

# 2025 ECE 461/561 HW1 Solutions

Summary spreadsheet and diagrams

| Question | Section                             | Subsection            | 561 Only | Response                                                                                                                                                                                                                                                                                                                                                                                                                                                | Response Location |
|----------|-------------------------------------|-----------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| GS       | Getting Started                     |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| GS-1     |                                     |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Sheet             |
| GS-2     |                                     |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Sheet             |
| GS-3     |                                     |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Sheet             |
| XOC      | Examining Object Code               |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| XOC-1    |                                     | Ignoring Control Flow |          | r0                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Sheet             |
| XOC-2    |                                     |                       |          | 0x000001D8 B5B0 PUSH {r4-r5,r7,lr}                                                                                                                                                                                                                                                                                                                                                                                                                      | Sheet             |
| XOC-3    |                                     |                       |          | 0x000001DE 4A1C LDR r2,[pc,#112] ; @0x00000250                                                                                                                                                                                                                                                                                                                                                                                                          | Sheet             |
| XOC-4    |                                     |                       |          | r2                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Sheet             |
| XOC-5    |                                     |                       |          | 0x00000250                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sheet             |
| XOC-6    |                                     |                       |          | 0x40048034                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sheet             |
| XOC-7    |                                     |                       |          | SIM_SCGC4                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sheet             |
| XOC-8    |                                     |                       |          | 0x0000024C BDB0 POP {r4-r5,r7,pc}                                                                                                                                                                                                                                                                                                                                                                                                                       | Sheet             |
|          |                                     | Simple Control Flow   |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| XOC-9    |                                     | bb1                   |          | <0x00000484 0x000004b2 no 0x000004b4>                                                                                                                                                                                                                                                                                                                                                                                                                   | Sheet             |
| XOC-9    |                                     | bb2                   |          | <0x000004b4 0x000004bc yes-branch 0x000004be 0x000004b4>                                                                                                                                                                                                                                                                                                                                                                                                | Sheet             |
| XOC-9    |                                     | bb3                   |          | <0x000004be 0x000004c2 yes-branch 0x000004c4 0x00000504>                                                                                                                                                                                                                                                                                                                                                                                                | Sheet             |
| XOC-9    |                                     | bb4                   |          | <0x000004c4 0x00000502 yes-return>                                                                                                                                                                                                                                                                                                                                                                                                                      | Sheet             |
| XOC-9    |                                     | bb5                   |          | <0x00000504 0x0000050a yes-call>                                                                                                                                                                                                                                                                                                                                                                                                                        | Sheet             |
| XOC-9    |                                     | bb6                   |          | <0x0000050e 0x0000050e yes-branch 0x0000050e>                                                                                                                                                                                                                                                                                                                                                                                                           | Sheet             |
| XOC-10   |                                     |                       |          | Submit Diagram in Report                                                                                                                                                                                                                                                                                                                                                                                                                                | Report            |
| XOC-11   |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| XOC-12   |                                     |                       | 561      | (depends on student's drawing)                                                                                                                                                                                                                                                                                                                                                                                                                          | Sheet             |
|          |                                     | Complex Control Flow  |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| XOC-13   |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| XOC-14   |                                     |                       |          | Any layout method acceptable                                                                                                                                                                                                                                                                                                                                                                                                                            | Sheet             |
| XOC-15   |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| XOC-16   |                                     |                       |          | Partial match. Initialization code is missing calls to functions Misc, Init_ADC. Loop is missing calls to functions Convert, Calculate.                                                                                                                                                                                                                                                                                                                 | Sheet             |
| XOC-17   |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| XOC-18   |                                     | B1                    | 561      | 0x000002e0                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sheet             |
| XOC-18   |                                     | B2                    | 561      | 0x00000312                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sheet             |
| XOC-18   |                                     | B3                    | 561      | 0x00000344                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sheet             |
| XOC-18   |                                     | B4                    | 561      | 0x00000374                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sheet             |
| XOC-19   |                                     |                       | 561      | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| XOC-20   |                                     |                       | 561      | Compiler loads 125 into r4, then shifts it left if needed to get 250 or 2000                                                                                                                                                                                                                                                                                                                                                                            | Sheet             |
| XFC      | Examining Function Calling Behavior |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| XFC-1    |                                     | Source                |          | Calculate Control_RGB_LEDs Convert Delay Init_ADC Init_DAC Init_LPTMR Init_RGB_LEDs Init_UART2 Misc Print printf Start_LPTMR                                                                                                                                                                                                                                                                                                                            | Sheet             |
| XFC-2    |                                     | Linker                |          | 2printf __aeabi_d2f __aeabi_ddiv __aeabi_dmul __aeabi_ui2d Control_RGB_LEDs Delay Init_DAC Init_LPTMR Init_RGB_LEDs Init_UART2 Print Start_LPTMR                                                                                                                                                                                                                                                                                                        | Sheet             |
| XFC-3    |                                     | Extra                 |          | 2printf __aeabi_d2f __aeabi_ddiv __aeabi_dmul __aeabi_ui2d                                                                                                                                                                                                                                                                                                                                                                                              | Sheet             |
| XFC-4    |                                     | Missing               |          | Calculate Convert Init_ADC Misc printf                                                                                                                                                                                                                                                                                                                                                                                                                  | Sheet             |
| XFC-5    |                                     | Ghidra                |          | Init_RGB_LEDs Init_UART2 Init_DAC Control_RGB_LEDs Init_LPTMR printf Delay Start_LPTMR __aeabi_ui2d __aeabi_ddiv __aeabi_dmul __aeabi_d2f Print                                                                                                                                                                                                                                                                                                         | Sheet             |
| XFC-6    |                                     |                       |          | _main_init_scatterload_rt2_main_scatterload                                                                                                                                                                                                                                                                                                                                                                                                             | Sheet             |
| XFC-7    |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| XFC-8    |                                     | __aeabi_ddiv          |          | Init_UART2 Calculate main_fp_digits                                                                                                                                                                                                                                                                                                                                                                                                                     | Sheet             |
| XFC-9    |                                     |                       |          | 2printf                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Sheet             |
| XFC-10   |                                     | Missing calls         |          | We find inlined code from body of the function which would have been called at each such location.                                                                                                                                                                                                                                                                                                                                                      | Sheet             |
| SVD      | Source Code vs. Decompiled Code     |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| SVD-1    |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| SVD-2    |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
| SVD-3    |                                     |                       |          | yes                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Sheet             |
| SVD-4    |                                     |                       |          | They should match, so no differences.                                                                                                                                                                                                                                                                                                                                                                                                                   | Sheet             |
| SVD-5    |                                     |                       |          | Submit Screenshot in Report                                                                                                                                                                                                                                                                                                                                                                                                                             | Report            |
|          |                                     |                       |          | It is the address of the ADC Status and Control Registers 1 (ADC0_SC1A). It is used in a do/while loop to block until conversion complete (COCO) status flag is 1. The register is read and then shifted left by 0x18 = 24 bit positions, which makes the COCO flag the MSB. Until the COCO flag is 1, the shifted value will be zero or positive, so the loop will repeat. When COCO is 0, the shifted value will be negative, and the loop will stop. | Sheet             |
| SVD-6    |                                     |                       |          | no                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Sheet             |
| SVD-7    |                                     |                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Sheet             |
| SVD-8    |                                     |                       |          | The calibration failure code (bbs 0x04be, 0x0504, 0x050e) is missing from the decompiled code.                                                                                                                                                                                                                                                                                                                                                          | Sheet             |

# Simple Control Flow: XOC-1 – XOC-8

## Disassembly

```

29: void Init_UART2(uint32_t baud_rate) {
30:     uint16_t sbr;
31:     uint8_t temp;
32:
33:     // Enable clock gating for UART2 and Port D
0x000001D8 B5B0 PUSH    {r4-r5,r7,lr}
0x000001DA 2101 MOVLS   r1,#0x01
0x000001DC 0309 LSLSL   r1,r1,#12
0x000001DE 4A1C LDR     r2,[pc,#112] ; @0x00000250
34:     SIM->SCGC4 |= SIM_SCGC4_UART2_MASK;
0x000001E0 6813 LDR     r3,[r2,#0x00]
0x000001E2 430B ORRS    r3,r3,r1
0x000001E4 6013 STR     r3,[r2,#0x00]
35:     SIM->SCGC5 |= SIM_SCGC5_PORTD_MASK;
36:
37:     // Make sure transmitter and receiver are disabled before i
0x000001E6 6853 LDR     r3,[r2,#0x04]
0x000001E8 430B ORRS    r3,r3,r1
0x000001EA 6053 STR     r3,[r2,#0x04]
0x000001EC 4D19 LDR     r5,[pc,#100] ; @0x00000254
38:     UART2->C2 &= ~UART_C2_TE_MASK & ~UART_C2_RE_MASK;
39:
40:     // Set pins D2, D3 to UART2 Rx and Tx
0x000001EE 78E9 LDRB    r1,[r5,#0x03]
0x000001F0 22F3 MOVSL   r2,#0xF3
0x000001F2 400A ANDSL   r2,r2,r1
0x000001F4 70EA STRB    r2,[r5,#0x03]
0x000001F6 4918 LDR     r1,[pc,#96] ; @0x00000258
0x000001F8 4A18 LDR     r2,[pc,#96] ; @0x0000025C
41:     PORTD->PCR[2] = PORT_PCR_ISF_MASK | PORT_PCR_MUX(3); // Rx
0x000001FA 600A STR     r2,[r1,#0x00]
42:     PORTD->PCR[3] = PORT_PCR_ISF_MASK | PORT_PCR_MUX(3); // Tx
43:
44:     // Set baud rate, oversampling ratio, stop bits
45:     sbr = (uint16_t)((BUS_CLOCK)/(baud_rate * UART_OVERSAMPLE_RATE))+0.5);
0x000001FC 604A STR     r2,[r1,#0x04]
0x000001FE 2120 MOVSL   r1,#0x20
46:     UART2->BDH = UART_BDH_SBNS(1);
0x00000200 7029 STRB    r1,[r5,#0x00]
45:     sbr = (uint16_t)((BUS_CLOCK)/(baud_rate * UART_OVERSAMPLE_RATE))+0.5);
46:     UART2->BDH = UART_BDH_SBNS(1);
0x00000202 0100 LSLSL   r0,r0,#4
0x00000204 F000FE2A BL.W    0x00000E5C __aeabi_ui2d
0x00000208 4602 MOV     r2,r0
0x0000020A 460B MOV     r3,r1
0x0000020C 2400 MOVSL   r4,#0x00
0x0000020E 4914 LDR     r1,[pc,#80] ; @0x00000260
0x00000210 4620 MOV     r0,r4
0x00000212 F000FDAB BL.W    0x00000D6C __aeabi_ddiv
0x00000216 4B13 LDR     r3,[pc,#76] ; @0x00000264
0x00000218 4622 MOV     r2,r4
0x0000021A F000FC9D BL.W    0x00000B38 __aeabi_dadd
0x0000021E F000FE2B BL.W    0x00000E78 __aeabi_d2iz
0x00000222 211F MOVSL   r1,#0x1F

```

```

75: }
0x0000024C BDB0 POP     {r4-r5,r7,pc}
0x0000024E 46C0 MOV     r8,r8
0x00000250 8034 DCW     0x4004
0x00000252 4004 DCW     0xC000
0x00000254 C000 DCW     0x4006
0x00000256 4006 DCW     0xC008
0x00000258 C008 DCW     0x4004
0x0000025A 4004 DCW     0x0300
0x0000025C 0300 DCW     0x0100
0x0000025E 0100 DCW     0xE360
0x00000260 E360 DCW     0x4176
0x00000262 4176 DCW     0x0000
0x00000264 0000 DCW     0x3FE0
0x00000266 3FE0 DCW     0xB5B0

```

- XOC-1: Arm Procedure Calling Standard says first  $\leq 32$ -bit arg is passed in r0
- XOC-2
- XOC-3
- XOC-6

# Simple Control Flow: XOC-9 – XOC-12

```

00000484 - Cali...
void __stdcall Calibrate_ADC(void)
void <VOID> <RETURN>
    Calibrate_ADC
...0484 push {r7,lr}
...0486 movs r1,#0x1
...0488 lsls r0,r1,#0x1b
...048a ldr r2,[_arm_cp.2_Q
...048c ldr r3,[r2,#0x0]==>DAT_4004803c
...048e orrs r3,r0
...0490 str r3,[r2,#0x0]==>DAT_4004803c
...0492 ldr r0,[_arm_cp.2_Q
...0494 mov r2,r0
...0496 subs r2,#0x1c
...0498 movs r3,#0x7c
...049a str r3,[r2,#0x0]==>DAT_4003b008
...049c mov r2,r0
...049e subs r2,#0x18
...04a0 movs r3,#0x0
...04a2 str r3,[r2,#0x0]==>DAT_4003b00c
...04a4 movs r2,#0x3
...04a6 str r2,[r0,#0x0]==>DAT_4003b024
...04a8 subs r2,r0,#0x4
...04aa str r1,[r2,#0x0]==>DAT_4003b020
...04ac ldr r1,[r0,#0x0]==>DAT_4003b024
...04ae movs r2,#0x80
...04b0 orrs r2,r1
...04b2 str r2,[r0,#0x0]==>DAT_4003b024
    
```

```

000004b4 - ...
LAB_000004b4
...04b4 mov r1,r0
...04b6 subs r1,#0x24
...04b8 ldr r1,[r1,#0x0]==>DAT_4003b000
...04ba lsls r1,r1,#0x18
...04bc bpl LAB_000004b4
    
```

```

000004c4
...04c4 ldr r1,[r0,#0x28]==>DAT_4003b04c
...04c6 ldr r2,[r0,#0x24]==>DAT_4003b048
...04c8 adds r1,r2,r1
...04ca ldr r2,[r0,#0x20]==>DAT_4003b044
...04cc adds r1,r1,r2
...04ce ldr r2,[r0,#0x1c]==>DAT_4003b040
...04d0 adds r1,r1,r2
...04d2 ldr r2,[r0,#0x18]==>DAT_4003b03c
...04d4 adds r1,r1,r2
...04d6 ldr r2,[r0,#0x14]==>DAT_4003b038
...04d8 adds r1,r1,r2
...04da lsrs r2,r1,#0x1
...04dc ldr r1,[_arm_cp.2_Q
...04de orrs r2,r1
...04e0 uxth r2,r2
...04e2 str r2,[r0,#0x8]==>DAT_4003b02c
...04e4 ldr r2,[r0,#0x48]==>DAT_4003b06c
...04e6 ldr r3,[r0,#0x44]==>DAT_4003b068
...04e8 adds r2,r3,r2
...04ea ldr r3,[r0,#0x40]==>DAT_4003b064
...04ec adds r2,r2,r3
...04ee ldr r3,[r0,#0x3c]==>DAT_4003b060
...04f0 adds r2,r2,r3
...04f2 ldr r3,[r0,#0x38]==>DAT_4003b05c
...04f4 adds r2,r2,r3
...04f6 ldr r3,[r0,#0x34]==>DAT_4003b058
...04f8 adds r2,r2,r3
...04fa lsrs r2,r2,#0x1
...04fc orrs r2,r1
...04fe uxth r1,r2
...0500 str r1,[r0,#0xc]==>DAT_4003b030
...0502 pop {r7,pc}
    
```

```

000004be
...04be ldr r1,[r0,#0x0]==>DAT_4003b024
...04c0 lsls r1,r1,#0x19
...04c2 bmi LAB_00000504
    
```

```

00000...
LAB_00000504
...0504 movs r0,#0x1
...0506 movs r1,#0x0
...0508 mov r2,r1
...050a bl Control_RGB_LEDs
    
```

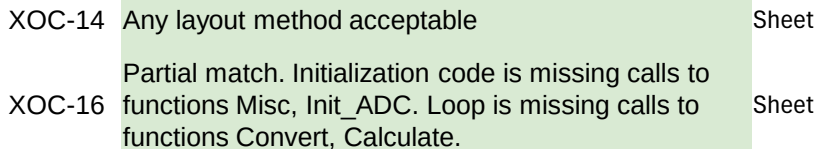
```

000...
LAB_0000050e
...050e b LAB_0000050e
    
```

- XOC-10 should look similar to this (XOC-11), but hand-drawn or made using diagrammer tool
- Notes:
  - Showing Ghidra-generated CFG of Calibrate\_ADC() here for clarity & convenience
  - In MDK source code window, need to click on declaration of function Calibrate\_ADC() (starting at/near line 41), not commented-out call to Calibrate\_ADC() (at/near line 137)
  - Calibrate\_ADC() is not called by main, but its object code is still included in the axf.

# XOC-13

Function Graph - main - 11 vertices (BasicUI.axf)



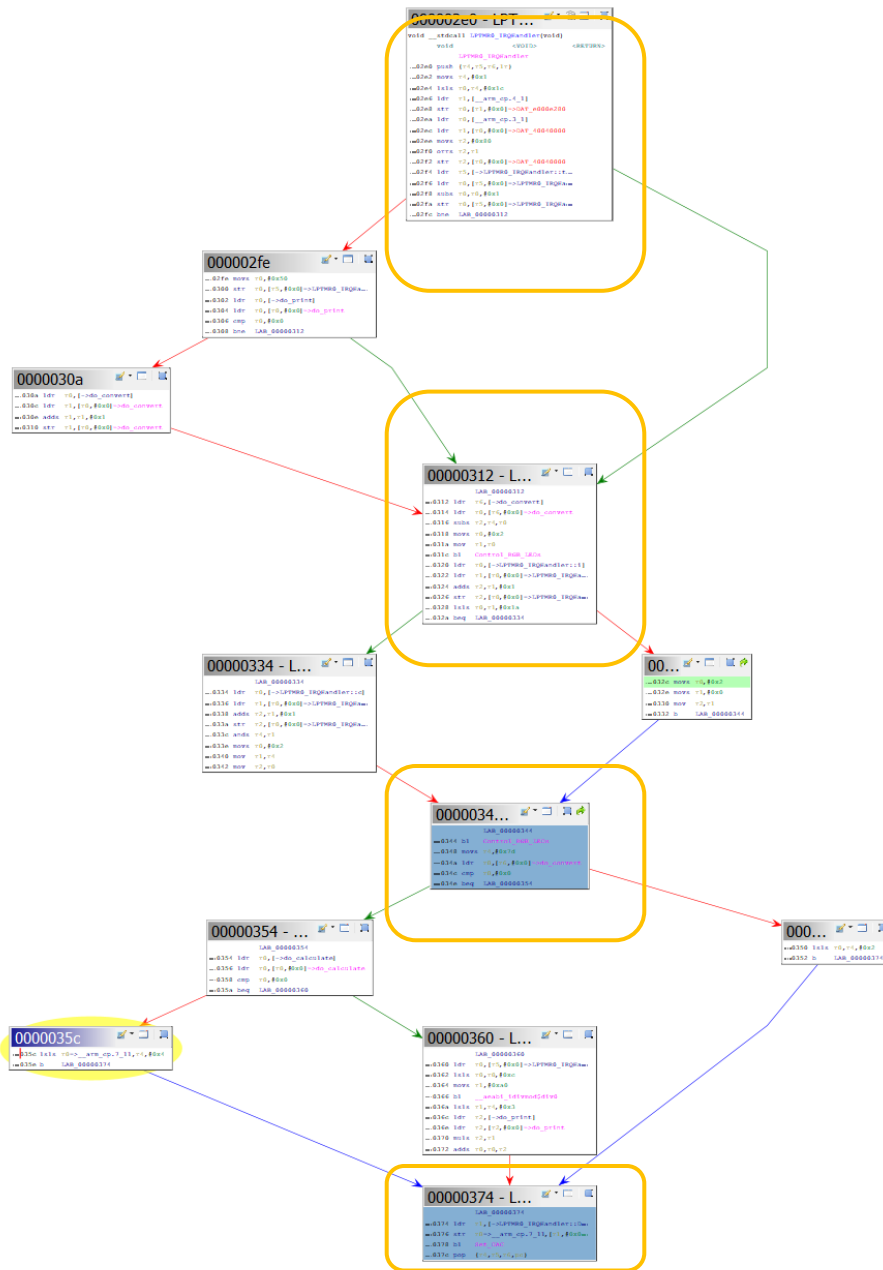
Sheet

Sheet

# Complex Control Flow: XOC-17 – XOC-18

## XOC-17

Function Graph - LPTMR0\_IRQHandler - 12 vertices (BasicUI.axf)



## XOC-18

```
000002e0 - LPT...
void __stdcall LPTMR0_IRQHandler(void)
void <VOID> <RETURN>

...02e0 push {r4,r5,r6,r7}
...02e2 movs r4,#0x1
...02e4 lsls r4,r4,#0x1c
...02e6 ldr r1,[_arm_cp_4_1]
...02e8 str r0,[r1,#0x0]=>DAT_e000e280
...02ea ldr r0,[_arm_cp_3_1]
...02ec ldr r1,[r0,#0x0]=>DAT_40040000
...02ee movs r2,#0x80
...02f0 orrs r2,r1
...02f2 str r2,[r0,#0x0]=>DAT_40040000
...02f4 ldr r5,[>LPTMR0_IRQHandler:>b
...02f6 ldr r0,[r5,#0x0]=>LPTMR0_IRQHa.
...02f8 subs r0,r0,#0x1
...02fa str r0,[r5,#0x0]=>LPTMR0_IRQHa.
...02fc bne LAB_00000312
```

## XOC-18:

- 0x02e0,
- 0x0312,
- 0x0344,
- 0x0374.

```
00000312 - L...
LAB_00000312
...0312 ldr r6,[>do_convertd
...0314 ldr r0,[r6,#0x0]=>do_convert
...0316 subs r2,r4,r0
...0318 movs r0,#0x2
...031a mov r1,r0
...031c bl Control_RGB_LEDs
...0320 ldr r0,[>LPTMR0_IRQHandler:>b
...0322 ldr r1,[r0,#0x0]=>LPTMR0_IRQHa.
...0324 adds r2,r1,#0x1
...0326 str r2,[r0,#0x0]=>LPTMR0_IRQHa.
...0328 lsls r0,r1,#0x1a
...032a beq LAB_00000334
```

```
00000344...
LAB_00000344
...0344 bl Control_RGB_LEDs
...0348 movs r4,#0x7d
...034a ldr r0,[r6,#0x0]=>do_convertd
...034c cmp r0,#0x0
...034e beq LAB_00000354
```

```
00000374 - L...
LAB_00000374
...0374 ldr r1,[>LPTMR0_IRQHandler:>b
...0376 str r0=>_arm_cp_7_1[r0,#0x0]
...0378 bl Set_DAC
...037c pop {r4,r5,r6,r7}
```

# Complex Control Flow: XOC-19 – XOC-20

XOC-19

XOC-20

Compiler loads 125 into r4, then shifts it left if needed to get 250 or 2000

```
00000344 - ...  
LAB_00000344  
...0344 bl Control_RGB_LEDs  
...0348 movs r4,#0x7d  
...034a ldr r0,[r6,#0x0]=>do_convert  
...034c cmp r0,#0x0  
...034e beq LAB_00000354
```

```
00000354 - ...  
LAB_00000354  
...0354 ldr r0,[->do_calculate]  
...0356 ldr r0,[r0,#0x0]=>do_calculate  
...0358 cmp r0,#0x0  
...035a beq LAB_00000360
```

```
000...  
...0350 lsls r0,r4,#0x2  
...0352 b LAB_00000374
```

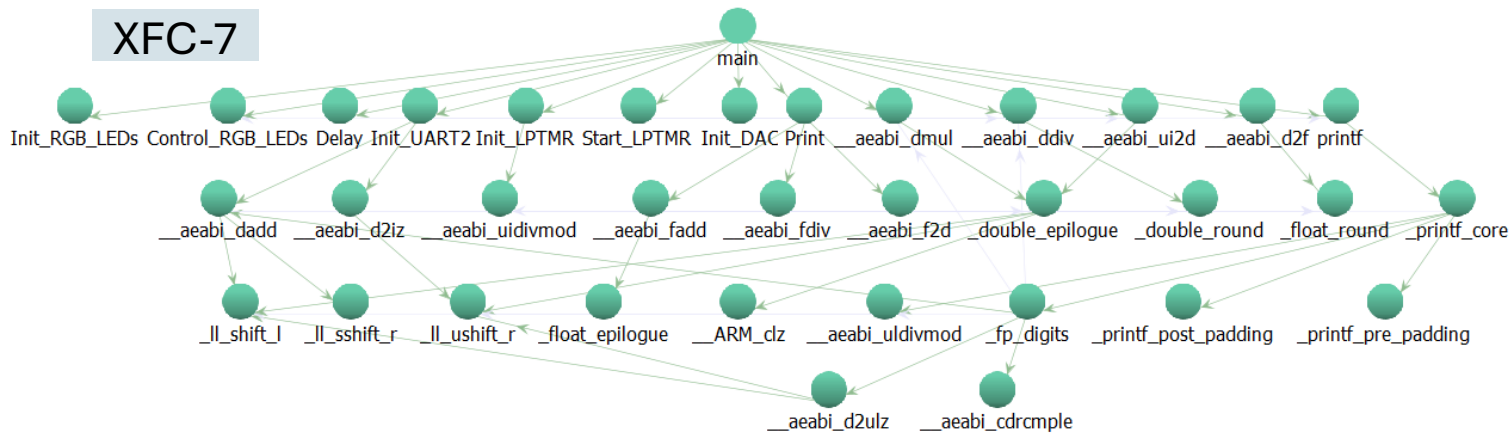
```
0000035c  
...035c lsls r0=>__arm_cp.7_l1,r4,#0x4  
...035e b LAB_00000374
```

```
00000360 - L...  
LAB_00000360  
...0360 ldr r0,[r5,#0x0]=>LPTMR0_IRQHa...  
...0362 lsls r0,r0,#0xc  
...0364 movs r1,#0xa0  
...0366 bl __aeabi_idivmod$div0  
...036a lsls r1,r4,#0x3  
...036c ldr r2,[->do_print]  
...036e ldr r2,[r2,#0x0]=>do_print  
...0370 muls r2,r1  
...0372 adds r0,r0,r2
```

```
00000374 - L...  
LAB_00000374  
...0374 ldr r1,[->LPTMR0_IRQHandler::D...  
...0376 str r0=>__arm_cp.7_l1,[r1,#0x0...  
...0378 bl Set_DAC  
...037c pop {r4,r5,r6,pc}
```

# XFC-1 – XFC-10

| XFC    |               | Examining Function Calling Behavior                                                                                                                |  |       |
|--------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|
| XFC-1  | Source        | Calculate Control_RGB_LEDs Convert Delay Init_ADC Init_DAC Init_LPTMR Init_RGB_LEDs Init_UART2 Misc Print printf Start_LPTMR                       |  | Sheet |
| XFC-2  | Linker        | __2printf __aeabi_d2f __aeabi_ddiv __aeabi_dmul __aeabi_ui2d Control_RGB_LEDs Delay Init_DAC Init_LPTMR Init_RGB_LEDs Init_UART2 Print Start_LPTMR |  | Sheet |
| XFC-3  | Extra         | __2printf __aeabi_d2f __aeabi_ddiv __aeabi_dmul __aeabi_ui2d                                                                                       |  | Sheet |
| XFC-4  | Missing       | Calculate Convert Init_ADC Misc printf                                                                                                             |  | Sheet |
| XFC-5  | Ghidra        | Init_RGB_LEDs Init_UART2 Init_DAC Control_RGB_LEDs Init_LPTMR printf Delay Start_LPTMR __aeabi_ui2d __aeabi_ddiv __aeabi_dmul __aeabi_d2f Print    |  | Sheet |
| XFC-6  |               | main_init __scatterload_rt2 __main_scatterload                                                                                                     |  | Sheet |
| XFC-8  | __aeabi_ddiv  | Init_UART2 Calculate main __fp_digits                                                                                                              |  | Sheet |
| XFC-9  |               | __2printf                                                                                                                                          |  | Sheet |
| XFC-10 | Missing calls | We find inlined code from body of the function which would have been called at each such location.                                                 |  | Sheet |



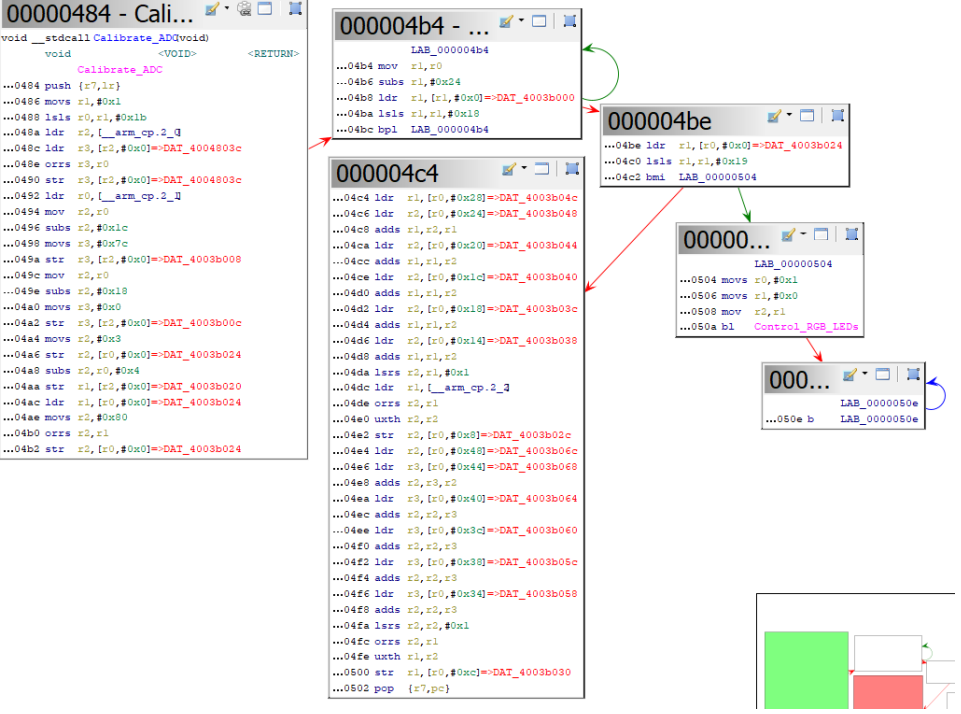


# Source vs. Object vs. Decompiled Code: SVD-1 – SVD-8

## SVD-1

```
41 void Calibrate_ADC(void) {
42     SIM->SCGC6 |= SIM_SCGC6_ADC0(1);
43     // From SRM section 28.4.6
44
45     // Set fADCK <= 4 MHz. Not low power, divide clock by 8, select bus clock, long
46     // With CLK_SETUP == 1, Bus clock = 24 MHz, so fADCK = 24 MHz/8 = 3 MHz
47     ADC0->CFG1 = ADC_CFG1_ADLP(0) | ADC_CFG1_ADIV(3) | ADC_CFG1_ADICLK(0) |
48         ADC_CFG1_ADLSMP(1) | ADC_CFG1_MODE(3);
49     // longest sample time, normal conversion speed, async clock output disabled, AD
50     ADC0->CFG2 = ADC_CFG2_ADLS(0) | ADC_CFG2_ADHSC(0) | ADC_CFG2_ADACKEN(0) |
51         ADC_CFG2_MUXSEL(0);
52     // Set maximum hardware averaging: AVGE = 1, AVGS = 11
53     ADC0_SC3 = ADC_SC3_AVGS(1) | ADC_SC3_AVGS(3);
54     // Use Vdda reference, software ADC trigger
55     ADC0->SC2 = ADC_SC2_REFSEL(1) | ADC_SC2_ADTRG(0);
56
57     // Start calibration
58     ADC0_SC3 |= ADC_SC3_CAL(1);
59     // Await calibration completion
60     while (!(ADC0->SC1[0] & ADC_SC1_COCO_MASK) )
61     ;
62
63     if (ADC0_SC3 & ADC_SC3_CALF_MASK) {
64         // calibration failed
65         Control_RGB_LEDs(1, 0, 0);
66         while (1);
67     }
68
69     // Read calibration results, assign gains
70     uint16_t pcal;
71     pcal = ADC0_CLP0 + ADC0_CLP1 + ADC0_CLP2 + ADC0_CLP3 + ADC0_CLP4 + ADC0_CLP5;
72     pcal /= 2;
73     pcal |= 0x8000;
74     ADC0_PG = pcal;
75
76     uint16_t mcal;
77     mcal = ADC0_CLM0 + ADC0_CLM1 + ADC0_CLM2 + ADC0_CLM3 + ADC0_CLM4 + ADC0_CLM5;
78     mcal /= 2;
79     mcal |= 0x8000;
80     ADC0_MG = mcal;
81 }
```

## SVD-2



## SVD-5

```
1 /* WARNING: Removing unreachable block (ram,0x00000504) */
2 /* WARNING: Removing unreachable block (ram,0x0000050e) */
3 /* WARNING: Globals starting with '_' overlap smaller symbols at the same address */
4
5 void Calibrate_ADC(void)
6 {
7
8     _DAT_4004803c = _DAT_4004803c | 0x80000000;
9     _DAT_4003b008 = 0x7c;
10    _DAT_4003b00c = 0;
11    _DAT_4003b020 = 1;
12    _DAT_4003b024 = 0x83;
13
14    do {
15    } while (-1 < _DAT_4003b000 << 0x18);
16    _DAT_4003b02c =
17        ((uint) (_DAT_4003b048 + _DAT_4003b04c + _DAT_4003b044 + _DAT_4003b040 + _DAT_4003b03c +
18            _DAT_4003b038) >> 1 | 0xffff8000) & 0xffff;
19    _DAT_4003b030 =
20        ((uint) (_DAT_4003b068 + _DAT_4003b06c + _DAT_4003b064 + _DAT_4003b060 + _DAT_4003b05c +
21            _DAT_4003b058) >> 1 | 0xffff8000) & 0xffff;
22
23    return;
```

SVD-3  
SVD-4

yes  
They should match, so no differences.

SVD-6  
SVD-7

It is the address of the ADC Status and Control Registers 1 (ADC0\_SC1A). It is used in a do/while loop to block until conversion complete (COCO) status flag is 1. The register is read and then shifted left by 0x18 = 24 bit positions, which makes the COCO flag the MSB. Until the COCO flag is 1, the shifted value will be zero or positive, so the loop will repeat. When COCO is 0, the shifted value will be negative, and the loop will stop.

The calibration failure code (bbs 0x04be, 0x0504, 0x050e) is missing from the decompiled code.

SVD-8

Sheet  
Sheet  
Sheet  
Sheet  
Sheet

# Reference: Disassembly listing for start of main

Disassembly

```

133: int main (void) {
0x0000065C B082      SUB      sp,sp,#0x08
134:      Init_RGB_LEDs();
0x0000065E F7FFFD39 BL.W     0x000000D4 Init RGB LEDs
0x00000662 2601      MOVS     r6,#0x01
0x00000664 2400      MOVS     r4,#0x00
135:      Control_RGB_LEDs(1, 1, 0); // Yellow
136:      Misc();
137:      // Calibrate_ADC();
138:      Init_ADC();
139:      // Control_RGB_LEDs(0, 0, 1); // Blue
0x00000666 4630      MOV      r0,r6
0x00000668 4631      MOV      r1,r6
0x0000066A 4622      MOV      r2,r4
0x0000066C F7FFFD68 BL.W     0x00000140 Control_RGB_LEDs
0x00000670 0270      LSLS     r0,r6,#9
0x00000672 4947      LDR      r1,[pc,#284] ; @0x00000790
20:      SIM->SCGC5 |= SIM_SCGC5_PORTA_MASK;
0x00000674 680A      LDR      r2,[r1,#0x00]
0x00000676 4302      ORRS     r2,r2,r0
0x00000678 600A      STR      r2,[r1,#0x00]
0x0000067A 2007      MOVS     r0,#0x07
0x0000067C 0200      LSLS     r0,r0,#8
0x0000067E 4945      LDR      r1,[pc,#276] ; @0x00000794
21:      PORTA->PCR[12] &= ~PORT_PCR_MUX_MASK;
0x00000680 680A      LDR      r2,[r1,#0x00]
0x00000682 4382      BICS     r2,r2,r0
0x00000684 600A      STR      r2,[r1,#0x00]
0x00000686 0230      LSLS     r0,r6,#8
22:      PORTA->PCR[12] |= PORT_PCR_MUX(1);
0x00000688 680A      LDR      r2,[r1,#0x00]
0x0000068A 4302      ORRS     r2,r2,r0
0x0000068C 600A      STR      r2,[r1,#0x00]
0x0000068E 0330      LSLS     r0,r6,#12
0x00000690 4941      LDR      r1,[pc,#260] ; @0x00000798
23:      PTA->PDDR |= 1 << 12;
0x00000692 680A      LDR      r2,[r1,#0x00]
0x00000694 4302      ORRS     r2,r2,r0
0x00000696 600A      STR      r2,[r1,#0x00]
24:      PTA->PCOR = 1 << 12;
25: }
26:
27: void Init_ADC(void) {
0x00000698 390C      SUBS     r1,r1,#0x0C
0x0000069A 6008      STR      r0,[r1,#0x00]
0x0000069C 4F3F      LDR      r7,[pc,#252] ; @0x0000079C
0x0000069E 207C      MOVS     r0,#0x7C
28:      ADC0->CFG1 = ADC_CFG1_ADLPSC(0) | ADC_CFG1_ADIC
29:      ADC_CFG1_ADLSMP(1) | ADC_CFG1_MODE(3)
0x000006A0 60B8      STR      r0,[r7,#0x08]
30:      ADC0->CFG2 = ADC_CFG2_ADLSTS(0) | ADC_CFG2_AD
31:      ADC_CFG2_MUXSEL(0);
0x000006A2 60FC      STR      r4,[r7,#0x0C]

```