I/O Systems

Hexadecimal Keypad Interface

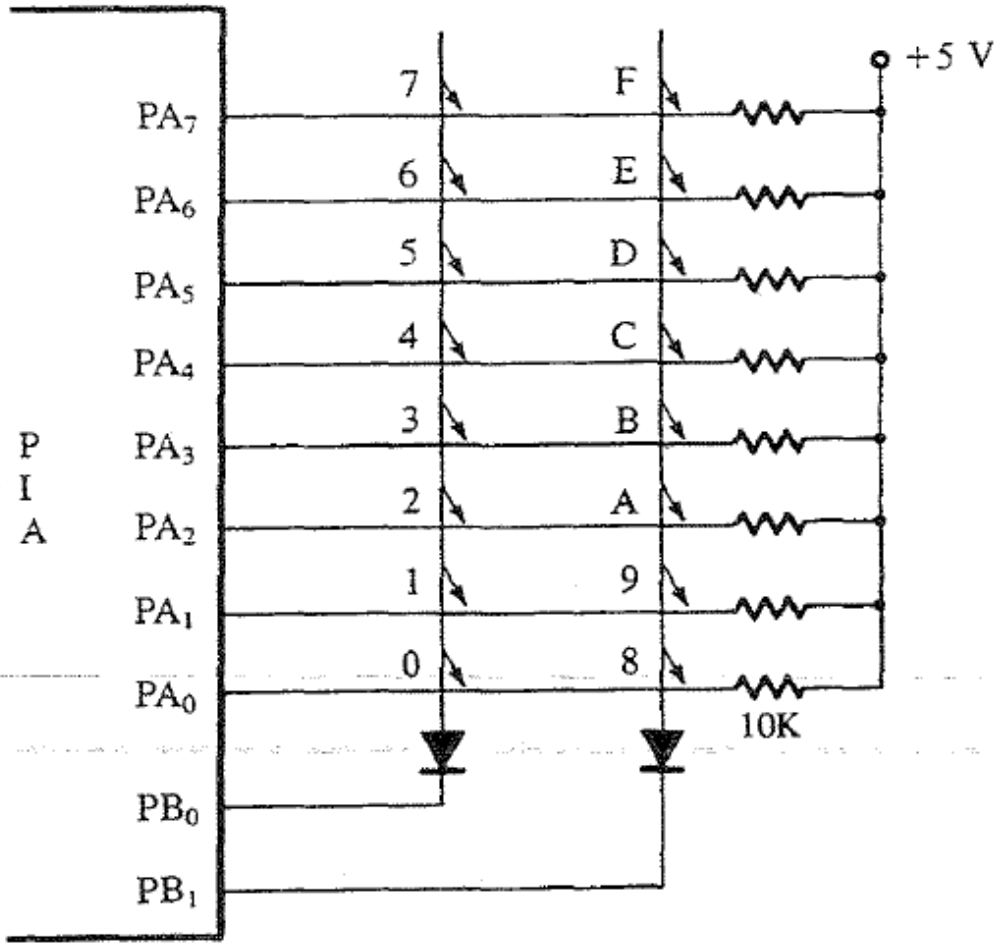
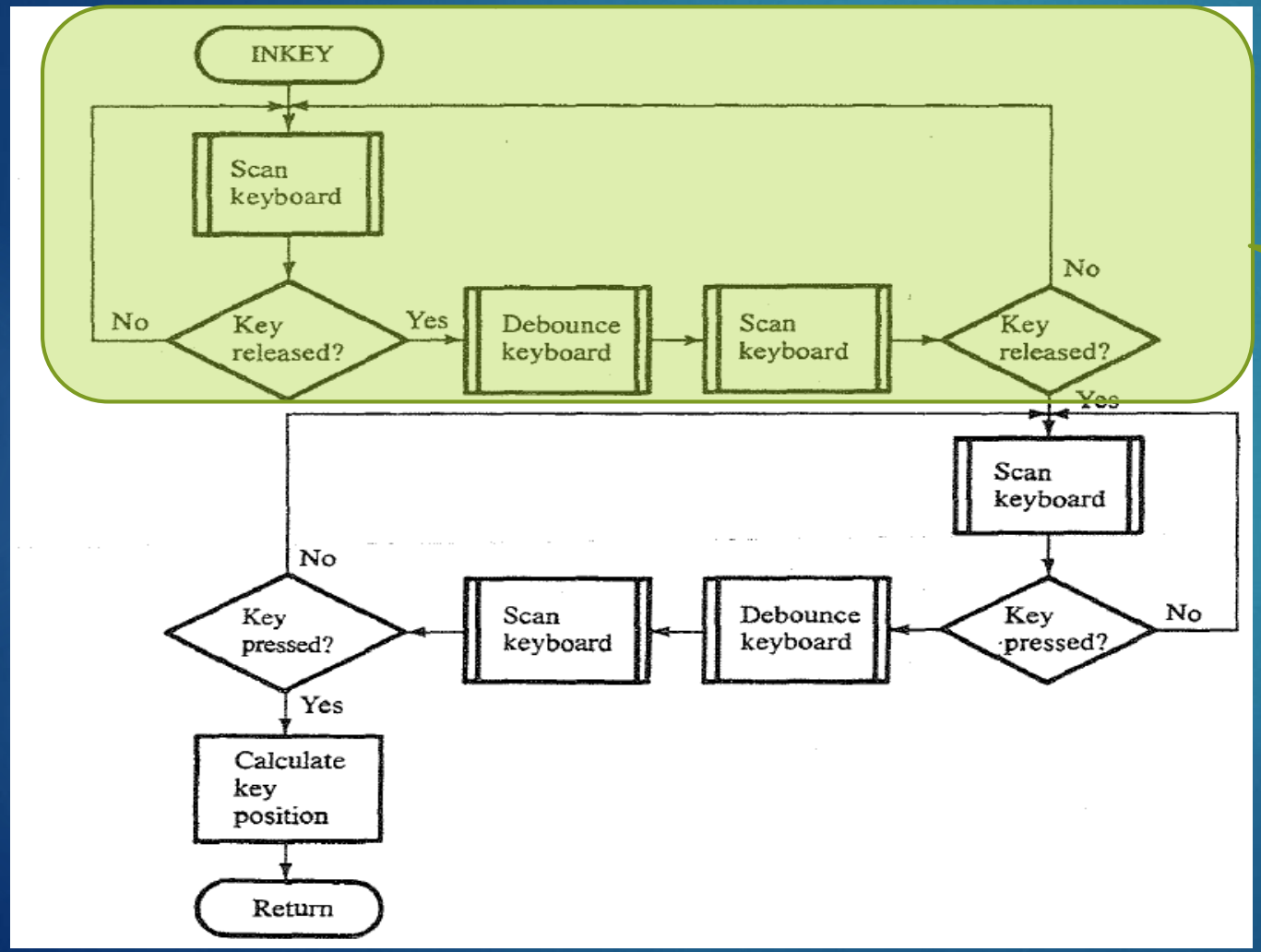


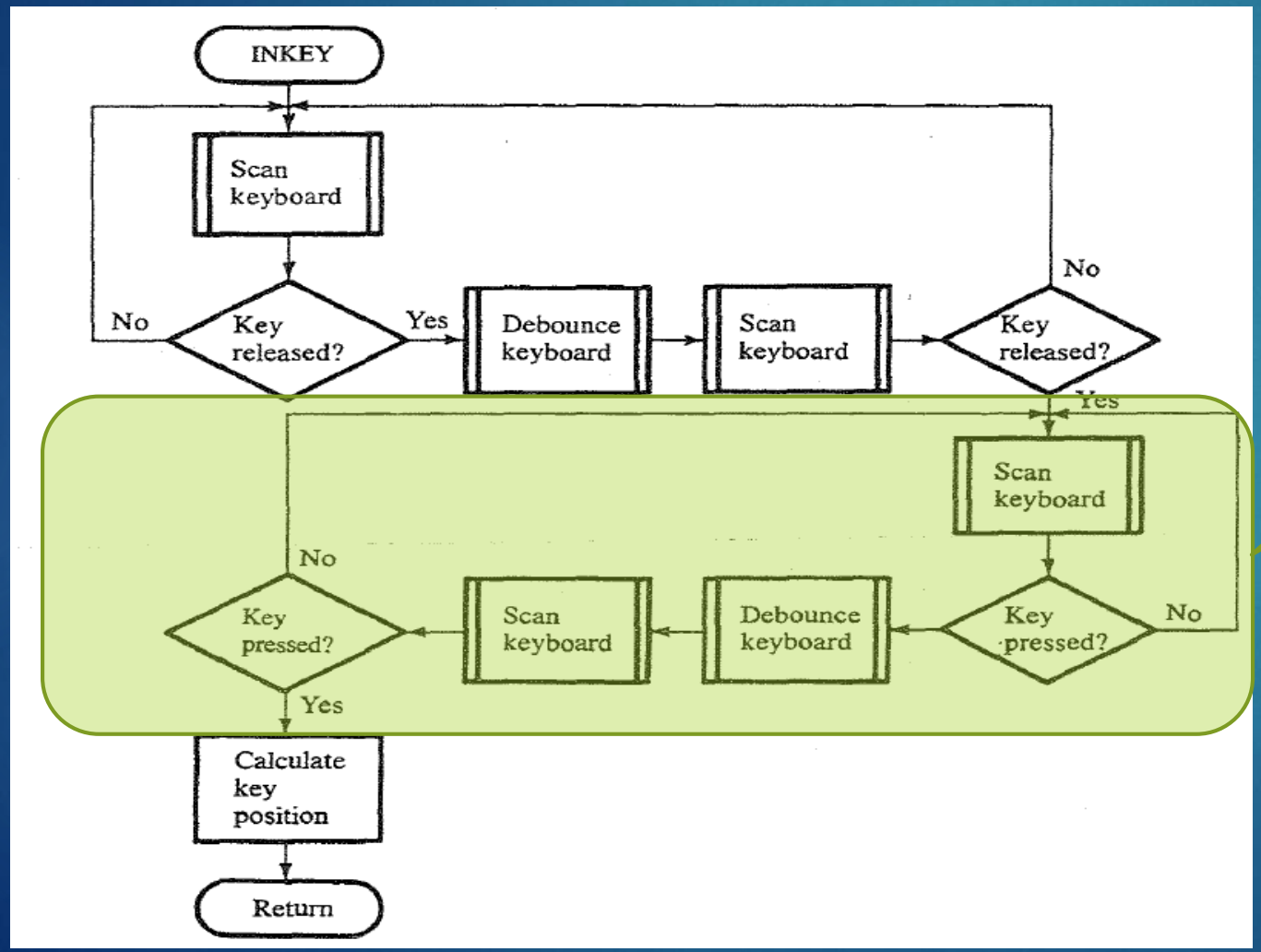
FIGURE 7–3 A hexadecimal keypad connected to Port A of a PIA.

Hexadecimal Keypad Interface – The Flowchart



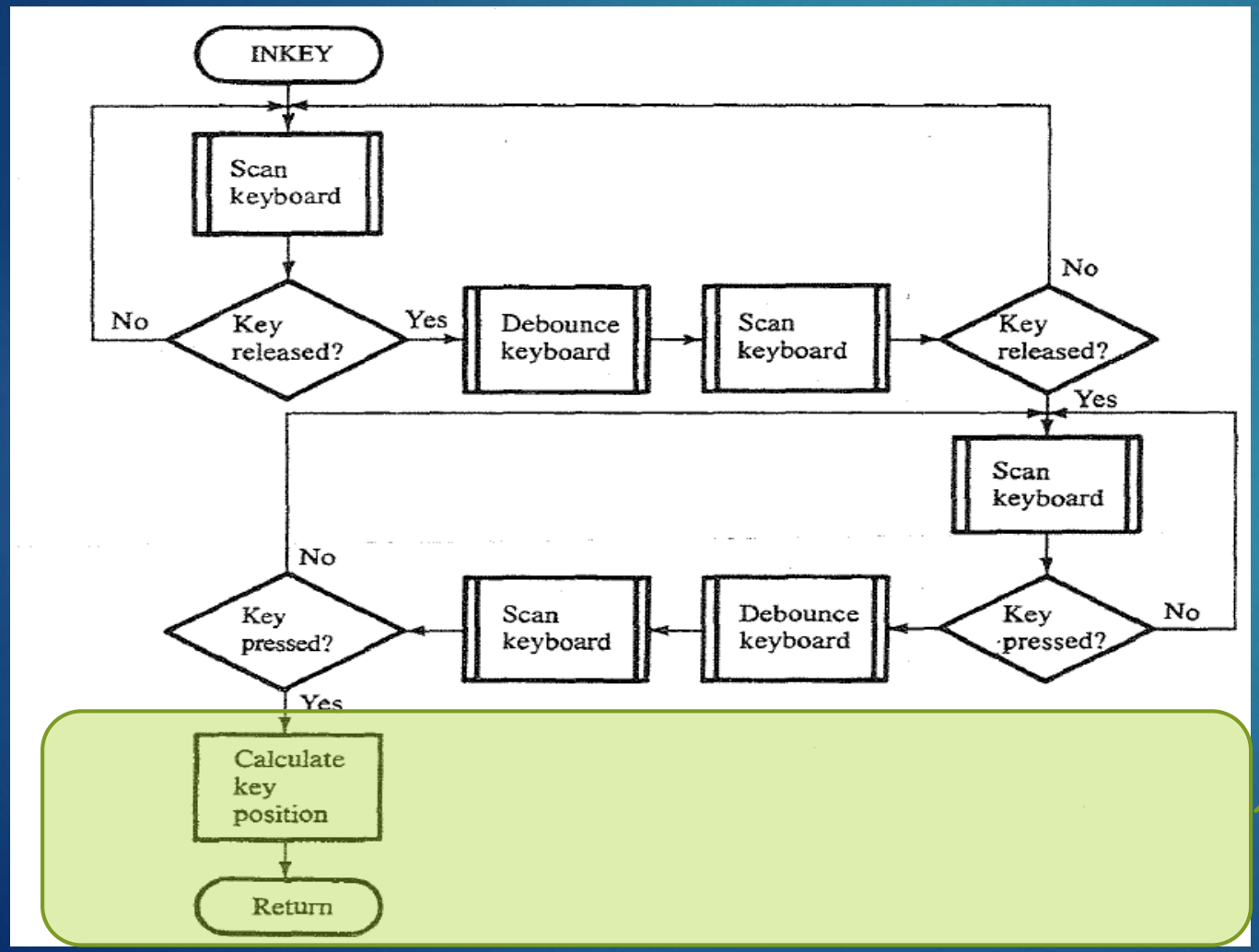
wait for a key release

Hexadecimal Keypad Interface – The Flowchart



wait for a key depression

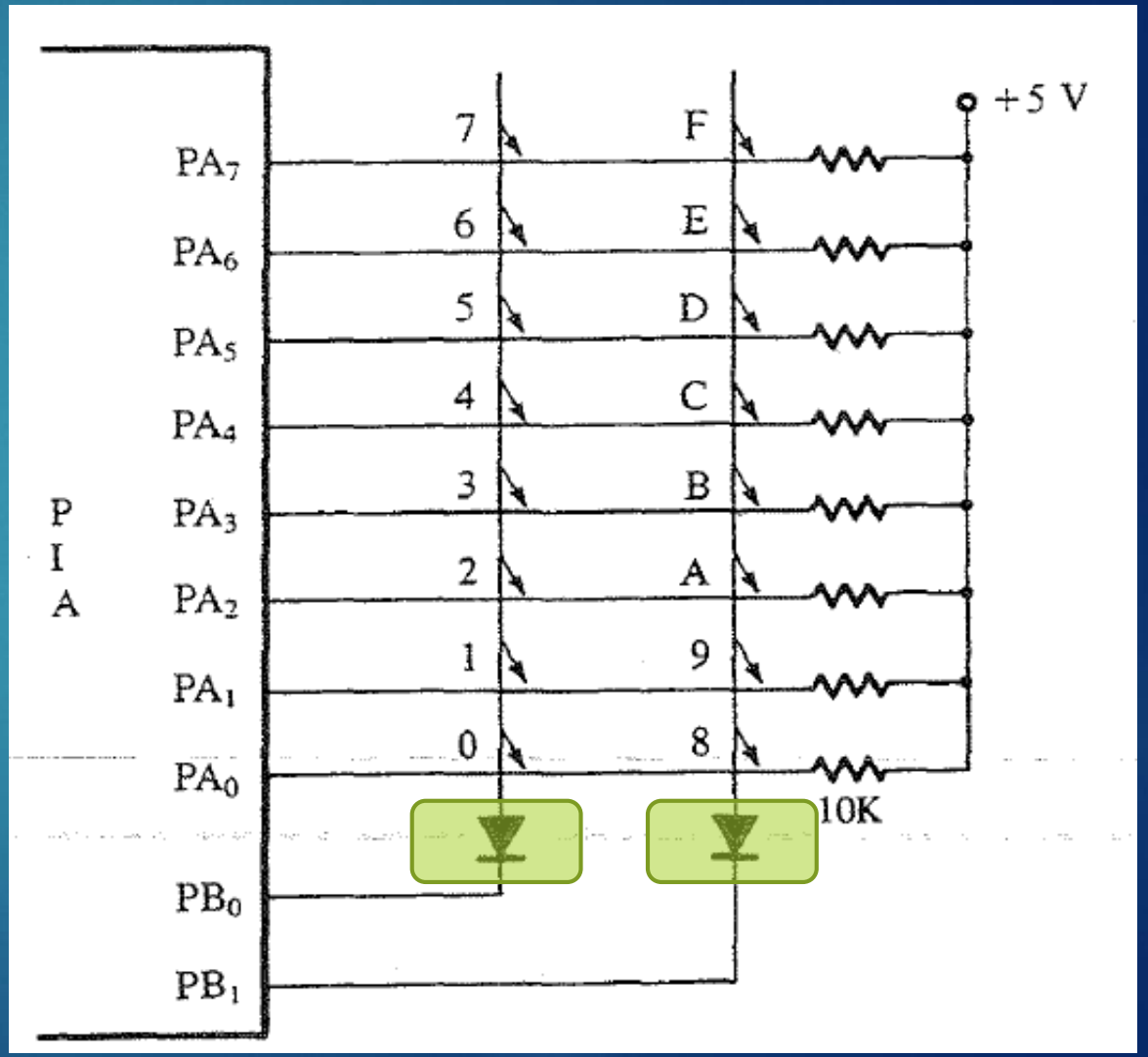
Hexadecimal Keypad Interface – The Flowchart



calculate the key code

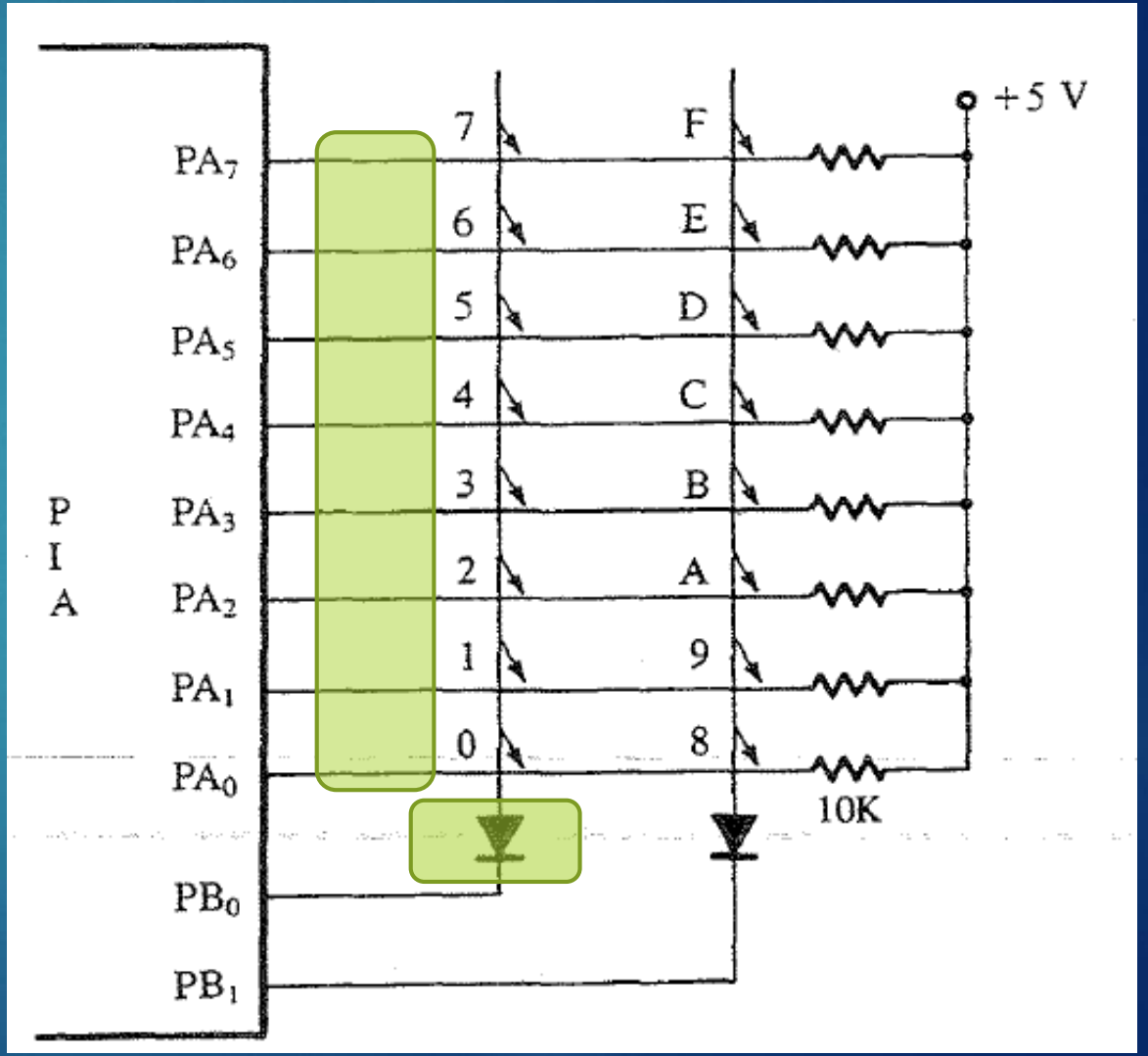
Keypad Software

- When developing the software for the 8085A keypad interface, binary bit patterns 0000 0010 and 0000 0001 are chosen as codes to select the colurrms, and binary bit patterns



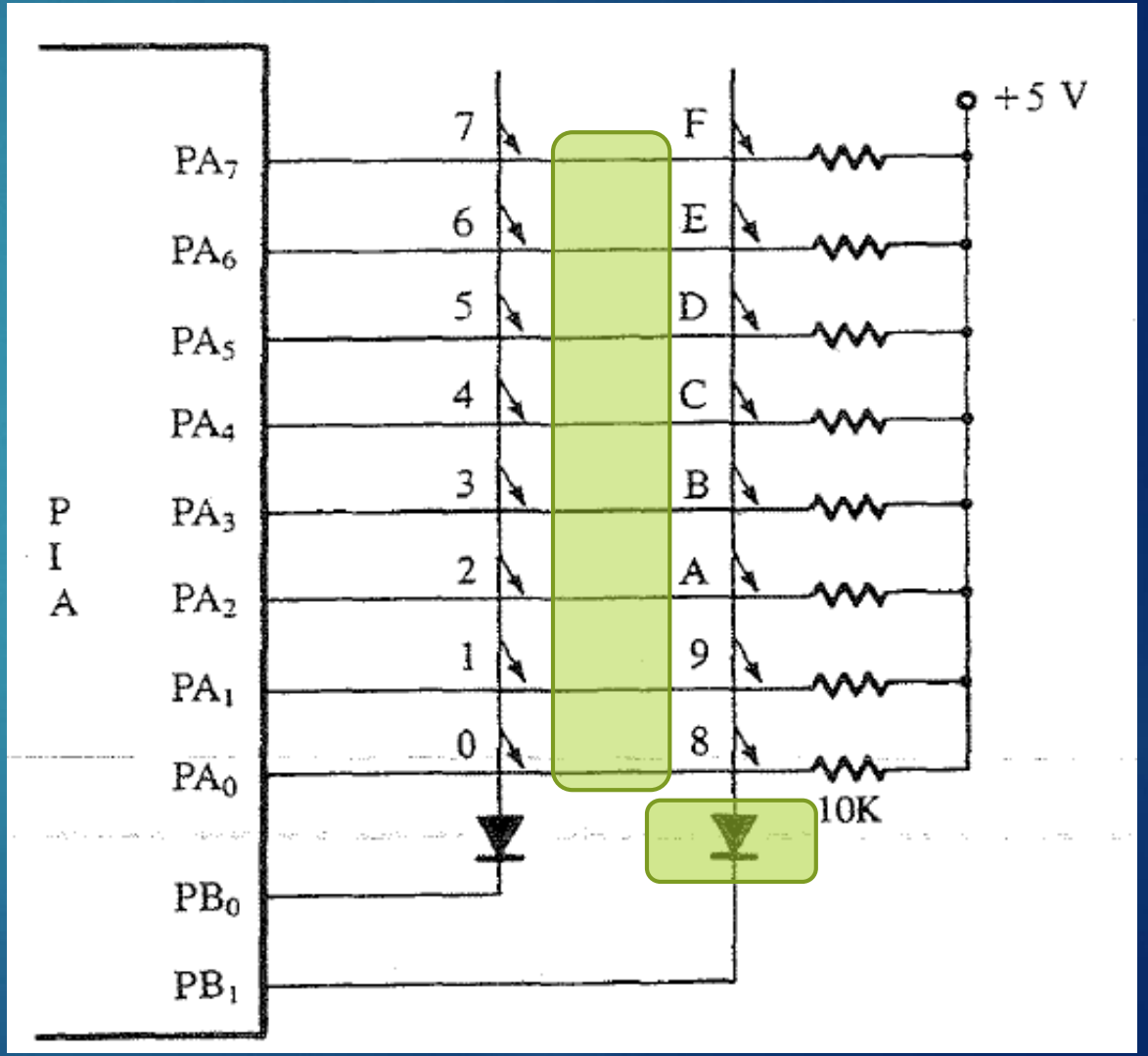
Keypad Software

- 0000 0000 is chosen as an indicator for the first key in the selected column.



Keypad Software

- 0000 1000 are chosen is an indicator for the first key in the selected column.

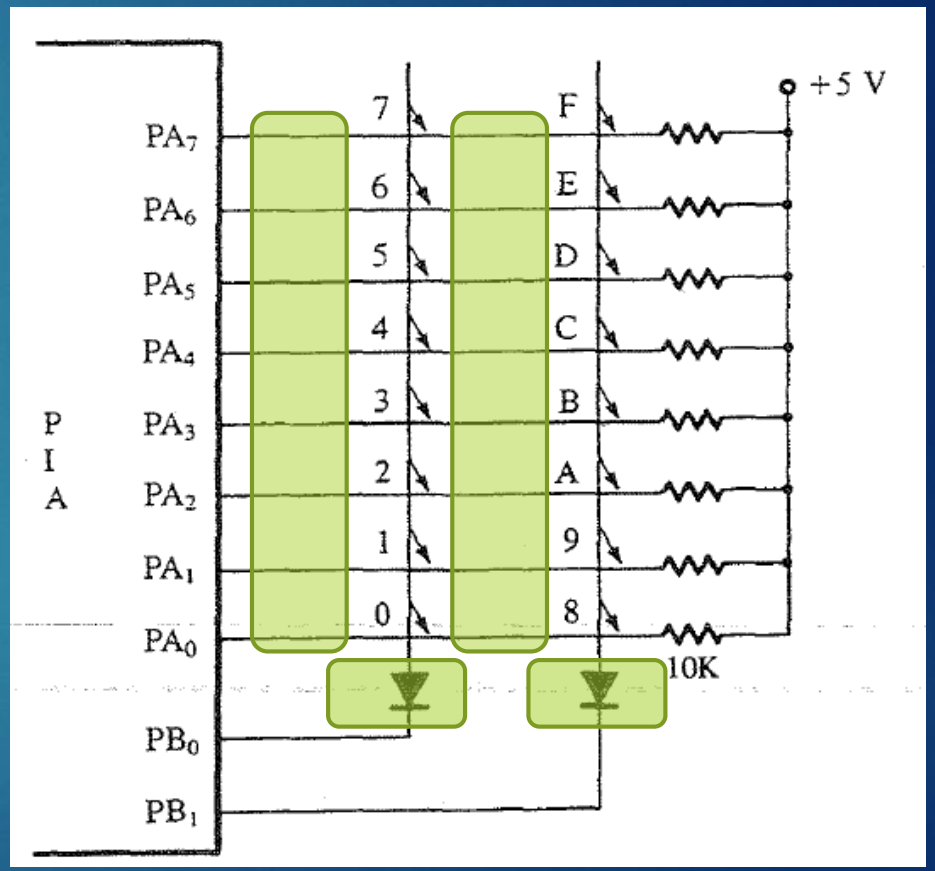


Keypad Software

```
                        ;initialization dialog for the 8155
                        ;keyboard interface
                        ;
0000  3E02              RESET:    MVI    A,00000010B     ;set port A = input
0002  D310                        OUT    COMMAND         ;set port B = output
```

Keypad Software

```
                        ;8085A assembly language version
                        ;
                        ;subroutine to detect a keystroke and return
                        ;with the key code in the C-register.
                        ;
                        ;all registers except HL are destroyed
                        ;uses the SCAN and DELAY subroutines
    2000                          ORG    2000H
                        ;
                        ;check for key release
                        ;
    2000 CD2F20         INKEY:    CALL   SCAN          ;check all keys
2003 C20020                       JNZ    INKEY         ;if key is depressed
2006 CD2520                       CALL   DELAY         ;debounce
2009 CD2F20                       CALL   SCAN          ;check all keys
200C C20020                       JNZ    INKEY         ;if key is depressed
                    ;
                    ;check for a key
                    ;
200F CD2F20         LOOP:         CALL   SCAN          ;check all keys
2012 CA0F20                       JZ     LOOP          ;if no key depressed
2015 CD2520                       CALL   DELAY         ;debounce
2018 CD2F20                       CALL   SCAN          ;check all keys
201B CA0F20                       JZ     LOOP          ;if no key depressed
                    ;
                    ;determine key code
                    ;
201E 0D                           DCR    C
201F 0F             LOOP1:        RRC                  ;locate row
2020 0C                           INR    C             ;modify key code
2021 DA1F20                       JC     LOOP1         ;if not found
2024 C9                           RET                  ;return
```



Keypad Software – Delay Subroutine

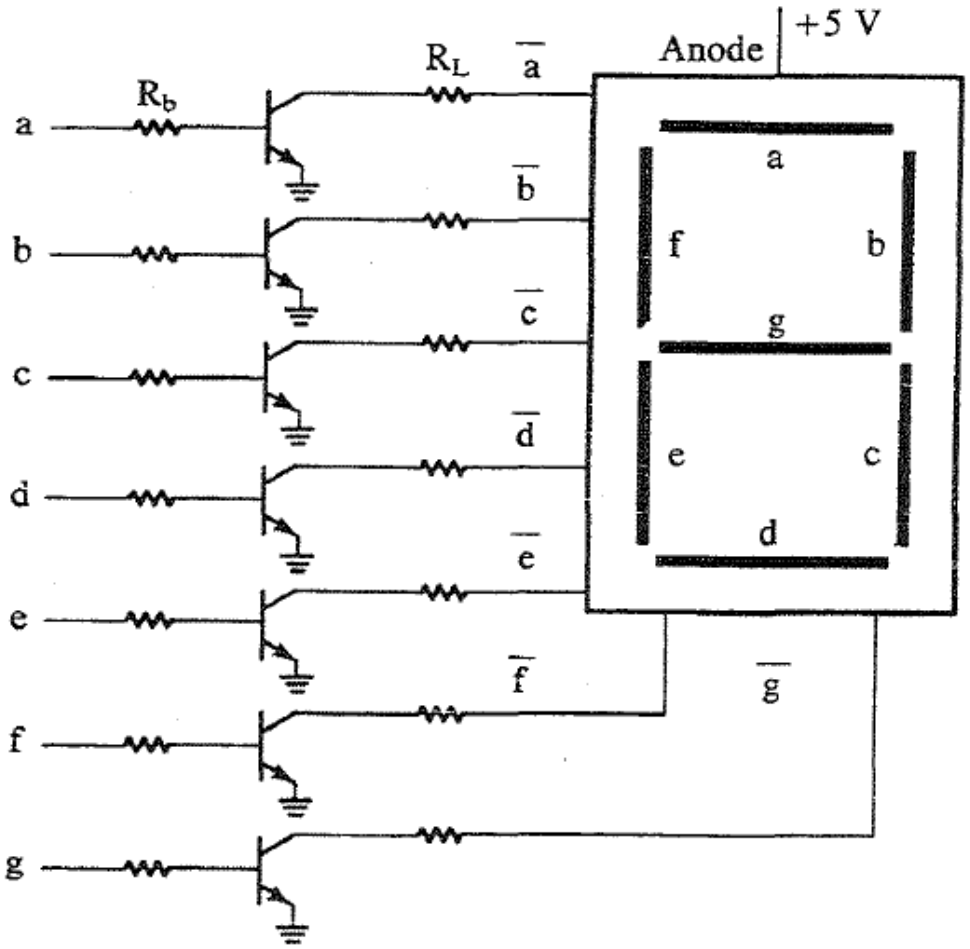
```
                        ;time delay subroutine (20 ms)
                        ;
2025  112006    DELAY:    LXI    D,1568      ;load count
2028  1B        DELAY1:   DCX    D           ;decrement count
2029  7A                MOV    A,D         ;test DE for a 0
202A  B3                ORA    E
202B  C22820            JNZ    DELAY1      ;if DE not 0
202E  C9                RET
```

The amount of time used for the contact debounce delay is left up to the user, since it varies with different switches. The count 1568 in the DELAY subroutine is chosen for a 20-ms time delay for this example.

MULTIPLEXED DISPLAYS

- Display devices are normally multiplexed to reduce the component count in a microprocessor based system.
- In microprocessors, the seven-segment code is developed with software to further reduce the an1ount of external hardware required in the system.

FIGURE 7–5 A seven-segment LED display illustrating the segment drivers.



BCD to Seven-Segment Code Conversion

TABLE 7–1 Common anode seven-segment lookup table.

Address	Data								Displayed Data
	X	a	b	c	d	e	f	g	
TABLE	0	1	1	1	1	1	1	0	0
TABLE+1	0	0	1	1	0	0	0	0	1
TABLE+2	0	1	1	0	1	1	0	1	2
TABLE+3	0	1	1	1	1	0	0	1	3
TABLE+4	0	0	1	1	0	0	1	1	4
TABLE+5	0	1	0	1	1	0	1	1	5
TABLE+6	0	1	0	1	1	1	1	1	6
TABLE+7	0	1	1	1	0	0	0	0	7
TABLE+8	0	1	1	1	1	1	1	1	8
TABLE+9	0	1	1	1	1	0	1	1	9

BCD to Seven-Segment Code Conversion

```
                        ;8085A assembly language version
                        ;
                        ;subroutine to convert the contents of
                        ;the accumulator to 7-segment code.
                        ;HL is destroyed
                        ;refer to table 7-1
                        ;
0000  E60F              CONVERT:    ANI     0FH         ;mask left nibble
0002  210010                        LXI     H,TABLE     ;point to lookup table
0005  85                            ADD     L           ;add BCD to address (HL)
0006  6F                            MOV     L,A
0007  7C                            MOV     A,H
0008  CE00                          ACI     0
000A  67                            MOV     H,A
000B  7E                            MOV     A,M         ;get 7-segment data
000C  C9                            RET
```

Multiple-Digit Display

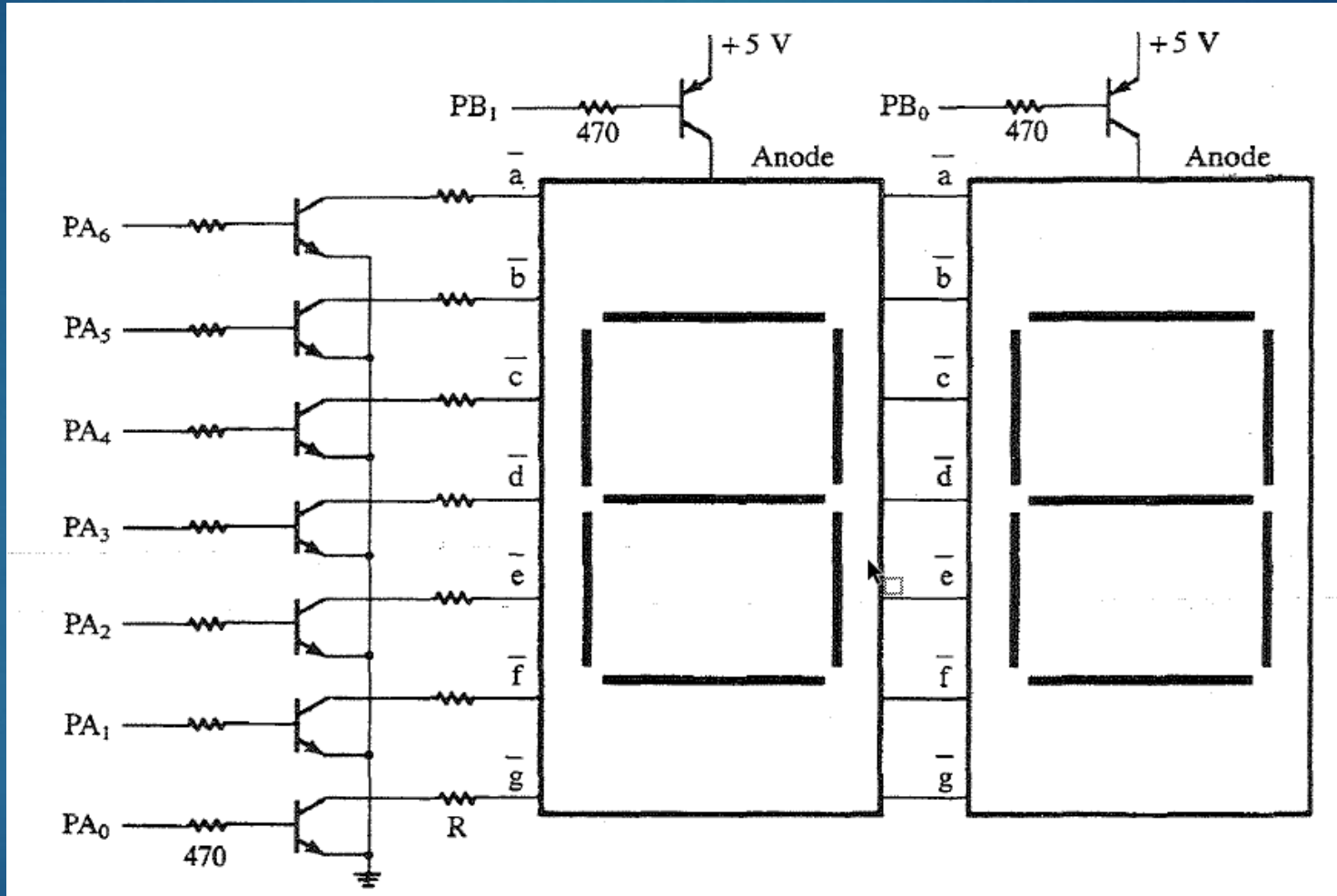
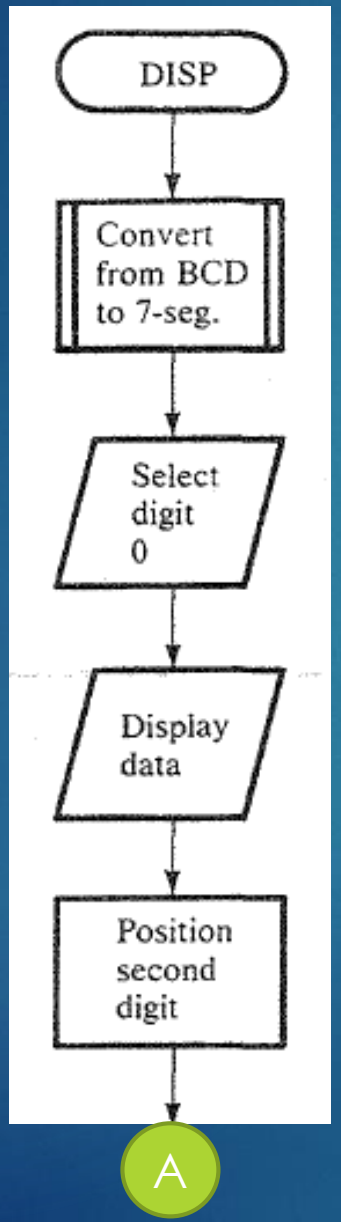
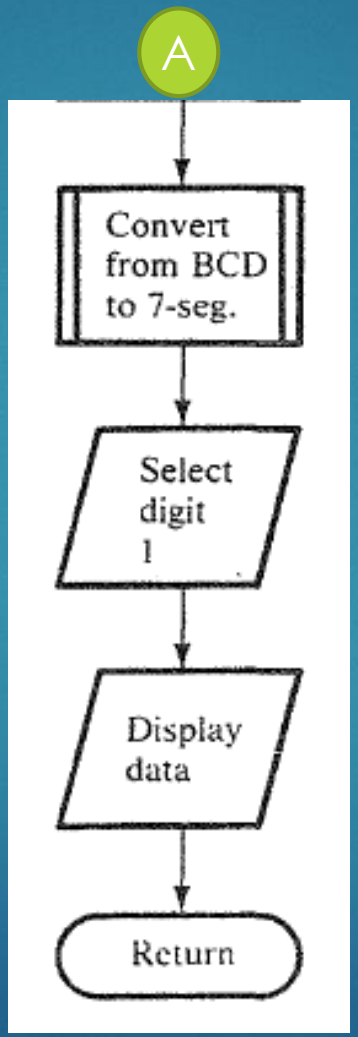


FIGURE 7–6 A two-digit multiplexed seven-segment LED display.

Flowchart of Multiple-Digit Display





Multiple-Digit Display Software

```
                ;8085 assembly language version
                ;subroutine to display the packed BCD number
                ;in the accumulator on the two-digit display
                ;
0100                    ORG   100H
0100  F5        DISP:  PUSH  PSW          ;save BCD
0101  CDXXXX          CALL  CONVERT       ;convert to 7-segment code
0104  D311            OUT   PORTA         ;send data
0106  3E02            MVI   A,2           ;select digit 0
0108  D312            OUT   PORTB
010A  CDXXXX          CALL  DELAY         ;wait 1 ms
010D  F1              POP   PSW           ;get BCD
010E  0F              RRC                 ;position next digit
010F  0F              RRC
0110  0F              RRC
0111  0F              RRC
0112  CDXXXX          CALL  CONVERT       ;convert to 7-segment code
0115  D311            OUT   PORTA         ;send data
0117  3E01            MVI   A,1
0119  D312            OUT   PORTB         ;select digit 1
011B  CDXXXX          CALL  DELAY         ;wait 1 ms
011E  C9              RET
```

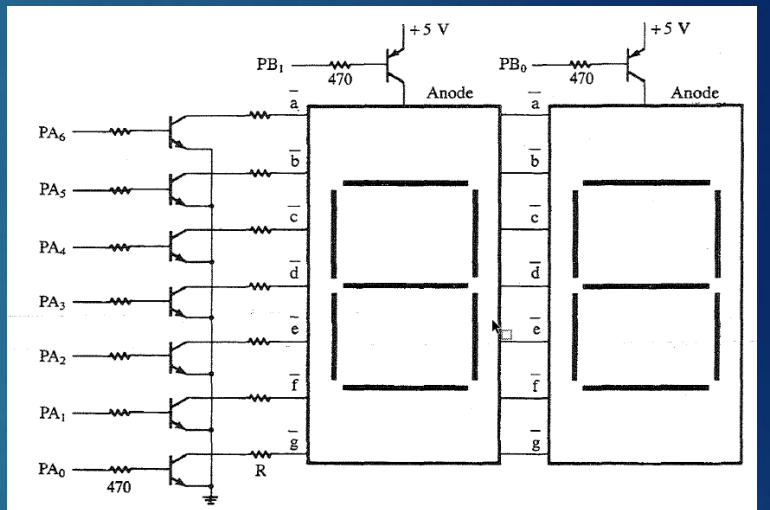


FIGURE 7–6 A two-digit multiplexed seven-segment LED display.