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H8/38602

Watch Dog Timer Example Code

Introduction

This short application note outlines the usage of the watch dog timer on the H8/38602. Firstly the watch dog timer is used as an interval timer to light an LED then the timer is used as a watchdog timer, and finally it is used to reset the device. Some lines of commented out code may also be used to turn the watchdog timer off.
The code is written for a MB-H838602 board. The tools used were an E8, HEW4, toolchain version 6.1.0.0

Contents

Development Environment

The following figure, figure 1, shows the environment used to develop the watch dog timer code.

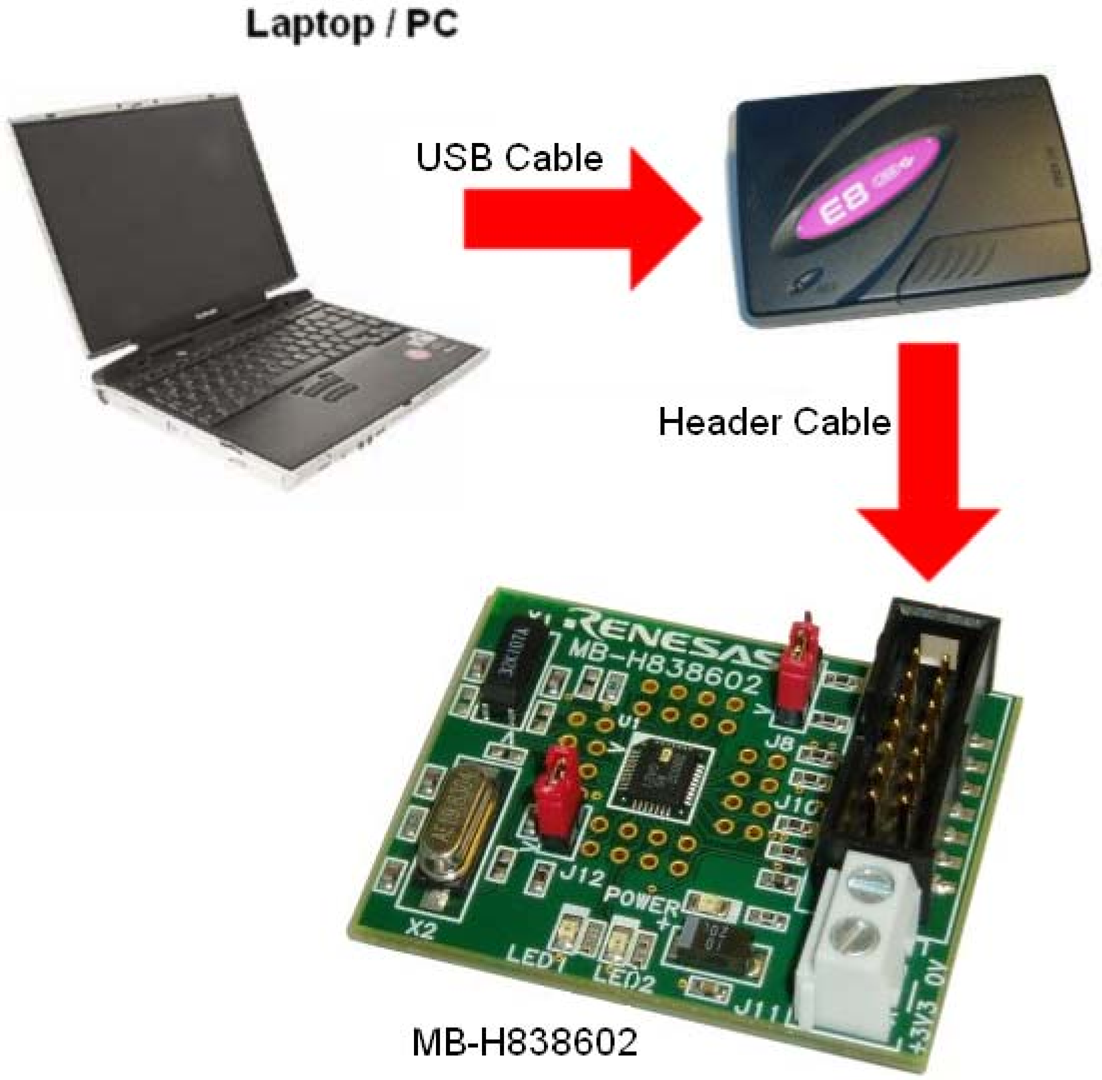


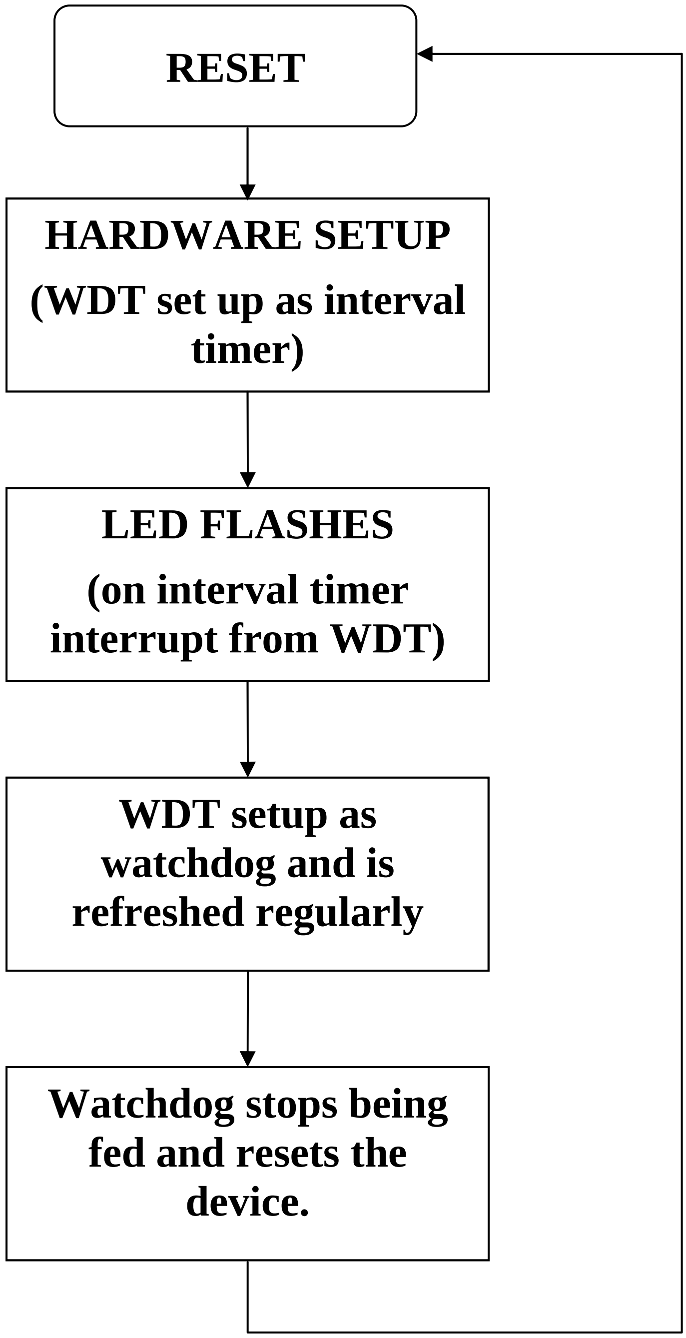
Figure 1: WDT on H8/38602 Development Environment

A laptop or PC is required to run HEW4 and the E8 driver. The USB port of the E8 may then be plugged into a PC USB port using a USB cable. A header cable may then be connected between the E8 and the MB-H838602 board.

External Program Operation

The program when run on the MB-H838602 will flash LED2 for a specific period of time. Once this period has elapsed the LED will stop flashing until the device is reset by the watchdog and the LED will start to flash once more. Figure 2 shows the program flow of the code.

Figure 2: Program flow



Program Code

This section outlines the code used to drive the watchdog timer.

Workspace

Figure 3 shows the workspace view window

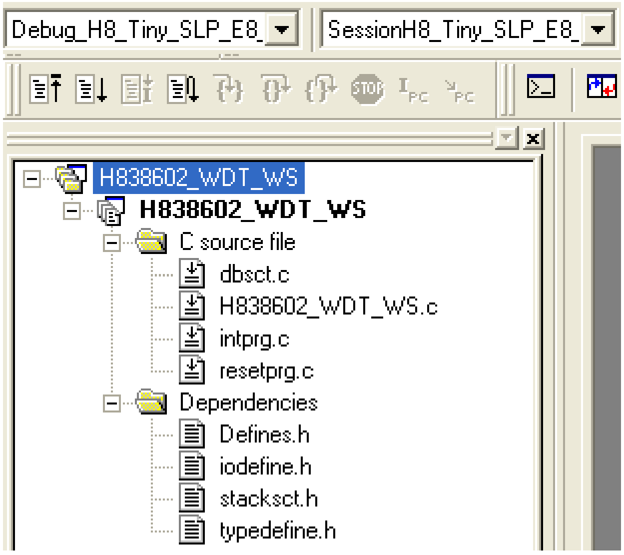


Figure 3: Workspace for the H8/38602 code.

There are four source files in the workspace. These are “resetprg.c”, “intprg.c”, “dbsct.c” and “H838602_WDT_WS.c”.

dbsct.c

This C file sets up the various memory sections.

intprg.c

This file lists the interrupt vector table.

resetprg.c

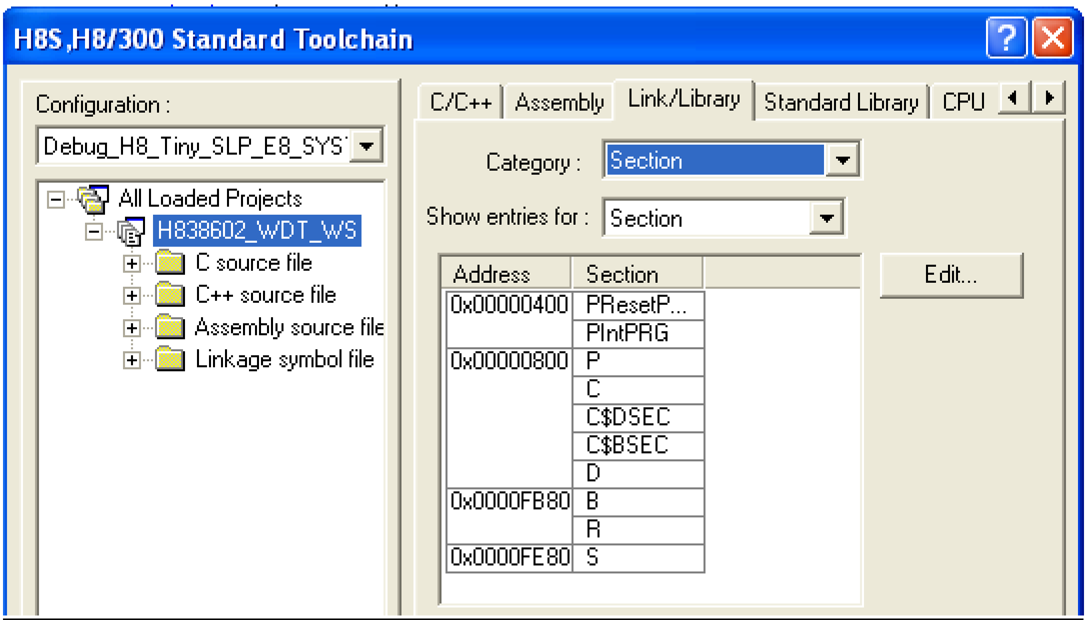
The code contained here is run after the device resets.

H838602_WDT_WS.c

The main function is contained in this file.

There are two session files in the workspace, these being “Release” and “SessionH8_Tiny_SLP_E8…”. The first is for downloading the finished monitor code into the device via the E8. The second is for debugging the code using the E8. In the Release session, when the connection dialogue appears, please select the third option “Writing Flash Memory”. In the “sessionH8_Tiny_SLP_E8…” session, please select the first option “Download emulator firmware”.

The sections of memory used in the program may be found by going to Build -> H8S, H8/300 Standard Toolchain… and then clicking on the Link/Library tab. Select “Section” in the category tab and the following window will appear.



The sections starting with “P” are code sections and are therefore located in ROM. The sections starting with “C” are constant data sections and therefore are also located in ROM. The “D” section is initialised data and so there is a value for these variables, structures etc. located in ROM (i.e. D). However this D section is also shadowed by the “R” section, located in RAM. Here the values of the variables, structures, arrays etc can change as the program runs. The B section is for uninitialised data which must have a value in RAM only which is free to change as the program runs. The S section represents the Stack and should therefore be placed in RAM.

Resetprg.c

```
#include    <machine.h>
#include    <_h_c_lib.h>
#include    "typedefine.h"
#include    "stacksct.h"

extern void main(void);
void PowerON_Reset(void);

#pragma section ResetPRG

__entry(vect=0) void PowerON_Reset(void)
{
     set_imask_ccr((_UBYTE)1);
    _INITSCT();

    set_imask_ccr((_UBYTE)0);

    main();

    sleep();
}
```

The code for the reset function is shown above. Once the device resets the device will start to run the code contained after the "__entry(vect = 0)…" line. The "#pragma section ResetPRG" line ensures that code in this file is placed in a code section called "ResetPRG". The I mask bit in the CCR register is set before the INITSCT function is run. This function initializes the memory sections in the device. The I mask bit in the CCR register is then cleared and the main function is called.

The stacksct.h file defines how large the stack is, the machine.h file contains the INITSCT function, the _h_c_lib.h file provides access to the CCR register and the typedefine.h file defines the size of _UBYTE.

H838602_WDT_WS.c

```
void main(void)
{// declare delay variable for creating a delay
 unsigned long int delay = 0;
 // declare i variable for loops
 unsigned char i = 0;
 // Set up LED 2 port pin for output
 led2();
 // Turn LED2 ON
 IO.PDR1.BIT.B0 = 0;
    // E8 has ability to switch WDT off
    // so in debug we can turn it on again
    #ifndef Release
    WDT.TCSRWD1.BYTE = 0x9e;     // unlock bits
    WDT.TCSRWD1.BYTE = 0x96;     // turn watchdog on
    WDT.TCSRWD1.BYTE = 0x86;    // lock bits
 // uncomment these for example of turning WDT off
 // WDT.TCSRWD1.BYTE = 0x92;    // unlock bits
 // WDT.TCSRWD1.BYTE = 0x92;     // turn watchdog off
    #endif
    // Set WDT as interval timer
    WDT.TCSRWD2.BYTE = 0x2F;
    // Enter "infinite" while loop
    while(1)
    {  // wait a while as LED will flash every time
       // WDT interval interrupt occurs
         for (delay = 0; delay < 0x900000; delay++);
       // Set WDT to WDT mode i.e. not interval
       WDT.TCSRWD2.BYTE = 0x0F;
       // Allow access to TMWD register
       WDT.TCSRWD1.BYTE = 0x5e;
       // Clear the WDT count register
       WDT.TMWD.BYTE = 0;
       // Lock bits again
       WDT.TCSRWD1.BYTE = 0x1e;

       // For an amount of time
      for(delay = 0; delay < 0x90000; delay++)
      {
        // Every so often
        for (i = 0; i < 20; i++);
        // unlock the bits
        WDT.TCSRWD1.BYTE = 0x5e;
        // Clear the WDT counter
        WDT.TCWD = 0;
        // Lock the bits again
        WDT.TCSRWD1.BYTE = 0x1e;
      }
    }
 }
```

The main function is shown in the previous code. Two variables are declared to be used as loop control variables. The microcontroller pin (P10 of the device) is connected to LED2 of the micon board. The led2() function sets up the P10 pin as an output pin, and LED 2 is then switched on by setting the P1 data register bit 0 to 0. The following three lines of code after "#ifndef Release" turn the Watchdog timer on. The first line unlocks the write protect bits in the timer control status register 1, the second sets the WDON bit and the third locks the write protect bits again helping to prevent erroneous access to this register during code runaway. The timer is then set as an interval timer using the timer control status register 2. The code then enters an infinite loop. Within the infinite loop, there is a delay. This allows the watchdog timer, functioning as an interval timer, to produce several interrupts. These interrupts toggle LED2 on and off. Once the delay is complete, the watchdog timer is then set as a watchdog timer (as opposed to an interval timer). The write protect bit (TCWE) in timer control status register 1 is then unlocked so that the TMWD (watchdog counter register) can be cleared. The TCWE bit is then locked again.

A second delay is introduced which clears the watchdog counter regularly. Once this delay is over the watchdog will reset the device and the code will start again.

Watchdog Interval Timer ISR

```
// ISR for Watchdog timer
__interrupt(vect=31) void INT_WDT(void)
{   // declare temp variable
    unsigned char temp = 0;

        // Clear WDT interrupt flag
        WDT.TCSRWD2.BYTE = 0x2F;

            // Determine whether LED is ON or OFF
            temp = IO.PDR1.BIT.B0;
            // If it is off
            if(temp == 1)
            // Turn it on
            IO.PDR1.BIT.B0 = 0;
            // If it is on, turn it off
            else    IO.PDR1.BIT.B0 = 1;

// If using the E8, ensure WDT is on
#ifndef Release
        WDT.TCSRWD1.BYTE = 0x9e;    /* Watchdog timer On */
        WDT.TCSRWD1.BYTE = 0xa6;
#endif
}
```

The code for the watchdog interval interrupt timer ISR is shown above. A temporary variable is declared (called "temp") which is used to determine whether LED2 is on or off. The second line of code clears the interrupt flag. A test is then made to see whether the LED is on or off; if it is off the LED is turned on, if it is on the LED is turned off.

The last few lines ensure the WDT timer remains on when using the E8 debugger.

Conclusion

The code written for the watchdog timer peripheral of the H8/38602 device utilised the timer both as an interval timer and a watchdog timer.

The interval timer function of the WDT peripheral was used to flash an LED, the watchdog timer part was used to reset the device.

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