- **CMOS Low Power Consumption**
- **Operating Voltage : 0.9V~10.0V**
- **Output Voltage Range: 2.0V~7.0V**
- **Output Voltage Accuracy: ±2.5%**
- **Selectable Oscillator Frequency: (50kHz, 100kHz, 180kHz)**

## Applications

- Cellular phones, Pagers
- Palmtops
- Cameras, Video recorders
- Portable products



## General Description

The XC6371 series is a group of PWM controlled step-up DC/DC converters. The XC6371 series employs CMOS process and laser trimming technologies so as to attain low power and high accuracy. On-chip proprietary phase compensation and slow start-up circuits ensure excellent transient response and improved performance.
Output voltage can be selected from 2.0V to 7.0V in 0.1V increments (accuracy: ±2.5%). Oscillator frequency is also selectable from three frequencies; 50, 100, and 180kHz (accuracy: ±15%).
Every built-in switching transistor type enables a step-up circuit to be configured using only three external components; a coil, a diode, and a capacitor. External transistor versions are available to accommodate high output current applications.
5-pin packages, which are provided with either a CE (chip enable) function that reduces power consumption during shut-down mode, or a $V_{DD}$ pin (separated power and voltage detect pins) are available.
SOT-89 small package.

## Features

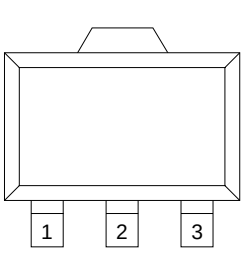
**Operating (start-up) voltage range:** 0.9V~10V
**Output voltage range:** 2.0V~7.0V in 0.1V increments
**Highly accurate:** Set-up voltage ±2.5%
**Oscillator frequency:** 50kHz, 100kHz, 180khz (±15%) selectable
**Maximum output currents (Tr built-in) :** Typ.100mA at $V_{IN}$=3.0, $V_{OUT}$=5.0V .....Note(1)
**Highly efficient (Tr built-in):** Typ.85% at $V_{IN}$=3.0, $V_{OUT}$=5.0V.....Note(1)
**Built-in switching transistor type and an external Tr type available.**
**Five-lead packaged units offer either Chip Enable or independent $V_{OUT}$ pin option.**
**Phase compensation and slow start-up circuits built-in**
**Small package:** SOT-89 mini-power mold (3-pin, 5-pin)

**Note(1):** Performance depends on external components and PCB layout.

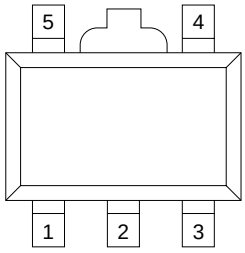
## Selection Guide

| PART TYPE | OPERATION MODE | PACKAGE | SWITCHING RELATED | ADDITIONAL FUNCTION | FEATURES |
|---|---|---|---|---|---|
| XC6371A | PWM | SOT-89-3 | Built-in Transistor "Lx"lead | ---------- | ・Switching transistor incorporated standard type.<br>・Low ripple and highly efficient from low current to high current. |
| XC6371B | PWM | SOT-89-3 | External Transistor "EXT"lead | ---------- | ・External switching transistor standard type.<br>・Adding external transistor can improve the output capability up to several hundred mA. |
| XC6371C | PWM | SOT-89-5 | Built-in Transistor "Lx"lead | Chip Enable(CE) | ・Stand-by (CE)function added version to the XC6371A.<br>・Stand-by current: 0.5μA max. |
| XC6371D | PWM | SOT-89-5 | External Transistor "EXT"lead | Chip Enable(CE) | ・Stand-by (CE)function added version to the XC6371B.<br>・Stand-by current: 0.5μA max. |
| XC6371E | PWM | SOT-89-5 | Built-in Transistor "Lx"lead | Separated "$V_{DD}$"and"$V_{OUT}$"leads | ・Individual power supply and set-up voltage sensing leads are available |
| XC6371F | PWM | SOT-89-5 | External Transistor "EXT"lead | Separated "$V_{DD}$"and"$V_{OUT}$"leads | ・Individual power supply and set-up voltage sensing leads are available. |

## ■ Pin Configuration




SOT-89
(TOP VIEW)




SOT-89-5
(TOP VIEW)

## ■ Pin Assignment

(XC6371A,XC6371B)

| PIN NUMBER | | PIN NAME | FUNCTION |
|---|---|---|---|
| XC6371A | XC6371B | | |
| 1 | 1 | $V_{SS}$ | Ground |
| 2 | 2 | $V_{OUT}$ | Output voltage monitor / IC internal power supply |
| 3 | -- | Lx | Switch |
| -- | 3 | EXT | External switch transistor drive |

(XC6371C,XC6371D)

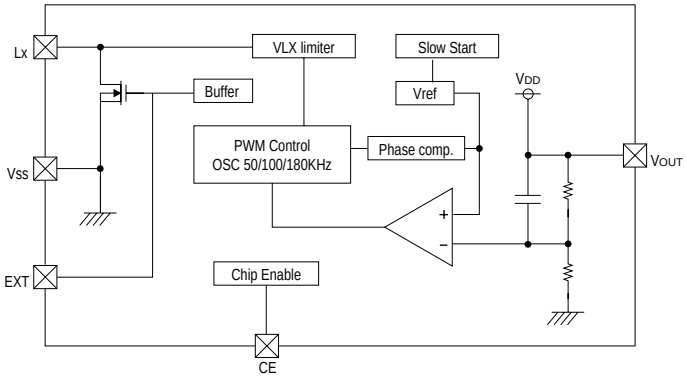
| PIN NUMBER | | PIN NAME | FUNCTION |
|---|---|---|---|
| XC6371C | XC6371D | | |
| 5 | 5 | $V_{SS}$ | Ground |
| 2 | 2 | $V_{OUT}$ | Output voltage monitor / IC internal power supply |
| 4 | -- | Lx | Switch |
| -- | 4 | EXT | External switch transistor drive |
| 3 | 3 | CE | Chip Enable |
| 1 | 1 | NC | No Connection |

(XC6371E,XC6371F)

| PIN NUMBER | | PIN NAME | FUNCTION |
|---|---|---|---|
| XC6371E | XC6371F | | |
| 5 | 5 | $V_{SS}$ | Ground |
| 2 | 2 | $V_{DD}$ | IC internal power supply |
| 4 | -- | Lx | Switch |
| -- | 4 | EXT | External switch transistor drive |
| 3 | 3 | $V_{OUT}$ | Output voltage monitor |
| 1 | 1 | NC | No Connection |

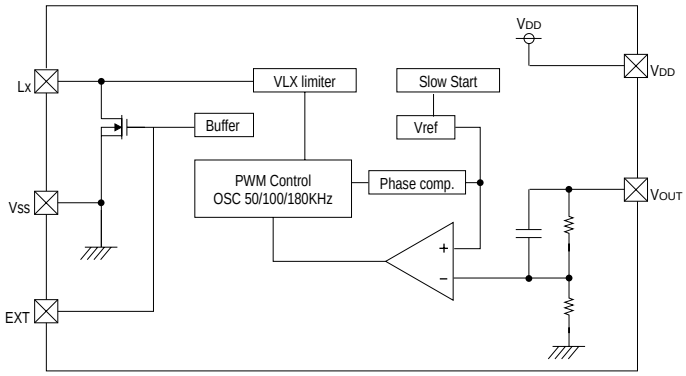
## Block Diagram

XC6371A ~ XC6371D
(The VOUT pin is used also for the VDD pin.)




Note: Built-in tr.type units use the LX pin. External tr.type units use the EXT pin.
The CE pin is only used with the XC6371C and XC6371D.

XC6371E and XC6371F




Note: The VDD pin is only used with XC6371E and XC6371F.
Built-in tr.type units use the LX pin. External tr.type units use the EXT pin.

## Absolute Maximum Ratings

Ta=25℃

| PARAMETER | SYMBOL | RATINGS | UNITS |
|---|---|---|---|
| VOUT Input Voltage | VOUT | 12 | V |
| Lx pin Voltage | VLX | 12 | V |
| Lx pin Current | ILX | 400 | mA |
| EXT pinVoltage | VEXT | VSS –0.3 ~ VOUT+0.3 | V |
| EXT pin Current | IEXT | ±50 | mA |
| CE Input Voltage | VCE | 12 | V |
| Continuous Total Power Dissipation | Pd | 500 | mW |
| VDD Input Voltage | VDD | 12 | V |
| Operating Ambient Temperature | Topr | –30 ~ +80 | ℃ |
| Storage Temperature | Tstg | –40 ~ +125 | ℃ |

## Electrical Characteristics

XC6371A501PR VOUT=5.0V,FOSC=100kHz Ta=25℃

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage | VOUT | | 4.875 | 5.000 | 5.125 | V |
| Maximum Input Voltage | VIN | | 10 | | | V |
| Operation Start-up Voltage | VST1 | External Components Connected. IOUT=1mA. | | | 0.90 | V |
| Oscillation Start-up Voltage | VST2 | No external components. Apply voltage to VOUT. Lx : 10kΩ pull-up to 5V. | | | 0.80 | V |
| Supply Current 1 | IDD1 | Same as VST2. Apply output voltage×0.95 to VOUT. | | 80.2 | 133.8 | μA |
| Supply Current 2 | IDD2 | Same as VST2. Apply output voltage×1.1 to VOUT. | | 8.2 | 16.5 | μA |
| Lx Switch-On Resistance | RSWON | Same as IDD 1. VLX=0.4V. | | 1.4 | 2.4 | Ω |
| Lx Leakage Current | ILXL | No external components. VOUT=VLX=10V. | | | 1.0 | μA |
| Oscillator Frequency | FOSC | Same as IDD 1. Measuring of Lx waveform. | 85 | 100 | 115 | kHz |
| Maximum Duty Ratio | MAXDTY | Same as IDD 1. Measuring of Lx waveform. | 80 | 87 | 92 | % |
| Lx Limit Voltage | VLXLMT | Same as IDD 1. Apply output voltage to Lx. Voltage required to produce FOSC×2 | 0.7 | | 1.3 | V |
| Efficiency | EFFI | | | 85 | | % |
| Slow-Start Time | TSS | | 4.0 | 10.0 | 20.0 | ms |

Measuring conditions : Unless otherwise specified, VIN=VOUT × 0.6, IOUT=50mA. See Typical Application Circuits, Fig.1.

## ■ Electrical Characteristics

XC6371B501PR Vout=5.0V,Fosc=100kHz Ta=25℃

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage | VOUT | | 4.875 | 5.000 | 5.125 | V |
| Maximum Input Voltage | VIN | | 10 | | | V |
| Operation Start-up Voltage | VST1 | External Components Connected.IOUT=1mA. | | | 0.90 | V |
| Oscillation Start-up Voltage | VST2 | No external components.<br>Apply voltage to VOUT. | | | 0.80 | V |
| Supply Current 1 | IDD1 | Same as VST2.<br>Apply output voltage×0.95 to VOUT. | | 40.0 | 66.8 | μA |
| Supply Current 2 | IDD2 | Same as VST2.<br>Apply output voltage×1.1 to VOUT. | | 8.2 | 16.5 | μA |
| EXT"High" On Resistance | REXTH | Same as IDD 1. VEXT=–0.4V. | | 37.5 | 62.5 | Ω |
| EXT"Low" On Resistance | REXTL | Same as IDD 1. VEXT=0.4V. | | 30 | 50 | Ω |
| Oscillator Frequency | FOSC | Same as IDD1. Measuring of EXT waveform. | 85 | 100 | 115 | kHz |
| Maximum Duty Ratio | MAXDTY | Same as IDD1. Measuring of EXT waveform. | 80 | 87 | 92 | % |
| Efficiency | EFFI | | | 85 | | % |
| Slow-Start Time | TSS | | 4.0 | 10.0 | 20.0 | ms |

Measuring conditions: Unless otherwise specified, VIN=VOUT×0.6, IOUT=50mA. See Typical Application Circuits, Fig.2.

XC6371C501PR Vout=5.0V,Fosc=100kHz Ta=25℃

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage | VOUT | | 4.875 | 5.000 | 5.125 | V |
| Maximum Input Voltage | VIN | | 10 | | | V |
| Operation Start-up Voltage | VST1 | External Components Connected.IOUT=1mA. | | | 0.90 | V |
| Oscillation Start-up Voltage | VST2 | No external components. Apply voltage to VOUT.<br>Lx : 10kΩ pull-up to 5V. | | | 0.80 | V |
| Supply Current 1 | IDD1 | Same as VST2.<br>Apply output voltage×0.95 to VOUT. | | 80.2 | 133.8 | μA |
| Supply Current 2 | IDD2 | Same as VST2.<br>Apply output voltage×1.1 to VOUT. | | 8.2 | 16.5 | μA |
| Lx Switch-On Resistance | RSWON | Same as IDD 1. VLX=0.4V. | | 1.4 | 2.4 | Ω |
| Lx Leakage Current | ILXL | No external components. VOUT=VLx=10V. | | | 1.0 | μA |
| Osicillator Frequency | FOSC | Same as IDD 1. Measuring of Lx waveform. | 85 | 100 | 115 | kHz |
| Maximum Duty Ratio | MAXDTY | Same as IDD 1. Measuring of Lx waveform. | 80 | 87 | 92 | % |
| Stand-by Current | ISTB | Same as IDD 1. | | | 0.5 | μA |
| CE"High"Voltage | VCEH | Same as IDD 1. Existence of Lx Oscillation. | 0.75 | | | V |
| CE"Low"Voltage | VCEL | Same as IDD 1. Disappearance of Lx Oscillation. | | | 0.20 | V |
| CE"High"Current | ICEH | Same as IDD 1.VCE=VOUT×0.95. | | | 0.25 | μA |
| CE"Low"Current | ICEL | Same as IDD 1. VCE=0V. | | | –0.25 | μA |
| Lx Limit Voltage | VLxLMT | Same as IDD 1. Apply output voltage to Lx.<br>Voltage required to produce FOSC×2. | 0.7 | | 1.3 | V |
| Efficiency | EFFI | | | 85 | | % |
| Slow-Start Time | TSS | | 4.0 | 10.0 | 20.0 | ms |

Measuring conditions: Unless otherwise specified, connect CE to VOUT,VIN=VOUT×0.6, IOUT=50mA. See Typical Application Circuits, Fig.3.

## ■ Electrical Characteristics

XC6371D501PR VOUT=5.0V,FOSC=100kHZ Ta=25℃

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage | VOUT | | 4.875 | 5.000 | 5.125 | V |
| Maximum Input Voltage | VIN | | 10 | | | V |
| Operation Start-up Voltage | VST1 | External Components Connected. IOUT=1mA. | | | 0.90 | V |
| Oscillation Start-up Voltage | VST2 | No external components.<br>Apply voltage to Vout. | | | 0.80 | V |
| Supply Current 1 | IDD1 | Same as VST2.<br>Apply output voltage×0.95 to VOUT. | | 40.0 | 66.8 | μA |
| Supply Current 2 | IDD2 | Same as VST2.<br>Apply output voltage×1.1 to VOUT. | | 8.2 | 16.5 | μA |
| EXT "High" On Resistance | REXTH | Same as IDD 1. VEXT=–0.4V. | | 37.5 | 62.5 | Ω |
| EXT "Low" On Resistance | REXTL | Same as IDD 1. VEXT=0.4V. | | 30 | 50 | Ω |
| Oscillator Frequency | FOSC | Same as IDD 1. Measuring of EXT waveform. | 85 | 100 | 115 | kHz |
| Maximum Duty Ratio | MAXDTY | Same as IDD 1. Measuring of EXT waveform. | 80 | 87 | 92 | % |
| Stand-by Current | ISTB | Same as IDD 1. | | | 0.5 | μA |
| CE"High"Voltage | VCEH | Same as IDD 1. Existence of Lx Oscillation. | 0.75 | | | V |
| CE"Low"Voltage | VCEL | Same as IDD 1. Disappearance of Lx Oscillation. | | | 0.20 | V |
| CE"High"Current | ICEH | Same as IDD 1.VCE=VOUT×0.95. | | | 0.25 | μA |
| CE"Low"Current | ICEL | Same as IDD 1.VCE=0V. | | | –0.25 | μA |
| Efficiency | EFFI | | | 85 | | % |
| Slow-Start Time | TSS | | 4.0 | 10.0 | 20.0 | ms |

Measuring conditions: Unless otherwise specified, connect CE to VOUT,VIN=VOUT×0.6, IOUT=50mA. See Typical Application Circuits,Fig.4.

XC6371E501PR VOUT=5.0V,FOSC=100kHz Ta=25℃

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage | VOUT | | 4.875 | 5.000 | 5.125 | V |
| Maximum Input Voltage | VIN | | 10 | | | V |
| Operation Start-up Voltage | VST1 | External Components Connected. IOUT=1mA. | | | 0.90 | V |
| Oscillation Start-up Voltage | VST2 | No external components.<br>Apply voltage to VOUT. | | | 0.80 | V |
| Supply Current 1 | IDD1 | Same as VST2.<br>Apply output voltage×0.95 to VOUT. | | 80.2 | 133.8 | μA |
| Supply Current 2 | IDD2 | Same as VST2.<br>Apply output voltage×1.1 to VOUT. | | 8.2 | 16.5 | μA |
| Lx Switch-On Resistance | RSWON | Same as IDD 1. VLX=0.4V. | | 1.4 | 2.4 | Ω |
| Lx Leakage Current | ILXL | No external components. VOUT=VLX=10V. | | | 1.0 | μA |
| Osicillator Frequency | FOSC | Same as IDD 1. Measuring of Lx waveform. | 85 | 100 | 115 | kHz |
| Maximum Duty Ratio | MAXDTY | Same as IDD 1. Measuring of Lx waveform. | 80 | 87 | 92 | % |
| Lx Limit Voltage | VLxLMT | Same as IDD 1.<br>Apply output voltage to Lx.<br>Voltage required to produce FOSC×2. | 0.7 | | 1.3 | V |
| Efficiency | EFFI | | | 85 | | % |
| Slow-Start Time | TSS | | 4.0 | 10.0 | 20.0 | ms |

Measuring conditions: Unless otherwise specified, connect VDD to Vout,VIN=VOUT×0.6, IOUT=50mA. SeeTypical Application Circuits,Fig.5.

Note: When the VDD and VOUT pins are independently used, the voltage range at the VDD pin should be 2.2V to 10V.
The IC operates from VDD=0.8V. However, output voltage and oscillator frequency are properly stabilized when VDD=2.2V or higher.

## Electrical Characteristics

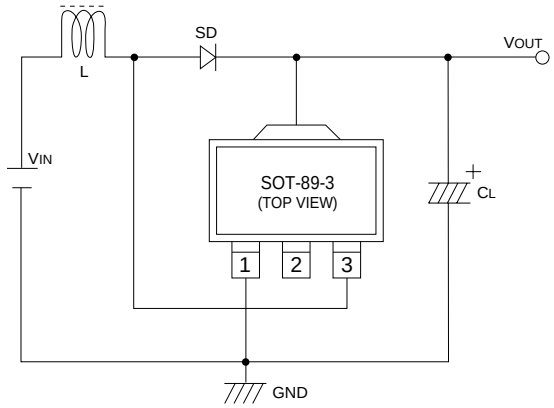
XC6371F501PR $V_{OUT}$=5.0V,$F_{OSC}$=100kHz Ta=25℃

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | | 4.875 | 5.000 | 5.125 | V |
| Maximum Input Voltage | $V_{IN}$ | | 10 | | | V |
| Operation Start-up Voltage | $V_{ST1}$ | External Components Connected. $I_{OUT}$=1mA. | | | 0.90 | V |
| Oscillation Start-up Voltage | $V_{ST2}$ | No external components. Appply voltage to $V_{OUT}$. | | | 0.80 | V |
| Supply Current 1 | $I_{DD1}$ | Same as $V_{ST2}$. Apply output voltage×0.95 to $V_{OUT}$. | | 40.0 | 66.8 | μA |
| Supply Current 2 | $I_{DD2}$ | Same as $V_{ST2}$. Apply output voltage×1.1 to $V_{OUT}$. | | 8.2 | 16.5 | μA |
| EXT "High" On-Resistance | $R_{EXTH}$ | Same as $I_{DD}$ 1. $V_{EXT}$=–0.4V. | | 37.5 | 62.5 | Ω |
| EXT "Low" On-Resistance | $R_{EXTL}$ | Same as $I_{DD}$ 1. $V_{EXT}$=0.4V. | | 30 | 50 | Ω |
| Oscillator Frequency | $F_{OSC}$ | Same as $I_{DD}$ 1.Measuring of EXT waveform. | 85 | 100 | 115 | kHz |
| Maximum Duty Ratio | MAXDTY | Same as $I_{DD}$ 1.Measuring of EXT waveform. | 85 | 87 | 92 | % |
| Efficiency | EFFI | | | 85 | | % |
| Slow-Start Time | $T_{SS}$ | | 4.0 | 10.0 | 20.0 | ms |

Measuring conditions: Unless otherwise specified, connect $V_{DD}$ to $V_{OUT}$,$V_{IN}$=$V_{OUT}$×0.6, $I_{OUT}$=50mA. See Typical Application Circuits, Fig.6.

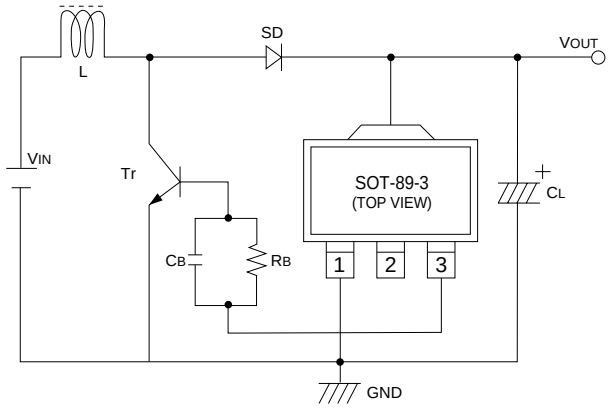
Note: When the $V_{DD}$ and $V_{OUT}$ pins are independently used, the voltage range at the $V_{DD}$ pin should be 2.2V to 10V.
The IC operates from $V_{DD}$=0.8V. However, output voltage and oscillator frequency are properly stabilized when $V_{DD}$=2.2V or higher.

## Typical Application Circuits




L: 100μH (SUMIDA, CD-54)
SD: Diode (Schottky diode; MATSUSHITA, MA735)
$C_L$: 16V 47μF (Tantalum capacitor; NICHICON, F93)

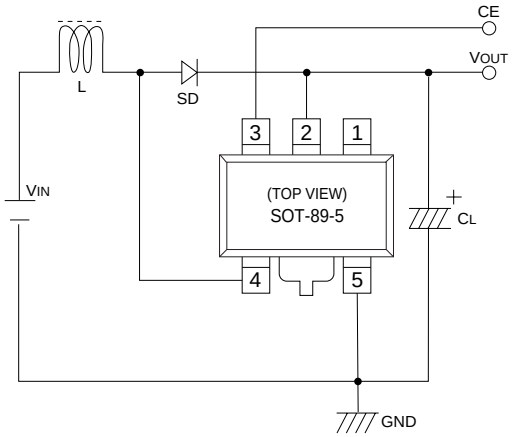
Fig.1 XC6371A Application




L: 47μH (SUMIDA, CD-54)
SD: MA735 (Schottky diode; MATSUSHITA)
$C_L$: 16V 47μF (Tantalum capacitor; NICHICON, F93)
$R_B$: 1kΩ, $C_B$:3300pF (FOSC=100kHz)
Tr: 2SC3279, 2SD1628G

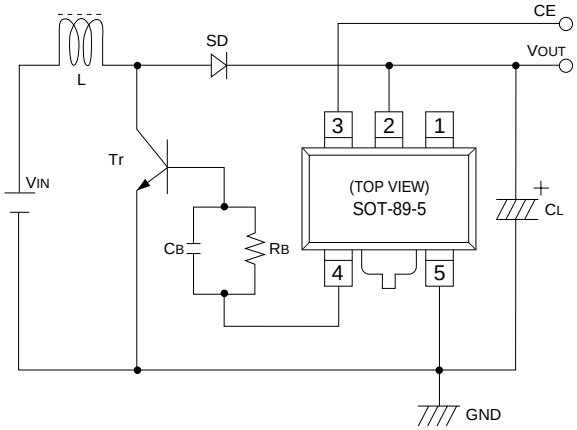
Fig.2 XC6371B Application

## ■ Typical Application Circuits



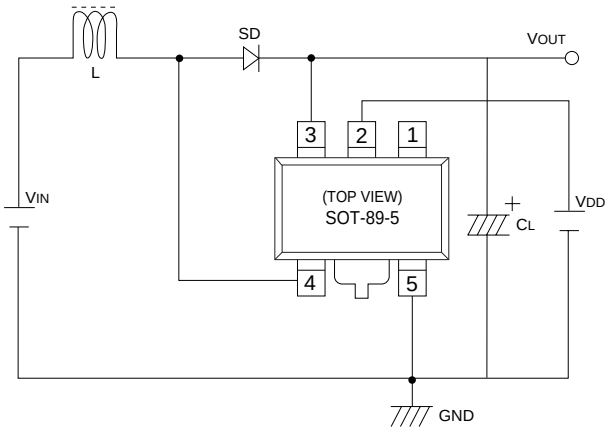

L: 100µH (SUMIDA, CD-54)
SD: Diode (Schottky diode; MATSUSHITA, MA735)
CL: 16V 47µF (Tantalum capacitor, NICHICON, F93)

Fig.3 XC6371C Application



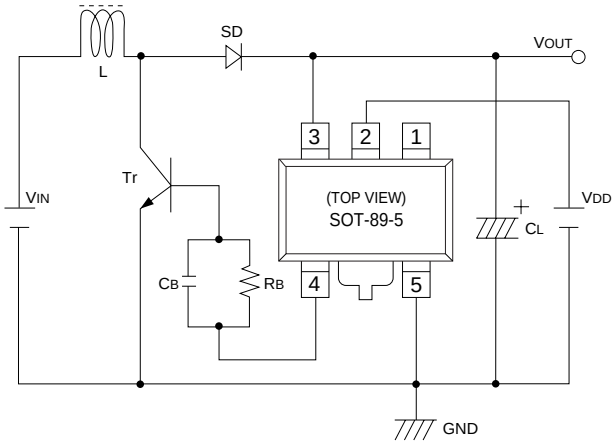

L: 47µH (SUMIDA, CD-54)
SD: MA735 (Schottky diode; MATSUSHITA)
CL: 16V 47µF (Tantalum capacitor, F93)
RB: 1kΩ, CB : 3300pF (FOSC=100kHz)
Tr: 2SC3279, 2SD1628G

Fig.4 XC6371D Application




L: 100µH (SUMIDA, CD-54)
SD: Diode (Schottky diode; MATSUSHITA, MA735)
CL: 16V 47µF (Tantalum capacitor, NICHICON, F93)

Fig.5 XC6371E Application



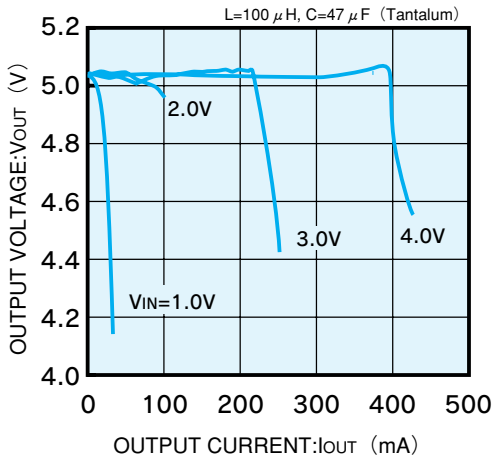

L: 47µH (SUMIDA, CD-54)
SD: MA735 (Schottky diode; MATSUSHITA)
CL: 16V 47µF (Tantalum capacitor, F93)
RB: 1kΩ,CB : 3300pF (FOSC=100kHz)
Tr: 2SC3279, 2SD1628G

Fig.6 XC6371F Application

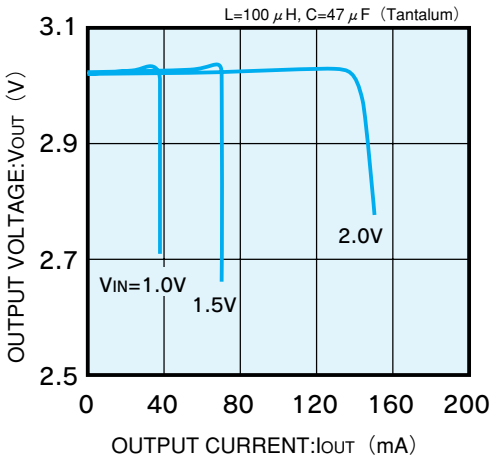
## ■ Electrical Characteristics XC6371A

(1)OUTPUT VOLTAGE vs. OUTPUT CURRENT

XC6371A501

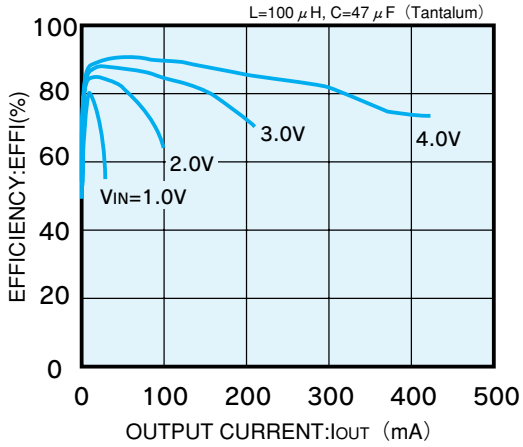



XC6371A301

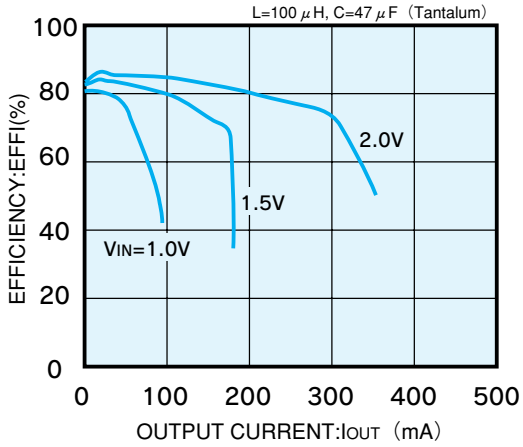



(2)EFFICIENCY vs. OUTPUT CURRENT

XC6371A501

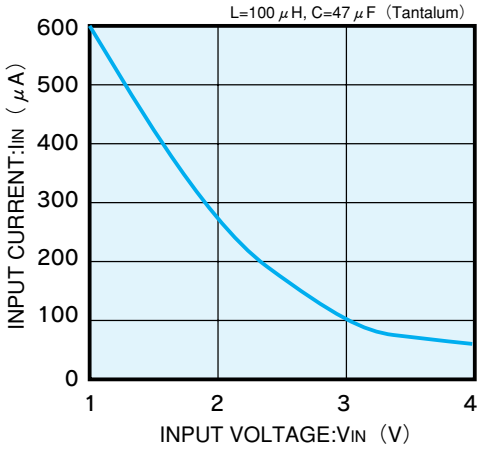



XC6371A301

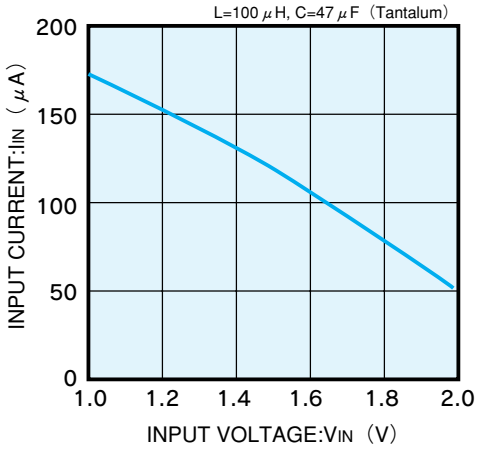



(3)NO LOAD, INPUT CURRENT vs. INPUT VOLTAGE

XC6371A501

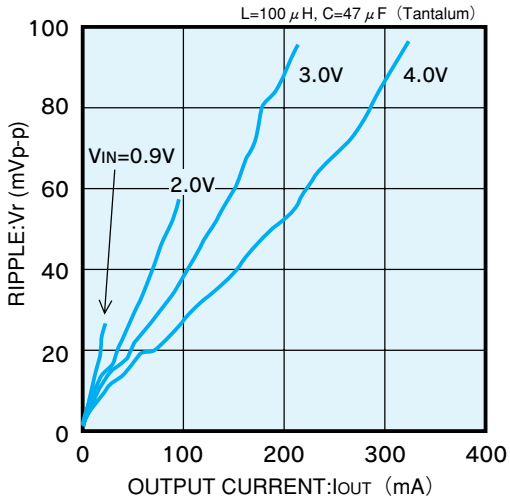



XC6371A301

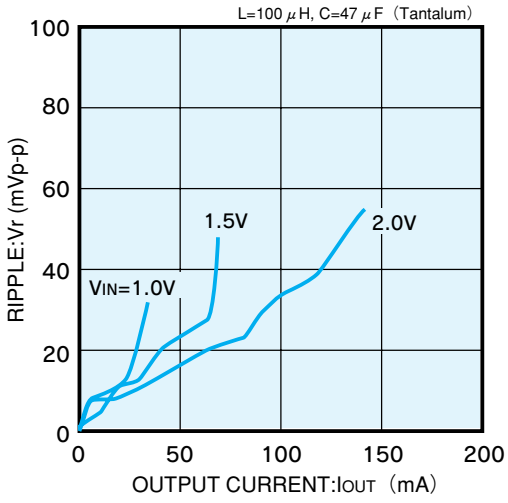


(4)RIPPLE VOLTAGE vs OUTPUT CURRENT

XC6371A501

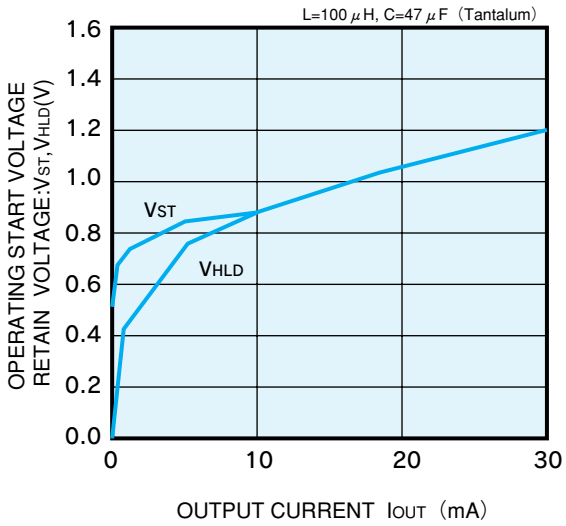



XC6371A301



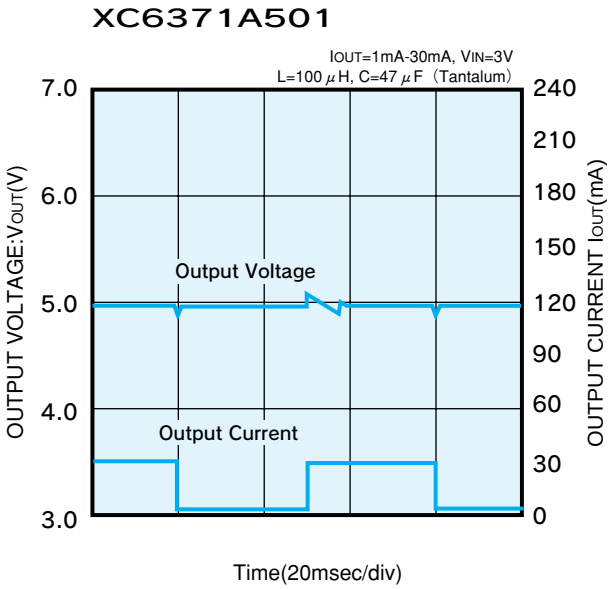

(5) OPERATING START VOLTAGE/RETAIN VOLTAGE vs. OUTPUT CURRENT

XC6371A501




(6) LOAD TRANSIENT RESPONSE

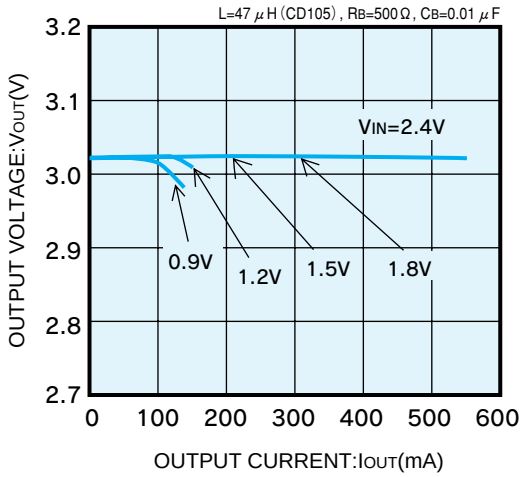
XC6371A501



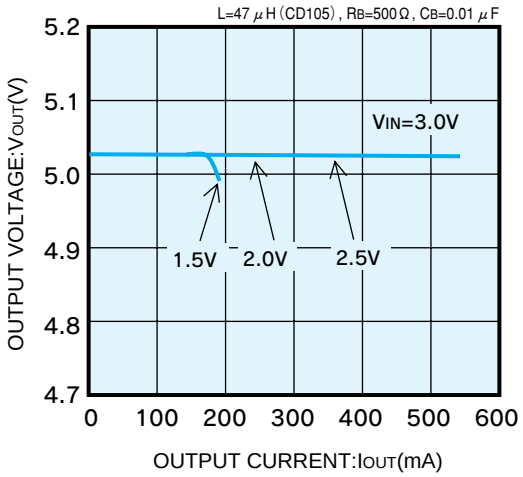
## ■ Electrical Characteristics XC6371B (External Tr)

(1) OUTPUT VOLTAGE vs. INPUT CURRENT

XC6371B301 (3V,100kHz)

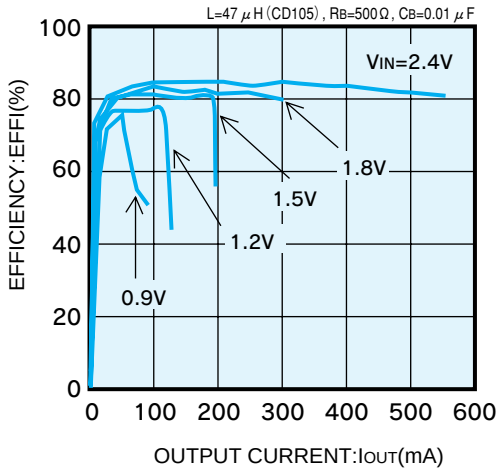



XC6371B501 (5V,100kHz)

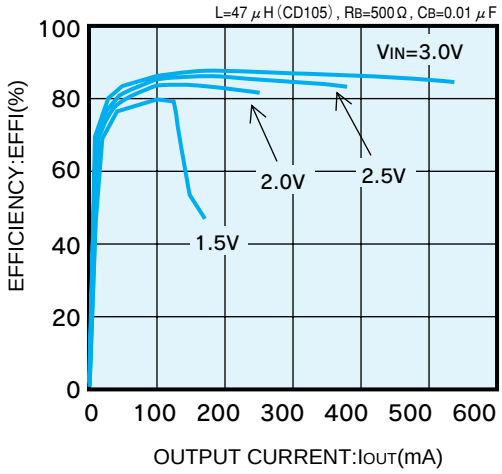



(2) EFFICIENCY vs. OUTPUT CURRENT

XC6371B301 (3V,100kHz)

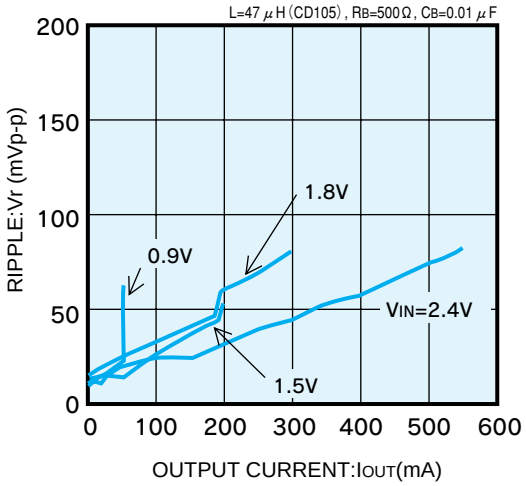



XC6371B501 (5V,100kHz)

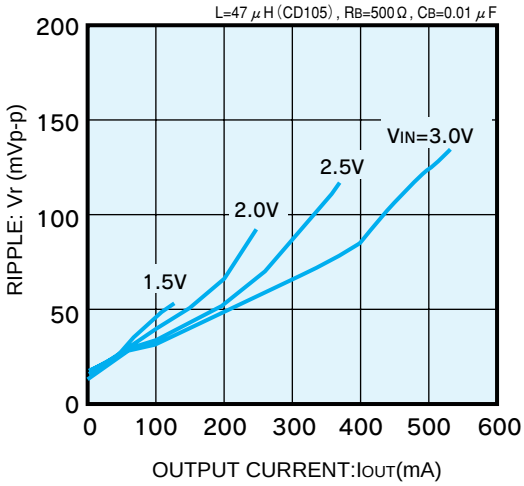



(3) RIPPLE VOLTAGE vs. OUTPUT CURRENT

XC6371B301 (3V,100kHz)




XC6371B501 (5V,100kHz)

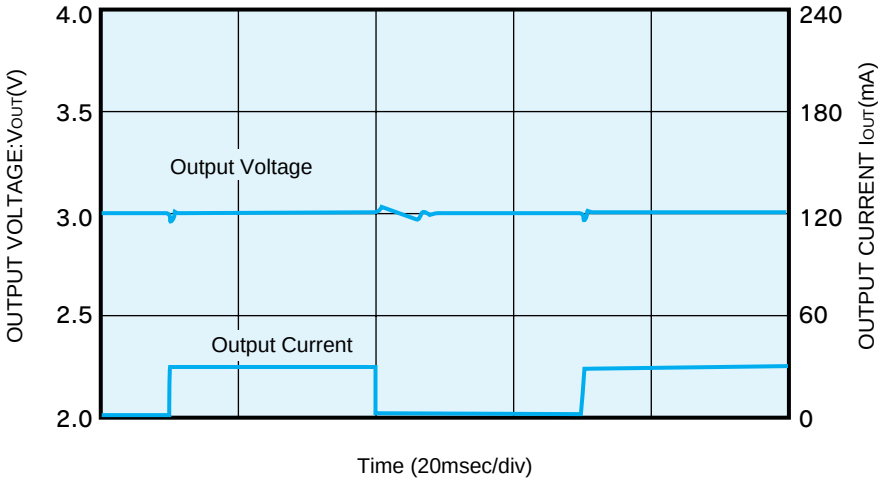



<External components>
CIN=100μF (Electrolytic), CL=47μF (Tantalum) X 2, SD:MA735, Tr:2SD1628G

(4) LOAD TRANSIENT RESPONSE

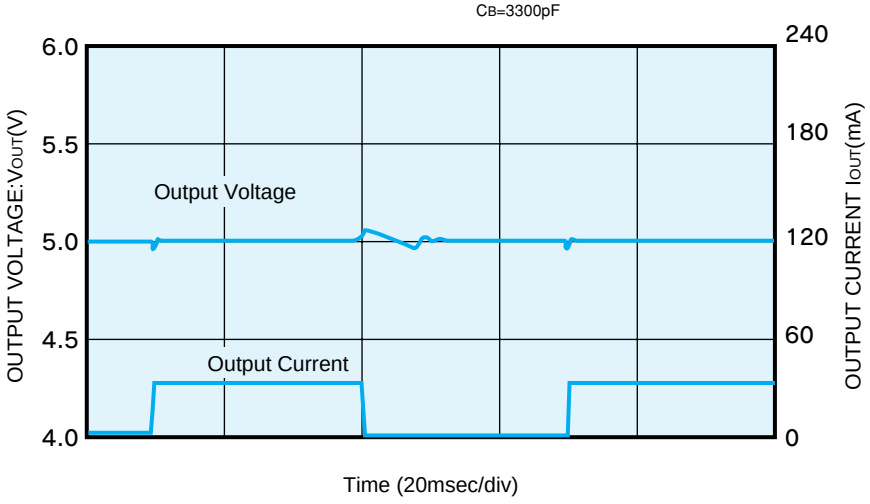
XC6371B301
(3V,100kHz)

IOUT=1mA-30mA
VIN=2.0V
L=47μH (CD54) ,RB=1kΩ,
CB=3300pF




XC6371B501
(5V,100kHz)

IOUT=1mA-30mA
VIN=3.0V
L=47μH (CD54) ,RB=1kΩ,
CB=3300pF




(External Components)
CIN=47μF (Tantalum)
CL=47μF (Tantalum) X 2
SD:MA735
Tr:2SD1628G