

Design of Solar Panel Tracking Control System

Huadong Zang¹, Yadong Chen²

¹Suzhou Vocational Institute of Industrial Technology, Suzhou 215104, China

²Liaoning Tiefsa Energy Co., Ltd, Tieling 112700, China

Abstract

This paper analyzes the overall scheme design, circuit design and PLC control program design of the system, and expounds the application research of realizing the conversion of solar energy to electric energy based on PLC control technology. With the development of economy and the progress of society, people put forward higher and higher requirements for energy. Finding sustainable development and green energy is one of the major issues facing mankind in this century and beyond. Developing new energy sources and making full use of existing energy sources have received great attention from scientists all over the world. As an inexhaustible and clean energy, solar power generation will get unprecedented development. With the development and industrialization of solar energy technology, its cost performance and efficiency will be greatly improved. Therefore, this design has high feasibility, practicality and energy conservation and environmental protection value.

Keywords

PLC; Complementary Scenery; Environment Protection Solar Energy.

1. Introduction

Scientists all over the world have attached great importance to the development of new energy and the rational and full use of existing energy. As an inexhaustible and clean energy, solar power generation will get unprecedented development. With the deepening of the development and industrialization of solar energy technology, its cost performance and efficiency will be greatly improved. It will be widely used in various fields, including BIPV, and will greatly promote and accelerate the rapid development of China's "green lighting project".

The solar power supply system is composed of photovoltaic power supply device and photovoltaic power supply system. The photovoltaic power supply system is composed of photovoltaic power supply control unit, photovoltaic output display unit, photovoltaic power supply control unit, DSP control unit, programmable controller (PLC), relay group, battery group, etc.

The photovoltaic power supply control unit is powered on and started, and all devices start to work. Photovoltaic power supply device converts solar energy into electric energy. After DSP judges that it meets the charging requirements, the relay group is connected to charge the battery group. If it does not meet the requirements, the relay group is disconnected, and the charging circuit is cut off to prevent charging. The DSP control unit is used to judge whether the battery pack needs to be charged. If it needs to be charged, turn on the relay, otherwise turn off the relay. This unit is mainly used to protect the battery pack from overcharge or overdischarge. When the photovoltaic power supply system is working, the photovoltaic output display unit will display the current and voltage of electricity generated by the photovoltaic power supply device in real time. The photovoltaic power supply control unit and PLC cooperate to control the direction of the solar panel module to meet the needs of different experiments and research.

2. System Overall Architecture and Electrical Schematic Diagram of Main Circuit

The whole system includes photovoltaic power supply device and photovoltaic power supply system. The function of photovoltaic power supply device is to convert solar energy into electric energy. The function of the photovoltaic power supply system is to control the movement of the solar cell module and handle the electrical energy provided by the solar cell module and other system functional requirements. The flow chart is shown in Figure 1 below.

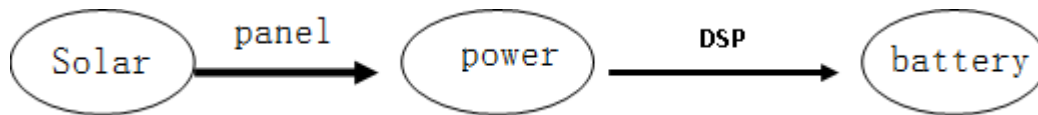


Figure 1. System Block Diagram

Photovoltaic power supply is completed by photovoltaic power supply device and photovoltaic power supply system. The electrical principle of photovoltaic power supply main circuit is shown in Figure 2.

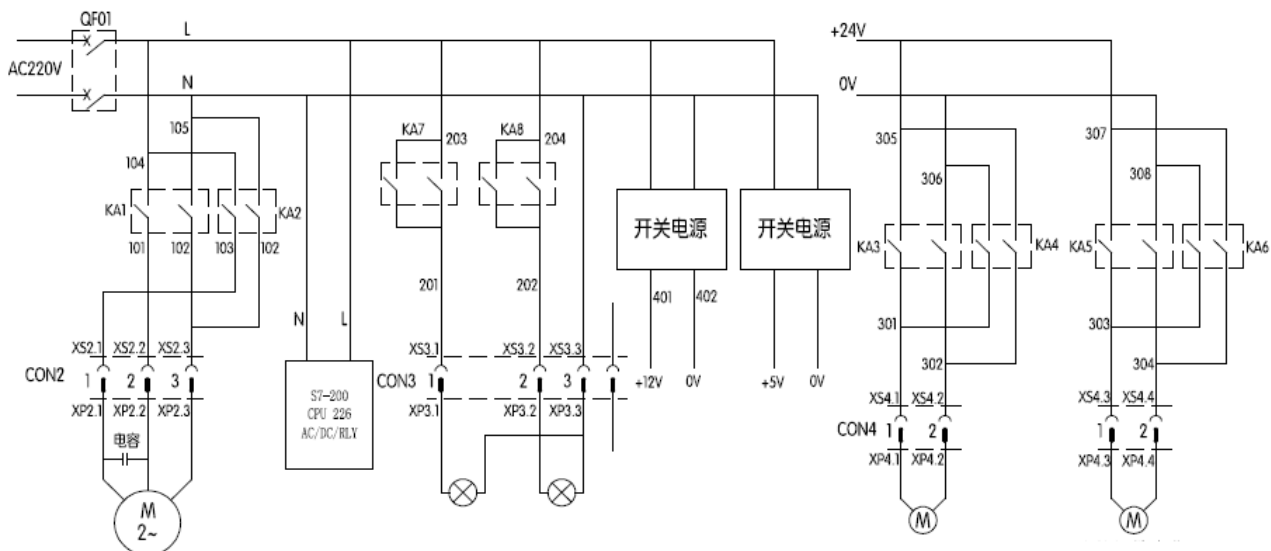


Figure 2. Electrical Schematic Diagram of PV Power Supply Main Circuit

Relay KA1 and relay KA2 provide single-phase AC220V to the swing rod deflection motor through socket. When the motor rotates, the projection lamp installed on the swing rod moves from east to west or from west to east. The swing rod deflection motor is a single-phase AC motor. The forward and reverse rotation are respectively completed by relay KA1 and relay KA2.

Relay KA7 and relay KA8 supply single-phase AC220V to projection lamp 1 and projection lamp 2 through socket.

The PV cell array deflects eastward or westward respectively, which is controlled by the horizontal motion DC motor. Relay KA3 and relay KA4 provide DC 24V power with different polarity to the DC motor through sockets to realize the forward and reverse rotation of the DC motor. The PV cell array deflects northward or southward respectively, which is controlled by another pitching DC motor. The forward and reverse rotation are completed by relay KA5 and relay KA6.

The DC 12V switching power supply is provided for the relay coil in the light sensor control box. The coil from relay KA1 to relay KA8 uses +24V power supply.

3. DSP Control Unit and Interface Unit

DSP is the abbreviation of Digital Signal Processing and Digital Signal Processor. The former refers to digital signal processing technology, while the latter refers to digital signal processor. DSP in this system refers to digital signal processor, mainly studying how to apply the theoretical digital signal processing technology to digital signal processor.

Generally, the voltage and current signals flowing through the device are continuous analog signals in time. Continuous analog signals can be sampled by A/D devices, converted into discrete pulse signals in time, and then these pulse signals are quantized, coded, and converted into binary codes consisting of 0 and 1, that is, commonly used digital signals. Of course, sampling, quantization and coding are all performed by A/D converter.

DSP can easily transform and filter these digital signals, and can also perform various complex operations to achieve the desired purpose.

The DSP control unit and interface unit are used to collect the output information of photovoltaic modules and the working state information of the battery to realize the charging and discharging process of the battery pack.

4. DSP Control System

The charging process and charging protection of the storage battery are completed by the DSP control unit, interface unit and program, and the discharge protection of the storage battery is completed by the DSP control unit, interface unit, optocoupler isolation switch and relay KA13. When the battery discharge voltage is lower than the specified value, the DSP control unit outputs a signal to drive the optocoupler disconnecter and relay KA13 to work, and the normally closed contact of relay KA13 is disconnected to cut off the battery discharge circuit.

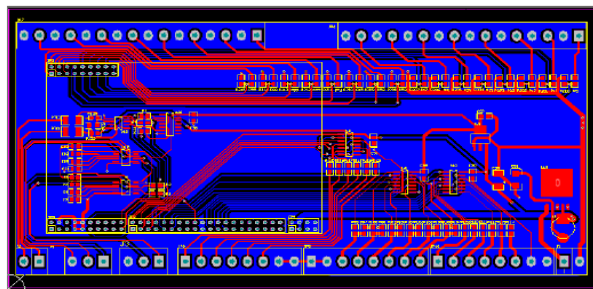


Figure 3. DSP Control Unit PCB

The interface unit PCB is shown in Figure 4:

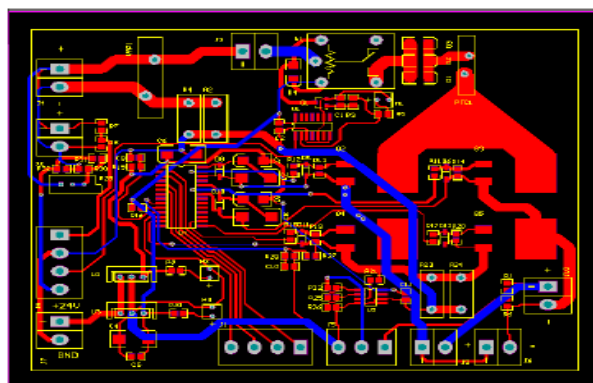


Figure 4. Interface Unit PCB

Actual charge detection of storage battery:

When the output voltage of the photovoltaic cell module is lower than the battery voltage, the module cannot charge the battery. Connect the detection probe of the oscilloscope to 0V and JP10-2 of the DSP control unit to obtain the waveform as shown in Figure 5, which indicates that it is not charged.

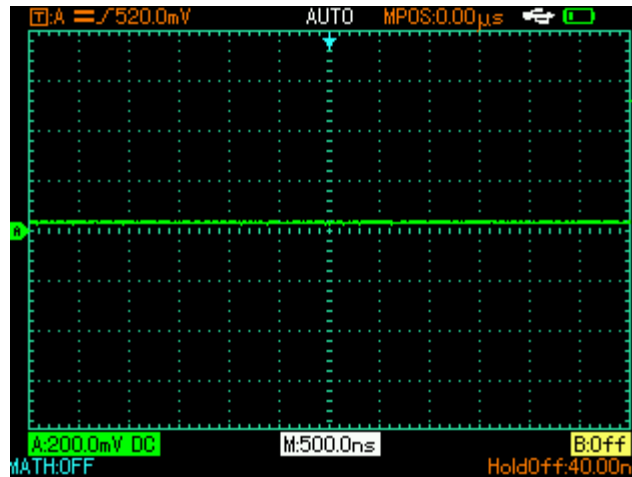


Figure 5. Waveform of No Charge

When the output voltage of the photovoltaic cell module is higher than the battery voltage, the module can charge the battery. Connect the detection probe of the oscilloscope to 0V and JP10-2 of the DSP control unit to obtain the waveform as shown in Figure 6, which indicates charging.

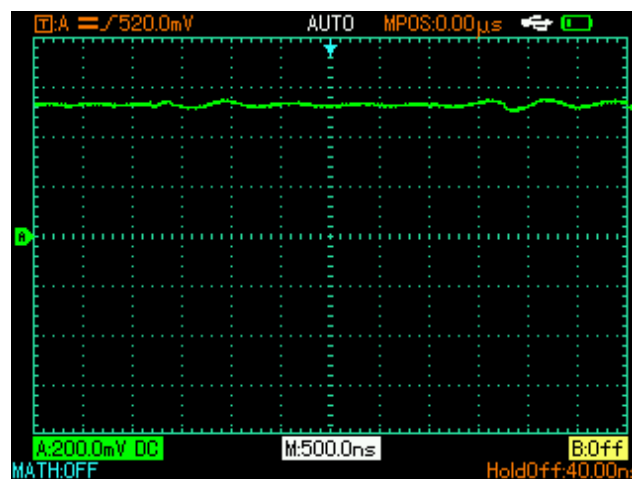


Figure 6. Charging Waveform

5. Output Characteristics of Photovoltaic Cells

Short circuit current I_{SC} of photovoltaic cells:

The short circuit current of the so-called photovoltaic cell is the current flowing through both ends of the photovoltaic cell when the photovoltaic cell is exposed to the standard light source and the output short circuit occurs.

Open circuit voltage of photovoltaic cell U_{OC}

The so-called open circuit voltage of the photovoltaic cell is the output voltage of the photovoltaic cell when the photovoltaic cell is placed under a specific solar intensity and ambient temperature and the output is open circuit.

Output characteristic curve of photovoltaic cell

When the resistance value of the load R_L of the photovoltaic cell gradually changes from 0 to infinity under the specific sunlight intensity and ambient temperature, the output characteristic curve of the photovoltaic cell, that is, the I-V characteristic curve of the photovoltaic cell, can be obtained. The output power characteristic curve of photovoltaic cells can be obtained by multiplying the output voltage value and current value of photovoltaic cells corresponding to each operating point of I-V characteristic curve. As shown in Figure 7.

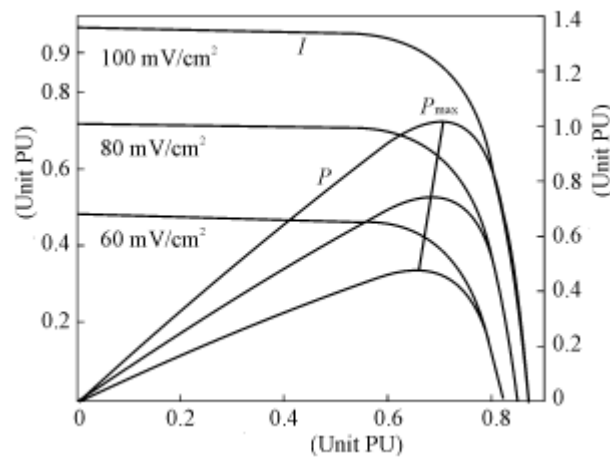


Figure 7. Output characteristic curve of photovoltaic cell

The output characteristic curve of the photovoltaic cell is very important for analyzing the characteristics of the photovoltaic cell. It can be seen that the photovoltaic cell is a nonlinear DC power source that is neither a constant voltage source nor a constant current source.

6. Conclusion

The solar panel tracking control system is a set of devices that simulate typical examples of actual solar power generation. This set of devices integrates mechanical, electrical and electronic, sensor, and programmable control (PLC) technologies. The research of the device greatly improves the power generation efficiency of the solar panel.

References

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