```
                                ===== Parallax PIC16C5x Assembler  v1.7 =====


      1                         ;*
      2                         ;* Sutekh Avatar Version 2.0
      3                         ;*
      4
      5                         ;*
      6                         ;*      equates
      7                         ;*
      8
      9     =0052               pass3   = 52H   ; password = 52321242
     10     =0032               pass2   = 32H
     11     =0012               pass1   = 12H
     12     =0042               pass0   = 42H
     13                         ;
     14     =0008               t1c_hi  = 8     ; tone constant registers
     15     =0009               t1c_lo  = 9
     16     =000A               t2c_hi  = 10
     17     =000B               t2c_lo  = 11
     18                         ;
     19     =000C               dur_hi  = 12    ; tone duration registers
     20     =000D               dur_lo  = 13
     21                         ;
     22     =000E               ph1_hi  = 14    ; phase accumulation registers
     23     =000F               ph1_lo  = 15
     24     =0010               ph2_hi  = 16
     25     =0011               ph2_lo  = 17
     26                         ;
     27     =0012               pwreg0  = 18    ; circulating pw digit regiters
     28     =0013               pwreg1  = 19
     29     =0014               pwreg2  = 20
     30     =0015               pwreg3  = 21
     31                         ;
     32     =0016               pulse   = 22    ; pulse counting register
     33     =0017               secure  = 23    ; holds security value
     34     =0018               digit   = 24    ; holds current digit
     35                         ;
     36     =001E               temp    = 30    ; temporary registers
     37     =001F               scratch = 31
     38                         ;
     39     =0006               dac     = rb            ; DAC is portb
     40                         ;
     41     =0005               buttona = ra.0          ; button constants
     42     =0025               buttonb = ra.1
     43     =0045               buttonc = ra.2
     44     =0065               buttond = ra.3
     45                         ;
     46     =004C               sine0   = 76            ; sine table constants
     47     =005F               sine1   = 95            ;
     48     =006F               sine2   = 111           ; this sine table is cal
culated for use
     49     =007A               sine3   = 122           ; with an emitter follow
er amplifier
     50     =007F               sine4   = 127           ; the table includes a d
c offset to insure
     51     =007A               sine5   = 122           ; that there will be no
clipping of the wave
     52     =006F               sine6   = 111
     53     =005F               sine7   = 95
     54     =004C               sine8   = 76
     55     =0039               sine9   = 57
     56     =0029               sine10  = 41
     57     =001E               sine11  = 30
     58     =001A               sine12  = 26
     59     =001E               sine13  = 30
     60     =0029               sine14  = 41
     61     =0039               sine15  = 57
     62                         ;
     63     =00A5               secval  = 0A5H
     64     =0000               nil     = 0
     65                         ;
     66     =0016               red1_hi = 016H          ; tone constants and dura
tions
     67     =00DB               red1_lo = 0DBH
     68     =001D               red2_hi = 01DH
     69     =0094               red2_lo = 094H
     70     =0005               ahi     = 005H          ; 440Hz
     71     =00EA               alo     = 0EAH
     72     =001B               chi     = 01BH          ; 2048Hz
     73     =0089               clo     = 089H
     74     =0022               ehi     = 022H          ; 2560Hz
     75     =006C               elo     = 06CH
     76     =0029               ghi     = 029H          ; 3072Hz
     77     =004E               glo     = 04EH
     78                         ;
     79     =0002               _15mshi = 002H          ; +1 added
     80     =001E               _15mslo = 01EH
     81     =0003               _33mshi = 003H          ; +1 added
     82     =0074               _33mslo = 074H
     83     =0005               _66mshi = 005H          ; +1 added
     84     =00E8               _66mslo = 0E8H
     85     =0026               _500msh = 026H          ; +1 added
     86     =0027               _500msl = 027H
     87     =0095               _2sechi = 095H          ; +1 added
     88     =00C0               _2seclo = 0C0H
     89
     90                         ;*************
     91                         ;* chip info *
     92                         ;*************
     93
     94     000-                        device  PIC16C54, XT_OSC, WDT_ON, PROTECT
_ON
     95     000-                        id      7777H
     96     1FF- A89                    reset   wake_up
     97
     98                         ;*****************
     99                         ;* start of code *
    100                         ;*****************
    101
    102     000-                        org     0
    103     000- 003                    sleep
    104
    105                         ;***************
    106                         ;* subroutines *
    107                         ;***************
    108
    109
    110     001- 000            twotone nop                     ; generate two to
nes (loop time = 47 cycles)
    111     002- 000                    nop                     ; at Fosc=3.57954
5 Hz, T=52.520641 uS.
    112
    113     003- 004            tt      clrwdt                  ; clear wdt
    114
    115     004- 209                    movf    t1c_lo, w       ; advance phase f
or tone1
    116     005- 1EF                    addwf   ph1_lo
```

```
   117      006- 208
   118      007- 603
   119      008- 288
   120      009- 1EE
   121
   122      00A- 20B
for tone2
   123      00B- 1F1
   124      00C- 20A
   125      00D- 603
   126      00E- 28A
   127      00F- 1F0
   128
   129      010- 20E
udes
   130      011- 91C
   131      012- 03F
   132      013- 210
   133      014- 91C
   134      015- 1DF
   135      016- 026
   136
   137      017- 2ED
y values
   138      018- A01
   139      019- 2EC
   140      01A- A03
make up for lost cycles
   141
   142      01B- 800
   143
   144      01C- 03E
vert from phase angle to
   145      01D- 39E
tude value
   146      01E- E0F
   147      01F- 03E
   148      020- C23
   149      021- 1DE
   150      022- 022
   151
   152      023- 84C
table
   153      024- 85F
   154      025- 86F
   155      026- 87A
   156      027- 87F
   157      028- 87A
   158      029- 86F
   159      02A- 85F
   160      02B- 84C
   161      02C- 839
   162      02D- 829
   163      02E- 81E
   164      02F- 81A
   165      030- 81E
   166      031- 829
   167      032- 839
   168
   169      033- C05
tandard pitch
   170      034- 028
   171      035- CEA
   172      036- 029
```

```
                movf    t1c_hi, w
                btfsc   c
                incf    t1c_hi, w
                addwf   ph1_hi

                movf    t2c_lo, w       ; advance phase

                addwf   ph2_lo
                movf    t2c_hi, w
                btfsc   c
                incf    t2c_hi, w
                addwf   ph2_hi

                movf    ph1_hi, w       ; look up amplit

                call    ph2sin
                movwf   scratch
                movf    ph2_hi, w
                call    ph2sin
                addwf   scratch, w      ; sum waves
                movwf   dac             ; ship to DAC

                decfsz  dur_lo          ; decrement dela

                goto    twotone
                decfsz  dur_hi
                goto    tt              ; jump short to


                retlw   nil

ph2sin          movwf   temp            ; routine to con

                swapf   temp, w         ; waveform magni

                andlw   0FH
                movwf   temp
                movlw   table
                addwf   temp, w
                movwf   pc              ; computed goto

table           retlw   sine0           ; return lookup

                retlw   sine1
                retlw   sine2
                retlw   sine3
                retlw   sine4
                retlw   sine5
                retlw   sine6
                retlw   sine7
                retlw   sine8
                retlw   sine9
                retlw   sine10
                retlw   sine11
                retlw   sine12
                retlw   sine13
                retlw   sine14
                retlw   sine15

su_A            movlw   ahi             ; set up for A s

                movwf   t1c_hi
                movlw   alo
                movwf   t1c_lo
```

```
   173      037- 06A
                clrf    t2c_hi          ; only a single t
one
   174      038- 06B
                clrf    t2c_lo
   175      039- 800
                retlw   nil
   176
   177      03A- C1B
su_C            movlw   chi             ; set up for C
   178      03B- 028
                movwf   t1c_hi
   179      03C- C89
                movlw   clo
   180      03D- 029
                movwf   t1c_lo
   181      03E- 06A
                clrf    t2c_hi          ; only a single t
one
   182      03F- 06B
                clrf    t2c_lo
   183      040- 800
                retlw   nil
   184
   185      041- C22
su_E            movlw   ehi             ; set up for E
   186      042- 028
                movwf   t1c_hi
   187      043- C6C
                movlw   elo
   188      044- 029
                movwf   t1c_lo
   189      045- 06A
                clrf    t2c_hi          ; only a single t
one
   190      046- 06B
                clrf    t2c_lo
   191      047- 800
                retlw   nil
   192
   193      048- C29
su_G            movlw   ghi             ; set up for G
   194      049- 028
                movwf   t1c_hi
   195      04A- C4E
                movlw   glo
   196      04B- 029
                movwf   t1c_lo
   197      04C- 06A
                clrf    t2c_hi          ; only a single t
one
   198      04D- 06B
                clrf    t2c_lo
   199      04E- 800
                retlw   nil
   200
   201      04F- C1B
su_3rd          movlw   chi             ; set up to play
a major third interval
   202      050- 028
                movwf   t1c_hi
   203      051- C89
                movlw   clo
   204      052- 029
                movwf   t1c_lo
   205      053- C22
                movlw   ehi
   206      054- 02A
                movwf   t2c_hi
   207      055- C6C
                movlw   elo
   208      056- 02B
                movwf   t2c_lo
   209      057- 800
                retlw   nil
   210
   211      058- C1B
su_5th          movlw   chi             ; set up a fifth
interval
   212      059- 028
                movwf   t1c_hi
   213      05A- C89
                movlw   clo
   214      05B- 029
                movwf   t1c_lo
   215      05C- C29
                movlw   ghi
   216      05D- 02A
                movwf   t2c_hi
   217      05E- C4E
                movlw   glo
   218      05F- 02B
                movwf   t2c_lo
   219      060- 800
                retlw   nil
   220
   221      061- 003
                sleep                   ; prevent fritzin
g cpu from getting past
   222
   223      062- C16
su_red          movlw   red1_hi         ; set up red box
tones
   224      063- 028
                movwf   t1c_hi
   225      064- CDB
                movlw   red1_lo
   226      065- 029
                movwf   t1c_lo
   227      066- C1D
                movlw   red2_hi
   228      067- 02A
                movwf   t2c_hi
```

```
   229      068- C94                movlw   red2_lo
   230      069- 02B                movwf   t2c_lo
   231      06A- 800                retlw   nil
   232
   233      06B- 068
ant register
   234      06C- 069
freq = 0
   235      06D- 06A
   236      06E- 06B
   237      06F- 800
   238
   239      070- C02
   240      071- 02C
   241      072- C1E
   242      073- 02D
   243      074- A01
   244
   245      075- C03
   246      076- 02C
   247      077- C74
   248      078- 02D
   249      079- A01
   250
   251      07A- C05
   252      07B- 02C
   253      07C- CE8
   254      07D- 02D
   255      07E- A01
   256
   257      07F- C26
   258      080- 02C
   259      081- C27
   260      082- 02D
   261      083- A01
   262
   263      084- C95
   264      085- 02C
   265      086- CC0
   266      087- 02D
   267      088- A01
   268
   269
   270
   271
   272
   273
   274
   275
   276      089- 040
   277      08A- 002
   278
   279      08B- 645
   280      08C- AE1
   281      08D- 665
   282      08E- AE6
   283
   284      08F- 217
   285      090- FA5
   286      091- 743
   287      092- ACF
   288
   289      093- 605
   290      094- A98

su_wait clrf    t1c_hi          ; zero out const
        clrf    t1c_lo          ; no tones e.g.
        clrf    t2c_hi
        clrf    t2c_lo
        retlw   nil

do_15   movlw   _15mshi
        movwf   dur_hi
        movlw   _15mslo
        movwf   dur_lo
        goto    twotone

do_33   movlw   _33mshi
        movwf   dur_hi
        movlw   _33mslo
        movwf   dur_lo
        goto    twotone

do_66   movlw   _66mshi
        movwf   dur_hi
        movlw   _66mslo
        movwf   dur_lo
        goto    twotone

do_500  movlw   _500msh
        movwf   dur_hi
        movlw   _500msl
        movwf   dur_lo
        goto    twotone

do_2sec movlw   _2sechi
        movwf   dur_hi
        movlw   _2seclo
        movwf   dur_lo
        goto    twotone


;***********
;*         *
;* wake up *
;*         *
;***********

wake_up clrw
        option

        btfsc   buttonc
        goto    test1
        btfsc   buttond
        goto    test2

        movf    secure, w
        xorlw   secval
        btfss   z
        goto    armed

unarmed btfsc   buttona
        goto    bump
```

```
   291      095- 625                btfsc   buttonb
   292      096- A9C                goto    enter
   293      097- 003                sleep
   294
   295      098- 2B8
   296      099- 94F
   297      09A- 970
   298      09B- 003
   299
   300      09C- C04
r 4 clicks
   301      09D- 03E
   302      09E- 372
   303      09F- 373
   304      0A0- 374
   305      0A1- 375
   306      0A2- 2FE
   307      0A3- A9E
   308
   309      0A4- 212
and digit
   310      0A5- EF0
   311      0A6- 178
   312      0A7- 078
   313      0A8- 800
   314
   315      0A9- C04
risons
   316      0AA- 03E
   317
   318      0AB- 212
   319      0AC- F42
   320      0AD- 643
   321      0AE- 0FE
   322      0AF- 213
   323      0B0- F12
   324      0B1- 643
   325      0B2- 0FE
   326      0B3- 214
   327      0B4- F32
   328      0B5- 643
   329      0B6- 0FE
   330      0B7- 215
   331      0B8- F52
   332      0B9- 643
   333      0BA- 0FE
   334      0BB- 743
   335      0BC- ABE
   336      0BD- AC2
   337
   338      0BE- 077
register
   339      0BF- 958
   340      0C0- 970
   341      0C1- 003
   342
   343      0C2- CA5
   344      0C3- 037
   345      0C4- 93A
   346      0C5- 97A
   347      0C6- 96B
   348      0C7- 97A
   349      0C8- 941
   350      0C9- 97A

bump    incf    digit           ; increment
        call    su_3rd
        call    do_15
        sleep

enter   movlw   4               ; rotate pw buffe
        movwf   temp
rl      rlf     pwreg0
        rlf     pwreg1
        rlf     pwreg2
        rlf     pwreg3
        decfsz  temp
        goto    rl

        movf    pwreg0,w        ; push in right h
        andlw   0F0H
        andwf   digit
        clrf    digit
        retlw   nil

chkpw   movlw   4               ; make four compa
        movwf   temp

        movf    pwreg0,w
        xorlw   pass0
        btfsc   z
        decf    temp
        movf    pwreg1,w
        xorlw   pass1
        btfsc   z
        decf    temp
        movf    pwreg2,w
        xorlw   pass2
        btfsc   z
        decf    temp
        movf    pwreg3,w
        xorlw   pass3
        btfsc   z
        decf    temp
        btfss   z
        goto    noway           ; no
        goto    arm             ; yes

noway   clrf    secure          ; stomp secureity

        call    su_5th
        call    do_15
        sleep

arm     movlw   secval
        movwf   secure
        call    su_C
        call    do_66
        call    su_wait
        call    do_66
        call    su_E
        call    do_66
```

```
   351     0CA- 96B                        call    su_wait
   352     0CB- 97A                        call    do_66
   353     0CC- 948                        call    su_G
   354     0CD- 97A                        call    do_66
   355     0CE- 003                        sleep
   356
   357     0CF- 205                armed   movf    ra,w
   358     0D0- F03                        xorlw   00000011b       ; both buttons d
own?
   359     0D1- 643                        btfsc   z
   360     0D2- AD8                        goto    disarm
   361
   362     0D3- 605                        btfsc   buttona
   363     0D4- AF6                        goto    quarter
   364     0D5- 625                        btfsc   buttonb
   365     0D6- B02                        goto    dime
   366     0D7- 003                        sleep
   367
   368     0D8- 077                disarm  clrf    secure
   369     0D9- 072                        clrf    pwreg0
   370     0DA- 073                        clrf    pwreg1
   371     0DB- 074                        clrf    pwreg2
   372     0DC- 075                        clrf    pwreg3
   373     0DD- 078                        clrf    digit
   374     0DE- 933                        call    su_A
   375     0DF- 97A                        call    do_66
   376     0E0- 003                        sleep
   377
   378     0E1- 040                test1   clrw                    ; output a 440Hz
 sine wave
   379     0E2- 006                        tris    dac
   380     0E3- 933                        call    su_A
   381     0E4- 984                t1      call    do_2sec
   382     0E5- AE4                        goto    t1
   383
   384     0E6- 004                test2   clrwdt
   385     0E7- 040                        clrw                    ; sweep DAC to t
est range, linearity, and
   386     0E8- 006                        tris    dac             ; amplifier clip
ping points
   387     0E9- 2BE                        incf    temp
   388     0EA- 21E                        movf    temp, w
   389     0EB- 026                        movwf   dac
   390     0EC- 000                        nop
   391     0ED- 000                        nop
   392     0EE- 000                        nop
   393     0EF- 000                        nop
   394     0F0- 000                        nop
   395     0F1- 000                        nop
   396     0F2- 000                        nop
   397     0F3- 000                        nop
   398     0F4- AE6                        goto    test2
   399                             ;
   400     0F5- 003                        sleep                   ; don't want fri
tzed processor
   401                             ;                               ; "falling into"
 next routines
   402     0F6- 040                quarter clrw
   403     0F7- 006                        tris    dac
   404     0F8- C05                        movlw   5
   405     0F9- 036                        movwf   pulse
   406     0FA- 962                qloop   call    su_red
   407     0FB- 975                        call    do_33
   408     0FC- 96B                        call    su_wait
   409     0FD- 975                        call    do_33
   410     0FE- 2F6                        decfsz  pulse
   411     0FF- AFA                        goto    qloop
   412     100- 97F                        call    do_500
   413     101- 003                        sleep
   414
   415     102- 040                dime    clrw
   416     103- 006                        tris    dac
   417     104- C02                        movlw   2
   418     105- 036                        movwf   pulse
   419     106- 962                dloop   call    su_red
   420     107- 97A                        call    do_66
   421     108- 96B                        call    su_wait
   422     109- 97A                        call    do_66
   423     10A- 2F6                        decfsz  pulse
   424     10B- B06                        goto    dloop
   425     10C- 97F                        call    do_500
   426     10D- 003                        sleep
   427                             ;fin
   428
   429


                                        ===== Errors: 0 =====
```