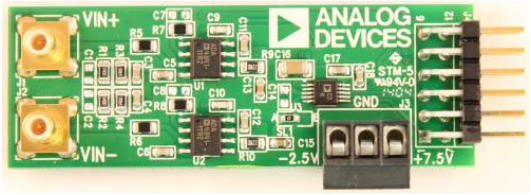
Analog Devices Wiki

This version (20 Feb 2024 07:41) was ***approved*** by Faizan Khan [https://ez.analog.com/members/fkhan].
The Previously approved version (/resources/eval/user-guides/circuits-from-the-lab/pulsar-adc-pmods?rev=1677802097) (03 Mar 2023 01:08) is available.

PulSAR ADC PMODs

These low power ADCs offer very high performance from 14-bits up to 18-bits with throughputs ranging from 100 kSPS (thousands of samples per second) to 1.3 MSPS (mega/millions of samples per second). The boards are designed to demonstrate the ADC's performance and to provide an easy digital interface for a variety of system applications. A full description of these products is available in their respective data sheets and should be consulted when utilizing the boards. To purchase hardware, please visit our website. [https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/PulsarPMODs.html]



(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/pulsar_pmod.jpg?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

The products which have PMOD boards associated with them can be found in the table below.

Products	Resolution	ADC Throughput*	Input Stage	Driver Amplifier	PMOD Part Number
AD7942 [https://www.analog.com/AD7942]	14-Bit	250 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7942-PMDZ [https://www.analog.com/EVAL-AD7942-PMDZ]
AD7946 [https://www.analog.com/AD7946]	14-Bit	500 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7946-PMDZ [https://www.analog.com/EVAL-AD7946-PMDZ]
AD7988-1 [https://www.analog.com/AD7988-1]	16-Bit	100 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7988-1-PMDZ [https://www.analog.com/EVAL-AD7988-1-PMDZ]
AD7685 [https://www.analog.com/AD7685]	16-Bit	250 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7685-PMDZ [https://www.analog.com/EVAL-AD7685-PMDZ]
AD7687 [https://www.analog.com/AD7687]	16-Bit	250 kSPS (thousands of samples per second)	Unipolar, Differential Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7687-PMDZ [https://www.analog.com/EVAL-AD7687-PMDZ]
AD7686 [https://www.analog.com/AD7686]	16-Bit	500 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7686-PMDZ [https://www.analog.com/EVAL-AD7686-PMDZ]
AD7688 [https://www.analog.com/AD7688]	16-Bit	500 kSPS (thousands of samples per second)	Unipolar, Differential Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7688-PMDZ [https://www.analog.com/EVAL-AD7688-PMDZ]
AD7693 [https://www.analog.com/AD7693]	16-Bit	500 kSPS (thousands of samples per second)	Unipolar, Differential Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7693-PMDZ [https://www.analog.com/EVAL-AD7693-PMDZ]
AD7988-5 [https://www.analog.com/AD7988-5]	16-Bit	500 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7988-5-PMDZ [https://www.analog.com/EVAL-AD7988-5-PMDZ]
AD7980 [https://www.analog.com/AD7980]	16-Bit	1000 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7980-PMDZ [https://www.analog.com/EVAL-AD7980-PMDZ]
AD7983 [https://www.analog.com/AD7983]	16-Bit	1333 kSPS (thousands of samples per second)	Unipolar, Single-Ended Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7983-PMDZ [https://www.analog.com/EVAL-AD7983-PMDZ]
AD7690 [https://www.analog.com/AD7690]	18-Bit	400 kSPS (thousands of samples per second)	Unipolar, Differential Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7690-PMDZ [https://www.analog.com/EVAL-AD7690-PMDZ]
AD7691 [https://www.analog.com/AD7691]	18-Bit	250 kSPS (thousands of samples per second)	Unipolar, Differential Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7691-PMDZ [https://www.analog.com/EVAL-AD7691-PMDZ]
AD7982 [https://www.analog.com/AD7982]	18-Bit	1000 kSPS (thousands of samples per second)	Unipolar, Differential Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7982-PMDZ [https://www.analog.com/EVAL-AD7982-PMDZ]
AD7984 [https://www.analog.com/AD7984]	18-Bit	1333 kSPS (thousands of samples per second)	Unipolar, Differential Input	ADA4841 [https://www.analog.com/ADA4841]	EVAL-AD7984-PMDZ [https://www.analog.com/EVAL-AD7984-PMDZ]

* The throughput of your PulSAR ADC will be limited to the SPI (Serial Peripheral Interface) bus speed of your platform. For example, if you are using the SDP platform the max bus rate on the SPI (Serial Peripheral Interface) is 30 MHz (megahertz).

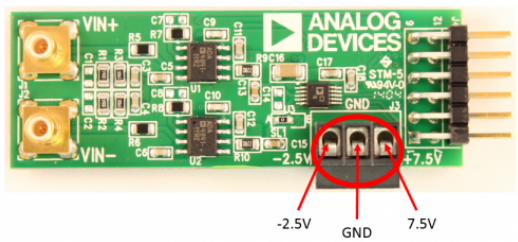
Hardware Setup

The PMOD board is small in size with dimensions approximately 1 inch in width by 3 inches in length. There are a few areas of the hardware I'd like to point out for you, in order to use the board.

Power Supply Requirements

Typically, when using a PMOD board the power for the module comes directly from the host board it is connected to. The power is generally capable of providing up to 100 mA (milliampere) at 3.3V, and for complete power specifications please click here [https://www.digilentinc.com/Pmods/Digilent-Pmod_%20Interface_Specification.pdf].

In the case of the high precision, successive approximation ADC's architecture, it was required to provide low noise external power supplies to obtain datasheet results. The ADC's are driven by precision amplifiers which are also optimized for noise and power. In order to enable those amplifiers to provide zero and full scale inputs to the ADC, power supplies above and below the ADC input range were needed.

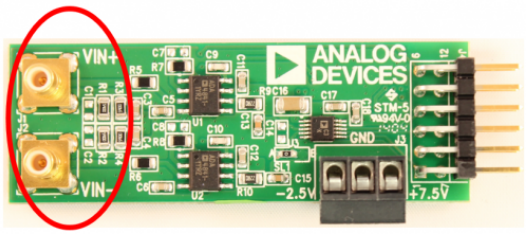


(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/pmod_power_supplies.png?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

With all these factors combined, the board was designed using external power supplies of -2.5V, GND (of course), and 7.5V. These supplies provide the power for the entire PMOD board, so even though power is coming in through the PMOD connector, it's not actually powering the components on the board.

Input Connectors

For the input signals coming into the PMOD board, SMB connectors were chosen to help minimize the noise at the input. There are two (2) SMB connectors per board, and thats because there are both positive(+) and negative(-) inputs to each converter. This will provide the user with the cleanest input signal possible, and fully utilize the resolution and speed of the converters.



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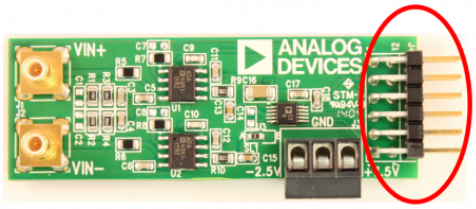
Each of the converters also has a combination of single-ended inputs, differential inputs, or pseudo-differential inputs. So in order to determine the input style of your converter it is imperative to look at the datasheet of the device you are using. The datasheet of any device should always be followed before using it in an application or on a board.

Digital Interface (PMOD)

The PMOD interface is a series of standardized digital interfaces for various digital communication protocols such as SPI (Serial Peripheral Interface), I2C (Inter-Integrated Circuit), and UART (universal asynchronous receiver/transmitter). These interface types were standardized by Digilent, which is now a division of National Instruments. Complete details on the PMOD specification can be found here [https://www.digilentinc.com/Pmods/Digilent-Pmod_%20Interface_Specification.pdf].

The specific interface used for the PulSAR PMOD boards is the extended SPI (Serial Peripheral Interface). In general ADI (Analog Devices, Inc.) has adopted the extended SPI (Serial Peripheral Interface) connector for all PMOD devices which have an SPI (Serial Peripheral Interface) interface. It provides flexibility to add interrupts, general purpose I/O, resets, and other important digitally controlled functions.



Pin	Function	Pin	Function
1	CNV (CS)	7	NC
2	NC	8	NC
3	MISO	9	NC
4	SCLK	10	NC
5	GND	11	GND
6	VCC	12	VCC

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Above is the connection to each of the PulSAR PMOD boards to the SPI (Serial Peripheral Interface) PMOD connector. Each of the PulSAR PMOD boards is hardware configured in a 3-wire mode with no busy indicator. This configuration can be better explained in the datasheet if you desire to learn more. This basically means that the only signals that go between the converter and the processor are the CNV (similar to a chip select in this mode), SCLK (System Clock) (serial Clock), and MISO (serial data out). There are no registers internal to the PulSAR ADC's, so there is no need for a data input line, the data just streams out using the CNVST pin.

Getting Started

Using any of the PulSAR ADC PMOD boards is very simple. To get started evaluating the ADCs, you are going to need the following equipment:

- EVAL-AD7xxx-PMDZ [https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/PulsarPMODs.html] PMOD board (whichever version you are interested in)
- EVAL-SDP-CB1Z [https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/SDP-B.html] (If you order this from the website it also includes the Mini USB (Universal Serial Bus) Cable)
- SDP-PMD-IB1Z [https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/EVAL_SDP-PMOD.html] (If you order this from the website it also includes the EVAL-CFTL-6V-PWRZ)
- EVAL-CFTL-6V-PWRZ [https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/EVAL-CFTL-6V-PWRZ.html]
- PC with Windows (.NET 3.5 or higher)
- Mini USB (Universal Serial Bus) Cable

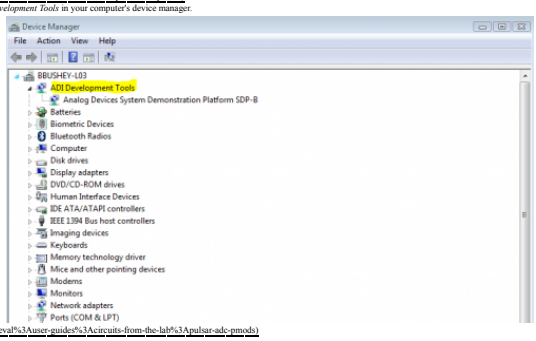
Evaluation

Evaluating the PulSAR ADC PMOD boards is very simple. Using the required equipment, follow these simple steps to get the evaluation working. Please make sure you completely unplug all the boards before beginning.

1. Plug in the Mini USB (Universal Serial Bus) cable from a USB (Universal Serial Bus) port on your PC, to the **J1** of the EVAL-SDP-CB1Z.

(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/sdp_usb.jpg?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

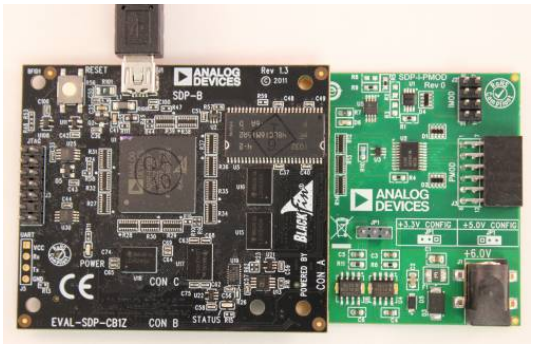
   - Make sure that the computer installs the device drivers, and that you can see the *ADI (Analog Devices, Inc.) Development Tools* in your computer's device manager.



(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/device_manager.png?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

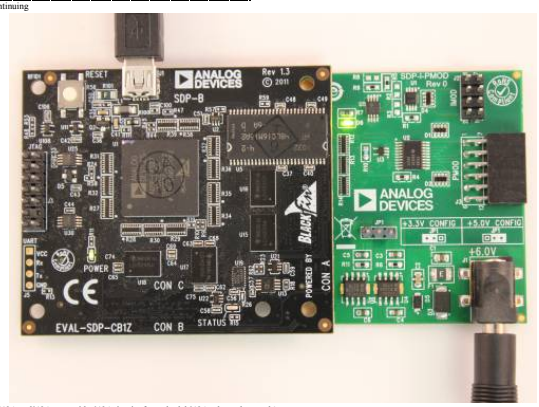
2. Ensure that you remove the shunt which is located at **JP1** of the SDP-PMD-IB1Z

3. Next take the EVAL-SDP-CB1Z board and connect **CON A** up to **J4** of the SDP-PMD-IB1Z interposer board.



(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/sdp_usb_interposer.jpg?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

4. Connect the EVAL-CFTL-6V-PWRZ to **J1** barrel jack of the SDP-PMD-IB1Z, and **WAIT 10 SECONDS** before continuing



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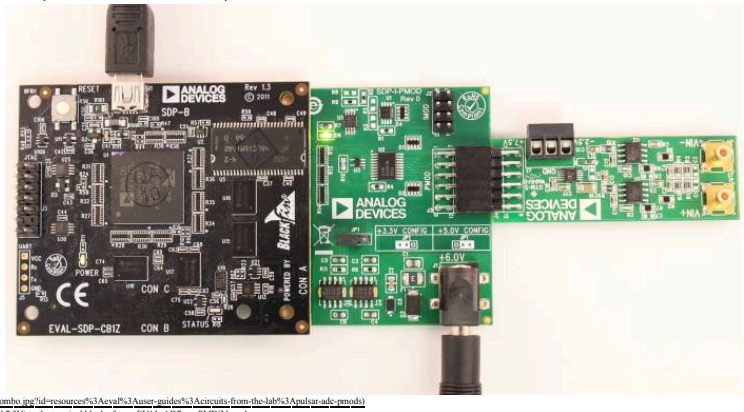
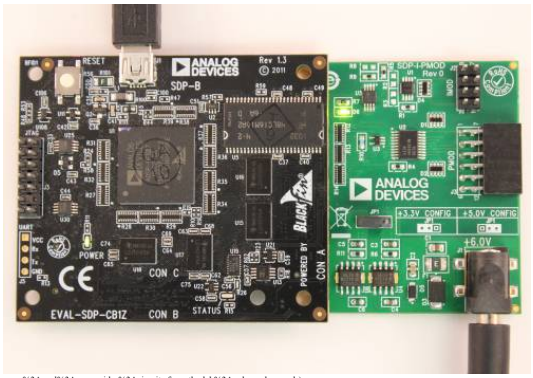
5. Take the PulSAR ADC PMOD board you are using and connect it to **J3** of the SDP-PMD-IB1Z interposer board. This should finish the hardware setup.



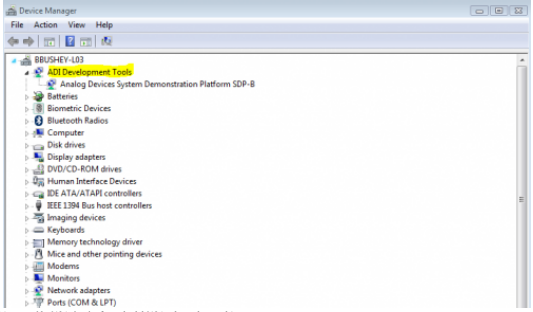
(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/sdp_evaluation_combo.jpg?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

6. With the power source turn **OFF**, connect your external power supplies (-2.5V, GND, and 7.5V) to the terminal block of your EVAL-AD7xxx-PMDZ board.
7. Turn **ON** your external power supplies (-2.5V, GND, and 7.5V) connected in the previous step.
8. Place the shunt across **JP1** of the SDP-PMD-IB1Z, according to the silkscreen so that you will have 3.3V going to the PMOD connector.



(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/sdp_usb_interposer_power_jumper.jpg?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

9. Check again in the device manager to make sure the *ADI (Analog Devices, Inc.) Development Tools* are still displaying. If yes, then you'll be able to proceed onto the evaluation software section. If you don't see ADI (Analog Devices, Inc.) Development Tools, than you will have to start the hardware evaluation procedure over at step 1.



(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/device_manager.png?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

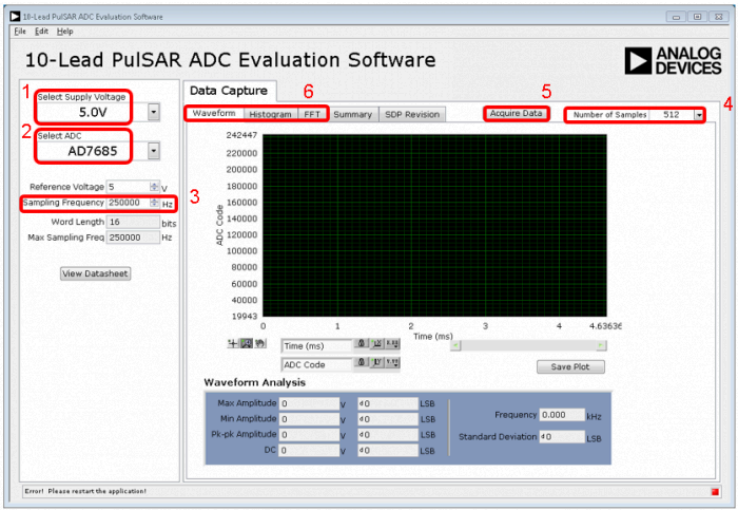
10. Connect your SMB cable from your signal source to the Vin+ and Vin- connectors of the EVAL-AD7xxx-PMDZ board.

Labview Software Application (GUI explained)

The PulSAR ADC PMOD boards have a special version of software needed to run the evaluation, so please install this version of the software.

PulSAR ADC PMOD Evaluation Software [ftp://ftp.analog.com/pub/cftl/EVAL-ADXXXX-PMDZ/1.0.0/]

Once you download and install the software, you'll be able to launch the application and communicate with the hardware setup. When you open up the application the front screen will look like the following:

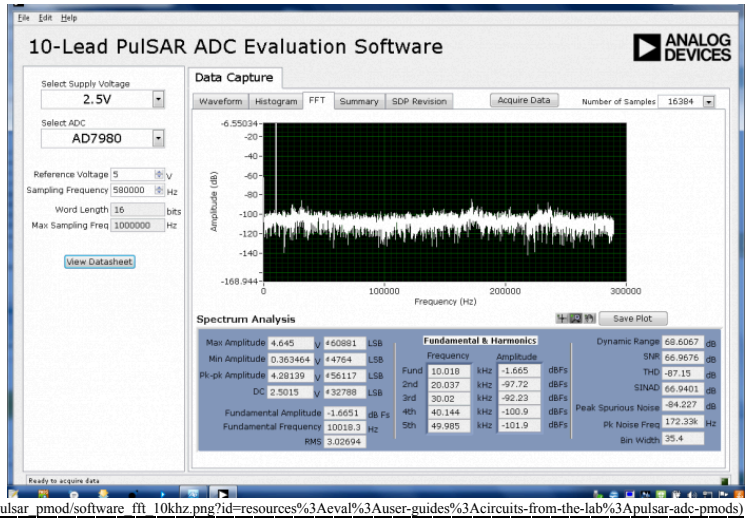


(/_detail/resources/eval/user-guides/circuits-from-the-lab/pulsar_pmod/software_panel_numbered.png?id=resources%3Aeval%3Auser-guides%3Acircuits-from-the-lab%3Apulsar-adc-pmods)

The following is the description of how to use the user panel:

1. Select Supply Voltage
   - The user must select either the **5.0V** or **2.5V** selection from the menu, that corresponds with the ADC supply voltage (VDD) of the PulSAR ADC PMOD they are using. This choice will limit the selections you can make under the *Select ADC* section.
2. Select ADC
   - Please select the **part number** of the PulSAR ADC you are using. If your converter selection appears to be "grayed out", please go back to step one and make sure you have the correct supply voltage selected.
3. Sampling Frequency
   - The user can set the desired sampling frequency, however the user cannot go beyond the max sampling frequency of the converter (shown just below in the panel). Units are entered in **Hz**, so you must type out all significant digits. (For example - 250 kHz (kilohertz) must be typed out as "250000")
4. Number of Samples
   - This drop down tells the software how many samples you want to take. Those samples will be used to make the waveform, histogram, and FFT displays and calculations.
5. Acquire Data
   - Hit this button once, and the software will gather the data, run the calculations, and display the results on the various tabs. (Waveform, Histogram, FFT)
6. Data Capture Displays
   a. Waveform - Time domain representation of the data
   b. Histogram - Bin representation of the data
   c. FFT - Frequency domain representation of the data

The following screen shot is an example of using the AD7980 ADC, and looking at the frequency domain to view a 10kHz input sine wave. This tab provided several frequency domain calculations such as SINAD, THD, SNR.



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Schematics, PCB Layout, Bill of Materials

- Schematics
- PCB Layout
- Bill of Materials
- Allegro Project

EVAL-AD7685-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7685-pmdz-designsupport.zip]
EVAL-AD7686-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7686-pmdz-designsupport.zip]
EVAL-AD7687-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7687-pmdz-designsupport.zip]
EVAL-AD7688-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7688-pmdz-designsupport.zip]
EVAL-AD7690-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7690-pmdz-designsupport.zip]
EVAL-AD7691-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7691-pmdz-designsupport.zip]
EVAL-AD7693-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7693-pmdz-designsupport.zip]
EVAL-AD7946-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7946-pmdz-designsupport.zip]
EVAL-AD7980-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7980-pmdz-designsupport.zip]
EVAL-AD7982-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7982-pmdz-designsupport.zip]
EVAL-AD7983-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7983-pmdz-designsupport.zip]
EVAL-AD7984-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7984-pmdz-designsupport.zip]
EVAL-AD7988-1-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7988-1-pmdz-designsupport.zip]
EVAL-AD7988-5-PMDZ Design & Integration Files [https://www.analog.com/media/en/evaluation-documentation/evaluation-design-files/eval-ad7988-5-pmdz-designsupport.zip]

Change Log

Rev 0 to Rev A

- Changed CAD tools from PADS to Allegro, so the reference designators have changed
- Replaced C9 and C10(Rev 0) and put in R5 and R7(Rev A)
- Added R16 and R17(Rev A) to be able to use more operating modes of the ADC (for example, daisy-chain mode)
- Removed U5 (ADG1401 on Rev 0) and connected the 5V reference directly to the ADC (U3 Rev 0)
- Removed U8 (ADP7104-3.3 on Rev 0) and connected the VIO pin of the ADC to VCC (J4 Rev 0)
- Separated out the AGND plane and DGND plane

Registration

Receive software update notifications, documentation updates, view the latest videos, and more when you register your hardware. Register below to receive all these great benefits and more!

- EVAL-AD7942-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7942-PMDZ?&v=RevA]
- EVAL-AD7946-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7946-PMDZ?&v=RevA]
- EVAL-AD7988-1-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7988-1-PMDZ?&v=RevA]
- EVAL-AD7685-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7685-PMDZ?&v=RevA]
- EVAL-AD7687-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7687-PMDZ?&v=RevA]
- EVAL-AD7691-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7691-PMDZ?&v=RevA]
- EVAL-AD7686-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7686-PMDZ?&v=RevA]
- EVAL-AD7688-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7688-PMDZ?&v=RevA]
- EVAL-AD7693-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7693-PMDZ?&v=RevA]
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- EVAL-AD7980-PMDZ [https://my.analog.com/en/app/registration/hardware/EVAL-AD7980-PMDZ?&v=RevA]
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