Vhodno izhodne naprave

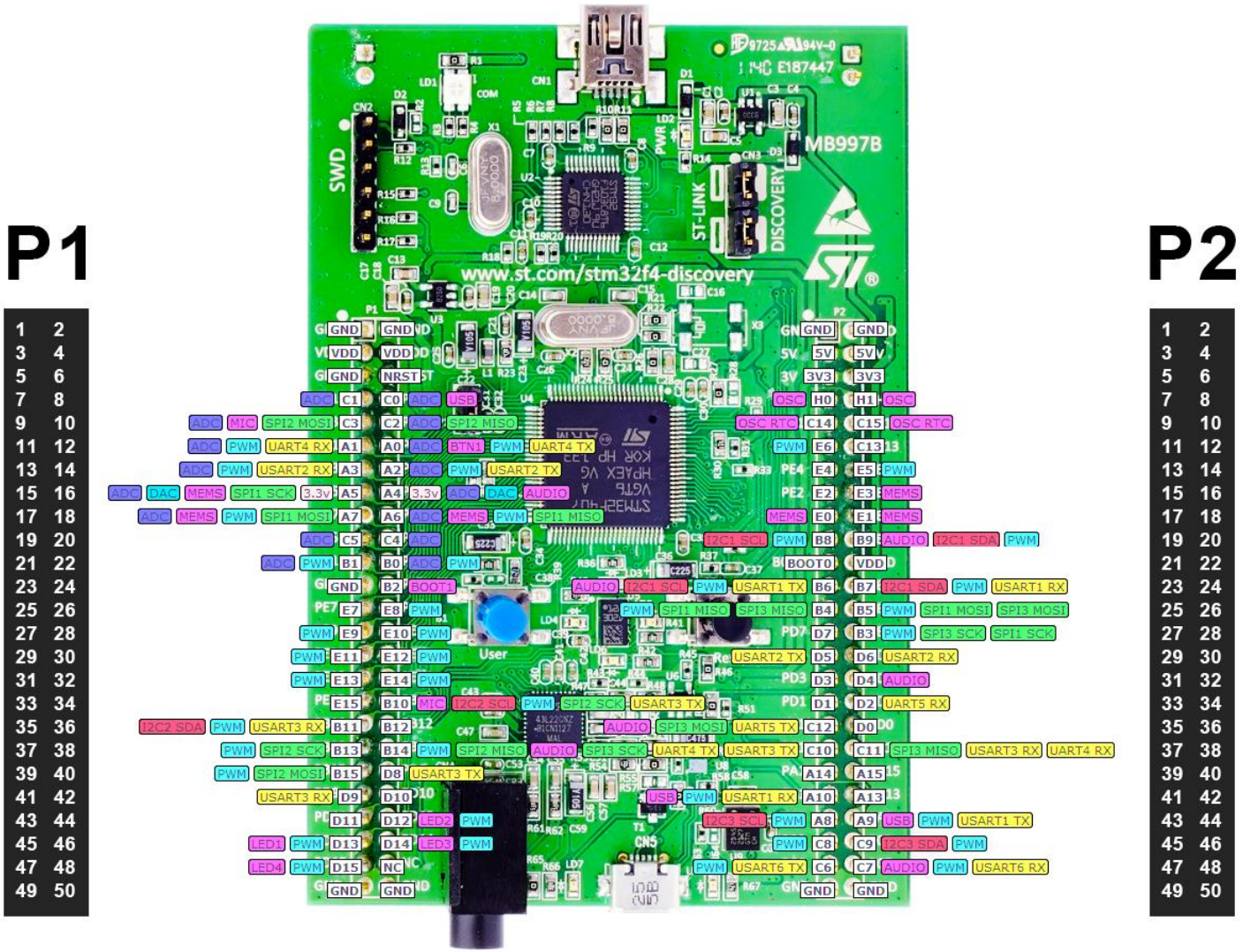
Laboratorijska vaja 6 - VP 6
STM32-breadboard, F4: PWM, Accel,
H7: Touch, LCD

VIN projekt - VP6: STM32-breadboard vezave

- Osvežitev: STM32 breadboard vezave
- Osciloskop
- Uporaba osciloskopa – VP4 :
  - SPI
  - PWM
  - I2C
- VIN Projekt

STM32F4DISCOVERY

3.3V !!!



STM32F4DISCOVERY

3.3V !!!

Table 11. Voltage characteristics

Symbol	Ratings	Min	Max	Unit
V_{DD}–V_{SS}	External main supply voltage (including V_{DDA}, V_{DD})(1)	–0.3	4.0	V
V_{IN}	Input voltage on five-volt tolerant pin(2)	V_{SS}–0.3	V_{DD}+4	
	Input voltage on any other pin	V_{SS}–0.3	4.0	
$\lvert\Delta V_{DDx}\rvert$	Variations between different V_{DD} power pins	-	50	mV
$\lvert V_{SSX} - V_{SS}\rvert$	Variations between all the different ground pins including V_{REF-}	-	50	
$V_{ESD(HBM)}$	Electrostatic discharge voltage (human body model)	see *Section 5.3.14: Absolute maximum ratings (electrical sensitivity)*		

Table 12. Current characteristics

Symbol	Ratings	Max.	Unit
I_{VDD}	Total current into V_{DD} power lines (source)(1)	240	mA
I_{VSS}	Total current out of V_{SS} ground lines (sink)(1)	240	
I_{IO}	Output current sunk by any I/O and control pin	25	
	Output current source by any I/Os and control pin	25	
$I_{INJ(PIN)}$ (2)	Injected current on five-volt tolerant I/O(3)	–5/+0	
	Injected current on any other pin(4)	±5	
$\Sigma I_{INJ(PIN)}$(4)	Total injected current (sum of all I/O and control pins)(5)	±25	

Delo na STM32F4 razvojnem sistemu

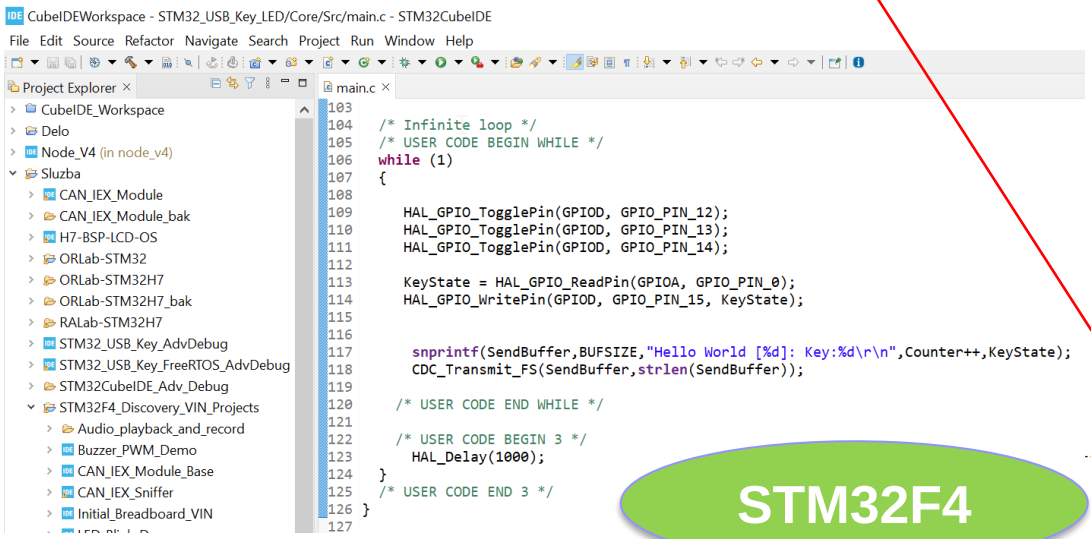
Mikro USB
VCom-port

Priključitev :

- **Mini USB** priklop na **krajši stranici**, svetita rdeči **LED** diodi

Poseben začetni projekt za *STM32F4* (e-učilnica) :

- ***dodajanje vsebine (main.c):***



STM32F4

--------- Razvojni sistem STM32F407 Discovery ----------

STM32F4DISCOVERY Discovery kit with STM32F407VG MCU

VINLab-STM32 - GitHub repozitorij

ORLab-STM32 - GitHub repozitorij

STM32F4 - Dokumentacija

Lastni viri :

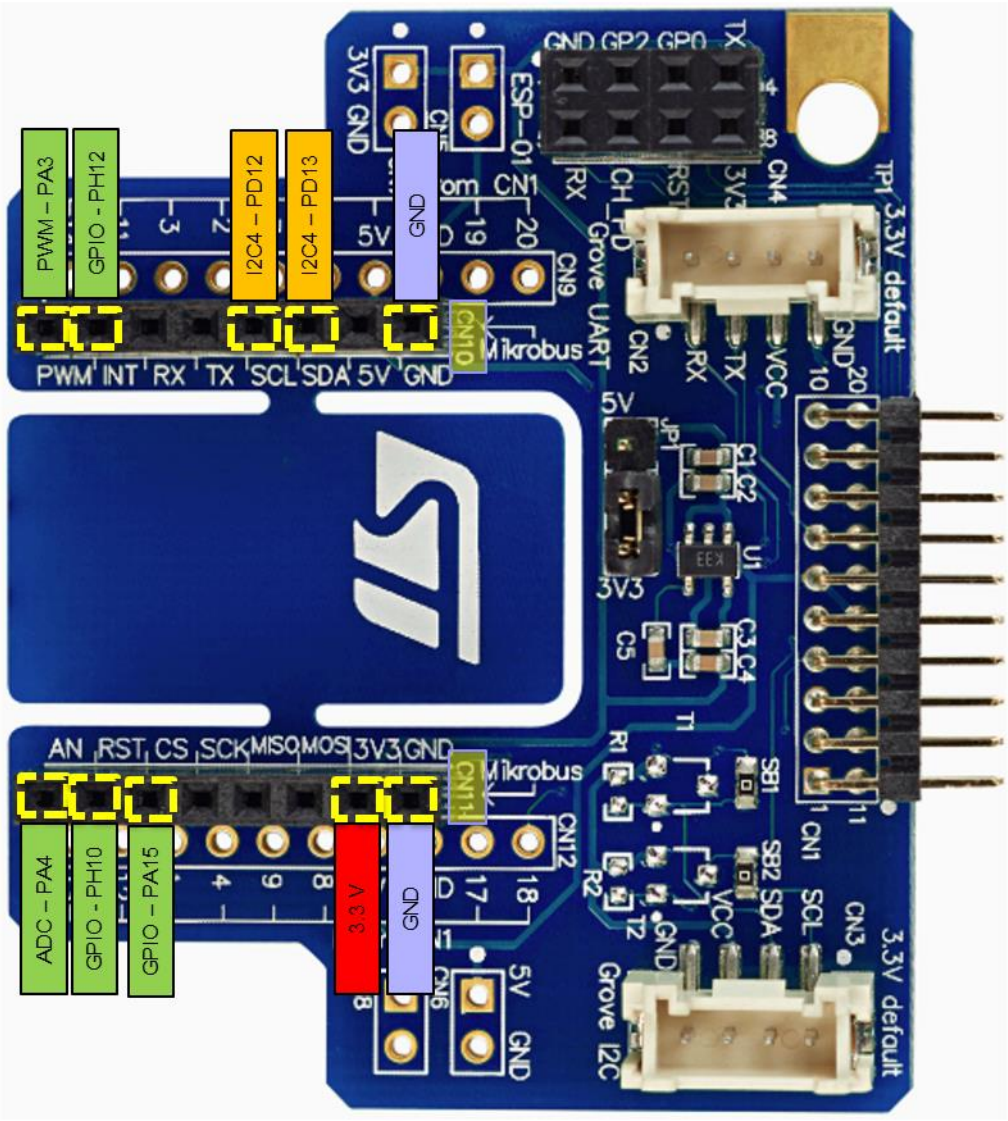
https://github.com/LAPSyLAB/STM32F4_Discovery_VIN_Projects

https://github.com/LAPSyLAB/STM32F4_Docs_and_Examples

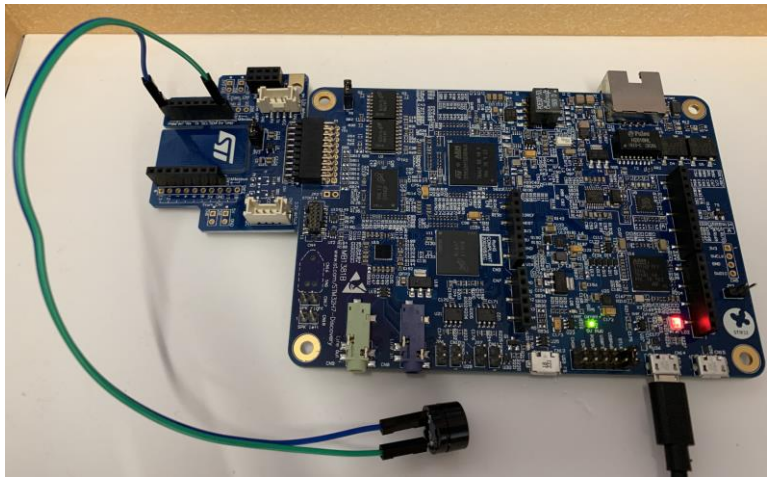
https://github.com/LAPSyLAB/ORLab-STM32

3.3V !!!

STM32H750B – DISCOVERY StMod+ konektor



Pravilna priključitev

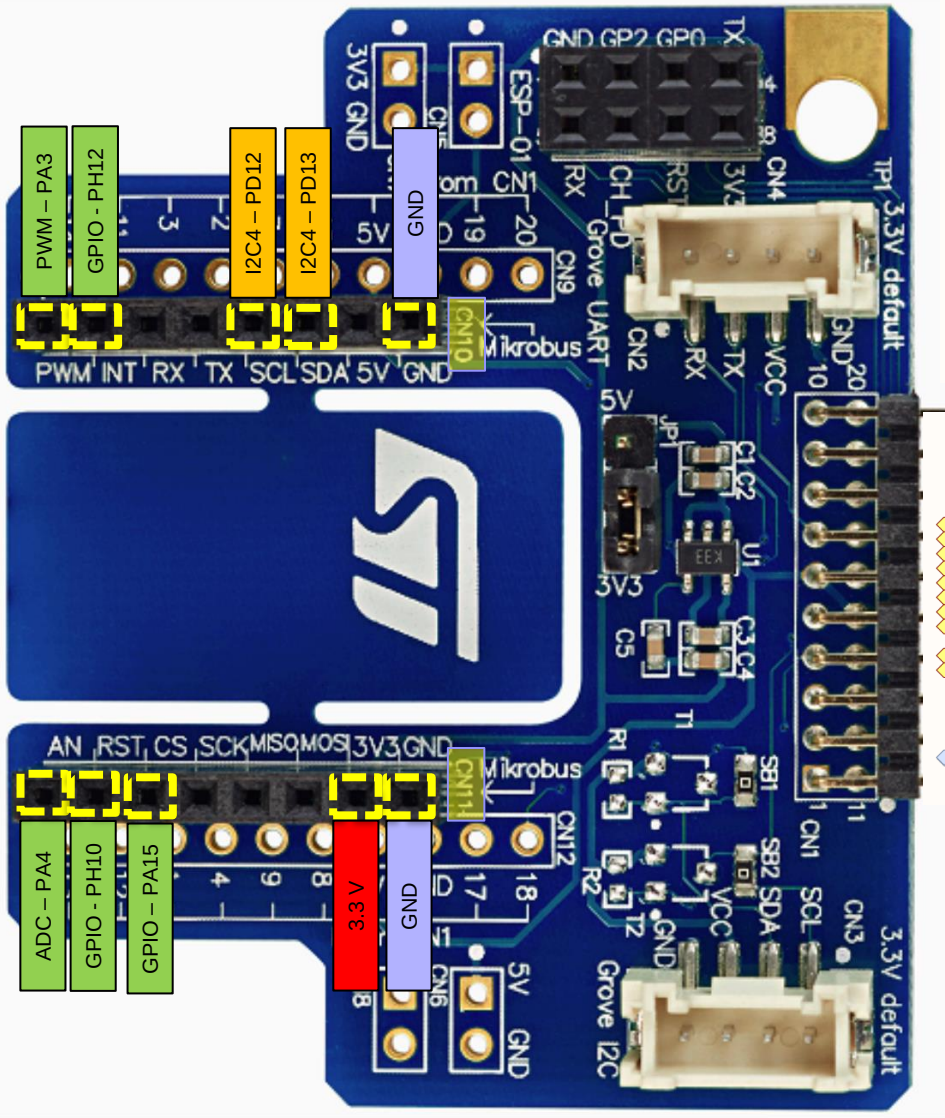


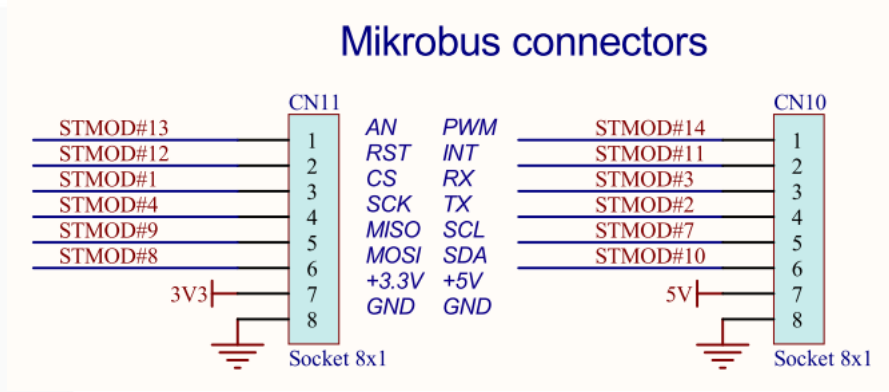
Nepravilna priključitev

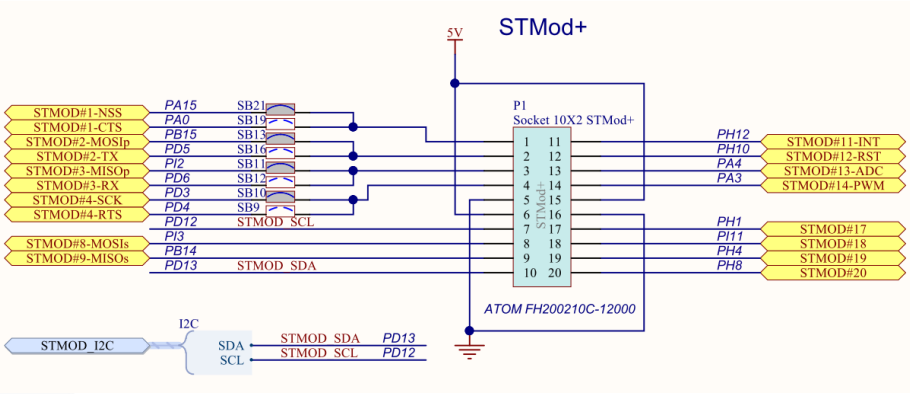
https://www.st.com/en/evaluation-tools/stm32h750b-dk.html

3.3V !!!

STM32H750B – DISCOVERY StMod+ konektor

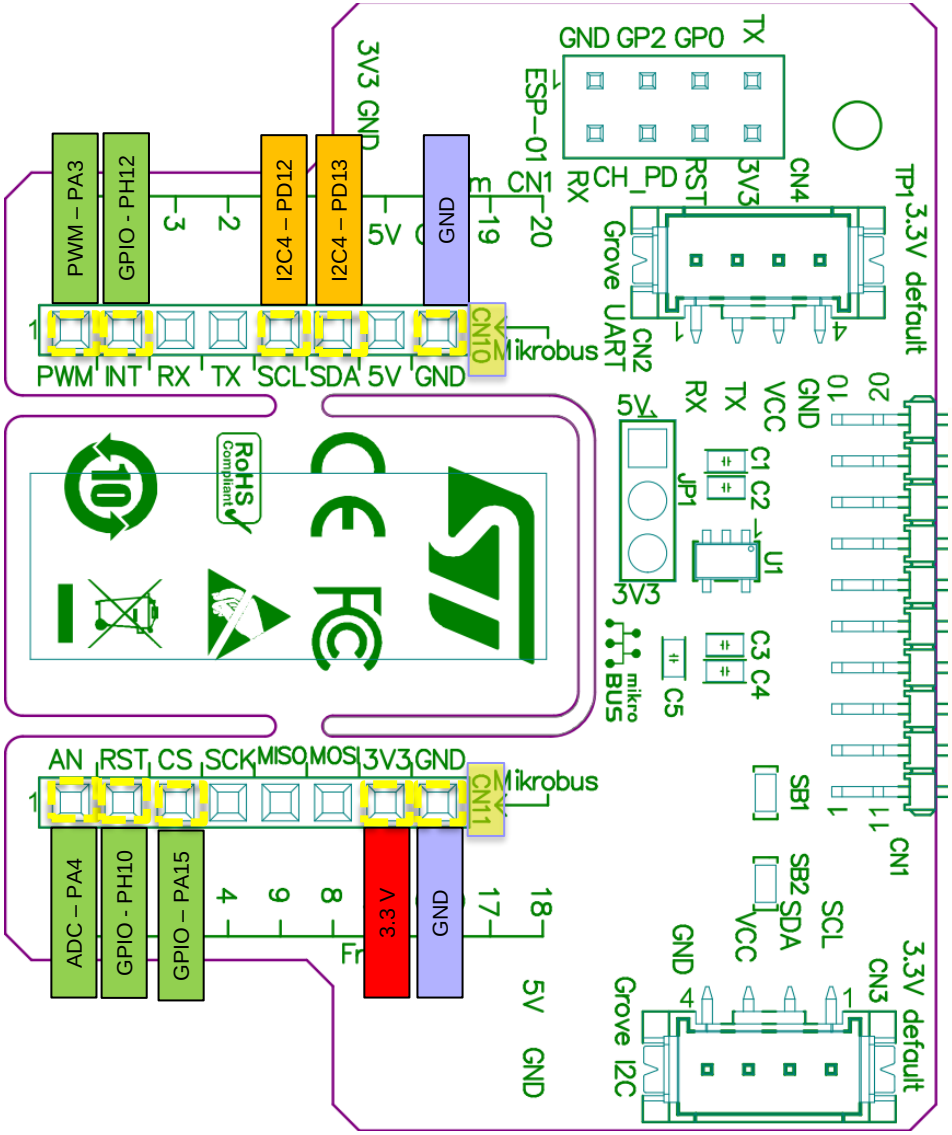


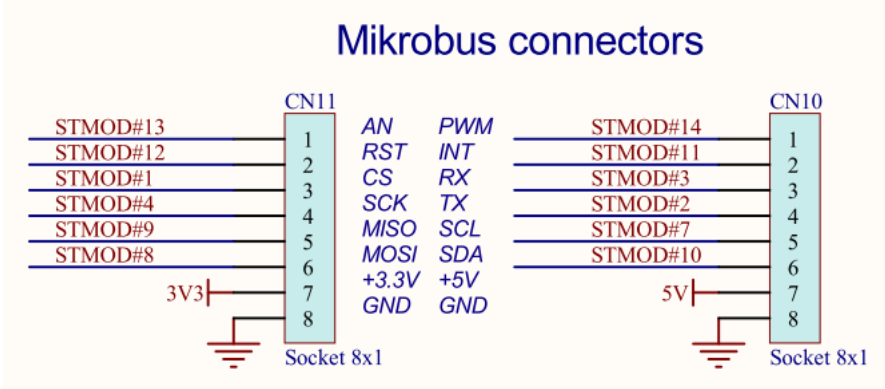


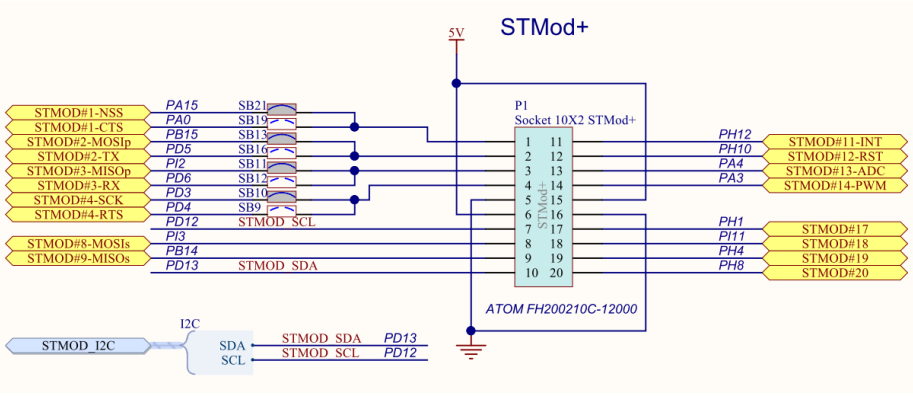


3.3V !!!

STM32H750B – DISCOVERY StMod+ konektor







STM32H750B – DISCOVERY

StMod+ konektor

3.3V !!!

3. This formula has to be applied on power supplies related to the IO structure described by the pin definition table.
4. To sustain a voltage higher than 4V the internal pull-up/pull-down resistors must be disabled.

Table 20. Current characteristics

Symbols	Ratings	Max	Unit
ΣIV_{DD}	Total current into sum of all V_{DD} power lines (source)(1)	620	mA
ΣIV_{SS}	Total current out of sum of all V_{SS} ground lines (sink)(1)	620	
IV_{DD}	Maximum current into each V_{DD} power pin (source)(1)	100	
IV_{SS}	Maximum current out of each V_{SS} ground pin (sink)(1)	100	
I_{IO}	Output current sunk by any I/O and control pin	20	
$\Sigma I_{(PIN)}$	Total output current sunk by sum of all I/Os and control pins(2)	140	
	Total output current sourced by sum of all I/Os and control pins(2)	140	
$I_{INJ(PIN)}$(3)(4)	Injected current on FT_xxx, TT_xx, RST and B pins except PA4, PA5	−5/+0	
	Injected current on PA4, PA5	−0/0	
$\Sigma I_{INJ(PIN)}$	Total injected current (sum of all I/Os and control pins)(5)	±25	

Output driving current

The GPIOs (general purpose input/outputs) can sink or source up to ±8 mA, and sink or source up to ±20 mA (with a relaxed V_{OL}/V_{OH}).

In the user application, the number of I/O pins which can drive current must be limited to respect the absolute maximum rating specified in *Section 6.2*. In particular:

Delo na STM32H7 razvojnem sistemu

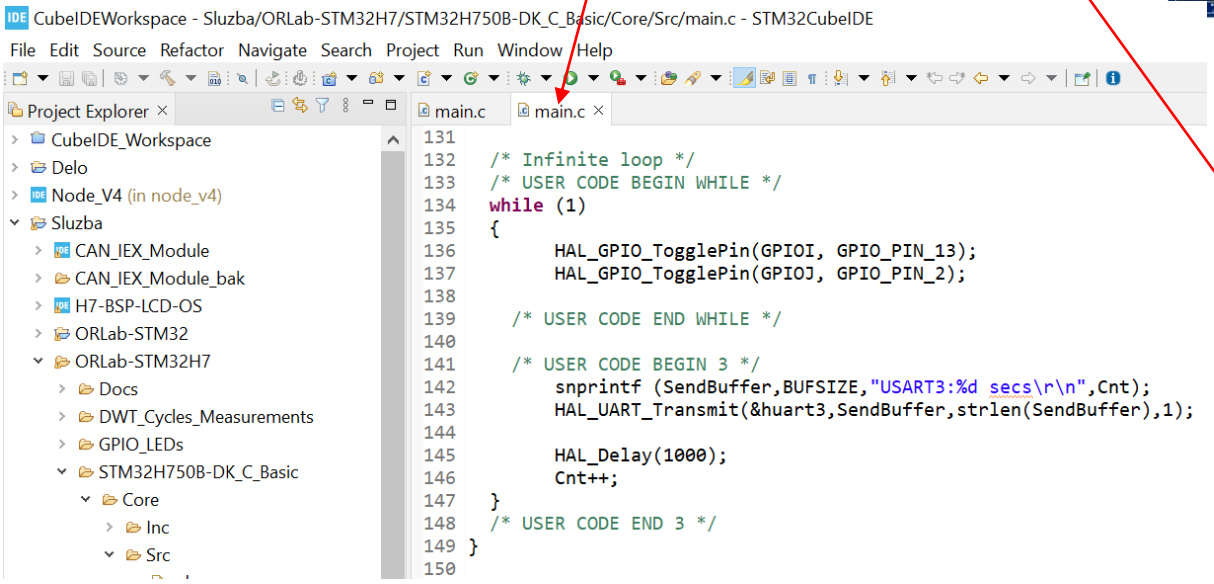
Mikro USB priklop na daljši stranici (srednji !!!)

Priključitev :

- **Mikro USB** priklop na **daljši stranici (srednji !!!)**

Poseben začetni projekt (github) in info za *STM32H7* (e-učilnica):

- ***dodajanje vsebine (main.c):***



--------- Razvojni sistem STM32H750-DK ----------

- STM32H750B-DK Discovery kit with STM32H750XB MCU
- VINLab-STM32H7 - GitHub repozitorij
- STM32H7-online training (tutorials from ST)
- ORLab-STM32H7 - GitHub repozitorij
- STM32H7 - Dokumentacija

Lastni viri :

https://github.com/LAPSyLAB/STM32H7_Discovery_VIN_Projects

https://github.com/LAPSyLAB/ORLab-STM32H7

STM32H7

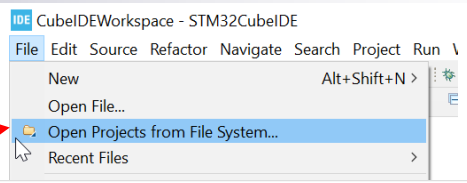
Delo v CubeIDE

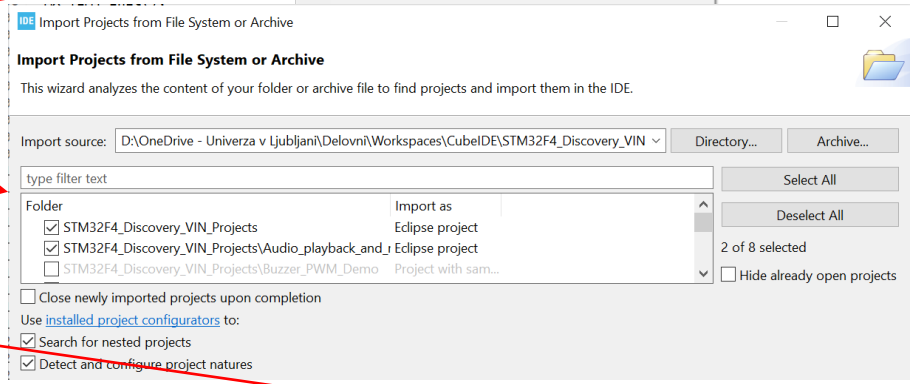
Vzpostavitev začetnega projekta :

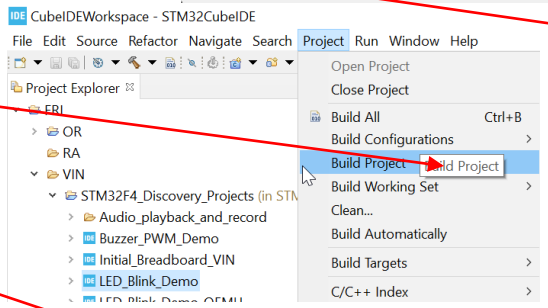
- **Uvoz obstoječega**
  - Open projects from File System
  - Select project(s)
- **Nov projekt Cube MX**
- **Kopiranje obstoječega**

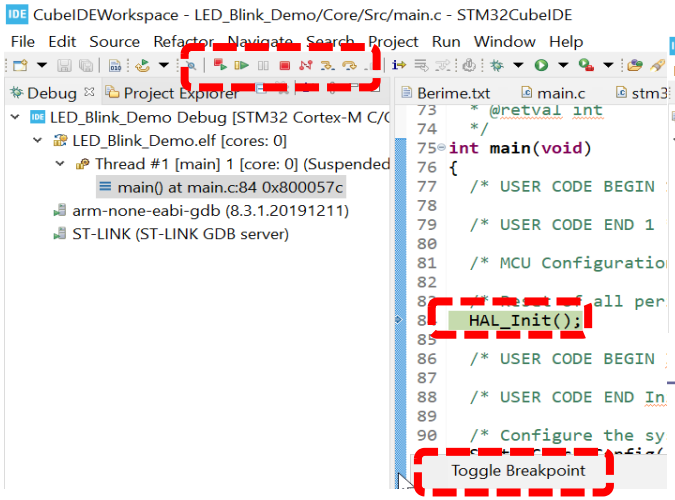
Prevajanje, zagon :

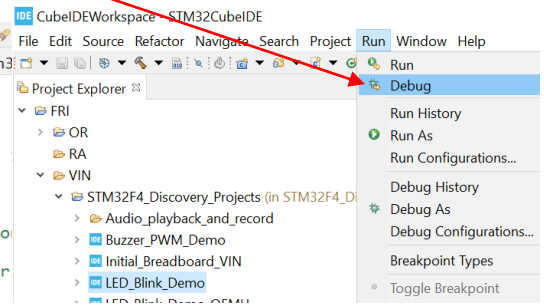
- Project -> Build Project
- Run -> Debug
- Step (Into,Over), Breakpoints











Navodila :

- CubeIDE asm projekt
  1) Edit > Copy.
  2) Edit > Paste.
  3) Delete the Debug.launch file.
  4) Project > Clean.
  5) Project > Build Project.
  6) Debug As Stm32 Application.
  7) And debug the application
  8) Add breakpoint on first instruction if necessary

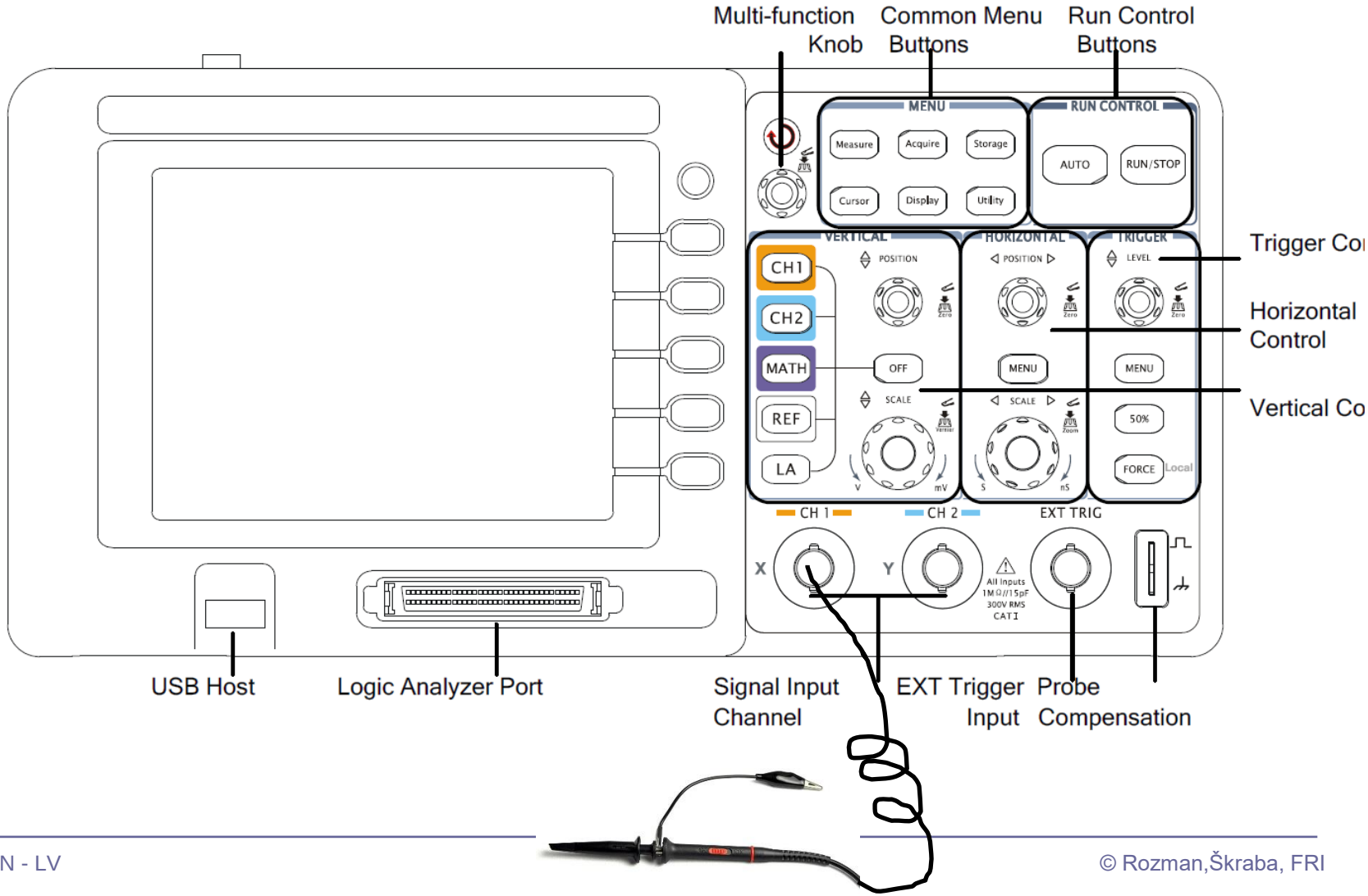
- CubeIDE projekt z CubeMX
  1) Edit > Copy.
  2) Edit > Paste.
  3) Rename the ioc files.
  4) Delete the Debug.launch file.
  5) Project > Clean.
  6) Generate the CubeMX.
  7) Project > Build Project.
  8) Debug As Stm32 Application.
  9) And debug the application.

Skopiram, preimenujem, generiram ioc, clean in build

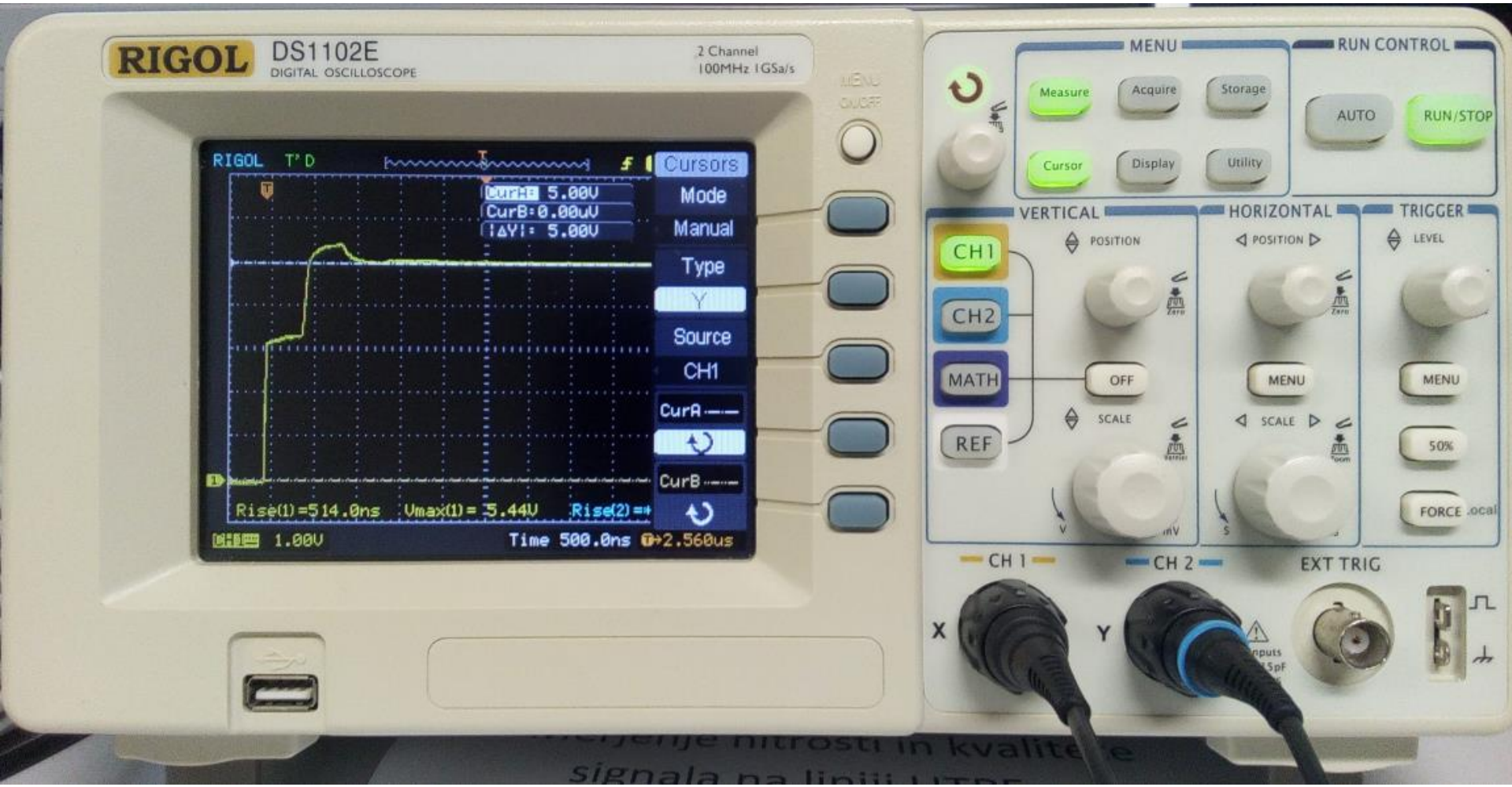
VIN projekt - VP6: STM32-breadboard vezave

- Osvežitev: STM32 breadboard vezave
- Osciloskop
- Uporaba osciloskopa – VP4 :
  - SPI
  - PWM
  - I2C
- VIN Projekt

Prednja stran osciloskopa - shema



Prednja stran osciloskopa - realna



Prednja stran osciloskopa - kontrole

Y-os (el. napetost)

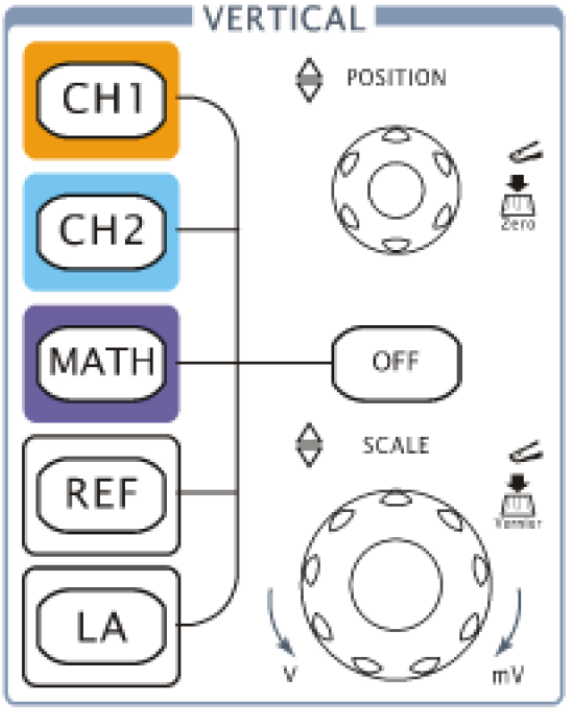
- **nastavitev merila [V/razdelek]**
- **pozicioniranje**

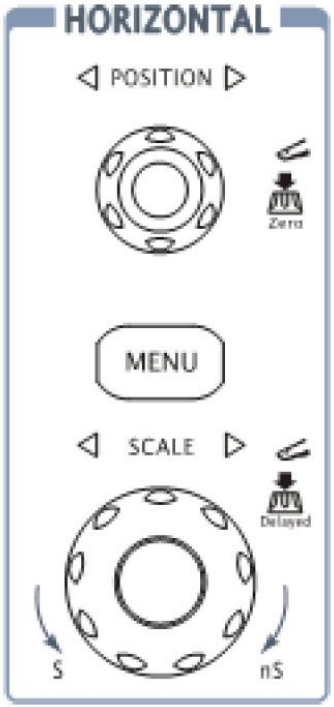
X-os (čas)

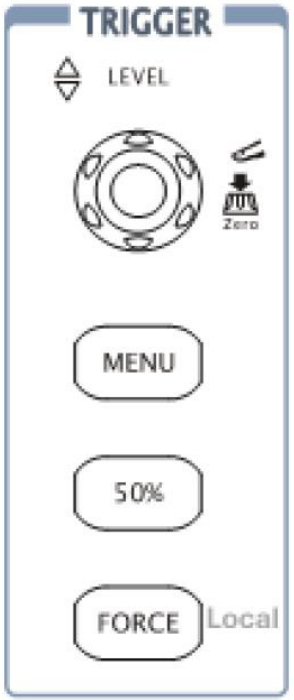
- **nastavitev merila [s/razdelek]**
- **pozicioniranje**

Prožilnik

- **začetek dogodka**
- **običajno 50%**



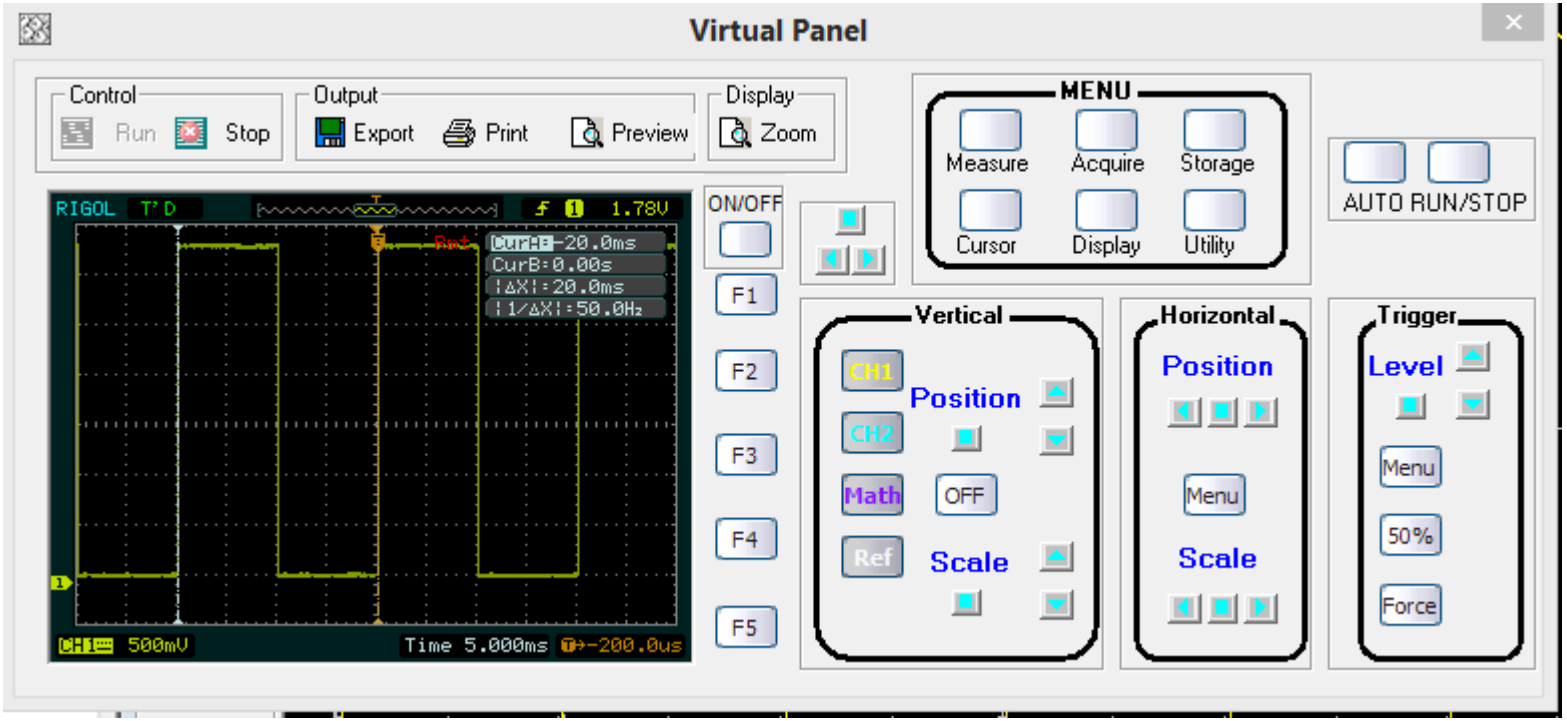




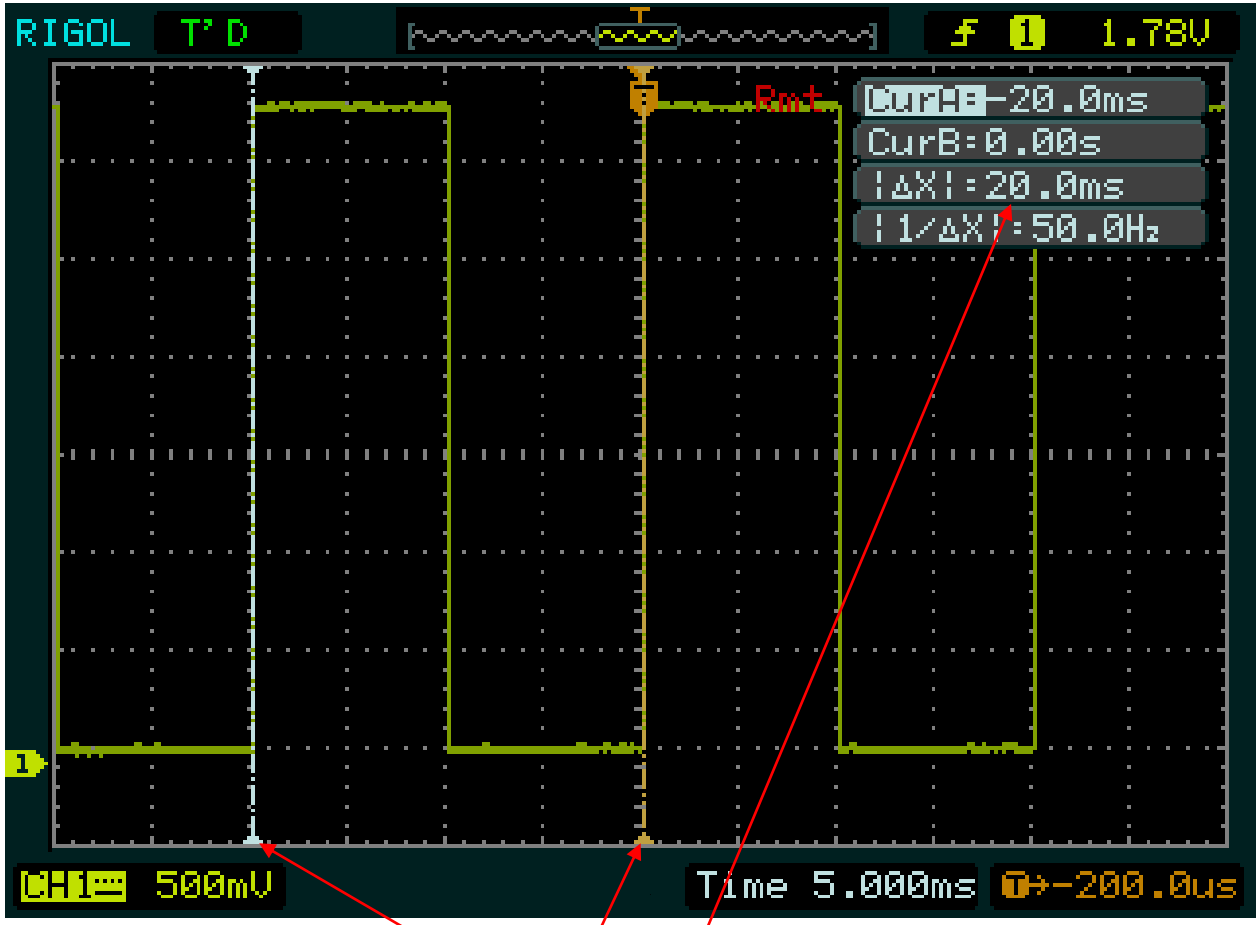
https://www.rigolna.com/products/digital-oscilloscopes/1000/
https://www.youtube.com/watch?v=TAQflYAa2VM

Spoznavanje merilne opreme…

PC aplikacija za osciloskop (USB povezava)



Zaslon osciloskopa – meritev periode



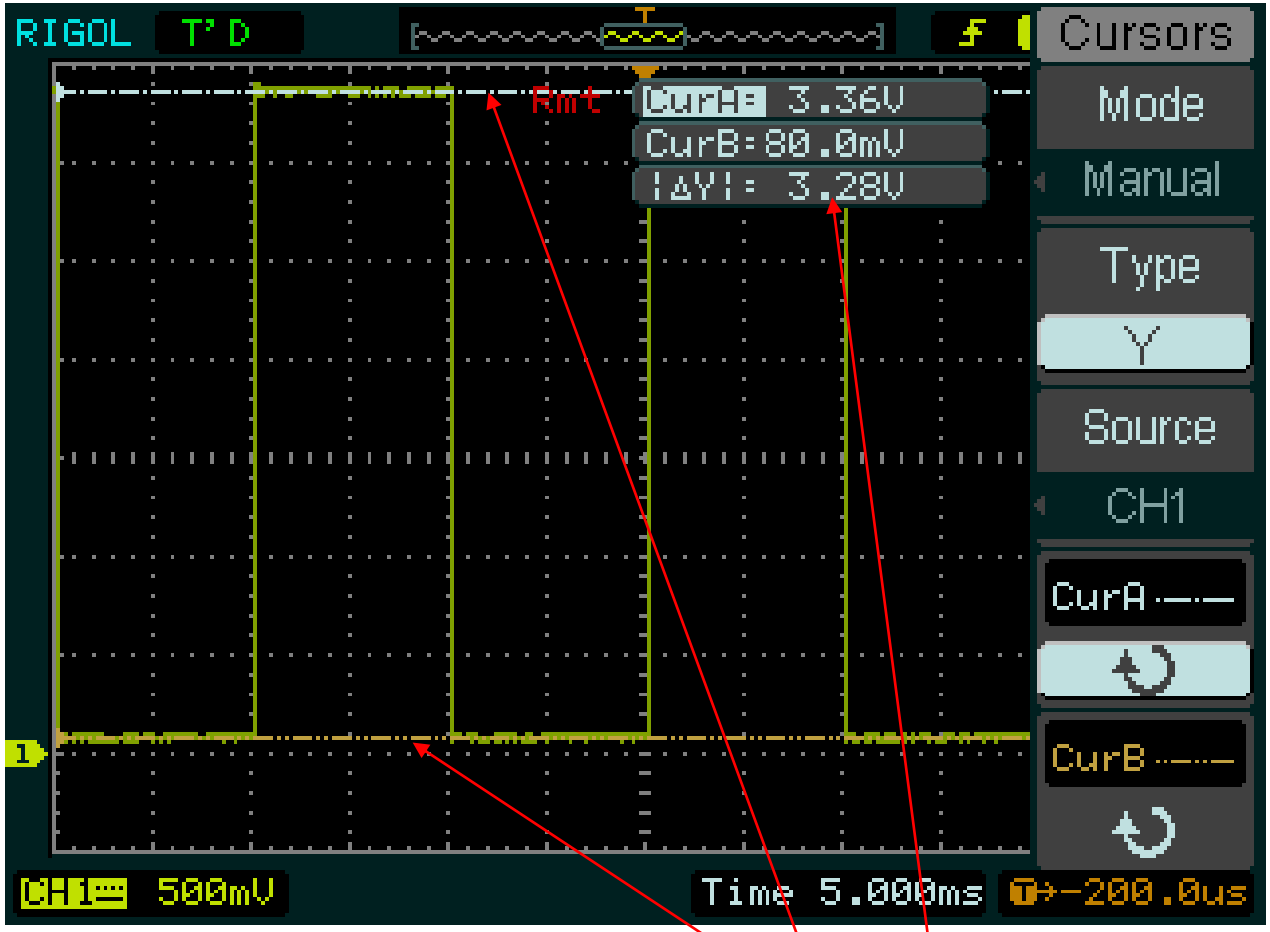
Programska nastavitev:

- **Delay 10ms**
- **Perioda 20ms**

Meritev periode signala:

- **20ms**

Zaslon osciloskopa – meritev amplitude



Meritev amplitude signala:

- **3.28V**

VIN projekt - VP6: STM32-breadboard vezave

- Osvežitev: STM32 breadboard vezave
- Osciloskop
- Uporaba osciloskopa – VP4 :
  - SPI
  - PWM
  - I2C
- VIN Projekt

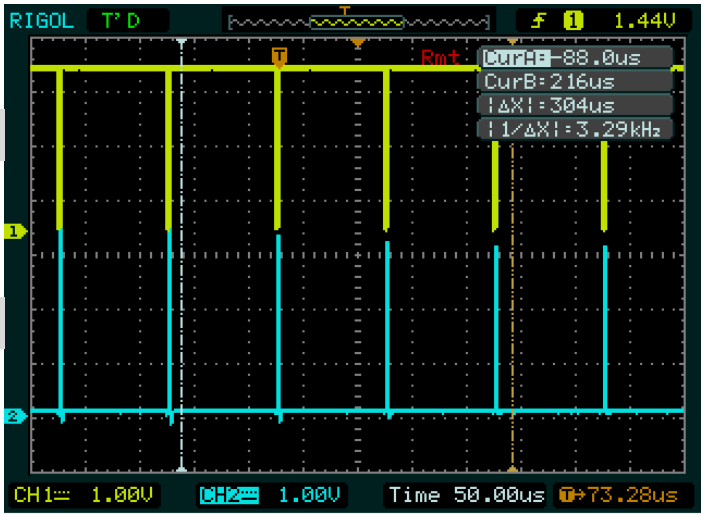
Osnovni projekt CubeIDE – GPIO – PWM, LED diode

HAL - C

```
/* USER CODE BEGIN PV */
#define BUFSIZE 256
char SendBuffer[BUFSIZE];

/* USER CODE END PV */
/* USER CODE BEGIN 2 */

  HAL_TIM_PWM_Start(&htim4, TIM_CHANNEL_1);
  HAL_TIM_PWM_Start(&htim4, TIM_CHANNEL_2);
  HAL_TIM_PWM_Start(&htim4, TIM_CHANNEL_3);
  HAL_TIM_PWM_Start(&htim4, TIM_CHANNEL_4);

  /* USER CODE END 2 */

 /* Infinite loop */
  /* USER CODE BEGIN WHILE */
  while (1)
  {
    htim4.Instance->CCR1 = duty;
    htim4.Instance->CCR2 = 100-duty;
    htim4.Instance->CCR3 = duty;
    htim4.Instance->CCR4 = 100-duty;

    /* USER CODE END WHILE */

    /* USER CODE BEGIN 3 */
    snprintf (SendBuffer,BUFSIZE,"USB:0.1 secs. Duty=%d%%\r\n",duty);
    CDC_Transmit_FS(SendBuffer,strlen(SendBuffer));

      duty = (duty + 1) ;
      if (duty > 100 )
        duty = 0;


    HAL_Delay(100);

  }
  /* USER CODE END 3 */
```

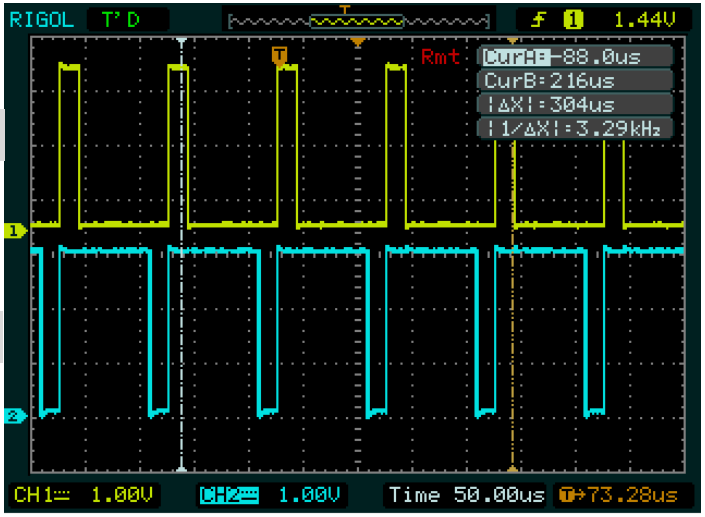
Max Duty

Min Duty



Min Duty

Max Duty



https://github.com/LAPSyLAB/STM32F4_Discovery_VIN_Projects/tree/main/LED_PWM_Demo

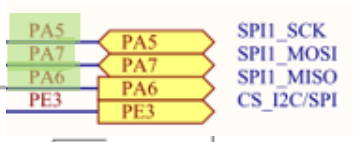
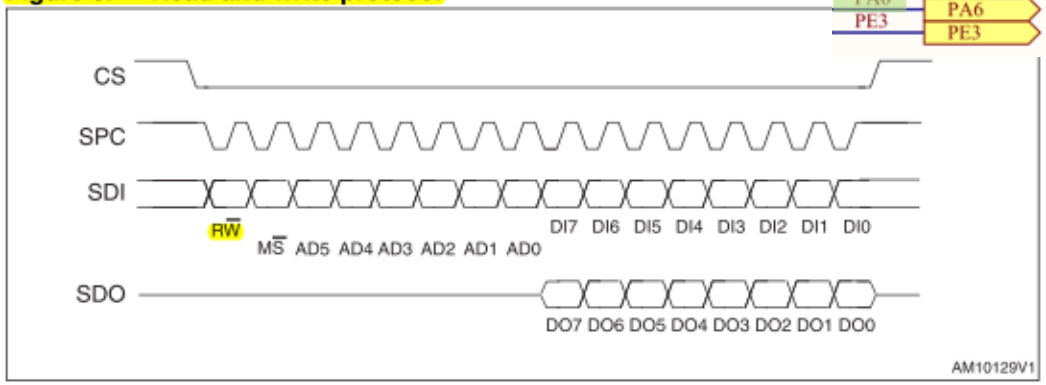


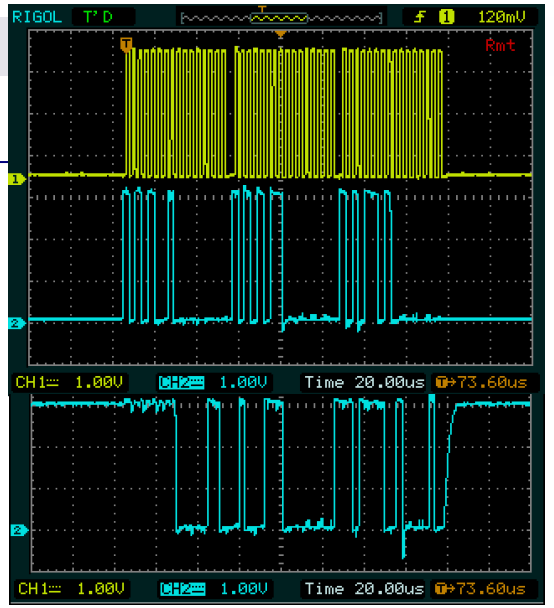
Figure 6. Read and write protocol



SCK

MOSI

MISO

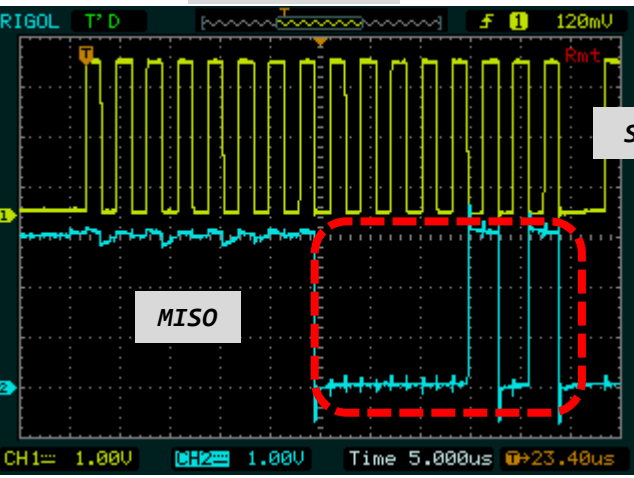


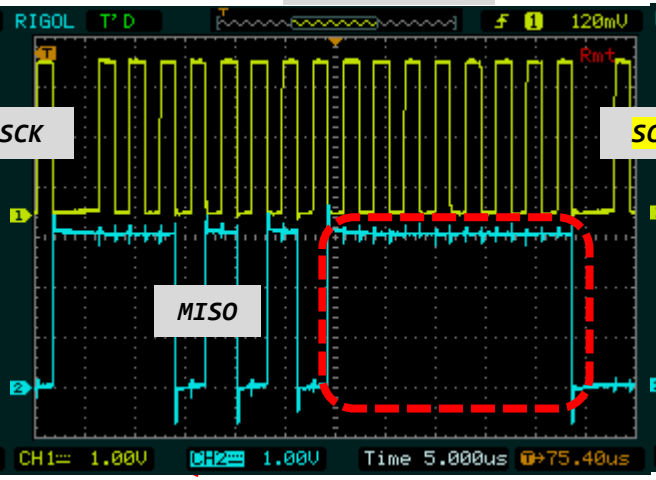

```
Hello World [3530]: Key:0000 Accel[ID:00] X:0005 Y:-1 Z:0066
Hello World [3531]: Key:0000 Accel[ID:00] X:0005 Y:-1 Z:0067
```

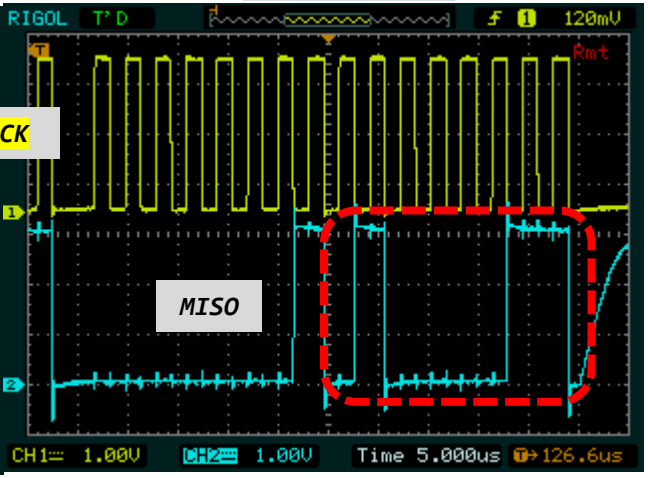
X-Accel: 5

Y-Accel: -1

Y-Accel: 67





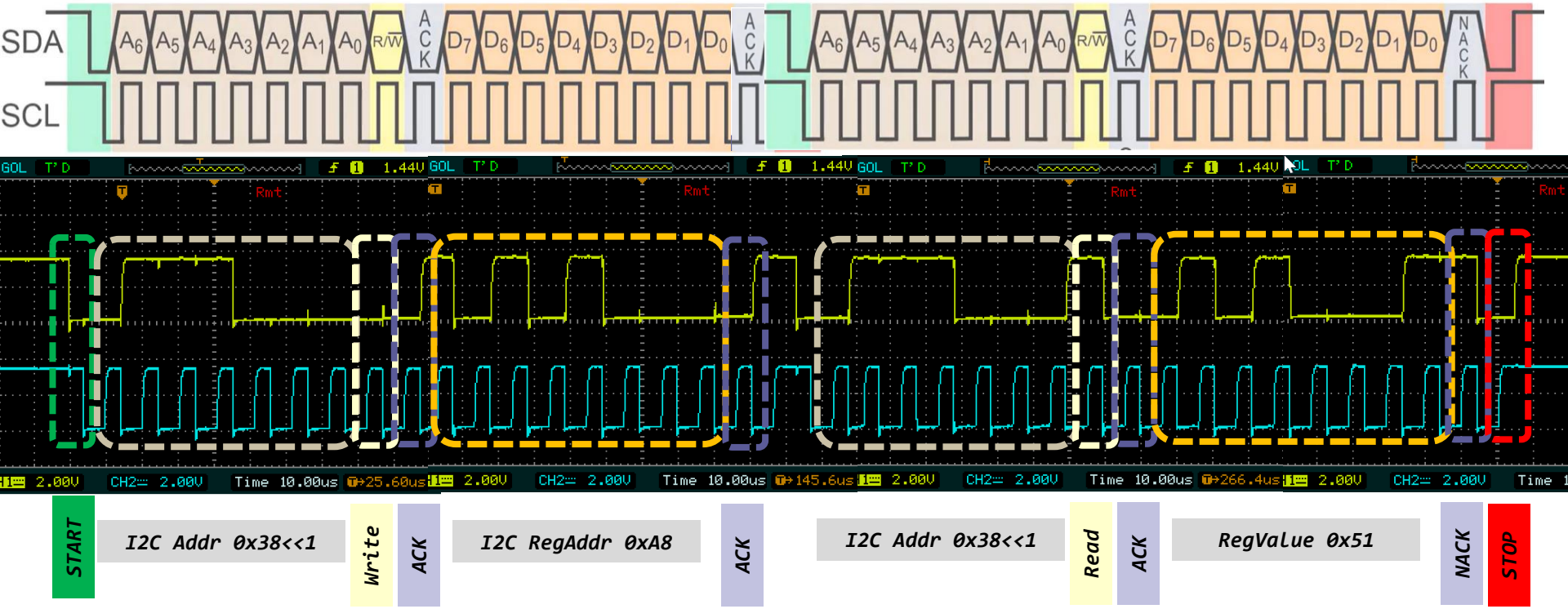


STM32H7

I2C branje

main.c : dodana koda

```
// Reading from address 0x38 register Vendor's Chip ID (addr. 0xA8) default value should be 0x51=81

retval = HAL_I2C_Mem_Read(&hi2c4, (0x38 << 1), 0xA8, I2C_MEMADD_SIZE_8BIT,&dataBuffer[5], 1, HAL_MAX_DELAY);
```



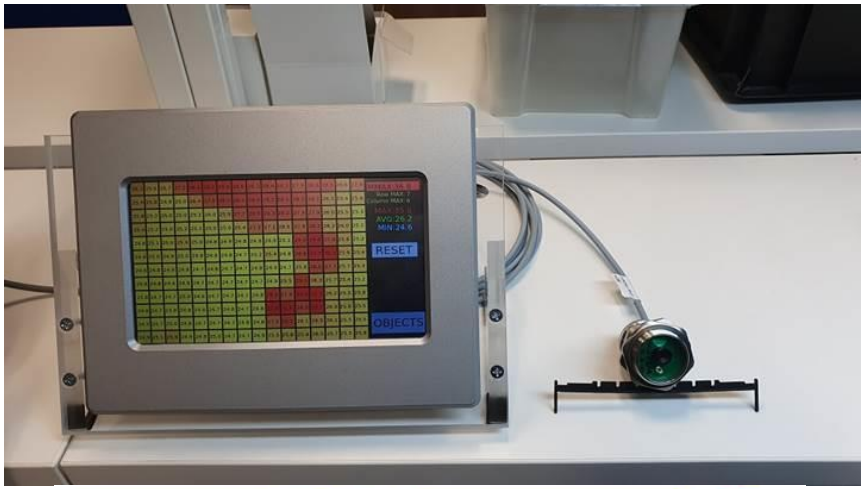
https://github.com/LAPSyLAB/STM32H7_Discovery_VIN_Projects/tree/main/STM32H750B-DK_I2C_Basic_Demo

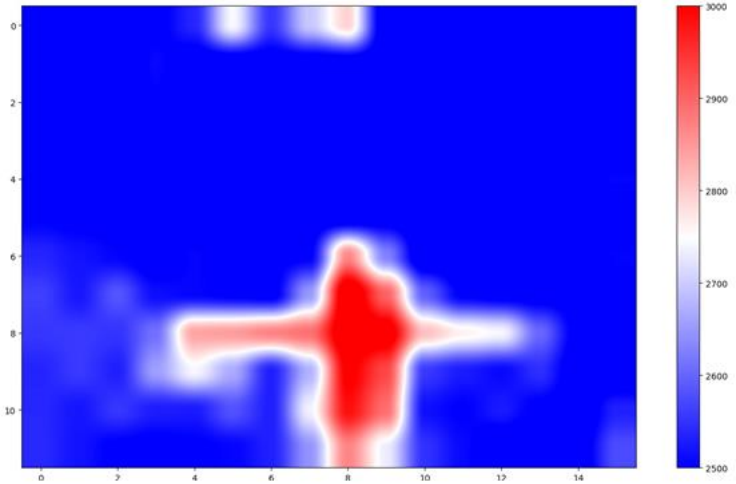
VIN projekt - VP6: STM32-breadboard vezave

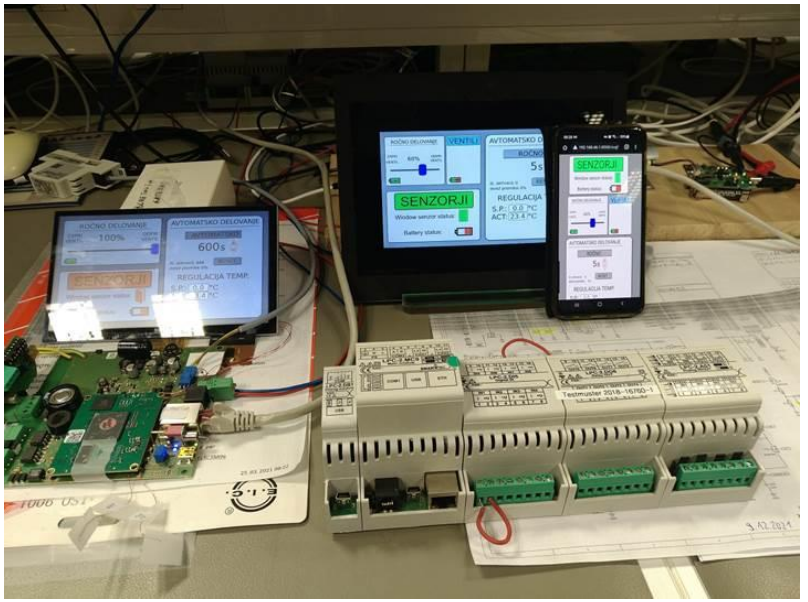
- Osvežitev: STM32 breadboard vezave
- Osciloskop
- Uporaba osciloskopa – VP4 :
  - SPI
  - PWM
  - I2C
- VIN Projekt .- Smarteh

Smarteh

Matrični senzorji (LIR, LIDAR)







Osnovni PLC komplet za uporabo :

- Model pametne hiše
- VIN LAB vaje
  - RS485, Modbus, osciloskopi, …