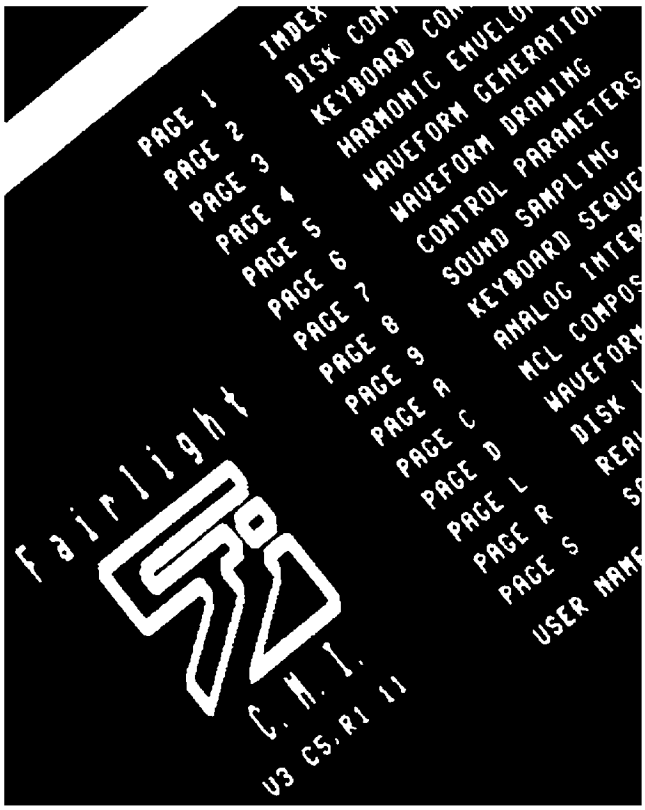

FAIRLIGHT

COMPUTER MUSICAL INSTRUMENT

USERS MANUAL

F A I R L I G H T

- C M I -

V4 ** 13

OPERATION MANUAL

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by Michael Carlos and Tom Stewart

15 Boundary Street
Rushcutters Bay
SYDNEY AUSTRALIA 2Ø11
Telephone (Ø2) 331 6333
Telex AA 27998

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Section A: INTRODUCTION TO THE FAIRLIGHT

THE FAIRLIGHT Computer Musical Instrument is a multiple processor micro-computer system configured as an octophonic audio synthesizer. It has extensive and powerful range of functions, expanding the possibilities and practicalities of electronic music composition and performance.

As you explore the FAIRLIGHT you will notice familiar and unfamiliar synthesis techniques. Conveniently though, it would be difficult to imagine a more comprehensive means for a systematic self-education in audio physics.

COMPUTERS IN GENERAL

While it is true that no formal knowledge of computers or programming is required for operation, a few fundamental concepts should be discussed before an exploration of the FAIRLIGHT can begin.

PROGRAMS

Like an amplifier, a computer requires **input** and generates **output.** Unlike an amplifier, with one function (amplification), a computer has many functions which are selected and implemented by specific instructions. These instructions are represented by numbers and are strung together in meaningful sequences called PROGRAMS. By changing only the program, a computer can be made to control a missile guidance system, or handle the accounting and inventory for a supermarket, or play a game of chess.

In the development of computer-based products, the creation of the program is typically the most difficult and time-consuming part of the exercise and is performed by specialists known as PROGRAMMERS. The **quality** of computer programs is the main thing determining its value to the user's particular requirements.

As users become more familiar with the potential of their computers, new programs can be added, providing new features, while old programs can be modified to improve their efficiency and "friendlyness".

The principle of continuing software development is fundamental to Fairlight.

INPUT AND OUTPUT

The input and output for a computer can take form as widely varied as the applications. Here are a few examples...

application	input	output
MISSILE GUIDANCE	inertia sensors on board missile	control signals to rocket engines
SUPERMARKET ACCOUNTS	transactions from cash registers	automatic reordering of stock
CHESS GAME	your move	its move
FAIRLIGHT	music keyboard playing or programming, sound sampling	music, new sounds

From the computer's point of view, all input and output is actually numeric; from the programs come the purpose and organization which gives meaning to the numbers.

TERMINALS

Communication between you and the computer is provided by a TERMINAL; of which the most common form is the now familiar video screen and typewriter-style keyboard seen at airline ticket counters, banks, pinball arcades, etc. The keyboard is an **input** device, and the video screen is an **output** device.

What is actually typed on the keyboard and displayed on the screen is very much a function of the application but can always be divided into certain catagories. Computer video output is said to be either **ALPHA-NUMERIC** (consisting of letters and numbers) or **GRAPHIC** (bar and line graphs or pictorial representations). The FAIRLIGHT video system uses both.

Since the keyboard is like a typewriter, and therefore provides primarily letters and numbers, it is known as an ALPHA-NUMERIC KEYBOARD. Punctuation is also provided along with a few special function keys. The catagorization of keyboard input is based on the PURPOSE of what is typed and what falls into two basic areas: COMMANDS and ASSIGNMENTS.

A **command** causes a specific ACTION to take place, whereas an **assignment** allocates a VALUE to a VARIABLE FUNCTION. Within the FAIRLIGHT system, for example, there is a command to LOAD a sound, and a value of 2ØØ milliseconds may be ASSIGNED to ATTACK TIME.

The video display is a fundamental component of computer systems because entirely new "displays" can be produced by designing new programs. With these come entirely new features, not even thought of when the computer was originally designed.

MEMORY

Computers have MEMORY, and without bogging down in technicalities, it can be divided into VOLATILE and NON-VOLATILE. This has nothing to do with it exploding, but refers to what happens when the power is shut off. **Volatile memory** is not permanent and loses its contents when the power is removed, whereas **non-volatile memory** is essentially permanent.

Known as RANDOM ACCESS MEMORY (RAM), a computer system's volatile memory can be thought of as a huge room full of tiny post office boxes, each of which can hold a single number. (Note that if someone pulls the plug, the bottom falls out of all the boxes!) As in a post office, each box also has a number which uniquely identifies it and is known as its ADDRESS. These boxes are called BYTES and the size of a computer's memory is usually given in KILOBYTES (K), or thousands of bytes. The FAIRLIGHT computer contains RAM, with each of the eight output channels having their own RAM to store "digitized" sound waveform.

RAM forms a workspace, or scratchpad for the computer as well as holding the program itself while it is running. In the FAIRLIGHT, an audio waveform is held as a sequence of numbers in thousands of bytes of memory. Each number represents the voltage level of a tiny slice of the waveform and when converted to a real voltage in rapid sucession the waveform is produced at the audio output. This is the essence of DIGITAL audio.

Non-volatile memory has many forms within the industry, but the one which concerns us regarding the FAIRLIGHT is the FLOPPY DISK, which is like a cross between a 45rpm record and magnetic tape. A similiar principle to audio recording is used to record information (numbers) in magnetic form on the disk. The FAIRLIGHT has two DISK DRIVES. The **lefthand** disk drive is loaded with the SYSTEM DISK which holds the set of programs which comprise the FAIRLIGHT SOFTWARE PACKAGE. (Programs are known as software as opposed to hardware which refers to the physical components of a computer system such as circuit boards, power supplies, nuts and bolts etc.) The **righthand** disk drive provides mass storage for your sounds, sequences, 'patches', etc.

FILES

Information is stored on disk as a system of FILES. Each file has a NAME that is given to it when the file is created. These names are chosen by the person using the computer and provide a more efficient means of identifying and selecting the information than simply using a number or disk location. Files are LOADED, SAVED, DELETED, COPIED, etc., by reference to their names. A file name also has a SUFFIX which identifies the type of file.

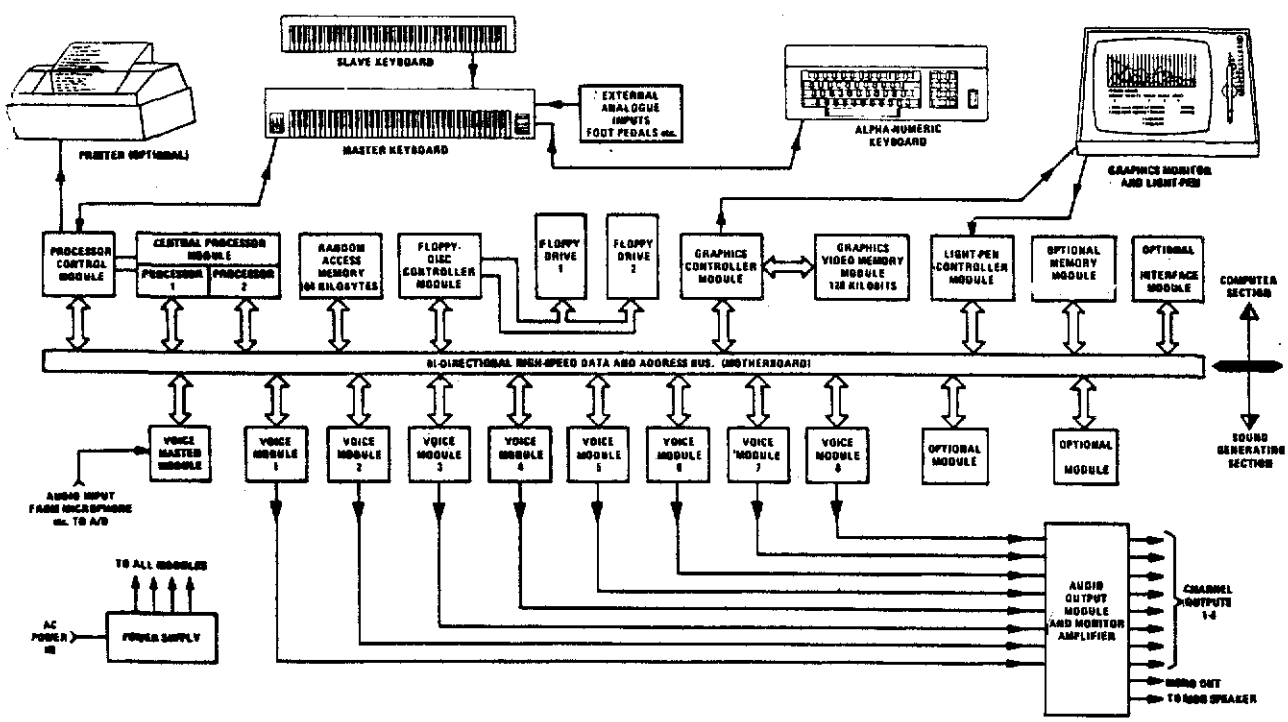
LOADING, SAVING, UPDATING, DELETING

The terms LOADING, SAVING and UPDATING refer to the transfer of information (files) between volatile and non-volatile memory. **LOADING** is moving a file **from** disk (non-volatile) to RAM (volatile); **SAVING** is moving information from RAM to a file **on** disk.

When saving, the action of overwriting an existing disk file with new or different information is termed UPDATING, and results in the loss of the previous information.

When information (such as a waveform) is held in RAM but has not been explicitly SAVED, it is termed UN-SAVED and will be **lost** if the power is cut.

To **DELETE** a file is to permanently eliminate it from the disk. The disk space which was previously occupied by the deleted file is returned for re-use.



[Figure A] SYSTEM BLOCK DIAGRAM

THE LIGHTPEN

The lightpen sensitivity is factory set, to provide good performance in most applications. If the **brightness** and/or **contrast** controls on the back of the graphics monitor have been turned right down, the lightpen may not respond properly when touched. Therefore ensure adequate illumination of the screen.

Removal - See Figure 1 below.

The light pen connector is mated to the connector on the Graphics monitor front panel via a locking-type connector. When transporting the CMI it is sometimes desireable to disconnect the light pen.

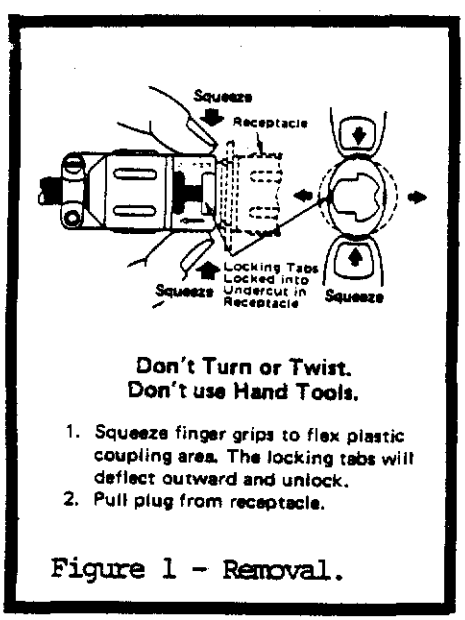
DO NOT TRY TO UNSCREW THE LIGHTPEN CONNECTOR

This will surely damage the wires inside the lightpen cable.

The light pen connector must be **squeezed** at the sides to disconnect.

Replacement - See Figure 2 below.

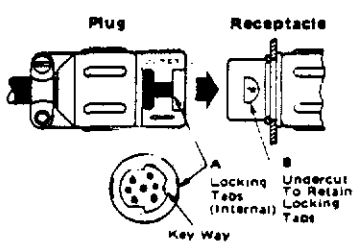
Connection is made by pushing the connecting plug onto the connector on the Graphics Monitor front panel until the locking tabs snap into the locked position.



Don't Turn or Twist.
Don't use Hand Tools.

1. Squeeze finger grips to flex plastic coupling area. The locking tabs will deflect outward and unlock.
2. Pull plug from receptacle.

Figure 1 - Removal.



1. Turn plug so "keyed" insulator faces align.
2. Push plug onto receptacle until locking tabs (A) snap into undercuts (B).

Figure 2 - Replacement.

THE FAIRLIGHT IN GENERAL

The FAIRLIGHT employs DIGITAL techniques for sound synthesis. Sounds are created and modified in digital form and are converted to an analog signal at the output stage for conventional amplification or recording.

SYSTEM CAPABILITIES

Here is a synopsis of the FAIRLIGHT's basic functions.

* The creation and/or modification of complex DYNAMIC TIMBRES is possible by any one or a combination of three methods:

  > SAMPLING EXTERNAL AUDIO SIGNALS by analog to digital conversion techniques for use as sound sources. Several sounds may be edited or blended together.

  > Additive harmonic synthesis through designation of AMPLITUDE/TIME CONTOURS for each of up to 32 harmonics.

  > Direct waveshape determination by literally DRAWING AUDIO WAVEFORMS on the video monitor using the lightpen.

* The 6-octave music KEYBOARD(s), featuring KEY VELOCITY SENSITIVITY, may be configured as a number of REGISTERS with a different sound or group of sounds assigned to each register. Up to eight different sounds can be simultaneously allocated over the keyboard(s) in this fashion.

* Additional REAL TIME EXPRESSION is provided by FADER, PUSH-BUTTON, and FOOTPEDAL controllers with variable functions.

* DUAL DOUBLE-SIDED FLOPPY DISKS or optional HARD DISK provide rapid access mass memory. Distinct families of information are generated and can be LOADED or SAVED individually:

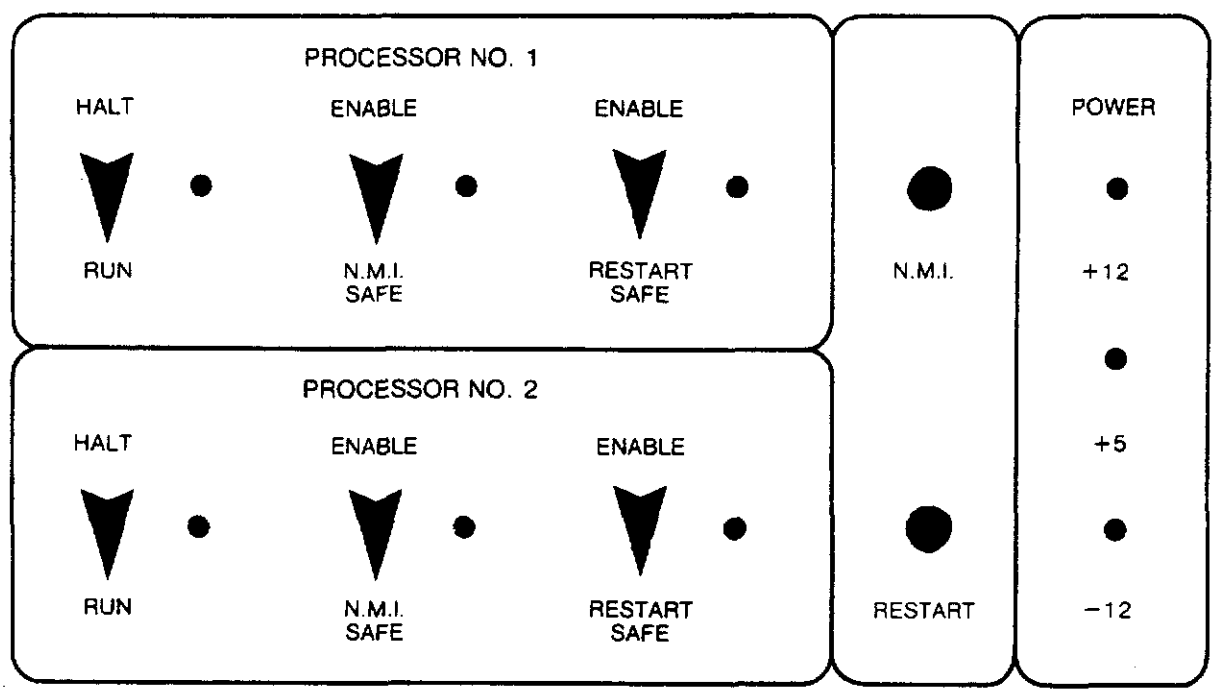
  > VOICE - a single 'sound'.

  > CONTROL - 'patching' and setting of special effects relating to a voice.

  > INSTRUMENT - total state of the system: which voices are loaded; how they are assigned to the keyboard; any tuning or special effects.

  > SEQUENCERS - 3 types - keyboard or programmed data for replay of music.

* A powerful EIGHT-VOICE POLYPHONIC SEQUENCER which is programmed from the music keyboard.
* The "Real-Time Composer", a **pattern** and **section** based composition and production facility.
* A Music Composition Language (M.C.L.) - where note and expression parameters can be "typed" in.
* Octophonic audio output.
* Variable digital metronome click track output.
* External synchronization facility for multi-track recording, or synchronizing with other CMI's, music sequencers.
* Optional SMPTE time code and MIDI operation.
* Continued improvement of features with time - at minimal cost.
* Other features and options - check with your distributor for recent releases.



[FIGURE B] FRONT PANEL

MAINFRAME ASSEMBLY

This houses the power supply, the central computer, the two disk drives or optional hard disk, interfaces for the video monitor and optional printer, plus the eight voice modules, voice master module, audio output module, and 20 watt monitor amplifier. All input, output, and intra-system connections are made at the back of the MAINFRAME (See Section E - Installation and Layout).

FRONT PANEL

This small collection of switches and lights is known as the FRONT PANEL of the mainframe assembly and relates to the correct operation of the computer. The positions of all switches must be as shown (see Figure B - FRONT PANEL).

The three yellow lights indicate that all power supplies are working and should always be illuminated. If not, check fuses.

The four left-most switches should be always pointing **down**, and the four left-most red lights should be constantly illuminated.

The other two switches should normally be pointing **down** as a safeguard against accidental re-start. See RESTART & NMI BUTTONS.

RESTART and NMI BUTTONS

Ordinarily these buttons are not used. Neither can do any real damage, except to whatever un-saved work you might be holding in the system (which may be lost).

The NMI (Non-Maskable Interrupt) button is used only for system diagnosis and testing procedures in case of a fault and then only under direct instruction from a Fairlight service centre.

The RESTART button does exactly what it says: the whole instrument is initialized as if the system disk had just been placed in the system drive after power-up.
Therefore, it can be used if you wish to CLEAR EVERYTHING and start fresh.

To RESTART, push **UP** the two switches labelled

PROCESSOR NO. 1 RESTART and
PROCESSOR NO. 2 RESTART

The two corresponding red lights should flash at you.
Now push the RESTART button.
As a precaution, push the two switches **DOWN** to the SAFE position after restarting.

If the FAIRLIGHT should ever appear to be malfunctioning (will not respond at all, or exhibits some aberrant symptom), first WRITE DOWN the exact nature of the problem along with details of what you were doing when it occurred and any messages that were displayed on the screen. This procedure will enable a remote diagnosis to be made. You will then have to press the RESTART button. If the suspected fault persists, try removing your disks and switch off all power to the system for about fifteen seconds, then start it up again. If the fault still persists, contact your FAIRLIGHT service centre.

DISK DRIVES

These are the 'record-replay' units for the 8" floppy disks which form the mass memory system for the FAIRLIGHT. They are not audio devices, but provide for the rapid storage and retrieval of digital data.

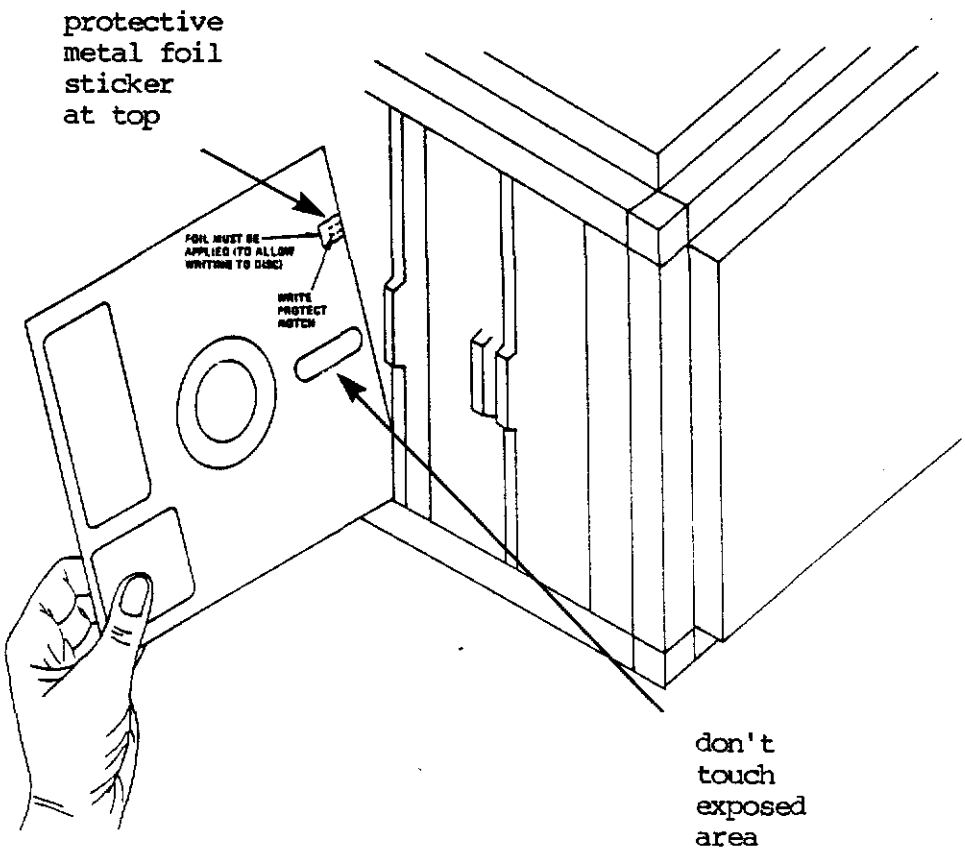
The disks should ONLY be inserted when the system has already been switched on and the power should NEVER be switched OFF until the disks have been removed. If this rule is ignored the data on your disks may be damaged. Only the SYSTEM DISK should ever be placed in the **lefthand** drive (except when using the TRANSFER function on Page 2). The **righthand** drive is exclusively for your sound/sequence (user) disks.

An optional HARD DISK is available in place of one floppy disk drive. This can store information equivalent to dozens of floppy disks. See your distributor.

DISK INSERTION AND CARE

When inserting a disk, take care to gently push the the disk into the drive until it seats with a click. The drive door is then carefully but firmly snapped shut. If the disk is not fully inserted it will be caught and possibly damaged by the door.

Disks must ALWAYS be inserted with the following orientation:



DISK INSERTION

To remove a disk, press the release catch on the left side of the door and the disk will pop out for removal. The red light on each drive is illuminated when the computer is using the disk. DO NOT open the door when the red light is on or blinking intermittently; wait until the computer is finished.

Always store the disks IN THEIR JACKETS and treat them as you would any valuable recording - away from heat, dust, and magnetic fields (loudspeakers, telephones, headphones, etc). When labelling your disks (a very good idea) do not use a writing implement which can cause a dent or depression in the disk. A felt pen is best.

MUSIC KEYBOARD

The MASTER keyboard and optional SLAVE keyboard are 73-key standard gauge music keyboards featuring a fully moulded key design. The MASTER keyboard has its own internal micro-computer which handles the collection and transmission of keying data to the central computer. The velocity of each keystroke is detected and may be used to control volume level or attack or both.

The MASTER keyboard includes three faders, two switches, and sockets for the optional FOOT PEDAL switches. These are used to control voice parameters such as volume, attack, damping, loop start and length, vibrato and so on.

The MASTER keyboard also incorporates a small 16-key calculator-type keypad with a LED display which may be used to load sounds from the keyboard with a minimum of effort. This would typically be used for convenience in a live performance situation.

THE TERMINAL

The terminal comprises three units:

ALPHA-NUMERIC KEYBOARD
LIGHTPEN
VIDEO MONITOR.

ALPHA-NUMERIC KEYBOARD

This is a 62 key typewriter-style keyboard used for entering COMMANDS and ASSIGNMENTS to the system. A separate pad to the right of the keyboard contains the ADD, SUB, and CURSOR CONTROL keys used in making assignments. See Section B - Operating Techniques. This keyboard is also referred to as the TERMINAL KEYBOARD.

LIGHTPEN

This pen-sized, light-sensitive device provides two distinctly different functions in relation to the video monitor:

SELECTION and
PLOTTING

In **selection**, the lightpen is used to choose a single item from a list of items presented on the screen by pointing the pen at the desired item.

In **plotting**, the lightpen is used to DRAW waveforms or time contours directly on the monitor screen in graphic form. The system function controlled by such a graph defines its meaning, but the use of the pen is consistent and rapidly becomes second nature. Everything that can be done with the lightpen can be done using the alpha-numeric keyboard.

VIDEO MONITOR

The VIDEO MONITOR is a 14" high resolution, green phosphor display device which is used to present the different control facilities of the system to the musician. Technically, this is an output device. In combination with the lightpen and alpha-numeric keyboard, however, the screen becomes TWO-WAY; displaying the information which you input to the system along with information which the system outputs to you.

THE DISPLAY PAGE CONCEPT

The functions of the FAIRLIGHT have been grouped into various catagories, which are characterised by different display formats. These display formats, or more exactly, the individual collections of operations they represent, are called DISPLAY PAGES and they are referred to by number or letter:

PAGE 1) INDEX
PAGE 2) DISK CONTROL
PAGE 3) KEYBOARD CONTROL
PAGE 4) HARMONIC PROFILES
PAGE 5) HARMONIC AMPLITUDE FADERS
PAGE 6) WAVEFORM DRAWING
PAGE 7) CONTROL PARAMETERS
PAGE 8) SOUND SAMPLING
PAGE 9) KEYBOARD SEQUENCER
PAGE A) ANALOG INTERFACE
PAGE C) MUSIC COMPOSITION LANGUAGE
PAGE D) VOICE WAVEFORM DISPLAY
PAGE F) USER DEFINED FUNCTIONS
PAGE I) GENERAL INTERFACE
PAGE L) DISK LIBRARY
PAGE R) REAL-TIME COMPOSER
PAGE S) SCREEN PRINT
PAGE T) DIAGNOSTIC TABLES

The design of the FAIRLIGHT is fundamentally linked to the video monitor. The concept of "pages" which it displays is extremely important in gaining a solid grasp of the systems potential, and can be thought of as a window which one moves in order to view and gain access to different areas of control within the instrument.

INTRODUCTION TO THE PAGES

PAGE 1 (INDEX) is like a table of contents, or menu, of CMI facilities available. The selection of the other pages is it's function.

PAGE 2 (DISK CONTROL) provides a DIRECTORY of all files on the currently loaded file disk along with commands to load, save, copy, delete, and rename files. By using only PAGE 2, you may load and play any sound in your disk library.

PAGE 3 (KEYBOARD CONTROL) provides for the allocation of output channels to the VOICE REGISTERS and assignments of REGISTERS to the music keyboard(s). All of the system's tuning controls are also found on PAGE 3.

PAGE 4 (HARMONIC PROFILES) offers facilities for rapid additive sine-wave Fourier synthesis by harmonic amplitude manipulation over time.

PAGE 5 (HARMONIC AMPLITUDE FADERS) provides extremely fine adjustment of sine-wave or any wave harmonic amplitude content by additive synthesis. Fourier analysis of sampled sounds is done here.

PAGE 6 (WAVEFORM DRAWING) allows the direct drawing of audio waveforms using the LIGHTPEN. Many other waveform manipulation commands permit rapid sound generation.

PAGE 7 (CONTROL PARAMETERS) provides the 'patching' and setting of expressive control parameters such as attack, level, vibrato, portamento and so on.

PAGE 8 (SOUND SAMPLING) allows an external audio signal to be digitized and stored for use as a sound source. Once sampled in this way, many of the functions provided on other pages may be used to modify the resultant waveform.

PAGE 9 (KEYBOARD SEQUENCER) is a music keyboard programmable sequencer.
Music information is stored as a disk file and may be repeatedly MERGED with successive keyboard performances much like overdubbing with audio tape.

PAGE A (ANALOG INTERFACE) will operate optional interface hardware allowing the user access to sixteen voltage controlled inputs and sixteen voltage controlled outputs as well as a guitar synthesizer interface. Various pitch, trigger, switch, control and key-velocity patches may be saved to disk for later recall.

PAGE C (MUSIC COMPOSITION LANGUAGE) allows music information to be "typed" into the Fairlight. Extreme timing precision and the ability to program control and switch settings is possible. **See the Music Composition Language manual.**

PAGE D (VOICE WAVEFORM DISPLAY) shows a "3-D picture" of the waveforms of any voice in various formats.

PAGE F (USER DEFINED FUNCTIONS) lets you draw function curves which can be patched to faders, footpedals and the keyboard to change their response.

PAGE I (GENERAL INTERFACE) is a SMPTE/MIDI/SYNC interface for use with optional hardware. SMPTE time coding and configuration of the CMI to other manufacturers equipment is the function of this page. **See separate manual.**

PAGE L (DISK LIBRARY) organizes and cross references all sound disk file types.

PAGE R (REAL-TIME COMPOSER) is a highly interactive music editor with a wide range of comprehensive commands permitting rapid music generation. **See Page R Manual.**

PAGE S (SCREEN PRINT) will print, via an optional dot-matrix printer, any CMI screen image in a variety of formats.

PAGE T (DIAGNOSTIC TABLE) is a continuously updated display status of the current system variables enabling long distance system diagnosis. It has no meaning to the Fairlight user. It may be used for remotely diagnosing faults when communicating with a Fairlight service centre.

PAGE RELATIONSHIPS

PAGES 1, 8, 9, D, L and T are functionally passive in that they play no part in the system's operation unless they are actually being displayed. PAGES 2 to 7 and F, however, relate to functions which are effectively active at all times, irrespective of the page displayed:

PAGE 2 (DISK CONTROL) displays the names of all files on a particular disk and protects against accidentally overwriting certain files, use of duplicate file names, etc.

PAGE 3 (KEYBOARD CONTROL) is also a utility page and performs voice allocation, keyboard splits and tuning functions that apply to the instrument at all times. It is therefore termed an INSTRUMENT-RELATED page and its entire configuration can be saved or loaded as an INSTRUMENT FILE.

PAGE 4 (HARMONIC PROFILES), PAGE 5 (WAVEFORM GENERATION) and PAGE 6 (WAVEFORM DRAWING) form the heart of FAIRLIGHT sound generation and provide three different approaches to waveform creation, modification and control.

PAGE 7 (CONTROL PARAMETERS) supports additional functions applying to the actual playing of a waveform.

PAGE F (USER DEFINED FUNCTIONS) is closely linked with PAGE 7 in controlling function responses specified by the user.

The selection of these pages does therefore NOT result in the ACTIVATION of their functions, but rather in giving you access so that inspection or modification may be performed.

In addition to PAGES 4-6, PAGE 8 (SOUND ANALYSIS) also provides for the creation of a waveform with its external sampling function. We therefore have five pages, 4-8, whose functions may be combined to define a particular sound, or as we call it - VOICE. These are the VOICE-RELATED pages.

Since the FAIRLIGHT can have up to eight voices active simultaneously, there is always a 'copy' of each of these voice-related pages for however many voices are active, each may be independently selected for inspection or modification by PAGES 4-8.

The interaction of the display pages is not always obvious at first glance, but a solid understanding should be gained after only a few days use. Once some familiarity is acquired, you will find yourself flitting from page to page, progressively honing a sound to your satisfaction by using all of the facilities provided.

When first using the Fairlight CMI, concentrate on using

Page 2 - DISK CONTROL
Page 7 - CONTROL PARAMETERS
Page R - REAL-TIME COMPOSER - see separate manual.

These three pages will "get you going" almost straight away.

OPERATING TECHNIQUES

From this point, exploration of the FAIRLIGHT's capabilities becomes the exploration of the display pages themselves, but first we must consider the basic techniques of using the pages within the instrument as a whole. The operation of the lightpen and alpha-numeric keyboard in association with the display page features will be best illustrated by direct examples, so it is now desirable that you have the FAIRLIGHT up and running in front of you.

THE STATUS LINE

When the system is first switched on and a system disk inserted in the left hand disk drive, PAGE 1 is displayed.

There is a message at the top of the screen:

*** PAGE 1 READY ***

The horizontal band (line) which is occupied by this greeting is called the STATUS LINE and its function is to display messages from the FAIRLIGHT to you. If you make an incorrect entry from the alpha-numeric keyboard or the lightpen, an ERROR MESSAGE will be printed to notify you. Whenever your input does not result in the expected action, look at the status line, and you may find a message waiting.

In certain operations (such as deleting files, overwriting some file types, etc.) a safeguard question will be printed in the STATUS LINE to give you the option of proceeding or aborting the action. When deleting a file, for example, the message:

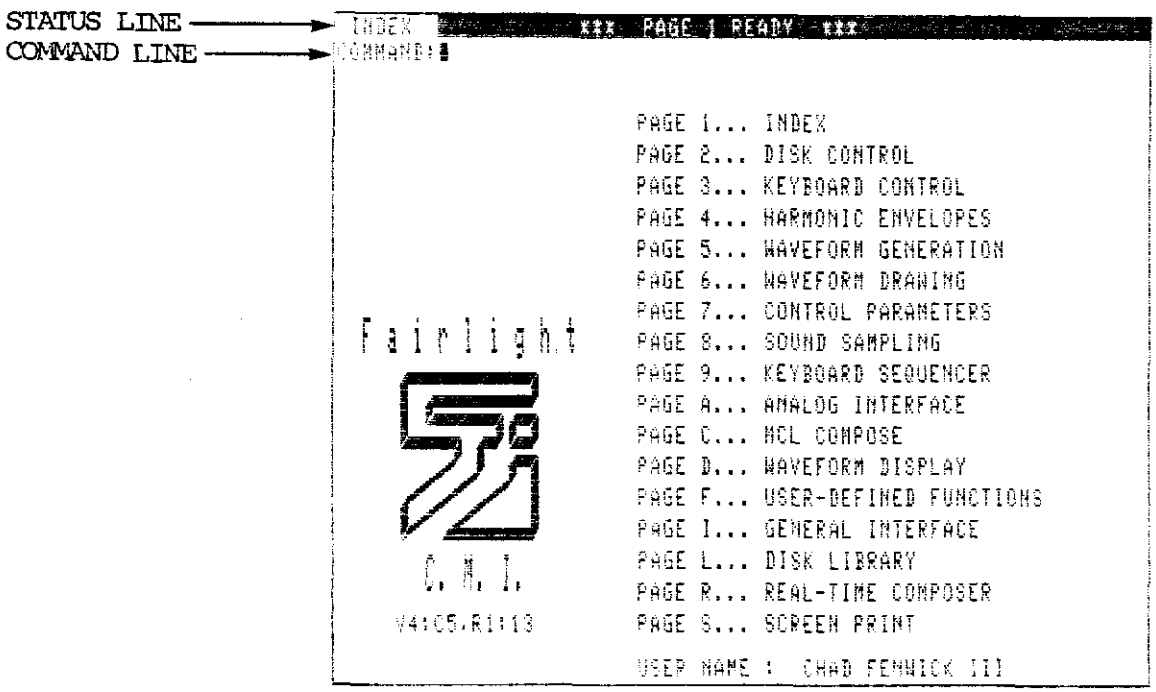
DELETE (filename) Y/N ?

will be displayed.

Typing anything but a **'Y'** followed by the **RETURN** key will abort the deletion.

THE COMMAND LINE

The line directly below the status line is known as the command line. Anything typed by you will appear immediately to the right of the word COMMAND so that you may see what you have typed before putting it into action.



USE OF THE TERMINAL KEYBOARD

The alpha-numeric keyboard follows conventional typewriter key layout with extra keys having special functions. All keys, with the exception of the **SHIFT** and **CTRL** (control) key, will repeat if held down for more than half a second.

Input from the alpha-numeric keyboard can be either a COMMAND or an ASSIGNMENT. In either case, after typing the required input into the command line, one of the TERMINATOR KEYS must be pressed. This lets the computer know that what you have typed is to be acted upon. It is the terminator which indicates whether a command or assignment is being made, and causes the required action to take place.

The terminator keys are: **RETURN**
ADD
SUB
SET

RETURN KEY

The form and use of a modern video terminal system has evolved from the teletype terminal used in earlier computer systems. This has in turn evolved from the typewriter. The CARRIAGE RETURN function of a typewriter (which TERMINATES a line of text) has been retained, and has developed into a standard COMMAND TERMINATOR in computer systems.

There are two keys marked **RETURN.**

Either of the two keys marked "RETURN" must be pressed as the last key in any COMMAND. The RETURN key causes the FAIRLIGHT to test the contents of the command line for one of the commands supported by the currently selected display page. If a valid command is found it is executed and the command line is CLEARED. If the SYNTAX (format) of the input is incorrect, an ERROR MESSAGE may be displayed in the status line and the command line may remain UNCLEARED.

The most commonly used command is the one to change display pages and is known as the PAGE command. To select any page type:

Pn<return>

where 'n' is page number or letter -

1 to 9, A, C, D, F, I, L, R, S, T,

and <return> is the RETURN key.

> This system of specifying input syntax with lower case letters representing an unknown which you supply, and brackets < > to indicate terminator or special function keys will be used throughout this manual.

Section B: OPERATING TECHNIQUES

Provided a SOUNDS DISK has been inserted into the right hand disk drive, we may use the LOAD (voice) command to get some sound!
First select PAGE 2 (DISK CONTROL) with the PAGE command.

Type **P2<return>**

The names of all files on the disk will be displayed.

Pick a VOICE FILE ('.VC' suffix) and type:

L,A,filename<return>

where 'filename' is the name of the VOICE (without the .VC suffix).
The lightpen or keypad can be used to speed all of this up. We will get to that soon.

If the necessary audio connections have been made (See Section E - Installation and Layout) the music keyboard should now be active. Try a few voices and have a look at the various pages.

ADD, SUB, & SET KEYS

To TERMINATE the ASSIGMENT of a value to a VARIABLE function, three ASSIGNMENT TERMINATOR KEYS have been provided.

These are marked **SUB , ADD** and **SET.**

FAIRLIGHT variables will accept either ALPHABETIC or NUMERIC (ALPHA-NUMERIC) assignments depending on the function concerned. Numeric variables require NUMBERS; alphabetic variables require LETTERS.

Examples of NUMERIC VARIABLES:

MASTER PITCH - PAGE 3 - Ø to 255
SPEED - PAGE 9 - 1ØØØ to 65535
VIBRATO DEPTH - PAGE 7 - Ø to 127

Examples of ALPHABETIC VARIABLES:

DISK ID - PAGE 2 - 8 character name
SUSTAIN - PAGE 7 - ON or OFF
SYNC - PAGE 9 - INT or EXT

PAGE 7 (CONTROL PARAMETERS) contains several special variables which accept BOTH alphabetic and numeric assignment.

The SET KEY is used to terminate input for assignment to EITHER variable type, and causes a direct replacement of the **old** displayed value with the **new** input value.

The ADD and SUB keys are used to terminate NUMERIC assignments ONLY and cause the arithmetic ADDITION or SUBTRACTION of the typed input against the current value of the variable.

Assignments do NOT cause the command line to be cleared so that by typing, for example, '1Ø', the ADD or SUB keys may be held down to 'wind' a parameter up or down.

CURSOR CONTROL KEYS

Since most pages have many variables, we must be able to select a particular one as the object of an assignment. This is performed through positional control of the ASSIGNMENT CURSOR.

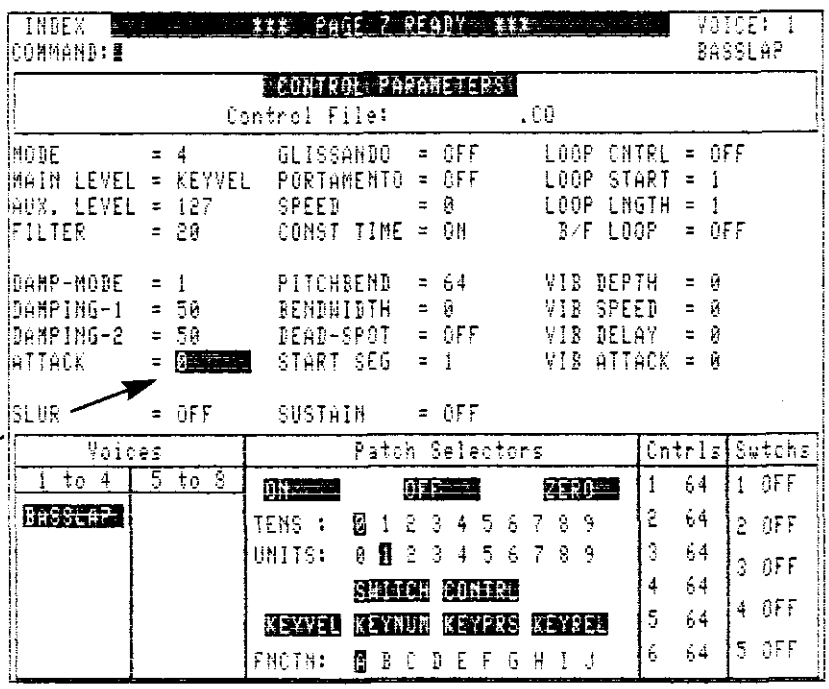
The CURSOR CONTROL KEYS consist of the four keys marked with ARROWS, plus the key marked 'HOME', situated in the small pad on the right of the terminal keyboard.

For a picture that's worth a thousand words, select PAGE 7 (CONTROL PARAMETERS) with the PAGE command.

Type **P7<return>**

Page 7 contains several variables. Press the 'down-arrow' repeatedly and then some of the other 'arrow' keys.

Observe how the CURSOR moves around.



The HOME KEY, marked **HOME** , will cause the cursor to return to the command line. All pages utilize this system of cursor control. The lightpen can provide instant positioning of the cursor on all pages.

RUBOUT & CLEAR KEYS

The key marked **RUBOUT** causes the deletion, or 'erasure', of the LAST CHARACTER in the command line. If a typing mistake is made, RUBOUT is used to 'backspace' and re-type the correct input.

The key marked **CLEAR** causes the command line to be cleared. Note that once an assignment or syntax error has been made the line will automatically clear on the next keystroke.

IN SUMMARY

Use the **<return>** key to issue a **command**
- make the CMI do something.

EXAMPLE **P6<return>** - Go to Page 6.

Use the **<add>**, **<sub>** or **<set>** keys to change a valid value.

EXAMPLE **5<add>** - Add 5 to the CURSORED variable.

REPEAT FUNCTION

The facility is provided to rapidly repeat the same key.

This is done by pressing and HOLDING DOWN the key for more than half a second.

Every key on the alpha-numeric keyboard has this feature giving this function a wide application. It is for your convenience, wherever you can apply it.

For example, consider repeating the RUBOUT key to erase the last half of the command line; or the ADD key to 'wind up' the value of a variable.

ASSIGNMENT EXAMPLES

Now we may explore the combined use of these features in making NUMERIC or ALPHABETIC ASSIGNMENTS from the alpha-numeric keyboard.

Select PAGE 8 (SOUND SAMPLING) with the PAGE command by typing

P8<return>

Then use the cursor control keys to TAB to SAMPLE RATE.
(This is the rate, in Hertz, at which an external signal is SAMPLED from this page; but we won't do any sampling - just try a few assignments.)

Note that SAMPLE RATE is already set to 14Ø8Ø Hz. This is the DEFAULT setting, meaning that it will always be set to this unless you change it.

Now type **3ØØØØ<set>**

The SAMPLE RATE is now **set** to a value of 3ØØØØHz.

Press **<RUBOUT>** **four** times to delete all but the '3' from the command line.

Now press **<SUB>**.

Note that **3** has been **subtracted** from 3ØØØØ to yield a sample rate of 29997Hz.

If you now use the REPEAT function (hold down the <sub> key), the rate will be 'wound-down' in steps of 3. Got the idea?

Assuming you have a VOICE loaded we can try a variable with an audible function by selecting PAGE 7 (CONTROL PARAMETERS).

Type **P7<return>**

Press the 'down-arrow' until the cursor is beside **MAIN LEVEL.**

LEVEL controls the volume and is an example of a variable which will accept BOTH alphabetic and numeric assignments.

SET MAIN LEVEL to 255.

Type **255<set>**

This represents maximum level. Typing <sub> will now subract 255 which will set LEVEL to Ø, or no level at all.

Now type **1<add>**

Hold down the <add> key to REPEAT the addition while playing on the music keyboard and you will hear the volume gradually increase.

ALPHABETIC assignments are performed in exactly the same fashion, except the SUB and ADD keys are meaningless.

Type **KEYVEL<set>**

This is the name of the KEY VELOCITY function and can be assigned to LEVEL which causes the keyboard to be touch sensitive.

Type **C1<set>**

This is the name of the first FADER on the master music keyboard which will now control LEVEL.

USE OF THE LIGHTPEN

Having gained an understanding of the basic principles of making commands and assignments, we may incorporate the various functions of the LIGHTPEN.

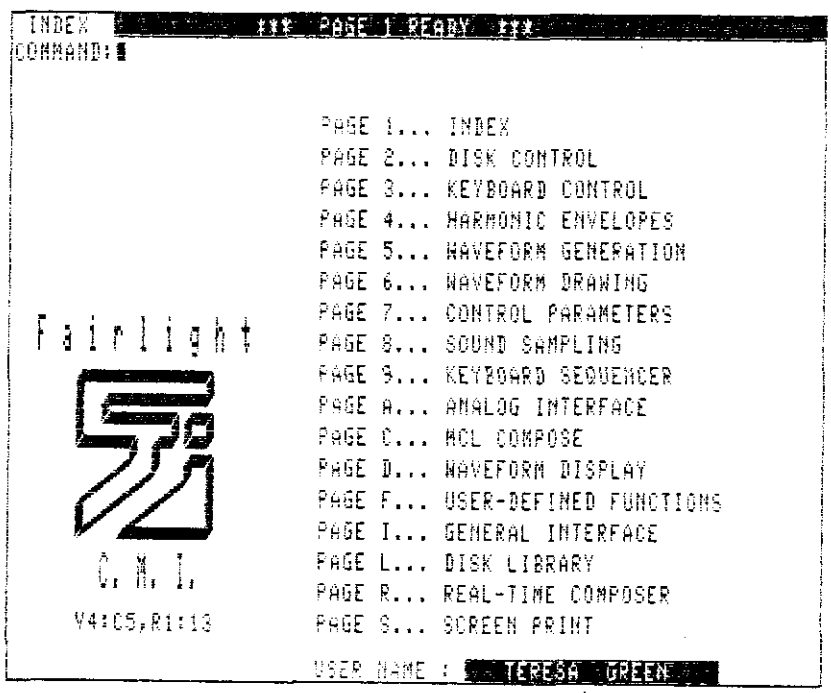
Getting a hit

The LIGHTPEN is light sensitive and operates by detecting the light from the video image. From this the system can determine the position of the pen and thereby identify the feature to which it is pointing.

Select PAGE 1 (INDEX).

Type **P1<return>**

Grasp the lightpen as if you were going to write with it, being careful not to touch the 'head' which is insulated from the body of the pen by a black plastic ring. Now point the lightpen at the word opposite 'USER NAME', holding the tip at right-angles against the surface of the screen.



point light-pen **here**

Note the 'blob' of light which appears directly beneath the tip.
Touch the head of the pen with your index finger and the 'blob' of light should disappear. If it doesn't, vary the angle and proximity of the pen to the screen until you can consistently cause the blob to appear and disappear at will.

This combined action of pointing the lightpen at a page feature and momentarily touching the head is known as a **"hit"**. Providing the feature is a lightpen-activated command (USER NAME is not) the hit will initiate the selected action.

Specifically, the pen should be positioned so that the left edge of the 'blob' of light just contacts the right edge of the target feature. A hit is then made by a single, positive, momentary contact with the index finger.

Lightpen-activated functions are divided into COMMANDS, CURSOR CONTROL and GRAPHIC CONTROLS.

LIGHT COMMANDS

Many commands can be given by lightpen and are referred to as LIGHT COMMANDS. Pages supporting light commands feature a list of COMMAND NAMES which are activated by "hitting" the required name with the lightpen.

On PAGE 1 (INDEX), the PAGE command is available as a light command and is given by hitting the name or number of the desired page. Use the lightpen to select PAGE 7 (CONTROL PARAMETERS).

CURSOR CONTROL

The lightpen can also be used like the cursor control keys to position the assignment cursor for variable assignment. To do this, the space occupied by the VALUE is hit; not the variable itself. Select MAIN LEVEL for assignment by hitting its current value. Once the cursor has been positioned in this manner, assignment can take place via the alpha-numeric keyboard and the ADD, SUB and SET keys.

GRAPHIC CONTROLS

Several pages support special purpose lightpen functions such as the KEYBOARD MAP on PAGE 3, the HARMONIC PROFILES on PAGE 4, the HARMONIC FADERS on PAGE 5 and the WAVEFORM DRAWING on PAGE 6.
These features cannot be demonstrated properly without entering into the finer points of individual page use. They will therefore be covered in the next section. The "hit" action is identical in all sections.

HELP PAGES

On all display pages **HELP** is available (except for Page A, C, G and T).

By typing **HELP<return>**
or **H<return>**

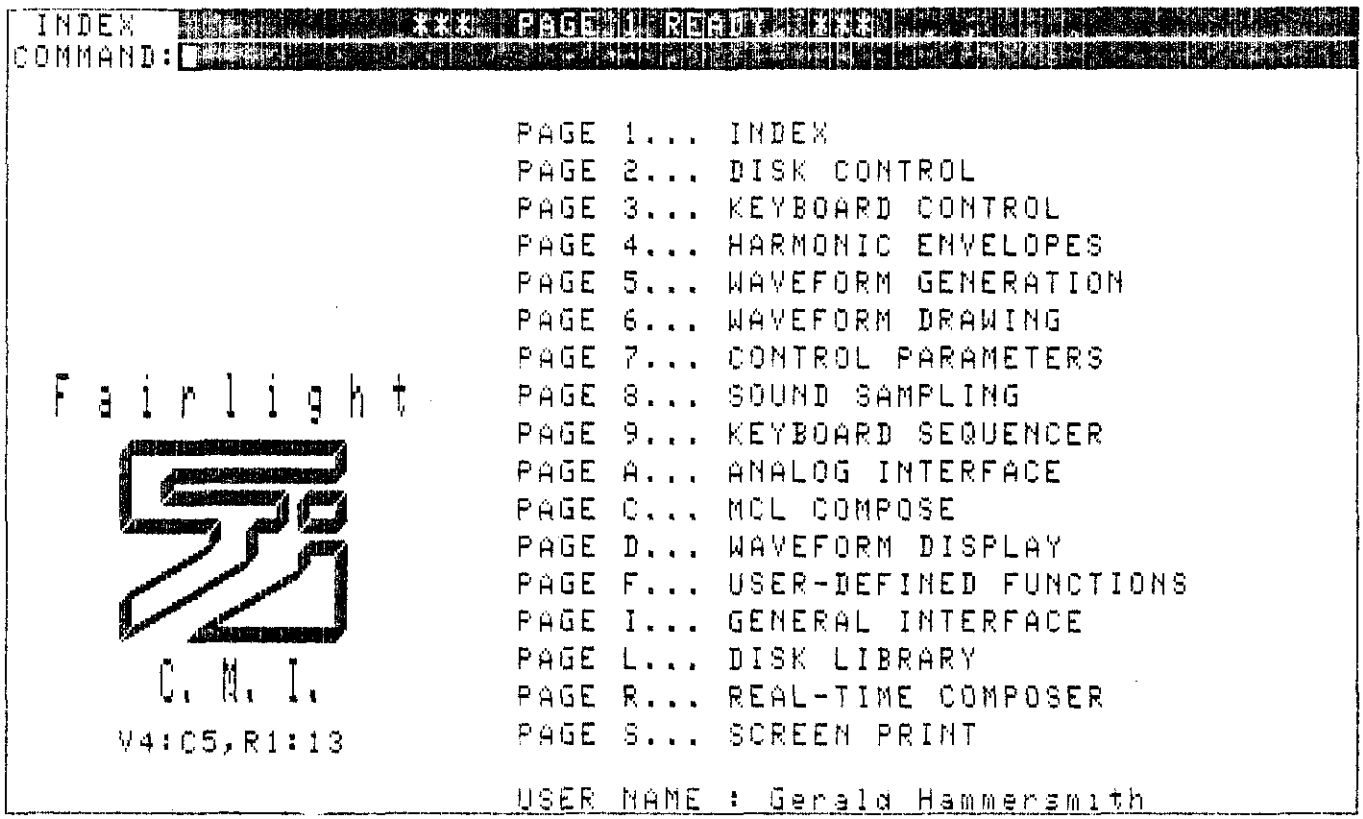
you will be presented with information describing the operation and commands available for that particular page.

Type **<return>**

to get back to the display page proper.

The following section explains how to use the HELP facility.

Section C: DISPLAY PAGE 1) INDEX



This page is an **index**, or menu, which shows you all the available pages and their functions. It is the first picture that appears on the video screen after the **system disk** is loaded into the **left hand** disk drive.

It is not used to change sound parameters, but rather as a starting point from which to proceed.

Hold the lightpen as you would hold a pen, taking care not to touch the end beyond the black plastic ring.

Put the tip of the lightpen on the screen and point to **PAGE 2... DISK CONTROL.**

Now, briefly touch the front of the lightpen with your index finger.

Otherwise, type **P2<return>**

You will hear the disk drive load Page 2, and a new picture will appear on the screen.

To get back to PAGE 1 touch the lightpen to the box at the top left hand corner of the screen marked "INDEX".

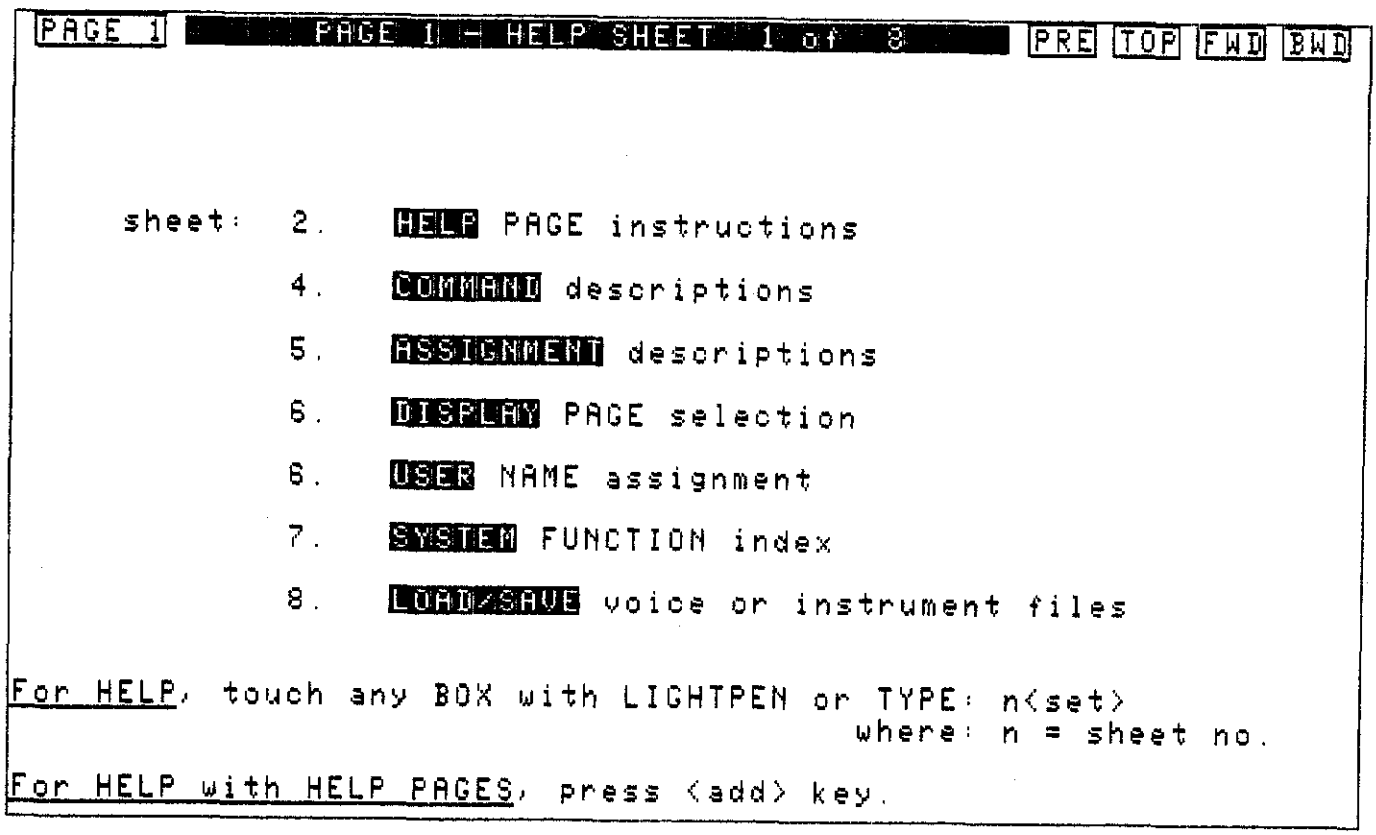
Otherwise, type **P1<return>**

1. HELP PAGE instructions

A HELP PAGE accompanies each standard DISPLAY PAGE, with full guidance for the use of the various features provided.

A "screen-full" of help is called a **SHEET** - each help page consists of several of these sheets.

Here is the first HELP sheet for Page 1 ...



A HELP INDEX is provided on the FIRST sheet of every help page to allow quick access to HELP for major features in two ways:

1. BY TYPING the sheet number and pressing **<set>** key.
2. BY HITTING an illuminated INDEX BOX with the LIGHTPEN
   ("Hit" means: point pen at item without touching tip with finger then "trigger" by a quick touch on tip.)

These INDEX BOXES are also provided **throughout** the HELP page. Any word inside an illuminated box may be hit with the lightpen for help on that topic.

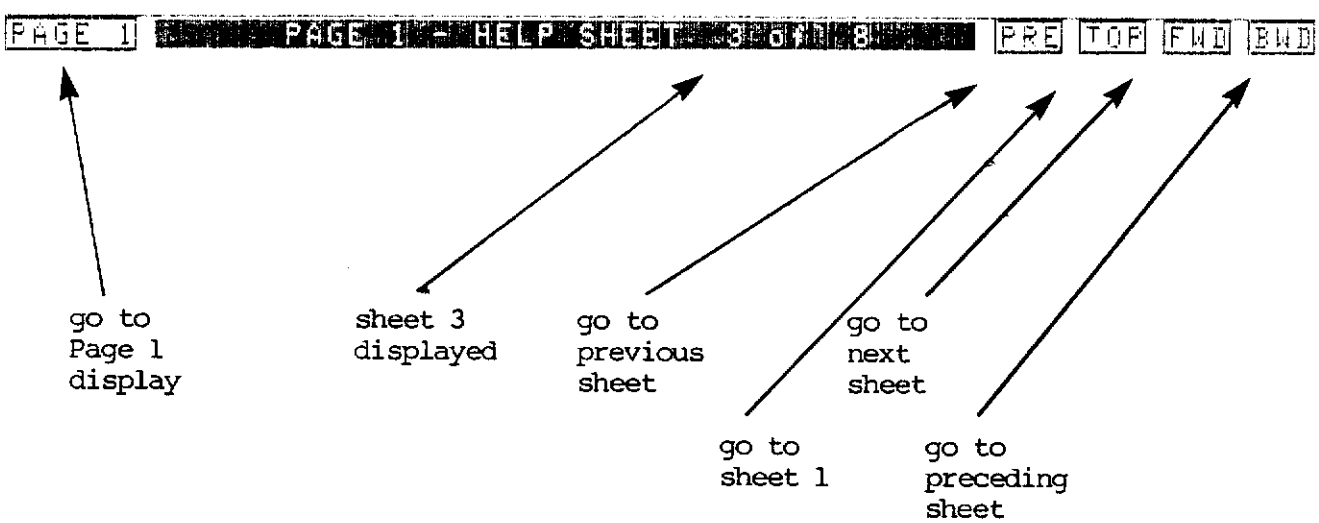
Thus, HELP sheets are cross referenced. See PREVIOUS SHEET box.

TO CHANGE HELP SHEETS with ALPHA-NUMERIC:

PRESS:		TO:
<add> key		go forward to next sheet
<sub> key		go backward to preceding sheet
<set> key		go to 1st sheet (HELP INDEX)
(sheet no.)**<set>**		go to any sheet; e.g. 3<set>
<clear> or **<return>**		return to DISPLAY PAGE

TO CHANGE HELP SHEETS with LIGHTPEN five "touchable" boxes are provided at the top of each sheet as well as the INDEX BOXES placed around key words.

TOUCH:		TO:
<PRE> box		go to **previous** sheet
<TOP> box		go to **1st** sheet - HELP INDEX
<FWD> box		go **forward** to next sheet
<BWD> box		go **backward** to preceding sheet
<PAGE x>		return to **DISPLAY** PAGE
<INDEX BOX>		select sheet for illuminated word



PREVIOUS SHEET BOX:

<PRE> is related to the illuminated INDEX boxes found around key words. When an INDEX box is touched with the lightpen, the sheet for that topic will be selected.

Touching <PRE> will then take you back to the original (previous) sheet. In fact you can backtrack through consecutive INDEX box touches in this way; each touch of <PRE> will take you back one further previous sheet. Thus the HELP sheets can be easily browsed with the LIGHTPEN without losing your place.

ALL COMMANDS provided by the DISPLAY PAGE shown at upper-left may be typed WHILE the HELP page is selected. Simply type the command as described by the HELP sheet. You will exit back to the display page automatically.

2. COMMAND descriptions

CONCISE DESCRIPTIONS of what you are to TYPE or touch with the LIGHTPEN to use the DISPLAY PAGES are presented with the aid of a few symbolic conventions.

Special Keys are indicated with lower-case letters within < > brackets:

<return> **<set>** **<add>** **<sub>** **<clear>** etc.

Lightpen Items are indicated with upper-case letters within "<>" brackets:

<FWD> **<BWD>** **<TOP>** etc.

Items which are defined when typed are indicated with lower-case letters (see "n" & "s" in the following example).

COMMANDS tell the CMI to "do something".

The **<return>** key is always used to enter a command.

Commands are described like this ...

TO SELECT a HELP PAGE type:

select HELP for current DISPLAY page - **H<return>**
select HELP for DISPLAY page (n) - **Hn<return>**
select HELP for page (n), SHEET (s) - **Hn,s<return>**

where: n = name (number or letter) of page: 1 to 9, D, F, L, R, S
s = sheet number

EXAMPLES: **H2<return>** Select PAGE 2 HELP (sheet 1)
HD,2<return> Select PAGE D HELP, sheet 2

This command may be given from either a DISPLAY or HELP page.

3. ASSIGNMENT descriptors

ASSIGNMENTS change the values, or "settings" of variable parameters.

The **<set>** key is usually the last key typed. Assignments are described like this example from PAGE 3....

To SET MASTER PITCH use <arrow> keys or LIGHTPEN to TAB to PITCH

type **n<set>**

where: n = desired tuning, Ø to 255

Because the value is a number we call this a **NUMERIC** assignment (as opposed to ALPHABETIC where the value is a **word** or **name**).

When making ANY NUMERIC ASSIGNMENT the **<add>** or **<sub>** keys can be used instead of **<set>** to ADD or SUBTRACT the typed number from the current value. The use of these keys is up to you; thus they are not often mentioned but are always available.

TABBING to an ITEM means to SELECT it for an assignment. This can be done with either the four <arrow> keys or LIGHTPEN.

ARROW KEYS: Press necessary keys to move the CURSOR (illuminated box) to the desired item.

LIGHTPEN: Touch displayed value of item.

THE COMMAND LINE is NOT CLEARED after a COMMAND ERROR or any ASSIGNMENT. The NEXT key typed will automatically clear the command line UNLESS it is one of the following keys:

<rubout> <arrow> <home> <add> <sub> <set>

4. DISPLAY PAGE selection

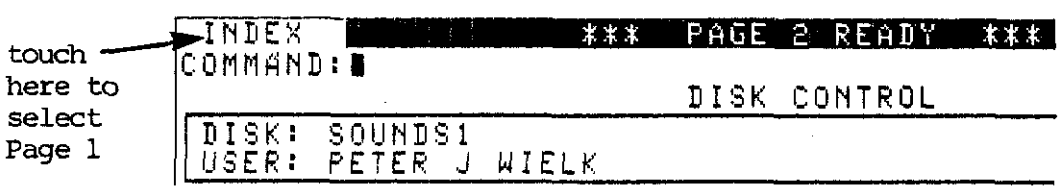
TO SELECT A DISPLAY PAGE

type **Pn<return>**

where: n = fill in the number or letter of desired page.
<return> = the RETURN key

EXAMPLE: **P2<return>** - select DISPLAY PAGE 2.

On PAGE 1 the LIGHTPEN may be used to select any other page by touching the page name or title. On other pages, touching the word INDEX (at upper left) will re-select PAGE 1.



5. USER NAME assignment

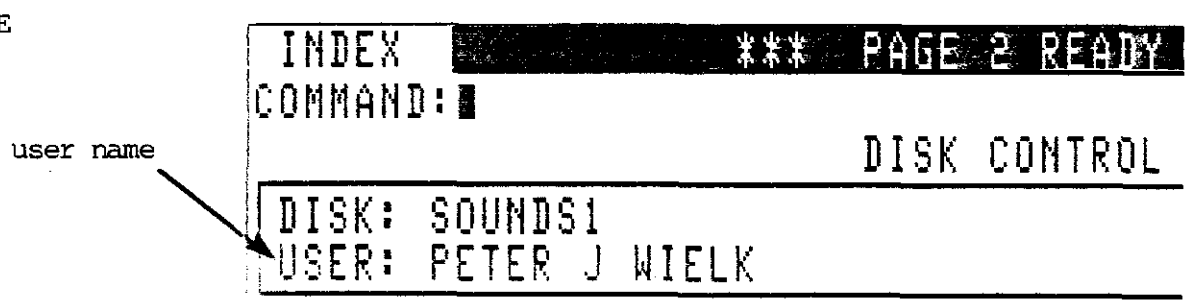
TO SET USER NAME ON SYSTEM DISK

First, use **<down-arrow>** key to move illuminated cursor to USER NAME.

type **up to 2Ø characters<set>**

where: <set> = the SET key.

EXAMPLE



6. SYSTEM FUNCTION index

The following is an index of SYSTEM FUNCTIONS and the DISPLAY PAGES on which they are provided.

Wherever a function is found on more than one page, parentheses indicate the HELP page with the most comprehensive description.

KEYBOARD/REGISTER CONTROL	DISPLAY (help) PAGES : 1 2 3 4 5 6 7 8 9 D F L C R
Keyboard Number selection	1 2(3)4 5 6 7 8 9 D F L C R
Nphony control/Register creation	. . 3 . . . . . R
Register-to-Keyboard mapping	. . 3 . . . . . R
Tuning	. . 3 . . . . .
VOICE CONTROL	
Harmonic Waveform Synthesis	. . .(4)5 . . . . .
Video-graphic Waveform Drawing	. . . . . 6 . . . . .
External Audio Waveform Sampling	. . . . . 8 . . . . .
Display Voice waveform	. . . . 5 6 . . . D . . . .
Mode	. . 3 . . .(7). . . . .
Loop	. . .(4). . 7 . . . . .
Amplitude	. . . 4 . 6(7). . . . .
Pitchbend/Vibrato/Key velocity	. . . . . 7 . . . . . R
Keyboard Controls & Switches	. . . . . 7 . . . . .
Real-Time function curves	. . . . . 7 . . .(F). . .
SEQUENCER CONTROL	
Record/Replay Keyboard Sequences	. . . . . 9 . . . . .
Create/Edit/Replay M.C.L. files	. . . . . C .
Create/Edit/Replay R.T.C. files	. . . . . R
DISK CONTROL	
Display/Change Filenames	. 2 . . . . .
Load/Save Voice/Instrument file	1 2(3)4 5 6 . 8 . D F L . .
Load/Save Control file	1 2 3 4 5 6(7)8 . D F L . .
Load Keyboard Sequence files	1 2 3 4 5 6 . 8(9)D . L . R
Load files by Keypad on master kbd	1(2)3 4 5 6 7 8 9 D F L C .
Free Space remaining on disk	.(2). . . . . 9 . . . . R
Delete/Transfer files	. 2 . . . . .
Disk Library	. . . . . L . .

7. LOAD/SAVE instrument or voice files

TO LOAD/SAVE VOICES or INSTRUMENTS type:

To LOAD a VOICE	-	**L,r,filename<return>**
To SAVE a VOICE	-	**S,filename<return>**
To CREATE a VOICE	-	**C,r,filename<return>**
To LOAD an INSTRUMENT	-	**L,filename.IN<return>**
To SAVE an INSTRUMENT	-	**S,filename.IN<return>**

where: r = register A - H
filename = 1-8 character filename

EXAMPLES:

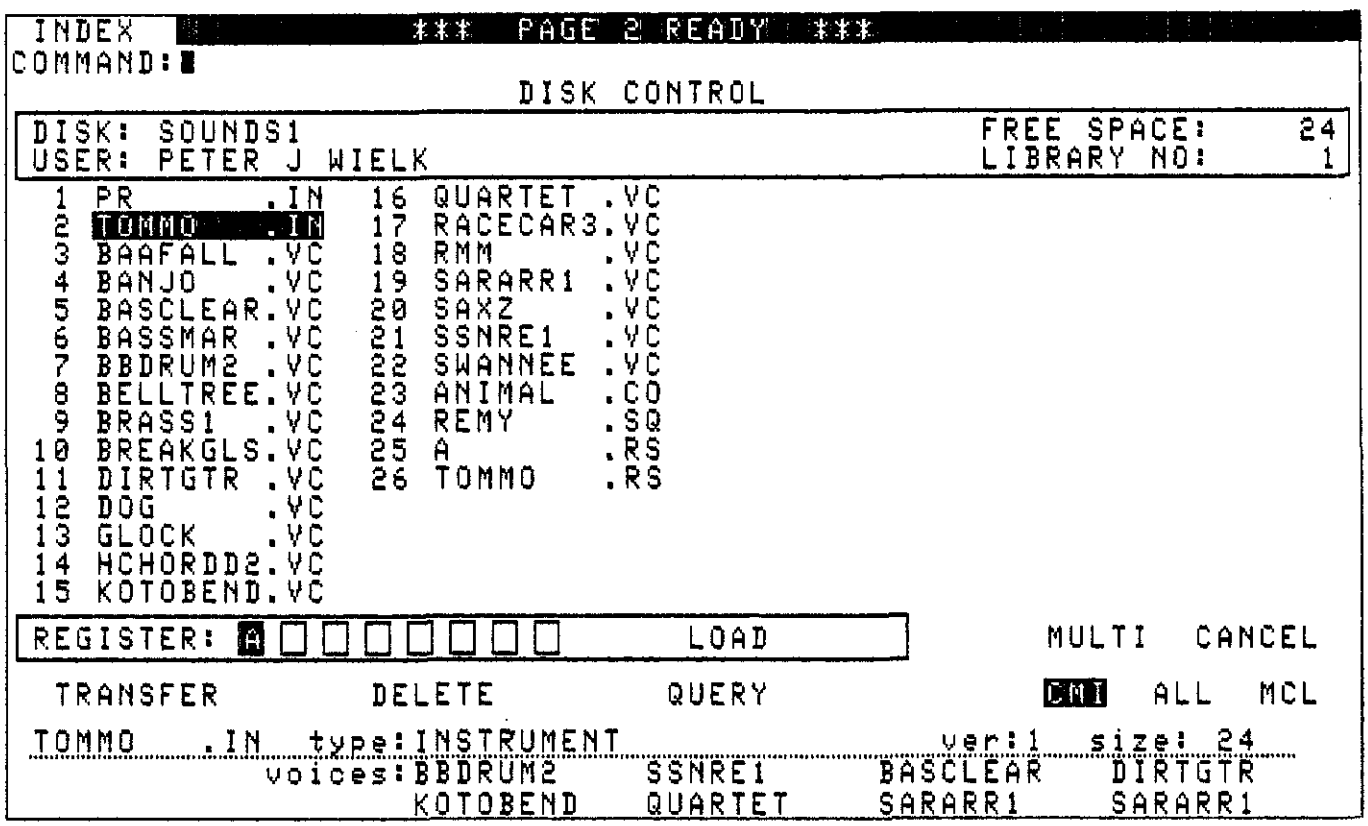
L,LUCK.IN<return>	Load instrument file called LUCK
L,A,FUZZ<return>	Load voice file called FUZZ into register A
C,A,NEWV<return>	Create voice called NEWV in register A

These commands may be given from ALL standard DISPLAY PAGES except PAGES **9** and **R.**

See PAGE 3 description for more about VOICES, INSTRUMENTS, and LOADING/SAVING files.

See PAGE 2 description to LOAD files with LIGHTPEN.

Section C: DISPLAY PAGE 2) DISK CONTROL



- A typical Page 2 display -

Here is the first HELP sheet for PAGE 2 ...

PAGE 2 PAGE 2 - HELP SHEET 1 of 11 PRE TOP FWD BWD

sheet: 2. FILENAMES and types
3. FREE SPACE on disk
3. LIBRARY number
3. SELECTING files (MULTI & CANCEL)
4. CHANGING disk, user or file names
4. QUERY command
5. SAVING instrument or voice files
5. LOADING instrument files
6. LOADING voice files
6. LOADING sequence files
7. DELETE command
8. TRANSFER command
9. DELETE/OVERWRITE protection
10. KEYPAD on master keyboard
11. COMMAND shortcuts

For HELP touch any BOX with LIGHTPEN or type: n<set>
where: n = sheet no.
For HELP with HELP PAGES, touch THIS or type: H1<return>

Page 2 is a convenient presentation of all the information on the sounds disk currently in the **right-hand** drive. From here you can "load" sounds or music, delete what you don't want anymore or copy any file to another disk.

1. FILENAMES and types

FILENAMES on disk in right hand disk drive are shown.

Up to **6Ø** files may be seen at once.

Displayed for each file is a **FILENAME, SUFFIX** and file **NUMBER.**

FILENAMES consist of 1-8 letters or numbers; the first of which must be a letter. A filename should be descriptive.

A 2-letter FILE SUFFIX indicates the TYPE of file.

Files with **different suffixes** may have the **same name,** but no two files on a disk will be allowed to have the **same name** AND **suffix.**

EXAMPLES

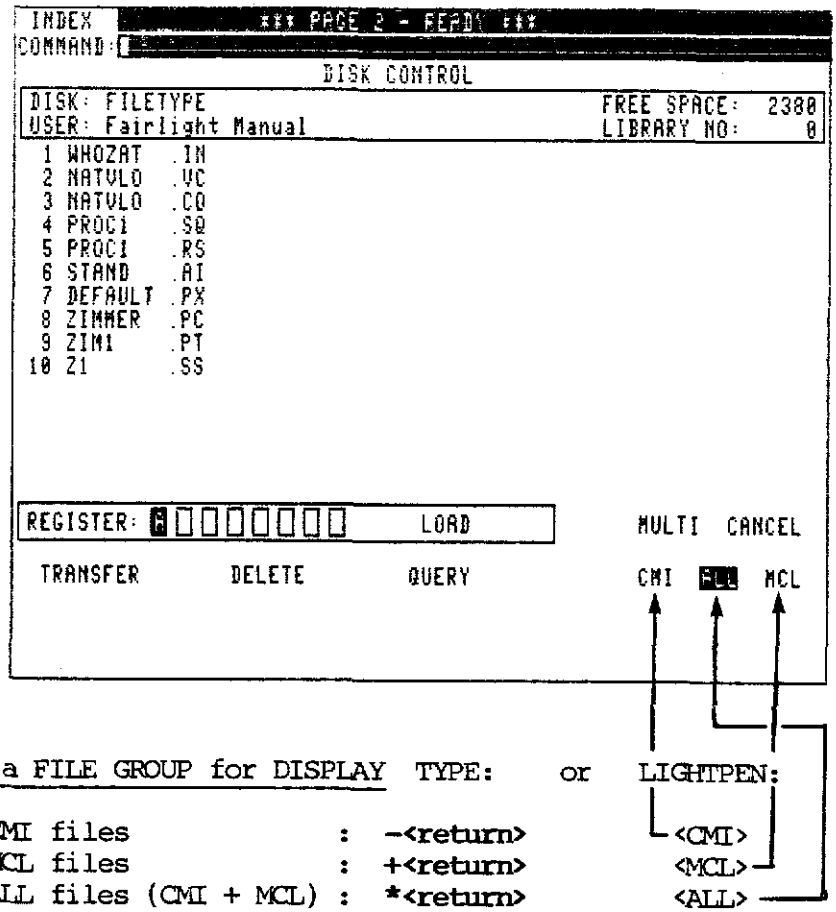
FRED1A.VC	valid
Q137BATO.CO	valid
1PATTERN.SQ	invalid - first character not alphabetic
SARABANDE.IN	invalid - more than eight characters
JAMES$1.VC	invalid - $ not a number or a letter
VOX1.IN }	
VOX1.VC }	valid - different suffixes
VOX1.CO }	

The "size" of a file is the amount of physical space occupied by the file measured in sectors, where one sector is 128 bytes.

group	suffix	FILE TYPES:	size	HELP
CMI files:	.IN -	INSTRUMENT	24	PAGE 3
	.VC -	VOICE	172	PAGE 3
	.CO -	CONTROL	16	PAGE 7,F
	.SQ -	KBD SEQUENCE	x	PAGE 9
	.AI -	ANALOG INTERFACE (optional software)	16	PAGE A
	.RS -	REAL TIME COMPOSER (optional software)	x	PAGE R
	.PX -	SCREEN PRINT (optional software)	132	PAGE S
MCL files: (optional software)	.PC -	PIECE	x	MCL manual
	.PT -	PART	x	MCL manual
	.SS -	SEQUENCE	x	MCL manual

"x" means variable size

Here is how all the different filetypes appear on Page 2 ...



TO SELECT a FILE GROUP for DISPLAY TYPE: or LIGHTPEN:

CMI files	:	-<return>	<CMI>
MCL files	:	+<return>	<MCL>
ALL files (CMI + MCL)	:	*<return>	<ALL>

The CMI group of files is displayed whenever PAGE 2 is selected.

2. FREE SPACE on disk

FREE SPACE shows size of largest single block of free disk space.

A **blank disk** will show **398Ø** free sectors.

A **sector** is **128 bytes** long.

The previous chart of file TYPES shows minimum number of sectors required for creating files.

Keyboard Sequence (Page 9), Music Composition Language (Page C) and Real-Time Composer (Page R) files **vary** in size depending on length of sequence.

3. LIBRARY number

LIBRARY NUMBER shows index number assigned to disk by PAGE L DISK LIBRARY. See DISPLAY PAGE L - DISK LIBRARY.

4. SELECTING files (MULTI & CANCEL)

SELECTING FILES for LIGHTPEN COMMANDS

The PAGE 2 lightpen commands all operate on files and require that filename(s) be selected before using a command.

To select a single file, use <arrow> keys or lightpen to TAB to the filename (illuminating it).

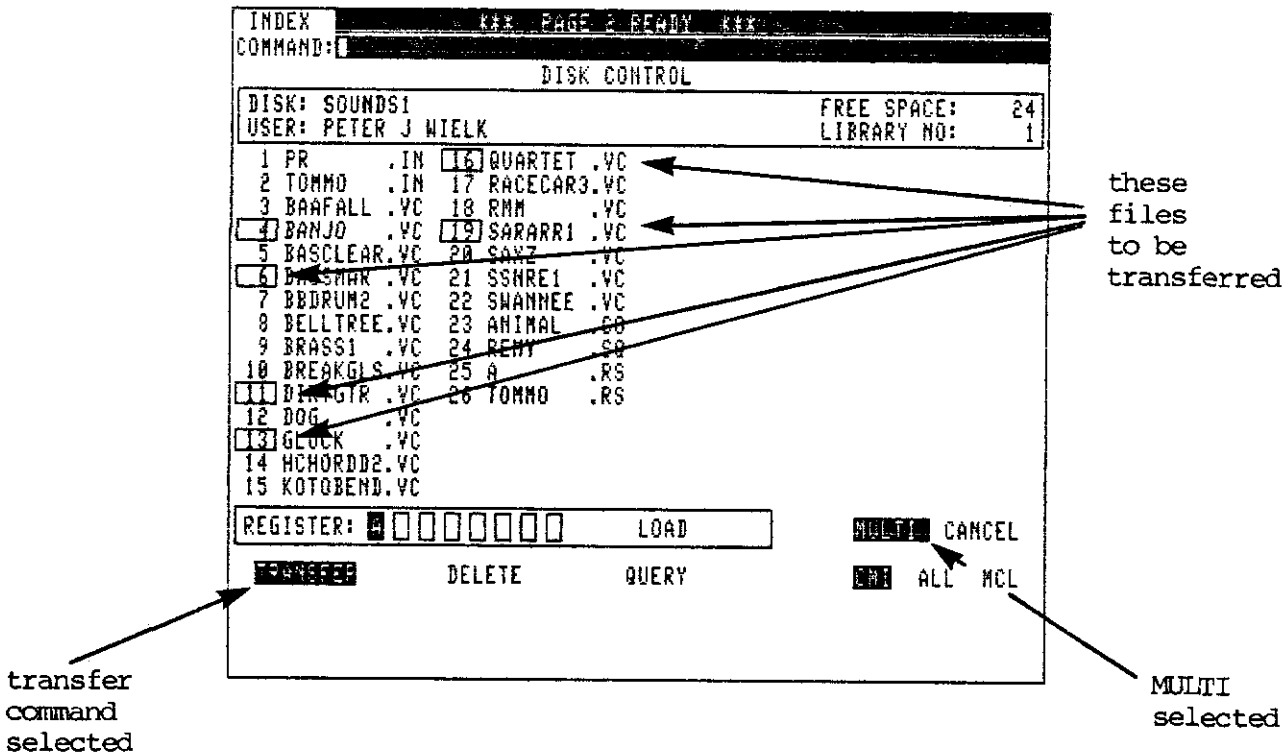
To select multiple files (shown by boxes around file numbers),

TYPE:	LIGHTPEN:
(Choose file with <arrow> keys or lightpen.)	Touch <MULTI>.
Press **<add>** key to select file.	Touch desired files.
Press **<sub>** key to deselect file.	Touch <CANCEL> to deselect.

To RESET (cancel all multiple file selections)

TYPE **<clear>**

Here we have a number of voice and control files ready to be transferred onto another disk.



5. CHANGING disk, user or file names

TO CHANGE DISK NAME, USER NAME or FILENAME

First, select item with <arrow> keys or LIGHTPEN.

TYPE: **filename<set>** :FILENAME or DISK NAME
<1-2Ø characters><set> :USER NAME

where: filename = 1-8 letters or numbers
1st must be a letter.

When a filename is changed it will automatically be positioned **alphabetically** within the list of filenames.

It should be noted that if a voice name is changed then any Instrument file (.IN) using that voice will not find the new voice name unless the instrument file is re-saved with the new voice name.

For MCL files it is recommended that only PIECE (.PC) filenames be changed on Page 2.

6. QUERY command

TO QUERY A FILE TYPE: **Q,file<return>** LIGHTPEN: <select file> <QUERY>

where: file = FILENAME.SF :filename with suffix
or
file = ## :file number

EXAMPLES: Q,ZOOM.VC<return> is the same as
Q,14<return> if ZOOM.VC is labelled file number 14

Version number, size and type will be displayed for selected file at the bottom of the screen.

VOICE names within INSTRUMENT files and CONTROL file names within VOICE files will also be displayed.

This means (for example) that you can see the Voice contents of an Instrument file without having to load the Instrument file.

7. SAVING instrument or voice files

TO SAVE INSTRUMENT or VOICE FILE TYPE:

INSTRUMENT: **S,filename.IN<return>**
or
S,IN,filename<return>

VOICE: **S,filename<return>**

EXAMPLE: S,ORCHY.IN<return> - save instrument: ORCHY
S,FLUTE<return> - save voice: FLUTE

If the filename already exists on the sounds disk in the right hand disk drive, the CMI will ask you whether you want to overwrite the filename.

Respond by typing **Y<return>** if so.

See PAGE 3 description for more about SAVE command.

8. LOADING instrument files

TO LOAD INSTRUMENT FILE (.IN suffix)

TYPE:
L,filename.IN<return>
or
L,IN,filename<return>

EXAMPLE: L,NICEINST.IN<return>
L,IN,NICEINST<return>

LIGHTPEN:
<select file>
<LOAD>

An INSTRUMENT file is a collection of voice filenames, keyboard splits and tunings, that is, a replica of Page 3 - Keyboard control.

An INSTRUMENT file will not load if any of the required VOICE files are not found (see PAGE 3).

Use QUERY command to see voice names within an instrument file.

9. LOADING voice files

TO LOAD VOICE FILE (.VC suffix)

TYPE:
L,r,filename<return>
where: r = register: "A-H"

EXAMPLE: L,B,TRUMPS<return>

LIGHTPEN:
<select files>
<select REGISTER>
<LOAD>

When using the lightpen, <select REGISTER> means touch the desired register in the REGISTER SELECTOR (inside LOAD box). This determines into which **register** the **voice** will be **loaded.**

There are **eight** possible registers A-H depending on the setting of NPHONY (polyphony) on PAGE 3.

Empty selection boxes indicate further possible registers. If the desired register is already selected (illuminated) then this step may be omitted.

Loading INSTRUMENT files wipes out any previous settings on Page 3 and may change the number of available registers.

Note that **multiple** VOICE files may be loaded into a **single** register if NPHONY has been set accordingly. See PAGE 3 description.

1Ø. LOADING sequence files

TO LOAD KEYBOARD SEQUENCE FILE (.SQ suffix)

TYPE:
L,filename.SQ<return>

LIGHTPEN:
<select file>
<LOAD>

Loads PAGE 9 KEYBOARD SEQUENCER REPLAY FILE.
See PAGE 9 description.

11. DELETE command

TO DELETE FILE(S) FROM DISK

TYPE:
D,file<return>
or
D,file,file,file(,...etc)<return>

LIGHTPEN:
<select files>
<DELETE>

where: file = FILENAME.SF :filename including SUFFIX
or
file = ## :displayed number of file (eg,"17")
or
file = ##-## :range of file numbers (eg,"4-27")
or
file = * (asterisk) :ALL FILES ON DISK

EXAMPLES: D,THING.VC<return>
D,2,5-9,REGS2.IN,THING.CO,27<return>
D,*<return>

When a file is DELETED it is **permanently removed** from the disk, freeing the space it occupied. See DELETE/OVERWRITE PROTECTION.

TO CREATE a BLANK DISK BY DELETING EVERY FILE

TYPE: **D,*;Y<return>**

Due to the scope of this operation, **two** confirmation messages will appear:

TOTALLY ERASE DISK IN RH DRIVE - (Y)?

ARE YOU SURE - DELETE ALL FILES - (Y)?

Reply to both by typing: **Y<return>**.

ALL files on the disk will be DELETED.

FREE SPACE will be **398Ø** sectors.

12. TRANSFER command

TO TRANSFER FILES TO ANOTHER DISK

TYPE:
T,file<return>
or
T,file,file,file(,...etc)<return>

LIGHTPEN:
<select files>
<TRANSFER>

where: file = FILENAME.SF or ## or ##-## or *
(same as DELETE; see above)

EXAMPLES: T,CHORUS.IN<return>
T,4-18,ABLE.VC,25<return>

Files will be copied **FROM** sounds disk in righthand drive (DISK A) **TO** another disk in lefthand drive (DISK B).

Give TRANSFER command with system disk in lefthand drive and DISK A in righthand drive.

When the message

PLACE FILE DISK IN LH DRIVE

appears, place DISK B in lefthand drive.

When the transfer is completed a final message will request the replacement of the system disk. If a file already exists on DISK B (has same name and suffix as file on DISK A), it will NOT be overwritten without your consent. See also DELETE/OVERWRITE PROTECTION.

TO COPY an ENTIRE DISK

TYPE: **T,*<return>**

When the message

PLACE FILE DISK IN LH DRIVE

appears place a BLANK file disk in left hand drive.

Replace **system disk** in lefthand drive when completed.

The new disk will usually show more FREE SPACE than the one it was copied from. This is because the CMI transfers one file at a time, re-organising free space allocation on the new disk.

13. DELETE/OVERWRITE protection

DELETE/OVERWRITE PROTECTION

As a safeguard, the TRANSFER and DELETE commands will not overwrite (write to an existing file) or delete a file without first requesting your confirmation.

The message:

DELETE/OVERWRITE <filename> (Y)?

will appear and the CMI waits for your reply.

TO REPLY:	TYPE:
YES, go ahead.	**Y<return>**
NO, skip to next specified file (if any).	**N<return>** (or just **<return>**)
NO, stop the command.	press **<esc>** while holding down **<cntrl>**

This will occur for EACH file to be deleted or overwritten if more than one file is specified in the command. To restrict this protection to a single confirmation for all selected files, type ";Y" before pressing <return> for the command. Then reply as above to the message which appears.

EXAMPLES: D,1Ø-19;Y<return>
T,ANICE.VC,ANICE.CO;Y<return>

14. KEYPAD on master keyboard

MUSIC KEYBOARD KEYPAD & LED DISPLAY

	TYPE (on keypad):
To DISPLAY last ERROR MESSAGE:	**<*>**
To display DISK NAME	**DD<*>**
To DISPLAY a FILENAME:	**D##<*>**
To DISPLAY FILENAMES sequentially	**D<*>**
To LOAD .IN or .SQ FILE:	**##<*>**
.VC FILE:	**##<*>** or **##r<*>**

where: <*> = "*" on keypad - equivalent to <return>.
= FILE NUMBER on PAGE 2 (not <#> key; see below)
r = REGISTER: "A-D". If register is not specified when loading a voice, the REGISTER SELECTOR on PAGE 2 will determine the register loaded.

note: <#> key on keypad functions like <rubout> key to delete last key typed.

EXAMPLES: D13<*> :DISPLAY name of file 13.
D<*> :DISPLAY next file
32B<*> :LOAD (voice) file 32 into register B.

The keypad on the master keyboard would typically be used in a live performance environment where voices or an instrument file could be loaded without having to use the alpha-numeric keyboard or video display. The video monitor and alpha-numeric keyboard need not be connected for the CMI to be used for live performance.

Keypad commands may be given from ALL standard display pages, and cause PAGE 2 to be automatically selected.

See also COMMAND SHORTCUTS.

15. COMMAND SHORTCUTS

	TYPE (on alphanumeric):
To CLEAR the command line only: (rather than <CLEAR>)	**<ctrl>Z**
To re-display the last command or *prompt from the CMI:*	**<ctrl>Q**

LOADING FILES

All KEYPAD commands may also be typed on your ALPHANUMERIC keyboard by using

<ctrl-E>

Press **<E>** while holding down **<ctrl>** instead of the keypad **<*>** key.

This allows files to be loaded by typing only the file NUMBER and <ctrl-E>.

Registers A-H may also be specified when loading voice files. This may be done from ANY standard display page.

EXAMPLES:

```
12<ctrl-E>  :LOAD file 12.
7C<ctrl-E>  :LOAD (voice) file 7 into register C.
```

All PAGE 2 TYPED Commands

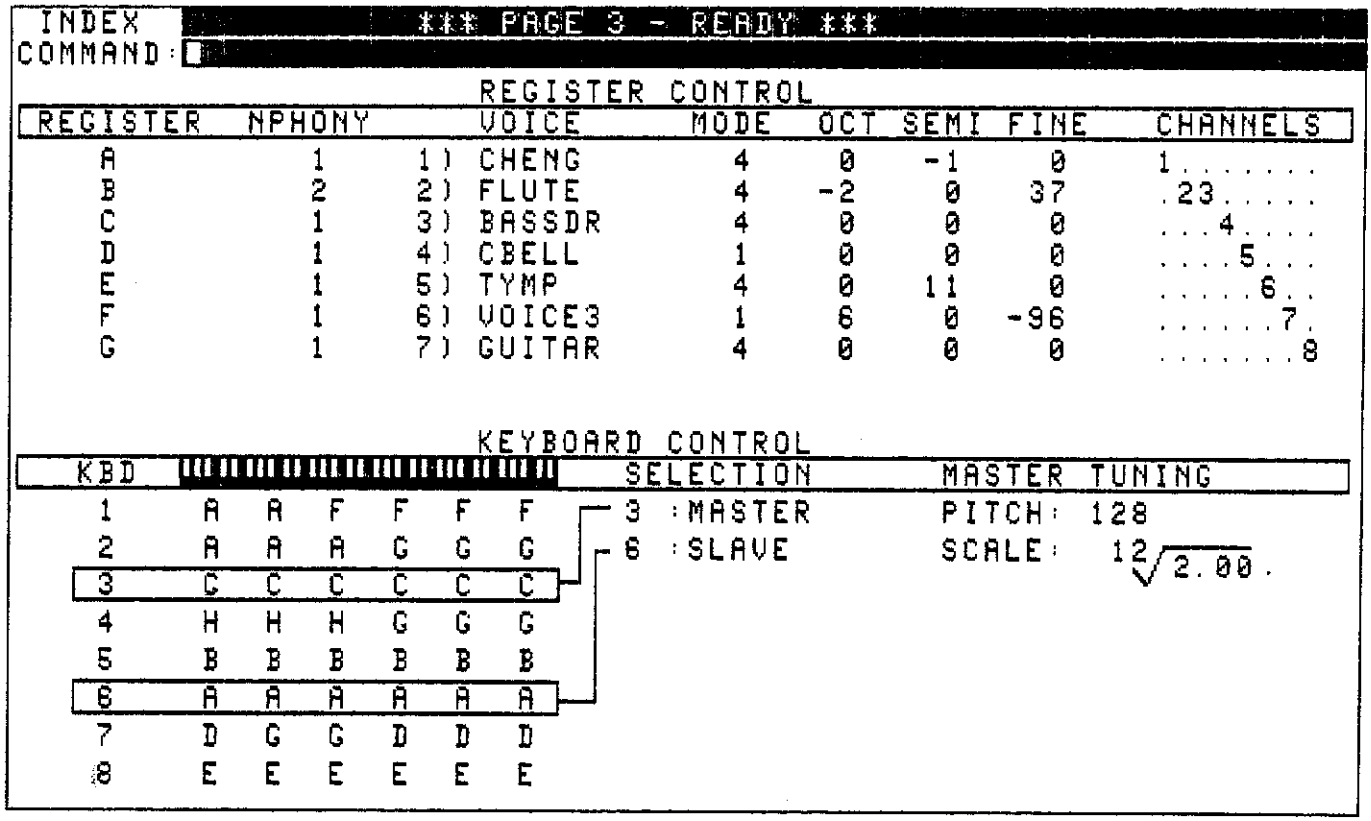
If only the 1st letter of a command is typed followed by <return> then filenames may be chosen as for a lightpen command (see SELECTING FILES).

EXAMPLES

To DELETE a file - position cursor then type: **D<return>**
To QUERY any file - position cursor then type: **Q<return>**
To LOAD any file - position cursor then type: **L<return>**
To LOAD MULTIPLE VOICES - position cursor, type: **L<return>**

Section C: DISPLAY PAGE 3) KEYBOARD CONTROL

A typical Page 3 voice, keyboard and tuning allocation



Here is the first HELP sheet for Page 3 ...

```
PAGE 3   PAGE 3 - HELP SHEET  1 of 14   PRE TOP FWD BWD
     sheet:  2.   REGISTER control
             2.       NPHONY of a register
             3.       TUNING of a register
             4.       NAME/MODE of a voice
             5.   KEYBOARD control
             5.       SELECTION of a keyboard number
             6.       MAPPING of registers to the keyboards
             7.       PITCH/SCALE tuning controls
             8.   VOICE files
             9.       LOAD voice command
             9.       SAVE voice command
            10.       MULTI-VOICE load command
            11.       CREATE voice command
            12.   INSTRUMENT files
            12.       LOAD instrument command
            13.       SAVE instrument command
            13.   PROTECTION against overwriting your files
            14.   OPTIONS to use with the SAVE commands
For HELP, touch any BOX with LIGHTPEN or type: n<set>
                                          where: n = sheet no.
For HELP with HELP PAGE, touch  THIS  or type: H1<return>
```

Page 3 shows you **voice, keyboard** and **tuning** allocation.

On this page you can see which voices are coming out of the eight audio channels connected at rear of CMI.

Any voice can be tuned in increments of **+/- 1/1ØØth** of a **semitone** to **+/- 6 octaves.** Tuning stability is quartz-crystal locked.

Furthermore, the Western tempered tuning of 12 root 2.ØØ (**doubling** of pitch every **12** semitones) can be changed to many other macro/micro tuned scales.

For example, to get a **1/4 tone scale** change the tuning to **24** root **2.ØØ (doubling** of pitch every **24** notes).

A **master tuning** control can vary the pitch of **all** loaded voices by +/- 1/4 tone in 256 discrete steps to tune in with other musical instruments if necessary. All such tunings can be "saved" as an instrument file for later recall.

A voice can be allocated to any of the 6 octaves in any of the 8 effective keyboards in the CMI's memory. As well, up to eight different voices can be loaded to play from a **single** keyboard note. Each will retain their separate control files (Page 7) and so may be expressed individually.

1. REGISTER control

REGISTERS are groups of 1 or more of the eight VOICE OUTPUT CHANNELS. You may have from 1 to 8 registers (identified by the letters: A-H) provided the TOTAL of their channels is not more than 8.

Each register may be:
- LOADED with one or more voice files.
- MAPPED to any octaves of the keyboard so the voice(s) may be played.
- TUNED in three ranges.

2. NPHONY of a register

Channels are allocated to each register BY THE CMI according to the **polyphonic capability** desired (number of notes that can be played at once).

This is the **NPHONY** for the register.

The default condition provides one register (A) with NPHONY=8; consuming channels 1-8 and precluding any more registers.

TO SET NPHONY of a REGISTER

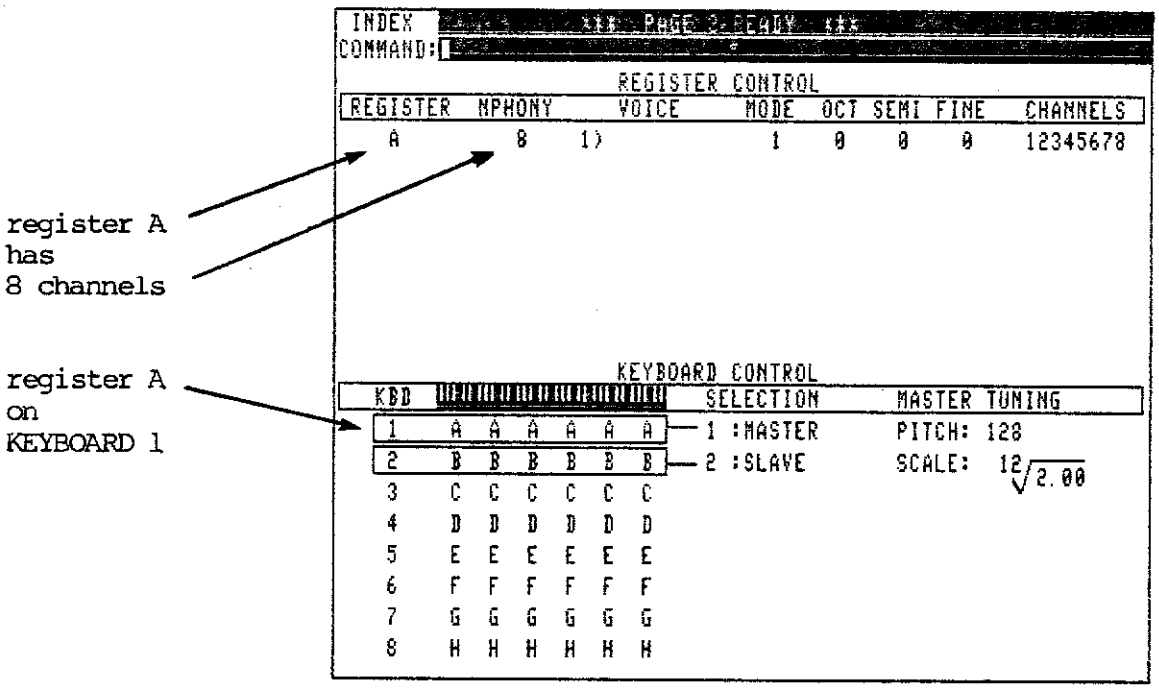
Use <arrow> keys to TAB to NPHONY for desired register.
TYPE: **n<set>**
where: n = desired polyphony: Ø - 8

To CREATE a NEW REGISTER reduce the NPHONY of the last register (bottom of NPHONY column). When the channel total is LESS than eight, a new register will be available with an NPHONY of zero. TAB down and set the desired nphony.

To DISPOSE of REGISTERS set NPHONY to zero. This will remove the register AND ALL REGISTERS BEYOND (higher letters).

WARNING: any voices IN the disposed register(s) will be LOST from memory.

Here is the default setting of Page 3 with Register A having all eight output **channels ...**

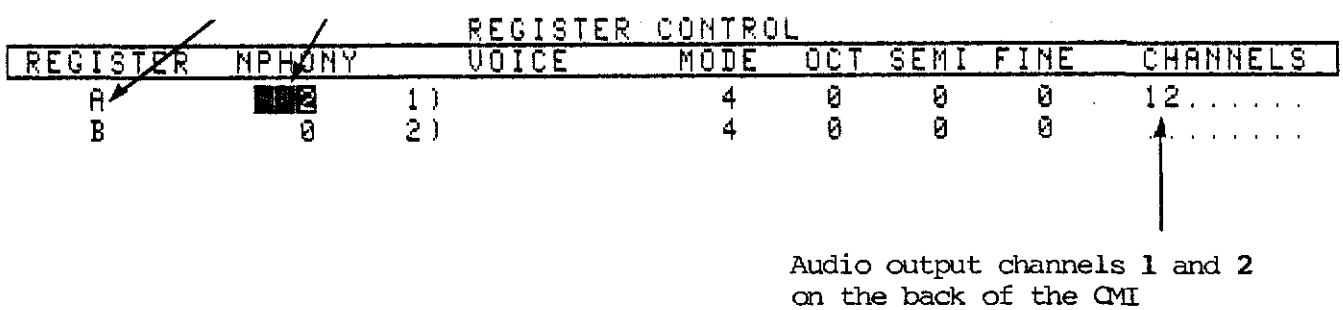


To allow different sounds to be loaded into the CMI, more **REGISTERS** have to be opened.

To do this move the CURSOR (by means of the lightpen or the arrow keys) to the NPHONY number "8".

TYPE: **2<set>**

This gives **Register A** two voices and automatically opens up **Register B.**



Audio output channels **1** and **2** on the back of the CMI

In a similar way all eight channels are allocated.

REGISTER CONTROL

REGISTER	NPHONY	VOICE	MODE	OCT	SEMI	FINE	CHANNELS
A	2	1)	4	0	0	0	12.....
B	1	2)	4	0	0	0	..3.....
C	1	3)	4	0	0	0	...4....
D	4	4)	4	0	0	0	5678

Separate channels for different registers

Now voices are **loaded** from **Page 2** using

REGISTER selection and LOAD command.

REGISTER: A B C D LOAD

TRANSFER DELETE QUERY

Having loaded in some voices, Page 3 now looks like...

REGISTER CONTROL

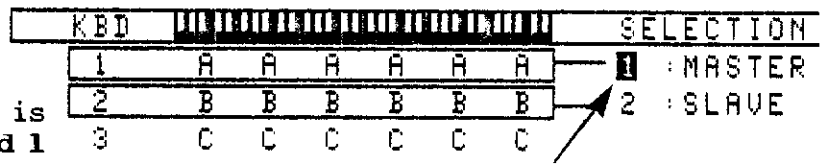
REGISTER	NPHONY	VOICE	MODE	OCT	SEMI	FINE	CHANNELS
A	2	1) BASSGT	4	0	0	0	12.....
B	1	2) SNARE	4	0	0	0	..3.....
C	1	3) BDRUM	4	0	0	0	...4....
D	4	4) PIANO	4	0	0	0	5678

So BASSGT voice comes out of CHANNELS **1** and **2.**
SNARE voice comes out of CHANNEL **3.**
BDRUM voice comes out of CHANNEL **4.**
PIANO voice comes out of CHANNELS **5,6,7,8.**

Each different sound is allocated to a different register and keyboard in the CMI memory. The CMI has **eight** different keyboards in its **memory.** We can specify which **memory keyboard** has a sound on it, and switch the **physical keyboard** between them.

We don't need four physical keyboards to play the memory keyboards. The actual **physical** MASTER keyboard in front of you can play any one of the memory keyboards. This is how.

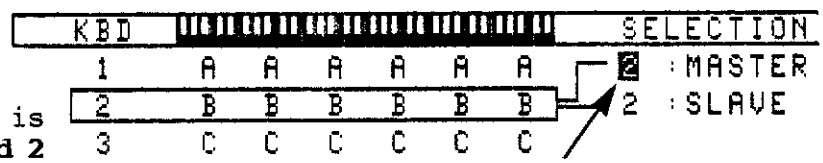
Move the CURSOR to the number **beside** MASTER.



The **MASTER** (physical) keyboard is now playing CMI memory **keyboard 1** which contains the **voice** in **Register A (BASSGT)** coming out of audio **channels 1 and 2** at the back of the CMI.

TYPE **1<add>**

Keyboard control should now look like this ...



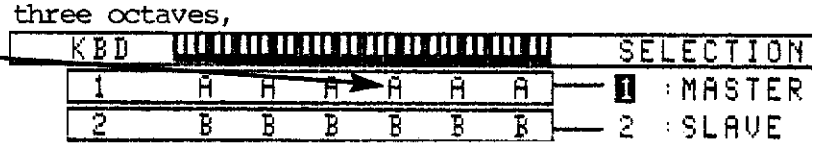
The **MASTER** (physical) keyboard is now playing CMI memory **keyboard 2** which contains the voice in **Register B (SNARE)** coming out of audio **channel 3.**

By changing the **MASTER** (physical) keyboard number, any of the **eight** CMI memory keyboards can be accessed. The optional SLAVE keyboard operates the same way. These keyboard changes work on all other pages.

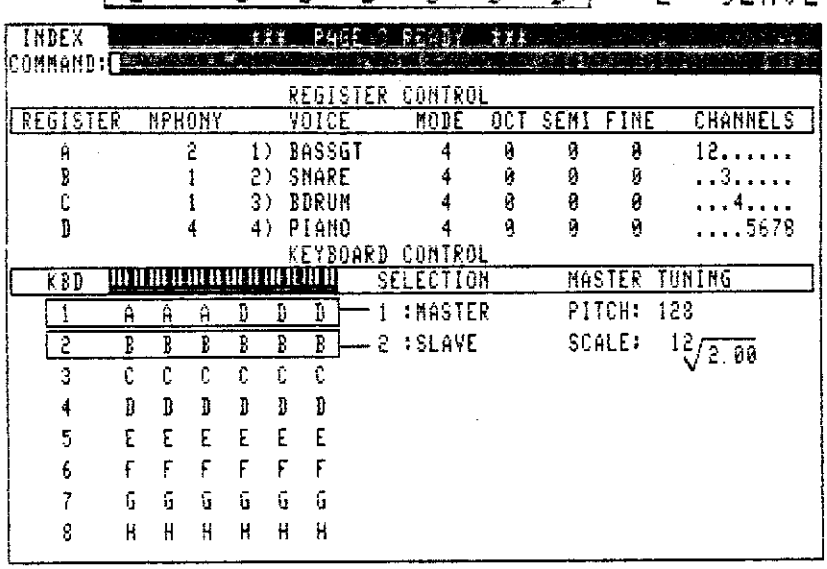
On any page, type **K6<return>** the MASTER keyboard will play CMI keyboard number **6.**

ON any page, type **KS3<return>** the SLAVE keyboard will play CMI keyboard number **3.**

To SPLIT Keyboard 1 such that **BASSGT** voice is in the lower three octaves and **PIANO** voice is in the higher three octaves, position cursor **here** and type **D<set>**
<right arrow>
<set>
<right arrow>
<set>



Page 3 finally looks like this and can be **saved** permanently onto floppy disk.



3. TUNING of a register

TO ADJUST TUNING of a REGISTER

Use <arrow> keys to TAB to OCT SEMI or FINE for the register.

TYPE: **nn<set>**

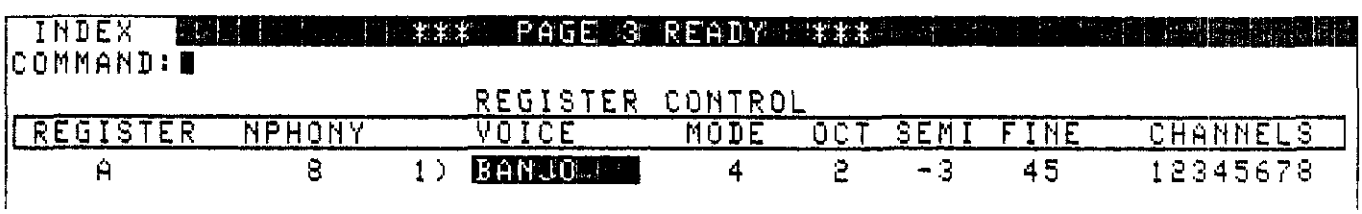
where: nn = OCT : -6 to +6 (octaves)
SEMI: -11 to +11 (semitones)
FINE: -99 to +99 (1/1ØØths of semitones)

You may type <minus>nn to **<set>**, **<add>**, **<sub>** a negative value.

This alters the **tuning offset** for the selected register. Any change will require a moment to take effect. You may make alterations as rapidly as you desire as long as you realize the CMI is "catching up" behind you.

The TUNING of REGISTERS is SAVED & LOADED with INSTRUMENT FILES.
It is convenient to have a small chromatic electronic tuner on hand for visual confirmation of fine tuning adjustments.

Here is voice BANJO tuned **2** octaves up, **3** semitones down and **45/1ØØths** of a semitone up ...



TO RESET PAGE 3

TYPE: **R<return>**

This resets PAGE 3 (the INSTRUMENT) to the start-up (default) condition:

1 register (A) with NPHONY=8, no voices loaded.

The following message will appear before proceeding:

RESET INSTRUMENT - UNLOAD ALL VOICES (Y)?

To reply YES, type: **Y<return>**
To reply NO, type: **N<return>** or **<return>** or **<ctrl-esc>**.

WARNING: All voices will be "unloaded" and thus LOST if not previously SAVED.

4. NAME/MODE of a voice

TO ASSIGN A VOICE NAME

Use <arrow> keys to TAB to name in the "VOICE" column.

TYPE: **filename<set>**

where: filename = 1-8 character filename without suffix
(See PAGE 2 description)

This simply changes the **name** of the voice AS LOADED - and has nothing to do with the VOICE FILENAME on disk (which may be changed on PAGE 2).

You may assign to a **BLANK** voice name (in an un-loaded register) in which case the result is the same as CREATING a VOICE (see below) except WAVEFORM is NOT zeroed and the voice will not be automatically saved to disk (unless you save it).

TO SET MODE of a VOICE

Use <arrow> keys to TAB to MODE for desired voice.

TYPE: **n<set>**

where: n = desired MODE: 1 or 4

This changes the operating MODE of the channels assigned to the voice.

See PAGE 4 & 7 description for more about MODE.

The MODE setting is LOADED & SAVED as part of a VOICE FILE.

5. KEYBOARD control

THE KEYBOARD MAPS each consist of a KEYBOARD NUMBER followed by six letters indicating the REGISTER assigned to each octave. The SELECTION table allows you to assign any of the eight keyboard numbers in **computer memory** to the actual **physical MASTER** or **optional SLAVE music keyboard**, thus "linking" it to the corresponding map.

Keys in any octave will then activate the register chosen for that octave.

Sequences made with Page 9 - Keyboard Sequencer or
Page C - M.C.L. or
Page R - Real Time Composer

also have keyboard numbers determining the map to which they are linked when replayed.

The KEYBOARD MAPS are LOADED & SAVED as part of an INSTRUMENT FILE.

6. SELECTION of a keyboard number

TO SET KEYBOARD SELECTION NUMBER

Use <arrow> keys to TAB to MASTER or SLAVE,

TYPE: **n<set>**

where: n = keyboard map no. 1 - 8

This links the selected MUSIC keyboard to the desired KEYBOARD MAP.

The keyboard selection is NOT confined to PAGE 3 - the keyboard will now remain linked to the map on any page.

TO SET KEYBOARD SELECTION NUMBER from ANY DISPLAY PAGE

TYPE: **Kn<return>** - to set master keyboard
KSn<return> - to set optional slave keyboard

7. MAPPING of registers to the keyboards

TO ASSIGN REGISTERS to KEYBOARD MAPS

To assign to ALL SIX octaves of a keyboard...

TYPE:	LIGHTPEN:
Use <arrow> keys to TAB to **keyboard** number in "KBD" column, then type **r<set>**	<select REG> <select KBD>

To assign to ONE octave of a keyboard...

TYPE:	LIGHTPEN:
Use <arrow> keys to TAB to **octave** within keyboard map, then type **r<set>**	<select REG> <select octave>

where: r = desired register A - H

When using the lightpen <select REG> means touch the desired register in the "REG" column. If the register is ALREADY selected (illuminated), this step is unnecessary.

Once a register is selected, just touch the keyboard number or octave to <select KBD> or <select octave>.

8. PITCH/SCALE tuning controls

TO ADJUST SYSTEM MASTER PITCH

Use <arrow> keys to TAB to PITCH, TYPE: **n<set>**

where: n = Ø - 255

This provides an overall tuning adjustment for all eight channels of about +/- 1/2 semitone.

The normal (default) setting is 128 and will produce A = 44Ø Hz.
The master pitch will be SAVED and LOADED as part of an INSTRUMENT FILE.

TO DEFINE KEYBOARD SCALE FUNCTION

Use <arrow> keys to TAB to desired item,

TYPE **n<set>**

where: n = desired value

The SCALE function sets the PITCH INCREMENT (change in pitch between keys) for the CMI.

The normal (default) setting is:

12 $\sqrt{}$ 2.ØØ (pronounced: twelfth root of two)

The 12 is the ROOT, 2 is the BASE(integer) and ØØ is the BASE(fraction).

This setting defines the standard tempered scale by specifying that 12 keys change the pitch by a factor of 2 (1 octave). For example to specify a 1/4-tone scale, set ROOT to 24 and BASE to 2; i.e, 24 keys = 1 octave.

The SCALE setting will be SAVED & LOADED as part of an INSTRUMENT FILE.

RANGES: ROOT=1 to 255 BASE(integer)=1 to 7 BASE(fraction)=Ø to 99

Note that a scale setting of 24 $\sqrt{}$ 4.ØØ gives the same result as the normal 12 $\sqrt{}$ 2.ØØ.

To stretch the tuning slightly **sharp** toward the top end of the keyboard (as in piano tuning) set the keyboard scale to

24 $\sqrt{}$ 4.ØI

9. VOICE files

LOADING and SAVING VOICES

A VOICE is a CMI "**sound**" consisting of:

1) WAVEFORM
   Digital waveform for the voice; synthesized on PAGES 4-6 or sampled from external source on PAGE 8.

2) HARMONIC AMPLITUDE PROFILES
   Dynamic amplitude profiles for 32 harmonics; used on PAGES 4 and 5 for timbre and amplitude modification.

3) MODE & LOOP
   Operating mode for output channels and waveform loop position (see PAGE 7 & 4 description).

4) CONTROL FILE NAME
The name (if any) assigned to CONTROL FILENAME on PAGE 7.

All the preceding may all be SAVED on **righthand sounds disk** as a VOICE FILE (.VC suffix).

By LOADING the file all characteristics of the voice will be restored. If there is a CONTROL FILE NAME on PAGE 7 when the voice is SAVED then that CONTROL FILE will be automatically loaded with the VOICE FILE (see PAGE 7 description for more about control files).

The SAVE/LOAD/CREATE voice commands described below may be used from ALL standard display pages EXCEPT PAGE 9 and R.

NOTE: As in most CMI commands, wherever **commas** are indicated **spaces** may be used instead.

1Ø. LOAD voice command

TO LOAD A VOICE

TYPE: **L,r,filename<return>**

where: r = register A - H
filename = 1-8 character voice filename with or without the .VC suffix (see PAGE 2 description).

EXAMPLE: L,H,CYMB3<return> - Load CYMB3.VC into register H

The register must exist, that is NPHONY must be not **zero.** If the file is found on the sounds disk in the **righthand drive** it will be loaded. If a CONTROL FILE NAME was linked to the voice with the SAVE or PAGE 7 "LNK" commands it will be loaded after the voice; otherwise the PAGE 7 CONTROL PARAMETERS will be set to voice defaults (see PAGE 7 description).

11. SAVE voice command

TO SAVE A VOICE

TYPE: **S,filename<return>**
or **S,filename,newname<return>**

where: filename = name of a loaded voice (shown on PAGE 3)
with or without .VC suffix
newname = new filename; to SAVE with a different name
EXAMPLE: S,FLUID<return> - Save voice FLUID.VC
S,FLUID,FLUID2<return> - Save voice FLUID.VC as new voice file FLUID2.VC

The selected VOICE will be SAVED, with a new name if desired.
See also OVERWRITE PROTECTION and SAVE COMMAND OPTIONS below.

12. MULTI-VOICE load command

Pressing one note on the music keyboard will play more than one sound.

TO LOAD MULTIPLE-VOICES

TYPE: **L,r,filename,filename,...<return>**

where: r = register A - H
filename = 1-8 character voice filename with or without .VC suffix (see PAGE 2 description)
,... = continue up to eight filenames

EXAMPLE:
L,B,DRUM,BRICK,DOG<return> - Load voice files: DRUM.VC, BRICK.VC and DOG.VC into register B

Interesting **phasing** effects arise when two voices with identical waveforms but different names, are loaded into one register.
If PAGE 7 pitchbend or vibrato speed and depth is changed on one voice it a frequency shift is produced.

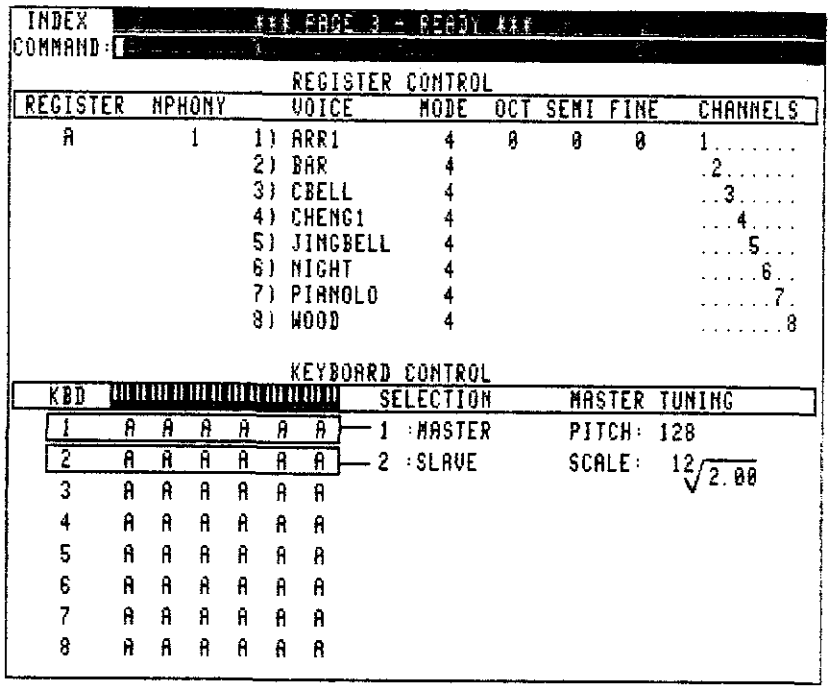
If more than one VOICE is loaded into a register the number of channels required by the register will be NPHONY multiplied by the NUMBER of VOICES. Thus the NPHONY must be set such that the channel TOTAL does not exceed 8 BEFORE loading multiple voices. The register becomes a MULTI-VOICE REGISTER: one key will play all its voices. NPHONY must first be reduced to less than 8.

For example, if NPHONY of register A is set to 1 and B to Ø, register A may be loaded with EIGHT voices - all of which will play when the register is activated.

type: L,A,V1,V2,V3,V4,V5,V6,V7,V8<return>
where: V1,V2,etc = eight voice filenames

Here is an extreme example of **8 voices** loaded into **one register.**

All eight voices will sound at once when a key is pressed.



See PAGE 2 to LOAD multiple voices by LIGHTPEN. Use the MULTI feature.

13. CREATE voice command

TO CREATE A NEW (BLANK) VOICE

TYPE: **C,r,filename<return>**

where: r = register A - H
filename = 1-8 character voice filename with or without the .VC suffix (see PAGE 2 description)

EXAMPLE: C,A,BOOM<return> - Create new voice BOOM.VC in register A

The register must exist, that is NPHONY must not be zero. A new VOICE will be created in the register with a zero WAVEFORM and HARMONIC PROFILES (PAGE 4). CONTROL PARAMETERS (PAGE 7) will all be reset to default values. The VOICE MODE may be set before the CREATE command is given.

Once created, the new voice is automatically SAVED to disk. However, if the CREATE command is given with a full disk, or NO disk in the RH drive, the voice will still have been successfully created in the register.

See also OVERWRITE PROTECTION , SAVE COMMAND OPTIONS and TO ASSIGN A VOICE NAME.

14. INSTRUMENT files

The INSTRUMENT consists of:

REGISTER CONTROL SETTINGS
Including the NPHONY and TUNING for all registers.

VOICE NAMES
The names of all loaded VOICES.

KEYBOARD CONTROL SETTINGS
The KEYBOARD MAPS and MASTER TUNING controls.

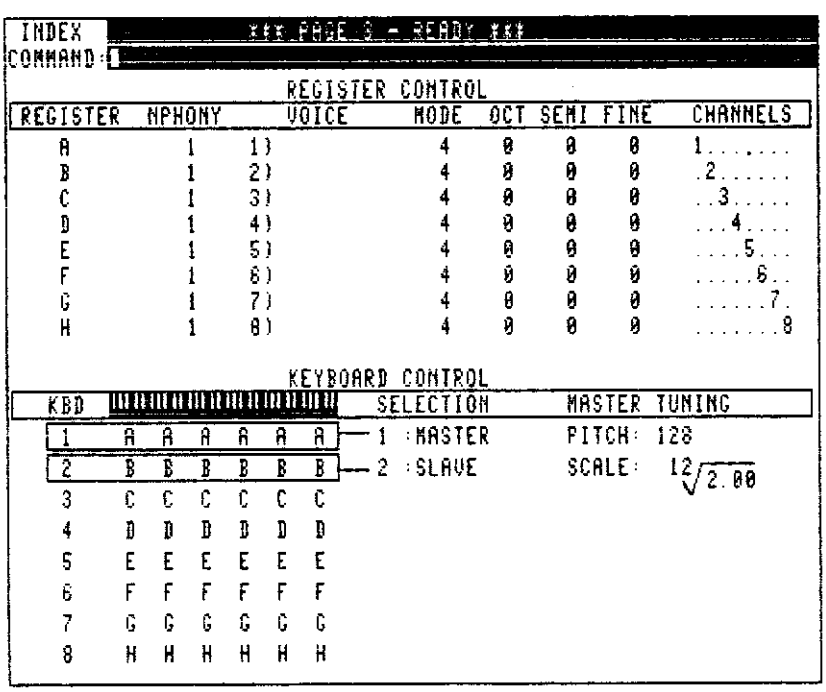
Thus DISPLAY PAGE 3 is the INSTRUMENT and may be SAVED as an INSTRUMENT FILE (.IN suffix).

By LOADING the file, the entire previous state of the CMI can be restored - all VOICE FILES will be automatically LOADED again PROVIDED they are all found on the **righthand** sounds disk.

The LOAD/SAVE instrument commands described below may be used from ALL standard display pages EXCEPT 7 & 9.

As well, Instruments "templates" can be saved having **no actual voice names** but commonly used tuning, keyboard and nphony settings.

Here is an instrument setup suitable for use with Page R - Real Time Composer.



15. LOAD instrument command

TO LOAD AN INSTRUMENT

TYPE: **L,filename.IN<return>**
or: **L,IN,filename<return>**

where: filename = 1-8 character filename (see PAGE 2 description)

EXAMPLE: L,BRASS.IN<return> - Load instrument file BRASS.IN

The REGISTER CONTROL and KEYBOARD CONTROL settings are LOADED and then all VOICE FILES are LOADED.

To HALT the loading for any reason,

TYPE: **<ctrl-esc>**
(press <esc> while holding down <ctrl>).

16. SAVE instrument command

TO SAVE AN INSTRUMENT

TYPE: **S,filename.IN<return>**
or: **S,IN,filename<return>**

where: filename = 1-8 character filename (see PAGE 2 description)

EXAMPLE: S,PERC.IN<return> - Save instrument file PERC.IN

The VOICE NAMES, REGISTER CONTROL and KEYBOARD CONTROL settings are SAVED.

Note that an instrument file may be saved even when NO voices are loaded - thus favourite configurations may be saved as "setup templates" (these take only a moment to load).

To save VOICE FILES with instrument see SAVE COMMAND OPTIONS.

17. PROTECTION against overwriting your files

OVERWRITE PROTECTION

When saving/creating voice or instrument files, if there is ALREADY a file on the right-hand sounds disk with the same name and suffix this question will appear:

OVERWRITE filename.sf (Y)?

TO REPLY:
Yes, overwrite file - **Y<return>**
No, do not overwrite - **N<return>** or **<return>** or **<ctrl-esc>**
(<ctrl-esc> = press <esc> while holding down <ctrl>)

If desired, this protection may be turned off by using the "yes" option - see SAVE COMMAND OPTIONS below.

18. OPTIONS to use with the SAVE command

SAVE COMMAND OPTIONS

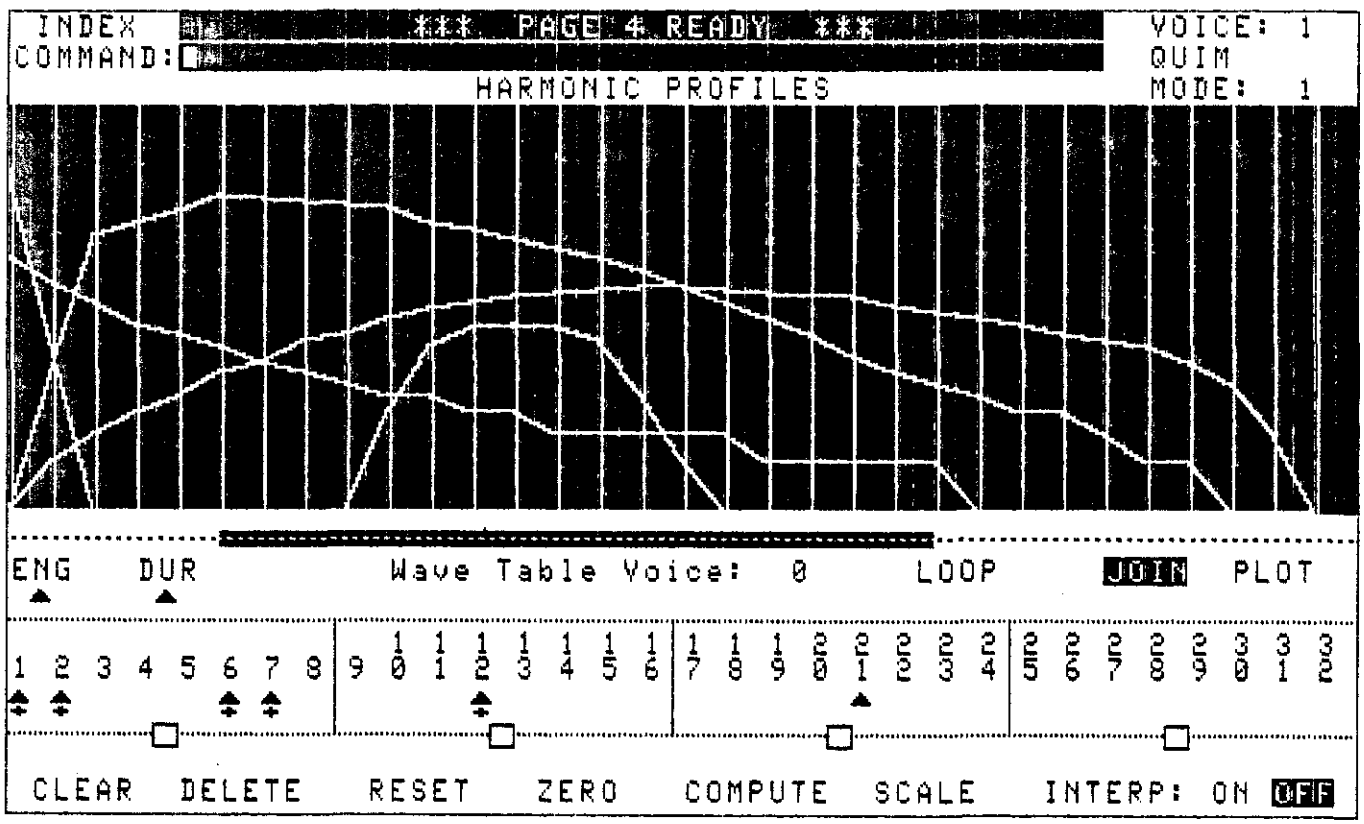
There are **three** options that may be used in conjunction with the commands to save voices and instruments. To use any or all of these,

TYPE: **;option** before pressing **<return>** for the command.
where: option(s) V - "voice" option; save voice files with instrument file.
C - "control" option; save control files with voices.
Y - "yes" option; overwrite any existing files.

EXAMPLES:

S,FLUTES.IN;V<return>	- Save instrument FLUTES and all loaded voices.
S,FLUTE1;C<return>	- Save voice FLUTE1 and its control file.
S,BIGONE.IN;VC<return>	- Save instrument BIGONE and all loaded voices AND control files.
S,EASY;Y<return>	- Save voice EASY, overwrite the file if it exists on sounds disk.
S,BIGGEST.IN;YVC<return>	- Save instrument BIGGEST including all voice and control files, overwrite any existing files. This command would be used after all loaded voices (.VC) had been chosen, and loaded control files (.CO) had been adjusted to satisfaction.

Section C: DISPLAY PAGE 4) HARMONIC PROFILES



Here is the Page 4 display of the harmonic profiles for the voice QUIM

Here is the first HELP sheet for Page 4 ...

```
PAGE 4 |  PAGE 4 - HELP SHEET  1 of 13  | PRE TOP FWD BWD
     sheet:  2.    PROFILE GRAPH
             3.    HARMONIC amplitude profiles
             4.    DURATION profile
             4.    ENERGY profile
             5.    DELETE command
             5.    ZERO command
             6.    WAVE TABLE voice
             7.    COMPUTE command
             7.    INTERP switch
             8.    SCALE command
             8.    JOIN/PLOT selector
             9.    LOOP control
            10.    CLEAR command
            10.    RESET command
            10.    VOICE selection
            11.    LOADING/SAVING files
            12.    WAVEFORM memory
            12.    MODE of a voice
For HELP touch any BOX with LIGHTPEN or TYPE: n<set>
                                        where: n = sheet no.
For HELP with HELP PAGES, touch THIS or TYPE: H1<return>
```

Page 4 and Page 5 enable sounds of an electronic nature to be created through additive synthesis.

ADDITIVE and SUBTRACTIVE SYNTHESIS

Subtractive synthesis occurs when a waveform rich in harmonics, such as a squarewave, is fed through filters which take away, or **subtract**, certain harmonics of the waveform, leaving a less complex waveform.

For example, a square wave may be heavily filtered to leave just the first and third harmonics.

This approach is most commonly used with analog synthesizers where voltage controlled waveforms are fed through voltage controlled filters. The limiting factors are the degree of complexity of the initial waveform and the frequency characteristic of the filter. Either way, precise control over dynamic harmonic content is not easy to specify.

Additive synthesis occurs by starting with the simplest building block of all sound, the **sine** wave, and **adding** various harmonics of that sine wave. Thus nothing is taken away from the waveform.

Using digital techniques, precise amounts of each harmonic can be added, so that a square wave for example can be constructed from a combination of sine waves.

The difference in **timbre**, or **tone**, between say, a trumpet and a violin both sustaining the same pitch is the harmonic structure, and the way the relative amplitude (volume) of each harmonic varies over time.

Page 4 permits the drawing of 32 harmonic amplitudes, each of which can change dynamically as the note is played.

HARMONICS

The **harmonic series** works in the following way:

if Harmonic 1 is taken to be the fundamental pitch, then

Harmonic **2** will be **twice** the pitch of Harmonic 1
Harmonic **3** will be **three** times the pitch of Harmonic 1 and so on.

Here are a few references for those readers who are unfamiliar with the **harmonic overtone series** and its application ...

Music, Physics and Engineering
Harry F. Olson
DOVER PUBLICATIONS - New York - 1967
ISBN 0-486-21769-8

Physics of Musical Sounds - C.A. Taylor
ENGLISH UNIVERSITY PRESS - London - 1965

The Physics of Music
Readings from Scientific American 1978
ISBN 0-7167-0095-6

Page 4 (and Page 5) offers 32 sine wave harmonics. These may be compared to the footage stops on an organ.

Harmonic No.	1	2	3	4	6	8	1Ø	12	16	32
equivalent to organ stop	16'	8'	$5\frac{1}{3}$'	4'	2'	$2\frac{2}{3}$'	$1\frac{3}{5}$'	$1\frac{1}{3}$'	1'	$\frac{1}{2}$'

Or using 32' as the fundamental:

Harmonic No.	1	2	3	4	6	8	1Ø	12	16	32
equivalent to organ stop	32'	16'	$1Ø\frac{2}{3}$'	8'	$5\frac{1}{3}$'	4'	$2\frac{2}{3}$'	2'	$1\frac{1}{3}$'	1'

Up to **32 sinewave harmonic envelopes**, a **duration envelope** and a **master volume (energy) envelope** can be drawn, displayed, modified and computed.

A **harmonic envelope** is similar in concept to the ADSR (Attack-Decay-Sustain-Release) envelope on synthesizers, but with much greater flexibility.

Every harmonic overtone can have it's own amplitude (volume) profile. This a very quick and easy way to create electronically derived sounds.

A looping feature means that any part of the overall waveform can be made to loop (sustain).

1. PROFILE graph

THE PROFILE GRAPH allows changing parameters to be specified with the LIGHTPEN as PROFILES.

The vertical scale represents **AMPLITUDE** (logarithmic) or **loudness.**

The **horizontal** represents TIME as WAVEFORM SEGMENTS.

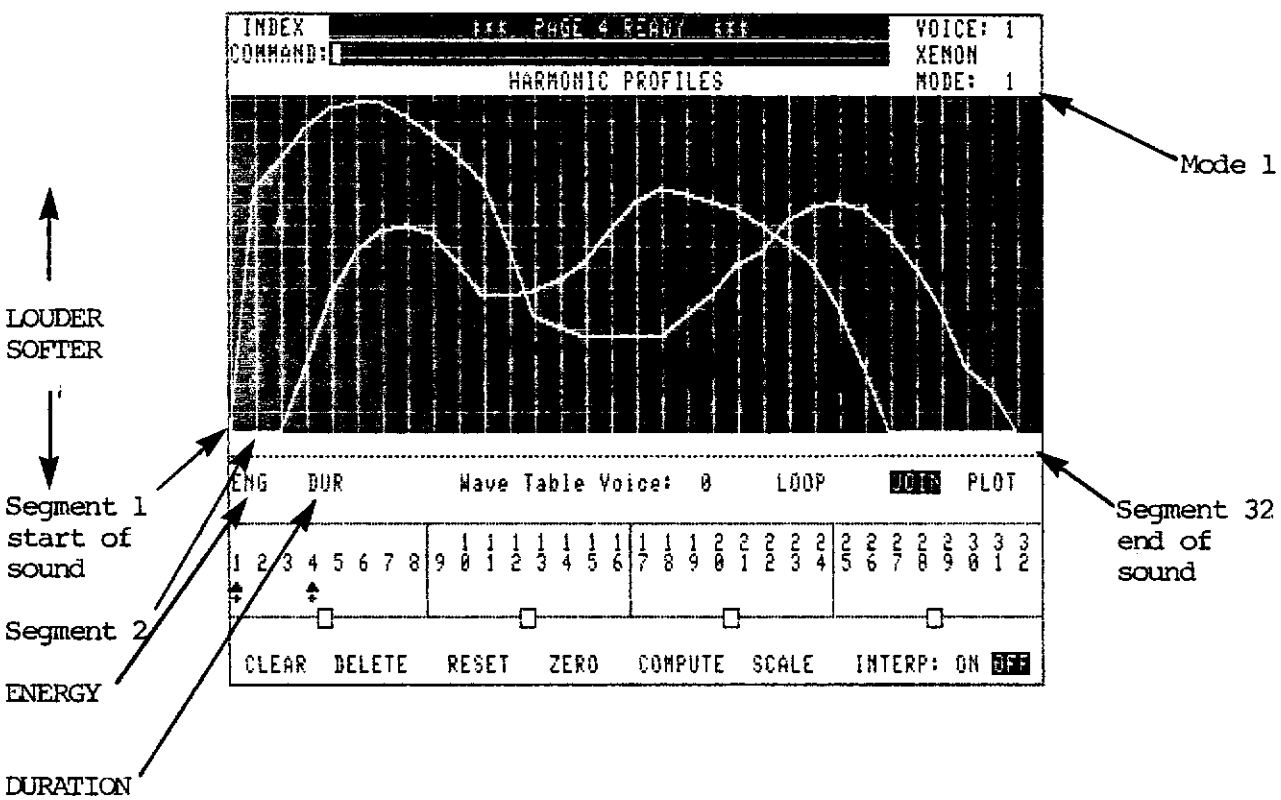
HARMONIC AMPLITUDE profiles provide control of the relative amplitudes of 32 harmonics. These are mathematically processed by the COMPUTE command to yield the implied waveform by the principle of ADDITIVE synthesis.

Any loaded VOICE may be chosen for display or modification. The setup of the graph is preserved separately for each voice and is SAVED/LOADED as part of VOICE files.

The MODE of the selected voice determines some important aspects of the profile graph and PAGE 4 in general.

When voice is in **MODE 1** -

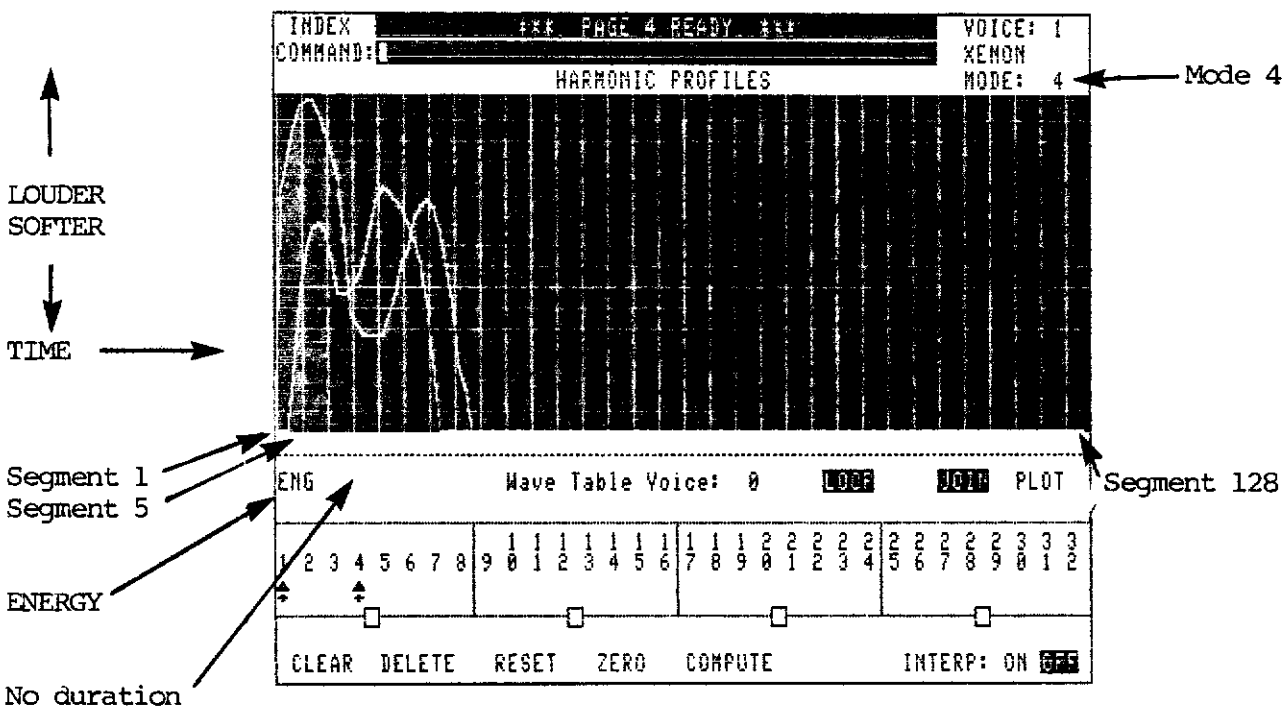
Each **vertical** division represents **1 waveform segment.**
There are **32** waveform segments that is 32 points per profile.
The **DURATION** profile sets **time-duration** of each **segment.**
The **ENERGY** profile controls **overall** voice **amplitude** envelope without changing the waveform.
The **SCALE** command is provided to make harmonic profiles **relative** to the total waveform.



When voice is in MODE 4 -

Each **vertical** division represents **4 waveform segments.**
There are **128** waveform segments that is 128 points per profile.
Duration of each segment is **one** cycle.
The **ENERGY** profile varies the waveform amplitude of sampled natural sounds or synthesized sounds.
The **SCALE** command is not displayed but is still present.

The MODE 4 **ATTACK** parameter is provided on **PAGE 7.**
(See PAGES 7 & 6 description for amplitude control in MODE 4.)



2. HARMONIC amplitude profiles

THE HARMONIC AMPLITUDE PROFILES are represented by the numbers 1-32 displayed across the screen. These numbers are lightpen switches to display each profile.

If desired, all 32 profiles may be displayed on the graph simultaneously for viewing; however, more than about 1Ø at once usually looks confusing and can make the lightpen response sluggish. This means that it is possible for profiles to be un-displayed and yet still remain ACTIVE (contributing to the sound).

For this reason, two INDICATOR lights (blank if off) are located under each harmonic number to show the status of that profile.

(**triangle**) : display indicator - profile is now displayed.
(**cross**) : active indicator - profile has NON-ZERO value.

TO DISPLAY/OPEN a HARMONIC PROFILE touch the desired number with the LIGHTPEN.

The profile will be DISPLAYED (if not already) and OPENED for modification with the LIGHTPEN.

A BOX around the harmonic number and a DOUBLE LINE on the profile graph identify the open profile.

The lightpen may now be used to modify the profile on the graph. See **JOIN/PLOT.**

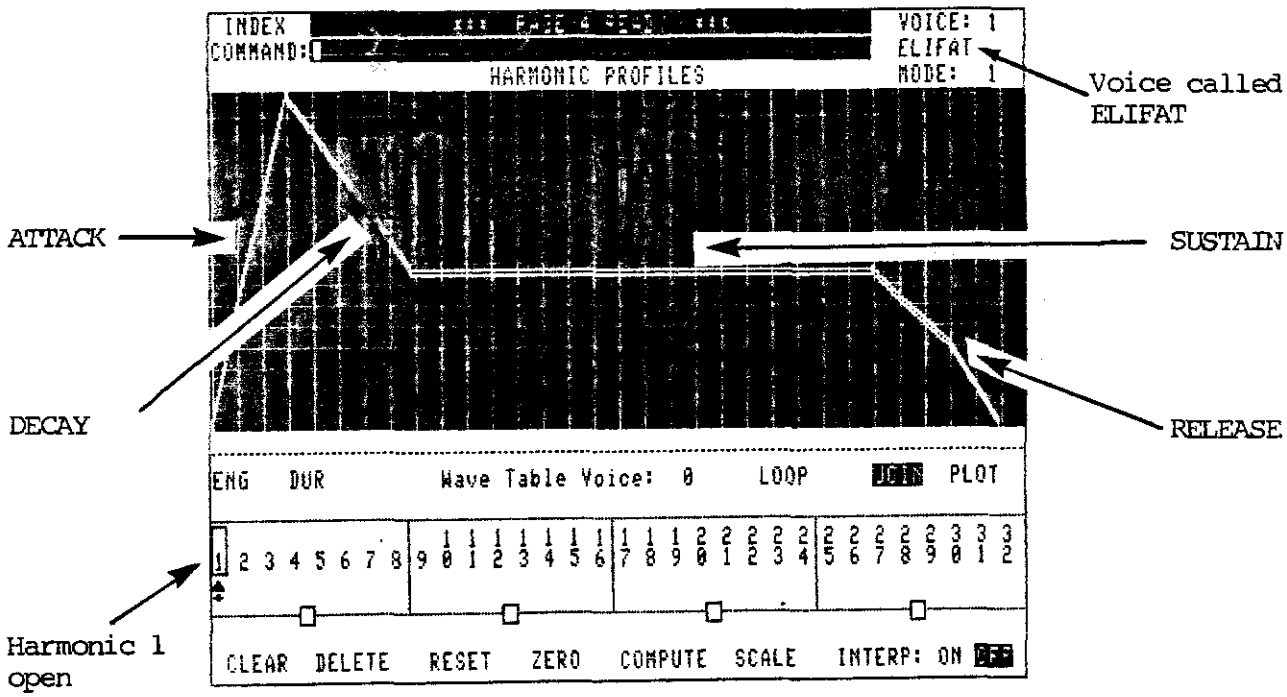
Only **one** profile can be open for drawing at a time.

Opening a new profile leaves the previous one displayed but closed.

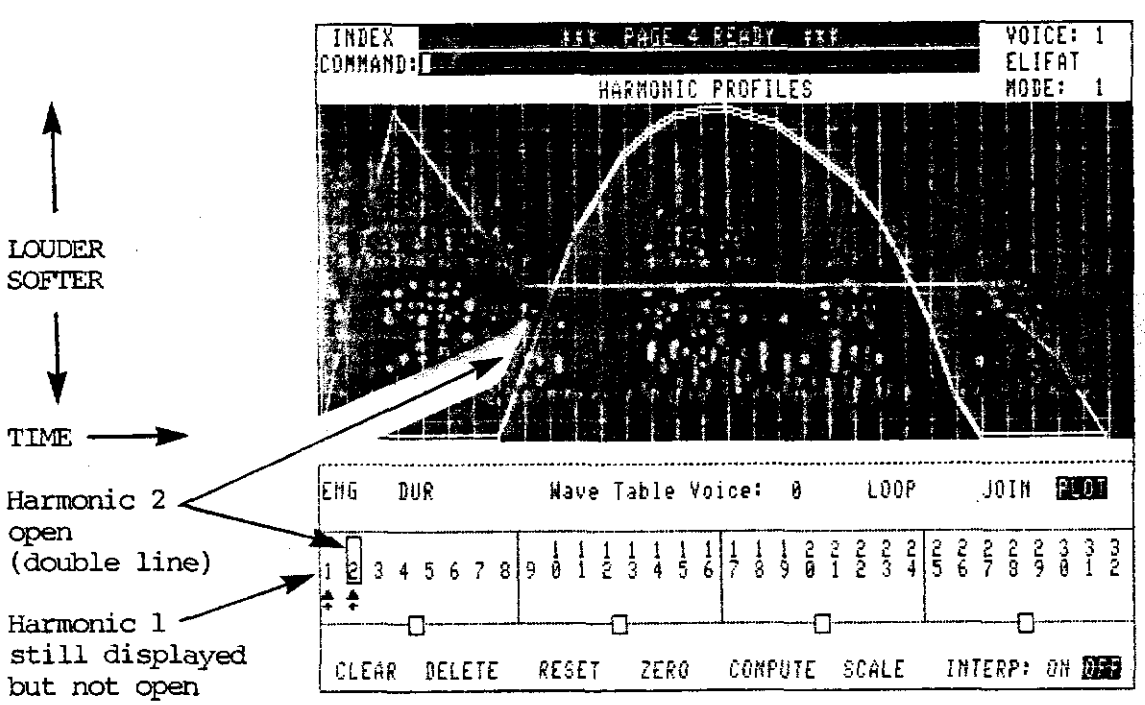
When harmonic profiles are altered no change will be heard in the voice until the COMPUTE command is given to translate the specified harmonic content into waveform.

When OPEN the profile may be DELETED or ZEROED.

Here we have Harmonic 1 profile drawn with the analog-type Attack-Decay-Sustain-Release envelope.

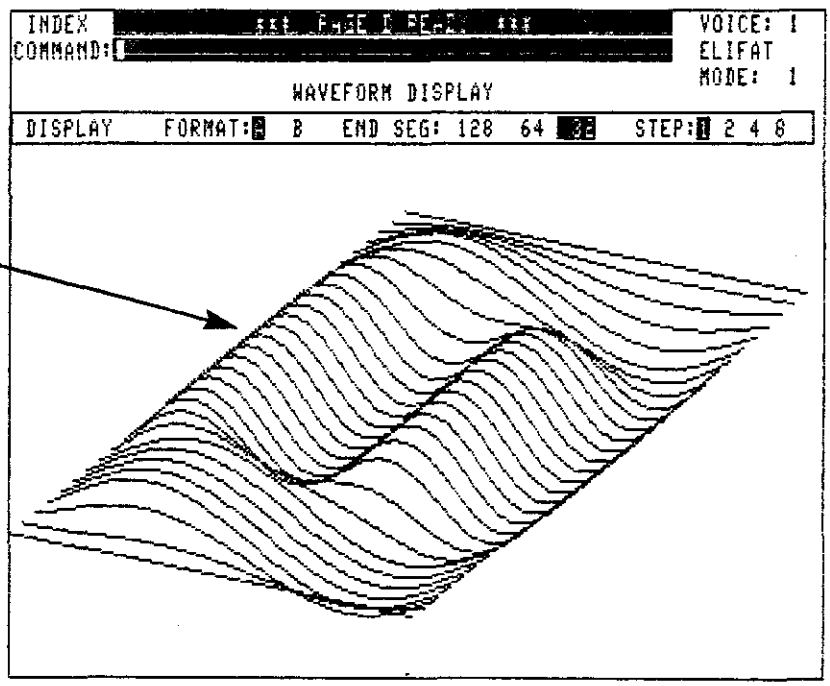


Here is Harmonic 2 drawn ***in addition*** to harmonic 1.
Harmonic 2 reaches full volume **halfway** through the voice.
Any shape is possible.



After the compute command on Page 4 has been given,
Page D looks like ...

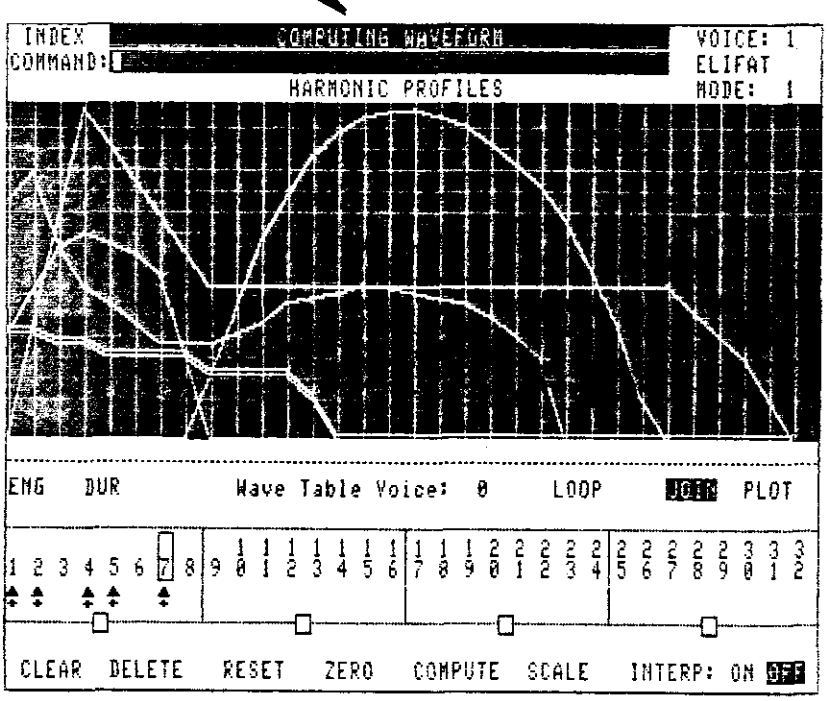
Harmonic 2 reaches full amplitude halfway through waveform



Computing Waveform

A few more harmonics have been drawn. The COMPUTE command has been given.

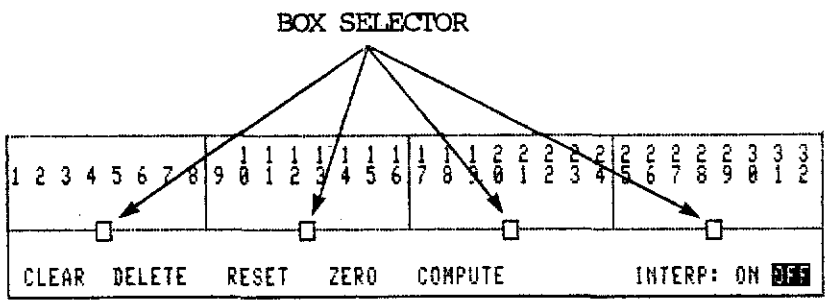
To see just a few harmonic profiles hit **CLEAR** with lightpen and then hit relevant harmonics.



TO DISPLAY/SELECT a BLOCK of 8 HARMONIC profiles touch one of the BLOCK SELECTOR boxes centred under each group of 8 harmonic numbers.

This will DISPLAY 8 profiles on the graph.

They are also now SELECTED for possible use of the DELETE or ZERO commands, which will act on ALL eight.



By using the box selector, harmonic profiles can be:

DISPLAYED
DELETED from display
ZEROED

in groups of 8.

3. DURATION profile

The DURATION PROFILE sets the **duration** of each WAVEFORM SEGMENT for a Mode 1 voice. There is no DURATION when a voice is in MODE 4.

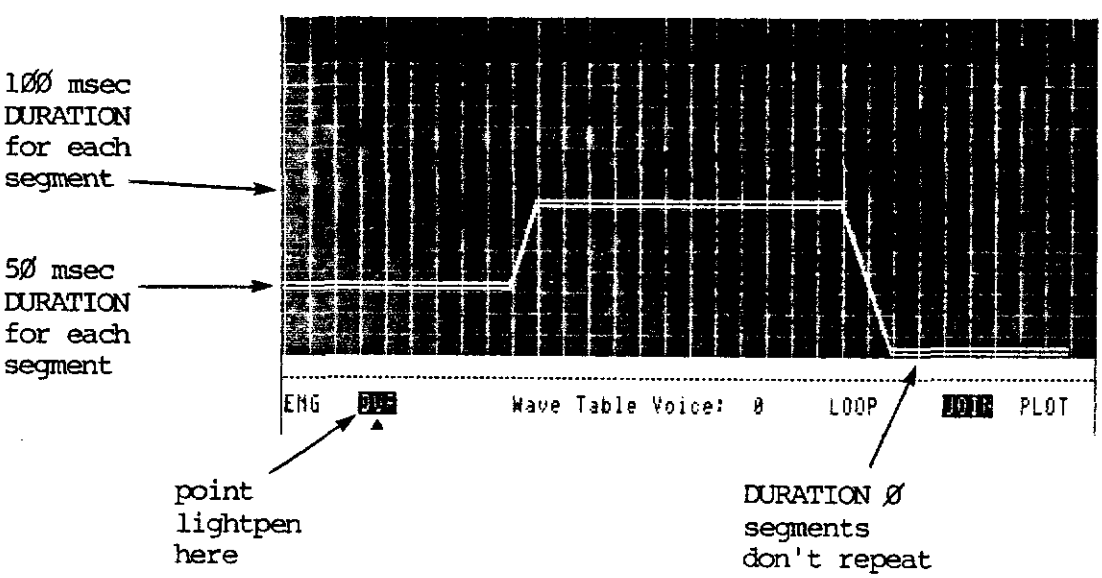
DURATION profile can be OPENED and modified with the lightpen.

The default (initial) value is approximately 5Ø msec per segment (condition after the CREATE or RESET commands).

When the voice is played each segment is repeated for a number of cycles determined by the combination of the duration profile and the pitch being produced. This maintains a fairly constant net event length for any pitch. If the duration profile is ZEROED a special case is created where each segment is only played once regardless of pitch; resembling MODE 4.

Robotic-type speech can be made by externally sampling a sound with the voice in Mode 4, changing to Mode 1 and drawing the duration profile to some non-zero value.

Here's a DURATION profile ...



4. ENERGY profile

THE ENERGY PROFILE defines the overall amplitude envelope of the voice. It's a master volume profile, and has an effect similar to the Page 6 **GAIN** command.

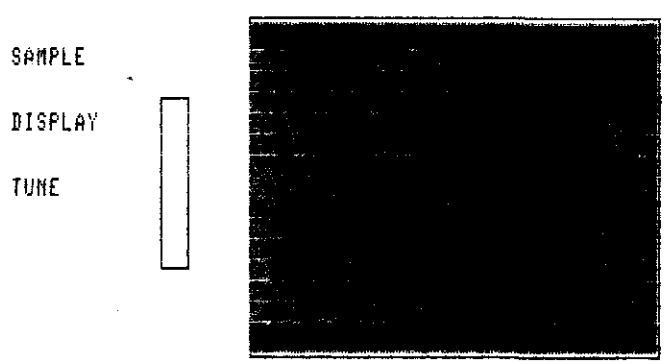
ENERGY can be OPENED and modified with the lightpen.

See also SCALE and LOOP commands.

In Mode 1 - the COMPUTE command automatically generates an ENERGY profile from the sum of harmonic profiles.
You may redraw ENERGY after COMPUTING.
Use the **SCALE** command to keep harmonics relative.

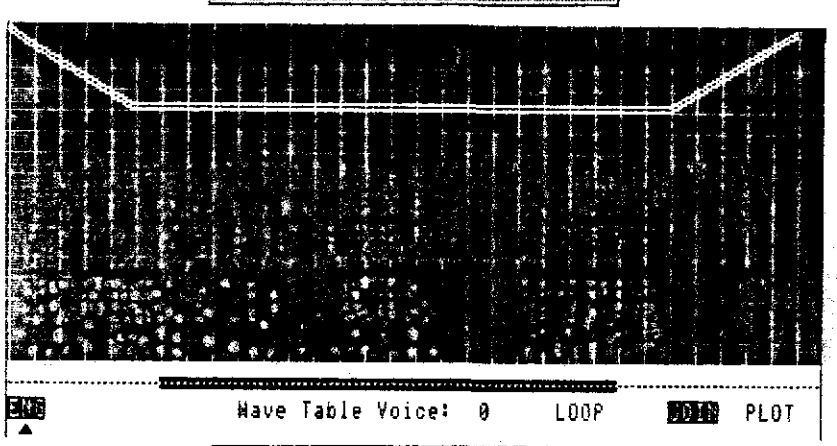
In Mode 4 - an ENERGY profile may be superimposed on any waveform, whether natural sampled sound, or synthesized by the CMI.
Use the **SCALE** command immediately after drawing an ENERGY profile.
Note that ENERGY changes the original amplitude envelope. To get the original sound back, reload from disk.

Page 8 voice envelope before Page 4 ENERGY profile

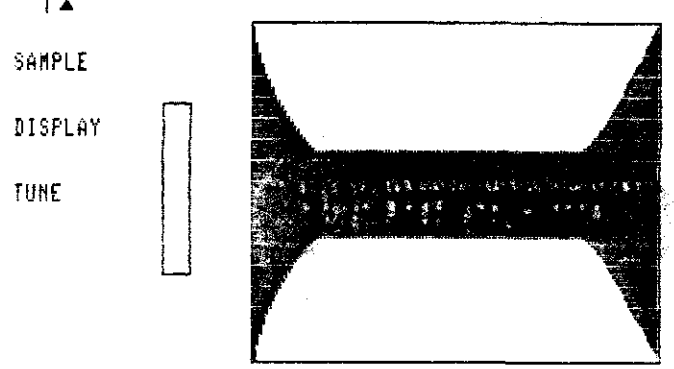


Page 4 ENERGY profile drawn

Type **S<return>**



Page 8 voice envelope changed by ENERGY



TO DISPLAY/OPEN the ENERGY or DURATION PROFILE

Touch: **<ENG>** or **<DUR>** with the LIGHTPEN.

The profile will be DISPLAYED (if not already) and OPENED for modification with the lightpen - see JOIN/PLOT.

While open, the profile is displayed with a DOUBLE LINE on the graph and ENG or DUR is illuminated. The results of altering the energy or duration profile can be heard in the voice immediately in Mode 1 (once you stop drawing).

Display indicator lights (triangles) directly under ENG and DUR are lit whenever the profiles are displayed.

When OPEN, either profile may be MODIFIED, DELETED or ZEROED.

5. DELETE/ZERO command

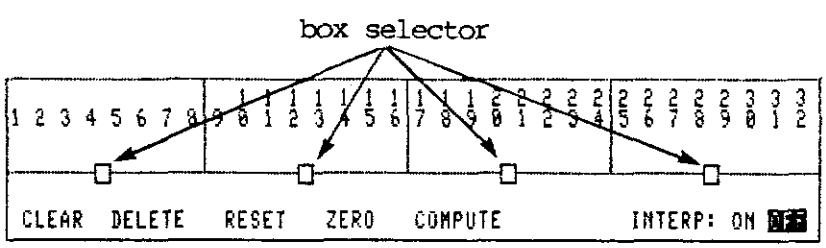
DELETE

TO DELETE or ZERO PROFILE(S)

TYPE:	LIGHTPEN:
D<return> - delete profile from graph	==><DELETE>
Z<return> - set profile to zero value	==><ZERO>

If a profile is OPEN for modification then it will be DELETED or ZEROED accordingly.

If a HARMONIC BLOCK has been selected by touching one of the selection boxes under each group of 8 harmonics then those 8 harmonic profiles will be DELETED or ZEROED at once.



Note that DELETE does not alter the value of a profile but only removes it from display.

ZERO sets the value of the profile to zero for all segments.

6. Wave Table Voice

You can use other waveforms instead of sinewaves on Page 4 for additive synthesis.

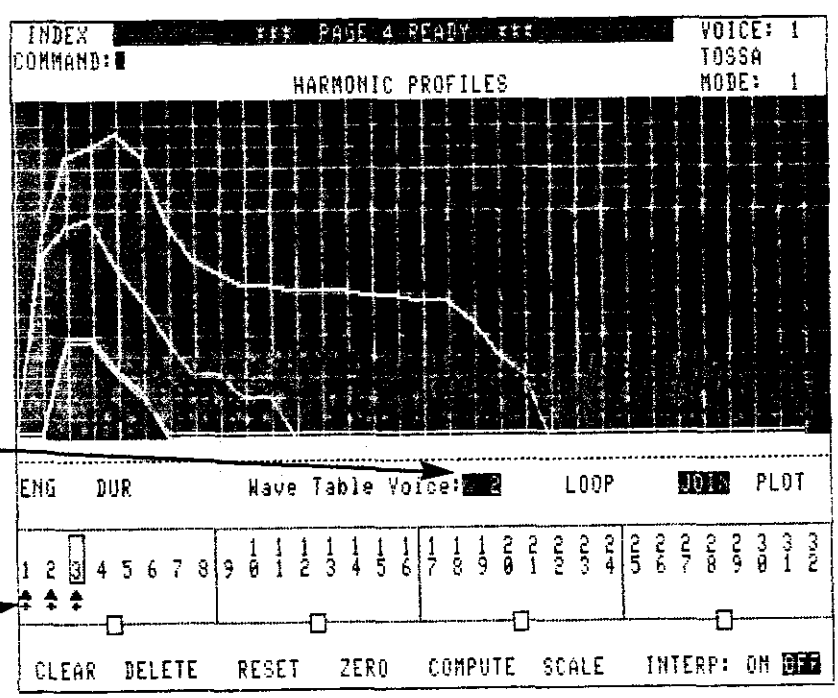
The Wave Table Voice facility lets waveform segments from another loaded voice be the source of sound.

Harmonic numbers now become segment numbers of another specified voice. Note that you can't select the current voice as a Wave Table.

> **Ø** (default) uses existing SINE wave table for harmonics.
> Enter **1** to **8** to use that voice as a wave table for compute.
> Currently selected voice cannot be used.

Cross fades between the first 32 segments are obtainable by drawing profiles. See Page 5 for more on this.

In this example, VOICE 2 has been selected as the source of waveforms. Amplitude profiles for segments 1, 2 and 3 have been used.



Voice 2 is source of waveforms

Waveform from segment 1, voice 2

7. COMPUTE command

TO COMPUTE WAVEFORM from HARMONICS

TYPE:	LIGHTPEN:
C<return>	==> <COMPUTE>

The COMPUTE command processes the HARMONIC AMPLITUDE PROFILES to generate the implied waveform in each segment of WAVEFORM MEMORY for the voice.

You will not hear changes made to harmonics until the COMPUTE command is used.

In MODE 4 this is done for **128** segments.

In MODE 1, **32** segments are computed AND the ENERGY profile is calculated from the combined harmonic amplitudes.

The waveform is always generated at maximum amplitude. If viewed on the PAGE 6 Waveform Graphand Page 8 envelope display, the amplitude will be a perfect "fit" within the audio range of the CMI.

In MODE 1 the **amplitude** changes are expressed in the ENERGY profile.

Depending on the harmonic complexity, the COMPUTE will require -
in MODE 1: max about 12 secs
in MODE 4: max about 48 secs

Whilst COMPUTING the waveform, the relevant voice will not sound.

Note: If you've previously **SAMPLED** a sound, through microphone or tape recorder, then the COMPUTE command will wipe out that sound and replace it with a harmonic profile waveform. If no harmonics have been drawn, then waveform will be blank.
If you want a sampled sound to be turned into harmonics, use the **ANALYZE** command on Page 5.

8. INTERP switch

TO USE INTERPOLATION SWITCH touch **<ON>** or **<OFF>** with LIGHTPEN.

The INTERP switch is a feature allowing you to choose whether or not an interpolation ("look-ahead") function is performed by the COMPUTE command.

When ON, each waveform segment is computed from a **mix** of the harmonic profile values of that segment and those of the next segment.

It's similar in a way to the **MERGE** command on Page 6.

The difference can be subtle and is most obvious when rapid or spikey changes exist in the harmonic profiles. The best idea is to experiment.

9. SCALE command

TO SCALE HARMONICS from ENERGY

TYPE:	LIGHTPEN:	
S<return>	==><SCALE>	(Mode 1 only)

In Mode 1, the SCALE command will RE-DRAW the harmonic profiles FROM a modified ENERGY profile. SCALE will keep the harmonic profiles in proportion to each other even though the overall ENERGY profile (combined amplitudes of all profiles) have been re-drawn. Original waveform is unaffected.

In Mode 4, the SCALE command will change waveform amplitude as drawn with the ENERGY curve. To restore original waveform, re-load sound from disk.

When the COMPUTE command is given in MODE 1, a new ENERGY profile is generated from the **combined** amplitudes of the harmonic profiles. This energy profile may of course be modified with the lightpen but the harmonic profiles remain unaltered and another COMPUTE would only restore the original energy profile.

If the message "OVERFLOW" appears it means at least one profile has reached its maximum amplitude and cannot be scaled up any further.

Note that there is no sure way to return to the condition prior to the scale except to reload the voice.

1Ø. JOIN/PLOT selector

TO SELECT JOIN/PLOT touch <JOIN> or <PLOT> with LIGHTPEN.

This selector determines the way the lightpen functions when drawing on the profile graph.

When **JOIN** is selected each point touched will be **joined** to the last by a line **connecting** the two.

When **PLOT** is selected each point on the profile

32 in MODE 1
128 in MODE 4

may be set individually with the lightpen without affecting the other points.

When drawing curves, use **JOIN.** Switch to **PLOT** and smooth out any bumps.

11. LOOP control

THE LOOP

One or more segments of a voice may be selected to be LOOPED (played repeatedly) for as long as the key is depressed and during the DAMPING period after release. See also PAGE 7 description.

The LOOP area (if any) is displayed as a solid BAR on the dotted line beneath the profile graph.

When in MODE 1 the effect of the ENERGY profile which lies within the LOOP is CUMULATIVE. If that portion of energy profile results in a net increase or decrease in volume then each repeat of the LOOP will be louder or softer than the preceding one.
The ENERGY profile can be modified within the LOOP area to provide the desired effect.

When in Mode 1 you may go to Page 7 and switch on **B/F LOOP** which is backward/forward loop. See Page 7 description.

TO SET LOOP with LIGHTPEN first touch <LOOP> with LIGHTPEN.

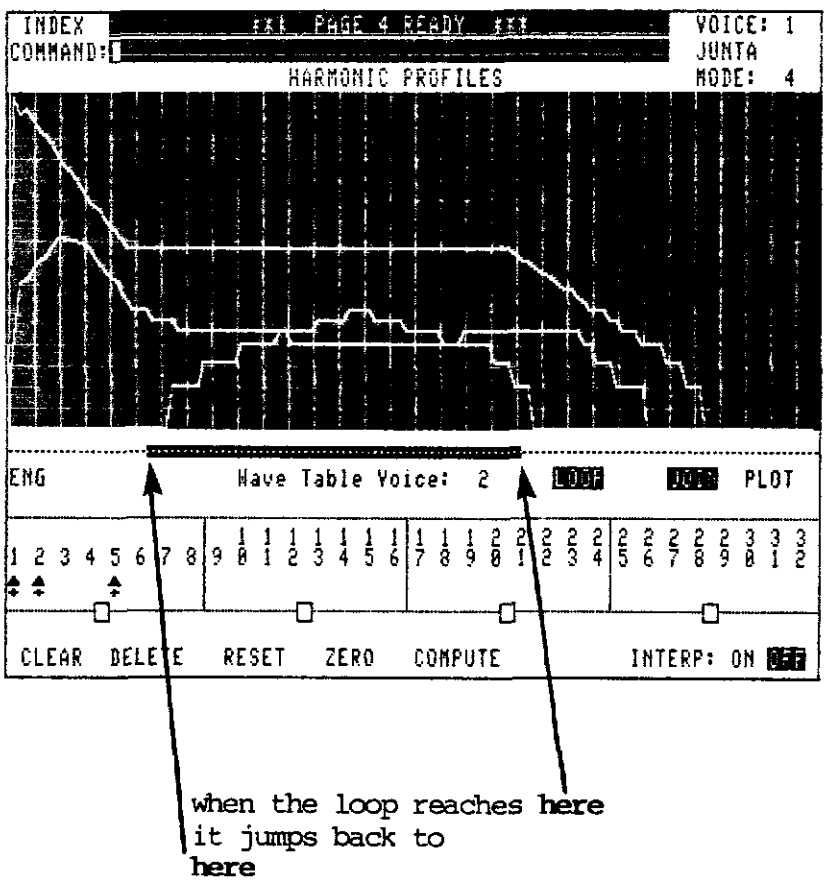
Touching the PROFILE GRAPH will now control the LOOP postion which consists of a START segment and END segment (if these are the same, there is a one-segment LOOP).

No loop prior to touch - create one-segment loop
Touch left of LOOP centre - set START of loop
Touch right of LOOP centre - set END of loop

Note that the LOOP can also be varied by the Page 7 controls.
See PAGE 7 - Control Parameters.

TO ZERO (remove) the LOOP

LIGHTPEN ==> <LOOP> then
LIGHTPEN ==> <ZERO>



12. CLEAR command

TO CLEAR THE PROFILE GRAPH touch <CLEAR> with the LIGHTPEN.

This DELETES all profiles (harmonics, energy and duration) from the profile graph. It does not ZERO or RESET. All profiles are still there. CLEAR just removes all profiles from the graph.

13. RESET command

TO RESET (ZERO all PROFILES)

TYPE:	LIGHTPEN:
R<return>	==><RESET>

This will RESET all profiles to ZERO.
The DURATION profile is restored to the default 5Øms per segment.

The following question will appear before RESET occurs:

RESET PAGE 4 - ZERO ALL PROFILES (Y)?

TO REPLY:	TYPE:
Yes, do the reset	**Y<return>**
No, do not reset	**N<return>** or **<return>** or **<ctrl-esc>**

14. VOICE selection

TO SELECT any loaded VOICE for display or modification,

TYPE: **V,filename<return>** or: **V,n<return>**

where: filename = the name of a loaded voice
n = the number 1-8 of a loaded voice

EXAMPLES: V,TUBA<return> - select voice TUBA
V,4<return> - select voice 4

The NAME, NUMBER & MODE of the current voice are shown in the **upper-right corner** of the page.

The names and numbers of all loaded voices are shown on PAGE 3 and 7.

15. LOADING/SAVING files

TO LOAD/SAVE VOICES or INSTRUMENTS TYPE:

To LOAD a VOICE	-	**L,r,filename<return>**
To SAVE a VOICE	-	**S,filename<return>**
To CREATE a VOICE	-	**C,r,filename<return>**
To LOAD an INSTRUMENT	-	**L,filename.IN<return>**
To SAVE an INSTRUMENT	-	**S,filename.IN<return>**

where: r = register A - H
filename = 1-8 character filename

See PAGE 3 description for more about loading/saving files.

16. WAVEFORM memory

HARMONIC MEMORY contains the harmonic profiles, energy and duration profiles from which waveform memory can be computed.

WAVEFORM MEMORY contains the voice waveform in digital form, stored in the 16,384 bytes of memory provided in each channel.

This memory is divided into **128 WAVEFORM SEGMENTS**, each with **128 POINTS** (bytes) of waveform.

128 SEGMENTS times 128 POINTS equals 16,384.

It is only coincidental that there is the same number of SEGMENTS as there are POINTS.

The basic principle of the CMI is to "replay" this memory at the rate required to produce the desired pitch. Each segment of memory contains exactly ONE CYCLE (period) of the waveform.

17. MODE of a voice

VOICE MODE controls the function of the waveform memory when a voice is played.

There are 2 MODES: MODE 1 and
MODE 4

When developing a new voice, the mode should usually be chosen according to the method of waveform generation to be used:

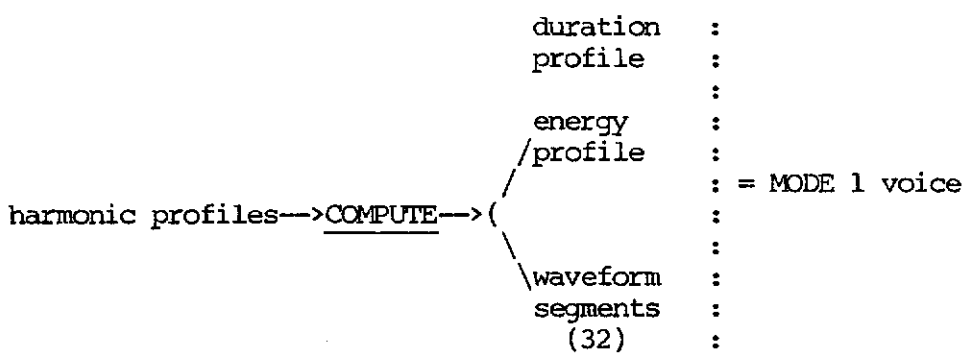
Harmonic synthesis, electronic sounds (PAGES 4,5) - MODE 1
Drawing/External sampling natural sounds (PAGES 6,8) - MODE 4

However these are not RULES and the mode may be changed at any time. Each has quite different characteristics.

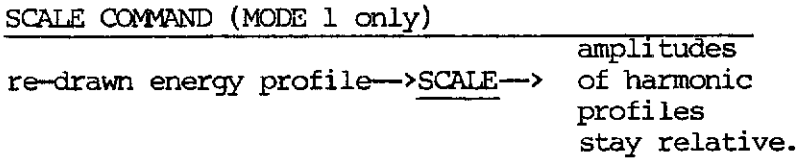
MODE 1: Segments 1-32 are used. Each segment in turn is sustained according to the DURATION profile position for the segment. During this time the amplitude is modulated according to the slope of the ENERGY profile. The net event duration remains virtually constant for any pitch.

MODE 4: Segments 1-128 are used. Each is played once before moving to the next segment (1 segment per cycle). The net event duration is (inversely) related to the pitch, that is, a segment plays twice as quickly if played an octave higher.

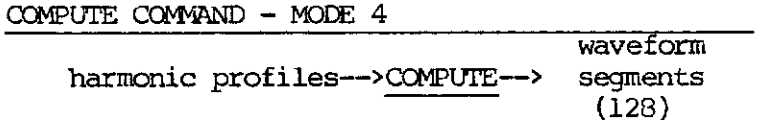
COMPUTE COMMAND - MODE 1



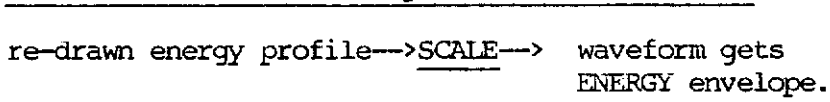
SCALE COMMAND (MODE 1 only)



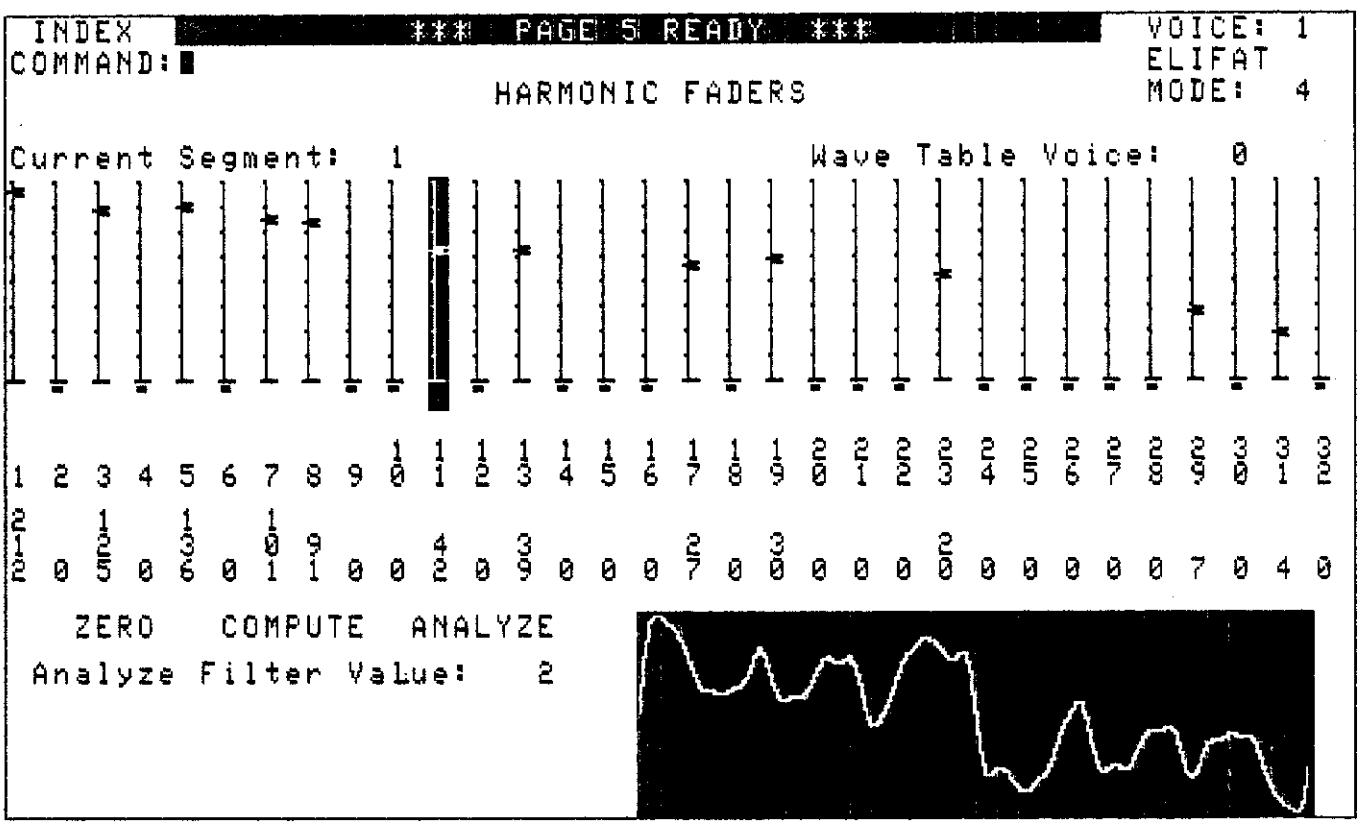
COMPUTE COMMAND - MODE 4



SCALE COMMAND (MODE 4 only)

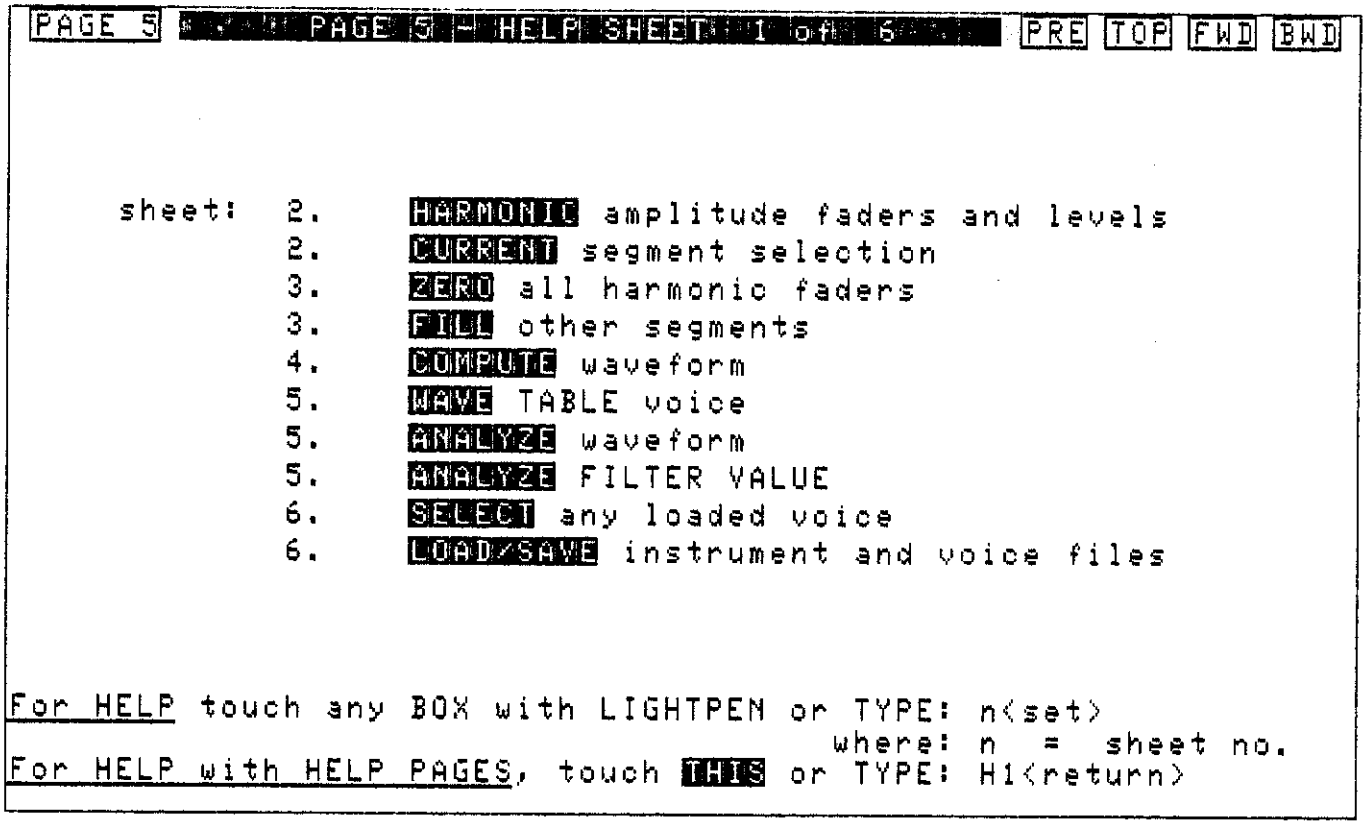


Section C: DISPLAY PAGE 5) HARMONIC AMPLITUDE FADERS



Here are the harmonic amplitude settings for segment 1 of the voice called ELIFAT.

Here is the first HELP sheet for PAGE 5 ...



Page 5 enables sounds of an electronic nature to be created through additive synthesis. A Fourier analysis command allows natural sampled sounds to be converted to harmonics.

ADDITIVE and SUBTRACTIVE SYNTHESIS

Subtractive synthesis occurs when a waveform rich in harmonics, such as a squarewave, is fed via filters which take away, or **subtract**, certain harmonics of the waveform.

For example, a square wave may be heavily filtered to leave just the first and third harmonics.

This approach is most commonly used for analog synthesizers where the output of voltage controlled waveforms is fed through voltage controlled filters. The limiting factors are the specifying of the initial waveform and the characteristic response of the filter. Either way, precise control over dynamic harmonic content is not easy to specify.

Additive synthesis occurs by starting with the simplest fundamental building block of sound, the **sine** wave, and **adding** various harmonics of that sine wave. Thus nothing is taken away from the waveform.

Using digital techniques, precise amounts of each harmonic can be added, so that a square wave for example can be constructed from a combination of sine waves.

Page 5 permits the simultaneous drawing of **32** harmonic amplitudes over **one** SEGMENT at a time.

Page 4 permits the drawing of **1** harmonic amplitude at a time over **all** SEGMENTS.

HARMONICS

The **harmonic series** works in the following way:

if Harmonic 1 is taken to be the fundamental pitch, as is assumed in the Fairlight, then

Harmonic **2** will be **twice** the pitch of Harmonic 1
Harmonic **3** will be **three** times the pitch of Harmonic 1 and so on.

Here are a few references for those readers unfamiliar with the **harmonic overtone series** and its application ...

Music, Physics and Engineering
Harry F. Olson
DOVER PUBLICATIONS - New York - 1967
ISBN 0-486-21769-8

Physics of Musical Sounds - C.A. Taylor
ENGLISH UNIVERSITY PRESS - London - 1965

The Physics of Music
Readings from Scientific American 1978
ISBN 0-7167-0095-6

Note: Often, persons referring to the "first harmonic" are actually referring to the first harmonic **ABOVE** the "fundamental" pitch of a sound i.e., the "**second**" harmonic in our terms. We have chosen the definitions described for the Fairlight to keep the arithmetic simple for the user. Nevertheless, the semantic relationship of harmonics to fundamental should be borne in mind.

Page 5 (and Page 4) offers 32 sine wave harmonics. These may be compared to the footage stops on an organ.

Page 5 Harmonic No.	1	2	3	4	6	8	1Ø	12	16	32
equivalent to organ stop	16'	8'	$5\frac{1}{3}$'	4'	2'	$2\frac{2}{3}$'	$1\frac{3}{5}$'	$1\frac{1}{3}$'	1'	$\frac{1}{2}$'

Or using 32' as the fundamental:

Page 5 Harmonic No.	1	2	3	4	6	8	1Ø	12	16	32
equivalent to organ stop	32'	16'	$1Ø\frac{2}{3}$'	8'	$5\frac{1}{3}$'	4'	$2\frac{2}{3}$'	2'	$1\frac{1}{3}$'	1'

This page displays the harmonic overtone series as a set of 32 faders, similar to a graphic equalizer or drawbars on an organ.

Extremely precise control of harmonic amplitude can be achieved, enabling the application of **Fourier-type** harmonic series.

For example, a square wave can be made from sine waves. Each "time slice" of the total waveform can have its own unique harmonic structure. It is possible to have 128 different waveforms in one voice.

1. HARMONIC amplitude faders

HARMONIC AMPLITUDE FADERS control the relative amplitudes of 32 HARMONICS for individual WAVEFORM SEGMENTS. Amplitude levels can be seen both as a number and a level on a fader.

The COMPUTE command mathematically processes these to generate the implied waveform in the WAVEFORM MEMORY by ADDITIVE SYNTHESIS.

The PROFILE GRAPH of PAGE 4 and the FADERS of PAGE 5 thus have similar functions; in fact any change in harmonic amplitudes on either of these pages will be reflected on the other since both are dealing with the SAME harmonics.

Any loaded VOICE may be selected.

PAGE 5 may be used in either MODE 1 or MODE 4.

See PAGE 4 description for more about WAVEFORM SEGMENTS and MODE.

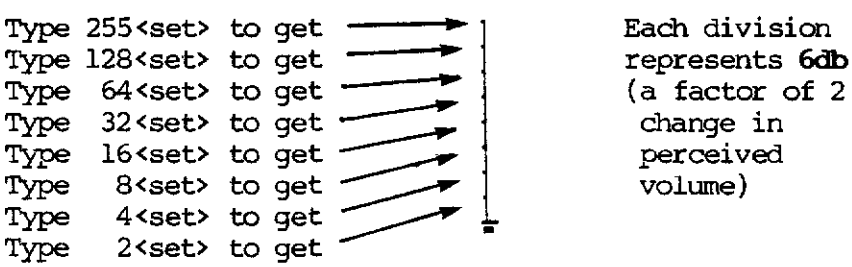
TO SET a HARMONIC FADER with LIGHTPEN touch desired fader with LIGHTPEN and position as required.

TO SET a HARMONIC FADER or LEVEL by ASSIGNMENT use <arrow> keys or LIGHTPEN to TAB to desired harmonic fader or level,

TYPE: **n<set>**
where: n = Ø - 255

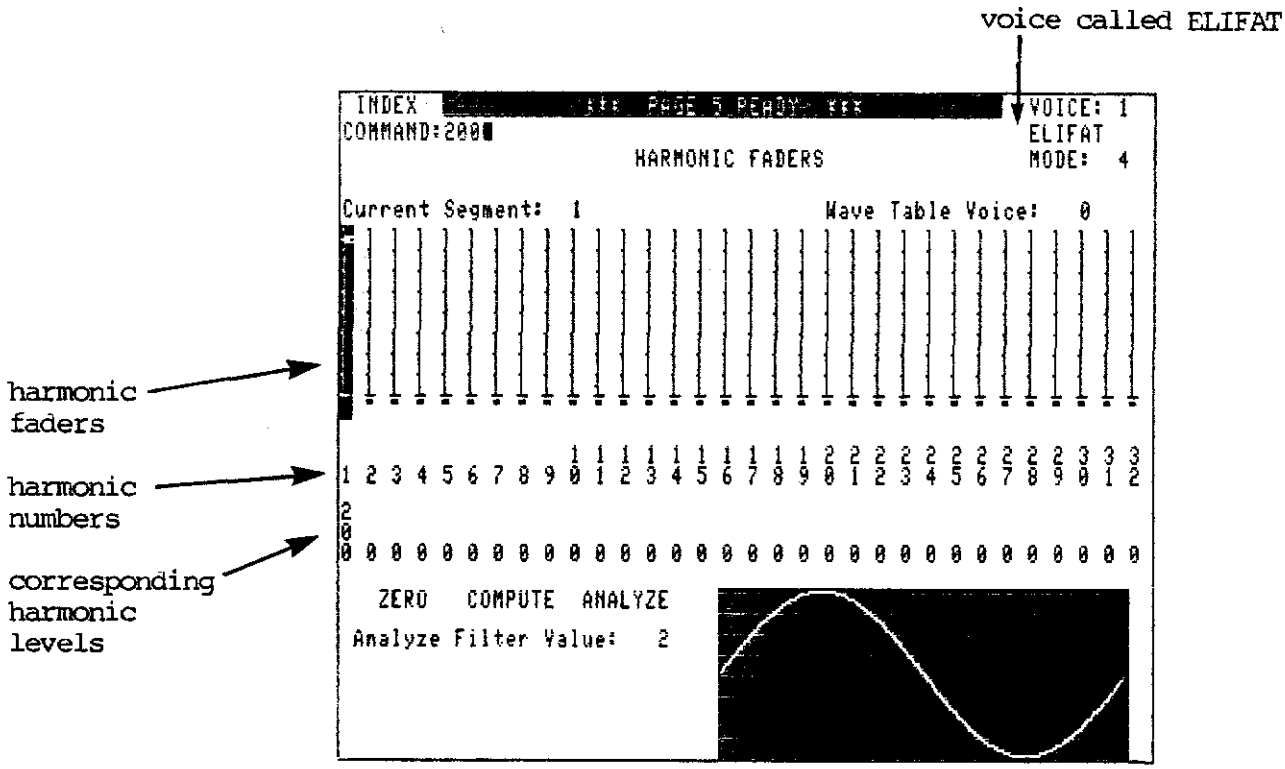
The faders are **logarithmic** in function.

The **top** of the fader is equivalent to typing **255<set>**.
Halfway up the fader is equivalent to typing **16<set>**

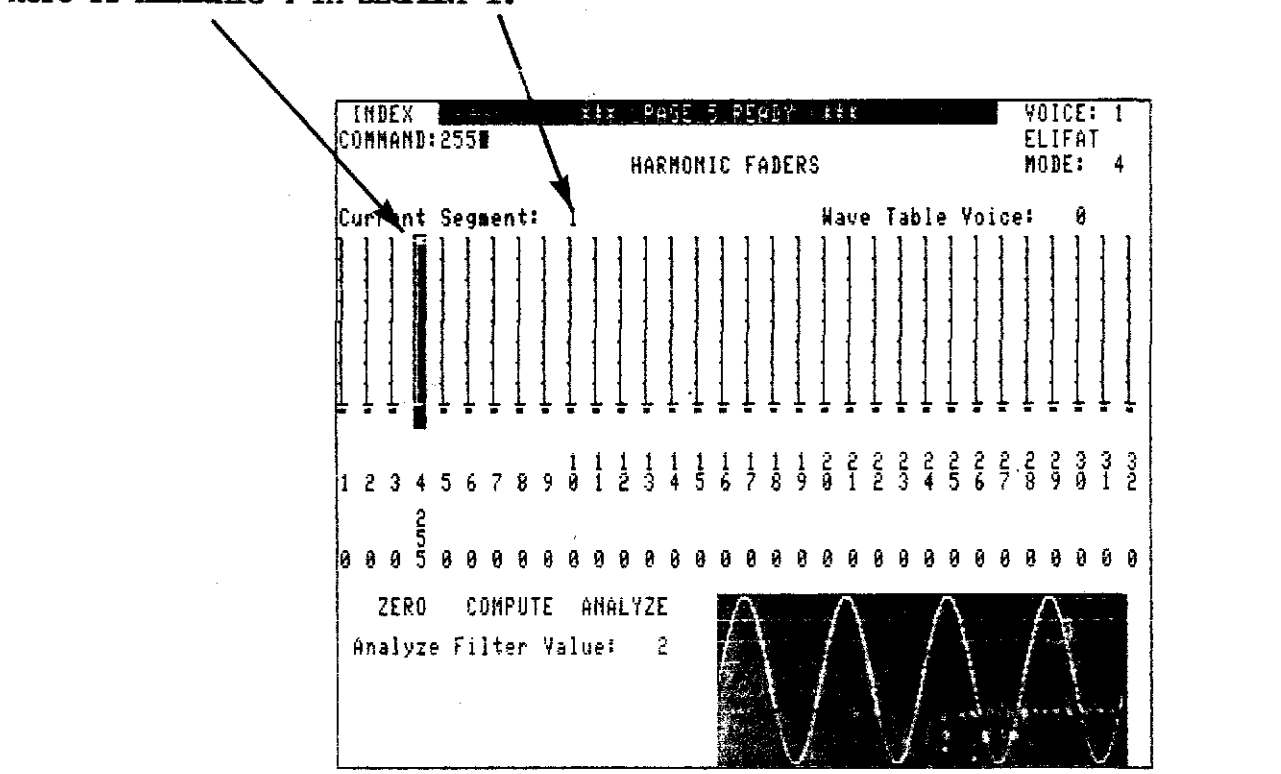


The **<add>** and **<sub>** keys may be used to add or subtract numbers from harmonic levels.

Here is **Harmonic 1** in **SEGMENT 1**

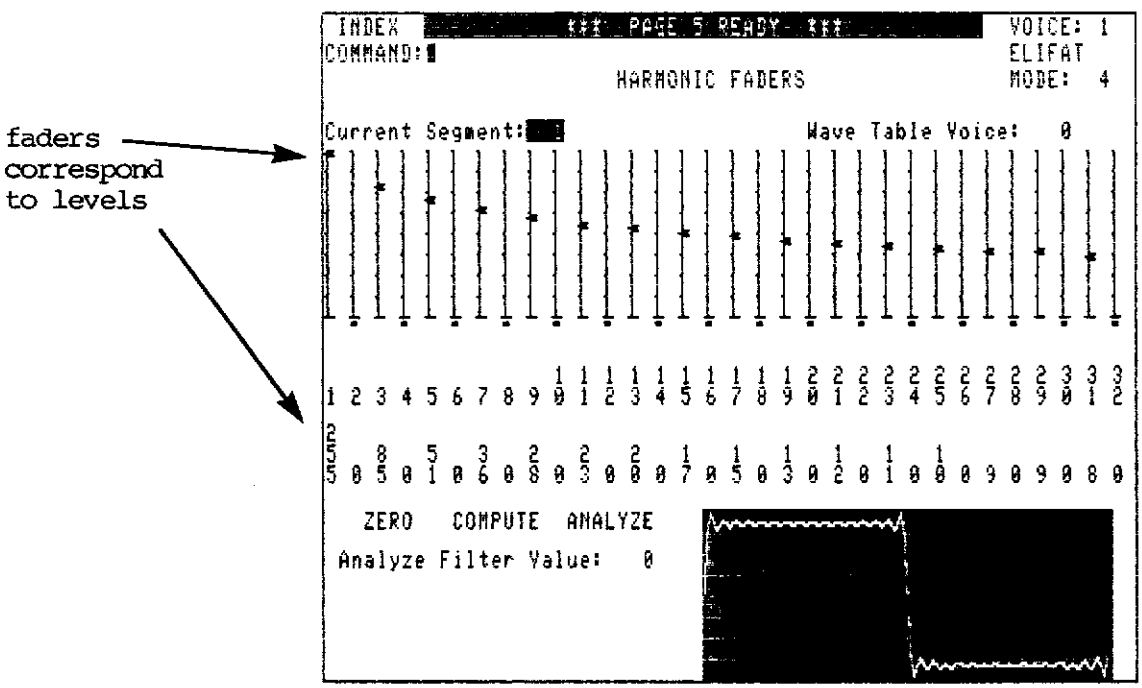


Here is **Harmonic 4** in **SEGMENT 1.**



Mr. Fourier said that any symmetrical waveform can be created using only sinewaves. He was right.

Here's a sine wave approximation of a square wave.
(A variable pulse-width square wave is available on Page 6.)



Page 5 and Page 4 change the same harmonics in different ways.

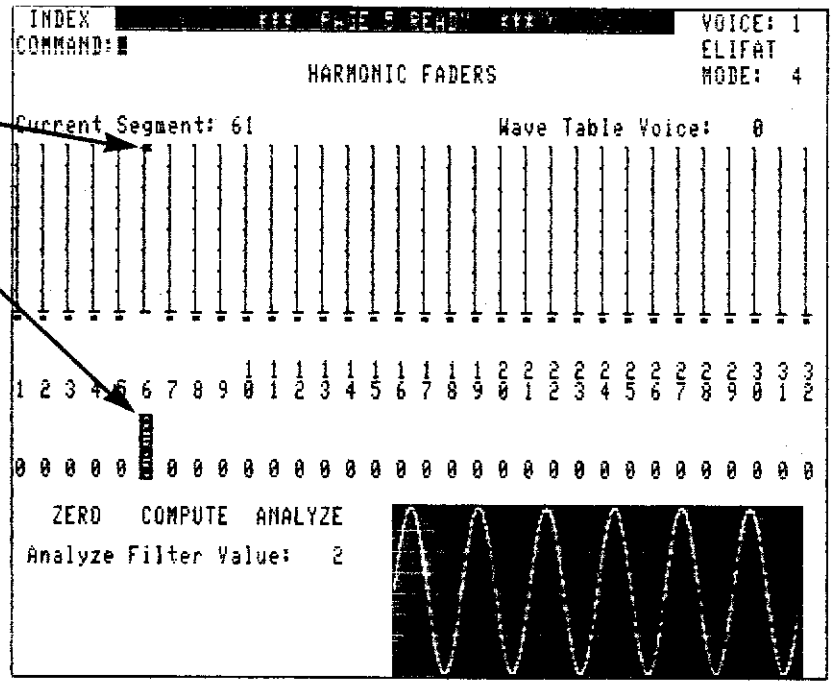
Page 4 can change **one** harmonic over **all** waveform segments at once.

Page 5 can change **all** harmonics over **one** waveform segment at once.

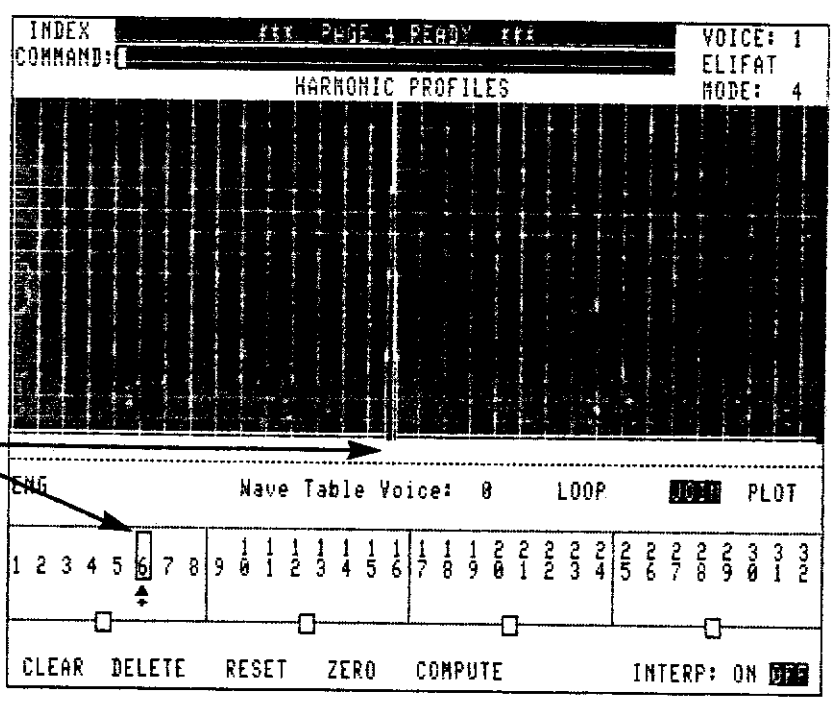
Here is an illustrative comparision between Page 5 and Page 4.

On Page 5 segment **61** harmonic **6** has level of 255

All other segments are empty

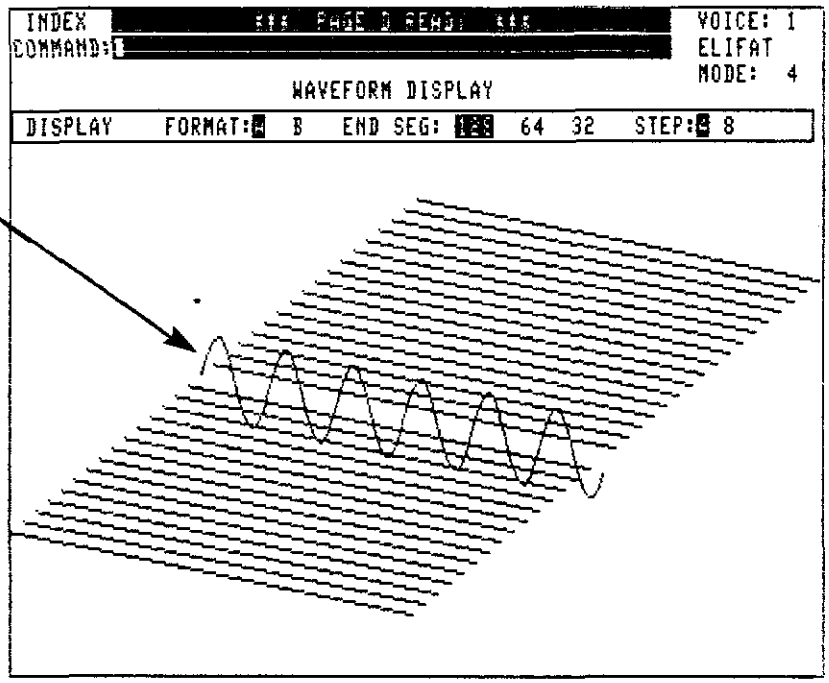


On Page 4 segment **61** harmonic **6** shows up here



On Page D segment **61** harmonic **6** shows up here

Rest of waveform empty



2. CURRENT segment selection

TO SELECT CURRENT WAVEFORM SEGMENT use <arrow> keys or LIGHTPEN to TAB to CURRENT SEGMENT

TYPE: **n<set>**
where: n = segment number

Maximum segment numbers are: **32** in MODE **1**
128 in MODE **4**

The FADERS and WAVEFORM for the segment will be displayed.

3. ZERO all harmonic faders

TO ZERO ALL HARMONIC FADERS TYPE: **Z<return>** LIGHTPEN: <ZERO>

All HARMONICS for the current segment will be set to ZERO.

No change will occur to the waveform until the COMPUTE command is given.

4. FILL other segments

TO FILL OTHER SEGMENTS	TYPE:
To fill segment n	- **F,n<return>**
To fill segments s thru e	- **F,s,e<return>**
To fill segments 1 thru 128	- **F,*<return>**

where: n = **number** of segment } maximum of 32 in mode 1.
s = **start** segment } maximum of 128 in mode 4.
e = **end** segment }

EXAMPLES: F,12 - Fill segment 12
F,4,32 - Fill segments 4 thru 32

This will FILL the specified segment(s) with the HARMONIC AMPLITUDES (not waveform) for the *CURRENT SEGMENT*.

No change will occur to the waveform until the COMPUTE command is given.

5. COMPUTE waveform

TO COMPUTE WAVEFORM FROM HARMONICS	TYPE:	LIGHTPEN:
To compute current segment only	- **C<return>**	<COMPUTE>
To compute segment n	- **C,n<return>**	n/a
To compute segments s thru e	- **C,s,e<return>**	n/a
To compute segments 1 thru 128	- **C,*<return>**	n/a

where: n = **number** of segment } maximum of 32 in mode 1.
s = **start** segment } maximum of 128 in mode 4.
e = **end** segment }

EXAMPLES: C<return> - Compute current segment
C,12<return> - Compute segment 12
C,1,98<return> - Compute segments 1 thru 98
C,*<return> - Compute all segments

The WAVEFORM for the selected segment(s) is generated and can be seen in the waveform display.

If the voice selected is in **MODE 4** the effect of the COMPUTE command on PAGE 5 is identical to that on PAGE 4 (except that any number of segments may be computed).

If the voice is in **MODE 1**, note that the ENERGY PROFILE (amplitude envelope) of the voice will NOT be affected by a PAGE 5 COMPUTE. Thus if developing a MODE 1 voice on PAGE 5, the ENERGY and DURATION profiles should be set on PAGE 4 for amplitude and duration control. See PAGE 4 description.

Depending on the number of segments being computed and their harmonic complexity the COMPUTE command will put your CMI "off the air" for up to thirty seconds or so.

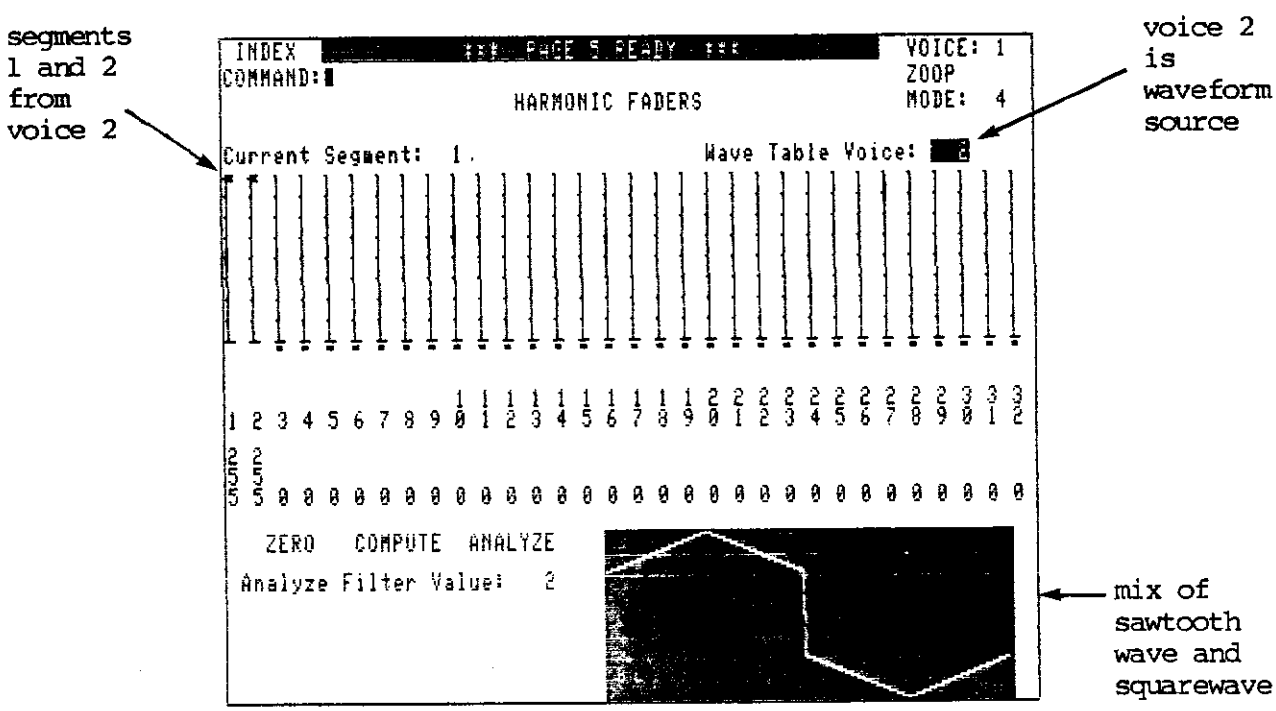
6. WAVE TABLE VOICE

This facility is also present on Page 4.

Page 5 normally uses sinewaves as it's waveform source. However another loaded voice can be used as a waveform source, that is a WAVE TABLE VOICE. **Harmonic** faders now act as **segment** faders, and a mix of any of the first **32** waveform segments of the other voice is possible.

EXAMPLE

In this example, VOICE 1 - ZOOP is using VOICE 2 as the Wave Table Voice. VOICE 2 has a sawtooth wave in segment 1 and a squarewave in segment 2.



7. ANALYZE

TO ANALYZE A WAVEFORM	TYPE:	LIGHTPEN:
To analyze current segment only	- **A<return>**	<ANALYZE>
To analyze segment n	- **A,n<return>**	n/a
To analyze segments s thru e	- **A,s,e<return>**	n/a
To analyze segments 1 thru 128 (mode 4 only)	- **A,*<return>**	n/a

where: n = **number** of segment } maximum of 32 in mode 1.
s = **start** segment } maximum of 128 in mode 4.
e = **end** segment }

EXAMPLES:
A<return> - Analyze current segment
A,12<return> - Analyze segment 12
A,1,98<return> - Analyze segments 1 thru 98
A,*<return> - Analyze all segments

Harmonics for the selected segment(s) are generated.

This command does a Fourier analysis of a waveform. This means that a sampled, natural sound in pitch, can be re-constructed with sinewave harmonics. These harmonics can be redrawn on Page 5 and Page 4.

This command is the reverse of **COMPUTE** command.

For ANALYZE to function correctly, the waveform to be analyzed must be roughly symmetrical, start with a rising edge and have no pitch change. If necessary, use the **ROTATE, INVERT** and **JUSTIFY** commands on Page 6 to prepare the waveform for analysis.

The **ANALYZE FILTER VALUE** is used to filter out higher harmonics from the analysis.

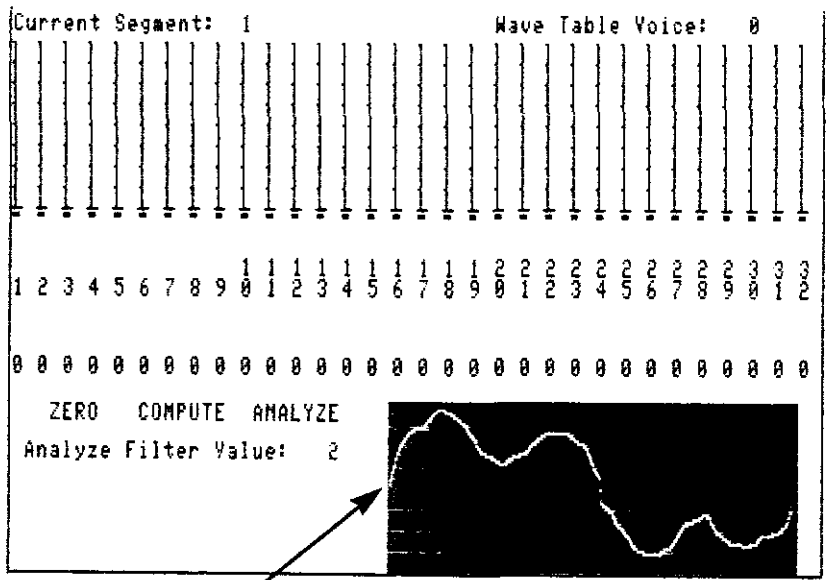
A filter value of **ø** is the **minimum** - no effect
A filter value of **2** is the **default**
A filter value of **7** is the **maximum** - greatest filtering

Once a waveform has been analyzed, use the **COMPUTE** command to compute the new sound.

EXAMPLE

This waveform is suitable for analyzing ...

Type **A<return>** then **C<return>**

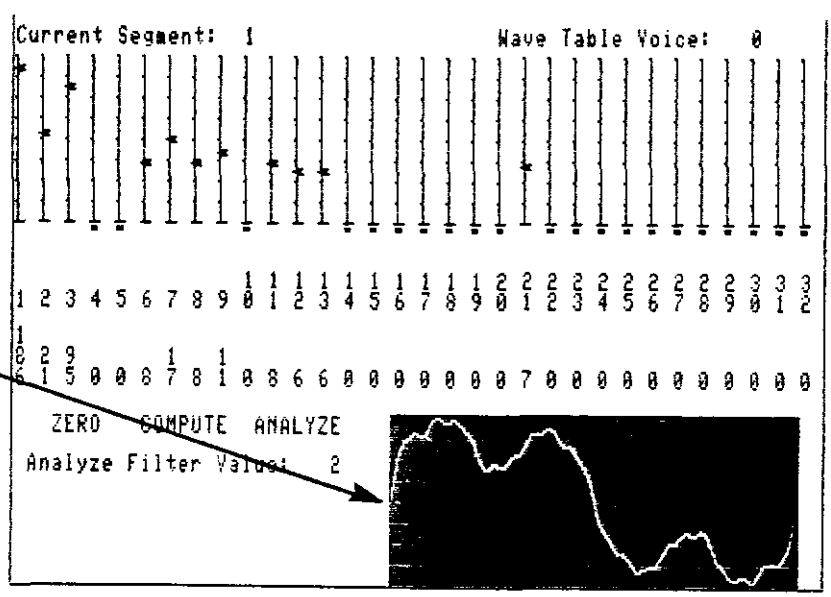


waveform starts with rising edge

waveform approximately symmetrical

Result ...

reconstituted waveform from harmonics



8. SELECT any loaded voice

TO SELECT any loaded VOICE for display or modification,
TYPE: **V,filename<return>** or: **V,n<return>**

where: filename = the name of a loaded voice
n = the number 1-8 of a loaded voice

EXAMPLES: V,TUBA<return> - select voice TUBA
V,4<return> - select voice 4

The NAME, NUMBER & MODE of the current voice are shown in the upper-right corner of the page.

The names and numbers of all loaded voices are shown on PAGE 3 and PAGE 7.

9. LOAD/SAVE instrument and voice files

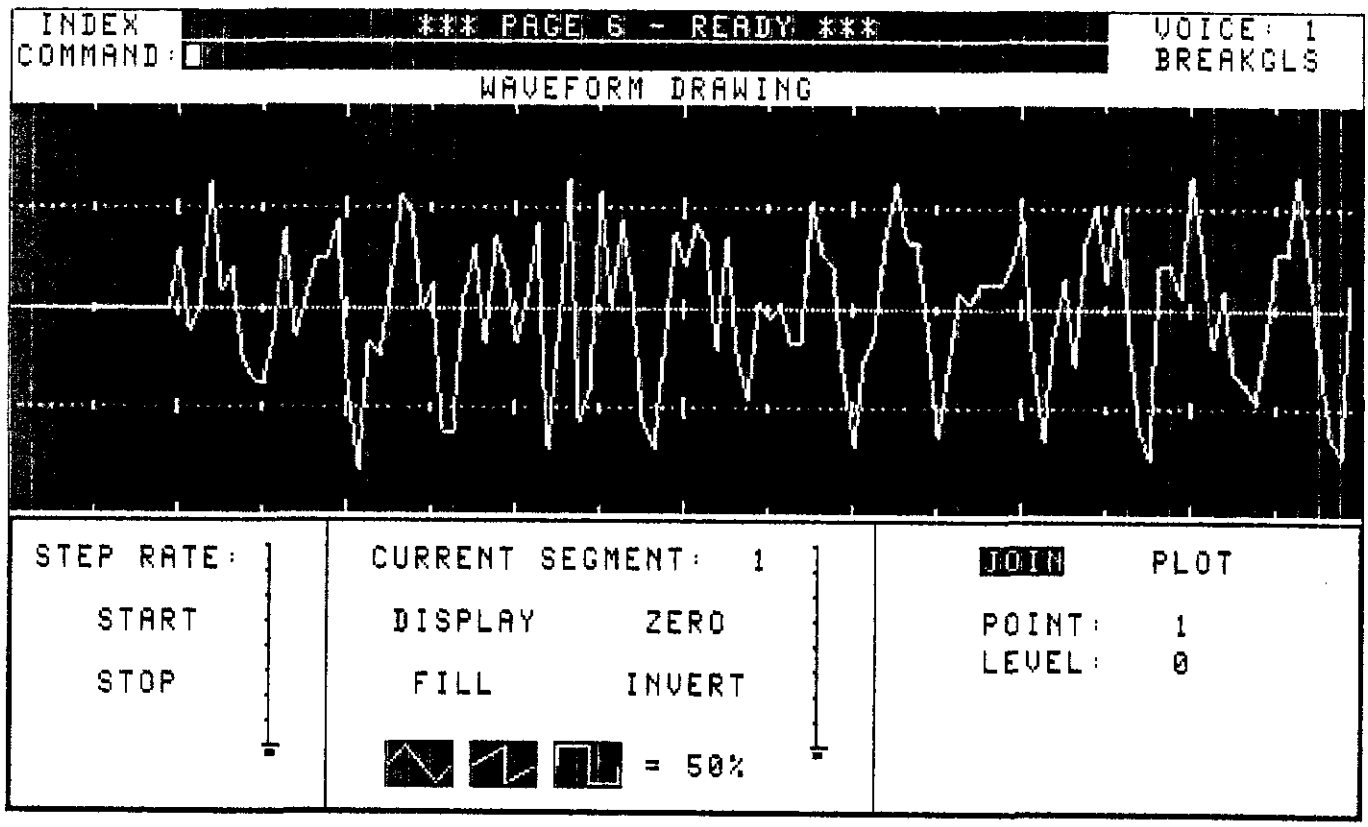
TO LOAD/SAVE VOICES or INSTRUMENTS TYPE:

To LOAD a VOICE	-	**L,r,filename<return>**
To SAVE a VOICE	-	**S,filename<return>**
To CREATE a VOICE	-	**C,r,filename<return>**
To LOAD an INSTRUMENT	-	**L,filename.IN<return>**
To SAVE an INSTRUMENT	-	**S,filename.IN<return>**

where: r = register A - H
filename = 1-8 character filename

See PAGE 3 description for more about loading/saving files.

Section C: DISPLAY PAGE 6) WAVEFORM DRAWING



Here is the actual waveform present in the **first** segment of the voice called BREAKGLS

Here is the first HELP page for PAGE 6 ...

PAGE 6 PAGE 6 - HELP SHEET 1 of 18 PRE TOP FWD BWD

sheet:		sheet:	
2.	WAVEFORM GRAPH	9.	GAIN command
3.	CURRENT SEGMENT	10.	MERGE command
3.	DISPLAY command	11.	MIX command
4.	START/STOP stepping	12.	ROTATE command
4.	LIGHTPEN waveforms	13.	REFLECT command
5.	POINT/LEVEL waveforms	13.	REVERSE command
6.	JOIN/PLOT switch	14.	TRANSFER command
6.	ZERO command	15.	ADD command
7.	INVERT command	16.	BLEND command
7.	TRADITIONAL waveforms	17.	JUSTIFY command
7.	WHITE NOISE	18.	VOICE selection
8.	FILL command	18.	LOAD/SAVE instrument, voice files

For HELP touch any BOX with LIGHTPEN or TYPE: n<set>
where: n = sheet no.

For HELP with HELP PAGES, touch THIS or TYPE: H1<return>

Page 6 is a **close-up** display of the actual **digital waveform** of the voice in the CMI's memory.

Electronically derived sounds, and naturally derived ("sampled") sounds can both have their waveforms **displayed** and **re-drawn** by the alphanumeric keyboard or the lightpen.

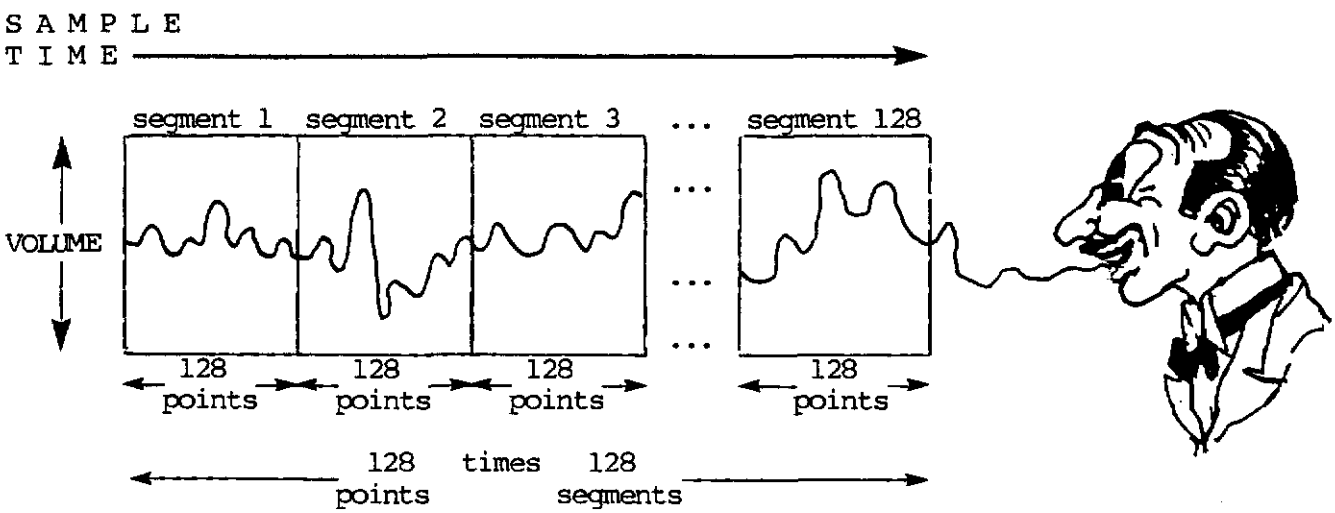
All the analog waveforms are here as well:

triangle
sawtooth
squarewave (with pulse-width adjustment)
white noise.

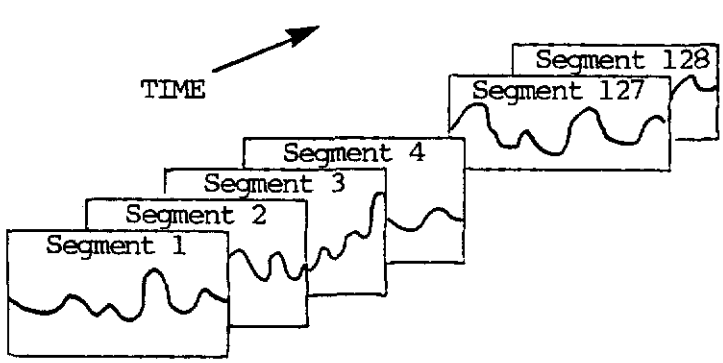
On Page 6 you can squeeze, stretch, reverse, reflect, merge, mix, add, transfer, fill, rotate left and right, invert and zero waveforms. This can be done to any degree down to 1/16,384 of the waveform. Again, extremely tight control can be achieved in a matter of seconds. The computer can merge or mix small changes over the complete sound.

The CMI divides the waveform into **128 segments** as shown.

The **waveform** corresponds to the way air moves when we hear a sound.



Page 6 stacks these segments one behind the other for viewing.



1. WAVEFORM GRAPH

THE WAVEFORM GRAPH displays one SEGMENT (128 points) of the WAVEFORM MEMORY of a voice as an oscilloscope-like image.

Any segment or range of segments may be displayed.

Waveforms can be created or altered either by drawing on the graph with the LIGHTPEN or by assigning LEVELS to individual waveform points. Horizontal divisions mark 1, 8 and 16 point intervals across the graph.

Any loaded VOICE may be SELECTED for display or modification. The voice may be in either MODE 1 or MODE 4, but remember that in MODE 1 the amplitude envelope is specified with the ENERGY profile on PAGE 4.

See PAGE 4 description for more about waveform memory, segments and voice mode.

The DISPLAY and FILL functions are exact opposites of each other.

The DISPLAY function refers to the moving of a voice waveform segment INTO the GRAPH.

The FILL function refers to the moving of the waveform displayed on the graph INTO a VOICE WAVEFORM SEGMENT. This allows a segment to be displayed and then modified to any degree without losing the original (which remains unaltered in waveform memory) until the segment is filled with the waveform displayed on the graph.

Thus the graph is a kind of temporary scratch-pad for waveform development.

The features of PAGE 6 fall into two groups:

* those which directly modify the waveform memory of the voice and
* those which change only the displayed waveform and thus require you to use the FILL command before the voice will actually be modified.

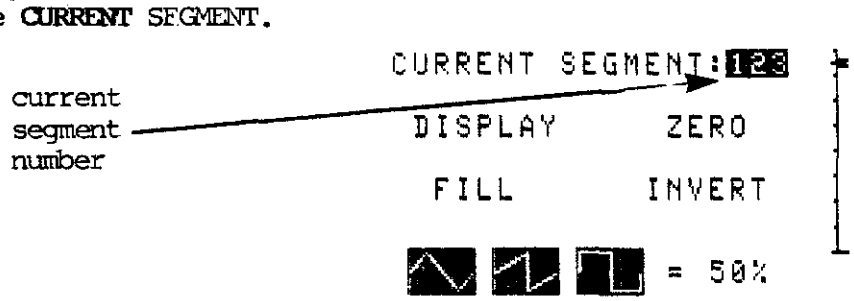
2. CURRENT SEGMENT assignment

TO SET CURRENT SEGMENT NUMBER use <arrow> keys or LIGHTPEN to TAB to CURRENT SEGMENT,

TYPE: **s<set>**

where: s = waveform segment number, range 1 - 128

The selected segment of WAVEFORM MEMORY will be DISPLAYED on the waveform graph. This is now the **CURRENT** SEGMENT.



3. DISPLAY command

TO DISPLAY a WAVEFORM SEGMENT	TYPE:	LIGHTPEN:
display current segment	- **D<return>**	<DISPLAY>
display segment (s)	- **D,s<return>**	n/a
display segment (s) thru (e)	- **D,s,e<return>**	n/a
display ALL segments	- **D,*<return>**	n/a

where: s = **start** segment number range 1 to 128
e = **end** segment number range 1 to 128

EXAMPLES: D,24<return> Display segment 24
D,1,16<return> Display segments 1 thru 16

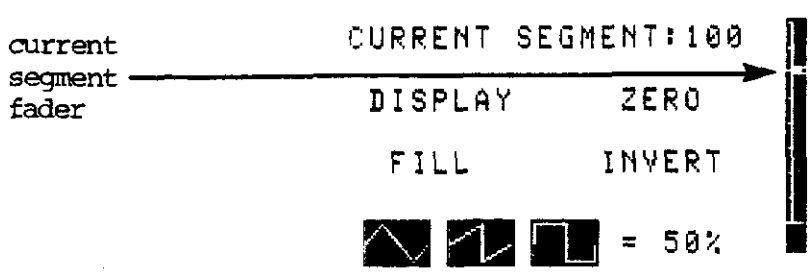
If only 1 segment number is specified (as in 1st example) the waveform segment is displayed and becomes the new CURRENT SEGMENT.

If a RANGE of segments is specified they will be displayed sequentially, called a STEPPING DISPLAY, at a speed set by the STEP RATE fader.

The LAST segment of the range will be the new current segment. If no segments are specified with the command, the current segment will be re-displayed.

Note that any redrawing of the displayed waveform will be lost if the FILL command is not used.

TO USE CURRENT SEGMENT FADER touch fader with the LIGHTPEN and position as desired. Any segment may be DISPLAYED by movement of this fader (located to right of current segment number).



4. START/STOP stepping display

TO START/STOP STEPPING DISPLAY	TYPE:	LIGHTPEN:
start display (when stopped)	- **S<return>**	<START>
stop display (when in progress)	- **S<return>**	<STOP>

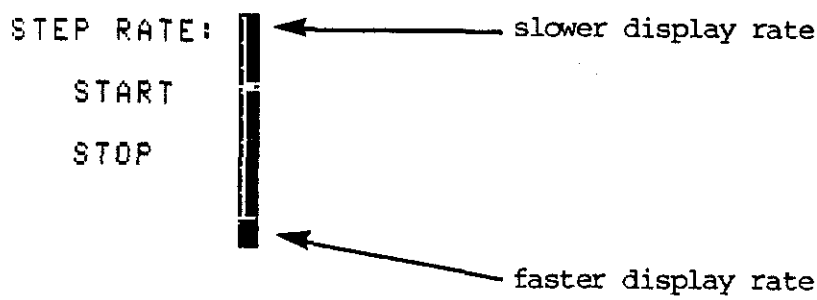
If a STEPPING DISPLAY is in progess, you may STOP it whenever desired. The last segment displayed will be the new CURRENT SEGMENT.

Alternatively, you may START a stepping display at any time which will proceed from the CURRENT SEGMENT to the last segment (128).

The STEP RATE fader sets the time for which each segment is displayed, and can be adjusted by positioning it with the LIGHTPEN (even while stepping display in progress).

A stepping display may also be STOPPED by pressing **<ctrl-esc>**.
(Press & hold <ctrl> - press <esc>).

The stepped display can show up possible **drift** in **pitch** from an externally sampled sound. See Page 8 - Sound Sampling.



5. LIGHTPEN waveform modification

TO CREATE or MODIFY DISPLAYED WAVEFORM with LIGHTPEN simply draw on the WAVEFORM GRAPH with the lightpen.

When drawing, the best accuracy will be usually be obtained by triggering the lightpen with a single quick "blip" of the finger rather than with a prolonged touch.

However, large flowing shapes are best drawn by selecting JOIN (see JOIN/PLOT switch) and using a prolonged touch.

Remember, the waveform graph is a **scratch pad:** the FILL command MUST be used to move whatever is drawn into WAVEFORM MEMORY before it becomes part of the voice (and can be heard or saved).

A good way to explore PAGE 6 is to put a LOOP (PAGE 4 or 7) in segment 1 of a MODE 4 voice. Select segment 1 on Page 6 by typing **D,1<return>** then simply

draw waveform
touch <FILL> and
play your creation.

6. POINT/LEVEL waveform modification

Waveforms can be modified by the alphanumeric keyboard on a point-to-point basis. This is slower than the lightpen but more precise.

TO CREATE or MODIFY DISPLAYED WAVEFORM with POINT/LEVEL use <arrow> keys or LIGHTPEN to TAB to POINT / LEVEL,

TYPE: **n<set>**

where: n = for POINT: desired point in segment, 1 to 128
for LEVEL: desired amplitude, -128 to +127

The LEVEL value will ALWAYS show the amplitude of the single point of the waveform segment indicated by POINT (even during a stepping display).

When you tab to either LEVEL or POINT a marker appears on the WAVEFORM GRAPH to identify the selected point.

Select desired POINT and then set LEVEL to modify the displayed waveform.

When cursor is tabbed to POINT or LEVEL, operation of the lightpen is different.

POINT: touching graph selects new POINT and displays its LEVEL.

LEVEL: touching graph assigns new LEVEL to selected POINT.

Lightpen operation reverts to normal when you tab away from POINT or LEVEL

Note that the WAVEFORM MEMORY is NOT affected until the FILL command is used. See JOIN/PLOT.

7. JOIN/PLOT switch

THE JOIN/PLOT SWITCH selects the way in which the WAVEFORM GRAPH responds to alteration by the LIGHTPEN or assignment to LEVEL.

There are 128 **points** in each **segment** waveform.
By coincidence there are **128 segments** in the **total** waveform.

Both the level control and lightpen work by setting the amplitudes of single points.

When JOIN is selected each subsequent alteration will be JOINED to the last by a straight line (the points between are set automatically).

JOIN is good for creating waveforms or large-scale alterations.

When PLOT is selected each point can be individually altered without affecting the others.

PLOT is better for fine detail.

To SELECT JOIN or PLOT	TYPE:	LIGHTPEN:
select JOIN -	**J<return>**	<JOIN>
select PLOT -	**P<return>**	<PLOT>

8. ZERO command

TO ZERO the DISPLAYED WAVEFORM	TYPE:	LIGHTPEN:
	Z<return>	<ZERO>

This will ZERO the waveform displayed on the WAVEFORM GRAPH.

Note that the WAVEFORM MEMORY is NOT affected until the FILL command is used.

To ZERO entire WAVEFORM MEMORY (silent voice)

TYPE: **Z<return>** - zero display waveform
F,*<return> - Fill all segments

9. INVERT command

TO INVERT the DISPLAYED WAVEFORM TYPE: **I<return>** LIGHTPEN: <INVERT>

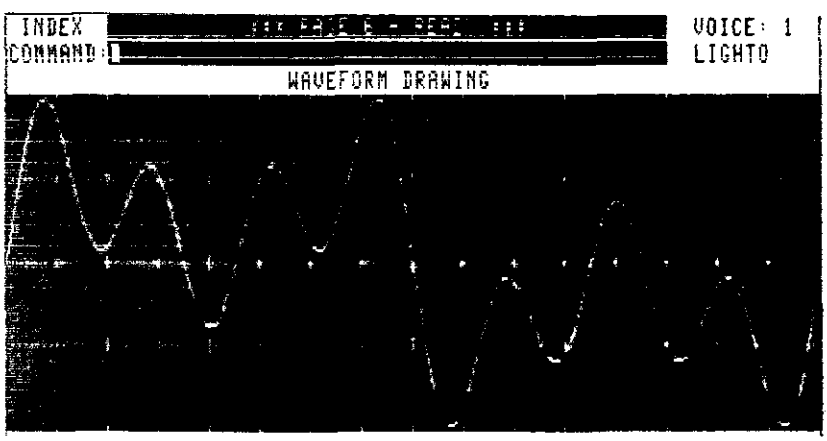
This will INVERT the PHASE of the waveform displayed on the WAVEFORM GRAPH.

Note that the WAVEFORM MEMORY is automatically FILLED when INVERT is used.

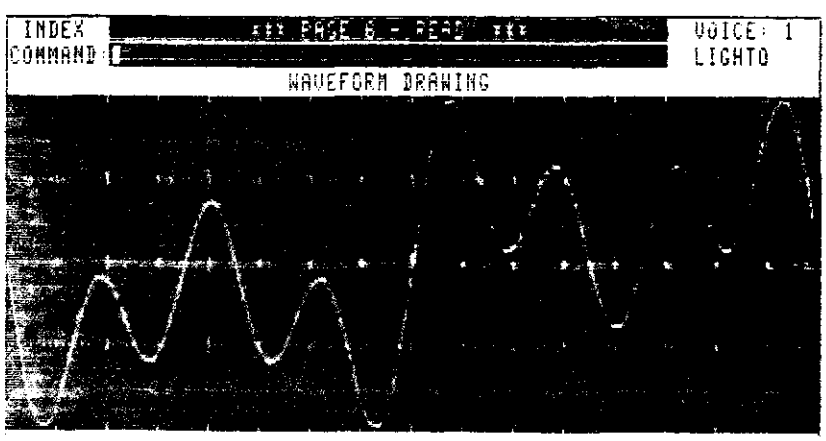
EXAMPLE

I,85,95<return>	INVERT and FILL waveform segments 85 to 95.

Here is a waveform segment **before** inversion ...



Here is the same waveform segment **after** inversion ...



1Ø. TRADITIONAL waveform generation

TO GENERATE TRADITIONAL WAVEFORMS touch desired waveshape image with LIGHTPEN.

TRIANGLE, SAWTOOTH or variable-width PULSE waveform will be generated on the graph.

Otherwise type **TRI<return>** for TRIANGLE waveform
SAW<return> for SAWTOOTH waveform
SQ<return> for SQUARE waveform.

Note that the WAVEFORM MEMORY is NOT affected until the FILL command is used. (To generate a sine wave or harmonic waveform use the HARMONIC FADERS and COMPUTE command provided on PAGE 5.)

To set PULSE WIDTH use <arrow> keys or LIGHTPEN to TAB to width control (to right of pulse image).

TYPE: **n<set>** where: n = 1% to 99%

Touching the pulse image will then generate a pulse wave of the percentage width specified.

11. FILL command

TO FILL WAVEFORM SEGMENT(S) with DISPLAYED WAVEFORM

	TYPE:	LIGHTPEN:
fill the current segment -	**F<return>**	<FILL>
fill segment (s) -	**F,s<return>**	n/a
fill segments (s) thru (e) -	**F,s,e<return>**	n/a
fill ALL segments -	**F,*<return>**	n/a

where: s = **start** segment number, range 1 to 128
e = **end** segment number, range 1 to 128

EXAMPLES: F,68<return> Fill segment 68
F,119,127<return> Fill segments 119 thru 127

The DISPLAYED waveform is moved into the selected segment(s) of WAVEFORM MEMORY for the current voice.

Modifications made to displayed waveform by:

LIGHTPEN drawing
POINT/LEVEL assignment
ZERO command

does not affect the waveform memory (sound) of the voice until the FILL command is used.

Before FILLED, these modifications exist only on the WAVEFORM GRAPH and are discarded if you display another segment or select another display page.

When FILLED, the changes become part of the voice - the previous content of the FILLED segment(s) is gone and can only be restored by LOADING the voice again.

12. GAIN command

modify current segment	-	**G,p<return>**
modify segments (s) thru (e)	-	**G,p,s,e<return>**
modify ALL segments	-	**G,p,*<return>**

where: p = desired GAIN as a **PERCENTAGE**
s = **start** segment number, range 1 to 128
e = **end** segment number, range 1 to 128

EXAMPLES:	G,5Ø<return>	Gain 5Ø% for current segment
	G,11Ø,4<return>	Gain 11Ø% for segment 4
	G,33,1Ø,64<return>	Gain 33% for segments 1Ø thru 64
	G,2ØØ,*<return>	Gain 2ØØ% for all segments
	G,MAX,*<return>	Gain largest amplitude to full scale and other segments in proportion.

The AMPLITUDE of the selected segment(s) of WAVEFORM MEMORY is modified according to the GAIN specified.

5Ø% will **halve** the amplitude (-6db)
2ØØ% will **double** the amplitude (+6db)

If the specified gain will **exceed** the amplitude range of the CMI this question will appear:

CLIPPING WILL OCCUR - PROCEED (Y)?

To reply: Yes - type: **Y<return>**
No - **N<return>** or **<return>**

If you decline then nothing will have changed, otherwise the GAIN command will proceed and at least one of the waveform segments will CLIP. This may be severe or so negligible as to be invisible on the graph.

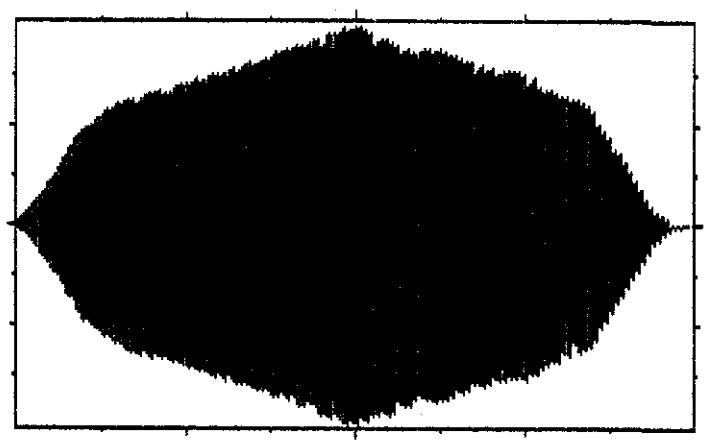
Clipping may be desired, of course.

Two special cases of the GAIN command are available.

These are	1)	G MAX	GAIN largest amplitude to full scale with the rest of the segment in proportion.
	2)	G =number between 1-1ØØ	GAIN largest amplitude to a percentage of full scale with the rest in proportion.
EXAMPLE		G =75,*	GAIN largest amplitude in waveform to 75% of full scale with the rest of the waveform in proportion.

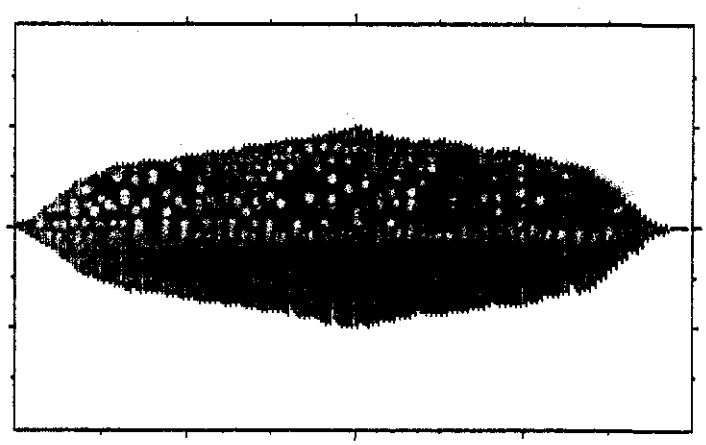
Here are some Page 8 cross sectional displays showing the effect on the waveform envelope of some Page 6 GAIN commands.

Original waveform envelope of voice

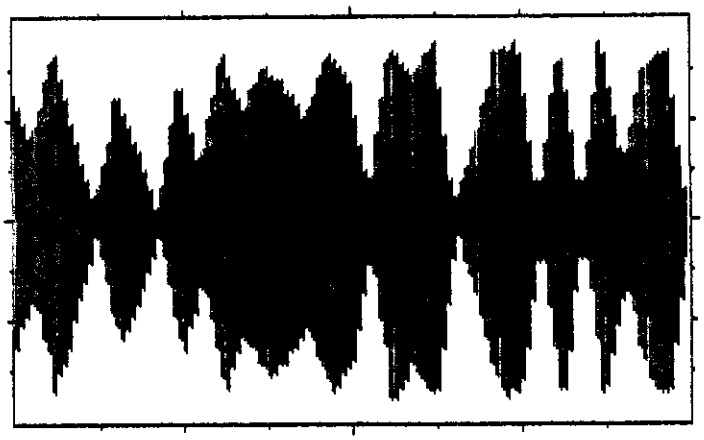


G,5Ø,*<return>

Reduce gain of **entire waveform** by 5Ø% (-6db)

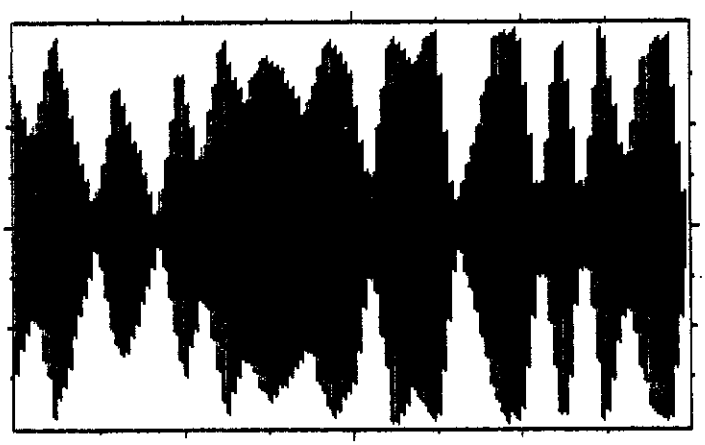


Original waveform envelope of voice



G,MAX,*<return>

Increase gain of **entire waveform** to just under clipping



13. MERGE command

TO MERGE BETWEEN TWO WAVEFORM SEGMENTS	TYPE:
merge from segment (s) to (e)	- **ME,s,e<return>**
merge from segment 1 to 128	- **ME,*<return>**
merge from current segment + (o)... to current segment	- **ME,o<return>**

where: s = **start** segment number, range 1 to 128
e = **end** segment number, range 1 to 128
o = **offset** number, range -127 to +127

EXAMPLES:

ME,1,8<return>	Merge from segment 1 to segment 8
ME,-32<return>	Merge from current segment -32 to current segment
ME,+6Ø<return>	Merge from current segment +6Ø to current segment (Merge backwards)

MERGE will generate a "crossfade" between the 2 segments - there must be at least one segment in between.

The START segment (1st number specified) and END segment (2nd number specifed) are not affected.

The WAVEFORM MEMORY of the segments in between the START and END segments is modified to contain the merge - the previous content of these segments is completely ignored.

Only the START and END segments have any significance in the MERGE command. MERGING from segment 1 to 128 (entire waveform) will take about 18 seconds. See also the MIX command.

Start segment (fading out).....
.....(fading in) End segment

14. MIX command

TO MIX BETWEEN TWO WAVEFORM SEGMENTS	TYPE:
mix from segment (s) to (e)	- **MI,s,e<return>**
mix from segment 1 to 128	- **MI,*<return>**
mix from current segment+(o)... to current segment	- **MI,o<return>**

where: s = **start** segment number, range 1 to 128
e = **end** segment number, range 1 to 128
o = offset, range -127 to +127

EXAMPLES:

MI,1,8<return>	Mix from segment 1 to segment 8
MI,48,5<return>	Mix from segment 48 to segment 5
MI,-32<return>	Mix from current segment -32 to current segment
MI,+6Ø<return>	Mix from current segment +6Ø to current segment (Mix backwards)

Like the MERGE command, this will generate a **crossfade** between the 2 segments - there must be at least one segment in between.

Unlike the MERGE command, segment contents between START and END are **not** wiped out but are proportionally mixed with the END segment.

The START segment (1st number specified) and END segment (2nd number specified) are not affected.

The WAVEFORM MEMORY of each segment in between will contain a MIX of the existing waveform of the segment (decreasing) and that of the END segment (increasing).

The start segment number can be GREATER than the end segment (for backwards MIXING).

Mixing from segment 1 to 128 (entire waveform) will take about 2Ø seconds.

```
                    (fading out).....
START segment, next seg, next seg, next seg,
               .....(fading in)          END segment
```

To have a sampled sound **finish smoothly** in waveform, MIX the last 1Ø or 2Ø segments to a ZEROED waveform in segment 128.

15. ROTATE command

TO ROTATE ENTIRE WAVEFORM MEMORY	TYPE:
rotate right 1 point	- **ROR<return>**
rotate right (s) segments	- **ROR,s<return>**
rotate right (s) segs & (p) points	- **ROR,s,p<return>**

rotate left (just the same, but use: ROL instead of ROR)

where: s = **segment** number, range 1 to 128
p = **point** (byte) number, range 1 to 128

EXAMPLES:

ROR,1<return>	Rotate right 1 segment
ROL,8,32<return>	Rotate left 8 segments and 32 points
ROR,Ø,2<return>	Rotate right 2 points (zero segments)

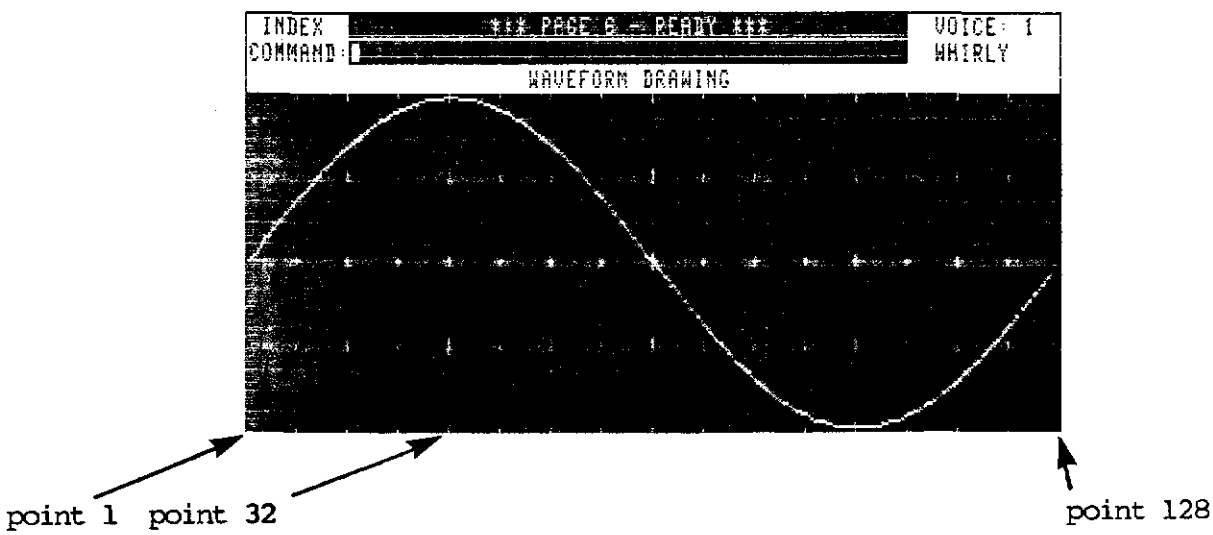
The entire WAVEFORM MEMORY of the voice will be ROTATED (shifted) RIGHT or LEFT as desired.

Consider the first example from the previous page which specifies a ROTATE RIGHT of 1 segment. This will cause segment 1 to be moved to segment 2, segment 2 to segment 3, and so on. This procedure will "wrap-around" - meaning that segment 128 will be moved to segment 1 (hence the name ROTATE).

If a ROTATE RIGHT of 2 points is requested (3rd example), point 1 will be moved to point 3, point 2 to 4, point 16,383 to point 1, and point 16,384 to point 2. (There are 16,384 points: 128 segments with 128 points each.)

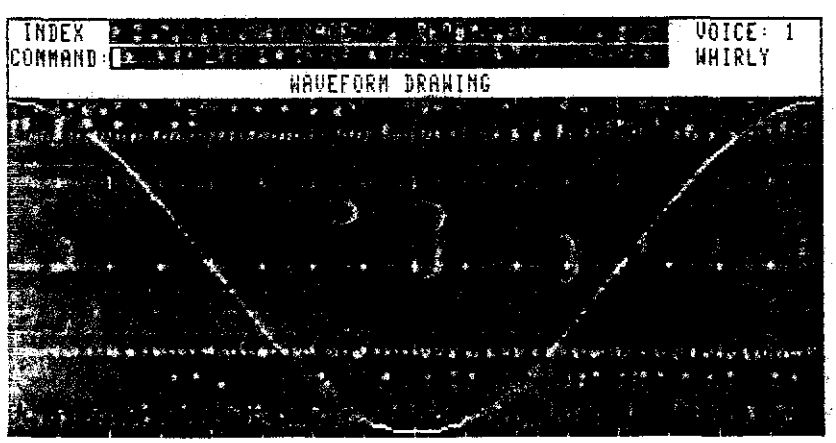
This can be used to trim the start of an externally sampled voice, or (with use of the TRANSFER and ADD commands) to generate "doubling" or phase cancellation/reinforcement effects.

In this example the entire waveform memory has already been filled with a Page 5 generated sine wave.



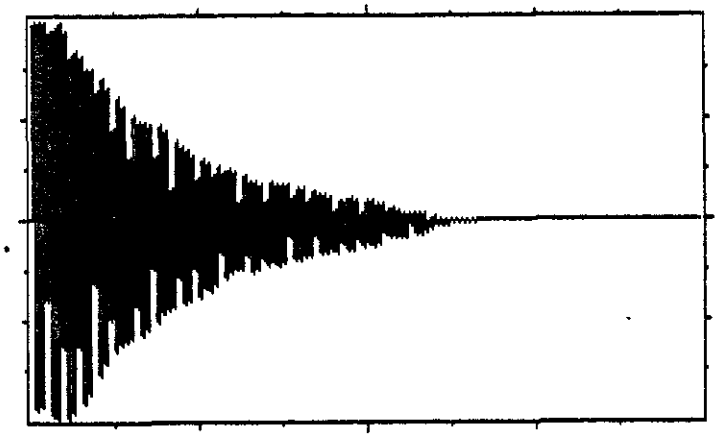
Typing **ROL,Ø,32**<return>

rotates the entire waveform **left** 32 points turning the waveform into **cosine.**



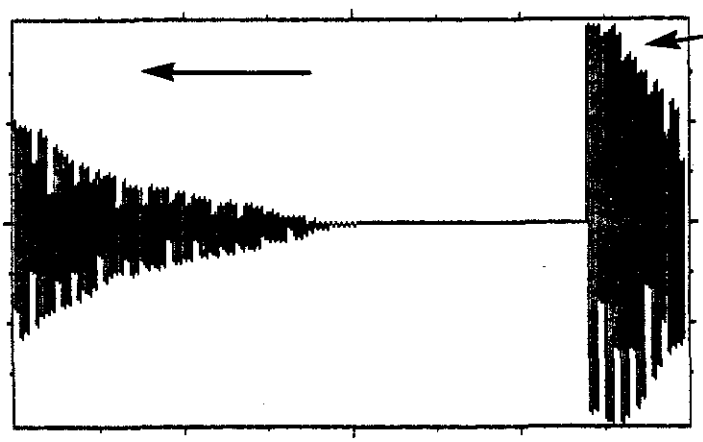
Here are Page 8 cross-sectional displays of a sound that has been ROTATED left and right ...

Original



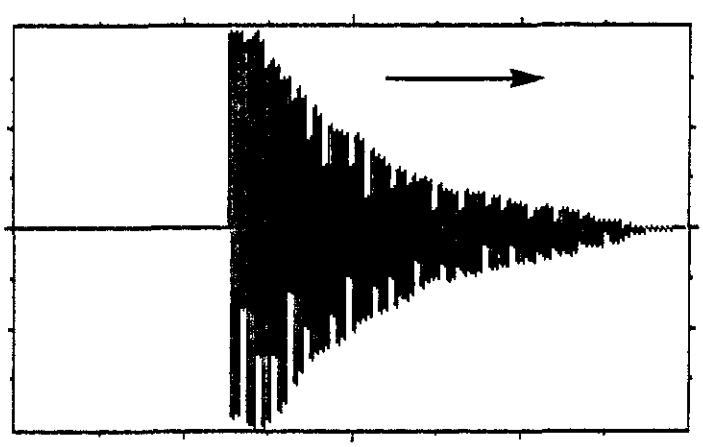
ROL,2Ø<return>

Rotate the entire waveform **left 2Ø** segments



ROR,4Ø<return>

Rotate the entire waveform **right 4Ø** segments



16. REFLECT command

TO REFLECT WAVEFORM MEMORY	TYPE:
reflect around segment 64 point 1	- **REF<return>**
reflect around segment (s) point 1	- **REF,s<return>**
reflect around segment (s) point (p)	- **REF,s,p<return>**

where: s = **segment** number, range 1 to 128
p = **point** (byte) number, range 1 to 128

EXAMPLES: REF,14<return> Reflect around seg 14 point 1
REF,32,64<return> Reflect around seg 32 point 64

The WAVEFORM MEMORY is **symmetrically** REFLECTED around the specified point - points preceding the reflection point are repeated after it in reverse order. It would be as if you held a mirror against the waveform at the point of reflection. See table below.

17. REVERSE command

TO REVERSE ENTIRE WAVEFORM MEMORY TYPE: **REV<return>**

The entire WAVEFORM MEMORY is completely **REVERSED end-for-end** giving backward sounds.

This table illustrates the effects of the REVERSE, ROTATE and REFLECT commands by using the alphabet to represent WAVEFORM MEMORY of a voice.

Letters represent single waveform POINTS.

original "waveform":	**ABCDEFGHIJKLMNOPQRSTUVWXYZ**
REVERSED:	ZYXWVUTSRQPONMLKJIHGFEDCBA
ROTATED **RIGHT** 6:	UVWXYZ**ABCDEFGHIJKLMNOPQRST**
ROTATED **LEFT** 4:	EFGHIJKLMNOPQRSTUVWXYZ**ABCD**
REFLECTED AROUND G:	**ABCDEFG**GFEDCBA**HIJKLMNOPQRS**

18. TRANSFER command

TO TRANSFER SEGMENT(S) from another VOICE	TYPE:
transfer current segment from voice (v)	- **T,v<return>**
transfer segment (s) from voice (v)	- **T,v:s<return>**
transfer segments (s) to (e) from voice (v)	- **T,v:s,e<return>**
transfer ALL segments from voice (v)	- **T,v:*<return>**

where: v = name or number (1-8) of any **loaded voice**
s = **start** segment number, range 1 to 128
e = **end** segment number, range 1 to 128

EXAMPLES:

T,FUDGE<return> Transfer current segment from voice FUDGE
T,FUDGE:16<return> Transfer segment 16 from voice FUDGE
T,2:16,1ØØ<return> Transfer segments 16 to 1ØØ from voice 2
T,4:*<return> Transfer ALL segments from voice 4

The selected segment(s) will be TRANSFERRED **from** the specified voice **to** the current voice.

It is often handy to create a scratch voice for temporary storage of waveform segments while developing sounds on PAGE 6.

To place segments **into** the scratch voice, SELECT it as the current voice and TRANSFER **from** the voice you are developing.

Remember that the current voice (shown in upper-right corner of page) will always be the RECEIVER of the transferred segments.

19. ADD command

TO ADD IN SEGMENTS(S) from another VOICE	TYPE:
add in current segment from voice (v)	- **A,v<return>**
add in segment (s) from voice (v)	- **A,v:s<return>**
add in segments (s) to (e) from voice (v)	- **A,v:s,e<return>**
add in ALL segments from voice (v)	- **A,v:*<return>**

where: v = name or number (1-8) of any **loaded voice**
s = **start segment number, range 1 to 128**
e = **end** segment number, range 1 to 128

EXAMPLES:

A,FUDGE<return> Add in current seg from voice FUDGE
A,FUDGE:16<return> Add in segment 16 from voice FUDGE
A,2:16,1ØØ<return> Add in segments 16 to 1ØØ from voice 2
A,4:*<return> Add in ALL segments from voice 4

The ADD command allows segment(s) of two voices to be blended.

The WAVEFORM MEMORY of the currently selected voice will be modified to contain an equal mix of the waveforms already in the specified segments and those from the selected voice.

An interesting operation involves the combined use of the TRANSFER, ROTATE, and ADD commands to achieve "doubling".

Use TRANSFER to move all segments to another (scratch) voice and then ROTATE it RIGHT by some amount (say, 48 points) thus DELAYING it. Now reselect **original** voice and ADD all segments back in.

Experiment with different rotation (delay) factors. This works best in best in MODE 4.

2Ø. BLEND command

BLEND makes a looped sound smoother by taking the loop length, dividing it into two halves, and fading the first half into the second half. After BLENDING the loop length is one half the original.

To BLEND a voice TYPE: **B,<voice>:<segments>**

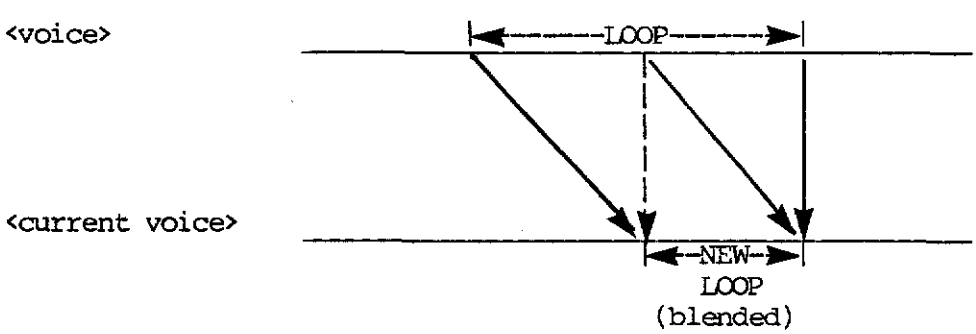
Transfers voice to current voice and blends in loop over the specified segments. Current voice is overwritten.

If no specified segments then defaults to current loop position in <voice>.

If no current loop in <voice> then default loop position is:

current segment on Page 6 to end of sound.

<voice> may be the SAME as current voice.



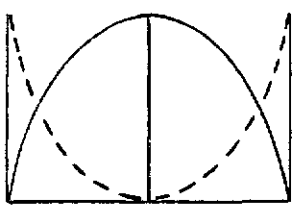
EXAMPLES

B 2	voice 2 - current voice - default loop.
B 2:*	voice 2 - current voice - loop over 128 segments.
B:1Ø,2Ø	blend current voice and loop over segments 1Ø to 2Ø.
B	blend the current voice with itself within the loop. The new loop is one half the original.

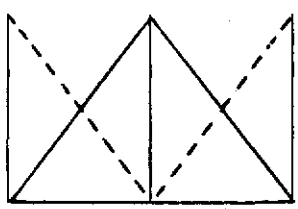
The simplest and quickest way to use this feature would be to load a voice, set up the loop on Page 7 (with the controls) or Page 4 (with the lightpen) for the smoothest loop, then go to Page 6 and

TYPE: **B<return>**

Also available is the ;L option, which causes the BLEND to use a linear ramping function instead of the default square root ramping function



without ;L



with ;L
e.g., B 2:*;L

The ;L option should be used for regular repetitive waveforms such as Page 4 and Page 5 generated sounds.

21. NOISE command

To fill segments sss to eee with white NOISE

TYPE: **NO,sss,eee<return>**

where: sss is the **start** segment
eee is the **end** segment

Default is current segment only.
You must type at least 2 letters of the word NOISE.

EXAMPLE

NO<return>	fill current segment with white noise.
NO,*<return>	fill **entire waveform** with white noise.

With electronic organ sounds, noise in the first segment will simulate key contact closure.

It also adds more bite to the beginning of percussive sounds.

Type **NO,1<return>**

22. JUSTIFY command

This command shrinks or stretches waveforms to fit segment boundaries. Waveforms can be pulled into tune, making it easier to LOOP (Page 4 & 7). It is essential to JUSTIFY if you want to ANALYZE (PAGE 5) a waveform. Ideally, each segment of waveform memory should contain one cycle of the waveform, and the zero-crossing points of the waveform should align perfectly with the boundaries between segments. With accurate use of the facilities provided on Page 8 it is possible to achieve nearly perfect results; however small pitch deviations in the original signal can make absolute fulfillment of these requirements difficult. Once the best possible sample has been obtained on Page 8, the JUSTIFY command may be used to "tidy-up"the results by smoothing out pitch deviations and forcing zero-crossing points to fall on segment boundaries. First ensure that the voice has been SAVED, since more than one attempt may be required with the *JUSTIFY command*.

To JUSTIFY a waveform

TYPE: **JU,s,a,p<return>**

where s = start point as <segment'point>
a = alignment point as <segment'point>
p = period 1 to 16383

Start is point at which justification is to begin. No change is made to waveform preceding this point. Default is 1.
Alignment is segment alignment point - a zero crossing. This point will be aligned to the nearest segment boundary. The alignment point must be **greater** than the start point. If a start point is specified, but NO alignment is desired, enter a value of **1** for the alignment point (or any value less then the start point).
Period - initial period in waveform **points**. This is the distance from the start point or alignment point (if specified) to the zero-crossing which marks the end of one cycle.

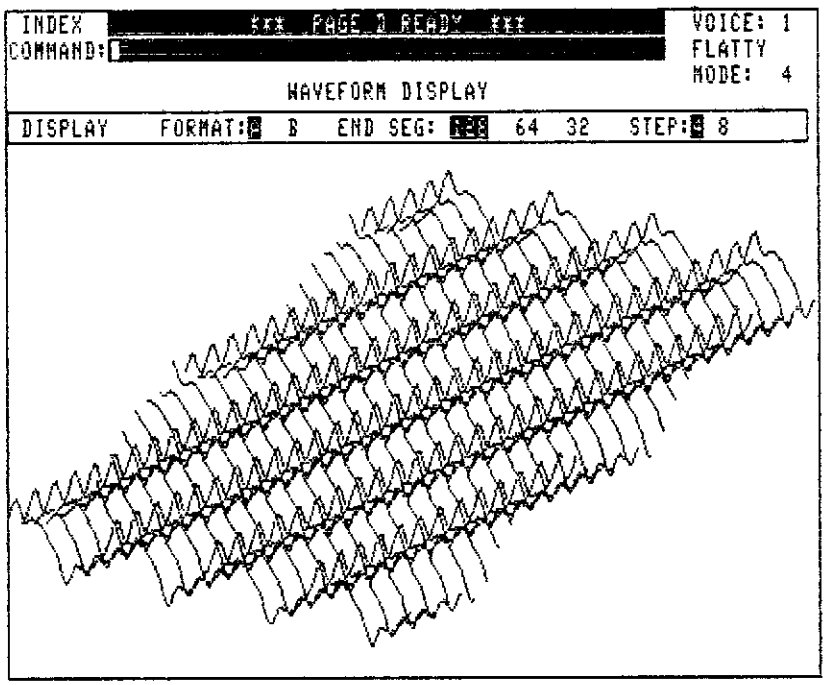
Note that alignment point and period may be approximated, since the CMI will search for zero-crossings, and only uses the command parameters as a guide. The JUSTIFY command always looks for waveforms starting from **zero** with a positive edge. If justification of negative going edge is required, use **I,*<return>** command first (INVERT entire waveform).

Note also that overtones of any periodic waveform may be generated by JUSTIFYING with the required period. For example, using a voice filled with squarewave, JUSTIFY from segment 1, point 1, with a period of:

256 to get a **2nd** harmonic squarewave ie., JU 1'1,1'1,256
384 to get a **3rd** harmonic squarewave ie., JU 1'1,1'1,384
512 to get a **4th** harmonic squarewave ie., JU 1'1,1'1,512

Here's a Page D picture of a waveform sampled flat.

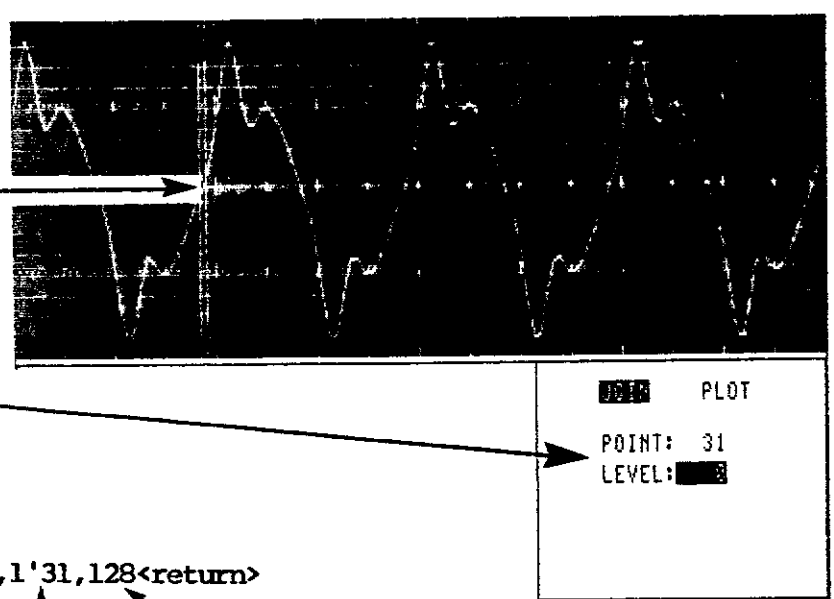
waveform "drifts" to right



On Page 6, we look for a positive rising edge starting from as close as possible to zero.

positive rising edge

segment 1 point 31 has zero LEVEL



Type **JU,1'31,1'31,128<return>**

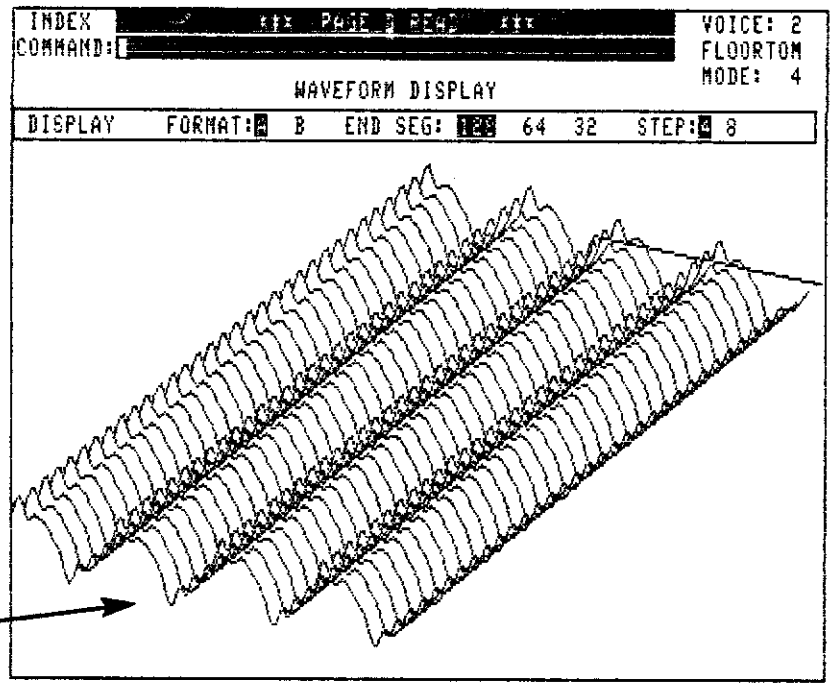
justify

start segment 1 point 31

alignment starts at segment 1 point 31

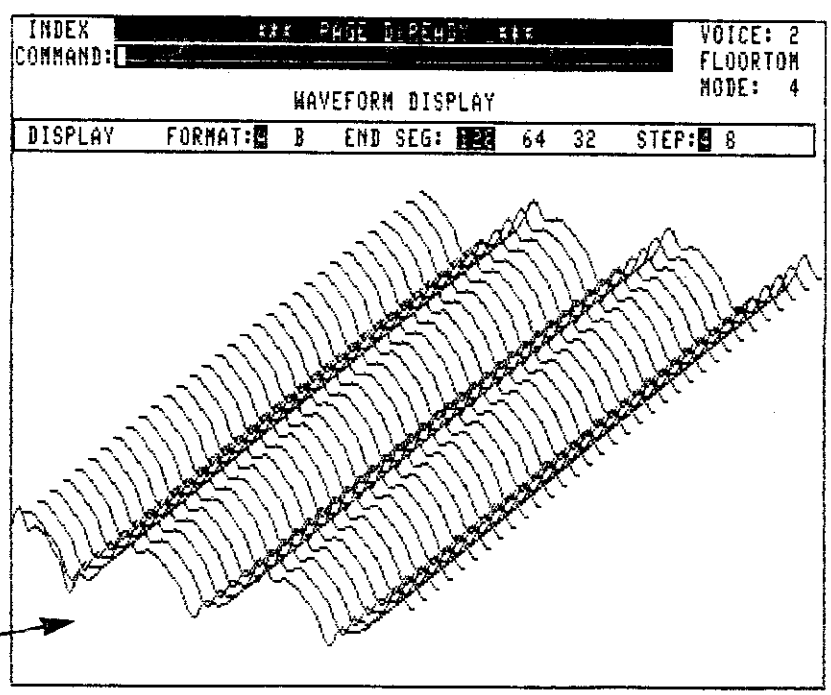
period is 128 points (1 segment)

Page D shows result. Waveform is squeezed slightly. There are exactly **four** waveform cycles per segment.



four cycles per segment

If, from the previous example, period was specified as **96** points, that is JU,1'31,1'31,**96<return>** , then waveform would be **stretched** to **three** waveform cycles per segment



three cycles per segment

23. VOICE selection

TO SELECT any loaded VOICE for display or modification,

TYPE: **V,filename<return>** or: **V,n<return>**

where: filename = the **name** of a loaded voice
n = the number **1** to **8** of a loaded voice

EXAMPLES: V,TUBA<return> Select voice TUBA
V,4<return> Select voice 4

The NAME and NUMBER of the current voice are shown in the **upper-right corner** of the page.

The names and numbers of all loaded voices are shown on PAGE 3.

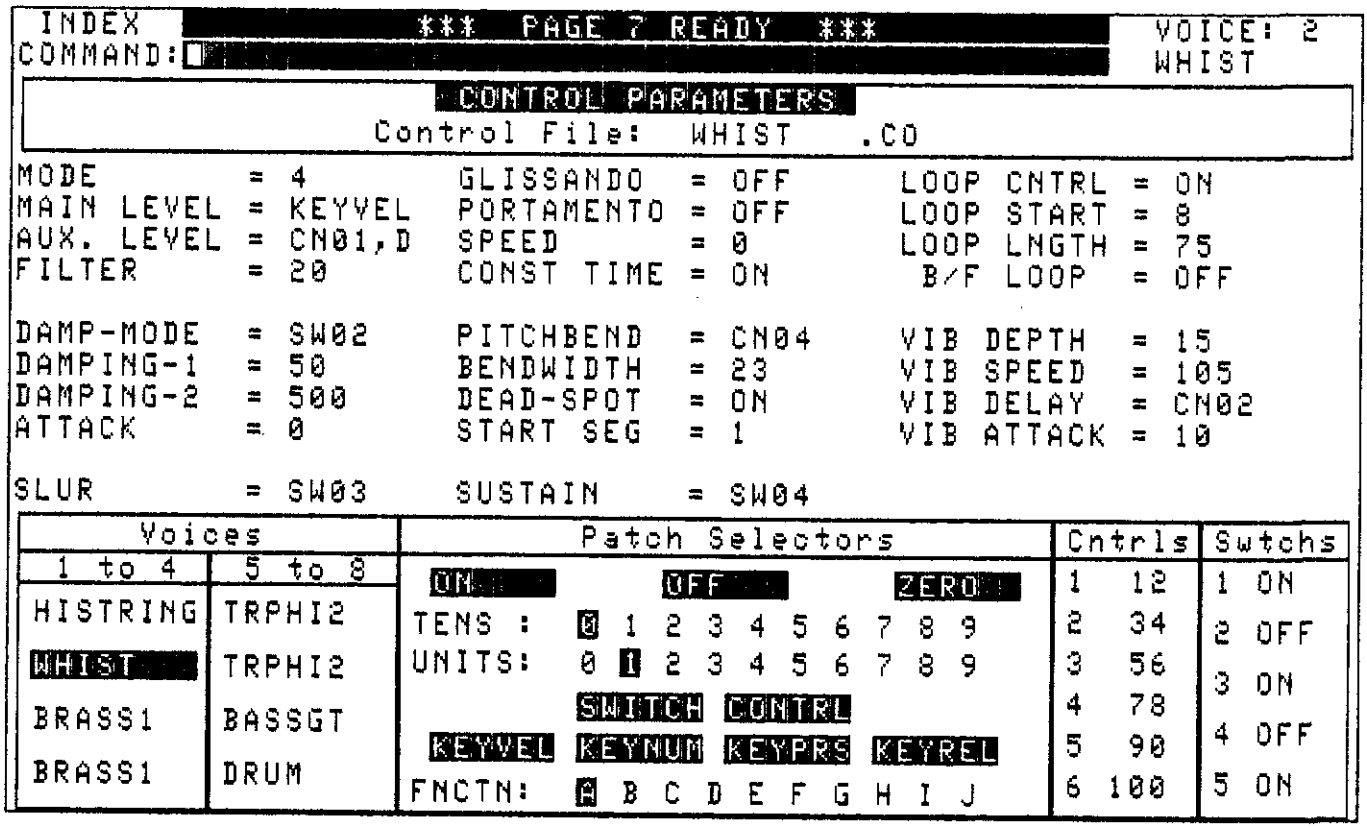
24. LOAD/SAVE instrument and voice files

TO LOAD/SAVE VOICES or INSTRUMENTS TYPE:

To LOAD a VOICE - **L,r,filename<return>**
To SAVE a VOICE - **S,filename<return>**
To CREATE a VOICE - **C,r,filename<return>**
To LOAD an INSTRUMENT - **L,filename.IN<return>**
To SAVE an INSTRUMENT - **S,filename.IN<return>**

where: r = register A - H
filename = 1 to 8 character filename

See PAGE 3 description for more about loading and saving files.



Here is a typical Page 7 display, where eight different voices have individual expression parameters.
The parameters for voice 2, WHIST are displayed.

Here is the HELP page for PAGE 7 ...

PAGE 7 PAGE 7 - HELP SHEET 1 of 17 PRE TOP FWD BWD

sheet:		sheet:	
2.	CONTROL PARAMETERS	11.	ATTACK
2.	CONTROLS/SWITCHES on KEYBOARD	12.	SLUR
3.	KEYBOARD FUNCTIONS	12.	GLISSANDO/PORTAMENTO
4.	FUNCTIONS - User Defined	13.	PITCHBEND/BENDWIDTH
4.	ASSIGN to CONTROL PARAMETERS	14.	DEAD-SPOT
5.	CONTROL FILENAME	14.	START SEGMENT
6.	LINK CONTROL FILE to VOICE	14.	SUSTAIN
6.	SAVE/LOAD CONTROL FILE	15.	LOOP
8.	QUICK REFERENCE for patches	16.	B/F LOOP
9.	MODE	16.	VIBRATO
10.	MAIN/AUX. LEVEL	17.	VOICE selection
10.	FILTER	17.	RESET PAGE 7
11.	DAMPING		

For HELP touch any BOX with LIGHTPEN or type: n<set>
where: n = sheet no.

For HELP with HELP PAGES, touch THIS or type: H1<return>

This page features the controls associated with modifying and controlling various aspects of a sound.

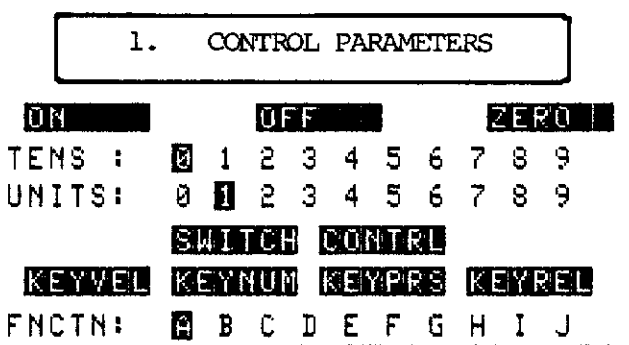
These include: level (volume), touch-sensitive level, attack, touch-sensitive attack, damping, pitch-bend, glissando, portamento, vibrato, slur, sustain, loop length, loop start, filter, mode (electronic or natural sound).

Each of the eight voices loaded can have its own unique control settings, which can be saved as part of the voice onto disk.

In conjunction with PAGE F, user-defined functions can be patched to certain effects, modifying their response.

Up to 64 software control faders and switches are accessable. Of these, **6** faders and **5** switches are real-time and patchable to most parameters. These have a continuous read-out of their current value.

Three faders and two switches are on the left-hand side of the music keyboard. The other real-time faders (or footpedals) and switches are accessable by Cannon XLR-type connectors on the **rear** of the music keyboard. These options are available from your friendly Fairlight distributor.



THE CONTROL PARAMETERS displayed on PAGE 7 consist of a number of operational and expressive factors which can be selected, adjusted or patched independently for any loaded VOICE.

They are arranged as a table of variables for assignment. Either the <arrow> keys or LIGHTPEN can be used to TAB to the value of each parameter.

A new value may be assigned according to the TYPE of the parameter -

CONTROL TYPE: Discretely variable, or "sliding". May be assigned a number or patched to a CONTROL. CONTROL puts out the equivalent of a number between **Ø** and **127**. This number can be seen in the lower right-hand corner of Page 7.

SWITCH TYPE: Two-state, or "on/off". May be set either "ON" or "OFF", or patched to a SWITCH. Switch state can be seen in the lower right-hand corner of Page 7.

2. CONTROLS/SWITCHES on keyboard

THE KEYBOARD CONTROLS and SWITCHES on the MASTER KEYBOARD (and optional FOOTPEDALS) correspond directly to the two types of control parameters -

sliding
on/off.

Any control parameter (except two - B/F LOOP and MODE) may be patched to a "device" of the matching type by assigning one of the following names:

devices	names
Keyboard controls =	CONTRL1,CONTRL2,CONTRL3
Keyboard switches =	SWIT1,SWIT2
Footswitches =	SWIT3,SWIT4,SWIT5
Footpedals =	CONTRL4,CONTRL5,CONTRL6

The optional software package - Page C Music Composition Language can control the settings of **all** 64 switches and 64 controls.

3. KEYBOARD functions

KEY VELOCITY is computed by the music keyboard for each key that is played.

The MAIN LEVEL and ATTACK control parameters can both be patched to the KEY VELOCITY function for touch control of the voice's volume and (in MODE 4) attack time.

Thus the **harder** you play the music keyboard the **louder** the sound or the **faster** the attack.

The default setting of MAIN LEVEL is KEYVEL.

KEYNUM is similar in operation to KEYVEL, except that the data controlling the effect is derived from the number of that key starting from the left side of the music keyboard. The **lowest F** generates a KEYNUM of **0.** The **highest F** generates a KEYNUM of **72.** Thus if KEYNUM was patched to MAIN LEVEL for a voice, the lowest keyboard note would be loudest, and the highest note would not sound. KEYNUM data can be used for cross-fades between multi-voice registers when patched with appropriate functions. See PAGE F description.

KEYPRS is key pressure. This is not generated by the CMI music keyboard but makes use of the continuous key after-pressure data generated by many MIDI devices. **PAGE I** and the optional **General Interface** hardware allows communication between the CMI and other MIDI equipment. KEYPRS is similar in operation to CONTRL patches, with the same range, 0 to 127.

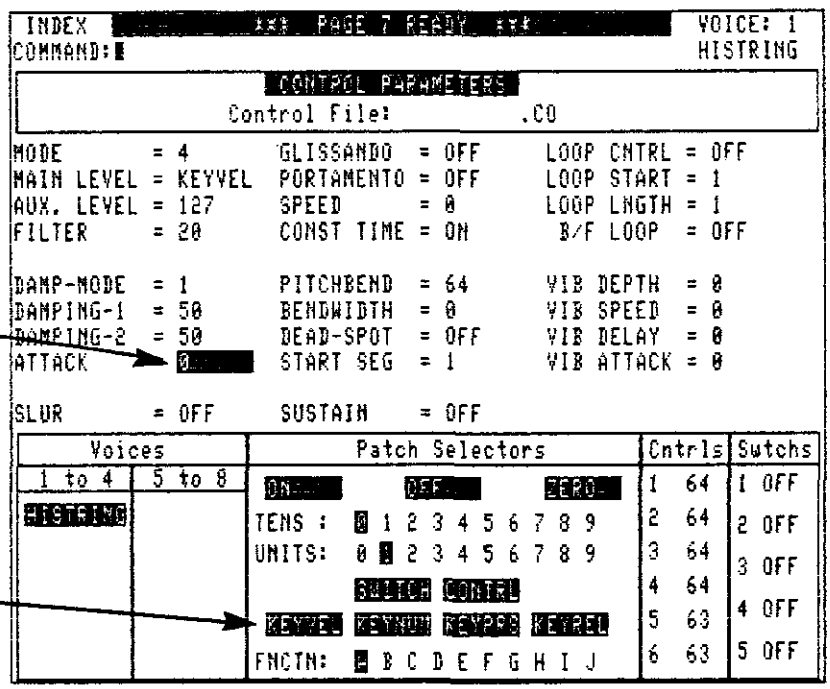
KEYREL is key release. This is not generated by the CMI music keyboard, and presently is not patchable to any effect. It will make use of key release data generated by other MIDI equipment.

EXAMPLE To make ATTACK **touch-sensitive ...**

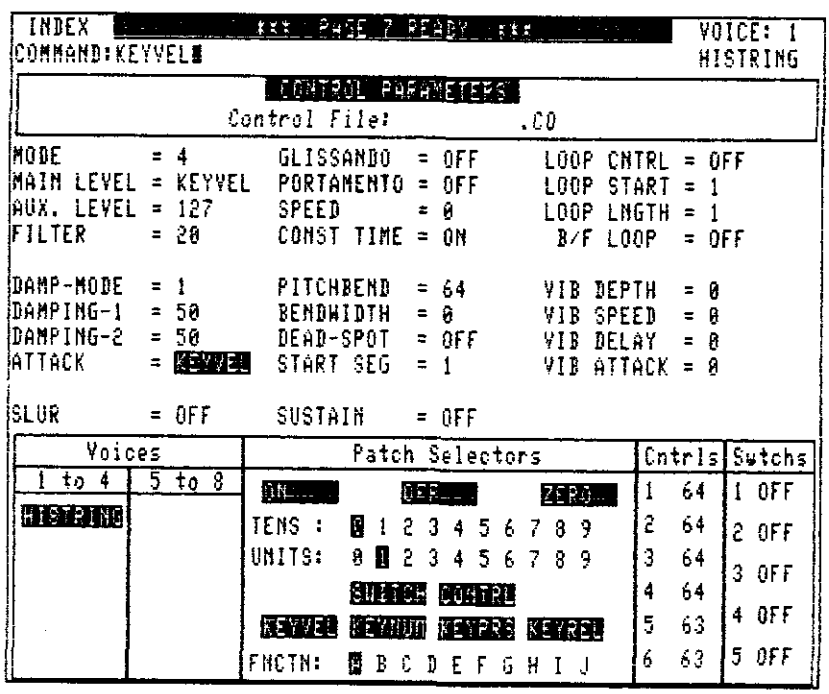
Point lightpen here and touch

Now point lightpen here and touch

Otherwise type **KEYVEL<set>**



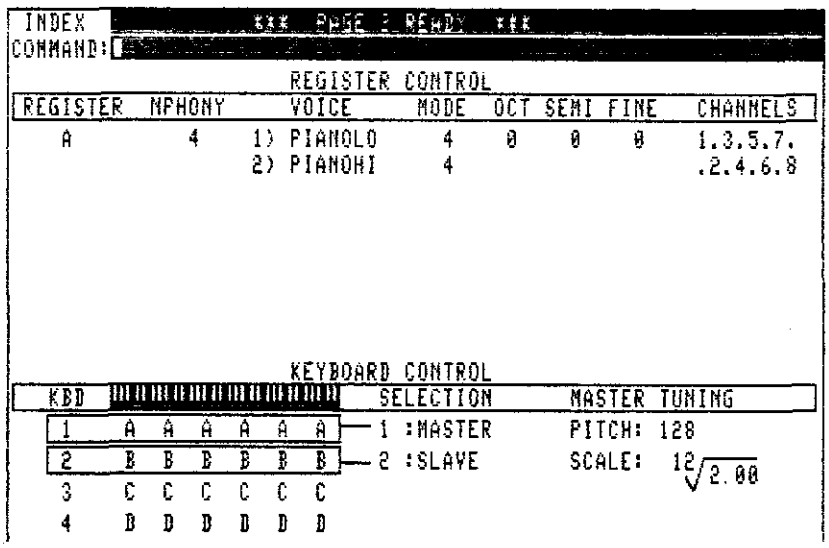
The result is ...



EXAMPLE 2 To make KEYNUM **cross-fade** between two voices ...

Load **two** voices into the **one** register. See PAGE 3 description under multi-voice load command.

Page 3 should look similar to this ...

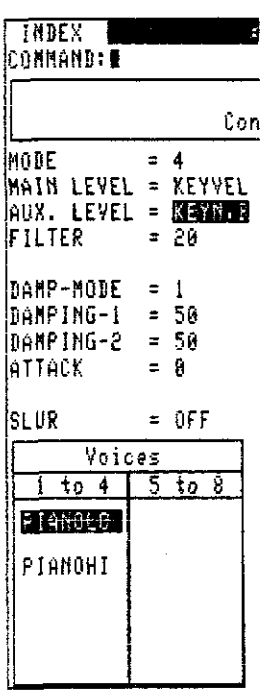


Go to Page 7.

We will now control the level of each voice by using KEYNUM and two preset function curves from PAGE F. Function B, on Page F, has a preset **logarithmic** curve. Function **C** has a preset **inverse** logarithmic curve. In this way, depending on which notes are played on the keyboard, one voice becomes louder and the other becomes quieter.

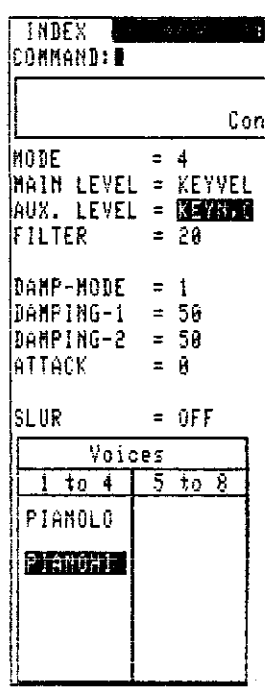
Patch **AUX. LEVEL** to **KEYNUM,B** for **voice 1**

Type **KEYNUM,B<set>**



Patch **AUX. LEVEL** to **KEYNUM,C** for **voice 2**

Type **KEYNUM,C<set>**



A control fader could be used instead of KEYNUM. Just substitute a **control number** for KEYNUM in the above example.

FUNCTIONS

User Defined are curves drawn on PAGE F and used on PAGE 7 allowing different responses for KEYVEL, KEYNUM, control faders, and KEYPRS.

Some possible uses are: a control fader could be given an exponential response, rather than linear; by doing a multi-voice load on Page 2, cross-fades between voices can be performed by KEYNUM or keyboard control faders; the music keyboard touch sensitivity can be varied to suit personal playing style.

Sixteen functions, A to P, are possible as seen on Page F. For compact display, only functions A to J are lightpen hittable on Page 7.

Function A is the default (linear) and is not seen if patched. If a function is not allowed for a particular patch, a warning message "UNRECOGNIZED ITEM" is displayed.

To include a FUNCTION in a patch	TYPE:	LIGHTPEN:
	PATCH,x<set>	x:PATCH

where PATCH = KEYVEL, KEYNUM, KEYPRS, CONTROL
x = function letter, A to P

EXAMPLES: KEYVEL,C<set> C6,P<set> KEYNUM,M<set>

4. ASSIGN to CONTROL parameters

ASSIGN TO CONTROL PARAMETERS by FIRST using <arrow> keys or LIGHTPEN to TAB to desired item; THEN type or use lightpen as indicated below to make assignments.

The LIGHTPEN "targets" are located in a MENU at the bottom of the display page.

To SET value of CONTROL-TYPE	TYPE:	LIGHTPEN:
	n<set>	<ZERO>

where: n = number between Ø and 127 - numeric assignment

To SET SWITCH-TYPE ON or OFF	TYPE:	LIGHTPEN:
	ON<set>	<ON>
	OFF<set>	<OFF>

To PATCH	TYPE:	LIGHTPEN:
CONTROL number (nn) -	**Cnn<set>**	<TENS-UNITS-CONTRL>
SWITCH number (nn) -	**Snn<set>**	<TENS-UNITS-SWIT>
KEY VELOCITY -	**KEYVEL<set>**	<KEYVEL>
KEY NUMBER -	**KEYNUM<set>**	<KEYNUM>

where: nn = CONTROL or SWITCH number 1-64

Examples: C2<set>
S4<set>

5. CONTROL filename

A CONTROL FILE (.CO suffix) can be SAVED on the RH disk to preserve a particular setup of the control parameters for a voice or group of voices.

By LOADING the voice file, all settings and patches will be restored. However, a control file may be LINKED to a voice, causing it to be loaded automatically whenever that voice is loaded, overriding voice settings.

TO SET CONTROL FILENAME for current VOICE use <arrow> keys or LIGHTPEN to TAB to CONTROL FILE,

TYPE: **filename<set>**

where: filename = 1-8 character filename
(see PAGE 2 description of filename)

This effectively assigns a **name** to the displayed setup of the control parameters.

When a VOICE is saved or the **LNK** command is used, this name is saved as part of the voice file.

If the name is not blank, loading the voice will cause the CONTROL FILE of that name to be automatically loaded also - the control file is thus LINKED to the voice.

TO SET BLANK CONTROL FILENAME

TYPE: **<space><set>**
where: <space> = a space, i.e. " "

6. LINK CONTROL file to VOICE

TO LINK CONTROL FILENAME to current VOICE

TYPE: **LNK<return>**

This writes the displayed CONTROL FILENAME to the VOICE FILE for the currently selected voice (like saving just this part of the voice).

If a CONTROL file is **not** linked to a voice then it will not load automatically with that voice. However, Page 7 parameters may be saved as part of a voice without using control file. Set a BLANK control filename before saving Page 7.

To UNLINK a control file, LINK a **blank** name.

TO SET BLANK CONTROL FILENAME

TYPE: **<space><set>**
where: <space> = a space, i.e. " "

7. SAVE/LOAD CONTROL file

TO SAVE CONTROL FILE

	TYPE:
within a voice file, but with no functions -	**S<return>**
to use displayed CONTROL FILENAME -	**S,CO,filename<return>**
to use a new CONTROL FILENAME -	**S,CO,newname<return>**

where: filename = 1-8 character filename
(see PAGE 2 description of filenames)

EXAMPLE:

S,CO,PLUCK<return>	Save PLUCK.CO - CONTROL FILENAME
or S,PLUCK.CO<return>	Same effect as above

The setup of all CONTROL PARAMETERS for the selected voice will be SAVED in a CONTROL FILE. If the file already exists on the disk, it will be OVERWRITTEN.

If no filename is specified then the displayed CONTROL FILENAME will be used.

> Note that **voice** and **instrument** files may be loaded and saved on Page 7. This means that you **must** type the **.CO** suffix to save or load a control file.

TO LOAD CONTROL FILE setting — TYPE:

as internal part of voice but no functions - **L;I<return>**

to use a CONTROL FILENAME - **L,CO,filename<return>**

to shuffle functions, no overwriting - **L,CO,filename;S<return>**

where: filename = 1-8 character filename
(see PAGE 2 description of filenames)

EXAMPLE:

L,CO,TRUMP<return> Load a new control file called TRUMP.

L,TRUMP.CO<return> Same effect as above

The setup of the CONTROL PARAMETERS at the time the file was last SAVED will be completely restored.

Loading PAGE F functions: Because different voices may use the SAME function letters for different things, the ;S option may be typed. This will SHUFFLE functions around when loading so that functions with the same letter are not overwritten.
A maximum of 16 functions may be loaded at once.

Note that on all pages except Page 9 and Page R, saving a voice with the ;C option will automatically SAVE the Control file and LINK it to the associated voice file.

EXAMPLE S QUIVER;C<return>

save	voice called QUIVER	save and LINK the Control file for QUIVER voice

8. QUICK REFERENCE for ranges & patches

QUICK REFERENCE CHART shows **ranges** and possible **patches** for each control parameter.

Control Parameter	Range:	Patch:	Function:
MODE	1,4	NO PATCH	NO
MAIN LEVEL	Ø-255	CONTRL 1-64, KEYVEL	YES
AUX. LEVEL	Ø-127	CONTRL 1-64	YES
FILTER	1-127	CONTRL 1-64	YES
DAMP-MODE	1,2	SWIT 1-64	NO
DAMPING 1 & 2	Ø-65535	CONTRL 1-64	YES
ATTACK	Ø-16383	CONTRL 1-64, KEYVEL	NO
SLUR	ON,OFF	SWIT 1-64	NO
GLISSANDO/PORTAMENTO	ON,OFF	SWIT 1-64	NO
SPEED	Ø-127	CONTRL 1-64	NO
CONSTANT TIME	ON,OFF	SWIT 1-64	NO
PITCHBEND, BENDWIDTH	Ø-127	CONTRL 1-64	NO
DEAD-SPOT	ON,OFF	SWIT 1-64	NO
START SEGMENT	1-128	CONTRL 1-64	NO
SUSTAIN	ON,OFF	SWIT 1-64	NO
LOOP CONTROL	ON,OFF	SWIT 1-64	NO
LOOP START	1-128	CONTRL 1-64	NO
LOOP LENGTH	Ø-128	CONTRL 1-64	NO
BACKWARD/FORWARD LOOP	ON,OFF	NO PATCH - Mode 1 only	
VIBRATO DEPTH	Ø-127	CONTRL 1-64	YES
VIBRATO SPEED	Ø-127	CONTRL 1-64	NO
VIBRATO DELAY	Ø-127	CONTRL 1-64	NO
VIBRATO ATTACK	Ø-127	CONTRL 1-64	NO

Controls 1 to 6 and switches 1 to 5 are real-time, adjustable from the music keyboard.

Controls 1 to 64 and switches 1 to 64 are adjustable through the Music Composition Language - Page C. See separate manual.

9. MODE

MODE range: 1 or 4 patch: (n/a)

This selects either of two modes of operation for the OUTPUT CHANNELS allocated to the voice.

MODE 1: **32** waveform segments are utilized. **ENERGY** and **DURATION** profiles on PAGE 4 determine the **amplitude/duration** characteristics of the voice.
ATTACK control parameter is not active.
Usually chosen for voices which are to SYNTHESIZED from HARMONICS on PAGE 4.

MODE 4: **128** waveform segments are utilized. Amplitude is a direct function of individual segment waveform amplitudes unless re-scaled by ENERGY profile.
ATTACK control parameter is active.
Should always be used when EXTERNAL SAMPLING is being performed on PAGE 8 and is usually chosen for voices to be SYNTHESIZED with combined facilities of PAGES 5 and 6.

Voice MODE may also be changed on PAGE 3 for convenience when CREATING voices.

See also PAGE 4 description for more about WAVEFORM SEGMENTS and MODE.

1Ø. MAIN/AUX. LEVEL

MAIN LEVEL range: Ø-255 patch: CONTRL,KEYVEL

This is the VOLUME control for the voice.

Setting MAIN LEVEL to zero will **mute** the voice completely.

Note that this parameter may be patched to KEY VELOCITY for **touch-sensitive** control of volume.

PAGE 9 KEYBOARD SEQUENCER and
PAGE C M.C.L. - PAGE C and
PAGE R REAL TIME COMPOSER

provide the ability to program KEY VELOCITY for individual note volumes.

To use this facility,

MAIN LEVEL must be patched to KEYVEL on PAGE 7.

AUX. LEVEL range: 0-127 patch: CONTRL

This allows a secondary volume control. For example, if KEYVEL were patched to MAIN LEVEL, AUX. LEVEL could control overall volume range of KEYVEL. Patching to functions allows cross-fades between multi-voice registers.

11. FILTER

FILTER range: 1-127 patch: CONTRL

A LOW-PASS **tracking** filter which is used for attenuating any unwanted high-frequency content present in the voice; cutoff frequency is raised by increasing the value. Cutoff frequency is also raised by playing higher up the music keyboard, hence the use of the word TRACKING.

The filter setting number is related harmonically to the note being played. Thus a setting of 16 means that the filter will start attenuating at 16 times the fundamental pitch (four octaves higher).

If set to 127, the filter is bypassed completely.

The filter should always be initially set to around **2Ø** when EXTERNAL SAMPLING is being performed on PAGE 8.

A patch to a control can set the filter value for live expression. When this is done, filter control is more logarithmic to provide greater filter resolution at low settings.

12. DAMPING/ATTACK

DAMP-MODE range: 1,2 patch: SWIT,CONTRL

This allows switching between the two damping rates (below).

DAMPING-1 and -2 range: 0-65535 msecs patch: CONTRL

Range is reduced to 16383 msecs in MODE 4.

This parameter is **not active** when SUSTAIN is **ON.** Provided SUSTAIN is off, the value determines the FINAL DECAY time of the voice (time from key release to silence).

If a LOOP is active, the voice will "hang" in the loop for the specified time when key is released.

If SUSTAIN is ON, the voice will continue through the remaining segments. If end of waveform is reached with SUSTAIN ON, before DAMPING period expires then the voice will stop abruptly.

Setting DAMPING to zero will usually cause a click at the end of the voice. Therefore always set DAMPING to at least 3Ø to avoid clicking at the end of a voice. Two damping rates allow switching between two presets (via DAMP-MODE).

See **Figure 7a** for a comparision of these different situations.

ATTACK range: Ø-16383 msecs patch: CONTRL,KEYVEL

This defines the ATTACK TIME for MODE 4 voices; **not active** in MODE 1.

ATTACK may be patched to KEY VELOCITY for **touch-sensitive** control of the **attack** time.

PAGE 9 - KEYBOARD SEQUENCER and
PAGE C - M.C.L. and
PAGE R - REAL TIME COMPOSER

can program key velocity for **individual** notes, thus allowing programmable attack time if ATTACK is patched to KEYVEL on PAGE 7.
The Page 6 waveform is not changed by different attack and decay settings.
It always remains intact. The attack and decay envelope is superimposed on the voice.

13. SLUR

SLUR range: ON,OFF patch: SWIT

If this switch is ON **and** there is a LOOP active, each channel will sustain **infinitely** in the LOOP until a new note is to be played.
At that time it will **start** the new note at the LOOP without playing any preceding segments, that is, the pitch is changed but the note will not re-attack.

This can be very effective when patched to the same KEYBOARD SWITCH or FOOT PEDAL as the GLISSANDO or PORTAMENTO switches - allowing both SLUR and a glide function to be switched simultaneously.

This would also be useful where a stable pilot tone or synchronizing tone of quite some length is required; it saves putting a heavy object on the keyboard.

14. GLISSANDO/PORTAMENTO

GLISSANDO range: ON,OFF patch: SWIT

When ON, each channel allocated to the voice will produce a **CHROMATIC glissando** between each **new** pitch it is to play and the **last** pitch it played.

SPEED determines the **rate** of the glissando.

Note that if GLISSANDO and PORTAMENTO are BOTH ON, PORTAMENTO will take precedence.

CONSTANT TIME determines the type of glissando. See below.

PORTAMENTO range: ON,OFF patch: SWIT

When ON, each channel allocated to the voice will produce a continuous **smooth portamento** (glide) between each **new** pitch it is to play and the **last** pitch it played.

The SPEED and CONSTANT TIME parameters determine the **rate** and **type** of the glide.

Note that if GLISSANDO and PORTAMENTO are BOTH ON, PORTAMENTO will take precedence.

This is usually patched to a KEYBOARD SWITCH or FOOT PEDAL.

SPEED range: Ø-127 patch: CONTRL

This is the SPEED control for the GLISSANDO and PORTAMENTO functions. See also CONSTANT TIME below.

CONSTANT TIME range: ON,OFF patch: SWIT

This switch allows selection of **two** types of GLISSANDO and PORTAMENTO.

When ON, the same time is taken to travel any interval - the **RATE** of change alters according to the pitch distance (hence CONSTANT TIME). In other words when playing chords all notes "land" together. It would take the **same** time to travel six octaves or one semitone.

When OFF, the RATE of change remains fixed (determined by SPEED) and the time taken **varies** with the **size** of the interval. Usually patched to a KEYBOARD SWITCH or FOOT PEDAL.

15. VIBRATO

VIB DEPTH range: Ø-127 patch: CONTRL

Provides control of the **depth** of the vibrato (*pitch shift*).
Zero produces NO vibrato.

VIB SPEED range: Ø-127 patch: CONTRL

Provides control of the **rate** of the vibrato cycle.

VIB DELAY range: Ø-127 patch: CONTRL

Vibrato effect comes in sometime after start of note.
Zero produces immediate vibrato.

VIB ATTACK range: Ø-127 patch: CONTRL

Rate at which vibrato comes in after delay.
Effective only if VIB DEPTH is non-zero.

Continuous delay **flanging** can be achieved with vibrato SPEED and DEPTH.

Here's how ...

Load a suitable **voice** file on Page 2, change the voice **name** on Page 3.

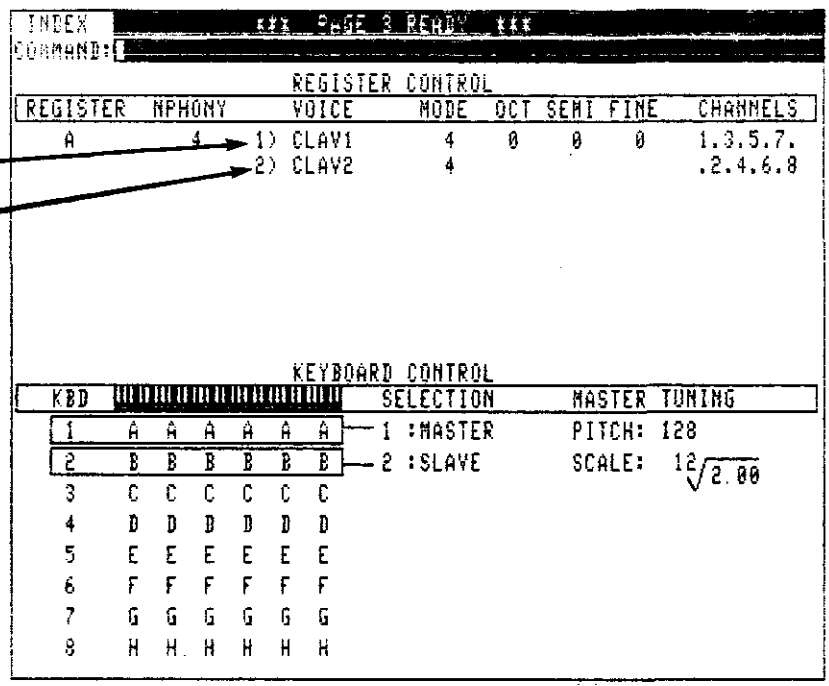
Save the voice with the **new** name. You have now got two voices with identical waveforms.

Load these two voices with the same waveform into a **single** register. See Page 3 - MULTI-VOICE load command.

Page 3 setup should look like this ...

CLAV1 is voice 1

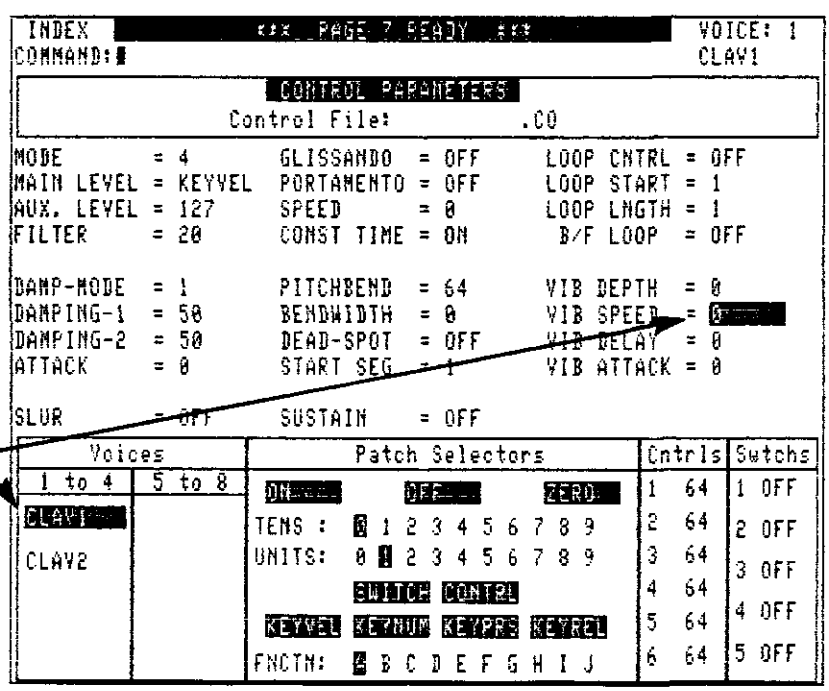
CLAV2 is voice 2



Now go to Page 7.

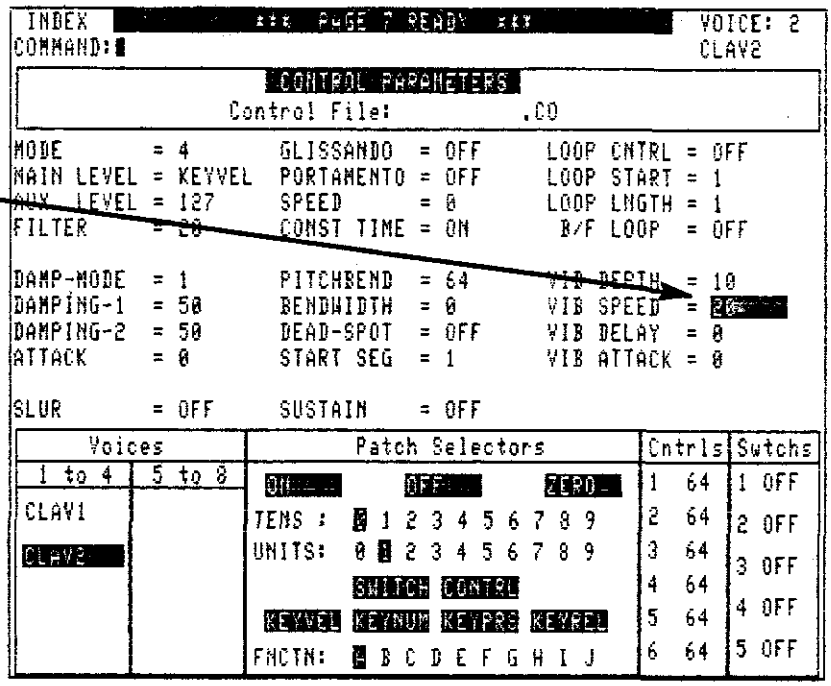
Type **V,1<return>** to select voice 1.

Set VIBRATO DEPTH and SPEED to **ZERO.**



Type **V,2<return>** to select voice 2.

Set VIBRATO DEPTH and SPEED to a value of between 1Ø and 2Ø.



16. PITCHBEND/BENDWIDTH

PITCHBEND range: Ø-127 patch: CONTRL

This shifts pitch of note being played.
Usually patched to a music keyboard control.
Active whenever BENDWIDTH greater than zero.

Ø = maximum pitchbend **down**
64 = normal pitch (default)
127 = maximum pitchbend **up**

If DEAD-SPOT is switched ON, a dead-spot will exist between 57 to 71 to help with centering to normal pitch.

BENDWIDTH range: Ø-127 patch: CONTRL

This controls amount of pitchbend. Typically this would be set to a number, rather than a control, so that amount of pitchbend would be suitable.

Ø = disable pitchbend
1 = +/- quarter-tone bend
127 = +/- 4 octave bend approximately

DEAD-SPOT range: ON,OFF patch: SWIT

This has nothing to do with a deceased dog.

This switches the PITCHBEND null in or out.

When DEAD-SPOT is switched ON, an area will exist between 57 to 71 where no pitch change occurs.

When DEAD-SPOT is switched OFF, pitchbend occurs for any value.
Useful with external LFO (low frequency oscillator) connected to a control.

17. START SEG

START SEG range: 1-128 segment patch: CONTRL

This feature offers control over the point in the waveform at which the sound starts playing. You can get the sound to begin say, **halfway** through the voice waveform when activated by a music key.

Note that by patching LOOP START and START SEG to the same KEYBOARD CONTROL, the two parameters can be modified in parallel (most effective in MODE 4). When choosing a loop setting, you could skip past the inherent attack of the sound.

Note that if the START SEGMENT is 128 then you will only ever hear the very last segment of the sound which may not be desirable.

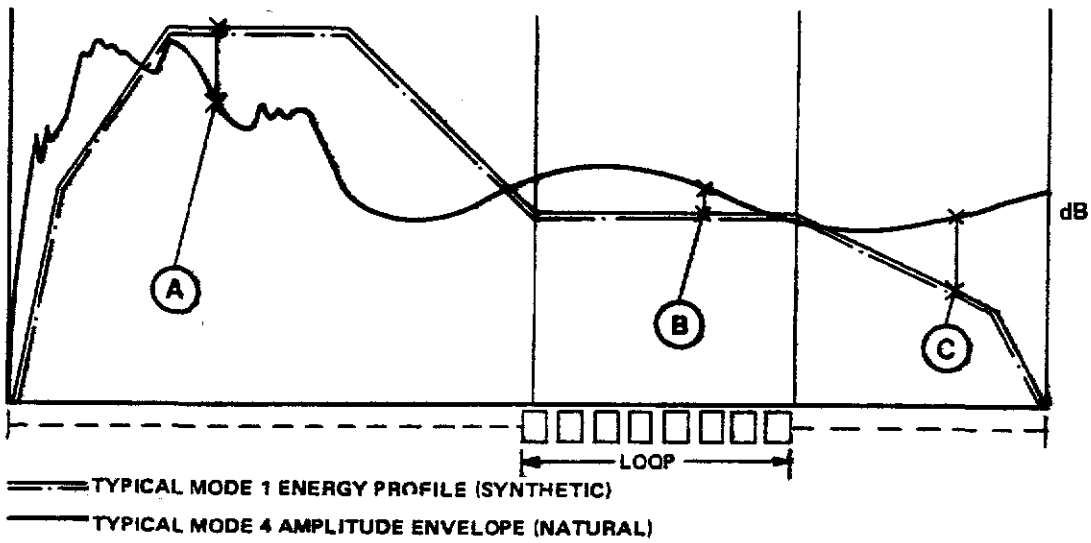
18. SUSTAIN

SUSTAIN range: ON,OFF patch: SWIT

This switch determines the behaviour of the voice upon key release.

When SUSTAIN is OFF, a key release causes the voice amplitude to begin decaying at a rate controlled by DAMPING. If there is a LOOP, the voice will continue looping until the DAMPING time has expired; otherwise it will continue playing the remaining segments after the loop until the end of the waveform is reached or the DAMPING time expires - whichever comes first.

When SUSTAIN is ON, DAMPING is ignored. The entire waveform is always played (all segments heard). If there is a LOOP, the voice will stop LOOPING after key-release and continue to the last segment with no decay in amplitude.
See **Figure 7a.**



RELEASE POINT	SUSTAIN STATE	WITHOUT LOOP	WITH LOOP
{A}	ON	All segments played. Key release point has NO EFFECT.	Same as with no loop. Loop is IGNORED.
	OFF	Amplitude begins ramping down for period specified by DAMPING until silence or the end segment is reached.	Amplitude begins ramping down for period specified by DAMPING. If this is sufficiently long, the voice will reach the loop & continue looping until silence is reached. Post loop segments are not played.
{B}	ON	as {A}	Loop becomes INACTIVE; amplitude begins ramping down for DAMPING period until silence or the end segment is reached.
	OFF	as {A}	Loop remains ACTIVE, and amplitude begins ramping down over DAMPING period (voice "hangs" in the loop). Post loop segments are not played.
{C}	ON	as {A}	Impossible (loop prevents voice from reaching this point).
	OFF	as {A}	Impossible.

FIGURE 7A Table of release conditions

19. LOOP

The LOOP facility will allow a sound to play continuously as described on Page 4.

LOOP CONTROL range: ON,OFF patch: SWIT

Set this switch ON to use any of the following LOOP CONTROL PARAMETERS. When OFF they are not active on Page 7 but can still be changed on Page 4.

The LOOP consists of a range of 1 or more waveform segments which are to played **continuously** for the duration of a key depression.

In MODE 1 the effect of the portion of the ENERGY PROFILE enclosed by the LOOP is CUMULATIVE; i.e., looping through a diminishing energy profile will quickly bring the amplitude to zero (see PAGE 4 description for more about this effect). See also SUSTAIN.

LOOP START range: 1-128 segment patch: CONTRL

This allows you to specify the number of the first segment where the LOOP begins.

By patching this parameter and LOOP LENGTH to KEYBOARD CONTROLS extremely precise adjustments can easily be made to the loop position - even while sustaining the voice.

If assigned a **numeric** value, modification of the loop on PAGE 4 will cause the assigned number to change accordingly on Page 7.

LOOP LENGTH range: Ø-128 segments patch: CONTRL

This determines the number of segments in the LOOP.

If set to ZERO, the LOOP is removed completely.

If assigned a numeric value, modification of the loop on PAGE 4 will cause the assigned length to change accordingly on Page 7.

If LOOP LENGTH is 1 and LOOP START is 1 then only the **FIRST** segment of a voice will be heard. This may be desirable if you are drawing waveforms in the first segment of Page 6.

B/F LOOP range: ON,OFF patch: SWIT

Backwards/forwards LOOP. For use in Mode 1 only.
If ON, loop is bi-directional.
If OFF, loop behaves as before.

EXAMPLE

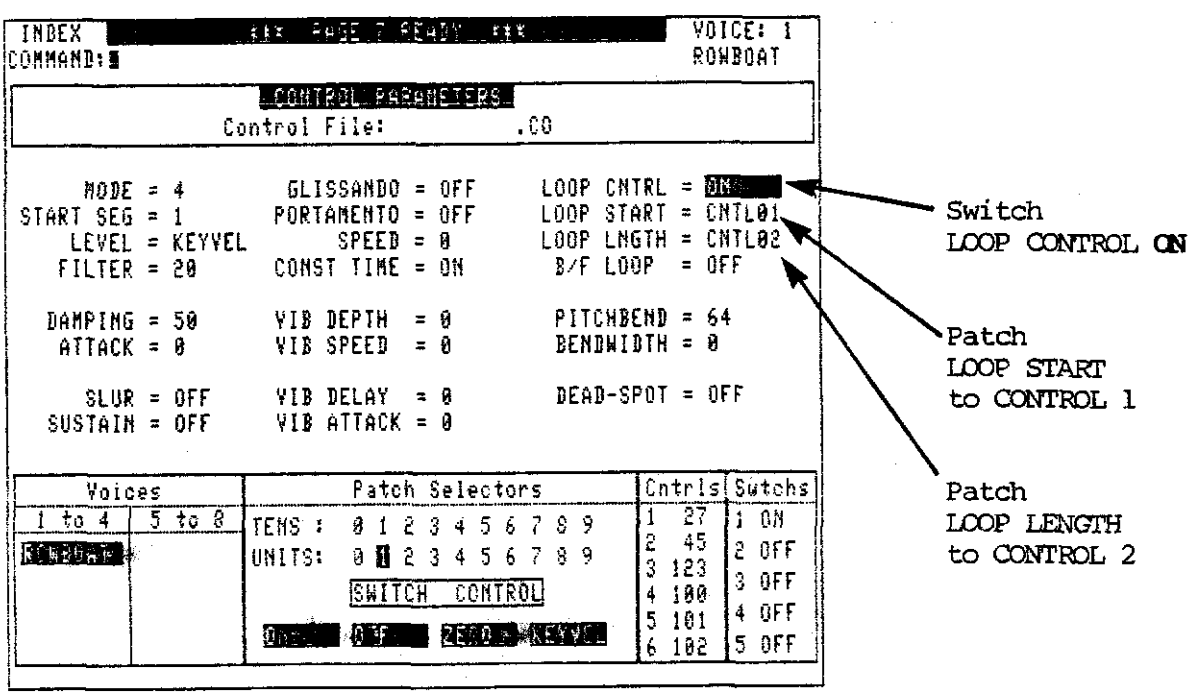
If LOOP START = 4 and
LOOP LENGTH = 3 then this is result ...

1 2 3 4 5 6 4 5 6 4 5 6 etc B/F LOOPING = OFF
1 2 3 4 5 6 5 4 4 5 6 etc B/F LOOPING = ON

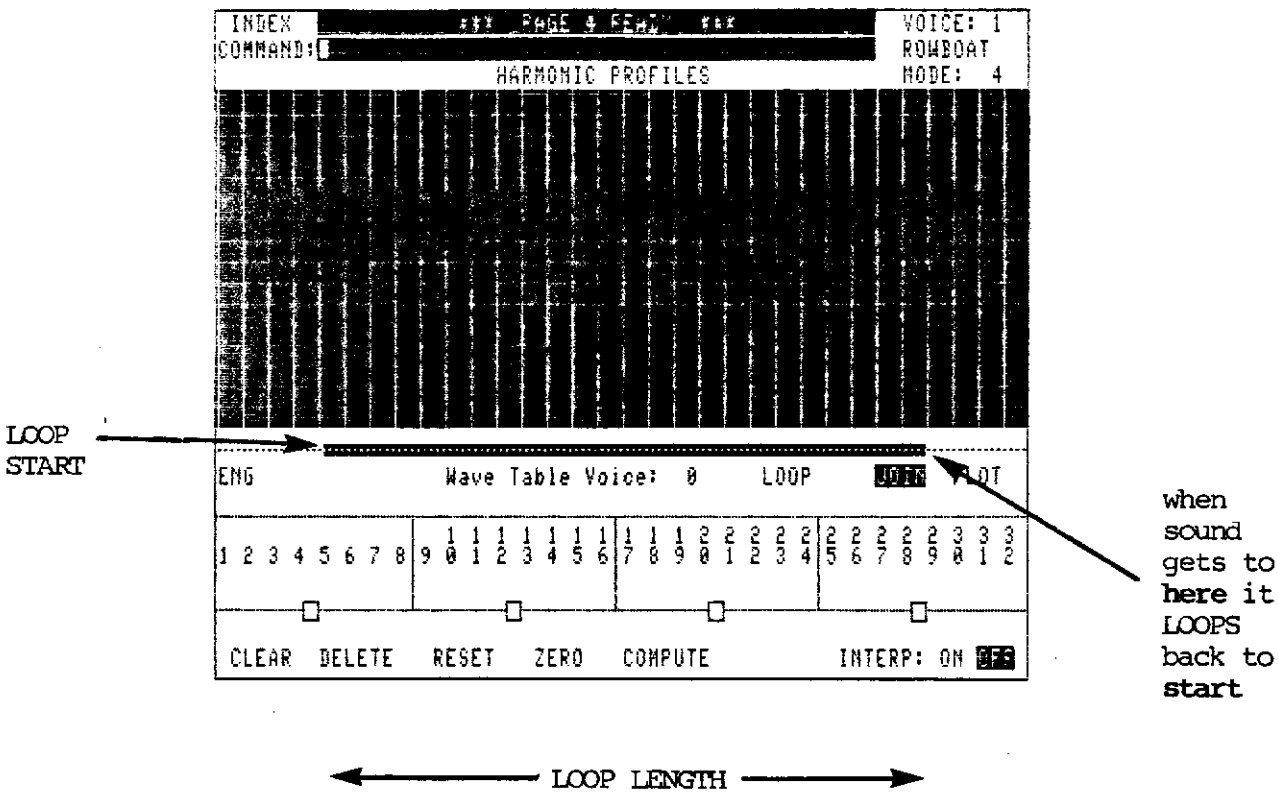
new loop entered here

Upon KEY-RELEASE, the loop continues until loop-end is next reached. Rest of sound is then played.

Here is Page 7 setup so that **CONTROL 1** and **CONTROL 2** on the music keyboard will change **LOOP START** and **LOOP LENGTH** for voice called **ROWBOAT**. The numeric readout of these controls could subsequently be substituted, locking the loop settings and freeing the controls for other purposes.



Go to Page 4 (**P4<return>**) to see the loop settings change.



2Ø. SELECT any loaded VOICE

TO SELECT any loaded VOICE TYPE: **V,voice<return>** LIGHTPEN: <voice>

where: voice = the name OR number (1-8) of a loaded voice

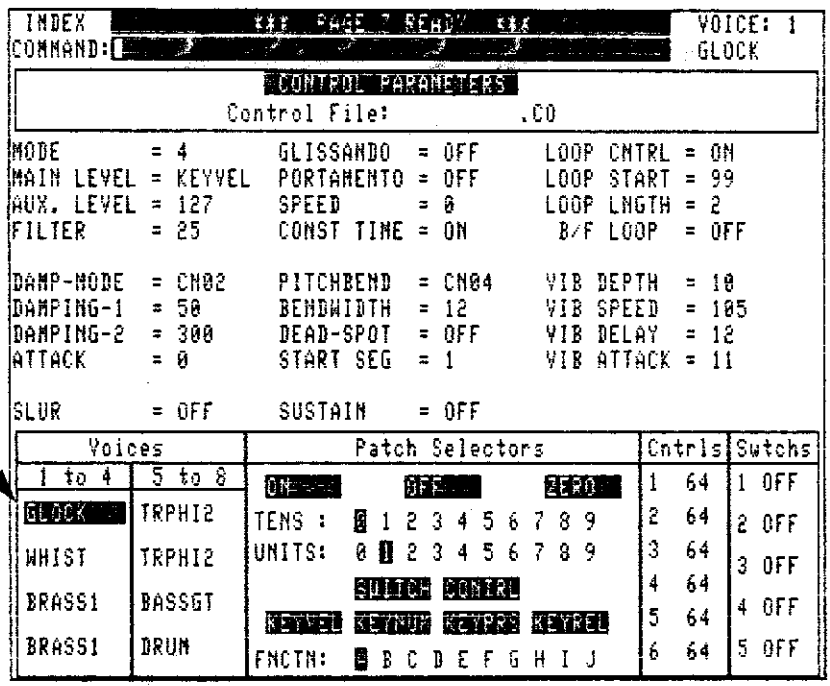
EXAMPLES: V,TUBA<return> - select voice TUBA
V,4<return> - select voice 4

The names of all loaded voices are shown inside the box. When using LIGHTPEN, select voice by touching its name.

The name and number of the current voice are shown in the **upper-right corner** of the page. The names and numbers of all loaded voices can be seen on PAGE 3.

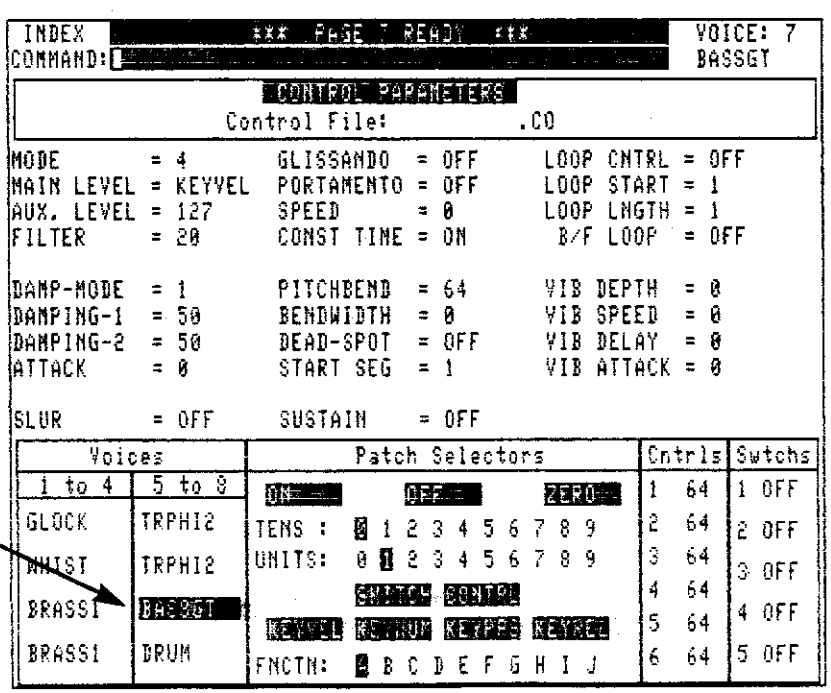
Here is the **Control file** setting for **Voice 1 - GLOCK.**

Type **V,1<return>** or touch lightpen to **GLOCK**



Here is the **Control file** setting for **Voice 7 - BASSGT.**

Type **V,7<return>** or touch lightpen to **BASSGT**



21. RESET all CONTROL parameters

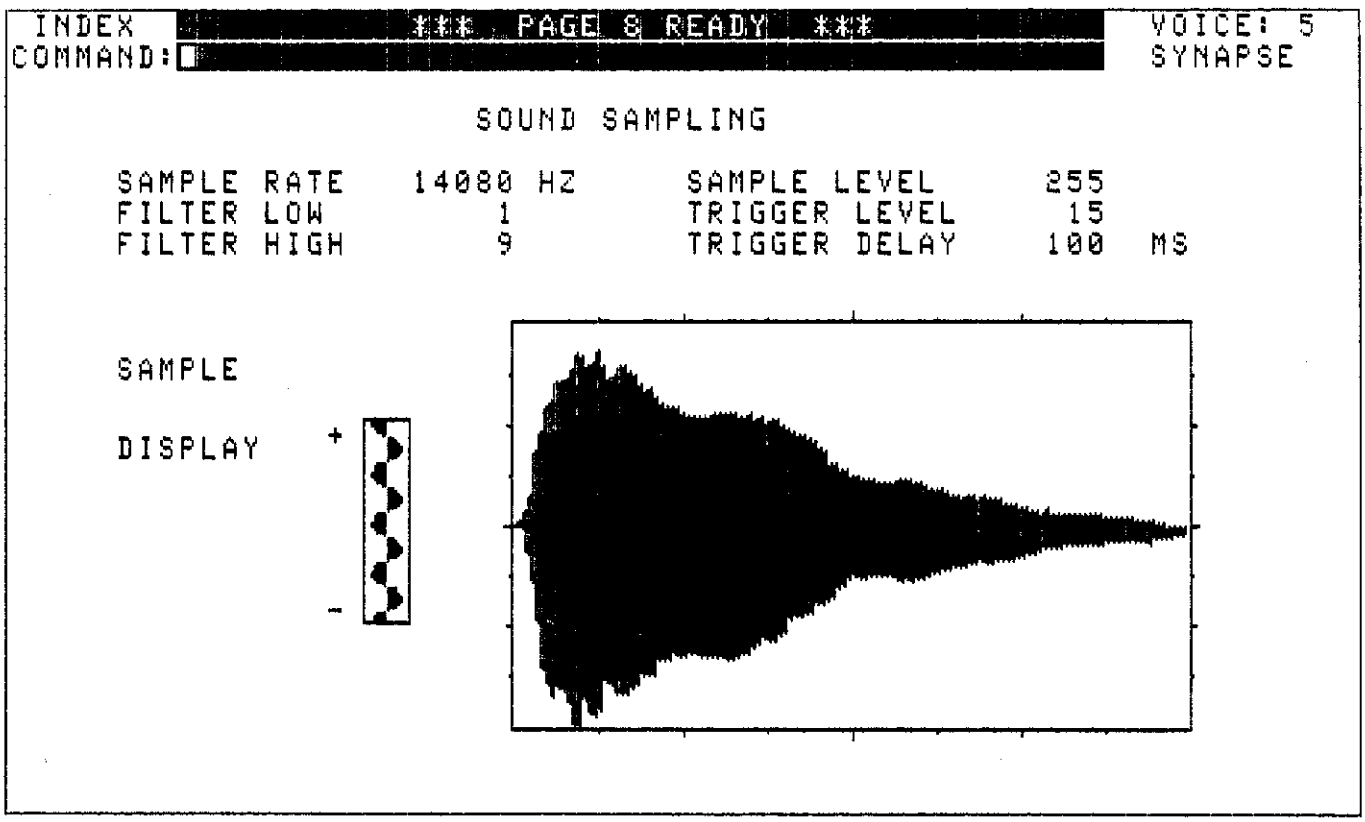
TO RESET all CONTROL PARAMETERS TYPE: **R<return>**

This will reset all control parameters for the current voice to their **default** values.

In other words Page 7 is reset to the same condition as when the CMI is **first switched on.**

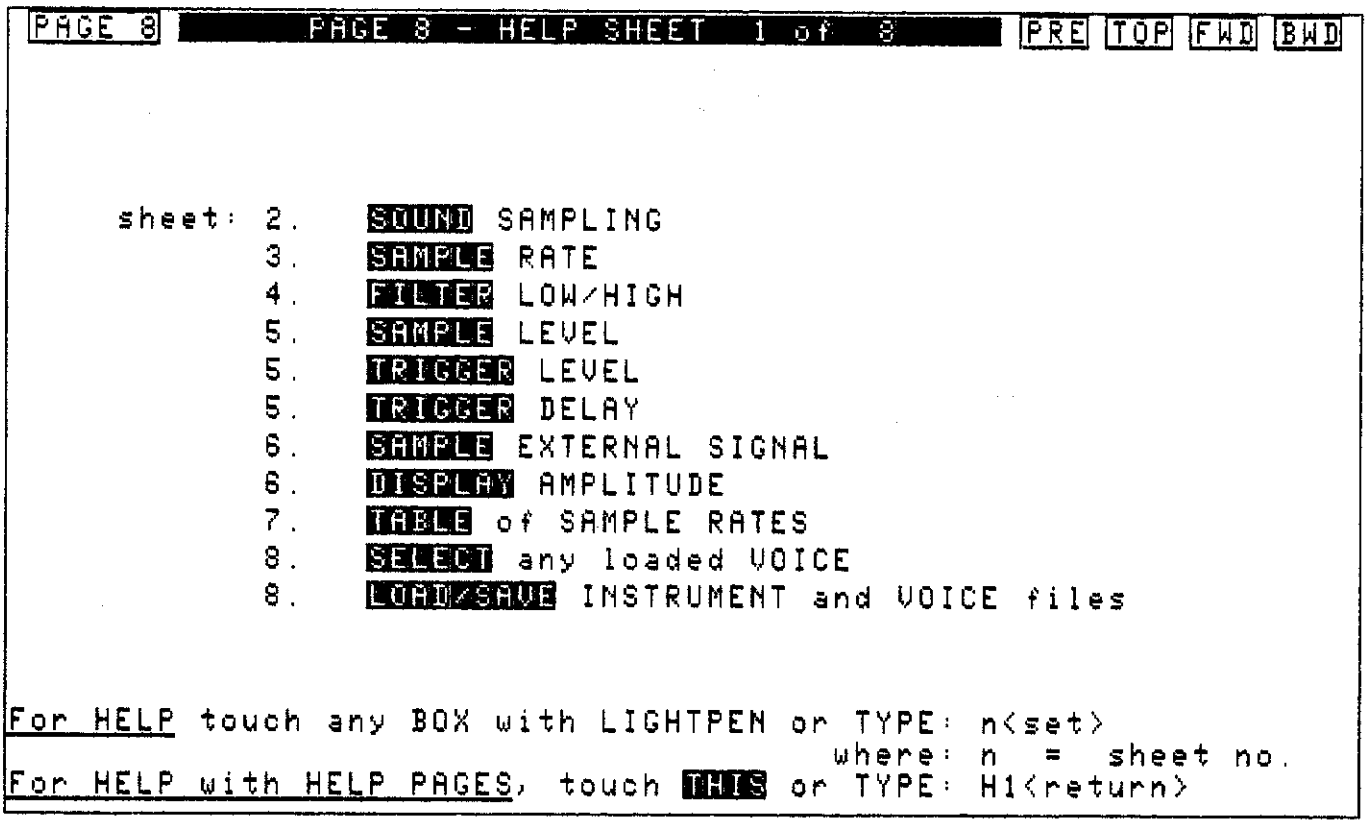
The CONTROL FILENAME is **blanked.** This reproduces the standard setup that is provided when a voice is CREATED (see PAGE 3 description).

The MODE is not changed.



Here is a cross-sectional display of a sound called SYNAPSE

Here is the first HELP sheet for PAGE 8 ...



Realworld sounds can be **sampled** on this page either through the **microphone** input, the **line** input, or straight to the **analog-to-digital** converter in a matter of seconds.

The **sample rate** can varied **minutely** over a wide range to sample perfectly in tune, using the stroboscope-type tuning indicator.

The new sound can then be played immediately over the whole range of the keyboard and with 8 note polyphony.

Make your favourite monophonic sound into octophonic sound with quartz-crystal controlled tuning. Because the new sound is now in digital memory as a series of thousands of numbers, it can be modified and copied indefinitely without losing fidelity.

Low-pass and **high-pass** filters are adjustable to filter out unwanted frequencies.

There is an output available at the back of the CMI to monitor the effect of any filtering.

To facilitate sampling, **level** adjustment and **triggering** controls are provided.

After each sample, a sound envelope is displayed for quick monitoring of input levels.

1. SOUND SAMPLING

SOUND SAMPLING is the process of creating a CMI voice waveform by analog-to-digital conversion of an external audio source.

The source must be connected to the MIC IN, LINE IN or ADC direct socket on back panel and the input selection switch set accordingly.

A voice must be CREATED or LOADED and should be in MODE 4 and ready to play on the keyboard (see PAGE 3 description).

A table of variables related to the sampling process occupies the top area of the display page. These may be selected for assignment by using the <arrow> keys or LIGHTPEN to TAB to the displayed value.

To modify, type number followed by <set>, <add>, or <sub> key.

2. SAMPLE RATE

SAMPLE RATE range: 21ØØHz - 3Ø2ØØ Hz

This is the frequency at which the external signal is sampled and converted; thus determining **two** aspects of the sample:

1. BANDWIDTH (fidelity) of the sample IMPROVES with increasing SAMPLE RATE. Bandwidth is approximately equal to **half** the sampling frequency.

2. DURATION of the sample gets **shorter** with **increasing** SAMPLE RATE.

   At a sample rate of **16384Hz** the sample is exactly **1 second.**
   At a sample rate of **8192Hz** the sample is exactly **2 seconds.**

The number of individual samples taken is fixed - the number of POINTS in the WAVEFORM MEMORY is 16,384. The **faster** these samples are taken, the **shorter** the **duration** of the sound becomes.

Some natural sounds contain complex phase relationships and may vary slightly in pitch and volume.

These minute variations are essential in giving characteristic "acousticness". The human voice and wind instruments are examples of this.

Variable pitched sounds make it hard to sample correctly **"live"** into the CMI.

In these cases, record the sound onto tape. This will "lock" the sound enabling accurate sampling by the CMI. It also enables half-speed mastering from tape for greater fidelity. Some pre-sampling equalization is usually a good idea.

There is no need to vari-speed (adjust the replay speed of the tape recorder) to pull a sound into pitch. The SAMPLE RATE can achieve the same result and with much greater precision.

Consider a SAMPLE RATE of 2Ø,ØØØ samples per second. Changing the SAMPLE RATE to 2Ø,ØØ1 samples per second is a change of Ø.ØØ5%, unachievable with variable pitch recorders.

The CORRECT setting of **SAMPLE RATE** is critical with pitched sounds since the voice will only be IN TUNE if **ONE CYCLE** of the resulting sampled waveform fits exactly into one SEGMENT of waveform memory.

This is achieved when the SAMPLE RATE equals the frequency of the source multiplied by 128 (128 samples per cycle).

The default setting (14Ø8Ø) is the correct sample rate for A=11Ø Hz. Usually a few test samples will need to be made to adjust the SAMPLE RATE correctly.

It is worth perservering to get the SAMPLE RATE exactly right.

Note that the SAMPLE RATE is **independent** of the music keyboard pitching.

Thus if a sound is sampled slightly flat to fit the waveform segment boundaries it will still play in tune if the Page 3 tuning adjustments are all set to zero.

It does not matter whether your sounds **to be sampled** are in tune or not.

PAGE D has been designed for viewing the sampled waveform to quickly determine the accuracy of the sample rate; see PAGE D - VOICE WAVEFORM DISPLAY description.

See also SAMPLE RATE TABLE.

3. FILTER LOW/HIGH

FILTER LOW/HIGH range: 1-9

These filters can be used as desired to remove unwanted high or low frequency components of the external sound to be sampled and will filter anything going into the **MIC** or **LINE** inputs. These filters are bypassed when using the **ADC DIRECT** input.

The FILTER OUT socket on back panel allows the signal to be monitored after these filters.

It is a good practice to set FILTER HIGH to cutoff at about half the SAMPLE RATE (since this is the bandwidth limit) resulting in an erroneous sample. Frequencies greater than half the SAMPLE RATE are only likely to contribute a "dirty" (aliasing) quality to the voice.

ALIASING occurs when the number of samples taken per second is not enough to record all the fluctuations in the sound. Either **increase** the SAMPLE RATE or use the **high** filter to reduce high frequency content.

value	FILTER LOW cutoff (Hz)	value	FILTER HIGH cutoff (KHz)	corresponding to a minimum SAMPLE RATE of:
1	18	1	Ø.6	1.2KHz
2	26	2	Ø.8	1.6KHz
3	37	3	1.Ø	2.ØKHz
4	52	4	2	4 KHz
5	73	5	3	6 KHz
6	1Ø4	6	4	8 KHz
7	147	7	6	12 KHz
8	2Ø8	8	8	16 KHz
9	294	9	12	24 KHz

4. SAMPLE LEVEL

SAMPLE LEVEL range: **Ø - 255**

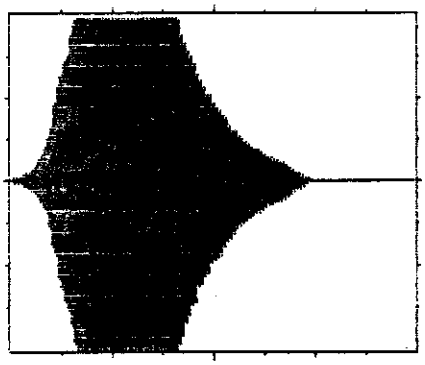
The amplitude of the sampled waveform is determined by this control.

It should be set so that the **loudest** section of the sound is neither CLIPPING or less than about 8Ø% of full scale.

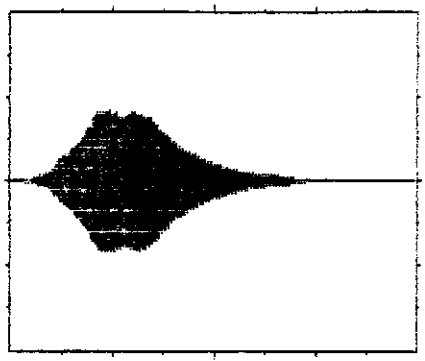
The TUNING INDICATOR and AMPLITUDE DISPLAY provided will indicate whether SAMPLE LEVEL should be increased or decreased.

Clipping may be desirable of course.

Too loud.
Reduce SAMPLE LEVEL
or input LEVEL.



Too quiet.
Increase SAMPLE LEVEL
or input LEVEL.



5. TRIGGER LEVEL

TRIGGER LEVEL range: **-128 to +127**

This is the amplitude THRESHOLD at which the sampling process is triggered to begin.

When the SAMPLE command is given the system will wait until this level is reached before proceeding. Note that a NEGATIVE value can be assigned if desired to cause triggering on a negative excursion of the signal.

Note that where it is important that **all** attack characteristics of a sound are required (percussion for example) use **TRIGGER DELAY** or **manual triggering.**

A trigger level of Ø will result in sampling commencing immediately after **S<return>** is typed. This is **manual** triggering.

6. TRIGGER DELAY

TRIGGER DELAY range: Ø - 65535 msecs

If desired, this can be used to cause a DELAY **after** the TRIGGER has occurred.

When sampling from a taped source, a **burst of tone** or a click can be recorded shortly **before** the signal to be sampled and used **instead** of the signal itself to TRIGGER the sampling process.

TRIGGER DELAY can then be used to precisely define the point at which sampling will actually begin, ranging from Ø seconds to 65.535 seconds in 1/1ØØØth second increments. This is extremely useful for preserving all attack characteristics of a sound.

7. SAMPLE EXTERNAL SIGNAL

TO SAMPLE EXTERNAL SIGNAL	TYPE:	LIGHTPEN:
	S<return>	<SAMPLE>

Use the continuous **tuning indicator** on Page 8 to check for correct sample rate.

If indicator drifts **up, increase** sample rate.
If indicator drifts **down, decrease** sample rate.

If the TRIGGER LEVEL is set **too high** or **no signal** is present the CMI will wait for about 15 seconds and finally give up with the message: **TRIGGER TIMEOUT.**

If this occurs, check for signal level - adjust TRIGGER LEVEL if necessary.

Check that the MIC/LINE switch and ADC INT/EXT switch are set correctly and try again.

When the SAMPLE is completed the AMPLITUDE DISPLAY in lower-right will show the amplitude envelope of the waveform.

If clipping or insufficient level can be seen adjust either SAMPLE LEVEL or source level accordingly.

Use PAGE 6 for detailed inspection for clipping.

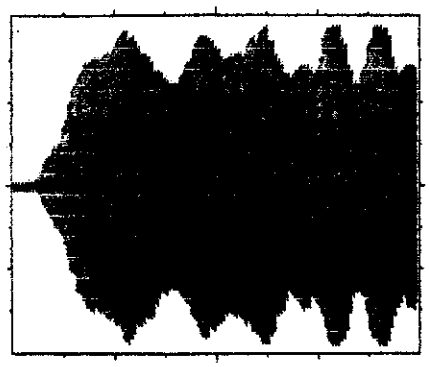
To interrupt sampling at any time, type **<ctrl-esc>.**
That is, hold down **<ctrl>**, press **<esc>.**

> Note: Continuous tuning indicator uses Voice Channel 1 for temporary storage of sample, preventing Channel 1 from sounding. Always use an NPHONY greater than 1 in register A (Page 3) when sampling. Channel 1 reverts to normal operation when you leave Page 8.

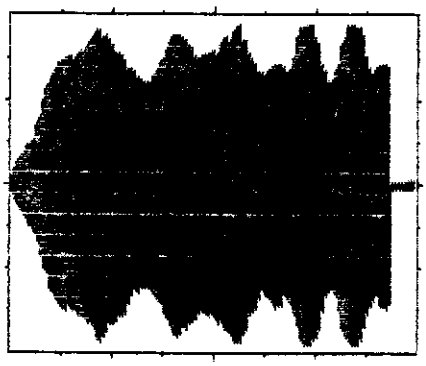
A sound, once sampled in pitch can then have its waveform tailored on Page 6 for smooth beginning and ending.

EXAMPLE

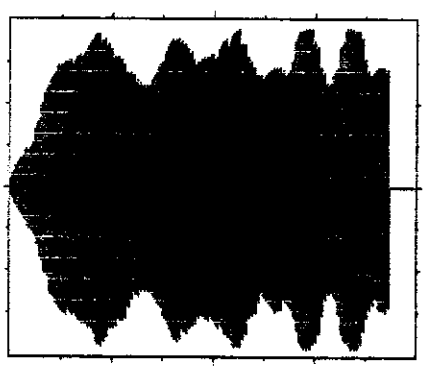
Original sample



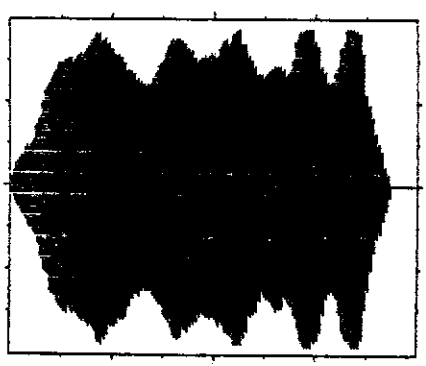
Now **rotate** entire waveform memory 8 segments to the **left.**
On Page 6 type **ROL,8<return>**



Now **ZERO** and **FILL** segments 121 to 128.
On Page 6
type **Z<return>**
then **F,121,128<return>**



Finally **MIX** down to **zero** over segments 11Ø to 121.
On Page 6
type **MI,11Ø,121<return>**



8. DISPLAY AMPLITUDE

TO DISPLAY WAVEFORM AMPLITUDE TYPE: **D<return>** LIGHTPEN: <DISPLAY>

This command activates the AMPLITUDE DISPLAY as a convenient separate function.

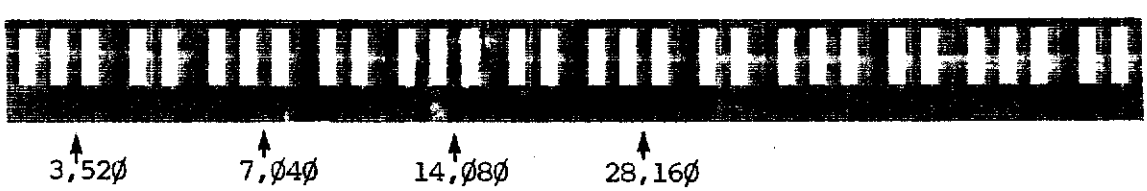
Any voice may be displayed but note that HARMONICALLY SYNTHESIZED MODE 1 voices will usually show no amplitude variation at all (amplitude envelope control in MODE 1 is provided by the ENERGY profile on PAGE 4). However the effects of PAGE 6 amplitude modification will be clearly visible.

9. TABLE of SAMPLE RATES

It would be worth making a copy of the following table and putting it in a convenient place near the CMI. This table is referenced often when sampling.

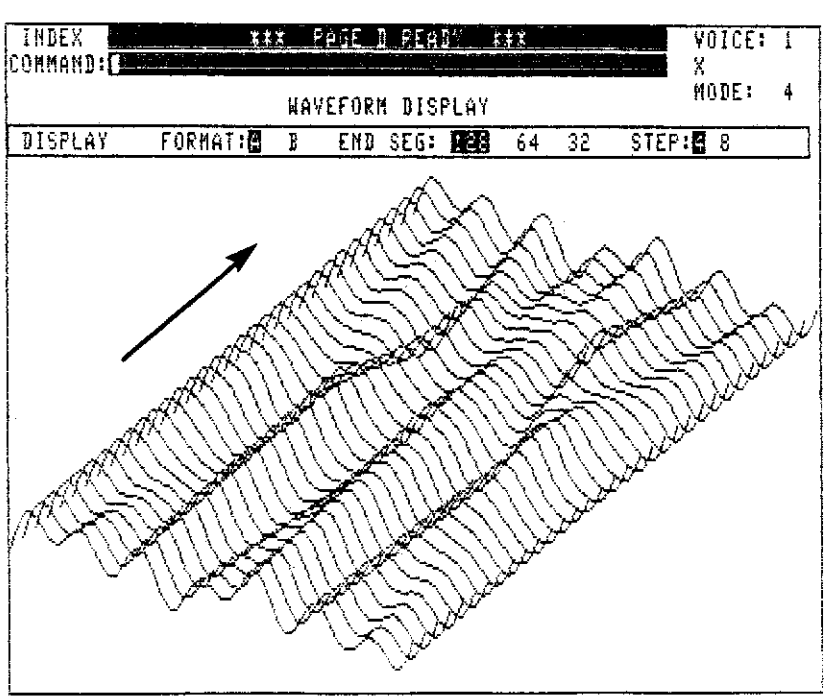
SAMPLE RATES

note		+8va	-8va	-16va
A = 11Ø Hz:	14Ø8Ø	2816Ø	7Ø4Ø	352Ø
A#	14917	29835	7459	3729
B	158Ø4	.	79Ø2	3951
C	16744	.	8372	4186
C#	1774Ø	.	887Ø	4435
D	18795	.	9397	4699
D#	19912	.	9956	4978
E	21Ø96	.	1Ø548	5274
F	22351	.	11175	5588
F#	2368Ø	.	1184Ø	592Ø
G	25Ø88	.	12544	6272
G#	2658Ø	.	1329Ø	6645

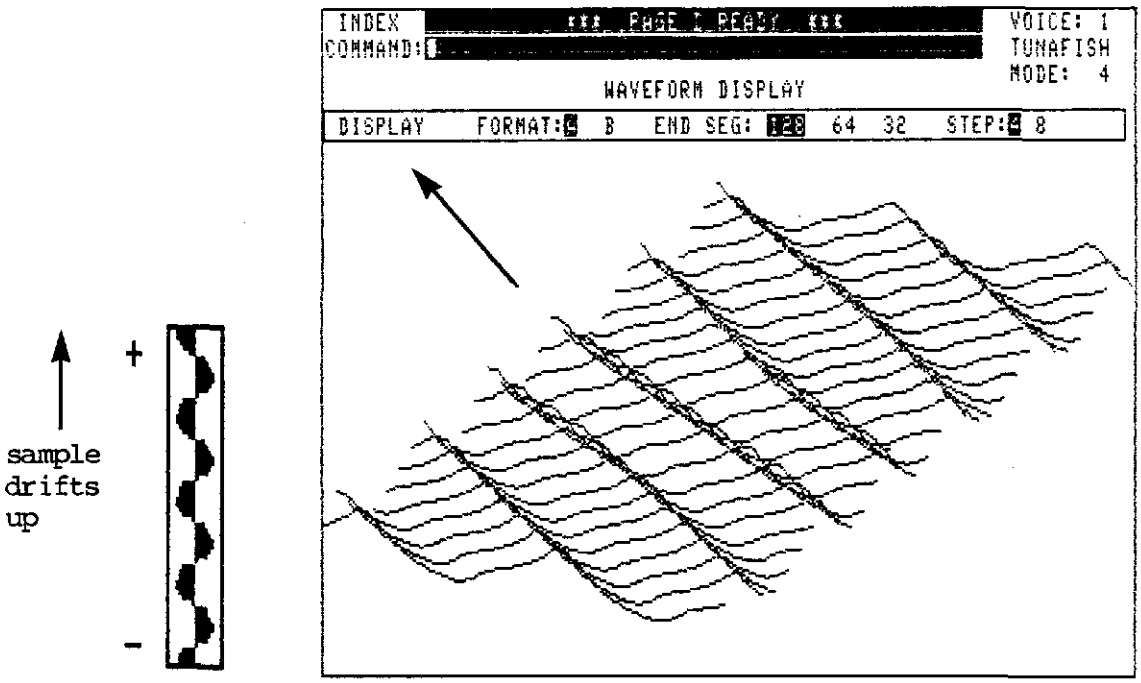


----SAMPLE RATE relationship on music keyboard----

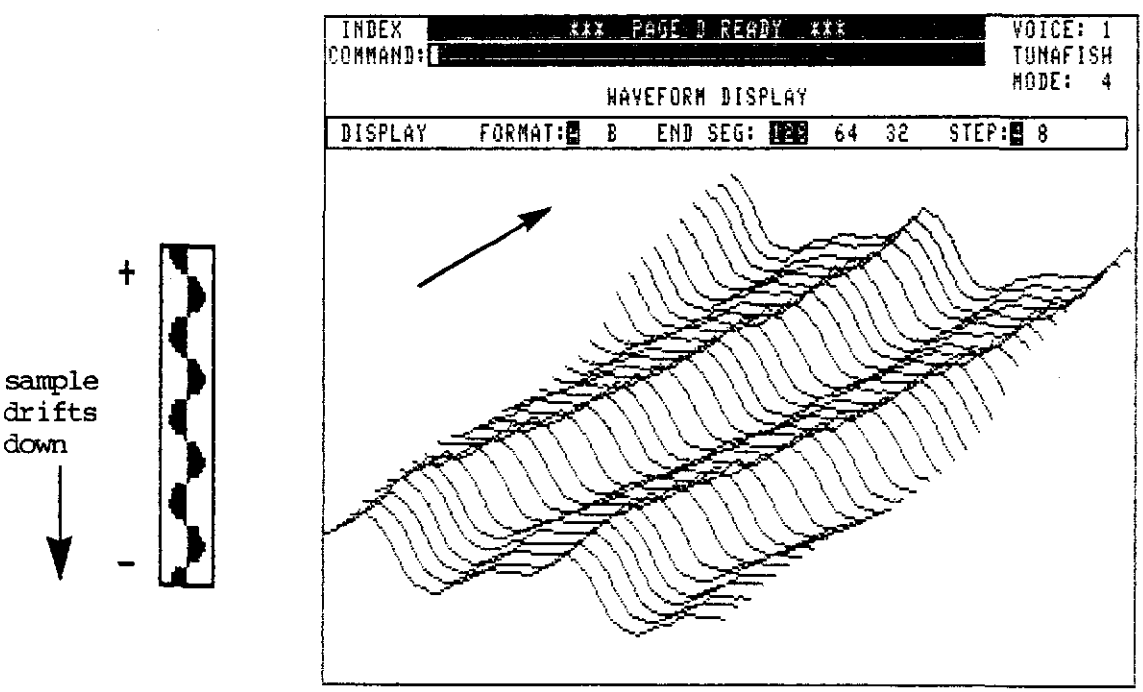
Here is a Page D representation of a sound sampled **in pitch.** The waveform is more or less **straight ...**



Page D display of a sound sampled slightly **flat** by the CMI.
The waveform drifts to the **left.**
Increase the SAMPLE RATE slightly ...



Page D display of a sound sampled slightly **sharp** by the CMI.
The waveform drifts to the **right.**
Decrease the SAMPLE RATE slightly ...



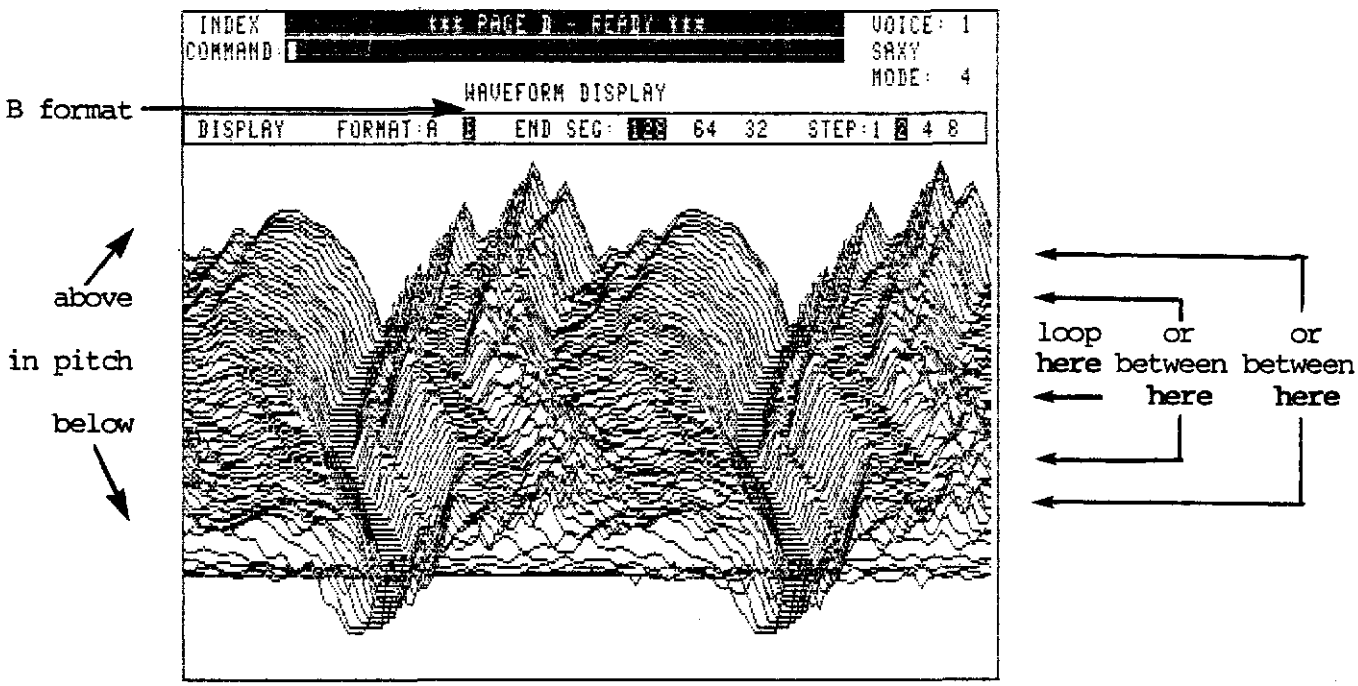
A sound may have an inherent **natural vibrato** meaning that the **pitch** varies **above** and **below** the actual note.

This adds interest and life to the sound.

The SAMPLE RATE should be adjusted so that there is equal shift **above** and **below** pitch.

Here is a Page D representation of a voice called **SAXY** which has natural vibrato ...

(The **"B"** display format has been used for greater clarity.)



1Ø. SELECT any loaded VOICE

TO SELECT any loaded VOICE for display or sampling.

TYPE: **V,filename<return>** or: **V,n<return>**

where: filename = the name of a loaded voice
n = the number 1-8 of a loaded voice

EXAMPLES: V,TUBA<return> - select voice TUBA
V,4<return> - select voice 4

The NAME & NUMBER of the current voice are shown in the **upper-right corner** of the page.

The names and numbers of all loaded voices are shown on PAGE 3.

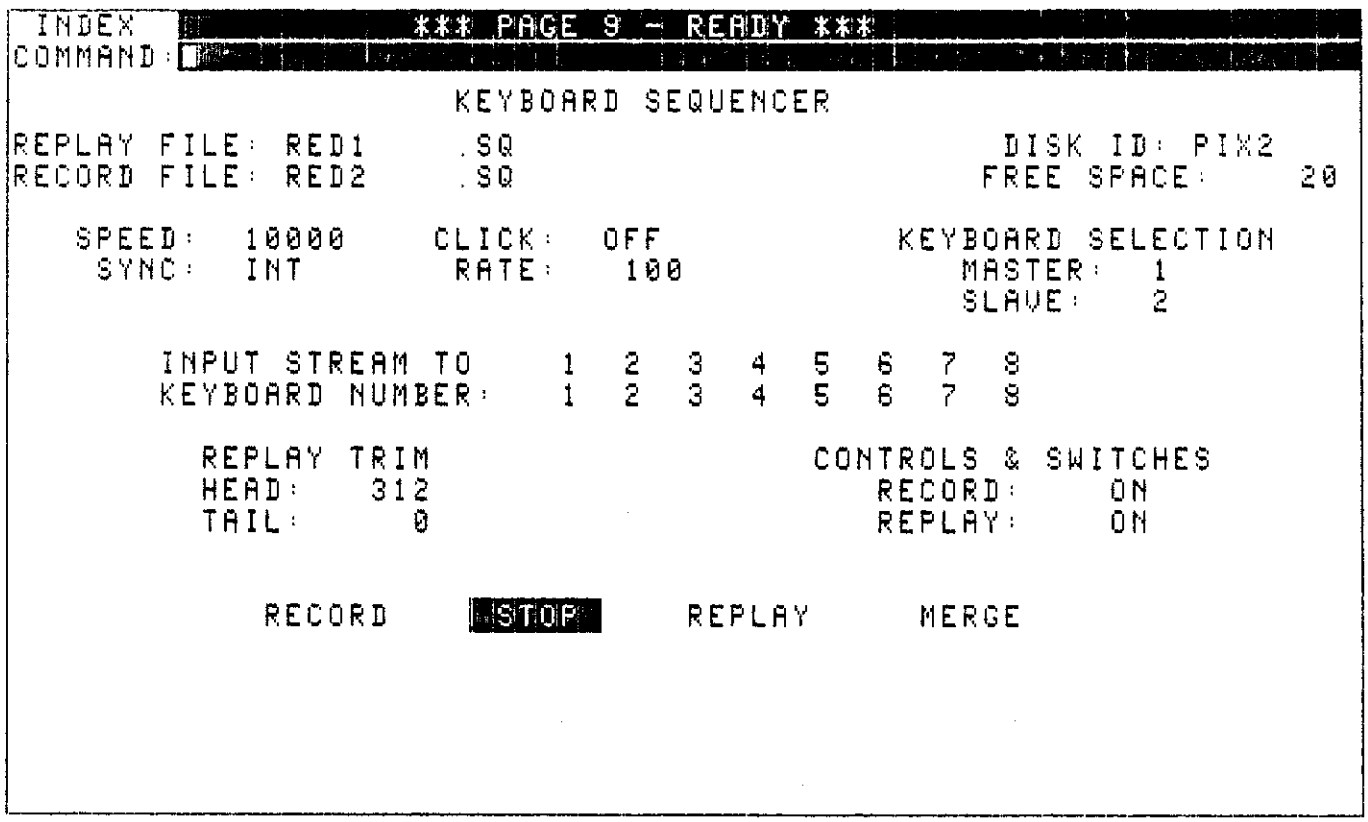
11. LOAD/SAVE INSTRUMENT and VOICE files

TO LOAD/SAVE VOICES or INSTRUMENTS TYPE:

To LOAD a VOICE	-	**L,r,filename<return>**
To SAVE a VOICE	-	**S,filename<return>**
To CREATE a VOICE	-	**C,r,filename<return>**
To LOAD an INSTRUMENT	-	**L,filename.IN<return>**
To SAVE an INSTRUMENT	-	**S,filename.IN<return>**

where: r = register A - H
filename = 1-8 character filename

See PAGE 3 description for more about loading/saving files.



Here is Page 9 with replay file (RED1) and record file (RED2) loaded.

Here is the first HELP sheet for PAGE 9 ...

PAGE 9 PAGE 9 - HELP SHEET 1 of 12 PRE TOP FWD BWD

sheet:	2.	INTRODUCTION to Keyboard Sequencer
	3.	FREE space on disk
	3.	ASSIGN record & replay files
	4.	RECORD command
	4.	STOP command
	5.	REPLAY command
	6.	MERGE command
	7.	OVERWRITE protection
	7.	TRIM replay file
	8.	CONTROLS/SWITCHES recorded or replayed
	8.	KEYBOARD selection
	9.	INPUT STREAM to keyboard number table
	10.	SPEED control
	11.	SYNC selection: internal or external
	12.	CLICK control

For HELP touch any BOX with LIGHTPEN, or TYPE: n<set>
where: n = sheet no.
For HELP with HELP PAGES, touch THIS or TYPE: H1<return>

Page 9 allows you to record music played on the keyboard and record the settings of the 6 faders and 5 switches.

Multiple overdubs can be achieved by **merging** subsequent recordings, that is **replaying** the first sequence whilst **recording** the new sequence.

Keyboard performances can be recorded or played back at any speed **without** changing pitch, in fact, so fast that you can't distinguish individual notes or so slowly that you may think the CMI has stopped playing altogether!

Any sequence or sequences can be replayed immediately and continuously up to 255 times.

Different voices can play the same sequences.

It is possible to synchronize the CMI to any external audio tone (usually recorded onto tape) to allow multi-track recording.

The CMI will then synchronize perfectly to that tone, slowing down as the pitch of the tone drops, speeding up as the pitch of the tone rises.

Up to 5Ø,ØØØ notes can be stored on a blank disk.

A variable digital metronome **click** facility is provided so "live" musicians can play along. You may want to record the click track onto multi-track tape to gate or trigger other electronic devices such as sequencers or drum machines. The click-track comes from a separate output on the CMI.

Page C Music Composition Language can be converted to Page 9 Sequence files. See the Music Composition Language manual under the **COMPILE** command.

1. INTRODUCTION to KEYBOARD SEQUENCER

RECORD

When recording, music keyboard EVENTS are timed and stored on disk in a file created as the RECORD FILE.

Events consist of KEY DEPRESSIONS (with VELOCITY), KEY RELEASES, and movements of the keyboard CONTROLS and SWITCHES. (See PAGE 7 description for use of controls, switches and key velocity.)

The current KEYBOARD SELECTION number for the master (or slave) keyboard is also recorded with key depressions and releases.

REPLAY

To replay, a previously recorded sequence is selected as the REPLAY FILE, from which keyboard events are read back, timed and replayed.

Key releases and depressions are sorted into eight INPUT STREAMS, corresponding to the recorded keyboard numbers. These input streams can be assigned to any of the eight KEYBOARD NUMBERS through the INPUT STREAM TO KEYBOARD NUMBER table.

MERGE

The merge function consists of **recording** and **replaying** at the **same** time.

Keyboard events are recorded exactly as in the RECORD function while the replay file is replayed and simultaneously re-recorded in the record file.

This allows a new keyboard performance to be effectively OVERDUBBED.

The resulting sequence can then be selected as the REPLAY FILE and the process repeated.

2. FREE SPACE on disk

FREE SPACE shows size (in sectors) of LARGEST SINGLE BLOCK of free disk space on disk in RH drive.

When a RECORD FILE is assigned all of this space is given to the new file. When recording (or merging) stops, any unused file space is returned to the disk; FREE SPACE then shows the size of the NEW largest single block.

A 128-note sequence will require about 1Ø sectors of disk space.
The maximum sequence size (an entire disk) is over 5Ø,ØØØ notes.

DISK ID shows name of disk in RH drive.

3. ASSIGN record & replay files

TO ASSIGN REPLAY or RECORD FILE

Use <arrow> keys to select replay or record filename.

TYPE: **filename<set>**

where: filename = 1-8 character filename without suffix.

When the REPLAY file is assigned the SPEED and CLICK rate are read from the file.

When the RECORD file is assigned, the SPEED and CLICK rate are written to the file.

The replay or record files may also be specified as part of the **typed** RECORD, REPLAY or MERGE commands.

See also OVERWRITE PROTECTION.

4. RECORD command

TO RECORD A SEQUENCE	TYPE:	LIGHTPEN:
If record file assigned -	**REC<return>**	<RECORD>
To also assign record file -	**REC,filename<return>**	n/a

EXAMPLE: REC,BOTTOM<return> Record file = BOTTOM.SQ

A RECORD FILE must be assigned, either prior to or as part of the command.

Recording begins when the word RECORD lights up.

The KEYBOARD SELECTION number determines the INPUT STREAM with which the sequence will be associated when replayed.

Play the music keyboard; give the STOP command when finished.

Keyboard CONTROLS and SWITCHES will be recorded if not disabled.

Note that the time from the BEGINNING until the FIRST event and the time from the LAST event until STOP are recorded (referred to as HEAD and TAIL times).

The sequencer must be STOPPED before the RECORD command can be given.

If the record file already exists, it will NOT be overwritten without your consent.

5. STOP command

RECORD **STOP** REPLAY MERGE

TO STOP record, replay & merge	TYPE:	LIGHTPEN:
	S<return> or **<ctrl-esc>**	<STOP>

where: <ctrl-esc> = press & hold **<ctrl>**, press **<esc>**

It is not necessary to STOP before changing display pages; this will happen automatically.

6. REPLAY command

RECORD STOP **REPLAY** MERGE

TO REPLAY A SEQUENCE	TYPE:	LIGHTPEN:
If replay file assigned -	**REP<return>**	<REPLAY>
To also assign replay file -	**REP,filename<return>**	n/a
To repeat replay xx times -	**REP,xx<return>**	n/a

where: xx = replay repeat count: 2-255

EXAMPLES:
```
REP,4<return>          (replay assigned file 4 times)
REP,TOP<return>        (replay file TOP.SQ 1 time)
REP,MIDDLE,48<return>  (replay MIDDLE.SQ 48 times)
```

A REPLAY FILE must be assigned, either prior to or as part of the command.

Replay begins when the word REPLAY lights up and continues until the end of the sequence. The sequencer must be STOPPED before the REPLAY command can be given.

Once the file has played to its own conclusion (without being stopped) the HEAD and TAIL times will be displayed under REPLAY TRIM.

Any CONTROL or SWITCH events will be replayed if not disabled.

KEY events are replayed through the INPUT STREAM corresponding to the KEYBOARD SELECTION number which was assigned to the master (or slave) keyboard when recorded. Each input stream can be assigned to "play" any one of the 8 keyboard numbers via the INPUT STREAM TO KEYBOARD NUMBER table.

Thus the loaded voices may be swapped around to play other sequences.

7. MERGE command

RECORD STOP REPLAY MERGE

TO MERGE A SEQUENCE	TYPE:	LIGHTPEN:
If both files assigned	- **M<return>**	<MERGE>
To also assign replay file	- **M,repfile<return>**	n/a
To also assign both files	- **M,repfile,recfile<return>**	n/a
To repeat replay xx times	- **M,xx<return>**	n/a

where: repfile = replay filename
recfile = record filename
xx = replay repeat count: 2-255

EXAMPLES:

M<return>	Merge (current Replay and Record files)
M,BAS1,BAS2<return>	Replay file=BAS1.SQ; Record file=BAS2.SQ
M,SOLO,16<return>	Replay file=SOLO.SQ - replay it 16 times
M,S3,S4,8,<return>	Replay file=S3.SQ; Record file=S4.SQ - replay 8 times

REPLAY and RECORD FILES must both be specified, either prior to or as part of the command.

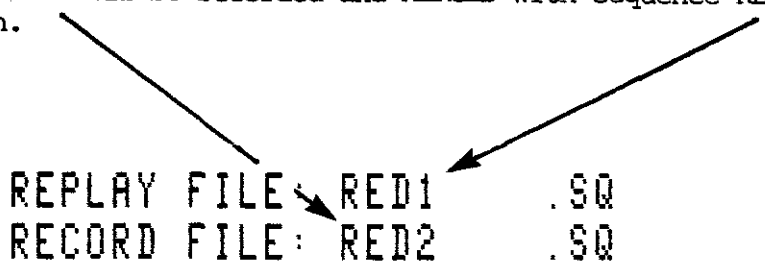
The replay file is replayed the specified number of times and simultaneously re-recorded in the RECORD FILE along with the new keyboard performance. Thus the drum pattern may be recorded once then REPLAYED indefinitely whilst MERGING other tracks.

Recording will continue after the end of the replay file until the STOP command is given.

The INPUT STREAM TO KEYBOARD NUMBER table determines the keyboard numbers which will be recorded for the replay events.

The sequencer must be STOPPED before the MERGE command can be given.

Here, sequence RED2 will be recorded and MERGED with sequence RED1 if the MERGE command is given.



Another feature is the ability to **convert** Page C - Music Composition Language (where music, control and switch settings are typed in) into Page 9 sequencer files. To do this, see the Music Composition Language manual under the **COMPILE** command.

Thus the preciseness and accuracy of Page C can be merged with the "live" feel of Page 9.

8. OVERWRITE protection

OVERWRITE PROTECTION

The sequencer will never OVERWRITE an existing RECORD file before displaying the question:

OVERWRITE filename.SQ (Y)?

TO REPLY:	TYPE:
Yes, overwrite the file -	**Y<return>**
No, do NOT overwrite file -	**N<return>** or
	<return> or
	<ctrl-esc>

9. TRIM replay file

```
REPLAY TRIM
HEAD:   312
TAIL:     0
```

These facilities allow you to trim out, or increase the "silent spots" at the start and end of sequences.

TO TRIM REPLAY FILE HEAD/TAIL

Use <arrow> keys to TAB to HEAD or TAIL, TYPE: **nnn<set>**

where: nnn = time in MICROBEATS: Ø - 65535

A REPLAY FILE must be assigned.

The HEAD TIME is the time from the **beginning** of the sequence to the first note played or the first movement of the faders or switches.

The TAIL TIME is the time from the **last** event (note played, switch or fader moved) to the **end** of the sequence.

Head and tail time may be adjusted either when the sequencer is STOPPED or during REPLAY or MERGE.

If the sequencer is STOPPED, the new head or tail time will be WRITTEN to the file.

If the sequencer is in REPLAY or MERGE, the new times will only be used for the REMAINDER of the run. To obtain a smooth repeat, adjust these times while replaying.

When the replay file is repeating smoothly, STOP and reassign the final settings, thereby writing them to the file.

HEAD time should usually be set to zero.

HEAD time can be adjusted to a multiple of the CLICK RATE setting to allow a "count-in" before the music starts.

1Ø. CONTROL/SWITCHES recorded or replayed

```
CONTROLS & SWITCHES
   RECORD:    ON
   REPLAY:    ON
```

TO RECORD/REPLAY CONTROLS & SWITCHES

Use <arrow> keys to TAB to RECORD or REPLAY, TYPE:
To ENABLE record/replay - **ON<set>**
To DISABLE record/replay - **OFF<set>**

When RECORD is ON, any use of the keyboard CONTROL faders or SWITCHES (including foot pedals) will be recorded during RECORD or MERGE.

When REPLAY is ON, any CONTROL or SWITCH events in the REPLAY file will be played during REPLAY or MERGE.

Thus during MERGE, if RECORD is OFF and REPLAY is ON, control or switch events will be replayed, but NOT recorded.

Note that you can merge a previous sequence with a sequence consisting of just CONTROL and SWITCH settings, allowing say, live mixdown to be done.

Recording busy CONTROLS can require a lot of disk space.

11. KEYBOARD selection

```
KEYBOARD SELECTION
   MASTER:  1
   SLAVE:   2
```

TO SET KEYBOARD SELECTION

Use <arrow> keys to TAB to MASTER or SLAVE,

TYPE: **n<set>**

where: n = Keyboard number: 1 - 8

The K command available on every page can also be used to set the keyboard selection number (see PAGE 3 description). This number determines which of the 8 KEYBOARD MAPS on PAGE 3 is linked with the selected music keyboard.

This corresponds to the Page 3 MASTER and SLAVE keyboard selection.

When using RECORD or MERGE to record a keyboard performance the keyboard selection number determines the INPUT STREAM with which that performance will be associated when REPLAYED.

When using MERGE to overdub successive performances a different keyboard number is usually assigned at each pass to retain the integrity of the parts.

12. INPUT STREAM to keyboard number table

INPUT STREAM TO	1	2	3	4	5	6	7	8
KEYBOARD NUMBER:	1	2	3	4	5	6	7	8

TO ASSIGN INPUT STREAM TO KEYBOARD NUMBER

Use <arrow> keys to TAB to desired INPUT STREAM.

TYPE: **n<set>**

where: n = Keyboard number: Ø - 8

This table allows each of the 8 INPUT STREAMS from the REPLAY FILE to be linked with any of the 8 KEYBOARD MAPS which are presented on DISPLAY PAGE 3.

This allows you to specify which REGISTER will be "played" by each input stream by setting up the desired keyboard configuration on PAGE 3.

Assigning a keyboard number of ZERO will turn OFF an input stream.

Keyboard numbers may be assigned to input streams DURING replay or merge.

During MERGE, this table determines the keyboard numbers which will be recorded for the replay events.

Thus the input streams may be dynamically reassigned or turned off while merging, and the results will be saved in the RECORD FILE.

13. SPEED control

SPEED: 10000

TO CHANGE SPEED use <arrow> keys to select SPEED.

TYPE: **nnnn<set>** or TYPE: **nn<add or sub>**

where: nnnn = 1ØØØ-65535 where: nn = 1-65535

The sequencer measures time in units called MICROBEATS.

The SPEED control defines the DURATION of a microbeat as a number of system clock cycles (1.ØØ525 MHz or 1,ØØ5,25Ø Hz).

Thus the TEMPO of the REPLAY sequence is the SAME as the recorded performance IF the speed setting is exactly the same.

Thus you may RECORD using a very SLOW (large) speed and speed up REPLAY to correct tempo without pitch change.

If you want to change key (pitch), go to Page 3 and adjust the tuning.

The tempo can be made FASTER by REDUCING the speed setting (shorter microbeats) or made SLOWER by INCREASING it (longer microbeats).

While recording, the smallest time interval which can be measured is one microbeat.

The RESOLUTION (rhythm accuracy) of the recording process is therefore governed by the SPEED:

$$\frac{\text{SPEED}}{1ØØØ} = \text{resolution in milliseconds (approx)}$$

When a sequence is recorded, the SPEED is stored in the file and will be automatically restored when the file is assigned as the REPLAY file.

The speed may then be altered either before or DURING replay but this does not affect the setting stored in the file. See INTERNAL/EXTERNAL SYNC.

TO WRITE the CURRENT SPEED to the REPLAY FILE

TYPE: **SPEED<return>** or **SP<return>**

SPEED can be related to beats per minute in the following way:

Set CLICK to **ON** and RATE to 192.
A SPEED of **5236** will be **60** beats (clicks) per minute.
A SPEED of **2618** will be **120** beats (clicks) per minute.

EXAMPLE

You have completed a piece and it has a SPEED of 5ØØØ and is 35 seconds long. The piece really should be just 29 seconds long. **Speed up** the piece in the following way ...

$$\frac{29 \text{ seconds}}{35 \text{ seconds}} \quad X \quad 5ØØØ \text{ (speed)} = 4142 \text{ (new speed)}$$

So move cursor to SPEED setting; type **4142<set>**

Now type **SP<return>** This writes the new speed to the file on disk.

14. SYNC selection: internal or external

TO SET INTERNAL/EXTERNAL SYNC use <arrow> keys to TAB to SYNC.

TO SELECT:	TYPE:
internal sync	- **INT<set>**
external sync	- **EXT<set>**
external sync (DIVIDE external tone by nn) where: nn = 2 - 65535	- **nn<set>**

When INTERNAL SYNC is selected (normal) the SPEED control defines the microbeat duration in cycles of the system clock as described.

When EXTERNAL SYNC is selected, SPEED is ignored, and a microbeat becomes ONE CYCLE of the EXTERNAL SYNC INPUT (which must be connected at the back panel). This allows the replay tempo to be controlled by varying the external sync frequency.

If a number "nn" is assigned to SYNC then a microbeat will be "nn" cycles of the external tone.

The external sync facility can be used to co-ordinate multi-track overdubbing of sequences by taping the sync tone and using the "sync-head" replay from the recorder to feed the external sync input of the CMI.

The tone can be any periodic waveform between 1ØØ Hz and 5,ØØØ Hz.

When multi-tracking, it should be around 1 volt peak-to peak.

It is necessary to record a SYNC tone on an unused track of the tape so that the Page 9 sequencer can follow variations in the tape speed for perfect synchronization.

The SYNC tone should be a constant pitch derived from:

a tone generator
an audio oscillator
a synthesizer
a CMI channel

The SYNC tone should NOT be a CLICK.

The CMI plays music with a resolution in the order of milliseconds and needs an AUDIO tone between 1ØØHz and 5,ØØØHz for such high resolution, rather than a CLICK which has a resolution of between .2Hz and 1ØHz.

If necessary, the CMI can provide a synchronized CLICK of any speed for external sequencers or drum machines.

The CMI detects the very beginning of the SYNC tone and uses that as its starting point.

If the pitch of the SYNC tone rises the CMI will play faster.
If the pitch of the SYNC tone falls the CMI will play slower.

The procedure for multi-tracking is as follows:

1) The Page 9 sequencer will play at the speed determined by the precise frequency of the SYNC tone.
To find out the correct frequency, connect an oscillator directly **into** Pin 2 of the SYNC connector at the rear of the CMI. The CLICK if turned ON will come **out** Pin 3.

Any oscillator with a variable frequency output in the range 1ØØHz to 5,ØØØ Hz can be used for a SYNC tone. The shape of the waveform is irrelevant, however a smooth waveform such as a SINEWAVE or TRIANGLE wave is to be preferred over, say a SQUAREWAVE, which tends to "spill" somewhat onto other tracks of a multi-track.

2) Select EXTERNAL SYNC on Page 9 by tabbing to SYNC and typing EXT<set>.
For greater synchronizing accuracy **set** SYNC=4 or higher. This will mean that the external tone is **divided** by 4, so four times the frequency can be used.
REPLAY the Page 9 sequence. Varying the PITCH of the oscillator will vary the replay speed of the sequence. Make sure the CMI is getting enough level from the oscillator.
Select a suitable speed or range of speeds.

3) Connect the audio oscillator to the tape recorder input associated with the track which is to carry the SYNC tone. SYNC tracks are usually physically positioned at the other end of the record head to minimise "spill".

EXAMPLE If music is to be recorded onto tracks 1-5 of an 8-track machine, then the SYNC track should be track 8.

4) Connect the appropriate output of the tape recorder to the SYNC input of the CMI (Pin 2 of the SYNC connector). This is a single-ended (unbalanced) input, requiring a minimum level of 1 volt P-P for reliable operation.

5) Record the SYNC track **BY ITSELF** while replaying and monitoring the sequence. Differences in the position of the RECORD head and the PLAYBACK head on the multi-track means that if the SYNC tone and the sequences are recorded simultaneously then subsequent synchronized recordings will be out of synchronization by the amount of time it takes for the tape to move from the RECORD head to the REPLAY head.
Alternatively take the SYNC tone directly from the RECORD head.
Make sure that the start of the SYNC tone is clean and is preceded by a few seconds of silence. Page 9 will start replaying as soon as the tone starts. It is possible to vary the speed of the piece dynamically by varying the oscillator frequency while laying down the SYNC track. For this purpose it is necessary to be MONITORING the Page 9 sequence in EXTERNAL SYNC mode while recording the SYNC track.
Let the SYNC track run for a few seconds longer than the Page 9 sequence.

6) From now on, all sequences will faithfully follow this SYNC track (unless SYNC=INT is re-selected). Record each group of sequences on a separate tape track, making sure that the PLAY is executed with SYNC=EXT.

For equal tempo between EXTernal and INTernal SYNC:

$$\text{SPEED} = \frac{2\emptyset1\emptyset.5}{\text{EXT SYNC in KHZ}} \qquad \text{EXT SYNC in KHz} = \frac{2\emptyset1\emptyset.5}{\text{SPEED}}$$

EXAMPLE

An EXTernal SYNC tone of 1 KHz is equivalent to an INTernal SPEED of 2ø1ø.

Choral effects are easily achieved by multi-tracking the same sequences with similar sounding voices.

For **phasing** and **flanging** effects, multi-track the same sequences but adjust **Page 3 fine tuning** by around +/- 5/1øøths of a semi-tone.

For **echo** effects, adjust the REPLAY TRIM HEAD value, thus offsetting the start of the sequences.

15. CLICK control

TO TURN CLICK ON/OFF use <arrow> keys to TAB to CLICK.

TYPE: **ON<set>** - Turn click output **on**
OFF<set> - Turn click output **off**

The CLICK (metronome) output must be connected at the back panel.

The CLICK is found on three outputs :

1: Phones output
2: Monitor Speaker output
3: Sync socket (Pin 3)

The CLICK volume coming from the Phones and Monitor is variable from the SYNC VOL MON control at the back of the CMI.

TO SET CLICK RATE use <arrow> keys to TAB to RATE.

TYPE: **nnn<set>**

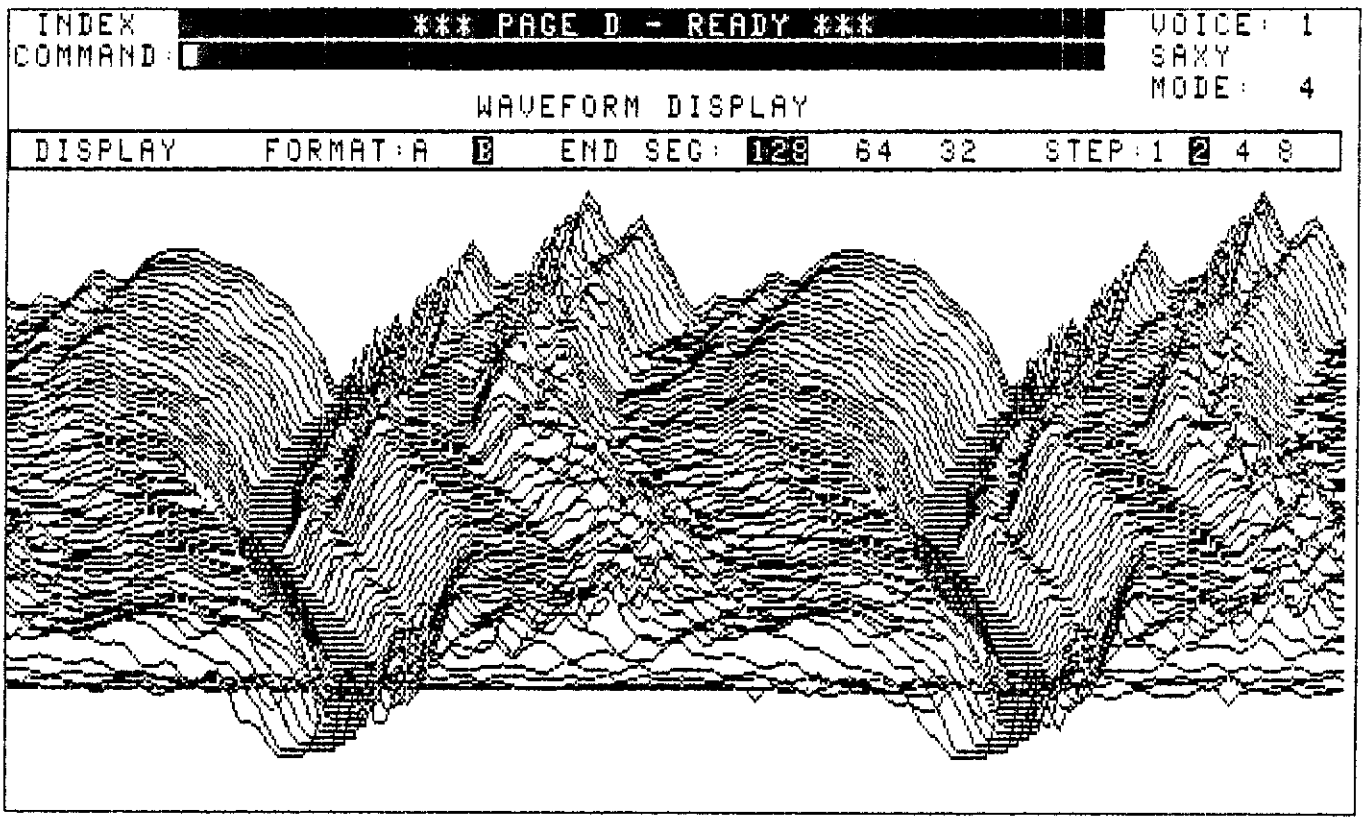
where: nnn = desired click rate

The CLICK RATE defines the number of MICROBEATS in one BEAT of the click tempo for both internal and external SYNC.

The following calibration table can be used when using the click with INTERNAL sync for cinema or television applications.

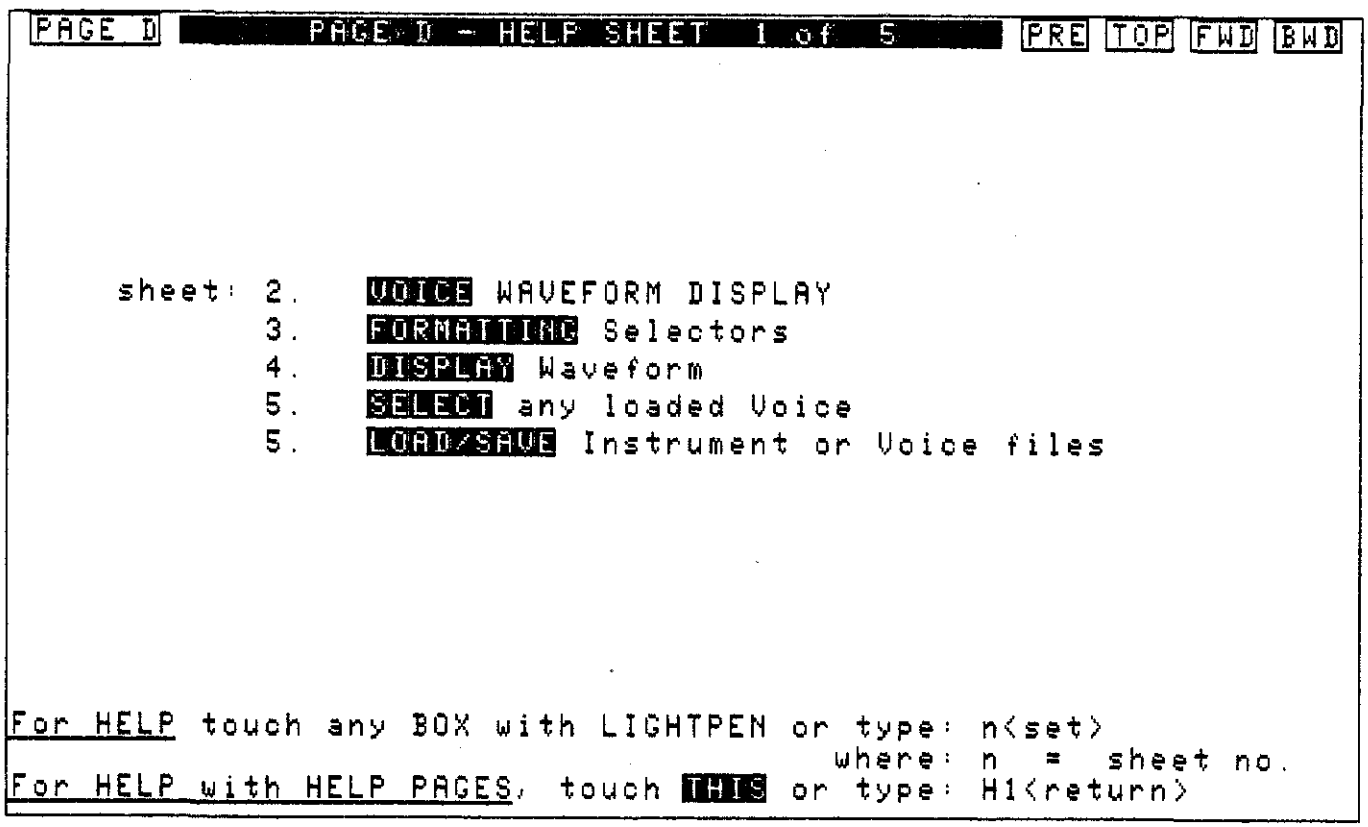
FOR microbeat calibration:	SET SPEED	24 fps 5236	25 fps 5Ø26
1 beat = 1 sec (6Ø mm):	CLICK RATE	192	2ØØ
1 beat =.5 sec (12Ø mm):	.	96	1ØØ
1 beat = S seconds:	.	S x 192	S x 2ØØ
Tempo = F frames per beat:	.	F x 8	F x 8
Tempo = T beats per min:	.	$\frac{T}{6Ø}$ x 192	$\frac{T}{6Ø}$ x 2ØØ

Section C: DISPLAY PAGE D) VOICE WAVEFORM DISPLAY



Here is the memory waveform display of a voice called SAXY.

Here is the first HELP sheet for PAGE D ...



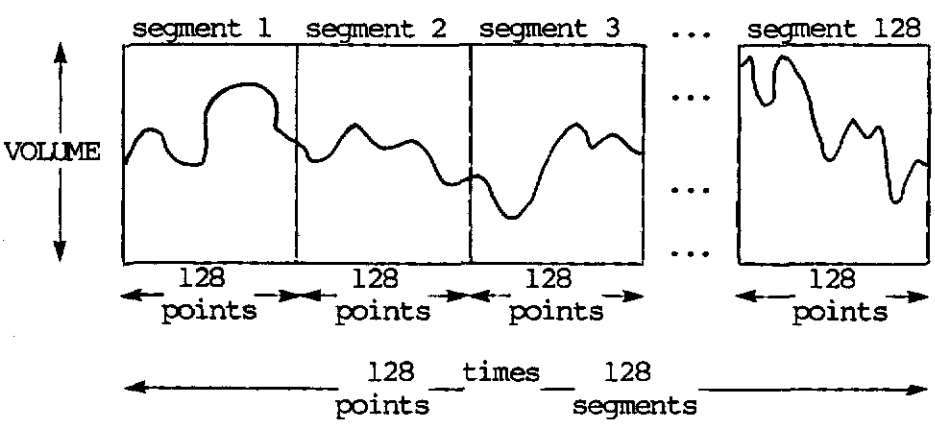
1. VOICE WAVEFORM display

VOICE WAVEFORM DISPLAY allows the **entire** WAVEFORM MEMORY for a voice to be displayed on the screen at once.

PAGE D is a purely **visual** page. The format of the display has been designed to reveal as much as possible about the voice waveform in a single glance, particularly when creating a voice by SAMPLING an EXTERNAL SOURCE (see PAGE 8 description).

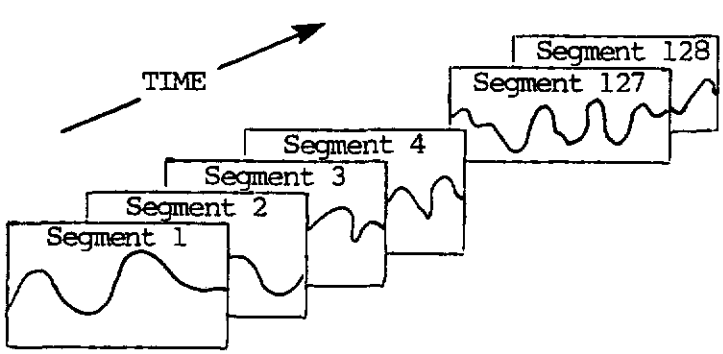
The CMI divides the waveform into **128 segments** as shown.

The **waveform** corresponds to the way air moves when we hear a sound.



Page D stacks these segments one behind the other.

So now we can see the **total** waveform at once ...



The waveform display will show immediately whether the SAMPLE RATE was appropriate for a pitched external source.

It would be worth making a copy of the next few pages of this manual as you will frequently turn to these pages when sampling external sounds.

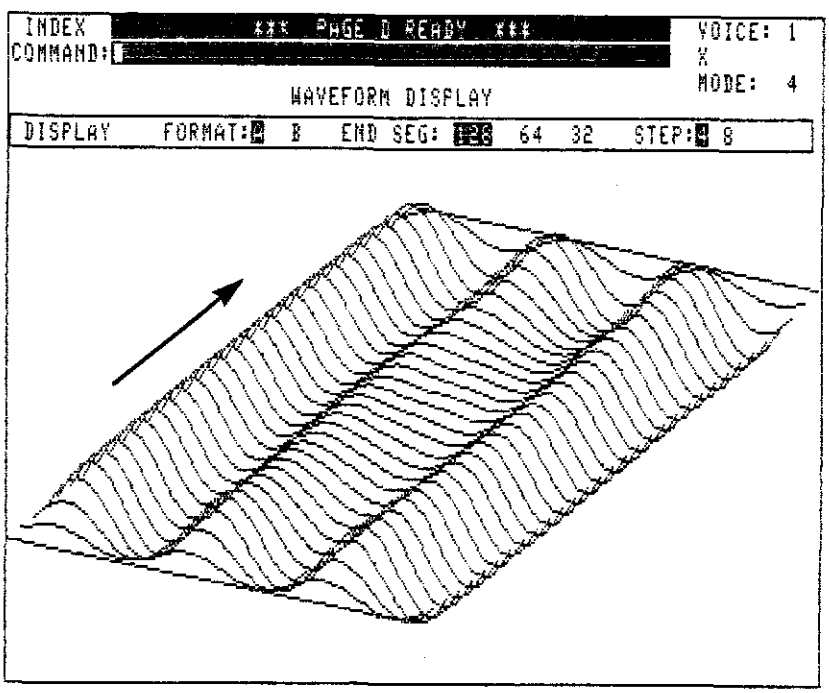
If SAMPLE RATE was appropriate

that is, voice is in tune with the CMI then

> waveform crests and troughs will proceed in a linear, orderly way along the display - varying little in their position within each successive segment.

Page D display of a sound sampled in pitch.

The waveforms are more or less in line ...



Page 8 tuning window doesn't move

If SAMPLE RATE was almost appropriate

that is, voice is slightly flat or sharp then

> a 1-segment LOOP will produce a sudden slight pitch shift and waveform crests and troughs will "drift" laterally through the display.

If this drift is to the **RIGHT** then sample rate was too **HIGH.**

If this drift is to the **LEFT** then sample rate was too **LOW.**

If SAMPLE RATE was totally wrong

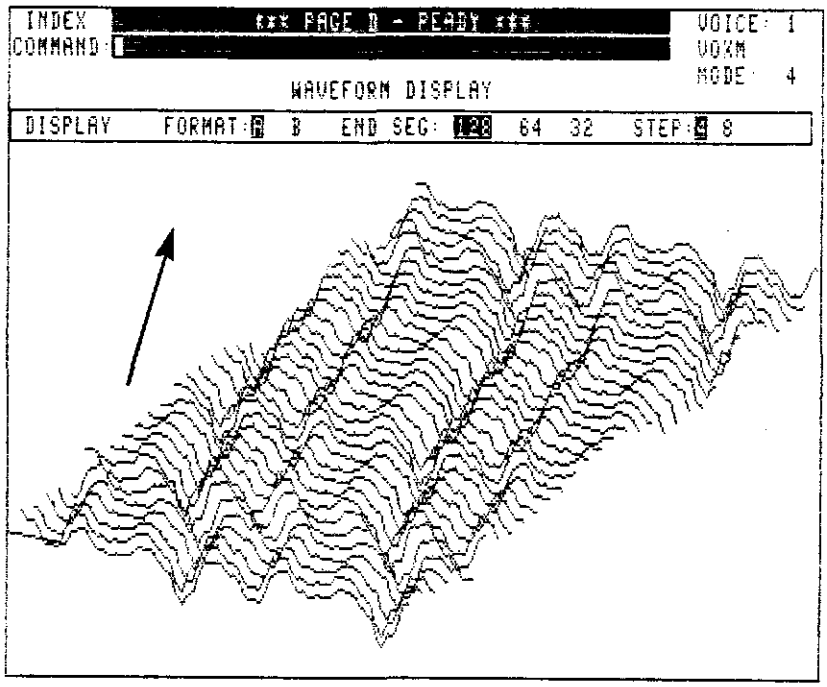
then the display will usually be a hopeless jumble.

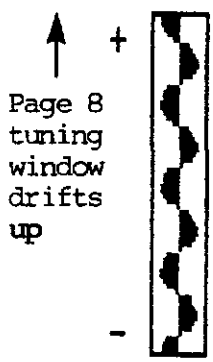
> The relationship of one cycle of signal to each segment of waveform memory necessary for correct tuning is also the relationship required for a visually coherent display. Thus voices that look good will generally sound good too.

Page D displaying a sound sampled slightly **flat** by Page 8.

The waveform drifts to the **left.**

Increase the SAMPLE RATE slightly ...

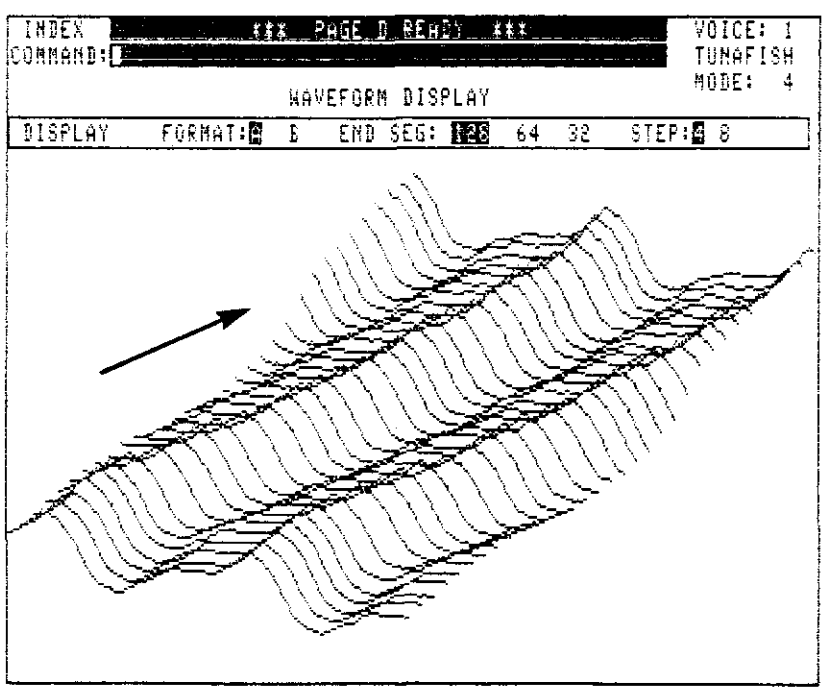


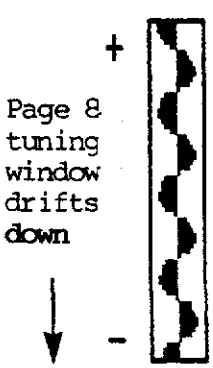


Page D showing a sound sampled slightly **sharp** by Page 8.

The waveform drifts to the **right.**

Decrease the SAMPLE RATE slightly ...





2. FORMATTING selectors

The effects of changing FORMATS will not be seen until the DISPLAY command is given.

FORMAT SELECTOR provides the choice of **two display formats.**

FORMAT (A) is "tilted" diagonally for a 3-dimensional effect.

FORMAT (B) is vertically aligned with the screen. The display resolution is greater and fine detail is more easily distinguished.

To select FORMAT touch <A> or <B> with LIGHTPEN.

The format may also be specified as part of the typed DISPLAY command.

FORMAT (A) display is provided automatically whenever PAGE D is selected.

Any **loaded VOICE** may be selected for display.

EXAMPLE **V,3<return>** Display the waveform for voice 3.

END SEGMENT SELECTOR indicates the SEGMENT number of the last segment displayed. This can be 128, 64 or 32.

To select END SEGMENT touch desired *number* with LIGHTPEN. The END SEGMENT may also be specified as part of the typed DISPLAY command.

STEP SELECTOR determines the NUMBER of SEGMENTS skipped between display traces.

Thus if STEP = 4, every fourth segment is displayed.

The STEP can be 1, 2, 4, or 8 within limits which are automatically displayed depending on the FORMAT selected.

To select STEP touch desired number with LIGHTPEN. The STEP value may also be specified as part of the typed DISPLAY command.

3. DISPLAY waveform

TO DISPLAY WAVEFORM	TYPE:	LIGHTPEN:
with current settings	- **D<return>**	<DISPLAY>
select Format A	- **DA<return>**	n/a
select Format B	- **DB<return>**	n/a
select (new) End Segment	- **D,e<return>**	n/a
select (new) End Seg and Step	- **D,e,s<return>**	n/a

where: e = end segment number: 32,64,128 only
s = step value: 1,2,4,8 only

EXAMPLES:

DA,128<return>	Display Format A, end segment = 128
DB,32,1<return>	Display Format B, end segment = 32, step = 1
D,64<return>	Display, end segment = 64
D,,2<return>	Display, step = 2

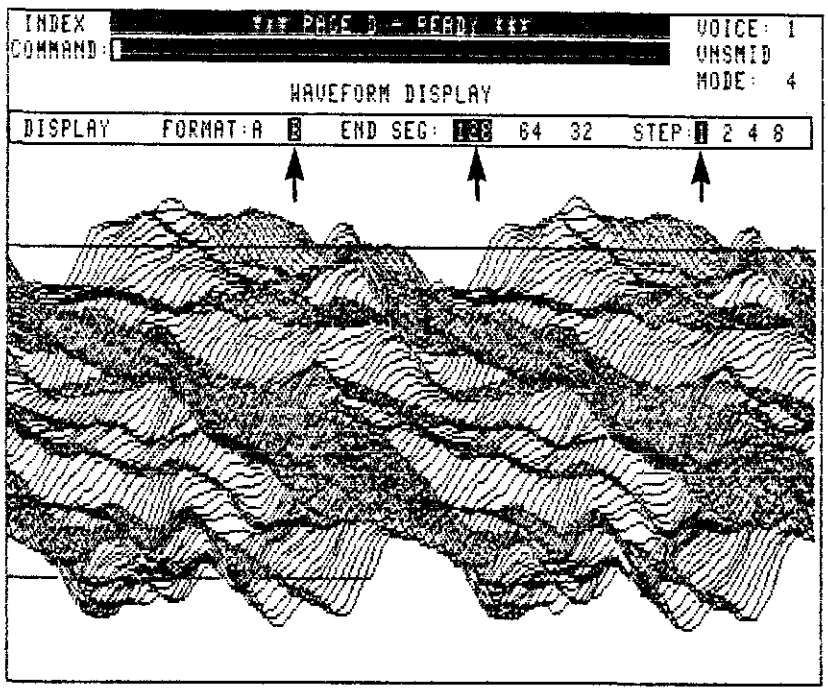
The voice WAVEFORM MEMORY is displayed with the selected **format, end segment** and **step.**

To INTERRUPT the DISPLAY for any reason,

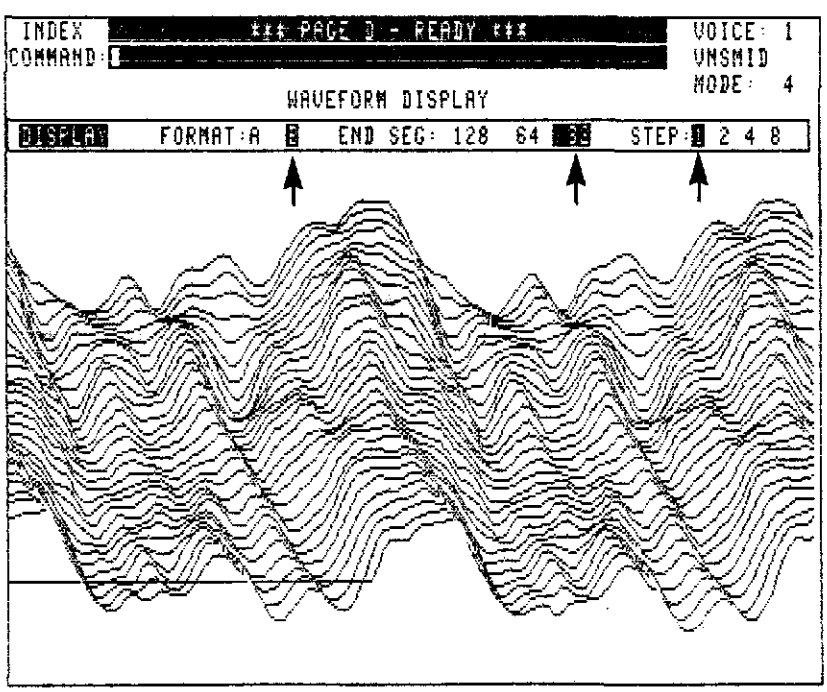
press **<esc>** while holding down **<ctrl>.**

Here are various displays of the same waveform ...

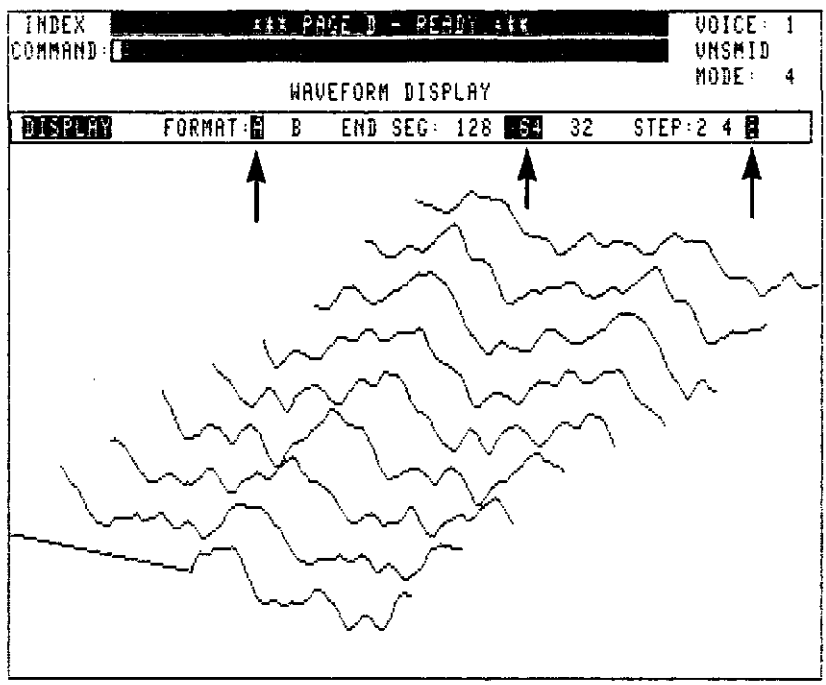
On Page D type **DB,128,1<return>**
meaning: display in format B, 128 segments,
increment steps by 1.



On Page D type **DB,32<return>**
meaning: display in format B, 32 segments,
increment steps by 1 (default).



On Page D type **DA,64,8<return>**
meaning: display in format A, 64 segments,
increment steps by 8.



4. SELECT any loaded VOICE

TO SELECT any loaded VOICE for display,

TYPE: **V,filename<return>** or: **V,n<return>**
where: filename = the name of a loaded voice
n = the number 1-8 of a loaded voice

EXAMPLES: V,TUBA<return> - select voice TUBA
V,4<return> - select voice 4

The NAME, MODE & NUMBER of the current voice are shown in the upper-right corner of the page. The names and numbers of all loaded voices are shown on PAGE 3.

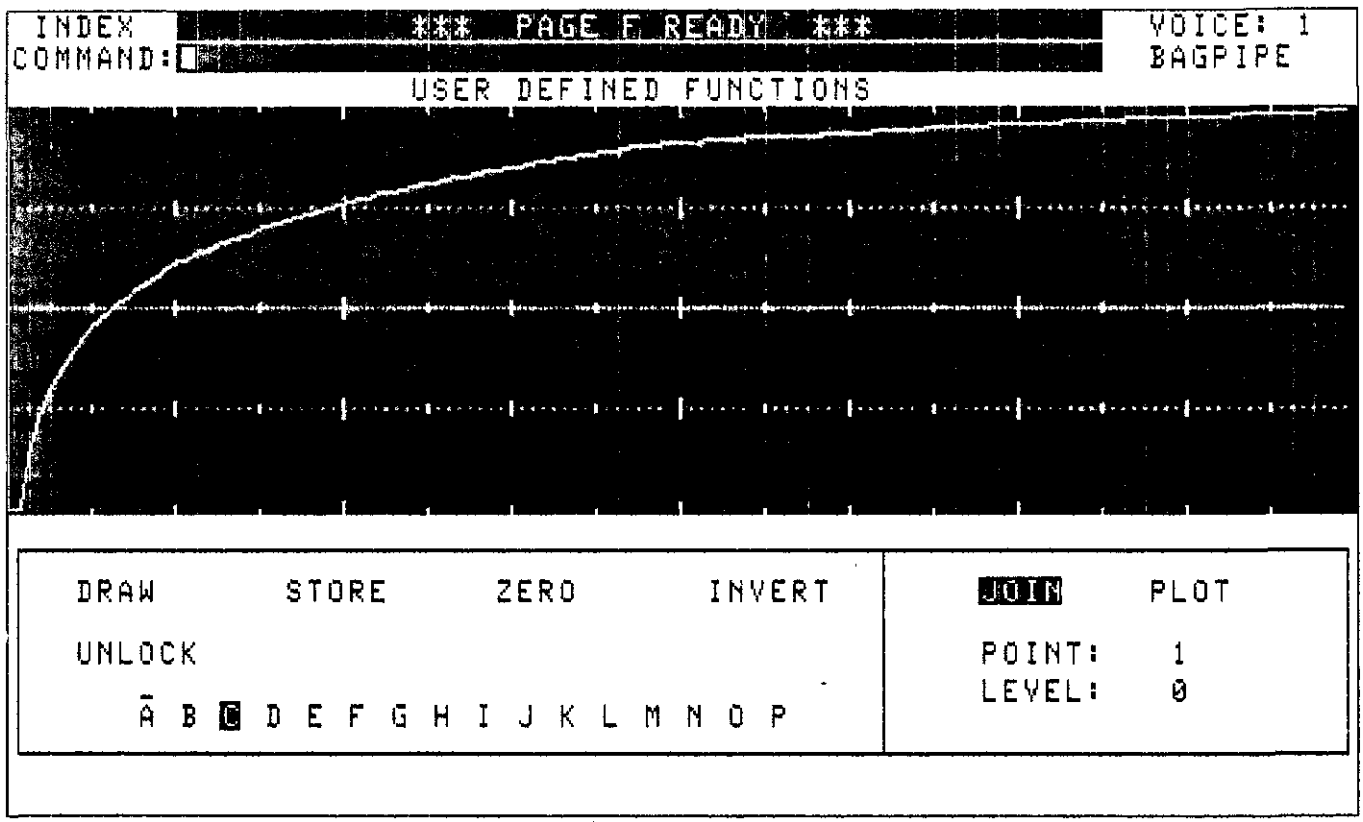
5. LOAD/SAVE Instrument or Voice files

TO LOAD/SAVE VOICES or INSTRUMENTS TYPE:

To LOAD a VOICE - **L,r,filename<return>**
To SAVE a VOICE - **S,filename<return>**
To CREATE a VOICE - **C,r,filename<return>**
To LOAD an INSTRUMENT - **L,filename.IN<return>**
To SAVE an INSTRUMENT - **S,filename.IN<return>**

where: r = register A - H
filename = 1-8 character filename

See PAGE 3 description for more about loading/saving files.



Here's Function curve **C** on Page F

Here is the first HELP page for PAGE F ...

```
PAGE F   PAGE F - HELP SHEET  1 of  6          PRE  TOP  FWD  BWD

      sheet:  2.  USER-DEFINED FUNCTIONS
              3.  PRESET FUNCTIONS
              3.  SELECT a FUNCTION for DRAWING
              4.  DRAW command
              4.  STORE command
              5.  ZERO command
              5.  INVERT command
              5.  UNLOCK command
              6.  LOAD/SAVE FUNCTIONS
              6.  LOAD/SAVE VOICES


For HELP touch any BOX with LIGHTPEN or type: n<set>
                                      where: n  =  sheet no.

For HELP with HELP PAGES, touch THIS or type: H1<return>
```

USER DEFINED FUNCTIONS are curves drawn on PAGE F and used on PAGE 7 letting you shape response curves for KEYVEL, KEYNUM, CONTROL faders, and KEYPRS.

Some typical applications would be: a control fader could be given an exponential response, rather than linear; by doing a multi-voice load on Page 2, cross-fades between voices can be performed by KEYNUM or keyboard control faders; touch sensitivity of music keyboard can be varied.

Sixteen functions letters, A to P, are presented on the bottom of the screen. Point the lightpen at any one of these letters to make it the currently displayed function.

For a drawn function to have an effect, it must be patched to desired control parameter on Page 7.

A function can be drawn on the screen with lightpen, similar to WAVEFORM DRAWING on PAGE 6. For detailed work, the alphanumeric keyboard can be used. All this works in real time, so that if a function is included in a PAGE 7 patch, and is being drawn, you can hear the results immediately.

PRESET FUNCTIONS

Three preset functions are loaded into function slots A, B and C at CMI start-up time.

Function A is the default setting (x=y) and is not able to be re-drawn.

Functions B and C are specific to AUX. LEVEL on Page 7 and are such that a CONTROL FADER or KEYNUM can be used to pan smoothly between two voices loaded in a multi-voice register. To do this, load a register with two voices on Page 2, go to PAGE 7 and patch AUX. LEVEL on one voice to KEYNUM,B or a control with function B. On the second voice, patch AUX. LEVEL to KEYNUM,C or a control with function C. This can improve realism with MODE 4 sounds, as well as allowing you to create some very interesting effects.

Unlike function "A", functions "B" and "C" can be re-drawn but once re-drawn, the original 'system defined' functions will be lost until the CMI is next re-booted.

EXAMPLE To make KEYNUM **cross-fade** between two voices ...

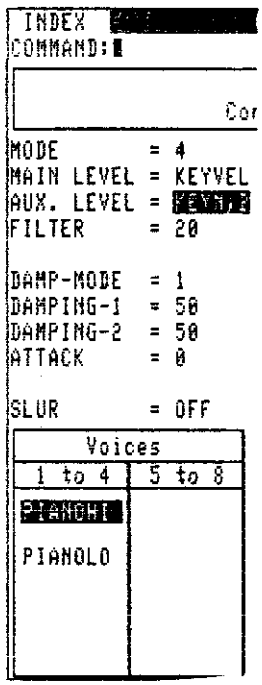
Load **two** voices into the **one** register. See PAGE 3 description under multi-voice load command.

Go to Page 7.

We will now control the level of each voice by using KEYNUM and two preset function curves from PAGE F. Function **B**, on Page F, has a preset **logarithmic** curve. Function **C** has a preset **inverse** logarithmic curve. In this way, depending on which notes are played on the keyboard, one voice becomes louder and the other becomes quieter.

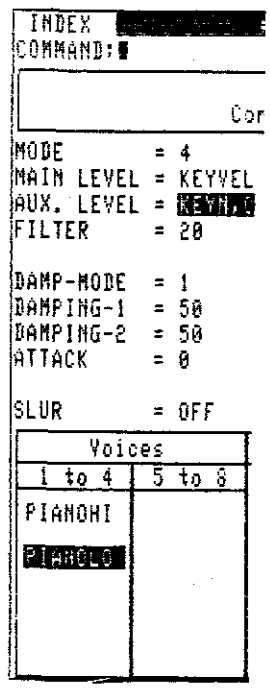
Patch **AUX. LEVEL** to **KEYNUM,B** for **voice 1**

Type **KEYNUM,B<set>**



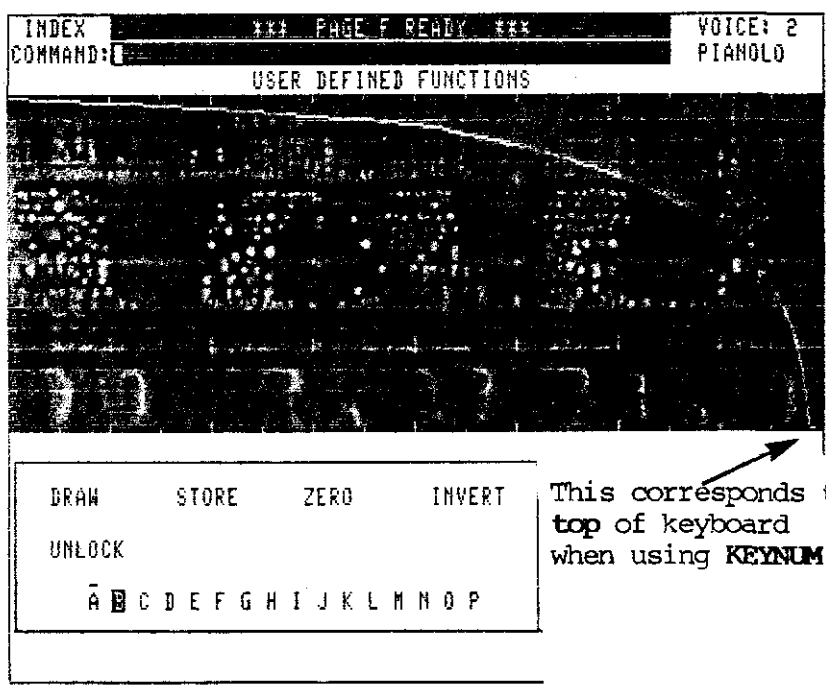
Patch **AUX. LEVEL** to **KEYNUM,C** for **voice 2**

Type **KEYNUM,C<set>**



Go to Page F and select function B, that is LIGHTPEN ==> B
==> DRAW.

Observe function B's logarithmic nature. This is what you should see ...



This corresponds to **bottom** of keyboard when using **KEYNUM**

This corresponds to **top** of keyboard when using **KEYNUM**

TO SELECT a FUNCTION for DRAWING point LIGHTPEN at a function letter. Then DRAW desired function curve. Alternatively, the cursor control keys and POINT/LEVEL assignment may be used for fine detail.

When drawing is complete, point lightpen at STORE or type

ST,function letter<return>.

A bar will appear above stored function signifying that the function is "locked" that is unable to be redrawn. To perform further modification, the function must be UNLOCKED. See UNLOCK description.

1. DRAW

DRAW command	TYPE:	LIGHTPEN:
	D,x<return>	==>x
		==>DRAW

where x = function letter A to P

This command displays current contents of selected function. By using DRAW, then selecting another function letter and STORING, curves may transferred between functions.

2. STORE

TO STORE A FUNCTION	TYPE:	LIGHTPEN:
	ST,x<return>	==>x
		==>STORE

where x = function letter B to P

Currently displayed curve is stored in function slot and a bar appears above function letter. This signifies overwrite protection. Opposite of UNLOCK. If functions are loaded from disk via CONTROL files (.CO), they are automatically assigned over-write protection.

NOTE: Function A is a system preset and permanently protected in that it cannot be re-drawn.

3. ZERO

TO ZERO A FUNCTION	TYPE:	LIGHTPEN:
	Z<return>	==>ZERO

Currently displayed curve is zeroed.

4. INVERT

TO INVERT A FUNCTION TYPE: I<return> LIGHTPEN: ==>INVERT

Currently displayed curve is inverted horizontally. This is useful in quickly creating the inverse curve, for example, when panning between two voices loaded in one register using one control fader.

5. UNLOCK

TO UNLOCK A FUNCTION TYPE: UN,x<return> LIGHTPEN: ==>x ==>UNLOCK

where x = function letter B to P

Opposite of STORE. Function loses over-write protection and may be re-drawn. Bar disappears above function letter.

NOTE: Function A is a system preset and cannot be UNLOCKED.

LOAD/SAVE FUNCTIONS

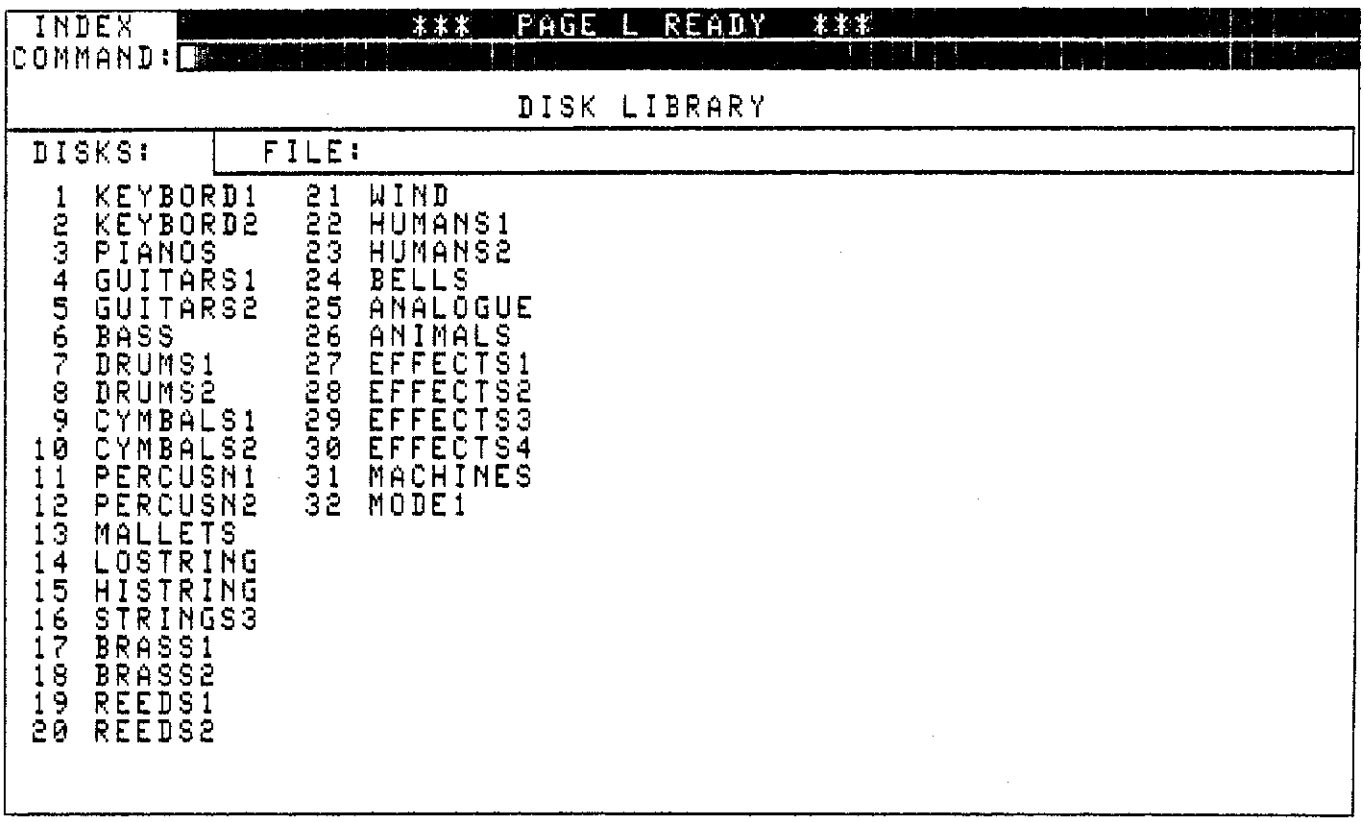
PAGE F function curves is stored as part of a CONTROL to which it relates on PAGE 7. If a control file contains several patches making use of functions, then saving that control file to disk will also save the appropriate functions as part of that control file. Loading that control file will then restore the function to their appropriate slots in memory. Function data already in those slots will be overwritten. If it is desired to preserve functions already loaded into memory, but the slots occupied clash with the function letters specified in the control file to be loaded, then a new load command option may be used.

The "S" for **SHUFFLE** option causes the function tables contained in the control file being loaded to be assigned to the first free slots in memory, regardless of their function letters. The CMI then adjusts any function letters specified in patches to match the position of the actual function within memory.

Type L <filename>.CO;S<return>

where filename is control filename
;S is the shuffle option

To save the adjusted patches to disk, re-save the control file in the normal way. A maximum of 10 function tables can be stored in a control file. A maximum of 16 function tables can be loaded into memory at any one time.



Sound Library Display

Here is the first HELP sheet for PAGE L ...

```
PAGE L   PAGE L - HELP SHEET  1 of  6    PRE TOP FWD BWD


     sheet: 2.   DISK LIBRARY
            3.   BUILD the library
            4.   READ a disk into library
            5.   FIND files in library
            6.   EXAMPLES of FIND command




For HELP touch any BOX with LIGHTPEN or type: n<set>
                                       where: n  =  sheet no.
For HELP with HELP PAGES, touch THIS or type: H1<return>
```

1. DISK LIBRARY

THE DISK LIBRARY allows the names of all your sounds, keyboard setup and music on your disks to be kept for quick reference on your CMI SYSTEM DISK (left-hand disk drive).

The Library keeps a record of all files and on which disks they can be found.

The FIND command enables you to easily identify the disk on which any single file is found.

Up to eighty disks can be maintained in the disk library on each system disk.

Each disk is given a NUMBER when the library is originally created with the BUILD command.

These numbers serve to identify the disks to the library (even if the DISKNAMES are changed) whenever the READ command is used to update the library for a single disk.

The current sound library consists of thirty disks containing around five hundred sounds.

The FIND command allows individual files to be **found** as well as providing a **PARTIAL MATCH** facility by which various sorts of searches can be made through the library.

For example you could display all VOICE files **beginning** with the letters "LOW", or display all files of any type which have the name "LA".

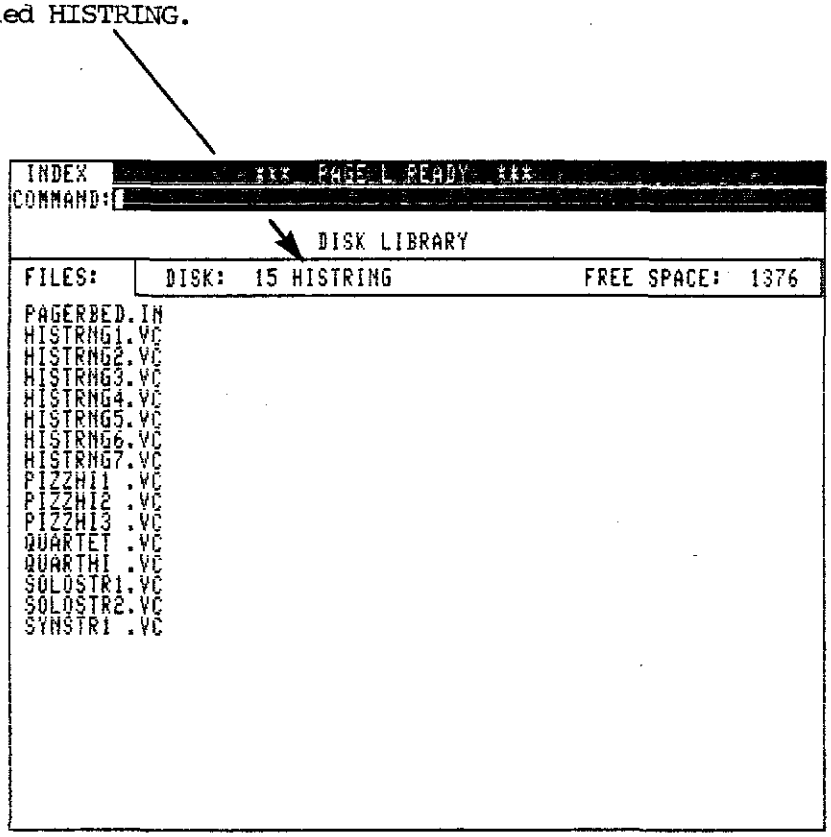
To simply DISPLAY ALL FILES on a DISK,

touch the DISKNAME with the LIGHTPEN.

To return to the DISKNAME display,

touch the TITLE of the PAGE: <DISK LIBRARY>.

Here are the contents of
sound disk 15 called HISTRING.



2. BUILD the library

TO BUILD A NEW LIBRARY first sort all your disks into some order meaningful to you. Number the labels of each disk starting with **1**.

DISK NUMBERS will be assigned sequentially as each disk is READ into the LIBRARY.

Place the first disk in the RH drive.

To begin the BUILD, TYPE: **B<return>**

This question will appear:

READ DISK IN RH DRIVE - ASSIGN NO. 1 (Y)?

TO REPLY:	TYPE:
Yes, proceed with BUILD.	**Y<return>**
No, stop the BUILD.	**N<return>** or **<return>** or **<ctrl-esc>**

When the disk has been READ the same question will appear again; this time requesting approval to READ disk and assign the number 2.

READ DISK IN RH DRIVE - ASSIGN NO. 2 (Y)?

Place the next disk in the RH drive and REPLY as before.

Continue this until ALL disks have been READ.

At that time reply NO to the question (as shown above).

The LIBRARY is now ready for use.

See the FIND command.

3. READ a disk into library

After a library has been BUILT, it can be easily updated as changes are made to disk contents. You do not have to re-build the library each time. The READ command will update the status of a disk, and re-number it if required.

TO READ A DISK INTO LIBRARY	TYPE:
Read disk	- **R<return>**
Read disk, assign new number (n)	- **R;n<return>**

where: n = new disk number, not larger than the number of disks now in the library plus 1.

This question will appear: READ DISK IN RH DRIVE - (Y)?

TO REPLY:	TYPE:
Yes, proceed with READ.	**Y<return>**
No, stop the READ.	**N<return>** or **<return>** or **<ctrl-esc>**

To keep your LIBRARY up to date, the READ command must be used whenever the content of a disk changes significantly.

EXAMPLE	
R<return>	READ the contents of the disk in the right-hand drive. Its library number will stay the same. If there is no library numb will assign a number.
R;16<return>	READ the contents of the disk in the right-hand drive. Assign a new library number 16. If there were only 1Ø disks already in the library, then current disk would be re-numbered 11.

4. FIND files in library

The FIND command is used to located files in the library.

It can be used in two ways:

1. SEARCH for a single, specific filename.
   In this case, each disk in the library is searched for the file; the name of any disk on which it was found will be displayed.

2. SEARCH for an incomplete, or partial filename.
   The library is searched disk-by-disk. For each disk on which any files are found matching the **partial name**, the **name** of the **disk** and **all matching files** are displayed.

TO FIND A FILENAME

TYPE: **F,filename.sf;dn<return>**

where: filename.sf = a complete or partial filename.
;dn = disk number (optional)

If the filename and suffix are specified then the name is COMPLETE.

If the filename or suffix or BOTH are missing, the name is INCOMPLETE.

The name is also incomplete if the special character "*" is used. This character indicates a "don't care" condition and its use is best described through the examples on next sheet.

5. EXAMPLES of FIND command

FIND COMMAND EXAMPLES:

F,TUBA2.VC<return>	-	Complete name: find **all** copies of file **TUBA.VC.**
F,TUBA2<return>	-	Incomplete name: find **all** files of **any** suffix with the name **TUBA2.**
F,TUB*.CO<return>	-	Incomplete name ("*" used): find **all** .CO files that begin with letters "**TUB**" (don't care about rest of name).
F,.IN<return>	-	Incomplete name: find **all** files with suffix **.IN**
F<return>	-	Incomplete name: find **all** files. Look at the contents of library.
F,T*<return>	-	Incomplete name: find **all** files beginning with letter **T.**
F;15<return>	-	Display contents of Disk 15.

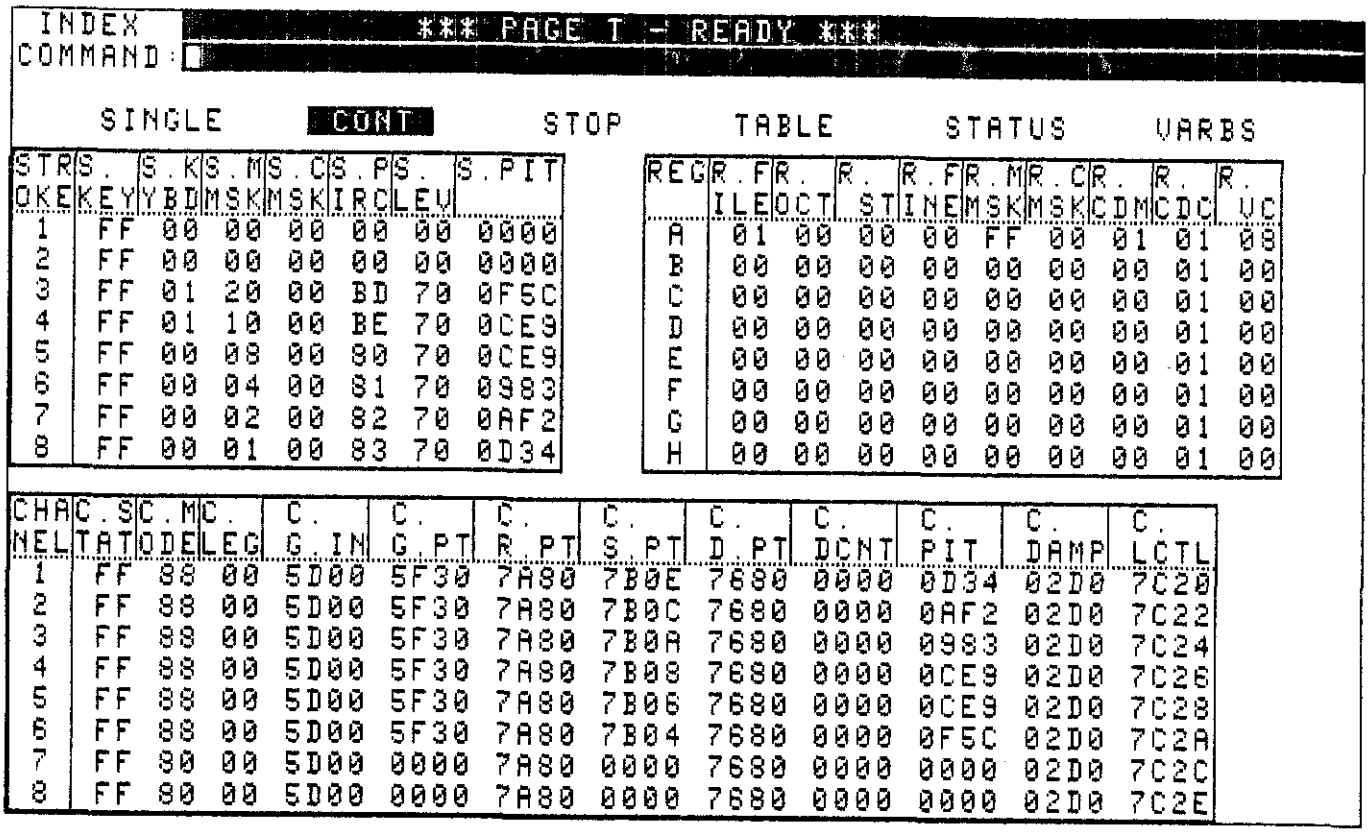
Whenever an incomplete name is specified, the system will print this message and wait whenever matches are found on a disk:

TYPE <RETURN> TO CONTINUE SEARCH

To proceed with the search press the **<return>** key.

To halt the search at this point,

press **<esc>** while holding down **<ctrl>.**



INDEX *** PAGE T - READY ***
COMMAND:

SINGLE CONT STOP TABLE STATUS VARBS

STROKE	S.KEY	S.KYBD	S.MSK	S.CMSK	S.PIRC	S.LEV	S.PIT
1	FF	00	00	00	00	00	0000
2	FF	00	00	00	00	00	0000
3	FF	01	20	00	BD	70	0F5C
4	FF	01	10	00	BE	70	0CE9
5	FF	00	08	00	80	70	0CE9
6	FF	00	04	00	81	70	0983
7	FF	00	02	00	82	70	0AF2
8	FF	00	01	00	83	70	0D34

REG	R.FILE	R.OCT	R.ST	R.FINE	R.MSK	R.CMSK	R.CDM	R.CDC	R.UC
A	01	00	00	00	FF	00	01	01	08
B	00	00	00	00	00	00	00	01	00
C	00	00	00	00	00	00	00	01	00
D	00	00	00	00	00	00	00	01	00
E	00	00	00	00	00	00	00	01	00
F	00	00	00	00	00	00	00	01	00
G	00	00	00	00	00	00	00	01	00
H	00	00	00	00	00	00	00	01	00

CHANEL	C.STAT	C.MODE	C.LEG	C.G.IN	C.G.PT	C.R.PT	C.S.PT	C.D.PT	C.DCNT	C.PIT	C.DAMP	C.LCTL
1	FF	88	00	5D00	5F30	7A80	7B0E	7680	0000	0D34	02D0	7C20
2	FF	88	00	5D00	5F30	7A80	7B0C	7680	0000	0AF2	02D0	7C22
3	FF	88	00	5D00	5F30	7A80	7B0A	7680	0000	0983	02D0	7C24
4	FF	88	00	5D00	5F30	7A80	7B08	7680	0000	0CE9	02D0	7C26
5	FF	88	00	5D00	5F30	7A80	7B06	7680	0000	0CE9	02D0	7C28
6	FF	88	00	5D00	5F30	7A80	7B04	7680	0000	0F5C	02D0	7C2A
7	FF	80	00	5D00	0000	7A80	0000	7680	0000	0000	02D0	7C2C
8	FF	80	00	5D00	0000	7A80	0000	7680	0000	0000	02D0	7C2E

This page is a continuously updated display status of the current system variables enabling long distance system diagnosis.

It is not used for music creation.

It may be used for remotely diagnosing faults when communicating with a Fairlight service centre.

Section D: HINTS

TO SAVE ALL SOUNDS AND TUNING SETUPS **EXACTLY** AS THEY ARE ...

TYPE **SAVE <filename>.IN;VCY<return>**

Save — name of setup as an **instrument** file — save all **voice** files — save all **control** files — Yes, **overwrite** any files on disk with the same names

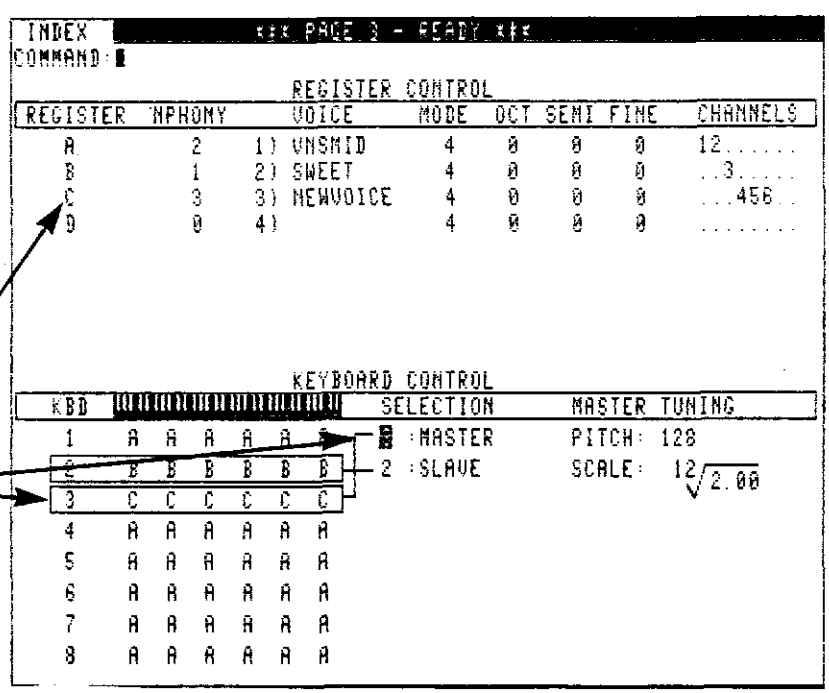
****

CAN'T HEAR A VOICE ?

Assuming everything was working prior to loading this new voice ...

* Can the voice be heard from the headphone socket ?
  Headphone VOLUME up.

*** Go to Page 3.**



Is the MASTER keyboard playing the desired voice register A-H?

In this case, **NEWVOICE** would be heard.

See Section C
DISPLAY PAGE 3)
KEYBOARD CONTROL.

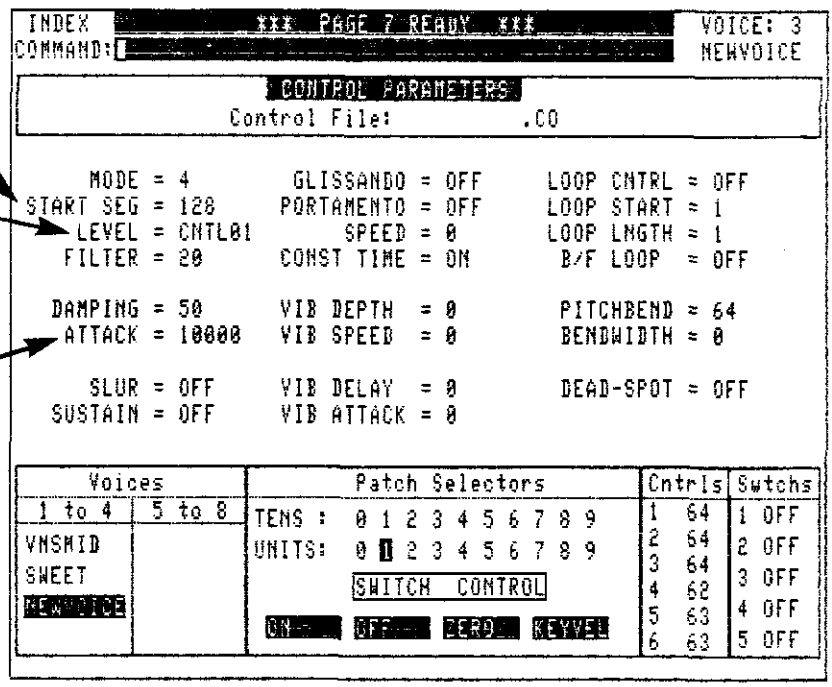
CAN'T HEAR A VOICE ? (continued)

*** Go to Page 7.**

Is START SEGMENT=1 ?
Set START SEGMENT to 1.

Has LEVEL got a CONTROL patched to it ?
Adjust relevant CONTROL on music keyboard or footpedal.

Is ATTACK very large (over 5ØØØ) ?
Set ATTACK to Ø.



See Section C
DISPLAY PAGE 7)
CONTROL PARAMETERS.

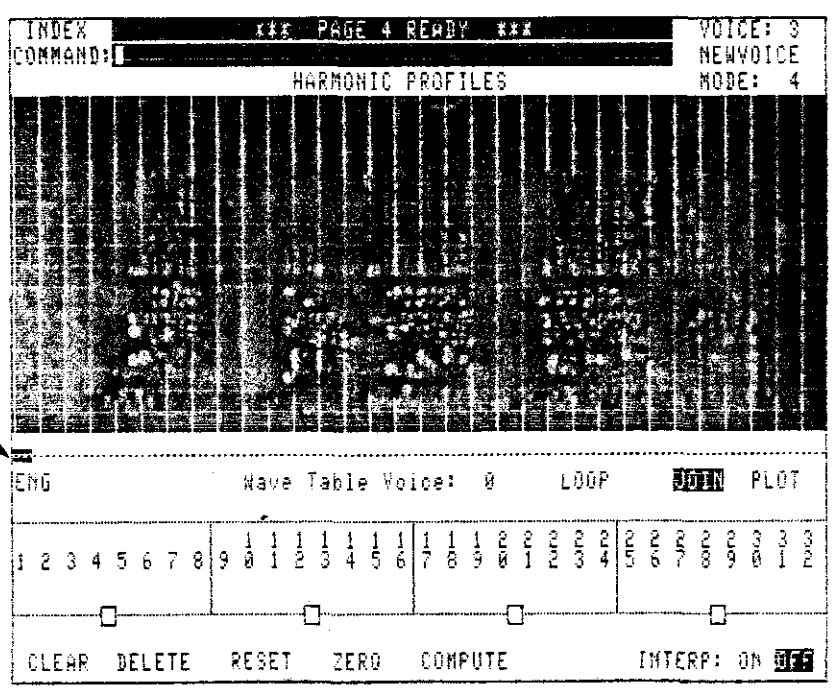
*** Go to Page 4.**

Is there a loop in the very beginning of the voice ?

Set LOOP to ZERO.

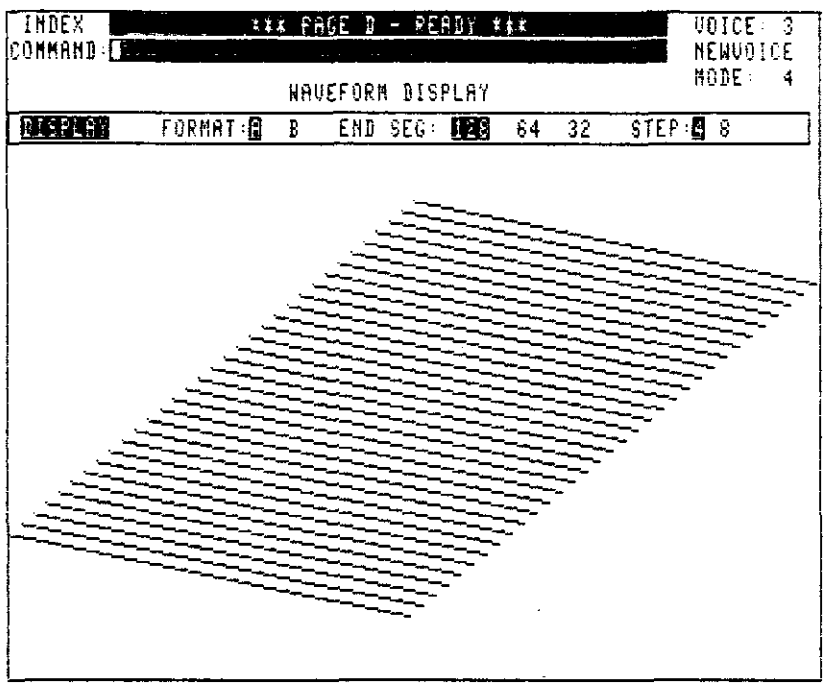
A short loop at the beginning of a voice means that any segment after the LOOP will not be played.

See Section C
DISPLAY PAGE 4)
HARMONIC PROFILES.



CAN'T HEAR A VOICE ? (continued)

*** Go to Page D.**



Is there actually any waveform present ?

Check your voice file.

Here is empty waveform.

Incorrect transferring or saving of a voice by user can result in an empty waveform memory.

****

TUNING Use a small chromatic tuner when adjusting FINE TUNE on Page 3. This will give visual verification of minute tuning changes.

****

SELECT a LOADED VOICE for viewing or modification of parameters

on Page D }
Page 6 } TYPE **V,number from**
or seeing Control file on Page 7 } **1 to 8.**

EXAMPLE V,3<return> Select Voice 3 (if it is loaded).

SELECT a KEYBOARD for playing for playing a sound if more than one voice is loaded at a time.

TYPE **Knumber between 1 and 8<return>**

EXAMPLE K6<return> Select Keyboard 6 as the Master Keyboard.

****

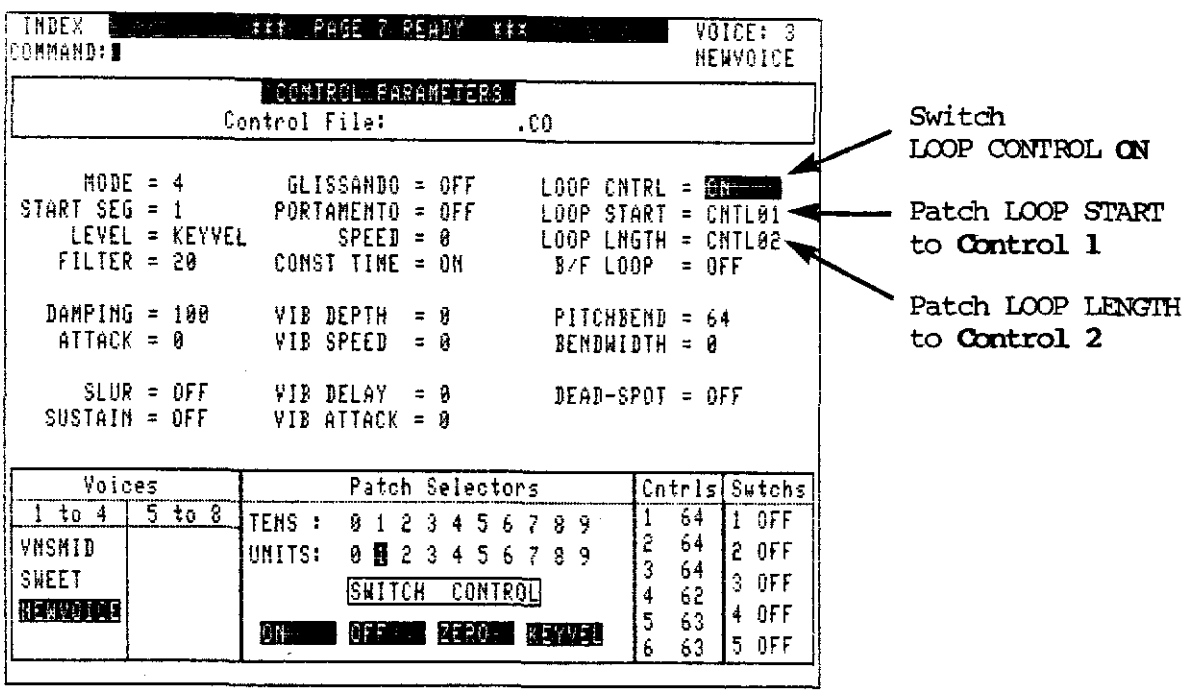
LOOPING Patch the CONTROLS on Page 7

for LOOP START
and LOOP LENGTH

as shown below to quickly and visually set the correct loop on Page 4.

CONTROL 1 and CONTROL 2 on the Music Keyboard will change LOOP START and LOOP LENGTH.

Go to Page 4 to see the LOOP settings change.



****

SEQUENCING

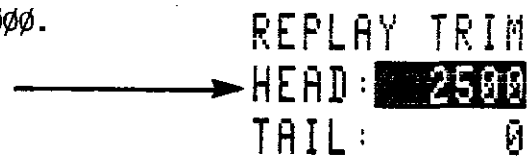
Sequencer wont play ?

Is SYNC set to INT(ernal)?
Set to INT(ernal).

Is SPEED unusually large?
(Over 3ØØØØ)

Set SPEED to between 5ØØØ-2ØØØØ.

Is the **HEAD** REPLAY TRIM
unusually large?
SET HEAD to zero.



****

MULTI-TRACKING

Sequencer wont synchronize onto multi-track tape from
a **tone** already recorded on tape ?

Is SYNC set to EXT ?
Set SYNC to EXT.

Is there enough tone coming from tape to the CMI ?
There must be around 1 volt peak-to-peak going into the
CMI SYNC socket - Pin 2. Confirm this with an oscilloscope
and amplify if necessary.

SYNC TONE must be free of effects such as reverberation.

SYNC TONE must be preceded by **silence** for around five seconds.

Is the SYNC TONE a tone or a CLICK ?
The CMI requires a **tone.** It **outputs** a CLICK.

Was the SYNC TONE recorded **by itself** on to a separate track ?
Listen to it to make sure.

Is the CMI synchronizing, but a constant amount ahead or behind?
Check which tape head (record or replay) is sending the tone to the CMI.

See Page 9 - KEYBOARD SEQUENCER - SYNC selection.

Section E: INSTALLATION AND LAYOUT

INSTALLATION AND EXTERNAL CONNECTIONS

The following details must be followed carefully for correct operation and to prevent damage to the system (refer to back page diagram).

All cables use different connectors to prevent accidental incorrect connection and so care must be taken not to force, for example, a seven-pin plug into a six-pin socket.

ALL CONNECTIONS SHOULD BE MADE WITH THE MAINS SWITCH TURNED OFF!

MAINS VOLTAGE AND FREQUENCY

It is very important that the mains selector switches on the back panel of the mainframe and the video monitor are in the appropriate positions for the available mains voltage.

FAILURE TO ENSURE CORRECT SWITCH SETTINGS MAY RESULT IN INCORRECT OPERATION OR DAMAGE TO THE UNIT

Systems are shipped with the voltage and frequency set according to the requirements of the local supply.

Should a system require changing from 11ØV to 24ØV or vice versa, your distributor must be consulted.

The appropriate mains connection should be fitted to the mains cable ensuring that the EARTH (GROUND) connection is utilized.

MONITOR CONNECTIONS

Plug the 3-pin insulated cable into the socket marked "GRAPHICS POWER" on the back of the card cage and video monitor.

Plug the round 5-pin cable connector into the socket marked "GRAPHICS" on the back of the card cage and video monitor.

MUSIC KEYBOARD

Plug the round 7-pin cable connector into the socket marked "KEYBOARD POWER" on the back of the CMI and master music keyboard.

Plug the flat 9-pin cable connector from the alpha-numeric keyboard into the socket mrked "ALPHA KEYBOARD" on the back of the master music keyboard.

If the music keyboard is not required, the alpha-numeric keyboard may be plugged directly into the socket marked "KEYBOARD" on the back of the CMI.

Connect the optional slave music keyboard to the master music keyboard.

PEDAL INPUTS

The sockets marked "PEDAL 1", "PEDAL 2" and "PEDAL 3" are for optional special effects foot pedals.

These are available from your friendly Fairlight distributor.

Either ON-OFF or continuously variable type pedals can be accommodated.

Connector type: Cannon 5-pin.

Pin 1	Ground
Pin 2	On-Off: <1V=Off, >4V=On.
Pin 3	-2ØV Supply Out.
Pin 4	+2ØV Supply Out.
Pin 5	Analog Input: -5V TO +5V.

PRINTER

For use with optional printer. For use with Music Composition Language, optional word processing, graphics.

Serial data from mainframe to printer, "busy" flag from printer to mainframe, plus "device on" signal used to switch on printer in readiness to receive data.

Connector type: Cannon 5 pin.

Pin 1 Signal Ground.

Pin 2 Not Connected.

Pin 3 FLAGØ. "Busy" flag from printer. RS-232C levels.
<-7 volts when printer ready,
>+7 volts when printer busy.

Pin 4 DONØ. "Device On" control from mainframe to printer. RS-232C level,
>+7 volts to enable printer,
<-7 volts to disable printer.
This signal is optional as some printers do not require it.

Pin 5 DATAØ. Serial data to printer. RS-232C levels, ASCII format. Normally at -1Ø volts. For each character sent from the mainframe to the printer a burst of +1Ø volt pulses lasting approximately 1 mS can be seen using an oscilloscope.

A U D I O C O N N E C T I O N S

The various audio connections are made to the FAIRLIGHT as follows ...

PHONES

Output for driving headphones. Monitors the MIXED LINE output.
Volume is controlled by the "MON VOL" control at the back of the CMI.
Internally, this output is taken from the MONITOR (speaker) output via a 1ØØ ohm resistor.

Connector type: 1/4" (6.25 MM) stereo phono jack.

MONITOR

Output for driving a monitor speaker.

The internal monitor amplifier will deliver a maximum of 2Ø watts R.M.S. into an 8 ohm speaker.

Note that the CMI is fitted with a 1 amp speaker fuse which will blow if the monitor amplifier is driven to full output under load for more than a second.

Connector Type: Cannon 3 pin.

Pin 1	Ground
Pin 2	Ground
Pin 3	Active. With all 8 channels producing a full-amplitude sinewave and the MONITOR control turned up to the point of clipping, this output should be approximately 38 volts P-P (with no load).

CHANNEL OUTPUTS 1-8

Individual channel outputs (balanced, 6ØØ ohms impedance).

Connector type: Cannon 3 pin.

Pin 1	Ground
Pin 2	Output Cold. Anti-phase output, maximum level 3.7 volts P-P.
Pin 3	Output Hot. Maximum level 3.7 volts P-P.

MIXED LINE OUTPUT

Mixed output of all eight channels (balanced, 6ØØ ohms impedance).

Connector Type: Cannon 3-Pin

Pin 1	Ground
Pin 2	Output Cold. Anti-phase output, maximum level 3.7 volts P-P.
Pin 3	Output Hot. Maximum level 3.7 volts P-P.

SYNC

Synchronizing input and output, for use with

Music Composition Language (Page C) or
Real Time Composer (Page R) or
Keyboard Sequencer (Page 9).

This connector serves as both an **input** and **ouput** so the connecting cable will have to be split.

Connector type: Cannon 3-pin.

Pin 1	Ground
Pin 2	Sync INPUT. Pulses or tone of 1 to 2Ø volts P-P. Waveform unimportant. Frequency range 2 Hz to 5 kHz. Impedance 1Ø K ohms.
Pin 3	CLICK TRACK OUTPUT. Periodic pulse, rate controlled by Music Composition Language (Page C) or Real Time Composer (Page R) or Keyboard Sequencer (Page 9). Waveform is a spike of approximately 5 volts peak, approximately 5 ms wide, alternately positive and negative going.

FILTER OUTPUT

Output of the bandpass filter used by the Analog-to-Digital converter.

It is designed to enable the operator to monitor the effect of various bandpass filter settings.

Connector type: Cannon 3-pin.

Pin 1	Ground
Pin 2	Ground
Pin 3	Output. Amplitude for full-scale conversion is 1Ø volts P-P. Source impedance 6ØØ ohms.

MIC IN

Balanced, 6ØØ ohms input suitable for high output dynamic or condenser microphones.

When the MIC/LINE switch is in the MIC position, this input is fed to the Analog-to-Digital converter.

Connector Type: Cannon 3-pin

Pin 1	Ground
Pin 2	Input A
Pin 3	Input B

LINE IN

Balanced, 6ØØ ohm line level input.

This input is connected to the Analog-to-Digital converter when the MIC/LINE switch is in the LINE position.

Connector Type: Cannon 3-pin

Pin 1	Ground
Pin 2	Input A. Amplitude of 1.4 volts P-P required for full scale conversion.
Pin 3	Input B. Amplitude of 1.4 volts P-P required for full scale conversion.

ADC DIRECT

Direct input to the Analog-to-Digital converter when the ADC DIRECT/MIC LINE switch is in the ADC DIRECT position.

Because this input is **Direct Coupled**, any D.C. offset on this input will result in a D.C. shift of a sound sample.

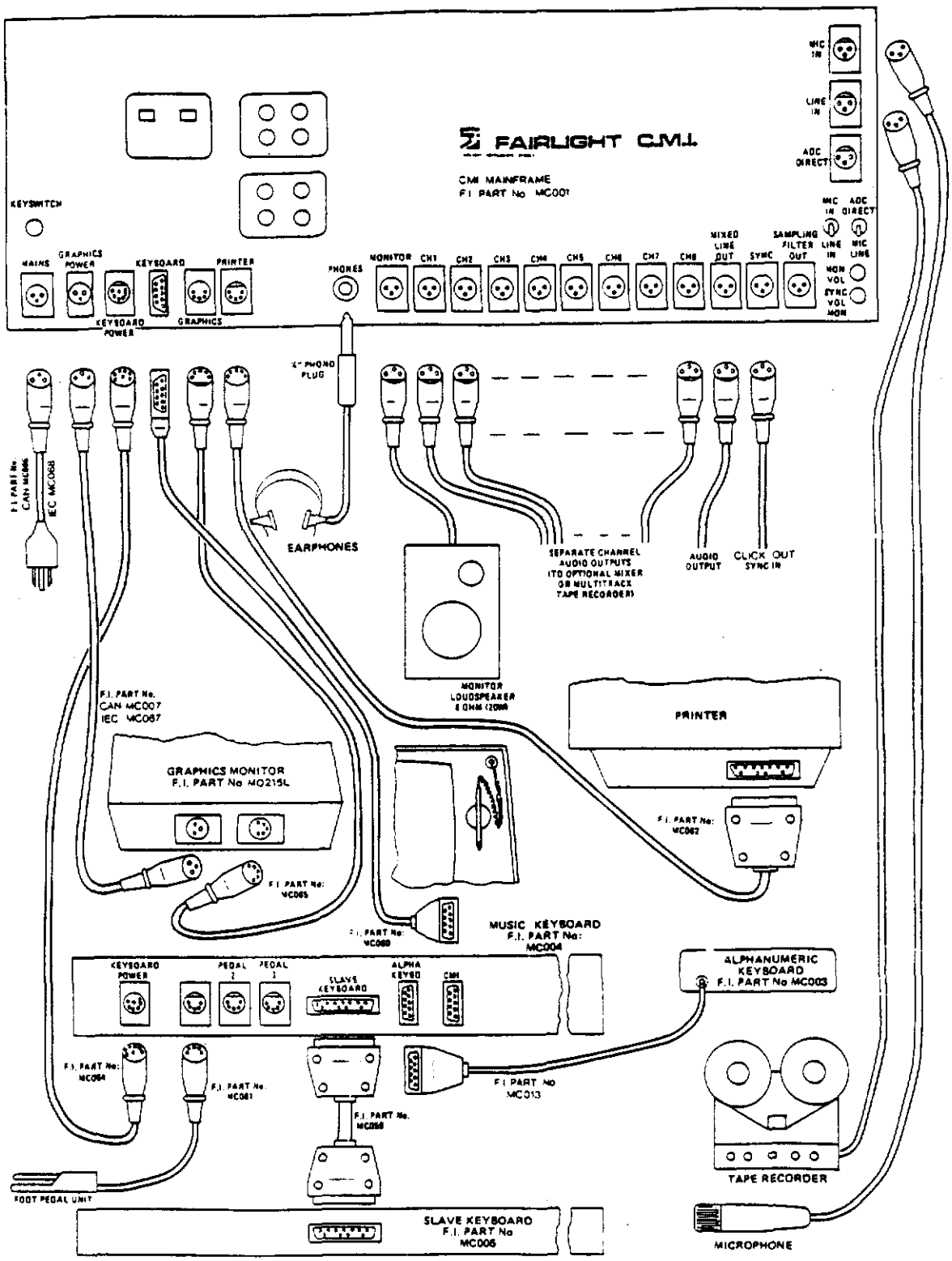
Connector Type: Cannon 3-pin.

Pin 1	Ground
Pin 2	Ground
Pin 3	Input. Amplitude for full scale conversion is 1Ø volts P-P.

DIMENSIONS and WEIGHT

	Weight	Height	Depth	Width
C.M.I. Mainframe	4Ø kg	33cm	44cm	75cm
Music Keyboard	2Ø kg	1Ø cm	44cm	123cm
Graphics Monitor	15kg	35cm	37cm	49cm
Alpha-numeric Keyboard	3kg	8cm	17cm	42cm

plus all Connecting Cables, Disks, Manuals.



C.M.I. SYSTEM CABLE CONNECTION DIAGRAM

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All about Fairlight

PDF format by *Jean-Bernard Emond* & *David Cilia*
Jean-Bernard.Emond@paris4.sorbonne.fr
http://www.fairlight.free.fr

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