF

XC6224x181

V$_{IN}$ = 2.30V 3.30V, tr=tf=5μs,
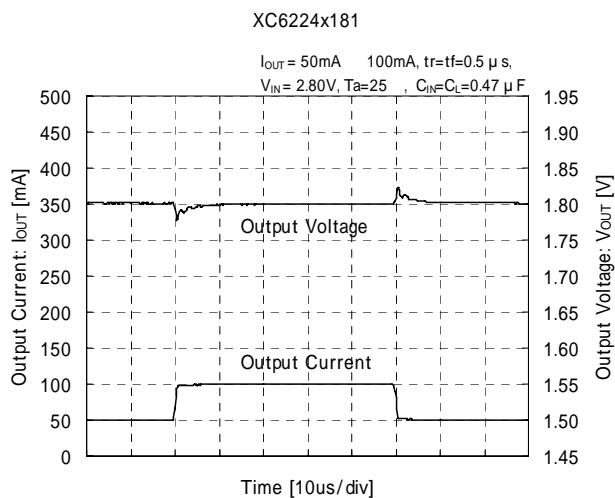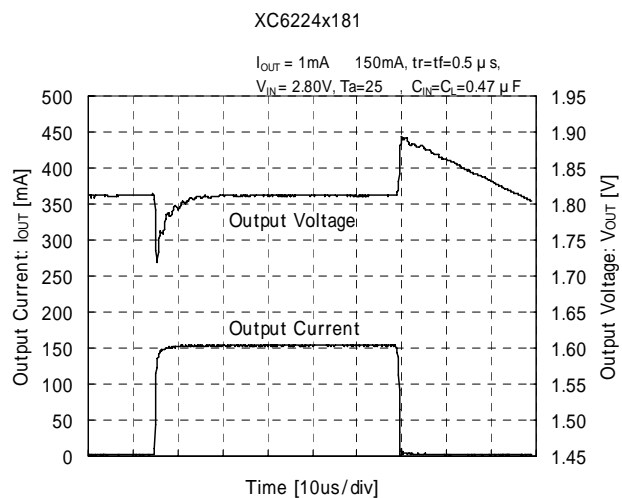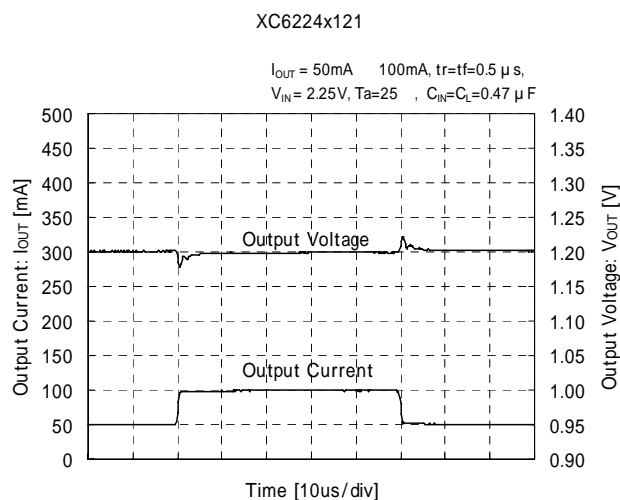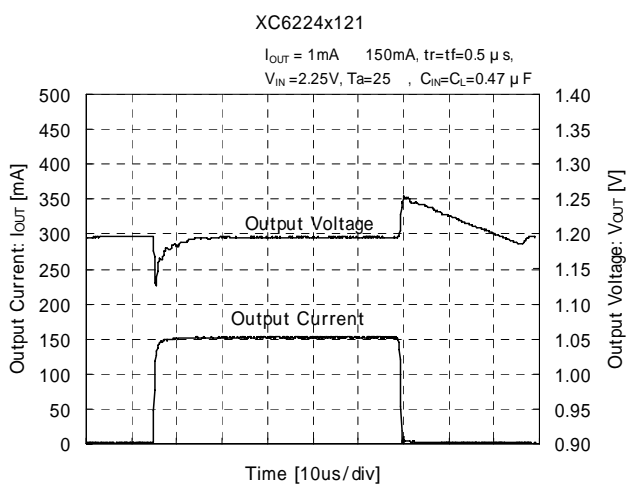I$_{OUT}$=30mA, Ta=25 , C$_{IN}$=C$_L$=0.47μF
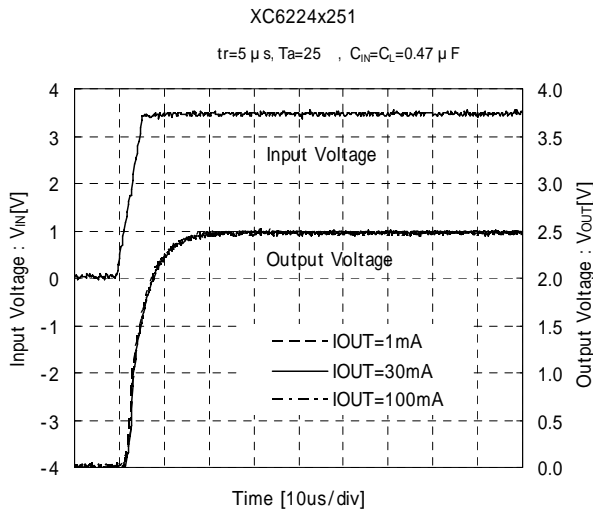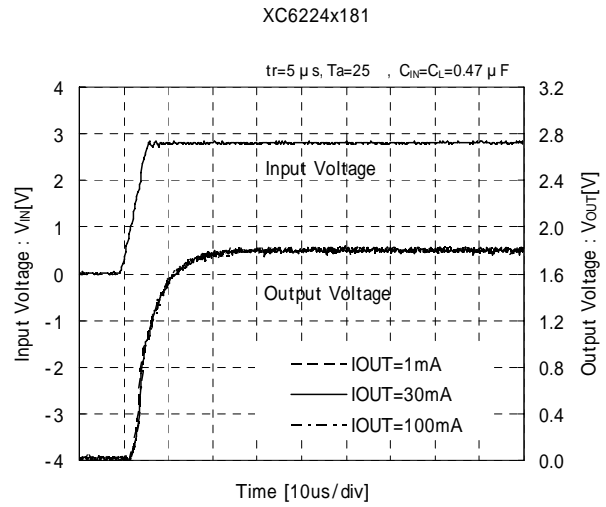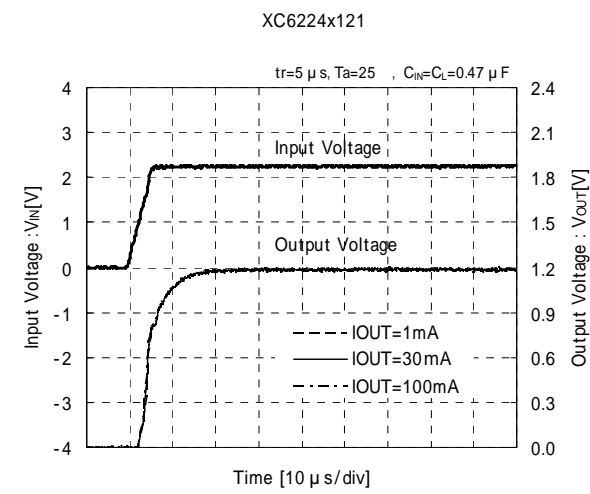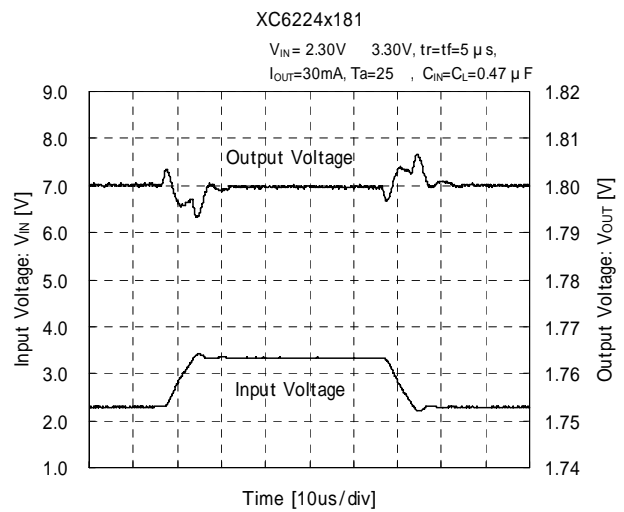
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Input Transient Response (Continued)

XC6224x251

V_{IN} = 3.00V   3.60V, tr=tf=5μ s,
I_{OUT}=30mA, Ta=25   , C_{IN}=C_L=0.47μ F

(8) Load Transient Response

XC6224x121

I_{OUT} = 1mA   150mA, tr=tf=0.5μ s,
V_{IN} =2.25V, Ta=25   , C_{IN}=C_L=0.47μ F

XC6224x121

I_{OUT} = 50mA   100mA, tr=tf=0.5μ s,
V_{IN} = 2.25V, Ta=25   , C_{IN}=C_L=0.47μ F

XC6224x181

I_{OUT} = 1mA   150mA, tr=tf=0.5μ s,
V_{IN} =2.80V, Ta=25   , C_{IN}=C_L=0.47μ F

XC6224x181

I_{OUT} = 50mA   100mA, tr=tf=0.5μ s,
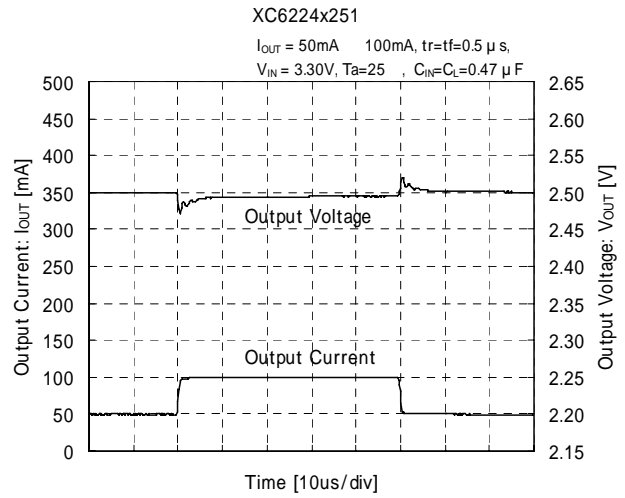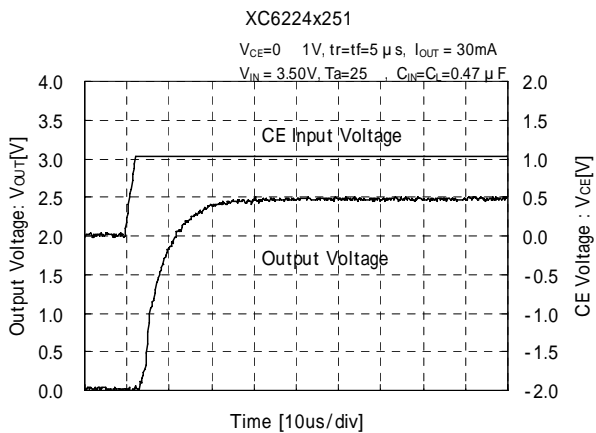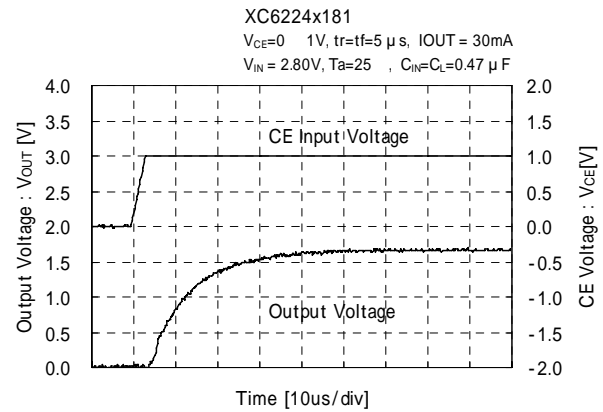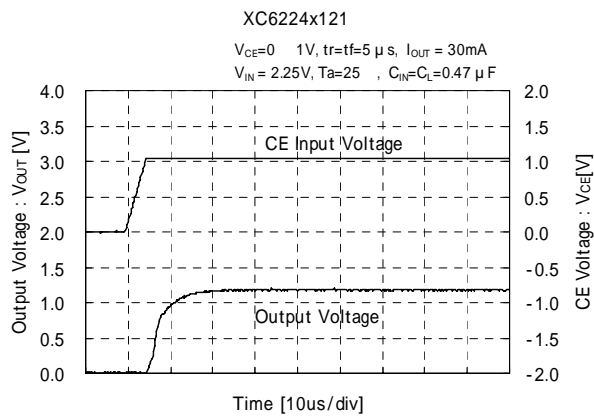V_{IN} = 2.80V, Ta=25   , C_{IN}=C_L=0.47μ F

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Load Transient Response (Continued)

XC6224x251

I_{OUT} = 1mA　150mA, tr=tf=0.5μ s,
V_{IN} = 3.30V, Ta=25　, C_{IN}=C_L=0.47μ F

XC6224x251

I_{OUT} = 50mA　100mA, tr=tf=0.5μ s,
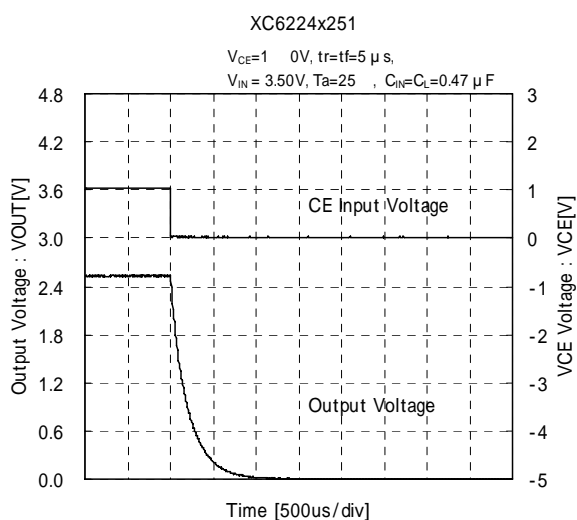V_{IN} = 3.30V, Ta=25　, C_{IN}=C_L=0.47μ F

(9) CE Rising Response Time

XC6224x121

V_{CE}=0　1V, tr=tf=5μ s, I_{OUT} = 30mA
V_{IN} = 2.25V, Ta=25　, C_{IN}=C_L=0.47μ F

XC6224x181

V_{CE}=0　1V, tr=tf=5μ s, IOUT = 30mA
V_{IN} = 2.80V, Ta=25　, C_{IN}=C_L=0.47μ F

XC6224x251

V_{CE}=0　1V, tr=tf=5μ s, I_{OUT} = 30mA
V_{IN} = 3.50V, Ta=25　, C_{IN}=C_L=0.47μ F
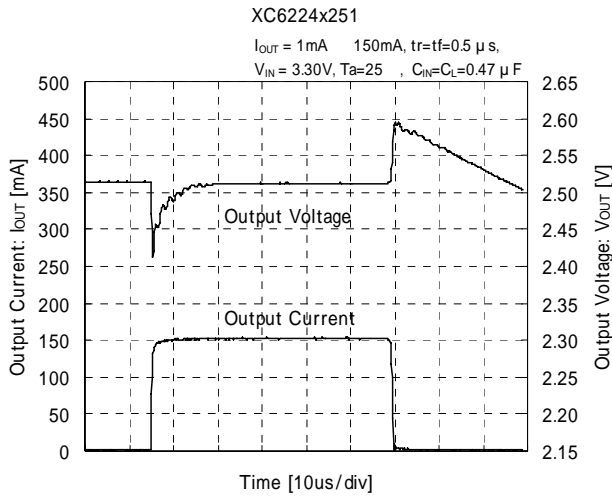
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(10) C$_L$ Discharge Response Time

XC6224x121

V$_{CE}$=1 0V, tr=tf=5μ s
V$_{IN}$ = 2.2V, Ta=25 , C$_{IN}$=C$_L$=0.47μ F

XC6224x181

V$_{CE}$=1 0V, tr=tf=5μ s
V$_{IN}$ = 2.80V, Ta=25 , C$_{IN}$=CL=0.47μ F

XC6224x251

V$_{CE}$=1 0V, tr=tf=5μ s,
V$_{IN}$ = 3.50V, Ta=25 , C$_{IN}$=C$_L$=0.47μ F

(11) Ripple Rejection Rate

XC6224x121

Ta=25 , V$_{IN}$=3.0V$_{DC}$+0.5Vp- p$_{AC}$
C$_{IN}$=C$_l$=0.47μ F

X6224x181

Ta=25 , V$_{IN}$=3.0V$_{DC}$+0.5Vp- p$_{AC}$
C$_{IN}$=C$_l$=0.47μ F

XC6224 Series
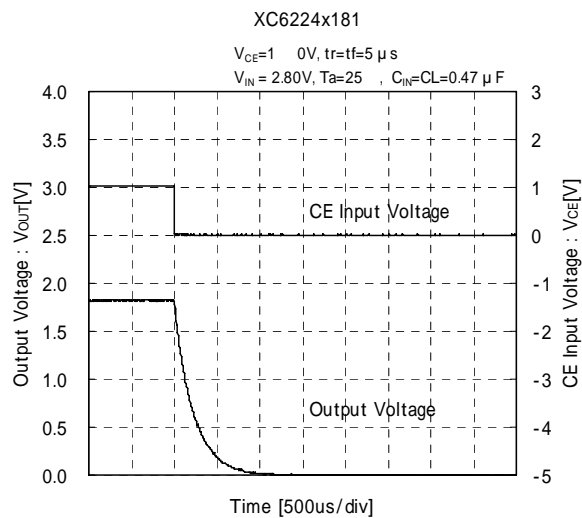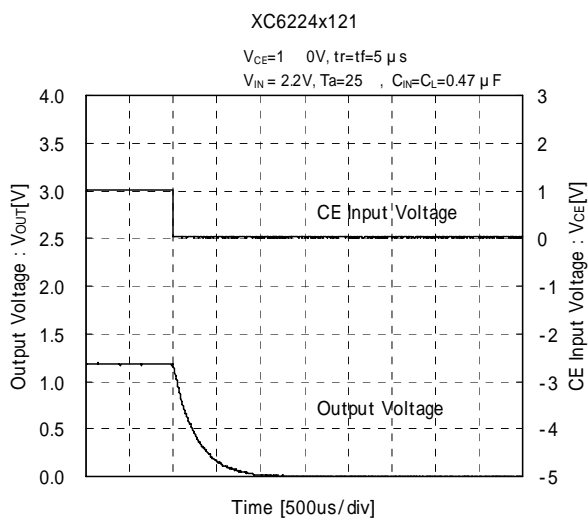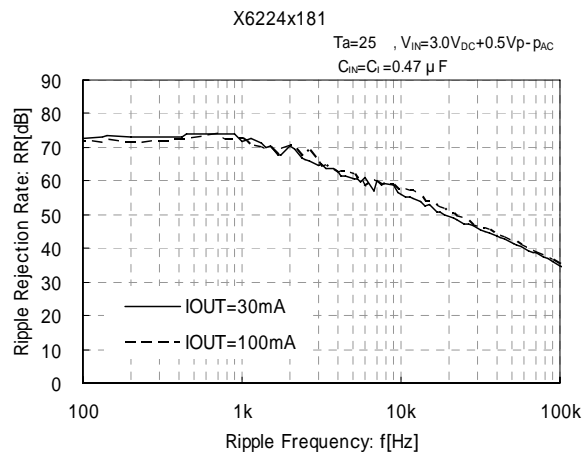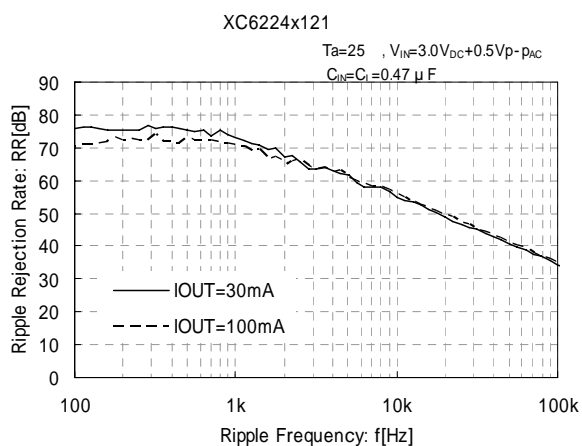
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(11) Ripple Rejection Rate

XC6224x251

Ta=25 , V$_{IN}$=3.0V$_{DC}$+0.5Vp-p$_{AC}$
C$_{IN}$=C$_L$=0.47μ F

IOUT=30mA

IOUT=100mA
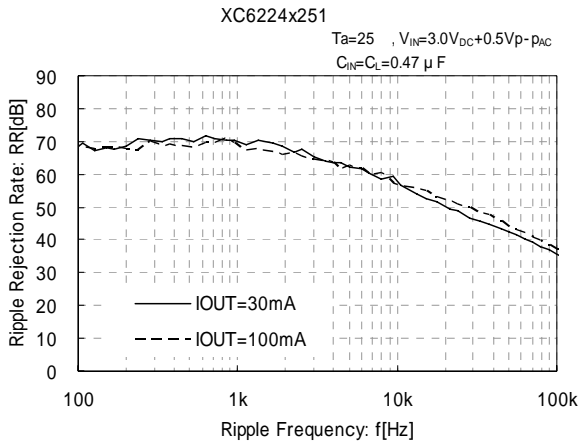
(12) The Minimum Operating Voltage

XC6224x081

Ta=25 , C$_{IN}$=C$_L$=0.47μ F

0.8V Operation Area
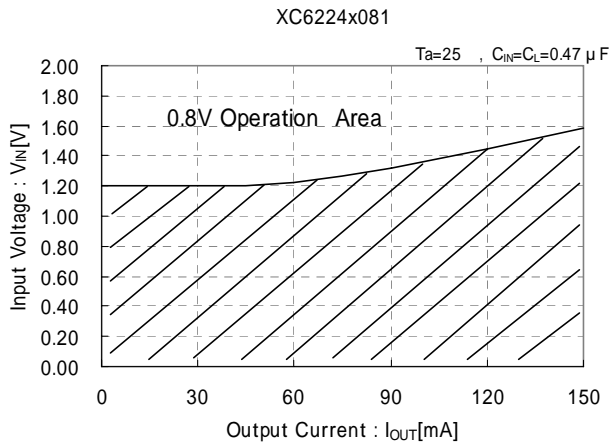
* The graph shows minimum input voltages as a function of output current.   The vales are influenced by a driver ON resistance.

PACKAGING INFORMATION

USPN-4B02
(unit : mm)

SSOT-24
(unit : mm)

SOT-25
(unit : mm)
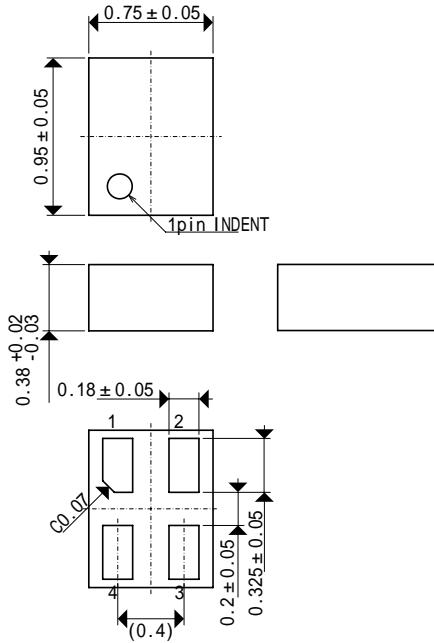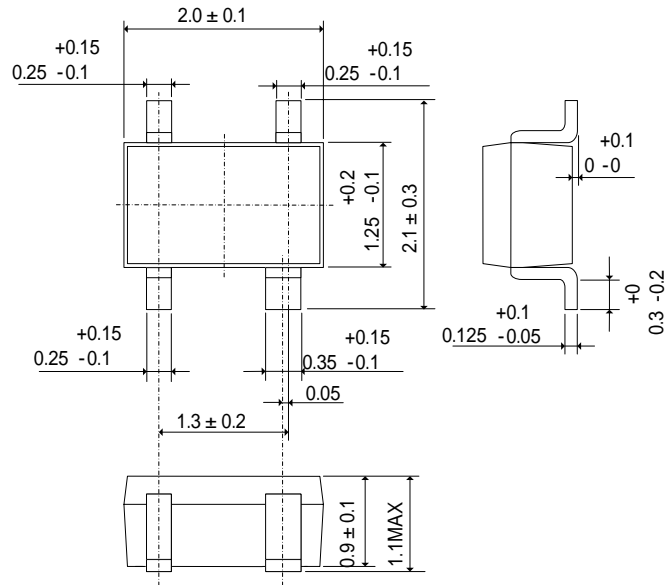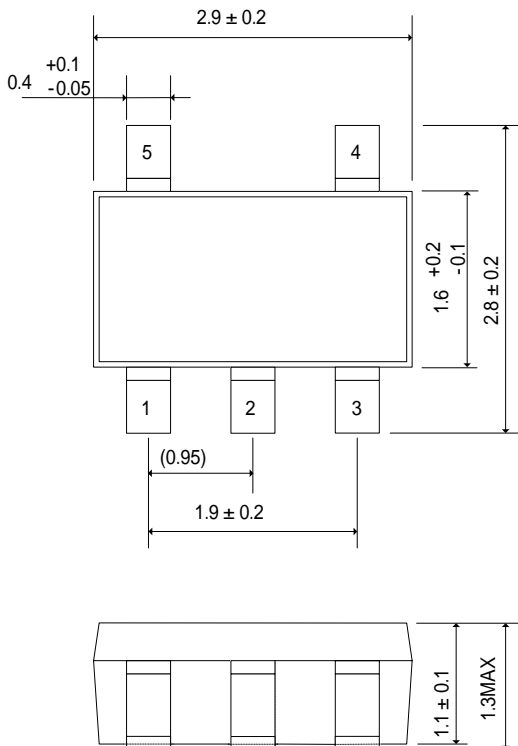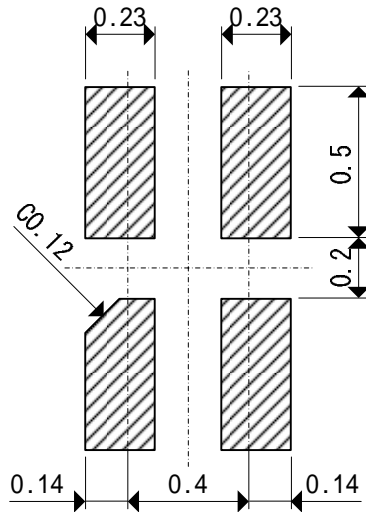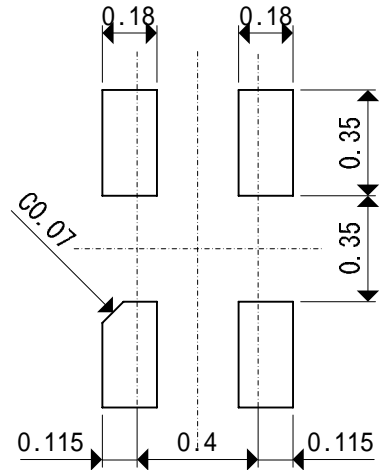
PACKAGING INFORMATION (Continued)

USPN-4B02 Reference Pattern Layout

USPN-4B02 Reference Metal Mask Design

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.

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   )

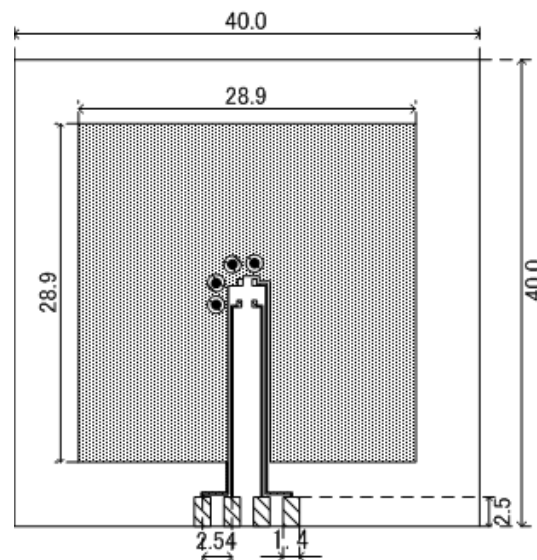| Ambient Temperature	Power Dissipation Pd mW	Thermal Resistance (/W)
25	500	200.00
85	200	

Pd vs Ta
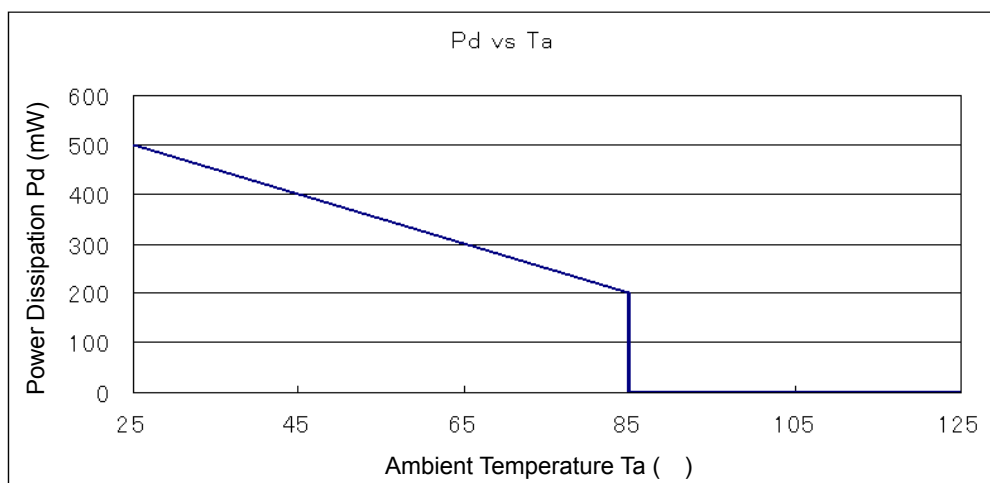
PACKAGING INFORMATION (Continued)

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)

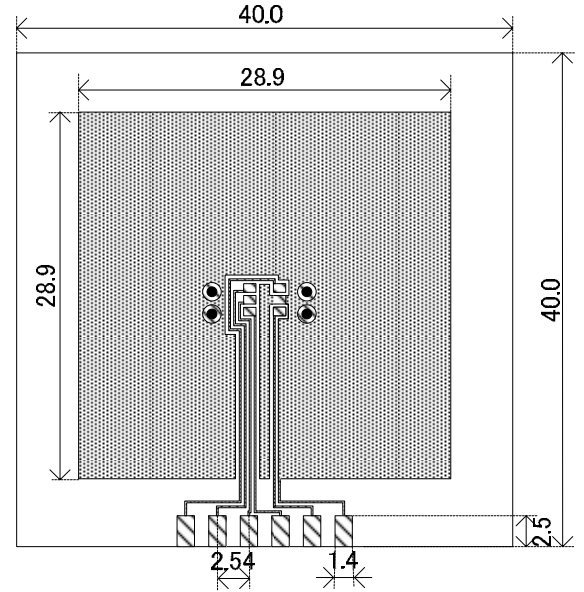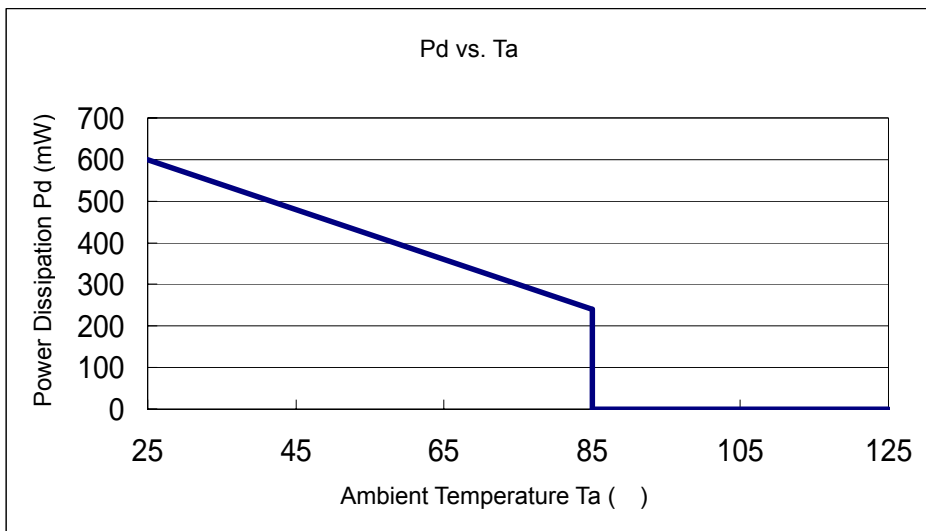| Ambient Temperature	Power Dissipation Pd mW	Thermal Resistance (/W)
25	600	166.67
85	240	

Pd vs. Ta

PACKAGING INFORMATION (Continued)

USPN-4B02 Power Dissipation

Power dissipation data for the USPN-4B02 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 front and 50% of the back.
               The copper area is divided into four block,
               one block is 12.5% of total.
               The USPN-4 package has for terminals.
               Each terminal connects one copper block in the front
               and one in the back.
    Material: Glass Epoxy (FR-4)
    Thickness: 1.6 mm
    Through-hole: 4 x 0.8 Diameter
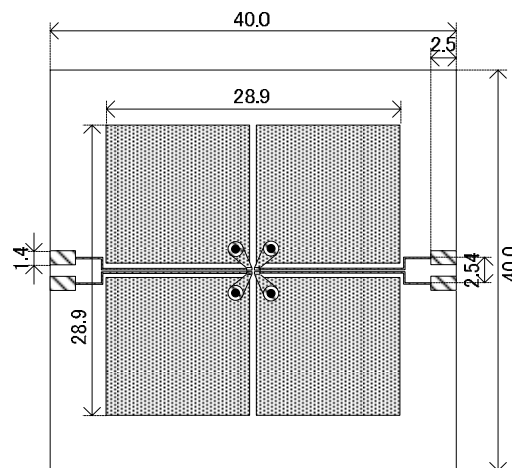
Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient temperature

Board Mount (Tj max = 125)

Ambient Temperature	Power Dissipation Pd mW	Thermal Resistance (/W)
25	550	181.82
85	220	

Pd vs. Ta

XC6224 Series

MARKING RULE

SOT-25

represents product series

MARK	PRODUCT SERIES
1	XC6224******-G
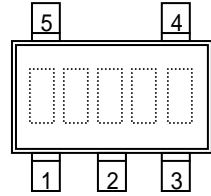
represents type of regulator and combination of output voltage

MARK		PRODUCT SERIES
OUTPUT VOLTAGE 0.1V INCREMENTS	OUTPUT VOLTAGE 0.05V INCREMENTS	
0.8 3.0V	0.85 2.95V	
C	H	XC6224A*****-G
D	K	XC6224B*****-G

represents output voltage

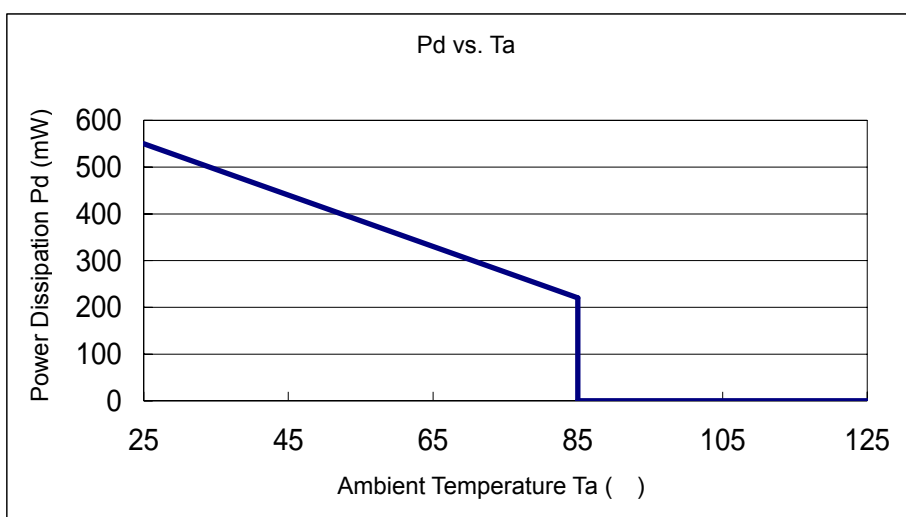| MARK	OUTPUT VOLTAGE (V)				MARK	OUTPUT VOLTAGE (V)			
	0.1V INCREMENTS		0.05V INCREMENTS			0.1V INCREMENTS		0.05V INCREMENTS	
0	0.80	-	0.85	-	F	2.30	-	2.35	-
1	0.90	-	0.95	-	H	2.40	-	2.45	-
2	1.00	-	1.05	-	K	2.50	-	2.55	-
3	1.10	-	1.15	-	L	2.60	-	2.65	-
4	1.20	-	1.25	-	M	2.70	-	2.75	-
5	1.30	-	1.35	-	N	2.80	-	2.85	-
6	1.40	-	1.45	-	P	2.90	-	2.95	-
7	1.50	-	1.55	-	R	3.00	-	-	-
8	1.60	-	1.65	-	S	-	-	-	-
9	1.70	-	1.75	-	T	-	-	-	-
A	1.80	-	1.85	-	U	-	-	-	-
B	1.90	-	1.95	-	V	-	-	-	-
C	2.00	-	2.05	-	X	-	-	-	-
D	2.10	-	2.15	-	Y	-	-	-	-
E	2.20	-	2.25	-	Z	-	-	-	-

represents production lot number

1 09, 0A 0Z, 11 9Z, A1 A9, AA Z9, ZA ZZ repeated.
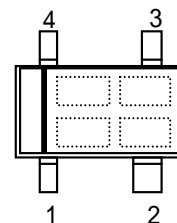
(G, I, J, O, Q, W excluded.)

* No character inversion used.

MARKING RULE (Continued)

SSOT24 (with bar)

represents type of regulator and combination of output voltage

MARK				PRODUCT SERIES
OUTPUT VOLTAGE 0.1V INCREMENTS		OUTPUT VOLTAGE 0.05V INCREMENTS		
VOLTAGE =0.8 2.4V	VOLTAGE =2.5 3.0V	VOLTAGE =0.85 1.95V	VOLTAGE =2.05 2.95V	
A	F	F	Z	XC6224A*****-G
H	P	P	R	XC6224B*****-G

represents output voltage

MARK	OUTPUT VOLTAGE (V)					MARK	OUTPUT VOLTAGE (V)			
	XC6224A/B			XC6224A			XC6224A/B		XC6224B	
0	0.80	0.85	-	2.05	-	F	-	-	-	-
1	0.90	0.95	-	2.15	-	H	-	-	-	-
2	1.00	1.05	-	2.25	-	K	-	-	-	-
3	1.10	1.15	-	2.35	-	L	-	-	-	-
4	1.20	1.25	-	2.45	-	M	-	-	-	-
5	1.30	1.35	-	2.55	-	N	2.10	-	2.05	-
6	1.40	1.45	-	2.65	-	P	-	-	2.15	-
7	1.50	1.55	-	2.75	-	R	-	-	2.25	-
8	1.60	1.65	-	2.85	-	S	-	-	2.35	-
9	1.70	1.75	-	2.95	-	T	-	-	2.45	-
A	1.80	1.85	-	-	-	U	2.20	2.60	2.55	-
B	1.90	1.95	-	-	-	V	2.30	2.70	2.65	-
C	2.00	-	2.50	-	-	X	2.40	2.80	2.75	-
D	-	-	-	-	-	Y	-	2.90	2.85	-
E	-	-	-	-	-	Z	-	3.00	2.95	-

represents production lot number

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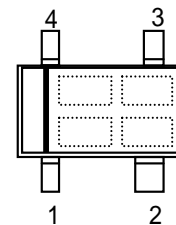(G, I, J, O, Q, W excluded.)
* No character inversion used.

MARKING RULE (Continued)

USPN-4B02

represents type of regulator and combination of output voltage

MARK		PRODUCT SERIES
OUTPUT VOLTAGE 0.1V INCREMENTS	OUTPUT VOLTAGE 0.05V INCREMENTS	
VOLTAGE =0.8 3.0V	VOLTAGE =0.85 2.95V	
0	1	XC6224A*****-G
2	3	XC6224B*****-G

represents output voltage

MARK	OUTPUT VOLTAGE (V)		MARK	OUTPUT VOLTAGE (V)	
0	0.80	0.85	F	2.30	2.35
1	0.90	0.95	H	2.40	2.45
2	1.00	1.05	K	2.50	2.55
3	1.10	1.15	L	2.60	2.65
4	1.20	1.25	M	2.70	2.75
5	1.30	1.35	N	2.80	2.85
6	1.40	1.45	P	2.90	2.95
7	1.50	1.55	R	3.00	-
8	1.60	1.65	S	-	-
9	1.70	1.75	T	-	-
A	1.80	1.85	U	-	-
B	1.90	1.95	V	-	-
C	2.00	2.05	X	-	-
D	2.10	2.15	Y	-	-
E	2.20	2.25	Z	-	-

represents production lot number
0 9, A Z repeated.
(G, I, J, O, Q, W excluded.)
* No character inversion used.

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