

XC6381

Series

PFM Controlled, Step - Up DC/DC Converters (Duty Ratio 58%)



- ◆Duty 58%
- ◆CMOS Low Power Consumption
- ◆Operating Voltage : 0.9V~10.0V
- ◆Output Voltage Range : 2.0V~7.0V
- ◆Output Voltage Accuracy : $\pm 2.5\%$

Applications

- Cellular phones, pagers
- Palmtops
- Cameras, video recorders
- Portable equipment

General Description

The XC6381 series is a group of PFM controlled step-up DC/DC converters.

The XC6381 series employs CMOS process and laser trimming technologies so as to attain low power and high accuracy.

Max. oscillator frequency is trimmed to 155kHz (accuracy: $\pm 15\%$).

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.

Both built-in and external transistor types include 5-pin and 3-pin packages, which are provided with either a CE (chip enable) function that reduces power consumption during shut-down mode, or a VDD pin function (separated power and voltage detect pins).

SOT-23, SOT-25, and SOT-89-5 super mini-mold packages.

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 $\pm 2.5\%$

Maximum oscillator frequency

: 155kHz ($\pm 15\%$)

Duty Ratio

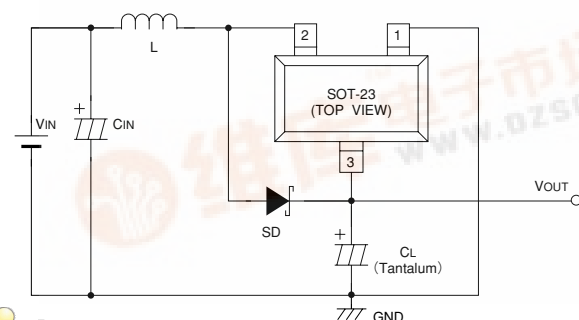
: 58% ($\pm 5\%$)

Both built-in switching transistor and external types are available

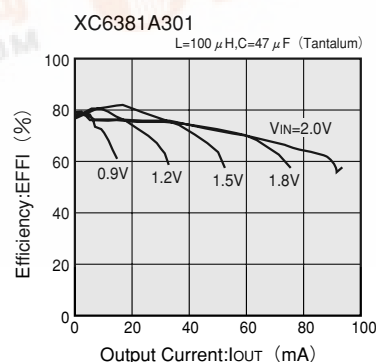
Five-lead packaged units offer either Chip Enable or independent Vout pin option.

Small package : SOT-23, 25 mini-mold (3-pin, 5-pin)
SOT-89, 89-5 mini-power mold
(3-pin, 5-pin)

Typical Application Circuit

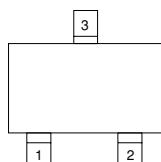


Typical Performance Characteristic

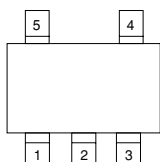


XC6381 Series

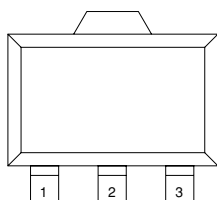
Pin Configuration



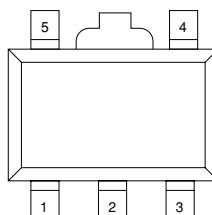
SOT-23
(TOP VIEW)



SOT-25
(TOP VIEW)



SOT-89
(TOP VIEW)



SOT-89-5
(TOP VIEW)

Pin Assignment

(XC6381A)

PIN NUMBER		PIN NAME	FUNCTION
XC6381A			
SOT-23	SOT-89		
1	1	VSS	Ground
3	2	VOUT	Output voltage monitor, IC internal power supply
2	3	LX	Switch

(XC6381C)

PIN NUMBER		PIN NAME	FUNCTION
XC6381C			
SOT-25	SOT-89-5		
4	5	VSS	Ground
2	2	VOUT	Output voltage monitor, IC internal power supply
5	4	LX	Switch
1	3	CE	Chip enable
3	1	NC	No connection

(XC6381E)

PIN NUMBER		PIN NAME	FUNCTION
XC6381E			
SOT-25	SOT-89-5		
4	5	VSS	Ground
2	2	VDD	IC internal power supply
5	4	LX	Switch
1	3	VOUT	Output voltage monitor
3	1	NC	No connection

■Product Classification

●Selection Guide

PART TYPE	DUTY RATIO	PACKAGE	SWITCHING RELATED	ADDITIONAL FUNCTION	FEATURES
XC6381A	58%	SOT-23, SOT-89	Built-in Transistor "Lx" lead	—	• Accommodates a duty ratio of 58%.
XC6381C	58%	SOT-25, SOT-89-5	Built-in Transistor "Lx" lead	Chip enable(CE)	• Stand-by (CE) function added version to the XC6381A. • Stand-by current: 0.5μA max.
XC6381E	58%	SOT-25, SOT-89-5	Built-in Transistor "Lx" lead	Separated "V _{DD} " and "V _{OUT} " leads	• Independent power supply and set-up voltage sensing leads allow designing of PFM controllers.

●Ordering Information

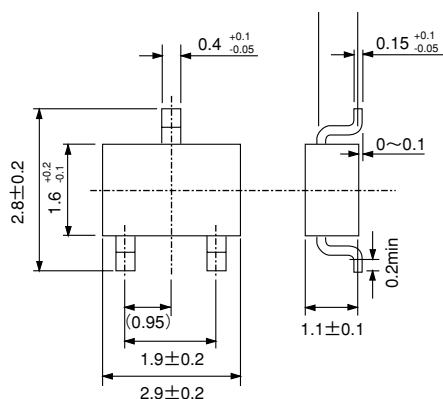
XC6381①②③④⑤⑥

XC6381 Series PFM Controlled Duty 58%

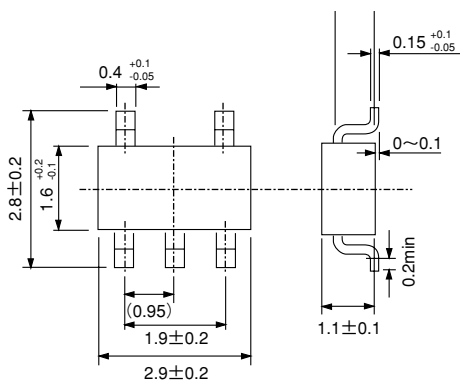
①	A	3-pin. Built-in switching transistor	
	C	Stand-by capability. (5-pin) Built-in switching transistor	
	E	Separated V _{DD} and V _{OUT} . (5-pin) Built-in switching transistor	
② ③	Output Voltage e.g. V _{OUT} =3.5V → ②=3, ③=5		
④	1	Maximum Oscillator Frequency	155kHz
⑤	M	Package	①=A-B SOT-23 ①=C-F SOT-25
	P	Package	①=A-B SOT-89 ①=C-F SOT-89-5
⑥	R	Embossed tape : Standard Feed	
	L	Embossed tape : Reverse Feed	

■ Packaging Information

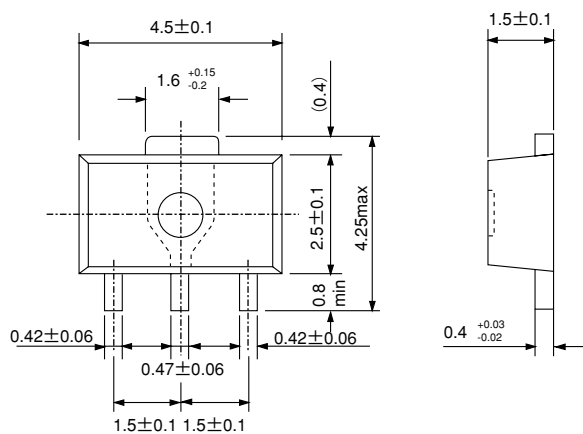
● SOT-23



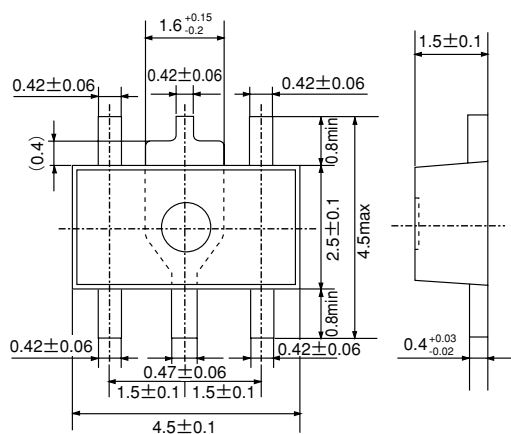
● SOT-25



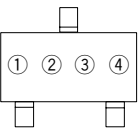
●SOT-89



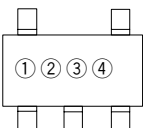
●SOT-89-5



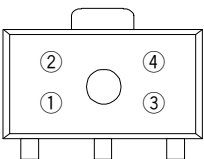
■Marking



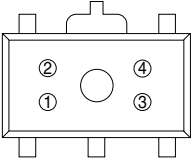
SOT-23
(TOP VIEW)



SOT-25
(TOP VIEW)



SOT-89
(TOP VIEW)



SOT-89-5
(TOP VIEW)

① Represents the Product Classification

DESIGNATOR	FUNCTION		PRODUCT NAME
$\overline{\text{C}}$	—	Built-in Transistor	XC6381A * * * * *
$\overline{\text{C}}$	CE	Built-in Transistor	XC6381C * * * * *
$\overline{\text{Y}}$	VDD/VIN	Built-in Transistor	XC6381E * * * * *

② Represents the integer of the Output Voltage and Oscillator Frequency

INTEGER OF THE OUTPUT VOLTAGE	OSCILLATOR FREQUENCY (kHz)
	155
1	1
2	2
3	3
4	4
5	5
6	6

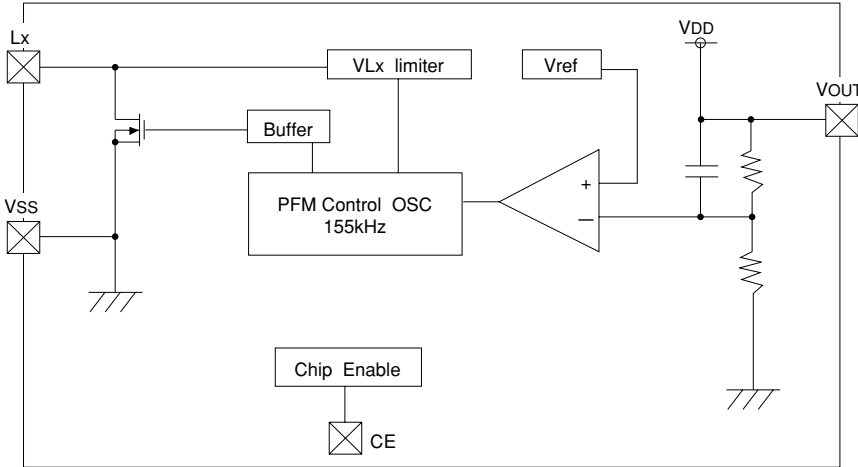
③ Represents the decimal number of the Output Voltage and Oscillator Frequency

OUTPUT VOLTAGE	OSCILLATOR FREQUENCY (kHz)
	155
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

④ Denotes the production lot number
0 to 9, A to Z repeated(G.I.J.O.Q.W excepted)

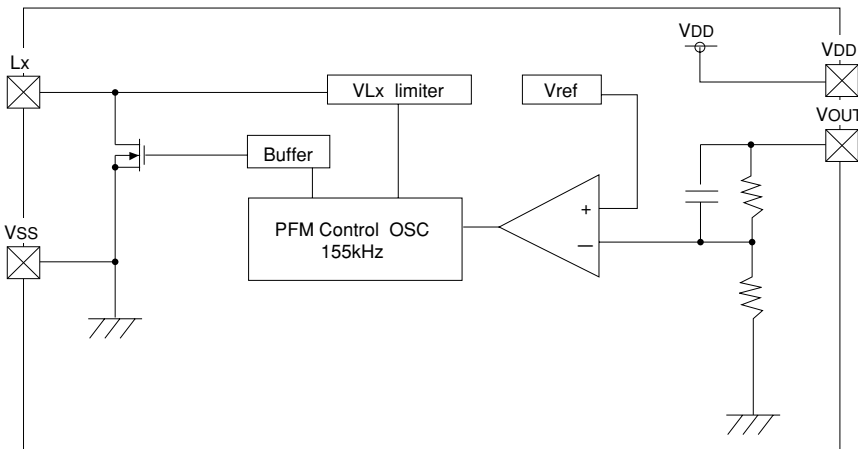
■Block Diagram

●XC6381A, XC6381C (V_{OUT} pin can also be used for V_{DD} pin.)



Note: Built-in Tr types use the Lx pin, external Tr types use the EXT pin.
The CE pin is only used with the XC6381C.

●XC6381E



Note: The VDD pin is only used with the XC6381E.
Built-in Tr types use the Lx pin, external Tr types use the EXT pin.

■Absolute Maximum Ratings

T_a=25°C

PARAMETER	SYMBOL	RATINGS	UNITS
V _{OUT} Input Voltage	V _{OUT}	12	V
Lx pin Voltage	V _{LX}	12	V
Lx pin Current	I _{LX}	400	mA
EXT pin Voltage	V _{EXT}	V _{SS} -0.3~V _{OUT} +0.3	V
EXT pin Current	I _{EXT}	±50	mA
CE Input Voltage	V _{CE}	12	V
V _{DD} Input Voltage	V _{DD}	12	V
Continuous Total Power Dissipation	SOT-23 SOT-89	P _D	mW
Operating Ambient Temperature	T _{opr}	-30~+80	°C
Storage Temperature	T _{stg}	-40~+125	°C

Electrical Characteristics

XC6381A301 $V_{OUT}=3.0V$

$T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V_{OUT}	L,SD,CL, etc. connected	2.925	3.000	3.075	V
Maximum Input Voltage	V_{IN}		10			V
Oscillation Start-up Voltage	V_{ST}	$I_{OUT}=1mA$		0.80	0.90	V
Oscillation Hold Voltage	V_{HLD}	$I_{OUT}=1mA$	0.70			V
No-Load Input Current	I_{IN}	$I_{OUT}=0mA$, (Note1)		4.6	9.3	μA
Supply Current 1 (Note 2)	I_{DD1}	$V_{IN}=V_{OUT} \times 0.95$		29.3	58.7	μA
Supply Current 2	I_{DD2}	$V_{IN}=V_{OUT}+0.5V$		2.1	4.2	μA
Lx Switch On-Resistance	R_{SWON}	Same as I_{DD1} , $V_{LX}=0.4V$		5.2	7.9	Ω
Lx Leakage Current	I_{LXL}	No external components, $V_{OUT}=V_{LX}=10V$			1.0	μA
Duty Ratio	DTY	Same as I_{DD1} Measuring of Lx waveform	53	58	63	%
Maximum Oscillation Frequency	MAXFOSC	Same as I_{DD1} , 58% duty.	131.75	155	178.25	kHz
Lx Limit Voltage	V_{LXLMT}	Same as I_{DD1} , $F_{OSC} \geq MAXFOSC \times 2$	0.7		1.1	V
Efficiency	EFFI	L,SD,CL, etc. connected		80		%

Measuring conditions: Unless otherwise specified, $V_{IN}=V_{OUT} \times 0.6$, $I_{OUT}=30mA$. See Typical application circuits, Fig.1.

Note: 1. The Schottky diode (SD) must be type MA735, with reverse current (I_R) $< 1.0\mu A$ at reverse voltage (V_R) $= 10.0V$.

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_{IN} source is represented by "No-Load Input Current (I_{IN})".

XC6381A501 $V_{OUT}=5.0V$

$T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V_{OUT}	L,SD,CL, etc. connected	4.875	5.000	5.125	V
Maximum Input Voltage	V_{IN}		10			V
Oscillation Start-up Voltage	V_{ST}	$I_{OUT}=1mA$		0.80	0.90	V
Oscillation Hold Voltage	V_{HLD}	$I_{OUT}=1mA$	0.70			V
No-Load Input Current	I_{IN}	$I_{OUT}=0mA$, (Note1)		5.3	10.6	μA
Supply Current 1 (Note 2)	I_{DD1}	$V_{IN}=V_{OUT} \times 0.95$		47.8	95.7	μA
Supply Current 2	I_{DD2}	$V_{IN}=V_{OUT}+0.5V$		2.4	4.8	μA
Lx Switch On-Resistance	R_{SWON}	Same as I_{DD1} , $V_{LX}=0.4V$		2.8	4.3	Ω
Lx Leakage Current	I_{LXL}	No external components, $V_{OUT}=V_{LX}=10V$			1.0	μA
Duty Ratio	DTY	Same as I_{DD1} Measuring of Lx waveform	53	58	63	%
Maximum Oscillation Frequency	MAXFOSC	Same as I_{DD1} , 58% duty.	131.75	155	178.25	kHz
Lx Limit Voltage	V_{LXLMT}	Same as I_{DD1} , $F_{OSC} \geq MAXFOSC \times 2$	0.7		1.1	V
Efficiency	EFFI	L,SD,CL, etc. connected		85		%

Measuring conditions: Unless otherwise specified, $V_{IN}=V_{OUT} \times 0.6$, $I_{OUT}=50mA$. See Typical application circuits, Fig.1.

Note: 1. The Schottky diode (SD) must be type MA735, with reverse current (I_R) $< 1.0\mu A$ at reverse voltage (V_R) $= 10.0V$.

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_{IN} source is represented by "No-Load Input Current (I_{IN})".

XC6381C301MR $V_{OUT}=3.0V$
 $T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V_{OUT}	L,SD,CL etc. connected	2.925	3.000	3.075	V
Maximum Input Voltage	V_{IN}		10			V
Oscillation Start-up Voltage	V_{ST}	$I_{OUT}=1mA$		0.80	0.90	V
Oscillation Hold Voltage	V_{HLD}	$I_{OUT}=1mA$	0.70			V
No-Load Input Current	I_{IN}	$I_{OUT}=0mA$, (Note1)		4.6	9.3	μA
Supply Current 1 (Note 2)	I_{DD1}	$V_{IN}=V_{OUT} \times 0.95$		29.3	58.7	μA
Supply Current 2	I_{DD2}	$V_{IN}=V_{OUT}+0.5V$		2.1	4.2	μA
Lx Switch-On Resistance	R_{SWON}	Same as I_{DD1} . $V_{LX}=0.4V$		5.2	7.9	Ω
Lx Leakage Current	I_{LXL}	No external components. $V_{OUT}=V_{LX}=10V$.			1.0	μA
Duty Ratio	DTY	Same as I_{DD1} . Measuring of Lx waveform.	53	58	63	%
Maximum Oscillation Frequency	$MAXFOSC$	Same as I_{DD1} . 58% duty.	131.75	155	178.25	kHz
Stand-by Current	I_{STB}	Same as I_{DD1} .			0.5	μA
CE "High" Voltage	V_{CEH}	Same as I_{DD1} . Existence of Lx Oscillation.	0.75			V
CE "Low" Voltage	V_{CEL}	Same as I_{DD1} . Disappearance of Lx Oscillation.			0.20	V
CE "High" Current	I_{CEH}	Same as I_{DD1} . $V_{CE}=V_{OUT} \times 0.95$.			0.25	μA
CE "Low" Current	I_{CEL}	Same as I_{DD1} . $V_{CE}=0V$.			-0.25	μA
Lx Limit Voltage	V_{LXLMT}		0.7		1.1	V
Efficiency	$EFFI$	L,SD,CL etc. connected		80		%

Measuring conditions: Unless otherwise specified, connect CE to V_{OUT} , $V_{IN}=V_{OUT} \times 0.6$, $I_{OUT}=30mA$. See Typical Application Circuits, Fig.2.

Note: 1. The Schottky diode (SD) must be type MA735, with reverse current (I_R)<1.0 μA at reverse voltage (V_R)=10.0V

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_{IN} source is represented by "No-Load Input Current (I_{IN})".

XC6381C501MR $V_{OUT}=5.0V$
 $T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V_{OUT}	L,SD,CL etc. connected	4.875	5.000	5.125	V
Maximum Input Voltage	V_{IN}		10			V
Oscillation Start-up Voltage	V_{ST}	$I_{OUT}=1mA$		0.80	0.90	V
Oscillation Hold Voltage	V_{HLD}	$I_{OUT}=1mA$	0.70			V
No-Load Input Current	I_{IN}	$I_{OUT}=0mA$ (Note1)		5.3	10.6	μA
Supply Current 1 (Note 2)	I_{DD1}	$V_{IN}=V_{OUT} \times 0.95$		47.8	95.7	μA
Supply Current 2	I_{DD2}	$V_{IN}=V_{OUT}+0.5V$		2.4	4.8	μA
Lx Switch-On Resistance	R_{SWON}	Same as I_{DD1} . $V_{LX}=0.4V$.		2.8	4.3	Ω
Lx Leakage Current	I_{LXL}	No external components. $V_{OUT}=V_{LX}=10V$.			1.0	μA
Duty Ratio	DTY	Same as I_{DD1} . Measuring of Lx waveform.	53	58	63	%
Maximum Oscillation Frequency	$MAXFOSC$	Same as I_{DD1} . 58% duty.	131.75	155	178.25	kHz
Stand-by Current	I_{STB}	Same as I_{DD1} .			0.5	μA
CE "High" Voltage	V_{CEH}	Same as I_{DD1} . Existence of Lx Oscillation.	0.75			V
CE "Low" Voltage	V_{CEL}	Same as I_{DD1} . Disappearance of Lx Oscillation.			0.20	V
CE "High" Current	I_{CEH}	Same as I_{DD1} . $V_{CE}=V_{OUT} \times 0.95$.			0.25	μA
CE "Low" Current	I_{CEL}	Same as I_{DD1} . $V_{CE}=0V$.			-0.25	μA
Lx Limit Voltage	V_{LXLMT}	Same as I_{DD1} . $FOSC > MAXFOSC \times 2$	0.7		1.1	V
Efficiency	$EFFI$	L,SD,CL etc. connected		85		%

Measuring conditions: Unless otherwise specified, connect CE to V_{OUT} , $V_{IN}=V_{OUT} \times 0.6$, $I_{OUT}=50mA$. See Typical Application Circuits, Fig.2.

Note: 1. The Schottky diode (SD) must be type MA735, with reverse current (I_R)<1.0 μA at reverse voltage (V_R)=10.0V

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_{IN} source is represented by "No-Load Input Current (I_{IN})".

XC6381 Series

XC6381E301MR $V_{OUT}=3.0V$

$T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V_{OUT}	L,SD,CL etc. connected	2.925	3.000	3.075	V
Maximum Input Voltage	V_{IN}		10			V
Oscillation Start-up Voltage	V_{ST}	$I_{OUT}=1mA$		0.80	0.90	V
Oscillation Hold Voltage	V_{HLD}	$I_{OUT}=1mA$	0.70			V
No-Load Input Current	I_{IN}	$I_{OUT}=0mA$ (Note1)		4.6	9.3	μA
Supply Current 1 (Note 2)	I_{DD1}	$V_{IN}=V_{OUT} \times 0.95$		29.3	58.7	μA
Supply Current 2	I_{DD2}	$V_{IN}=V_{OUT}+0.5V$		2.1	4.2	μA
Lx Switch-On Resistance	R_{SWON}	Same as I_{DD1} . $V_{Lx}=0.4V$		5.2	7.9	Ω
Lx Leakage Current	I_{LXL}	No external components. $V_{OUT}=V_{Lx}=10V$			1.0	μA
Duty Ratio	DTY	Same as I_{DD1} Measuring of Lx waveform.	53	58	63	%
Maximum Oscillation Frequency	MAXFOSC	Same as I_{DD1} . 58% duty.	131.75	155	178.25	kHz
Lx Limit Voltage	V_{LxLMT}	Same as I_{DD1} . $F_{OSC}>MAXFOSC \times 2$	0.7		1.1	V
Efficiency	EFFI	L,SD,CL etc. connected		80		%

Measuring conditions: Unless otherwise specified, connect V_{DD} to V_{OUT} , $V_{IN}=V_{OUT} \times 0.6$, $I_{OUT}=30mA$. See Typical Application Circuits, Fig.3.

Note: 1. The Schottky diode (SD) must be type MA735, with reverse current (I_R) $<1.0\mu A$ at reverse voltage (V_R)=10.0V.

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_{IN} source is represented by "No-Load Input Current (I_{IN})".

* 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.

XC6381E501MR $V_{OUT}=5.0V$

$T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V_{OUT}	L,SD,CL etc. connected	4.875	5.000	5.125	V
Maximum Input Voltage	V_{IN}		10			V
Oscillation Start-up Voltage	V_{ST}	$I_{OUT}=1mA$		0.80	0.90	V
Oscillation Hold Voltage	V_{HLD}	$I_{OUT}=1mA$	0.70			V
No-Load Input Current	I_{IN}	$I_{OUT}=0mA$,(Note1)		5.3	10.6	μA
Supply Current 1 (Note 2)	I_{DD1}	$V_{IN}=V_{OUT} \times 0.95$		47.8	95.7	μA
Supply Current 2	I_{DD2}	$V_{IN}=V_{OUT}+0.5V$		2.4	48	μA
Lx Switch-On Resistance	R_{SWON}	Same as I_{DD1} . $V_{Lx}=0.4V$.		2.8	4.3	Ω
Lx Leakage Current	I_{LXL}	No external components. $V_{OUT}=V_{Lx}=10V$.			1.0	μA
Duty Ratio	DTY	Same as I_{DD1} . Measuring of Lx waveform.	53	58	63	%
Maximum Oscillation Frequency	MAXFOSC	Same as I_{DD1} . 58% duty.	131.75	155	178.25	kHz
Lx Limit Voltage	V_{LxLMT}	Same as I_{DD1} . $F_{OSC}>MAXFOSC \times 2$	0.7		1.1	V
Efficiency	EFFI	L,SD,CL etc. connected		85		%

Measuring conditions: Unless otherwise specified, connect V_{DD} to V_{OUT} , $V_{IN}=V_{OUT} \times 0.6$, $I_{OUT}=50mA$. See Typical Application Circuits, Fig.3.

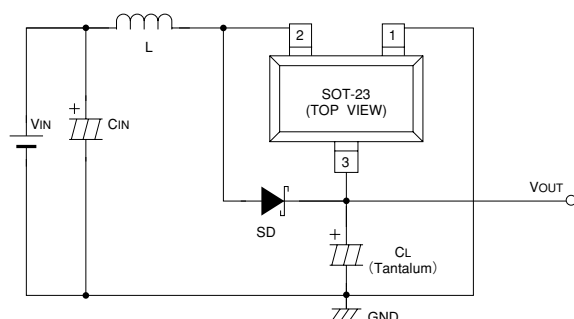
Note: 1. The Schottky diode (SD) must be type MA735, with reverse current (I_R) $<1.0\mu A$ at reverse voltage (V_R)=10.0V.

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_{IN} source is represented by "No-Load Input Current (I_{IN})".

* 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.

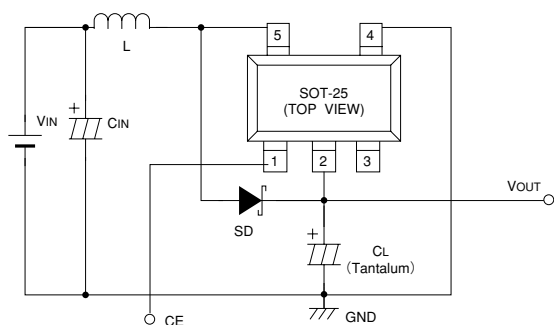
The IC operates from $V_{DD}=0.8V$. However, output voltage and oscillator frequency are properly stabilized when $V_{DD}=2.2V$ or higher.

■ Typical Application Circuits



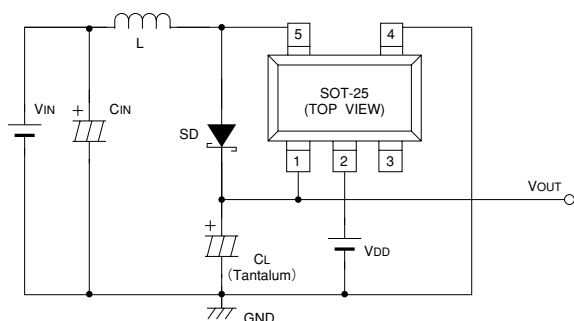
L : 100 μ H (SUMIDA, CR-54)
SD : MA2Q735 (Schottky diode; MATSUSHITA)
CL : 16V 47 μ F (Tantalum capacitor, NICHICON, MCE)
CIN : 16V 220 μ F (Aluminium Electrolytic Capacitor)

Fig.1 XC6381A Application



L : 100 μ H (SUMIDA, CR-54)
SD : MA2Q735 (Schottky diode; MATSUSHITA)
CL : 16V 47 μ F (Tantalum capacitor, NICHICON, MCE)
CIN : 16V 220 μ F (Aluminium Electrolytic Capacitor)

Fig.2 XC6381C Application

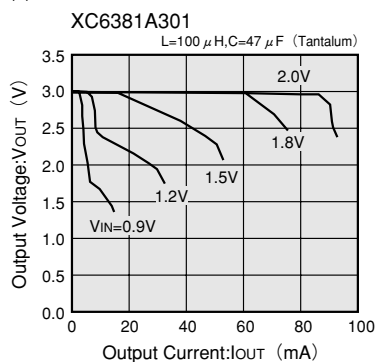


L : 100 μ H (SUMIDA, CR-54)
SD : MA2Q735 (Schottky diode; MATSUSHITA)
CL : 16V 47 μ F (Tantalum capacitor, NICHICON, MCE)
CIN : 16V 220 μ F (Aluminium Electrolytic Capacitor)

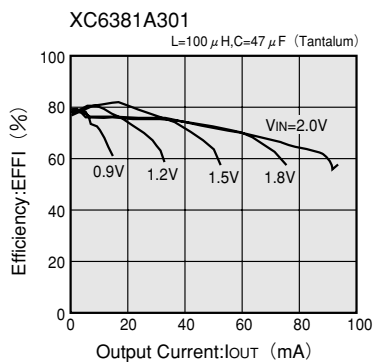
Fig.3 XC6381E Application

Typical Performance Characteristics

(1) OUTPUT VOLTAGE vs. OUTPUT CURRENT



(2) EFFICIENCY vs. OUTPUT CURRENT



(3) RIPPLE VOLTAGE vs. OUTPUT CURRENT

