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

- ●Multi-function power supplies
- ●Note PC / Tablet PC
- ●Digital still cameras / Camcorders
- ●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 (V_{OUT}=5.0V) (TYP.)
: 0.2μA (Stand-by) (TYP.)

Output Voltage Temperature Characteristics : ±100ppm/ ℃ (TYP.)

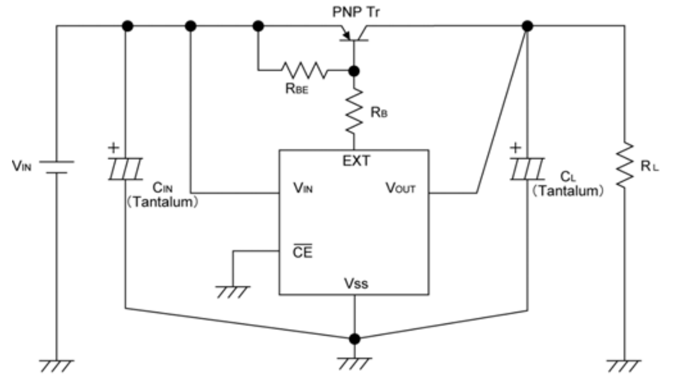
Line Regulation : 0.1%/V (TYP.)

CMOS Low Power Consumption

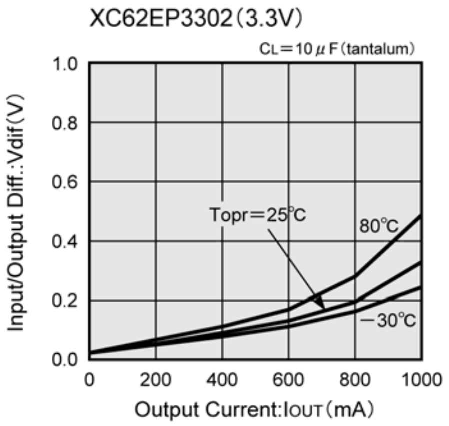
Package : SOT-25

Environmentally Friendly : EU RoHS Compliant

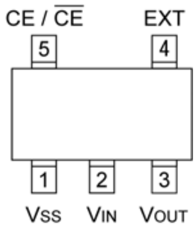
■TYPICAL APPLICATION CIRCUIT



■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	EXT	Base Current Control
5	$\overline{CE}$/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

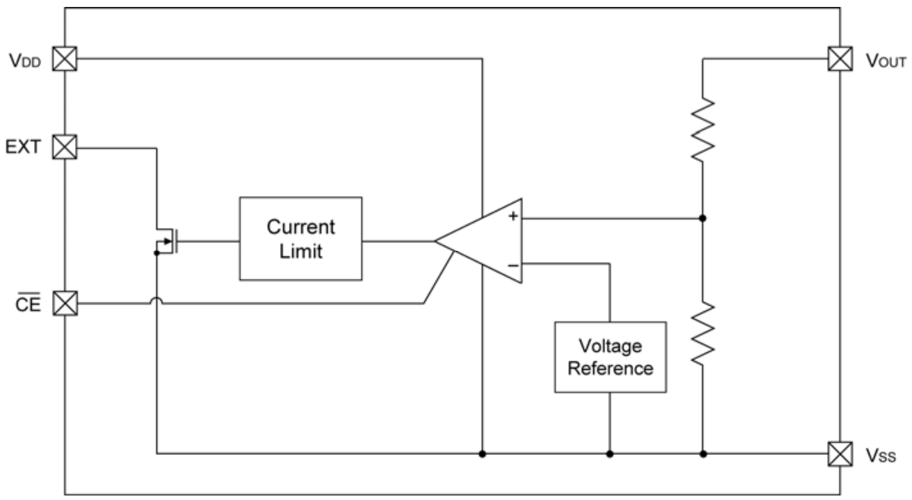
●Ordering Information

XC62E①②③④⑤⑥⑦-⑧[*1]

DESIGNATOR	ITEM	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 (Order Unit)	MR	SOT-25 (3,000pcs/Reel)
		MR-G	SOT-25 (3,000pcs/Reel)

(*1) The “-G” suffix denotes Halogen and Antimony free as well as being fully RoHS compliant.

■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/$\overline{CE}$ 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	VOUT(E) (*2)	IOUT=50mA VIN=4.0V	2.940	3.000	3.060	V
Maximum Output Current*	IOUT max	VIN=4.0V	-	1000	-	mA
Load Regulation (*6)	△VOUT	VIN=4.0V 1mA≦IOUT≦100mA	-60	-	60	mV
Dropout Voltage (*3)	Vdif	IOUT=100mA	-	100	-	mV
Supply Current 1	ISS1	VIN=4.0V, VCE=VSS	-	50	80	μA
Supply Current 2	ISS2	VIN=8.0V,VCE=VIN	-	-	0.6	μA
Line Regulation (*6)	△VOUT / △VIN・VOUT	IOUT=50mA 4.0V≦VIN≦8.0V	-	0.1	0.3	%V
Input Voltage	△VIN		-	-	8.0	V
Output Voltage Temperature Characteristics (*6)	△VOUT / △Topr・VOUT	IOUT=10mA -30℃≦Topr≦80℃	-	±100	-	ppm/℃
EXT Output Voltage	VEXT		-	-	8.0	V
EXT Leak Current	ILEAK		-	-	0.5	μA
CE "High" Level Voltage	VCEH		1.5	-	-	V
CE "Low" Level Voltage	VCEL		-	-	0.25	V
CE "High" Level Current	ICEH	VCE=VIN	-	-	0.1	μA
CE "Low" Level Current	ICEL	VCE=VSS	-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: VOUT(T)=Specified output voltage.
*2: VOUT(E)=Effective output voltage (i.e. the output voltage when "VOUT(T)+1.0V" is provided at the VIN pin while maintaining a certain IOUT value).
*3: Vdif= {VIN1 (*5)-VOUT1 (*4)}
*4: VOUT1= A voltage equal to 98% of the output voltage whenever an amply stabilized IOUT {VOUT(T)+1.0V} is input.
*5: VIN1=The input voltage when VOUT1 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	VOUT(E) (*2)	IOUT=50mA VIN=5.0V	3.920	4.000	4.080	V
Maximum Output Current (*6)	IOUT max	VIN=5.0V	-	1000	-	mA
Load Regulation (*6)	△VOUT	VIN=5.0V 1mA≦IOUT≦100mA	-60	-	60	mV
Dropout Voltage (*3)	Vdif	IOUT=100mA	-	100	-	mV
Supply Current 1	ISS1	VIN=5.0V, VCE=VSS	-	50	80	μA
Supply Current 2	ISS2	VIN=8.0V,VCE=VIN	-	-	0.6	μA
Line Regulation (*6)	△VOUT / △VIN・VOUT	IOUT=50mA 5.0V≦VIN≦8.0V	-	0.1	0.3	%V
Input Voltage	VIN		-	-	8.0	V
Output Voltage Temperature Characteristics (*6)	△VOUT / △Topr・VOUT	IOUT=10mA -30℃≦Topr≦80℃	-	±100	-	ppm/℃
EXT Output Voltage	VEXT		-	-	8.0	V
EXT Leak Current	ILEAK		-	-	0.5	μA
$\overline{CE}$ "High" Level Voltage	VCEH		1.5	-	-	V
$\overline{CE}$ "Low" Level Voltage	VCEL		-	-	0.25	V
$\overline{CE}$ "High" Level Current	ICEH	VCE=VIN	-	-	0.1	μA
$\overline{CE}$ "Low" Level Current	ICEL	VCE=VSS	-0.2	-0.05	0	μA

XC62EP4002 VOUT(T)=5.0V(*1) Ta=25℃

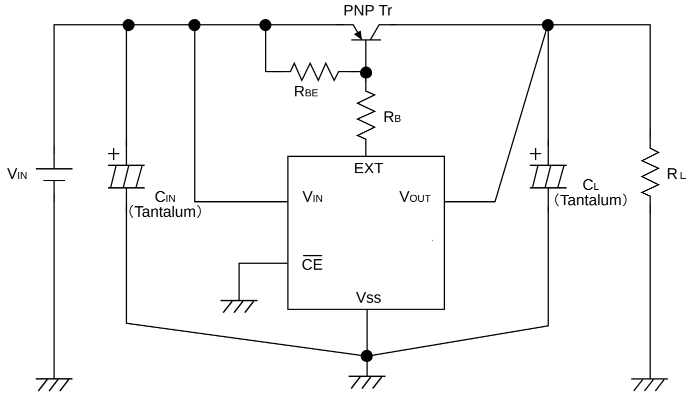
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Voltage	VOUT(E) (*2)	IOUT=50mA VIN=6.0V	4.940	5.000	5.100	V
Maximum Output Current (*6)	IOUT max	VIN=6.0V	-	1000	-	mA
Load Regulation (*6)	△VOUT	VIN=6.0V 1mA≦IOUT≦100mA	-60	-	60	mV
Dropout Voltage (*3)	Vdif	IOUT=100mA	-	100	-	mV
Supply Current 1	ISS1	VIN=6.0V, VCE=VSS	-	50	80	μA
Supply Current 2	ISS2	VIN=8.0V,VCE=VIN	-	-	0.6	μA
Line Regulation (*6)	△VOUT / △VIN・VOUT	IOUT=50mA 6.0V≦VIN≦8.0V	-	0.1	0.3	%V
Input Voltage	VIN		-	-	8.0	V
Output Voltage Temperature Characteristics (*6)	△VOUT / △Topr・VOUT	IOUT=10mA -30℃≦Topr≦80℃	-	±100	-	ppm/℃
EXT Output Voltage	VEXT		-	-	8.0	V
EXT Leak Current	ILEAK		-	-	0.5	μA
$\overline{CE}$ "High" Level Voltage	VCEH		1.5	-	-	V
$\overline{CE}$ "Low" Level Voltage	VCEL		-	-	0.25	V
$\overline{CE}$ "High" Level Current	ICEH	VCE=VIN	-	-	0.1	μA
$\overline{CE}$ "Low" Level Current	ICEL	VCE=VSS	-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. VOUT(T)=Specified output voltage.
*2. VOUT(E)=Effective output voltage (i.e. the output voltage when "VOUT(T)+1.0V" is provided at the VIN pin while maintaining a certain IOUT value).
*3. Vdif= {VIN1 (*5)-VOUT1 (*4)}
*4. VOUT1= A voltage equal to 98% of the output voltage whenever an amply stabilized IOUT {VOUT(T)+1.0V} is input.
*5. VIN1= The input voltage when VOUT1 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 (V_{OUT}) 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 (V_{CE}) 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 (R_B) 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 I_{OUT} (MAX.) at V_{IN} (MIN.). However, the larger the input current, the larger the output current (I_{OUT}) 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.

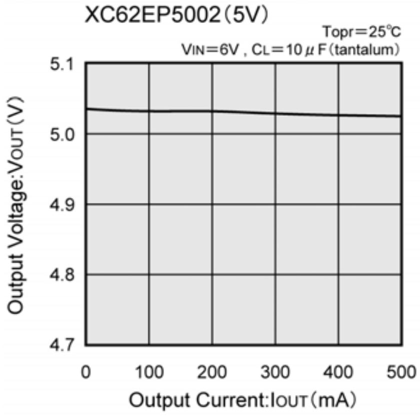
●Protection Circuit

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.

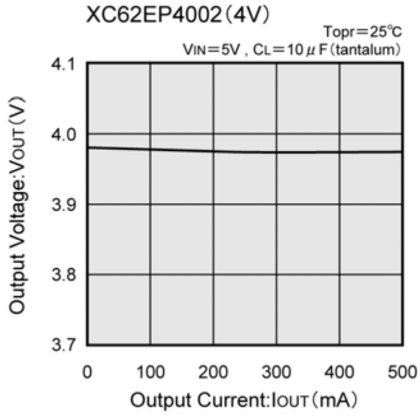
■TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

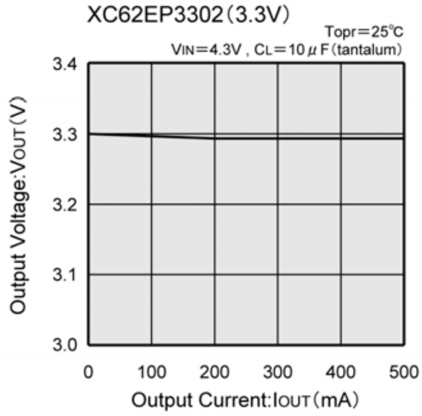
XC62EP5002(5V)



XC62EP4002(4V)

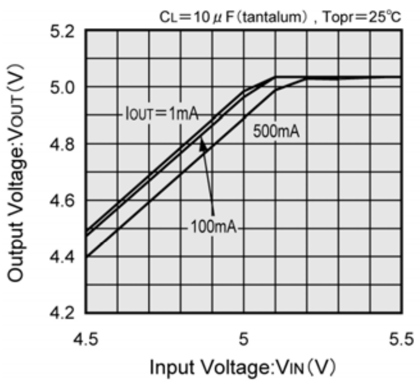


XC62EP3302(3.3V)

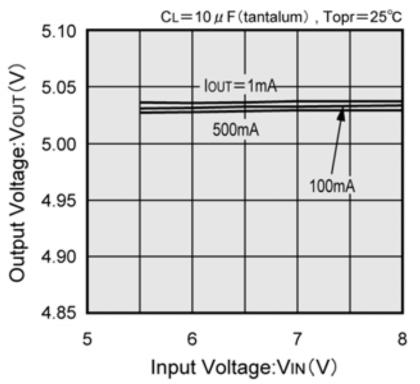


(2) Output Voltage vs. Input Voltage

XC62EP5002(5V)



XC62EP5002(5V)



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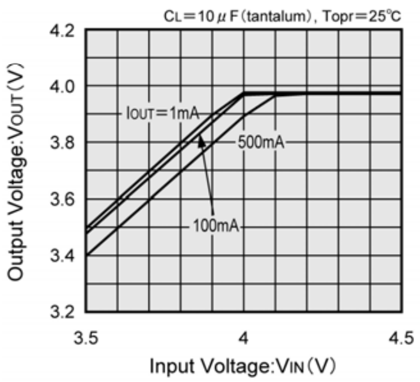

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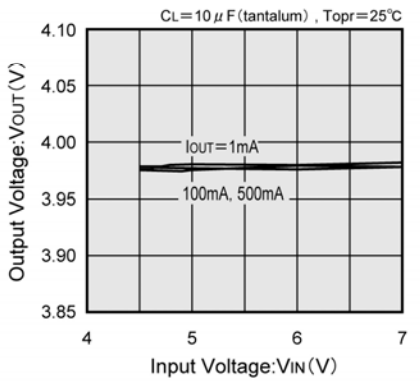
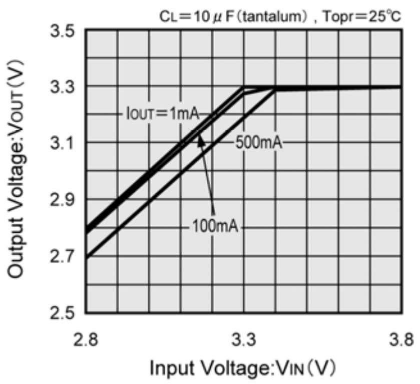


XC62EP3302(3.3V)



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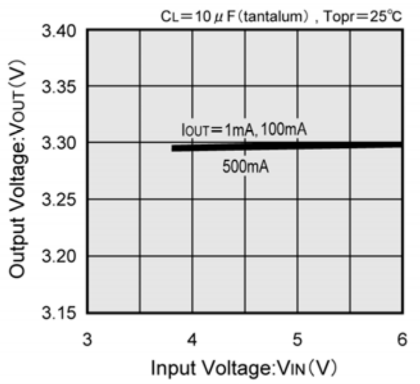
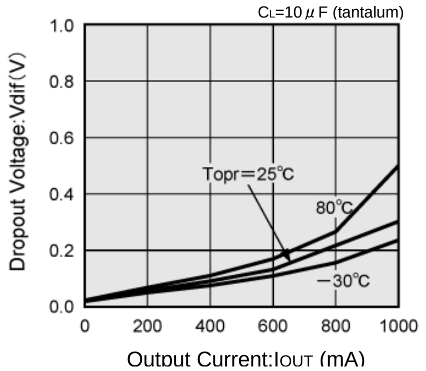


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

XC62EP5002(5V)



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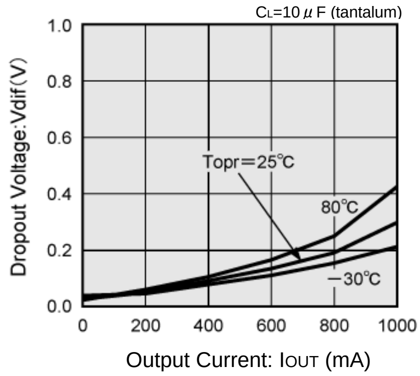
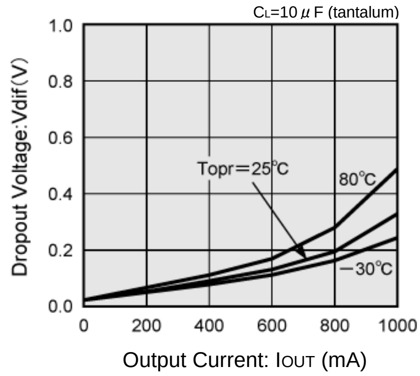
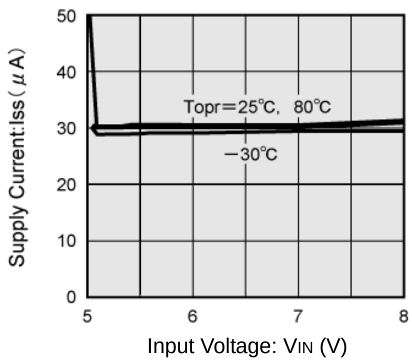


XC62EP3302(3.3V)

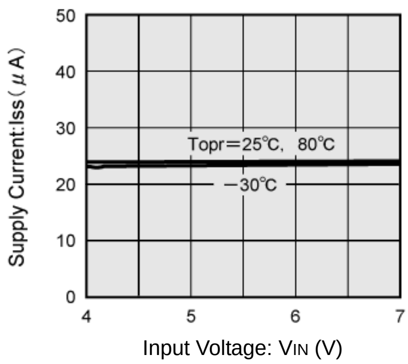


(4) Supply Current vs. Input Voltage

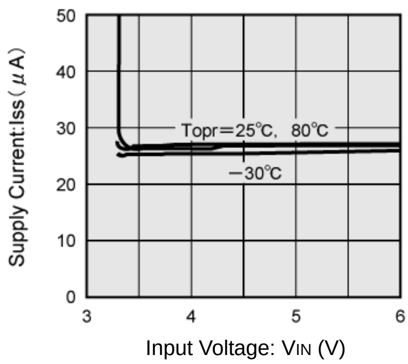
XC62EP5002(5V)



XC62EP4002(4V)

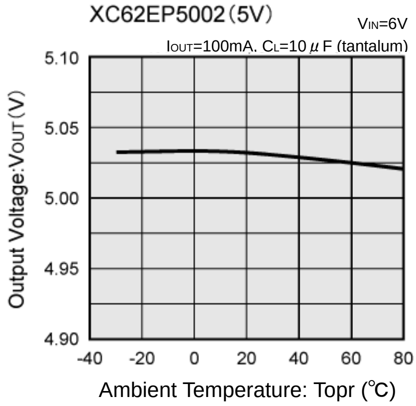


XC62EP3302(3.3V)

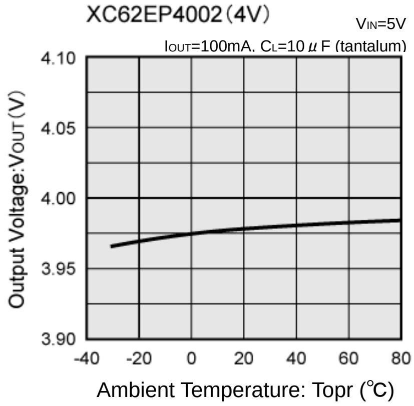


(5) Output Voltage vs. Ambient Temperature

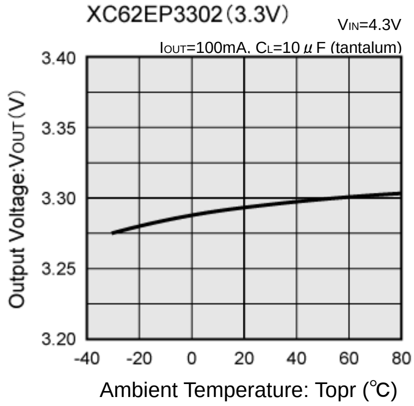
XC62EP5002(5V)



XC62EP4002(4V)

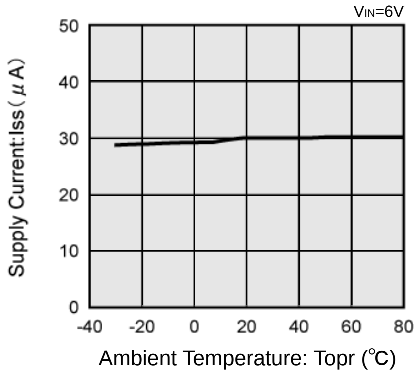


XC62EP3302(3.3V)



(6) Supply Current vs. Ambient Temperature

XC62EP5002(5V)



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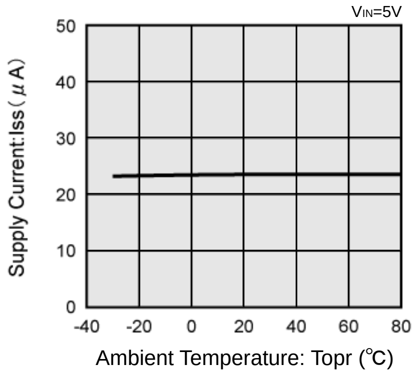
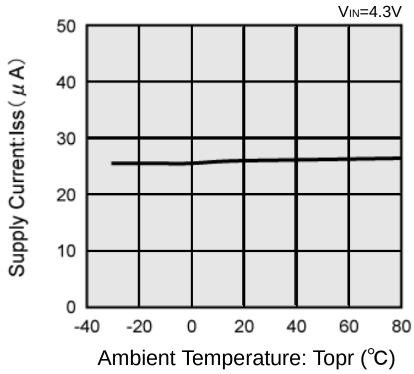
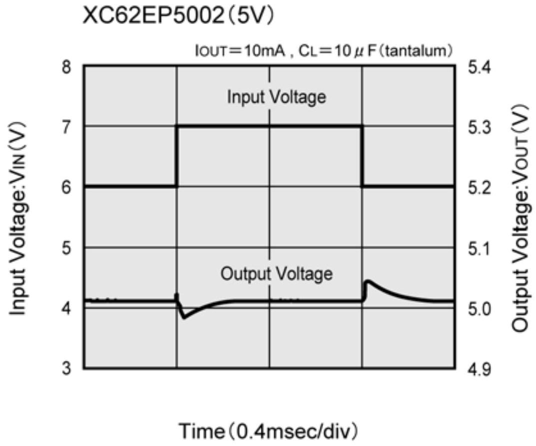


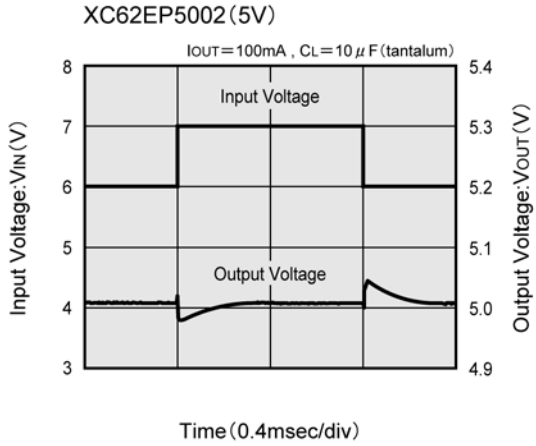
XC62EP3302(3.3V)

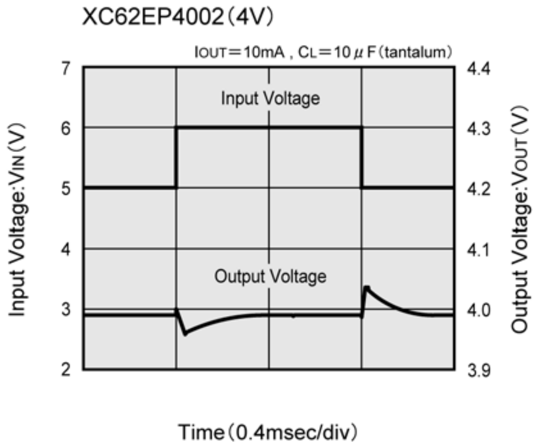


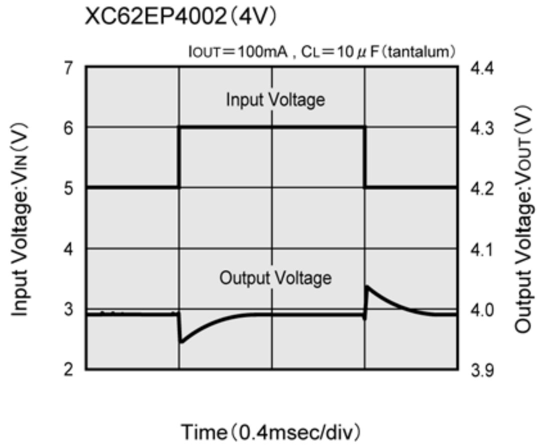
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

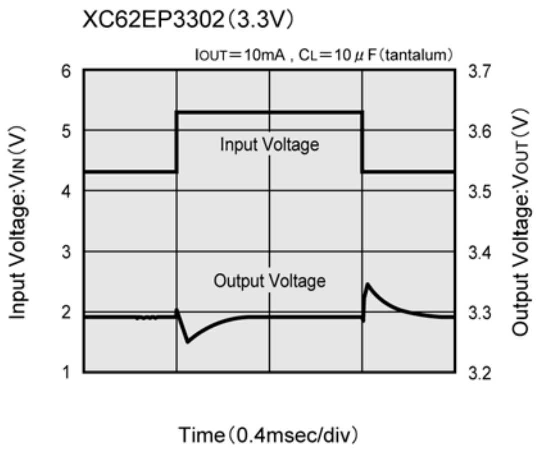
(7) Input Transient Response

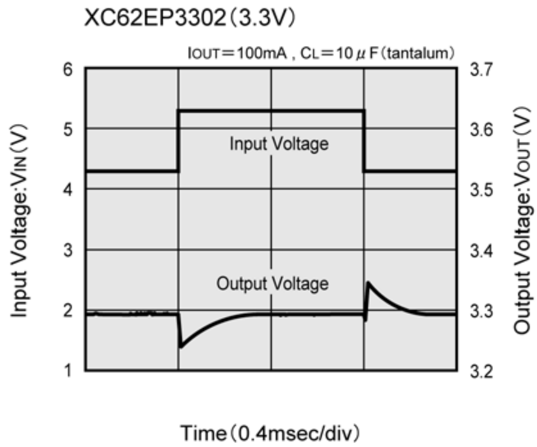






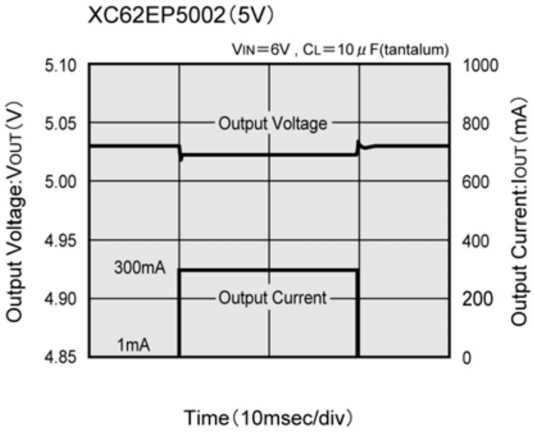


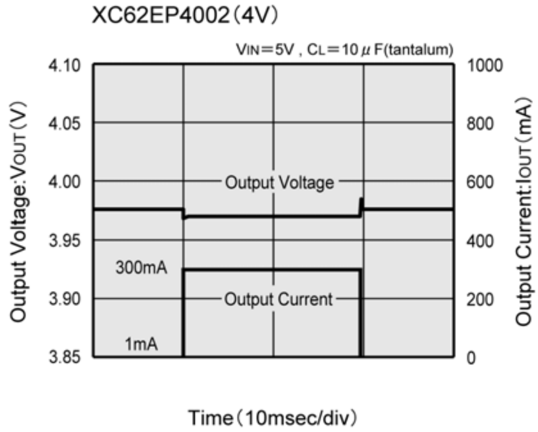


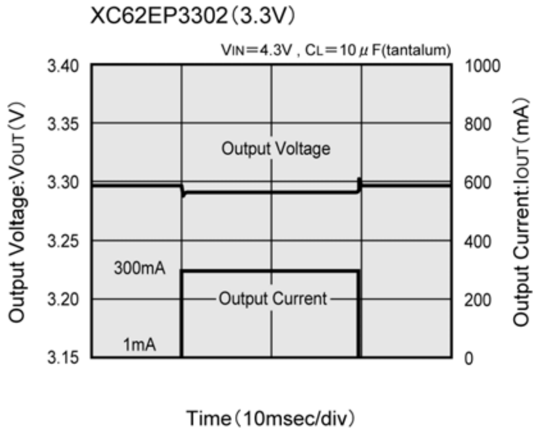


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

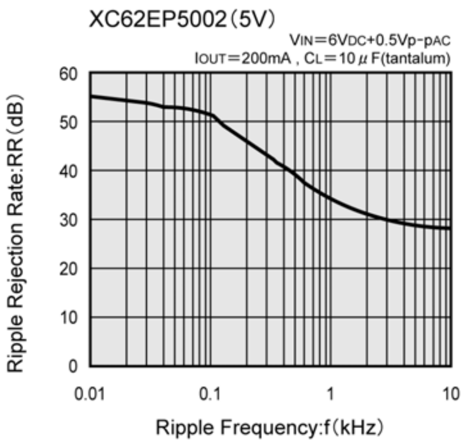
(8) Load Transient Response

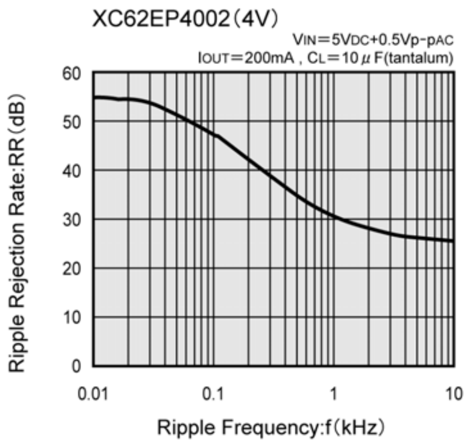


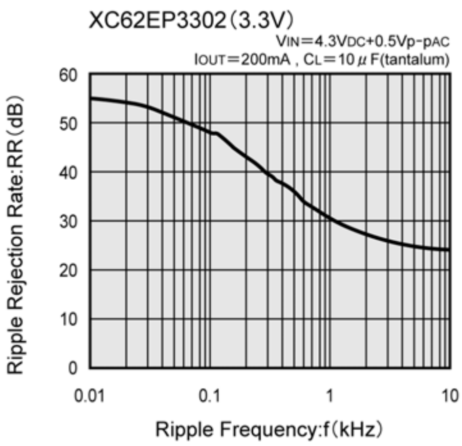




(9) Ripple Rejection Rate

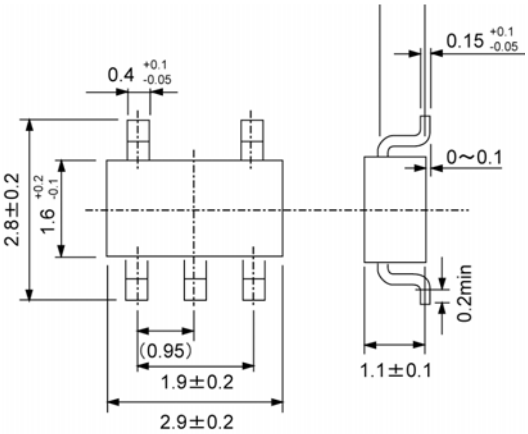






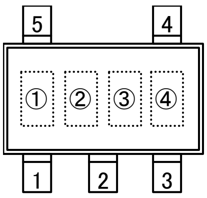
■PACKAGING INFORMATION

●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

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.

3. Applicable export control laws and regulations should be complied and the procedures required by such laws and regulations should also be followed, when the product or any information contained in this datasheet is exported.

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.

TOREX SEMICONDUCTOR LTD.