

CMOS Temperature Sensor

■ GENERAL DESCRIPTION

The XC31B series are ultra small CMOS temperature sensor ICs. As a bandgap type temperature sensor is built-into the XC31B, linearity, in comparison to thermistor type temperature sensors, is much better.

The operating temperature range of the series is from -30°C to +80°C. The XC31B comes in a mini molded SOT-25 and USP-6B packages with a supply current of only 7 μ A

(@V_{OUT}=2.0V) and as such, is suitable for use with various portable devices. Output voltage is selectable in 0.1V increments within a range of 2.0V to 6.0V (at 25°C).

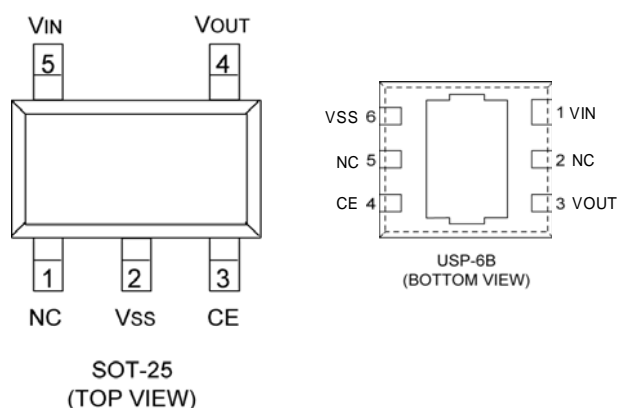
■ APPLICATIONS

- Mobile phones
- Portable AV equipment
- Palm top computers, PDAS
- Battery powered equipment

■ FEATURES

| | |
|---|---------------------------------------|
| Operating Voltage Range | : 3.0V ~ 10.0V |
| Output Voltage Range | : 2.0V~ 6.0V |
| Output Voltage Accuracy | : $\pm 3\%$ |
| Detectable Temperature Range | : -30°C ~ +80°C |
| Output Voltage Temp. Coefficient | : -3900ppm/°C (TYP.) |
| Low Power Consumption | : 7 μ A (@V _{OUT} =2.0V) |
| Packages | : SOT-25, USP-6B |
| Environmentally Friendly | : EU RoHS Compliant, Pb Free |

■ 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-25 | USP-6 | | |
| 1 | 2, 5 | NC | No Connection |
| 2 | 6 | Vss | Ground |
| 3 | 4 | CE | Chip Enable |
| 4 | 3 | VOUT | Output |
| 5 | 1 | VIN | Power Supply |

PRODUCT CLASSIFICATION

Ordering Information

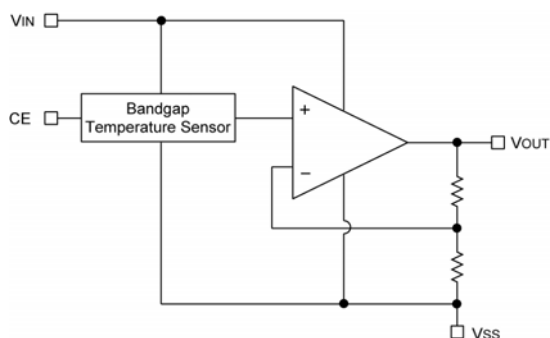
XC31B①②③④⑤⑥⑦⑧^(*)

| DESIGNATOR | DESCRIPTION | SYMBOL | DESCRIPTION |
|------------|--|--------|-----------------------|
| ① | Polarity of Output Voltage | P | + (Positive) |
| ② | Temperature Coefficient | N | - (Negative) |
| ③④ | Output Voltage (25°C) | 20~60 | e.g. 20=2.0V, 30=3.0V |
| ⑤ | Revision Character | A ~ | - |
| ⑥⑦⑧ | Packages Taping Type ^(*) | MR | SOT-25 |
| | | MR-G | SOT-25 |
| | | DR | USP-6B |

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

^(*) 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°C, Vss=0V

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|-----------------------------|--------|--------|----------------|------|
| Input Voltage | | VIN | -0.3 ~ 12 | V |
| Output Voltage | | VOUT | -0.3 ~ 12 | V |
| CE Pin Voltage | | VCE | -0.3 ~ VIN+0.3 | V |
| Output Current | | IOUT | 20 | mA |
| Power Dissipation | SOT-25 | Pd | 150 | mW |
| | USP-6B | | 100 | |
| Operating Temperature Range | | Topr | -30 ~ +80 | °C |
| Storage Temperature Range | | Tstg | -40 ~ +125 | °C |

■ ELECTRICAL CHARACTERISTICS

XC31BPN20A $V_{OUT(T)}^{(*)1} = 2.0V$

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS |
|--|------------------|---|-------|-------|-------|-----------------|
| Input Voltage | V_{IN} | | — | — | 10 | V |
| Output Voltage | V_{OUT} | $I_{OUT} = 100 \mu A^{(*)2}$, $V_{IN} = 4.0V$, $T_a = 25^\circ C$ | 1.94 | 2.0 | 2.06 | V |
| Detectable Temperature Range | | | -30 | — | +80 | $^\circ C$ |
| Output Voltage Temperature Coefficient | $T_D^{(*)3}$ | $I_{OUT} = 100 \mu A$, $V_{IN} = 4.0V$ $-30^\circ C \leq T_a \leq 80^\circ C$ | -3400 | -3900 | -4400 | ppm/ $^\circ C$ |
| Temperature Sensitivity | T_{SE} | $-30^\circ C \leq T_a \leq 80^\circ C$ | -6.8 | -7.8 | -8.8 | mV/ $^\circ C$ |
| Linearity Margin Error | $T_L^{(*)4}$ | $-30^\circ C \leq T_a \leq 80^\circ C$ | — | 1 | 3.5 | % |
| Load Regulation | ΔV_{OUT} | $V_{IN} = 4.0V$ $1 \mu A \leq I_{OUT} \leq 100 \mu A$ | — | 2.0 | — | mV |
| Supply Current 1 | I_{SS1} | $V_{IN} = V_{CE} = 4.0V$, $T_a = 25^\circ C$ | — | 7 | 17 | μA |
| Supply Current 2 | I_{SS2} | $V_{IN} = 4.0V$, $V_{CE} = V_{SS}$, $T_a = 25^\circ C$ | — | — | 0.1 | μA |
| CE "High" Level Voltage | V_{CEH} | | 1.5 | — | — | V |
| CE "Low" Level Voltage | V_{CEL} | | — | — | 0.3 | V |

XC31BPN40A $V_{OUT(T)}^{(*)1} = 4.0V$

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS |
|--|------------------|---|-------|-------|-------|-----------------|
| Input Voltage | V_{IN} | | — | — | 10 | V |
| Output Voltage | V_{OUT} | $I_{OUT} = 100 \mu A^{(*)2}$, $V_{IN} = 6.0V$, $T_a = 25^\circ C$ | 3.88 | 2.0 | 4.12 | V |
| Detectable Temperature Range | | | -30 | — | +80 | $^\circ C$ |
| Output Voltage Temperature Coefficient | $T_D^{(*)3}$ | $I_{OUT} = 100 \mu A$, $V_{IN} = 6.0V$ $-30^\circ C \leq T_a \leq 80^\circ C$ | -3400 | -3900 | -4400 | ppm/ $^\circ C$ |
| Temperature Sensitivity | T_{SE} | $-30^\circ C \leq T_a \leq 80^\circ C$ | -13.6 | -15.6 | -17.6 | mV/ $^\circ C$ |
| Linearity Margin Error | $T_L^{(*)4}$ | $-30^\circ C \leq T_a \leq 80^\circ C$ | — | 1 | 3.5 | % |
| Load Regulation | ΔV_{OUT} | $V_{IN} = 6.0V$ $1 \mu A \leq I_{OUT} \leq 100 \mu A$ | — | 3.0 | — | mV |
| Supply Current 1 | I_{SS1} | $V_{IN} = V_{CE} = 6.0V$, $T_a = 25^\circ C$ | — | 8 | 18 | μA |
| Supply Current 2 | I_{SS2} | $V_{IN} = 6.0V$, $V_{CE} = V_{SS}$, $T_a = 25^\circ C$ | — | — | 0.1 | μA |
| CE "High" Level Voltage | V_{CEH} | | 1.5 | — | — | V |
| CE "Low" Level Voltage | V_{CEL} | | — | — | 0.3 | V |

NOTE:

*1: $V_{OUT(T)}$ = Specified output voltage at $25^\circ C$.

*2: When output current exceed $100 \mu A$, output voltage drop will increase.

If this IC is to be used in applications where such currents are required, please use a buffer on the output

*3: Output voltage temperature coefficient (T_D) is defined as:

$$T_D = \frac{\Delta V_{OUT}}{T_a \cdot V_{OUT}}$$

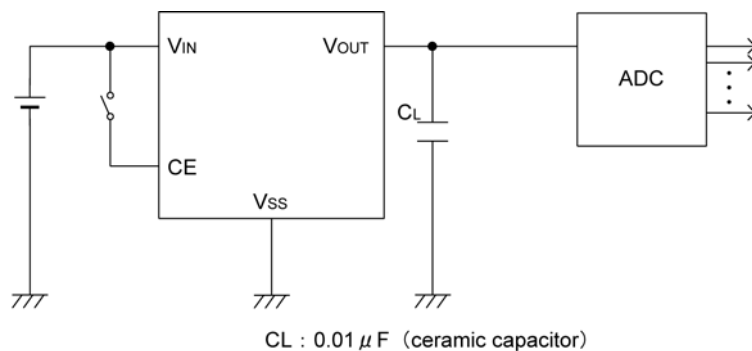
*4: Linearity margin error (T_L) is calculated as follows:

$$T_L = \frac{e_{max}}{T_{se} \cdot \Delta T_a}$$

where e_{max} = maximum error.

The maximum error is the maximum difference between the actual measured value and the value on an approximated straight line.

■ TYPICAL APPLICATION CIRCUIT

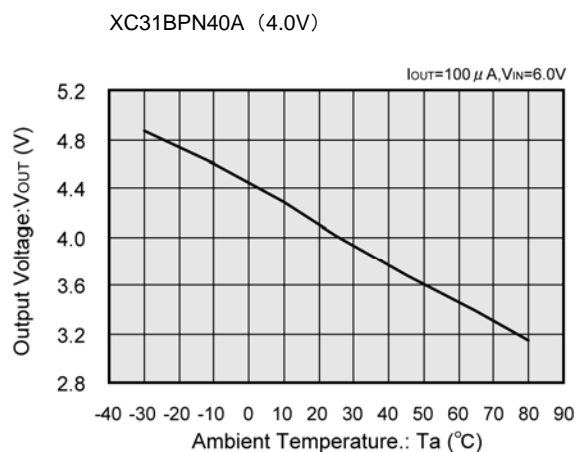
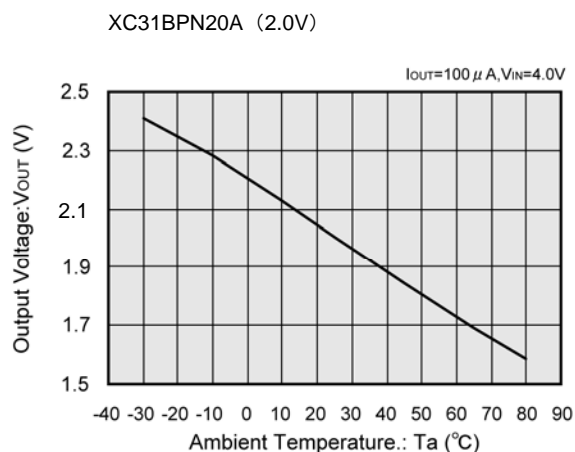


■ NOTE ON USE

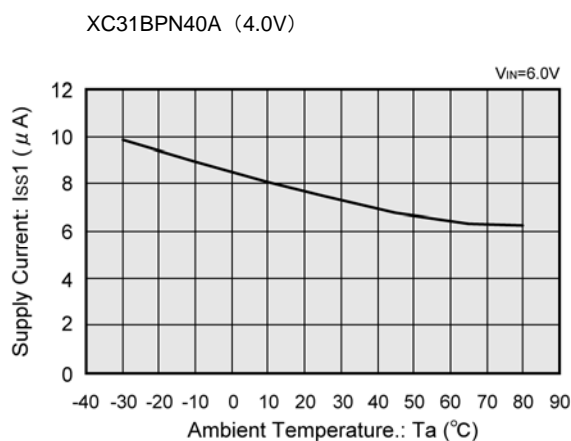
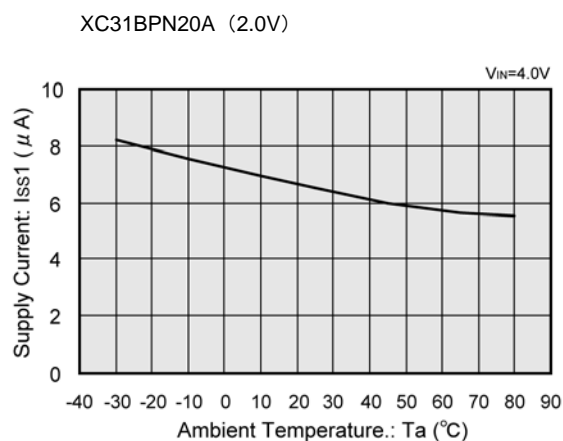
1. When the load capacitance C_L is too large, oscillation may occur on the output signal.
2. Output signal overshoot will occur when the power (V_{IN}) is switched on or when the power drastically fluctuates. The chip enable (CE) function is effective for helping to avoid overshoot and also in saving consumption current.

■ TYPICAL PERFORMANCE CHARACTERISTICS

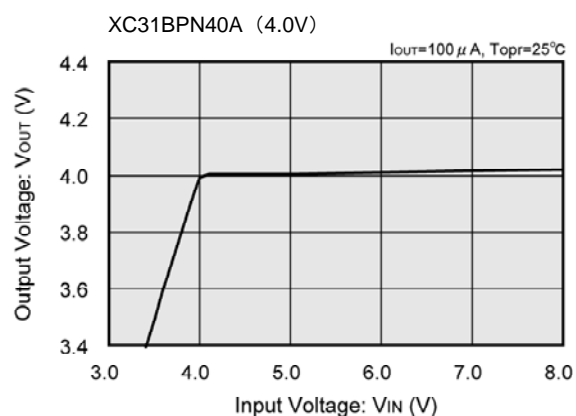
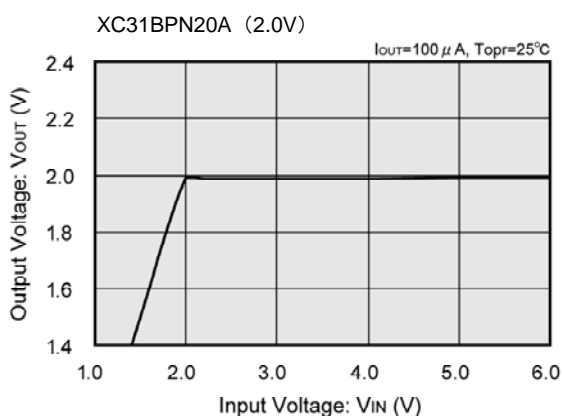
(1) Output Voltage vs. Ambient Temperature



(2) Supply Current vs. Ambient Temperature

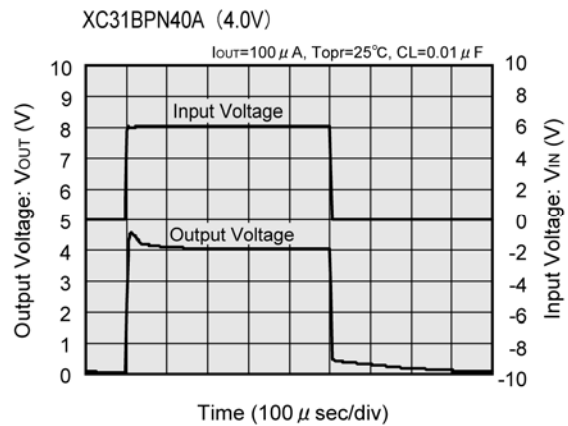
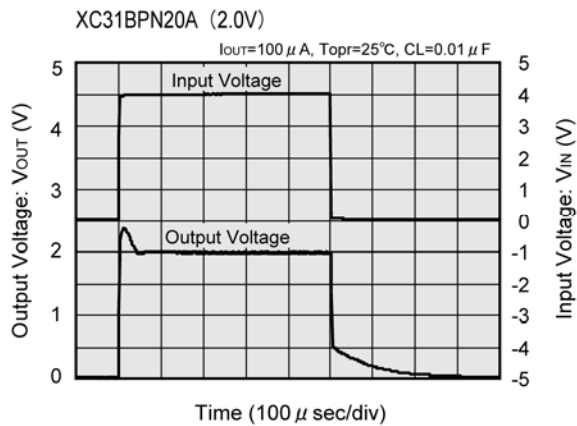


(3) Output Voltage vs. Input Voltage

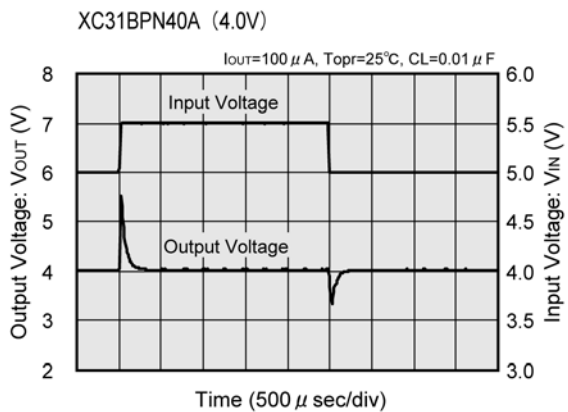
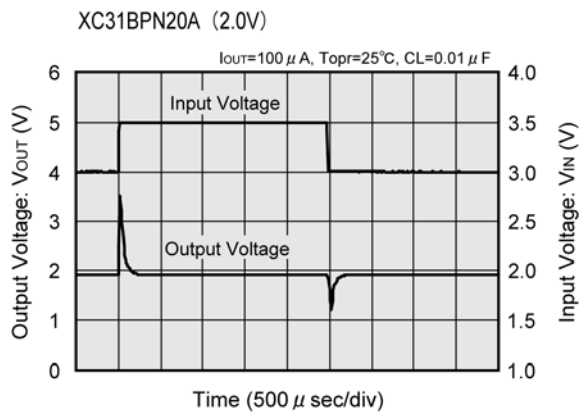


TYPICAL PERFORMANCE CHARACTERISTICS(Continued)

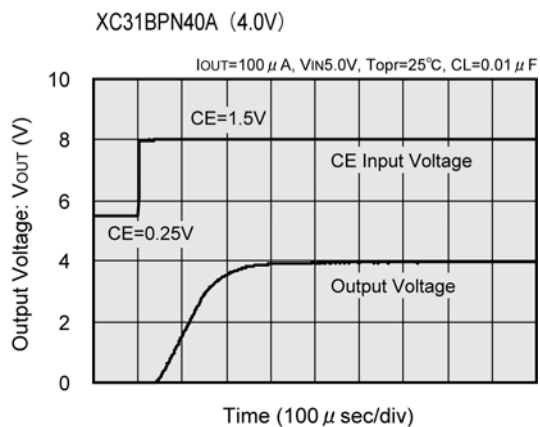
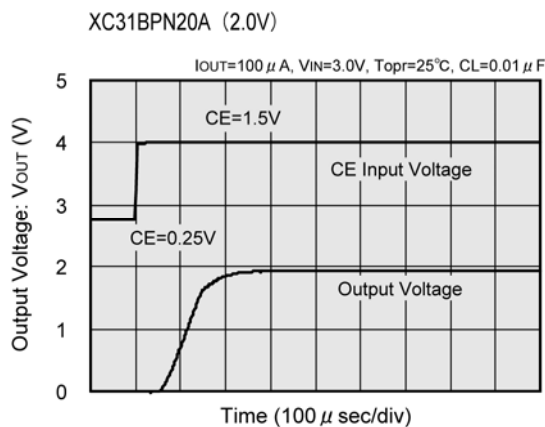
(4) Input Transient Response 1



(5) Input Transient Response 2

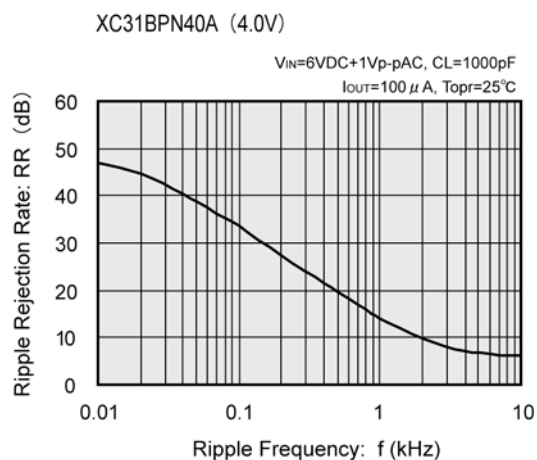


(6) CE Pin Transient Response



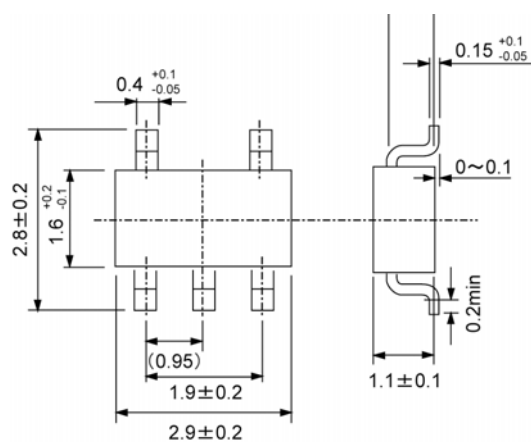
■ TYPICAL PERFORMANCE CHARACTERISTICS(Continued)

(7) Ripple Rejection Rate

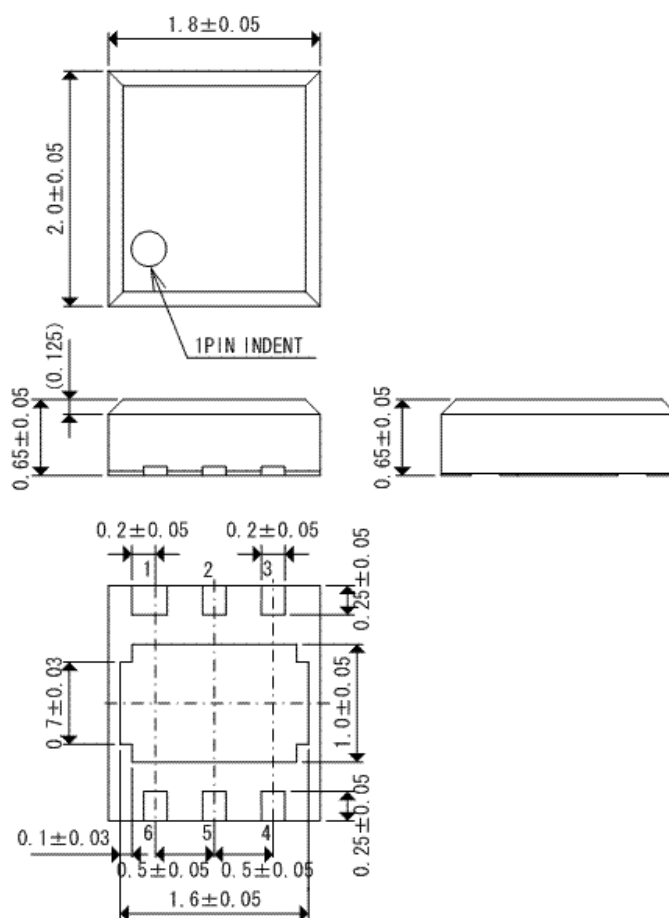


■ PACKAGING INFORMATION

● SOT-25

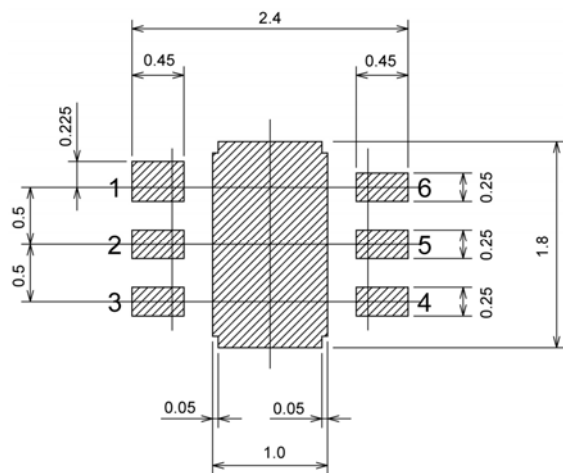


● USP-6B

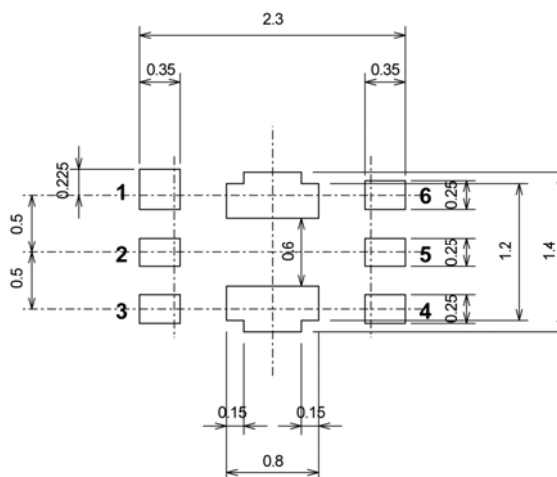


■ PACKAGING INFORMATION (Continued)

● USP-6B Recommended Pattern Layout

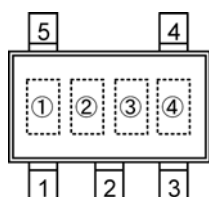


● USP-6B Recommended Metal Mask Design



MARKING RULE

● SOT-25



SOT-25
(TOP VIEW)

① based on internal standards

② represents integer of output voltage

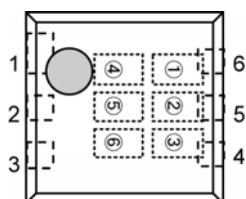
| MARK | VOLTAGE (V) |
|------|-------------|
| 2 | 2.x |
| 3 | 3.x |
| 4 | 4.x |
| 5 | 5.x |
| 6 | 6.x |

③ represents decimal number point of output voltage

| MARK | VOLTAGE (V) |
|------|-------------|
| 0 | x.0 |
| 1 | x.1 |
| 2 | x.2 |
| 3 | x.3 |
| 4 | x.4 |
| 5 | x.5 |
| 6 | x.6 |
| 7 | x.7 |
| 8 | x.8 |
| 9 | x.9 |

④ represents assembly lot number
(Based on internal standards)

● USP-6B



USP-6B
(TOP VIEW)

① represents polarity of output voltage

| MARK | POLARITY | PRODUCT SERIES |
|------|----------|----------------|
| P | + | XC31BPN**AD* |

② represents temperature coefficient

| MARK | COEFFICIENT | PRODUCT SERIES |
|------|-------------|----------------|
| N | - | XC31BPN**AD* |

③④ represents output voltage(25°C)

Ex)

| MARK | | VOLTAGE (V) | PRODUCT SERIES |
|------|---|----------------|----------------|
| ③ | ④ | | |
| 2 | 0 | 2.0 | XC31BPN20AD* |
| 3 | 0 | 3.0 | XC31BPN30AD* |

⑤ represents revision character

Ex)

| MARK | PRODUCT SERIES |
|------|----------------|
| A | XC31BPN**AD* |

⑥ represents production lot number

0~9, A~Z repeated. (G, I, J, O, Q, W excluded)

*No character inversion used.

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