

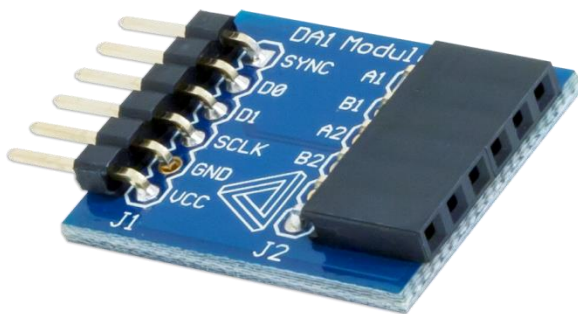
PmodDA1™ Reference Manual

Revised May 24, 2016

This manual applies to the PmodDA1 rev. C

Overview

The Digilent PmodDA1 is an 8-bit Digital-to-Analog Converter module that can output up to four different analog signals simultaneously. This module is ideal for users who want to output a variable voltage signal but do not want to use up their system board's analog capable pins.



The PmodDA1.

Features include:

- Two 8-bit DACs
- Four D/A conversion channels
- Maximum conversion rate of 1.875 MSa
- Small PCB size for flexible designs 1.0" × 0.8" (2.5 cm × 2.0 cm)
- 6-pin Pmod connector with GPIO interface
- Library and example code available in [resource center](#)

1 Functional Description

The PmodDA1 converts an 8-bit digital input signal to a corresponding analog output voltage ranging from 0 to V_{dd}. Each of the two [AD7303s](#) on this Pmod have two 8-bit DACs allowing the user to select which DAC they want their stream of data to be passed through. Because each chip is double buffered, users may also choose to send two separate streams of data on an input and then update the two corresponding outputs simultaneously.

2 Interfacing with the Pmod

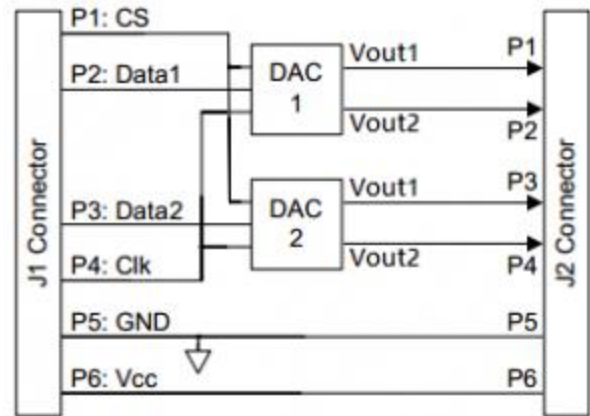
The PmodDA1 communicates with the host board via an SPI-like communication protocol. The difference between the standard SPI protocol and this protocol is manifested in the pin arrangement on this Pmod. A typical SPI interface would expect a Chip Select, a Master-Out-Slave-In, a Master-in-Slave-Out, and a Serial Clock signal. However, with the two DACs on this chip, both of the data lines (MOSI and MISO) are designed to operate only as inputs, making them both Master-Out-Slave-In data lines.

The PmodDA1 will receive its 8 bits of information from the system board through 16 clock cycles with first eight bits consisting of eight control bits and the remaining eight bits representing the 8 bits of the data with the MSB first. Each bit is received by the rising edge of the serial clock line. The function dictated by the first eight control bits is executed when the chip select line is brought high.

A pinout table and diagram for the PmodDA1 are provided below:

| Header J1 | | |
|-----------|--------|--------------------------|
| Pin | Signal | Description |
| 1 | ~SYNC | Chip Select (active low) |
| 2 | D0 | Input Data 1 |
| 3 | D1 | Input Data 2 |
| 4 | SCK | Serial Clock |
| 5 | GND | Power Supply Ground |
| 6 | VCC | Power Supply (3.3V/5V) |

| Header J2 | | |
|-----------|--------|-----------------------|
| Pin | Signal | Description |
| 1 | A1 | Output Data A1 |
| 2 | B1 | Output Data B1 |
| 3 | A2 | Output Data A2 |
| 4 | B2 | Output Data B2 |
| 5 | GND | Power Supply Ground |
| 6 | VCC | Positive Power Supply |



DA1 Circuit Diagram

Figure 1. PmodDA1 circuit diagram.

Table 1. Connector J1: Pin descriptions as labeled on the Pmod.

The on-board DACs can in principle use either an external or internal reference voltage; however, the PmodDA1 is designed that the internal reference voltage of $V_{dd}/2$ volts must be used. Because of this, the first bit in the command signal sent to the Pmod must always be a logic low signal in order to use the internal reference voltage on the DAC. Tables describing the command signal and the associated bits from the [AD7303 datasheet](#) are provided below.

| Control Bits | | | | | | | | Data Bits | | | | | | | |
|--------------|---|------|-----|-----|------|-----|-----|-----------|-----|-----|-----|-----|-----|-----|-----|
| ~INT/EXT | X | LDAC | PDB | PDA | ~A/B | CR1 | CR0 | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| (MSB) | | | | | | | | (LSB) | | | | | | | |

Table 2. PmodDA1 input shift register structure.

Note: The "~" signifies that the signal is active when driven low.

| Bite Name | Description |
|-----------|---|
| ~INT/EXT | Selects between the internal and external voltage reference |
| X | Don't care |
| LDAC | Load DAC bit to both load and update the DAC outputs |
| PDB | Power-down DAC B |
| PDA | Power-down DAC A |
| ~A/B | Selects either DAC A or DAC B to process the data |
| CR1 | Works with CR0 as per the Control Bits Truth Table below |
| CR0 | Works with CR1 as per the Control Bits Truth Table below |
| Data | The user submitted data where DB7 is the MSB and DB0 is the LSB |

Table 3. Bit descriptions.

| LDAC | ~A/B | CR1 | CR0 | Resulting Operation |
|------|------|-----|-----|---|
| 0 | X | 0 | 0 | Both DAC registers loaded from the shift register |
| 0 | 0 | 0 | 1 | Update DAC A register from the shift register |
| 0 | 1 | 0 | 1 | Update DAC B register from the shift register |
| 0 | 0 | 1 | 0 | Update DAC A DAC register from the input register |
| 0 | 1 | 1 | 0 | Update DAC B DAC register from the input register |
| 0 | 0 | 1 | 1 | Update DAC A DAC register from the shift register |
| 0 | 1 | 1 | 1 | Update DAC B DAC register from the shift register |
| 1 | 0 | X | X | Load DAC A input register from the shift register and update both DAC registers |
| 1 | 1 | X | X | Load DAC B input register from the shift register and update both DAC registers |

Table 4. Control bits truth table.

| PDA | PDB | Description |
|----------|---|---|
| 0 | 0 | Both DACs are active |
| 0 | 1 | DAC A is active and DAC B is in power-down mode |
| 1 | 0 | DAC B is active and DAC is in power-down mode |
| 1 | 1 | Both DACs are in power-down mode |
| ~INT/EXT | Description | |
| 0 | Internal Vdd/2 reference voltage selected | |
| 1 | External reference voltage selected | |

Table 5. Another truth table compiled from the AD7303 datasheet.

3 Physical Dimensions

The pins on the pin header are spaced 100 mil apart. The PCB is 1 inch 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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