

MUS-X1

"A HIGH LEVEL MUSIC INTERPRETER"



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1.0 INTRODUCTION

MUS-XI is a high level Interpreter for decoding music notation that was placed into memory into computer commands that are necessary to generate music from the SB-1 (Synthesizer board 1). The interpreter was written to run real time in an 8080 CPU based system. The tempo/timing of the music being played is controlled by a software (or hardware) timer set for 1/192 note durations. MUS-XI will drive up to eight SB-1 cards at once.

The size of MUS-XI is approximately 4K bytes of RAM. The interpreter part of MUS-XI is about 2.5K bytes with look-up tables occupying the rest of the 4K. MUS-XI was written to start at the 16K (4000 Hex) point in RAM. This leaves the beginning of memory up to 16K free for a monitor, Basic, or any other user defined software program. The waveform, envelope and frequency of the SB-1 are all defined by the user and saved in tables within MUS-XI. Up to eight different waveforms and eight envelopes can be saved for different voices anytime in the music piece.

2.0 USER INFORMATION

2.1 MUS-XI has been provided on paper tape in Intel Hex Checksum format. The object code on tape will load from 16K (16,384) up to almost 20K.

2.2 Interpreter tables

The tables in MUS-XI have been preset with the following information:

WMEM....Waveform shape memory

(W1-0)....Squarewave
(W1-1)....Sinewave
(W1-2)....Trianglewave
(W1-3)....Fundamental plus second harmonic wave
(W1-4)....Half wave rectified sinewave
(W1-5)....Full diapason
(W1-6)....Cello
(W1-7)....Trumpet

EMEM....Envelope shape memory

(E1-0)....Linear decay to one
(E1-1)....Linear decay to eight
(E1-2)....Up and Down
(E1-3)....Up, level, down
(E1-4)....Accented constant level
(E1-5)....Fast Decay
(E1-6)....Wavering Decay
(E1-7)....Moderate attack and slow decay

NMEM....Note memory

One octave of half-tones for the tempered scale.

IMEM....Inverted note memory

One octave of the tempered scale inverted.

CMEM....Card memory

16 bytes per card of control data. The 1st two bytes of each table points to where the card is in memory and can be changed by the user to locate the cards somewhere else. Present card addresses:

Card 1	8000 Hex
Card 2	8100
Card 3	8200
Card 4	8300
Card 5	8400
Card 6	8500
Card 7	8600
Card 8	8700

.....Scratch memory

The scratch memory table is used for holding the computer's stack, saving tempo, counting the number of music cards, saving music statement points, saving repeat pointers, and saving special control parameters. The two bytes labeled "A1:" is the pointer to where the music notation will start in memory and can be changed by the user to any starting location in memory. Presently:

A1: 5000 Hex

2.3 Entry points to MUS-X1

MUS-X1 has five entry points and one software exit point.
(See 6.0, the source listing)

Hardware timer entry points.

- 4000 Hex Play Music! Be sure you have first initialized the cards. This entry point must be called.
- 4003 Hex Initialize cards and pass in registers H&L the starting address of the music listing. This entry point must be called.
- 4006 Hex Initialize cards with no H&L address passed. This entry point must be called.

Software timer entry points.

- 4009 Hex Play music with built-in software timer. Pass in registers H&L the starting address of the music listing.
- *400C Hex Play music with built-in software timer. No address is passed. (Address is preset to 5000H).

Exit point

- 400F Hex Exit to the user's program from the software timer after playing music. This exit point has been preset to jump to itself for an endless loop. Change this jump to exit to your monitor, tape, or disk system's entry point.

*...This is the main entry point for playing music (in most applications).
Jump to this address to play music.

3.0 COMMANDS

3.1 Standard command table

N=number

Data=several numbers separated by commas.

Notes=any series of pitches preceded with a + or - and separated by a comma.

<u>Command</u>	<u>Comments</u>
	Pitch.....
C	Low frequency (start of an octave)
D	
E	
F	
G	
A	
B	High frequency (end of an octave)
	Pitch Modifiers.....
number	One digit sets octave range. 4= middle-C
+	Sharp a note
-	Flat a note
=	Don't sharp or flat a note
(FN)	Direct frequency control. N=0 to 254.
	Duration.....
W	Whole note duration
H	Half note
Q	Quarter note
O	Eighth note (octal)
S	Sixteenth note
T	Thirty-second note
X	Sixty-fourth note
	Duration modifiers.....
.	Adds 50% more time to duration
≡	Decreases note duration by 33%. Start of triplets.
	End of triplets.
(L1)	Can tie durations together.
(L0)	End of tie.
	Volume levels.....
Z	Very loud (Forzato)
II	Very intense (Fortissimo)
I	Intense (Forte)
MI	Medium intense (Mezzo Forte)
MP	Medium soft (Mezzo Piano)
P	Soft (Piano)
PP	Very soft (Pianissimo)
(VN)	Direct volume control. N=0 to 15.
	Waveforms.....
(W0-N, Data)	Save a waveform in the interpreter's table. N=0 to 7. Data= 32 integers, value 0 to 255.
(W1-N)	Get a waveform and put into synthesizer.
(W2-N)	Put a 2nd waveform into synthesizer.
(W1)	Use waveform one.
(W2)	Use waveform two.

3.1 (continue)

<u>Command</u>	<u>Comments</u>
	Envelopes.....
(E0-N, Data)	Save an envelope in the interpreter's table. N=0 to 7. Data=16 integers, value 0 to 15.
(E1-N)	Get an envelope and put into synthesizer.
	Special commands.....
(K, Notes)	Automatically sharp or flat the following notes.
(RN)	Repeat "N" times musical passage, start pt.
(RO)	Repeat, ending point.
(J)	Alternate exit out of the last pass of a repeat.
:	Repeat once the following passage.
J	Alternate exit out of this repeat.
(TN)	Set the time for an envelope shape.
(CXXXX)	Set one of the four control bits for SB-1.

3.2 Definitions

3.2.1 Pitch

The fundamental frequency produced as related to the pure or tempered musical scale. In the middle octave (octave #4), the pitch of the tempered scale would be:

<u>Note</u>	<u>Frequency (pitch)</u>
C	261.62 cps (cycles per second)
D	293.66 cps
E	329.63 cps
F	349.23 cps
G	391.99 cps
A	440.00 cps
B	493.88 cps

Note: Any one of these single letter commands will start the SB-1 producing a sound, so be sure to set all parameters (like duration, volume, waveform, tempo, etc.) you want before giving pitch.

3.2.2 Pitch modifier

There are three basic commands that will change the pitch:

- (1) change the octave
- (2) make the note sharp or flat
- (3) direct frequency control

Octave change

The octave command can increase or decrease a pitch by multiples of two. The octave command is a one digit number from 0 to 8 that precedes a group of notes.

Simple example:

3A = 220 cps

4A = 440 cps

4C = 261.6 cps (middle-C)

5C = 523.2 cps

3.2.2 (continue)

Half tone change

The plus or minus signs (sharp or flat) preceding a note will increase or decrease the pitch by about 5.95%.

Therefore:

$$4E = 329.6 \text{ cps}$$

$$+E = 349.2 \text{ cps}$$

$$-E = 311.1 \text{ cps}$$

Direct control

For direct control of the frequency to within $\pm 0.5\%$ a special command is given with "F" followed by a number from 0 to 254 all within parentheses. Example (FN).

N = any integer number from 0 to 254.

R = octave number from 0 to 8.

$$\text{Frequency} = \frac{20000000}{(256-N) (32) (2^{8-R})}$$

3.2.3 Duration

Duration is the length of time a note (pitch) is held on. The software (or hardware) timer is dividing time into 1/192 notes, therefore a 1/64 note is actually 3 times 1/192. The duration commands in order of longest time to shortest is as follows:

W	Whole note
H	Half
Q	Quarter
O	Eighth
S	Sixteenth
T	Thirty-second
X	Sixty-fourth

The actual duration is relative and will change with the tempo.

3.2.4 Duration modifier

There are three basic commands that will change the duration of a note:

- (1) a dotted note
- (2) triplet notation
- (3) tying durations together

Dotted note

To increase the duration of a note by 50%, then follow the duration character with a period.

Example:

$$Q. = Q+O$$

$$H. = H+Q$$

$$O. = O+S$$

$$H.. = H+Q+O$$

The smallest duration, a 1/64 note, can not be increased by 50%.

3.2.4 (continue)

Triplet notation

Triplet notation is used when you want to play three notes in the time it would normally take to play two notes. The character used is " " and " ". It's as if the tempo, for a very short instant, was increased by 50% for just three notes.

Example:

$$\frac{\text{Tempo 100 beats/min.}}{\langle \text{QCCC} \rangle} = \frac{\text{Tempo 150 beats/min.}}{\text{QCCC}}$$

Tieing

The capability of adding any duration time to any other is available in MUS-X1. The command is (L1) for start adding durations and (L0) to stop this suming process.

Example:

$$H(L1)C S(L0)C = (HC) + (SC) \text{ in time}$$

This notation is useful in tieing duration of one note from one measure of music into the next measure.

3.2.5 Tempo

The tempo of a piece of music is like setting the speed at which the music is played. 150 beats a minute is 50% faster than 100 beats.

Example notation:

(100, 4, 4)

- (1) The first number indicates how many beats per minute (similar to a metronome). Range is 40 to 200 beats.
- (2) The second number indicates how many beats per musical measure. Range is 1 to 16.
- (3) The last number indicates which duration value for a note gets one beat. Range 2 to 8.
 - ,8 = eighth duration
 - ,4 = quarter duration (most common)
 - ,2 = half duration

Note: Changing a piece from (100, 4, 4) to (100, 2, 2) will double the speed (tempo) of the musical piece.

3.2.6 Volume

The volume level of each SB-1 card can be set individually at one of sixteen levels. There are two ways to change volume:

- (1) notation similar to musical notation
- (2) direct control

Musical notation

The following letter commands can change the volume approximately 3 DB(±30%).

Z	(+6DB) very loud
II	(+3DB)
I	(+0DB)
MI	(-3DB)
MP	(-6DB)
P	(-9DB)
PP	(-12DB) very soft

For no sound for a set duration the command is "R", this is a Rest in music.

3.2.7 (continue)

(E1-N) Load SB-1 with an envelope shape.
N= table number 0 thru 7.

- (3) Switch between two waveforms saved in the SB-1. Be sure you save two waveform in the two memories of the SB-1 before you use this command. (See 3.2.7 (2)).

Example:

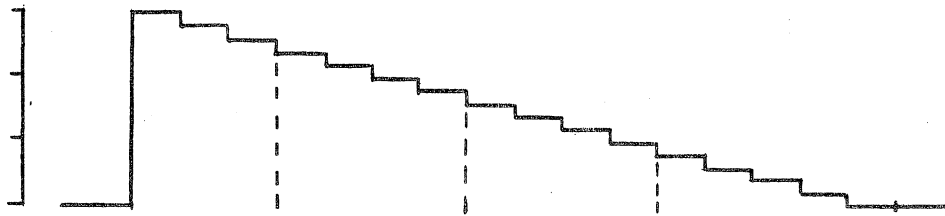
(W1) Switch to memory one.

(W2) Switch to memory two

Shape encoding

To give you an idea of what is meant by "Shape", here is an example:

- (1) Generate an envelope with a fast attack and a ramp decay shape and save it in table 6.



Code:

(E0-6, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0)

3.2.8 Repeat Commands

MUS-X1 will let you repeat any passage, one measure or greater in length, up to 255 times. There are two repeat command sets. One set is for a single repeat and the other set will allow multiple repeats. Important, do not nest multiple repeats with itself or single repeats with itself.

Single repeats

Command set

:

Letter command for start or end of a repeated musical passage.

J

Letter command for a jump out exit point to be used on the second pass through-out the measure.

Example:

/: /...../...../ :/
Repeat the following four measures (/) once.

/: /...../.....J/ :/
Repeat the following four measures and jump over last measure on the last pass.

3.2.8 (continue)

Multiple repeats Command set

- (RN) This command marks the start of a passage to repeat.
N = number of repeats.
- (J) This command marks an exit point to be used on the last pass of a repeat.
- (R0) This command marks the end of a passage to repeat.

Example:

/(R2)...;(R2).../...../.....(R0);....(R0)/...

Repeat the three measures (/) for the two SB-1 cards two more times.

/(R6)..../...../.....(J)/.....(R0)/.....

Repeat the four measures for one SB-1 card six times more and jump out on the last pass to next measure after (R0).

3.2.9 Key Signature

The key-signature can be set anytime in the music. The notes that are to be automatically made sharp (+) or flat (-) within the music are directly stated within this command.

Example:

(K, notes)

(K,+F).....G Major

(K,+F,+C).....D Major

(K,+F,+G,+C,+D).....E Major

3.2.10 Special Card Control

There are a couple of commands that are used for special control of the SB-1.
Envelope duration

The duration of the envelope shape can be control separately from the duration of the note. The longest time is set by the screw adjustment at the upper right-hand edge of the SB-1 (for adjustment see Hardware manual). The longest envelope time can be shortened to 1/8 its value under computer control. Typical setting for the longest time is 1.2 seconds.

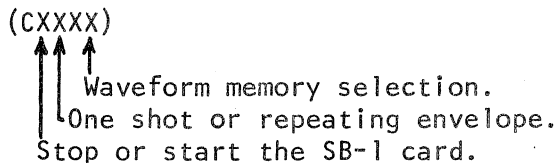
Example:

- (TN) N = number from 0 to 14.
0.....Longest time
14.....Shortest time

3.2.10 (continue)

Control bits

There are four bits in a control byte that can be set or cleared by this command. The command breaks down as follows:



Examples:

(COXXX)	Start (turn-on) SB-1.
(CXXX0)	Use waveform in memory 1. This is like a (W1) command.
(CX0XX)	Repeat the envelope continuously. This command is something like tremolo.
(COXXI)	Use waveform in memory 2 and start SB-1.

Manual stop command

The music interpreter can be stopped from completing a musical tune and will return under user control by typing a "S" in on the console. To have this control, one byte must be changed in the object code (MUS-X1) to match your keyboard port address (see Source listing, section 6.0). Find the routine labeled ENTRI near the first page of the source listing. At address 4020 Hex you will find the following code:

<u>Code</u>	<u>Mnemonic</u>
DB, 01	IN KYBD
E6, 5F	ANI 5FH
FE, 53	CPI 'S'

The 01 Hex byte at 4021 Hex will have to be changed to match your keyboard data port's address if it is not port one.

4.0 WRITING MUSIC

4.1 Sentence structure

A music listing is a series of characters (ASCII) loaded into memory for the interpreter to read. To give some examples of music coding the following symbols will be used:

↵ - carriage-return & line feed

N - a number (integer)

Ⓢ - a space

Some rules:

1. All music notation will be written in statement lines.
2. All statement lines begin with a line number (0 to 65535) and a space.
3. All statement lines end with a carriage-return.

Example:

N Ⓢ statement line information ↵

4. All letters are in upper case, except comments can be upper or lower case.
5. All musical measures will end with a slash (/).

Example:

N Ⓢ measure information/ measure/ measure/ ↵

6. All comments or titles should be within double-quotes. You cannot use a slash (/) or a semi-colon (;) in a comment.

Example:

N Ⓢ "comment"/measure/ measure/ ↵

7. Information for each SB-1 card is separated by a semi-colon within a measure.

Example:

N Ⓢ /Card1; Card2; Card3; Card4/Card1; ↵

4.2 Encoding music

Here comes the fun part. MUSIC!

To start out, your musical tunes may be as simple as "Mary had a little lamb", but as your understanding of the encoding process improves the quality and quantity of music will increase. For a simple tune you must type in the tempo, volume level, octave number, note duration, and then the notes (pitch).

Example:

Coding

1 "A MUSICAL SCALE FOR ONE OCTAVE, START WITH MIDDLE-C."

2 (100, 4, 4) I

3 4QC+CD+DEF+FG+GA+AB/ L

Music symbols



4.2 (continue)

Music Symbols

Comments



----- Known as the Treble (or G) Clef. The curl in the base of this symbol encircles the line for a G-note. Notes on these staff lines are in octaves 4 and 5.



----- Known as the Bass (or F) Clef. The point in the middle of the curl falls on the line for a F-note. Notes on these staff lines are in octaves 2 and 3.



----- A symbol like a "C" at the begin of a measure means Common Time which is four beats per measure with the quarter note receiving one beat. The beats per minute may vary, but the general coding for MUS-XI would be:

(100, 4, 4)



----- One half Common Time so coding for MUS-XI would be:

(100, 2, 2)



----- Some of the musical tunes define the time-signature with numbers in the first measure. In MUS-XI coding, this would be:

(100, 3, 4)

100 beats per minute is a good tempo to start with, if you do not know how fast the music should be played.



----- A sharp (\sharp) or flat (\flat) symbol at the beginning of a music piece with no note but placed at the position of a note means that note should be automatically sharpened or flattened in a song.

MUS-XI coding:

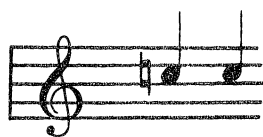
(K,+F,+C)

Known as the key_signature.

4.2 (continue)

Music Symbols

Comments

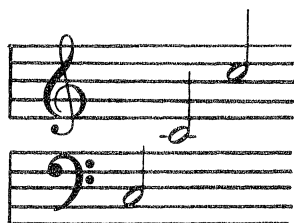


----- A natural (\natural) is used to cancel, for only one measure, the automatic function of the key-signature for a note.

Coding:

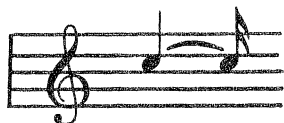
4Q=C=C

The equals symbol (=) must be put in front of every note that should be naturalled in a measure.



----- Octaves. The note symbol in the middle is called Middle-C. Every eighth position up the measure increases the pitch of a note by two times (or one octave). MUS-XI uses numbers to define an octave range. The coding of these three notes would be:

H3C4C5C



----- A tie between two notes means to extend the duration of the first note into the second note as if it was one note. It takes two commands in MUS-XI to do this.

Coding:

5Q(L1)CS(L0)C

pp

----- A volume level symbol for very quiet music.

Coding: PP

p

----- Volume levels. Soft to loud.

p

mp

MP

mf

Mf

f

f

ff

ff

sf

Z

4.2 (continue)

Music Symbols

Comments



--- Multiple notes. This would require three SB-1 cards to play. If you are only playing the melody then code only the very top note. Coding for these notes would be:

40F;40A;40C

The melody will be carried by:

40C

5.0 Special Features

5.1 Relocatable SB-1 Cards

The Interpreter (MUS-X1) uses tables to save the parameters and the address for each SB-1 card. If the user wishes to move the SB-1 to another location in memory, only a table value (2 bytes) has to be changed. Near the end of MUS-X1 (6.0 source listing) are the tables for the cards called CMEM. Just change the first two bytes in each CMEM table to the new starting address you want for each SB-1.

5.2 Mode Selection

The Interpreter has been set-up to run with Solid State Music's VB-1B card (Video Display card). The video card will display the frequency byte as a 7-bit binary pattern on the TV screen in time with the music for each card every 1/64 note. The Interpreter can also flip over the tempered scale and octaves to play inverted music. These two modes can be set by changing one byte in MUS-X1 called PASS (see 6.0 source listing). PASS is at address 49C2 Hex.

<u>PASS Code</u>	<u>Comments</u>
00	This will play the music listing with no video display.
01	This will play the music listing with a video display from the VB-1B.
02	Play the music inverted with no video display.
03	Play the music inverted with a video display from the VB-1B.

5.3 Relocate the VB-1B

The Interpreter uses tables to set the display address for the VB-1B card. To move the Video card from EC00 (present address) to a new starting location change the following bytes to the new address (upper 8-bits only).

Table at 4EED.

<u>Label</u>	<u>Address</u>	<u>Upper address byte</u>
GTBL1(+5)	4EFC	New address
GTBL2	4F02	" "
GTBL3	4F08	" " +256
GTBL4	4F0E	" " "
GTBL5	4F14	" " +512
GTBL6	4F1A	" " "
GTBL7	4F20	" " +768
GTBL8	4F26	" " "
VIDEO	4139	New address

5.4 Redesignating the start of a Music File.

MUS-X1 can be set to start interpreting a musical piece anywhere in memory. There are software entry points described in Section 2.3 which allow the user's software to pass on to MUS-X1 a new music address. If you would like to manually set a new starting point, then preset "A1" (at address 49AF) with another address other than 5000.

Solid State Music

6.0 SOURCE LISTING

```
;;; "MUS-XI", REVISION 1.
;"MUS-XI", REV.0 WRITTEN BY MALCOLM T. WRIGHT
;COPYRIGHT 1978 BY SOLID STATE MUSIC
;; MODIFIED BY WALTER WHITE 12-3-77
;;; MODIFIED AGAIN, M.T. WRIGHT, 1-18-77

;MUS-XI IS AN INTERPRETER OF A SPECIAL LANGUAGE
;USED TO ENCODE MUSIC FOR COMPUTER PROCESSING.
;MUS-XI HAS BEEN ADAPTED FOR DRIVING THE SB-1
;MUSIC CARD.
;
;
4000      LOC      EQU      4000H      ;;; START OF MUS-XI
E000      VIDEO   EQU      0EC00H    ;; START OF VIDEO BOARD
00C8      VDMP    EQU      0C8H      ;; VDM CONTROL PORT
0001      KYBD    EQU      1         ;; KEYBOARD DATA PORT
8000      CARDS   EQU      8000H     ;; LOCATION OF FIRST SB-1
0008      DELTA   EQU      8         ;; A FUDGE FACTOR
000F      FLG     EQU      0FH       ;;; DTO, EOM & TRIPLET FLAG
                                           ;;; BITS D0&D1=TRIPLET FLAG
                                           ;;; BIT D2=EOM FLAG
                                           ;;; BIT D6=DTO FLAG

;; IF PASS = 0 PLAYS NORMAL MUSIC WITH NO DISPLAY
;; IF PASS = 1 PLAYS NORMAL MUSIC WITH DISPLAY
;; IF PASS = 2 PLAYS INVERTED MUSIC WITH NO DISPLAY
;; IF PASS = 3 PALYS INVERTED MUSIC WITH DISPLAY

4000      ORG      LOC      ;;;

;JUMP TABLE TO THE MAIN ENTRY AND EXIT POINTS:
;      1 INTERPRET THE MUSIC FILE AND UPDATE
;      MUSIC CARDS TO PLAY A 1/64 DURATION.
;      (MUST BE "CALLED")
4000 C31240      JMP      ENTRI
;      2 INITIALIZE THE MUSIC CARDS TO BE
;      READY TO PLAY MUSIC AND PASS IN
;      H&L THE MUSIC FILE ADDRESS.
;      (MUST BE "CALLED")
4003 C39B40      JMP      STRT1
;      3 INITIALIZE CARDS ,BUT NO MUSIC FILE
;      ADDRESS IS READ FROM H&L.
;      (MUST BE "CALLED")
4006 C39E40      JMP      STRT1+3
;      4 JUMP TO SOFTWARE TIMER ROUTINE TO
;      PLAY MUSIC IF NO HARDWARE TIMER IS
;      AVAILABLE. PASS MUSIC FILE'S
;      ADDRESS IN H&L.
4009 C3D645      JMP      NBRD2
;      5 JUMP TO SOFTWARE TIMER TO PLAY MUSIC.
;      NO MUSIC FILE ADDRESS IS PASSED.
400C C3D945      JMP      NBRD2+3
;      6 EXIT THE SOFTWARE TIMER TO USER'S
;      MONITOR AFTER MUSIC IS COMPLETED.
400F C30F40      LOOP:   JMP      LOOP
```

```

;ENTER MUSIC FILE INTERPRETER AND SAVE USER'S
;RETURN ADDRESS AND REGISTERS.

```

```

4012 E5      ENTR1:  PUSH    H
4013 210000      LXI     H,0
4016 39        DAD     SP      ;GET OLD STACK POINTER
4017 22A049      SHLD   TOPS2
401A 31A049      LXI     SP,TOPS2
401D D5        PUSH   D
401E C5        PUSH   B
401F F5        PUSH   PSW
4020 DB01      IN     KYBD      ;; CHECK KEYBOARD FOR "S"
4022 E65F      ANI    5FH      ;; STRIP PARITY & LOWER CASE
4024 FE53      CPI    'S'      ;; STOP IF "S" TYPED
4026 CC3C45      CZ     STOPI    ;
4029 C3F843      JMP    PLAY     ;GO MAKE "MUSIC"
402C 3AED4E      ENTR2:  LDA    SPT0   ;;GET 1/3 RING COUNTER
402F 1F        RAR     ;;BIT IN CARRY?
4030 32ED4E      STA    SPT0   ;;SAVE ROTATED COUNTER
4033 D29340      JNC   ENTR3   ;;IF NO C, SKIP VIDEO
4036 3E04      MVI    A,4    ;;RESET RING COUNTER
4038 32ED4E      STA    SPT0   ;; BIT AND STORE.
403B 3AAD49      LDA    NI     ;; NUMBER OF CARDS
403E 32EE4E      STA    SPT1   ;; PUT COPY HERE
4041 21CD49      LXI    H,CMEM+10 ;; FREQ BYTE + 2
4044 22F14E      SHLD  SPT3
4047 21F74E      LXI    H,GTBL1 ;; START OF GRAPHIC TABLE
404A 22F54E      SHLD  SPT5   ;; STORE IT

```

```

;; START THE DISPLAY

```

```

404D 2AF14E      DSP2:  LHLD   SPT3   ;; POINT TO CTRL BYTE
4050 7E        MOV    A,M     ;; GET IT
4051 B7        ORA    A      ;; SET SIGN FLAG
4052 3E20      MVI    A,' '   ;; SPACE INTO A
4054 E5        PUSH   H
4055 2B        DCX   H
4056 2B        DCX   H
4057 FA6140      JM    DSP4
405A 7E        MOV    A,M
405B 0F        RRC
405C 0F        RRC
405D E63F      ANI    3FH     ;; NORMALIZE BYTE
405F F680      ORI    80H     ;; SET GRAPHIC BIT
4061 D1        DSP4:  POP    D
4062 2AEF4E      LHLD  SPT2   ;; GET DELTA
4065 19        DAD   D
4066 22F14E      SHLD  SPT3   ;; UPDATE POINTER

```

```

;; CHECK NOTE PATTERN FOR POSSIBLE UPDATE

```

```

4069 2AF54E      LHLD  SPT5
406C BE        CMP    M      ;; DID NOTE CHANGE?
406D 77        MOV    M,A    ;; SAVE NEW PATTERN
406E 4F        MOV    C,A
406F E5        PUSH   H
4070 23        INX   H      ;;
4071 23        INX   H      ;; POINT TO "OR" MASK

```

```

4072 46      MOV      S,M
4073 23      INX      H          ;; POINT TO "AND" MASK
4074 7E      MOV      A,M
4075 23      INX      H          ;; POINT TO LOW ADDRESS
4076 A6      ANA      M
4077 B0      ORA      B          ;; COMPLETE MASKING
4078 5F      MOV      E,A
4079 23      INX      H          ;; POINT TO HIGH ADDRESS
407A 56      MOV      D,M
407B 79      MOV      A,C          ;; GET PATTERN
407C 12      STAX     D          ;; DISPLAY NEW PATTERN
407D 1C      INR      E          ;; MOVE DISPLAY POINTER
407E 2B      DCX      H
407F 73      MOV      M,E          ;; SAVE DISPLAY POINTER
4080 E1      POP      H
4081 EB      DSP3:   XCHG
4082 2AF34E  LHLD     SPT4          ;; GET DELTA
4085 19      DAD      D
4086 22F54E  SHLD     SPT5          ;; SAVE POINTER
4089 3AEE4E  LDA      SPT1          ;; NUMBER OF CARDS
408C 3D      DCR      A
408D 32EE4E  STA      SPT1          ;; SAVE NEW TOTAL
4090 C24D40  JNZ      DSP2          ;; DONE YET?
4093 F1      ENTR3:  POP      PSW
4094 C1      POP      B
4095 D1      POP      D
4096 E1      POP      H
4097 F9      SPHL
4098 E1      POP      H
4099 FB      EI
409A C9      RET

```

```

;MAIN ENTRY POINT TO START MUSIC IS HERE
;

```

```

409B 22AF49  STRT1:  ;CALL  HERE
409E E5      SHLD     A1          ;SAVE MUSIC FILE ADDR.
409F 210000  PUSH    H          ;SECOND ENTRY POINT
40A2 39      LXI     H,0
40A3 22A049  DAD     SP
40A6 31A049  SHLD   TOPS2
40A9 D5      LXI     SP,TOPS2
40AA C5      PUSH   D
40AB F5      PUSH   B
40AB F5      PUSH   PSW

```

```

;COPY THE START OF THE MUSIC FILE INTO THE
;MOVING ADDRESS POINTER. GO THROUGH THE
;MUSIC FILE AND SET-UP POINTERS FOR LINES
;TO BE INTERPRETED BY EACH MUSIC CARD IN
;CMEM. SET "EOM" FLAGS TO FALSE STATE.
;SET THE MODE BYTE IN EACH CARD AND TURN
;OFF ALL CARDS. LOAD EACH CARD WITH A
;SINEWAVE AND BELL SHAPE ENVELOPE.

```

```

40AC 2AAF49  STRT2:  LHLD     A1          ;GET START OF FILE
40AF 3E01    MVI     A,1          ;SERVICE CARD ONE
40B1 32AE49  STA     N2
40B4 11C349  LXI     D, CMEM
40B7 CD6642  CALL   NNUM2        ;ELIMINATE 1ST LINE NO.
40BA 22B149  SHLD   A2
40BD 22B849  SHLD   BREP          ;;FOR COLON ROUTINE

```

40C0	CD7044	CALL	SETUP	;SET-UP POINTERS
40C3	21C349	LXI	H,CMEM	
40C6	E5	STRT3: PUSH	H	;SAVE CMEM POINTER
40C7	23	INX	H	
40C8	66	MOV	H,M	;GET CARD'S ADDRESS
40C9	2EF3	MVI	L,0F3H	;POINT TO MODE CONTROL
40CB	3E80	MVI	A,80H	
40CD	77	MOV	M,A	;SET MODE BYTE
40CE	2B	DCX	H	
40CF	77	MOV	M,A	;TURN OFF CARD
40D0	0E80	MVI	C,80H	;128 BYTES
40D2	2E00	MVI	L,0	
40D4	11ED4A	LXI	D,WMEM	
40D7	CDE143	CALL	TRAN1	;TRANSFER WAVEFORM
40DA	0E10	MVI	C,10H	;16 BYTES
40DC	2EE0	MVI	L,0E0H	
40DE	116D4A	LXI	D,EMEM	
40E1	CDE143	CALL	TRAN1	;TRANSFER ENVELOPE
40E4	E1	POP	H	;GET CMEM POINTER
40E5	E5	PUSH	H	
40E6	110A00	LXI	D,10	
40E9	19	DAD	D	;POINT TO MSCB
40EA	7E	MOV	A,M	
40EB	F6C0	ORI	0C0H	;SET "OFF" BIT
40ED	77	MOV	M,A	
40EE	3AAE49	LDA	N2	;GET CARD NUMBER
40F1	FE08	CPI	08H	
40F3	CA0241	JZ	STRT4	;FINISHED ALL CARDS?
40F6	3C	INR	A	
40F7	32AE49	STA	N2	
40FA	E1	POP	H	
40FB	111000	LXI	D,010H	;MOVE 16 PLACES AND
40FE	19	DAD	D	;POINT TO NEXT CARD
40FF	C3C640	JMP	STRT3	
4102	E1	STRT4: POP	H	;CLEAN UP STACK
4103	060E	MVI	B,0EH	;14 BYTES
4105	AF	XRA	A	;;
4106	215F4A	LXI	H,KMEM	
4109	77	STRT5: MOV	M,A	;CLEAR "KMEM"
410A	23	INX	H	
410B	05	DCR	B	
410C	C20941	JNZ	STRT5	
410F	3E64	MVI	A,64H	;100 BEATS
4111	32AA49	STA	T3	;;;
4114	3E04	MVI	A,04H	;X/4 TIME
4116	32AC49	STA	T5	;;;
4119	CD9245	CALL	TIMER	
411C	3AA949	LDA	T2	
411F	F680	ORI	80H	
4121	D341	OUT	I01Q	;TURN-ON INTERRUPT
4123	3E80	MVI	A,80H	
4125	32C149	STA	STPFG	;SET FLAG TO RUN
4128	3AC249	LDA	PASS	;; GET OPTION NUMBER
412B	E601	ANI	I	;; CHECK LEAST SIG BIT
412D	32ED4E	STA	SPT0	;;0 OR 1 INTO RING CTR
4130	CA2C40	JZ	ENTR2	;; GO BACK TO USER IF NO VIDEO
4133	3E0F	MVI	A,0FH	;; SET VDM TO DISPL 1ST CARD
4135	D3C8	OUT	VDMF	;; AT TOP OF SCREEN


```

4137 2100EC      LXI      H,VIDEO
413A 010004      LXI      B,1024   ;;;
413D 3620        CL1:     MVI      M,' '   ;;;BLANK POSITION
413F 23          INX      H        ;;; NEXT DISPLAY POSITION
4140 0B          DCX      B        ;;;
4141 79          MOV      A,C      ;;;
4142 B0          ORA      B        ;;;FINISHED YET?
4143 C23D41      JNZ      CL1      ;; LOOP TO BLANK NEXT POSITION
4146 C32C40      JMP      ENTR2    ;GO BACK TO USER

```

```

;GO FIND ROUTINE FOR CHARACTER, WHILE
;REMOVING SPACES, LINE NUMBERS, AND REMARKS.

```

```

4149 CD7642      FIND1:   CALL     NNUM4
414C CDEA43      CALL     REM1
414F D621        SUI      '!'.     ;;;NORMALIZE CODE
4151 DA4941      JC       FIND1    ;;IGNORE SPACES & CTRL CODES
4154 FE3A        CPI      'Z'- '!'+1 ;;;IGNORE LOWER CASE & SYMB
4156 D24941      JNC     FIND1
4159 E5          PUSH     H        ;SAVE STATEMENT ADDR.
415A 216941      LXI      H,LOOK1 ;GET LOOK-UP TABLE
415D 87          FIND2:   ADD      A        ;;DOUBLE CODE
415E 4F          MOV      C,A      ;;
415F 0600        MVI      B,0      ;;
4161 09          DAD      B        ;ADD OFFSET
4162 7E          MOV      A,M      ;GET ROUTINE ADDR.
4163 23          INX      H
4164 66          MOV      H,M
4165 6F          MOV      L,A
4166 E3          XTHL
4167 B7          ORA      A        ;BE SURE CARRY IS CLEARED.
4168 C9          RET          ;TRICK JUMP

```

```

;THIS IS A TABLE OF ADDRESSES FOR ROUTINES
;THAT WILL INTERPRET EACH CHARACTER TYPED.

```

```

4169 4941      LOOK1:   DW       FIND1   ;!
416B 4941      DW       FIND1   ;"
416D 4941      DW       FIND1   ;#
416F 4941      DW       FIND1   ;$
4171 4941      DW       FIND1   ;%
4173 4941      DW       FIND1   ;&
4175 4941      DW       FIND1   ;'
4177 DD41      DW       FIND3   ;(
4179 4941      DW       FIND1   ;)
417B 4941      DW       FIND1   ;*
417D 4941      DW       FIND1   ;+
417F 4941      DW       FIND1   ;,
4181 4941      DW       FIND1   ;-
4183 4941      DW       FIND1   ;.
4185 2F45      DW       END1    ;/
4187 8443      DW       OCT1    ;0
4189 8443      DW       OCT1    ;1
418B 8443      DW       OCT1    ;2
418D 8443      DW       OCT1    ;3
418F 8443      DW       OCT1    ;4
4191 8443      DW       OCT1    ;5
4193 8443      DW       OCT1    ;6
4195 8443      DW       OCT1    ;7
4197 8443      DW       OCT1    ;8
4199 8443      DW       OCT1    ;9
419B 3D47      DW       COLON   ;:

```

419D	2F45	DW	END1	;;
419F	D847	DW	TRIP1	;;<
41A1	4941	DW	FIND1	;;=
41A3	DB47	DW	TRIP2	;;>
41A5	4941	DW	FIND1	;;?
41A7	4941	DW	FIND1	;;@
41A9	0843	DW	NOTE6	;;A
41AB	0B43	DW	NOTE7	;;B
41AD	F942	DW	NOTE1	;;C
41AF	FC42	DW	NOTE2	;;D
41B1	FF42	DW	NOTE3	;;E
41B3	0243	DW	NOTE4	;;F
41B5	0543	DW	NOTE5	;;G
41B7	CA42	DW	DURA6	;;H
41B9	BD43	DW	VOL3	;;I
41BB	6E47	DW	JREP	;;J
41BD	4941	DW	FIND1	;;K
41BF	3C45	DW	STOP1	;;L
41C1	AF43	DW	VOL2	;;M
41C3	4941	DW	FIND1	;;N
41C5	C442	DW	DURA4	;;O
41C7	A243	DW	VOL1	;;P
41C9	C742	DW	DURA5	;;Q
41CB	7643	DW	ZZZ1	;;R
41CD	C142	DW	DURA3	;;S
41CF	BE42	DW	DURA2	;;T
41D1	4941	DW	FIND1	;;U
41D3	4941	DW	FIND1	;;V
41D5	CF42	DW	DURA7	;;W
41D7	B842	DW	DURA1	;;X
41D9	4941	DW	FIND1	;;Y
41DB	CA43	DW	VOL4	;;Z

;;GO FIND ROUTINE FOR CHARACTER INSIDE THE
 ;;PARENTHESIS WITH A LOOK-UP TABLE. SEE
 ;;"FIND1" ROUTINE.

41DD	CD7642	FIND3:	CALL	NNUM4	
41E0	D621		SUI	'1'	;;;
41E2	DADD41		JC	FIND3	
41E5	FE3A		CPI	'Z'-'1'+1	;;;
41E7	D2DD41		JNC	FIND3	
41EA	ES		PUSH	H	
41EB	21F141		LXI	H,LOOK2	
41EE	C35D41		JMP	FIND2	;;USE HALF OF FIND1

;;THIS IS A TABLE OF ADDRESSES FOR
 ;;ROUTINES THAT WILL INTERPET A CHAR-
 ;;ACTER THAT FOLLOWED A PARENTHESIS.

41F1	4941	LOOK2:	DW	FIND1	;;1
41F3	4941		DW	FIND1	;;"
41F5	4941		DW	FIND1	;;#
41F7	4941		DW	FIND1	;;\$
41F9	4941		DW	FIND1	;;%
41FB	4941		DW	FIND1	;;&
41FD	4941		DW	FIND1	;;'
41FF	DD41		DW	FIND3	;;(
4201	4941		DW	FIND1	;;)
4203	4941		DW	FIND1	;;*
4205	4941		DW	FIND1	;;+

4207	DD41	DW	FIND3	;
4209	4941	DW	FIND1	;-
420B	4941	DW	FIND1	;
420D	4941	DW	FIND1	;/
420F	7745	DW	BEAT1	;0
4211	7745	DW	BEAT1	;1
4213	7745	DW	BEAT1	;2
4215	7745	DW	BEAT1	;3
4217	7745	DW	BEAT1	;4
4219	7745	DW	BEAT1	;5
421B	7745	DW	BEAT1	;6
421D	7745	DW	BEAT1	;7
421F	7745	DW	BEAT1	;8
4221	7745	DW	BEAT1	;9
4223	4941	DW	FIND1	;;
4225	4941	DW	FIND1	;;
4227	4941	DW	FIND1	;<
4229	4941	DW	FIND1	;;=
422B	4941	DW	FIND1	;>
422D	4941	DW	FIND1	;;?
422F	4941	DW	FIND1	;;@
4231	4941	DW	FIND1	;;A
4233	4941	DW	FIND1	;;B
4235	5548	DW	CTRL1	;;C
4237	4941	DW	FIND1	;;D
4239	0348	DW	SHAPE	;;E
423B	8447	DW	FREQ1	;;F
423D	4941	DW	FIND1	;;G
423F	4941	DW	FIND1	;;H
4241	4941	DW	FIND1	;;I
4243	1B47	DW	JUMP1	;;J
4245	EB47	DW	KEYS1	;;K
4247	C147	DW	LEVON	;;L
4249	4941	DW	FIND1	;;M
424B	4941	DW	FIND1	;;N
424D	4941	DW	FIND1	;;O
424F	4941	DW	FIND1	;;P
4251	4941	DW	FIND1	;;Q
4253	B146	DW	REPM1	;;R
4255	4941	DW	FIND1	;;S
4257	9347	DW	RTIME	;;T
4259	4941	DW	FIND1	;;U
425B	A947	DW	LEVEL	;;V
425D	B246	DW	WAVE1	;;W
425F	4941	DW	FIND1	;;X
4261	4941	DW	FIND1	;;Y
4263	4941	DW	FIND1	;;Z

;THIS ROUTINE WILL EAT-UP LINE NUMBERS
;AT THE BEGINNING OF A STATEMENT STRING.

4265	23	NNUM1:	INX	H	
4266	7E	NNUM2:	MOV	A,M	
4267	CD8042		CALL	NUMB	;FIND LINE NO.
426A	DA6542		JC	NNUM1	;JUMP, IF NOT FOUND
426D	23	NNUM3:	INX	H	
426E	7E		MOV	A,M	
426F	CD8042		CALL	NUMB	
4272	D26D42		JNC	NNUM3	;EAT-UP LINE NO.
4275	2B		DCX	H	

```

4276 23      NNUM4:  INX      H
4277 7E      MOV      A,M
4278 E67F    ANI      7FH      ;;; REMOVE PARITY
427A FE3D    CPI      015D    ;CARRIAGE-RETURN?
427C CA6542  JZ       NNUM1
427F C9      RET

;THIS ROUTINE FLAGS A CHARACTER IF IT IS A
;NUMBER.

4280 E67F    NUMB:   ANI      7FH      ;;;
4282 FE3D    CPI      '0'      ;;; START NUMBER CHECK
4284 D8      RC          ;RET, IF LESS THAN ZERO
4285 FE3A    CPI      '9'+1    ;;;
4287 3F      CMC          ;GREATER THAN NINE?
4288 C9      RET          ;IF NO., THEN NO CARRY

;THIS ROUTINE EATS UP SPACES IN A LINE.

4289 7E      SPACE:  MOV      A,M
428A E67F    ANI      7FH      ;;
428C FE2D    CPI      ' '      ;;; IS IT A SPACE?
428E C0      RNZ
428F 23      INX      H
4290 C38942  JMP      SPACE    ;EAT ANOTHER SPACE

;; FIND A NUMBER AND CONVERT IT TO A BINARY
;; VALUE BETWEEN ZERO AND 255, THEN RETURN.

4293 23      NRDI:   INX      H      ;;
4294 7E      NREAD:  MOV      A,M      ;; GET A CHARACTER
4295 CD8042  CALL     NUMB     ;; IS IT A NUMBER?
4298 DA9342  JC      NRDI     ;; IF NOT, TRY TO FIND ONE

;CHECK IF CHARACTER IS A NUMBER AND RETURN IF
;NOT. IF A NUMBER, THEN MULTIPLY LAST RESULTS
;BY TEN AND ADD ON NUMBER.

429B 0600    DEC1:   MVI      B,0      ;CLEAR RESULTS
429D E67F    DEC2:   ANI      7FH      ;; REMOVE PARITY
429F FE3A    CPI      '9'+1    ;;; CHECK IF NUMBER
42A1 3F      CMC          ;; RETURN WITH CARRY SET IF
42A2 D8      RC          ;; NOT A NUMBER
42A3 FE3D    CPI      '0'      ;;; CONTINUE NUMBER CHECK
42A5 D8      RC          ;; RETURN IF NOT NUMB
42A6 E60F    ANI      0FH      ;GET NO. PART
42A8 32C049  STA      M3        ; SAVE DIGIT
42AB 78      MOV      A,B      ;GET OLD SUM
42AC 87      ADD      A          ;X2
42AD 87      ADD      A          ;X4
42AE 80      ADD      B          ;X4+1=X5
42AF 87      ADD      A          ;X10
42B0 47      MOV      B,A
42B1 3AC049  LDA      M3        ;GET LSD
42B4 80      ADD      B          ;X10+NEW DIGIT
42B5 47      MOV      B,A      ;SAVE NEW SUM
42B6 23      INX      H
42B7 7E      MOV      A,M      ;GET NEXT CHAR.
42B8 C39D42  JMP      DEC2

;GET BINARY VALUE OF CHARACTER AND SAVE
;VALUE IN "CMEM" AT LOCATION "INT1".

42B3 0E01    DURAI:  MVI      C,1      ;; ENTER HERE IF "X"
42BD DA      DB       0DAH      ;;
42BE 0E02    DURAI:  MVI      C,2      ;; ENTER HERE, "T"
42C0 DA      DB       0DAH      ;;

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42C1 0E04      DURA3: MVI      C,4      ;; "S"
42C3 DA        DB        0DAH    ;;
42C4 0E08      DURA4: MVI      C,08H    ;; "O"
42C6 DA        DB        0DAH    ;;
42C7 0E10      DURA5: MVI      C,10H    ;; "Q"
42C9 DA        DB        0DAH    ;;
42CA 0E20      DURA6: MVI      C,20H    ;; "H"
42CC C3DE42    JMP        SKIP    ;;
42CF 0E40      DURA7: MVI      C,40H    ;; "W"
42D1 23        INX        H        ;;
42D2 7E        MOV        A,M      ;; GET CHAR FOLLOWING "W"
42D3 FE57      CPI        'W'      ;; ANOTHER W?
42D5 CADC42    JZ        DBLE     ;;
42D8 2B        DCX        H        ;;
42D9 C3DE42    JMP        SKIP    ;;
42DC 0E80      DBLE:   MVI      C,80H    ;;
42DE 41        SKIP:   MOV        B,C    ;;
42DF 23        DURA8: INX        H        ;;
42E0 7E        MOV        A,M      ;; NEXT CHARACTER
42E1 FE2E      CPI        '.'      ;; IS IT A PERIOD?
42E3 C2EE42    JNZ        DURA9   ;; NO
42E6 79        MOV        A,C      ;;
42E7 1F        RAR        ;;
42E8 4F        MOV        C,A      ;;
42E9 80        ADD        B        ;; ADD-ON 1/2 VALUE
42EA 47        MOV        B,A      ;;
42EB C3DF42    JMP        DURA8   ;;
42EE 2B        DURA9: DCX        H        ;;
42EF E5        PUSH       H        ;; SAVE STATEM. ADDR.
42F0 210400    LXI       M,04     ;;
42F3 19        DAD        D        ;; POINT TO "INT!"
42F4 70        MOV        M,B      ;; SAVE DURATION
42F5 E1        POP        H        ;;
42F6 C34941    JMP        FIND1    ;; NEXT CHAR.

;CHECK IF A NOTE SHOULD BE SHARP(+) OR FLAT(-)
;USING A KEY SIGNATURE TABLE.  SELECT FREQUENCY
;VALUE FROM "NMEM".

42F9 0E00      NOTE1: MVI      C,0      ;; "IF (C) ,ENTER HERE
42FB DA        DB        0DAH    ;;
42FC 0E02      NOTE2: MVI      C,2      ;; "D"
42FE DA        DB        0DAH    ;;
42FF 0E04      NOTE3: MVI      C,4      ;; "E"
4301 DA        DB        0DAH    ;;
4302 0E05      NOTE4: MVI      C,5      ;; "F"
4304 DA        DB        0DAH    ;;
4305 0E07      NOTE5: MVI      C,7      ;; "G"
4307 DA        DB        0DAH    ;;
4308 0E09      NOTE6: MVI      C,9      ;; "A"
430A DA        DB        0DAH    ;;
430B 0E0B      NOTE7: MVI      C,11     ;; "B"
430D CD6C43    CALL     PUTAD    ;;
4310 0600      MVI      B,0      ;;
4312 2B        DCX        H        ;; CHECK PRECEDING CHAR.
4313 7E        MOV        A,M      ;;
4314 FE2D      CPI        '-'      ;; FLAT?
4316 CA2D43    JZ        NOTES    ;;
4319 0C        INR        C        ;;
431A FE3D      CPI        '='      ;; NATURAL?

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431C CA2D43      JZ      NOTES
431F 0C          INR      C
4320 FE2B        CPI      '+'      ;;SHARP?
4322 CA2D43      JZ      NOTES
4325 0D          DCR      C
4326 215F4A      LXI      H,KMEM  ;;POINT TO KEY SIGN.TABLE
4329 09          DAD      B      ;;
432A 7E          MOV      A,M
432B 81          ADD      C      ;ADD ON DELTA
432C 4F          MOV      C,A
432D 21434A      NOTE8: LXI      H,NMEM  ;;POINT TO NOTE TABLE
4330 3AC249      LDA      PASS     ;; GET OPTION NUMBER
4333 E602        ANI      2        ;; WANT INVERTED MUSIC?
4335 CA3B43      JZ      NOTE9    ;; NO, USE NMEM TABLE
4338 21514A      LXI      H,IMEM  ;; YES, USE IMEM TABLE
433B 09          NOTE9: DAD      B
433C 7E          MOV      A,M     ;GET FREQUENCY
433D 210800      LXI      H,8     ;MOVE 8 PLACES
4340 19          DAD      D      ;POINT TO "MFREQ"
4341 77          MOV      M,A
4342 23          INX      H      ;;
4343 23          INX      H      ;;
4344 7E          MOV      A,M     ;;GET MSCB
4345 E67F        ANI      7FH     ;;SET "ON" BIT
4347 77          MOV      M,A     ;;
4348 210400      NOTE0: LXI      H,04
434B 19          DAD      D
434C 7E          MOV      A,M     ;GET DURATION,"INT1"
434D 23          INX      H
434E 77          MOV      M,A     ;SAVE IN "INT2"
434F 23          INX      H     ;;POINT TO TRIPLET
4350 23          INX      H     ;;
4351 7E          MOV      A,M     ;;GET FLAG BYTE
4352 E603        ANI      3      ;;MASK TRIPLET COUNT
4354 2B          DCX      H     ;;
4355 77          MOV      M,A     ;;STORE TRIPLET
;TRANSFER THREE BYTES FROM CMEM TO THE CARD
;BEING SERVICED. THIS WILL SET FREQUENCY,
;VOLUME,OCTAVE,AND SPECIAL CONTROL BYTE AS
;FAST AS POSSIBLE TO REDUCE DISCONTINUITES
;IN THE CARD'S VOICING.
4356 D5          GO:    PUSH   D
4357 2EF0        MVI    L,0F0H  ;;LO ADDR OF CFREB IN CARDS
4359 13          INX    D      ;;HI ADDR OF CFREB
435A 1A          LDAX  D
435B 67          MOV   H,A
435C E5          PUSH  H      ;;PUT CFREB IN STACK
435D 210700      LXI   H,7    ;;CALC ADDR OF MFRES
4360 19          DAD   D
4361 E3          XTHL        ;;CFREB IN H&L
4362 D1          POP   D      ;;MFRES IN D&E
4363 0E03        MVI   C,3    ;;TRANSFER 3 BYTES TO CARD
4365 CDE143      CALL  TRAN1
4366 D1          POP   D
4369 3E04        MVI   A,4    ;;PASS BACK "EOM" FLAG
436B C9          RET

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;THIS ROUTINE TAKES THE PRESENT STATEMENT'S
;ADDRESS AND PUTS IT INTO "CMEM" OF THE CARD

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;BEING SERVICED.
436C D5      PUTAD:  PUSH   D      ;SAVE CMEM ADDRESS
436D 13      INX     D
436E 13      INX     D
436F EB      XCHG    ;POINT TO STATEM. AREA
4370 73      MOV     M,E
4371 23      INX     H
4372 72      MOV     M,D
4373 EB      XCHG
4374 D1      POP     D
4375 C9      RET

```

```

;THIS ROUTINE WILL TURN-OFF THE CARD TO
;GENERATE A REST FOR A PRE-DETERMINED DURATION.

```

```

4376 CD6C43  ZZI:   CALL   PUTAD  ;PUT ADDR.INTO CMEM
4379 210A00  LXI    H,10
437C 19      DAD     D      ;POINT TO MSCB
437D 7E      MOV     A,M
437E F680    ORI    80H    ;SET BIT TO "OFF"
4380 77      MOV     M,A    ;SAVE
4381 C34843  JMP    NOTE0  ;;CONTINUE AT NOTE0

```

```

;
;PUT THE OCTAVE NUMBER INTO CMEM AREA FOR THE
;CARD BEING SERVICED.

```

```

4384 7E      OCT1:  MOV     A,M    ;GET ASCII NUMBER
4385 E60F    ANI    0FH    ;STRIP-OFF UPPER 4 BITS
4387 47      MOV     B,A
4388 3AC249  LDA    PASS    ;; GET OPTION NUMBER
438B E602    ANI    2      ;; WANT INVERTED MUSIC?
438D CA9443  JZ     OCT2    ;; NO, SKIP SOME STMTS
4390 3E08    MVI    A,8     ;; YES, SUBTRACT OCTAVE
4392 90      SUB     B      ;; FROM 8
4393 47      MOV     B,A    ;; AND RETURN TO B REG
4394 E5      OCT2:  PUSH   H
4395 210900  LXI    H,09H
4398 19      DAD     D      ;POINT TO MVOB IN CMEM
4399 7E      MOV     A,M
439A E6F0    ANI    0F0H    ;REMOVE OLD OCTAVE NO.
439C B0      ORA    B      ;ADD-ON NEW OCT. NO.
439D 77      MOV     M,A
439E E1      POP     H
439F C34941  JMP    FINDI   ;GET NEXT CHARACTER

```

```

;READ IN "P","M",OR "I" AND SET-UP VOLUME HALF
;OF MVOB IN CMEM.

```

```

43A2 CDDB43  VOL1:  CALL   EQ1    ;ENTER HERE IF A "P"
43A5 3E20    MVI    A,20H    ;PP?    -12DB
43A7 CACC43  JZ     VOL5
43AA 3E30    MVI    A,30H    ;P?     -9DB
43AC C3CC43  JMP    VOL5
43AF 23      VOL2:  INX     H      ;ENTER HERE IF "M"
43B0 7E      MOV     A,M
43B1 FE50    CPI    'P'     ;;
43B3 3E40    MVI    A,40H    ;MP?    -6DB
43B5 CACC43  JZ     VOL5
43B8 3E60    MVI    A,60H    ;MI?    -3DB
43BA C3CC43  JMP    VOL5
43BD CDDB43  VOL3:  CALL   EQ1    ;ENTER HERE IF "I"
43C0 3E80    MVI    A,80H    ;I?     +0DB
43C2 C2CC43  JNZ    VOL5

```

```

43C5 3EB0          MVI    A,0B0H  ;II?   +3DB
43C7 C3CC43       JMP    VOL5
43CA 3EF0          VOL4:  MVI    A,0F0H  ;IF "Z", THEN +6DB
43CC 47           VOL5:  MOV    B,A
43CD E5           PUSH   H
43CE 210900       LXI    H,09H
43D1 19           DAD    D           ;POINT TO MVOB IN CMEM
43D2 7E           MOV    A,M
43D3 E60F         ANI    0FH        ;REMOVE OLD VOLUME
43D5 B0           ORA    B           ;ADD-ON NEW VOLUME
43D6 77           MOV    M,A
43D7 E1           POP    H
43D8 C34941       JMP    FIND1      ;NEXT CHAR.
43DB 7E           EQ1:  MOV    A,M
43DC 23           INX    H
43DD BE           CMP    M           ;PP OR II?
43DE C8           RZ
43DF 2B           DCX    H
43E0 C9           RET

```

```

;TRANSFER DATA FROM ONE LOCATION OF MEMORY
;TO ANOTHER. H&L=DESTINATION ADDRESS
;D&E=SOURCE ADDRESS,C=NO. OF BYTES TO
;TRANSFER.

```

```

43E1 1A          TRAN1: LDAX   D           ;GET DATA
43E2 77          MOV    M,A         ;PUT IT HERE
43E3 13          INX    D
43E4 23          INX    H
43E5 0D          DCR    C           ;COUNT THE BYTES
43E6 C2E143      JNZ    TRAN1       ;JUMP FOR MORE
43E9 C9          RET

```

```

;THIS ROUTINE EATS UP COMMENTS PUT IN THE
;MUSIC FILE.

```

```

43EA FE22       REM1:  CPI    022H    ;"?
43EC C0         RNZ
43ED 23       REM2:  INX    H           ;START EATING CHAR.
43EE 7E       MOV    A,M
43EF FE22       CPI    022H
43F1 C8         RZ           ;END OF COMMENT. EXIT
43F2 FE0D       CPI    0DH     ;OOPS!
43F4 C2ED43     JNZ    REM2
43F7 C9         RET

```

```

;SERVICE EACH CARD BY CHECKING THE
;"EOM" FLAG. IF EOM IS SET, THEN GO
;TO THE NEXT CARD ELSE GO AN UPDATE
;THE CARD. IF ALL THE CARDS ARE AT
;EOM THEN MOVE STATEMENT POINTERS FOR
;EACH CARD TO THE NEXT MEASURE.

```

```

43F8 0600       PLAY:  MVI    B,0     ;CLEAR EOM ACC.
43FA 3E01       MVI    A,1
43FC 32AE49     STA    N2         ;START WITH CRD 1
43FF 4F         MOV    C,A
4400 11C349     LXI    D,CMEM
4403 210700     NXTCD: LXI    H,7
4406 19         DAD    D           ;POINT TO EOM BYTE
4407 7E         MOV    A,M        ;GET EOM
4408 E604       ANI    4           ;;
440A CA4F44     JZ     OREOM      ;JUMP IF EOM

```



```

;CHECK IF INTERRUPT COUNTER REGISTER
;IS ZERO YET. IF THE COUNTER IS ZERO
;THEN CHECK "D0" FLAG AND TURN-OFF CARD,
;IF THE FLAG IS CORRECT. ALSO,IF COUNTER
;IS ZERO,THEN INTERPRET NEXT CHARACTER.
440D 79      NEOM:  MOV    A,C      ;;
440E 32BC49  STA    B1      ;;SAVE CARD COUNTER
4411 78      MOV    A,B      ;;
4412 32BD49  STA    B2      ;;SAVE EOM ACCUM.
4415 7E      MOV    A,M      ;;GET TRIPLET FLAGS
4416 2B      DCX    H      ;;POINT TO TRIPLET COUNTER
4417 35      DCR    M      ;;      AND DECREMENT
4418 C24A44  JNZ    CONT2   ;;CONTINUE IF NOT ZERO
441B E603    ANI    3      ;;MASK 2 TRIPLET BITS
441D 77      MOV    M,A     ;;      AND STORE IN CTR.
441E 2B      DCX    H      ;;POINT TO INTERRUPT CTR.
441F 35      DCR    M      ;;CHECK COUNT
4420 C24A44  JNZ    CONT2   ;;NOT DONE YET?
4423 34      INR    M      ;;
4424 23      INX    H      ;;POINT TO TRIPLET CTR
4425 3601    MVI    M,1     ;;
4427 23      INX    H      ;;POINT TO FLAG BYTE
4428 7E      MOV    A,M      ;;GET FLAG
4429 E640    ANI    40H     ;;TEST D0 BIT
442B C23E44  JNZ    CONT1   ;;DON'T TURN-OFF(D0)
442E 210A00  LXI    H,10    ;;
4431 19      DAD    D      ;;POINT TO MSCB
4432 7E      MOV    A,M      ;;
4433 F680    ORI    80H     ;;SET "OFF" BIT
4435 77      MOV    M,A     ;;UPDATE CMEM
4436 D5      PUSH   D      ;;SAVE CMEM POINTER
4437 EB      XCHG             ;;
4438 1EF2    MVI    E,0F2H  ;;LO ADDR OF CSCB
443A 23      INX    H      ;;
443B 56      MOV    D,M     ;;HI ADDR OF CSCB
443C 12      STAX   D      ;;TURN-OFF CARD
443D D1      POP    D      ;;
443E D5      CONT1:  PUSH  D      ;;
443F EB      XCHG             ;;
4440 23      INX    H      ;;
4441 23      INX    H      ;;
4442 5E      MOV    E,M     ;;
4443 23      INX    H      ;;
4444 56      MOV    D,M     ;;GET STATEM. PNTR
4445 EB      XCHG             ;;
4446 D1      POP    D      ;;
;NOW INTERPRET STATEMENT WITH D&E=CMEM
;ADDRESS AND H&L=STATEMENT ADDRESS.
4447 CD4941  CALL   FINDI   ;;
;BE SURE TO PASS BACK EOM IN REGISTER-A
;AND CMEM ADDRESS IN D&E.
444A 2ABC49  CONT2:  LHLD   B1   ;;
444D 4D      MOV    C,L     ;;
444E 44      MOV    B,H     ;;
444F B0      OREOM:  ORA    B      ;;COMBINE EOM BYTES
4450 47      MOV    B,A     ;;
4451 3AAD49  LDA    N1     ;;
4454 B9      CMP    C      ;;LAST CARD YET?

```

```

4455 CA6544      JZ      CKEOM    ;FINISHED ALL CARDS?
4458 0C          INR      C          ;NEXT CARD
4459 79          MOV      A,C
445A 32AE49      STA      N2
445D 211000      LXI      H,16
4460 19          DAD      D          ;MOVE POINTER IN CMEM
4461 EB          XCHG
4462 C30344      JMP      NXTCD
4465 04          CKEOM: INR      B
4466 05          DCR      B          ;ALL CARDS @ EOM?
4467 C22C40      JNZ      ENTR2
446A CD7044      CALL     SETUP    ;SET PNTR FOR NEXT MEAS.
446D C3F843      JMP      PLAY

;;THIS ROUTINE CLEARS ALL 8 EOM FLAGS.
4470 111000      SETUP: LXI      D,16    ;;ADDS 16 TO EOM POINTER
4473 010408      LXI      B,0804H ;;B IS CARD CTR, C IS MASK
4476 21CA49      LXI      H,CMEM+7; ;POINTS TO 1ST EOM FLAG
4479 7E          SET1:  MOV      A,M    ;;
447A B1          ORA      C          ;;
447B 77          MOV      M,A    ;;SAVE CLEARED EOM FLAG
447C 19          DAD      D          ;;POINT TO NEXT FLAG
447D 05          DCR      B          ;;8 CARDS YET?
447E C27944      JNZ      SET1    ;;IF NOT, LOOP

;THIS ROUTINE WILL SET THE STATEMENT ADDR
;FOR EACH CARD AND PUT THIS ADDR INTO CMEM.
4481 2AB149      LHL      A2      ;GET MOVING PNTR
4484 EB          XCHG          ;;PUT IN D&E
4485 21C549      LXI      H,CMEM+2; ;POINT TO 1ST CMEM
4488 010F00      LXI      B,0FH   ;;ADDER FOR CMEM PNTR
448B 3E01        MVI      A,1     ;;FIRST CARD
448D 32AD49      SET2:  STA      N1    ;;SAVE CARD CTR
4490 73          MOV      M,E     ;;SAVE STMT ADDR IN CMEM
4491 23          INX      H          ;;
4492 72          MOV      M,D     ;;
4493 09          DAD      B          ;;POINT TO NEXT CMEM
4494 13          SET3:  INX      D          ;;POINT TO NEXT CHAR
4495 1A          LDAX     D          ;;GET NEXT CHAR
4496 E67F        ANI      7FH     ;;
4498 FE2F        CPI      '/'     ;;END OF MEASURE?
449A CAB244      JZ      SET6     ;;YES,QUIT
449D FE3B        CPI      ';'     ;;END OF CARD'S CODING?
449F C29444      JNZ      SET3     ;;NO,LOOP
44A2 3AAD49      SET4:  LDA      N1    ;;GET CARD COUNTER
44A5 3C          INR      A          ;;ADD ONE
44A6 FE09        CPI      9        ;;MORE THEN 8 CARDS?
44A8 C28D44      JNZ      SET2     ;;NO,GO SAVE STMT POINTER
44AB 13          SET5:  INX      D          ;;POINT TO NEXT CHAR
44AC 1A          LDAX     D          ;;GET CHARACTER
44AD FE2F        CPI      '/'     ;;END OF MEASURE YET?
44AF C2AB44      JNZ      SET5     ;;NO,LOOP
44B2 E3          SET6:  XCHG
44B3 22B149      SHLD     A2      ;;END OF MEASURE SO STORE
44B6 11C349      LXI      D,CMEM  ;;SAVE NEW MOVING PNTR
44B9 2AC549      LHL      CMEM+2 ;GET 1ST STATEMENT ADDR.
44BC 3E01        MVI      A,1
44BE 32AE49      STA      N2      ;FIRST CARD PLEASE
44C1 3AC249      LDA      PASS    ;; GET OPTION NUMBER
44C4 E601        ANI      1        ;; CHECK LEAST SIG BIT

```

```

44C6 C8          RZ          ;; RETURN IF NO VIDEO
                ;; START OF NEW MEASURE, SO CLEAR THE SCREEN AND
                ;; INITIALIZE POINTERS TO BEGINNING OF EACH LINE.

44C7 C5          PUSH       B          ;;
44C8 D5          PUSH       D          ;;
44C9 E5          PUSH       H          ;;
44CA AF          XRA        A          ;; PUT 0 IN A.
                LXI        H,VIDEO    ;; H HAS ADDRESS OF 1ST VIDEO LIN

44CB 2100EC      LXI        D,80H     ;; ADD 64 FOR NEXT VIDEO LINE
44CE 118000      STA        GTBL1    ;; STORE FREQUENCY BYTE
44D1 32F74E      SHLD      GTBL1+4    ;; STORE DISPLAY POINTER
44D4 22FB4E      DAD        D          ;;
44D7 19          STA        GTBL2
44D8 32FD4E      SHLD      GTBL2+4
44DB 22014F      DAD        D          ;;
44DE 19          STA        GTBL3
44DF 32034F      SHLD      GTBL3+4
44E2 22074F      DAD        D          ;;
44E5 19          STA        GTBL4
44E6 32094F      SHLD      GTBL4+4
44E9 220D4F      DAD        D          ;;
44EC 19          STA        GTBL5
44ED 320F4F      SHLD      GTBL5+4
44F0 22134F      DAD        D          ;;
44F3 19          STA        GTBL6
44F4 32154F      SHLD      GTBL6+4
44F7 22194F      DAD        D          ;;
44FA 19          STA        GTBL7
44FB 321B4F      SHLD      GTBL7+4
44FE 221F4F      DAD        D          ;;
4501 19          STA        GTBL8
4502 32214F      SHLD      GTBL8+4
4505 22254F      ;; CLEAR ONLY THE LINES USED

4508 0E08      MVI        C,8          ;; 8 LINES
450A 11F54E      LXI        D,GTBL1-2
450D 210600      MEAS2:  LXI        H,6
4510 19          DAD        D          ;; POINT TO GTBL1'S POINTER
4511 5D          MOV        E,L
4512 54          MOV        D,H
4513 7E          MOV        A,M
4514 23          INX        H
4515 66          MOV        H,M
4516 6F          MOV        L,A
4517 0610      MVI        B,16
4519 3E20      MVI        A,' '      ;; SPACE INTO REG.-A
451B 77          MEAS3:  MOV        M,A      ;; FILL 4 CONSECUTIVE MEMORY
451C 23          INX        H          ;; LOCATIONS WITH SPACES
451D 77          MOV        M,A
451E 23          INX        H
451F 77          MOV        M,A
4520 23          INX        H
4521 77          MOV        M,A
4522 23          INX        H
4523 05          DCR        B          ;; DO 16 TIMES TO CLEAR EACH
4524 C21B45      JNZ        MEAS3      ;; LINE.
4527 0D          DCR        C          ;; FINISHED ALL USED LINES?

```

```

4528 C20D45      JNZ      MEAS2
452B E1          POP      H
452C D1          POP      D
452D C1          POP      B
452E C9          RET

;FOUND THE END OF A MEASURE FOR THE MUSIC
;CARD BEING SERVICED.  SET FLAGS.
452F CD6C43     END1:  CALL    PUTAD
4532 210700     LXI      H,7      ;;
4535 19         DAD      D      ;POINT TO EOM
4536 7E         MOV      A,M
4537 E6FB       ANI      0FBH    ;;SET EOM FLAG
4539 77         MOV      M,A    ;PUT BACK
453A AF         XRA      A      ;PASS ON EOM FLAG
453B C9         RET

;FOUND THE END OF THE MUSIC FILE.  TURN
;OFF ALL THE MUSIC CARDS, SET EOM=0FH,
;SET DTO=0, SET INTERRUPT COUNT=1, SET
;STOP FLAG=0 AND TURN OFF INTERRUPT.
453C CD6C43     STOP1: CALL    PUTAD  ;POINT TO "SI"
453F 0608       MVI      B,08    ;CHG 8 AREAS OF CMEM
4541 11C349     LXI      D,CMEM
4544 210400     STOP2: LXI      H,04
4547 19         DAD      D      ;POINT TO INT1
4548 3601       MVI      M,1
454A 23         INX      H      ;POINT TO INT2
454B 3601       MVI      M,1
454D 23         INX      H      ;;POINT TO TRIPLET CTR
454E 3603       MVI      M,3    ;;STORE NOT TRIPLET COUNT
4550 23         INX      H      ;;DTO/EOM TRIPLET FLAG
4551 360F       MVI      M,0FH
4553 210A00     LXI      H,10
4556 19         DAD      D
4557 7E         MOV      A,M    ;GET MSCB BYTE
4558 F680       ORI      80H
455A 77         MOV      M,A    ;UPDATE CMEM
455B CD5643     CALL    GO      ;TURN-OFF CARD
455E 211000     LXI      H,10H
4561 19         DAD      D      ;NEXT CMEM AREA
4562 EB         XCHG
4563 05         DCR      B      ;ALL CMEM?
4564 C24445     JNZ      STOP2
4567 3E00       MVI      A,0    ;SET STPFG=STOP
4569 32C149     STA     STPFG
456C D341       OUT     1010   ;TURN-OFF INTERRUPT
456E E1         POP     H      ;CLEAR STACK
456F F1         POP     PSW
4570 C1         POP     B
4571 D1         POP     D
4572 E1         POP     H
4573 F9         SPHL
4574 E1         POP     H
4575 F3         DI
4576 C9         RET

;READ IN BEATS/MIN. AND TIME SIGNATURE
;THEN LOAD TIMER ROUTINE(OR CIRCUIT).
4577 CD9442     BEAT1: CALL   NREAD ;CONVERT BEATS TO BINARY
457A 78         MOV     A,B

```

```

457B 32AA49      STA      T3          ;;;SAVE BEATS
457E 7E          MOV      A,M
457F FE2C        CPI      ','        ;;;MORE NUMBERS?
4581 C29245      JNZ      TIMER      ;;;
4584 CD9442      CALL     NREAD      ;;;BEATS PER MEASURE
4587 78          MOV      A,B        ;;;
4588 32AB49      STA      T4          ;;;
458B CD9442      CALL     NREAD      ;;;DURATION FOR BEAT
458E 78          MOV      A,B        ;;;
458F 32AC49      STA      T5          ;;;

;USING THE NUMBER IN "T5" AND
;THE NUMBER OF BEATS IN "T3", COMPUTE
;A BINARY VALUE THAT WILL SET THE SOFT-
;WARE(OR CIRCUIT) AT THE RIGHT TEMPO.

4592 3AAA49      TIMER:  LDA      T3          ;GET BEATS
4595 E6FE        ANI      0FEH      ;;;EVEN NUMBERS ONLY.
4597 D628        SUI      40         ;SUBTRACT 40
4599 D5          PUSH     D
459A E5          PUSH     H
459B 5F          MOV      E,A
459C 1600        MVI      D,0
459E 210F46      LXI      H,BMEM    ;POINT TO BEAT MEMORY
45A1 19          DAD      D
45A2 5E          MOV      E,M        ;LSB OF VALUE
45A3 23          INX      H
45A4 56          MOV      D,M        ;MSB OF VALUE
45A5 6B          MOV      L,E
45A6 62          MOV      H,D
45A7 3AAC49      LDA      T5          ;;;NOTE DURATION PER BEAT
45AA 3D          TIM1:  DCR      A          ;;
45AB CAB245      JZ       TIM2
45AE 19          DAD      D          ;INCREASE VALUE BY B
45AF C3AA45      JMP      TIM1

;*.....LOAD----FOR HARDWARE TIMER,SWLD1----
;FOR SOFTWARE TIMER.
45B2 CDBB45      TIM2:  CALL     SWLD1    ;* LOAD TIMER
45B5 E1          POP      H
45B6 D1          POP      D
45B7 2B          DCX      H          ;;;
45B8 C3DD41      JMP      FIND3      ;;;

;SOFTWARE TIMER LOAD ROUTINE. TAKE TIMER'S
;VALUE IN H&L REGISTERS AND DIVIDE BY FOUR
;TO CORRECT FOR THE DIFFERENCES IN TIMING
;BETWEEN HARDWARE(5 MICRO-S) VS SOFTWARE
;(20 MICRO-S).
45BB 0602      SWLD1: MVI      B,2
45BD AF        SWLD2: XRA      A          ;CLEAR CARRY FLAG
45BE 7C          MOV      A,H
45BF 1F          RAR
45C0 67          MOV      H,A
45C1 7D          MOV      A,L
45C2 1F          RAR
45C3 6F          MOV      L,A
45C4 05          DCR      B
45C5 C2BD45      JNZ      SWLD2

;GENERATE 2'S COMPLEMENT OF VALUE

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45C8 7D          MOV      A,L
45C9 2F          CMA
45CA 6F          MOV      L,A
45CB 7C          MOV      A,H
45CC 2F          CMA
45CD 67          MOV      H,A
45CE 23          INX      H          ;COMPLEMENT
;SAVE NEW TIMER VALUE
45CF 22A849     SHLD    TI
45D2 C9          RET
;THIS TIMER WILL SUPPORT THE MUSIC ROUTINE
;IF YOU DON'T HAVE AN INTERRUPT TIMER CARD
;ACCURACY IS FAIR TO GOOD, DUE TO VARIABLE
;TIME IN INTERPETING THE MUSIC LANGUAGE.
45D3 31A649     NBRD1: LXI      SP,TSTK
45D6 22AF49     NBRD2: SHLD    AI          ;SAVE FILE ADDRESS
45D9 CD9E40     CALL    STRT1+3 ;SET-UP CARDS
45DC 2AA849     NBRD3: LHL    TI          ;GET TIME VALUE
45DF 110800     LXI    D,DELTA ;A FUDGE FACTOR
45E2 19          DAD    D
45E3 CDF345     CALL    STIM1 ;WASTE TIME
45E6 CD1240     CALL    ENTRI ;CALL MUSIC
45E9 3AC149     LDA    STPFG ;CHECK STOP FLAG
45EC B7          ORA    A          ;ZERO?
45ED C2DC45     JNZ    NBRD3 ;REPEAT
45F0 C30F40     NBRD4: JMP    LOOP ;END. LOOP FOREVER
45F3 AF          STIM1: XRA    A
45F4 110100     LXI    D,1
;;STIM2 TAKES 20 MICROSECONDS PER CYCLE.
;;THE ROUTINE IS WRITTEN FOR 0 WAIT STATES
;;BUT THE COMMENTS SHOW HOW TO CHANGE THE
;;ROUTINE TO 1 OR 2 WAIT STATES.
45F7 19          STIM2: DAD    D          ;;1W DAD D          2W DAD D
45F8 00          NOP                    ;; NOP          NOP
45F9 00          NOP                    ;; NOP          NOP
45FA 00          NOP                    ;; MOV A,B          JNC STIM2
45FB 00          NOP                    ;; JNC STIM2          NOP
45FC 00          NOP                    ;; NOP          NOP
45FD D2F745     JNC    STIM2          ;; NOP          NOP
4600 C9          RET                    ;; RET          RET
;LOAD SCRATCH MEMORY WITH TIMER VALUE FROM
;H&L. TRANSFER VALUE TO HARDWARE CARD.
4601 22A849     LOAD: SHLD    TI          ;SAVE NEW TIME
4604 7C          MOV      A,H          ;1/2 OF NEW TIME
4605 F680     ORI      80H          ;SET MSB=1
4607 67          MOV      H,A
4608 7D          MOV      A,L
4609 D340     OUT     100Q          ;LOAD 1/2 OF TIME
460B 7C          MOV      A,H
460C D341     OUT     101Q          ;LOAD 1/2 OF TIME
460E C9          RET
;THIS TABLE DEFINES ALL THE CONSTANTS NEEDED
;FOR TEMPOS FROM 40 TO 200 BEATS A MINUTE.
460F 5307     BMEM: DW      1875D ;40 BEATS
4611 D005     DW      1488D ;42
4613 8D05     DW      1421D ;44
4615 4F05     DW      1359D ;46
4617 1605     DW      1302D ;48

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4619 E204	DW	1250D	::50
461B B204	DW	1202D	::52
461D 8504	DW	1157D	::54
461F 5C04	DW	1116D	::56
4621 3604	DW	1078D	::58
4623 1204	DW	1042D	::60
4625 F003	DW	1008D	::62
4627 D103	DW	977D	::64
4629 B303	DW	947D	::66
462B 9703	DW	919D	::68
462D 7D03	DW	893D	::70
462F 6403	DW	868D	::72
4631 4D03	DW	845D	::74
4633 3603	DW	822D	::76
4635 2103	DW	801D	::78
4637 0D03	DW	781D	::80
4639 FA02	DW	762D	::82
463B E802	DW	744D	::84
463D D702	DW	727D	::86
463F C602	DW	710D	::88
4641 B602	DW	694D	::90
4643 A702	DW	679D	::92
4645 9902	DW	665D	::94
4647 8B02	DW	651D	::96
4649 7E02	DW	638D	::98
464B 7102	DW	625D	::100
464D 6502	DW	613D	::102
464F 5902	DW	601D	::104
4651 4E02	DW	590D	::106
4653 4302	DW	579D	::108
4655 3802	DW	568D	::110
4657 2E02	DW	558D	::112
4659 2402	DW	548D	::114
465B 1B02	DW	539D	::116
465D 1202	DW	530D	::118
465F 0902	DW	521D	::120
4651 0002	DW	512D	::122
4663 F801	DW	504D	::124
4665 F001	DW	496D	::126
4667 E801	DW	488D	::128
4669 E101	DW	481D	::130
466B D901	DW	473D	::132
466D D201	DW	466D	::134
466F CC01	DW	460D	::136
4671 C501	DW	453D	::138
4673 BE01	DW	446D	::140
4675 B801	DW	440D	::142
4677 B201	DW	434D	::144
4679 AC01	DW	428D	::146
467B A601	DW	422D	::148
467D A101	DW	417D	::150
467F 9B01	DW	411D	::152
4681 9601	DW	406D	::154
4683 9101	DW	401D	::156
4685 8C01	DW	396D	::158
4687 8701	DW	391D	::160
4689 8201	DW	386D	::162
468B 7D01	DW	381D	::164

468D	7901	DW	377D	;;166
468F	7401	DW	372D	;;168
4691	7001	DW	368D	;;170
4693	6B01	DW	363D	;;172
4695	6701	DW	359D	;;174
4697	6301	DW	355D	;;176
4699	5F01	DW	351D	;;178
469B	5B01	DW	347D	;;180
469D	5701	DW	343D	;;182
469F	5401	DW	340D	;;184
46A1	5001	DW	336D	;;186
46A3	4C01	DW	332D	;;188
46A5	4901	DW	329D	;;190
46A7	4601	DW	326D	;;192
46A9	4201	DW	322D	;;194
46AB	3F01	DW	319D	;;196
46AD	3C01	DW	316D	;;198
46AF	3901	DW	313D	;;200

```

;THIS ROUTINE WILL READ THE NUMBER AFTER A
;REPEAT CHARACTER AND DETERMINE IF IT IS
;THE BEGINNING OR END OF A MUSICAL PASSAGE
;UNDER REPEAT CONTROL.

```

46B1	CD9442	REPM1:	CALL	NREAD	;	LOOK FOR NUMBER
46B4	AF		XRA	A	;	SET A=0
46B5	B8		CMP	B		
46B6	CAE146		JZ	REPM3	;	END OF REPEAT CMD?

```

;
;SERVICE THE START OF A REPEAT COMMAND.
;
;NOTE: THIS PIECE OF ASSEMBLY CODE WAS ADDED
;TO MAKE SURE THE NUMBER OF REPEATS ARE THE
;SAME FOR EACH OF THE CARDS.
;

```

46B9	E5		PUSH	H	;;;	
46BA	D5		PUSH	D	;;;	
46BB	0E08		MVI	C,8	;	UPDATE 8 CARDS
46BD	04		INR	B	;	CORRECT REPEAT NO.
46BE	21CE49		LXI	H,CMEM+11	;	POINT TO REPN
46C1	70	REPM6:	MOV	M,B		
46C2	111000		LXI	D,10H		
46C5	19		DAD	D	;	NEXT REPN IN CMEM
46C6	0D		DCR	C	;	DONE YET?
46C7	C2C146		JNZ	REPM6		
46CA	D1		POP	D		
46CB	E1		POP	H	;;;	
46CC	EB		XCHG		;;;	
46CD	E5		PUSH	H	;;;	
46CE	010C00		LXI	B,12		
46D1	09		DAD	B	;	POINT TO REPS IN CMEM
46D2	73		MOV	M,E		
46D3	23		INX	H		
46D4	72		MOV	M,D		
46D5	2AB149		LHLD	A2	;	GET MOVING POINTER
46D8	22B349		SHLD	A3	;	SAVE NEXT MEASURE ADDR.
46DB	E1		POP	H		
46DC	EB		XCHG			
46DD	2B		DCX	H		
46DE	C34941		JMP	FIND1	;	NEXT CMD PLEASE


```

;
;SERVICE THE END-OF-REPEAT COMMAND.
;

```

```

46E1 E5      REPM3:  PUSH      H          ;;;
46E2 D5      PUSH      D
46E3 EB      XCHG
46E4 010E00  LXI        B,14
46E7 09      DAD        B          ;POINT TO REPE IN CMEM
46E8 73      MOV        M,E
46E9 23      INX        H
46EA 72      MOV        M,D
46EB D1      POP        D
46EC 2AB149  LHLD       A2
46EF 22B549  SHLD      A4          ;SAVE END OF REPEAT
46F2 210B00  LXI        H,11
46F5 19      DAD        D          ;POINT TO REPN IN CMEM
46F6 35      DCR        M          ;DECREMENT REPEAT NO.
46F7 CA1647  JZ        REPM5      ;FINISHED REPEATING?
46FA 210C00  LXI        H,12
46FD 19      DAD        D          ;POINT TO REPS IN CMEM
46FE D5      PUSH      D
46FF 5E      MOV        E,M
4700 23      INX        H
4701 56      MOV        D,M
4702 EB      XCHG
4703 D1      POP        D
4704 E3      XTHL
4705 3AAD49  LDA        N1          ;PUT REPS INTO STACK
4708 47      MOV        B,A        ;HOW MANY CARDS?
4709 3AAE49  LDA        N2          ;CARD BEING SERVICED
470C B8      CMP        B          ;LAST CARD YET?
470D C21647  JNZ       REPM5
4710 2AB349  LHLD       A3          ;GET SPECIAL REPEAT ADDR.
4713 22B149  SHLD      A2          ;MOVE POINTER BACKWARDS
4716 E1      REPM5:  POP        H          ;GET STATEMENT ADDRESS.
4717 2B      DCX        H
4718 C34941  JMP        FIND1

```

```

;CHECK FOR A MUSICAL EXIT POINT WITHIN
;A REPEATED SECTION, AND EXIT TO THE
;END-OF-REPEAT COMMAND DURING THE LAST
;PASS.

```

```

471B 23      JUMP1:  INX        H          ;;;
471C E5      PUSH      H          ;SAVE STATEMENT ADDR.
471D 210B00  LXI        H,11
4720 19      DAD        D          ;POINT TO REPN
4721 35      DCR        M          ;CHECK REPEAT NO.
4722 CA2A47  JZ        JUMP2
4725 34      INR        M          ;NOT LAST PASS YET
4726 E1      POP        H
4727 C34941  JMP        FIND1
472A 2AB549  JUMP2:  LHLD       A4          ;GET END ADDRESS
472D 22B149  SHLD      A2          ;MOVE MAIN POINTER
4730 210E00  LXI        H,14
4733 19      DAD        D          ;POINT TO REPE
4734 7E      MOV        A,M
4735 23      INX        H
4736 66      MOV        H,M

```

```

4737 6F      MOV      L,A
4738 E3      XTHL           ;PUSH END ADDR.

4739 E1      POP      H
473A C34941  JMP      FIND1

;;THIS IS A SECOND SERIES OF REPEAT INSTRUCTIONS
;;WHICH USES THE COLON AS A REPEAT INDICATOR.
;;THE BEGINNING OF A REP HAS THE COLON AS THE FIRST
;;CHARACTER IN A MEASURE.
;;THE END OF REPEAT COLON MUST IMMEDIATELY PRECEED
;;AN END OF MEASURE SYMBOL(I.E. :/)
473D 23      COLON: INX      H           ;;LOOK AT CHAR FOLLOWING ":"
473E 7E      MOV      A,M           ;;
473F FE2F    CPI      '/'         ;;IF IT'S AN END OF MEASURE,
4741 CA4B47  JZ       COL1         ;; THEN IT'S AND END REPEAT.
4744 2B      DCX      H           ;;IF NOT,IT'S BEGIN REPEAT
4745 22B849  SHLD    BREP         ;;SO STORE BEGIN ADDR AND
4748 C34941  JMP      FIND1       ;; CONTINUE ON.
474B 3AB749  COL1:  LDA      INREP    ;;IF REPEAT FLAG SET,
474E B7      ORA      A           ;; IT'S THE SECOND TIME THRU.
474F CA5A47  JZ       COL2         ;;JMP IF 1ST TIME THRU
4752 AF      XRA      A           ;;2ND TIME THRU,SO CLEAR INREP
4753 32B749  STA      INREP       ;; AND CONTINUE ON AS IF
4756 2B      DCX      H           ;; NOTHING HAPPENED
4757 C34941  JMP      FIND1       ;;
475A 3EFF    COL2:  MVI      A,0FFH   ;;SET INREP-FLAG,GET ADDRESS
475C 32B749  STA      INREP       ;; OF BEGINNING OF REPEAT AND
475F 22BA49  SHLD    EREP         ;; PLAY MUSIC OVER AGAIN.
4762 E5      PUSH     H           ;;
4763 2AB849  LHL     BREP         ;;GET BEGINNING OF REP. AND
4766 22B149  SHLD    A2           ;; PUT IT IN MOVING POINTER
4769 E1      POP      H           ;; SO IT WILL BE PLAYED NEXT.
476A 2B      DCX      H           ;;
476B C34941  JMP      FIND1       ;;CONTINUE

;;IF A "J" IS ENCOUNTERED, JUMP OUT OF REPEAT AND
;;SETUP CARDS AFTER END OF REPEAT SYMBOL AT ADDRESS
;;PREVIOUSLY STORED IN EREP.
476E 3AB749  JREP:  LDA      INREP    ;;IF 1ST TIME THRU REPEAT
4771 B7      ORA      A           ;; SIMPLY IGNORE ANY "J"
4772 CA4941  JZ       FIND1       ;;
4775 AF      XRA      A           ;;OTHERWISE,CLEAR REPEAT FLAG
4776 32B749  STA      INREP       ;;
4779 E5      PUSH     H           ;;SAVE POINTER
477A 2ABA49  LHL     EREP         ;;GET END OF REPEAT ADDRESS
477D 22B149  SHLD    A2           ;; AND PUT IT IN MOVING PNTR
4780 E1      POP      H           ;;RECOVER POINTER
4781 C34941  JMP      FIND1       ;; AND CONTINUE

;;THIS ROUTINE ALLOWS DIRECT CONTROL OF
;;THE FREQUENCY OF THE CARD BY ENTERING
;;A DECIMAL NUMBER INTO "MFREQ" OF CMEM.
4784 CD9442  FREQ1: CALL     NREAD    ;GET VALUE
4787 2B      DCX      H           ;;
4788 CD6C43  CALL     PUTAD        ;SAVE STATEMENT ADDR.
478B 210800  LXI     H,8
478E 19      DAD     D           ;POINT TO MFREQ
478F 70      MOV     M,B
4790 C34843  JMP     NOTE0        ;CONTINUE AT NOTE0

```

;THIS ROUTINE WILL SET THE DURATION OF AN
;ENVELOPE ATTACK TIME.

```

4793 CD9442  RTIME:  CALL  NREAD  ;GET VALUE
4796 78      MOV    A,B
4797 E60F    ANI    0FH    ;SAVE ONLY 4 BITS
4799 47      MOV    B,A
479A E5      PUSH   H      ;SAVE STATEMENT ADDR.
479B 210A00  LXI    H,10
479E 19      DAD    D      ;POINT TO MSCB
479F 7E      MOV    A,M    ;GET OLD TIME
47A0 E6F0    ANI    0F0H
47A2 B0      ORA    B      ;INSERT NEW TIME
47A3 77      MOV    M,A
47A4 E1      POP    H
47A5 2B      DCX    H
47A6 C3DD41  JMP    FIND3  ;NEXT CMD PLEASE.

```

;THIS ROUTINE ALLOWS THE DIRECT CONTROL OF
;THE CARD'S VOLUME.

```

47A9 CD9442  LEVEL:  CALL  NREAD  ;GET VALUE
47AC 78      MOV    A,B
47AD 87      ADD    A      ;;SHIFT LEFT 4 BITS
47AE 87      ADD    A      ;;
47AF 87      ADD    A      ;;
47B0 87      ADD    A      ;;
47B1 47      MOV    B,A
47B2 E5      PUSH   H      ;SAVE STATEMENT ADDR.
47B3 210900  LXI    H,9
47B6 19      DAD    D      ;POINT TO MVOB
47B7 7E      MOV    A,M
47B8 E60F    ANI    0FH    ;REMOVE OLD VOLUME
47BA B0      ORA    B      ;PUT TOGETHER
47BB 77      MOV    M,A
47BC E1      POP    H
47BD 2B      DCX    H
47BE C3DD41  JMP    FIND3  ;GET NEXT CHARACTER

```

;THIS ROUTINE WILL SET A DON'T-TURN-OFF
;FLAG(DTO).THE MUSIC CARD WILL BE UPDATED
;WITHOUT RETRIGGERING THE ENVELOPE
;CIRCUIT FOR ONLY ONE ATTACK ENVELOPE. BE
;SURE TO USE AN ENVELOPE WHICH ENDS IN A
;CONSTANT AMPLITUDE OR NO MORE SOUNDS WILL
;BE HEARD FROM THE CARD AFTER THIS COM-
;MAND.

```

47C1 CD9442  LEVON:  CALL  NREAD
47C4 E5      PUSH   H      ;;
47C5 210700  LXI    H,7    ;;CALC ADDR OF FLAG BYTE
47C8 19      DAD    D      ;;
47C9 7E      MOV    A,M    ;;GET FLAG BYTE
47CA E6BF    ANI    0BFH   ;;CLEAR DTO BIT
47CC 05      DCR    B      ;;TEST DIGIT AFTER " L"
47CD C2D247  JNZ    LEV1   ;;JMP IF DIGIT WASN'T 1
47D0 F640    ORI    40H    ;;SET DTO BIT
47D2 77      LEV1:  MOV    M,A  ;;STORE NEW DTO BIT
47D3 E1      POP    H
47D4 2B      DCX    H
47D5 C3DD41  JMP    FIND3  ;NEXT CHARACTER
;THIS ROUTINE SETS OR CLEARS THE TRIPLET FLAG.
47D8 0602    TRIPL:  MVI    B,2  ;;SET COUNT 2,TRIPLETS

```

```

47DA DA DB 0DAH ;;
47DB 0603 TRIP2: MVI B,3 ;;SET COUNT 3,NO TRIPLETS
47DD E5 PUSH H ;;
47DE 210700 LXI H,7 ;;CALC ADDR OF FLAGS
47E1 19 DAD D ;;
47E2 7E MOV A,M ;;GET FLAG BYTE
47E3 E6FC ANI 0FCH ;;CLEAR TRIPLET FLAG BIT
47E5 B0 ORA B ;;SET BITS TO 2 OR 3
47E6 77 MOV M,A ;;STORE TRIPLET FLAG
47E7 E1 POP H ;;
47E8 C34941 JMP FIND1 ;;

```

```

;THIS ROUTINE WILL LET THE USER SET THE
;KEY SIGNATURE FOR A MUSICAL PIECE.
;THE NOTES THAT SHOULD BE SHARPED OR FLATED
;WILL BE TYPED IN AFTER THIS COMMAND.
;EXAMPLE: (K,+F,-B)

```

```

47EB E5 KEYS1: PUSH H ;SAVE STATEMENT ADDR.
47EC 215F4A LXI H,KMEM
47EF 060E MVI B,14
47F1 AF XRA A
47F2 77 KEYS8: MOV M,A ;CLEAR KMEM
47F3 23 INX H
47F4 05 DCR B
47F5 C2F247 JNZ KEYS8
47F8 E1 POP H ;RESTORE STATEMENT
47F9 23 KEYS7: INX H
47FA 7E MOV A,M
47FB E67F ANI 7FH ;;
47FD 0600 MVI B,0
47FF FE2B CPI '+' ;SHARP?
4801 C20948 JNZ KEYS2
4804 0601 MVI B,1 ;DELTA=1
4806 C31048 JMP KEYS3
4809 FE2D KEYS2: CPI '-' ;FLAT?
480B C23E48 JNZ KEYS5
480E 06FF MVI B,0FFH ;DELTA=-1
4810 23 KEYS3: INX H
4811 7E MOV A,M ;GET LETTER
4812 E67F ANI 7FH ;;
4814 0E01 MVI C,1 ;SET KMEM OFFSET

```

```

4816 E5 PUSH H ;SAVE STATEMENT ADDR.
4817 213B48 LXI H,KEYS4
481A E3 XTHL ;SET A RETURN ADDRESS
481B FE43 CPI 'C'
481D C8 RZ
481E 0C INR C
481F 0C INR C
4820 FE44 CPI 'D'
4822 C8 RZ
4823 0C INR C
4824 0C INR C
4825 FE45 CPI 'E'
4827 C8 RZ
4828 0C INR C
4829 FE46 CPI 'F'
482B C8 RZ

```

```

482C 0C          INR      C
482D 0C          INR      C
482E FE47       CPI      'G'
4830 C8         RZ
4831 0C          INR      C
4832 0C          INR      C
4833 FE41       CPI      'A'
4835 C8         RZ
4836 0C          INR      C
4837 0C          INR      C
4838 FE42       CPI      'B'
483A C9         RET
483B CA4648     KEYS4: JZ      KEYS6   ;RETURN TO KEYS4
483E FE29       KEYS5: CPI      '),'   ;JUMP, IF A LETTER
4840 C2F947     JNZ      KEYS7   ;COMMAND END?
4843 C34941     JMP      FIND1   ;JUMP, IF NOT AT END
4846 D5         KEYS6: PUSH     D      ;END, SO EXIT
4847 E5         PUSH     H
4848 215F4A     LXI      H, KMEM
484B 59         MOV      E, C
484C 1600       MVI      D, 0
484E 19         DAD      D      ;POINT AT NOTE IN KMEM
484F 70         MOV      M, B   ;SET DELTA
4850 E1         POP      H
4851 D1         POP      D
4852 C3F947     JMP      KEYS7   ;BACK FOR MORE NOTES

;THIS ROUTINE CAN SET, CLEAR OR LEAVE
;UNCHANGED THE FOUR UPPER CONTROL BITS OF
;THE SPECIAL CONTROL BYTE AT XXF2H OF THE
;MUSIC CARD.

4855 23         CTRL1: INX      H
4856 CD8942     CALL     SPACE   ;;;GET CODE
4859 CD8042     CALL     NUMB    ;;;NUMBER?
485C DA6548     JC      CTRL2   ;;;NUMBER?
485F CD9A48     CALL     MASK    ;;;
4862 C35548     JMP      CTRL1   ;;;
4865 FE58       CTRL2: CPI      'X'  ;IS IT "X" ?
4867 C27A48     JNZ      CTRL3   ;;;
486A 3E01       MVI      A, 1    ;;;
486C CD9A48     CALL     MASK
486F 3ABE49     LDA      MI      ;;;
4872 E6FE       ANI      0FEH   ;;;CORRECT "OR" MASK
4874 32BE49     STA      MI      ;;;
4877 C35548     JMP      CTRL1   ;BACK FOR MORE
487A 2B         CTRL3: DCX     H   ;;;END OF CMD?
487B E5         PUSH     H      ;;;SAVE STATEMENT ADDR
487C 3ABF49     LDA      M2     ;GET "AND" MASK
487F 07         RLC
4880 07         RLC
4881 07         RLC
4882 07         RLC
4883 F60F       ORI      0FH    ;;;
4885 47         MOV      B, A   ;SAVE M2
4886 3ABE49     LDA      MI     ;GET "OR" MASK
4889 07         RLC
488A 07         RLC
488B 07         RLC
488C 07         RLC

```

```

488D E6F0      ANI      0F0H      ;;;
488F 210A00    LXI      H,10
4892 19        DAD      D          ;POINT TO MSCB
4893 B6        ORA      M          ;SET ALL 1 BITS

4894 A0        ANA      B          ;SET ALL 0 BITS
4895 77        MOV      M,A       ;SAVE NEW MSCB
4896 E1        POP      H          ;;;
4897 C3DD41    JMP      FIND3     ;;;EXIT. FINISHED.
489A E601      MASK: ANI      1          ;IS LSB=0 OR 1?
489C 47        MOV      B,A       ;;;
489D 3ABE49    LDA      M1        ;;;GET "OR" MASK
48A0 07        RLC
48A1 E6FE      ANI      0FEH
48A3 B0        ORA      B          ;;;
48A4 32BE49    STA      M1        ;;;CREATE NEW "OR"
48A7 3ABF49    LDA      M2        ;;;GET "AND" MASK
48AA 07        RLC
48AB E6FE      ANI      0FEH
48AD B0        ORA      B          ;;;
48AE 32BF49    STA      M2        ;;;CREATE NEW "AND"
48B1 C9        RET

```

```

;THIS ROUTINE WILL LOAD IN THE PARAMETERS
;SPECIFIED FOR A WAVEFORM(W0-X) OR AN ENVELOPE
;(E0-X) INTO A TABLE FOR LATER USE IN MUSIC.
;"X" CAN BE ANY VALUE FROM 0 TO 7.

```

```

48B2 CD9442    WAVE1: CALL    NREAD
48B5 78        MOV      A,B       ;GET NUMBER
48B6 B7        ORA      A          ;CHECK FOR ZERO
48B7 C21049    JNZ      WVX       ;JUMP,IF NOT A LOAD CMD
48BA D5        PUSH     D
48BB 11ED4A    LXI      D,WMEM    ;POINT TO WAVEFORM MEMORY
48BE 0E04      MVI      C,4
48C0 C3D148    JMP      FLT1      ;GO COMPUTE TABLE ADDR.
48C3 CD9442    SHAPE: CALL    NREAD
48C6 78        MOV      A,B
48C7 B7        ORA      A
48C8 C24249    JNZ      SHX       ;JUMP,IF NOT LOAD CMD
48CB D5        PUSH     D
48CC 116D4A    LXI      D,EMEM   ;POINT TO ENVELOPE MEMORY
48CF 0E01      MVI      C,1
48D1 CDFD48    FLT1:  CALL    TADJ1  ;COMPUTE TABLE ADDRESS
48D4 2B        DCX      H
48D5 23        FLT5:  INX      H
48D6 CD8942    FLT2:  CALL    SPACE   ;;
48D9 FE0D      CPI      0150
48DB CAF248    JZ       FLT3      ;GO REMOVE LINE NO.
48DE FE29      CPI      ')'
48E0 CAF948    JZ       FLT4      ;END OF COMMAND
48E3 CD8042    CALL    NUMB       ;CHECK FOR A NUMBER
48E6 DAD548    JC       FLT5      ;JUMP,IF NOT A NUMBER
48E9 CD9442    CALL    NREAD      ;GET NEXT NUMBER
48EC 78        MOV      A,B       ;GET DATA
48ED 12        STAX    D          ;SAVE NO. IN TABLE
48EE 13        INX      D
48EF C3D648    JMP      FLT2
48F2 2B        FLT3:  DCX      H

```

48F3	CD7642	CALL	NNUM4	
48F6	C3D648	JMP	FLT2	
48F9	D1	POP	D	
48FA	C34941	JMP	FIND1	
48FD	CD9442	TADJ1:	CALL	NREAD ;GET TABLE NUMBER
4900	E5		PUSH	H ;SAVE STATEMENT ADDR.
4901	2600		MVI	H,0
4903	68		MOV	L,B ;SET H&L=NUMBER
4904	29		DAD	H ;X2
4905	29		DAD	H ;X4
4906	29		DAD	H ;X8
4907	29	TADJ2:	DAD	H ;X16
4908	0D		DCR	C
4909	C20749		JNZ	TADJ2 ;INCREASE AGAIN?
490C	19		DAD	D ;ADD TABLE START
490D	EB		XCHG	
490E	E1		POP	H ;RESTORE STATEMENT
490F	C9		RET	
4910	3D	WVX:	DCR	A
4911	E601		ANI	1
4913	07		RLC	
4914	07		RLC	
4915	07		RLC	
4916	07		RLC	
4917	47		MOV	B,A ;ADJUST CTRL BIT
4918	E5		PUSH	H ;SAVE CTRL BIT
4919	210A00		LXI	H,10 ;SAVE STATEMENT ADDR.
491C	19		DAD	D ;POINT TO MSCB
491D	7E		MOV	A,M
491E	E6EF		ANI	3570
4920	B0		ORA	B ;CHANGE WAVEFORM SELECT
4921	77		MOV	M,A ;PUT INTO CMEM
4922	E1		POP	H ;RESTORE STATEMENT
4923	7E		MOV	A,M
4924	FE2D		CPI	'-' ;TRANSFER WAVEFORM?
4926	C23E49		JNZ	WVX1 ;; JUMP, IF NO.
4929	CD5E49		CALL	OFF ;TURN-OFF CARD
492C	D5		PUSH	D ;;;SAVE CMEM ADDRESS
492D	C5		PUSH	B ;SAVE CARD'S ADDRESS
492E	11ED4A		LXI	D,WMEM
4931	0E04		MVI	C,4
4933	CDFD48		CALL	TADJ1
4936	E3		XTHL	
4937	0E80		MVI	C,128 ;;;SET H&L=CARD'S ADDR.
4939	CDE143		CALL	TRAN1 ;TRANSFER WAVEFORM
493C	E1		POP	H ;;;
493D	D1		POP	D
493E	2B	WVX1:	DCX	H
493F	C3DD41		JMP	FIND3 ;;
4942	CD5E49	SHX:	CALL	OFF ;TURN-OFF CARD
4945	D5		PUSH	D ;;;
4946	C5		PUSH	B
4947	116D4A		LXI	D,EMEM
494A	0E01		MVI	C,1
494C	CDFD48		CALL	TADJ1
494F	E3		XTHL	
4950	01E000		LXI	B,0E0H ;;;GET CARD'S ADDR.

```

4953 09          DAD      B          ;POINT TO CRD ENVELOPE
4954 0E10       MVI      C,16
4956 CDE143     CALL     TRAN1    ;TRANSFER ENVELOPE,
4959 E1         POP      H          ;;
495A D1         POP      D
495B C33E49     JMP      WVX1     ;FIND END OF CMD.

```

```

495E D5         OFF:    PUSH     D
495F E5         PUSH     H
4960 210A00     LXI      H,10
4963 19         DAD      D
4964 7E         MOV      A,M      ;GET MSCB
4965 F680       ORI      80H      ;SET "OFF" BIT
4967 EB         XCHG
4968 4E         MOV      C,M      ;;LOW ADDR OF CARD
4969 23         INX      H
496A 46         MOV      B,M      ;;HIGH ADDR OF CARD
496B 60         MOV      H,B      ;;B&C POINT TO CARD
496C 2EF2       MVI      L,0F2H   ;;H&L POINT TO CSCB
496E 77         MOV      M,A      ;TURN-OFF CARD
496F E1         POP      H
4970 D1         POP      D
4971 C9         RET

```

;SCRATCH MEMORY TABLE

```

4972          DS      056Q      ;SPACE FOR STACK-2
49A0 0000     TOPS2:  DW      0        ;SAVE OLD STACK POINTER
49A2 0000     DW      0
49A4 0000     DW      0
49A6 0000     TSTK:   DW      0        ;STACK FOR SOFTW. TIMER
49A8 00       T1:     DB      0        ;TIME STORAGE
49A9 00       T2:     DB      0        ;DITTO
49AA 64       T3:     DB      100D     ;BEATS PER MINUTE
49AB 04       T4:     DB      4        ;BEATS PER MEASURE
49AC 04       T5:     DB      4        ;NOTE DURATION /BEAT
49AD 01       N1:     DB      1        ;NO. OF CARDS/MEASURE
49AE 01       N2:     DB      1        ;CARD BEING SERVICED
49AF 0050     A1:     DW      05000H   ;START OF MUSIC FILE.
49B1 0050     A2:     DW      05000H   ;NEXT MEASURE POINTER
49B3 0050     A3:     DW      05000H   ;REPEAT POINTER, START
49B5 0050     A4:     DW      05000H   ;REPEAT POINTER, END
49B7 00       INREP:  DB      0        ;;COLON FLAG
49B8 0050     BREP:   DW      5000H    ;;COLON, STARTING ADDRESS
49BA 0050     EREP:   DW      5000H    ;;COLON, END ADDRESS
49BC 01       B1:     DB      1        ;CARD COUNTER
49BD 0F       B2:     DB      0FH      ;EOM ACCUMULATER
49BE 00       M1:     DB      0        ;SAVE "OR" MASK BYTE
49BF 00       M2:     DB      0        ;SAVE "AND" MASK BYTE
49C0 00       M3:     DB      0        ;USED BY "DEC1"
49C1 FF       STPFG:  DB      0FFH    ;STOP FLAG(SOFTWARE TIMER)
49C2 00       PASS:   DB      0        ;CONTROL PARAMETER

```

;THIS TABLE SAVES ALL INFORMATION

;NECESSARY TO UPDATE AND CONTROL UP TO

;EIGHT MUSIC CARDS.

```

MAC1      MACRO    C1
          DW      CARDS+C1  ;; POINTER TO CARD'S ADDR.
          DW      05000H    ;POINTER TO STATEMENT
          DB      04        ;FIX NO., INTERRUPT CT.(INT1)
          DB      01        ;INTERRUPT COUNTER (INT2)

```



```

DB      01      ;;TRIPLET COUNTER
DB      FLG     ;;DTO, EOM & TRIPLET FLAGS
DB      247Q    ;MFREQ. FREQUENCY BYTE
DB      0F4H    ;MVOB. VOL./OCT. BYTE
DB      0C0H    ;MSCB. SPECIAL CTRL BYTE
DB      01      ;REPN. NUMBER OF REPEATS
DW      05000H  ;REPS. START OF REPEATS
DW      05080H  ;REPE. END OF REPEATS
ENDM

```

```

;
CMEM:  MACI     000H   ;CARD 1
        DW      CARDS+00000H ;; POINTER TO CARD'S ADDR.

```

```

49C3  0080
49C5  0050      DW      05000H  ;POINTER TO STATEMENT
49C7  04        DB      04      ;FIX NO., INTERRUPT CT.(INT1)
49C8  01        DB      01      ;INTERRUPT COUNTER (INT2)
49C9  01        DB      01      ;;TRIPLET COUNTER
49CA  0F        DB      FLG     ;;DTO, EOM & TRIPLET FLAGS
49CB  A7        DB      247Q    ;MFREQ. FREQUENCY BYTE
49CC  F4        DB      0F4H    ;MVOB. VOL./OCT. BYTE
49CD  C0        DB      0C0H    ;MSCB. SPECIAL CTRL BYTE
49CE  01        DB      01      ;REPN. NUMBER OF REPEATS
49CF  0050      DW      05000H  ;REPS. START OF REPEATS
49D1  8050      DW      05080H  ;REPE. END OF REPEATS

```

```

MACI     100H   ;CARD 2
        DW      CARDS+00100H ;; POINTER TO CARD'S ADDR.

```

```

49D3  0081
49D5  0050      DW      05000H  ;POINTER TO STATEMENT
49D7  04        DB      04      ;FIX NO., INTERRUPT CT.(INT1)
49D8  01        DB      01      ;INTERRUPT COUNTER (INT2)
49D9  01        DB      01      ;;TRIPLET COUNTER
49DA  0F        DB      FLG     ;;DTO, EOM & TRIPLET FLAGS
49DB  A7        DB      247Q    ;MFREQ. FREQUENCY BYTE
49DC  F4        DB      0F4H    ;MVOB. VOL./OCT. BYTE
49DD  C0        DB      0C0H    ;MSCB. SPECIAL CTRL BYTE
49DE  01        DB      01      ;REPN. NUMBER OF REPEATS
49DF  0050      DW      05000H  ;REPS. START OF REPEATS
49E1  8050      DW      05080H  ;REPE. END OF REPEATS

```

```

MACI     200H   ;CARD 3
        DW      CARDS+00200H ;; POINTER TO CARD'S ADDR.

```

```

49E3  0082
49E5  0050      DW      05000H  ;POINTER TO STATEMENT
49E7  04        DB      04      ;FIX NO., INTERRUPT CT.(INT1)
49E8  01        DB      01      ;INTERRUPT COUNTER (INT2)
49E9  01        DB      01      ;;TRIPLET COUNTER
49EA  0F        DB      FLG     ;;DTO, EOM & TRIPLET FLAGS
49EB  A7        DB      247Q    ;MFREQ. FREQUENCY BYTE
49EC  F4        DB      0F4H    ;MVOB. VOL./OCT. BYTE
49ED  C0        DB      0C0H    ;MSCB. SPECIAL CTRL BYTE
49EE  01        DB      01      ;REPN. NUMBER OF REPEATS
49EF  0050      DW      05000H  ;REPS. START OF REPEATS
49F1  8050      DW      05080H  ;REPE. END OF REPEATS

```

```

MACI     300H   ;CARD 4
        DW      CARDS+00300H ;; POINTER TO CARD'S ADDR.

```

49F3 0083
49F5 0050
49F7 04
49F8 01
49F9 01
49FA 0F
49FB A7
49FC F4
49FD C0
49FE 01
49FF 0050
4A01 8050

DW 05000H ; POINTER TO STATEMENT
DB 04 ; FIX NO., INTERRUPT CT.(INT1)
DB 01 ; INTERRUPT COUNTER (INT2)
DB 01 ; ; TRIPLET COUNTER
DB FLG ; ; DTO, EOM & TRIPLET FLAGS
DB 247Q ; MFREQ. FREQUENCY BYTE
DB 0F4H ; MVOB. VOL./OCT. BYTE
DB 0C0H ; MSCB. SPECIAL CTRL BYTE
DB 01 ; REPN. NUMBER OF REPEATS
DW 05000H ; REPS. START OF REPEATS
DW 05080H ; REPE. END OF REPEATS

MAC1 400H ; CARD 5
DW CARDS+00400H ; ; POINTER TO CARD'S ADDR.

4A03 0084
4A05 0050
4A07 04
4A08 01
4A09 01
4A0A 0F
4A0B A7
4A0C F4
4A0D C0
4A0E 01
4A0F 0050
4A11 8050

DW 05000H ; POINTER TO STATEMENT
DB 04 ; FIX NO., INTERRUPT CT.(INT1)
DB 01 ; INTERRUPT COUNTER (INT2)
DB 01 ; ; TRIPLET COUNTER
DB FLG ; ; DTO, EOM & TRIPLET FLAGS
DB 247Q ; MFREQ. FREQUENCY BYTE
DB 0F4H ; MVOB. VOL./OCT. BYTE
DB 0C0H ; MSCB. SPECIAL CTRL BYTE
DB 01 ; REPN. NUMBER OF REPEATS
DW 05000H ; REPS. START OF REPEATS
DW 05080H ; REPE. END OF REPEATS

MAC1 500H ; CARD 6
DW CARDS+00500H ; ; POINTER TO CARD'S ADDR.

4A13 0085
4A15 0050
4A17 04
4A18 01
4A19 01
4A1A 0F
4A1B A7
4A1C F4
4A1D C0
4A1E 01
4A1F 0050
4A21 8050

DW 05000H ; POINTER TO STATEMENT
DB 04 ; FIX NO., INTERRUPT CT.(INT1)
DB 01 ; INTERRUPT COUNTER (INT2)
DB 01 ; ; TRIPLET COUNTER
DB FLG ; ; DTO, EOM & TRIPLET FLAGS
DB 247Q ; MFREQ. FREQUENCY BYTE
DB 0F4H ; MVOB. VOL./OCT. BYTE
DB 0C0H ; MSCB. SPECIAL CTRL BYTE
DB 01 ; REPN. NUMBER OF REPEATS
DW 05000H ; REPS. START OF REPEATS
DW 05080H ; REPE. END OF REPEATS

MAC1 600H ; CARD 7
DW CARDS+00600H ; ; POINTER TO CARD'S ADDR.

4A23 0086
4A25 0050
4A27 04
4A28 01
4A29 01
4A2A 0F
4A2B A7
4A2C F4
4A2D C0
4A2E 01
4A2F 0050
4A31 8050

DW 05000H ; POINTER TO STATEMENT
DB 04 ; FIX NO., INTERRUPT CT.(INT1)
DB 01 ; INTERRUPT COUNTER (INT2)
DB 01 ; ; TRIPLET COUNTER
DB FLG ; ; DTO, EOM & TRIPLET FLAGS
DB 247Q ; MFREQ. FREQUENCY BYTE
DB 0F4H ; MVOB. VOL./OCT. BYTE
DB 0C0H ; MSCB. SPECIAL CTRL BYTE
DB 01 ; REPN. NUMBER OF REPEATS
DW 05000H ; REPS. START OF REPEATS
DW 05080H ; REPE. END OF REPEATS

	MAC1	700H	;LAST,CARD 8
	DW	CARDS+00700H	; ; POINTER TO CARD'S ADDR.
4A33	0087		
4A35	0050	DW	05000H ;POINTER TO STATEMENT
4A37	04	DB	04 ;FIX NO.,INTERRUPT CT.(INT1)
4A38	01	DB	01 ;INTERRUPT COUNTER (INT2)
4A39	01	DB	01 ;;TRIPLET COUNTER
4A3A	0F	DB	FLG ;;DTO, EOM & TRIPLET FLAGS
4A3B	A7	DB	247Q ;MFREQ. FREQUENCY BYTE
4A3C	F4	DB	0F4H ;MVOB. VOL./OCT. BYTE
4A3D	C0	DB	0C0H ;MSCB. SPECIAL CTRL BYTE
4A3E	01	DB	01 ;REPN. NUMBER OF REPEATS
4A3F	0050	DW	05000H ;REPS. START OF REPEATS
4A41	8050	DW	05080H ;REPE. END OF REPEATS

;THIS TABLE DEFINES ONE OCTAVE OF
;NOTES FOR THE MUSIC CARD.

4A43	63	NMEM: DB	143Q	; -C
4A44	6B	DB	153Q	; C
4A45	73	DB	163Q	; -D
4A46	7B	DB	173Q	; D
4A47	82	DB	202Q	; +D
4A48	89	DB	211Q	; E
4A49	90	DB	220Q	; F
4A4A	96	DB	226Q	; +F
4A4B	9C	DB	234Q	; G
4A4C	A2	DB	242Q	; +G
4A4D	A7	DB	247Q	; A
4A4E	AC	DB	254Q	; +A
4A4F	B1	DB	261Q	; B
4A50	B6	DB	266Q	; +B

; ; THIS TABLE DEFINES ONE OCTAVE OF
; ; NOTES FOR INVERTED MUSIC

4A51	B6	IMEM: DB	266Q	; ; -C PLAYS +B
4A52	B1	DB	261Q	; ; C PLAYS B
4A53	AC	DB	254Q	; ; -D PLAYS +A
4A54	A7	DB	247Q	; ; D PLAYS A
4A55	A2	DB	242Q	; ; +D PLAYS +G
4A56	9C	DB	234Q	; ; E PLAYS G
4A57	96	DB	226Q	; ; F PLAYS +F
4A58	90	DB	220Q	; ; +F PLAYS F
4A59	89	DB	211Q	; ; G PLAYS E
4A5A	82	DB	202Q	; ; +G PLAYS +D
4A5B	7B	DB	173Q	; ; A PLAYS D
4A5C	73	DB	163Q	; ; +A PLAYS +C
4A5D	6B	DB	153Q	; ; B PLAYS C
4A5E	63	DB	143Q	; ; -C PLAYS +B

;THIS IS A KEY SIGNATURE TABLE WHICH
;INDICATES WHICH NOTE SHOULD BE SHARPED
;OR FLATED. 0=NATURAL,1=SHARP,FFH=FLAT.

4A5F	00	KMEM: DB	0	
4A60	00	DB	0	; C
4A61	00	DB	0	
4A62	00	DB	0	; D

```

4A63 00 DB 0
4A64 00 DB 0 ;E
4A65 00 DB 0 ;F
4A66 00 DB 0
4A67 00 DB 0 ;G
4A68 00 DB 0
4A69 00 DB 0 ;A
4A6A 00 DB 0
4A6B 00 DB 0 ;B
4A6C 00 DB 0

```

```

;THIS TABLE DEFINES EIGHT ATTACK ENVELOPES
;OF 16 BYTES EACH .

```

```

4A6D 0F0E0D0C EMEM: DB 15,14,13,12 ;;E0-0
4A71 0B0A0908 DB 11,10,9,8 ;; LINEAR DECAY
4A75 07060504 DB 7,6,5,4, ;; TO ONE.
4A79 03020101 DB 3,2,1,1 ;;
;
4A7D 0F0E0D0C DB 15,14,13,12 ;;E0-1
4A81 0B0A0808 DB 11,10,8,8 ;; LINEAR DECAY
4A85 08080808 DB 8,8,8,8 ;; TO EIGHT.
4A89 08080808 DB 8,8,8,8 ;;
;
4A8D 0306090C DB 3,6,9,12 ;;;E0-2
4A91 0F0E0D0C DB 15,14,13,12 ;;; UP AND DOWN
4A95 0B0A0908 DB 11,10,9,8 ;;;
4A99 07060504 DB 7,6,5,4 ;;;
;
4A9D 0205090B DB 2,5,9,11 ;;E0-3
4AA1 0D0D0D0D DB 13,13,13,13 ;; UP,LEVEL,DOWN
4AA5 0D0D0D0D DB 13,13,13,13 ;;
4AA9 0B090502 DB 11,9,5,2 ;;
;
4AAD 0F0D0C0C DB 15,13,12,12 ;;E0-4
4AB1 0C0C0C0C DB 12,12,12,12 ;; CONSTANT AMPL.
4AB5 0C0C0C0C DB 12,12,12,12 ;;
4AB9 0C0C0C0C DB 12,12,12,12 ;;
;
4ABD 0F0C0A09 DB 15,12,10,9 ;;E0-5
4AC1 08070605 DB 8,7,6,5 ;; FAST DECAY
4AC5 04040303 DB 4,4,3,3 ;;
4AC9 02020201 DB 2,2,2,1 ;;
;
4ACD 0F080E07 DB 15,8,14,7 ;;E0-6
4AD1 0D060C05 DB 13,6,12,5 ;; WAVERING DECAY
4AD5 0B040A03 DB 11,4,10,3 ;;
4AD9 09020801 DB 9,2,8,1 ;;
;
4ADD 080E0F0F DB 8,14,15,15 ;;E0-7
4AE1 0F0F0F0F DB 15,15,15,15 ;; MODERATE ATTACK
4AE5 0F0E0D0C DB 15,14,13,12 ;; AND SLOW DECAY
4AE9 0B0A0908 DB 11,10,9,8 ;;
;

```

```

;THIS TABLE DEFINES EIGHT WAVEFORMS OF
;128 BYTES LONG EACH TO BE TRANSFERRED IN
;THE FUTURE TO A MUSIC CARD.

```

```

WM0 MACRO
DW 0C0C0H,0C0C0H ;SQUAREWAVE

```

```

DW      0C0C0H,0C0C0H
DW      0C0C0H,0C0C0H
DW      0C0C0H,0C0C0H
DW      04040H,04040H
DW      04040H,04040H
DW      04040H,04040H
DW      04040H,04040H
ENDM

;
WM1     MACRO                                     ;;
DW      0A894H,0CABAH                           ;; SINEWAVE
DW      0E1D7H,0E9E7H
DW      0E1E7H,0CAD7H
DW      0A8BAH,08094H
DW      0586CH,03646H
DW      01F29H,01719H
DW      01F19H,03629H
DW      05846H,0806CH
ENDM

;
WM2     MACRO                                     ;;
DW      0A090H,0C0B0H                           ;; TRIANGLE WAVE
DW      0E0D0H,0FFF0H
DW      0E0F0H,0C0D0H
DW      0A0B0H,08090H
DW      06070H,04050H
DW      02030H,00010H
DW      02010H,04030H
DW      06050H,08070H
ENDM

;
WM3     MACRO                                     ;;
DW      0AE98H,0C8BFH                           ;; FUNDAMENTAL AND
DW      0C5CAH,0AABAH                           ;; 2ND HARMONIC
DW      08999H,0747CH
DW      07270H,08078H
DW      08E88H,08C90H
DW      07784H,05667H
DW      03B46H,03836H
DW      05241H,08068H
ENDM

;
WM4     MACRO                                     ;;
DW      0724AH,0B696H                           ;; RECTIFIED SINEWAVE
DW      0E3D0H,0F3EFH
DW      0E3EFH,0B6D0H
DW      07296H,0214AH
DW      02121H,02121H
DW      02121H,02121H
DW      02121H,02121H
DW      02121H,02121H
ENDM

;
WM5     MACRO                                     ;;
DB      128,255,225,122 ;; FULL DIAPASON
DB      114,162,157,137 ;;
DB      174,210,184,171 ;;

```

```

DB      207,185,67,15  ;;
DB      128,241,189,71 ;;
DB      49,85,72,46   ;;
DB      82,119,99,94  ;;
DB      142,134,31,0  ;;
ENDM

```

```

;
WM6     MACRO          ;;
DB      128,167,195,214 ;; CELLO
DB      227,234,237,239 ;;
DB      235,224,210,195 ;;
DB      180,167,155,142 ;;
DB      128,114,101,89  ;;
DB      76,61,46,32    ;;
DB      21,17,19,22    ;;
DB      29,42,61,89    ;;
ENDM

```

```

;
WM7     MACRO          ;;
DB      128,241,255,229 ;; TRUMPET
DB      206,180,154,138 ;;
DB      136,144,147,150 ;;
DB      153,146,140,138 ;;
DB      128,118,116,110 ;;
DB      103,106,109,112 ;;
DB      120,118,102,76  ;;
DB      50,27,1,15     ;;
ENDM

```

```

;
WMEM:   WM0           ; W0-0
4AED    C0C0C0C0     DW      0C0C0H,0C0C0H  ; SQUAREWAVE
4AF1    C0C0C0C0     DW      0C0C0H,0C0C0H
4AF5    C0C0C0C0     DW      0C0C0H,0C0C0H
4AF9    C0C0C0C0     DW      0C0C0H,0C0C0H
4AFD    40404040     DW      04040H,04040H
4B01    40404040     DW      04040H,04040H
4B05    40404040     DW      04040H,04040H
4B09    40404040     DW      04040H,04040H

```

```

WM0
4B0D    C0C0C0C0     DW      0C0C0H,0C0C0H  ; SQUAREWAVE
4B11    C0C0C0C0     DW      0C0C0H,0C0C0H
4B15    C0C0C0C0     DW      0C0C0H,0C0C0H
4B19    C0C0C0C0     DW      0C0C0H,0C0C0H
4B1D    40404040     DW      04040H,04040H
4B21    40404040     DW      04040H,04040H
4B25    40404040     DW      04040H,04040H
4B29    40404040     DW      04040H,04040H

```

```

WM0
4B2D    C0C0C0C0     DW      0C0C0H,0C0C0H  ; SQUAREWAVE
4B31    C0C0C0C0     DW      0C0C0H,0C0C0H
4B35    C0C0C0C0     DW      0C0C0H,0C0C0H
4B39    C0C0C0C0     DW      0C0C0H,0C0C0H
4B3D    40404040     DW      04040H,04040H
4B41    40404040     DW      04040H,04040H
4B45    40404040     DW      04040H,04040H

```

4B49	40404040	DW	04040H,04040H	
		WM0		
4B4D	C0C0C0C0	DW	0C0C0H,0C0C0H	; SQUAREWAVE
4B51	C0C0C0C0	DW	0C0C0H,0C0C0H	
4B55	C0C0C0C0	DW	0C0C0H,0C0C0H	
4B59	C0C0C0C0	DW	0C0C0H,0C0C0H	
4B5D	40404040	DW	04040H,04040H	
4B61	40404040	DW	04040H,04040H	
4B65	40404040	DW	04040H,04040H	
4B69	40404040	DW	04040H,04040H	

		WM1		; W0-1
4B6D	94A8BACA	DW	0A894H,0CABAH	; SINEWAVE
4B71	D7E1E7E9	DW	0E1D7H,0E9E7H	
4B75	E7E1D7CA	DW	0E1E7H,0CAD7H	
4B79	BAA89480	DW	0A8BAH,08094H	
4B7D	6C584636	DW	0586CH,03646H	
4B81	291F1917	DW	01F29H,01719H	
4B85	191F2936	DW	01F19H,03629H	
4B89	46586C80	DW	05846H,0806CH	

		WM1		
4B8D	94A8BACA	DW	0A894H,0CABAH	; SINEWAVE
4B91	D7E1E7E9	DW	0E1D7H,0E9E7H	
4B95	E7E1D7CA	DW	0E1E7H,0CAD7H	
4B99	BAA89480	DW	0A8BAH,08094H	
4B9D	6C584636	DW	0586CH,03646H	
4BA1	291F1917	DW	01F29H,01719H	
4BA5	191F2936	DW	01F19H,03629H	
4BA9	46586C80	DW	05846H,0806CH	

		WM1		
4BAD	94A8BACA	DW	0A894H,0CABAH	; SINEWAVE
4BB1	D7E1E7E9	DW	0E1D7H,0E9E7H	
4BB5	E7E1D7CA	DW	0E1E7H,0CAD7H	
4BB9	BAA89480	DW	0A8BAH,08094H	
4BBD	6C584636	DW	0586CH,03646H	
4BC1	291F1917	DW	01F29H,01719H	
4BC5	191F2936	DW	01F19H,03629H	
4BC9	46586C80	DW	05846H,0806CH	

		WM1		
4BCD	94A8BACA	DW	0A894H,0CABAH	; SINEWAVE
4BD1	D7E1E7E9	DW	0E1D7H,0E9E7H	
4BD5	E7E1D7CA	DW	0E1E7H,0CAD7H	
4BD9	BAA89480	DW	0A8BAH,08094H	
4BDD	6C584636	DW	0586CH,03646H	
4BE1	291F1917	DW	01F29H,01719H	
4BE5	191F2936	DW	01F19H,03629H	
4BE9	46586C80	DW	05846H,0806CH	

		WM2		; W0-2
4BED	90A0B0C0	DW	0A090H,0C0B0H	; TRIANGLE WAVE
4BF1	D0E0F0FF	DW	0E0D0H,0FFF0H	
4BF5	F0E0D0C0	DW	0E0F0H,0C0D0H	
4BF9	B0A09080	DW	0A0B0H,08090H	

4BFD	70605040	DW	06070H,04050H
4C01	30201000	DW	02030H,00010H
4C05	10203040	DW	02010H,04030H
4C09	50607080	DW	06050H,08070H

		WM2		
4C0D	90A0B0C0	DW	0A090H,0C0B0H	; TRIANGLE WAVE
4C11	D0E0F0FF	DW	0E0D0H,0FFF0H	
4C15	F0E0D0C0	DW	0E0F0H,0C0D0H	
4C19	B0A09080	DW	0A0B0H,08090H	
4C1D	70605040	DW	06070H,04050H	
4C21	30201000	DW	02030H,00010H	
4C25	10203040	DW	02010H,04030H	
4C29	50607080	DW	06050H,08070H	

		WM2		
4C2D	90A0B0C0	DW	0A090H,0C0B0H	; TRIANGLE WAVE
4C31	D0E0F0FF	DW	0E0D0H,0FFF0H	
4C35	F0E0D0C0	DW	0E0F0H,0C0D0H	
4C39	B0A09080	DW	0A0B0H,08090H	
4C3D	70605040	DW	06070H,04050H	
4C41	30201000	DW	02030H,00010H	
4C45	10203040	DW	02010H,04030H	
4C49	50607080	DW	06050H,08070H	

		WM2		
4C4D	90A0B0C0	DW	0A090H,0C0B0H	; TRIANGLE WAVE
4C51	D0E0F0FF	DW	0E0D0H,0FFF0H	
4C55	F0E0D0C0	DW	0E0F0H,0C0D0H	
4C59	B0A09080	DW	0A0B0H,08090H	
4C5D	70605040	DW	06070H,04050H	
4C61	30201000	DW	02030H,00010H	
4C65	10203040	DW	02010H,04030H	
4C69	50607080	DW	06050H,08070H	

		WM3	; W0-3	
4C6D	98AEBFC8	DW	0AE98H,0C8BFH	; ; FUNDAMENTAL AND
4C71	CAC5BAAA	DW	0C5CAH,0AABAH	; ; 2ND HARMONIC
4C75	99897C74	DW	08999H,0747CH	
4C79	70727880	DW	07270H,08078H	
4C7D	888E908C	DW	08E88H,08C90H	
4C81	84776756	DW	07784H,05667H	
4C85	463B3638	DW	03B46H,03836H	
4C89	41526880	DW	05241H,08068H	

		WM3		
4C8D	98AEBFC8	DW	0AE98H,0C8BFH	; ; FUNDAMENTAL AND
4C91	CAC5BAAA	DW	0C5CAH,0AABAH	; ; 2ND HARMONIC
4C95	99897C74	DW	08999H,0747CH	
4C99	70727880	DW	07270H,08078H	
4C9D	888E908C	DW	08E88H,08C90H	
4CA1	84776756	DW	07784H,05667H	
4CA5	463B3638	DW	03B46H,03836H	
4CA9	41526880	DW	05241H,08068H	

		WM3		
4CAD	98AEBFC8	DW	0AE98H,0C8BFH	; ; FUNDAMENTAL AND
4CB1	CAC5BAAA	DW	0C5CAH,0AABAH	; ; 2ND HARMONIC

4CB5	99897C74	DW	08999H,0747CH
4CB9	70727880	DW	07270H,08078H
4CBD	888E908C	DW	08E88H,08C90H
4CC1	84776756	DW	07784H,05667H
4CC5	463B3638	DW	03B46H,03836H
4CC9	41526880	DW	05241H,08068H

WM3			
4CCD	98AEBFC8	IW	0AE98H,0C8BFH
4CD1	CAC5BAAA	LW	0C5CAH,0AABAH
4CD5	99897C74	IW	08999H,0747CH
4CD9	70727880	IW	07270H,08078H
4CDD	888E908C	IW	08E88H,08C90H
4CE1	84776756	IW	07784H,05667H
4CE5	463B3638	IW	03B46H,03836H
4CE9	41526880	IW	05241H,08068H

;; FUNDAMENTAL AND
;; 2ND HARMONIC

WM4			
; W0-4			
4CED	4A7296B6	DW	0724AH,0B696H
4CF1	D0E3EFF3	DW	0E3D0H,0F3EFH
4CF5	EFE3D0B6	DW	0E3EFH,0B6D0H
4CF9	96724A21	DW	07296H,0214AH
4CFD	21212121	DW	02121H,02121H
4D01	21212121	DW	02121H,02121H
4D05	21212121	DW	02121H,02121H
4D09	21212121	DW	02121H,02121H

; RECTIFIED SINEWAVE

WM4			
4D0D	4A7296B6	DW	0724AH,0B696H
4D11	D0E3EFF3	DW	0E3D0H,0F3EFH
4D15	EFE3D0B6	DW	0E3EFH,0B6D0H
4D19	96724A21	DW	07296H,0214AH
4D1D	21212121	DW	02121H,02121H
4D21	21212121	DW	02121H,02121H
4D25	21212121	DW	02121H,02121H
4D29	21212121	DW	02121H,02121H

; RECTIFIED SINEWAVE

WM4			
4D2D	4A7296B6	DW	0724AH,0B696H
4D31	D0E3EFF3	DW	0E3D0H,0F3EFH
4D35	EFE3D0B6	DW	0E3EFH,0B6D0H
4D39	96724A21	DW	07296H,0214AH
4D3D	21212121	DW	02121H,02121H
4D41	21212121	DW	02121H,02121H
4D45	21212121	DW	02121H,02121H
4D49	21212121	DW	02121H,02121H

; RECTIFIED SINEWAVE

WM4			
4D4D	4A7296B6	DW	0724AH,0B696H
4D51	D0E3EFF3	DW	0E3D0H,0F3EFH
4D55	EFE3D0B6	DW	0E3EFH,0B6D0H
4D59	96724A21	DW	07296H,0214AH
4D5D	21212121	DW	02121H,02121H
4D61	21212121	DW	02121H,02121H
4D65	21212121	DW	02121H,02121H
4D69	21212121	DW	02121H,02121H

; RECTIFIED SINEWAVE



4E21	4C3D2E20	DB	76,61,46,32	::
4E25	15111316	DB	21,17,19,22	::
4E29	1D2A3D59	DB	29,42,61,89	::

WM6

4E2D	80A7C3D6	DB	128,167,195,214	:: CELLO
4E31	E3EAEDEF	DB	227,234,237,239	::
4E35	EBE0D2C3	DB	235,224,210,195	::
4E39	B4A79B8E	DB	180,167,155,142	::
4E3D	80726559	DB	128,114,101,89	::
4E41	4C3D2E20	DB	76,61,46,32	::
4E45	15111316	DB	21,17,19,22	::
4E49	1D2A3D59	DB	29,42,61,89	::

WM6

4E4D	80A7C3D6	DB	128,167,195,214	:: CELLO
4E51	E3EAEDEF	DB	227,234,237,239	::
4E55	EBE0D2C3	DB	235,224,210,195	::
4E59	B4A79B8E	DB	180,167,155,142	::
4E5D	80726559	DB	128,114,101,89	::
4E61	4C3D2E20	DB	76,61,46,32	::
4E65	15111316	DB	21,17,19,22	::
4E69	1D2A3D59	DB	29,42,61,89	::

WM7

::W0-7

4E6D	80F1FFE5	DB	128,241,255,229	:: TRUMPET
4E71	CEB49A8A	DB	206,180,154,138	::
4E75	88909396	DB	136,144,147,150	::
4E79	99928C8A	DB	153,146,140,138	::
4E7D	8076746E	DB	128,118,116,110	::
4E81	676A6D70	DB	103,106,109,112	::
4E85	7876664C	DB	120,118,102,76	::
4E89	321B010F	DB	50,27,1,15	::

WM7

4E8D	80F1FFE5	DB	128,241,255,229	:: TRUMPET
4E91	CEB49A8A	DB	206,180,154,138	::
4E95	88909396	DB	136,144,147,150	::
4E99	99928C8A	DB	153,146,140,138	::
4E9D	8076746E	DB	128,118,116,110	::
4EA1	676A6D70	DB	103,106,109,112	::
4EA5	7876664C	DB	120,118,102,76	::
4EA9	321B010F	DB	50,27,1,15	::

WM7

4EAD	80F1FFE5	DB	128,241,255,229	:: TRUMPET
4EB1	CEB49A8A	DB	206,180,154,138	::
4EB5	88909396	DB	136,144,147,150	::
4EB9	99928C8A	DB	153,146,140,138	::
4EBD	8076746E	DB	128,118,116,110	::
4EC1	676A6D70	DB	103,106,109,112	::
4EC5	7876664C	DB	120,118,102,76	::
4EC9	321B010F	DB	50,27,1,15	::

WM7

4ECD	80F1FFE5	DB	128,241,255,229	:: TRUMPET
4ED1	CEB49A8A	DB	206,180,154,138	::
4ED5	88909396	DB	136,144,147,150	::

```

4ED9 99928C8A      DB      153,146,140,138 ;;
4EDD 8076746E      DB      128,118,116,110 ;;
4EE1 676A6D70      DB      103,106,109,112 ;;
4EE5 7876664C      DB      120,118,102,76  ;;
4EE9 321B010F      DB      50,27,1,15     ;;

```

```
;; SPECIAL TABLE FOR VIDEO ROUTINES
```

```

4EED 01      SPT0:  DB      1      ;;DIV.BY 3 RING CTR
4EEE 01      SPT1:  DB      1      ;;NUMBER OF CARDS
4EEF 1000    SPT2:  DW      16     ;; CMEM DELTA
4EF1 CD49    SPT3:  DW      CMEM+10 ;;
4EF3 0600    SPT4:  DW      6      ;;GTBL SIZE
4EF5 F74E    SPT5:  DW      GTBL1  ;;

```

```
;;
;; SCRATCH PAD FOR GRAPHIC INFORMATION
;;
```

```

MM1      MACRO   G1,G2,G3      ;;
          DB      0      ;; FREQ BYTE
          DB      0      ;; SPARE
          DB      G1     ;; OR-MASK
          DB      G2     ;; AND-MASK
          DW      G3     ;; DISPLAY POINTER
        ENDM      ;;

```

```

;;
GTBL1:   MM1      0, 3FH,VIDEO
4EF7 00      DB      0      ;; FREQ BYTE
4EF8 00      DB      0      ;; SPARE
4EF9 00      DB      00000H  ;; OR-MASK
4EFA 3F      DB      0003FH  ;; AND-MASK
4EFB 00EC    DW      0EC00H  ;; DISPLAY POINTER

```

```

GTBL2:   MM1      80H,0BFH,VIDEO+80H
4EFD 00      DB      0      ;; FREQ BYTE
4EFE 00      DB      0      ;; SPARE
4EFF 80      DB      00080H  ;; OR-MASK
4F00 BF      DB      000BFH  ;; AND-MASK
4F01 80EC    DW      0EC80H  ;; DISPLAY POINTER

```

```

GTBL3:   MM1      0, 3FH,VIDEO+100H
4F03 00      DB      0      ;; FREQ BYTE
4F04 00      DB      0      ;; SPARE
4F05 00      DB      00000H  ;; OR-MASK
4F06 3F      DB      0003FH  ;; AND-MASK
4F07 00ED    DW      0ED00H  ;; DISPLAY POINTER

```

```

GTBL4:   MM1      80H,0BFH,VIDEO+180H
4F09 00      DB      0      ;; FREQ BYTE
4F0A 00      DB      0      ;; SPARE
4F0B 80      DB      00080H  ;; OR-MASK
4F0C BF      DB      000BFH  ;; AND-MASK
4F0D 80ED    DW      0ED80H  ;; DISPLAY POINTER

```

```

GTBL5:   MM1      0, 3FH,VIDEO+200H
4F0F 00      DB      0      ;; FREQ BYTE
4F10 00      DB      0      ;; SPARE
4F11 00      DB      00000H  ;; OR-MASK
4F12 3F      DB      0003FH  ;; AND-MASK
4F13 00EE    DW      0EE00H  ;; DISPLAY POINTER

```

```

GTBL6: MM1      80H,0BFH,VIDEO+280H
4F15 00        DB      0          ;; FREQ BYTE
4F16 00        DB      0          ;; SPARE
4F17 80        DB      00080H    ;; OR-MASK
4F18 BF        DB      000BFH    ;; AND-MASK
4F19 80EE      DW      0EE80H    ;; DISPLAY POINTER

```

```

GTBL7: MM1      0, 3FH,VIDEO+300H
4F1B 00        DB      0          ;; FREQ BYTE
4F1C 00        DB      0          ;; SPARE
4F1D 00        DB      00000H    ;; OR-MASK
4F1E 3F        DB      0003FH    ;; AND-MASK
4F1F 00EF      DW      0EF00H    ;; DISPLAY POINTER

```

```

GTBL8: MM1      80H,0BFH,VIDEO+380H
4F21 00        DB      0          ;; FREQ BYTE
4F22 00        DB      0          ;; SPARE
4F23 80        DB      00080H    ;; OR-MASK
4F24 BF        DB      000BFH    ;; AND-MASK
4F25 80EF      DW      0EF80H    ;; DISPLAY POINTER

```

```

0000          END      ;END      OF SOURCE

```

7.0 SOFTWARE/HARDWARE TIMER

7.1 Software Timer

Written within MUS-XI is a software timer that times out the duration of sixty-fourth notes. The time-signature presets the timer with a value which will set the right tempo to the music. Since the timer relies on the execution time of a routine in software, the number of memory wait-states will affect the tempo. To correct for zero, one or two wait-states on RAM board, look at a routine named "STIM2" in the source listing (6.0) and a program change is shown that will adjust the timer.

7.2 Hardware Timer

MUS-XI was written with multi-programming in mind. If MUS-XI was supported with a interrupting timer of hardware, then the music program and another program could be run at the same time (time sharing). This hardware system would allow for software games with sound effects at the same time, like "Star Trek" with sound effects. Another case would be writing corrections to one piece of music while listening to a copy of it.

The hardware timer is still under development at this time, but can be described.

- a) The 2MHZ clock on the S-100 Bus would be tapped off through a buffer gate to drive a divide-by-ten counter.
- b) The 200KHZ signal from the divide-by-ten counter then drives four cascaded four-bit count-down counters.
- c) The four four-bit counter must be loadable with a four-bit code each.
- d) The four four-bit codes come from two parallel output ports at 40 Hex and 41 Hex. (The software to drive these ports is already present within MUS-XI).
- e) The data at port 40 Hex is the LSD and at port 41 Hex is the MSD of the time. The most significant bit of port 41 Hex should turn-on and off the 16-bit counter (four stages).

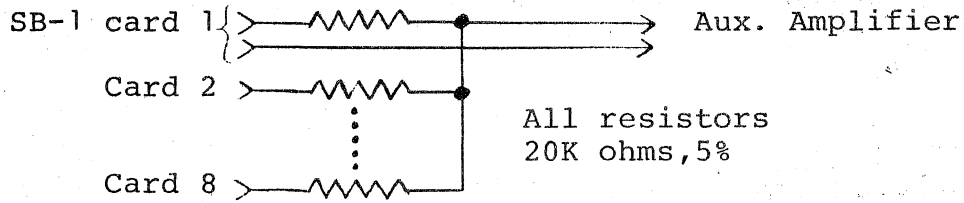
OFF = 0, ON = 1

- f) When the 16-bit counter counted down to zero, a circuit would interrupt the computer and then vector the computer to the entry point for "ENTRI" and reload the counters from the two ports.
- g) The vector command would be a "call" instruction with the address for "ENTRI" so when the music cards were updated MUS-XI would return control back to the other program that was running at the same time.

MIXERS

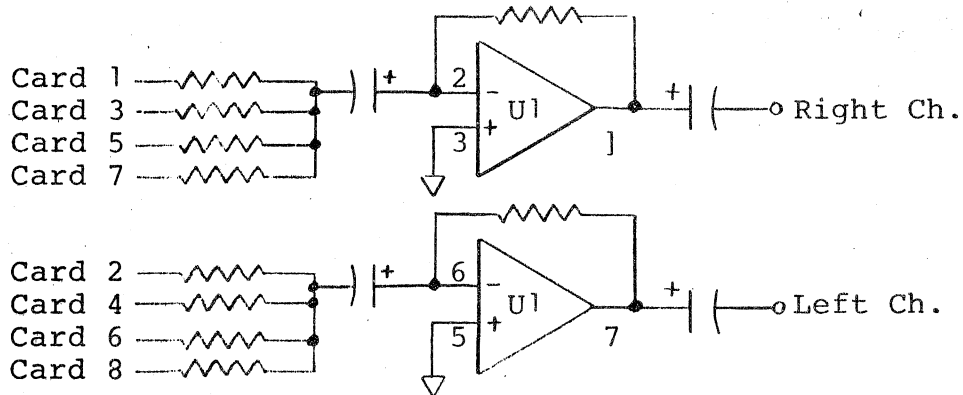
As more SB-1's are added to the computer, the outputs will have to be mixed into one or two common outputs to drive a mono or stereo amplifier. One of the following mixers can be used.

Passive



Active

Two 9 volt batteries, U1, pin8=+9V, U1, pin4=-9V



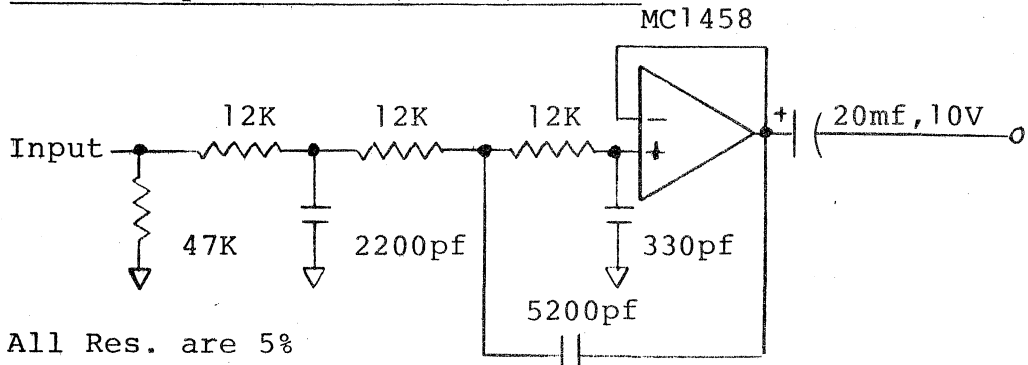
All Res.=20K, 5%
 All Cap.=20mf, 10V

MC1458

FILTER CIRCUIT

In some applications, the upper harmonics in a particular waveform is harsh sounding. The waveform out of the mixer can be filtered above 8KHz to soften the sound.

8KHz Low-pass Filter, 18 DB/Octave



















All Res. are 5%

MUSIC DECODING SHEET

Octave 4 Octave 5 Octave 6

NOTE.... C D E F G A B C D E F G A B C D E F G A B

Octave 1 Octave 2 Octave 3

- | | | | |
|---|--|---|--------------------------|
|  | ...Whole note (W) |  | ...Quarter rest (QR) |
|  | ...Half note (H) |  | ...Eighth rest (OR) |
|  | ...Quarter note (Q) |  | ...Half rest (HR) |
|  | ...Eighth note (O) |  | ...Whole rest (WR) |
|  | ...Sixteenth note (S) |  | ...Flat (-) |
|  | ...Thirtysecond note (T) |  | ...Sharp (+) |
|  | ...Increase note duration by 50% |  | ...Natural () |
|  | ...Repeat (between these brackets repeat the measures as indicated.) |  | ...Measure separator (/) |

Solid State Music

August 2, 1978

Sorry we goofed!

In adding the Video Driver and Additional Commands to MUS-XI, we also added two bugs. These errors can be corrected in MUS-XI, revision I with the following changes:

Error 1

See page 6-4, bottom of page.

Change "JZ ENTR2" to a "JZ ENTR3", and also change the code at address 4130 to CA9340, instead of CA2C40.

Error 2

See page 6-5, top of page.

Change "JMP ENTR2" to a "JMP ENTR3", and also change the code at address 4146 to C39340, instead of C32C40.

Error 3

See page 6-17, middle of page.

"TIMER" is a routine that is being used by "STRT5" as a subroutine. This causes problems since TIMER has no return instruction. This problem can be cured with a software patch.

- 1) Change "STA T5" to a "JMP PATCH", and also change the code at address 458F to C3E04F, instead of 32AC49.
- 2) Change "JNZ TIMER" to "JNZ P1", and also change the code at address 4581 to C2E34F, instead of C29245.
- 3) Change "DCX H" to a "RET", and also change the code at address 45B7 to C9, instead of 2B.
- 4) Now add the software routine called PATCH starting at address 4FE0.

<u>Address</u>	<u>Code</u>	<u>MNEMONIC</u>
4FE0	32AC49	PATCH: STA T5
4FE3	CD9245	P1: CALL TIMER
4FE6	2B	DCX H
4FE7	C3DD41	JMP FIND3

Sorry for the inconvenience.

Malcolm Wright
Director of R & D

MW:dp