

## PmodISNS20™ Reference Manual

Revised April 12, 2016

This manual applies to the PmodISNS20 rev. A

### Overview

The Digiilent PmodISNS20 is a small current sense module with a digital SPI interface. The board combines an [Allegro ACS722 Hall Effect current sensor](#) with a 12-bit analog-to-digital converter from [Texas Instruments](#). The PmodISNS20 is quick, accurate, and easy to use for a variety of applications.



*The PmodISNS20.*

Features include:

- High accuracy current sensor
- Measure current with 120Hz/20kHz/80kHz jumper selections
- $\pm 20\text{A}$  DC or AC input
- Accurate to within  $\pm 2\%$
- 12-bit ADC
- Small PCB size for flexible designs 1.3 in  $\times$  0.8 in (3.3 cm  $\times$  2.0 cm)
- 6-pin Pmod port with SPI interface
- Follows Digiilent Pmod Interface Specification Type 2
- Library and example code available in [resource center](#)

Applications:

- Current measurement
- Power metering
- Closed loop current control
- Over-current protection

## 1 Functional Description

The PmodISNS20 is designed to send current data over Serial Peripheral Interface to a host board. The PmodISNS20 sends a 12-bit digital value that represents the amount of current flowing through the terminal block. It should be mentioned that unlike reading voltage, current is read in series. This digital representation can be used in software or FPGA logic, displayed, or sent through a serial monitor.

## 2 Interfacing with the Pmod

The PmodISNS20 communicates with the host board via the SPI protocol. The 12 bits of digital data are sent to the system board in 16 clock cycles with the most significant bit first. For the ADC7476, each bit is shifted out on each falling edge of the serial clock line after the chip select line is brought low with the first four bits as leading zeroes and the remaining 12 bits representing the 12 bits of data. The datasheet for the ADC7476 recommends that for faster microcontrollers or DSPs, the serial clock line is first brought to a high state before being brought low after the fall of the chip select line to ensure that the first bit is valid.

Header J1		
Pin	Signal	Description
1	CS	Chip Select
2	(NC)	Not Connected
3	MISO	Master-In-Slave-Out
4	CLK	Serial Clock
5	GND	Power Supply Ground
6	VCC	Positive Power Supply (3.3V)

Table 1. Pinout description table.

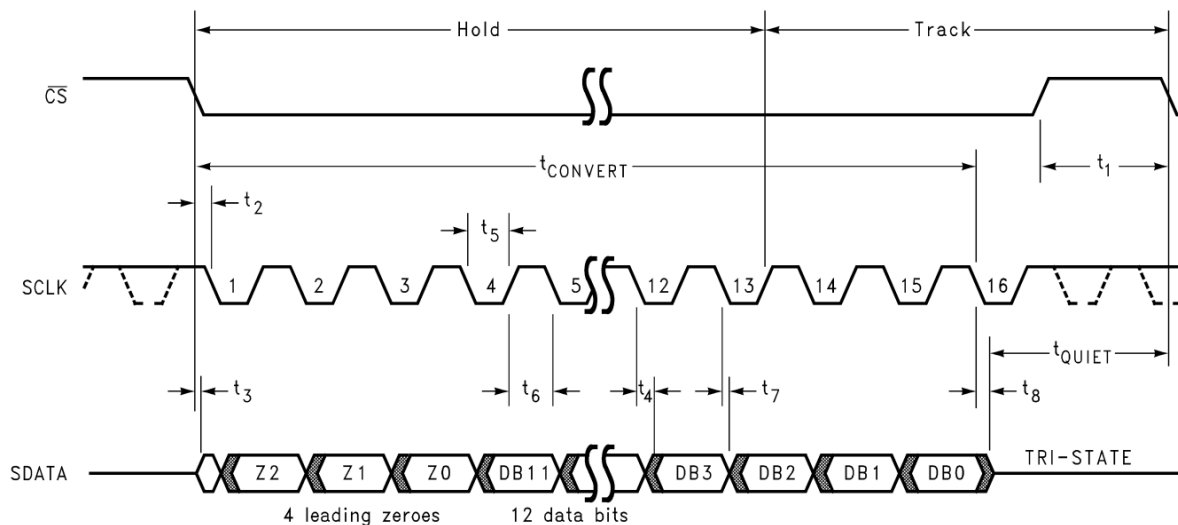


Figure 1. PmodISNS20 timing diagram.

The PmodISNS20 uses three wires to communicate with the host board. The wires used are Chip Select (CS), Serial Clock (CLK), and Data Out (DO) – also known as MISO. At 0.0 Amps, the ADC will return over SPI a value of 2048. At full negative current, a value of 0 will be returned, and likewise at full positive current a value of 4095 will be returned. Knowing this we can derive the equation needed in order to convert this signal into useful information.

$$I_{mA} = \frac{1000}{89.95} (ADC_{VALUE} - 2048)$$

The scaling value at the beginning of the equation was derived using the provided sensitivity of 66mV/A off of the ACS722 datasheet. Note that the provided sensitivity is based on a reference voltage of 3.3V to the sensor and our design provides a regulated 3.0V for a cleaner signal, so some more correction may be needed if absolute accuracy is needed.

Table 2 below shows how to configure the sampling rate frequency. The current sensing chip allows either 20 kHz or 80 kHz sampling rate which is configured with Jumper 2. Enabling Jumper 1 turns on an analog filter to bring it down to 120 Hz. The lower frequency is useful to keep noise down on <120 Hz AC circuit applications, such as reading from mains power.

Rate	JP1	JP2
120 Hz	Enabled	Enabled
120 Hz	Enabled	Disabled
20 kHz	Disabled	Enabled
80 kHz	Disabled	Disabled

Table 2. Sample rate frequency configuration.

In order to read the amperage flowing through the ISNS20, the power source will need to be wired in series through the green terminal block, noting proper polarity indicated by the silkscreen on the PCB. When using the ISNS20 for measuring Alternating Current (such as from mains), absolute care should be taken. Improper use of the ISNS20 on mains power can result in fire, injury, and even death – extreme caution should be taken.

Any external power applied to the PmodISNS20 must be within 3.0V and 3.6V; however, it is recommended that Pmod is operated at 3.3V.

### 3 Physical Dimensions

The pins on the pin header are spaced 100 mil apart. The PCB is 1.3 inches long on the sides parallel to the pins on the pin header and 0.8 inches long on the sides perpendicular to the pin header.

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