XC6224 Series

ETR0340-006

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) 0.47μF.

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 VOUT pin quickly returns to the VSS level.

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

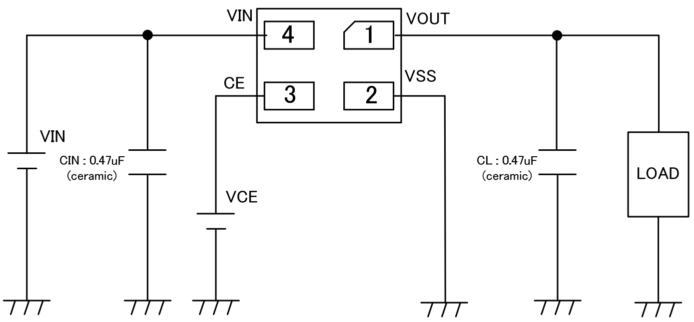
■APPLICATIONS

- ●Cell phones
- ●Digital still cameras
- ●Portable electronic devices
- ●Portable media players
- ●Bluetooth
- ●Wireless LAN
- ●Terrestrial digital TV tuners

■FEATURES

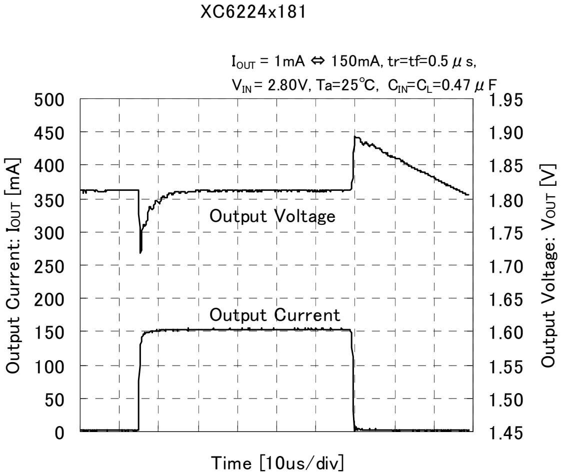
Maximum Output Current	: 150mA
Operating Voltage Range	: 1.2V～3.6V
High Accuracy	: ±1.5% (V_{OUT} =1.25V～3.0V) ±20mV (V_{OUT} = 0.8V～1.20V)
Low Power Consumption	: 33μA (TYP.)
Stand-by Current	: 0.1μA
High Ripple Rejection	: 70dB@1kHz
Dropout Voltage	: 210mV@150mA (V_{OUT}=2.8V)
Protection Circuits	: 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

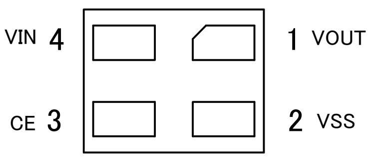


USPN-4B02 0.75mm×0.95mm size
(BOTTOM VIEW)

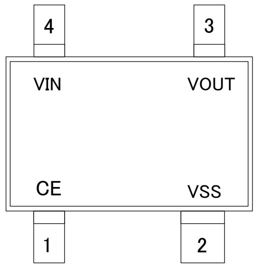
■TYPICAL PERFORMANCE CHARACTERISTICS



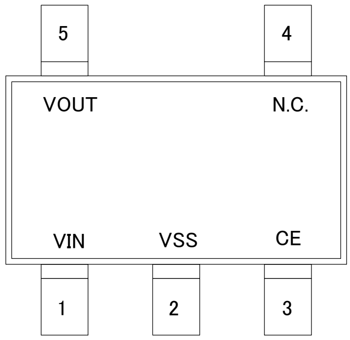
■PIN CONFIGURATION



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	$0V \leqq V_{CE} \leqq 0.3V$
	H	$1.0V \leqq V_{CE} \leqq 3.6V$
	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

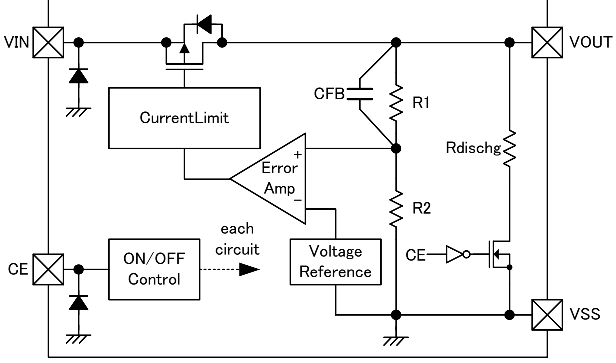
XC6224①②③④⑤⑥-⑦(*1)

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	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
②③	Output Voltage	08～30	ex.) 2.5V → ②=2, ③=5
④	Output Voltage (The 2nd Decimal Place)	1	{x.x0V} (the 2nd decimal place is “0”)
		B	{x.x5V} (the 2nd decimal place is “5”)
⑤⑥-⑦	Packages (Order Unit)	7R-G	USPN-4B02 (5,000/Reel)
		MR-G	SOT-25 (3,000/Reel)
		NR-G	SSOT-24 (3,000/Reel)

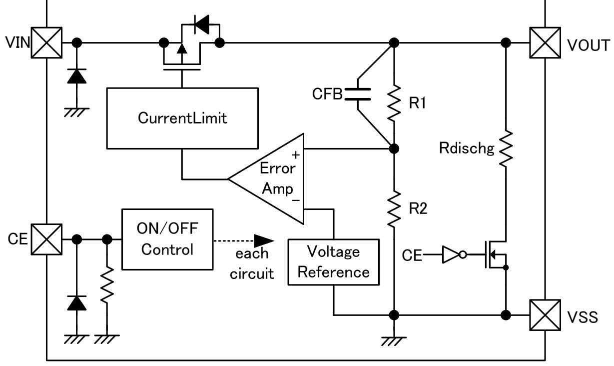
(*1) The “-G” suffix denotes Halogen and Antimony free as well as being fully RoHS compliant.

■BLOCK DIAGRAMS

XC6224Axxxxx



XC6224Bxxxxx



■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	①
		$V_{OUT(T)}$≦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	①
Load Regulation	ΔV_{OUT}	V_{CE}=V_{IN} 0.1mA≦I_{OUT}≦150mA	-	5	20	mV	①
Dropout Voltage (*4)	Vdif	I_{OUT}=150mA V_{CE}=V_{IN}, V_{IN}=$V_{OUT(E)}$×0.98 (*3)	E-1			mV	①
Supply Current	I_{DD}	V_{CE}=V_{IN}, I_{OUT}=0mA	-	33	77	μA	②
Stand-by Current	I_{STBY}	V_{CE}=V_{SS}		0.01	0.4	μA	②
Line Regulation	ΔV_{OUT}/ (ΔV_{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	①
Input Voltage	V_{IN}		1.2	-	3.6	V	①
Output Voltage Temperature Characteristics	ΔV_{OUT}/ (ΔTa・V_{OUT})	V_{CE}=V_{IN}, I_{OUT}=30mA (*1) -40℃≦Ta≦85℃	-	±100	-	ppm/℃	①
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	③
Current Limit	I_{LIM}	V_{CE}=V_{IN}	150	250	-	mA	①
Short Current	I_{SHORT}	V_{CE}=V_{IN}, V_{OUT} is connected to V_{SS}	-	35	-	mA	①
CE High Level Voltage	V_{CEH}		1.0	-	3.6	V	④
CE Low Level Voltage	V_{CEL}		-	-	0.3	V	④
CE High Level Current	I_{CEH}	V_{CE}=V_{IN} A Type	-0.1	0	0.1	μA	④
CE High Level Current	I_{CEL}	V_{CE}=V_{SS}	-0.1	0	0.1	μA	④
C_L Discharge Resistance	R_{DCHG}	V_{IN}=3.6V, V_{CE}=V_{SS}	-	450	-	Ω	①

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)

●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	$V_{OUT(T)}$×0.985 (*2)	$V_{OUT(T)}$ (*2)	$V_{OUT(T)}$×1.015 (*2)	V	①
		$V_{OUT(T)}$≦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	①
Load Regulation	ΔV_{OUT}	$V_{CE}=V_{IN}$ (*1) 0.1mA≦I_{OUT}≦150mA	-	5	20	mV	①
Dropout Voltage (*4)	Vdif	I_{OUT}=150mA, $V_{CE}=V_{IN}$ $V_{IN}=V_{OUT(E)}$×0.98 (*3)	E-1			mV	①
Supply Current	I_{DD}	$V_{CE}=V_{IN}$ (*1) I_{OUT}=0mA	-	33	77	μA	②
Stand-by Current	I_{STBY}	$V_{CE}=V_{SS}$	-	0.01	0.4	μA	②
Line Regulation	ΔV_{OUT}/ ($\Delta V_{IN}\cdot V_{OUT}$)	$V_{OUT(T)}$≧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	①
Input Voltage	V_{IN}		1.2	-	3.6	V	①
Output Voltage Temperature Characteristics	ΔV_{OUT}/ ($\Delta Ta\cdot V_{OUT}$)	$V_{CE}=V_{IN}$, I_{OUT}=30mA (*1) -40℃≦Ta≦85℃	-	±100	-	ppm/℃	①
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	③
Current Limit	I_{LIM}	$V_{CE}=V_{IN}$	150	250	-	mA	①
Short Current	I_{SHORT}	$V_{CE}=V_{IN}$, V_{OUT} is connected to V_{SS}	-	35	-	mA	①
CE High Level Voltage	V_{CEH}		1.0	-	3.6	V	④
CE Low Level Voltage	V_{CEL}		-	-	0.3	V	④
CE High Level Current	I_{CEH}	$V_{CE}=V_{IN}$ B Type	-	5.5	13.0	μA	④
CE High Level Current	I_{CEL}	$V_{CE}=V_{SS}$	-0.1	0	0.1	μA	④
C_L Discharge Resistance	R_{DCHG}	V_{IN}=3.6V, $V_{CE}=V_{SS}$	-	450	-	Ω	①

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.

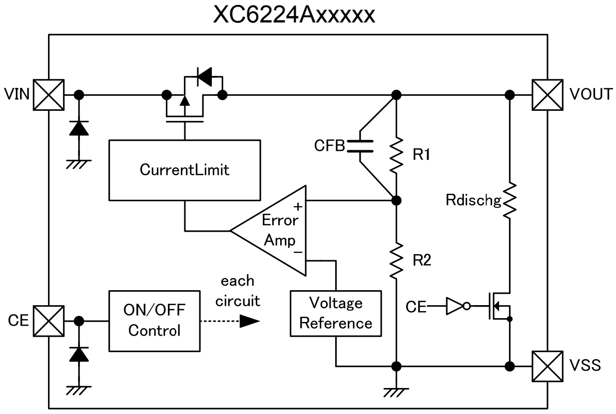
■ELECTRICAL CHARACTERISTICS (Continued)

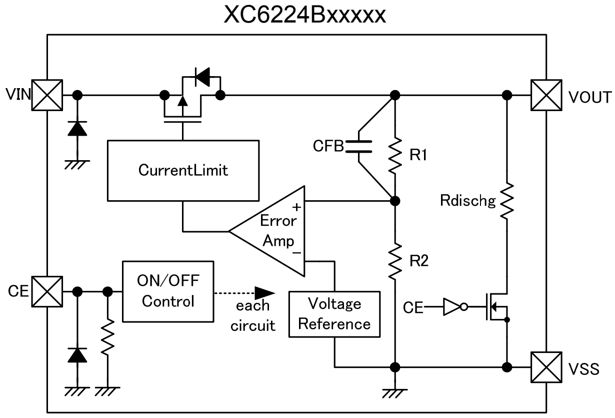
●Voltage Table

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





The voltage divided by resistors R1 & R2 is compared with the internal reference voltage by the error amplifier. The P-channel MOSFET which is connected to the VOUT pin is then driven by the subsequent output signal. The output voltage at the VOUT pin is controlled 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 0.47 μF or bigger at the V_{OUT} pin as close as possible. For a stable power input, please connect an input capacitor C_{IN} of 0.47 μF 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>

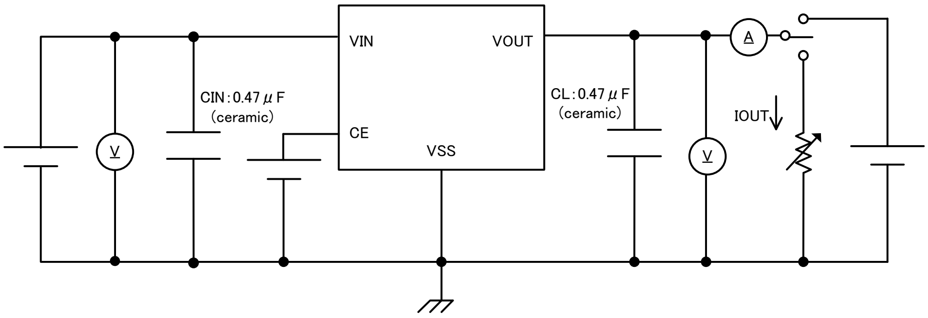
The IC's internal circuitry can be shutdown via the signal from the CE pin. In shutdown mode, output at the V_{OUT} pin will be pulled down to the V_{SS} level in the XC6224B series. When the CE pin is open, the output voltage becomes undefined state in the XC6224A series because of a high active and 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

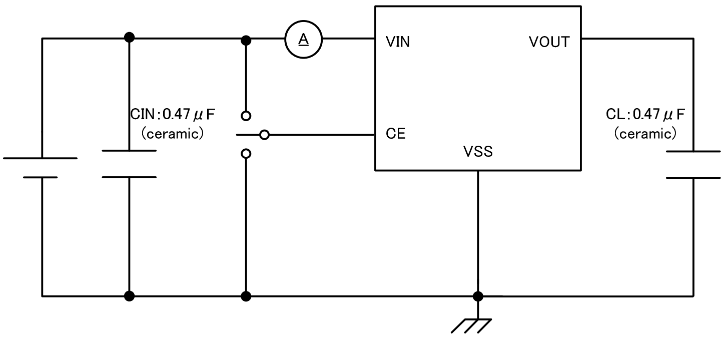
1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. Torex places an importance on improving our products and its reliability.
   However, by any possibility, we would request user fail-safe design and post-aging 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

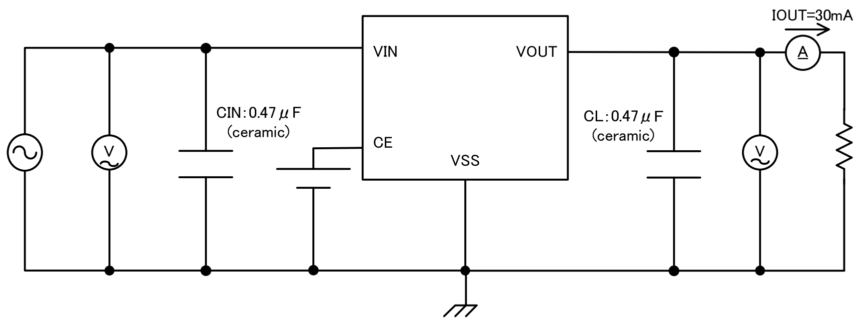
●Circuit ①



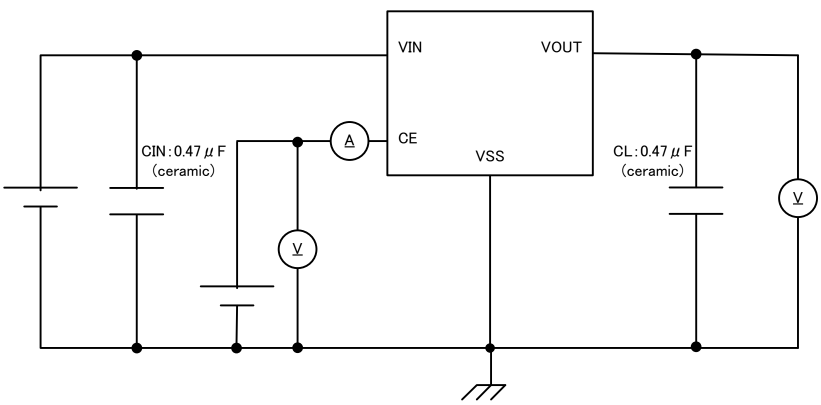
●Circuit ②



●Circuit ③

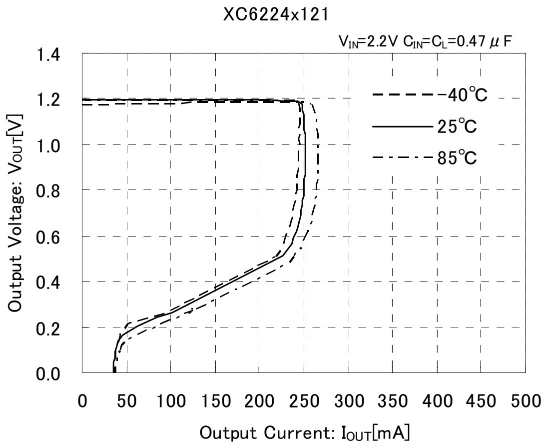


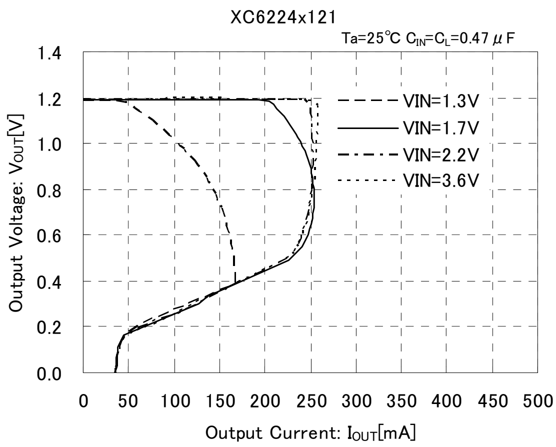
●Circuit ④

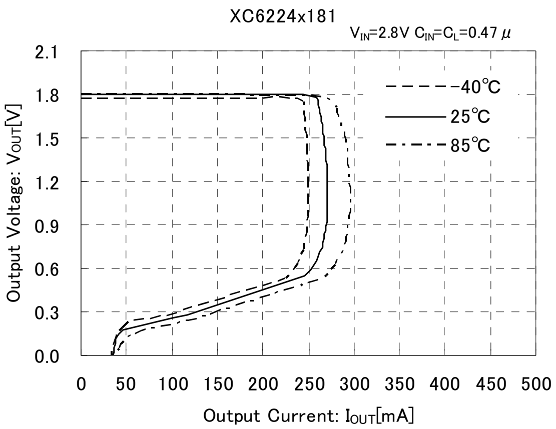


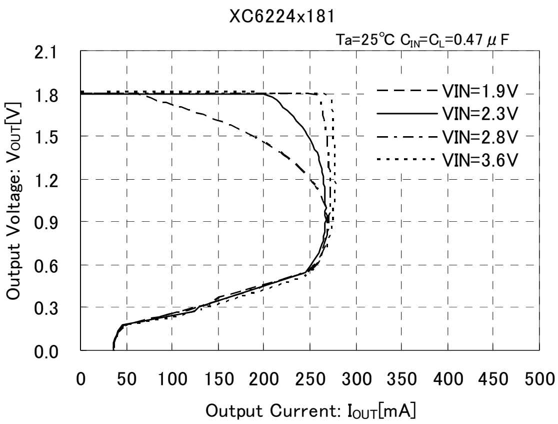
■TYPICAL PERFORMANCE CHARACTERISTICS

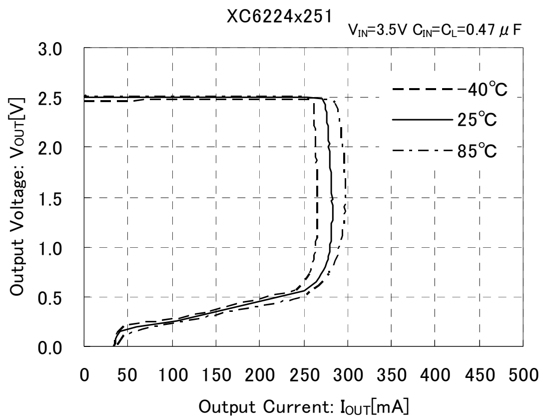
(1) Output Voltage vs. Output Current

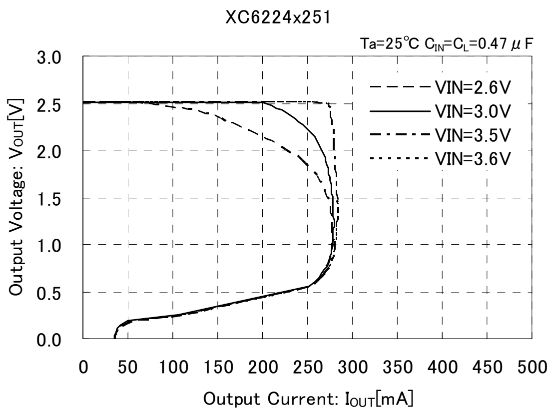






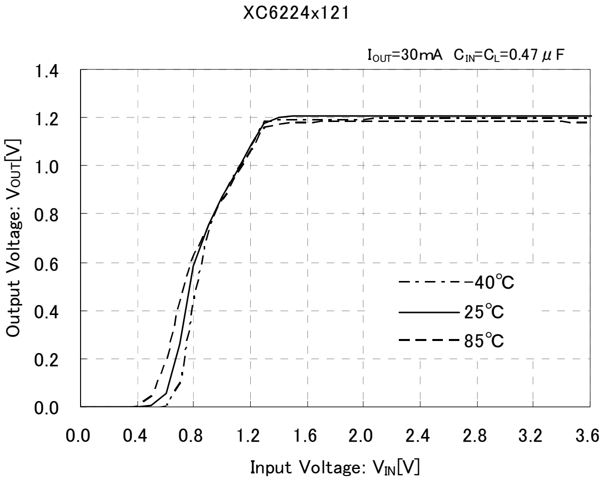


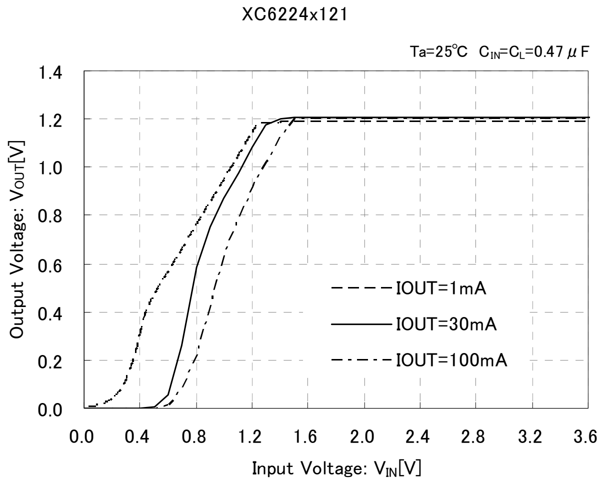


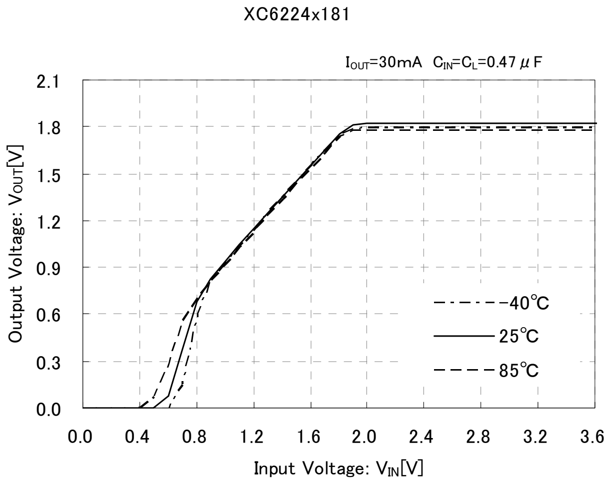


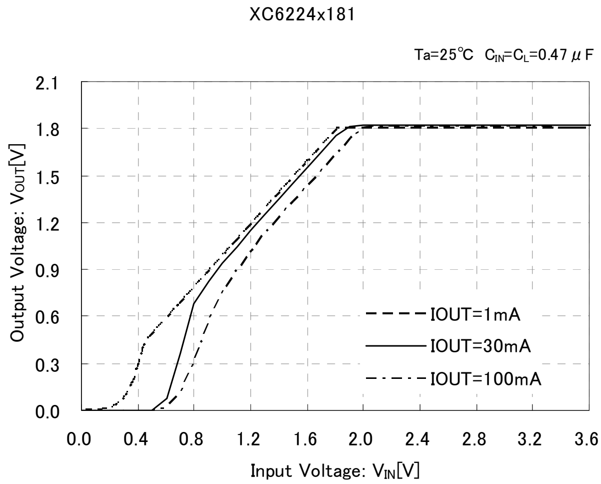
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

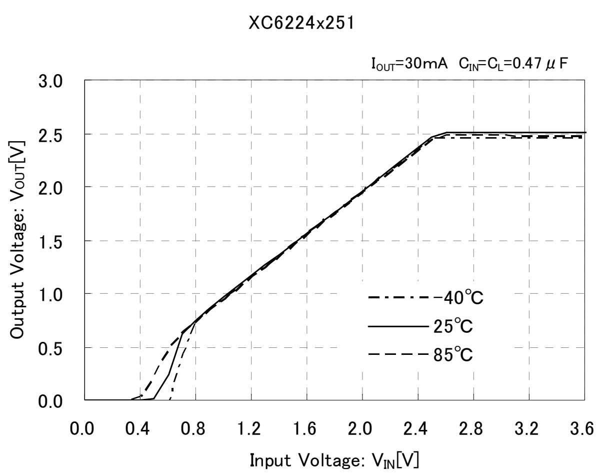
(2) Output Voltage vs. Input Voltage

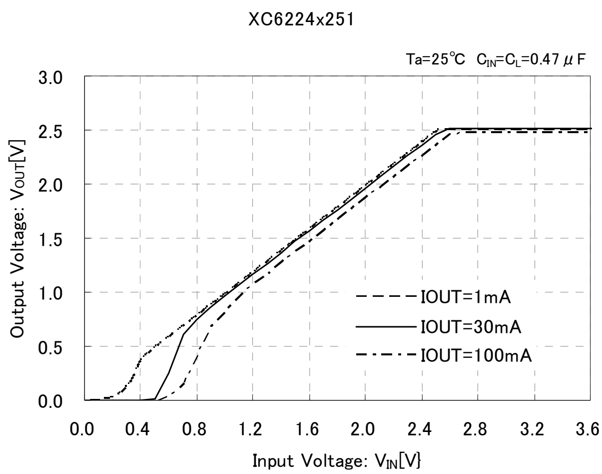








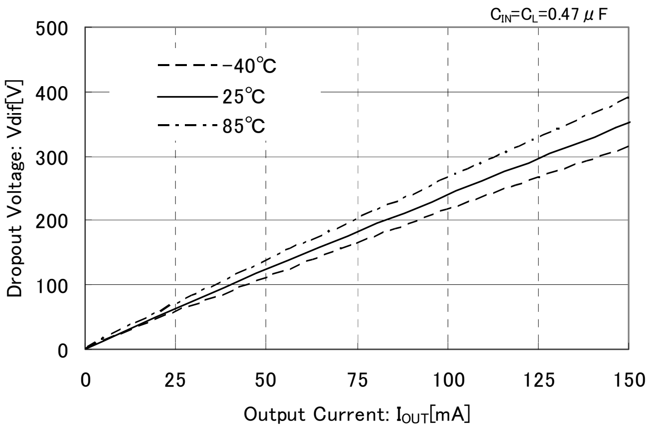




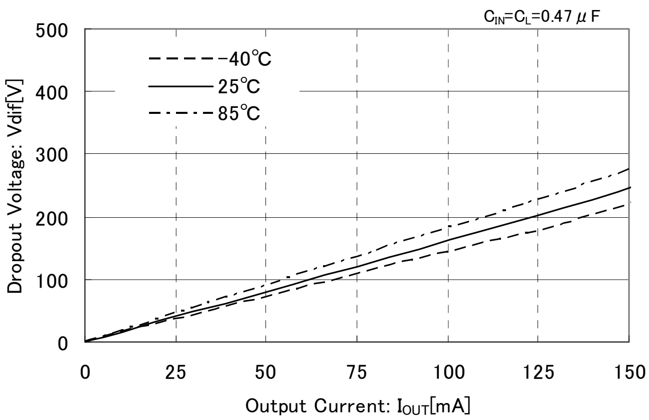
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

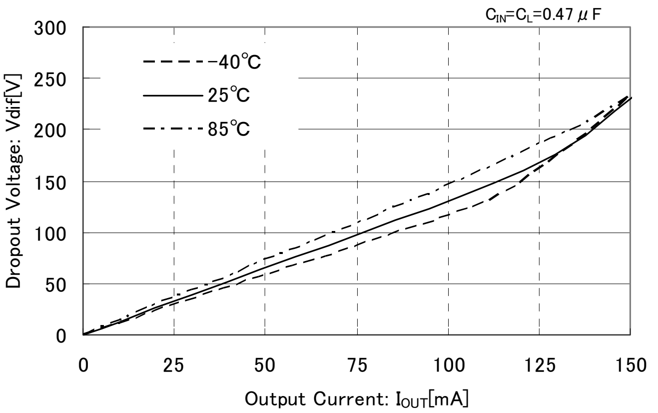
XC6224x121



XC6224x181

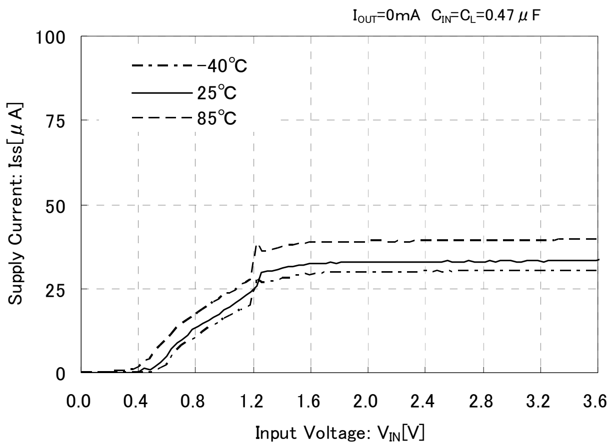


XC6224x251

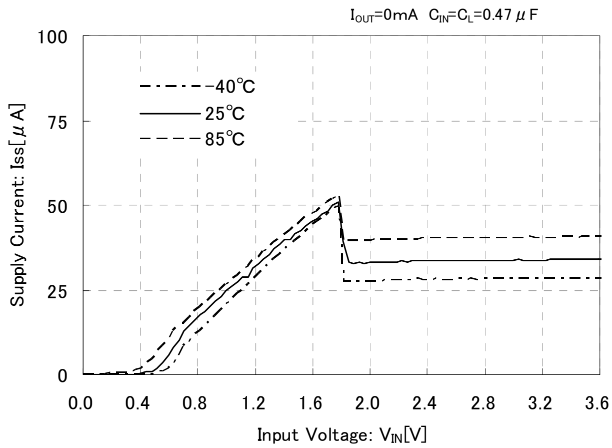


(4) Supply Current vs. Input Voltage

XC6224x121

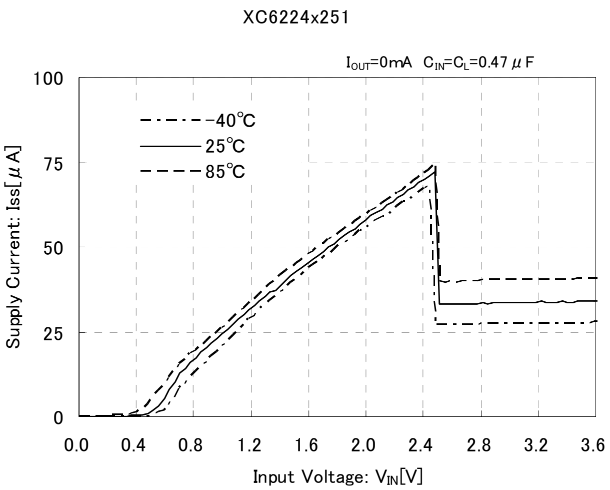


XC6224x181

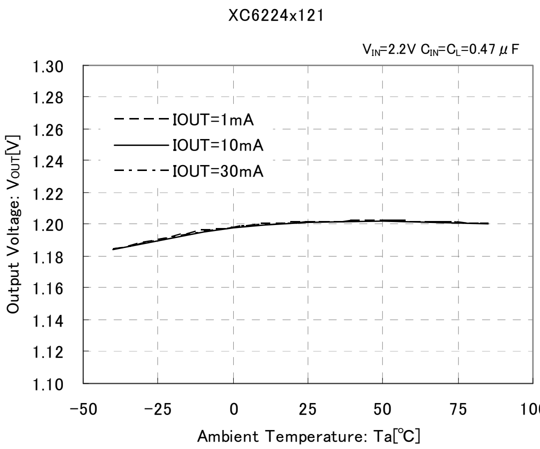


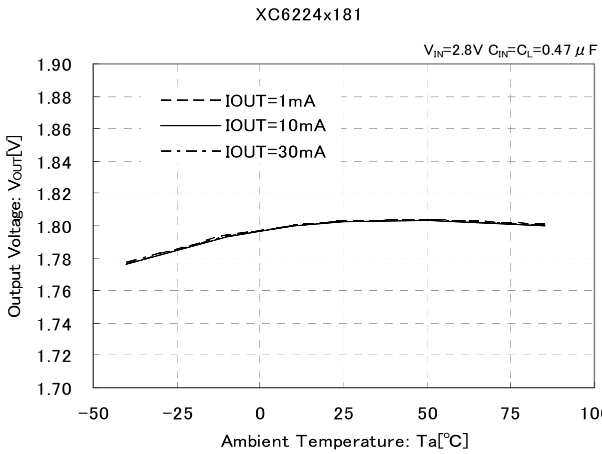
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

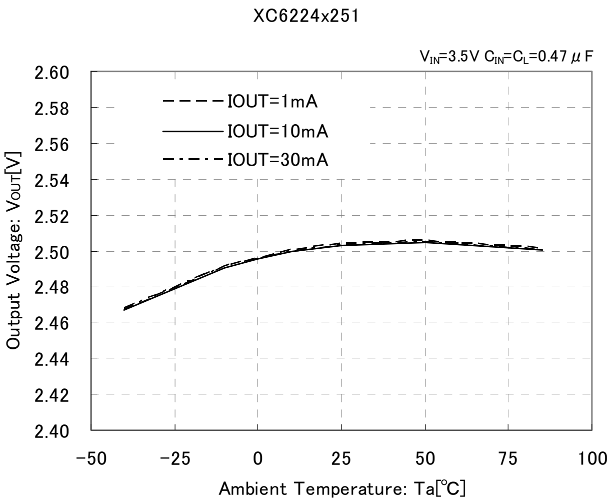
(4) Supply Current vs. Input Voltage (Continued)



(5) Output Voltage vs. Ambient Temperature



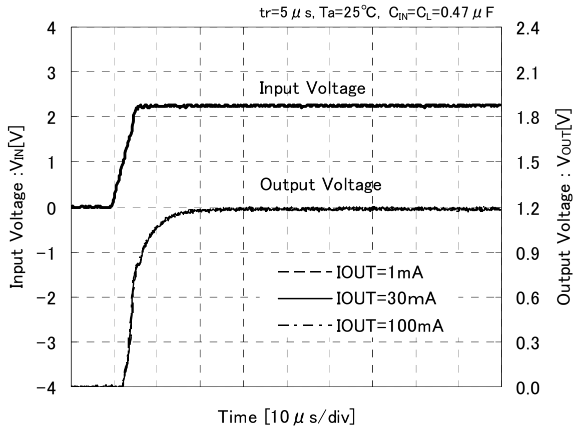




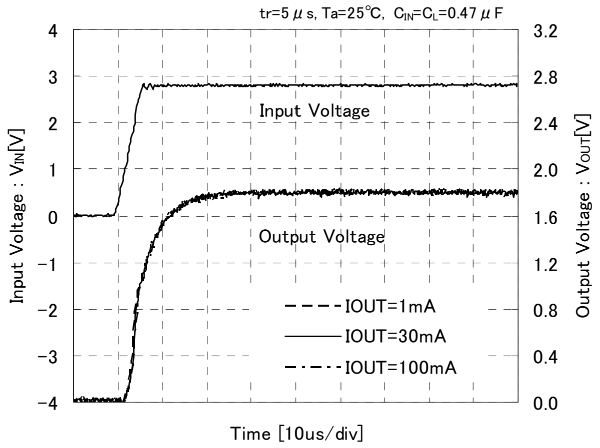
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(6) Rising Response Time

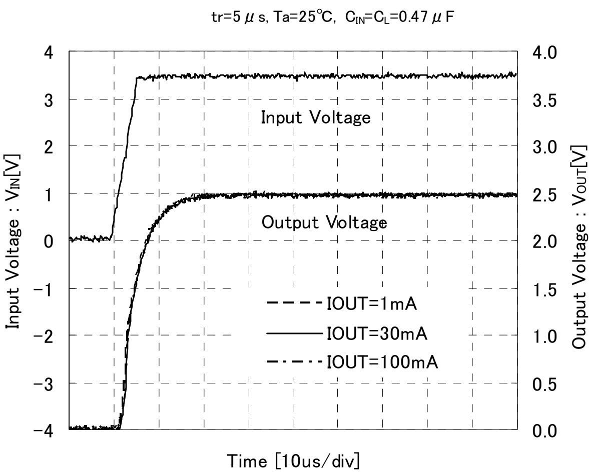
XC6224x121



XC6224x181

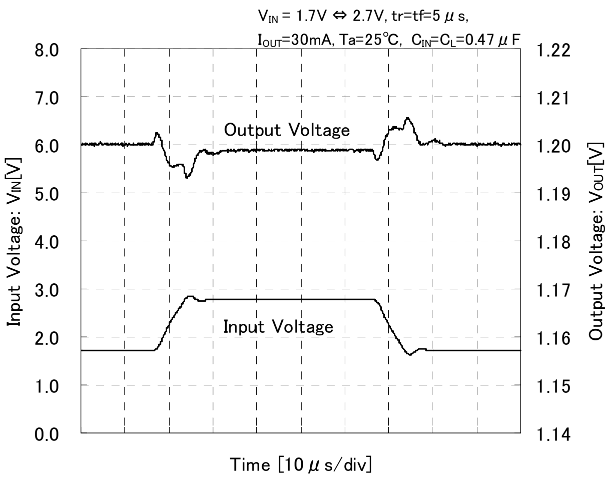


XC6224x251

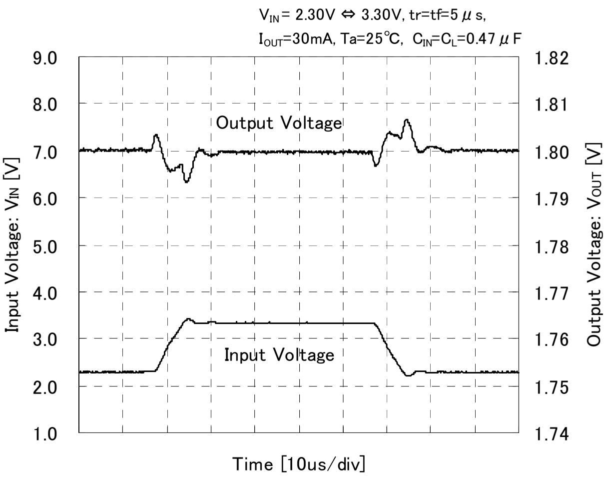


(7) Input Transient Response

XC6224x121

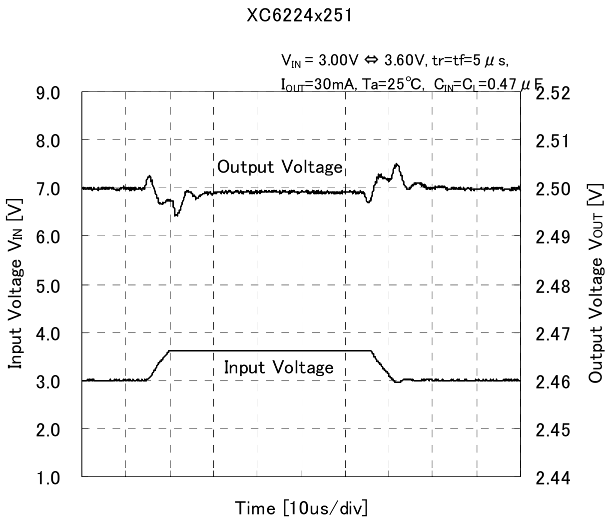


XC6224x181

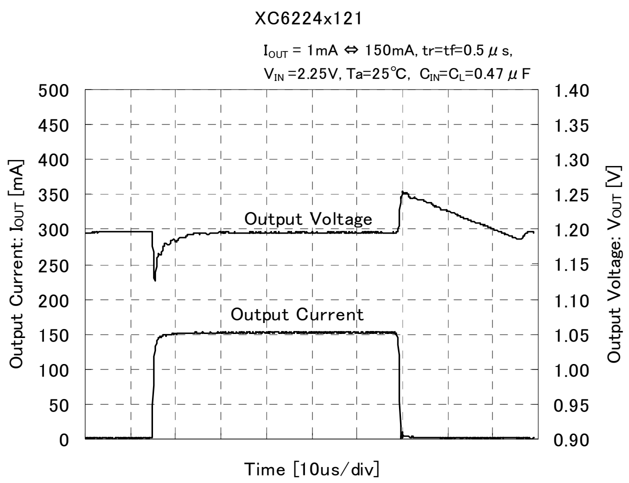


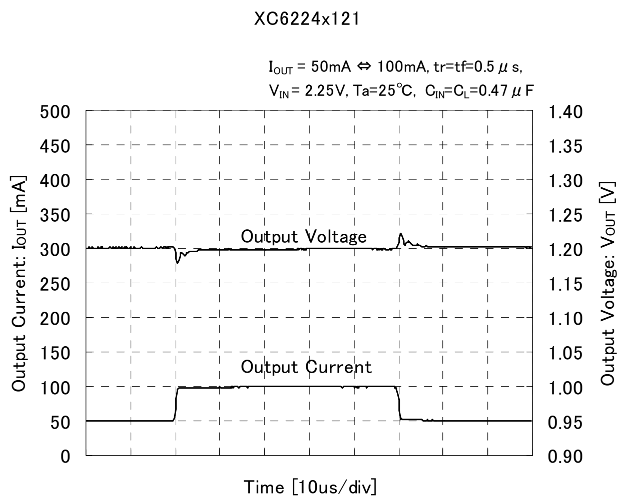
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

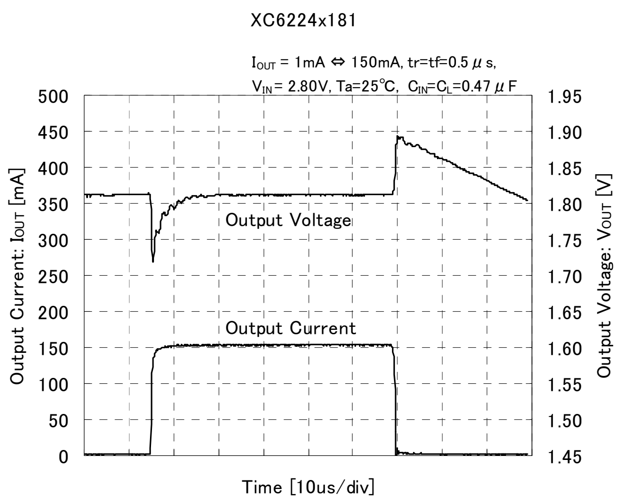
(7) Input Transient Response (Continued)

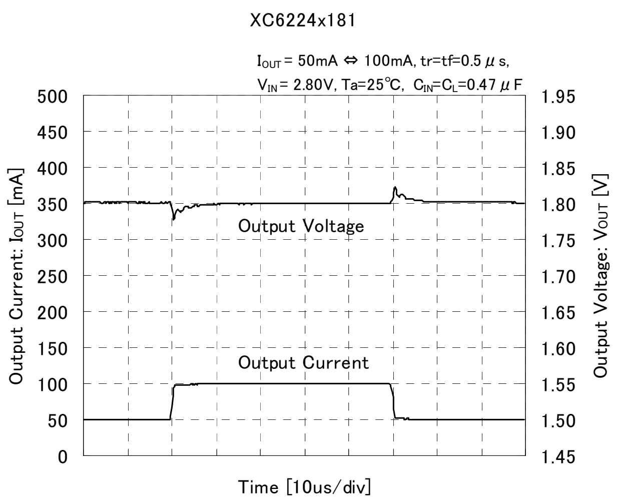


(8) Load Transient Response



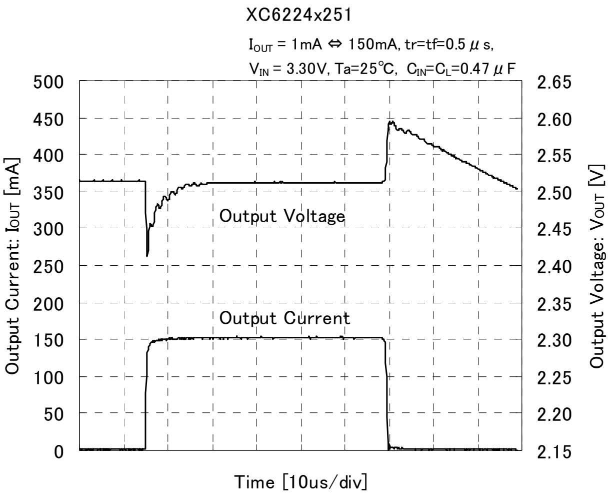


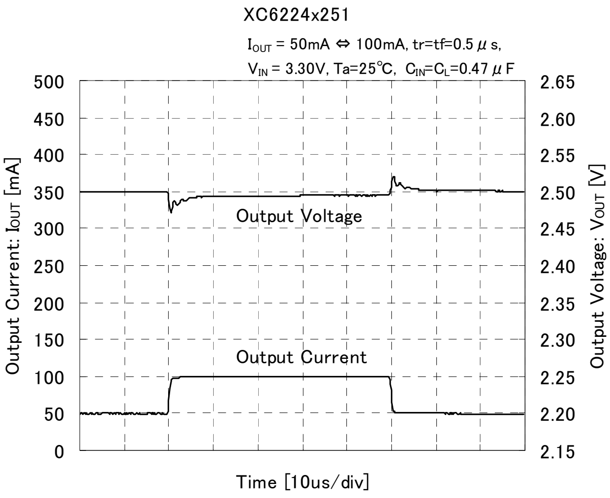




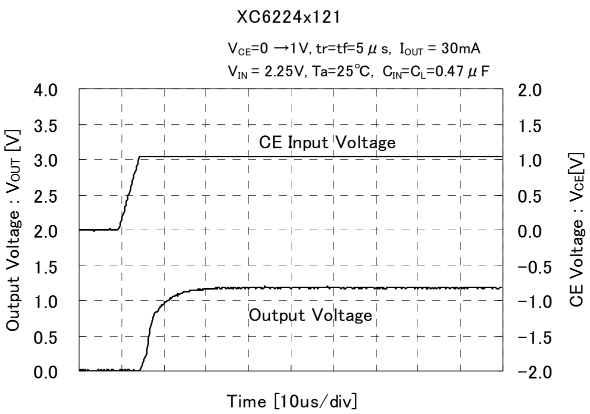
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

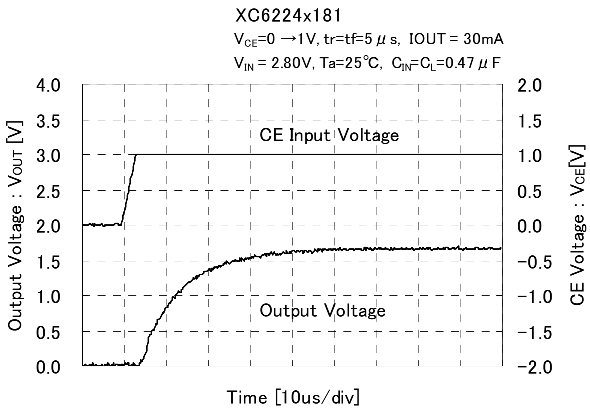
(8) Load Transient Response (Continued)

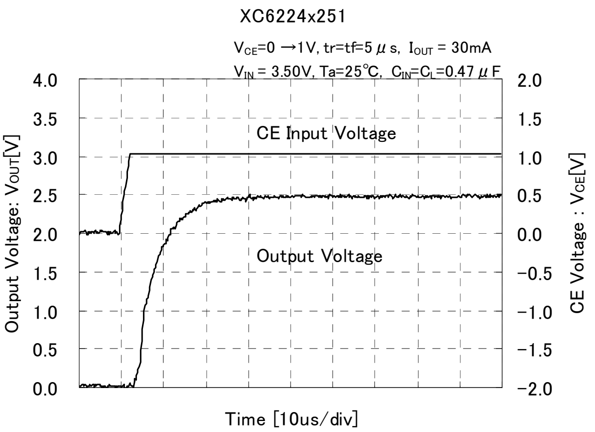




(9) CE Rising Response Time

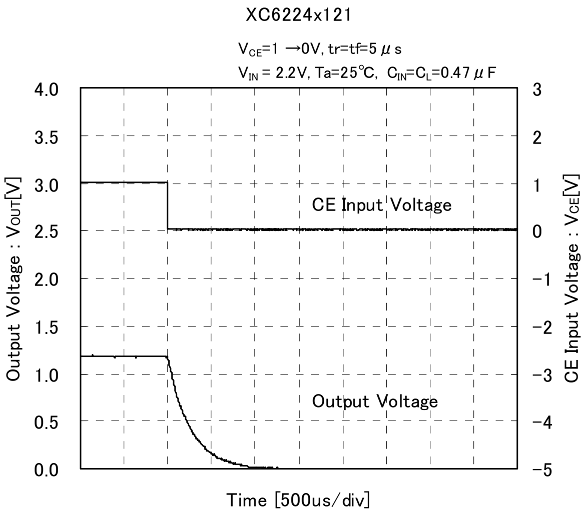


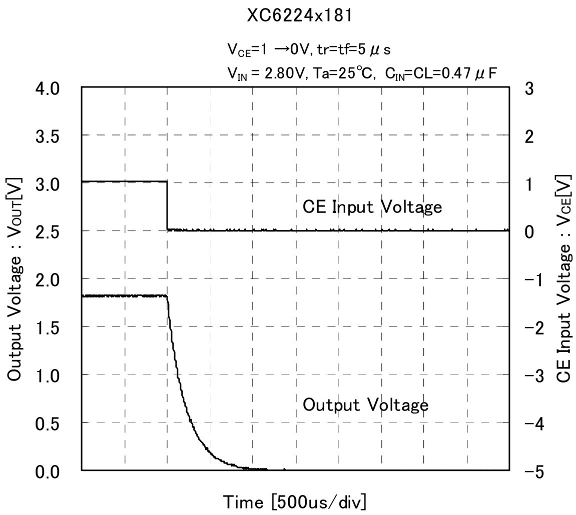


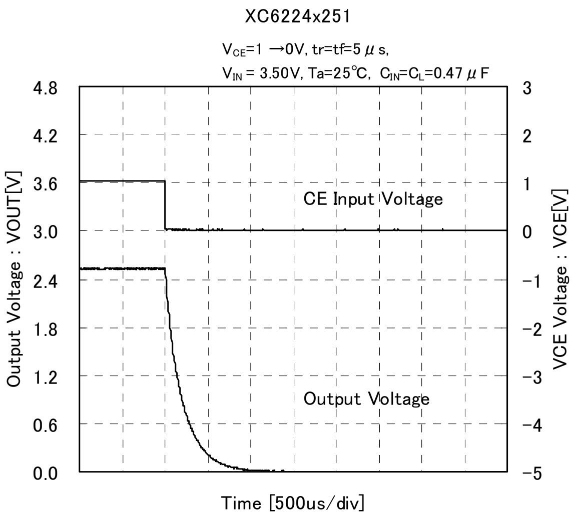


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

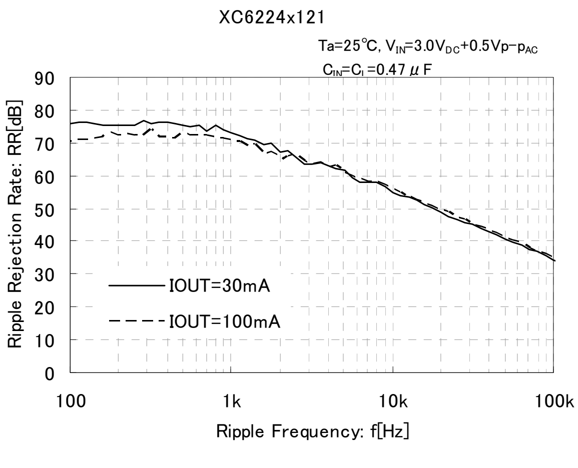
(10) C_L Discharge Response Time

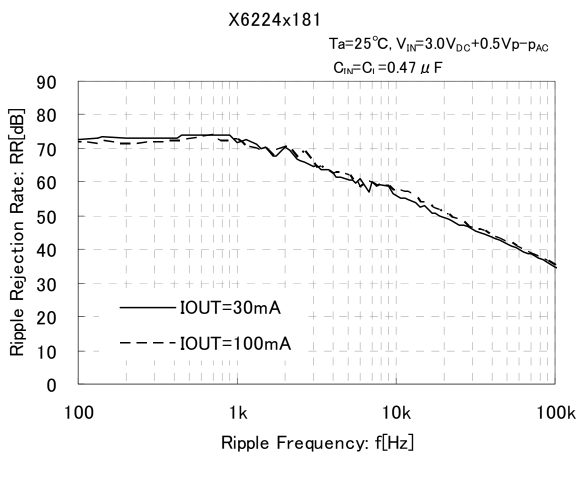






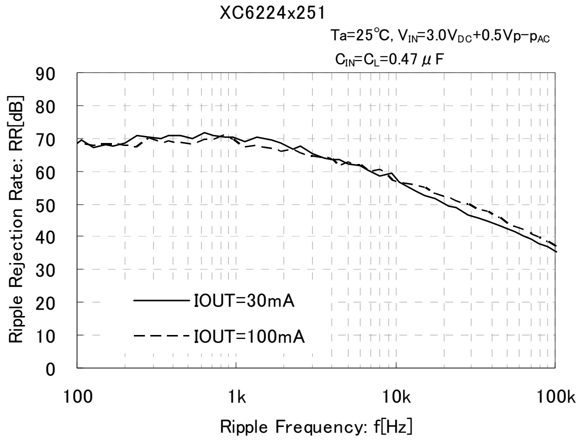
(11) Ripple Rejection Rate



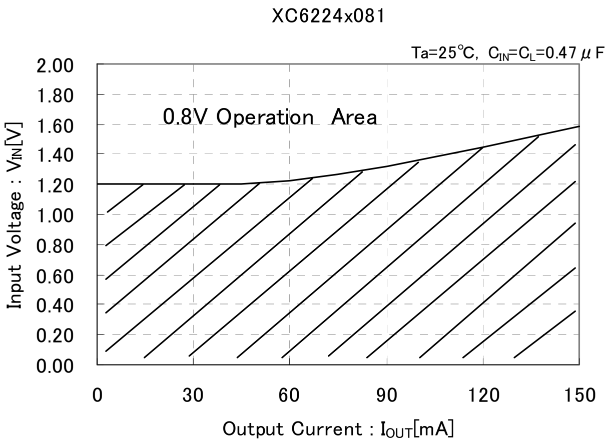


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(11) Ripple Rejection Rate



(12) The Minimum Operating Voltage

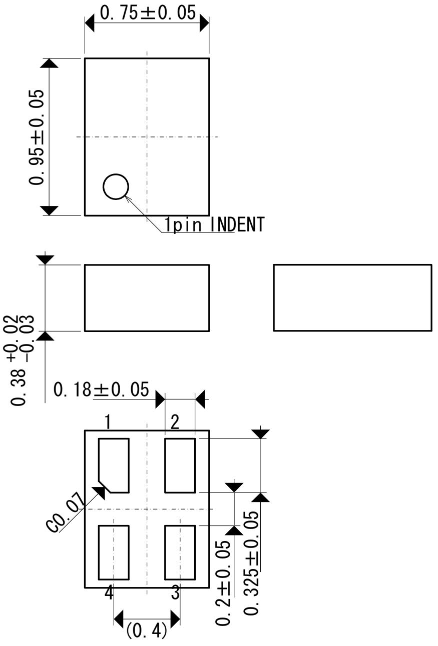


* The graph shows minimum input voltages as a function of output current. The vales are influenced by a driver ON resistance.

■PACKAGING INFORMATION

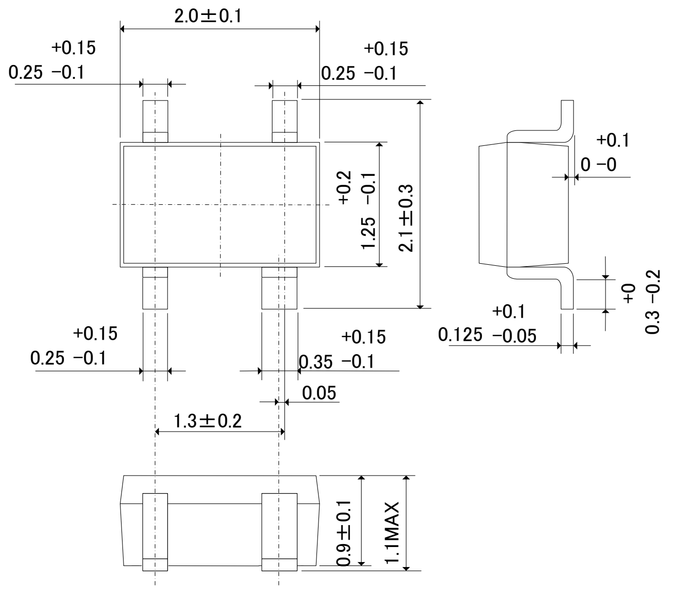
USPN-4B02

(unit : mm)



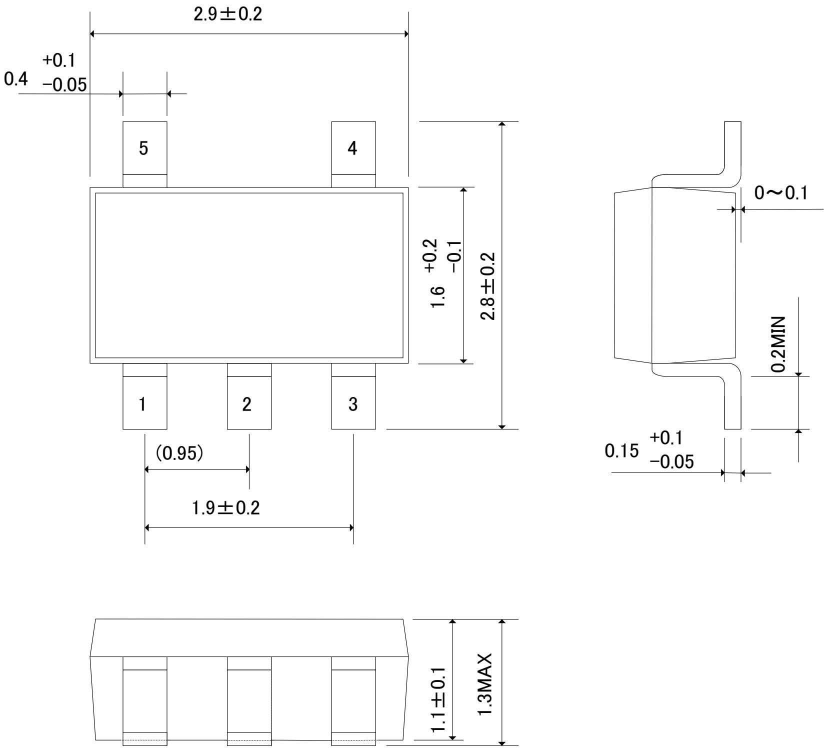
SSOT-24

(unit : mm)



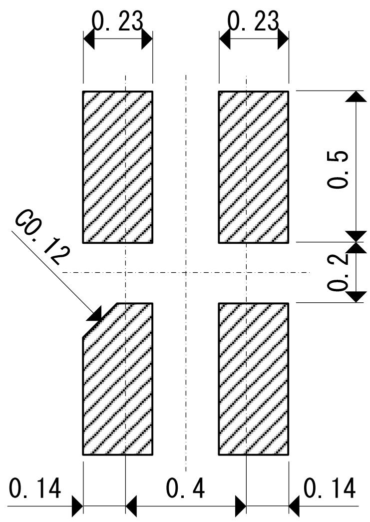
SOT-25

(unit : mm)

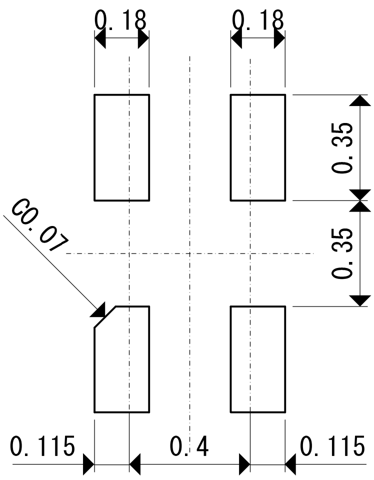


■PACKAGING INFORMATION (Continued)

●USPN-4B02 Reference Pattern Layout



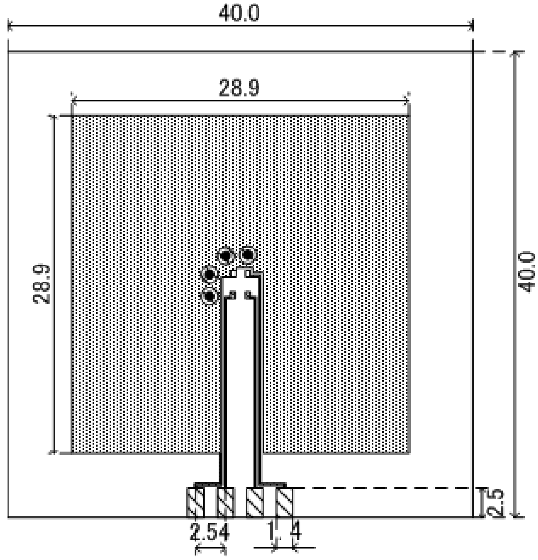
●USPN-4B02 Reference Metal Mask Design



■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.



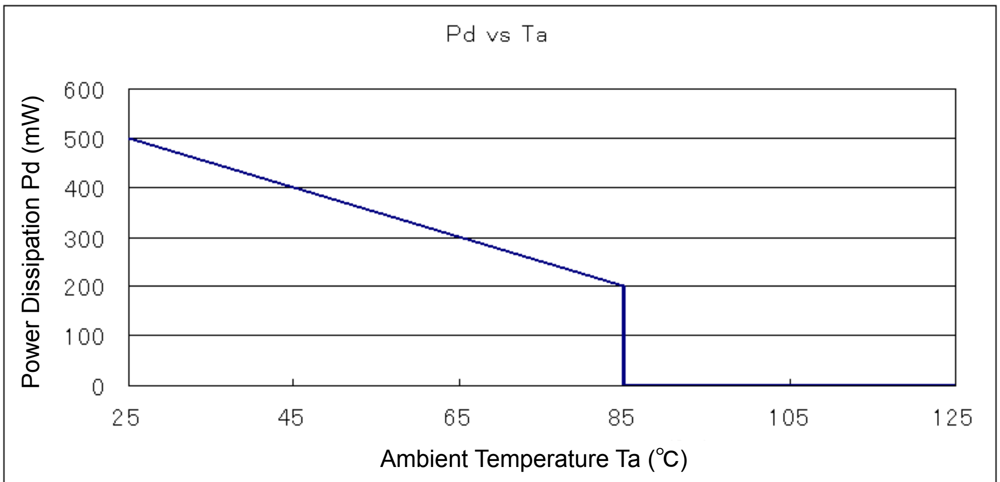
Evaluation Board (Unit: mm)

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

2. Power Dissipation vs. Ambient temperature

Board Mount (Tj max = 125℃)

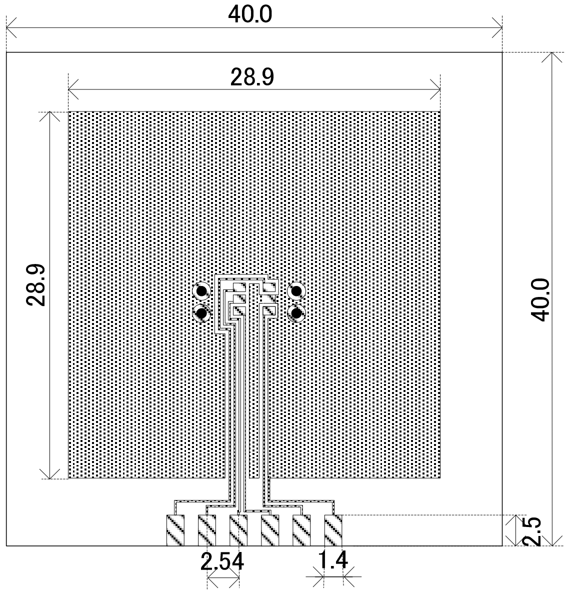
Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	500	200.00
85	200	



■PACKAGING INFORMATION (Continued)

● 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.



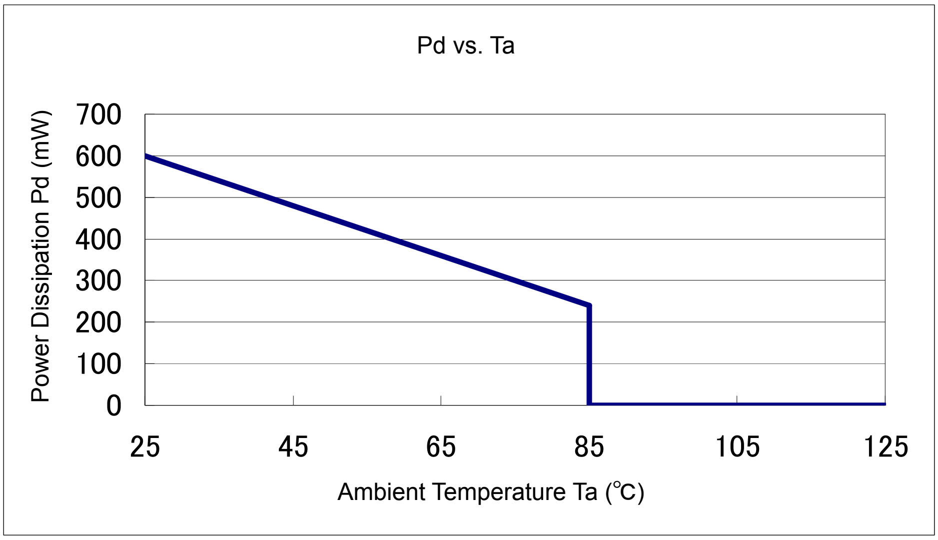
Evaluation Board (Unit: mm)

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

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	



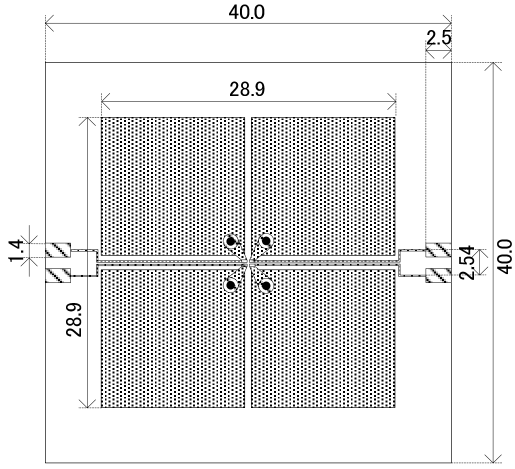
■PACKAGING INFORMATION (Continued)

● 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

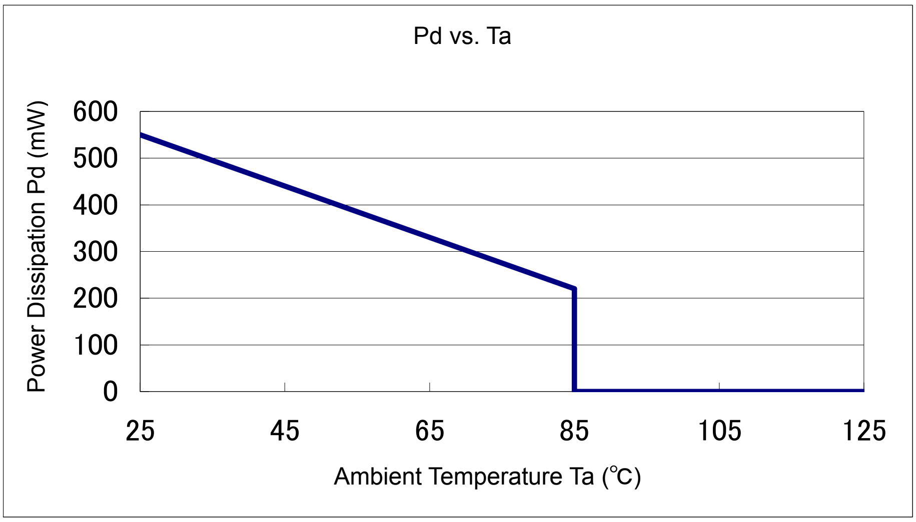


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient temperature

Board Mount (Tj max = 125℃)

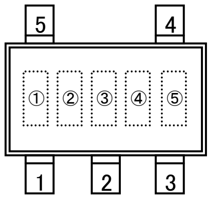
Ambient Temperature(℃)	Power Dissipation Pd(mW)	Thermal Resistance (℃/W)
25	550	181.82
85	220	



■ MARKING RULE

●SOT-25

① represents product series



MARK	PRODUCT SERIES
1	XC6224******-G

② 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

③ 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	-	-	-	-

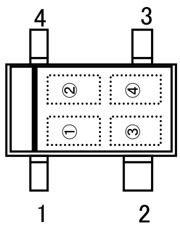
④⑤ represents production lot number
1～09, 0A～0Z, 11･･･9Z, A1～A9, AA･･･Z9, ZA～ZZ repeated.
(G, I, J, O, Q, W excluded.)
* No character inversion used.

■ MARKING RULE (Continued)

●SSOT24 (with bar)

① 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



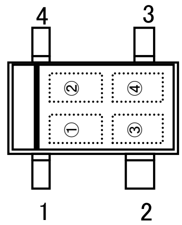
② represents output voltage

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	-

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.

■ MARKING RULE (Continued)

●USPN-4B02



① 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

② 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	-	-

③ represents production lot number
0～9, A～Z repeated.
(G, I, J, O, Q, W excluded.)
* No character inversion used.

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4. The products in this datasheet are not developed, designed, or approved for use with such equipment whose failure of malfunction can be reasonably expected to directly endanger the life of, or cause significant injury to, the user.
   (e.g. Atomic energy; aerospace; transport; combustion and associated safety equipment thereof.)
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