

- ◆ **Input Voltage Range: 2.2~10.0V**
- ◆ **Output Voltage Range: 1.5~6.0V(±2.5%)**
- ◆ **Oscillator Frequency: 300kHz(±15%)**
- ◆ **Maximum Duty Ratio: 100%**
- ◆ **High Efficiency: 92%**
- ◆ **PWM/PFM Switching Control (XC6366)**
- ◆ **SOT-25 Package**

## ■ General Description

The XC6365/66 series are multi-functional step-down DC/DC converters with built-in high speed, low ON resistance drivers. An output current of more than 1A is possible using an externally connected transistor, coil, diode and capacitor.

Output voltage is programmable in 0.1V steps between 1.5V to 6.0V (V<sub>OUT</sub>) (±2.5% accuracy). Further, with 1.0V of standard voltage supply internal and using externally connected components, output voltage can be set up freely (FB).

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 XC6366 (PWM/PFM switchable) and the series is highly efficient from light loads to large output currents.

In relation to soft-start time, both internally set-up 10msec types (A,B) and external resistor or capacitor regulated types (C,D) are available.

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

With U.V.L.O internal, the external Tr. will be forcibly switched off if used below the stipulated voltage.

## ■ Applications

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

## ■ Features

**Input voltage range:** 2.2V~10V (V<sub>OUT</sub> type)

**Output voltage range:** 1.5V~6.0V programmable in 0.1V steps (±2.5%)

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

Custom products for 180, 500kHz

**Output Current:** 1.0A + (V<sub>IN</sub>=5.0V, V<sub>OUT</sub>=3.0V)

**High Efficiency:** 92% (typ.)

**Stand-by capability:** I<sub>STB</sub>=0.5μA (max.)

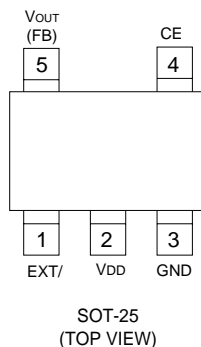
**Soft-start time set-up externally type possible**

**Internally set-up output voltage type possible (V<sub>OUT</sub>)**

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

**Package:** SOT-25

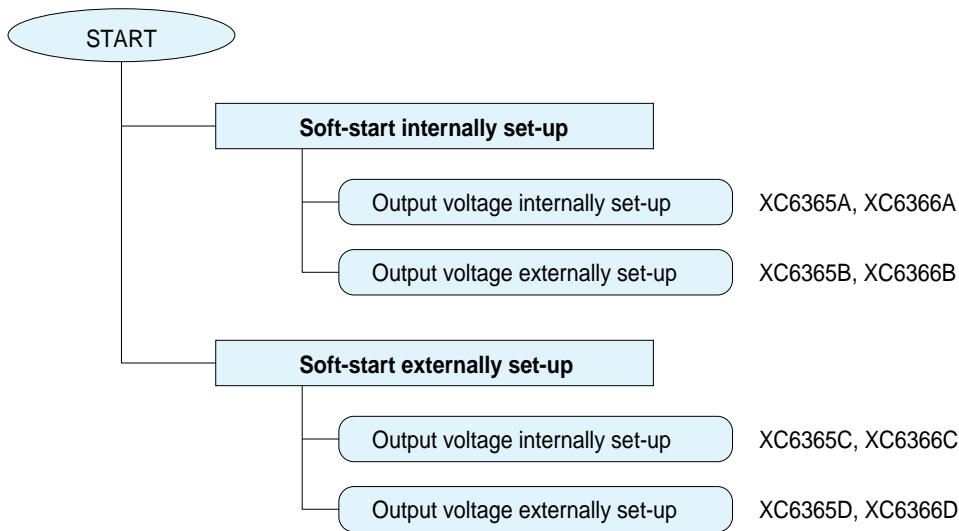
## ■ Pin Configuration



## ■ Pin Assignment

PIN NUMBER	PIN NAME	FUNCTION
1	EXT/	External Transistor Connection
2	V <sub>DD</sub>	Power Supply
3	GND	Ground
4	CE	Chip Enable Soft-start capacitor connection with soft-start externally set-up types (C,D)
5	V <sub>OUT</sub> (FB)	Output Voltage Monitor FB with externally set-up types (B,D)

## ■ Selection Guide



3

## ■ Ordering Information

### XC6365①②③④⑤⑥

XC6365 Series      PWM Control

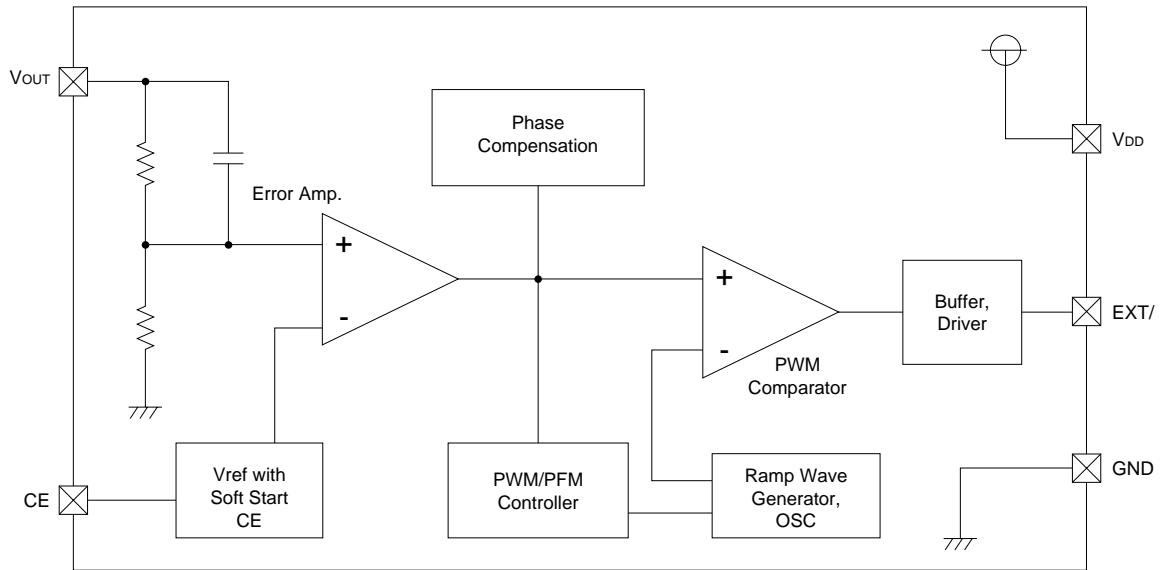
①	A	V <sub>OUT</sub> type - internally set-up soft-start
	B	FB type - internally set-up soft-start
	C	V <sub>OUT</sub> type - externally set-up soft-start
	D	FB type - externally set-up soft-start
② ③		Output voltage e.g. 3.0V output : (②=3, ③=0), N.B. with FB (B,D) types (②=1, ③=0)
④	3	Oscillator frequency 300kHz
	5	Oscillator frequency 500kHz (Custom)
	2	Oscillator frequency 180kHz (Custom)
⑤	M	Package SOT-25
⑥	R	Embossed Tape : standard loading
	L	: reverse loading

### XC6366①②③④⑤⑥

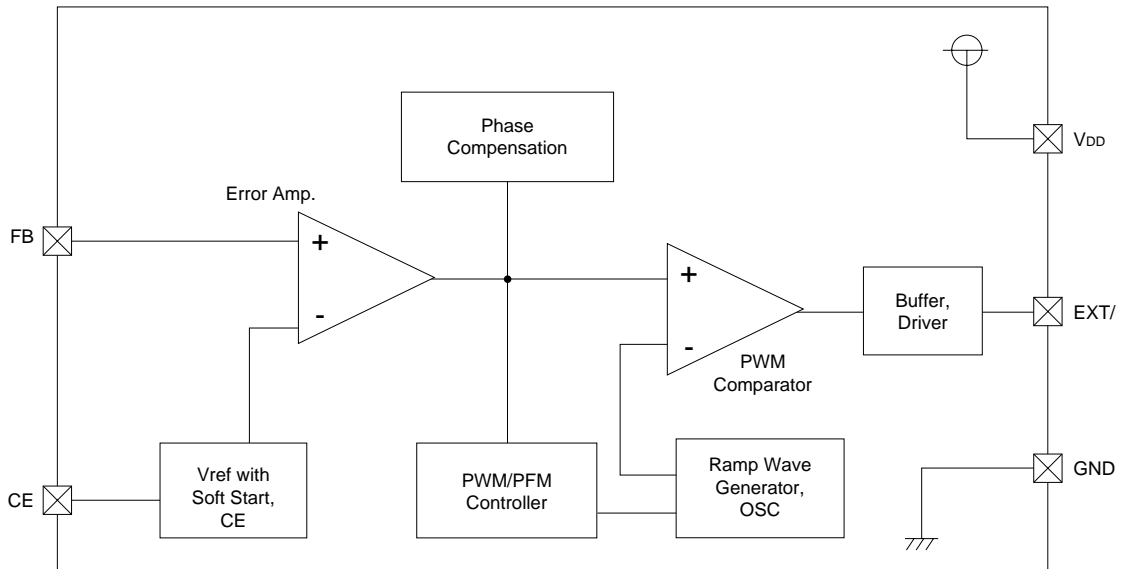
XC6366 Series      PWM/PFM switching control  
(same as XC6365 series)

## Block Diagram

XC6365, XC6366 Series A,C type (Vout)



XC6365, XC6366 Series B,D type (FB)



### Absolute Maximum Ratings

Ta=25°C

PARAMETER	SYMBOL	RATINGS	UNITS
V <sub>IN</sub> Pin Voltage	V <sub>DD</sub>	-0.3 ~ 12	V
V <sub>OUT</sub> Pin Voltage	V <sub>OUT</sub>	-0.3 ~ V <sub>IN</sub> +0.3	V
FB Pin Voltage	V <sub>FB</sub>	-0.3 ~ V <sub>IN</sub> +0.3	V
CE Pin Voltage	V <sub>CE</sub>	-0.3 ~ V <sub>IN</sub> +0.3	V
EXT/ Pin Voltage	V <sub>EXT/</sub>	-0.3 ~ V <sub>IN</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

3

### Electrical Characteristics

XC6365A333MR, XC6366A333MR

(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
Maximum Input Voltage	V <sub>IN</sub>		10.0			V
UVLO Voltage (min. operating voltage)	V <sub>UVLO</sub>	Same as I <sub>DD1</sub> , voltage required to maintain H at EXT/	0.9		2.2	V
Supply Current 1	I <sub>DD1</sub>	No external components, CE=V <sub>IN</sub> , V <sub>OUT</sub> =0V		57	102	μA
Supply Current 2	I <sub>DD2</sub>	No external components, XC6365		57	102	μA
		CE=V <sub>OUT</sub> =V <sub>IN</sub> XC6366		15	27	μA
Stand-by Current	I <sub>STB</sub>	No external components, CE=V <sub>OUT</sub> =0V			0.5	μA
Oscillator Frequency	F <sub>OSC</sub>	Measuring of EXT/ waveform, V <sub>IN</sub> =output voltage + 0.3V	255	300	345	kHz
Maximum Duty Ratio	MAXDTY		100			%
PFM Duty Ratio	PFMDTY	No load (XC6366 only)	15	25	35	%
CE "High" Voltage	V <sub>CEH</sub>	No external components, V <sub>OUT</sub> =0V, apply 0.65V (min.) to CE, determine EXT/ "Low"	0.65			V
CE "Low" Voltage	V <sub>CEL</sub>	Same as V <sub>CEH</sub> , determine EXT/ "High"			0.20	V
EXT "High" ON Resistance	R <sub>EXTBH</sub>	Same as I <sub>DD2</sub> , V <sub>EXT/</sub> =V <sub>IN</sub> -0.4V		16	22	μA
EXT "Low" ON Resistance	R <sub>EXTBL</sub>	Same as I <sub>DD1</sub> , V <sub>EXT/</sub> =0.4V		14	19	μA
Efficiency	EFFI	Use of a XP162A01B5 transistor recommended		92		%
Soft-Start Time	T <sub>SS</sub>		5	10	20	msec

Measuring conditions: Unless otherwise specified, connect external components. V<sub>IN</sub>=5.0V, I<sub>OUT</sub>=220mA

Series Amendments:

XC6365C, XC6366C series

External Components : C<sub>SS</sub>=0.033μF, R<sub>SS</sub>=470kΩ

The following parameter applies :

Soft Start Time (T<sub>SS</sub>) : Connect R<sub>SS</sub>, C<sub>SS</sub>. CE, 0V → 3.0V (When V<sub>IN</sub><3.0V, V<sub>IN</sub>=3.0V)

## Electrical Characteristics

XC6365A503MR, XC6366A503MR

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

$T_a=25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	$V_{OUT}$		4.875	5.000	5.125	V
Maximum Input Voltage	$V_{IN}$		10.0			V
UVLO Voltage (min. operating voltage)	$V_{UVLO}$	Same as $I_{DD1}$ , voltage required to maintain H at EXT/	0.9		2.2	V
Supply Current 1	$I_{DD1}$	No external components, $CE=V_{IN}$ , $V_{OUT}=0V$		67	122	$\mu A$
Supply Current 2	$I_{DD2}$	XC6365		67	122	$\mu A$
		XC6366		16	29	$\mu A$
Stand-by Current	$I_{STB}$	No external components, $CE=V_{OUT}=0V$			0.5	$\mu A$
Oscillator Frequency	$F_{OSC}$	Measuring of EXT/ waveform, $V_{IN}=\text{output voltage} + 0.3V$	255	300	345	kHz
Maximum Duty Ratio	MAXDTY		100			%
PFM Duty Ratio	PFMDTY	No load (XC6366 only)	15	25	35	%
CE "High" Voltage	$V_{CEH}$	No external components, $V_{OUT}=0V$ , apply 0.65V (min.) to CE, determine EXT/ "Low"	0.65			V
CE "Low" Voltage	$V_{CEL}$	Same as $V_{CEH}$ , determine EXT/ "High"			0.20	V
EXT "High" ON Resistance	$R_{EXTBH}$	Same as $I_{DD2}$ , $V_{EXT}/=V_{IN}-0.4V$		12	17	$\mu A$
EXT "Low" ON Resistance	$R_{EXTBL}$	Same as $I_{DD1}$ , $V_{EXT}/=0.4V$		10	14	$\mu A$
Efficiency	EFFI	Use of a XP162A01B5 transistor recommended		93		%
Soft-Start Time	$T_{SS}$		5	10	20	msec

Measuring conditions: Unless otherwise specified, connect external components.  $V_{IN}=7.5V$ ,  $I_{OUT}=330mA$

Series Amendments:

XC6365C, XC6366C series

External Components :  $C_{SS}=0.033\mu F$ ,  $R_{SS}=470k\Omega$

The following parameter applies :

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

### Electrical Characteristics

XC6365B103MR, XC6366B103MR

( $V_{OUT}=3.0V$  [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
Maximum Input Voltage	$V_{IN}$		10.0			V
UVLO Voltage (min. operating voltage)	$V_{UVLO}$	Same as $I_{DD1}$ , voltage required to maintain H at EXT/	0.9		2.2	V
Supply Current 1	$I_{DD1}$	No external components, $CE=V_{IN}$ , $FB=0V$		55	100	$\mu A$
Supply Current 2	$I_{DD2}$	XC6365		55	100	$\mu A$
		XC6366		15	27	$\mu A$
Stand-by Current	$I_{STB}$	No external components, $CE=FB=0V$			0.5	$\mu A$
Oscillator Frequency	$F_{OSC}$	Measuring of EXT/ waveform, $V_{IN}=\text{output voltage} + 0.3V$	255	300	345	kHz
Maximum Duty Ratio	MAXDTY		100			%
PFM Duty Ratio	PFMDTY	No load (XC6366 only)	15	25	35	%
CE "High" Voltage	$V_{CEH}$	No external components, $FB=0V$ , apply 0.65V (min.) to CE, determine EXT/ "Low"	0.65			V
CE "Low" Voltage	$V_{CEL}$	Same as $V_{CEH}$ , determine EXT/ "High"			0.20	V
EXT "High" ON Resistance	$R_{EXTBH}$	Same as $I_{DD2}$ , $V_{EXT}/=V_{IN}-0.4V$		17	24	$\mu A$
EXT "Low" ON Resistance	$R_{EXTBL}$	Same as $I_{DD1}$ , $V_{EXT}/=0.4V$		15	20	$\mu A$
Efficiency	EFFI	Use of a XP162A01B5 transistor recommended		92		%
Soft-Start Time	$T_{SS}$		5	10	20	msec

Measuring conditions: Unless otherwise specified, connect external components.  $V_{IN}=4.5V$ ,  $I_{OUT}=200mA$

External components:  $R_{FB1} = 400k\Omega$ ,  $R_{FB2} = 200k\Omega$ ,  $C_{FB} = 100pF$

Series Amendments:

XC6365D, XC6366D series

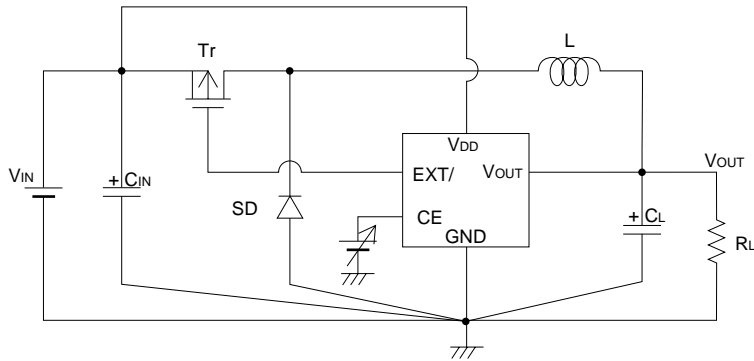
External Components :  $C_{SS}=0.033\mu F$ ,  $R_{SS}=330k\Omega$

The following parameter applies :

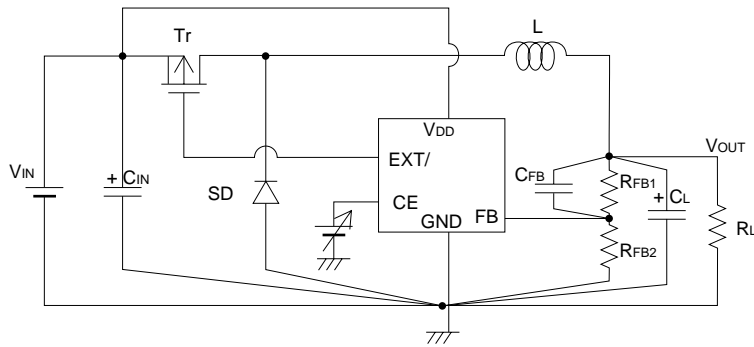
Soft Start Time ( $T_{SS}$ ) : Connect  $R_{SS}$ ,  $C_{SS}$ .  $CE, 0V \rightarrow 3.0V$

## Typical Application Circuits

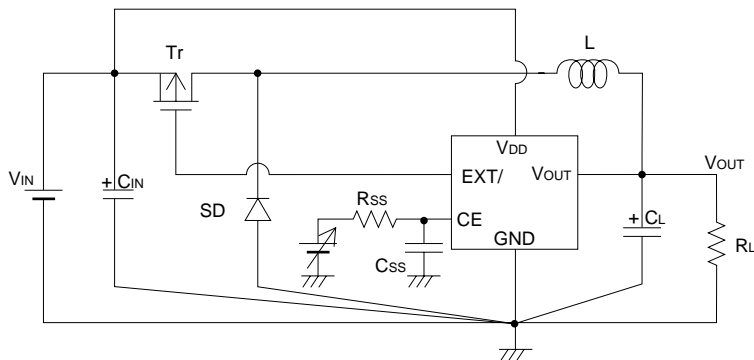
Circuit 1. XC6365A, XC6366A



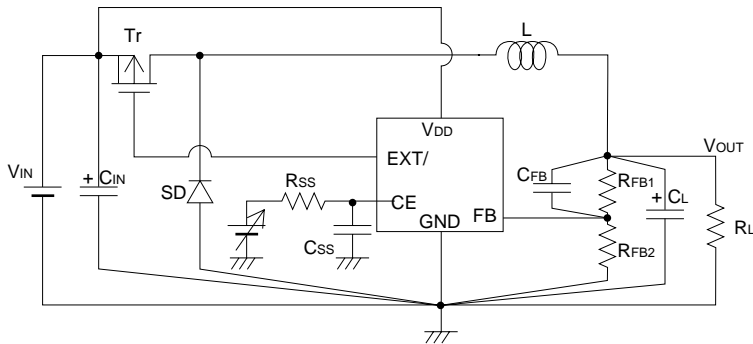
Circuit 2. XC6365B, XC6366B



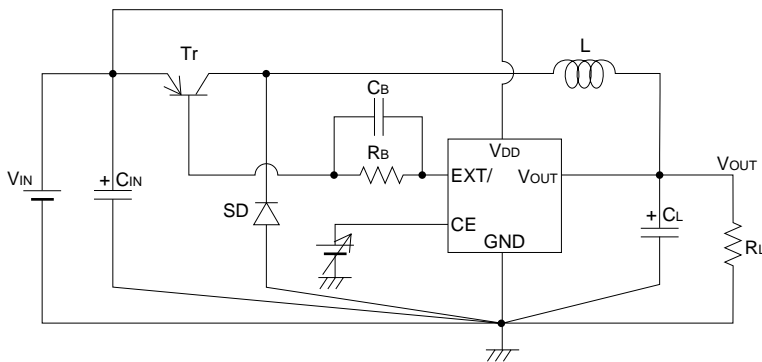
Circuit 3. XC6365C, XC6366C



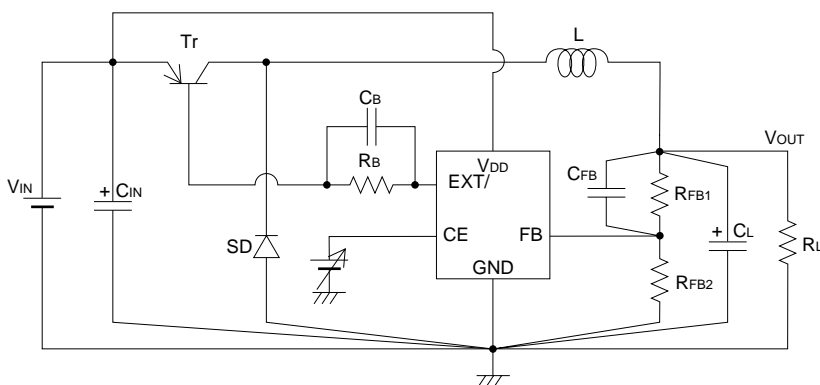
Circuit 4. XC6365D, XC6366D



Circuit 5. XC6365A, XC6366A (when used with a PNP transistor)

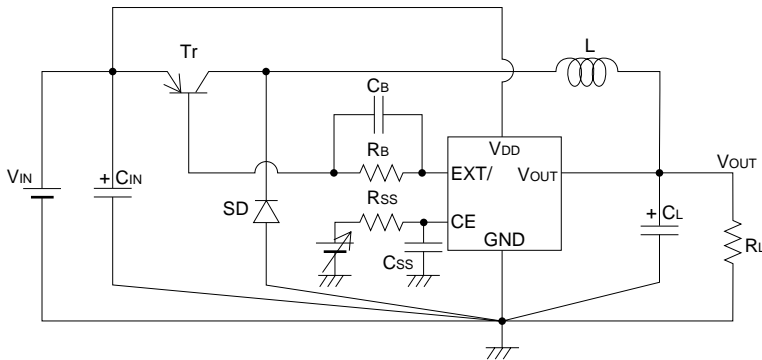


Circuit 6. XC6365B, XC6366B (when used with a PNP transistor)

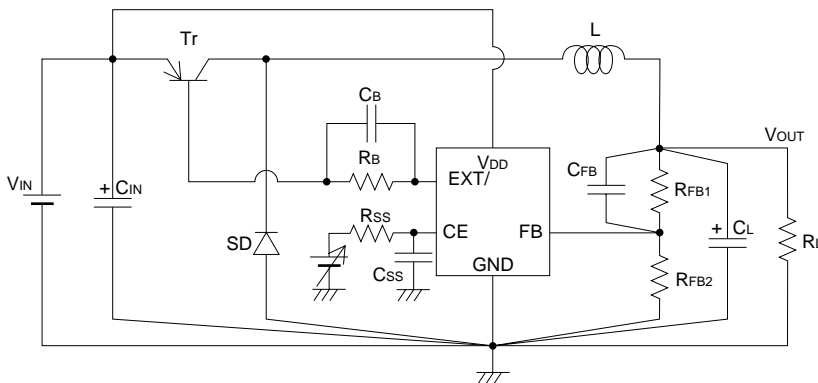




Circuit 7. XC6365C, XC6366C (when used with a PNP transistor)



Circuit 8. XC6365D, XC6366D (when used with a PNP transistor)



## Recommended Components

Tr	: XP162A01B5PR (Torex P-channel Power MOSFET) Please use a PNP transistor where $V_{IN} < 2.5V$
L	: 22 $\mu$ H (Sumida CD54, $F_{osc}=300kHz$ ) 47 $\mu$ H (Sumida CD75, $F_{osc}=180kHz$ ) 10 $\mu$ H (Sumida CD54, $F_{osc}=500kHz$ )
SD	: MA737 (Schottky Diode, Matsushita)
CL	: 10V 47 $\mu$ F (Tantalum capacitor, Nichicon F93)
CIN	: 16V 10 $\mu$ F (Tantalum capacitor, Nichicon F93)

## PNP Tr type :

Tr	: 2SA1213 (Toshiba)
Rb	: 500 $\Omega$ (Adjust according to load and Tr. hFE levels)
Cb	: 2200pF (Ceramic type)

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

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

Css	: 0.033 $\mu$ F (Ceramic capacitor)
Rss	: 470k $\Omega$ (C type), 330k $\Omega$ (D type)

## B, D type (FB versions)

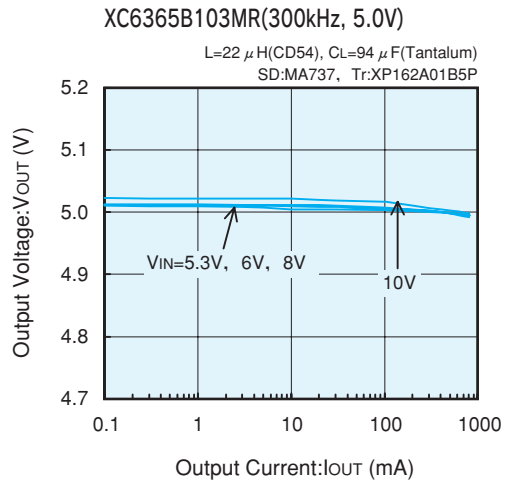
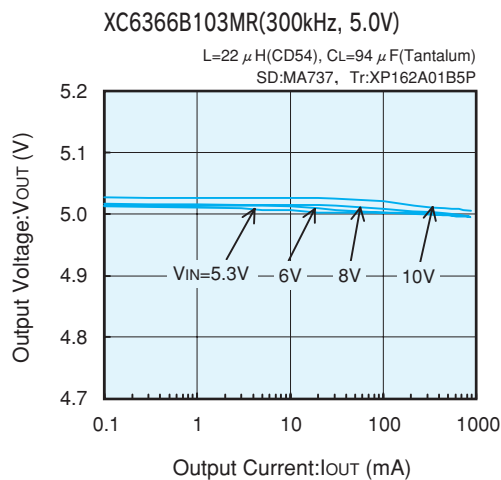
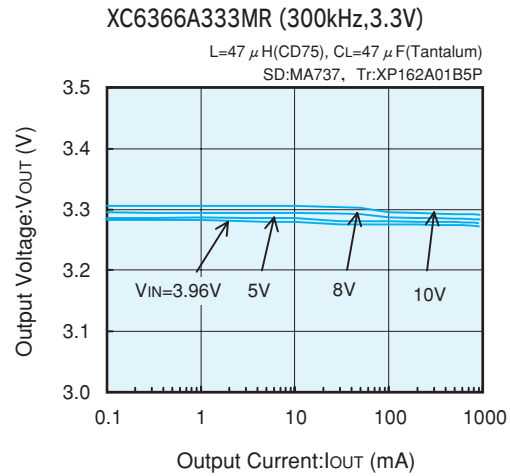
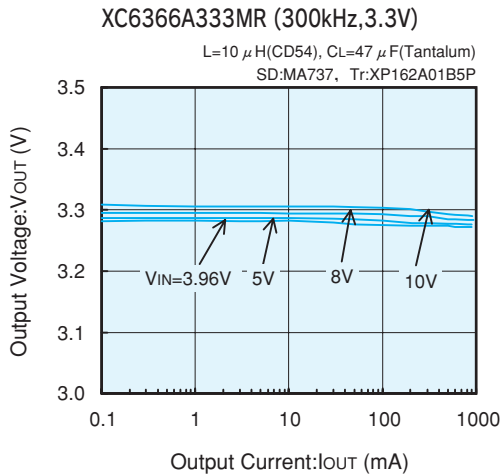
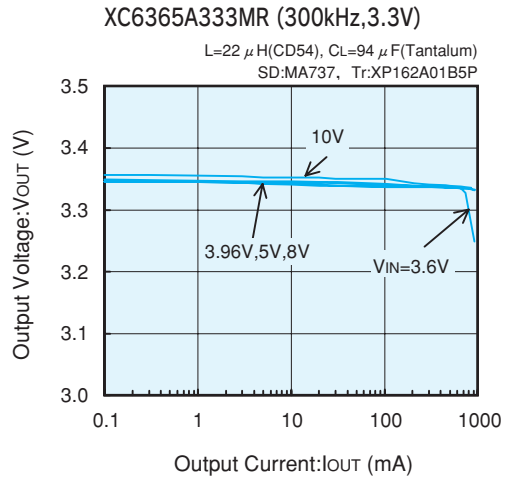
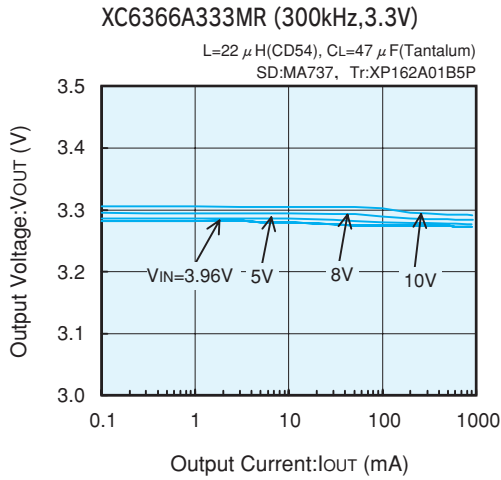
RFB	: Set up so that $R_{FB1} \div R_{FB2} = V_{OUT} - 1$ ( $V_{OUT}$ = set output voltage), $R_{FB1} = R_{FB2} \leq 2M\Omega$
CFB	: Set up so that $f_{zfb} = 1 \div (2 \times \pi \times C_{FB} \times R_{FB1})$ is within the 0.5 to 20kHz range (10kHz conventional) Adjustments necessary in respect of L, CL.
e.g.	$V_{OUT} = 3.0V$ $R_{FB1} = 400k\Omega$ , $R_{FB2} = 200k\Omega$ , $C_{FB} = 100pF$

## 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.

### Electrical Characteristics

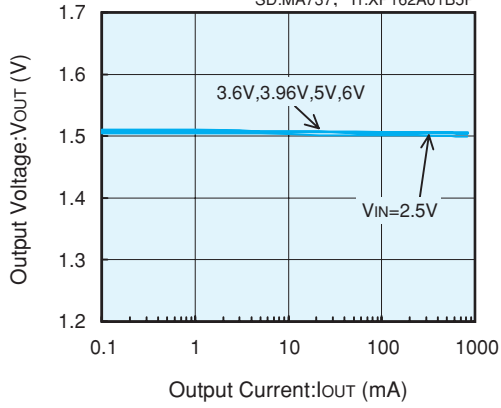
#### (1) Output Voltage vs. Output Current



Note: < External component > C<sub>IN</sub>=47  $\mu$ F(Tantalum)

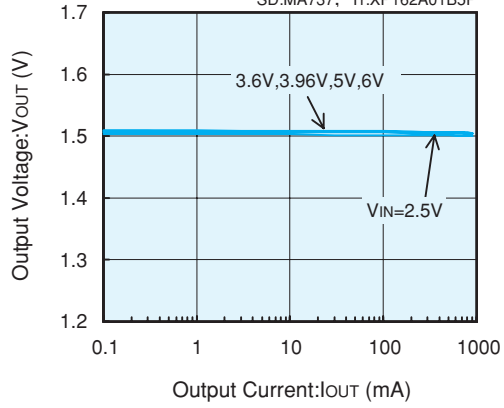
**XC6366B103MR (300kHz, 1.5V)**

L=22  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP162A01B5P



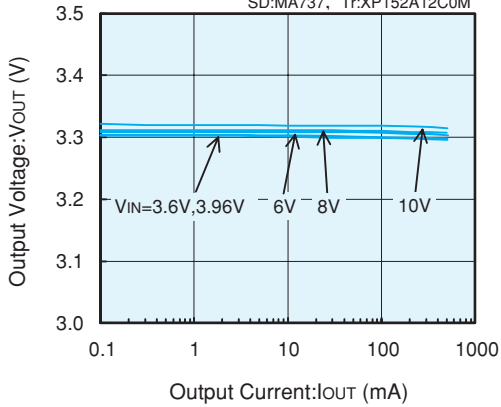
**XC6365B103MR (300kHz, 1.5V)**

L=22  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP162A01B5P



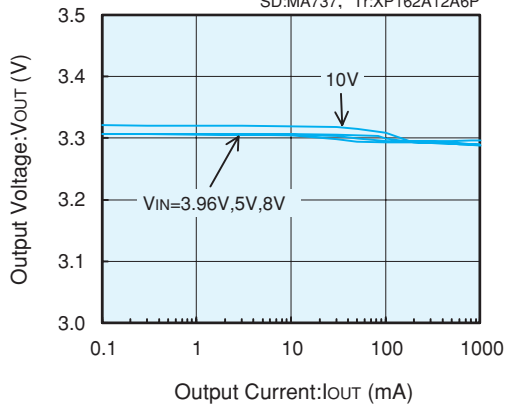
**XC6366B102MR (180kHz, 3.3V)**

L=22  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP152A12C0M



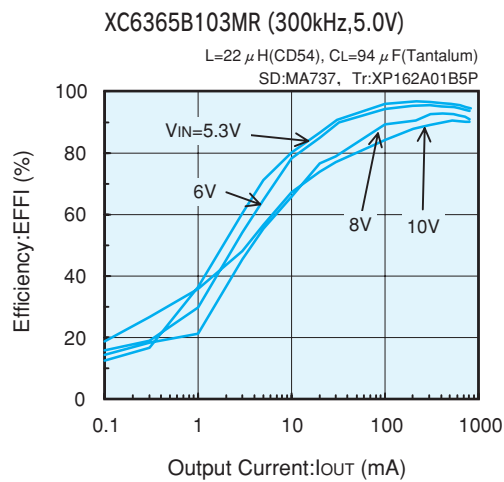
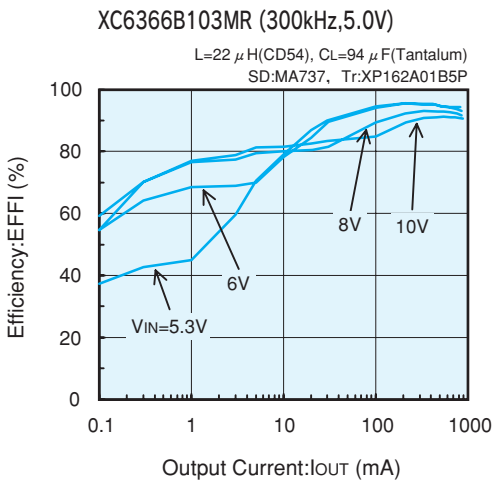
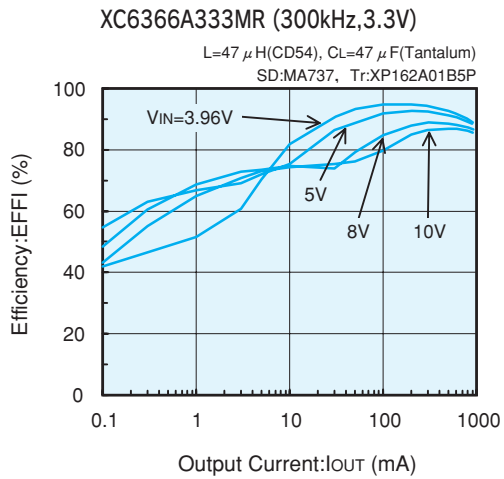
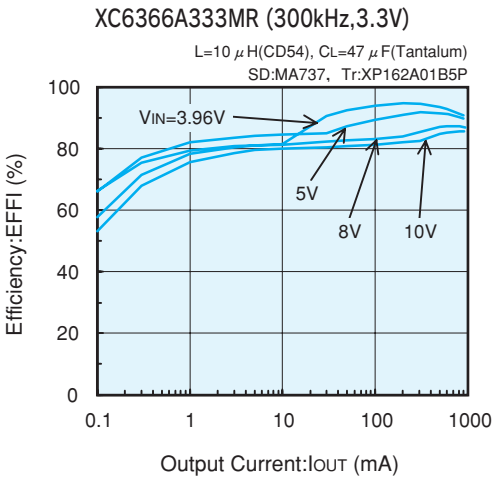
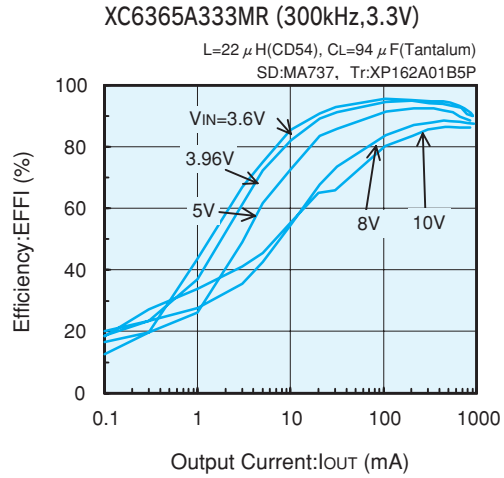
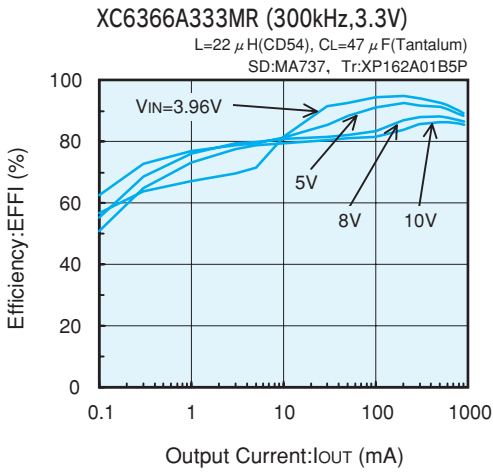
**XC6366A335MR (500kHz, 3.3V)**

L=10  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP162A12A6P



Note: <External component> C<sub>IN</sub>=47  $\mu$ F(Tantalum)

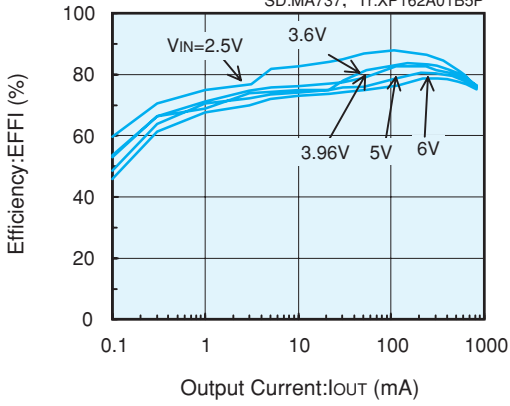
### (2) Efficiency vs. Output Current



Note: < External component >  $C_{IN}=47 \mu$ F(Tantalum)

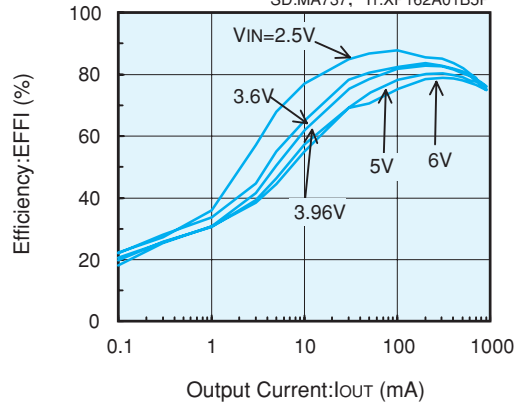
XC6366B103MR (300kHz, 1.5V)

L=22  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP162A01B5P



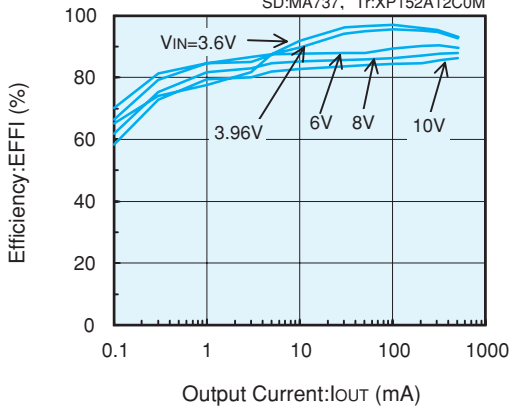
XC6365B103MR (300kHz, 1.5V)

L=22  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP162A01B5P



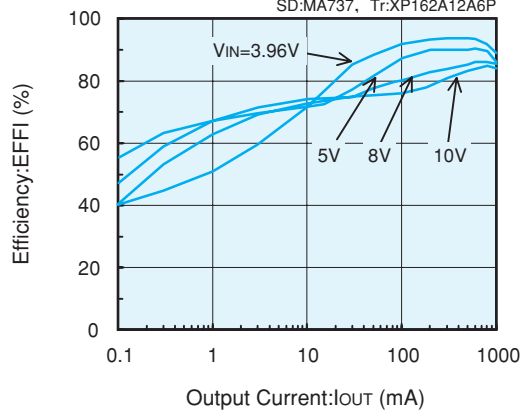
XC6366B102MR (180kHz, 3.3V)

L=22  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP152A12C0M



XC6366A335MR (500kHz, 3.3V)

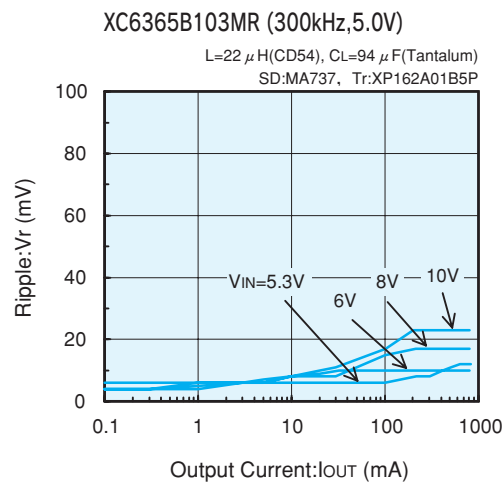
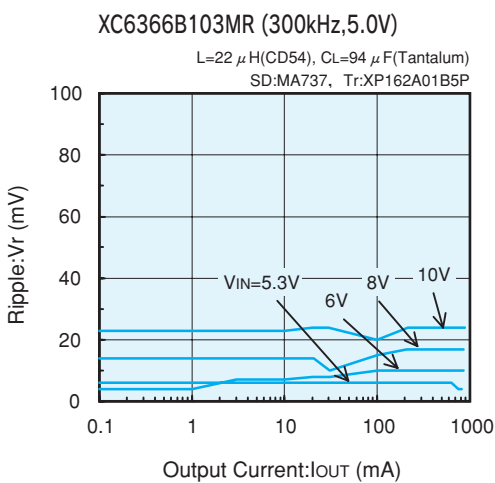
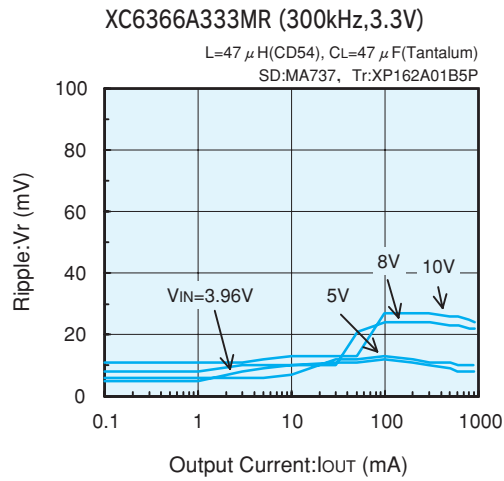
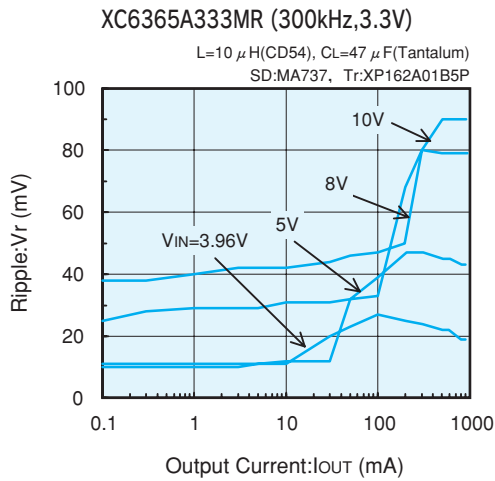
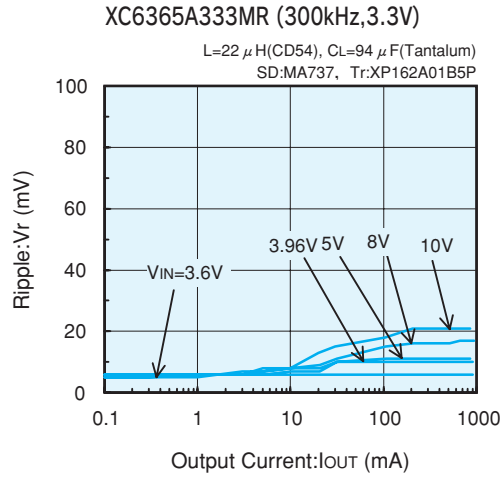
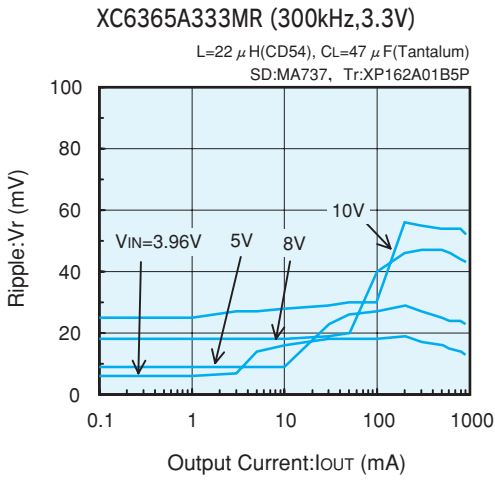
L=10  $\mu$ H(CD54), CL=94  $\mu$ F(Tantalum)  
SD:MA737, Tr:XP162A12A6P



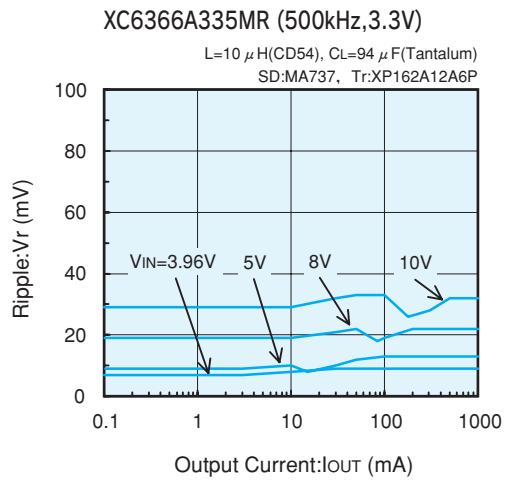
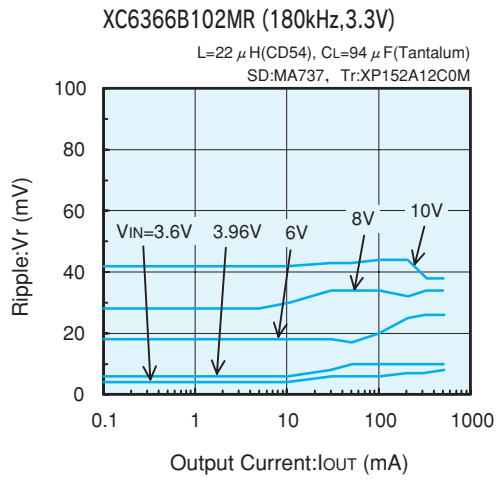
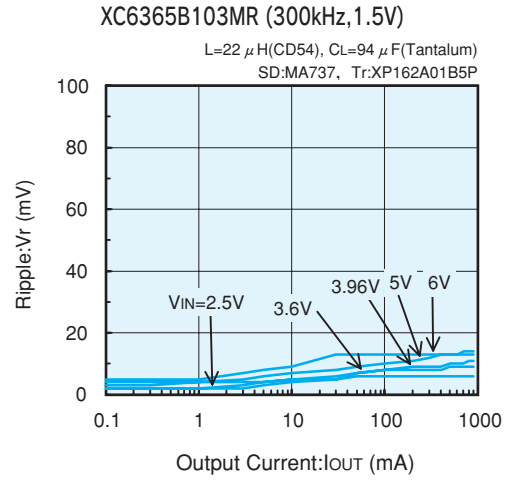
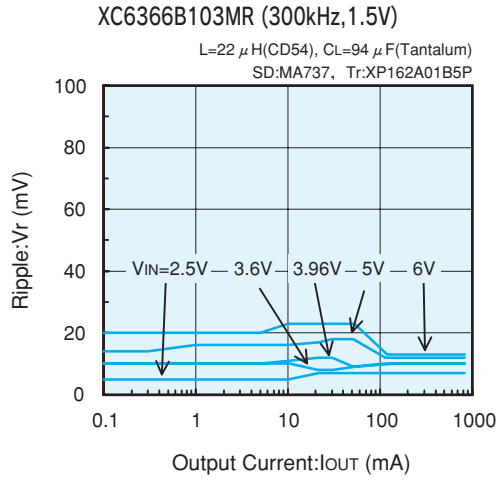
Note: <External component> CIN=47  $\mu$ F(Tantalum)

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

3

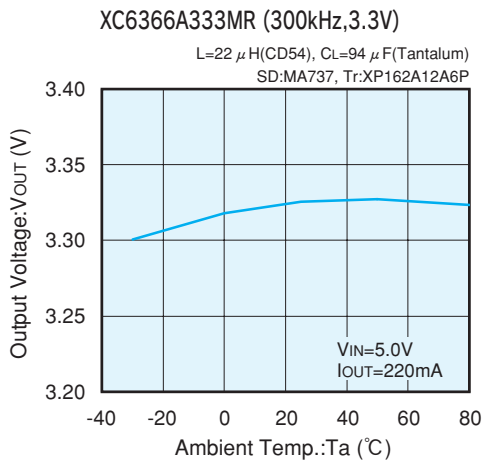


Note: < External component > CIN=47  $\mu$ F(Tantalum)

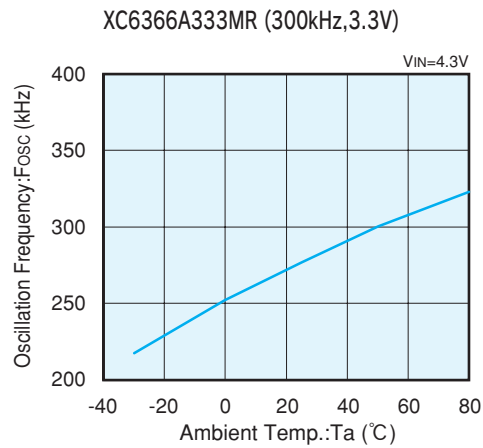


Note: <External component>  $C_{IN}=47 \mu F$ (Tantalum)

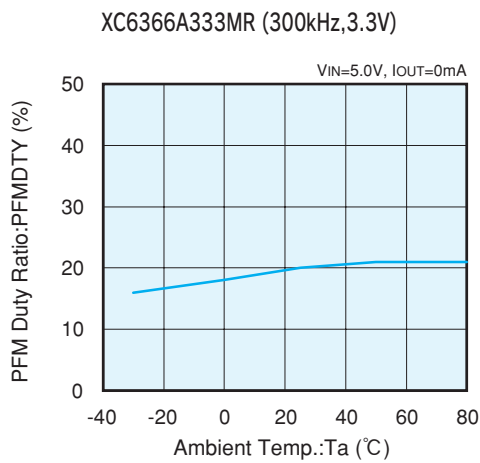
(4) Output Voltage vs. Ambient Temperature



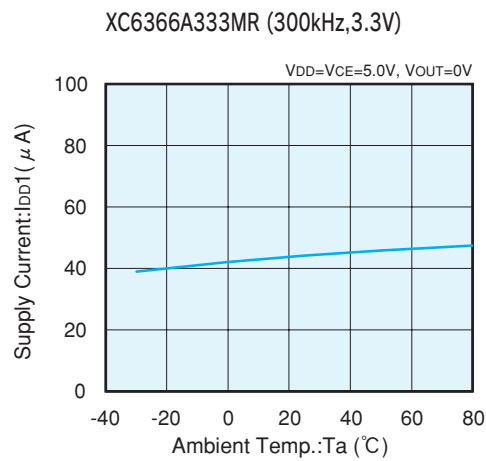
(5) Oscillation Frequency vs. Ambient Temperature



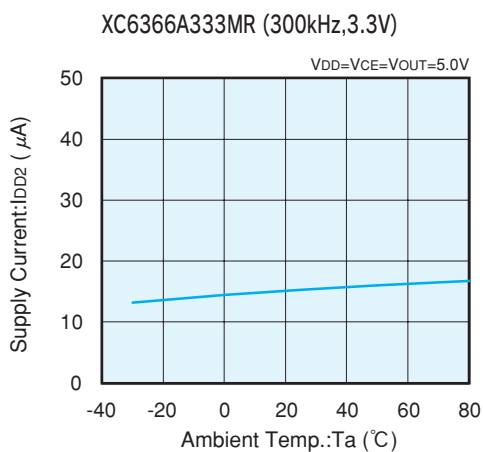
(6) PFM Duty Ratio vs. Ambient Temperature



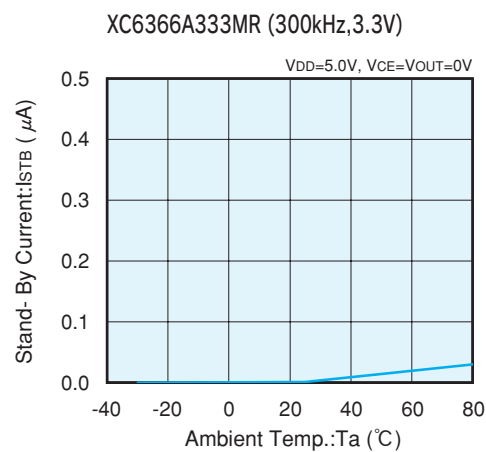
(7) Supply Current1 vs. Ambient Temperature



(8) Supply Current2 vs. Ambient Temperature

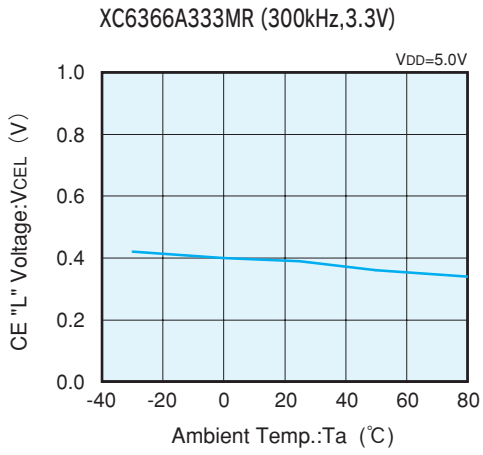


(9) Stand-By Current vs. Ambient Temperature

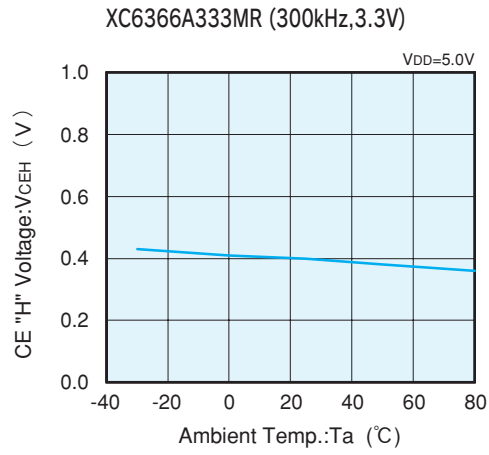




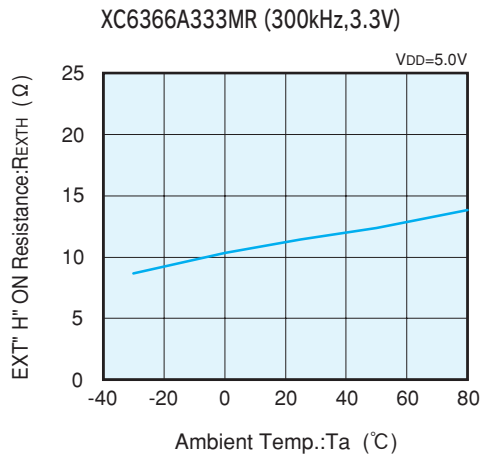
(10) CE "L" Voltage vs. Ambient Temperature



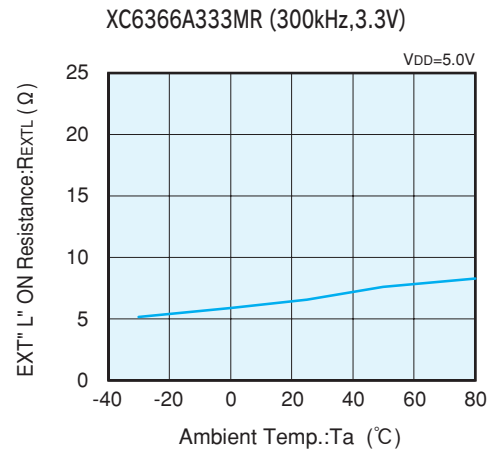
(11) CE "H" Voltage vs. Ambient Temperature



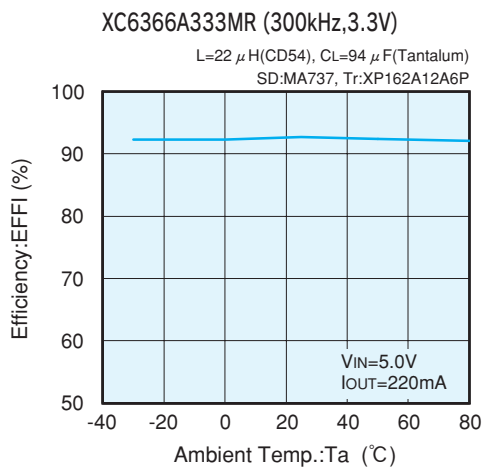
(12) EXT "H" ON Resistance vs. Ambient Temperature



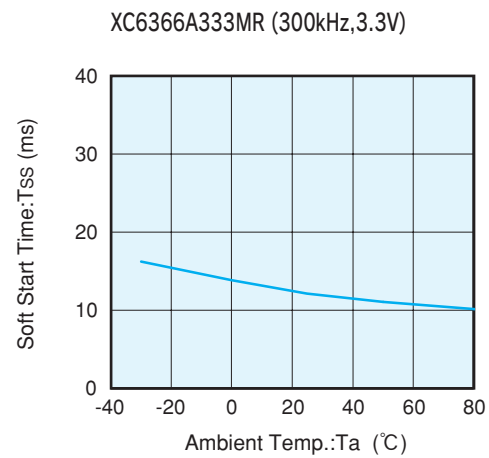
(13) EXT "L" ON Resistance vs. Ambient Temperature



(14) Efficiency vs. Ambient Temperature

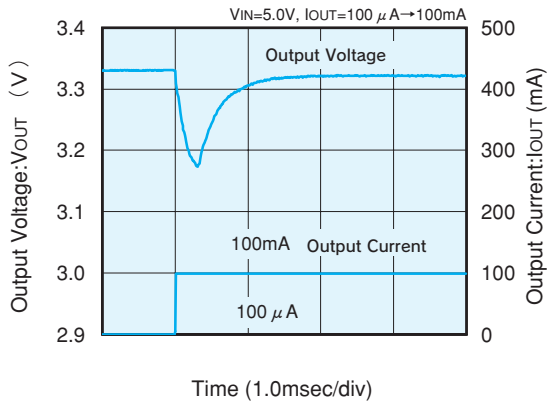


(15) Soft Start Time vs. Ambient Temperature

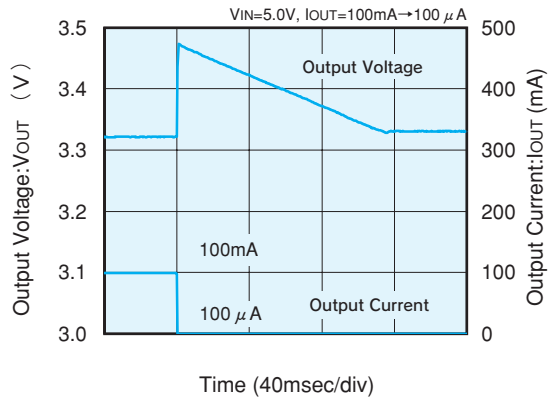


### (16) Load Transient Response

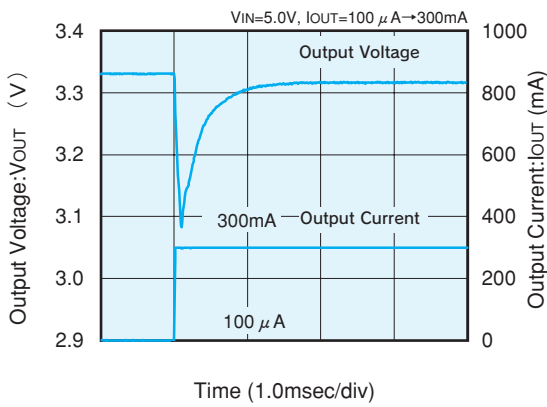
XC6366A333MR (300kHz, 3.3V)



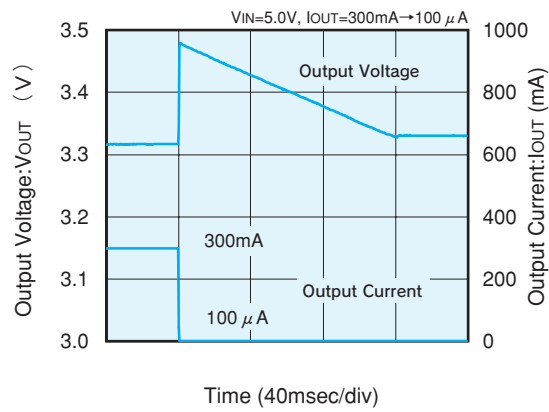
XC6366A333MR (300kHz, 3.3V)



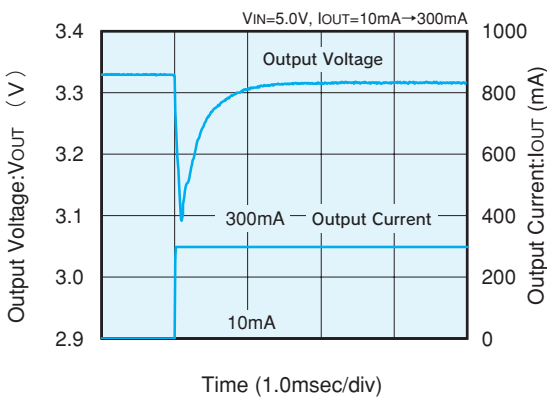
XC6366A333MR (300kHz, 3.3V)



XC6366A333MR (300kHz, 3.3V)



XC6366A333MR (300kHz, 3.3V)



XC6366A333MR (300kHz, 3.3V)

