USB Driver for AVR (sort of)

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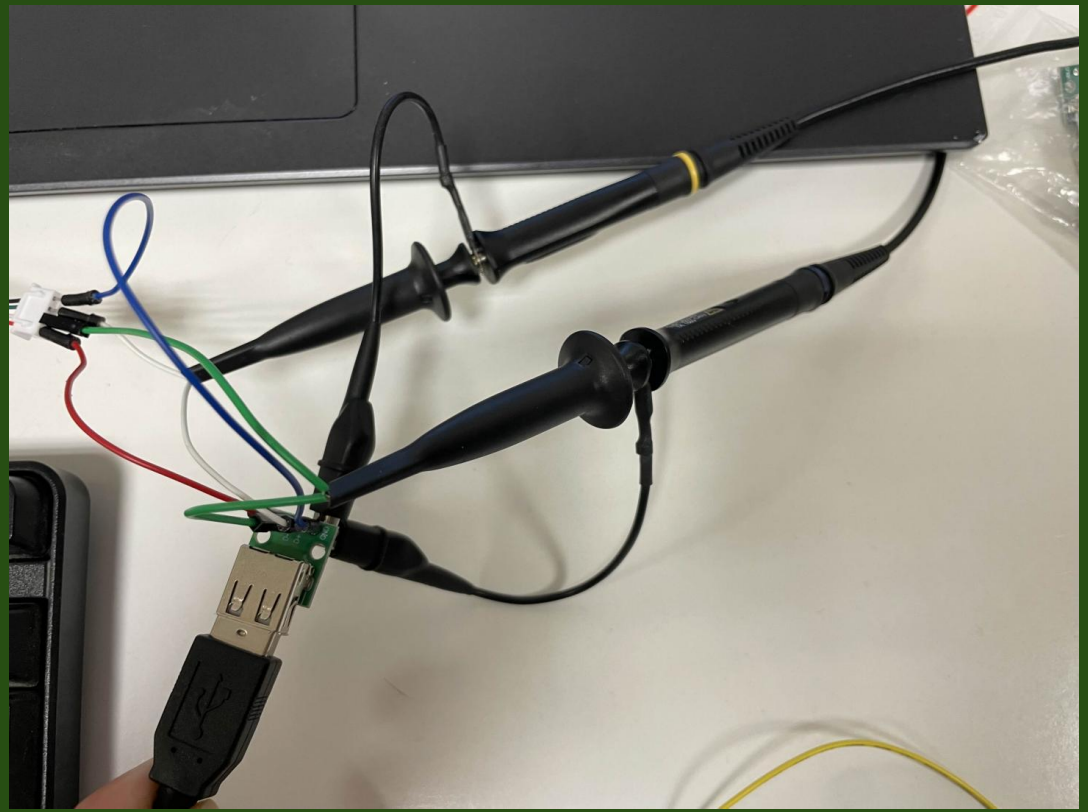
USB Protocol

- 4-wire: Vcc, Gnd, D- ,D+
- Differential 1/ Differential 0/ SE0/ SE1
- NRZI encoding
- Change in state → Logical 0
- No change in state → Logical 1
- Low/Full Speed and more (Superspeed, Superspeed+)

State	D+	D-
Differential 1	H	L
Differential 0	L	H
SE0	L	L
SE1	H	H

Desktop - Keyboard Connection with USB



USB Transactions

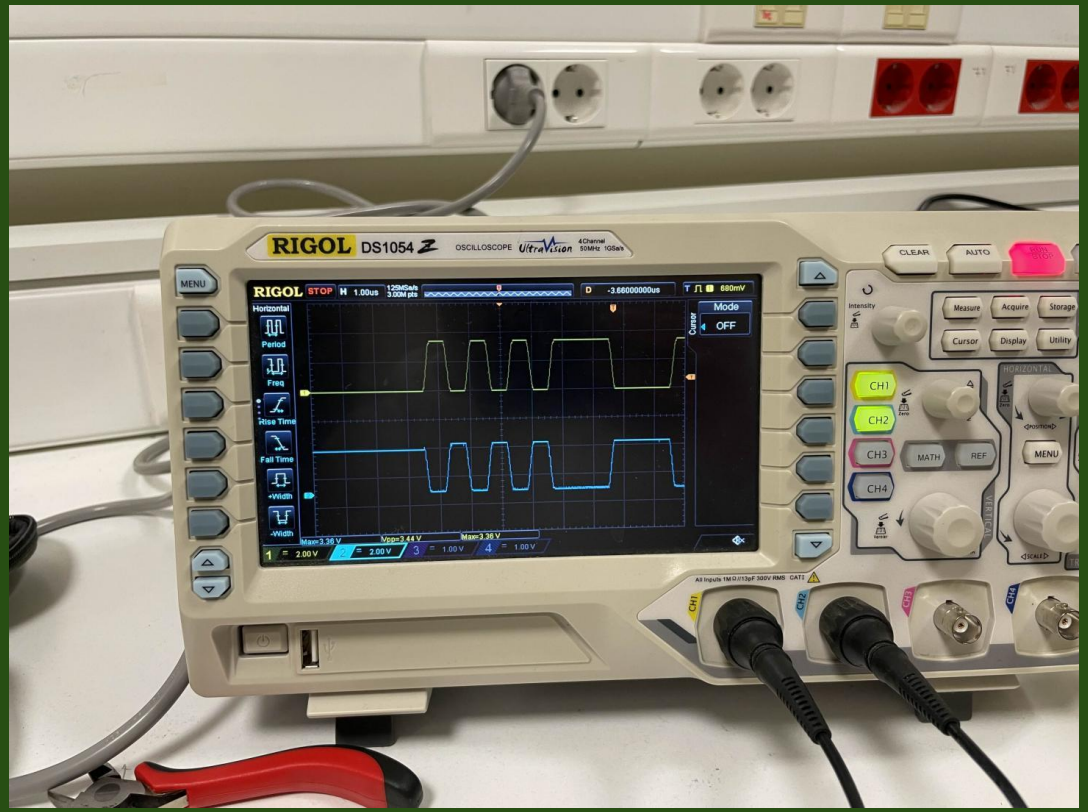
- Control/ In/ Out Transactions
- Setup/ Data/ Status Stage
- Token/ Data/ Handshake Packet
- Each packet field is in Little Endian
- Complementary PID
- Bit Stuffing every 6 consecutive 1s
- 5bit/ 16bit CRC

TOKEN	SYNC	PID	ADDRESS	ENDPOINT	CRC	EOP

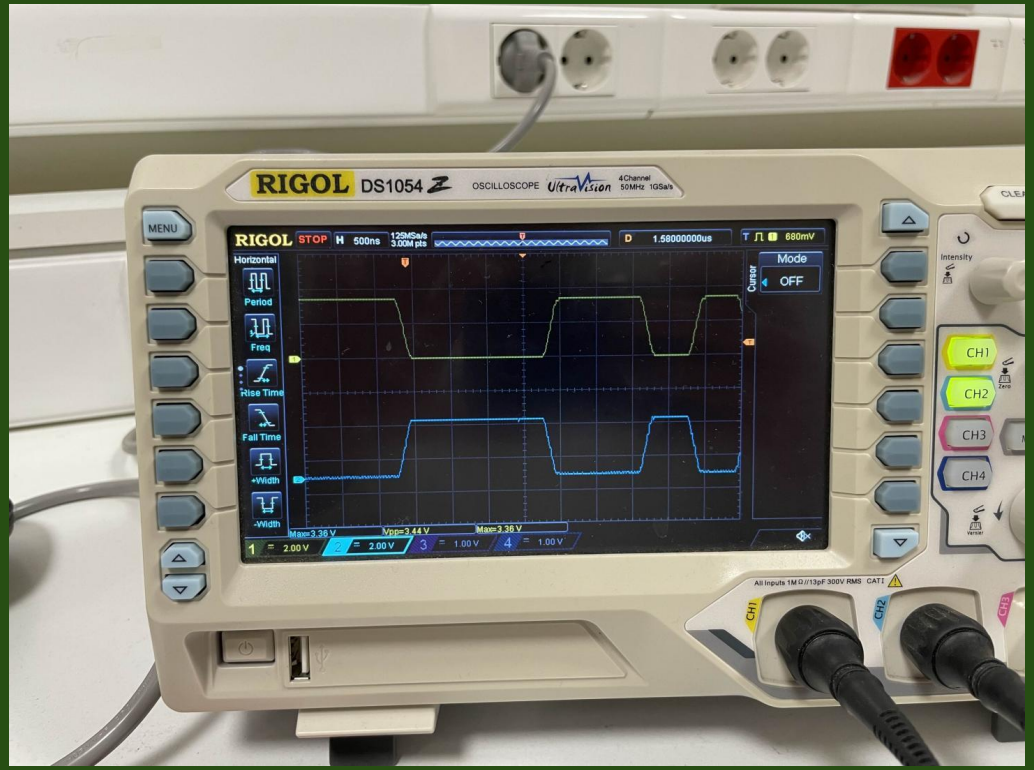
DATA	SYNC	PID	PAYLOAD	CRC	EOP

H/S	SYNC	PID	EOP

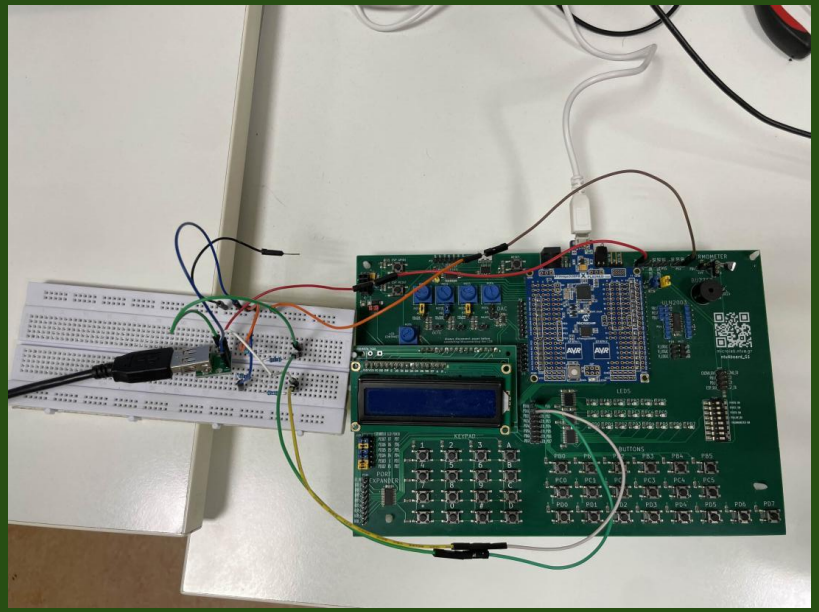
SYNC PATTERN

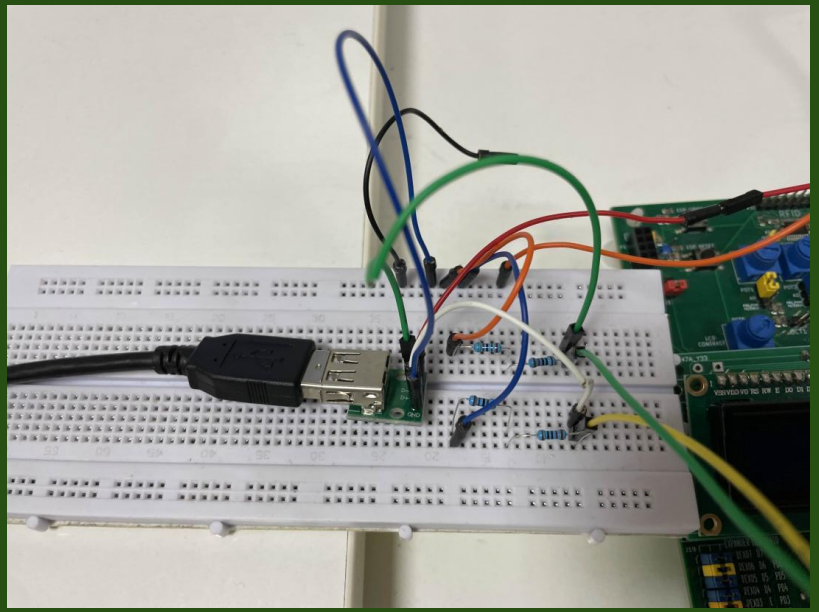


PID Field


RIGOL DS1054 Z
OSCILLOSCOPE UltraVision 4 Channel 50MHz 1GSa/s
MENU
RIGOL STOP
Horizontal
Period
Freq
Rise Time
Fall Time
+Width
-Width
Mode
OFF
Cursor
CH1
CH2
CH3
CH4

Attempt(s) at AVR - Keyboard Communication





Why Did We Fail?

- Difference in voltage from AVR?
- Couldn’t match/synchronize frequency?
- Faulty Configuration?

Backup: Simulating Keyboard with another AVR

Sources

Universal Serial Bus Specification

USB 101: An Introduction to Universal Serial Bus 2.0 by **Robert Murphy**

USB in a NutShell, **Beyond Logic**

Ben Eater

USB HID Keyboard scan codes