XC6223 Series

ETR0339-002

Built-in Inrush Current Protection, 300mA High Speed LDO Voltage Regulator

■GENERAL DESCRIPTION

The XC6223 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, a phase compensation circuit, a thermal shutdown circuit and an inrush current protection circuit.

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 output stabilization capacitor C_L is also compatible with low ESR ceramic capacitors.

The output voltage is selectable in 0.05V increments within the range of 1.2V to 4.0V which fixed by laser trimming technologies. The over current protection circuit and the thermal shutdown circuit are built-in. These two protection circuits will operate when the output current reaches current limit level or the junction temperature reaches temperature limit level.

■APPLICATIONS

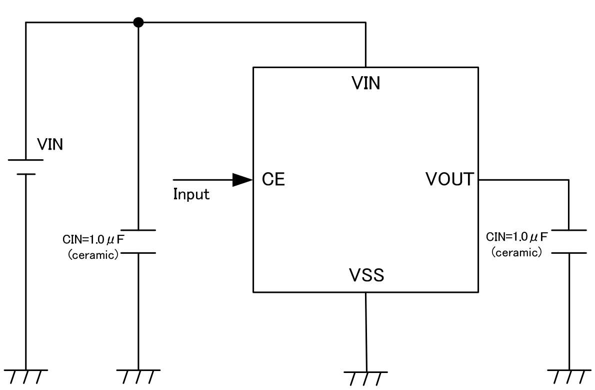
- ●Digital still cameras
- ●Cell phones
- ●Portable games
- ●Camera modules
- ●IC recorders
- ●Portable media players
- ●Bluetooth
- ●Wireless LAN
- ●Terrestrial digital TV tuners
- ●Cordless phones

■FEATURES

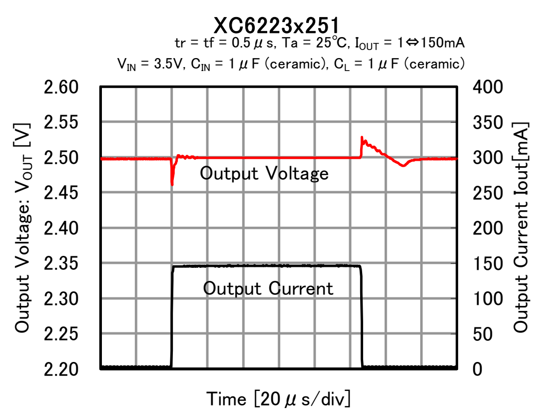
Input Voltage Range	: 1.6～5.5V
Output Voltages	: 2.0～4.0V (Accuracy ±1%) 1.2～1.95V (Accuracy ±20mV) 0.05V increments
Dropout Voltage	: 200mV@I_{OUT}=300mA (V_{OUT}=3.0V)
Low Power Consumption	: 100 μA
Stand-by Current	: 0.1 μA
High Ripple Rejection	: 80dB@f=1kHz
Protection Circuits	: Current Limit (400mA) Short Circuit Protection Over Heat Protection Inrush Current Protection
Low ESR Capacitors	: C_{IN} =1.0 μF, C_L=1.0 μF
CE Function	: C_L High Speed Discharge
Small Packages	: USPQ-4B03 * SSOT-24 SOT-25 SOT-89-5
Environmentally Friendly	: EU RoHS Compliant, Pb Free

*USPQ-4B03 is under development.

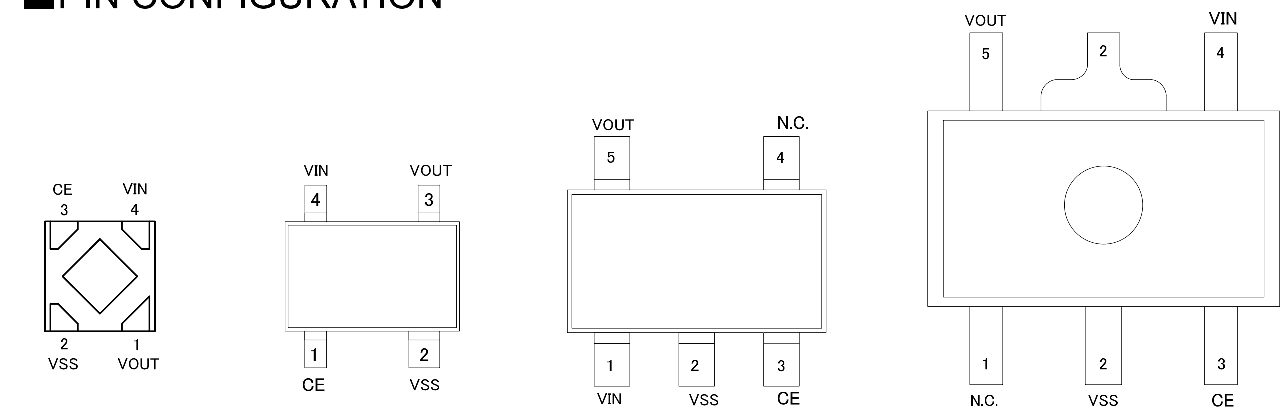
■TYPICAL APPLICATION CIRCUIT



■ TYPICAL PERFORMANCE CHARACTERISTICS



■PIN CONFIGURATION



USPQ-4B03 (BOTTOM VIEW)

SSOT-24 (TOP VIEW)

SOT-25 (TOP VIEW)

SOT-89-5 (TOP VIEW)

*USPQ-4B03 is under development.

■PIN ASSIGNMENT

PIN NUMBER				PIN NAME	FUNCTIONS
USPQ-4B03	SSOT-24	SOT-25	SOT-89-5		
4	4	1	4	V_{IN}	Power Input
1	3	5	5	V_{OUT}	Output
2	2	2	2	V_{SS}	Ground
3	1	3	3	CE	ON/OFF Control
-	-	4	1	NC	No Connection

■PRODUCT CLASSIFICATION

●Ordering Information

XC6223①②③④⑤⑥-⑦[*1]

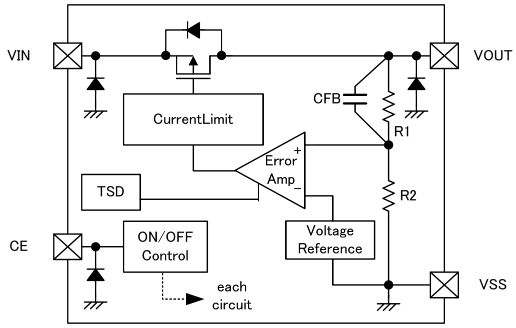
DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION		
①	Type of Regulator (All CE logic is high active)		Inrush current protection	CE Pull-Down	C_L discharge
		A	NO	NO	NO
		B	NO	NO	YES
		C	NO	YES (1MΩ TYP built-in) *	NO
		D	NO	YES (1MΩ TYP built-in) *	YES
		E	YES	NO	NO
		F	YES	NO	YES
		G	YES	YES (1MΩ TYP built-in) *	NO
		H	YES	YES (1MΩ TYP built-in) *	YES
②③	Output Voltage	12～40	ex.) 2.80V → ②=2, ③=8, ④=please see down below.		
④	Output Accuracy	1	±1% accuracy and output voltage {x.x0V} (the 2nd decimal place is "0")		
		B	±1% accuracy and output voltage {x.x5V} (the 2nd decimal place is "5")		
⑤⑥-⑦	Packages Taping Type [*2]	9R-G	USPQ-4B03 *under development		
		NR-G	SSOT-24		
		MR-G	SOT-25		
		PR-G	SOT-89-5		

* CE Pin with Pull-down resistance

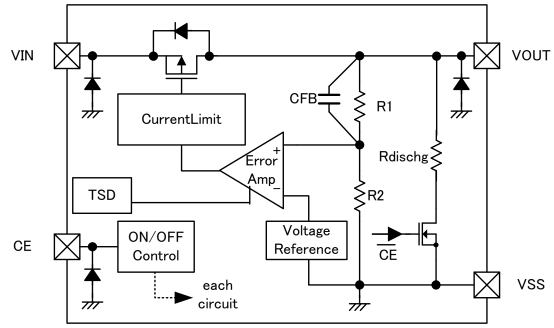
[*1] The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.

[*2] The device orientation is fixed in its embossed tape pocket. For reverse orientation, please contact your local Torex sales office or representative. (Standard orientation: ⑤R-⑦, Reverse orientation: ⑤L-⑦)

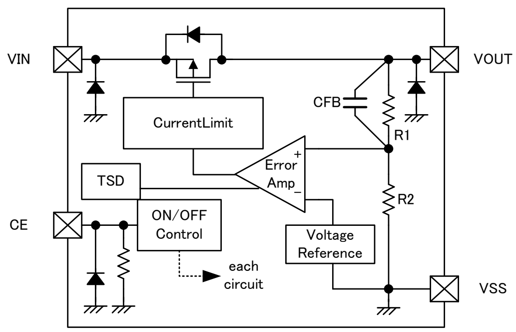
■BLOCK DIAGRAMS



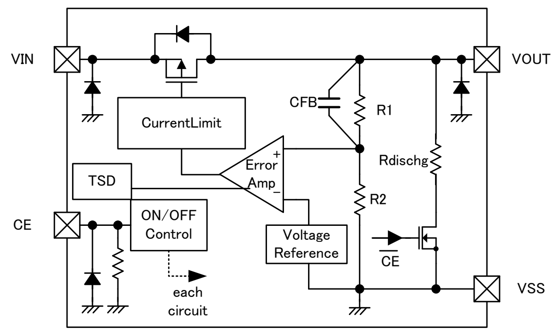
XC6223Aseries



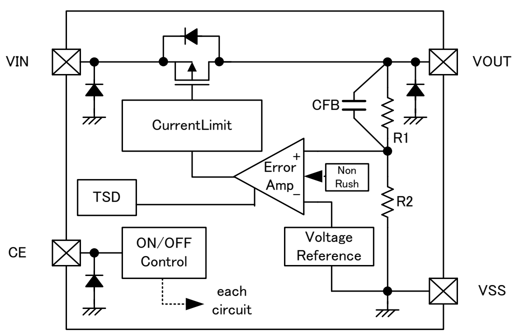
XC6223Bseries



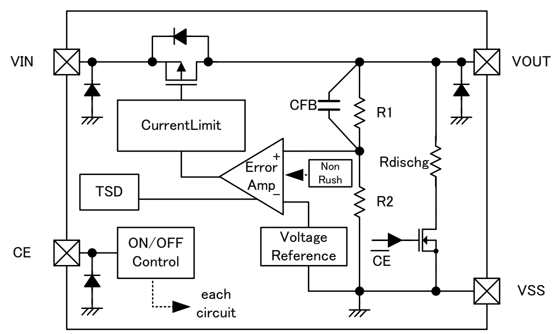
XC6223Cseries



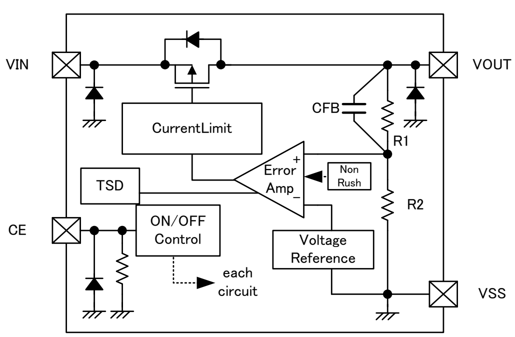
XC6223Dseries



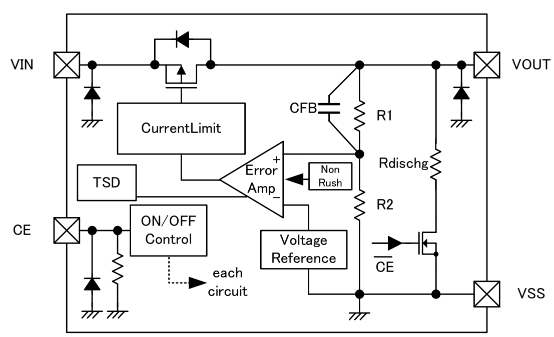
XC6223Eseries



XC6223Fseries



XC6223Gseries



XC6223Hseries

■ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	V_{SS}-0.3～+7.0	V
Output Current		I_{OUT}	500 (*1)	mA
Output Voltage		V_{OUT}	V_{SS}-0.3～V_{IN}+0.3	V
CE Input Voltage		V_{CE}	V_{SS}-0.3～+7.0	V
Power Dissipation	USPQ4 *	Pd	120	mW
	SSOT-24		150	
			500 (PCB mounted) (*2)	
	SOT-25		250	
			600 (PCB mounted) (*2)	
	SOT-89-5		500	
			1300 (PCB mounted) (*2)	
Operating Temperature Range		Topr	-40～+85	℃
Storage Temperature Range		Tstg	-55～+125	℃

*USPQ-4B03 is under development.

(*1) : $I_{OUT} \leqq Pd / (V_{IN}-V_{OUT})$

(*2) : The power dissipation figure shown is PCB mounted. Please refer to page 25～27 for details.

■ELECTRICAL CHARACTERISTICS

●XC6223A/B/C/D/E/F/G/H Series

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUITS
Output Voltage	$V_{OUT(E)}$ (*1)	V_{OUT}≧2.0V, V_{CE}=V_{IN}, V_{OUT}=10mA	$V_{OUT(T)}$×0.99	$V_{OUT(T)}$ (*2)	$V_{OUT(T)}$×1.01	V	①
		V_{OUT}<2.0V, V_{CE}=V_{IN}, V_{OUT}=10mA	$V_{OUT(T)}$-20mV (*3)	$V_{OUT(T)}$	$V_{OUT(T)}$+20mV (*3)	V	
Maximum Output Current	I_{OUT}MAX	V_{CE}=V_{IN}	300	-	-	mA	①
Load Regulation	ΔV_{OUT}	V_{CE}=V_{IN}, 0.1mA≦I_{OUT}≦300mA	-	25	45	mV	①
Dropout Voltage	Vdif (*4)	V_{CE}=V_{IN}, I_{OUT}=300mA	E-1			mV	①
Supply Current	I_{SS}	V_{CE}=V_{IN}	-	100	220	μA	②
Stand-by Current	Istby	V_{CE}=V_{SS}	-	0.01	0.4	μA	②
Line Regulation	ΔV_{OUT}/ (ΔV_{IN}・V_{OUT})	$V_{OUT(T)}$+0.5V≦V_{IN}≦5.5 V V_{CE}=V_{IN}, I_{OUT}=50mA	-	0.01	0.1	%/V	①
Input Voltage	V_{IN}	-	1.6	-	5.5	V	①
Output Voltage Temperature Characteristics	ΔV_{OUT}/ (ΔTa・V_{OUT})	V_{CE}=V_{IN}, I_{OUT}=10mA -40℃≦Ta≦85℃	-	±100	-	ppm / ℃	①
Ripple Rejection Rate	PSRR	$V_{OUT(T)}$<2.5V V_{IN}=3.0V+0.5VppAC V_{CE}=$V_{OUT(T)}$+1.0V I_{OUT}=30mA, f=1kHz	-	80	-	dB	③
		$V_{OUT(T)}$≧2.5V V_{IN}={$V_{OUT(T)}$+1.0} +0.5Vp-pAC V_{CE}=$V_{OUT(T)}$+1.0V I_{OUT}=30mA、f=1kHz					
Current Limit	I_{LIM}	V_{CE}=V_{IN}	310	400	-	mA	①
Short Current	I_{SHORT}	V_{CE}=V_{IN}, V_{OUT}=V_{SS}	-	50	-	mA	①
CE High Level Voltage	V_{CEH}	-	1.0	-	5.5	V	④
CE Low Level Voltage	V_{CEL}	-	-	-	0.3	V	④
CE High Level Current (A/B/E/F Type)	I_{CEH}	V_{CE}=V_{IN}=5.5V	-0.1	-	0.1	μA	④
CE High Level Current (C/D/G/H Type)	I_{CEH}	V_{CE}=V_{IN}=5.5V	3.0	5.5	9.0	μA	④
CE Low Level Current	I_{CEL}	V_{CE}=V_{SS}	-0.1	-	0.1	μA	④
CL Discharge Resistance (Only B/D/F/H Type)	R_{DCHG}	V_{IN}=5.5V, V_{OUT}=2.0V, V_{CE}=V_{SS}	-	300	-	Ω	①
Inrush Current (Only E/F/G/H Type)	Irush	V_{IN}=V_{CE}=5.5V	-	150	-	mA	⑤
TSD Detect Temperature	T_{TSD}	Junction Temperature	-	150	-	℃	①
TSD Release Temperature	T_{TSR}	Junction Temperature	-	120	-	℃	
Hysteresis Width	T_{TSD} - T_{TSR}	Junction Temperature	-	30	-	℃	

NOTE:

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

(i.e. the output voltage when "$V_{OUT(T)}$+1.0V" is provided at the V_{IN} pin while maintaining a certain I_{OUT} value.)

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

*3: The standard output voltage is specified in $V_{OUT(T)}$±20mV where $V_{OUT(T)}$<2.0V.

*4: Vdif={V_{IN1}{*5}−V_{OUT1}{*6}} (V_{IN1}≧1.6V)

*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: Unless otherwise stated regarding input voltage conditions, V_{IN}=$V_{OUT(T)}$+1.0V.

■ELECTRICAL CHARACTERISTICS (Continued)

●Voltage Chart 1

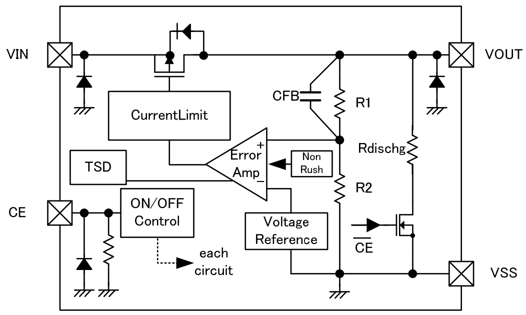
SYMBOL	E-0		E-1	
PARAMETER / NOMINAL OUTPUT VOLTAGE (V)	OUTPUT VOLTAGE (V)		DROPOUT VOLTAGE (mV)	
$V_{OUT(T)}$	$V_{OUT(E)}$		Vdif	
	MIN	MAX	TYP	MAX
1.200	1.180	1.220	480	630
1.250	1.230	1.270		
1.300	1.280	1.320	440	480
1.350	1.330	1.370		
1.400	1.380	1.420	420	460
1.450	1.430	1.470		
1.500	1.480	1.520		
1.550	1.530	1.570		
1.600	1.580	1.620	400	440
1.650	1.630	1.670		
1.700	1.680	1.720		
1.750	1.730	1.770		
1.800	1.780	1.820	300	410
1.850	1.830	1.870		
1.900	1.880	1.920		
1.950	1.930	1.970		
2.000	1.980	2.020	270	380
2.050	2.030	2.071		
2.100	2.079	2.121		
2.150	2.129	2.172		
2.200	2.178	2.222		
2.250	2.228	2.273		
2.300	2.277	2.323		
2.350	2.327	2.374		
2.400	2.376	2.424		
2.450	2.426	2.475		
2.500	2.475	2.525	240	350
2.550	2.525	2.576		
2.600	2.574	2.626		
2.650	2.624	2.677		
2.700	2.673	2.727		
2.750	2.723	2.778		

■ELECTRICAL CHARACTERISTICS (Continued)

●Voltage Chart2

SYMBOL	E-0		E-1	
PARAMETER / NOMINAL OUTPUT VOLTAGE (V)	OUTPUT VOLTAGE (V)		DROPOUT VOLTAGE (mV)	
$V_{OUT(T)}$	$V_{OUT(E)}$		Vdif	
	MIN.	MAX.	TYP.	MAX.
2.800	2.772	2.828	240	350
2.850	2.822	2.879		
2.900	2.871	2.929		
2.950	2.921	2.980		
3.000	2.970	3.030	200	305
3.050	3.020	3.081		
3.100	3.069	3.131		
3.150	3.119	3.182		
3.200	3.168	3.232		
3.250	3.218	3.283		
3.300	3.267	3.333		
3.350	3.317	3.384		
3.400	3.366	3.434		
3.450	3.415	3.484		
3.500	3.465	3.535		
3.550	3.514	3.585		
3.600	3.564	3.636		
3.650	3.613	3.686		
3.700	3.663	3.737		
3.750	3.712	3.787		
3.800	3.762	3.838		
3.850	3.811	3.888		
3.900	3.861	3.939		
3.950	3.910	3.989		
4.000	3.960	4.040		

■ 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 and heat dissipation. Further, the IC's internal circuitry can be shutdown via the CE pin signal.

<Low ESR Capacitor>

The XC6223 series needs an output capacitor C_L for phase compensation. In order to ensure the stable phase compensation, please place an output capacitor of 1.0μF or bigger at the V_{OUT} pin and V_{SS} pin as close as possible. For a stable power input, please connect an input capacitor (CIN) of 1.0μF between the VIN pin and the VSS 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 50mA 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, the XC6223B/D/F/H series enables the electric charge at the output capacitor (C_L) to be discharged via the internal auto-discharge switch, and as a result the V_{OUT} pin quickly returns to the V_{SS} level. When the CE pin is open, the output voltage becomes undefined state in the XC6223A/B/E/F series because of a high active and no pull-down. On the other hand, the XC6223C/D/G/H series has a pull-down resistor at the CE pin inside, so that the CE pin input current flows.

<Thermal Shutdown>

The over heat protection circuit is built-in with the XC6223 series. When the junction temperature of the IC reaches the temperature limit level (150℃ TYP.), the thermal shutdown circuit operates and the driver transistor will be turned off. The IC resumes its operation when the thermal shutdown function is released as a result of the junction temperature drops to the release point.

<Inrush Current Protection>

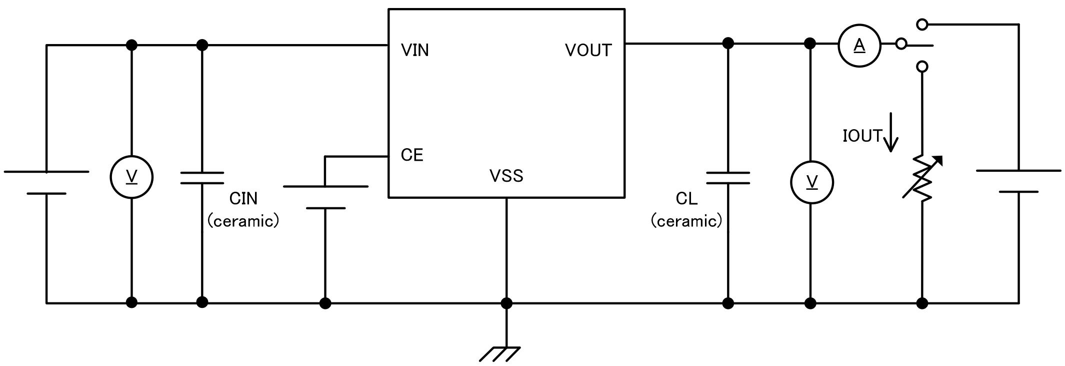
The inrush current protection circuit is built in the XC6223 series.
When the IC starts to operate, the protection circuit limits the inrush current from V_{IN} to V_{OUT} to charge C_L capacitor. This function is built in the XC6223E/F/G/H series.

NOTES ON USE

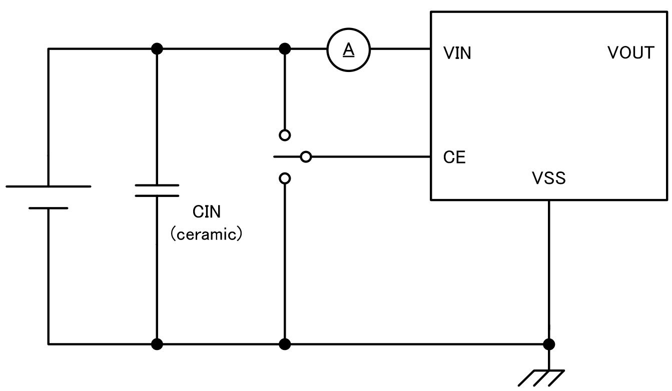
1. Please use this IC within the stated absolute maximum ratings.
   The IC is liable to malfunction should the ratings be exceeded.
2. Where wiring impedance is high, operations may become unstable due to the noise and/or phase lag depending on output current. Please strengthen V_{IN} and V_{SS} wiring in particular.
3. 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.
4. The IC is controlled with constant current start-up. Start-up sequence control is requested to draw a load current after rising up the output voltage.

■TEST CIRCUITS

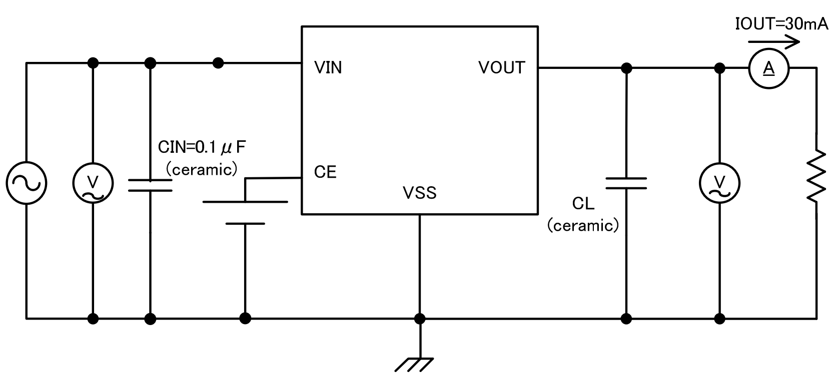
●Circuit ①



●Circuit ②

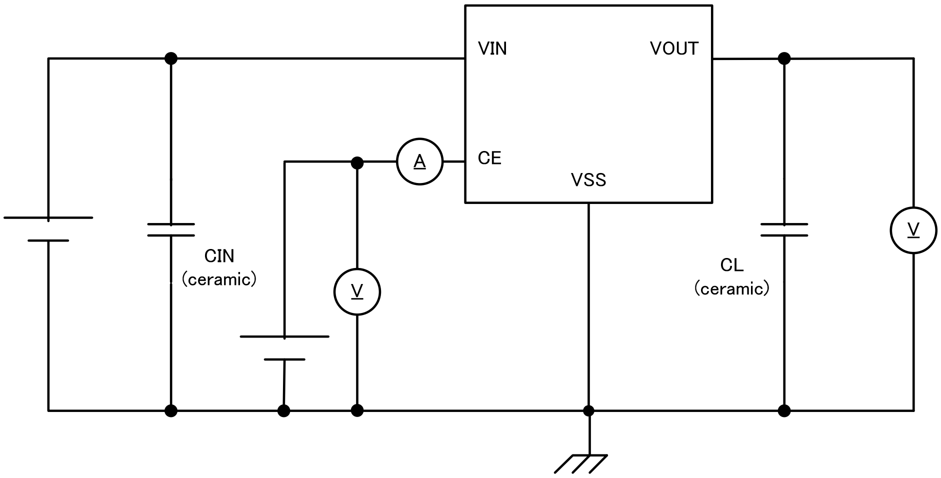


●Circuit ③

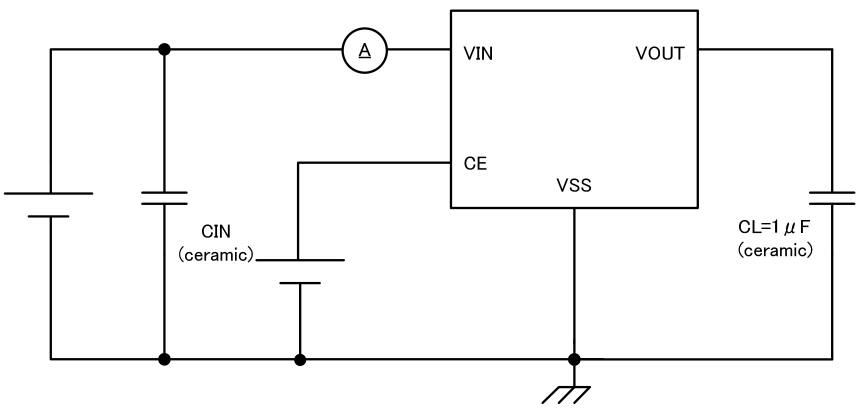


■TEST CIRCUITS (Continued)

●Circuit ④



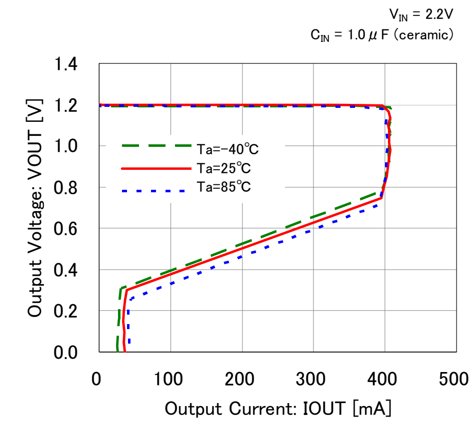
●Circuit ⑤



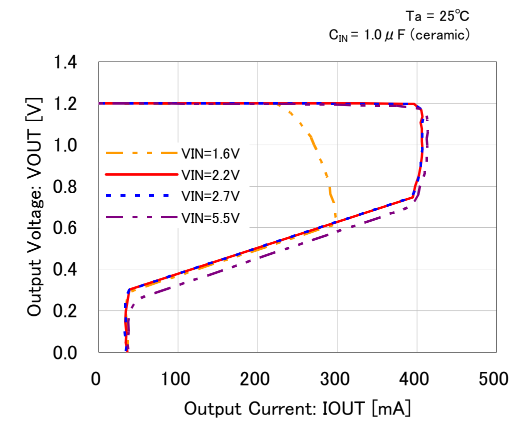
■TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

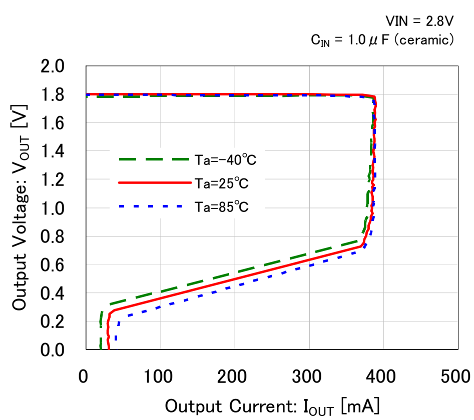
XC6223x121



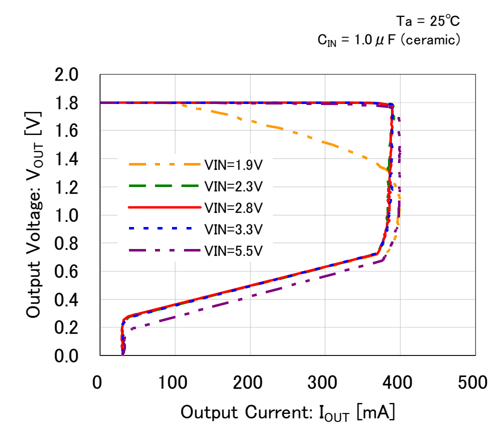
XC6223x121



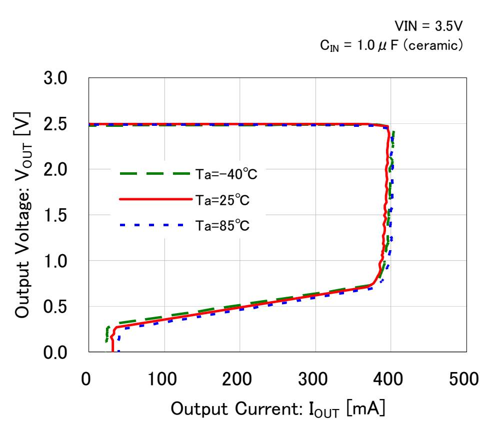
XC6223x181



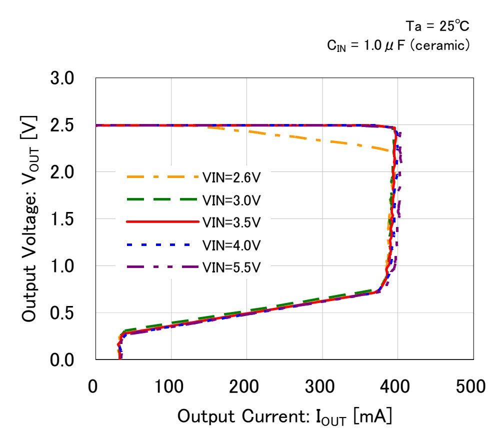
XC6223x181



XC6223x251



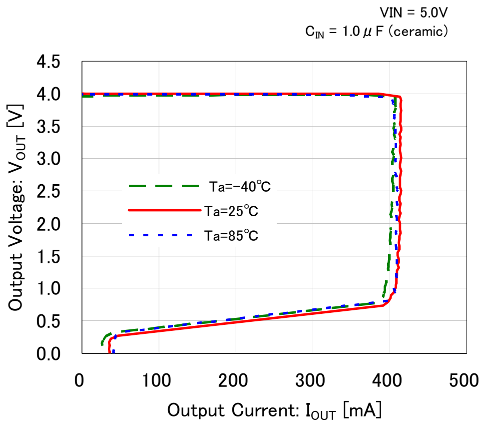
XC6223x251



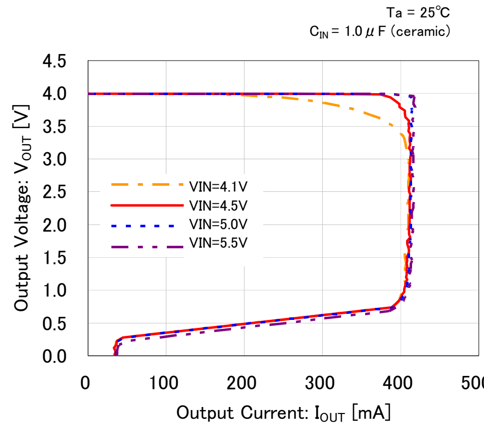
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

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

XC6223x401

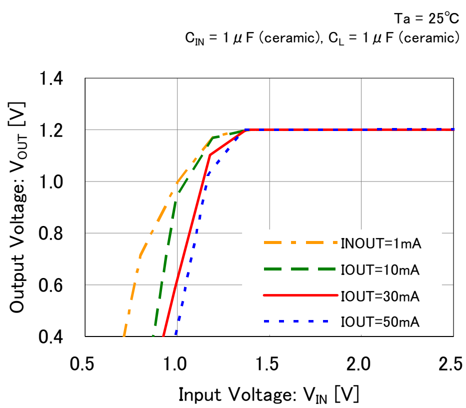


XC6223x401



(2) Output Voltage vs. Input Voltage

XC6223x121



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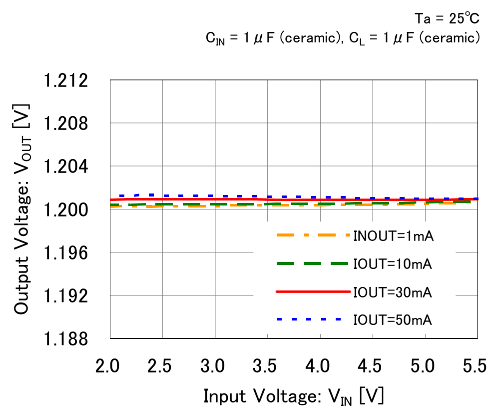
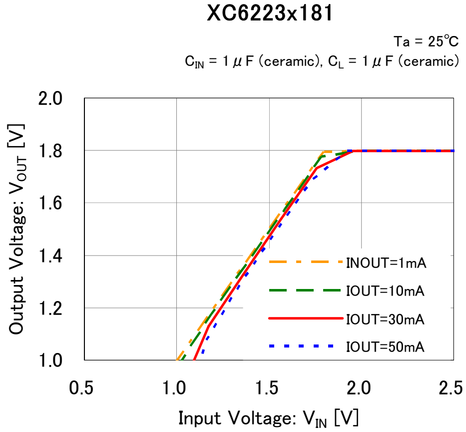
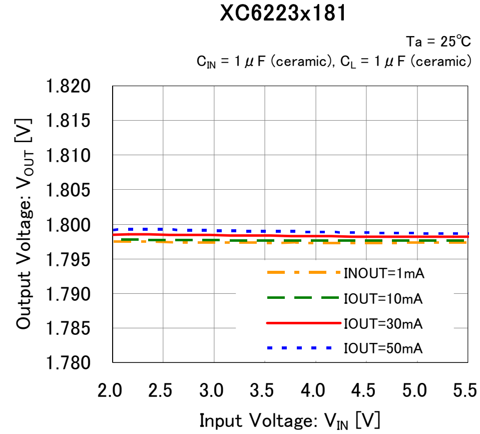


XC6223x181



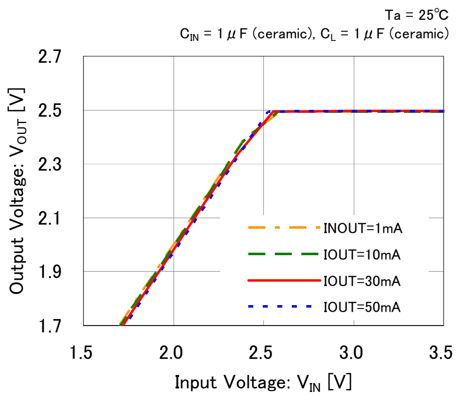
XC6223x181



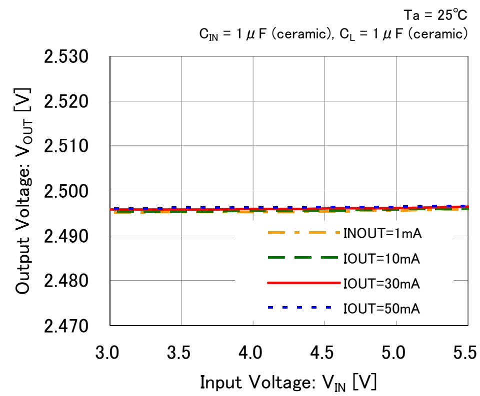
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) Output Voltage vs. Input Voltage (Continued)

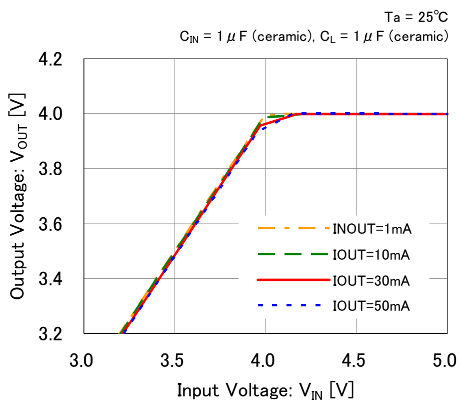
XC6223x251



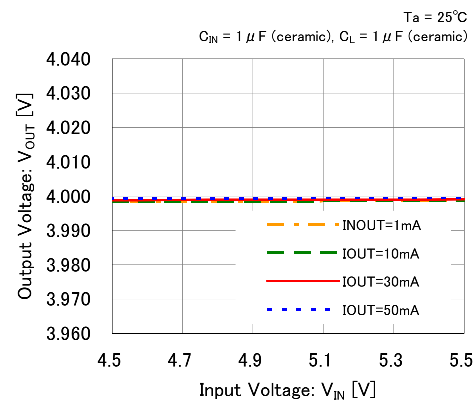
XC6223x251



XC6223x401

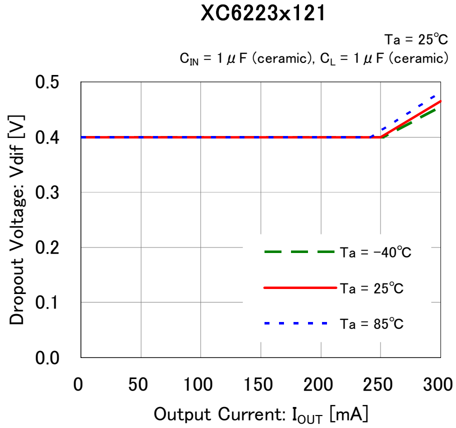


XC6223x401

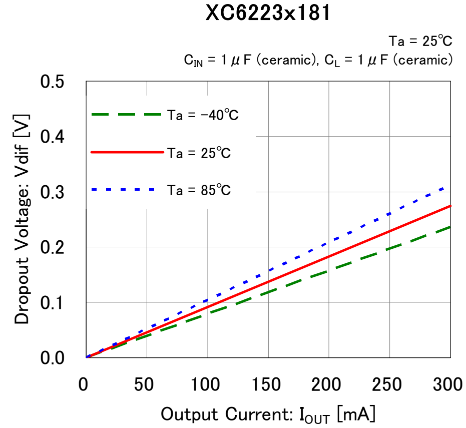


(3) Dropout Voltage vs. Output Current

XC6223x121



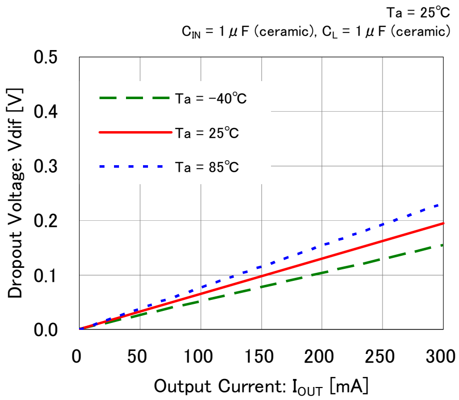
XC6223x181



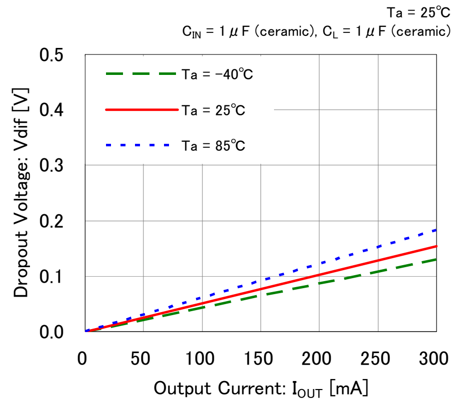
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current (Continued)

XC6223x251

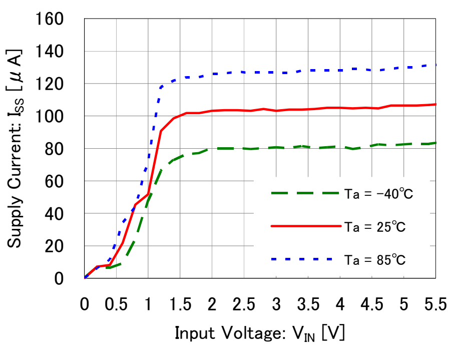


XC6223x401

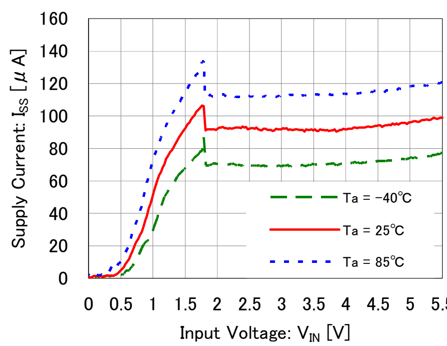


(4) Supply Current vs. Input Voltage

XC6223x121



XC6223x181



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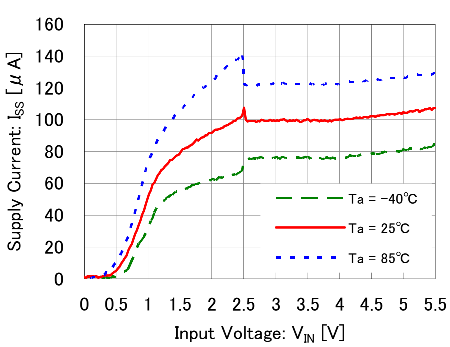
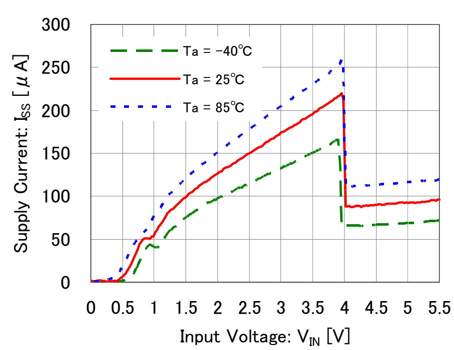
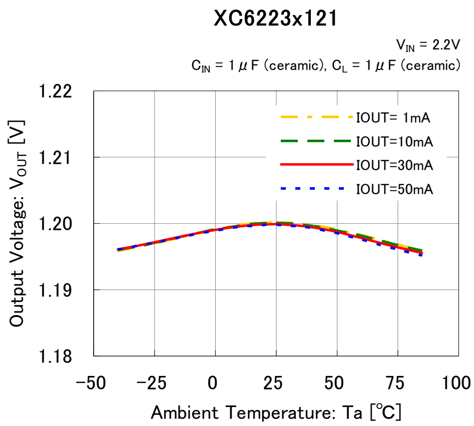


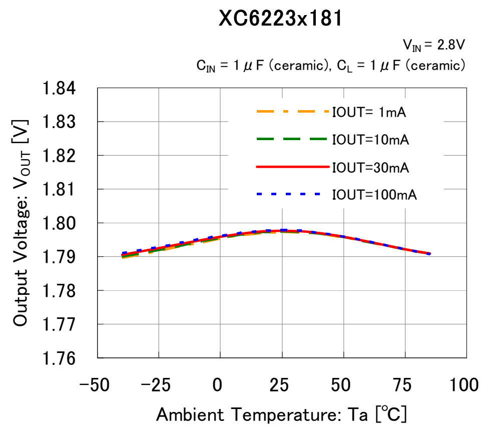
XC6223x401

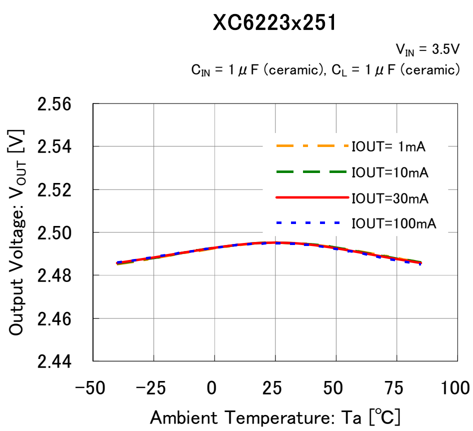


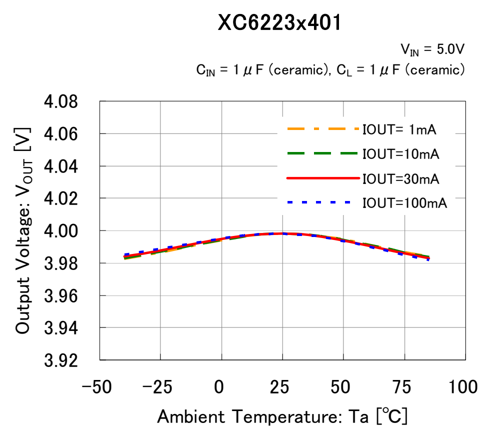
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(5) Output Voltage vs. Ambient Temperature

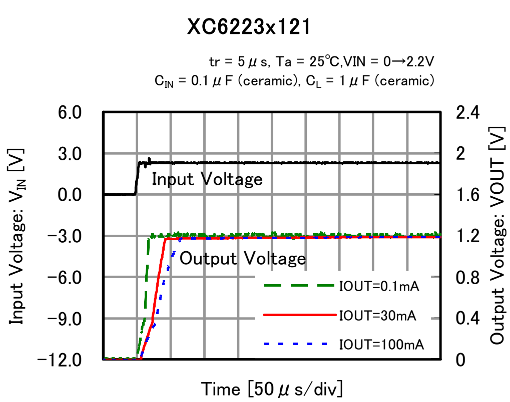


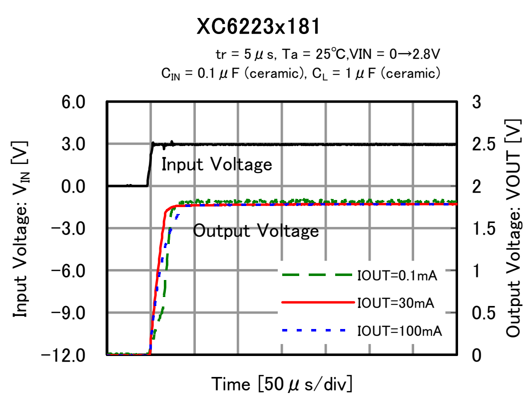






(6) Rising Response Time



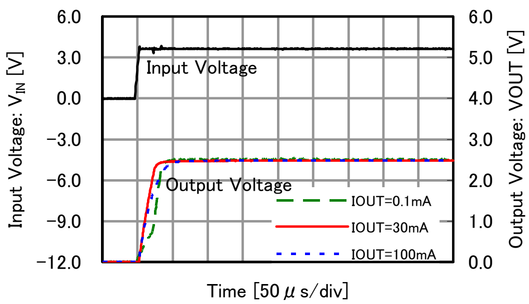


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(6) Rising Response Time (Continued)

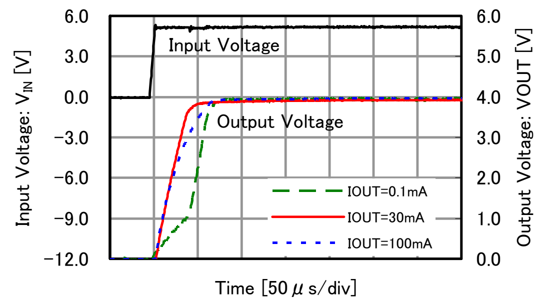
XC6223x251

tr = 5 μ s, Ta = 25℃,VIN = 0→3.5V
CIN = 0.1 μ F (ceramic), C_L = 1 μ F (ceramic)



XC6223x401

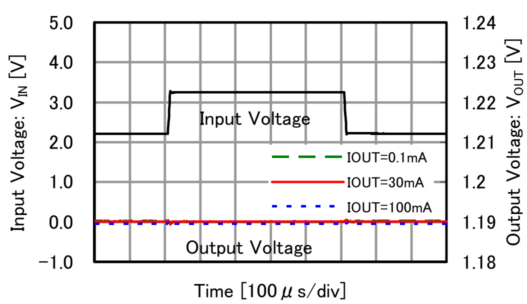
tr = 5 μ s, Ta = 25℃,VIN = 0→5.0V
C_{IN} = 0.1 μ F (ceramic), C_L = 1 μ F (ceramic)



(7) Input Transient Response

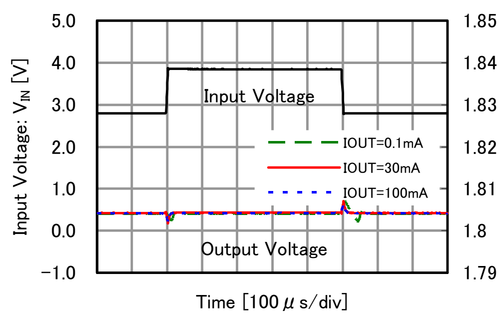
XC6223x121

tr = tf = 5 μ s, Ta = 25℃, VIN = 2.2V⇔3.2V
C_{IN} = 0.1 μ F (ceramic), CL = 1.0 μ F (ceramic)



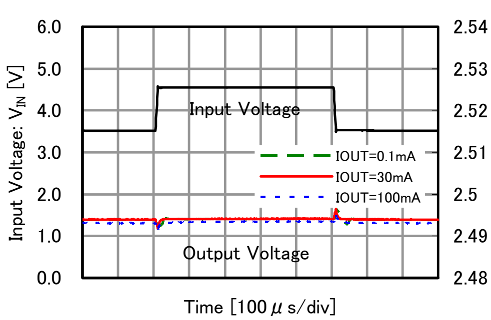
XC6223x181

tr = tf = 5 μ s, Ta = 25℃, VIN = 2.8V⇔3.8V
C_{IN} = 0.1 μ F (ceramic), CL = 1.0 μ F (ceramic)



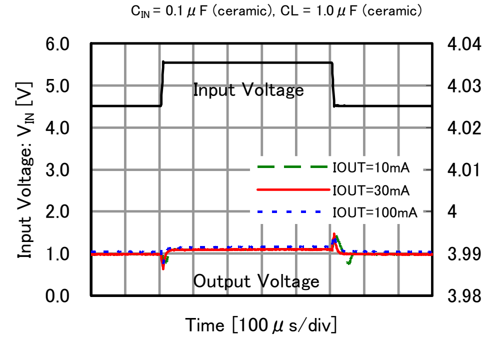
XC6223x251

tr = tf = 5 μ s, Ta = 25℃, VIN = 3.5V⇔4.5V
C_{IN} = 0.1 μ F (ceramic), CL = 1.0 μ F (ceramic)



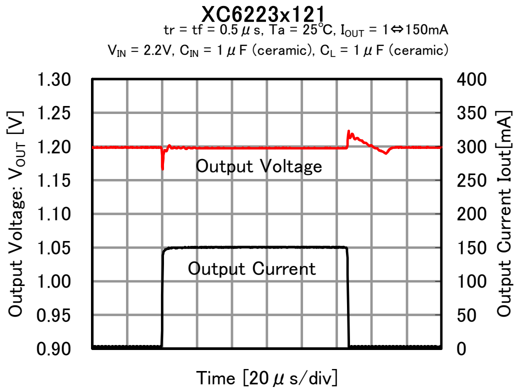
XC6223x401

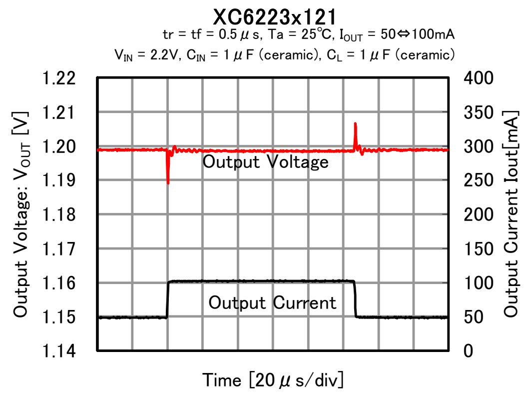
tr = tf = 5 μ s, Ta = 25℃, VIN = 4.5V⇔5.5V
C_{IN} = 0.1 μ F (ceramic), CL = 1.0 μ F (ceramic)

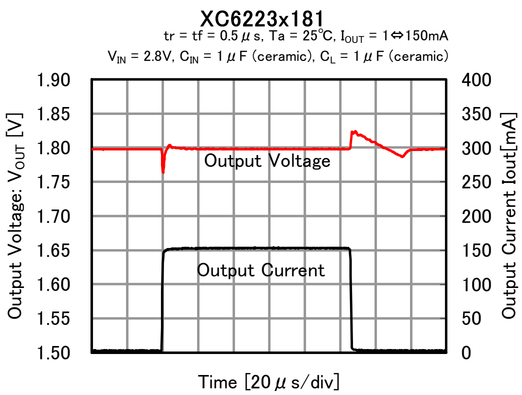


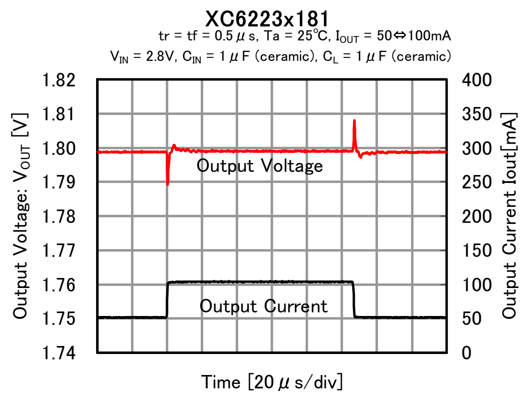
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

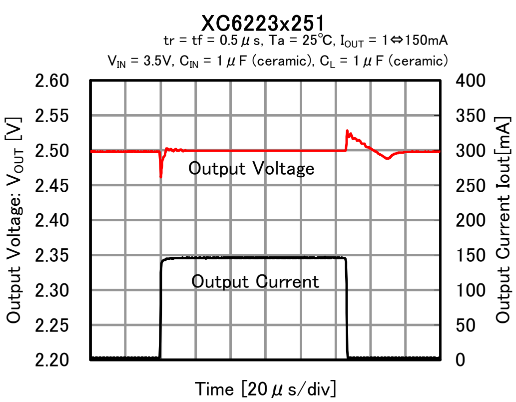
(8) Load Transient Response (tr=tf=0.5 μs)

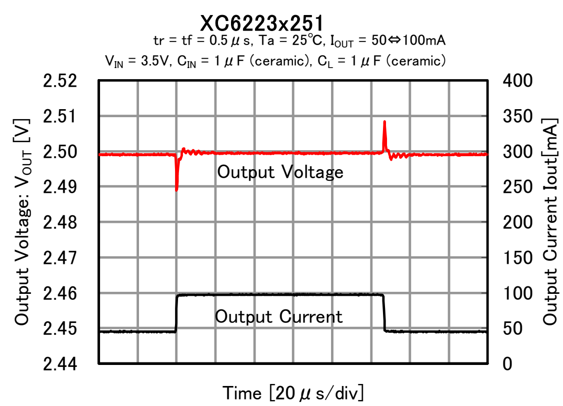










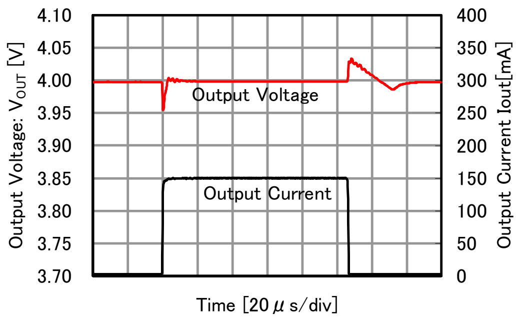


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Load Transient Response (tr=tf=0.5 μ s) (Continued)

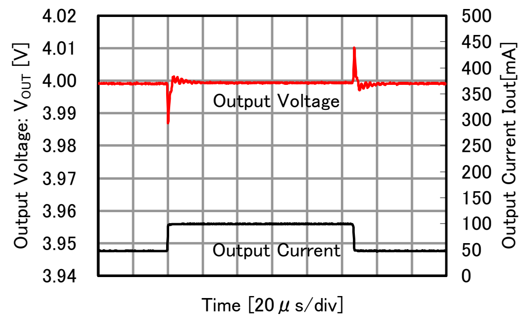
XC6223x401

tr = tf = 0.5 μ s, Ta = 25℃, I_{OUT} = 1⇔150mA
V_{IN} = 5.0V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



XC6223x401

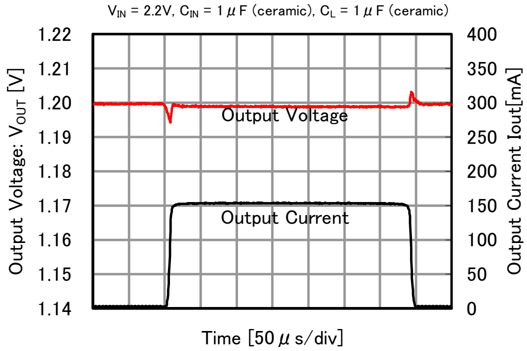
tr = tf = 0.5 μ s, Ta = 25℃, I_{OUT} =50⇔100mA
V_{IN} = 5.0V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



(8) Load Transient Response (tr=tf=5 μ s) (Continued)

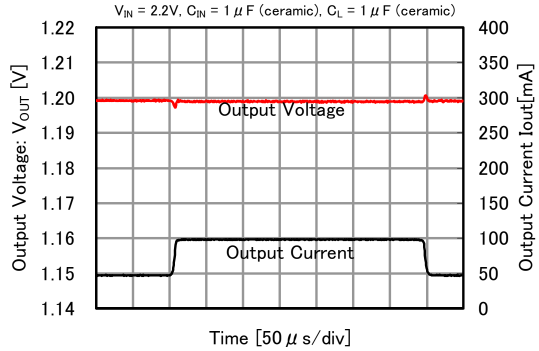
XC6223x121

tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 1⇔150mA
V_{IN} = 2.2V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



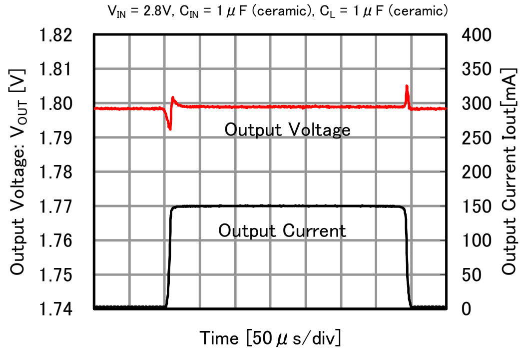
XC6223x121

tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 50⇔100mA
V_{IN} = 2.2V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



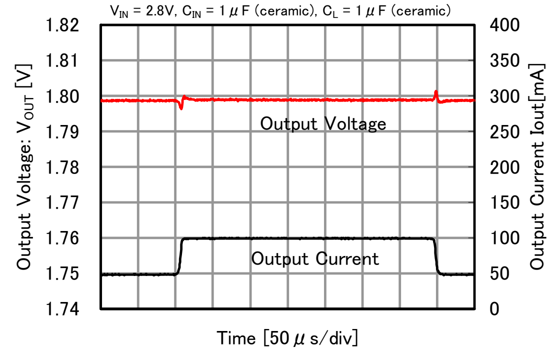
XC6223x181

tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 1⇔150mA
V_{IN} = 2.8V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



XC6223x181

tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 50⇔100mA
V_{IN} = 2.8V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)

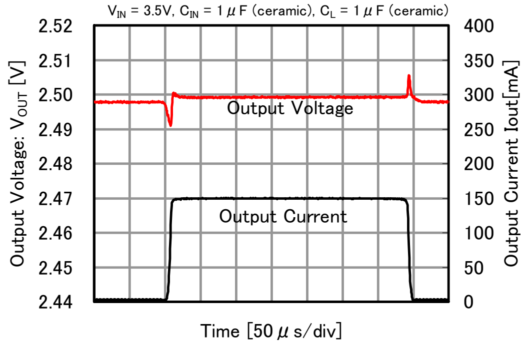


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Load Transient Response (tr=tf=5 μ s) (Continued)

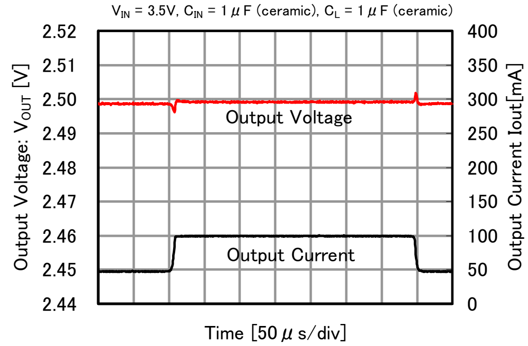
XC6223x251

tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 1⇔150mA
V_{IN} = 3.5V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



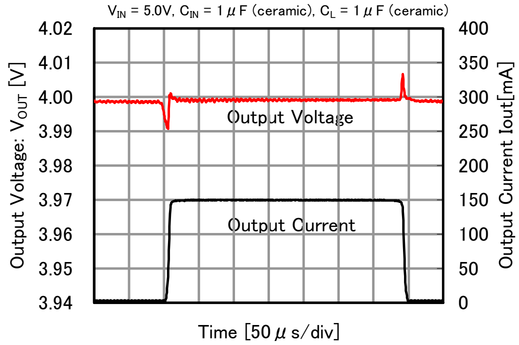
XC6223x251

tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 50⇔100mA
V_{IN} = 3.5V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



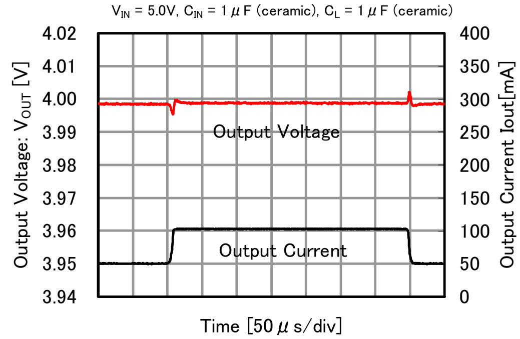
XC6223x401

tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 1⇔150mA
V_{IN} = 5.0V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



XC6223x401

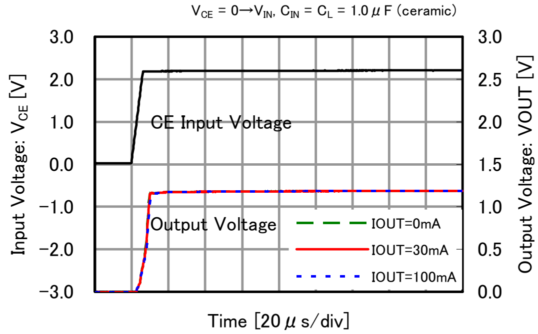
tr = tf = 5 μ s, Ta = 25℃, I_{OUT} = 50⇔100mA
V_{IN} = 5.0V, C_{IN} = 1 μ F (ceramic), C_L = 1 μ F (ceramic)



(9) CE Rising Response Time (A,B,C,D Type)

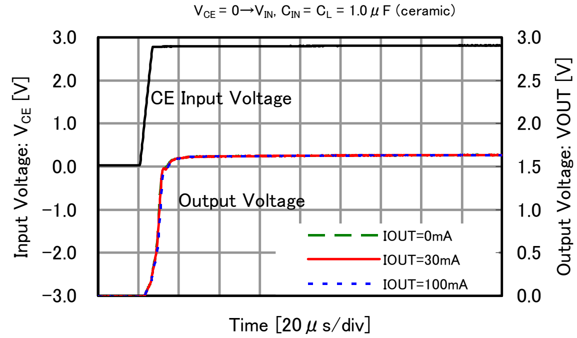
XC6223x121

V_{IN} = 2.2V, tr = 5 μ s, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μ F (ceramic)



XC6223x181

V_{IN} = 2.8V, tr = 5 μ s, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μ F (ceramic)

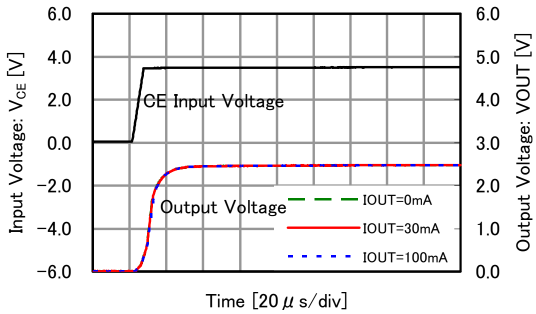


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) CE Rising Response Time (A,B,C,D Type) (Continued)

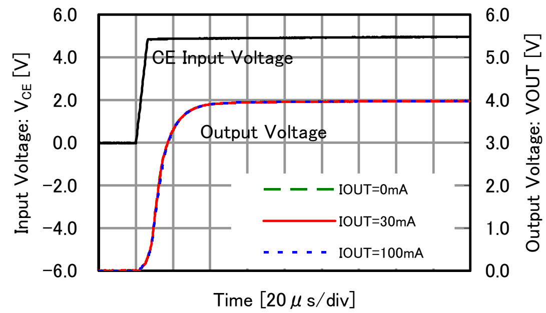
XC6223x251

V_{IN} = 3.5V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



XC6223x401

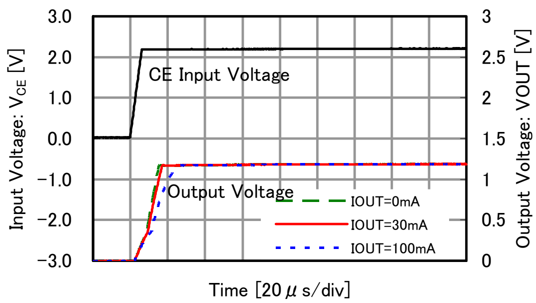
V_{IN} = 5.0V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



(9) CE Rising Response Time (E,F,G,H Type) (Continued)

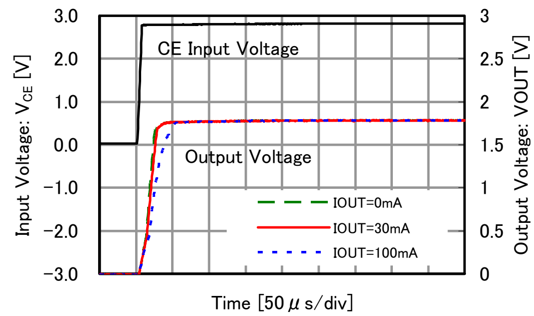
XC6223x121

V_{IN} = 2.2V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



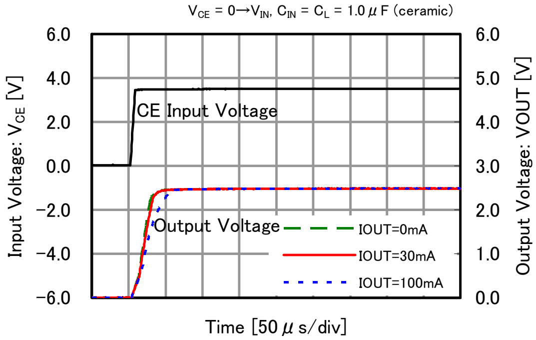
XC6223x181

V_{IN} = 2.8V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



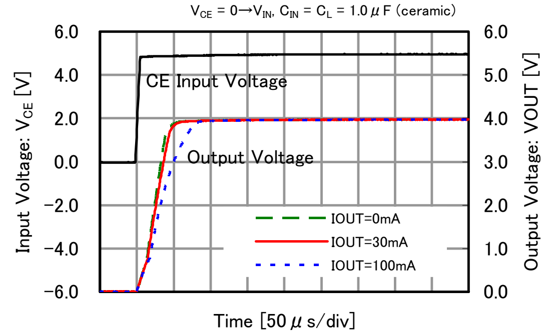
XC6223x251

V_{IN} = 3.5V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



XC6223x401

V_{IN} = 5.0V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)

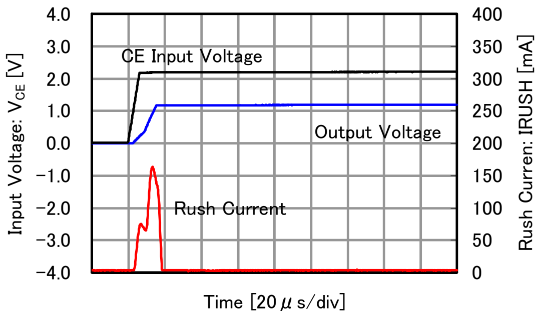


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(10) Inrush Current Response Time (E,F,G,H Type)

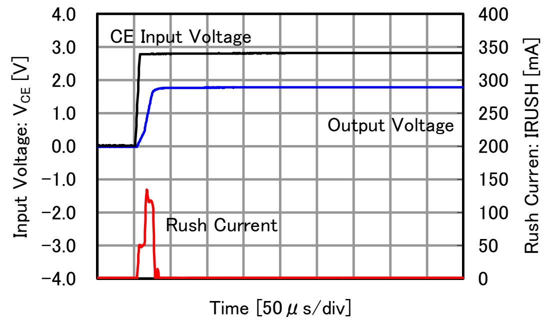
XC6223x121

V_{IN} = 2.2V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



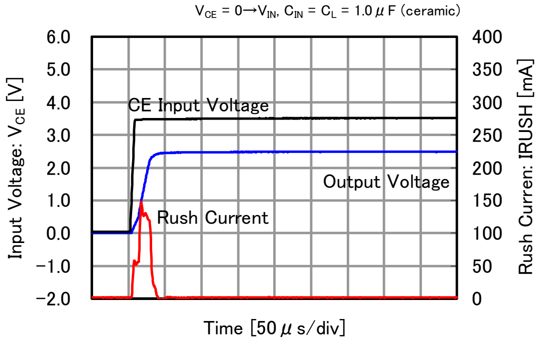
XC6223x181

V_{IN} = 2.8V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



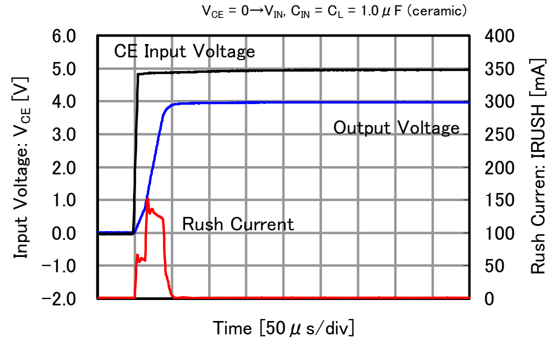
XC6223x251

V_{IN} = 3.5V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)



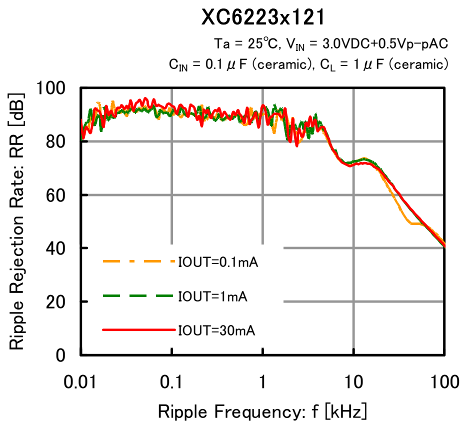
XC6223x401

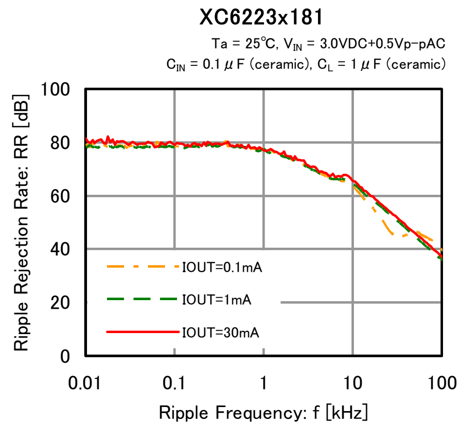
V_{IN} = 5.0V, tr = 5 μs, Ta = 25℃
V_{CE} = 0→V_{IN}, C_{IN} = C_L = 1.0 μF (ceramic)

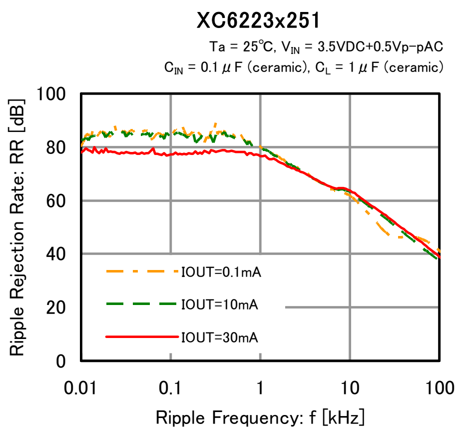


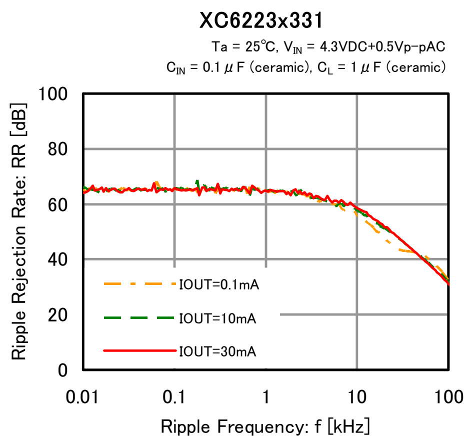
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(11) Ripple Rejection Rate



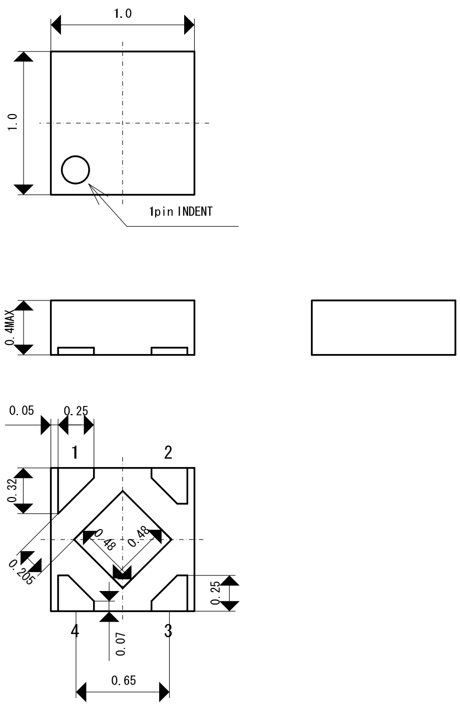




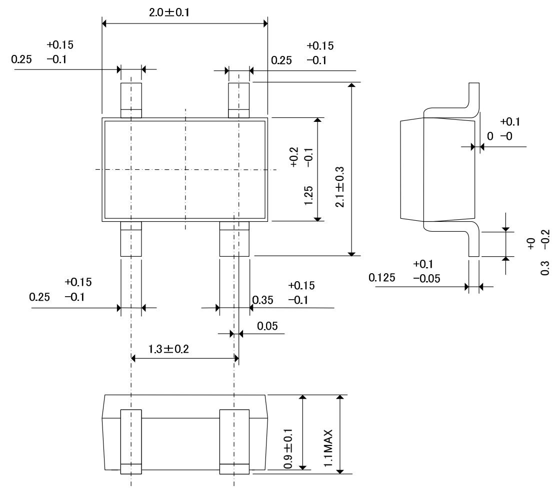


■PACKAGING INFORMATION

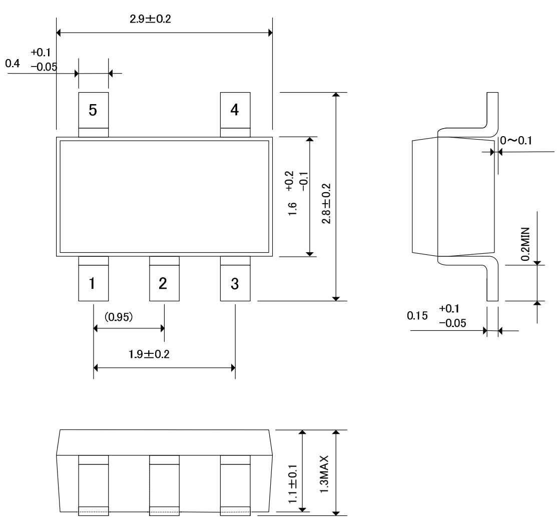
USPQ-4B03(preliminary)　*USPQ-4B03 is under development.
(unit : mm)



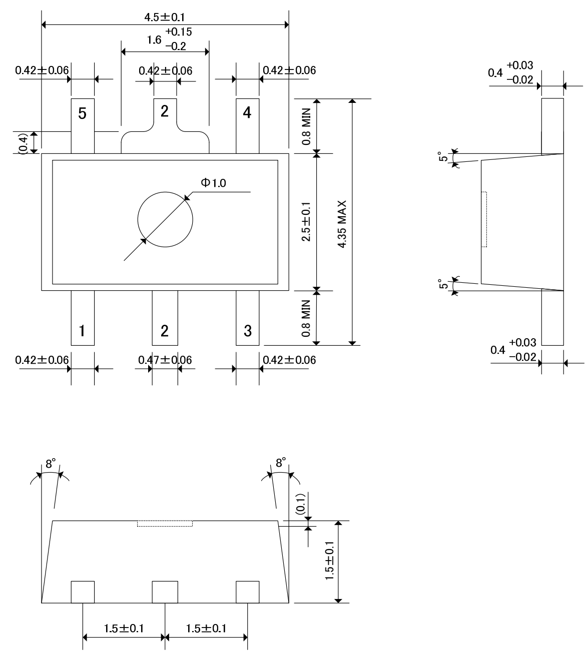
SSOT-24
(unit : mm)



SOT-25
(unit : mm)



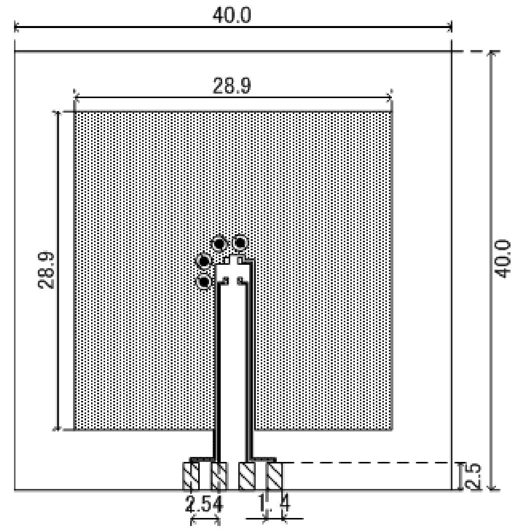
SOT-89-5
(unit : mm)



■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.



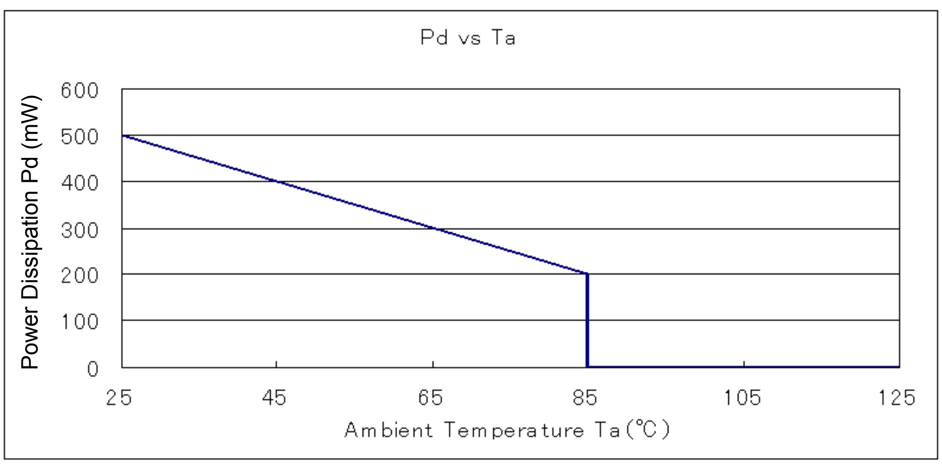
Evaluation Board (Unit: mm)

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℃)

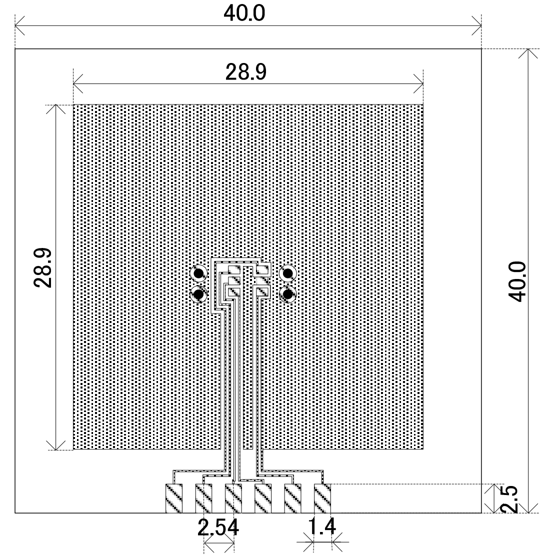
Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	500	200.00
85	200	



■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.



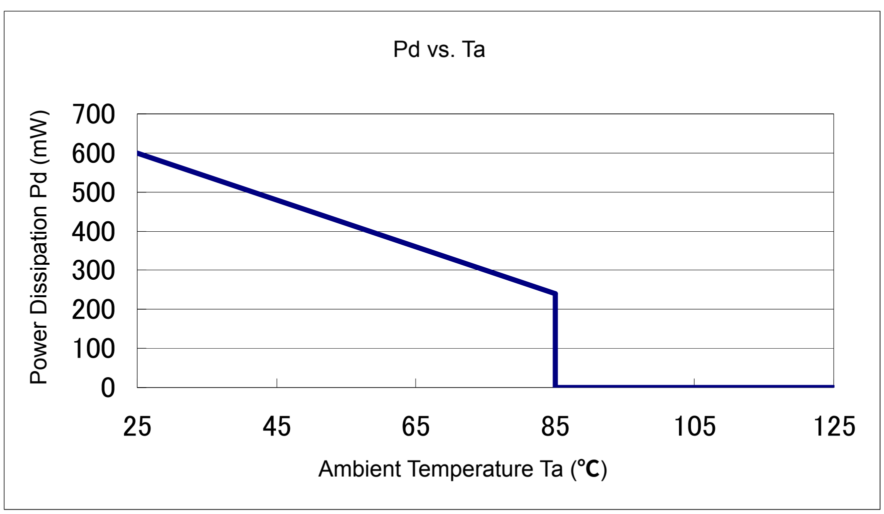
Evaluation Board (Unit: mm)

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	

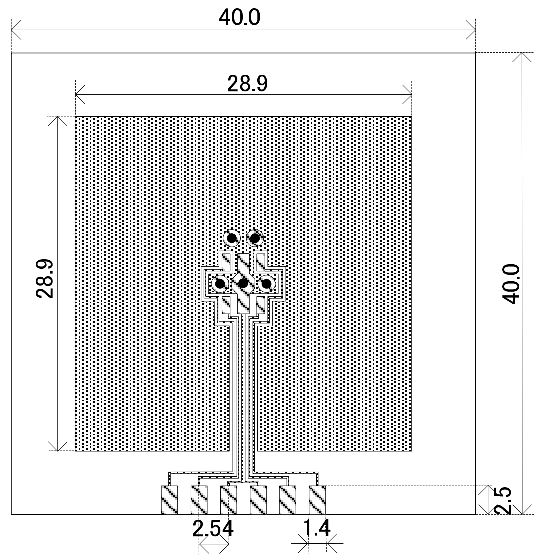


■PACKAGING INFORMATION (Continued)

● SOT-89-5 Power Dissipation

Power dissipation data for the SOT-89-5 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: 5 x 0.8 Diameter

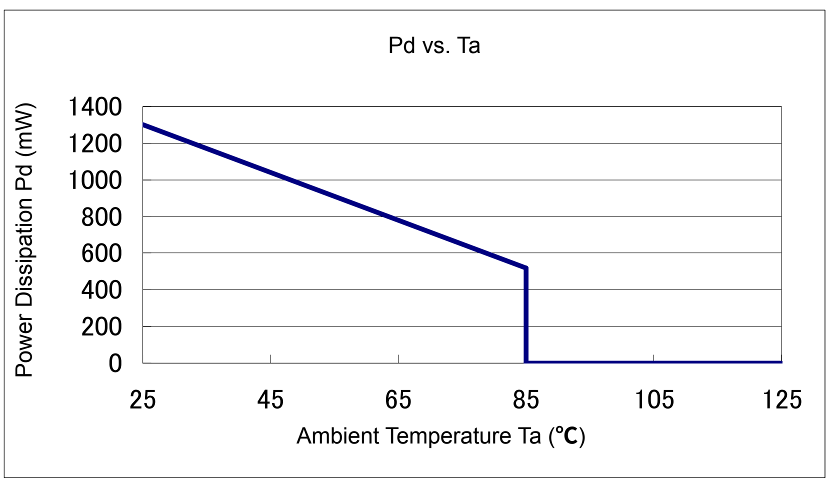


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Operating temperature

Board Mount (Tj max = 125℃)

Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	1300	76.92
85	520	

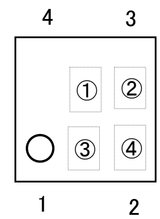


■MARKING RULE

●USPQ-4B03 *USPQ-4B03 is under development.

① represents type of regulator and output voltage range.

MARK			PRODUCT SERIES
OUTPUT VOLTAGE 0.1V INCREMENTS		OUTPUT VOLTAGE 0.05V INCREMENTS	
VOLTAGE=1.2～3.9V	VOLTAGE =4.0V	VOLTAGE =1.25～3.95V	
0	H	8	XC6223A*****
1		9	XC6223B*****
2		A	XC6223C*****
3		B	XC6223D*****
4		C	XC6223E*****
5		D	XC6223F*****
6		E	XC6223G*****
7		F	XC6223H*****



USPQ-4B03
(TOP VIEW)

② represents output voltage.

VOLTAGE=1.2～3.95[V]

MARK	OUTPUT VOLTAGE (V)		MARK	OUTPUT VOLTAGE (V)	
0	-	-	F	2.50	2.55
1	-	-	H	2.60	2.65
2	1.20	1.25	K	2.70	2.75
3	1.30	1.35	L	2.80	2.85
4	1.40	1.45	M	2.90	2.95
5	1.50	1.55	N	3.00	3.05
6	1.60	1.65	P	3.10	3.15
7	1.70	1.75	R	3.20	3.25
8	1.80	1.85	S	3.30	3.35
9	1.90	1.95	T	3.40	3.45
A	2.00	2.05	U	3.50	3.55
B	2.10	2.15	V	3.60	3.65
C	2.20	2.25	X	3.70	3.75
D	2.30	2.35	Y	3.80	3.85
E	2.40	2.45	Z	3.90	3.95

VOLTAGE=4.0[V]

PRODUCT SERIES	MARK
XC6223A*****	0
XC6223B*****	1
XC6223C*****	2
XC6223D*****	3
XC6223E*****	4
XC6223F*****	5
XC6223G*****	6
XC6223H*****	7

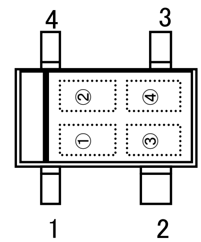
③④ represents production lot number.
01 to 09, 0A to 0Z, 11 to 9Z, A1 to A9, AA to Z9, ZA to ZZ in order.
(G, I, J, O, Q, W excepted)
*No character inversion used.

■MARKING RULE (Continued)

●SSOT-24 (with bar)

① represents type of regulator and output voltage range.

MARK			PRODUCT SERIES
OUTPUT VOLTAGE 0.1V INCREMENTS		OUTPUT VOLTAGE 0.05V INCREMENTS	
VOLTAGE =1.2～2.9V	VOLTAGE =3.0～4.0V	VOLTAGE =1.25～3.95V	
B	3	8	XC6223A*****
C	5	9	XC6223B*****
D	7	S	XC6223C*****
E	A	T	XC6223D*****
K	F	U	XC6223E*****
L	H	V	XC6223F*****
M	P	X	XC6223G*****
N	Z	Y	XC6223H*****



SSOT-24(with bar)
(TOP VIEW)

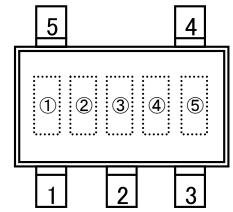
② represents output voltage.

MARK	OUTPUT VOLTAGE (V)				MARK	OUTPUT VOLTAGE (V)			
0	-	-	-	-	F	2.50	3.20	-	2.55
1	-	-	-	-	H	2.60	3.30	-	2.65
2	1.20	-	-	1.25	K	2.70	3.40	-	2.75
3	1.30	-	-	1.35	L	2.80	3.50	-	2.85
4	1.40	-	-	1.45	M	2.90	3.60	-	2.95
5	1.50	-	-	1.55	N	-	-	-	3.05
6	1.60	-	-	1.65	P	-	3.70	-	3.15
7	1.70	-	-	1.75	R	-	3.80	-	3.25
8	1.80	-	-	1.85	S	-	3.90	-	3.35
9	1.90	-	-	1.95	T	-	4.00	-	3.45
A	2.00	-	-	2.05	U	-	-	-	3.55
B	2.10	-	-	2.15	V	-	-	-	3.65
C	2.20	-	-	2.25	X	-	-	-	3.75
D	2.30	3.00	-	2.35	Y	-	-	-	3.85
E	2.40	3.10	-	2.45	Z	-	-	-	3.95

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

■MARKING RULE (Continued)

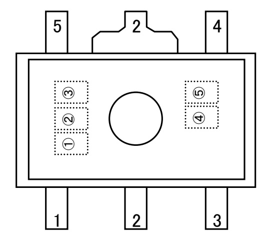
●SOT-25, SOT-89-5



SOT-25
(TOP VIEW)

① represents product series

MARK	PRODUCT SERIES
9	XC6223******



SOT-89-5
(TOP VIEW)

② represents type of regulator.

MARK			PRODUCT SERIES
OUTPUT VOLTAGE 0.1V INCREMENTS		OUTPUT VOLTAGE 0.05V INCREMENTS	
VOLTAGE =1.2～3.9V	VOLTAGE =4.0V	VOLTAGE =1.25～3.95V	
C	D	E	XC6223A*****
F	H	K	XC6223B*****
L	M	N	XC6223C*****
P	R	S	XC6223D*****
T	U	V	XC6223E*****
X	Y	Z	XC6223F*****
0	1	2	XC6223G*****
3	4	5	XC6223H*****

③ represents output voltage.

MARK	OUTPUT VOLTAGE (V)				MARK	OUTPUT VOLTAGE (V)			
0	-	4.00	-		F	2.50	-	2.55	-
1	-	-	-		H	2.60	-	2.65	-
2	1.20	-	1.25	-	K	2.70	-	2.75	-
3	1.30	-	1.35	-	L	2.80	-	2.85	-
4	1.40	-	1.45	-	M	2.90	-	2.95	-
5	1.50	-	1.55	-	N	3.00	-	3.05	-
6	1.60	-	1.65	-	P	3.10	-	3.15	-
7	1.70	-	1.75	-	R	3.20	-	3.25	-
8	1.80	-	1.85	-	S	3.30	-	3.35	-
9	1.90	-	1.95	-	T	3.40	-	3.45	-
A	2.00	-	2.05	-	U	3.50	-	3.55	-
B	2.10	-	2.15	-	V	3.60	-	3.65	-
C	2.20	-	2.25	-	X	3.70	-	3.75	-
D	2.30	-	2.35	-	Y	3.80	-	3.85	-
E	2.40	-	2.45	-	Z	3.90	-	3.95	-

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

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