Solar Technology for OEM Applications

The C&C Signal Advantage for OEMs

C&C Signal has achieved a breakthrough in the harvesting of solar energy for small devices. Small-scale solar energy (<10W) devices have been plagued by inefficient and unreliable operation. C&C Signal has developed a Patent Pending method to precisely and effectively squeeze the maximum amount of energy out of small solar energy systems. The C&C method allows for the use of single 0.5V cells as energy sources while other methods require expensive cutting and reconnecting cells in order to raise the input voltage. The C&C method is embodied in the C&C Solar Converter (CCSC). The CCSC uses a unique PWM/PFM regulation method to extract energy from the solar cells at their Maximum Power Point, even at input voltages as low as 300mV.

Fig 1. A single 7A solar cell is efficient and produces 3.5W at 500mV. This cell can be used as-is, without cutting and stacking..

The Maximum Power Point (MPP)

Small solar devices have a reputation for unreliable, weak operation because the output of solar cells is poorly matched to the recharge cycle of storage batteries. Figure 2 shows the output characteristics of a typical cell rated for 1.3A at 500mV, or a total of 650mW. A typical Lithium battery takes in about 90% of its charge energy from 3.20V to 3.35V, but the charge cycle starts at 2.5V and ends at 4.0V. The way this problem is addressed in small inexpensive systems is to size the output of a series connected group of solar cells to somewhere in the middle of the charge cycle, i.e. 3.5V. To make a 3.5V stack of cells, 7 would have to be connected in series. A dead battery would start its charge cycle at 2.5V, where each solar cell is contributing 350mV. At 350mV the cell is still producing 1.3A for a total of 450mW. The cell efficiency is therefore reduced to 70% of normal. When the batteries become fully charged the voltage will approach 4.0V, or 570mV per solar cell. At this voltage the output current of the solar cell is 0, so the efficiency is 0%. One could increase the number of cells to 8 to increase the output per cell would be 0.5V, but then the output at low battery would be only 310mV, or 62% efficiency. The better solution is to operate the solar cells at 100% efficiency, at the MPP all the time, regardless of the battery voltage.

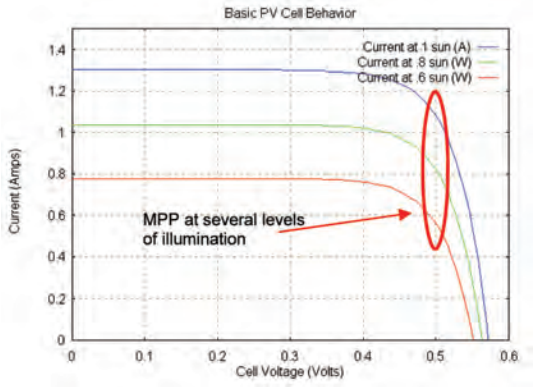

Fig 2. A solar cell produces its maximum output at only one combination of voltage and current. Other combinations result is low efficiency and poor performance.

The C&C Signal Method

The C&C Solar Converter (CCSC) uses a synchronous boost topology to efficiently convert the 500mV solar input to whatever the battery charge algorithm calls for.
The proprietary circuit also isolates the battery from the input when no solar energy is available. In older solar technologies the battery isolation function is typically accomplished with a Schottky diode which is very inefficient. This diode alone can absorb 14% of the solar cell output at low battery.

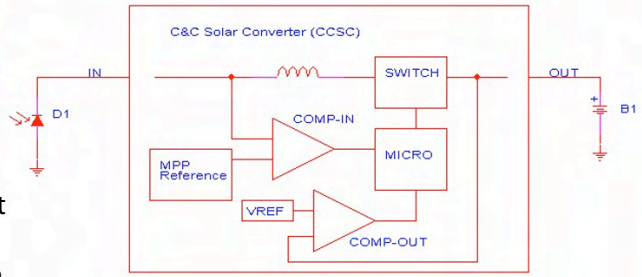

Fig 3. The CCSC uses an intelligent control algorithm, using a combination of PWM/PFM techniques, to regulate the output of the solar cell to its MPP under all conditions. The microcontroller in the CCSC has resources left over to provide load disconnect, efficient LED drive, and other functions at no additional cost.

The CCSC is compatible with Lithium Iron Phosphate, Lithium Ion, Lithium Polymer, NiCd, NIMH, or Pb-acid batteries. At the heart of the CCSC is a small, inexpensive microcontroller, which allows for easy changes to the configuration of the solar cell size and type, or easy changes to different battery size, voltage, and chemistries.

The CCSC Controller also controls the Depth of Discharge (DOD) of the batteries. The DOD is a critical factor, which allows OEMs to trade battery capacity for service life. Figure 4 shows the relationship between DOD and charge/discharge cycle life for a typical Lithium battery. For example, limiting the battery discharge to 40% of total capacity yields a service life of 3000 cycles, or about 8 years of daily use.

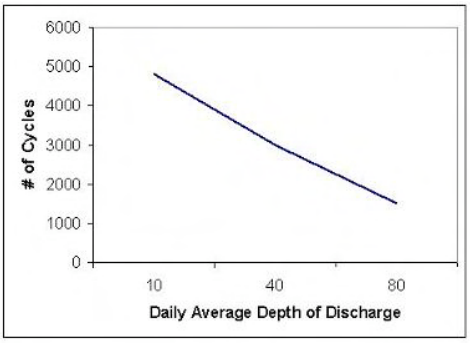

Fig 4. The CCSC controls the Depth of Discharge of the batteries to reliably extend the service life of the batteries as a tradeoff of battery size.

The microcontroller used in the CCSC is small and inexpensive, yet powerful enough to efficiently drive LEDs , low battery load disconnect, remote control, etc..

C&C OEM Partners

The CCSC is available as a complete product that we can help you finish, as a module, or as a pre-programmed microcontroller that you can easily and quickly integrate into your design. Adding solar input to your product has never been better or easier. If you're ready to step into solar, but you want low price and high efficiency then give us a call.