Isolated Current Sensing Module with ACPL-C79X

User Guide

Introduction

The ACPL-C79x isolated current sense evaluation module, shown in Figure 1, is pin-to-pin compatible with several Hall effect current transducers. The evaluation module has a ±1% (ACPL-C79A) isolation amplifier gain accuracy, but the ACPL-C79x is also offered with a ±0.5% (ACPL-C79B) or ±3% (ACPL-C790) specification. The ACPL-C79B/C79A/C790 isolation amplifiers were designed for current and voltage sensing in electronic power converter, motor drive and renewable energy applications.

For many compact power drive designs, a shunt resistor plus isolation amplifier measurement solution has many benefits over traditional Hall effect current sensors. The benefits include a smaller, lower profile component with better linearity, lower temperature drift, and lower cost.

As shown in Figure 2, the evaluation module is 20 mm by 16 mm and 24 mm high.

Key components, including the shunt resistor and isolation amplifier, are available in small surface mount packages. Some designers who are familiar with current transducers can find using the shunt resistor plus optically isolated isolation amplifier a challenge. This evaluation module makes the evaluation quick and very easy.

The evaluation module is pin-to-pin compatible with selected Hall effect current transducers, such as LEM's LTS 6-NP, LTS 15-NP, LTS 25-NP, CAS 6-NP, CAS 15-NP, and CAS 25-NP models [1]. With the evaluation module, designers using the LTS and CAS devices will find it easy to evaluate and compare the ACPL-C79X based current sensing solution against their existing Hall effect current transducer solutions. For example, a designer can simply remove an LTS 15-NP device and plug in the evaluation module and start a quick evaluation.

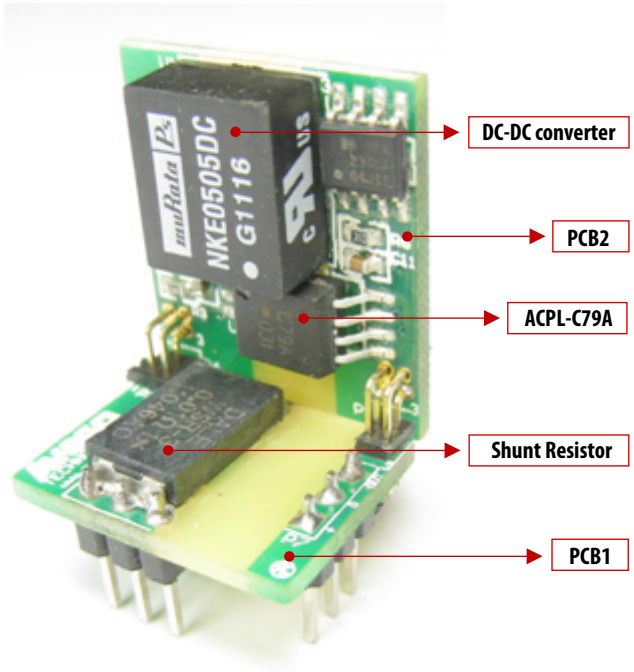


Figure 1. ACPL-C79x isolated current sense evaluation module

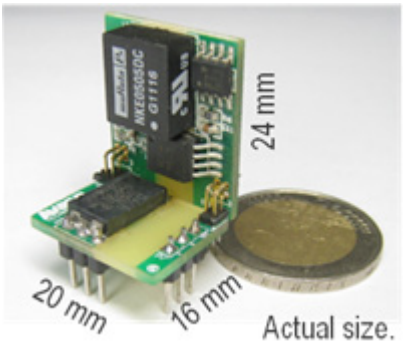


Figure 2. Current sense isolation amplifier evaluation module

Note 1. Products of LEM Holding SA

Schematic

The evaluation module circuit schematic is show in Figure 3. The evaluation module is made from two printed circuit boards (PCBs): PCB1 and PCB2. PCB1 has the shunt resistor and two header connectors to form a current path; a third header connector is used as an interface. PCB2 has an ACPL-C79A isolation amplifier (±1% gain accuracy) and an isolated DC-DC converter. The two PCBs are assembled with header connectors P4 and P5.

AC or DC current through shunt resistor R1 results in a voltage that is proportional to current. This voltage is filtered by the anti-aliasing filter formed by R2, R3 and C1 and then sensed by the differential input ACPL-C79A. A differential output voltage that is proportional to the input voltage is created on the other side of the optical isolation barrier.

Following the isolation amplifier, an OPA237 configured as a difference amplifier converts the differential signal to a single-ended output. This stage can be configured to further amplify the signal, if required, and form a low-pass filter to limit the bandwidth.

In the evaluation module, the difference amplifier is designed for a gain of 1 with a low-pass filter corner frequency of 234 kHz. Resistors R6 and R7 can be selected for a different gain. The bandwidth can be reduced by adding capacitors to the positions of C6 and C8.

With the ACPL-C79A gain of 8.2, the overall transfer function is:

$$Vout = I \times R1 \times 8.2 + Vref .$$

The output signal, Vout, is then connected to the next stage, such as a signal processor, through the P7 header connector, pin 3.

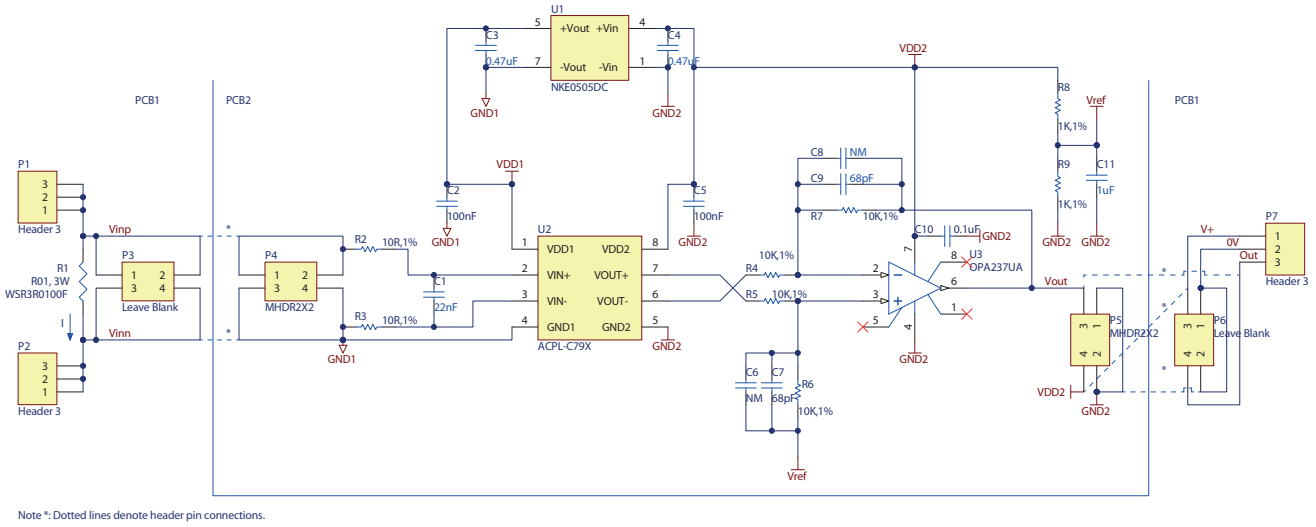
Shunt Resistor and Current Range

The shunt resistor in this module is fixed at 10 milliohm. The appropriate current measurement range is about 15 A_{RMS}. This is calculated from the nominal input range of ±200 mV of the ACPL-C79A. The ACPL-C79x specifies a full scale input range of ±300 mV, which allows accurate overload current detection of up to 21 A_{PEAK}. Because the evaluation module does not provide good heat dissipation for the shunt resistor due to small PCB size, limit current to 10 A_{RMS} during evaluation or for a quick functional check at 15 A_{RMS}. For a detailed performance evaluation, a PCB with proper layout for the shunt resistor and other components is recommended.

Power Supplies

The evaluation module works on a single 5 V supply, which can be the same power supply for the signal processor and controller device connected through pin 1 and 2 of P7.

The isolated DC-DC converter (U1 in Figure 3) is included in the evaluation module to power up the signal input side of the ACPL C79A; this makes the evaluation an easy plug-and-play operation. However, to make an ACPL C79A based solution cost effective in mass production, the 5 V supply would usually be supplied by a floating power supply, which in many applications could be the same supply that is used to drive the high-side power transistor. A simple three-terminal voltage regulator will provide a stable voltage. Another method is to add an additional winding to an existing transformer to produce a 5 V supply.



Note *: Dotted lines denote header pin connections.

Figure 3. The Evaluation module schematic

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

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