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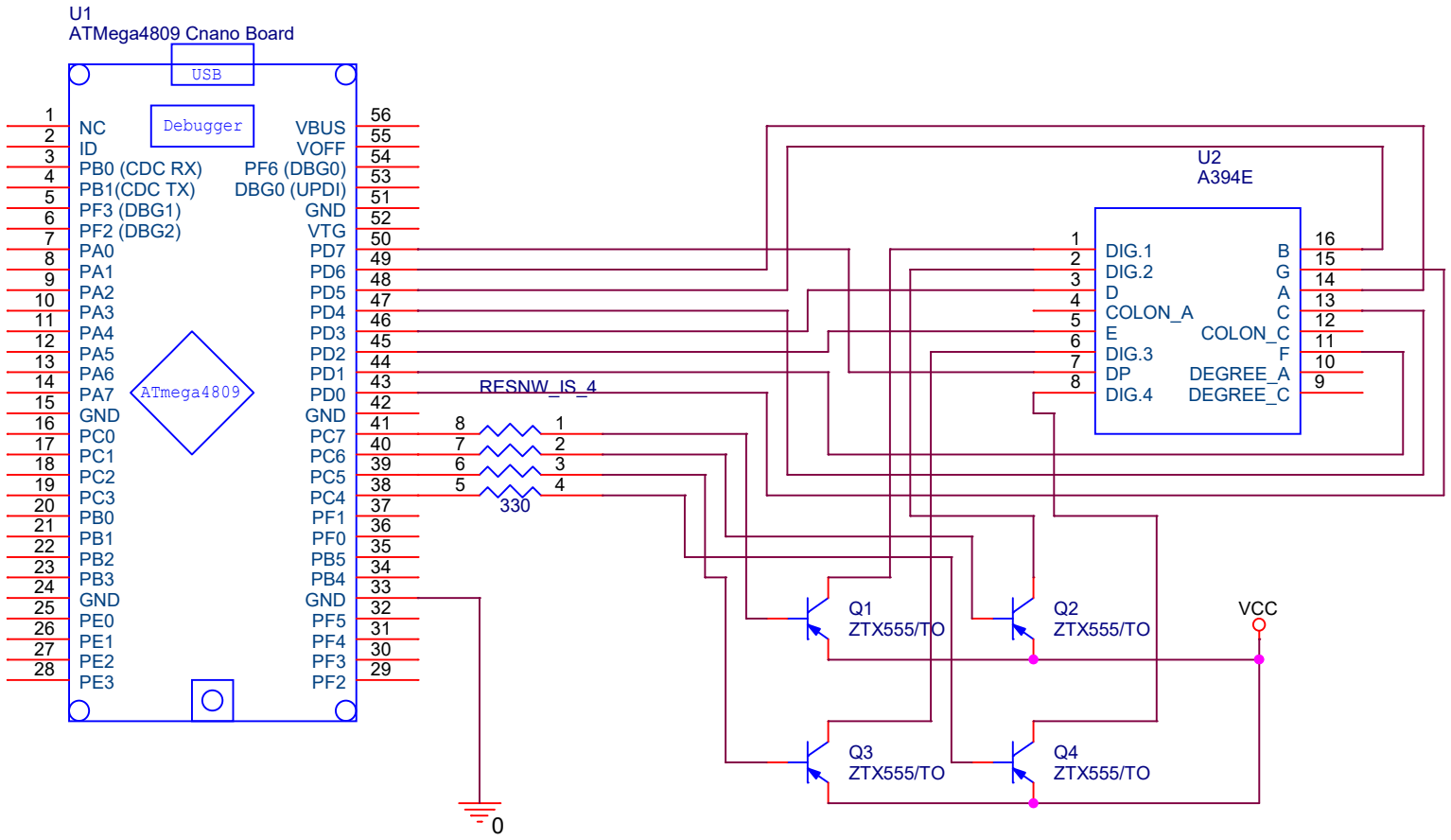
Lab 7:

Four Digit Multiplexed Seven-Segment LED Display

Questions:

1. 5040, 7!
2. 68, 30, 4F, 18
3. Place the scope on the collector of the corresponding pnp transistor, trigger on falling edge
4. You would use high side drive, npn, and 1 to turn on, because the diode orientation is reversed
5.



Title	Segment and Digit Test	
Size A	Document Number <Doc>	Rev <RevCo
Date: Tuesday, October 20, 2020	Sheet 1 of 1	

```
 1
 2  AVRASM ver. 2.2.7  F:\ESE_280\$MyDocuments$\Atmel Studio\7.0\lab_7
      \AssemblerApplication1\main.asm Wed Oct 21 11:23:43 2020
 3
 4  F:\ESE_280\$MyDocuments$\Atmel Studio\7.0\lab_7\AssemblerApplication1\main.asm
      (9): Including file 'C:/Program Files (x86)\Atmel\Studio\7.0\Packs\atmel
      \ATmega_DFP\1.2.209\avrasm\inc\m4809def.inc'
 5  F:\ESE_280\$MyDocuments$\Atmel Studio\7.0\lab_7\AssemblerApplication1\main.asm
      (9): Including file 'C:/Program Files (x86)\Atmel\Studio\7.0\Packs\atmel
      \ATmega_DFP\1.2.209\avrasm\inc\m4809def.inc'
 6
 7
 8                                    ; display_hex_digit_at_pos.asm
 9                                    ;
10                                    ; Created: 10/20/2020 8:30:20 PM
11                                    ; Author : hp
12                                    ;
13
14                                    .list
15
16                                    start:
17  000000 e000                          ldi r16, $00
18  000001 ef1f                          ldi r17, $FF
19  000002 b900                          out VPORTA_DIR, r16
20  000003 b91c                          out VPORTD_DIR, r17
21  000004 b918                          out VPORTC_DIR, r17
22  000005 b91d                          out VPORTD_OUT, r17
23
24                                    main_loop:
25  000006 b102                          in r16, VPORTA_IN
26  000007 1710                          cp r17, r16
27  000008 1720                          cp r18, r16
28  000009 7c10                          andi r17, $C0
29  00000a 700f                          andi r16, $0F
30  00000b 3010                          cpi r17, $00
31  00000c f039                          breq zero
32  00000d 3410                          cpi r17, $40
33  00000e f039                          breq one
34  00000f 3810                          cpi r17, $80
35  000010 f039                          breq two
36  000011 3c10                          cpi r17, $C0
37  000012 f039                          breq three
38  000013 cff2                          rjmp main_loop
39
40                                    zero:
41  000014 984f                          cbi VPORTC_OUT, 7
42  000015 c005                          rjmp hex_to_7seg
43
44                                    one:
```

```
000016 984e                         cbi VPORTC_OUT, 6
000017 c003                         rjmp hex_to_7seg

                                two:
000018 984d                         cbi VPORTC_OUT, 5
000019 c001                         rjmp hex_to_7seg

                                three:
00001a 984c                         cbi VPORTC_OUT, 4


                                    ;*****************************************
                    ******************************
                                    ;*
                                    ;* "hex_to_7seg" - Hexadecimal to Seven
                    Segment Conversion
                                    ;*
                                    ;* Description: Converts a right justified
                    hexadecimal digit to the seven
                                    ;* segment pattern required to display it.
                    Pattern is right justified a
                                    ;* through g. Pattern uses 0s to turn
                    segments on ON.
                                    ;*
                                    ;* Author:                      Ken Short
                                    ;* Version:                         1.0

                                    ;* Last updated:                101620
                                    ;* Target:                      ATmega4809
                                    ;* Number of words:                 8
                                    ;* Number of cycles:            13
                                    ;* Low registers modified:      none
                                    ;* High registers modified:         r16, r18,
                    ZL, ZH
                                    ;*
                                    ;* Parameters: r18: right justified hex
                    digit, high nibble 0
                                    ;* Returns: r18: segment values a through g
                    right justified
                                    ;*
                                    ;* Notes:
                                    ;*
                                    ;*****************************************
                    ******************************
                                hex_to_7seg:
00001b 702f                         andi r18, 0x0F              ;clear ms
     nibble
00001c e0f0                          ldi ZH, HIGH(hextable * 2)  ;set Z to
```

```
      point to start of table
 83  00001d e4e6                          ldi ZL, LOW(hextable * 2)
 84  00001e e000                          ldi r16, $00               ;add offset
      to Z pointer
 85  00001f 0fe2                          add ZL, r18
 86  000020 1ff0                          adc ZH, r16
 87  000021 9124                          lpm r18, Z                 ;load byte
      from table pointed to by Z
 88  000022 c008                         rjmp output
 89
 90                                        ;Table of segment values to display
                     digits 0 - F
 91                                        ;!!! seven values must be added - verify
                     all values
 92  000023 4f01
 93  000024 0612
 94  000025 244c
 95  000026 0f20
 96  000027 0400
 97  000028 6008
 98  000029 4231
 99  00002a 3830                      hextable: .db $01, $4F, $12, $06, $4C, $24,
      $20, $0F, $00, $04, $08, $60, $31, $42, $30, $38
100
101                                   output:
102  00002b b92d                         out VPORTD_OUT, r18
103
104
105  RESOURCE USE INFORMATION
106  ------------------------
107
108  Notice:
109  The register and instruction counts are symbol table hit counts,
110  and hence implicitly used resources are not counted, eg, the
111  'lpm' instruction without operands implicitly uses r0 and z,
112  none of which are counted.
113
114  x,y,z are separate entities in the symbol table and are
115  counted separately from r26..r31 here.
116
117  .dseg memory usage only counts static data declared with .byte
118
119  "ATmega4809" register use summary:
120  x  :   0 y  :   0 z  :   1 r0 :   0 r1 :   0 r2 :   0 r3 :   0 r4 :   0
121  r5 :   0 r6 :   0 r7 :   0 r8 :   0 r9 :   0 r10:   0 r11:   0 r12:   0
122  r13:   0 r14:   0 r15:   0 r16:   8 r17:  10 r18:   5 r19:   0 r20:   0
123  r21:   0 r22:   0 r23:   0 r24:   0 r25:   0 r26:   0 r27:   0 r28:   0
124  r29:   0 r30:   2 r31:   2
125  Registers used: 6 out of 35 (17.1%)
```

```
126
127 "ATmega4809" instruction use summary:
128 .lds  :   0 .sts  :   0 adc   :   1 add   :   1 adiw  :   0 and   :   0
129 andi  :   3 asr   :   0 bclr  :   0 bld   :   0 brbc  :   0 brbs  :   0
130 brcc  :   0 brcs  :   0 break :   0 breq  :   4 brge  :   0 brhc  :   0
131 brhs  :   0 brid  :   0 brie  :   0 brlo  :   0 brlt  :   0 brmi  :   0
132 brne  :   0 brpl  :   0 brsh  :   0 brtc  :   0 brts  :   0 brvc  :   0
133 brvs  :   0 bset  :   0 bst   :   0 call  :   0 cbi   :   4 cbr   :   0
134 clc   :   0 clh   :   0 cli   :   0 cln   :   0 clr   :   0 cls   :   0
135 clt   :   0 clv   :   0 clz   :   0 com   :   0 cp    :   2 cpc   :   0
136 cpi   :   4 cpse  :   0 dec   :   0 des   :   0 eor   :   0 fmul  :   0
137 fmuls :   0 fmulsu:   0 icall :   0 ijmp  :   0 in    :   1 inc   :   0
138 jmp   :   0 ld    :   0 ldd   :   0 ldi   :   5 lds   :   0 lpm   :   2
139 lsl   :   0 lsr   :   0 mov   :   0 movw  :   0 mul   :   0 muls  :   0
140 mulsu :   0 neg   :   0 nop   :   0 or    :   0 ori   :   0 out   :   5
141 pop   :   0 push  :   0 rcall :   0 ret   :   0 reti  :   0 rjmp  :   6
142 rol   :   0 ror   :   0 sbc   :   0 sbci  :   0 sbi   :   0 sbic  :   0
143 sbis  :   0 sbiw  :   0 sbr   :   0 sbrc  :   0 sbrs  :   0 sec   :   0
144 seh   :   0 sei   :   0 sen   :   0 ser   :   0 ses   :   0 set   :   0
145 sev   :   0 sez   :   0 sleep :   0 spm   :   0 st    :   0 std   :   0
146 sts   :   0 sub   :   0 subi  :   0 swap  :   0 tst   :   0 wdr   :   0
147
148 Instructions used: 12 out of 114 (10.5%)
149
150 "ATmega4809" memory use summary [bytes]:
151 Segment   Begin    End      Code   Data   Used    Size   Use%
152 ----------------------------------------------------------------
153 [.cseg] 0x000000 0x00005a     74     16     90   49152   0.2%
154 [.dseg] 0x002800 0x002800      0      0      0    6144   0.0%
155 [.eseg] 0x000000 0x000000      0      0      0     256   0.0%
156
157 Assembly complete, 0 errors, 0 warnings
158
```