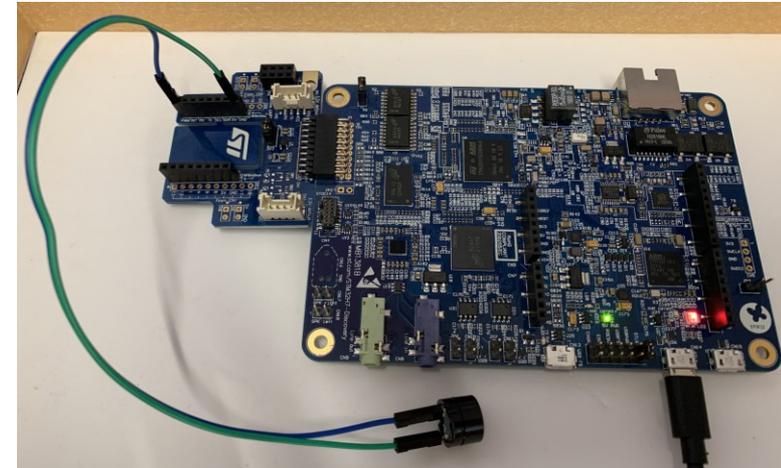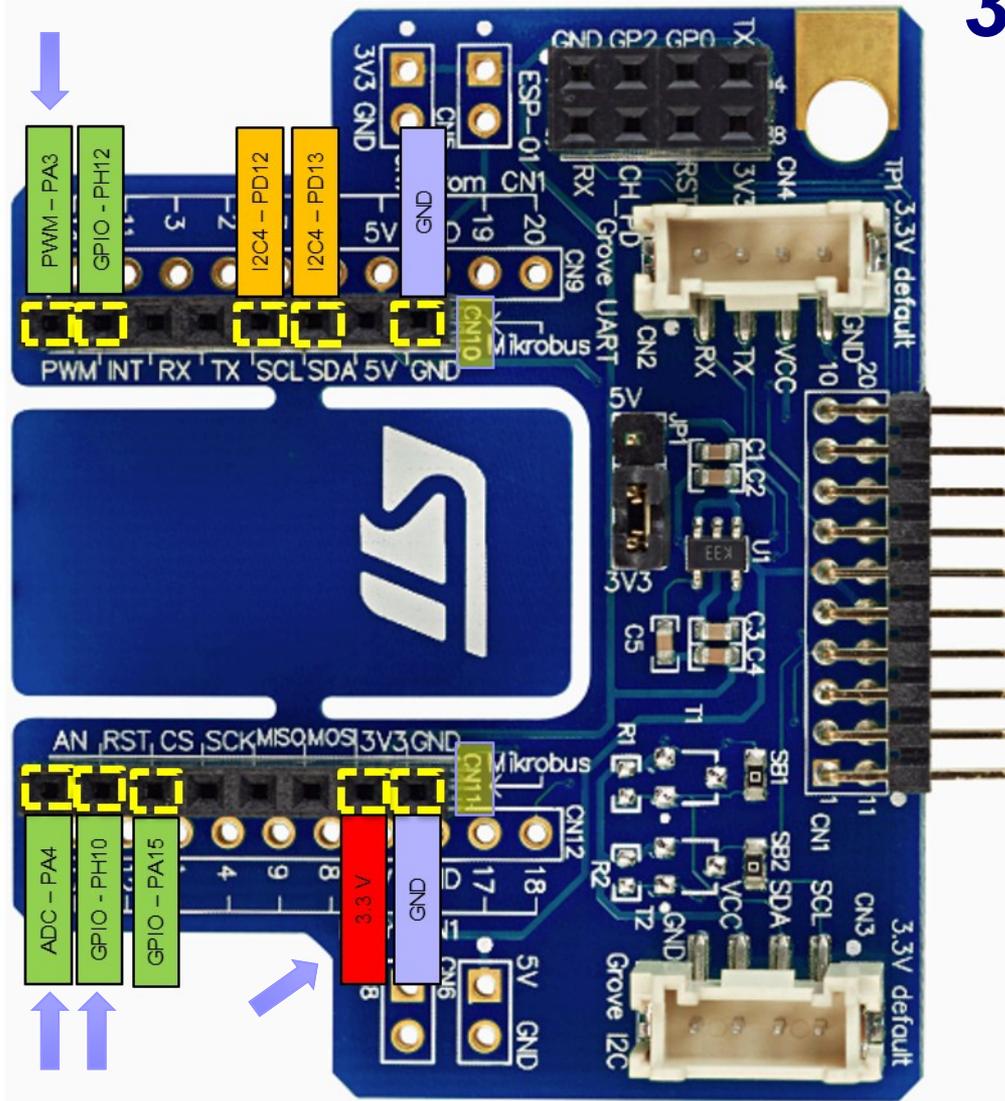# Vhodno izhodne naprave
Izbor gradiv za izvedbo vaje

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

STM32H750B – DISCOVERY StMod+ konektor
3.3V !!!
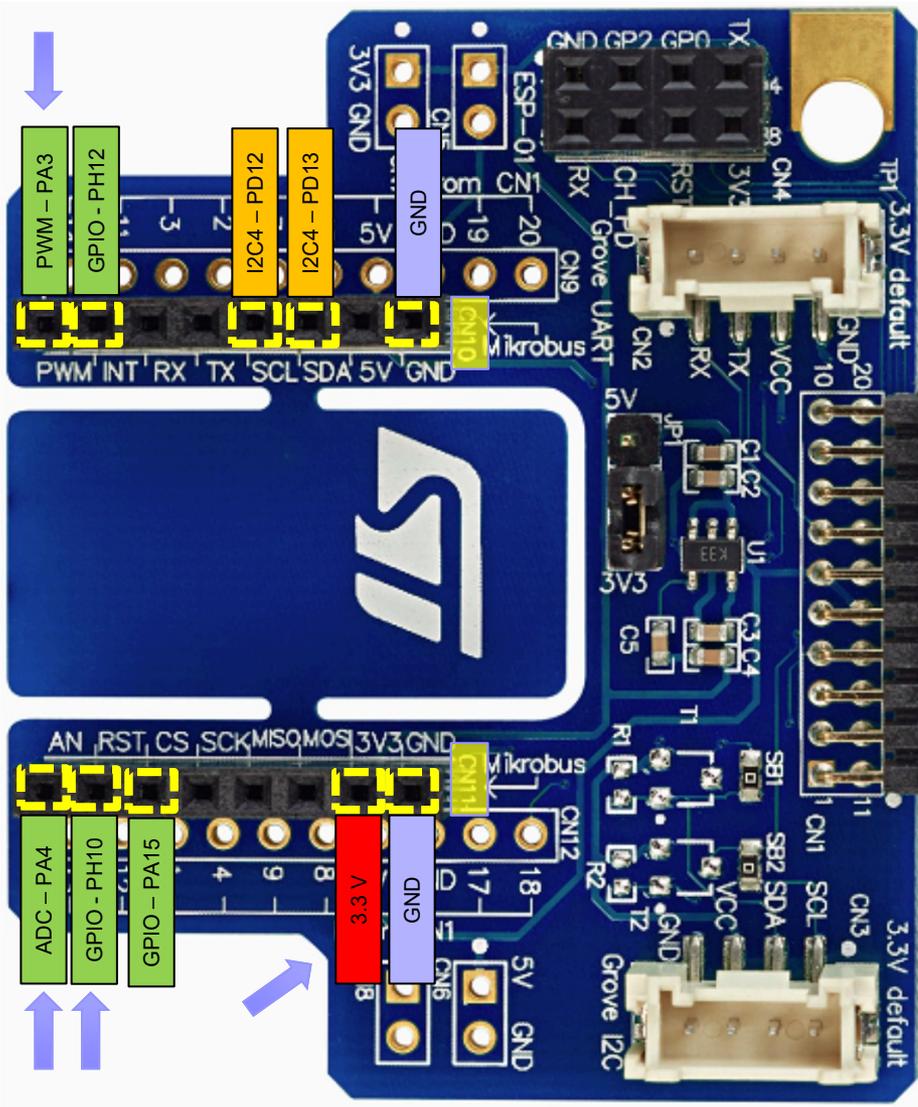

Pravilna priključitev
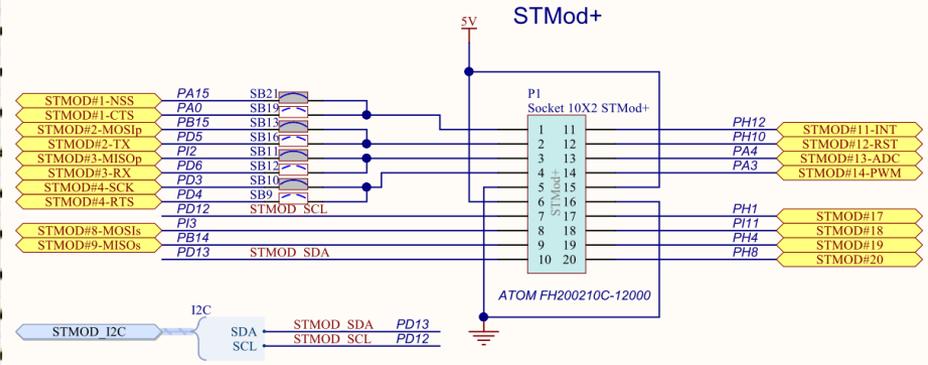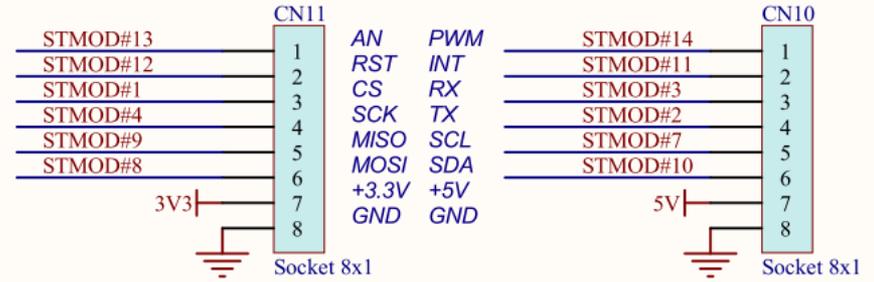
Nepravilna priključitev

2

STM32H750B – DISCOVERY StMod+ konektor

Mikrobus connectors

	CN11		AN	PWM		CN10
STMOD#13	1		AN	PWM	STMOD#14	1
STMOD#12	2		RST	INT	STMOD#11	2
STMOD#1	3		CS	RX	STMOD#3	3
STMOD#4	4		SCK	TX	STMOD#2	4
STMOD#9	5		MISO	SCL	STMOD#7	5
STMOD#8	6		MOSI	SDA	STMOD#10	6
3V3	7		+3.3V	+5V	5V	7
	8		GND	GND		8

Socket 8x1   Socket 8x1

Testno vezje (primer) - STM32H7 :

GPIO	Vrsta	Povezava
PC13	User tipka	Modra tipka
PA4	Analogni vhod	Rumena žička
PH10	Dig. Vhod	Zelena žička
PA3	Dig. Izhod - LED	Oranžna žička
PJ2,Pi13	Dig. Izhodi	vgr. LED diode

STM32H7

Uporovna tipala   LDR – Light Dependent Resistor PGM5337

FOTO UPOR PGM5537 100mW 16-50kR 540nm

▶ **Electronics Characteristics**

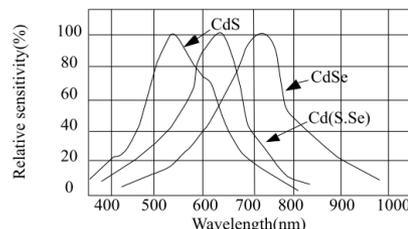| Model	Vmax (VDC)	Pmax (mW)	Ambient Temp (°C)	Spectral Peak (nm)	Photo Resistance (10Lx) (KΩ)	Dark Resistance (MΩ)min	γ . min	ResponseTime (ms)	
								Rise	Decay
PGM5506	100	90	-30 ~ +70	540	2 ~ 6	0.15	0.6	30	40
PGM5516	100	90	-30 ~ +70	540	5 ~ 10	0.2	0.6	30	40
PGM5526	150	100	-30 ~ +70	540	8 ~ 20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

TOKEN   **PGM CDS Photoresistors**

▶ **Terminology**

● **Light Resistance :**
Measured at 10 lux with standard light A (2854K-color temperature) and 2hr. preillumination at 400-600 lux prior testing.

● **Dark Resistance :**
Measured at 10th seconds after closing 10 lux.

● **Gamma characteristic :**
Under 10 lux and 100 lux and given by $\gamma = \log(R10/R100) / \log(100/10) = \log(R10/R100)$
R10, R100: resistance at 10 lux and 100 lux.
The tolerance of γ is ±0.1.
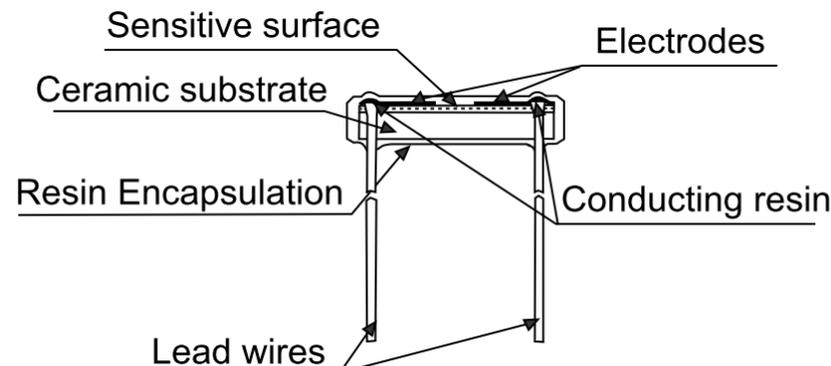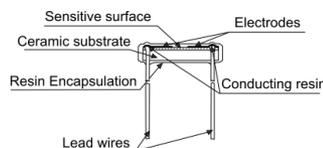
● **Pmax :**
Max. power dissipation at ambient temperature of 25°C. At higher ambient temperature, the maximum power permissible may be lowered.

● **Vmax :**
Max. voltage in darkness that may be applied to the device continuously.

● **Spectral peak :**
Spectral sensitivity of photoresistors depends on the wavelength of light they are exposed to and in accordance with figure 'Spectral Response'. The tolerance of spectral peak is ±50nm.

Sensitive surface
Electrodes
Ceramic substrate
Resin Encapsulation
Conducting resin
Lead wires

UPOR NTC 2K2 5%

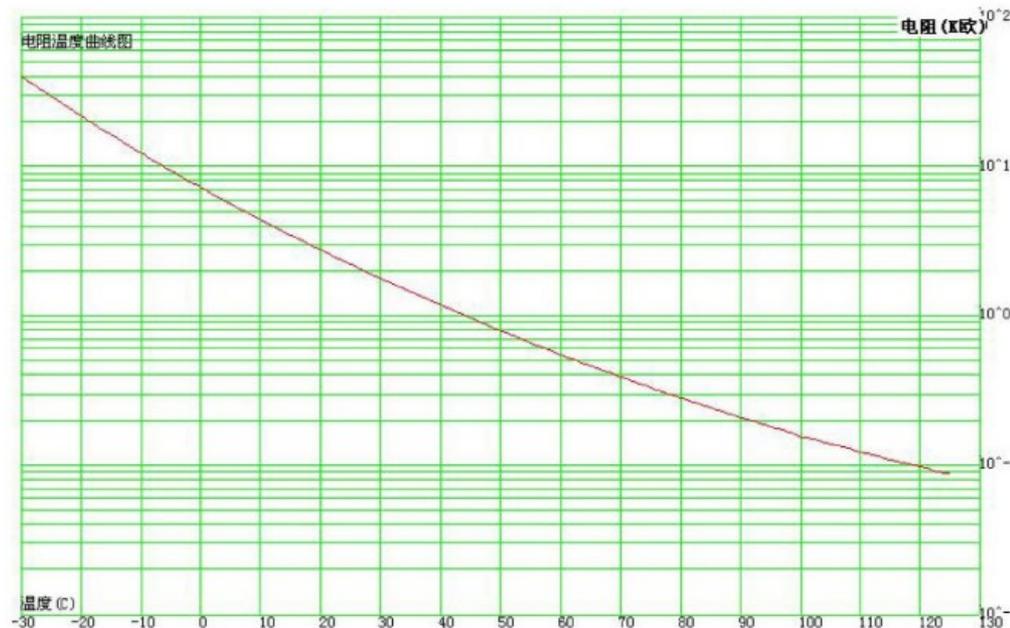## Uporovna tipala

NTC – Termistor NTCC-2K2

R25 = 2.2kΩ   B25/50 = 3950K

NTCC-2K2 SR PASSIVES
NTC thermistor; 2.2kΩ; THT; 3900K; -55÷125° C; 500mW; Ø6.5mm

T°C	R kΩ	T°C	R kΩ	T°C	R kΩ	T°C	R kΩ	T°C	R kΩ	T°C	R kΩ
-30	40.128	-4	8.871	22	2.511	48	0.857	74	0.341	100	0.154
-29	37.694	-3	8.415	23	2.402	49	0.824	75	0.33	101	0.154
-28	35.418	-2	7.986	24	2.298	50	0.794	76	0.319	102	0.15
-27	33.289	-1	7.581	25	2.2	51	0.764	77	0.309	103	0.146
-26	31.298	0	7.238	26	2.105	52	0.736	78	0.3	104	0.142
-25	29.436	1	6.839	27	2.016	53	0.709	79	0.29	105	0.139
-24	27.693	2	6.499	28	1.931	54	0.683	80	0.281	106	0.135
-23	26.064	3	6.179	29	1.85	55	0.659	81	0.273	107	0.132
-22	24.539	4	5.876	30	1.773	56	0.635	82	0.265	108	0.129
-21	23.112	5	5.59	31	1.699	57	0.612	83	0.257	109	0.125
-20	21.776	6	5.32	32	1.629	58	0.59	84	0.249	110	0.122
-19	20.526	7	5.064	33	1.562	59	0.57	85	0.242	111	0.12
-18	19.355	8	4.823	34	1.498	60	0.55	86	0.234	112	0.117
-17	18.258	9	4.594	35	1.437	61	0.53	87	0.228	113	0.114
-16	17.231	10	4.378	36	1.379	62	0.512	88	0.221	114	0.111
-15	16.267	11	4.173	37	1.324	63	0.494	89	0.215	115	0.109
-14	15.364	12	3.979	38	1.271	64	0.477	90	0.208	116	0.106
-13	14.517	13	3.795	39	1.221	65	0.461	91	0.202	117	0.104
-12	13.722	14	3.62	40	1.172	66	0.445	92	0.197	118	0.102
-11	12.976	15	3.455	41	1.126	67	0.43	93	0.191	119	0.099
-10	12.275	16	3.298	42	1.082	68	0.416	94	0.186	120	0.097
-9	11.617	17	3.15	43	1.04	69	0.402	95	0.181	121	0.095
-8	10.999	18	3.008	44	1	70	0.389	96	0.176	122	0.093
-7	10.417	19	2.874	45	0.962	71	0.376	97	0.171	123	0.091
-6	9.87	20	2.747	46	0.925	72	0.364	98	0.167	124	0.089
-5	9.356	21	2.626	47	0.89	73	0.352	99	0.162	125	0.088

电阻温度曲线图   电阻(K欧)   温度(C)
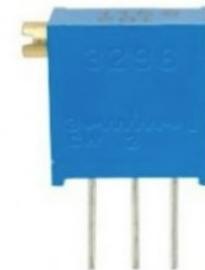
Uporovna tipala   TrimPot – Trimer Potenciometer TSR-3296Z-104
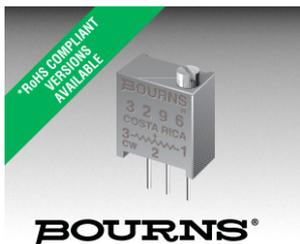
Features
- Multiturn / Cermet / Industrial / Sealed
- 5 terminal styles
- Tape and reel packaging available
- Chevron seal design
- Listed on the QPL for style RJ24 per MIL-R-22097 and RJR24 per High-Rel Mil-R-39035
- Mounting hardware available (H-117P)
- RoHS compliant* version available
- For trimmer applications/processing guidelines, click here

BOURNS®

3296 - 3/8 " Square Trimpot® Trimming Potentiometer

Proizvajalec	Suntan
Številka proizvajalca	TSR-3296Z-104

Proizvajalec	Suntan
Številka proizvajalca	TSR-3296Z-104
Upornost	100KOhm
Moč	0.5W
Toleranca	± 10%
Tip	THT

Standard Resistance Table

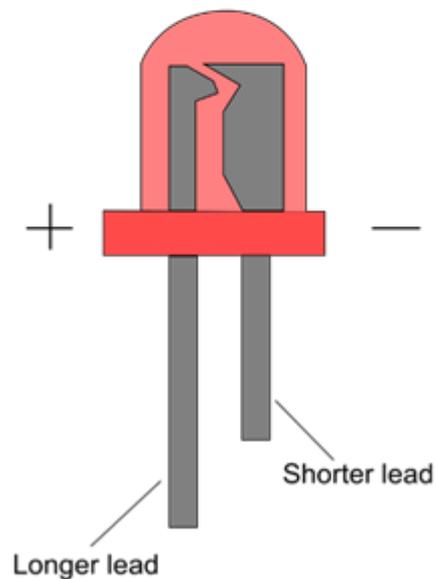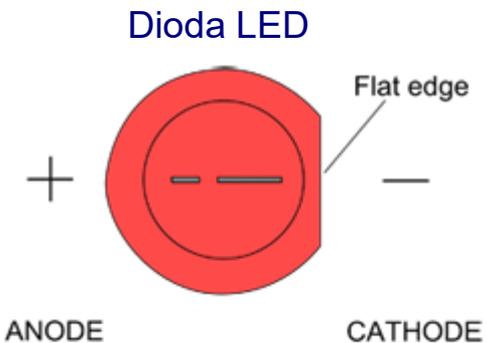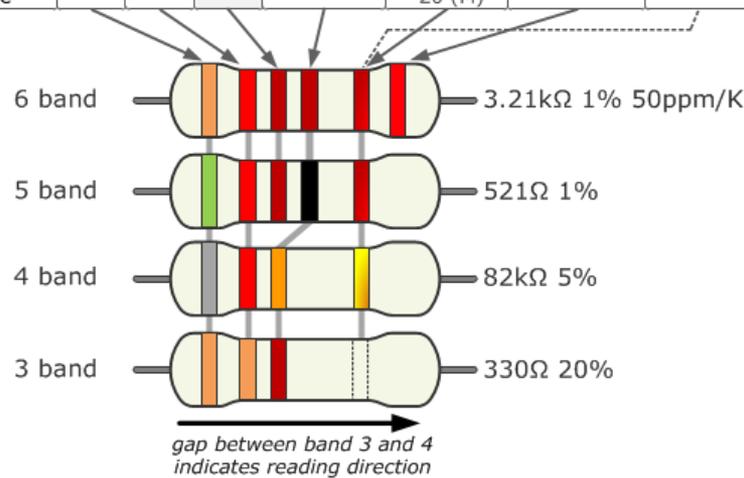| Resistance (Ohms)	Resistance Code
10	100
20	200
50	500
100	101
200	201
500	501
1,000	102
2,000	202
5,000	502
10,000	103
20,000	203
25,000	253
50,000	503
100,000	104
200,000	204

https://www.ic-elect.si/trimpot-cer-64z-100k-tsr-3296z.html

Uporniki

Elektronske komponente

Dioda LED

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)		

Flat edge

+ —

ANODE   CATHODE

6 band — 3.21kΩ 1% 50ppm/K

5 band — 521Ω 1%

4 band — 82kΩ 5%

3 band — 330Ω 20%

gap between band 3 and 4
indicates reading direction

+ —

Shorter lead

Longer lead

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

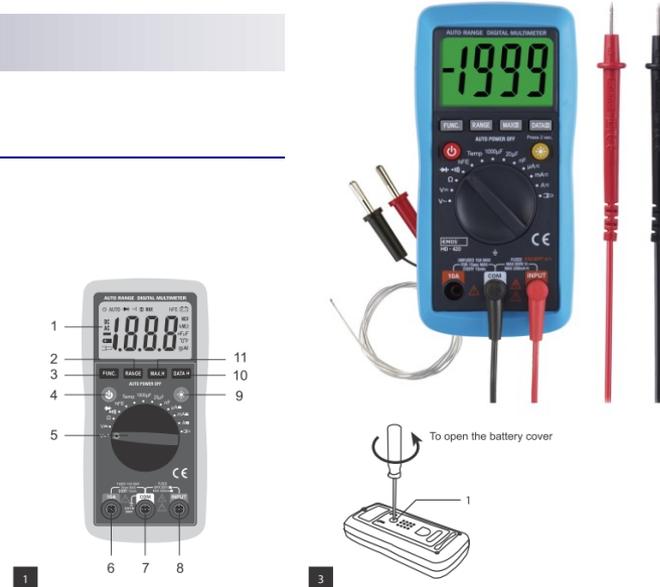# Multimeter EMOS MD-420

Preverjanje povezav

Merjenje upornosti

Merjenje el. napetosti
- enosmerna DC
- **vzporedna** vezava !!!
- **visoka** upornost

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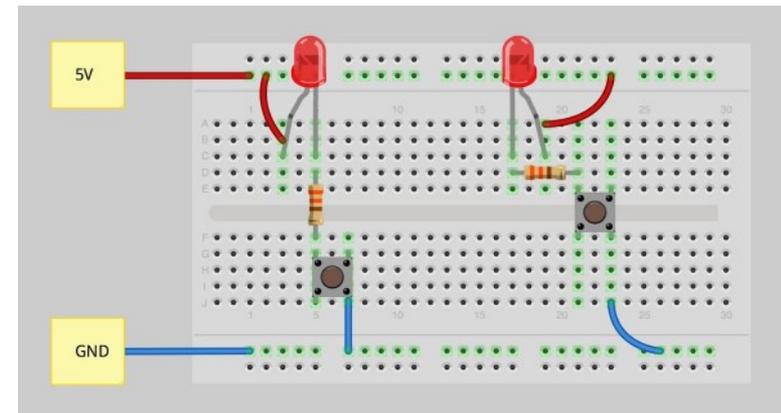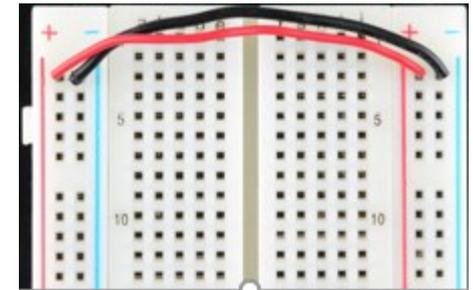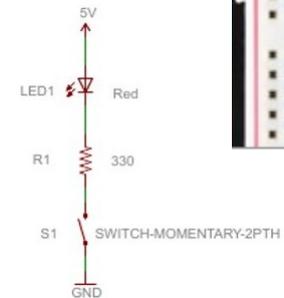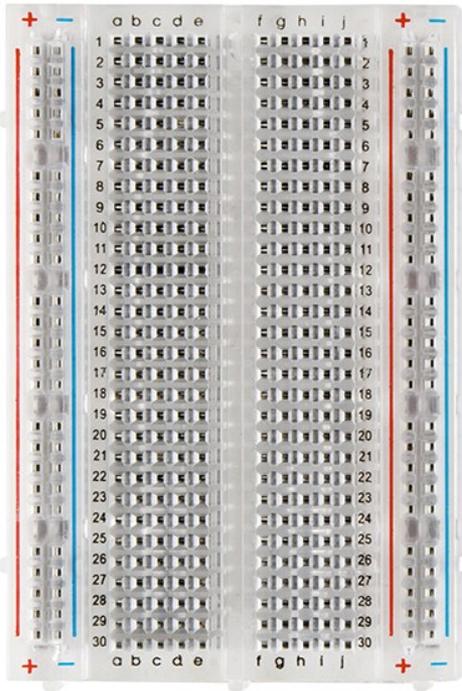- **zaporedna** vezava !!!
- **nizka** upornost

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

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

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

Breadboard vezava

Osnovna priporočila za potek praktičnega dela vaje :

- *1. Vezava na breadboardu:*
  - v dvoje izvedite lastno vezavo (GPIO: tipka, led, ADC: uporovno tipalo)
    - previdno priključujte žice, konektorje

- *2. Preveritev vezav (multimeter, …):*
  - z multimetri še brez povezave s STM32 sistemom
    - preverite posamezne komponente pred vezavo (upornosti, …)
    - po vezavi: posamezne veje, stike, povezave, upornosti med Vcc in GND
  - preverite logiko in pravilnost povezav
    - preverite tudi slike povezanih sistemov

- *3. Povezava s STM32 in programiranje:*
  - povežite s STM32 sistemom (naj bo izkopljen)
  - STM32: vklop in delo na STM32 programu (že pripravljen projekt):
    - https://github.com/LAPSyLAB/STM32H7_Discovery_VIN_Projects/tree/main/STM32H750B-DK_Breadboard_VIN

- *Zanimivost: z multimetri lahko preverite še druge vezave*
  - „napajano" vezavo - „VIN LAB Breadboard Demo"
  - vezavo - „VIN LAB Breadboard STM32 IO Demo"

Breadboard vezave – izhodišči za delo :

❑ „VIN LAB Breadboard STM32 IO Demo" : demo breadboard vezava za povezavo s STM32 sistemoma

https://www.tinkercad.com/things/cZld7zNU6Yd
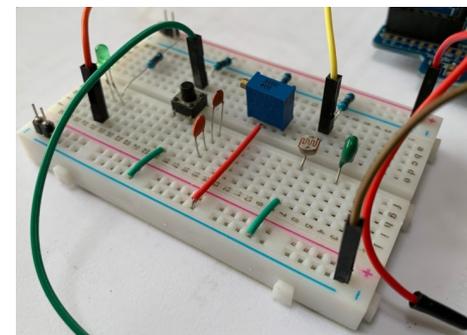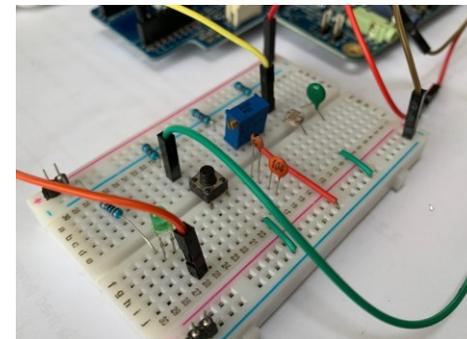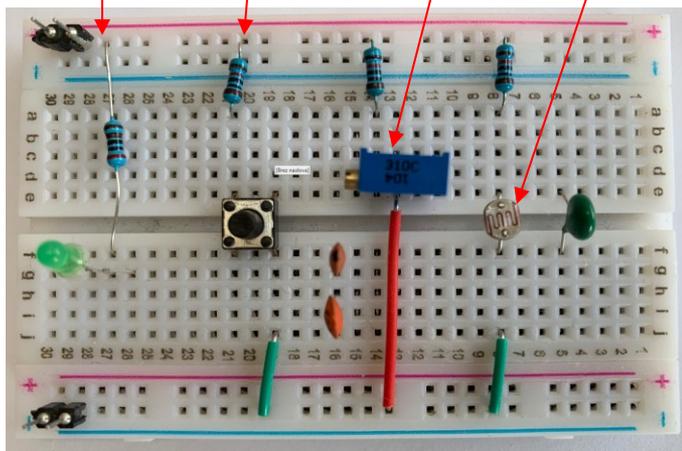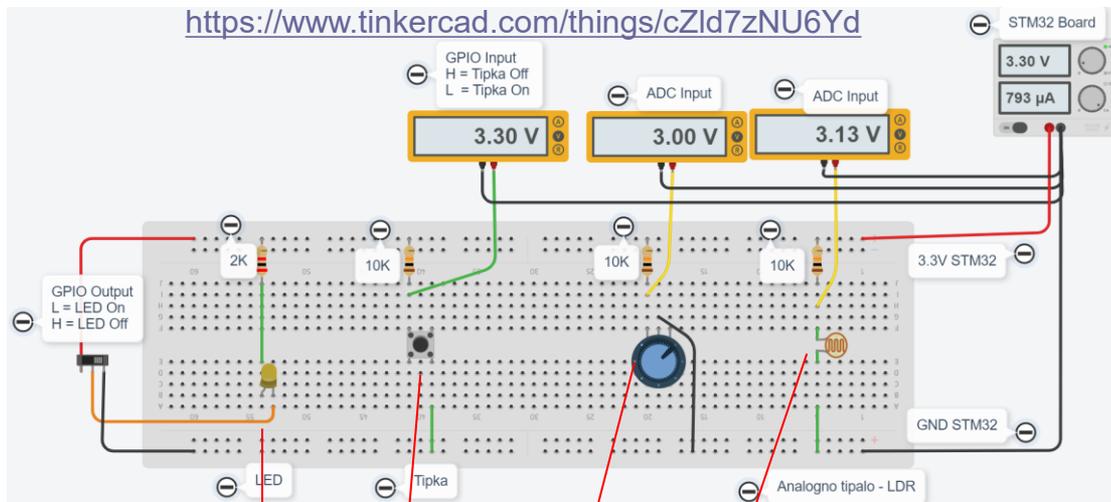
Izhodišče : **VIN LAB Breadboard STM32H7 IO Demo**
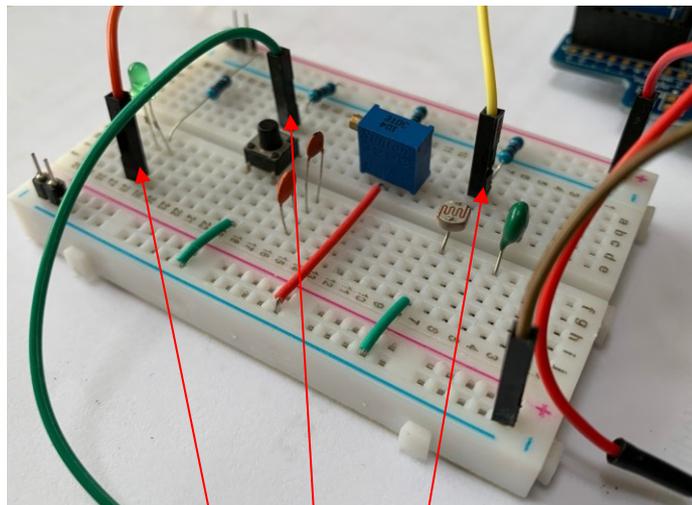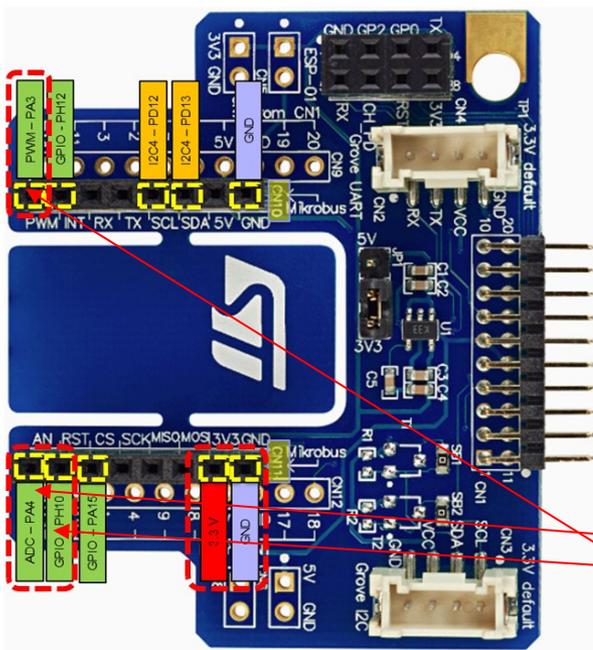
Priključitev na STM32 :   1x analogni, 1x digitalni vhod, 1x digitalni izhod
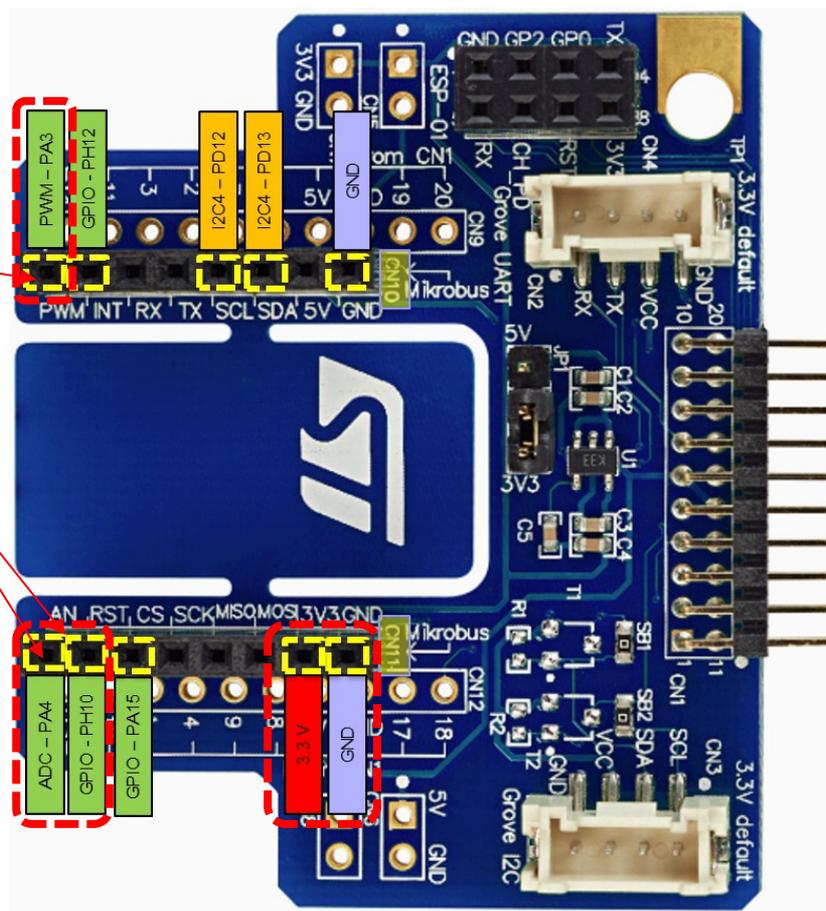
Testno vezje (primer) - STM32H7 :

| GPIO	Vrsta	Povezava
PC13	User tipka	Modra tipka
PA4	Analogni vhod	Rumena žička
PH10	Dig. Vhod	Zelena žička
PA3	Dig. Izhod - LED	Oranžna žička
PJ2,Pi13	Dig. Izhodi	vgr. LED diode

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

Testno vezje (primer) - STM32H7 :

| GPIO	Vrsta	Povezava
PC13	User tipka	Modra tipka
PA4	Analogni vhod	Rumena žička
PH10	Dig. Vhod	Zelena žička
PA3	Dig. Izhod - LED	Oranžna žička
PJ2,Pi13	Dig. Izhodi	vgr. LED diode

STM32H7

Priključitev na STM32 : 1x analogni,
1x digitalni vhod, 1x digitalni izhod

Testno vezje (primer) - STM32H7 :

GPIO	Vrsta	Povezava
PC13	User tipka	Modra tipka
PA4	Analogni vhod	Rumena žička
PH10	Dig. Vhod	Zelena žička
PA3	Dig. Izhod - LED	Oranžna žička
PJ2,Pi13	Dig. Izhodi	vgr. LED diode
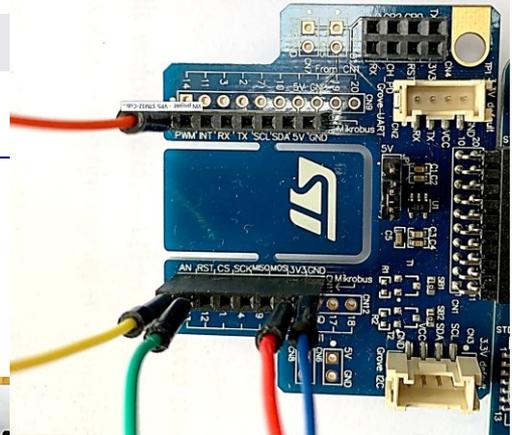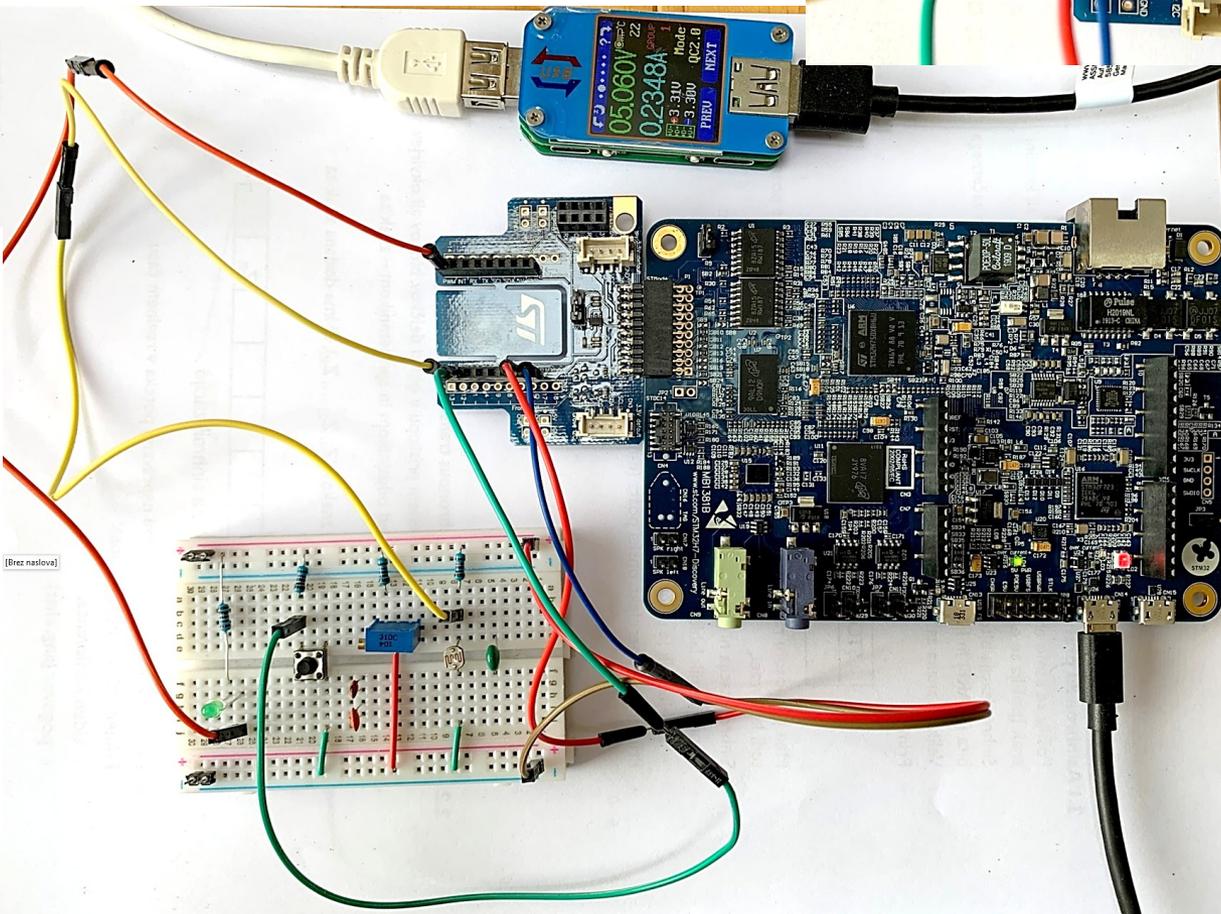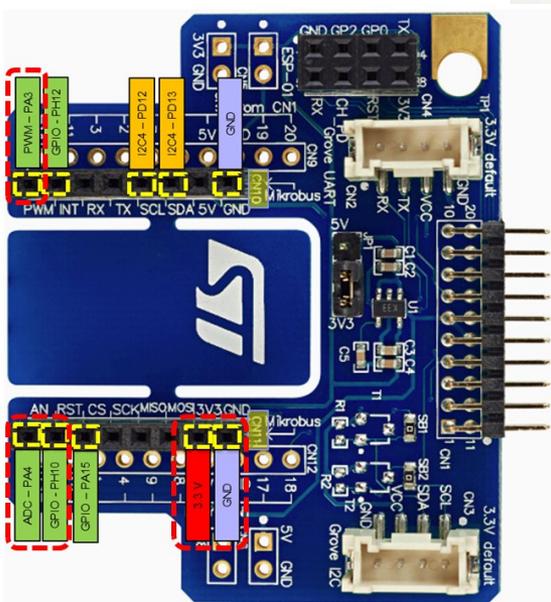
Delo na STM32H7 razvojnem sistemu

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

Poseben začetni projekt (github) in info za *STM32H7* (e-učilnica):
- ***dodajanje vsebine (main.c):***

```
131
132    /* Infinite loop */
133    /* USER CODE BEGIN WHILE */
134    while (1)
135    {
136        HAL_GPIO_TogglePin(GPIOI, GPIO_PIN_13);
137        HAL_GPIO_TogglePin(GPIOJ, GPIO_PIN_2);
138
139      /* USER CODE END WHILE */
140
141      /* USER CODE BEGIN 3 */
142        snprintf (SendBuffer,BUFSIZE,"USART3:%d secs\r\n",Cnt);
143        HAL_UART_Transmit(&huart3,SendBuffer,strlen(SendBuffer),1);
144
145        HAL_Delay(1000);
146        Cnt++;
147    }
148    /* USER CODE END 3 */
149 }
150
```

--------- 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

VIN projekt - VP 5 breadboard vezave

Konfiguracija 2: (PB5 DIG_OUT, PB4 DIG_INP, PA1 ADC1_IN1)

Testno vezje (primer) - STM32H7 :

GPIO	Vrsta	Povezava
PC13	User tipka	Modra tipka
PA4	Analogni vhod	Rumena žička
PH10	Dig. Vhod	Zelena žička
PA3	Dig. Izhod - LED	Oranžna žička
PJ2,Pi13	Dig. Izhodi	vgr. LED diode

Že pripravljen projekt:
https://github.com/LAPSyLAB/STM32H7_Discovery_VIN_Projects/tree/main/STM32H750B-DK_Breadboard_VIN

Program : za branje tipal in pošiljanje po USB Virtual COM Port

```
/* USER CODE BEGIN PV */
#define BUFSIZE 256
char SendBuffer[BUFSIZE];
int Counter;
int KeyState=0;
int AnalogValue;

/* USER CODE END PV */
```

```
/* Infinite loop */
 /* USER CODE BEGIN WHILE */
 while (1)
 {
   HAL_GPIO_TogglePin(GPIOI, GPIO_PIN_13);

   HAL_ADC_Start(&hadc1);
   HAL_ADC_PollForConversion(&hadc1, HAL_MAX_DELAY);
   AnalogValue = HAL_ADC_GetValue(&hadc1);        // Read ADC value on analog input


   KeyState = HAL_GPIO_ReadPin(GPIOH, GPIO_PIN_10);   // Read state of PH10
   HAL_GPIO_WritePin(GPIOA, GPIO_PIN_3, KeyState);    // Write to PA3 accordingly


   snprintf(SendBuffer,BUFSIZE,"Hello World [%d]: Key:%d | ADC:%d\n\r",Counter++,KeyState,AnalogValue);
   HAL_UART_Transmit(&huart3,SendBuffer,strlen(SendBuffer),100);

   HAL_Delay(1000);
   /* USER CODE END WHILE */

   /* USER CODE BEGIN 3 */

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

Testno vezje (primer) - STM32H7 :

GPIO	Vrsta	Povezava
PC13	User tipka	Modra tipka
PA4	Analogni vhod	Rumena žička
PH10	Dig. Vhod	Zelena žička
PA3	Dig. Izhod - LED	Oranžna žička
PJ2,Pi13	Dig. Izhodi	vgr. LED diode

Že pripravljen projekt:
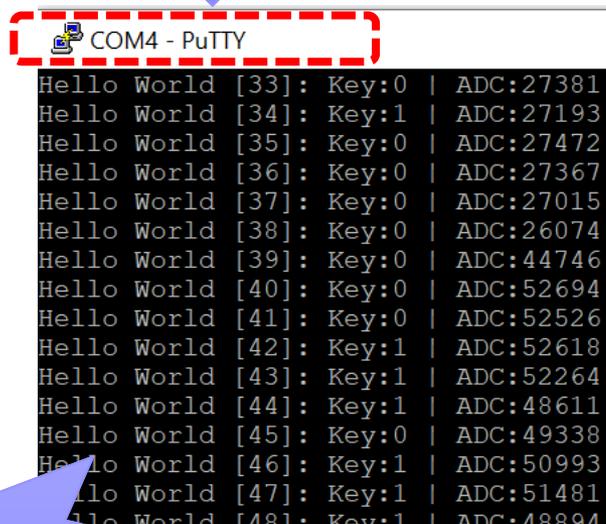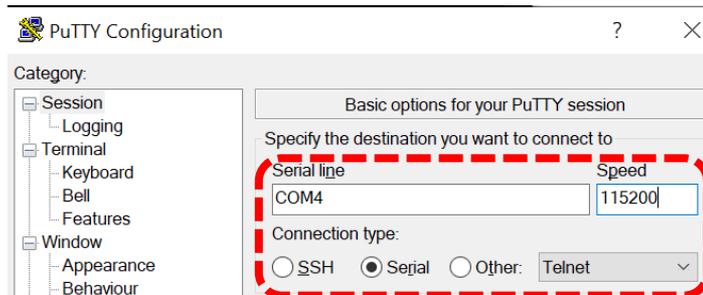https://github.com/LAPSyLAB/STM32H7_Discovery_VIN_Projects/tree/main/STM32H750B-DK_Breadboard_VIN

Osnovni projekt CubeIDE – USB Virtual COM Port (USART3 na STM strani)

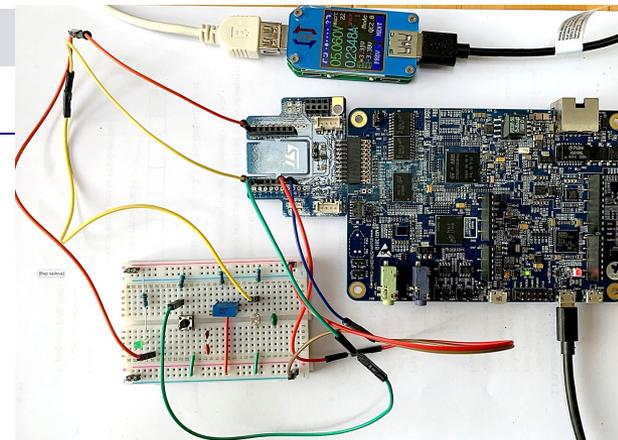Program : sprejem na PC strani (povezava že vzpostavljena z Micro-USB kablom)

https://the.earth.li/~sgtatham/putty/latest/w64/putty.exe
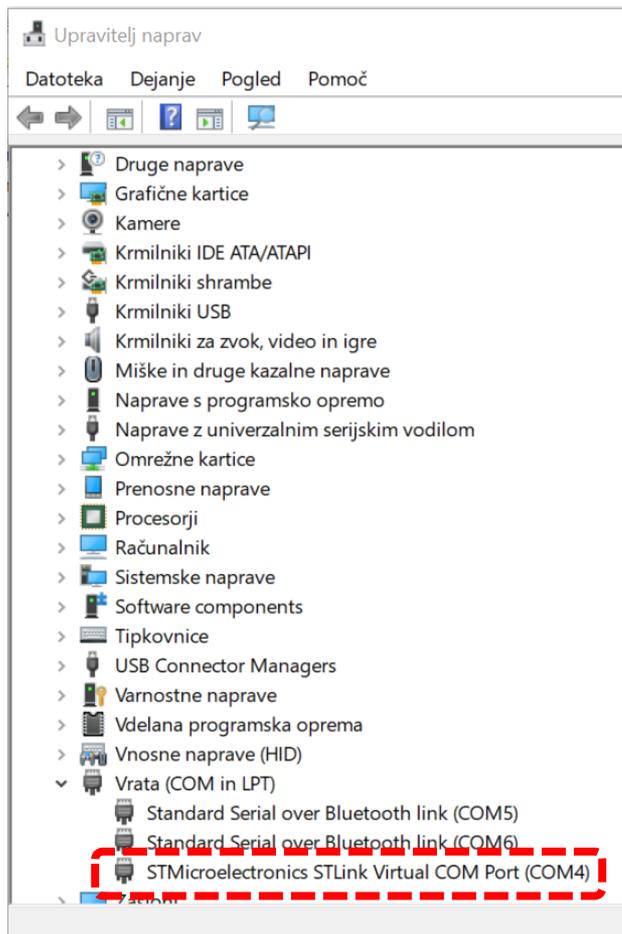
Test serial comm.

Breadboard – DN2-VP4:

- **Spada v sklop poročila DN2 z LAB vaj**
- **Naredite sebi zanimivo rešitev z ustrezno kodo**
- **Objavite v OneNote delovnem zvezku**
  - ☐ **_Prostor za sodelovanje, razdelek DN2-VP4 Breadboard**

| ↺ | Uporaba prostora za sodelovanje | DN1-VI naprave | DN2-VP3 TinkerCad | **DN2-VP4 Breadboard** | + |

Preberi.me

sreda, 16. marec 2022   18:09

Tukaj objavite svoje rešitve naloge:
- Naredite svojo stran z naslovom rešitve
- Par stavkov opisa, slika in izseki kode
- Rešitev shranite v svojem zvezku za vključitev v DN2 poročilo z laboratorijskih vaj (naloga DN2-VP4)

RR