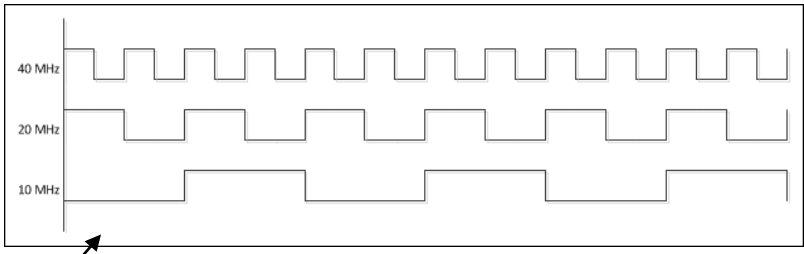
STM32H7

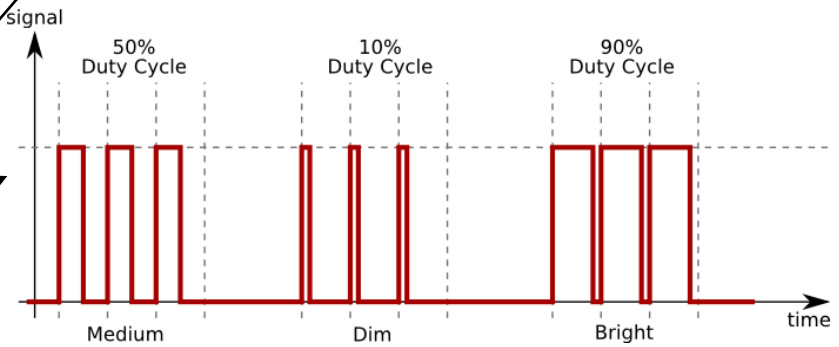
Vhodno / izhodne naprave

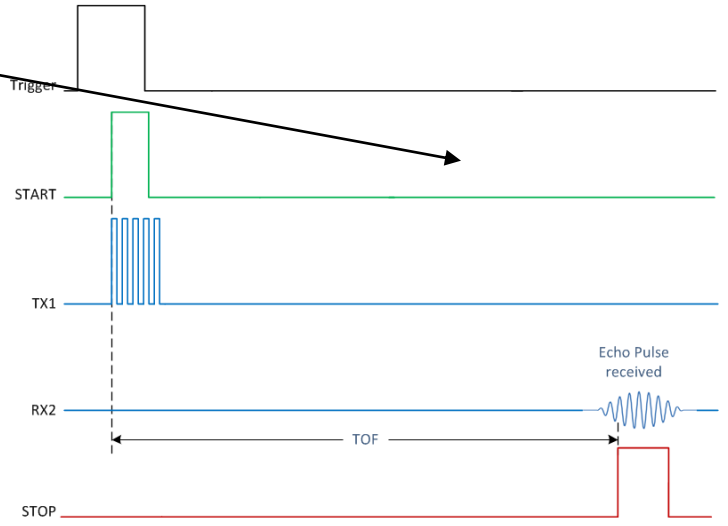
SysTick Časovnik

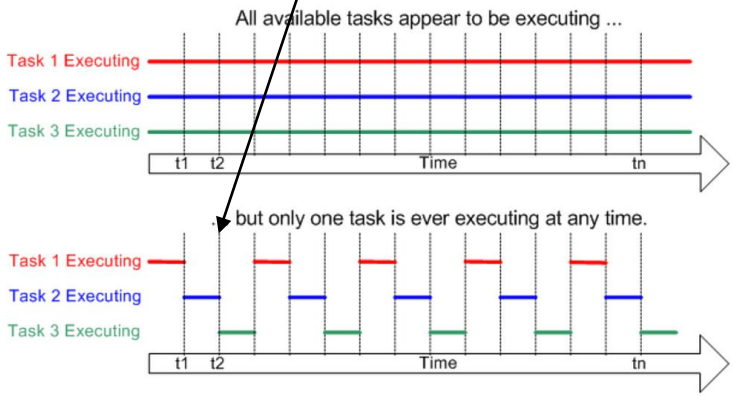
TC (časovnik / števec)



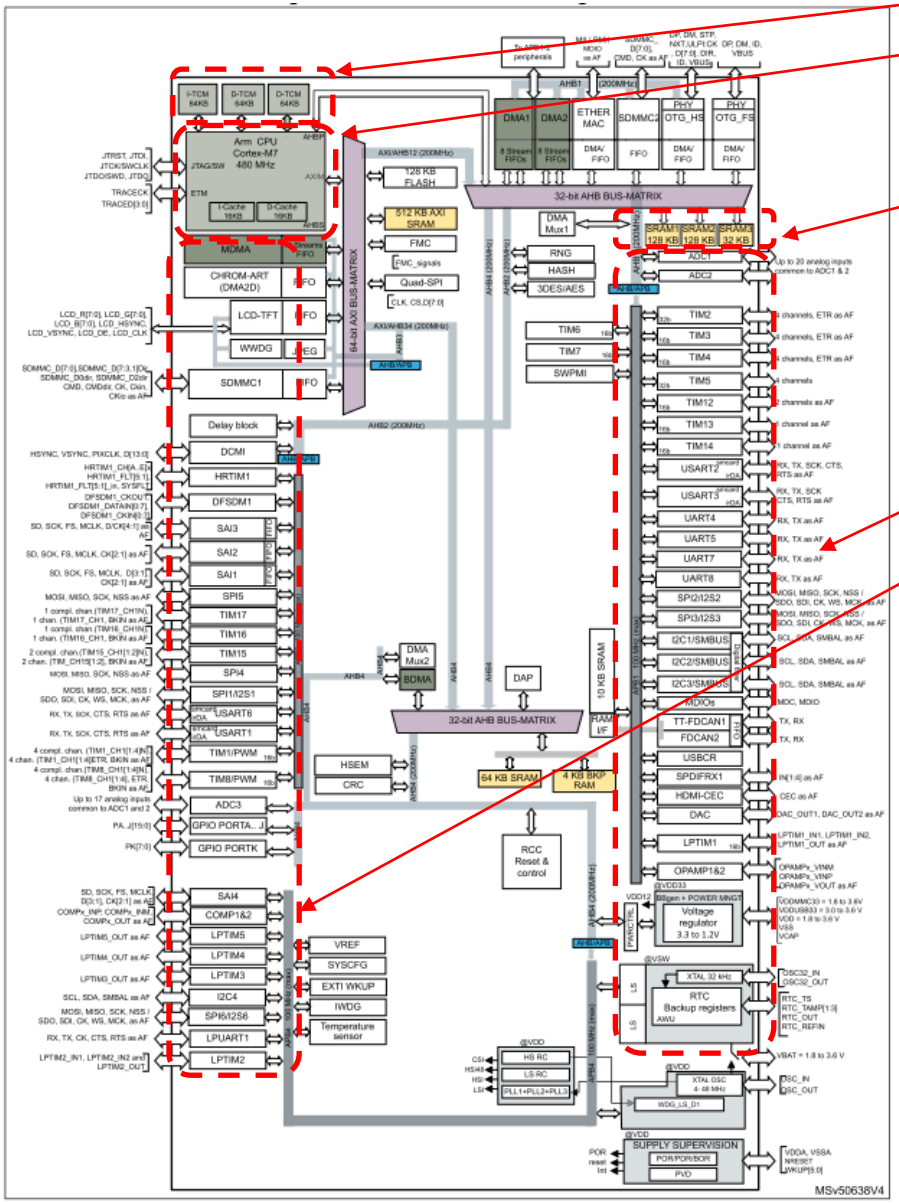
- **Uporabni za štetje dogodkov**
  ali generiranje časovnih signalov (Waveform).
  - zakasnitve (DELAY s časovnikom !)
  - generiranje signala določene frekvence
  - pulzno širinska modulacija (PWM)
  - merjenje intervalov
  - ciklične prekinitve!

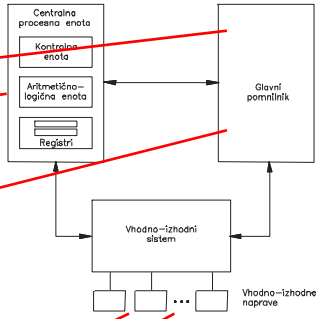






STM32H750XB





Delo na STM32H7 razvojnem sistemu

Priključitev :

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

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

- ***dodajanje vsebine (Main.s):***

CubeIDEWorkspace - stm32h7-asm/Core/Src/Main.s - STM32CubeIDE

File Edit Source Refactor Navigate Search Project Run Window Help

Project Explorer

- CubeIDE_Workspace
  - stm32f4-asm-qemu
- Delo
  - ARM9Template
  - stm32f4-asm (in STM32AsmTemplate)
  - ARM9Template.zip
- Node_V4 (in node_v4)
- Sluzba
  - CAN_IEX_Module
  - ORLab-STM32H7
    - stm32h7-asm
      - Binaries
      - Includes
      - Core
        - Src
          - Main.s
        - Startup
          - startup_stm32h750xbhx.s
      - Debug
      - out
      - makefile
      - README.md
      - STM32H750X.svd
      - STM32H750XBHX_FLASH.ld
      - STM32H750XBHX_RAM.ld
    - README.md
  - RALab-STM32H7
    - stm32h7-asm_RA_LED
    - README.md
  - STM32_USB_Key_AdvDebug
  - STM32_USB_Key_FreeRTOS_AdvDebug
  - STM32CubeIDE_Adv_Debug
  - STM32F4_Discovery_VIN_Projects

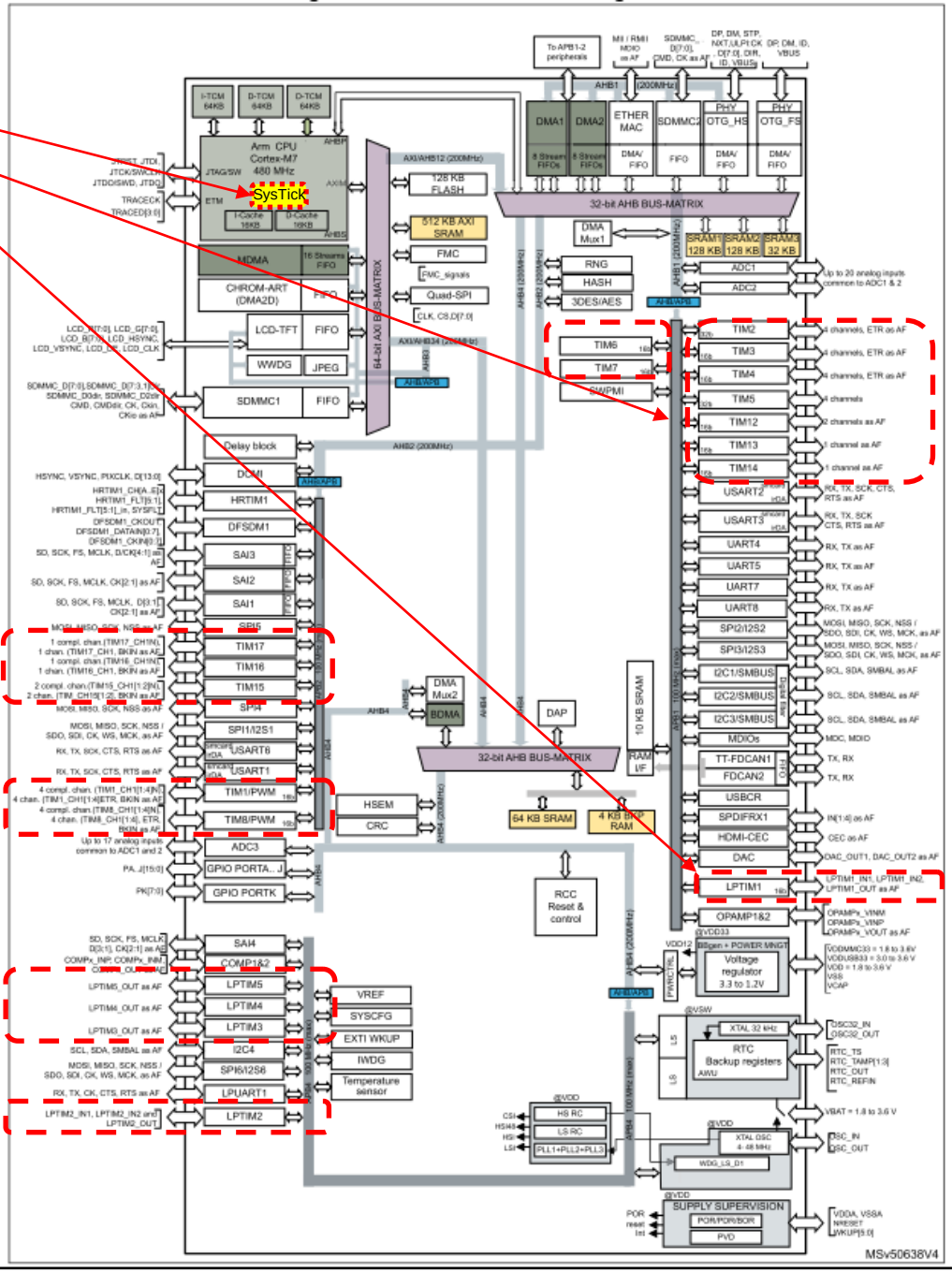
Main.s × startup_stm32h750xbhx.s

```
12
13 ////////////////////////////////////////////////////////////////////////////////
14 // Definitions
15 ////////////////////////////////////////////////////////////////////////////////
16 // Definitions section. Define all the registers and
17 // constants here for code readability.
18
19 // Constants
20
21
22 // Start of data section
23         .data
24
25         .align
26
27 STEV1:  .word   0x10    // 32-bitna spr.
28 STEV2:  .word   0x40    // 32-bitna spr.
29 VSOTA:  .word   0       // 32-bitna spr.
30
31
32 // Start of text section
33         .text
34
35         .type  main, %function
36         .global main
37
38         .align
39 main:
40         ldr r0, =STEV1   // Naslov od STEV1 -> r0
41         ldr r1, [r0]     // Vsebina iz naslova v r0 -> r1
42
43         ldr r0, =STEV2   // Naslov od STEV1 -> r0
44         ldr r2, [r0]     // Vsebina iz naslova v r0 -> r2
45
46         add r3,r1,r2     // r1 + r2 -> r3
47
48         ldr r0, =VSOTA   // Naslov od STEV1 -> r0
49         str r3,[r0]      // iz registra r3 -> na naslov v r0
50
51 __end:  b    __end
52
```

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

- STM32H750B-DK Discovery kit with STM32H750XB MCU
- ORLab-STM32H7 - GitHub repozitorij
- User Manual Discovery kit stm32h750xb Uploaded 11/11/22, 10.15
- DataSheet_stm32h750xb Uploaded 11/11/22, 10.16
- Reference Manual rm0433-stm32h750xb Uploaded 11/11/22, 10.17
- Programming_Manual_pm0253-stm32h750xb Uploaded 11/11/22, 10.17
- Errata_es0396-stm32h750xb Uploaded 11/11/22, 10.19

Časovniki


SysTick
Arm CPU Cortex-M7 480 MHz
32-bit AHB BUS-MATRIX
64-bit AXI BUS-MATRIX
TIM2
TIM3
TIM4
TIM5
TIM6
TIM7
TIM12
TIM13
TIM14
TIM1/PWM
TIM8/PWM
TIM15
TIM16
TIM17
LPTIM1
LPTIM2
LPTIM3
LPTIM4
LPTIM5
SDMMC1
SDMMC2
ADC1
ADC2
ADC3
DAC
RTC
Backup registers
IWDG
WWDG
Temperature sensor
SUPPLY SUPERVISION
Voltage regulator
MSv50638V4

Vira: Reference & Programming manuals

life.augmented

PM0253
Programming manual

STM32F7 Series and STM32H7 Series Cortex®-M7 processor programming manual

4 Cortex-M7 peripherals

4.1 About the Cortex-M7 peripherals

The address map of the *Private peripheral bus* (PPB)

Core peripherals PM0214

4.5 SysTick timer (STK)

0xE000E100-0xE000E4EF	Nested Vectored Interrupt Controller	Table 40 on page 184
0xE000ED00-0xE000ED3F	System control block	Table 50 on page 192
0xE000ED78- 0xE000ED84	Processor features	Table 77 on page 217
0xE000ED90-0xE000EDB8	Memory Protection Unit	Table 84 on page 222
0xE000EF00-0xE000EF03	Nested Vectored Interrupt Controller	Table 40 on page 184
0xE000EF30-0xE000EF44	Floating-Point Unit	Table 94 on page 233
0xE000EF50-0xE000EF78	Cache maintenance operations	Table 100 on page 240
0xE000EF90-0xE000EFA8	Access control	Table 104 on page 245

Table 71. System timer registers summary

Address	Name	Type	Required privilege	Reset value	Description
0xE000E010	SYST_CSR	RW	Privileged	0x00000004	*SysTick control and status register*
0xE000E014	SYST_RVR	RW	Privileged	UNKNOWN	*SysTick reload value register*
0xE000E018	SYST_CVR	RW	Privileged	UNKNOWN	*SysTick current value register*
0xE000E01C	SYST_CALIB	RO	Privileged	0xC0000000	*SysTick calibration value register*

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RM0433
Reference manual

STM32H742, STM32H743/753 and STM32H750 Value line advanced Arm®-based 32-bit MCUs

SysTick časovnik – stanje , nastavitve

Bazni naslov za registre SysTick je 0xE000E010

Figure 40. SysTick SYST_CSR bit assignments

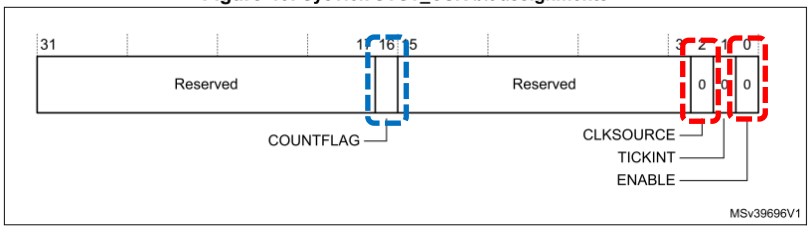


Figure 41. SYST_RVR bit assignments

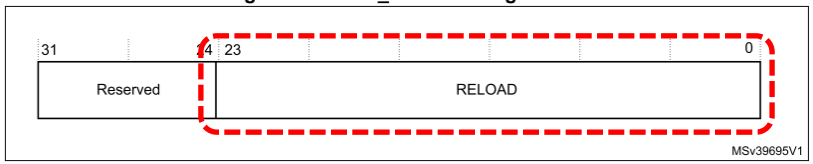
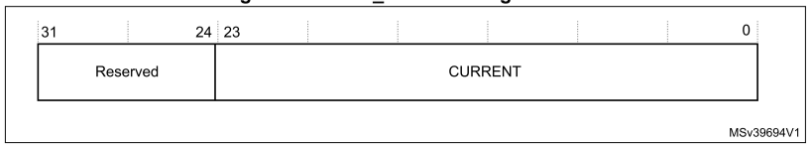


Figure 42. SYST_CVR bit assignments:



Osnovni registri za delovanje SysTick časovnika:

SYST_CSR : vklop časovnika

CLKSOURCE=1, ENABLE=1

COUNTERFLAG=1, ko prešteje do 0 (postavi na SYST_RVR in nadaljuje)

SYST_RVR : zač. vrednost štetja (šteje proti 0)

SYST_RVR = število period

SYST_CVR : trenutna vrednost števca

SYST_CVR = nekje med SYST_RVR in 0

SysTick časovnik *(Registri za nastavitve delovanja)*

Figure 40. SysTick SYST_CSR bit assignments

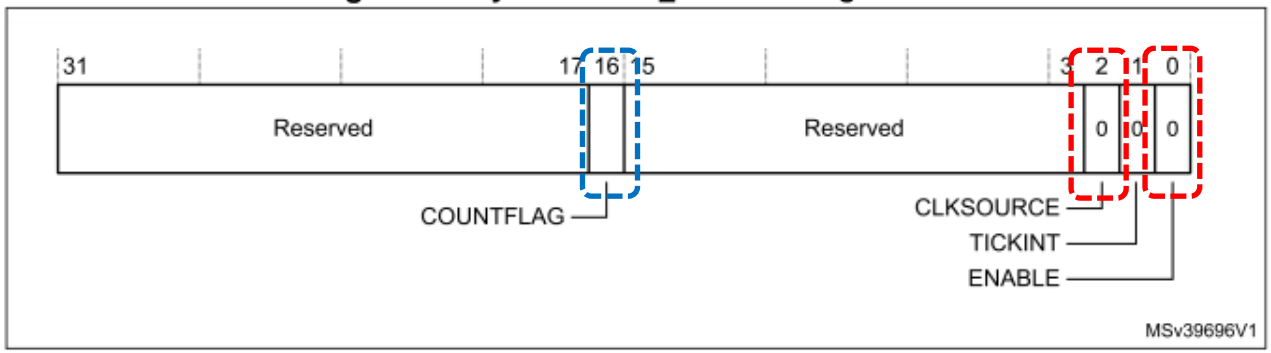


Table 72. SysTick SYST_CSR bit assignments

Bits	Name	Function
[31:17]	-	Reserved.
[16]	COUNTFLAG	Returns 1 if timer counted to 0 since last time this was read.
[15:3]	-	Reserved.
[2]	CLKSOURCE	Indicates the clock source: – 0: External clock. – 1: Processor clock.
[1]	TICKINT	Enables SysTick exception request: 0: Counting down to zero does not assert the SysTick exception request. 1: Counting down to zero asserts the SysTick exception request. Software can use COUNTFLAG to determine if SysTick has ever counted to zero.
[0]	ENABLE	Enables the counter: 0: Counter disabled. 1: Counter enabled.

SysTick časovnik *(Registri za nastavitve delovanja)*

4.4.2 SysTick reload value register

The SYST_RVR register specifies the start value to load into the SYST_CVR register. See the register summary in *Table 71 on page 213* for its attributes. The bit assignments are:

Figure 41. SYST_RVR bit assignments

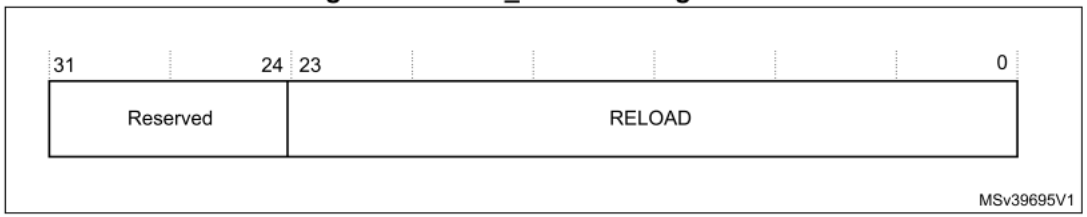


Table 73. SYST_RVR bit assignments

Bits	Name	Function
[31:24]	-	Reserved.
[23:0]	RELOAD	Value to load into the SYST_CVR register when the counter is enabled and when it reaches 0, see *Calculating the RELOAD value*.

Calculating the RELOAD value

The RELOAD value can be any value in the range 0x00000001-0x00FFFFFF. A start value of 0 is possible, but has no effect because the SysTick exception request and COUNTFLAG are activated when counting from 1 to 0.

The RELOAD value is calculated according to its use. For example, to generate a multi-shot timer with a period of N processor clock cycles, use a RELOAD value of N-1. If the SysTick interrupt is required every 100 clock pulses, set RELOAD to 99.

SysTick časovnik *(Registri za nastavitve delovanja)*

4.4.3 SysTick current value register

The SYST_CVR register contains the current value of the SysTick counter. See the register summary in *Table 71 on page 213* for its attributes. The bit assignments are

Figure 42. SYST_CVR bit assignments:

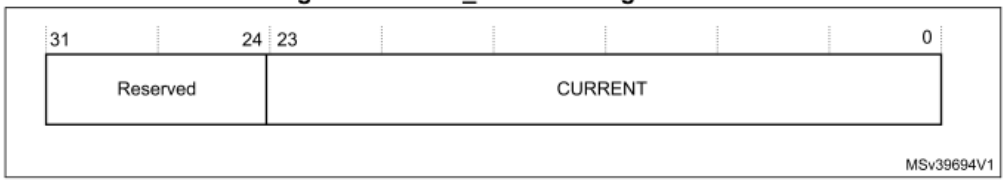


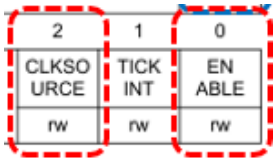
Table 74. SYST_CVR bit assignments

Bits	Name	Function
[31:24]	-	Reserved.
[23:0]	CURRENT	Reads return the current value of the SysTick counter. A write of any value clears the field to 0, and also clears the SYST_CSR COUNTFLAG bit to 0.

SysTick Časovnik – krmiljenje

Potrebni koraki za krmiljenje časovnika SysTick:

1. **SYST_RVR (Reload Value Register): Value** SYSTICK_RELOAD_1MS
2. **SYST_CVR (Current Value Register): 0, reset to zero**
3. **SYST_CSR (Control/Status Register): 0b101 : Proc. Clock, enable**
   -> Start SysTick

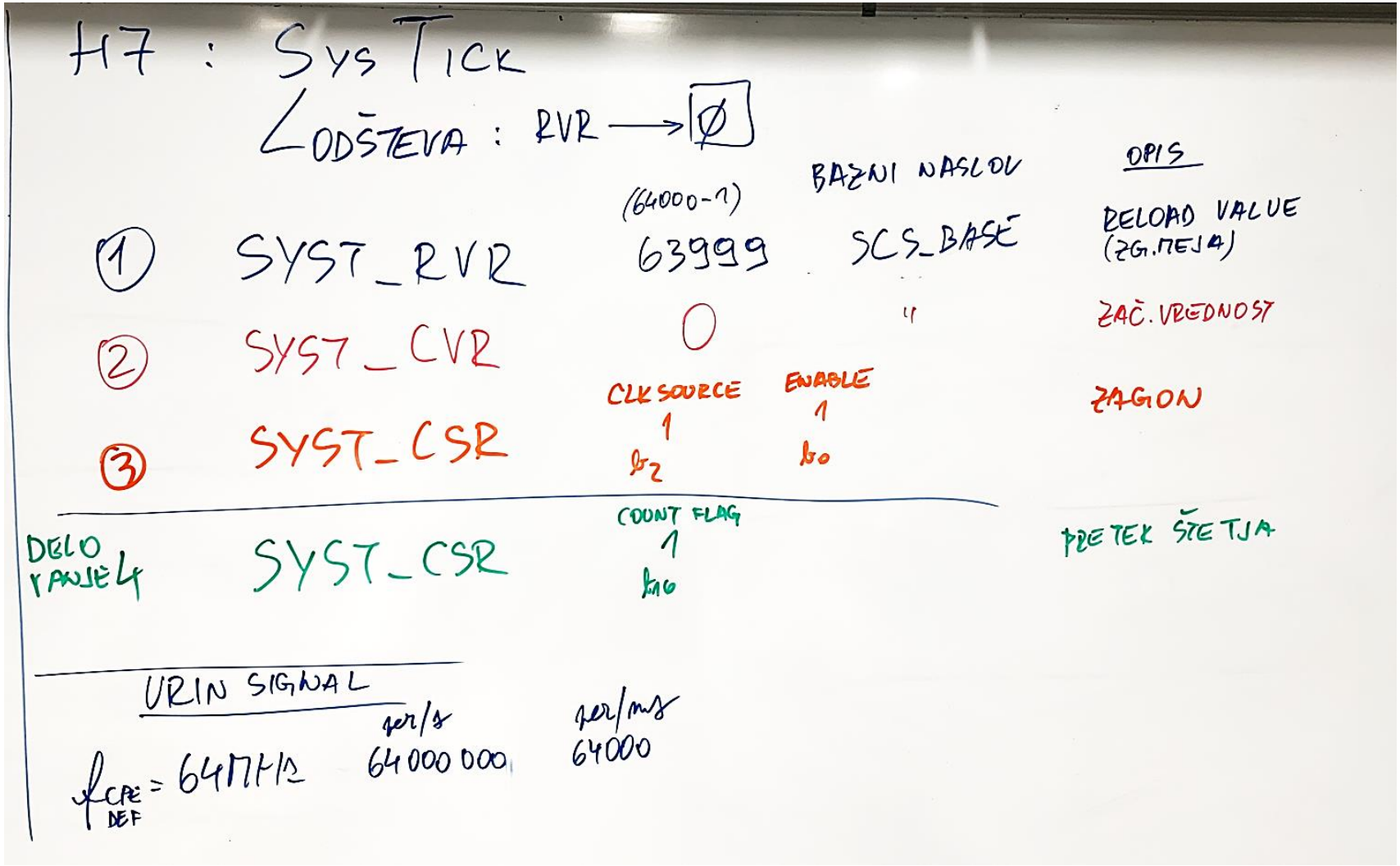


4. **Delovanje:**
   Čakanje na pojavitev COUNT_FLAG=1 (b_{16}) v SYST_CSR

Naslovi registrov:

```
// SysTick Timer definitions
.equ     SCS_BASE,0xe000e000
.equ     SCS_SYST_CSR,0x10// Control/Status register
.equ     SCS_SYST_RVR,0x14// Value to countdown from
.equ     SCS_SYST_CVR,0x18// Current value

 .equ    SYSTICK_RELOAD_1MS,     63999  //1 msec at 64MHz ...
```

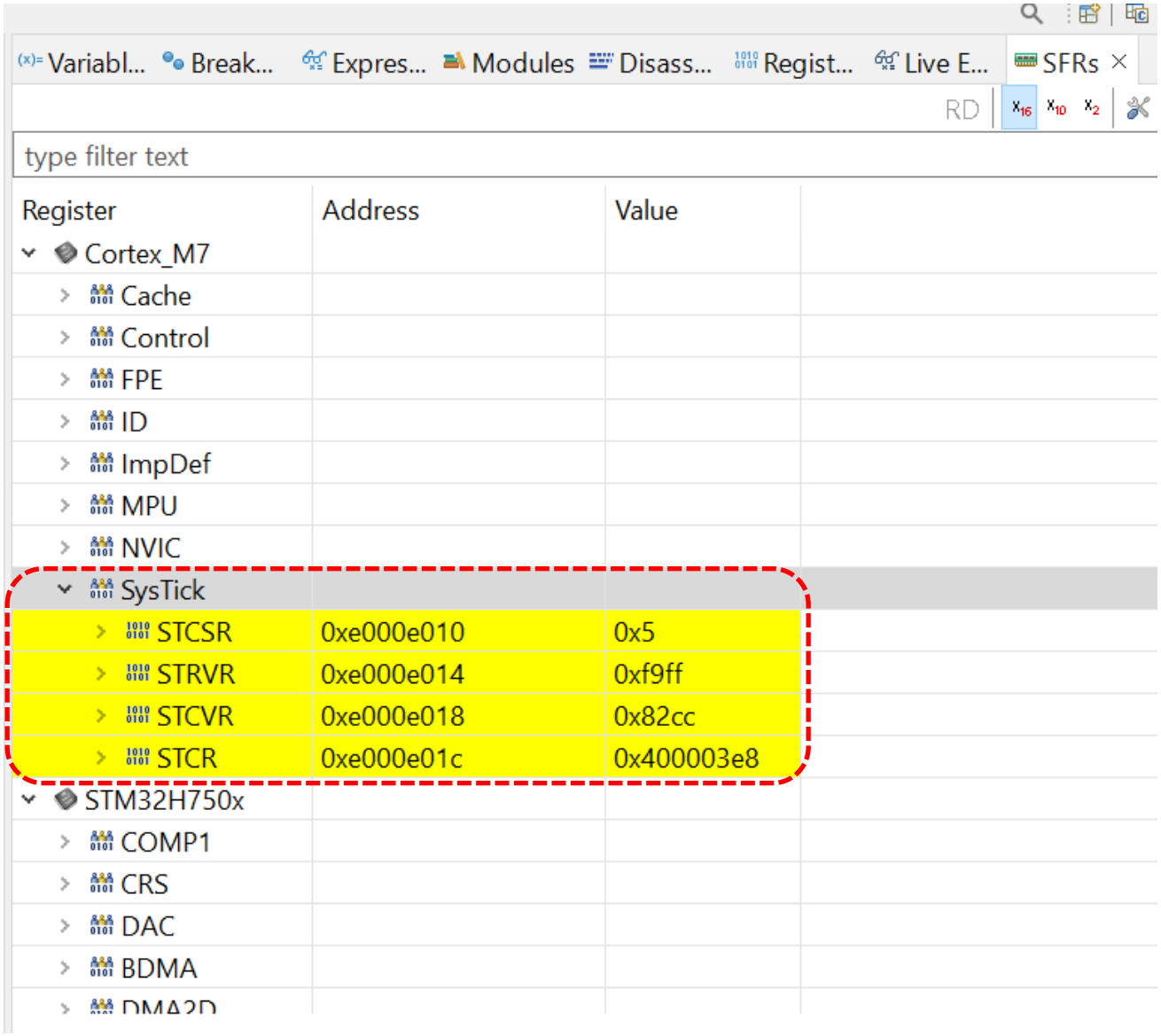
SysTick časovnik



CubeIDE – Registers okno

Name	Value
General Registers	
r0	0x0
r1	0x0
r2	0x0
r3	0x0
r4	0x0
r5	0x1000
r6	0x40020c14
r7	0x0
r8	0x0
r9	0x0
r10	0x0
r11	0x0
r12	0x0
sp	0x20020000
lr	0xffffffff
pc	0x800002a
xpsr	0x41000000

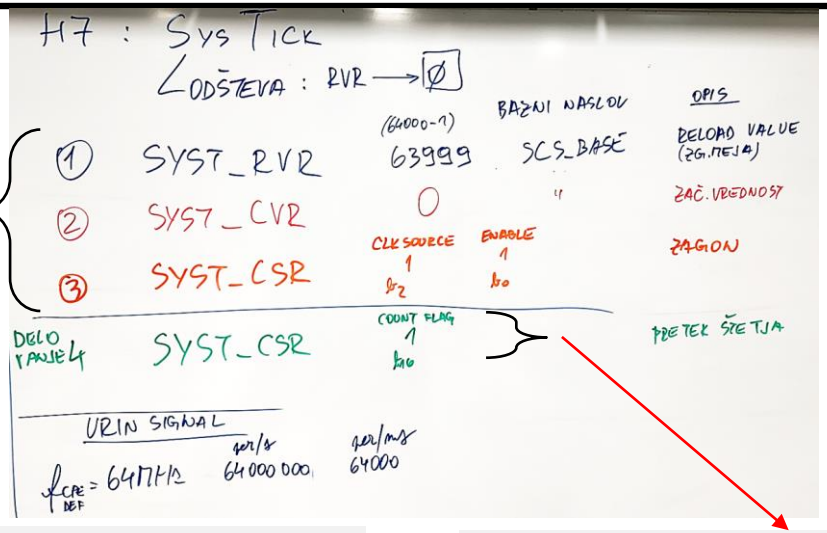
CubeIDE – SFR okno



Utripanje LED diode – s časovnikom :

```
main:

                bl      INIT_IO     // Priprava za kontrolo LED diode
                bl      INIT_TC     // Priprava SysTick časovnika

loop:
                bl LED_ON       // Vklop LED diode

                mov r0,#500
//              bl DELAY            // Zakasnitev SW Delay: r0 x 1msec
                bl DELAYTC                  // Zakasnitev SysTick : r0 x 1msec


                bl LED_OFF      // Izlop LED diode

                mov r0,#500
//              bl DELAY            // Zakasnitev SW Delay: r0 x 1msec
                bl DELAYTC                  // Zakasnitev SysTick : r0 x 1msec

                b loop          // skok na vrstico loop:
```

Utripanje LED diode – s časovnikom :




```
INIT_TC:
          push {r0, r1, lr}
          ldr r1, =SCS_BASE

          ldr r0, =SYSTICK_RELOAD_1MS
          str r0, [r1, #SCS_SYST_RVR]

          mov r0, #0
          str r0, [r1, #SCS_SYST_CVR]

          mov r0, #0b101
          str r0, [r1, #SCS_SYST_CSR]

          pop {r0, r1, pc}
```

```
// Delay with internal timer based loop approx.
r0 x ms
DELAYTC:
    push {r1, r2, lr}
    ldr r1, =SCS_BASE


LOOPTC:     ldr r2, [r1, #SCS_SYST_CSR]
            tst r2, #0x10000   // COUNT_FLAG=1?
            beq LOOPTC

      subs r0, r0, #1
      bne LOOPTC
    pop {r1, r2, pc}
```