khs instruments

analog::blocks

SPI and I²C Interface with the QT-Py

Application Note

Rev. 1.0

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1) General Description

The analog::blocks Base Board Ver 2.0 provides the layout for SPI and I²C communication via a digital interface. Together with an adapter board it allows an Adafruit QT-Py microcontroller module to be connected to the Base Board. SPI and I²C communication can then be controlled using the Arduino IDE.

2.1) Control Bus Isolation

The Adafruit QT-Py control signals for SPI Module Select and I²C are galvanically isolated from the analog system by the ISO devices. This reduces ground-loop interference and allows the analog ground potential to be defined independently from the host interface.

Note: Resistor R41 must remain unpopulated, so the CLOCK/REF can be used on the isolated side by modules only.

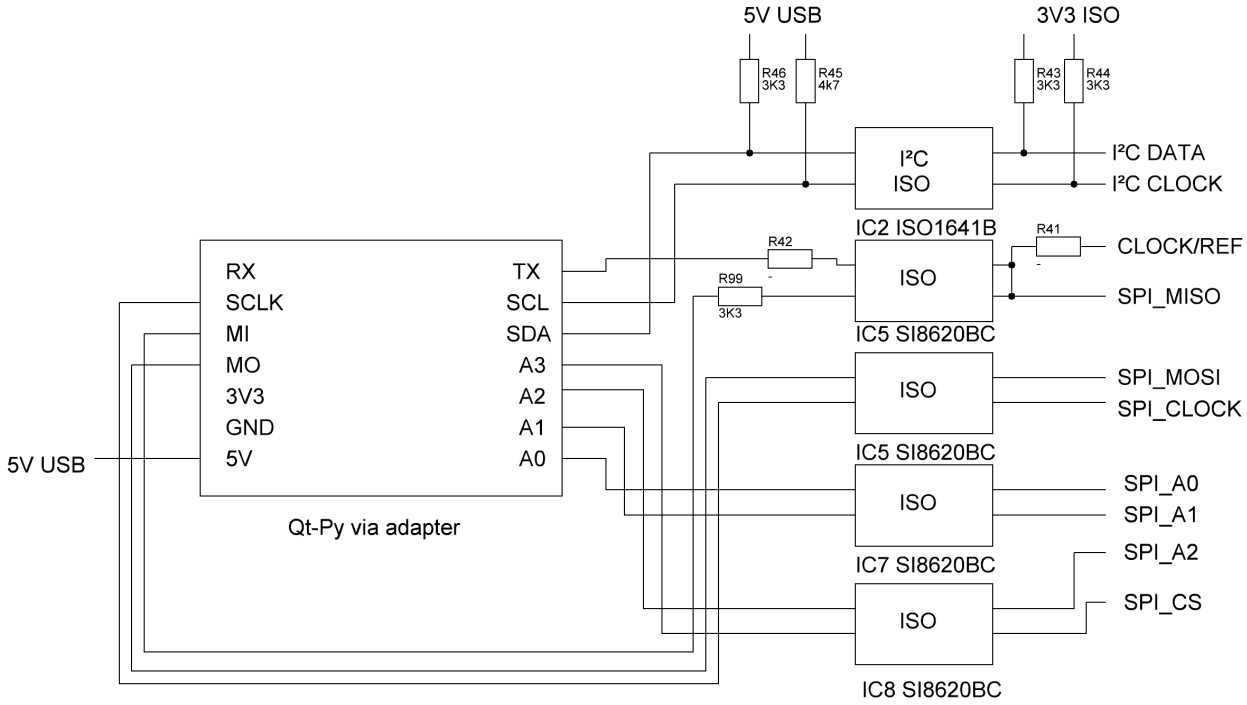


Figure 2. CPU Interface and Isolation

Note: To use the QT-Py USB controller with the analog::blocks Base Board, the QT-Py adapter is required.

2.2) Control Bus

The isolated SPI MOSI, MISO and CLOCK signals are shared between the module positions. An addressable chip-select multiplexer provides individual chip-select signals for up to eight SPI devices.

This allows multiple SPI modules to share the control bus without requiring a separate chip-select line from the host for each module.

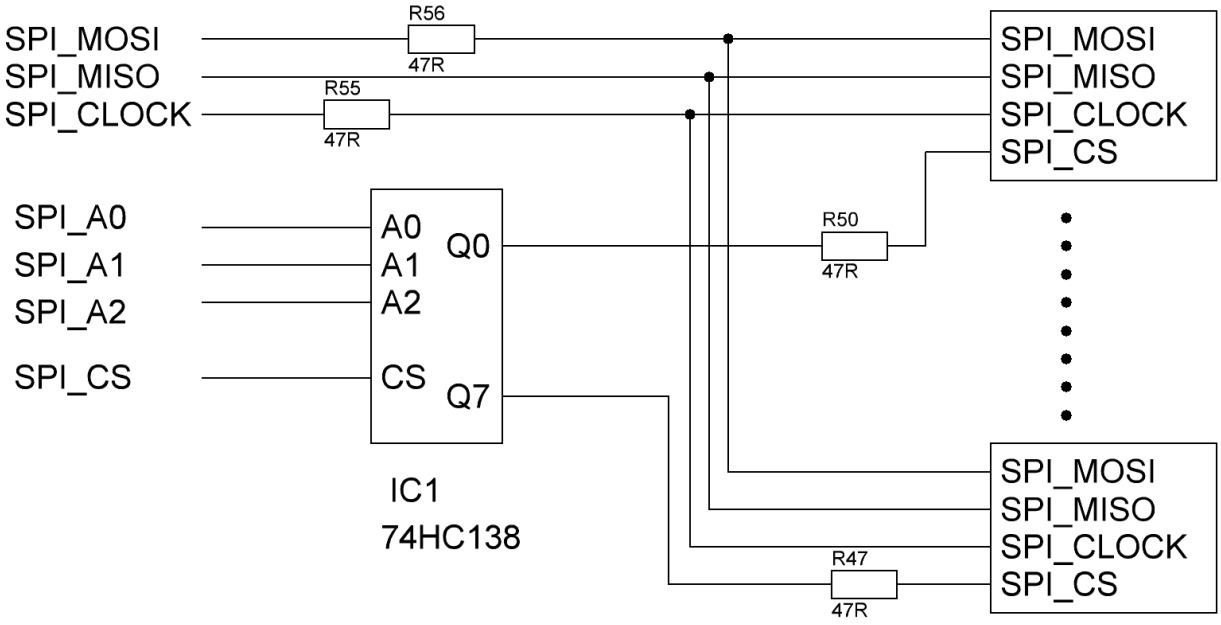


Figure 1. SPI Module Select

2.3) Internal +3.3 V Power Supply

The internal 3.3 V power supply generates power for the isolated interface logic from the +5 V power rail.

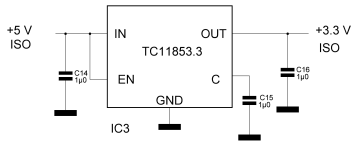


Figure 3. Internal 3.3 V Regulator

2.4) Internal +5 V Power Supply

The isolated digital interface circuitry requires a +5 V supply for SPI and I²C communication.

If no separate +5 V supply is available, the internal 78L05 voltage regulator can generate +5 V from the +12 V power rail. Jumper SV6 connects the regulator output to the +5 V power rail.

Note: SV6 must be open when the +5 V power rail is supplied from another source.

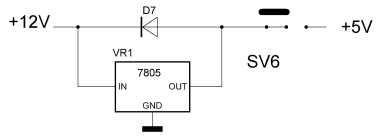


Figure 4. Internal 5 V Regulator

2.5) USB +5 V Power Supply

Jumpers SV4 and SV5 allow the +5 V power rail to be supplied directly from USB.

Note: In this configuration, there is no galvanic isolation between USB ground and the analog section of the Base Board.

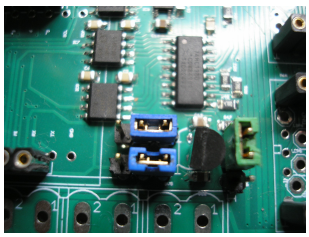


Figure 5. Jumper SV4, SV5 and SV 6 in the USB +5 V power position

3) Population of the base-board

The analog::blocks main board provides a layout for an isolated SPI and I²C interface. Populate all components not marked with '-' in Figure 6.

3.1) Layout

Figure 6 shows the positions of the components to populate.

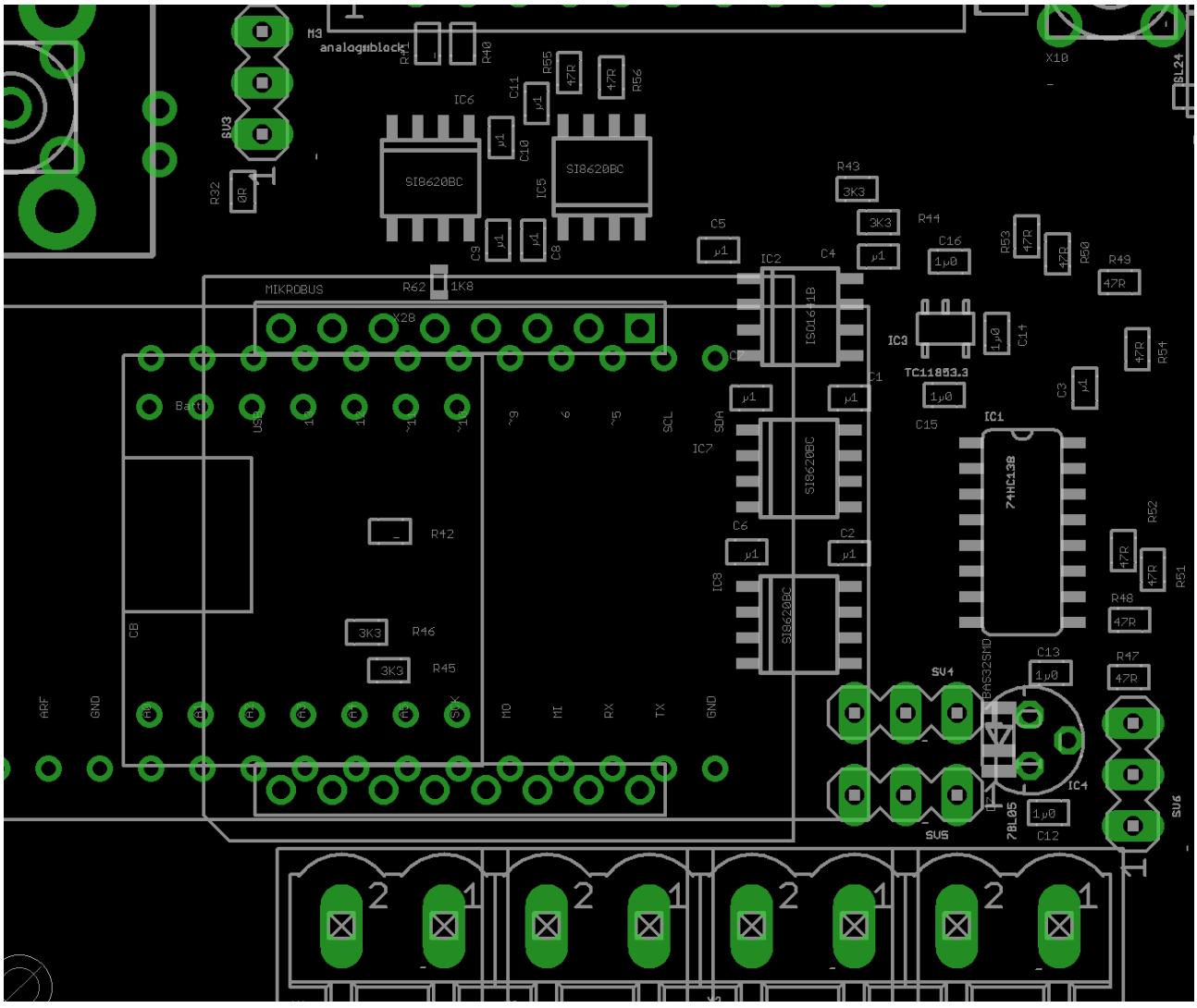


Figure 6. analog::blocks Partial Interface Layout

3.2) Schematic

Figure 7 shows the interface schematic. Note that IC 1 and the resistors R47 to R54 are not shown. Components marked with '-' are not populated. Please refer to Figure 1. SPI Module Select.

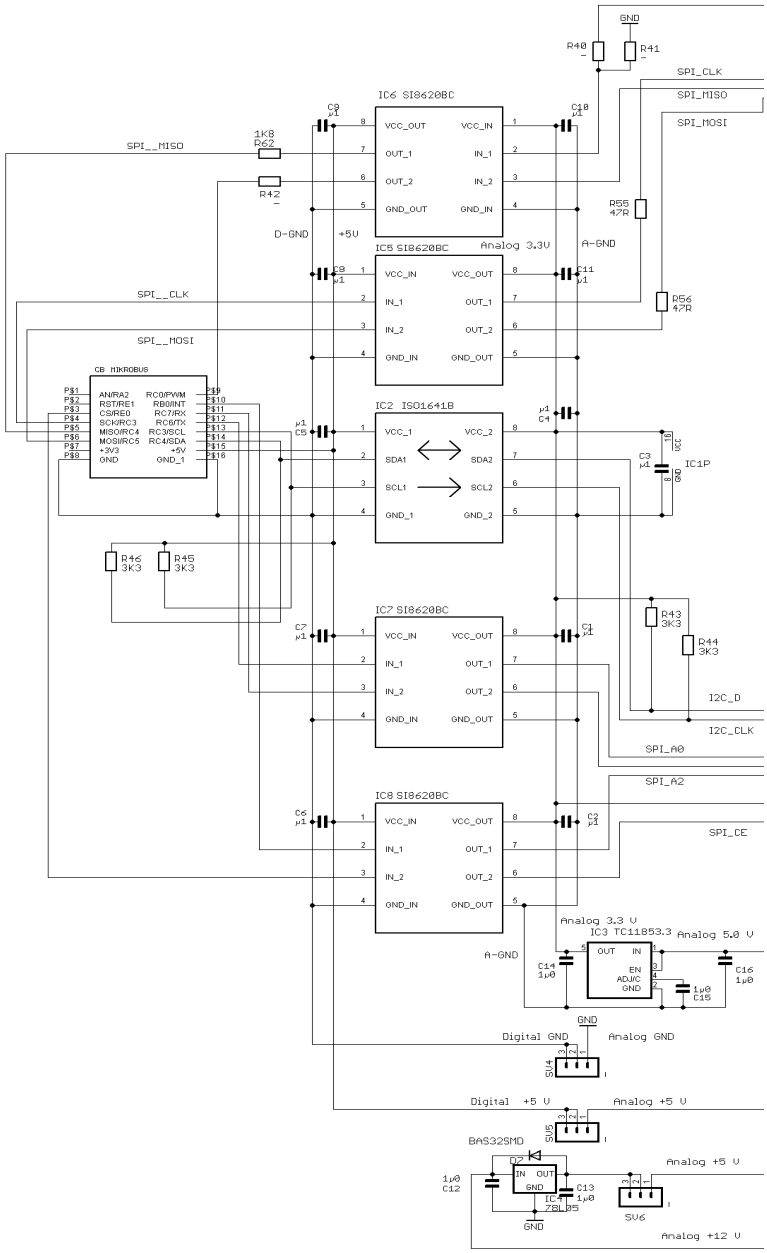


Figure 7. Partial Interface Schematic

3.3) Required modifications

Version 2.0 requires some minor modifications for the SPI interface to work with the digital interface board.

The voltage swing of the digital SPI signals is +5V. The QT-Py board signal levels are 3.3V, so there is the need to insert the limiting resistor R62, 1K8 between the output of IC6 and the MISO input of the QT-Py board. To do this cut the PCB trace near pin 7 of IC6 and bridge the gap with R62.

Additionally, add a solder bridge between pin 2 and pin 3 of IC6.

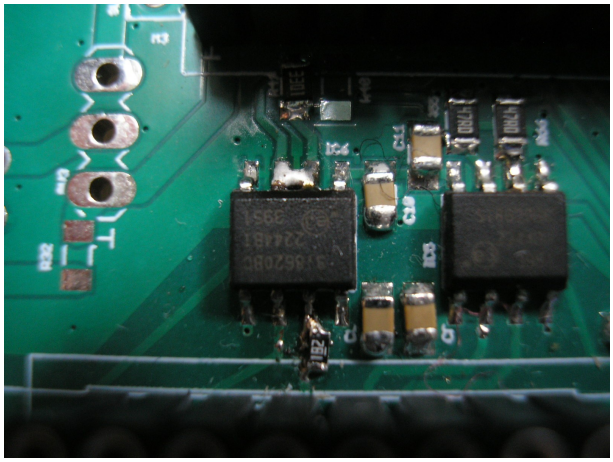


Figure 8. Required modifications near IC6

3.4) Mounting the QT-Py Board

Figure 9 shows how to mount the QT-Py board via the digital interface board in the analog::blocks base board. The power for the digital interface comes from the USB via the QT-Py board.

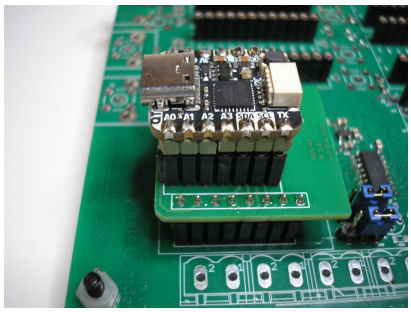


Figure 9 QT-Py Board mounted on the base-board

4) Bill of Materials (BOM) – Parts List

This list summarizes the components required for assembly and ordering. Refer to Figures 6 and 7 for component placement and circuit details.

1	Value: µ1	Package: 0805	Device: C-ceramic X7R	Mfg:	Mfg#:	Parts:	11
2	Value: 1µ0	Package: 0805	Device: C-ceramic 25V X7R	Mfg:	Mfg#	Parts:	5
3	Value: SI8620BC	Package: SO8	Device: ISO_DIG-2CH_UNIDIR	Mfg	Mfg#:	Parts:	4
4	Value: ISO1641B	Package: SO8	Device: ISO_DIG-I2C	Mfg: TX	Mfg#: ISO1641BDR	Parts:	1
5	Value: 1K8	Package: R0603	Device: R 1%	Mfg:	Mfg#:	Parts:	1
6	Value: 47R	Package: 0805	Device: R 1%	Mfg:	Mfg#:	Parts:	10
7	Value: 3K3	Package: 0805	Device: R 1%	Mfg	Mfg#:	Parts:	4
8	Value: 74HC138	Package: SO16	Device: TTL 3 to 8 demux	Mfg: Nexp.	Mfg#: 74HC138D-Q100,118	Parts:	1
9	Value: TC11853.3	Package: SOT-23-5	Device: VREG +03.3V 150mA	Mfg:	Mfg#:	Parts:	1
10	Value: 78L05	Package: TO-92	Device: VREG +5V 100mA	Mfg:	Mfg#:	Parts:	1

History:

Revision	date yy/mm/dd	Changes
1.0	26/10/23	Initial.