LAB2 – BASICS OF OPTO-ELECTRONICS

DATA COMMUNICATION

In this Lab we will focus on the data communication over an optical fiber.

a) Available Material

ii. A board with a fiber coupled photodiode (SHF250), coupled photoreceiver (SHF551) and a coupled transmitter (SHF727)
iii. Plastic Optical fiber
iv. Multimeter
v. Photodetector
vi. Analog discovery
vii. Fiber optic click module
viii. MCP2221 module for communication
ix. The Datasheets of the components
x. Introduction

As we have seen in the course optical data can be transported over optical fibers. We have seen the different parameters that rules this transmissions. In this lab you will use the different components to send data over an optical fiber and received them as well.

a) Optical fiber (you can do this part at home)

1. Using the datasheet of the plastic optical fiber (POF) calculate the V-number and therefore the number of modes
2. Calculate the maximum theoretical bandwidth that can be supported by this POF

b) Transmitter

The transmitter SHF727 is a laser diode that can be used to transmit data.

Look at the datasheet and work out what is the voltage to get emission

Slowly increase the voltage and observe when you get light out of the module (don't put your eye in front of it!)

Becareful to the polarity as well!

Make it blink using a low frequency (1 Hz) pulse

1. Measurement

First use the photodiode SHF250. Ideally you should use a reverse voltage.

Connect the cathode to the 5V and through an appropriate resistor to the ground.

Using the analog discovery send ramps of voltage (no more than 2.5V) into the transmitters.

Using an optical fiber connect to the photodiode and measure the voltage on the series resistor of the photodiode.

Try to obtain the characteristic of the transmitter using the datasheet of the photodiode and the current measurement.

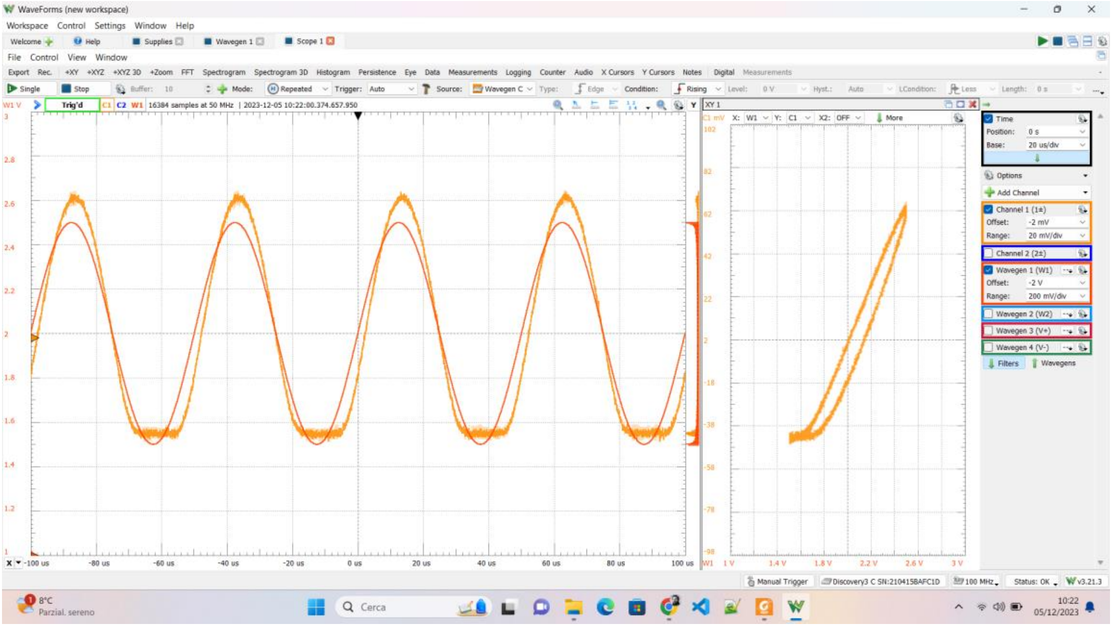


Figure 1 - Measurement of the transmitter on the photodiode.

Try different shapes of the input signal on the transmitter.

In particular:

1. a sinewave with an offset of 2V and an amplitude of 200mV. (figure up)
2. A square signal from 0 to 2 V at different frequency (like below)

3. Response frequency

Stop the wave generator.

Go on the network analyser module.

Set a source with an offset of 2V and an amplitude of 200 mV. Measure on channel 1 the signal on the photodiode resistor and in channel 2 the input signal of the transmitter.

Measure the bode diagram up to 5 MHz and observe the frequency response.

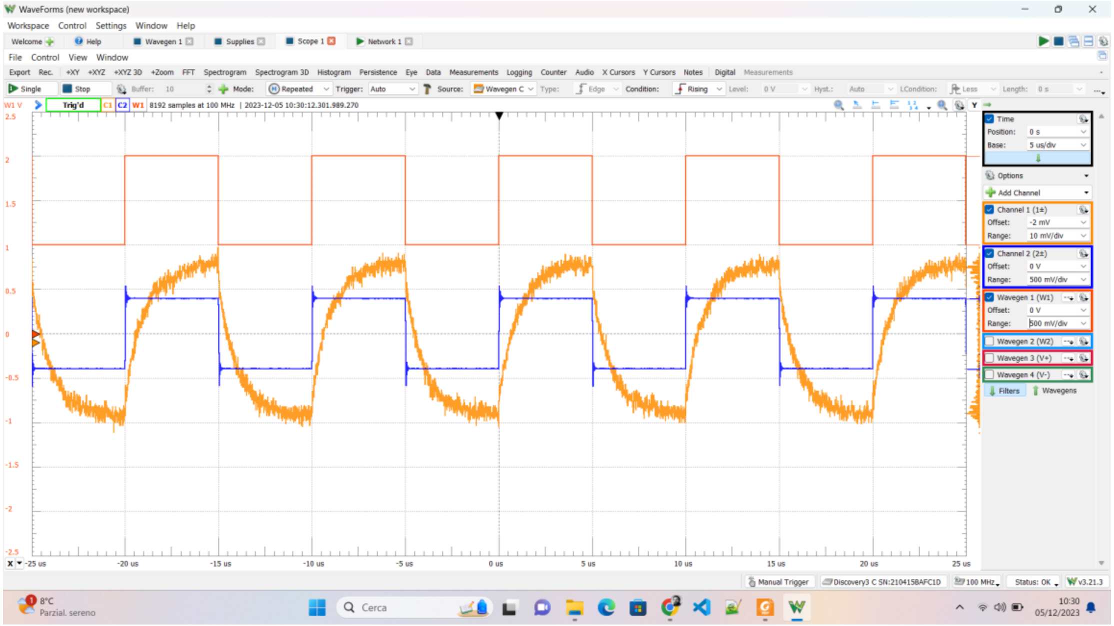


Figure 2 - measurement obtained with the photodiode, using different resistor the fall and rise time will be different but also the amplitude.

2. Receiver

Repeat the previous measurement using the receiver.

Connect the receiver according to the datasheet.

Observe the signal as below.

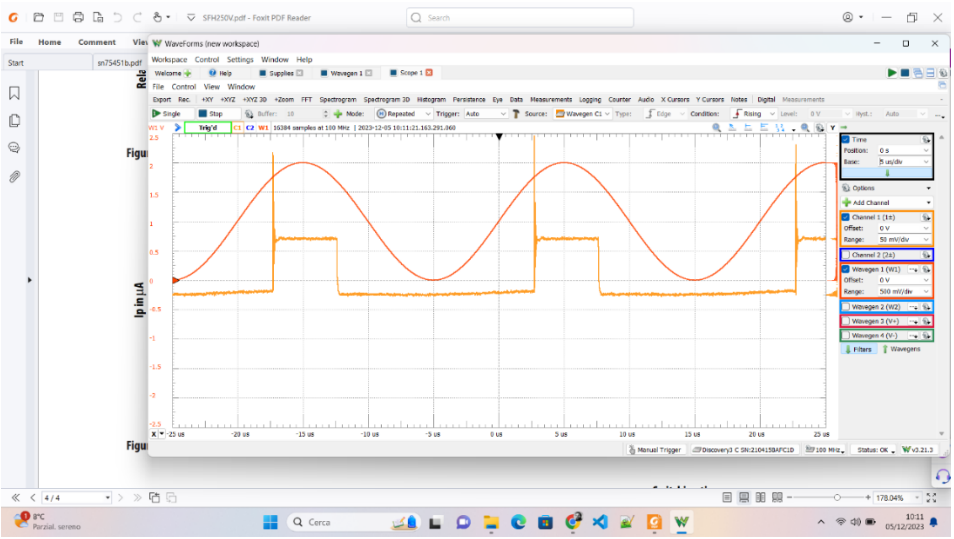
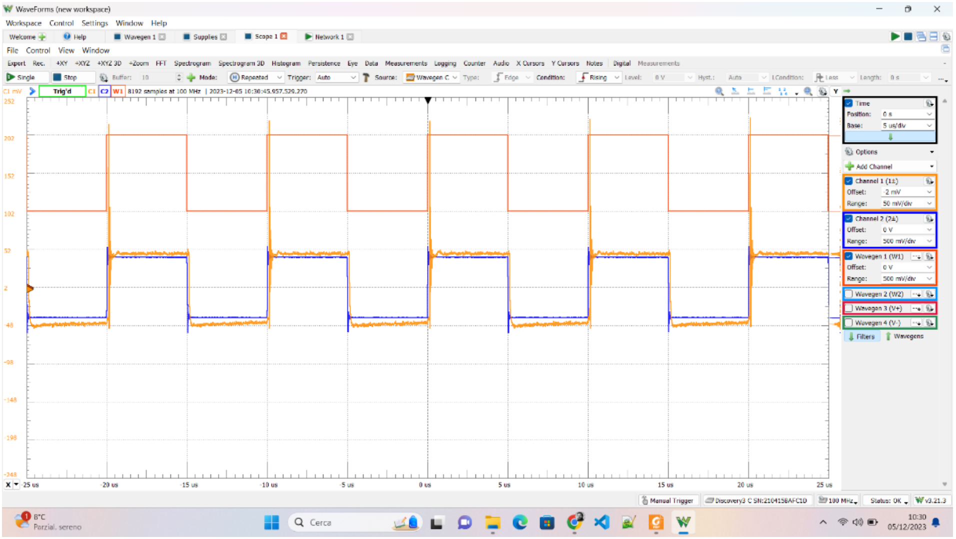


Figure 3 - Measurement obtained with the receiver.



Pulse

Now try to measure pulse that are narrow as possible. And observe the relaxation oscillations. In particular, connect an external load (around 50 ohm) to the ground and other values and observe the change.

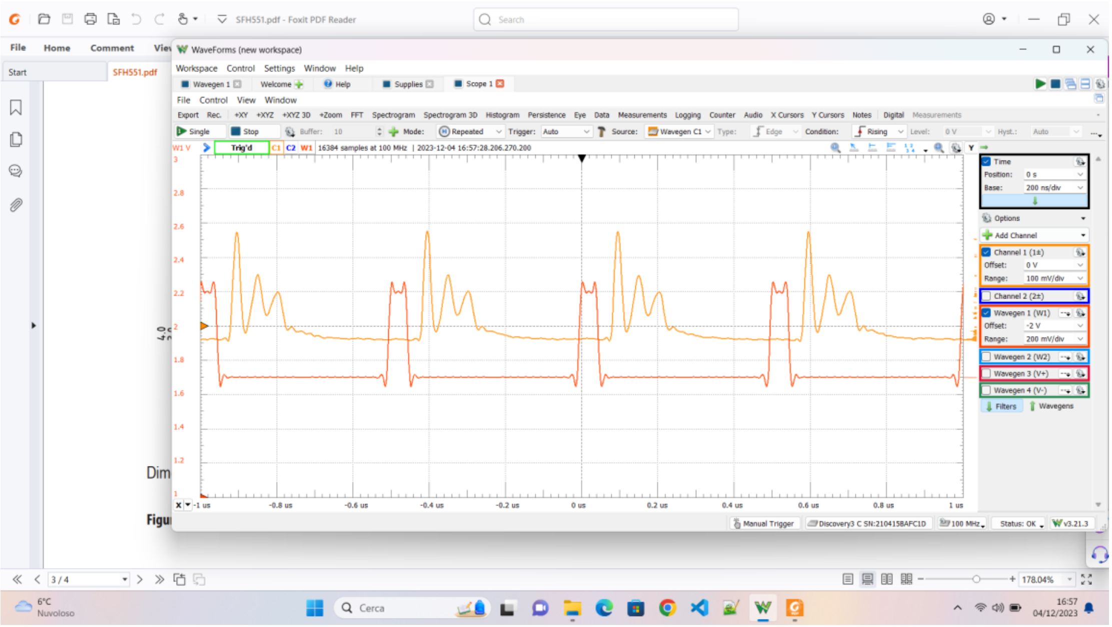


Figure 4 - Measurement obtained with the receiver. No load connected.

Conclude on the usable bandwidth of the components.

c) Module fiber optic click

Fiber Opt Click is a compact add-on board that adds fiber-optic communication to your design. This board features one IF-D91, a fiber-optic photodiode, and one IF-E97, a fiber-optic LED, both from Industrial Fiber Optics. It provides a plastic optic connection feature over a plastic fiber cable with data rates of up to 512Kbps. Received data from the IF-D91 photodiode is filtered and amplified through dual operational amplifier, the MCP6284 from Microchip, and sent for further processing via selected mikroBUS™ lines. This Click board™ makes the perfect solution for highspeed digital data links, local area networks, video links, EMC/EMI signal isolation, fiber optic modems, and more.

PINOUT DIAGRAM

This table shows how the pinout on Fiber Opt Click corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin	mikroBUS				Pin	Notes
	NC	1	AN	PWM	16	**PWM**	GPIO TX
	NC	2	RST	INT	15	NC	
	NC	3	CS	RX	14	**TX**	UART TX
	NC	4	SCK	TX	13	**RX**	UART RX
	NC	5	MISO	SCL	12	NC	
	NC	6	MOSI	SDA	11	NC	
Power Supply	**3.3V**	7	3.3V	5V	10	**5V**	Power Supply
Ground	**GND**	8	GND	GND	9	**GND**	Ground

ONBOARD SETTINGS AND INDICATORS

Label	Name	Default	Description
LD1	PWR	-	Power LED Indicator
J1-J2	TX SEL	Right	Communication Lines Selection PWM/UART: Left

			position PWM, Right position UART

FIBER OPT CLICK ELECTRICAL SPECIFICATIONS

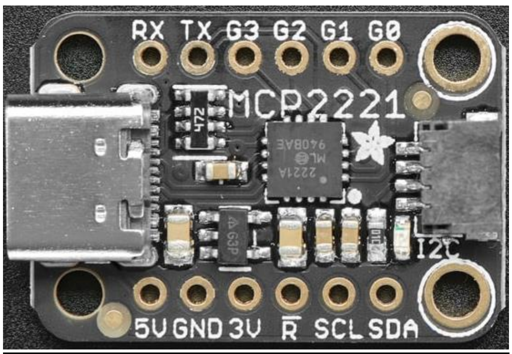
Description	Min	Typ	Max	Unit
Supply Voltage	3.3	-	5	V
Output Spectrum Peak	-	650	-	nm
Output Data Rate	-	1	-	Mbps
Input Data Rate	-	100	-	Mbps

d) MCP2221

What can the MCP2221 chip do? This chip from Microchip is similar to a USB to serial converter chips but adds a GPIO and I2C interface as well. The analog/digital GPIO pins can act as 10-bit analog inputs (ADC) and there's even a 5-bit DAC output. The I2C interface is great for talking to OLEDs, sensors, PWM drivers, its the most popular interface for small devices. You can use the GPIO to do things like flash LEDs, read switches or buttons, and more. The MCP2221A breakout is like adding a little swiss army knife for serial protocols to your computer!

This chip is powerful and useful to have when you want to use Python (for example) to quickly iterate and test a device that uses I2C or general purpose digital and analog I/O. There's no firmware to deal with, so you don't have to deal with how to "send data to and from an Arduino which is then sent to and from" an electronic sensor or display or part.

This breakout has an MCP2221A chip, USB C connector, on-board 3V regulator, and a 4 pin JST SH port for I2C connectivity with 3V power and logic.



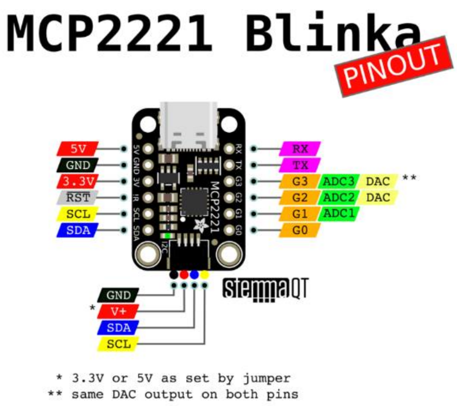


Figure 5 – MCP2221 module for serial communication.

We are interested in the RX and TX output to communicate to the click board.

If you don't have a python Ide, we recommend you install Thonny then you will need to install the following librarires:

- Hidapi library

pip install hidapi

- pyMCP2221A library

pip install PyMCP2221A

Connect your module to the click module.

Use the following code to transmit data over and try out different possible baudrates.

```
import serial

#baudarates:

#110, 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200, 128000 and
256000 bits per second.


ser = serial.Serial(port='/dev/ttyACM0',baudrate
=19200,timeout=0,parity=serial.PARITY_EVEN,rtscts =1, stopbits=serial.STOPBITS_ONE)

#uncomment the following to send the text

#ser.write(b' The quick brown fox, jumps. Over the lazy dog! '*10)

ser.write(b'R'*1000)

#the following line waits for up to 1000 bit to read
```