Si9161 Optimized-Efficiency Boost Converter Demonstration Board

FEATURES

- Synchronous Boost Converter
- Voltage Mode Control
- Si9160 Architecture Optimized for “Light-Load” Efficiency
- High Frequency Switching (up to 2 MHz)
- Optimized Gate Drive Current (300 mA)
- Wide Bandwidth Feedback Amplifier
- Single-Cell Li+ and 3-Cell NiCd or NiMH Operation

DESCRIPTION

The Si9161 controller incorporates all the features of Siliconix’ Si9161 boost converter IC while adding a light-load optimized-efficiency feature. Targeting the RF power amplifier in CDMA and PCS handsets, the Si9161 is a fixed-frequency, pulsewidth-modulated power conversion controller. Two versions of the Si9161 demo board, using different LITTLE FOOT® power MOSFET package styles, are available: Si9161DB-68 uses a TSSOP-8 power MOSFET (Si6803DQ) for a peak drain current of 2 to 2.5 A, while Si9161DB-98 uses an SO-8 power MOSFET (Si9801DY) for a 3.8- to 4.5-A peak drain current.

The Si9161 demo board has been configured to generate a 5-V regulated output with an input range of 2.7 to 5 V. The output voltage set point can be adjusted easily by changing the value of R11 (see Figure 1) following the formula

$$R_{11} = \frac{(1.5)\,R_{10}}{V_O - 1.5}$$

Changing R10 will alter control loop compensation and is not recommended.

The Si9161’s LL pin does not affect circuit operation when connected to logic high. When it is low, the oscillator frequency is reduced and synchronous rectification is disabled to improve light load efficiency. This pin is pulled up to input voltage via a 100-kΩ resistor (R12) on the demo board. In PWM mode, the switching frequency is set at 1 MHz. However, by pulling down on this pin, the converter can be forced into pulse-skipping mode. Demo board efficiency has been tested for comparison purposes with the LL pin set both low and high. Light-load efficiency is improved significantly when the LL pin is grounded.

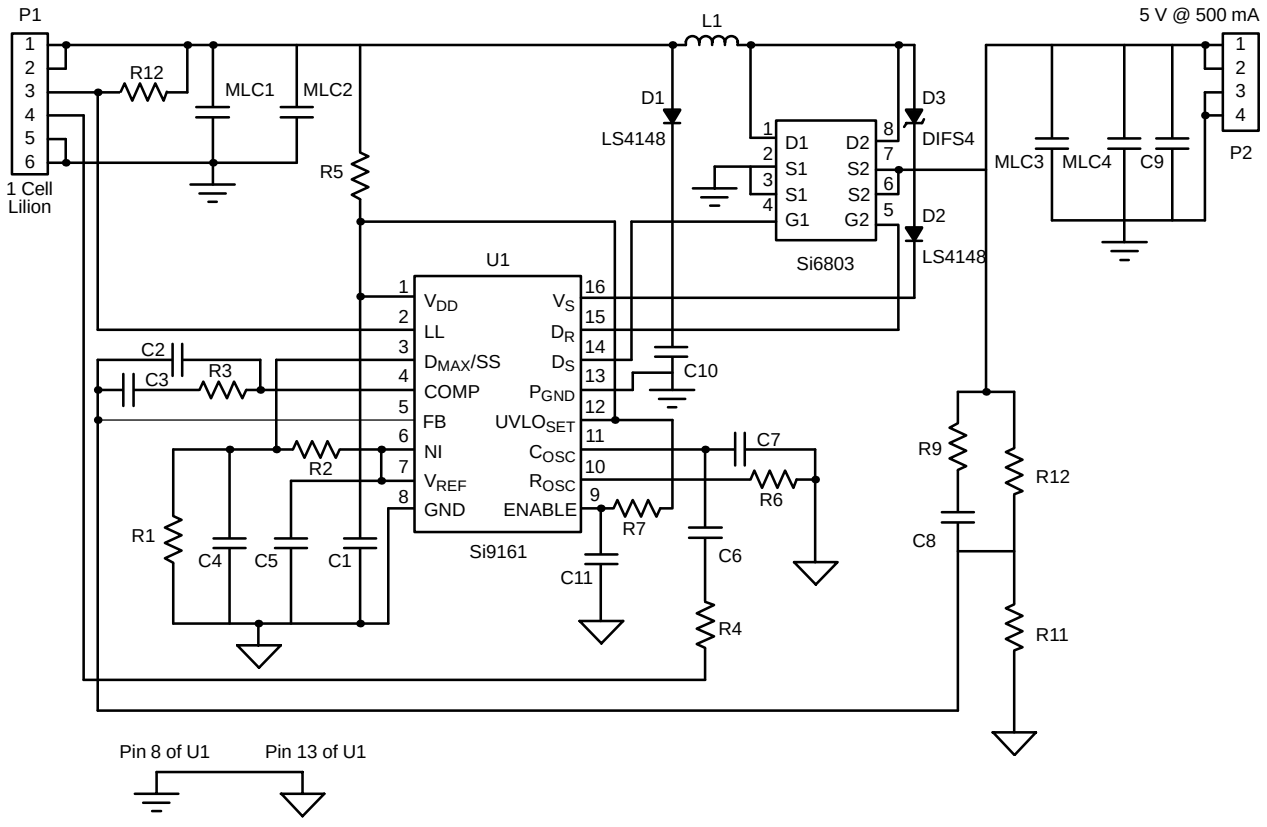
Included in this document are schematics (Figures 1 and 2), efficiency comparison plots (Figures 3 and 4), demo board sample waveform (Figure 5), PCB layout (Figures 6 through 11), and Bill-Of-Material (Table 1).

The demonstration board layout is available in Gerber file format. Please contact your Vishay Siliconix sales representative or distributor for a copy.

ORDERING INFORMATION: **Part Number Si9161DB**
-68: With Si6803
-98: With Si9801

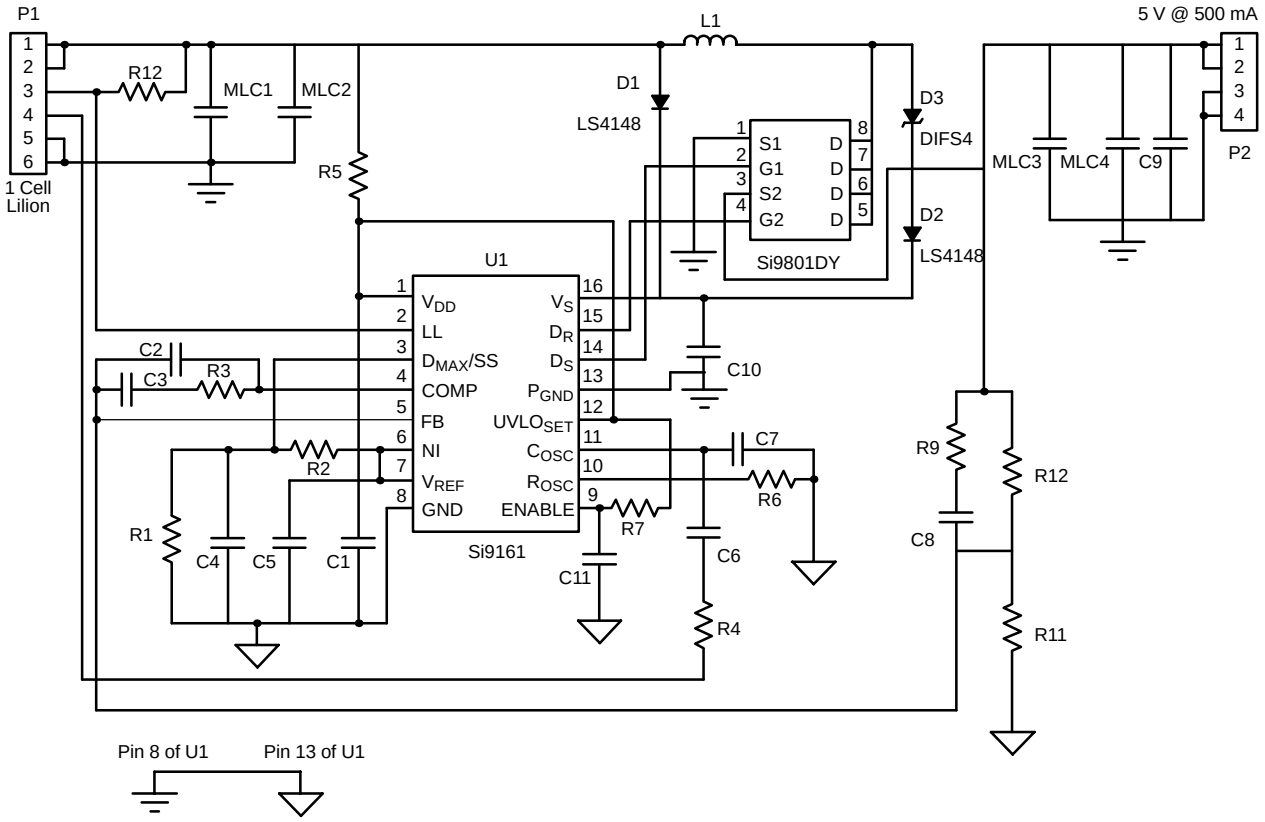
TEST SETUP AND OPERATION:

1. Attach an electronic load set to either resistive or current mode, to the output pins on the demo board. Set the current to any level between 0 and 0.5 A. Alternatively, use a resistor of value between 10 Ω and 1 MΩ. After the converter is powered up, output load current can be increased.
2. Attach a 2.7- to 5-V power supply, with at least 3-A current capability, to the input pins on the left side of the demo board.
3. Put an oscilloscope ground on the input ground, and the Ch-1 probe on pin 8 of Si6803/9801 (the MOSFET drain). Connect Ch-2 probe on pin 14 of Si9161 (Ds) and Ch-3 on pin 15 (DR). The waveform should appear approximately as shown in Figure 5.
4. To synchronize to external clock frequency, connect a square wave clock between pin 4 (sync) and ground pin on the input side, with pulse amplitude greater than 1.5 V.
5. The light-load efficiency can be improved by injecting a power management signal into pin 3 on the input side to override the default logic high signal.



Note: Do Not Leave LL pin (Pin 2 of U1) unconnected. Connect to GND or V_{DD}.

FIGURE 1. Schematic of Si9161DB With Si6803



Note: Do Not Leave LL pin (Pin 2 of U1) unconnected. Connect to GND or V_{DD}.

FIGURE 2. Schematic of Si9161DB With Si9801

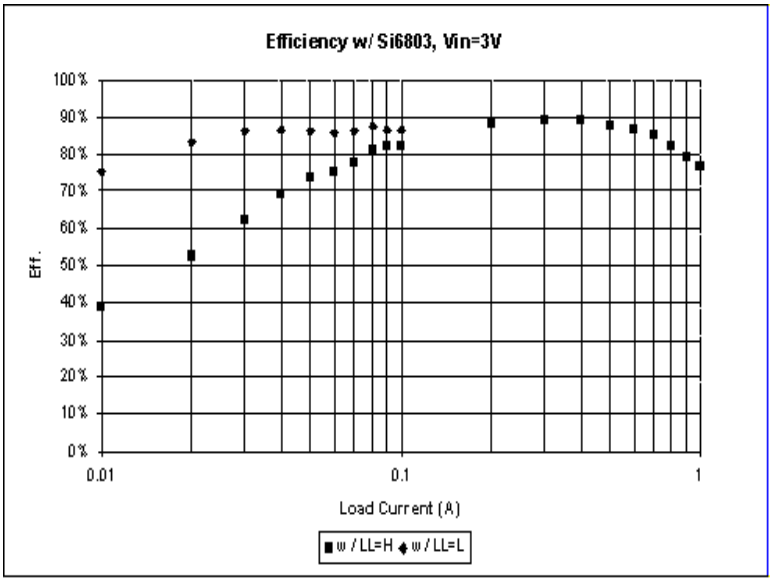


FIGURE 3. Si9161DB Efficiency Comparison With Si6803

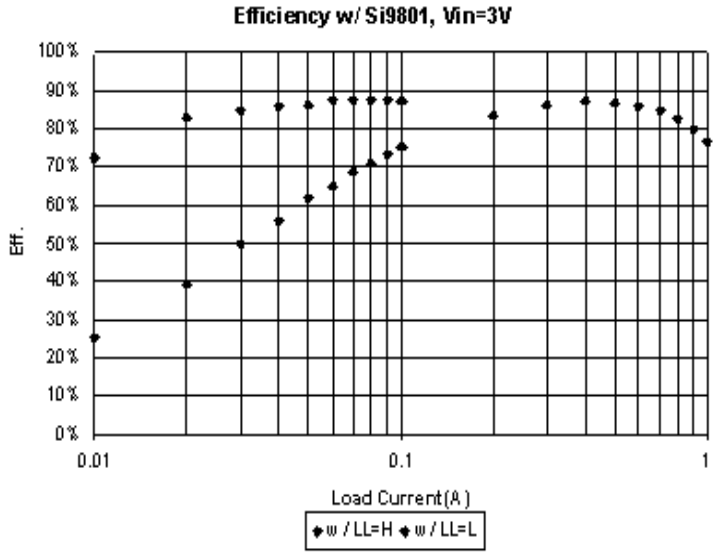
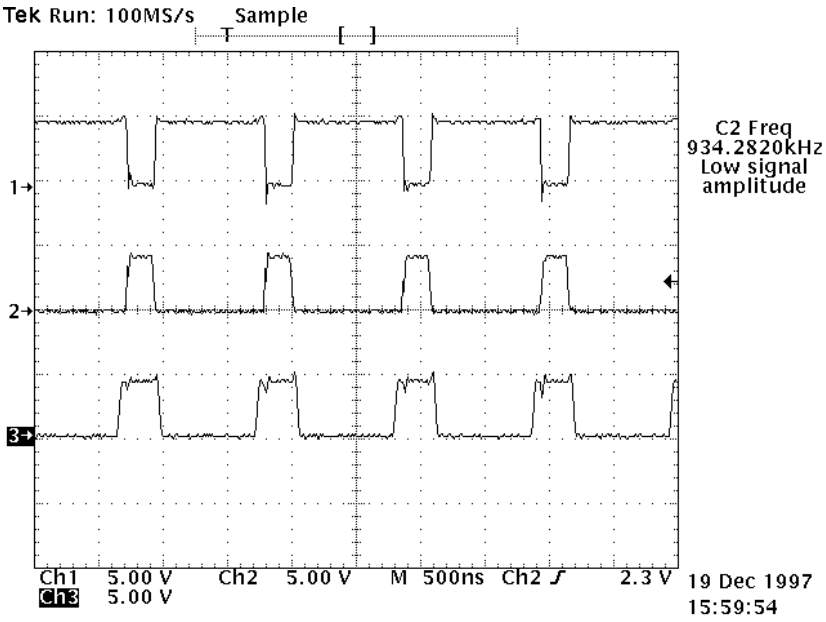


FIGURE 4. Si9161DB Efficiency Comparison With Si9801



Ch-1: Drain Voltage of MOSFET Pin 8
Ch-2: Low-Side Switch Drive (Si9161, Pin 14)
Ch-3: High-Side Switch Drive (Si9161, Pin 13)

FIGURE 5. Si9161DB Sample Waveform

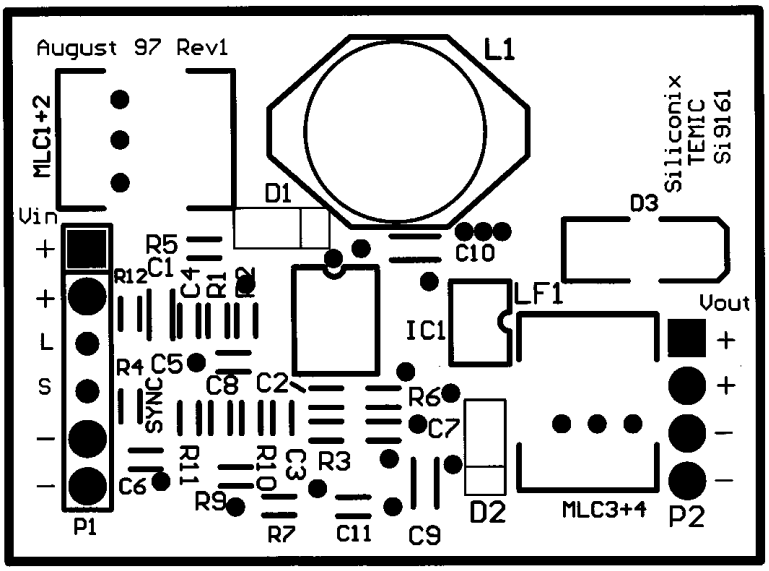


FIGURE 6. Si9161DB Silk Screen With Si6803

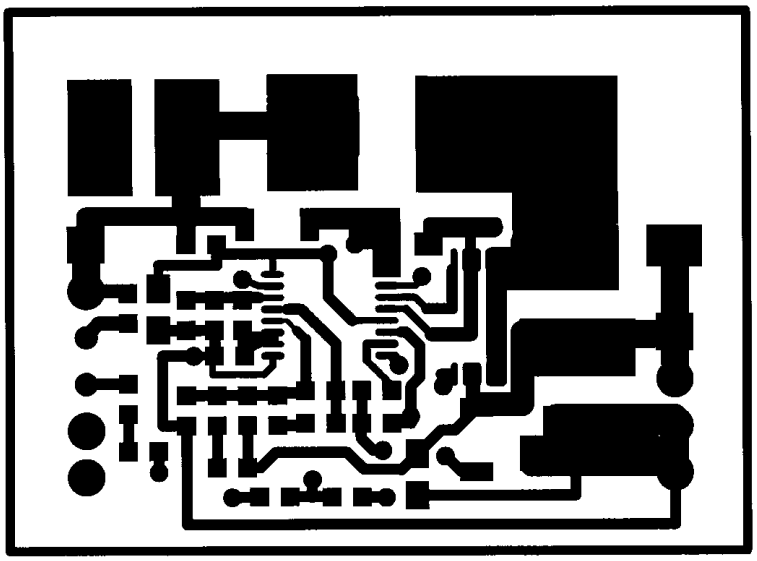


FIGURE 7. Si9161DB Top Layer With Si6803

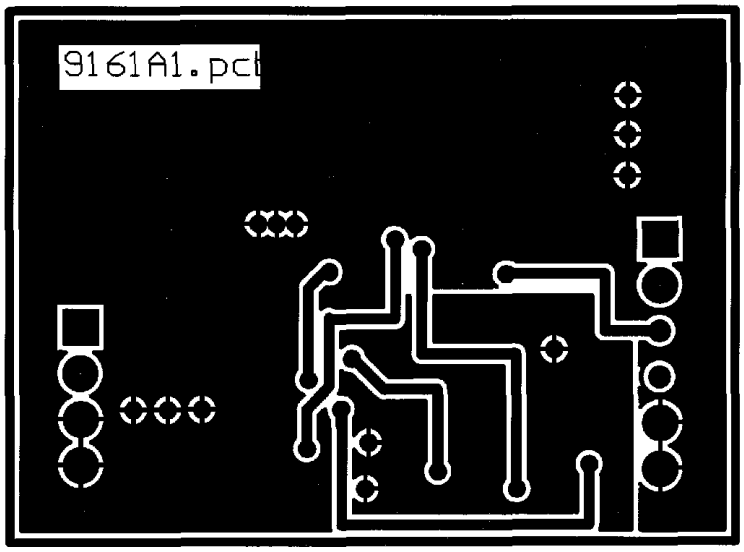


FIGURE 8. Si9161DB Bottom Layer With Si6803

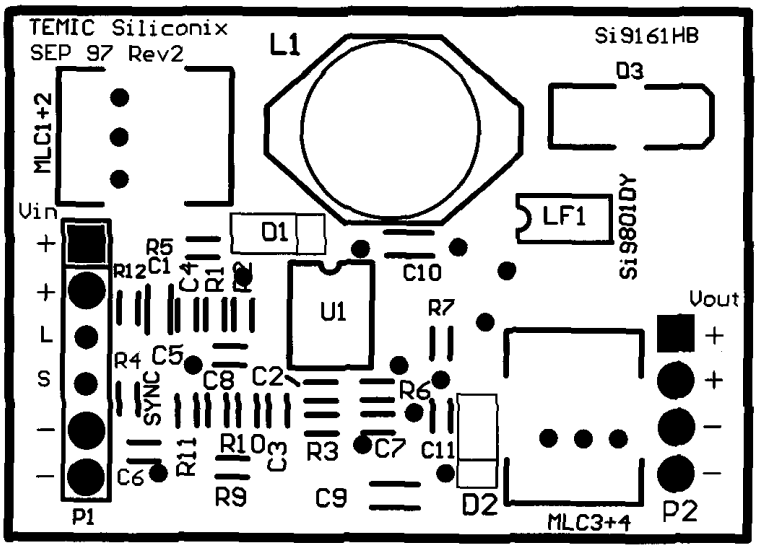


FIGURE 9. Si9161DB Silk Screen With Si9801

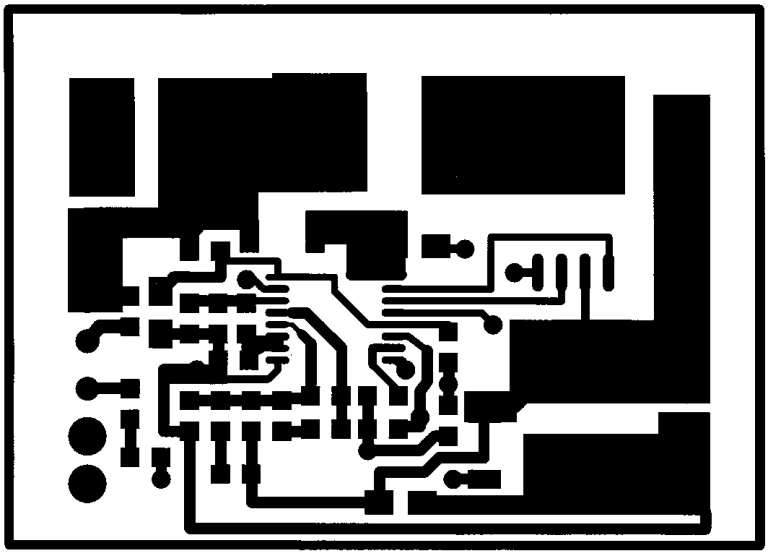


FIGURE 10. Si9161DB Top Layer With Si9801

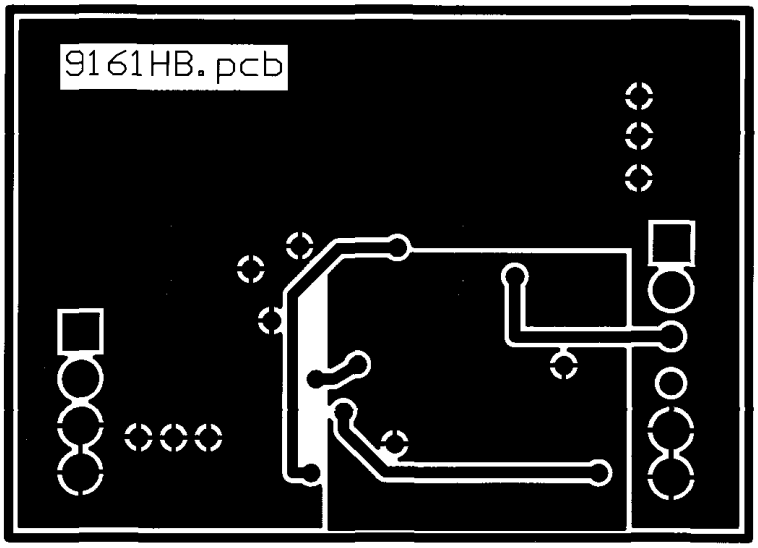


FIGURE 11. Si9161DB Bottom Layer With Si9801

TABLE 1. BILL-OF-MATERIAL

Item	Qty	Designators	Part Type	Description	Footprint	Part Number	Vendor
1	4	MLC1 + MLC2, MLC3 + MLC4	10 μF, 16 V		1210	GRM235Y5V106Z016AL	Murate
			10 μF, 16 V		1210	OR: 1210YG106ZAT	AVX
			10 μF, 25 V		1812	OR: C25Y5U1E106ZP	Tokin
2	6	C1, C4, C5, C9, C10, C11	100 nF	Capacitor	805	VJ0805104KXXAT	Vishay Vitramon
3	1	C2	0.039 μF	Capacitor	805	VJ0805393KXXAT	Vishay Vitramon
4	1	C3	Open	Capacitor	805	Open	
5	1	C6	22 pF	Capacitor	603	VJ0603220KXXAT	Vishay Vitramon
6	1	C7	56 pF	Capacitor	603	VJ0603560KXXAT	Vishay Vitramon
7	1	C8	Open	Capacitor	603	Open	
8	1	L1	10 μH	Inductors	DO3308	DO3308P-103	Coil Craft
9	1	LF1	MOSFET	Dual N- and P-Ch MOSFET	SO-8	Si9801	Vishay Siliconix
			MOSFET	Dual N- and P-Ch MOSFET	TSSOP-8	Si6803	Vishay Siliconix
10	1	D3	D1FS4	Diode, Shottky, 40 V, 1.1	4528	DIF4	Shindengen
11	2	D1, D2	LS4148	Diode	LS4148	LS4148	Multi-Source
12	3	R1, R7, R12	100 kΩ	Resistor	603	CRW06031003FRT1	Vishay Dale
13	1	R2	10 kΩ	Resistor	603	CRW06031002FRT1	Vishay Dale
14	1	R3	Open	Resistor	603		
15	1	R4	2.2 kΩ	Resistor	603	CRW06032201FRT1	Vishay Dale
16	1	R5	100 Ω	Resistor	603	CRW06031000FRT1	Vishay Dale
17	1	R6	12 kΩ	Resistor	603	CRW06031202FRT1	Vishay Dale
18	1	R9	Open	Resistor	603		
19	1	R10	35 kΩ	Resistor	603	CRW06033502FRT1	Vishay Dale
20	1	R11	15.4 kΩ	Resistor	603	CRW06031542FRT1	Vishay Dale
21	1	P1	1-Cell Lilon	6-Pin Headers	SIP6	SIP6	Multi-Source
22	1	P2	6 V @500 m	4-Pin Headers	SIP4	SIP4	Multi-Source
23	1	U1	Switches	Boost Converter	TSSOP-16	Si9161	Vishay Siliconix