GPIO HAL

```
HAL_GPIO_WritePin(XXX_GPIO_Port, XXX_Pin, GPIO_PIN_(RE)SET);
HAL_GPIO_ReadPin (XXX_GPIO_Port, XXX_Pin);
HAL_GPIO_TogglePin(XXX_GPIO_Port, XXX_Pin);
HAL_Delay(1000);
void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin) // Enable interrupt EXTI in NVIC
{
        if (GPIO_Pin == B1_Pin)
        { }
}
```

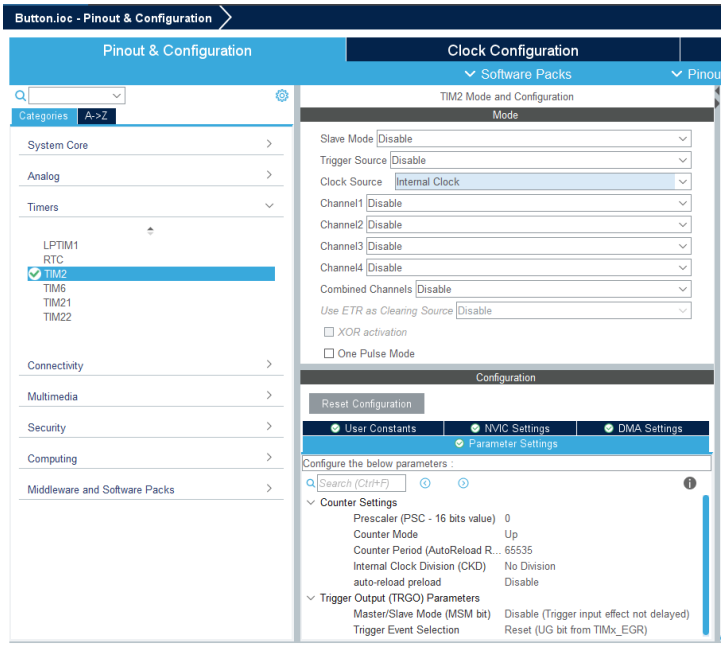
HAL/SysTick

```
#define DELAY_1s 1000
 static uint16_t delay = 0;
if (HAL_GetTick() > delay + DELAY_1s)
{
delay = HAL_GetTick();
}
```

Timers

In main while without interupt

```
HAL_TIM_Base_Start(&htim2);
if (__HAL_TIM_GET_FLAG(&htim2, TIM_FLAG_UPDATE) != RESET)
{
 __HAL_TIM_CLEAR_FLAG(&htim2, TIM_FLAG_UPDATE);
HAL_GPIO_TogglePin(GPIOA, GPIO_PIN_5);
}
```



As interupt

```
HAL_TIM_Base_Start_IT(&htim2);
void HAL_TIM_PeriodElapsedCallback(TIM_HandleTypeDef
*htim)
{
 if (htim->Instance == TIM2)
 { }
}
```

ADC convertors

Project-Properties-C/C++Build-Settings-Linker Misc-other flags: -u _printf_float

```
float adc_value = 0.0f;
float volt_value = 0.0f;
HAL_ADC_Start(&hadc);
if (HAL_ADC_PollForConversion(&hadc, 10) == HAL_OK)
{
uint32_t value = HAL_ADC_GetValue(&hadc);
}
```

DAC convertors

```
HAL_DAC_Start(&hdac, DAC_CHANNEL_1);
HAL_DAC_SetValue(&hdac, DAC_CHANNEL_1, DAC_ALIGN_12B_R, 4095);
```

UART communication with DMA

Project-Properties-C/C++Build-Settings-Linker Misc-other flags: -u _printf_float

DMA: USART2_RX Circular mode

```
#include <string.h>
#include <stdio.h>
#define RX_BUFFER_LEN 64
#define CMD_BUFFER_LEN 256
static uint8_t uart_rx_buf[RX_BUFFER_LEN];
static volatile uint16_t uart_rx_read_ptr = 0;
#define uart_rx_write_ptr (RX_BUFFER_LEN - hdma_usart2_rx.Instance->CNDTR)
char msg[30];
static void uart_process_command(char *cmd) {
        char *token;
        token = strtok(cmd, " ");
        if (strcasecmp(token, "GetData") == 0) {
                sprintf(msg, "%.3f\r\n", 3.3);
                HAL_UART_Transmit(&huart2, (uint8_t*) msg, strlen(msg), HAL_MAX_DELAY);
        }
}
static void uart_byte_available(uint8_t c) {
        static uint16_t cnt;
        static char data[CMD_BUFFER_LEN];
```

```
        if (cnt < CMD_BUFFER_LEN && c >= 32 && c <= 126)
                data[cnt++] = c;
        if ((c == '\n' || c == '\r') && cnt > 0) {
                data[cnt] = '\0';
                uart_process_command(data);
                cnt = 0;
        }
}
HAL_UART_Receive_DMA(&huart2, uart_rx_buf, RX_BUFFER_LEN);
while (uart_rx_read_ptr != uart_rx_write_ptr) {
                        uint8_t b = uart_rx_buf[uart_rx_read_ptr];
                        if (++uart_rx_read_ptr >= RX_BUFFER_LEN)
                                uart_rx_read_ptr = 0; // increase read pointer
                        uart_byte_available(b); // process every received byte with the RX state machine
                }
```

Python serial communication

```
import serial
PORT = "COM4"
BAUDRATE = 115200
ser = serial.Serial(PORT, BAUDRATE, timeout=1)
message = "GetData\r\n"
ser.write(message.encode())

line = ser.readline().decode(errors="ignore").strip()
adc_val = float(line)
print(f"Přijatá hodnota ADC: {adc_val} V")
ser.close()
```

SPI communication

```
uint8_t txData[] = "Hello"; uint8_t rxData[6];
HAL_SPI_Transmit(&hspi1, XXX, sizeof(XXX), HAL_MAX_DELAY)
HAL_SPI_Receive(&hspi1, XXX, sizeof(XXX), HAL_MAX_DELAY)
HAL_SPI_TransmitReceive (&hspi1, XXX, XXX, sizeof(XXX), HAL_MAX_DELAY)
if (strcmp((char*)rxData, "Hello") == 0) { }
```

uint8_t txData = 0x0B; uint8_t rxData;

HAL_SPI_Transmit(&hspi1, &XXX, 1, HAL_MAX_DELAY)

HAL_SPI_Receive(&hspi1, &XXX, 1, HAL_MAX_DELAY)

HAL_SPI_TransmitReceive (&hspi1, &XXX, &XXX, 1, HAL_MAX_DELAY)

if (rxData[0] == 0x00) { }

void HAL_SPI_(Tx)(RX)(TxRx)CpltCallback(SPI_HandleTypeDef * hspi){ }

I2C communication with EEPROM

HAL_I2C_Master_Transmit (&hi2c1, Address, Data, Size, HAL_MAX_DELAY);

HAL_I2C_Master_Recieve (&hi2c1, Address, Data, Size, HAL_MAX_DELAY);

HAL_I2C_Slave_Transmit (&hi2c1, Data, Size, HAL_MAX_DELAY);

HAL_I2C_Slave_Recieve (&hi2c1, Data, Size, HAL_MAX_DELAY);

#define EEPROM_ADDR 0xA0

HAL_I2C_Mem_Write (&hi2c1, EEPROM_ADDR, MemAddress, I2C_MEMADD_SIZE_16BIT, Data, Size, HAL_MAX_DELAY);

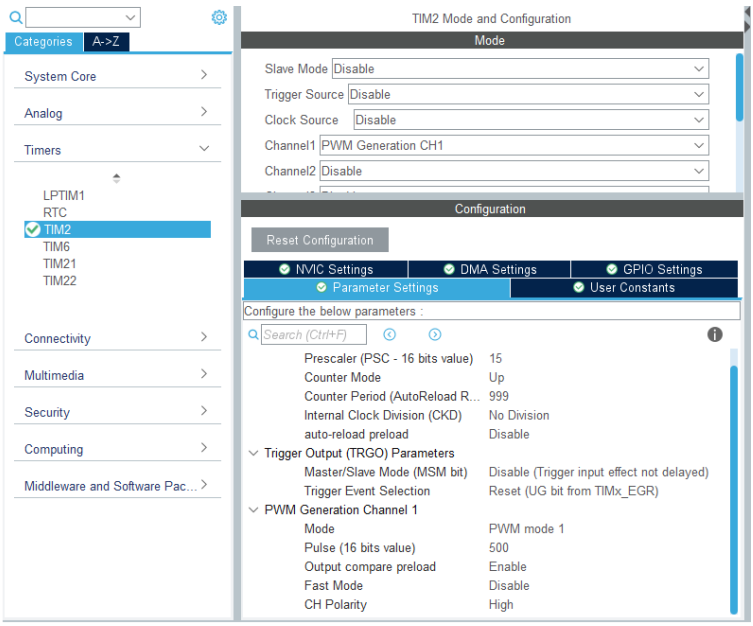
HAL_I2C_Mem_Read (&hi2c1, EEPROM_ADDR, MemAddress, I2C_MEMADD_SIZE_16BIT, Data, Size, HAL_MAX_DELAY);

while (HAL_I2C_IsDeviceReady(&hi2c1, EEPROM_ADDR, 300, 1000) == HAL_TIMEOUT) {}

PWM

HAL_TIM_PWM_Start(&htim2, TIM_CHANNEL_1);

__HAL_TIM_SET_COMPARE(&htim2, TIM_CHANNEL_1, 250);



8-seg LED display

```
#include <stdio.h>
#include <math.h>
static const uint32_t reg_values[10] = {};
void sct_led(uint8_t address, uint8_t data) {
   uint8_t tx[2] = {address, data};
   HAL_GPIO_WritePin(CS_PORT, CS_PIN, GPIO_PIN_RESET);
   HAL_SPI_Transmit(&hspi1, tx, 2, HAL_MAX_DELAY);
   HAL_GPIO_WritePin(CS_PORT, CS_PIN, GPIO_PIN_SET);
}
void sct_value(uint32_t value) {
        uint8_t reg = 0;
        for (uint8_t i = 0; i < 8; i++) {
                reg = reg_values[(value / (int)pow(10, i)) % 10];
```

```
            sct_led(i+1, reg);
        }
}
```

Rotary encoder

TIM: Combined Channels – Encoder mode (Polarity: CH1 – Falling Edge, CH2 – Rising Edge, Counter Period)

```
HAL_TIM_Encoder_Start(&htim2, htim2.Channel);
__HAL_TIM_GET_COUNTER(&htim2);
```

Matrix keyboard

Row1-4: GPIO Output Open Drain

Col1-4: GPIO Input Pull-up

```
static volatile int key = -1;
static const uint32_t code[5] = {7,9,3,2,12};
uint32_t position = 0;
if (key != -1) {
  if (key == code[position] && position == 0){
  position = 1;
  }
}
void HAL_TIM_PeriodElapsedCallback(TIM_HandleTypeDef *htim) {
        static int row = 0;
        static const int keyboard[4][4] = {
                { 1, 2, 3, 21 },
                { 4, 5, 6, 22 },
                { 7, 8, 9, 23 },
                { 11, 0, 12, 24 },
        };
        if (key == -1) {
            if (HAL_GPIO_ReadPin(Col1_GPIO_Port, Col1_Pin) == GPIO_PIN_RESET)
                key = keyboard[row][0];
            if (HAL_GPIO_ReadPin(Col2_GPIO_Port, Col2_Pin) == GPIO_PIN_RESET)
                key = keyboard[row][1];
            if (HAL_GPIO_ReadPin(Col3_GPIO_Port, Col3_Pin) == GPIO_PIN_RESET)
                key = keyboard[row][2];
            if (HAL_GPIO_ReadPin(Col4_GPIO_Port, Col4_Pin) == GPIO_PIN_RESET)
```

```
                key = keyboard[row][3];
        }
        HAL_GPIO_WritePin(Row1_GPIO_Port, Row1_Pin, GPIO_PIN_SET);
        HAL_GPIO_WritePin(Row2_GPIO_Port, Row2_Pin, GPIO_PIN_SET);
        HAL_GPIO_WritePin(Row3_GPIO_Port, Row3_Pin, GPIO_PIN_SET);
        HAL_GPIO_WritePin(Row4_GPIO_Port, Row4_Pin, GPIO_PIN_SET);
        switch (row) {
        case 0:
                row = 1;
                HAL_GPIO_WritePin(Row2_GPIO_Port, Row2_Pin, GPIO_PIN_RESET);
                break;
        case 1:
                row = 2;
                HAL_GPIO_WritePin(Row3_GPIO_Port, Row3_Pin, GPIO_PIN_RESET);
                break;
        case 2:
                row = 3;
                HAL_GPIO_WritePin(Row4_GPIO_Port, Row4_Pin, GPIO_PIN_RESET);
                break;
        case 3:
                row = 0;
                HAL_GPIO_WritePin(Row1_GPIO_Port, Row1_Pin, GPIO_PIN_RESET);
                break;
        }
}
```