1A、2.25MHz、同步降压DC-DC转换器

UM3510S *SOT23-6*
UM3510DA *DFN6 2.0×2.0*

描述

UM3510是高效的脉宽调制(PWM)同步降压DC-DC转换器,输入电压范围为2.5V至6.0V，可为单块锂离子电池提供高达1000mA的输出电流。UM3510在2.25MHz固定开关频率下运行，进入省电模式后可在轻负载条件下保持高效率。

对于低噪声应用，UM3510可通过将MODE引脚的电平拉高来强制芯片进入固定频率脉宽调制(PWM)模式。

当EN引脚拉低时，UM3510进入关断模式，工作电流降至1μA以下。该器件还具备2%精度的低内部基准电压、过温保护和过流保护等其他特性。

UM3510采用SOT23-6和6引脚DFN 2mm×2mm封装。

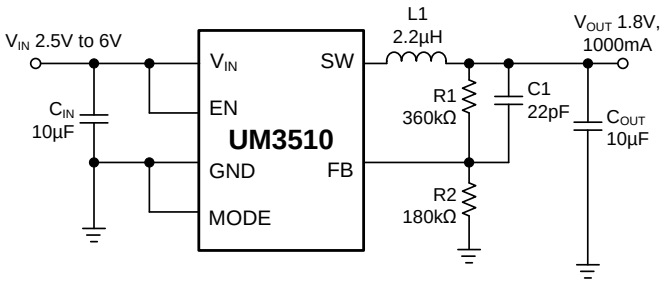
应用

- 蜂窝电话和智能手机
- 微处理器和DSP核心电源
- 无线和DSL解调器
- PDAs、GPS
- WLAN
- 便携式仪器

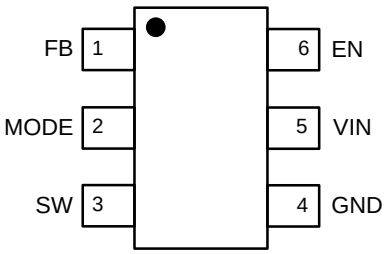
特性

- 效率高达95%
- 恒定开关频率：2.25MHz
- 输出电流：1000mA
- 集成主开关和同步整流器，无需肖特基二极管
- 输入电压范围：2.5V至6.0V
- 低静态电流：56μA
- 过温保护
- 关断电流：<1μA

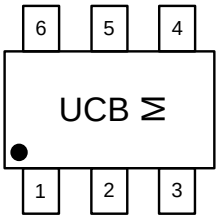
典型应用电路



引脚配置

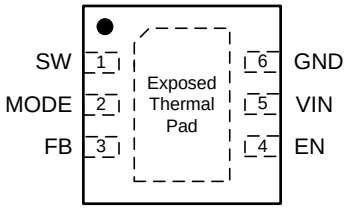


俯视图

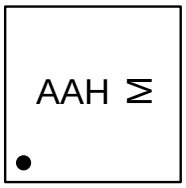


M: Month Code
UM3510S
SOT23-6

Pin Configurations Top View



(Top View)



M: Month Code
UM3510DA
DFN6 2.0×2.0

Ordering Information

Part Number	Packaging Type	Marking Code	Shipping Qty
UM3510S	SOT23-6	UCB	3000pcs/7Inch Tape & Reel
UM3510DA	DFN6 2.0×2.0	AAH	

Pin Description

Pin Number		Symbol	Function
SOT23-6	DFN6 2.0×2.0		
3	1	SW	Power switch output. It is the switch node connection to the inductor. This pin connects to the drains of the internal P-CH and N-CH MOSFET switches.
2	2	MODE	MODE pin=high forces the device to operate in fixed-frequency PWM mode. Mode pin=low enables the Power Save Mode with automatic transition from PFM mode to fixed-frequency PWM mode.
1	3	FB	Feedback input pin. Connect FB to the center point of the external resistor divider.
6	4	EN	Regulator enable control input. Pulling this pin to high enables the device. Pulling this pin to low forces the device into shutdown mode. This pin must be terminated.
5	5	VIN	Input voltage.
4	6	GND	Ground.

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Value	Unit
V_{IN}	Input Voltage	-0.3 to +6.0	V
V_{EN},V_{FB}	EN, FB Voltages	-0.3 to V_{IN}+0.3	V
V_{SW}	SW Voltage	-0.3 to V_{IN}+0.3	V
I_{SW}	Peak SW Sink and Source Current	2.0	A
T_O	Operating Temperature	-40 to +85	℃
T_{STG}	Storage Temperature Range	-65 to +150	℃

Note 1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Thermal Capabilities

Symbol	Description		Value	Unit
θ_{JA}	Thermal Resistance	SOT23-6	190	℃/W
		DFN6 2×2	165	℃/W
P_D	Power Dissipation	SOT23-6	0.526	W
		DFN6 2×2	0.606	W
ΔP/℃	Derating Factor above T_A=25℃	SOT23-6	-5.26	mW/℃
		DFN6 2×2	-6.06	mW/℃

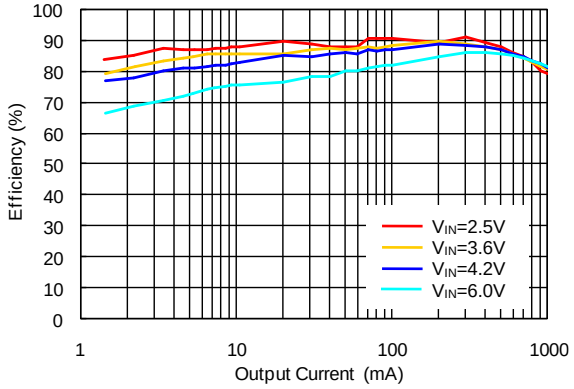
Electrical Characteristics

(V_{IN}=V_{EN}=3.6V, T_A=+25℃, unless otherwise noted)

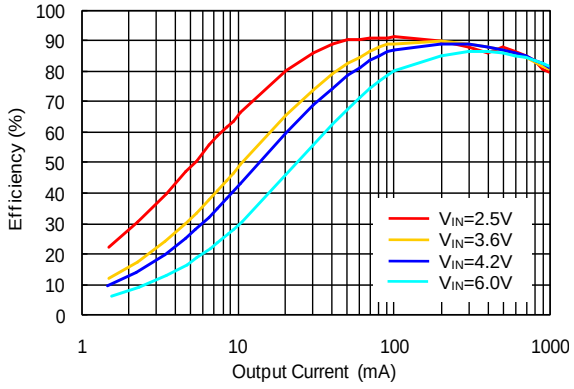
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
SUPPLY						
V_{IN}	Input Voltage Range		2.5		6.0	V
UVLO	Under Voltage Lockout Threshold	Falling Edge	1.8		2.3	V
UVLO_HYS	Under Voltage Lockout Hysteresis			200		mV
I_Q	Input DC Supply Current (MODE=GND)	I_{LOAD}=0mA		56	80	μA
	Input DC Supply Current (MODE=VIN)	I_{LOAD}=0mA		5.6		mA
I_{SD}	Input Supply Current (Shutdown Mode)	V_{FB}=0V, V_{IN}=6.0V		0.1	1.0	μA
OUTPUT						
V_{FB}	Regulated Feedback Voltage	T_A=+25℃	0.588	0.600	0.612	V
I_{FB}	FB Input Bias Current	V_{FB}=0.65V			30	nA
	Output Voltage Line Regulation	2.5V≤V_{IN}≤6.0V, I_{OUT}=10mA, MODE=V_{IN}/GND		0.10	0.20	%/V
	Output Voltage Load Regulation	0.1A≤I_{OUT}≤1A		0.5		%/A
$I_{O(MAX)}$	Maximum Output Current		1000			mA
t_{SS}	Soft Start Time			400		μs
I_{SWL}	SW Leakage	V_{EN}=0V, V_{IN}=6V, V_{SW}=0V or 6V		±0.01	±1	μA
POWER SWITCH						
$R_{DS(ON)}$	$R_{DS(ON)}$ of P-CH MOSFET	V_{IN}=3.6V, I_{SW}=100mA		0.25	0.30	Ω
	$R_{DS(ON)}$ of N-CH MOSFET	V_{IN}=3.6, I_{SW}=-100mA		0.18	0.23	Ω
I_P	Peak Inductor Current	V_{IN}=2.5V to 6.0V	1.6	1.8	2.0	A
	Thermal Shutdown Temperature			150		℃
	Thermal Shutdown Temperature Hysteresis			20		℃
OSILLATOR						
f	Oscillator Frequency		1.95	2.25	2.55	MHz
ENABLE, MODE						
V_{IH}	High-Level Threshold		1.2			V
V_{IL}	Low-Level Threshold				0.4	V
I_I	Input Leakage Current			0.1	1	μA

Typical Operating Characteristics

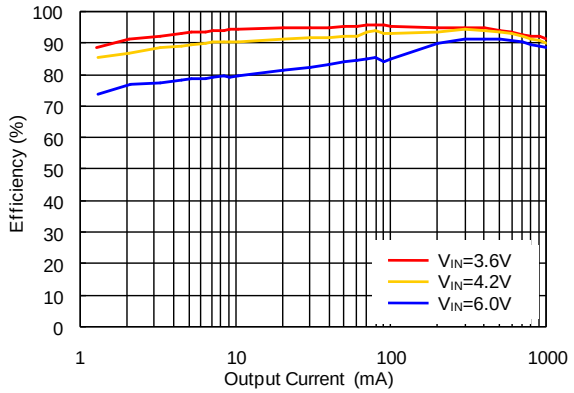
Efficiency vs. Load Current
V_{OUT}=1.8V, Power Save Mode



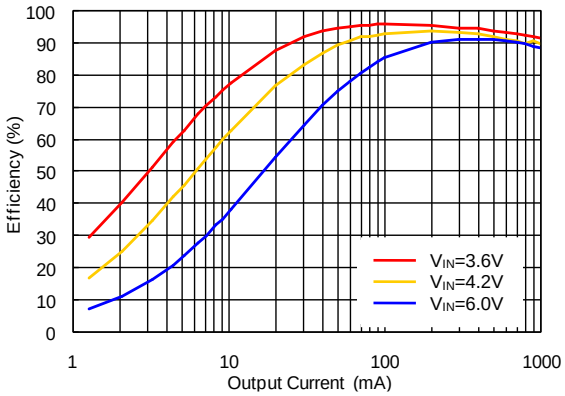
Efficiency vs. Load Current
V_{OUT}=1.8V, Forced PWM Mode



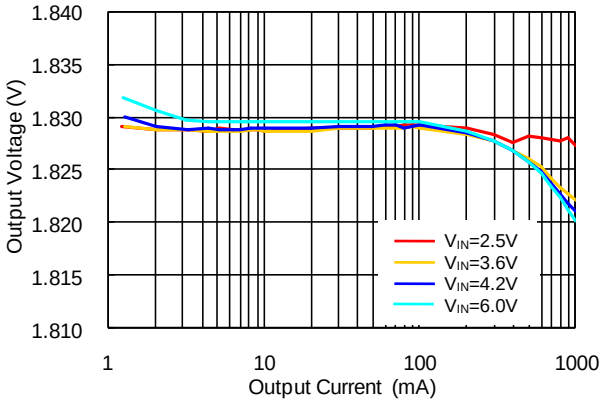
Efficiency vs. Load Current
V_{OUT}=3.3V, Power Save Mode



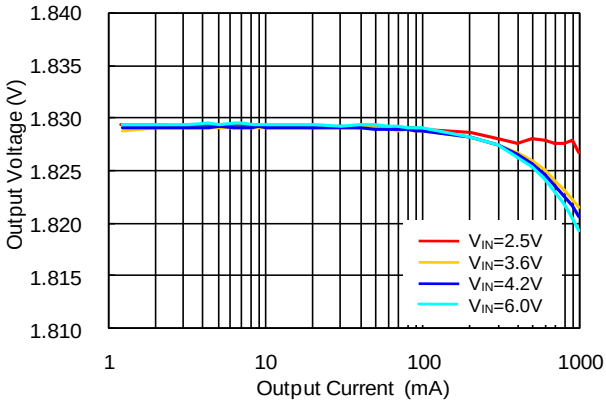
Efficiency vs. Load Current
V_{OUT}=3.3V, Forced PWM Mode



Output Voltage vs. Load Current
V_{OUT}=1.8V, MODE=L

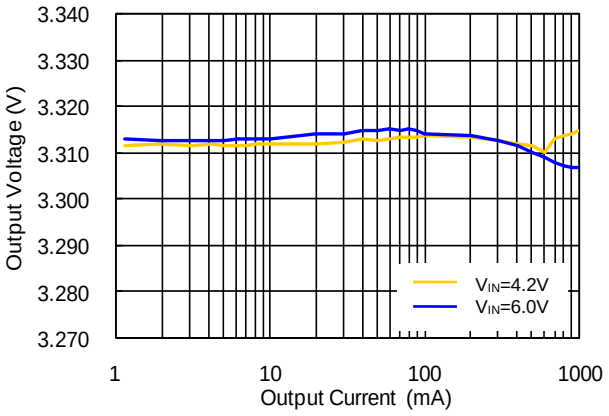


Output Voltage vs. Load Current
V_{OUT}=1.8V, MODE=H

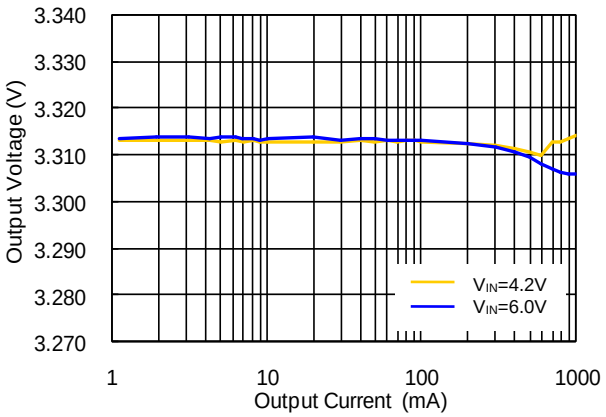


Typical Operating Characteristics (Continued)

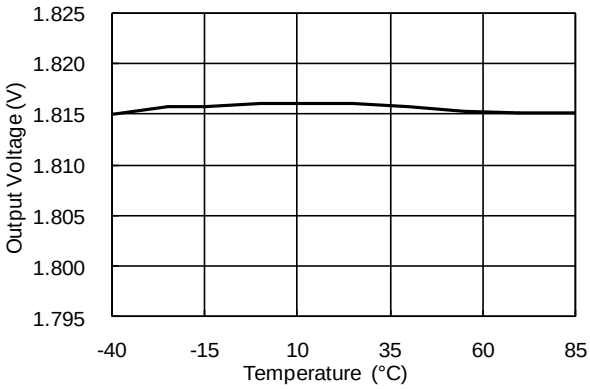
Output Voltage vs. Load Current
V_{OUT}=3.3V, MODE=L



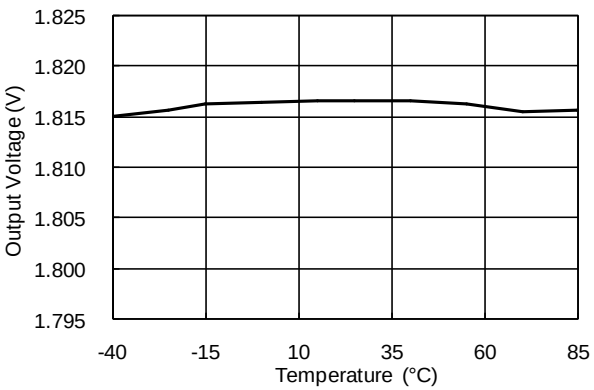
Output Voltage vs. Load Current
V_{OUT}=3.3V, MODE=H



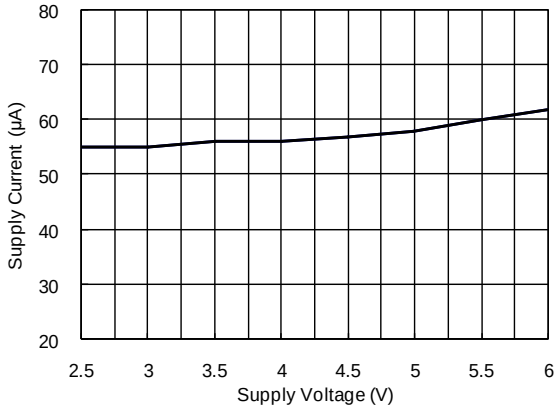
Output Voltage vs. Temperature
V_{IN}=3.6V, MODE=L, I_{LOAD}=10mA



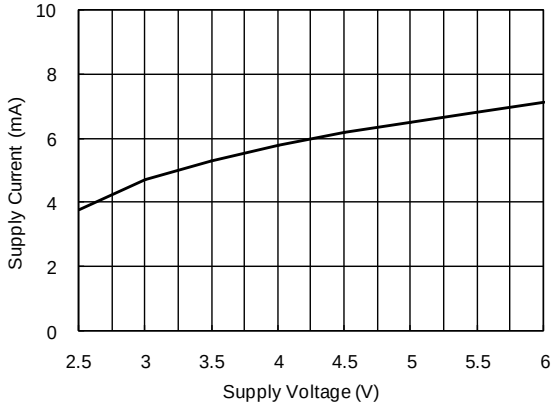
Output Voltage vs. Temperature
V_{IN}=3.6V, MODE=H, I_{LOAD}=10mA



Supply Current vs. Supply Voltage
Power Save Mode, MODE=L

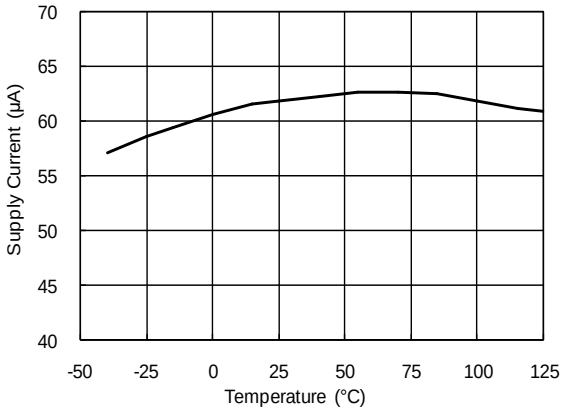


Supply Current vs. Supply Voltage
Forced PWM Mode, MODE=H

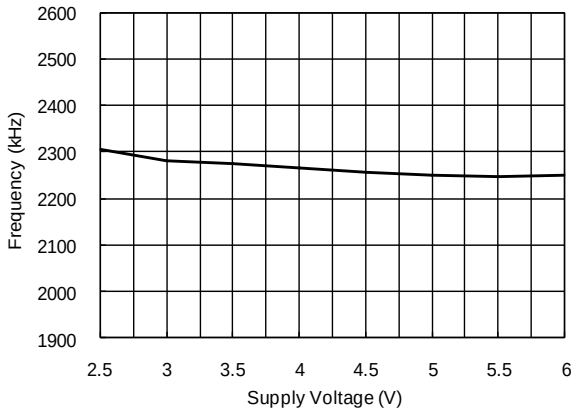


Typical Operating Characteristics (Continued)

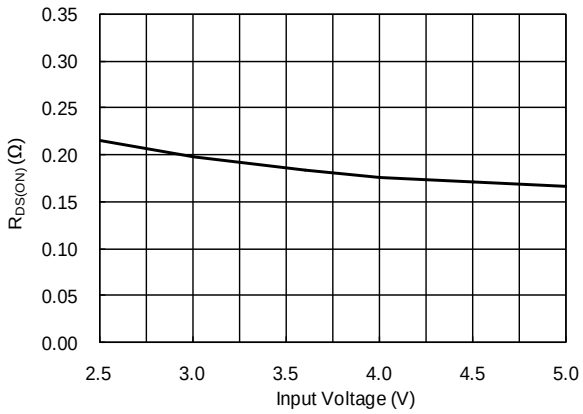
Supply Current vs. Temperature
V_{IN}=6V, MODE=L



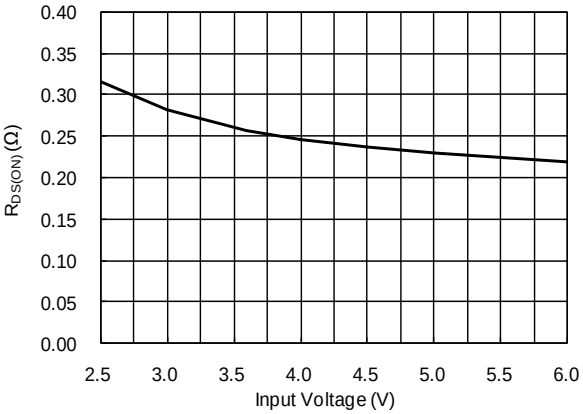
Frequency vs. Supply Voltage
V_{OUT}=1.8V, I_{LOAD}=200mA



L-Side $R_{DS(ON)}$ vs. Input Voltage

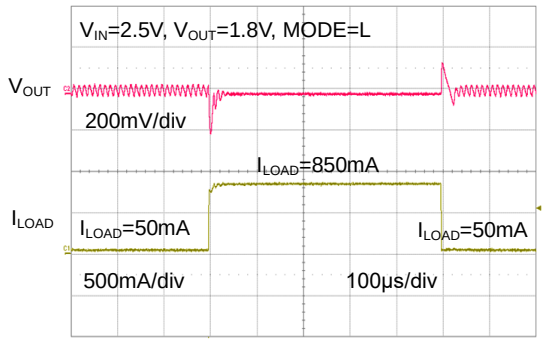


H-Side $R_{DS(ON)}$ vs. Input Voltage

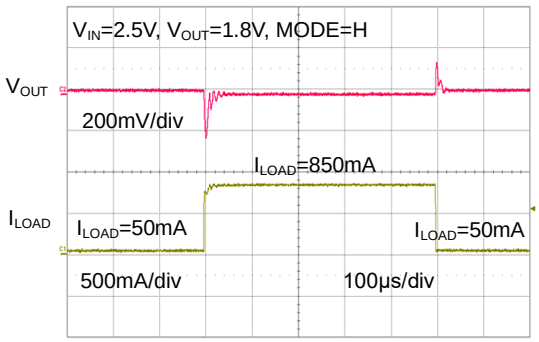


Typical Operating Characteristics (Continued)

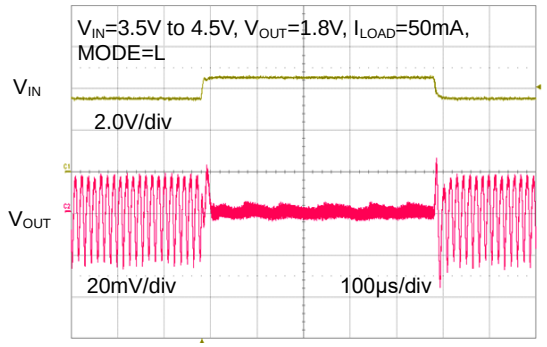
Load Transient Response



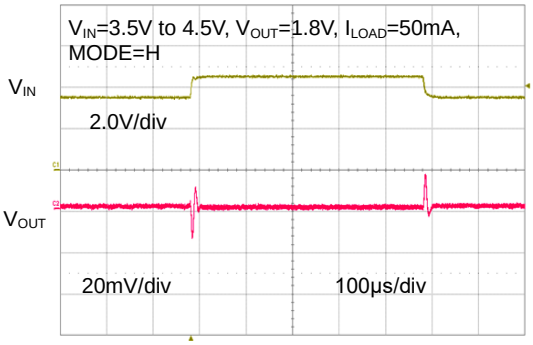
Load Transient Response



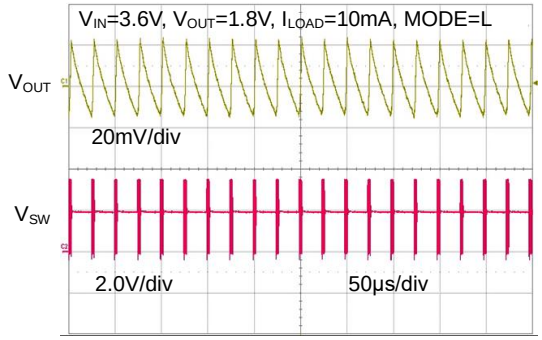
Line Transient Response



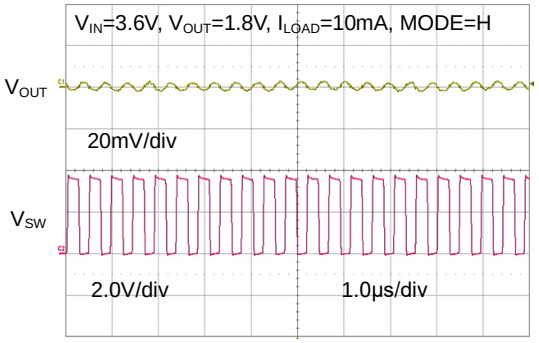
Line Transient Response



PFM Mode Operation



PWM Mode Operation



Application Information

Output Voltage Setting

The output voltage can be caculated according to the formula below with an internal reference volatge V_{REF} typical 0.6V:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R1}{R2}\right)$$

To minimize the current through the feedback divider network, the recommended value of R2 is about 180kΩ. The sum of R1 and R2 should not exceed about 1MΩ to keep the network robust against noise. An external feed forward capacitor C1 is required for optimum load transient response. The value of C1 should be in the range between 10pF and 33pF.
Route the FB line away from noise sources, such as the inductor or the SW line.

Inductor Selection

A 1μH to 10μH inductor with DC current rating at least 25% higher than the maximum load current is recommended for most applications. For best efficiency, the inductor DC resistance shall be <200mΩ.
For most designs, the inductance value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where ΔI_L is the inductor ripple current. Choose inductor ripple current approximately 30% of the maximum load current, 1000mA.
The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

The following table is a list of recommended inductors.

List of Recommended Inductors

Dimension [mm³]	Inductor Type	Supplier
4.5×4×3.2	744773022	Würth Elektronik
3×3×1.5	LQH3NPN2R2NM0	MURATA
3×3×1.5	LPS3015	Coilcraft

Input Capacitor Selection

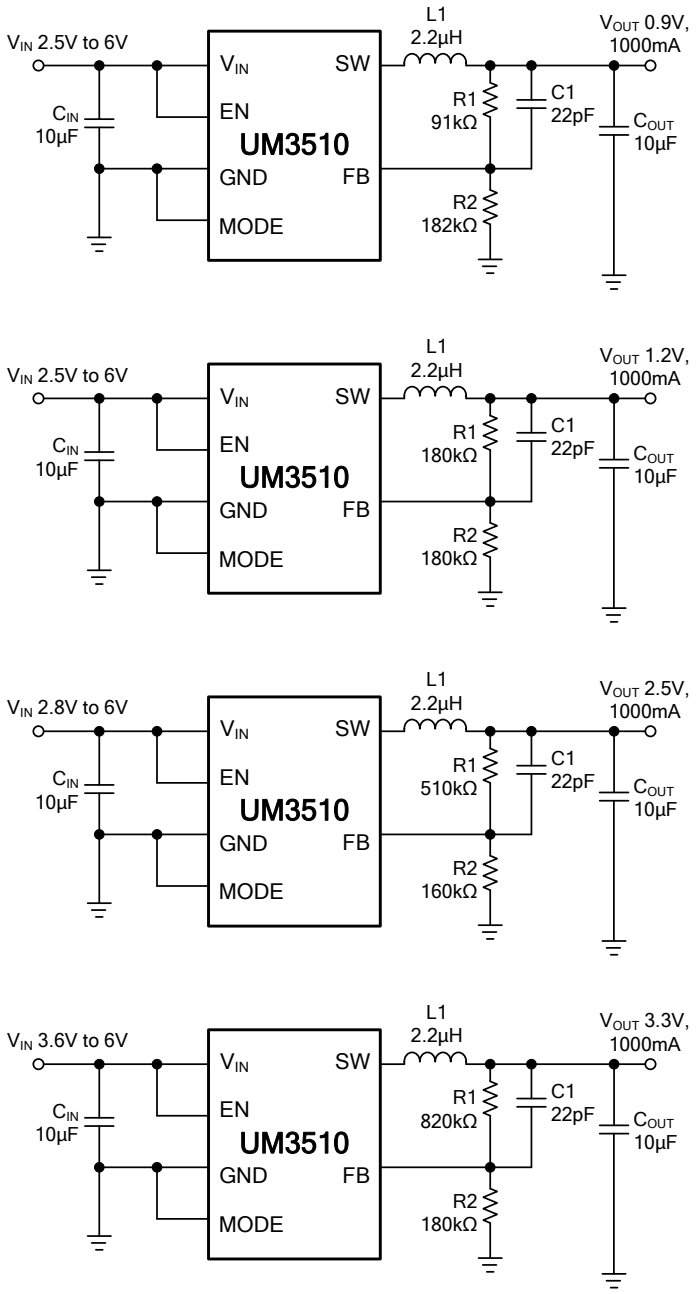
The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency shall be less than the input source impedance to prevent high frequency switching current passing to the input. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. For most applications, a 10μF capacitor is sufficient. The input capacitor can be increased without any limit for better input voltage filtering.

Output Capacitor Selection

The output capacitor keeps output voltage ripple small and ensures regulation loop stable. The output capacitor impedance shall be low at the switching frequency. Ceramic capacitor with X5R or X7R dielectrics are recommended. The output ripple ΔV_{OUT} is approximately:

$$\Delta V_{OUT} \leq \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(ESR + \frac{1}{8 \times f_{OSC} \times C_{OUT}}\right)$$

Typical Application Circuit



Layout Guidance

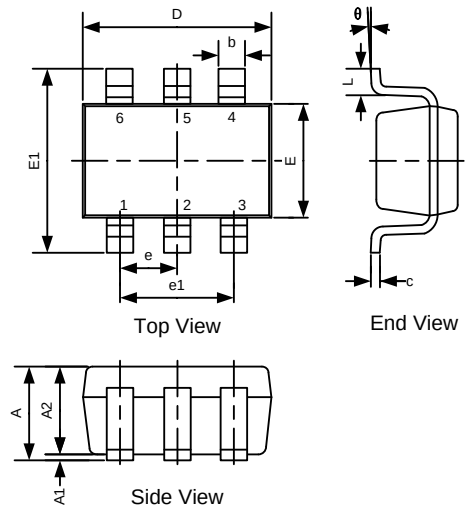
When laying out the PC board, the following suggestions should be taken to ensure proper operation of the UM3510.

1. The power traces, including the GND trace, the SW trace and the VIN trace should be kept short, direct and wide to allow large current flow.
2. Connect the input capacitor C_{IN} to the VIN pin as closely as possible to get good power filter effect.
3. Keep the switching node, SW, away from the sensitive FB node.
4. Do not trace signal line under inductor.

Package Information

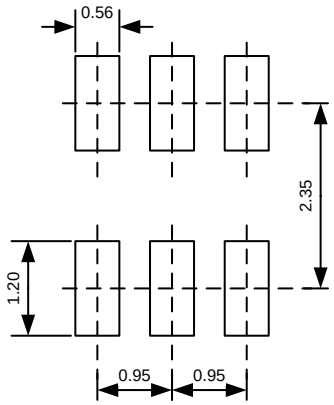
UM3510S: SOT23-6

Outline Drawing



DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	1.013	1.15	1.40	0.040	0.045	0.055
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	1.00	1.10	1.30	0.039	0.043	0.051
b	0.30	-	0.50	0.012	-	0.020
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.82	-	3.10	0.111	-	0.122
E	1.50	1.60	1.70	0.059	0.063	0.067
E1	2.60	2.80	3.00	0.102	0.110	0.118
e	0.95REF			0.037REF		
e1	1.90REF			0.075REF		
L	0.30	-	0.60	0.012	-	0.024
θ	0°	-	8°	0°	-	8°

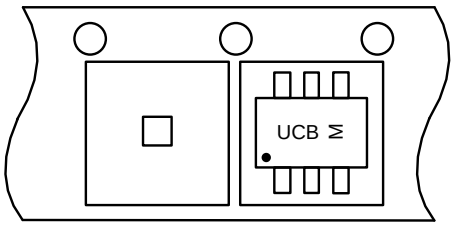
Land Pattern



NOTES:

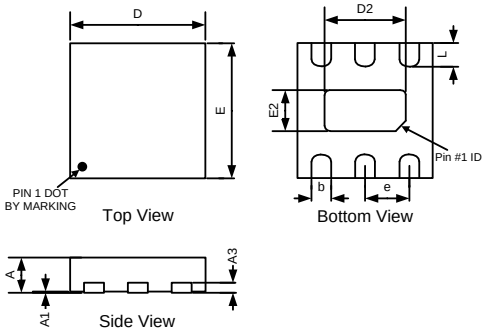
1. Compound dimension: 2.92×1.60；
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

Tape and Reel Orientation



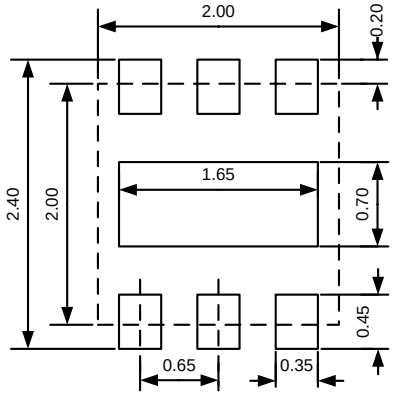
UM3510DA DFN6 2.0×2.0

Outline Drawing



DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	0.55	-	0.80	0.022	-	0.031
A1	0.00	-	0.05	0.000	-	0.002
A3	0.20REF			0.008REF		
b	0.25	0.30	0.35	0.010	0.012	0.014
D	1.924	2.00	2.076	0.076	0.079	0.082
D2	1.35	-	1.75	0.053	-	0.069
E	1.924	2.00	2.076	0.076	0.079	0.082
E2	0.65	-	1.06	0.026	-	0.042
e	0.65BSC			0.026BSC		
L	0.224	-	0.45	0.009	-	0.018

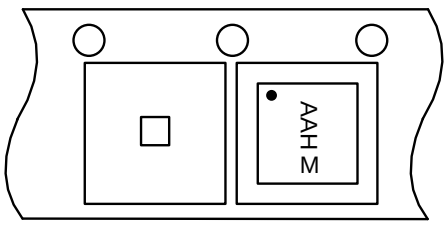
Land Pattern



NOTES:

1. Compound dimension: 2.00×2.00；
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

Tape and Reel Orientation



GREEN COMPLIANCE

Union Semiconductor is committed to environmental excellence in all aspects of its operations including meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.
All Union components are compliant with the RoHS directive, which helps to support customers in their compliance with environmental directives. For more green compliance information, please visit:
http://www.union-ic.com/index.aspx?cat_code=RoHSDeclaration

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