Isolation Products Solution to Power Generation Applications

Avago Technologies' Isolation Products Solution to Power Generation Applications

Introduction

Alternative Power Generation is an emerging trend in renewable energy nowadays, driven by a market in which gasoline demand outstrips the supply from the producers and drives up prices. This move is motivated, in part, by the readily abundant availability of renewable energy sources in the environment, as well as their low running cost and their ability to self-regenerate. As a result, natural resources like solar and wind are now being converted to generate alternative sources for use in commercial and industrial markets (Figure 1 and 2).

Inverters, chargers and converters play a crucial role in enabling this conversion process. But, as the demand for their use in power-generation applications increases, high-frequency noises from switching devices and the power surges from instantaneous glitches in the systems will adversely affect the power supply quality. Optocouplers offer an effective means of protection by providing isolation from unwanted signals, as well as insulation from high-voltage glitches in the power converters.

As a worldwide market leader in optical isolation devices, Avago Technologies develops optocouplers that are specifically designed and manufactured to meet the stringent requirements in power-generation system applications. Featuring high CMR performance, high maximum insulation voltage and a wide operating temperature, Avago Technologies' broad range of isolation products are flexible enough for power-generation system designs in both commercial and industrial applications. They are fully compliant with worldwide regulatory standards, including IEC (International Electrotechnical Commission), UL (Underwrites Laboratories, Inc.), CSA (Canadian Standard Association) and EN (European Union) approvals.

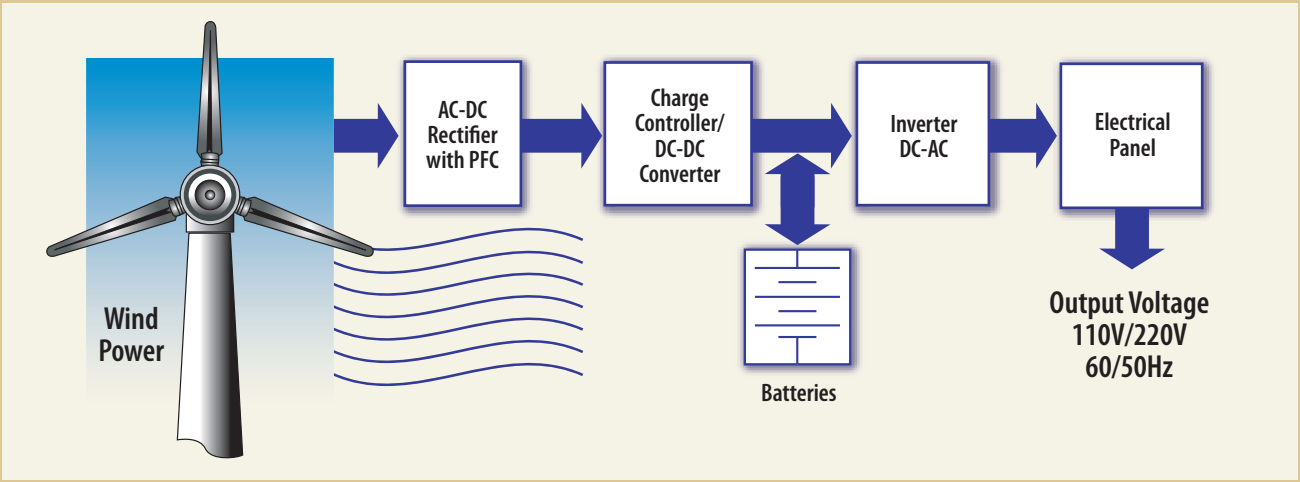

Figure 1: Wind-Power Generation Block Diagram

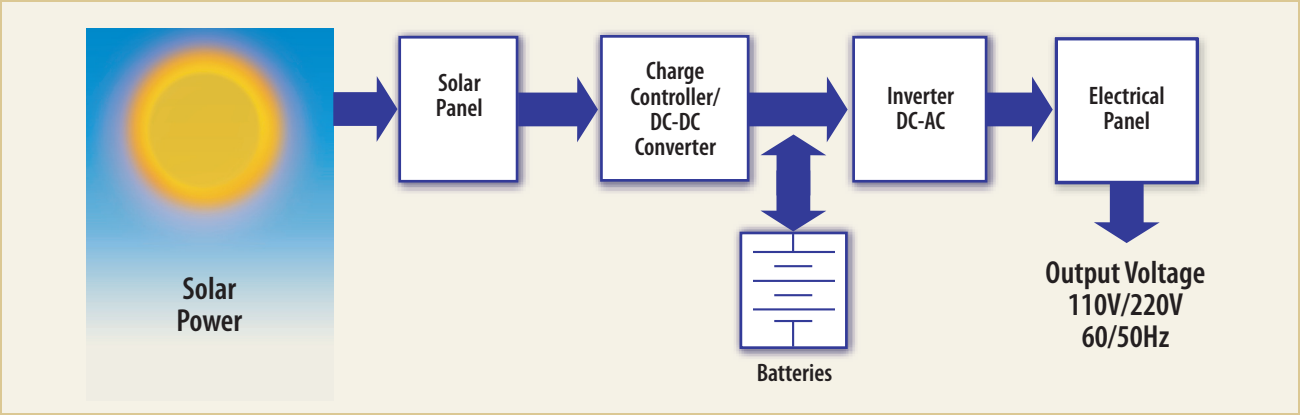

Figure 2: Solar Power Generation Block Diagram

Key applications for isolation and insulation solutions in power-generation system components include:

- **Inverters (single/three-phase)**
- **Charge controllers (DC-DC converters)**
- **Communications (for system controls and monitoring)**

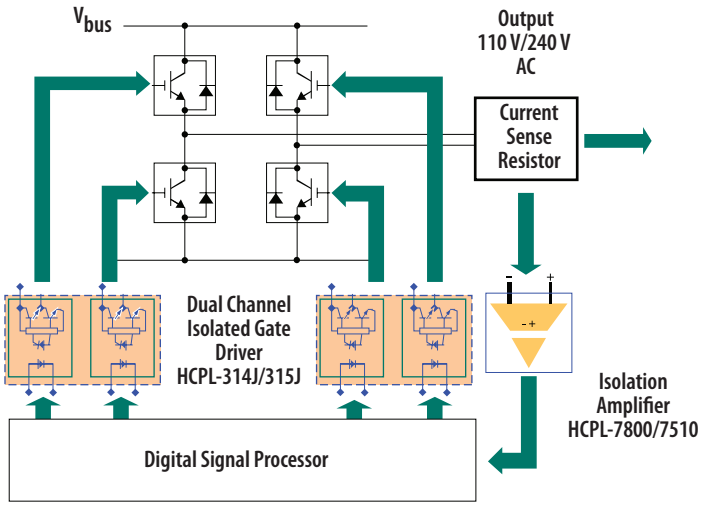

Figure 3: Single-Phase Inverter System with Gate-Drive Optocoupler and DSP

Inverter Systems

The inverter is the intelligent block of a renewable energy system. It seamlessly converts DC power to clean and reliable AC electricity. Inverters can be either single (commercial) or three-phase (industrial) discrete components or modules and are controlled by a DSP or microcontroller to provide high-efficiency switching control (Figure 3). High-performance inverter systems require precision timing control of power devices as well as isolation.

IGBT/MOSFET Gate Drive

IGBT/MOSFET power devices convert DC-to-AC voltages and currents in the power inverter stages to drive electrical devices operating at 110 and 240 V. Avago's gate-drive optocouplers, such as the HCPL-316J, provide isolation for direct drive to power devices, and between low-voltage control system's MCU/PWM controllers and high-voltage power devices. They feature high insulation voltage, high CMR, minimum peak output current up to 2 A, the fastest switching available, and IGBT desaturation detection and fault detection status feedback. As an added benefit, these integrated drivers eliminate extra circuitry which results in reduced board space and lowers the cost to the designer. Avago Technologies also offers gate-drive optocouplers that provide different output drive currents with various types of inverter ratings to suit a variety of different design requirements.

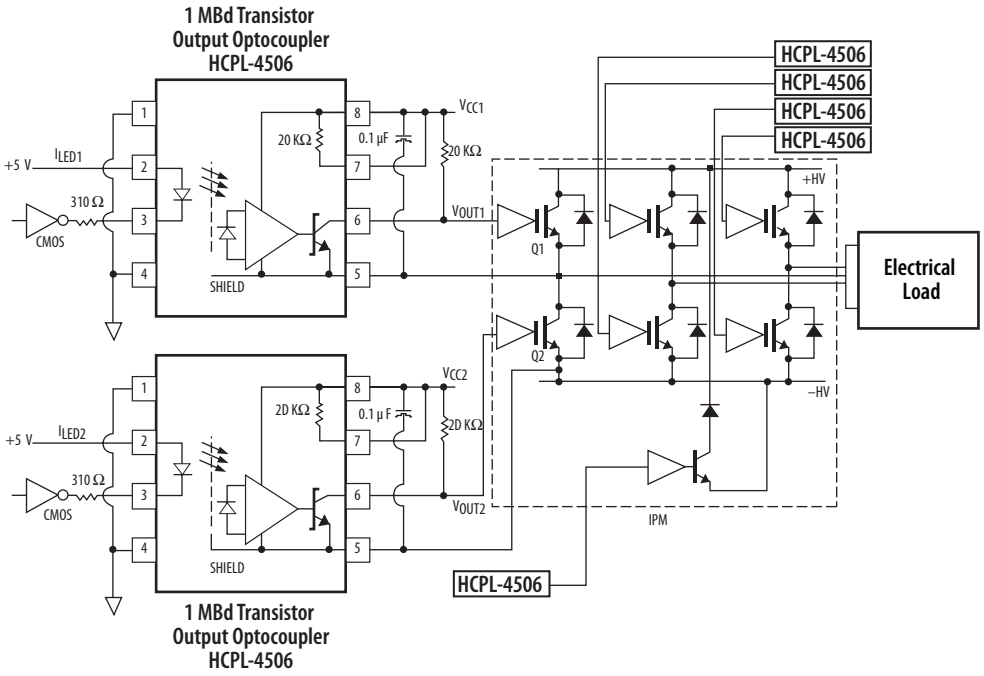

Figure 4: Typical IPM Optocoupler Inverter Interface

Intelligent Power Module (IPM) Interface Optocoupler

Avago Technologies has developed a series of IPM interface optocouplers, ranging from 1 to 5 MBd (Figure 4). Its most recent offering, the ACPL-4800, is the fastest IPM Optocoupler on the market with a HVCMR of 30 kV/µs at 1 kV-Vcm and a propagation delay of 50 ns, maximum. This module has a built-in Schmitt trigger that provides logic-compatible waveforms which eliminate the need for additional wave shaping, and a totem pole output which eliminates the need for a pull-up resistor and a positive input/output logic inverter. With these features, a direct drive IPM or gate-drive application from a high-output current of up to 50 mA is viable. Avago Technologies' IPM Optocouplers also feature a transistor output driving capability.

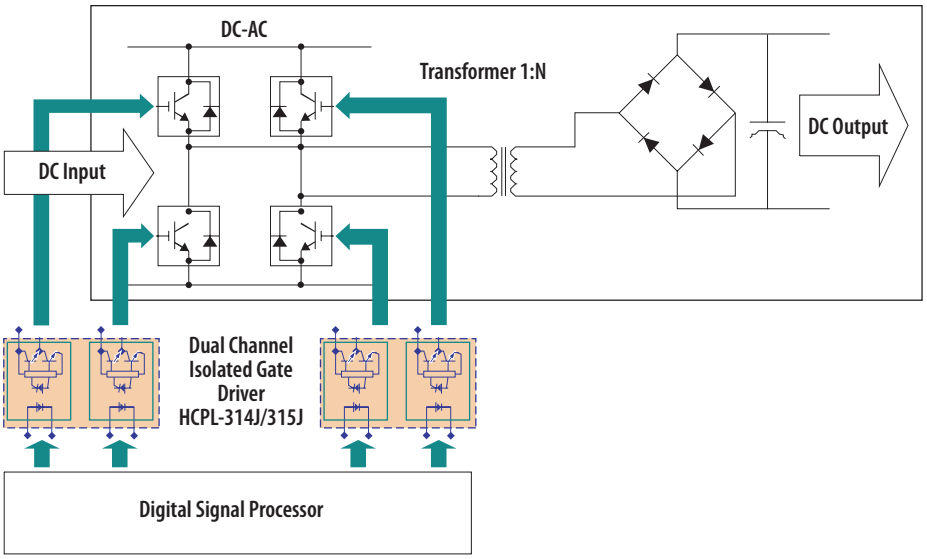

Figure 5: Typical Single-Phase Dual Active Full-Bridge DC-DC Converter

Charge Controller (DC-DC Converter)

The charge controller (DC-DC converter) is the mainstream component of the solar power system. It converts the solar energy in DC voltages into a higher or lower potential, depending on the load as well as the battery system. Typical DC-DC converter topologies are half-/full-bridge type (Figure 5). Depending on the system requirement, each will deliver different output requirements. To achieve higher efficiency of the DC-DC converter, a high switching frequency converter is used. In high-frequency switching, noise is an issue and requires some form of isolation. Proper grounding is also needed to eliminate leakage current that will affect the stability of the electrical system. For these applications, Avago Technologies' selection of gate-drive optocouplers are available in different output drive currents ranging from 0.4 to 2 A.

Rectifier/Charge Controller (AC-DC Converter)

The rectifier/charge controller (AC-DC controller) is the front-end of the wind-power system that transforms AC power to DC by means of rectification. Typical AC-DC rectifier/converter topologies are half-/full-bridge/three-phase, together with power factor correction circuitry. Typical rectification components use controlled switches such as Thyristors, IGBTs or MOSFETs. Since high voltage is present in the switching between the microcontroller, isolation is required. For this application, Avago Technologies' selection of gate-drive optocouplers are available in different output drive currents ranging from 0.2 to 2 A, as well as different switching speeds (Figure 6). Dual-channel versions are available in an SO16 package to better conform to the constraints of a small system board.

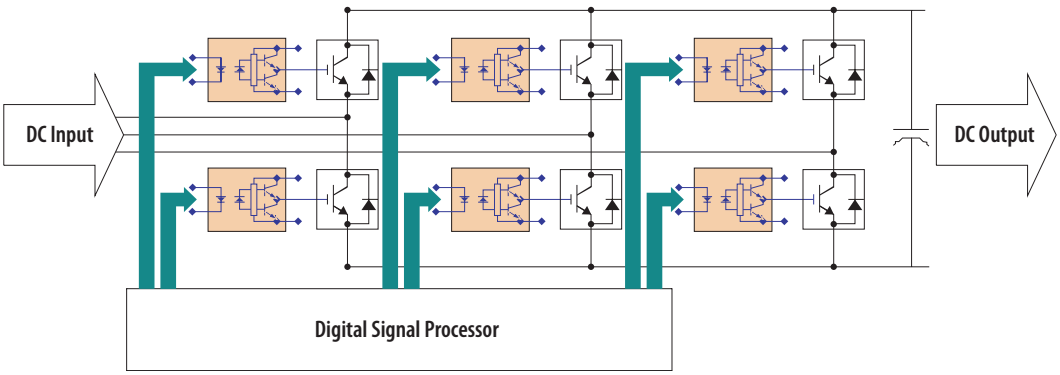

Figure 6: AC-DC Rectification with Gate-Drive Optocouplers for discrete control in high-powered systems.

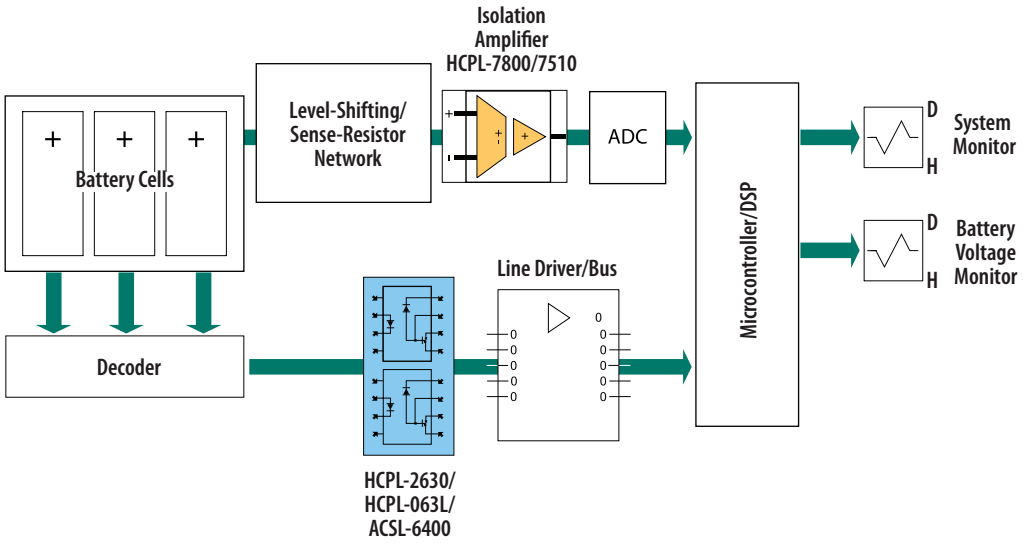

Figure 7: Battery and System power monitoring

Communications (for system controls and monitoring)

The complete solar-power generation system is illustrated in Figures 7 and 8. The overall system will typically comprise the key components that complete the run of an alternative renewable energy. The battery charge status and power status can be easily monitored with the microcontroller system. Since the monitoring of the power signal occurs between the low-voltage systems, isolation is required to eliminate interference and transient instances.

Avago Technologies has a wide range of interface optocouplers with speed ranging from 100 kBd to 10 MBd, High-speed CMOS optocouplers range from 12.5 MBd to 50 MBd and up to 100 MBd for digital isolators. In addition, Avago Technologies is the first in the industry to offer multichannel, bidirectional optocouplers to suit designs with multiple communication interfaces that help reduce system board space and increase higher integration.

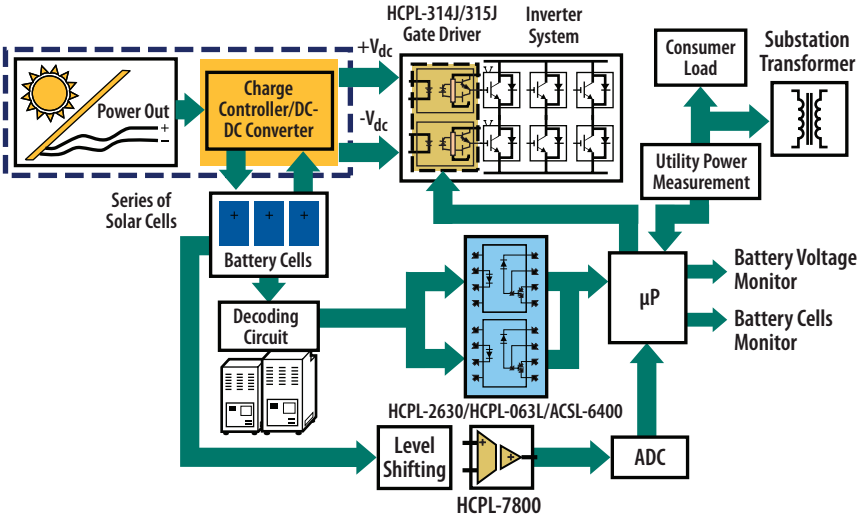

Figure 8: Typical Solar Power system block diagram

For product information and a complete list of distributors, please go to our web site:

www.avagotech.com

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