

- ◆ **Input Voltage Range: 0.9~10.0V**
- ◆ **Output Voltage Range: 1.5~6.5V(±2.5%)**
- ◆ **Oscillator Frequency: 300kHz(±15%)**
- ◆ **PWM/PFM Switching Control (XC6368)**
- ◆ **High Efficiency: 84% (typ.)**
- ◆ **SOT-25 Package**

## ■ Applications

- Electronic Information Organizers
- Palmtops
- Cellular and portable phones
- Portable Audio Systems
- Various Multi-function Power Supplies

## ■ General Description

The XC6367/68 series are multi-functional step-up DC/DC converter controllers with built-in high speed, low ON resistance drivers.

Large output currents are possible using an externally connected transistor, coil, diode and condenser.

Output voltage ( $V_{OUT}$ ) is programmable in 0.1V steps from 1.5V to 6.5V (±2.5% accuracy). Further, with 1.0V of standard voltage supply internal, and using externally connected components, output voltage (FB) can be set up at will.

With a 300kHz switching frequency, the size of the external components can be reduced.

Control switches from PWM to PFM during light loads with the XC6368 (PWM/PFM switchable) and the series is highly efficient from light loads to large output currents.

Both internally set-up 10msec types (A, B, E), and adjustable soft-start time types (C, D, F) using externally connected resistors and capacitors are available.

During stand-by time (CE pin "Low"), current consumption is reduced to less than 0.5μA.

## ■ Features

**Input voltage range:** 0.9V~10V

**Operating voltage range:** 2.0V~10V

**Output voltage range:** 1.5V~6.5V programmable in 0.1V steps (±2.5%)

**Oscillator frequency:** 300, 100kHz (±15%)

Custom products for 180, 500kHz

**Output Current:** 200mA + ( $V_{IN}=1.8V$ ,  $V_{OUT}=3.3V$ )

**High Efficiency:** 84% (typ.)

**Stand-by capability:**  $I_{STB}=0.5\mu A$  (max.)

**Soft-start time set-up externally type possible**

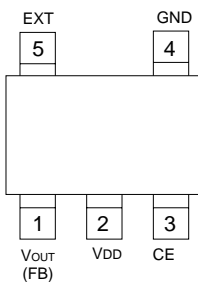
**Internally set-up output voltage type possible ( $V_{OUT}$ )**

**Externally set-up output voltage type possible (FB)**

**Package:** SOT-25

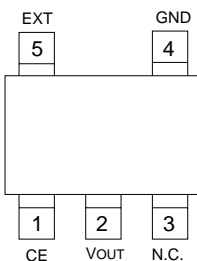
## ■ Pin Configuration

XC6367/XC6368 series  
A, B, C, D types



SOT-25  
(TOP VIEW)

XC6367/XC6368 series  
E, F types

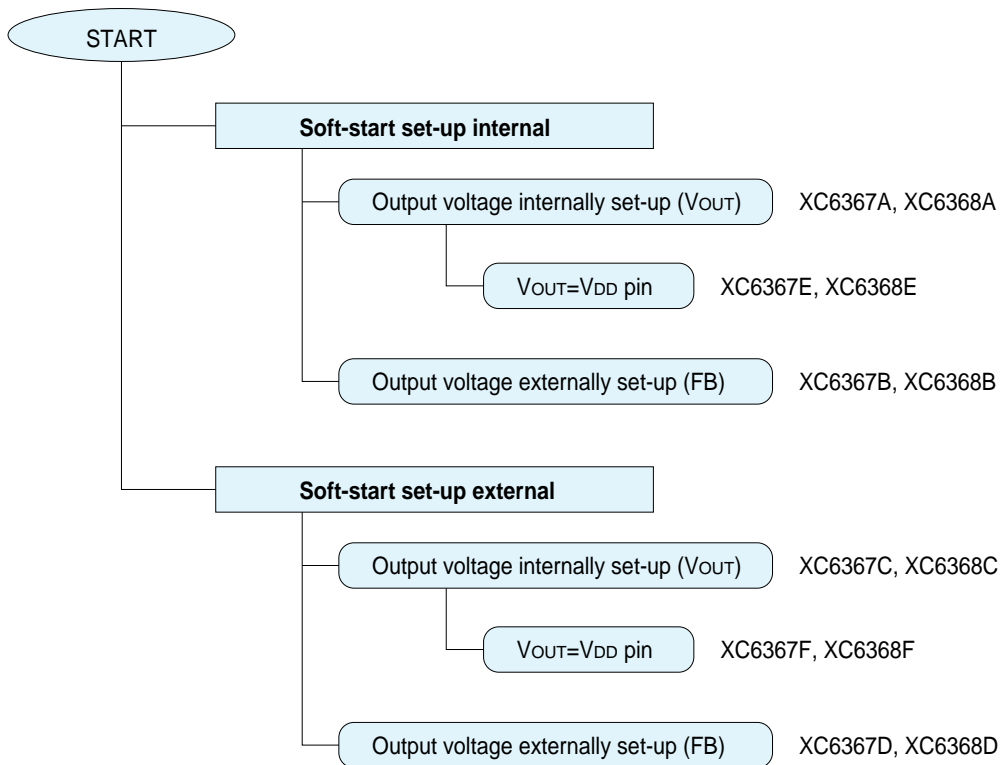


SOT-25  
(TOP VIEW)

## ■ Pin Assignment

PIN NUMBER		PIN NAME	FUNCTION
XC6367 / XC6368			
A, B, C, D	E, F		
5	5	EXT	External transistor connection
2	–	$V_{DD}$	Supply voltage input
4	4	GND	Ground
3	1	CE	Chip Enable (C, D, F types : soft start set-up external, soft start capacitor connected)
1	2	$V_{OUT}$ (FB)	Output voltage monitor (E, F types : output voltage monitor, power supply) (B, D types : output voltage set-up external)

## Selection Guide



## Ordering Information

### XC6367①②③④⑤⑥

XC6367 Series PWM Control

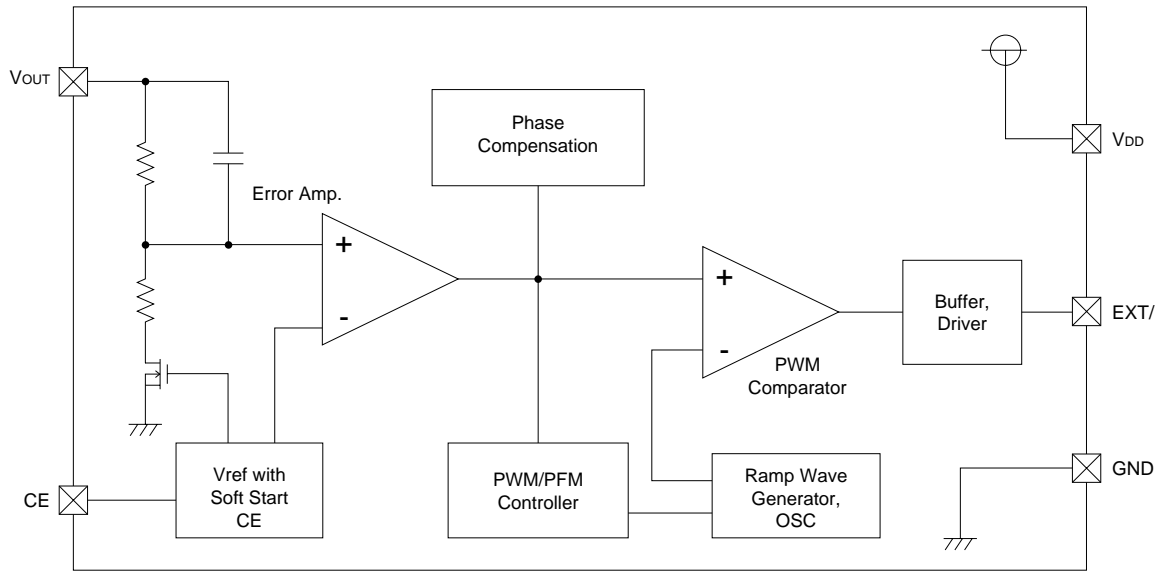
SYMBOL		FUNCTION	V <sub>OUT</sub> /FB	SOFT-START
①	A	(5 pin)	V <sub>OUT</sub>	Internally set-up
	B	(5 pin)	FB	Internally set-up
	C	(5 pin)	V <sub>OUT</sub>	Externally set-up
	D	(5 pin)	FB	Externally set-up
	E	CE (4 pin)	V <sub>OUT</sub>	Internally set-up
	F	CE (4 pin)	V <sub>OUT</sub>	Externally set-up
② ③	Output voltage value : e.g. 3.0V output : (②=3, ③=0), F.B. products (B,D types) : (②=1, ③=0)			
④	3	Oscillator frequency 300kHz		
	1	Oscillator frequency 100kHz		
	2	Oscillator frequency 180kHz (Custom)		
	5	Oscillator frequency 500kHz (Custom)		
⑤	M	Package SOT-25		
⑥	R	Embossed Tape : standard loading		
	L	: reverse loading		

### XC6368①②③④⑤⑥

XC6368 Series PWM/PFM switching control (same as XC6367 series)

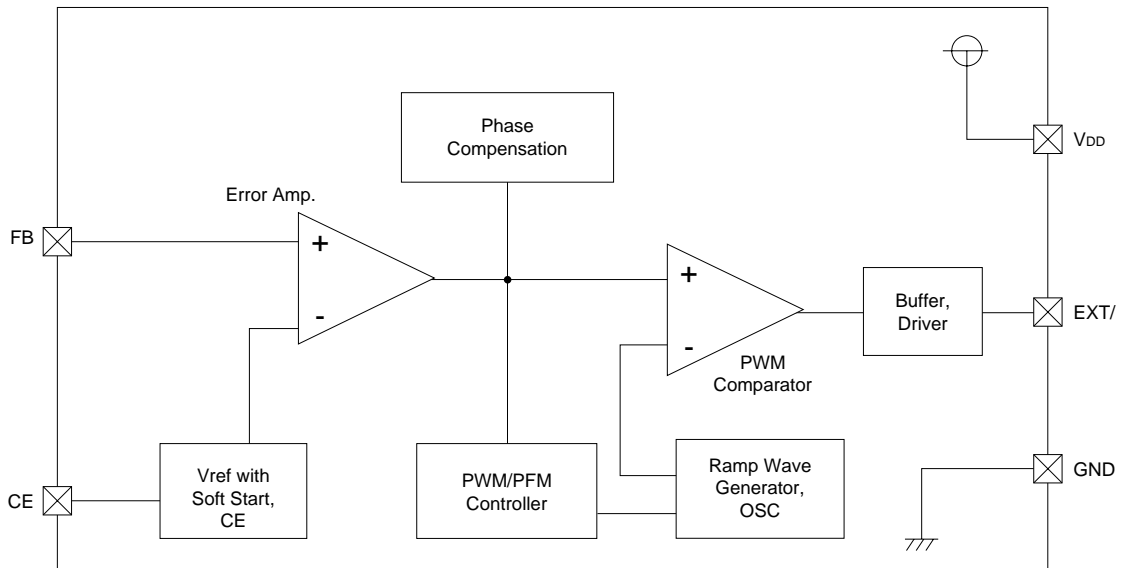
## Block Diagram

XC6367, XC6368 Series A, C, E, F types (V<sub>out</sub>)



Note : Connect V<sub>OUT</sub> and V<sub>DD</sub> internally with E, F types.

XC6367, XC6368 Series B,D types (FB)



### Absolute Maximum Ratings

Ta=25°C

PARAMETER	SYMBOL	RATINGS	UNITS
V <sub>DD</sub> Pin Voltage	V <sub>DD</sub>	-0.3 ~ 12	V
V <sub>OUT</sub> Pin Voltage	V <sub>OUT</sub>	-0.3 ~ 12	V
FB Pin Voltage	V <sub>FB</sub>	-0.3 ~ 12	V
CE Pin Voltage	V <sub>CE</sub>	-0.3 ~ 12	V
EXT Pin Voltage	V <sub>EXT</sub>	-0.3 ~ V <sub>DD</sub> +0.3	V
EXT Pin Current	I <sub>EXT</sub>	±100	mA
Continuous Total Power Dissipation	P <sub>d</sub>	150	mW
Operating Ambient Temperature	T <sub>opr</sub>	-30 ~ +80	°C
Storage Temperature	T <sub>stg</sub>	-40 ~ +125	°C

### Electrical Characteristics

XC6367A333MR, XC6368A333MR (V<sub>OUT</sub>=3.3V, F<sub>OSC</sub>=300kHz)

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V <sub>OUT</sub>		3.218	3.300	3.383	V
Supply Voltage (Note 1)	V <sub>DD</sub>		2.0	–	10.0	V
Maximum Input Voltage	V <sub>IN</sub>		10.0	–	–	V
Oscillation Start-up Voltage 1	V <sub>ST1</sub>	Use of a 2SD1628 transistor recommended, I <sub>OUT</sub> =1.0mA	–	–	0.9	V
Oscillation Start-up Voltage 2	V <sub>ST2</sub>	V <sub>OUT</sub> =CE : Apply voltage	–	–	0.8	V
Oscillation Hold Voltage	V <sub>HLD</sub>	Use of a 2SX1628 transistor recommended, I <sub>OUT</sub> =1.0mA	–	–	0.7	V
Supply Current 1	I <sub>DD1</sub>	V <sub>OUT</sub> =CE=set-up output voltage x 0.95	–	130	200	μA
Supply Current 2	I <sub>DD2</sub>	V <sub>OUT</sub> =CE=set-up output voltage + 0.5V	–	20	35	μA
Stand-by Current	I <sub>STB</sub>	V <sub>OUT</sub> =set-up output voltage x 0.95, CE=0V	–	–	0.5	μA
Oscillator Frequency	F <sub>OSC</sub>	Same as I <sub>DD1</sub>	255	300	345	kHz
Maximum Duty Ratio	MAXDTY	Same as I <sub>DD1</sub>	78	85	92	%
PFM Duty Ratio (Note 3)	PFMDTY	I <sub>OUT</sub> =0mA	15	25	35	%
CE "High" Voltage	V <sub>CEH</sub>	V <sub>OUT</sub> =set-up output voltage x0.95	0.65	–	–	V
CE "Low" Voltage	V <sub>CEL</sub>	V <sub>OUT</sub> =set-up output voltage x0.95	–	–	0.20	V
EXT "High" ON Resistance	R <sub>EXTH</sub>	Same as I <sub>DD1</sub> , V <sub>EXT</sub> =V <sub>OUT</sub> -0.4V	–	29	43	Ω
EXT "Low" ON Resistance	R <sub>EXTL</sub>	Same as I <sub>DD1</sub> , V <sub>EXT</sub> =0.4V	–	19	27	Ω
Efficiency (Note 2)	EFFI		–	84	–	%
Soft-Start Time	T <sub>SS</sub>		5	10	20	msec

Measuring conditions: Unless otherwise specified, connect V<sub>DD</sub> to V<sub>OUT</sub> ; V<sub>IN</sub>=set-up output voltage x 0.6, I<sub>OUT</sub>=130mA

Note 1: When taking V<sub>DD</sub> from another power source please ensure that V<sub>DD</sub> = 2.0V or more.  
Oscillation will occur with a value of V<sub>DD</sub> = 0.8V or more, but with a value of V<sub>DD</sub> = 2.0V or more, output voltage and oscillation frequency will be stable.

Note 2: EFFI = [(output voltage) x (output current)] ÷ [(input voltage) x (input current)] x 100

Note 3: Applies to the XC6368 series only (duty ratio when control changes to PFM).

## Electrical Characteristics

XC6367A503MR, XC6368A503MR

( $V_{OUT}=5.0V$ ,  $F_{osc}=300kHz$ )

$T_a=25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	$V_{OUT}$		4.875	5.000	5.125	V
Supply Voltage (Note 1)	$V_{DD}$		2.0	–	10.0	V
Maximum Input Voltage	$V_{IN}$		10.0	–	–	V
Oscillation Start-up Voltage 1	$V_{st1}$	Use of a 2SD1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.9	V
Oscillation Start-up Voltage 2	$V_{st2}$	$V_{OUT}=CE$ : Apply voltage	–	–	0.8	V
Oscillation Hold Voltage	$V_{HLD}$	Use of a 2SX1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.7	V
Supply Current 1	$I_{DD1}$	$V_{OUT}=CE=$ set-up output voltage x 0.95	–	180	280	$\mu A$
Supply Current 2	$I_{DD2}$	$V_{OUT}=CE=$ set-up output voltage + 0.5V	–	22	38	$\mu A$
Stand-by Current	$I_{STB}$	$V_{OUT}=$ set-up output voltage x 0.95, $CE=0V$	–	–	0.5	$\mu A$
Oscillator Frequency	$F_{osc}$	Same as $I_{DD1}$	255	300	345	kHz
Maximum Duty Ratio	$MAXDTY$	Same as $I_{DD1}$	78	85	92	%
PFM Duty Ratio (Note 3)	$PFMDTY$	$I_{OUT}=0mA$	15	25	35	%
CE "High" Voltage	$V_{CEH}$	$V_{OUT}=$ set-up output voltage x0.95	0.65	–	–	V
CE "Low" Voltage	$V_{CEL}$	$V_{OUT}=$ set-up output voltage x0.95	–	–	0.20	V
EXT "High" ON Resistance	$R_{EXTH}$	Same as $I_{DD1}$ , $V_{EXT}=V_{OUT}-0.4V$	–	20	29	$\Omega$
EXT "Low" ON Resistance	$R_{EXTL}$	Same as $I_{DD1}$ , $V_{EXT}=0.4V$	–	13	19	$\Omega$
Efficiency (Note 2)	$EFFI$		–	87	–	%
Soft-Start Time	$T_{SS}$		5	10	20	msec

Measuring conditions: Unless otherwise specified, connect  $V_{DD}$  to  $V_{OUT}$ ;  $V_{IN}$ =set-up output voltage x 0.6,  $I_{OUT}=200mA$

Note 1: When taking  $V_{DD}$  from another power source please ensure that  $V_{DD} = 2.0V$  or more.  
Oscillation will occur with a value of  $V_{DD} = 0.8V$  or more, but with a value of  $V_{DD} = 2.0V$  or more, output voltage and oscillation frequency will be stable.

Note 2:  $EFFI = \{[(\text{output voltage}) \times (\text{output current})] \div [(\text{input voltage}) \times (\text{input current})] \times 100$

Note 3: Applies to the XC6368 series only (duty ratio when control changes to PFM).

### Series Amendments:

#### XC6367C, XC6368C series

Please note that the following condition applies :  
Soft Start Time ( $T_{SS}$ ) : Connect  $R_{ss}$ ,  $C_{ss}$ .  $CE\ 0V \rightarrow 3.0V$

#### XC6367E, XC6368E series

Please delete 'Supply Voltage ( $V_{DD}$ )' and '(Note 1)'  
Please add the following note :

Note 4: There are no products within the XC6367E, XC6368E series range which have a set-up voltage of less than 2.0V.

#### XC6367F, XC6368F series

Please note that the following condition applies :  
Soft Start Time ( $T_{SS}$ ) : Connect  $R_{ss}$ ,  $C_{ss}$ .  $CE\ 0V \rightarrow 3.0V$

Please delete 'Supply Voltage ( $V_{DD}$ )' and '(Note 1)'  
Please add the following note :

Note 4: There are no products within the XC6367F, XC6368F series range which have a set-up voltage of less than 2.0V.

### Electrical Characteristics

XC6367B103MR, XC6368B103MR

$V_{OUT}=3.0V$  (when set-up),  $F_{OSC}=300kHz$

$T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	$V_{OUT}$		2.925	3.000	3.075	V
Supply Voltage (Note 1)	$V_{DD}$		2.0	–	10.0	V
Maximum Input Voltage	$V_{IN}$		10.0	–	–	V
Oscillation Start-up Voltage 1	$V_{ST1}$	Use of a 2SD1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.9	V
Oscillation Start-up Voltage 2	$V_{ST2}$	$V_{DD}=CE$ : Apply voltage, $FB=0V$	–	–	0.8	V
Oscillation Hold Voltage	$V_{HLD}$	Use of a 2SX1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.7	V
Supply Current 1	$I_{DD1}$	$V_{DD}=CE=2.85V$ , $FB=0V$	–	120	190	$\mu A$
Supply Current 2	$I_{DD2}$	$V_{DD}=CE=3.5V$ , $FB=1.2V$	–	20	34	$\mu A$
Stand-by Current	$I_{STB}$	$V_{DD}=2.85V$ , $CE=0V$ , $FB=0V$	–	–	0.5	$\mu A$
Oscillator Frequency	$F_{OSC}$	Same as $I_{DD1}$	255	300	345	kHz
Maximum Duty Ratio	MAXDTY	Same as $I_{DD1}$	78	85	92	%
PFM Duty Ratio (Note 3)	PFMDTY	$I_{OUT}=0mA$	15	25	35	%
CE "High" Voltage	$V_{CEH}$	$V_{DD}=2.85V$ , $FB=0V$	0.65	–	–	V
CE "Low" Voltage	$V_{CEL}$	$V_{DD}=2.85V$ , $FB=0V$	–	–	0.20	V
EXT "High" ON Resistance	$R_{EXTH}$	Same as $I_{DD1}$ , $V_{EXT}=V_{OUT}-0.4V$	–	32	47	$\Omega$
EXT "Low" ON Resistance	$R_{EXTL}$	Same as $I_{DD1}$ , $V_{EXT}=0.4V$	–	20	30	$\Omega$
Efficiency (Note 2)	EFFI		–	84	–	%
Soft-Start Time	$T_{SS}$		5	10	20	msec

Measuring conditions: Unless otherwise specified,  $V_{IN}=1.8V$ ,  $I_{OUT}=120mA$   
 External components :  $R_{FB1} = 400k\Omega$ ,  $R_{FB2} = 200k\Omega$ ,  $C_{FB} = 47pF$

Note 1: When taking  $V_{DD}$  from another power source please ensure that  $V_{DD} = 2.0V$  or more.  
 Oscillation will occur with a value of  $V_{DD} = 0.8V$  or more, but with a value of  $V_{DD} = 2.0V$  or more, output voltage and oscillation frequency will be stable.

Note 2:  $EFFI = \{[(\text{output voltage}) \times (\text{output current})] \div [(\text{input voltage}) \times (\text{input current})] \times 100$

Note 3: Applies to the XC6368 series only (duty ratio when control changes to PFM).

Series Amendments:

XC6367D, XC6368D series

Please note that the following condition applies :

Soft Start Time ( $T_{SS}$ ) : Connect  $R_{SS}$ ,  $C_{SS}$ .  $CE\ 0V \rightarrow 3.0V$

## Electrical Characteristics

XC6367A331MR, XC6368A331MR

(V<sub>OUT</sub>=3.3V, F<sub>OSC</sub>=100kHz)

T<sub>a</sub>=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	V <sub>OUT</sub>		3.218	3.300	3.383	V
Supply Voltage (Note 1)	V <sub>DD</sub>		2.0	–	10.0	V
Maximum Input Voltage	V <sub>IN</sub>		10.0	–	–	V
Oscillation Start-up Voltage 1	V <sub>ST1</sub>	Use of a 2SD1628 transistor recommended, I <sub>OUT</sub> =1.0mA	–	–	0.9	V
Oscillation Start-up Voltage 2	V <sub>ST2</sub>	V <sub>OUT</sub> =CE : Apply voltage	–	–	0.8	V
Oscillation Hold Voltage	V <sub>HLD</sub>	Use of a 2SX1628 transistor recommended, I <sub>OUT</sub> =1.0mA	–	–	0.7	V
Supply Current 1	I <sub>DD1</sub>	V <sub>OUT</sub> =CE=set-up output voltage x 0.95	–	50	100	μA
Supply Current 2	I <sub>DD2</sub>	V <sub>OUT</sub> =CE=set-up output voltage + 0.5V	–	11	20	μA
Stand-by Current	I <sub>STB</sub>	V <sub>OUT</sub> =set-up output voltage x 0.95, CE=0V	–	–	0.5	μA
Oscillator Frequency	F <sub>OSC</sub>	Same as I <sub>DD1</sub>	85	100	115	kHz
Maximum Duty Ratio	MAXDTY	Same as I <sub>DD1</sub>	78	85	92	%
PFM Duty Ratio (Note 3)	PFMDTY	I <sub>OUT</sub> =0mA	15	25	35	%
CE "High" Voltage	V <sub>CEH</sub>	V <sub>OUT</sub> =set-up output voltage x0.95	0.65	–	–	V
CE "Low" Voltage	V <sub>CEL</sub>	V <sub>OUT</sub> =set-up output voltage x0.95	–	–	0.20	V
EXT "High" ON Resistance	R <sub>EXTH</sub>	Same as I <sub>DD1</sub> , V <sub>EXT</sub> =V <sub>OUT</sub> -0.4V	–	29	43	Ω
EXT "Low" ON Resistance	R <sub>EXTL</sub>	Same as I <sub>DD1</sub> , V <sub>EXT</sub> =0.4V	–	19	27	Ω
Efficiency (Note 2)	EFFI		–	84	–	%
Soft-Start Time	T <sub>SS</sub>		5	10	20	msec

Measuring conditions: Unless otherwise specified, connect V<sub>DD</sub> to V<sub>OUT</sub> ; V<sub>IN</sub>=set-up output voltage x 0.6, I<sub>OUT</sub>=130mA

Note 1: When taking V<sub>DD</sub> from another power source please ensure that V<sub>DD</sub> = 2.0V or more.  
Oscillation will occur with a value of V<sub>DD</sub> = 0.8V or more, but with a value of V<sub>DD</sub> = 2.0V or more, output voltage and oscillation frequency will be stable.

Note 2: EFFI = {(output voltage) x (output current)} ÷ [(input voltage) x (input current)] x 100

Note 3: Applies to the XC6368 series only (duty ratio when control changes to PFM).

### Electrical Characteristics

XC6367A501MR, XC6368A501MR

( $V_{OUT}=5.0V$ ,  $F_{OSC}=100kHz$ )

$T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	$V_{OUT}$		4.875	5.000	5.125	V
Supply Voltage (Note 1)	$V_{DD}$		2.0	–	10.0	V
Maximum Input Voltage	$V_{IN}$		10.0	–	–	V
Oscillation Start-up Voltage 1	$V_{ST1}$	Use of a 2SD1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.9	V
Oscillation Start-up Voltage 2	$V_{ST2}$	$V_{OUT}=CE$ : Apply voltage	–	–	0.8	V
Oscillation Hold Voltage	$V_{HLD}$	Use of a 2SX1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.7	V
Supply Current 1	$I_{DD1}$	$V_{OUT}=CE=$ set-up output voltage x 0.95	–	70	120	$\mu A$
Supply Current 2	$I_{DD2}$	$V_{OUT}=CE=$ set-up output voltage + 0.5V	–	11	22	$\mu A$
Stand-by Current	$I_{STB}$	$V_{OUT}=$ set-up output voltage x 0.95, $CE=0V$	–	–	0.5	$\mu A$
Oscillator Frequency	$F_{OSC}$	Same as $I_{DD1}$	85	100	115	kHz
Maximum Duty Ratio	$MAXDTY$	Same as $I_{DD1}$	78	85	92	%
PFM Duty Ratio (Note 3)	$PFMDTY$	$I_{OUT}=0mA$	15	25	35	%
CE "High" Voltage	$V_{CEH}$	$V_{OUT}=$ set-up output voltage x0.95	0.65	–	–	V
CE "Low" Voltage	$V_{CEL}$	$V_{OUT}=$ set-up output voltage x0.95	–	–	0.20	V
EXT "High" ON Resistance	$R_{EXTH}$	Same as $I_{DD1}$ , $V_{EXT}=V_{OUT}-0.4V$	–	20	29	$\Omega$
EXT "Low" ON Resistance	$R_{EXTL}$	Same as $I_{DD1}$ , $V_{EXT}=0.4V$	–	13	19	$\Omega$
Efficiency (Note 2)	$EFFI$		–	87	–	%
Soft-Start Time	$T_{SS}$		5	10	20	msec

Measuring conditions: Unless otherwise specified, connect  $V_{DD}$  to  $V_{OUT}$  ;  $V_{IN}=\text{set-up output voltage} \times 0.6$ ,  $I_{OUT}=200mA$

Note 1: When taking  $V_{DD}$  from another power source please ensure that  $V_{DD} = 2.0V$  or more.  
Oscillation will occur with a value of  $V_{DD} = 0.8V$  or more, but with a value of  $V_{DD} = 2.0V$  or more, output voltage and oscillation frequency will be stable.

Note 2:  $EFFI = \{[(\text{output voltage}) \times (\text{output current})] \div [(\text{input voltage}) \times (\text{input current})] \times 100$

Note 3: Applies to the XC6368 series only (duty ratio when control changes to PFM).



## Electrical Characteristics

XC6367B101MR, XC6368B101MR

$V_{OUT}=3.0V$  (when set-up),  $F_{OSC}=100kHz$

$T_a=25^{\circ}C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	$V_{OUT}$		2.925	3.000	3.075	V
Supply Voltage (Note 1)	$V_{DD}$		2.0	–	10.0	V
Maximum Input Voltage	$V_{IN}$		10.0	–	–	V
Oscillation Start-up Voltage 1	$V_{ST1}$	Use of a 2SD1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.9	V
Oscillation Start-up Voltage 2	$V_{ST2}$	$V_{DD}=CE$ : Apply voltage, $FB=0V$	–	–	0.8	V
Oscillation Hold Voltage	$V_{HLD}$	Use of a 2SX1628 transistor recommended, $I_{OUT}=1.0mA$	–	–	0.7	V
Supply Current 1	$I_{DD1}$	$V_{DD}=CE=2.85V$ , $FB=0V$	–	50	90	$\mu A$
Supply Current 2	$I_{DD2}$	$V_{DD}=CE=3.5V$ , $FB=1.2V$	–	11	20	$\mu A$
Stand-by Current	$I_{STB}$	$V_{DD}=2.85V$ , $CE=0V$ , $FB=0V$	–	–	0.5	$\mu A$
Oscillator Frequency	$F_{OSC}$	Same as $I_{DD1}$	85	100	115	kHz
Maximum Duty Ratio	$MAXDTY$	Same as $I_{DD1}$	78	85	92	%
PFM Duty Ratio (Note 3)	$PFMDTY$	$I_{OUT}=0mA$	15	25	35	%
CE "High" Voltage	$V_{CEH}$	$V_{DD}=2.85V$ , $FB=0V$	0.65	–	–	V
CE "Low" Voltage	$V_{CEL}$	$V_{DD}=2.85V$ , $FB=0V$	–	–	0.20	V
EXT "High" ON Resistance	$R_{EXTH}$	Same as $I_{DD1}$ , $V_{EXT}=V_{OUT}-0.4V$	–	32	47	$\Omega$
EXT "Low" ON Resistance	$R_{EXTL}$	Same as $I_{DD1}$ , $V_{EXT}=0.4V$	–	20	30	$\Omega$
Efficiency (Note 2)	$EFFI$		–	84	–	%
Soft-Start Time	$T_{SS}$		5	10	20	msec

Measuring conditions: Unless otherwise specified,  $V_{IN}=1.8V$ ,  $I_{OUT}=120mA$   
 External components :  $R_{FB1} = 400k\Omega$ ,  $R_{FB2} = 200k\Omega$ ,  $C_{FB} = 47pF$

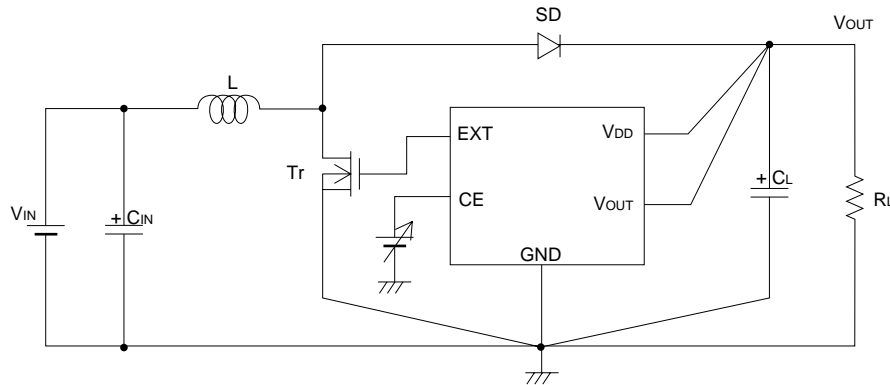
Note 1: When taking  $V_{DD}$  from another power source please ensure that  $V_{DD} = 2.0V$  or more.  
 Oscillation will occur with a value of  $V_{DD} = 0.8V$  or more, but with a value of  $V_{DD} = 2.0V$  or more,  
 output voltage and oscillation frequency will be stable.

Note 2:  $EFFI = \{[(\text{output voltage}) \times (\text{output current})] \div [(\text{input voltage}) \times (\text{input current})] \} \times 100$

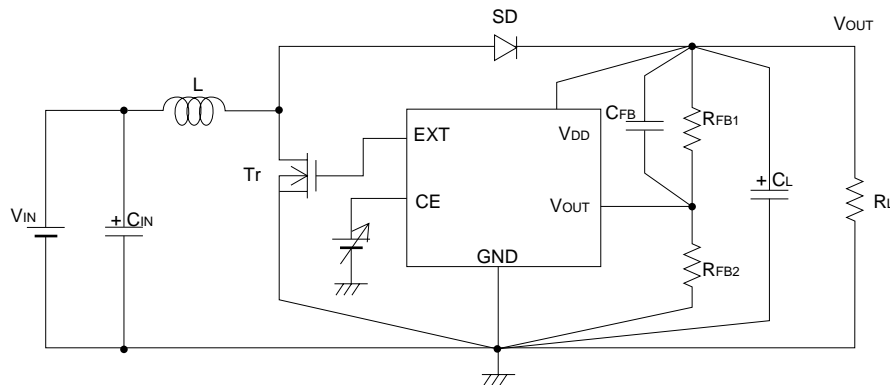
Note 3: Applies to the XC6368 series only (duty ratio when control changes to PFM).

### Typical Application Circuits

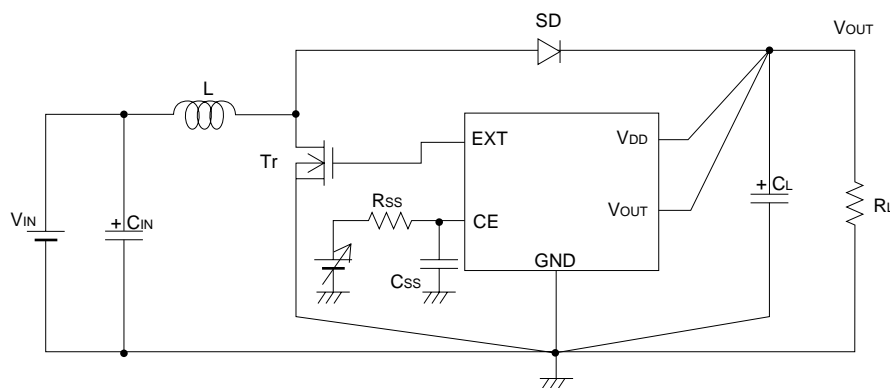
Circuit 1. XC6367A, XC6368A



Circuit 2. XC6367B, XC6368B

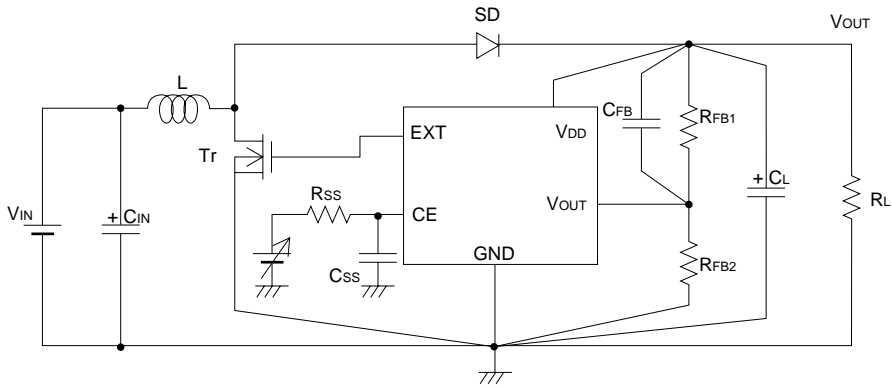


Circuit 3. XC6367C, XC6368C

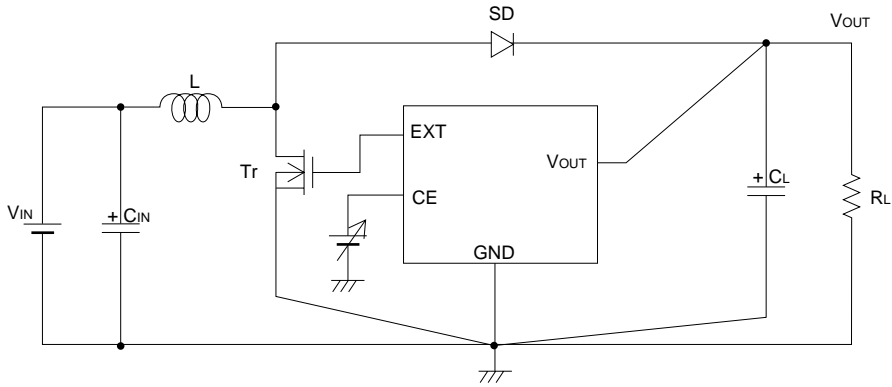


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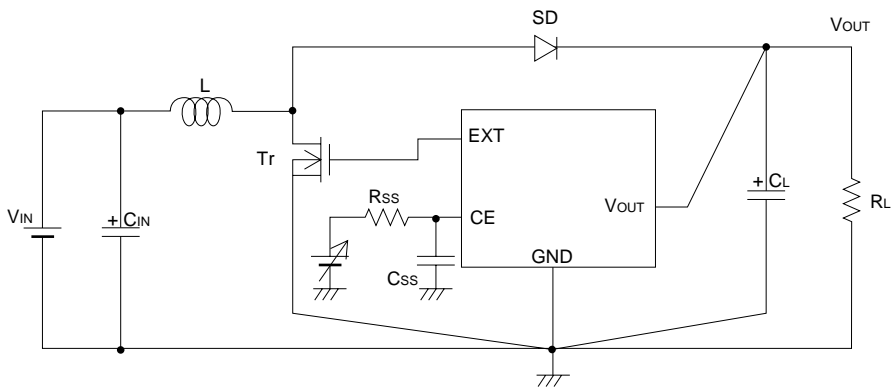
Circuit 4. XC6367D, XC6368D



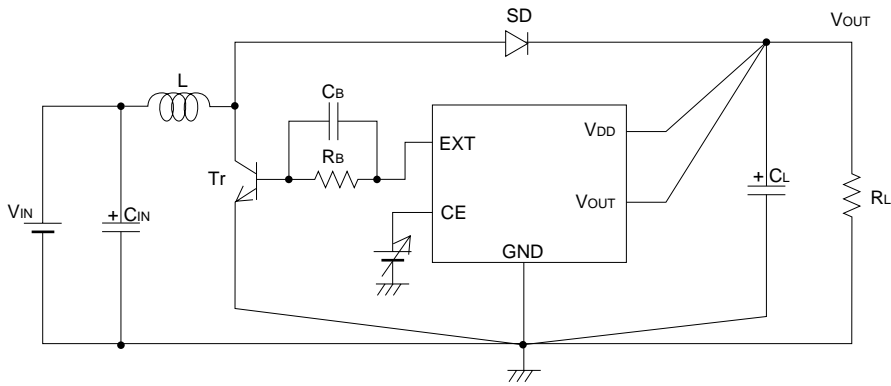
Circuit 5. XC6367E, XC6368E



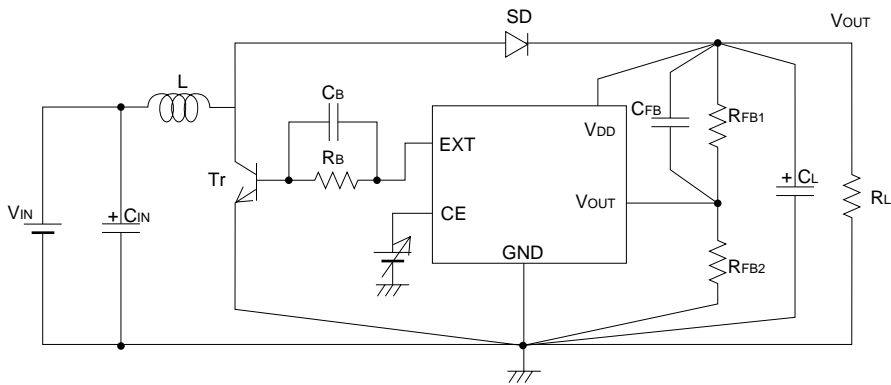
Circuit 6. XC6367F, XC6368F



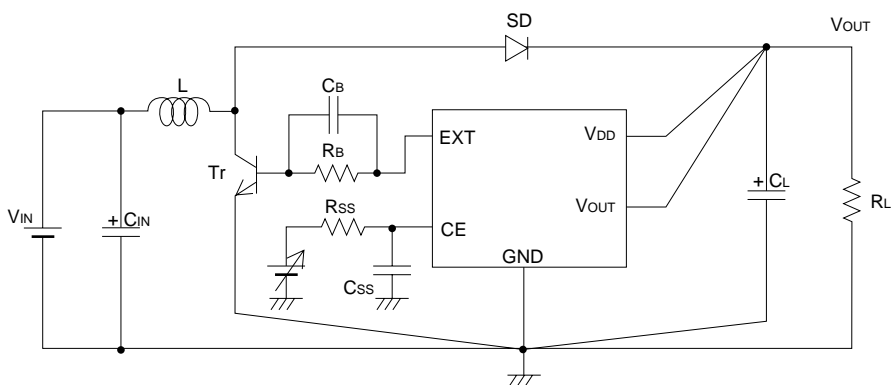
Circuit 7. XC6367A, XC6368A (NPN Transistor)



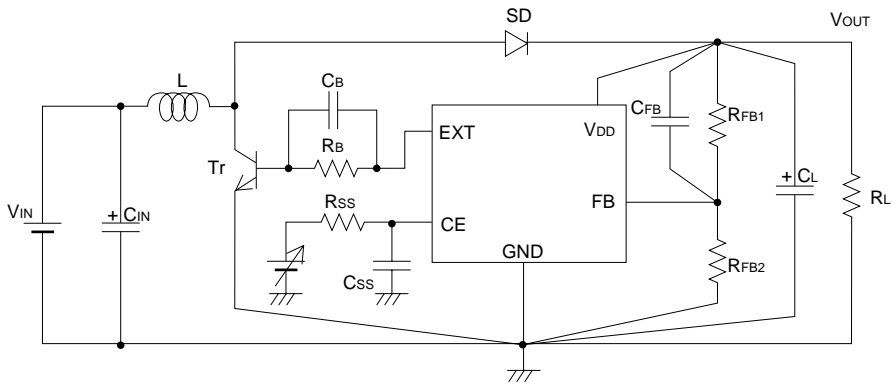
Circuit 8. XC6367B, XC6368B (NPN Transistor)



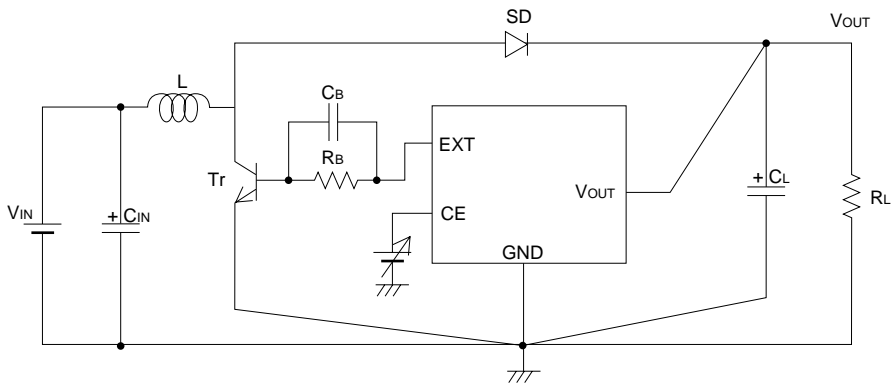
Circuit 9. XC6367C, XC6368C (NPN Transistor)



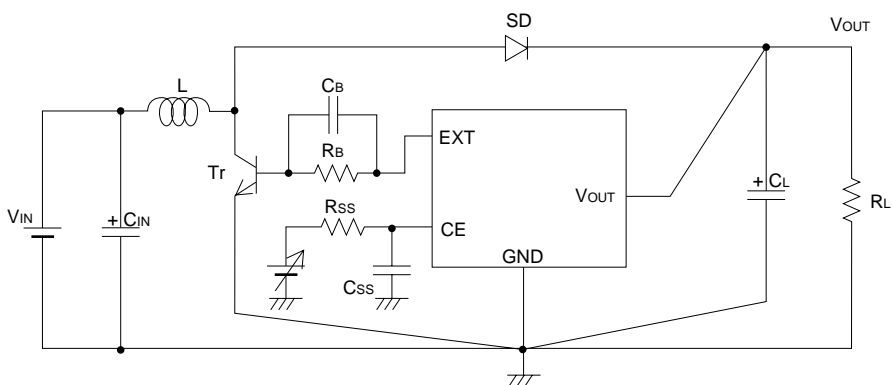
Circuit 10. XC6367D, XC6368D (NPN Transistor)



Circuit 11. XC6367E, XC6368E (NPN Transistor)



Circuit 12. XC6367F, XC6368F (NPN Transistor)



### Recommended Components

- Tr : XP161A0390PR (Torex N-channel Power MOSFET)  
 As the breakdown voltage of XP161A0390PR is 8V take care with the power supply voltage. With output voltages over 6V, use the XP161A02A1PR with a breakdown voltage of 12V.  
 V<sub>ST1</sub> : XP161A0390PR = 1.2V (max)  
           XP161A02A1PR = 1.5V (max)
- L : 22μH (Sumida CD54, F<sub>osc</sub>=300kHz)  
     47μH (Sumida CD75, F<sub>osc</sub>=100, 180kHz)  
     10μH (Sumida CD54, F<sub>osc</sub>=500kHz)
- SD : MA737 (Schottky Diode, Matsushita)
- C<sub>IN</sub> : 10V 10μF (Tantalum capacitor, Nichicon F93)
- CL : 16V 47μF (Tantalum capacitor, Nichicon F93)

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### NPN Tr type :

- Tr : 2SD1628 (Sanyo)  
 R<sub>b</sub> : 500Ω (Adjust according to load and Tr. hFE levels)  
 C<sub>b</sub> : 2200pF (Ceramic type)

Set up so that  $C_b \leq 1 \div (2\pi \times R_b \times F_{osc} \times 0.7)$

### C, D, F type (soft-start externally set-up) :

- C<sub>SS</sub> : 0.1μF (Ceramic capacitor)  
 R<sub>SS</sub> : 470kΩ (C type), 220kΩ (D type)

### B, D type (FB versions)

- R<sub>FB</sub> : Set up so that  $R_{FB1} \div R_{FB2} = V_{OUT} - 1$  ( $V_{OUT}$  = set-up output voltage),  
 Please use with  $R_{FB1} + R_{FB2} \leq 2M\Omega$
- C<sub>FB</sub> : Set up so that  $f_{zfb} = 1 \div (2 \times \pi \times C_{FB} \times R_{FB1})$  is within the  
 0.1 to 20kHz range (10kHz conventional)  
 Adjustments necessary in respect of L, CL.
- e.g  $V_{OUT} = 3.0V$   
 $R_{FB1} = 400k\Omega$ ,  $R_{FB2} = 200k\Omega$ ,  $C_{FB} = 47pF$

If using a Torex MOSFET, We recommend using one which has a gate protection diode built-in.

		Gate Protection Diode Built-in
	XP161A0390PR	XP161A1355PR
R <sub>ds(ON)</sub>	0.3 Ω @ V <sub>gs</sub> =1.5V	0.15 Ω @ V <sub>gs</sub> =1.5V
	XP161A02A1PR	XP161A1265PR
R <sub>ds(ON)</sub>	0.17 Ω @ V <sub>gs</sub> =2.5V	0.095 Ω @ V <sub>gs</sub> =2.5V

### Notes on Use

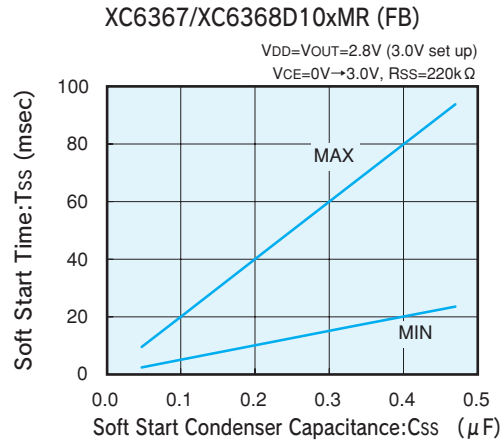
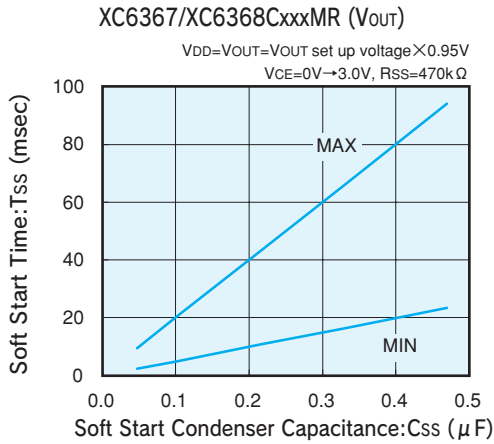
Take ample care to ensure that none of the IC's, nor the external component's, absolute maximum ratings are exceeded. Be extremely careful when selecting parts and do not limit your reference to the specifications and characteristics for the DC/DC converter alone. The IC also depends, to a great extent, upon the external components. Arrange the peripherals in the environs of the IC. In order to reduce wiring impedance, use short, thick wires. In particular, wire the load capacitor as close as possible and strengthen the ground wiring sufficiently. Ground current during switching may cause the IC's operations to become unstable due to changes in ground voltage, so please strengthen the IC's GND pin surroundings.

## External Components

### 1. Soft start time set up

If you wish to lengthen soft start time we recommend that you use the C or D versions of the series which have soft start time externally set up.

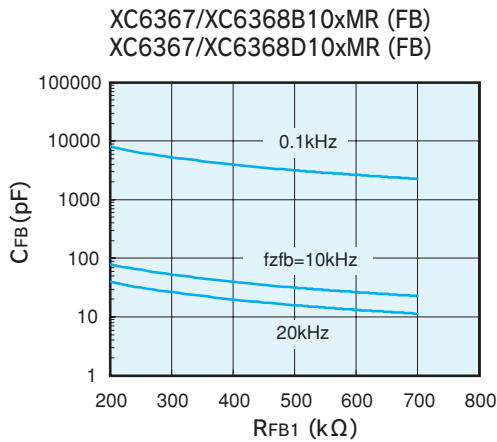
Soft start time (Tss) is between MIN & MAX, as indicated in the graphs below, so please select soft start condenser capacitance (C<sub>SS</sub>) to suit your application.



### 2. RFB1, CFB set up

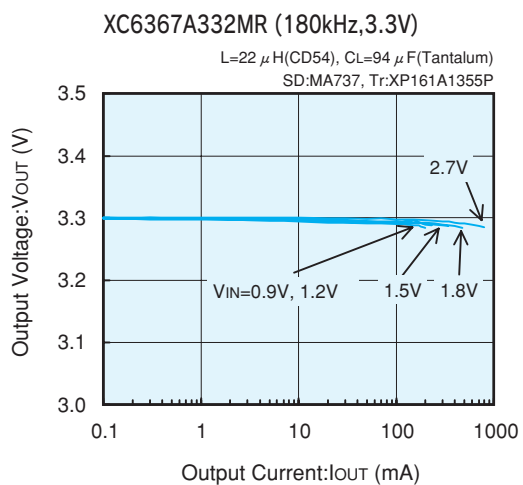
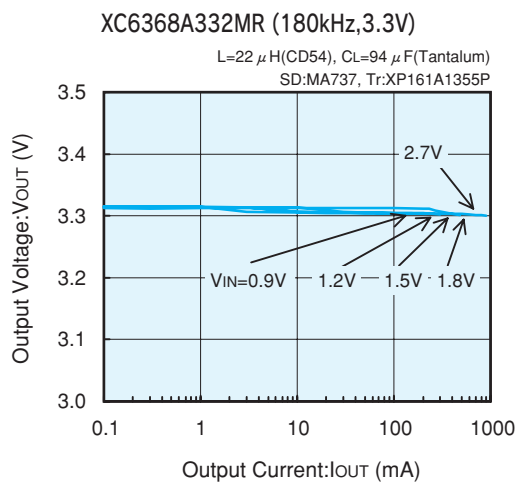
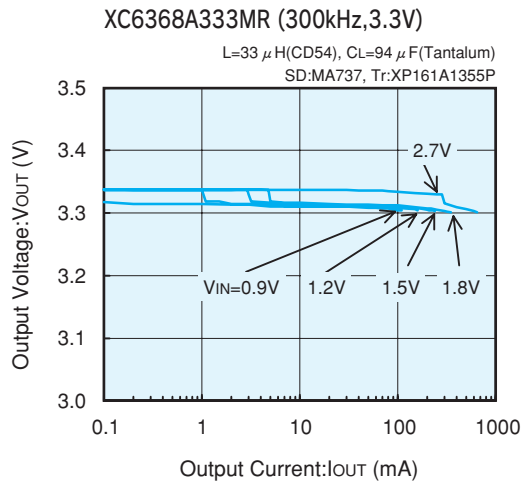
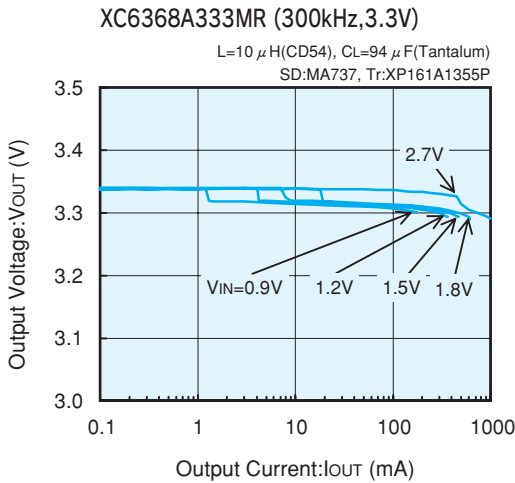
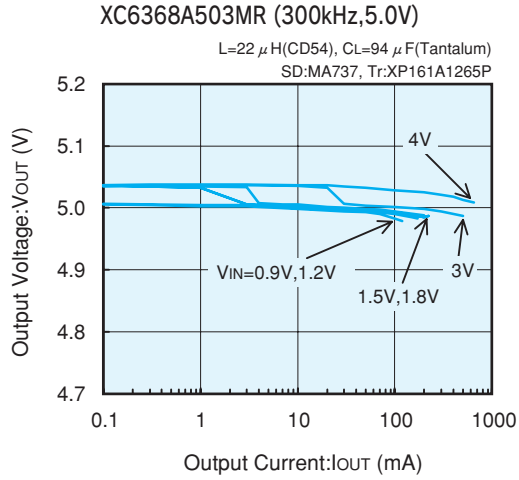
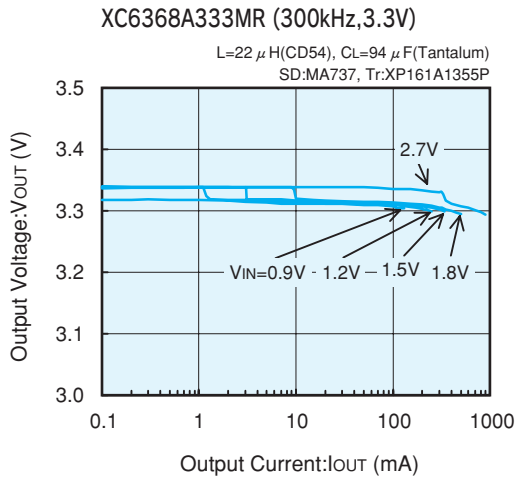
$$f_{zfb} = 1 \div (2\pi \times C_{FB} \times R_{FB1})$$

In order to achieve a value for f<sub>zfb</sub> within the range of 0.1kHz to 20kHz, we recommend that values for R<sub>FB1</sub> & C<sub>FB</sub> are selected from the area indicated within the lines of f<sub>zfb</sub> = 0.1kHz and f<sub>zfb</sub> = 20 kHz as shown on the graph below. Please select combinations of values as close to the f<sub>zfb</sub> = 10kHz line as possible.



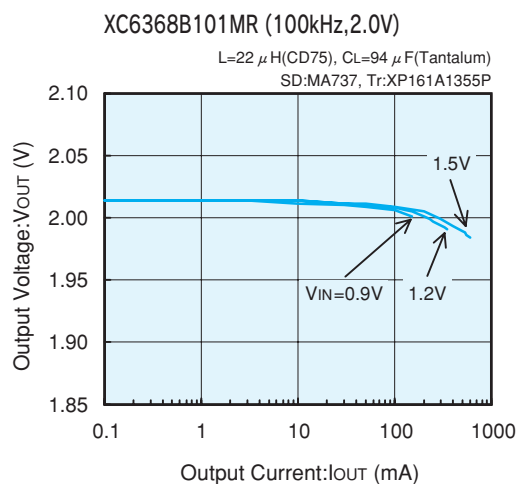
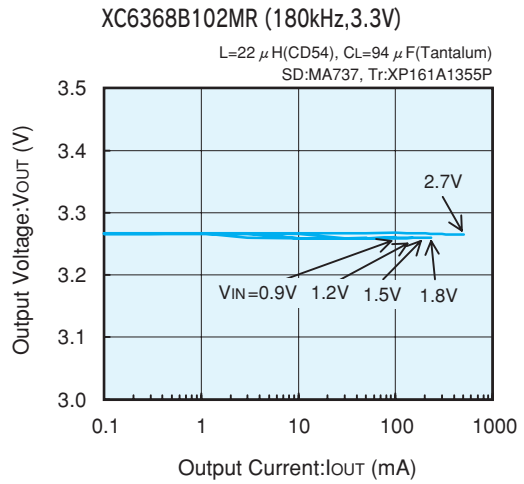
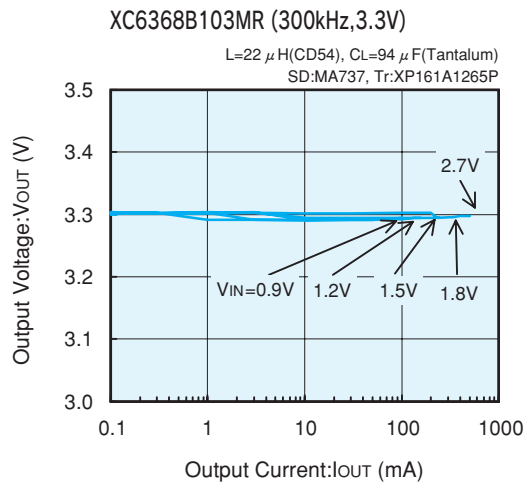
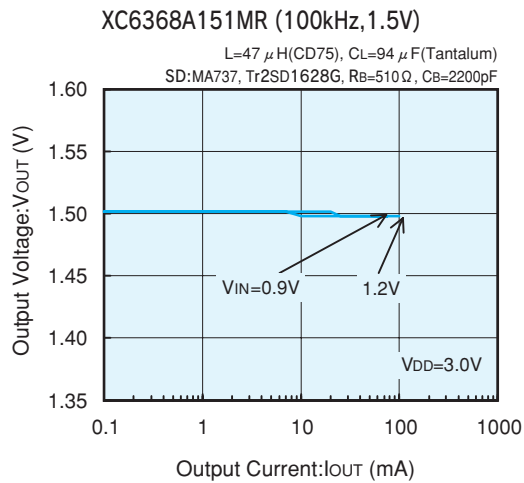
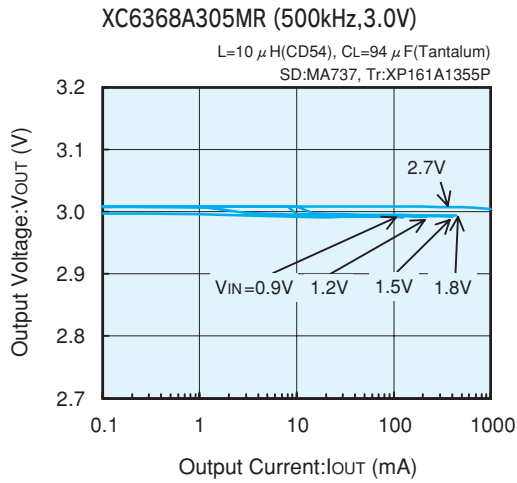
### Electrical Characteristics

#### (1) Output Voltage vs. Output Current



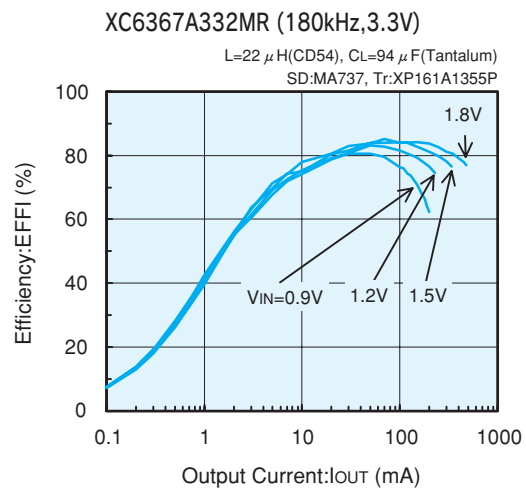
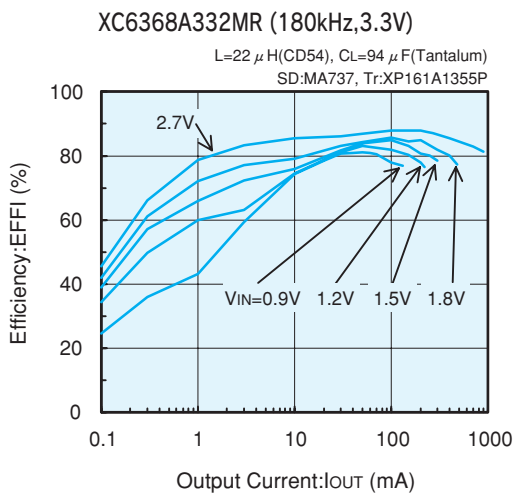
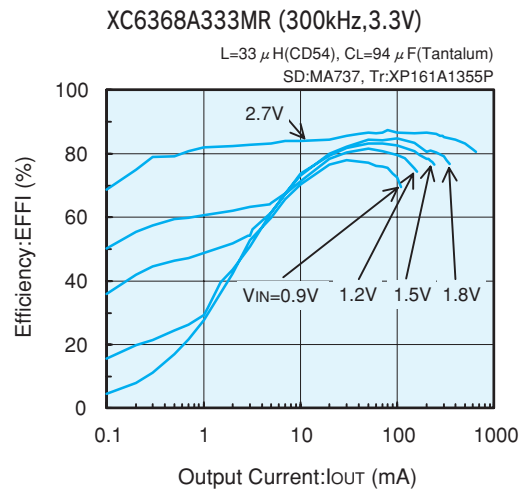
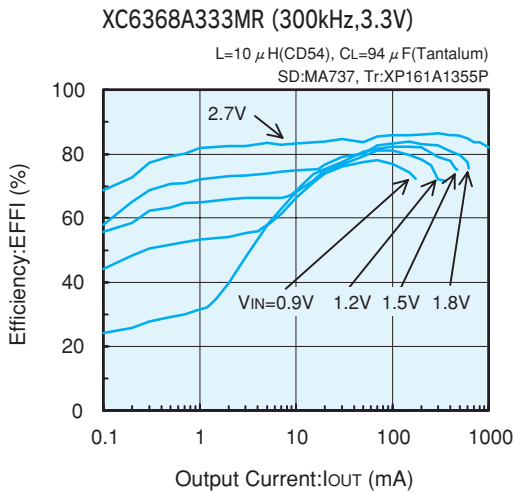
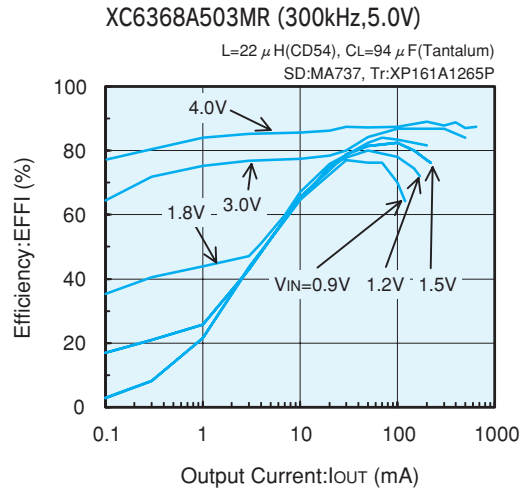
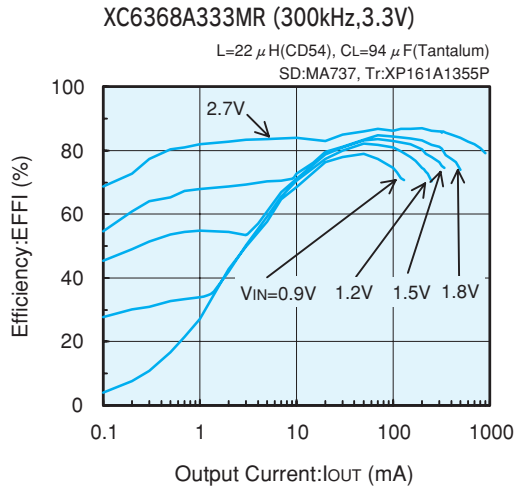
Note: <External component> CIN=220  $\mu$ F(Electrolytic capacitor)



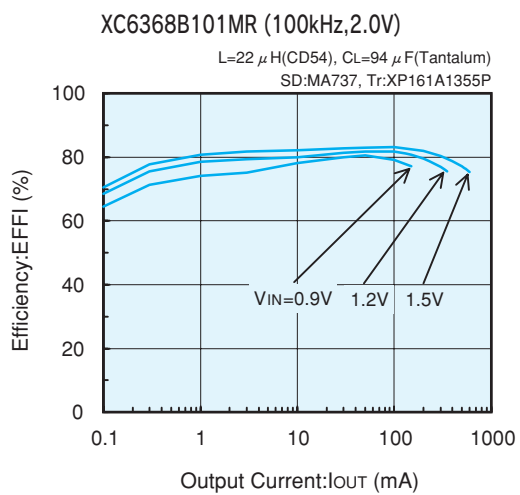
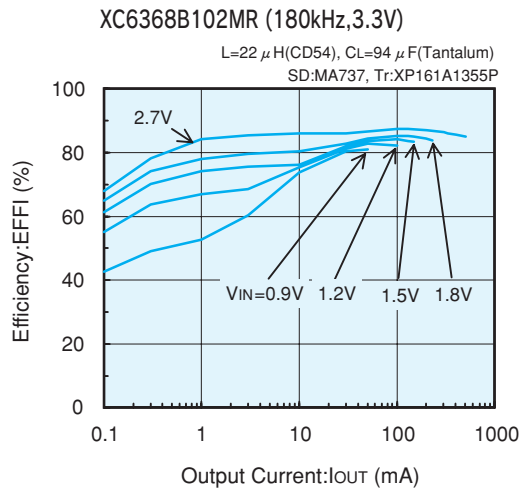
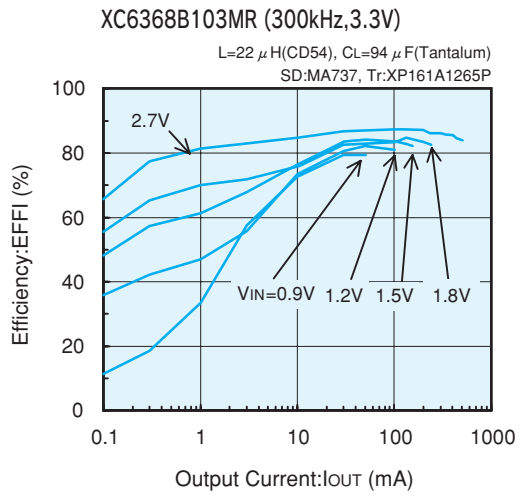
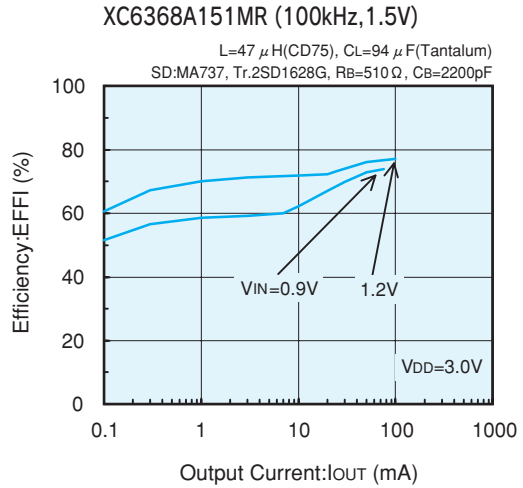
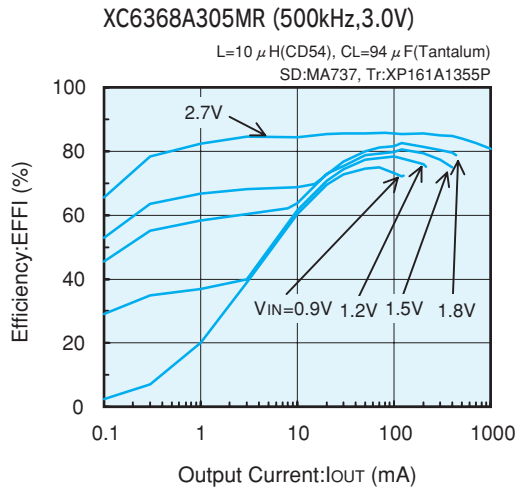


Note: <External component> CIN=220  $\mu$ F(Electrolytic capacitor)

### (2) Efficiency vs. Output Current



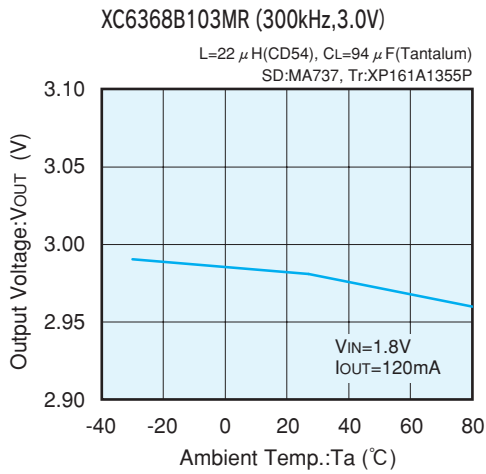
Note: <External component> CIN=220  $\mu$ F(Electrolytic capacitor)



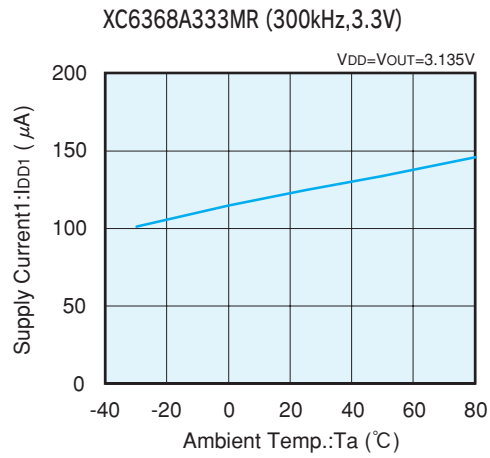
Note: <External component> CIN=220  $\mu$ F(Electrolytic capacitor)

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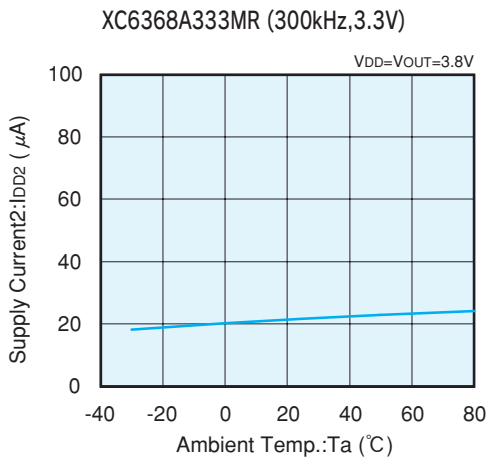
(3) Output Voltage vs. Ambient Temperature



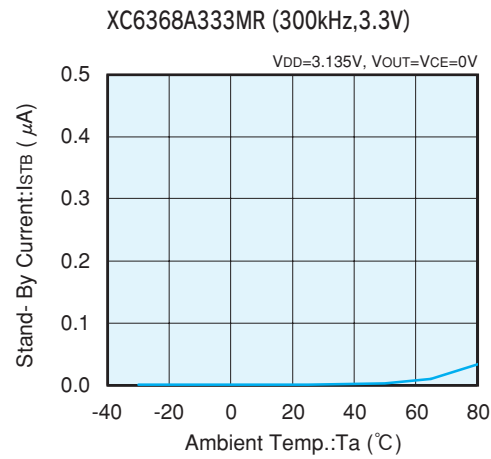
(4) Supply Current 1 vs. Ambient Temperature



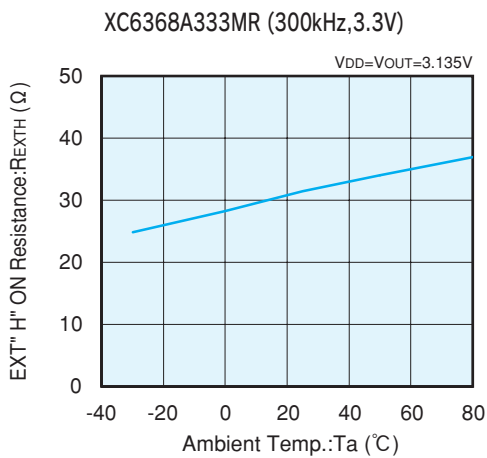
(5) Supply Current 2 vs. Ambient Temperature



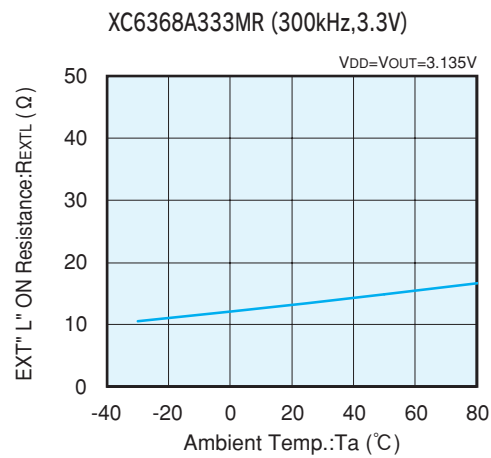
(6) Stand-By Current vs. Ambient Temperature



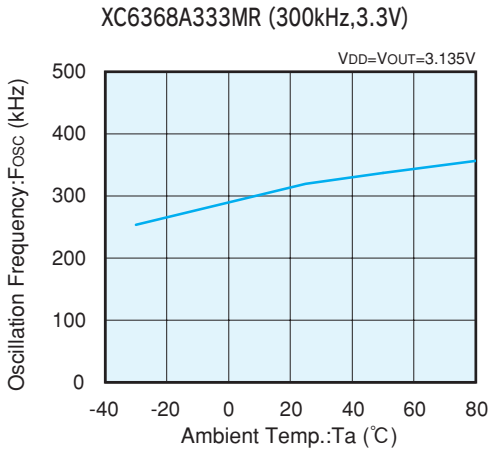
(7) EXT" H" ON Resistance vs. Ambient Temperature



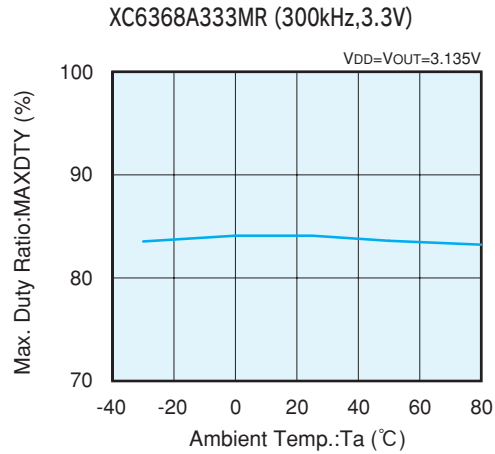
(8) EXT" L" ON Resistance vs. Ambient Temperature



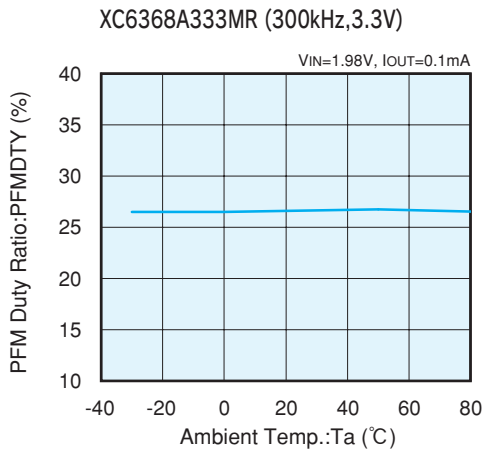
(9) Oscillation Frequency vs. Ambient Temperature



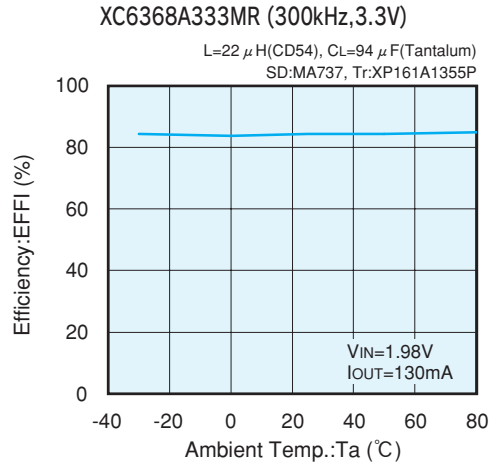
(10) Max. Duty Ratio vs. Ambient Temperature



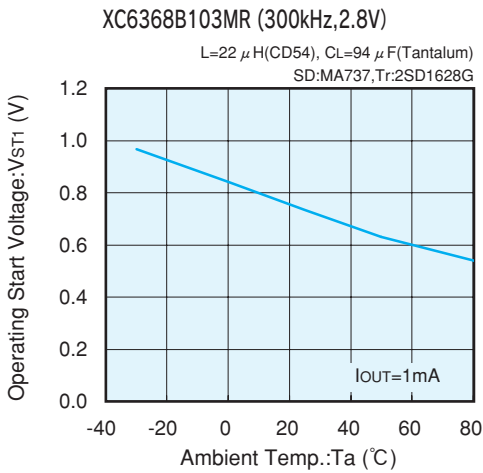
(11) PFM Duty Ratio vs. Ambient Temperature



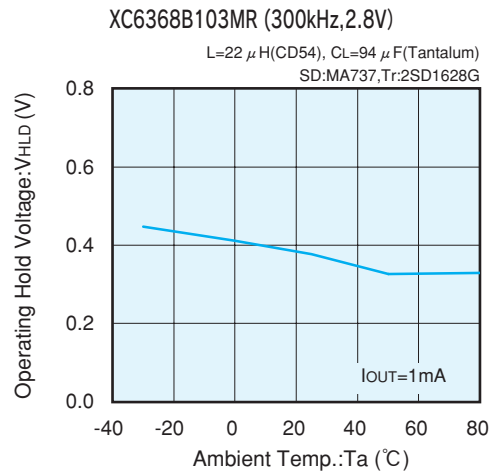
(12) Efficiency vs. Ambient Temperature



(13) Operating Start Voltage vs. Ambient Temperature

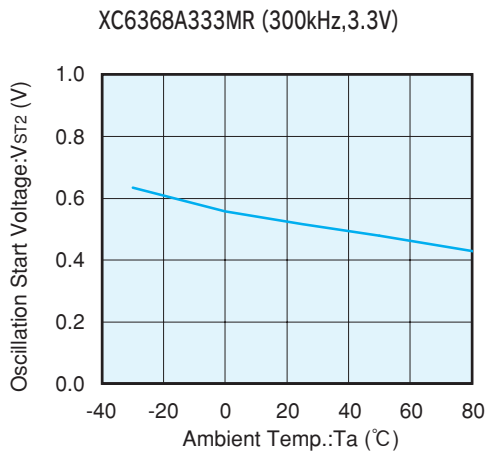


(14) Operating Hold Voltage vs. Ambient Temperature

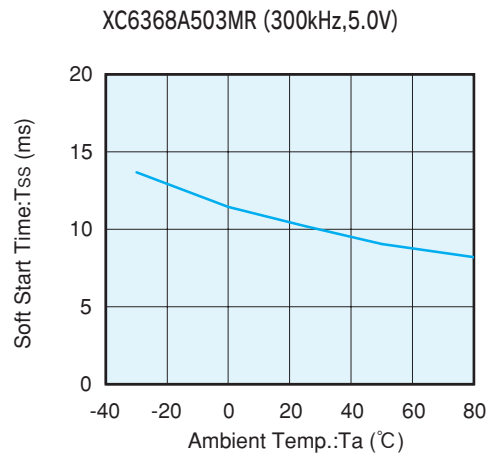


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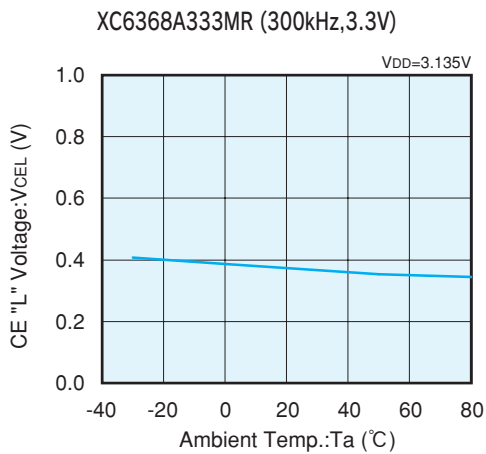
(15) Oscillation Start Voltage vs. Ambient Temperature



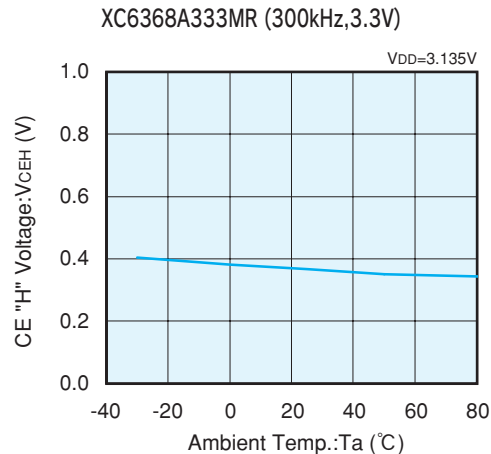
(16) Soft Start Time vs. Ambient Temperature



(17) CE "L" Voltage vs. Ambient Temperature



(18) CE "H" Voltage vs. Ambient Temperature



(19) Load Transient Response

