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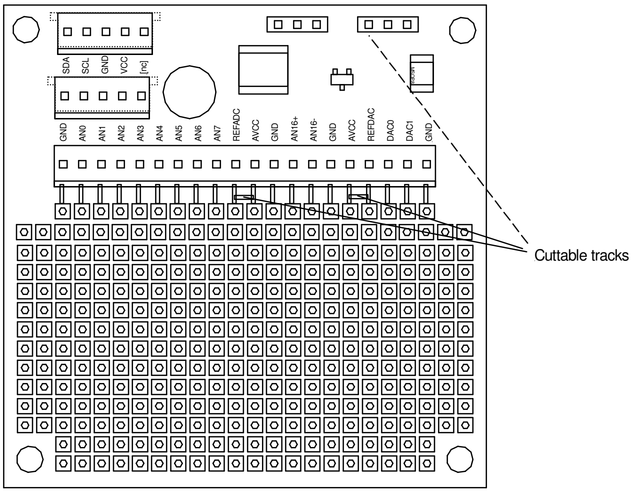
18- and 12-bit Analogue I/O Port: 5624



Introduction

The 5624 Analogue I/O Port is intended for prototyping and low-volume production.

Features

- 1 channel of differential 18-bit analogue input
- 8 channels of 12-bit analogue input
- 2 channels of 12-bit analogue output
- Standard Micro-Robotics I^2C Bus connector
- 3 and 5 Volt operation
- Prototyping area

Connection

To attach the port to your controller system, use the I^2C Bus cable provided.

You can check that the Port is connected to the controller's I^2C Bus number 1 by the following command. You should see the following devices reported.

```
-->PRINT net
Devices on I2C network No.1:
Number   Channels    Device     Description
------   --------    ------     -----------
   0       ---       ???        Unknown
  24       ---       ???        Unknown
  64     128-135     PCF8574    8 digital I/O lines
 208       ---       ???        Unknown
```

-->

Note that the 12-bit ADC is mistakenly reported as a PCF8574 as they share address space. If you have any other devices on the I^2C Bus then there may be other devices present in the list that are not on this Port.

18-bit ADC

The device used for the high-resolution analogue input is the MCP3421. This is a Sigma-Delta device, which tend to be inexpensive and accurate, though usually rather slow compared to other ADC architectures.

The MCP3421 can be programmed for different input resolutions. In our example code below we program it for 16 bits. Lowering the resolution may be traded off against the speed of reading the device. At 16 bits the device can read 15 samples per second.

The input to this device is differential, i.e. the difference in voltage between the positive and negative inputs is what is measured. Either of the inputs may be set to any voltage between the supply rails, but the maximum voltage that can be digitised is ± 2.048 volts.

The device has a programmable input amplifier (with gains of 1, 2, 4 and 8) that may be used to match the ADC input range to the signal being measured. At x 8 gain, the full-scale input voltage is ±256mV, and the resolution of each LSB at 16 bits is around 4µV.

The device has a finite input impedance and so should ideally be driven from a low impedance source.

See the device datasheet for more information on all the above issues.

12-bit ADC

This device will measure single polarity signals in the range 0V to the reference voltage.

12-bit DAC

This device will generate single polarity signals in the range 0V to the reference voltage.

Reference voltages

The 12-bit DAC and 12-bit ADC have reference voltage inputs. These are initially connected to AVCC (the supply voltage) using cuttable copper tracks between J3 and the prototyping area.

You may cut these tracks and then provide your own reference voltage input to either or both of the 12-bit devices. Please observe the reference voltage input requirements for each device as set out in its datasheet. See *Specification* for which devices are used.

The 16-bit ADC has its own internal reference. This is not available externally.

Pinout

All the input and output channels are brought to the 20-way connector J3. The pin functions are labelled on the PCB.

Also brought out are the GND and VCC supplies, and the analogue reference voltages for the 12-bit ADC and the DAC.

Note: the port is shipped with the reference inputs for the DAC and 12-bit ADC connected to AVCC.

The signals are explained below:

GND	Ground voltage, connected to the controller ground 0V/GND
AVCC	Analogue supply voltage: this is the controller's supply voltage (around 3-5 Volts) filtered with 47uH/10uF
REFADC	The 12-bit ADC's reference voltage – factory connected to AVCC
REFDAC	The 12-bit DAC's reference voltage – factory connected to AVCC
AN0-AN7	The 12-bit ADC input channels
DAC0-DAC1	The 12-bit DAC output channels
AN16+ / AN16-	The 18-bit ADC differential inputs, positive and negative

Prototyping area

Note: the20-way header for J3 is supplied unsoldered so you have the option of using different or no connectors, or using the same connector in a different position.

Each signal on J3 is brought out also on J4 – a row of pads on the prototyping area. All the other pads on this area are isolated. You may solder wires and pins into them and link them using wires soldered to the pads.

More than one port

It is possible to connect more than one 5624 port to a single I^2C Bus, however you won't easily be able to use the 18-bit ADC if you do this as it can only have one I^2C Bus address.

The most likely configuration is to have two ports, where the links LK1 and LK2 are used to select different addresses for the 12-bit ADC and 12-bit DAC. The 18-bit ADC is not used.

Port #1 would have the links set to the factory default.

Port #2 would have LK1 linking pins 2 & 3, and LK2 linking pins 1 & 2.

Daisy chaining

You can daisy chain I^{2}C Bus modules on the same bus by either using a cable made up with multiple connectors or by soldering in the spare header provided in the kit and then using the supplied two-ended cable.

Other I^{2}C Bus devices

It is possible to connect any other Micro-Robotics I^{2}C device to the system when using this port. The only problem is likely to be address clashes, which are usually resolvable by changing one device's address.

Note: the 12-bit ADC (AD7998) shares some I^{2}C Bus addresses with the PCF8574 digital I/O port, which is used in several Micro-Robotics products. In most configurations you should be able to avoid an address clash.

I^{2}C Bus Addresses

Normally you won't need to think about the I^{2}C Bus addresses for the devices on this card; the software we suggest to drive the devices has the default addresses built in.

However, if you do need to change the addresses of the devices on the Port, you can use the LK1 and LK2 links to do this. You will need to solder wire links between the pins, and also cut a track under LK1.

The 18-bit device cannot have its address changed using a link, so it is not usable when there is more than one of these ports on the I^{2}C Bus.

Note: It may be possible to have these boards custom-built with differently addressed devices for the 18-bit ADC. Please contact our Sales desk for a quotation.

See the tables below for the I^{2}C Bus address selection.

LK1 position	**I^{2}C Bus Address for AD5339**
Link pins 1 & 2 (default)	**24**
Link pins 2 & 3	26

Note: LK1 is factory set by a cuttable copper track on the underside of the board. This will need to be cut before using the link in the other position.

LK2 position	**I^{2}C Bus Address for AD7998 - 0**
Link open/not fitted (default)	**64**
Link pins 1 & 2	66
Link pins 2 & 3	68

I^{2}C Bus Address for MCP3421 A0
208

Specification

Please refer to the manufacturers datasheet for a detailed description of each device used in this product. Using the device outside of the ratings listed below could cause the device to fail and will invalidate the warranty.

General

Power supply: 2.7 – 5.5 Volts, via the I^{2}C Bus connector

12-bit ADC

Input voltage range: at least GND to AVcc (AVcc is the supply voltage)

Input Impedance: 30pF charged at each reading

18-bit ADC

Common mode range: at least GND to AVcc (AVcc is the supply voltage)

Input voltage range: at least GND to AVcc (AVcc is the supply voltage)

Full scale input: ±2.048V / PGA[1]

Input Impedance: 2.25M Ω / PGA

Resolutions available, verses speed of reading:

Resolution - bits	Samples per second
18	3.75
16	15
14	60
12	240

DAC

Nominal output voltage range: GND to AVcc

DC Output Impedance: 0.5Ω

Output Source/Sink capability: equivalent to ~ 60Ω to each supply rail.

Mechanical

Size: 64mm square

Mounting: 3.5mm holes on 56mm square

[1] *PGA is the input amplifier gain*

Devices

18-bit ADC: MCP3421

12-bit DAC: AD5339

12-bit ADC: AD7998

Code

See the product entry for this device on our website for the latest code examples.