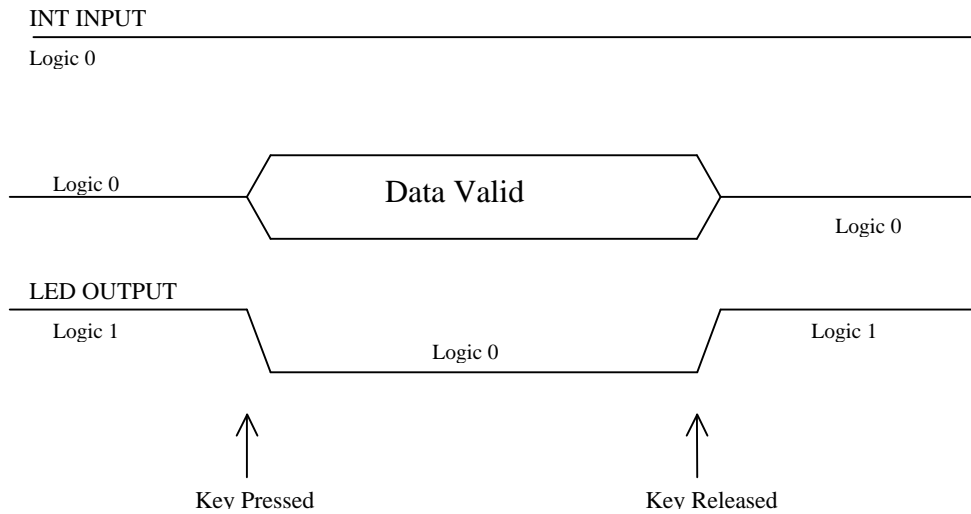


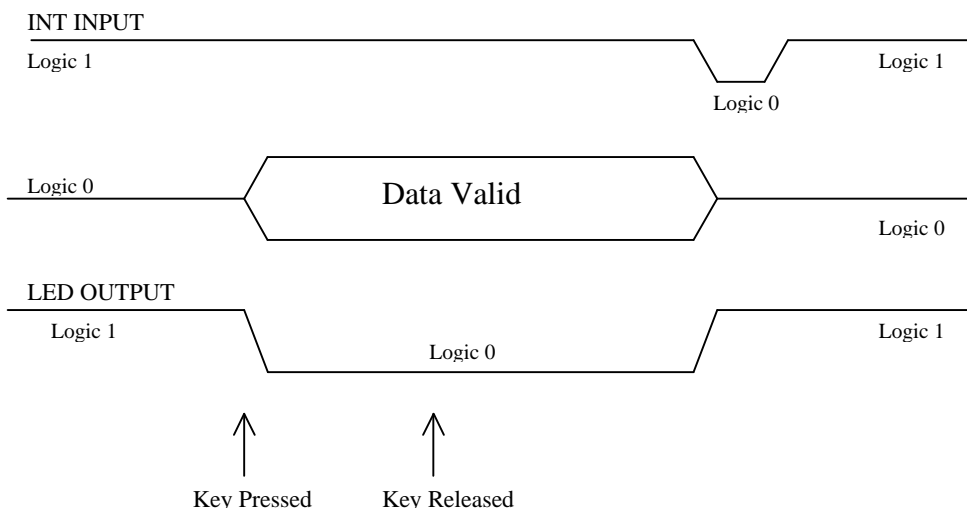


## Timing diagrams.

### MOM mode

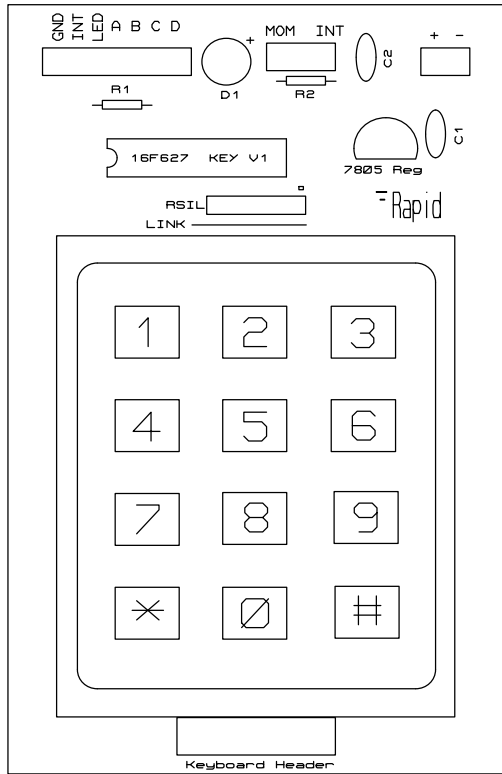


### INT mode

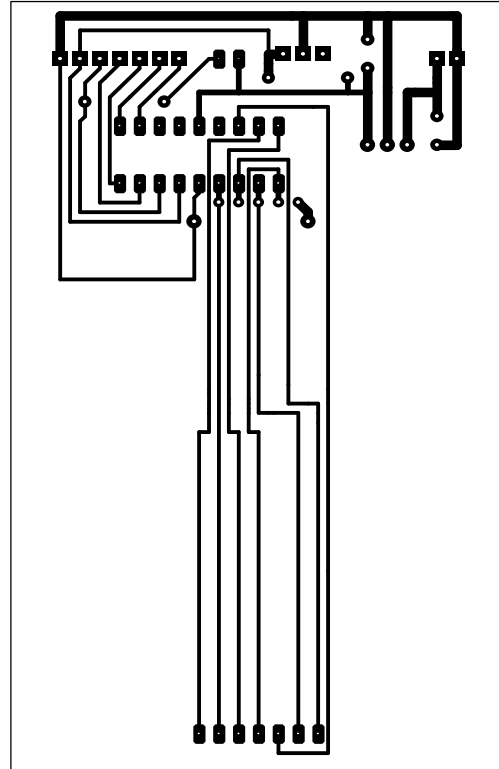


### Component list

Component Reference	Description	Rapid Order Code
R1	1k $\Omega$ 0.25W	62-0370
R2	4k7 $\Omega$ 0.25W	62-0386
C1 and C2	100nF	08-0235
D1	Red LED	55-0117
U1	PIC16F627-20/IP	73-3260
U2	1k $\Omega$ x 4 SIL	63-0250
U3	78L05 voltage regulator	47-3278
	18 pin IC holder	22-0165
Con 1 plug	7 pin RA pin header 0.1 pitch	22-2420
Con 2 plug	2 pin RA pin header 0.1 pitch	22-1005
Con 1 socket	7 pin Crimp terminal housing	22-2350
Con 1 socket	2 pin Crimp terminal housing	22-0905
INT / MOM	SPDT switch	76-0302
K1	Matrix keyboard	78-0305
PCB	Keyboard PCB	70-0270
Screw	4 - M2.5 x 10mm pan head screws	33-2205
Nut	8 - M2.5 nuts	33-0705



**Keyboard layout.**



**Keyboard foil**

**Key to BCD relationship.**

KEY	A	B	C	D
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
#	1	0	1	0
*	1	1	1	1

**Keyboard software.**

```

; *****
; ***** Assembler Code File Details *****
; *****
;   Filename: Keyboard Assembly File.
;   Date: 27-01-04
;   File Version: V1
;   Written by: Rapid Ltd
;   Function: Matrix Keyboard to BCD Encoder.

; *****
; ***** (1) Setup PICmicro type. *****
; *****

        list      p=16F627          ; define PICmicro type
        #include <p16F627.inc>      ; variable definitions
        errorlevel -302           ; suppress warning 302

; *****
; ***** (2) Setup PICmicro config. *****
; *****

;This default line uses external ceramic resonator
;   __CONFIG  _CP_OFF & _WDT_OFF & _XT_OSC & _PWRTE_ON & _BODEN_ON &
;   _LVP_OFF& _MCLRE_ON

;uncomment this line instead for internal resonator (provides two extra input
pins on PORTA)
;   __CONFIG  _CP_OFF & _WDT_OFF & _INTRC_OSC_NOCLKOUT & _PWRTE_ON &
;   _BODEN_ON & _LVP_OFF& _MCLRE_OFF

; *****
; ***** (3) RAM File Registers *****
; *****

;Declarations.

        cblock      h'20'

temp1          ;Scanned BCD register
temp2          ;Scan temp register
temp3          ;GP temp register

        endc

; *****
; ***** (4) Assembler code reset vectors *****
; *****

; ***** Reset vector *****
        org  d'00'
        clrf  PORTA      ; initialise PORTA
        clrf  PORTB      ; initialise PORTB
        goto  init       ; jump to init

```

```

; ***** Interrupt vector *****
    org    d'04'
    return                ; return

; *****
; ***** (5) Common sub-procedures *****
; *****

;DELAY ROUTINE

delay movlw h'08'
    movwf temp2
loop1 movlw h'08'
    movwf temp3
loop2 decfsz    temp3,1
    goto loop2
    decfsz    temp2,1
    goto loop1
    return

;KEY LOOKUP TABLE

lut    addwf PCL,f
    retlw b'00110000' ;Led & Ready ON.   BCD 0
    retlw b'00110001' ;Led & Ready ON.   BCD 1
    retlw b'00110100' ;Led & Ready ON.   BCD 4
    retlw b'00000000' ;x
    retlw b'00110111' ;Led & Ready ON.   BCD 7
    retlw b'00000000' ;x
    retlw b'00000000' ;x
    retlw b'00111010' ;Led & Ready ON.   HEX #
    retlw b'00111111' ;Led & Ready ON.   HEX *
    retlw b'00110010' ;Led & Ready ON.   BCD 2
    retlw b'00110101' ;Led & Ready ON.   BCD 5
    retlw b'00111001' ;Led & Ready ON.   BCD 9
    retlw b'00111000' ;Led & Ready ON.   BCD 8
    retlw b'00110110' ;Led & Ready ON.   BCD 6
    retlw b'00110011' ;Led & Ready ON.   BCD 3
    retlw b'00000000' ;x

; *****
; ***** (6) Start of assembler code *****
; *****

; ***** Initialisation *****
init:                ; (initialisation goes here)

    ;Note that if using code originally for 16F84A these two extra lines are
required.
;    movlw b'00000111'    ; set all of PORTA pins to be digital
;    movwf CMCON          ; inputs rather than default comparators

```

**;Setup Program.**

```

start  clrf  PORTA
       clrf  PORTB

       bsf   STATUS,RP0   ;set bank 1
       movlw h'0f'
       movwf TRISB        ;pb0-3 keyboard row
                           ;pb4-6 keyboard col
                           ;pb7-
       movlw h'E0'
       movwf TRISA        ;pa0-3 bcd output
                           ;pa4 ready
                           ;pa5 LED
                           ;pa6 reset
                           ;pa7
       bcf   STATUS,RP0   ;set bank 0

; ***** Main program *****

; MATRIX KEYBOARD SCAN ROUTINE.

scan   bcf   PORTB,7
       bcf   PORTB,6
       bcf   PORTB,5
       bsf   PORTB,4      ;Scan column 1
       call  delay        ;2ms delay

       clrf  temp1
       movf  PORTB,0      ;read for active key
       andlw h'0f'
       movwf temp1
       btfsc STATUS,Z
       goto  next2
       movf  PORTB,0      ;read key again
       andlw h'0f'
       movwf temp1        ;save key
       btfsc STATUS,Z
       goto  next2
       movf  temp1,0
       call  lut           ;Get code from lookup table
       movwf PORTA        ;Output code with LED and Ready
check1 movf  PORTB,0      ;Check button release
       andlw h'0f'
       btfss STATUS,Z
       goto  check1
int1   btfsc PORTA,5
       goto  int1
       bcf   PORTA,4      ;Clear Ready and LED

next2  bcf   PORTB,7
       bcf   PORTB,6
       bcf   PORTB,4
       bsf   PORTB,5      ;Scan column 2
       call  delay        ;2ms delay/ scan display

       clrf  temp1
       movf  PORTB,0      ;read for active key

```

```

        andlw h'0f'
        movwf temp1
        btfsc STATUS,Z
        goto next3
        movf PORTB,0      ;read key again
        andlw h'0f'
        movwf temp1      ;save key
        btfsc STATUS,Z
        goto next3      ;Correct keyboard code
        andlw h'0f'      ;mask nibble
        call lut          ;Get code from lookup table
        movwf PORTA      ;Output code with LED and Ready
check2  movf PORTB,0      ;Check button release
        andlw h'0f'
        btfss STATUS,Z
        goto check2
int2    btfsc PORTA,5
        goto int2
        bcf PORTA,4      ;Clear Ready
next3   bcf PORTB,4
        bcf PORTB,5
        bcf PORTB,7
        bsf PORTB,6      ;Scan column 3
        call delay       ;2ms delay/ scan display
        clrf temp1
        movf PORTB,0      ;read for active key
        andlw h'0f'
        movwf temp1
        btfsc STATUS,Z
        goto rets
        movf PORTB,0      ;read key again
        andlw h'0f'
        movwf temp1      ;save key
        btfsc STATUS,Z
        goto rets
        movf temp1,0
        comf temp1,0      ;Correct keyboard code
        andlw h'0f'      ;mask nibble
        call lut          ;Get code from lookup table
        movwf PORTA      ;Output code with LED and Ready
check3  movf PORTB,0      ;Check button release
        andlw h'0f'
        btfss STATUS,Z
        goto check3
int3    btfsc PORTA,5
        goto int3
        bcf PORTA,4      ;Clear Ready

rets    goto scan

; *****
; ***** (7) End of Program *****
; *****

        end

```

**NOTE.** Declarations need to include STATUS, PORT A,B TRISA,B etc.  
The Revolution Education Program Editor has a template for this PIC and  
using this the declarations are automatic.