XC62E Series

Boosting Voltage Regulators

■GENERAL DESCRIPTION

The XC62E series are a group of positive output voltage regulators that can supply up to 1A of output current using an external transistor. Low power and high accuracy are achieved through CMOS process and laser trimming technologies.
The series consists of a high precision voltage reference, an error correction circuit and a short-circuit protected output driver. In stand-by mode, supply current can be dramatically cut. Since the input-output voltage differential is small, loss control efficiency is good.
The XC62E is particularly suited for use with battery operated portable products, and products where supply current regulation is required.
The series are available in an ultra small SOT-25 package.
In connection with the CE function, apart from the negative logic XC62EP series, a positive logic XC62ER series (custom) is also available.

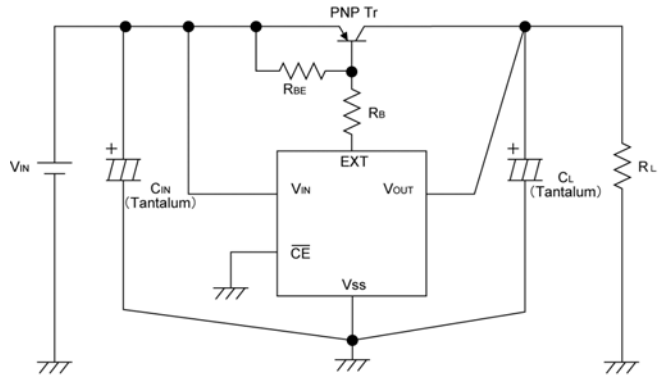
■APPLICATIONS

- ●Portable cameras and video recorders
- ●Battery powered equipment
- ●Palmtops
- ●Reference voltage sources

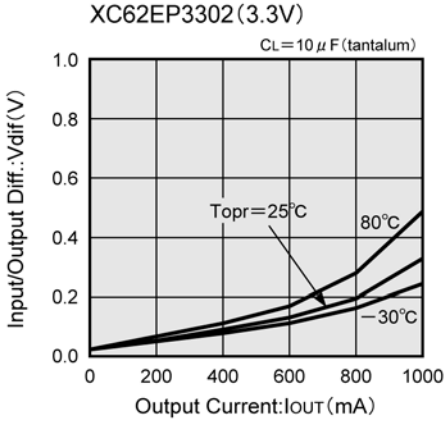
■FEATURES

Dropout Voltage : 0.1A@100mA
(Performance depends on the external transistor characteristics.)
Maximum Output Current : 1000mA
Output Voltage Range :1.5V~6.0V in 100mV increments
Highly Accurate : Setting voltage ±2%
Low Power Consumption: 50μA (VOUT=5.0V) (TYP.)
: 0.2μA (Stand-by) (TYP.)
Output Voltage Temperature Characteristics
: ±100ppm/ ℃ (TYP.)
Line Regulation : 0.1%/V (TYP.)
CMOS Low Power Consumption
Package : SOT-25
Environmentally Friendly : EU RoHS Compliant

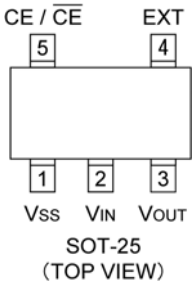
■TYPICAL APPLICATION CIRCUIT



■TYPICAL PERFORMANCE CHARACTERISTICS



■PIN CONFIGURATION



SOT-25
(TOP VIEW)

■PIN ASSIGNMENT

PIN NUMBER	PIN NAME	FUNCTION
1	VSS	Ground
2	VIN	Supply Voltage Input
3	VOUT	Regulated Voltage Output
4	$\overline{EXT}$	Base Current Control
5	CE/$\overline{CE}$	Chip Enable

■FUNCTION

SERIES	CE	OUTPUT VOLTAGE
XC62ER	H	ON
	L	OFF
XC62EP	H	OFF
	L	ON

H=High level
L=Low level

■PRODUCT CLASSIFICATION

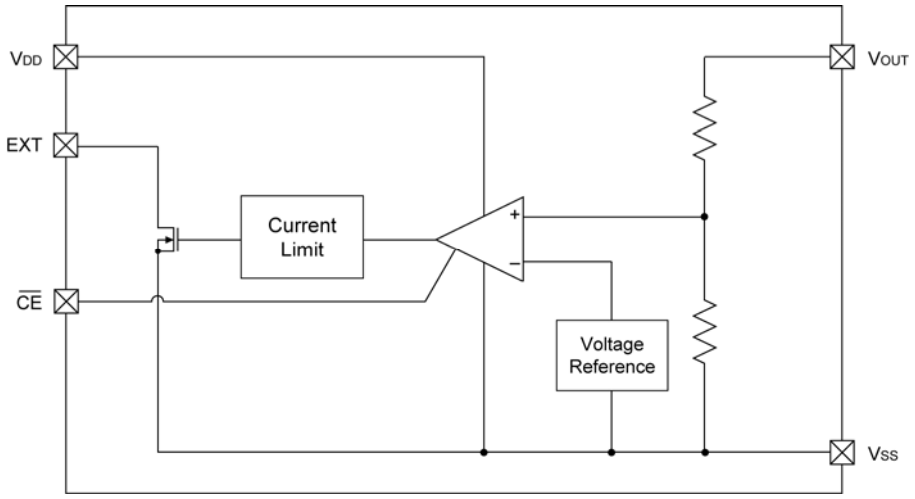
●Ordering Information

XC62E①②③④⑤⑥⑦-⑧(*1)

DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION
①	CE Pin Logic	R	Positive
		P	Negative
②③	Output Voltage	15 ~ 60	e.g. VOUT 1.5V→②=1, ③=5 VOUT 6.0V→②=6, ③=0
④	Temperature Characteristics	0	±100ppm (TYP.)
⑤	Output Voltage Accuracy	2	±2%
⑥⑦-⑧	Packages Taping Type (*2)	MR	SOT-25
		MR-G	SOT-25

(*1) The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.
(*2) The device orientation is fixed in its embossed tape pocket. For reverse orientation, please contact your local Torex sales office or representative. (Standard orientation: ⑥R-⑧, Reverse orientation: ⑥L-⑧)

■BLOCK DIAGRAM



■ABSOLUTE MAXIMUM RATINGS

Ta = 25℃

PARAMETER	SYMBOL	RATINGS	UNITS
VIN Input Voltage	VIN	12.0	V
VOUT Output Voltage	VOUT	VSS-0.3~VIN+0.3	V
CE/CE Input Voltage	VCE	VSS-0.3~VIN+0.3	V
EXT Output Voltage	VEXT	12.0	V
EXT Output Current	IEXT	50	mA
Power Dissipation	Pd	150	mW
Operating Temperature Range	Topr	-30~+80	℃
Storage Temperature Range	Tstg	-40～+125	℃

■ELECTRICAL CHARACTERISTICS

XC62EP3002 VOUT(T)=3.0V (*1)

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	I_{OUT}=50mA V_{IN}=4.0V	2.940	3.000	3.060	V
Maximum Output Current*	$I_{OUT\ max}$	V_{IN}=4.0V	-	1000	-	mA
Load Regulation (*6)	ΔV_{OUT}	V_{IN}=4.0V 1mA≦I_{OUT}≦100mA	-60	-	60	mV
Dropout Voltage (*3)	Vdif	I_{OUT}=100mA	-	100	-	mV
Supply Current 1	I_{SS1}	V_{IN}=4.0V, V_{CE}=V_{SS}	-	50	80	μA
Supply Current 2	I_{SS2}	V_{IN}=8.0V,V_{CE}=V_{IN}	-	-	0.6	μA
Line Regulation (*6)	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	I_{OUT}=50mA 4.0V≦V_{IN}≦8.0V	-	0.1	0.3	%V
Input Voltage	ΔV_{IN}		-	-	8.0	V
Output Voltage Temperature Characteristics (*6)	$\frac{\Delta V_{OUT}}{\Delta Topr \cdot V_{OUT}}$	I_{OUT}=10mA -30℃≦Topr≦80℃	-	±100	-	ppm/℃
EXT Output Voltage	V_{EXT}		-	-	8.0	V
EXT Leak Current	I_{LEAK}		-	-	0.5	μA
CE "High" Level Voltage	V_{CEH}		1.5	-	-	V
CE "Low" Level Voltage	V_{CEL}		-	-	0.25	V
CE "High" Level Current	I_{CEH}	V_{CE}=V_{IN}	-	-	0.1	μA
CE "Low" Level Current	I_{CEL}	V_{CE}=V_{SS}	-0.2	-0.05	0	μA

The characteristics for the XC62ER series are the same as above except for the CE operating logic, which is the opposite.

NOTE:

*1: $V_{OUT(T)}$=Specified output voltage.
*2: $V_{OUT(E)}$=Effective output voltage (i.e. the output voltage when "$V_{OUT(T)}$+1.0V" is provided at the V_{IN} pin while maintaining a certain I_{OUT} value).
*3: Vdif= {V_{IN1} (*5)-V_{OUT1} (*4)}
*4: V_{OUT1}= A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT} {$V_{OUT(T)}$+1.0V} is input.
*5: V_{IN1}=The input voltage when V_{OUT1} appears as input voltage is gradually decreased.
*6: The characteristics for the parameters are liable to vary depending on which transistor is used.
Please use a transistor with a low saturation voltage level and hFE equal to 100 or more.
*7: The maximum output current value is not a value representing continuous output due to the limitations of the 2AS1213 transistor's power dissipation.

■ELECTRICAL CHARACTERISTICS (Continued)

XC62EP4002 VOUT(T)=4.0V(*1) Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	I_{OUT}=50mA V_{IN}=5.0V	3.920	4.000	4.080	V
Maximum Output Current (*6)	$I_{OUT\ max}$	V_{IN}=5.0V	-	1000	-	mA
Load Regulation (*6)	ΔV_{OUT}	V_{IN}=5.0V 1mA≦I_{OUT}≦100mA	-60	-	60	mV
Dropout Voltage (*3)	Vdif	I_{OUT}=100mA	-	100	-	mV
Supply Current 1	I_{SS1}	V_{IN}=5.0V, V_{CE}=V_{SS}	-	50	80	μA
Supply Current 2	I_{SS2}	V_{IN}=8.0V,V_{CE}=V_{IN}	-	-	0.6	μA
Line Regulation (*6)	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	I_{OUT}=50mA 5.0V≦V_{IN}≦8.0V	-	0.1	0.3	%V
Input Voltage	V_{IN}		-	-	8.0	V
Output Voltage Temperature Characteristics (*6)	$\frac{\Delta V_{OUT}}{\Delta Topr \cdot V_{OUT}}$	I_{OUT}=10mA -30℃≦Topr≦80℃	-	±100	-	ppm/℃
EXT Output Voltage	V_{EXT}		-	-	8.0	V
EXT Leak Current	I_{LEAK}		-	-	0.5	μA
$\overline{CE}$ "High" Level Voltage	V_{CEH}		1.5	-	-	V
$\overline{CE}$ "Low" Level Voltage	V_{CEL}		-	-	0.25	V
$\overline{CE}$ "High" Level Current	I_{CEH}	V_{CE}=V_{IN}	-	-	0.1	μA
$\overline{CE}$ "Low" Level Current	I_{CEL}	V_{CE}=V_{SS}	-0.2	-0.05	0	μA

XC62EP4002 $V_{OUT(T)}$=5.0V(*1) Ta=25℃

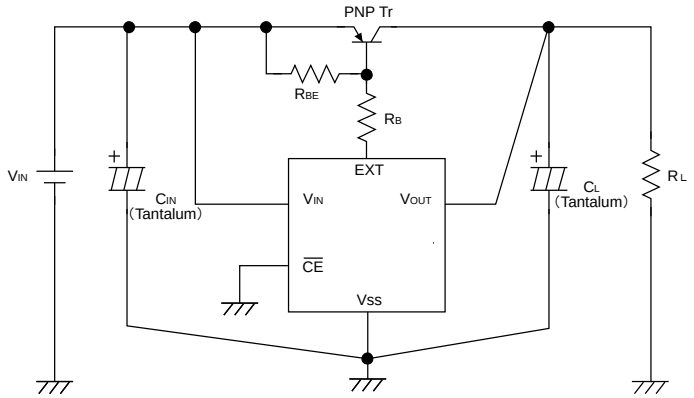
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	$V_{OUT(E)}$ (*2)	I_{OUT}=50mA V_{IN}=6.0V	4.940	5.000	5.100	V
Maximum Output Current (*6)	$I_{OUT\ max}$	V_{IN}=6.0V	-	1000	-	mA
Load Regulation (*6)	ΔV_{OUT}	V_{IN}=6.0V 1mA≦I_{OUT}≦100mA	-60	-	60	mV
Dropout Voltage (*3)	Vdif	I_{OUT}=100mA	-	100	-	mV
Supply Current 1	I_{SS1}	V_{IN}=6.0V, V_{CE}=V_{SS}	-	50	80	μA
Supply Current 2	I_{SS2}	V_{IN}=8.0V,V_{CE}=V_{IN}	-	-	0.6	μA
Line Regulation (*6)	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	I_{OUT}=50mA 6.0V≦V_{IN}≦8.0V	-	0.1	0.3	%V
Input Voltage	V_{IN}		-	-	8.0	V
Output Voltage Temperature Characteristics (*6)	$\frac{\Delta V_{OUT}}{\Delta Topr \cdot V_{OUT}}$	I_{OUT}=10mA -30℃≦Topr≦80℃	-	±100	-	ppm/℃
EXT Output Voltage	V_{EXT}		-	-	8.0	V
EXT Leak Current	I_{LEAK}		-	-	0.5	μA
$\overline{CE}$ "High" Level Voltage	V_{CEH}		1.5	-	-	V
$\overline{CE}$ "Low" Level Voltage	V_{CEL}		-	-	0.25	V
$\overline{CE}$ "High" Level Current	I_{CEH}	V_{CE}=V_{IN}	-	-	0.1	μA
$\overline{CE}$ "Low" Level Current	I_{CEL}	V_{CE}=V_{SS}	-0.2	-0.05	0	μA

The characteristics for the XC62ER series are the same as above except for the CE operating logic, which is the opposite.

Note: *1. $V_{OUT(T)}$=Specified output voltage.
*2. $V_{OUT(E)}$=Effective output voltage (i.e. the output voltage when "$V_{OUT(T)}$+1.0V" is provided at the V_{IN} pin while maintaining a certain I_{OUT} value).
*3. Vdif= {V_{IN1} (*5)-V_{OUT1} (*4)}
*4. V_{OUT1}= A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT} {$V_{OUT(T)}$+1.0V} is input.
*5. V_{IN1}= The input voltage when V_{OUT1} appears as input voltage is gradually decreased.
*6. The characteristics for the parameters are liable to vary depending on which transistor is used.
Please use a transistor with a low saturation voltage level and hFE equal to 100 or more.
*7. The maximum output current value is not a value representing continuous output due to the limitations of the 2AS1213 transistor's power dissipation.

■TYPICAL APPLICATION CIRCUIT

●Standard Circuit



External Components:
PNP Tr.: 2SA1213
RBE: 20kΩ ~ 47kΩ
RB: Please refer to Note 2 on the following page.
CIN: 10μF (Tantalum)
CL: 47μF (Tantalum) 10μF minimum

■OPERATIONAL EXPLANATION

Output voltage (VOUT) can be fixed by revising the external transistor's base current. This can be done by comparing the detected voltage level and the setting voltage power supply level.
With the XC62EP (CE negative voltage), if a voltage above the $\overline{CE}$ pin's "H" level is applied, the IC will enter stand-by mode where the base and differential amplifier's currents are regulated.

■NOTES ON USE

1. PNP Transistor
   The selection of a transistor should take into account output current, input voltage and power dissipation for each specific application. It is recommended that a transistor that has a low output saturated voltage (VCE) and high hFE characteristics be used.
2. RB Resistor
   Although the IC unit is protected by a base current remitter circuit, it is recommended that a resistor (RB) be connected between the transistor's base and the IC's EXT pin to protect the transistor.
   Required output current can be calculated using the following equation although characteristic variations and conditions of use should be carefully checked before use. The following equation also indicates the conditions needed to obtain IOUT (MAX.) at VIN (MIN.). However, the larger the input current, the larger the output current (IOUT) that can be obtained.

$$\frac{V_{IN}\,(MIN.)-1.2(V)}{R_B} - \frac{0.7(V)}{R_{BE}} > \frac{I_{OUT}\,(MAX.)}{hFE}$$

3. RBE Resistor, CL Capacitor
   To prevent oscillation due to output load variation, use of a phase compensation capacitor CL is recommended. Please use a Tantalum capacitor of at least 10mF. Please also use an RBE resistor of less than 47kΩ.
   An RBE resistor of between 20kΩ and 47kΩ is recommended for less power consumption.
4. Input Impedance
   In order to control oscillation brought about as a result of impedance at the power supply line, connect a capacitor of 10μF or more (Tantalum) between the external transistor's emitter and the ground pin.

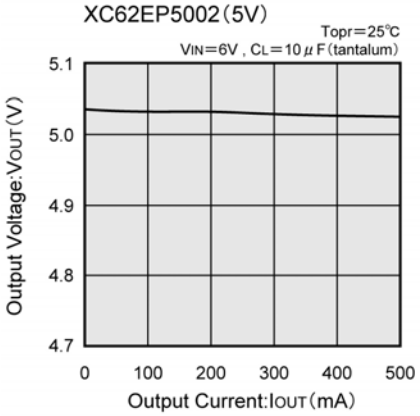
●Protection Circuit

The built-in protection circuit is to protect the IC only. Therefore to prevent output shorts and overshoot current through the transistor, use of a resistor RB or an overshoot current protection circuit is recommended.
Care should also be taken with the transistor's power dissipation.

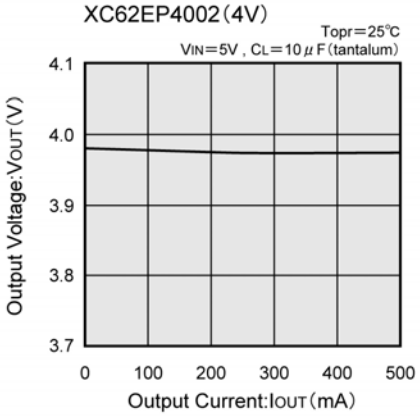
■TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

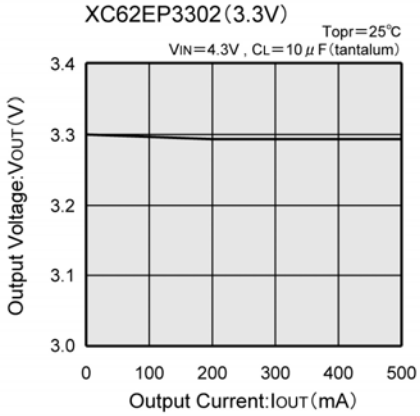
XC62EP5002(5V)



XC62EP4002(4V)

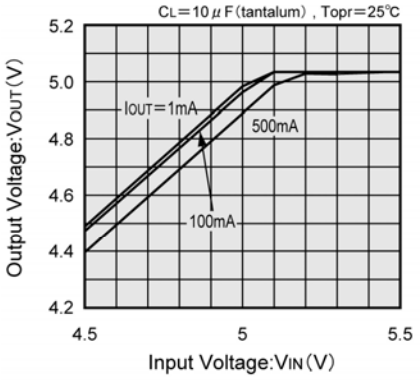


XC62EP3302(3.3V)

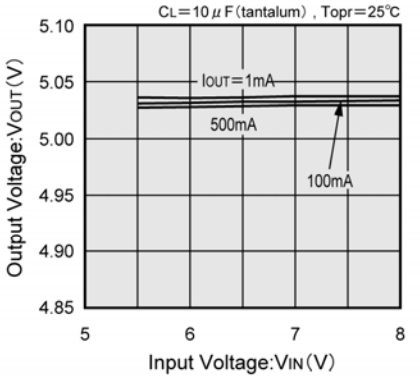


(2) Output Voltage vs. Input Voltage

XC62EP5002(5V)



XC62EP5002(5V)



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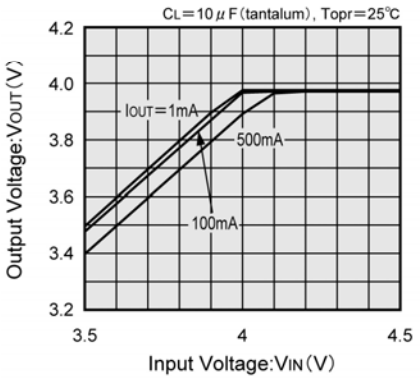

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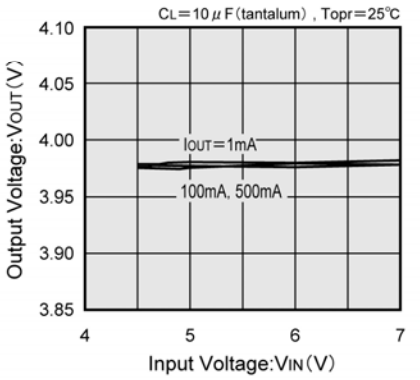

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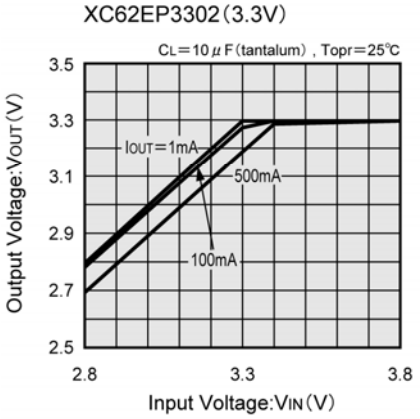
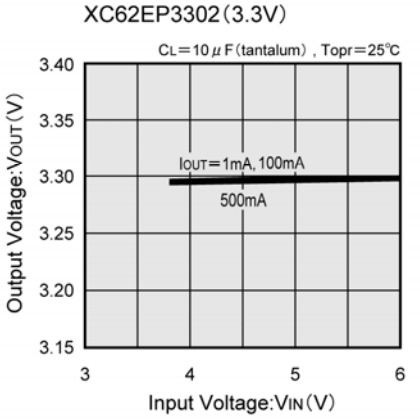


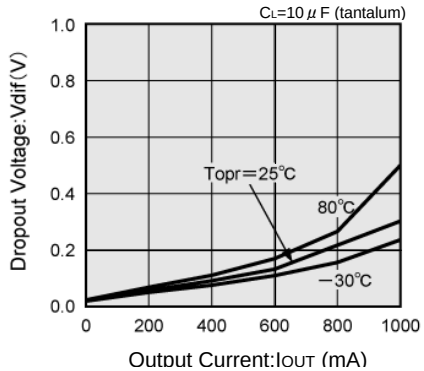
XC62EP3302(3.3V)



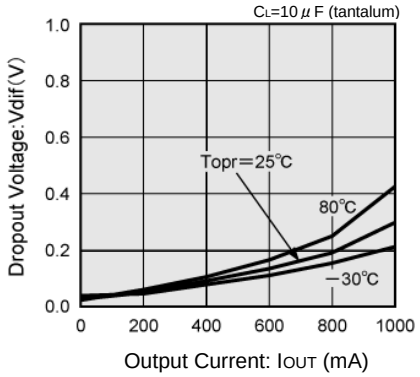
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

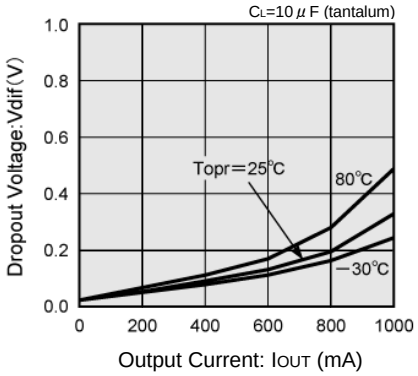
XC62EP5002(5V)



XC62EP4002(4V)

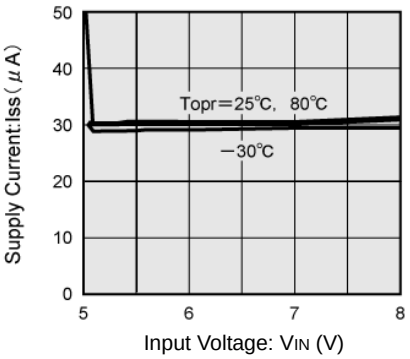


XC62EP3302(3.3V)



(4) Supply Current vs. Input Voltage

XC62EP5002(5V)



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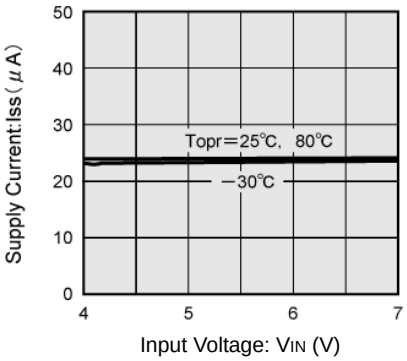
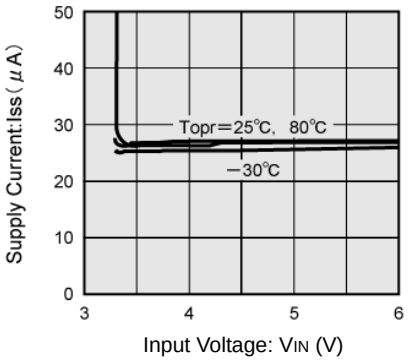
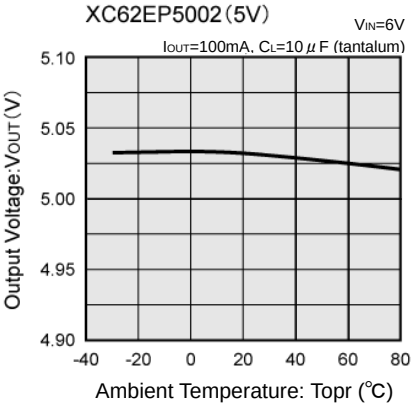


XC62EP3302(3.3V)

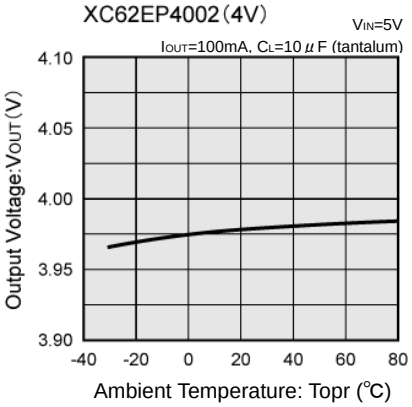


(5) Output Voltage vs. Ambient Temperature

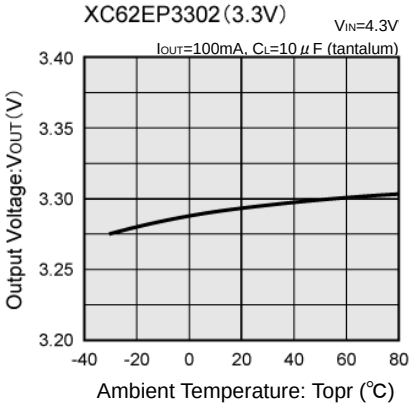
XC62EP5002(5V)



XC62EP4002(4V)

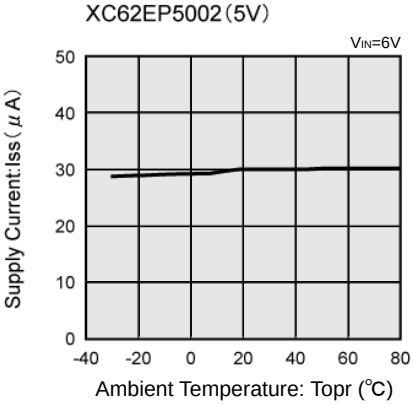


XC62EP3302(3.3V)

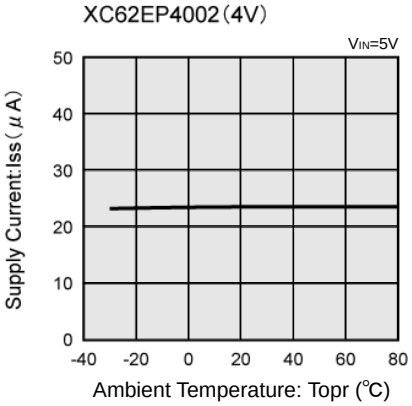


(6) Supply Current vs. Ambient Temperature

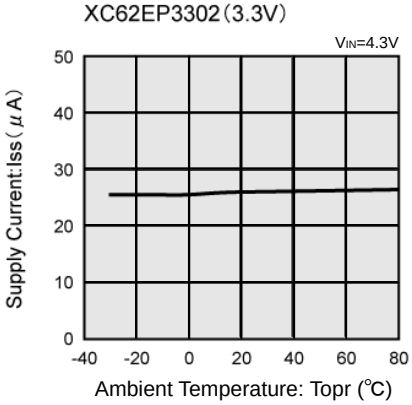
XC62EP5002(5V)



XC62EP4002(4V)



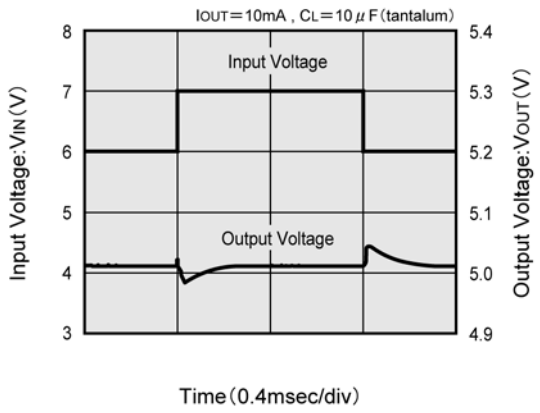
XC62EP3302(3.3V)



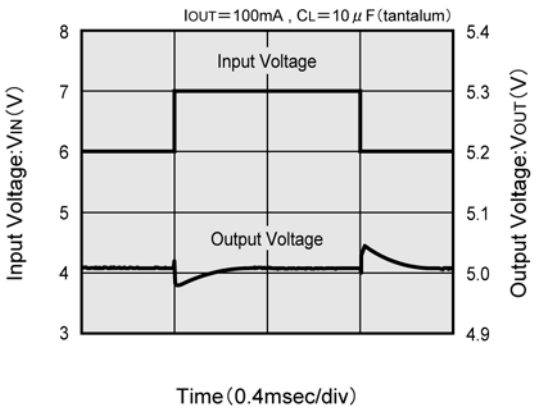
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Input Transient Response

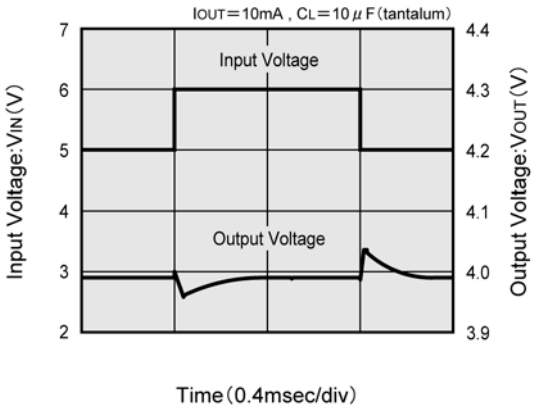
XC62EP5002(5V)



XC62EP5002(5V)



XC62EP4002(4V)



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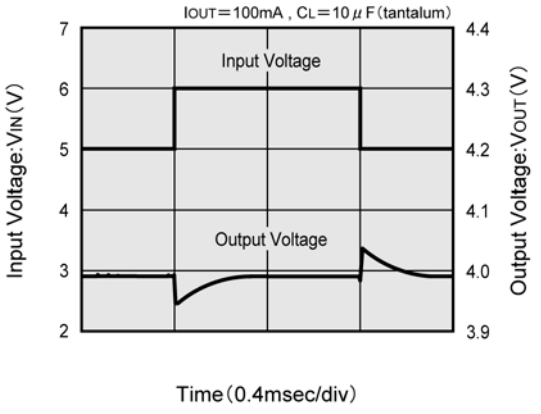
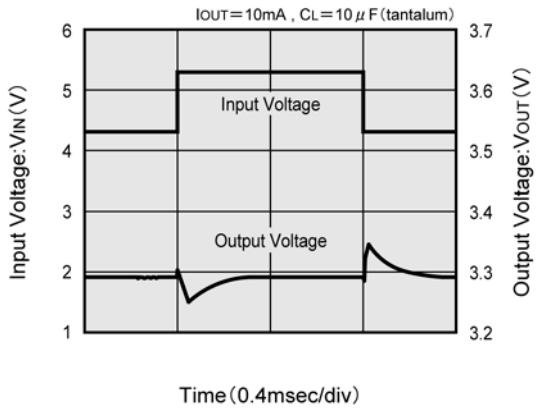


XC62EP3302(3.3V)



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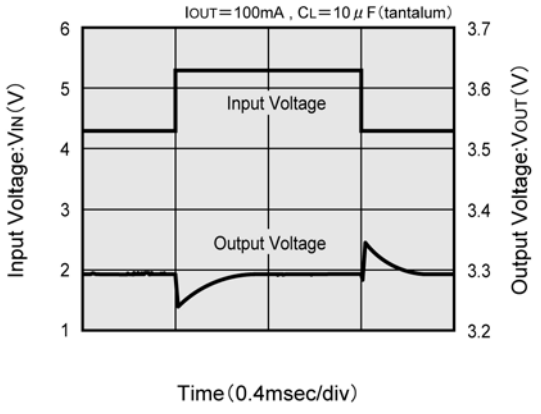
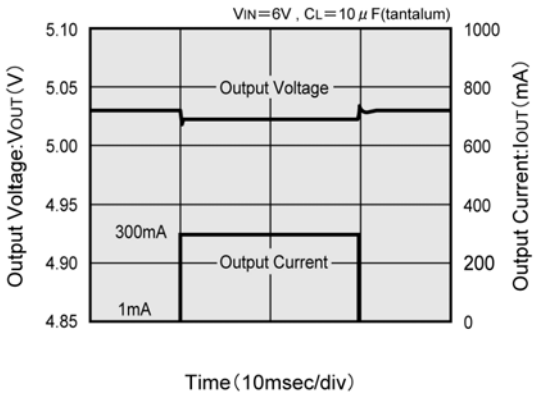


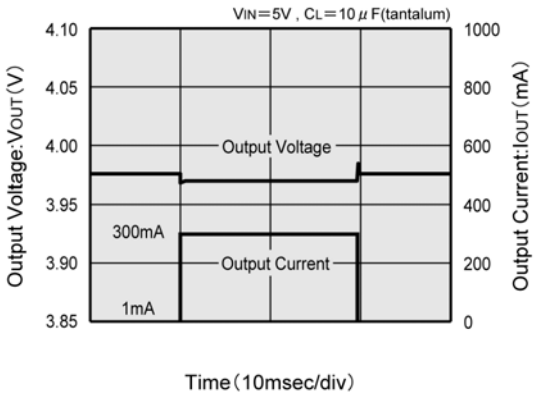
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Load Transient Response

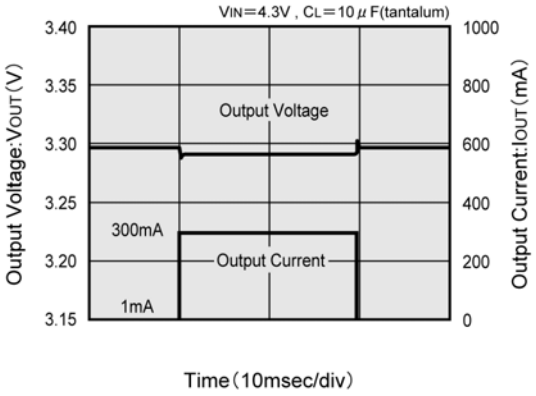
XC62EP5002(5V)



XC62EP4002(4V)

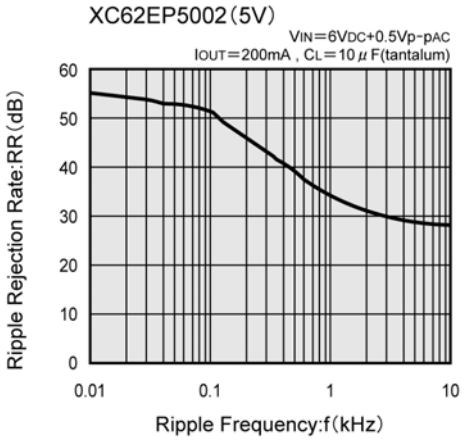


XC62EP3302(3.3V)

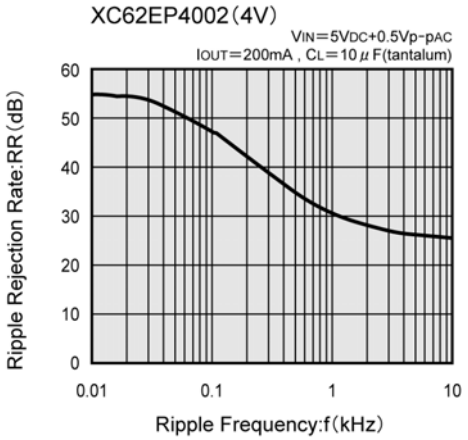


(9) Ripple Rejection Rate

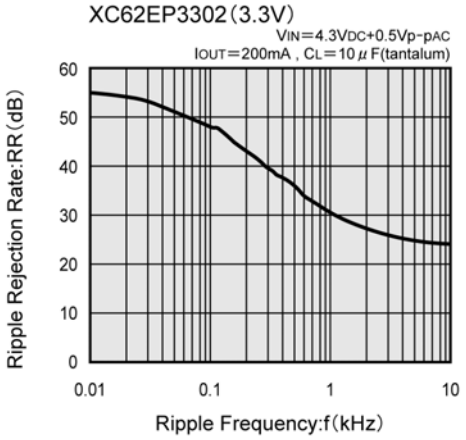
XC62EP5002(5V)



XC62EP4002(4V)

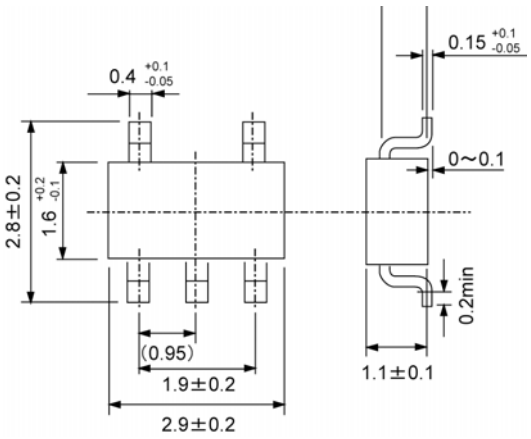


XC62EP3302(3.3V)



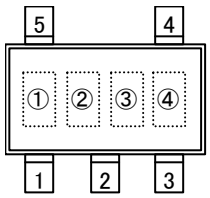
■PACKAGING INFORMATION

●SOT-25



■MARKING RULE

●SOT-25



SOT-25
(TOP VIEW)

① not used

② represents integer of output voltage

MARK (XC62ER Type)	VOLTAGE (V)	MARK (XC62EP Type)	VOLTAGE (V)
$\overline{2}$	2.x	2	2.x
$\overline{3}$	3.x	3	3.x
$\overline{4}$	4.x	4	4.x
$\overline{5}$	5.x	5	5.x
$\overline{6}$	6.x	6	6.x

③ represents decimal number of output voltage

MARK (XC62ER Type)	VOLTAGE (V)	MARK (XC62EP Type)	VOLTAGE (V)
0	x.0	0	x.0
1	x.1	1	x.1
2	x.2	2	x.2
3	x.3	3	x.3
4	x.4	4	x.4
5	x.5	5	x.5
6	x.6	6	x.6
7	x.7	7	x.7
8	x.8	8	x.8
9	x.9	9	x.9

④ based on internal standards

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