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Keywords: USB, buck-boost, SEPIC, usb powered, dsl modem supply

APPLICATION NOTE 1767

# USB-Powered DSL Modem Supply

Oct 21, 2002

*Abstract: The MAX1896, MAX1973, and MAX8863 combine to deliver 5V at 225mA, 1.8V at 220mA, and 3.3V at 60mA from a USB port. The schematics, BOM and performance data appear below.*

USB devices draw power from the USB port. The voltage is 4.5V to 5.25V and the current is limited initially to 100mA maximum. After enumeration, the current limit may be increased to 500mA maximum. Therefore, the practical power consumption is limited to about 2W at 4.5V. Switching power supplies are preferred so that this limited power can be fully utilized. The DSL frequency band extends to about 1.1MHz. To maintain maximum data throughput in DSL modems, the fundamental switching frequency should be 1.2MHz or higher.

The MAX1896, MAX1973, and MAX8863 combine to deliver 5V at 225mA, 1.8V at 220mA, and 3.3V at 60mA from a USB port. The schematics, BOM and performance data appear below. The MAX1896 is a step-up regulator configured as a SEPIC that switches at 1.4MHz. The MAX1973 is a step-down regulator that switches at 1.4MHz. The MAX8863 is a 100mA linear regulator. Each has a shutdown control to facilitate USB port enumeration and standby mode. The total input current required at 4.5V input to provide maximum output power is less than 491mA. The overall efficiency is 79.8% for 1.76W output at 4.5V input. The tallest component is the 3.3μH Sumida inductor at 1.8mm maximum.

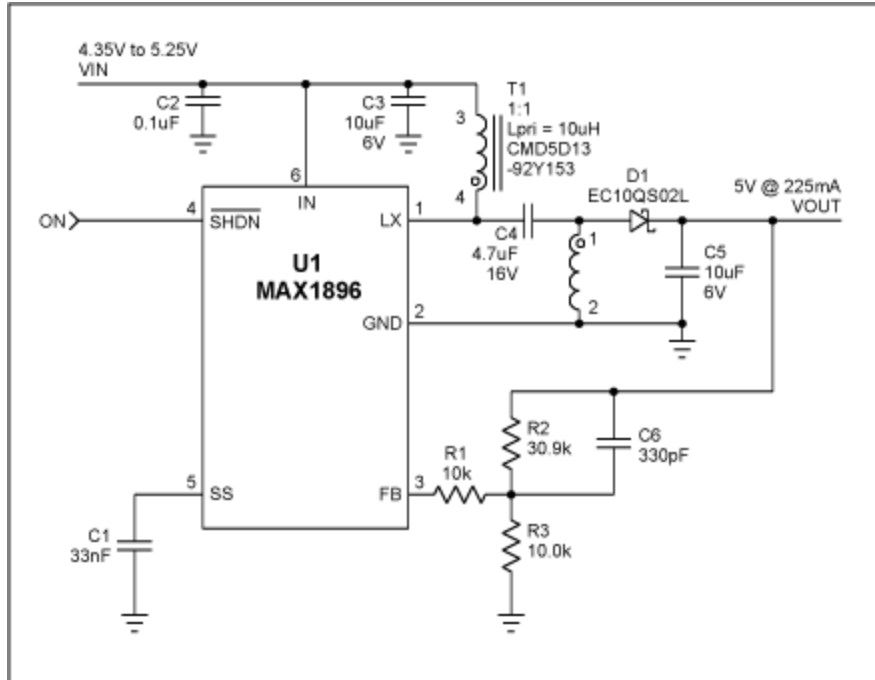


Figure 1. The MAX1896 schematic.

Table 1. The MAX1896 Performance Data

V <sub>IN</sub>	I <sub>IN</sub>	V <sub>OUT</sub>	I <sub>OUT</sub>	Efficiency
5.0028	520µA	5.0523	0	
4.3429	0.342	5.0511	0.2302	0.783
4.4928	0.328	5.0503	0.2302	0.789
5.0094	0.289	5.0468	0.2302	0.802
5.2508	0.275	5.0449	0.2302	0.804
		25mV <sub>P-P</sub>		

The MAX1896 Bill of Materials (4.35V to 5.25V Input; 5V at 225mA Output)

Designation	QTY	Description
C1	1	33nF ceramic capacitor (0603)
C2	1	0.1µF 16V X7R ceramic capacitor (0603) Taiyo Yuden EMK107BJ104KA
C3, C5	2	10µF 6V X5R ceramic capacitor (1206) Taiyo Yuden JMK316BJ106ML
C4	1	4.7µF 16V X5R ceramic capacitor (1206) Taiyo Yuden EMK316BJ475ML
C6	1	330pF ceramic capacitor (0603)
R1	1	10kΩ 5% resistor (0603)
R2	1	30.9kΩ 1% resistor (0603)
R3	1	10.0kΩ 1% resistor (0603)

T1	1	1:1 Power transformer Lpri = 10μH Sumida CMD5D13-92Y153
U1	1	MAX1896EUT (6-SOT23)

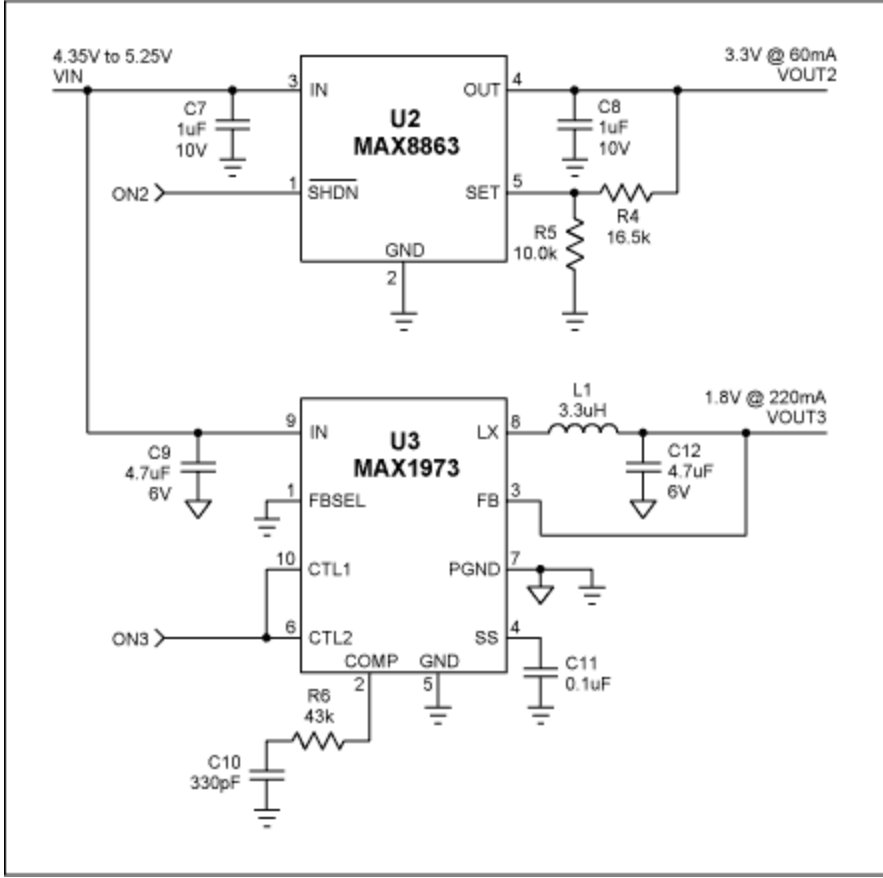


Figure 2. The MAX1973 and MAX8863 schematic.

Table 2. The MAX1973 Performance Data

V <sub>IN</sub>	I <sub>IN</sub>	V <sub>OUT</sub>	I <sub>OUT</sub>	Efficiency
5.0085	0.009	1.7938	0	
4.3306	0.105	1.7945	0.2236	0.882
4.4972	0.102	1.7945	0.2235	0.874
5.0066	0.094	1.7941	0.2236	0.852
5.2636	0.090	1.7936	0.2236	0.846
		30mV <sub>P-P</sub>		

The MAX1973 Bill of Materials (4.35V to 5.25V Input; 1.8V at 220mA Output)

Designation	QTY	Description
C7, C8	2	1μF 10V X7R ceramic capacitor (0805) Taiyo Yuden LMK212BJ105MG

C9, C12	2	4.7μF 6V X5R ceramic capacitor (0805) Taiyo Yuden JMK212BJ475MG
C10	1	330pF ceramic capacitor (0603) Murata GRM39C0G331J050AD
C11	1	0.1μF 16V X7R ceramic capacitor (0603) Taiyo Yuden EMK107BJ104KA
L1	1	3.3μH 1.1A Power inductor Sumida CDRH3D16-3R3
R4	1	16.5kΩ 1% resistor (0603)
R5	1	10.0kΩ 1% resistor (0603)
R6	1	43kΩ 5% resistor (0603)
U2	1	<b>MAX8863TEUK (5-SOT23-5)</b>
U3	1	<b>MAX1973EUB (10-μMAX®)</b>

**Table 3. The MAX8863 Performance Data**

V <sub>IN</sub>	I <sub>IN</sub>	V <sub>OUT</sub>	I <sub>OUT</sub>	Efficiency
5.0100	232μA	3.2947	0	
4.4919	0.061	3.2830	0.0604	0.724
5.0021	0.061	3.2821	0.0604	0.650
5.2558	0.061	3.2815	0.0604	0.618
		< 10mV <sub>P-P</sub>		

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#### Related Parts

<a href="#">MAX1896</a>	1.4MHz SOT23 Current-Mode Step-Up DC-DC Converter	
<a href="#">MAX1973</a>	Smallest 1A, 1.4MHz Step-Down Regulators	<a href="#">Free Samples</a>
<a href="#">MAX8863</a>	Low-Dropout, 120mA Linear Regulators	<a href="#">Free Samples</a>

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