Mockingboard, ALF,
and Super-Music
Synthesizer Compatible

PHASOR

Advanced Stereo Sound
Expansion Card

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Since 2005

OWNER'S MANUAL

PHASOR

Advanced Stereo Sound Expansion Card

Manual v1.2 10/04/2024

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Prepare to be blown away by your Apple.™

PHASOR - For the thunderous, booming power you so desperately need!

Phasor is a complete high performance stereo music, sound and speech synthesizer for the Apple IIe and II+. Phasor offers 12 musical and sound effects voices (channels) and 4 white noise generators for percussive sounds. Phasor also gives your Apple the power of uncanny speech, with its unlimited vocabulary speech synthesizer.

What makes Phasor so desirable is not just that it offers the very best in both sound and speech, but the fact that Phasor automatically enhances and is recognized by more off the shelf hardware than any other sound card. Phasor works with ANY program that works with ANY sound card. Programs written for the Mockingboard™, the ALF music card, Synphonix™ and the Super Music Synthesizer actually sound better on Phasor. In fact, Phasor has twice the accuracy and 4 times the output power of the nearest competitor. Phasor adds exciting pulse pounding sound to all of the better games like Skyfox, Under Fire, Willy Byte, Tactical Armor Command, Maze Craze, Zaxxon, Ultima IV; to name a few. Educational software like music construction set. Guitar Master and Music Star are greatly enhanced by Phasor's power. And a complete long list of compatible software is included with each Phasor.
But even if you don't own any software, Phasor comes with a ton of entering and educational software that will let you enjoy Phasor for a long, long time. Phasor is an astonishing peripheral card that generates explosive sound effects, vibrant music and excellent speech from your Apple. It adds a new educational dimension of exciting sounds to games, educational programs, music programs and programs you create yourself.

FEATURES

- Three sound cards in one that is fully compatible with the MOCKINGBOARD, ALF, and Super-Music Synthesizer but with many enhanced capabilities.

- 12 simultaneous sound channels, 4 white noise generators, 1 voice channel expandable to 2 voices.

- Easy to use "COMPOSE" software. You'll start right away at inputting your favorite songs. Our manual shows you how, step by step. The Hi-Res screen shows what you've entered in standard sheet music format.

- Included Software: Music Editor, Sound Effects Editor, Text to Speech, and over 30 songs and sound effects ready to run, not copy protected! ProDos based.

- Easy to program in Basic to generate speech and complex sound effects. Now your games can have explosions, phasor zaps, train whistles, death cries. You name it, this card can do it.

- Unlimited vocabulary voice.

- Simple commands adjust rate of speech, pitch, volume and more.

- Powerful 4 watt stereo amplifier for direct connection to any size speakers.

- Requires Apple II+, //e or IIGS (64K minimum) with one disk drive or disk image compatible device.

- Software is RAM based when used with any standard RAM card for ultra-fast operation.

- Re-designed by Henry S. Courbris

WARNING: ReActiveMicro.com will not be responsible for shattered windows, cracks in plaster, or government personnel mistakenly thinking an alien attack is taking place in your neighborhood. Keep them volume controls at an appropriate level. Thank you.

PART 1
GETTING STARTED

INTRODUCTION

About this Manual...

This manual was written for users (like us) who want to jump right in and use the Phasor, but don't like to read lengthy instructions.

Part 1... Getting Started. It tells you how to install the Phasor in your computer and then how to use the music, speech, and sound effect demonstration programs provided on the Phasor Program disk which can be downloaded as a .DSK image file from ReActiveMicro.com, there are 4 disks in total.

Part 2...Getting Serious, explains how to create your own music, sound effects, or speech files.

We hope you have as much fun using the Phasor as we had developing it!

Installing and Testing the Phasor

Before you begin...

Download the disk image files .DSK for the Phasor from ReActiveMicro.com, the Phasor Program is on is on disk 1. The other disk images contain synthesized music selections.

Here's what you need to use your Phasor...

Essential Equipment

- One of the following computer systems, capable of running ProDOS:
    - Apple IIGS, Apple //e (Standard or Enhanced)
    - Franklin Ace 2000 series
    - Laser 128
    - Apple II+ or Franklin Ace 1000 series with:
        - Applesoft BASIC in ROM
        - 48K of RAM on the main board
        - 16K Language Card RAM
- Game paddles
- One disk drive or disk image compatible device (ex: CFFA 3000)
- Video monitor

Optional equipment

- Videx compatible 80 column text card and monitor capable of 80 column text display.
- RamWorks Memory Expansion card. (Apple //e only.) RamWorks also functions as an 80 column card and can optionally allow the entire Phasor Program and Songs disk to be loaded to and run from a high-speed RAMdisk.
- TransWarp Accelerator card. Creating your own music with the COMPOSE music editor program is appreciably faster at TransWarp speed.
- Game Paddles (Joysticks won't do.) Game paddles are supported by the COMPOSE music editor and speech synthesis programs, which are explained in Part 2 of this manual.

Installation Procedure

Step 1: Set the switches

Locate the option switch block on the Phasor card. See Figure 1. The Phasor is shipped from the factory with all four switches set to the CLOSED position. This is called "Phasor Mode."

Figure 1: Phasor controls and stereo sound mini jack
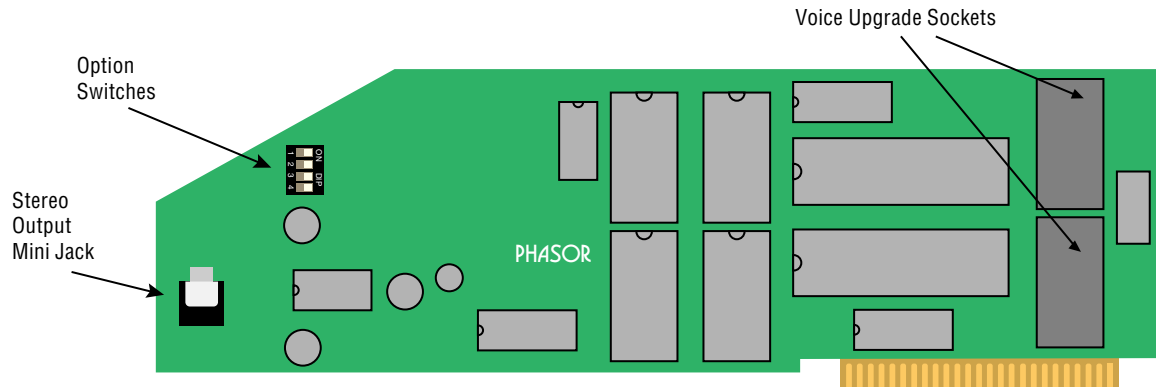
To change a switch setting, slide the rocker switch by pressing up on the small raised portion of the dip switch, just as you would a up an down type household light switch. Sliding the switch in at the end nearest the word "OPEN" will open the switch or turn it OFF. The switch can be moved to the CLOSED or ON position by pressing in at the end nearest the row of numbers on the switch block. Never use a pen or pencil to change a switch setting. Use a small pointed object like a wooden toothpick or bent-out paper clip.

Figure 2: Phasor option switches
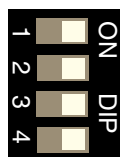
Mode Selection

Switch 1:	CLOSED	Software selectable mode. The Phasor mode.
	OPEN	Hardware mode selection. The actual mode is determined by the position of switch 2.
Switch 2:	OPEN	Echo+ mode.
	CLOSED	MOCKINGBOARD mode.
Switch 3:		Not used.
Switch 4:		Not used.

Step 2: Set the Phasor volume level

A safe volume level is already set on the card by default.

Step 3: Install the Phasor in the computer

Turn the computer's power OFF and plug the Phasor into any expansion slot except slot 3. If you will be running MOCKINGBOARD-compatible music programs, install the Phasor in slot 4.

Step 4: Connect the Phasor output

Phasor's 4 watt stereo amplifier is capable of driving most speaker systems directly. If you really want to disrupt your neighborhood, you can connect the Phasor's output directly to your stereo amplifier's auxiliary inputs. For privacy, stereo headphones can be connected directly to the Phasor's output mini jack.

The Output audio connection is located on the keyboard end of the Phasor. Speakers and headphones should not have an impedence rating lower than 8 ohms. If you connect directly to a stereo amplifier, use the amplifier's AUXiliary, TAPE, or TUNER inputs. DO NOT use the PHONO inputs.

Step 5: Configure the Phasor Program disk

Boot the write-enabled backup copy of the Phasor Program disk. The Phasor startup program will search for an installed Phasor and display this message:

Phasor is configured for' slot X with music graphics enabled.

(X represents the Phasor's slot.)

Enter Y if the statement is correct. If your Phasor is in another slot, answer N and enter the correct slot number. To enable or disable the graphics option, answer Y or N to the prompt:

Graphics during play?

The graphics display gives your eyes something to do while your ears are enjoying the music. It has no effect on the music.

Whenever this disk is booted, it will expect the Phasor to be installed in the configured slot. If it is not, it will find the Phasor and ask you to confirm the configuration again. You can also change the configuration at any time by selecting the main menu option, "Change Phasor Slot."

Step 6: Test the Phasor

NOTE: The Escape key is the Phasor Program's panic button. Pressing the Escape key anywhere in the program will return to the previous menu.

Phasor Music Player:

Make sure the Phasor's volume controls are turned all the way down. (Fully counterclockwise.) Select option 1 (Music Programs) from the Phasor Program disk's main menu, then select option 1 (Phasor Music Player) from the music menu. Allow the program to load and display the catalog of songs from the disk. Choose one (or all) of the selections. Adjust the Phasor's volume controls (and the amplifier's, if applicable) as the music is playing.

If your Phasor is connected to an amplifier and the sound is distorted or becomes very loud when the Phasor volume controls are increased only slightly, it is likely that the Phasor's output and the amplifier's input are not properly matched. Weak output at higher volume levels could also indicate mismatched impedances. Try another set of input ports on the amplifier and make sure to set the amplifier's input selector control to the appropriate ports. If you get no output at higher volume (Phasor and amplifier combined), connect the Phasor outputs directly to the speakers and check again.

To load the selections from the Phasor Songs disk, select the *"I"* command, insert the copy of the backside of the Phasor Program disk, enter "/SONGS", and press Return. When playing musical selections with the Phasor Music Player, the right-arrow key is the fast-forward button. Press any other key to resume playing at normal speed. When playing any selections, the Escape key will stop the current selection and begin the next. Pressing the Escape key twice will cause the program to exit to the Phasor music menu.

Speech demonstrations:

Use the Escape key to return to the Phasor Program's main menu. Select option 2 (Speech Programs). Then select option 1 (Dr. Fay Zor's Advice) from the speech menu. The Phasor will speak only from channel B.

After you've had enough advice, press the Escape key and select option 2 (Talking Keyboard). Experiment. The Phasor will attempt to say anything you type on the keyboard. If a particular word doesn't sound just right, try a different (phonetic) spelling. When you're finished, just press the Escape key. If you have a TimeMaster II H.O. Clock card in your computer, try the Talking Clock option.

Sound effects demonstration:

From the Phasor main menu, select option 3 (Sound Effects Programs), then option 1 (Sound Effects Demo) from the Sound Effects menu. Be prepared to dodge bullets and low-flying space ships!

What's next...

This concludes Part 1 of this manual. It has given you a brief introduction to the Phasor and the Phasor Program disk. Part 2... *Getting Serious* tells you how to create your own music, access the speech synthesizer through BASIC programs, and make your own sound effects.

PART 2
GETTING SERIOUS

INTRODUCTION

Part 1... *Getting Started* gave you an introduction to the Phasor's music, speech, and sound synthesis capabilities. The information contained in Part 2... *Getting Serious* explains how to create your own music, speech, and sound-effects files.

COMPOSE Music Editor

The instructions for playing music were covered in *Getting Started.* This section explains how to use the COMPOSE music editor to edit and create Phasor songs files.

Don't worry; you don't have to be a composer or musician to use the COMPOSE music editor. Even a non-musician will be able to create a Phasor music file by copying notes from a page of sheet music, but trying to learn everything at once can be very confusing and frustrating. Don't rush. Take it one step at a time. First, read Exploring COMPOSE —become familiar with the basic operation of the music editor. Then, read the next section, COMPOSE Commands, to learn more about the more advanced features and commands. After just a few minutes of practice, you will be able to use COMPOSE to create your own Phasor music files.

What you need...

All that is required to use the COMPOSE editor on an Apple //e, IIGS, Laser 128, or Franklin ACE 2000 system is a Phasor correctly installed. If you are using an Apple IIplus, you will need a set of game paddles.

Only use a backup copy of the Phasor program disk! Keep your original in a safe place. While you're at it, format a couple of data disks to store your musical creations! (ProDOS format.)

Exploring COMPOSE

The COMPOSE program is entered by selecting the "Compose Music Editor" option of the Phasor Music Menu. The first screen displayed is a HELP screen, the KEYBOARD COMMAND TABLE, shown in Figure 5. This same help screen will be re-displayed any time a non-valid keyboard entry is made. These commands will be described in detail in the *Entering COMPOSE Keyboard Commands* section. Pressing the spacebar will display the COMPOSE Edit Screen, shown in Figure 3.

Figure 3: COMPOSE Edit Screen

Edit Cursor   Command Ticks   Option Window   Mode Indicators

Music Score

Edit Staff

Command Input

Status Lines
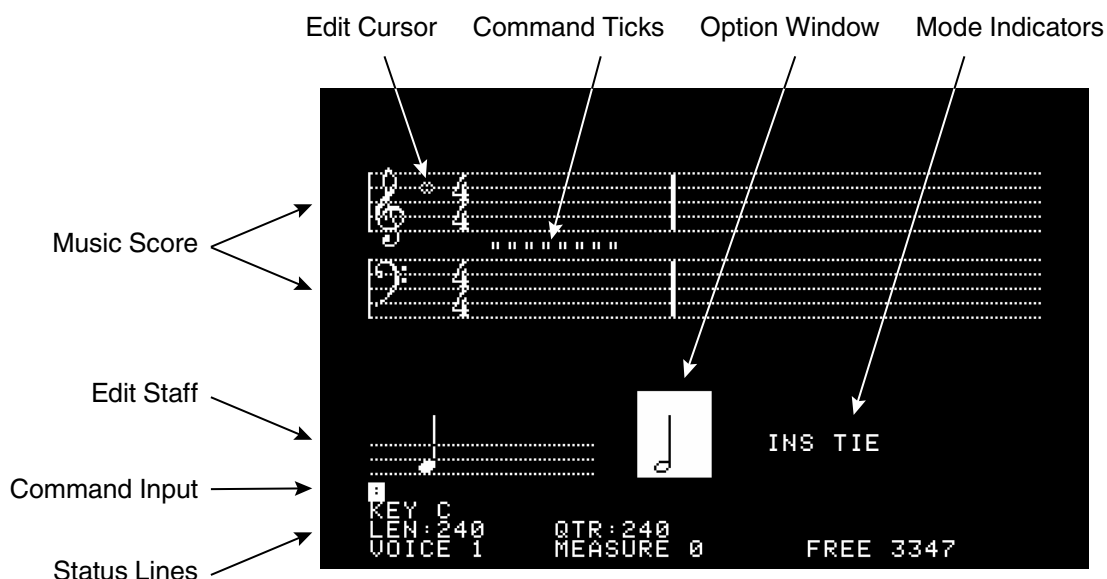
Edit Screen Symbols:

Music Score   Displays the musical score for the selected voice as it will be played.

Edit Cursor   Used to select the position of a note or command along the score and the pitch of a note to be entered.

Command Ticks   Indicates that there are COMPOSE commands in the Music Score. The Key and Time signatures are also Command Ticks, but are displayed in standard musical notation. The command represented by a Command Tick can be displayed by using the Current Command Indicator. (See next page.)

Edit Staff   Allows the selected note, tied notes, rests, or triplets to be displayed before being entered to the score.

Option Window   Used to select the desired note length, accidental (sharp, flat, or natural), or edit mode.

Edit Mode Indicators

INS   Insert mode active. Notes entered to score will be inserted immediately to the left of the current Edit Cursor position.

TIE   Tied note mode is active. Notes (and rests) entered to the Edit Staff will be tied.

♭ ♯ ♮   Accidentals are indicated by the appropriate symbol. (sham, flat, or natural)

Speaker symbol: Edit speaker active. Causes each note (of the current voice) to be sounded as the Edit Cursor is moved forward (right) across it.

Keyboard Command Input Line (flashing colon prompt)

Allows special COMPOSE keyboard commands to be entered. These commands are summarized in the KEYBOARD COMMAND TABLE and desribed in the COMPOSE commands section.

Edit Screen Status Lines:

Current Command Indicator

Identifies the note or command associated with the current Edit Cursor position.

If the Edit Cursor is positioned at a command tick, the command name will be displayed, followed by its assigned argument values and variables. Rests are indicated by the word REST and the length of the rest. Notes are indicated as in this example:

```
NOTE BN2 120
```

In this example, "NOTE" indicates that the Edit Cursor is currently positioned at a note. "BN2" indicates that the current note is a B natural and is in the second octave. Octaves are numbered from 0 to 4, Bass to Treble. The length of the current note is 120.

LEN: Indicates the length of the note, or tied notes, currently shown on the Edit Staff. If the Edit Cursor is used to select a rest, LEN: will display the length of the rest and the corresponding rest symbol(s) will be shown on the Edit Staff.

QTR: Indicates the length of a quarter note. The COMPOSE program calculates all notes and rests from the assigned length of the quarter note.

VOICE: Indicates which voice or subroutine is currently shown on the Music Score.

MEASURE: Measures of the Music Score are numbered beginning with measure 0. The end of the last measure in a voice is indicated by the Current Command Indicator message, STOP." In the highest numbered voice, the end of the last measure is indicated by "END." (The Music Player will stop if it encounters an END.)

FREE: Indicates the number of available entries (commands or notes) remaining. Each COMPOSE Music file can contain up to 3,357 entries.

COMPOSE Editor Controls

Here is a quick summary of the basic COMPOSE Music Editor controls:

Function	Command key
Scroll the Options Window selections	Left and Right caret (<or>) Keys (upper or lower case)or Game Paddle 0
Move Edit Cursor up or down	Up and Down Arrows or Game Paddle 1
Move Edit Cursor left or right	Left and Right Arrows
Select Option Window item	Open-Apple Key or Game Button 0
Transfer from Edit Staff to the Music Score	Closed-Apple Key or Game Button 1
Advance one measure at a time Advances are made to the first NOTE to be played (not command) in a measure.	TAB (Apple II+ users: TAB = CTRL-I)

Entering Notes

IMPORTANT: Before entering any notes into a new music file, move the Edit Cursor past the default Command Ticks. Use the TAB key or Right Arrow key to advance to the first note in Measure 0.

First, move the Edit Cursor to the desired position in the Music Score. In a NEW music file, this is MEASURE 0. Next, scroll through the Option Window until the desired note is displayed. Press the Open Apple key to enter the note onto the Edit Staff. Finally, move the Edit Cursor to the desired pitch and press the Closed Apple key to enter the selected note to the Music Score.

Triplet notes are indicated by a "3" above the note or rest. Any note or rest marked as a triplet will be played for two-thirds of its normal length.

Tied Notes can be created by entering a note of a specified length, activating the TIE mode from the Options Window, and entering the subsequent note or notes to the Edit Staff. When the length of a note exceeds the count for a given measure, it is automatically converted to tied notes and extended to the next measure.

Accidentals are entered by using the Open Apple key to select the desired accidental from the Option Window. Until the Accidental Mode is deactivated or changed, any subsequent note entered will be affected. (An accidental is a sharp, flat, or natural not indicated in the key signature.)

Rests are entered by selecting the desired length note from the Option Window and moving the Edit Cursor all the way up or down. As the Edit Cursor moves past the highest or lowest pitch on the Music Staff it jumps to the rest position and the rest symbol is displayed on the Edit Staff. Pressing the Closed Apple key while the Edit Cursor is in the Rest position will enter the Rest from the Edit Staff to the Music Score.

Inserting a forgotten note or command is done by turning on the Insert Mode. The Insert Mode is toggled (turned on or off) by selecting INS from the Options Window. In the normal mode, notes entered from the Edit Staff replace the command or note at the current Edit Cursor position. In the Insert Mode, notes entered from the Edit Staff are inserted one position before the note or command at the current Edit Cursor position.

Deleting a Note (or command) from the Music Score is accomplished by moving the Edit Cursor to the desired note or command position, selecting DEL from the Options Window, and pressing the Closed-Apple key.

Figure 4: Single Key Shortcuts

Edit Cursor UP	Up Arrow or CTRL- K
Edit Cursor DOWN	Down Arrow or CTRL- J
Edit Cursor RIGHT one space	Right Arrow
Edit Cursor LEFT one space	Left Arrow
Voice 1 through 9	Keys 1 through 9
Voice 10	0 key (zero)
Voice 11	- key (hyphen)
Voice 12	= key (equal sign)
Scroll Option Window FORWARD	. or>
Scroll Option Window BACKWARD	, or<
Select Option Window character	Open-Apple key or Paddle Button 0
Enter Note or Rest	Closed-Apple key or Paddle Button 1
Insert mode toggle ON/OFF	I or i
Delete current position	Delete key or CTRL- D
Next measure	TAB or CTRL- I
Quit, Cancel Keyboard Command	ESC key
Help Screen	? or any undefined Control Key

These single-key commands are summarized on the COMPOSE Keyboard Command Table (Figure 5) as "Keys."

Entering COMPOSE Keyboard Commands

This section describes the three groups of keyboard commands: Operating System Commands, Editing Commands, and Note Envelope Commands.

The keyboard commands can be entered at any point and in any voice within the Music Score. You only need to enter the first three characters of a command, followed by a space, the command argument, and a carriage return. The space following the command is usually required, even if an argument is not needed. When the first three characters of the command are entered and the spacebar is pressed, the remaining letters of the command are automatically added in the Keyboard Command Line. The command argument, if required, can then be entered. If a typing error is made while entering a command, use the left or right arrow key to edit the entry or press the ESC key to clear the entry completely.

Pressing the ? key or any other non-valid command will display the Keyboard Command Table help screen. This help screen is shown in Figure 5. For your convenience, the valid ranges for all keyboard commands described in this section are summarized in Figure 6. This information is also provided on the Phasor Program disk in a text file which can be printed using a ProDOS-based word processor program (e.g. AppleWorks or AppleWriter // 2.0).

Figure 5: COMPOSE Keyboard Command Table

KEYBOARD COMMAND TABLE

NOTE: In the command descriptions which follow on pages 13-20, brackets {} are used to identify required argument data. Argument data enclosed by parentheses () is optional. A Return key entry is shown by a <cr>. Remember that a space between the command and its argument is important. For clarity, a spacebar character (space) is indicated by a — (underline) in the following command examples.

```
                                 125,000,000
              Tempo value = ----------------------------
                              Beat rate x Quarter value
```

Figure 6: Valid Ranges for COMPOSE Keyboard Commands

Command	Range	Default
PRE(fix)	ProDOS pathname	Same as COMPOSE program
CAT(alog)	ProDOS directory	Same as COMPOSE program
LOA(d)	ProDOS pathname/filename or =	
SAV(e)	ProDOS pathname/filename or =	
	(required data) (optional data)	
PLA(y)		
QUI(t)		
NEW		
KEY	{C}or (1 ...7F or 1...7S)	Key of C
TIM(e)	{1...19/1...16}	4/4
TEM(po)	{1...65535}	4096
MEA(sure)	{0...65535}	
ED 1(t)		
VOI(ce)	{1...12}	1
POS(ition)	{*Twelve voice positions*}	123412341P2P3P4P
DEL(ete)	{1...65535}	
TRA(nspose)	{-127...0...+127}	0
SUB(routine)	{0...127}	1...sequential, step 1
CAL(l)	{1...127}	
QUA(rter)	{1...65535}	240
LEN(gth)	{1...65535}	240
SPE(ed)	{1...65535)(/1...65535)(1...127)(-2...127){S or V}	no default value
ATT(ack)	{1...65535}	8192
VOL(ume)	{1...65535}	55000
DEC(ay)	{1...65535}	25
SUS(tain)	{0.. .65535}	0
GAP	{1...65535}	20
REL(ease)	{1...65535}	65500
PER(cussion)	(ON or OFF)	OFF

Operating System (ProDOS) Commands

PREFIX   Sets or displays the current ProDOS prefix.

PRE(fix)_(prefix)<cr> Depending on the optional argument, this command can be used to set or display the current ProDOS prefix only for Phasor music files. The normal (default) music file prefix is the same as the COMPOSE program prefix. This command affects only the music file prefix; it does not alter the COMPOSE program prefix. The prefix entered as the command argument must be a valid ProDOS pathname. If no leading slash (/) delimiter is used, the prefix will be appended to the existing prefix.

The current music prefix can be displayed only if it is different from the default prefix. To display the current prefix, enter the command followed by a space. Be careful! Not entering a command argument and pressing Return or the spacebar will clear the current music prefix and reset the default music prefix. If you do not wish to change or clear the prefix, press the ESC key to cancel the command.

CATALOG   List a disk directory

CAT(alog)_(prefix)<cr> The prefix or ProDOS pathname entered as the command argument determines the directory to be listed. If no argument is specified, the currently-prefixed directory is cataloged.

LOAD   Load a Phasor music file from a ProDOS device (disk).

LOA(d){filename, pathname, or =}<cr> Loads the file specified by the filename or ProDOS pathname into the COMPOSE music editor. If only a filename is entered (no beginning slash), the file is loaded from the currently-prefixed directory.

If the command argument is a filename or partial pathname residing under the current prefix, you do not need to enter a leading slash. Remember, slashes are required between elements of a partial pathname. A complete ProDOS pathname must begin with a slash.

The equal sign (=) can be entered as the command argument to reload the last file loaded or saved.

SAVE   Save a Phasor music file to a ProDOS device (disk).

SAV(e){filename, pathname, or =)<cr> Saves the music file under the filename or pathname specified in the command argument. The rules for the SAVe command argument are the same as for the LOAd command.

COMPOSE Editing Commands

PLAY   Play the Phasor music file.

PLA(y)<cr> No command argument is allowed. The file currently in memory will be played from beginning to end or until the ESC key is pressed.

QUIT   Quit and exit COMPOSE Music Editor.

QUI(t)<cr> No space is required and no command argument is allowed. You will be prompted to enter Y (yes) or N (no) to confirm.

NEW   Open a new Phasor music score.

NEW<cr> No command argument is allowed. A confirmation prompt will appear below the Edit Staff. Answering Y will clear the current music file and create a blank score with the default commands listed below. Remember that the commands are represented by the Command Ticks between the staves of the Music Score.

Figure 7: New File Command Defaults

```
Voice                 1
Measure               Ø

Key                   C (no flats or sharps)
Time                  4/4
Quarter note length 24Ø
Transpose             Ø
Attack                8192
Volume                55ØØØ
Decay                 25
Sustain               Ø
Gap                   2Ø
Release               655ØØ
```

KEY   Set the present key signature of the Music Score.

KEY (nF or nS)<cr> This command will set the key signature at the current Edit Cursor position for only the current voice. The n variable in the command argument represents the number of sharps (5) or flats (F) to be entered. For example, the argument for the key of E flat major would be entered as 3F. If the Return key is pressed with no command argument, the key signature will be changed to C, no sharps or flats. The key signature can be changed at any point in the Music Score. Cancelled sharps or flats from the preceding key signature will be indicated by naturals on the music score.

The key signatures and their command arguments are provided in Figure 8.

Figure 8: Key Signatures

```
G major / E minor               1S
D major / B minor               2S
A major / F sharp minor         3S
E major / C sharp minor         4S
B major / G sharp minor         5S
F sharp major / D sharp minor 6S
C sharp major / A sharp minor 7S

F major / D minor               1F
B flat major / G minor          2F
E flat major / C minor          3S
A flat major / F minor          4S
D flat major / B flat minor     5S
G flat major / E flat minor     6S
C flat major / A flat minor     7S
```

TIME   Set the present time signature on the Music Score.

TIM(e){1...19/1...16}<cr> This command will set the time signature at the current Edit Cursor position for only the current voice. The time signature can be changed at any point in the Music Score. The first number of the argument sets the number of

beats per measure (the top number in the time signature), and the second number determines which note gets one beat.

As shown in Measure 0 of a new Music Score, the default time signature is 4/4. This indicates that there are four beats per measure (the top number) and a quarter note (the bottom number) gets one beat.

TEMPO   Set the number of beats per minute.

TEM(po){1 ...65535}<cr>. This command sets the beat rate for all voices! The tempo can be entered in any active voice; however, for consistency, it is recommended that you use only voice 1. Any value between 1 and 65,535 can be entered as the command argument to set the beat rate (beats per minute). The TEMPO value required to set a specific rate can be calculated with this formula:

$$\text{Tempo value} = \frac{125{,}000{,}000}{\text{Beat rate} \times \text{Quarter value}}$$

If your wish to calculate the Beat Rate for a known TEMPO value:

$$\text{Beat rate} = \frac{125{,}000{,}000}{\text{Tempo value} \times \text{Quarter value}}$$

NOTICE: The TEMPO command is not absolutely required. If no tempo is defined, the PLAY program assumes a TEMPO value of 4096.

MEASURE   Move to a specified measure of the current voice.

MEA(sure)_{0...65535} <cr> The Edit Cursor will be moved to the first note or rest of the measure specified in the command argument. If you wish to edit Command Ticks in the target measure, use the left and right arrow keys to position the Edit Cursor. Measure 0 is the first measure. An argument value greater than the number of measures in the current voice will move the Edit Cursor to the last measure.

When beginning a new Music Score, first enter the MEA 0 command to move the Edit cursor past the initial Command Ticks.

EDIT   Set the number of voices and enter the music file title block.

EDI(t)<cr> No space is required and no command argument is allowed. When entered, this command will first prompt you for the number of voices. Voices can be added but not deleted from existing music files. Enter the desired number, between 1 and 12. You will then be prompted to enter the first, second, third, and fourth title lines. These title lines will appear in the lower portion of the screen when the music is played.

When you edit a previously entered title line, any characters entered will replace existing characters, and any remaining characters to the left of the cursor will be

removed when the Return key is pressed. The right and left arrow keys can be used to position the cursor without affecting entered text. Leading spaces can be used to center the title lines on the screen.

VOICE   Select and display the specified voice on the Music Score.

VOI(ce)_(1...12)<cr> The Edit Cursor will be moved to the first entry measure 0 of the voice specified in the command argument.

The default number of voices in a new music file is one. Before additional voices can be addressed by this command, use the EDIT command to set the number of voices allowed.

POSITION   Specify voice channels and percussion voices.

POS(ition)_(123412341P2P3P4P)<cr> Looks confusing, doesn't it? It's not, really. The POSition command allows you to specify which voices are to be played by channel A and which are to be played by channel B.

The Phasor uses four integrated circuit devices (chips) to generate the twelve possible musical voices. Each of these chips is capable of synthesizing three voices, one of which can be a percussive voice. These chips are designated 1,2,3, and 4. Chips 2 and 4 generate Channel A voices; 1 and 3 generate Channel B voices.

The POSition command argument is actually a code list used to specify which of the available voices are assigned to a given chip. Each position in the code list represents a voice, beginning with voice 1. The position of a chip number in the code list determines the chip assignment for the corresponding voice. The default code list for a full twelve voices, also shown in the syntax example, is 123412341 P2P3P4P. The first position in the default list corresponds to voice 1; therefore, the value of 1 at this position assigns voice 1 to chip 1. Output will be to Channel B. Position 8 in the list contains a 4. This assigns voice 8 to chip 4. Chip 4 output is to Channel A. Position 11 of this (default) code list contains a 3P. This means that voice 11 is assigned to chip 3 and can be used as a percussive voice. (See also: PERcussion command description.)

Chip assignments within the code list argument can be in any order. The number of voices (created by the EDIt command) determines the maximum number of code list positions. If the POSition command is used to define only the first three positions of six possible voices, the remaining three voices will be added in default-position order. If an error is made in entering a code, press the ESC key and re-enter the command and argument.

The POSition command displays the position code list currently in effect. DO NOT enter a space and a carriage return, unless you want to reset the code list to the default order! Press the ESC key to cancel the command.

DELETE   Delete commands or notes.

DEL(ete)_{1 . .65535}<cr> This command is used to delete a string of commands, notes, or rests from the current voice. The number of entries deleted is determined by the value of the command argument. The specified number of entries will be deleted, starting at the current Edit Cursor position, until the end of the voice or subroutine.

TRANSPOSE   Raise or lower the pitch of a note or notes.

TRA(nspose)_{-127...O...+127}<cr> When played, the pitch of any notes following this command in the current voice will be increased or decreased by the number of quarter-steps specified in the command argument. A transposed pitch will always be relative to the pitch indicated on the Music Score. For example, a high-C to be transposed one octave down (middle-C) would require an argument value of -24. An argument of zero will reset the pitch of subsequent notes to their indicated pitch.

CAUTION: The pitch accuracy of notes transposed beyond one or two octaves above or below the range of the Edit Cursor may become unacceptable. Pitch accuracy two octaves above the high end of the scale diminishes quickly.

SUBROUTINE   Create or display a music or command phrase.

SUB(routine)_(1...127)<cr> A subroutine can be a set or a combination of notes, rests, or commands which can be called at any point in a given voice or voices. See the CALL command description for an explanation of how to call a subroutine. A subroutine is very similar to a voice, except that a subroutine can be called by one or more voices at the same time. Since the size of a COMPOSE music file is limited to 3,357 entries, subroutines are an excellent way to conserve file space. Subroutines are useful for playing musical passages which are repeated often. They can also be used to define special Note Envelope Parameters, which are described later in this section. Unlike a voice, a newly-created subroutine does not contain any default commands.

To create a new subroutine, enter the SUBroutine command without a command argument. Subroutine numbers are assigned automatically and sequentially. When a subroutine is displayed on the Music Score, the Voice: (number) message displayed at the bottom of the Edit Screen is replaced by a <SUB>: (number) message. Enter and edit the subroutine just as if it were another voice. All subroutines, like voices, become a permanent part of the music file. Once created, subroutines cannot be deleted. Their contents can be edited or completely deleted, but the subroutine number remains valid. The end of a subroutine is identified by a RETURN message in the Current Command Indicator line.

To display a previously-created subroutine on the Music Score, enter its subroutine number as the SUBroutine command argument. Within the 3,357-entry limit of the COMPOSE music file, up to 127 subroutines are allowed. A command argument value greater than the number of actual subroutines will display the last subroutine.

CALL   Invoke (Call) a music file subroutine.

CAL(l)_{1 ... 1 27)<cr> When a CALL command is encountered as a music file is being played, the program branches to the subroutine specified in the command argument, plays through the subroutine, and returns to the note or command in that particular voice. One or more voices can call the same subroutine at the same time. If a subroutine number greater than the last available subroutine is called, the command is ignored.

This command is indicated on the Edit Screen by a Command Tick between the staves of the Music Score.

Advanced Editing Commands

QUARTER   Set the length of a quarter note.

QUA(rter)_{1 ...65535)<cr> The default value for a quarter note is 240. The command argument sets the length, in "time units," of a quarter note for the current voice or subroutine. A "time unit" is approximately two milliseconds for a TEMPO value of 4096. This command affects only the notes and rests entered following it, not those entered prior to it.

The length of all standard notes and rests in a given voice or subroutine are calculated as multiples or submultiples of the current value of the Quarter note. Keep this in mind when assigning a non-standard value for the quarter note. Inaccurate note/rest lengths can result if the calculated lengths are not an even multiple of the quarter note value.

LENGTH   Create a note or rest of non-standard length.

LEN(gth)_{1 . .65535} <cr> This command can be used to assign a specific length, in "time units," to a note or rest. The value entered as the command argument will be assigned as the length of the note or rest shown on the Edit Staff. This command is useful for entering a series of rests in a Music Score.

SPEED   Adjust note lengths in one or more voices or subroutines.

SPE(ed)_{1...65535}(/1...65535){1...127}(2...127){S or V}<cr> This command is used to change the length of all notes, rests, and QUArter commands in one or more voices or subroutines. The lengths are multiplied by the first value in the command argument and divided by the second (optional) value, if specified. The range of the speed value changes is specified by the next two values, separated by a hyphen. The first range value (required) determines the number of the first voice or subroutine to be altered. The second (optional) range value determines the last voice or subroutine modified. Finally, an S or V must be entered to specify whether the command is to change a range of subroutines or voices.

Note Envelope Commands

The following commands affect the note envelope, or loudness contour, of notes played by the Phasor. These commands are graphically represented in Figure 9. The music files on side two of the Phasor program disk provide many examples of various Note Envelope combinations.

ATTACK

The rate (volume increase per time unit) at which a note's volume increases as it is sounded.

VOLUME

ATT(ack)_{1...65535}<cr> Default: 8192. As the command argument value is increased, the attack rate becomes faster.

The peak loudness of the Attack interval.

VOL(ume)_{1 . . .65535)<cr> Default: 55000. As the command argument value is increased, the volume level becomes greater.

DECAY

The rate at which a note's volume decreases after peak volume.

DEC(ay)_(1 . .65535}<cr> Default: 25. As the command argument value is increased, the decay rate becomes faster.

SUSTAIN

The volume level to be maintained until the Release interval.

SUS(tain)_{0....65535}<cr> Default: 0. As the command argument value is increased, the volume is sustained at a higher level. This command does not affect the length of the sustained volume. GAP and RELease determine that.

GAP

The minimum amount of time prior to the end of a note that a RELease interval will begin.

GAP{1 . . .65535}<cr> Default: 20. At the default GAP value, the RELease interval begins 20 time units before the end of the note. As the command argument value is increased the release interval begins sooner in the note.

RELEASE

The final decay rate; the rate at which a note's volume decreases to zero after sustained volume.

REL(ease){1...65535)<cr> Default: 65500 As the command argument value is increased, the time period of the final decay rate becomes faster.

PERCUSSION

Toggle percussion mode. (On or Off)

PER(cussion)_{ON or OFF}<cr> Default: OFF. The proper operation of this command is dependent on the voice definitions created by the POSition command. This command can be used in all voices and subroutines. In the default state, the notes of a voice with the P (percussive) option defined will be sounded as normal musical notes. In the ON state, the percussive voices will create "white noise" sound, emulating a percussion instrument. The Note Envelope commands affect the percussive notes in the same manner as normal notes.

Figure 9: Note Envelope Command Combinations
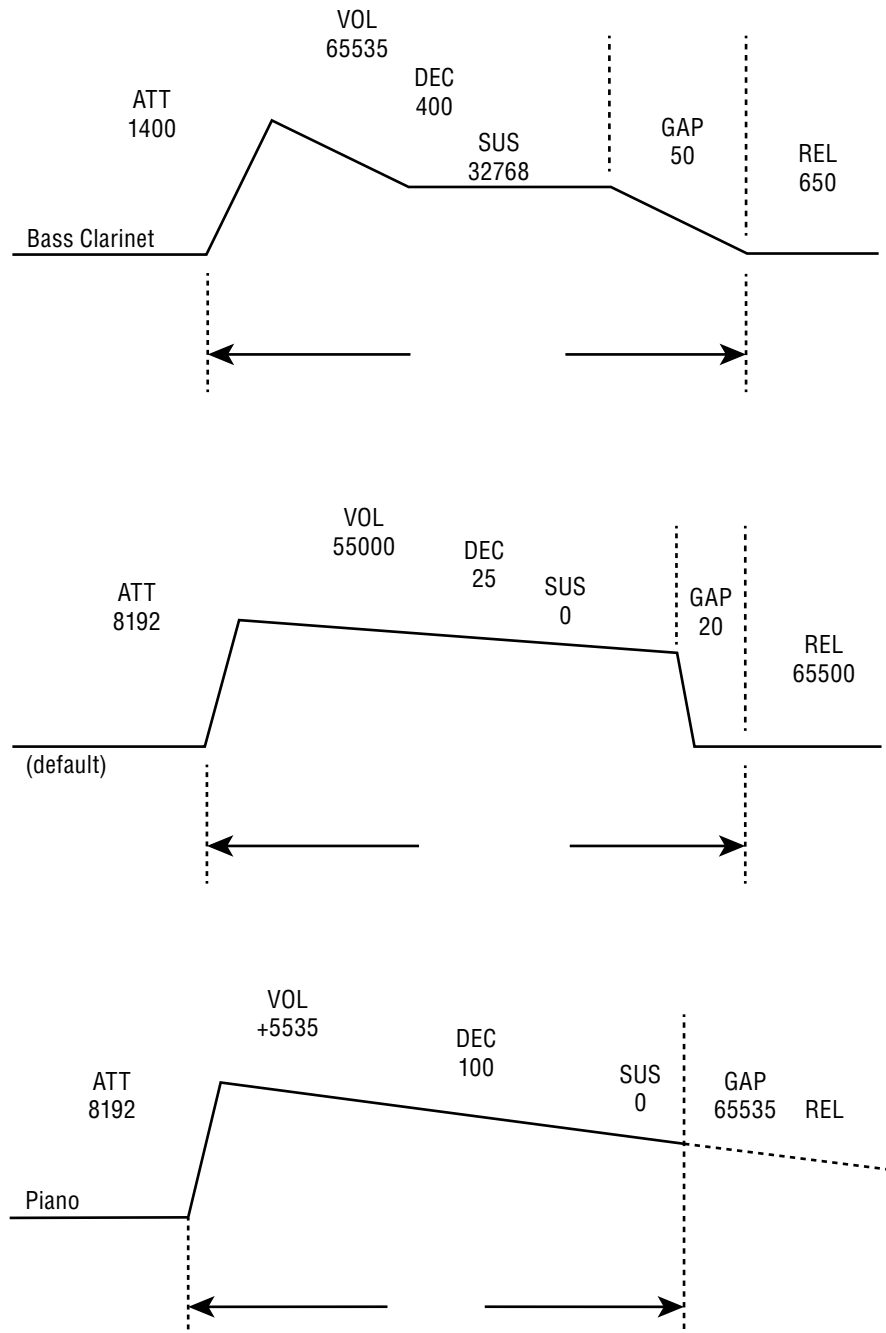
Converting Music Files

Applied Engineering Super Music Synthesizer or ALF Apple Music Synthesizer song files can be converted from DOS 3.3 disk format to ProDOS format and played by the Phasor Music Player. Apple Computer's ProDOS Users Disk or System Utilities disk can be used to convert DOS 3.3 files to ProDOS format. Once the file is converted to ProDOS file format, no further conversion is required to play these files, but if the files are to be loaded into the COMPOSE music editor, their ProDOS file types must be changed. The "Convert Song Fire Types" option of the Phasor Music Menu enables you to convert ALF Apple Music Synthesizer files and Super Music Synthesizer files into COMPOSE music editor file format.

To be loaded into the COMPOSE music editor, the music files must be binary ProDOS files with a file type of MUSS. The BASIC.SYSTEM file on the Phasor program disk has been modified to display the Phasor music files as a file type of MUSS. If the file directory is displayed under an unmodified BASIC.SYSTEM file, the file type will appear as $F5.

ALF Apple Music Synthesizer files, in their original DOS 3.3 format, are Integer files and have a filename prefixed with an 'M:'. The colon (:) in a filename is not allowed under ProDOS, so it is automatically changed to a period during DOS 3.3 to ProDOS conversion. Applied Engineering Super Music Synthesizer music files, also in DOS 3.3 format, are binary files and contain a 'B.' filename prefix. When converted to Pro DOS format, the filenames and file types remain the same.

The Phasor conversion utility will first prompt you for a source pathname, then a destination pathname. An equal sign (=) can be entered in place of the destination pathname if it is the same as the source. If the source and destination pathnames are the same, the utility will load a source file into memory, delete the source (unlocked) file on disk, and save the file back to the disk, dropping the 'B.' or 'M.' filename prefix and changing the file type to MUSS (or $F5). If you specify a destination pathname different from the source, the converted files will be copied to the destination without affecting the source files. The converted files can then be loaded into the COMPOSE music editor, as long as they are not larger than 21 ProDOS disk blocks and do not contain more than 3,357 entries.

The conversion utility can also be used to convert Phasor music files back to ALF Apple Music Synthesizer- or Super Music Synthesizer-compatible files,which can then be converted to DOS 3.3 format.

Copy Disk to /RAM Option

This Phasor main menu option is available only on an Apple //e with a RamWorks auxiliary memory expansion card installed. The expanded auxiliary memory of the RamWorks card will be used to create a ProDrive emulated solid-state disk drive to which the contents of the Phasor Program disk will be copied and from which they will be executed. Phasor Program files will be loaded to memory from a ProDrive much faster than from a conventional drive. Being able to run the Phasor programs from a ProDrive is very useful on a single-disk-drive system.

When the Phasor Program disk is booted, the startup program checks for the presence of a RamWorks auxiliary memory expansion card with at least 192K of memory. If the amount of auxiliary memory is less than 192K, the "Copy Disk to /RAM" option will not appear.

Should you need to exit to Applesoft BASIC and wish to return to the Phasor Program, set the ProDOS prefix to "/RAM" and run the BASIC program "STARTUP."

Even though a ProDrive is convenient and fast, it is a volatile storage medium. It is only temporary storage! When the computer is rebooted, or power is removed for even an instant, the contents of the ProDrive are lost. For this reason, storing data files in a ProDrive is not recommended.

Phasor Speech Programs

This section tells you how to use the Text-to-Speech capability of the Phasor from within your own Applesoft BASIC programs. You don't have to be an advanced programmer, but you should at least have some experience in Applesoft BASIC programming.

The Text-to-Speech program, TTS, is the link between your Applesoft BASIC program and the Phasors speech synthesizer. TIS will work only with the Phasor switches set to Phasor mode (switches 1 and 2 closed).

The installation of the Text-to-Speech software is accomplished by booting ProDOS and BASIC.SYSTEM, then executing US. TTS can be run (BRUN) from either the immediate (keyboard) or deferred (program) mode. When executed, US installs the Text—to—Speech software between $7700 (30464) and $9600 (38400). HIMEM is automatically lowered to $7300 (29440). US is initially loaded at $2000, so it is recommended that larger BASIC programs be loaded only after executing US.

The US program creates five new Applesoft BASIC ampersand (&) commands which are used to control the Phasor's Text-to-Speech feature. The five ampersand commands are:

```
&T,string Speech string (e.g. "fazer is neat" or A$)
&S,string Spell string
&W Wait until current string is completed.
&I Reinitialize speech
&Q Quit US; reset HIMEM to $9600
```

The following sample program demonstrates the use of the ampersand commands.

```
10 PRINT CHR$(4)."-TIS"
20 &T, "Peter Piper picked a peck of pickled peppers."
30 &W
40 &T,"Thee propper spelling of fazer is"
50 &W
60 &S, "PHASOR"
70 &W
80 &I
90 &Q
99 END
```

Editing TTS Speech Parameters

The TTS program is initially configured for a Phasor installed in slot 4. If your Phasor is not in slot 4 and the TTS program is to be run from a different disk, the US program must first be reconfigured. (The Phasor Speech Menu program modifies the ITS program in memory to recognize the Phasor in its actual slot.) Synthesized speech volume, inflection, and rate parameters can also be altered. If you have a set of game paddles, the "Paddle Talk" option on the Phasor Speech Menu provides a convenient way to experiment with different speech parameter values. If the indicator parameter is set to "Y," as each character is spoken, the letter in the upper right corner of the screen will change.

Here's the recommended method for configuring the US parameters:

1. Boot a Backup copy of the Phasor program disk.
2. Select the Speech Programs options from the main menu and then the Edit Speech Parameters option from the Speech Menu.
3. Enter and accept the US parameters for the desired configuration.
4. Boot a ProDOS file copy utility program and copy the newly configured US program to your speech program disk.

Figure 10: EDIT.TTS.PARMS Screen (with default parameters)

```
Text-to-Speech Parameters:

Slot = 4
Volume (0-15) = 12
Rate (0-15) = 11
Inflection (0-31) = 11
Indicator (Y/N) = H

Are these correct? (Y/N)
```

In the above procedure, EDIT.TTS.PARMS is the BASIC program which actually modifies the TTS parameters. EDIT.TTS.PARMS loads the binary US file into memory and displays its current speech parameters, allowing you to change the parameters and save the US file back to the disk. For this reason, US and EDIT.TTS.PARMS must be under the currently-prefixed directory name.

About the Speech Chip Sockets...

The Phasor comes with two sockets that accomodate the speech synthesizer chips, currently the Phasor speaks only through the lower channel, channel B (lower socket). The other socket on the Phasor is for a channel A speech synthesizer circuit chip, for future expansion. The software required to support this chip is not currently available.
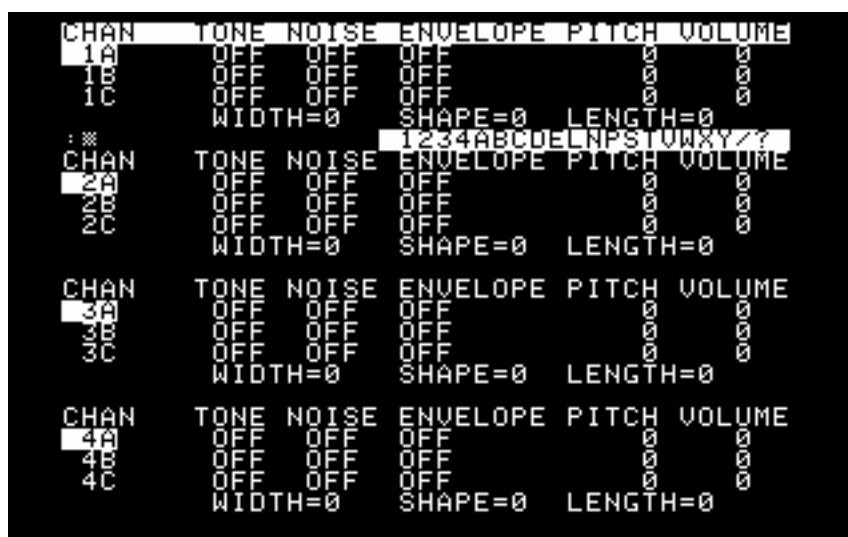
Sound Effects "Sound Builder"

The Sound Builder menu option of the Phasor Effects Menu allows you to experiment and explore the capabilities of the Phasor's four sound generator chips. With the Sound Builder, you can create special sound effects and save them on disk for playback from within your own Applesoft BASIC programs. (For experienced programmers only!)

When the Sound Builder is first accessed, the Sound Builder Help Screen is displayed. This screen summarizes all of the single-key commands used to create, edit, load, and save sound effects. This help screen can be displayed at any time by entering a question mark at the command prompt. Pressing the spacebar will display the Sound Builder edit screen.

Figure 11: Sound Builder Edit Screen

SOUND BUILDER EDIT SCREEN

To simplify the commands, Sound Builder directs all parameter commands to only one chip at a time. The chip currently being addressed is indicated on the screen by the position of the command line prompt, which is displayed in inverse video. (The characters in the command line prompt are the legal single key commands.) The command input cursor is a blinking square, just to the left of the command line prompt. The current voice of the addressed chip (A,B, or C) is also identified by inverse video.

Channels 1, 2, 3, and 4 represent the Phasor's four sound generator chips. (These are the same chips used to generate the Phasors synthesized music.) Sound output from chips 1 and 3 goes to Phasor speaker channel B, chips 2 and 4 to speaker channel A. Each of the four sound chips is capable of producing three individual voices, designated subchannels A, B, and C.

The Tone and Noise commands toggle the on/off states for the tone or noise generators. Each subchannel, or voice, can be used to generate a tone, "white noise," or both. The frequency of a tone can be specified by the P (pitch period) command. The pitch period can be any number from 0

to 4095. A short pitch period of 1 creates a very high-frequency note. The longest period is 0, which doesn't make sense unless you think of it as 4096! This formula can be used to calculate the frequency (or pitch period) of a given tone:

```
                           1Ø2Ø,484
          Frequency = --------------------
                         Pitch period x 16


          2319 = 27.5 Hz (low A note)
          145  = 44Ø Hz  (middle A note)
```

In the formula above,1020484 is the average frequency of the Apple's internal clock, usually stated as 1.020484 MHz.

The W (noise width) command affects only a voice generating white noise (noise ON). The noise width value range is from 0 to 31. A low value causes the white noise to be more intense in the higher-frequency range. A higher value (0 and 31 are highest) produces more white noise in the lower frequencies.

Volume for a given voice can be controlled by the volume (V) command or the envelope (E) command. The volume command range is from 0 to 15, with 0 being completely silent. A sound envelope has two parameters which can be controlled: the shape (S) and the envelope period (L), or length. The volume of all voices which are under the control of an envelope will rise or fall at a rate determined by the envelope period (length) specified. Depending on which of eight different shapes is selected, the volume will step (ramp) from 0 to 15 or from 15 to 0 during a period. The time for up or down ramp can be determined by the following formula:

```
                        256 x Length
          Frequency = -----------------
                         1,Ø2Ø,484
```

The envelope length can be any value from 0 to 65535. The shortest length is 1. The longest period is 0 (65536). The actual meaning of the length parameter is that the volume is incremented or decremented at a rate equal to 1020484 / (length x 16) or 63780.25 /length cycles per second.

The eight shape options, selectable under the S command, are numbered 0 through 7. Two of the shapes cause the envelope to play for one period only, followed by silence. Two others generate one ramp, followed by full volume. The other four repeat in a pattern. For voices with the envelope option ON, the different sound shapes are represented in the envelope column of the Phasor Sound editor screen by the symbols shown in Figure 12.

Figure 12: Sound Builder Shape Patterns

```
\ downward ramp pattern, volume falling from 15 to Ø.
/ upward ramp pattern, volume rising from Ø to 15.
T continuous volume level of 15.
_ continuous volume level of Ø.


Shape    Volume
Number   Pattern   Pattern description
---------------------------------------------------------------------

Ø        \\\\      Repeating downward ramp cycles, with volume from
                   15 to Ø on each ramp cycle

1        \__+      One downward ramp to a sustained Ø volume

2        \/\/      Repeating downward then upward ramp cycles

3        \TTT      One downward ramp, followed by a sustained volume of 15

4        ////      Repeating upward ramp cycles

5        /TTT      One Upward ramp, maintaining a volume of 15

6        /\/\      Repeating upward then downward ramp cycles

7        /__       One upward ramp, dropping to a sustained Ø volume
```

The sound effect for single channels can be activated by the X (execute current channel) command. All channels can be played with the Y command. The sound from all channels can be stopped with the 0 (deactivate) command. The / (slash) command provides access to the disk commands: SAVE, LOAD, and CATALOG. The ESC key can be used to cancel an unentered command or exit the Sound Builder.

Several sample sound effects files are provided on the Phasor Program disk. The files, SOUND.1, SOUND.2, SOUND.3, SOUND.4, and SURF demonstrate the effects of different sound envelope combinations.

Calling Sounds from Applesoft BASIC

The following BASIC program outlines the procedure for calling a sound effects file created by the SOUND.BUILDER program.

```
10   HIMEM: 36064
20   PRINT CHR$(4) "BLOAD BIN.SOUNDS"
30   PRINT CHR$(4) "BLOAD SURF,R$9500"
40   SLOT = 2: POKE 30200,SLOT
50   FOR CH = 1 TO 4
60   POKE 36281,CH
70   CALL 35289
80   NEXT
90   WAIT 49155426
100  CALL 36283
```

Line 10 sets the HIMEM limit down from 38400 ($9600) to 36864 ($9000). The binary file, BINSOUNDS, loaded in line 20, automatically loads at $9538. Line 30 loads the sound effects file, "SURF," at $9500, just below the BINSOUNDS program. In this example, the Phasor is installed in slot 2, as indicated in line 40. Line 50 uses the CH variable to set up a FOR-NEXT loop to assign a synthesizer chip number for lines 60 and 70 POKE 38201, CH selects the chip to be loaded by the CALL 38209 command. The sound chip is activated by loading 14 bytes from the appropriate memory locations into the chip registers. Line 90 waits for any key to be pressed before executing line 100, which will deactivate all sound chips.

BINSOUNDS Technical details

The BINSOUNDS program loads into memory, starting at location $9538. The fourteen bytes of control parameters for each chip are stored in the 56 bytes from $9500 to $9537. (HIMEM should be set no higher than $9100.)

```
Chip 1 $9500-950D (38144-38159)
Chip 2 $950E-951B (38160-38171)
Chip 3 $951C-9529 (38172-38185)
Chip 4 $952A-9537 (38186-38199)
```

Three additional memory locations are for program use:

```
$9538 (38200) Phasor slot number
$9539 (38201) Chip number (1 to 4) for current CALL 38206 or CALL 38209
$953A (38202) Register number for current CALL 38206
```

Three CALL routines are contained in BIN.SOUNDS.

```
CALL 38203 Reset all four chips (silence).
CALL 38206 Update a particular register in the chip specified in $9539.
CALL 38209 Send all 14 bytes to registers of the chip specified in $9539.
```

The sound synthesizer chip registers are numbered from 0 to 13, as follows:

```
 Ø  PAL (low byte of pitch for voice A)
 1  PAH (high byte of pitch for voice A)
 2  PBL
 3  PBH
 4  PCL
 5  PC H
 6  Noise width ($ØØ to $FF) Enable bits (Ø Ø nc nb na tc tb ta)
        ta = Ø for tone in voice A
        tb = Ø for tone in voice B
        tc = Ø for tone in voice C
        na = Ø for noise in voice A
        nb = Ø for noise in voice B
        no = Ø for noise in voice C

 8  Volume and Envelope flag, voice A
 9  Volume and Envelope flag, voice B
1Ø  Volume and Envelope flag, voice C
        Format:(Ø Ø Ø m vvvv)
        m = Ø for volume control
        m = 1 for envelope control
        vvvv = $Ø to $F for volume level (m = Ø only)
11   Low byte of envelope length
12   High byte of envelope length
13   Sound shape number ($ØØ to $ØF)
        $ØØ-$Ø3 are the same as $Ø9
        $Ø4-$Ø7 are the same as $ØF
        $Ø8 =\\\\
        $Ø9 = \___
        $ØA = \/\/
        $ØB = \TTT
        $ØC = ////
        $ØD =/TTT
        $ØE =/\/\
        $ØF = /___
```

Phasor Software

Airsim -3	MIND SYSTEMS
Apple Cider Spider	SIERRA ON-LINE
Auto Gyro	BANDINELLI SOFTWARE
Bouncing Kamungas	PENGUIN SOFTWARE
Broadside	SSI/STRATEGIC SIMULATIONS
Clarinet Master	MASTERY IN MUSIC
Crime Wave	PENGUIN SOFTWARE
Exodus/Ultima Ill	ORIGIN SYSTEMS, INC.
Flute Master	MASTERY IN MUSIC
Lady Tut	CALIFORNIA PACIFIC
Lancaster	SILICON VALLEY SYSTEMS
Maze Craze	DTI/DATA TREK INC.
Music Construction Set	ELECTRONIC ARTS
One-on-One	ELECTRONIC ARTS
Quest Avatar/Ultima IV	ORIGIN SYSTEMS, INC.
Saxophone Master	MASTERY IN MUSIC
Silent Service	MICROPROS
Skyfox	ELECTRONIC ARTS
Tactical Armor Command	AVALON HILL
The Spy Strikes Back	PENGUIN SOFTWARE
Trumpet Master	MASTERY IN MUSIC
Ultima V	ORIGIN SYTEMS, INC.
Willy Byte	DTI/DATA TREK INC.
Window	WINDOW
Zaxxon	DATA SOFT
ZooKeeper	EARTHWARE COMPUTER

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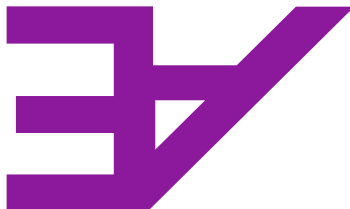
Label Size 5x1.536 (Inches)

PHASOR
PROGRAM DISK 1/4
RM
ReActiveMicro
Since 2005

PHASOR
DISK 2/4
RM
ReActiveMicro
Since 2005

PHASOR
DISK 3/4
RM
ReActiveMicro
Since 2005

PHASOR
DISK 4/4
RM
ReActiveMicro
Since 2005

Label Size 5x1.536 (Inches)

PHASOR
PROGRAM DISK 1/4

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PHASOR
DISK 2/4

RM
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PHASOR
DISK 3/4

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ReActiveMicro
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PHASOR
DISK 3/4
RM
ReActiveMicro
Since 2005

PHASOR
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