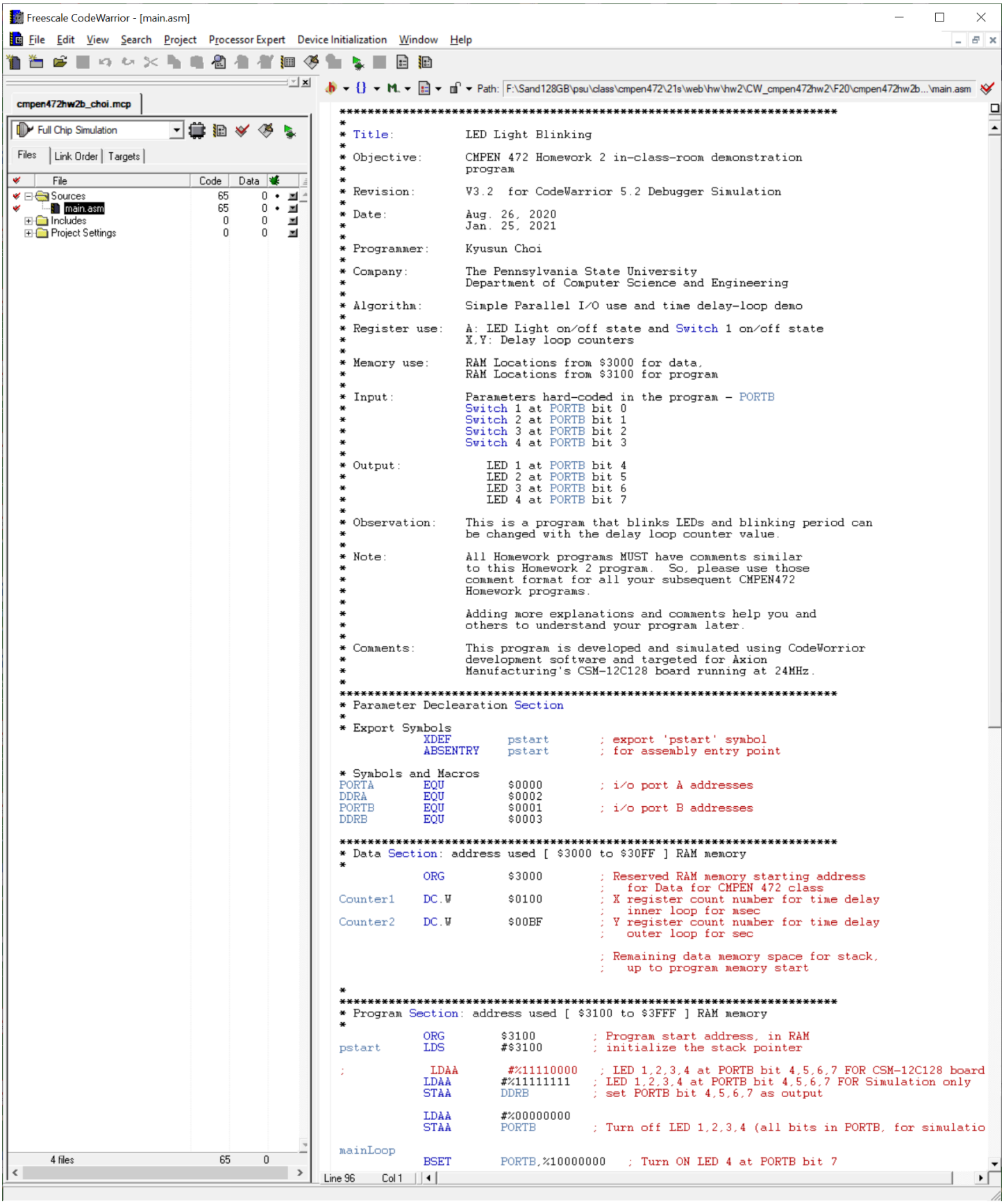
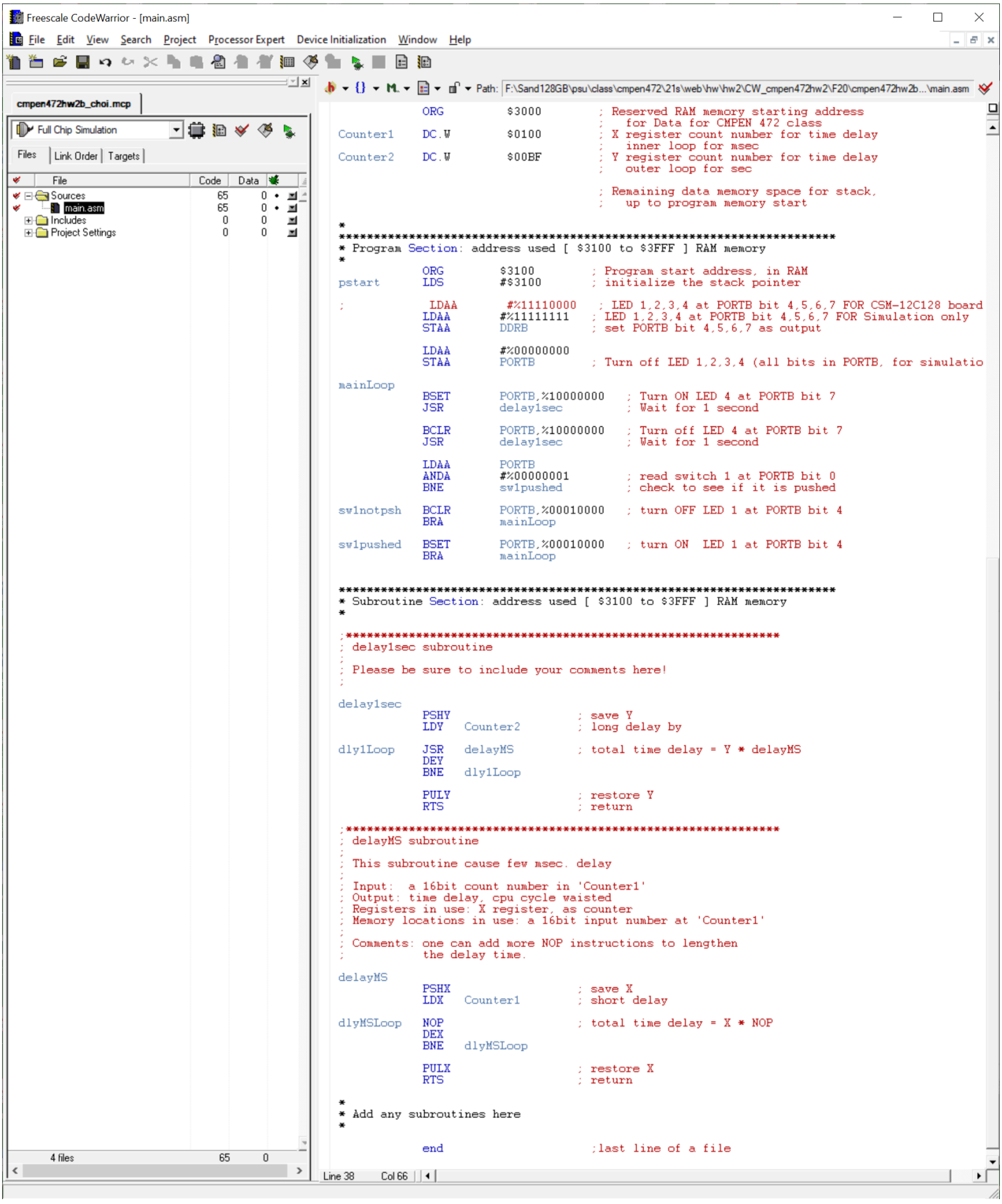
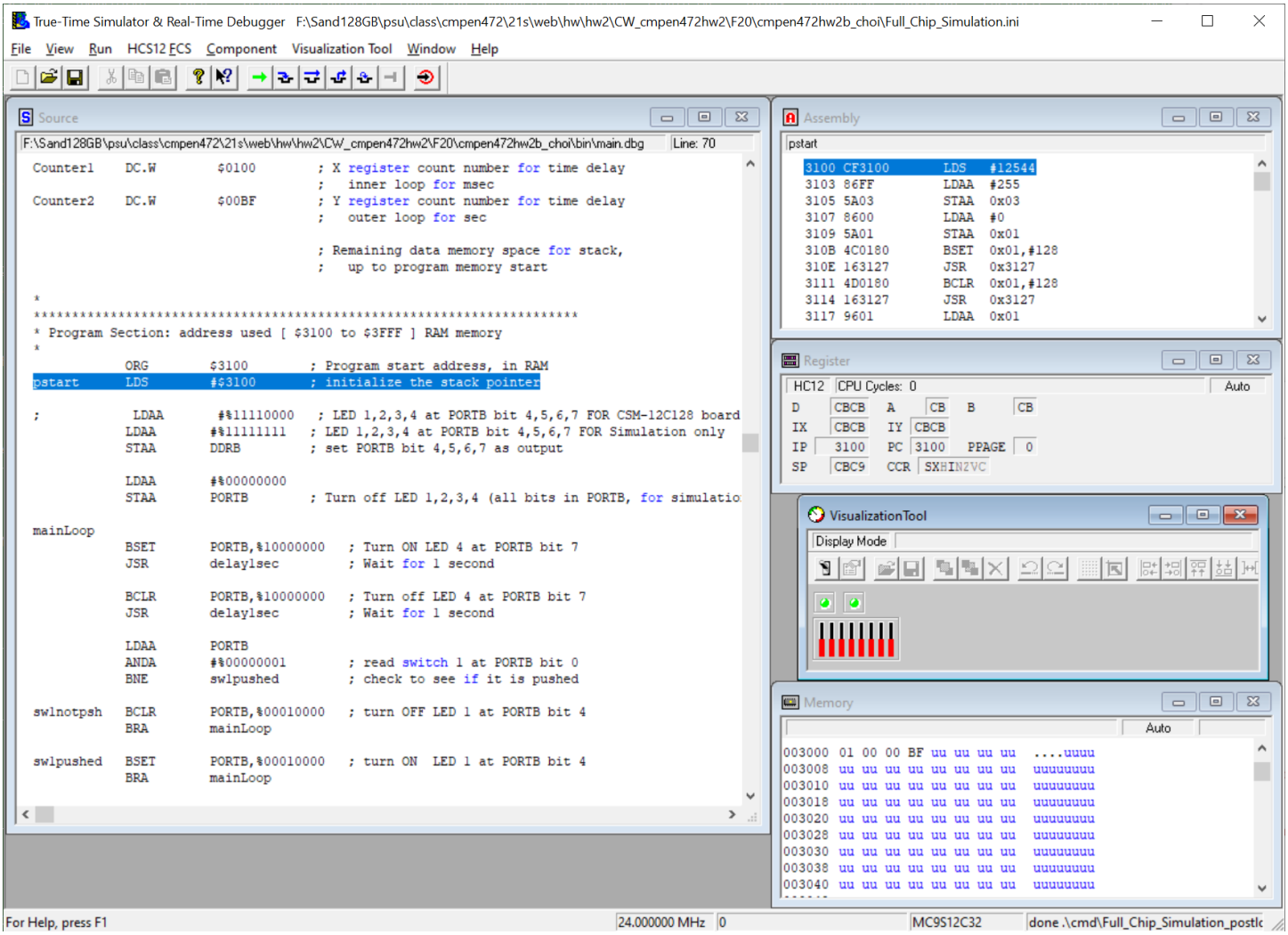
CMPEN 472 Homework 2, Blinking LED on HC12C128 Simulation




```
*****************************************************************
*
* Title:          LED Light Blinking
*
* Objective:      CMPEN 472 Homework 2 in-class-room demonstration
*                 program
*
* Revision:       V3.2  for CodeWarrior 5.2 Debugger Simulation
*
* Date:           Aug. 26, 2020
*                 Jan. 25, 2021
*
* Programmer:     Kyusun Choi
*
* Company:        The Pennsylvania State University
*                 Department of Computer Science and Engineering
*
* Algorithm:      Simple Parallel I/O use and time delay-loop demo
*
* Register use:   A: LED Light on/off state and Switch 1 on/off state
*                 X,Y: Delay loop counters
*
* Memory use:     RAM Locations from $3000 for data,
*                 RAM Locations from $3100 for program
*
* Input:          Parameters hard-coded in the program - PORTB
*                 Switch 1 at PORTB bit 0
*                 Switch 2 at PORTB bit 1
*                 Switch 3 at PORTB bit 2
*                 Switch 4 at PORTB bit 3
*
* Output:            LED 1 at PORTB bit 4
*                    LED 2 at PORTB bit 5
*                    LED 3 at PORTB bit 6
*                    LED 4 at PORTB bit 7
*
* Observation:    This is a program that blinks LEDs and blinking period can
*                 be changed with the delay loop counter value.
*
* Note:           All Homework programs MUST have comments similar
*                 to this Homework 2 program.  So, please use those
*                 comment format for all your subsequent CMPEN472
*                 Homework programs.
*
*                 Adding more explanations and comments help you and
*                 others to understand your program later.
*
* Comments:       This program is developed and simulated using CodeWorrior
*                 development software and targeted for Axion
*                 Manufacturing's CSM-12C128 board running at 24MHz.
*
*****************************************************************
* Parameter Declearation Section
*
* Export Symbols
            XDEF        pstart      ; export 'pstart' symbol
            ABSENTRY    pstart      ; for assembly entry point

* Symbols and Macros
PORTA       EQU         $0000       ; i/o port A addresses
DDRA        EQU         $0002
PORTB       EQU         $0001       ; i/o port B addresses
DDRB        EQU         $0003

*****************************************************************
* Data Section: address used [ $3000 to $30FF ] RAM memory
*
            ORG         $3000       ; Reserved RAM memory starting address
                                    ;   for Data for CMPEN 472 class
Counter1    DC.W        $0100       ; X register count number for time delay
                                    ;   inner loop for msec
Counter2    DC.W        $00BF       ; Y register count number for time delay
                                    ;   outer loop for sec

                                    ; Remaining data memory space for stack,
                                    ;   up to program memory start

*
*****************************************************************
* Program Section: address used [ $3100 to $3FFF ] RAM memory
*
            ORG         $3100       ; Program start address, in RAM
pstart      LDS         #$3100      ; initialize the stack pointer

;            LDAA       #%11110000  ; LED 1,2,3,4 at PORTB bit 4,5,6,7 FOR CSM-12C128 board
            LDAA        #%11111111  ; LED 1,2,3,4 at PORTB bit 4,5,6,7 FOR Simulation only
            STAA        DDRB        ; set PORTB bit 4,5,6,7 as output

            LDAA        #%00000000
            STAA        PORTB       ; Turn off LED 1,2,3,4 (all bits in PORTB, for simulatio

mainLoop
            BSET        PORTB,%10000000   ; Turn ON LED 4 at PORTB bit 7
```



Save Make Debug



HCS12_FCS: Clock Frequency 24MHz

Component: VisualizationTool

VisualizationTool: Properties

VisualizationTool: Properties: Refresh Mode = CPU Cycles, Cycle Refresh Count = 1

VisualizationTool: Add New Instrument = LED

VisualizationTool: LED: Properties:

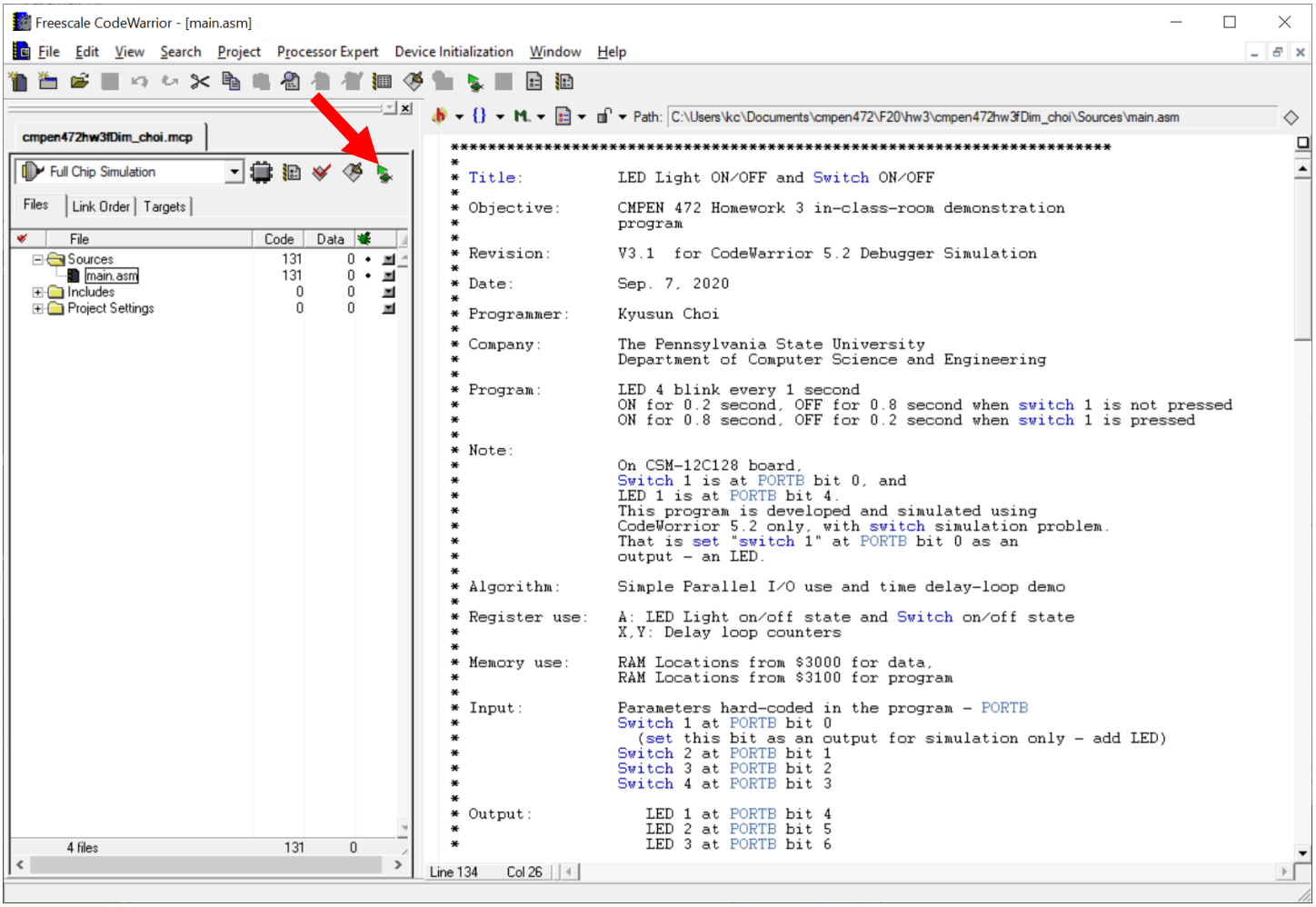
Set Port to Display to 0x0001 PORTB
Set Size 1 Byte 8bit port
Set Byte Order to Big Endian
Set Bit Number to Display to 4 LED 1

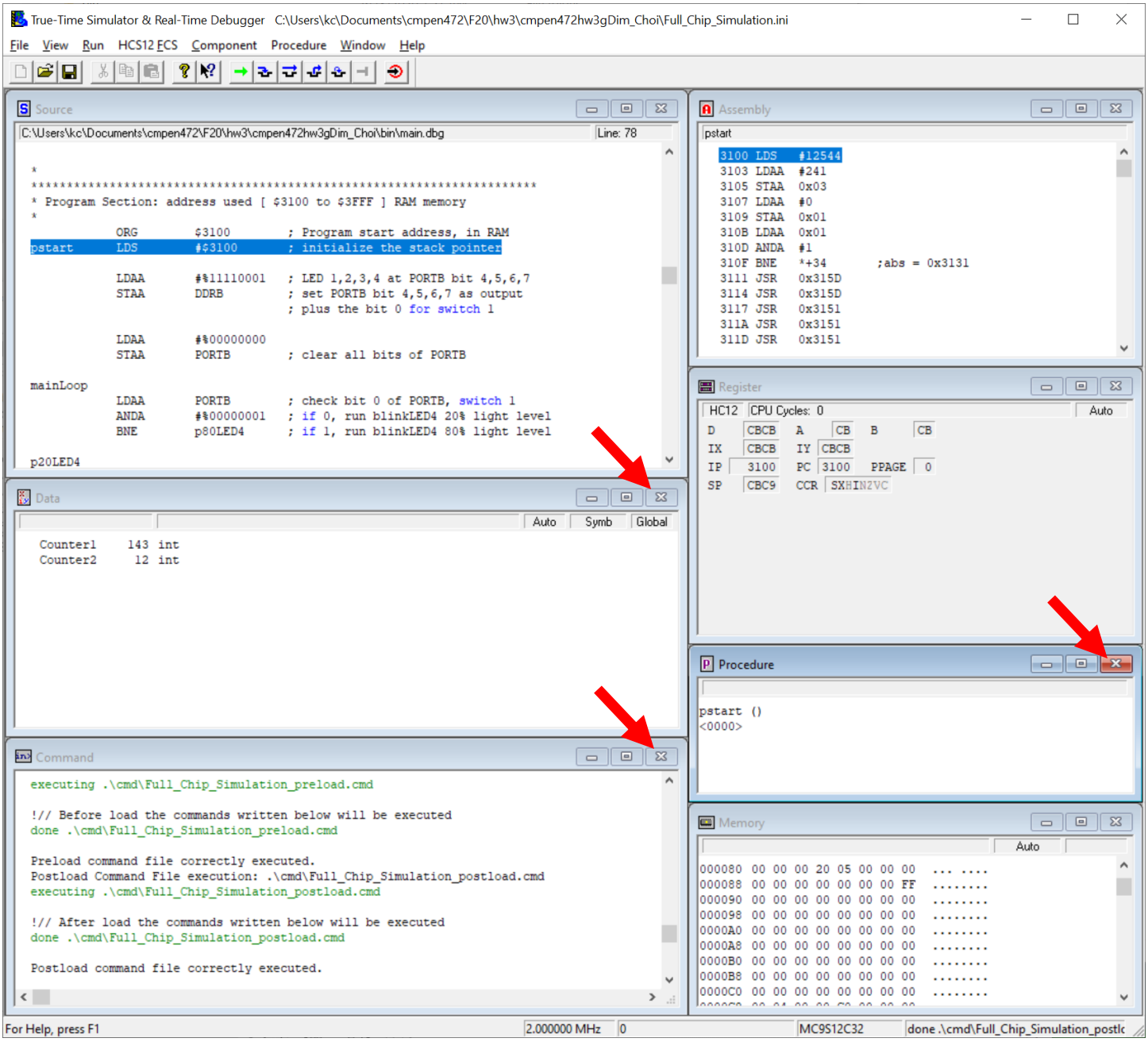
VisualizationTool: Save Layout As . . . . cmpen472hw2_choi.vtl

Source
Assembly
Register
VisualizationTool
Memory

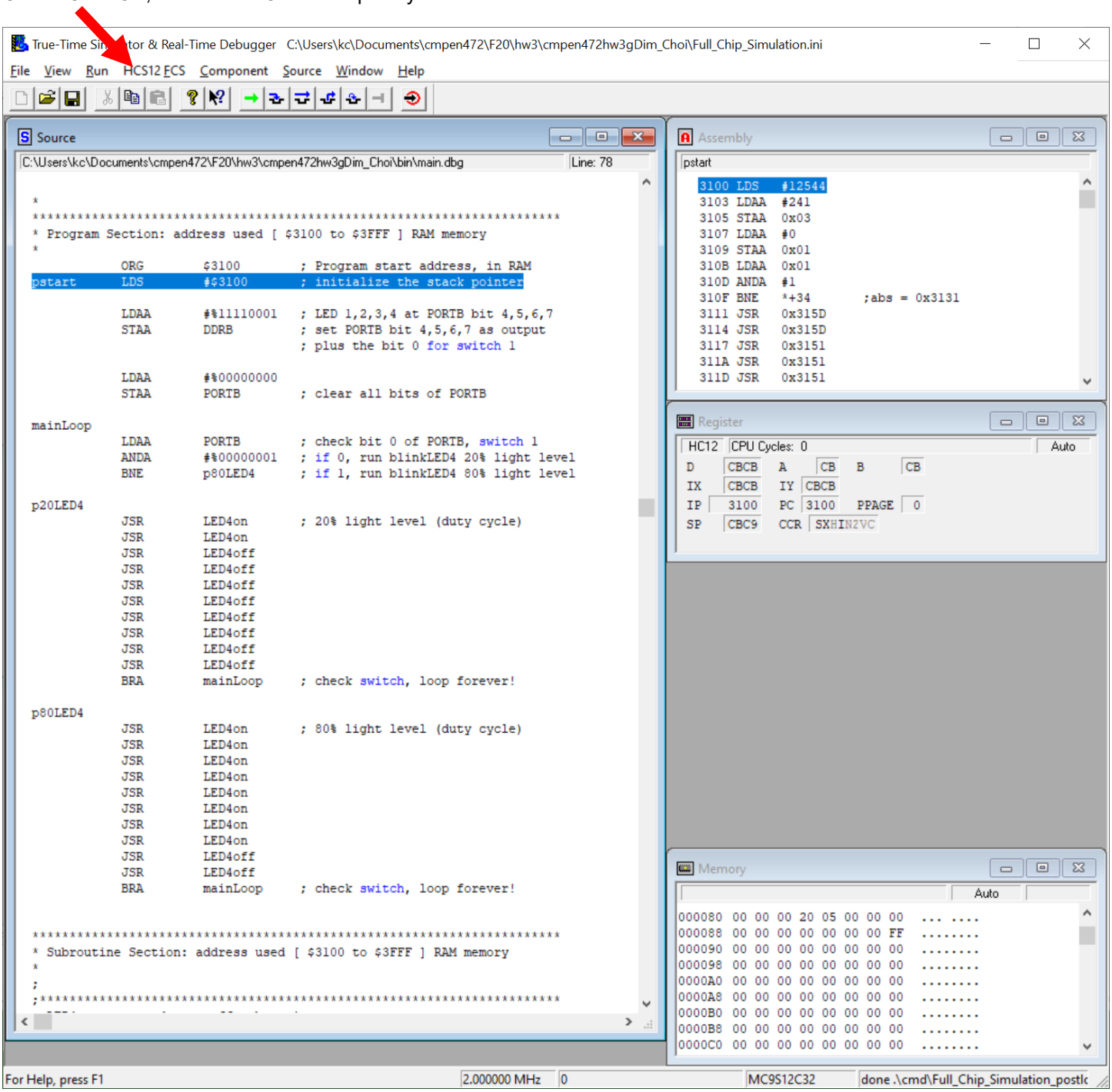
File: Save Configuration

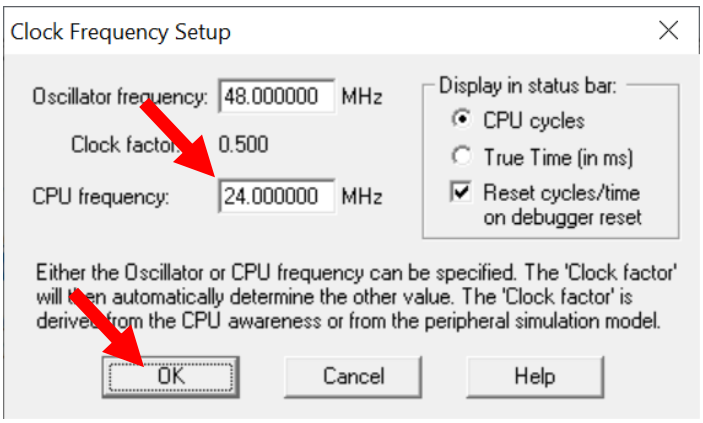
Start CodeWarrior Debugger/Simulator – pictorial instruction

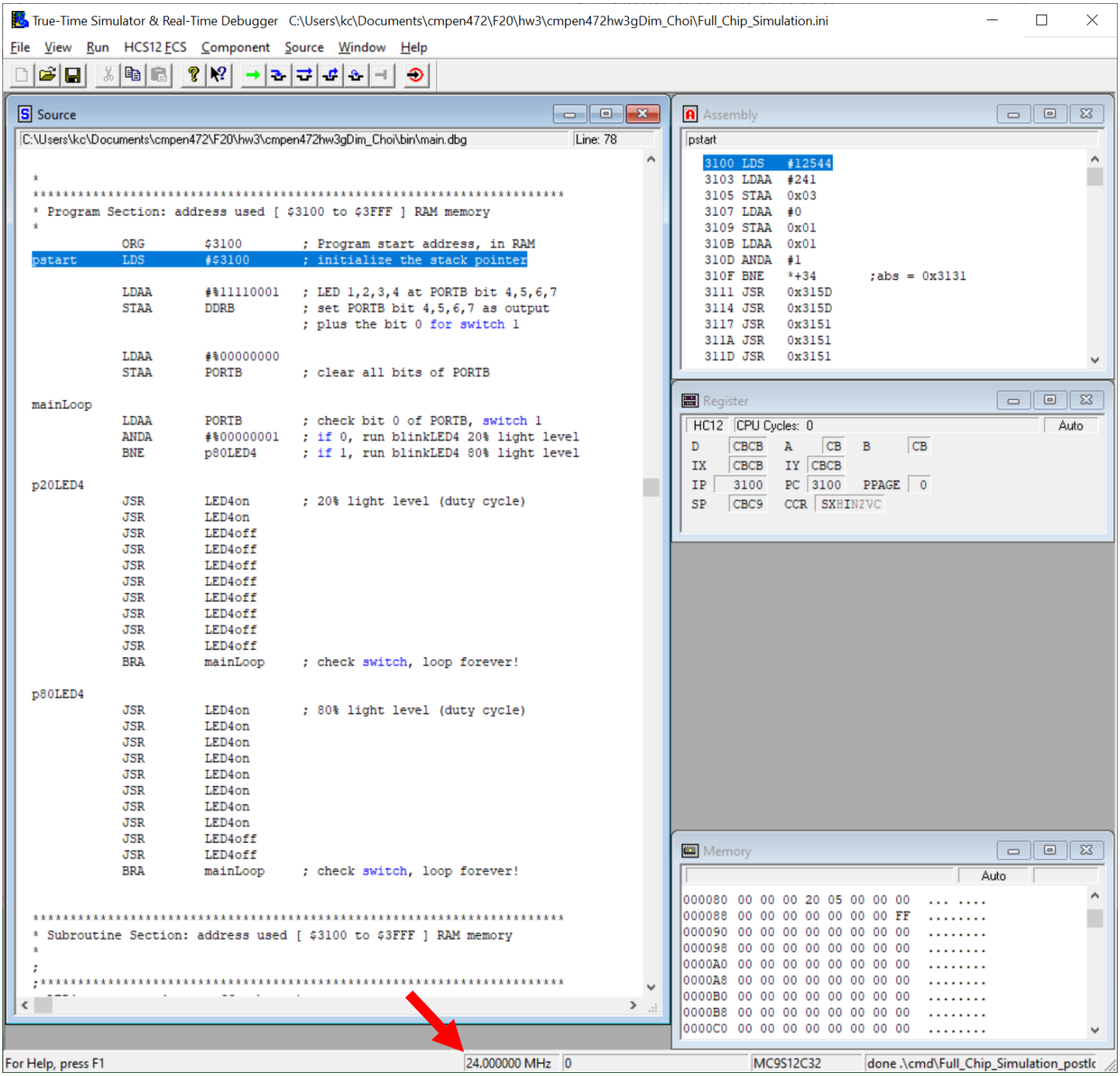



True-Time Simulator & Real-Time Debugger C:\Users\kc\Documents\cmpen472\F20\hw3\cmpen472hw3gDim_Choi\Full_Chip_Simulation.ini
File View Run HCS12 FCS Component Procedure Window Help
Source
C:\Users\kc\Documents\cmpen472\F20\hw3\cmpen472hw3gDim_Choi\bin\main.dbg
Line: 78
* Program Section: address used [$3100 to $3FFF] RAM memory
ORG $3100 ; Program start address, in RAM
pstart LDS #$3100 ; initialize the stack pointer
LDAA #%11110001 ; LED 1,2,3,4 at PORTB bit 4,5,6,7
STAA DDRB ; set PORTB bit 4,5,6,7 as output
; plus the bit 0 for switch 1
LDAA #%00000000
STAA PORTB ; clear all bits of PORTB
mainLoop
LDAA PORTB ; check bit 0 of PORTB, switch 1
ANDA #%00000001 ; if 0, run blinkLED4 20% light level
BNE p80LED4 ; if 1, run blinkLED4 80% light level
p20LED4
Assembly
pstart
3100 LDS #12544
3103 LDAA #241
3105 STAA 0x03
3107 LDAA #0
3109 STAA 0x01
310B LDAA 0x01
310D ANDA #1
310F BNE *+34 ;abs = 0x3131
3111 JSR 0x315D
3114 JSR 0x315D
3117 JSR 0x3151
311A JSR 0x3151
311D JSR 0x3151
Register
HC12 CPU Cycles: 0 Auto
D CBCB A CB B CB
IX CBCB IY CBCB
IP 3100 PC 3100 PPAGE 0
SP CBC9 CCR SXHIN2VC
Data
Auto Symb Global
Counter1 143 int
Counter2 12 int
Procedure
pstart ()
<0000>
Command
executing .\cmd\Full_Chip_Simulation_preload.cmd
!// Before load the commands written below will be executed
done .\cmd\Full_Chip_Simulation_preload.cmd
Preload command file correctly executed.
Postload Command File execution: .\cmd\Full_Chip_Simulation_postload.cmd
executing .\cmd\Full_Chip_Simulation_postload.cmd
!// After load the commands written below will be executed
done .\cmd\Full_Chip_Simulation_postload.cmd
Postload command file correctly executed.
Memory
Auto
000080 00 00 00 20 05 00 00 00 ... .
000088 00 00 00 00 00 00 00 FF ....
000090 00 00 00 00 00 00 00 00 ....
000098 00 00 00 00 00 00 00 00 ....
0000A0 00 00 00 00 00 00 00 00 ....
0000A8 00 00 00 00 00 00 00 00 ....
0000B0 00 00 00 00 00 00 00 00 ....
0000B8 00 00 00 00 00 00 00 00 ....
0000C0 00 00 00 00 00 00 00 00 ....
For Help, press F1
2.000000 MHz
0
MC9S12C32
done .\cmd\Full_Chip_Simulation_postlc

Click HC12FCS, and select “Clock Frequency . . . . ”

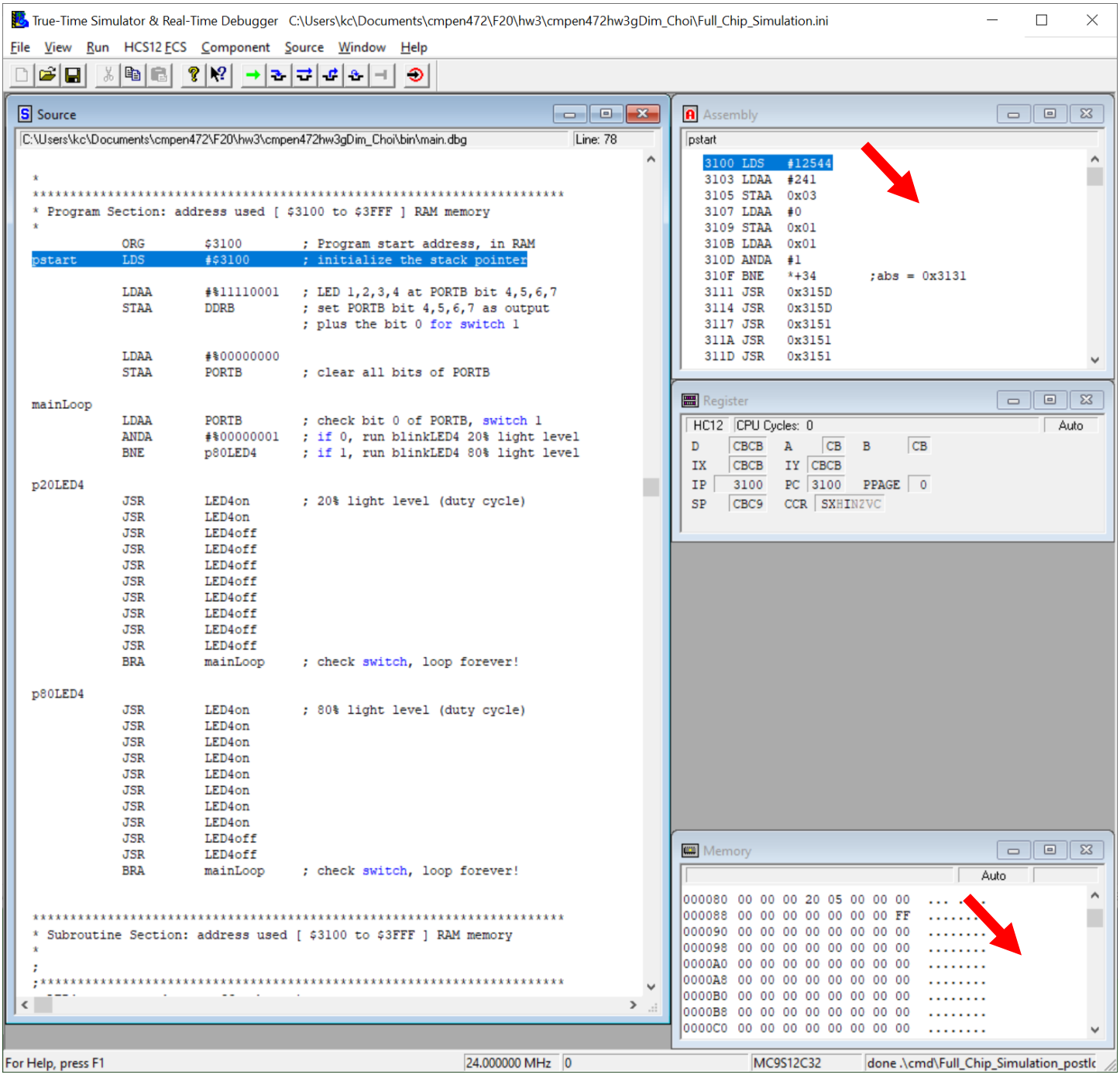


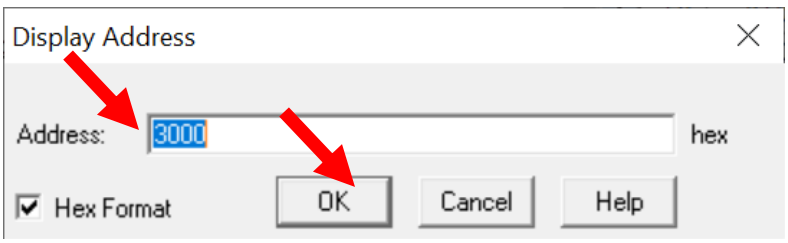


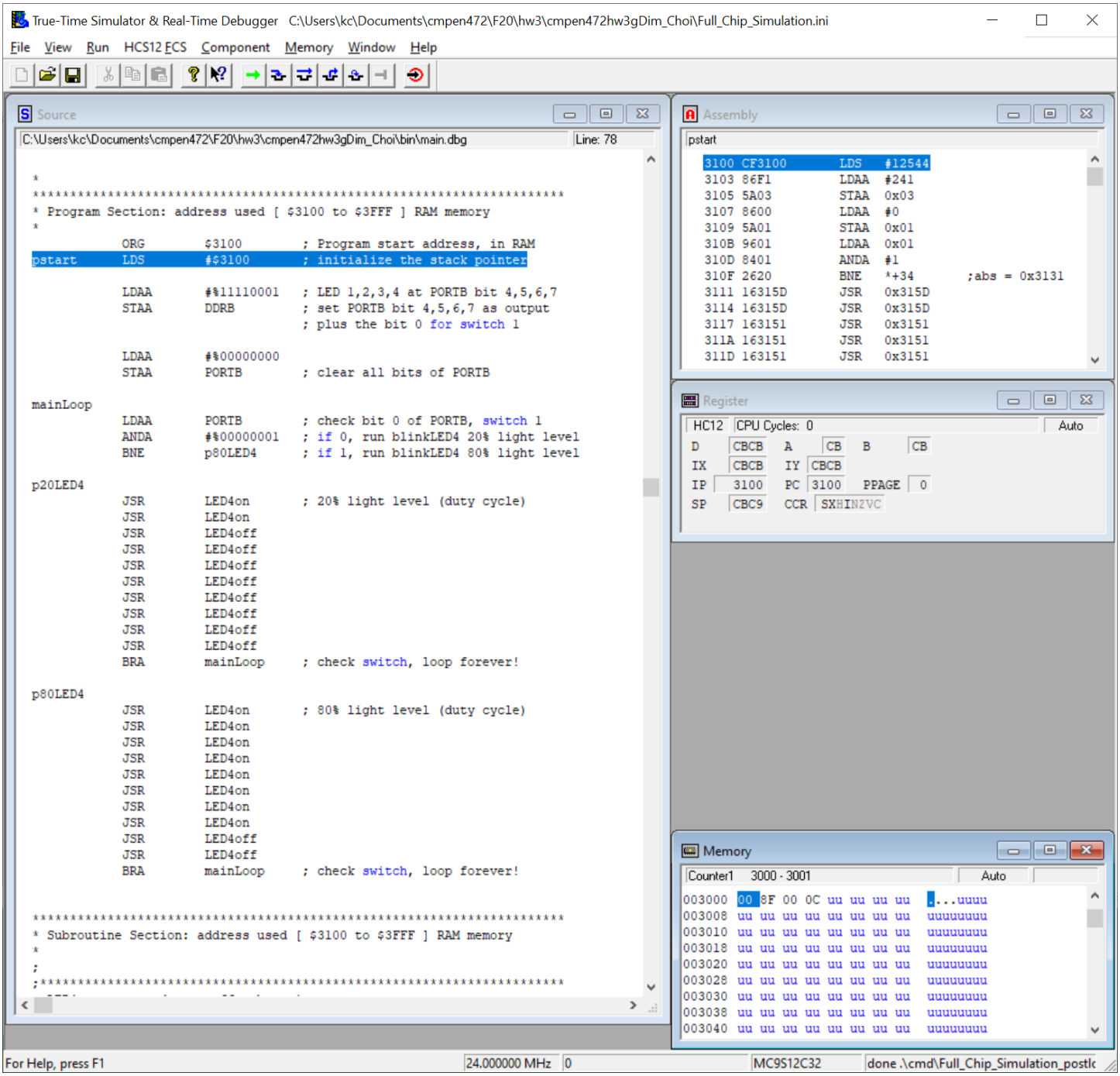

True-Time Simulator & Real-Time Debugger C:\Users\kc\Documents\cmpen472\F20\hw3\cmpen472hw3gDim_Choi\Full_Chip_Simulation.ini
File View Run HCS12 FCS Component Source Window Help
Source
C:\Users\kc\Documents\cmpen472\F20\hw3\cmpen472hw3gDim_Choi\bin\main.dbg
Line: 78
* Program Section: address used [$3100 to $3FFF] RAM memory
ORG $3100 ; Program start address, in RAM
pstart LDS #$3100 ; initialize the stack pointer
LDAA #%11110001 ; LED 1,2,3,4 at PORTB bit 4,5,6,7
STAA DDRB ; set PORTB bit 4,5,6,7 as output
; plus the bit 0 for switch 1
LDAA #%00000000
STAA PORTB ; clear all bits of PORTB
mainLoop
LDAA PORTB ; check bit 0 of PORTB, switch 1
ANDA #%00000001 ; if 0, run blinkLED4 20% light level
BNE p80LED4 ; if 1, run blinkLED4 80% light level
p20LED4
JSR LED4on ; 20% light level (duty cycle)
JSR LED4on
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
BRA mainLoop ; check switch, loop forever!
p80LED4
JSR LED4on ; 80% light level (duty cycle)
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4off
JSR LED4off
BRA mainLoop ; check switch, loop forever!
* Subroutine Section: address used [$3100 to $3FFF] RAM memory
Assembly
pstart
3100 LDS #12544
3103 LDAA #241
3105 STAA 0x03
3107 LDAA #0
3109 STAA 0x01
310B LDAA 0x01
310D ANDA #1
310F BNE *+34 ;abs = 0x3131
3111 JSR 0x315D
3114 JSR 0x315D
3117 JSR 0x3151
311A JSR 0x3151
311D JSR 0x3151
Register
HC12 CPU Cycles: 0 Auto
D CBCB A CB B CB
IX CBCB IY CBCB
IP 3100 PC 3100 PPAGE 0
SP CBC9 CCR SXHINZVC
Memory
Auto
000080 00 00 00 20 05 00 00 00 ... .
000088 00 00 00 00 00 00 00 FF ....
000090 00 00 00 00 00 00 00 00 ....
000098 00 00 00 00 00 00 00 00 ....
0000A0 00 00 00 00 00 00 00 00 ....
0000A8 00 00 00 00 00 00 00 00 ....
0000B0 00 00 00 00 00 00 00 00 ....
0000B8 00 00 00 00 00 00 00 00 ....
0000C0 00 00 00 00 00 00 00 00 ....
For Help, press F1
24.000000 MHz
0
MC9S12C32
done .\cmd\Full_Chip_Simulation_postlc

Display machine code on Assembly window: right click Assembly window and select “Display”, and then select “Code”.

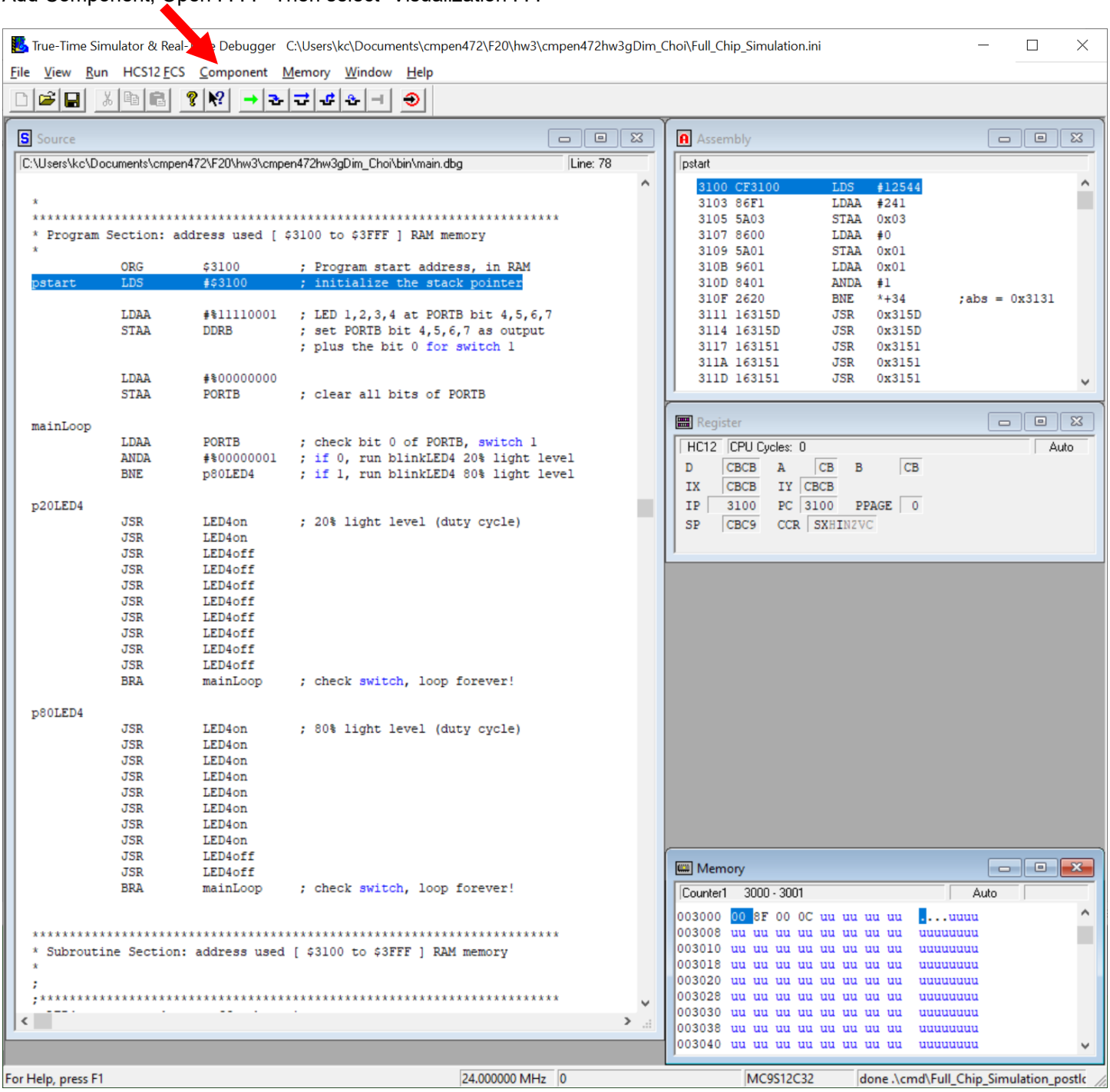
Also display memory location $3000 on the Memory window: right click Memory window and select “Address”. Then type “3000” and click “OK”.

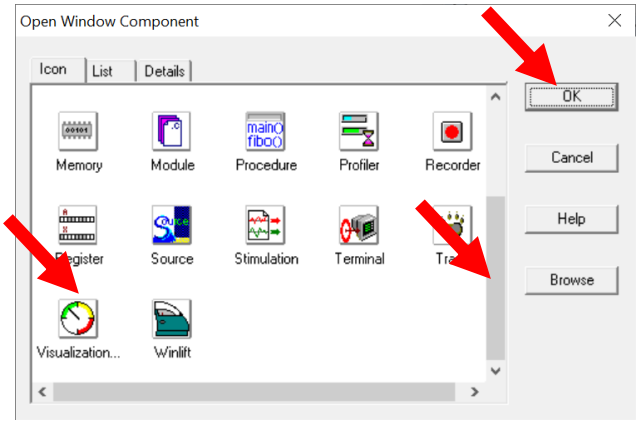




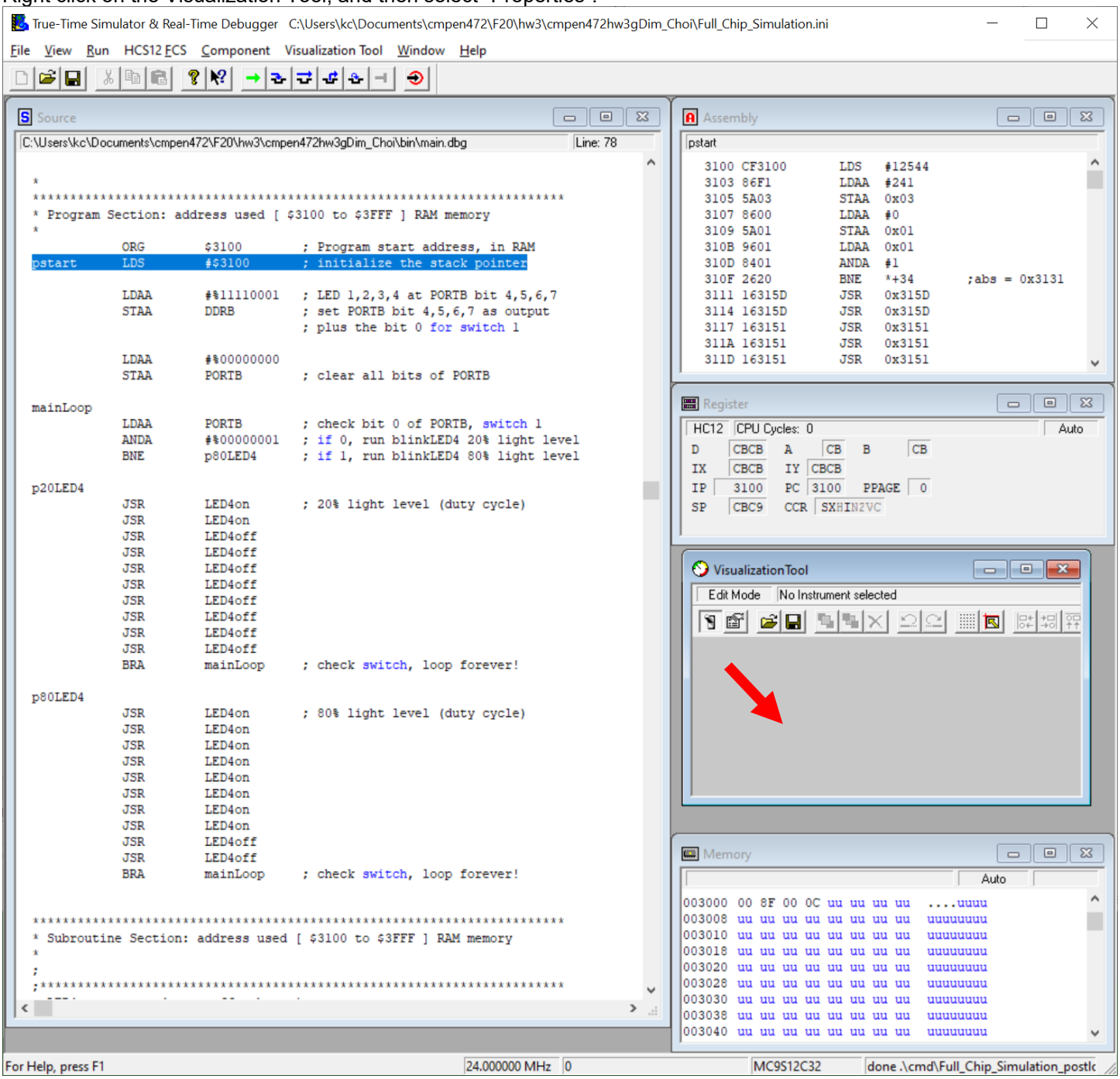

True-Time Simulator & Real-Time Debugger C:\Users\kc\Documents\cmpen472\F20\hw3\cmpen472hw3gDim_Choi\Full_Chip_Simulation.ini
File View Run HCS12 FCS Component Memory Window Help
Source
C:\Users\kc\Documents\cmpen472\F20\hw3\cmpen472hw3gDim_Choi\bin\main.dbg
Line: 78
* Program Section: address used [$3100 to $3FFF] RAM memory
ORG $3100 ; Program start address, in RAM
pstart LDS #$3100 ; initialize the stack pointer
LDAA #%11110001 ; LED 1,2,3,4 at PORTB bit 4,5,6,7
STAA DDRB ; set PORTB bit 4,5,6,7 as output
; plus the bit 0 for switch 1
LDAA #%00000000
STAA PORTB ; clear all bits of PORTB
mainLoop
LDAA PORTB ; check bit 0 of PORTB, switch 1
ANDA #%00000001 ; if 0, run blinkLED4 20% light level
BNE p80LED4 ; if 1, run blinkLED4 80% light level
p20LED4
JSR LED4on ; 20% light level (duty cycle)
JSR LED4on
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
JSR LED4off
BRA mainLoop ; check switch, loop forever!
p80LED4
JSR LED4on ; 80% light level (duty cycle)
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4on
JSR LED4off
JSR LED4off
BRA mainLoop ; check switch, loop forever!
* Subroutine Section: address used [$3100 to $3FFF] RAM memory
Assembly
pstart
3100 CF3100 LDS #12544
3103 86F1 LDAA #241
3105 5A03 STAA 0x03
3107 8600 LDAA #0
3109 5A01 STAA 0x01
310B 9601 LDAA 0x01
310D 8401 ANDA #1
310F 2620 BNE *+34 ;abs = 0x3131
3111 16315D JSR 0x315D
3114 16315D JSR 0x315D
3117 163151 JSR 0x3151
311A 163151 JSR 0x3151
311D 163151 JSR 0x3151
Register
HC12 CPU Cycles: 0 Auto
D CBCB A CB B CB
IX CBCB IY CBCB
IP 3100 PC 3100 PPAGE 0
SP CBC9 CCR SXHINZVC
Memory
Counter1 3000 - 3001 Auto
003000 00 8F 00 0C uu uu uu uu .....uuuu
003008 uu uu uu uu uu uu uu uu uuuuuuuu
003010 uu uu uu uu uu uu uu uu uuuuuuuu
003018 uu uu uu uu uu uu uu uu uuuuuuuu
003020 uu uu uu uu uu uu uu uu uuuuuuuu
003028 uu uu uu uu uu uu uu uu uuuuuuuu
003030 uu uu uu uu uu uu uu uu uuuuuuuu
003038 uu uu uu uu uu uu uu uu uuuuuuuu
003040 uu uu uu uu uu uu uu uu uuuuuuuu
For Help, press F1
24.000000 MHz
0
MC9S12C32
done .\cmd\Full_Chip_Simulation_postlc

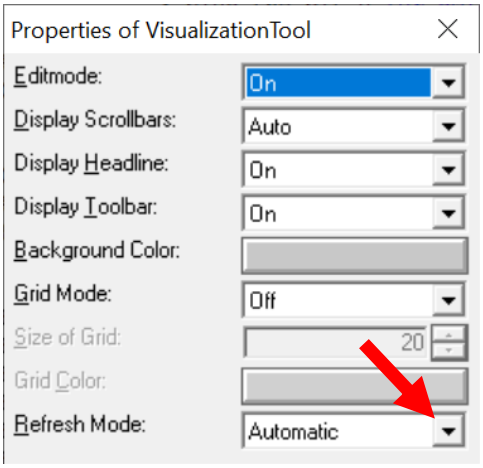
Add Component, Open . . . . Then select “Visualization . . .”

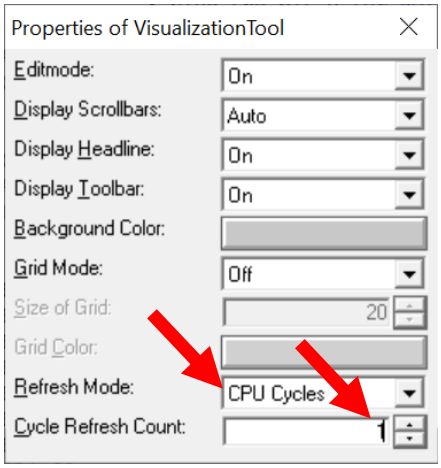




Right click on the Visualization Tool, and then select “Properties”.

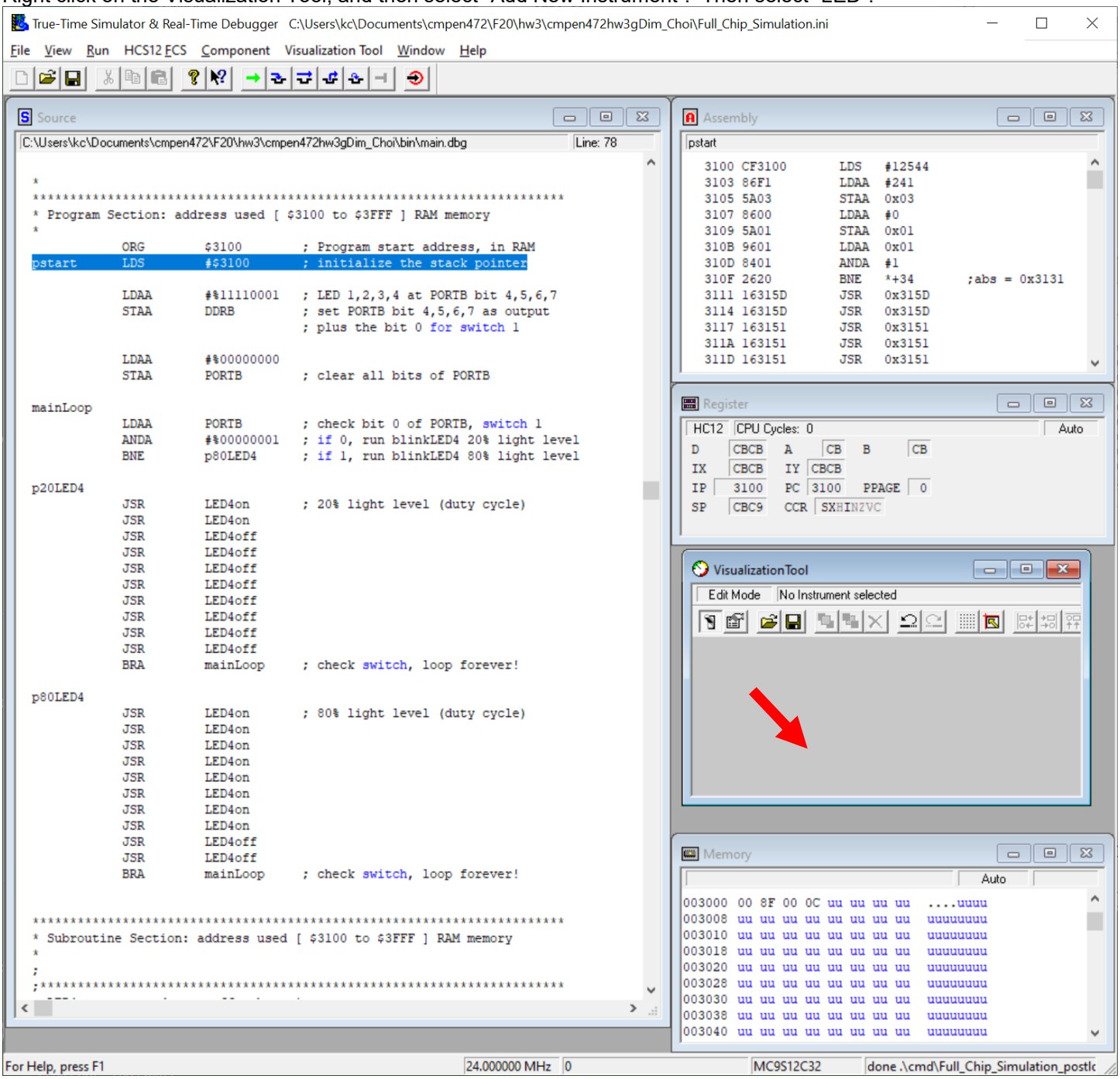




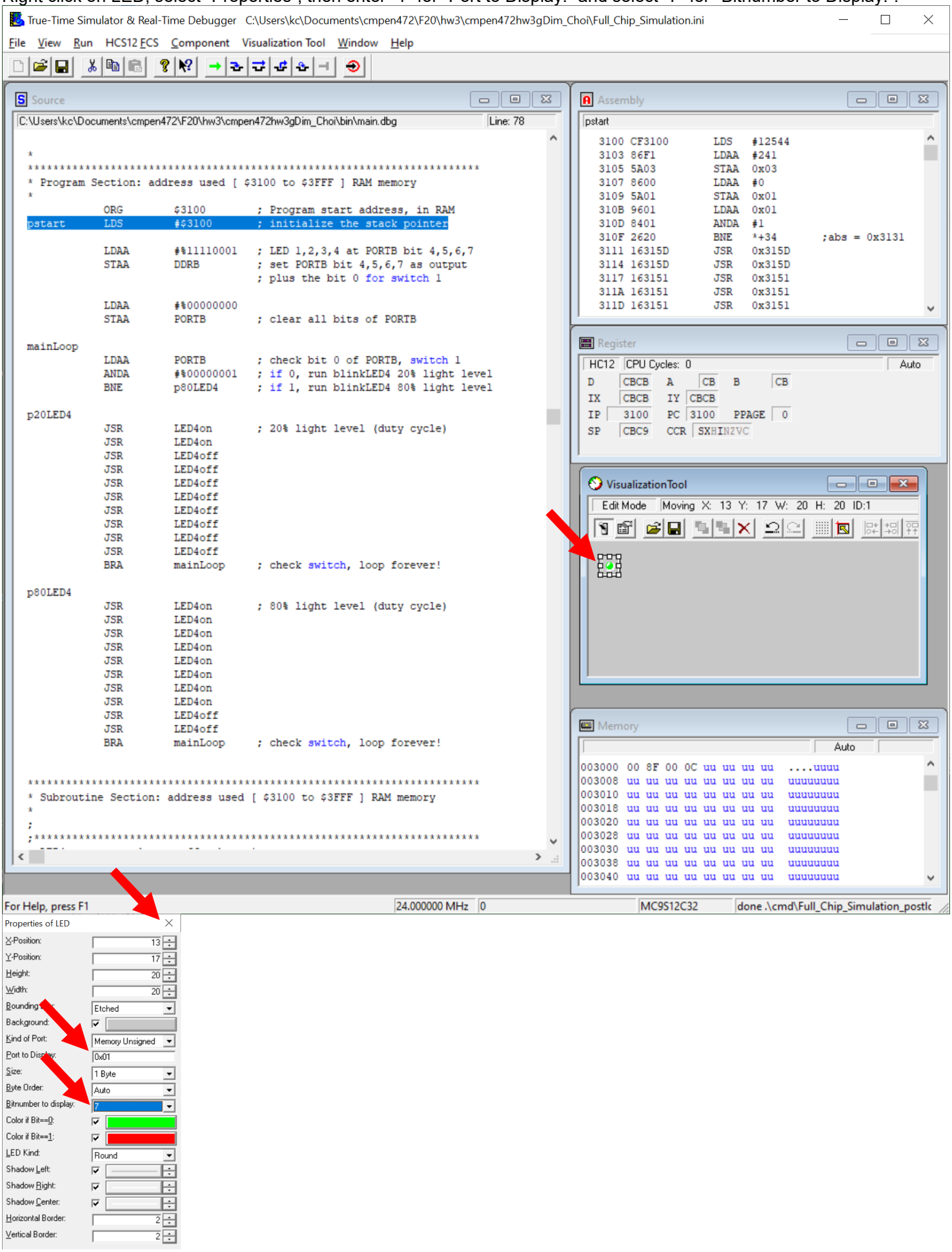


Enter “1” for Cycle Refresh Count.

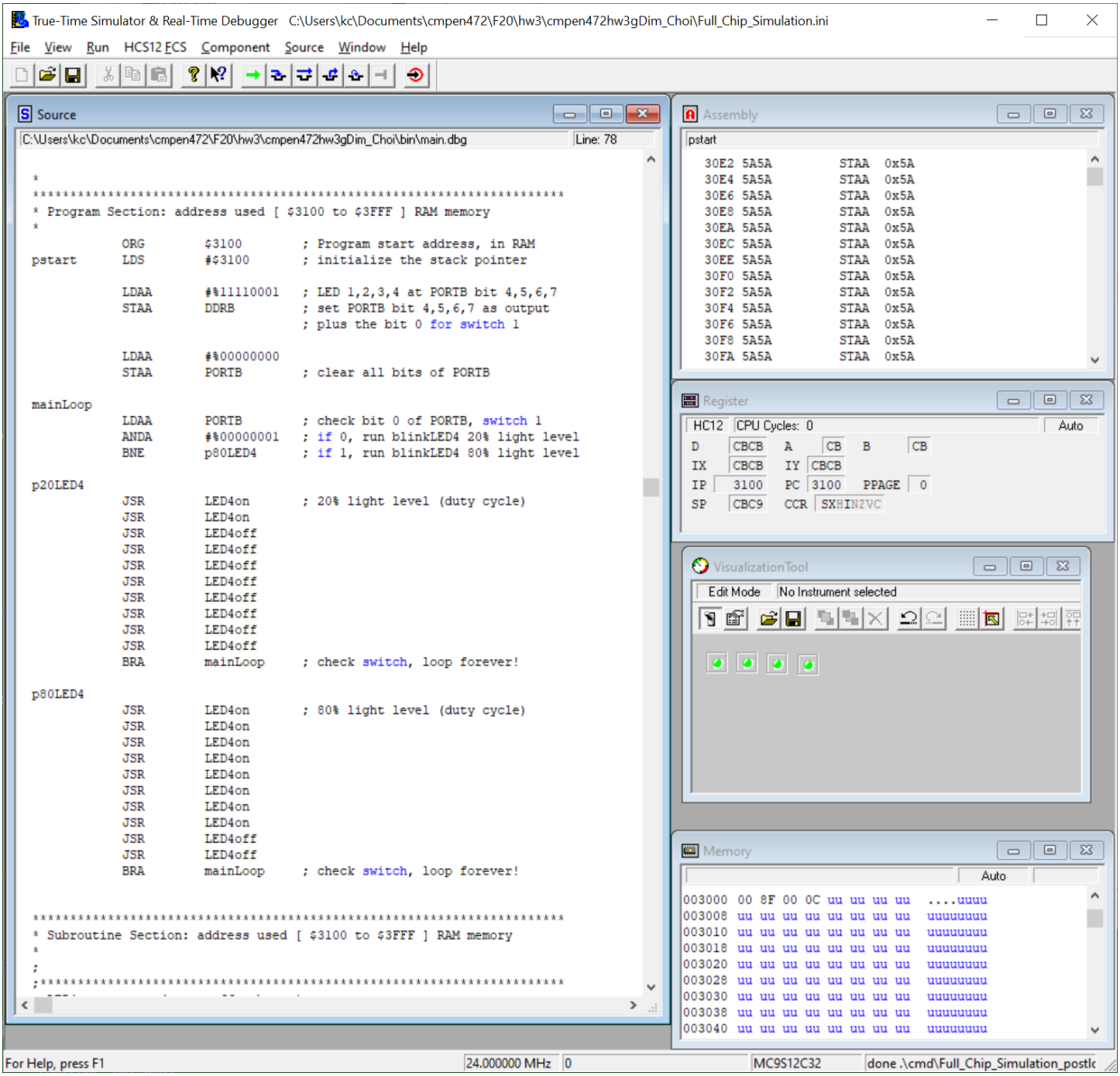
Right click on the Visualization Tool, and then select “Add New Instrument”. Then select “LED”.



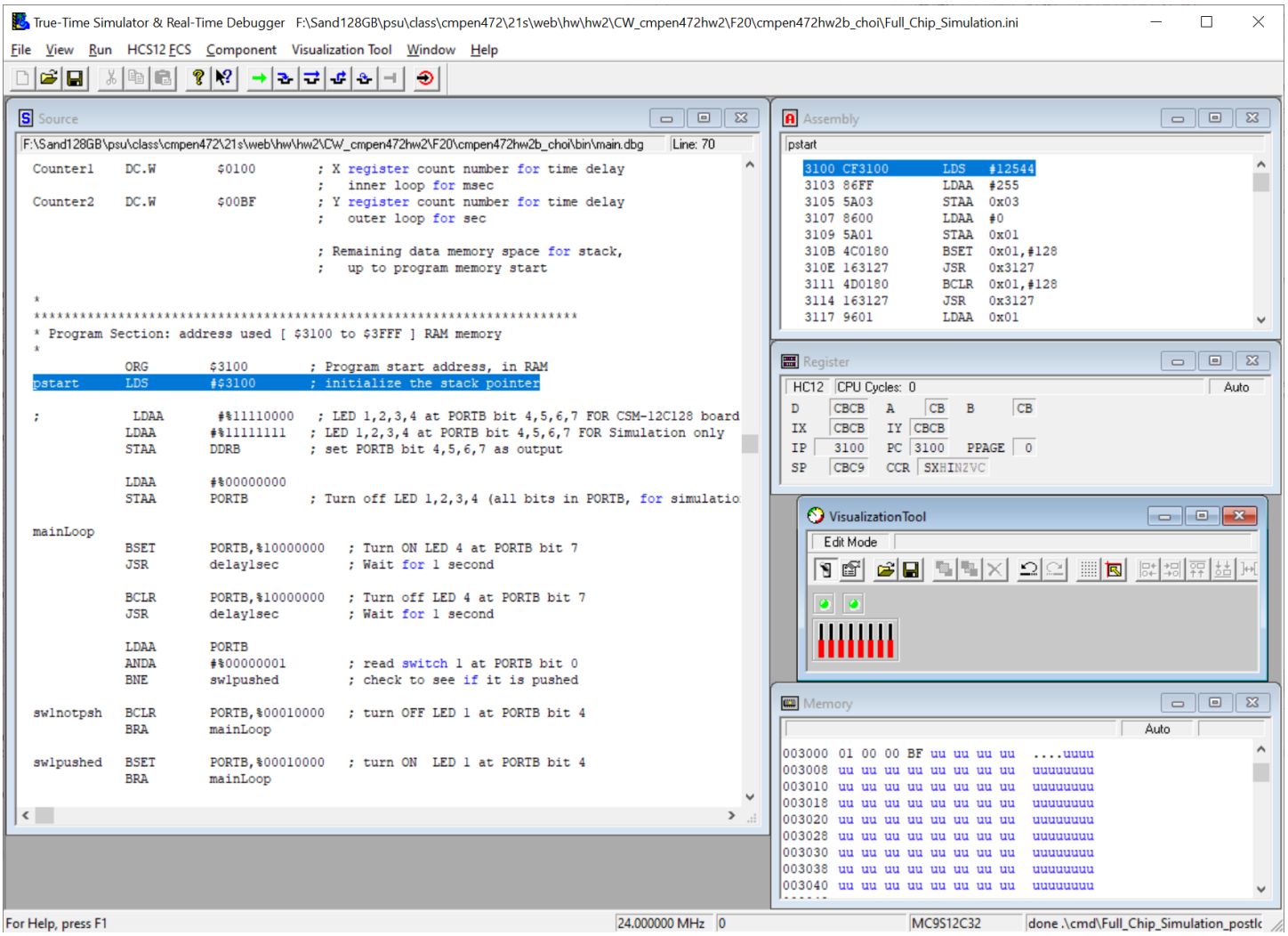
Right click on LED, select “Properties”, then enter “1” for “Port to Display:” and select “7” for “Bitnumber to Display:”.



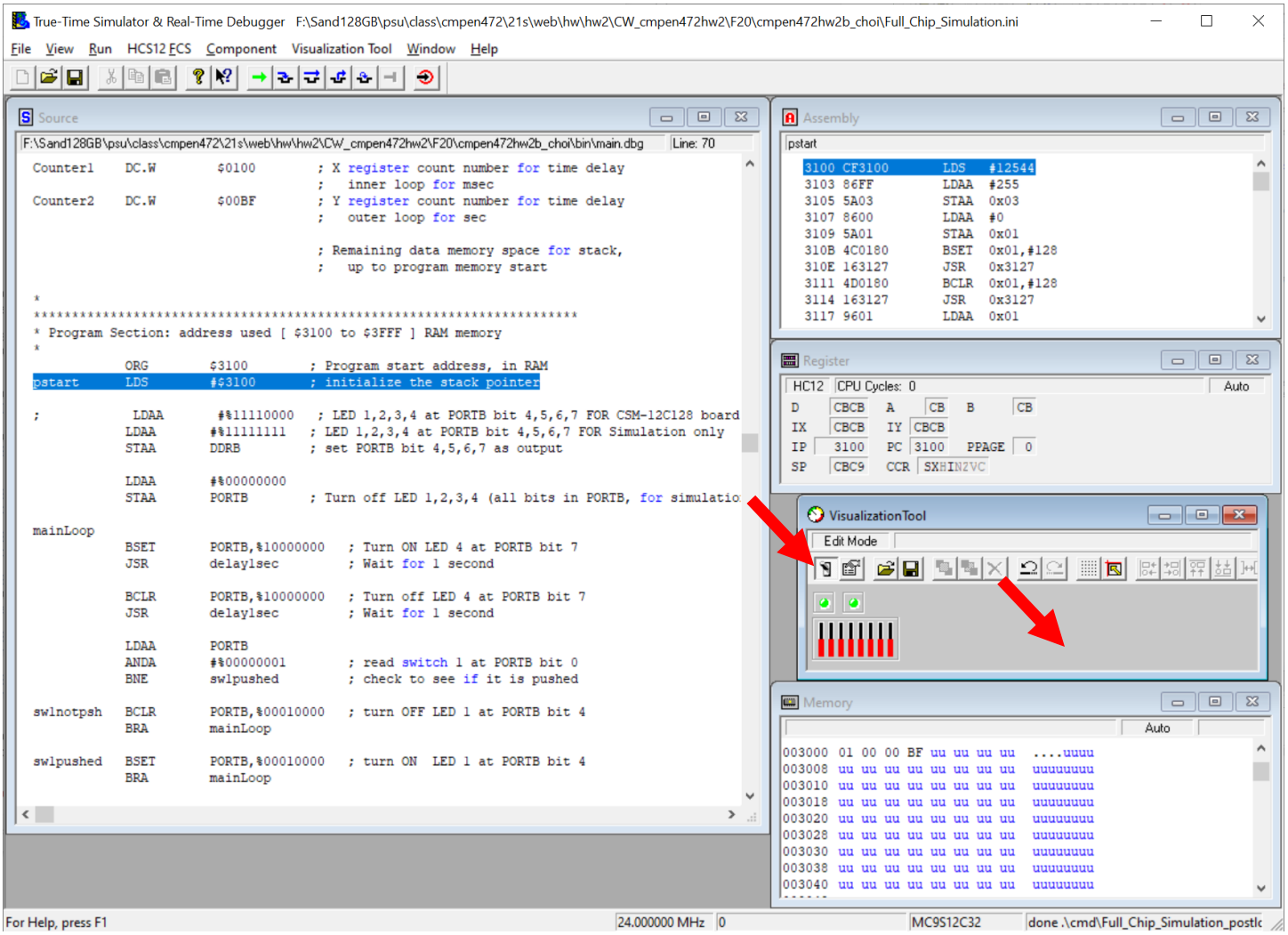
In a similar way, add LED 1, 2, and 3. That is, connect LED 1, 2, 3, and 4 to PORTB bit 4, 5, 6, and 7, respectively.



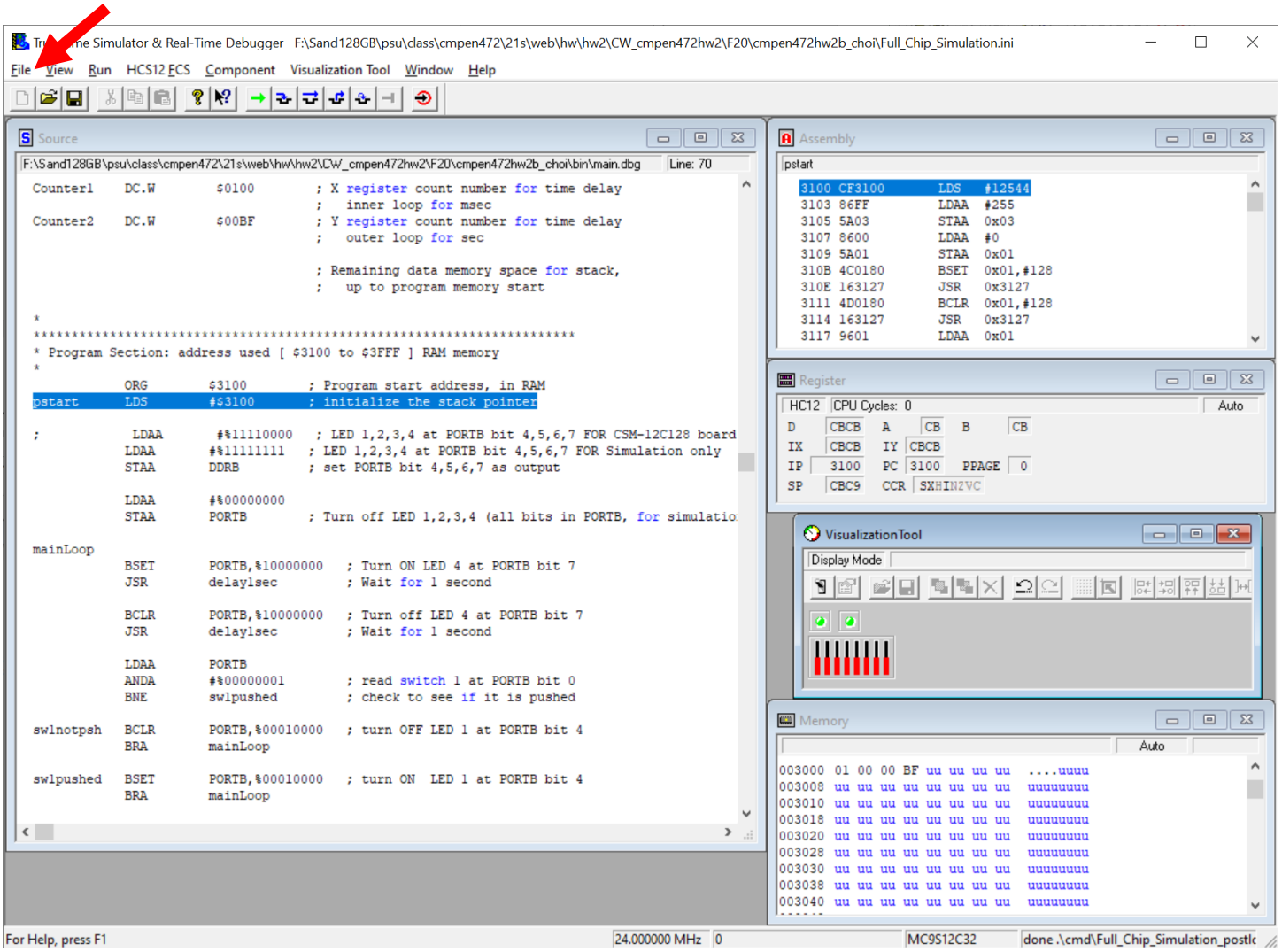
Right click on the Visualization Tool, and then select “Add New Instrument”. Then select “DIL Switch”.
Be sure to connect DIL Switch to PORTB (Port to Display set to 0x01 address) in its “properties”.



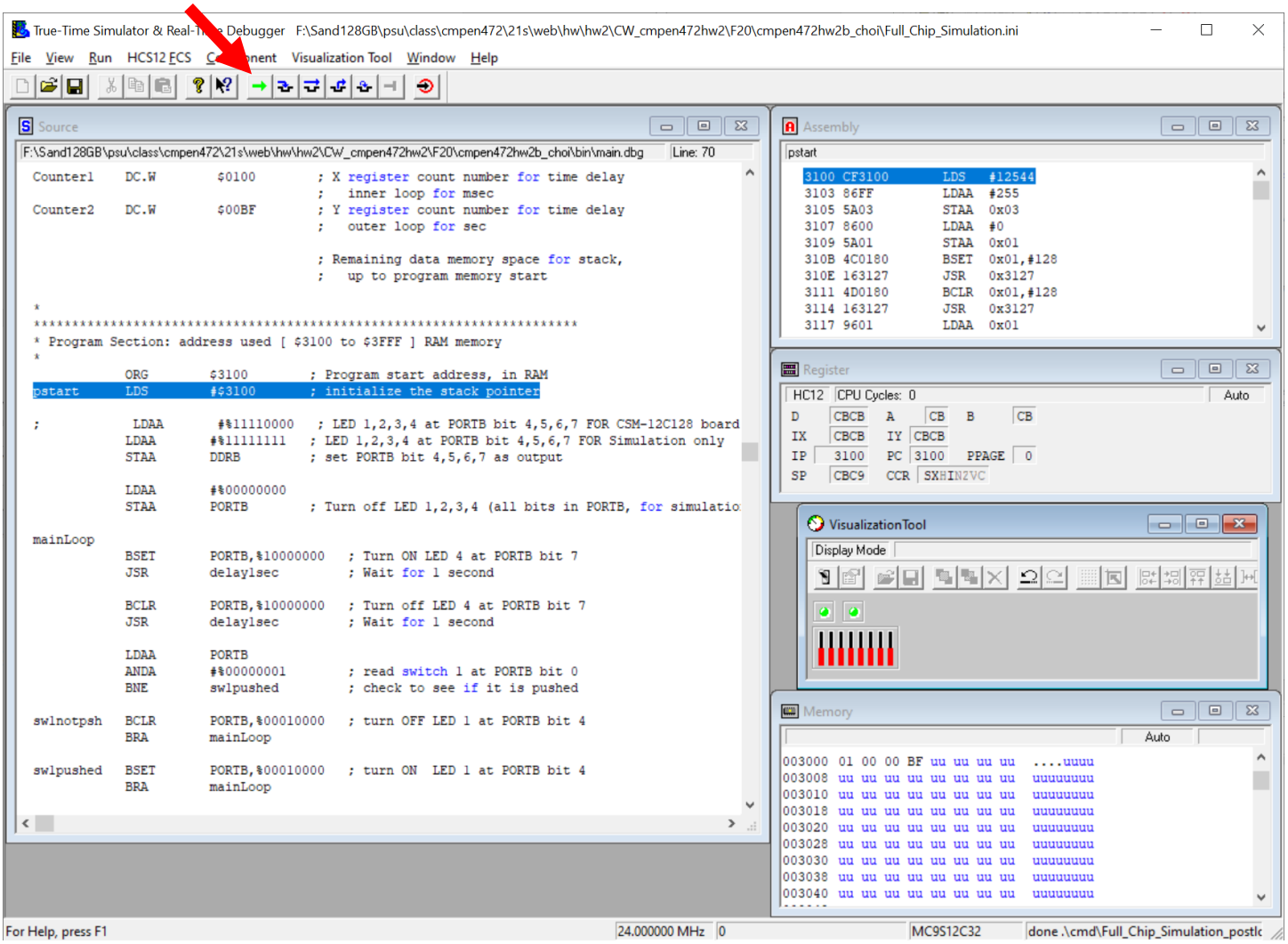
Now change your Visualization Tool from “Edit Mode” to “Display Mode”, by right clicking the Visualization Tool and select the checked “Edit Mode”. The switch at PORTB will not work on “Edit Mode”, they work only on “Display Mode”.



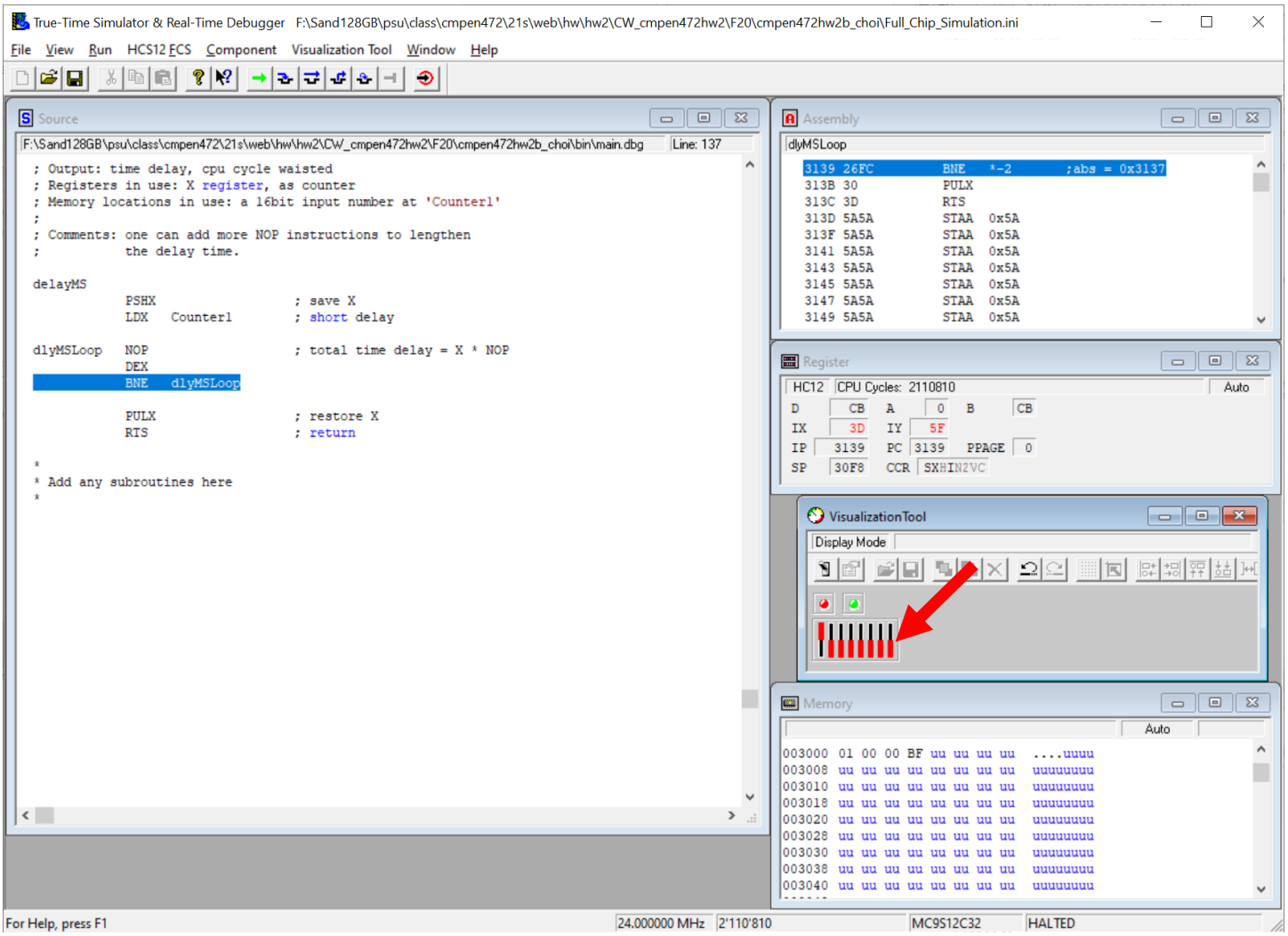
Now the Debugger/Simulator is ready to simulate Homework 2 Sample program and you want to SAVE the setting. Click on the “File” menu and select the “Save Configuration”.



Now run your program and observe LED 4 blinking.



While the program is running, click the Switch 1 in the Visualization Tool. And observe the LED 1 state changing based on the Switch 1 ON or OFF state.



Now you can modify the Sample Homework 2 program to finish the full Homework 2, modify to meet program's full specification.