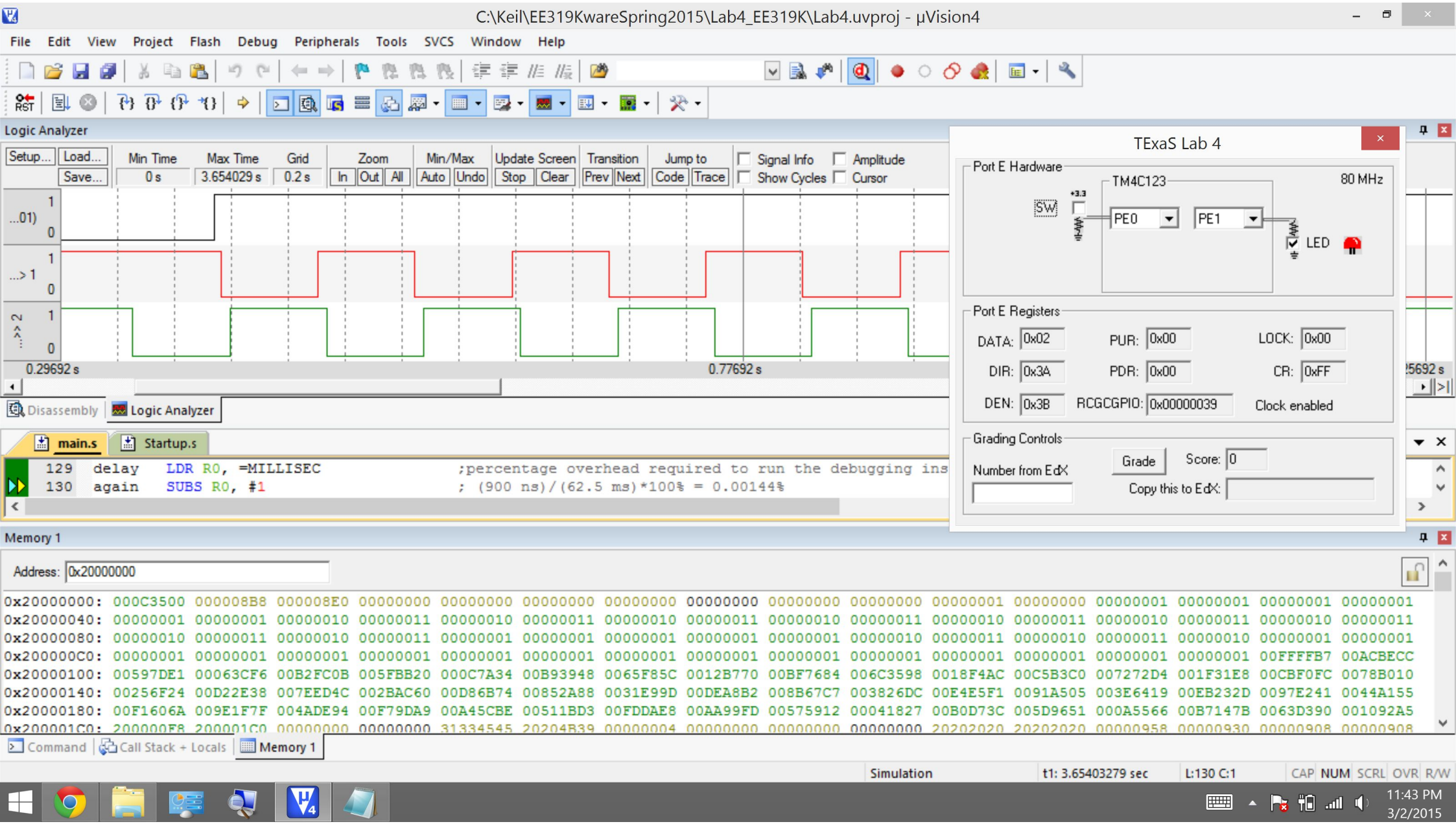
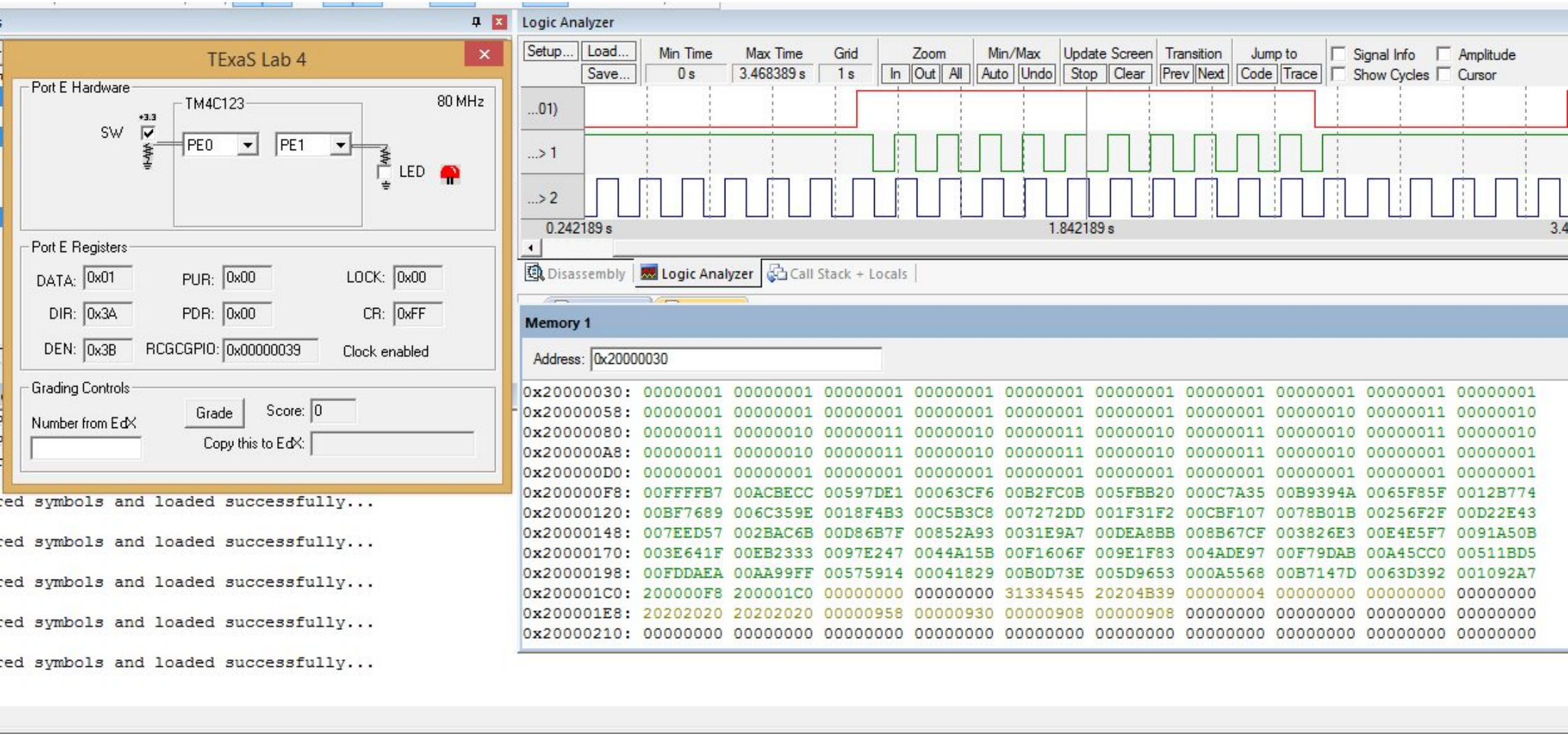

C:\Keil\EE319KwareSpring2015\Lab4_EE319K\Lab4.uvproj - µVision4
File Edit View Project Flash Debug Peripherals Tools SVCS Window Help
Logic Analyzer
Setup... Load... Save...
Min Time 0 s
Max Time 3.654029 s
Grid 0.2 s
Zoom In Out All
Min/Max Auto Undo
Update Screen Stop Clear
Transition Prev Next
Jump to Code Trace
Signal Info
Show Cycles
Amplitude
Cursor
0.29692 s
0.77692 s
Disassembly
Logic Analyzer
main.s
Startup.s
129 delay LDR R0, =MILLISEC ;percentage overhead required to run the debugging ins
130 again SUBS R0, #1 ; (900 ns)/(62.5 ms)*100% = 0.00144%
Memory 1
Address: 0x20000000
0x20000000: 000C3500 000008B8 000008E0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000001 00000000 00000001 00000001 00000001 00000001
0x20000040: 00000001 00000001 00000010 00000011 00000010 00000011 00000010 00000011 00000010 00000011 00000010 00000011 00000010 00000011 00000010 00000011
0x20000080: 00000010 00000011 00000010 00000011 00000001 00000001 00000001 00000001 00000001 00000010 00000011 00000010 00000011 00000010 00000001 00000001
0x200000C0: 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00000001 00FFFFB7 00ACBECC
0x20000100: 00597DE1 00063CF6 00B2FC0B 005FBB20 000C7A34 00B93948 0065F85C 0012B770 00BF7684 006C3598 0018F4AC 00C5B3C0 007272D4 001F31E8 00CBF0FC 0078B010
0x20000140: 00256F24 00D22E38 007EED4C 002BAC60 00D86B74 00852A88 0031E99D 00DEA8B2 008B67C7 003826DC 00E4E5F1 0091A505 003E6419 00EB232D 0097E241 0044A155
0x20000180: 00F1606A 009E1F7F 004ADE94 00F79DA9 00A45CBE 00511BD3 00FDDAE8 00AA99FD 00575912 00041827 00B0D73C 005D9651 000A5566 00B7147B 0063D390 001092A5
0x200001C0: 200000F8 200001C0 00000000 00000000 31334545 20204B39 00000004 00000000 00000000 00000000 20202020 20202020 00000958 00000930 00000908 00000908
Command Call Stack + Locals Memory 1
Simulation t1: 3.65403279 sec L:130 C:1 CAP NUM SCRL OVR R/W
TExaS Lab 4
Port E Hardware
TM4C123
80 MHz
SW
+3.3
PE0
PE1
LED
Port E Registers
DATA: 0x02 PUR: 0x00 LOCK: 0x00
DIR: 0x3A PDR: 0x00 CR: 0xFF
DEN: 0x3B RCGCGPIO: 0x00000039 Clock enabled
Grading Controls
Number from EdX
Grade
Score: 0
Copy this to EdX:
11:43 PM
3/2/2015




```
ed symbols and loaded successfully...

ed symbols and loaded successfully...

ed symbols and loaded successfully...

ed symbols and loaded successfully...

ed symbols and loaded successfully...
```

```
;****************** main.s ***************
; Program written by: Aria Pahlavan and Khalid Qarryzada
; Date Created: 1/24/2015
; Last Modified: 3/1/15
; Section 1-2pm     TA: Wooseok Lee
; Lab number: 4
; Brief description of the program
;   If the switch is presses, the LED toggles at 8 Hz
; Hardware connections
;  PE0 is switch input  (1 means pressed, 0 means not pressed)
;  PE1 is LED output (1 activates external LED on protoboard)
;Overall functionality of this system is the similar to Lab 3, with four changes:
;1-  activate the PLL to run at 80 MHz (12.5ns bus cycle time)
;2-  initialize SysTick with RELOAD 0x00FFFFFF
;3-  add a heartbeat to PF2 that toggles every time through loop
;4-  add debugging dump of input, output, and time
; Operation
;           1) Make PE1 an output and make PE0 an input.
;           2) The system starts with the LED on (make PE1 =1).
;   3) Wait about 62 ms
;   4) If the switch is pressed (PE0 is 1), then toggle the LED once, else turn the LED on.
;   5) Steps 3 and 4 are repeated over and over


SWITCH                EQU 0x40024004  ;PE0
LED                   EQU 0x40024008  ;PE1
SYSCTL_RCGCGPIO_R       EQU 0x400FE608
SYSCTL_RCGC2_GPIOE      EQU 0x00000010   ; port E Clock Gating Control
SYSCTL_RCGC2_GPIOF      EQU 0x00000020   ; port F Clock Gating Control
```

```
GPIO_PORTE_DATA_R       EQU 0x400243FC
GPIO_PORTE_DIR_R        EQU 0x40024400
GPIO_PORTE_AFSEL_R      EQU 0x40024420
GPIO_PORTE_PUR_R        EQU 0x40024510
GPIO_PORTE_DEN_R        EQU 0x4002451C
GPIO_PORTF_DATA_R       EQU 0x400253FC
GPIO_PORTF_DIR_R        EQU 0x40025400
GPIO_PORTF_AFSEL_R      EQU 0x40025420
GPIO_PORTF_DEN_R        EQU 0x4002551C
NVIC_ST_CTRL_R          EQU 0xE000E010
NVIC_ST_RELOAD_R        EQU 0xE000E014
NVIC_ST_CURRENT_R       EQU 0xE000E018
        THUMB
        AREA    DATA, ALIGN=4
SIZE      EQU    50
;You MUST use these two buffers and two variables
;You MUST not change their names
;These names MUST be exported
        EXPORT DataBuffer
        EXPORT TimeBuffer
        EXPORT DataPt [DATA,SIZE=4]
        EXPORT TimePt [DATA,SIZE=4]
DataBuffer SPACE  SIZE*4
TimeBuffer SPACE  SIZE*4
DataPt     SPACE  4
TimePt     SPACE  4

          ALIGN
          AREA    |.text|, CODE, READONLY, ALIGN=2
```

```
        THUMB
        EXPORT  Start
        IMPORT  TExaS_Init

Start BL   TExaS_Init  ; running at 80 MHz, scope voltmeter on PD3
                LDR R1, =SYSCTL_RCGCGPIO_R
                LDR R0, [R1]
                ORR R0, #0x30                           ;Initialize Port E and Port F
                STR R0, [R1]
                NOP
                NOP                                             ; allow time for clock to finish
                LDR R1, =GPIO_PORTE_DIR_R       ; Set direction register
                ORR R0, #0x02
                BIC R0, #0x01
                STR R0, [R1]
                LDR R1, =GPIO_PORTE_DEN_R       ; 7) enable Port E digital port
                ORR R0, #0x03
                STR R0, [R1]
                LDR R1, =GPIO_PORTE_DATA_R
                LDR R0, [R1]
                ORR R0, #0x02
                STR R0, [R1]

                LDR R1, =GPIO_PORTF_DIR_R
                LDR R0, [R1]
                ORR R0, #0x04
                STR R0, [R1]
                LDR R1, =GPIO_PORTF_DEN_R
                LDR R0, [R1]
```

```
        ORR R0, #0x04
        STR R0, [R1]



    CPSIE  I    ; TExaS voltmeter, scope runs on interrupts
        BL Debug_Init
loop    BL Debug_Capture

Hdelay  EQU 124000
heartb  LDR R0, =Hdelay                 ;percentage overhead required to run the debugging
instrument:
hagain  SUBS R0, #1                                 ; (900 ns)/(62.5 ms)*100% = 0.00144%
        BNE hagain
        LDR R5, =GPIO_PORTF_DATA_R
        LDR R6, [R5]
        EOR R6, #0x04
        STR R6, [R5]



        BL      delay
        LDR R1, =GPIO_PORTE_DATA_R
        LDR R0, [R1]                            ;R1 has GPIO_PORTE_DATA_R
        AND R2, R0, #0x01
        CMP R2, #0
        BEQ     turnon
        B       toggle
```

```
toggle   LDR R0, [R1]
                EOR R0, #0x02
                STR R0, [R1]

                B loop

turnon  LDR R0, [R1]
                ORR R0, #0x02
                STR R0, [R1]

                B loop

MILLISEC        EQU     1240000
delay    LDR R0, =MILLISEC                      ;percentage overhead required to run the debugging instrument:
again    SUBS R0, #1                                    ; (900 ns)/(62.5 ms)*100% = 0.00144%
                BNE again
                BX LR
; Delay
;input PE0 test output PE1
          B    loop


;------------Debug_Init------------
; Initializes the debugging instrument
; Input: none
; Output: none
; Modifies: none
; Note: push/pop an even number of registers so C compiler is happy
```

```
Debug_Init
        PUSH {R0-R6, LR}
                LDR R0, =DataBuffer                     ;Put the address of DataBuffer
into DataPt
                LDR R1, =DataPt
                STR R0, [R1]

                LDR R2, =TimeBuffer
                LDR R3, =TimePt
                STR R2, [R3]

                MVN R5, #0
                MOV R4, #50
dloop1  STR R5, [R0]
                ADD R0, #4
                SUB R4, #1
                CMP R4, #0
                BNE dloop1

                MOV R4, #50
dloop2  STR R5, [R2]
                ADD R2, #4
                SUB R4, #1
                CMP R4, #0
                BNE dloop2

        BL SysTick_Init
        POP {R0-R6,LR}
        BX      LR
```

```
; init SysTick
SysTick_Init
        PUSH{R0,R1}
        LDR R1, =NVIC_ST_CTRL_R
        MOV R0, #0                                  ;First disable SysTick
        STR R0, [R1]
        LDR R1, =NVIC_ST_RELOAD_R       ;R1 = &NVIC_ST_RELOAD_R
        LDR R0, =0xFFFFFF                       ;maximum value that we can hold
        STR R0, [R1]
        LDR R1, =NVIC_ST_CURRENT_R
        MOV R0, #0
        STR R0, [R1]
        LDR R1, =NVIC_ST_CTRL_R
        MOV R0, #0x05
        STR R0, [R1]
        POP{R0,R1}
        BX LR

;------------Debug_Capture------------
; Dump Port E and time into buffers
; Input: none
; Output: none
; Modifies: none
; Note: push/pop an even number of registers so C compiler is happy
Debug_Capture
                PUSH {R0-R6, LR}                                ;Estimated time to process: 900
nanoseconds
                LDR R0, =DataBuffer
                LDR R1, =TimeBuffer
```

```
        ADD R4, R0, #200                    ;R0 now points to the location
right after the end of the array
        ADD R5, R1, #200
        LDR R2, =DataPt
        LDR R2, [R2]
        LDR R3, =TimePt
        LDR R3, [R3]
        CMP R2, R4
        BEQ     fin
        CMP R3, R5
        BEQ fin

        LDR R0, =GPIO_PORTE_DATA_R
        LDR R0, [R0]
        AND R2, R0, #1
        AND R3, R0, #2
        LSR R3, #1
        LSL R2, #4
        ADD R4, R3, R2
        LDR R5, =DataPt
        LDR R5, [R5]
        STR R4, [R5]                        ;Dump port info into DataBuffer
        ADD R5, #4
        LDR R6, =DataPt
        STR R5, [R6]

        LDR R1, =NVIC_ST_CURRENT_R                  ;Dump time
info into TimeBuffer (?)
        LDR R1, [R1]
```

```
                LDR R2, =TimePt
                LDR R2, [R2]
                STR R1, [R2]
                ADD R2, #4
                LDR R6, =TimePt
                STR R2, [R6]

fin             POP {R0-R6, LR}
                BX LR



  ALIGN                 ; make sure the end of this section is aligned
  END                   ; end of file
```

```
:020000042000DA
:1000000000350C00B8080000E00800000000000007
:10001000000000000000000000000000000000E0
:10002000000000000000000001000000000000CF
:10003000010000000100000001000000010000BC
:10004000010000000100000001000000010000AC
:10005000010000000100000001000000010000009C
:10006000010000000100000001000000010000008C
:10007000010000000100000011000000100000004E
:10008000110000001000000011000000100000002E
:10009000110000001000000011000000100000001E
:1000A000110000001000000011000000100000000E
:1000B000110000001000000011000000100000FE
:1000C000110000001000000010000000100000000D
:1000D000010000001000000010000000100000001C
:1000E000010000001000000010000000100000000C
:1000F000010000001000000B7FFFF00CCBEAC0013
:10010000E17D5900F63C06000BFCB20020BB5F000D
:10011000357A0C004A39B9005FF8650074B71200EF
:100120008976BF009E356C00B3F41800C8B3C500D3
:10013000DD727200F2311F0007F1CB001BB07800B6
:100140002F6F2500432ED20057ED7E006BAC2B00A5
:100150007F6BD800932A8500A7E93100BBA8DE0099
:10016000CF678B00E3263800F7E5E4000BA591008C
:100170001F643E003323EB0047E297005BA144007D
:100180006F60F100831F9E0097DE4A00AB9DF70071
:01019000C0AE
:00000001FF
```

4. Estimation of the run time for Debug_Capture: 900ns
   Time between calls to Debug_Capture: 62.5ms
   (900 ns)/(62.5 ms)*100% = 0.00144% intrusiveness

5. Period of the LED is 1/16 = 0.0625
   0x0078B01B – 0x00256F2F = 0x005340EC = #5456108
   Period of the LED is 5456108/80MHz = 0.0682 s