```
1           LIST    p=16F84 ; PIC16F844 is the target processor

2

3           #include "P16F84A.INC" ; Include header file

4

5           CBLOCK 0x10   ; Temporary storage
6           tempo
7           tptrl
8           tptrh
9           note
10          length
11          pitch
12          temp
13          dl1
14          dl2
15          ENDC

16

17

18          ORG   0
19 entrypoint    goto  initialise

20

21          ORG   4
22 intvector    goto    toggle

23

24 initialise    ; Register set up:
25          clrw              ; Zero.
26          movwf  PORTA      ; Ensure PORTB is zero before we enable it.
27          movwf  PORTB      ; Ensure PORTB is zero before we enable it.
28          bsf    STATUS,RP0    ; Select Bank 1
29          clrf   TRISB       ; Port B is outputs

30

31          ; Set up timer 0 for tone generation
32          movlw  0x02        ; Prescaler on, internal clocking, divide by 4
33          movwf  OPTION_REG
34          bcf    STATUS,RP0    ; Back to bank 0

35

36

37          ; Poll for a button
38 wait     clrf   PORTB
39 wloop        btfss   PORTA,0
40      goto   playtune0
41      btfss  PORTA,1
42      goto   playtune1
43      goto   wloop

44

45 ;Routines to play the tunes
46 playtune0    movlw   0x13
47      movwf  PORTB
48      movlw  0x50
49        movwf  tempo
50      movlw   high tune0
51      movwf  tptrh
52      movlw   low tune0
53      movwf  tptrl
54      goto   playtune

55

56 playtune1    movlw   0x23
57      movwf  PORTB
58      movlw  0xA0
59        movwf  tempo
60      movlw   high tune1
61      movwf  tptrh
62      movlw   low tune1
```

```
63            movwf   tptrl
64            goto    playtune
65
66   ;Subroutine to play a tune
67   playtune   call   gettunedata      ; Lookup note from tune table
68            movwf   note              ; Store the note code
69            btfsc   note,7    ; Bit 7 set => end of tune
70            goto    wait        ; Back to waiting for a button press
71            incf    tptrl,F           ; Increment the tune pointer
72            call    gettunedata      ; Get the note length
73            movwf   length            ; Store it
74
75   ; Play the stored note
76   ; The tune table supports two octaves and 8 note lengths.
77   playnote   btfsc   note,6       ; Bit 6 set => rest
78            goto    playwait          ; Silence ensues...
79            movf    note,W      ; Retrieve the note
80            andlw   0x3F              ; Mask off the pitch index
81            call    pitchtable      ; and look it up in the pitchtable
82            movwf   pitch             ; Transfer the value to Timer 0
83            movwf   TMR0
84            bcf     INTCON,T0IF      ; Clear Timer Interrupt
85            bsf     INTCON,T0IE      ; Enable interrupts for Timer 0
86            bsf     INTCON,GIE
87   playwait   movf   length,W         ; Retrieve the note length
88            movwf   dl1               ; and store it in delay counter 1
89   loop1       movf   tempo,W          ; This value sets the timing resolution
90            movwf   dl2
91   loop2       nop                     ; Inner delay loop delay
92            nop
93            decfsz  dl2,F
94            goto    loop2
95            decfsz  dl1,F           ; Outer delay loop
96            goto    loop1
97            bcf     INTCON,T0IE      ; Timer interrupts off
98
99   ;Fetch next note/length pair:
100          incf    tptrl,F           ; Increment tune ptr
101          btfsc   STATUS,Z     ; Test for low byte rollover
102          incf    tptrh,F         ; Inc high byte
103          goto    playtune          ; Loop for next note
104
105  ; Routine to fetch data from the tune tables
106  gettunedata  movf   tptrh,W         ; Set up PCLATH for the jump
107          movwf   PCLATH
108          movf    tptrl,W         ; Get low address of tptr
109          movwf   PCL        ; Jump off to the table entry
110
111  ; Pitch lookup function
112  pitchtable   clrf   PCLATH           ; Clear PCLATH for zero page
113          addwf   PCL,F
114          retlw   0x11            ;C5  // Midi Code 60
115          retlw   0x1F            ;C#
116          retlw   0x2B            ;D
117          retlw   0x37            ;D#
118          retlw   0x42            ;E
119          retlw   0x4D            ;F
120          retlw   0x57            ;F#
121          retlw   0x61            ;G
122          retlw   0x6A            ;G#
123          retlw   0x72            ;A (440)
124          retlw   0x7A            ;Bb
```

```
125        retlw 0x81              ;B
126        retlw 0x89              ;C6 // Midi Code 72
127        retlw 0x8F              ;Db
128        retlw 0x96              ;D
129        retlw 0x9C              ;Eb
130        retlw 0xA1              ;E
131        retlw 0xA7              ;F
132        retlw 0xAC              ;F#
133        retlw 0xB0              ;G
134        retlw 0xB5              ;Ab
135        retlw 0xB9              ;A (880)
136        retlw 0xBD              ;Bb
137        retlw 0xC1              ;B
138        retlw 0xC4              ;C7 // Midi Code 84
139        retlw 0xC8              ;Db
140        retlw 0xCB              ;D
141        retlw 0xCE              ;Eb
142        retlw 0xD1              ;E
143        retlw 0xD3              ;F
144        retlw 0xD6              ;F#
145        retlw 0xD8              ;G
146        retlw 0xDA              ;Ab
147        retlw 0xDC              ;A (1760)
148        retlw 0xDE              ;Bb
149        retlw 0xE0              ;
150        retlw 0xE2              ;C8 // Midi Code 96
151
152
153
154
155   ;Interrupt service - toggle the drive polarity to the sounder
156   ;Note that this does not preserve the status bits - be careful,
157   ;and that there is an assumption we are addressing bank 0.
158   toggle     movwf  temp
159          movf   pitch,W
160          movwf  TMR0
161       movf   PORTB,W
162          xorlw  0x0F
163          movwf  PORTB
164       bcf    INTCON,T0IF
165       movf   temp,w
166       retfie
167
168   ;Tune Tables
169   ;Must be on even byte boundary
170
171          org 0x0080
172
173   ; Tune 0 Data
174   ; Bach 'Badinerie' from Suite No 2
175   tune0  retlw 0x17   ;B
176      retlw 0x78   ;240
177      retlw 0x1A   ;D
178      retlw 0x3C   ;120
179      retlw 0x17   ;B
180      retlw 0x3C   ;120
181      retlw 0x12   ;F#
182      retlw 0x78   ;240
183      retlw 0x17   ;B
184      retlw 0x3C   ;120
185      retlw 0x12   ;F#
186      retlw 0x3C   ;120
```

```
187    retlw 0x0E   ;D
188    retlw 0x78   ;240
189    retlw 0x12   ;F#
190    retlw 0x3C   ;120
191    retlw 0x0E   ;D
192    retlw 0x3C   ;120
193    retlw 0x0B   ;B
194    retlw 0xF0   ;480
195    retlw 0x06   ;F#
196    retlw 0x3C   ;120
197    retlw 0x0B   ;B
198    retlw 0x3C   ;120
199    retlw 0x0E   ;D
200    retlw 0x3C   ;120
201    retlw 0x0B   ;B
202    retlw 0x3C   ;120
203    retlw 0x0D   ;C#
204    retlw 0x3C   ;120
205    retlw 0x0B   ;B
206    retlw 0x3C   ;120
207    retlw 0x0D   ;C#
208    retlw 0x3C   ;120
209    retlw 0x0B   ;B
210    retlw 0x3C   ;120
211    retlw 0x0A   ;A#
212    retlw 0x3C   ;120
213    retlw 0x0D   ;C#
214    retlw 0x3C   ;120
215    retlw 0x10   ;E
216    retlw 0x3C   ;120
217    retlw 0x0D   ;C#
218    retlw 0x3C   ;120
219    retlw 0x0E   ;D
220    retlw 0x78   ;240
221    retlw 0x0B   ;B
222    retlw 0x78   ;240
223    retlw 0x17   ;B
224    retlw 0x78   ;240
225    retlw 0x1A   ;D
226    retlw 0x3C   ;120
227    retlw 0x17   ;B
228    retlw 0x3C   ;120
229    retlw 0x12   ;F#
230    retlw 0x78   ;240
231    retlw 0x17   ;B
232    retlw 0x3C   ;120
233    retlw 0x12   ;F#
234    retlw 0x3C   ;120
235    retlw 0x0E   ;D
236    retlw 0x78   ;240
237    retlw 0x12   ;F#
238    retlw 0x3C   ;120
239    retlw 0x0E   ;D
240    retlw 0x3C   ;120
241    retlw 0x0B   ;B
242    retlw 0xF0   ;480
243    retlw 0x0E   ;D
244    retlw 0x78   ;240
245    retlw 0x0E   ;D
246    retlw 0x78   ;240
247    retlw 0x0E   ;D
248    retlw 0x78   ;240
```

```
249    retlw 0x0E   ;D
250    retlw 0x78   ;240
251    retlw 0x17   ;B
252    retlw 0x78   ;240
253    retlw 0x0E   ;D
254    retlw 0x78   ;240
255    retlw 0x10   ;E
256    retlw 0x3C   ;60
257    retlw 0x0E   ;D
258    retlw 0x3C   ;30
259    retlw 0x0D   ;C#
260    retlw 0x78   ;240
261    retlw 0x12   ;F#
262    retlw 0x78   ;240
263    retlw 0x12   ;F#
264    retlw 0x78   ;240
265    retlw 0x12   ;F#
266    retlw 0x78   ;240
267    retlw 0x12   ;F#
268    retlw 0x78   ;240
269    retlw 0x1A   ;D
270    retlw 0x78   ;240
271    retlw 0x12   ;F#
272    retlw 0x78   ;220
273    retlw 0x12   ;F#
274    retlw 0x3C   ;30
275    retlw 0x14   ;G#
276    retlw 0x3C   ;65
277    retlw 0x11   ;F
278    retlw 0x78   ;270
279    retlw 0x0D   ;C#
280    retlw 0x3C   ;120
281    retlw 0x12   ;F#
282    retlw 0x3C   ;120
283    retlw 0x15   ;A
284    retlw 0x3C   ;120
285    retlw 0x12   ;F#
286    retlw 0x3C   ;120
287    retlw 0x14   ;G#
288    retlw 0x3C   ;120
289    retlw 0x12   ;F#
290    retlw 0x3C   ;120
291    retlw 0x14   ;G#
292    retlw 0x3C   ;120
293    retlw 0x12   ;F#
294    retlw 0x3C   ;120
295    retlw 0x11   ;F
296    retlw 0x3C   ;120
297    retlw 0x14   ;G#
298    retlw 0x3C   ;120
299    retlw 0x17   ;B
300    retlw 0x3C   ;120
301    retlw 0x14   ;G#
302    retlw 0x3C   ;120
303    retlw 0x15   ;A
304    retlw 0x3C   ;120
305    retlw 0x14   ;G#
306    retlw 0x3C   ;120
307    retlw 0x15   ;A
308    retlw 0x3C   ;120
309    retlw 0x14   ;G#
310    retlw 0x3C   ;120
```

```
311    retlw 0x12   ;F#
312    retlw 0x3C   ;120
313    retlw 0x15   ;A
314    retlw 0x3C   ;120
315    retlw 0x12   ;F#
316    retlw 0x3C   ;120
317    retlw 0x11   ;F
318    retlw 0x3C   ;120
319    retlw 0x12   ;F#
320    retlw 0x3C   ;120
321    retlw 0x17   ;B
322    retlw 0x3C   ;120
323    retlw 0x12   ;F#
324    retlw 0x3C   ;120
325    retlw 0x11   ;F
326    retlw 0x39   ;115
327    retlw 0x12   ;F#
328    retlw 0x3C   ;120
329    retlw 0x19   ;C#
330    retlw 0x3E   ;125
331    retlw 0x12   ;F#
332    retlw 0x3C   ;120
333    retlw 0x11   ;F
334    retlw 0x3C   ;120
335    retlw 0x12   ;F#
336    retlw 0x39   ;115
337    retlw 0x1A   ;D
338    retlw 0x3E   ;125
339    retlw 0x12   ;F#
340    retlw 0x3C   ;120
341    retlw 0x11   ;F
342    retlw 0x3C   ;120
343    retlw 0x12   ;F#
344    retlw 0x3C   ;120
345    retlw 0x1A   ;D
346    retlw 0x3C   ;120
347    retlw 0x19   ;C#
348    retlw 0x3C   ;120
349    retlw 0x17   ;B
350    retlw 0x3C   ;120
351    retlw 0x19   ;C#
352    retlw 0x3C   ;120
353    retlw 0x15   ;A
354    retlw 0x3C   ;120
355    retlw 0x14   ;G#
356    retlw 0x3C   ;120
357    retlw 0x12   ;F#
358    retlw 0x3C   ;130
359    retlw 0x15   ;A
360    retlw 0x78   ;210
361    retlw 0x14   ;G#
362    retlw 0x3C
363    retlw 0x12   ;F#
364    retlw 0x3C   ;
365    retlw 0x12   ;F#
366    retlw 0xE0   ;480
367    retlw 0xFF
368    retlw 0
369
370  ; Tune 1
371  ; Mozart Eine Klein Nachtmusik
372
```

```
tune1

        retlw 0x13    ;G
        retlw 0x43    ;538
        retlw 0x40    ;REST
        retlw 0x4D    ;617
        retlw 0x0E    ;D
        retlw 0x18    ;193
        retlw 0x40    ;REST
        retlw 0x1D    ;232
        retlw 0x13    ;G
        retlw 0x3E    ;498
        retlw 0x40    ;REST
        retlw 0x48    ;582
        retlw 0x0E    ;D
        retlw 0x1B    ;218
        retlw 0x40    ;REST
        retlw 0x18    ;192
        retlw 0x13    ;G
        retlw 0x15    ;168
        retlw 0x40    ;REST
        retlw 0x19    ;207
        retlw 0x0E    ;D
        retlw 0x15    ;168
        retlw 0x40    ;REST
        retlw 0x15    ;172
        retlw 0x13    ;G
        retlw 0x17    ;188
        retlw 0x40    ;REST
        retlw 0x18    ;197
        retlw 0x17    ;B
        retlw 0x17    ;188
        retlw 0x40    ;REST
        retlw 0x1B    ;222
        retlw 0x1A    ;D
        retlw 0x3B    ;478
        retlw 0x40    ;REST
        retlw 0x83    ;1052
        retlw 0x18    ;C
        retlw 0x47    ;568
        retlw 0x40    ;REST
        retlw 0x4A    ;597
        retlw 0x15    ;A
        retlw 0x15    ;168
        retlw 0x40    ;REST
        retlw 0x1D    ;237
        retlw 0x18    ;C
        retlw 0x3C    ;483
        retlw 0x40    ;REST
        retlw 0x52    ;657
        retlw 0x15    ;A
        retlw 0x16    ;183
        retlw 0x40    ;REST
        retlw 0x16    ;177
        retlw 0x18    ;C
        retlw 0x1C    ;228
        retlw 0x40    ;REST
        retlw 0x12    ;147
        retlw 0x15    ;A
        retlw 0x16    ;183
        retlw 0x40    ;REST
```

```
435    retlw 0x18   ;197
436    retlw 0x12   ;F#
437    retlw 0x18   ;198
438    retlw 0x40   ;REST
439    retlw 0x14   ;167
440    retlw 0x15   ;A
441    retlw 0x1D   ;238
442    retlw 0x40   ;REST
443    retlw 0x18   ;192
444    retlw 0x0E   ;D
445    retlw 0x39   ;458
446    retlw 0x40   ;REST
447    retlw 0x82   ;1042
448    retlw 0x13   ;G
449    retlw 0x27   ;313
450    retlw 0x40   ;REST
451    retlw 0x3E   ;497
452    retlw 0x13   ;G
453    retlw 0x6B   ;858
454    retlw 0x40   ;REST
455    retlw 0x1E   ;242
456    retlw 0x17   ;B
457    retlw 0x31   ;395
458    retlw 0x15   ;A
459    retlw 0x21   ;268
460    retlw 0x40   ;REST
461    retlw 0x07   ;57
462    retlw 0x13   ;G
463    retlw 0x16   ;183
464    retlw 0x40   ;REST
465    retlw 0x18   ;197
466    retlw 0x13   ;G
467    retlw 0x16   ;180
468    retlw 0x15   ;A
469    retlw 0x13   ;155
470    retlw 0x13   ;G
471    retlw 0x12   ;145
472    retlw 0x12   ;F#
473    retlw 0x10   ;133
474    retlw 0x40   ;REST
475    retlw 0x22   ;272
476    retlw 0x12   ;F#
477    retlw 0x68   ;833
478    retlw 0x40   ;REST
479    retlw 0x1F   ;252
480    retlw 0x15   ;A
481    retlw 0x2C   ;355
482    retlw 0x18   ;C
483    retlw 0x1B   ;218
484    retlw 0x40   ;REST
485    retlw 0x14   ;162
486    retlw 0x12   ;F#
487    retlw 0x13   ;158
488    retlw 0x40   ;REST
489    retlw 0x19   ;202
490    retlw 0x15   ;A
491    retlw 0x2F   ;380
492    retlw 0x13   ;G
493    retlw 0x13   ;158
494    retlw 0x40   ;REST
495    retlw 0x22   ;272
496    retlw 0x13   ;G
```

```
497    retlw 0x78    ;963
498    retlw 0x40    ;REST
499    retlw 0x1D    ;237
500    retlw 0x17    ;B
501    retlw 0x2A    ;343
502    retlw 0x40    ;REST
503    retlw 0x03    ;27
504    retlw 0x15    ;A
505    retlw 0x22    ;278
506    retlw 0x40    ;REST
507    retlw 0x0C    ;102
508    retlw 0x13    ;G
509    retlw 0x16    ;183
510    retlw 0x40    ;REST
511    retlw 0x1A    ;212
512    retlw 0x13    ;G
513    retlw 0x19    ;205
514    retlw 0x15    ;A
515    retlw 0x12    ;150
516    retlw 0x13    ;G
517    retlw 0x11    ;140
518    retlw 0x12    ;F#
519    retlw 0x12    ;148
520    retlw 0x40    ;REST
521    retlw 0x1F    ;252
522    retlw 0x12    ;F#
523    retlw 0x5B    ;728
524    retlw 0x40    ;REST
525    retlw 0x27    ;317
526    retlw 0x15    ;A
527    retlw 0x2D    ;365
528    retlw 0x18    ;C
529    retlw 0x1A    ;208
530    retlw 0x40    ;REST
531    retlw 0x13    ;152
532    retlw 0x12    ;F#
533    retlw 0x14    ;163
534    retlw 0x40    ;REST
535    retlw 0x19    ;207
536    retlw 0x13    ;G
537    retlw 0x14    ;163
538    retlw 0x40    ;REST
539    retlw 0x19    ;207
540    retlw 0x13    ;G
541    retlw 0x13    ;153
542    retlw 0x40    ;REST
543    retlw 0x1A    ;212
544    retlw 0x13    ;G
545    retlw 0x1C    ;225
546    retlw 0x12    ;F#
547    retlw 0x15    ;175
548    retlw 0x10    ;E
549    retlw 0x1E    ;240
550    retlw 0x12    ;F#
551    retlw 0x12    ;150
552    retlw 0x13    ;G
553    retlw 0x18    ;198
554    retlw 0x40    ;REST
555    retlw 0x16    ;177
556    retlw 0x13    ;G
557    retlw 0x10    ;128
558    retlw 0x40    ;REST
```

```
559    retlw 0x23    ;287
560    retlw 0x17    ;B
561    retlw 0x17    ;190
562    retlw 0x15    ;A
563    retlw 0x0D    ;105
564    retlw 0x13    ;G
565    retlw 0x1F    ;255
566    retlw 0x15    ;A
567    retlw 0x0F    ;125
568    retlw 0x17    ;B
569    retlw 0x18    ;193
570    retlw 0x40    ;REST
571    retlw 0x1A    ;212
572    retlw 0x17    ;B
573    retlw 0x10    ;128
574    retlw 0x40    ;REST
575    retlw 0x20    ;257
576    retlw 0x1A    ;D
577    retlw 0x19    ;200
578    retlw 0x18    ;C
579    retlw 0x0F    ;125
580    retlw 0x17    ;B
581    retlw 0x1F    ;250
582    retlw 0x18    ;C
583    retlw 0x10    ;135
584    retlw 0x1A    ;D
585    retlw 0x59    ;713
586    retlw 0x40    ;REST
587    retlw 0x7B    ;987
588    retlw 0x0E    ;D
589    retlw 0xBA    ;1495
590    retlw 0x10    ;E
591    retlw 0x7C    ;998
592    retlw 0x40    ;REST
593    retlw 0x48    ;577
594    retlw 0x0E    ;D
595    retlw 0x19    ;205
596    retlw 0x0C    ;C
597    retlw 0x16    ;183
598    retlw 0x40    ;REST
599    retlw 0x31    ;397
600    retlw 0x0C    ;C
601    retlw 0x14    ;163
602    retlw 0x40    ;REST
603    retlw 0x4C    ;612
604    retlw 0x0C    ;C
605    retlw 0x17    ;190
606    retlw 0x0B    ;B
607    retlw 0x12    ;148
608    retlw 0x40    ;REST
609    retlw 0x39    ;457
610    retlw 0x0B    ;B
611    retlw 0x13    ;153
612    retlw 0x40    ;REST
613    retlw 0x43    ;537
614    retlw 0x0B    ;B
615    retlw 0x17    ;190
616    retlw 0x09    ;A
617    retlw 0x13    ;153
618    retlw 0x40    ;REST
619    retlw 0x37    ;447
620    retlw 0x09    ;A
```

```
621    retlw 0x16   ;178
622    retlw 0x40   ;REST
623    retlw 0x41   ;522
624    retlw 0x07   ;G
625    retlw 0x2E   ;375
626    retlw 0x06   ;F#
627    retlw 0x33   ;410
628    retlw 0x04   ;E
629    retlw 0x2D   ;363
630    retlw 0x40   ;REST
631    retlw 0x01   ;12
632    retlw 0x06   ;F#
633    retlw 0x35   ;428
634    retlw 0x40   ;REST
635    retlw 0x02   ;22
636    retlw 0x07   ;G
637    retlw 0x16   ;178
638    retlw 0x40   ;REST
639    retlw 0x50   ;642
640    retlw 0x09   ;A
641    retlw 0x10   ;133
642    retlw 0x40   ;REST
643    retlw 0x4C   ;612
644    retlw 0x0B   ;B
645    retlw 0x0E   ;113
646    retlw 0x40   ;REST
647    retlw 0xB4   ;1442
648    retlw 0x0E   ;D
649    retlw 0xBA   ;1495
650    retlw 0x10   ;E
651    retlw 0x82   ;1043
652    retlw 0x40   ;REST
653    retlw 0x39   ;462
654    retlw 0x0E   ;D
655    retlw 0x2D   ;360
656    retlw 0x0C   ;C
657    retlw 0x16   ;178
658    retlw 0x40   ;REST
659    retlw 0x1E   ;242
660    retlw 0x0C   ;C
661    retlw 0x10   ;128
662    retlw 0x40   ;REST
663    retlw 0x1F   ;252
664    retlw 0x0C   ;C
665    retlw 0x10   ;133
666    retlw 0x40   ;REST
667    retlw 0x1C   ;227
668    retlw 0x0C   ;C
669    retlw 0x2C   ;355
670    retlw 0x0B   ;B
671    retlw 0x13   ;153
672    retlw 0x40   ;REST
673    retlw 0x1E   ;247
674    retlw 0x0B   ;B
675    retlw 0x0D   ;108
676    retlw 0x40   ;REST
677    retlw 0x23   ;282
678    retlw 0x0B   ;B
679    retlw 0x10   ;133
680    retlw 0x40   ;REST
681    retlw 0x1E   ;247
682    retlw 0x0B   ;B
```

```
683        retlw 0x2F    ;380
684        retlw 0x09    ;A
685        retlw 0x13    ;158
686        retlw 0x40    ;REST
687        retlw 0x1B    ;222
688        retlw 0x09    ;A
689        retlw 0x13    ;153
690        retlw 0x40    ;REST
691        retlw 0x1E    ;242
692        retlw 0x09    ;A
693        retlw 0x10    ;128
694        retlw 0x40    ;REST
695        retlw 0x23    ;282
696        retlw 0x07    ;G
697        retlw 0x2B    ;350
698        retlw 0x06    ;F#
699        retlw 0x2F    ;380
700        retlw 0x04    ;E
701        retlw 0x31    ;395
702        retlw 0x06    ;F#
703        retlw 0x35    ;428
704        retlw 0x40    ;REST
705        retlw 0x05    ;47
706        retlw 0x07    ;G
707        retlw 0xB4    ;468
708        retlw 0xFF


           END
```