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BS2p "Plus Pack" AppKit (#45184)

Introduction

The BS2p "Plus Pack" is a selection of components and ready-to-run source code to assist experimenters with mastering some of the exciting new features of the BS2p; specifically the use of parallel LCDs, Philips I²C™ components and Dallas Semiconductor 1-Wire® components.

Please note that this AppKit is designed for intermediate to advanced users. The schematics and source code have been carefully checked and are commented, but the expectation is that the user will consult the appropriate product data sheets (not duplicated here) for detailed explanation of each component's operation.

Each of the enclosed experiments was built, tested and run on the BS2p Demo Board (#45183). Should you desire more space for connecting components, please consider the NX-1000 lab board (#28135).

Packing List

Verify that your BS2p "Plus Pack" package is complete in accordance with the list below. The contents of the package include:

- Packing List (this page)
- Documentation/Source Code Diskette
- Parallel LCD module; 2 lines x 16 characters (HD44780-compatible)
- PCF8574 Remote 8-Bit I/O Expander
- PCF8583 Clock/Calendar with 240 x 8-Bit RAM
- PCF8591 8-Bit A/D and D/A Converter
- 24LC32 32K Serial EEPROM
- (2) DS1822 Econo-MicoLAN Digital Thermometer
- DS2405 Addressable Switch
- DS2890 1-Wire Digital Potentiometer
- (4) Jumper wires packs
- 220 ohm resistor
- (2) 1K resistor
- 10K resistor
- 100K potentiometer
- 0.01 uF capacitor
- (2) low-current LED
- Normally-open pushbutton switch
- 32.678 kHz crystal

PP_LCDDEMO1.BSP

- Connect LCD to the BS2p Demo Board X5
- Install jumper X6
- Adjust contrast pot for best display

```
' -----[ Title ]-----------------------------------------------------------
'
' BS2p Plus Pack
'
' File...... PP_LCDDEMO1.BSP
' Purpose... Basic LCD Demo - Single Line Mode
' Author.... Parallax, Inc.
' E-mail.... stamptech@parallaxinc.com
' Started...
' Updated... 26 SEP 2001

' {$STAMP BS2p}


' -----[ Program Description ]---------------------------------------------
'
' This program demonstrates LCD basics using the BS2p.
'
' To run this program on the BS2p Demo Board, connect the LCD and install
' Jumper X6. Adjust contrast pot for best display.
'
' Refer to the Hitachi HD44780 documentation for details on LCD control.


' -----[ Revision History ]-------------------------------------------------
'


' -----[ I/O Definitions ]--------------------------------------------------
'
LCDpin  CON     0                               ' connect LCD to OutL


' -----[ Constants ]-------------------------------------------------------
'
NoCmd           CON     $00                     ' No command in LCDOUT
ClrLCD          CON     $01                     ' clear the LCD
CrsrHm          CON     $02                     ' move cursor to home position
CrsrLf          CON     $10                     ' move cursor left
CrsrRt          CON     $14                     ' move cursor right
DispLf          CON     $18                     ' shift displayed chars left
DispRt          CON     $1C                     ' shift displayed chars right
DDRam           CON     $80                     ' Display Data RAM control

DispCtrl        CON     %00001000               ' display control command

On              CON     1
Off             CON     0



' -----[ Variables ]-------------------------------------------------------
'
cmd             VAR     Byte                    ' command sent to LCD
```

```
display         VAR     cmd.Bit2                ' display on/off bit
cursor          VAR     cmd.Bit1                ' cursor on/off bit
blinking        VAR     cmd.Bit0                ' blinking on/off bit

char            VAR     cmd                     ' character sent to LCD
idx             VAR     Byte                    ' loop counter


' -----[ EEPROM Data ]----------------------------------------------------------
'


' -----[ Initialization ]-------------------------------------------------------
'
Initialize:
  PAUSE 500                                     ' let the LCD settle
  LCDCMD LCDpin,%00110000 : PAUSE 5             ' 8-bit mode
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00100000 : PAUSE 0             ' 4-bit mode
  LCDCMD LCDpin,%00001100 : PAUSE 0             ' no crsr, no blink
  LCDCMD LCDpin,%00000110                       ' inc crsr, no disp shift


' -----[ Main Code ]------------------------------------------------------------
'
Main:
  LCDCMD LCDpin,ClrLCD                          ' clear display
  PAUSE 500

Splash_Screen
  LCDOUT LCDpin,NoCmd,["THE BASIC STAMP!"]
  PAUSE 2000

Cursor_On:
  LCDCMD LCDpin,CrsrHm                          ' move the cursor home
  cmd = DispCtrl
  display = On
  cursor = On
  LCDCMD LCDpin,cmd
  PAUSE 500

Move_Cursor:
  FOR idx = 1 TO 15                             ' move the cursor across display
    LCDCMD LCDpin,CrsrRt
    PAUSE 150
  NEXT

  FOR idx = 14 TO 0                             ' go backward by moving cursor
    cmd = DDRam + idx                           '  to a specific address
    LCDCMD LCDpin,cmd
    PAUSE 150
  NEXT

  PAUSE 1000

Block_Cursor:
  cmd = DispCtrl
  display = On
  blinking = On                                 ' enable block cursor
  LCDCMD LCDpin,cmd
  PAUSE 2000
  blinking = Off                                ' turn it off
```

```
  LCDCMD LCDpin,cmd

Flash_Display:
  cmd = DispCtrl
  display = On

  FOR idx = 1 TO 10                             ' flash display by
    display = ~display                          '  toggling display bit
    LCDCMD LCDpin,cmd
    PAUSE 250
  NEXT

  PAUSE 1000

Shift_Display:
  FOR idx = 1 TO 16                             ' shift display to right
    LCDCMD LCDpin,DispRt
    PAUSE 100
  NEXT

  PAUSE 1000

  FOR idx = 1 TO 16                             ' shift display back
    LCDCMD LCDpin,DispLf
    PAUSE 100
  NEXT

  PAUSE 1000
  GOTO Main                                     ' do it all over
  END


' -----[ Subroutines ]------------------------------------------------------
'
```

PP_LCDDEMO2.BSP

- Connect LCD to the BS2p Demo Board X5
- Install jumper X6
- Adjust contrast pot for best display

```
' -----[ Title ]-----------------------------------------------------------
'
' BS2p Plus Pack
'
' File...... PP_LCDDEMO2.BSP
' Purpose... Basic LCD Demo - Multi-line mode with custom characters
' Author.... Parallax, Inc.
' E-mail.... stamptech@parallaxinc.com
' Started...
' Updated... 26 SEP 2001

' {$STAMP BS2p}


' -----[ Program Description ]---------------------------------------------
'
' This program demonstrates the use of the multi-line initialization and
' the use of custom characters.  When using the standard 5x7 font, the LCD
' will hold up to eight customer characters.
'
' To run this program on the BS2p Demo Board, connect the LCD and install
' Jumper X6. Adjust contrast pot for best display.
'
' Refer to the Hitachi HD44780 documentation for details on LCD control.


' -----[ Revision History ]-------------------------------------------------
'


' -----[ I/O Definitions ]--------------------------------------------------
'
LCDpin          CON     0                       ' connect LCD to OutL


' -----[ Constants ]-------------------------------------------------------
'
NoCmd           CON     $00                     ' No command in LCDOUT
ClrLCD          CON     $01                     ' clear the LCD
CrsrHm          CON     $02                     ' move cursor to home position
CrsrLf          CON     $10                     ' move cursor left
CrsrRt          CON     $14                     ' move cursor right
DispLf          CON     $18                     ' shift displayed chars left
DispRt          CON     $1C                     ' shift displayed chars right
DDRam           CON     $80                     ' Display Data RAM control
CGRam           CON     $40                     ' Custom character RAM
Line1           CON     $80                     ' DDRAM address of line 1
Line2           CON     $C0                     ' DDRAM address of line 2


' -----[ Variables ]-------------------------------------------------------
'
```

```
cmd             VAR     Byte                    ' commnand sent to LCD
char            VAR     Byte                    ' character sent to LCD
newChr          VAR     Byte                    ' new character for animation
addr            VAR     Byte                    ' address in EE and display
cNum            VAR     Byte                    ' character number


' -----[ EEPROM Data ]----------------------------------------------------------
'
' custom character definitions

Mouth0          DATA    $0E,$1F,$1F,$1F,$1F,$1F,$0E,$00
Mouth1          DATA    $0E,$1F,$1F,$18,$1F,$1F,$0E,$00
Mouth2          DATA    $0E,$1F,$1C,$18,$1C,$1F,$0E,$00
Smile           DATA    $00,$0A,$0A,$00,$11,$0E,$06,$00

Msg             DATA    " IS VERY COOL! ",3     ' revealed message


' -----[ Initialization ]------------------------------------------------------
'
Initialize:
  PAUSE 500                                     ' let the LCD settle
  LCDCMD LCDpin,%00110000 : PAUSE 5             ' 8-bit mode
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00100000 : PAUSE 0             ' 4-bit mode
  LCDCMD LCDpin,%00101000 : PAUSE 0             ' 2-line mode
  LCDCMD LCDpin,%00001100 : PAUSE 0             ' no crsr, no blink
  LCDCMD LCDpin,%00000110                       ' inc crsr, no disp shift

DLChars:                                        ' download custom chars to LCD
  LCDCMD LCDpin,CGRam                           ' prepare to write CG data
  FOR addr = Mouth0 TO (Smile + 7)              ' build 4 custom chars
    READ addr,char                              ' get byte from EEPROM
    LCDOUT LCDpin,NoCmd,[char]                  ' put into LCD CGRAM
  NEXT


' -----[ Main Code ]------------------------------------------------------------
'
Main:
  LCDCMD LCDpin,ClrLCD
  PAUSE 1000
  LCDOUT LCDpin,NoCmd,["THE BASIC STAMP"]
  PAUSE 2000

  ' Animation by character replacement

  FOR addr = 0 TO 15                            ' cover 16 characters
    READ (Msg + addr),newChr                    ' get new char from message
    cmd = Line2 + addr                          ' set new DDRAM address
    FOR cNum = 0 TO 4                           ' 5 characters in cycle
      LOOKUP cNum,[2,1,0,1,newChr],char
      LCDOUT LCDpin,cmd,[char]                  ' write animation character
      PAUSE 100                                 ' delay between animation chars
    NEXT
  NEXT

  PAUSE 3000
  GOTO Main                                     ' do it all over
  END
```

```
' -----[ Subroutines ]------------------------------------------------------
'
```

PP_LCDFONT.BSP

- Connect LCD to the BS2p Demo Board X5
- Install jumper X6
- Adjust contrast pot for best display

```
' -----[ Title ]-----------------------------------------------------------------
'
' BS2p Plus Pack
'
' File...... PP_LCDCFONT.BSP
' Purpose... Advanced LCD Demo - custom numeric font(s)
' Author.... Parallax, Inc.
' E-mail.... stamptech@parallaxinc.com
' Started...
' Updated... 26 SEP 2001

' {$STAMP BS2p}


' -----[ Program Description ]---------------------------------------------------
'
' This program demonstrates character definition replacement in order to create
' a custom font for numbers.  This program creates three custom characters that
' are used to display the tens, ones and tenths value of a counter.
'
' The program analyzes the counter and updates the screen by downloading the
' appropriate character map for each digit.
'
' To run this program on the BS2p Demo Board, connect the LCD and install
' Jumper X6. Adjust contrast pot for best display.
'
' Refer to the Hitachi HD44780 documentation for details on LCD control.


' -----[ Revision History ]-------------------------------------------------------
'


' -----[ I/O Definitions ]--------------------------------------------------------
'
LCDpin          CON     0                       ' connect LCD to OutL


' -----[ Constants ]-------------------------------------------------------------
'
NoCmd           CON     $00                     ' No command in LCDOUT
ClrLCD          CON     $01                     ' clear the LCD
CrsrHm          CON     $02                     ' move cursor to home position
CrsrLf          CON     $10                     ' move cursor left
CrsrRt          CON     $14                     ' move cursor right
DispLf          CON     $18                     ' shift displayed chars left
DispRt          CON     $1C                     ' shift displayed chars right
DDRam           CON     $80                     ' Display Data RAM control
CGRam           CON     $40                     ' Custom character RAM
Line1           CON     $80                     ' DDRAM address of line 1
Line2           CON     $C0                     ' DDRAM address of line 2

CLines          CON     8                       ' lines per character
Space           CON     10
```

```
' -----[ Variables ]------------------------------------------------------------
'
char            VAR     Byte                    ' character sent to LCD
addr            VAR     Byte                    ' EE starting address of map
cNum            VAR     Nib                     ' character number
idx             VAR     Nib                     ' loop counter

counter         VAR     Word


' -----[ EEPROM Data ]-----------------------------------------------------------
'
' character definitions - digits 0 - 9 and space
'
Dig_0           DATA    $1F,$11,$11,$19,$19,$19,$1F,$00
Dig_1           DATA    $04,$04,$04,$0C,$0C,$0C,$0C,$00
Dig_2           DATA    $1F,$01,$01,$1F,$18,$18,$1F,$00
Dig_3           DATA    $1E,$02,$02,$1F,$03,$03,$1F,$00
Dig_4           DATA    $18,$18,$18,$19,$1F,$01,$01,$00
Dig_5           DATA    $1F,$18,$18,$1F,$01,$01,$1F,$00
Dig_6           DATA    $18,$10,$10,$1F,$19,$19,$1F,$00
Dig_7           DATA    $1F,$11,$01,$03,$03,$03,$03,$00
Dig_8           DATA    $0E,$0A,$0A,$1F,$13,$13,$1F,$00
Dig_9           DATA    $1F,$11,$11,$1F,$03,$03,$03,$00
Dig_Spc         DATA    $00,$00,$00,$00,$00,$00,$00,$00


' -----[ Initialization ]--------------------------------------------------------
'
Initialize:
  PAUSE 500                                     ' let the LCD settle
  LCDCMD LCDpin,%00110000 : PAUSE 5             ' 8-bit mode
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00100000 : PAUSE 0             ' 4-bit mode
  LCDCMD LCDpin,%00101000 : PAUSE 0             ' 2-line mode
  LCDCMD LCDpin,%00001100 : PAUSE 0             ' no crsr, no blink
  LCDCMD LCDpin,%00000110                       ' inc crsr, no disp shift

  FOR cNum = 0 TO 2                             ' initialize cust chars
    LOOKUP cNum,[Dig_0,Dig_0,Dig_Spc],addr
    GOSUB Update_CC
  NEXT


' -----[ Main Code ]-------------------------------------------------------------
'
Main:
  LCDOUT LCDpin,ClrLCD,["CUSTOM DIGITS"]        ' setup display
  LCDOUT LCDpin,(Line2 + 12),[2,1,".",0]

Show_Counter:
  FOR counter = 0 TO 999                        ' count in tenths 0 - 99.9
    FOR cNum = 0 TO 2
      addr = counter DIG cNum                   ' get a digit
      IF (cNum < 2) OR (addr > 0) THEN DigitOK
      addr = Space                              ' leading space if < 10
    DigitOK:
      addr = addr * CLines                      ' calculate map for this digit
      GOSUB Update_CC                           ' download to LCD
    NEXT
```

```
    PAUSE 100
  NEXT

  GOTO Main
  END


' -----[ Subroutines ]------------------------------------------------------
'
Update_CC:                                      ' update custom character
  LCDCMD LCDpin,(CGRam + (cNum * CLines))       ' point to character map
  FOR idx = 0 TO (CLines - 1)
    READ (addr + idx),char                      ' get data for character line
    LCDOUT LCDpin,NoCmd,[char]                  ' write to LCD CGRAM
  NEXT
  RETURN
```

PP_LCDODO.BSP

- Connect LCD to the BS2p Demo Board X5
- Install jumper X6
- Adjust contrast pot for best display

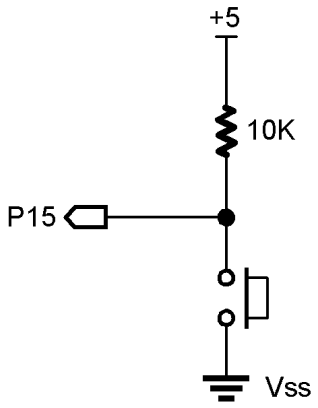
```
' -----[ Title ]-----------------------------------------------------------
'
' BS2p Plus Pack
'
' File...... PP_LCDODO.BSP
' Purpose... Advanced LCD Demo - rewriting CGRAM on the fly
' Author.... Parallax, Inc.
' E-mail.... stamptech@parallaxinc.com
' Started...
' Updated... 26 SEP 2001

' {$STAMP BS2p}


' -----[ Program Description ]---------------------------------------------
'
' This program demonstrates LCD character animation by writing to the
' character map (in CGRAM) for a character that is already displayed. The
' refresh cycle of the LCD will cause the character to change when its
' map is changed.  This technique (originally by Scott Edwards) allows
' the programmer to create advanced animations by storing character (cell)
' definitions in the Stamp's EEPROM.
'
' This program displays a rolling odometer type reading (last digit
' "rolls").  Character definitions are copied from the standard set
' (using "LCD Character Creator" software from Parallax).
'
' Each character definition is separated by 2 blank lines in order to create
' 10 lines per "rolling" character.  This makes the math for calculating
' the starting line of the roller very easy.
'
' To run this program on the BS2p Demo Board, connect the LCD and install
' Jumper X6. Adjust contrast pot for best display.
'
' Refer to the Hitachi HD44780 documentation for details on LCD control.


' -----[ Revision History ]-------------------------------------------------
'


' -----[ I/O Definitions ]--------------------------------------------------
'
LCDpin          CON     0                       ' connect LCD to OutL


' -----[ Constants ]-------------------------------------------------------
'
NoCmd           CON     $00                     ' No command in LCDOUT
ClrLCD          CON     $01                     ' clear the LCD
CrsrHm          CON     $02                     ' move cursor to home position
CrsrLf          CON     $10                     ' move cursor left
CrsrRt          CON     $14                     ' move cursor right
DispLf          CON     $18                     ' shift displayed chars left
```

```
DispRt          CON     $1C                     ' shift displayed chars right
DDRam           CON     $80                     ' Display Data RAM control
CGRam           CON     $40                     ' Custom character RAM
Line1           CON     $80                     ' DDRAM address of line 1
Line2           CON     $C0                     ' DDRAM address of line 2

CLines          CON     8                       ' lines per character
OdoChar         CON     0                       ' animated odometer character


' -----[ Variables ]------------------------------------------------------
'
cmd             VAR     Byte                    ' commnand sent to LCD
char            VAR     Byte                    ' character sent to LCD
addr            VAR     Byte                    ' EE starting address of map
cNum            VAR     Nib                     ' character number
idx             VAR     Nib                     ' loop counter

counter         VAR     Word
hundreds        VAR     Byte                    ' hundredths value of counter

temp            VAR     Word                    ' temp value for RJ display
width           VAR     Nib                     ' width of rt justified
pos             VAR     Byte                    ' LCD display position
digits          VAR     Nib                     ' digits to display


' -----[ EEPROM Data ]----------------------------------------------------
'
' rolling odometer character definitions
'
Char0           DATA    $0E,$11,$13,$15,$19,$11,$0E,$00,$00,$00
Char1           DATA    $04,$0C,$04,$04,$04,$04,$0E,$00,$00,$00
Char2           DATA    $0E,$11,$01,$02,$04,$08,$1F,$00,$00,$00
Char3           DATA    $1F,$02,$04,$02,$01,$11,$0E,$00,$00,$00
Char4           DATA    $02,$06,$0A,$12,$1F,$02,$02,$00,$00,$00
Char5           DATA    $1F,$10,$1E,$01,$01,$11,$0E,$00,$00,$00
Char6           DATA    $06,$08,$10,$1E,$11,$11,$0E,$00,$00,$00
Char7           DATA    $1F,$01,$02,$04,$08,$08,$08,$00,$00,$00
Char8           DATA    $0E,$11,$11,$0E,$11,$11,$0E,$00,$00,$00
Char9           DATA    $0E,$11,$11,$0F,$01,$02,$0C,$00,$00,$00


' inverted character definitions (white on black)
'
Char0i          DATA    $11,$0E,$0C,$0A,$06,$0E,$11,$1F,$1F,$1F
Char1i          DATA    $1B,$13,$1B,$1B,$1B,$1B,$11,$1F,$1F,$1F
Char2i          DATA    $11,$0E,$1E,$1D,$1B,$17,$00,$1F,$1F,$1F
Char3i          DATA    $00,$1D,$1B,$1D,$1E,$0E,$11,$1F,$1F,$1F
Char4i          DATA    $1D,$19,$15,$0D,$00,$1D,$1D,$1F,$1F,$1F
Char5i          DATA    $00,$0F,$01,$1E,$1E,$0E,$11,$1F,$1F,$1F
Char6i          DATA    $19,$17,$0F,$01,$0E,$0E,$11,$1F,$1F,$1F
Char7i          DATA    $00,$1E,$1D,$1B,$17,$17,$17,$1F,$1F,$1F
Char8i          DATA    $11,$0E,$0E,$11,$0E,$0E,$11,$1F,$1F,$1F
Char9i          DATA    $11,$0E,$0E,$10,$1E,$1D,$13,$1F,$1F,$1F


MapStart        CON     Char0i


' -----[ Initialization ]------------------------------------------------
'
Initialize:
```

```
  PAUSE 500                                          ' let the LCD settle
  LCDCMD LCDpin,%00110000 : PAUSE 5                  ' 8-bit mode
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00100000 : PAUSE 0                  ' 4-bit mode
  LCDCMD LCDpin,%00101000 : PAUSE 0                  ' 2-line mode
  LCDCMD LCDpin,%00001100 : PAUSE 0                  ' no crsr, no blink
  LCDCMD LCDpin,%00000110                            ' inc crsr, no disp shift

  cNum = OdoChar
  addr = 0
  GOSUB Update_CC                                    ' put "0" into custom character


' -----[ Main Code ]----------------------------------------------------------
'
Main:
  LCDOUT LCDpin,ClrLCD,["ROLLER   COUNTER"]
  LCDOUT LCDpin,Line2, ["   0",OdoChar,"       0.00"]
  PAUSE 1000

Show_Counters:
  FOR counter = 0 TO 999
    FOR hundreds = 0 TO 99
      temp = counter                                 ' display odometer version
      width = 3
      pos = Line2 + 1
      GOSUB RJ_Print
      addr = hundreds
      GOSUB Update_CC                                ' update rolling character
      pos = Line2 + 10                               ' display digital version
      GOSUB RJ_Print
      LCDOUT LCDpin,NoCmd,["."DEC2 hundreds]
      PAUSE 100
    NEXT
  NEXT

  GOTO Main
  END


' -----[ Subroutines ]--------------------------------------------------------
'
Update_CC:                                           ' update custom character
  LCDCMD LCDpin,(CGRam + (cNum * CLines))            ' point to character map
  FOR idx = 0 TO (CLines - 1)
    READ MapStart + (addr + idx // 100),char
    LCDOUT LCDpin,NoCmd,[char]                       ' write to LCD CGRAM
  NEXT
  RETURN


RJ_Print:                                            ' right justified printing
  digits = width
  LOOKDOWN temp,<[0,10,100,1000,65535],digits
  LCDOUT LCDpin,pos,[REP " "\(width-digits),DEC temp]
  RETURN
```

PP_LCD5x10.BSP

- Connect LCD to the BS2p Demo Board X5
- Install jumper X6
- Adjust contrast pot for best display
- Assemble pushbutton circuit on breadboard



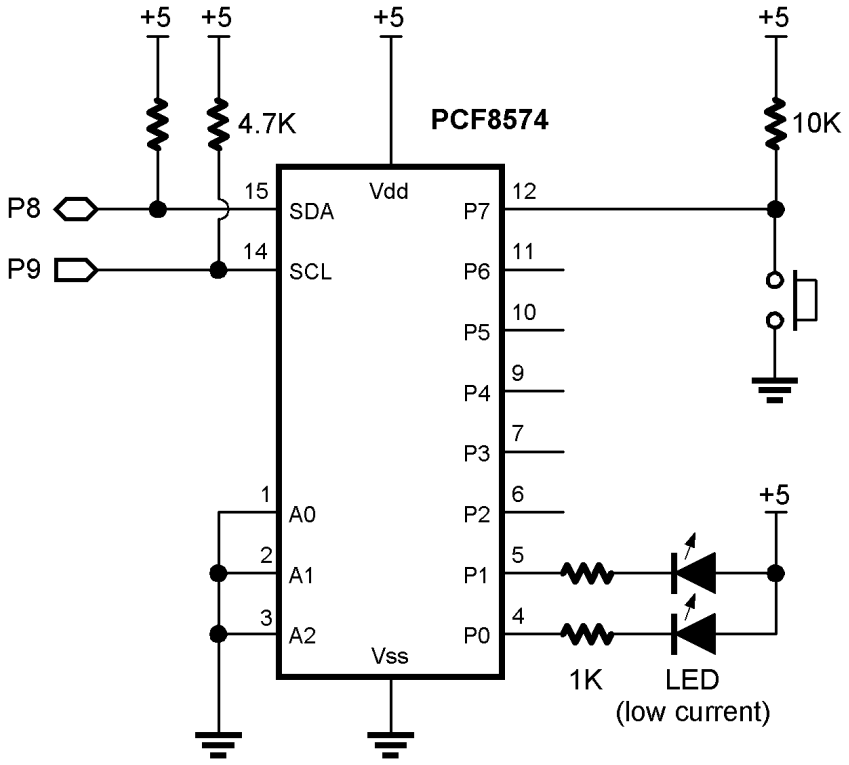

```
' -----[ Title ]-------------------------------------------------------------
'
' BS2p Plus Pack
'
' File..... PP_LCD5x10.BSP
' Purpose... Basic LCD Demo -- Using 5x10 font and descended characters
' Author.... Parallax, Inc.
' E-mail.... stamptech@parallaxinc.com
' Started...
' Updated... 26 SEP 2001

' {$STAMP BS2p}


' -----[ Program Description ]-------------------------------------------------
'
' This program demostrates a method of intializing a 2x16 LCD so that it behaves
' like a single-line LCD that will display the 5x10 character set.  The LCD
' character map includes properly descended characters, but they are not mapped
' in the normal ASCII set.  A simple conversion routine can be used to replace
' "squishy" descended characters with proper ones.
'
' Stamp pin 15 is pulled up to Vdd (+5) through 10K.  This pin is connected to
' Vss (ground) through a N.O. pushbutton switch.  The pin will read 1 when the
' switch is open, 0 when pressed.
'
' To run this program on the BS2p Demo Board, assemble the the switch circuit on
' the breadboard, connect the LCD to X5 and install Jumper X6. Adjust contrast
' pot for best display.
'
' Refer to the Hitachi HD44780 documentation for details on LCD control.


' -----[ Revision History ]----------------------------------------------------
'
```

```
' -----[ I/O Definitions ]-------------------------------------------------
'
LCDpin          CON     0                       ' LCD is connected to OutL
AskBtn          VAR     In15                    ' Ask button input pin


' -----[ Constants ]-------------------------------------------------------
'
NoCmd           CON     $00                     ' No command in LCDOUT
ClrLCD          CON     $01                     ' clear the LCD
CrsrHm          CON     $02                     ' move cursor to home position
CrsrLf          CON     $10                     ' move cursor left
CrsrRt          CON     $14                     ' move cursor right
DispLf          CON     $18                     ' shift displayed chars left
DispRt          CON     $1C                     ' shift displayed chars right
DDRam           CON     $80                     ' Display Data RAM control

NumAns          CON     6                       ' 6 possible answers

_g              CON     $E7                     ' DDROM addresses of descenders
_j              CON     $EA
_p              CON     $F0
_q              CON     $F1
_y              CON     $F9

Pressed         CON     0                       ' button input is active low


' -----[ Variables ]-------------------------------------------------------
'
char            VAR     Byte                    ' character sent to LCD
addr            VAR     Byte                    ' message address
answer          VAR     Nib                     ' answer pointer
clock           VAR     Nib                     ' animation clock
pntr            VAR     Nib                     ' pointer to animation character


' -----[ EEPROM Data ]-----------------------------------------------------
'
Prompt          DATA    "Ask a question",0      ' messages for LCD

Ans0            DATA    "Definitely YES",0
Ans1            DATA    "Possible...",0
Ans2            DATA    "Definitely NO",0
Ans3            DATA    "Not likely...",0
Ans4            DATA    "Answer uncertain",0
Ans5            DATA    "Please ask again",0


' -----[ Initialization ]--------------------------------------------------
'
Initialize:
  PAUSE 500                                     ' let the LCD settle
  LCDCMD LCDpin,%00110000 : PAUSE 5             ' 8-bit mode
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00100000 : PAUSE 0             ' 4-bit mode
  LCDCMD LCDpin,%00100100 : PAUSE 0             ' 5x10 font
  LCDCMD LCDpin,%00001100 : PAUSE 0             ' no crsr, no blink
  LCDCMD LCDpin,%00000110                       ' inc crsr, no disp shift
```

```
' -----[ Main Code ]-----------------------------------------------------------
'
Main:
  LCDCMD LCDpin,ClrLCD                          ' clear the LCD
  addr = Prompt
  GOSUB Show_Msg                                ' print prompt

Rollem:
  GOSUB Shuffle                                 ' shuffle until button pressed
  PAUSE 5
  IF (AskBtn = Pressed) THEN Show_Answer
  GOTO Rollem

Show_Answer:
  ' get address of answer message
  LOOKUP answer,[Ans0,Ans1,Ans2,Ans3,Ans4,Ans5],addr

  LCDCMD LCDpin,ClrLCD
  GOSUB Show_Msg

  PAUSE 2000                                    ' give time to read answer
  GOTO Main                                     ' do it all over
  END


' -----[ Subroutines ]----------------------------------------------------------
'
Show_Msg:
  READ addr,char                                ' read a character
  IF (char = 0) THEN Msg_Done                   ' if 0, message is complete
  GOSUB Translate                               ' fix letters with descenders
  LCDOUT LCDpin,NoCmd,[char]
  addr = addr + 1                               ' point to next character
  GOTO Show_Msg
Msg_Done:
  RETURN


' convert to descender font
' - does not change other characters

Translate:
  LOOKDOWN char,["g","j","q","p","y"],char      ' translate decended characters
  LOOKUP char,[_g,_j,_q,_p,_y],char
  RETURN


Shuffle:
  answer = answer + 1 // NumAns                 ' update answer pointer
  clock = clock + 1 // 15                       ' update pointer clock
  IF (clock > 0) THEN Shuffle_Done              ' time to update animation?
  LOOKUP pntr,["-+|*"],char                     ' load animation character
  LCDOUT LCDpin,DDRam + 15,[char]               ' write it at column 15
  pntr = pntr + 1 // 4                          ' update animation char
Shuffle_Done:
  RETURN
```

PP_PCF8574.BSP

- Assemble PCF8583574 circuit on breadboard
  -- use on-board 4.7K resistors (R1 and R2) for pull-ups



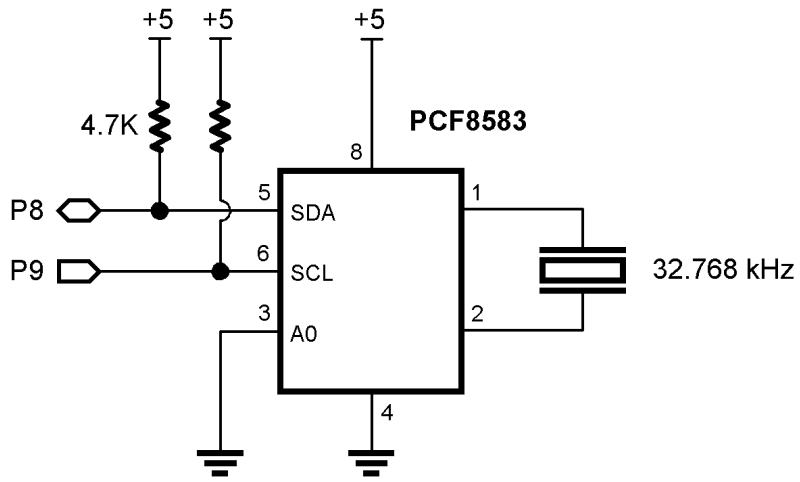

```
' -----[ Title ]-------------------------------------------------------------
'
' BS2p Plus Pack
'
' File..... PP_PCF8574.BSP
' Purpose... Reads remote input and updates 2 remote outputs on PCF8574
' Author.... Parallax
' E-mail.... stamptech@parallaxinc.com
' Started...
' Updated... 26 SEP 2001

' {$STAMP BS2p}


' -----[ Program Description ]-------------------------------------------------
'
' This program reads bit 7 from the PCF8574.  If that bit is high (button is
' pressed), a counter is incremented and displayed via LEDs on PCF8574 bits
' 0 and 1.
'
' Note: Most (not all) I2C devices have multiple internal addresses, so the
' I2CIN and I2COUT commands support this with an address parameter (this byte
' comes after the Slave Address byte).  With the PCF8574, replace the address
' byte with a value that reflects the desired state of the I/O pins, where
```

```
' 1 is an input.  For example:
'
' %11100000 = Bits 0 - 4 are outputs, bits 5 - 7 are inputs
'
' For the PCF8574 the syntax becomes:
'
'    I2CIN  pin, ddr_value, [in_byte]
'    I2COUT pin, ddr_value, [out_byte]
'
' Special Note: When reading inputs while using the PCF8574 in mixed I/O mode,
' you must refresh the output bits during the read.  This is easily accomplished
' by ORing the state of the output pins with the DDR value.
'
'    I2CIN  pin, (ddr_value | out_bits), [out_byte]
'
' This program uses the bits in mixed mode and will use the syntax described
' immediately above.
'
' I/O Notes:
'
' The input bit is pulled up to Vdd (+5) through 10K.  This input is connected
' to Vss (ground) through a N.O. pushbutton switch.  The input will read 1 when
' the switch is open, 0 when pressed.
'
' PCF8574 can sink current, but provide almost no source current.  Outputs for
' this program are setup as active-low.  The tilde (~) in front of the variable
' cntr inverts the bits since we're using active low outputs.


' -----[ Revision History ]---------------------------------------------------
'


' -----[ I/O Definitions ]----------------------------------------------------
'
I2Cpin          CON     8                       ' SDA on 8; SCL on 9


' -----[ Constants ]----------------------------------------------------------
'
DevType         CON     %0100 << 4              ' Device type
DevAddr         CON     %000 << 1               ' address = %000 -> %111
Wr8574          CON     DevType | DevAddr       ' write to PCF8574
Rd8574          CON     Wr8574 | 1              ' read from PCF8574

MixDDR          CON     %11111100               ' 1 = input, 0 = output


' -----[ Variables ]----------------------------------------------------------
'
ioByte          VAR     Byte                    ' i/o byte for PCF8574
btn             VAR     ioByte.Bit7             ' button input (0 = pressed)
cntr            VAR     Nib                     ' counter


' -----[ EEPROM Data ]--------------------------------------------------------
'


' -----[ Initialization ]-----------------------------------------------------
'
Initialize:
  DEBUG CLS
```

```
  PAUSE 100
  DEBUG "PCF8574 Demo", CR
  DEBUG "Press button to update counter"


' -----[ Main Code ]----------------------------------------------------------
'
Main:
  I2CIN I2Cpin, Rd8574, (MixDDR | ~cntr), [ioByte]
  IF (btn) THEN Main                            ' wait for press
  cntr = cntr + 1 // 4                          ' update counter
  DEBUG Home, 10, 10, 10, BIN2 cntr             ' display on screen
  I2COUT I2Cpin, Wr8574, MixDDR, [~cntr]        ' send new value
  PAUSE 200
  GOTO Main


' -----[ Subroutines ]--------------------------------------------------------
'
```

PP_PCF8583.BSP

- Assemble PCF8583 circuit on breadboard
  -- use on-board 4.7K resistors (R1 and R2) for pull-ups




```
' -----[ Title ]-------------------------------------------------------------
'
' BS2p Plus Pack
'
' File..... PP_PCF8583.BSP
' Purpose... PCF8583 RTC Demo
' Author.... Parallax
' E-mail.... stamptech@parallaxinc.com
' Started...
' Updated... 26 SEP 2001

' {$STAMP BS2p}


' -----[ Program Description ]-------------------------------------------------
'
' The program demonstrates the PCF8583 RTC/RAM.  When the program starts, you
' will be asked if you want to set the time.  If Yes, you'll enter the hours,
' minutes and day.  When running, the program displays the time and the day
' (by name) on a two-line LCD.

' To run this program on the BS2p Demo Board, connect the LCD and install
' Jumper X3.
'
' Refer to the Hitachi HD44780 documentation for details on LCD control.


' -----[ Revision History ]----------------------------------------------------
'




' -----[ I/O Definitions ]-----------------------------------------------------
'
```

```
LCDpin          CON     0                       ' LCD is connected to OutL
I2Cpin          CON     8                       ' SDA on 8; SCL on 9
RxD             CON     16                      ' serial receive (from DEBUG)


' -----[ Constants ]-------------------------------------------------------
'
DevType         CON     %1010 << 4              ' device type
DevAddr         CON     %000 << 1               ' address = %000 -> %001
Wr8583          CON     DevType | DevAddr       ' write to PCF8583
Rd8583          CON     Wr8583 | 1              ' read from PCF8583

' LCD control characters
'
NoCmd           CON     $00                     ' just print
ClrLCD          CON     $01                     ' clear the LCD
CrsrHm          CON     $02                     ' cursor home
CrsrLf          CON     $10                     ' cursor left
CrsrRt          CON     $14                     ' move cursor right
DispLf          CON     $18                     ' shift display left
DispRt          CON     $1C                     ' shift displayright
DDRam           CON     $80                     ' Display Data RAM control
Line1           CON     $80                     ' address of line 1
Line2           CON     $C0                     ' address of line 2

Yes             CON     1
No              CON     0

Baud96          CON     240                     ' 9600-8-N-1 (matches DEBUG)


' -----[ Variables ]-------------------------------------------------------
'
seconds         VAR     Byte
minutes         VAR     Byte
hours           VAR     Byte
day             VAR     Nib                     ' 0 - 6 (day of week)
date            VAR     Byte                    ' 1 - 31
month           VAR     Nib
year            VAR     Nib                     ' 0 - 3 (LeapYear offset)

rawTime         VAR     Word                    ' minutes past midnight

regCtrl         VAR     Byte                    ' [0] control/status
regHuns         VAR     Byte                    ' [1] hundredths (bcd)
regSecs         VAR     Byte                    ' [2] seconds (bcd)
regMins         VAR     Byte                    ' [3] minutes (bcd)
regHrs          VAR     Byte                    ' [4] hours (bcd)
regYrDate       VAR     Byte                    ' [5] year & date (bcd+)
regMoDay        VAR     Byte                    ' [6] day & month (bcd+)

regAddr         VAR     Byte                    ' register address
regData         VAR     Byte                    ' data to/from register

eeAddr          VAR     Byte                    ' EE data pointer
char            VAR     Byte                    ' character from EE
idx             VAR     Byte                    ' loop counter

response        VAR     Byte


' -----[ EEPROM Data ]-----------------------------------------------------
'
```

```
Su              DATA    "   SUNDAY",0
Mo              DATA    "   MONDAY",0
Tu              DATA    "  TUESDAY",0
We              DATA    "WEDNESDAY",0
Th              DATA    " THURSDAY",0
Fr              DATA    "   FRIDAY",0
Sa              DATA    " SATURDAY",0


' -----[ Initialization ]----------------------------------------------------
'
Initialize:
  DEBUG CLS                                     ' open DEBUG window
  PAUSE 500                                     ' let LCD settle


LCD_Setup:
  LCDCMD LCDpin,%00110000 : PAUSE 5             ' 8-bit mode
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00110000 : PAUSE 0
  LCDCMD LCDpin,%00100000 : PAUSE 0             ' 4-bit mode
  LCDCMD LCDpin,%00101000 : PAUSE 0             ' 2-line mode
  LCDCMD LCDpin,%00001100 : PAUSE 0             ' no crsr, no blink
  LCDCMD LCDpin,%00000110                       ' inc crsr, no disp shift

  LCDOUT LCDpin,ClrLCD,["BSP <--> PCF8583"]     ' splash screen


Check_Set_Clock:
  DEBUG "Would you like to set the clock? (Y/N)"
  SERIN RxD,Baud96,10000,Main,[response]
  idx = 99
  LOOKDOWN response,["nNyY"],idx
  idx = idx / 2
  IF (idx = 0) THEN Main


Enter_Hours:
  DEBUG CR, "Hours (0..23): "
  SERIN RxD,Baud96,[DEC2 hours]
  IF (hours < 24) THEN Enter_Minutes
  hours = 6


Enter_Minutes:
  DEBUG CR, "Minutes (0..59): "
  SERIN RxD,Baud96,[DEC2 minutes]
  IF (hours < 60) THEN Enter_Day
  minutes = 0


Enter_Day:
  DEBUG CR, "Day (0..6 [0 = Sunday]): "
  SERIN RxD,Baud96,[DEC1 day]
  IF (day < 7) THEN Set_The_Clock
  day = 0


Set_The_Clock:
  month = 9
  date = 18
  year = 1
  GOSUB Put_Clock
```

```
' -----[ Main Code ]-----------------------------------------------------------
'
Main:
  DEBUG CLS, "The clock is running..."
  LCDCMD LCDpin, ClrLCD

Show_Clock:
  GOSUB Get_Time_And_Day
  LCDOUT LCDpin,Line1,[DEC2 hours,":",DEC2 minutes,":",DEC2 seconds]
  LCDCMD LCDpin, (Line2 + 7)
  GOSUB Print_Day
  GOTO Show_Clock


' -----[ Subroutines ]----------------------------------------------------------
'
Put_Register:
  I2COUT I2Cpin,Wr8583,regAddr,[regData]        ' send data to register
  RETURN


Get_Register:
  I2CIN I2Cpin,Rd8583,regAddr,[regData]         ' get data from register
  RETURN


Put_Raw_Clock:                                  ' set with rawTime
  minutes = rawTime // 60
  hours = rawTime / 60

Put_Clock:
  regSecs = 0
  regMins.HighNib = minutes / 10                ' convert regs to BCD
  regMins.LowNib = minutes // 10
  regHrs.HighNib = hours / 10
  regHrs.LowNib = hours // 10
  regMoDay.HighNib = month / 10
  regMoDay.LowNib = month // 10
  regMoDay = regMoDay | (day << 5)              ' pack weekday in
  I2COUT I2Cpin,Wr8583,2,[STR regSecs\5]        ' write time & day
  RETURN


Get_Time_And_Day:
  I2CIN I2Cpin,Rd8583,0,[STR regCtrl\7]

  ' convert from BCD

  seconds = (regSecs.HighNib * 10) + regSecs.LowNib
  minutes = (regMins.HighNib * 10) + regMins.LowNib
  hours = (regHrs.HighNib * 10) + regHrs.LowNib
  rawTime = (hours * 60) + minutes
  day = regMoDay >> 5
  RETURN


Print_Day:
  LOOKUP day,[Su,Mo,Tu,We,Th,Fr,Sa],eeAddr      ' point to EE string
Print_Loop:
  READ eeAddr,char                              ' read a character
  IF (char = 0) THEN Print_Done                 ' done?
```

```
  LCDOUT LCDpin,NoCmd,[char]                    ' print the character
  eeAddr = eeAddr + 1                           ' point to next
  GOTO Print_Loop:                              ' go get it
Print_Done:
  RETURN
```