



The length parameter determines the duration of the pitches produced. It also affects the character of the sound; extremely short lengths like one or two produce percussive sounds, while longer lengths sound more organ-like. To set the length parameter from Applesoft, simply POKE 9 with any value from 0 to 255. Table 4 lists useful length values for a variety of tempos.

The proper syntax for using the Duet and Sound entry points is as follows:

<b>Duet</b>	<b>Sound</b>
POKE 6, PDIST	POKE 6, PDIST
POKE 7, PITCH1	POKE 7, PITCH1
POKE 9, LENGTH	POKE 8, PITCH2
CALL 768	POKE 9, LENGTH
	CALL 774

The three demonstration programs show you how to use the Sound Master with Applesoft. Most of the demo programs employ some kind of loop, either a FOR/NEXT loop or a GOTO and IF/THEN statement. The music programs require a large amount of data, so a READ/DATA statement is included in the loop.

### ENTERING THE PROGRAM

If you have an assembler, enter the source code in Listing 1 and save the assembled object code as SOUND. If you don't have an assembler, use the hex codes from Listing 2 and save the file with the command

```
BSAVE SOUND, A$300, L$56
```

Enter the Applesoft program in Listing 3 and save it with the command

```
SAVE SOUND.DEMO1
```

Type NEW, enter Listing 4, and save it with

```
SAVE SOUND.DEMO2
```

Type NEW, key in Listing 5, and save it to disk with the command

```
SAVE SOUND.DEMO3
```

For help with entering *Nibble* listings, see the Typing Tips section.

Table 1: Function of Variable PDIST

PDIST=0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PITCH1=5	s				X					X						X
PITCH2=5	s				X					X						X
Output					X					X						X
PDIST=1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PITCH1=5	s				X					X						X
PITCH2=5	s				X					X						X
Output					X	X				X	X					X
PDIST=2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PITCH1=5	s				X					X						X
PITCH2=5	s				X					X						X
Output					X	X				X	X					X

s = starting point of pitch  
X = toggle speaker

PDIST is an offset value that delays the starting point of PITCH2. If PDIST=0 then PITCH1 and PITCH2 start at the same time. If PDIST=1 then PITCH2 starts one pass after PITCH1. If PDIST=2 then PITCH2 starts two passes after PITCH1, etc. The greatest distance between PITCH1 and PITCH2 is 127. Values up to 255 are possible, but they are equivalent to values below 127. For example, 1=255, 2=254, 3=253, etc., because 3 is 3 after PITCH1 and 253 is 3 before PITCH1.

### HOW THE PROGRAM WORKS

Like all sound programs for the Apple, Sound Master accesses the speaker softswitch at memory location \$C030 (49200 or -16336 decimal). Either a read or write to this location will toggle the speaker. Pitches of different frequencies are produced by changing the rate at which the speaker is accessed. Accessing the speaker quickly produces a high pitch, while accessing it slowly produces a low pitch.

Table 2: Sound Types

Sound type:	Pitch ratio:	Effect of PDIST:
Same pitch in both voices	1 to 1	PDIST=0 produces the traditional "buzzy" sound. If the value in PDIST is greater than 0, it acts as a volume control, with 1 being the softest level and 127 the loudest. The most dramatic change in volume occurs within the range of 1 to 30. PDIST also affects the sound quality. The sound is somewhat like an oboe or reed stop on an organ.
Fundamental plus a harmonic of a fifth	2 to 3	PDIST=0 sounds bassoon-like with a harsh edge on the sound. If PDIST is greater than zero, a metallic or robotic-like edge is added to the basic sound, and the quality is more throaty and harsh as the value increases.
Duet emulation	N to N + 1	PDIST has a very subtle effect on sounds produced by DUET. The value in PDIST determines the attack on the note, not the sustained sound or sound quality. The softest attack, and closest to Nibble Duet, is a value of zero. The sharpest or crispest attack is 127.
Harmony	4 to 3 (Perfect fourth) 5 to 4 (Major third) 6 to 5 (Minor third) 9 to 8 or 10 to 9 (Major second) 16 to 15 (Minor second). Theoretically 3 to 2, 5 to 3, 8 to 5, 15 to 8, and 16 to 9 should produce the missing intervals, but for some reason they do not produce the desired results.	PDIST should always be set to zero. Any other value distorts the sound. Timbre or sound quality is the traditional "buzzy" sound, only you hear two pitches instead of one.

Table 3: Note Values

NOTE NAME	BASE VALUE	PERFECT FIFTH	PERFECT FOURTH	MAJOR THIRD	MINOR THIRD	MAJOR SECOND	MINOR SECOND
C	240	240,160	240,180	240,192	240,200	240,216	240,228
C#	228	228,152	228,171	225,180	228,190	225,200	228,216
D	215	216,144	216,162	215,172	216,180	216,192	216,204
D#	203	204,136	204,153	205,164	204,170	(200,180)	204,192
E	192	192,128	192,144	190,152	192,160	190,171	192,180
F	180	180,120	180,135	180,144	180,150	180,160	180,170
F#	170	168,112	168,126	170,136	168,140	170,153	170,160
G	160	159,106	160,120	160,128	162,135	160,144	160,150
G#	151	150,100	152,114	150,120	150,125	150,135	152,144
A	144	144,96	144,108	145,116	144,120	144,128	144,135
A#	135	135,90	136,102	135,108	(138,115)	135,120	136,128
B	125	126,84	124,93	125,100	126,105	126,112	126,119
C'	120	120,80	120,90	120,96	120,100	120,108	120,114
C#'	113	114,76	112,84	(115,92)	114,95	(110,99)	112,105
D'	105	105,70	104,78	105,84	(108,90)	104,96	105,98
D#'	99	99,66	100,75	100,80	(102,85)	99,88	98,91
E'	93	93,62	92,69	(90,72)	(90,75)	(90,81)	(91,84)
F'	88	87,58	88,66	85,68	(84,70)	(84,77)	85,80
F#'	82	81,54	(84,63)	+	+	81,72	+
G'	79	78,52	80,60	80,64	78,65	+	(80,75)
G#'	74	75,50	(76,57)	75,60	(72,60)	(72,64)	75,70
A'	70	69,46	68,51	70,56	70,60	70,63	70,65
A#'	66	66,44	+	65,52	66,55	66,60	65,60
B'	63	63,42	(64,48)	+	+	63,56	+
C''	60	60,40	60,45	60,48	60,50	60,54	60,56
RATIO:		3:2	4:3	5:4	6:5	9:8 or 10:9	approx. 16:15

Values in parentheses () are so out of tune that they should be avoided.

An asterisk (\*) means there are no values for that interval.

To get "one voice" sound, POKE the BASE VALUE into both pitch addresses:

```
POKE 7,66 : REM PITCH1
POKE 8,66 : REM PITCH2
```

To produce one of the intervals on the chart, POKE the first value into PITCH1 and the second value into PITCH2:

```
POKE 7,66 : REM PITCH1
POKE 8,44 : REM PITCH2
```

To produce a rest or pause, POKE a zero into PITCH1; the value in PITCH2 does not matter.

Machine language is used for sound programs because BASIC is too slow to produce more than a few low buzzes. The need for machine language can be illustrated by executing this simple BASIC program:

```
10 X = PEEK(-16336) : GOTO 10
```

Sound Master uses eight zero page locations that are unused by either DOS 3.3, ProDOS, Applesoft, or the Monitor. Six additional unused zero page locations, \$FA through \$FF, are available for modifications.

Lines 30-32 establish a relationship between PITCH1 and PITCH2 that produces an output very similar to Nibble Duet. The pitch value in PITCH1 is copied to PITCH2. Then PITCH2 is increased by one. After this initial setup, Duet falls through to the Sound entry point.

Lines 36-38 copy the LENGTH parameter you enter into LENGTHA, an internal length parameter used by the Sound routine. LENGTHA is then increased by one in order to compensate for the logic employed by the program. If it was not increased by one, 1 would be decremented to 0 and 0 would be decremented to 255 because the value in LENGTHA is decreased by one before being checked by the logic statement BNE (Branch Not Equal) in lines 71 and 84.

Lines 40-46 check PITCH1 to make sure it is not zero. If it is zero, then the program branches to lines 76-85 to delay the program for the amount of time indicated by the length parameter. If PITCH1 is not zero, then PITCH1 is copied to PITCHA and PITCH2 plus PDIST is copied to PITCHB. There is a chance that PITCH2 plus PDIST is more than 255, which will set the Carry bit. So line 46 clears the Carry bit just in case it was set.

Lines 47-49 set the speaker flag, PLUCK, to zero and the X-register to zero. The value held by PLUCK indicates when the speaker should toggle. If PLUCK is zero, then the speaker will not toggle. If PLUCK is any number greater than zero, then the speaker will toggle and reset PLUCK to zero.

The X-register is an internal length parameter that ensures all pitch values execute in roughly the same amount of time.

Lines 53-72 contain the section of the program that actually produces the sound. The program flow in this section is a single loop that travels from VOICE1 to WAIT and then branches back to the top at VOICE1.

Lines 53-57 make up the code for VOICE1. PITCHA is decreased by one, and then checked to see if it equals zero. If PITCHA contains a value of zero, the speaker flag is increased, the original pitch value is restored in PITCHA, and control falls through to VOICE2.

Table 4: Rhythm Values

RHYTHM	<--Slower			Faster-->			
	-	-	240	192	144	96	48
Whole	-	-	240	192	144	96	48
Dotted-Half	252	216	180	144	108	72	36
Half	168	144	120	96	72	48	24
Dotted-Quarter	126	108	90	72	54	36	18
Triplet-Half	112	96	80	64	48	32	16
Quarter	84	72	60	48	36	24	12
Dotted-Eighth	63	54	45	36	27	18	9
Triplet-Quarter	56	48	40	32	24	16	8
Eighth	42	36	30	24	18	12	6
Triplet-Eighth	28	24	20	16	12	8	4
Sixteenth	21	18	15	12	9	6	3

To use the rhythm values above, simply POKE the value into LENGTH before CALLing Sound or Duet.

POKE 9,48 : REM LENGTH

These rhythm values were selected for their ability to produce both simple and compound meters (rhythms that are multiples of 2 and 3). To compute your own rhythm values, select a value for the quarter note and divide or multiply by 2 to get the other values. To get compound meter (i.e., triplets), divide or multiply by 3.

If the value in PITCHA is not zero, the program branches directly to VOICE2 without setting the speaker flag.

Lines 58-62 contain the code for VOICE2. VOICE2 works in exactly the same way as VOICE1, except it branches to or falls through to TOGGLE.

Lines 63-67 have the code for TOGGLE. First the speaker flag, PLUCK, is checked to see if it contains a value greater than zero. If PLUCK is greater than zero, the speaker is accessed, PLUCK is restored to zero, and control passes on to WAIT. If PLUCK equals zero, then control passes directly to WAIT without toggling the speaker.

Lines 68-72 contain two length parameters. The X-register contains the low length parameter, initially set to the largest value. LENGTHA contains the high length parameter, set by the user. First, the X-register is decremented by one, and the program branches to VOICE1. This cycle continues until the X-register reaches zero. Then the length value contained in LENGTHA is decreased by one and the program branches to VOICE1. This cycle, decreasing the X-register until it reaches zero and then decreasing LENGTHA, is continued until they both reach zero. The program then returns to the calling program, which is usually BASIC, via the RTS in line 72.

## MODIFICATIONS

You can make the process of writing alternate entry points to Sound Master much easier. Move lines 53-69 to the end of the program and add an RTS to the end of it. Then rewrite lines 53-72 to read as follows:

```
57 PLAY JSR VOICE1
58 DEC LENGTHA
59 BNE PLAY
60 RTS
```

These simple modifications allow you to CALL the sound-producing routine without having to worry about the extra baggage of the

LENGTHA parameter. Other possible additions or modifications could include:

1. An entry point designed specifically to produce game sounds. Game programs usually can increase or decrease the pitch quickly, like "Ascending Fifths" in SOUND.DEMO3, only at machine language speed.
2. An ampersand or external command routine would make Sound Master easier to use for the Applesoft programmer.
3. You could use the volume control controlled by PDIST with pitch ratios of 1:1 to produce a pseudo-vibrato. This could be accomplished by increasing and decreasing the volume level as the sound is produced.
4. The truly ambitious could use the volume control to develop an ADSR envelope on each note produced. This routine could be designed to operate like Applied Engineering's Super Music Synthesizer card, which uses six parameters to control the ADSR envelope. These six parameters are Attack, Volume, Decay, Sustain, Release, and Gap. Attack is the rate of the notes increase in volume. Volume is the volume level reached by Attack. Decrease is the rate of decrease in volume from Volume to the sustained volume level. Sustain is the volume level held throughout most of the note's existence. Release is the rate of decrease in volume from Sustain to no sound. Gap is the minimum length required to release the note.

## REFERENCES

1. Apel, Willi. "Intervals, Calculation of." *Harvard Dictionary of Music*, 1975.
2. Jefferys, Doug. "Nibble Duet." *Nibble*, December 1985 Vol. 6/No. 12, pp. 137-141.
3. *Super Music Synthesizer Users Manual*, Carrollton, Texas: Applied Engineering.
4. Wagner, Roger, *Assembly Lines, the Book*. Santee: Roger Wagner Publishing Inc., 1984

### THE SEPTEMBER 1988 DISK CONTAINS THIS PROGRAM

If you'd rather not type in the listing for this program, you can buy it on disk, complete, free of types and ready to run. Nibble's September 1988 programs are available on a single disk for an introductory price of \$12.95 from Nibble, 52 Domino Dr., Concord, MA 03342. Add \$2.50 for shipping/handling within the U.S. and Canada; \$7.50 for overseas air mail. Introductory price expires 10/30/88; after that date, the price will be \$16.95. See the coupon on page 114 of the Nibble Software Catalog for ordering information. ORDER NO: W11

### LISTING 1: SOUND Source Code

```
1 -
2 - SOUND Source Code
3 - By Jim Richardson
4 - Copyright(c) 1988
5 - MicroSPARC, Inc
6 - Concord, MA 01742
7 - EOLsm
8 PDEST EQU 106
9 PITCH1 EQU 107
10 PITCH2 EQU 108
11 LENGTH EQU 109
12 PITCHA EQU 110
13 PITCHB EQU 111
14 LENGTHA EQU 112
15 PLUCK EQU 113
16 -
17 SPWR EQU 10030
18 -
19 ORG 1200
20
21 *Program is completely relocatable. Parameters never
22 *move, are always at ADDRs 106-109. If you relocate
23 *program, you will need to recalculate entry points.
24 *Zero page ADDRs 10A-10F and STACK are available for
25 *modifications. SOUND scrambles A,X and Y registers.
26 *-----
27 *-----
28 *SETUP FOR DUET
29 *-----
```

## LISTING 1: SOUND Source Code continued

```

30 DUET LDA PITCH1 ;Places PITCH1 in PITCH2
31 STA PITCH2 ;and adds one to it so
32 INC PITCH2 ;ratio is always N:N+1
33 .....
34 SETUP FOR SOUND .....
35 SOUND LDA LENGTH
36 STA LENGTHM
37 LDA LENGTHM ;INC needed because DEC
38 INC LENGTHM ;done before ONE in 71 and 84
39 .....
40 LDA PITCH1
41 BEQ REST ;if PITCH1=0 goto REST
42 STA PITCHM
43 LDA PITCH2
44 ADC PDIST ;Add PITCH2 + PDIST
45 STA PITCHM
46 CLC
47 LDA #90 ;In case of overflow
48 STA PLUCK ;FLAG. 0=no PLUCK->0 PLUCK
49 TAB
50 .....
51 SOUND PRODUCING RTN
52 .....
53 VOICE1 BEQ PITCHA
54 BNE VOICE2
55 INC PLUCK ;SPKR FLAG=0. SPKR plucks
56 LDA PITCH1
57 STA PITCHM ;Restore original pitch
58 VOICE2 DEC PITCHM
59 BNE TOGGLE ;SPKR FLAG=0. SPKR plucks
60 INC PLUCK
61 LDA PITCH2 ;Restore original pitch
62 STA PITCHM
63 TOGGLE LDA PLUCK
64 BEQ WAIT ;if PLUCK=0 goto WAIT
65 STA SPKR ;Plucks SPKR twice
66 LDA #90
67 STA PLUCK ;Restore Pluck to zero
68 WAIT DEX
69 BNE VOICE1
70 DEC LENGTHM
71 BNE VOICE1
72 RTS
73 .....
74 REST ROUTINE
75 .....
76 REST LDX #107 ;Waste spaces, same amount
77 DELAY1 DEX ;of time as it takes 2
78 LDY #90 ;median pitches to go
79 DELAY1 DECY ;thru Sound Producing.
80 BNE DELAY1 ;Rtn.
81 CPX #81
82 BEQ DELAY1
83 DEC LENGTHM
84 BNE REST
85 RTS

```

END OF LISTING 1

## LISTING 2: SOUND

Start: 300 Length: 56

```

97 0300:A5 07 85 08 E6 08 A5 09
D5 0308:85 1C E5 1C A5 07 F8 35
0D 0310:85 1A A5 08 65 96 85 1B
85 0318:18 A9 00 85 1E AA C6 1A
07 0320:D0 06 E5 1E A5 07 85 1A
D0 0328:C6 18 D0 06 E5 1E A5 08
40 0330:85 1B A5 1E F0 07 8D 30
64 0338:C0 A9 00 85 1E CA D0 DE
8F 0340:C6 1C D0 DA 60 A2 07 CA
8F 0348:A0 DD BE D0 FD E0 01 B0
82 0350:F6 C6 1C D0 F0 60

```

TOTAL: E6B6

END OF LISTING 2

## LISTING 3: SOUND.DEMO1

```

C7 10 REM .....
C0 20 REM + SOUND DEMO1 +
B9 30 REM + BY JIM RICHARDSON +
AE 40 REM + COPYRIGHT(C) 1988 +
CB 50 REM + MICROSPARC, INC +
24 60 REM + CONCORD, MA 01742 +
45 70 REM .....
A4 80 HOME : PRINT CHR$(21)
41 90 REM *****
1C 100 REM SETUP
D7 110 REM *****

```

```

A8 120 PRINT CHR$(4) "BLOAD SOUND"
130 MTPPL = 1:PD(0) = 0:PD(1) = 1:PD(2) = 3:PD(3)
; 7:PD(4) = 15
48 140 PD(5) = 0:PD(6) = 1:PD(7) = 15:PD(8) = 0:PD
(9) = 127
D6 150 FOR N = 0 TO 4:STVP$(N) = "SAME PITCH VALU
E"
E5 160 RTS(N) = "1 TO 1": NEXT N
EA 170 FOR N = 5 TO 7:STVP$(N) = "FUNDAMENTAL + F
IFTH"
6B 180 RTS(N) = "2 TO 3": NEXT N
89 190 FOR N = 8 TO 9:STVP$(N) = "DUET EMULATION
": REM 5 BLANK SPACES
4A 200 RTS(N) = "N TO N+1": NEXT N
3A 210 VTAB 9: HTAB 12: PRINT "SONG: 'CHARGE'"
1D 220 REM .....
5E 230 REM SOUND LOOP FOR SOUND
8E 240 REM .....
4E 250 FOR N = 0 TO 9: POKE 6,PD(N): IF N > 4 THE
N MTPPL = 2 / 3
61 260 VTAB 11: HTAB 6: PRINT "SOUND TYPE: ":STVP
$(N)
5D 270 VTAB 13: HTAB 11: PRINT "RATIO: ":RT$(N)
C2 280 VTAB 15: HTAB 18: PRINT " ": REM 3 BLANK
SPACES
7E 290 VTAB 15: HTAB 11: PRINT "PDIST=" :PD(N)
54 300 RESTORE : IF N > 7 THEN 378
C6 310 FOR M = 1 TO 8: READ P1,LE:P2 = P1 + MTPPL
34 320 POKE 7,P1: POKE 8,P2: POKE 9,LE: CALL 774:
NEXT M
4F 330 NEXT N
55 340 REM .....
AE 350 REM SOUND LOOP FOR DUET
97 360 REM .....
71 370 FOR M = 1 TO 8: READ P1,LE
F3 380 POKE 7,P1: POKE 9,LE: CALL 768: NEXT M
30 390 NEXT : HOME : VTAB 23: END
2B 400 REM .....
4E 410 REM DATA FOR 'CHARGE'
A5 420 REM .....
CB 430 DATA 159,24,128,24,93,24,78,24,0,24,93,12
,78,72,0,24

```

TOTAL: 3101

END OF LISTING 3

## LISTING 4: SOUND.DEMO2

```

37 10 REM .....
C0 20 REM + SOUND.DEMO2 +
B9 30 REM + BY JIM RICHARDSON +
AE 40 REM + COPYRIGHT(C) 1988 +
CB 50 REM + MICROSPARC, INC +
24 60 REM + CONCORD, MA 01742 +
45 70 REM .....
86 80 HOME
86 90 HOME
27 90 PRINT CHR$(21)
9B 100 PRINT CHR$(4) "BLOAD SOUND"
45 110 POKE 6,0. REM SET PDIST=0
4B 120 HOME: VTAB 5: PRINT "THIS DEMONSTRATION
PROGRAM WILL DISCUSS": PRINT "AND ILLUSTRAT
E VARIOUS USES OF HARMONY": PRINT
8A 130 PRINT "AS IT APPLIES TO THE 'SOUND' PROGRA
M.": PRINT "PRINT: PRINT" THE DISCUSSION
WILL BEGIN WITH THE": PRINT "PRINT 'LARGE
ST INTERVAL, THE FOURTH, AND": PRINT "PRIN
T 'PROGRESS ON TO SUCCESSIVELY SMALLER":
PRINT
64 140 PRINT "INTERVALS.": GOSUB 570
8B 150 HOME: VTAB 3: PRINT "AROUND THE FIFTH CE
NTURY, A FORM OF": PRINT "PRINT 'MUSIC KNO
WN AS ORGANUM (ALSO CALLED': PRINT "PRINT
'PLAIN SONG OR GREGORIAN CHANT) EMERGED.":
PRINT
84 160 PRINT "ORGANUM USED PARALLEL OCTAVES, FIFT
HS": PRINT "PRINT 'AND FOURTHS TO HARMONIZ
E MODAL MELODIES.": PRINT "PRINT 'MUSICIA
NS IN LATER ERAS TENDED TO AVOID"

```

LISTING 4: SOUND.DEMO

```

F1 170 PRINT "THESE INTERVALS BECAUSE IT SOUNDED
    TOO": PRINT "PRINT "MUCH LIKE CHURCH MUSIC
    ": GOSUB 570
72 180 HOME : VTAB 3: PRINT " THEREFORE, FOURTHS
    WILL BE OF LIMITED": PRINT " VALUE T
    O YOU WHEN HARMONIZING MOST": PRINT " PRINT
    "MUSIC. ALTHOUGH, IT CAN BE USED WHEN":
    PRINT " PRINT "A MEDIEVAL CHURCH MUSIC FEEL
    IS DESIRED": PRINT
6E 190 PRINT " PRINT "PRESS RETURN TO HEAR A DEM
    ONSTRATION": PRINT " PRINT "OF MUSIC HARMON
    IZED WITH PARALLEL": PRINT " PRINT "FOURTHS
    "
2A 200 GOSUB 570: GOSUB 660
82 210 HOME : VTAB 3: PRINT " THE MOST USEFUL INTE
    RVALS AVAILABLE TO": PRINT " PRINT "YOU ARE
    THOSE OF MAJOR AND MINOR THIRDS."
98 220 PRINT " A C MAJOR SCALE CONSTRUCTED OUT
    OF": PRINT " PRINT "THIRDS WOULD BE AS FOLL
    OWS": PRINT
3F 230 PRINT "BASE LETTER PITCH": REM
    12 SPACES
C7 240 PRINT "NOTE INTERVAL NAMES VALUES": REM
    2 SPACES BETWEEN TITLES
DC 250 PRINT " C MAJOR 3RD C E 240,192": RE
    M 3 SPACES BETWEEN COLUMNS
DB 260 PRINT " D MINOR 3RD D F 216,180"
A7 270 PRINT " E MINOR 3RD E G 192,160"
FE 280 PRINT " F MAJOR 3RD F A 180,144"
3E 290 PRINT " G MAJOR 3RD G B 160,128"
8E 300 PRINT " A MINOR 3RD A C 144,120"
3E 310 PRINT " B MINOR 3RD B D 126,105"
4B 320 PRINT " C MAJOR 3RD C E 120,96"
91 330 GOSUB 570
7B 340 HOME : VTAB 3: PRINT " A SCALE MADE UP OF
    THIRDS IS FAIRLY IN": PRINT " PRINT "TUNE W
    ITHIN THE FIRST OCTAVE.": GOSUB 660
0B 350 PRINT " PRINT "... BUT THE SECOND OCTAVE IS
    NOT": GOSUB 660
DB 360 PRINT " PRINT " TO AVOID THESE INT
    ERVALS, EITHER": PRINT " PRINT "HARMONIZE W
    ITH THE FIRST OCTAVE ONLY.": PRINT " PRINT "
    OR BE CAREFUL TO HARMONIZE AROUND THE":
    PRINT " PRINT "BAD INTERVALS IN THE SECOND
    OCTAVE.": GOSUB 570
C7 370 HOME : VTAB 3: PRINT " INTERVALS OF SECOND
    S MAY BE USED IN": PRINT " PRINT "MANY WAYS
    , THE MOST USEFUL OF THESE IS": PRINT "
    PRINT "AS A DOMINANT SEVENTH CHORD": PRIN
    T
83 380 PRINT " PRINT "THE DOMINANT 7TH CHORD IS B
    UILT UPON THE": PRINT "FIFTH SCALE DEGREE.
    IN THE KEY OF C": PRINT
0B 390 PRINT " THAT WOULD BE THE NOTE G": PRINT " THE G 7
    TH": PRINT " PRINT "CHORD IS SPOILED G-B-D-
    F": TO SUGGEST THE CHORD "DOMINANT 7TH CHO
    RD USE THE ROOT AND THE": PRINT
6D 400 PRINT "7TH. (IE. F-G)": GOSUB 570
4A 410 HOME : VTAB 3: PRINT " THE 7TH IS USUALLY
    APPROACHED AND": PRINT " PRINT "RESOLVED IN
    STEPWISE MOTION.": PRINT " PRINT "FOLLOWI
    NG ARE THREE EXAMPLES OF HOW TO": PRINT "
    PRINT "USE THE DOMINANT 7TH CHORD."
0A 420 GOSUB 570: HTAB 1: VTAB 14: PRINT "1 C-E
    F-G C-E": GOSUB 660: GOSUB 570: HTAB 1:
    VTAB 15: PRINT "2 E-G F-G C-E": GOSUB 6
    60: GOSUB 570: HTAB 1: VTAB 16: PRINT "3 C
    E-F A-E G-F G-C-E": GOSUB 660: GOSUB 5
    70
FF 430 HOME : VTAB 3: PRINT " THERE IS ONE OTHER
    DEVICE THAT IS": PRINT " PRINT "AVAILABLE T
    O YOU. THE FAN. IT IS CALLED": PRINT " PRIN
    T "A FAN BECAUSE THE NOTES SLOWLY MOVE":
    PRINT " PRINT "APART LIKE A FAN BEING UNFO
    LDED.": PRINT
BA 440 PRINT " FANS CAN BE EITHER OBLIQUE (IE. ON
    E)": PRINT " PRINT "NOTE MOVES WHILE THE OTH
    ER STAYS THE": PRINT " PRINT "SAME" OR CONT
    RARY (IE. BOTH NOTES MOVE): PRINT " PRINT "
    APART".
DB 450 PRINT " PRINT " FOLLOWING ARE SEVERAL EXAM
    PLES OF FANS": GOSUB 570
0B 460 HOME : VTAB 3: PRINT "1. OBLIQUE FAN": HTA
    B 3: VTAB 5: PRINT "A. STEPWISE MOTION":
    HTAB 5: VTAB 7: PRINT "1. OPENING": GOSUB
    660
    
```

```

DB 470 GOSUB 570: HTAB 5: VTAB 8: PRINT "2. CLOSI
    NG": GOSUB 660: HTAB 3: VTAB 10: PRINT "B.
    CHROMATIC": GOSUB 570: HTAB 5: VTAB 12: PRIN
    T "1. OPENING": GOSUB 660
C2 480 GOSUB 570: HTAB 5: VTAB 13: PRINT "2. CLOS
    ING": GOSUB 660: HTAB 1: VTAB 15: PRINT "II
    , CONTRARY FAN": HTAB 3: VTAB 17: PRINT "A.
    CHROMATIC"
3E 490 GOSUB 570: HTAB 5: VTAB 19: PRINT "1. OPEN
    ING": GOSUB 660: GOSUB 570: HTAB 5: VTAB 20
    : PRINT "2. CLOSING": GOSUB 660: GOSUB 570
BB 500 HOME : VTAB 3: PRINT " THE FINAL SELECTION
    IS A FOLK SONG": PRINT " PRINT "ENTITLED '
    THE BLUE TAIL FLY. MOST OF": PRINT " PRINT "
    THIS SONG IS HARMONIZED IN THIRDS.": PRIN
    T
1D 510 PRINT " ONLY TWO SECONDS WERE USED IN THIS
    SONG.": PRINT " AND THEY WERE USED AS DOMINA
    NT 7THS.": GOSUB 570: GOSUB 660
C2 520 HTAB 2: VTAB 14: PRINT "SEE HOW SIMPLE IT
    IS?": PRINT " PRINT "NOW IT'S YOUR TURN TO
    EXPERIMENT AND": PRINT " PRINT "EXPLORE THE
    NEW WORLD OF HARMONY ON": PRINT " PRINT "T
    HE APPLE."
68 530 END
F5 540 REM *****
FC 550 REM + CONTINUE SUBR TN +
0E 560 REM *****
0E 570 POKE - 16368,0: REM STROBE. CLEAR KBD BU
    F
AC 580 HTAB 7: VTAB 23: PRINT "PRESS <RETURN> TO
    CONTINUE"
17 590 IF PEEK ( - 16384) < 128 THEN 590
62 600 VTAB 23: PRINT "
    ": REM 33 SPACES
A2 610 POKE - 16368,0: REM STROBE. CLEAR KBD BUF
    FER
05 620 RETURN
D7 630 REM *****
C4 640 REM + CALL SOUND SUBR TN +
C5 650 REM *****
94 660 READ P1,P2,LE: IF P1 < 0 THEN RETURN
2D 670 POKE 7,P1: POKE 8,P2: POKE 9,LE: CALL 774:
    GOTO 660
38 680 REM *****
53 690 REM DATA FOR PLAIN SONG
8E 700 REM *****
2E 710 DATA 216,162,60,240,180,60,216,162,60,180,
    135,60
75 720 DATA 216,162,60,240,180,60,216,162,180,0,0
    ,120
21 730 DATA 216,162,60,192,144,60,180,135,60,192,
    144,60
E7 740 DATA 216,162,60,240,180,60,216,162,240
13 750 DATA -1,-1,-1
80 760 REM *****
81 770 REM DATA FOR C SCALE IN THIRDS
9E 780 REM *****
8E 790 DATA 240,192,48,216,180,48,192,160,48,180,
    144,48
19 800 DATA 160,128,48,144,120,48,126,105,48,120,
    96,48
E5 810 DATA -1,-1,-1
9E 820 REM *****
5F 830 REM DATA FOR C SCALE IN THIRDS
6C 840 REM *****
5G 850 DATA 120,96,48,108,90,48,90,75,48,85,68,48
3F 860 DATA 80,64,48,70,60,48,63,54,48,60,48,48
CE 870 DATA -1,-1,-1
A0 880 REM *****
5F 890 REM DATA FOR DOMINATE 7TH CHORD CADENCE
DA 900 REM *****
FC 910 DATA 240,192,96,180,160,96,240,192,96
D9 920 DATA -1,-1,-1
97 930 DATA 192,160,96,180,160,96,240,192,96
4C 940 DATA -1,-1,-1
4C 950 DATA 240,192,96,180,144,96,192,160,96,180,
    160,96,240,192,96
02 960 DATA -1,-1,-1
ED 970 REM *****
A2 980 REM DATA FOR FANS
E5 990 REM *****
03 1000 REM #OBLIQUE STEPWISE#
02 1010 REM OPEN
    
```

## LISTING 4: SOUND.DEMO continued from page 49

```

F5 1020 DATA 80,80,48,160,170,48,192,160,48,216,1
    62,96
76 1030 DATA -1,-1,-1
17 1040 REM CLOSE
EA 1050 DATA 216,162,48,192,160,48,160,170,48,80,
    80,96
DB 1060 DATA -1,-1,-1
F0 1070 REM #OBLIQUE CHROMATIC#
0D 1080 REM OPEN
CC 1090 DATA 160,160,48,170,160,48,180,160,48,192
    160,48
FA 1100 DATA 205,164,48,216,162,96
C0 1110 DATA -1,-1,-1
C7 1120 REM CLOSE
84 1130 DATA 216,162,48,205,164,48,192,160,48,180
    160,48
85 1140 DATA 170,160,48,80,80,96
77 1150 DATA -1,-1,-1
2B 1160 REM #CONTRARY CHROMATIC#
52 1170 REM OPEN
71 1180 DATA 80,80,48,170,153,48,180,144,96
2D 1190 DATA -1,-1,-1
80 1200 REM CLOSE
10 1210 DATA 180,144,48,170,153,48,80,80,96
50 1220 DATA -1,-1,-1
77 1230 REM *****
8C 1240 REM DATA FOR 'THE BLUE TAIL FLY'
69 1250 REM *****
1E 1260 DATA 144,120,48,135,108,48,144,120,48,162
    135,48
09 1270 DATA 180,144,48,216,180,48,216,180,48,135
    108,72
49 1280 DATA 240,180,24,180,144,48,180,144,48,180
    144,48
D3 1290 DATA 180,144,48,192,160,24,192,160,24,180
    144,48
A4 1300 DATA 162,135,72,144,120,24,135,108,48,144
    120,48
90 1310 DATA 162,135,24,162,135,24,180,144,48,216
    180,48
80 1320 DATA 216,180,48,135,108,72,216,180,24,240
    192,48
79 1330 DATA 192,160,48,162,135,72,135,120,24,144
    120,48
54 1340 DATA 180,144,48,180,144,96,240,180,24,180
    144,24
F6 1350 DATA 180,144,48,180,144,72,180,144,24,192
    160,48
55 1360 DATA 162,135,48,162,135,96,240,180,24,162
    135,24
86 1370 DATA 162,135,48,162,135,72,162,135,24,180
    144,48
59 1380 DATA 144,120,48,144,120,96,180,144,24,144
    120,24
60 1390 DATA 144,120,48,144,120,72,144,120,24,135
    108,48
8F 1400 DATA 108,90,48,108,90,72,108,90,24,120,96
    48
20 1410 DATA 120,96,48,135,120,48,162,135,48,180,
    144,144
2C 1420 DATA -1,-1,-1

```

TOTAL: CF57

END OF LISTING 4

## LISTING 5: SOUND.DEMO3

```

37 10 REM *****
C0 20 REM = SOUND.DEMO3 -
B9 30 REM = BY JIM RICHARDSON -
AE 40 REM = COPYRIGHT(C) 1988 -
CB 50 REM = MICROSPARC, INC. -
24 60 REM = CONCORD, MA 01742 -
45 70 REM *****
86 80 HOME
27 90 PRINT CHR$(21)
9B 100 PRINT CHR$(4) "BLOOD SOUND"
14 110 AS(0) = "PLAY THEM ALL"
120 AS(1) = "ASCENDING FIFTHS"
25 130 AS(2) = "BATTLE STATIONS"
DA 140 AS(3) = "PHASER"
18 150 AS(4) = "SPACESHIP ALARM"
40 160 AS(5) = "DOOR BELL"

```

```

9A 170 AS(6) = "AUTO ENGINE"
9B 180 AS(7) = "EXIT TO BASIC"
CD 190 HOME : GOSUB 300:V = 0
3D 200 INVERSE : VTAB 2 + (V + 2): HTAB 12: PRINT
    AS(V)
34 210 KS = PEEK (- 16384): IF KS < 128 THEN 210
A0 220 POKE - 16368,0: NORMAL : VTAB 2 + (V + 2)
    : HTAB 12: PRINT AS(V)
F2 230 IF KS = 141 THEN INVERSE : VTAB 2 + (V +
    2): HTAB 12: PRINT AS(V): ON (V + 1) GOSUB
    370,440,530,670,740,890,1030,1220
80 240 IF KS = 136 OR KS = 139 THEN V = V - 1: IF
    V < 0 THEN V = 7
0A 250 IF KS = 138 OR KS = 149 THEN V = V + 1: IF
    V > 7 THEN V = 0
D5 260 IF KS > 175 AND KS < 184 THEN V = KS - 176
    7
76 270 IF KS < 136 OR KS > 183 THEN PRINT CHR$(
    7)
AA 280 GOTO 200
DC 290 REM SCREEN SETUP SUB RT'N
44 300 VTAB 22: PRINT "
    " : REM 39 UNDERLINES
D0 310 PRINT "TYPE NUMBER, OR USE ARROWS," : PRINT
    "THEN PRESS RETURN."
AF 320 FOR K = 0 TO 7: VTAB 2 + (K + 2)
C0 330 HTAB 9: PRINT K: " ";AS(K): NEXT : RETURN
55 340 REM *****
AE 350 REM = PLAY THEM ALL +
97 360 REM *****
CD 370 NORMAL : VTAB 2 + (V + 2): HTAB 12: PRINT
    AS(V)
50 380 FOR PN = 1 TO 8: INVERSE : VTAB 2 + (PN +
    2): HTAB 12: PRINT AS(PN)
7B 390 ON PN GOSUB 440,530,670,740,890,1030
400 NORMAL : VTAB 2 + (PN + 2): HTAB 12: PRINT
    AS(PN): NEXT PN: RETURN
4E 410 REM *****
45 420 REM = ASCENDING FIFTHS +
C4 430 REM *****
A3 440 POKE 6,127: REM POIST=127
5D 450 POKE 9,1: REM LENGTH=1
90 460 FOR N = 80 TO 2 STEP - 1
54 470 POKE 7,2 + N: POKE 8,3 + N
ED 480 CALL 774: REM SOUND ROUTINE
F8 490 NEXT N: RETURN
11 500 REM *****
F0 510 REM = BATTLE STATIONS +
07 520 REM *****
8A 530 POKE 6,15: REM POIST=15
F7 540 POKE 9,2: REM LENGTH=2
6F 550 FOR J = 1 TO 4
5A 560 FOR N = 120 TO 80 STEP - 2
50 570 POKE 7,N: POKE 8,N
BD 580 CALL 774: REM SOUND ROUTINE
4D 590 NEXT N
50 600 POKE 7,0: POKE 9,20: REM PAUSE / LENGTH=20
80 610 CALL 774
94 620 POKE 9,2: REM LENGTH=2
8C 630 NEXT J: RETURN
C4 640 REM *****
C5 650 REM = PHASER +
3E 660 REM *****
8B 670 POKE 6,42:POIST = 42
ED 680 POKE 7,219: POKE 8,17: REM PITCHS 1 & 2
A1 690 POKE 9,255: REM LENGTH=255
0F 700 CALL 774: RETURN
73 710 REM *****
9C 720 REM = SPACESHIP ALARM -
75 730 REM *****
D3 740 POKE 6,0: REM POIST=0
76 750 POKE 9,2: REM LENGTH=2
3D 760 A = 3: B = 5
19 770 FOR LOOP = 1 TO 8
DC 780 FOR N = 6 TO 1 STEP - 1
DE 790 POKE 7,A + N: POKE 8,B + N
D3 800 CALL 774: REM SOUND ROUTINE
F3 810 NEXT N
04 820 FOR N = 2 TO 5
4F 830 POKE 7,A + N: POKE 8,B + N
56 840 CALL 774: REM SOUND ROUTINE
42 850 NEXT N,LOOP: RETURN
AA 860 REM *****
43 870 REM = DOOR BELL +

```

LISTING 5: SOUND.DEMO3 *continued*

```

A0 880 REM *****
7C 890 POKE 9,2: REM LENGTH=2
C3 900 POKE 7,57: POKE 8,57: REM PITCH1 & 2=CH
90 910 FOR VOL = 21 TO 1 STEP - 1
14 920 POKE 6,VOL: REM PDIST CONTROLS VOLUME
81 930 CALL 774: REM SOUND ROUTINE
72 940 NEXT VOL
BF 950 POKE 7,84: POKE 8,84: REM PITCH1 & 2=F
53 960 FOR VOL = 21 TO 1 STEP - 1
22 970 POKE 6,VOL: REM PDIST CONTROLS VOLUME
EB 980 CALL 774: REM SOUND ROUTINE
AB 990 NEXT VOL: RETURN
03 1000 REM *****
02 1010 REM - AUTO ENGINE -
09 1020 REM *****
71 1030 POKE 6,1: REM PDIST=1
50 1040 POKE 9,2: REM LENGTH=2
AB 1050 FOR N = 1 TO 30
31 1060 POKE 7,120: POKE 8,200: CALL 774: REM IDL
E
0E 1070 POKE 7,0: CALL 774: REM PAUSE
71 1080 NEXT N
C0 1090 POKE 6,3: REM PDIST=3
5C 1100 FOR N = 40 TO 30 STEP -.2
16 1110 POKE 7, INT (3 + N): POKE 8, INT (5 + N):
CALL 774: REM 1ST GEAR!
06 1120 POKE 257,0: CALL 774: REM PAUSE BETWEEN P
UTTS
39 1130 NEXT N
81 1140 POKE 6,7: REM PDIST=7
22 1150 FOR N = 30 TO 18 STEP -.25
71 1160 POKE 7, INT (3 + N): POKE 8, INT (5 + N):
CALL 774: REM 2ND GEAR!
10 1170 POKE 752,0: CALL 774: REM PAUSE
60 1180 NEXT N: RETURN
48 1190 REM *****
80 1200 REM - END -
85 1210 REM *****
2D 1220 POP : NORMAL : HOME : VTAB 23: PRINT "BYE
": END

```

TOTAL: 97C3

END OF LISTING 5