APPLICATION OPERATION:

This application generates a melody. It was a little bit difficult to place the tables because of the program counter's 8 bits, but I found a way to do this. There are 8 melodies programmed in the PIC12C509 device. When you push the button a melody is played. Every melody finishes with "retlw 0x0" which is the mark to stop playing. When the button is pressed again the next melody is played.

There are two software generators of 7.5Hz and 100KHz. The first defines the continuation of the played note and the second gives the frequency of the played note.

The 7.5Hz generator uses TMR0 and two flags (Flag.0 and Flag.1) to make the frequency.

The 100KHz generator uses 10 instruction cycles to make the frequency.

Here is a table of the used frequencies:

<table>
<thead>
<tr>
<th>Note</th>
<th>Code 0x01</th>
<th>Code 0x06</th>
<th>Code 0x33</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>0xCA</td>
<td>0x65</td>
<td>0x33</td>
</tr>
<tr>
<td>A#</td>
<td>0xD6</td>
<td>0x6B</td>
<td>0x36</td>
</tr>
<tr>
<td>A</td>
<td>0xE4</td>
<td>0x72</td>
<td>0x39</td>
</tr>
<tr>
<td>G#</td>
<td>0xF0</td>
<td>0x78</td>
<td>0x3C</td>
</tr>
<tr>
<td>G</td>
<td>0xFF</td>
<td>0x80</td>
<td>0x40</td>
</tr>
<tr>
<td>F#</td>
<td>0x87</td>
<td>0x44</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>0x8F</td>
<td>0x48</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>0x98</td>
<td>0x4C</td>
<td></td>
</tr>
<tr>
<td>D#</td>
<td>0xA1</td>
<td>0x50</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>0xAA</td>
<td>0x55</td>
<td></td>
</tr>
<tr>
<td>C#</td>
<td>0xB4</td>
<td>0x5A</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0xBF</td>
<td>0x60</td>
<td></td>
</tr>
</tbody>
</table>

code 0x01 is used for pause

code 0x00 is used for stop mark

Flow Chart:

begin
  Waiting for button press
  Increment the melody counter
  melody counter = 0
  note counter = 0
  label: get note (Melody counter, note counter)
  increment note counter
  goto label
  Is the note 0? no yes
  goto begin
  Is the note 1? yes no
  play pause
  play note
  increment note counter
goto label
Graphical hardware representation:

Bill of Materials (BOM):

<table>
<thead>
<tr>
<th>Part#</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC12C509</td>
<td>MICROCHIP</td>
</tr>
<tr>
<td>Switch</td>
<td></td>
</tr>
<tr>
<td>Speaker</td>
<td></td>
</tr>
<tr>
<td>Resistor 1K</td>
<td></td>
</tr>
<tr>
<td>KT805AM</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX A: SOURCE CODE

;****************************************************************
; MLDY509.ASM
;****************************************************************

LIST p=12C509

#include ".\inc\p12c509.inc"

__config _WDT_OFF & _IntRC_OSC & _MCLRE_OFF & _CP_OFF

RAM equ 0x07 ;Begining of RAM

NumSongs equ .8

Out equ GPIO
Speaker equ 2
In equ GPIO
Btn equ 0

cblock RAM

Counter
Flag
Dta
Melody
Note
Count1
Count2

endcode

org 0x00

goto begin

ProgLp:

goto ProgLoop

;-------------------------------------------

GetNote:

bcf STATUS,5
bcf STATUS,C
rlf Melody,W
addwf PCL,F

bcf STATUS,5

goto Melody1

bcf STATUS,5

goto Melody2

bcf STATUS,5

goto Melody3

bcf STATUS,5

goto Melody4

bsf STATUS,5

goto Melody5

bsf STATUS,5

goto Melody6

bsf STATUS,5

goto Melody7
Discrete Logic Replacement

bsf STATUS, 5
goto Melody8

; ----------------------------------------
; PINCO
; ----------------------------------------

Melody1:
       movf Note, W
       addwf PCL, F
       retlw 0xCA
       retlw 0xBF
       retlw 0x01
       retlw 0x01
       retlw 0x01
       retlw 0xAA
       retlw 0xA1
       retlw 0x01
       retlw 0x01
       retlw 0x01
       retlw 0x01
       retlw 0x01
       retlw 0x78
       retlw 0x080
       retlw 0x01
       retlw 0xBF
       retlw 0xA1
       retlw 0x01
       retlw 0x87
       retlw 0x87
       retlw 0x87
       retlw 0x87
       retlw 0x87
       retlw 0x87
       retlw 0x01
       retlw 0x01
       retlw 0x01
       retlw 0x87
       retlw 0x8F
       retlw 0xA1
       retlw 0xBF
       retlw 0xD6
       retlw 0xBF
       retlw 0xBF
       retlw 0xBF
       retlw 0xBF
       retlw 0xBF
       retlw 0xBF
       retlw 0xBF
       retlw 0xBF
       retlw 0xBF
       retlw 0x01

; ----------------------------------------
; MENDELSON
; ----------------------------------------

Melody2:
       movf Note, W
       addwf PCL, F
       retlw 0x48
       retlw 0x48
       retlw 0x48
       retlw 0x48
       retlw 0x48
retlw 0x4C
retlw 0x4C
retlw 0x4C
retlw 0x4C
retlw 0x65
retlw 0x55
retlw 0x55
retlw 0x60
retlw 0x60
retlw 0x6B
retlw 0x6B
retlw 0x80
retlw 0x80
retlw 0x8F
retlw 0x8F
retlw 0x98
retlw 0x8F
retlw 0x8F
retlw 0x8F
retlw 0x8F
retlw 0x8F
retlw 0x60
retlw 0x8F
retlw 0x60
retlw 0x72
retlw 0x72
retlw 0x8F
retlw 0x72
retlw 0x72
retlw 0x8F
retlw 0x72
retlw 0x72
retlw 0x8F
retlw 0x72
retlw 0x72
retlw 0x48
retlw 0x48
retlw 0x48
retlw 0x48
retlw 0x4C
retlw 0x4C
retlw 0x4C
retlw 0x4C
retlw 0x65
retlw 0x65
retlw 0x55
retlw 0x55
retlw 0x60
retlw 0x60
retlw 0x6B
retlw 0x6B
retlw 0x6B
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x8F
retlw 0x8F
retlw 0x98
retlw 0x8F
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x80
retlw 0x80
retlw 0x72
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x8F
retlw 0x8F
retlw 0x8F
retlw 0x8F
retlw 0x0

;---------------------------------------------------------
; A MELODY I
;---------------------------------------------------------
Melody3:

```assembly
movf Note, W
addwf PCL, F
retlw 0x80
retlw 0x80
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x60
retlw 0x60
retlw 0x65
retlw 0x65
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x60
retlw 0x60
retlw 0x65
retlw 0x65
retlw 0x60
retlw 0x60
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x80
retlw 0x80
retlw 0x65
retlw 0x65
retlw 0x60
retlw 0x60
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x60
retlw 0x60
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x80
retlw 0x80
retlw 0x65
retlw 0x65
retlw 0x60
retlw 0x60
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x0
```

; ------------------------------
; ENGLISH WALTZ
; ------------------------------

Melody4:

```assembly
movf Note, W
addwf PCL, F
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x4C
```
retlw 0x4C
retlw 0x4C
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x4C
retlw 0x4C
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x60
retlw 0x55
retlw 0x55
retlw 0x55
retlw 0x0

org 0x100

begin:
movwf OSCCAL ;calibrating the internal oscillator
clrf GPIO

movlw B'001111011'
TRIS GPIO

movlw B'10000111'
OPTION

clrf Melody

main:

btfsc In, Btn
goto $-1

clrf Count1
movlw .52
movwf Count2

Loop

decfsz Count1, F
goto $-1

decfsz Count2, F
goto Loop

btfsc In, Btn
goto main
btfsc In, Btn
goto main

incf Melody, F
movlw NumSongs
subwf Melody, W
btfsc STATUS, C
clrf Melody

clrf Note

Loop1:
call GetNote
movwf Dta

movf Dta, W
movwf Counter
xorlw 1
btfss STATUS, Z
bsf Out, Speaker ; sets the output to high

; gallery

ProgLoop1:

movf Dta, W
movwf Counter
xorlw 1
btfss STATUS, Z
bsf Out, Speaker ; sets the output to high

100KHz (10 us) generator

ProgLoop1:
btfsc TMR0,7
bsf Flag,0

btfss Flag,0
goto ProgDelay1

movf TMR0,W
btfsc STATUS,Z
bsf Flag,1

BackProgDelay1:

decfsz Counter,F
goto ProgLoop1
goto Prog2

ProgDelay1:
goto BackProgDelay1
;
;--------------------------------------

Prog2:
movf Data,W
movwf Counter

bcf Out,Speaker ;sets the output to low

ProgLoop2:

btfsc TMR0,7
bsf Flag,0

btfss Flag,0
goto ProgDelay2

movf TMR0,W
btfsc STATUS,Z
bsf Flag,1

BackProgDelay2:

decfsz Counter,F
goto ProgLoop2
goto ProgLoop3

ProgDelay2:
goto BackProgDelay2

ProgLoop3

btfss Flag,1
goto ProgLoop

btfsb Flag,7
return
clf Flag
bsf Flag,7
goto ProgLoop

org 0x200

;--------------------------------------------------------------------------
;
SLEEP BABE SLEEP
;--------------------------------------------------------------------------

Melody5:
movf Note, W
addwf PCL, F
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x87
retlw 0x87
retlw 0x87
retlw 0x87
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0xAA
retlw 0xAA
retlw 0x87
retlw 0x87
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x65
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x80
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x72
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x87
retlw 0x87
retlw 0x87
retlw 0x87
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0x87
retlw 0x87
retlw 0x87
retlw 0x87
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0xAA
retlw 0x0

;---------------------------------------------------------
; A MELODY II
;---------------------------------------------------------
Melody6:
    movf Note,W
    addwf PCL, F
    retlw 0x84
    retlw 0xB4
    retlw 0xB4
    retlw 0xB4
    retlw 0x8F
    retlw 0x8F
    retlw 0x78
    retlw 0x78
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x50
    retlw 0x50
    retlw 0x78
    retlw 0x78
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x6B
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x48
    retlw 0x78
    retlw 0x80
    retlw 0x78
    retlw 0x50
    retlw 0x78
    retlw 0x80
    retlw 0x78
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
    retlw 0x5A
retlw 0x0

;--------------------------------------
; FINAL COUNTDOWN
;--------------------------------------
Melody7:
    movf Note, W
    addwf PCL, F
    retlw 0x4C
    retlw 0x55
    retlw 0x4C
    retlw 0x4C
    retlw 0x4C
    retlw 0x4C
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
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    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x4C
    retlw 0x4C
    retlw 0x4C
    retlw 0x55
    retlw 0x55
    retlw 0x55
    retlw 0x55
    retlw 0x55
    retlw 0x55
    retlw 0x01
    retlw 0x01
    retlw 0x48
    retlw 0x4C
    retlw 0x48
    retlw 0x48
    retlw 0x48
    retlw 0x48
    retlw 0x48
    retlw 0x48
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x72
    retlw 0x4C
    retlw 0x55
    retlw 0x4C
    retlw 0x4C
    retlw 0x4C
    retlw 0x60
    retlw 0x60
    retlw 0x60
    retlw 0x065
    retlw 0x065
    retlw 0x55
    retlw 0x55
    retlw 0x60
    retlw 0x60
    retlw 0x60
    retlw 0x60
    retlw 0x60
    retlw 0x0
;---------------------------------------------------------
;    IN THE MORNING
;---------------------------------------------------------
Melody8:

    movf  Note,W
    addwf  PCL,F
    retlw  0x98
    retlw  0x98
    retlw  0x87
    retlw  0x87
    retlw  0x78
    retlw  0x78
    retlw  0x98
    retlw  0x98
    retlw  0x98
    retlw  0x98
    retlw  0x87
    retlw  0x87
    retlw  0x78
    retlw  0x78
    retlw  0x72
    retlw  0x72
    retlw  0x65
    retlw  0x65
    retlw  0x65
    retlw  0x65
    retlw  0x65
    retlw  0x65
    retlw  0x65
    retlw  0x65
    retlw  0x5A
    retlw  0x65
    retlw  0x72
    retlw  0x78
    retlw  0x78
    retlw  0x98
    retlw  0x98
    retlw  0x98
    retlw  0x98
    retlw  0x98
    retlw  0x98
    retlw  0xA1
    retlw  0xA1
    retlw  0xA1
    retlw  0xA1
    retlw  0xA1
    retlw  0xA1
    retlw  0xA1
    retlw  0xA1
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x98
retlw 0x0

END