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Intelligent Charge Controller for PV Panels

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Abstract: **In this study, a computer controller charge control system is developed for solar panels using micro-controller. The system has ability to be followed and controlled by the computer interface. Electricity generations of solar panels are strongly related with solar radiation intensity. However the intensity is not stable. Therefore the generation outputs of the PV are not stable. On the other hand the most important parameter that should be taken into account while designing a charge controller is the output voltage of the panels indeed. It is desired to make the output voltage around the voltage level accepted by the batteries. Therefore using charge controller designed is aimed to reduce (buck) the voltage if it is higher than the desired level and must increase (boost) it if the voltage level is lower than the desired level. In this study, buck-boost type power circuit is designed for charge control system and so the efficiency on charging battery by the panels is attempted to increase.**

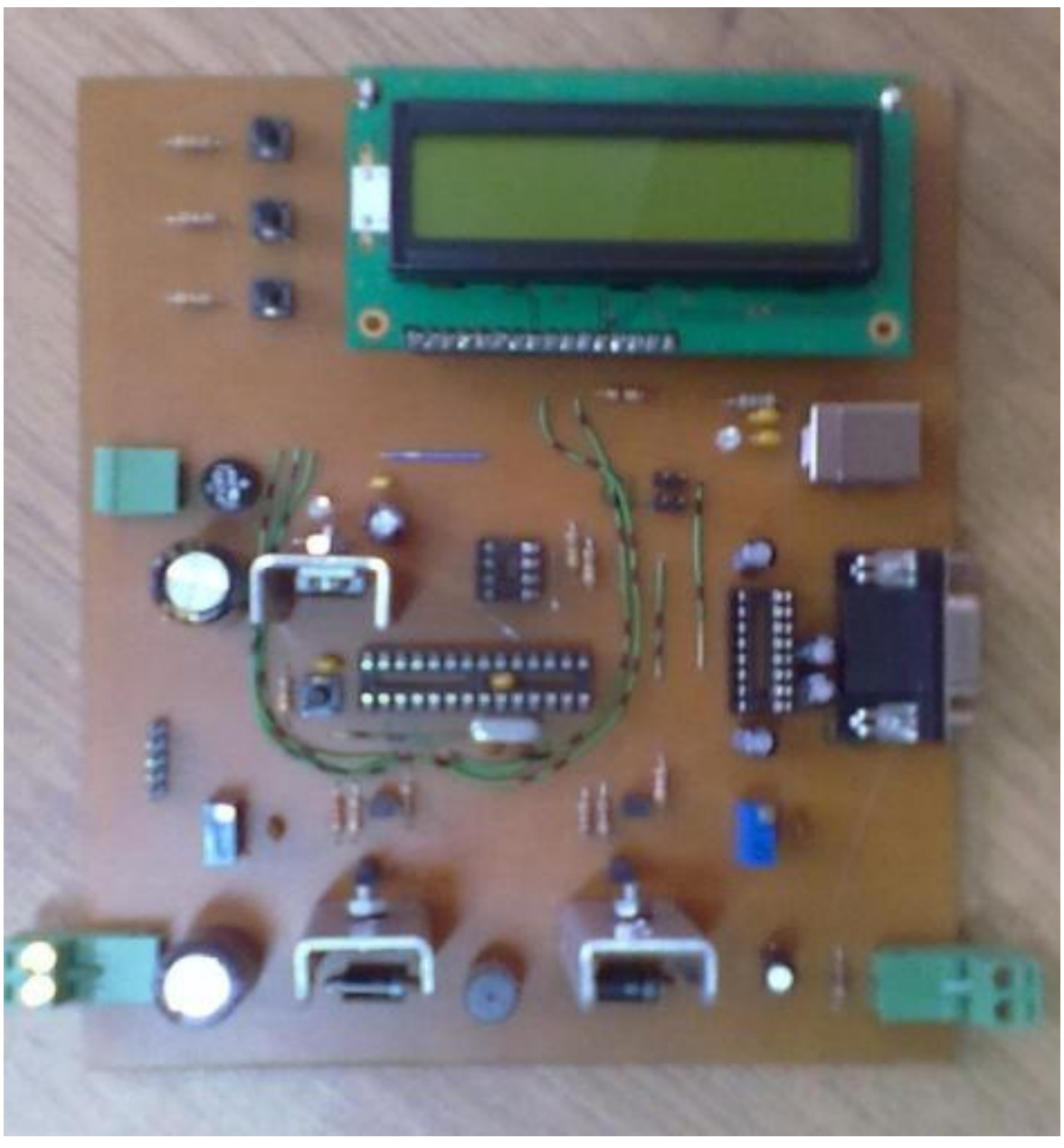

Figure 1. Charge controller circuit

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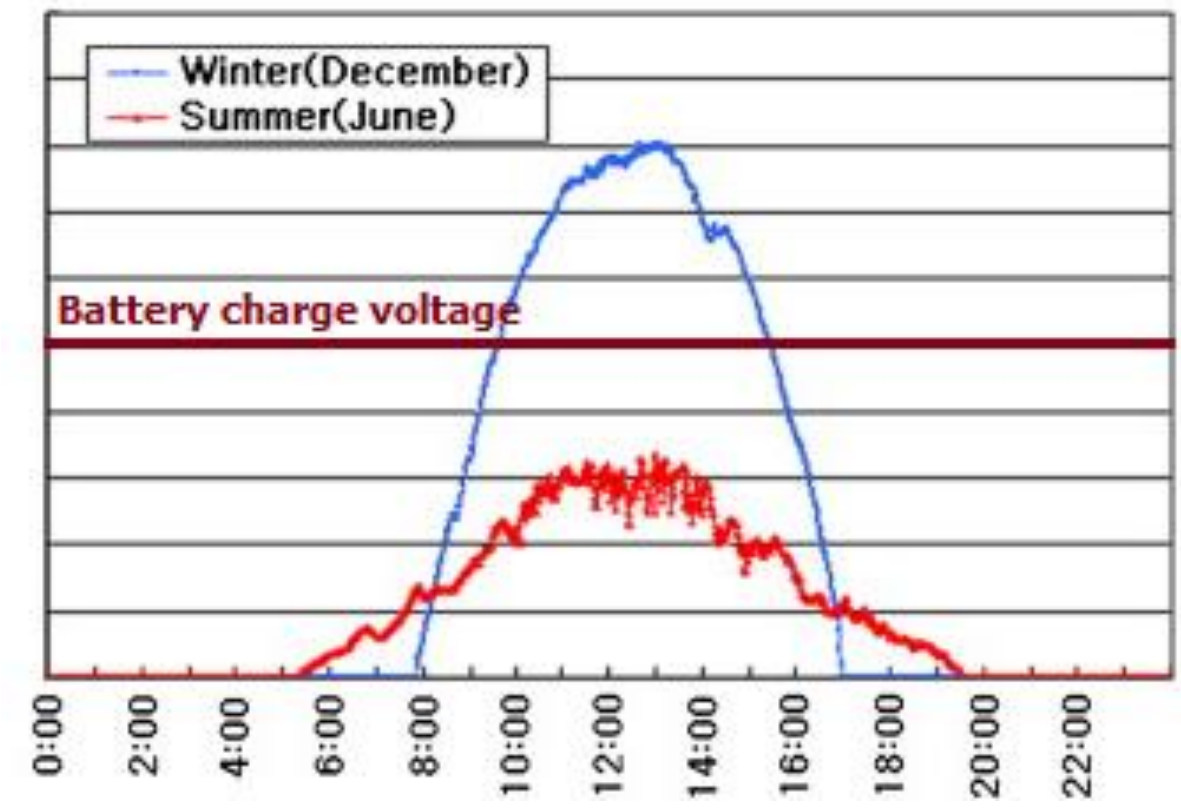

Figure 2. Hourly panel voltage in summer and winter

- Panels produce different voltage throughout the day.
- Battery charge voltage must be stable. So charge voltage should be decreased in noon time, because panel voltage is higher than the charge voltage.
- Generally, if panel voltage is higher than the battery voltage, charge voltage stability is performed by decreasing it in charge control systems.
- In this study, buck-boost type power circuit is designed for charge control system and so the efficiency on charging battery by the panels is attempted to increase.

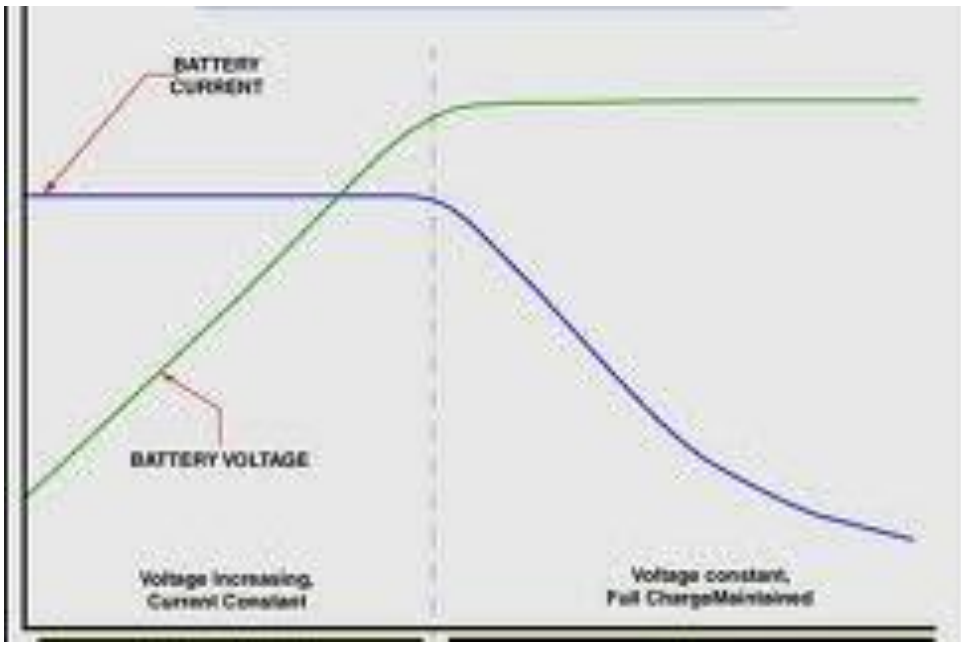

Figure 3. Battery charge voltage and current curve

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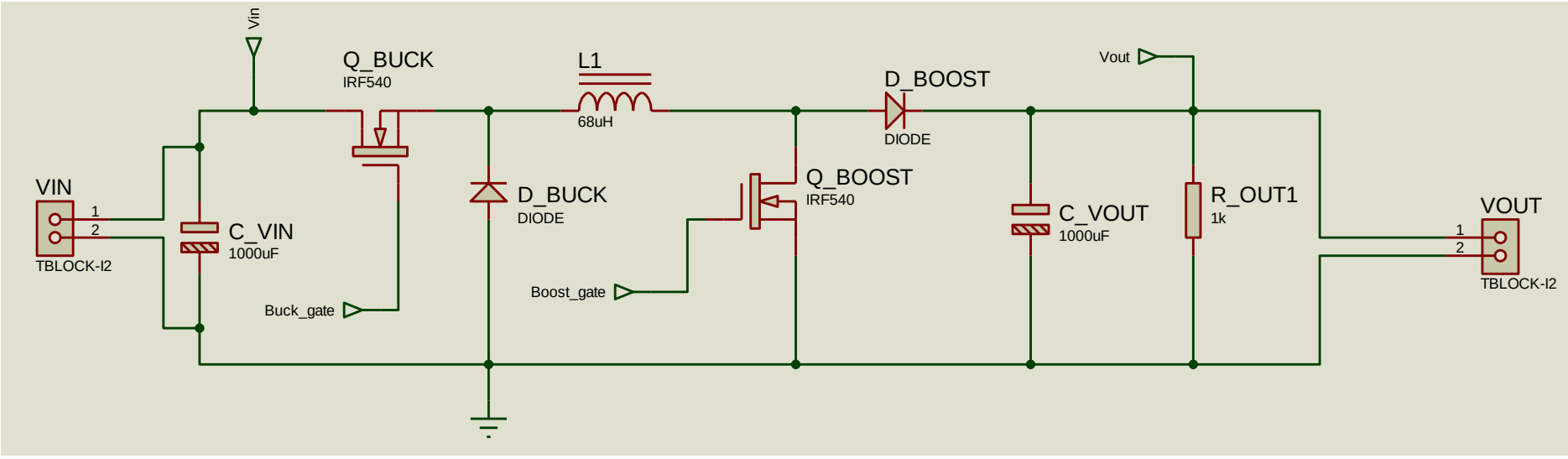

Figure 4. The schema of buck-boost controller

- Measuring circuit observes the input voltage (V_{in}), if V_{in} is higher than the battery voltage, Q_BUCK mosfet is switched and V_{in} voltage is reduced to battery voltage.

- Also, if the V_{in} is lower than the battery voltage, Q_BOOST and Q_BUCK are switched together, so V_{in} voltage is increased to battery voltage.

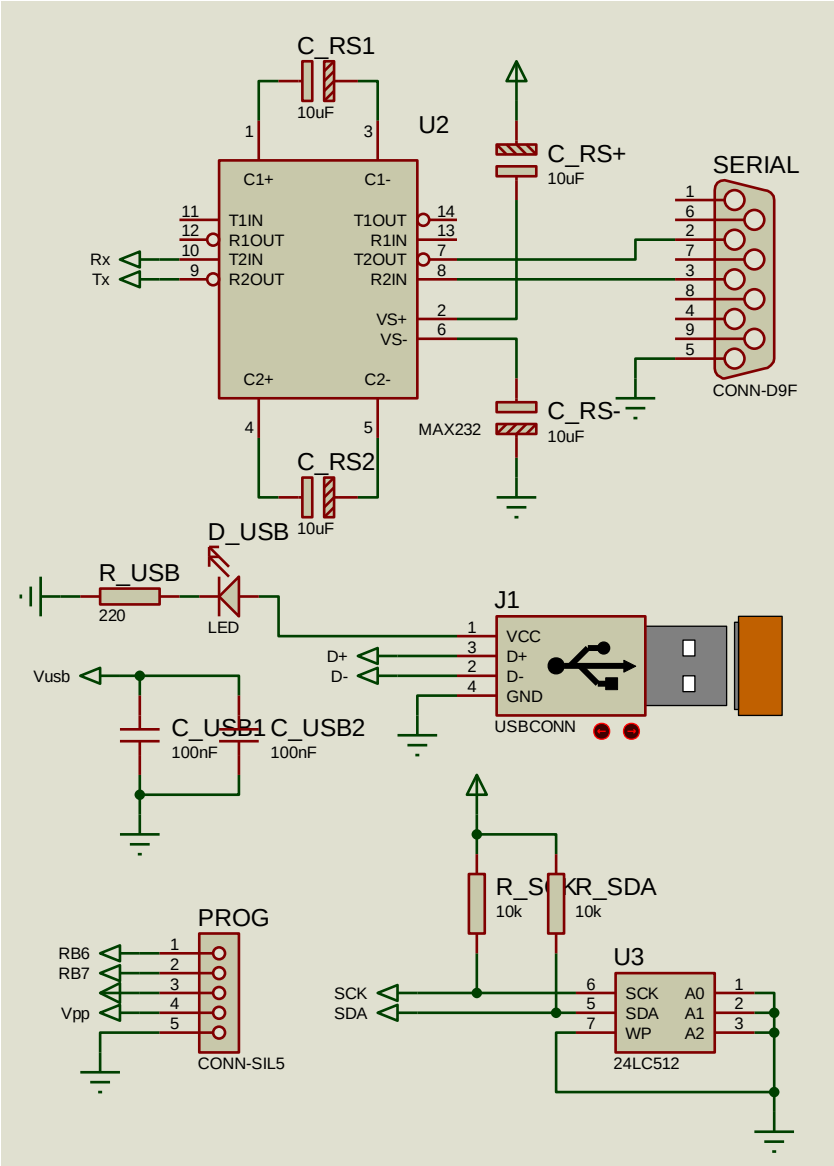

Figure 5. Communication circuits

- The control circuit has some communication devices such as USB, RS232.. etc.

- We prefer to use USB communication ports.

- Also the control circuit has a memory device (24LC512). The memory device is used in order to saving experiment data and it has 512KB capacity.

- In addition, the circuit has a programming port for programming the micro controller.

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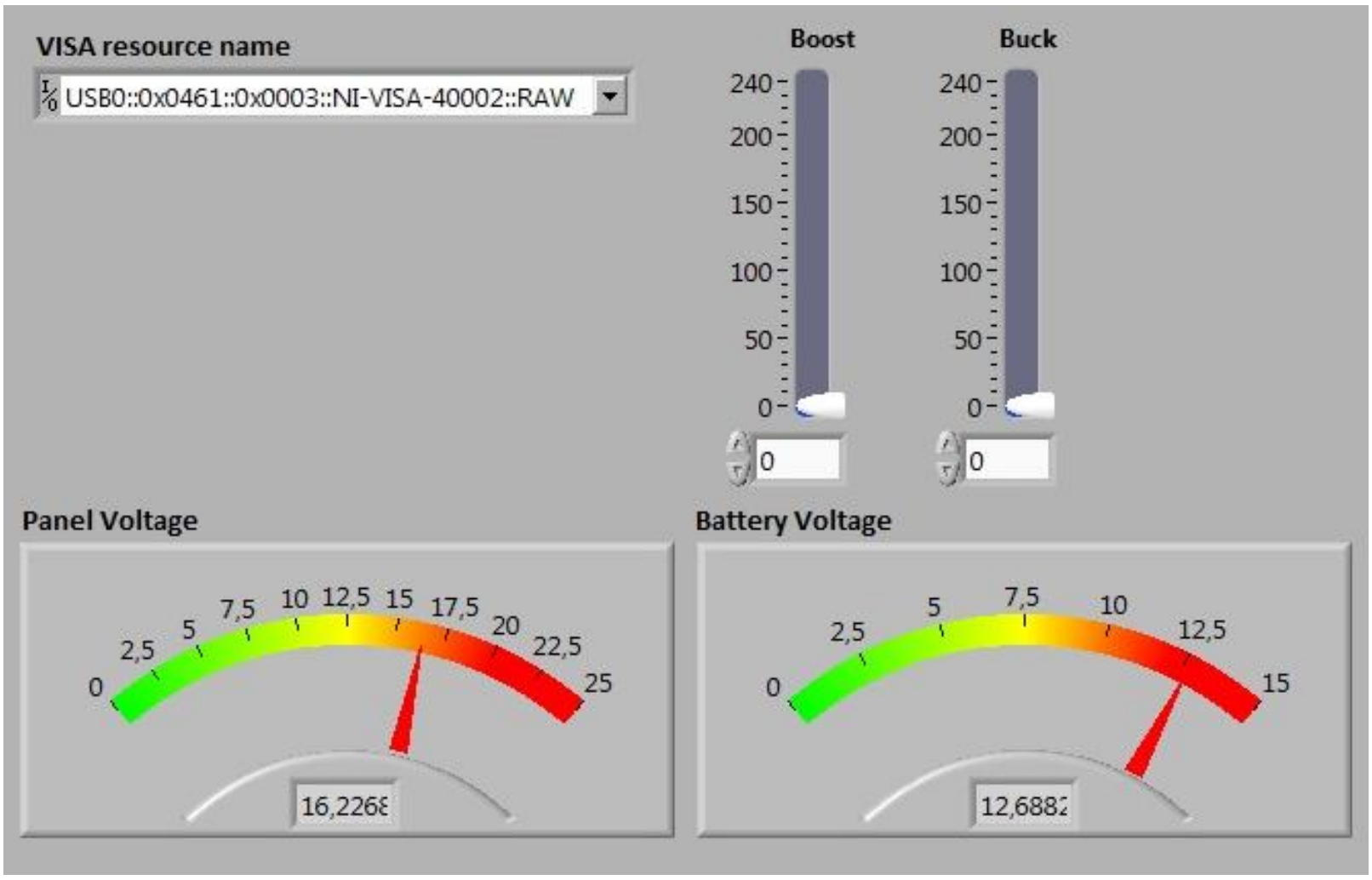

Figure 6. Computer interface for control the circuit and collect the data

- **By using the interface, buck and boost operations can made manually, panel and battery voltages can observed, data can collected, etc.**

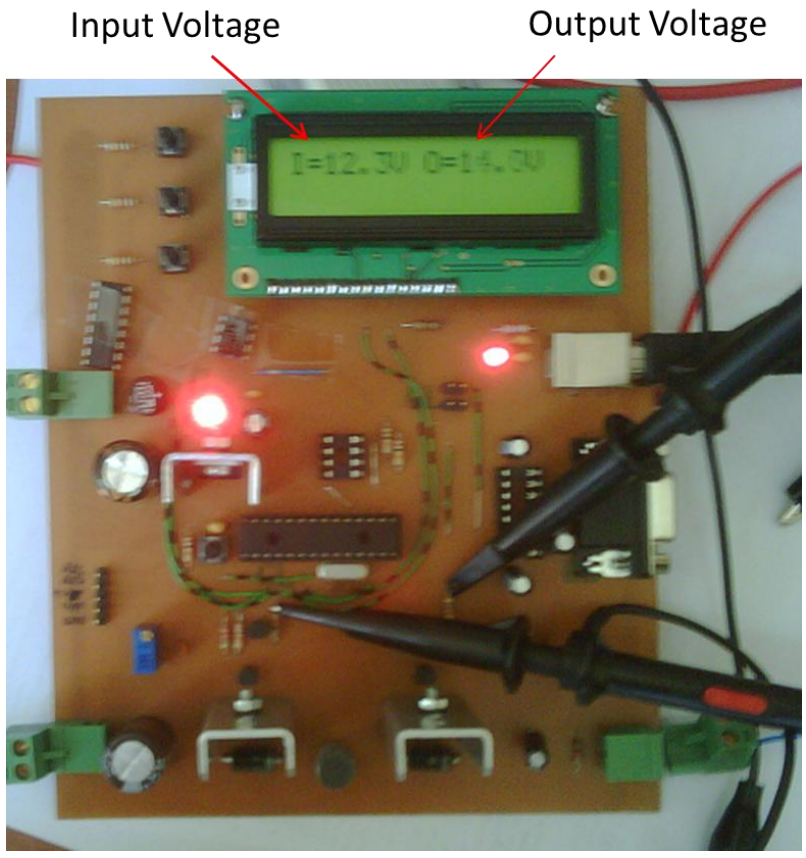

Figure 7. Buck-Boost control device for PV Panels

- **Device has Buck-Boost convertor, micro-controller, communication circuits, and memory circuit for data record, control buttons and LCD display.**

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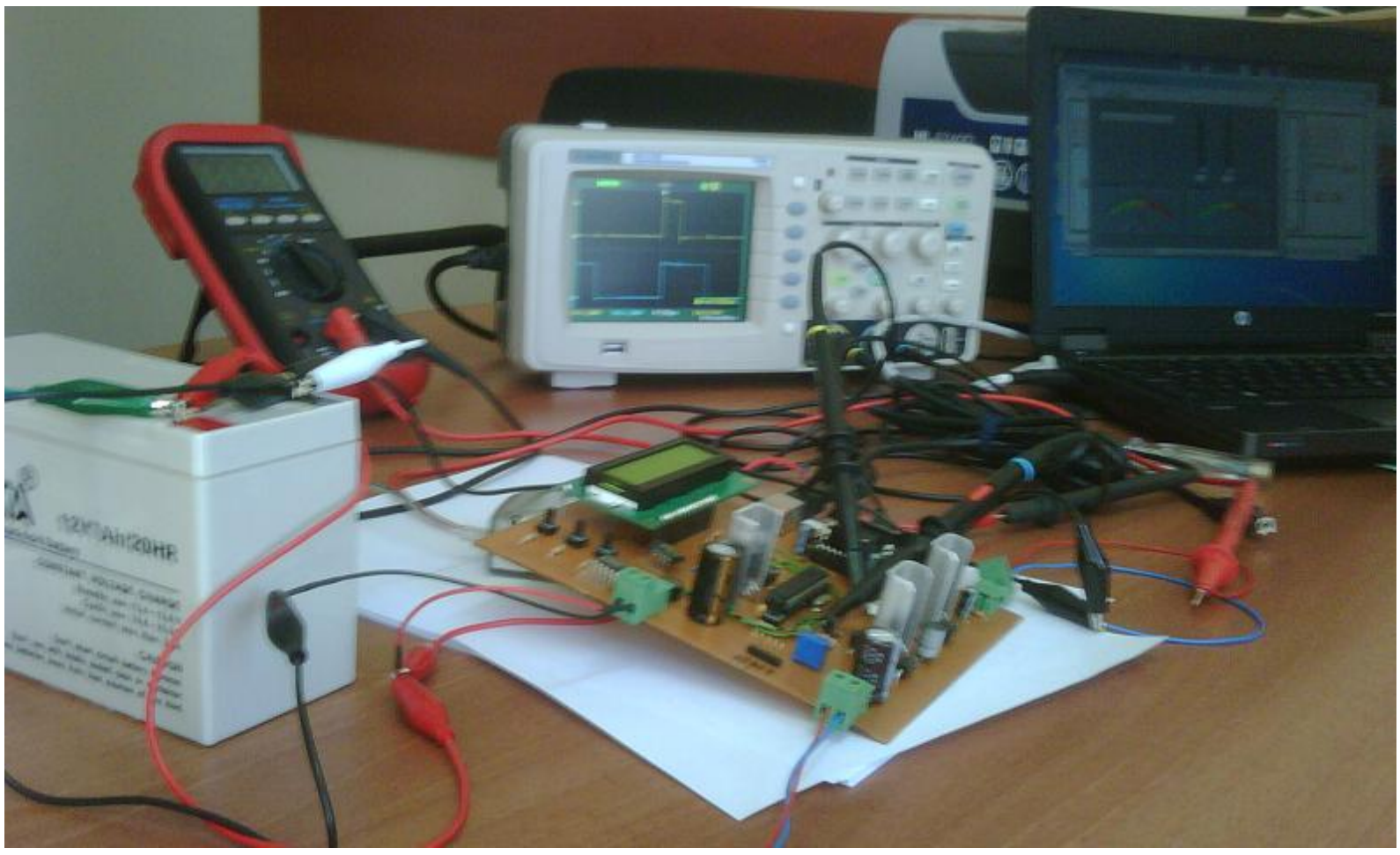

Figure 8. Testing the Buck-Boost Charge Controller device

- In test of Buck-Boost Charge Controller device, a mobile PV panel is used.
- PV panel is connected to control device's input, device output connect to the battery, an oscilloscope and an multi-meter are used to scope signals, and computer interface is used to manage the system.

CONCLUSION

Most of the charge control circuits, are designed for reduce the input voltage to the charge voltage level if this value is higher than battery charge voltage. Therefore, input voltage must higher than charge voltage for charging. In this study, a Buck-Boost convertor is used so charge process can be implemented when the input voltage is not only higher but also lower than charge voltage. So, the storage efficiency of electrical energy in the battery is tried to increase.

Some parameters can be added in this circuit, for example panel and ambient temperature, etc...

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