

Microcontroller Engineering

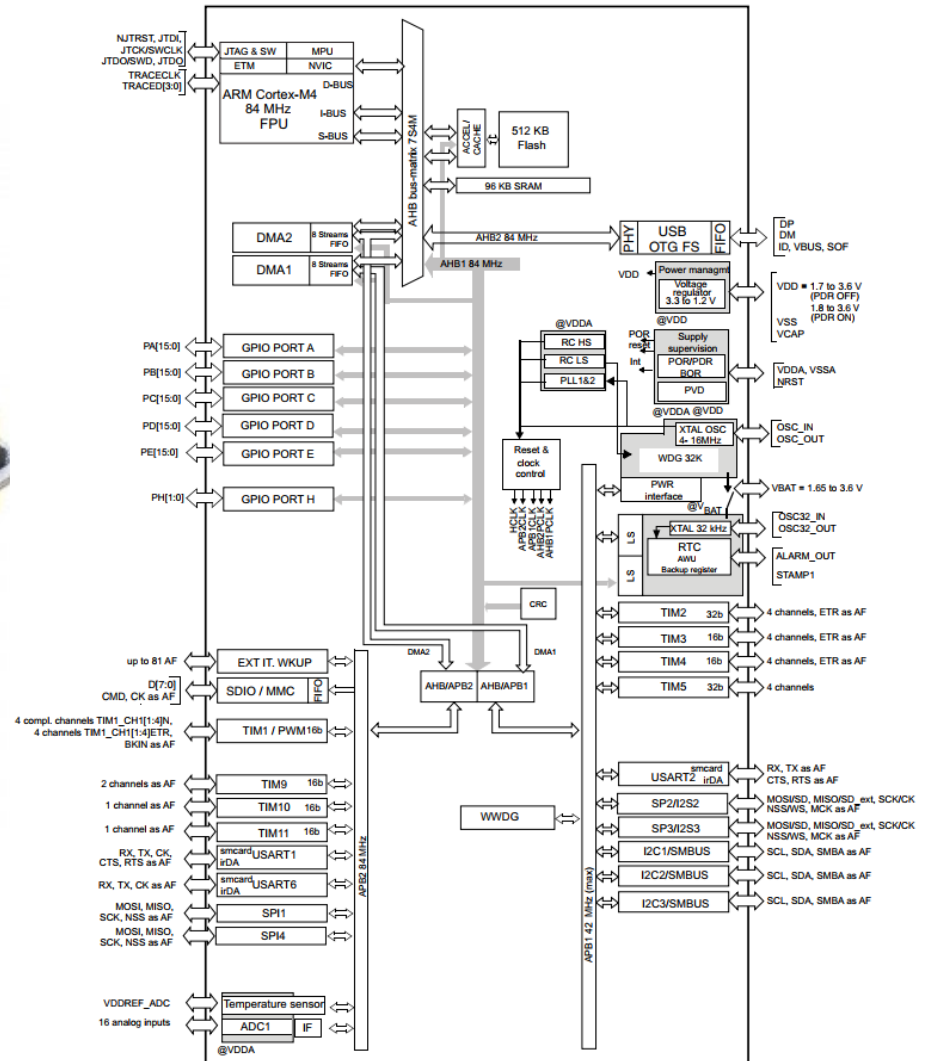
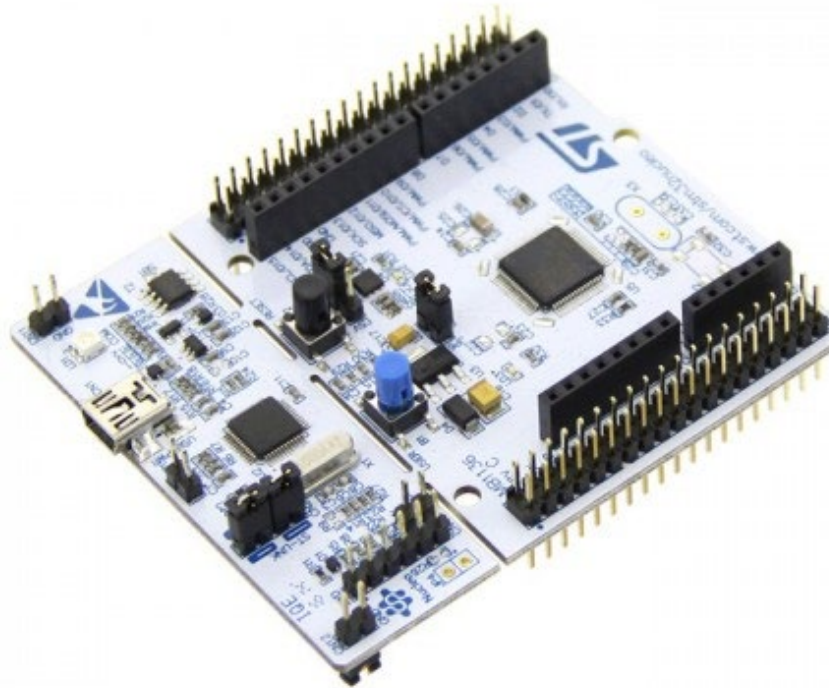
TMIK13

Lecture 12

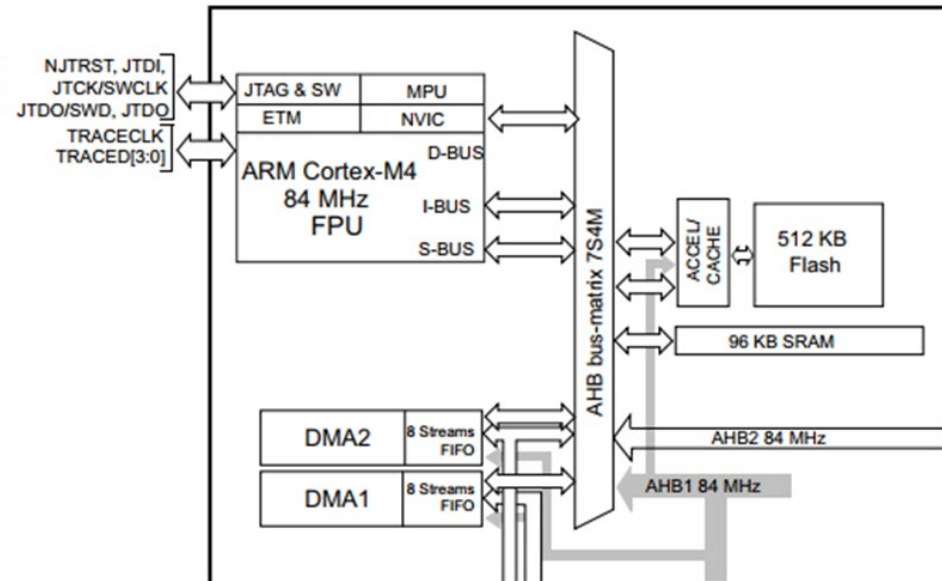
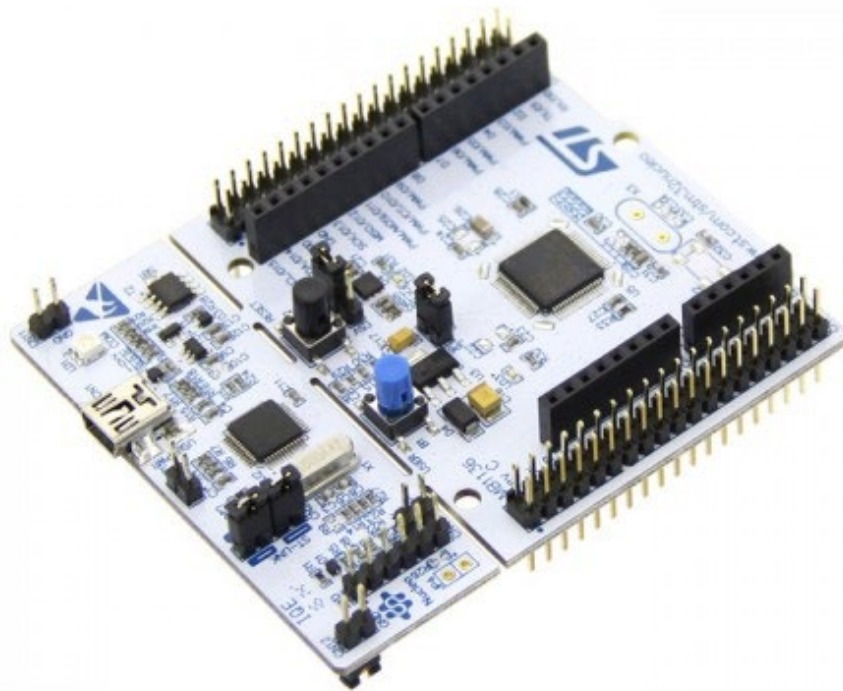
ADVANCED DEBUGGING

ANDREAS AXELSSON (ANDREAS.AXELSSON@JU.SE)

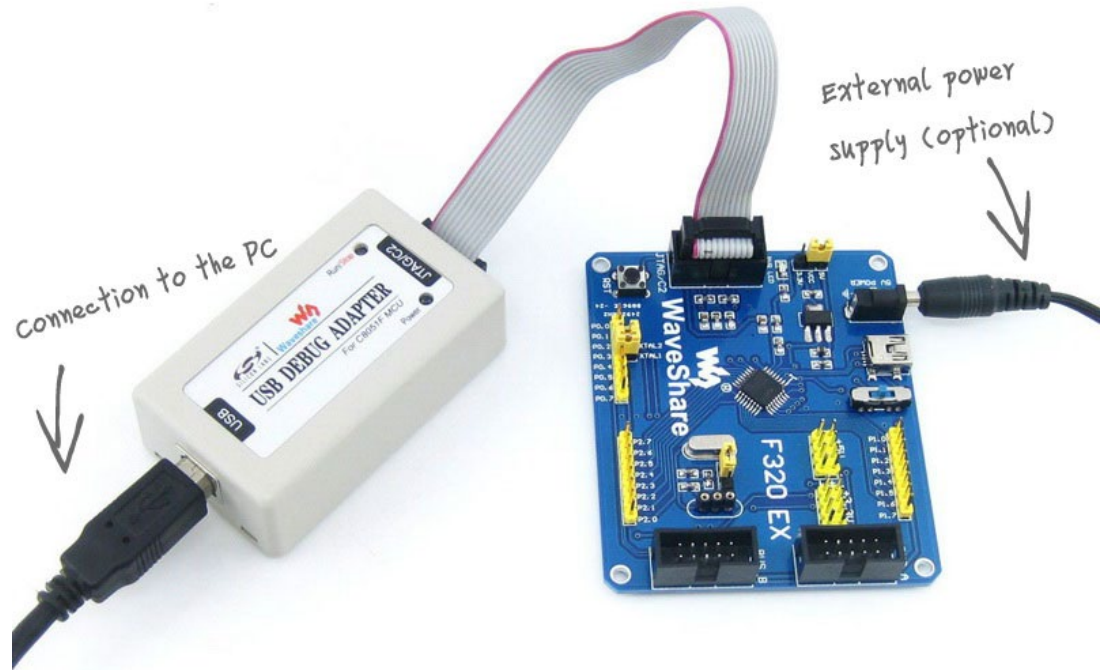
Nucleo-64 STM32F401RE



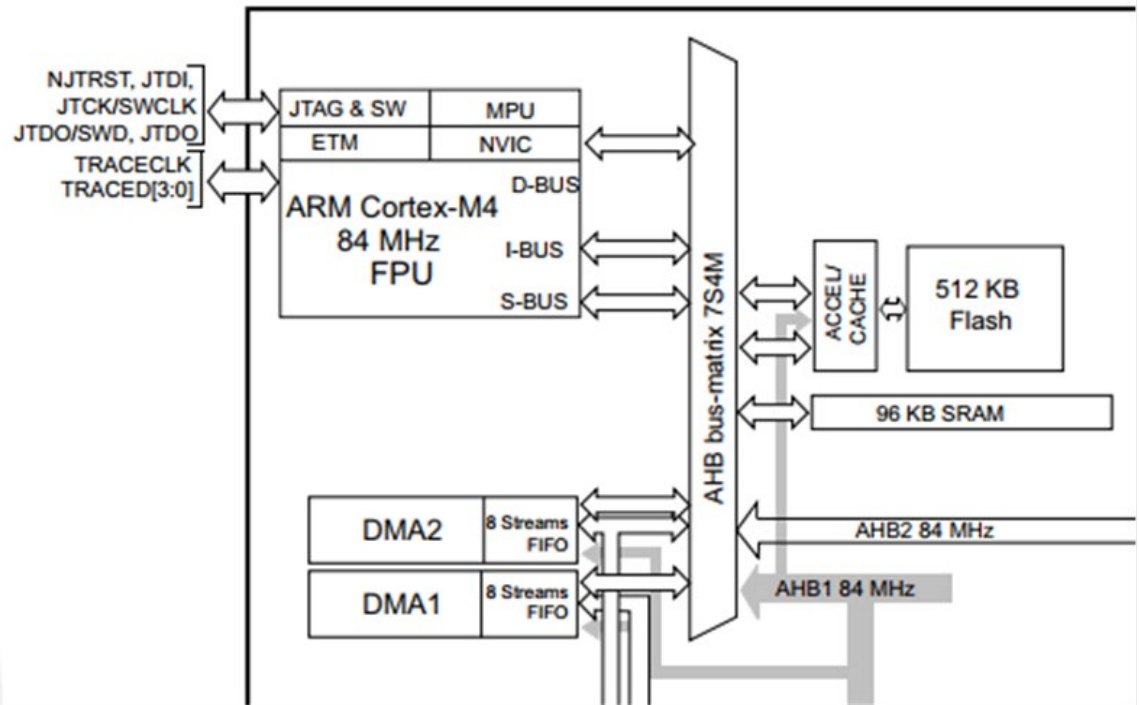
Nucleo-64 STM32F401RE



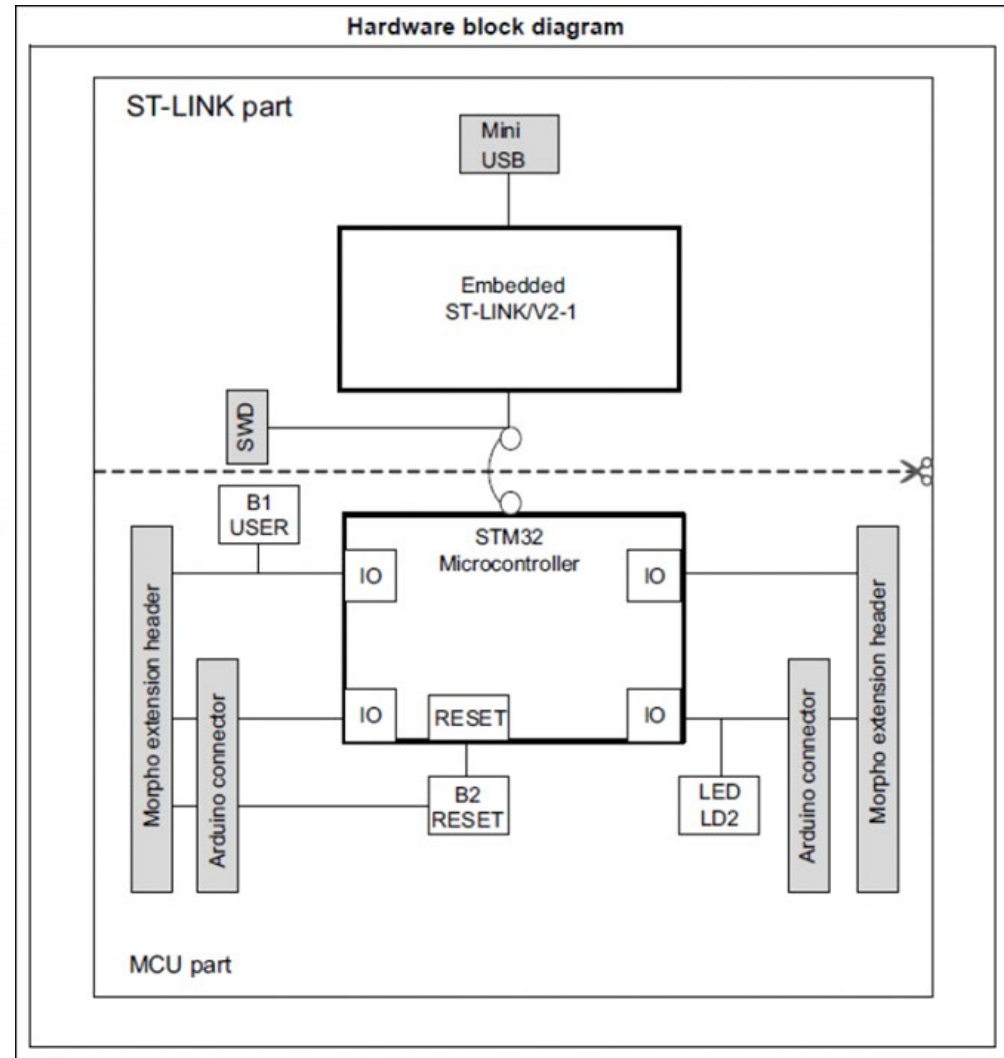
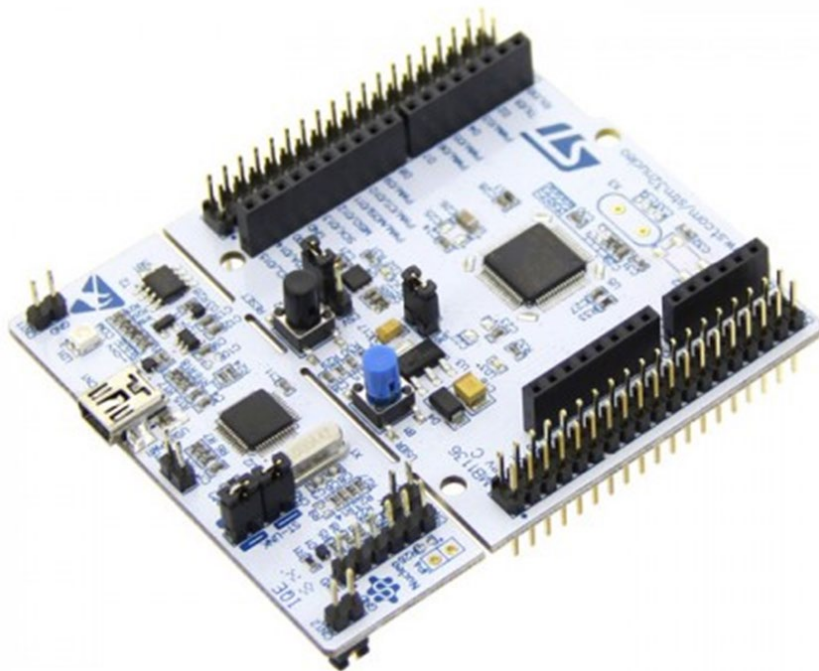
Hardware Debugger



Hardware Debugger



Hardware Debugger – ST-LINK/V2



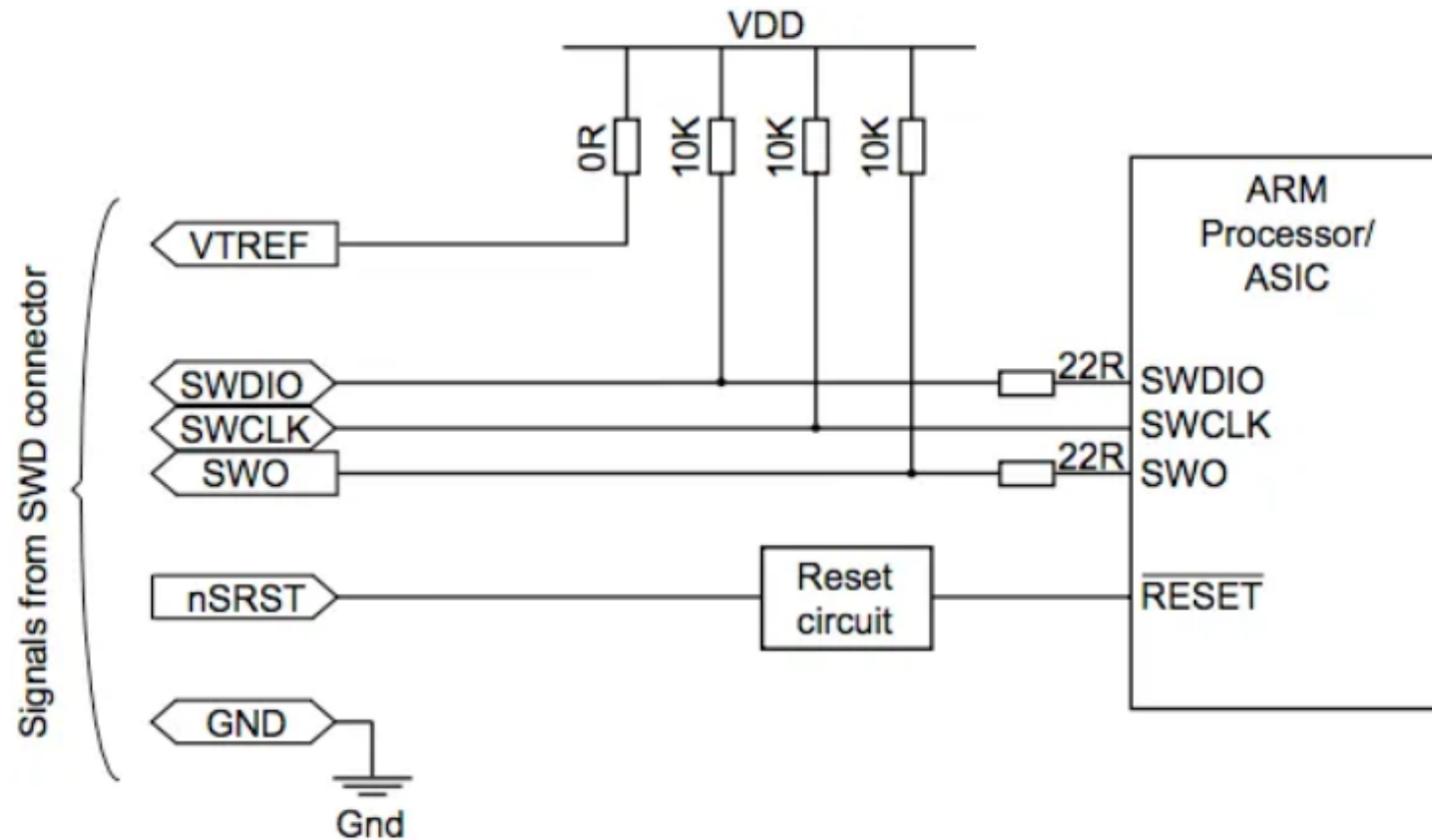
Software Debugger

The screenshot displays the Atollic TrueSTUDIO for ARM software debugger interface. The main window is titled "TGMK15 - Debug - SpiritLevel/Src/main.c - Atollic TrueSTUDIO for ARM". The interface is divided into several panes:

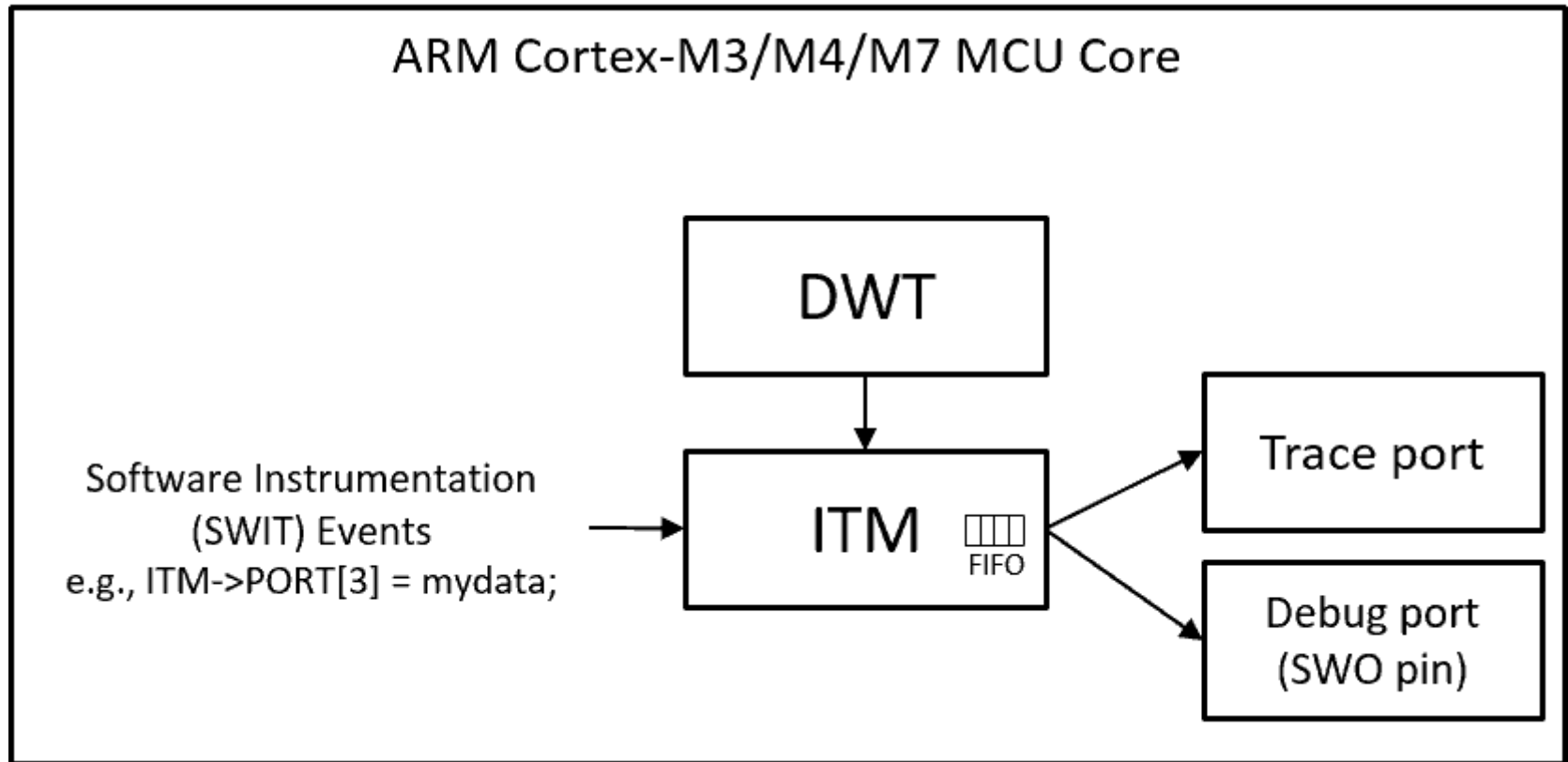
- Debug Console:** Shows the current thread "Thread #1 <main> (Suspended: User Request)" and the current function "main.c [function: main] [type: Temporary]". It also displays the current instruction address "main() at main.c:161 0x80023b8".
- Registers:** A table showing the current state of registers. The "General Register" is highlighted, showing a value of "0x00000000".
- Code Editor:** Displays the source code for "main.c". The current line of code is "HAL_RCC_GPIOC_CLK_ENABLE();" at line 321. The code includes various GPIO initialization and configuration functions.
- Console:** Shows the output of the program, including the text "SpiritLevel.elf [Embedded C/C++ Application] C:/Program Files (x86)/Atollic/TrueSTUDIO for ARM 8.1.0/ARMTools/bin/arm-atollic-eabi-gdb (7.10.1.20)".
- Memory:** A pane for viewing memory contents.
- Freertos Task List:** A pane for viewing the list of tasks in the system.
- SWV Trace Log:** A pane for viewing the SWV trace log.
- SWV Exception Trace Log:** A pane for viewing the SWV exception trace log.
- Problems:** A pane for viewing any errors or warnings.
- Executables:** A pane for viewing the list of executables.
- Terminal:** A pane for viewing the output of the terminal.
- Serial COM7 (2/2/18 1):** A pane for viewing the serial output of the device.
- Port 0:** A pane for viewing the port output of the device.

The status bar at the bottom indicates the current state of the debugger, including "Writable", "Smart Insert", and the current instruction address "321 : 1".

Serial Wire Debug



Instrumentation Trace Macrocell



DWT – Debug Watchpoint and Trace (Handles breakpoints and debugging)

ITM – Instrumentation Trace Macrocell (Transfers debug data. 32 custom channels)

Demo of different techniques

1. (Printout using serial to terminal)
2. Use Live expression
3. Redirect printf to ITM (Instrumentation Trace Macrocell)
 1. Print to SWV ITM Data Console
 2. Can be text and numbers (both integers and float) formatted
4. Advanced breakpoints
 1. Conditions
 2. Actions
5. Call-stack and memory peeking
6. Asserts (assert_param & assert_failed, or assert)
7. SWV Data Trace (Similar to Live Expression, advanced)
 1. Can output data both numerically and as graph
8. Use GPIO and oscilloscope for debugging and time measurement
9. Use SWV Trace log to measure time

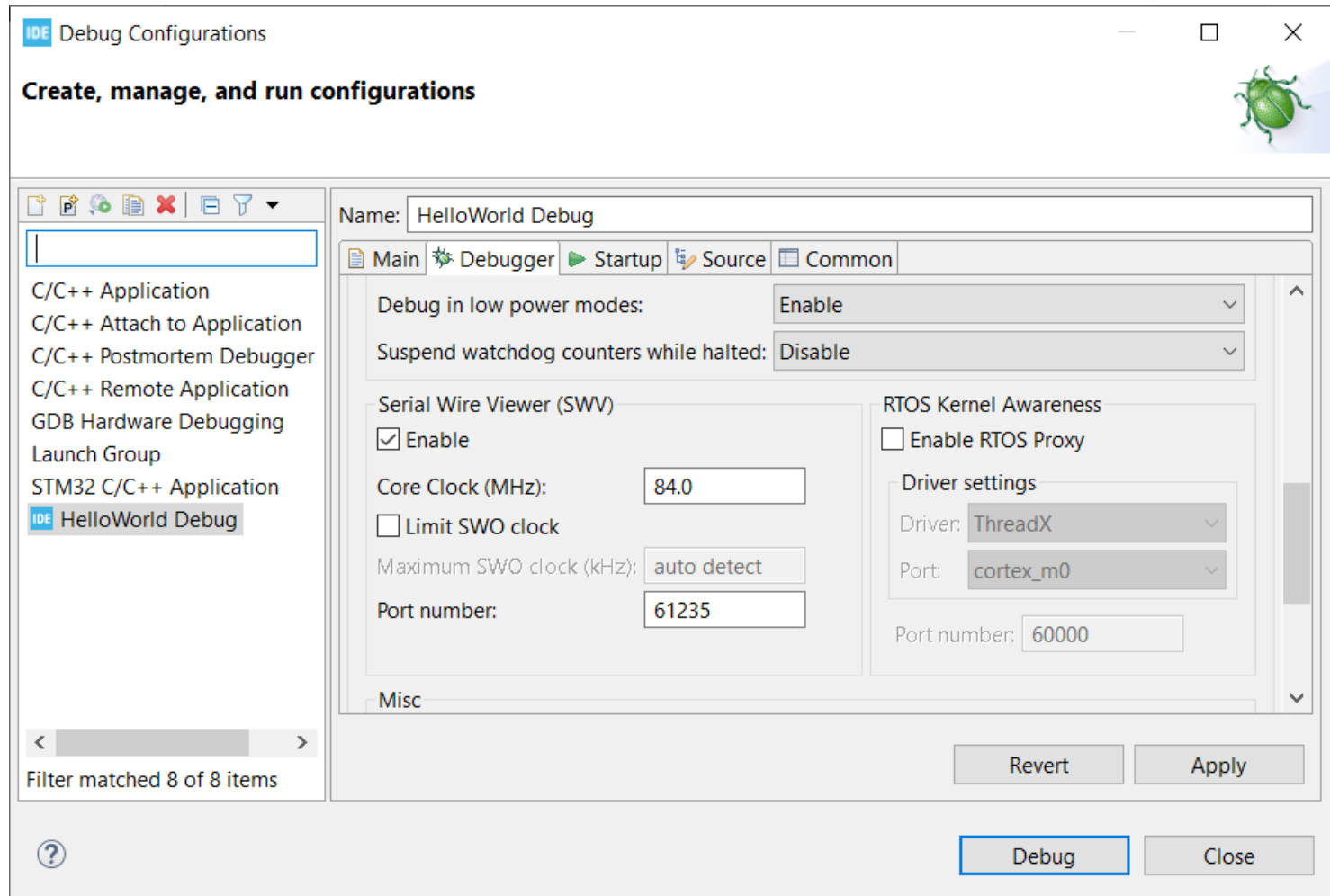
Redirection of printf

Override `_write` (weak declared in `syscall.c`)

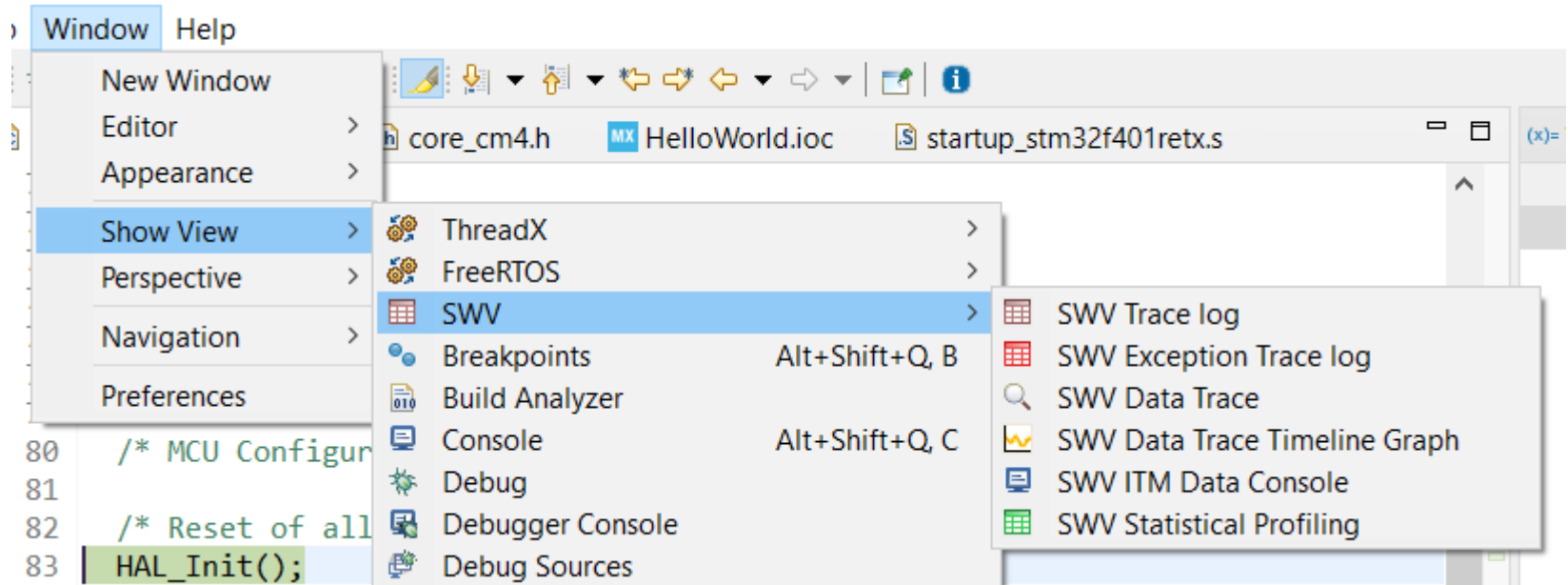
```
/* USER CODE BEGIN 0 */
int _write(int file, char *ptr, int len)
{
    int DataIdx;

    for(DataIdx = 0; DataIdx < len; DataIdx++)
    {
        ITM_SendChar(*ptr++);
    }
    return len;
}
/* USER CODE END 0 */
```

Activate SWV (ITM debugging)



SWV – Serial Wire Viewer



SWV Configuration

IDE

Serial Wire Viewer settings forHelloWorld Debug

×

Clock Settings

Core Clock: 84 MHz

Clock Prescaler: 42

SWO Clock: 2000.0 kHz

Trace Events

☐ CPI: Cycles per instruction ☐ EXC: Exception overhead

☐ SLEEP: Sleep cycles ☐ LSU: Load store unit cycles

☐ FOLD: Folded instructions ☐ EXETRC: Trace Exceptions

PC Sampling

☐ Enable Resolution: 16384 Cycles/sample

Timestamps

☒ Enable Prescaler: 1

Data Trace

Comparator 0

☒ Enable

Var/Addr: i

Access: Read/Write

Size: Word

Generate: Data Value + PC

Comparator 1

☐ Enable

Var/Addr: 0x0

Access: Read/Write

Size: Word

Generate: Data Value

Comparator 2

☐ Enable

Var/Addr: 0x0

Access: Read/Write

Size: Word

Generate: Data Value

Comparator 3

☐ Enable

Var/Addr: 0x0

Access: Read/Write

Size: Word

Generate: Data Value

ITM Stimulus Ports

Enable port: 31 24 23 16 15 8 7 0

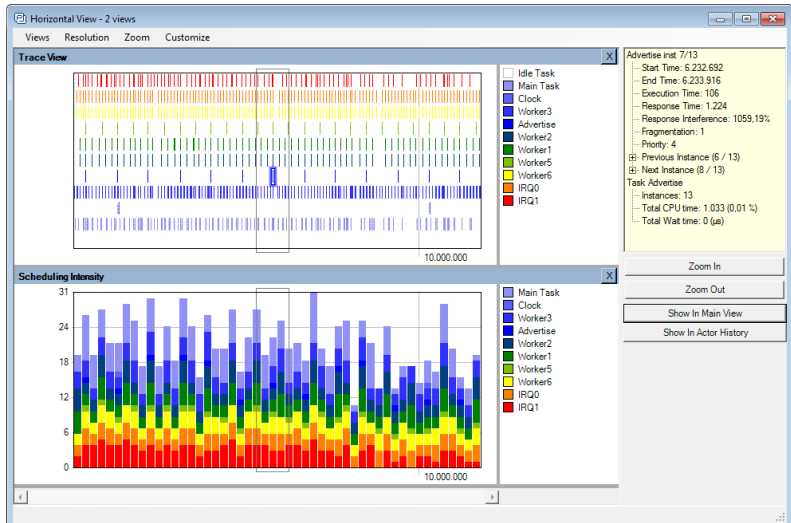
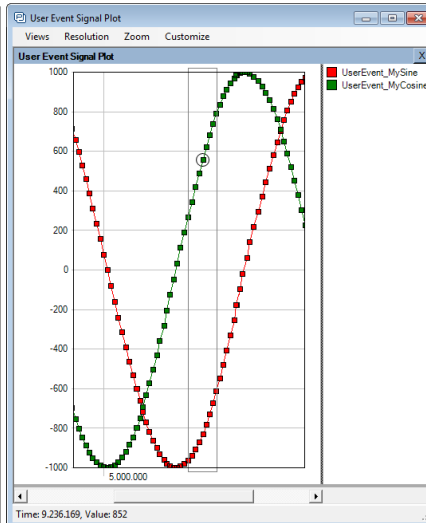
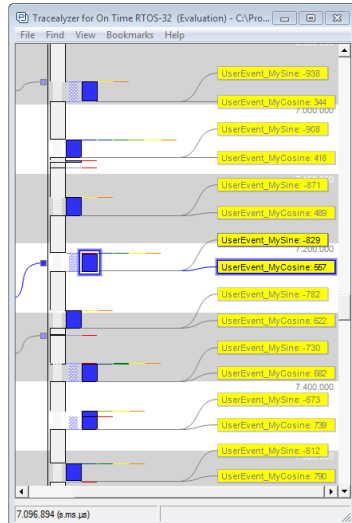
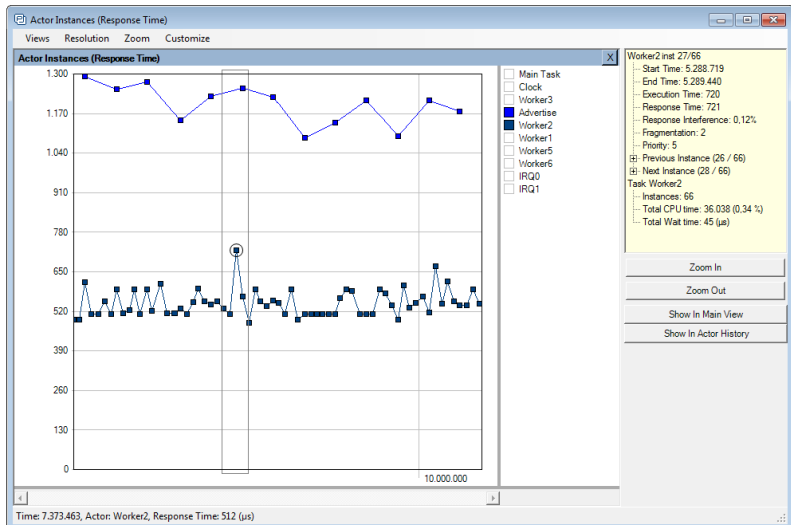
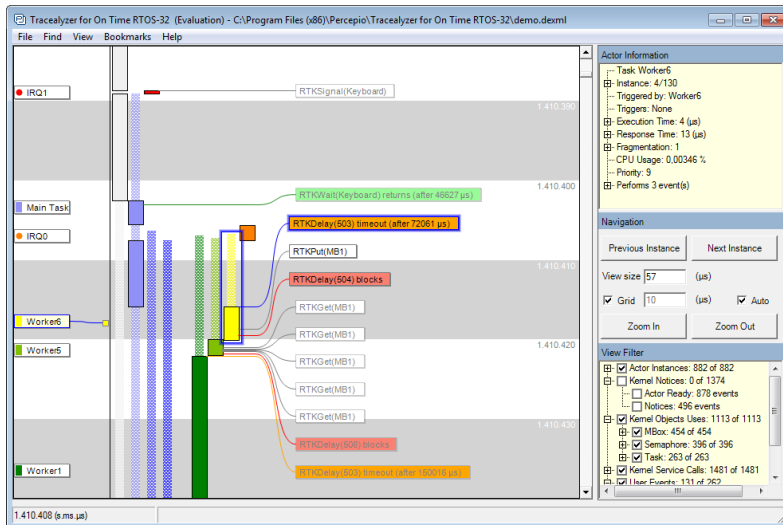
Privileged only ports: ☐ Port 31..24 ☐ Port 23..16 ☐ Port 15..8 ☐ Port 7..0

OK

Cancel

Tracealyzer

<https://percepio.com/tracealyzer/>



Microcontroller Engineering

Questions?

Contact information

Andreas Axelsson

Email: andreas.axelsson@ju.se

Mobile: 0709-467760