XC6504 Series

ETR0347-004

0.6μA Ultra Low Power Consumption Small Voltage Regulator (C$_L$ Capacitor-Less)

■ GENERAL DESCRIPTION

The XC6504 series is a highly accurate CMOS voltage regulator that achieves very low supply current operation of 0.6μA. Even output current is 1μA (when light load), the XC6504 can provide high accurate outputs, which is ideally suited for the applications to draw less output current. The usage of super small package USPN-4B02 (0.75 x 0.95mm) and the advantage of capacitor-less stable operation can contribute the board space saving outstandingly. The IC consists of a reference voltage source, an error amplifier, a driver transistor, over-current protection circuit, and a phase compensation circuit.

The device is compatible with a low ESR ceramic output capacitor C$_L$. Moreover, the device can provide stable output even without a C$_L$ output capacitor because of the excellent internal phase compensation.

Output voltage is fixed internally by laser trimming technology and can be selectable in 0.1V increments within the range of 1.1V to 5.0V. The CE function enables the device to be put into standby mode by inputting a low level signal to the CE pin thereby reducing current consumption to less than 0.1μA. In the standby mode, if a C$_L$ output capacitor is used, the electric charge stored at C$_L$ can be discharged via the internal switch and as a result, the V$_{OUT}$ pin quickly returns to the V$_{SS}$ level.

### ■ APPLICATIONS

● Mobile equipments
● Wireless LAN
● Modules

■ FEATURES

Supply Current	:	0.6μA
Input Voltage Range	:	1.4V～6.0V
Output Voltage Range	:	1.1V～5.0V (0.1V increments)
Output Accuracy	:	±0.02V@V$_{OUT}$＜2.0V
		±1%@V$_{OUT}$≧2.0V
Temperature Stability	:	±50ppm/℃
Maximum Output Current	:	150mA
Low On Resistance	:	3.3Ω@V$_{OUT}$=3.0V
Standby Current	:	0.01μA
Protection Current	:	Current Limiter
		Shot Circuit Protection
CE Function	:	C$_L$ Auto Discharge
		ON/OFF Logic=Enable High
Output Capacitor	:	Low ESR Ceramic Capacitor
		(C$_L$ Capacitor-Less Compatible)
Operating Ambient Temperature	:	-40℃～+85℃
Packages	:	USPN-4B02
		SSOT-24
		SOT-25
Environmentally Friendly	:	EU RoHS Compliant, Pb Free

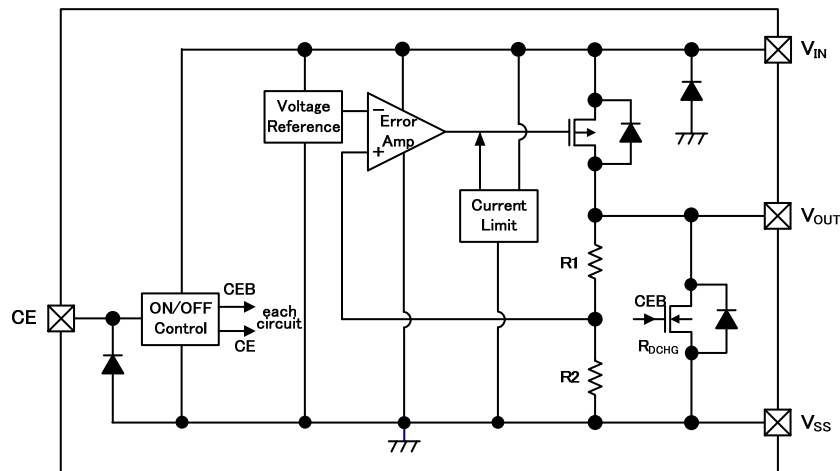### ■ TYPICAL APPLICATION CIRCUIT
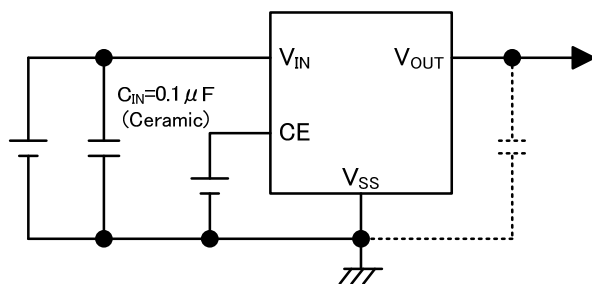
■ TYPICAL PERFORMANCE CHARACTERISTICS
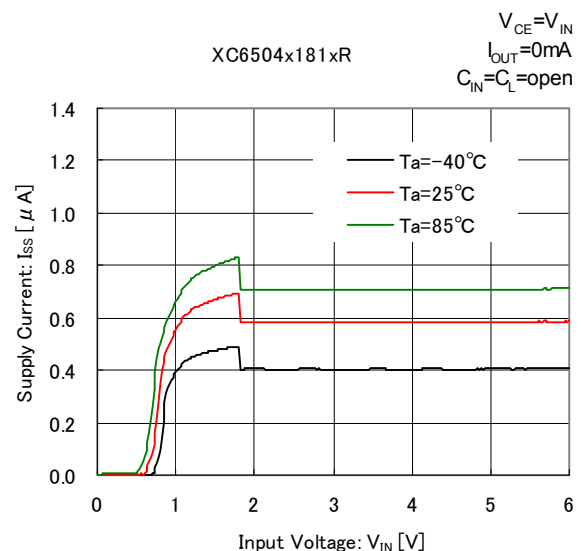
■BLOCK DIAGRAM

XC6504 Series, Type A

* Diodes inside the circuits are ESD protection diodes and parasitic diodes.

■PRODUCT CLASSIFICATION

●Ordering Information

XC6504①②③④⑤⑥-⑦

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	Type	A	Refer to Selection Guide
②③	Output Voltage	11~50	e.g. 1.8V → ②=1, ③=8
④	Output Voltage Accuracy	1	±0.02V (V_{OUT}＜2.0V), ±1% (V_{OUT}≧2.0V)
⑤⑥-⑦[*1]	Packages (Order Unit)	7R-G	USPN-4B02 (5,000/Reel)
		NR-G	SSOT-24 (3,000/Reel)
		MR-G	SOT-25 (3,000/Reel)

[*1] The "-G" suffix denotes Halogen and Antimony free as well as being fully RoHS compliant.

●Selection Guide

TYPE	CURRENT LIMITTER	CE PULL-DOWN RESISTOR	C_L AUTO-DISCHARGE
A	Yes	No	Yes

■PIN CONFIGURATION

USPN−4B02
（BOTTOM VIEW）

SSOT−24
（TOP VIEW）
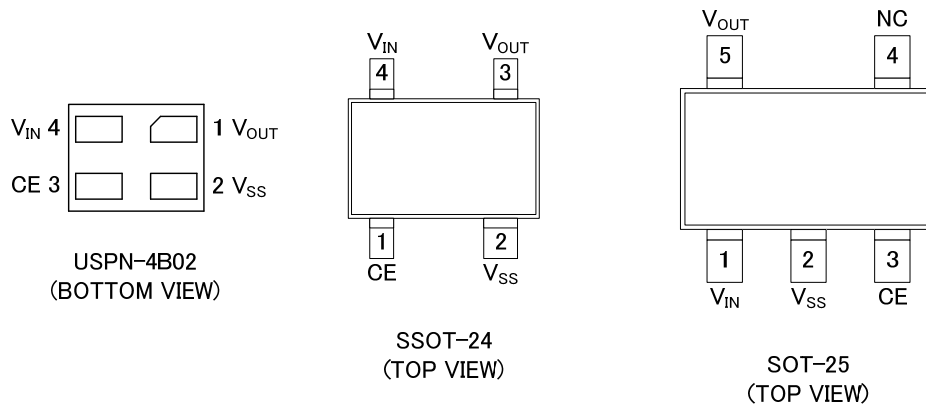
SOT−25
（TOP VIEW）

■PIN ASSIGNMENT

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

■FUNCTION CHART

PIN NAME	SIGNAL	STATUS
CE	L	Stand-by
	H	Active
	OPEN	Unstable

* Please avoid the state of OPEN, and connect CE pin to any arbitrary voltage.

■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	-0.3～+6.5	V
Output Current		I_{OUT}	470 [*1]	mA
Output Voltage		V_{OUT}	-0.3～V_{IN}+0.3 or +6.5 [*2]	V
CE Input Voltage		V_{CE}	-0.3～+6.5	V
Power Dissipation	USPN-4B02	Pd	100	mW
			550 (PCB mounted) [*3]	
	SSOT-24		150	
			500 (PCB mounted) [*3]	
	SOT-25		250	
			600 (PCB mounted) [*3]	
Operating Ambient Temperature		Topr	-40～+85	℃
Storage Temperature		Tstg	-55～+125	℃

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

[*1] Please use within the range of $I_{OUT} \leqq Pd / (V_{IN}-V_{OUT})$

[*2] The maximum rating corresponds to the lowest value between V_{IN}+0.3 or +6.5.

[*3] This is a reference data taken by using the test board.　Please refer to page 24～26 for details.

■ELECTRICAL CHARACTERISTICS

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.	MAX.	UNITS	CIRCUIT
Input Voltage	V_{IN}	$I_{OUT}=1\mu A$		1.4	-	6.0	V	①
Output Voltage	$V_{OUT(E)}$ [*1]	$V_{OUT(T)}<2.0V$		-0.02	$V_{OUT(T)}$ [*2]	+0.02	V	①
		$V_{OUT(T)}\geqq2.0V$		×0.99		×1.01		
Maximum Output Current	I_{OUTMAX}			150	-	-	mA	①
Load Regulation	ΔV_{OUT}	$1\mu A\leqq I_{OUT}\leqq1mA$		-	3	16	mV	①
		$1mA\leqq I_{OUT}\leqq150mA$		-	17	50		
Dropout Voltage	Vdif1 [*3]	$I_{OUT}=50mA$		-	E-1 [*4]		V	①
	Vdif2 [*3]	$I_{OUT}=150mA$		-	E-2 [*4]			
Supply Current	I_{SS}	$I_{OUT}=0mA$	$V_{OUT(T)}<1.9V$	-	0.60	1.27	μA	②
			$1.9V\leqq V_{OUT(T)}<4.0V$	-	0.65	1.50		
			$V_{OUT(T)}\geqq4.0V$	-	0.80	1.80		
Stand-by Current	I_{STB}	$V_{IN}=6.0V, V_{CE}=V_{SS}$		-	0.01	0.10	μA	②
Line Regulation	$\Delta V_{OUT}/$ $(\Delta V_{IN}\cdot V_{OUT})$	$I_{OUT}=1\mu A$	$V_{OUT(T)}+0.5V\leqq V_{IN}\leqq6.0V$	-	0.01	0.13	%/V	①
		$I_{OUT}=1mA$	$V_{OUT(T)}<1.2V,$ $1.7V\leqq V_{IN}\leqq6.0V$	-	0.01	0.19		
			$V_{OUT(T)}\geqq1.2V,$ $V_{OUT(T)}+0.5V\leqq V_{IN}\leqq6.0V$					
Output Voltage Temperature Characteristics	$\Delta V_{OUT}/$ $(\Delta Topr\cdot V_{OUT})$	$I_{OUT}=10mA,$ $-40℃\leqq Topr\leqq85℃$		-	±50	-	ppm/℃	①
Current Limit	I_{LIM}	$V_{OUT}=V_{OUT(E)}×0.95$		150	270	-	mA	①
Short-Circuit Current	I_{SHORT}	$V_{OUT}=V_{SS}$		-	80	-	mA	①
C_L Auto-Discharge Resistance	R_{DCHG}	$V_{CE}=V_{SS}, V_{OUT}=V_{OUT(T)}$		280	450	640	Ω	①
CE "H" Level Voltage	V_{CEH}			0.91	-	6.00	V	③
CE "L" Level Voltage	V_{CEL}			V_{SS}	-	0.38	V	③
CE "H" Level Current	I_{CEH}	$V_{IN}=6.0V$		-0.1	-	0.1	μA	③
CE "L" Level Current	I_{CEL}	$V_{IN}=6.0V, V_{CE}=V_{SS}$		-0.1	-	0.1	μA	③

NOTE:

Unless otherwise stated, $V_{CE}=V_{IN}$, $I_{OUT}=1mA$, $C_{IN}=C_L$=open, V_{IN} is below:

$V_{OUT(T)}<2.5V$: $V_{IN}=3.5V$

$V_{OUT(T)}\geqq2.5V$: $V_{IN}=V_{OUT(T)}+1.0V$

[*1] $V_{OUT(E)}$ is Effective output voltage

[*2] $V_{OUT(T)}$ is Nominal output voltage

[*3] Vdif={$V_{IN1}-V_{OUT1}$}

V_{IN1} is the input voltage when V_{OUT1} appears at the V_{OUT} pin while input voltage is gradually decreased.

V_{OUT1} is the voltage equal to 98% of the normal output voltage when amply stabilized $V_{OUT(T)}$ +1.0V is input at the V_{IN} pin.

[*4] E-1 / E-2: DROPOUT VOLTAGE (Refer to the Voltage Chart)

## ■ELECTRICAL CHARACTERISTICS (Continued)

Voltage Chart

Ta=25℃

NOMINAL OUTPUT VOLTAGE	-		E-1		E-2	
	OUTPUT VOLTAGE (V)		DROPOUT VOLTAGE (V)			
$V_{OUT(T)}$ (V)	$V_{OUT(E)}$		Vdif1		Vdif2	
	MIN.	MAX.	TYP.	MAX.	TYP.	MAX.
1.1	1.0800	1.1200	0.96	1.35	1.51	2.05
1.2	1.1800	1.2200	0.87	1.23	1.41	1.93
1.3	1.2800	1.3200	0.77	1.12	1.33	1.83
1.4	1.3800	1.4200	0.69	1.01	1.24	1.72
1.5	1.4800	1.5200	0.62	0.91	1.17	1.63
1.6	1.5800	1.6200	0.56	0.84	1.10	1.54
1.7	1.6800	1.7200	0.51	0.77	1.04	1.47
1.8	1.7800	1.8200	0.47	0.72	0.99	1.40
1.9	1.8800	1.9200	0.42	0.64	0.92	1.29
2.0	1.9800	2.0200	0.37	0.58	0.86	1.20
2.1	2.0790	2.1210				
2.2	2.1780	2.2220	0.31	0.47	0.75	1.05
2.3	2.2770	2.3230				
2.4	2.3760	2.4240	0.26	0.40	0.67	0.92
2.5	2.4750	2.5250				
2.6	2.5740	2.6260	0.23	0.34	0.60	0.82
2.7	2.6730	2.7270				
2.8	2.7720	2.8280	0.20	0.30	0.54	0.74
2.9	2.8710	2.9290				
3.0	2.9700	3.0300	0.17	0.26	0.50	0.67
3.1	3.0690	3.1310				
3.2	3.1680	3.2320				
3.3	3.2670	3.3330				
3.4	3.3660	3.4340				
3.5	3.4650	3.5350	0.15	0.22	0.43	0.59
3.6	3.5640	3.6360				
3.7	3.6630	3.7370				
3.8	3.7620	3.8380				
3.9	3.8610	3.9390				
4.0	3.9600	4.0400	0.13	0.19	0.38	0.51
4.1	4.0590	4.1410				
4.2	4.1580	4.2420				
4.3	4.2570	4.3430				
4.4	4.3560	4.4440				
4.5	4.4550	4.5450	0.11	0.17	0.35	0.47
4.6	4.5540	4.6460				
4.7	4.6530	4.7470				
4.8	4.7520	4.8480				
4.9	4.8510	4.9490				
5.0	4.9500	5.0500	0.10	0.16	0.32	0.43

■TEST CIRCUITS

Circuit ①
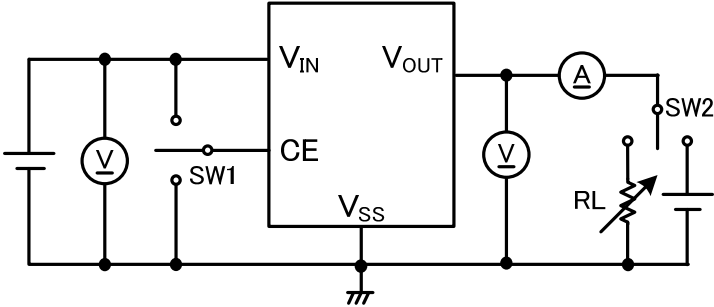
Circuit ②
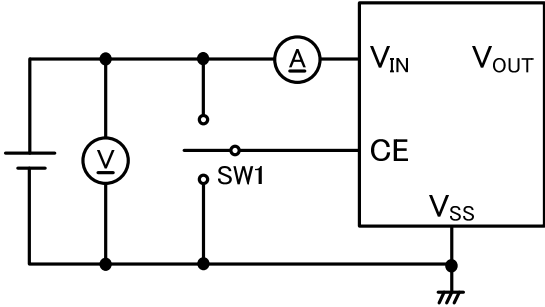
Circuit ③
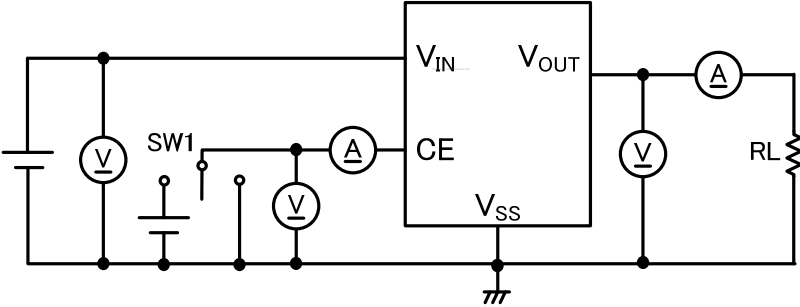
■ OPERATIONAL EXPLANATION

The voltage divided by resistors R1 & R2 is compared with the internal reference voltage by the error amplifier.　The V$_{OUT}$ pin is then driven by the subsequent output signal.　The output voltage at the V$_{OUT}$ pin is controlled and stabilized by a system of negative feedback.
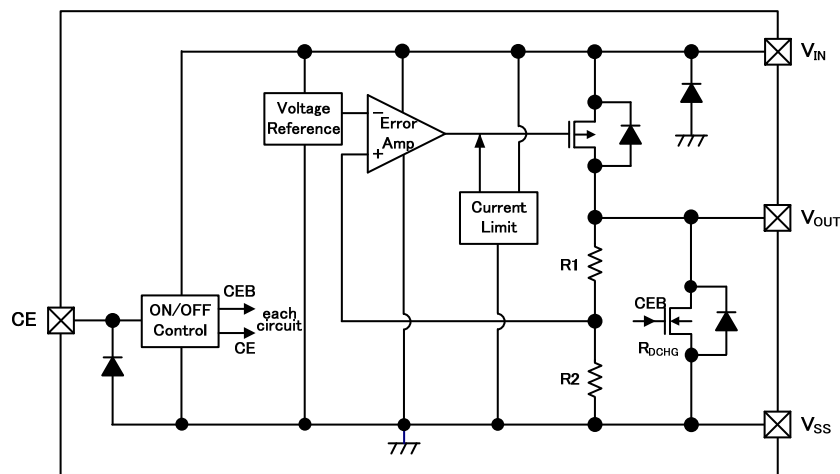
XC6504 Series, Type A

<Current Limiter, Short-Circuit Protection>

The XC6504 series includes a combination of a fixed current limiter circuit & a foldback circuit, which aid the operations of the current limiter and circuit protection. 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, output voltage drops further and output current decreases.

<CE Pin>

The XC6504 internal circuitry can be shutdown via the signal from the CE pin with the XC6504 series.　In shutdown mode with CE low level voltage is input, output at the V$_{OUT}$ pin will be pulled down to the V$_{SS}$ level via parallel to R1 & R2 and C$_L$ discharge resistance (R$_{DCHG}$).

If this IC is used with the correct output voltage for the CE pin, the logic is fixed and the IC will operate normally.　However, supply current may increase as a result of through current in the IC's internal circuitry when medium voltage is input. The output voltage becomes unstable when the CE pin is opened.

<CL Auto-Discharge Function>

The XC6504 series can quickly discharge the electric charge at the output capacitor (C$_L$), when a low signal to the CE pin, which enables a whole IC circuit put into OFF state, is inputted via an internal switch located between the V$_{OUT}$ pin and the V$_{SS}$ pin.　In this state, the application is protected from a glitch operation caused by the electric charge at the output capacitor (C$_L$). Moreover, discharge time of the output capacitor (C$_L$) is set by the C$_L$ auto-discharge resistance (R$_{DCHG}$) and the output capacitor (C$_L$).　By setting time constant of a C$_L$ auto-discharge resistance value (R$_{DCHG}$) and an output capacitor value (C$_L$) as τ (τ = C$_L$ x R$_{DCHG}$), the output voltage after discharge via the internal switch is calculated by the following formulas.　Please also note R$_{DCHG}$ is depended on V$_{IN}$ and When V$_{IN}$ is high, R$_{DCHG}$ is low.

$$V = V_{OUT(E)} \times e^{-t/\tau} \ or \ t = \tau \ ln\,(V_{OUT(E)} \,/\, V)$$

V: Output voltage after discharge
V$_{OUT(E)}$: Output voltage
t: Discharge time
τ : C$_L$ x R$_{DCHG}$

<Low ESR Capacitors>

The XC6504 series can provide a stable output voltage even if without C$_L$ capacitor or with a low ESR C$_L$ capacitor because of a built-in phase compensation circuit. In case of adding a C$_L$ capacitor, we suggest that an output capacitor (C$_L$) is connected as close as possible to the V$_{OUT}$ pin and the V$_{SS}$ pin.　When V$_{IN}$ stabilization is needed, please place an input capacitor (C$_{IN}$) as close as to the V$_{IN}$ pin and the V$_{SS}$ pin.

■NOTES ON USE

1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.

2. Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please keep the resistance low between 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.

4. Capacitances of these capacitors (C_{IN}, C_L) are decreased by the influences of bias voltage and ambient temperature. Care shall be taken for capacitor selection to ensure stability of phase compensation from the point of ESR influence.

5. Torex places an importance on improving our products and their reliability.
We request that users incorporate fail-safe designs and post-aging prevention treatment when using Torex products in their systems.

■TYPICAL PERFORMANCE CHARACTERISTICS

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}<2.5V$: V_{IN}=3.5V

$V_{OUT(T)}\geqq2.5V$: $V_{IN}=V_{OUT(T)}+1.0V$

（1） Output Voltage vs. Output Current

XC6504x121xR

XC6504x121xR

XC6504x181xR

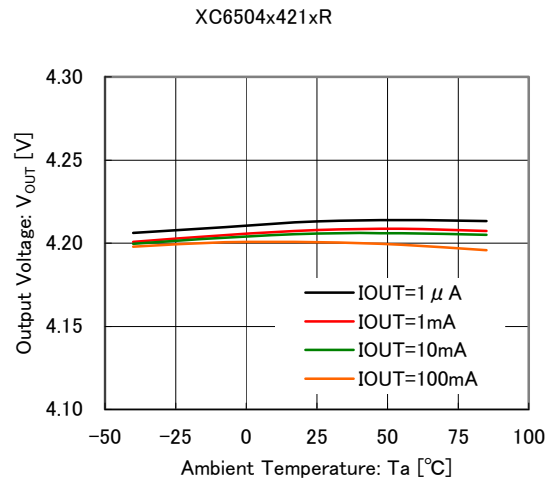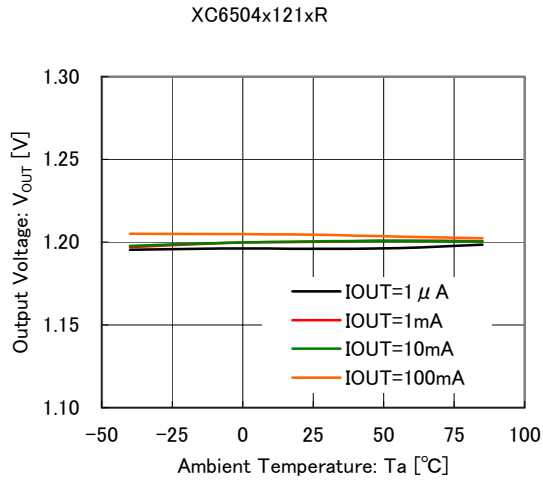
XC6504x181xR

XC6504x281xR

XC6504x281xR

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}$＜2.5V : V_{IN}=3.5V
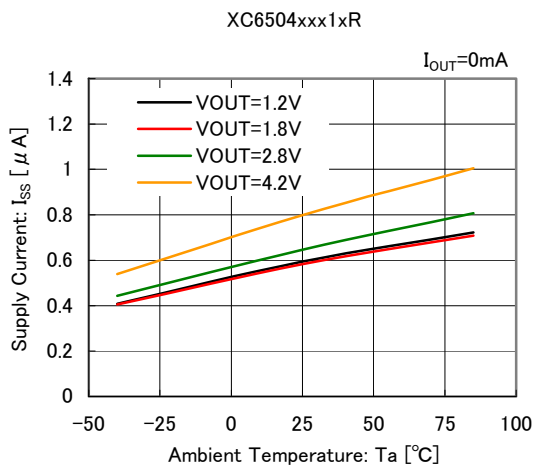
$V_{OUT(T)}$≧2.5V : $V_{IN}=V_{OUT(T)}$+1.0V

（1） Output Voltage vs. Output Current

XC6504x421xR

XC6504x421xR

（2） Output Voltage vs. Input Voltage
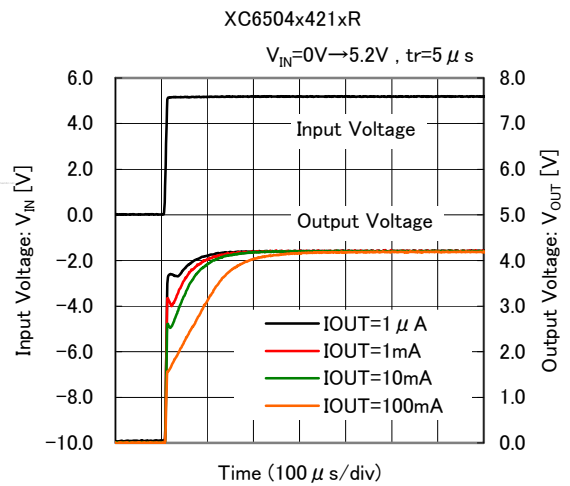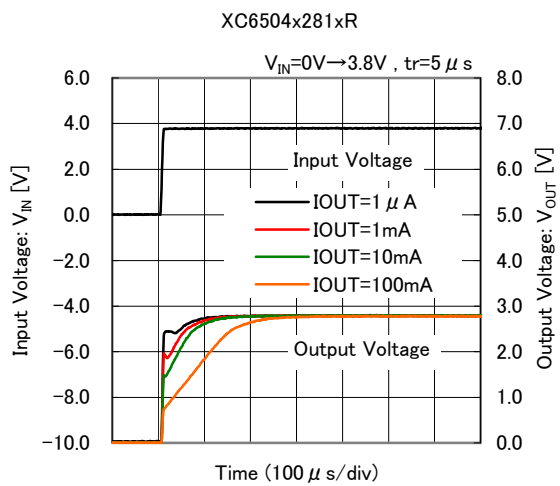
XC6504x121xR

XC6504x121xR

XC6504x181xR

XC6504x181xR
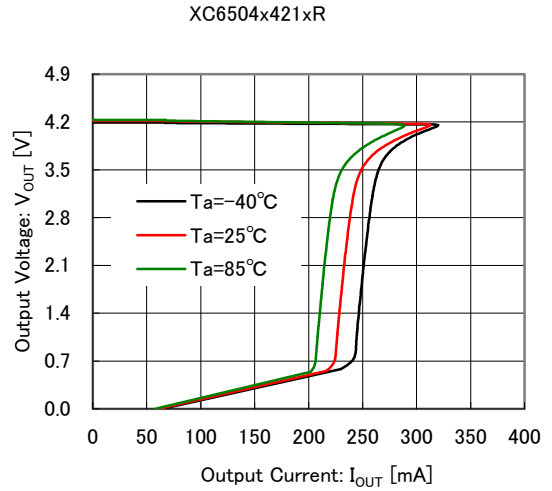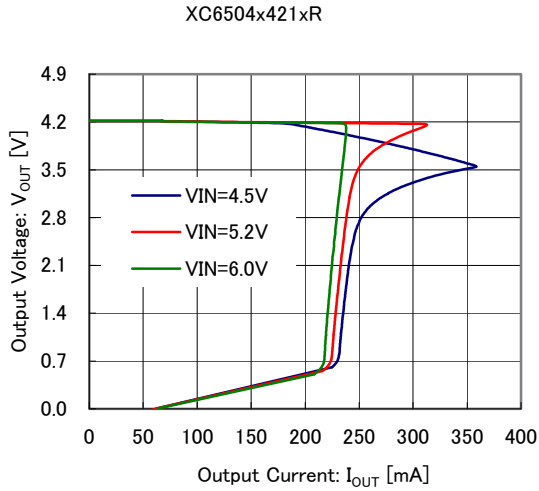
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, V_{CE}=V_{IN}, I_{OUT}=1mA, C_{IN}=C_L=open, V_{IN} is below.

$V_{OUT(T)}$＜2.5V ： V_{IN}=3.5V

$V_{OUT(T)}$≧2.5V ： V_{IN}=$V_{OUT(T)}$+1.0V

（2）Output Voltage vs. Input Voltage
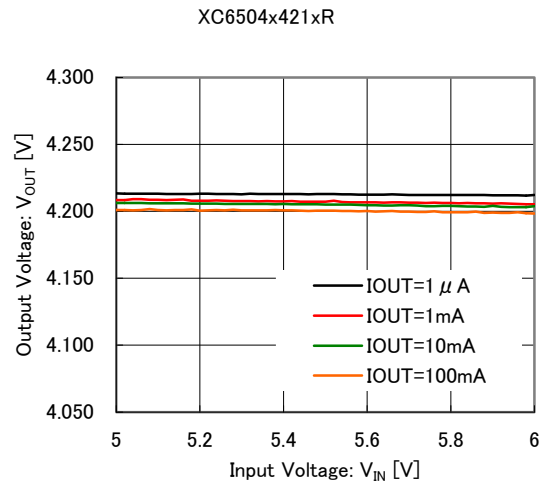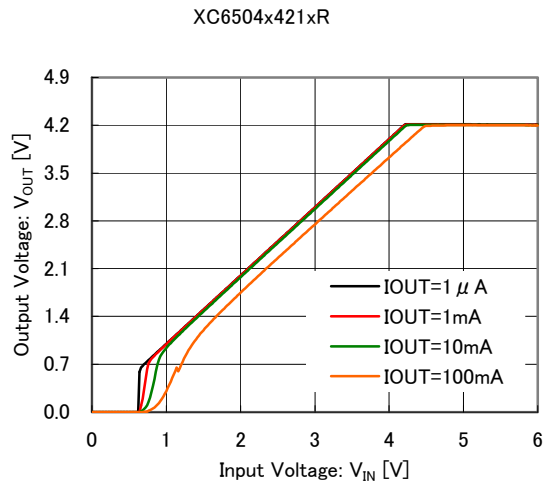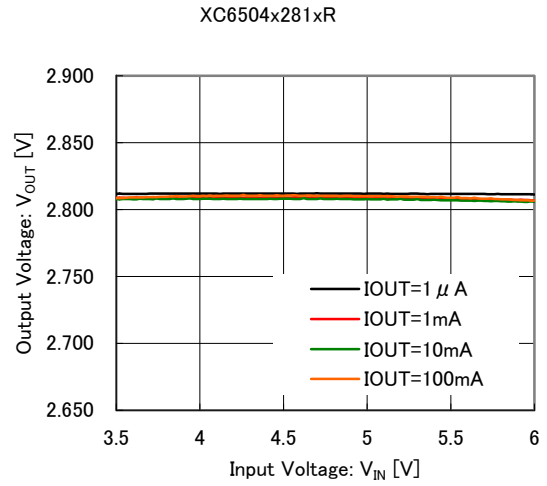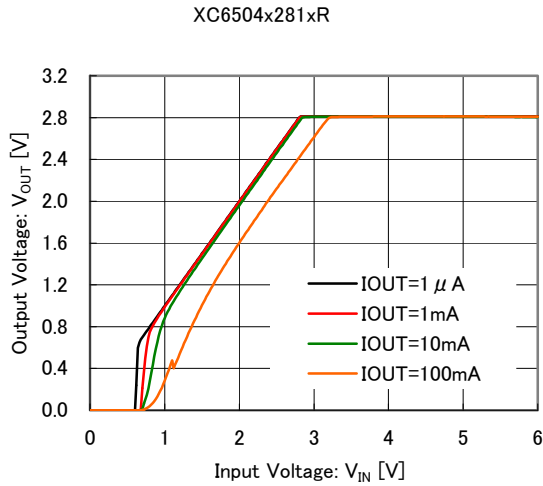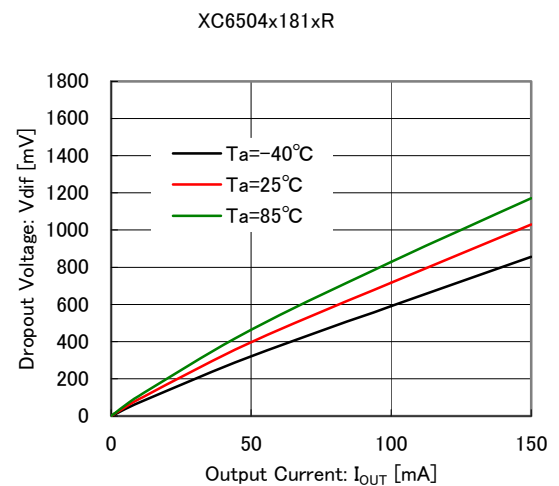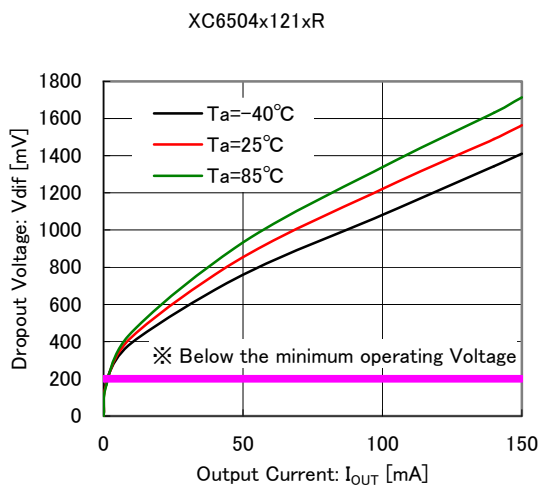
XC6504x281xR

XC6504x281xR

XC6504x421xR

XC6504x421xR

（3）Dropout Voltage vs. Output Current

XC6504x121xR

XC6504x181xR

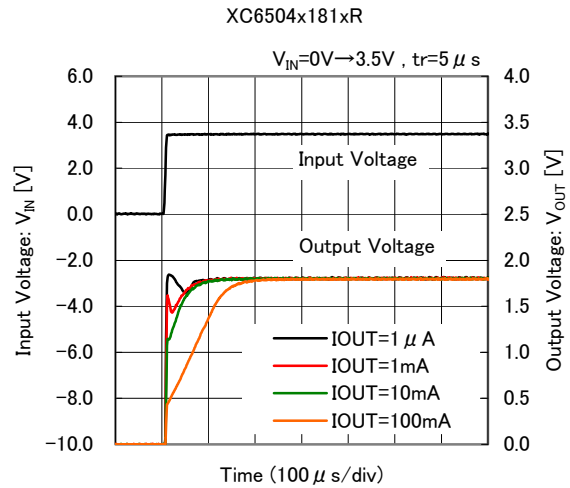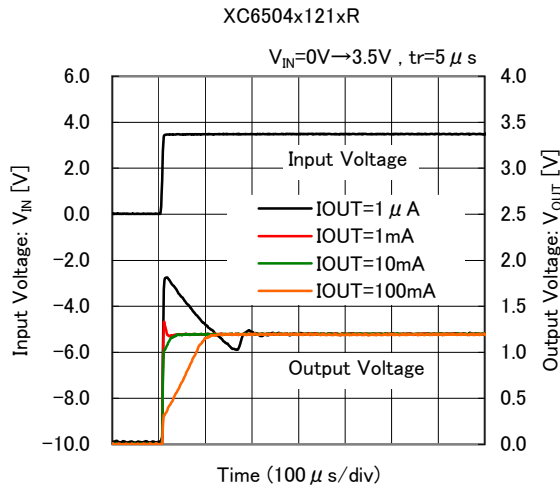# ■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

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$V_{OUT(T)}\geqq2.5V$: $V_{IN}=V_{OUT(T)}+1.0V$

（3）Dropout Voltage vs. Output Current

XC6504x281xR

XC6504x421xR
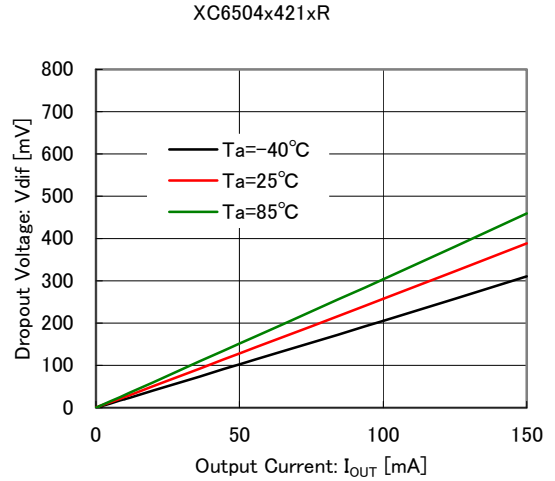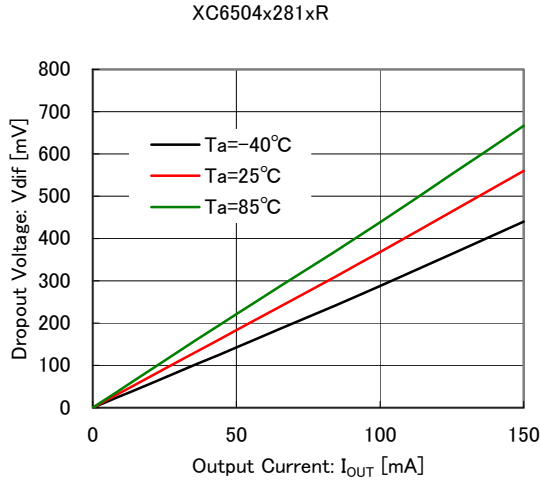
（4）Supply Current vs. Input Voltage
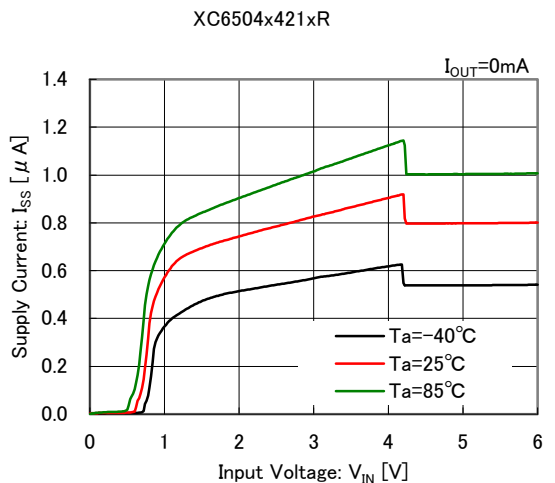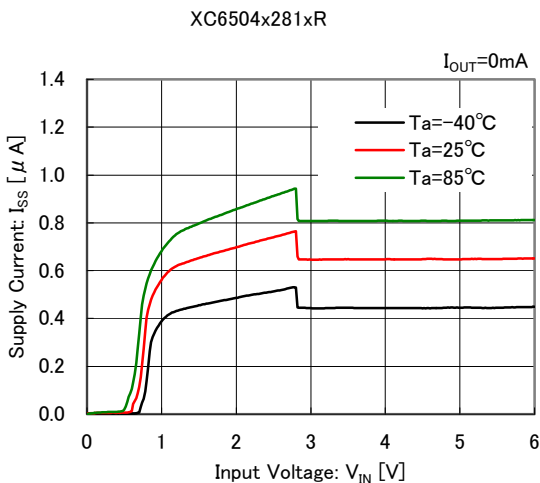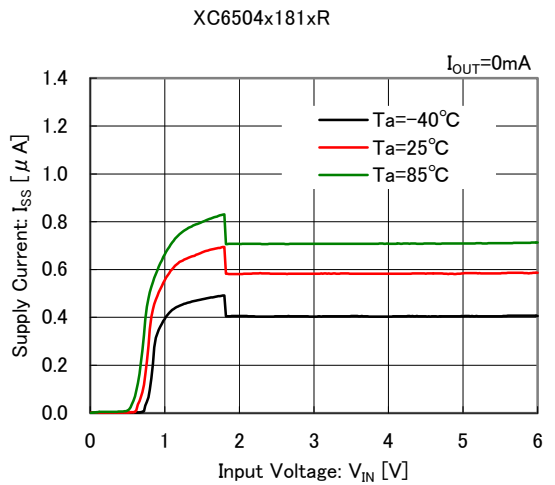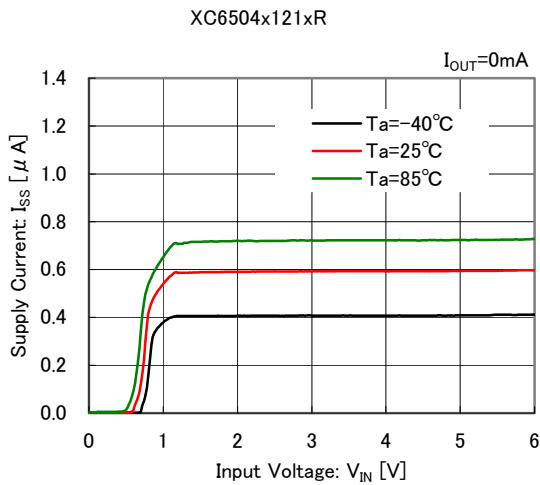
XC6504x121xR

XC6504x181xR

XC6504x281xR

XC6504x421xR

TOREX

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}$＜2.5V : V_{IN}=3.5V
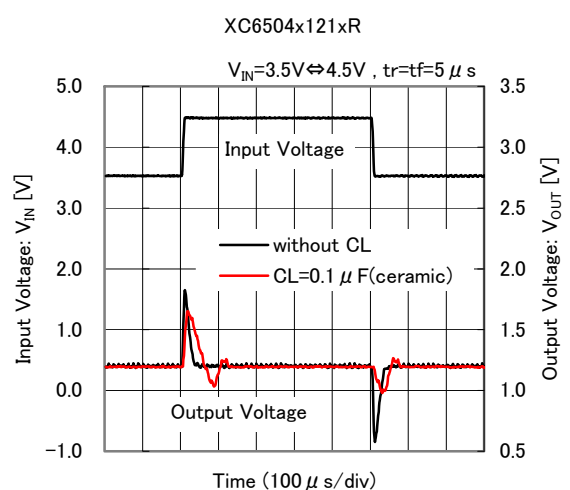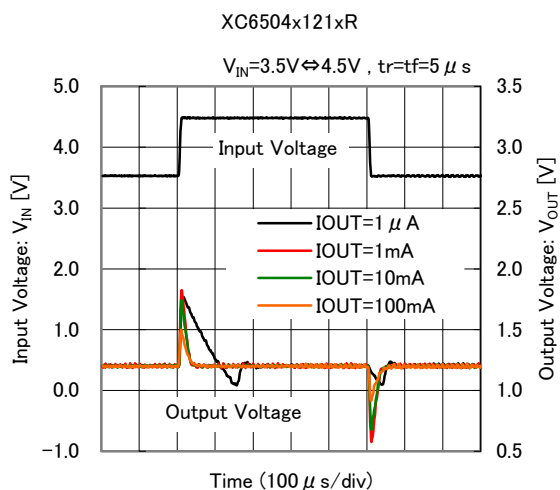
$V_{OUT(T)}$≧2.5V : $V_{IN}=V_{OUT(T)}$+1.0V

（5）Output Voltage vs. Ambient Temperature

XC6504x121xR

XC6504x181xR

XC6504x281xR

XC6504x421xR
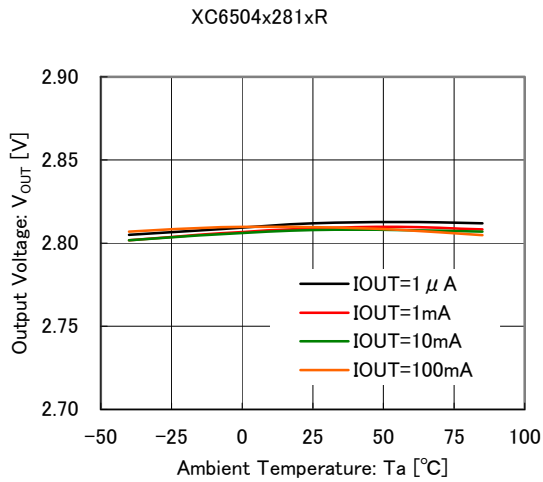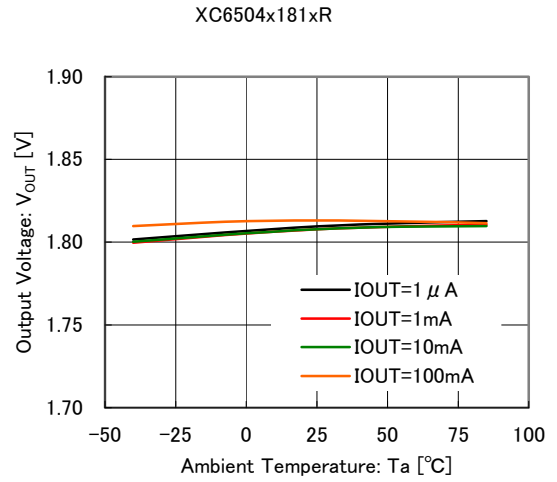
（6）Supply Current vs. Ambient Temperature

（7）CE Threshold Voltage vs. Ambient Temperature
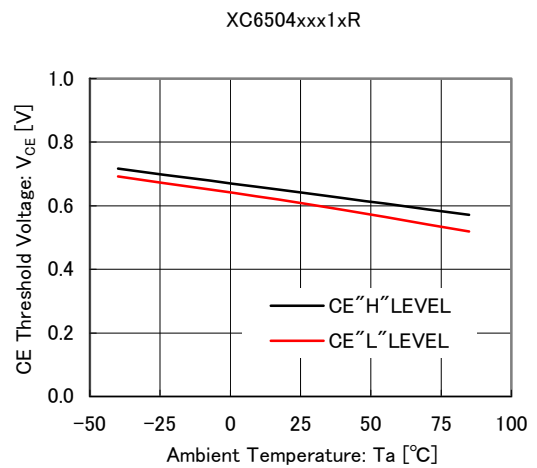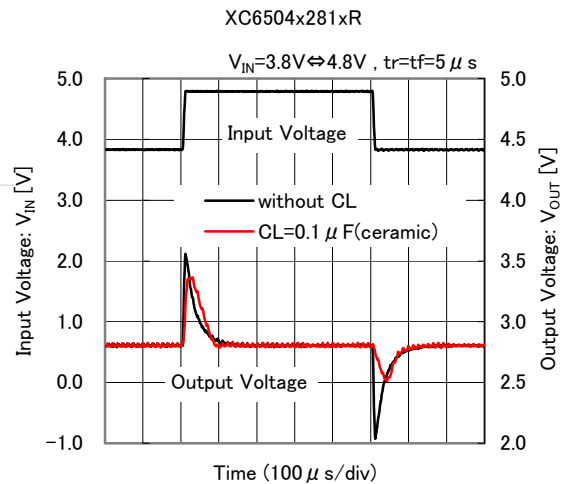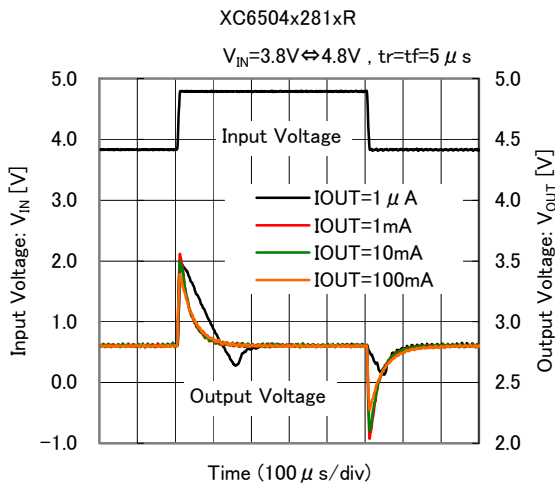
XC6504xxx1xR

XC6504xxx1xR

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}<2.5V$: V_{IN}=3.5V

$V_{OUT(T)}≧2.5V$: $V_{IN}=V_{OUT(T)}$+1.0V

（8） Rising Response Time

XC6504x121xR

V_{IN}=0V→3.5V , tr=5μs

XC6504x181xR

V_{IN}=0V→3.5V , tr=5μs

XC6504x281xR

V_{IN}=0V→3.8V , tr=5μs

XC6504x421xR

V_{IN}=0V→5.2V , tr=5μs

（9） Input Transient Response

XC6504x121xR
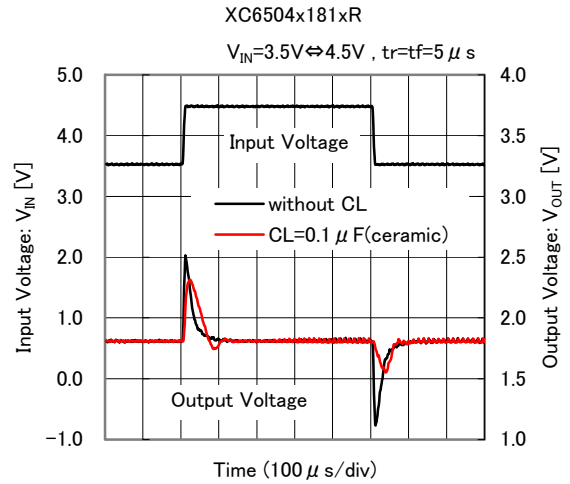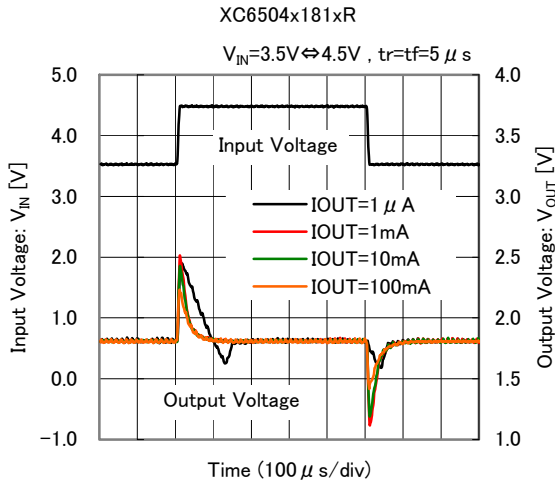
V_{IN}=3.5V⇔4.5V , tr=tf=5μs

XC6504x121xR

V_{IN}=3.5V⇔4.5V , tr=tf=5μs

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}$＜2.5V ： V_{IN}=3.5V

$V_{OUT(T)}$≧2.5V ： $V_{IN}=V_{OUT(T)}$+1.0V

（9） Input Transient Response

XC6504x181xR

V_{IN}=3.5V⇔4.5V , tr=tf=5μs

XC6504x181xR

V_{IN}=3.5V⇔4.5V , tr=tf=5μs

XC6504x281xR

V_{IN}=3.8V⇔4.8V , tr=tf=5μs

XC6504x281xR

V_{IN}=3.8V⇔4.8V , tr=tf=5μs

XC6504x421xR

V_{IN}=5.2V⇔6.0V , tr=tf=5μs
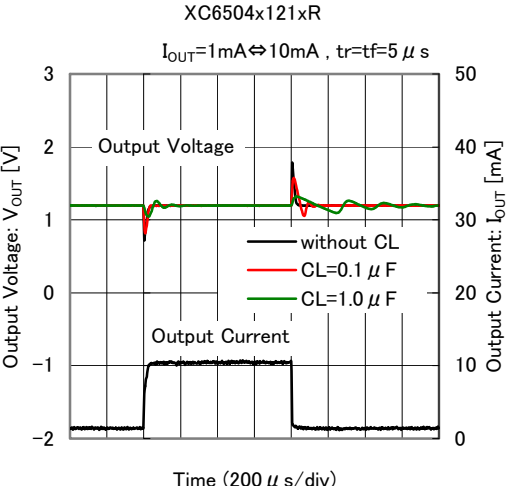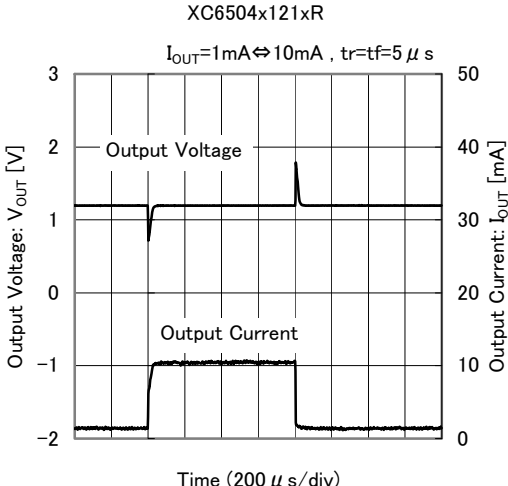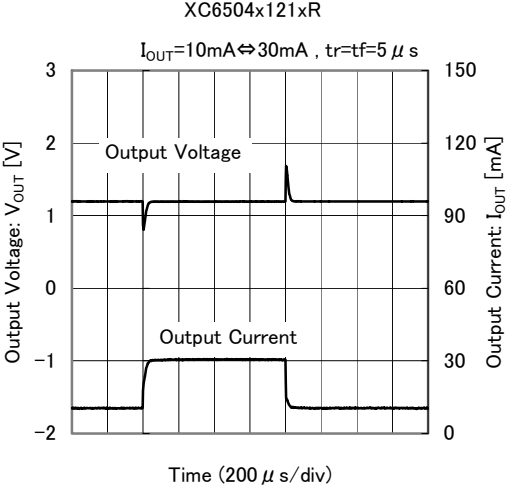

XC6504x421xR

V_{IN}=5.2V⇔6.0V , tr=tf=5μs

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, V_{CE}=V_{IN}, I_{OUT}=1mA, C_{IN}=C_L=open, V_{IN} is below.

$V_{OUT(T)}$＜2.5V ： V_{IN}=3.5V

$V_{OUT(T)}$≧2.5V ： V_{IN}=$V_{OUT(T)}$+1.0V

（10）Load Transient Response

XC6504x121xR

I_{OUT}=1μA⇔10mA , tr=tf=5μs

XC6504x121xR

I_{OUT}=10mA⇔30mA , tr=tf=5μs

XC6504x121xR

I_{OUT}=1mA⇔10mA , tr=tf=5μs

XC6504x121xR

I_{OUT}=1mA⇔10mA , tr=tf=5μs

XC6504x181xR

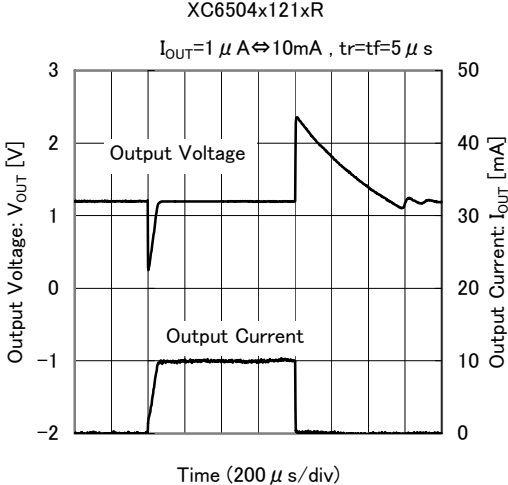I_{OUT}=1μA⇔10mA , tr=tf=5μs

XC6504x181xR

I_{OUT}=10mA⇔30mA , tr=tf=5μs

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}$＜2.5V　：　V_{IN}=3.5V

$V_{OUT(T)}$≧2.5V　：　$V_{IN}=V_{OUT(T)}$+1.0V

（10）Load Transient Response

XC6504x181xR
I_{OUT}=1mA⇔10mA , tr=tf=5μs

XC6504x181xR
I_{OUT}=1mA⇔10mA , tr=tf=5μs

XC6504x281xR
I_{OUT}=1μA⇔10mA , tr=tf=5μs

XC6504x281xR
I_{OUT}=10mA⇔30mA , tr=tf=5μs

XC6504x281xR
I_{OUT}=1mA⇔10mA , tr=tf=5μs
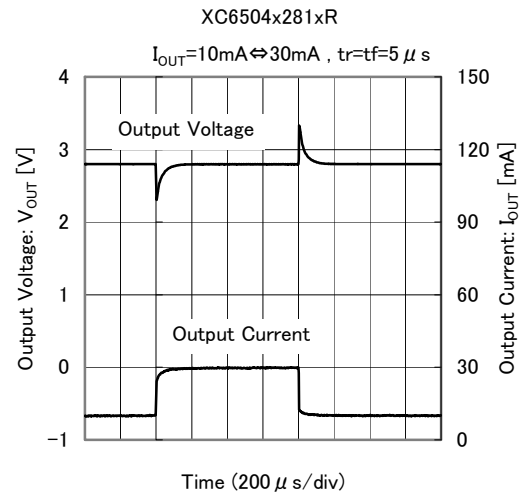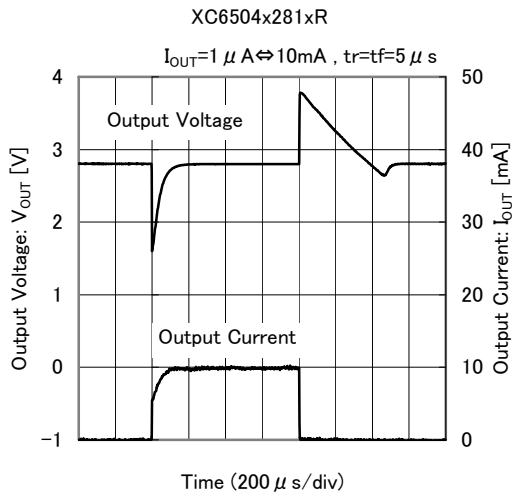

XC6504x281xR
I_{OUT}=1mA⇔10mA , tr=tf=5μs

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}$＜2.5V ： V_{IN}=3.5V

$V_{OUT(T)}$≧2.5V ： $V_{IN}=V_{OUT(T)}$+1.0V

（10）Load Transient Response

XC6504x421xR

I_{OUT}=1μA⇔10mA , tr=tf=5μs

XC6504x421xR

I_{OUT}=10mA⇔30mA , tr=tf=5μs

XC6504x421xR

I_{OUT}=1mA⇔10mA , tr=tf=5μs

XC6504x421xR

I_{OUT}=1mA⇔10mA , tr=tf=5μs

（11）CE Rising Response Time

XC6504x121xR
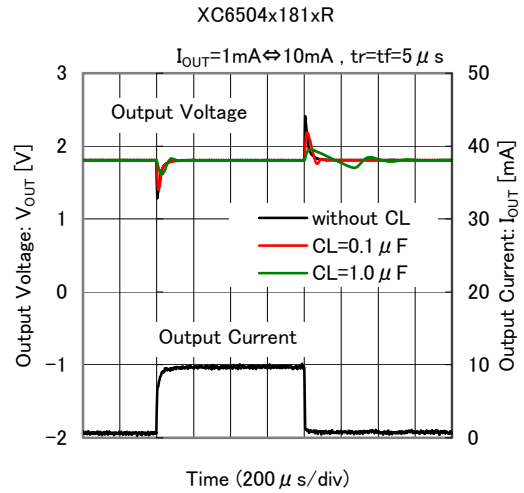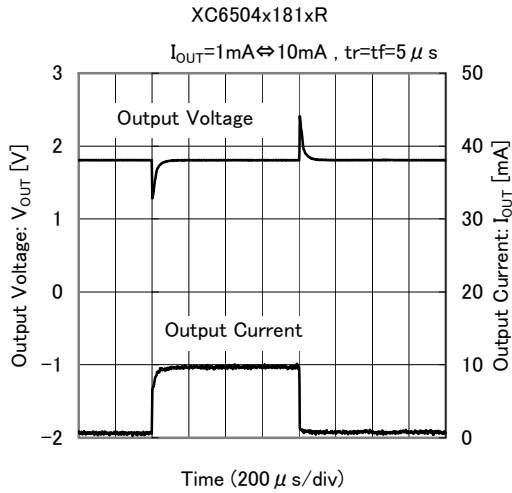
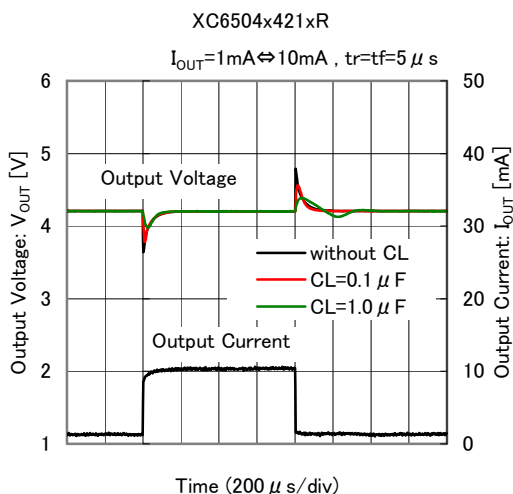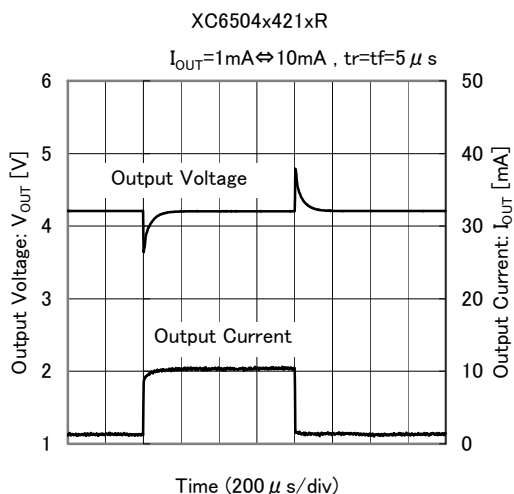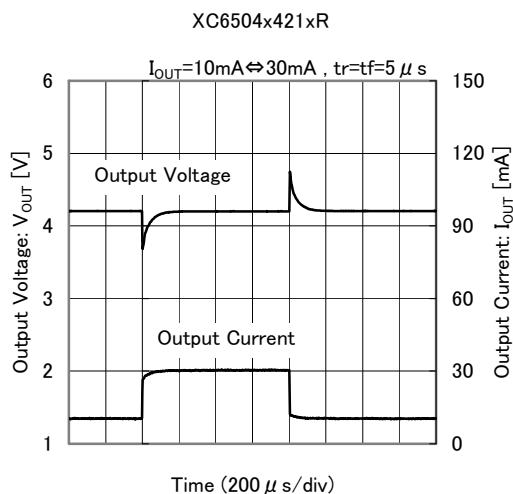V_{CE}=0V→V_{IN} , tr=5μs

XC6504x181xR

V_{CE}=0V→V_{IN} , tr=5μs

■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, $I_{OUT}=1mA$, $C_{IN}=C_L=open$, V_{IN} is below.

$V_{OUT(T)}<2.5V$: $V_{IN}=3.5V$

$V_{OUT(T)}≧2.5V$: $V_{IN}=V_{OUT(T)}+1.0V$

(11) CE Rising Response Time
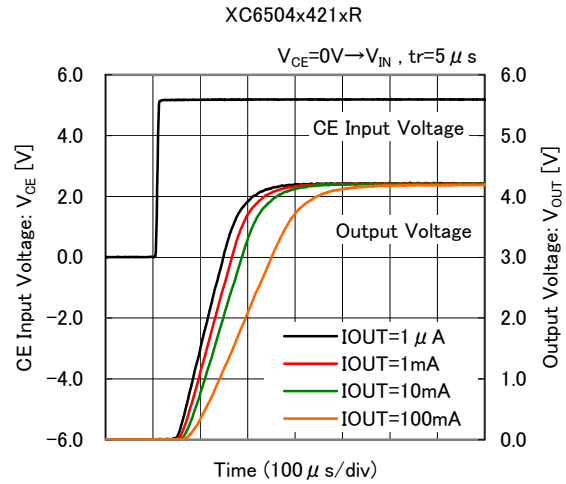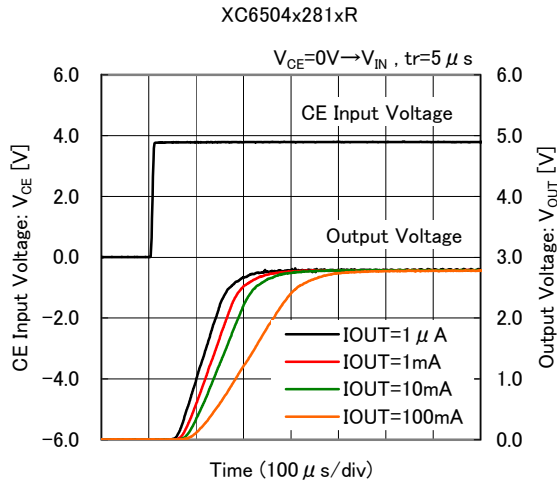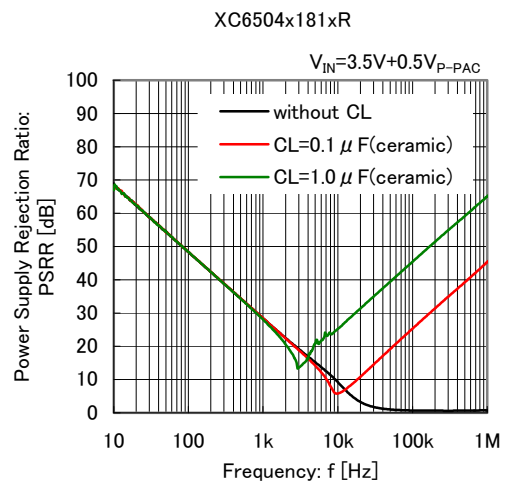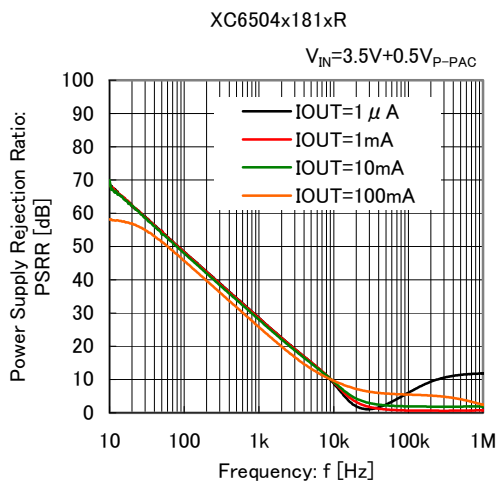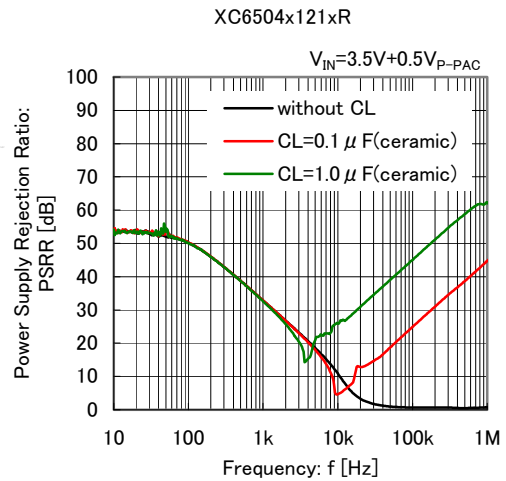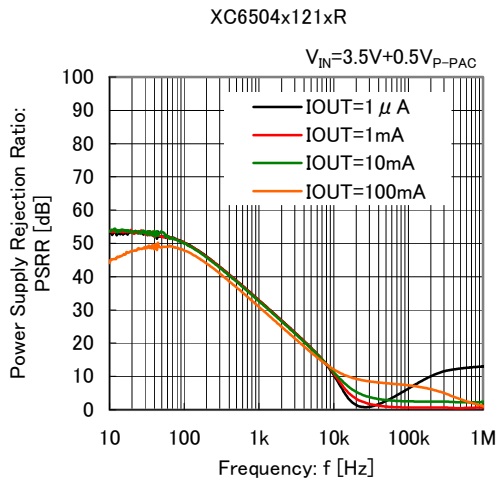
XC6504x281xR

XC6504x421xR

(12) Power Supply Rejection Ratio

XC6504x121xR

XC6504x121xR

XC6504x181xR

XC6504x181xR

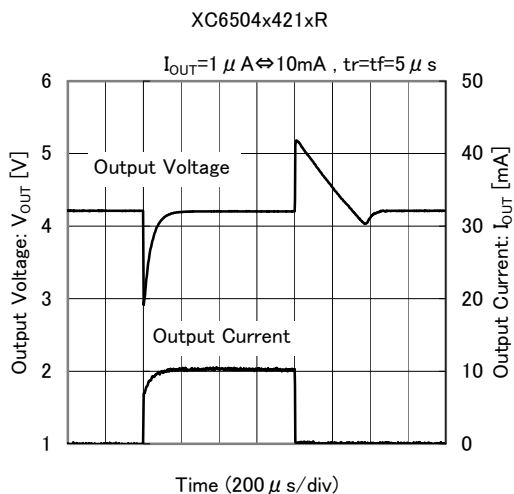# ■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Unless otherwise stated, Ta=25℃, $V_{CE}=V_{IN}$, I_{OUT}=1mA, $C_{IN}=C_L$=open, V_{IN} is below.

$V_{OUT(T)}<2.5V$: V_{IN}=3.5V
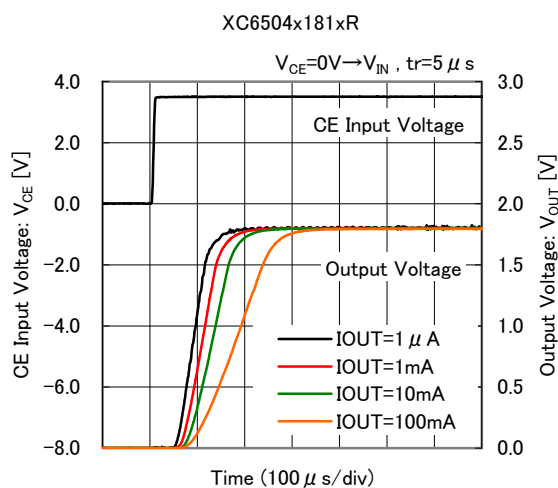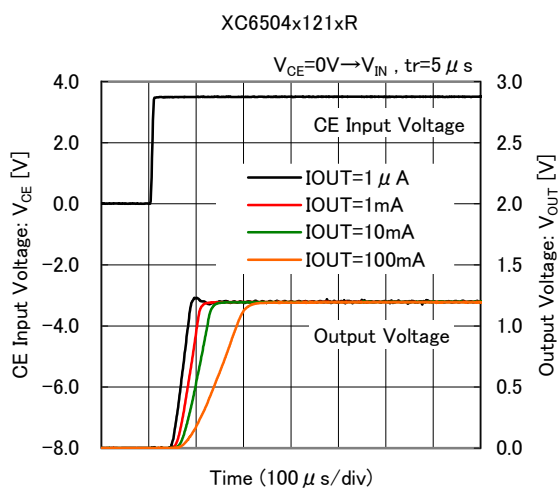
$V_{OUT(T)}\geqq2.5V$: $V_{IN}=V_{OUT(T)}$+1.0V

（12）Power Supply Rejection Ratio

XC6504x281xR
V_{IN}=3.8V+0.5V_{P-PAC}

XC6504x281xR
V_{IN}=3.8V+0.5V_{P-PAC}

XC6504x421xR
V_{IN}=5.2V+0.5V_{P-PAC}

XC6504x421xR
V_{IN}=5.2V+0.5V_{P-PAC}
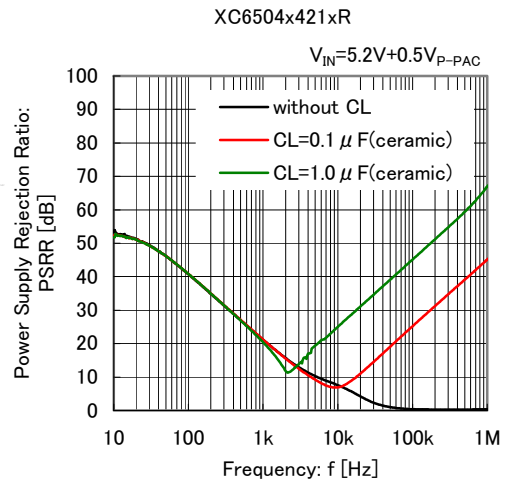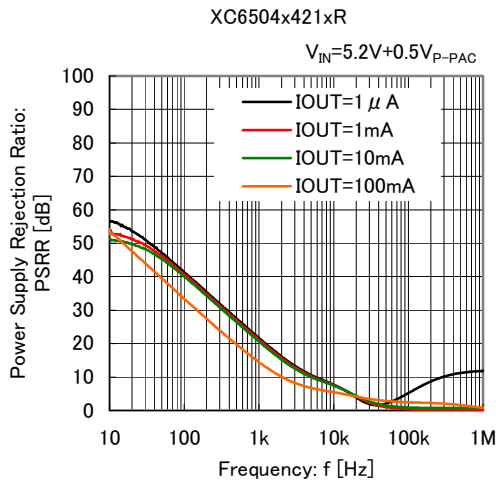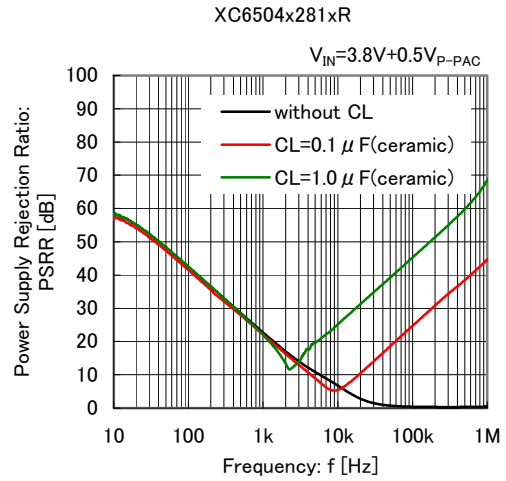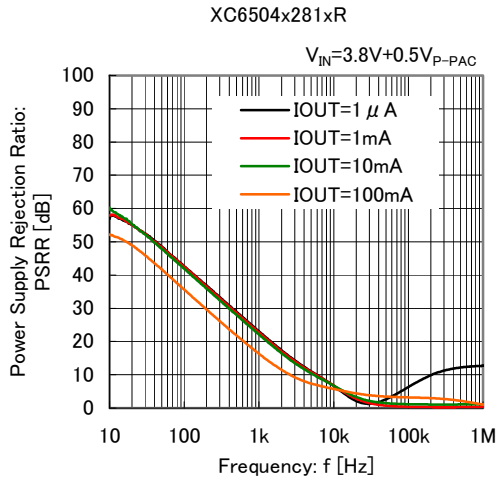
■PACKAGING INFORMATION

● USPN−4B02 (unit：mm)

0.75±0.05

0.95±0.05

1pin INDENT

0.38 +0.02 −0.03

0.18±0.05

| 1 | 2 |

C0.07

0.325±0.05

0.2±0.05

| 4 | 3 |

(0.4)
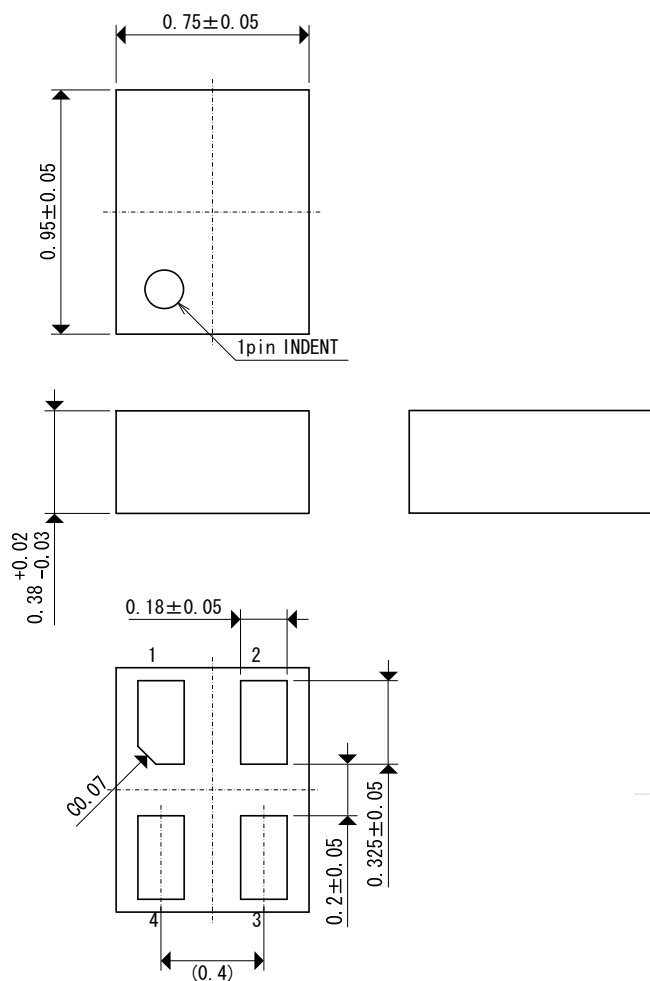
● USPN-4B02 Reference Pattern Layout
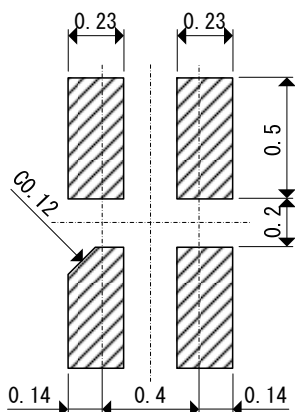
● USPN-4B02 Reference Metal Mask Design

0.23   0.23

0.5

0.2

C0.12

0.14   0.4   0.14

0.18   0.18

0.35

0.35

C0.07

0.115   0.4   0.115
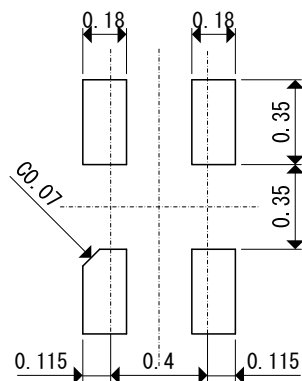
■PACKAGING INFORMATION (Continued)

●SSOT−24 (unit：mm)
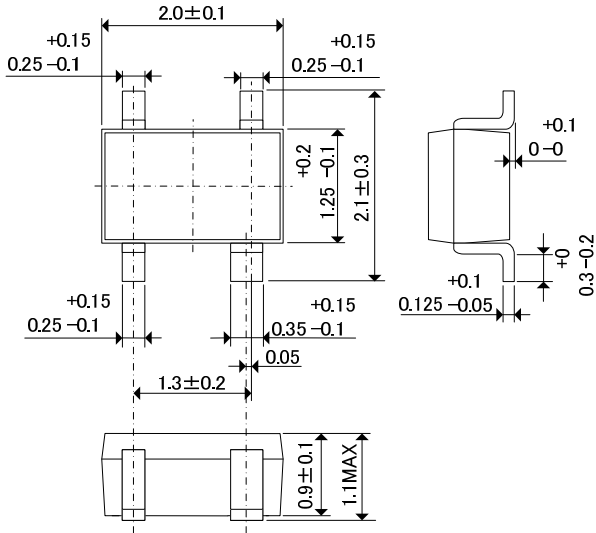
●SOT−25 (unit：mm)
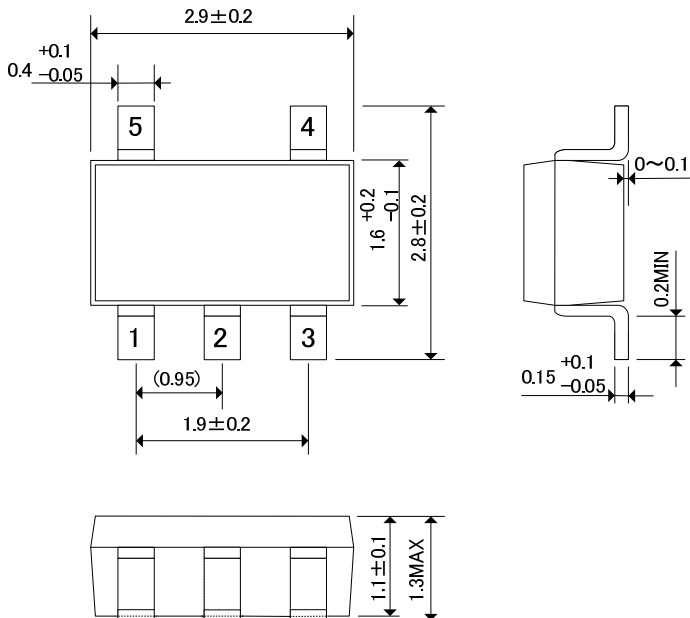
■PACKAGING INFORMATION (Continued)

● USPN-4B02 Power Dissipation

Power dissipation data for the USPN-4B02 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as the reference data taken in the following condition.

1. Measurement Condition

Condition:	Mount on a board
Ambient:	Natural convection
Soldering:	Lead (Pb) free
Board:	Dimensions 40 x 40 mm (1600mm² in one side)
	Copper (Cu) traces occupy 50% of the front and 50% of the back.
	The copper area is divided into four block,
	One block is 12.5% of total.
	The USPN-4B02 package has for terminals.
	Each terminal connects one copper block in the front
	and one in the back.
Material:	Glass Epoxy (FR-4)
Thickness:	1.6 mm
Through-hole:	4 x 0.8 Diameter

Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tjmax=125℃)

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

Pd vs. Ta

■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 the reference data taken in the following condition.

1. Measurement Condition

Condition:	Mount on a board
Ambient:	Natural convection
Soldering:	Lead (Pb) free
Board:	Dimensions 40 x 40 mm (1600 mm^2 in one side)
	Copper (Cu) traces occupy 50% of the board area
	In top and back faces
	Package heat-sink is tied to the copper traces
Material:	Glass Epoxy (FR-4)
Thickness:	1.6 mm
Through-hole:	4 x 0.8 Diameter
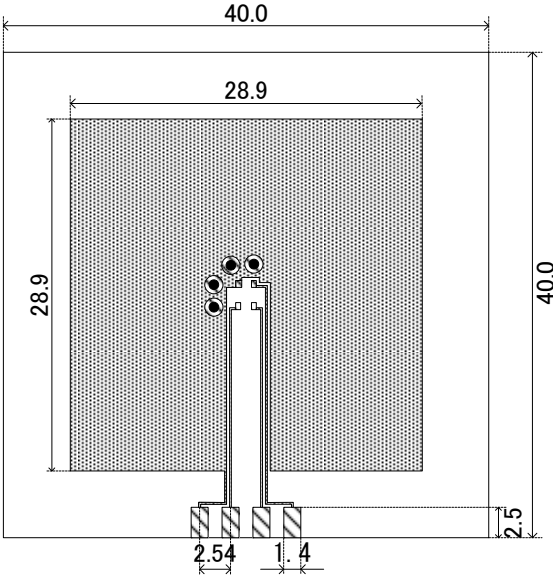
Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

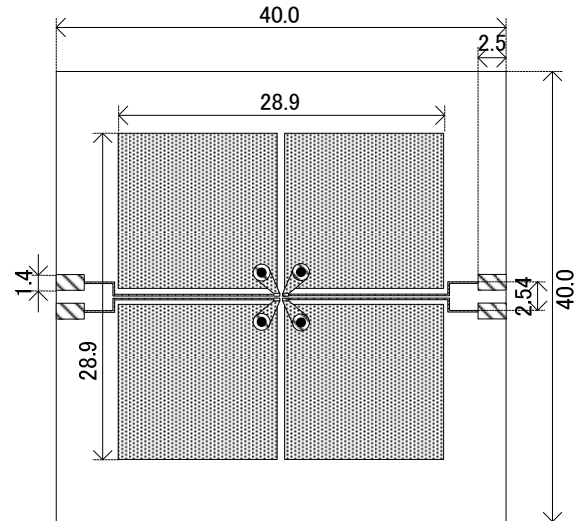| Ambient Temperature（℃）	Power Dissipation Pd（mW）	Thermal Resistance (℃/W)
25	500	200.00
85	200	

Pd vs. Ta
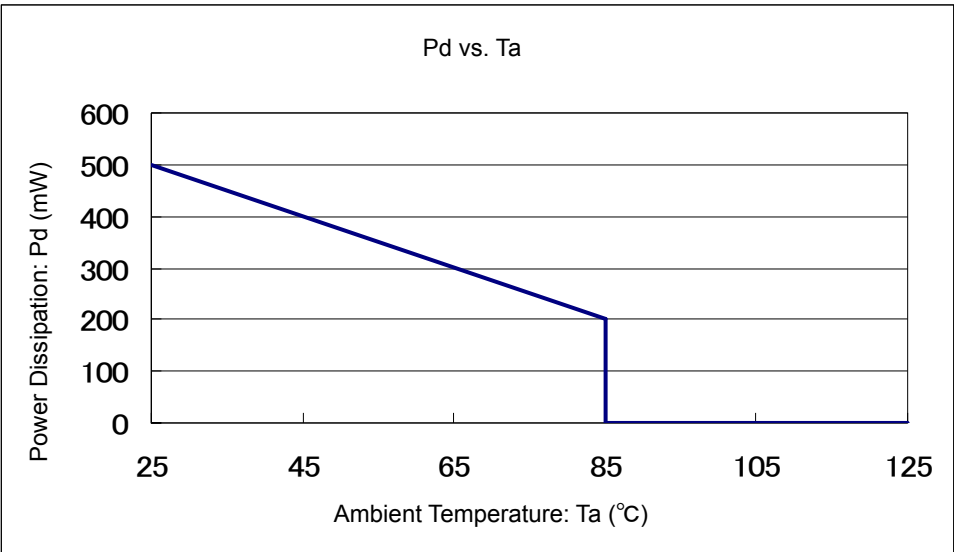
■PACKAGING INFORMATION (Continued)

● SOT-25 Power Dissipation

Power dissipation data for the SOT-25 is shown in this page.

The value of power dissipation varies with the mount board conditions.

Please use this data as the reference data taken in the following condition.

1. Measurement Condition

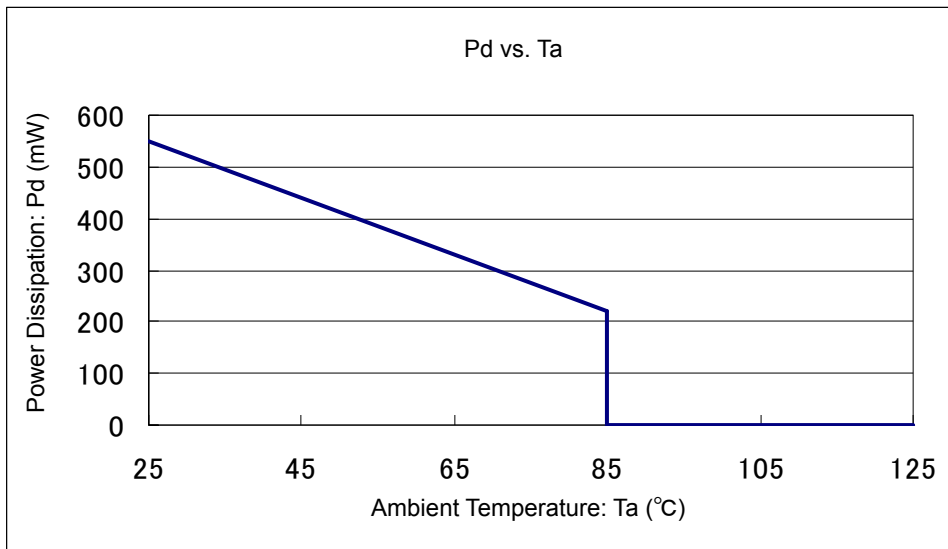|	
Condition:	Mount on a board
Ambient:	Natural convection
Soldering:	Lead (Pb) free
Board:	Dimensions 40 x 40 mm (1600 mm^2 in one side)
	Copper (Cu) traces occupy 50% of the board area
	In top and back faces
	Package heat-sink is tied to the copper traces
	(Board of SOT-26 is used.)
Material:	Glass Epoxy (FR-4)
Thickness:	1.6 mm
Through-hole:	4 x 0.8 Diameter
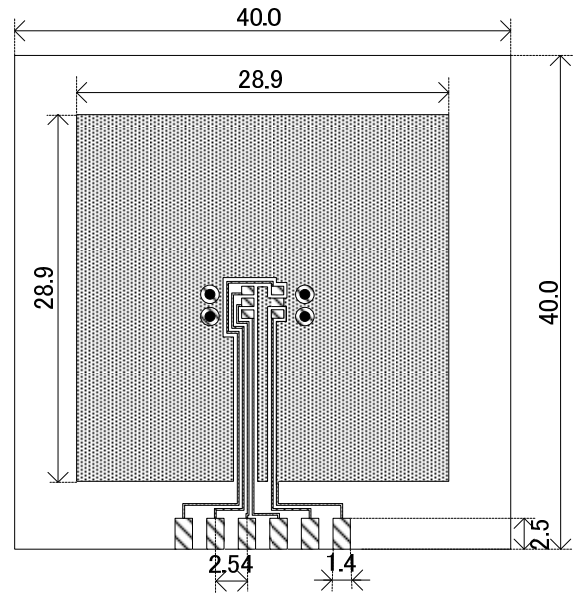
Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient temperature

Board Mount (Tj max = 125℃)

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

Pd vs. Ta

■MARKING RULE

SOT-25 (Under-dot)

Magnified
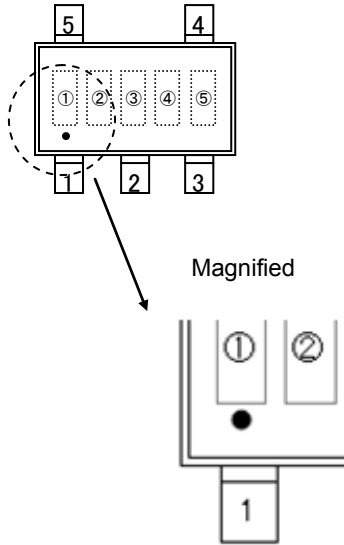
* SOT-25 with the under-dot marking is used.

① represents products series

MARK	PRODUCT SERIES
9	XC6504A*****-G

② represents output voltage range

MARK		PRODUCT SERIES
OUTPUT VOLTAGE 1.1V~3.9V	OUTPUT VOLTAGE 4.0V~5.0V	
A	B	XC6504A*****-G

③ represents output voltage

MARK	OUTPUT VOLTAGE (V)		MARK	OUTPUT VOLTAGE (V)	
0	-	4.00	F	2.50	-
1	1.10	4.10	H	2.60	-
2	1.20	4.20	K	2.70	-
3	1.30	4.30	L	2.80	-
4	1.40	4.40	M	2.90	-
5	1.50	4.50	N	3.00	-
6	1.60	4.60	P	3.10	-
7	1.70	4.70	R	3.20	-
8	1.80	4.80	S	3.30	-
9	1.90	4.90	T	3.40	-
A	2.00	5.00	U	3.50	-
B	2.10	-	V	3.60	-
C	2.20	-	X	3.70	-
D	2.30	-	Y	3.80	-
E	2.40	-	Z	3.90	-

④,⑤ represents production lot number
01~09, 0A~0Z, 11~9Z, A1~A9, AA~AZ, B1~ZZ in order.
(G, I, J, O, Q, W excluded)
*No character inversion used.

TOREX

■MARKING RULE (Continued)

SSOT-24 (With the orientation bar at the bottom)

* SSOT-24 with the orientation bar at the bottom is used.

① represents output voltage range

MARK		PRODUCT SERIES
OUTPUT VOLTAGE 1.1V~3.9V	OUTPUT VOLTAGE 4.0V~5.0V	
P	R	XC6504A*****-G

② represents output voltage

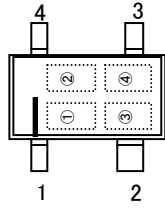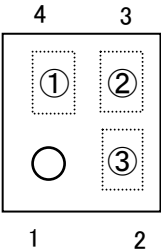| MARK	OUTPUT VOLTAGE (V)		MARK	OUTPUT VOLTAGE (V)	
0	-	4.00	F	2.50	-
1	1.10	4.10	H	2.60	-
2	1.20	4.20	K	2.70	-
3	1.30	4.30	L	2.80	-
4	1.40	4.40	M	2.90	-
5	1.50	4.50	N	3.00	-
6	1.60	4.60	P	3.10	-
7	1.70	4.70	R	3.20	-
8	1.80	4.80	S	3.30	-
9	1.90	4.90	T	3.40	-
A	2.00	5.00	U	3.50	-
B	2.10	-	V	3.60	-
C	2.20	-	X	3.70	-
D	2.30	-	Y	3.80	-
E	2.40	-	Z	3.90	-

③,④ represents production lot number
01~09, 0A~0Z, 11~9Z, A1~A9, AA~AZ, B1~ZZ in order.
(G, I, J, O, Q, W excluded)
*No character inversion used.

■MARKING RULE (Continued)

USPN-4B02

```
      4      3
    ┌──────────┐
    │ ┌─┐  ┌─┐ │
    │ │①│  │②│ │
    │ └─┘  └─┘ │
    │      ┌─┐ │
    │  ◯   │③│ │
    │      └─┘ │
    └──────────┘
      1      2
```

① represents output voltage range

MARK		PRODUCT SERIES
OUTPUT VOLTAGE 1.1V~3.9V	OUTPUT VOLTAGE 4.0V~5.0V	
A	B	XC6504A*****-G

② represents output voltage

MARK	OUTPUT VOLTAGE (V)		MARK	OUTPUT VOLTAGE (V)	
0	-	4.00	F	2.50	-
1	1.10	4.10	H	2.60	-
2	1.20	4.20	K	2.70	-
3	1.30	4.30	L	2.80	-
4	1.40	4.40	M	2.90	-
5	1.50	4.50	N	3.00	-
6	1.60	4.60	P	3.10	-
7	1.70	4.70	R	3.20	-
8	1.80	4.80	S	3.30	-
9	1.90	4.90	T	3.40	-
A	2.00	5.00	U	3.50	-
B	2.10	-	V	3.60	-
C	2.20	-	X	3.70	-
D	2.30	-	Y	3.80	-
E	2.40	-	Z	3.90	-

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

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