Debugging Techniques

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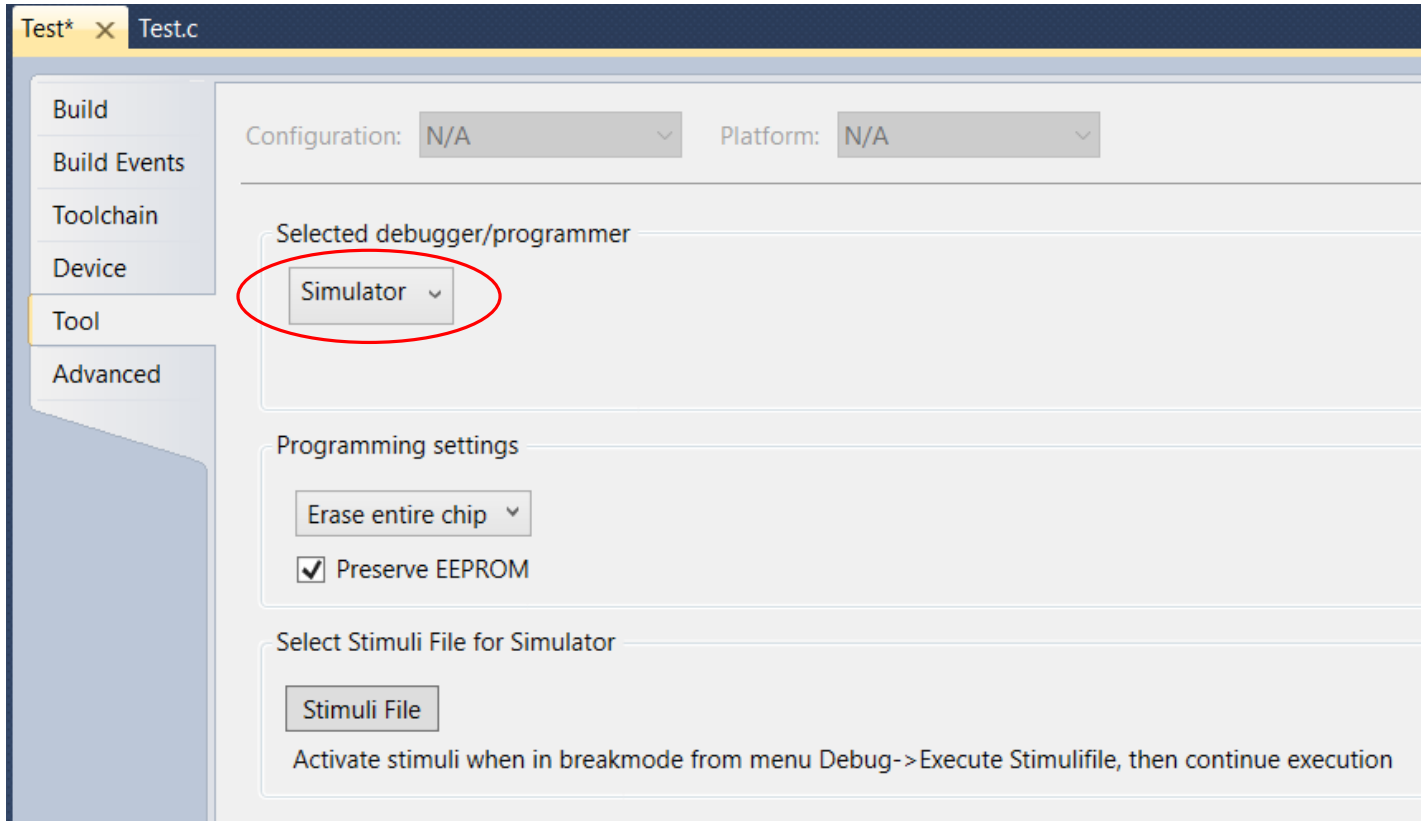
Debugging Techniques

- Debugging in Atmel Studio
  - Simulator mode
  - On-chip debugging using debugWire interface for Xplained Mini kits
- Debugging using Assert library
- Debugging using Hardware Peripherals
  - LEDs, LCD
  - Observing output signals using Oscilloscope

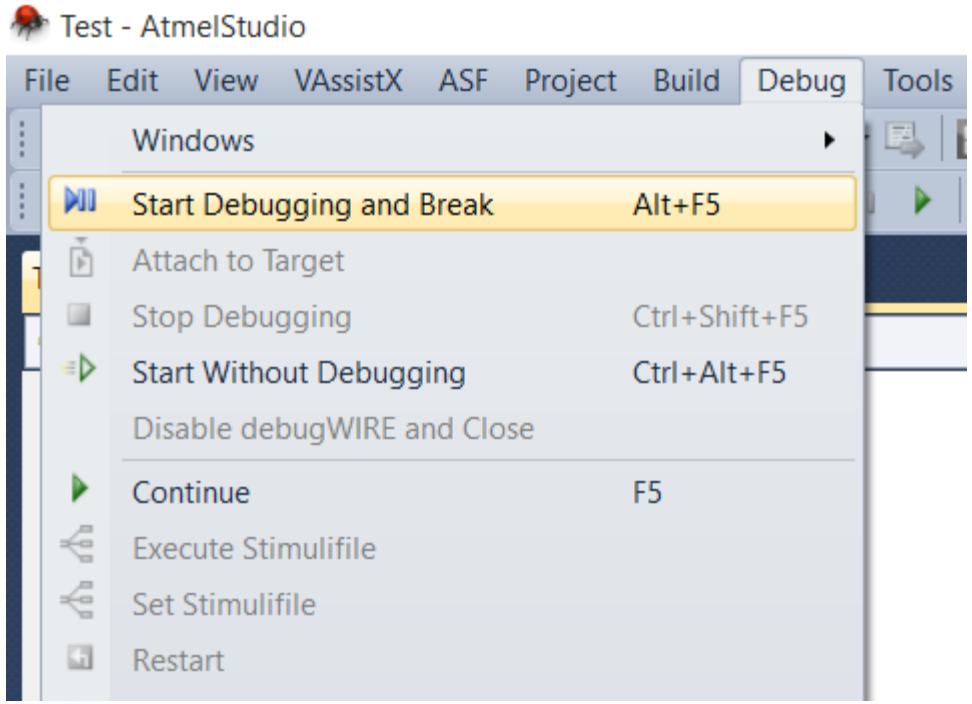
Debugging in Atmel Studio (Simulator Mode)

- Create a new Atmel Studio project
- Select “Simulator” from the Tool Selection tab



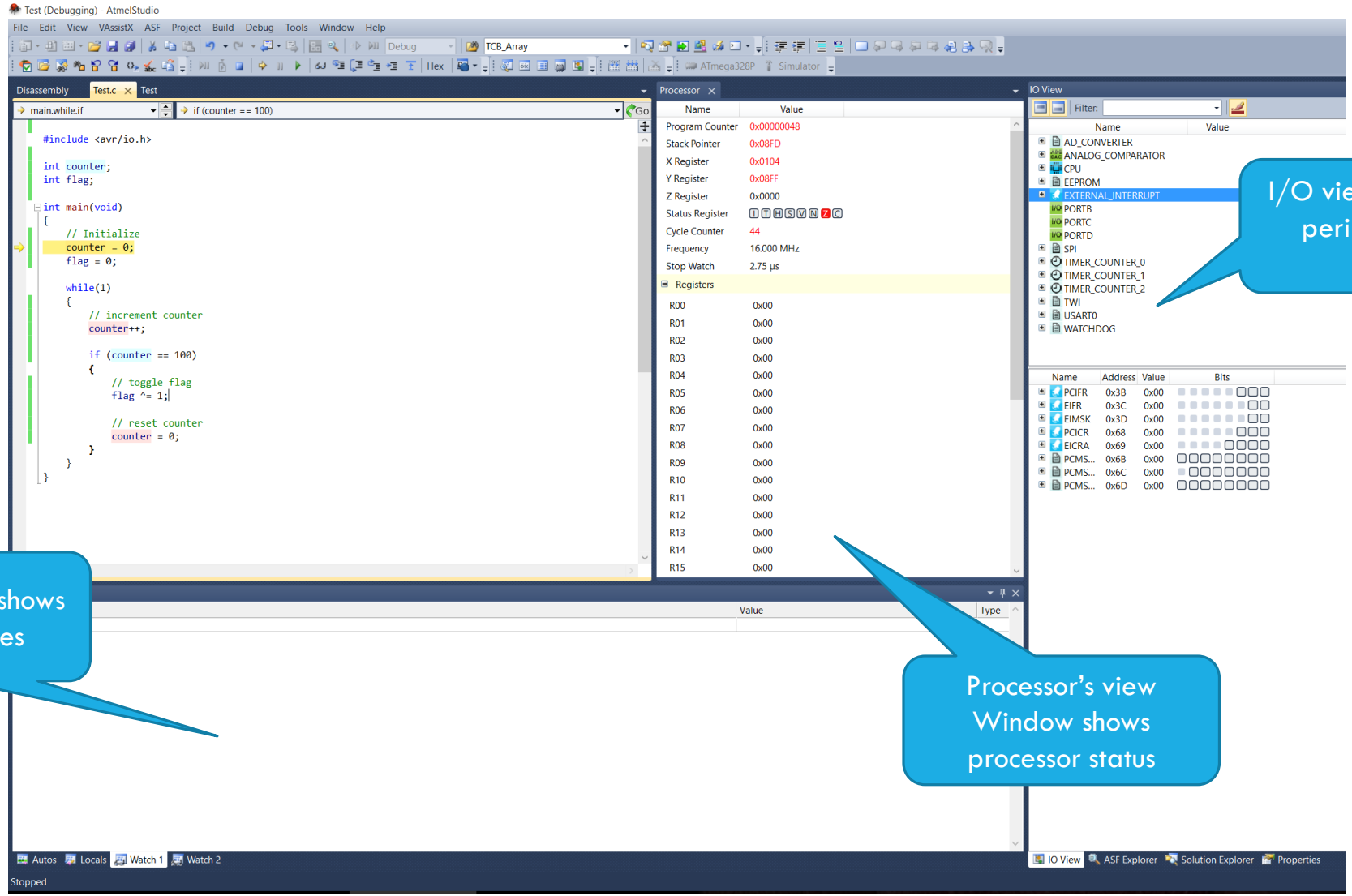
Starting a Debugging Session

- Build the project. (Hit F7)
- From Debug tab, select “Start Debugging and Break”
- The debugger pauses at the start of main.



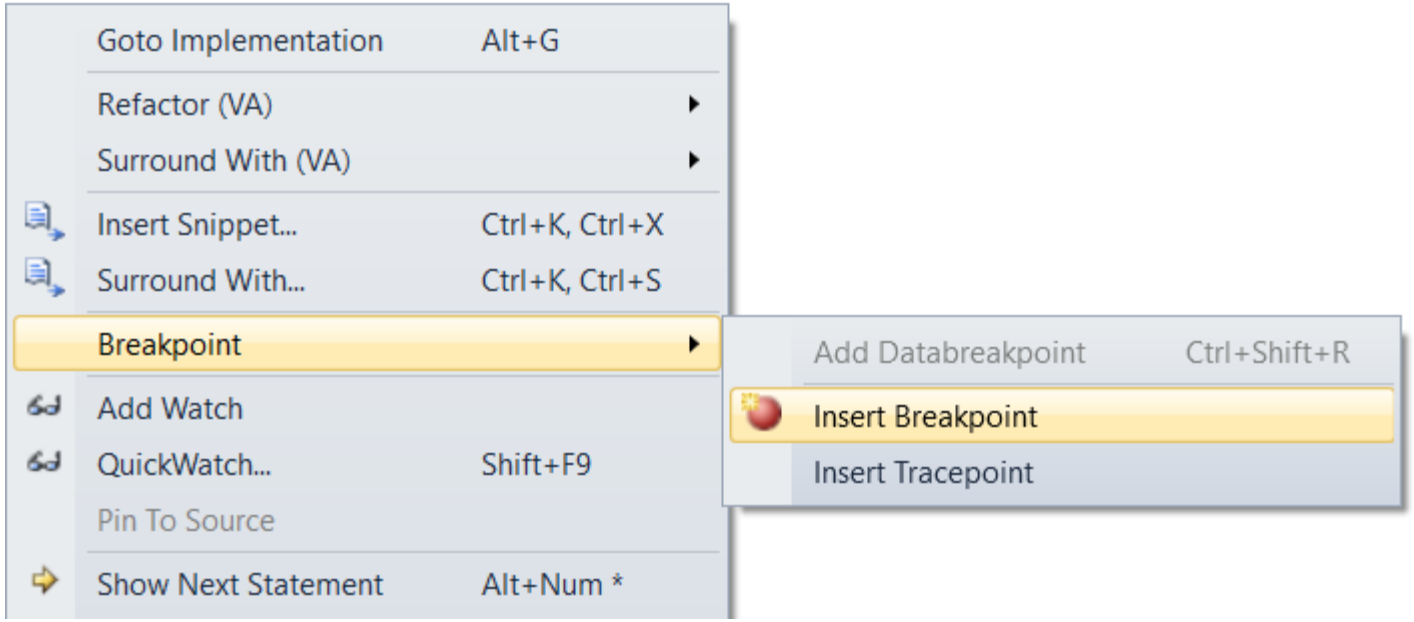

```c
#include <avr/io.h>

volatile int counter;
volatile int flag;

int main(void)
{
    // Initialize
    counter = 0;
    flag = 0;

    while(1)
    {
        // increment counter
        counter++;

        if (counter == 100)
        {
            // toggle flag
            flag ^= 1;

            // reset counter
            counter = 0;
        }
    }
}
```

Various Windows in Debugging Session



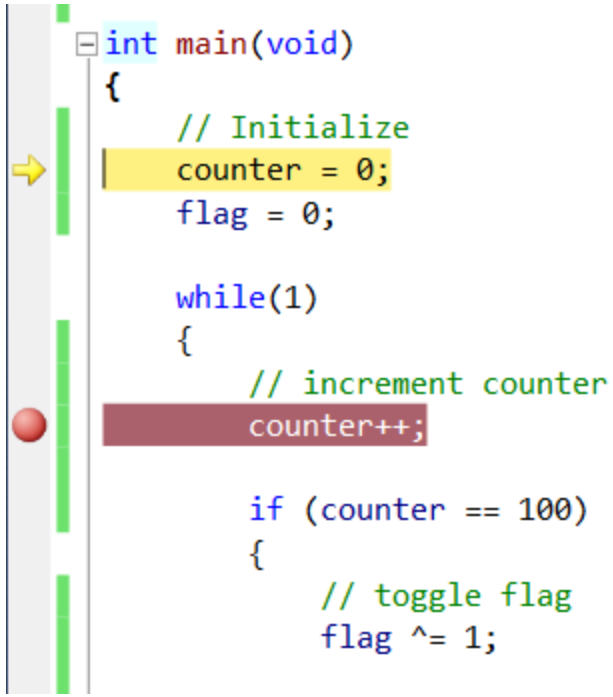
Adding a Breakpoint in Debugging Session

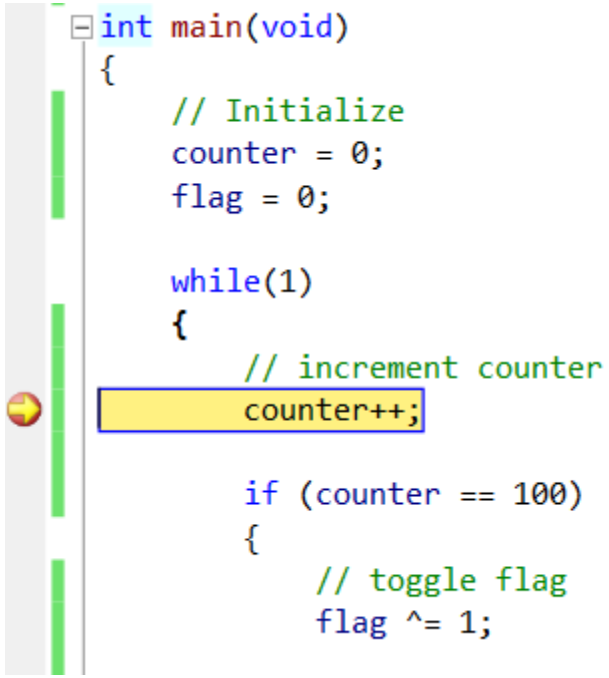
- Select any instruction in the code
- Right Click and insert a Breakpoint as follows



Continue to the next Breakpoint

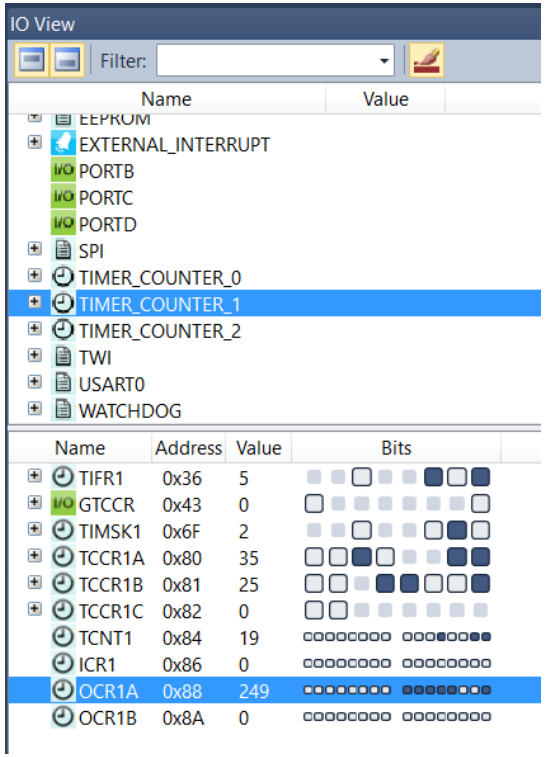
- After inserting a breakpoint, click Continue (F5)
- The program will stop at Breakpoint as shown in the right window.

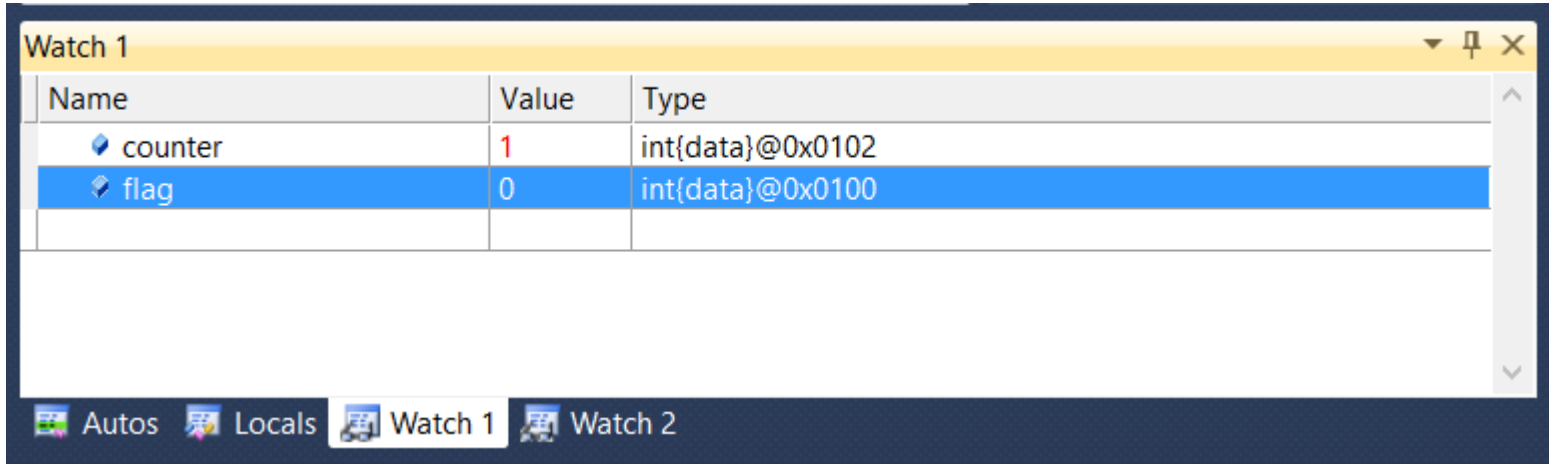




Observing Register/Variable Values at a Breakpoint

- Select particular peripheral and then the register to observe the value. (shown on left)
- Type variable names from your code in Watch Window to monitor their values. (shown on right)
  - Notice that I have ran through the loop once → counter = 1

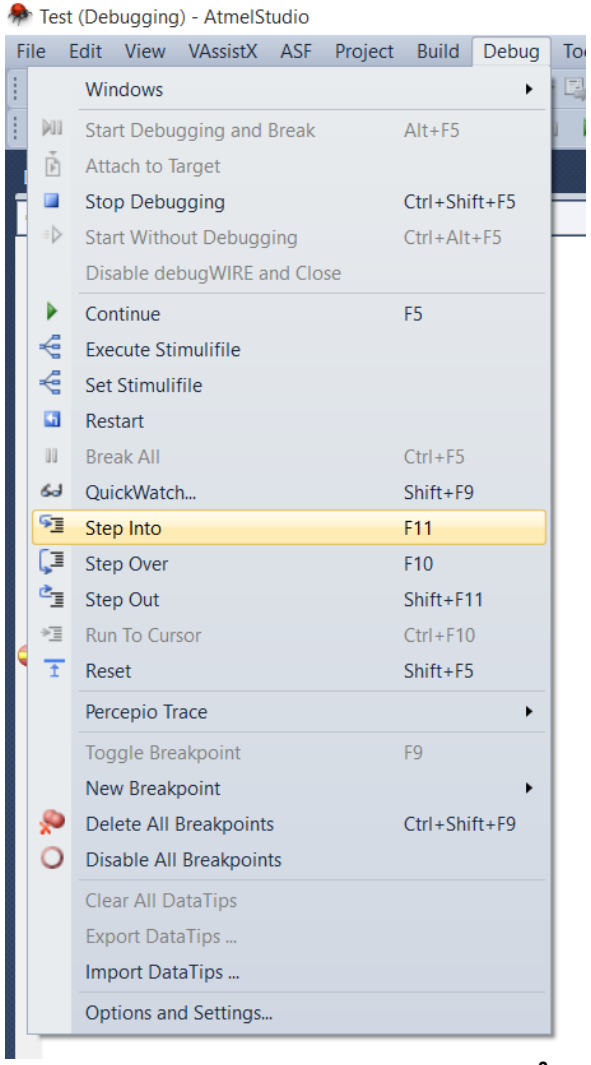




Other Commands in Debugging Session

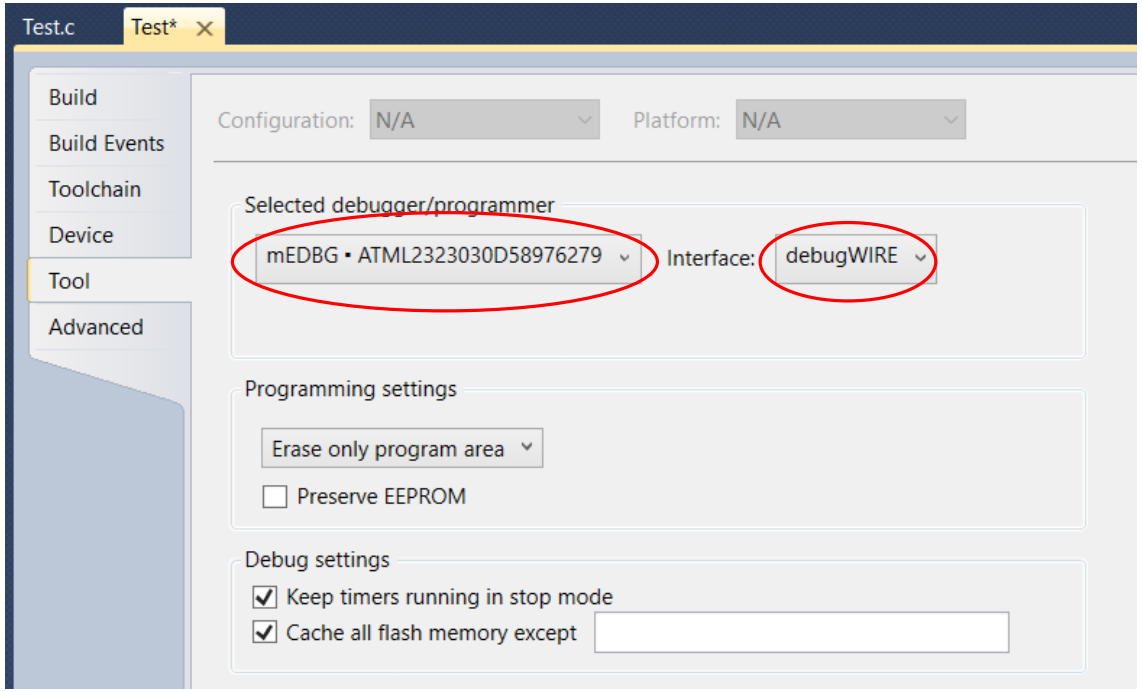
Inside 'Debug' tab, you'll see various useful debugging commands.

- 'Stop Debugging' exists the debugging session.
- 'Continue' run the code until the next breakpoint.
- 'Restart' restarts the debugging session and runs the code.
- 'Step Into' steps through the code line by line.
- 'Step Over' jumps over a function and stops after executing it.
- 'Step Out' returns from the current function and stops.
- 'Run to cursor' runs down to where the cursor is.
- 'Reset' command resets the current debugging session.



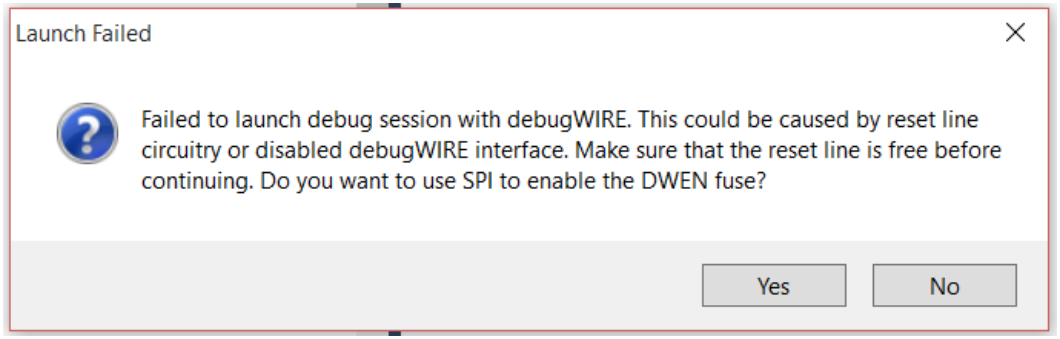
Debugging in Atmel Studio (debugWire Mode)

- On-chip debugging for Xplained Mini kits using debugWire interface is also quite similar to the simulator mode.
  - Simulator mode simulates the code as if it is running on the actual microcontroller
  - debugWire allows you to actually run the code on the microcontroller while you debug it step by step.
- Connect the Xplained Mini board with your computer
- Go to the Tool tab and select mEDBG with debugWire interface.



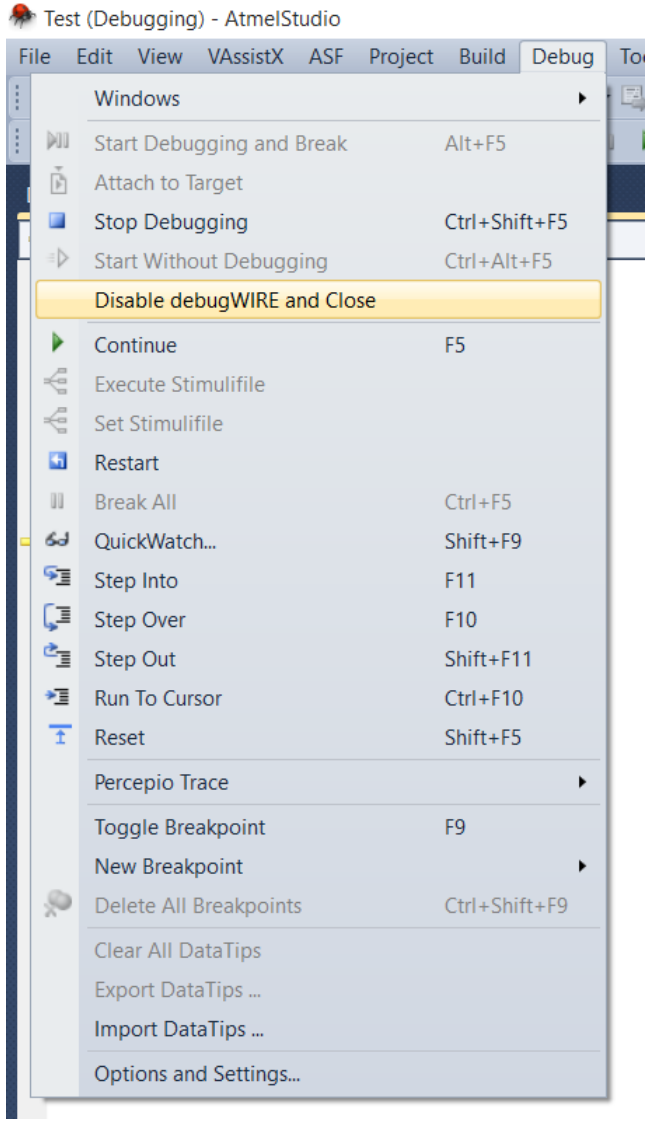
Starting a Debugging Session (debugWire Mode)

- Build the project (hit F7) and from Debug tab, select "Start Debugging and Break"
- Most likely you'll see an error message asking you to enable DWEN fuse (as shown below).
  - DWEN fuse (debugWire Enable fuse) enables the debugWire interface on your microcontroller.
  - Click 'Yes' on the error message window and enable DWEN fuse.
- The debugger will pause at the start of main, just like simulator mode.
- Now you may use similar debugging techniques as done in Simulator mode
  - Use breakpoints to stop at a particular instruction.
  - Use Watch windows to observe/set program variables.
  - Use I/O view to observe/set the peripheral registers.



Exiting a Debugging Session (debugWire Mode)

- It is really important to exit the debugWire debugging session in a proper way!
- To exit the debugging session, click on "Disable debugWire and Close".
  - This will first disable the DWEN fuse in the microcontroller.
  - Then it will close the debugging session.
- If DWEN fuse is not disabled, you'll not be able to program the microcontroller in ISP mode (which we want to use most frequently).



Debugging using Assert library

- http://people.ece.cornell.edu/land/courses/ece4760/Debugging/index.htm has many great suggestions
- One can use the assert library (http://en.wikipedia.org/wiki/Assert.h) to test assertions in code
- Example:

```
//set up the debugging utility ASSERT
#define __ASSERT_USE_STDERR
#include <assert.h>

//test assertion - will print message if argument is NOT true;
assert(time<10);
```

Debugging using Hardware Peripherals

- Debugging can also be performed by hardware peripherals.
  - By setting GPIO pins, for example, one can test the frequency of ISRs or certain program conditions (i.e. PORTD |= 0x01; when something happens) and measure results with an oscilloscope.
- Once the LCD lab has been done, one can also display variables and conditions on the screen as code is executed, if there are problems.