```
'--------Title--------

' File......signed_num1.pbp
' Started....4/25/08
' Microcontroller used:  Microchip Technology PIC16F88
'                        microchip.com
' PBPro Code, micro-Engineering Labs, Inc.
'             melabs.com

'--------Program Desciption--------

' This program displays signed numbers in
' PicBasic Pro in an output range of values -50.0 to +50.0.
' The input is a 10-bit digital range of 0 to 1023.

'------------Connections-----------

'       16F88 Pin           Wiring
'       ---------           ----------
'       RA0                 LCD pin 11(DB4)
'       RA1                 LCD pin 12(DB5)
'       RA2                 LCD pin 13(DB6)
'       RA3                 LCD pin 14(DB7)
'       RA4                 Resistive Input
'       RB3                 LCD Enable(E)
'       RB4                 LCD Register Select(RS)
'       See schematic for the usual connections

'---------LCD Connections---------

'        LCD Pin              Wiring
'       ---------           ----------
'          1               Ground(Vss)
'          2               + 5v(Vdd)
'          3               Center of 20K Pot(Contrast)
'          4               RB4(Register Select,RS)
'          5               Ground(Read/Write,R/W)
'          6               RB3(Enable)
'          7               No Connection(DB0)
'          8               No Connection(DB1)
'          9               No Connection(DB2)
'         10               No Connection(DB3)
'         11               RA0(DB4)
'         12               RA1(DB5)
'         13               RA2(DB6)
'         14               RA3(DB7)

'---------Constants/Defines-------

' To free up AN4 (Pin RA4) for an analog input, the
' default LCD Register Select (RS) function must be
' removed from RA4. This is relocated to PORTB.4
' using the LCD DEFINE statements below.  All other
' default LCD pins and functions are left unchanged.
' See Curriculum Year 2, Lesson LCD3, POT Command and
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' LCD DEFINES on this web site for more details.

    DEFINE LCD_RSREG    PORTB    ' PORTB - RS port
    DEFINE LCD_RSBIT    4        ' Bit 4 - RS bit

    DEFINE ADC_BITS     10     ' Sets the number of bits in
                               ' the result to 10

'---------Variables---------

    x            VAR WORD      ' BYTE for potentiometer input
    temp_int     VAR WORD      ' WORD for temporary interger, temp_int
    temp_fract   VAR WORD      ' WORD for temporary fraction, temp_fract

'---------Initialization--------

    ANSEL = %00010000          ' Leaves AN4 in analog mode, but

                               ' changes other analog bits to digital.
                               ' See table below.

'    Analog Bit    Analog or Digital      PIC16F88 Pin
'   ------------  ------------------     --------------
'       AN0            Digital                RA0
'       AN1            Digital                RA1
'       AN2            Digital                RA2
'       AN3            Digital                RA3
'       AN4            Analog                 RA4
'       AN5            Digital                RB6
'       AN6            Digital                RB7

    ADCON1 = %10000000         ' Right justifies 10-bit value of x
                               ' in 16-bit WORD.  Adds "0" in the
                               ' 6 Most Significant bits of the Word,
                               ' shifting the 10-bit value of x to
                               ' the right.

    OSCCON = $60               ' Sets the internal oscillator in the
                               ' 16F88 to 4 MHz

'--------Main Code--------

start:

    PAUSE 1000                 ' 1 second pause to allow LCD to setup

    ADCIN 4, x                 ' Read analog voltage on AN4 and
                               ' convert to 10-bit digital value
                               ' and store as x.

    LCDOUT $FE,1,DEC x         ' On first line, display 10-bit
                               ' value of x

    x = x * 44/45              ' Begin converting 10-bit input range,
                               ' (0 - 1023), to LCD output range
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                              '(-50.0 - 50.0).
                              ' Output Range/Input Range = 100/1023
                              ' = 0.09775.  Must use whole number
                              ' numerator for calculation.  Numerator
                              ' must be less than 65 since
                              ' 65 * 1023 > 65535, the limit for WORD
                              ' variable.  Found that 44/45 = 0.9777
                              ' approximates the significand of 0.09775.
                              ' The shift in the decimal point is done
                              ' in the next formula.

temp_int = x/10 - 50          ' Get integer portion.  Divide by 10 to
                              ' shift decimal point from 0.9777 to
                              ' 0.09777.  Subtract 50 to shift 0 - 100
                              ' output range to -50.0 - 50.0.

temp_fract = x//10            ' Get the remainder portion

LCDOUT $FE,$c0,SDEC temp_int, ".", DEC1 temp_fract
                              ' On the second LCD line, display the integer
                              ' portion of x, temp_int, as a signed decimal
                              ' (SDEC) and the remainder portion of x,
                              ' temp_fract, as a decimal.


PAUSE 250                     ' Pause 250 ms

GOTO start                     ' Jump to start label

END
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