Specy – Documentation and Tutorial

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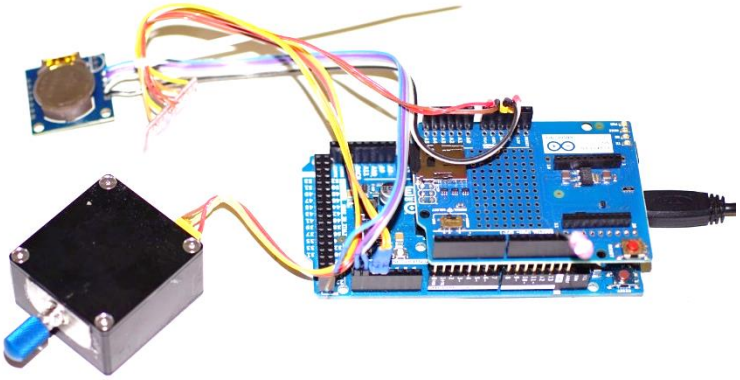
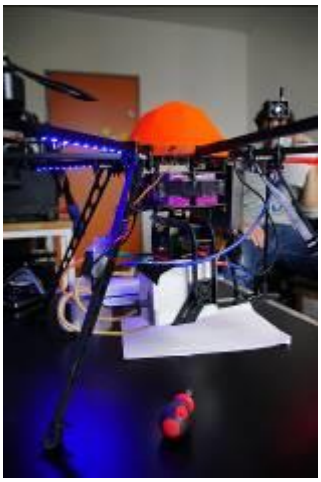
Introduction:

Specy is a small and simple spectroscopy system that relies on the Ocean Optics STS spectrometer module and Arduino based open source hardware. The system is small, lightweight and consumes a minimum of energy. Further it is fully autonomous and basically will consequently measure hyperspectral data to SD card once it´s activated.
The firmware of Specy is easy to understand and written in Arduino which allows to freely adapt the base code to specific needs. Adaptations of Specy have been used on UAVs, Tractors, in various lab application and as field instrument.





Bill of material:

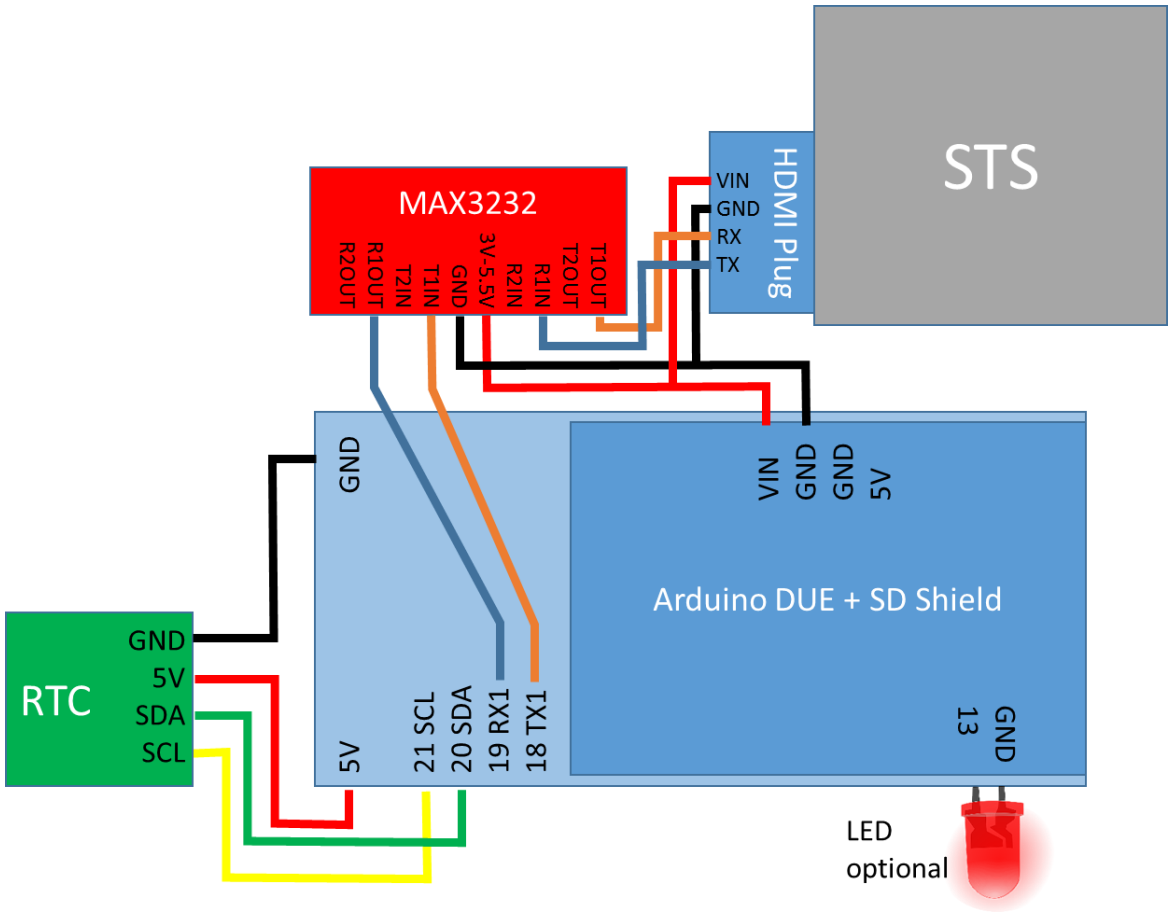
- Ocean Optics STS (UV/VIS/NIR)
- Arduino DUE
- Xbee-SD Shield or similar
- RTC module (I^2C)
- MAX2323
- miniHDMI Plug
- SD card

Optional for use on battery/solar

- LiPo Battery 1S
- Lipo Rider PRO
- Solar panel, 6V, 1W or more
- Case

Soldering

To make the whole system working a few connections have to be wired by soldering. See the following schematics for an overview of the necessary connections. The firmware will only work if all the components (except the LED) are wired as shown below.

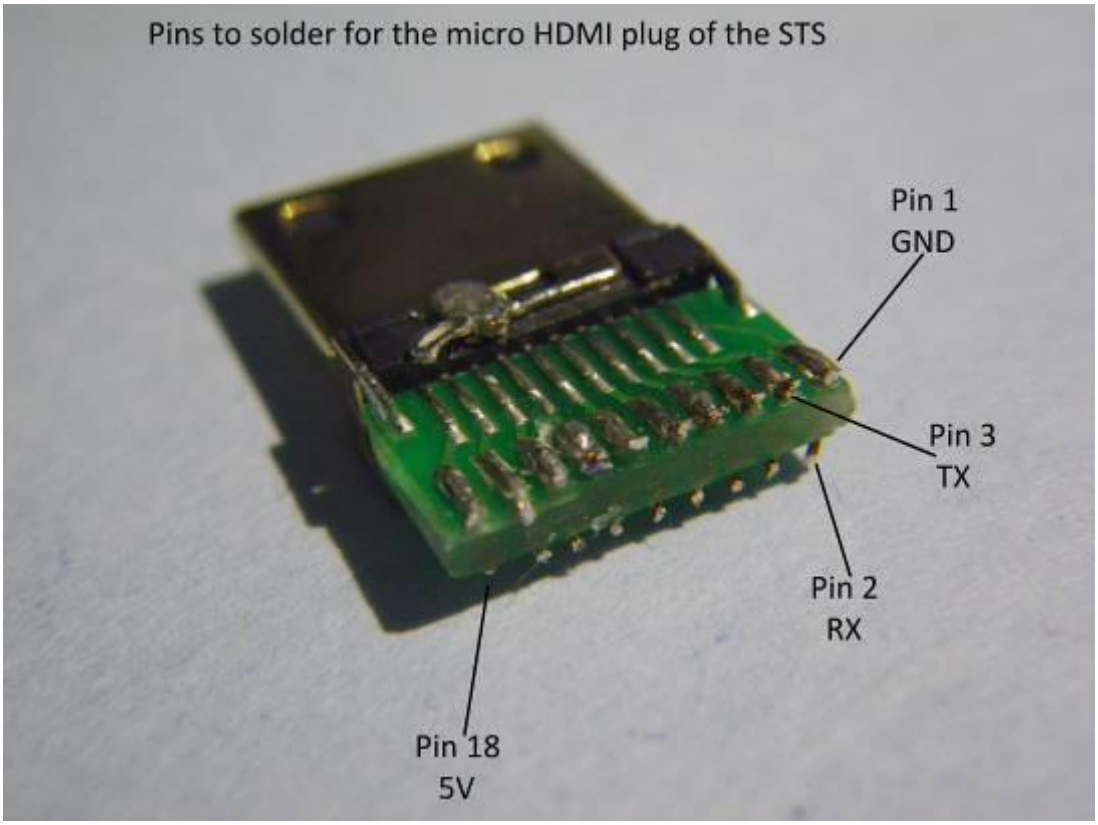


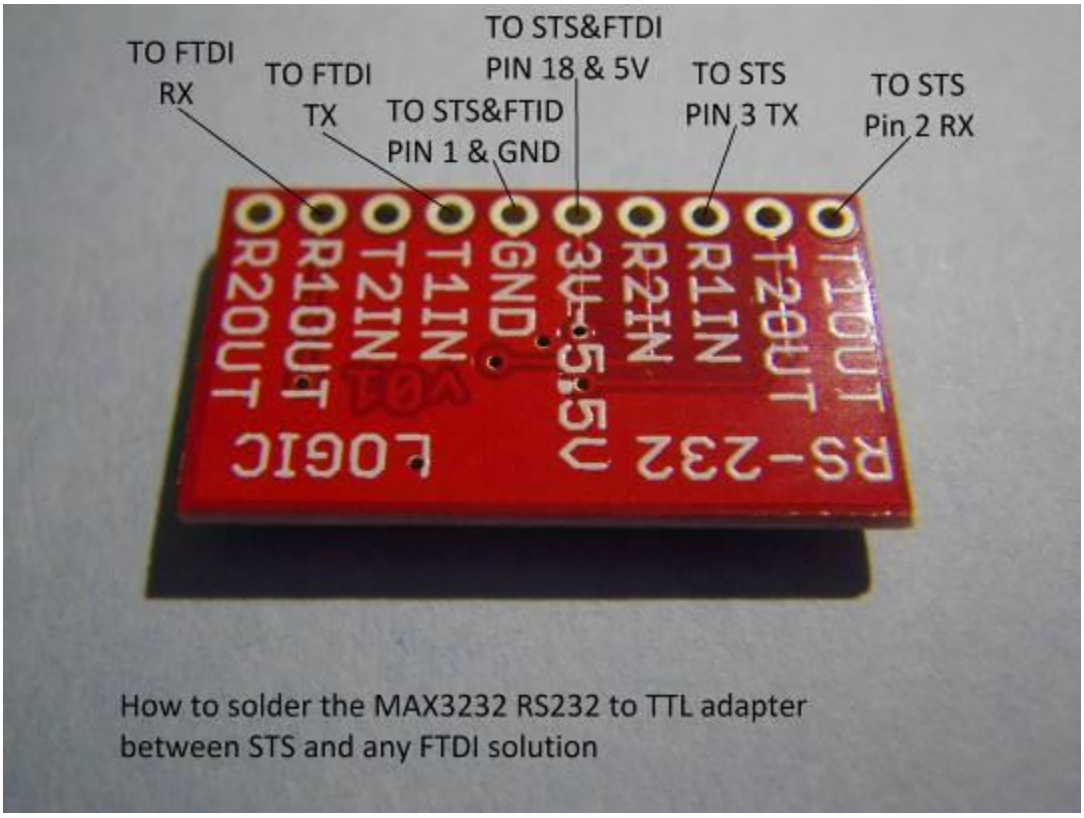
1. RTC – This unit provides the timestamp and will be connected directly to the Arduino DUE using the four lines 5V, GND, SDA, SCL as shown in the following table. The RTC can be soldered on the SD shield of the Arduino due, since there is some space available.

RTC Side	Arduino DUE
GND	GND
5V	5V
SDA	20 SDA
SCL	21 CL

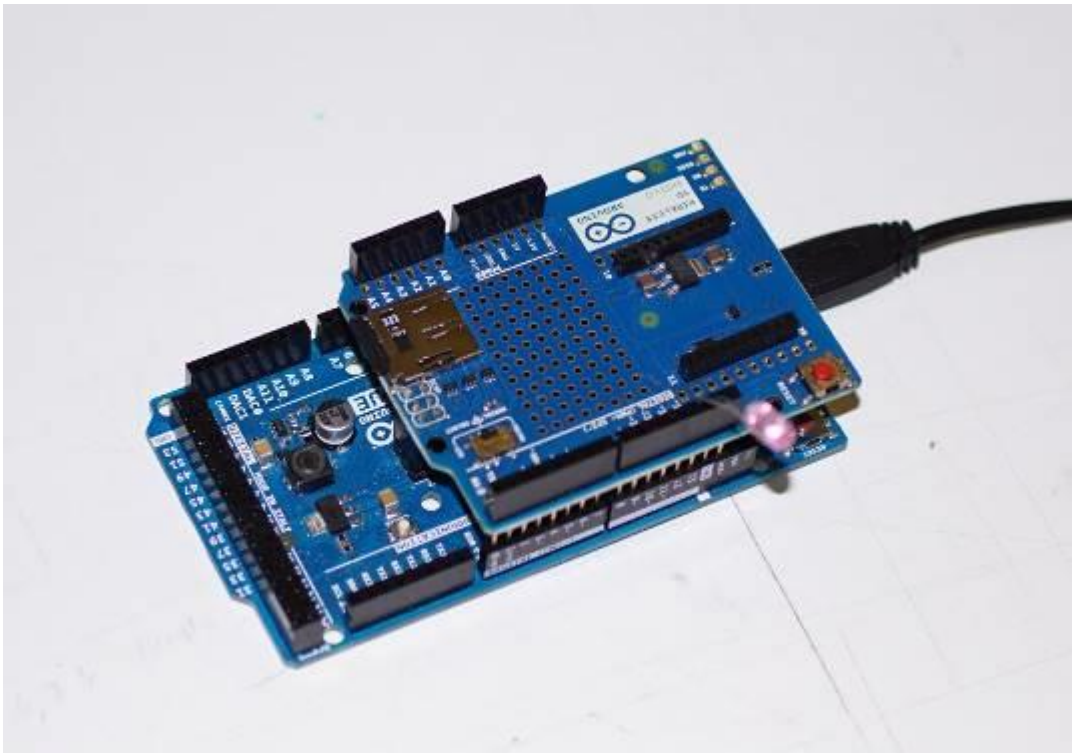
2. MAX2323 and micro HDMI Plug – This part creates connection and power delivery to the STS spectrometer and is the trickiest. Connect the wires according to the following table. The pin layout of the miniHDMI connector of the STS is found in the OEM datasheet of the spectrometer. A miniHDM plug can be simply recycled from a common adaptor or cable. When applying power to the VIN/USB connection of the Arduino DUE, make sure it´s stabilized at 5V. Higher voltage levels will harm the STS spectrometer. The voltage converter of the Arduino does barely provide enough current for the STS spectrometer so do not wire it to the 5V pin.

STS	MAX3232	Arduino DUE
Pin 3 TX	R1 In	
Pin 2 RX	T1 Out	
Pin 18 5V	5V	VIN
Pin 1GND	GND	GND
	R1 Out	19 RX1
	T1 In	18 TX1





3. SD Shield – The shield can be simply plugged on top of the Arduino DUE. Only remove or insert the SD card while the whole system is not powered.



Programming

To upload the firmware to the Arduino DUE download the Arduino programming software and open the Specy code. Specy was programmed and compiled with the version “arduino-1.5.6-r2” and will maybe but is not guaranteed to work with other releases. Connect the Arduino DUE with a micro USB cable to the computer. Use the programming port of the Arduino Due (the one in the middle). Install the USB driver if necessary. Load the Specy firmware to the Arduino and chose the Arduino Due “Programming Port” from the Tools->Boards menu. Press the upload button.

Using the serial monitor set to 57600 baud the system can be monitored.

If the RTC was not set yet, you might have to do so. There are various tutorials in the web.

Remove power from the system and plug the SD card into the computer to see the spectral files that were measured.

Notes on using the hardware/software

Once the Specy system is powered on, it will perform a self-check and see if an SD card is inserted and the spectrometer is connected. This is indicated by the on-board LED of the Arduino (Pin13), blinking for 1 second at start-up and blinking for one second after the setup is complete. If something goes wrong, the LED will continuously flash.

If everything is fine, the Specy will go in measurement mode and sets integration time and measures a spectrum every second. The successful storage of the spectral data is indicated by one blink of the LED.

Questions and trouble shoot

Many problems that could arise during the work with Specy or Arduino can be resolved by an online search in the Arduino Forums. If further problems remain contact an.burkart@fz-juelich.de

Housing:

Several 3D printed cases were designed to house all components of Specy, contact us for more information.