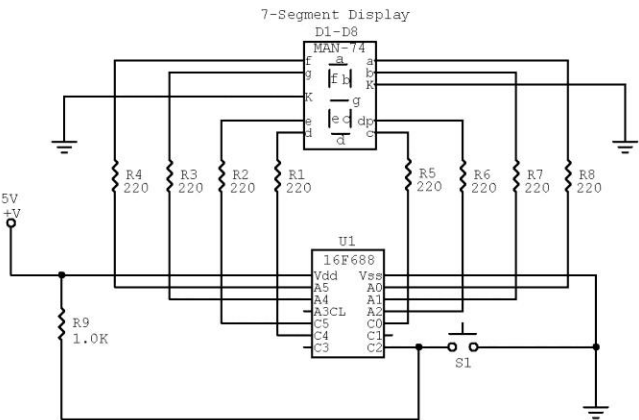
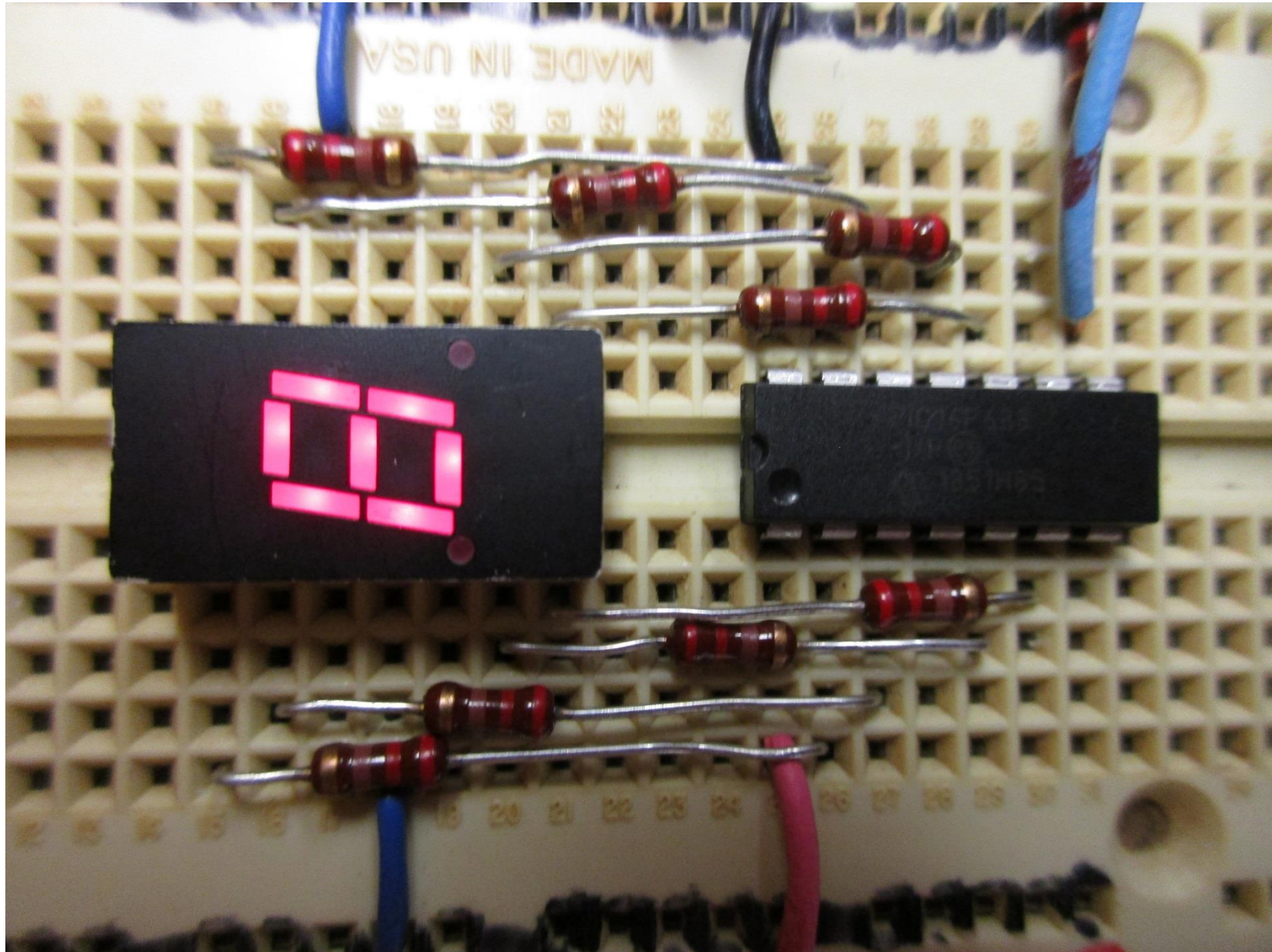


The circuit for our first test was shown exploded in Theory 13. You may want to print that out now from Theory. The entire drawing looks like this:



|                              |                      |
|------------------------------|----------------------|
| PIC 16F688 to MAN-74 Display |                      |
| Rev                          | ID                   |
| A                            | MECH1 Application 13 |
| Date: 15 Nov 2019            | Page: 1 of 1         |

The actual circuit on a breadboard “trainer” looks like this:



Now, I freely admit that to make it this nice and neat took nearly half an hour to make. HOWEVER, it will most probably save well over that in troubleshooting the circuit if we use long resistor leads that will touch one another or we pull out a power lead when moving the 16f688 around for programming. Your call.

The program you can cut and paste to test the “Betty1” circuit is given in the Theory section as Betty1.bas. You can cut and paste that into Studio to make your hex file. That is the ONLY cut-and-paste in this Applications Section.

Here are the additions for BETTY2 **in BOLD ITALIC UNDERLINE**

```
' Name      : 7segjw-App13-betty2.bas
' Compiler  : PICBASIC PRO Compiler 3.1
' Assembler : MPLAB X IPE v5.20
' Target PIC : 16F688
' Hardware   : Lab Protoboard
' Oscillator : Internal 4 MHz.
' Keywords   : 7 segment display
' Description : PICBASIC PRO program to light a 7-segment digital
'               LED display.
'
' Definitions
'
'      segment dp is Port A.2 Pin 11
'      segment a  is port A.0 pin 13
'      segment b  is port A.1 pin 8
'      segment c  is port C.0 pin 10
'      segment d  is port C.4 pin 6
'      segment e  is port C.5 pin 5
'      segment f  is port A.5 pin 2
'      segment g  is port A.4 pin 3
'
'
'      number 0 is a,b,c,d,e,f
'      number 1 is b.c
'      number 2 is a,b,d,e,g
'      number 3 is a,b,c,d,g
'      number 4 is b,c,f,g
'      number 5 is a,c,d,f,g
'      number 6 is a,c,d,e,f,g
'      number 7 is a,b,c
'      number 8 is a,b,c,d,e,f,g
'      number 9 is a,b,c,f,g
'
'
'      letter b is c,d,e,f,g
'      letter i is e,f
'      letter t is a,e,f
```

```
'      letter c is a,d,e,f
'      letter h is b,c,e,f,g
'      letter n is c,e,g
'      letter g is a,b,c,d,f,g
'      letter e is a,d,e,f,g
'      letter y is b,c,f,g
'
```

```
#CONFIG
```

```
__config _INTRC_OSC_NOCLKOUT & _WDT_OFF & _MCLRE_OFF & _CP_OFF
```

```
#ENDCONFIG
```

```
CMCON0 = %00000111    ;sets A.0, A.1, and A.2 port bits to digital
ANSEL   = %00000000    ;sets all ports to digital
TRISA   = %00000000    ;sets all A ports to output
TRISC   = %00000100    ;sets port C.2 to input, all the rest to output
```

```
DP      var PORTA.2      ' Alias PORTA.2 to DP
SA      var PORTA.0      ' Alias PORTA.0 to SA
SB      var PORTA.1      ' Alias PORTA.1 to SB
SC      var PORTC.0      ' Alias PORTC.0 to SC
SD      var PORTC.4      ' Alias PORTC.4 to SD
SE      var PORTC.5      ' Alias PORTC.5 to SE
SF      var PORTA.5      ' Alias PORTA.5 to SF
SG      var PORTA.4      ' Alias PORTA.4 to SG
```

```
IQ      var byte        ' Loop variable
NN      var byte        ' number variable
```

```
gosub portset
```

```
pushbtn:
```

```
IF PORTC.2 = 0 THEN    ;Button is pushed
PAUSE 20               ;debounce sensitivity
IF PORTC.2 = 0 THEN    ;Button is still pushed, debounced
```

```
GOTO mainloop          ;Go to the main program
ENDIF
ENDIF
GOSUB betty
Pause 200
GOTO pushbutn
```

**mainloop:**

```
    NN=5
    Gosub decpt
    PAUSE 500
```

```
    NN=2          'segment a'
    HIGH SA
    gosub decpt
    Pause 500
    gosub portset
```

```
    HIGH SB          'segment b'
    gosub decpt
    Pause 500
    gosub portset
```

```
    HIGH SC          'segment c'
    gosub decpt
    Pause 500
    gosub portset
```

```
    HIGH SD          'segment d'
    gosub decpt
    Pause 500
    gosub portset
```

```
    HIGH SE          'segment e'
    gosub decpt
    Pause 500
```

gosub portset

HIGH SF 'segment f

gosub decpt

Pause 500

gosub portset

HIGH SG 'segment g

gosub decpt

Pause 500

gosub portset

HIGH SA 'all segments

HIGH SB

HIGH SC

HIGH SD

HIGH SE

HIGH SF

HIGH SG

gosub decpt

Pause 500

gosub portset

goto pushbutn

end

decpt:

FOR IQ = 1 to NN

High DP

Pause 500

Low DP

Pause 500

NEXT IQ

return

portset:

```
PORTC.0 = 0
PORTC.1 = 0
PORTC.3 = 0
PORTC.4 = 0
PORTC.5 = 0
```

```
PORTA.0 = 0
PORTA.1 = 0
PORTA.2 = 0
PORTA.4 = 0
PORTA.5 = 0
Return
```

betty:

```
HIGH SA
HIGH SB
HIGH SC
HIGH SD
HIGH SE
HIGH SF
HIGH SG
Pause 200
gosub portset
return
```

Here is the program for BETTY3. This adds the digit showing all numerical digits 0-9. Here are the additions for BETTY3 ***in BOLD ITALIC UNDERLINE***

```
' Name      : 7segjw-App13-betty3.bas
' Compiler  : PICBASIC PRO Compiler 3.1
' Assembler : MPLAB X IPE v5.20
' Target PIC : 16F688
' Hardware   : Lab Protoboard
' Oscillator : Internal 4 MHz.
' Keywords   : 7 segment display
' Description : PICBASIC PRO program to light a 7-segment digital
'              LED display.
'
' Definitions
'
'      segment dp is Port A.2 Pin 11
'      segment a  is port A.0 pin 13
'      segment b  is port A.1 pin 8
'      segment c  is port C.0 pin 10
'      segment d  is port C.4 pin 6
'      segment e  is port C.5 pin 5
'      segment f  is port A.5 pin 2
'      segment g  is port A.4 pin 3
'
'
'      number 0 is a,b,c,d,e,f
'      number 1 is b.c
'      number 2 is a,b,d,e,g
'      number 3 is a,b,c,d,g
'      number 4 is b,c,f,g
'      number 5 is a,c,d,f,g
'      number 6 is a,c,d,e,f,g
'      number 7 is a,b,c
'      number 8 is a,b,c,d,e,f,g
'      number 9 is a,b,c,f,g
'
'
'      letter b is c,d,e,f,g
'      letter i is e,f
'      letter t is a,e,f
```



```
'      letter c is a,d,e,f
'      letter h is b,c,e,f,g
'      letter n is c,e,g
'      letter g is a,b,c,d,f,g
'      letter e is a,d,e,f,g
'      letter y is b,c,f,g
'
```

```
#CONFIG
```

```
__config _INTRC_OSC_NOCLKOUT & _WDT_OFF & _MCLRE_OFF & _CP_OFF
```

```
#ENDCONFIG
```

```
CMCON0 = %00000111    ;sets A.0, A.1, and A.2 port bits to digital
ANSEL   = %00000000    ;sets all ports to digital
TRISA   = %00000000    ;sets all A ports to output
TRISC   = %00000100    ;sets port C.2 to input, all the rest to output
```

```
DP      var PORTA.2      ' Alias PORTA.2 to DP
SA      var PORTA.0      ' Alias PORTA.0 to SA
SB      var PORTA.1      ' Alias PORTA.1 to SB
SC      var PORTC.0      ' Alias PORTC.0 to SC
SD      var PORTC.4      ' Alias PORTC.4 to SD
SE      var PORTC.5      ' Alias PORTC.5 to SE
SF      var PORTA.5      ' Alias PORTA.5 to SF
SG      var PORTA.4      ' Alias PORTA.4 to SG
```

```
IQ      var byte        ' Loop variable
NN      var byte        ' number variable
```

```
gosub portset
```

```
pushbtn:
```

```
IF PORTC.2 = 0 THEN    ;Button is pushed
PAUSE 20               ;debounce sensitivity
IF PORTC.2 = 0 THEN    ;Button is still pushed, debounced
```

```
GOTO mainloop          ;Go to the main program
ENDIF
ENDIF
GOSUB betty
Pause 200
GOTO pushbutn
```

mainloop:

```
NN=5
Gosub decpt
PAUSE 500
```

```
NN=2      'segment a
HIGH SA
gosub decpt
Pause 500
gosub portset
```

```
HIGH SB      'segment b
gosub decpt
Pause 500
gosub portset
```

```
HIGH SC      'segment c
gosub decpt
Pause 500
gosub portset
```

```
HIGH SD      'segment d
gosub decpt
Pause 500
gosub portset
```

```
HIGH SE      'segment e
gosub decpt
Pause 500
```

gosub portset

HIGH SF            'segment f  
gosub decpt  
Pause 500  
gosub portset

HIGH SG            'segment g  
gosub decpt  
Pause 500  
gosub portset

HIGH SA            'all segments  
HIGH SB  
HIGH SC  
HIGH SD  
HIGH SE  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset

For IQ=1 to 5  
gosub betty  
Pause 200  
Next IQ

NN=2            'digit 1  
HIGH SB  
HIGH SC  
gosub decpt  
Pause 500  
gosub portset

HIGH SA        'digit 2  
HIGH SB

HIGH SD  
HIGH SE  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset

HIGH SA 'digit 3  
HIGH SB  
HIGH SC  
HIGH SD  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset

HIGH SB 'digit 4  
HIGH SC  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset

HIGH SA 'digit 5  
HIGH SC  
HIGH SD  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset

HIGH SA 'digit 6  
HIGH SC  
HIGH SD  
HIGH SE  
HIGH SF  
HIGH SG

gosub decpt  
Pause 500  
gosub portset

HIGH SA     'digit 7  
HIGH SB  
HIGH SC  
gosub decpt  
Pause 500  
gosub portset

HIGH SA     'digit 8  
HIGH SB  
HIGH SC  
HIGH SD  
HIGH SE  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset

HIGH SA     'digit 9  
HIGH SB  
HIGH SC  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset

HIGH SA     'digit 0  
HIGH SB  
HIGH SC  
HIGH SD  
HIGH SE  
HIGH SF  
gosub decpt

Pause 500

gosub portset

goto pushbutn

end

decpt:

FOR IQ = 1 to NN

High DP

Pause 500

Low DP

Pause 500

NEXT IQ

return

portset:

PORTC.0 = 0

PORTC.1 = 0

PORTC.3 = 0

PORTC.4 = 0

PORTC.5 = 0

PORTA.0 = 0

PORTA.1 = 0

PORTA.2 = 0

PORTA.4 = 0

PORTA.5 = 0

Return

betty:

HIGH SA

HIGH SB

HIGH SC

HIGH SD

HIGH SE

```
HIGH SF  
HIGH SG  
Pause 200  
gosub portset  
return
```

And here is my admittedly humorous attempt at Betty4 in ***Bold Italic Underline***

```
' Name      : 7segjw-App13-betty4.bas
' Compiler  : PICBASIC PRO Compiler 3.1
' Assembler : MPLAB X IPE v5.20
' Target PIC : 16F688
' Hardware   : Lab Protoboard
' Oscillator : Internal 4 MHz.
' Keywords   : 7 segment display
' Description : PICBASIC PRO program to light a 7-segment digital
'               LED display.
'
'
' Definitions
'
'      segment dp is Port A.2 Pin 11
'      segment a  is port A.0 pin 13
'      segment b  is port A.1 pin 8
'      segment c  is port C.0 pin 10
'      segment d  is port C.4 pin 6
'      segment e  is port C.5 pin 5
'      segment f  is port A.5 pin 2
'      segment g  is port A.4 pin 3
'
'
'      number 0 is a,b,c,d,e,f
'      number 1 is b.c
'      number 2 is a,b,d,e,g
'      number 3 is a,b,c,d,g
'      number 4 is b,c,f,g
'      number 5 is a,c,d,f,g
'      number 6 is a,c,d,e,f,g
'      number 7 is a,b,c
'      number 8 is a,b,c,d,e,f,g
'      number 9 is a,b,c,f,g
'
'
'      letter b is c,d,e,f,g
'      letter i is e,f
'      letter t is a,e,f
'      letter c is a,d,e,f
'      letter h is b,c,e,f,g
'      letter n is c,e,g
'      letter g is a,b,c,d,f,g
'      letter e is a,d,e,f,g
```



```
'      letter y is b,c,f,g
'
```

```
#CONFIG
```

```
    __config _INTRC_OSC_NOCLKOUT & _WDT_OFF & _MCLRE_OFF & _CP_OFF
```

```
#ENDCONFIG
```

```
CMCON0 = %00000111    ;sets A.0, A.1, and A.2 port bits to digital
ANSEL   = %00000000    ;sets all ports to digital
TRISA   = %00000000    ;sets all A ports to output
TRISC   = %00000100    ;sets port C.2 to input, all the rest to output
```

```
DP      var PORTA.2      ' Alias PORTA.2 to DP
SA      var PORTA.0      ' Alias PORTA.0 to SA
SB      var PORTA.1      ' Alias PORTA.1 to SB
SC      var PORTC.0      ' Alias PORTC.0 to SC
SD      var PORTC.4      ' Alias PORTC.4 to SD
SE      var PORTC.5      ' Alias PORTC.5 to SE
SF      var PORTA.5      ' Alias PORTA.5 to SF
SG      var PORTA.4      ' Alias PORTA.4 to SG
```

```
IQ      var byte        ' Loop variable
NN      var byte        ' number variable
```

```
gosub portset
```

```
pushbtn:
```

```
    IF PORTC.2 = 0 THEN    ;Button is pushed
    PAUSE 20               ;debounce sensitivity
    IF PORTC.2 = 0 THEN    ;Button is still pushed, debounced
    GOTO mainloop          ;Go to the main program
    ENDIF
    ENDIF
    GOSUB betty
    Pause 200
```

GOTO pushbutn

mainloop:

NN=5

Gosub decpt

PAUSE 500

NN=2            'segment a

HIGH SA

gosub decpt

Pause 500

gosub portset

HIGH SB            'segment b

gosub decpt

Pause 500

gosub portset

HIGH SC            'segment c

gosub decpt

Pause 500

gosub portset

HIGH SD            'segment d

gosub decpt

Pause 500

gosub portset

HIGH SE            'segment e

gosub decpt

Pause 500

gosub portset

HIGH SF            'segment f

gosub decpt

```
Pause 500
gosub portset
```

```
HIGH SG      'segment g
gosub decpt
Pause 500
gosub portset
```

```
HIGH SA      'all segments
HIGH SB
HIGH SC
HIGH SD
HIGH SE
HIGH SF
HIGH SG
gosub decpt
Pause 500
gosub portset
```

```
For IQ=1 to 5
gosub betty
Pause 200
Next IQ
```

```
NN=2        'digit 1
HIGH SB
HIGH SC
gosub decpt
Pause 500
gosub portset
```

```
HIGH SA      'digit 2
HIGH SB
HIGH SD
HIGH SE
HIGH SG
gosub decpt
Pause 500
```

```
gosub portset
```

```
HIGH SA    'digit 3  
HIGH SB  
HIGH SC  
HIGH SD  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset
```

```
HIGH SB    'digit 4  
HIGH SC  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset
```

```
HIGH SA    'digit 5  
HIGH SC  
HIGH SD  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset
```

```
HIGH SA    'digit 6  
HIGH SC  
HIGH SD  
HIGH SE  
HIGH SF  
HIGH SG  
gosub decpt  
Pause 500  
gosub portset
```

```
HIGH SA      'digit 7
HIGH SB
HIGH SC
gosub decpt
Pause 500
gosub portset
```

```
HIGH SA      'digit 8
HIGH SB
HIGH SC
HIGH SD
HIGH SE
HIGH SF
HIGH SG
gosub decpt
Pause 500
gosub portset
```

```
HIGH SA      'digit 9
HIGH SB
HIGH SC
HIGH SF
HIGH SG
gosub decpt
Pause 500
gosub portset
```

```
HIGH SA      'digit 0
HIGH SB
HIGH SC
HIGH SD
HIGH SE
HIGH SF
gosub decpt
Pause 500
gosub portset
```

```
For IQ=1 to 5
gosub betty
```

Pause 200  
Next IQ

'letter b

HIGH SC

HIGH SD

HIGH SE

HIGH SF

HIGH SG

gosub decpt

Pause 500

gosub portset

'letter i

HIGH SE

HIGH SF

gosub decpt

Pause 500

gosub portset

'letter t

HIGH SA

HIGH SE

HIGH SF

gosub decpt

Pause 500

gosub portset

'letter c

HIGH SA

HIGH SD

HIGH SE

HIGH SF

gosub decpt

Pause 500

gosub portset

'letter h

HIGH SB

HIGH SC

HIGH SE

HIGH SF

HIGH SG

gosub decpt

Pause 500

gosub portset

'letter i

HIGH SE

HIGH SF

gosub decpt

Pause 500

gosub portset

'letter n

HIGH SC

HIGH SE

HIGH SG

gosub decpt

Pause 500

gosub portset

'letter q

HIGH SA

HIGH SB

HIGH SC

HIGH SD

HIGH SF

HIGH SG

gosub decpt

Pause 500

gosub portset

\_\_\_\_\_  
\_\_\_\_\_

Pause 500

'letter b

HIGH SC

HIGH SD

HIGH SE

HIGH SF

HIGH SG

gosub decpt

Pause 500

gosub portset

'letter e

HIGH SA

HIGH SD

HIGH SE

HIGH SF

HIGH SG

gosub decpt

Pause 500

gosub portset

'letter t

HIGH SA

HIGH SE

HIGH SF

gosub decpt

Pause 500

gosub portset

'letter t

HIGH SA

HIGH SE

HIGH SF



```
gosub decpt  
Pause 500  
gosub portset
```

```
'letter y
```

```
HIGH SB
```

```
HIGH SC
```

```
HIGH SF
```

```
HIGH SG
```

```
gosub decpt
```

```
Pause 500
```

```
gosub portset
```

```
gosub decpt
```

```
goto pushbutn
```

```
end
```

```
decpt:
```

```
FOR IQ = 1 to NN
```

```
High DP
```

```
Pause 500
```

```
Low DP
```

```
Pause 500
```

```
NEXT IQ
```

```
return
```

```
portset:
```

```
PORTC.0 = 0
```

```
PORTC.1 = 0
```

```
PORTC.3 = 0
```

```
PORTC.4 = 0
```

```
PORTC.5 = 0
```

```
PORTA.0 = 0
```

```
PORTA.1 = 0
PORTA.2 = 0
PORTA.4 = 0
PORTA.5 = 0
Return
```

betty:

```
HIGH SA
HIGH SB
HIGH SC
HIGH SD
HIGH SE
HIGH SF
HIGH SG
Pause 200
gosub portset
return
```

\*\*\*\*\*