NOTICE!!

Dear Customer:

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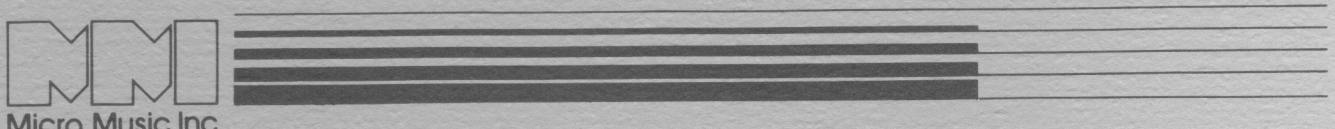
MUSIC COMPOSER™

DISK VERSION (48K)
INTEGER OR APPLESOFT FIRMWARE BASIC



309 Beaufort, Normal, Illinois 61761

MMI Micro Music Inc is dedicated to the design of quality, learner-verified computer software for music and music education through the lowest-cost technology available. Using the APPLE II computer, MMI's software library of music programs will teach the basic concepts and skills of music listening, performance, and composition to all ages. MMI's software is developed and tested by nationally recognized persons in music instruction and research.

INSTRUCTIONS

FOR INSTALLING THE MUSIC COMPOSER

BEFORE YOU DO ANYTHING
PLEASE READ THIS!!!!

STEP 1 Check your folder for the following contents:

a. (1) MICRO MUSIC DAC Card
b. (1) MUSIC COMPOSER User's Guide
c. (1) MUSIC COMPOSER floppy disk

STEP 2 To install MICRO MUSIC DAC card:

a. TURN ALL POWER TO THE APPLE II OFF! This will prevent damage to your Apple.

b. CHECK AGAIN. IS THE POWER OFF?

c. Remove the lid from the APPLE II. Insert the MICRO MUSIC DAC circuit into SLOT #2 of the Apple. If you have something else installed there, put the MICRO MUSIC DAC there temporarily until you can read the technical section of the User's Guide to find out how to change the slot location.

The lever of the volume control should stick out of the rear slot of the Apple.

d. Plug the audio cable into an 8 ohm or 16 ohm speaker. You do not need an amplifier; there is one built into the MICRO MUSIC DAC circuit.

e. Replace the lid.

STEP 3 Your MUSIC COMPOSER system is designed for either Integer or Applesoft Firmware BASIC. Select the language below to custom tailor the software to your Apple II.
If your disk drive is in a slot other than 7, change the 7 in PR#7 to your slot number.

a. **Applesoft Firmware BASIC:**

1. Boot the DISK normally using

* (CTRL) B (RETURN)

] PR#7 (RETURN)

and you're ready to go.

2. However, the > sign throughout the manual should be substituted with a] sign for Applesoft BASIC

b. **Integer BASIC** (do this only if you want to permanently change your DISK to Integer MUSIC COMPOSER):

1. Boot the DISK using:

   * (CTRL) B (RETURN)
   > PR#7 (RETURN)

2. This message will appear if Applesoft Firmware BASIC is not available

   LANGUAGE NOT AVAILABLE

3. Then type in

   > RUN FIX (RETURN)

4. After a few seconds of assorted sounds from the DISK DRIVE, the MUSIC COMPOSER will execute and run.

5. All future boots of the DISK will give a normal INTEGER execution.

STEP 4 Now proceed to the User's Guide to find out how to use and enjoy the MUSIC COMPOSER!!

CAUTION — — To use the MUSIC COMPOSER the Game Paddles must be plugged into the computer. Check this before proceeding!!

DEMONSTRATION

DEMONSTRATION:

There are 3 levels to introduce you to the MUSIC COMPOSER.

1. A demonstration loop that automatically plays some selections for you.
2. The PLAIN AND EASY INTRO in Section 2.0 of the User's Guide which walks you through a self-instruction introduction to the commands.
3. The technical sections of the manual which explain all commands in detail.

Here is how to do #1—An automatic demonstration.

1. Turn the APPLE and TV monitor on (switch in back of machine).
2. Insert MUSIC COMPOSER floppy disk.
3. Type (**CTRL**) **B** (**RETURN**). Hold the CTRL and B key down together.
4. When > appears type **PR#7** (RETURN).
5. After some introduction information, the TV will stop and display:

   DO YOU NEED HELP??? **X**

6. Type an **X** to start the special demonstration program.
7. You are now in the automatic demo loop!
8. To stop the loop, type the (RESET) key.

MUSIC COMPOSER™ USER'S GUIDE

Version 2.3 (7/79)

DISK-BASED VERSION

Applesoft Firmware or Integer BASIC

The MUSIC COMPOSER uses the MICRO MUSIC board and sound generation system developed for MMI by MICRO TECHNOLOGY UNLIMITED and Hal Chamberlin.

MUSIC COMPOSER™ USER'S GUIDE
Version 2.3 (7/79)

1.0 INTRODUCTION

The MUSIC COMPOSER is a general purpose music interpreter and editor designed by the folks at MMI for the music amateur or the music student. MUSIC COMPOSER lets you transcribe a piece of music or compose a piece of music, and then play the music through the APPLE II computer using the MICRO MUSIC sound board. We think you will find the MUSIC COMPOSER easy to use. It is flexible enough that you will be able to edit music, display notation, change timbres (even create your own), enter up to four voices of polyphonic music (that's a music term for different melodies going on at the same time), play polyphonic music, and then save your music on disk. We have divided this user's guide into four parts:

2.0 A PLAIN AND EASY INTRO to using the MUSIC COMPOSER

3.0 A discussion of terminology used in MUSIC COMPOSER, the dimensions of the program, and a review of its commands.

4.0 A detailed description of each command feature.

5.0 A discussion of the design of the program and its technical features.

We recommend you start by walking through the PLAIN AND EASY INTRO to get a feel for how the program works. Then, read through the entire manual carefully in order to fully grasp the workings of the MUSIC COMPOSER and its commands.

2.0 PLAIN AND EASY INTRO TO THE MUSIC COMPOSER

2.1.1. Before we begin showing how the MUSIC COMPOSER works, a few "rules of the road." Whenever anything is bold, that means you are supposed to enter that letter(s) into the computer using the keyboard. Things that are not bold are printed by the computer on the TV screen.

2.1.2. If you see a set of letters enclosed in parentheses like this (RETURN) or this (CTRL) or this (SHIFT), press **one** key with that label. The (RETURN) key is used a lot to enter information into the computer. We will abbreviate this key as (R).

2.1.3. Sometimes you will enter something that disagrees with the computer, and the MUSIC COMPOSER program will stop. Whenever you see a > on the far left side of the screen, the program has stopped. To restart, enter **RUN 10(R)**. The computer will ask for the number of music voices and, then a ?? or double question mark will appear. You are now ready to enter a new MUSIC COMPOSER command.

2.2 READ, PLAY, AND DISPLAY MUSIC

2.2.1 First, let us get the program loaded and play a piece of music. Just follow the sequence below after loading the MUSIC COMPOSER disk into the disk drive. On the left we have shown you the computer text and the information you need to enter. On the right are comments to help you understand what is happening.

(CTRL) B (R) **>PR#7**	Enter Basic Start the disk and execute the program.
DO YOU NEED HELP??? **N** **V**OICES = 4 **(R)**	No help now. We will help you! We need 4 voices for this music.
??**R**	The **R** stands for READ in a music file from the disk.
DO YOU WANT A LIST OF THE FILES? **N** TYPE THE NAME OF THE FILE: **MUSKRAT RAMBLE (R)**	Type each letter and space exactly. The COMPOSER will find this music file on the disk.
??TIMBRE VOICE #1?**2 (R)** VOICE #2?**2 (R)** VOICE #3?**2 (R)** VOICE #4?**2 (R)** ??PLAY THE MUSIC ?**1(R)**	Let's set timbres (music colors) for each voice in the music. There are 7 to choose from. Now it's time to **P**lay the music. The "1" tells the computer to start at the beginning of the music.
SET THE TEMPO WITH PADDLE **(0)** PUSH THE BUTTON TO PLAY	We need to set the speed of the music from 0 (very slow) to 255 (very fast). Turn the paddle until #222 appears, then press the button
??PLAY THE MUSIC ?**1 (R)**	Let's play it again.
??TIMBRE	Let's change the timbres.
VOICE #1?**3 (R)** VOICE #2?**5 (R)** VOICE #3?**2 (R)** VOICE #4?**1 (R)**	
??PLAY THE MUSIC ?**1**	Then **P**lay it again from the beginning.
SET TEMPO WITH PADDLE **(0)** PUSH THE BUTTON TO PLAY	The tempo is the same. Push the button to start the music.
??**R**	That is enough of that music. Time for a new piece. Type **R** to read from disk.
DO YOU WANT A LIST OF YOUR FILES? **N**	
TYPE THE NAME OF THE FILE: **OVERTURE (R)**	Make sure you spell it correctly! Wait while the computer finds it.
??VOICES = **4(R)**	

?? **M**ETER

Set the **M**eter.

OF BEATS ? **4 (R)**
BEAT ? **4 (R)**

??PLAY THE MUSIC ?**1 (R)**

Then play it starting at the beginning or Set 1.

SET TEMPO WITH PADDLE (**0**)
PUSH THE BUTTON TO PLAY

#175 is a good tempo for the **O**verture. When you have it, push the button.

??TIMBRE

Maybe a different timbre would sound better?!

VOICE #1?**6 (R)**
VOICE #2?**6 (R)**
VOICE #3?**6 (R)**
VOICE #4?**6 (R)**

?? **P**LAY THE MUSIC ?**1 (R)**

And, again to play it we type a **P** command for play.

?? DISPLAY AND PLAY ?**1 (R)**

As you listen, try turning the knob on Paddle #0 to slow down or speed up the tempo of the music.

(try pushing the button on Paddle #0 to stop and start the music)

2.2.2. Well, that is the general idea. See if you can **R**ead some of the other music selections we have put on the disk. We have put a list below. Remember, set the **M**eter, set the number of **V**oices, set the **T**imbre to any of 7 timbres, **P**lay the music, and **D**isplay the music. The commands should be entered in that order. You might have noticed that a ??, a double question mark, appears whenever the MUSIC COMPOSER is ready for a command. After a ?? you can type **R** or **D** or **V** or **P**, etc., depending on what you want to do.

For example, to load and play the MINUET, you would first use a **R**ead command to load the music. Then, set the meter with an **M** command to 3,4 and the number of voices with the **V** command to 3. Now you are ready to play, so type a **P** command and the number **1** to start at the beginning. Then, to see the music, use the **D**isplay command. Try it, you'll like it! Here is a list of the music on your disk

Title	**# of voices**	**Meter**	**Tempo Setting ("PLAY" Mode Only)**
OVERTURE	4	4,4	175
MINUET	3	3,4	205
TWINKLE	3	2,4	200
NONAME ROCK	4	4,4	180
MUSKRAT RAMBLE	4	6,8	222
IS THAT ALL THERE IS?	3	3,4	170
SAINT JAMES	4	6,8	210

2.2.3. Also, you can change the timbres for the different voices in each piece. Use this guide for selecting the timbres:

1 = rich string sound for the bass voice only
2 = wind-flute sound
3 = horn-brass sound
4 = bassoon-oboe sound
5 = clarinet choir sound
6 = electronic organ sound
7 = funky oboe!

2.2.4. If you ever get stuck and cannot remember the commands, just type **H** for HELP to review. HELP also shows you how to enter music notation into the computer.

2.3 COMPOSING

2.3.1. Let's see how to enter a single melody into the computer:

This is the motive from the Bach Two-Part Invention in F major.

??VOICES = **1 (R)**	Set up the COMPOSER for just 1 voice.
??COMPOSE ?**Ø (R)**	Now, we need to tell the computer we want to compose. Enter the **C**ompose command. The "Ø" means start a new music file. (Ø is the number zero)

****Note: follow each pitch entered with a **(R)** ****

1:1?**ER**

Enter an **E**ighth **R**est
in set 1 of voice 1.
That is what "1:1" means.

2:1?**EF3**

Enter an **E**ighth note **F**
in the 3rd octave in set 2
of voice 1. Watch the
notes appear on the screen!
And hear the pitch!

3:1? **EA3**

And, we continue on entering
in each note. We always
enter the rhythm, the pitch,
and the octave, in that order.

4:1? **EF3**

5:1? **EC4**
6:1? **EF3**
7:1? **EF4**
8:1? **SE4**
9:1? **SD4**
10:1? **SC4**
11:1? **SD4**
12:1? **SC4**

If you type a wrong code, the
computer will beep, then retype
the music note.

We have finished one measure.
A **S**ixteenth note in set 8!

13:1? **SBF3**

There is one more letter here.
We need a B **F**lat. So we
use **F** for flat. If we need
a sharp, we would type **S**.

14:1? **SA3**
15:1? **SBF3**
16:1? **SA3**
17:1? **SG3**
18:1? **.HF3**

Put a dot before the rhythm
to make a dotted value!

19:1? * (R)

An asterisk "*" tells the computer to stop
composing and return to the
command mode. (remember, you
must press the **shift**
key to get the asterisk.)

??METER # OF BEATS ? **3 (R)**
BEAT ? **4 (R)**

Let's set the Meter.

??DISPLAY AND PLAY? **1 (R)**

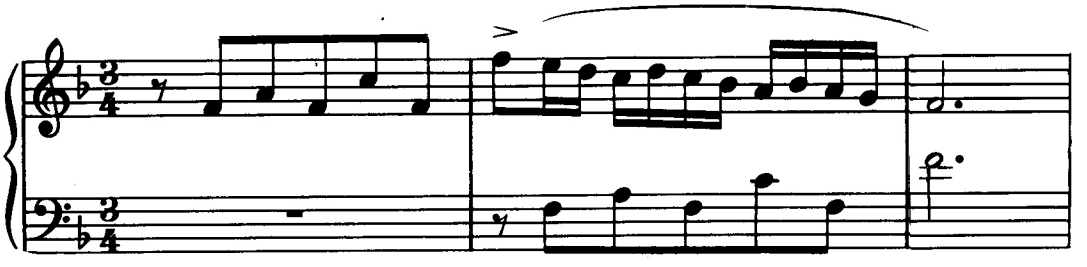
We want to see and hear our own work. Let's play and display the music.

If you do this you will see the notation as well as hear the music. This will be a lot of help when you edit music while you are composing.

Turn the Paddle to change the tempo in the "Display" mode.

2.3.2. This music has 2 voices going on at the same time. Let's see how to compose with 2 voices. We will take the same piece and just add a new voice.

Vivace *Con Allegrezza*



??VOICES = **2 (R)**

Set for 2 voices.

??COMPOSE? **ø (R)**

Compose. The "ø" indicates that you are starting a new music piece.

1:2? **.HR**

Put a dotted **H**alf **R**est in voice 2 of set 1 and an **E**ighth **R**est in voice 1 of set 1. (Notice, the computer asks for the lowest voice first and the prompt moves up as you build the chord.

1:1? **ER**
2:1? **EF3**
3:1? **EA3**
3:1? **EA3**

The computer will not ask you for voice 2 until the dotted half rest is used up.

4:1? **EF3**
5:1? **EC4**
6:1? **EF3**
7:2? **ER**
7:1? **EF4**
8:2? **EF2**
8:1? **SE4**
9:1? **SD4**
10:2? **EA2**
10:1? **SC4**
11:1? **SD4**
12:2? **EF2**
12:1? **SC4**
13:1? **SBF3**
14:2? **EC3**
14:1? **SA3**
15:1? **SBF3**
16:2? **EF2**
16:1? **SA3**
17:1? **SG3**
18:2? **.HF3**
18:1? **.HF3**
19:1? * **(R)**

Just let the computer lead you. It keeps track of rhythmic values and cues you for the next note needed in the music.

End composing!

??METER **(R)**
#OF BEATS? **3 (R)**
BEAT? **4 (R)**

Set the meter.

??DISPLAY AND PLAY? **1 (R)**
??PLAY THE MUSIC? **1 (R)**

Then display and play!
Just play——

??**W (R)**

Let's save the music on disk.

DO YOU WANT TO SAVE A SONG OR A TIMBRE FILE (S OR T)? **S**

TYPE A NAME FOR YOUR SONG: **MY SONG**

YOUR SONG IS SAVED!

?? (Now the COMPOSER is ready for a new command.)

That is all there is to it folks—

You enter the notes vertically, entering either a note or a rest for each voice. Each vertical group of notes represents a "set" of notes. The computer keeps track of notes by these sets. Each set is determined by the **smallest** rhythm active at any point in time. Just think of the music as a series of vertical "slices" of time from beginning to end. The MUSIC COMPOSER lets you compose up to 4 polyphonic voices.

2.4 EDITING

The COMPOSER has an EDIT mode that lets you change any set. For example, take the little Bach piece we entered. If we want to change the eighth note F in the top voice beginning at the second measure to an F sharp, we would:

1. First enter **D**isplay mode and using the button on Paddle #0 walk through the music until you locate that set.

   ??DISPLAY AND PLAY?**1** **(R)**

   Just push the button for each note to stop and start. You might try this a few times just for practice.

2. Then, when you have located the set, with the button still down, PRESS THE SPACE BAR. This will always return you to the command mode with ?? displayed on the TV screen.

   ?? STOPPED ON SET#7

   Try this a few times to practice. With the button and the space bar you can easily skip around through a piece of music. You can stop whenever you wish. And, you can start where you wish simply by typing a different set number for the display or play commands. The button and space bar can be used in PLAY or DISPLAY.

3. Now, let's enter the EDIT command. Type **E** for EDIT and then **7** for Set #7.

   ??EDIT ?**7** **(R)**

   The notes for that set should be displayed on the staff in front of you.

4. Type in the new pitch codes for **every** voice in the set.

   7:2? **ER**
   7:1? **EFS4**

   The COMPOSER should now show the new, changed set.

5. Now, display and play the piece.

   ??DISPLAY AND PLAY ?**1** **(R)**

8. Let's continue to destroy our BACH piece a little more! Change the first B flat in the second measure to a B natural.

   ??DISPLAY AND PLAY ?**1** **(R)**

   Walk through the piece with the button on the Paddle and stop on the set with the B flat. Then press the space bar to return to command mode.

STOPPED ON SET #13

??EDIT ? **13** **(R)** — Enter the EDIT mode at set #13 to change the note to B natural

9. The B flat should have been displayed on the staff. Nothing is shown for the second voice because it is sustaining through from the last eighth note, F natural. There is a special edit character to use when you need to skip a voice because it is sustaining through from a previous set. The character is a dash, — . Type a dash, — , to tell the computer not to enter a note for this set. This is most important. If you had entered another note for the lower voice, the rhythm would be wrong when you tried to play it.

   So enter the B natural and the dash to skip the lower voice:

   13:2? — Skip this voice
   13.1? **SBN3** Enter the B natural

   ??DISPLAY AND PLAY ? **1** **(R)** Now display and play

10. There is one other special character you can use in either the COMPOSER or the EDIT modes. Whenever you want to erase the current set you are entering and then start over, type a (SHIFT) N, or ^ , character followed by a (RETURN) as the **first** character after the prompt. This will clear all notes entered in that set and you can start over.
11. Since we have completely destroyed the piece, why not go back using the EDIT mode and put the notes back the way they are supposed to be! It will be good practice in using the EDIT command.

2.5 TIMBRE

The COMPOSER has a TIMBRE mode that lets you assign any one of seven timbres to any voice. Besides the preset timbres available, you can also create your own timbres (harmonic spectra) using the FOURIER command. To create any timbre you must specify the relative amplitude (loudness) of each harmonic, 0 to 100 percent. Let's say we want to create a clarinet timbre like Timbre #5 that is already in the COMPOSER. That timbre has 7 harmonics and the relative amplitude for each is: 100, 0, 50, 10, 60, 5 and 30, in that order.

To create that timbre enter the FOURIER command:

??**F** — The computer will ask you for some information.

HOW MANY HARMONICS
(1 to 16) ?**7** **(R)** — We need 7 harmonics.

WHAT TIMBRE CODE NUMBER
(1 to 7) ?**1** **(R)** — Let's store the timbre in Location 1.

PEAK AMPLITUDE ? **63 (R)**

The number 63 makes all 4 voices come out the same amplitude. This sets the overall loudness for a timbre when it is played in a music piece.

AMPLITUDE (0 to 100%)
HARMONIC 1 = ?**100 (R)**
HARMONIC 2 = ?**0 (R)**
HARMONIC 3 = ?**50 (R)**
HARMONIC 4 = ?**10 (R)**
HARMONIC 5 = ?**60 (R)**
HARMONIC 6 = ?**5 (R)**
HARMONIC 7 = ?**30 (R)**

Now we enter the relative amplitude for each harmonic,

COMPUTING

The computer is computing the timbre and storing it in Location 1.

??TIMBRES
VOICE #1?**1 (R)**
VOICE #2?**1 (R)**
VOICE #3?**1 (R)**
VOICE #4?**1 (R)**
??PLAY THE MUSIC ?**1**

NOW WE'LL ASSIGN TIMBRE #1 TO ALL FOUR VOICES TO HEAR WHAT IT SOUNDS LIKE (make sure you have a 4 voice piece of music loaded!) Then play it and hear the timbre you've created!

Don't be afraid to experiment. Fooling around with the timbres and the FOURIER command is an excellent way to teach yourself about how tone colors are made up of different harmonics at different amplitudes. You can't hurt a thing by goofing around and just making up timbres at random. Should you want to get more technical, you might want to check into some acoustics of music textbooks like those by BENADE, BACKUS, and CULVER.

You may want to save a set of timbres you have created. To do this you use the WRITE command just as though you were saving a Music File.

??**W**

Enter the WRITE command.

DO YOU WANT TO SAVE A SONG OR
A TIMBRE FILE (S OR T) ?**T**

But, this time type **T** for Timbre.

TYPE A NUMBER (1 to 9) FOR
YOUR TIMBRE FILE? **1**

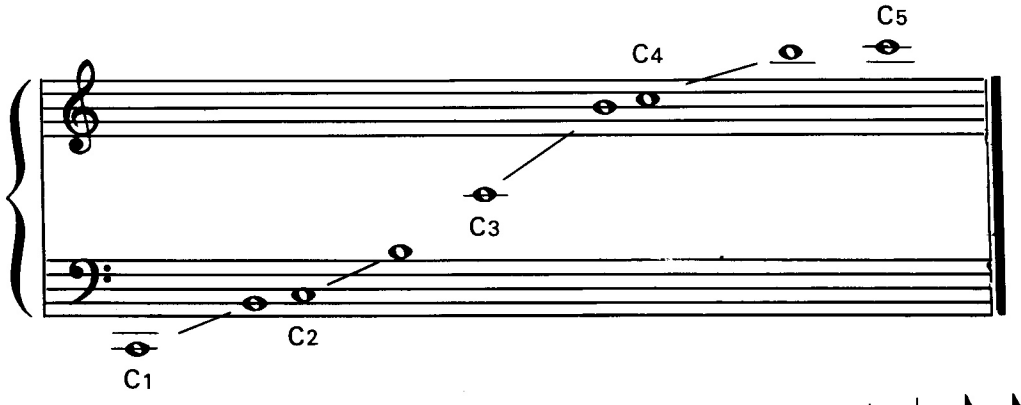
Let's save this as #1.

And, that's all there is to it. Your set of 7 timbres will be saved as a file named, TIMBRE1. Use the READ command to retrieve the TIMBRE1 file just as you would a music file.

3.0 DIMENSIONS OF THE MUSIC COMPOSER

3.1 Music parameters

3.1.1 Range of notes: The COMPOSER has a 4-octave range of 25 equal-tempered, chromatic steps. The range is from C1 (65.41 Hz) to C5 (1046.5 Hz). The octaves are numbered as follows:



3.1.2 Range of rhythmic durations: The rhythmic durations permitted are 

3.1.3 Voices: music with 1, 2, 3, or 4 voices may be entered into the COMPOSER.

3.1.4 Sets: a music set represents one time unit equivalent to the smallest note value in the music. Each set contains all of the rhythm and pitch information needed during that time unit. There are 8K bytes of memory set aside for storing the music codes and each set takes (Voice X2) + 3 bytes. Thus 1 -voice music permits 1638 sets; 2-voice music permits 1170 sets; 3 -voice music permits 910 sets; and 4 -voice music permits 744 sets.

3.1.5 Music file: a music file consists of a consecutive series of music sets.

3.1.6 Tempo: Tempo of the music is controlled by the Apple paddle #0. In "Play" mode, the paddle sets tempo from 0 (very slow) to 255 (very fast). Pushing the button starts the music once the tempo is set. In "Display" mode, tempo can be varied **during** a selection by turning the paddle.

3.1.7 Timbre (harmonic spectrum): the MUSIC COMPOSER has 7 preset timbres (numbers 1 through 7). Any timbre can be assigned to any voice. They can best be described as follows:

1. Rich string sound for the bass voice
2. Wind-flute sound
3. Horn-brass sound
4. Bassoon-oboe sound
5. Clarinet choir sound
6. Electronic organ sound
7. Funky oboe!

The COMPOSER also provides a feature for constructing and saving your own timbres. This is done with the **Fourier** command.

In this command mode, you can enter the relative amplitude for each harmonic, and the MUSIC COMPOSER will compute a harmonic waveform table (timbre) which you can use in any voice of your music. These limitations apply:

1. The maximum number of harmonics is 16.
2. The sum of the peak amplitudes of the timbres of all voices playing simultaneously must be 255. If this is exceeded, the sound will be distorted. To have all voices with the same amplitude, 63 is an appropriate value to select for amplitude.
3. The highest frequency permitted is 5000 Hz. When constructing a harmonic spectrum, you must not exceed this 5K Hz limit. When the limit is exceeded, aliasing or distortion will occur. What this means is that you should restirct the number of harmonics used in a timbre as the notes of a voice increase in register.

(Refer to Section 2.5 of this Guide for an example of the **Fourier** command)

3.2 Music Coding:

Each music note is input as a literal music code. The code is:

r p a o : Where **r** = rhythm (W, H, Q, E, S, T)
p = pitch base (C, D, E, F, G, A, or B)
a = accidental (N, S, or F)
o = octave (1 to 4); C5 is permitted.

Thus, a code CN3, will provide middle C, 263 Hz.

3.2.1 The rhythm codes are:
W = whole
H = half
Q = quarter
E = eight
S = sixteenth
T = thirty second
A dot, ".", before any letter makes the rhythm a dotted value. Dotted sixteenth or dotted whole notes are not permitted.

3.2.2 REST: To code a rest, input an R in place of the pitch, accidental, and octave. Thus, QR, is a quarter rest.

3.2.3 Accidentals: The flat sign is coded as an **F**, the sharp sign as an **S**, and the natural sign as an **N**. However, only use the **N** where you need a natural sign specifically to cancel out a previous accidental. In all other cases simply omit the accidental.

For example: QCN3 would show a natural sign.
QC3 would not show a natural sign.

The composer translates accidentals to the simplest enharmonic when displaying. A QES3 will appear as a QF3.

3.2.4 Entering music codes into the MUSIC COMPOSER:
Music code can be entered in either the COMPOSE or EDIT modes. The computer requests notes for each voice in each set in ascending order, the lowest voice to the highest. The best way to understand how this works is to work through the example in Section 2.3 of the Guide before reading further. You soon find that the entry system is "smart." It checks your input for legitimate rhythm, pitch, accidental, and octave codes. If there is an error, a beep is heard and you will have to re-enter the note.

3.3 Commands

3.3.1 P = Play a music file
D = Display and play a music file
C = Compose a music file
E = Edit a music file
F = Fourier computation of a harmonic spectrum
V = Set the number of voices in the music file
M = Set the meter of the music file
T = Assign timbres (1 to 7) to each voice
H = HELP!
R = Read a music file from disk
W = Write a music file to disk
Q = Quit the MUSIC COMPOSER

3.3.2 The double question mark, ?? , is the command prompt. Whenever the COMPOSER is ready for a new command, it will display ?? . Any of the commands in Section 3.2.1 may be entered at this point.

The single question mark, ? , is the data prompt. Whenever the COMPOSER needs data in a command mode it will display ? .

3.3.3 Data request under the EDIT, COMPOSE, and PLAY commands take the following form:
?? command ? starting set number

Example: ?? COMPOSE? **50**
Compose beginning with set #50.
Example: ?? PLAY THE MUSIC? **1**
Play beginning with set #1

3.3.4 Data requests for music notes in compose. COMPOSER requests notes for each voice in ascending order, lowest to highest VOICE. The data prompt is preceeded by two numbers in the form, s:v?, where s = set number and v = VOICE. In response to this prompt, type in the rhythm, pitch, and octave information for a note in a given set as indicated in section 3.2.

3.3.5 Special features of the COMPOSE and EDIT commands:

1. When entering the COMPOSE mode, 2 special numbers may be entered in place of the prompt for data.
   A Ø indicates you want to start a new music file;
   a−1 indicates you want to start at the end of the music file. This lets you start composing where you last ended in the music file.
2. In the COMPOSE and EDIT modes 2 special editing features are available: First the ^ (or shift N) will erase all notes entered in a set.
   For example, if you had entered
   1:1? ^
   1:2? QF2
   1:3? QC3
   Note: The prompt scrolls upward!

   and then realized a mistake, the ^ for 1:1 would erase all the notes and you could start over.

   Second, the dash, — , entered for a request for note data will cause the composer to skip that voice and store no information for that voice in that set in the music file.

3. Entering an asterisk, * , for a request for note data will terminate the COMPOSE and EDIT modes and place and end-of-file marker at the end of the music file.

3.4 Paddle #0

The Apple II paddle #0 is used for

1. changing the tempo of the music through the knob on the paddle when in "Display" mode. and
2. stopping the music by pushing the button on the paddle during a selection.
3. pre-setting tempo during "Play" mode. Pushing the button starts the music.

NOTE

You can return to the command mode at any time by holding down the button to stop the music and then pressing the space bar on the Apple keyboard.

3.5 Graphic display of notation

The MUSIC COMPOSER provides graphic display of standard notation during the DISPLAY, EDIT, and COMPOSE modes. The current music set is always displayed on the right side of the screen; the music then scrolls left across the screen and off.

Graphic display is intended only for editing purposes. Stem placement and note position are set by simple, arbitrary rules in order to maintain the speed needed for music production.

Rests are omitted. The slight re-articulation between each set is caused by the time needed to display the notes.

3.6 Re-starting the MUSIC COMPOSER.

Should the MUSIC COMPOSER become hung-up or some error causes the software to abort and stop, try the following techniques to re-enter the COMPOSER (the music file will not be destroyed).

1. If an * is being displayed

   Type: **9DBFG (R)**
   >RUN 10 (R)

2. if a > is being displayed
   Type: **RUN 10 (R)**

4.0 COMMANDS FOR THE MUSIC COMPOSER

COMPOSE
??COMPOSE ?s **(R)**

Where **s** = the starting set. **S** should not exceed 744 sets for 4-voice music. See 3.1.4

4.1.1 The COMPOSE mode is used to enter 1, 2, 3, or 4-voice music into a music file for performance with the MUSIC COMPOSER. All music is entered in vertical, contiguous sets.

4.1.2 There are 2 special **s** values, Ø and -1.

s = Ø is used to start composing a new file.
s = -1 is used to start composing at the last end-of-file marker.

4.1.3 To terminate COMPOSE mode, end by entering an asterisk, *, in place of a music code. This places an end-of-file marker in a music file. Should a music file not have an EOF marker, the MUSIC COMPOSER will get hung-up at the end of a PLAY or DISPLAY command. Recover can be made by (RESET). (Refer to Section 3.6)

4.1.4 The COMPOSE mode requests music code for each music voice in contiguous sets. The requests for code are in ascending order from the lowest to the highest voice. The prompts for music code in a 4-voice composition would be (s = current set number):

s:1? code for soprano voice **(R)**
s:2? code for alto voice **(R)**
s:3? code for tenor voice **(R)**
s:4? code for bass voice **(R)**

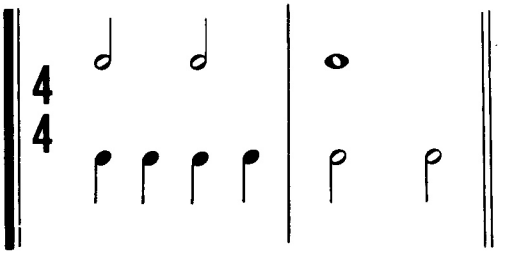
with the request ordered, s:4?, s:3?, s:2?, then s:1?.

After entry of the entire set, the music code is displayed on the CRT music staff in standard notation. Rests are not displayed.

CAUTION — — If a set number is entered greater than the allowed number (744 for 4 voices) or a set number is entered greater than the end of the music plus 1 set, the computer will get hung. You will have to reset and run the MUSIC COMPOSER again. See 3.6.

4.1.5 Music code is entered according to the rules set forth in Section 3.2. The COMPOSER checks input for legal code. If an error is detected, the Apple will beep and the prompt will request that the code be re-entered.

4.1.6 The COMPOSE mode keeps track of the rhythmic values of each voice. Each set represents the shortest active rhythmic duration. The COMPOSE mode requests entry of music code for a voice only if the duration of the last rhythmic value is exhausted. For example, if a two-voice piece had these simultaneous rhythms:



The prompts for the **rhythm** of the music code could be illustrated as:

1:1?H- - - 3:1?H- - - 5:1?W- - -

1:2?Q- - - 2:2?Q- - - 3:2?Q- - - 4:2?Q- - - 5:2?H- - - 6:2?H- - - 7:2?*

The asterisk*, would end COMPOSE, place an EOF marker in the music file, and return to the command prompt, ?? .

4.1.7 There is a special edit character, the ^ or (SHIFT) N. The ^ character will erase all entry in a set and let you re-enter a music set. This can be used when you have made a mistake (before entering the entire set) and you want to start the set over. Note: the ^ must be typed as the first character on an input line. Errors detected after the set has been entered must be corrected with the EDIT mode.

4.2 EDIT

??EDIT ‹? **s**

where **s** = the set to be edited.

4.2.1 The EDIT mode is used to change one (1) set in a music file. Upon entry to the EDIT mode, the set to be changed is displayed. The EDIT mode then requests entry of the new music code using the same prompts and rules as the COMPOSE mode. Code must be entered for **all** voices. After the new code is entered, the EDIT mode then displays the changed code and exits back to the command prompt, ??.

4.2.2 There is a special edit character, the — or dash. When changing a set using EDIT, all voices must be accounted for either with a note or a rest. However, many times a voice is sustaining through from a previous set. In this case, enter a — (dash) in place of the music code so that that voice is skipped. If the — is not used in this instance, the rhythm of the music will be out of synch when an attempt is made to play the music file.

PLAY

??PLAY THE MUSIC ? **s** (R)

Where **s** = the starting set. **S** should not exceed 744 sets for 4-voice music. See 3.1.4.

4.3.1 The PLAY mode is used to play a music file previously created in the COMPOSE mode. The tempo (speed) of playing is controlled by the APPLE Paddle #0. PLAY can be stopped at any point by depressing the button on Paddle #0. If the (SPACE BAR) on the keyboard is pushed while the button is depressed, the COMPOSER will return to the command prompt, ?? .

4.3.2 You should enter a value for **s** that starts at the beginning of a music measure. This insures that all rhythmic durations for all voices are activated. If not, the first several sets in PLAY may be out of synch.

4.3.3 Should the PLAY mode get hung-up, type the (RESET) key and refer to Section 3.6.

4.3.4 The MUSIC DOES NOT PLAY!! If the music doesn't play, check the following:

a. Correct number of voices should have been set in the VOICE command before playing.
b. There is no EOF marker on the end of the music file, i. e., you didn't use an * to end composing.
c. There is no music file loaded from disk or composed. Use the READ command to load a music file before PLAY.
d. The MICRO MUSIC DAC card is not in SLOT #4 or SLOT #2 of the APPLE peripheral slots as assigned at the beginning of the program. See Section 5.2.1.
e. The volume of the MICRO MUSIC DAC is too low and/or is not connected correctly to the speaker.

DISPLAY (and play)

??DISPLAY AND PLAY ?**s** (**R**)

Where **s** = the starting set. **S** should not exceed 744 sets for 4-voice music.

4.4.1 The DISPLAY mode is used to see and hear, in standard music notation, what has been stored in a music file. All of the comments regarding the PLAY command are applicable to the DISPLAY command. It should be stressed that the DISPLAY mode is intended for editing purposes only. Slight distortions occur in the rhythm of the music in this mode; these distortions are most noticeable in complex rhythmic music. Further, a slight separation occurs between each music set due to the computer time needed to display the notes on the staff. This results in sustained notes being rearticulated due to faster changing rhythms occurring simultaneously.

4.4.2 In the interest of speed of computation and screen spacing, certain tradeoffs had to be made in the standard notation displayed. These tradeoffs are the elimination of rests, and the setting up of simple, arbitrary rules for stem placement and note position. The primary objective was to provide visual notation readable enough to permit editing of the music file.

4.4.3 DISPLAY of the graphics on the music staff is right to left. The current music set sounding is displayed on the right; previous sets scroll left off of the screen.

4.4.4 Bar lines are set by the METER command. The assignment of bar lines is computed during display based on maintaining a rhythmic count.

VOICES

??VOICES = ?**n** **(R)**

Where **n** = number of voices (1-4)

The VOICES command sets the number of voices to be used in a music file. PLAY, DISPLAY, EDIT, COMPOSE, and TIMBRE will not work correctly unless the voices have been set.

METER

??**METER**
# of BEATS?**i** **(R)**
BEAT ?**j** (R)

Where **i** = the # of beats in a measure (2 to 9) and
Where **j** = what value gets the beat (2, half; 4, quarter; and 8 eighth note).

The METER command only need be set for the DISPLAY mode. A simple rhythmic count is made during display. If the count equals the METER value, then a bar line is placed on the music staff.

TIMBRE

??TIMBRES
VOICE #1? **t** **(R)**
VOICE #2? **t** **(R)**
VOICE #3? **t** **(R)**
VOICE #4? **t** **(R)**

Where **t** = the timbre number (1 to 7) to assign each voice.

4.7.1 The TIMBRE command is used to assign one of 7 timbres to each music voice. The timbres can be one of the 7 preset timbres or timbres created in the FOURIER command mode.

4.7.2 The preset timbres are shown below with the amplitude of each harmonic present in the spectrum:

a. Rich string for bass voice: 100, 60, 60, 65, 55, 20, 55, 10, 55, 25, 35, 35, 15, 35, 10, 35
b. Wind/flute: 10, 100, 0, 0, 0, 100
c. Horn/brass: 100, 100, 80, 75, 40, 30, 10, 10, 5, 5
d. Bassoon/oboe: 18, 45, 100, 20, 8, 10, 3
e. Clarinet choir: 100, 0, 50, 10, 60, 5, 30
f. Electronic organ: 100, 100, 0, 100, 0, 100
g. Funky oboe: 13, 22, 31, 44, 100, 38, 19, 100

4.8 FOURIER

??F

FOURIER COMPUTATION OF TIMBRES
HARMONICS ABOVE 5 KHz WILL CAUSE DISTORTION

HOW MANY HARMONICS (1 to 16)? **i (R)**
WHAT TIMBRE NUMBER (1 to 7)? **j (R)**
PEAK AMPLITUDE (0 to 255)? **k (R)**

HARMONIC 1 (0 to 100%)? **a (R)**

•
•
•

HARMONIC i (0 to 100%)? **a (R)**

4.8.1 The FOURIER command is used to create harmonic spectra to be assigned to voices using the TIMBRE command. Three variables must be entered: the number of harmonics in the spectrum (i), the code number to assign the timbre for storage (j), and the amplitude of the timbre (k). This amplitude sets the overall loudness of the voice during the PLAY mode. Then, the computer requests the relative amplitude (0 to 100%) of each of i harmonics. The input is displayed in a bar graph.

4.8.2 The FOURIER command is actually constructing a waveform table in memory. The music produced by the MUSIC COMPOSER uses digital music synthesis. The tones for 4 voices are generated using a software sampling technique and waveform tables stored in memory. The resulting digital code is sent to the 8 bit digital-to-analog converter on the MICRO MUSIC DAC board. Thus, timbres can easily be changed by constructing new waveform tables through the FOURIER command.

Due to the 1 MHz clock of the APPLE and the 8 bit DAC there are some limitations on computing waveform tables:

a. The harmonics computed cannot exceed 5 KHz. This means that the number of harmonics (i) for upper voices should not exceed 6 to 7 harmonics, since the upper harmonics on high tones could be beyond the 5 KHz limit. When the limit is exceeded, aliasing and distortion occurs. Low register voices can easily use timbres with 12 to 16 harmonics (i) present.

b. The additive amplitude of **all** voices must not exceed a sum of 255. If you want all of the four voices equal in amplitude, set the PEAK AMPLITUDE (k) to 63. But, you can also make the bass voice louder than the top voice to achieve balance just so long as the total sum is less than 255. Excessive amplitude will cause distortion in the PLAY mode.

READ

??R

DO YOU WANT A LIST OF YOUR FILES? (type Y or N)

If your response was **Y,** then a listing of all your timbre and music files is given.

TYPE THE NAME OF THE FILE: name

(Be sure each and every letter is correct, exactly as stored!)

?? (return to command mode signifies the file has been read.)

The READ command is used to read a music or a timbre file from disk into the music file storage area or the timbre storage area.

DISK errors are trapped by the program. When they occur, the program returns to command mode.

WRITE

??W

DO YOU WANT TO SAVE A SONG OR A TIMBRE FILE (S or T). **r**

4.10.1 If you typed **S**
TYPE A NAME FOR YOUR SONG: name

YOUR SONG IS SAVED! (This signifies the file has been stored on disk)

?? (return to command mode)

4.10.2 If you typed **T**

TYPE A NUMBER (1 to 9) FOR YOUR TIMBRE FILE: **i**

(Timbre file of all 7 waveforms is saved under the label of TIMBREi)
?? (return to command mode)

The WRITE command lets you save Music or Timbre files on disk.

HELP

??H

The HELP command lists:

- the command set
- rules of notation
- function of APPLE Paddle #0

QUIT

??Q

The QUIT command gracefully exits the MUSIC COMPOSER.

5.0 TECHNICAL DESIGN OF THE MUSIC COMPOSER

5.1 MUSIC COMPOSER software. The software consists of two modules, a loader/editor program written in BASIC and a music sound/graphics interpreter written in machine language.

5.1.1 MUSIC COMPOSER memory usage:

zero page	variable storage
$0300-0400	variable storage
$0800-1800	music interpreter machine code
$1800-1F00	7 waveform tables
$1F00-2000	saved zero page
$2000-4000	high resolution graphics and play compile storage
$4000-6000	music file storage
$6000-9600	BASIC music loader/editor
$9600-	Apple DOS

5.1.2 8K of memory space is allocated for storing the music file. During PLAY, a compiled version of the music code is stored in $2000 to $4000.

5.1.3 The music interpreter is a self-running, machine language program that interprets music sound and graphics from codes stored in the music file. When playing or displaying music, machine operation is completely under control of this interpreter. To halt execution either press the button of Paddle #0 simultaneously with the (SPACE BAR), OR PRESS THE (RESET) key. The music file is created thru the BASIC loader/editor. The literal music codes input to the loader are translated into a concise music code and stored in a fix record structure in the music file. The format for each music record is:

$R_1P_1, R_2P_2, \ldots R_jP_j, \$EO, PNTH, PNTL$

Where each record represents one music set and contains a pair of bytes (RP) to code rhythm and pitch for each of j voices active in that set. A special $EO marker is then inserted (to be used with future software expansion) followed by a two-byte pointer (PNT) locating the address of the next set in memory. The pointer is stored high byte first.

5.1.4 Due to numerous zero page conflicts, zero page is saved ($1F00) whenever the music interpreter is called and then replaced when the interpreter returns control to the calling program.

5.1.5 Those persons wishing to use the music interpreter may contact MICRO MUSIC INC. for a licensing agreement which will provide an Experimenter's Package detailing the workings of the interpreter and its stand alone operation.

5.2 MUSIC COMPOSER hardware. The MUSIC COMPOSER hardware consists of the MICRO MUSIC DAC card designed by Micro Technology Unlimited and Hal Chamberlin. The board is an 8 bit DAC with a filter and high-fidelity amplifier. Music is generated by software digital synthesis. Tones are generated using a sampling technique and waveform tables stored in memory. In operation, a string of 8 bit bytes is sent to the 8 bit DAC hardware at a rate of 8 KHz or greater. The converted output voltage is fed to a sharp cutoff low-pass filter to remove switching spikes, thus generating a smooth waveform. The filtered output is then routed to a low-power high-fidelity amplifier capable of driving any 8 or 16 ohm speaker. The DAC concept offers a low-cost approach to music synthesis.

5.2.1 **The DAC must fit in SLOT #2 or SLOT #4 of the** Apple Peripheral Connectors. This is because of the **slide potentiometer that must protrude** through one of the slots on the backplate of the Apple.

5.2.2 **Tuning. The software is tuned** to an equal-tempered music scale. Since the music generation is **software originated, stability** of the sound generation is comparable to the performance **characteristics of the Apple** crystal controlled clock. The following gives the software tuning for the **4 octave range of the MUSIC** COMPOSER:

Octave 1: 65.41, 69.30, 73.42, 77.78, 82.41, 87.31, 92.50, 98.00
103.83, 110.00, 116.54, 123.47

Octave 2: 130.81, 138.59, 146.83, 155.57, 164.82, 174.62, 185.00,
196.00, 207.65, 220.00, 233.08, 246.94

Octave 3: 261.62, 277.18, 293.66, 311.13, 329.63, 349.23, 369.99,
391.99, 415.30, 440.00, 466.16, 493.88

Octave 4: 523.24, 554.36, 587.32, 622.26, 659.26, 698.46, 739.98,
783.98, 830.60, 880.00, 932.32, 987.76

Octave 5: 1046.5

5.2.3 **Principles of operation.** The MICRO MUSIC DAC consists of three distinct sections. The 8 bit digital-to-analog converter (DAC) accepts an 8 bit binary input from a data latch on the computer's bus and produces a DC voltage directly proportional to the unsigned binary value of the input. The 6-pole lowpass filter blocks all sampling distortion frequencies above approximately 3.5kHz. This filter is necessary for clean sounding music from the DAC. The audio power amplifier boosts the filter output signal to the level required for driving a speaker. A volume control determines the gain of the amplifier and thus the volume of the sound reproduced in the speaker. In order for the board to operate solely from a single 5 volt power supply, several innovative circuit techniques have been incorporated.

U5 and U6 form the data latch that is necessary to get output data from the Apple II bus. Type 74LS173 synchronous load latches are used which eliminates the need for additional gating. In operation the latches will capture new data only when the READ/$\overline{\text{WRITE}}$ line is low (bus write operation) and $\overline{\text{DEVICE SELECT}}$ makes a true to false transition.

Looking at the DAC section, it is seen that the weighted resistor method of conversion is used. The CMOS buffers in U1 and U2 make very good analog switches which switch their outputs between exactly ground and exactly the supply voltage (+ 5 volts) in response to the input signal. The only error in this switching action is a finite output impedance of approximately 200 ohms. CMOS buffers, rather than inverters, are used because the two stages of "gain" internally assures complete switching of the output even if the input swings less than 5 volts. The DAC network produces an output voltage directly with a source impedance of approximately 6.25K. With all zeroes input, the output is zero volts; with all ones input, the output is 5 volts. Loading the output has no effect on linearity but it will reduce the signal swing.

In order to insure accurate, monotonic performance of the DAC, the most significant bit is actually four CMOS gates and four 51K resistors in parallel while the next most significant bit is two in parallel. The remaining bits are single gates since the ratio of the weighting resistors to the gate output impedance is large enough to ignore. By using parallel and series combinations of 51K resistors for the most significant 5 bits, it is possible to use relatively inaccurate resistors in the DAC and still achieve ¼ LSB linearity which is about .2%. This is due to statistical averaging among the resistors, particularly the critical most significant bit. Even so, factory assembled units have had the 51K resistors matched to within 1%. Although the more common R-2R resistor ladder network could have been used, more resistors would have been required to get the same degree of statistical matching. An integrated circuit DAC was not practical since all that are currently available require a negative supply voltage for either the DAC itself or for a current-to-voltage converter operational amplifier. Note that the 5 volt power supply is filtered and used as a reference for the DAC. While small amounts of noise are filtered out, 60Hz ripple on the 5 volt supply is likely to result in hum from the speaker.

The filter circuit is where things start getting unconventional. The filter actually consists of three two-pole stages connected in cascade. Each section is a resonant lowpass filter, i.e., the response curve may peak somewhat just before cutoff. With proper selection of section cutoff frequencies and Q factors (peaking), a very nearly flat passband and sharp cutoff is obtained. Passband ripple is less than .5dB and the cutoff slope is such that 30dB attenuation is obtained at just 1.35 times the cutoff frequency of 3.5kHz. Note that the 5 volt swing of the DAC is reduced to about 2.5 volts through the filter by virture of the 220K input resistor to the first filter stage.

Each filter section is implemented as a **biquadratic** filter which consists of an inverting summing amplifier, a leaky integrator, and an ideal integrator all connected in a loop. Although three operational amplifiers are required for the circuit, its advantages are many. In particular, high Q factors are possible with modest amplifier gain. In addition, sensitivity of the response curve to component tolerance is very low. These characteristics allow the use of linearly biased CMOS gates as inverting operational amplifiers. Performance of the filter using the CMOS gates is indistinguishable from the performance using true op-amps such as a 741. See the National Semiconductor CMOS data book for more information on linear CMOS applications.

The audio power amplifier is a special high efficiency design that allows a significant power output with only a single 5 volt power supply and no output transformer. Three parallel connected CMOS gates provide most of the voltage amplification in the circuit as well as presenting a high input impedance and having a moderately low output impedance. The output stage is fully complementary and incorporates considerable local feedback of its own. The voltage gain of the output stage is approximately 18. Overall feedback from the output back to the voltage amplifier input completes the loop and gives a closed loop again of about 3.5 with maximum volume. The 92PU01 (NPN) and 92PU51 (PNP) output transistors actually contain one-amp capability transistor chips in a modified TO-92 plastic case. This is the same chip as used in the Motorola MPSU01 and MPSU51 plastic power transistors. With an 8 ohm load, the amplifier output can swing to within .3 volts of the 5 volt supply or ground before saturating. The 2.7 ohm resistor and .1μF capacitor (R46 and C9) across the output prevent possible oscillation with inductive loads. R39, R40, D1 and D2 form a bias network which allows a couple of milliamps to flow in the output transistors at all times to minimize class-B crossover distortion.

5.2.4. **Troubleshooting.** Diagnosing problems with the MICRO MUSIC DAC is fairly simple because of the unidirectional signal flow and minimal interaction among circuit components. If the board is completely inoperative, first do a thorough visual inspection of the board. Look on the solder side of the board for component leads that may be bent and shorting out to adjacent pads or PC runs. Check for loose components and the possibility of a cold solder joint.

If careful inspection fails to turn up anything, enter and run the program given on page 24. Then using a scope or amplifier/speaker if a scope is unavailable, find out where the signal is being lost. The first point to check is the two latch IC's. Each of the 8 Q outputs from U5 and U6 should be switching in a regular pattern which repeats about 200 times per second. If this is OK next check where all of the DAC resistors are tied together. Next check the output of the first filter section which is U3-8. The waveform should be somewhat rounded with voltage levels of about 1.25 and 3.75 volts. The next stage output (U3-6) should be somewhat less rounded with a hint of ringing on the square edges of the wave. Again the signal levels (less ringing) should be 1.25 and 3.75 volts. The last stage output (U4-6) has considerable ringing at a little over 3kHz but still the same voltage levels. If the signal is lost anywhere in the filter or the voltage levels are considerably offset (greater than .5 volt deviation) from their proper values first wiggle all associated components to see if anything changes. If this fails, the associated CD4069 (the 74CO4 is an equivalent) should be replaced. Be sure to use a CD4069 or a 74CO4; other varieties of inverters may not be suitable for linear operation or may have too high an internal impedance.

If the problem is in the power amplifier, first measure the output transistor collector voltage (the little tabs sticking out of the top of the transistors are the collectors) with no signal. This voltage should be within a quarter volt of 2.5 volts. If it is off considerably, one of the 4 transistors in the output stage may be shorted or open or the CMOS voltage amplifier may be bad. Temporarily cut the line running from U4-8, 10, and 12 to the junction of D1 and D2 and measure the collector voltage again. If it is now centered, the CMOS is bad; otherwise one or more transistors are bad or one of the biasing resistors (R38-R43) is open.The amplifier is only partially protected from output shorts so exercise care in connecting the speaker and don't run the unit with volume full up when there is an obvious problem such as a speaker line short.

If the customer is unable to find the problem, return the unit to the factory for servicing along with a description of the malfunction. This is a relatively simple board and factory repair can usually be accomplished in a couple of days.

5.2.5 **MICRO MUSIC DAC Unpacking and Installation.** The MICRO MUSIC DAC is a carefully engineered, manufactured, and tested product that should operate perfectly when handled and installed according to the following instructions. Since CMOS integrated circuits are used on the board, damage from static discharge is possible. When handling the board, always pick it up by the output jack which is connected to ground. Before plugging it into or removing it from the Apple II, discharge yourself to ground (the power supply box in the Apple is ideal).

Installation is accomplished by plugging in the board into one of the expansion sockets on the Apple II. Be sure to select a slot that allows the volume control handle to move freely up and down. Slot #2 is recommended and is assumed when using the verification program below. Any 8 or 16 ohm speaker may be connected to the cable and RCA phono plug supplied. Alternatively the audio cable may be plugged into an external amplifier for more volume such as at a club meeting or show.

To verify that the MICRO MUSIC DAC is working, enter the program shown on the next page and start execution at zero. Make sure the DAC is in Slot #2. A clear robust buzz should be heard in the speaker and the volume control should have a range from complete silence to somewhat above the point of distortion.

Address	Contents	Address	Contents	Address	Contents
0000	A9	0010	FA	0020	F8
0001	FF	0011	A2	0021	60
0002	8D	0012	02		
0003	A0	0013	20		
0004	C0	0014	19		
0005	AB	0015	00		
0006	A2	0016	4C		
0007	02	0017	00		
0008	20	0018	00		
0009	19	0019	A0		
000A	00	001A	C8		
000B	C8	001B	88		
000C	8C	001C	D0		
000D	A0	001D	FD		
000E	C0	001E	CA		
000F	D0	001F	D0		

Alternatively, the MICRO MUSIC DAC Music Software package may be used to verify board operation.

This completes checkout of the MICRO MUSIC DAC. If any problems are experienced, see the section on troubleshooting before returning the board to the factory.

5.2.6 **Specifications.**

Physical Size: 6 inches wide by 3 inches deep overall by .625 inches thick. Direct plug-in compatibility with the Apple II computer.

Connections: 1 set of 50 edge fingers, 25 on each side, .1" spacing

Latch section: Latches data on positive edge of a clock input when an enable input is low as required by the Apple II bus.

DAC section: 8 bits, offset binary encoded, typical ¼ LSB linearity, guaranteed monotonic, 5 volt swing, 6.25K output impedance, 5 volt supply is filtered and used as the reference voltage.

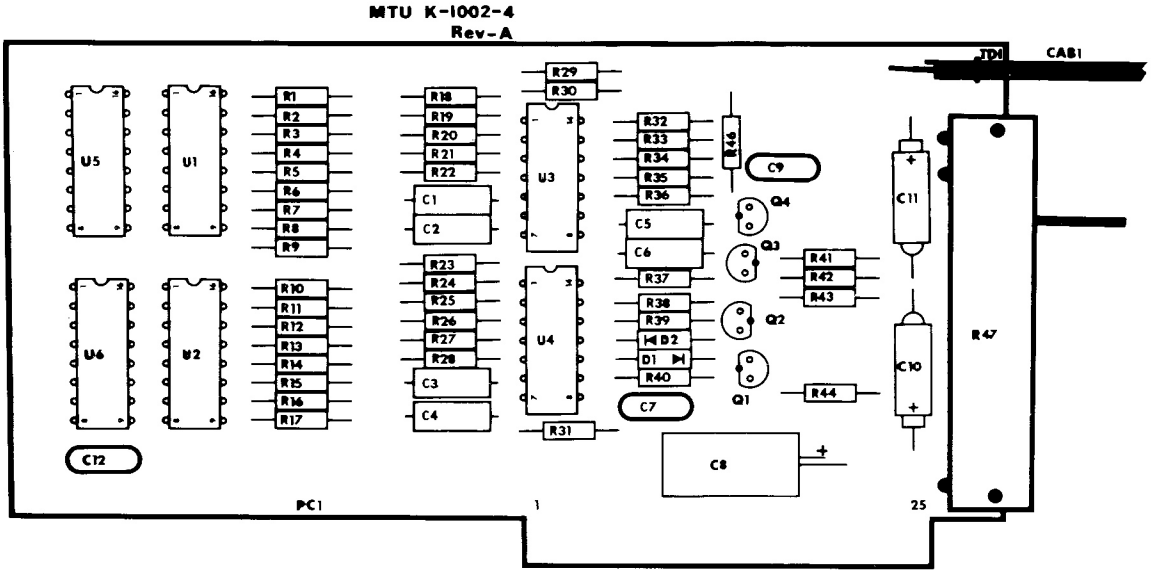
Filter section: 6 poles, 0.5dB Chebyshev response, cutoff frequency is 3.5kHz.

Power amp section: power output: 150MW into 16 ohms and 300MW into 8 ohms. Amplifier response is flat within 3dB from 30 to 20kHz with an 8 ohm load. Distortion at full power output into 8 ohms at 1kHz is less than 2%.

Power requirements: Single +5 volt supply. Ripple and noise within the audio range should be less than 20 MV.

Power Consumption: Quiescent current drain is less than 70 MA. Worst case drain at rated power, 8 ohm load, and sine wave output is 145 MA.

Bus signal loading: 1 LS load (360uA) on data inputs, 2 LS loads on clock (Device select) input and enable (read/write) input.



PARTS LIST
K-1002-4A MICRO MUSIC DAC
REV-A

DISCRIPTION	UNIT QTY	DESCRIPTOR
RESISTOR 2.7 OHM	1	R46
RESISTOR 10 OHM	1	R44
RESISTOR 100 OHM	2	R41, 43
RESISTOR 1K	1	R42
RESISTOR 10K	2	R39, R40
RESISTOR 51K (MATCHED)	13	R1-13
RESISTOR 100K	12	R18, 19, 23-26, 28, 30-33, 37
RESISTOR 130K	2	R20,22
RESISTOR 180K	1	R35
RESISTOR 220K	1	R29
RESISTOR 240K	3	R21, 34, 36
RESISTOR 390K	1	R14
RESISTOR 680K	1	R27
RESISTOR 820K	3	R15-17, 38
SLIDE POT 100K	1	R47
CAP ELECT 6V 220UF AXIAL	2	C10, 11
CAP ELECT 10V 1000UF RADIAL	1	C8
CAP POLY 470PF	6	C1-6
CAP Z5U .1UFD 12V	2	C7, 9
CAP Z5U .047UFD 12V	1	C12
DIODE 1N4148	2	D1, 2
TRANSISTOR PN2222	1	Q2
TRANSISTOR PN2907	1	Q1
TRANSISTOR 92PU01	1	Q3
TRANSISTOR 92PU51	1	Q4
LOGIC TTL 74LS173	2	U5, 6
LOGIC CMOS CD4050	2	U1, 2
LOGIC CMOS CD4069	2	U3, 4
PHONO CABLE	1	CAB1
CABLE TIE DOWN	1	TD1
PC BOARD	1	PC1

PIN CONNECTIONS
(Apple II standard numbering)

MICRO MUSIC DAC PIN	SIGNAL
18	READ/$\overline{\text{WRITE}}$
23	INTERRUPT IN (connect to pin 28)
24	DMA OUT (connected to pin 27)
25	+ 5 VOLTS
26	GROUND
27	DMA IN (connected to pin 24)
28	INTERRUPT OUT (connected to pin 23)
42	BUS DATA BIT 7
43	BUS DATA BIT 6
44	BUS DATA BIT 5
45	BUS DATA BIT 4
46	BUS DATA BIT 3
47	BUS DATA BIT 2
48	BUS DATA BIT 1
49	BUS DATA BIT 0

There are no connections to unlisted pins

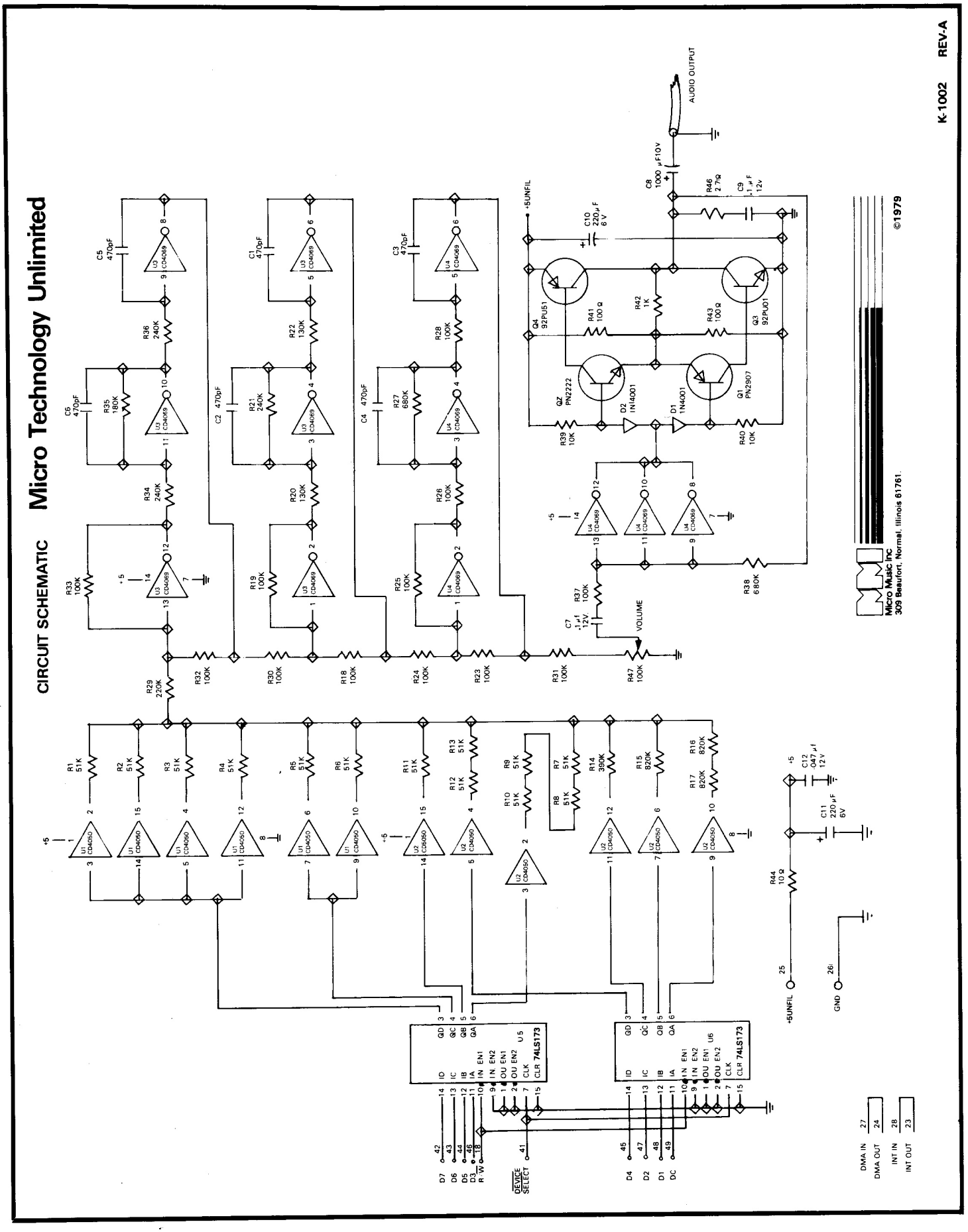
Micro Music Inc

WARRANTY

Your factory-built MICRO MUSIC sound circuit is warranted against defects in materials and workmanship for a period of three (3) months from the date of delivery. We will repair or replace products that prove to be defective during the warranty period, provided they are returned to MICRO MUSIC INC. No other warranty is expressed or implied. We are not liable for consequential damages or damage to the Apple II Computer. We reserve the right to refuse to repair any product that in our opinion has been subjected to abnormal electrical or mechanical abuse. Products out-of-warranty are subject to a minimal service fee.

Please feel free to contact us if you have any questions or problems.

MICRO MUSIC INC.
309 W. Beaufort Street
Normal, Illinois 61761


CIRCUIT SCHEMATIC
Micro Technology Unlimited
K-1002 REV-A
AUDIO OUTPUT
VOLUME
+5UNFIL
GND
DEVICE SELECT
74LS173
DMA IN 27
DMA OUT 24
INT IN 28
INT OUT 23
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MUSIC COMPOSER DIGISONG PACKS™

Your Apple Dealer also has DIGISONG PAKS to play on your Apple using the MUSIC COMPOSER. Use the MUSIC COMPOSER just like a player piano. Simply select and play a variety of music selections on each DIGISONG PAK.

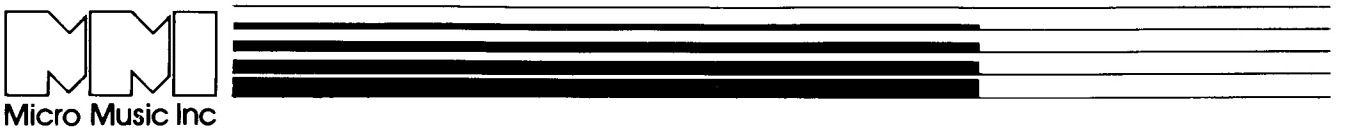
Current PAKS available are:

- Dixieland Swingers
- Oldies-but-Goodies
- J.S. Bach Sampler
- Hymn Favorites
- MMI Disco
- Christmas Wonderland

Watch for future MMI Software to accompany the MICRO MUSIC DAC card.

★ ★ ★ UPDATES TO MUSIC COMPOSER ★ ★ ★

Updates and revisions of MUSIC COMPOSER will be made available to all purchasers at a reduced charge with the exchange of their old diskette. To be placed on our mailing list, please send your name and address to:



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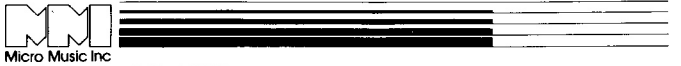
Please place my name on the MMI mailing list to receive updates to MUSIC COMPOSER (Ver 2.3).



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NAME _____

STREET _____

CITY _____ STATE _____ ZIP _____

PHONE _____

DATE PURCHASED _____

PURCHASED FROM _____

_____

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