GENERAL DESCRIPTION

The UCT1301 is a low start-up voltage step-up DC/DC converter. It comprises of an error amplifier, a ramp generator, a PWM comparator, a switch pass element and the driver. It provides stable and high efficient operation over a wide range of load currents without external compensation.

The below 1V start-up input voltage makes the UCT1301 suitable for single battery cell applications. The built-in power transistor is able to provide up to 300mA output current while working under Li-Battery Supply. Besides, it provides extra pin to drive external power devices (NMOS or NPN) in case higher output current or higher output voltage is needed. The output voltage is set with two external resistors. The 500KHz switching rate reduces the size of external components. Besides, the 14μA low quiescent current together with high efficiency maintains long battery lifetime.

The UCT1301 is available in SOT23-6 package.

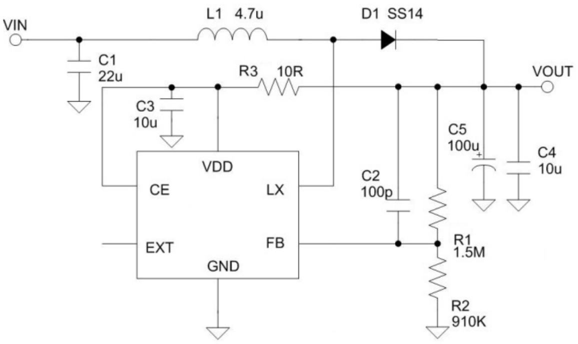
FEATURES

- Low Quiescent Supply Current: 14μA
- Low Start-up Input Voltage: typical 0.8V
- High Supply Capability
- Zero Shutdown Mode Supply Current
- High efficiency: 90%
- Fixed switching frequency: 500KHz
- Options for internal or external power switches
- Package type: SOT23-6

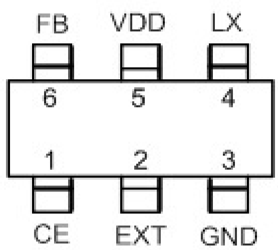
APPLICATIONS

- Backpack Power
- USB port
- MP3, PDA
- Dictionary, DSC, LCD, RF-Tag
- Portable Devices, Wireless Devices
- High Voltage Power Supplies

TYPICAL APPLICATION CIRCUIT



PIN ASSIGNMENT



ORDER INFORMATION

TYPE NAME	DESCRIPTION	PACKING
UCT1301	SOT23-6,Vfb=1.25V，500KHz	3000PCS/REEL

PIN DESCRIPTION

PIN No	SYMBOL	DESCRIPTTION
1	CE	Chip Enable.
2	EXT	Output pin for driving external power transistor
3	GND	Ground
4	LX	Output for internal power switch
5	VDD	Power Supply
6	FB	Feedback input

ABSOLUTE MAXIMUM RATINGS (Note 1)

SYMBOL	ITEM	RATING	UNIT
V_{DD}	Supply Voltage	-0.3~7.0V	V
V_{LX}	LX pin Switch Voltage	-0.3~7.0V	V
V_{IO}	Voltage on other I/O pins	-0.3V to (VDD+0.3V)	V
I_{LX}	LX pin Output Current	1.5	A
I_{EXT}	EXT pin Drive Current	200	mA
PTR	Package Thermal Resistance SOT23-6, Θ_{JC}	145	W/℃
T_{OPT}	Operating Temperature Range	-40~125	℃
T_{STG}	Storage Temperature Range	-65~150	℃
T_{SOLDER}	Lead Temperature (Soldering)	260℃, 10s	

Note1: Absolute Maximum Ratings are threshold limit values that must not be exceeded even for an instant under any condition. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

RECOMMANDED OPERATING RANGE

SYMBOL	ITEMS	VALUE	UNIT
V_{DD}	VDD Supply Voltage	2.0 to 6.0(Note 2)	V
T_{OPT}	Operating Temperature	-40 to +85	℃

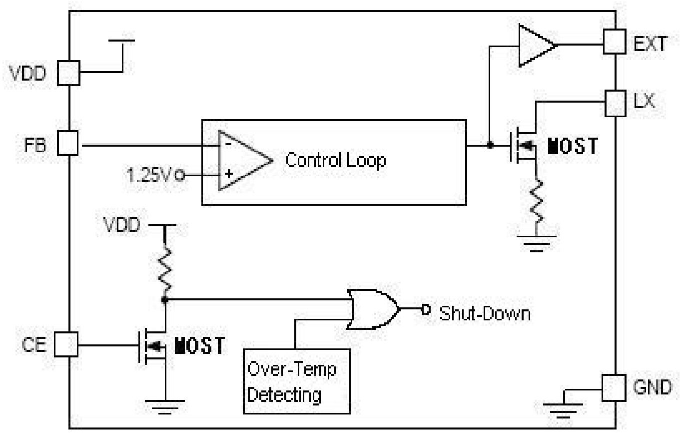
Note 2: Though the Minimum operating VDD listed here is 2.0V, the device can definitely operates below 2.0V by supplied from output instead of system supply in.

ELECTRICAL CHARACTERISTICS

(V_{IN}=1.5V, VDD=3.3V, load current=0, TA =25℃, unless otherwise specified.)

SYMBOL	ITEM	TEST CONDITION	MIN	TYP	MAX	UNIT
V_{ST}	Startup Voltage	IL = 1mA		0.80	1.05	V
V_{DD}	Operating VDD Range	VDD pin Voltage	2		6	V
I_{OFF}	Shutdown Current	CE Pin = 0V, VIN = 4.5V		0.01	1	µA
$I_{SWITCH\ OFF}$	Switch-Off Current	VDD = 6V		14	25	µA
I_{SWITCH}	Continuous Switching Current	VDD = CE= 3.3V, VFB = GND	0.22	0.24	0.7	mA
$I_{NO\ LOAD}$	No Load Current	VDD = 1.5V, VOUT = 3.3V		56		µA
V_{REF}	Feedback Reference Voltage	Close loop, VDD = 3.3V	1.225	1.25	1.275	V
Fs	Switching Frequency	VDD = 3.3V	400	500	600	KHz
D_{MAX}	Maximum Duty	VDD = 3.3V	85	94		%
R_{ONLX}	On Resistance, LX to GND	VDD = 3.3V		0.3	1.1	Ω
I_{LIMIT}	Current Limit	VDD = 3.3V	1.1			A
R_{ONEXTP}	On Resistance, EXT to VDD	VDD = 3.3V		4.4	8.5	Ω
R_{ONEXTN}	On Resistance, EXT to GND	VDD = 3.3V		2.45	8.5	Ω
$\triangle V_{LINE}$	Line Regulation	VIN = 3.5 ~ 6V, IL = 1mA		1.25	5	mV/V
$\triangle V_{LOAD}$	Load Regulation	VIN = 2.5V, IL = 1 ~ 100mA		0.14		mV/mA
VCE	CE trigger Level	VDD = 3.3V	0.4	0.8	1.2	V
TSD	Thermal Shutdown Temp			150		℃
△TSD	Thermal Shutdown Hysteresis			20		℃

SIMPLIFIED BLOCK DIAGRAM



DETAIL OPERATION DESCRIPTION

The UCT1301 is a low start-up voltage 5V step-up DC/DC converter. The start-up input voltage can be as low as 0.8V. This makes the UCT1301 suitable for single battery cell applications. The built-in power transistor is able to provide up to 300mA output current while working under Li-Battery Supply. Besides, it provides extra pin to drive external power devices (NMOS or NPN) in case higher output current or higher output voltage is needed. The output voltage is set with two external resistors. The 500KHz switching rate reduces the size of external components. Besides, the 14μA low quiescent current together with high efficiency maintains long battery lifetime.

Input and Output

VDD is the power source connection to the internal circuitry. LX is the drain of the internal N-type MOSFET.

Enable

The switch will be disabled when the CE pin is in a logic low condition. During this condition, the internal circuitry and MOSFET are turned off, reducing the supply current to 0.1uA typical. Floating the CE may cause unpredictable operation. CE should not be allowed to go negative with respect to GND. The CE pin may be directly tied to VDD to keep the part on.

Soft Start

In order to eliminate the upstream voltage droop caused by the large inrush current during hot-plug events, the soft-start feature effectively eliminates the inrush current.

Current Limiting

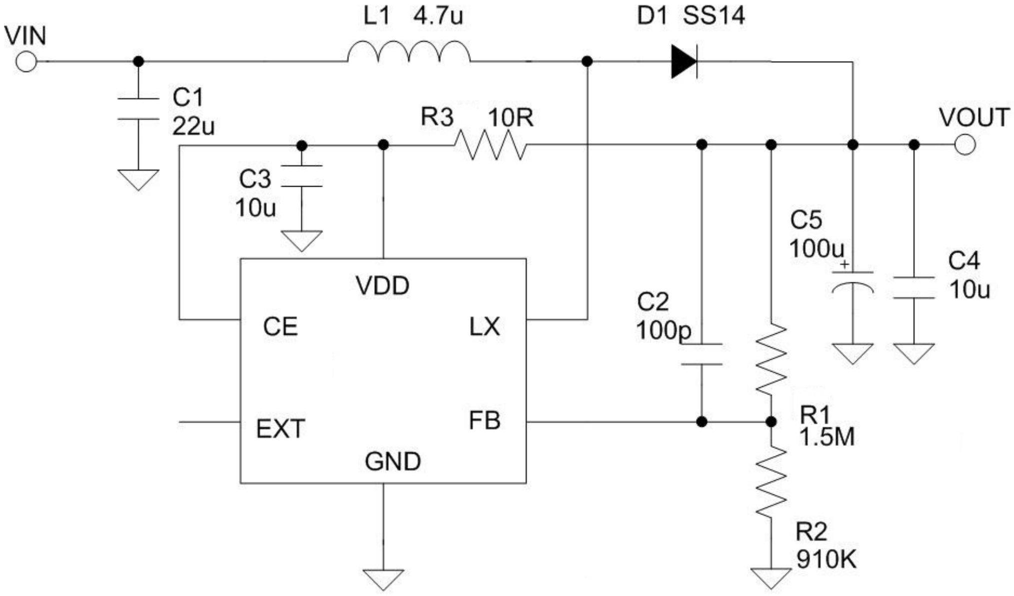
The current limit circuitry prevents damage to the MOSFET switch but can deliver load current up to the current limit threshold of typically 1.5A through the switch. When a heavy load or short circuit is applied to an enabled switch, a large transient current may flow until the current limit circuitry responds. Once this current limit threshold is exceeded the device enters constant current mode until the thermal shutdown occurs or the fault is removed.

Thermal Shutdown

Thermal shutdown is employed to protect the device from damage if the die temperature exceeds approximately 150°C. If enabled, the switch automatically restarts when the die temperature falls 20°C. The output will cycle on and off until the device is disabled or the fault is removed.

ADDITIONAL APPLICATION CIRCUITS

Basic Application Circuit

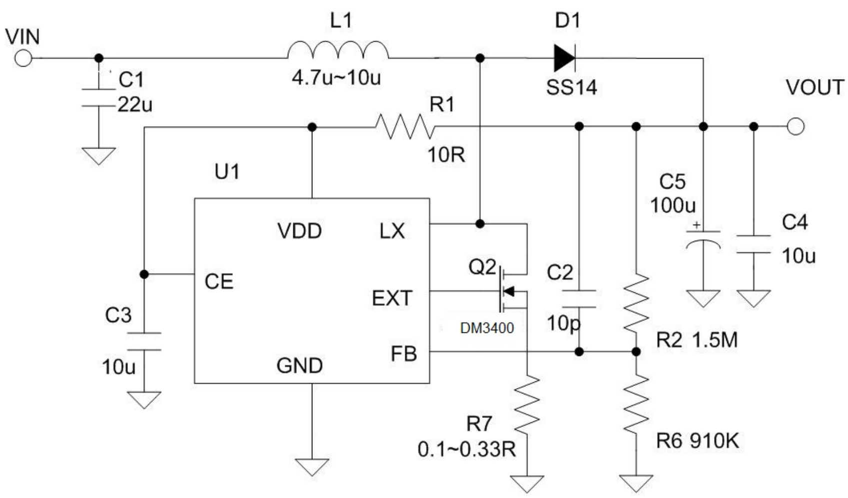


The basic application circuit for UCT1301 is shown as above figure. The output voltage VOUT can be derived from:

VOUT = (1+R1/R2)*VFB = (1+1.5/0.91)*1.25 = 3.310V

Note that VDD is derived from VOUT through the R3-C3 RC network. The benefit is that VIN can be much lower than the UCT1301 minimum operation voltage (typically 2V), while the start-up voltage is around 0.3V higher.

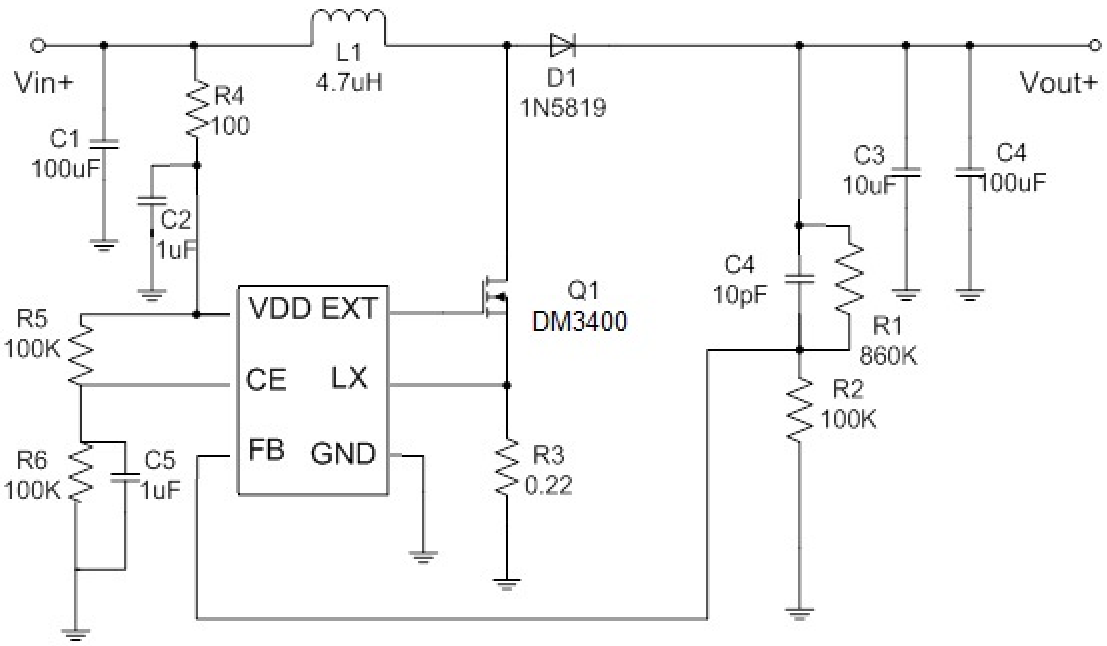
Large IOUT Application Circuit



Extending Output Current

The above circuit can provide extra output current by adding an external power MOSFET DM3400 (or NPN) driven by the EXT pin. Note R4 is necessary and C5 must be electrolytic capacitor for stability.

High VOUT Application Circuit



High V Large I Output

Adding an external power MOSFET DM3400 (or NPN) still driven by the EXT pin of the UCT1301 as the above figure can get VOUT higher than 5V. The VOUT of the above circuit is:

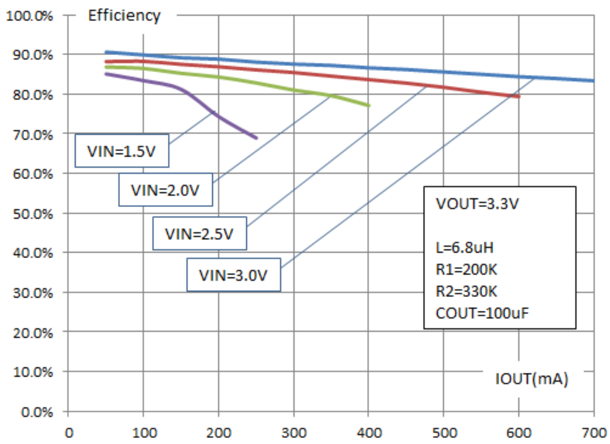
VOUT = (1+R1/R2)*VFB = (1+860/100)*1.25 = 12 V

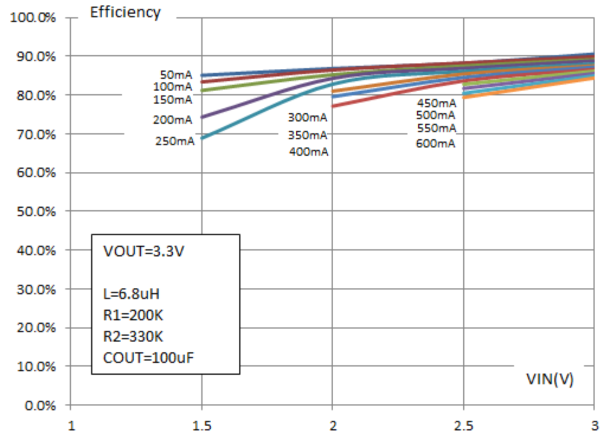
Note the R3 is both for stability and for current limit setting. Another point is that VDD is supplied from VIN (via R4 and C2 network). This is because VIN shall be higher than 2V in such application whereas VOUT is too high for UCT1301. The third point is the R5-R6-C5 network is necessary for proper start-up.

TYPICAL OPERATING CHARACTERISTICS

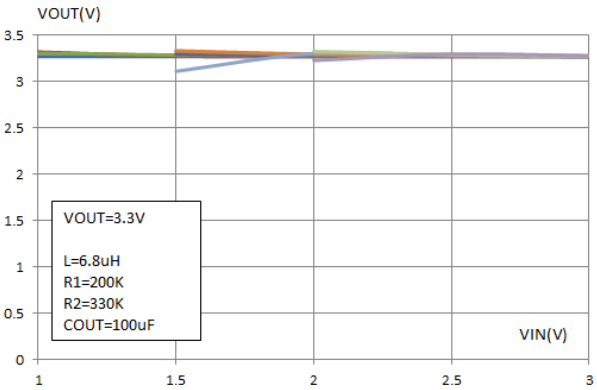
TA=25C, typical application circuit, unless otherwise specified.

(1) Efficiency

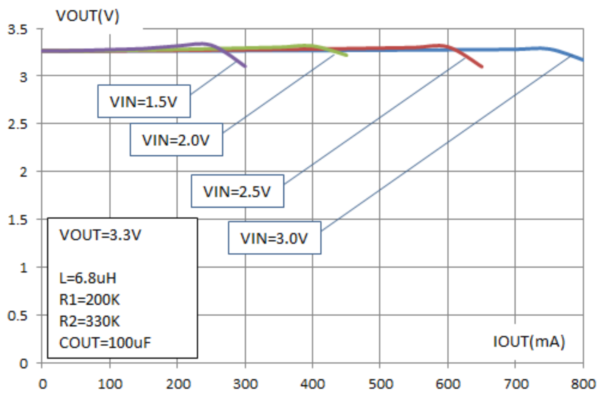




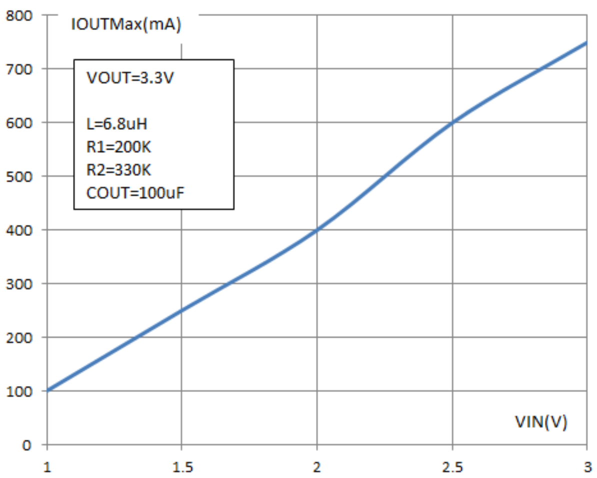
(2) Line Regulation



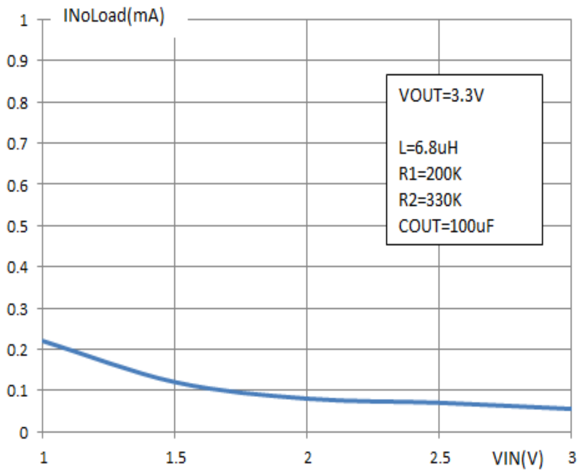
(3) Load Regulation



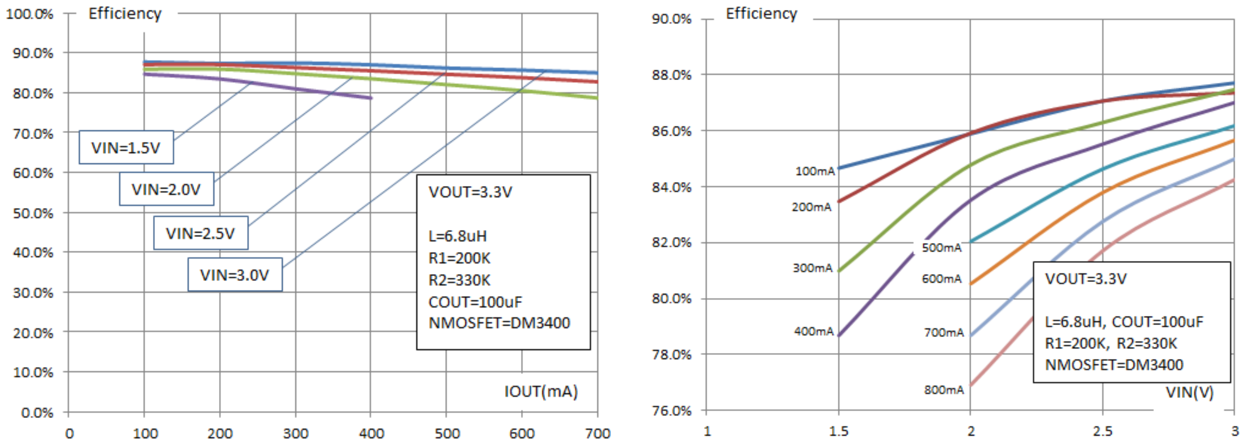
(4) IOUTMax vs VIN



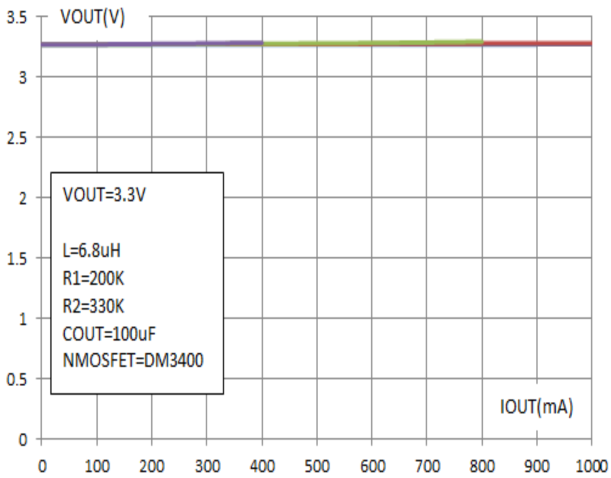
(5) INoLoad vs VIN



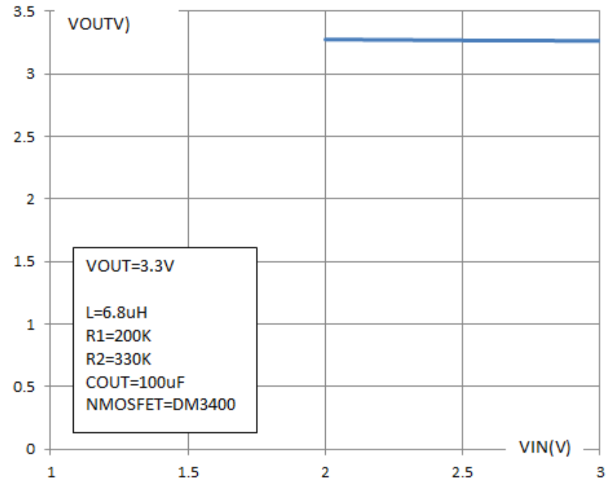
(7) Efficiency for Expanded Current with NMOSFET DM3400



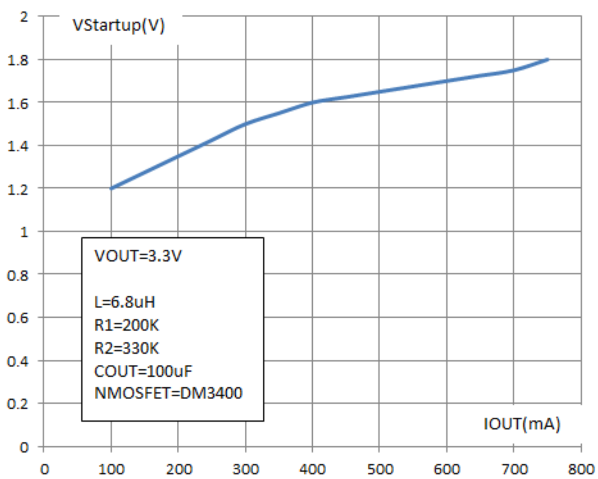
(8) Load Regulation for Expanded Current



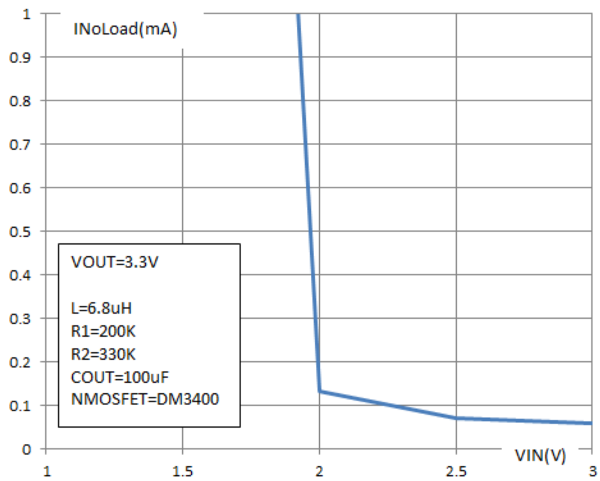
(9) Line Regulation for IOUT=600mA



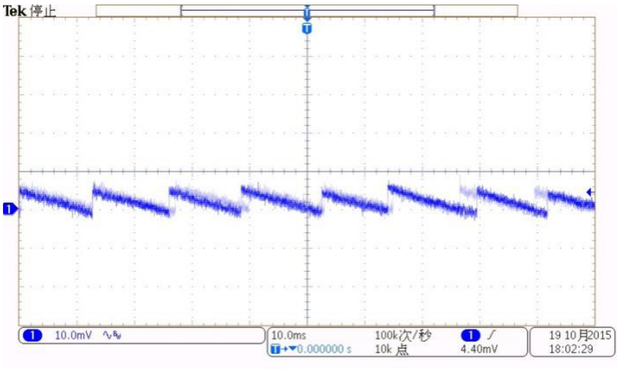
(10) Start-up Voltage vs IOUT for Expanded Current



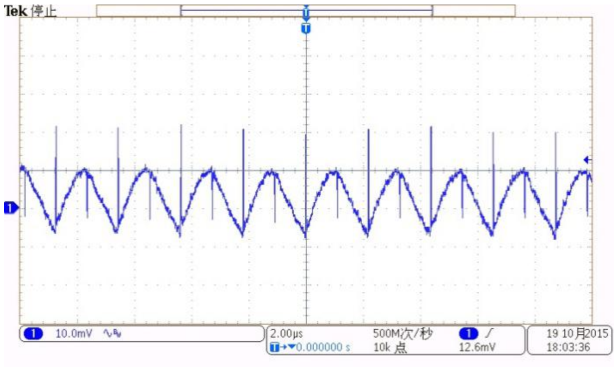
(11) INoLoad vs VIN for Expanded Current



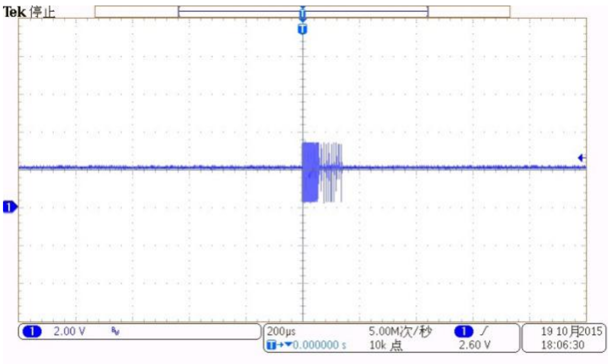
(12) Output Ripple for No Load



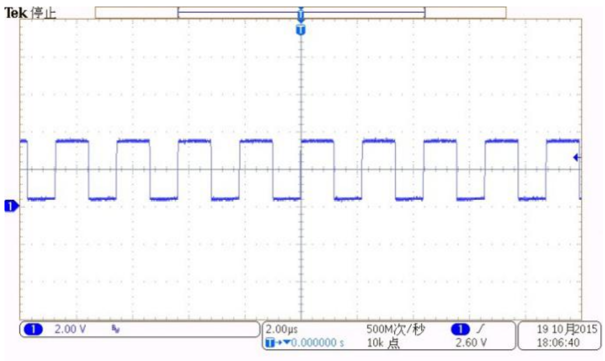
(13) Output Ripple for IOUT=200mA



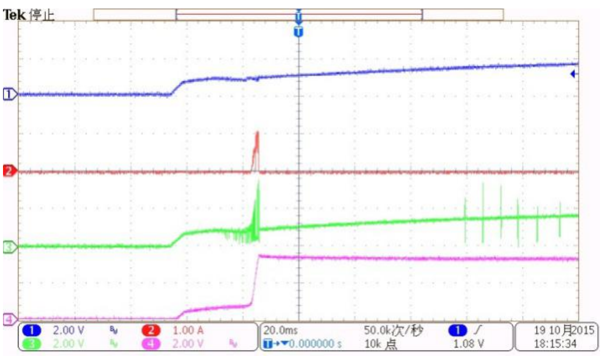
(14) SW waveform for No Load



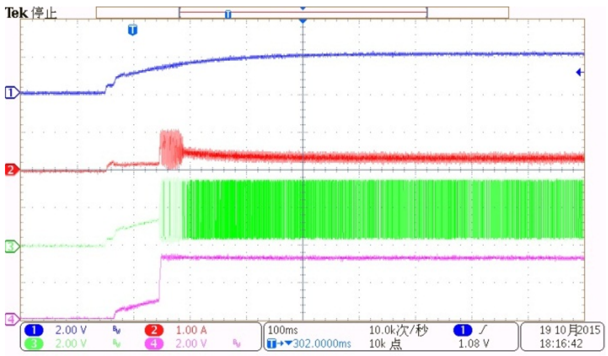
(15) SW waveform for IOUT=200mA



(16) Start-up for No Load

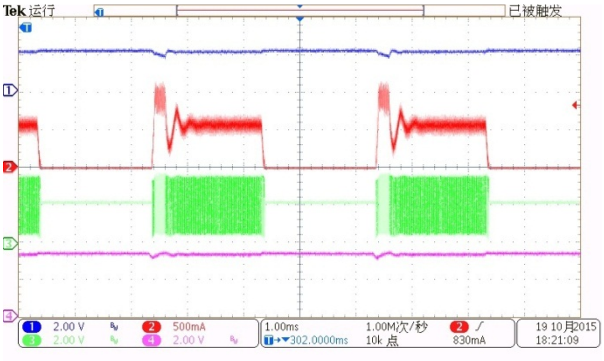


(17) Start-up for IOUT=200mA

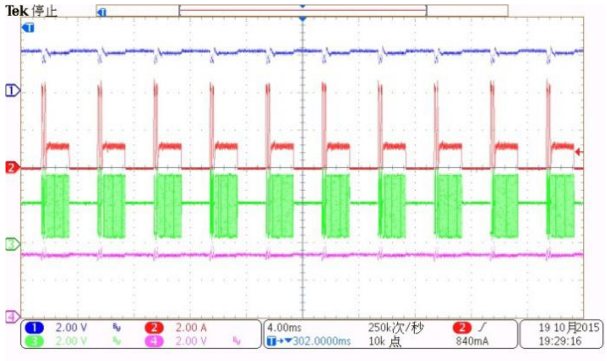


Channel1(Blue): VIN, Channel2(Red):IL, Channel3(Green): SW, Channel4(Pink): VOUT

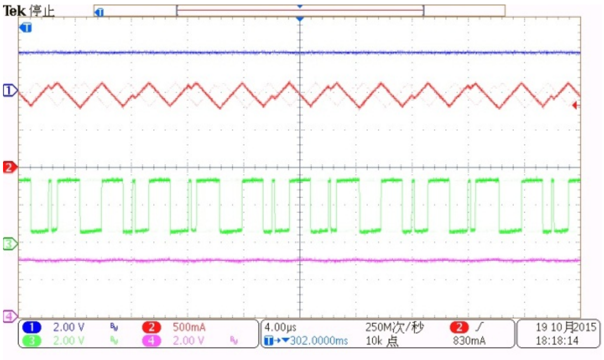
(18) Transient Response for 0/200mA, 0.5ms



(19) Transient Response for 0/200mA, 2ms



(20) Current Limit



APPLICATION INFORMATION

Output Voltage Setting

Referring to Typical Application Circuit 1, the output voltage of switching regulator (VOUT) is set with following equation:

VOUT=(1+R1/R2)*VFB

Where the VFB is 1.25V typically.

Feedback Loop Design

Referring to Typical Application Circuit 1 again, the selection of R1 and R2 is a trade-off between quiescent current consumption and interference immunity besides abiding by the above equation.

- Higher R reduces quiescent current (I=1.25V/R2)
- Lower R gives better interference immunity, and is less sensitive to interference, layout parasitic, FB node leakage, and improper probing to FB pin.

Hence for applications without standby or suspend modes lower R1 and R2 values are preferred, while for applications concerning the current consumption in standby or suspend modes, higher values of R1 and R2 are needed. Such high impedance feedback loop is sensitive to any interference, which requires careful PCB layout and avoid any interference, especially to FB pin.

To improve the system stability, a proper value capacitor between FB pin and VOUT is suggested. An empirical suggestion is around 100pF for MΩ feedback resistors and 10nF～0.1uF for lower R values.

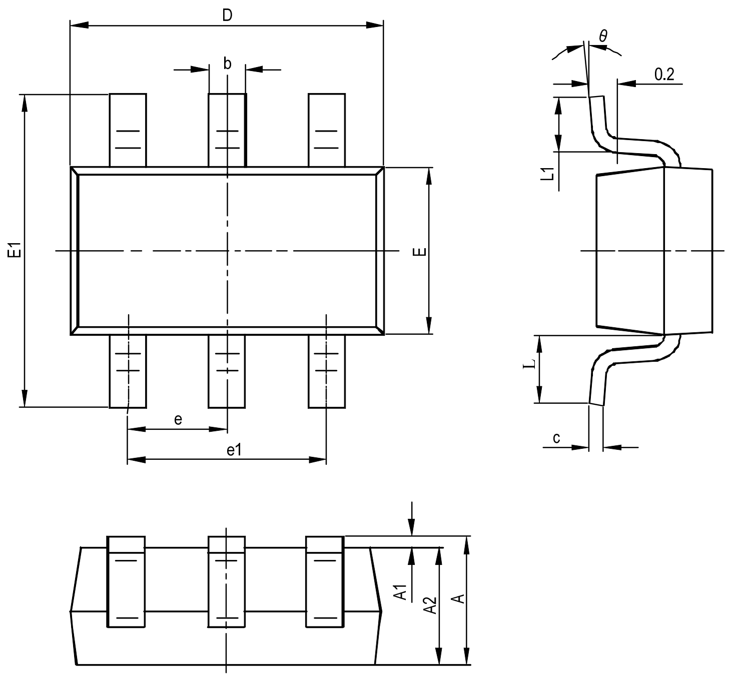
PCB Layout Guide

PCB Layout shall follow these guidelines for better system stability:

- A full GND plane without any gap break.
- VDD to GND bypass Cap – The 1μF MLCC noise bypass Cap between pin 5 and pin 3 shall have short and wide connections.
- Vin to GND bypass Cap – Add a Cap close to the inductor when Vin is not an idea voltage source.
- Minimize the FB node copper area and keep it far away from noise sources.
- Minimize the parasitic capacitance connected to LX and EXT nodes to reduce the switch loss.

PACKAGE OUTLINE

SOT23-6



SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°