Vhodno izhodne naprave

Laboratorijska vaja 5 - VP 4
STM32-CubeIDE projekt, breadboard vezave, komunikacije

VIN projekt - VP4: STM32-CubeIDE projekt, breadboard vezave, komunikacije

- Osvežitev
- Breadboard vezava
- STM32 CubeIDE + Breadboard
  - LED, tipka, potenciometer, uporovna tipala
  - PWM brenčač z melodijami
- Primeri komunikacijskih projektov
  - STM32+LIS3DSH
  - Arduino

VIN Projekt – Osnovna platforma

STM32F407 ST Discovery

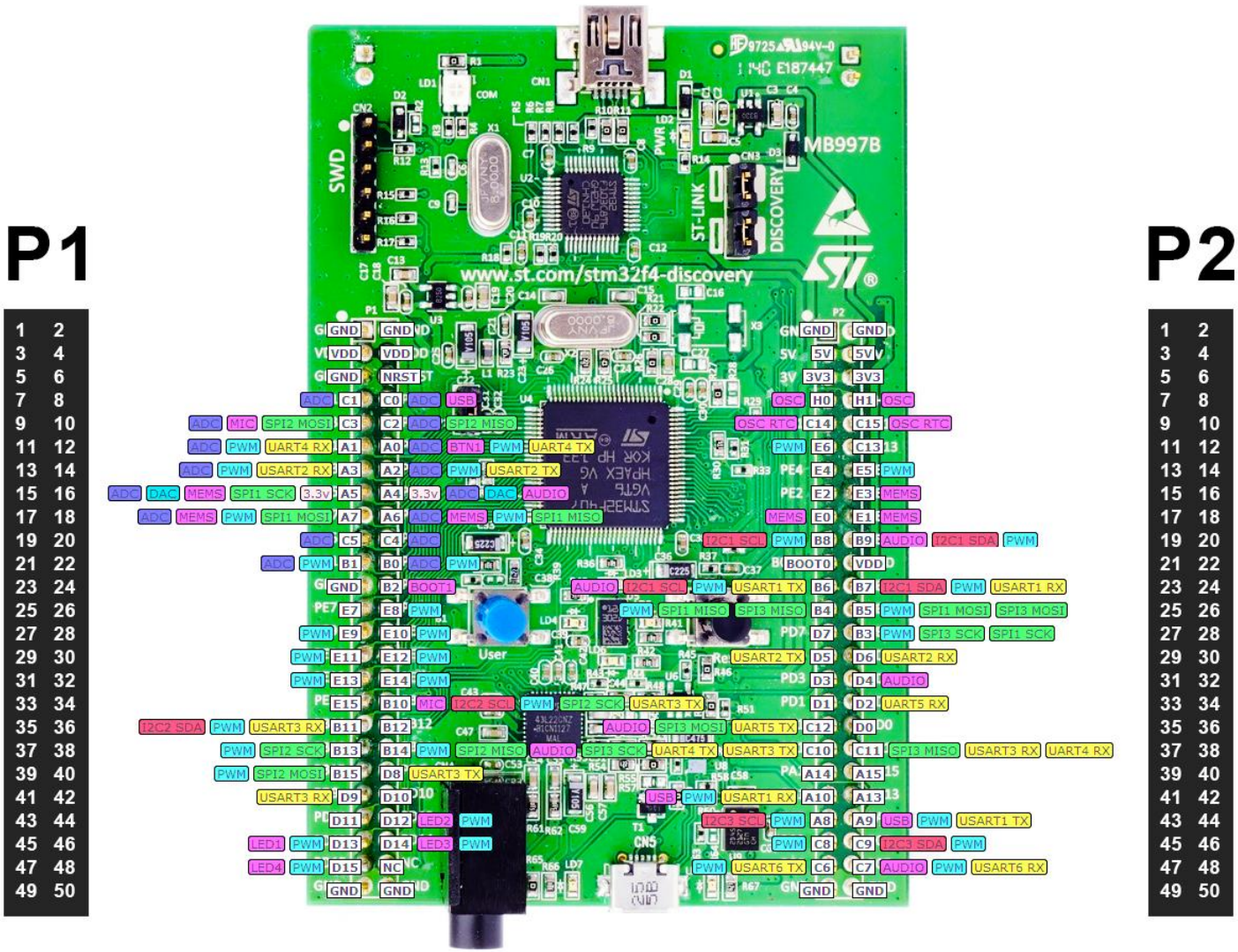
STM Discovery F4 (Cortex M4)

- STM32F407VGT6 microcontroller featuring 32-bit Arm® Cortex®-M4 with FPU core, 1-Mbyte Flash memory and 192-Kbyte RAM in an LQFP100 package
- USB OTG FS
- ST MEMS 3-axis accelerometer
- ST-MEMS audio sensor omni-directional digital microphone
- Audio DAC with integrated class D speaker driver
- User and reset push-buttons
- Eight LEDs:
  - LD1 (red/green) for USB communication
  - LD2 (red) for 3.3 V power on
  - Four user LEDs, LD3 (orange), LD4 (green), LD5 (red) and LD6 (blue)
- Board connectors:
  - USB with Micro-AB
  - Stereo headphone output jack
  - 2.54 mm pitch extension header for all LQFP100 I/Os for quick connection to prototyping board and easy probing
- External application power supply: 3 V and 5 V

STM32

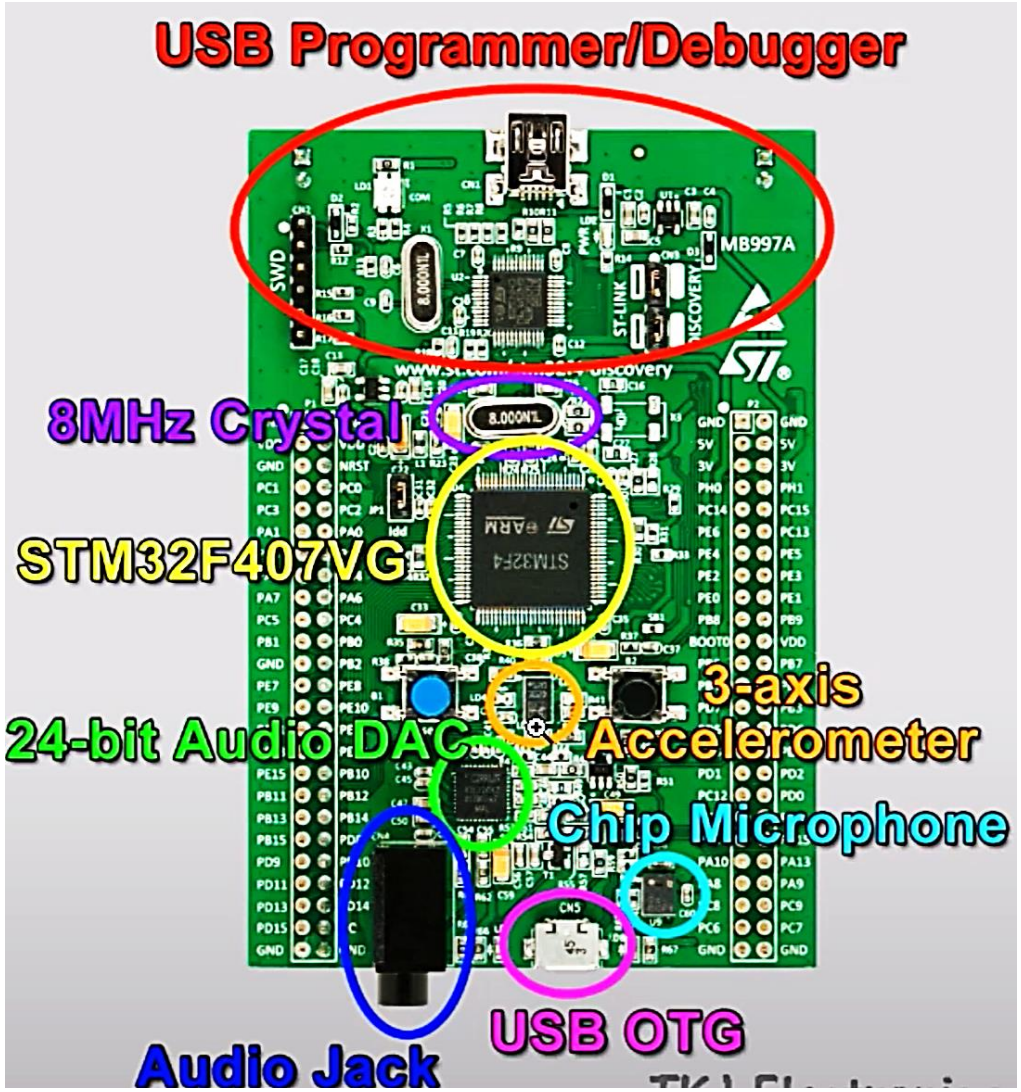
STM32F4DISCOVERY

3.3V !!!

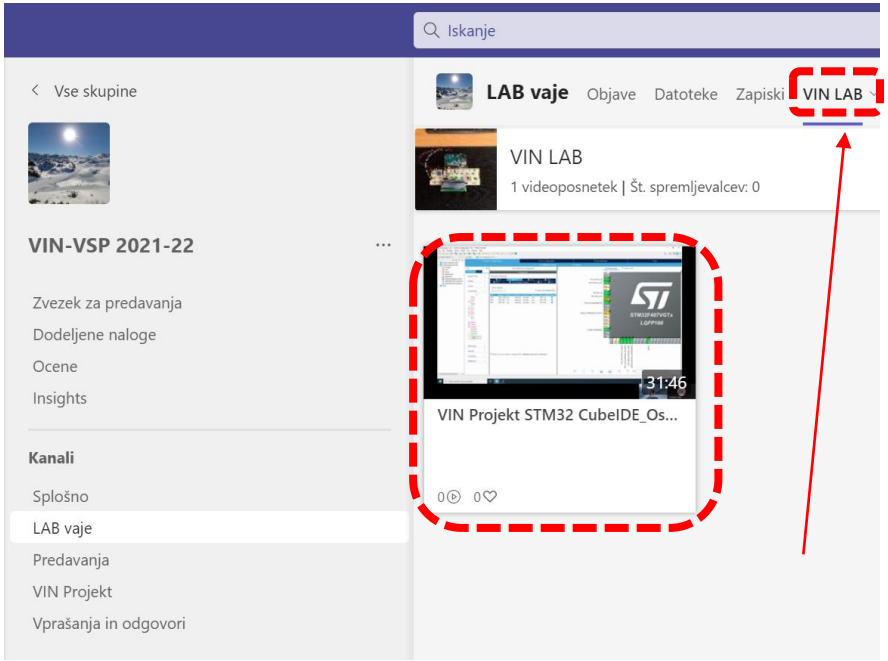


STM32F4DISCOVERY

3.3V !!!



Delo na STM32F4 razvojnem sistemu



Lastni viri :

https://github.com/LAPSyLAB/STM32F4_Discovery_VIN_Projects

https://github.com/LAPSyLAB/STM32F4_Docs_and_Examples

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

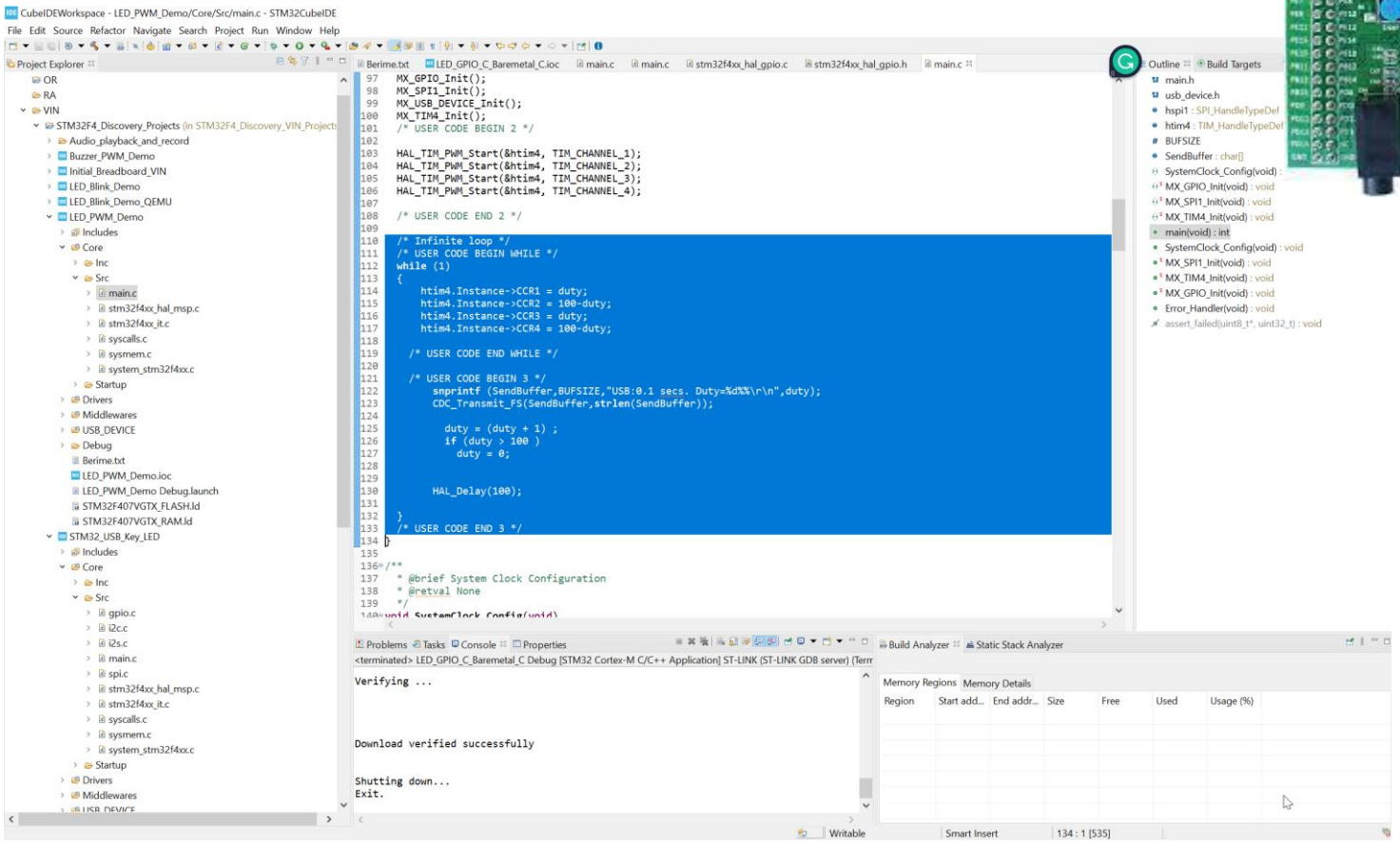
Delo na STM32F4 razvojnem sistemu

Priključitev :

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

STM32 CubeIDE

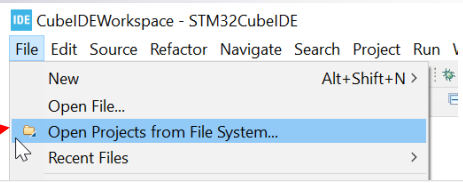
- https://www.st.com/en/development-tools/stm32cubeide.html

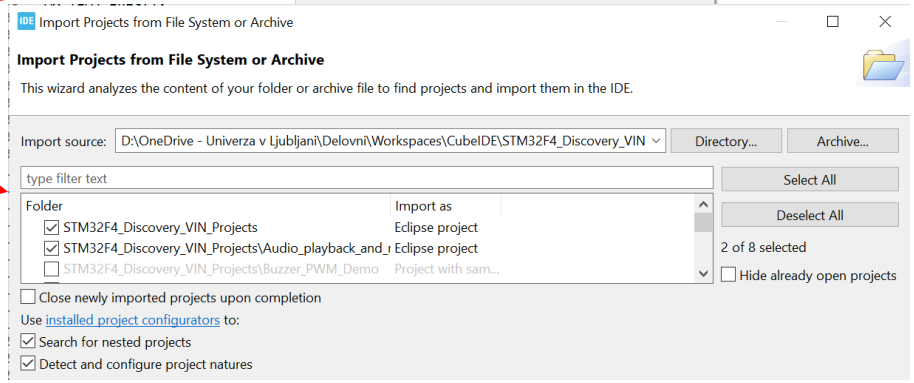


Delo na STM32F4 razvojnem sistemu

Vzpostavitev začetnega projekta :

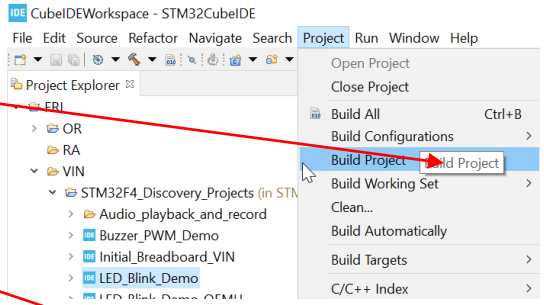
- **Uvoz obstoječega**
  - Open projects from File System
  - Select project(s)
- **Nov projekt Cube MX ->**
  (v nadaljevanju)

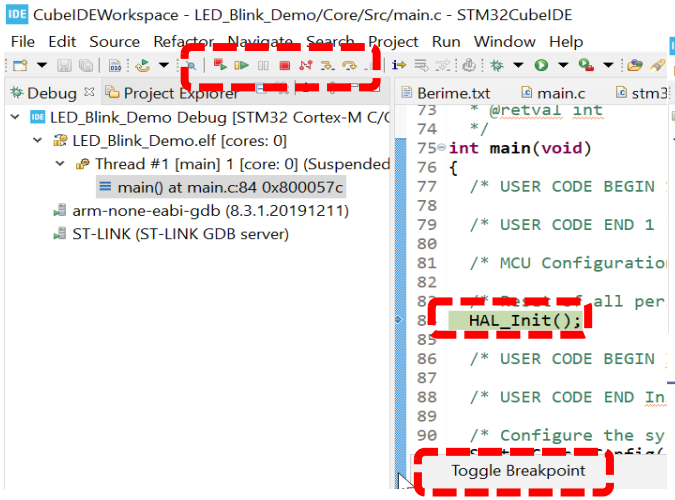


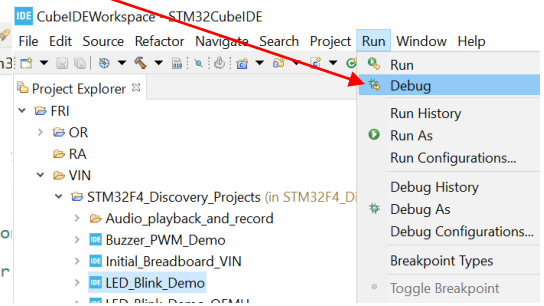


Prevajanje, zagon :

- 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 - VP4: STM32-CubeIDE projekt, breadboard vezave, komunikacije

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- STM32 CubeIDE + Breadboard
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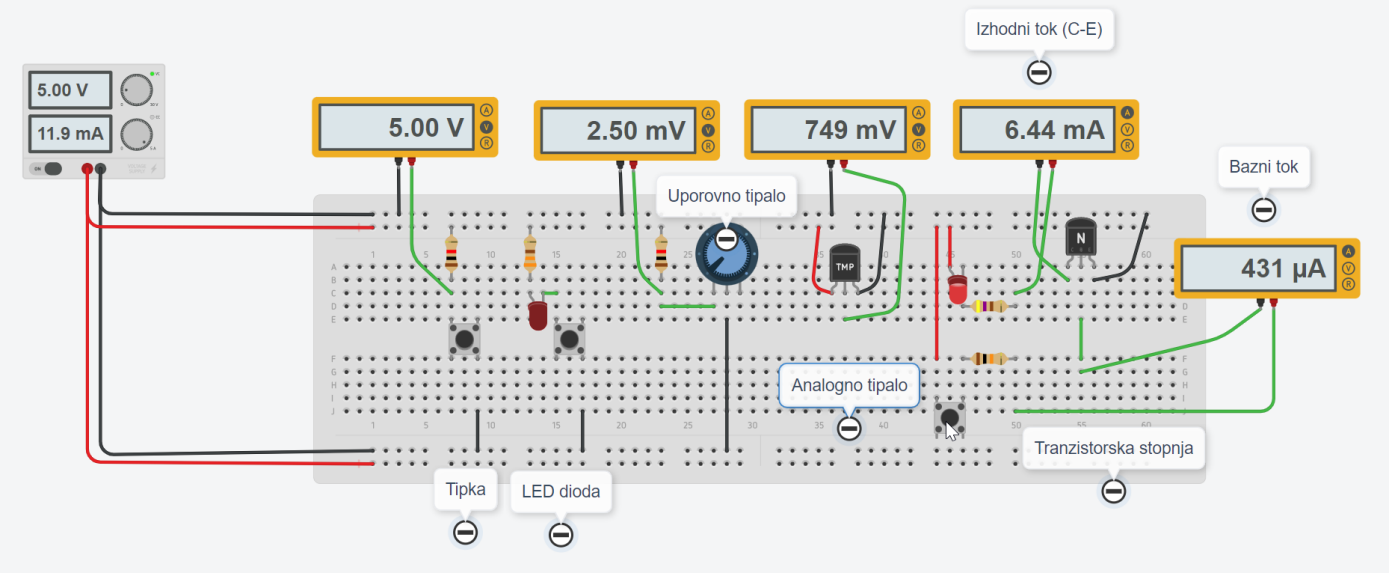
  - PWM brenčač z melodijami
- Primeri komunikacijskih projektov
  - STM32+LIS3DSH
  - Arduino

Izhodišče : breadboard vezava TinkerCad



Priključitev na STM32 : 1x analogni, 1x digitalni vhod, 1x digitalni izhod, 4x vgrajene LED diode

Testno vezje (primer) :

GPIO	Vrsta	Povezava
PA0	User tipka	
PA1	Analogni vhod	Rumena žička
PB4	Dig. Vhod	Zelena žička
PB5	Dig. Izhod - LED	Oranžna žička
PD12-PD15	Dig. Izhodi	vgr. LED diode

Uporovna tipala

LDR – Light Dependent Resistor PGM5337

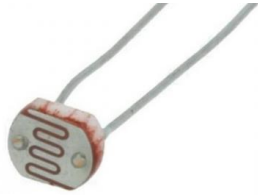


FOTO UPOR PGM5537 100mW 16-50kR 540nm

Electronics Characteristics

Model	Vmax (VDC)	Pmax (mW)	Ambient Temp (°C)	Spectral Peak (nm)	Photo Resistance (10Lx) (KΩ)	Dark Resistance (MΩ)min	γ min	ResponseTime (ms)	
								Rise	Decay
PGM5506	100	90	-30 ~ +70	540	2 ~ 6	0.15	0.6	30	40
PGM5516	100	90	-30 ~ +70	540	5 ~ 10	0.2	0.6	30	40
PGM5526	150	100	-30 ~ +70	540	8 ~ 20	1.0	0.6	20	30
PGM5537	150	100	-30 ~ +70	540	16 ~ 50	2.0	0.7	20	30

NTC – Termistor NTCC-2K2

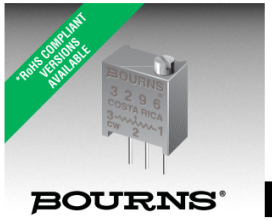
UPOR NTC 2K2 5%

NTCC-2K2 SR PASSIVES

NTC thermistor; 2.2kΩ; THT; 3900K; -55÷125° C; 500mW; Ø6.5mm

TrimPot – Trimer Potenciometer TSR-3296Z-104

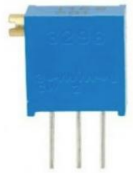
Proizvajalec	Suntan
Številka proizvajalca	TSR-3296Z-104



Features

- Multiturn / Cermet / Industrial / Sealed
- 5 terminal styles
- Tape and reel packaging available
- Chevron seal design
- Listed on the QPL for style RJ24 per MIL-R-22097 and RJR24 per High-Rel Mil-R-39035
- Mounting hardware available (H-117P)
- RoHS compliant* version available
- For trimmer applications/processing guidelines, click here

3296 - 3/8 " Square Trimpot® Trimming Potentiometer

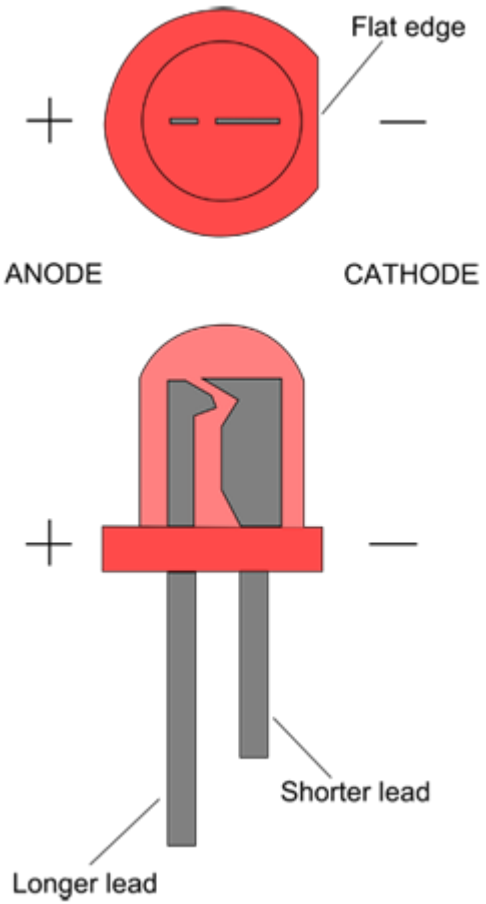


Standard Resistance Table

Resistance (Ohms)	Resistance Code
10	100
20	200
50	500
100	101
200	201
500	501
1,000	102
2,000	202
5,000	502
10,000	103
20,000	203
25,000	253
50,000	503
100,000	104

Elektronske komponente

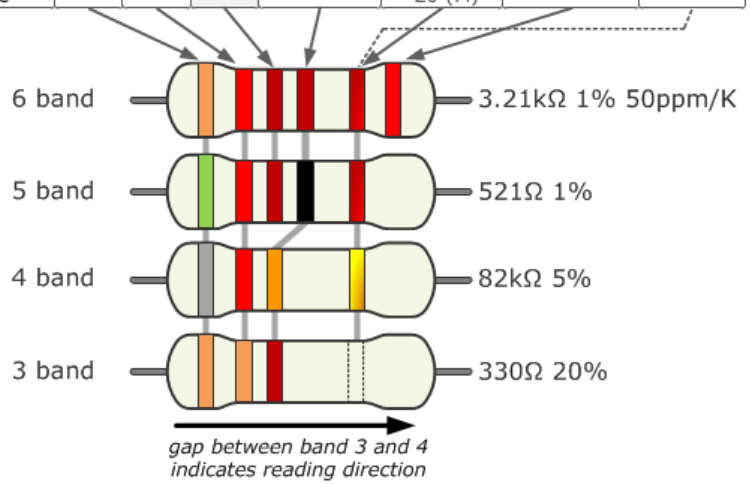
Dioda LED



Uporniki

www.resistorguide.com

	Color	Signficant figures			Multiply	Tolerance (%)	Temp. Coeff. (ppm/K)	Fail Rate (%)
Bad	black	0	0	0	x 1		250 (U)	
Beer	brown	1	1	1	x 10	1 (F)	100 (S)	1
Rots	red	2	2	2	x 100	2 (G)	50 (R)	0.1
Our	orange	3	3	3	x 1K		15 (P)	0.01
Young	yellow	4	4	4	x 10K		25 (Q)	0.001
Guts	green	5	5	5	x 100K	0.5 (D)	20 (Z)	
But	blue	6	6	6	x 1M	0.25 (C)	10 (Z)	
Vodka	violet	7	7	7	x 10M	0.1 (B)	5 (M)	
Goes	grey	8	8	8	x 100M	0.05 (A)	1(K)	
Well	white	9	9	9	x 1G			
Get	gold			3th digit only for 5 and 6 bands	x 0.1	5 (J)		
Some	silver				x 0.01	10 (K)		
Now!	none					20 (M)		

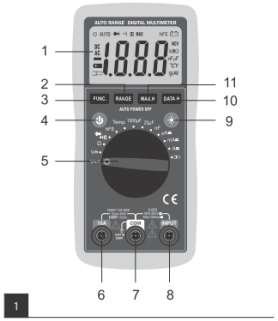


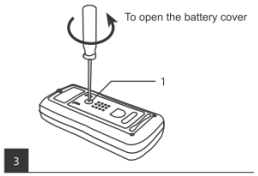
Resistor Color Code Calculator and Chart (4-band, 5-band or 6-band)

Z naslova <https://www.allaboutcircuits.com/tools/resistor-color-code-calculator/>

Orodja

Multimeter EMOS MD-420





Preverjanje povezav

Merjenje upornosti

Merjenje el. Napetosti DC
- vzporedna vezava !!!
- visoka upornost

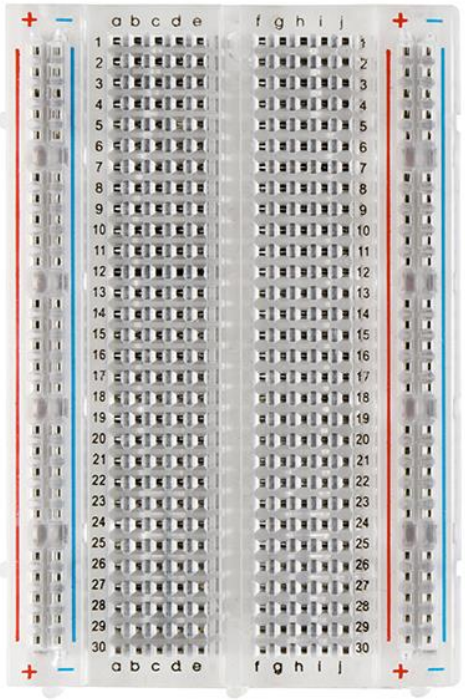
Merjenje el. toka
- zaporedna vezava !!!
- nizka upornost

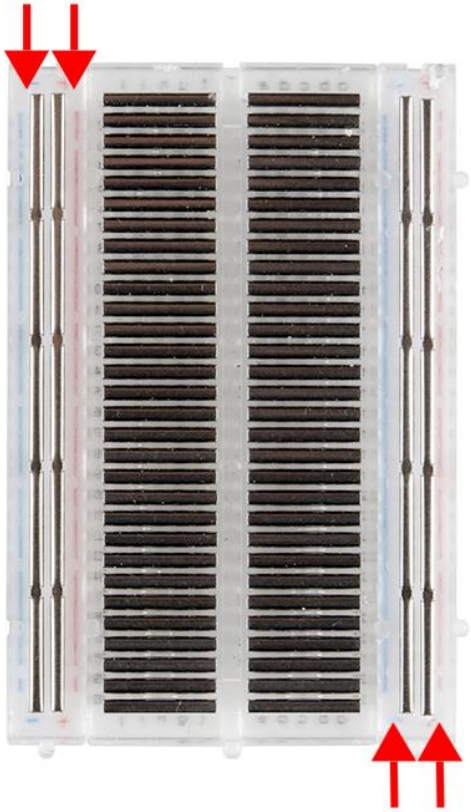
Praktični nasveti :
- *Večinoma merimo napetost, upornost*
- *upornost samo izven tokokroga*
- *pazimo, da ne sklenemo kratkega stika z merilno sondo*
- *pazimo predvsem na majhne upornosti:*
  - *Med +V in GND*
  - *Na izhodih, vhodih mikrokrmilnikov*

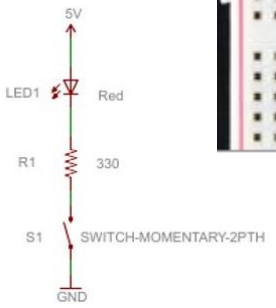
https://www.emos-si.si/multimeter-md-420

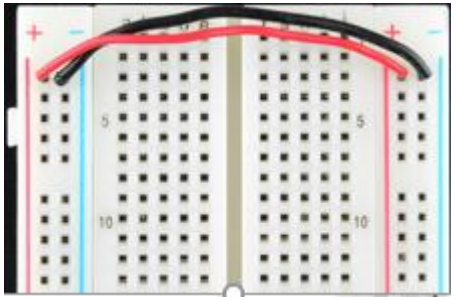
Ponovitev

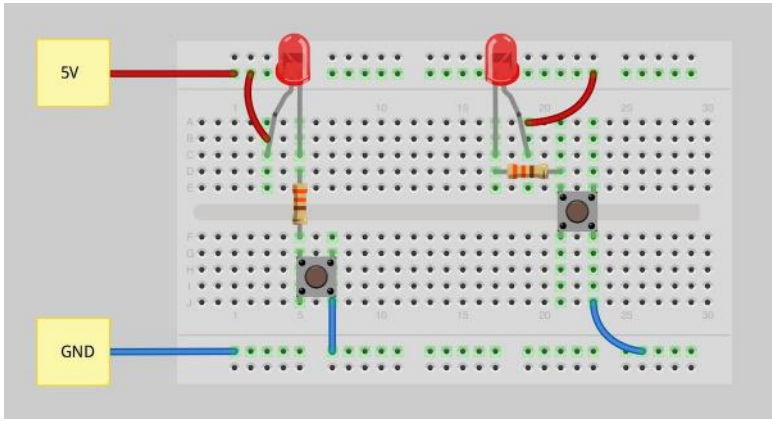
VIN projekt : TinkerCad
Breadboard vezave











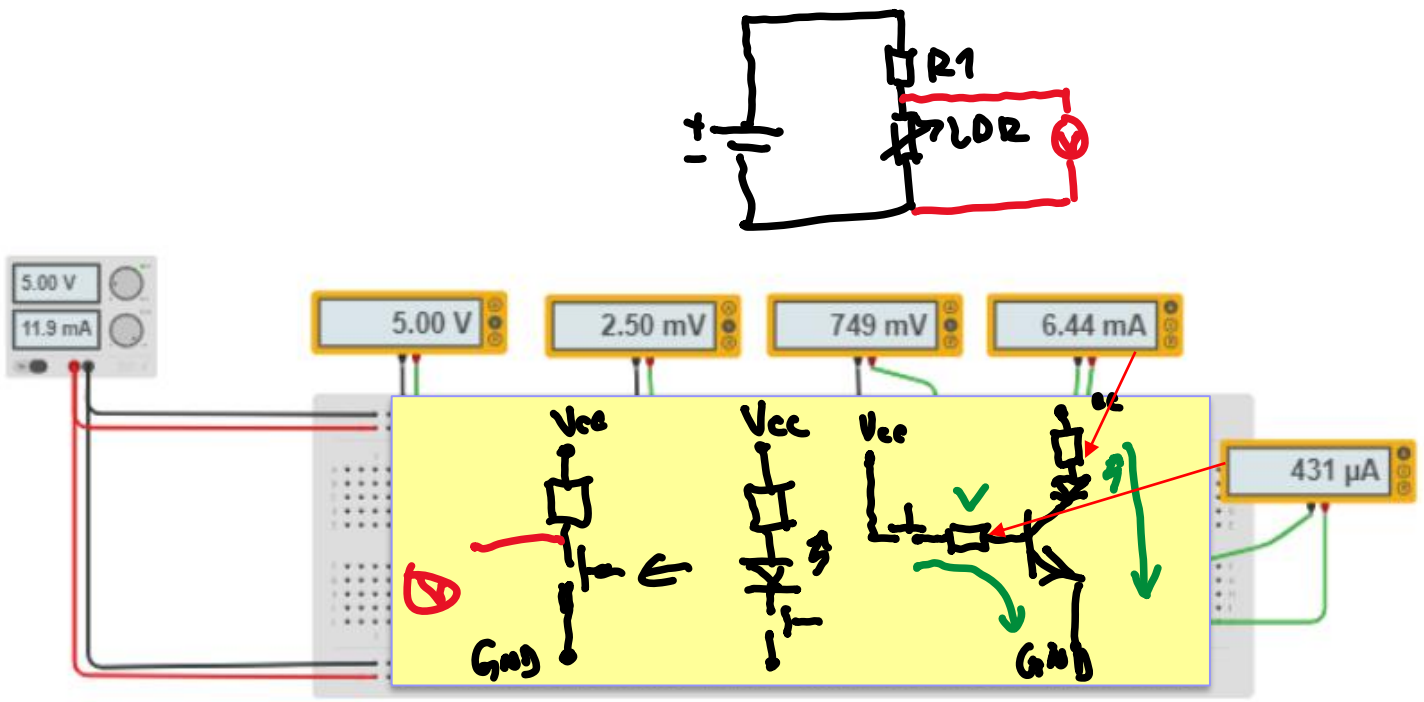
Viri

- https://learn.sparkfun.com/tutorials/how-to-use-a-breadboard/
- https://www.sciencebuddies.org/science-fair-projects/references/how-to-use-a-breadboard

VIN projekt : TinkerCad

Breadboard vezave – primeri vezav

Breadboard vezave



Breadboard vezava

Priključitev na STM32 : 1x analogni, 1x digitalni vhod, 1x digitalni izhod, 4x vgrajene LED diode

Testno vezje (primer) :

GPIO	Vrsta	Povezava
PA0	User tipka	
PA1	Analogni vhod	Rumena žička
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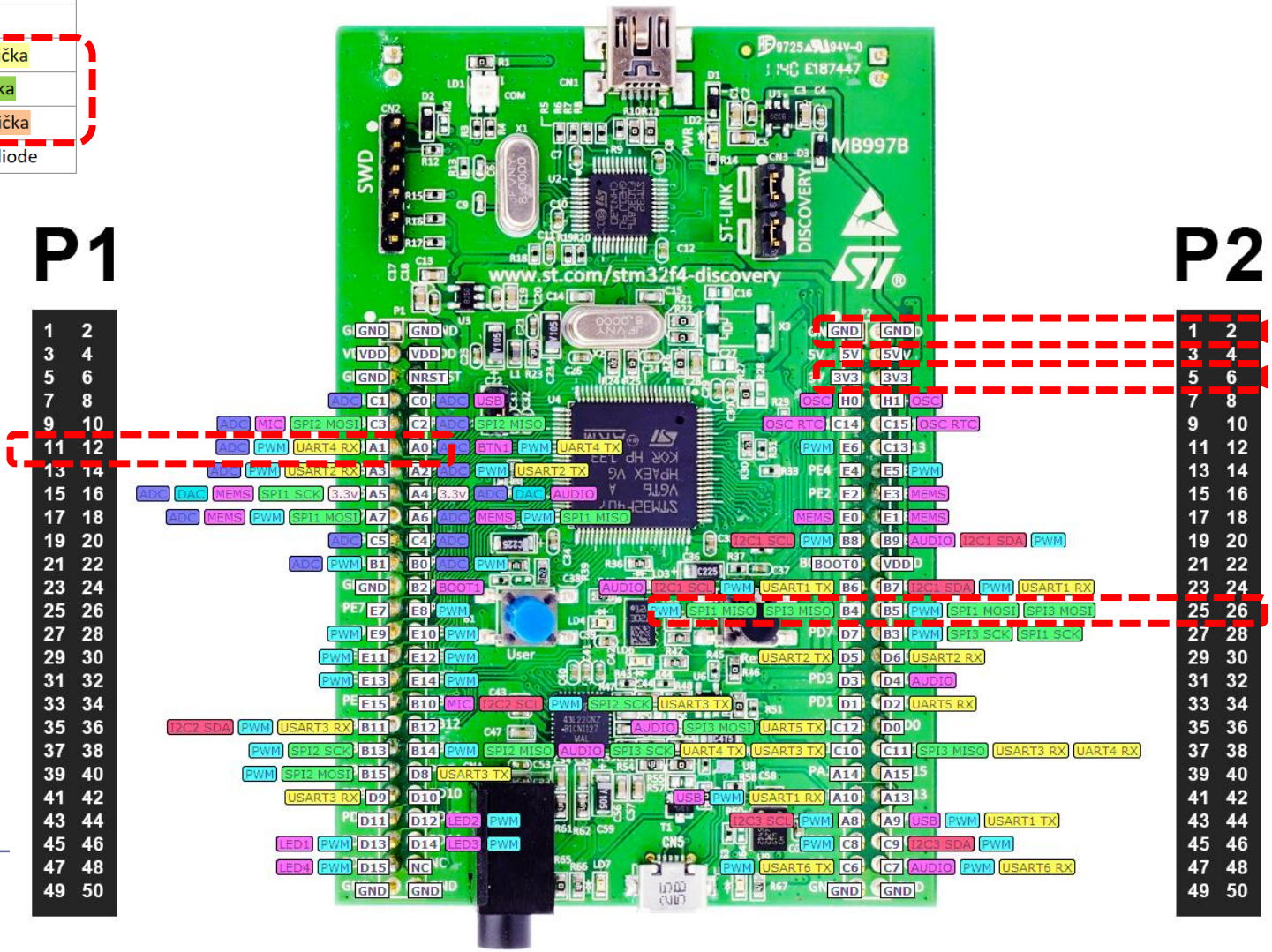
PD12-PD15	Dig. Izhodi	vgr. LED diode



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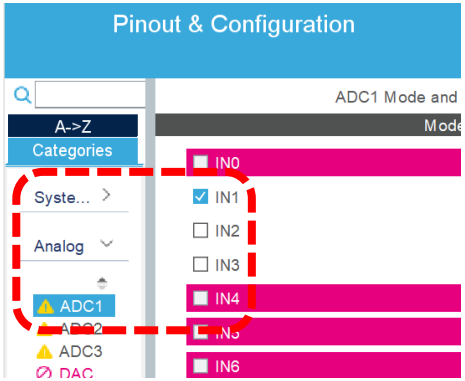
Osnovni projekt CubeIDE

Spremembe v projektu :



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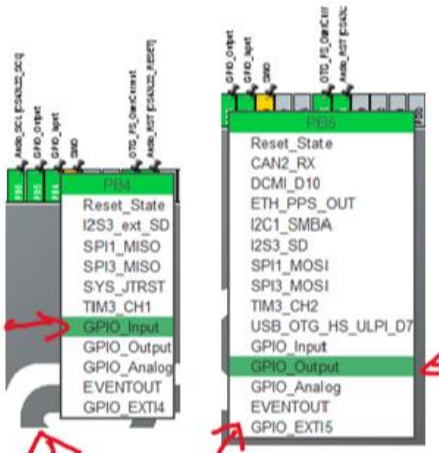

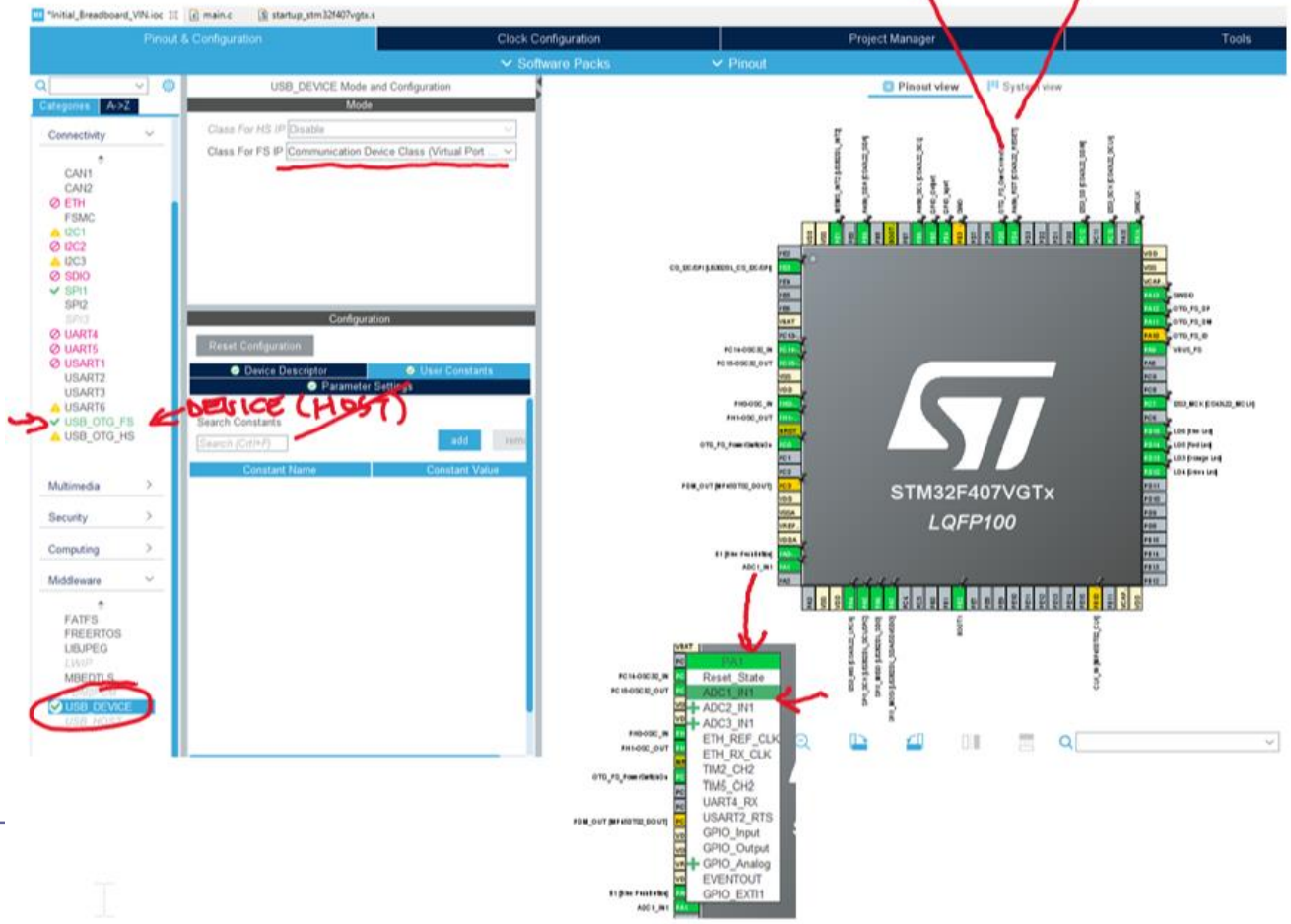

Program : za pošiljanje po USB Virtual COM Port

```
/* Infinite loop */
 /* USER CODE BEGIN WHILE */
 while (1)
 {

    HAL_ADC_Start(&hadc1);
    HAL_ADC_PollForConversion(&hadc1, HAL_MAX_DELAY);
    AnalogValue = HAL_ADC_GetValue(&hadc1);

    HAL_GPIO_TogglePin(GPIOD, GPIO_PIN_12);

    HAL_GPIO_TogglePin(GPIOB, GPIO_PIN_5);   //External LED on PB5
    KeyState = HAL_GPIO_ReadPin(GPIOB, GPIO_PIN_4); //External Key on PB4

    snprintf (SendBuffer,BUFSIZE,"Hello [%d]: Key:%d Analog:%d\r\n",Counter++, 1-KeyState, AnalogValue);
    CDC_Transmit_FS(SendBuffer,strlen(SendBuffer));

    /* USER CODE END WHILE */

    /* USER CODE BEGIN 3 */
        HAL_Delay(1000);
 }
 /* USER CODE END 3 */
```

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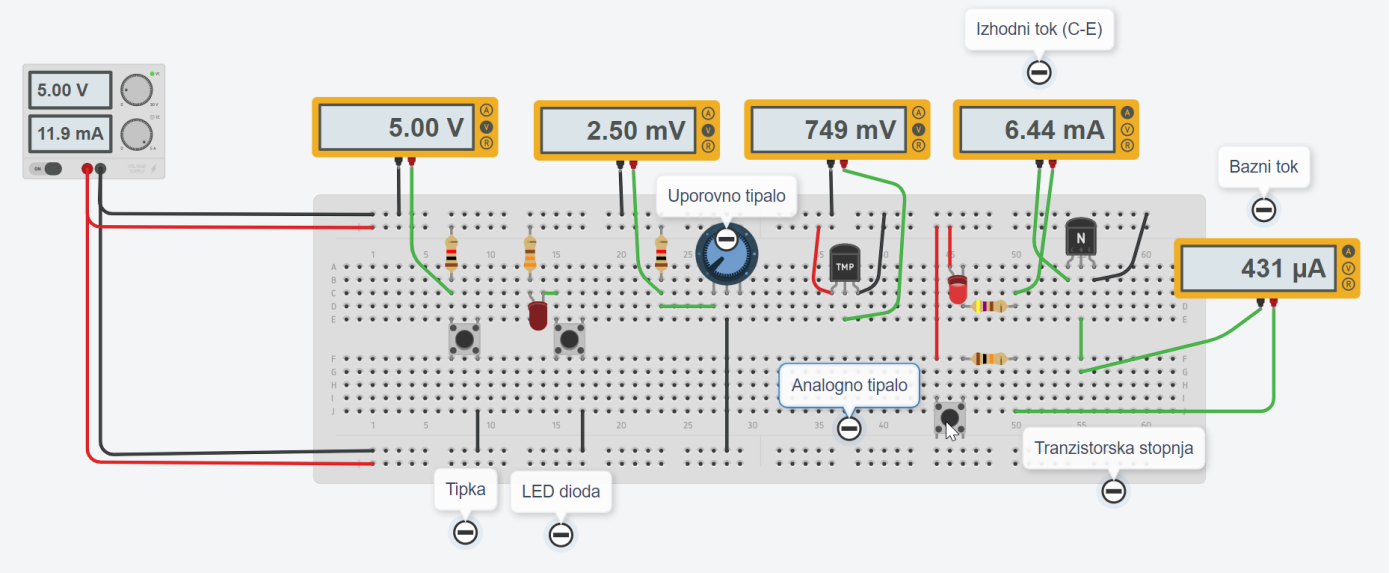

Priključitev na STM32 : 1x PWM izhod, 1x GND, 4x vgrajene LED diode

Testno vezje (primer) :

GPIO	Vrsta	Povezava
PA15	Brencac	+
GND	Brencac	-
PD12-PD15	Dig. Izhodi	vgr. LED diode

Vezava brenčača

Priključitev na STM32 : 1x PWM izhod, 1x GND, 4x vgrajene LED diode

Testno vezje (primer) :

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PA15	Brencac	+
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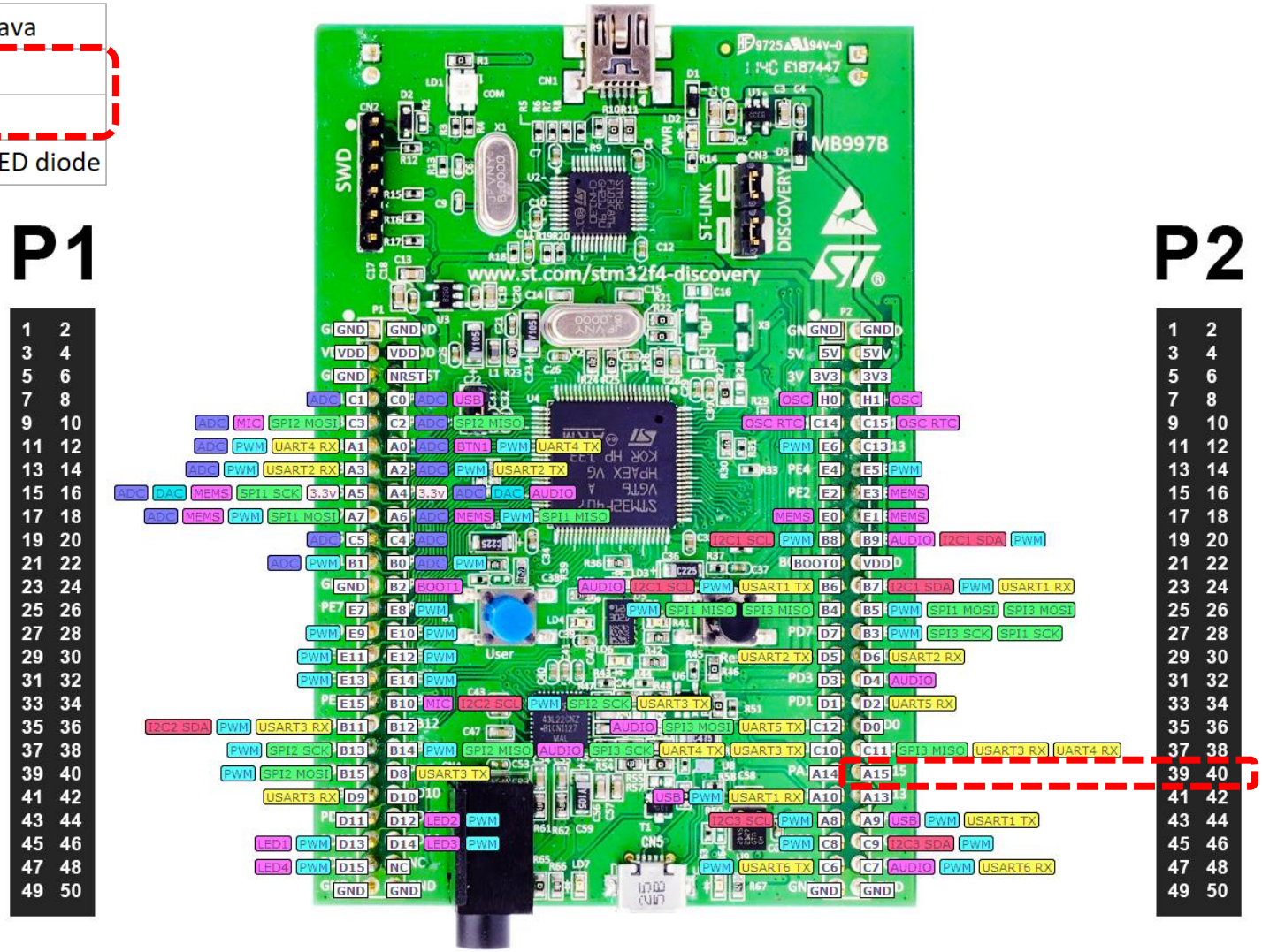
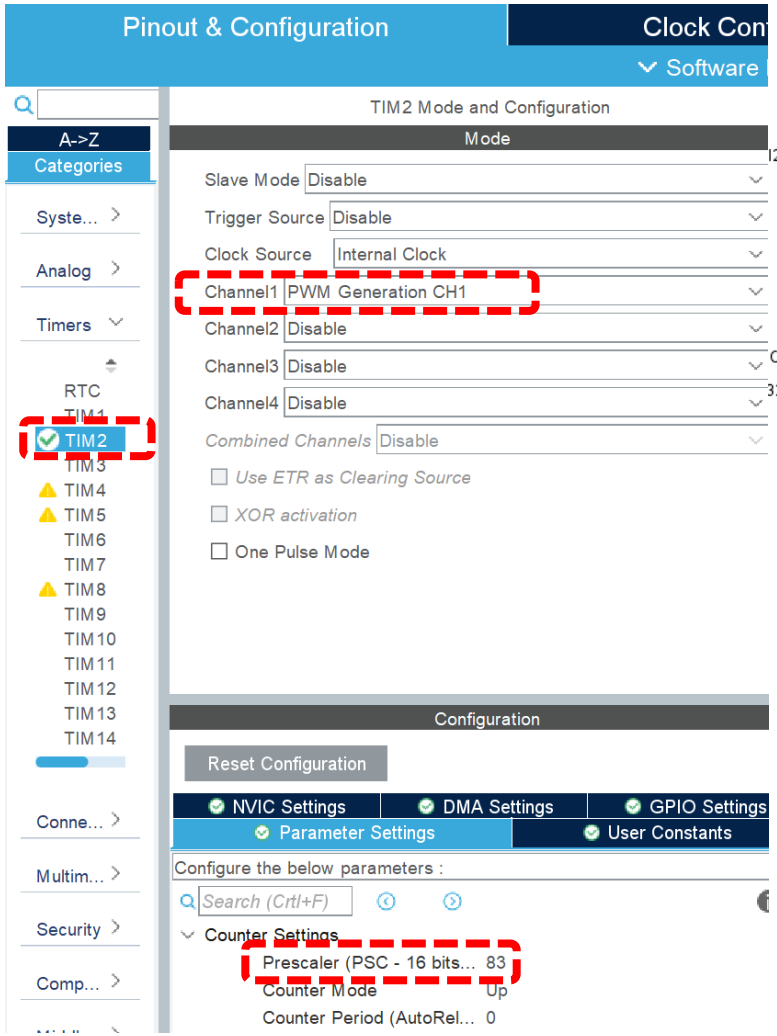
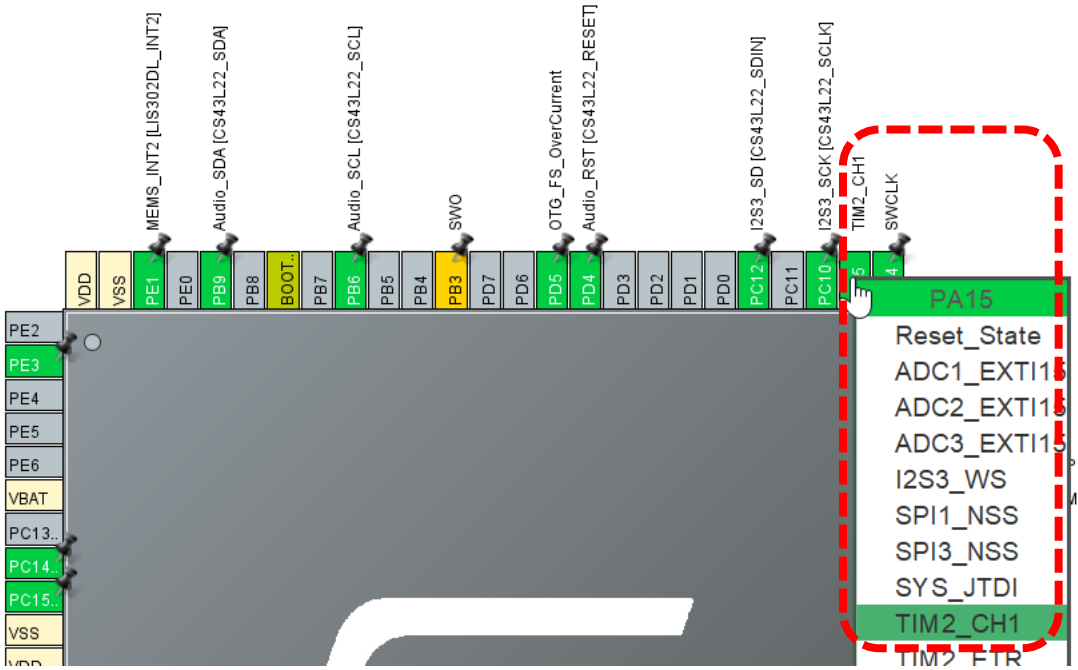


Vezava brenčača

Spremembe v projektu :





Program : za pošiljanje po USB Virtual COM Port

```
/* Inicializacija*/
 HAL_TIM_PWM_Start(&htim2, TIM_CHANNEL_1);

 while (1) {

 melodyCount = sizeof(melodySizes)/ sizeof(uint32_t);

            …

 ARR_period = (int)(1000000/NoteFreq);  //Already prescaled to 1 MHz
 setPWM(htim2, TIM_CHANNEL_1, ARR_period, ARR_period/2);

 Delaymsecs = noteDurations[melodyIndex][noteIndex] * melodySlowfactor[melodyIndex];

 snprintf (SendBuffer,BUFSIZE,"Melody[%d],Note #%d F=%d Hz Duration:%d ms| ARR=%d
CCR1=%d\r\n",melodyIndex,noteIndex,melody[melodyIndex][noteIndex],Delaymsecs,htim2.Instance->ARR,htim2.Instance-
>CCR1);
    CDC_Transmit_FS(SendBuffer,strlen(SendBuffer));

    HAL_Delay(Delaymsecs);
          }
      }

     HAL_Delay(2000);

  }
```

```
void setPWM(TIM_HandleTypeDef timer, uint32_t channel, uint16_t period, uint16_t pulse)
{
    HAL_TIM_PWM_Stop(&timer, channel); // stop generation of pwm
    TIM_OC_InitTypeDef sConfigOC;
    timer.Init.Period = period; // set the period duration
    HAL_TIM_PWM_Init(&timer); // reinititialise with new period value
    sConfigOC.OCMode = TIM_OCMODE_PWM1;
    sConfigOC.Pulse = pulse; // set the pulse duration
    sConfigOC.OCPolarity = TIM_OCPOLARITY_HIGH;
    sConfigOC.OCFastMode = TIM_OCFAST_DISABLE;
    HAL_TIM_PWM_ConfigChannel(&timer, &sConfigOC, channel);
    HAL_TIM_PWM_Start(&timer, channel); // start pwm generation
}
```

melody.h
Melodije in notni zapis : https://github.com/bogusz2233/Buzzer_music_stm32/blob/master/Inc/melody.h

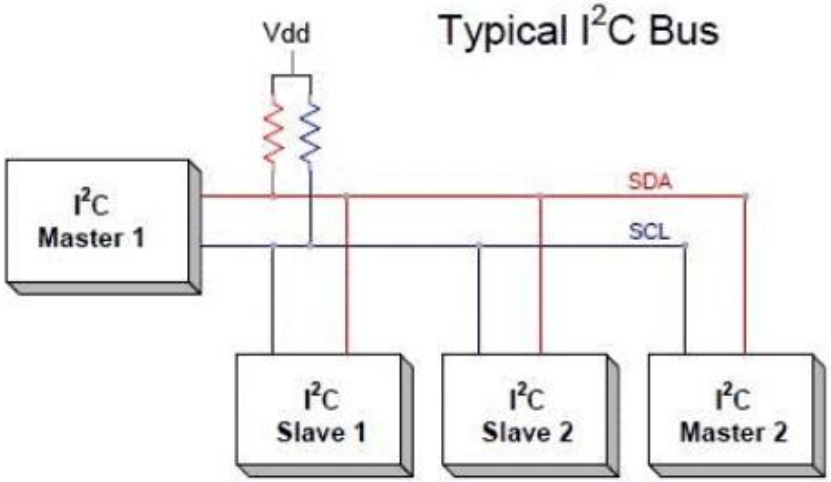
https://circuitdigest.com/microcontroller-projects/playing-melodies-on-piezo-buzzer-using-arduino-tone-function

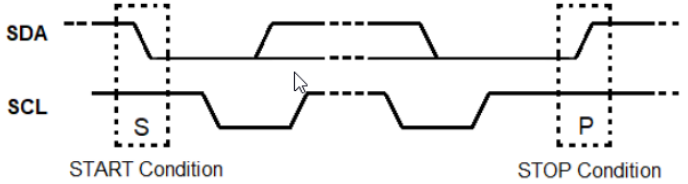
VIN projekt - VP4: STM32-CubeIDE projekt, breadboard vezave, komunikacije

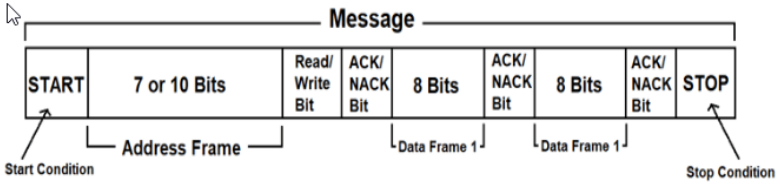
- Osvežitev
- Breadboard vezava
- STM32 CubeIDE + Breadboard
  - LED, tipka, potenciometer, uporovna tipala
  - PWM brenčač z melodijami
- Primeri komunikacijskih projektov
  - STM32+LIS3DSH
  - Arduino

Serijske komunikacije – I2C

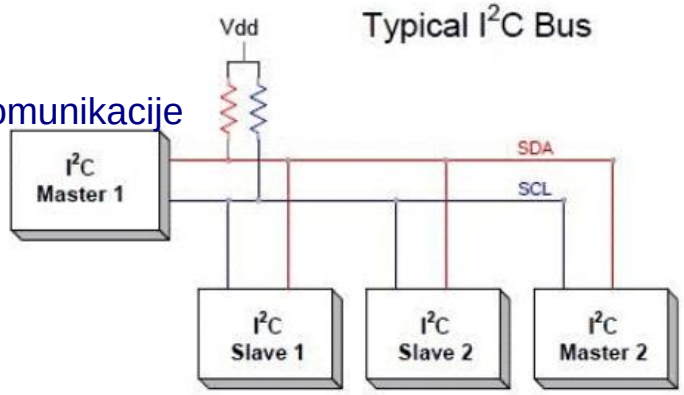
- **How to use I2C in Arduino: Communication between two Arduino Boards**
  - Z naslova <https://circuitdigest.com/microcontroller-projects/arduino-i2c-tutorial-communication-between-two-arduino>
- **Communication Between Two Arduinos (I2C)**
  - Z naslova <https://www.instructables.com/id/Communication-Between-Two-Arduinos-I2C/>
- **Master Slave I2C Connection**
  - Z naslova <https://www.hackster.io/PIYUSH_K_SINGH/master-slave-i2c-connection-f1aa53>

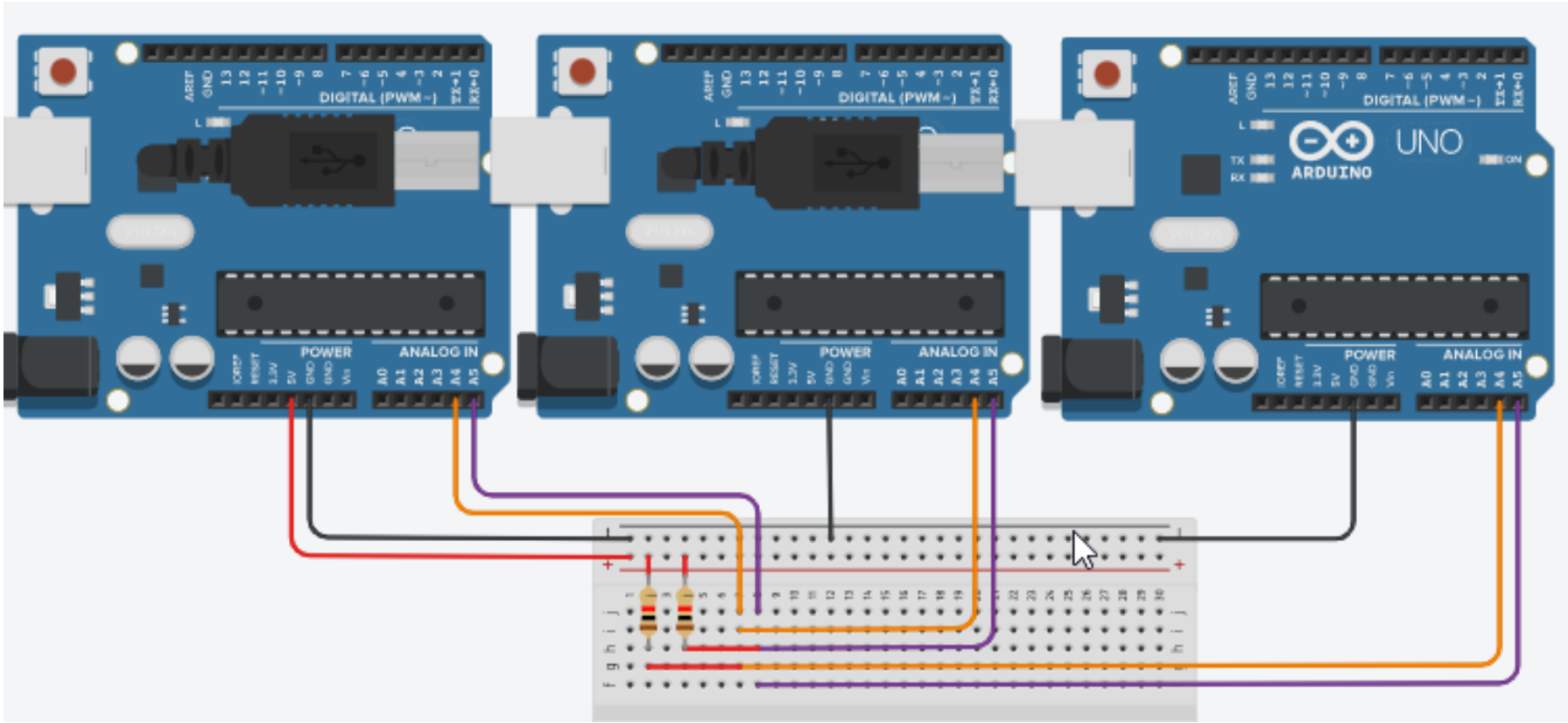




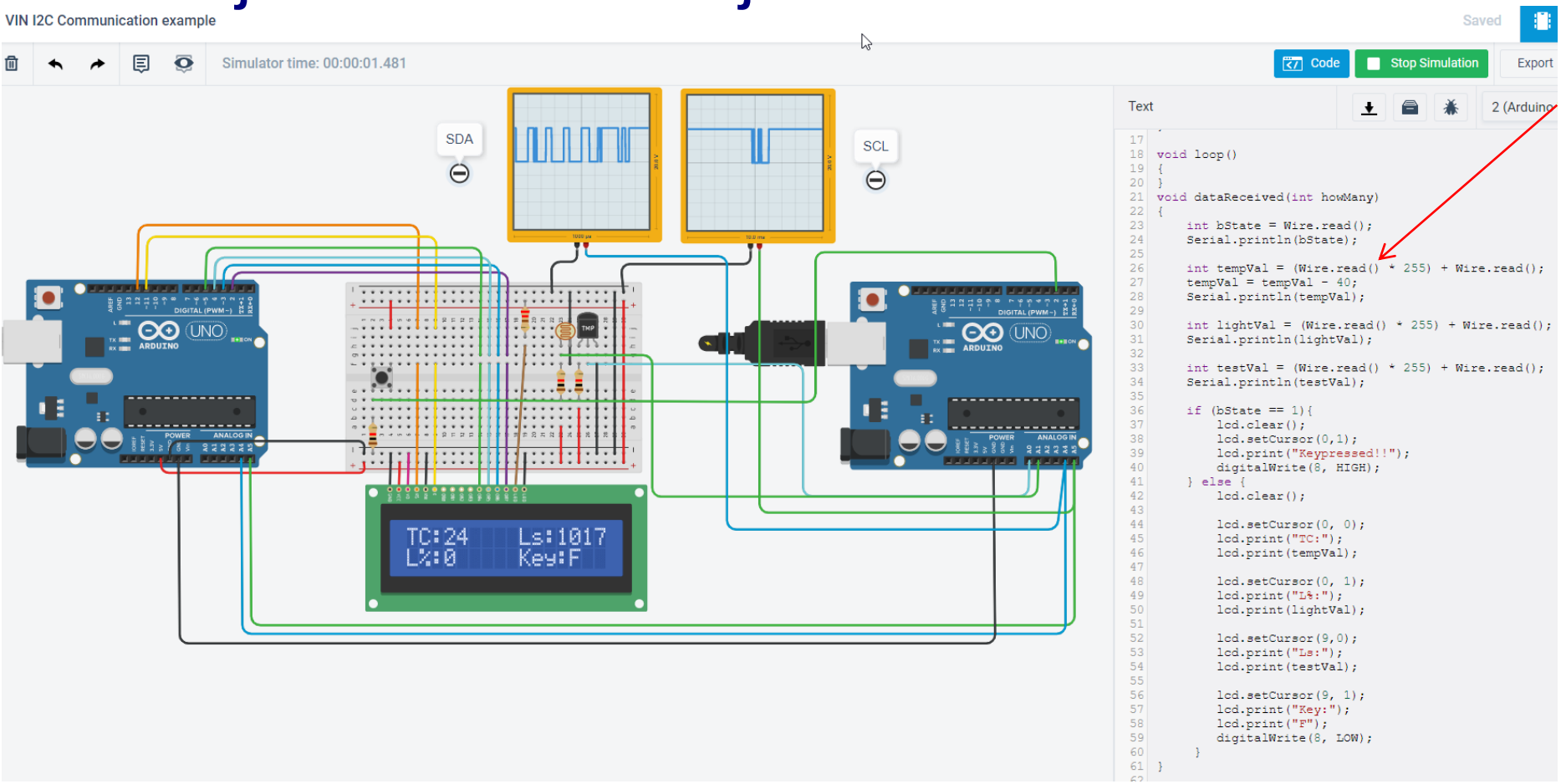


Serijske komunikacije – I2C





Serijske komunikacije – I2C - Primer



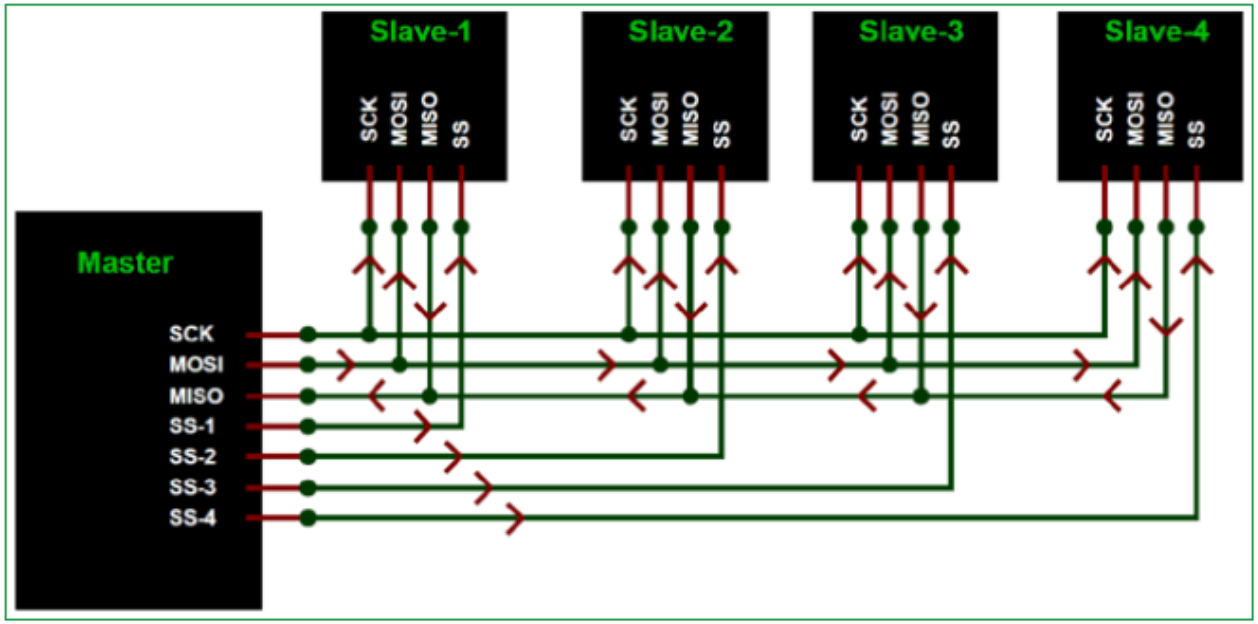
https://www.tinkercad.com/things/14ImcXzZtzb-vin-i2c-communication-example

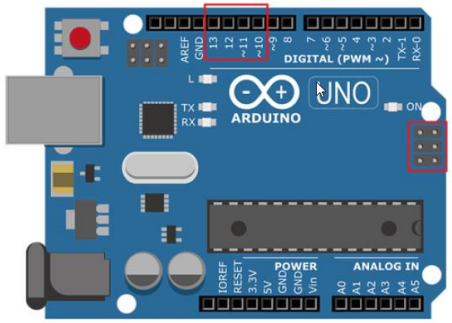
Serijske komunikacije – SPI

- **How to use SPI in Arduino: Communication between two Arduino Boards**
  - Z naslova <https://circuitdigest.com/microcontroller-projects/arduino-spi-communication-tutorial>

SPI Line	Pin in Arduino
MOSI	11 or ICSP-4
MISO	12 or ICSP-1
SCK	13 or ICSP-3
SS	10

SPI Master with Multiple Slaves





Serijske komunikacije – SPI

- **How to use SPI in Arduino: Communication between two Arduino Boards**
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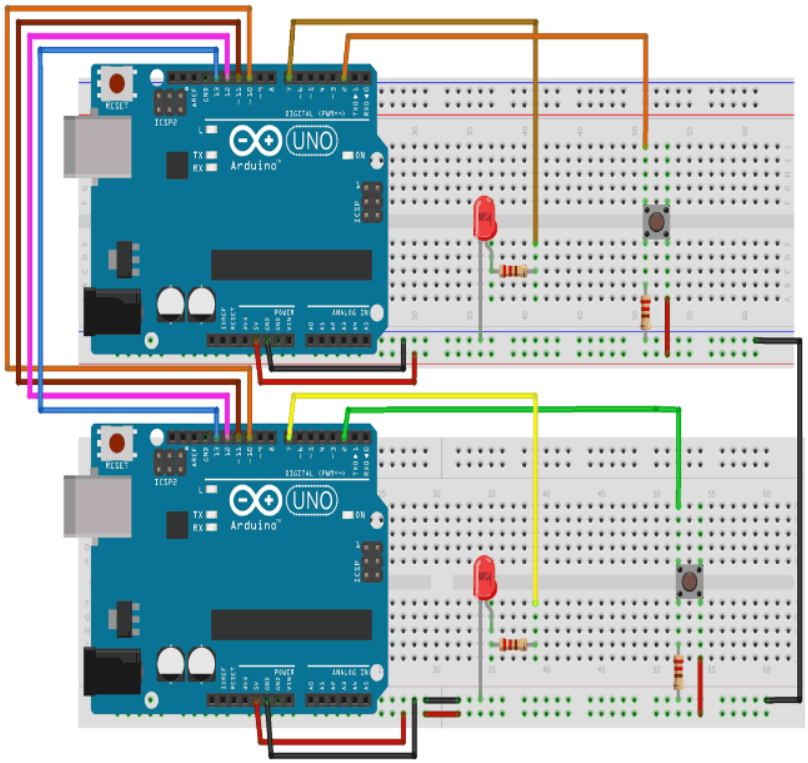
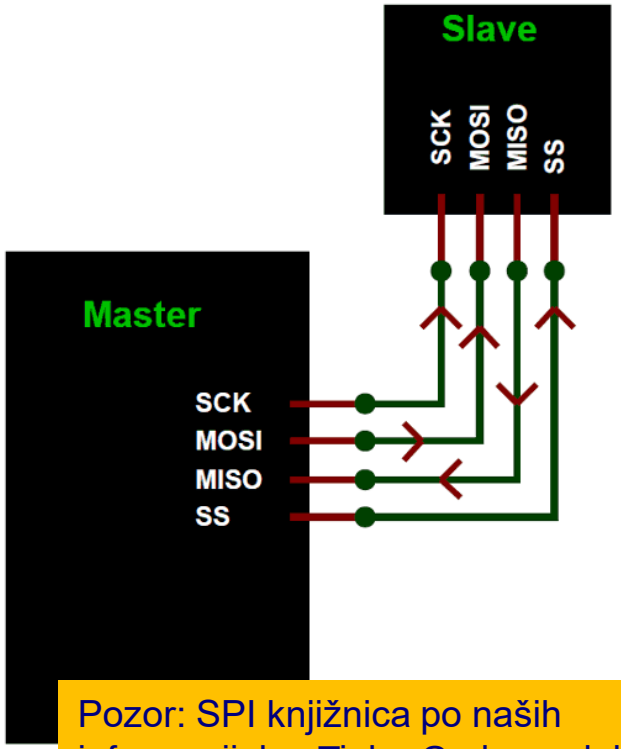
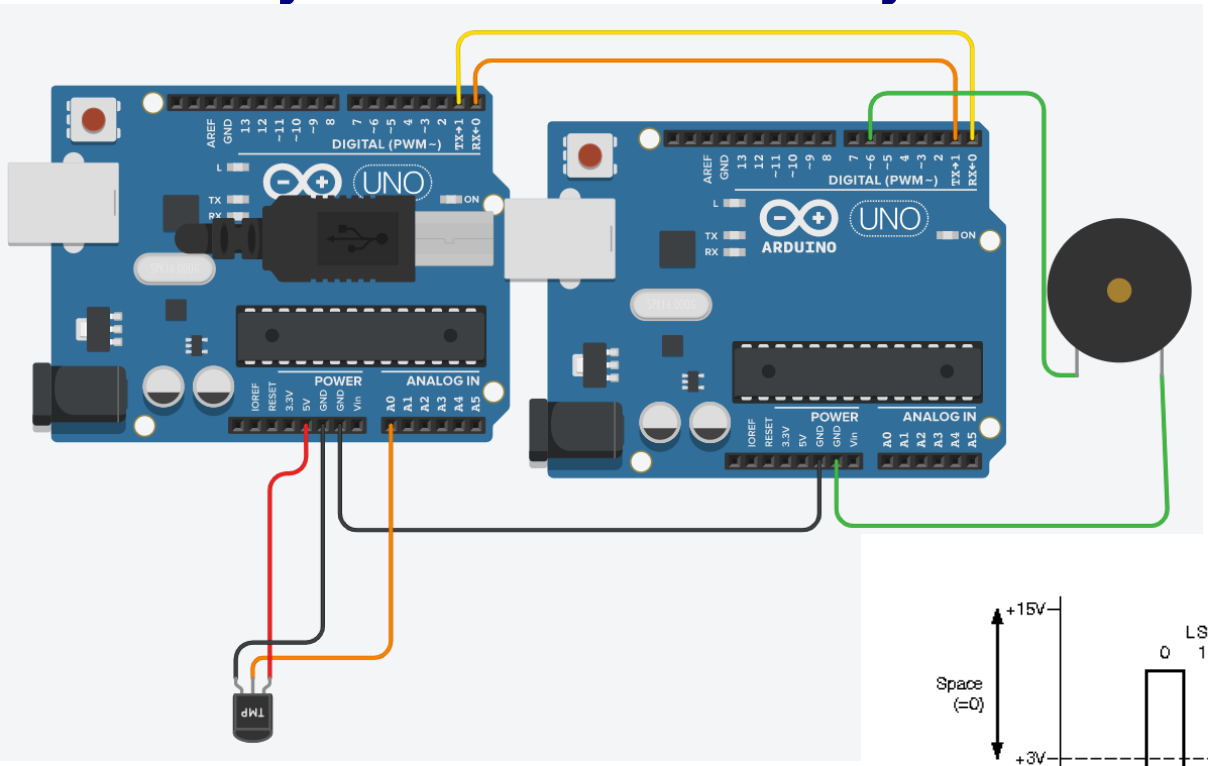
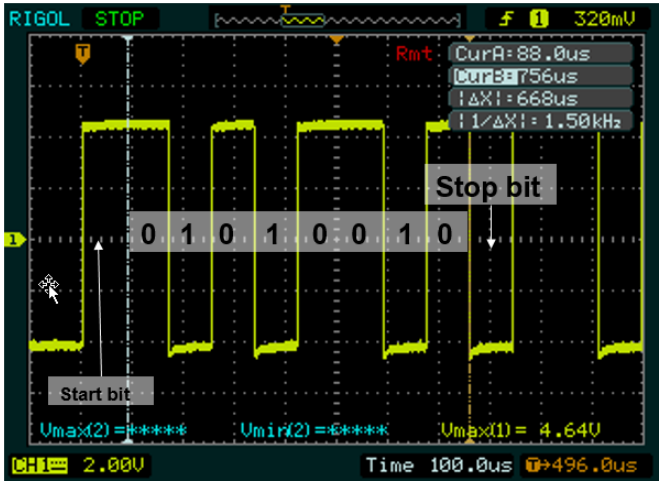




Pozor: SPI knjižnica po naših informacijah v TinkerCadu ne deluje, je pa mogoče protokol implementirati v lastni kodi.

Serijske komunikacije – UART

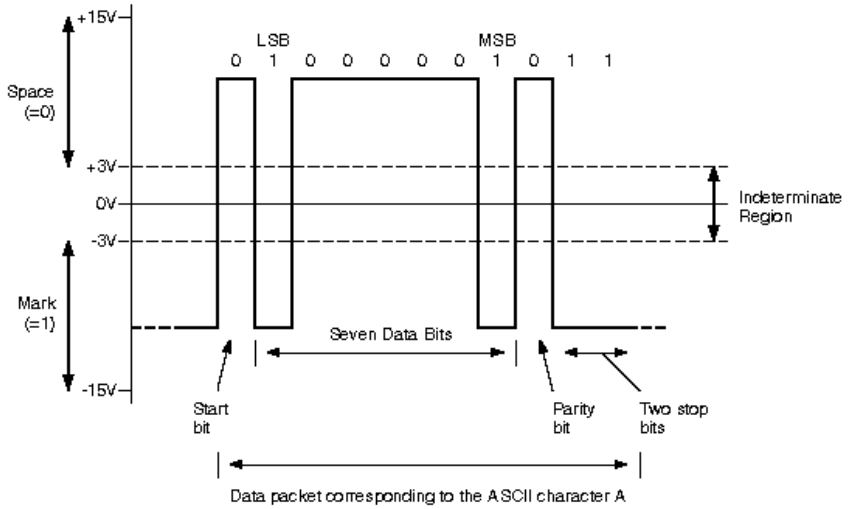




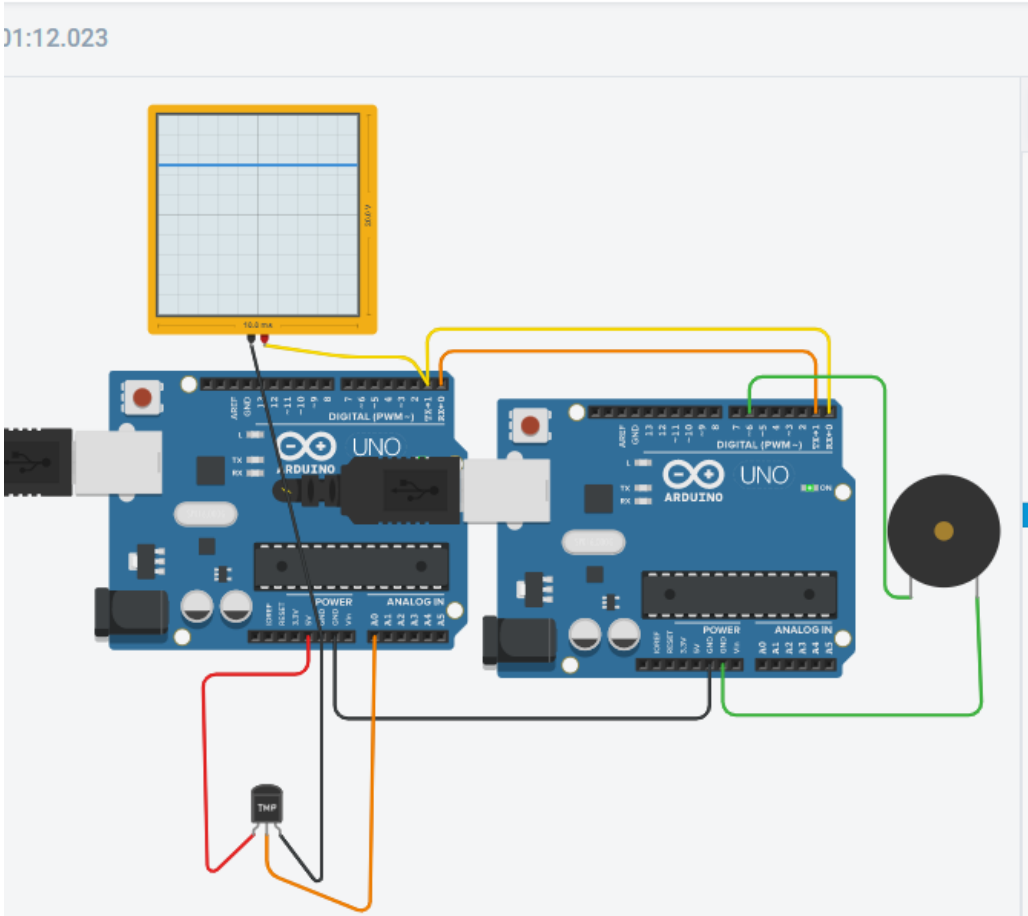
Pozor :

Po tej povezavi poteka UART komunikacija na TTL napetostnih nivojih

Ni namreč povezave na zunanji RS232 pretvornik !



Serijske komunikacije – UART - Primer



https://www.tinkercad.com/things/8TvZHTxb8jv-vin-uart-communication-demo