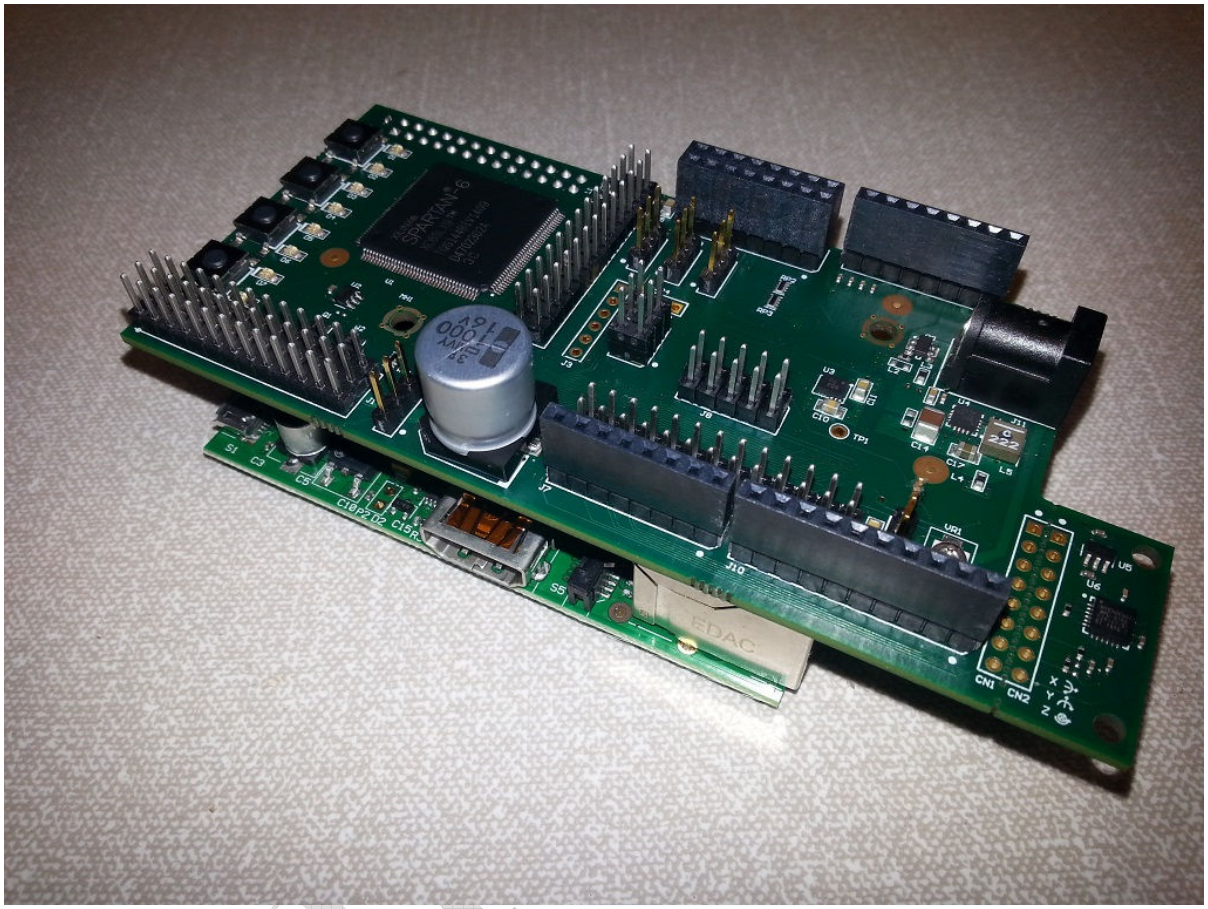
Application Note AN-021 (v1.0)

Connecting an Arduino™ Shield to the PiXi (2.0)



Summary

The PiXi add-on board is designed to expand the general-purpose I/O capabilities of the Raspberry Pi and provide a low cost means of introducing the user to the world of digital electronics and FPGA technology as well as giving the 'Pi Enthusiast' a few more features to play with. The low product cost and feature-packed specification of the PiXi-200 makes it ideal for applications in computing, hobby-electronics, education, training and product development.

This application note looks at the Arduino™ compatible Shield Interface on the PiXi (2.0) and looks at the Shields that have been considered during the design process for the PiXi(2.0), looking at key areas of the design that make the PiXi compatible with some of these shields. In the cases where the PiXi has been found to be not compatible with some shields, the reasons for the incompatibility are highlighted.

Changes

Revision	Date	Changes
1.0	26/07/2014	Preliminary Release

Introduction

The PiXi (2.0) has been designed so that it can accept a reasonably wide-range of add-on 'Shields' that have been design to be compatible with the Arduino™ range of open source electronics platforms.

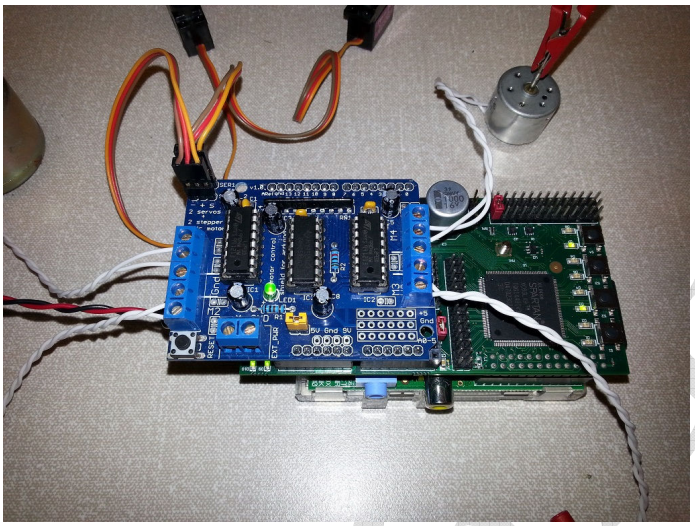


Figure 1 Adafruit Motor Shield connected to the PiXi (2.0)

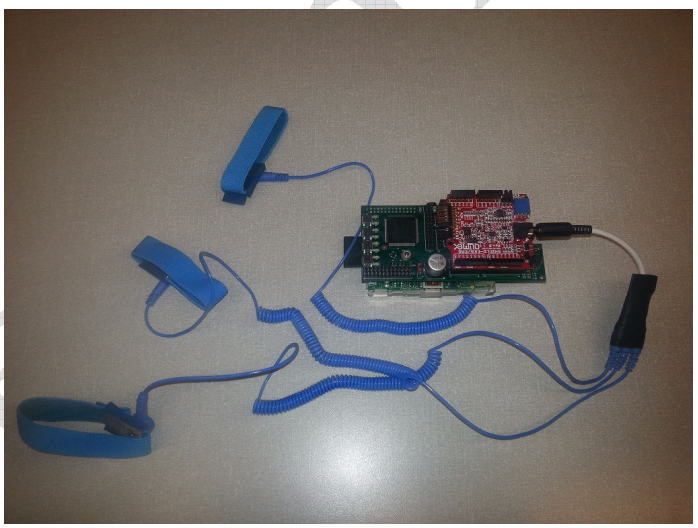


Figure 2 ECG Shield connected to the PiXi (2.0)

The Arduino™ interface on the PiXi (2.0) includes five connectors that are physically compatible with the Shield form factor defined by the Arduino™ products. One connector provides power, I/O reference & reset signalling, a second connector provides analogue & I2C interfaces, a third connector provides digital I/O, a fourth connector provides digital I/O and analogue reference and the fifth connector provides power, digital I/O & reset signalling. These five connectors don't offer the full capabilities that the Arduino™ products offer but they offer enough compatibility to make the whole Arduino™ interface on the PiXi compatible with a wide range of commercially available Shields. Table 1 thru Table 5 list the pinouts for the Arduino™ interface connectors.

J9: Arduino Shield Interface (Power, Reference & Reset)			
Pin	**Function**	**Pin**	**Function**
1	N/C	2	GPIO3_+V
3	RESET#	4	+3V3
5	+5V	6	GND
7	GND	8	VIN

Table 1 Power, I/O Reference & Reset Connector

J4: Arduino Shield Interface (Analogue)			
Pin	**Function**	**Pin**	**Function**
1	ADC_CH1	2	
3	ADC_CH2	4	
5	ADC_CH3	6	
7	ADC_CH4	8	
9	ADC_CH5 Or I2C	10	
11	ADC_CH6 Or I2C	12	
13		14	
15		16	

Table 2 Analogue & I2C Connector

J7: Arduino Shield Interface (Digital I/O)			
Pin	**Function**	**Pin**	**Function**
1	GPIO3(7)	2	GPIO3(6)
3	GPIO3(5)	4	GPIO3(4)
5	GPIO3(3)	6	GPIO3(2)
7	GPIO3(1)	8	GPIO3(0)

Table 3 Digital I/O Connector

J10: Arduino Shield Interface (Power, Reference & Reset)			
Pin	**Function**	**Pin**	**Function**
1	GPIO3(15)	2	GPIO3(14)
3	REF_IN	4	GND
5	GPIO3(13)	6	GPIO3(12)
7	GPIO3(11)	8	GPIO3(10)
9	GPIO3(9)	10	GPIO3(8)

Table 4 Digital I/O, Analogue Reference & I2C Connector

J5: Arduino Shield Interface (SPI, Power, Reset)			
Pin	**Function**	**Pin**	**Function**
1	GPIO3(12)	2	GPIO3_+V
3	GPIO3(13)	4	GPIO3(11)
5	RESET#	6	GND

Table 5 Power, Digital I/O 'ISP/SPI' Connector

Shield List

The list of Shields that can be seen in Table 6 represents all of the Shields that were considered during the design of the PiXi. Some are not compatible but the majority are believed to be compatible. This list is being added to as more and more Shields are considered for use with the PiXi and this application note will be updated regularly to reflect the full range of Shields that have been evaluated to-date.

Please be aware that most of these Shields have not been tested with the PiXi. In these cases the compatibility is based on an analysis of the schematics for the Shield, taking into consideration the I/O compatibility and the optional interfaces available on the PiXi. In the vast majority of cases, given the abilities of the FPGA on the PiXi, most Shields are compatible with no change needed to the FPGA. Note however that the PiXi FPGA can be re-designed & re-programmed by the user to further improve the level of compatibility by implementing some of the more dedicated I/O functions that are available on the Arduino™. There are a few cases where the PiXi will not be compatible with an Arduino™ Shield. An example of this is any shield that uses the first four analogue inputs (A0, A1, A2 & A3) as digital I/O. The Arduino™ products support both digital & analogue I/O on these pins but the PiXi only connects these four signals to the first four inputs of the PiXi analogue to digital converter. A5 & A6 can be optionally connected to 3.3V or 5V digital I/O on the PiXi using jumpers on the PiXi board – this allows these inputs to be used as analogue inputs, digital inputs or outputs or even as an I2C interface.

Shield	Compatible	Comments
1.8” TFT Shield (Adafruit	Yes	Not tested
2.8” TFT Touch Shield (Adafruit)	No	Incompatible as some analogue pins are used for digital I/O.
6 Button Shield (Batsocks)	Yes	Not tested
Ardumoto Shield (Sparkfun)	Yes	Not tested
Bees Shield (Seeed Studio)	Yes	Not tested
BrewPi Shield (Unknown)	No	Incompatible as some analogue pins are used for digital I/O.
CAN Bus Shield (Sparkfun)	No	Incompatible as some analogue pins are used for digital I/O.
CNC Shield (Unknown)	No	Incompatible as some analogue pins are used for digital I/O.
Colour LCD & Joystick Shield (Nu Electronics)	Yes	Not tested
ECG Shield B (Olimex)	Yes	Not Tested
Ethernet Shield 3 (Arduino)	Yes	Not tested
Ethernet Shield 4 (Arduino)	Yes	Not tested
Ethernet Shield 5 (Arduino)	Yes	Not tested
Ethernet Shield (Adafruit)	Yes	Not tested
GPS Shield (Dexter Industries)	Yes	Not tested
HPLED Shield (Unknown)	Yes	Not tested
Input Shield (LiquidWare)	Yes	Not tested
IR Remote Shield (Cooking Hacks)	Yes	Not tested
K3NG Keyer Shield (Unknown)	No	Incompatible as some analogue pins are used for digital I/O.
LCD Shield 1.1 (DFRobot)	Yes	Not tested
LED Cube (Unknown)	Yes	Not tested
LED Matrix Shield Shield (WiseTime)	No	Incompatible as some analogue pins are used for digital I/O.
Logger Shield (Adafruit)	Yes	Not tested
Motor Shield (Adafruit)	Yes	The interface to this shield relies on the digital outputs from GPIO3 which are duplicated on the Shield interface connector. All outputs are PWM capable. The SPI interface used to control the motor direction can be driven directly from the Raspberry Pi’s SPI interface or through a separate simpler SPI ‘master’ implemented within the FPGA.
Motor Shield 1.2 (Adafruit)	Yes	Not tested
Motor Shield 1.1 (Arduino)	Yes	Not tested
Motor Shield 3 (Arduino)	Yes	Not tested
MP3 Shield (Sparkfun)	Yes	Not tested
Mux Shield (Mayhew Labs)	Yes	Not tested
Mux Shield 2 (Mayhew Labs)	Yes	Not tested
NXT Shield (tkjelectronics)	Yes	Not tested
NXT Shield 2 (tkjelectronics)	Yes	Not Tested
Proto Screwshield (Adafruit)	Yes	Not tested
Proto Shield (Adafruit)	Yes	Not tested
Proto Shield (Sparkfun)	Yes	Not tested
RFID Shield (Adafruit)	Yes	Not tested
RS232 Shield (CuteDigi)	Yes	Not tested
Sensing Shield 3,12 (Harizonov)	Yes	Not tested
Sensor Shield 4 (Emartee)	Yes	Not tested

SmartGPU 2 Shield (Arduino)	Yes	Not tested
Sudden TX Shield 1.4 (Kanga Products)	Yes	Not tested
TellyMate Shield	Yes	Not tested
USB Host Shield (Sparkfun)	Yes	Not tested
Wave Shield 1.0 (Adafruit)	Yes	Not tested
Wave Shield 1.1 (Adafruit)	Yes	Not tested
XBee Shield (Arduino)	Yes	Not tested
XBee Shield 1.4 (DFRobot)	Yes	Not tested
XBee Wireless Shield 1.2 (Sparkfun)	Yes	Not tested
XBee Wireless Shield 1.4 (Sparkfun)	Yes	Not tested

Table 6 A selection of Arduino™ compatible Shields and their compatibility with the PiXi (2.0)

Further Reading

The PiXi User Manual (UM-002) has complete information on the pin functions for GPIO3, the Shield interface and other interfaces on the PiXi.

PiXi-Tools is described in more detail in application note AN-020 "Installing PiXi-Tools on the Raspberry Pi".

The full register map for the PiXi can be found in application note AN-025 "PiXi SPI & I2C Register Map".

All of these documents and other documents are available for download from www.astro-designs.com.

Acknowledgements

“Raspberry Pi” is a trademark of the Raspberry Pi Foundation.

“Arduino™” is a trademark of Arduino.