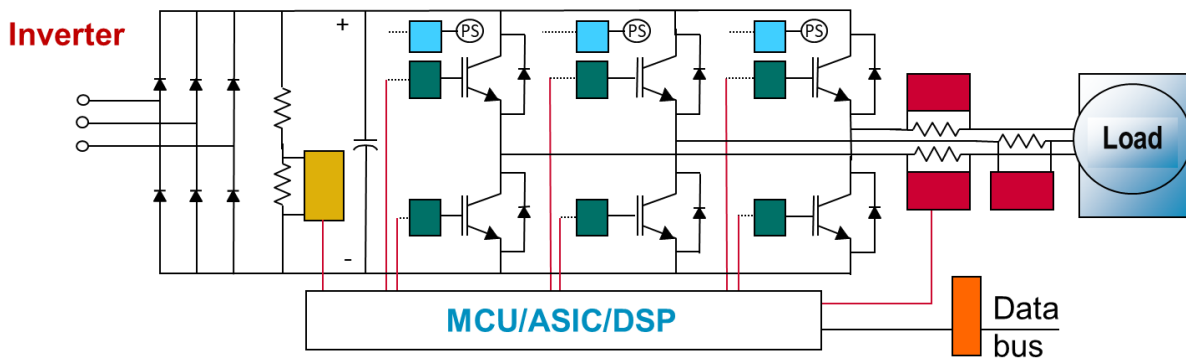


Broadcom 15 mm Wide ACNT Optocouplers for High Voltage Applications

Introduction

Broadcom ACNT optocouplers family offers 15 mm creepage and 14.2 mm clearance for high voltage isolation applications. These optocouplers provide 2,262 V_{PEAK} working insulation voltage and 12,000 V_{PEAK} transient overvoltage in compact stretched surface mount SO-8 package. The ACNT optocouplers consist of comprehensive product types to meet the different galvanic isolation requirements and features. They are the ACNT-H343 gate drive optocoupler, ACNT-H61L low power 10 MBd digital optocoupler, ACNT-H790/H79A/H79B high linearity isolation amplifier for current sensing, ACNT-H870/H87A/H87B voltage sense and ACNT-H50L/H511 low speed analog optocoupler. In the example of a 3-phase inverter that converts DC-AC power to a load (motor), Figure 1 highlights the various isolation locations and the purpose by each ACNT optocoupler product type. ACNT optocouplers are easy to use and reliable.




Isolation	Optocoupler	Purpose
	1) ACNT-H343 Gate Drive 	Drive IGBT/MOSFET
	2) ACNT-H61L 10MBd Low Power	LV-HV control interface (isolate MCU & HVIC gate driver)
	ACNT-H790/H79A/H79B Current Sense	Feedback current for system control
	ACNT-H870/H87A/H87B Voltage Sense	Voltage level control for system safety
	ACNT-H50L/H511 Low Speed Analog	Isolate power feedback, UVLO detect, fault feedback
	ACNT-H61L 10 MBd Low Power	Isolate data bus communication

Figure 1: ACNT optocouplers for various isolation needs in an inverter

High Voltage Trend and Requirements

In the market segments of renewable (solar or wind) power, traction and healthcare systems, there is trend for higher DC bus voltage or high transient voltage immunity requirement. The new solar/PV systems have been adopting 1500V DC from 1000V. This upgrade has benefits term of higher energy efficiency and lower costs. One benefit is more PV blocks per string (longer string of PV arrays) are able to form. Combiner boxes consolidate incoming power into one main feed. With long and lesser number of PV strings, the need for combiner boxes become fewer. Higher DC voltage of input also reduce wire (copper) power losses. As a whole, the 1500V system has lesser connections between PV string arrays and inverter compare to 1000V or lower DC voltage system. The higher power density and fewer equipment also reduce labor maintenance costs. One challenge of 1500V system is the electrical safety and full range of certification standards for components. The isolation between the control module and the power products must be able to withstand high voltage (steady and transient) and the relevant creepage distance (Figure 2). Broadcom 15mm wide ACNT optocouplers are able to meet these requirements.

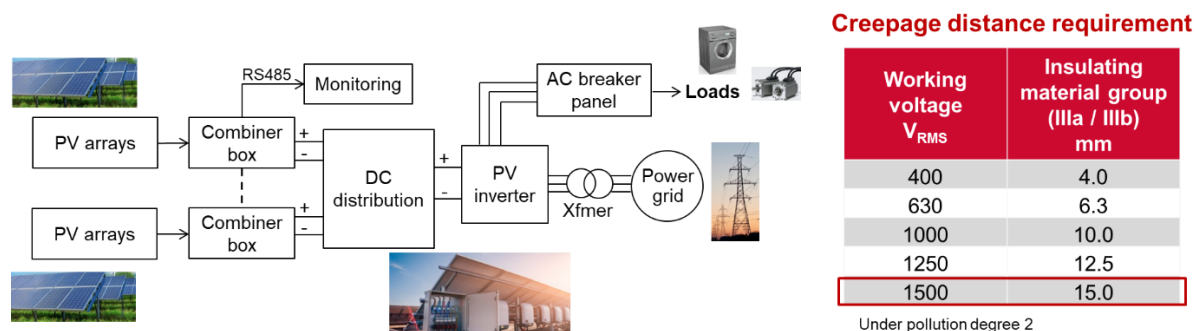
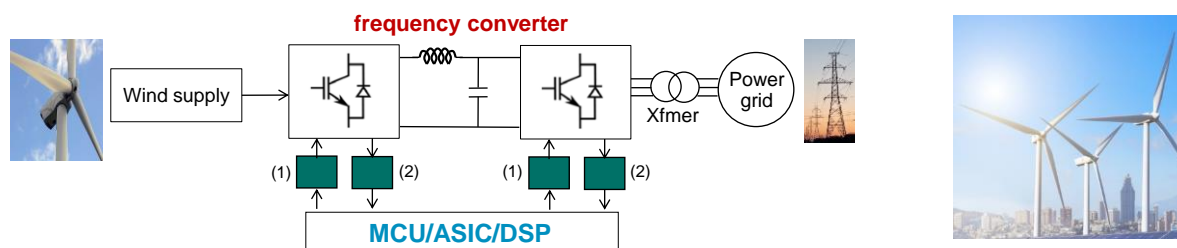


Figure 2: PV power generation system – 1500V

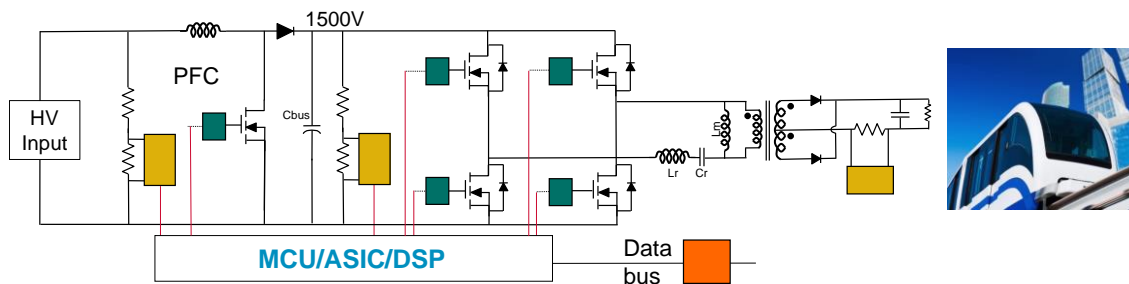
In the wind solution of the renewable energy segment, ACNT optocouplers gain popularity in the European countries as part of a national-level program of distribution grid renewal to replace nuclear power plants with renewable resources. From Figure 3 of the frequency converter, the 15mm wide ACNT-H61L 10 MBd low power optocoupler isolates the control and fault feedback signals between low voltage control and high voltage IGBTs. In another sub-segment of the electrical grid, metering for low or mid voltage distribution line becomes more advanced as part of the smart grid adoption. Wider creepage is required in the 3-phase (>400Vac metering) for safety and high voltage isolation of data communication. Security gains importance in smart grid. The low speed analog optocoupler ACNT-H50L's long term reliability helps secure isolated data communication.



Isolation	Optocoupler	Purpose
	ACNT-H61L 10 MBd Low Power	a) LV-HV control interface (isolate MCU & HVIC gate driver) b) Fault feedback isolation

Figure 3: Renewable energy – Frequency converter of wind solutions

Another high voltage application in the example of light rail or monorail (traction control), the ACNT optocouplers are used in DC-DC converter of 1500V. From Figure 4 of a monorail power converter with 1500V DC bus voltage, there are 4 x digital optocouplers for isolated high voltage - low voltage control interface, 2 x voltage sense of isolation amplifiers for isolated voltage level control and low speed analog optocouplers for isolated I/O communication to provide high voltage insulation long usage reliability and robust in the noise immunity.



Isolation	Optocoupler	Purpose
	ACNT-H61L 10MBd Low Power	LV-HV control interface (isolate MCU & HVIC gate driver)
	ACNT-H870/H87A/H87B Voltage Sense	Voltage level control for system safety
	ACNT-H50L/H511 Low Speed Analog ACNT-H61L 10MBd Low Power	Isolate data bus communication

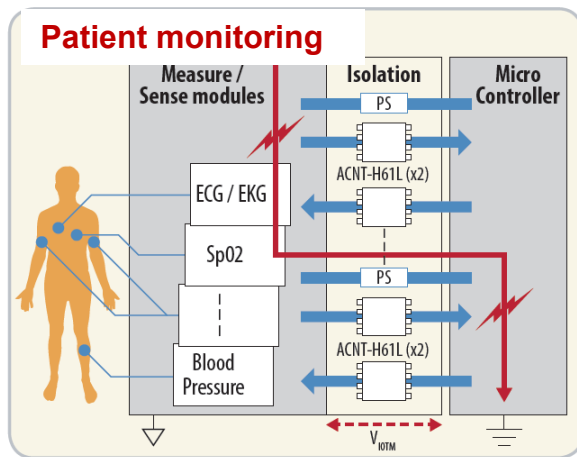
Figure 4: Power converter in traction applications

In the healthcare systems, the 4th edition medical standard IEC 60601-1-2 revises higher ESD level of contact and air discharge types. This ESD immunity type test applies between the sensing circuitry (eg blood pressure, ECG) where patient's direct contact and the control board of a patient monitoring device. The ACNT-H61L meets this revised requirement with transient overvoltage of 12,000 Vac. Its wide creepage and clearance allow wider isolating gap and minimize electric arcing.

Revision in the regulatory standards

More stringent creepage and clearance requirements during the harmonization of international standard bodies UL and IEC. From 2016, UL 508C (Power Conversion Equipment) transits to IEC 61800-5-1 (Adjustable speed electrical power drive systems). Wider creepage and clearance for new drive model are needed to maintain the same rating specification. For example, at least 13.8 mm creepage and clearance require for reinforced insulation of 690Vac rating.

In the medical systems, ACNT optocouplers have benefits in addressing the high ESD immunity discharge transient overvoltage need across the isolation barrier. In patient monitoring application, ESD immunity type test applies between the sensing circuitry (eg blood pressure, ECG where patient direct contacts) and control board of the device. To address electromagnetic interference (EMI) threats of today for medical devices' increasingly use outside hospitals, there is new fourth edition of the medical electrical equipment standard IEC 60601-1-2 that increase higher ESD immunity discharge levels testing for medical devices (Figure 5). ACNT-H61L use in patient monitoring devices has the benefits of transient overvoltage 12,000 V_{PEAK} and its 15 mm wide creepage and clearance allow wider isolating gap to minimize arcing.



Medical electrical equipment standard - IEC 60601-1-2 4th edition - Higher ESD levels

ESD levels ref transient immunity standard IEC 61000-4-2
IEC 61000-4-2 Electrostatic Discharge

IEC 61000-4-3 Radiated
IEC 61000-4-4 Electromagnetic
IEC 61000-4-5 Surge
IEC 61000-4-6 Conductive

Test type	3 rd edition	4 th edition
Contact Discharge	±2, 4, 6 kV	±2, 4, 8 kV
Air Discharge	±2, 4, 8 kV	±2, 4, 8, 15 kV

Figure 5: Meet high insulation voltage need in medical systems – ACNT-H61L

Broadcom ACNT Optocouplers

Broadcom optocouplers have excellent performance in withstand high voltage surge (1.2μs / 50 μs voltage waveform). As per component safety standard IEC 60747-5-5, Broadcom ACNT optocouplers pass more than 25 kV. The pass criteria is no puncture or partial breakdown of solid insulation at less than 5 pC partial discharge. As shown in Figure 6, ACNT-H50L is tested under non-air condition to remove electric arcing at high voltage surge (ref TUV test result report).

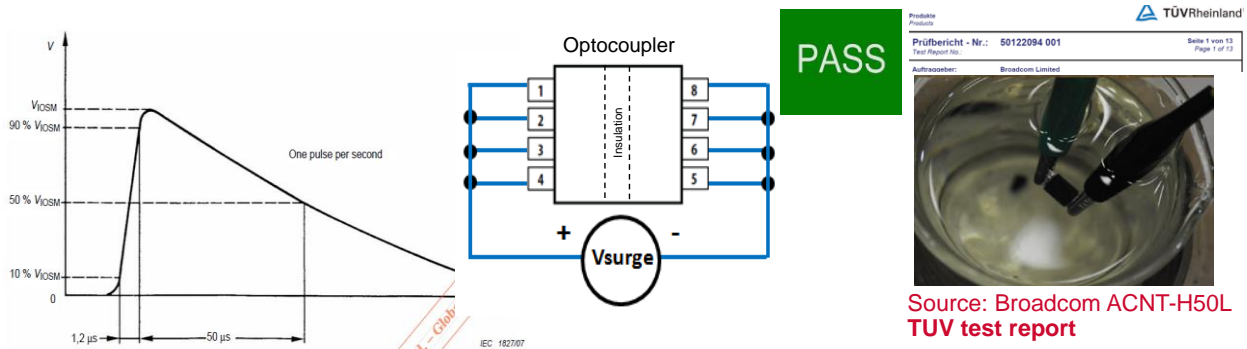


Figure 6: Broadcom optocouplers meet high voltage surge per IEC 60747-5-5

ACNT-H343 is a newly released 5 A gate drive optocoupler in the 15 mm SSO-8 package designed for high voltage, space-constrained industrial applications including 690 VAC motor drives and 1500 V solar inverters. The ACNT-H343 features common mode transient immunity (CMTI) greater than 100 kV/ μ s, preventing erroneous gate driver failures in noisy environments. The device has minimal propagation delay, three times faster than the previous generation device, enabling high-frequency switching to improve efficiency in driving IGBT (insulated-gate bipolar transistor) and SiC/GaN MOSFET.

ACNT-H61L is a 10 MBd low power digital optocoupler that requires only 4.5 mA minimum of LED driving current and detector IC consumes 2 mA maximum I_{DD} across operating temperature. The output of the detector IC is a CMOS output. The internal Faraday shield provides a guaranteed common-mode transient immunity specification of 20 kV/ μ s. The ACNT-H61L suits isolated logic interface communication and control in high voltage or transient power conversion systems.

ACNT-H50L/H511 is a single channel 1 MBd optocoupler of open collector transistor output. Separate connections for the photodiode bias and output transistor collector increase the speed up to a hundred times over that of a conventional photo-transistor by reducing the base-collector capacitance. The ACNT-H50L/H511 suits for applications such as low speed analog, isolated fault or power control feedback.

ACNT-H87B ($\pm 0.5\%$ gain tolerance), ACNT-H87A ($\pm 1\%$ gain tolerance), ACNT-H870 ($\pm 3\%$ gain tolerance) voltage sensors are optical isolation amplifiers designed specifically for voltage sensing. Its 2 V input range and high 1 G Ω input impedance meet the isolated voltage sensing requirements in electronic power converters applications. In a typical voltage sensing implementation, a resistive voltage divider is used to scale the DC-link voltage to suit the input range of the voltage sensor. A differential output voltage that is proportional to the input voltage is created on the other side of the optical isolation barrier.

ACNT-H79B ($\pm 0.5\%$ gain tolerance), ACNT-H79A ($\pm 1\%$ gain tolerance), ACNT-H790 ($\pm 3\%$ gain tolerance) isolation amplifiers are designed for current and voltage sensing in electronic power converters applications. These optocouplers provide the precision and stability needed to accurately monitor motor current in high noise motor control environments, providing for smoother control (less “torque ripple”) in various types of motor control. Combined with superior optical coupling technology, the ACNT-H79B/H79A/H790 uses sigma-delta (Σ - Δ) analog-to-digital modulation, chopper stabilized amplifiers, and a fully differential circuit topology to provide unequaled isolation-mode noise rejection, low offset, high gain accuracy and stability.

Evaluation boards of ACNT optocouplers are available. Please approach Broadcom sales or their authorized distributors for your design needs.

