From Papilio

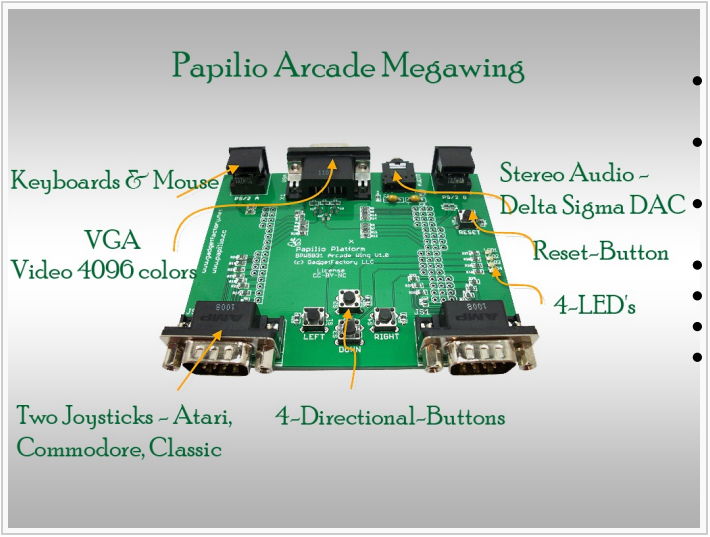
Papilio: ArcadeMegaWing

参考資料

Hardware | **Papilio One** - **Papilio Pro** - **MegaWings** - **Wings**

Arcade MegaWing

The Arcade MegaWing provides all of the arcade hardware in one convenient and easy to connect circuit board. It snaps into the Papilio One and gives it the necessary hardware resources to communicate with the outside world. Continue reading for more information about each hardware section of the Arcade MegaWing. Be sure to visit the **Papilio Arcade** wiki for more information.



Specifications

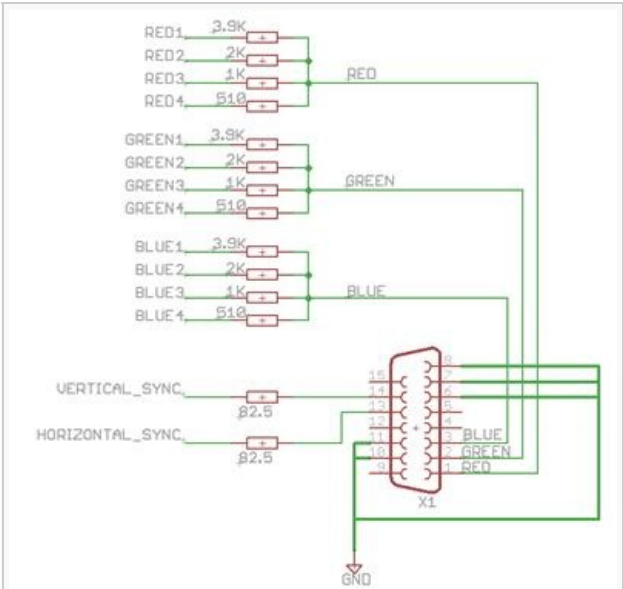
- VGA Port - DB15 Female VGA connector capable of generating 4096 colors.
- Stereo Audio Jack - 1/8" Stereo jack with low pass filter is ready for CD quality Delta-Sigma audio output.
- Joystick Ports - Two DB9 Male joystick ports accept Atari, Commodore, and classic arcade joysticks.
- PS/2 Ports - Two PS/2 ports accept a keyboard and mouse.
- 4 Way Buttons - 4 buttons in a plus configuration for user input.
- 4 LED's - 4 LED's for user feedback.
- Reset Button - A single reset button.

MegaWing VGA


VGA Video - 4096 colors

The VGA section of the Arcade MegaWing uses 12 resistors to implement 4K color depth. VGA video is analog in nature so there needs to be some way to vary the RGB (Red, Green, and Blue) signals between 0V and .7V. For each RGB signal the shade, or intensity, of the color is controlled by varying the voltage of the pin between 0 and .7V. The finer control you have over the voltage the more colors you can create. For the Arcade Wing we are able to control 4 different bits per color which allows us to generate 16 different voltage levels between 0 and .7V. This means we can generate 16 shades for each color. If we add all three colors together we have 12 bit video which gives us (2^12=4096) the possibility of 4096 colors.

The usual options for controlling voltage on a pin are to use a DAC, PWM, Delta-Sigma, or a resistor ladder. For the Arcade Wing we wanted to use the lowest cost and easiest method for a hobbyist. PWM and Delta-Sigma were ruled out because we did not think we would be able to vary the voltage with these methods fast enough to keep up with the VGA timing requirements. A DAC would be a good solution but was more than we needed for our modest requirements. A resistor ladder fit the bill perfectly because it is very low cost and easy to implement. The resistor ladder is made up of 4 resistors per RGB color that all connect, in common, to the VGA connector on one side and individually to a digital I/O pin on the other side. The lowest resistor starts at ~500 ohms and each successive resistor doubles in size with the final resistor ending with ~4K ohms. Each digital I/O pin is controlled by the VGA controller inside the FPGA. Each pin can be set to either 0 or 1 with a 1 causing the resistor to contribute its voltage to the final voltage level. The voltage can be stepped up from 0 to the desired output voltage which in this case is .7V.



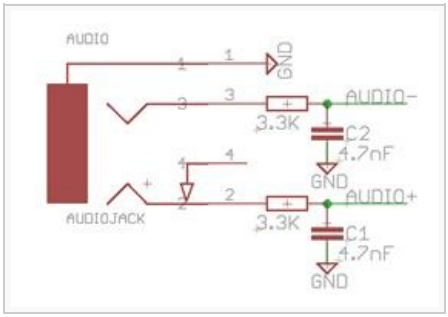
Name	Function	Direction	Papilio One Pin	Papilio Pro Pin	Arduino
Red 0	Red Bit 0	Output	P98	P118	36

Red 1	Red Bit 1	Output	P2	P119	37
Red 2	Red Bit 2	Output	P3	P120	38
Red 3	Red Bit 3	Output	P4	P121	39
Green 0	Green Bit 0	Output	P68	P84	20
Green 1	Green Bit 1	Output	P66	P82	21
Green 2	Green Bit 2	Output	P63	P80	22
Green 3	Green Bit 3	Output	P61	P78	23
Blue 0	Blue Bit 0	Output	P85	P99	16
Blue 1	Blue Bit 1	Output	P83	P97	17
Blue 2	Blue Bit 2	Output	P78	P92	18
Blue 3	Blue Bit 3	Output	P71	P87	19
HSync	Horizontal Sync	Output	P95	P117	35
VSynch	Vertical Sync	Output	P94	P116	34

The way the desired output voltage is accomplished is by carefully managing the parallel voltage that the 4 resistors add up to. Using a Parallel Resistance Calculator we see that 500 ohm, 1000 ohm, 2000 ohm, and 4000 ohm give a total resistance of 266 ohm. The final key bit of information is that there is a 75 ohm resistance built into VGA cables, so that means that the point where our 4 resistors come together on our VGA connector forms a Voltage divider circuit. Using a Voltage Divider calculator with 3.3V as the Input Voltage, 266 ohm as R1, and 75 ohm as R2 we end up with an Output Voltage of .73V. The end result is that if all 4 resistors are set to '1' then we will see .73V at the VGA connector. If all 4 resistors are set to '0' then we will see 0V at the VGA connector, any combinations in between will give us evenly stepped voltages between 0 and .73V. The voltages will be evenly stepped because we picked resistors that double in size.

MegaWing Sound

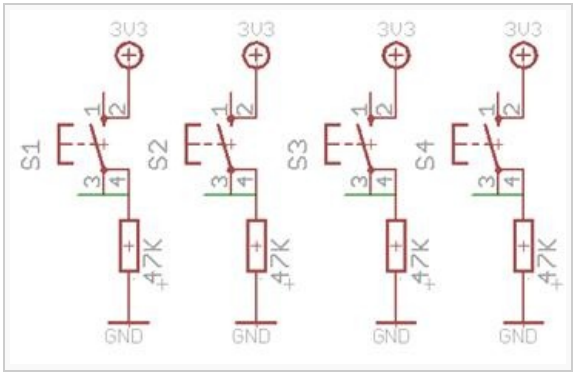
The sound section implements a 1/8th inch stereo jack with a low pass filter. Arcade projects simply implement a Delta-Sigma DAC as outlined in Xilinx App Note 154. A Delta-Sigma DAC allows high quality audio to be implemented with a minimum amount of physical hardware required. The high speed of the FPGA clock allows the FPGA to do the heavy lifting of the Digital to Analog conversion.



Name	Function	Direction	Papilio One Pin	Papilio Pro Pin	Arduino
Audio-	Audio Left	Output	P84	P98	14
Audio+	Audio Right	Output	P86	P100	15

MegaWing Directional Buttons

The Arcade MegaWing provides 4 directional buttons that can be used for general input. They can be used with homebrew games that do not need joysticks or for the coin/start buttons on classic games.

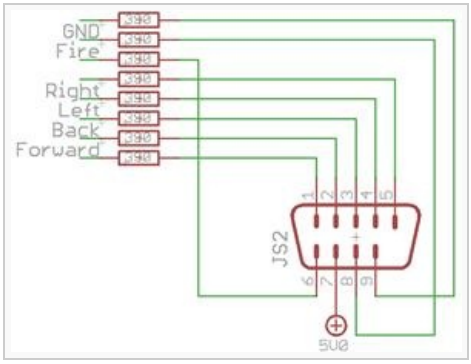


Name	Function	Direction	Papilio One Pin	Papilio Pro Pin	Arduino
Left	Left	Input	P58	P74	24
Up	Up	Input	P54	P95	25
Right	Right	Input	P36	P59	27
Down	Down	Input	P41	P62	26

MegaWing Joystick


Two Joysticks -Atari, Commodore, Classic

The Papilio Arcade Wing supports Atari 2600, Commodore 64, classic Arcade joystick, and any joystick that uses digital inputs. The board comes with a Male DB9 connector that allows an Atari 2600 joystick to be plugged in and used without any custom wiring. For a custom Arcade style joystick it is necessary to wire the joystick to a female DB9 connector using the diagram below. Each pin of the DB9 connector is protected by a current limiting resistor to provide compatibility with 5V powered joysticks.



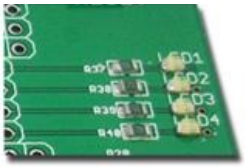
Joystick A

Name	Function	Direction	DB9 Pin	Papilio One Pin	Papilio Pro Pin	Arduino
Up	Up	Input	1	P5	P123	40
Down	Down	Input	2	P10	P126	42
Left	Left	Input	3	P11	P127	43
Right	Right	Input	4	P15	P132	45
Fire 2	Fire 2	Input	5	P17	P134	47
Fire 1	Fire 1	Input	6	P9	P124	41
5V	5V	Input	7	N/A	N/A	
GND	GND	Input	8	P12	P131	44

Joystick B

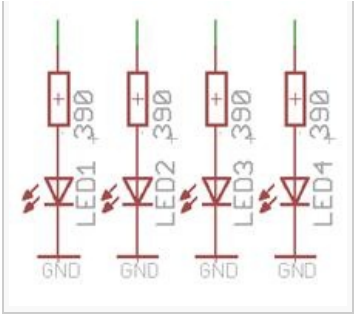
Name	Function	Direction	DB9 Pin	Papilio One Pin	Papilio Pro Pin	Arduino
Up	Up	Input	1	P34	P57	28
Down	Down	Input	2	P25	P50	30
Left	Left	Input	3	P22	P47	31
Right	Right	Input	4	P23	P51	1
Fire 2	Fire 2	Input	5	P33	P58	3
Fire 1	Fire 1	Input	6	P32	P55	29
5V	5V	Input	7	N/A	N/A	
GND	GND	Input	8	P18	P48	0

MegaWing LED's



4LED'S

The Arcade MegaWing provides 4 LED's for visual feedback of game status.

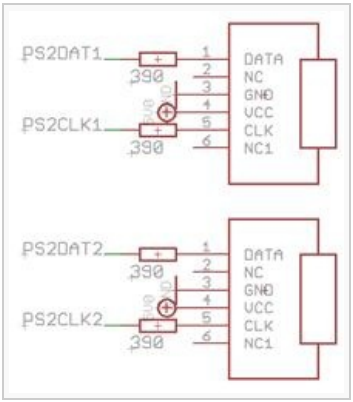


Name	Function	Direction	Papilio One Pin	Papilio Pro Pin	Arduino
LED1	Player 1	Output	P57	P75	7
LED2	Player 2	Output	P53	P67	6
LED3	Flipped	Output	P40	P66	5
LED4		Output	P35	P61	4

MegaWing Keyboard and Mouse

Keyboard and Mouse

The Papilio Arcade MegaWing has two PS/2 ports that can be used to connect a keyboard and mouse.

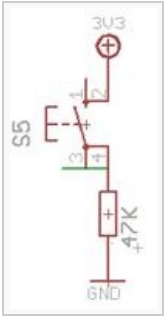


Name	Function	Direction	Papilio One Pin	Papilio Pro Pin	Arduino
PS/2 A CLK	Clock	Output	P92	P115	33
PS/2 A Data	Data	Input	P91	P114	32
PS/2 B CLK	Clock	Output	P79	P93	13
PS/2 B Data	Data	Input	P70	P88	14

MegaWing Reset Button

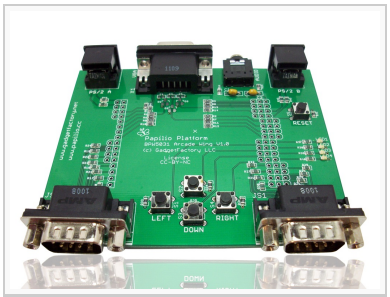
Reset Buttons

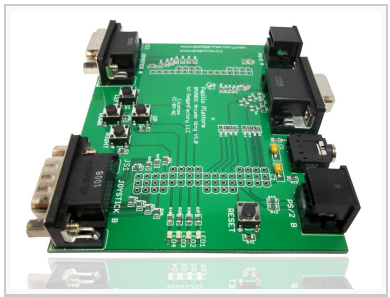
The Papilio One has a reset button that resets the game instead of the entire FPGA.

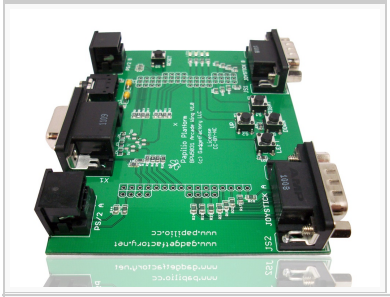


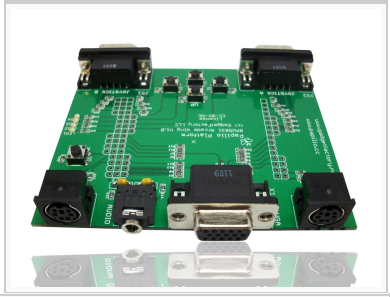
Name	Function	Direction	Papilio One Pin	Papilio Pro Pin	Arduino
Reset	Reset	Input	P67	P85	11

Images



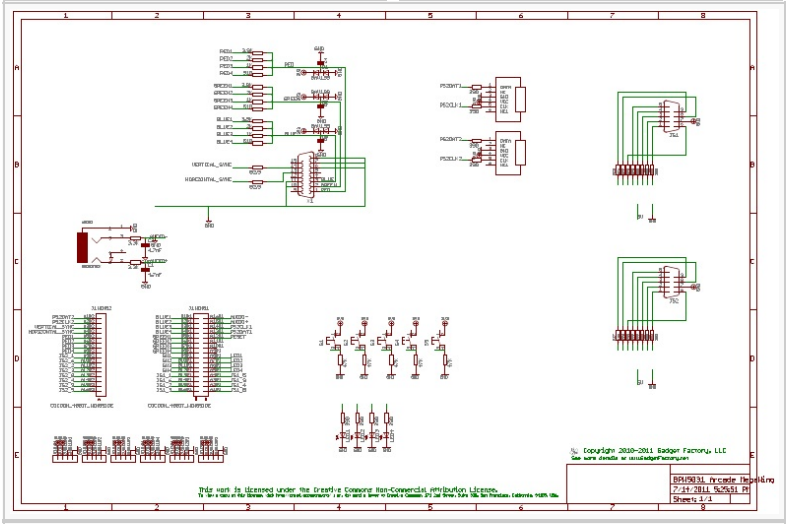






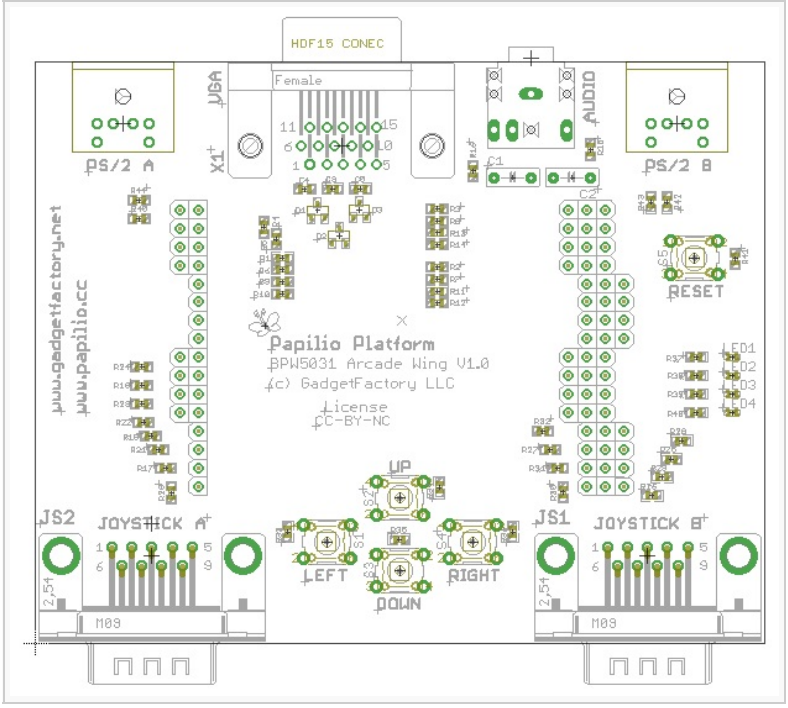
Papilio Arcade MegaWing

Click the images for full size hi-resolution views of the Papilio Arcade MegaWing.



Arcade MegaWing Schematic

Click the image to load a PDF version of the Arcade MegaWing Schematic



Assembly View

Click the image for a full size view of the boards part layout.