

Negative Voltage Regulators

■ GENERAL DESCRIPTION

The XC62K series are highly precise, low power consumption, negative voltage regulators, manufactured using CMOS and laser trimming technologies. The series achieves high output currents with small input-output voltage differentials, and consists of a high precision voltage reference, an error correction circuit, and an output driver with current limitation. SOT-23 (150mW), SOT-89 (500mW), USP-6B (100mW) and TO-92 (300mW) packages are available.

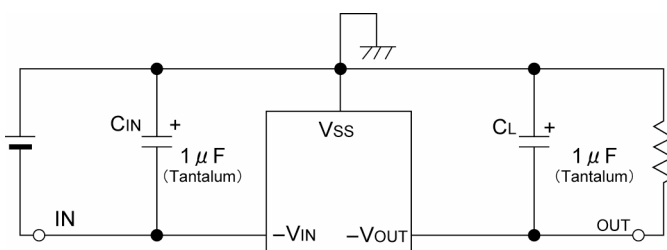
■ APPLICATIONS

- Battery powered equipment
- Portable & cellular phones
- Various portable equipment
- Power supply for GaAs applications

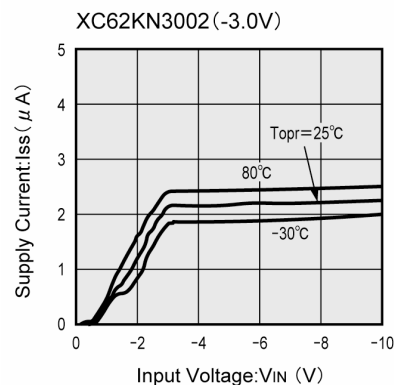
■ FEATURES

- Dropout Voltage** : 0.12V@50mA ($V_{OUT}=-5.0V$)
: 0.38V@100mA
- Maximum Output Current** : 100mA (within MAX. power dissipation, $V_{OUT}=-5.0V$)
- Output Voltage Range** : -2.1V ~ -6.0V in 100mV increments
-5.0, -4.0, -3.0V, -2.5V standard
(All other voltages are semi-custom)
- Highly Accurate** : Setting output voltage $\pm 2\%$
($\pm 1\%$ for semi-custom products)
- Low Power Consumption** : 3.0 μA @ $V_{OUT}=-5.0V$ (TYP.)
- Output Voltage Temperature Characteristics**
: $\pm 100ppm/^{\circ}C$ (TYP.)
- Line Regulation** : 0.1%/V (TYP.)
- CMOS Low Power Consumption**
- Ultra Small Packages** : SOT-23 (150mW) mini-mold,
SOT-89 (500mW) mini-power mold
TO-92 (300mW)
USP-6B (100mW)

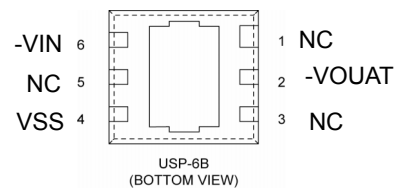
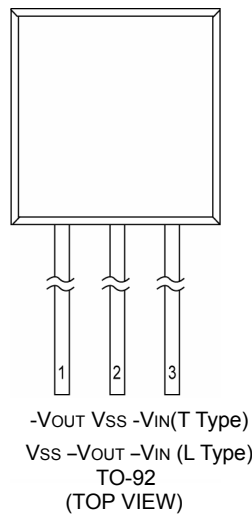
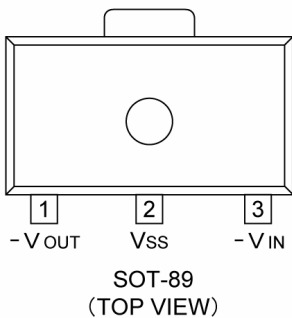
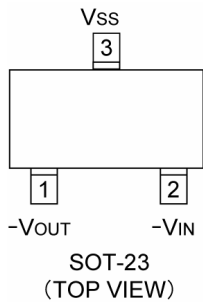
■ TYPICAL APPLICATION CIRCUIT



■ TYPICAL PERFORMANCE CHARACTERISTICS



PIN CONFIGURATION



*The dissipation pad for the USP-6B package should be solder-plated in recommended mount pattern and metal masking so as to enhance mounting strength and heat release.
If the pad needs to be connected to other pins, it should be connected to the VSS pin.

PIN ASSIGNMENT

| PIN NUMBER | | | | PIN NAME | FUNCTION |
|------------|------------------|-----------|--------|----------|--------------------|
| SOT-23 | SOT-89/TO-92 (T) | TO-92 (L) | USP-6B | | |
| 2 | 3 | 3 | 6 | -VIN | Power Supply Input |
| 3 | 2 | 1 | 4 | VSS | Ground |
| 1 | 1 | 2 | 2 | -VOUT | Output |
| — | — | — | 1.3.5 | NC | No Connection |

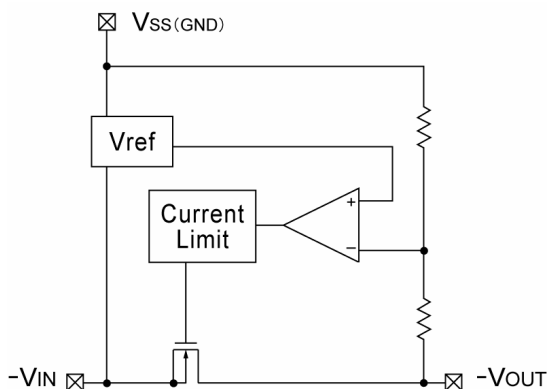
PRODUCT CLASSIFICATION

Ordering Information

XC62K①②③④⑤⑥⑦

| MARK | DESCRIPTION | SYMBOL | DESCRIPTION |
|------|-----------------------------|---------|---|
| ① | Polarity of Output Voltage | N | : Negative |
| ② ③ | Output Voltage | 21 ~ 60 | : e.g. V _{OUT} = 2.1V → ②=2, ③=1 V _{OUT} = 6.0V → ②=6, ③=0 |
| ④ | Temperature Characteristics | 0 | : ± 100ppm (TYP.) |
| ⑤ | Output Voltage Accuracy | 1 | : ± 1% (Semi-custom) |
| | | 2 | : ± 2% |
| ⑥ | Package | M | : SOT-23 |
| | | P | : SOT-89 |
| | | T | : TO-92 (Standard) |
| | | L | : TO-92 (Custom pin configuration) |
| | | D | : USP-6B |
| ⑦ | Device Orientation | R | : Embossed tape, standard feed |
| | | L | : Embossed tape, reverse feed |
| | | H | : Paper type (TO-92) |
| | | B | : Bag (TO-92) |

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

| Ta=25°C | | | |
|-----------------------------|------------------|--|-------|
| PARAMETER | SYMBOL | RATINGS | UNITS |
| Input Voltage | V _{IN} | -12.0 | V |
| Output Current | I _{OUT} | 200 | mA |
| Output Voltage | V _{OUT} | -V _{DD} -0.3~V _{IN} +0.3 | V |
| Power Dissipation | SOT-23 | 150 | mW |
| | SOT-89 | 500 | |
| | TO-92 | 300 | |
| | USP-6B | 100 | |
| Operating Temperature Range | T _{opr} | -30 ~ +80 | °C |
| Storage Temperature Range | T _{stg} | -40 ~ +125 | °C |

Note: Please ensure that I_{OUT} is less than Pd/(V_{OUT}-V_{IN}).

ELECTRICAL CHARACTERISTICS

XC62KN5002

$V_{OUT(T)} = -5.0V$

$T_a = 25^\circ C$

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS | CIRCUIT |
|--|--|--|-----------------|-----------------------|-----------------|--------------------|---------|
| Output Voltage (*2) | $V_{OUT(E)}$ | $I_{OUT} = 20mA$ $V_{IN} = -6.0V$ | x 0.98 -4.90 | $V_{OUT(T)}$ -5.00 | x 1.02 -5.10 | V | 2 |
| Maximum Output Current | $I_{OUT\ max}$ | $V_{IN} = -6.0V, V_{OUT(E)} \geq -4.5V$ | 100 | - | - | mA | 4 |
| Load Regulation | ΔV_{OUT} | $V_{IN} = 6.0V$ $1mA \leq I_{OUT} \leq 50mA$ | - | 40 | 80 | mV | 4 |
| Dropout Voltage (*3) | V_{dif} | $I_{OUT} = 50mA$ | - | 120 | 300 | mV | 3 |
| | | $I_{OUT} = 100mA$ | - | 380 | 600 | | |
| Supply Current | I_{SS} | $V_{IN} = -6.0V$ | - | 3.0 | 7.0 | μA | 1 |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$ | $I_{OUT} = 20mA$ $-6.0V \leq V_{IN} \leq -10.0V$ | - | 0.1 | 0.3 | %V | 3 |
| Input Voltage | V_{IN} | - | - | - | -10.0 | V | - |
| Output Voltage Temperature Characteristics | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$ | $I_{OUT} = 20mA$ $-30^\circ C \leq T_{opr} \leq 80^\circ C$ | - | ± 100 | - | ppm/ $^\circ C$ | - |

XC62KN4002

$V_{OUT(T)} = -4.0V$

$T_a = 25^\circ C$

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS | CIRCUIT |
|--|--|--|-----------------|-----------------------|-----------------|--------------------|---------|
| Output Voltage (*2) | $V_{OUT(E)}$ | $I_{OUT} = 20mA$ $V_{IN} = -5.0V$ | x 0.98 -3.92 | $V_{OUT(T)}$ -4.00 | x 1.02 -4.08 | V | 2 |
| Maximum Output Current | $I_{OUT\ max}$ | $V_{IN} = -5.0V, V_{OUT(E)} \geq -3.6V$ | 80 | - | - | mA | 4 |
| Load Regulation | ΔV_{OUT} | $V_{IN} = -5.0V$ $1mA \leq I_{OUT} \leq 45mA$ | - | 40 | 80 | mV | 4 |
| Dropout Voltage (*3) | V_{dif} | $I_{OUT} = 45mA$ | - | 120 | 300 | mV | 3 |
| | | $I_{OUT} = 90mA$ | - | 380 | 600 | | |
| Supply Current | I_{SS} | $V_{IN} = -5.0V$ | - | 3.0 | 6.5 | μA | 1 |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$ | $I_{OUT} = 20mA$ $-5.0V \leq V_{IN} \leq -10.0V$ | - | 0.1 | 0.3 | %V | 3 |
| Input Voltage | V_{IN} | - | - | - | -10.0 | V | - |
| Output Voltage Temperature Characteristics | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$ | $I_{OUT} = 20mA$ $-30^\circ C \leq T_{opr} \leq 80^\circ C$ | - | ± 100 | - | ppm/ $^\circ C$ | - |

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: $V_{dif} = \{V_{IN1} - V_{OUT1}\}$

*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 a voltage equal to 98% of $V_{OUT(E)}$ appears. (Input voltage is gradually decreased.)

*6: I_{OUTMAX} = Please ensure that output current is within the values given for power dissipation.

■ ELECTRICAL CHARACTERISTICS (Continued)

XC62KN3002

$V_{OUT(T)} = -3.0V$

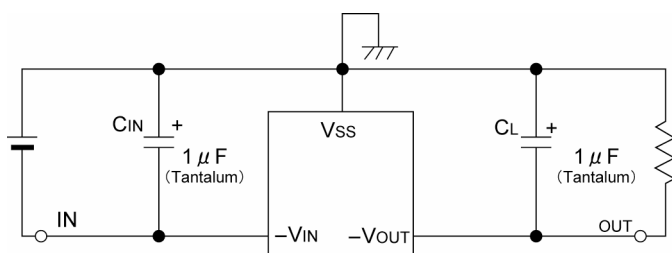
$T_a = 25^\circ C$

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS | CIRCUIT |
|--|--|--|------------------------|-----------------------|------------------------|--------------------|---------|
| Output Voltage (*2) | $V_{OUT(E)}$ | $I_{OUT} = 20mA$ $V_{IN} = -4.0V$ | $\times 0.98$ -2.94 | $V_{OUT(T)}$ -3.00 | $\times 1.02$ -3.06 | V | 2 |
| MAX. Output Current | $I_{OUT\ max}$ | $V_{IN} = -4.0V, V_{OUT(E)} \geq -2.7V$ | 60 | - | - | mA | 4 |
| Load Regulation | ΔV_{OUT} | $V_{IN} = -4.0V$ $1mA \leq I_{OUT} \leq 40mA$ | - | 40 | 80 | mV | 4 |
| Dropout Voltage | V_{dif} | $I_{OUT} = 40mA$ | - | 120 | 300 | mV | 3 |
| | | $I_{OUT} = 80mA$ | - | 380 | 600 | | |
| Supply Current | I_{SS} | $V_{IN} = 4.0V$ | - | 2.5 | 6.0 | μA | 1 |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$ | $I_{OUT} = 20mA$ $-4.0V \leq V_{IN} \leq -10.0V$ | - | 0.1 | 0.3 | %V | 3 |
| Input Voltage | V_{IN} | - | - | - | -10.0 | V | - |
| Output Voltage Temperature Characteristics | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$ | $I_{OUT} = 20mA$ $-30^\circ C \leq T_{opr} \leq 80^\circ C$ | - | ± 100 | - | ppm/ $^\circ C$ | - |

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: $V_{dif} = \{V_{IN1} - V_{OUT1}\}$
- *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 a voltage equal to 98% of $V_{OUT(E)}$ appears. (Input voltage is gradually decreased.)
- *6: $I_{OUT\ MAX}$ = Please ensure that output current is within the values given for power dissipation.

■ TYPICAL APPLICATION CIRCUIT

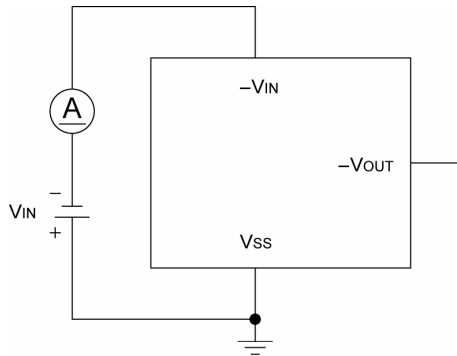


■ NOTES ON USE

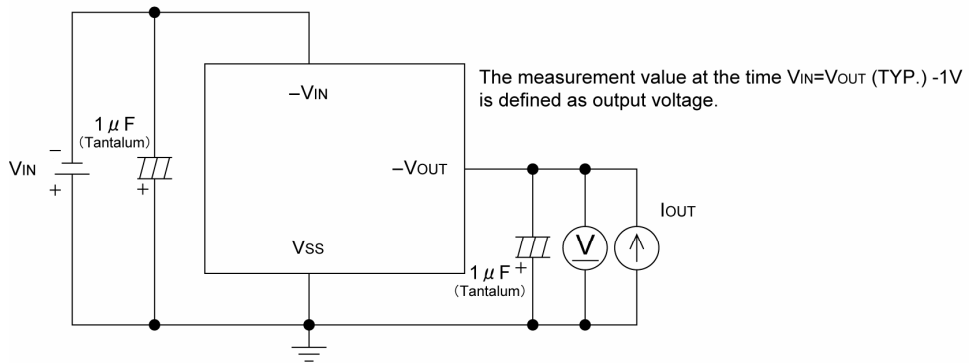
Please ensure that values for input capacitance, C_{IN} and out capacitance, C_L , are more than $1 \mu F$ (Tantalum).

TEST CIRCUITS

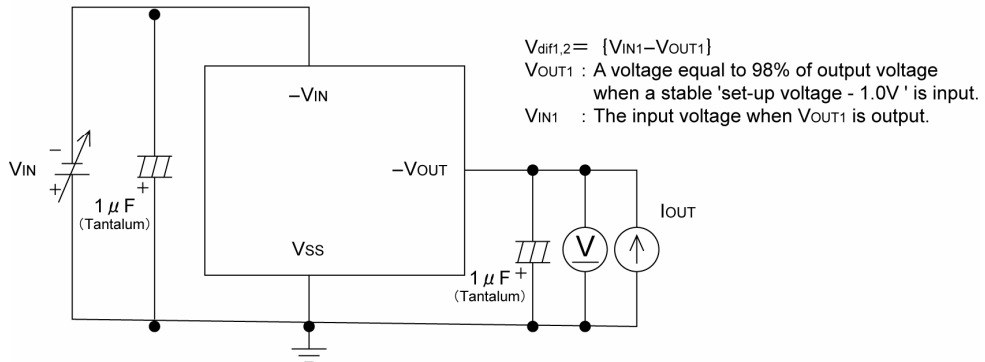
Circuit 1. Supply Current



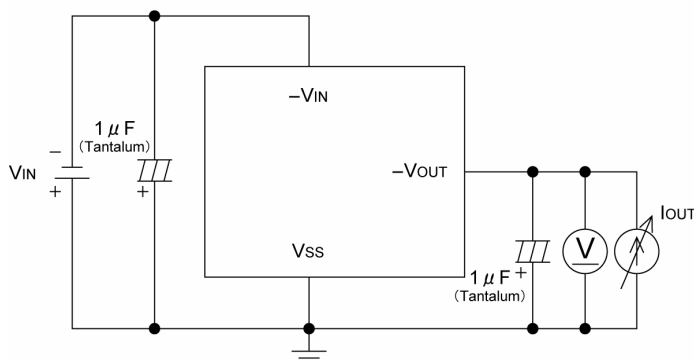
Circuit 2. Output Voltage



Circuit 3. Line Regulation Dropout Voltage

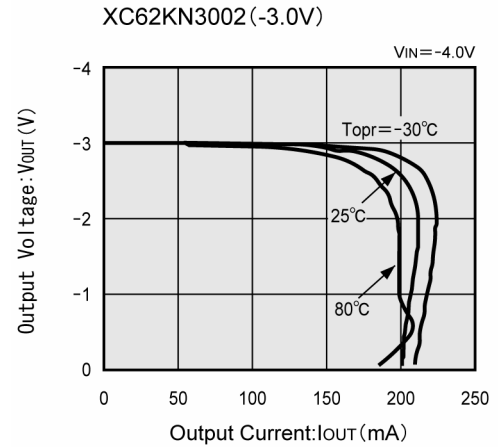
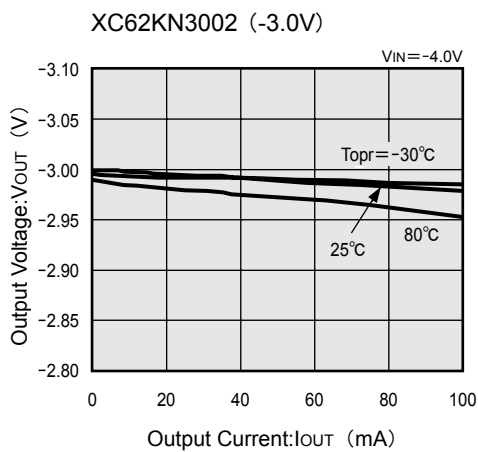
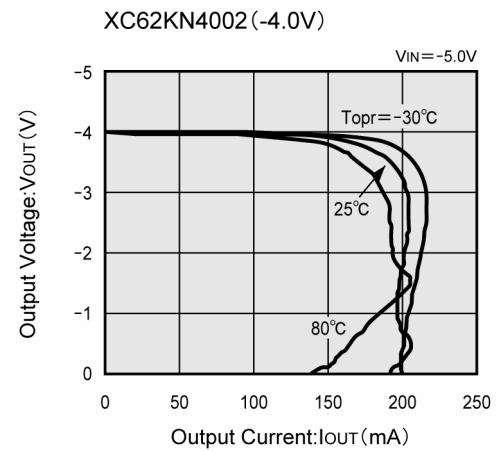
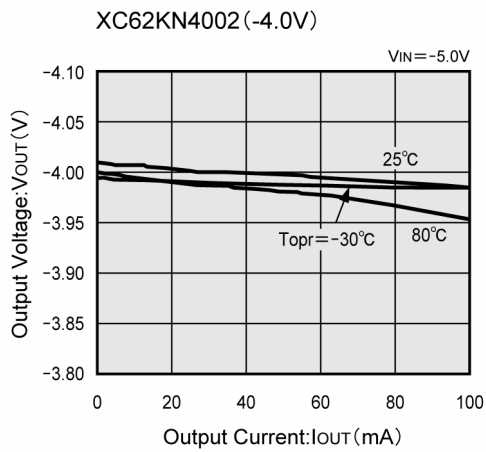
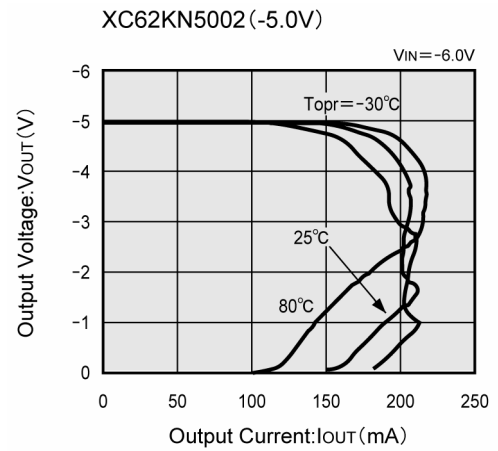
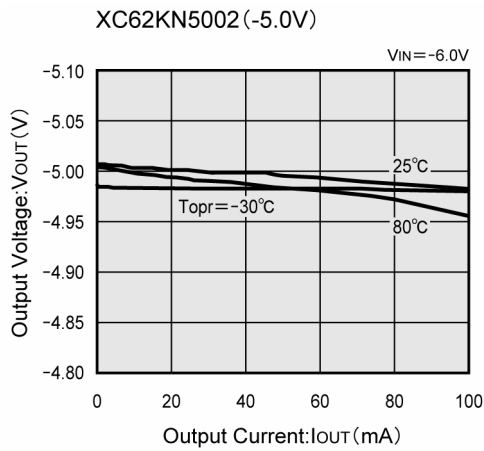


Circuit 4. Load Regulation, Maximum Output Current



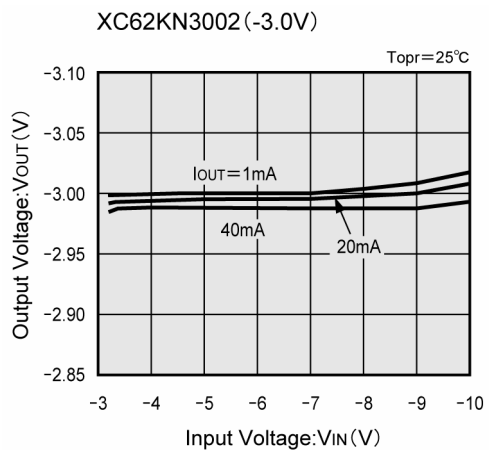
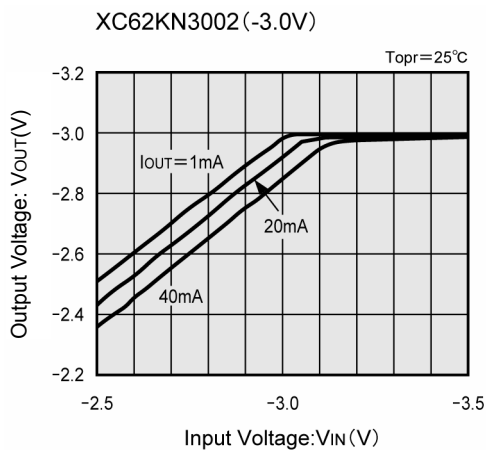
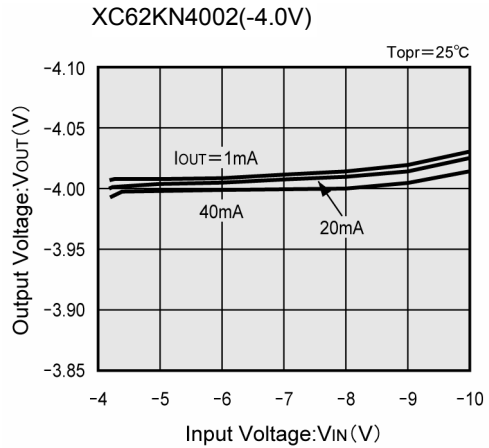
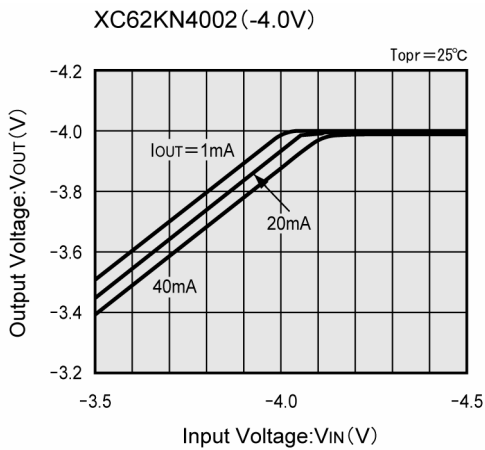
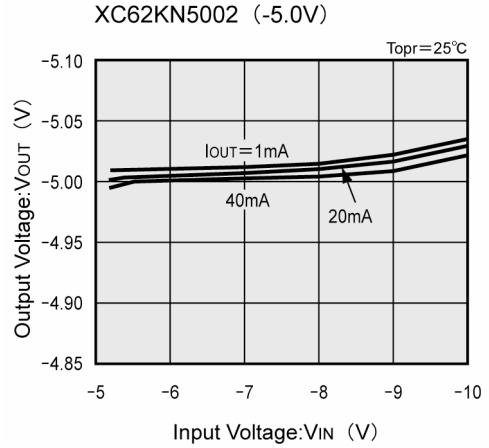
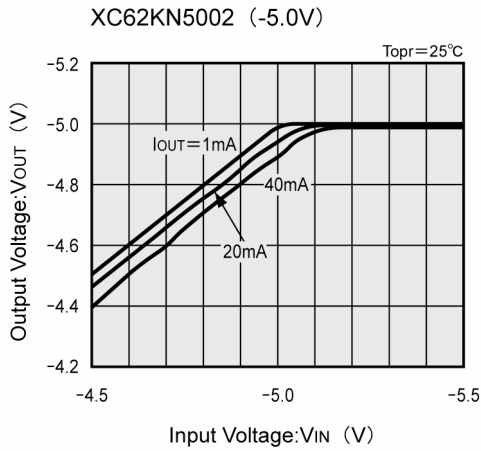
■ TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current



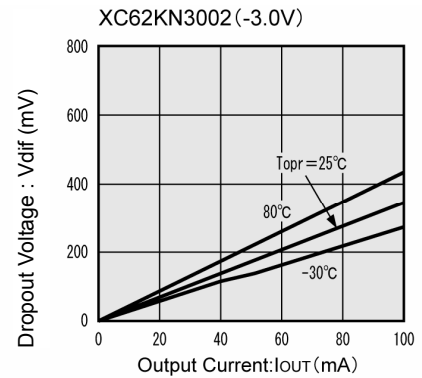
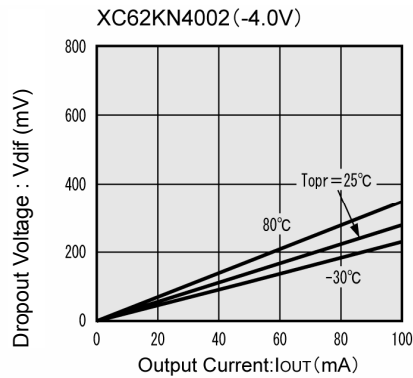
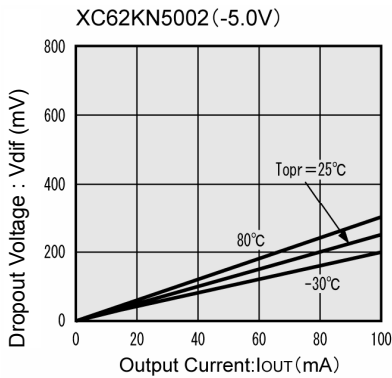
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) Output Voltage vs. Input Voltage

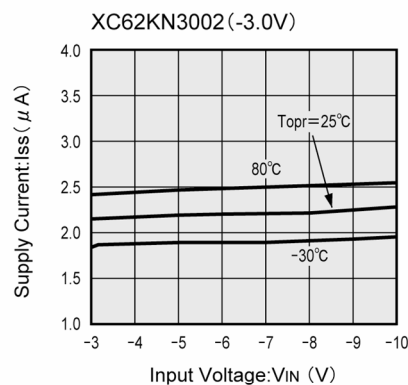
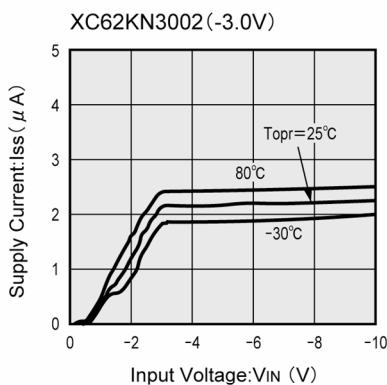
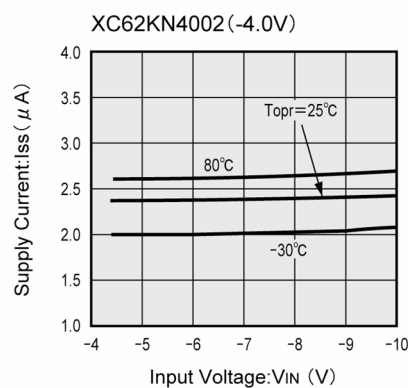
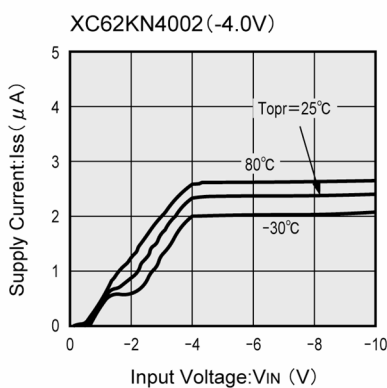
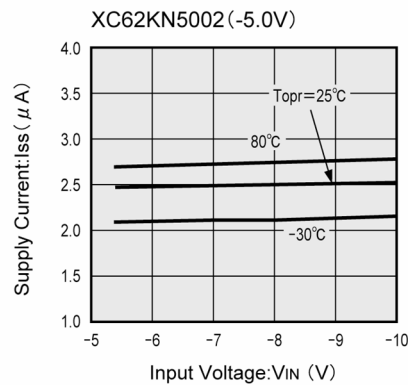
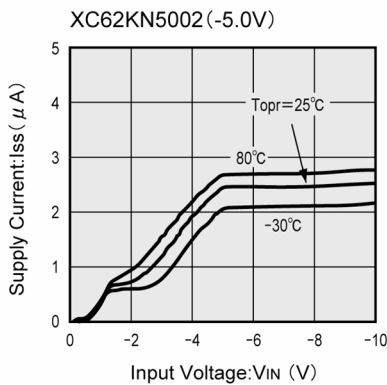


■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Dropout Voltage vs. Output Current

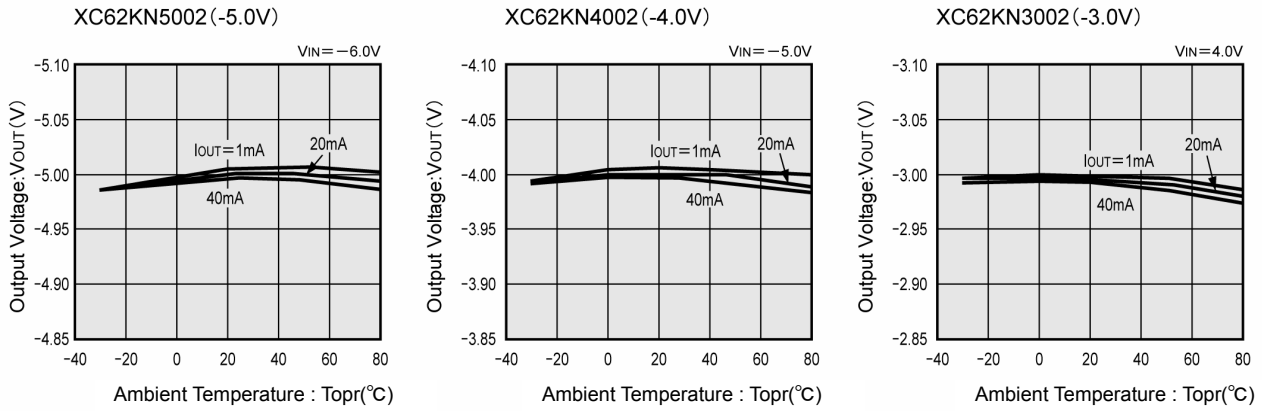


(4) Supply Current vs. Input Voltage

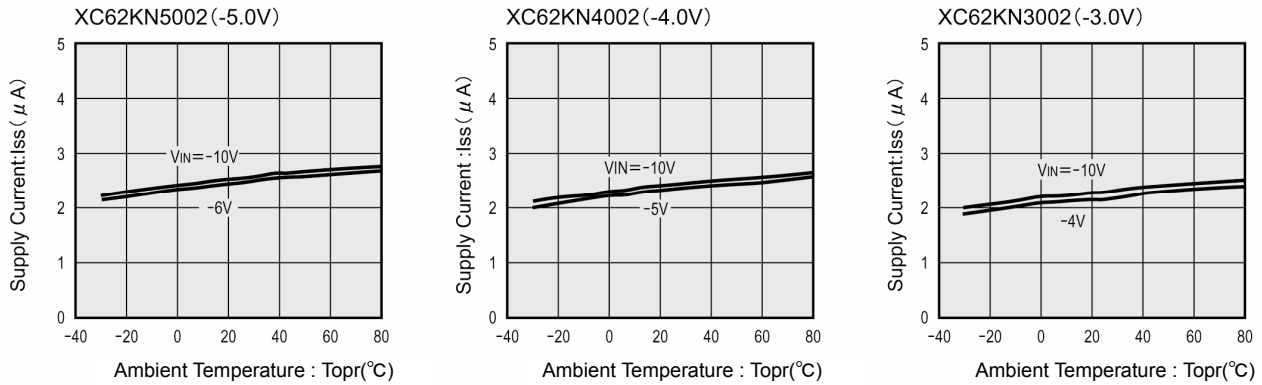


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

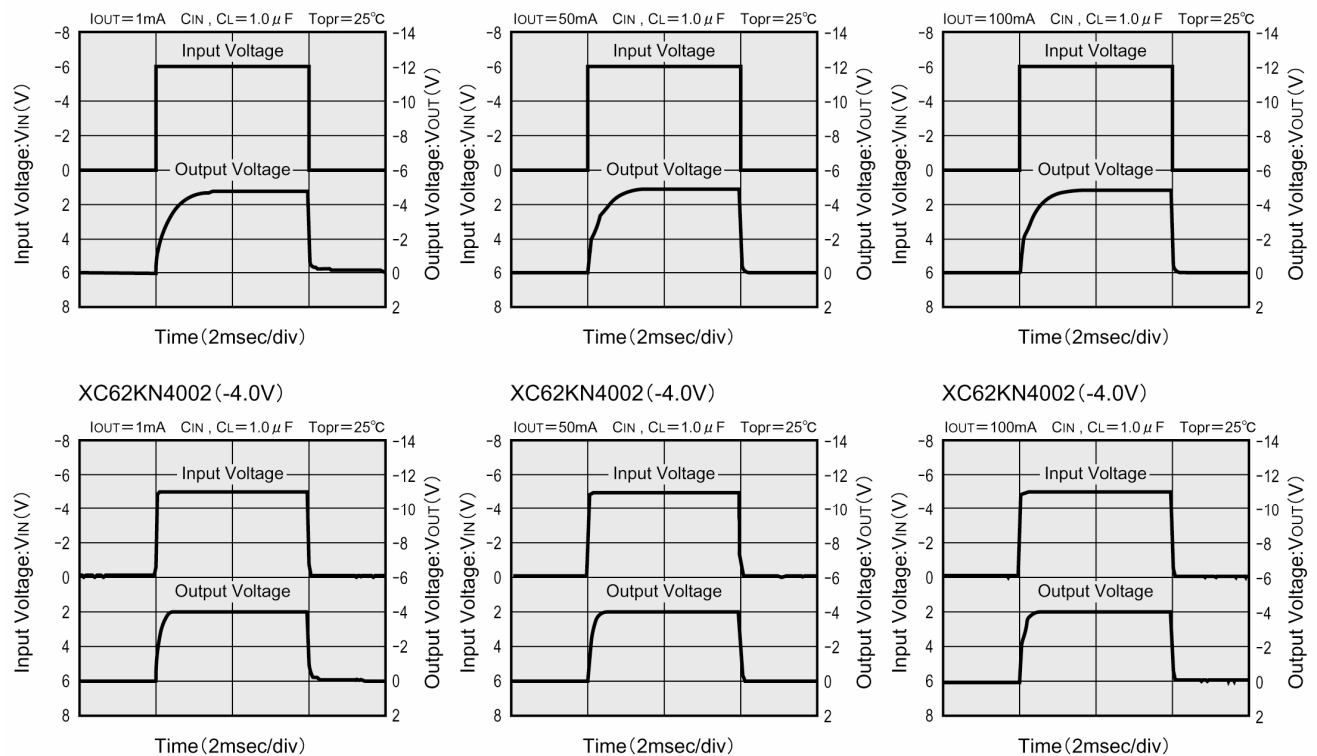
(5) Output Voltage vs. Ambient Temperature



(6) Supply Current vs. Ambient Temperature

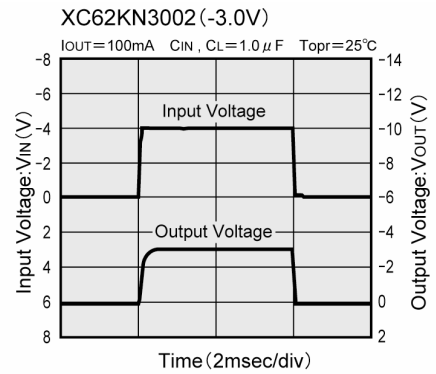
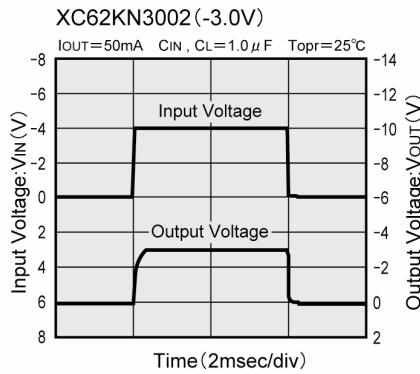
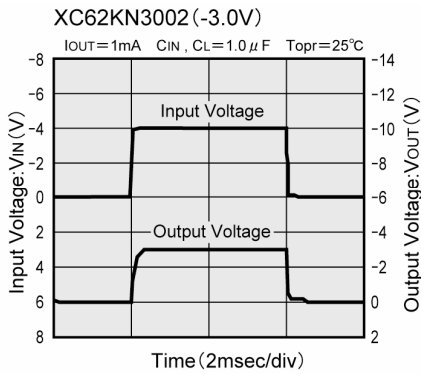


(7) Input Transient Response 1

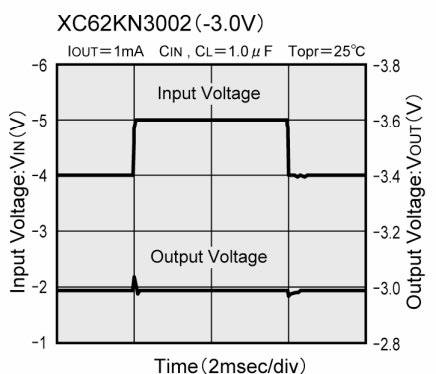
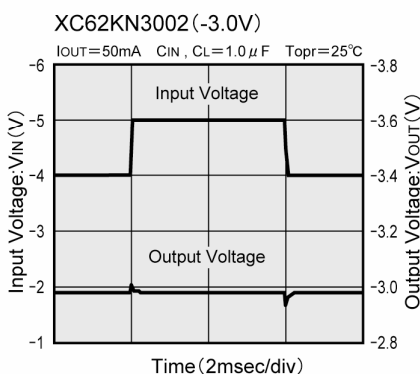
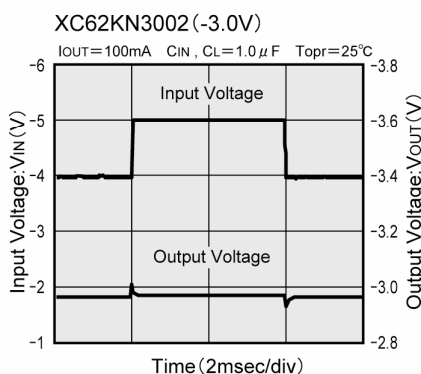
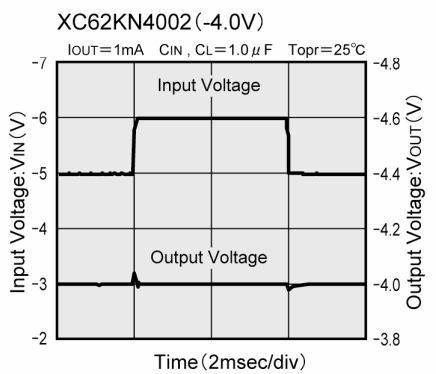
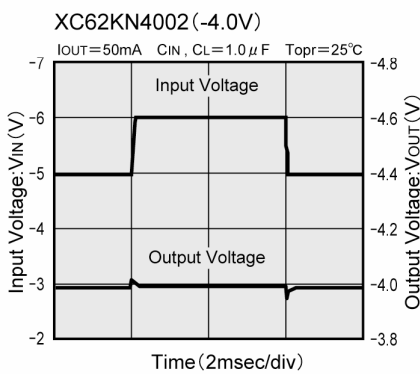
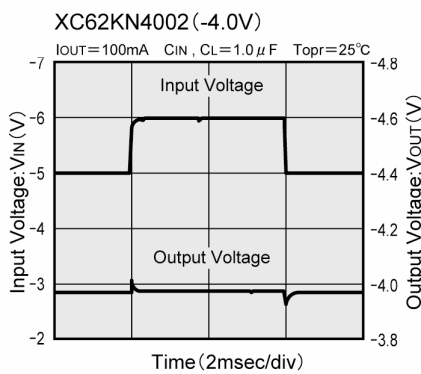
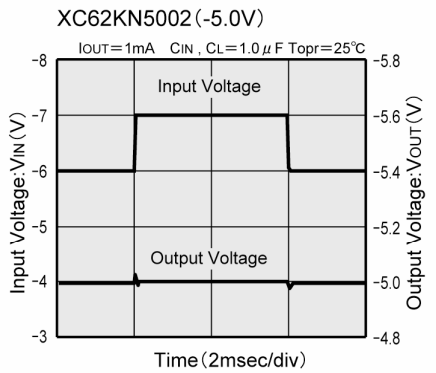
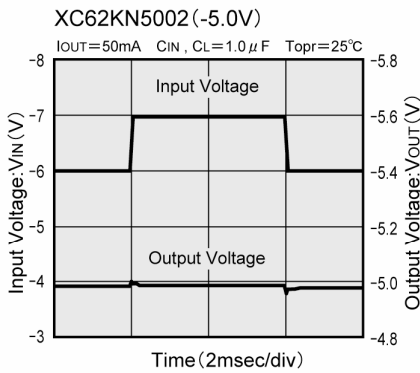
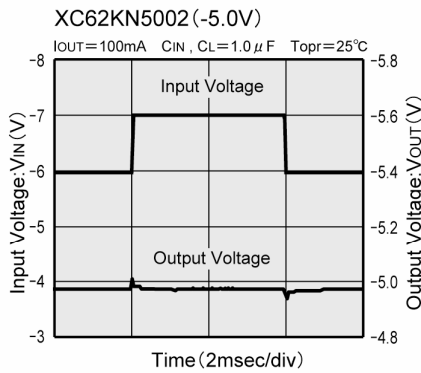


■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Input Transient Response 1

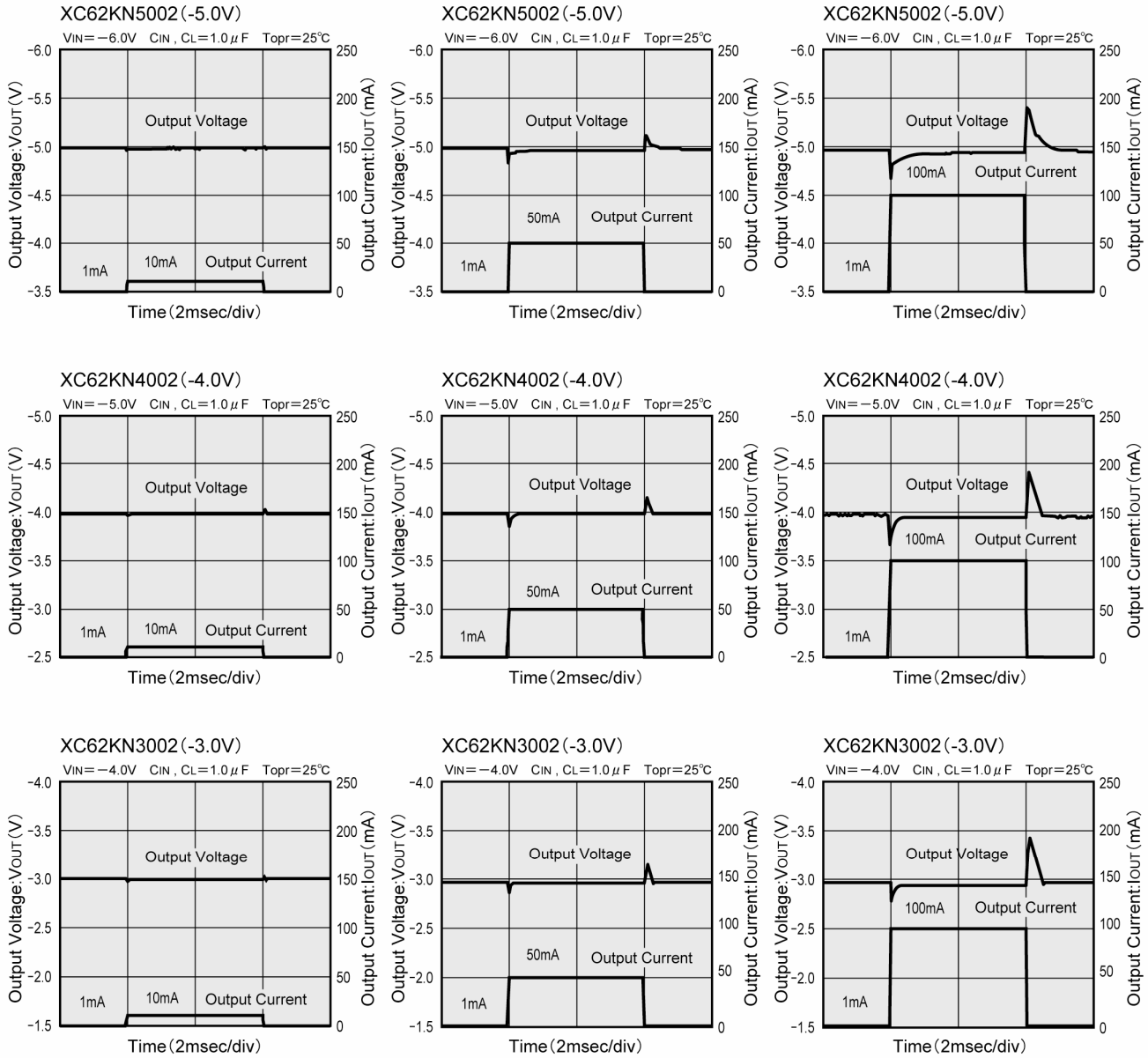


(8) Input Transient Response 2

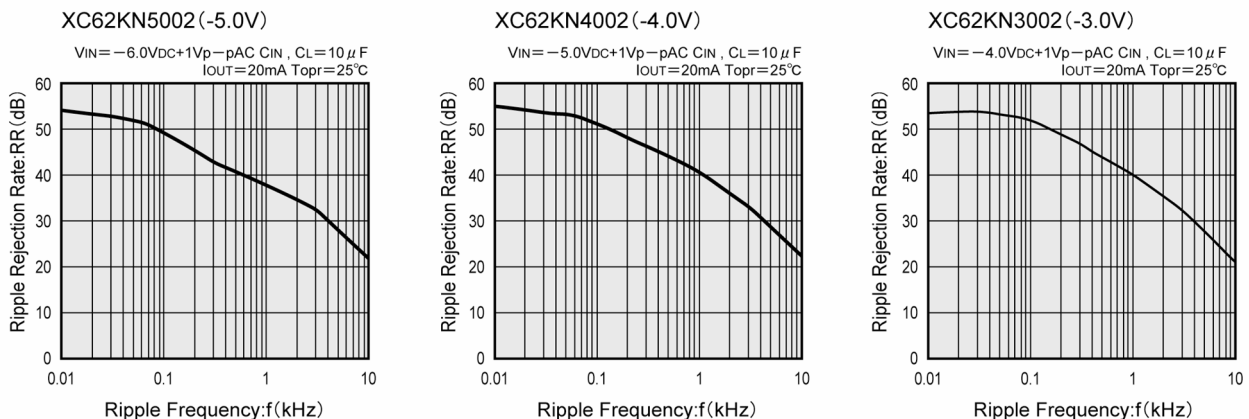


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) Load Transient Response

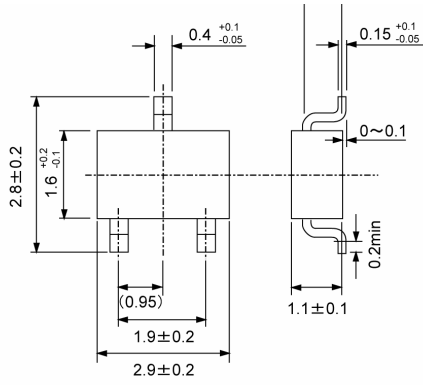


(10) Ripple Rejection Rate

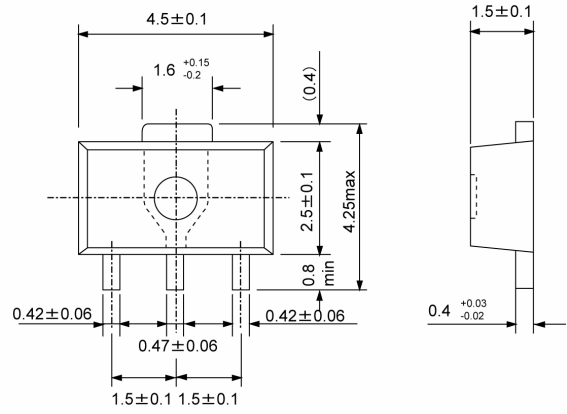


PACKAGING INFORMATION

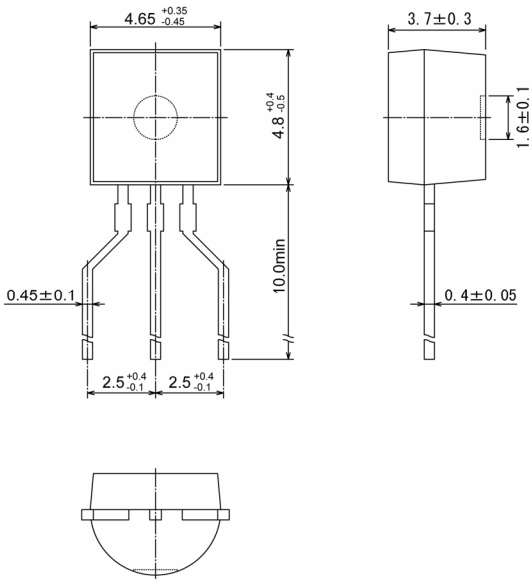
● SOT-23



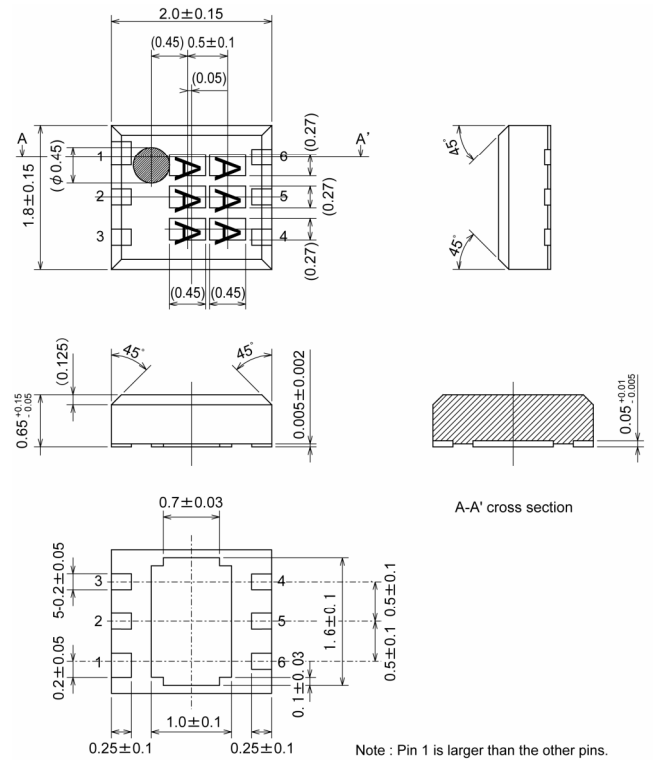
● SOT-89



● TO-92

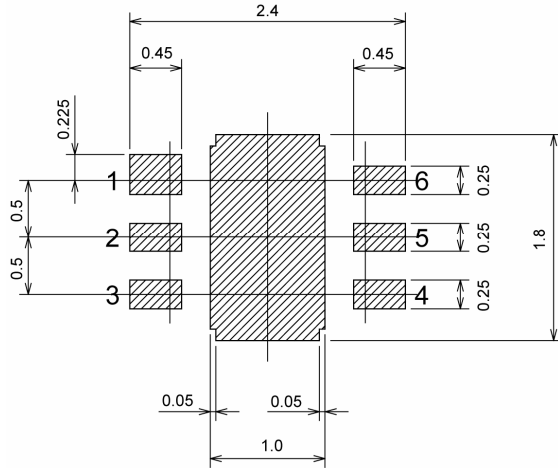


● USP-6B

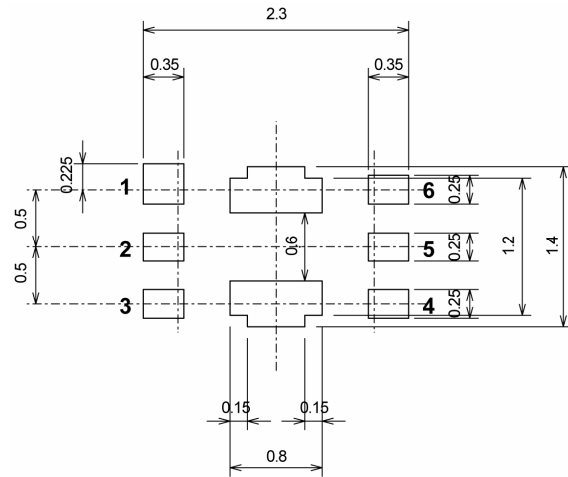


PACKAGING INFORMATION (Continued)

USP-6B Recommended Pattern Layout

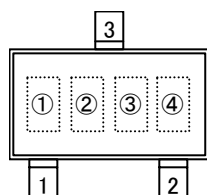


USP-6B Recommended Metal Mask Design

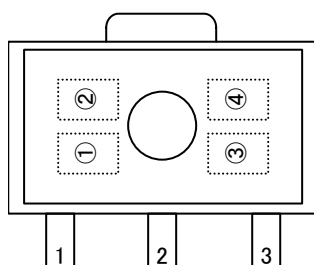


MARKING RULE

●SOT-23, SOT-89



SOT-23
(TOP VIEW)



SOT-89
(TOP VIEW)

①Represents integral number of output voltage

| MARK | VOLTAGE (V) | MARK | VOLTAGE (V) |
|------|-------------|------|-------------|
| 2 | 2.X | 5 | 5.X |
| 3 | 3.X | 6 | 6.X |
| 4 | 4.X | | |

②Represents decimal number of output voltage

| MARK | VOLTAGE (V) | MARK | VOLTAGE (V) |
|------|-------------|------|-------------|
| A | x.0 | F | x.5 |
| B | x.1 | H | x.6 |
| C | x.2 | K | x.7 |
| D | x.3 | L | x.8 |
| E | x.4 | M | x.9 |

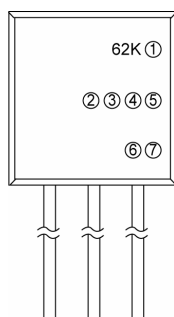
③Represents polarity of output voltage

| MARK | POLARITY |
|------|----------|
| 5 | Negative |

④Represents production lot number

0 to 9, A to Z repeated, reverse character 0 to 9, A to Z repeated
(G, I, J, O, Q, W excepted)

●TO-92



TO-92 (T Type)
(TOP VIEW)

①Represents polarity of output voltage

| MARK | OUTPUT CONFIGURATION |
|------|----------------------|
| N | — (Negative) |

②③Represents output voltage (ex.)

| MARK | | VOLTAGE (V) |
|------|---|-------------|
| ② | ③ | |
| 3 | 3 | 3.3 |
| 5 | 0 | 5.0 |

④Represents temperature characteristics

| MARK | TEMPERATURE CHARACTERISTICS |
|------|-----------------------------|
| 0 | ±100 ppm (TYP.) |

⑤Represents output voltage accuracy

| MARK | OUTPUT VOLTAGE ACCURACY |
|------|--------------------------|
| 1 | Within ±1% (semi-custom) |
| 2 | Within ±2% |

⑥Represents least significant digit of production year (ex.)

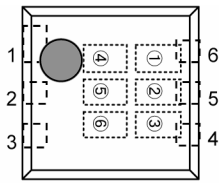
| MARK | PRODUCTION YEAR |
|------|-----------------|
| 3 | 2003 |
| 4 | 2004 |

⑦Represents production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excepted)

MARKING RULE (Continued)

● USP-6B



USP-6B
(TOP VIEW)

① Represents production series

| MARK | PRODUCT SERIES |
|------|----------------|
| K | XC62KNxx0xDx |

② Represents polarity of output voltage

| MARK | POLARITY | PRODUCT SERIES |
|------|--------------|----------------|
| N | – (Negative) | XC62KNxx0xDx |

③④ Represents output voltage (ex.)

| MARK | | VOLTAGE (V) | PRODUCT SERIES |
|------|---|-------------|----------------|
| ③ | ④ | | |
| 3 | 3 | 3.3 | XC62KN330xDx |
| 5 | 0 | 5.0 | XC62KN500xDx |

⑤ Represents temperature characteristics

| MARK | TEMPERATURE CHARACTERISTICS | PRODUCT SERIES |
|------|-----------------------------|----------------|
| 0 | ± 100 ppm (TYP.) | XC62KNxx0xDx |

⑥ Represents production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excepted)

Note: No character inversion used.

1. The products 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 catalog is up to date.
2. We assume no responsibility for any infringement of patents, patent rights, or other rights arising from the use of any information and circuitry in this catalog.
3. Please ensure suitable shipping controls (including fail-safe designs and aging protection) are in force for equipment employing products listed in this catalog.
4. The products in this catalog are not developed, designed, or approved for use with such equipment whose failure of malfunction can be reasonably expected to directly endanger the life of, or cause significant injury to, the user.
(e.g. Atomic energy; aerospace; transport; combustion and associated safety equipment thereof.)
5. Please use the products listed in this catalog within the specified ranges.
Should you wish to use the products under conditions exceeding the specifications, please consult us or our representatives.
6. We assume no responsibility for damage or loss due to abnormal use.
7. All rights reserved. No part of this catalog may be copied or reproduced without the prior permission of Torex Semiconductor Ltd.

TOREX SEMICONDUCTOR LTD.