

## PWM, PWM/PFM Controlled Step-up DC/DC Converters

☆GreenOperation Compatible

## ■GENERAL DESCRIPTION

The XC6371/XC6372 series is a group of PWM controlled and PWM/PFM controlled step-up DC/DC converters. The built-in  $1.4\Omega$  switching transistor type enables a step-up circuit to be configured using only three components, a coil, a diode, and a capacitor.

Output voltage can be selectable in the range from 2.0V to 7.0V in increments of 0.01V (accuracy:  $\pm 2.5\%$ ). Oscillation frequency is also selectable from 50kHz, 100kHz, and 180kHz (accuracy:  $\pm 15\%$ ) for the XC6371 and the XC6372 series. Soft-start time is internally set and offers protection against in-rush currents when the power is switched on and prevents voltage overshoot. Packages with CE (chip enable) pin are also available which can reduce the IC power consumption during during stand-by mode.

The XC6371 series is the standard PWM controlled products. The control of the XC6372 series switches from PWM to PFM control during light loads when automatically switching is selected and the series is highly efficient from light loads to large output currents.

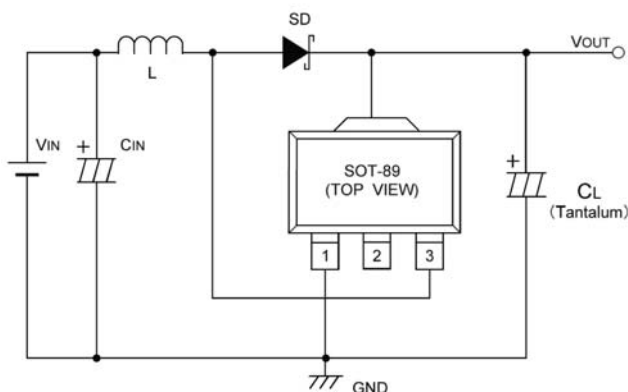
## ■APPLICATIONS

- Smart phones / Mobile phones
- Note PCs / Tablet PCs
- Digital still cameras / Camcorders
- Mobile devices / terminals

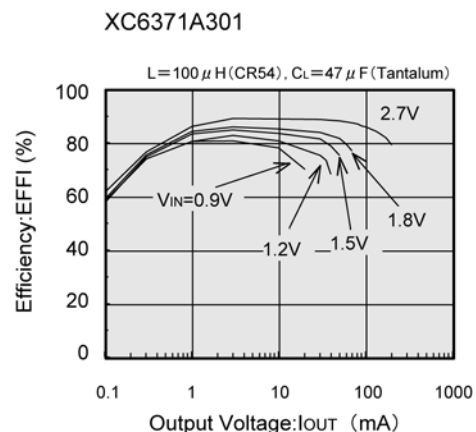
## ■FEATURES

- Operation Start Voltage Range : 0.9V~10V
- Output Voltage Range : 2.0V~7.0V (0.1V increments)
- Highly Accurate :  $\pm 2.5\%$
- Oscillation Frequency : 50kHz, 100kHz, 180kHz ( $\pm 15\%$ )
- Maximum Output Currents : 100mA(TYP.) @  $V_{IN}=3.0V$ ,  $V_{OUT}=5.0V$  \*
- Highly Efficient : 85%(TYP.) @  $V_{IN}=3.0V$ ,  $V_{OUT}=5.0V$  \*
- Built-in switching transistor.
- CE pin type (XC6371C, XC6372C)
- Phase compensation and soft start-up circuits built-in
- CMOS Low Power Consumption
- Packages : SOT-89, SOT-89-5, USP-6B
- Environmentally Friendly: EU RoHS Compliant, Pb Free
- \* Performance depends on external components and PCB layout.

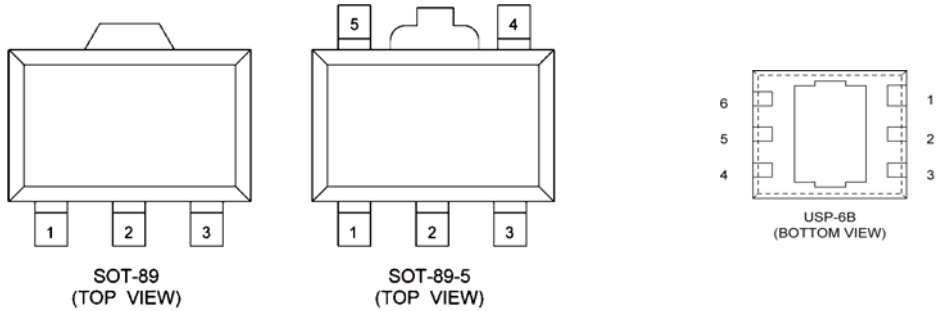
## ■TYPICAL APPLICATION CIRCUIT



## ■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 pin No.1.

## PIN ASSIGNMENT

XC6371/XC6372A

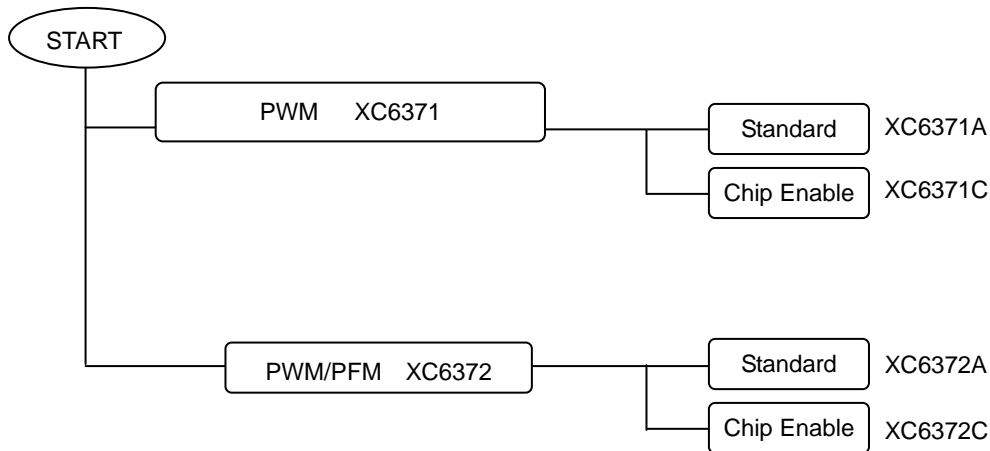
| PIN NUMBER |         | PIN NAME | FUNCTION  |
|------------|---------|----------|---|
| SOT-89     | USP-6B  |          |   |
| 1          | 6       | VSS      | Ground  |
| 2          | 1       | VOUT     | Output Voltage Monitor/IC Internal Power Supply |
| 3          | 4       | Lx       | Switch  |
| —          | 2, 3, 5 | NC       | No Connection                                   |

XC6371/XC6372C

| PIN NUMBER |        | PIN NAME | FUNCTION  |
|------------|--------|----------|---|
| SOT-89-5   | USP-6B |          |   |
| 5          | 6      | VSS      | Ground  |
| 2          | 1      | VOUT     | Output Voltage Monitor/IC Internal Power Supply |
| 4          | 4      | Lx       | Switch  |
| 3          | 3      | CE       | Chip Enable                                     |
| 1          | 2, 5   | NC       | No Connection                                   |

## ■ PRODUCT CLASSIFICATION

### ● Selection Guide



### ● Ordering Information

XC6371①②③④⑤⑥-⑦<sup>(\*)</sup> : PWM controlled

XC6372①②③④⑤⑥-⑦<sup>(\*)</sup> : PWM/PFM switching control

| DESIGNATOR | DESCRIPTION                          | SYMBOL  | DESCRIPTION  |
|------------|--------------------------------------|---------|--|
| ①          | Type of DC/DC Converter              | A       | 3-pin DC/DC converter with built-in switching transistor |
|            |                                      | C       | Stand-by capability with built-in switching transistor   |
| ②③         | Output Voltage                       | Integer | e.g. V <sub>OUT</sub> =3.5V→②=3, ③=5                     |
| ④          | Oscillation Frequency                | 0       | 50kHz  |
|            |                                      | 1       | 100kHz   |
|            |                                      | 2       | 180kHz   |
| ⑤⑥-⑦       | Packages Taping Type <sup>(**)</sup> | PR      | SOT-89 (XC6371/72 A type)                                |
|            |                                      |         | SOT-89-5 (XC6371/72 C type)                              |
|            |                                      | PR-G    | SOT-89 (XC6371/72 A type)                                |
|            |                                      |         | SOT-89-5 (XC6371/72 C type)                              |
|            |                                      | DR      | USP-6B   |
| DR-G       | USP-6B                               |         |  |

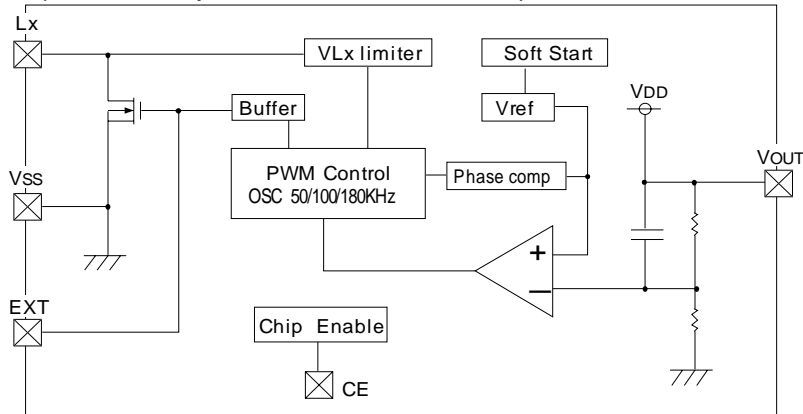
<sup>(\*)</sup> The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully EU RoHS compliant.

<sup>(\*\*)</sup> The device orientation is fixed in its embossed tape pocket. For reverse orientation, please contact your local Torex sales office or representative. (Standard orientation: ⑤R-⑦, Reverse orientation: ⑤L-⑦)

## ■ BLOCK DIAGRAMS

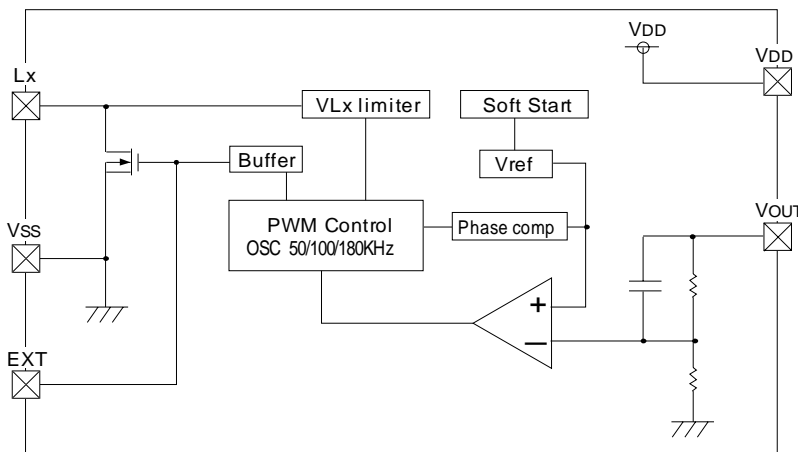
XC6371/XC6372A, C

(The VOUT pin serves also as VDD)



Note: The CE pin is only used with the XC6371C.

XC6371/72/73E



Note: Built-in transistor type units use the Lx pin.

## ■ ABSOLUTE MAXIMUM RATINGS

Ta=25°C

| PARAMETER                   | SYMBOL              | RATINGS  | UNITS |
|-----------------------------|---------------------|----------|-------|
| Vout Input Voltage          | Vout                | 12       | V     |
| Lx pin Voltage              | VLX                 | 12       | V     |
| Lx pin Current              | ILX                 | 400      | mA    |
| CE Input Voltage            | VCE                 | 12       | V     |
| Power Dissipation           | SOT-89,<br>SOT-89-5 | 500      | mW    |
|                             | USP-6B              |          |       |
|                             | VDD Input Voltage   | VDD      |       |
| Operating Temperature Range | Topr                | -30~+80  | °C    |
| Storage Temperature Range   | Tstg                | -40~+125 | °C    |

## ■ ELECTRICAL CHARACTERISTICS

| XC6371/72A501                  |                    | V <sub>OUT</sub> =5.0V, FOSC=100kHz  |       | T <sub>a</sub> =25°C |       |       |
|--------------------------------|--------------------|--|-------|----------------------|-------|-------|
| PARAMETER                      | SYMBOL             | CONDITIONS   | MIN.  | TYP.                 | MAX.  | UNITS |
| Output Voltage                 | V <sub>OUT</sub>   |  | 4.875 | 5.000                | 5.125 | V     |
| Maximum Input Voltage          | V <sub>IN</sub>    |  | 10    | -                    | -     | V     |
| Operation Start Voltage        | V <sub>ST1</sub>   | External Components Connected, I <sub>OUT</sub> =1mA   | -     | -                    | 0.90  | V     |
| Oscillation Start Voltage      | V <sub>ST2</sub>   | No external components. Apply voltage to V <sub>OUT</sub><br>Lx : 10kΩ pull-up to 5V           | -     | -                    | 0.80  | V     |
| No Load Input Current          | I <sub>IN</sub>    | V <sub>IN</sub> =V <sub>OUT</sub> × 0.8, I <sub>OUT</sub> =0mA <sup>(*)1</sup>                 | -     | 12.8                 | 25.7  | μA    |
| Supply Current 1               | I <sub>DD1</sub>   | Same as V <sub>ST2</sub> ,<br>Apply output voltage × 0.95 to V <sub>OUT</sub>                  | -     | 80.2                 | 133.8 | μA    |
| Supply Current 2               | I <sub>DD2</sub>   | Same as V <sub>ST2</sub> ,<br>Apply output voltage × 1.1 to V <sub>OUT</sub>                   | -     | 8.2                  | 16.5  | μA    |
| Lx Switch-On Resistance        | R <sub>SWON</sub>  | Same as I <sub>DD1</sub> , V <sub>LX</sub> =0.4V   | -     | 1.4                  | 2.4   | Ω     |
| Lx Leak Current                | I <sub>LXL</sub>   | No external components. V <sub>OUT</sub> =V <sub>LX</sub> =10V                                 | -     | -                    | 1.0   | μA    |
| Oscillation Frequency          | FOSC               | Same as I <sub>DD1</sub> . Measuring of Lx waveform  | 85    | 100                  | 115   | kHz   |
| Maximum Duty Ratio             | MAXDTY             | Same as I <sub>DD1</sub> . Measuring of Lx waveform  | 80    | 87                   | 92    | %     |
| PFM Duty Ratio <sup>(*)4</sup> | PFMDTY             | Same as I <sub>DD1</sub> . Measuring of Lx waveform  | 10    | 17                   | 25    | %     |
| Lx Limit Voltage               | V <sub>LXLMT</sub> | Same as I <sub>DD1</sub> . Apply output voltage to Lx,<br>Voltage required to produce FOSC × 2 | 0.7   | -                    | 1.3   | V     |
| Efficiency                     | EFFI               |  | -     | 85                   | -     | %     |
| Slow-Start Time                | T <sub>SS</sub>    |  | 4.0   | 10.0                 | 20.0  | ms    |

NOTE: Unless otherwise stated, V<sub>IN</sub>=V<sub>OUT</sub> × 0.6, I<sub>OUT</sub>=50mA. See Typical Application Circuits, Circuit1

\*1: The Schottky diode (SD) must be type MA735, with reverse current (I<sub>R</sub>)<1.0 μA at reverse voltage (V<sub>R</sub>)=10.0V.(XC6372A)

\*2: "Supply Current 1" is the supply current while the oscillator is continuously oscillating. In actual operation the oscillator periodically operates which results in less average power consumption. The current actually provided by an external V<sub>IN</sub> source is represented by "No Load Input Current (I<sub>IN</sub>)".

\*3: When PWM operates at PWM Mode.

\*4: When PFM operates at PFM Mode.(XC6372A)

## ELECTRICAL CHARACTERISTICS (Continued)

XC6371/72C501

V<sub>OUT</sub>=5.0V, FOSC=100kHz

T<sub>a</sub>=25°C

| PARAMETER                      | SYMBOL             | CONDITIONS   | MIN.  | TYP.  | MAX.  | UNITS |
|--------------------------------|--------------------|--|-------|-------|-------|-------|
| Output Voltage                 | V <sub>OUT</sub>   |  | 4.875 | 5.000 | 5.125 | V     |
| Maximum Input Voltage          | V <sub>IN</sub>    |  | 10    | -     | -     | V     |
| Operation Start Voltage        | V <sub>ST1</sub>   | External Components Connected, I <sub>OUT</sub> =1mA   | -     | -     | 0.90  | V     |
| Operation Start Voltage        | V <sub>ST2</sub>   | No external components. Apply voltage to V <sub>OUT</sub> , Lx : 10kΩ pull-up to 5V            | -     | -     | 0.80  | V     |
| No Load Input Current          | I <sub>IN</sub>    | V <sub>IN</sub> =V <sub>OUT</sub> × 0.8, I <sub>OUT</sub> =0mA <sup>(*1)</sup>                 | -     | 12.8  | 25.7  | μA    |
| Supply Current 1               | I <sub>DD1</sub>   | Same as V <sub>ST2</sub> ,<br>Apply output voltage × 0.95 to V <sub>OUT</sub>                  | -     | 80.2  | 133.8 | μA    |
| Supply Current 2               | I <sub>DD2</sub>   | Same as V <sub>ST2</sub> ,<br>Apply output voltage × 1.1 to V <sub>OUT</sub>                   | -     | 8.2   | 16.5  | μA    |
| Lx Switch-On Resistance        | R <sub>SWON</sub>  | Same as I <sub>DD1</sub> , V <sub>Lx</sub> =0.4V   | -     | 1.4   | 2.4   | Ω     |
| Lx Leak Current                | I <sub>LXL</sub>   | No external components, V <sub>OUT</sub> =V <sub>Lx</sub> =10V                                 | -     | -     | 1.0   | μA    |
| Oscillation Frequency          | FOSC               | Same as I <sub>DD1</sub> , Measuring of Lx waveform  | 85    | 100   | 115   | KHZ   |
| Maximum Duty Ratio             | MAXDTY             | Same as I <sub>DD1</sub> , Measuring of Lx waveform  | 80    | 87    | 92    | %     |
| PFM Duty Ratio <sup>(*4)</sup> | PFMDTY             | Same as I <sub>DD1</sub> , Measuring of Lx waveform  | 10    | 17    | 25    | %     |
| Stand-by Current               | I <sub>STB</sub>   | Same as I <sub>DD1</sub>   | -     | -     | 0.5   | μA    |
| CE "High" Voltage              | V <sub>CEH</sub>   | Same as I <sub>DD1</sub> , Lx Oscillation start  | 0.75  | -     | -     | V     |
| CE "Low" Voltage               | V <sub>CEL</sub>   | Same as I <sub>DD1</sub> , Lx Oscillation stop   | -     | -     | 0.20  | V     |
| CE "High" Current              | I <sub>CEH</sub>   | Same as I <sub>DD1</sub> , V <sub>CE</sub> =V <sub>OUT</sub> × 0.95                            | -     | -     | 0.25  | μA    |
| CE "Low" Current               | I <sub>CEL</sub>   | Same as I <sub>DD1</sub> , V <sub>CE</sub> =0V   | -     | -     | -0.25 | μA    |
| Lx Limit Voltage               | V <sub>LxLMT</sub> | Same as I <sub>DD1</sub> , Apply output voltage to Lx,<br>Voltage required to produce FOSC × 2 | 0.7   | -     | 1.3   | V     |
| Efficiency                     | EFFI               |  | -     | 85    | -     | %     |
| Slow-Start Time                | T <sub>SS</sub>    |  | 4.0   | 10.0  | 20.0  | ms    |

NOTE: Unless otherwise stated, connect CE to V<sub>OUT</sub>, V<sub>IN</sub>=V<sub>OUT</sub> × 0.6, I<sub>OUT</sub>=50mA. See Typical Application Circuits, Circuit 2.

\*1: The Schottky diode (SD) must be type MA735, with reverse current (I<sub>R</sub>)<1.0μA at reverse voltage (V<sub>R</sub>)=10.0V.(XC6372C)

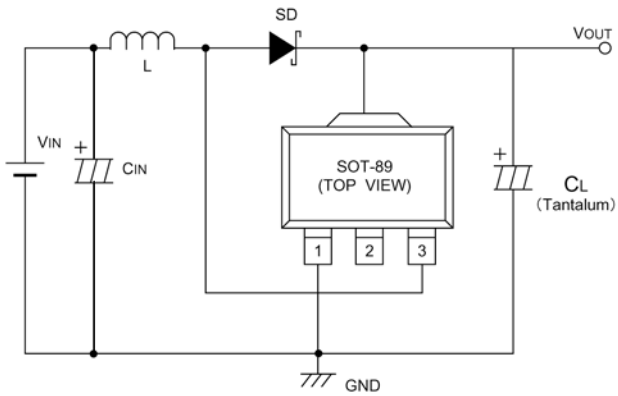
\*2: "Supply Current 1" is the supply current while the oscillator is continuously oscillating. In actual operation the oscillator periodically operates which results in less average power consumption. The current actually provided by an external V<sub>IN</sub> source is represented by "No Load Input Current (I<sub>IN</sub>)".

\*3: When PWM operates at PWM Mode.

\*4: When PFM operates at PFM Mode.(XC6372C)

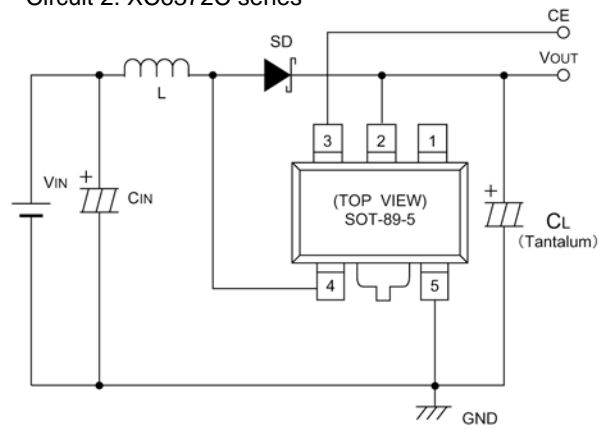
■ TYPICAL APPRICATION CIRCUITS

Circuit 1: XC6372A series



- L : 100  $\mu$  H (SUMIDA, CR54)
- SD : MA2Q735 (Schottky diode; MATSUSHITA)
- CL : 16V 47  $\mu$  F (Tantalum capacitor, NICHICHEMI MCE)
- CIN : 16V 220  $\mu$  F (Aluminium Electrolytic Capacitor)

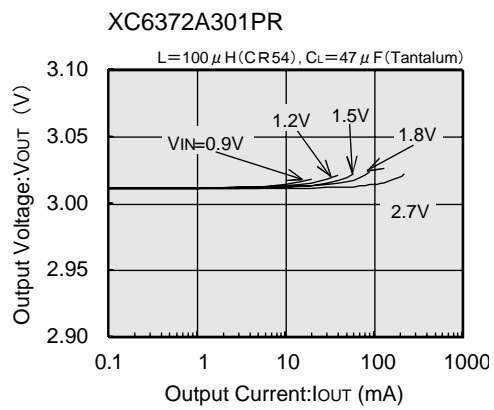
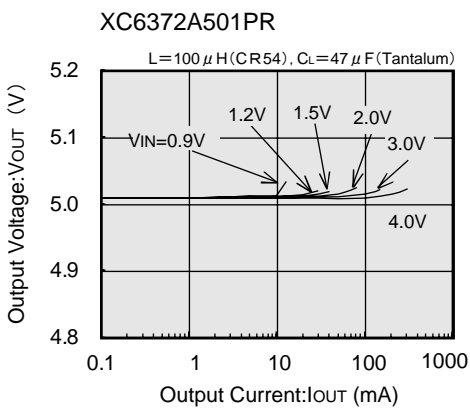
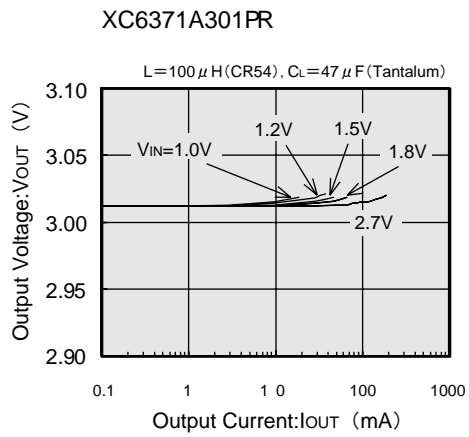
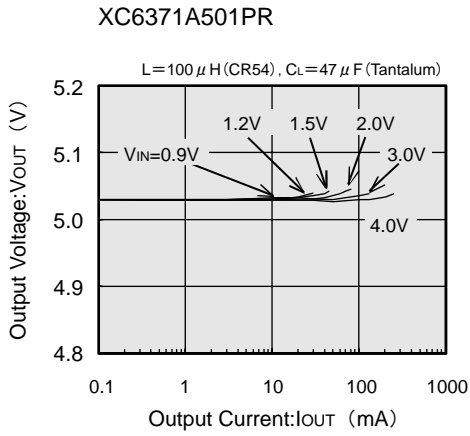
Circuit 2: XC6372C series



- L : 100  $\mu$  H (CR54, SUMIDA)
- SD : MA2Q735 (Schottky Diode; MATUSHITA)
- CL : 16V 47  $\mu$  F (Tantalum Capacitor, NICHICHEMI MCE)
- CIN : 16V 220  $\mu$  F (Aluminium Electrolytic Capacitor)

## TYPICAL PERFORMANCE CHARACTERISTICS

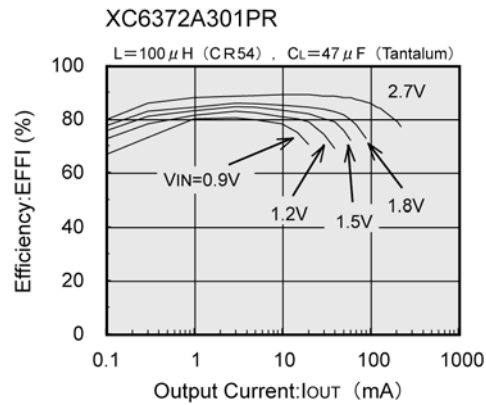
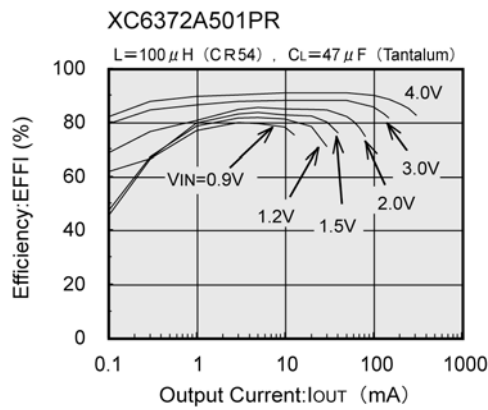
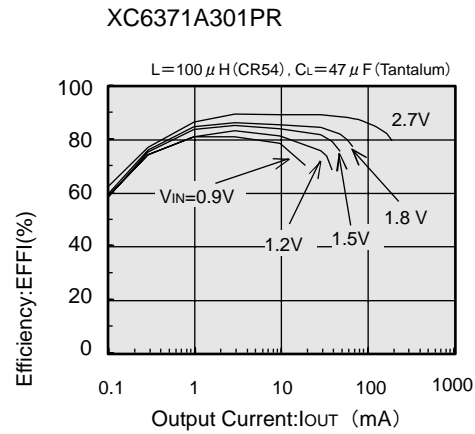
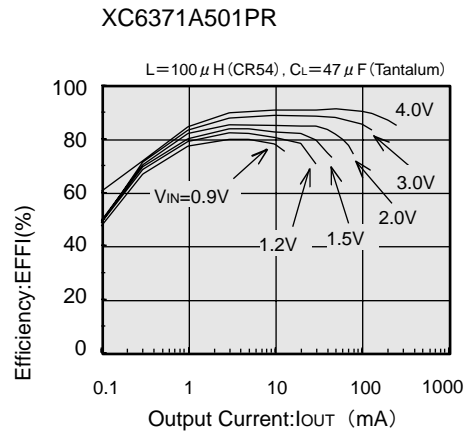
(1) Output Voltage vs. Output Current





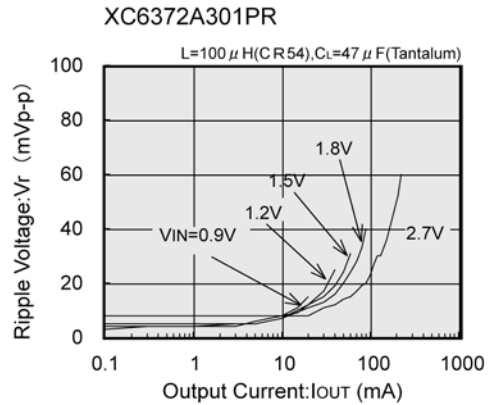
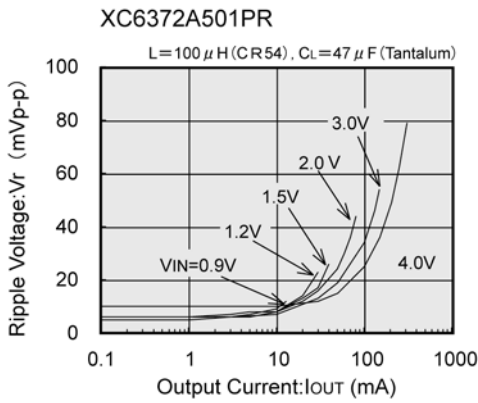
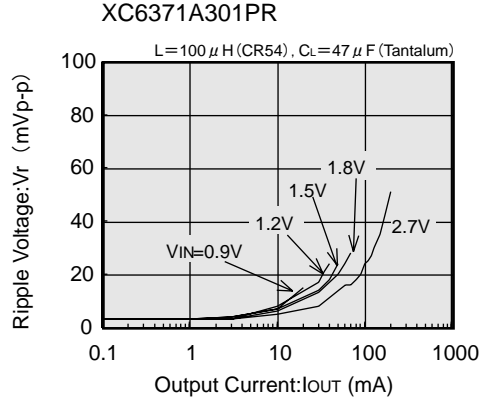
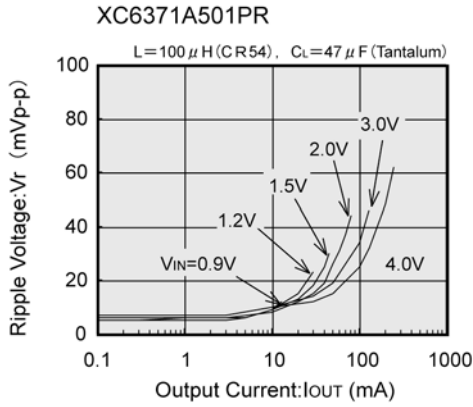
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (2) Efficiency vs. Output Current



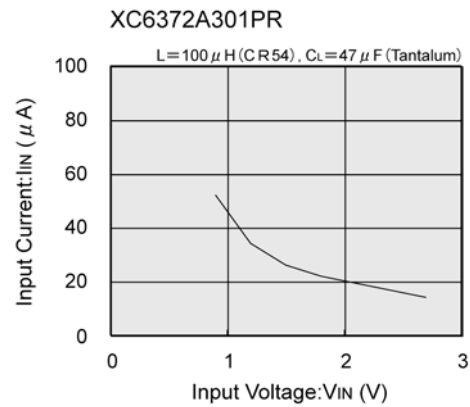
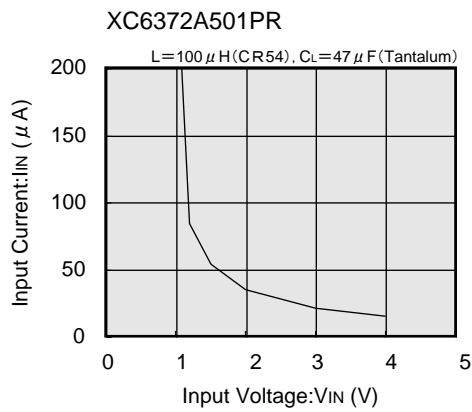
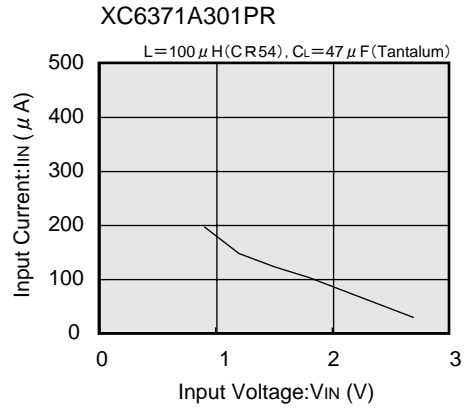
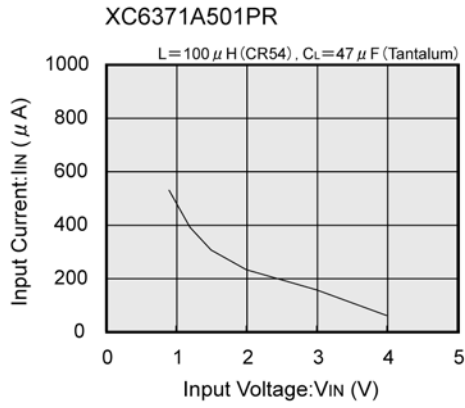
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (3) Ripple Voltage vs. Output Current



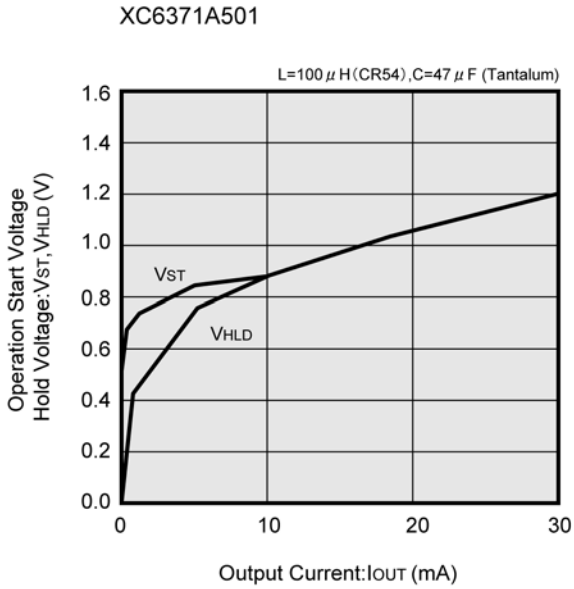
■ **TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

(4) No Load Input Current vs. Input Voltage

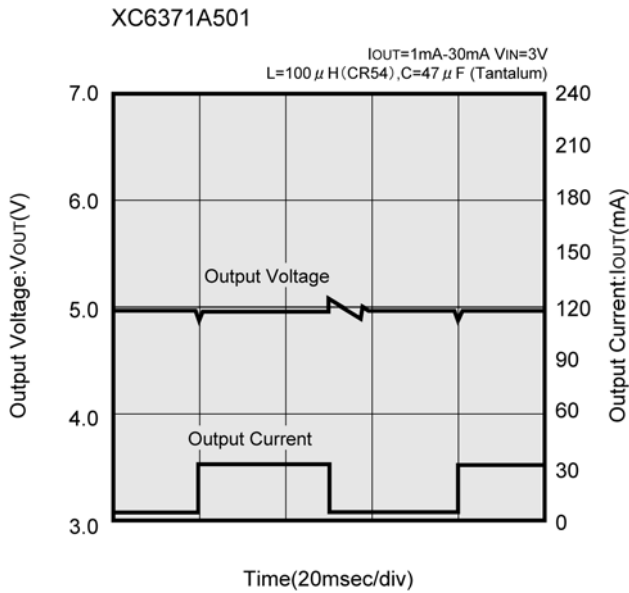


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(5) Operation Start Voltage / Hold Voltage vs. Output Current

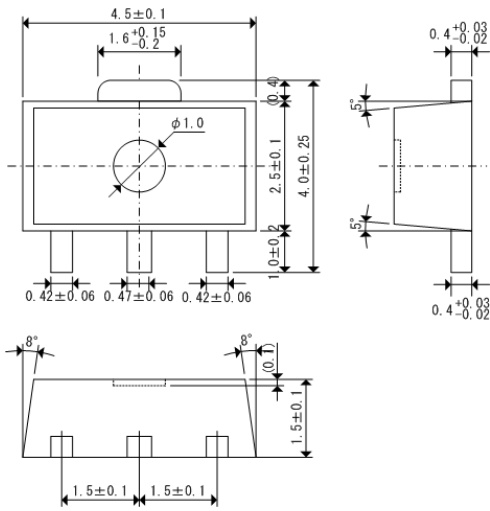


(6) Load Transient Response

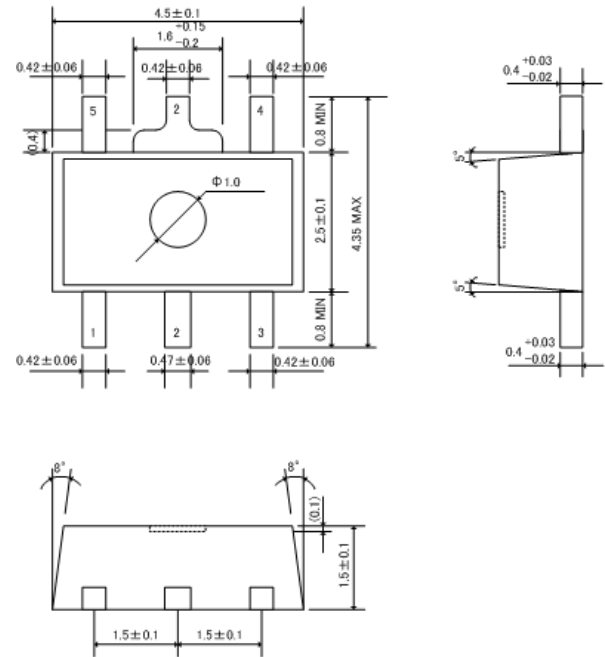


## PACKAGING INFORMATION

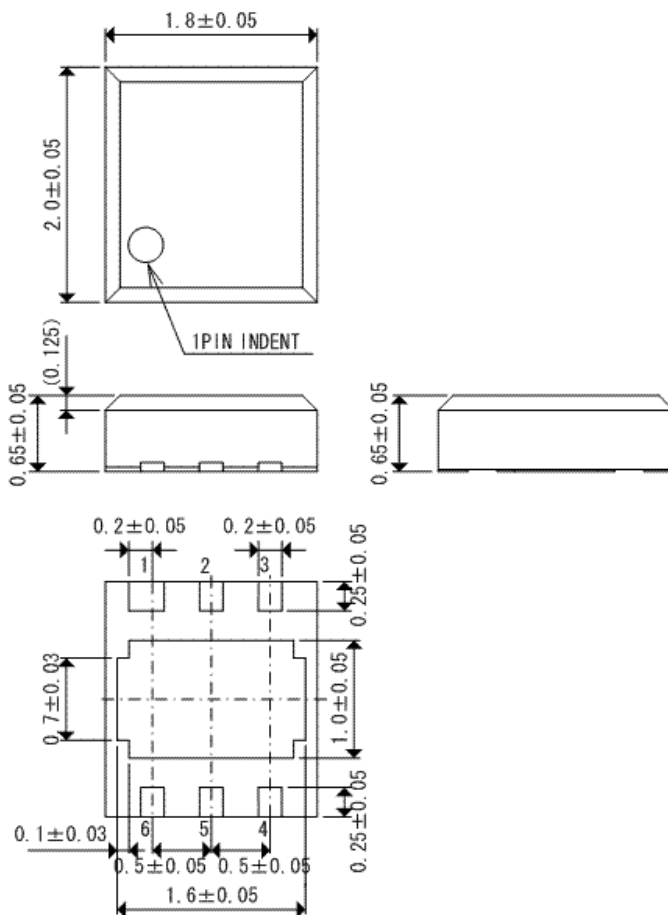
### ● SOT-89



### ● SOT-89-5

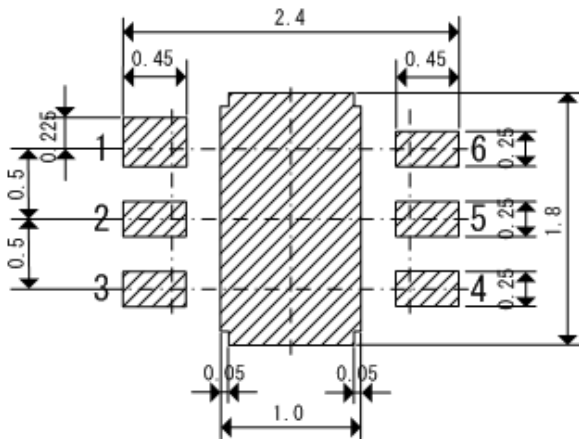


### ● USP-6B

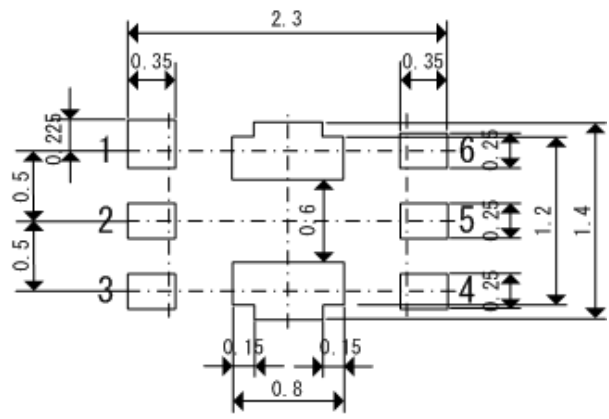


## PACKAGING INFORMATION (Continued)

● USP-6B Reference Pattern Layout



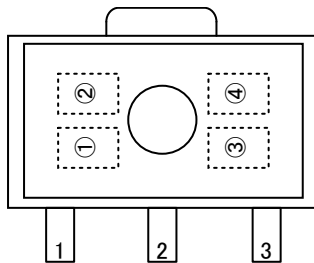
● USP-6B Reference Metal Mask Design



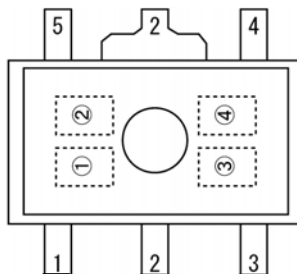
## MARKING RULE

[XC6371/XC6372]

● SOT-89, SOT-89-5



SOT-89  
(TOP VIEW)



SOT-89-5  
(TOP VIEW)

① represents product series

| MARK | PRODUCT SERIES |
|------|----------------|
| A    | XC6371A        |
| A    | XC6371C        |

| MARK | PRODUCT SERIES |
|------|----------------|
| 1    | XC6372A        |
| 1    | XC6372C        |

② represents integer of output voltage and oscillation frequency

| OUTPUT VOLTAGE (V) | OSCILLATION FREQUENCY |        |        |
|--------------------|-----------------------|--------|--------|
|                    | 50kHz                 | 100kHz | 180kHz |
| 1.x                | B                     | 1      | 1      |
| 2.x                | C                     | 2      | 2      |
| 3.x                | F                     | 3      | 3      |
| 4.x                | E                     | 4      | 4      |
| 5.x                | F                     | 5      | 5      |
| 6.x                | H                     | 6      | 6      |
| 7.x                | K                     | 7      | 7      |

③ represents decimal number of output voltage and oscillation frequency

| OUTPUT VOLTAGE (V) | OSCILLATION FREQUENCY |        |        |
|--------------------|-----------------------|--------|--------|
|                    | 50kHz                 | 100kHz | 180kHz |
| x.0                | 0                     | 0      | A      |
| x.1                | 1                     | 1      | B      |
| x.2                | 2                     | 2      | C      |
| x.3                | 3                     | 3      | D      |
| x.4                | 4                     | 4      | E      |
| x.5                | 5                     | 5      | F      |
| x.6                | 6                     | 6      | H      |
| x.7                | 7                     | 7      | K      |
| x.8                | 8                     | 8      | L      |
| x.9                | 9                     | 9      | M      |

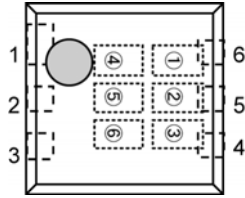
④ represents production lot number

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

## MARKING RULE (Continued)

[XC6371/XC6372] (Continued)

### ● USP-6B



USP-6B  
(TOP VIEW)

① represents product series

| MARK | PRODUCT SERIES |
|------|----------------|
| 5    | XC6371xxxxDx   |
| 2    | XC6372xxxxDx   |

② represents product classification

| MARK | PRODUCT SERIES |
|------|----------------|
| A    | XC6371A        |
| C    | XC6371C        |

③④ represents output voltage (ex.)

| MARK |   | OUTPUT VOLTAGE (V) |
|------|---|--------------------|
| ③    | ④ |                    |
| 3    | 3 | 3.3                |
| 5    | 0 | 5.0                |

⑤ represents oscillation frequency

| MARK | OSCILLATION FREQUENCY (kHz) |
|------|-----------------------------|
| 0    | 50                          |
| 1    | 100                         |
| 2    | 180                         |

⑥ represents production lot number

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

Note: No character inversion used.



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