600mA, 600kHz Step-Up DC-DC Converter

UM3433 *SOT23-6*

General Description

The UM3433 is a synchronous fixed frequency, step-up DC/DC converter delivering high efficiency in a SOT23-6 package. With an internal NMOS switch and PMOS synchronous rectifier and high switching frequency of 600kHz, the UM3433-3.3/UM3433-3.0 are capable of supplying fixed 3.3V/3.0V at 100mA from a single AA cell input using low profile inductors and ceramic capacitors. The UM3433-ADJ features an adjustable output voltage from 2.5V to 5V with the voltage divider resistors connected to the FB pin. The voltage mode PWM design is with an external compensation pin, and gives the user freedom to tune the transient of the converter. At light loads, the PWM control shifts to power-saving mode to keep high efficiency at light load. Anti-ringing control circuitry reduces EMI concerns by damping the inductor in discontinuous mode and the device features low shutdown current of under 1μA.

Applications

- MP3 Players
- Digital Cameras
- LCD Bias Supplies
- Handheld Instruments
- Wireless Handsets
- GPS Receivers

Features

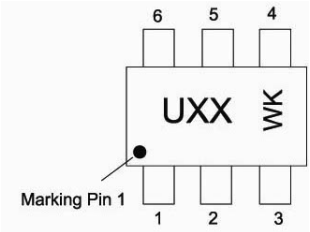
- Up to 92% efficiency
- Fixed output voltages : 3.3V(UM3433-3.3), 3.0V(UM3433-3.0)
- Adjustable output voltage(UM3433-ADJ): 2.5V to 5V
- Low Voltage Start-Up: 0.9V
- PWM at heavy load
- Automatic Power-Saving Mode Operation at light load
- Proprietary fast response voltage-mode PWM design
- External compensation pin to tune transient response
- Short Circuit Protection
- 600kHz Switching Frequency for low profile inductor/capacitor
- Anti-ringing Control at Discontinuous Conduction Mode to minimizes EMI
- Low Profile SOT23-6 Package

Pin Configurations

Top View

UM3433-3.3/3.0 **UM3433-ADJ**

Top View



UM3433-3.3 (UCR)
UM3433-3.0 (UDR)
UM3433-ADJ (UCS)
SOT23-6

Pin Description

Pin Number	Symbol	Description
1	SW	Switch pin for external inductance
2	GND	Ground
3	NC(UM3433-3.3/3.0)	Not Connect
	FB(UM3433-ADJ)	Feedback input pin
4	$\overline{SHDN}$	Logic Controlled Shutdown Input $\overline{SHDN}$=high, Normal operation mode $\overline{SHDN}$=low, shutdown mode
5	VOUT	Output Voltage
6	VIN	Input Voltage

Ordering Information

Part Number	Packaging Type	Marking Code	Shipping Qty
UM3433-3.3	SOT23-6	UCR	3000pcs/7Inch Tape & Reel
UM3433-3.0	SOT23-6	UDR	3000pcs/7Inch Tape & Reel
UM3433-ADJ	SOT23-6	UCS	3000pcs/7Inch Tape & Reel

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{IN}	V_{IN} Supply Voltage	-0.3 to +6V	V
V_{SW}	SW Voltage	-0.3 to +6V	V
V_{FB}	FB Voltage	-0.3 to +6V	V
$V_{\overline{SHDN}}$	$\overline{SHDN}$ Voltage	-0.3 to +6V	V
V_{OUT}	Output Voltage	-0.3 to +6V	V
T_{OP}	Operating Temperature Range	-40 to +85	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_L	Maximum Lead Temperature (Soldering , 10s)	+300	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

Electrical Characteristics

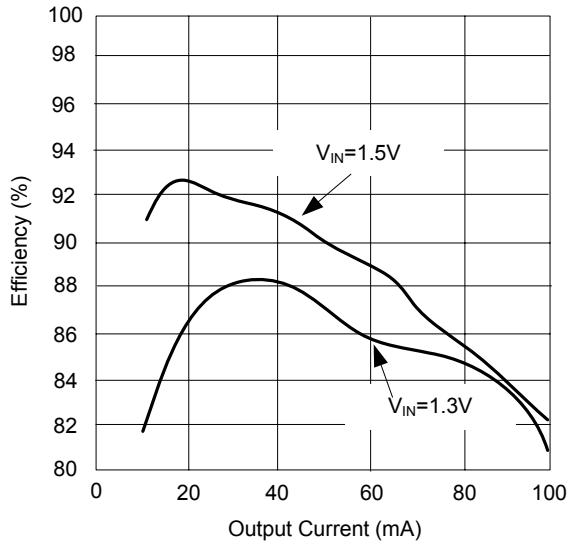
(V_{IN}= +1.2V, V_{OUT}= +3.3V T_A=+25°C, unless otherwise noted.)

Parameter	Test Conditions	Min	Typ	Max	Unit
Minimum Start-Up Voltage	I_{load}=1mA		0.9		V
Output Voltage	I_{load}=100mA	3.22	3.3	3.38	V
Output Voltage Adjustable Range		2.5		5	V
Feedback Voltage		1.192	1.230	1.268	V
Quiescent Current (power-saving mode)	I_{load}=0mA		20		μA
Quiescent Current (Active)	I_{load}=100mA		380	550	μA
Quiescent Current (shutdown)	I_{load}=100mA, $\overline{SHDN}$=0V			1	μA
NMOS Leakage	V_{SW}=3.3V		0.1		μA
PMOS Leakage			0.1		μA
NMOS On-resistance			0.35		Ω
PMOS On-resistance			0.45		Ω
NMOS Current limit		600	850		mA
Power-Saving Mode Operation Current threshold	L=10μH (Note)		3		mA
Current Limit Delay to Output			40		ns
Switching Frequency	I_{load}=100mA, $\overline{SHDN}$=1V		600		kHz
$\overline{SHDN}$ Input High	I_{load}=100mA	1			V
$\overline{SHDN}$ Input Low	I_{load}=100mA			0.35	V
$\overline{SHDN}$ Input Current	I_{load}=100mA, $\overline{SHDN}$=1V		0.01	1	μA

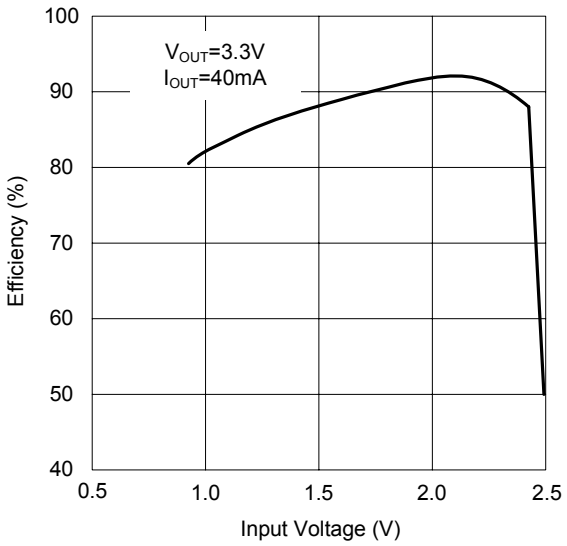
Note: Design guaranteed.

Typical Operating Characteristics

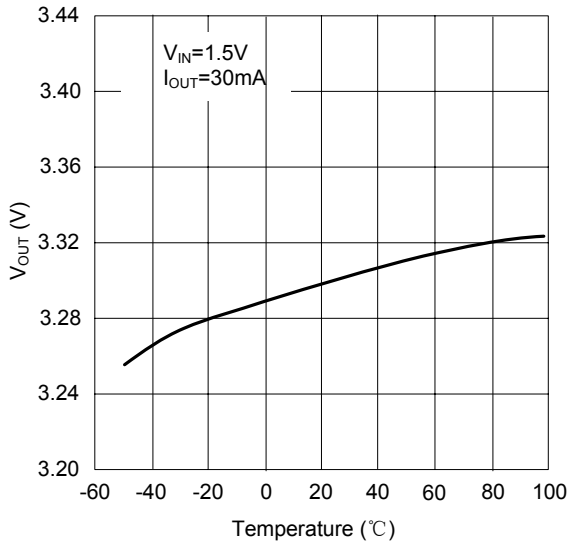
Efficiency vs Output Current



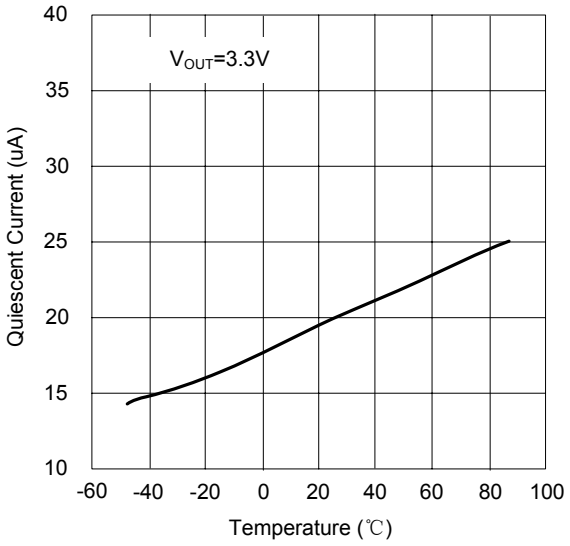
Efficiency vs Input Voltage



Output Voltage vs Temperature

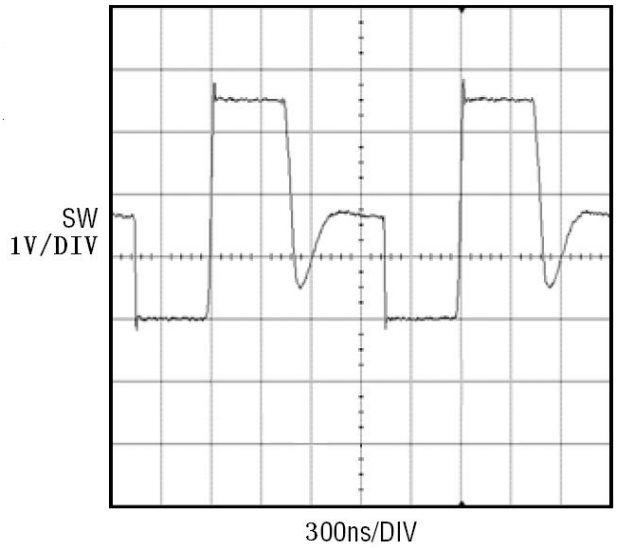


Power-Saving Mode Quiescent Current vs Temperature

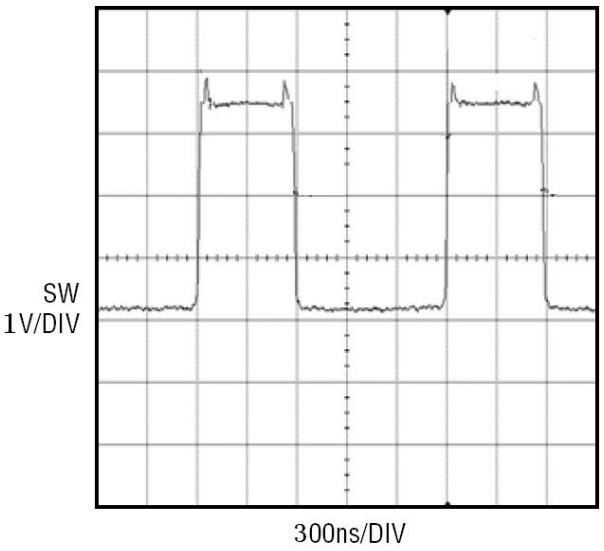


Typical Operating Characteristics

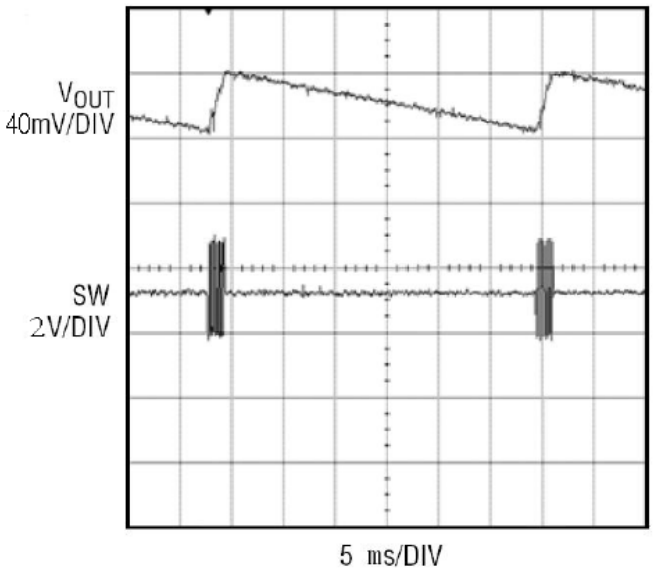
Fixed Frequency Discontinuous Mode Operation



Fixed Frequency Continuous Mode Operation



Power-Saving Mode Operation



Pin Functions

SW (Pin 1): Switch Pin. Connect inductor between SW and V_{IN}. Keep these PCB trace lengths as short and wide as possible to reduce EMI and voltage overshoot.
GND (Pin 2): Signal and Power Ground. Provide a short direct PCB path between GND and the (–) side of the output capacitor(s).
NC (Pin 3): Not Connect.
FB (Pin 3): Feedback input. Connect resistor divider tap to this pin. The output voltage can be adjusted from 2.5V to 5V by:
$V_{OUT}=V_{FB}\times(1+R1/R2)$

$\overline{\text{SHDN}}$ (Pin 4): Logic Controlled Shutdown Input.

$\overline{\text{SHDN}}$=High: Normal free running operation, 600kHz typical operating frequency.

$\overline{\text{SHDN}}$=Low: Shutdown, quiescent current <1μA.Output capacitor can be completely discharged through the load.
VOUT (Pin 5): Output Voltage Sense Input and Drain of the Internal Synchronous Rectifier MOSFET. Bias is derived from V_{OUT}. PCB trace length from V_{OUT} to the output filter capacitor(s) should be as short and wide as possible.
VIN (Pin 6): Battery Input Voltage. The device gets its start-up bias from V_{IN}. Once V_{OUT} exceeds V_{IN}, bias comes from V_{OUT}. Thus, once started, operation is completely independent from VIN. Operation is only limited by the output power level and the battery's internal series resistance.

Typical Application Circuits

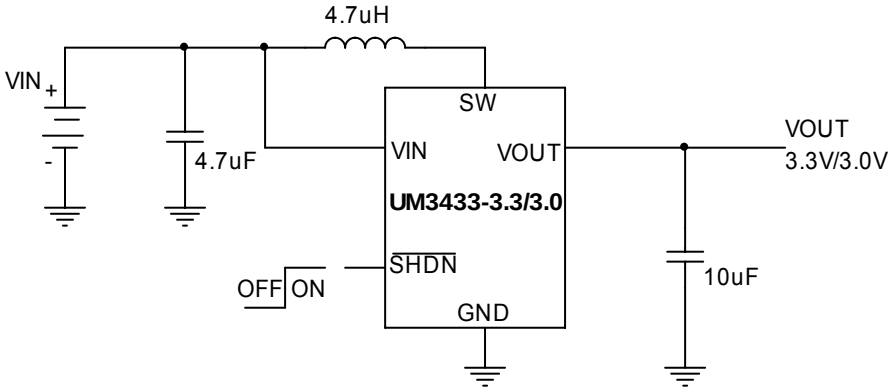


Figure 1 Fixed output application circuit

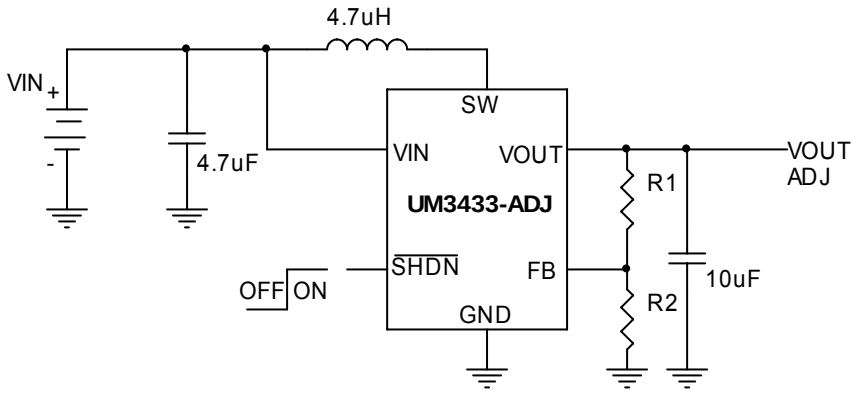


Figure 2 Adjustable output application circuit

Applications Information

Inductor Selection

The UM3433 can utilize small surface mount and chip inductors due to its 600kHz switching frequency. Typically, a 4.7μH inductor is recommended for most applications. Larger values of inductance will allow greater output current capability by reducing the inductor ripple current. Increasing the inductance above 10μH will increase size while providing little improvement in output current capability.

The approximate output current capability of the UM3433 versus inductance value is given in the equation below.

$$I_{OUT(MAX)} = \eta \bullet \left(I_P - \frac{V_{IN} \bullet D}{f \bullet L \bullet 2}\right) \bullet (1 - D)$$

where:

η = estimated efficiency

I_P = peak current limit value (0.6A)

V_{IN} = input (battery) voltage

D = steady-state duty ratio = $(V_{OUT} - V_{IN})/V_{OUT}$

f = switching frequency (600kHz typical)

L = inductance value

The inductor current ripple is typically set for 20% to 40% of the maximum inductor current (I_P). High frequency ferrite core inductor materials reduce frequency dependent power losses compared to cheaper powdered iron types, improving efficiency. The inductor should have low ESR (series resistance of the windings) to reduce the I^2R power losses, and must be able to handle the peak inductor current without saturating. Molded chokes and some chip inductors usually do not have enough core to support the peak inductor currents of 850mA seen on the UM3433. To minimize radiated noise, use a toroid, pot core or shielded bobbin inductor.

Output and Input Capacitor Selection

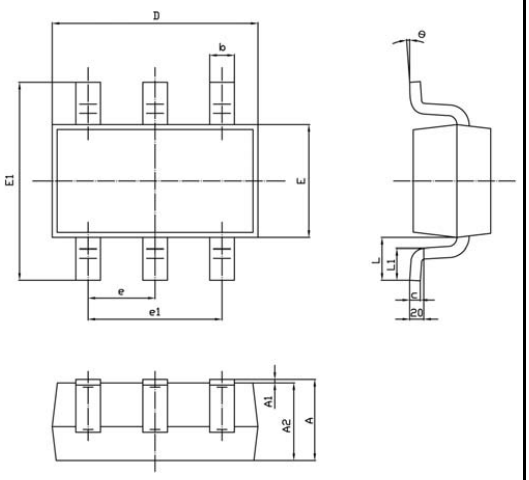
Low ESR (equivalent series resistance) capacitors should be used to minimize the output voltage ripple. Multilayer ceramic capacitors are an excellent choice as they have extremely low ESR and are available in small footprints. A4.7μF to 15μF output capacitor is sufficient for most applications. Larger values up to 22μF may be used to obtain extremely low output voltage ripple and improve transient response. An additional phase lead capacitor may be required with output capacitors larger than 10μF to maintain acceptable phase margin. X5R and X7R dielectric materials are preferred for their ability to maintain capacitance over wide voltage and temperature ranges.

Low ESR input capacitors reduce input switching noise and reduce the peak current drawn from the battery. It follows that ceramic capacitors are also a good choice for input decoupling and should be located as close as possible to the device. A 10μF input capacitor is sufficient for virtually any application. Larger values may be used without limitations.

Package Information

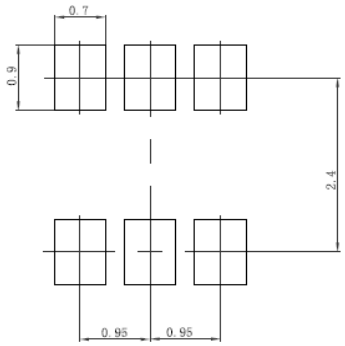
UM3433: SOT23-6

Outline Drawing



Symbol	DIMENSIONS			
	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	0.500	0.012	0.020
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	0.950REF		0.037REF	
e1	1.800	2.000	0.071	0.079
L	0.600REF		0.023REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

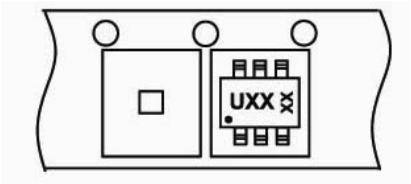
Land Pattern



NOTES:

1. Compound dimension: 2.92×1.60 ;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

Tape and Reel Orientation



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