



UC3550

CMOS IC

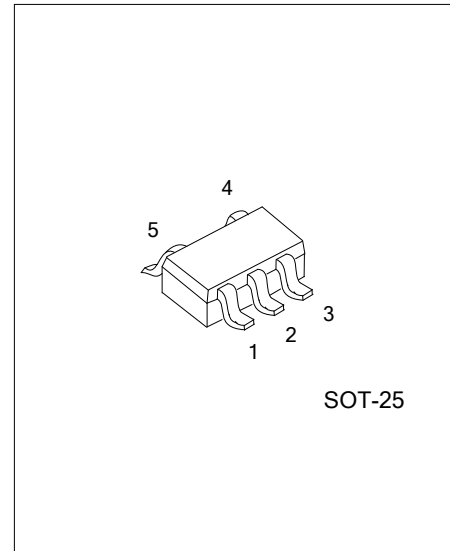
PWM CONTROLLED, PWM/PFM SWITCHABLE STEP-UP DC-DC CONTROLLER

DESCRIPTION

The UTC **UC3550** series is a compact, high efficiency, step-up DC/DC controllers includes an error amplifier, oscillator, PWM comparator, skip cycle comparator, voltage reference, soft-start, and high speed lower ON-resistance driver for driving external power devices (NMOS or NPN) ,Additionally, a CE (chip enable) function that reduces power consumption during shut-down mode.

That typically operated from a single-or dual-cell battery packs. It have a driver pin ,ext pin, for connecting to an external transistor(NMOS or NPN). a lower ON-resistance external transistor can obtain larger output current. With only external components, this series allow a simple means to accommodate high output current applications.

The UTC **UC3550** series goes automatically into skip switching cycles under light load condition to maintain high efficiency.



FEATURES

- * Input Voltage Range: 0.9~8V
- * Output Voltage Range: 1.8~6V Programmable in 0.1V with High Accuracy $\pm 2.5\%$
- * High Efficiency 88% (Typ.)
- * Low Start-up Voltage of 0.9V Typical at $I_{OUT} = 1.0mA$
- * Oscillator Frequency: 300kHz.($\pm 20\%$)
- * Chip Enable Pin with Pull-up Current Source
- * High Output Current up to 1000mA ($V_{IN} = 2.0V, V_{OUT} = 3.3V$)

ORDERING INFORMATION

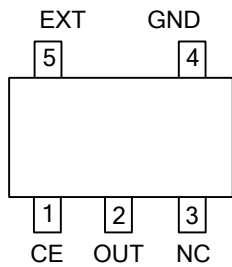
Ordering Number		Package	Packing
Lead Free	Halogen Free		
UC3550L-xx-AF5-R	UC3550G-xx-AF5-R	SOT-25	Tape Reel

<p>UC3550L-xx-AF5-R</p> <p>(1)Packing Type (2)Package Type (3)Voltage Code (4)Lead Free</p>	<p>(1) R: Tape Reel (2) AF5: SOT-25 (3) xx: reference to Marking Information (4) G: Halogen Free, L: Lead Free</p>
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MARKING INFORMATION

PACKAGE	VOLTAGE CODE	MARKING
SOT-25	33:3.3V 36:3.6V 37:3.7V 50:5.0V	

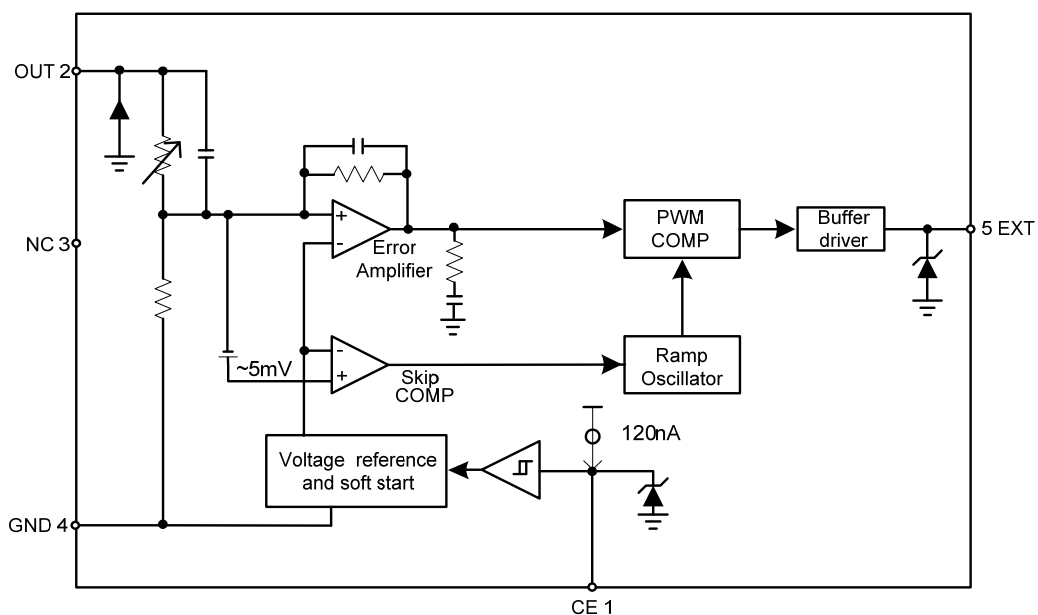
PIN CONFIGURATION



PIN DESCRIPTION

PIN NO	PIN NAME	DESCRIPTION
1	CE	Chip Enable: The chip is enabled if a voltage equal to or greater than 1.0V or left floating is applied. The chip is disabled if a voltage less than 0.3V is applied.
2	OUT	Output voltage monitor, IC internal power supply
3	NC	No connection
4	GND	Ground
5	EXT	External transistor drive

BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{OUT}	-0.3~8	V
EXT Voltage	V_{EXT}	-0.3 ~ 8	V
EXT Sink/Source Current	I_{EXT}	-150 ~ +150	mA
CE Input Voltage Range	V_{CE}	-0.3 ~ 12.0	V
CE Input Current Range	I_{CE}	-155 ~ 155	mA
Power Dissipation ($T_a=25^{\circ}C$)	P_D	500	mW
Junction Temperature	T_J	+150	$^{\circ}C$
Operating Temperature	T_{OPR}	-40 ~ +85	$^{\circ}C$
Storage Temperature	T_{STG}	-55 ~ +150	$^{\circ}C$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	θ_{JA}	250	$^{\circ}C/W$

■ ELECTRICAL CHARACTERISTICS ($T_A=25^{\circ}C$, $f_{OSC}=300kHz$, unless otherwise specified)

UC3550-3.3V

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
OSCILLATOR							
Frequency	f_{OSC}	$V_{OUT}=V_{SET}\times 0.96$	240	300	360	kHz	
Frequency Temperature Coefficient	Δf	$T_A=-40^{\circ}C \sim 85^{\circ}C$		0.10		%/ $^{\circ}C$	
Maximum PWM Duty Cycle	D_{MAX}	$V_{OUT}=V_{SET}\times 0.96$	70	80	90	%	
Minimum Start-up Voltage	V_{START1}	$I_{OUT}=0mA$		800	900	mV	
Minimum Start-up Voltage	V_{START2}	$I_{OUT}=1mA$		900	1000	mV	
Minimum Start-up Voltage Temperature Coefficient	ΔV_{START}	$T_A=-40^{\circ}C \sim 85^{\circ}C$		-1.6		mV/ $^{\circ}C$	
Minimum Operation Hold Voltage	V_{OPR}	$I_{OUT}=0mA$		600	700	mV	
Soft-Start Time	t_{SS}	$V_{OUT}=V_{SET}$		60	250	ms	
CE (PIN 1)							
CE Input Voltage :							
High State, Device Enabled	V_{CEH}	$V_{OUT}=V_{SET}\times 0.96$	900			mV	
Low State, Device Disabled	V_{CEL}				680	mV	
CE Input Current :							
High State, Device Enabled	I_{CEH}	$V_{OUT}=V_{CE}=5.0V$	-0.5	0	0.5	μA	
Low State, Device Disabled	I_{CEL}	$V_{OUT}=5.0V, V_{CE}=0V$	0	0.15	0.5	μA	
EXT (PIN 5)							
ON Resistance	EXT "H"	R_{EXTH}	$V_{EXT}=V_{OUT}-0.4V$		11	15	Ω
	EXT "L"	R_{EXTL}	$V_{EXT}=0.4V$		8	12	Ω
TOTAL DEVICE							
Output Voltage	V_{OUT}		3.218	3.3	3.383	V	
Output Voltage temperature coefficient	ΔV_{OUT}	$T_A=-40 \sim 85^{\circ}C$		150		ppm/ $^{\circ}C$	
Operating Current	I_{DD}	$V_{OUT}=V_{CE}=V_{SET}\times 0.96$		103	160	μA	
Stand-by Current	I_{STN-BY}	$V_{OUT}=V_{CE}=V_{SET}+0.5V$		15	38	μA	
Off-State Current	I_{OFF}	$V_{OUT}=5.0V, V_{CE}=0V, T_A=-40 \sim +85^{\circ}C$		0.6	1.5	μA	
Efficiency	η	$I_{OUT} = 200mA, V_{IN} = 2.0V$	80	88		%	

■ ELECTRICAL CHARACTERISTICS (Cont.)

UC3550-3.6V

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
OSCILLATOR							
Frequency	f_{OSC}	$V_{OUT}=V_{SET}\times 0.96$	240	300	360	kHz	
Frequency Temperature Coefficient	Δf	$T_A=-40^{\circ}C \sim 85^{\circ}C$		0.10		%/ $^{\circ}C$	
Maximum PWM Duty Cycle	D_{MAX}	$V_{OUT}=V_{SET}\times 0.96$	70	80	90	%	
Minimum Start-up Voltage	V_{START1}	$I_{OUT}=0mA$		800	900	mV	
Minimum Start-up Voltage	V_{START2}	$I_{OUT}=1mA$		900	1000	mV	
Minimum Start-up Voltage Temperature Coefficient	ΔV_{START}	$T_A=-40^{\circ}C \sim 85^{\circ}C$		-1.6		mV/ $^{\circ}C$	
Minimum Operation Hold Voltage	V_{OPR}	$I_{OUT}=0mA$		600	700	mV	
Soft-Start Time	t_{SS}	$V_{OUT}=V_{SET}$		60	250	ms	
CE (PIN 1)							
CE Input Voltage :							
High State, Device Enabled	V_{CEH}	$V_{OUT}=V_{SET}\times 0.96$	900			mV	
Low State, Device Disabled	V_{CEL}				680	mV	
CE Input Current :							
High State, Device Enabled	I_{CEH}	$V_{OUT}=V_{CE}=5.0V$	-0.5	0	0.5	μA	
Low State, Device Disabled	I_{CEL}	$V_{OUT}=5.0V, V_{CE}=0V$	0	0.15	0.5	μA	
EXT (PIN 5)							
ON Resistance	EXT "H"	R_{EXTH}	$V_{EXT}=V_{OUT}-0.4V$		11	15	Ω
	EXT "L"	R_{EXTL}	$V_{EXT}=0.4V$		8	12	Ω
TOTAL DEVICE							
Output Voltage	V_{OUT}		3.51	3.6	3.69	V	
Output Voltage temperature coefficient	ΔV_{OUT}	$T_A=-40 \sim 85^{\circ}C$		150		ppm/ $^{\circ}C$	
Operating Current	I_{DD}	$V_{OUT}=V_{CE}=V_{SET}\times 0.96$		103	160	μA	
Stand-by Current	I_{STN-BY}	$V_{OUT}=V_{CE}=V_{SET}+0.5V$		15	38	μA	
Off-State Current	I_{OFF}	$V_{OUT}=5.0V, V_{CE}=0V, T_A=-40 \sim +85^{\circ}C$		0.6	1.5	μA	
Efficiency	η	$I_{OUT} = 200mA, V_{IN} = 2.0V$	80	88		%	

■ ELECTRICAL CHARACTERISTICS (Cont.)

UC3550-3.7V

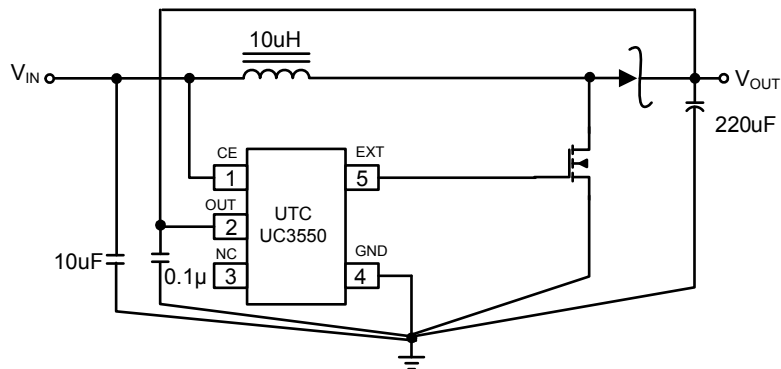
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
OSCILLATOR							
Frequency	f_{OSC}	$V_{OUT}=V_{SET}\times 0.96$	240	300	360	kHz	
Frequency Temperature Coefficient	Δf	$T_A=-40^{\circ}C \sim 85^{\circ}C$		0.10		%/ $^{\circ}C$	
Maximum PWM Duty Cycle	D_{MAX}	$V_{OUT}=V_{SET}\times 0.96$	70	80	90	%	
Minimum Start-up Voltage	V_{START1}	$I_{OUT}=0mA$		800	900	mV	
Minimum Start-up Voltage	V_{START2}	$I_{OUT}=1mA$		900	1000	mV	
Minimum Start-up Voltage Temperature Coefficient	ΔV_{START}	$T_A=-40^{\circ}C \sim 85^{\circ}C$		-1.6		mV/ $^{\circ}C$	
Minimum Operation Hold Voltage	V_{OPR}	$I_{OUT}=0mA$		600	700	mV	
Soft-Start Time	t_{SS}	$V_{OUT}=V_{SET}$		60	250	ms	
CE (PIN 1)							
CE Input Voltage :							
High State, Device Enabled	V_{CEH}	$V_{OUT}=V_{SET}\times 0.96$	900			mV	
Low State, Device Disabled	V_{CEL}				680	mV	
CE Input Current :							
High State, Device Enabled	I_{CEH}	$V_{OUT}=V_{CE}=5.0V$	-0.5	0	0.5	μA	
Low State, Device Disabled	I_{CEL}	$V_{OUT}=5.0V, V_{CE}=0V$	0	0.15	0.5	μA	
EXT (PIN 5)							
ON Resistance	EXT "H"	R_{EXTH}	$V_{EXT}=V_{OUT}-0.4V$		11	15	Ω
	EXT "L"	R_{EXTL}	$V_{EXT}=0.4V$		8	12	Ω
TOTAL DEVICE							
Output Voltage	V_{OUT}		3.608	3.7	3.793	V	
Output Voltage temperature coefficient	ΔV_{OUT}	$T_A=-40 \sim 85^{\circ}C$		150		ppm/ $^{\circ}C$	
Operating Current	I_{DD}	$V_{OUT}=V_{CE}=V_{SET}\times 0.96$		103	160	μA	
Stand-by Current	I_{STN-BY}	$V_{OUT}=V_{CE}=V_{SET}+0.5V$		15	38	μA	
Off-State Current	I_{OFF}	$V_{OUT}=5.0V, V_{CE}=0V, T_A=-40 \sim +85^{\circ}C$		0.6	1.5	μA	
Efficiency	η	$I_{OUT} = 200mA, V_{IN} = 2.0V$	80	88		%	

■ ELECTRICAL CHARACTERISTICS (Cont.)

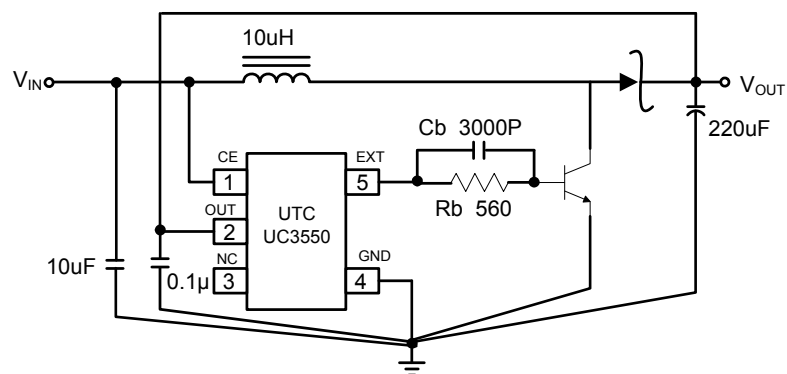
UC3550-5.0V

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
OSCILLATOR							
Frequency	f_{OSC}	$V_{OUT}=V_{SET}\times 0.96$	240	300	360	kHz	
Frequency Temperature Coefficient	Δf	$T_A=-40^{\circ}C \sim 85^{\circ}C$		0.1		%/ $^{\circ}C$	
Maximum PWM Duty Cycle	D_{MAX}	$V_{OUT}=V_{SET}\times 0.96$	70	80	90	%	
Minimum Start-up Voltage	V_{START1}	$I_{OUT}=0mA$		800	900	mV	
Minimum Start-up Voltage	V_{START2}	$I_{OUT}=1mA$		900	1000	mV	
Minimum Start-up Voltage Temperature Coefficient	ΔV_{START}	$T_A=-40^{\circ}C \sim 85^{\circ}C$		-1.6		mV/ $^{\circ}C$	
Minimum Operation Hold Voltage	V_{OPR}	$I_{OUT}=0mA$		600	700	mV	
Soft-Start Time	t_{SS}	$V_{OUT}=V_{SET}$		60	200	ms	
CE (PIN 1)							
CE Input Voltage :							
High State, Device Enabled	V_{CEH}	$V_{OUT}=V_{SET}\times 0.96$	900			mV	
Low State, Device Disabled	V_{CEL}				680	mV	
CE Input Current :							
High State, Device Enabled	I_{CEH}	$V_{OUT}=V_{CE}=5.0V$	-0.5	0	0.5	μA	
Low State, Device Disabled	I_{CEL}	$V_{OUT}=5.0V, V_{CE}=0V$	0	0.15	0.5	μA	
EXT (PIN 5)							
ON Resistance	EXT "H"	R_{EXTH}	$V_{EXT}=V_{OUT}-0.4V$		6	10	Ω
	EXT "L"	R_{EXTL}	$V_{EXT}=0.4V$		6	10	Ω
TOTAL DEVICE							
Output Voltage	V_{OUT}		4.875	5	5.125	V	
Output Voltage temperature coefficient	ΔV_{OUT}	$T_A=-40 \sim 85^{\circ}C$		150		ppm/ $^{\circ}C$	
Operating Current	I_{DD}	$V_{OUT}=V_{CE}=V_{SET}\times 0.96$		136	220	μA	
Stand-by Current	I_{STN-BY}	$V_{OUT}=V_{CE}=V_{SET}+0.5V$		15	38	μA	
Off-State Current	I_{OFF}	$V_{OUT}=5.0V, V_{CE}=0V, T_A=-40 \sim +85^{\circ}C$		0.6	1.5	μA	
Efficiency	η	$I_{OUT} = 200mA, V_{IN} = 3.0V$	80	88		%	

■ TYPICAL STEP-UP CONVERTER APPLICATION



Step-up Converter using external MOSFET



Step-up Converter using external NPN

Recommended components

Nmos t_R : XP161A0390PR/ (Torex) or NTGS3446T1(ON SEMI)

L : 10uH(Sunida CD54 $f_{OSC}=300kHz$)

SD : MA737, or MBRM110L

C_{IN} : 10V 10uF (tantalum)

C_L : 16V220uF (tantalum)

NPN t_R type

t_R : 2SD1628(Sanyo), MMJT9410

R_B : 500~1000 Ω (Adjust according to load and T_r , h_{FE} levels)

C_B : 3000p(ceramic type)

■ EXTERNAL COMPONENT SELECTION

Inductor Selection

An inductor value of 10 μ H performs well in most application. The UC3550 series also work with inductors in the 4.7 μ H to 12 μ H range. An inductor with higher peak inductor current tends a higher output voltage ripple($I_{PEAK} \times$ output filter capacitor ESR). The inductor's DC resistance significantly affects efficiency.

Output Capacitor Selection

The output ripple voltage($I_{PEAK} \times$ output filter capacitor ESR)is the product of the peak inductor current and the output capacitor Equivalent Series Resistance (ESR). Best performances are obtained with good high frequency characteristics capacitors and low ESR. The best compromise for the value of the Output Capacitance is 220F Tantalum Capacitor. The output capacitor as close as possible to the device pins.

Input Capacitor Selection

The Input Capacitor is required to compensate, if present, the series impedance between the Supply Voltage Source and the Input Voltage of the Application. A value of 10 F is enough to guarantee stability for distances less than 2". In any case we suggest to connect both capacitors, The input capacitor as close as possible to the device pins.

Diode Selection

The Schottky diode with an high switching speed and a very low Forward Voltage (VF) is needed. Higher VF may cause lost power as heat in the diode, with a decrease of the Efficiency. Moreover, since the Output Voltage pin is also used as the device Supply Voltage, the Start-up Voltage (see related plots) is strictly due to the diode Forward Voltage at the rated Forward Current.

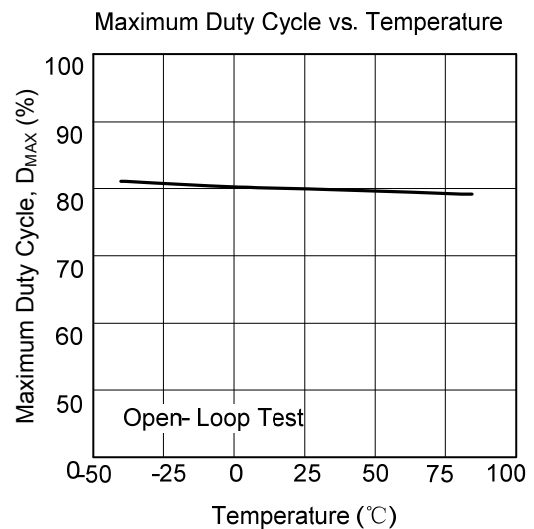
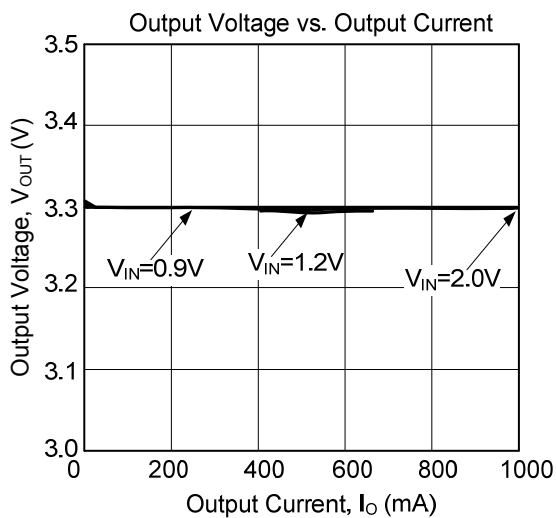
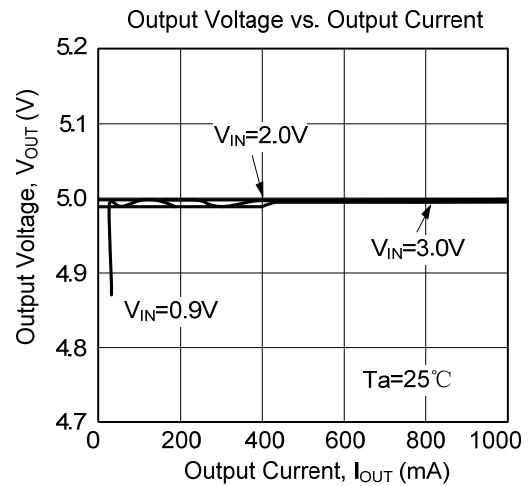
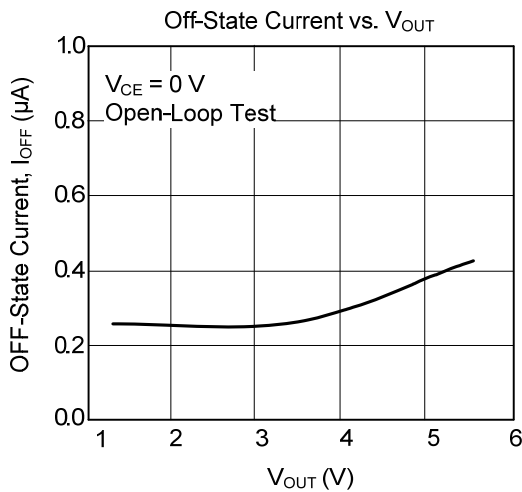
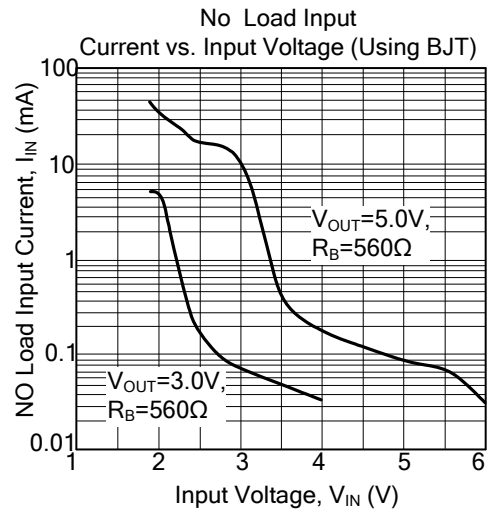
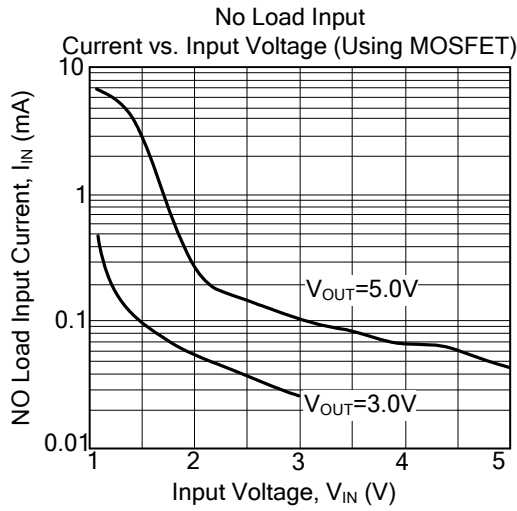
External Component Selection

An enhancement N-channel MOSFET or a bipolar NPN transistor can be used as the external switch transistor. since enhancement N-channel MOSFET is a voltage driven device, it is a more efficient switch than a BJT transistor. However, he MOSFET requires a higher voltage to turn on as compared with BJT transistor

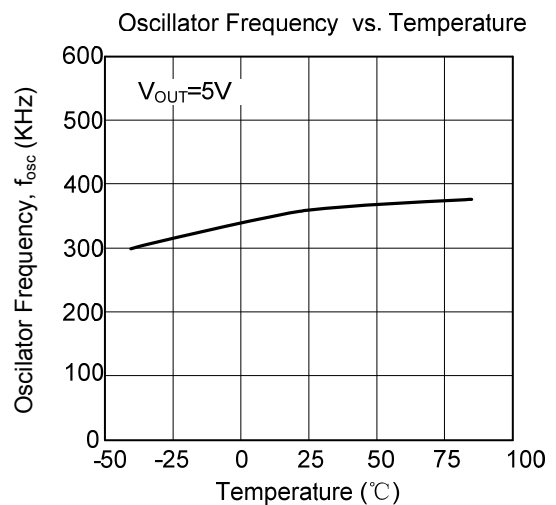
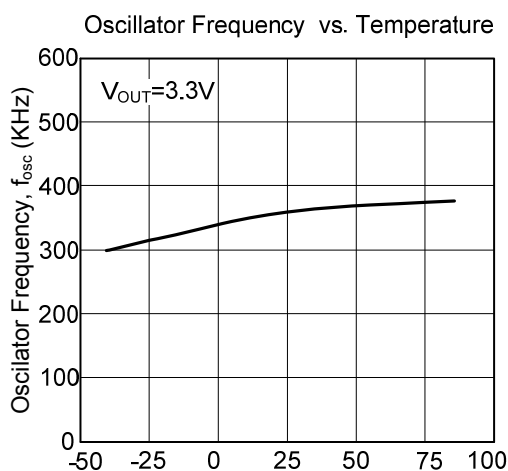
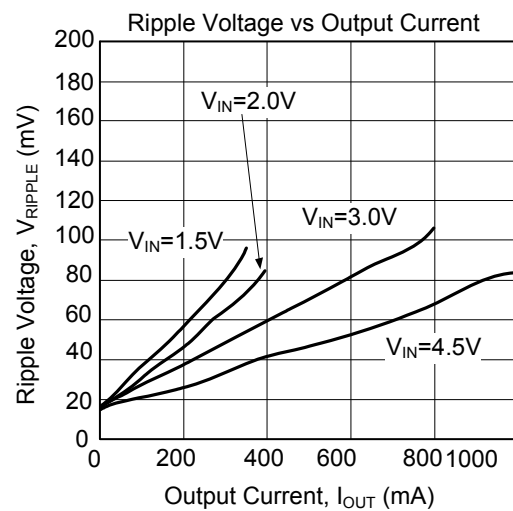
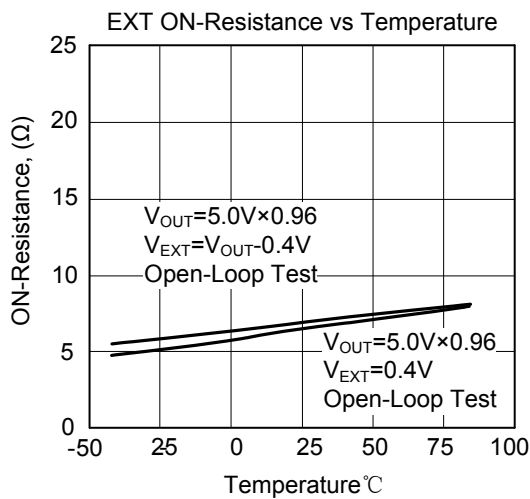
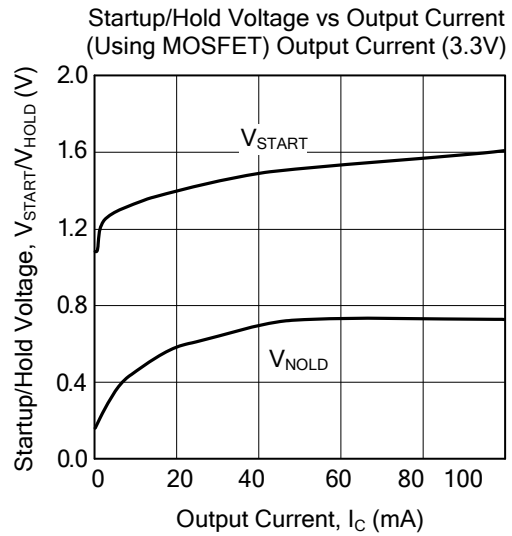
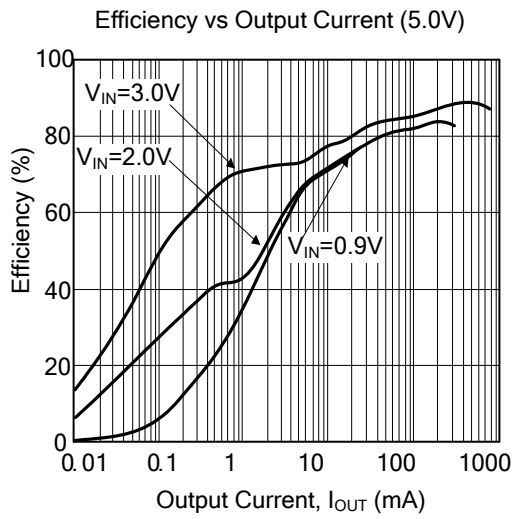
For enhancement N-channel MOSFET (it is especially importance for $R_{DS(ON)}$, typically <0.1 Ω , threshold voltage, $V_{GS(TH)}$ must be < V_{OUT} , typically <1.5V.

For bipolar NPN transistor, continuous collector current typically 1A to 4A and $V_{CE(SAT)}$ <0.2V. the driving capability is determined by the DC current gain, H_{FE} , of the transistor and the base resistor, R_B . Moreover, a speed-up capacitor, C_B should be connected in paralld with R_B to reduce switch loss and improve efficiency.

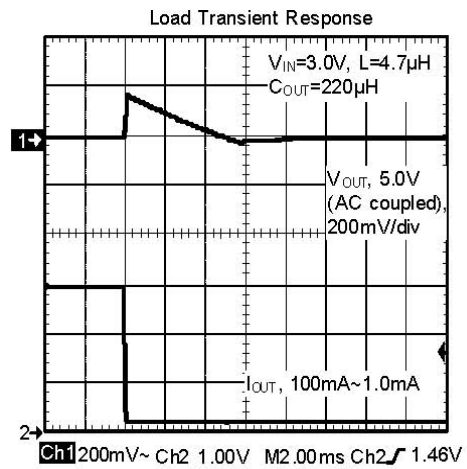
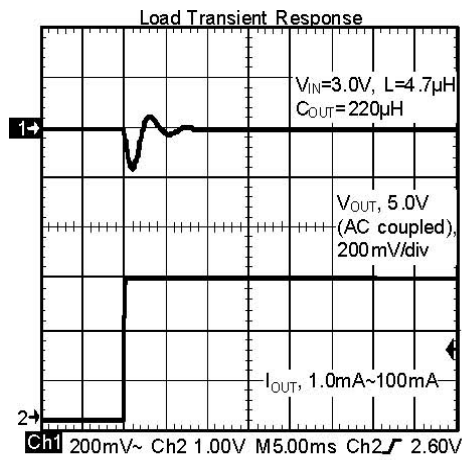
TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS(Cont.)



■ TYPICAL CHARACTERISTICS(Cont.)



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