

# The FAIRLIGHT CMI

COMPUTER MUSICAL INSTRUMENT





# A 'MUSICIAN'S' INSTRUMENT FOR LIVE PERFORMANCE, STUDIO AND EDUCATION

- ☆ Plays virtually any sound-by digital synthesis or processing samples of natural sounds.
- ☆ Up to eight-note polyphonic or eight different sounds simultaneously.
- ☆ Sophisticated sequencing facilities and composing language.
- ☆ Floppy-disc storage of all sounds and sequences.
- ☆ Interactive graphics display with light-pen.

**The Fairlight C.M.I. is a new type of musical instrument. It has been designed to provide musicians with a powerful tool for composing and performing music.**

Unlike conventional synthesizers which use oscillators and filters to generate sounds, the Fairlight's built-in computer is programmed to create even the most complex waveforms. This means that the Fairlight is not restricted to a limited range of sounds. It has no characteristic sound of its own.

Using the Fairlight's unique sound sampling capability it is now possible to capture any sound at all and play it as a musical instrument. A sample of just one note is all that's required to produce a whole polyphonic ensemble of any sound — even sounds not previously considered as "musical" can be pitched right across the keyboard and become the basis of an unlimited number of exciting new instruments.

Sounds can also be synthesised using additive harmonic synthesis (Fourier Synthesis), arbitrary waveform synthesis and other techniques using the Fairlight's Video display and Light-Pen which allow sounds to be defined by simply drawing on the screen. Using a combination of techniques, samples of "real" sounds can be used as the basis of synthesised sound which the musician can manipulate in many ways.

The Fairlight may be played live, using its six octave, velocity sensitive keyboard or may be programmed to play itself using its keyboard sequencer or Music Composition Language — The Composer.

## DIGITAL SOUND

Sounds are generated digitally in the Fairlight, as distinct from analogue techniques used in conventional synthesizers. The use of digital techniques is ideal for synthesis and manipulation of sound because it can create any possible audio waveform. The Fairlight allows the information used to create the sound, as well as control and performance information, to be stored on floppy disc for recall at a later

time. The use of digital techniques also ensures accurate repeatability.

Historically, digital synthesis has not been simple, because large amounts of data must be entered and manipulated to create even the simplest sound. Complex digital sound synthesis has previously been possible only by using expensive computers, making it exclusive to Universities and wealthy electronic music studios. Even in these environments, sounds and compositions are usually created by manually entering vast quantities of data via computer terminals or occasionally by other ingenious techniques. In addition to this, the musician is often expected to have an advanced technical appreciation of computers and programming techniques before he even starts.

## HISTORY OF THE FAIRLIGHT

The Fairlight is the outcome of two earlier designs of Digital Synthesizers called the QASAR I and the QASAR M8 (Multimode 8). Experimental work on these started in the late 1960's by a small Company called Creative Strategies. Fairlight Instruments was formed in 1975 and took over most of the final development work of the M8 System which was completed by early 1978.

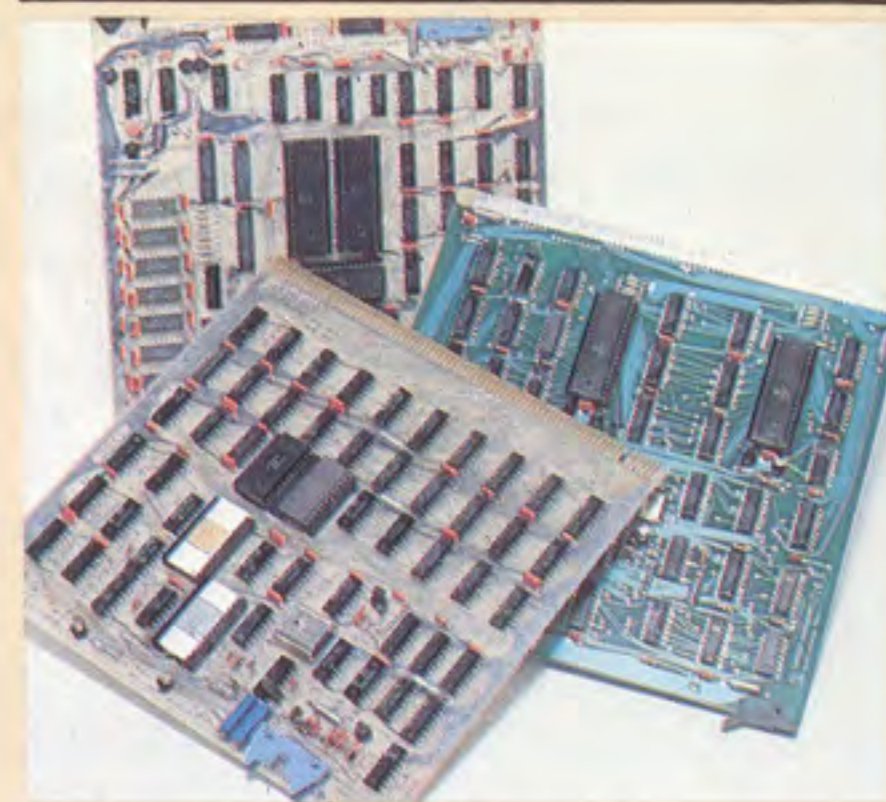
Experience gained was then incorporated in a major redesign and simplification of the sound generating part of the M8 also leading to the ability to sample long duration natural sounds. In this process, the latest available MOS Silicon Chips were used, cutting the size and price of the system in half while providing considerably improved capabilities and expansion potential.

It soon became clear that the natural sound facility was certainly one of the most important capabilities and so the phrase "Computer Musical Instrument" was chosen as being more appropriate than "Digital Synthesizer".

## THE FAIRLIGHT COMPUTER MUSICAL INSTRUMENT

The Fairlight is unique because it was originally designed as a musical instrument using computer techniques rather than trying to adapt a computer to be a musical instrument.

As well as a powerful dual central processing unit, the Fairlight has specialized hardware for directly generating sounds. Each of these "Voice Modules" contains large amounts of sound waveform memory which can be controlled to provide pitch and level variations of the waveforms generated. The Timbre of the sound is determined by the harmonic content of the waveforms.



Up to 20 circuits modules can be accommodated in the Fairlight. Shown here are the "Graphics controller" (front), "Voice module" (rear left) and the "Dual Processor Module". Key modules plug into the Fairlight from the front.

Eight Voice Modules are normally installed in the Fairlight, allowing eight note polyphony or the simultaneous playing of up to eight totally different sounds.

A main emphasis in the design of the Fairlight has been on simplicity of control and although it contains nearly 1,000 silicon chips, it is easier and faster to operate than many analogue synthesizers. The use of advanced graphic display and light-pen techniques gives complete control of the instrument's parameters, allowing the musician to "design" an instrument without any previous knowledge of computers or programming.

All information is displayed in a logically organized series of graphics display "pages". Using the light-pen, the musician simply points at the parameter he wants to change and enters the new data — either by using a typewriter style alpha-numeric keyboard or drawing curves directly onto the screen.



DISK FILE MAINTENANCE: Displays the names of "files" which are available for loading from the user's disc. Files may describe Voices (the sounds themselves), Sequences, and Instruments (combinations of sounds with control details). Other special files such as composition sequences can be accessed via this page, operating the light-pen enables loading of sounds from the disc in several seconds.



The Fairlight has no knobs, switches or patch cords to deal with except those used for performance. The equivalent of these are displayed in a meaningful way on the graphics monitor for manipulation by the user when creating a sound or instrument. It takes only a few seconds to save, onto floppy-disc, many parameters which can be recalled later and modified if desired.

Apart from the velocity sensitive music keyboard, the Fairlight's performance controls include three faders, two push button switches, up to three variable output foot-pedals and three switched pedals. When a sound is loaded, these controls are automatically configured to control aspects such as Vibrato, Timbre mixing, Attack Decay, Sustain and Portamento.

### DYNAMIC HARMONIC CONTROL

When the Fairlight is to synthesize original sounds, the light-pen is used to draw harmonic envelopes or the actual sound waveform itself on the high resolution Video Graphics Monitor. In this way sounds of great complexity can be graphically created. From these drawings, a series of 32 (Mode 1) to 128 (Mode 4) waveforms are loaded into the Voice Modules' Waveform Memory.

When the sound is required to play, each waveform is sequentially cycled at correct pitch while any other effects, such as amplitude or pitch variations may be made. Timbre changes occur in much the same way as still photographs are viewed sequentially to form a motion picture. Even more complex sounds are possible by using two or more Voice Modules in parallel, allowing dynamic mixing between totally different sounds.



### HARMONIC ENVELOPES:

A separate amplitude envelope can be drawn for each harmonic when synthesizing a sound. Up to 8 of these may be shown at a time, their numbers being displayed below the graph. In this case, harmonic number 1 (the fundamental) has been selected and its envelope is displayed as a double line. A selected envelope can be directly modified with the light-pen. The dashed line below the curve indicates the sustain (or loop) portion of the sound.

A series of commands below the harmonic numbers are activated by the light-pen. The desired harmonic number (up to 32) is selected by the light-pen using the two rows of numbers at bottom left.

The horizontal axis of this display represents time elapsed from striking a key, the vertical axis is relative amplitude.

### NATURAL SOUNDS

Certainly one of the most powerful features of the Fairlight is its ability to sample a sound from a microphone or tape recorder, digitize it, then load it into

the Waveform Memory of a Voice Module. In this way, and due to the way in which the waveform memory is controllable, any sound whatever can be played and manipulated, pitched to the keyboard. An audio line input is supplied for this purpose.

The Fairlight can be set to start sampling a sound when its level has reached a certain threshold. The sample rate selected determines the duration of the sound that can be accommodated in the memory and the pitch at which it will be replayed.

The sound being sampled may be from one half to several seconds long, depending on its high frequency content. For example, a Bass drum could be sampled for about four seconds, whereas a high harmonic spectrum sound would be sampled for about one second.

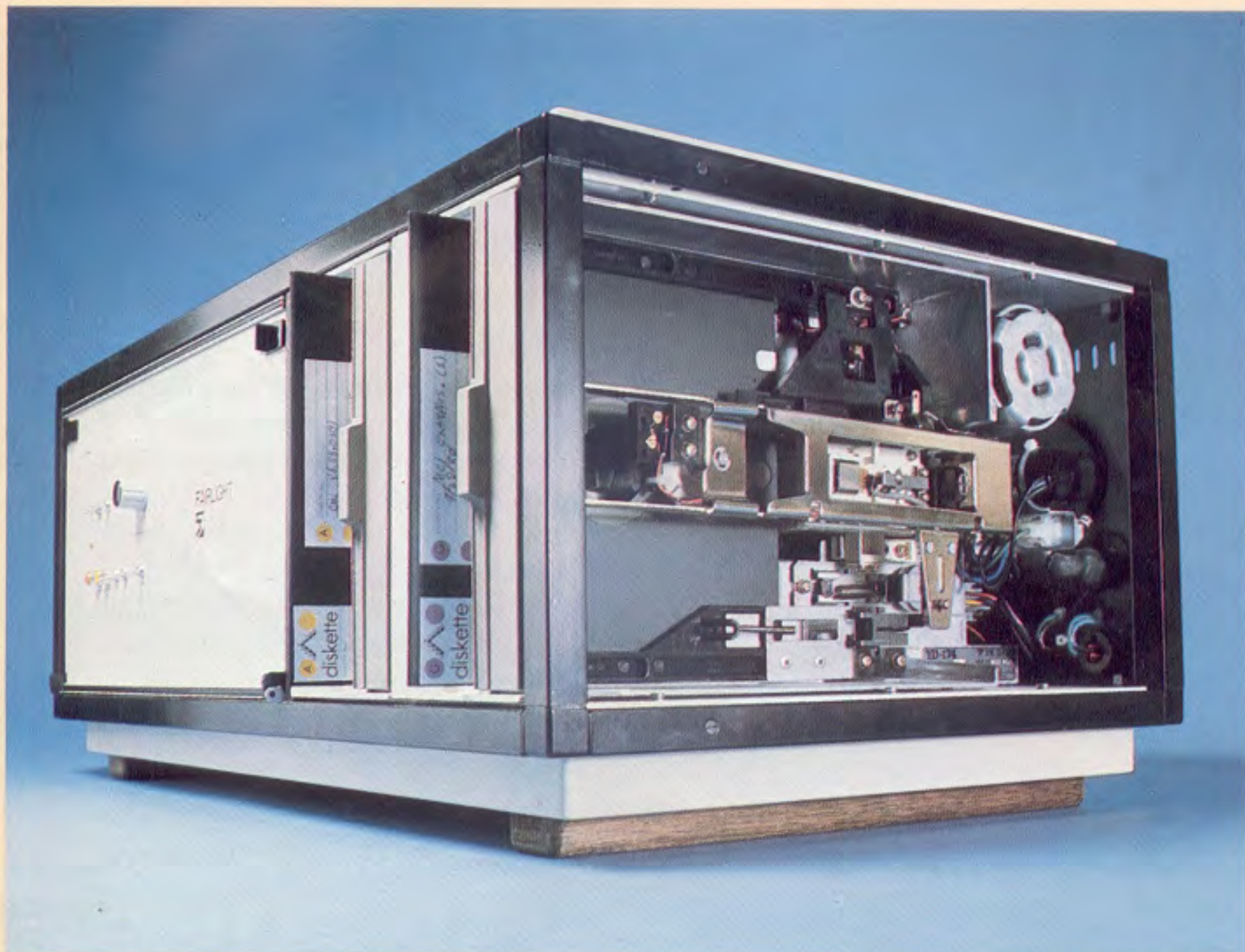
A process of waveform "Looping" enables portions of any sampled sounds to be sustained indefinitely, from a single segment (of 128) to all segments. Here, the graphic display and light-pen enables the sustained segments to be selected.



### SOUND SAMPLING:

Sampling of external sounds can be achieved via Fairlight's audio input. A high and low pass filter can be set to limit the bandwidth of the sampled sound.

The sample's amplitude envelope is displayed to show optimum level adjustment and to allow full use of the available sample period.



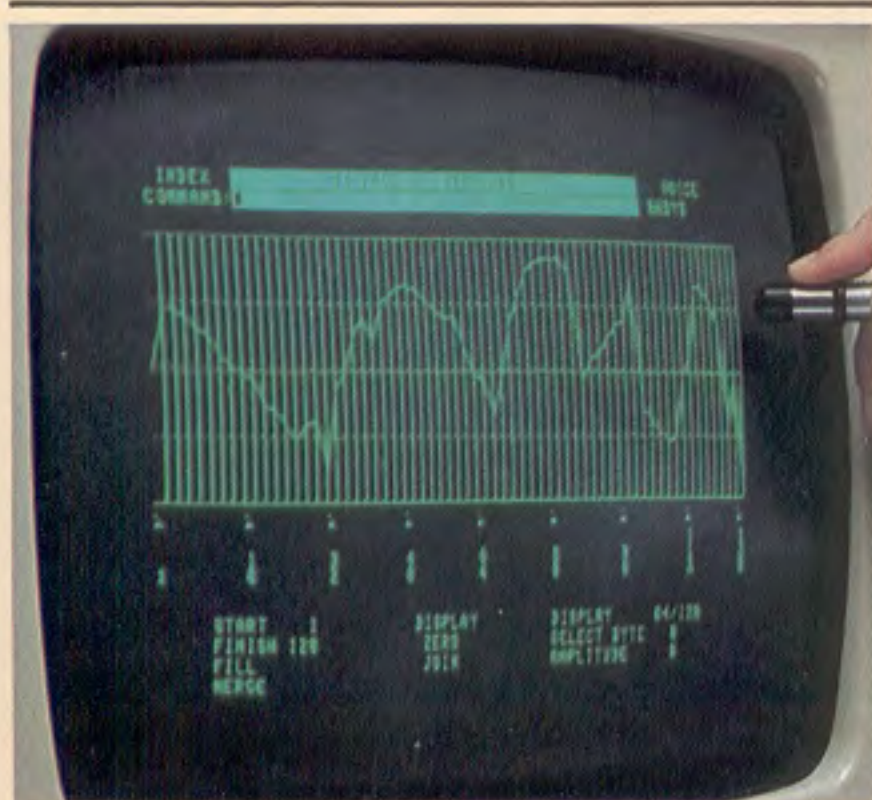
- Highest quality floppy disc drives ensure reliable long term service.



## DRAW YOUR OWN WAVEFORMS

The Fairlight has a unique feature which allows the musician to actually draw waveforms on the Graphics Monitor. You draw the waveform, the Fairlight makes the sound.

A further facility is the ability for a whole sequence of waveforms (up to 128) to be computed as varying blends between any two drawn or existing waveforms. It is also possible to display and modify natural sound waveforms or synthesized waveforms directly using this technique, since any information in the waveform memory can be displayed and altered.



### DRAW A WAVEFORM:

The light-pen can be used directly to draw waveforms or alter those already in the memory. When the light-pen is required to draw, a graticule appears to allow accurate location of points of the cycle.

Commands at the bottom of the screen allow selected waveforms to be "merged" with others, and for point to point joining across the display. Up to 128 of these waveforms may be held in a single voice channel.

## KEYBOARD:

The Fairlight can play any combination of synthesized or natural sounds simultaneously, and each may be allocated to certain areas of the keyboard(s).

The unit is supplied with a six-octave Master Keyboard containing its own central processor unit which is used to pre-process data from the keyboard and external control inputs such as foot pedals and faders. The keyboard processor also calculates the velocity of any key depression, and this information may control an effect on the Control page of the Graphics display.



**CONTROL PAGE:** Here, control parameters are allocated to performance controls such as faders, foot pedals and key velocity outputs. Above, for example, key velocity is effecting attack speed, while Pedal 1 (CNTRL 4) Volume, Pedal 2 (CNTRL 5) Vibrato depth and Fader 1 Vibrato Speed. Most controls can be allocated to any or several effects if required, even if several Voices are loaded at once. If parameters are to be fixed, a value is set in place of a control device.

A second, velocity sensitive, six-octave keyboard is available and may be located above the master keyboard.

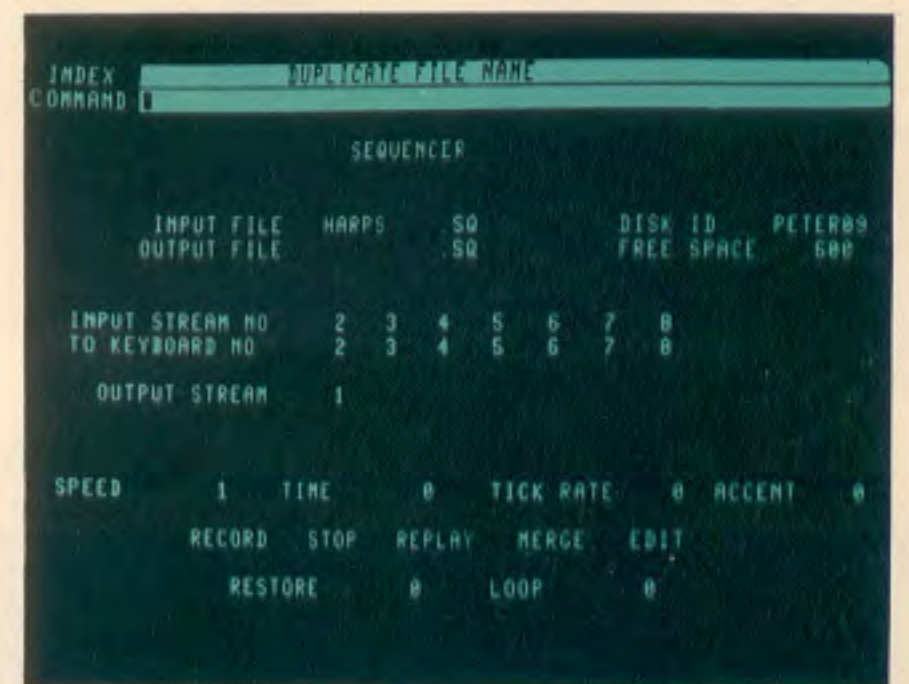
As the Fairlight has up to eight voice modules, chords of up to eight notes of the same voice can be played. This means that the musician can, for example, use two keyboards, each with a different voice and each with four-note capability. Each keyboard octave may have a different Voice loaded if desired.

## KEYBOARD SEQUENCER

The Fairlight's keyboard sequencer allows real-time recording of music played in from the Keyboard, including Key Velocity information. Playing is stored continuously on floppy disc. The sequences can be replayed or merged with other sequences to produce complex multi-voice works.

The musician can record one sequence on disc while the Fairlight is replaying up to seven other different sequences simultaneously from the same disc.

Depending on the music, one floppy disc might store about 30 minutes of playing. The speed of replay of sequences can be varied over a wide range without any change in pitch. A "click track" is also provided to aid synchronisation with other instruments, tape recorders and motion pictures. An external Sync input can be used to "conduct" playback speed if desired.



### SEQUENCER:

By specifying an output file the musician can store about 30 minutes of keyboard playing on disc, even polyphonically. The sequence is replayed by requesting a particular input file and selecting the desired speed.

The sequencer can replay and record simultaneously, so that complex multi-voice works can be built on the disc. The voices used can be changed independently without affecting the sequence file itself.



**KEYBOARD:** The master keyboard has its own processor for pre-processing key-strokes and control information from the musician. External controls such as pedals can be plugged into the keyboard unit. A separate 16 button control panel and alpha-numeric display can be used

in live performance situations instead of the graphics terminal. Pushing three of these buttons will enter large strings of pre-programmed commands to the Fairlight allowing a minimum of distraction.





**WAVEFORM FROM HARMONICS:** A single cycle of waveform is displayed as its constituent harmonics are specified by setting a series of "slide pots" with the light-pen.

## THE COMPOSER — MUSIC COMPOSITION LANGUAGE

The Composer allows music notation to be entered via the alpha-numeric keyboard. It is both a flexible scoring language and powerful composition tool.

Conceptually, the Composer works in a tree structured way, whereby each PIECE of music may consist of several PARTS (up to eight), where each PART can access one or more SEQUENCES (max 30).

When used for entering pre-composed scores, extensive use is made of default specifications, so that commonly used values need not be used for every note. Nested repeats further minimise the amount of typing necessary to enter the score. Key velocity and Tempo changes may also be incorporated into the score, while further expression can be manually

performed as a piece is being played back.

In composition mode, the Composer can generate complex scores from general rules defined by the musician, allowing extremely intricate patterns of pitch and rhythm to be easily created.

Once a score has been entered, changes can be made easily using the Composer's "Screen Based Editor". This allows complete sequences or parts to be rolled up and down the screen, and updated where necessary.

The Composer can be used to perform either as a soloist or backing in live performance situations and external controls such as switch foot pedals can be used to start, stop and synchronize the replay.

The Fairlight's eight separate audio outputs can be utilized to provide quite startling spacial effects in a suitably equipped listening environment, particularly when under control of the Composer.

In specialized applications, the composer can even provide a series of analogue outputs for external Synthesis and Audio or Lighting Control. This requires the use of the D/A Interface card (available 1st quarter, 1981).

### THE COMPOSER:

This shows a typical sequence description used by the Composer. Notice that lines preceded by an \* are comments to the user and are ignored by the Fairlight.

An ! sets a new default (normalizing) condition which might refer to a new tempo setting, octave select or key velocity.



Notes may be entered in from the Music Keyboard directly and timing information can be added later using the Editor Controls on the Alpha-numeric keyboard. Line numbering (left hand column) is provided automatically.

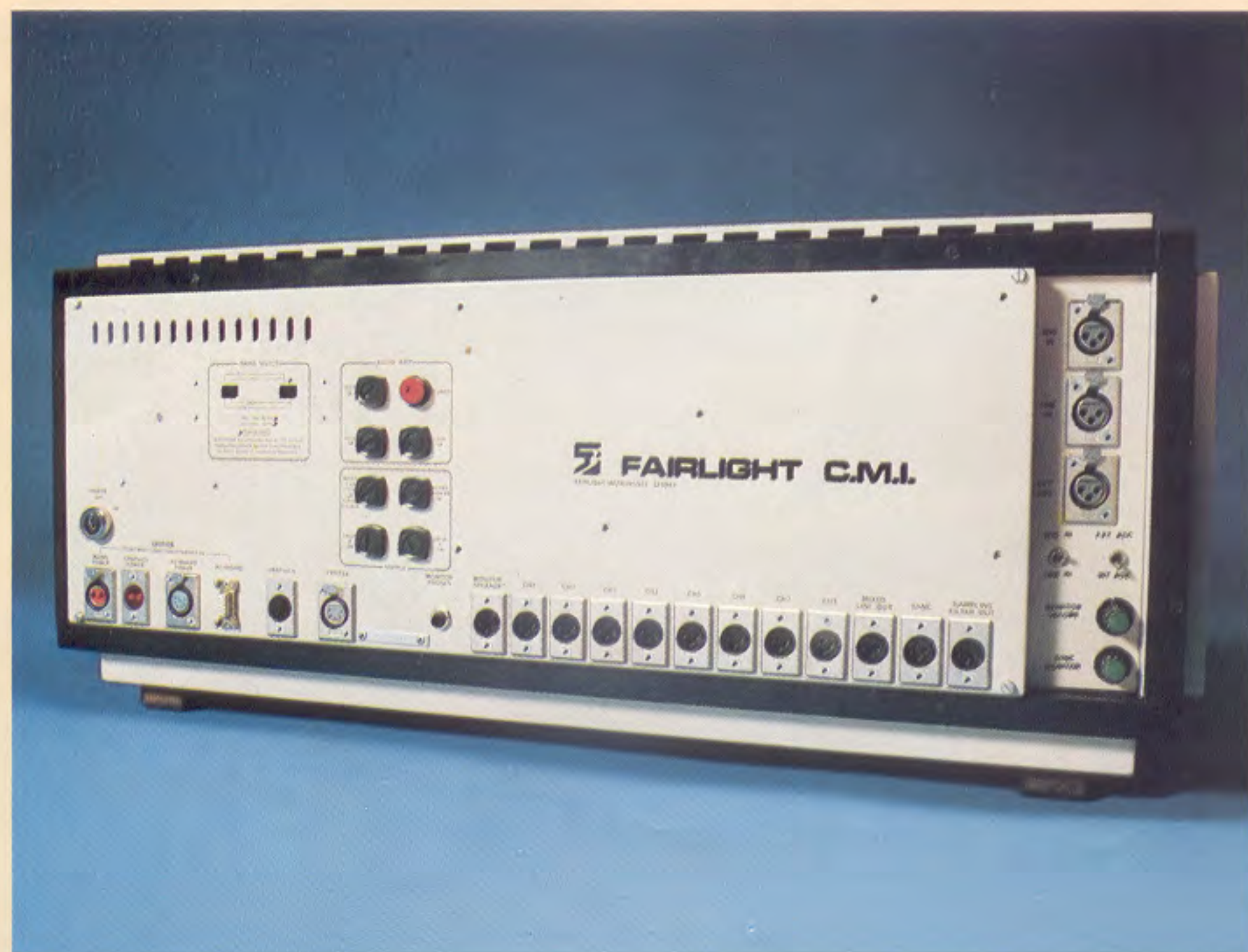
### TUNING

The Fairlight has a master crystal "clock" providing all timing information which will not drift out of tune.

The pitch of any note played on the keyboard is normally calculated according to a formula defining a conventional 12-note equally tempered scale, however, virtually any scale can be specified. To completely change the keyboard tuning to a new scale takes only a few seconds.



**KEYBOARD CONTROL:** Provides allocation of Voices to various Registers in the keyboard or sequencer. In this example ANDY8 is able to play 4 note polyphonically in register A which is on all keyboards except for keyboard 1, where the top 3 octaves are playing "TRUMPET2" (Register C) and the bottom 3 octaves are playing "TRUMPET1" (Register B). Selection of keyboard registers is done with the light-pen. The top right hand page allows pitch adjustment and scale changing.



- **EXTERNAL CONNECTIONS:** High quality connectors are used throughout the system and standard 3 pin Cannon connectors are used for Audio. The Fairlight contains its own 20 watt audio amplifier which can be directly connected to a portable monitor speaker. The mains switch is operated by a removable key.



## LIBRARY FACILITY

The Fairlight contains two floppy diskettes. The left hand drive contains the "System Disc", containing all the programmes defining the Fairlight's operation and capabilities. It also contains a "Library" of all sounds, sequences or Instrument files which are contained on the user's disc which is located in the right hand drive.

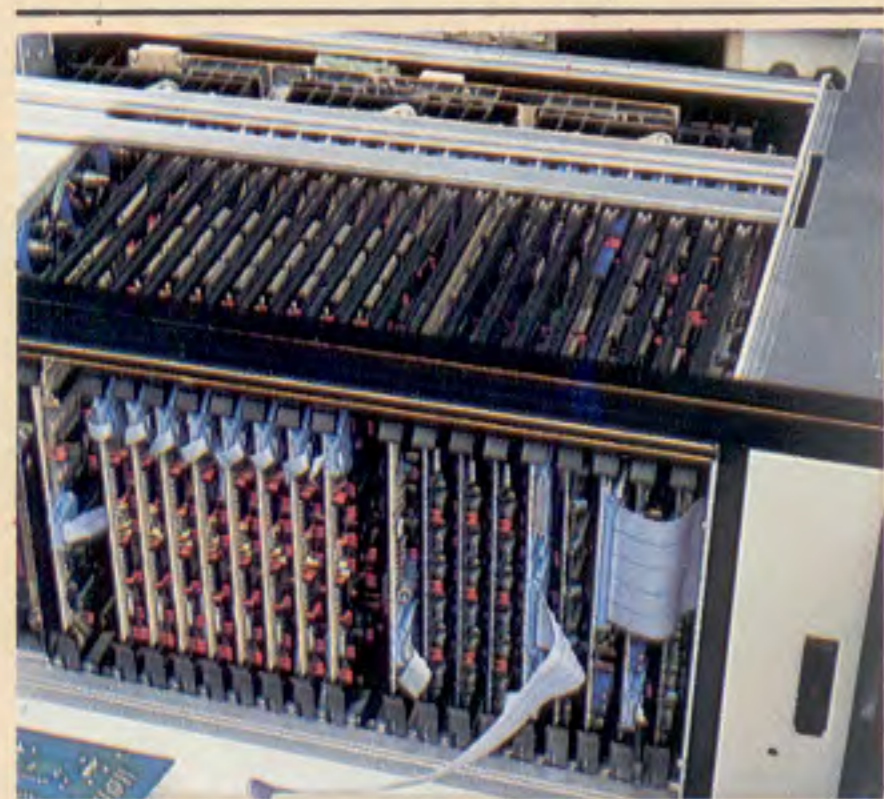
Each of the user's discs will hold approximately twenty "Voices" or a combination of Voices, Instrument Configurations, Sequences and Compositions. The library facility keeps track of up to eighty user's discs and will advise which contains the required sound or sequence. Quite a necessity when the disc library contains many hundreds of entirely different sounds and composition configurations.

The library can be updated simply by typing "R" (read) while on the library page. This will note any changes which have been made on the user disc presently installed.

## TECHNICALITIES

The heart of the Fairlight is a powerful central processor unit (C.P.U.) containing two microprocessors. Two processors were chosen which could be configured to operate at full speed but "out of phase" with each other and so communicate through common areas of memory without the need for the time consuming practice of "Interrupting". This allows effective throughput comparable to mini computers while allowing dramatic cost savings because of the inherent low cost of "Micro" technology.

The Fairlight comes with 80 kilobytes of Random Access Memory (R.A.M.) in the processor section and 16 kilobytes in each of the eight voice modules making a total of 208 kilobytes. Four extra module slots are available for expansion and special interfaces. The two disc drives provide One Megabyte of on-line disc storage.



*Modular construction allows field replacement of virtually all modules. Extensive use of MOS and Low Power Schottky technology keeps heat dissipation to less than 500 watts.*

## CONFIGURATIONS

As a playing device only, the Fairlight can be used without the alpha-keyboard Graphics Monitor, Light-pen and their associated modules. In this case, control instructions may be given via the small keypad with alpha-numeric readout on the master keyboard. A few key presses may be programmed to provide a series of complex commands for sound loading and system configuration. This is particularly useful in live performance situations.

## PROVEN RELIABILITY

Although the Dual-Processor system (known as the QASAR) was developed for the Fairlight, it is a proven design which has been in use since 1977 for business systems, industrial control and telecommunications monitoring. Each plug-in module is temperature tested from 0°C to 70°C while diagnostic tests are being made. This causes latently weak components to fail before the system leaves the factory, dramatically improving field reliability.

## OTHER CAPABILITIES

While the Fairlight is a complete Musical Instrument, it is nonetheless entirely computer based, and so can be expanded in capabilities, as new programs are developed. A Fairlight owner receives any program updates at no charge (other than the cost of diskettes) for the first year, and thereafter at only a nominal charge.

The Fairlight may also be used for some General Purpose Computing applications such as Word Processing and a Printer Output on the rear provides an Industry Standard Interface allowing a range of graphics or character printers to be simply connected.

The Fairlight's structured design philosophy means that future enhancements are not limited to Software developments. Although the the Fairlight already incorporates the latest innovations from a variety of technologies, a major consideration has been to allow low cost future Hardware expandability or enhancement if new materials and techniques are developed.

All of these considerations help protect the investment of the Purchaser against obsolescence sometimes characteristic of electronic musical instruments and computer systems.

The Fairlight C.M.I. is manufactured by Fairlight Instruments Pty. Limited, 15 Boundary Street, Rushcutters Bay, Sydney, Australia 2011. Telephone (02) 33 5222 — Telex AA27998.

For further details regarding system specifications, operating instructions and options, please do not hesitate to contact your local representative.

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### NOTICE:

The System incorporates the QASAR (T.M.) — Dual Processor System. Copyright is held by Fairlight Instruments and Creative Strategies Pty. Limited from whom licence is granted for the manufacture of some components.

The C.M.I.'s specifications are subject to continuous change and Fairlight reserve the right to alter specifications without notice.