XC6228 Series

300mA High Speed LDO Regulator with ON/OFF Switch

Preliminary (For Test Sample)

■GENERAL DESCRIPTION

The XC6228 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.

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 V_{SS} level. The output stabilization capacitor C_L is also compatible with low ESR ceramic capacitors.

The output voltage is selectable from 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.1V, 3.3V which fixed by laser trimming technologies. The over current protection circuit is built-in. This protection circuit will operate when the output current reaches current limit level.

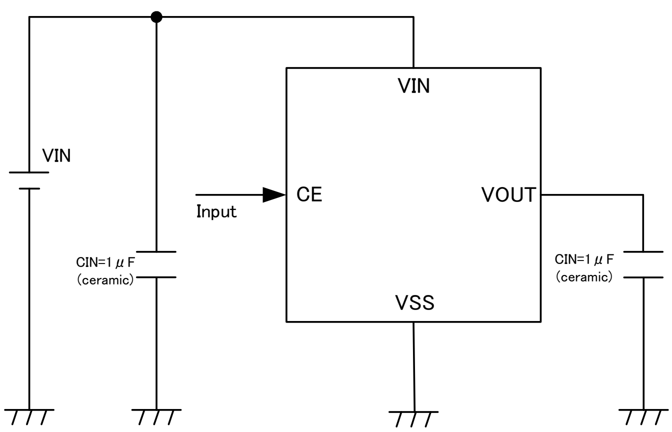
■APPLICATIONS

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

■FEATURES

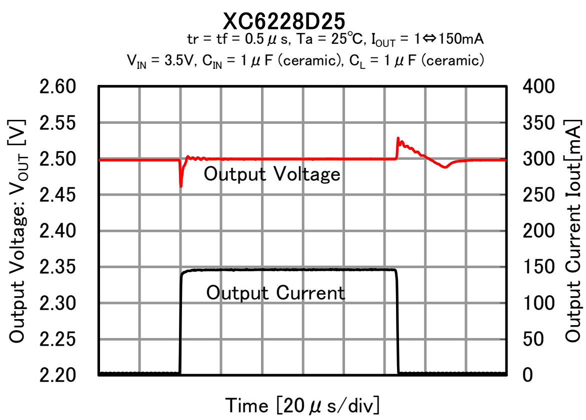
Maximum Output Current	: 300mA
Input Voltage Range	: 1.6～5.5V
Output Voltages	: 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.1V, 3.3V (±2%)
Dropout Voltage	: 200mV@I_{OUT}=300mA (V_{OUT}=3.0V)
Low Power Consumption	: 100 μA
Stand-by Current	: 0.1 μA
High Ripple Rejection	: 80dB@f=1kHz
Protection Circuits	: Current Limit（400mA） Short Circuit Protection
Low ESR Capacitors	: C_{IN}=1 μF, C_L=1 μF
CE Function	: Active High, C_L High Speed Discharge
Small Package	: SOT-25J
Environmentally Friendly	: EU RoHS Compliant, Pb Free

■TYPICAL APPLICATION CIRCUIT

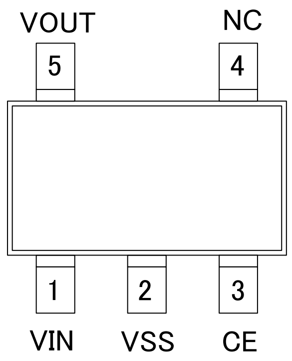


■ TYPICAL PERFORMANCE CHARACTERISTICS

●Load Transient Response



■PIN CONFIGURATION



SOT-25J
(TOP VIEW)

■PIN ASSIGNMENT

PIN NUMBER	PIN NAME	FUNCTIONS
1	VIN	Power Input
5	VOUT	Output
2	VSS	Ground
3	CE	ON/OFF Control
4	NC	No Connection

■PIN FUNCTION ASSIGNMENT

CE INPUT SIGNAL	IC OPERATION STATE
H	ON
L	OFF (Stand-by)
OPEN	OFF (Stand-by) *

* An internal pull-down resister maintains the CE pin voltage to be low.

■PRODUCT CLASSIFICATION

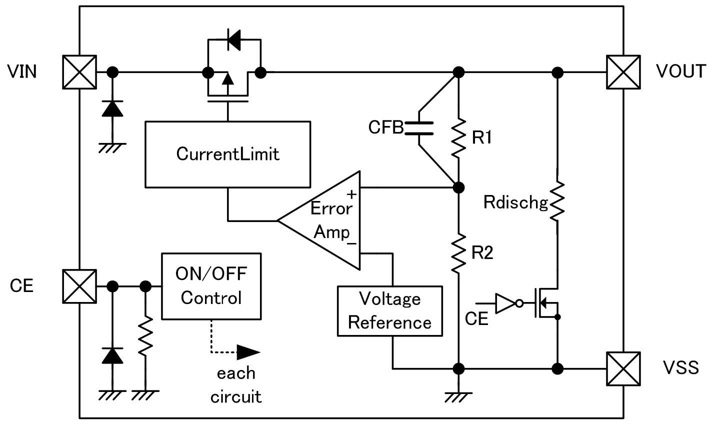
●Ordering Information

XC6228D①②③④⑤-⑥(*1)

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①②	Output Voltage	12	1.2V
		15	1.5V
		18	1.8V
		25	2.5V
		28	2.8V
		30	3.0V
		31	3.1V
		33	3.3V
③	Output Voltage Accuracy	2	±2%
④⑤-⑥ (*1)	Package (Order Unit)	VR-G	SOT-25J (3,000/Reel)

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

■BLOCK DIAGRAMS



XC6228Dseries

■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	SOT-25J	Pd	TBD	mW
			TBD (PCB mounted) (*2)	
Operating Temperature Range		Topr	-40～+85	℃
Storage Temperature Range		Tstg	-55～+125	℃

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

(*2) : This power dissipation figure shown is PCB mounted and is for reference only.

ELECTRICAL CHARACTERISTICS

● XC6228D Series

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.	MAX.	UNITS	CIRCUITS
Output Voltage	$V_{OUT(E)}$ (*1)	$V_{CE}=V_{IN}$, I_{OUT}=10mA		1.176	1.20	1.224	V	①
				1.470	1.50	1.530		
				1.764	1.80	1.836		
				2.450	2.50	2.550		
				2.744	2.80	2.856		
				2.940	3.00	3.060		
				3.038	3.10	3.162		
				3.234	3.30	3.366		
Maximum Output Current	I_{OUTMAX}	$V_{CE}=V_{IN}$		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	$V_{OUT(T)}$ (*2)=1.2V	-	480	630	mV	①
			=1.5V	-	420	460		
			=1.8V	-	300	410		
			=2.5V～2.8V	-	240	350		
			=3.0V～3.3V	-	200	305		
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}/ ($\Delta V_{IN}\cdot V_{OUT}$)	$V_{OUT(T)}$+0.5V≦V_{IN}≦5.5V $V_{CE}=V_{IN}$, 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}/ ($\Delta Ta\cdot V_{OUT}$)	$V_{CE}=V_{IN}$, I_{OUT}=10mA -40℃≦Ta≦85℃		-	±100	-	ppm/℃	①
Ripple Rejection Rate	PSRR	$V_{OUT(T)}$<2.5V V_{IN}=3.0V_{DC}+0.5Vp-p_{AC} $V_{CE}=V_{OUT(T)}$+1.0V I_{OUT}=30mA, f=1kHz		-	80	-	dB	③
		$V_{OUT(T)}$≧2.5V V_{IN}={$V_{OUT(T)}$+1.0}V_{DC}+0.5Vp-p_{AC} $V_{CE}=V_{OUT(T)}$+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	I_{CEH}	$V_{CE}=V_{IN}$=5.5V		3.0	5.5	9.0	μA	④
CE High Level Current	I_{CEL}	$V_{CE}=V_{SS}$		-0.1	-	0.1	μA	④
CL Discharge Resistance	R_{DCHG}	V_{IN}=5.5V, V_{OUT}=2.0V, $V_{CE}=V_{SS}$		-	300	-	Ω	①

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.

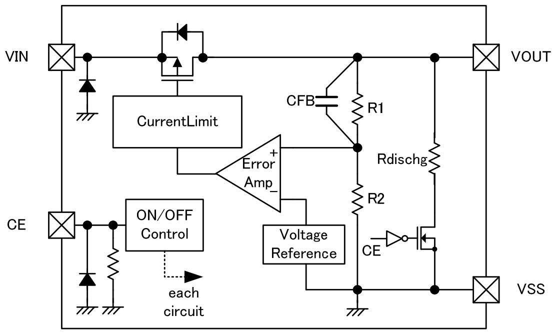
(*4) Vdif={V_{IN1}{*5}－V_{OUT1}{*6}} (V_{IN1}≧1.6V)

(*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.

■ OPERATIONAL EXPLANATION



XC6228Dseries

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 XC6228 series needs an output capacitor C_L for phase compensation. Please place an output capacitor of 1.0μF or bigger at the VOUT pin and VSS pin as close as possible. For a stable power input, please connect an input capacitor (C_{IN}) 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>

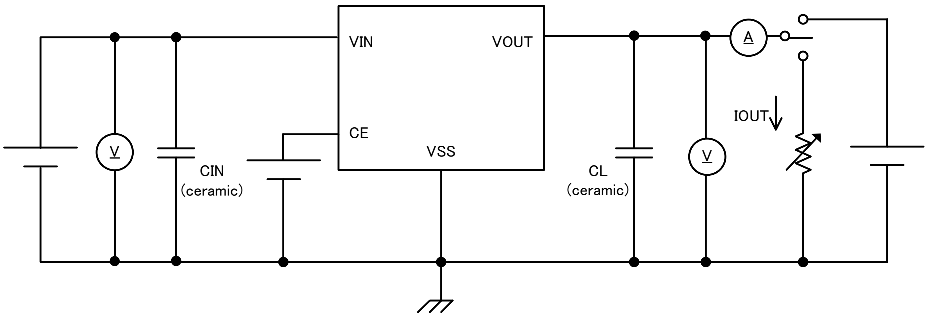
The IC's internal circuitry can be shutdown via the signal from the CE pin. In shutdown mode, the XC6228 series enables the electric charge at the output capacitor (C_L) to be discharged via the internal switch located between the VOUT and VSS pins, and as a result the VOUT pin quickly returns to the V_{SS} level. The XC6228D series has a pull-down resistor at the CE pin inside, so that the CE pin input current flows.

NOTES ON USE

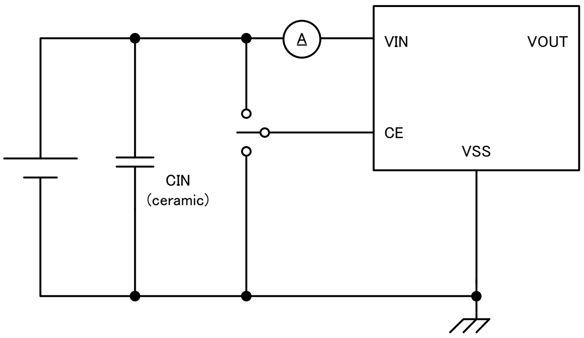
1. Where wiring impedance is high, operations may become unstable due to the noise and/or phase lag depending on output current. Please strengthen V_{IN} and V_{SS} wiring in particular.
2. The input capacitor C_{IN} and the output capacitor C_L should be placed to the as close as possible with a shorter wiring.
3. 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.
4. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
5. 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.

■TEST CIRCUITS

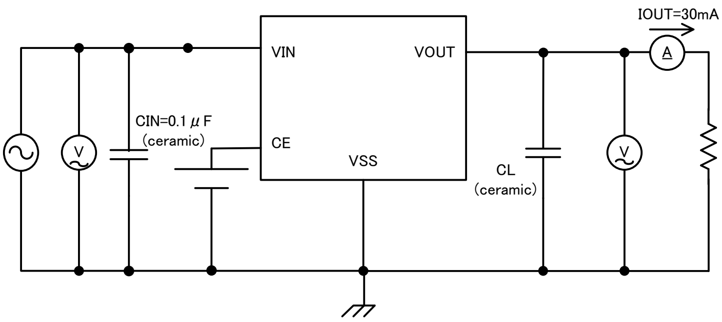
●Circuit ①



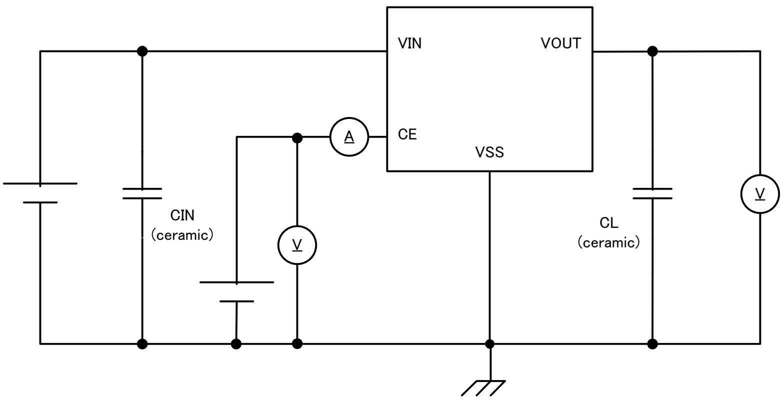
●Circuit ②



●Circuit ③



●Circuit ④

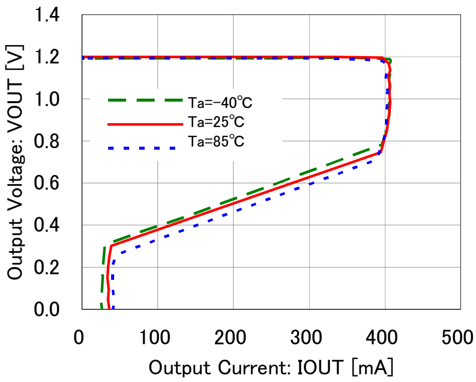


■TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

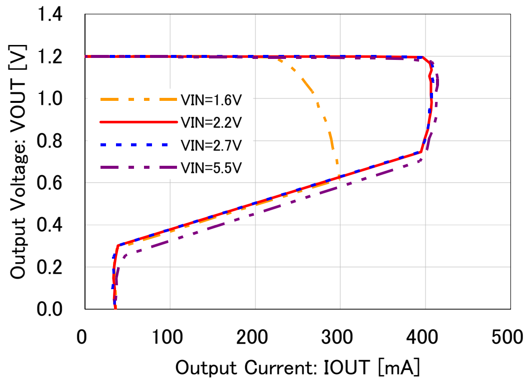
XC6228D12

V_{IN} = 2.2V
C_{IN} = 1.0μF (ceramic)



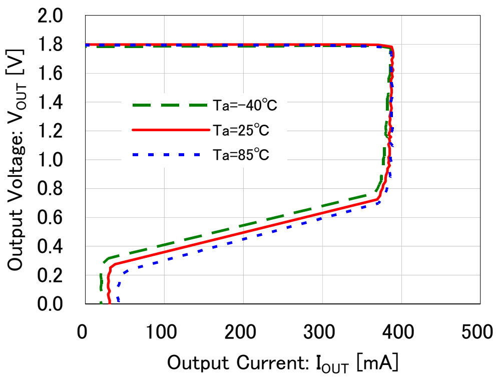
XC6228D12

Ta = 25℃
C_{IN} = 1.0μF (ceramic)



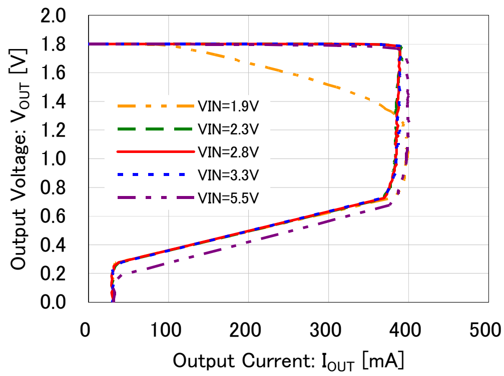
XC6228D18

VIN = 2.8V
C_{IN} = 1.0μF (ceramic)



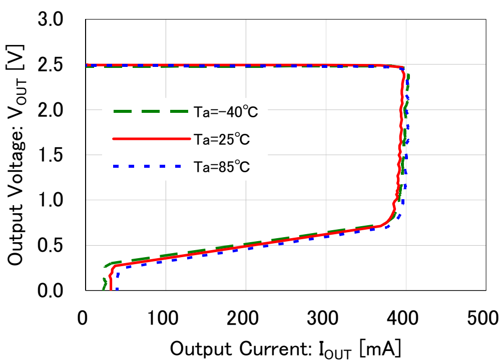
XC6228D18

Ta = 25℃
C_{IN} = 1.0μF (ceramic)



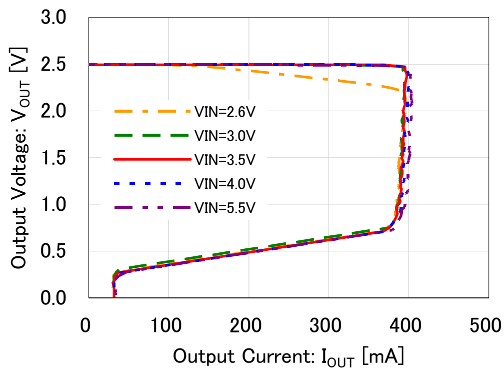
XC6228D25

VIN = 3.5V
C_{IN} = 1.0μF (ceramic)



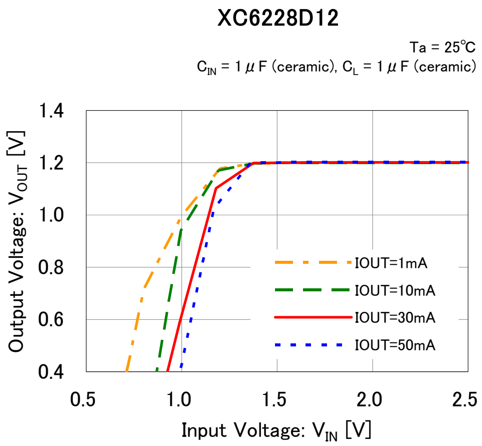
XC6228D25

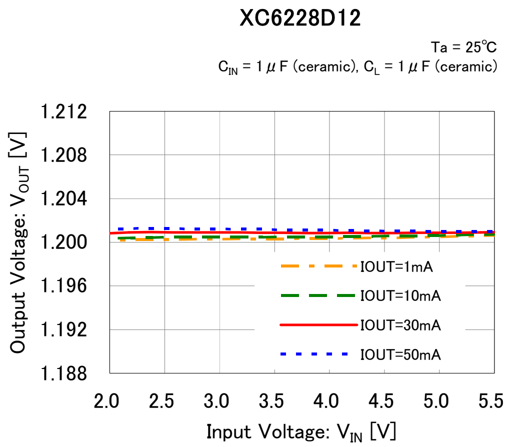
Ta = 25℃
C_{IN} = 1.0μF (ceramic)

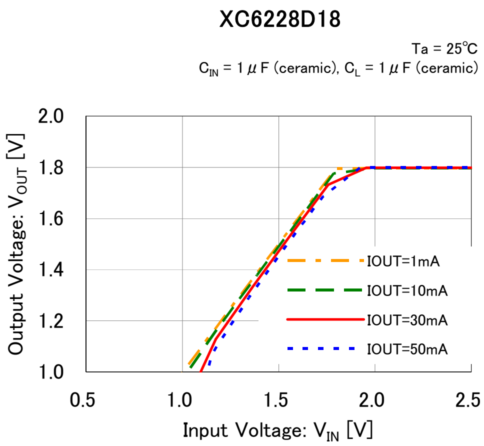


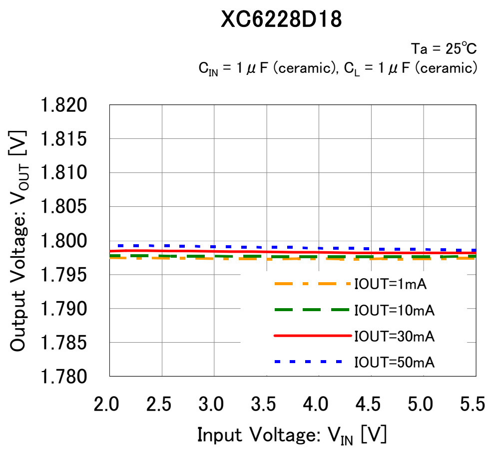
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

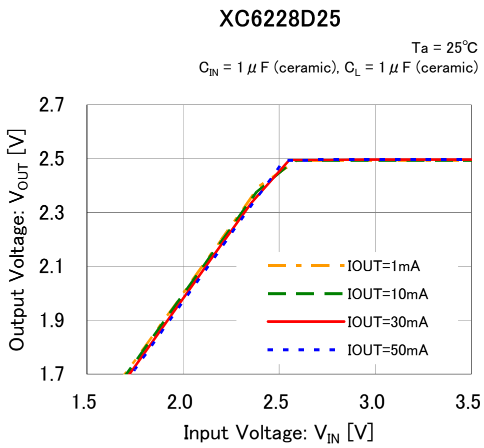
(2) Output Voltage vs. Input Voltage

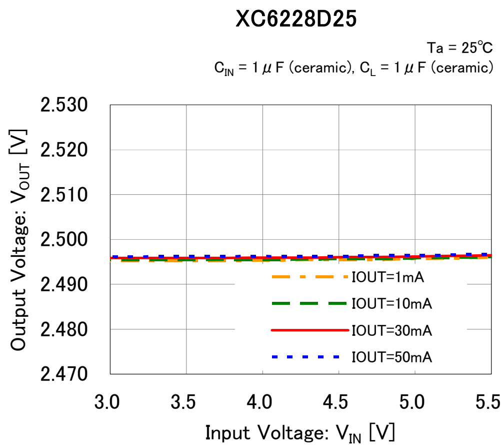








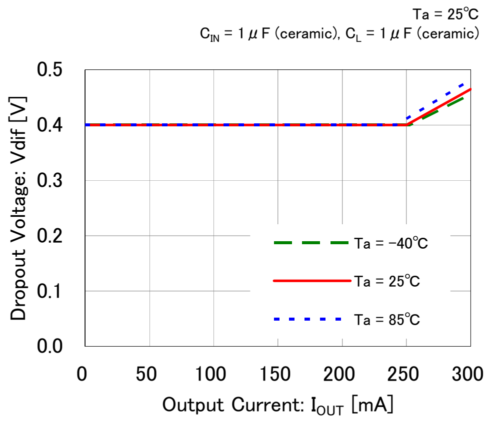




■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

XC6228D12



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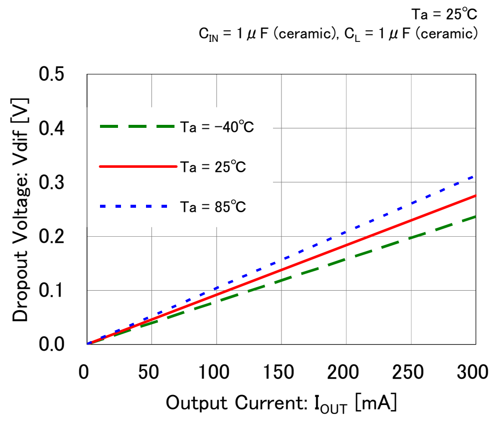

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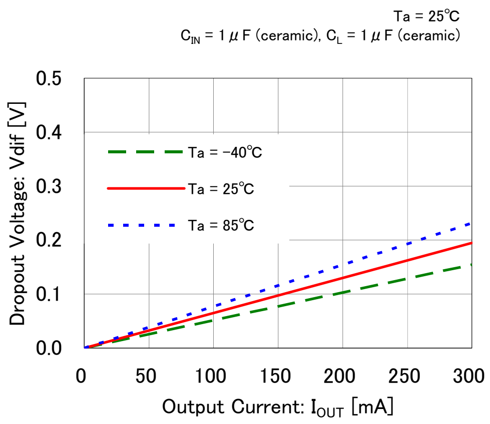
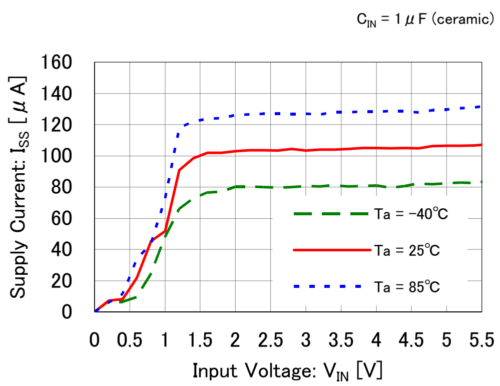


(4) Supply Current vs. Input Voltage

XC6228D12



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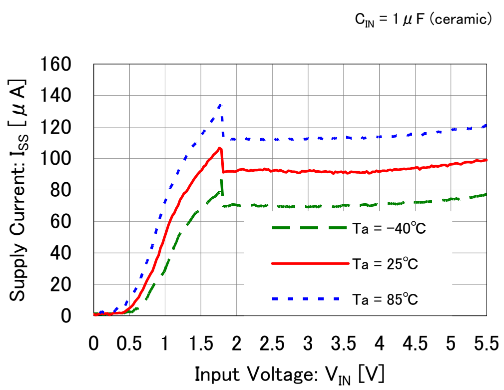
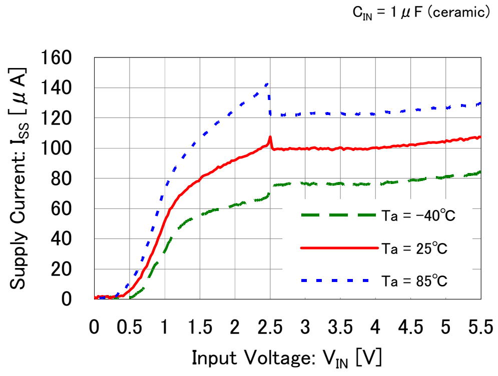


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

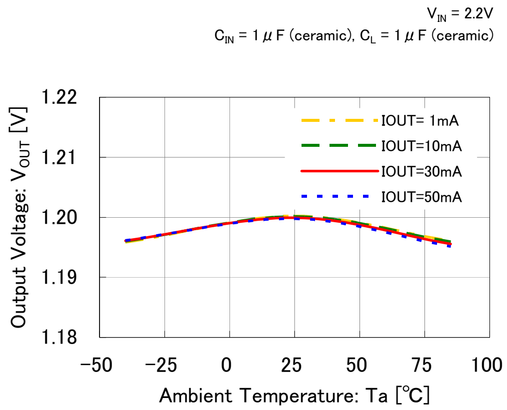
(4) Supply Current vs. Input Voltage (Continued)

XC6228D25



(5) Output Voltage vs. Ambient Temperature

XC6228D12



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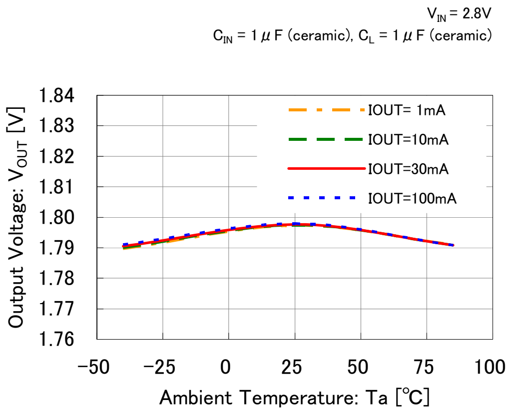

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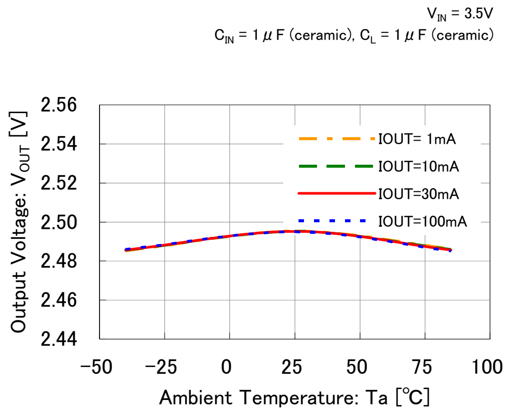
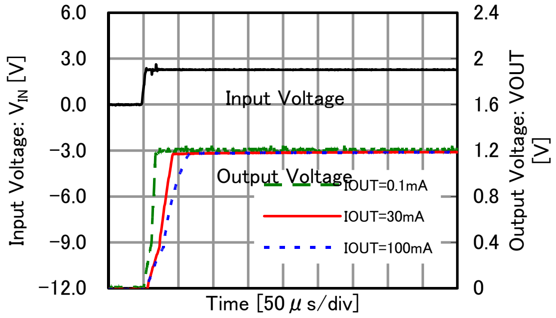


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(6) Rising Response Time

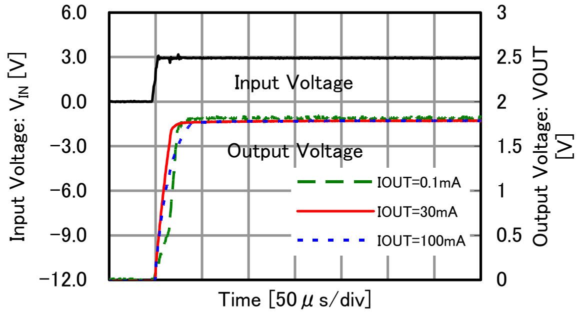
XC6228D12

tr = 5μs, Ta = 25℃,VIN = 0→2.2V
C_{IN} = 0.1μF (ceramic), C_L = 1μF (ceramic)



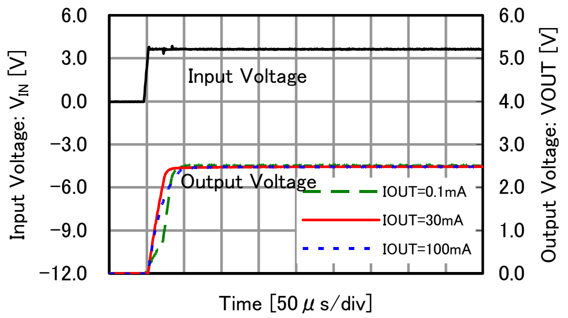
XC6228D18

tr = 5μs, Ta = 25℃,VIN = 0→2.8V
C_{IN} = 0.1μF (ceramic), C_L = 1μF (ceramic)



XC6228D25

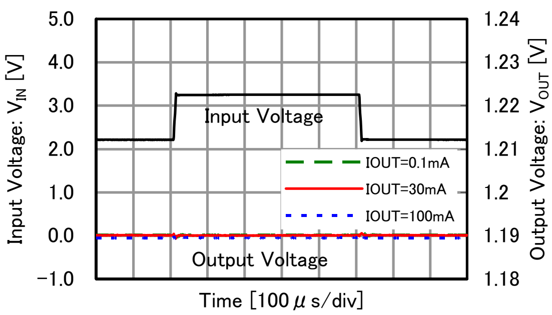
tr = 5μs, Ta = 25℃,VIN = 0→3.5V
CIN = 0.1μF (ceramic), C_L = 1μF (ceramic)



(7) Input Transient Response

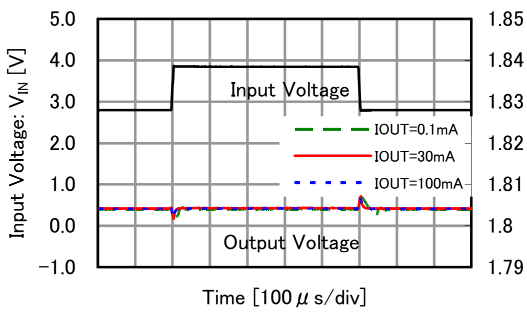
XC6228D12

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



XC6228D18

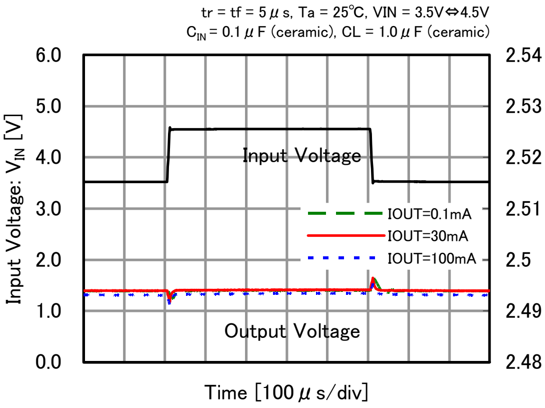
tr = tf = 5μs, Ta = 25℃, VIN = 2.8V⇔3.8V
C_{IN} = 0.1μF (ceramic), CL = 1.0μF (ceramic)



■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

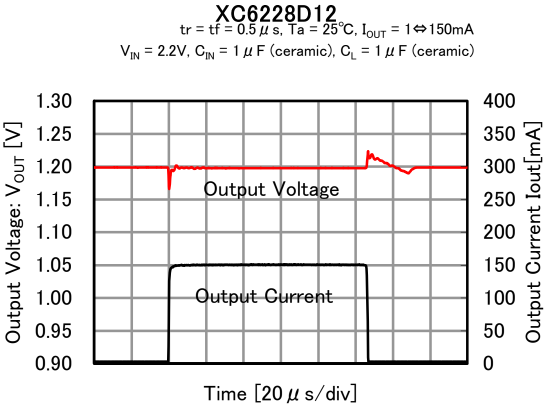
(7) Input Transient Response (Continued)

XC6228D25

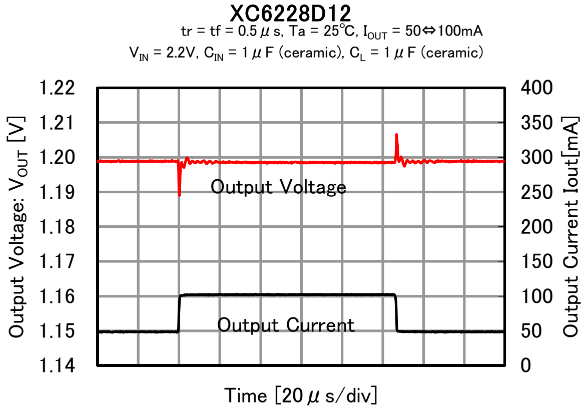


(8) Load Transient Response (tr=tf=0.5μs)

XC6228D12



XC6228D12



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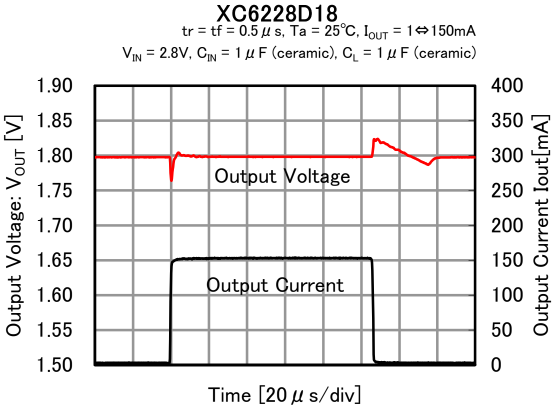

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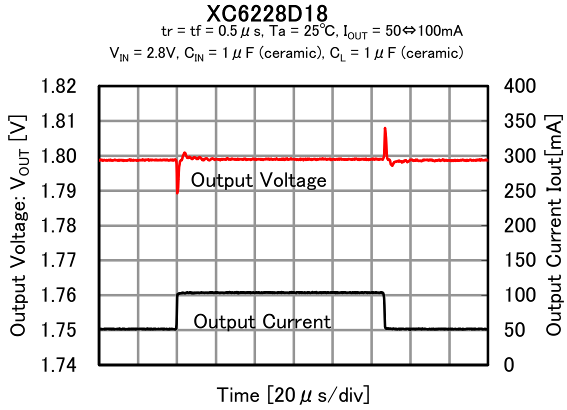
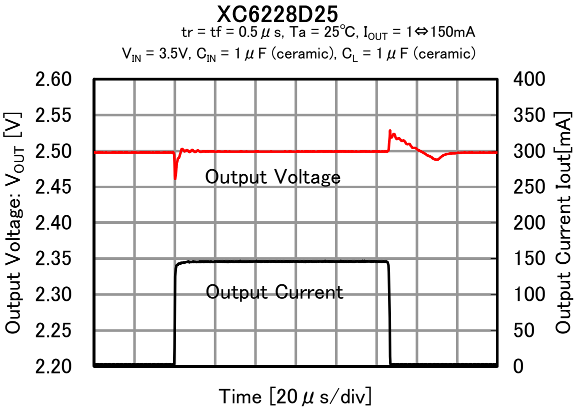
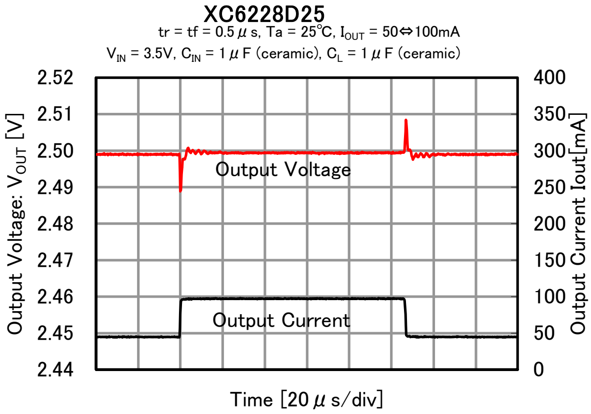


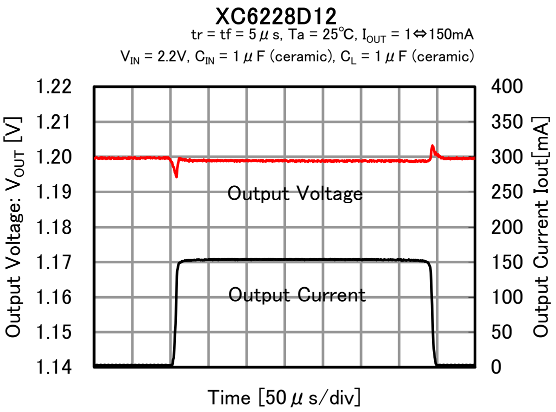
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

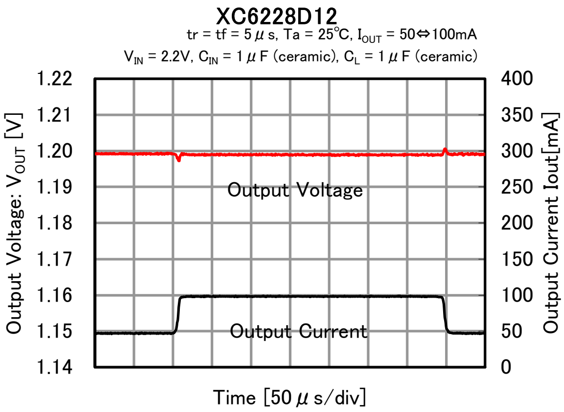
(8) Load Transient Response (tr=tf=0.5 μ s) (Continued)

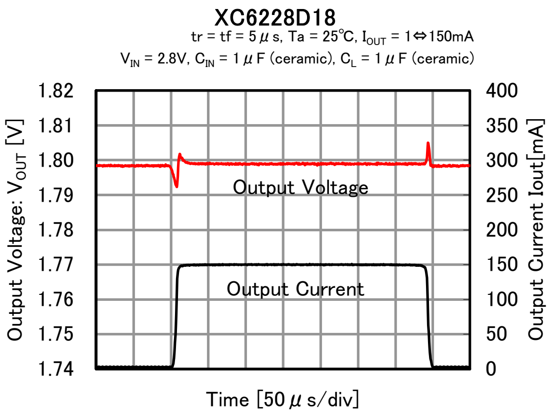


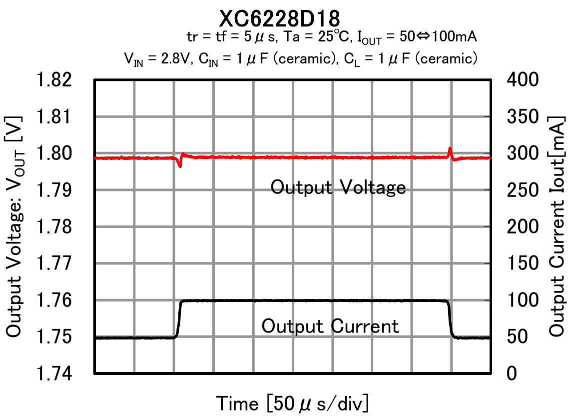


(9) Load Transient Response (tr=tf=5 μ s)



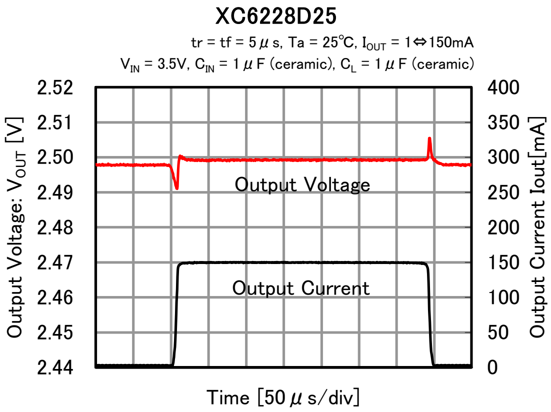


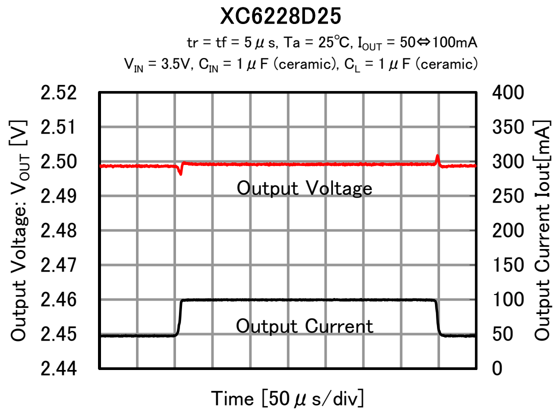




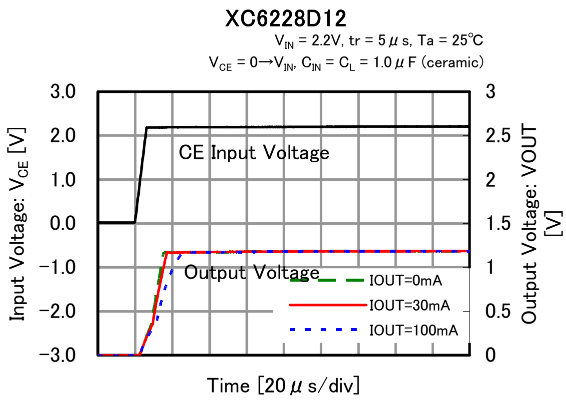
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

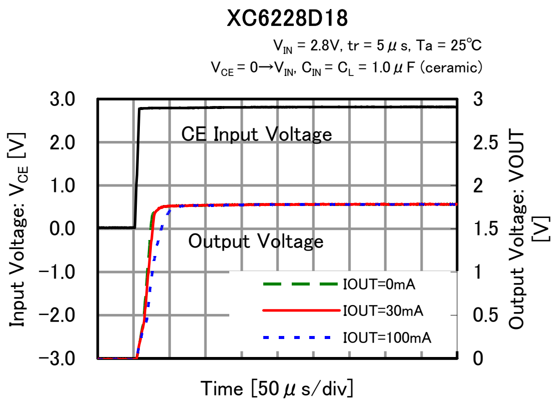
(9) Load Transient Response (tr=tf=5 μ s) (Continued)

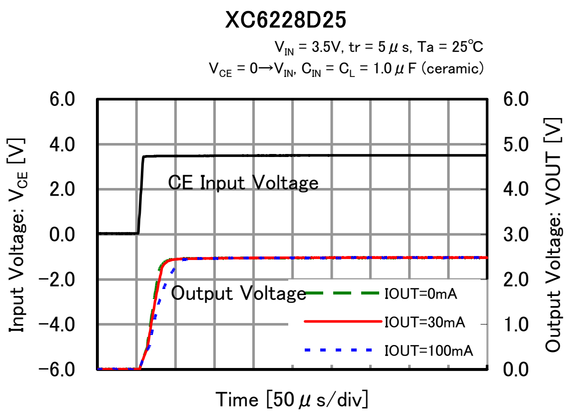




(10) CE Rising Response Time

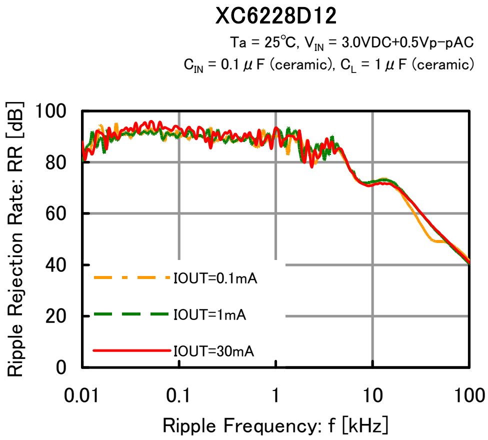


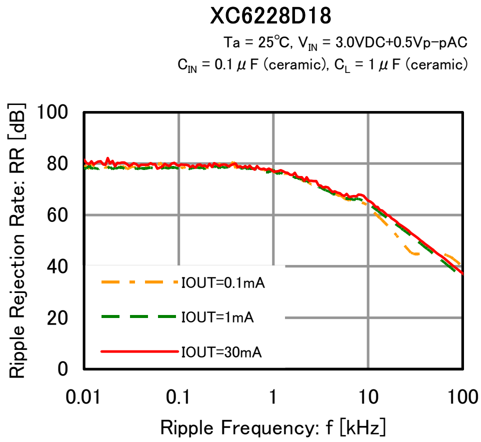


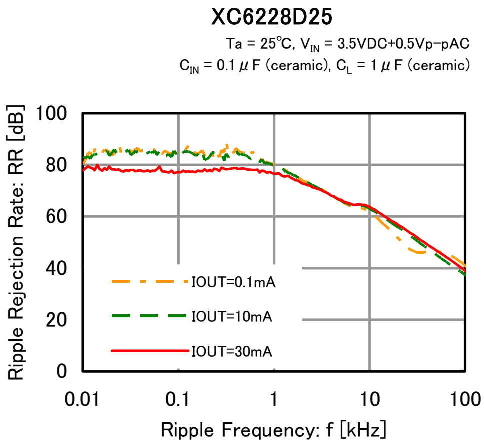


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(11) Ripple Rejection Rate

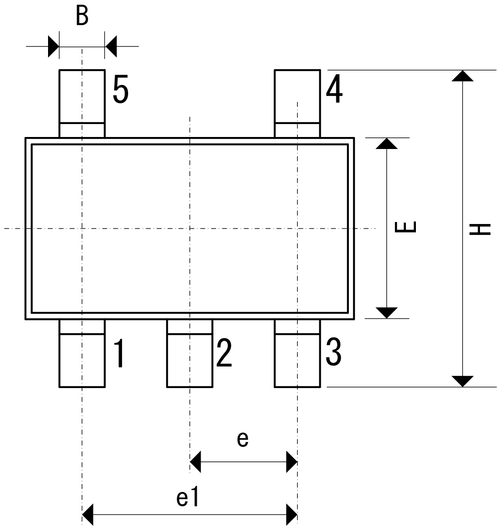




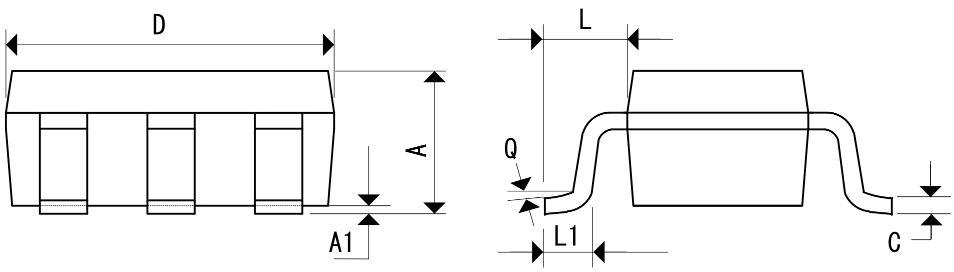


■PACKAGING INFORMATION

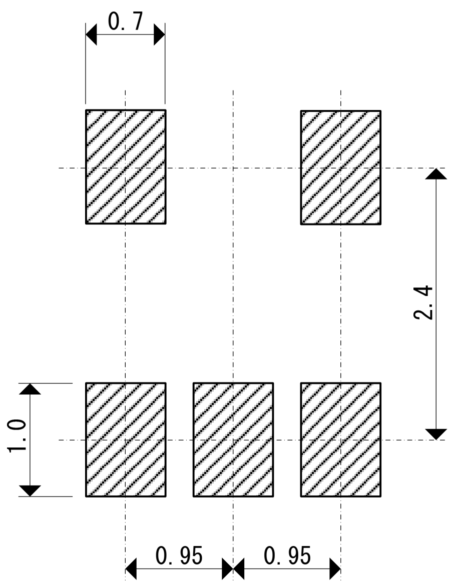
●SOT-25J (Preliminary)



Dimension	Min.	Max.
A	0.9	1.45
A1	0.01	0.15
B	0.3	0.5
C	0.09	0.22
D	2.8	3.0
H	2.5	3.1
E	1.5	1.7
e	0.95 REF.	
e1	1.9 REF.	
L1	0.2	0.6
L	0.35	0.8
Q	0°	10°



●SOT-25J Reference Pattern Layout (Preliminary)



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