Sources of PMOD information

Digilent Pmod Interface Specification 1.2.0 is dated October 5, 2017. Note that some PMODs do not quite follow the specs. For example, the I2S2: Stereo Audio Input and Output is in violation of the specs. You cannot use it with RiskZero. (It is regrettable.)

1. https://reference.digilentinc.com/reference/pmod/specification
2. https://reference.digilentinc.com/reference/pmod/start

The list of modules available from Digilent is here. You can also buy them from DigiKey.

3. https://store.digilentinc.com/pmod-modules-connectors/

What is a PMOD?

PMOD is a small PCB board with either a six-pin or 12-pin, 0.1" right angle connector. It plugs into the mating socket at the edge of the main PCB. If you follow the specs of how wide is the PMOD board, you can stack them horizontally next to each other. You will be able to plug three PMODs into three RiskZero sockets, and they should not bump into one another.

The PMOD connector provides ground, power, and GPIO pins to talk to the PMOD add-on. The GPIO usually imeans SPI. Many PMOD boards are just break outs for SPI-based ADC's, DAC's, temperature sensors, etc., You can add their functionality to your main board without providing the footprints for those sensor chips on the main board.

Simple PMODs are priced at a few $$ each. There are also more complex PMODs, like a Blootooth module, a WiFi module, or a GPS unit. These are priced aroud $30 each.

You can build your own PMODs. You do not need to design a PCB and have it manufactured. Since the PMOD connector is 0.1" pin header, you can solder it onto a pre-perforated board and add through hole parts on the 0.1" grid. The opamps and other such chips still exist in 0.1" packaging. Just be aware that these are not high performance parts. Doing audio with 0.1" parts is perfectly viable. You can reach into a few MHz transfer over PMOD, while tens of MHz is iffy, and hundreds will not be possible.

If you design a PMOD board which is wider than the proscribed width, then you can connect it to the PMOD socket on the main board with an extension cable.

Things to keep in mind when using PMODs with the RiskZero board

RiskZero is providing three PMOD sockets, sharing the SPI bus and four GPIOs. Each socket has its own individual CS# line (chip select, active LOW). These are the only signals which are not shared. It means that the PMODs have to be accessed sequentially, one SPI transaction at a time. There is no restriction on the transaction order. Concurrent access is not possible.

Four GPIOs can implement extra signals, like muxing or interrupts. Most PMODs do not use any extra GPIOs. (Such PMODs can be implemented with only one row of six pins.) Some PMODs do use the extra pins. This depends on the PMOD.

Be aware that the four extra GPIOs are bussed across all three sockets. Consider the possible contention. It is advised to dedicate the GPIO to only one PMOD at a time. You can also make them input at the PMOD side. Avoid driving the GPIOs from more than one source.

What can you do with PMOD and the RiskZero board?

The most freedom is afforded if you develop your own PMOD boards. You can use either the PMOD BB (the breadboard with the PMOD connector) or a prototyping board of any size and connect them to the RiskZero with a PMOD Cable Kit from Digilent ($7).

Planning these experiments, keep in mind that the SPI signals are shared with all the SPI chips on the RiskZero board. This includes the W5500 Ethernet chip, Nordic radio, and the microSD card. You can decrease the load on this common SPI bus by using the full size SD card for the System Disk, because the full size SD has its own dedicated connections to the FPGA. It is not sharing the common SPI bus.

Since the main SPI bus is shared, the traffic is not predictable because it depends on all the SPI activities such as networking. If you need communication at regular time intervals, then you can use the GPIOs. The six-pin PMODs can be plugged into either the upper or the lower pin rows. Such PMODs will connect to either the common SPI bus or the GPIOs. The DA2 digital-to-analog PMOD is one example.

Here are some ideas, using some selected Digilent PMODs.

1. Using PMOD USB to UART Interface with FTDI FT232R implement the mouse and keybord interface superseding the legacy PS/2. This PMOD will use all four GPIO pins. It will not use SPI.

2. Using PMOD WiFi with Microchip MRF24WG0MA, implement WiFi networking in Oberon.

3. Using PMOD BT2 Bluetooth Interface with Roving Networks RN-42, implement Blootooth under Oberon, communicatinng with RN42 over UART.

4. Using PMOD KYPD 16-button Keypad and PMOD OLEDrgb: 96 x 64 RGB OLED Display with 16-bit color resolution, implement a User Input keypad with a feedback on the OLED display. Both these PMODs are larger than the standard PMOD size, so you will need to use PMOD extender cables to connect them to RiskZero.

5. Using PMOD AD1 with two A/D channels, implement a dual channel digital scope. Use the main Oberon screen to display the waveforms, because the add on display from Project 4 may be too crude for this purpose. Use the GPIOs for the interface to avoid loading the main SPI bus. This 6-pin PMOD plugs into either the upper or the lower pin row.

6. Using either PMOD AD2 or AD5 with four A/D channels, implement a quad channel digital scope. Use the main Oberon screen to display the waveforms. Note that AD2 uses I2C interface which you will have to implement with two GPIO pins in the upper pin row.

7. Using the PMOD DA2 with two 12-bit D/A Outputs, implement a dual channel arbitrary signal generator running with up to 30 MHz SPI clock. Use the GPIO pins for the interface, because the main SPI bus may not be able to run at regular time intervals. Note that this PMOD can be plugged into either row of the PMOD connector, what makes the GPIO pins a viable option to drive the D/A chips.