Design Note

SEPIC, Boost, Inverting, and Flyback Controller Solves the Voltage Drop Problem of High Impedance, Long Length Industrial Power Lines

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Introduction

The LT®8710 is a versatile DC/DC controller that supports boost, SEPIC, inverting, or flyback configurations, and is widely used in automotive and industrial systems. The LT8710 includes features that enable use in applications with high impedance power supplies, or where input current must be limited.[1] For example, long power lines in industrial plants and warehouses add significant input source resistance as well as a significant voltage drop from converter to load. This value can change as equipment is relocated, further complicating regulation. Solar panels also have a high impedance input, with a peak power output and a narrow voltage range. This design note demonstrates how the LT8710 can solve the problems of high impedance and current limited input sources, through the example of a lithium-ion battery charger.

Circuit Description and Functionality

Figure 1 shows a charger solution for a 20V lithium-ion battery, commonly used in portable power tools. The voltage source, V_{SRC}, is 24V via a high impedance power line, resistor R_{LN}, resulting in the voltage V_{IN} at the charger input terminals. The voltage source could be considered as a popular 12V solar panel with 22V to 24V open-circuit and 18V to 19V optimum operating voltage. The charger is based on a synchronous non-coupled SEPIC topology and controlled by the LT8710. The power train consists of discrete inductors L1, L2, transistors Q1, Q2, decoupling capacitors between the inductors, and input/output filters. Resistor R_{SC} sets 2A of charge current, I_{CHRG}; resistor $R_{V(FL)}$ sets the float voltage of 21V. The resistor divider R_{IN1}, R_{IN2} sets input voltage regulation level which is 18.6V in this example.

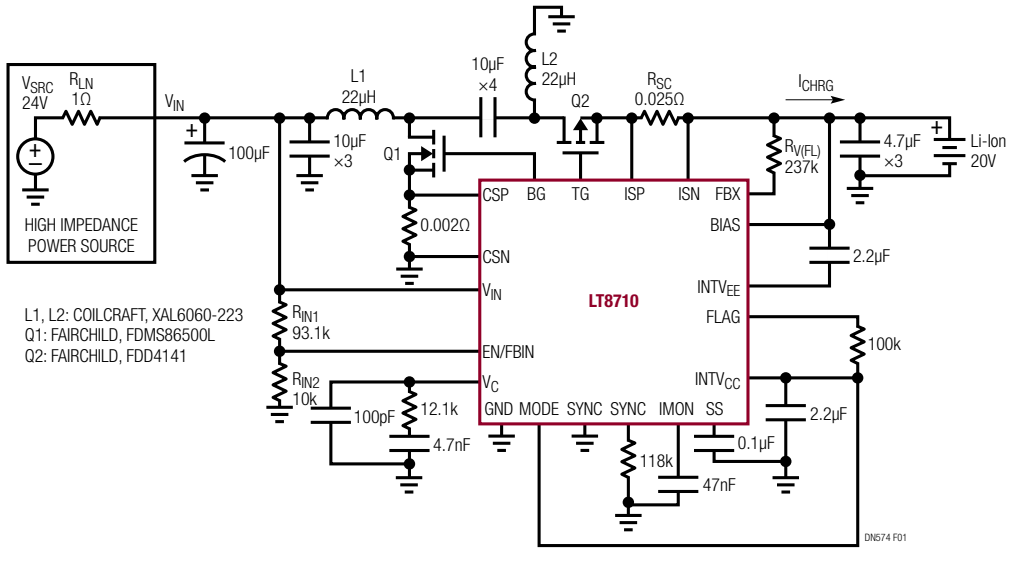

Figure 1. Electrical Schematic of LT8710 Li-Ion Battery Charger In High Impedance Input Lines

Figure 2 illustrates the functionality of the charging solution over time. When V_{IN} and power source voltage V_{SRC} are above 19V, the LT8710-based SEPIC charges the lithium-ion battery to the programmed 2A, I_{CHRG}. As V_{SRC} drops below 20V, the value of V_{IN} drops correspondingly. When V_{IN} reaches the input voltage regulation level, the LT8710 reduces the charging current, I_{CHRG}, to maintain V_{IN}, even as V_{SRC} continues to decline. The horizontal axis represents normalized time, which can be hours for a solar panel, or minutes, or seconds for power supplies in complex industrial systems.

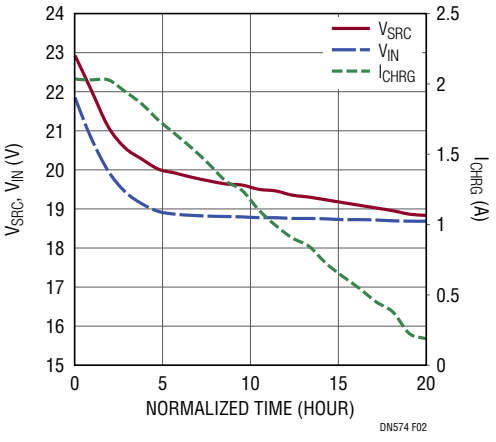

Figure 2. Graphs of Charging Current (I_{CHRG}) as a Function of the Voltages Power Supply (V_{SRC}) and Charger Input Terminals (V_{IN})

Another way to control the load for converters based on the LT8710's input current is to monitor voltage of the capacitor from the IMON pin. Select resistor R_{SC} to provide a voltage close to 50mV at the maximum current. A corresponding voltage is reflected across the IMON capacitor. If there is no current flow and the voltage across the ISP and ISN pins is zero, then the IMON voltage is approximately 0.616V. If the ISP–ISN voltage is 50mV, it reflects the IMON voltage as 1.213V. This feature, as well as many others, can be evaluated using our demonstration circuit DC2067A[2] and corresponding LTspice models[3].

Conclusion

The LT8710 is a versatile and flexible controller that supports synchronous SEPIC, boost, and inverting converter topologies. Along with a wide range of input voltages and switching frequencies, it includes advanced features, such as the ability to regulate the input voltage and output current based on input current or voltage. These features make the LT8710 ideal for industrial, solar panel systems and other current limited applications.

References

1. Data Sheet, *LT8710 Synchronous SEPIC/ Inverting/ Boost Controller with Output Current Control*. http://www.analog.com/LT8710
2. Demo Board, *DC2067A—LT8710EFE Inverting Demo Board | 4.5V ≤ VIN ≤ 28V; VOUT: –5V @ 6A* http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/dc2067a.html
3. Circuit Simulation, LTspice Models of the Converters Based on LT8710 www.analog.com/en/design-center/evaluation-hardware-and-software/lt-spice-demo-circuits.html

Data Sheet Download
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