Czech
Technical
University
in Prague

F3

Faculty of Electrical Engineering
Deparment of measurement

Manual for STM32 diagnostic logic probe

Milan Jiříček

Supervisor: doc. Ing. Jan Fischer, CSc.
Study programme: Open Informatics
April 2025

Contents

1 Build **2**

1.1 STM32G030 SOP8 . . . 2

1.2 STM32G030 TSSOP20 . . . 2

2 Local mode **3**

2.0.1 How to enable . . . 3

2.1 Logic probe mode . . . 3

2.2 Logic levels . . . 3

2.3 Generating periodic pulses . . . 4

2.4 Rise edge detection . . . 4

2.5 Falling edge detection . . . 4

3 Terminal mode **5**

3.1 Universal keys . . . 5

3.2 How to enable . . . 5

3.3 PINOUT . . . 6

3.4 MENU . . . 6

3.5 Basic Mode . . . 6

3.5.1 Voltmeter/Ohmmeter . . . 6

3.5.2 Signal detect . . . 8

3.5.3 Signal generator . . . 9

3.6 Advanced Mode . . . 10

3.6.1 SHIFT Register . . . 10

3.6.2 NEOPIXEL . . . 11

3.6.3 UART . . . 11

3.6.4 I2C . . . 12

3.6.5 SPI . . . 13

Section 1

Build

1.1 STM32G030 SOP8

TODO: doplnit podrobnosti

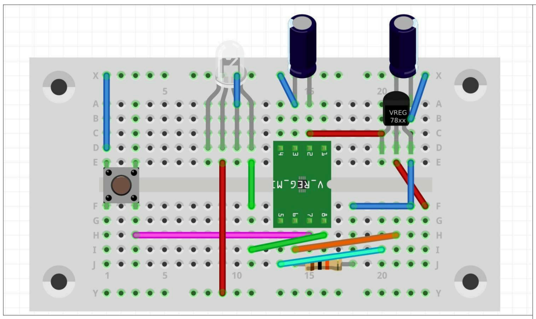


Figure 1: Diagram SOP8 ve Fritzingu

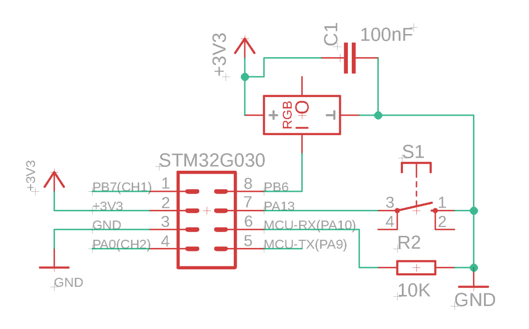


Figure 2: Diagram SOP8

1.2 STM32G030 TSSOP20

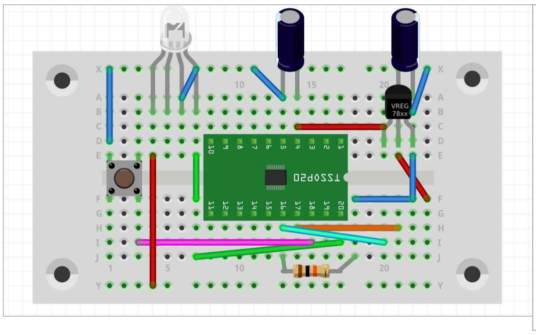


Figure 3: Diagram TSSOP20 ve Fritzingu

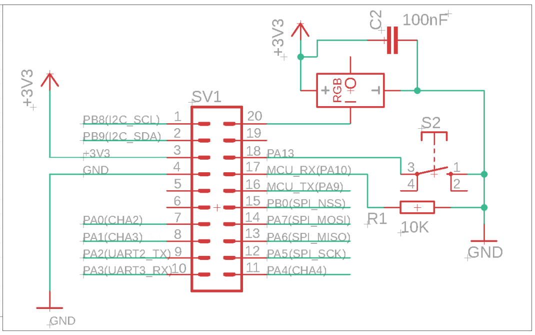


Figure 4: Diagram TSSOP20

Section 2

Local mode

This mode is used to quickly identify the problem without having to connect to a desktop computer. It allows the following actions:

- **analysing circuit by simple logic probe**
- **detecting rise or fall edge**
- **setting logic levels on channels**

By holding the button for a long time (approx. 500 ms) it is possible to switch between modes. The modes are differentiated by RGB LEDs, where the colour of the mode is displayed when the button is released.

2.0.1 How to enable

Local mode is enabled by the user connecting the assembled circuit only to the power supply. This means that the mode is activated when after switching on the device it detects a **logic zero** on the **recieve pin**, which is intended for communication with the computer. When the communication with the computer is connected, the default is logic one.

The activation of the mode can be detected so that when switched on, a sequence of colours on the RGB LEDs is triggered.

2.1 Logic probe mode

- LED Color: AQUA
- Channels are switched with **button press**. After press, LED shows color of the selected channel.
  - Channel 1: PURPLE
  - Channel 2: YELLOW
- LED indicates if state is HIGH by GREEN color, LOW state by RED color, and interstate by led turned off.
- **SOP8** - logic probe can be use on PB7(CH1) and PA0(CH2) pins.

2.2 Logic levels

- LED Color: ORANGE
- Channels are switched with **button double press**. After double press, LED shows color of the selected channel.
  - Channel 1: PURPLE
  - Channel 2: YELLOW
- Logic levels are changed with **button press**. After press, level on channel is toggled. State of the channel is indicated by LED.
- **SOP8** - logic levels can be toggled on PB7(CH1) and PA0(CH2) pins.

2.3 Generating periodic pulses

- LED Color: WHITE
- PA0 is used for generating pulses
- after **button press** generation is turned on, another press generation is turned off. While on LED is WHITE.

2.4 Rise edge detection

- LED Color: BLUE
- PA0 is used for detection of rising edge
- if edge is detected, Green color is indicated. After one second led is turned off.

2.5 Falling edge detection

- LED Color: Purple
- PA0 is used for detection of falling edge
- if edge is detected, Green color is indicated. After one second led is turned off.

Section 3

Terminal mode

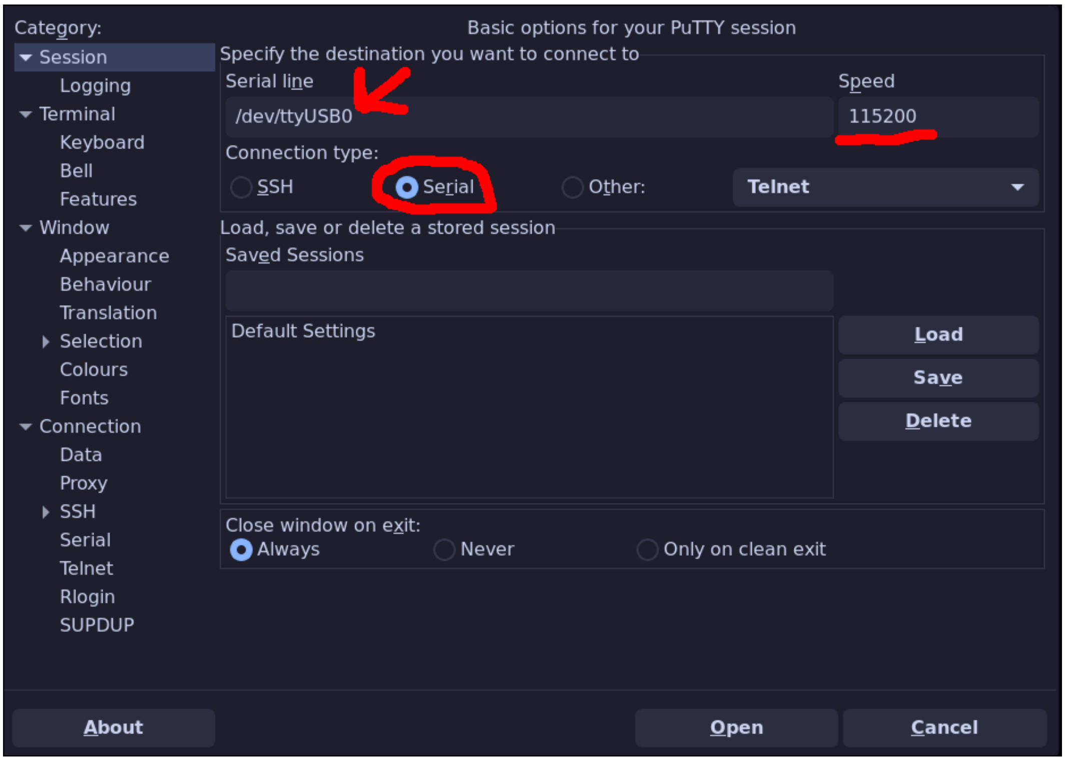
This mode is used for deeper identification of the problem.

3.1 Universal keys

- **[R]** - reload page to fix broken ansi sequences
- **[Q]** - return to menu

3.2 How to enable

Terminal mode is enabled by connecting device through converter. After connecting device to USB, open terminal which supports ANSI sequences. Recommended application is **PUTTY**.



Basic options for your PuTTY session

Specify the destination you want to connect to

Serial line: /dev/ttyUSB0

Speed: 115200

Connection type: ○ SSH ● Serial ○ Other: Telnet

Load, save or delete a stored session

Saved Sessions

Default Settings

Close window on exit: ● Always ○ Never ○ Only on clean exit

Figure 5: Putty settings

Select Serial as connection type. Enter **115200** as Speed of the serial communication and enter correct type of serial line. Usually on linux `/dev/ttyUSB0`.

After connection, press letter `R` on keyboard and menu appear.

3.3 PINOUT

Colors of wires show location of connect devices. If some text is colored, like PA0, that is pin 4(SOP8)/pin 7(TSSOP20).

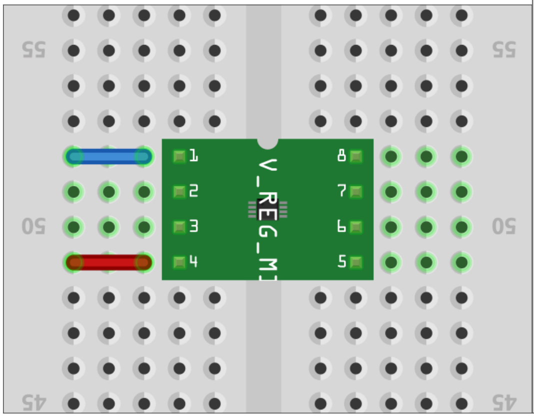


Figure 6: Voltage channels SOP8

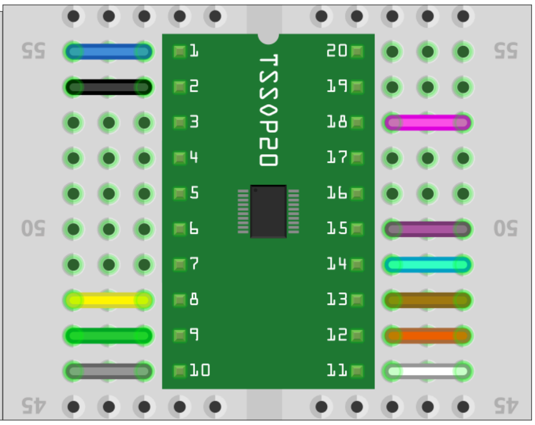
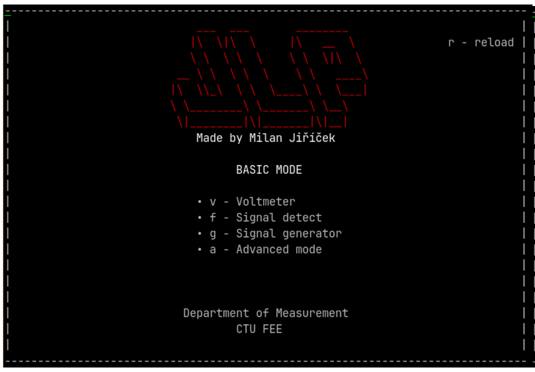


Figure 7: Voltage channels TSSOP20

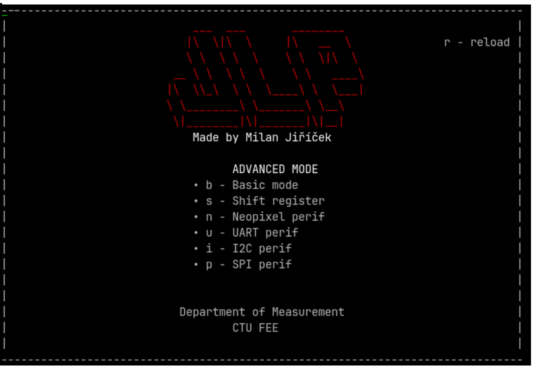
3.4 MENU

The menu is divided into basic functions and advanced functions. In the **SOP8** version only the basic function is available. By pressing letter on keyboard written next to name, function can be selected.



```
                                            r - reload

        Made by Milan Jiříček

             BASIC MODE

        • v - Voltmeter
        • f - Signal detect
        • g - Signal generator
        • a - Advanced mode


      Department of Measurement
              CTU FEE
```

Figure 8: Basic menu



```
                                            r - reload

        Made by Milan Jiříček

            ADVANCED MODE
        • b - Basic mode
        • s - Shift register
        • n - Neopixel perif
        • u - UART perif
        • i - I2C perif
        • p - SPI perif

      Department of Measurement
              CTU FEE
```

Figure 9: Advanced menu

3.5 Basic Mode

3.5.1 Voltmeter/Ohmmeter

Voltmeter

Voltmeter shows different channels. Versions differs in the number of channels. Page shows **Reference voltage**, which is used for calibrating channel voltage.

- In paranthesses is shown which pin is used as channel.

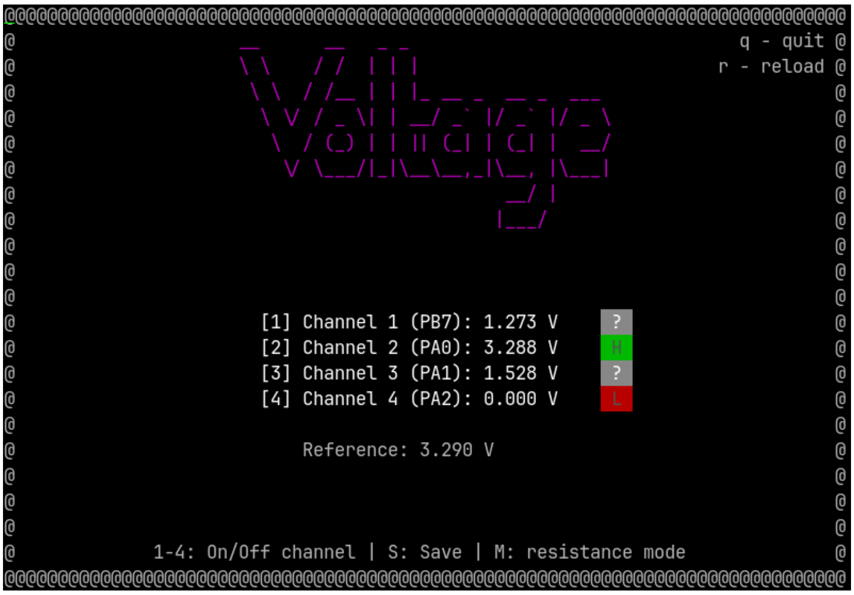
- **[1-4]** - Toggle channel on or off
- **[S]** - Apply settings of toggling channels
- **[M]** - switch between Voltmeter and ohmmeter

Red arrow points to the logic level of voltage.

- If shows **H**, channel is in high level
- If shows **L**, channel is in low level
- If shows **?**, channel is in interstate

If channel has **x** instead of value, it is turned off. To turn off or turn on the channel, it is nesessary to press key of the number.

Example: For turn off the channel 1 press **1** on the keyboard and then **S** for saving the value.



```
                                                    q - quit
                                                  r - reload

          [1] Channel 1 (PB7): 1.273 V     ?
          [2] Channel 2 (PA0): 3.288 V     H
          [3] Channel 3 (PA1): 1.528 V     ?
          [4] Channel 4 (PA2): 0.000 V     L

                 Reference: 3.290 V

      1-4: On/Off channel | S: Save | M: resistance mode
```

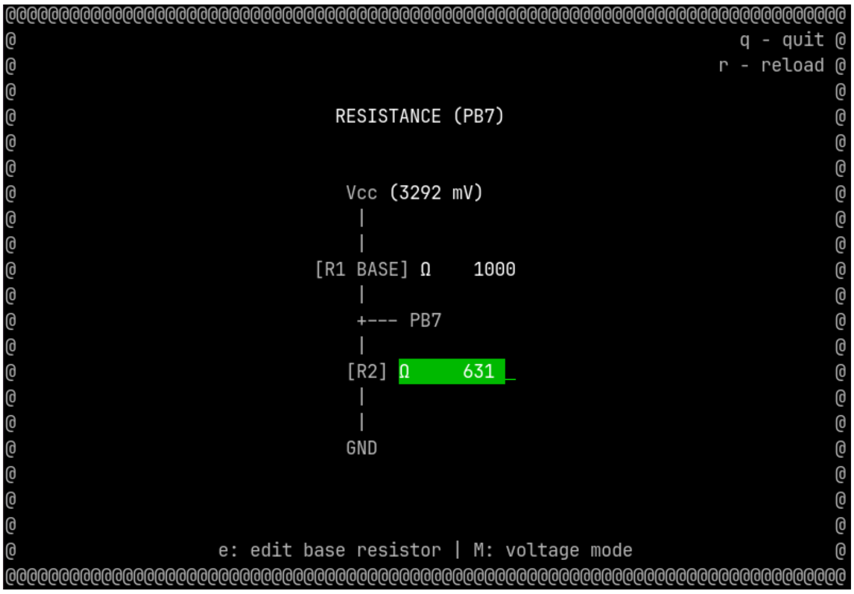
Figure 10: Voltmeter page

Figure 6 and Figure 7 shows, which pins are used for channels. SOP8 has channel 1(PB7) and channel 2(PA0), but TSSOP20 has also channel 3(PA1) and channel 4(PA2).

Ohmmeter

By pressing **M**, in mode is changed to **Ohmmeter mode**. Ohmmeter page, illustrate, how to connect resistor to measure Ohms. Next to **Vdd** is showed, what reference voltage is used. R1 resistor is based. this resistor can be changed by pressing **E**. Value can be entered with number keys and delete with **X**. In green field is calculated value of measured resistor. Resistance is measured on Channel 1(PB7).

- **[E]** - edit base resistor and exit edit mode
- **[0-9]** - changing value
- **[X]** - delete number
- **[M]** - change mode to voltmeter



```
                                                              q - quit
                                                            r - reload

                         RESISTANCE (PB7)


                          Vcc (3292 mV)
                            |
                            |
                       [R1 BASE] Ω    1000
                            |
                            +--- PB7
                            |
                          [R2] Ω      631 _
                            |
                            |
                          GND




                e: edit base resistor | M: voltage mode
```

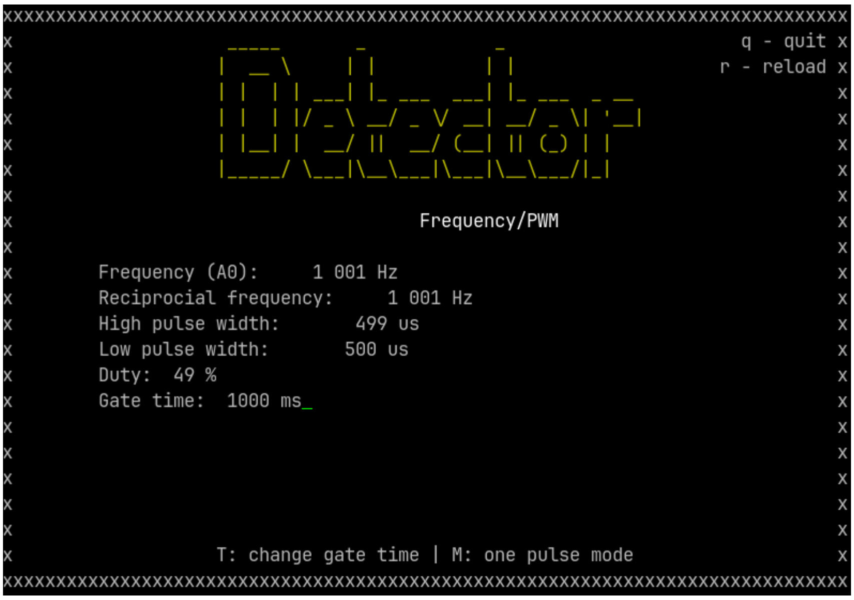
Figure 11: Ohmmeter page

3.5.2 Signal detect

Frequency

Frequency is measured on pin PA0. Device can measure, frequency, reciprocial frequency[1], width of pulse and duty time. By key **T**, user can change gate time.

- **[T]** - change gate time
- **[M]** - change mode



```
                 _____       _            _                   q - quit
                |  __ \     | |          | |                r - reload
                | |  | | ___| |_ ___  ___| |_ ___  _ __
                | |  | |/ _ \ __/ _ \/ __| __/ _ \| '__|
                | |__| |  __/ ||  __/ (__| || (_) | |
                |_____/ \___|\__\___|\___|\__\___/|_|


                                Frequency/PWM

       Frequency (A0):     1 001 Hz
       Reciprocial frequency:     1 001 Hz
       High pulse width:       499 us
       Low pulse width:       500 us
       Duty:  49 %
       Gate time:  1000 ms_






                T: change gate time | M: one pulse mode
```

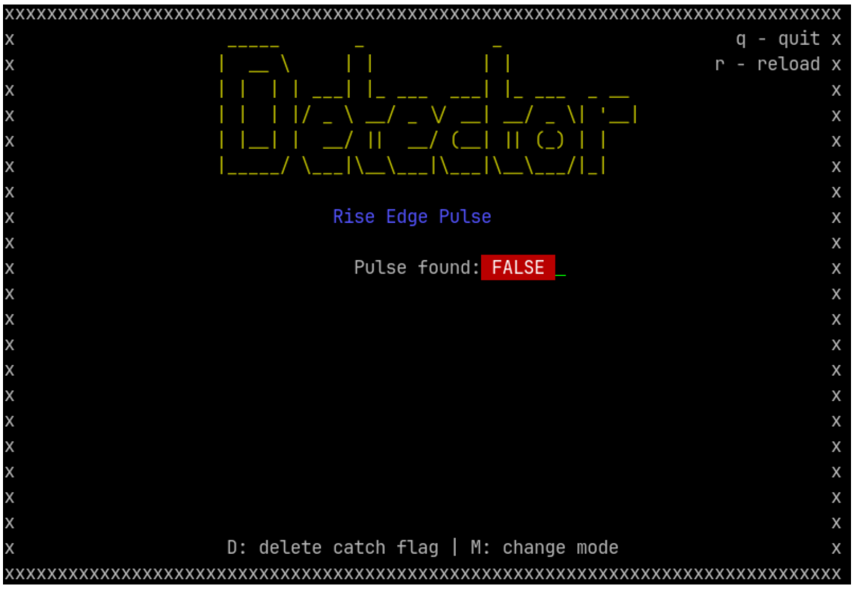
Figure 12: Frequency page

[1] Frequency and reciprocial frequency difference is in way of calculating.

3.5.2.1.1 Pulse

Pressing **M** will change mode to pulse up or down mode. Pulse up will catch rising edge and pulse down will catch falling edge. If edge is catched, Flag will be changed to TRUE. To delete flag, press **D**. Pulse is catched on PA0.

- **[D]** - delete flag of catched signal
- **[M]** - change mode



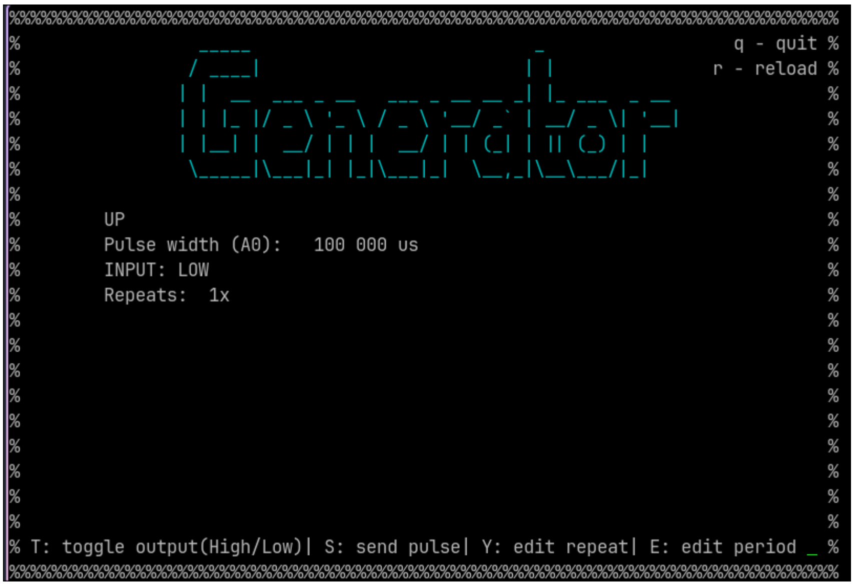
```
                                                    q - quit
  ____       _            _                       r - reload
 |  _ \  ___| |_ ___  ___| |_ ___  _ __
 | | | |/ _ \ __/ _ \/ __| __/ _ \| '__|
 | |_| |  __/ ||  __/ (__| || (_) | |
 |____/ \___|\__\___|\___|\__\___/|_|

                Rise Edge Pulse

                  Pulse found: FALSE _

       D: delete catch flag | M: change mode
```

Figure 13: Pulse page

3.5.3 Signal generator

- **[E]** - edit pulse width or end edit mode
- **[Y]** - edit repeat count or end edit mode
- **[T]** - toggle mode from pulse up to pulse down
- **[S]** - send signal
- **[1-9]** - change pulse width
- **[X]** - delete pulse width number

On PA0 pin can be send signal with specific pulse width. Width can be edited by **E**. There are two modes. When pulse up is choosed, default pin setup is **LOW LEVEL**. When signal is sent **HIGH LEVEL** is set for specified time. When pulse down is choosed, default pin setup is **HIGH LEVEL** and when signal is sent **LOW LEVEL** is set for specific time. By changing repeat counter, user can generate signal x times.



```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%                  ____                           _                   q - quit %
%                 / ___| ___ _ __   ___ _ __ __ _| |_ ___  _ __     r - reload %
%                | |  _ / _ \ '_ \ / _ \ '__/ _` | __/ _ \| '__|               %
%                | |_| |  __/ | | |  __/ | | (_| | || (_) | |                  %
%                 \____|\___|_| |_|\___|_|  \__,_|\__\___/|_|                  %
%                                                                              %
%        UP                                                                    %
%        Pulse width (A0):   100 000 us                                        %
%        INPUT: LOW                                                            %
%        Repeats:  1x                                                          %
%                                                                              %
%                                                                              %
%                                                                              %
%                                                                              %
%                                                                              %
%                                                                              %
%                                                                              %
%                                                                              %
%                                                                              %
% T: toggle output(High/Low)| S: send pulse| Y: edit repeat| E: edit period _ %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Figure 14: Generate signal page

3.6 Advanced Mode

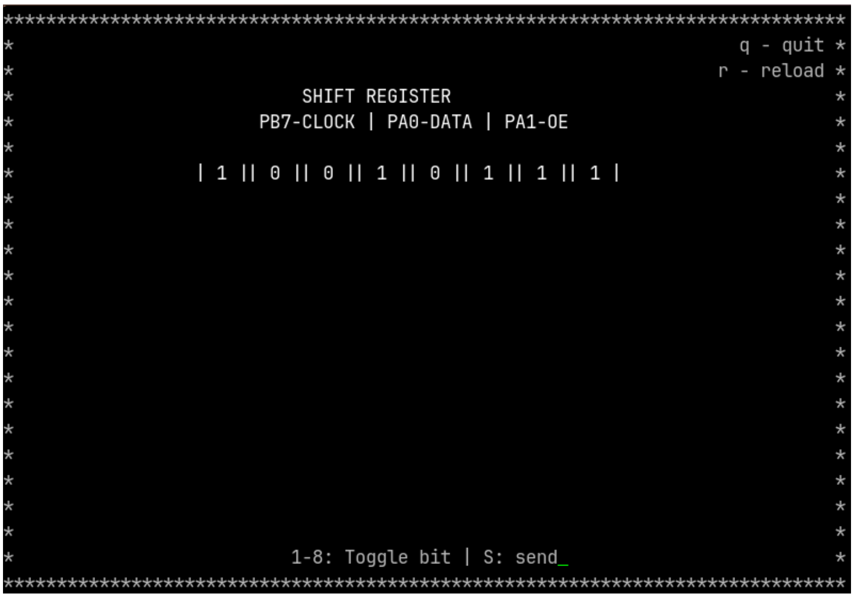
This function is only on **TSSOP20**!

3.6.1 SHIFT Register

Pin PA0 is used for send data and pin PB7 is used as clock signal. In case of **74HC595** pin PA1 is used as Output enable.

User can change sequence for shift register which will be sent.

- **[1-8]** - Toggle 1 or 0 on specified position
- **[S]** - send sequence



```
*******************************************************************************
*                                                                    q - quit *
*                                                                  r - reload *
*                             SHIFT REGISTER                                  *
*                    PB7-CLOCK | PA0-DATA | PA1-OE                            *
*                                                                             *
*                 | 1 || 0 || 0 || 1 || 0 || 1 || 1 || 1 |                   *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                       1-8: Toggle bit | S: send_                            *
*******************************************************************************
```

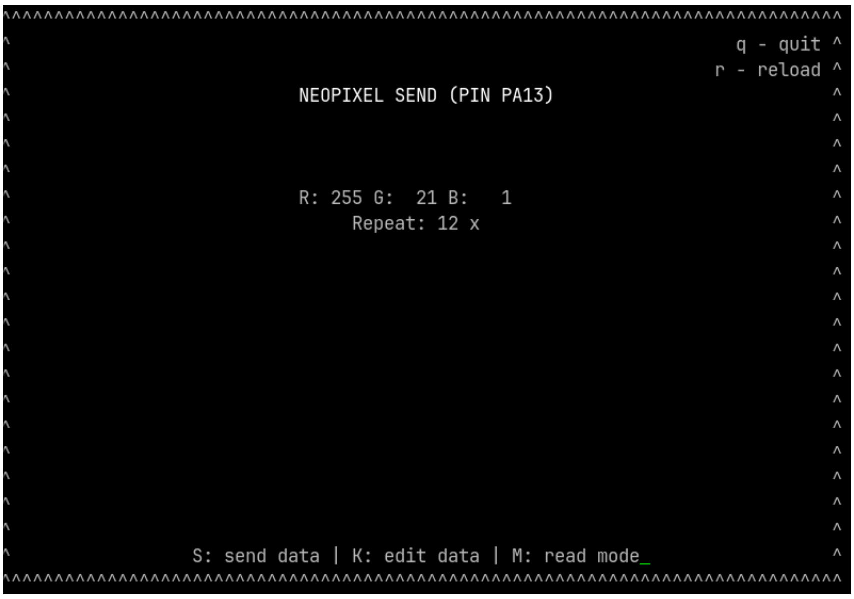
Figure 15: Neopixel page

3.6.2 NEOPIXEL

Neopixel perif, can be read or wrote. Modes can be changed by pressing **M**. Neopixel is read on pin PA0. When signal is detected. Value is showed on the display. Data can be send to Neopixel by pin PA13.

On write, user can choose color from 0 to 255 for every color element. By pressing **S** selected signal will be sent.

- **[0-9]** - Change value
- **[X]** - Delete value
- **[M]** - Change mode
- **[K]** - Edit values
- **[L]** - Move cursor
- **[S]** - Send neopixel data



```
                                                   q - quit
                                                 r - reload
                 NEOPIXEL SEND (PIN PA13)



                 R: 255 G:  21 B:   1
                     Repeat: 12 x













       S: send data | K: edit data | M: read mode_
```

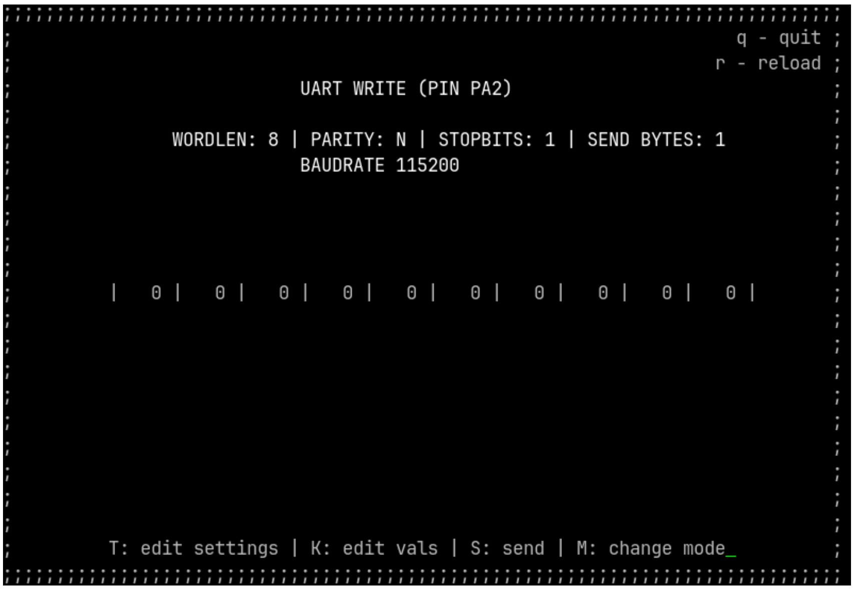
Figure 16: Neopixel page

3.6.3 UART

UART peripheral, can be read and write. Modes can be changed by pressing **M**. MCU TX and MCU RX is connected to PA2 and PA3. Read mode shows letters which are accepted. Write mode has 10 bytes and parameter `SEND BYTES` set how many bytes are sent. In settings mode, user can change word length, parity, number of stopbits and baudrate. In value mode and settings mode can be edit by numkeys and letter `X`. By pressing **S** selected signal will be sent.

- **[0-9]** - Change value
- **[X]** - Delete value
- **[M]** - Change mode
- **[K]** - Edit values
- **[L]** - Move cursor
- **[S]** - Send data

- **[T]** - Edit settings
- **[O]** - Count bytes to send
- **[Y]** - Word length
- **[U]** - Switch between parity
- **[I]** - Number of stopbit



```
                                                          q - quit
                                                        r - reload
                      UART WRITE (PIN PA2)

            WORDLEN: 8 | PARITY: N | STOPBITS: 1 | SEND BYTES: 1
                      BAUDRATE 115200




        |  0 |  0 |  0 |  0 |  0 |  0 |  0 |  0 |  0 |  0 |




        T: edit settings | K: edit vals | S: send | M: change mode_
```

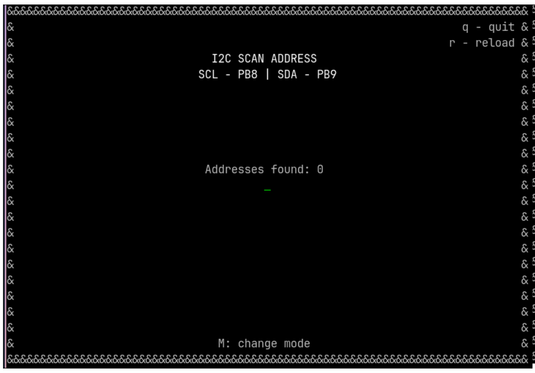
Figure 17: UART page

3.6.4 I2C

I2C peripheral can be read and write. Modes can be changed by pressing **M**. SCL use PB8 and SDA use PB9.

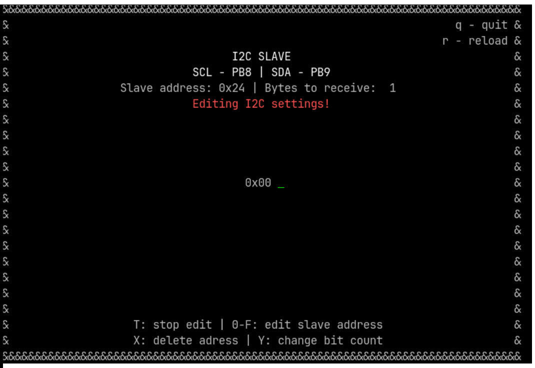
First mode is address scan, where probe shows, which adress on I2C is active. Second mode is slave mode, where probe is behaving as slave. User can set I2C address of the slave. Third mode is master mode, where probe is behaving as master. To selected adress, probe send entered data by user. Fourth mode is testing **SSD1306** display, where after pressing **S**, display set all pixels active.

- **[0-F]** - Change hex value
- **[X]** - Delete value
- **[M]** - Change mode
- **[K]** - Edit values
- **[L]** - Move cursor
- **[S]** - Send data
- **[T]** - Edit settings
- **[Y]** - Change bytes to send
- **[U]** - Switch read write



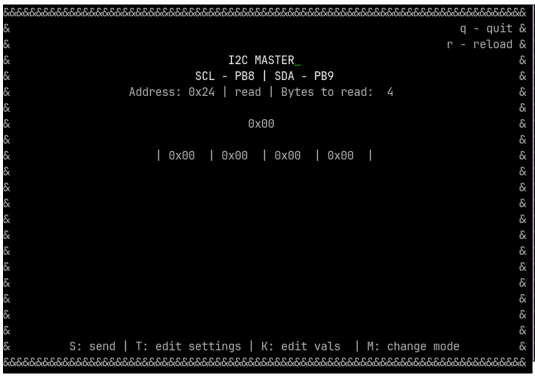
```
                                                     q - quit
                                                   r - reload
                    I2C SCAN ADDRESS
                  SCL - PB8 | SDA - PB9






                   Addresses found: 0
                           _










                     M: change mode
```

Figure 18: I2C Scan address page



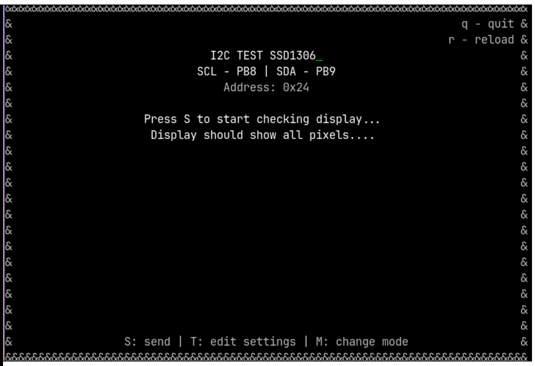
```
                                                     q - quit
                                                   r - reload
                         I2C SLAVE
                   SCL - PB8 | SDA - PB9
        Slave address: 0x24 | Bytes to receive:  1
                  Editing I2C settings!





                         0x00 _










           T: stop edit | 0-F: edit slave address
           X: delete adress | Y: change bit count
```

Figure 19: I2C Slave page



```
                                                     q - quit
                                                   r - reload
                       I2C MASTER_
                  SCL - PB8 | SDA - PB9
         Address: 0x24 | read | Bytes to read:  4

                          0x00

             | 0x00  | 0x00  | 0x00  | 0x00  |














     S: send | T: edit settings | K: edit vals  | M: change mode
```

Figure 20: I2C Master page



```
                                                     q - quit
                                                   r - reload
                     I2C TEST SSD1306_
                   SCL - PB8 | SDA - PB9
                      Address: 0x24

              Press S to start checking display...
               Display should show all pixels....














           S: send | T: edit settings | M: change mode
```

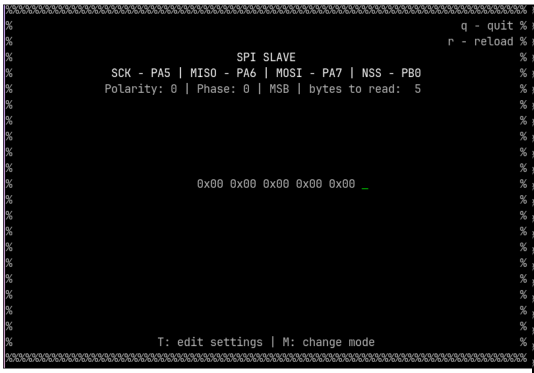
Figure 21: I2C display testing page

3.6.5 SPI

SPI peripheral can be read and write. Modes can be changed by pressing **M**. SCK use PA5, MISO use PA6, MOSI use PA7 a NSS use PB0.

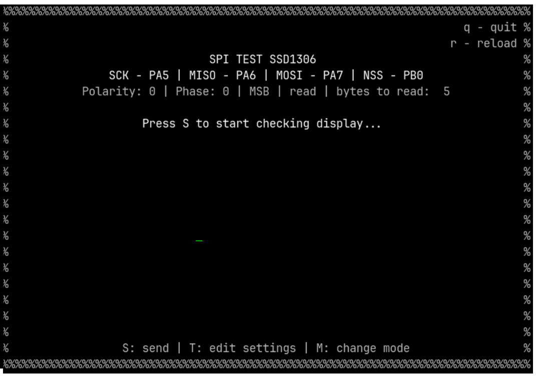
First mode is slave mode, where probe is behaving as slave. second mode is master mode, where probe is behaving as master. Fourth mode is testing **SSD1306** display, where after pressing **S**, display set all pixels active.

- **[0-F]** - Change hex value
- **[X]** - Delete value
- **[M]** - Change mode
- **[K]** - Edit values
- **[L]** - Move cursor
- **[S]** - Send data
- **[T]** - Edit settings
- **[Y]** - Switch Phase
- **[U]** - switch Polarity
- **[P]** - read/write
- **[I]** - Change bytes to send



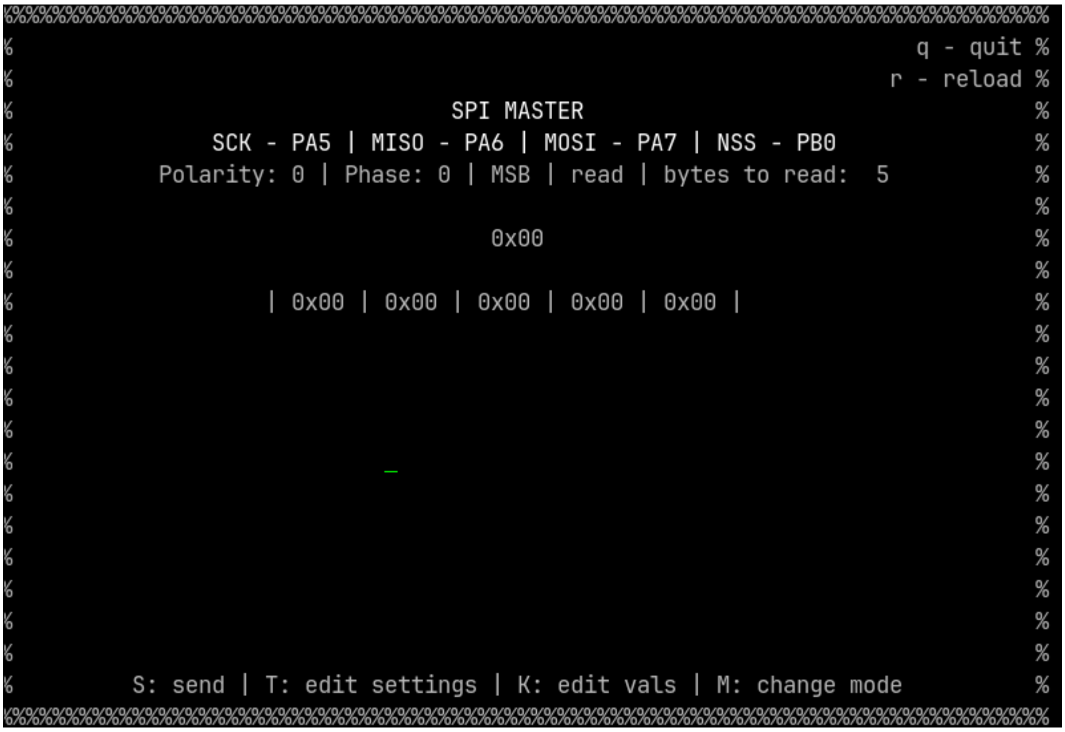
```
                                                    q - quit %
                                                  r - reload %
                        SPI SLAVE
      SCK - PA5 | MISO - PA6 | MOSI - PA7 | NSS - PB0
    Polarity: 0 | Phase: 0 | MSB | bytes to read:  5


                0x00 0x00 0x00 0x00 0x00 _


              T: edit settings | M: change mode
```

Figure 22: SPI Slave page



```
                                                    q - quit %
                                                  r - reload %
                      SPI TEST SSD1306
      SCK - PA5 | MISO - PA6 | MOSI - PA7 | NSS - PB0
 Polarity: 0 | Phase: 0 | MSB | read | bytes to read:  5

            Press S to start checking display...


                      _


       S: send | T: edit settings | M: change mode
```

Figure 23: SPI Display test page



```
                                                    q - quit %
                                                  r - reload %
                         SPI MASTER
          SCK - PA5 | MISO - PA6 | MOSI - PA7 | NSS - PB0
    Polarity: 0 | Phase: 0 | MSB | read | bytes to read:  5

                            0x00

            | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 |


                     _


   S: send | T: edit settings | K: edit vals | M: change mode
```

Figure 24: SPI Master page