

4x4 Matrix Membrane Keypad (#27899)

This 16-button keypad provides a useful human interface component for microcontroller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications.

Features

- Ultra-thin design
- Adhesive backing
- Excellent price/performance ratio
- Easy interface to any microcontroller
- Example programs provided for the BASIC Stamp 2 and Propeller P8X32A microcontrollers

Key Specifications

- Maximum Rating: 24 VDC, 30 mA
- Interface: 8-pin access to 4x4 matrix
- Operating temperature: 32 to 122 °F (0 to 50°C)
- Dimensions:
Keypad, 2.7 x 3.0 in (6.9 x 7.6 cm)
Cable, 0.78 x 3.5 in (2.0 x 8.8 cm)

Application Ideas

- Security systems
- Menu selection
- Data entry for embedded systems



How it Works

Matrix keypads use a combination of four rows and four columns to provide button states to the host device, typically a microcontroller. Underneath each key is a pushbutton, with one end connected to one row, and the other end connected to one column. These connections are shown in Figure 1.

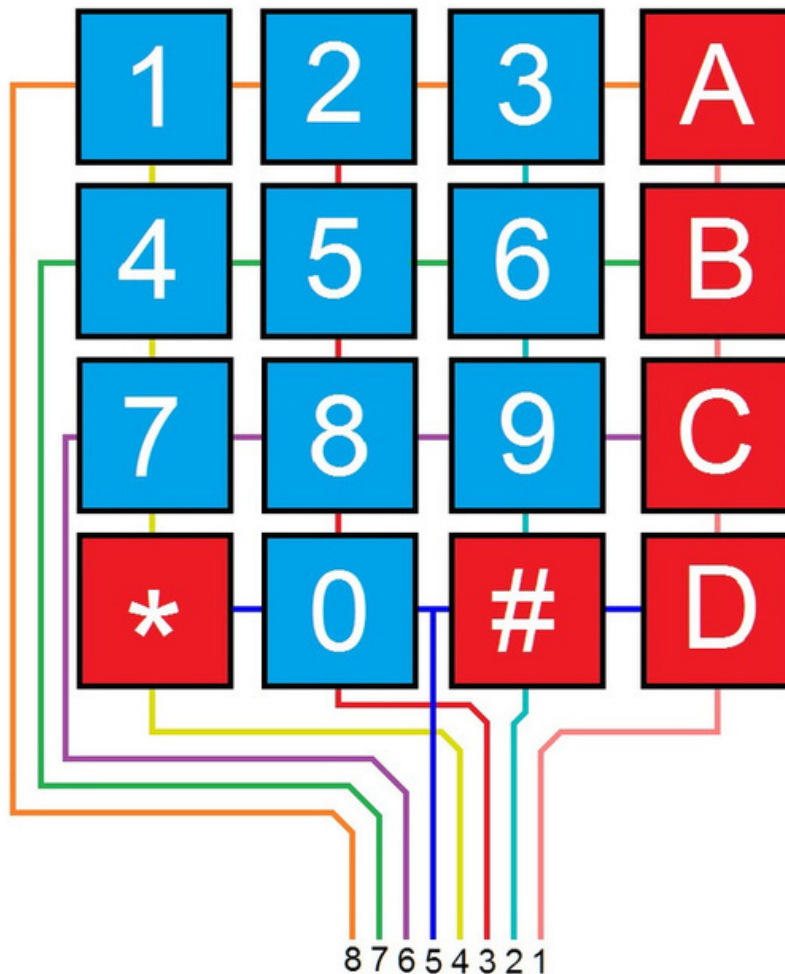


Figure 1: Matrix Keypad Connections

In order for the microcontroller to determine which button is pressed, it first needs to pull each of the four columns (pins 1-4) either low or high one at a time, and then poll the states of the four rows (pins 5-8). Depending on the states of the columns, the microcontroller can tell which button is pressed.

For example, say your program pulls all four columns low and then pulls the first row high. It then reads the input states of each column, and reads pin 1 high. This means that a contact has been made between column 4 and row 1, so button 'A' has been pressed.

Connection Diagrams

Figure 2

For use with the BASIC Stamp example program listed below.

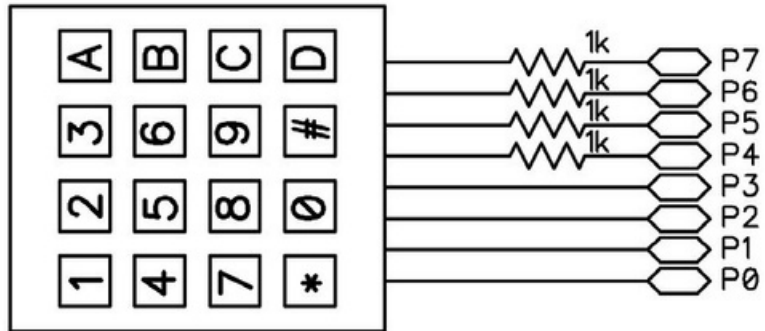
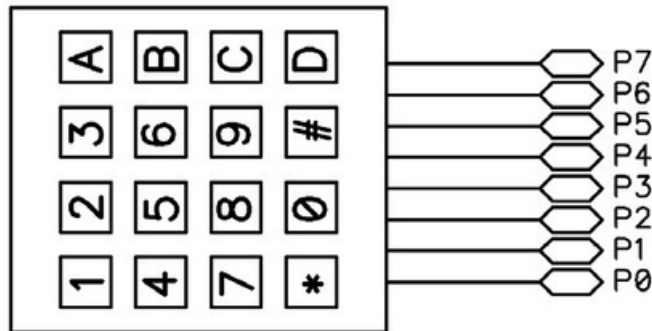


Figure 3

For use with the Propeller P8X32A example program listed below.



BASIC Stamp® Example Code

The example code below displays the button states of the 4x4 Matrix Membrane Keypad. It uses the Debug Terminal, which is built into the BASIC Stamp Editor software. The software is a free download from www.parallax.com/basicstampsoftware.

```
' 4x4MatrixKeypad_Demo.bs2
' Display buttons pressed on the 4x4 Matrix Membrane Keypad
' Author: Parallax HK Engineering

'{$STAMP BS2}
'{$PBASIC 2.5}

row VAR Nib ' Variable space for row counting
column VAR Nib ' Variable space for column counting
keypad VAR Word ' Variable space to store keypad output
keypadOld VAR Word ' Variable space to store old keypad output
temp VAR Nib ' Variable space for polling column states

DEBUG CLS ' Clear Debug Terminal
GOSUB Update ' Display keypad graphic

DO
GOSUB ReadKeypad ' Read keypad button states
DEBUG HOME, BIN16 keypad, CR, CR, ' Display 16-bit keypad value
BIN4 keypad >> 12, CR, ' Display 1st row 4-bit keypad value
BIN4 keypad >> 8, CR, ' Display 2nd row 4-bit keypad value
BIN4 keypad >> 4, CR, ' Display 3rd row 4-bit keypad value
BIN4 keypad ' Display 4th row 4-bit keypad value
```

```

IF keypad <> keypadOld THEN ' If different button is pressed,
GOSUB Update ' update the keypad graphic to clear
ENDIF ' old display

IF keypad THEN ' Display button pressed in graphic
GOSUB display
ENDIF

keypadOld = keypad ' Store keypad value in variable keypadOld

LOOP

' ----[ Subroutine - ReadKeypad ]-----
' Read keypad button states
ReadKeypad:
keypad = 0
OUTL = %00000000 ' Initialize IO
DIRL = %00000000
FOR row = 0 TO 3
DIRB = %1111 ' Set columns (P7-P4) as outputs
OUTB = %0000 ' Pull columns low (act as pull down)
OUTA = 1 << row ' Set rows high one by one
DIRA = 1 << row

temp = 0 ' Reset temp variable to 0
FOR column = 0 TO 3
INPUT (column + 4) ' Set columns as inputs
temp = temp | (INB & (1 << column)) ' Poll column state and store in temp
NEXT

keypad = keypad << 4 | (Temp REV 4) ' Store keypad value
NEXT
RETURN

' ----[ Subroutine - Update ]-----
' Graphical depiction of keypad
Update:
DEBUG CRSRXY,0,7,
"+---+---+---+---+",CR,
"| | | | |",CR,
"+---+---+---+---+",CR,
"| | | | |",CR,
"+---+---+---+---+",CR,
"| | | | |",CR,
"+---+---+---+---+",CR,
"| | | | |",CR,
"+---+---+---+---+",CR,
"| | | | |",CR,
"+---+---+---+---+"
RETURN

' ----[ Subroutine - Display ]-----
' Display button pressed in keypad graphic
Display:
IF KeyPad.BIT15 THEN DEBUG CRSRXY, 02,08,"1"
IF KeyPad.BIT14 THEN DEBUG CRSRXY, 06,08,"2"
IF KeyPad.BIT13 THEN DEBUG CRSRXY, 10,08,"3"
IF KeyPad.BIT12 THEN DEBUG CRSRXY, 14,08,"A"
IF KeyPad.BIT11 THEN DEBUG CRSRXY, 02,10,"4"
IF KeyPad.BIT10 THEN DEBUG CRSRXY, 06,10,"5"
IF KeyPad.BIT9 THEN DEBUG CRSRXY, 10,10,"6"
IF KeyPad.BIT8 THEN DEBUG CRSRXY, 14,10,"B"
IF KeyPad.BIT7 THEN DEBUG CRSRXY, 02,12,"7"
IF KeyPad.BIT6 THEN DEBUG CRSRXY, 06,12,"8"
IF KeyPad.BIT5 THEN DEBUG CRSRXY, 10,12,"9"

```

```

IF Keypad.BIT4 THEN DEBUG CRSRXY, 14,12,"C"
IF Keypad.BIT3 THEN DEBUG CRSRXY, 02,14,"*"
IF Keypad.BIT2 THEN DEBUG CRSRXY, 06,14,"0"
IF Keypad.BIT1 THEN DEBUG CRSRXY, 10,14,"#"
IF Keypad.BIT0 THEN DEBUG CRSRXY, 14,14,"D"

```

```
RETURN
```

[™]Propeller P8X32A Example Code

The example code below displays the button states of the 4x4 Matrix Membrane Keypad, and is a modified version of the 4x4 Keypad Reader DEMO object by Beau Schwabe.

Note: This application uses the 4x4 Keypad Reader.spin object. It also uses the Parallax Serial Terminal to display the device output. Both objects and the Parallax Serial Terminal itself are included with the with the Propeller Tool v1.2.7 or higher, which is available from the Downloads link at www.parallax.com/Propeller.

```

{{ 4x4 Keypad Reader PST.spin
Returns the entire 4x4 keypad matrix into a single WORD variable indicating which buttons are
pressed. }}

CON

_clkmode = xtal1 + pll16x
_xinfreq = 5_000_000

OBJ

text : "Parallax Serial Terminal"
KP : "4x4 Keypad Reader"

VAR

word keypad
PUB start

'start term
text.start(115200)
text.str(string(13,"4x4 Keypad Demo..."))
text.position(1, 7)
text.str(string(13,"RAW keypad value 'word'"))
text.position(1, 13)
text.str(string(13,"Note: Try pressing multiple keys"))
repeat
keypad := KP.ReadKeyPad '<-- One line command to read the 4x4 keypad
text.position(5, 2)
text.bin(keypad>>0, 4) 'Display 1st ROW
text.position(5,3)
text.bin(keypad>>4, 4) 'Display 2nd ROW
text.position(5, 4)
text.bin(keypad>>8, 4) 'Display 3rd ROW
text.position(5, 5)
text.bin(keypad>>12, 4) 'Display 4th ROW
text.position(5, 9)
text.bin(keypad, 16) 'Display RAW keypad value

```

Revision History

v1.0: original document
v1.1: Updated Figure 1 on page 2
v1.2: Updated Figure 1 on page 2 (again); updated BS2 comments