

An Inexpensive Internet Accessible Instrumentation System Photovoltaic/Lithium-Ion Monitoring Example

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For \$70 a system was built to present real-time performance data on the internet via a web page (shown on the next page), which can be viewed on computers (PC or Macs) and hand-held devices such as iPhones and iPads.

The cost comprises \$40 for a *LabRecon* chip and software, \$10 for auxiliary parts, and a \$20 solar spotlight purchased from Home Depot.

LabRecon software was used to develop the graphical interface, design the circuitry, interface to the hardware, and generate/serve the web page. No other software was necessary.

A measurement circuit, based on a *LabRecon* chip, was built to monitor the voltage and current of both the polycrystalline photovoltaic (PV) panel and the lithium-ion (LiFePO₄) battery, the light intensity at both the PV panel and lamp LED, and the PV panel temperature. A solderless breadboard was used to facilitate construction and future modifications, such as accommodating larger PV systems.

A graphical interface was created to display the measured parameters, the calculated PV panel and battery power, PV panel and battery I/V (current/voltage) curves, and a strip chart to show historical data.

The software, available as a free download from www.LabRecon.com, allows others to customize their own graphical presentation and analysis by “tapping” into the source data stream over the internet as an alternative to the web page interface.



Figure 1: Hampton Bay Solar LED Spotlight with *LabRecon* chip and circuitry on solderless breadboard

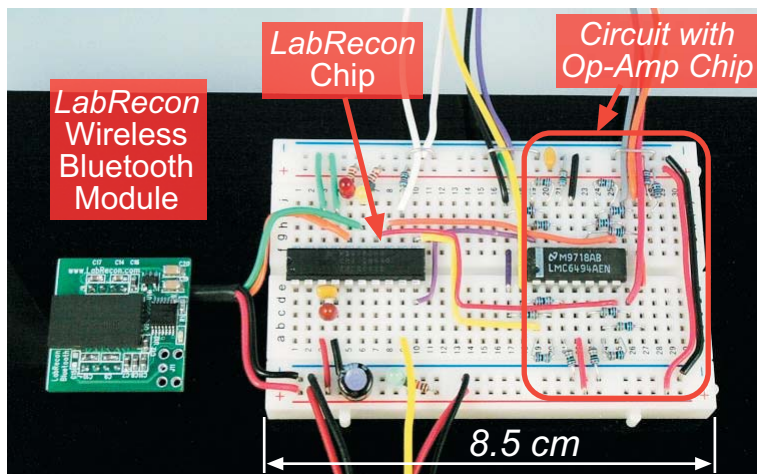


Figure 2: *LabRecon* chip and circuitry on solderless breadboard.

(A Bluetooth interface was not included in the system cost, but a RS-232 connection to the computer can be used instead.)

The *LabRecon* software and chip were developed to allow students and engineers to inexpensively and easily implement data acquisition and control systems with rich graphical interfaces.

The philosophy behind using *LabRecon* for educational experiments is to allow others to easily construct their own setups at a very low cost.

The software can also be used to create simulations of system dynamics and is available as a free download at www.LabRecon.com.

The below screen shot shows the graphical interface created by placing and customizing “objects” such as LED displays, gauges, X/Y charts, animations, and a strip chart. The interface can be as simple or complex as desired by the user and is easily modified to include additional measurements.

This interface appears on the user’s computer and the generated web page, which can be viewed by others over the internet.

The LabRecon software is free and can be downloaded and installed in less than 1 minute since it’s file size is only 1.7 Meg. This allows one to “share” the project with interested parties. A “remote” user can connect over the internet to the computer interfaced to the hardware, download the project (interface and functionality), and make modifications to create their desired customized analysis and presentation of the data stream.

PV panel power, voltage, and current

battery power, voltage, and current



Figure 3: LabRecon screen shot including strip chart view of 48 hour time span

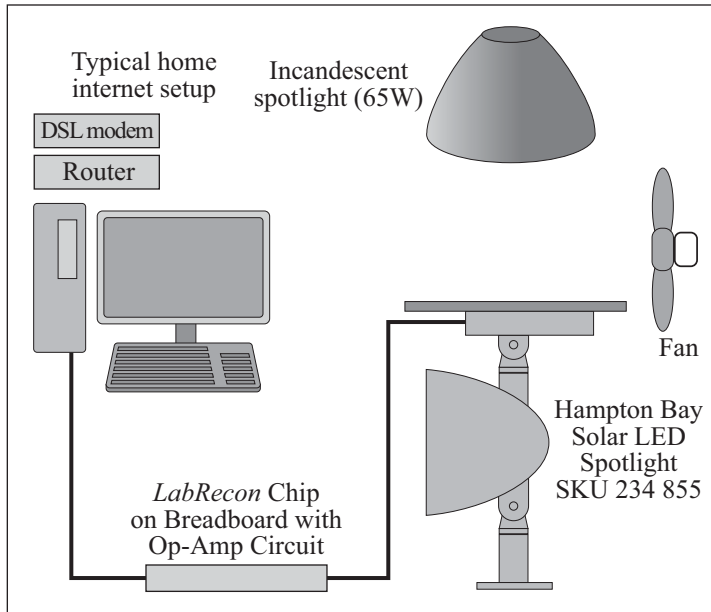


Figure 4: System diagram

The *LabRecon* chip has output channels in addition to its input (measurement) channels, which can be used to control system variables to perform automated performance analysis.

For example, an output could be used to adjust the brightness of the incandescent light to experiment with the correlation of output current with PV panel illumination. An output could also be used to set the cooling fan speed to control the PV panel temperature to measure the temperature dependency of PV performance. A load could also be controlled to create IV (current to voltage) curves and experiment with Maximum Power Point Tracking to optimize efficiency.

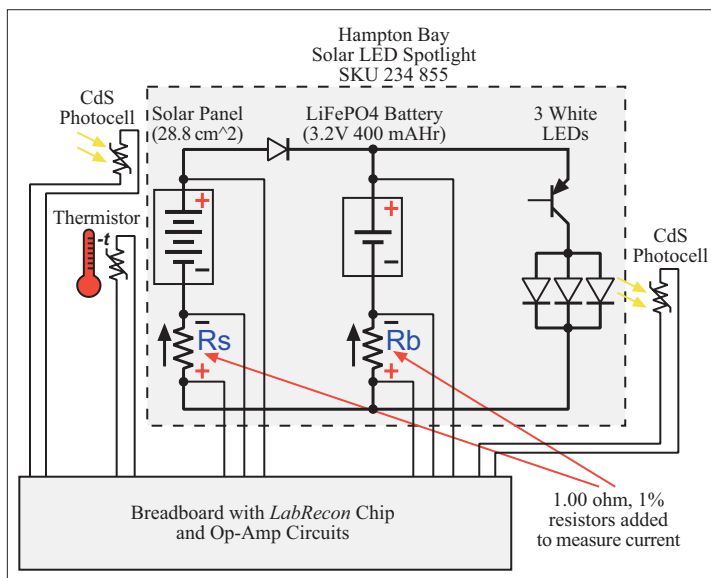


Figure 5: Sensor and measurement connections

The *LabRecon Measurement Wizard* was used to design the circuits to measure currents, voltages, light intensities, and temperature.

The *Measurement Wizard* guides the user in selecting sensors by providing lists of commercially available sensors and their measurement parameters. *LabRecon* contains embedded data for each sensor to automatically implement linear or non-linear scaling and provide circuit component values.

The user may also import scaling data for sensors not included in the embedded database.

To allow the user to learn about the circuits used, circuit notes and design considerations can be accessed.

Software calibration correction is also available to eliminate the need to calibrate on the "analog" front end.

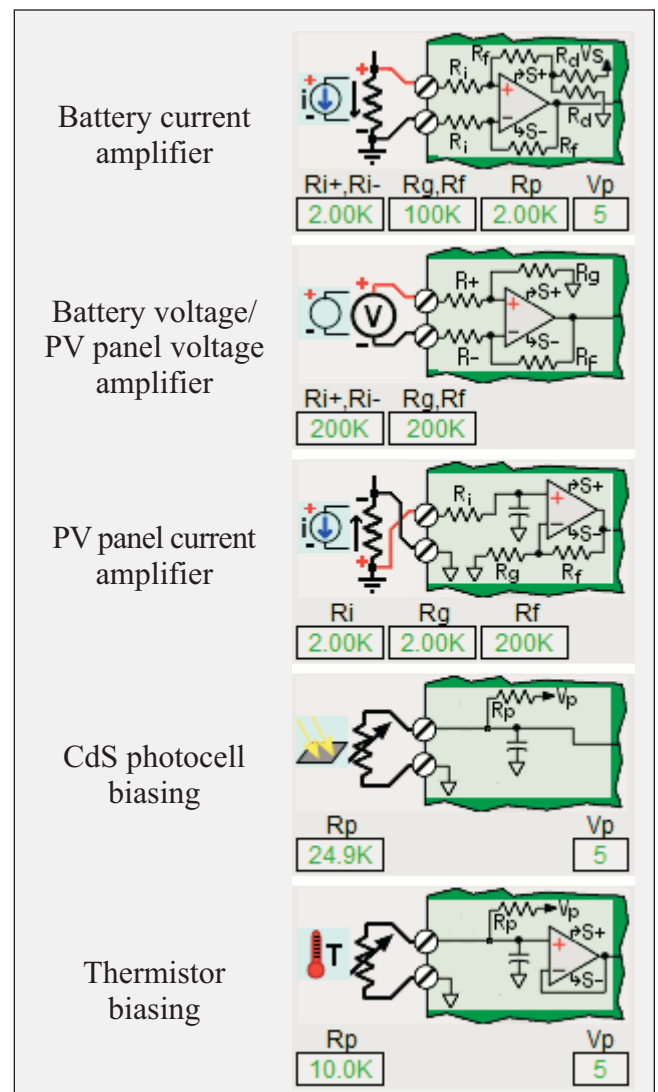


Figure 6: Circuits designed with *LabRecon*