XC6402 Series

ETR1001_006

High Current, High Speed LDO Regulators, Voltage Detector Function

■GENERAL DESCRIPTION

The XC6402 series are precise, low noise, high current, positive voltage low dropout regulators with built-in voltage detector. They are fabricated using Torex's CMOS process. The series features a voltage reference, an error amplifier, a current limiter, a voltage detector, and a phase compensation circuit plus a driver transistor.

The output voltage of the LDO and detect voltage of the detector is selectable in 50mV increments within the range of 0.8V to 5.0V. With a low ON resistance driver transistor built-in, batteries can be used until input-output voltage differential is minimal and can accordingly be used for a longer time.

The series is also compatible with low ESR ceramic capacitors which give added output stability. The series provides options to the user to select from a variety of circuit features, such as detector monitoring, detector output logic, EN pin input logic, and internal pull-up / down resistance (semi-custom). The IC's internal regulator circuit can be placed in stand-by mode via the EN function (XC6402C series). In the stand-by mode, power consumption is greatly reduced. The XC6402F series offers the option of a delay on the detector output: the delay time can be controlled by the use of an external capacitor.

■APPLICATIONS

- ●Optical disk drive
- ●Magnetic disk drive
- ●Digital still cameras / Camcorders
- ●Digital audio equipments
- ●Multi-function power supplies

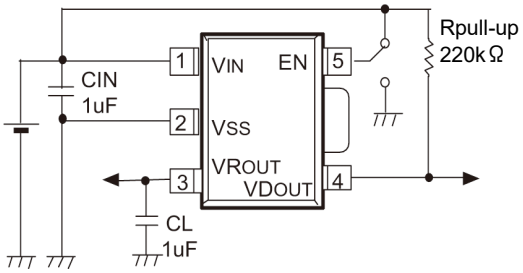
■FEATURES

Maximum Output Current	: More than 700mA (800mA limit) (1.6V≦$V_{ROUT(T)}$≦5.0V)
Dropout Voltage	: 50mV @ 100mA 100mV @ 200mA
Maximum Operating Voltage	: 1.5V ~ 6.0V
VR Output Voltage Range	: 0.8V ~ 5.0V (50mV increments)
VD Detect Voltage Range	: 0.8V ~ 5.0V (50mV increments) More than 1.5V (V_{IN} sensing)
Highly Accurate	: ± 2%
Low Power Consumption	: 35μA (TYP.)
High Ripple Rejection	: 60dB @1kHz
Ambient Temperature	: -40℃ ~ 85℃
Output Capacitor	: Ceramic capacitor compatible
Ultra-Small Packages	: SOT-25, SOT-89-5
Environmentally Friendly	: EU RoHS Compliant, Pb Free

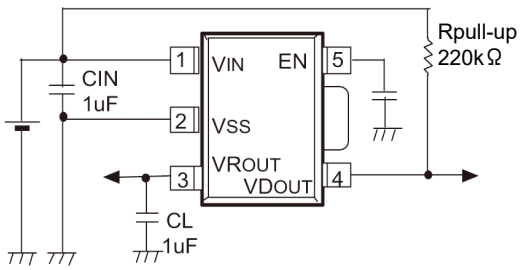
* VD: Voltage Detector

■TYPICAL APPLICATIONS CIRCUITS

●XC6402C Series

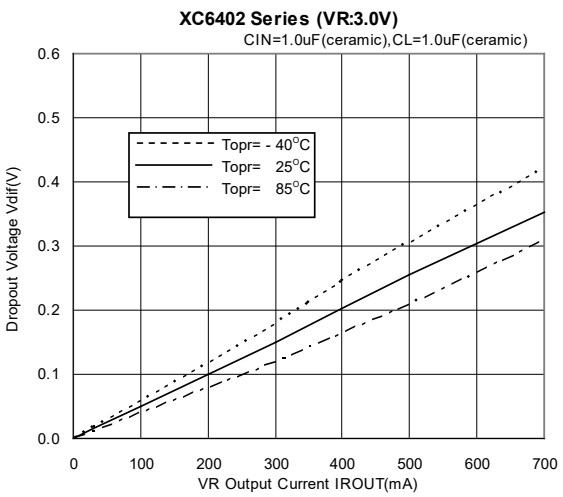


●XC6402F Series



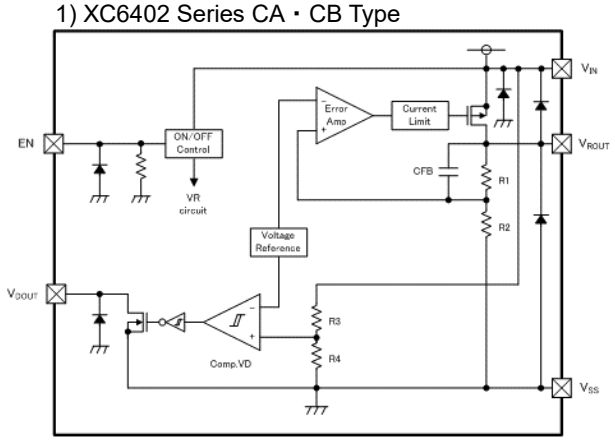
■TYPICAL PERFORMANCE CHARACTERISTICS

●Dropout Voltage vs. VR Output Current

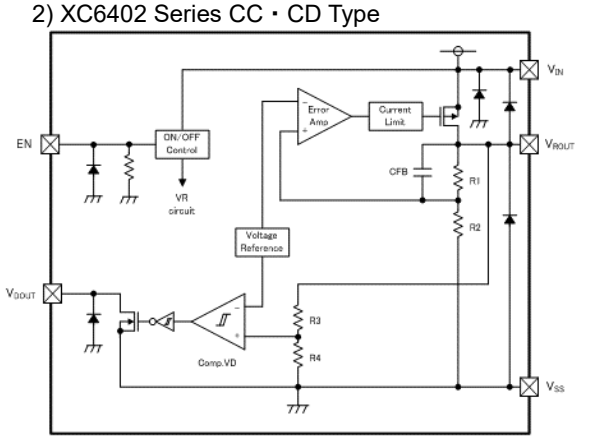


■BLOCK DIAGRAMS

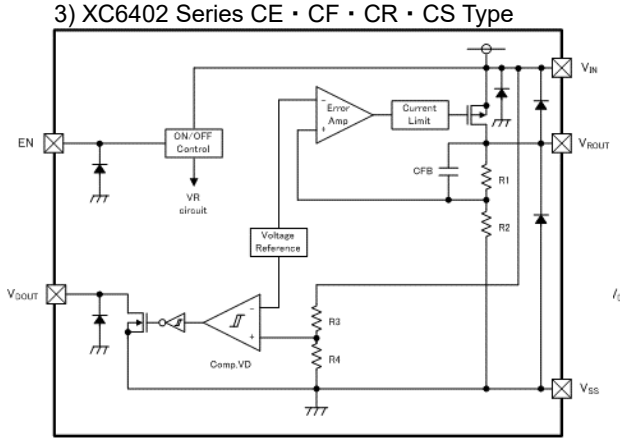
1) XC6402 Series CA・CB Type



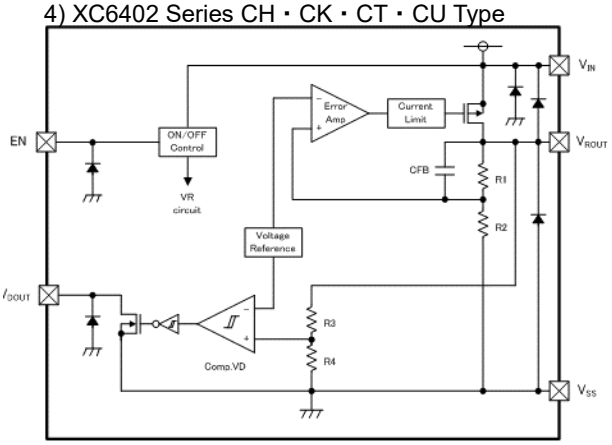
2) XC6402 Series CC・CD Type



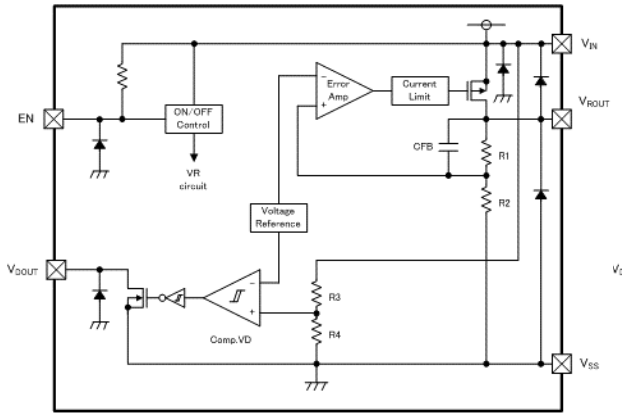
3) XC6402 Series CE・CF・CR・CS Type



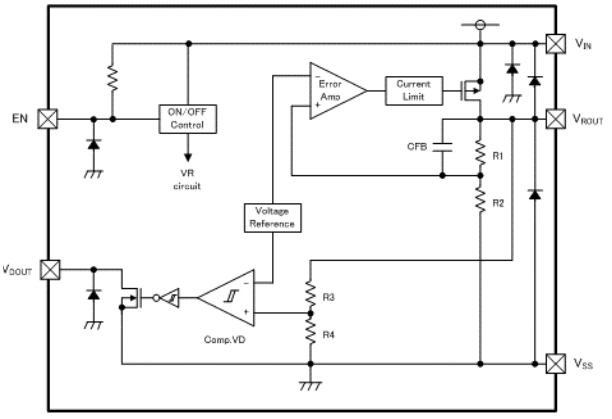
4) XC6402 Series CH・CK・CT・CU Type



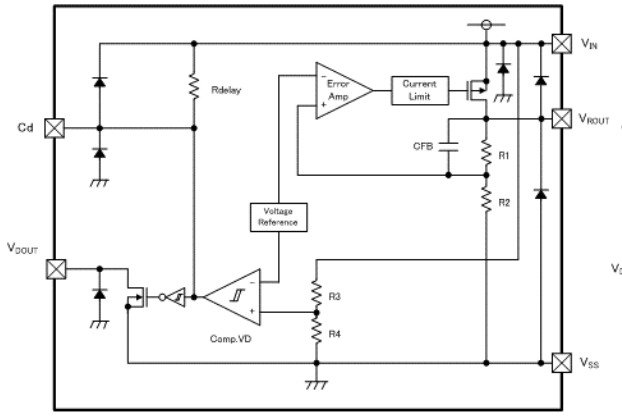
5) XC6402 Series CL・CM Type



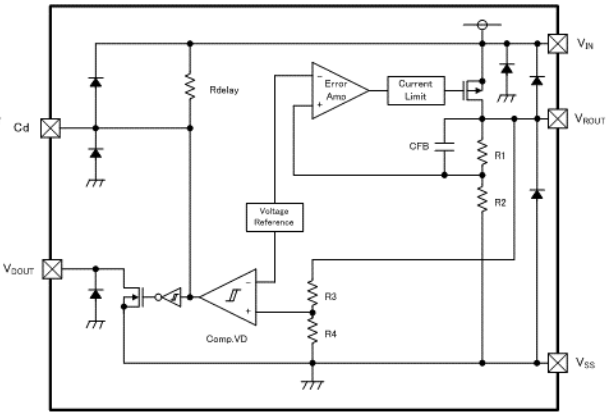
6) XC6402 Series CN・CP Type



7) XC6402 Series FV・FX Type



8) XC6402 Series FY・FZ Type



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

■PRODUCT CLASSIFICATION (Continued)

●Ordering Information

XC6402 ①②③④⑤⑥-⑦(*1)

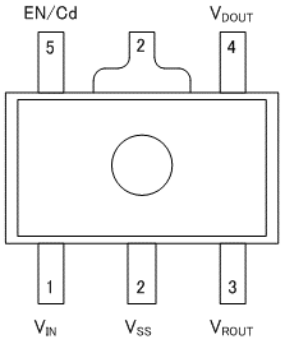
DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION
①	Operational Function	C	EN function
		F	Cd Pin
②	Type	A ~ Z	Selection Guide
③ ④	Output Voltage & Detect Voltage	01~	Internally set sequential number relating to output voltage and detect voltage. VR setting output voltage range: 0.8V ~ 5.0V (0.05V Step) Detect voltage setting range: 0.8V ~ 5.0V (0.05V Step)
⑤⑥-⑦	Packages	MR	SOT-25 (3,000pcs/Reel)
		MR-G	SOT-25 (3,000pcs/Reel)
		PR	SOT-89-5 (1,000pcs/Reel)
		PR-G	SOT-89-5 (1,000pcs/Reel)

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

●Selection Guide

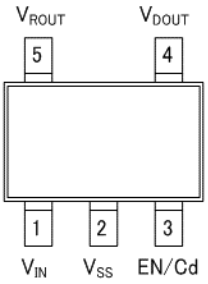
Type	EN FUNCTION	EN SINGNAL	PULL-UP/DOWN RESISTOR	VD-SENSE PIN	VDOUT SIGNAL	Operational Function
A	Yes	High Active	Pull-Down, Yes	V_{IN}	Detect Low	C Type
B	Yes	High Active	Pull-Down, Yes	V_{IN}	Detect High	
C	Yes	High Active	Pull-Down, Yes	V_{ROUT}	Detect Low	
D	Yes	High Active	Pull-Down, Yes	V_{ROUT}	Detect High	
E	Yes	High Active	No	V_{IN}	Detect Low	
F	Yes	High Active	No	V_{IN}	Detect High	
H	Yes	High Active	No	V_{ROUT}	Detect Low	
K	Yes	High Active	No	V_{ROUT}	Detect High	
L	Yes	Low Active	Pull-Down, Yes	V_{IN}	Detect Low	
M	Yes	Low Active	Pull-Down, Yes	V_{IN}	Detect High	
N	Yes	Low Active	Pull-Down, Yes	V_{ROUT}	Detect Low	
P	Yes	Low Active	Pull-Down, Yes	V_{ROUT}	Detect High	
R	Yes	Low Active	No	V_{IN}	Detect Low	
S	Yes	Low Active	No	V_{IN}	Detect High	
T	Yes	Low Active	No	V_{ROUT}	Detect Low	
U	Yes	Low Active	No	V_{ROUT}	Detect High	
V	No	-	-	V_{IN}	Detect Low	F Type
X	No	-	-	V_{IN}	Detect High	
Y	No	-	-	V_{ROUT}	Detect Low	
Z	No	-	-	V_{ROUT}	Detect High	

■PIN CONFIGURATION



SOT-89-5

(TOP VIEW)



SOT-25

(TOP VIEW)

■PIN ASSIGNMENT

PIN NUMBER		PIN NAME	FUNCTION
SOT-25	SOT-89-5		
1	1	V_{IN}	Power Input
2	2	V_{SS}	Ground
5	3	V_{ROUT}	VR Output
4	4	V_{DOUT}	VD Output
3	5	EN	VR ON/OFF Control (C Series)
3	5	Cd	Delay Capacitor Connection (F Series)

■PIN FUNCTION ASSIGNMENT

XC6402 Series CA/CB/CC/CD Type

PIN NAME	SIGNAL	STATUS	
		REGULATOR	DETECTOR
EN	L	Stand-by	Active
	H	Active	Active
	OPEN	Stand-by	Active

XC6402 Series CE/CF/CH/CK Type

PIN NAME	SIGNAL	STATUS	
		REGULATOR	DETECTOR
EN	L	Stand-by	Active
	H	Active	Active
	OPEN	Undefined state	Active

XC6402 Series CL/CM/CN/CP Type

PIN NAME	SIGNAL	STATUS	
		REGULATOR	DETECTOR
EN	L	Active	Active
	H	Stand-by	Active
	OPEN		

XC6402 Series CR/CS/CT/CU Type

PIN NAME	SIGNAL	STATUS	
		REGULATOR	DETECTOR
EN	L	Active	Active
	H	Stand-by	Active
	OPEN	Undefined state	Active

※XC6402FV/FX/FY/FZ does not have EN function.

■ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	-0.3 ~ 6.5	V
VR Output Current		I_{ROUT}	800(*1)	mA
VR Output Voltage		V_{ROUT}	-0.3 ~ V_{IN} + 0.3 or 6.5(*2)	V
VD Output Current		I_{DOUT}	50(*1)	mA
VD Output Voltage		V_{DOUT}	-0.3 ~ 6.5	V
EN Pin Voltage		V_{EN}	-0.3 ~ 6.5	V
Cd Pin Voltage		Cd	-0.3 ~ V_{IN} + 0.3 or 6.5(*2)	V
Power Dissipation (Ta=25℃)	SOT-25	Pd	250	mW
			600 (40mm x 40mm standard board)(*3)	
			760 (JESD51-7 board)(*3)	
	SOT-89-5		500	
			1300 (40mm x 40mm standard board)(*3)	
			1750 (JESD51-7 board)(*3)	
Operating Temperature Range		Topr	-40 ~ 85	℃
Storage Temperature Range		Tstg	-55 ~ 125	℃

All voltages are described based on the V_{SS} pin.

(*1) Please use within the range of I_{ROUT}>Pd /(V_{IN}-V_{ROUT})

(*2) The maximum rating corresponds to the lowest value between V_{IN}+0.3V or 6.5V

(*3) The power dissipation figure shown is PCB mounted and is for reference only.
Please refer to PACKAGING INFORMATION for the mounting condition.

Ta=25

■ELECTRICAL CHARACTERISTICS

XC6402 Series C Type

■ELECTRICAL CHARACTERISTICS (Continued)

XC6402 Series C Type (Continued)

Ta=25℃

	PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
REGULATOR	Output Voltage	$V_{ROUT(E)}$ (*2, 7)	I_{ROUT}=30mA V_{EN}=ON（V_{IN} or V_{SS}）	×0.98 (-30m)	$V_{ROUT(T)}$ (*1)	×1.02 (+30mV)	V	①
	Maximum Output Current [$V_{ROUT(E)}$≧1.6V]	$I_{ROUTMAX}$	V_{IN}=$V_{ROUT(T)}$+1.0V V_{EN}=ON（V_{IN} or V_{SS}）	700	-	-	mA	①
	Maximum Output Current [$V_{ROUT(E)}$＜1.6V]			500	-	-	mA	①
	VR Load Regulation	$\triangle V_{ROUT}$	1mA≦I_{ROUT}≦100mA	-	15	60	mV	①
	VR Dropout Voltage	Vdif1(※3)	I_{ROUT}=30mA	E-1			mV	①
		Vdif2(※3)	I_{ROUT}=100mA	E-2				
	Supply Current (CA/CB/CC/CD type)	I_{DD}	V_{EN}=V_{IN}=$V_{ROUT(T)}$+1.0V, I_{ROUT}=0mA	-	E-3		μA	②
	Supply Current (CL/CM/CN/CP type)		V_{IN}=$V_{ROUT(T)}$+1.0V, V_{EN}=V_{SS}, I_{ROUT}=0mA				μA	②
	Supply Current (CE/CF/CH/CK type)		V_{EN}=V_{IN}=$V_{ROUT(T)}$+1.0V, I_{ROUT}=0mA	-	35	70	μA	②
	Supply Current (CR/CS/CT/CU type)		VIN=VROUT(T)+1.0V, VEN=VSS, IROUT=0mA	-	35	70	μA	②
	VR Line Regulation	$\frac{\triangle V_{ROUT}}{\triangle V_{IN} \cdot V_{ROUT}}$	$V_{ROUT(T)}$+1.0V≦V_{IN}≦6.0V I_{ROUT}=30mA	-	0.01	0.20	%/V	①
	Input Voltage	VIN		1.5	-	6.0	V	-
	VR Output Voltage Temperature Characteristics	$\frac{\triangle V_{ROUT}}{\triangle Topr \cdot V_{ROUT}}$	I_{ROUT}=30mA -40℃≦Topr≦85℃	-	±100	-	ppm / ℃	①
	Ripple Rejection Rate V_{ROUT}≧4.75V	PSRR	V_{IN}=5.75V_{DC}.0. 5Vp-pAC I_{ROUT}=30mA, f=1kHz	-	60	-	dB	③
	Ripple Rejection Rate V_{ROUT}<4.75V		V_{IN}=[$V_{ROUT(T)}$+1.0]V_{DC}+0.5Vp-pAC I_{ROUT}＝30mA、 f ＝1kHz					
	Current Limiter [V_{ROUT}≧1.6V]	I_{RLIM}	V_{IN}=$V_{ROUT(T)}$+1.0V V_{EN}=ON(V_{IN} or V_{SS})	700	800	-	mA	①
	Current Limiter [V_{ROUT}＜1.6V]			-	800	-	mA	①
	Short Circuit Current	I_{SHORT}	V_{IN}=$V_{ROUT(T)}$+1.0V V_{EN}=ON(V_{IN} or V_{SS})	-	30	-	mA	①

NOTE : Unless otherwise stated, V_{IN}=$V_{ROUT(T)}$+1.0V

*1: $V_{ROUT(T)}$=Specified VR output voltage

*2: $V_{ROUT(E)}$=Effective VR output voltage.

*3: Vdif={V_{IN1} - V_{ROUT1}}

A voltage equal to 98% of the VR output voltage whenever a stabilized VROUT1=IROUT{VROUT(T)+1.0V} is input.

V_{IN1}=The input voltage when V_{OUT1}, which appears as input voltage is gradually decreased.

*4: $V_{DF(T)}$: Specified detect voltage value

*5: $V_{DF(E)}$: Effective detect voltage value.

*6: VD output current value of detect 'L' type equal to current value during detection and that of Detect 'H' type equal to current value before detection.

*7: $V_{ROUT(T)}$≦1.45V, $V_{DF(T)}$≦1.45V → MIN : $V_{ROUT(T)}$ -30mV, $V_{DF(T)}$ -30mV,
→ MAX : $V_{ROUT(T)}$ +30mV, $V_{DF(T)}$ +30mV

*8: EN conditions: XC6402CZ / CB / CC / CD / CE / CF / CH / CK type: ON=V_{IN}, OFF=V_{SS}
XC6402CL / CM / CN / CP / CR / CS / CT / CU type: ON=V_{SS}, OFF=V_{IN}

*9: VD detect voltage: For V_{IN} sense version, XC6402CA / CB / CE / CF / CL / CM / CR / CS, only $V_{DF(T)}$≧1.5V type are available.

■ELECTRICAL CHARACTERITICS (Continued)

Ta=25℃

XC6402F Series F Type

	PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
REGULATOR DETECTOR	Output Voltage	$V_{ROUT(T)}$ (*2, 7)	I_{ROUT}=30mA	× 0.98 (-30mV)	$V_{ROUT(T)}$ (*1)	× 1.02 (+30mV)	V	①
	VR Maximum Output Current	$I_{ROUTMAX}$	V_{IN}= $V_{ROUT(T)}$+1.0V	700	-	-	mA	①
	VD Detect Voltage [$V_{ROUT(E)}$≧1.6V]	$V_{DF(E)}$ (*5, 7)		× 0.98 (-30mV)	$V_{DF(T)}$ (*4)	× 1.02 (+30mV)	V	④
	VR Maximum Output Current [$V_{ROUT(E)}$＜1.6V]	$I_{ROUTMAX}$	V_{IN}= $V_{ROUT(T)}$+1.0V	500	-	-	mA	①
	VD Hysteresis Range	V_{HYS}		$V_{DF(E)}$ × 0.02	$V_{DF(E)}$ × 0.05	$V_{DF(E)}$ × 0.08	V	④
	Load Regulation	$\triangle V_{ROUT}$	V_{EN}=ON(≧1.4V), 1mA≦I_{ROUT}≦100mA	-	15	50	mV	①
	VD Supply Current	I_{DIF1} (*3)	V_{EN}=OFF(V_{IN} or V_{SS}) VIN = 1.5V	-	5.0	14.0	μA	②
			V_{EN}=OFF(V_{IN} or V_{SS}) VIN = 2.0V	-	5.5	14.5		
			V_{EN}=OFF(V_{IN} or V_{SS}) VIN = 3.0V	-	6.0	15.0		
			V_{EN}=OFF(V_{IN} or V_{SS}) VIN = 4.0V	-	6.5	15.5		
	VR Dropout Voltage (*4)	Vdif1 (*3)	I_{ROUT}=30mA	-	E-1	-	mV	①
		Vdif2 (*3)	I_{ROUT}=100mA	-	E-2	-		
			V_{EN}=OFF(V_{IN} or V_{SS}) VIN = 5.0V	-	7.0	16.0		
			V_{EN}=OFF(V_{IN} or V_{SS}) VIN = 6.0V	-	7.5	17.0		
	Supply Current	I_{DD}	V_{IN}=$V_{ROUT(T)}$+1.0V VIN = 1.5V	-	35	70	μA	②
			$V_{ROUT(T)}$+1.0V≦V_{IN}≦6.0V VIN = 2.0V	-	35	-		
	VR Line Regulation	$\frac{\triangle V_{ROUT}}{\triangle V_{IN} \cdot V_{ROUT}}$	I_{ROUT}=30mA VIN = 3.0V	-	0.01	0.20	%/V	①
	VD Output Current (*6)	I_{DOUT}	V_{DOUT} = 0.5V VIN = 4.0V	1.9	3.8	-	mA	⑤
	Input Voltage	V_{IN}		1.5	-	6.0	V	-
			V_{DOUT} = 0.5V VIN = 5.0V	1.9	3.9	-		
	Output Voltage Temperature Characteristics	$\frac{\triangle V_{ROUT}}{\triangle Topr \cdot V_{ROUT}}$	I_{ROUT}=30mA VIN = 6.0V	2.0	4.0	-	ppm/℃	①
	VD Detect Voltage Temperature Characteristics	$\frac{\triangle V_{DF}}{\triangle Topr \cdot V_{DF}}$	-40℃≦Topr≦85℃	-	±100	-	ppm/℃	④
	VR Ripple Rejection Rate	PSRR	V_{IN}=5.75V_{DC}+0.5Vp-p_{AC} I_{ROUT}=30mA, f=1kHz	-	60	-	dB	① ③
SWITCH DETECTOR	EN "H" Level Voltage	V_{ENH}	V_{IN}=[$V_{ROUT(T)}$+1.0]V_{DC}+0.5Vp-p_{AC} I_{ROUT}=30mA、 f =1kHz	1.30	-	V_{IN}	V	①
	EN "L" Level Voltage	V_{ENL}		V_{SS}	-	0.25	V	①
	Current Limiter (CA/CB/CC/CD type)	I_{RLIM}	V_{IN}=$V_{ROUT(T)}$+1.0V	700	800	-	mA	①
	EN "H" Level Current (CE/CF/CH/CK/CL/CM/CN/CP/CR/CS/CT/CU type)	I_{ENH}	V_{EN}=V_{IN}=$V_{ROUT(T)}$+1.0V	-0.10	-	0.10	μA	①
	Short-Circuit Current	I_{RSHORT}	V_{IN}=$V_{ROUT(T)}$+1.0V	-	30	-	mA	①
	VD Detect Voltage (CL/CM/CN/CP type)	$V_{DF(E)}$ (※5,※7)		× 0.98 (-30mV)	$V_{DF(T)}$ (※4)	× 1.02 (+30mV)	V	④
	VD Hysteresis Range	V_{HYS}		$V_{DF(E)}$ × 0.02	$V_{DF(E)}$ × 0.05	$V_{DF(E)}$ × 0.08	V	④
	EN "H" Level Current (CA/CB/CC/CD/CE/CF/CH/CK/CR/CS/CT/CU type)	I_{ENL}	V_{IN}=$V_{ROUT(T)}$+1.0V, V_{EN}=V_{SS}	-0.10	0.00	0.10	μA	①
	VD Output Current (*6)	I_{DOUT}	V_{DOUT}=0.5V , V_{IN} = 1.5V	1.5	3.0	-	mA	①
			V_{DOUT}=0.5V , V_{IN} = 2.0V	1.8	3.5	-		⑤
			V_{DOUT}=0.5V , V_{IN} = 3.0V	1.8	3.7	-		
			V_{DOUT}=0.5V , V_{IN} = 4.0V	1.9	3.8	-		
			V_{DOUT}=0.5V , V_{IN} = 5.0V	1.9	3.9	-		
			V_{DOUT}=0.5V , V_{IN} = 6.0V	2.0	4.0	-		
	VD Detect Voltage Temperature Characteristics	$\frac{\triangle V_{DF}}{\triangle Topr \cdot V_{DF}}$	-40℃≦Topr≦85℃	-	±100	-	ppm/℃	④
	Delay Resistance	Rdelay	V_{IN}=6.0V, VCD=0V	1.0	2.0	3.5	MΩ	⑥

NOTE: Unless otherwise stated, V_{IN}=$V_{ROUT(T)}$+1.0V
*1: $V_{ROUT(T)}$=Specified VR output voltage
*2: $V_{ROUT(E)}$=Effective VR output voltage.
*3 Vdif={V_{IN1}- V_{ROUT1}}
A voltage equal to 98% of the ~~VR~~ output voltage whenever a stabilized V_{ROUT1}=I_{ROUT}{$V_{ROUT(T)}$+1.0V} is input.
V_{IN1}=The input voltage when V_{OUT1}, which appears as input voltage is gradually decreased.
*4: $V_{DF(T)}$: Specified detect voltage value
*5: $V_{DF(E)}$: Effective detect voltage value.
*6: VD output current value of Detect 'L' type equal to current value during detection and that of Detect 'H' type equal to current value before detection.
*7: $V_{ROUT(T)}$≦1.45V, $V_{DF(T)}$≦1.45V → MIN: $V_{ROUT(T)}$ -30mV, $V_{DF(T)}$ -30mV,
→ MAX: $V_{ROUT(T)}$ +30mV, $V_{DF(T)}$ +30mV
*9: VD detect voltage: For V_{IN} Sense version, XC6402FV / FX, only $V_{DF(T)}$>1.5V type are available.

■ELECTRICAL CHARACTERISTICS (Continued)

●Dropout Voltage, Supply Current, EN'H/L' Level Current

XC6402 Series C Type

SETTING OUTPUT VOLTAGE (V)	E-0		E-1		E-2		E-3		E-4	E-5
	VR OUTPUT VOLTAGE VD DETECT VOLTAGE (V)		DROPOUT VOLTAGE 1 (I_{ROUT}=30mA) (mV)		DROPOUT VOLTAGE 2 (I_{ROUT}=100mA)(mV)		SUPPLY CURRENT (μA)		EN'H'LEVEL CURRENT (μA)	EN'H'LEVEL CURRENT (μA)
$V_{ROUT(T)}$ /$V_{DF(T)}$	V_{ROUT}/V_{DF}		Vdif1		Vdif2		I_{DD}		I_{ENH}	I_{ENL}
	MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	MAX.	MIN.
0.80	0.770	0.830	100	700	250	800	38.0	80.0	5.0	-5.0
0.85	0.820	0.880								
0.90	0.870	0.930		600		700				
0.95	0.920	0.980								
1.00	0.970	1.030	50	500	150	600	38.5	81.5	6.5	-6.5
1.05	1.020	1.080								
1.10	1.070	1.130		400		500				
1.15	1.120	1.180								
1.20	1.170	1.230	30	300	100	400				
1.25	1.220	1.280								
1.30	1.270	1.330		200		300				
1.35	1.320	1.380								
1.40	1.370	1.430		100		250				
1.45	1.420	1.480								
1.50	1.470	1.530	27.0	41.0	90.0	135.0	39.0	83.0	8.0	-8.0
1.55	1.519	1.581								
1.60	1.568	1.632								
1.65	1.617	1.683								
1.70	1.666	1.734								
1.75	1.715	1.785								
1.80	1.764	1.836								
1.85	1.813	1.887								
1.90	1.862	1.938								
1.95	1.911	1.989								
2.00	1.960	2.040	25.0	37.0	80.0	120.0	39.5	84.5	9.5	-9.5
2.05	2.009	2.091								
2.10	2.058	2.142								
2.15	2.107	2.193								
2.20	2.156	2.244								
2.25	2.205	2.295								
2.30	2.254	2.346								
2.35	2.303	2.397								
2.40	2.352	2.448								
2.45	2.401	2.499								
2.50	2.450	2.550	18.0	28.0	60.0	90.0	40.0	86.0	11.0	-11.0
2.55	2.499	2.601								
2.60	2.548	2.652								
2.65	2.597	2.703								
2.70	2.646	2.754								
2.75	2.695	2.805								
2.80	2.744	2.856								
2.85	2.793	2.907								
2.90	2.842	2.958								
2.95	2.891	3.009								

■ELECTRICAL CHARACTERITICS (Continued)

●Dropout Voltage, Supply Current, EN'H/L' Level Current (Continued)

XC6402 Series C Type (Continued)

SETTING OUTPUT VOLTAGE (V)	E-0 VR OUTPUT VOLTAGE VD DETECT VOLTAGE (V)		E-1		E-2		E-3		E-4	E-5
			DROPOUT VOLTAGE 1 (I_{ROUT}=30mA) (mV)		DROPOUT VOLTAGE 2 (I_{ROUT}=100mA)(mV)		SUPPLY CURRENT (μ A)		EN'H'LEVEL CURRENT (μA)	EN'H'LEVEL CURRENT (μA)
$V_{ROUT(T)}$ /$V_{DF(T)}$	V_{ROUT}/V_{DF}		Vdif1		Vdif2		I_{DD}		I_{ENH}	I_{ENL}
	MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MIN.	MAX.	TYP.
3.00	2.940	3.060	15.0	23.0	50.0	75.0	40.5	87.5	12.5	-12.5
3.05	2.989	3.111								
3.10	3.038	3.162								
3.15	3.087	3.213								
3.20	3.136	3.264								
3.25	3.185	3.315								
3.30	3.234	3.366								
3.35	3.283	3.417								
3.40	3.332	3.468								
3.45	3.381	3.519								
3.50	3.430	3.570					41.0	89.0	14.0	-14.0
3.55	3.479	3.621								
3.60	3.528	3.672								
3.65	3.577	3.723								
3.70	3.626	3.774								
3.75	3.675	3.825								
3.80	3.724	3.876								
3.85	3.773	3.927								
3.90	3.882	3.978								
3.95	3.871	4.029								
4.00	3.920	4.080					41.5	90.5	15.5	-15.5
4.05	3.969	4.131								
4.10	4.018	4.182								
4.15	4.067	4.233								
4.20	4.116	4.284								
4.25	4.165	4.335								
4.30	4.214	4.386								
4.35	4.263	4.437								
4.40	4.312	4.488								
4.45	4.361	4.539								
4.50	4.410	4.590								
4.55	4.459	4.641					42.0	92.0	17.0	-17.0
4.60	4.508	4.692								
4.65	4.557	4.743								
4.70	4.606	4.794								
4.75	4.655	4.845								
4.80	4.704	4.896								
4.85	4.753	4.947								
4.90	4.802	4.998								
4.95	4.851	5.049								
5.00	4.900	5.100								

■ELECTRICAL CHARACTERITICS (Continued)

●Dropout Voltage

XC6402 Series F Type

SETTING OUTPUT VOLTAGE (V)	E-0		E-1		E-2	
	VR OUTPUT VOLTAGE VD DETECT VOLTAGE (V)		DROPOUT VOLTAGE 1 (I_{ROUT}=30mA) (mV)		DROPOUT VOLTAGE 2 (I_{ROUT}=100mA) (mV)	
$V_{ROUT(T)}$ /$V_{DF(T)}$	V_{ROUT}/V_{DF}		Vdif1		Vdif2	
	MIN.	MAX.	TYP.	MAX.	TYP.	MAX.
0.80	0.770	0.830	100	700	250	800
0.85	0.820	0.880				
0.90	0.870	0.930		600		700
0.95	0.920	0.980				
1.00	0.970	1.030	50	500	150	600
1.05	1.020	1.080				
1.10	1.070	1.130		400		500
1.15	1.120	1.180				
1.20	1.170	1.230	30	300	100	400
1.25	1.220	1.280				
1.30	1.270	1.330		200		300
1.35	1.320	1.380				
1.40	1.370	1.430		100		250
1.45	1.420	1.480				
1.50	1.470	1.530	27.0	41.0	90.0	135.0
1.55	1.519	1.581				
1.60	1.568	1.632				
1.65	1.617	1.683				
1.70	1.666	1.734				
1.75	1.715	1.785				
1.80	1.764	1.836				
1.85	1.813	1.887				
1.90	1.862	1.938				
1.95	1.911	1.989				
2.00	1.960	2.040	25.0	37.0	80.0	120.0
2.05	2.009	2.091				
2.10	2.058	2.142				
2.15	2.107	2.193				
2.20	2.156	2.244				
2.25	2.205	2.295				
2.30	2.254	2.346				
2.35	2.303	2.397				
2.40	2.352	2.448				
2.45	2.401	2.499				
2.50	2.450	2.550	18.0	28.0	60.0	90.0
2.55	2.499	2.601				
2.60	2.548	2.652				
2.65	2.597	2.703				
2.70	2.646	2.754				
2.75	2.695	2.805				
2.80	2.744	2.856				
2.85	2.793	2.907				
2.90	2.842	2.958				
2.95	2.891	3.009				

■ELECTRICAL CHARACTERISTICS (Continued)

●Dropout Voltage (Continued)

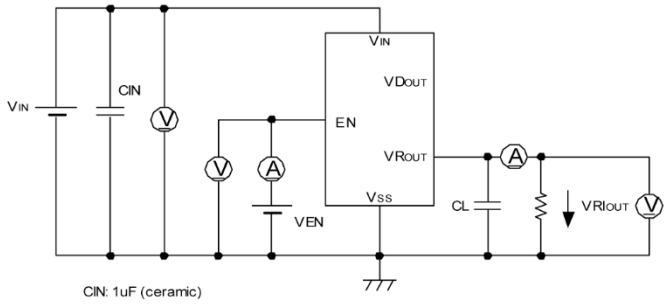
XC6402 Series F Type (Continued)

SETTING OUTPUT VOLTAGE (V)	E-0		E-1		E-2	
	VR OUTPUT VOLTAGE VD DETECT VOLTAGE (V)		DROPOUT VOLTAGE 1 (I_{ROUT}=30mA) (mV)		DROPOUT VOLTAGE 2 (I_{ROUT}=100mA) (mV)	
$V_{ROUT(T)}$ /$V_{DF(T)}$	V_{ROUT}/V_{DF}		Vdif1		Vdif2	
	MIN.	MAX.	TYP.	MAX	MIN.	MAX.
3.00	2.940	3.060	15.0	23.0	50.0	75.0
3.05	2.989	3.111				
3.10	3.038	3.162				
3.15	3.087	3.213				
3.20	3.136	3.264				
3.25	3.185	3.315				
3.30	3.234	3.366				
3.35	3.283	3.417				
3.40	3.332	3.468				
3.45	3.381	3.159				
3.50	3.430	3.570				
3.55	3.479	3.621				
3.60	3.528	3.672				
3.65	3.577	3.723				
3.70	3.626	3.774				
3.75	3.675	3.825				
3.80	3.724	3.876				
3.85	3.773	3.927				
3.90	3.882	3.978				
3.95	3.871	4.029				
4.00	3.920	4.080				
4.05	3.969	4.131				
4.10	4.018	4.182				
4.15	4.067	4.233				
4.20	4.116	4.284				
4.25	4.165	4.335				
4.30	4.214	4.386				
4.35	4.263	4.437				
4.40	4.312	4.488				
4.45	4.361	4.539				
4.50	4.410	4.590				
4.55	4.459	4.641				
4.60	4.508	4.692				
4.65	4.557	4.743				
4.70	4.606	4.794				
4.75	4.655	4.845				
4.80	4.704	4.896				
4.85	4.753	4.947				
4.90	4.802	4.998				
4.95	4.851	5.049				
5.00	4.900	5.100				

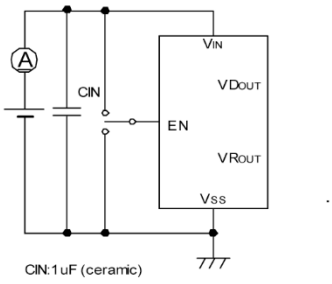
■TEST CIRCUITS

XC6402 Series C Type

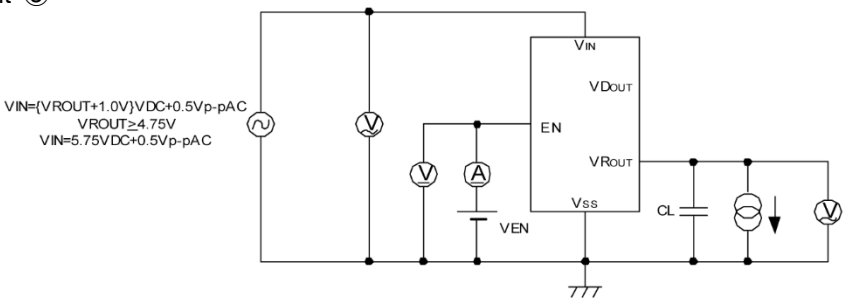
Circuit ①



Circuit ②

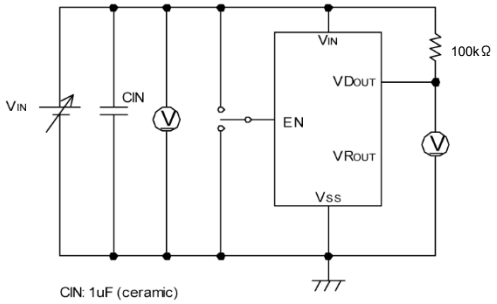


Circuit ③

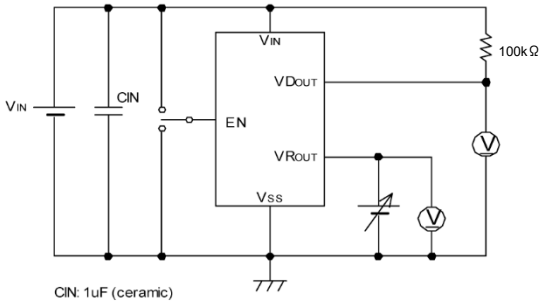


Circuit ④

XC6402 Series CA・CE・CL・CR・CB・CF・CM・CS Type

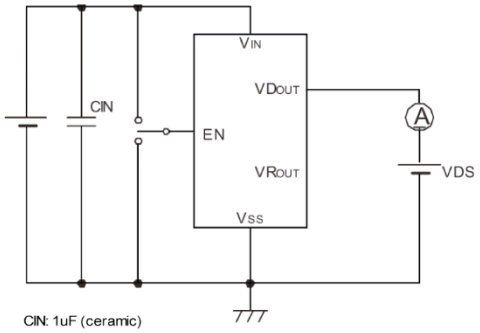


XC6402 Series CC / CD / CH / CK / CN / CP / CT / CU Type

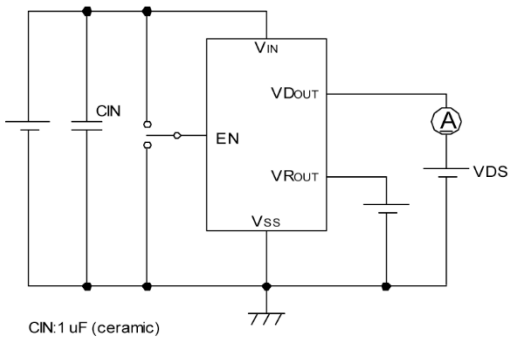


Circuit ⑤

XC6402 Series CA・CE・CL・CR・CB・CF・CM・CS Type



XC6402 Series CC / CD / CH / CK / CN / CP / CT / CU Type



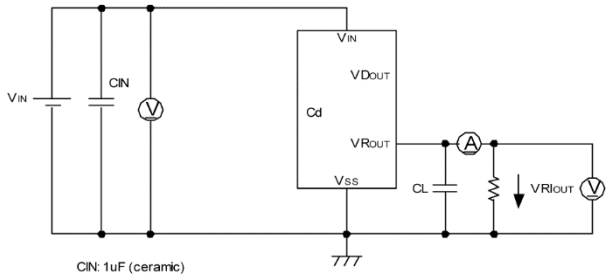
Output Capacitor Corresponding Chart

VR OUTPUT VOLTAGE	0.8 ~1.45V	1.5 ~ 1.75V	1.8V ~ 5.0V
C_L	6.8μF	2.2μF	1.0μF

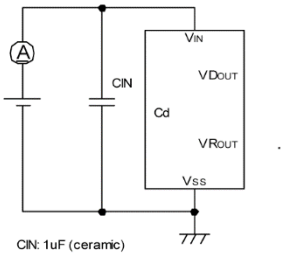
■TEST CIRCUITS (Continued)

XC6402 Series F Type

Circuit ①

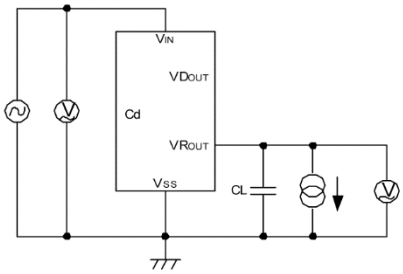


Circuit ②



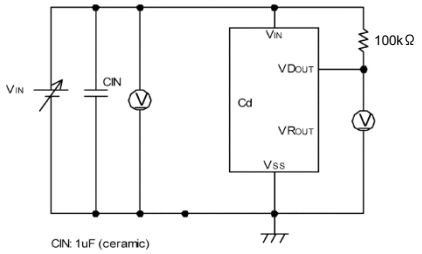
Circuit ③

VIN={VROUT+1.0V}VDC+0.5Vp-pAC
VROUT≥4.75V
VIN=5.75VDC+0.5Vp-pAC

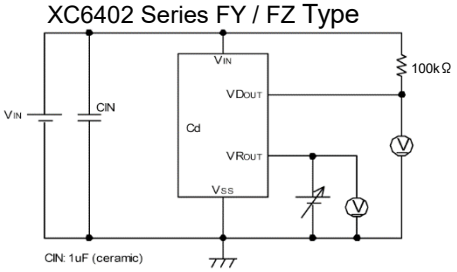


Circuit ④

XC6402 Series FY / FX Type

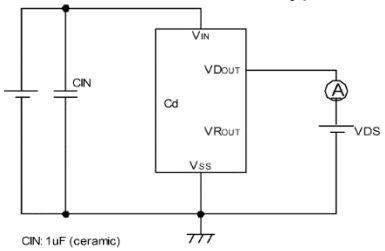


XC6402 Series FY / FZ Type

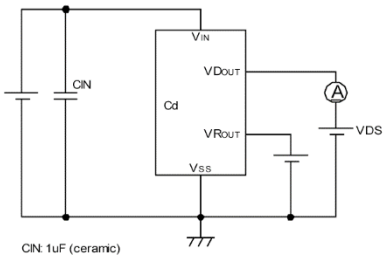


Circuit ⑤

XC6402 Series FY / FX Type

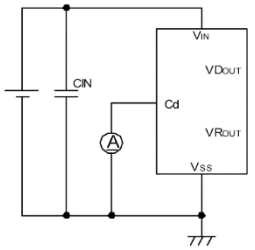


XC6402 Series FY / FZ Type

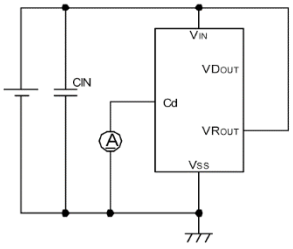


Circuit ⑥

XC6402 Series FY / FX Type



XC6402 Series FY / FZ Type



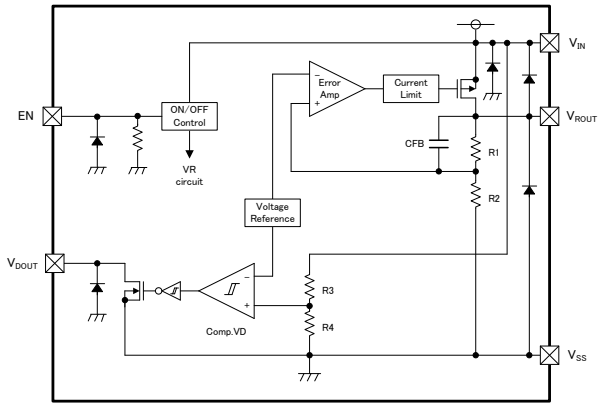
Output Capacitor Corresponding Chart

VR OUTPUT VOLTAGE	0.8 ~1.45V	1.5 ~ 1.75V	1.8V ~ 5.0V
C_L	6.8 μF	2.2 μF	1.0 μF

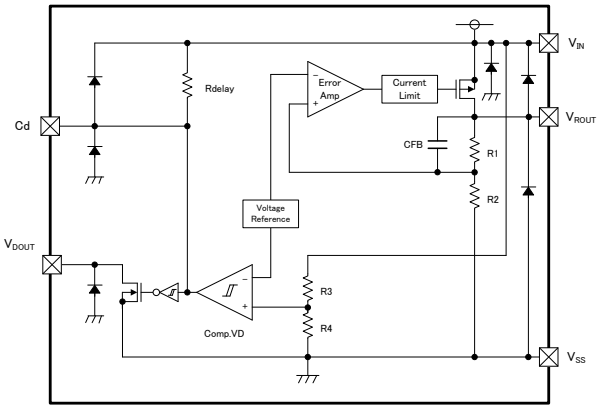
■OPERATIONAL EXPLANATION

< VOLTAGE REGULATOR >

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



XC6402 Series CA/CB Type



XC6402 Series FV/FX Type

< VOLTAGE DETECTOR >

The series' detector function monitors the voltage divided by resistors R3 & R4 which are connected to the V_{ROUT} pin or the V_{IN} pin, as well as monitoring the voltage of the internal reference voltage source via the comparator.
The VDSEN pin has options (please refer to the Selection Guide, item 2).

A 'High' or 'Low' signal level can be output from the V_{DOUT} pin when the VD pin voltage level goes below the detect voltage. The VD output logic has options (please refer to the Selection Guide, item 3). As V_{DOUT} is an open-drain N-channel output, a pull-up resistor of about 100kΩ is needed to achieve a voltage output. Because of hysteresis at the detector function, output at the V_{DOUT} pin will invert when the detect voltage level increases above the release voltage (105% of the detect voltage).

For the XC6402C type, the detector function is active even in a stand-by, and the output of the V_{DOUT} pin is determined by the VD sense pin voltage.

Even at a stand-by, if the VD sense pin voltage is higher than the release voltage, the V_{DOUT} pin will be high impedance mode, and the pull up voltage will be output at V_{DOUT}. By connecting the Cdelay pin to a capacitor (Cd), the XC6402F series can apply a delay time to V_{DOUT} voltage when releasing voltage. The delay time can be calculated from the internal resistance, Rdelay (2MΩ TYP. fixed) and the value of Cd as per the following equation.

Delay Time = Cdelay x Rdelay x 0.7

Delay Time　　Rdelay standard : 1.0 ~ 3.5MΩ　　TYP : 2.0MΩ

Cdelay	DELAY TIME (TYP.)	DELAY TIME
0.01μF	14 ms	7.0 ~ 24.5 ms
0.022μF	30.8 ms	15.4 ~ 53.9 ms
0.047μF	65.8 ms	32.9 ~ 115.15 ms
0.1μF	140 ms	70.0 ~ 245.0 ms
0.22μF	308 ms	154.0 ~ 539.0 ms
0.47μF	658 ms	329.0 ~ 1151.5 ms
1μF	1400 ms	700.0 ~ 2450.0 ms

■OPERATIONAL EXPLANATION (Continued)

<Low ESR Capacitors>

With the XC6402 series regulator, a stable output voltage is achievable even if low ESR capacitors are used, as a phase compensation circuit is built-in to the regulator. In order to ensure the effectiveness of the phase compensation, we suggest that an output capacitor (C_L) be connected as close as possible, between the output pin (V_{ROUT}) and the V_{SS} pin. Please use an output capacitor (C_L) with a capacitance, based on the chart below. We also suggest an input capacitor (C_{IN}) of 1 μF : this should be connected between V_{IN} and V_{SS} in order to stabilize input power source.

Output Capacitor Corresponding Chart

VR OUTPUT VOLTAGE	C_L
0.8 ~1.45V	1.5 ~ 1.75V
6.8 μF	2.2 μF
1.8V ~ 5.0V	1.0 μF

<Current Limiter, Short-Circuit Protection>

The XC6402 series regulator offers a combination of current limit and circuit protection by means of a built-in fixed current limiter circuit and a foldback circuit. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, the output voltage drops further and output current decreases. When the output pin is shorted, a current of about 30mA flows.

<EN Pin>

The IC's internal regulator circuitry can be shut down via the signal from the EN pin with the XC6402C series. In shutdown mode, output at the V_{ROUT} pin will be pulled down to the V_{SS} level via R1 & R2. Note that as the XC6402*E to K types of the XC6402C series are 'High Active / No Pull-Down' and XC6402*R to U types of the XC6402C series are 'Active LOW / No Pull-Up', operations will become unstable with the EN pin open (See the chart below).

SERIES	EN INPUT LOGIC
XC6402C A ~ D	High Active with pull-Down resistor
XC6402C E ~ K	High Active with no pull-Down resistor
XC6402C L ~ P	Low Active with pull-Up resistor
XC6402C R ~ U	Low Active with no pull-Up resistor

We suggest that you use this IC with either a V_{IN} voltage or a V_{SS} voltage input at the EN pin. If this IC is used with the correct specifications for the EN pin, the IC will operate normally. However, supply current may increase as a result of through current in the IC's internal circuitry if a voltage other than VIN or VSS is applied.

■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 noise and/or phase lag depending on output current. Please strengthen V_{IN} and V_{SS} wiring in particular.

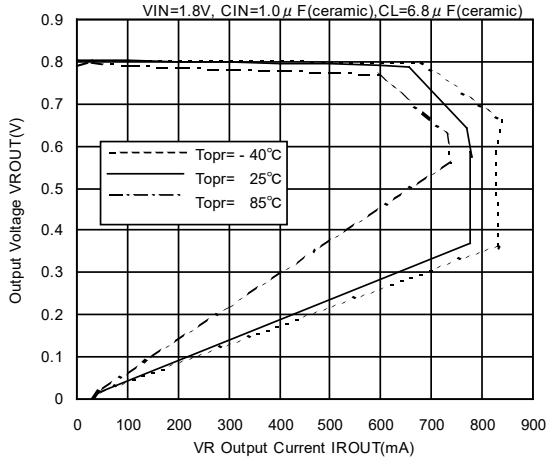
3. Please wire the input capacitor (C_{IN}) and the output capacitor (C_L) as close to the IC as possible.
Should rapidly input fluctuation or load fluctuation occur, please increase the capacitor value such as C_{IN} or C_L to stabilize the operation.

4. We place importance on improving our products and increasing reliability. However, please design safety into the device and system, including fail-safe design and post-aging treatment.

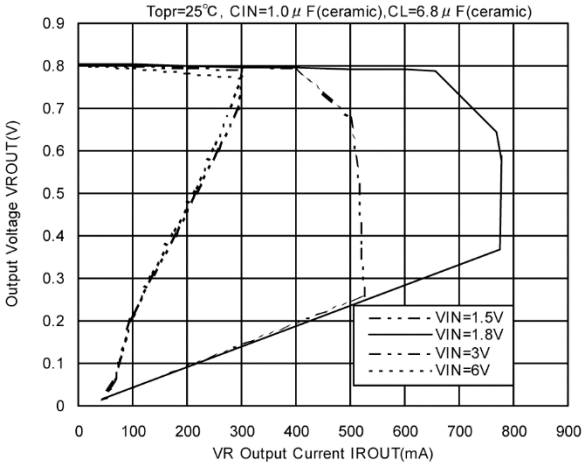
■TYPICAL PERFORMANCE CHARACTERISTICS

(1) VR Output Voltage vs. VR Output Current

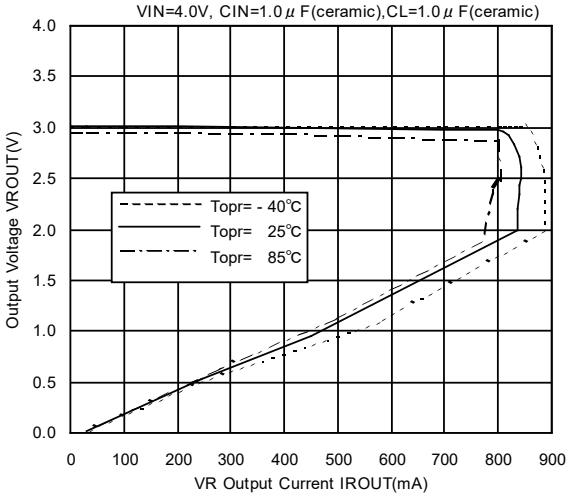
XC6402 Series (VR: 0.8V)



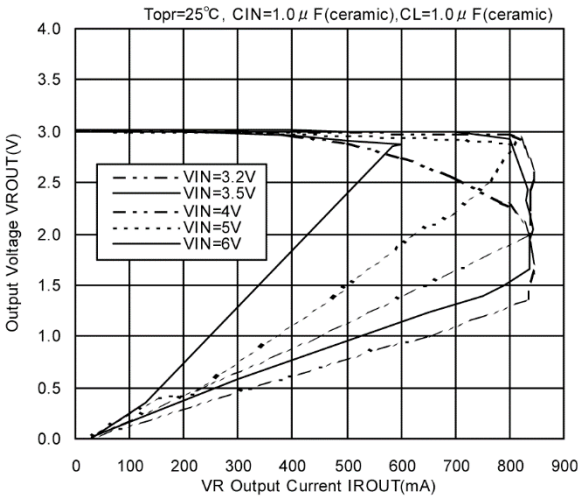
XC6402 Series (VR: 0.8V)



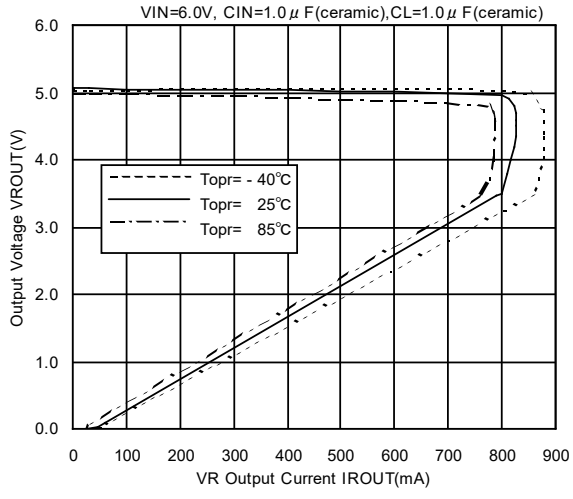
XC6402 Series (VR: 3.0V)



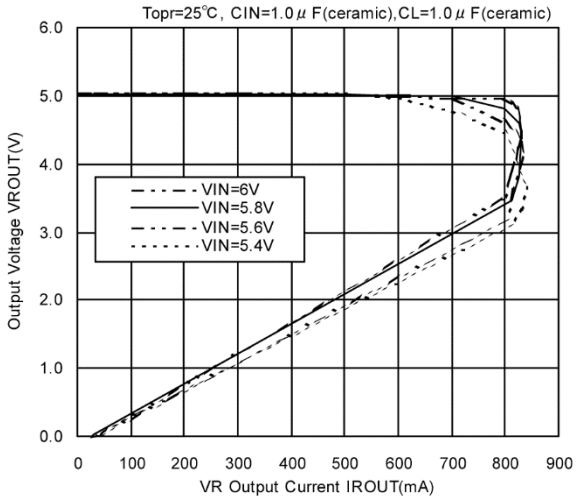
XC6402 Series (VR: 3.0V)



XC6402 Series (VR: 5.0V)



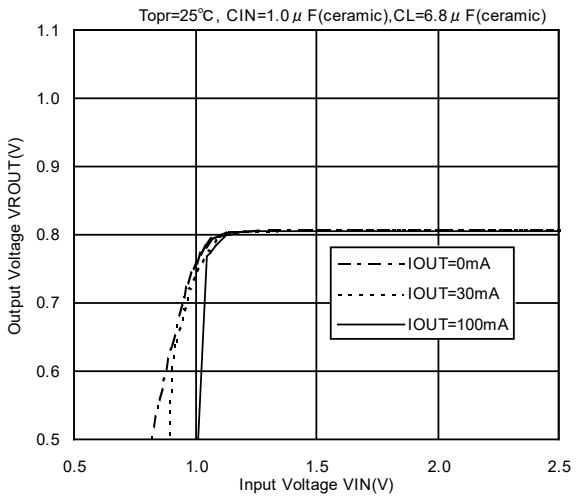
XC6402 Series (VR: 5.0V)



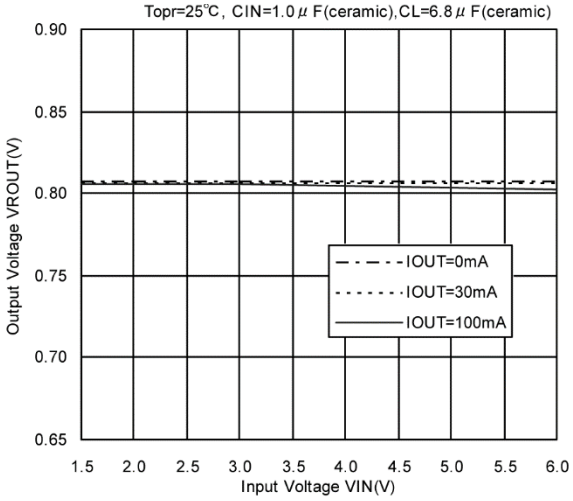
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) VR Output Voltage vs. Input Voltage

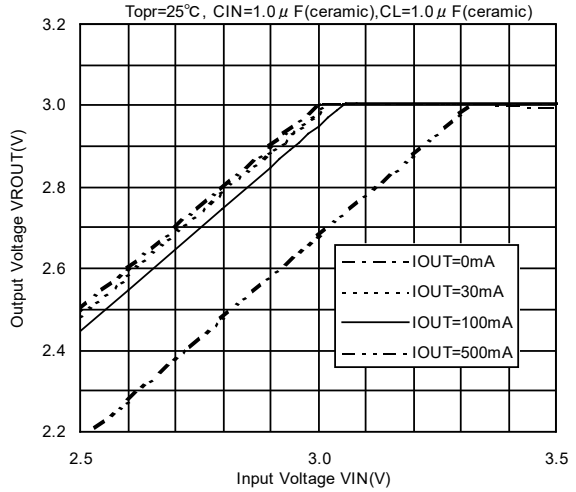
XC6402 Series (VR: 0.8V)



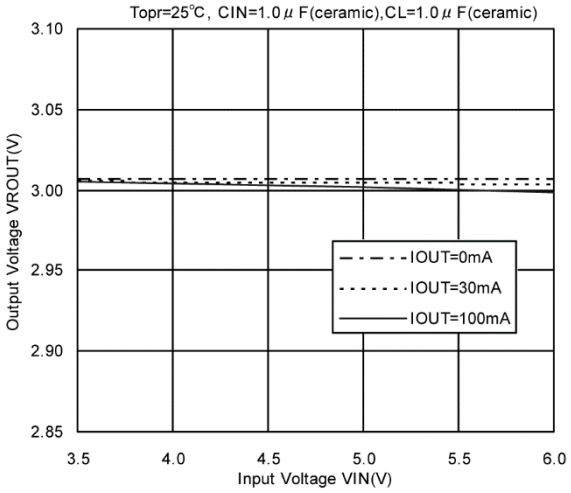
XC6402 Series (VR: 0.8V)



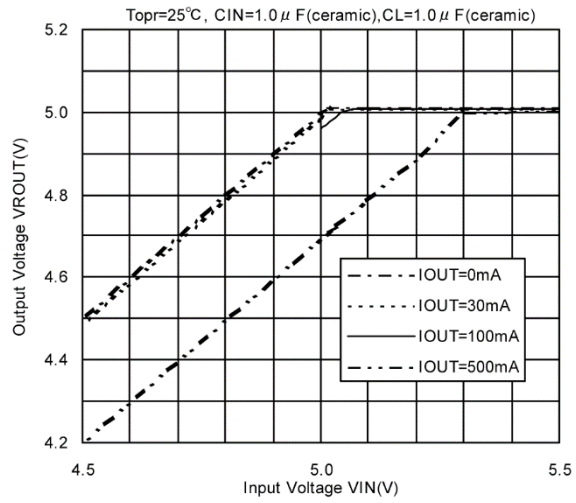
XC6402 Series (VR: 3.0V)



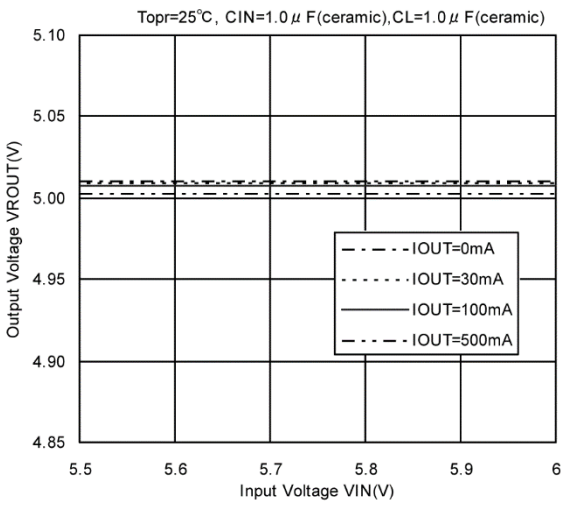
XC6402 Series (VR: 3.0V)



XC6402 Series (VR: 5.0V)



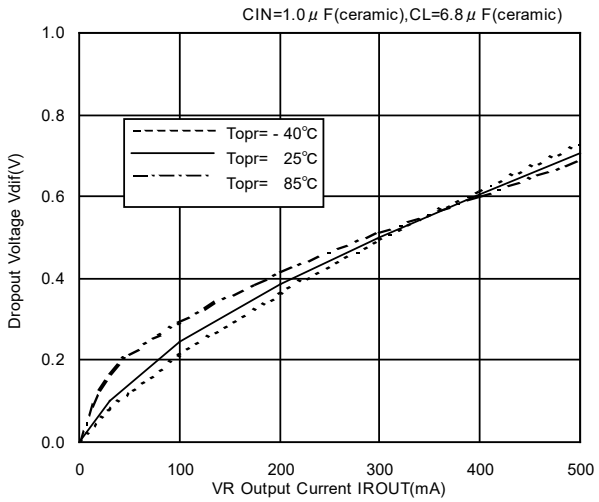
XC6402 Series (VR: 5.0V)



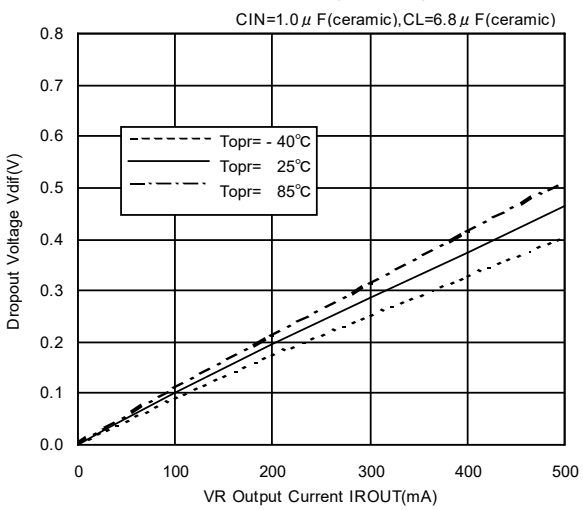
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

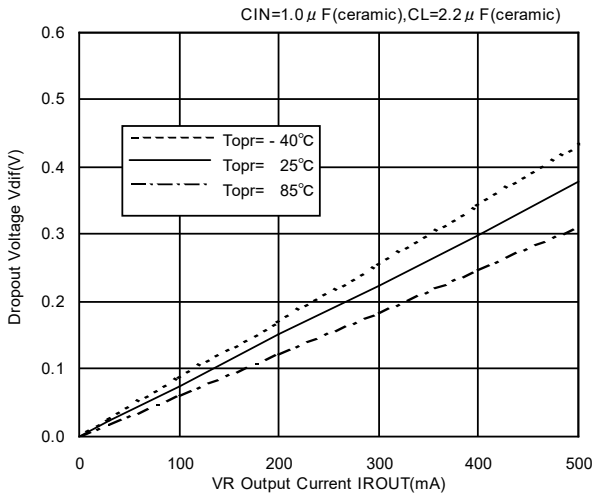
XC6402 Series (VR: 0.8V)



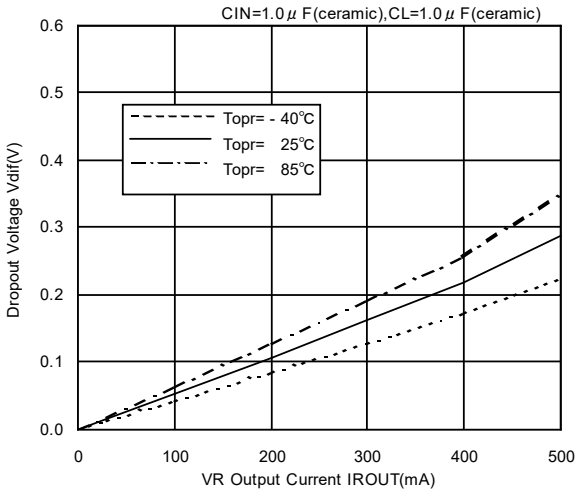
XC6402 Series (VR: 1.2V)



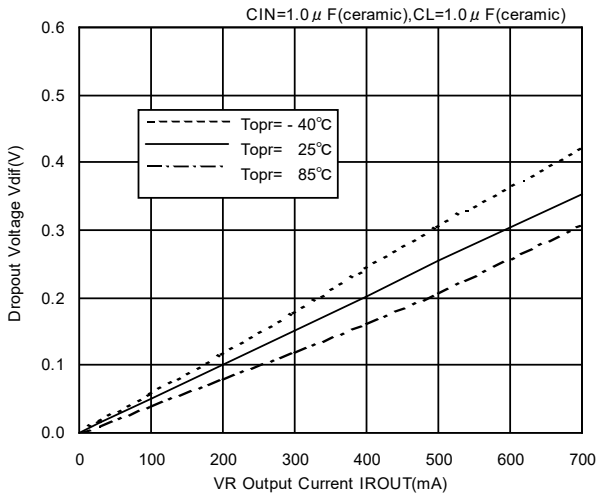
XC6402 Series (VR: 1.5V)



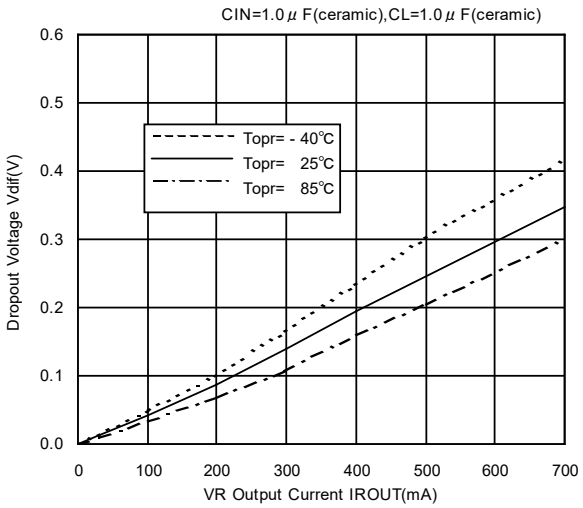
XC6402 Series (VR: 2.5V)



XC6402 Series (VR: 3.0V)

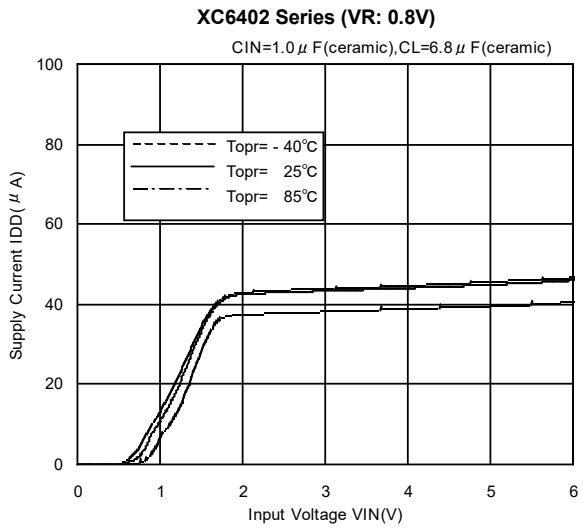


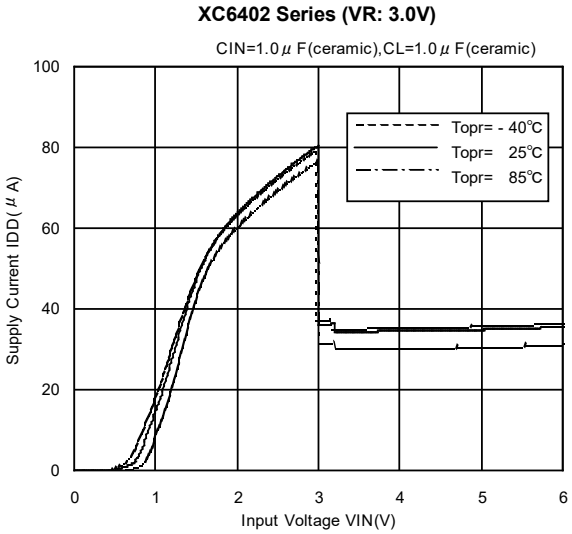
XC6402 Series (VR: 5.0V)

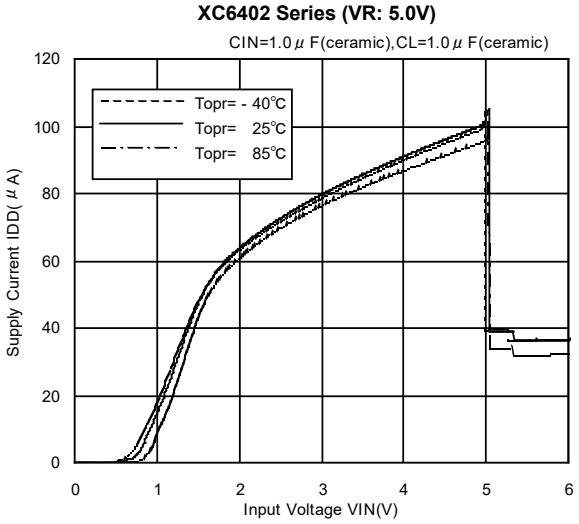


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

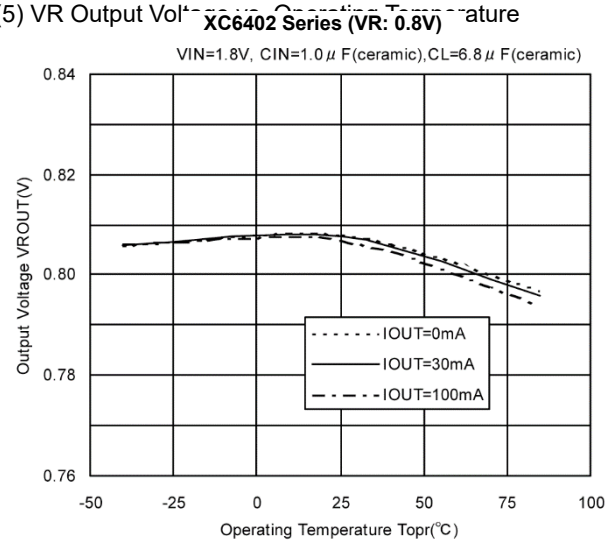
(4) Supply Current vs. Input Voltage

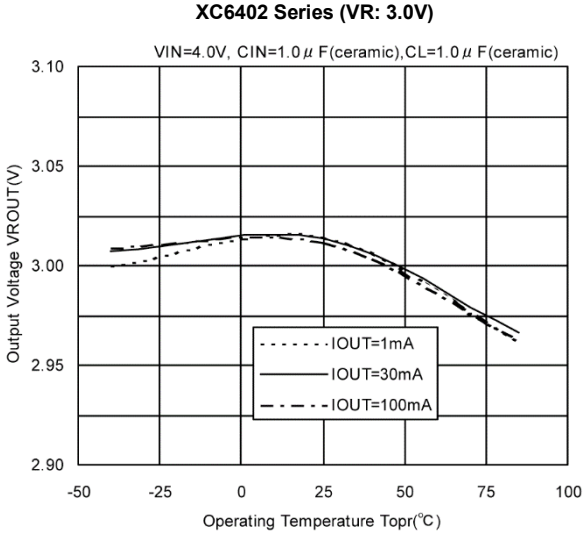


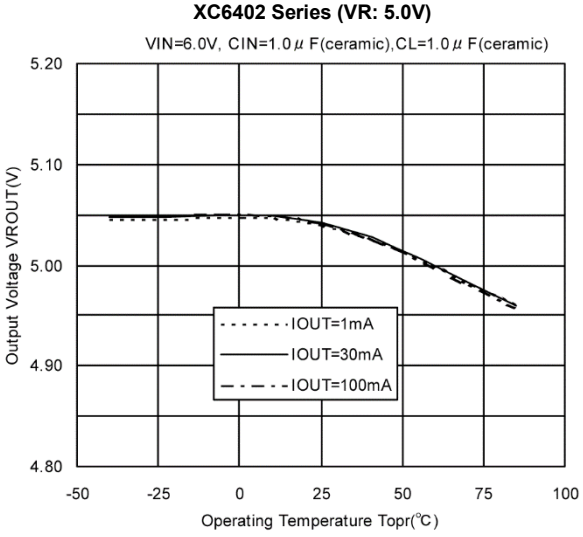




(5) VR Output Voltage vs. Operating Temperature

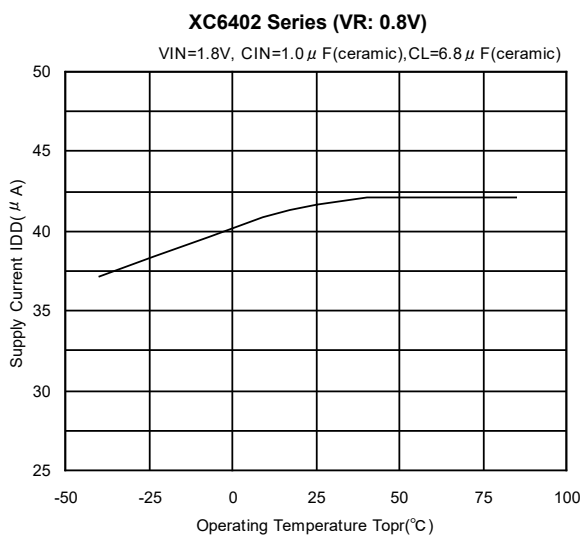


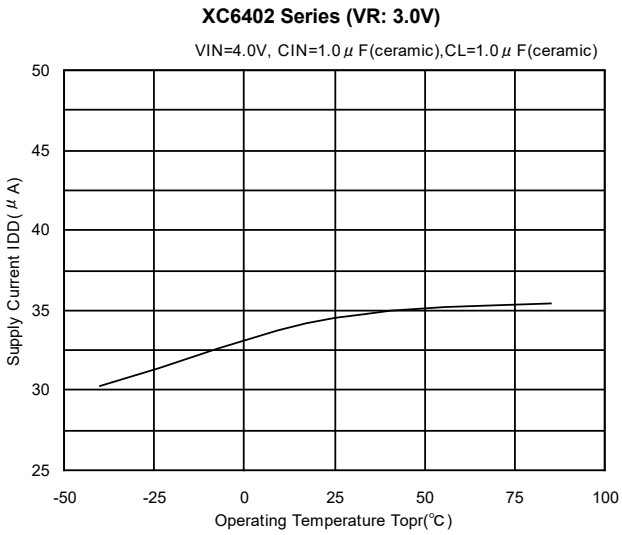


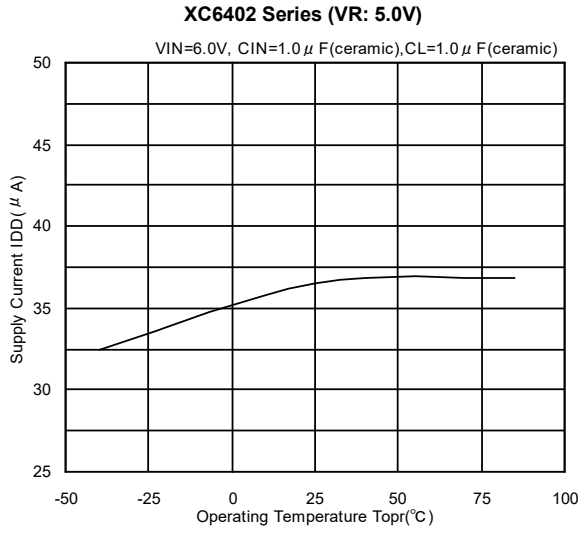


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

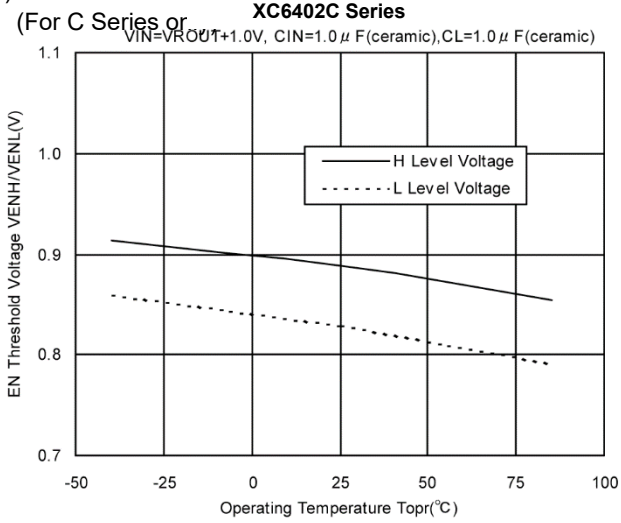
(6) Supply Current vs. Operating Temperature



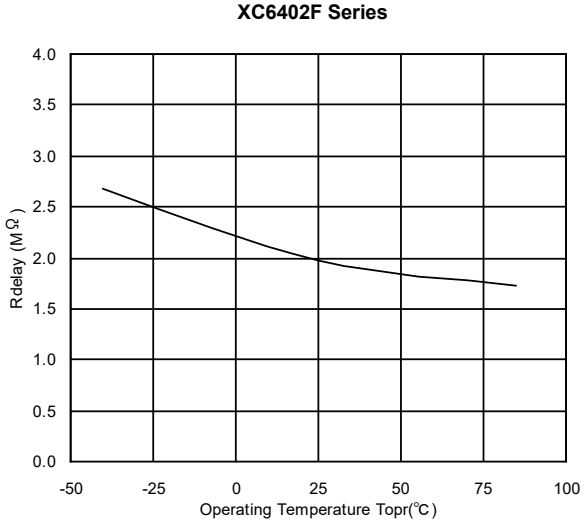




(7) EN Threshold Voltage vs. Operating Temperature
(For C Series or ...)



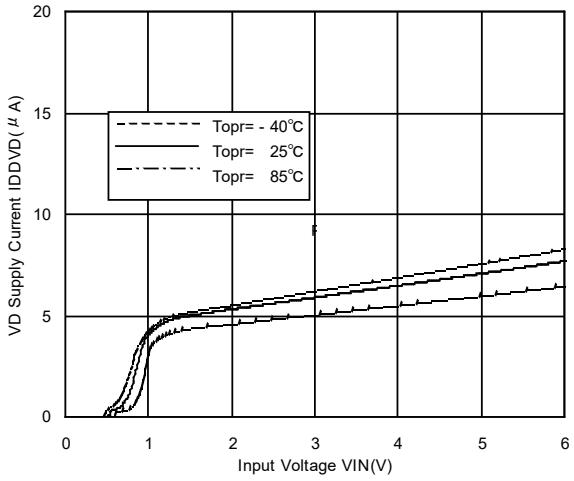
(8) Rdelay vs. Operating Temperature (For F Series only)



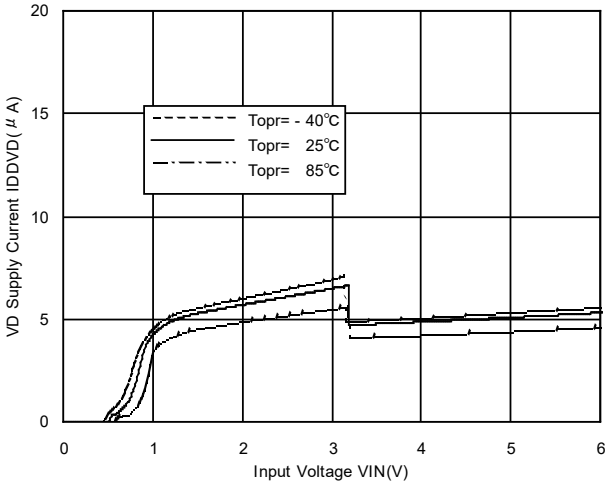
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) VD Supply Current vs. Input Voltage (For C Series only)

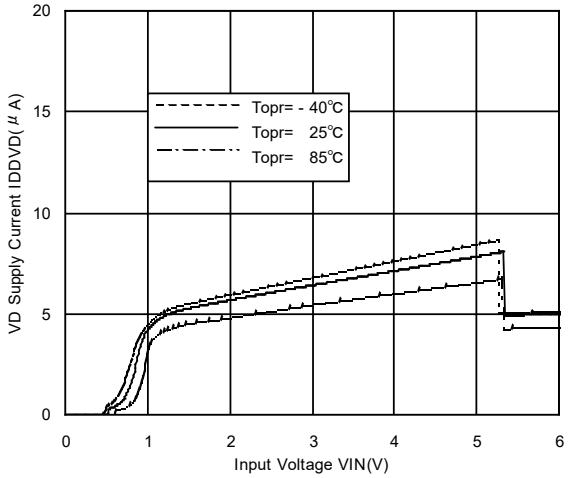
XC6402C Series (VD: 0.8V)



XC6402C Series (VD: 3.0V)

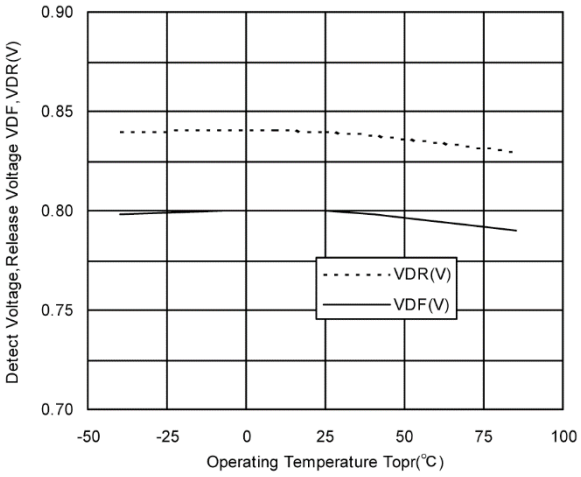


XC6402C Series (VD: 5.0V)

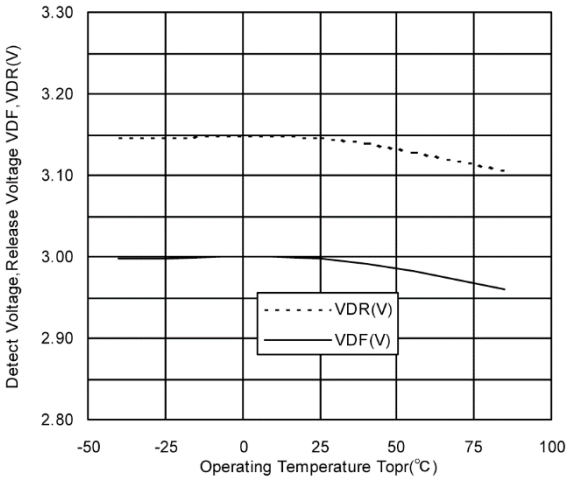


(10) Detect Voltage & Release Voltage vs. Operating Te

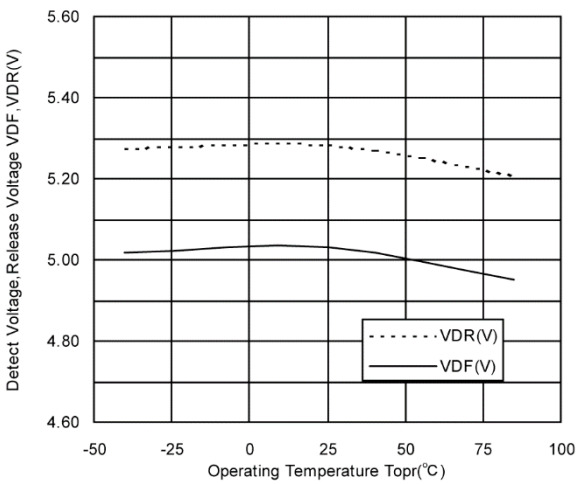
XC6402 Series (VD: 0.8V)



XC6402 Series (VD: 3.0V)



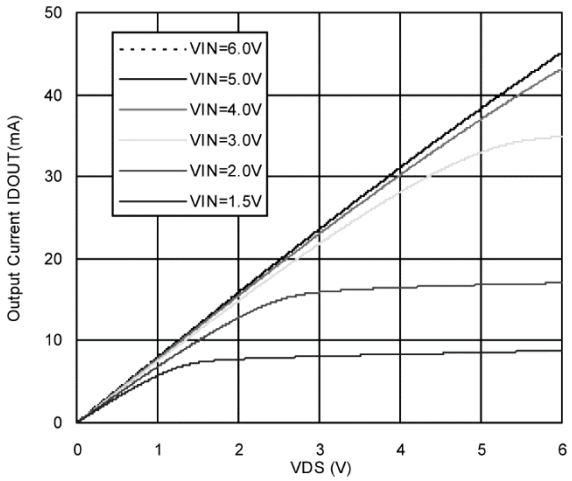
XC6402 Series (VD: 5.0V)



■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

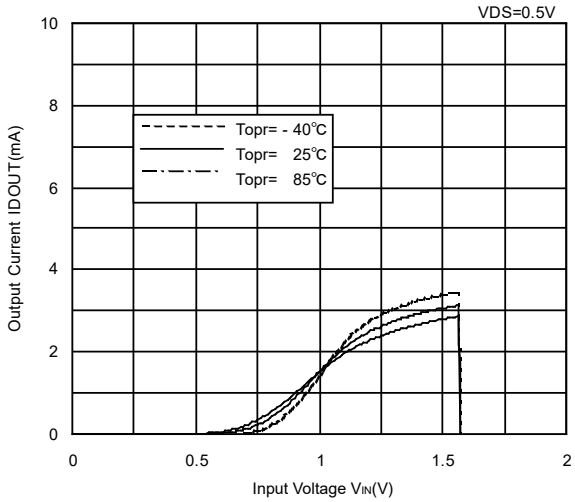
(11) VD N-ch Driver Tr. Output Current vs. V_{DS}

XC6402 Series (VD)

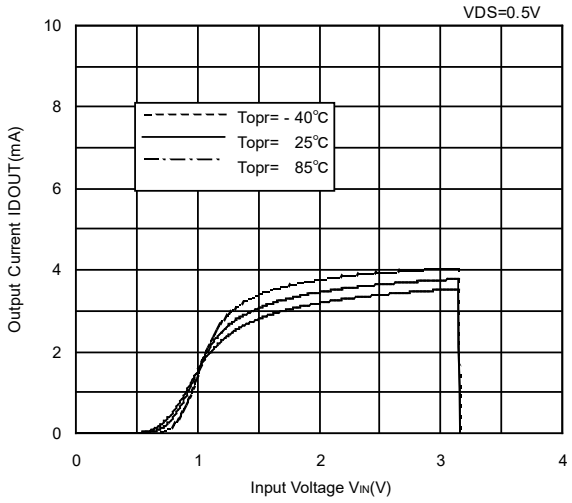


(12) VD N-ch Driver Tr. Output Current vs. Input Voltage

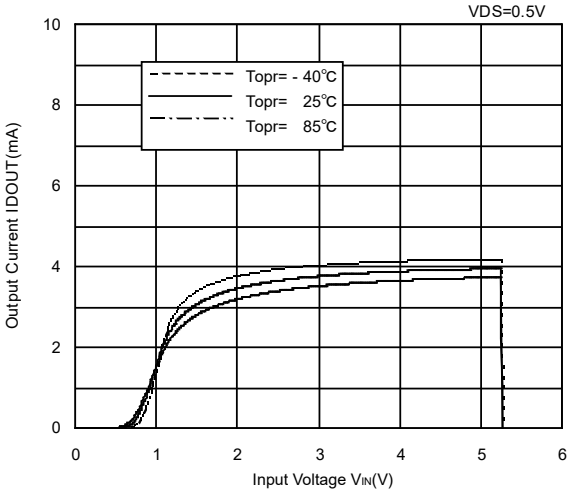
XC6402 Series (VD : 1.5V)



XC6402 Series (VD: 3.0V)



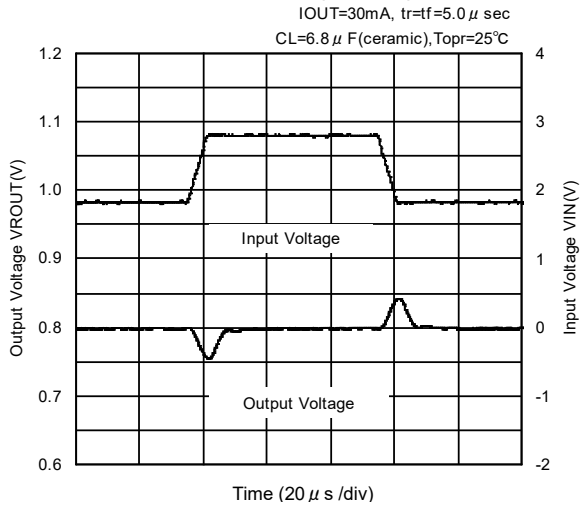
XC6402 Series (VR: 5.0V)



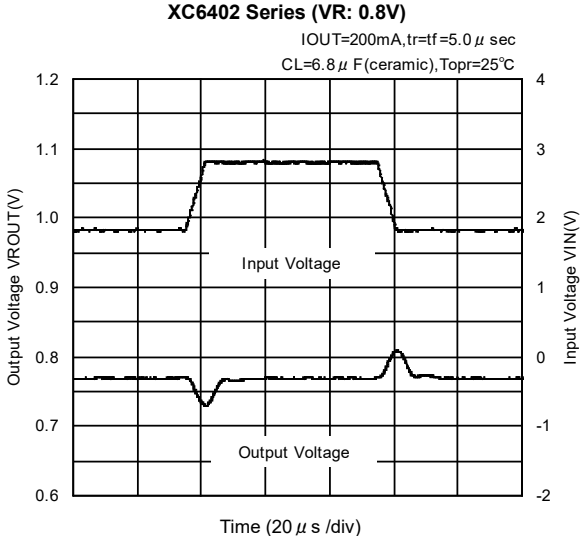
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(13) VR Input Transient Response

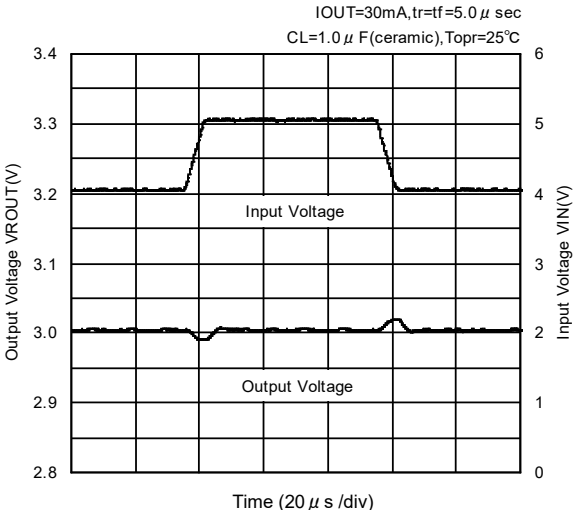
XC6402 Series (VR: 0.8V)



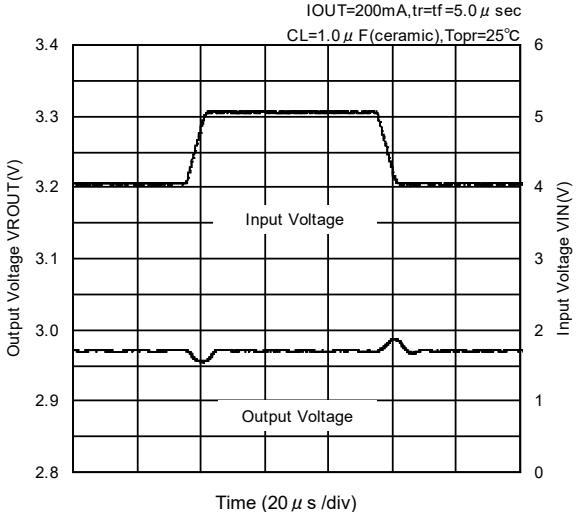
XC6402 Series (VR: 0.8V)



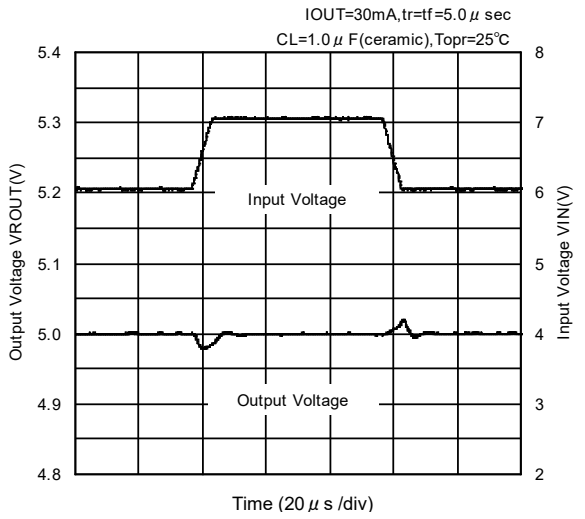
XC6402 Series (VR: 3.0V)



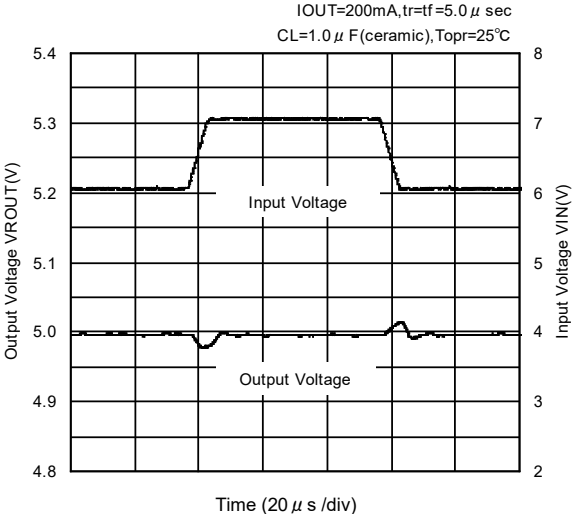
XC6402 Series (VR: 3.0V)



XC6402 Series (VR: 5.0V)



XC6402 Series (VR: 5.0V)

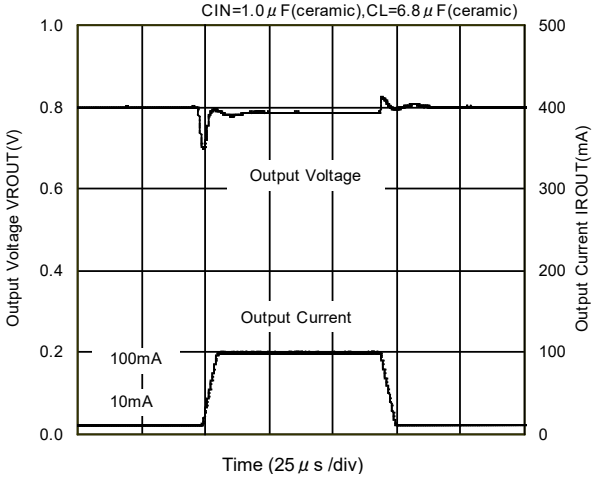


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(14) VR Load Transient Response

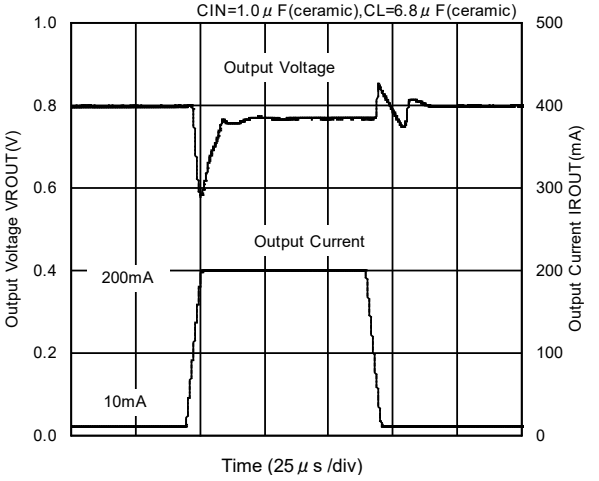
XC6402 Series (VR: 0.8V)

VIN=1.8V,tr=tf=5.0μsec,Topr=25℃
CIN=1.0μF(ceramic),CL=6.8μF(ceramic)



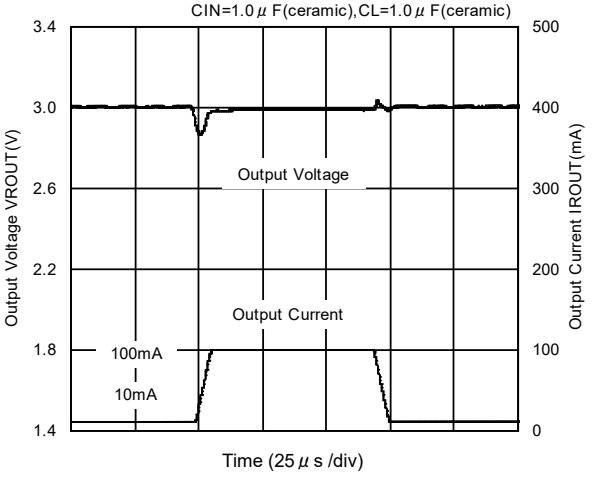
XC6402 Series (VR: 0.8V)

VIN=1.8V,tr=tf=5.0μsec,Topr=25℃
CIN=1.0μF(ceramic),CL=6.8μF(ceramic)



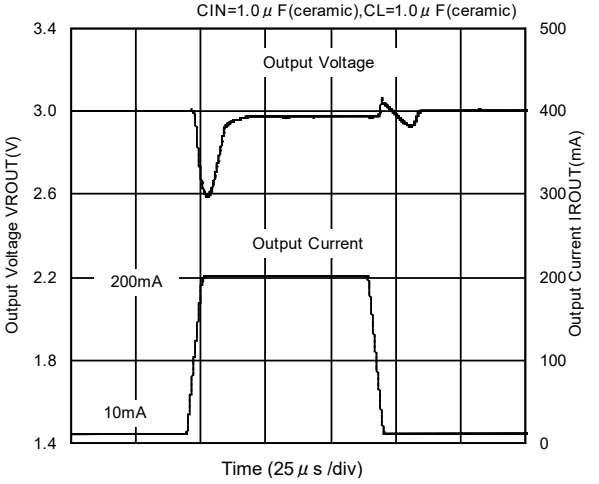
XC6402 Series (VR: 3.0V)

VIN=4.0V,tr=tf=5.0μsec,Topr=25℃,
CIN=1.0μF(ceramic),CL=1.0μF(ceramic)



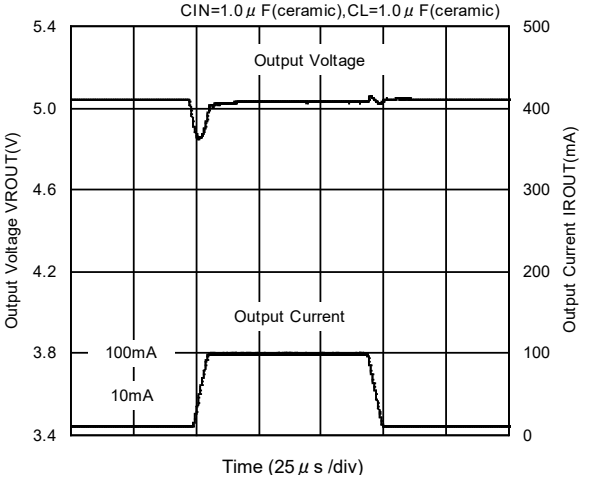
XC6402 Series (VR: 3.0V)

VIN=4.0V,tr=tf=5.0μsec,Topr=25℃
CIN=1.0μF(ceramic),CL=1.0μF(ceramic)



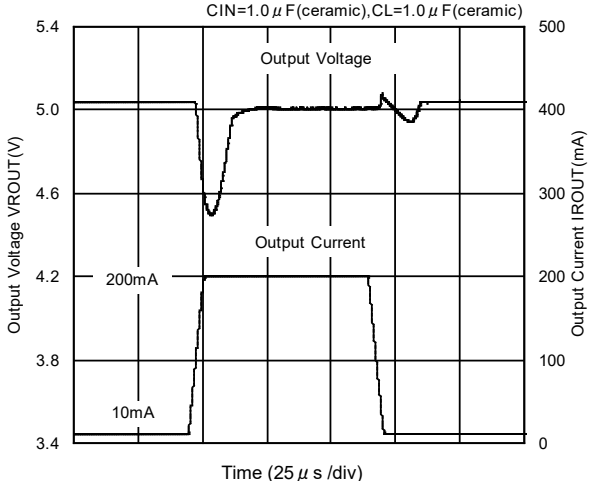
XC6402 Series (VR: 5.0V)

VIN=6.0V,tr=tf=5.0μsec,Topr=25℃
CIN=1.0μF(ceramic),CL=1.0μF(ceramic)



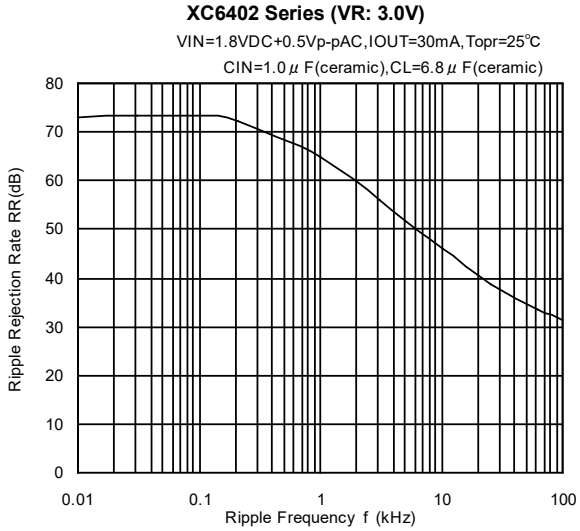
XC6402 Series (VR: 5.0V)

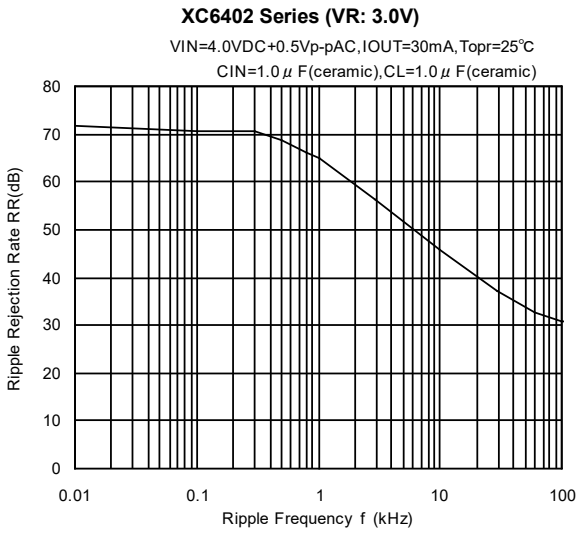
VIN=6.0V,tr=tf=5.0μsec,Topr=25℃
CIN=1.0μF(ceramic),CL=1.0μF(ceramic)

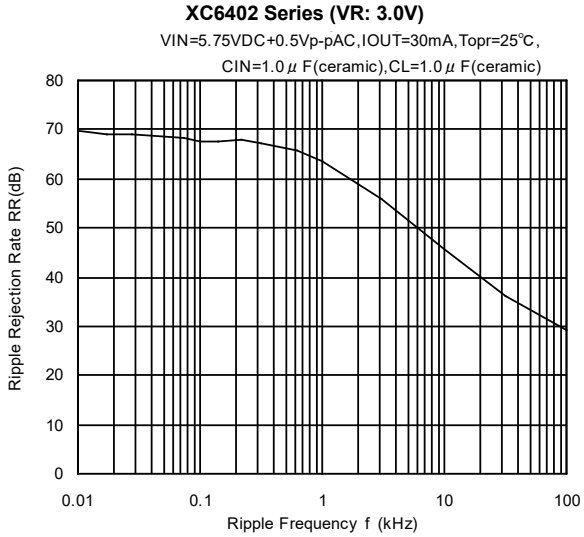


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(15) Ripple Rejection Rate



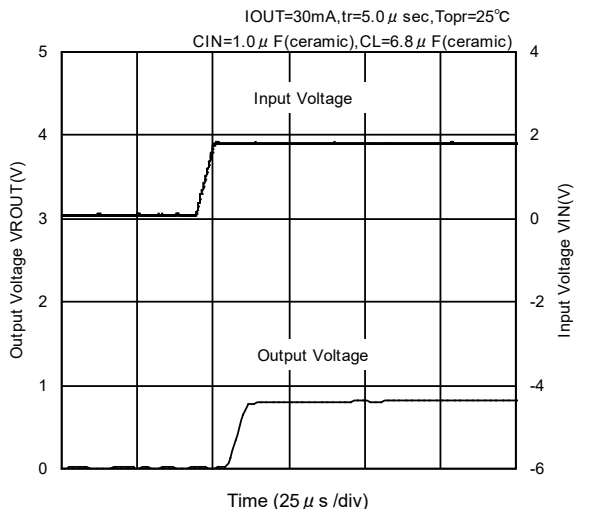




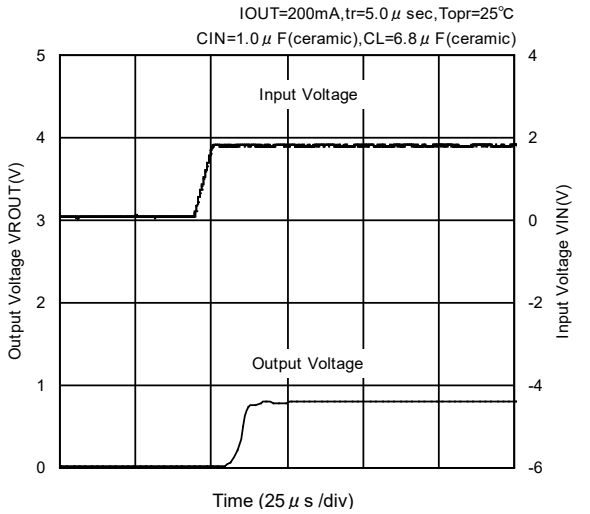
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(16) Rising Response Time

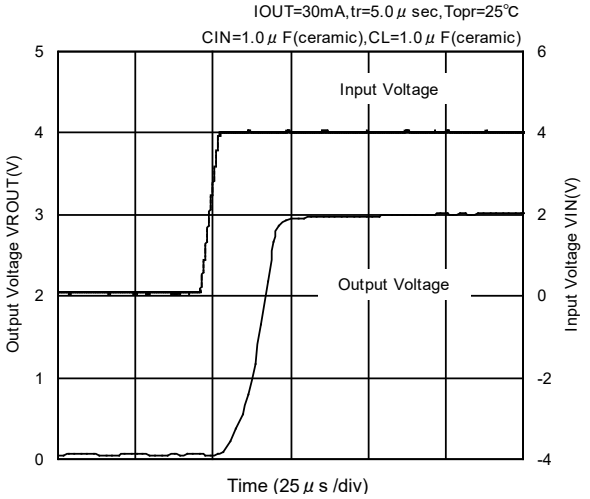
XC6402 Series (VR: 0.8V)



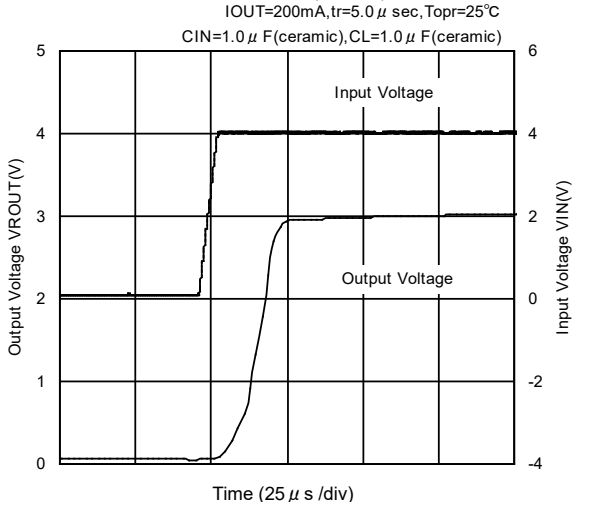
XC6402 Series (VR: 0.8V)



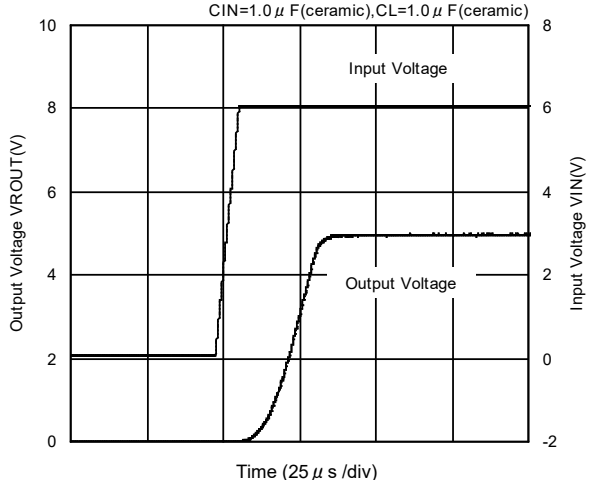
XC6402 Series (VR: 3.0V)



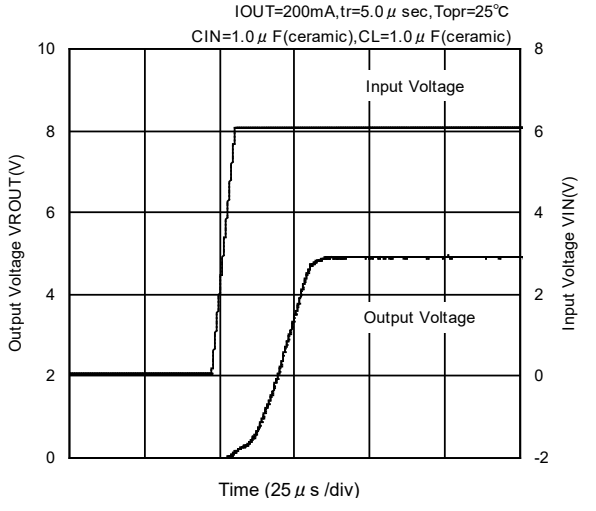
XC6402 Series (VR: 3.0V)



XC6402 Series (VR: 5.0V)



XC6402 Series (VR: 5.0V)

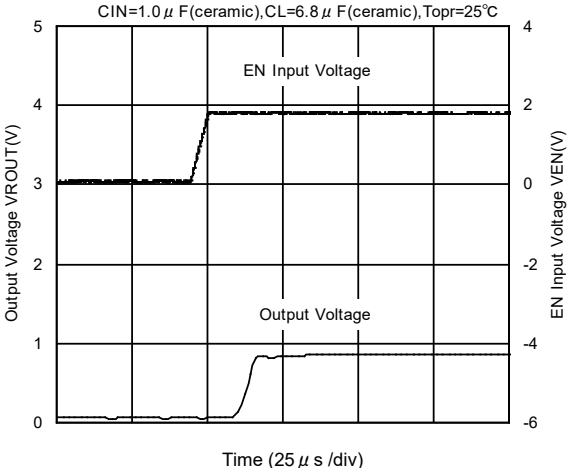


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(17) EN Rising Response Time (For C Series only)

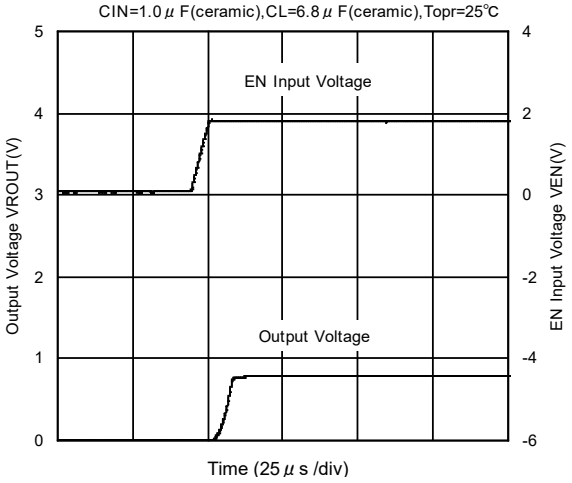
XC6402 Series (VR: 0.8V)

VIN=1.8V,IOUT=30mA,tr=5.0μsec
CIN=1.0μF(ceramic),CL=6.8μF(ceramic),Topr=25℃



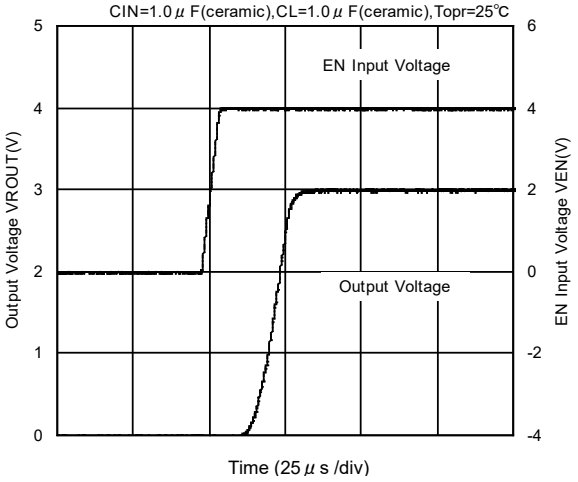
XC6402 Series (VR: 0.8V)

VIN=1.8V,IOUT=30mA,tr=5.0μsec
CIN=1.0μF(ceramic),CL=6.8μF(ceramic),Topr=25℃



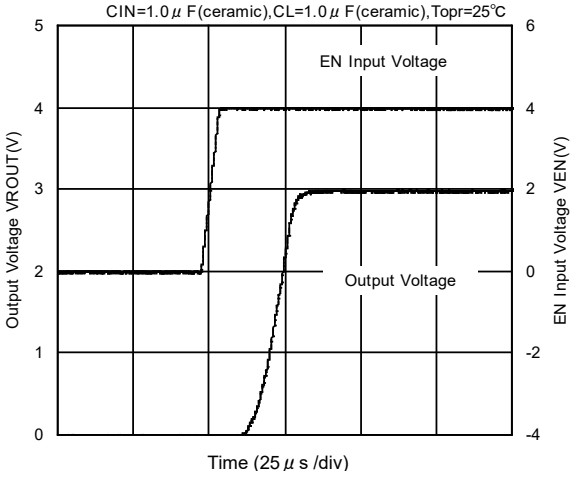
XC6402 Series (VR: 3.0V)

VIN=4.0V,IOUT=30mA,tr=5.0μsec
CIN=1.0μF(ceramic),CL=1.0μF(ceramic),Topr=25℃



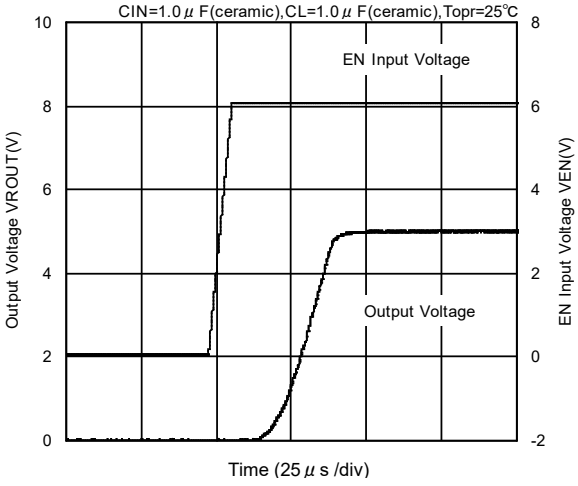
XC6402 Series (VR: 3.0V)

VIN=4.0V,IOUT=30mA,tr=5.0μsec
CIN=1.0μF(ceramic),CL=1.0μF(ceramic),Topr=25℃



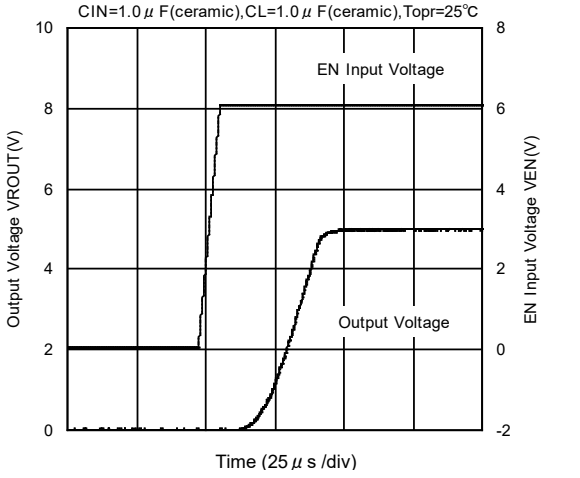
XC6402 Series (VR: 5.0V)

VIN=6.0V,IOUT=30mA,tr=5.0μsec
CIN=1.0μF(ceramic),CL=1.0μF(ceramic),Topr=25℃



XC6402 Series (VR: 5.0V)

VIN=6.0V,IOUT=30mA,tr=5.0μsec
CIN=1.0μF(ceramic),CL=1.0μF(ceramic),Topr=25℃



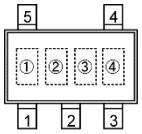
■PACKAGING INFORMATION

For the latest package information go to, www.torexsemi.com/technical-support/packages

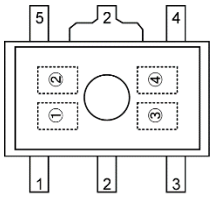
PACKAGE	OUTLINE / LAND PATTERN	THERMAL CHARACTERISTICS	
SOT-25	SOT-25 PKG	Standard Board	SOT-25 Power Dissipation
		JESD51-7 Board	
SOT-89-5	SOT-89-5 PKG	Standard Board	SOT-89-5 Power Dissipation
		JESD51-7 Board	

■MARKING RULE

●SOT-25 / SOT-89-5



SOT-25
(TOP VIEW)



SOT-89-5
(TOP VIEW)

① represents product series

MARK	PRODUCT SERIES
2	XC6402xxxxxx

②③ represents internal sequential number
01～09，10～99，A0～A9，B0～，B9～，Z9～repeated.(G，I，J，O，Q，W excluded)

④ represents production lot number
0 to 9,A to Z reverse character 0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

1. The product and product specifications contained herein are subject to change without notice to improve performance characteristics. Consult us, or our representatives before use, to confirm that the information in this datasheet is up to date.

2. The information in this datasheet is intended to illustrate the operation and characteristics of our products. We neither make warranties or representations with respect to the accuracy or completeness of the information contained in this datasheet nor grant any license to any intellectual property rights of ours or any third party concerning with the information in this datasheet.

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4. The product is neither intended nor warranted for use in equipment of systems which require extremely high levels of quality and/or reliability and/or a malfunction or failure which may cause loss of human life, bodily injury, serious property damage including but not limited to devices or equipment used in 1) nuclear facilities, 2) aerospace industry, 3) medical facilities, 4) automobile industry and other transportation industry and 5) safety devices and safety equipment to control combustions and explosions. Do not use the product for the above use unless agreed by us in writing in advance.

5. Although we make continuous efforts to improve the quality and reliability of our products; nevertheless Semiconductors are likely to fail with a certain probability. So in order to prevent personal injury and/or property damage resulting from such failure, customers are required to incorporate adequate safety measures in their designs, such as system fail safes, redundancy and fire prevention features.

6. Our products are not designed to be Radiation-resistant.

7. Please use the product listed in this datasheet within the specified ranges.

8. We assume no responsibility for damage or loss due to abnormal use.

9.

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XC6402FY31PR-G XC6402CH31PR-G XC6402FV36PR-G XC6402CC31PR-G