MusiCalc™ 1

Synthesizer & Sequencer

OWNER'S MANUAL

MUSICALC
MANUAL

Software realized by Richard Wolton

ACKNOWLEDGEMENTS

Writing a software manual is a difficult task. It can't be done by one person working alone in a locked room. A software manual is the result of many people's efforts, each providing a necessary link in the process. The following are the people who helped put this manual together:

Richard Wolton, Bill Moulton, John Shepard, Michael Miller, Cris Grigg, Iasos, and Steve Wolfe.	Programmers and program designers who provided technical information on the inner workings of MusiCalc and on the physics of music.
Tom Weiser, Harry Likas	Composers who created great music using MusiCalc. Harry Likas, in particular, for composing the standard preset scores #1,2,3,4,5,8,9, and 10.
Michael McCreery	A 14 year old whiz-kid whose comments helped cause a complete draft rewrite. Thanks a lot.
Karen and Loyal Mealer	A generous and knowledgeable couple who helped devise the manual's approach and working outline.
George and Janet Kelts	Reviewed and critiqued a draft between plays of a 49er football game.
Tom McCreery, Nancy Nieradka, Tom Casner	Debugged the manual for accuracy and readability.
Mary Perry	The tireless editor and proofreader of the drafts.
Michael Fitzgerald	Writer.

PREFACE

CONGRATULATIONS! You have in your hands the most powerful and easy-to-use music software yet devised for the Commodore 64.

Welcome to the world of the MusiCalc 1: Synthesizer and Sequencer system. Even if you have no musical background, MusiCalc will allow you to sound like a one-person band within the first few minutes. But MusiCalc is also a professional musical instrument worthy of serious study and exploration. It provides many exciting and sophisticated sound synthesis and music composing features. The more time you spend with MusiCalc, the more you'll want to learn and take advantage of its many features.

"Music Calculating" is a unique way to learn more about music, rhythms, and sound synthesizers. For the novice or the professional it opens up an exciting new way of playing, composing and understanding music.

You can begin to use MusiCalc by exploring the many scores and sounds built into it. You will find whole songs, rhythms, and a world of different sounds. You can take any of these preset music scores or instrument sounds and immediately change any aspect of them without stopping play. Then–almost in the same breath–change the key in which you're playing. Surprise! You've composed new music and invented new instrument sounds.

MusiCalc functions as an independent musical instrument, a music sequence scorer (a composer), and an instrument sound editor. It will let you build up libraries of your own music sequences, whole songs, and both common and unusual instrument sounds. If you want to jump in and use MusiCalc immediately, read the Introduction and Quick Start-up section.

The remainder of the manual explains MusiCalc's functions and capabilities in detail.

TABLE OF CONTENTS

INTRODUCTION

ABOUT MUSICALC

MusiCalc 1: Synthesizer and Sequencer is a software package that turns your Commodore 64 into a programmable music and sound making machine with some of the same features and performance as professional equipment costing several thousand dollars or more.

MusiCalc can be used as:
- a musical instrument in its own right
- a compositional or songwriting aid
- a tool for learning music theory
- a sound effects generator
- a tool for learning about synthesizers
- a source for background music (of your own creation)
- an extremely fun and creative recreation
- a conventional synthesizer and/or sequencer

With MusiCalc, you can easily create your own music and sounds, or listen to, change, and play with preprogrammed musical creations. Create entire libraries of songs and sounds, and save them to work on later or play later.

Use MusiCalc to create music with 1 to 3 parts (or "voices"), and to control the score and sound for each part. MusiCalc also lets you play your Commodore 64's keyboard like a piano keyboard.

MusiCalc 1 is the first product in the creative music system called MusiCalc. The MusiCalc System is a group of modular software and hardware products that turns your Commodore 64 computer into an extremely versatile, high-quality music and sound system unlike anything available before at any price. Use it to compose, edit, process, and manipulate music and sound. Each new MusiCalc product will add to the capabilities of this exciting music system.

ADMINISTRATIVE INFORMATION

Please fill out and mail the warranty card. This will entitle you to purchase backup and replacement copies of MusiCalc, and allow us to keep you informed of new developments and products.

BACKUP AND REPLACEMENT DISKS

One backup diskette may be purchased for $5.00 when the warranty card is mailed to Waveform.

Original and backup diskettes that have become damaged may be replaced by returning the damaged disk and $15.00 to Waveform. The damaged disk must be returned with payment.

Mail to: WAVEFORM CORPORATION
1912 Bonita Way
Berkeley, CA 94704

WARNING

Do not cut out the "write protect notch" on your MusiCalc disk.

Keep your disk in a safe, dry place.

Do not touch the exposed surface of the disk (the oval slot).

Do not turn the disk drive's power switch on or off while a disk is in the drive.

Do not place the disk near sources of magnetism (electric motors, televisions, magnets, telephones, etc.).

NEW MUSIC AND SOUNDS THAT YOU CREATE WITH MUSICALC CAN BE SAVED TO DISK, BUT YOU MUST USE A SEPARATE DISK.

QUICK START-UP

Use these instructions to get MusiCalc up and working quickly and to get an idea of what you and MusiCalc can do.

Before getting started, check the hardware to see if it is properly connected and adjusted (see the Owner's Manual or Appendix A). Once your computer is ready, open the disk drive door and pick up the MusiCalc disk. Hold the disk with the MusiCalc label up and between your thumb and forefinger. The oval slot should be away from you. Insert it into the disk drive and close the door.

Start by typing:

LOAD "M* ",8,1 (then press the RETURN key)

The disk drive is now loading the program. At the bottom of your T.V. or monitor you should see the abbreviations "E.T.A." for Estimated Time of Arrival and "C.S.T." for Commodore Standard Time. CST counts the 2 minutes and 13 seconds necessary to load the program. If your disk takes more than 2 minutes and 30 seconds to load MusiCalc, your drive may need servicing. After the program has loaded, you will see the MusiCalc Panel.

The MusiCalc Panel shows the synthesizer (sound display) on the left and the sequencer (score display) on the right.

To turn up the volume, press:

G	to select volume control slider (it flickers)
f1	increases the volume (f1 is a function key)
f7	decreases the volume (f7 is a function key)

The function keys are located on the right hand side of the Commodore keyboard.

If you don't hear anything, check your T.V. monitor or stereo volume.

We will use "/" to mean hold down a particular key while pressing another key. For example, SHIFT/RETURN will mean hold down the SHIFT key while pressing the RETURN key. Now press:

SHIFT/RETURN to Main Menu

You are looking at the Main Menu. There are many options, but try this first:

P to Presets Mode

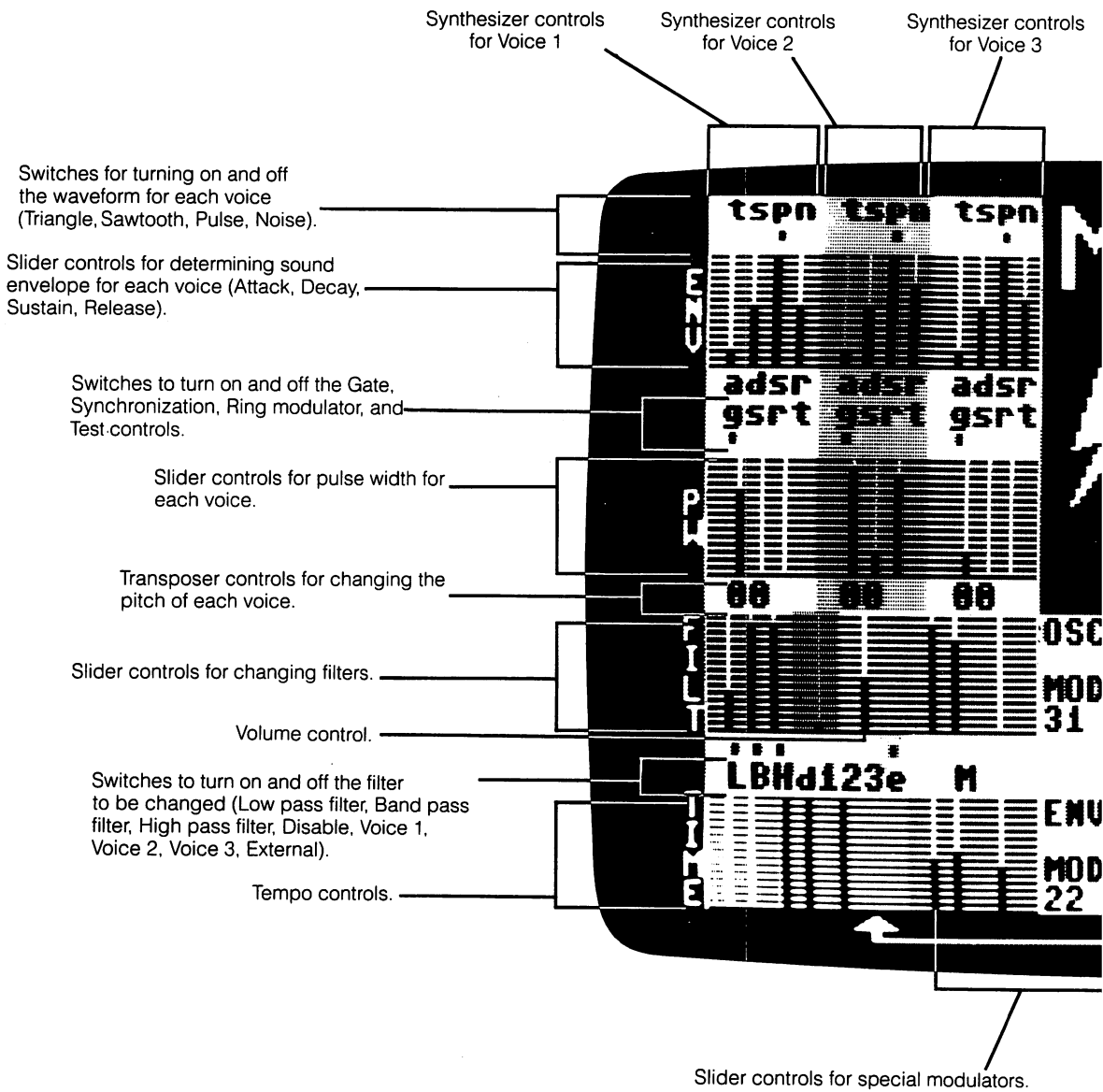
The MusiCalc Panel border changed from grey to green. The green border indicates that you are in the Presets Mode. To change the sound press "C=," which refers to the Commodore Key in the lower left hand corner of the keyboard, and press "F" at the same time.

C=/F	change sound preset
SHIFT/4	change score preset

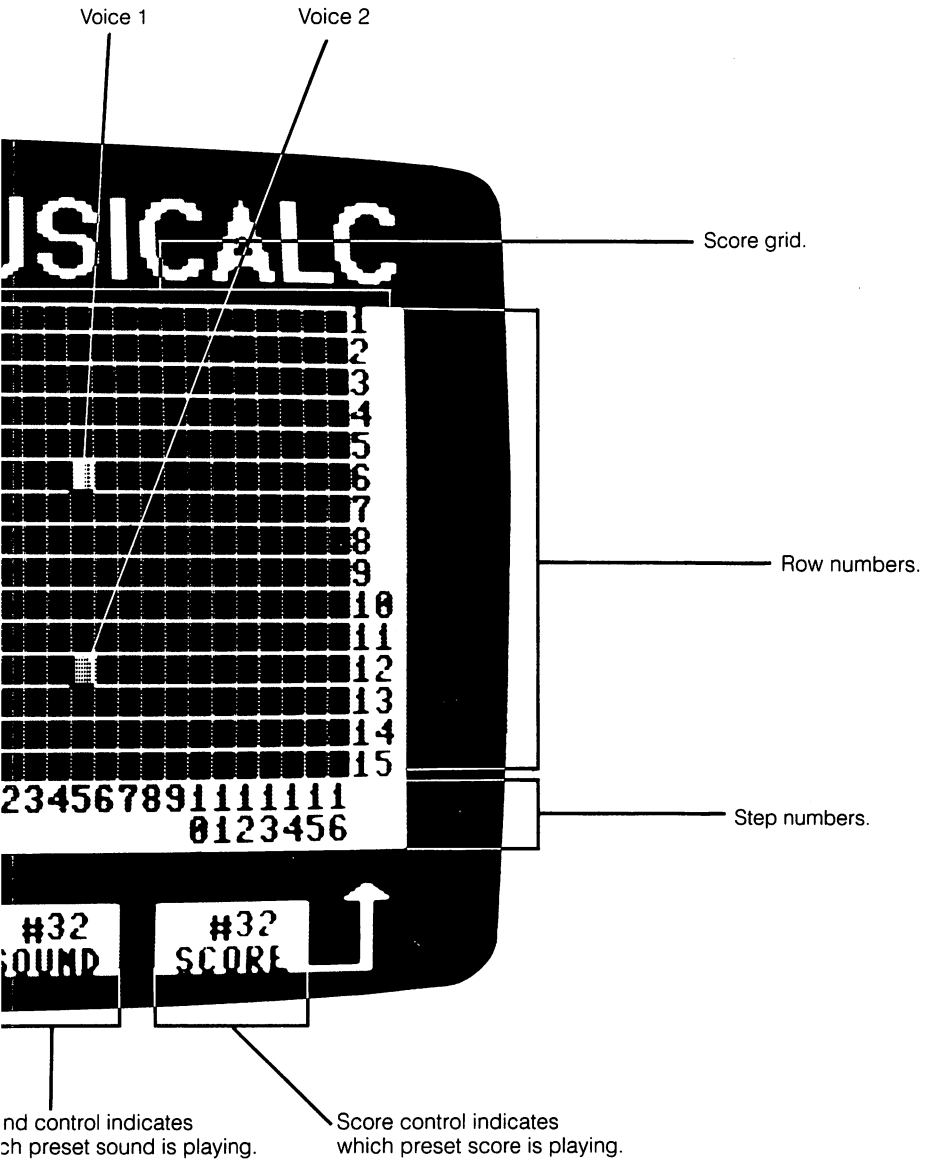
You have changed the sound # and the score # as shown in the lower right hand corner of the MusiCalc Panel. Presets are arranged so that Score #1 goes best with Sound #1, Score #2 goes best with Sound #2, etc. (More on presets is found in the following Basics of MusiCalc section, and in the Preset Feature Summary.) You now know how to get into the Presets Mode and change the sound and score! Press:

↑ to MusiCalc Panel

Now you're back to the grey bordered MusiCalc Panel (the Synthesizer Mode). Note that ↑ takes you back to the MusiCalc Panel.


Synthesizer controls for Voice 1
Synthesizer controls for Voice 2
Synthesizer controls for Voice 3
Switches for turning on and off the waveform for each voice (Triangle, Sawtooth, Pulse, Noise).
Slider controls for determining sound envelope for each voice (Attack, Decay, Sustain, Release).
Switches to turn on and off the Gate, Synchronization, Ring modulator, and Test controls.
Slider controls for pulse width for each voice.
Transposer controls for changing the pitch of each voice.
Slider controls for changing filters.
Volume control.
Switches to turn on and off the filter to be changed (Low pass filter, Band pass filter, High pass filter, Disable, Voice 1, Voice 2, Voice 3, External).
Tempo controls.
Slider controls for special modulators.
tspn
adsr
gsrt
ENV
PW
FILT
TIME
LBHd123e
M
OSC
MOD
31
ENV
MOD
22

) MUSICALC PANEL



BASICS OF MUSICALC

BASICS CONCEPTS

No formal knowledge of music is necessary to use MusiCalc. It was designed to be useful to both the trained musician and the person who plays by ear. MusiCalc allows the trained musician to transcribe a score from sheet music directly into the computer. Complex timings, rests, slurs, key transpositions, and other tools of the composer are available in MusiCalc.

For the musician without formal training (or the beginning musician), MusiCalc will let you compose entirely by ear. It plays notes as soon as they are entered; and notes can be entered either by specifying a particular note, or by playing the keyboard like a piano. If you like what you hear, keep it! If not, change the notes and you hear the change immediately.

SYNTHESIZER

A synthesizer is a device that makes sound electronically. The modern electronic organ, for example, is a type of synthesizer that is designed to make musical instrument sounds.

A sound synthesizer works by producing sound waves, and by controlling the shape of the sound waves. To make a sound like a flute, the synthesizer closely duplicates a real flute's sound wave shape. Because a synthesizer produces sound waves directly, it can create a much wider variety of sounds than musical instruments. Percussion sounds, special effects sounds, and completely new sounds can be created. The only limit is your imagination.

The Commodore 64 has a powerful sound synthesizer built in. The synthesizer can produce three completely different sound waves (or voices) at the same time. You can shape the sound wave of each voice individually. For example, you can set Voice 1 to sound like a drum, Voice 2 like a bass guitar, and Voice 3 like a horn. The MusiCalc program is designed to easily give you complete control over the Commodore 64's ability to synthesize sound.

SEQUENCER

To make music, it's not enough just to make sounds. Music has a regular beat that causes notes (sounds) to be played in a steady, predictable sequence (ONE two three four, ONE two three four). The sequencer keeps time for you, and tells the computer WHEN to play the notes in a tune. The sequencer reads through the tune one step at a time for each voice. If there are notes to be played, the sequencer plays them and then moves on to the next steps. Three notes in three steps can be played at any one time (remember the synthesizer has three voices). When you compose a tune using MusiCalc, you will tell the sequencer what notes to play, and when to play them.

CREATIVITY TOOL:

A program like MusiCalc is called a creativity tool. One of the most important ways mankind can use a computer is as a tool to extend creative abilities.

Creativity implies exploring infinite possibilities, therefore a computerized creativity tool allows you to rapidly and easily explore limitless possibilities. MusiCalc gives you the power to creatively explore an infinite variety of sounds and three-note score arrangements.

As you use MusiCalc, you'll find that the notes and various synthesizer settings all interact to make music. Therefore, changing one setting on the synthesizer may or may not cause a dramatic change in the sound. Sound is the result of the relationships among all of the synthesizer settings.

So explore, experiment, and create. MusiCalc provides you with a lifelong Creativity Tool. *We* haven't even discovered all the sounds that MusiCalc can make.

PROGRAM CONCEPTS

MusiCalc has six major abilities. The program allows you to:

1. Create (synthesize) sounds
2. Compose and edit music
3. Play the keyboard like a piano keyboard
4. Instantly select any combination of 32 preset sounds and 32 preset tunes (scores)
5. Save up to 32 sounds and 32 scores to disk at a time
6. Call in other programs and files to work with MusiCalc

PRESETS

A preset, in general, is any outside data (or information) used by MusiCalc, and stored to or retrieved from disk. Preset files are:

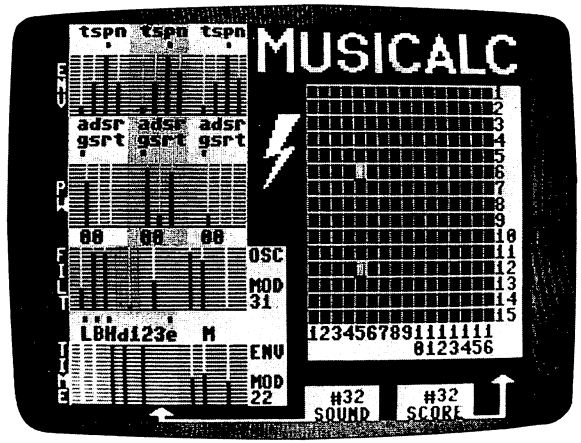
	Disk File Name
pre-programmed sounds and scores	P.filename
keyboard scales	K.filename
keyboard scale intonation	S.filename

MusiCalc automatically loads the preset sound and score file P.DEMO when it first boots up. P.DEMO contains 32 pre-programmed sounds and 32 pre-programmed scores. Sound #32 and Score #32 begin playing automatically. P.DEMO sample sounds and scores are summarized in the Presets Feature Summary.

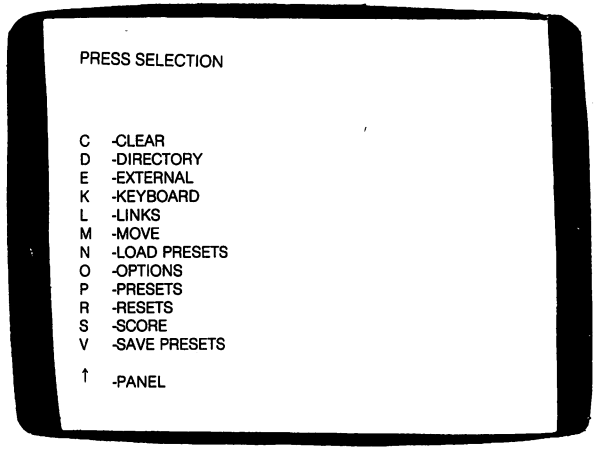
MusiCalc also automatically loads a preset keyboard scale file (K.KBD), and a scale intonation file (S.SCALE). See Preset and Keyboard in the Feature Summary for additional information.

SCREENS

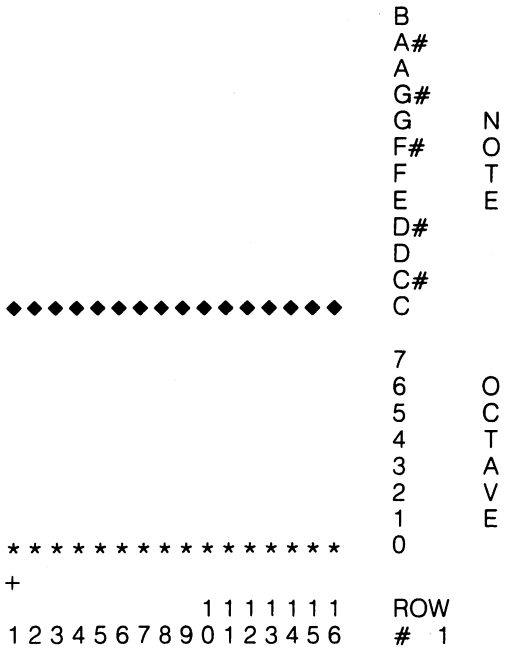
MusiCalc is controlled through three basic screens: the MusiCalc Panel, the Main Menu, and the Score Screen.



The MusiCalc Panel provides access to the synthesizer controls, the Presets, and the Keyboard.



The Main Menu is where you move from screen to screen, select various options, and access the disk drive.



The Score Screen is where you compose and/or edit music.

MUSICALC PANEL

The MusiCalc Panel is displayed after MusiCalc is loaded into the computer, or any time the ↑ key is pressed. The left side of the screen displays the sound controls. The colored squares moving through the grid on the right represent the Commodore 64's three voices as they step through a tune. The MusiCalc Panel explanation follows, while the grid is explained in the Score Screen section.

The MusiCalc Panel has three modes of operation. The border around the panel changes color to indicate which mode you're in.

SCREEN COLORS

BORDER COLOR	MODE	KEYBOARD USAGE
Grey	Synthesizer	Control switches & sliders
Green	Presets	Select from 32 sounds & 32 scores
Blue or voice color	Keyboard	Play along

SYNTHESIZER MODE

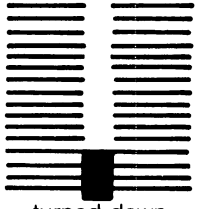
To get to the Sound Synthesizer Mode press:

↑ to MusiCalc Panel Synthesizer Mode

The Synthesizer Mode (grey border) allows you to adjust all the sound controls on the MusiCalc Panel. You adjust sounds by changing the sliders and switches on the screen.

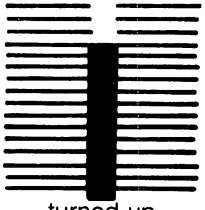
SLIDERS

With the sliders, you control precisely how much a particular sound effect is used. The volume slider, for example, allows you to control how loud the music sounds. With the volume slider like this, the music plays softly:



turned-down

With the volume slider like this, the music plays loudly:



turned-up

The CRSR⇆ key sets the keyboard to control the Sliders. f1 and f3 turn sliders up. f5 and f7 turn sliders down.

f1	slide Sliders up
f3	step Sliders up
f5	step Sliders down
f7	slide sliders down

Note: Some settings are controlled using multiple sliders to achieve very fine adjustments. With two sliders, you have a coarse and a fine control. When you slide the fine slider all the way to the maximum setting, the coarse slider increments by one step and the fine slider starts over.

SWITCHES

The switches turn things on or off, like a light switch. Rectangle symbols indicate a switch is on.

For example:

```
tspn
■
```

would mean that the function represented by the t (the triangle sound wave) is active, and the s.p., and n functions are not. The CRSR ↑ ↓ key sets the keyboard to control the switches. f3 turns switches on and off.

KEYBOARD CONTROLS

When MusiCalc is in Synthesizer Mode, the keyboard keys correspond with the switches and sliders on the screen. The top row on the keyboard controls the top row on the screen, and the second row on the keyboard controls the second row on the screen, etc. When you touch a key on the keyboard, you'll see the slider or switch it controls flicker. You can always find the key that controls the slider or switch you want by running your fingers across the keyboard until the one you want flickers. (For a complete description of all the switch and slider controls, see the Feature Summary at the end of this manual).

PRESETS MODE

To get to Preset Mode press:

↑	Start from MusiCalc Panel Synthesizer Mode
SHIFT/RETURN	To get to Main Menu
P	Select P for Presets

You'll once again see the MusiCalc Panel, but in the Preset Mode (green border).

The Preset Mode allows you to switch from the sound settings currently playing to other settings stored in the computer's memory. You can also switch from the score (tune) you are currently playing to another score in the computer's memory. The music scores and synthesizer sound settings are called Presets (the term Presets can also be applied to preset keyboard scales. See Keyboard Feature Summary). To switch to a different sound preset, press:

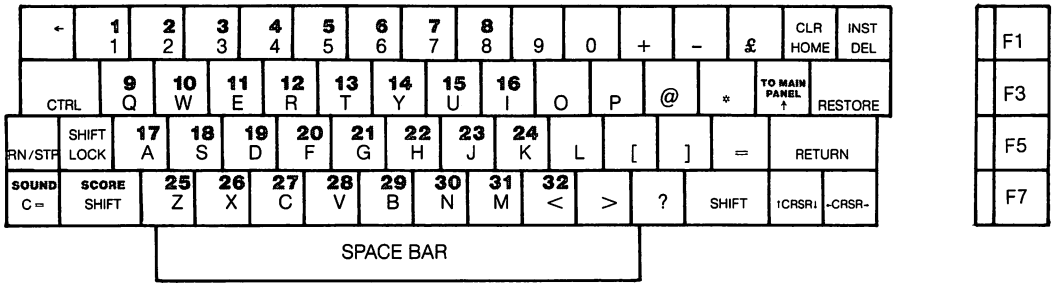
C=/1

To switch to a different score, press:

SHIFT/1

You see the sound # and score # boxes on the lower right of the screen change according to the key you press.

PRESETS



PRESETS: 1-32

KEYBOARD MODE

The Keyboard Mode can be operated in three different ways:

1. Voice	Select a voice and play along with the other two voices.
2. Step	Change a note in your composition or in a preset score by playing the new note on the keyboard.
3. Recorder	Just like Voice (above) except the notes you play on the keyboard are recorded while you play.

Playing the Keyboard (blue border or voice color)

To get there press:

↑	to MusiCalc Panel Synthesizer Mode
SHIFT/RETURN	to Main Menu
K	select K for Keyboard
1,2, or 3	select 1 for Voice select 2 for Step select 3 for Recorder
RETURN	

In the Keyboard Mode, MusiCalc turns your computer's typewriter keyboard into a piano-like keyboard. When you press a key, it plays a note.

This "piano" keyboard, however, can play only one voice at a time. When you choose Voice, the border around the screen will change to blue. When you choose Recorder, the border will change to the color of the voice as follows:

Voice 1	Yellow
Voice 2	Red/Orange
Voice 3	Purple

Note: Colors may be slightly different depending on how you have your color monitor adjusted.

The keyboard normally plays notes in a major scale; however, the keyboard can be reprogrammed to play other scales such minor, blues, rock, etc., (see page 35). Load the keyboard scales from the disk by:

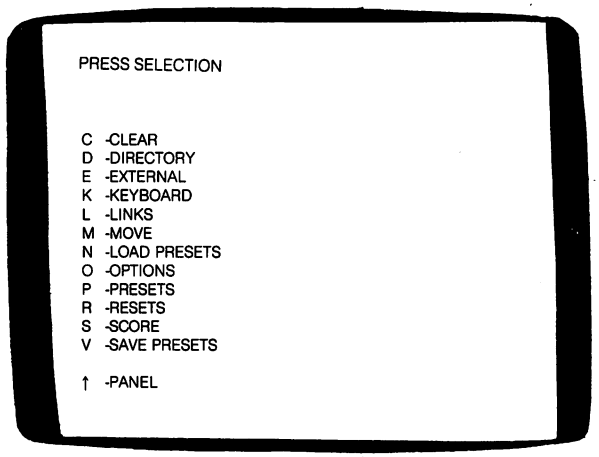
↑	to MusiCalc Panel Synthesizer Mode
SHIFT/RETURN	to Main Menu
N	Load Presets
-	MusiCalc asks: "File to Load?"
K.Blues	Name of keyboard scale file to load from disk (blues scale)
RETURN	

Note: All keyboard scale files begin with K. For a complete description, see Feature Summary Sheets describing the Keyboard features.

MAIN MENU

To get there press:

↑	to MusiCalc Panel Synthesizer Mode
SHIFT/RETURN	to Main Menu



The Main Menu is used to:

1. Select the mode for MusiCalc Panel:

   ↑ Synthesizer Mode

   K Playing the Keyboard Mode

   P Preset Sounds and Scores Mode

2. Access the disk drive:

   D Directory of files on disk

   E Load an external program that works with MusiCalc

   N Load a file of 32 preset sounds and 32 preset scores, load a file of keyboard scales, or a file of scale intonations.

   V Save a file of 32 preset sounds and 32 preset scores

3. Access the score editing function:

   S Go to the Score Screen (to enter and edit a tune)

   L Set up a repeating sequence of notes

   R Set up the place (reset) for each voice to begin playing

   C Erase a section of a score
   Erase the sound settings

   M Move a sound setting from one preset slot (1-32) to another (1-32)

   Move a score from one preset slot (1-32) to another (1-32)

   Move or copy a row within a score to another row in the same score

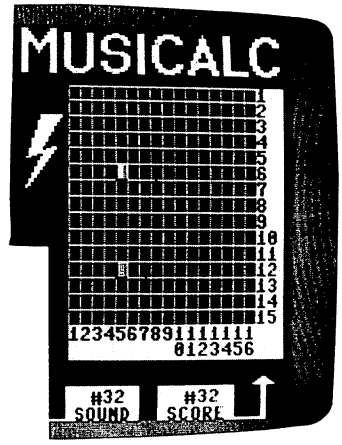
4. Improve sounds and timing:

   O Turn off the screen so the computer can concentrate completely on making sounds and playing notes.

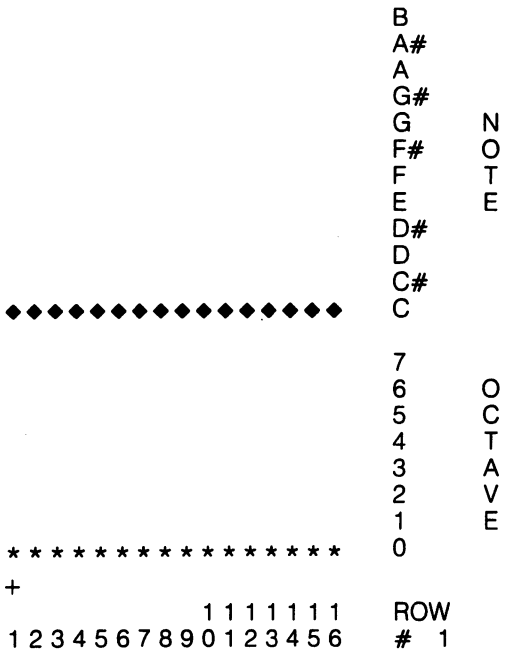
SCORE SCREEN

To get there press:

↑	to MusiCalc Panel Synthesizer Mode
SHIFT/RETURN	to Main Menu
S	Score
1-15	to select a row #
RETURN	to Score Screen



Score Grid



Score Screen

Use the Score Screen to compose a tune or edit a tune already composed. Each row on the screen corresponds to a row on the Score Grid of the MusiCalc panel. There are sixteen boxes in each row (box numbers one through sixteen are across the bottom of the Score Screen). Each box is called a step. MusiCalc will play a single note for each box. The "+" on the bottom of the screen points to the step being changed. The following keys are used to enter/edit a score:

CRSR ⇆	Move "+" to the right
CRSR ↑ ↓	Move "+" to the left
f1	Raise pitch of note
f7	Lower pitch of note
f3	Raise octave of note
f5	Lower octave of note

Note: Any note played in octave 0 will be silent. This is how you play a rest (periods of silence between notes).

Using the Score Screen, you can compose music from scratch, edit (change) a present score, or edit notes recorded from the keyboard.

The colored squares moving through the Score Grid represent the voices as they play the notes entered on the Score Screen. You can watch as one voice repeats a short sequence of steps over and over while another voice travels through a longer sequence of steps.

VOICE CONTROLS

To get there press:

↑	to MusiCalc Panel Synthesizer Mode

When you're composing with MusiCalc, it is sometimes helpful to be able to stop a voice from playing, so you can hear the others more clearly. MusiCalc can stop, start, or restart each voice individually, or all together. The voice commands can:

Stop a voice from playing.
Start a voice playing at the last note played.
Restart a voice playing at the beginning.

Voice commands are as follows:

Command	Voice			
	1	2	3	All
to Stop	SHIFT/Q	SHIFT/W	SHIFT/E	SHIFT/R
to Start	SHIFT/1	SHIFT/2	SHIFT/3	SHIFT/4
to Reset	SHIFT/Z	SHIFT/X	SHIFT/C	SHIFT/V

SEQUENCER TUTORIAL– How to enter music

This tutorial will show you, step by step, how to enter music using MusiCalc. You can enter music either by copying notes and timing in from sheet music, or by arranging notes and timing by ear. The first step is to load the preset tutorial from disk.

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
N	Load Presets
	MusiCalc asks: "Preset File to Load?"
P.TUTOR	to load tutor file
RETURN	
SHIFT/RETURN	back to Main Menu
P	to Preset Mode

Now you're at the MusiCalc Panel–Presets Mode. We're going to call up a blank score and a preset sound to work with.

SHIFT/X	call up Score #26 (blank)
C=/1	call up Sound #1
↑	back to MusiCalc Panel

On the screen to the right, you see Voice 3 (purple box) stepping through the Score Grid. If you watch for a minute, Voice 3 will step all the way to Row #15 and then begin again at Row #1.

To enter a song, we need to determine which rows will contain the notes for each voice to play.

The voices in our sample will be assigned rows as follows:

Voice 1 (bass)	Row #1
Voice 2 (melody)	Row #2 and row #3
Voice 3 (drums)	Row #4

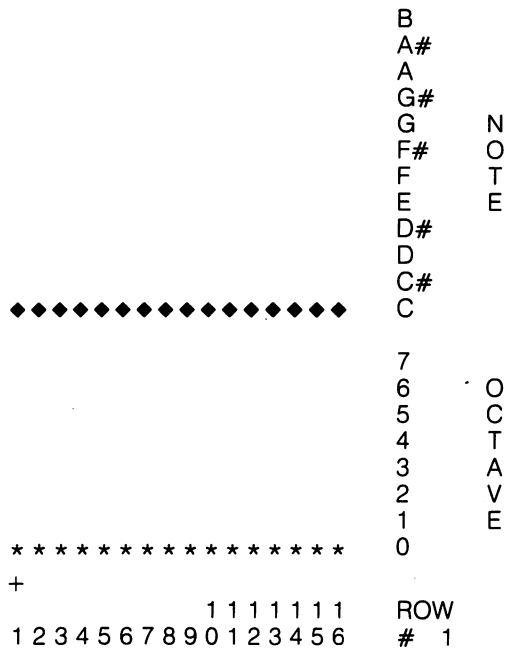
Now let's set up Voice 1 so it steps only through Row #1. We'll use Reset to set up the beginning place for Voice 1, and Link to determine the ending spot.

SHIFT/RETURN	to Main Menu
R	Resets
	MusiCalc asks: "Row,Step,Voice?"
1,1,1	Row #1, Step #1, Voice #1 (beginning point)
RETURN	back to MusiCalc Panel
SHIFT/RETURN	to Main Menu
L	Link
	MusiCalc asks: "row,Step,Row,Step?"
1,16,1,1	Link Row #1, Step #16 to Row #1, Step #1
RETURN	back to MusiCalc Panel
SHIFT/V	Restart voice at beginning position

Voice 1 is now stepping through Row #1. When it gets to Step 16 in Row #1, it will start over at Step 1 in Row #1. Voice 1 is captured in a 1 row loop. Let's put some notes in Row #1 for the voice to play.

SHIFT/RETURN	to Main Menu
S	Score (Score Screen)
	MusiCalc asks: "Which row?"
1	Row #1
RETURN	to Score Screen

You see the following screen:

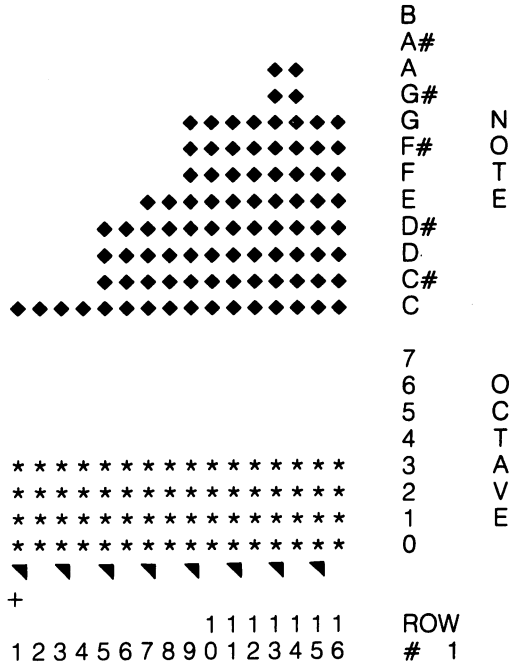


The row # we're working on is shown at the lower right corner (Row #1). Steps 1-16 are shown across the bottom of the screen. The "+" points to the step being entered or changed. The note played for each step is shown on the upper graph, and the octave the note will be played in is shown on the lower graph. It's worth noting that a C note played in Octave 0 results in a rest (silent pause).

The following keys are used to enter and change notes and octaves.

f1	Raise Note (◆)
f7	Lower Note (◆)
f3	Raise Octave (★)
f5	Lower Octave (★)
CRSR ⇆	Move (+) to the right
CRSR↑↓	Move (+) to the left
Space Bar	Ties two notes together (◥)

Enter the following notes for the bass voice to play:



Notice how you can hear the notes just as soon as they've been entered. Let's go ahead and put in notes for the other two voices to play. Start by putting in the beginning (reset) and ending point (link).

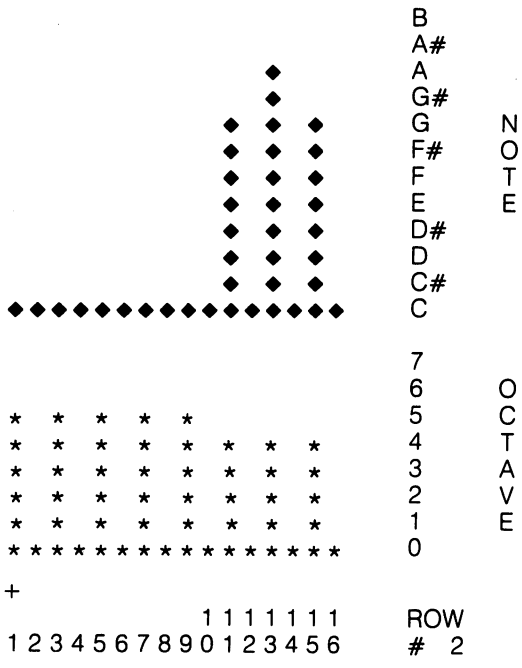
↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
R	Resets
	MusiCalc asks: "Row,Step,Voice?"
2,1,2	Row #2, Step #1, Voice 2 (beginning point)
RETURN	back to MusiCalc Panel
SHIFT/RETURN	to Main Menu
L	Links
	MusiCalc asks: "Row,Step,Row,Step?"
3,16,2,1	Link Row #3, Step #16 to Row #2, Step #1

RETURN	back to MusiCalc Panel
SHIFT/V	Restart voices at beginning points

Voice 2 is now set to play Row #2 and Row #3. To enter the melody notes for Voice 2 to play:

SHIFT/RETURN	to Main Menu
S	Score
	MusiCalc asks: "Which Row?"
2	Row #2
RETURN	to Score Screen

Now put the notes in:



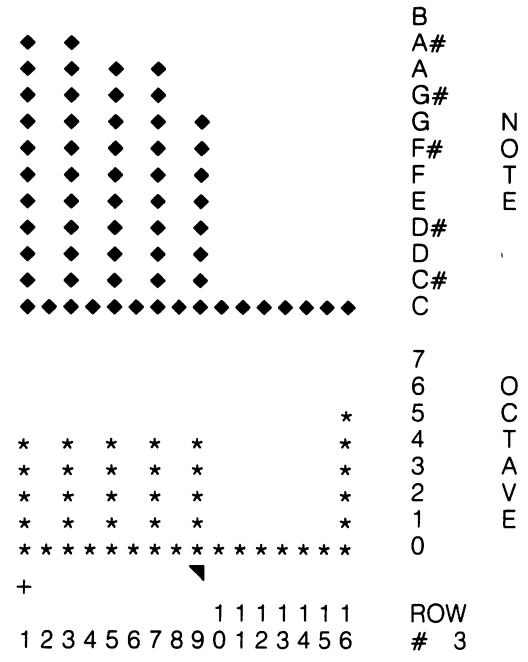
Now, we can go directly to another row without going through the MusiCalc Panel and the Main Menu.

SHIFT/↑	Shifts Score Screen down one row
C=/↑	Shifts Score Screen up one row

To get to Row #3 from Row #2 press:

SHIFT/↑	Down one row

Enter notes in Row #3 for Voice 2 to play:



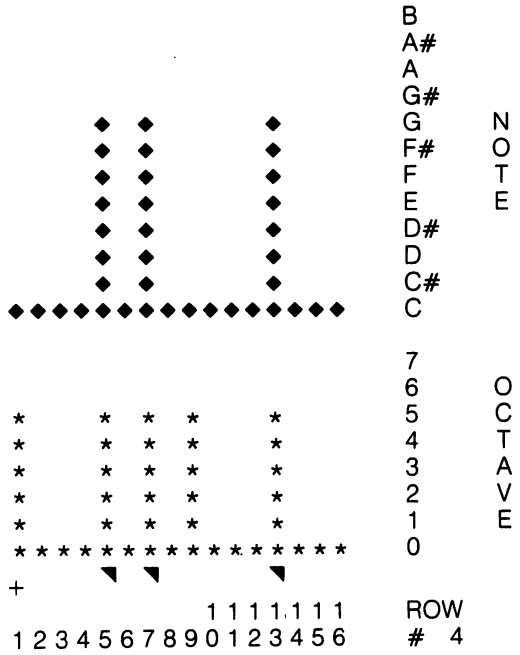
One more voice to go:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
R	Resets
	MusiCalc asks: "Row,Step,Voice?"
4,1,3	Row #1, Step #1, Voice 3 (beginning point)
RETURN	back to MusiCalc Panel
SHIFT/RETURN	to Main Menu
L	Links
	MusiCalc asks: "Row,Step,Row,Step?"
4,16,4,1	Link Row #4, Step #16, to Row #4, Step #1
RETURN	back to MusiCalc Panel
SHIFT/V	Reset voices to beginning points

Voice 3 is set to play the notes in Row #4. Next, enter the notes in Row #4:

SHIFT/RETURN	to Main Menu
S	Score
4	Row #4
RETURN	to Score Screen

Put the notes in:



You're done! You've created a score! Now go to the second tutorial to change the sounds each voice makes.

If you're not going to go right on to the next tutorial, you'll want to save your score to disk, so you can read it back into MusiCalc when you're ready to continue the tutorials. To save your score (Score #26), do the following:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
V	save all Presets to disk
	MusiCalc asks: "Preset to Save?" (You must insert a formatted file disk before saving anything to disk. "E.DOS –Format a disk" will format a blank disk without leaving MusiCalc. Do not try to save on the MusiCalc Disk!)
P.SAVE	save them in a file called P.SAVE (or any legal filename beginning with P.)
RETURN	MusiCalc saves file of presets

SYNTHESIZER TUTORIAL– How to change sounds

This tutorial works with the preceding Sequencer Tutorial. If this is your first time through the tutorials, complete the Sequencer Tutorial first. If you saved your score at the end of the Sequencer Tutorial, re-load it by doing the following:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
	MusiCalc asks: "Preset to load?"
N	Load Presets from disk
P.SAVE	load back the file we saved
	(or use the file name you made up)
RETURN	back to MusiCalc Panel
SHIFT/RETURN	to Main Menu
P	Presets
SHIFT/X	call up your tutorial Score #26
C=/1	call up Sound #1

It is assumed that you have the tutorial score entered and selected while you go through the Sound Tutorial.

There must be some sound settings on the synthesizer controls before you can hear your tune. To hear a voice you have to:

1. Turn on a sound wave switch (triangle, sawtooth, pulse or noise).
2. Turn on the gate switch for that voice.
3. Turn up the volume slider.
4. If a pulse wave is used, you must set a pulse width using the pulse width sliders.
5. Adjust attack, decay, sustain, and release sliders to get a good tone.

First, let's clear Sound #1.

↑	to MusiCalc Panel Synthesizer Mode
SHIFT/RETURN	to Main Menu
C	Clear
	MusiCalc asks: "Score Range, Link Range, or Sound?"
3	Clear Sound
RETURN	
	MusiCalc asks: "Sound #?"
1	Clear Sound #1
RETURN	back to MusiCalc Panel

All sound settings have been reset. Sliders have been turned all the way down and switches turned off. The only exception is the tempo slider (bottom slider row, fifth from the left).

Turn on the triangle wave switch for Voice 1 (yellow).

CRSR↑↓	select switches
1	select triangle wave–Voice 1
f3	turn on switch

Did you notice the small black rectangle under the "t" for Voice 1? It flickered when you pressed the "1" key to select the switch. It stayed on when you pressed f3. Now, turn on the gate to let the sound wave through.

	switches already selected
Q	select gate–Voice 1
f3	turn on switch

Turn up the volume.

CRSR ⇆	select Sliders
G	select volume slider (it flickers)
f3	increase volume 8 notches

The volume slider is in the middle of the third row of sliders. You see it flicker when you press the G (above). f3 raises the slider one notch. f5 lowers the slider one notch. f1 continuously raises the slider, while f7 continuously lowers it.

When you turn up the volume, you will hear a popping sound. That's the sound of the gate opening. There still isn't enough shape to the sound to give us a recognizable musical tune, however. We need to adjust the envelope sliders (top row) for Voice 1.

	sliders already selected
1	select attack slider–Voice 1

f3	raise slider 6 notches
2	select decay slider–Voice 1
f3	raise slider to the top
3	select sustain slider–Voice 1
f3	raise slider to the top
4	select release slider
f3	raise slider 3 notches

Now we have a good bass tone. To summarize at this point, the sequencer is stepping through Row #1 of our score, and playing the notes in that row using the sound we've just created. Now we'll do the same for Voice 2.

CRSR ↑ ↓	select switches
7	select pulse wave–Voice 2 (flickers)
f3	turn on switch
T	select gate–Voice 2 (flickers)
f3	turn on switch
CRSR ⇆	select sliders
5	select attack slider–Voice 2 (flickers)
f3	raise slider 2 notches
7	select sustain slider–Voice 2 (flickers)
f3	raise slider 4 notches
T	select pulse width slider– Voice 2 (flickers)
f3	raise slider 4 notches

Notice we had to set the pulse width before we could hear Voice 2. This is because we selected a pulse wave, and a pulse wave that has no width makes no sound. The pulse width control for each voice actually uses three sliders to achieve a very precise setting. The left slider is a coarse control, the middle is a medium control, and the right is a fine control.

U	select fine pulse width slider, Voice 2
Hold f1	raise slider continuously

When the fine control slider gets to the top, the medium control raises one notch. Select the medium control slider (Y) and raise it continuously (f1). It will raise the coarse control when it gets to the top. Coarse, medium, and fine sliders can each be adjusted directly, or automatically incremented as the slider to the right rolls over the top adjustment.

Set up sound for Voice 3 (percussion):

CRSR ↑ ↓	select switches
–	select noise switch–Voice 3 (flickers)
f3	turn on switch
0	select gate–Voice 3 (flickers)
f3	turn on switch
CRSR ⇆	select sliders
+	select sustain slider–Voice 3 (flickers)
f3	raise slider to the top

We've got the percussion playing and our score and sound is complete.

If you're not going to go right on the the next tutorial, you'll want to save your score and sound to disk, so you can read them back into MusiCalc when you're ready to continue the tutorials. To save your score (Score #26) and sound (Sound #1), do the following:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
V	save all Presets to disk (You must insert a formatted file disk before saving anything to disk. "E.DOS–Format a disk" will format a blank disk without leaving MusiCalc. Do not try to save on the MusiCalc Disk!)
P.SAVE	save them in a file called P Save (or any legal filename beginning with P.)
RETURN	MusiCalc saves file of presets
	re-insert MusiCalc into the disk drive

KEYBOARD TUTORIAL– Playing along with MusiCalc

This tutorial works with the preceding Sequencer and Sound Tutorials. If this is your first time through the tutorials, complete the Sequencer and Sound Tutorials first. If you saved your score and sound at the end of the previous Tutorials, re-load them by doing the following:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
N	Load Presets from disk
P.SAVE	load back the file we saved (or use the file name you made up)
RETURN	back to MusiCalc Panel
SHIFT/RETURN	to Main Menu
P	Presets
SHIFT/X	call up your tutorial Score #26
C=/1	call up Sound #1

MusiCalc lets you play the Commodore 64's keyboard like a piano keyboard. This keyboard is monophonic, which means it can only play one voice at a time.

You have three ways to use the keyboard:

1. Voice–you can choose any of three available voices for the keyboard to play. The other two voices will continue to play whatever is in the Score Grid.
2. Step–you can use the keyboard to change the note in a specific row and step of the Score Grid.
3. Recorder–just like Voice (above) except what you play is recorded in the Score Grid.

KEYBOARD VOICE MODE

To play a voice:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
K	to Keyboard
1	Voice
RETURN	
	MusiCalc asks "Voice #?"
1	Voice 1
RETURN	to MusiCalc Panel–Keyboard Mode

Notice the screen has a light blue border. This indicates the keyboard can be used. If you listen for a minute, you'll hear that Voice 1 (the bass) has quit playing. It is waiting for you to play the bass line on the keyboard. Try these keys:

1 Q A Z	(all are C notes in different octaves)

Now, go ahead and play the keyboard yourself. You'll notice that in the Keyboard Voice Mode you have to press the Space Bar or another note to stop a note once it's played. When you're finished:

↑	to MusiCalc Panel

KEYBOARD STEP MODE

To change a note:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
K	Keyboard
	MusiCalc asks: "Voice, Step, Recorder?"
2	Step Mode
RETURN	
	MusiCalc asks: "Row, Step?"
1,1	change Row #1, Step #1
RETURN	to MusiCalc Panel Keyboard Mode
E	the note changes in Row #1, Step #1

Can you hear the difference at the beginning of the bass line? Press any key you like until you find a note that sounds good. To keep the new note, just press:

↑	to MusiCalc Panel

KEYBOARD RECORD MODE

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
K	Keyboard

	MusiCalc asks: "Voice, Step, Recorder?"
3	Recorder Mode
RETURN	to MusiCalc Panel Keyboard Mode

The border is now yellow, the color of Voice 1. Any notes we play on the keyboard will be played with Voice 1 and entered into the Score Grid where Voice 1 plays. To change voices:

SHIFT/↑	to Voice 2
SHIFT/↑	to Voice 3
SHIFT/↑	back to Voice 1

You can play and record all the voices, if you wish (one at a time). However, Voice 1 is all we're interested in now. First, let's erase the notes in Voice 1.

Space Bar	Hold down until voice 1 cycles completely through its steps.

The Space Bar key puts a rest in each step as the voice moves through its sequence. This means you can also put rests in by ear, if you like.

Now play the keyboard. Stop and listen. Hear your new bass line? If you think you can do better, just play it again; the new sequence of notes will replace the previous one.

Look at what you've recorded:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
S	Score
1	Row #1 (our bass line)
RETURN	

Here, you'll see the new notes you entered by playing the keyboard. You can even change them now, using the commands we learned in the Sequencer Tutorial.

↑	to MusiCalc Panel

TUTORIALS CONCLUSION

These tutorials have provided an introduction to the basic operating features of MusiCalc. Because of MusiCalc's open ended design, it's not possible to show you every sound, score, and operating feature combination. These tutorials are meant to get you started, while the Feature Summary provides the reference detail. Now its time for you to create your own music and to continue to explore MusiCalc. Have fun!

FEATURE SUMMARY

The Feature Summary is designed to be the most heavily used part of the manual. It is arranged alphabetically for easy reference, and contain information on every feature of MusiCalc. The general format is shown below. However, if a section clearly does not apply to a feature, that section will not appear in the summary.

FEATURE SUMMARY–GENERAL

FEATURE: **Name of feature or command—arranged alphabetically**

DESCRIPTION: What it is and what it does.

ACCESSED FROM: What part of the program you have to be in to use this feature

SELECT KEYS: Keys used to select this feature

ADJUST KEYS: Keys used to adjust this feature

ADDITIONAL: Anything not covered above

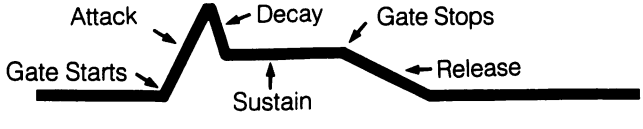
EXAMPLE: An example taking you from the MusiCalc Panel Synthesizer Mode to feature use.

If the word "filename" is used in the example, you can use an appropriate, legal, Commodore 64 file name.

NOTE: IN MOST CASES, YOU MUST HAVE A PRESET ALREADY SELECTED TO USE THE EXAMPLE.

FEATURE: **Attack (a in adsr)**

DESCRIPTION: How fast a note builds up to the desired volume. Instruments that make notes with long attacks are horns and string instruments. Short attack instruments are drums and bells.



ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:

1	Voice 1
5	Voice 2
9	Voice 3

ADJUST KEYS:

f1—Slide Up
f3—Step up
f5—Step Down
f7—Slide Down

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders

	1	Attack in Voice 1
	f3	step up attack time

FEATURE: **Clear**

DESCRIPTION: Allows you to erase a sound, a range of steps in a score, or a range of links in a score.

ACCESSED FROM: Main Menu

SELECT KEYS: C Clear

EXAMPLE: Clear Score Range:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
C	Clear
	MusiCalc asks: "Score Range, Link Range, or Sound?"
1	Clear Score Range
	MusiCalc asks: "Row,Step,Row,Step?"
1,1,1,16	erase all notes from Row #1, Step #1 to Row #1, Step #16

Clear Link Range:

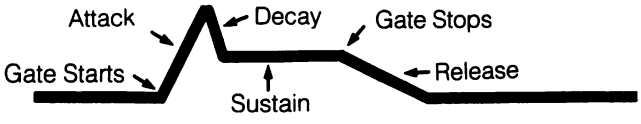
↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
C	Clear
	MusiCalc asks: "Score Range, Link Range, or Sound?"
2	Clear Link Range
	MusiCalc asks: "Row,Step,Row,Step?"
1,1,2,16	remove all links from Row#1, Step #1 to Row #2, Step #16

Clear Sound:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
C	Clear
	MusiCalc asks: "Score Range, Link Range, or Sound?"
3	Clear Sound
	MusiCalc asks: "Sound #?"
1	erase sound #1

FEATURE: **Decay (d in adsr)**

DESCRIPTION: How fast a note goes from its maximum attack volume to its secondary volume (sustain). A bell has a lot of decay whereas tight drums do not.



ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:
2 Voice 1
6 Voice 2
0 Voice 3

ADJUST KEYS:
f1—Slide Up
f3—Step Up
f5—Step Down
f7—Slide Down

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders
2	Decay for Voice 1
f3	step up decay time

FEATURE: **Directory**

DESCRIPTION: A directory (list) of files on the disk currently in the disk drive.

ACCESSED FROM: Main Menu

SELECT KEYS: D Directory

ADJUST KEYS: C= stop scrolling of the directory

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
D	Directory

FEATURE: **Disable**

DESCRIPTION: Turns off Voice 3, but allows Voice 3 envelope settings to seed the Envelope Modulator.

ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS: V to disable Voice 3

ADJUST KEYS: f3 turn on/off switch

ADDITIONAL: Voice 3 supplies the seed information to the modulators. The waveforms of Voice 3 (tspn) provide seed numbers to the Oscillator Modulator and the Voice 3 envelope (adsr) provide seed numbers to the Envelope Modulator.

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select switches
V	to select Voice 3 Disable
f3	turn on/off Voice 3 Disable

FEATURE: **E.Auto**

DESCRIPTION: Program randomly selects sound and score presets.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.Auto

ADJUST KEYS: Any key selects random sound or score.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.Auto	load E.Auto
Any key (except ↑)	select random score or sound
↑	exit to MusiCalc Panel

FEATURE: **E.Blast**

DESCRIPTION: Program to demonstrate how a programmer can write a program that interfaces with MusiCalc while MusiCalc continues to play.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.Blast

ADJUST KEYS: None

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.Blast	load E.Blast
	displays flashing MusiCalc Panel
↑	exit to MusiCalc Panel

FEATURE: **E.Blaster**

DESCRIPTION: Program to demonstrate how a programmer can write a program that interfaces with MusiCalc while MusiCalc stops playing.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.Blaster

ADJUST KEYS: None

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.Blaster	load E.Blaster
	displays beautiful graphic
↑	exit to MusiCalc Panel

FEATURE: **E.Bolt**

DESCRIPTION: Program to demonstrate how a programmer can write a program to customize the MusiCalc Panel. Changes the color of the lightning bolt.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.Bolt

ADJUST KEYS: 1-17

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.Bolt	load E.Bolt
	MusiCalc asks: "# between 1 and 17?"
5	changes lightning bolt color to purple
	exits to MusiCalc Panel

FEATURE: **E.DOS**

DESCRIPTION: A utility program on the MusiCalc disk which allows the user to get a catalog of a disk, delete files, rename files, initialize DOS, or format a disk.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.DOS

ADDITIONAL: MusiCalc disk must be in the disk drive when entering and exiting this option.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External Programs
	MusiCalc asks: "Name?"
E.DOS	load E.DOS

FEATURE: **E.DOS—Catalog**

DESCRIPTION: Lists files on a disk

ACCESSED FROM: E.DOS

SELECT KEYS: 1 to select Catalog

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External Programs
	MusiCalc asks: "Name?"
E.DOS	load E.DOS
1	Catalog

FEATURE: **E.DOS—Delete Files**

DESCRIPTION: Deletes a file from a disk

ACCESSED FROM: E.DOS

SELECT KEYS: 2 to select Delete Files

ADDITIONAL: Note that if your respond "F*" when the program asks which file to delete, it will delete every program which begins with F.

Note also that the disk which contains the file must be in the drive when deletion is to occur.

Finally, note that once a file is deleted, it is gone forever.

Remember: The MusiCalc disk must be in the drive before exiting E.DOS.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External Programs
	MusiCalc asks: "Name?"
E.DOS	load E.DOS

		insert your file disk
	2	Delete Files
	filename	file to delete
	Y	delete it (N to abort)
		reinsert MusiCalc disk

FEATURE: **E.DOS—Exit**

DESCRIPTION: Gets you out of E.DOS

ACCESSED FROM: E.DOS

SELECT KEYS: 6 to exit E.DOS

ADDITIONAL: MusiCalc disk must be in the drive when this option is employed.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.DOS	load E.DOS
6	Exit E.DOS

FEATURE: **E.DOS—Format Disk**

DESCRIPTION: Sets up disk so it can be written to and read from by a Commodore 64. Erases entire disk!

ACCESSED FROM: E.DOS

SELECT KEYS: 5 to format disk

ADDITIONAL: This option will erase the disk in the drive completely. No history. Blank. Nothing left. A brand new disk must be formatted before it can be used.

Remember: The MusiCalc disk must be in the drive before exiting E.DOS.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.DOS	load E.DOS
	insert your disk
5	format disk
Y	format it
	reinsert MusiCalc disk

FEATURE: **E.DOS—Initialize DOS**

DESCRIPTION: Resets Commodore DOS

ACCESSED FROM: E.DOS

SELECT KEYS: 4 to reset Commodore DOS

ADDITIONAL: The Commodore disk operating system (DOS) can get confused on occasion. This usually manifests itself as a disk fault or error (you see a blinking red light on the front of the disk drive). When you try to continue what you were doing at this point, the Commodore doesn't respond. E.DOS—Initialize DOS will reset the Commodore DOS. It has the same effect as turning the disk drive off and on.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.DOS	load E.DOS
4	to reset Commodore DOS

FEATURE: **E.DOS—Rename File**

DESCRIPTION: Gives a file a new name

ACCESSED FROM: E.DOS

SELECT KEYS: 3 to rename a file

ADDITIONAL: The new file name cannot already be used on the disk.

Remember: The MusiCalc disk must be in the drive before exiting E.DOS.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External Programs
	MusiCalc asks: "Name?"
E.DOS	load E.DOS
	insert your disk
3	Rename Files
	MusiCalc asks: "Enter the name of file to rename"
old filename	file you want to rename
	MusiCalc asks: "Enter the new name of this file"
new filename	new name of the file
Y	rename it (N to abort)
	reinsert MusiCalc disk

FEATURE: **E.Links**

DESCRIPTION: Rearranges the order of your links. The new links are random and unpredictable.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.Links

ADJUST KEYS:
1—Backwards
2—Forwards
3—Random
4—Exit

ADDITIONAL: Creates very weird melodic statements, but fun to experiment with.

You must reload your preset file to get the original links back.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E. Links	load E.Links
1	rearrange links to link backwards
	MusiCalc asks: "Score #?"
1	Score #1 wait a minute
4	exit to MusiCalc Panel (look at the Score Grid) select Preset #1

FEATURE: **E.Trans**

DESCRIPTION: Allows you to transpose the voices in any score up or down a number of octaves.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.Trans

ADDITIONAL: If you transpose too high, or too low, you will just get the highest or lowest note that MusiCalc will play.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
	MusiCalc asks: "Name?"
E.Trans	load E.Trans
	MusiCalc asks: "Which Score?"

1	Preset Score #1
	MusiCalc asks: "How Many Octaves?"
+1	transposes all Voices up 1 octave
	MusiCalc asks: "More?"
Y	to do more transposing
	MusiCalc asks: "Which Score?"
1	Preset Score #1
	MusiCalc asks: "How Many Octaves?"
–1	transpose all Voices down 1 octave
	MusiCalc asks: "More?"
N	to exit to MusiCalc Panel

FEATURE: **E.Tuner**

DESCRIPTION: Allows user to tune MusiCalc to another instrument.

ADDRESSED FROM: Main Menu—External

SELECT KEYS: E.Tuner

ADJUST KEYS:
f1—a lot sharper
f3—a little sharper
f5—a little flatter
f7—a lot flatter

ADDITIONAL: E.Tuner plays a middle C as a tuning note. Middle C in MusiCalc is a C note in the third octave.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
E.Tuner	load E.Tuner
f3	sharpen MusiCalc's middle C
f5	flatten middle C
↑	to exit to MusiCalc Panel

FEATURE: **E.#**

DESCRIPTION: Allows you to merge individual sound and score files created by the Sound File and Score File programs into the preset sounds and scores in memory.

ACCESSED FROM: Main Menu—External

SELECT KEYS: E.#

ADJUST KEYS:

T—Toggle changes file type expected from sound to score, or vice versa.

X—Allows user to listen to presets without exiting program.

↑—Goes from presets to program, or from program back to MusiCalc (the MusiCalc disk must be in the disk drive before you can go back to MusiCalc)

?—Redisplays menu

ADDITIONAL:

You must have the disk containing the sound and score disk file(s) you want to use in the disk drive when you enter an individual sound or score filename.

Disk containing MusiCalc must be preset when exiting E.#.

See Sound File and Score File Feature Summary.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
E	External
E.#	load E.#
	(already expecting sound file: T changes to expecting score file)
	insert disk containing individual sound file to be merged
	MusiCalc asks: "Name?"
filename	Name of sound file saved with Sound File program. This sound file will be merged into the sound presets in memory
	MusiCalc asks: "#?"
2	replace sound Preset #2 in memory with 'filename' sound file
?	Redisplay menu
	put MusiCalc disk back in the disk drive
↑	to MusiCalc Panel

FEATURE:

Filters

DESCRIPTION:

A sound filter selectively removes frequencies from a sound system, thus modifying the sound.

Low Pass: A low pass removes all frequencies above a certain "center frequency." This could change a full orchestra into just the bass drums.

High Pass: A high pass removes all frequencies below the "center frequency."

Band Pass: A band pass only passes a narrow set of frequencies near the "center frequency."

This, of course, is the simplest way to look at filters. The center frequency of those filters is not fixed; with MusiCalc, you control it.

A different characteristic of all these filters is a quality called "resonance." Resonance is an extremely important variable. When the resonance is varied from nothing to extreme, the sound can change from "mellowed" to oscillating at the center frequency. Somewhere between these extremes, there are many pleasing alterations to the basic waveforms.

MusiCalc actually has a total of 7 filter controls.
They are:

L Low Pass Filter
B Band Pass Filter
H High Pass Filter
d This is not a filter switch—see Disable
1 Filter for Voice 1
2 Filter for Voice 2
3 Filter for Voice 3
e External input filter (This allows an external sound source to be filtered. You'll probably want to leave this on. When it's off you may pick up interference.)

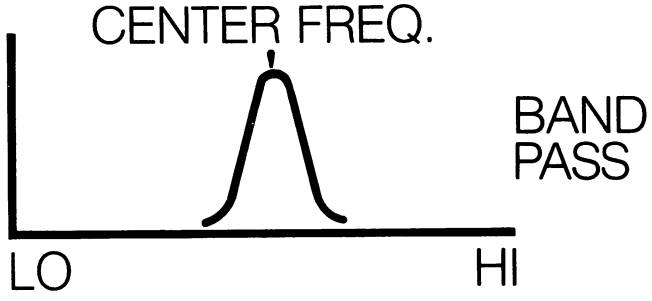
While you turn on the filters with switches, you use the sliders to control the filters' resonance and determine the center frequency (or cut-off frequency).

Cut off some of the lower frequencies and you'll hear more "highs."

Adjust the resonance slider and you'll hear the sound becoming more distorted or less distorted.

FEATURE: **Filter—Band Pass**

DESCRIPTION: Allows the sound at the center frequencies to pass through the filter (to be heard). Normally this enhances the mid-range.



ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS: X Band Pass Filter

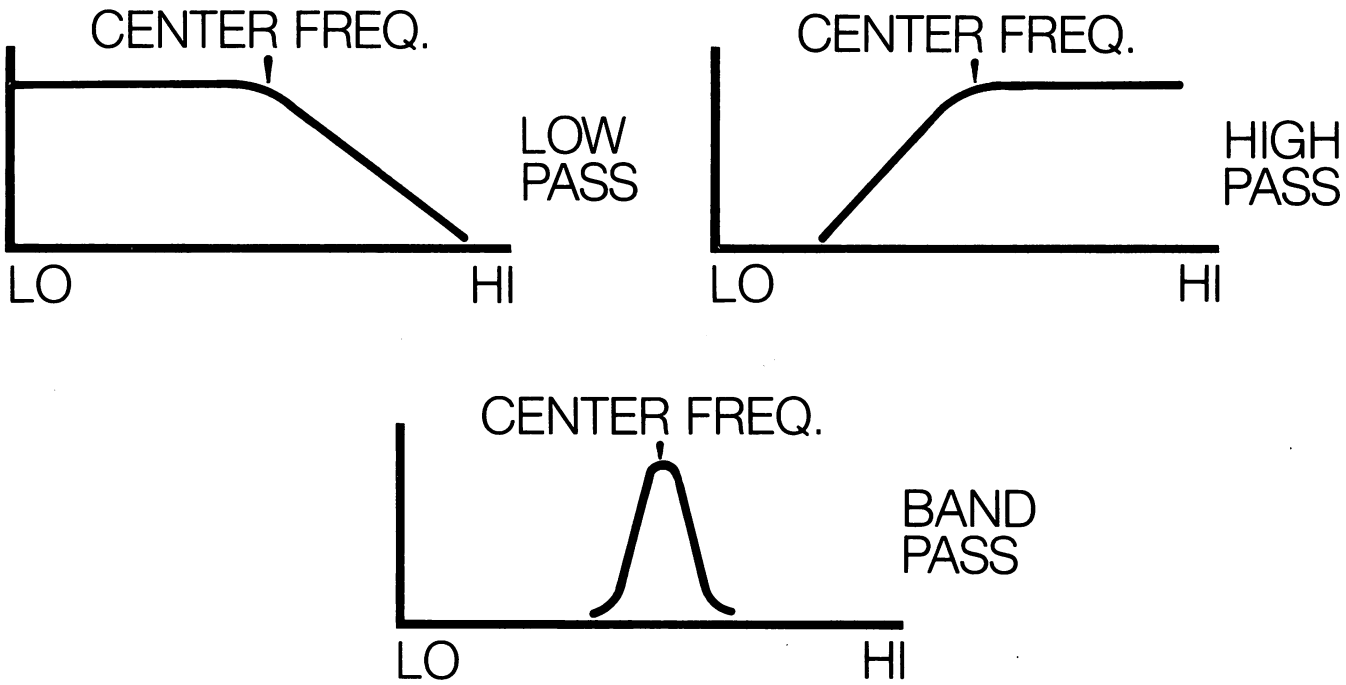
ADJUST KEYS: f3 turn on/off switch

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
X	to select Band Pass Filter
f3	to turn on/off band pass filter

FEATURE: **Filter—Center Frequency**

DESCRIPTION: The reference point for low, band, and high pass filtering. This reference point is controllable and determines the high and low frequency cut-off point for each type of filter.



ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:
A Coarse
S Medium
D Fine

ADJUST KEYS:
f1—Slide Up
f3—Step Up
f5—Step Down
f7—Slide Down

ADDITIONAL: For medium and fine, when slider rolls over the top, it increments slider to the left. When it rolls under the bottom, it decrements slider to the left.

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders
A	to select the Coarse slider for center frequency
f3	to select step up slider

FEATURE: **Filter—External input**

DESCRIPTION: MusiCalc can interact with an external sound source or instrument through the filters. Connect sound source to the Commodore 64 using pin 5 (audio in) of the audio/video connector. Refer to page 142 of the Commodore 64's User Guide.

ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS: < external filter input

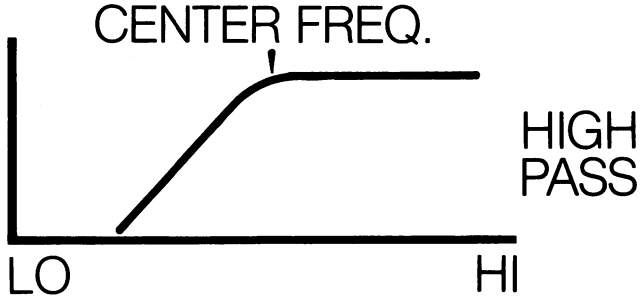
ADJUST KEYS: f3 turn on/off switch

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
<	to select External Filter input
f3	to turn on/off external input

FEATURE: **Filter—High Pass**

DESCRIPTION: Allows the sound above the center frequency to pass through the filter (to be heard). Normally enhances the treble.



ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS: C High Pass Filter

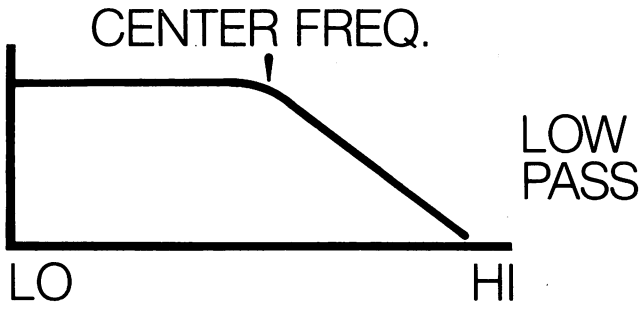
ADJUST KEYS: f3 turn on/off switch

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
C	to select High Pass Filter
f3	to turn on/off high pass filter

FEATURE: **Filter—Low Pass**

DESCRIPTION: Allows the sound below the center frequency to pass through (to be heard). Normally enhances the bass.



ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS: Z Low Pass Filter

ADJUST KEYS: f3 turn on/off switch

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
Z	to select Low Pass Filter
f3	to turn on/off low pass filter

FEATURE: **Filter—Voice 1, 2, and 3**

DESCRIPTION: Allows you to select which voice or voices are affected by the filter settings.

ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS:

B	Selects Voice 1
N	Selects Voice 2
M	Selects Voice 3

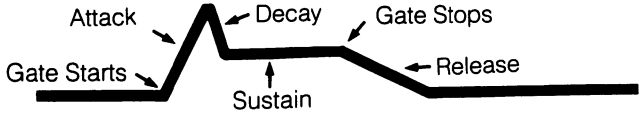
ADJUST KEYS: f3 turn on/off switch

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
B	to select Voice 1 filters
f3	to turn on/off Voice 1 filters

FEATURE: **Gate (g in gsrt)**

DESCRIPTION: The gate controls when a voice begins making sound and when it stops. This gives us individual tones.



ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS:

Q	Voice 1
T	Voice 2
O	Voice 3

ADJUST KEYS:

f3	turn on/off switch

ADDITIONAL: The gate must be on (open) to hear a voice. If the gate is off, the envelope generator will not work for the associated voice. (Voice 3 can be an exception. See Disable Feature Summary.)

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
Q	to select Voice 1
f3	to turn on/off gate

FEATURE: **Keyboard**

DESCRIPTION: MusiCalc allows the Commodore 64's keyboard to be played like a piano keyboard. The keyboard can be used to play any one of three voices, to play and record the notes played in the Score Grid, and to change a single note in the Score Grid byear. (See Keyboard–Voice, Keyboard-Step, Keyboard-Recorder).

The keyboard can also be reprogrammed to play in one of several preset scales. These scales are stored on the MusiCalc Disk with the prefix K (i.e. K. Chromatic, etc.) The following list is available:

File Name	Notes in Scale
K. Chromatic	C,C#,D,D#,E,F,F#,G,G#,A,A#,B
K.KBD1	C,C#,D,D#,E,F,F#,G,G#,A,A#,B
K.KBD (std setting)	C,D,E,F,G,A,B
K.Minor	C,D,Eb,F,G,A,Bb
K.Rock	C,Eb,F,G,Bb
K.Japanese	C,Db,F,G,Bb
K.Hindu	C,Db,Eb,F#,G#
K.Arabian	C,Db,E,F,G,Ab,B
K.Egyptian	C,D,F,G,Bb
K.Maiden	C,E,F#,G#,B

K.Baroque	C,Db,Eb,F,Gb,A,Bb
K.Blues	C,Eb,F,F#,G,Bb
K.145Chord	CEG,FAC,GBD,ACE
K.Balinese	C,Db,Eb,G,Ab
K.Hebrew	C,Db,E,F,G,Ab,Bb
K.W-Tone	C,D,E,F#,G#,A#
K.Rockblues	C,Eb,F,F#,G,Bb,B,C,Eb,E,F,G
K.Dim-7th	C,Eb,Gb,A,C,Db,Eb,E,Gb,G,A,Bb

In addition, you can use a different set of presets files to control the scale intonation. They are as follows:

S.SCALE—A 12-tone scale with equal temperament
S.PYTH —Pythagorean intonation of a 12-tone scale with augmented 7th
S.PYTH1 —Pythagorean intonation of a 12-tone scale with diminished 7th
S.JUST —Just intonation of a 12-tone scale with augmented 7th
S.JUST1 —Just intonation of a 12-tone scale with diminished 7th

ACCESSED FROM: Main Menu

ADDITIONAL: See Load Presets Feature Summary to load keyboard presets.

FEATURE: **Keyboard—Recorder**

DESCRIPTION: In Keyboard—Recorder mode, you select a particular voice and record the score as you play the voice. When you leave Recorder mode the score has changed according to what keys you tapped or held down. You record as much of the score as you want just by improvising with the keyboard.

ACCESSED FROM: Main Menu—Keyboard

SELECT KEYS: 3 Keyboard Recorder

ADJUST KEYS: Commodore 64 Keyboard

Run-Stop—Erase notes
Shift/↑ —Change voices
C=/↑ —Toggle to keyboard voice and back to Keyboard Recorder

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
K	to select Keyboard
3	to select Recorder (Return)
	Play the Keyboard for Voice 1 (yellow)
Shift/↑	to change to voice 2
	Play the keyboard for Voice 2 (red)
↑	to exit to MusiCalc Panel

FEATURE: **Keyboard—Step**

DESCRIPTION: Used to edit a note in a specific step by playing a new note on the keyboard.

ACCESSED FROM: Main Menu—Keyboard

SELECT KEYS: 2 Keyboard Step

ADJUST KEYS: Commodore 64 Keyboard

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
K	to select Keyboard
2	to select Step
1,1	Row #1, Step #1 (Return)
↑	Play new note on keyboard
	to exit to MusiCalc Panel

FEATURE: **Keyboard—Voice**

DESCRIPTION: Allows you to use a voice to play notes selected on the keyboard. The notes you play are not recorded.

ACCESSED FROM: Keyboard Mode

SELECT KEYS:

1	Select Voice
Space Bar	Stop note from playing

ADJUST KEYS: Commodore 64 keyboard

ADDITIONAL: Notes played on the keyboard in the Keyboard Voice mode continue to play until you hit another key or press the Space Bar.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
K	to select Keyboard
1	to select Play Voice
1	to select Voice #1
	Now play keyboard
	to exit to MusiCalc Panel

FEATURE: **Links**

DESCRIPTION: Links are the way you make part of a score repeat itself, or skip to any row and step.

Links are set up FROM one step of a score TO another step in that same score. When MusiCalc comes across a step that's the FROM step of a link, it will play that step, and then, rather than playing the next step as usual, it will play the TO step of the link and continue from there.

ACCESSED FROM: Main Menu

SELECT KEYS: L Links

ADDITIONAL: You can use as many links as you want.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
L	to select Links
	MusiCalc asks: "Row,Step,Row,Step"
1,4,1,1	Link Row #1, Step #4 to Row #1, Step #1

FEATURE: **Load Presets**

DESCRIPTION: Loads preset files from disk. Preset file types are the following:

K.filename Keyboard Scales
S.filename Scale Intonation
P.filename Preset sounds and scores

ACCESSED FROM: Main Menu

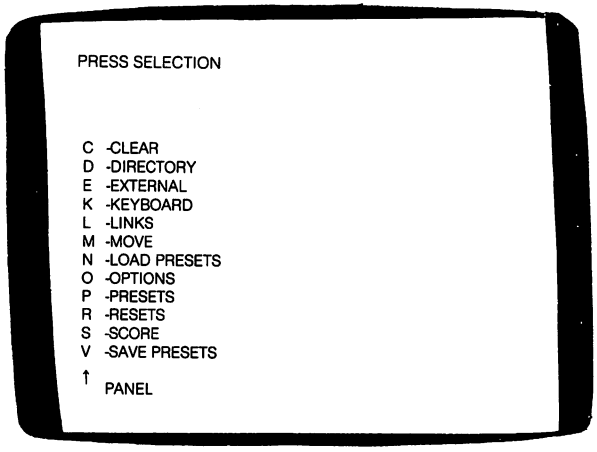
SELECT KEYS: N

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
N	to select Load Presets
P.EXTRA	to load Extra presets file

FEATURE: **Main Menu**

DESCRIPTION: The Main Menu provides access to the disk drive, changes the mode of the MusiCalc Panel, provides the score editing functions, and provides improved sound and timing options.



ACCESSED FROM: MusiCalc Panel

SELECT KEYS: SHIFT/RETURN to Main Menu

ADJUST KEYS:

M = Move: Lets you move a sound or a score from one of the 32 slots to another, or one row of a score to another row of the same score.

V = Save Presets: Lets you save all 32 sounds and all 32 scores to a disk file, so that you can use them later.

P = Presets: Lets you instantly choose any of the 32 scores and any of the 32 sounds you've loaded into your computer's memory.

K = Keyboard: Lets you create a score by playing notes directly on the Commodor 64's keyboard, or change the notes in your existing score.

N = Load Presets: Lets you replace the 32 sounds and 32 scores in the computer with another set of 32 sounds and 32 scores from a file on a disk. Also used to load keyboard scales and Templates.

O = Options: Turns off certain parts of MusiCalc to improve the quality of the sound.

↑ = Panel: Returns you to the MusiCalc Panel.

E = External: Lets you load any external program file that carries an "E." prefix.

D = Directory: Lists files and programs on the disk in the disk drive.

S = Score: Lets you change the note in each step in a score.

R = Resets: Lets you start each voice at a particular step.

L = Links: Lets you make sections of a score repeat themselves.

C = Clear: Lets you clear out a sound or any part of a score.

EXAMPLE: ↑ to MusiCalc Panel

SHIFT/RETURN to Main Menu

FEATURE: **Modulator**

DESCRIPTION: MusiCalc's modulator performs a mathematical modification on any of 25 (0-24) different sound parameters.

Voice 1	**Voice 2**	**Voice 3**	**Filter**
0 FREQ LO	7 FREQ LO	14 FREQ LO	21 FC LO
1 FREQ HI	8 FREQ HI	15 FREQ HI	22 FC HI
2 PW LO	9 PW LO	16 PW LO	23 RES/FLT
3 PWHI	10 PW HI	17 PW HI	24 MODE/VOL
4 CONTROL REG	11 CONTROL REG	18 CONTROL REG	25-30 UNKNOWN
5 ATTACK/DECAY	12 ATTACK/DECAY	19 ATTACK/DELAY	31 MODULATOR OFF
6 SUSTAIN/RELEASE	13 SUSTAIN/RELEASE	20 SUSTAIN/RELEASE	

The number below the words "MOD" on the MusiCalc Panel corresponds to the numbers in the above chart. Where there are two parameters in the chart (6 Sustain/Release), the left modulator slider affects the left parameter (sustain in this case) and the middle modulator slider affects the right parameter (release).

Where there is one parameter in the chart (1 Freq Hi), the left and middle modulator sliders work as coarse and fine sliders.

The right modulator slider controls the degree of modulation, i.e. how much the parameters are mathematically modified.

The left and middle modulator sliders determine how much of a particular parameter will be fed into the modulator.

MusiCalc can perform two types of modulation: oscillator modulation and envelope modulation. Each affects a different section of the sound gathering circuitry, therefore MusiCalc allows you to control each separately. The Oscillator Modulator and the Envelope Modulator can be used individually or together to create a myriad of sounds and sound effects. The possibilities here are nearly endless, so exploration and experimentation will be the best instruction.

Voice 3 supplies the seed information to the modulators. The waveforms of Voice 3 (tspn) provides seed numbers to the Oscillator Modulator and the Voice 3 envelope (adsr) provide seed numbers to the Envelope Modulator. Disable turns off Voice 3 but still allows the envelope settings to seed the Envelope Modulator.

ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:

Space Bar	turn on/off modulators
SHIFT/J	Osc Mod Chart # Up
SHIFT/M	Osc Mod Chart # Down
SHIFT/K	Env Mod Chart # Up
SHIFT/<	Env Mod Chart # Down
J	Osc Mod parameter coarse slider (or left parameter)
K	Osc Mod Parameter fine slider (or right parameter)
L	Osc Mod modulation slider
M	Env Mod parameter coarse slider (or left parameter)
<	Env Mod parameter fine slider (or right parameter)
>	Env Mod modulation slider
V	Disable Voice 3 but allow Voice 3 envelope to affect the Envelope Modulator

ADJUST KEYS:

For sliders:
f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

ADDITIONAL: Keep the modulator switch (space bar) off when changing chart numbers. Otherwise you may get unreliable results.

EXAMPLE:

↑	MusiCalc panel
CRSR ⇆	to select Sliders
SHIFT/J	Chart #1 (Freq hi, Voice 1), Osc Mod
Space Bar	to select modulators
f3	to turn on/off modulators
J	to select Coarse slider
f3	to step it up
L	to select Modulation slider
f3	to step it up

FEATURE: **Move**

DESCRIPTION: The Move option on the menu can copy the sound you're currently using to any of the 32 sound slots, or copy the score that's currently being played to any of the 32 score slots. This is a way to put related scores and sounds in consecutive slots, so that you can call them up by pressing adjacent keys in Presets. For example, one score could be the introduction to a song, another could be the verse, another the chorus, and another could be the end section. Using Move, you could put those 4 scores in slots 1, 2, 3, and 4, so that you could play your whole song in Presets just by pressing SHIFT/1, SHIFT/2, SHIFT/3, and SHIFT/4 at the proper times. You can also use Move to move a sound or a score to a more convenient slot.

ACCESSED FROM: Main Menu

SELECT KEYS: M Move

ADDITIONAL: When the Move commands are carried out, they copy the contents of the current sound or score into the slot you specify, which wipes out whatever was in that slot before the copy. If you want to keep the original sound or score, you have to first move it to another slot. Consequently, it's a good idea to always reserve one sound slot and one score slot as a temporary holder.

If you want to move a sound or score to a different slot with Move, you have to do two things first:

1. You have to make sure that you can afford to replace the contents of the destination slot. The previous sound or score will be lost.

2. You have to call up the sound or score you want to move from Presets (if you're already playing or working on the one you want to move, you don't have to call it up).

EXAMPLE: Move Sound:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
P	Presets
C=/1	choose sound #1

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
M	Move
	MusiCalc asks: "Move Sound, Score, or Row?"
1	Move sound
	MusiCalc asks: "Which #?"
2	move sound in slot #1 to sound slot #2

Move Score:

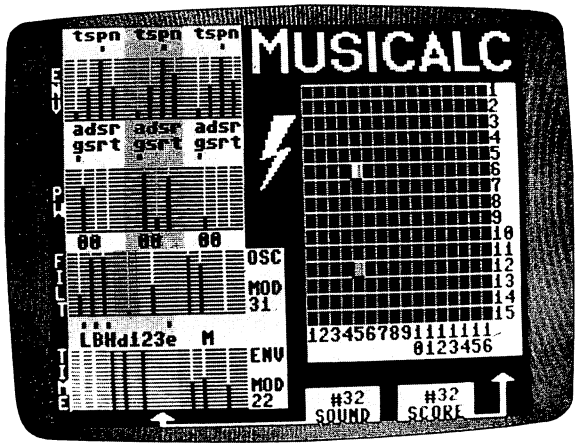
↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
P	Presets
SHIFT/1	choose score #1
↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
M	Move
	MusiCalc asks: "Move Sound, Score, or Row?"
2	Move Score
	MusiCalc asks: "Which #?"
2	move Score in slot #1 to score slot #2

Move Row:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
M	Move
	MusiCalc asks: "Move Sound, Score, or Row?"
3	Move Row
	MusiCalc asks: "From Row?"
1	Move from row #1
	MusiCalc asks: "To Row?"
3	Move to row #3

FEATURE: **MusiCalc Panel**

DESCRIPTION: The main display for MusiCalc, this is displayed in 3 operating modes: Synthesizer (grey border), Presets (green border), and Keyboard (blue or voice color border).



ACCESSED FROM: Boot up or any of the operating modes.

SELECT KEYS: ↑ to MusiCalc Panel

EXAMPLE: MusiCalc Panel Synthesizer Mode:

↑	to MusiCalc Panel

Keyboard Mode:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
K	Keyboard Mode

Presets Mode:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
P	Presets Mode

FEATURE: **Noise Wave (n in tspn)**

DESCRIPTION: A sound wave that makes percussive, wind, surf and jet sounds.

ACCESSED FROM: MusiCalc Panel Switches Mode

SELECT KEYS:

4	Voice 1
8	Voice 2
–	Voice 3

ADJUST KEYS: f3 turn on/off switch

ADDITIONAL: Does not work well with other sound waves.

Due to the design of the Commodore SID Music Chip, you may have to turn the voice Test switch on and then off again to hear the noise sound wave.

EXAMPLE:

↑	MusiCalc Panel
CRSR ↑↓	to select Switches
8	to select Voice 2
f3	to turn on/off noise wave

FEATURE: **Options**

DESCRIPTION: MusiCalc has a special feature that allows you to improve the quality of the tempo being produced. Options lets you turn off the parts of the MusiCalc program that handle the video display. With those parts disconnected, MusiCalc allows the Commodore 64 to concentrate on controlling the synthesizer faster and better. You'll generally want to create your MusiCalc pieces with the display on, and then use the Options to turn off the display and improve the sound when you're recording the music onto a tape recorder.

The first choice, 1 (OFF), will cause the screen to black out immediately and will cause the tempo to improve at the same time. The screen will stay black and the tempo will remain improved until you press a key. As soon as you press any key, everything will go back to normal.

The second choice, 2 (KEYBOARD/PRESETS OFF), will cause the screen to blank out only while you're in Presets and while you're in any of the Keyboard modes. The controls will behave the same as usual in both cases, but the whole screen will be the color of the usual border for that part of the program (blue, yellow, red, or purple for Preset). When you leave Keyboard or Presets Mode by pressing ↑, the display will turn on again. Once you choose this option, the Keyboard and Presets screen will blank out for you every time you use them, until you turn this option off by choosing option 3.

If you've chosen option 2 and want to turn the Keyboard and Presets screens back on again, choose option 3 (KEYBOARD/PRESETS ON). The next time you use Keyboard or Presets, the normal displays will come up.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
O	to select Options
1	to turn display off—press any key to turn it back on

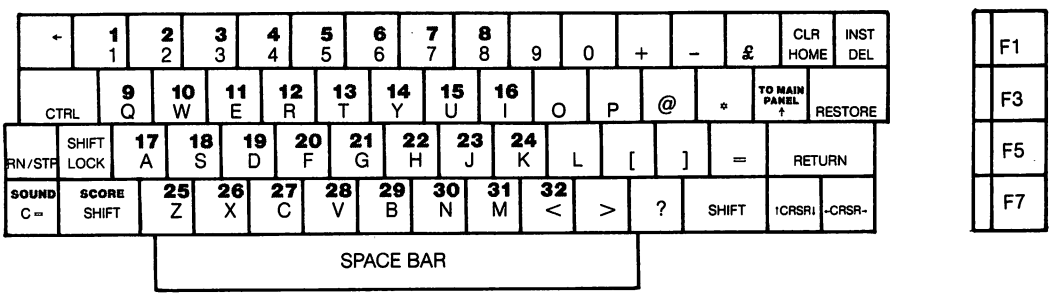
FEATURE: **Presets**

DESCRIPTION: A sound preset is the combination of predetermined settings on the synthesizer controls. A score preset is a previously entered tune (score).

ACCESSED FROM: Main Menu

SELECT KEYS:

PRESETS



PRESETS: 1-32

ADDITIONAL: Presets are a central part of MusiCalc. Preset scores and sounds are stored together as a group. Each preset group holds 32 scores and 32 sounds.

MusiCalc allows you to save these preset files of sounds and scores on disk, and to load them from disk at any time. Once you've loaded a file into MusiCalc, you can instantly choose any score and any sound in the file because they are now in the memory of the Commodore 64.

MusiCalc always has 32 scores and 32 sounds available for use. Remember when you booted MusiCalc? The score and sound that started playing came from a preset file (P.Demo). Score #32 and sound #32 from the file always start playing immediately after you load a preset file. Every time you boot MusiCalc, you load in a preset file. You can load in another preset file at any time while MusiCalc is running (doing this shuts MusiCalc down for about 30 seconds each time).

Once you've loaded a preset file, you can choose any of the 32 sounds and any of the 32 scores by entering Presets mode and pressing a few keys. You can play any of the scores with any of the sounds, so in each preset file you have 1024 different combinations of sounds and scores (32 x 32)!

On the panel there are 2 boxes along the bottom of the screen that always identify the score number and the sound number that is playing. Right now, MusiCalc should be showing you the panel, and the score number and sound number should both be 32. This means that you're hearing score #32 and sound #32 from preset file "P.DEMO" (that was the file that loaded when you booted MusiCalc).

P.DEMO sample sounds and scores:

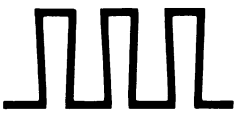
Music Type	Sound #	Score #
Jazz	1-4	1-4
Misc	5-8	5-8
Latin	9-11	9-11
Percussion	12-16	12-16
Rock	17-24	17-24
Rounds	25-28	25-28
Strauss	29	29
Bach	30-31	30-31

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
P	to select Presets
SHIFT/3	to change to Score #3
C=/3	to change to Sound #3
↑	to exit Preset Mode

FEATURE: **Pulse Wave (p in tspn)**

DESCRIPTION: A sound wave that sounds full and harsh in tone.



ACCESSED FROM: MusiCalc Panel Switches Mode

SELECT KEYS:

3	Voice 1
7	Voice 2
+	Voice 3

ADJUST KEYS: f3 turn on/off switch

ADDITIONAL: Works well with triangle waves. A pulse width must be set for a pulse wave to make a sound.

EXAMPLE:

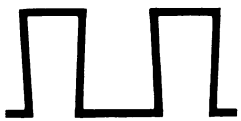
↑	MusiCalc Panel
CRSR↑,↓	to select Switches
7	to select Voice 2
f3	to turn on/off pulse wave

FEATURE: **Pulse Width**

DESCRIPTION: The width of the pulse in a pulse wave.

Narrow Pulse

Wide Pulse



A narrow pulse width presents a tinny, thin sound. A wide pulse will yield a fuller, more solid sound. Pulse width affect the tone or timbre of a note.

ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:

	Voice 1	Voice 2	Voice 3
Coarse	Q	T	O
Medium	W	Y	P
Fine	E	U	@

ADJUST KEYS:
f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

ADDITIONAL: Note that due to negative reinforcement, pulse will cancel out sawtooth. However, pulse and triangle will work together.

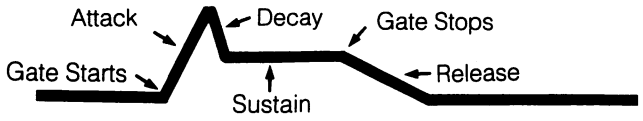
A pulse width must be set for a pulse wave to make sound (see Pulse Wave Feature Summary).

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders
O	to select Coarse pulse width slider
f3	to step up (increase) pulse width

FEATURE: **Release (r in adsr)**

DESCRIPTION: How fast a note goes from the sustain volume to no volume. A classical guitar has a long release.



ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:

4	Voice 1
8	Voice 2
–	Voice 3

ADJUST KEYS:

f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

EXAMPLE:

↑	to MusiCalc Panel
CRSS ⇆	to select Sliders
4	to select Release for Voice 1
f3	to step up release

FEATURE: **Resets (step resets)**

DESCRIPTION: Determines the step at which a voice begins playing after a voice reset.

ACCESSED FROM: Main Menu

ADDITIONAL: Unless you tell MusiCalc otherwise when you create a score, all 3 voices have Row #1, Step #1 as their reset steps.

Since there is always a reset in effect for each voice, you never create a new reset, you just change the existing resets. You do this with the R (for Reset) option on the main menu.

The first thing you'll notice after a reset is that nothing happened. There is a reason for this. Your new resets won't go into effect until you either restart this score by reselecting the preset or until you do a voice reset (See Voice—Start Feature Summary).

EXAMPLE:

↑	to MusiCalc panel
SHIFT/RETURN	to Main Menu
R	to select Resets

		MusiCalc asks: "Row,Step,Voice?"
	1,4,1	Row #1, Step #4 is the new beginning point for Voice 1
	SHIFT/Z	send Voice 1 to beginning point

FEATURE: **Resonance**

DESCRIPTION: Resonance is the effect of a sound being fed back upon itself. MusiCalc creates resonance through the filters. Part of the sound coming out of the filters is fed back into the filters. A higher resonance setting tends to concentrate the sound around the cut-off frequency (See Filters Feature Summary).

ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS: F Resonance

ADJUST KEYS:
f1–Slide Up
f3–Step Up
f5–Slide Down
f7–Step Down

EXAMPLE:		
	↑	to MusiCalc Panel
	CRSR ⇆	to select Sliders
	F	to select Resonance
	f3	to step up Resonance

FEATURE: **Ring Modulator (r in gsrt)**

DESCRIPTION: Modifies a triangle sound wave by multiplying it with another triangle sound wave.

ACCESSED FROM: MusicCalc Panel Switches

SELECT KEYS:
E Voice 1
U Voice 2
@ Voice 3

ADJUST KEYS: f3 turn on/off switch

ADDITIONAL: Tends to add more "highs" and sharpness to sound. Can result in interesting timbres.

EXAMPLE:		
	↑	MusiCalc Panel
	CRSR↑↓	to select Switches
	E	to select Voice 1
	f3	to turn on/off Ring Modulator

FEATURE: **Save Presets**

DESCRIPTION: Command to save the sound and score presets currently in memory to disk.

ACCESSED FROM: Main Menu

SELECT KEYS: V Save Presets

ADDITIONAL: You must have a formatted disk in the drive when you save preset files. Do not try to save a file on the MusiCalc disk. Begin preset files with "P" (like P.DEMO). Put the MusiCalc disk back in the drive when you're finished saving presets.

See E.DOS Feature Summary to format a disk.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
V	to select Save Presets
	MusiCalc asks: "Name?"
P.Test	to save the 32 sounds and 32 scores currently in memory to a disk file called P. Test. (or choose any legal filename that begins with P.)

FEATURE: **Sawtooth Wave (s in tspn)**

DESCRIPTION: A sound wave that sounds full and rich in tone

ACCESSED FROM: MusiCalc Panel Switches Mode

SELECT KEYS:

2	Voice 1
6	Voice 2
0	Voice 3

ADJUST KEYS: f3 turn on/off switch

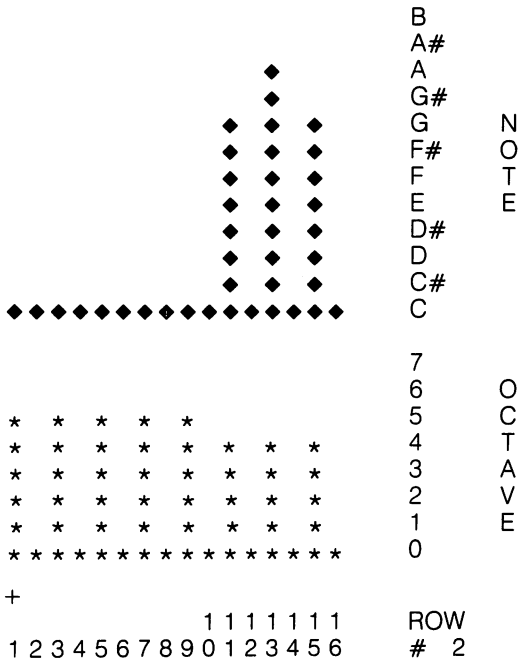
ADDITIONAL: Does not work with other sound waves.

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
6	to select Voice 2
f3	to turn on/off sawtooth wave

FEATURE: **Score (Score Screen)**

DESCRIPTION: The Score Screen is bar graph representation of a music score (tune). You can enter and edit notes while viewing the score screen. Any changes to the score can be heard as soon as they are made. This allows you to compose and edit scores by ear.



ACCESSED FROM: Main Menu

SELECT KEYS: S Score Screen

ADJUST KEYS:

CRSR↑↓	Move + to the left
CRSR ←→	Move + to the right
Space Bar	Tie note to the note on the right (◥).
f1	Note up 1/2 step
f3	Octave up
f5	Octave down
f7	Note down 1/2 step
SHIFT/↑	Page down one row #
C=/↑	Page up one row #
←	to exit back to MusiCalc Panel

ADDITIONAL:

Scores are the way you tell MusiCalc what notes to play, and when to play them. The Score Screen shows you which note is in each of the sequencer steps.

A score can be up to 240 steps long. Each step can hold one note or one rest (a rest is a step where no note is played; a silent step). A score is represented on the panel as a grid of small squares, with 15 rows and 16 steps in each row (15 times 16 is 240). Each small square in the grid represents one step in the score.

All steps in a score have equal time value; that is, when MusiCalc plays a score, it spends the same amount of time playing each step. You have to decide whether each step will be a quarter note, eighth note, sixteenth note, or any other musical time value.

If you decide to make each step an eighth note, every step in the whole score will be an eighth note. You can then make a quarter note by giving two consecutive steps the same note and "envelope latching" them. You can't make a sixteenth note, however. The time value of the step is the shortest note you can really play.

MusiCalc moves from step to step through the entire grid if you leave it alone, but you'll hardly ever want to leave it alone. You can use LINKS to tell it to repeat groups of steps, or skip groups of steps.

Note: Any note played in octave O is a rest. If you want rests longer than one step, latch them together (this removes the popping sound of the gate).

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
S	to select Score
	MusiCalc asks: "Row #?"
1	to enter/edit Row #1 of the Score
	proceeds to Score Screen
↑	to exit to MusiCalc Panel

Also see Score Tutorial.

FEATURE: **Score File Program**

DESCRIPTION: Takes an individual score out of a preset file and turns it into a separate file, which can then be merged into a different preset file, via E. #.

ACCESSED ROM: Power Up or Commodore Basic "Ready"

SELECT KEYS:

```
Load "Score File",8
Run
```

ADDITIONAL: A score file is only useful for merging. You can't play it or load it as a preset. Only E.# can use it.

EXAMPLE:

From Commodore Basic "Ready"
Load "Score File",8
Run

MusiCalc asks: "Preset File?"

Insert the disk containing the preset file you want to use into the disk drive (if not already in the disk drive)

P.DEMO — Name of any preset file you want to use. P.Demo is the standard MusiCalc presets file and is found on the MusiCalc disk.

Insert the disk you want to use to save the individual score files (if not already in the disk drive)

MusiCalc asks: "Name?"

SCR — This will be the prefix for your individual score files. You can make your own prefix, but keep it less than 8 letters. Files will be stored as "Prefix" #. The # will be the score file number.

MusiCalc asks: "Do you want all 32 created?"

N — N will allow you to save only scores that you select.

Y will cause all 32 sounds to be saved on the disk as individual score files.

MusiCalc asks: "SCR 1?"

Y — Store Score Preset #1 in a disk file as SCR 1 (N will skip to next score #; SCR 2).

continue through all 32 scores.

FEATURE: **Sequencer**

DESCRIPTION:

The MusiCalc Score Sequencer proceeds with evenly-spaced time periods, each of which is considered "one step." Once loaded into sequencer memory, the notes can be played back through these "steps" faster or slower, by varying the time rate. The music you wish to input into the score sequence will be played during this time period. There are 16 steps per row, but passages longer than 16 steps can be entered.

A voice that plays the last step in a row will automatically continue to play in the first step of the very next row. By linking one row and step with another row and step, passages that repeat or jump to a non-adjacent row and step can be created (See Links Feature Summary).

You must first decide on the smallest time increment you need for the music you're entering into the score sequencer. Is it an eighth note? A sixteenth note? A thirty-second note? Once you decide on the smallest time increment, this time increment will equal one step in memory. For example, if a 16th note is the smallest increment in the music, then:

16th note = 1 step

8th note = 2 steps

quarter note = 4 steps

4 quarter notes = 16 steps = 1 row of memory

If you make the smallest increment something smaller than a time value you will actually be using, then you will be wasting memory unnecessarily.

If you make the smallest time increment longer than the shortest note you will need to play, you will not be able to play that note. For example, if you decide that an 8th note is the smallest time increment you will need, then an 8th note = 1 step. Later, if you find that you need to play a 16th note, there would be no way of playing it, since 1 step = 8th note, and 1 step is the smallest time value in score sequencer memory.

So first, determine the smallest music time value that should equal one step in sequencer memory. Now we can decide how many steps will be necessary for each note or rest. This is straightforward and simple. For example, if a 16th note = 1 step, then an 8th note = 2 steps, an 8th note rest = 2 steps, a quarter note = 4 steps, and a quarter note rest = 4 steps. Note the convenience that if a 16th note = 1 step, then 1 row = 16 steps = 4 quarter notes, which fits in nicely for music where there are 4 beats per measure.

ACCESSED FROM: Main Menu

FEATURE: **Sliders**

DESCRIPTION: Sound adjusters graphically represented on the MusiCalc Panel.

ACCESSED FROM: MusiCalc Panel Synthesizer Mode

SELECT KEYS: CRSR ⇆ to select Sliders

ADJUST KEYS:
f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders
3	to select Sustain for Voice 1
f3	to step up sustain

FEATURE: **Sound File Program**

DESCRIPTION: Takes an individual sound out of a preset file and turns it into a separate file, which can then be merged into a different preset file, via E. #.

ACCESSED FROM: Power up, or Commodore Basic "Ready"

SELECT KEYS:
Load "Sound File",8
Run

ADDITIONAL: A sound file is only useful for merging. You can't play it or load it as a preset, Only E.# can use it.

EXAMPLE:

From Commodore Basic "Ready"
Load "Sound File",8
Run

MusiCalc asks: "Preset File?"

Insert the disk containing the preset file you want to use into the disk drive (if not already in the disk drive)

P.DEMO

Name of any preset file you want to use. P.Demo is the standard MusiCalc presets file and is found on the MusiCalc disk.

Insert the disk you want to use to save the individual sound files (if not already in the disk drive)

MusiCalc asks: "Name?"

SND

This will be the prefix for your individual sound files. You can make up your own prefix, but keep it less than 8 letters. Files will be stored as "Prefix" #. The # will be the sound file number.

MusiCalc asks: "Do you want all 32 created?"

N

N will allow you to save only scores that you select.

Y will cause all 32 sounds to be saved on the disk as individual score files.

MusiCalc asks: "SND 1?"

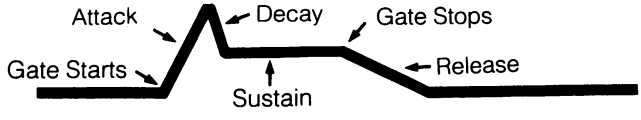
Y

Store score Preset #1 in a disk file as SND 1 (N will skip to next score ,#: SND 2)

Continue through all 32 scores

FEATURE: **Sustain (s in adsr)**

DESCRIPTION: The volume at which a note remains after decay. Maximum sustain would mean there could be no decay.



ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:

3 Voice 1
7 Voice 2
+ Voice 3

ADJUST KEYS:

f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

EXAMPLE:	↑	to MusiCalc Panel
	CRSR ⇆	to select Sliders
	3	to select Sustain for Voice 1
	f3	to step up sustain

FEATURE: **Switches**

DESCRIPTION: A switch turns certain sound parameters on and off.

ADDRESSED FROM: MusiCalc Panel Synthesizer Mode

SELECT KEYS: CRSR↑↓ to select Switches

ADJUST KEYS: f3 turn on/off switch

EXAMPLE:	↑	to MusiCalc Panel
	CRSR↑↓	to select Switches
	V	to Sync Voice 2 with Voice 1
	f3	to turn on/off sync

FEATURE: **Synchronization (s in gsrt)**

DESCRIPTION: The synthesizer tries to synchronize a voice sound wave and pitch with the voice to the left.

ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS:

W	Voice 1
Y	Voice 2
P	Voice 3

ADJUST KEYS: f3 turn on/off switch

ADDITIONAL: Tends to make sharper sounds.

This feature can't completely synchronize one voice's waveform with another. This yields additional sound effects.

Voice 1 synchronizes with Voice 3

Voice 2 synchronizes with Voice 1

Voice 3 synchronizes with Voice 2

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
Y	to Sync Voice 2 with Voice 1
f3	to turn on/off sync

FEATURE: **Tempo**

DESCRIPTION: Controls the overall speed at which notes are played.

ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS: B Overall Tempo

ADJUST KEYS:
f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

ADDITIONAL: For reliable results, the tempo slider should not be set lower than three notches from the bottom. When the modulators are used, the tempo slider should not be set lower than four steps from the bottom.

Note: you don't always want reliable results.

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders
B	to select Tempo slider
f3	to step up

FEATURE: **Tempo—Attack Time**

DESCRIPTION: The length of the attack time period.

ACCESSED FROM: MusiCalc Panel

SELECT KEYS:
Z—Coarse Slider
X—Fine Slider

ADJUST KEYS:
f1 = Slide Up
f3 = Step Up
f5 = Step Down
f7 = Slide Down

ADDITIONAL: A longer attack period slows down the overall tempo. A shorter one speeds it up. Attack time, Decay time, and Tempo all interact to set the final tempo.

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders
Z	to select Attack time coarse slider
f3	to step up

FEATURE: **Tempo–Decay Time**

DESCRIPTION: The length of the decay time period, i.e. how long decay is allowed to occur.

ACCESSED FROM: MusiCalc Panel

SELECT KEYS:
C–Coarse Slider
V–Fine Slider

ADJUST KEYS:
f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

ADDITIONAL: A long decay period slows down the overall tempo by putting more time between notes. A shorter delay period speeds up the tempo. Attack time, Decay time, and Tempo interact to set the final tempo.

EXAMPLE:

↑	to MusiCalc Panel
CRSR ⇆	to select Sliders
C	to select Decay time coarse slider
f3	to step up

FEATURE: **Test (t in gsrt)**

DESCRIPTION: A test switch to check whether or not a voice is operating. It's normally off; i.e. when you turn test on, that voice drops out.

ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS:

R	Voice 1
I	Voice 2
*	Voice 3

ADJUST KEYS: f3 turn on/off switch

ADDITIONAL: Test is the source of an apparent glitch in the Commodore synthesizer chip. There are times when the chip seems to get confused, and doesn't play a voice, even though the sound settings are right. This seems to happen more with the noise waves than with the others. The answer is to turn Test on, then off again. The voice will start playing.

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
R	to select Voice 1
f3	to turn on/off Test (Must be off to hear voice)

FEATURE: **Transposing a Voice**

DESCRIPTION: The transpose controls tell MusiCalc to play the voice's notes a certain number of half steps above (never below) the notes on the score.

If MusiCalc finds a G in octave 6 in a step to be played by Voice 2, and Voice 2's transpose control is set at 1, Voice 2 would play a G# for that step. All other notes Voice 2 plays will also be one half step above the notes in the score.

You can always set a voice's transpose control to 0, and it will play exactly the notes in the score, not raising them at all. Transpose settings are part of the score, just like resets and links.

The transpose controls are an easy way to change a score from one key signature into another. Instead of painstakingly re-entering each step in the score, you can just set the transpose conrols to raise the voices by the amount you need. Also, you can set up parallel chords by scoring the root note at each step, having all three voices play the same sequence and transposing two of the voices up (for a major chord, you'd transpose one voice up by 4 half steps and transpose the other up by 7).

Remember, even though the transpose settings appear on the synthesizer (sound) side of the screen, they're really part of the sequencer (score).

ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS:

Voice	1	2	3
Raise Key	SHIFT/0	SHIFT/+	SHIFT/—
Lower Key	SHIFT/0	SHIFT/#	SHIFT/*

ADDITIONAL: Transposer settings are saved as part of the presets file.

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/0	Transpose Voice 1 up one half step in key pitch

FEATURE: **Triangle Wave (t in tspn)**

DESCRIPTION: A sound wave that makes a pure, hollow tone.

ACCESSED FROM: MusiCalc Panel Switches

SELECT KEYS:

1	Voice 1
5	Voice 2
9	Voice 3

ADJUST KEYS: f3 turn on/off switch

ADDITIONAL: Works well with pulse waves. A triangle wave is very quiet in the lower octaves.

EXAMPLE:

↑	to MusiCalc Panel
CRSR↑↓	to select Switches
5	to select Voice 2
f3	to turn on/off triangle wave

FEATURE: **Tying notes together—Envelope Latching**

DESCRIPTION: When you want to have more than one step in a sequence sound like a single note, you use something called the envelope latch (◥). While entering scores on the Score Screen, press the space bar and just above the + sign "cursor" you will see a (◥) symbol appear. It means the note at that step will "slur" into the step after it on the score page. The envelope generator for that voice thinks those two steps latched together are one step that's twice as long as an ordinary step. If the 2 notes latched together are the same pitch in the same octave, they will sound like one note. If the 2 notes are different in pitch and/or octave, the 2 note values will still sound like 2 notes but will be "slurred" together.

If you place two of the envelope latch symbols next to each other on the score page, the envelope that's playing that note will latch 3 notes together as one "slurred" articulation.

ACCESSED FROM: Main Menu—Score Screen

SELECT KEYS: Space bar

EXAMPLE:

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
S	to select Score
1	Row #1
Space bar	to Tie first two notes together

FEATURE: **Voice—Start**

DESCRIPTION: Starts a single voice or all voices playing. Starts from the step where the voice was previously stopped.

ACCESSED FROM: MusiCalc Panel

SELECT KEYS:	Voice	1	2	3	All
		SHIFT/1	SHIFT/2	SHIFT/3	SHIFT/4

EXAMPLE:	↑	to MusiCalc Panel Synth Mode
	Shift/1	to Start Voice 1 (Voice has to be stopped before you can see it start)

FEATURE: **Voice—Stop**

DESCRIPTION: Stops a single voice or all voices from playing.

ACCESSED FROM: MusiCalc Panel

SELECT KEYS:	Voice	1	2	3	All
		SHIFT/Q	SHIFT/W	SHIFT/E	SHIFT/R

EXAMPLE:	↑	to MusiCalc Panel
	Shift/Q	to Stop Voice 1

FEATURE: **Volume**

DESCRIPTION: Controls overall volume of MusiCalc.

ACCESSED FROM: MusiCalc Panel Sliders

SELECT KEYS: G

ADJUST KEYS:
f1–Slide Up
f3–Step Up
f5–Step Down
f7–Slide Down

EXAMPLE:	↑	MusiCalc Panel
	CRSR ⇆	to select Sliders
	G	to select Volume slider
	f3	to step up

GLOSSARY

Attack
The start or "pluck" of a sound event called an envelope. The complete sound envelope is defined by attack, decay, sustain, and release (adsr).

The attack determines the amount of time it takes from the beginning of the sound event where the volume level is zero until the volume reaches its maximum level. The attack is conventionally initiated by pressing a key on a keyboard. In MusiCalc, it is initiated by the beginning of each sequencer step.

Band Pass Filter
All frequencies within a pre-selected middle range of frequencies are allowed to pass through, and all frequencies above and below this preselected range are diminished.

Decay
When the volume has reached maximum value (during attack) the decay determines how much time it takes to go from maximum volume to the "sustain" level. If the sustain level is also maximum, the decay time becomes irrelevant. Decay is part of the sound envelope (attack, decay, sustain, release).

"E."
The prefix used for disk files that are external programs called up after pressing option "E" on the Main Menu. You must always enter a disk file name with E. as its prefix. These files are programs that can be run at the same time (concurrently) as the sequencer and synthesizer.

Envelope
A control of volume and the overall sound event with respect to time. MusiCalc controls the shape of an envelope width by allowing you to set the level of attack, decay, sustain, and release.

The envelope precisely defines changing volume levels with respect to precise rates of time. By changing the envelope you can control the loudness of the sound and the timbre of a note.

Filter
A control that changes (filters) the sound of a waveform. MusiCalc processes the oscillator's (sound generator's) waveform with a selection of one of three filter types: low pass (bass), band pass (mid-range), high pass (treble). Low pass lets through sound frequencies below a center frequency; high pass the exact opposite. Band pass only lets through pitches close to the center frequency.

Gate
The internal starting of the envelope. When gate begins, the envelope attack also begins. When gate ends, the envelope releases.

Graphic Equalizer
A series of filters that can reduce or amplify specific frequencies.

High Pass Filter
All sound frequencies below the center (cut-off) frequency are diminished, and all sound frequencies above the center (cut-off) frequency are allowed to pass through.

Intonation
See "S."

"K."
This is the prefix we use to indicate that a disk file is a keyboard layout for playing in a particular scale of notes selected out of the 12 notes in an octave. For instance, if you want to play in the major scale (notes c, d, e, f, g, a, b,) you press "N" on main menu and enter: K.KBD and press RETURN. These K. files are used when you play in keyboard mode.

Low Pass Fiter (the most common type of filter)
All sound frequencies above the center (cut-off) frequency are diminished, whereas all sound frequencies below the center (cut-off) frequency are allowed to pass through.

Modulator
A control that enables you to modulate (change) very specific aspects of a sound, like low and high frequencies or pulse widths. Modulators often create complex and unusual sounding waveforms.

Noise
A random waveform. Noise is used to create percussive, wind, surf and jet sounds.

Note
A voice's pitch-sound occurrence. Each note has a birth, life, and end. A note's pitch is its frequency, and a note's sound is controlled by a note's envelope.

Octave
Scientifically, this means twice the frequency, for an octave higher, or half the frequency, for an octave lower. Musically, this means the same note, taken up or down, until you reach the same note occurring again in the next range. For example, if you start with middle C on a piano, then, 1 octave up would be the next C higher up on the piano.

Oscillator
The module in a synthesizer that produces the basic sound wave. The sound generator.

"P."
This is used to indicate that a disk file is a 32 sound/32 score preset file to be loaded using the "N" selection on the Main Menu.

Patch Cord & Adapters
Audio cords of various ends and lengths. Adapters and cord ends can be "RCA phono," "mini-phone," and "phone types." Commodore 64 cables use "phono jacks."

Pitch
The frequency (number of vibrations per second) of a sound. One of the ear's most sensitive functions is the hearing of pitch differences.

Preset
Sound (tone or timbre) and score (sequence of musical notes) already saved to disk and/or memory.

Pulse
This waveform looks like a rectangle. The width of the rectangle is called pulse width.

Pulse Width
The width of rectangular-shaped sound wave (a pulse wave). Each pulse width has its own unique "tone" or "timbre." Changing the pulse width results in changing tone or timbre. If a modulator is periodically changing the pulse width, you'll get periodic changes in tone happening at the rate determined by the modulator.

Release
The end of the sound or "drop" rate. The release determines how much time it takes to go from the "sustain" level back to "zero" level. Traditionally, the release begins when one releases a pressed key from a keyboard. In MusiCalc, the release is initiated when each step of a sequencer ends. Release is the end of the sound envelope (attack, decay, sustain, and release).

Reset
Starts a voice over at the first step (reset step) of a note sequence.

Resonance
MusiCalc can vary a filter's resonance, changing the filter's sharpness from dull to bright. Resonance is created by a feedback loop in the filter whereby the filter output gets fed back to the filter input along with the original signal. As the resonance is turned up, this means more of the filter output is being fed back to the input. The effect of increasing the resonance is to emphasize the passing of frequencies through the filter near the cut-off frequency. As the resonance is progressively turned higher, the emphasis of frequencies around the cut-off frequencies becomes progressively more pronounced and more sharply focused on precisely and only the cut-off frequency.

Ring Modulator
A ring modulator accepts any two inputs and multiplies their values to create the output. This creates a very interesting source of unusual clanging sounds, like bells.

"S."
This is the prefix for telling that a disk file is a particular scale intonation. MusiCalc comes with 5 variations: a well known 12-Tone Equal Temperament, two Just Intonation Variants, and two Pythagorean Intonation Variants. Call these up in the same way as you call a K. file (from "N" on the main menu).

Sawtooth
A waveform that goes up at a constant rate, then drops back to zero.

Score
A progression of musical notes, as in sheet music.

Score Block
A 240-step block of sequencer "memory" that you can use to put in musical notes.

Sequence
A series of musical notes which is repeated.

Sound
The instrument sound created by MusiCalc. Set automatically with presets and/or adjustable by MusiCalc. With MusiCalc, you can adjust the envelope (attack, decay, sustain, release), pulse width (narrow to wide), waveform (triangle, sawtooth, pulse, noise), and filter (low, band, high) to create many different sounds.

Step
Each note in a score sequence occurs one step at a time. A step is represented by each square in the Score Grid.

A step also refers to musical notation. Each musical note is said to be one-half step apart from its neighboring note.

Sustain
The holding of the note. Sustain is a part of the sound envelope (attack, decay, sustain, release). Sustain is volume level whereas attack, decay, and release are time values.

Synchronization
Another internal function which brings the pitch of oscillator 1 into a locked ratio with oscillator 3, oscillator 3 with oscillator 2, or oscillator 2 with oscillator 1.

Synthesizer
Any electronic circuit capable of producing waves which can be amplified to sound.

Tempo
The speed at which the music proceeds in time: the rate, pulse, or "heartbeat" of the music. On the MusiCalc score sequencer, the tempo is determined by:

1. The computer's clock rate, which establishes the speed at which the sequencer goes from one step to the next step.
2. The musical time interval (1/8 note, 1/16 note) that is assigned to each step in the sequencer.

Test
A Commodore SID chip function which fixes a latch-up waveform (usually a noise waveform).

Timbre
The tonal qualities of a voice's sound. Pulse width and filter settings affect timbre.

Transpose
To shift the note value of a musical passage up or down by a specific number of half-steps. For example, if you have the note F and you transpose up by 3 half-steps, you would have A flat or G sharp.

Triangle
A waveform that goes up at a constant rate and down at the same rate. It has a smooth and muted sound.

Waveform
The specific shape of the wave which oscillates from zero to full to zero to negative full and back to zero. The MusiCalc system uses 4 waveforms, any one of which may be selected (triangle, sawtooth, pulse, noise).

APPENDICES

APPENDIX A: THE HARDWARE

WHAT YOU WILL NEED

1. A COMMODORE 64 PERSONAL COMPUTER with power supply module.
2. A COMMODORE (VIC) 1541 DISK DRIVE unit with connector cable and disk drive power cord. This disk drive requires 5¼" disks. Ask your dealer or another Commodore 64 user for a recommended brand of diskettes.
3. AN RCA TYPE CORD AND A TV RF MODULATOR BOX (comes with the purchase of a Commodore 64),–OR– an "Audio/Video connector cable" (see "Optional Connections").
4. YOUR HOME TELEVISION SET–OR–A CRD MONITOR. The TV or monitor may be monochromatic (black and white) or color. COLOR is recommended, as MusiCalc uses color graphics to enhance ease of use of the program features.
5. YOUR MusiCalc DISKETTE in this package.

HARDWARE SET UP

IF YOU HAVE JUST PURCHASED a Commodore 64 computer system, you should have:

1. Commodore 64
2. Power supply (black box with an AC plug and supply cord)
3. Video cable
4. TV switchbox (small silver box with short antenna leads)

Refer to your Commodore 64 User's Guide for hardware installation of the computer, power cable, and TV or monitor connectors as required. This manual is not meant to replace the start-up sequence as detailed in the Commodore User's Guide when installing and using the disk drive system.

CONNECTING UP THE SYSTEM

Follow the Commodore 64 User's Guide, chapter 1: "Unpacking and connecting the Commodore 64." There are both side panel and rear connections to the Commodore 64. Make sure you know which connection is which!

OPTIONAL CONNECTIONS

The Commodore 64 gives you a separate channel for high quality sound, so you may want to play MusiCalc through your home stereo system or through a quality sound amplifier system.

This option is available by using the AUDIO/VIDEO OUTPUT JACK on the rear panel of the COMMODORE 64. To use this jack you will need:

1. A Commodore audio/video output cable OR an ATARI 400™ audio/video output cable OR a standard 5-pin DIN audio cable. If you use an audio/video cable from Commodore or Atari, there will be two separate cords coming out of the "Y" cable–one for Audio and one for the Video signals. (Both lines will have standard RCA type male jacks on the end so you might get them mixed up at first. Put some colored tape on them to tell them apart.) Most CRT monitors accept RCA type jacks for video signal IN. Most stereo systems also accept the same type jack. If you are going to use a standard musicians amplifier, you will need to go to your local electronics store to get an RCA-to-¼" standard phone jack adapter (RCA female to ¼" male), as most music amps use standard phone jack IN.
2. A sound amplifier system of some kind. You have lots of alternatives; home stereos and guitar amplifiers of all types, even direct to your Walkman headphones using a mono to stereo headphone jack adapter. Of course, you can do more with the sound before listening to it, like putting it through a reverb unit or any of the host of different music effects boxes available.

The Commodore 64 also provides a standard "composite" video signal, allowing you to use a color or black and white CRT monitor.

1. A CRT black and white OR color MONITOR. WAVEFORM RECOMMENDS YOU USE A COLOR MONITOR. There are several aspects of MusiCalc software that use color to help you tell what's what. A color monitor can make using MusiCalc a richer and possibly more rewarding experience. On the other hand, you can still effectively use MusiCalc with a black and white monitor and not miss out on any crucial features of the system. You may, however, encounter occasional problems knowing which sequence line is assigned to which synthesizer voice because they are color-keyed.

BE CAREFUL...

1. WHEN CONNECTING UP THE SYSTEM DO NOT CONNECT ANY AC POWER CORDS UNTIL AFTER YOU HAVE CONNECTED EVERYTHING ELSE; AND BE SURE ALL THE POWER SWITCHES ON THE TV, COMPUTER, AND DISK DRIVE ARE OFF BEFORE YOU PLUG IN THE AC POWER CORDS TO YOUR OUTLET.
2. AFTER YOU HAVE TURNED YOUR SYSTEM ON, YOU SHOULD SEE SOME TEXT ON THE TV OR MONITOR SCREEN WITH A "READY" FOLLOWED BY A "CURSOR" SQUARE-DOT BLINKING. IF THIS HASN'T HAPPENED, CONSULT YOUR COMMODORE 64 USERS GUIDE SECTION ON COMPUTER INSTALLATION. IF THIS DOES NOT HELP, CALL YOUR COMMODORE DEALER AND ASK THEM TO EXPLAIN TO YOU WHAT MIGHT BE WRONG OR TAKE YOUR COMMODORE BACK TO WHERE YOU PURCHASED IT AND HAVE THEM SHOW YOU WHAT YOU DID WRONG OR REPLACE THE UNIT IF DEFECTIVE. (If you purchased your Commodore 64 at some outlet that doesn't know how to help you, or won't, then call up your local computer store that carries the Commodore 64, and ask them if they would be willing to give you some free advice. If not, ask them how to get in contact with the nearest certified Commodore service and repair store in your area.)
3. THE TV OR MONITOR SCREEN SHOULD APPEAR TO HAVE A "DARK" BLUE BACKGROUND COLOR, WITH LIGHT BLUE BORDER AND LETTERS. IF THE COLOR DOESN'T SEEM TO BE RIGHT, ADJUST YOUR TV OR YOUR MONITOR.

APPENDIX B: SWEETENING AND PERFORMING

Once you have created some interesting sounds and written some original scores and you're ready to perform for yourself, your friends, or the world, it's time for "sweetening"!

That means there are other things to do with the Commodore sound output before you put it through stereo speakers, your guitar amplifier or headphones. "Sweetening" means processing and massaging and putting more "effects" in your sound. Common ways of sweetening include: Equalization (EQ), Reverberation (Reverb), Phase Shifting (phasers), Flanging (Flangers), Echo (Echo machine)... and other types of "effects."

If you want to make the Commodore 64 sounds a little less dry, more juicy, easier to listen to, more spacious, you might consider investing in one of these "effects" units that you can find at most musical instrument stores.

Probably the most startling difference you can make to your sound is to add some REVERB! Reverb units are still pretty expensive ($150-350) but can be very worthwhile, especially if you want to tape record your sounds and scores to share with friends. Also, some guitar amplifiers costing about the same have "reverb" units built in.

Of course, if you only get an "EQ" unit or a "reverb" unit, installation will be simpler. Just put it between the computer and the speaker!

If you're thinking of performing for groups (or already are) then we recommend you consider "sweetening" your sound between the computer and the speaker. You've got to hear the difference! Go down to your music store and ask for a demonstration of some different "effects" devices, especially a "reverb unit."

If you will be performing, be sure to take advantage of MusiCalc's sound/score manager special option programs. It enables you to organize your preset sounds and scores so they are available on a single row of keys in the order you'll be playing them! (See Sound File and Score File Feature Summary)

The same goes for your instrument sounds.

By the way, there will probably be times you'll want to tune up with some friends. Just use the "E.Tuner" program special option to tune MusiCalc to your friends' instruments and save your "tuning" with a name onto a disk. (See E.Tuner Feature Summary).

APPENDIX C: TRIPLETS

This concerns how to fit triplets into this time scheme. As you will see, the basic decision is whether to properly and exactly define the triplets, with the disadvantage of using up 3 times as much memory, or to "approximate" by distortion triplets, and not use up so much memory.

Example: If we say that a 16th note = 1 step and later decide that we want 16th note triplets, this means that we wish to have 3 equally-spaced notes that use up the same amount of time as would be normally used by 2 16th notes. In other words, we need to have 3 time slots in what is normally 2 time slots worth of time.

To properly "fit in" these triplets, we need to triple the smallness of each time unit, each step. That is, we need a step to equal ⅓ of a 16th note, whereas before 1 step equalled one 16th note.

By making time slots 3 times as small, we can now accommodate triplets as well as non-triplets. But in the process, we need 3 times as many steps, and thus are using up 3 times as much memory.

APPENDIX D: HOW TO FIX PROBLEMS

1. If you adjust the sound on the Synthesizer control panel and don't hear a sound, or lose a voice, it may be caused by:
   - turned off waveforms (no dots under tspn)
   - turned off gate (no dot under g in gsrt)
   - time too slow (squares not moving on score grid)
   - routed all voices into filter and didn't turn on any filter outputs
   - routed voices into filter and didn't adjust filter sliders right
   - selected incompatible combination of waveforms (usually only triangle and pulse waves can work together)
   - turned on test switches (dot under t in gsrt)
   - turned down volume on synthesizer
   - audio/video cable loose
   - forgot to turn up TV volume
   - some voices so loud, can't hear the softer voice
   - selected pulse waveform and pulse width slider course control is too high (all the way up) or too low (all the way down)

2. Program "crashes" and you see the "READY" on a blue screen.

   SOLUTION:

   Type RUN and press RETURN.

3. Program "crashes" and you see some graphic characters and strange information.

   SOLUTION:

   Turn power off and re-boot MusiCalc.

4. Program won't load.

   SOLUTION:

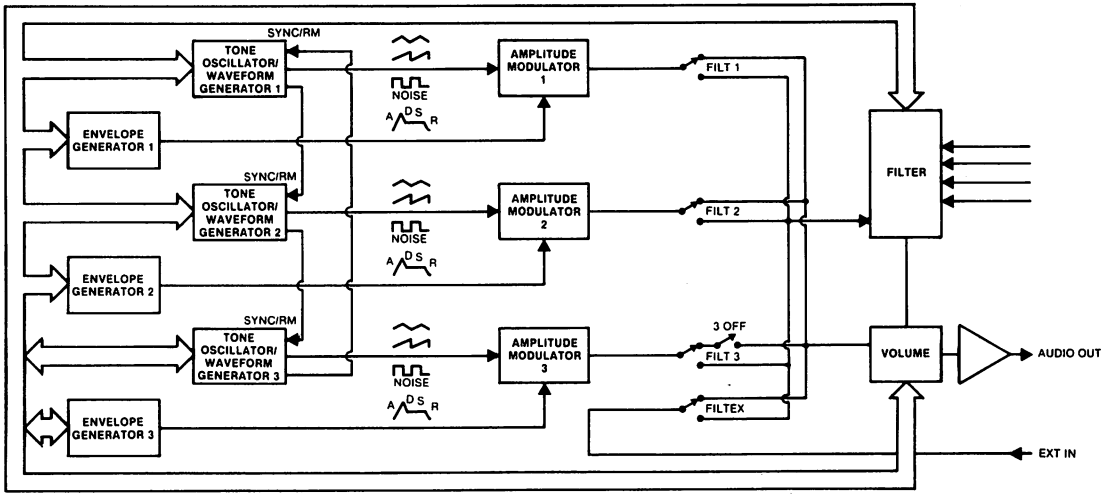
   Try again. You might have a defective disk drive. Make sure your other programs on other disks are loading O.K.

APPENDIX E: PROGRAMMER'S GUIDE

THE COMMODORE "SID" CHIP

The first thing you should know about the actual synthesizer of MusiCalc is that youve always had it inside your Commodore 64! It's called the SID chip, for Sound Interface Device. Essentially, it's a whole electronic music synthesizer on a chip, with the features of synthesizers costing over $1,000. MusiCalc tells the SID chip what to do.

It's easier to understand the MusiCalc synthesizer if you understand the structure of the SID chip. Below is a diagram of it:



MUSICALC CONTROL

It is possible to write your own external programs to work with MusiCalc. On your disk there is a program called "EXT," which is a skeleton to develop an external program.

There are two types of external programs: ones that allow the sequencer to continue running and ones that shut the sequencer off.

Line 100 of the program contains a REM statement. If the "REM" is removed, this line will shut the sequencer off. The two values poked to memory set the IRQ vector to $EA13. You can turn the sequencer back on by replacing those two values with their previous values which should be "peeked" and held in variables before line 100 replaces them.

Line 60010 determines how the main menu program will be re-entered. If a value of 0 is poked to 820 then the sequencer will be restarted (with this option there is no need for you to replace the values set on line 100 if you used line 100). If a value of 66 is poked to 820, then the main program will be re-entered with the assumption that the sequencer is still running.

Line 60000 is the exit point of the program. Your code should be placed between lines 100 and 60000.

MODULATOR FORMULA

$$X = (((\text{ENVELOPE \#3} \text{ or } \text{OSCILLATOR \#3}) + 2^N) + (A \times 16) + B) \text{ and } 255)$$

The result (X) is sent to the I/O Byte on the S.I.D. chip specified by the MOD #. This operation is the same for both the oscillator and envelope modulators.

N = fader "." (or "L")

A = fader "M" (or "J")

B = fader "," (or "K")

N is the index of modulation. 0 is the maximum and 8 is the minimum.

APPENDIX F: MUSICALC 2 AND MUSICALC 3

MUSICALC 2: Scorewriter

This program works in conjunction with MusiCalc 1 and lets you:

Turn your MusiCalc composition into standard music notation (sheet music). View your music on the screen or print it out.

Link MusiCalc 1 scores together to make songs as long as 7680 notes.

Synchronize MusiCalc 1 to other MusiCalc 1 systems, drum machines, and various sound effects devices such as echo machines. Cable instructions are provided in the MusiCalc 2: Scorewriter instructions.

MUSICALC 3: Keyboard Maker

This program works in conjunction with MusiCalc 1 and lets you:

Customize the Commodore 64's ASCII keyboard to play your own scales.

Transpose, combine and move keyboard scales.

Choose from 80 different scales from around the world. These scales are included with MusiCalc 3.

NOTES

MUSICALC 1

COMMAND SUMMARY

THE 3 MOST IMPORTANT CONTROLS

↑	to MusiCalc Panel
SHIFT/RETURN	to Main Menu
RETURN	to escape any menu selection to get to Main Panel.

SCORE MODE

Which row?	1 through 15
Shift/↑	Pages up through score Rows 1,2,3...
C=/↑	Pages down through score Rows 5,4,3...
CRSR←→	Moves score step select to right
CRSR↑↓	Moves score step select to left
f1	Note up selection (highest diamond indicates note)
f7	Note down selection (highest diamond indicates note)
f3	Octave up selection (highest asterisk indicates octave)
f5	Octave down selection (highest asterisk indicates octave)
Space Bar	Envelope latch ( ) Select on

MUSICALC PANEL SYNTHESIZER

CRSR←→	Sliders mode
CRSR↑↓	Switches mode
SLIDER ADJUSTMENTS	
f1	Slide up (turn "up")
f3	Slider step up
f5	Slider step down
f7	Slide down
STOP AND START VOICES	
SHIFT/1	Voice 1 START
SHIFT/2	Voice 2 START
SHIFT/3	Voice 3 START
SHIFT/4	All voices START
SHIFT/Q	Voice 1 STOP
SHIFT/W	Voice 2 STOP
SHIFT/E	Voice 3 STOP
SHIFT/R	All voices STOP
RESETS	
SHIFT/Z	Voice 1 RESTART
SHIFT/X	Voice 2 RESTART
SHIFT/C	Voice 3 RESTART
SHIFT/V	All voices RESTART
TRANSPOSERS	
SHIFT/0	Voice 1 transpose UP
SHIFT/+	Voice 2 transpose UP
SHIFT/-	Voice 3 transpose UP
SHIFT/P	Voice 1 transpose DOWN
SHIFT/@	Voice 2 transpose DOWN
SHIFT/*	Voice 3 transpose DOWN
MODULATORS	
CRSR←→ Space Bar	Modulators on/off (sliders must be selected)
SHIFT/J	Oscillator modulator select UP
SHIFT/M	Oscillator modulator select DOWN
SHIFT/K	Envelope modulator select UP
SHIFT/<	Envelope modulator select DOWN

SYNTHESIZER SLIDER SELECTION CONTROLS

1	Attack Voice 1
2	Decay Voice 1
3	Sustain Voice 1
4	Release Voice 1
5	Attack Voice 2

6	Decay Voice 2
7	Sustain Voice 2
8	Release Voice 2
9	Attack Voice 3
0	Decay Voice 3
+	Sustain Voice 3
-	Release voice 3
Q	Pulse width coarse Voice 1
W	Pulse width medium Voice 1
E	Pulse width fine Voice 1
T	Pulse width coarse Voice 2
Y	Pulse width medium Voice 2
U	Pulse width fine Voice 2
O	Pulse width coarse Voice 3
P	Pule width medium Voice 3
@	Pulse width fine Voice 3
A	Filter—Center Frequency coarse
S	Filter—Center Frequency medium
D	Filter—Center Frequency fine
F	Resonance "Q"
G	Overall volume
Z	Attack overall coarse
X	Attack overall fine
C	Decay overall coarse
W	Decay overall fine
B	Tempo overall
J	Osc. modulator number coarse gain
K	Osc. modulator number fine gain
L	Osc. moculator overall gain
M	Envelope modulator number coarse gain
<	Envelope modulator number fine gain
>	Envelope modulator overall gain

SYNTHESIZER SWITCH SELECTION CONTROLS

f3	Select on/off
1	Triangle wave Voice 1
2	Square wave Voice 1
3	Pulse wave Voice 1
4	Noise Voice 1
5	Triangle wave Voice 2
6	Square wave Voice 2
7	Pulse wave Voice 2
8	Noise Voice 2
9	Triangle wave Voice 3
0	Square wave Voice 3
+	Pulse wave Voice 3
-	Noise Voice 3
Q	Gate Voice 1
W	Sync. Voice 1
E	Ring modulator Voice 1
R	Test Voice 1
T	Gate Voice 2
Y	Sync. Voice 2
U	Ring modulator Voice 2
I	Test Voice 2
0	Gate Voice 3
P	Sync. Voice 3
@	Ring modulator Voice 3
*	Test Voice 3
Z	Low pass filter
X	Band pass filter

C	High pass filter
V	Disable vilter
B	Voice 1 to filter
N	Voice 2 to filter
M	Voice 3 to filter
<	External input to filter

EXTERNAL PROGRAMS

E.DOS	Keep files in order
E.TUNER	Tune up with friends and records
E.LINKS	Re-arrange your links at random
E.TRANS	Transpose a score up or down in octaves
E.AUTO	Demo automatic sound/score player
E.#	Merge individual sound and scores into a preset file.
E.BOLT	Demonstrates how to write a program to customize the MusiCalc Panel.
E.BLAST	Demonstrates how to write a program to work with MusiCalc while MusiCalc is playing.
E.BLASTER	Demonstrates how to write a program to work with MusiCalc but turn off MusiCalc's sound.

MUSIC PRODUCTS DIVISION

MAKING MUSIC PLAY

1912 Bonita Way, Berkeley, CA 94704