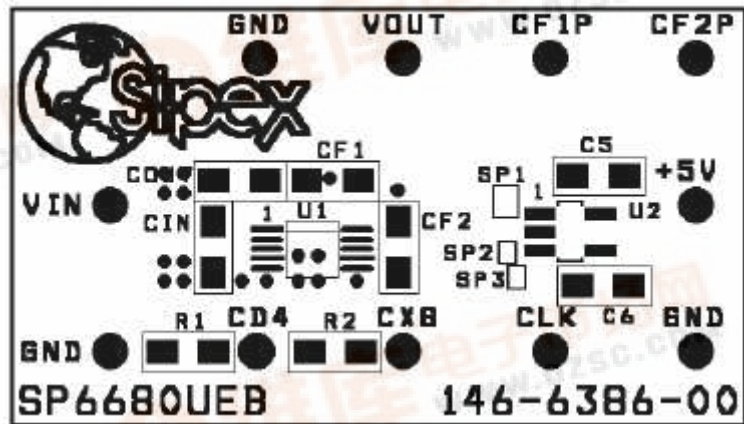




## SP6680 Evaluation Board Manual

- Easy Evaluation for the SP6680 Li-Ion Battery to 5V Inductorless Converter
- Ideal for SIMM Card Power Supply Applications in Cellular Phones
- High Efficiency: 80 to 95% with Li-Ion Battery
- $\mu$ SOIC Package & SMT components for small, low profile Power Supply



### DESCRIPTION

The **SP6680 Evaluation Board** is designed to help the user evaluate the performance of the SP6680 for use as a single Li-Ion battery input to +5V output DC-DC Converter. The SP6680 operates from 2.7V to 6.3V input, with the highest efficiency in the range 3.0V to 4.2V where the Li-Ion battery has the most energy. The SP6680UEB evaluation board is a complete power supply circuit with +5V LDO Regulator to provide ease of use to evaluate system DC/DC Converter performance.

The evaluation board is a completely assembled and tested surface mount board which provides easy probe access points to all SP6680 Inputs and Outputs so that the user can quickly connect and measure electrical characteristics and waveforms.

The next two sections describe the SP6680 Board Layout and Using the SP6680 Evaluation Boards. A table of SP6680 Pin Assignments is also included with details on input/output pin function. A SP6680 Evaluation Board List of Materials table is provided with some manufacturers part numbers to use as a reference. Finally, a schematic and drawings of the PC Layout are included as a design-in tool for the user of the SP6680.

### BOARD LAYOUT

The **SP6680 Evaluation Board** has been designed for easy and convenient access to all Inputs and Outputs of the SP6680 device under test. Position the board with the silkscreen lettering upright, (also see the drawing on the front page of this manual) and you will see the SP6680  $\mu$ SOIC, labeled U1 in the left center of the board, and surrounding it the Capacitors Cin, CF1, CF2 and Cout forming the switched capacitor DC-DC Converter circuit. On the right is U2, the LDO, in a small SOT23-5 package providing a low-noise, regulated +5V output.



The SP6680 Evaluation Board provides convenient test points to connect the input to Power Supply or Li-Ion Battery. The Input and Output connections are made with raised female pin receptacles which can accommodate easy-hook connection leads for power and meter connections, as well as scope probe hooks and grounds for waveform measurements.

## USING THE EVALUATION BOARD

### 1) Powering Up the SP6680 Circuit

The SP6680 Evaluation Board can be powered from a single Li-Ion battery or a +2.7 to +6.3V power supply. Connect with short leads directly to the “Vin” and “Gnd” posts. Note the SP6680 will remain in “shutdown” until a Clock input is applied to the “CLK” input post.

### 2) Enabling the SP6680 Output with CLK Input

The SP6680 output will typically be in low current “shutdown” mode until a Clock Input is applied to the “CLK” post. This input typically is a CMOS level 32.768kHz clock derived from a real-time clock crystal, but any stable square wave function generator with a  $V_{IL} < 0.4V$  and  $V_{IH} > 1.3V$  will do. You can now measure the SP6680 pre-regulated output of 5.2V to 6.3V with a voltmeter or scope across the “Vout” and “Gnd” posts.

### 3) Controlling the Pump Frequency

The SP6680 has 3 frequency modes controlled by the presence of a 32.768kHz Clock at “CLK” input, and levels at the digital inputs at posts “CD4” or “CX8”. Basically, the SP6680 will pump at the 32.768kHz Clock input frequency unless a High level is present at CD4 or CX8, as illustrated in the Pump Frequency Control table below.

Apply Logic High to “CD4” post and the SP6680 will pump at  $\frac{1}{4}$  frequency or 8.192kHz. Or, apply a Logic High to “CX8” post and the SP6680 will pump at 8 times the Clock frequency or 262.14kHz. Observe the pump frequency by applying a scope probe to CF2P post.

**TABLE1: PUMP FREQUENCY CONTROL**

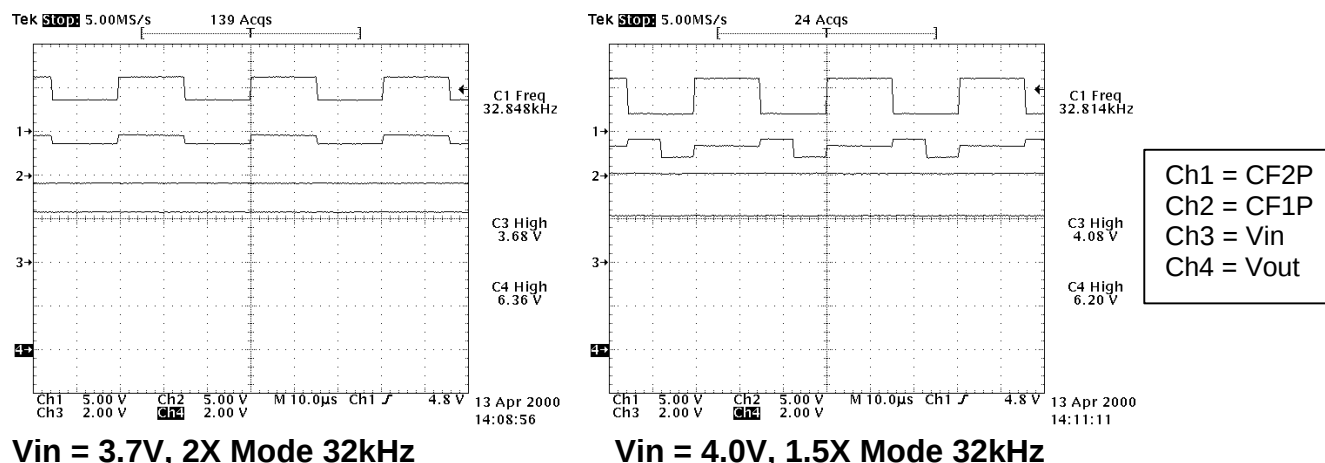
| CLK pin     | CD4  | CX8  | Fpump Frequency | Maximum Output |
|-------------|------|------|-----------------|----------------|
| not present | X    | X    | 0               | 0              |
| 32.768kHz   | Low  | Low  | 32.768kHz       | 20mA           |
| 32.768kHz   | Low  | High | 262.14kHz       | 60mA           |
| 32.768kHz   | High | Low  | 8.192kHz        | 2mA            |
| 32.768kHz   | High | High | 262.14kHz       | 60mA           |

As you can see from the table, as pump frequency increases, the capability of the SP6680 maximum output current increases (and quiescent current will rise). See the SP6680 datasheet specification table to compare how the Output Resistance, Output Voltage and Power Efficiency parameters vary with Pump Frequency.

### 4) Dynamic Charge Pump Action

The charge pump configuration dynamically changes to optimize efficiency. At low input voltages the charge pump doubles the input, while at higher inputs the output is 1.5 times the input. You can observe this action by monitoring how the output voltage

changes with input changes. Also, you can see these mode changes by attaching a scope probe to the “CF1P” post and observe how the pump waveform changes from the 2X mode to the 1.5X mode, as shown in the scope traces shown below. As seen in the datasheet specification for Power Efficiency, by dynamically changing modes with input voltages the SP6680 optimizes power efficiency.



**TABLE2: SP6680UEB PIN ASSIGNMENTS**

| Pin No.                               | Pin Name | Pin Function                | Input/Output Pin Name |
|---------------------------------------|----------|-----------------------------|-----------------------|
| <b>U1 - SP6680UEB Pin Assignments</b> |          |                             |                       |
| 1                                     | VOUT     | PreRegulated 5.2 to 6.3Vout | VOUT                  |
| 2                                     | CFIP     | Fly Capacitor One Positive  | CFIP                  |
| 3                                     | VIN      | Input Voltage               | VIN                   |
| 4                                     | CD4      | Digital Input for CLK/4     | CD4                   |
| 5                                     | CX8      | Digital Input for CLK*8     | CX8                   |
| 6                                     | CLK      | Clock Input                 | CLK                   |
| 7                                     | CF2N     | Fly Capacitor Two Negative  |                       |
| 8                                     | GND      | Ground                      | GND                   |
| 9                                     | CF1N     | Fly Capacitor One Negative  |                       |
| 10                                    | CF2P     | Fly Capacitor Two Positive  | CF2P                  |
| <b>U2 - SP6200EM5 Pin Assignments</b> |          |                             |                       |
| 1                                     | VIN      | LDO Input                   |                       |
| 2                                     | GND      | Ground                      | GND                   |
| 3                                     | ON/OFF N | ON = H or Shutdown =L       |                       |
| 4                                     | N/C      | No Connect                  |                       |
| 5                                     | VOUT     | +5V Output                  | +5V                   |

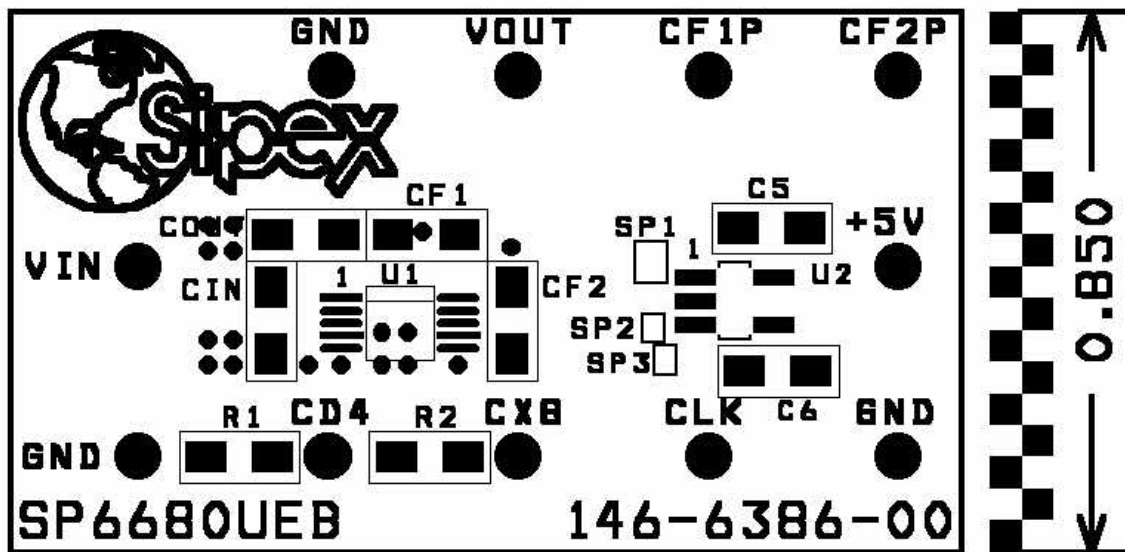


FIGURE 1: SP6680UEB COMPONENT PLACEMENT

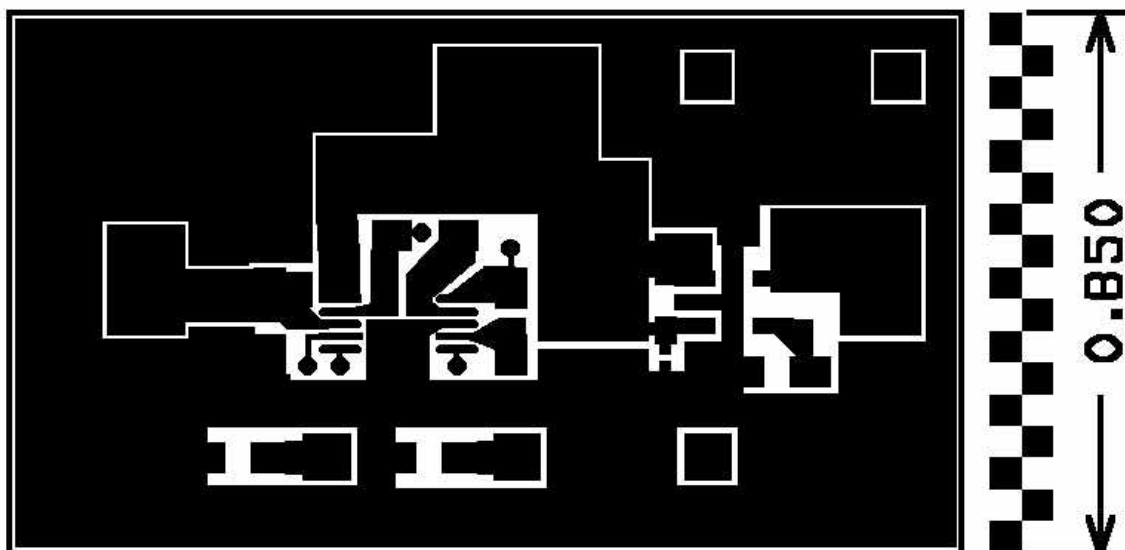


FIGURE 2: SP6680UEB PC LAYOUT TOP SIDE

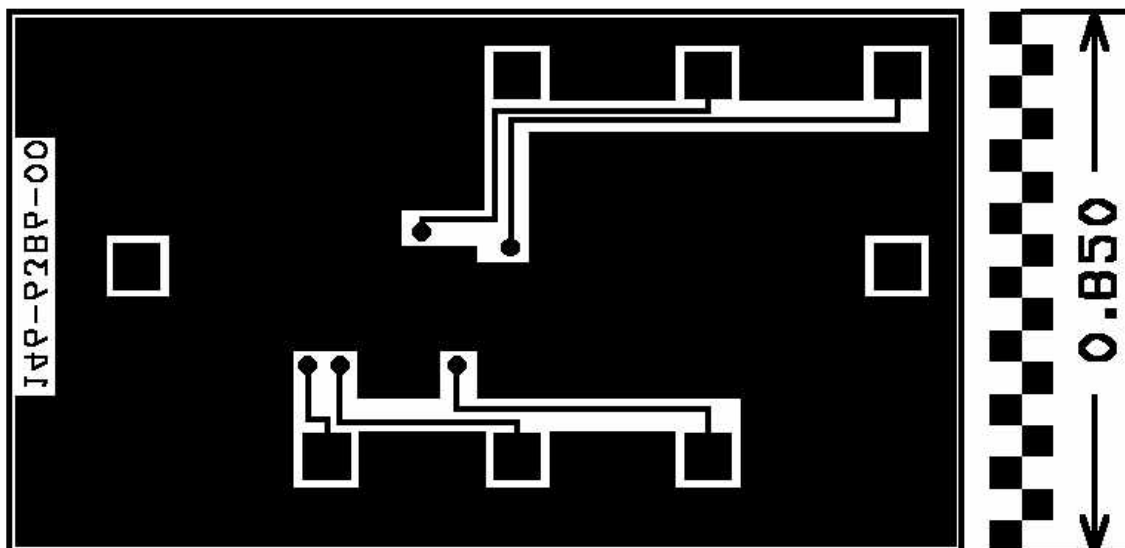


FIGURE 3: SP6680UEB PC LAYOUT BOTTOM SIDE

SP6680 EVALUATION BOARD SCHEMATIC

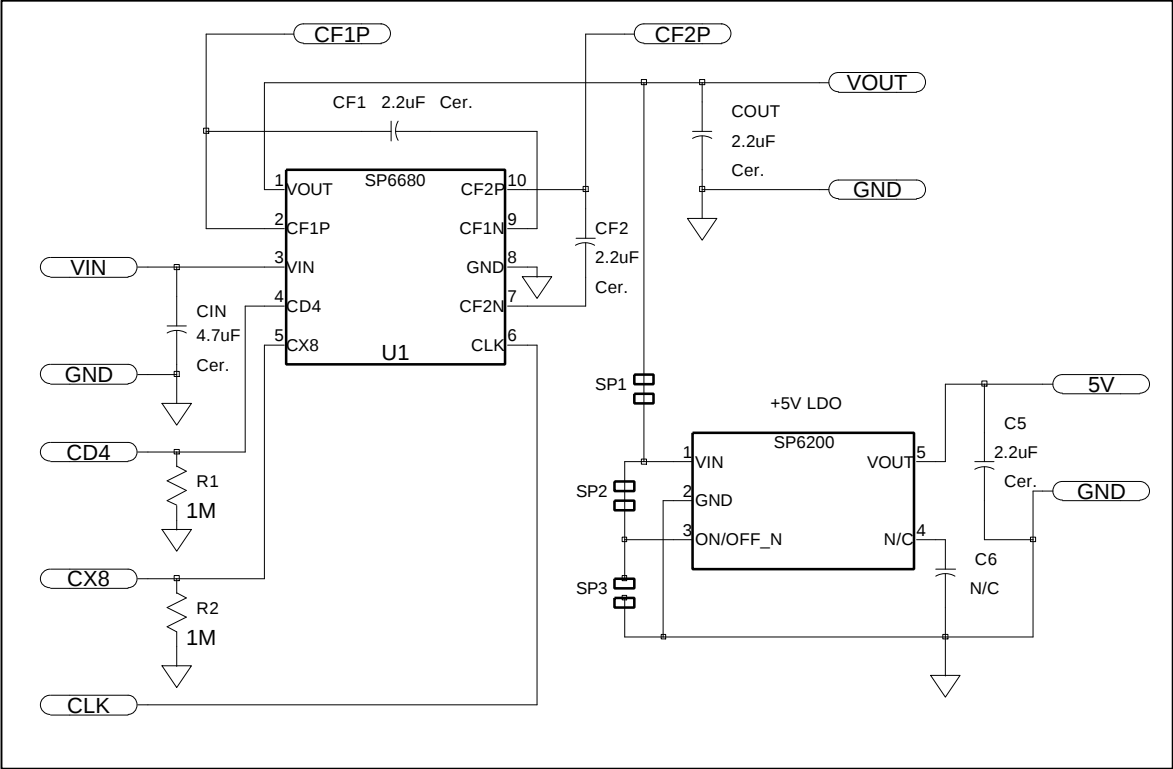


TABLE3: SP6680EB LIST OF MATERIALS

| Ref.            | Qty. | Manuf.    | Manuf.            | Layout    | Component             | Vendor       |
|-----------------|------|-----------|-------------------|-----------|-----------------------|--------------|
| Des.            |      |           | Part Number       | Size      |                       | Phone Number |
| PCB             | 1    | Sipex     | 146-6386-00       | .85"x1.5" | SP6680 Eval PCB       | 978-667-7800 |
| U1              | 1    | Sipex     | SP6680EU          | uSO-10    | 5V Reg. Charge Pump   | 978-667-7800 |
| U2              | 1    | Sipex     | SP6200EM5-5.0     | SOT23-5   | 5V LDO Regulator      | 978-667-7800 |
| Cout,Cf1,Cf2,C5 | 4    | TDK       | C2012X5R1A225K    | 0805 SM   | 2.2uF 10V SM X5R      | 847-803-6100 |
| Cin             | 1    | TDK       | C3216X5R1C475K    | 1206 SM   | 4.7uF 10V SM X5R      | 847-803-6100 |
| C6              | 0    |           |                   |           | No Connection         |              |
| R1,2            | 2    | Panasonic | ERJ-8GEYJ105      | 1206 SM   | 1M Thick Film Res 5%  | 800-344-4539 |
| TP              | 11   | Mill-Max  | 3137-3002-10-0080 | .042 Dia  | Test Point Female Pin | 800-344-4539 |

ORDERING INFORMATION

| Model           | Temperature Range   | Package Type            |
|-----------------|---------------------|-------------------------|
| SP6680UEB ..... |                     | SP6680 Evaluation Board |
| SP6680EU.....   | -40°C to +85°C..... | 10-pin $\mu$ SOIC       |