5MBd Digital Optocouplers Targeting Low Power/ Low Supply Voltage Applications

Introduction

Digital optocouplers in electrical system provide high voltage insulation and noise rejection for data transmission. A high quality insulation barrier in the optocoupler is needed to provide outstanding reliability and durability for signal isolation.

In addition to insulation and noise rejection capabilities, Avago's new 5MBd digital optocouplers, ACPL-M21L/021L/024L/W21L/K24L, the ACPL-x2xL family offers significant improvement in power saving and efficiency for power conscious applications. Lower system power consumption is now a requirement for many electronics applications ranging from industrial, medical, power control system, communications, etc. These new digital optocouplers consume 80% lesser power as compared to the conventional 5MBd digital optocouplers in the market.

Key Features and Specifications

The ACPL-x2xL digital optocouplers are newly designed optocouplers with CMOS outputs for low power consumptions. They are designed for various applications such as computer peripheral interfaces, microprocessors system interfaces, high speed line receiver, power control system, etc. Device performance is guaranteed over a wide temperature range from –40 to 105°C, making them ideal for industrial applications.

The key features of ACPL-x2xL digital optocoupler family are as follow:

- Low LED input current allows direct drive from CMOS outputs without the need for an external buffer (refer to Figure 1)
- Low supply current and supply voltage for low power consumption
- 25 kV/µs static common mode rejection - no compromise on noise immunity!
- Schmitt Trigger input for better noise immunity
- IEC60747-5-5 certification for reinforced insulation with continuous working voltages at 567Vpeak and transient voltages of 6kVpeak for ACPL-M21L/021L/024L and continuous working voltages at 1140Vpeak and transient voltages of 8kVpeak for ACPL-W21L/K24L

Table 1 shows a selection of key technical specifications.

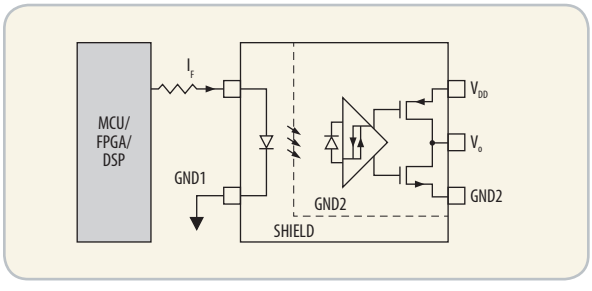

Figure 1. ACPL-M21L directly driven from MCU / FPGA / DSP without external buffer

Table 1. Key technical specifications of ACPL-x2xL

Parameter	Specification
Propagatiion Delay	250ns (max)
Propagatiion Delay Skew	220ns (max)
Pulse Width Distortion	200ns (max)
LED Input Current	1.6 to 6 mA
IDD Supply Current	1.1mA (max)
Common Mode Noise Rejection	25 kV/µs @ V_{CM} = 1000V
Supply Voltage	2.5 to 5.5V
Temperature Range	–40 to 105°C
Continuous Working Voltage, V_{IORM}	567Vpeak / 1140Vpeak
Isolation Voltage, V_{ISO}	3750Vrms / 5000Vrms

Low Power Consumption

The advantage of the new 5MBd digital optocoupler family is the feature of low power consumption. The new ACPL-x2xL family of optocouplers consume less than 10mW of power without compromising signal isolation capability. With minimum input drive current of 1.6mA, maximum supply current of 1.1mA and a low supply voltage of 3.3V, the new 5MBd digital optocouplers reduce power consumption by as much as 80% as compared to the conventional 5MBd digital optocouplers and other isolators in the market.

Figure 2 shows the new 5MBd digital optocouplers having the lowest power among the other 5MBd digital optocouplers in the market.

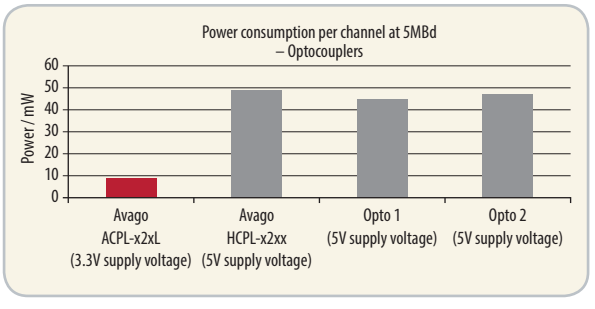

Figure 2. Power consumption comparison : ACPL-x2xL to conventional 5MBd optocouplers in the market

Better and Improved Performance

The new ACPL-x2xL family of optocouplers offered upgraded performance and improved features as compared to the HCPL-x2xx conventional optocouplers in low voltage logic applications (Refer to Table 2). The upgraded ACPL-x2xL family of optocouplers include performances such as low supply current, low LED input current, low supply voltage, higher CMR and wider temperature range. The new 5MBd digital optocouplers are used with low voltage logic applications (2.5V/3.3V/5V supply voltage).

Table 2. ACPL-x2xL Comparison to HCPL-x2xx

Type	Conventional Avago 5MBd Parts (Package)	New Product	Package/ Configuration	Advantage for Upgrading to New Product	Upgraded Features
5MBd Digital Optocouplers	HCPL-0201/0211(SO8)	ACPL-M21L	SO5 Single Channel	Smaller footprint	• ≥80% power consumption saving • Low forward current (I_F ≥1.6mA min) • Low supply current (I_{DD} ≤ 1.1mA) • Wide temperature range (-40°C to 105°C) • Low supply voltage (2.5V to 5.5V) • Excellent CMR performance 25kV/µs @ Vcm 1000V --- Part specific (ACPL-W21L/K24L): • Offer higher working insulation voltage 1140Vpk, isolation voltage 5000Vrms with smaller footprint and with wider Creepage/Clearance (8mm/8mm)
		ACPL-021L	SO8 Single Channel	Same footprint (Direct drop in)	
	HCPL-2231/2232 (300mil DIP8)	ACPL-024L	SO8 Dual Channel	Smaller footprint	
	HCPL-2219/2200/2201/2211 HCPL-2202/2212 (300mil DIP8)	ACPL-W21L	SSO6 Single Channel	Smaller footprint	
	HCPL-2231/2232 (300mil DIP8)	ACPL-K24L	SSO8 Dual Channel	Smaller footprint	

Optocoupler CMR Performance

Common mode noise can be a significant problem in data communication applications, especially in industrial environments where electric motors, sensors and programmable logic controllers are connected together.

An internal proprietary Faraday shield which is an effective planar metal tracks around the output receiver provides ESD protection and decouples the input side and output side of the optocouplers. This unique package design also minimizes the input to output capacitance. These two factors minimize the effects of common-mode noise and thus achieving high common mode transient immunity of >25kV/µs @Vcm = 1000V.

The "split resistor" input LED drive configuration shown in Figure 3 balances the impedance across the anode and cathode of the LED which further improves the CMR performance. A common mode noise voltage rise on the LED is symmetrical and therefore cannot switch the LED on. The series connected LED and current limiting resistor form a low pass filter that helps to filter noise transients.

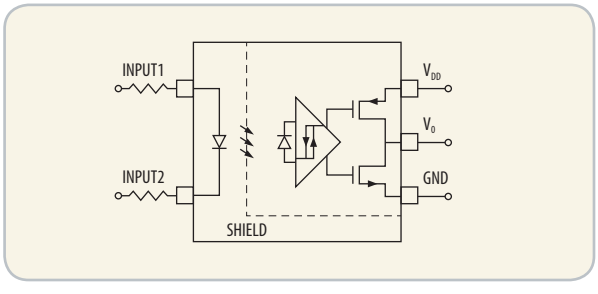

Figure 3: Typical high-CMR drive circuit configuration

LED Reliability

The quality of the LED used in an optocoupler is an important factor for determining the life time of the product. Avago produces high reliability LEDs for optocouplers at its in-house facility. The infrared, AlGaAs LED used in the ACPL-x2xL provides excellent stability over both temperature and time. As shown in Figure 4, LED degradation is minimal after the lifetime of 30 years. This is based on the typical LED driving current of 2.2mA at temperature of 100°.

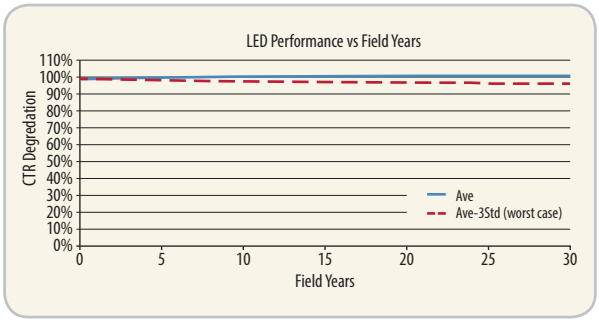

Figure 4: CTR degradation over field years

CANBus / Serial Data Transmission Applications

Digital optocouplers can be used to isolate I/O networking communication ports ranging from CANbus, RS-485, RS-232 and I^2C applications. In Figure 5, the digital optocouplers are placed between the transceiver and the bus interface so as to isolate transient/burst interference and also to transmit data between the bus transceiver and the controller.

CANbus evaluation board is available. The design of this application example is for CANbus isolations using ACPL-M21L.

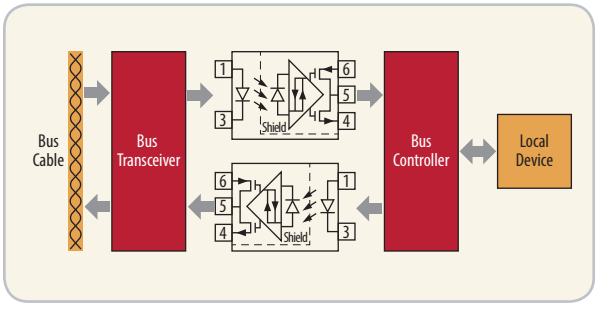

Figure 5: Optocouplers provide isolation between MCU and CAN bus transceiver

Contact us for your design needs at: **www.avagotech.com/5mbd_family**

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