

Regulated Voltage Step-Up Charge Pump ICs

■ GENERAL DESCRIPTION

The XC9801 series are fixed regulated voltage step-up charge pump ICs which provide stable, highly efficient, positive voltages with the only external components required being 2 capacitors.

Since regulating is done via the control of the charge pump's gate voltage waveform, ripple is minimal. Output voltage is selectable in 100mV steps within a 2.5V ~ 6.0V range.

Control of the XC9802 switches to PFM (pulse skip) during light loads without affecting output impedance or ripple so that the IC is protected against drops in efficiency. Connecting the SENSE pin to the GND pin allows the IC to be used as a voltage doubler.

As well as the ultra small MSOP-8A and USP-8 packages, the small consumption current and high efficiencies of the series make the XC9801 suitable for use with all types of battery operated applications.

■ APPLICATIONS

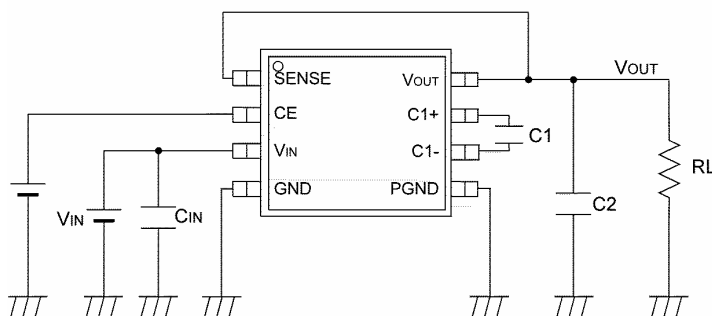
- Palm top computers, PDAs
- On board local power supplies
- Various battery powered devices

■ FEATURES

| | |
|--|-------------------------------|
| Input Voltage Range | : 1.8V ~ 5.5V |
| Output Voltage Range | : 2.5V ~ 6.0V |
| Small Input Current | : 80 μ A (no load:XC9802) |
| Output Current | : 80mA (3.6V→5.0V step-up) |
| Oscillation Frequency | : 300kHz |
| Stand-by Current (CE 'L') | : 2.0 μ A (MAX.) |
| PFM Operation During Light Loads (XC9802) | |
| CE (Chip Enable) Function | |
| Can be used as a step-up doubler (sense = 0V) | |
| Packages | : MSOP-8A, USP-8 |

■ TYPICAL APPLICATION CIRCUIT

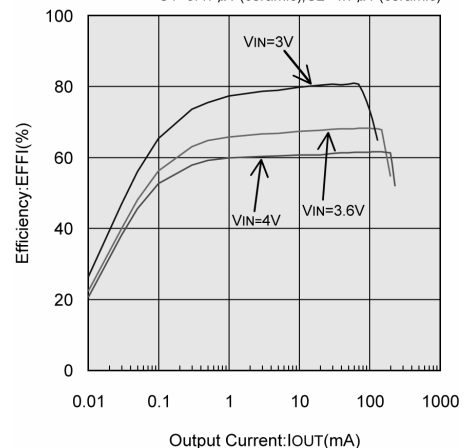
Regulation Output



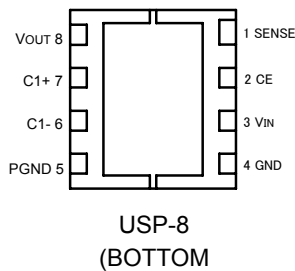
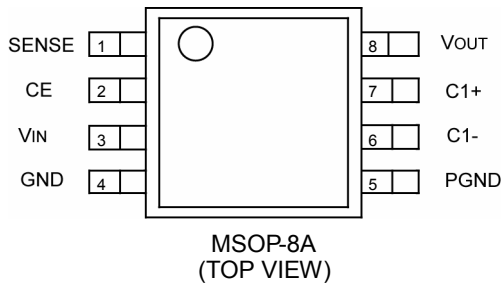
■ TYPICAL PERFORMANCE CHARACTERISTICS

XC9802B503KR(300kHz,5.0V)

CIN=1 μ F(ceramic)
C1=0.47 μ F(ceramic),C2=4.7 μ F(ceramic)



PIN CONFIGURATION



PIN ASSIGNMENT

| PIN NUMBER | | PIN NAME | FUNCTION |
|------------|---------|----------|---------------------------|
| USP-8 | MSOP-8A | | |
| 1 | 1 | SENSE | Output Voltage Monitor |
| 2 | 2 | CE | Chip Enable (High Active) |
| 3 | 3 | VIN | Input (Power Supply) |
| 4 | 4 | GND | Ground |
| 5 | 5 | PGND | Power Ground |
| 6 | 6 | C1- | External Capacitor - Pin |
| 7 | 7 | C1+ | External Capacitor + Pin |
| 8 | 8 | VOUT | Output |

PRODUCT CLASSIFICATION

● Selection Guide

| SERIES | PULSE SKIP MODE |
|--------|-----------------|
| XC9801 | Not Available |
| XC9802 | Available |

● Ordering Information

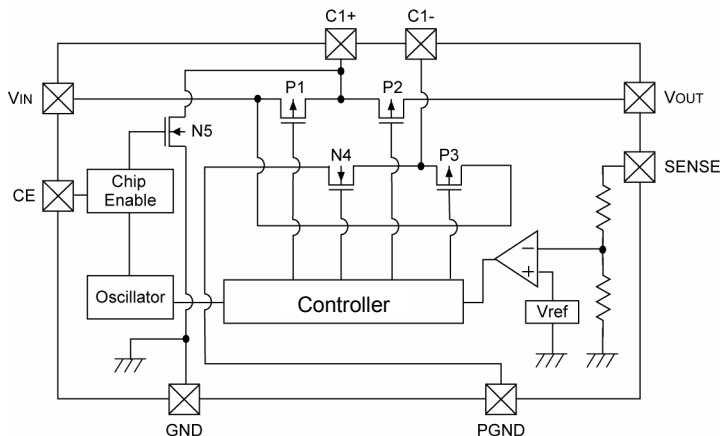
XC9801/02 ①②③④⑤⑥

| DESIGNATOR | DESCRIPTION | SYMBOL | DESCRIPTION |
|------------|----------------------------|---------|---|
| ① | True Logic Level at CE Pin | B | : Positive |
| ② ③ | Output Voltage | 50 | : Standard voltage V _{OUT} =5.0V→②=5, ③=0 |
| | | 25 ~ 60 | : Semi-custom voltage e.g. V _{OUT} =2.5V→②=2, ③=5 |
| ④ | Oscillation Frequency | 3 | : 300kHz |
| ⑤ | Package | K | : MSOP-8A |
| | | D | : USP-8 |
| ⑥ | Device Orientation | R | : Embossed tape, standard feed |
| | | L | : Embossed tape, reverse feed |

Regulated output voltage function cannot be used by the following input voltage condition:

$$V_{IN} < (V_{OUT}/2), \text{ or } V_{IN} \geq V_{OUT}$$

■ BLOCK DIAGRAM



(1) Basic Operations

Using the XC9801/02's clock generated by the internal oscillator, a step-up charge pump operation can be brought about as a result of the alternate switching between operating conditions where P1 & N4 are ON with P2 & P3 OFF (or) P1 & N4 are OFF with P2 & P3 ON. By connecting the SENSE pin to V_{OUT}, output voltage can be feedback and the difference between the feedback voltage and the reference voltage (V_{ref}) are compared by the internal operational amplifier. Output voltage can be stabilized (* 2) by controlling P3's gate voltage waveform via the signal generated by the internal amplifier.

Please note that this stabilizing function will not operate with $V_{IN} < (V_{OUT}/2)$ or $V_{IN} \geq V_{OUT}$.

By connecting SENSE to ground, the output stability function, as described above, can be halted and the IC can be used as a step-up doubler.

* 2 : As a result of P3 gradually reaching an ON state with each clock (signal), rush current is controlled, the ripple decreases and with the combination of the independent phase compensation circuit, output voltage is stabilized

(2) Stand-by Function

When the voltage at CE (chip enable) is 'low' (0V), P1, P2 & P3 will be OFF with N4 & N5 ON. The external capacitor C1 will discharge and impedance at V_{OUT} will be high.

(3) PFM (Pulse Skip) Operations

Whilst maintaining output voltage, the XC9802 provides the added security of protection against drops in efficiency during light loads as a result of the pulse, generated by the internal oscillator, being skipped and the operating frequency being changed.

■ ABSOLUTE MAXIMUM RATINGS

T_a = 25°C, GND = 0V

| PARAMETER | SYMBOL | CONDITIONS | UNITS |
|-------------------------------------|------------------|----------------------------|-------|
| V _{IN} pin Voltage | V _{IN} | -0.3~6.0 | V |
| V _{OUT} pin Voltage | V _{OUT} | -0.3~12.0 | V |
| C1 + pin Voltage | C1+ | -0.3~V _{OUT} +0.3 | V |
| C1 - pin Voltage | C1- | -0.3~V _{OUT} +0.3 | V |
| CE pin Voltage | V _{CE} | -0.3~V _{IN} +0.3 | V |
| V _{OUT} Pin Output Current | I _{OUT} | 200 | mA |
| Power Dissipation | MSOP-8A | P _d | mW |
| | USP-8 | | |
| Operating Temperature Range | T _{opr} | -40~+85 | °C |
| Storage Temperature Range | T _{stg} | -40~+125 | °C |

ELECTRICAL CHARACTERISTICS

XC9801B503KR V_{OUT}=5.0V

T_a=25°C

| PARAMETER | SYMBOL | CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
|-------------------------------|-------------------|--|-------------------------------|-------|-------|-------|-------|
| Output Voltage | V _{OUT} | Regulation Output | I _{OUT} =1mA | 4.875 | 5.000 | 5.125 | V |
| Load Regulation | ΔV _{OUT} | Regulation Output | 1mA ≤ I _{OUT} ≤ 80mA | -100 | - | 100 | mV |
| Operating Voltage Range | V _{IN} | Doubler Output, V _{OUT} > V _{IN} × 2 × 0.95 | | 1.8 | - | 5.5 | V |
| Supply Current | I _{DD} | V _{IN} =3.6V, External Components=C _{IN} only, SENSE=0V, V _{OUT} =V _{IN} | | 1 | 3 | 6 | mA |
| Stand-by Current | I _{STB} | CE=0V | | - | - | 2.0 | μA |
| Oscillation Frequency | F _{OSC} | External Component=C _{IN} only, SENSE=0V, V _{OUT} open | | 255 | 300 | 345 | kHz |
| Output Impedance | R _{OUT} | Doubler Output | I _{OUT} =10mA | - | 20 | 40 | Ω |
| Input Current | I _{IN} | Doubler Output | | - | 5 | - | mA |
| | I _{IN2} | Regulation Output | | - | 1.5 | - | mA |
| Voltage Converting Efficiency | V _{EFF1} | Doubler Output | | 95 | 99 | - | % |
| Power Converting Efficiency | EFF1 | Doubler Output | I _{OUT} =10mA | 73 | 78 | - | % |
| | EFFI2 | Regulation Output | I _{OUT} =1mA | - | 40 | - | % |
| | EFFI3 | | I _{OUT} =80mA | 64 | 69 | - | % |
| CE / 'H' Level Voltage | V _{CEH} | | | 1.5 | - | - | V |
| CE / 'L' Level Voltage | V _{CEL} | | | - | - | 0.25 | V |
| CE / Input Current | I _{CE} | V _{IN} =5.5V, SENSE=0V, External Components=C _{IN} only | | -2.0 | - | 2.0 | μA |

Test Conditions: Unless otherwise stated, Typical Application Circuit, V_{IN}=3.6V,
GND=0V, CE=V_{IN}, No Load, SENSE=V_{OUT} (Regulation Output)

XC9802B503KR V_{OUT}=5.0V

T_a=25°C

| PARAMETER | SYMBOL | CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
|-------------------------------|-------------------|--|-------------------------------|-------|-------|-------|-------|
| Output Voltage | V _{OUT} | Regulation Output | I _{OUT} =1mA | 4.875 | 5.000 | 5.125 | V |
| Load Regulation | ΔV _{OUT} | Regulation Output | 1mA ≤ I _{OUT} ≤ 80mA | -100 | - | 100 | mV |
| Operating Voltage Range | V _{IN} | Doubler Output, V _{OUT} > V _{IN} × 2 × 0.95 | | 1.8 | - | 5.5 | V |
| Supply Current | I _{DD} | V _{IN} =3.6V, External Components=C _{IN} only, SENSE=0V, V _{OUT} =V _{IN} | | 1 | 3 | 6 | mA |
| Stand-by Current | I _{STB} | CE=0V | | - | - | 2.0 | μA |
| Oscillation Frequency | F _{OSC} | External Component = C _{IN} only, SENSE=0V, V _{OUT} open | | 255 | 300 | 345 | kHz |
| Switching Pulse Frequency | F _{OSC2} | Regulation Output | I _{OUT} =1mA | - | 10 | - | kHz |
| Output Impedance | R _{OUT} | Doubler Output | I _{OUT} =10mA | - | 20 | 40 | Ω |
| Input Current | I _{IN} | Doubler Output | | - | 5 | - | mA |
| | I _{IN2} | Regulation Output | | - | 0.08 | - | mA |
| Voltage Converting Efficiency | V _{EFF1} | Doubler Output | | 98 | 99 | - | % |
| Power Converting Efficiency | EFF1 | Doubler Output | I _{OUT} =10mA | 73 | 78 | - | % |
| | EFFI2 | Regulation Output | I _{OUT} =1mA | - | 59 | - | % |
| | EFFI3 | | I _{OUT} =80mA | 64 | 69 | - | % |
| CE / 'H' Level Voltage | V _{CEH} | | | 1.5 | - | - | V |
| CE / 'L' Level Voltage | V _{CEL} | | | - | - | 0.25 | V |
| CE / Input Current | I _{CE} | V _{IN} =5.5V, SENSE=0V, External Components=C _{IN} only | | -2.0 | - | 2.0 | μA |

Test Conditions: Unless otherwise stated, Typical Application Circuit, V_{IN}=3.6V,
GND=0V, CE=V_{IN}, No Load, SENSE=V_{OUT} (Regulation Output)

■ ELECTRICAL CHARACTERISTICS (Continued)

XC9801B333KR $V_{OUT}=3.3V$

$T_a=25^{\circ}C$

| PARAMETER | SYMBOL | CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
|-------------------------------|------------------|--|-----------------------------|-------|-------|-------|----------|
| Output Voltage | V_{OUT} | Regulation Output | $I_{OUT}=1mA$ | 3.218 | 3.300 | 3.383 | V |
| Load Regulation | ΔV_{OUT} | Regulation Output | $1mA \leq I_{OUT} \leq 2mA$ | -66 | - | 66 | mV |
| Operating Voltage Range | V_{IN} | Doubler Output, $V_{OUT} > V_{IN} \times 2 \times 0.95$ | | 1.8 | - | 5.5 | V |
| Supply Current | I_{DD} | $V_{IN}=3.6V$, External components= C_{IN} only, SENSE=0V, $V_{OUT}=V_{IN}$ | | 1 | 3 | 6 | mA |
| Stand-by Current | I_{STB} | CE=0V | | - | - | 2.0 | μA |
| Oscillation Frequency | FOSC | External component= C_{IN} only, SENSE=0V, V_{OUT} open | | 255 | 300 | 345 | kHz |
| Output Impedance | R_{OUT} | Doubler Output | $I_{OUT}=10mA$ | - | 20 | 40 | Ω |
| Input Current | I_{IN} | Doubler Output | | - | 5 | - | mA |
| | I_{IN2} | Regulation Output | | - | 1.1 | - | mA |
| Voltage Converting Efficiency | V_{EFF1} | Doubler Output | | 95 | 99 | - | % |
| Power Converting Efficiency | $EFF1$ | Doubler Output | $I_{OUT}=10mA$ | 73 | 78 | - | % |
| | $EFFI2$ | Regulation Output | $I_{OUT}=1mA$ | - | 40 | - | % |
| | $EFFI3$ | | $I_{OUT}=32mA$ | 64 | 69 | - | % |
| CE / 'H' Level Voltage | V_{CEH} | | | 1.5 | - | - | V |
| CE / 'L' Level Voltage | V_{CEL} | | | - | - | 0.25 | V |
| CE / Input Current | I_{CE} | $V_{IN}=5.5V$, SENSE=0V, External Components= C_{IN} only | | -2.0 | - | 2.0 | μA |

Test Conditions: Unless otherwise stated, Typical Application Circuit, $V_{IN}=2.376V$,
GND=0V, CE= V_{IN} , No Load, SENSE= V_{OUT} (Regulation Output)

XC9802B333KR $V_{OUT}=3.3V$

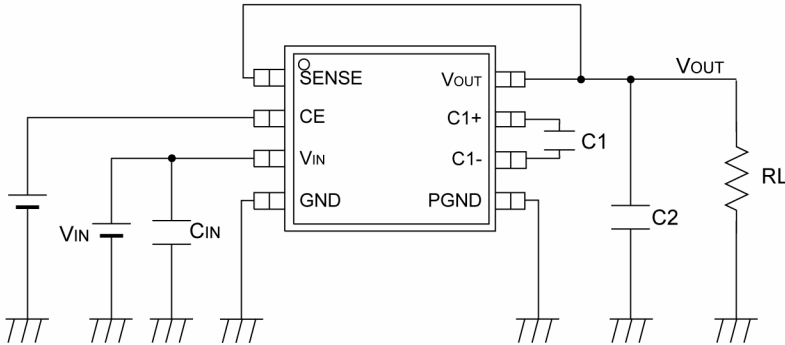
$T_a=25^{\circ}C$

| PARAMETER | SYMBOL | CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
|-------------------------------|------------------|--|------------------------------|-------|-------|-------|----------|
| Output Voltage | V_{OUT} | Regulation Output | $I_{OUT}=1mA$ | 3.218 | 3.300 | 3.383 | V |
| Load Regulation | ΔV_{OUT} | Regulation Output | $1mA \leq I_{OUT} \leq 32mA$ | -66 | - | 66 | mV |
| Operating Voltage Range | V_{IN} | Doubler Output, $V_{OUT} > V_{IN} \times 2 \times 0.95$ | | 1.8 | - | 5.5 | V |
| Supply Current | I_{DD} | $V_{IN}=3.6V$, External Components= C_{IN} only, SENSE=0V, $V_{OUT}=V_{IN}$ | | 1 | 3 | 6 | mA |
| Stand-by Current | I_{STB} | CE=0V | | - | - | 2.0 | μA |
| Oscillation Frequency | FOSC | External Component = C_{IN} only, SENSE=0V, V_{OUT} open | | 255 | 300 | 345 | kHz |
| Switching Pulse Frequency | FOSC2 | Regulation Output | $I_{OUT}=1mA$ | - | 10 | - | kHz |
| Output Impedance | R_{OUT} | Doubler Output | $I_{OUT}=10mA$ | - | 20 | 40 | Ω |
| Input Current | I_{IN} | Doubler Output | | - | 5 | - | mA |
| | I_{IN2} | Regulation Output | | - | 0.08 | - | mA |
| Voltage Converting Efficiency | V_{EFF1} | Doubler Output | | 98 | 99 | - | % |
| Power Converting Efficiency | $EFF1$ | Doubler Output | $I_{OUT}=10mA$ | 73 | 78 | - | % |
| | $EFFI2$ | Regulation Output | $I_{OUT}=1mA$ | - | 63 | - | % |
| | $EFFI3$ | | $I_{OUT}=32mA$ | 64 | 69 | - | % |
| CE / 'H' Level Voltage | V_{CEH} | | | 1.5 | - | - | V |
| CE / 'L' Level Voltage | V_{CEL} | | | - | - | 0.25 | V |
| CE / Input Current | I_{CE} | $V_{IN}=5.5V$, SENSE=0V, External Components= C_{IN} only | | -2.0 | - | 2.0 | μA |

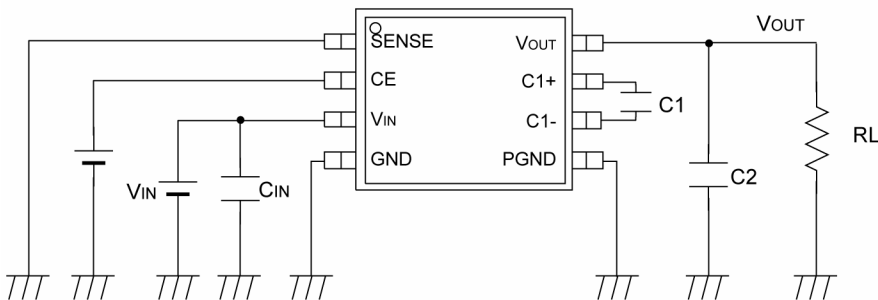
Test Conditions: Unless otherwise stated, Typical Application Circuit, $V_{IN}=2.376V$,
GND=0V, CE= V_{IN} , No Load, SENSE= V_{OUT} (Regulation Output)

TYPICAL APPLICATION CIRCUITS

① Regulation Output



② Doubler Output



External Components:

$C_{IN}=1\ \mu\text{F}$ (Ceramic Capacitor: TAIYO YUDEN)

$C1=0.47\ \mu\text{F}$ (Ceramic Capacitor: TAIYO YUDEN)

$C2=4.7\ \mu\text{F}$ (Ceramic Capacitor: TAIYO YUDEN)

Note: The XC9801 series are step-up charge pump voltage doublers which provide regulated output voltage.

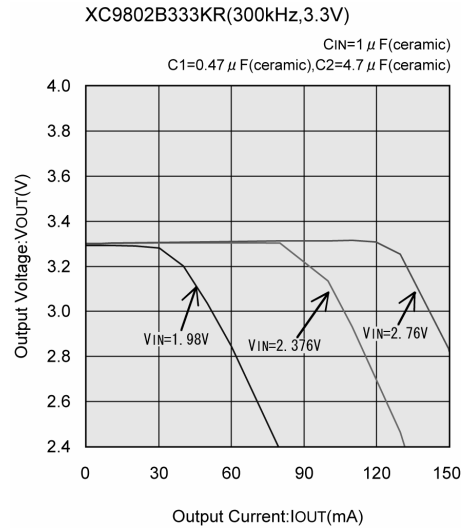
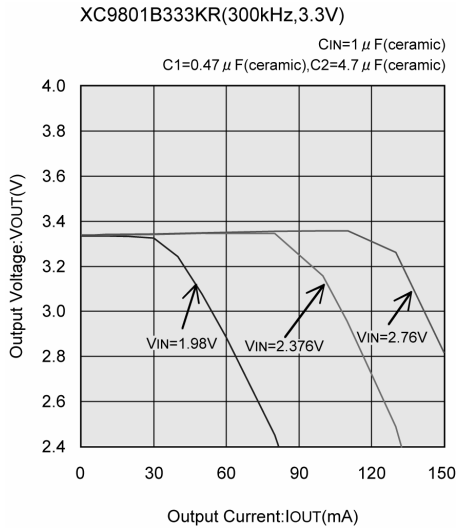
The application circuit of the doubler output (②) halts the regulated output function and operates as a normal voltage doubler.

The output voltage is stable when connected as in (①) above, except when $V_{IN} < (V_{OUT} / 2)$ and $V_{IN} \geq V_{OUT}$.

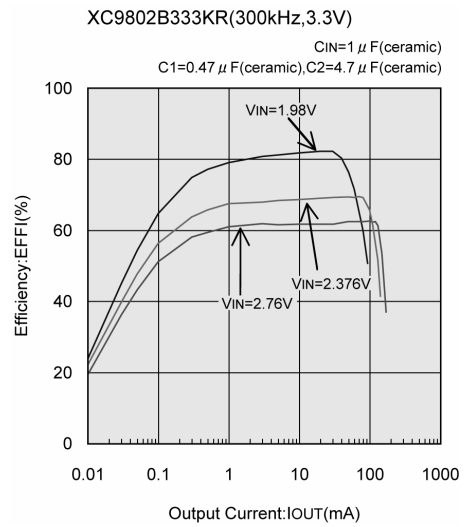
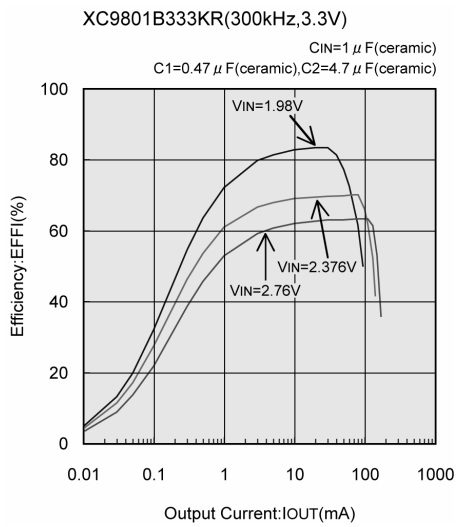
TYPICAL PERFORMANCE CHARACTERISTICS

● XC9801B333KR (300kHz, 3.3V)

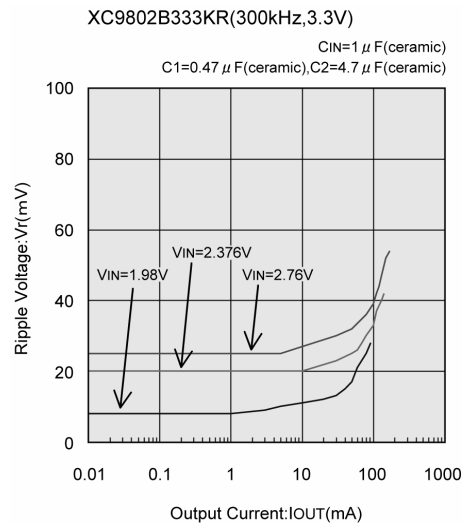
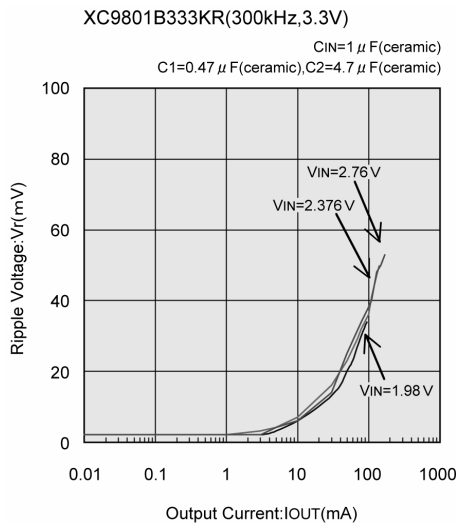
(1) Output Voltage vs. Output Current



(2) Efficiency vs. Output Current



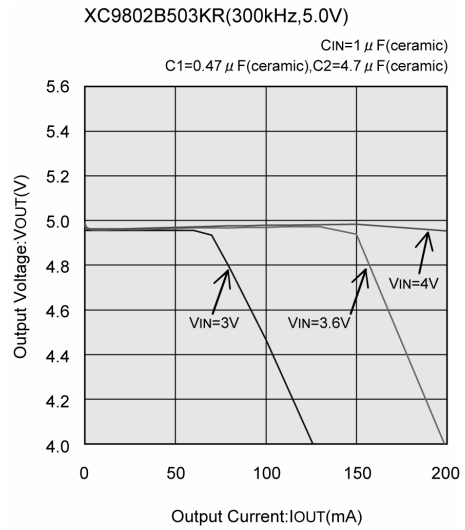
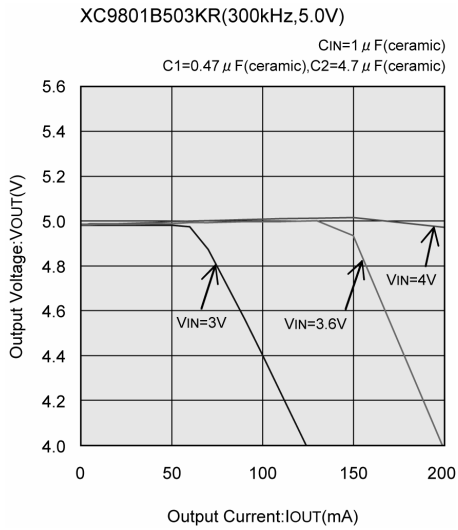
(3) Ripple Voltage vs. Output Current



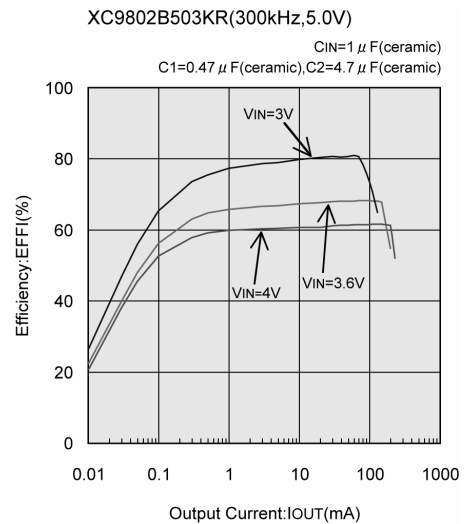
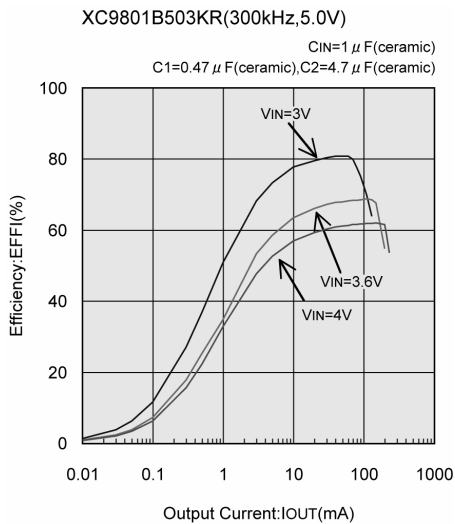
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC9801B503KR (300kHz, 5.0V)

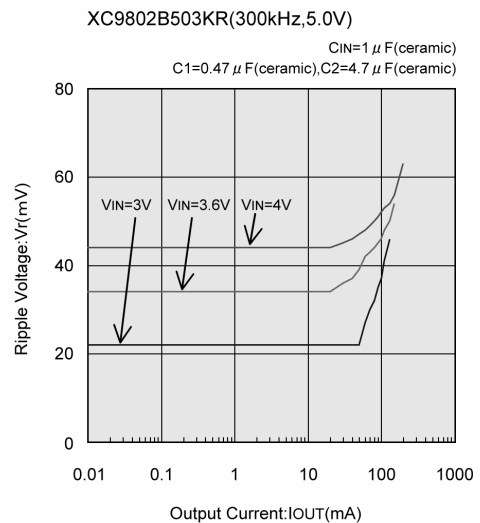
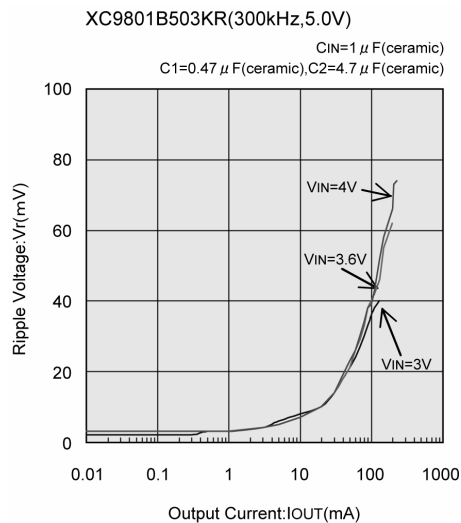
(1) Output Voltage vs. Output Current



(2) Efficiency vs. Output Current



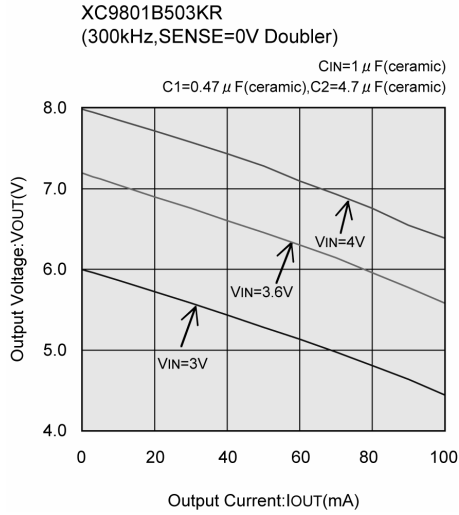
(3) Ripple Voltage vs. Output Current



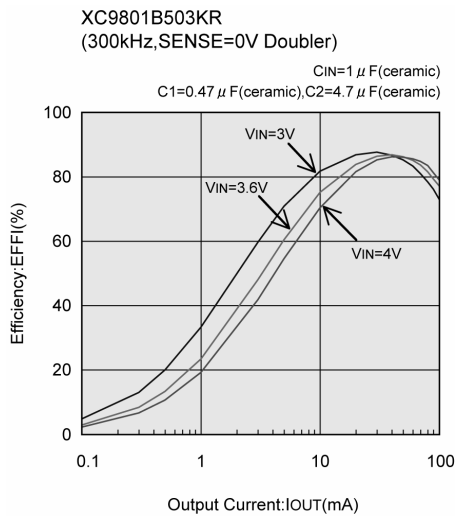
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

● XC9801B503KR (300kHz, SENSE=0V, Doubler)

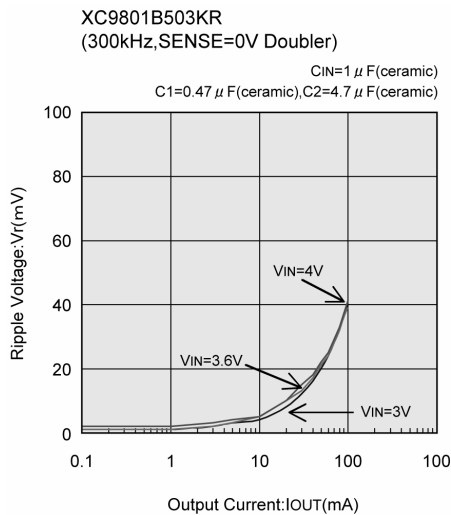
(1) Output Voltage vs. Output Current



(2) Efficiency vs. Output Current

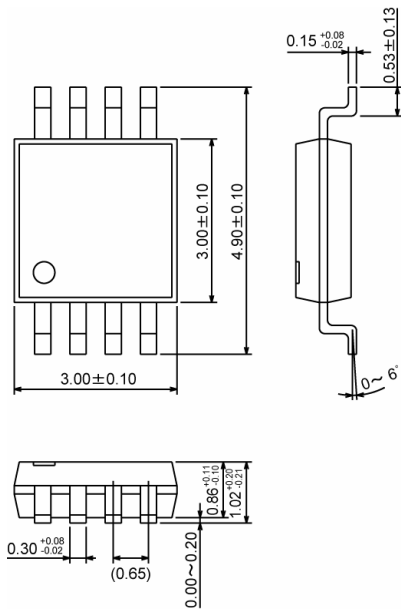


(3) Ripple Voltage vs. Output Current

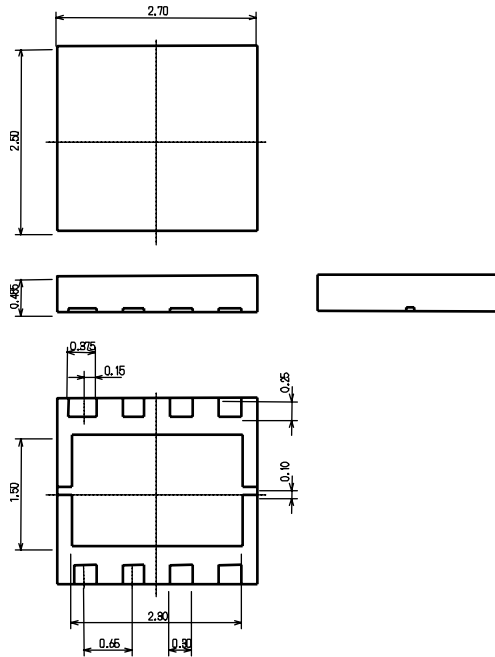


PACKAGING INFORMATION

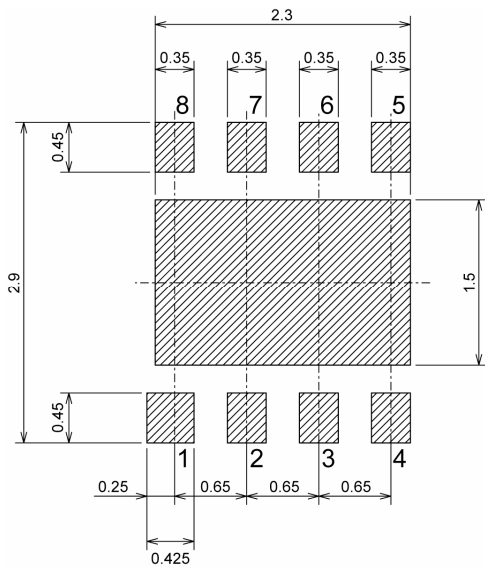
● MSOP-8A



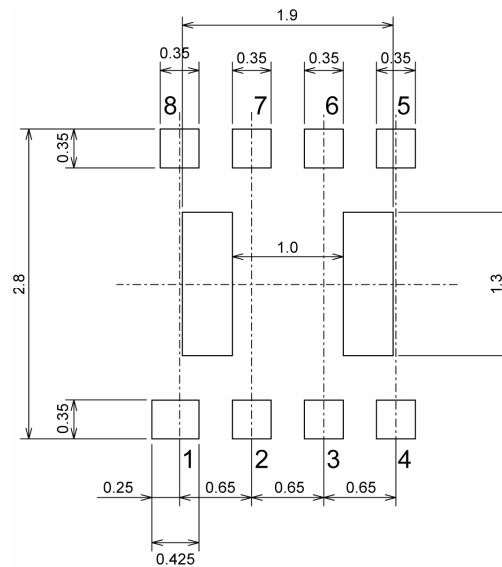
● USP-8



● USP-8 Recommended Pattern Layout

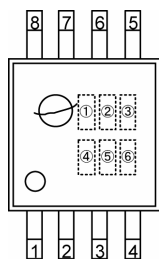


● USP-8 Recommended Metal Mask Design



MARKING RULE

●MSOP-8A



MSOP-8A
(TOP VIEW)

① Represents product series

| MARK | PRODUCT SERIES |
|------|----------------|
| 2 | XC9801Bxx3Kx |
| 3 | XC9802Bxx3Kx |

② Represents true logic level at the CE pin

| MARK | PRODUCT SERIES |
|------|-------------------|
| B | XC9801/9802Bxx3Kx |

③④ Represents output voltage

| MARK | | VOLTAGE (V) | PRODUCT SERIES |
|------|---|-------------|-------------------|
| ③ | ④ | | |
| 3 | 3 | 3.3 | XC9801/9802B333Kx |
| 5 | 0 | 5.0 | XC9801/9802B503Kx |

⑤ Represents oscillation frequency

| MARK | OSCILLATION FREQUENCY (kHz) | PRODUCT SERIES |
|------|-----------------------------|-------------------|
| 3 | 300 | XC9801/9802Bxx3Kx |

⑥ Represents production lot number
0 to 9, A to Z repeated (G, I, J, O, Q, W excepted)
Note: No character inversion used.

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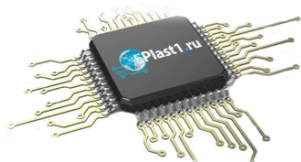
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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