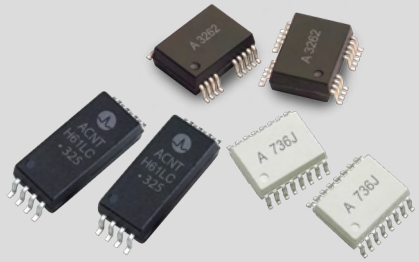
BROADCOM®

Going Green?

Protect with Broadcom Optocouplers



Broadcom Optocouplers

Enabling Green Energy Applications

Broadcom optocouplers are used in an array of **green applications** ranging from **solar** and **wind inverters**, **energy storage, automotive electric vehicles** and **charging** and **power supplies**. The primary purpose of an optocoupler is to provide both electrical insulation and signal isolation.

Optocouplers eliminate the effects of electrical noise caused by crosstalk, power glitches and electrical interference. They provide high voltage isolation allowing safe interface between high and low voltages in electrical circuits.

Broadcom's key optocoupler products include gate drivers for driving power switches like IGBT, SiC and GaN, isolation amplifiers for phase current and bus voltage measurements, high speed digital optocoupler for data transmission and communication.

The popularity of Broadcom optocouplers in these green applications is due to their ability to **drive inverters more efficiently**, to **reduce copper losses by providing high insulation voltage** and to **consume less power during current sensing and data transmission.**

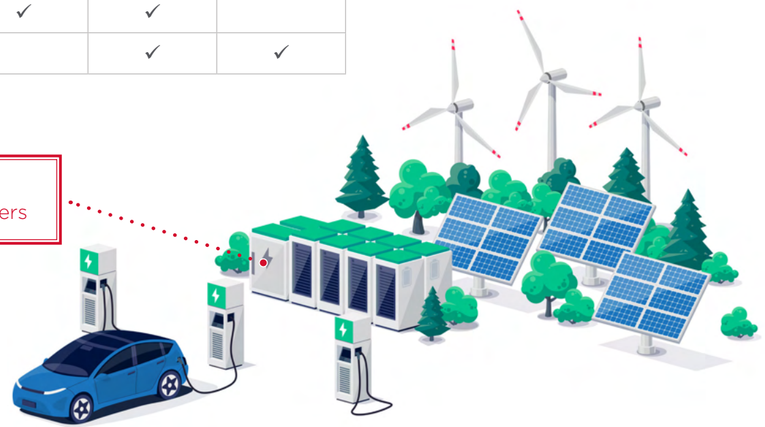
Green Energy Applications

Isolation Solutions for EV Chargers, Renewable Energy Systems

	Gate Driver	Voltage / Current Sensor	Digital	Specific Function, SSR
ESS[1] – Power Conversion System, Battery Mgmt Sys	✓	✓	✓	✓
Renewable Energy Inverter	✓	✓	✓	
Wind Turbines	✓	✓	✓	
DC Fast Charger, Wall Boxes	✓	✓	✓	
AC Wall Boxes, IC-CPD[2]			✓	✓

1. Energy Storage System
2. In-Cable Control & Protection Devices

Green Energy Conversion
Protect with Broadcom Optocouplers



Automotive Applications

Optimized for Critical Under-the-hood and EV Powertrain

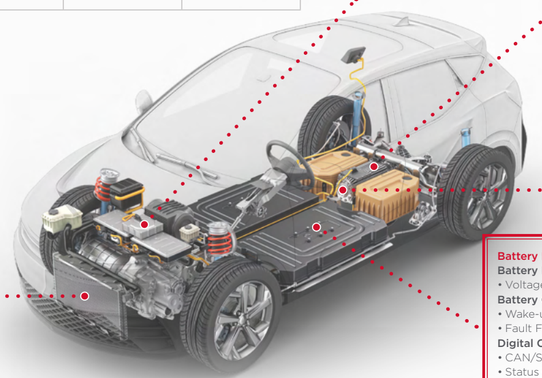
	Gate Driver	Voltage / Current Sensor	Digital	Photo MOSFET/ Driver
On-Board Charger (OBC)	✓	✓	✓	✓
DC/DC Converter	✓	✓	✓	✓
Traction Inverter	✓	✓	✓	✓
Heating, Ventilation, Air Conditioning (HVAC)	✓	✓	✓	✓
Battery Management System (BMS)		✓	✓	✓

Traction Inverter
Analog Sensing
• Voltage Sensing
• Current Sensing
• Analog Feedback
Digital Communication Interface
• CAN/SPI/I²C Bus
• Status Control
Gate Driver
• SiC/IGBT/MOSFET Driver
Active Discharging / Pre-Charging Driver
• SiC/IGBT/MOSFET Driver

On-Board Charger (OBC)
Analog Sensing
• Voltage Sensing
• Current Sensing
• Analog Feedback
Digital Communication Interface
• Wake-up/Status Control
• Fault Feedback
Gate Driver
• SiC/IGBT/MOSFET Driver

DC/DC Converter
Analog Sensing
• Voltage Sensing
• Current Sensing
• Analog Feedback
Digital Communication Interface
• CAN/SPI/I²C Bus
• Status Control
Gate Driver
• SiC/IGBT/MOSFET Driver

Heating, Ventilation, Air Conditioning (HVAC)
Analog Sensing
• Voltage Sensing
• Current Sensing
• Analog Feedback
Digital Communication Interface
• CAN/SPI/I²C Bus
• Status Control
Gate Driver
• SiC/IGBT/MOSFET Driver



Battery Management System (BMS)
Battery Pack Monitoring
• Voltage Sensing
Battery Cell Management
• Wake-up/Status Control
• Fault Feedback
Digital Communication Interface
• CAN/SPI/I²C Bus
• Status Control

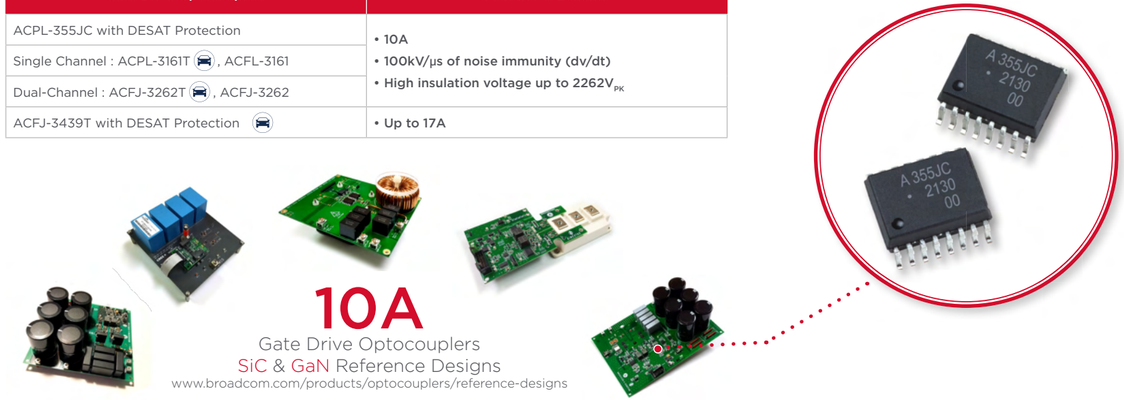
Gate Drive Optocouplers

10A gate drive optocouplers enable efficient green power conversion

The green energy harnessed needs to be conditioned before it can be used for household needs, for charging electric vehicles or be fed into the grid. The conditioning process is done using a power inverter or converter which consists of power switches like the IGBT. With the emergence of **wide bandgap semiconductors, Silicon Carbide (SiC)** and **Gallium Nitride (GaN)** power switches, **the efficiency of power conversion has reached new heights of 99%.**

To enable SiC and GaN power switches, Broadcom has released **10A gate drive optocouplers** to drive them efficiently, with **low conduction and switching losses**. These 10A drivers come with **smart FAULT protection** features, in **single or dual channels**, and can withstand more than **100kV/µs of noise immunity** (dv/dt).

Gate Drive Optocouplers	Features & Benefits
ACPL-355JC with DESAT Protection	• 10A • 100kV/µs of noise immunity (dv/dt) • High insulation voltage up to 2262V_{PK}
Single Channel : ACPL-3161T (automotive), ACFL-3161	
Dual-Channel : ACFJ-3262T (automotive), ACFJ-3262	
ACFJ-3439T with DESAT Protection (automotive)	• Up to 17A



10A
Gate Drive Optocouplers
SiC & GaN Reference Designs
www.broadcom.com/products/optocouplers/reference-designs

Current & Voltage Sensors

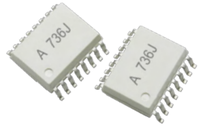
±50mV isolation amplifiers designed for efficient high current sensing

Isolation amplifiers are widely used for current and voltage sensing in renewable energy systems such as solar inverter systems and wind power converter systems.

In a typical solar inverter system, voltage sensors are used to measure the bus voltage of the DC-AC inverter while current sensors are used to measure the output current of the DC-AC inverter. They have a **high gain accuracy of ± 0.5%** and excellent linearity for precise, stable and accurate measurements.

Our **±50mV** linear input range isolation amplifiers are capable of **lower shunt power dissipation while measuring high current**. They are available in compact packages that meet worldwide safety approvals and are RoHS compliant.

Isolation Amplifiers & Modulators	Features & Benefits
ACPL-C72B/A/0	• **±50mV** linear input range • High gain accuracy of ±0.5% / ±1% / ±3% • Very low shunt power dissipation
ACPL-736J	
ACPL-C87BT/AT (automotive)	• DC Voltage Sensor (+2.0V, 0.5% /1%)



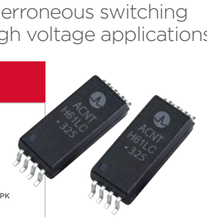
ACNT Optocouplers

15mm package technology enables high voltage applications to achieve high power conversion efficiency

In the field of renewable energy generation, storage, and rail traction control systems, there is a growing trend towards higher DC bus operation and increased requirements for handling transient overvoltages. For instance, in recent years, new solar systems have been upgraded to operate at 1500V_{DC}, aiming to enhance power density through higher voltage. This approach allows the system to **achieve high power conversion efficiency without increasing current, thereby reducing copper losses**. However, a significant challenge faced by the 1500V_{DC} system is finding components that comply with the stringent electrical safety standards and worldwide certifications for high voltage.

This challenge can be overcome with Broadcom's innovative ACNT package, which offers a compact footprint with a 15mm wide creepage, ensuring sufficient clearance for high voltages. Additionally, the ACNT package provides enhanced high voltage protection (**2262V_{PK}**) and signal isolation in confined spaces. It also improves common mode transient immunity (CMTI) to over **100kV/µs** for gate drive products, effectively minimizing erroneous switching failures. The ACNT package is an ideal choice for such high voltage applications.

Optocouplers in ACNT package	Features & Benefits
ACNT-H343 Gate Drive	ACNT Package **15mm Creepage** Highest Working Voltage **2262V_{PK}**
ACNT-H79B/A/0 Current Sense	
ACNT-H87B/A/0 Voltage Sense	
ACNT-H61L/H61LC 10MBd ACNT-H50L/H511/H511C 1MBd	

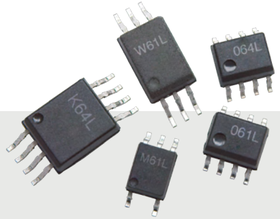


Digital & Specific Function Optocouplers

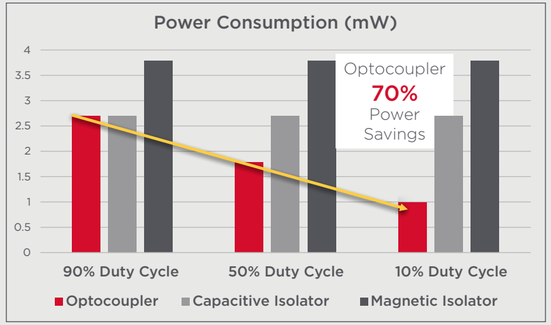
Unique low-power features for power-efficient applications

Broadcom's LED-input optocouplers **consume very little** power especially when they are not transmitting, **unlike capacitive and magnetic-based isolators** which are in a continuous on state, regardless of the output logic. This unique feature makes optocouplers the **most power-efficient** choice for applications operating in extended standby mode, or where duty cycles are low.

Even when the optocouplers are actively transmitting, the low input current (~1.6mA) coupled with a low turn on voltage (~1.3V) of the LED ensures that optocouplers are always energy efficient and cool to operate.



Optocouplers lead in low power consumption!



Low Power Optocouplers	Description
ACPL-M50L/054L/W50L/K54L	1MBd, Open-collector output
ACPL-M61L/064L/W61L/K64L	10MBd, CMOS output
ACPL-K376	AC/DC Voltage/Current Detector
ACPL-M417T/M419T	80V Transistor Output. Low IF with high gain

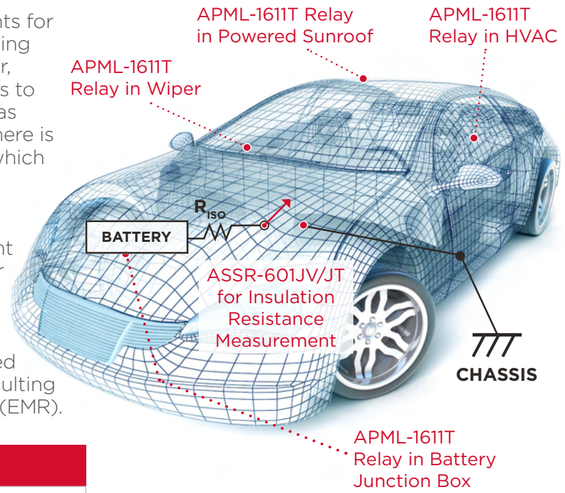
Photovoltaic MOSFET & Driver in Electric Vehicles

Replace mechanical relays with solid state relays

Solid-state relays (SSRs) have gained popularity as replacements for mechanical relays due to their enhanced reliability, faster switching times, absence of switching bounce, and compact size. However, some designers are hesitant to transition from mechanical relays to their solid-state counterparts due to potential drawbacks such as higher relative ON resistance and increased cost. Fortunately, there is an alternative solution that addresses both of these concerns, which involves employing a combination of a **photovoltaic driver and discrete MOSFETs to create a solid-state relay.**

Given the competitive prices of MOSFETs available in the current market, utilizing a photovoltaic driver in conjunction with one or two discrete MOSFETs to construct a solid-state relay presents a favorable option for replacing mechanical relays.

Furthermore, when two back-to-back MOSFETs are incorporated into the setup, the combination forms a bidirectional switch, resulting in the SSR being equivalent to a 1FormA Electromechanical Relay (EMR).

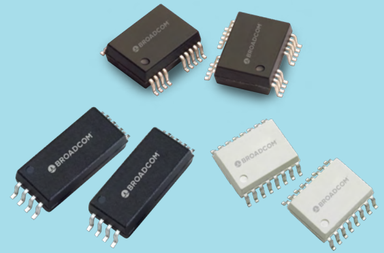


Photovoltaic MOSFET & Driver	Description
ACPL-K30T ACPL-K309T	Photovoltaic MOSFET Driver, 7V open circuit voltage at I_F = 10mA Photovoltaic MOSFET Driver, 14.3V open circuit voltage at I_F = 10mA
ASSR-601JV/JT APML-600JV/JT	1500V Photo MOSFET with 1uA leakage current
APML-1611T	60V/2.5A Photo MOSFET to replace low voltage expensive mechanical relays

Optocouplers Product Stewardship

Broadcom strives to provide the highest quality products while ensuring compliance with the relevant regulatory requirements, including RoHS, REACH and regulations related to Conflict Minerals. Refer to Broadcom's Environmental, Social & Governance (ESG) report for more information on environmental stewardship.

- RoHS
- REACH
- TSCA
- China VOC



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Broadcom Inc. (NASDAQ: AVGO) is a global technology leader that designs, develops and supplies a broad range of semiconductor and infrastructure software solutions.

Broadcom's category-leading product portfolio serves critical markets including data center, networking, enterprise software, broadband, wireless, storage and industrial. Our solutions include data center networking and storage, enterprise, mainframe and cybersecurity software focused on automation, monitoring and security, smartphone components, telecoms and factory automation. For more information, go to www.broadcom.com.

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