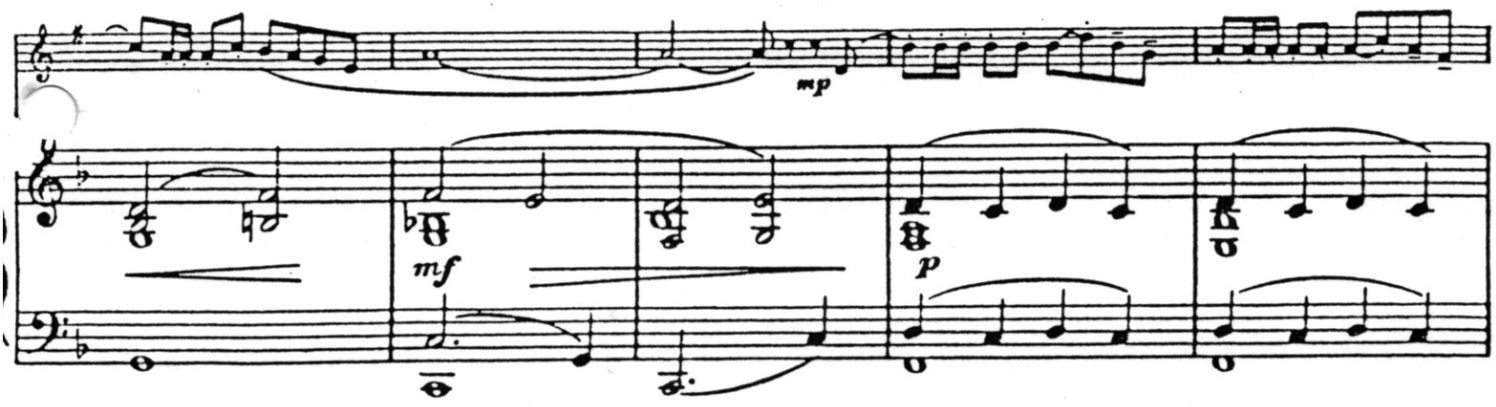
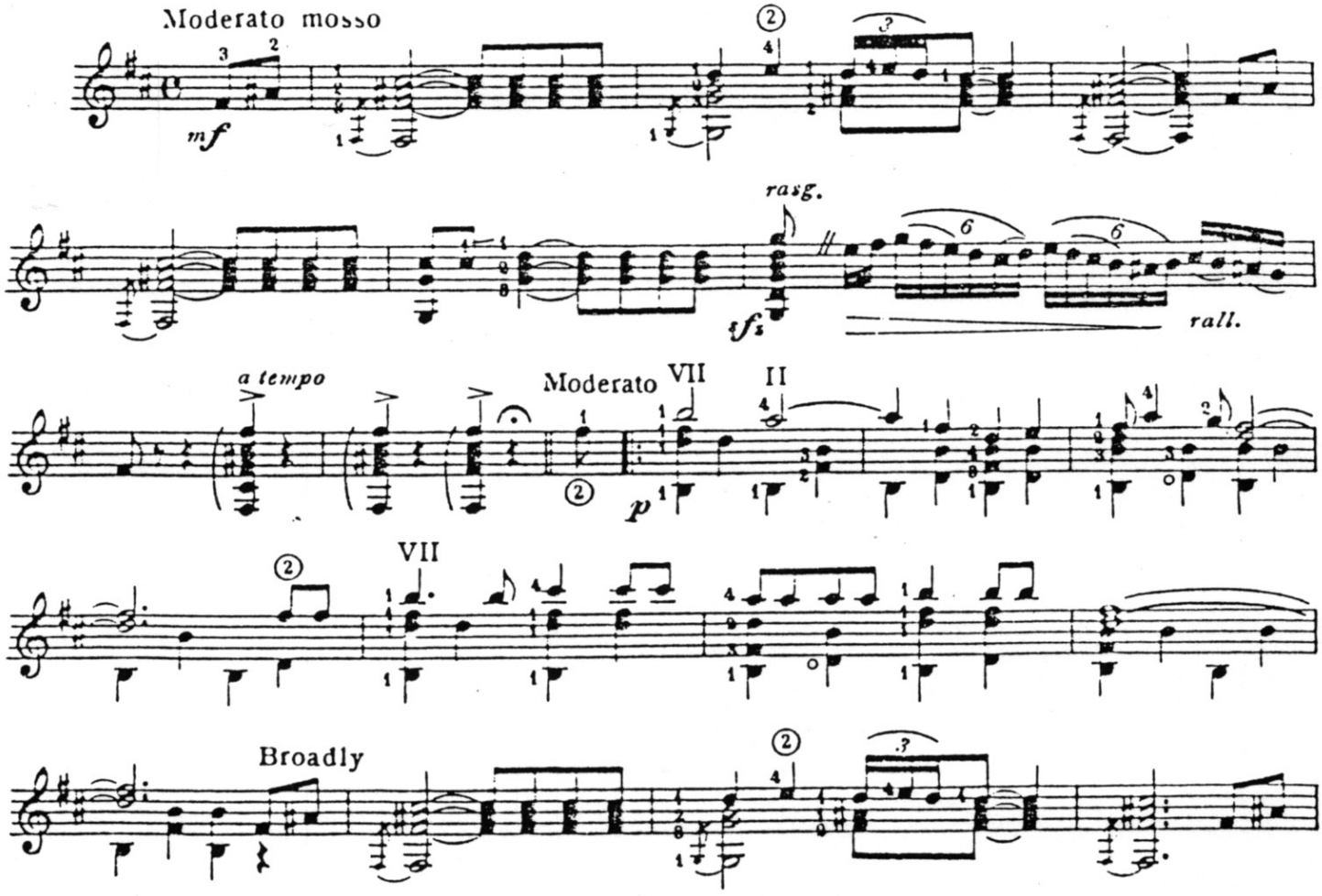


MUSICA



Speech Systems
38W255 DEERPATH ROAD
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TABLE OF CONTENTS

INTRODUCTION ----------1

Congratulations on your purchase of MUSICA! Whether you are a professional musician, or simply a hobbyist in search of yet another program, you will find this addition to your Radio Shack Color Computer a simple to use yet powerful tool to compose music in four part harmony.

To use this program you will need a Radio Shack Color Computer and either a disk drive with at least 32K of memory or a cassette recorder with 16K memory or more and Extended Basic. (This program is compatible with all disk ROM versions.)

Some of the features of MUSICA include:

Entry of music is almost as easy as writing it on paper since all notes are displayed on standard musical treble and bass staffs and the pitches of each note are selected by moving a cursor up and down with the arrow keys or a joystick

Editing of entered music is a snap with simple to use insert and delete commands

Music can be played at any time during the entry process; there is no wait for compilation

Up to four voices (chords in four-part harmony) can be entered

Each voice can have its own timbre (such as the sound of a violin, flute, or oboe); up to four timbre definitions can be specified and the assignment to each voice can be varied during the composition

The user may synthesize an almost unlimited number of timbre definitions using a super-fast waveform synthesis option

The tempo of the music can be varied during the composition

Music can be saved to disk or tape using standard format files

Music can easily be called from a BASIC program; complete documentation for the interfacing machine language program is provided

The program is 100% machine language (except for a short BASIC I/O interface), making all operations almost instantaneous

Sound quality has been optimized to make the most of the Color Computer's capabilities

Over 1,700 chords can be entered if you have 32K of memory

No more fussing with complicated music codes!

Sound output can be through either the TV or the "STEREO COMPOSER" port

Special effects include chorus or vibrato, 3-position stereo, and exchanging stereo channels during music

Sound quality may be greatly improved with the "fast play" option which runs the CPU at twice the normal speed

DISK/TAPE CONTENTS ----------2

MUSICA/BAS	
JOPLIN/MUS	"The Entertainer" by Joplin
SABER/MUS	"Saber Dance" by Khachaturian
JESUJOY/MUS	"Jesu Joy Of Man's Desiring" by Bach
SONATA2B/MUS	The second movement from the second Trio Sonata for organ by Bach
PRELUDE/MUS	Prelude #1 from Eight Little Preludes and Fugues for organ by Bach
GIGUE/MUS	Gigue Fugue for organ by Bach
PLAY/BIN	The BASIC interfacing program
PLAYSTER/BIN	Same as PLAY/BIN; for the STEREO COMPOSER
BASS DBL/CMD	Used with the "A" command (Disk only)
CLRVOICE/CMD	Used with the "A" command (Disk only)

Please note that the music files all require 32K memory. While the tape version will run on 16K, the amount of music that may reside in memory is rather limited.

START-UP ----------3

DISK VERSION: After turning the computer and disk drive on, insert the supplied diskette into the disk drive and type RUN "MUSICA" and then hit the ENTER key. After a short pause, the TV screen will display treble and bass staves with a copyright notice. Press any key; the notice will erase and the memory and voice indicators will appear at the bottom of the screen. You are now ready to start composing!

CASSETTE VERSION: After turning the computer on, position the tape at the beginning and load the program from cassette by typing CLOAD "MUSICA" and then hitting the ENTER key. When the program has loaded, type RUN. As soon as the TV screen displays the treble and bass staves and copyright notice, press any key.

Once you get the hang of how MUSICA works, you will find it rather easy to use. Most of the commands operate just as you would expect them to, almost like writing music on paper.

LOADING MUSIC ----------4

Let's hear some music! After loading the program as described above, press the "L" key. If you have the disk version, a directory of the music files on the disk will be displayed. Enter the name of the music you want to load (pressing ENTER without a name loads the next file in the cassette version). As soon as the composition has been loaded, the screen will display the first 12 chords. Press the "P" key to play.

Should you goof in entering the name of the music file, the program will halt and Basic will give you an error message. Merely enter "RUN" and try again.

ENTERING MUSIC----------5

Whenever you see a little flashing black box on the screen, you are in the "command mode". This means you can enter or edit music. This flashing black box is called a cursor. It marks the exact spot in a composition where a command will take place.

At the bottom of the screen you will see a line that reads "1705=MEMORY 1=VOICE" (or a different number than 1705).

Memory tells you how much room there is left for more music. Each time you enter a chord, that number decrements by one. Voice is a reminder of which of the four possible voices you are entering music into.

Make sure the music memory is clear by pressing the "SHIFT" and "CLEAR" keys together and then "Y" in response to the question displayed. The screen will display the copyright notice; press any key to continue. The cursor is positioned over the space between the treble and bass staves corresponding to middle "C", exactly as with written music. Press the "ENTER" key. A quarter note will appear where the cursor was. Now move the cursor forward by pressing the "RIGHT ARROW" key. Press the "UP ARROW" key and the cursor will move up to the note "D". Press "ENTER". Again move the cursor forward and up by pressing "RIGHT ARROW" followed by "UP ARROW". Press "ENTER". Now you have a short composition of 3 notes. The cursor should be over the last note entered, the "E". Move it back to the start of music by pressing the "LEFT ARROW" key 2 times. Now play your masterpiece by pressing the "P" key.

Sharps and flats may be entered by pressing either "S" or "F" before pressing ENTER.

In addition to entering notes pitches by the up/down arrow, "S", and "F" keys, the right joystick can be used. First press the "J" key and try moving the joystick up and down. The cursor should move accordingly. When you have the cursor positioned correctly, press the "FIRE" button to enter a note. Sharps and flats are written by moving the joystick to the right for sharps and left for flats before pressing "FIRE". To turn the joystick off, just press the "J" key again. While the joystick is on, you will notice that the cursor flashes more rapidly than usual, and is gray instead of solid black.

EDITING MUSIC ----------6

Starting with the composition you have just entered, the notes C, D, E, let's make some changes. Suppose you goofed entering the last note; you actually wanted the note "F". Move the cursor forward until it is directly over, above, or below (it doesn't matter which) the last note. Press "ENTER". The note vanishes and the cursor is positioned where the note used to be. Now move the cursor up once and press "ENTER" again. Your composition should now have the notes C, D, F.

In addition to changing individual notes, MUSICA can add or delete notes. Let's change your composition to C, D, E, F. We will have to insert a note between the "D" and "F". Move the cursor so it is directly over, above, or below (again it doesn't matter which) the "F" note. Press the "I" key. Notice what has happened: now the screen shows the notes C, D, F, F. An extra note has been copied, the same note as where the cursor was positioned before you pressed "I". Now alter the first "F" by pressing "ENTER", moving the cursor down once, and pressing "ENTER" once more. Now the screen should show the notes C, D, E, F. Move the cursor back one position and press "D". The note D that used to be at that position has been deleted, leaving the notes C, E, F.

CHANGING NOTE LENGTHS ----------7

MUSICA is capable of handling much more than just quarter notes. In fact, it is very easy to change the note value. Simply position the cursor directly over, under, or above the note you want to change (the vertical position is not important) and press 1 to get a whole note, 2 for a half note, 3 for a triplet, 4 for a quarter note, 6 for a sixteenth note, 7 for a thirty-second note, 8 for a eighth note, and 9 for a sixty-fourth note. (Notice the numbers 1 through 4 and 8 correspond to the musical value of the note whereas 6 sounds similar to the note name and 7 is the next shorter value and 9 is the shortest.)

You will notice that MUSICA plays consecutive notes without a break between notes. This is important to you because it enables you to enter a note of any length. For example, to enter a dotted eighth note, enter an eighth note and then a sixteenth note of the same pitch. While you see two notes on the screen, when they are played you will hear only one, a dotted eighth note. If you want repeated notes to have breaks between them, you will have to insert rests between each note. A good rule of thumb is to half the note length, and make the rest the same value. For example, repeated quarter notes should be written as eighth notes with eighth rests between.

When entering polyphonic music (music in which all the voices move independently of each other), remember that MUSICA understands only chords. If the first voice is moving in eighth notes but the fourth voice is only half notes, the fourth voice must be changed so that it is a string of 4 eighth notes for each half note.

RESTS----------8

Rests are displayed as a blank space with a number over the middle C position indicating the value of the rest. This number has the same meaning as the numbers 1, 2, 3, 4, 6, 7, 8, and 9 described above for note values. To enter a rest, press "R". A rest will be entered at the cursor position.

MOVING THE CURSOR QUICKLY ----------9

Once you have entered a fair amount of music, there are some cursor commands that will save you time pressing the arrow keys. "B" will reset the cursor to the start of the music whereas "E" will position it at the end. Pressing "SHIFT" and either the right or left arrow keys will move you forward or backward 12 notes. "SHIFT" and either the up or down arrow keys will move the cursor up or down an octave.

Any time you press a key during the playing of a composition, the music will immediately stop and you will be able to edit the composition. Normally the screen will return to the position in the music before you pressed "P"; the exception is if you press the key "U" which will cause the screen to update to the point at which you stopped the music.

Long compositions may be edited by the use of the "U" key. Position the cursor to the start of the composition with "B" and play it with "P". As soon as you hear an error, stop the playing with "U". The screen will update by displaying the music starting with the note you interrupted. If you overshoot the part you want to change, use the arrow keys to move backward. Pressing "P" now will start playing the music where the cursor is positioned. Use this feature to see whether you made the right change. Remember, the playing of music can be interrupted at any time by pressing a key; only the "U" key will update the screen and thus change the starting point of music execution the next time you press "P".

HANDLING MORE THAN ONE VOICE ----------10

MUSICA can handle up to 4 separate parts of music. Each part is called a "voice" and is numbered 1 through 4. Each

voice must be entered separately. Once you specify which voice you want to work with by the "V" key, the program will enter all notes into that voice until you specify another voice. You can easily tell which voice you are in by looking at the right hand side of the bottom of the screen. Just after loading the program, you will see "1=VOICE". This means that all notes will be entered into the first voice. You can change the voice by pressing "V" and then 1, 2, 3, or 4.

For example, clear memory by pressing "SHIFT CLEAR". Press "ENTER". The middle "C" displayed is in voice #1. Set the program to voice #2 by pressing "V", "2" (notice what happens to the voice indicator at the bottom of the screen). Move the cursor down to "G" and press enter. Set voice #3 by pressing "V", "3", move the cursor down to "E", and press "ENTER". Finally set voice #4 ("V", "4"), move the cursor down to "C" and press "ENTER". Press "P" to hear the C major chord you have created! Now reset the voice to "2". Press "ENTER". Notice what has happened: a note has disappeared and the cursor is positioned where the note used to be. The note that was erased was in voice 2.

SAVING MUSIC ----------11

To save a composition, press the "K" (keep) key. For the tape version, use a fresh cassette and position position the tape beyond the initial leader. Enter the composition name and press "ENTER".

HIGHLIGHTING VOICES ----------12

When you have entered a large amount of music in four parts, it can be very difficult to figure out what notes are in voice 1 (soprano) or which are in voice 3 (tenor). This problem may be remedied with the "H" key. All voices except for the one selected are displayed in half-tone, making it very easy to follow a particular voice through your composition. Note that the highlighting effect takes effect on all notes following the current cursor position, and that it has no effect on the actual music code stored in memory.

ENTERING BARLINES ----------13

Entering barlines will greatly improve the legibility of your music when you are in the process of editing it. Simply position the cursor at the spot you want a barline and press the "M" (measure) key. As you would expect, barlines have no effect on the music, but they do use up memory.

CHANGING TIMBRE AND TEMPO ----------14

Each voice may be assigned a particular timbre, or distinctive sound such as a flute, violin, or oboe. In MUSICA, the timbre of each voice is controlled by a list of numbers called a "tone table". The program loads a single "tone table" into memory at start-up. There are actually four tone tables, numbered 0 through 3. You can generate new timbres for each tone table if you wish (see below).

All voices are assigned to tone 0 initially. You can change this assignment by pressing the "C" key (read the rest of this section before you try this). The screen will tell you what the last assignment was (4 numbers, corresponding to voices 1 through 4) and ask you to enter a new assignment. As soon as you have entered your assignments (pressing "ENTER" makes no change), they will be displayed vertically on the treble score. Next you will be asked to enter the tempo (the speed at which the music is played). You will be prompted to enter a number from 01 to 99 (you must enter 2 numbers). By pressing "ENTER", no change will be made. Tone and tempo assignments may be made anywhere in the music as many times as you wish. Use this feature to give variety to your composition, and to produce changes in speed (accellerandos and ritardandos).

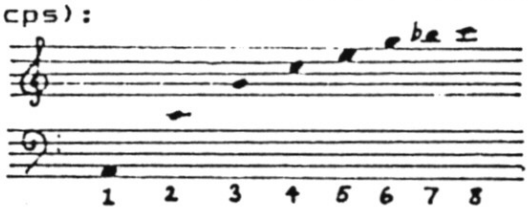
Only tone table 0 has anything in it initially. If you wish to assign voices to a tone table other than 0, you will have to create a new tone table with the "G" key. You will be prompted for eight numbers which correspond to amplitudes of the first eight harmonics. After you have entered 8 numbers, you will be asked for the location to copy the new timbre to. Initially the new tone table is at location "0" but may be copied to one of the other locations 1 through 3. The best way to use this program is to do a lot of experimentation. Here are some suggested numbers to use:

90000000	Pure flute sound ("sine" wave)
99090000	Bright flutey sound
90900000	Imitation clarinet sound
98765432	Buzzy, reedy sound

90090009 Sparkling flutey sound
97250000 A good "basic" sound

You may be wondering, "what are harmonics?" Harmonics are the rudiments of any musical sound that give it character. It is the harmonic content of the sound of a flute that distinguishes it from the sound of an oboe. When an instrument sounds a note (such as "440 A", for example), the pitch that is heard is called the Fundamental. Depending on the instrument, a whole series of additional pitches (generally less prominent) will also sound. It is these additional pitches which give the sound its distinctive character; they are called the Harmonics.

Harmonics are related to the Fundamental in a fixed manner. The second harmonic is one octave above the Fundamental, the third is a fifteenth above, the fourth is two octaves, etc. Here is an example of the first 7 harmonics of the C below middle C (128 cps):



Tones may be created to simulate a solo voice with accompaniment. The "Q" key may be used to decrease the volume of a tone table if you find the accompaniment drowns out the solo.

MUSICA will automatically produce tone tables that are compatible with the type of output you select (either TV or STEREO COMPOSER). If you decide to play a composition through an output other than what you had selected when the tone tables were created, you may have a rather distorted sound. This will happen only when a tone table created with the STEREO COMPOSER output selected is played through the TV. Fortunately this problem is easily corrected. Just use the "Q" command to decrease the volume of each tone used by setting the volume to 5. (See the section on the STEREO COMPOSER port.)

TONE VOLUME ----------15

The volume of each voice is set at maximum initially. You can use the "Q" command to decrease the volume of any tone table. Note that this command only decreases the volume of a tone table; once decreased, it cannot be increased.

USING THE STEREO COMPOSER PORT ----------16

The STEREO COMPOSER port, produced by SPEECH SYSTEMS, is a metal black box about the size of a disk controller that plugs into the side of the Color Computer. Besides providing two phono plugs to connect to two speakers or your stereo system, the STEREO COMPOSER greatly improves the sound quality of MUSICA.

If you have the STEREO COMPOSER, connect it according to the instructions that come with it. If you want to use it with a disk drive, you will need a Y-connector or an expansion interface such as the Multi-Pak Interface. Load MUSICA and whatever music you want to play. Before pressing "P", press the "@" key. An "S" will appear in the middle of the bottom of the screen. Press "@" again, and the "S" will disappear. When the "S" is on, all music is channeled to the STEREO COMPOSER port.

With the STEREO COMPOSER port, music is split into two channels; voices 1 and 3 are sent to one and 2 and 4 are sent to the other. This makes 2 and 3 position stereo possible as described in the special effects section.

You may be wondering, "why buy the STEREO COMPOSER port?" True, it is not exactly cheap. I am sure, however, that once you have heard the difference in the quality of sound that MUSICA makes with the port, you will decide that the cost is worth it. The port greatly cuts down on noise (the hissing sound) and decreases the amount of distortion. See the technical notes for more details.

SPECIAL EFFECTS ----------17

Two special effect keys are "X" (exchange) and "Y" (copy). The "X" key is of interest only if you have the STEREO COMPOSER port attached. It allows flip-flopping of the stereo channels (voice 1 is exchanged with voice 2, and 3 with 4). This effect starts at the current cursor position and continues to the end of music. Multiple flip-flops may be made through the music, producing an "echo" effect.

The "Y" key can have a number of effects. It will copy the notes of a given voice to a second voice. Be careful when you use it because it will destroy whatever was in the second voice (the voice that was copied to). By pressing "0" in response to the prompt "DEPTH OF VIBRATO (0=NONE)?", the notes of one voice will be copied exactly to the next. If, however, you press any other number key (1 through 9), a

number proportional to the key you pressed will be subtracted from the first voice before it is stored in the second. The second voice now has notes that are slightly flat to the notes in the first. When a note is played with another note that is slightly flat, an undulating "beat" is created. This causes a useful effect when the music is played: vibrato or chorus, depending on the number pressed. Numbers 1 through 2 give a rather pleasing chorus effect, while higher numbers give a progressively faster vibrato. Remember, when you use this command, you reduce the number of available voices by one.

When you use the "Y" command to produce a chorus or vibrato effect, MUSICA will not be able to recognize the off-pitch notes. At any time the screen has to be completely updated (such as pressing "B"), MUSICA will display a warning message "UNRECOGNIZED PITCH VALUE". This is just a reminder that you have used the "Y" key to create notes that do not have standard pitches. These non-standard notes also are not displayed. They will sound correctly, however, when you use the "P" command.

The other effect that "Y" has is of interest only if you have the STEREO COMPOSER port attached. When music is played, voices 1 and 3 are sent to one channel, and 2 and 4 go to the other. If you are writing music in 3 parts, and want to have each part sound separate (rather than having two voices on one channel and the other voice by itself on another channel), a voice may be moved so that it sounds "in the middle". For example, suppose that a composition uses voices 1, 2 and 3, and you wish to have voice 3 sound "in the middle". Use the "Y" command to copy voice 3 to voice 4 with no vibrato. Now when the music is played back, the desired effect will be realized. You will probably find it necessary to assign a separate tone table to the "middle" voice that has a volume half that of the other voices because it otherwise will be too loud.

If your computer is capable of running at twice the usual clock speed, you will be able to realize a significant improvement in the quality of sound from MUSICA, particularly if you have the STEREO COMPOSER port attached.

Before you try this command, be sure you have saved whatever music you have in memory. This is because MUSICA permanently alters the music code and your computer may lock up while attempting to run in the speeded up mode. In addition, all

half and whole notes must be changed to quarter notes (use the insert to copy 4 quarter notes for each whole note, etc.).

Press the "O" key. If you have saved the music, press "Y" in response to the question displayed. If all goes well, music will be produced as with the "P" command. The screen display will be lost until the end of the music. If when the music ends the screen returns to normal with the flashing cursor, all is well!

Resetting to the start with "B" will point out an important change. Probably not all the notes will display. This is because MUSICA lowers the pitch of each note and doubles the note values to compensate for the increased speed. When the high speed play is over, it restores the pitches and note values to close to their original value. In some cases, "close" is far enough off to be unrecognizable to MUSICA. As mentioned in the previous section, this may cause the "UNRECOGNIZED PITCH VALUE" warning to show. You will find that even though the graphics is of no help, the music may be played again in either the normal or high speed mode.

ADDITIONAL COMMANDS (DISK VERSION ONLY) ----------19

The "A" key opens MUSICA to a host of user-definable commands as well as a few additional supplied commands. Pressing the "A" key causes a directory of the available commands on disk to be displayed. Entering a name will load the appropriate program into memory, execute it, and return to MUSICA.

Supplied commands include "BASS DBL" which lowers the pitch of voice 4 an octave and "CLRVOICE" which clears a specified voice (starting at the current cursor position).

Most users of MUSICA will not create their own commands because it requires a good knowledge of machine language. However, if you are interested, turn to the "Technical Notes" section for details.

PLAYING MUSIC FROM BASIC ----------20

Music may be played independently of MUSICA and merged with a BASIC program of your creation. Here is how to do it (disk version):

1. Create your BASIC program.
2. Include at its start the statement "CLEAR N,&H3F40" where N depends on how much string space you need (100 is a good general value to use).
3. Load the music file using the command "LOADM F$" where F$ is the filename with the extension "/MUS" and then load the interface program ("PLAY/BIN").
4. Stop the disk motor with "POKE &HFF40".
5. Start playing the music with the "EXEC &H3F40" command.

Here is an example:

```
    (DISK)
10 CLEAR 100,&H3F3F
20 LOADM "SABER/MUS"
30 LOADM "PLAY"
40 POKE &HFF40
50 EXEC &H3F40
60 END
```

```
    (TAPE)
10 CLEAR 100,&H3540
20 CLOADM "SABER"
30 CLOADM "PLAY"
40 EXEC &H3540
50 END
```

You will probably want to copy the "PLAY" program to the start of another tape if you have the tape version. This is how to do it. First reserve memory with CLEAR 50,&H353F. Now load the program with CLOADM"PLAY". Change the tape in the recorder, prepare to record, and then start recording with CSAVEM"PLAY",&H3540,&H35FF,&H3540.

A music file may be modified so that merely typing EXEC after loading it will play the music. Make sure you have reserved memory with the appropriate CLEAR command (as above). Load the music file. Detemine the ending address by typing A=HEX$(256*PEEK(&H9D) + PEEK(&H9E)) then load the PLAY program. For disk users, save with SAVEM"F", &H3F40, A, &H3F40. For tape users, save with CSAVEM"F", &H3540, A, &H3540. "F" is the filename.

The "PLAY" program is in the public domain; you are free to copy and modify it as you wish.

For those of you who have the STEREO COMPOSER port, the program PLAYSTER/BIN has been provided. The only difference with PLAY/BIN is that music is routed to the STEREO port. The starting address of this program is &H3F40 ($3540 tape).

HOW DOES IT WORK? ----------21

Briefly, MUSICA generates a stream of numbers that the Color Computer converts to voltages through the sound port (6 bit digital to analog convertor). By varying the numbers and thus the voltages at the appropriate rate, a tone is produced through the TV speaker. The character of the tone produced ("timbre") depends on a table of numbers known as a "tone table". In its simplist form a tone table is merely the list of the values of a sine wave. If the values of the sine wave are repetitively sent to the sound port, a sine wave is produced that would make the TV speaker sound a pure flute tone.

The tone table can be thought of as an endless loop of numbers. Once the last one has been sent to the sound port, the program immediately goes back to the first number. The rate at which the numbers are sent to the sound port is fixed at about 8000 numbers per second. Pitch is varied by skipping an appropriate number of numbers in the tone table. Thus, a tone that is generated by skipping every other number is an octave higher than one that utilizes every number.

This method of varying pitch may seem a bit round-about but it makes it possible to produce more than one note at once! The correct value for each note is calculated, and then the values are all added together and sent to the sound port. The result is the production of 1 or more tones, each independent of the other.

If you are interested in learning more about the theory of digital music production, an excellent reference is "Musical Applications of Microprocessors" by Hal Chamberlin published by Hayden.

A: Additional commands (disk version only)-user definable commands may be loaded from disk

B: Begin-reset the program to the start of the present composition

C: Change-change the tone assignments for each voice and the tempo; pressing "ENTER" at each prompt will assign the default ("current") values

D: Delete-delete the chord (all 4 voices) at the position of the cursor

E: End-move the cursor to the end of music

F: Flat-make the next note entered flat

G: Generate-create a new tone table; it is created on page 0 but may be copied to any other page

H: Highlight-highlight a specified voice

I: Insert-insert a chord at the present position of the cursor; the chord at the cursor position will be duplicated

J: Joystick-turn on/off the option to use the right joystick to select pitch; right/left positions of the joystick correspond to sharp/flat; use the "FIRE" button to enter notes; all other keys except for the up/down keys work as before

K: Keep-save the present composition to disk or tape. You will be prompted for the name, which can be up to 8 letters long.

L: Load-load a composition from disk or tape. With the disk version, a directory of music files will be displayed.

M: Measure-write a barline at the current cursor position

O: Same as "P" except that the CPU runs at double speed; the result is music of much higher tone quality. All half and whole notes must be changed to quarter note equivalents before using this option to prevent them from becoming silent during playing. Be sure that you have saved the composition before using this option as it permanently alters the music code.

P: Play-play the composition starting at the current cursor position. This command may be interrupted at any time by pressing any key; see the "U" command

Q: Quiet-decrease the volume of a tone table

R: Rest-enter a rest

S: Sharp-make the next note entered sharp

U: Update-when used to interrupt the "P" (play) command, will update the screen to the chord being played at the time of interrupt and the following 11 chords

V: Voice-used to change the current voice assignment

X: Exchange voices 1 and 3 with 2 and 4; this results in flip-flopping of the channels if you are using the STEREO COMPOSER port

Y: Copy from one voice to another. Use this option only after completion of music entry and only with 3-part harmony. This command may be used to create chorus or

vibrato effects or 3-position stereo if you are using the STEREO COMPOSER port

Z: Exit-exit to BASIC

1-9: Change the note value of the chord or rest at the current cursor position. 1=whole note, 2=half note, 3=triplet, 4=quarter, 6=sixteenth, 7=thirty-second, 8=eighteenth, 9=sixty-fourth

@: STEREO COMPOSER/TV port flip flop; select where the sound will go. When the STEREO COMPOSER port is selected, an "S" at the middle bottom screen will appear; to reset to TV, press "@" again

"SHIFT+CLEAR"-Erase the music memory; when the copyright notice is displayed, press any note to continue

"ENTER"-Enter a note (or erase one if the current voice assignment is the same as a note under or above the cursor) at the current cursor position. The note may be written in any one of 4 voices (see the "V" command). This command affects only the current voice displayed at the right-hand side of the bottom of the screen

"UP ARRROW"-Move the cursor up

"DOWN ARROW"-Move the cursor down

"RIGHT ARROW"-Move the cursor forward

"LEFT ARROW"-Move the cursor back

"SHIFT UP ARROW"-Move the cursor up an octave

"SHIFT DOWN ARROW"-Move the cursor down an octave

"SHIFT RIGHT ARROW"-Move the cursor forward 12 chords

"SHIFT LEFT ARROW"-Move the cursor back 12 chords

SOME TECHNICAL NOTES ----------23

1-Memory map (tape version in parentheses):

$009D-$009E		Address of last note in a music file after it has been loaded into memory
$0E00-$3FFF	(0600-35FF)	Reserved for use by the program
$2702-$2703		Current end of music pointer (disk only)
$2704-$2705		Current cursor position pointer (disk only)
$4000-$40FF	(3600-36FF)	Tone table #0
$4100-$41FF	(3700-37FF)	Tone table #1
$4200-$42FF	(3800-38FF)	Tone table #2
$4300-$43FF	(3900-39FF)	Tone table #3
$4400-$4404	(3A00-3A04)	Default assignments of tempo and tone tables
$4405-$7FFF	(3A05-7FFF)	Music code

2-Description of music code:

Each chord is represented by 9 bytes. The first byte is the note length or an indicator of a barline or tone table and tempo assignment change. The first bit of this byte is always "0" if it represents the note length. Barlines and new tone table and tempo assignments are marked by having the first bit of the first byte set to "1" (a barline is marked with the first byte set to a value of $FF and new tone table assignments with $FE). The first byte is followed by 4 2-byte words which control the pitch of the 4 voices. The end of the music is marked by all 9 bytes being set to zero.

Byte #	0	1	2	3	4	5	6	7	8
Contents	Chord Descriptor	Voice 1		Voice 2		Voice 3		Voice 4	

3-Description of music disk (and tape) files:

Each file consists of memory from $4000 ($3600) to the end of the music code so that the 4 tone tables are saved. A file may be loaded with the standard "LOADM" ("CLOADM") command. The address of the last byte in the composition may be determined after it is loaded into memory by entering "PRINT 256 * PEEK(&H9D) + PEEK(&H9E)".

4-Notes for Hi-Fi buffs:

While the sound can be considerably improved by connecting the color computer's output to a stereo system (using the "aux" jack of the cassette cable), harmonic distortion and signal noise limit the quality of the sound.

The operating speed of the 6809 microprocessor is only 0.879 megahertz which limits the production of high frequencies. If the harmonic content of the tone table includes too many high harmonics, the result is a rather distorted signal. This distortion can be reduced by making the 6809 run faster. Your computer may be capable of running at 1.7 megahertz by using the "0" command. Be sure you save any music you have in memory before using this command so that if your computer can't handle the speed and locks up, forcing you to turn it off, you won't have lost the music. Noise is mostly due to the nature of the 6 bit digital-to-analog convertor used in the Color Computer. The noise can be drastically reduced with the Speech System's "Stereo Composer" 16 bit digital-to-analog convertor. In addition to reducing the noise, it also allows true stereo production with direct connections to either a pair of speakers or a stereo system. If you have a serious interest in music, you will find the investment in this product well worth the expense. You will notice that no provision has been made to control the envelope of the sounds generated by MUSICA. While this makes percussive sounds impossible, it is felt that if a choice has to be made whether to include envelope control and have a rather low quality sound, or ignore envelope and have a relatively good sound, the proper choice is to ignore envelope control. The reason for this is that the 6809 runs at a speed that is too slow to control envelope and produce a good quality sound at the same time.

5-Assembly-language listing of the play subroutine:
(This is the listing of the program titled "PLAY/BIN" which allows you to call music from BASIC programs.)

```
        ORG $3F40       ($3540 IN TAPE VERSION)
PLAY    LDA #$3F        SET DP REGISTER ($35 IN TAPE VERSION)
        TFR A,DP
        SETDP $3F       ($35 IN TAPE VERSION)
        LDA $FF01       TURN ON TV SOUND PORT
        ANDA #$F7
        STA $FF01
        LDA $FF03
        ANDA #$F7
        STA $FF03
        LDA #$3C
        STA $FF23
        PSHS CC         SAVE CONDITION REGISTER
        ORCC #$50       DISABLE INTERRUPTS
        LDX #$4400      X=NOTE POINTER ($3A00 IN TAPE VERSION)
        LDA ,X+         LOAD TEMPO FROM MUSIC
        STA TEMPO
        LDD ,X++        LOAD TONE TABLE HIGH ADDRESSES
```

```
        STA <V1PT
        STB <V2PT
        LDD ,X++
        STA <V3PT
        STB <V4PT
        BRA NEWNT1
TEST    CMPA #$FE       TEST FOR NEW WAVE TABLE POINTERS
        BNE NEWNOT
        LDD 0,X         UPDATE WAVE TABLE POINTERS
        STA <V1PT
        STB <V2PT
        LDD 2,X
        STA <V3PT
        STB <V4PT
        LDA 4;X         UPDATE TEMPO
        STA <TEMPO
NEWNOT  LEAX 8,X        ADVANCE NOTE POINTER
NEWNT1  LDA ,X+         LOAD NOTE DURATION
        BMI TEST        IF DURATION>$7F, NOT A NOTE
        BEQ PLAY2       DURATION=0 IF END OF MUSIC
PLAY1   STA <DUR
        LDB <TEMPO      SAVE TEMPO
        STB <TEMPO+1
MAIN    LDA [V1PT]      OUTPUT VOICES TO SOUND PORT
        ADDA [V2PT]
        ADCA [V3PT]
        ADCA [V4PT]
        STA $FF20
        LDD <V1PT+1     INCREMENT VOICE POINTERS
        ADDD ,X         ONLY THE LSB AND "FRACTIONAL"
        STD <V1PT+1     BYTES ARE CHANGED.
        LDD <V2PT+1     SECOND VOICE
        ADDD 2,X
        STD <V2PT+1
        LDD <V3PT+1     THIRD VOICE
        ADDD 4,X
        STD <V3PT+1
        LDD <V4PT+1     FOURTH VOICE
        ADDD 6,X
        STD <V4PT+1
        DEC <TEMPO+1 UPDATE TEMPO COUNTER
        BNE WAIT
        DEC <DUR        UPDATE DURATION COUNTER
        BEQ NEWNOT
        LDB <TEMPO      RESTORE TEMPO COUNTER
        STB <TEMPO+1
        BRA MAIN
WAIT    LEAX 0,X        (TO EQUALIZE LOOP TIMES)
        LEAX 0,X
        LEAX 0,X
        LEAX 0,X
        LEAX 0,X
```

```
        BRA MAIN
WAIT    LEAX 0,X        (TO EQUALIZE LOOP TIMES)
        LEAX 0,X
        LEAX 0,X
        LEAX 0,X
        LEAX 0,X
        BRA MAIN
PLAY2   CLRA            RETURN FROM SUBROUTINE
        TFR A,DP
        PULS CC,PC
V1PT    RMB $3          VOICE TONE TABLE POINTERS
V2PT    RMB $3          ONLY THE LAST 2 BYTES ARE
V3PT    RMB $3          CHANGED; THE 3RD BYTE IS
V4PT    RMB $3          "FRACTIONAL"
DUR     RMB $1
TEMPO   RMB $2
        END PLAY
```

6-ADDING COMMANDS TO "A" (DISK VERSION ONLY)

As mentioned previously, the user may construct his own commands and call them by pressing the "A" key. If you have a working knowledge of assembly language, you will find this option interesting and rewarding!

All commands are stored on disk as machine language files with the extension "/CMD". To interface your program with MUSICA, you will need to review the material presented in parts 1 and two of this section. Particularly important is the current cursor position pointer at $2704. This pointer, 2 bytes long, is the address of the chord in memory that the cursor is now positioned at. Also, pay especial attention to the description of the 9 bytes used to define a chord (part 2).

All command programs start at $3F00, end before $4000, and terminate with a RTS instruction.

As an example of how to do it, here is a listing of the "BASS DBL/CMD" file. This command will lower the pitch of voice 4 one octave starting at the current cursor position.

```
        ORG $3F00    STARTING ADDRESS
START   LDX $2704    X POINTS TO THE CURRENT CURSOR POSITION
LOOP    LDD 7,X      LOAD REGISTER D WITH VOICE 4
        LSRA         DIVIDE PITCH BY 2 TO SET PITCH ONE OCTAVE
        RORB         LOWER
        STD 7,X      STORE NEW PITCH IN VOICE 4
NEXT    LEAX 9,X     ADVANCE POINTER TO NEXT CHORD
        TST 0,X      TEST CHORD DESCRIPTOR
        BEQ DONE     IF DESCRIPTOR=0, END OF COMPOSITION
        BMI NEXT     IF MSB=1, NOT A CHORD
        BRA LOOP     PROCESS NEXT CHORD
DONE    RTS
        END START
```

Here is a final example which allows you to selectively clear a voice (CLRVOICE/CMD), starting at the current cursor position.

```
        ORG $3F00
START   LDX #MESSAG REGISTER X POINTS TO MESSAGE TO BE DISPLAYED
DSPMSG  LDA ,X+     LOAD BYTE OF MESSAGE,
        BEQ GETANS  TEST FOR END OF MESSAGE (=0)
        JSR [$A002] DISPLAY BYTE
        BRA DSPMSG
GETANS  JSR [$A000] WAIT FOR RESPONSE
        BEQ GETANS
        CMPA #'0    TEST RESPONSE (MUST BE 1, 2, 3, OR 4)
        BLE GETANS
        CMPA #'5
        BGE GETANS
        JSR [$A002] DISPLAY RESPONSE
        SUBA #'1    CONVERT ASCII TO BINARY NUMBER
        LSLA        MULTIPLY BY 2 AND
        INCA        ADD 1
        TFR A,B     MOVE REGISTER A TO B
        LDX $2704   X POINTS TO THE CURRENT CURSOR POSITION
        LDY $2704
        ABX         X POINTS TO DESIRED VOICE
        LDD #0
CLRV    TST ,Y      TEST CHORD DESCRIPTOR
        BEQ DONE    IF DESCRIPTOR=0, THEN DONE
        BMI NEXT    IF DESCRIPTOR IS MINUS (MSB=1), NOT A CHORD
        STD ,X      CLEAR VOICE
NEXT    LEAX 9,X    ADVANCE VOICE POINTER TO NEXT CHORD
        LEAY 9,Y    ADVANCE CHORD DESCRIPTOR POINTER TO NEXT CH.
        BRA CLRV    LOOP BACK FOR NEXT CHORD
DONE    RTS         DONE, RETURN TO MUSICA
MESSAG  FCC "ENTER A NUMBER (1-4) CORRESPON- "
        FCC "DING TO THE VOICE YOU YOU WISH  "
        FCC "TO CLEAR: "
        FCB 0       END OF MESSAGE MARKER
        END START
```