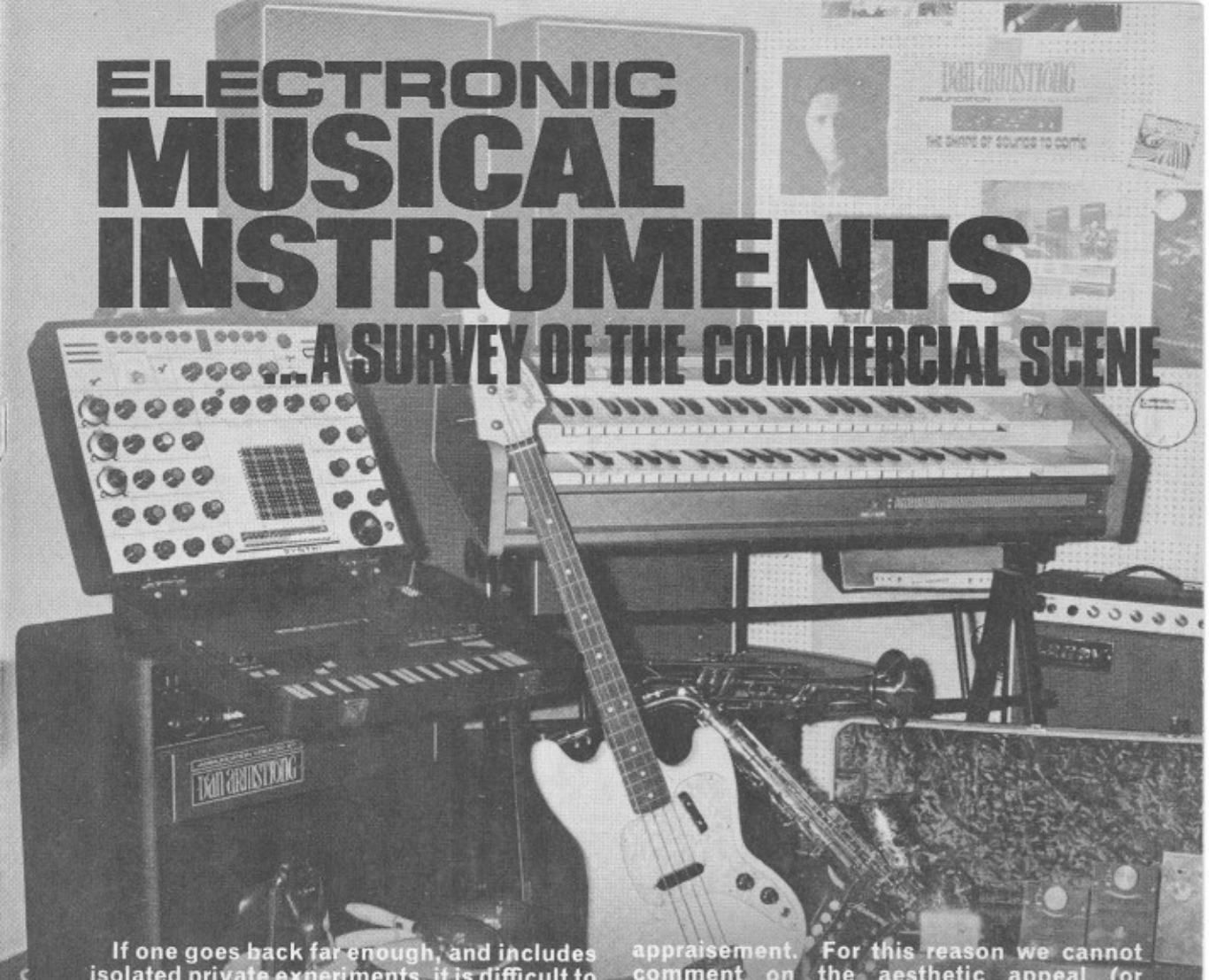
# ELECTRONIC MUSICAL INSTRUMENTS

## ...A SURVEY OF THE COMMERCIAL SCENE



If one goes back far enough, and includes isolated private experiments, it is difficult to know just when electrical music started. It is certainly more than 100 years ago. But practical instruments have only been in existence for some 40 years, so it is a comparatively new art, now rapidly expanding with the semiconductor and its offshoots.

Electronics is linked to music in two ways; either the sound is produced by a conventional instrument which uses electrical means to process it in some way (e.g. amplification or change in tonal quality), but where the sound could still be heard if there were no electronics; or, the "sound" is generated by electronic circuits, originating as electrical oscillations or waveforms and therefore inaudible without further electronic processing.

Electronics is a science; music is an art. They do not speak the same language for one is based on provable parameters, whilst the other relies entirely on personal appraisement. For this reason we cannot comment on the aesthetic appeal (or otherwise) of electronic music. But to the technically inclined, there are other appeals; the future is pregnant with unlimited scope for generating new sounds, modifying existing ones, simplifying playing techniques and many other facets of the art.

Electronics and music have grown into a formidable combination, and so we take this opportunity of bringing together some of the many examples of this association. But fully to appreciate these great advances, which so many people take for granted, one should know something of the long and fascinating history of electronic musical instrument development; the more so as this is a hobbies journal, and some of the ideas which were not suitable for commercial development make interesting propositions for "one-off" projects.

# ELECTRONIC ORGANS

We begin with electronic organs, because these instruments represent the most ingenious combination of mechanics and electronics, can often be built at home, and are capable of endless development. All such instruments are played from keyboards and the controls follow internationally recognised methods to a great extent, but certainly not exclusively. The whole concept of organs has changed in the last 20 years. There is now no resemblance (in the popular mind) to the conventional organ with pipes. Yet, incredibly, the same conventional names for the sounds appear on the stops!

Harking back to the days when valve circuits tended to be unstable, mechanical systems with transducers seemed the best answer; of these, two survive today, Hammond and Compton. Such organs are permanently in tune but require complex circuitry and switching devices. With the increasing cost of manufacture it seems probable that they will disappear in time. Already solid state circuitry is taking the place of mechanical switching in pipe organs, although slowly, but for other kinds of electronic organ, semiconductors are paramount.

It is easier to start from the top and work downwards, so we give an example of an imitative organ by Conn as representing the "real thing". Fig. 1 illustrates a church or concert organ having tonal and control properties exactly corresponding with pipes.

This instrument has independently tuned oscillators for each note and these can give at least three different waveforms for tonal synthesis. As the sound in a pipe organ comes from a widely dispersed source, so this class of electronic organ requires many channels of amplification and many loudspeakers—a minimum of perhaps 25.

Multiple oscillators are never exactly in tune, but perhaps more important is the fact that there are trifling differences in the harmonic content of each oscillator. This gives a close resemblance to organ pipes, which have the same properties. The sound is full and rich, excellent for a real organ, but quite useless for pop or jazz.

Nine out of ten organs of the popular domestic type which can be seen in any music shop use a quite different generating system. The 12 top notes are produced by tuned master oscillators, but all other pitches downwards are obtained by frequency division. Since the octave is an exact doubling or halving of any frequency, 2 : 1 bistables or flip-flop circuits serve admirably. Readers will recall that this was the method used in the P.E. organ. It lends itself to mass production especially now that i.c.s are becoming so cheap; and with diode or transistor keying, cheap single contacts per key suffice.

If properly designed, this kind of organ can be very satisfying more especially at the low output levels demanded in the home. Unfortunately it is commonly found in forms which have neither the proper playing facilities of imitative organs, or the "new" sounds associated with rhythmic organs. Excessive amplification makes these organs lose what character they possess, and underlines the old saying that you can't get a quart out of a pint pot.

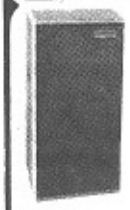
However, the prompt attack and the easy application of rhythm units to this kind of instrument makes them eminently suitable for pop groups and this has led to a form of tonal synthesis which contrasts well with guitar or voice. To a great extent they must be treated

***Fig. 1. The three manual Conn Custom organ has independently tuned oscillators for each note. These can provide at least three different waveforms for tonal synthesis of a church or concert pipe organ.***

***The Kentucky Challenger with string, flute and woodwind voicing available via the 4-octave solo and accompaniment manuals.***

***The effects include solo manual and pedal sustain, variable attack, reverberation, vibrato and Hawaiian glide.***

# Disco SOUND & LIGHTING EQUIPMENT from 4 SPECIALISED DISCO STUDIOS



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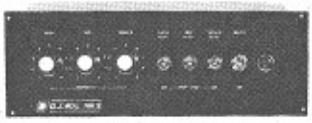

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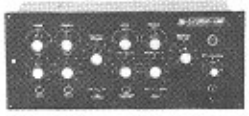

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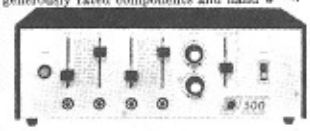

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| Signal/Noise Ratio | better than −50db. | | |
| Harmonic Distortion | less than 1% | | |
| Speaker Impedance | 8-16 ohms. | | |
| Inputs: Mic 1 & 2 Aux 3 & 4 | 5mV at 50K ohms (50 or 600 ohm to order) 100mV at 1 meg ohm. | | |
| Size (all models) | 15½" × 5" × 6". | | |
| Power Output: (at 8 ohms) | Model D.J.500 | 50 watts R.M.S. | **£58-25** |
| | Model D.J.700 | 70 watts R.M.S. | **£67-50** |
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## DISCO MINI

Hardly larger than a suitcase yet contains all the necessary features for a high quality mobile unit. The pre-amp has separate tone controls for both mic. and decks, and each input has its own individual volume controls and inputs, plus the addition of a cross fade for deck to deck sound transfer. A built in P.F.L. system for cueing, together with mic-over-ride facility are standard on all units. Response 20-20,000 Hz. Mic. input 5mV. 50K. Output 1 volt.
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as new sound devices and we show one of the most modern and effective examples in Fig. 2. This is made by Jennings Electronic Instruments, and bristles with ingenious features.

In this organ, the emphasis is on facilities for rhythmic playing rather than on simulation of conventional organ tonecolours; a special training and a special mentality is required to conform to the needs of a purely rhythmic group, and this is an excellent example of an instrument specially designed to this end.

The foregoing organs have all had tuned oscillators for each primary function and once these are adjusted, it is not possible to alter them easily. But now, it is possible to design and make an organ having only one master oscillator from which all pitches are derived. One great advantage is clearly that transposing is easily carried out—i.e., if one presses just one key, the pitch can be changed by a single adjustment so that one passes through a succession of keys. The player who can only use the white keys can now accompany say, a B flat clarinet whilst still using his white keys.

There are several ways of doing all this, mostly very complex, and all a tribute to microminiature circuits; for without these it would be quite impossible to build such an organ within any console or case. Modern i.c. component density can reach 2,000 elements in a chip only $\frac{1}{8}$in square and so the very complex circuitry required to steer and smooth the pulses of such a system can be made quite small. Two of the present methods for generating the frequency spectrum from a single source have been described in Practical Electronics for July 1972 but in the picture of the Philips generator the actual size was not obvious; in Fig. 3 you can see the relative size of this unit.

An organ built from half a dozen of these units would have amazing powers of synthesis.

***Fig. 3. Demonstrating the small size of the N.V. Philips' digital organ generator.***

***Fig. 2. The three manual, portable, Jennings J.71 with drawbar control of harmonics from 16′ to 1′ pitch and percussive attack. This, with the provision of dual waveforms, enables the organist to reproduce any mixture of sound required.***

***Other features include separate by-pass tabs for Theatre and Baroque organ. The top manual covers three octave providing 16′-8′- and 2′ pitch with controls for tonal effects which include vibraharp, piano, string, percussion and sustain.***

***One of Hammond's new models, the Concorde, incorporates custom built LSI packages. This harmonic tone-bar organ has two 61 note keyboards and such features as polysynthesis percussion, manual and pedal sustain, automatic accompaniment and automatic rhythm, lower manual to pedal couples and cassette recorder.***

Talking about synthesis, we find small keyboard controlled devices mounted in the Wurlitzer organs on which many effects not obtainable with any ordinary organ circuits can be produced. For instance, gliding tones, wah-wah, touch sensitive vibrato, extended pitch range and other effects are some of the attributes of the Orbit synthesisers on this organ. Certainly it is time that double touch was more used on organs, especially since it was an integral fitment of all cinema organs since the 1920s. So many things can be done with a second touch.

Now we have seen three kinds of tone generating systems for organs of a more or less conventional kind. But for the beginner, or one who does not wish to lay out much money on a single-purpose instrument, there are other ways of making musical sounds. Perhaps the simplest device is the stylophone, shown in Fig. 4. This is a simple multivibrator, played by using a metallic stylus to make the connection for changing the pitch. It is a continuously re-tuned system, capable of only one note at a time, but having a vibrato circuit which relieves the monotony. Constructional articles for something of this kind have appeared in various journals and it is a nice project for the beginner.

A more sophisticated device is the Pianomate. This assumes ownership of a piano, although it could be energised by a separate keyboard. It can be seen in Fig. 5 lying over the keys of a piano. Again, it is a simple generator, but chords can be played with care. The system uses one generator for every three notes, but if played with the piano, which of course is fully polyphonic, it appears that the organesque sounds from the generator are also fully polyphonic.

A small mains unit which stands on the floor contains all the electronics and allows changes of tone-colour; a volume control pedal is also available. Incidentally, as the contact unit for the four octaves of keys only rests on the back of the piano keyboard, it can be removed or placed on another make of piano in a moment and cannot damage the woodwork.

We find many people interested in playing music who are not satisfied with synthetic tone colours; certainly many organs become very trying to listen to for long and rely heavily on vibrato to break up the lifeless sounds. Many attempts have been made to bring the actual sounds from organ pipes or orchestral instruments to the keyboard, culminating in the Mellotron. Originally this instrument was much more complex but the present version is easily portable and just as accurate tonally.

***Fig. 4. The Dubreq Stylophone has a reedy voice, derived from a multivibrator circuit. To this vibrato can be added if desired. This instrument is only capable of producing one note at a time, each being selected with a metal stylus which constitutes part of the electronic circuit. In concert the sound produced can be very pleasant.***

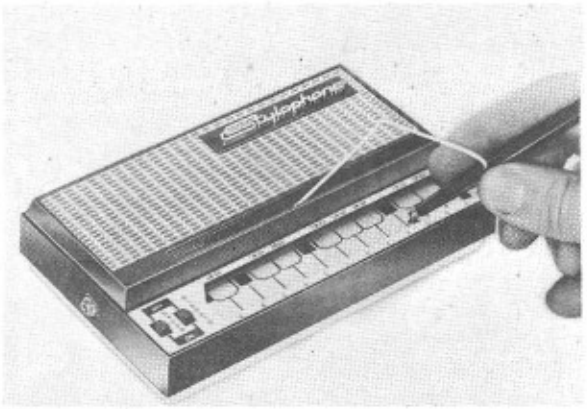
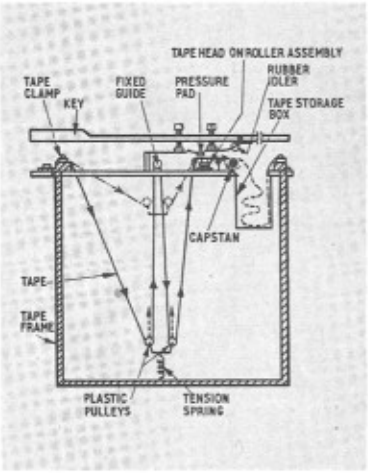



***Fig. 5. The Dubreq Pianomate in position on a conventional pianoforte keyboard. This consists of two double octave unit whose contacts move with the piano key to augment the piano sounds with organesque tone colours. A tone selector switch provides three different colours: flute, church organ and jazz buzz. A two speed vibrato is also included. The Pianomate is completely tuneable via a single control for pianos which may be out of pitch by as much as a semitone***

The system uses pre-recorded tapes but these are not in the form of loops as might be thought; the ingenious mechanism is too complex to describe here, but in essence when a key is pressed, a tape head is brought into contact with a record of the selected sound and continues to sound (so long as the key is held down) for up to 8 seconds. The tape then rewinds at once and is ready again. All the sounds provided are of course as authentic as the fidelity of the reproducer, all can be mixed, and many effects sounds can be brought in on other tapes; indeed, the Mellotron is popular as a pure effects machine, from which every conceivable noise can be obtained at will. Fig. 6 illustrates the action of this instrument.

***Fig. 6 A pure effects machine, the Mellotron is a source for every conceivable noise. The system uses prerecorded tapes of other instrumental sounds or special effects which can be mixed at will by the performer making him, in effect, a one man band. The action of the Mellotron can be understood by referring to the profile drawing of the key and tape transport system;when the key is depressed the idler engages with the capstan pulling the tape into the storage box; the tape is kept in tension by the rising pulleys; with the key released the tape is made ready for replay as the tension spring returns to its original position pulling the stored tape with it.***




***The RIHA Largo, besides having the normal footages in the upper and lower manual, has fractional number stops to provide more colourful registration. Playing features include a two-speed Leslie tremulant (a spatial effect achieved by feeding the loudspeaker output into a rotatable drum), vibrato delay, which provides a much more natural vibrato sound and solo percussion which gives the choice of many effects such as banjo and Hawaiian guitar.***

***The sustain feature on the pedals provides a string-bass effect on the pedal 8′ stops so giving rhythmic support to melody on the manuals. The sustain can also be used to play legato on the 13 note pedalboard.***

***The Harmonics Solette organ with a specification designed to cover all aspects of organ music from the classics to pop. It has a full size 61 note keyboard and a total of 19 registers.***

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## ISSUE ONE (NOVEMBER) OUT OCT 19

# INSTRUMENT TRANSDUCERS

Electric guitar pick ups have been with us for a long time; more recently the use of transducers has spread to other instruments such as clarinets, saxophones, violins and accordions. The aim of these methods is twofold; to amplify the original sound, and to be able to alter the waveform of the sound by electronic means, e.g. to remove harmonics or to add extra octaves by frequency division; or to modify the steady tone in some other way. But firstly let us look at how the guitar operates.

The diameter of a string is so small compared with the wavelength of any frequency within the range of that string that the back wave from the vibration would at once neutralise the front wave and nothing would be heard; the string produces no sound, it drives the belly or resonating body of the guitar and this couples with sufficient air to make the resultant vibrations audible as sound. However, it is costly to make a good acoustic guitar and the resulting sound is not loud enough to compete with other sounds in a modern group; the acoustic guitar is therefore reserved for the classical player, since it is many times more sensitive to fingering than its electrical counterpart, and the tone is not coloured by amplifiers or loudspeakers.

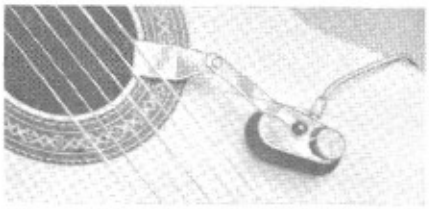
For the pop scene, it is desirable to convert all sounds into electrical waveforms and hence have complete control over them. So all we need is the vibrating string with suitable pick-ups. This means a simpler instrument in theory, but by the time that electronic controls and perhaps multiple pick-ups are fitted, it may well be more complex. Constructional data for pick-ups has been published and it is very easy to amplify this sound; one can then add simple tone controls and so alter the effect. If, therefore, it is possible to use steel strings or strings wrapped with steel wire over the pick-up location, magnetic pick ups are easily applied to any stringed instrument.

Note that the string pick-up is to be preferred to any form of microphone attachment; because the latter is sensitive to air pressure waves as well, and can pick up breathing and scratching noises from fingering the string. But when one comes to other instruments, in which the same amount of energy is not required of the player (or in a different form, such as blowing a clarinet), then it is possible to use noise cancelling types of microphone to amplify the tone. Certainly this has advantages if only because the waveform of the generated sound can be changed and one may get the effect of several different kinds of instrument from the one. An excellent example of this is the electric mouth organ or harmonica.

There are examples of amplified accordions and a number of purely electronic ones, using the circuitry of a miniature organ and connected to external amplifiers and loudspeakers. Then again, it is possible to obtain an electronic string bass unit, buttons producing all the effects from normal bowing to pizzicato or col legno (playing with the back of the bow). This is made by Hohner.

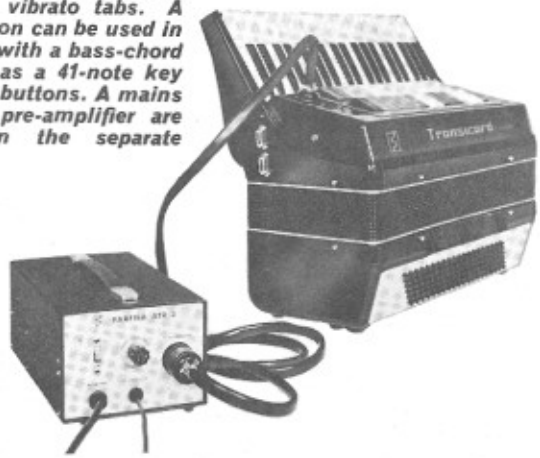
Many of these existing tone qualities can be completely transformed by, say, a percussion unit; this enables some sound which would normally be smooth and sonorous to be made aggressive and staccato. This kind of percussion unit can be wired in anywhere between a pick-up and its amplifier. It is not to be confused with a rhythm unit, which is a quite independent source of percussive sounds acting as rhythm markers and non-musical in effect. Many such rhythm boxes are on the market now, nearly every large domestic organ has one as an integral part and many can be bought to add to whatever sound source would benefit.

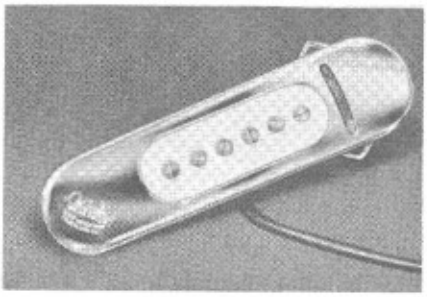
***Hornby-Skewes accordion microphone is connected to the side of the accordion and picks up sound for feeding to an amplifier***



***Magnetic type contact pick-up with fingertip control. Suitable for nylon string guitar.***

***Farfissa Transicord electric accordion with seven voices, sustain and vibrato tabs. A rhythm section can be used in conjunction with a bass-chord facility. It has a 41-note key and 120 bass buttons. A mains supply and pre-amplifier are contained in the separate module***



***Six magnet pick-up for flat top guitars.***

*The Farfisa Super Piano with keyboard and decay as on the conventional piano. The effects which can be obtained on the first 24 notes are, for the bass: bass, string bass and bass guitar. For the chords: pianoforte, guitar and banjo. Also available is automatic bass and chord rhythms. Output available is 25 watts.*

*A Yamaha electric guitar.*

*The Harmony Baroque electric mandoline with a body shape that departs from the classical for ease of playing.*

*The Jennings Winchester "Rifle" guitar with a body which is constructed entirely of metal providing a crisp, pure tone. Apart from the normal guitar sound this instrument has internal electronics to provide bass, treble, fuzz, presence and repeat.*


*Maestro ring modulator.*


*Typical reverberation unit from the Laney Sound Supergroup Series.*


*Soundimension: a device for providing echo and reverberation affects when used with an amplifying system.*


*A "Cry-baby" wah-wah pedal.*

*"Fuzz-face" distortion unit with separate volume and fuzz controls.*

# SPECIAL EFFECTS

The continual search for new effects has led to the electronic controls known as wah-wah, growl, glide, etc. All of these do something not normally expected from the instrument to which they are attached. Once associated solely with the guitar, they are now found on electronic organs and other complex devices. Readers will be familiar with the effects on the tone, and constructional details for most have been described in the press.

The wah-wah is a tuned circuit, the resonance of which can be altered at will; some band of frequencies is then accentuated and moves progressively to another band by the manipulation of a foot control. The growl is almost identical, but operates at lower frequencies. A glide circuit is found on some organs, usually it provides a limited frequency shift by altering the base biasing of a transistor oscillator through a voltage control; again the foot is used to move a variable resistor of some form.

Since some of these effects may be needed at short notice, it is possible to combine the controls on a single foot pedestal where the toe selects the function, whilst the heel operates a rotary volume or similar control. A commercial multiple control unit is shown in Fig. 7. There is clearly a limit to the number of controls which can be used by someone who is usually playing an instrument at the same time.

The vibrato produced by a violinist, which is an important part of his technique, may be imparted by a mechanism which alters the tension of the guitar strings by a lever; but it can also be done by an electronic circuit—commonly a form of adjustable speed multivibrator. This again can be inserted between the pick-up and the amplifier but naturally it is not so expressive or controllable as manipulation of the strings. However, playing finesse is not so important with groups.

Since power is such an essential ingredient with today's performers, we find large amplifiers which are now sophisticated in that they have mixing and vibrato circuits incorporated; however, we shall not discuss these or loudspeakers at this time. Suffice it to say that many groups prefer valves, since they stand such overloads and misuse.

There is room for improvement in the means for connecting units together, there still are casualties from time to time and it is difficult to understand why Ministry of Defence or Home Office approved connectors are not compulsory.

One final piece of apparatus which has effects uses is the ring modulator. This is a circuit artifice whereby two applied signals are combined to form sum and difference frequencies, one of which is extracted and used as a final signal. For this reason the device should be fed from sine waves, but since these do not exist outside the laboratory, some very peculiar sounds result—always discordant.

The ring modulator is often fed from a musical source, a singing voice via a microphone, a pick-up from a saxophone, etc. Many intriguing effects are possible with care, certainly all are novel and often incapable of analysis by the hearing system yet of too short a duration to give rise to irritation. It is in fact interesting to note that distortion is deliberately sought, so intense is the search for novelty. The clipping amplifier or fuzz box is a good example of such techniques. Of course, as the ambient noise level around us increases, discomfort arising from other noises has less effect and we come to accept it.


***Fig. 7. The Jennings Scrambler is a complete remote foot control of effects associated with amplification. Besides the quadrant of foot switches the Scrambler has two rotary turntable controls for intensity volume and wah-wah.***

***A quartet of effects units that can be used with almost any kind of electronic musical instrument.***

# SYNTHESISERS

The idea of compounding sounds from their bare ingredients is far from new; indeed, one of the most successful synthesisers was built 20 years ago; but, it occupies a whole room! So for a more general acceptance of these devices, we had once again to wait for the semiconductor.

Now a synthesiser is nothing more than a number of units which represent the basic parameters of sounds, so organised that they are easily controlled by the operator and of such a nature that the absolute values of these parameters can be set up again and again with accuracy; in other words, so far as is possible, the elements are calibrated.

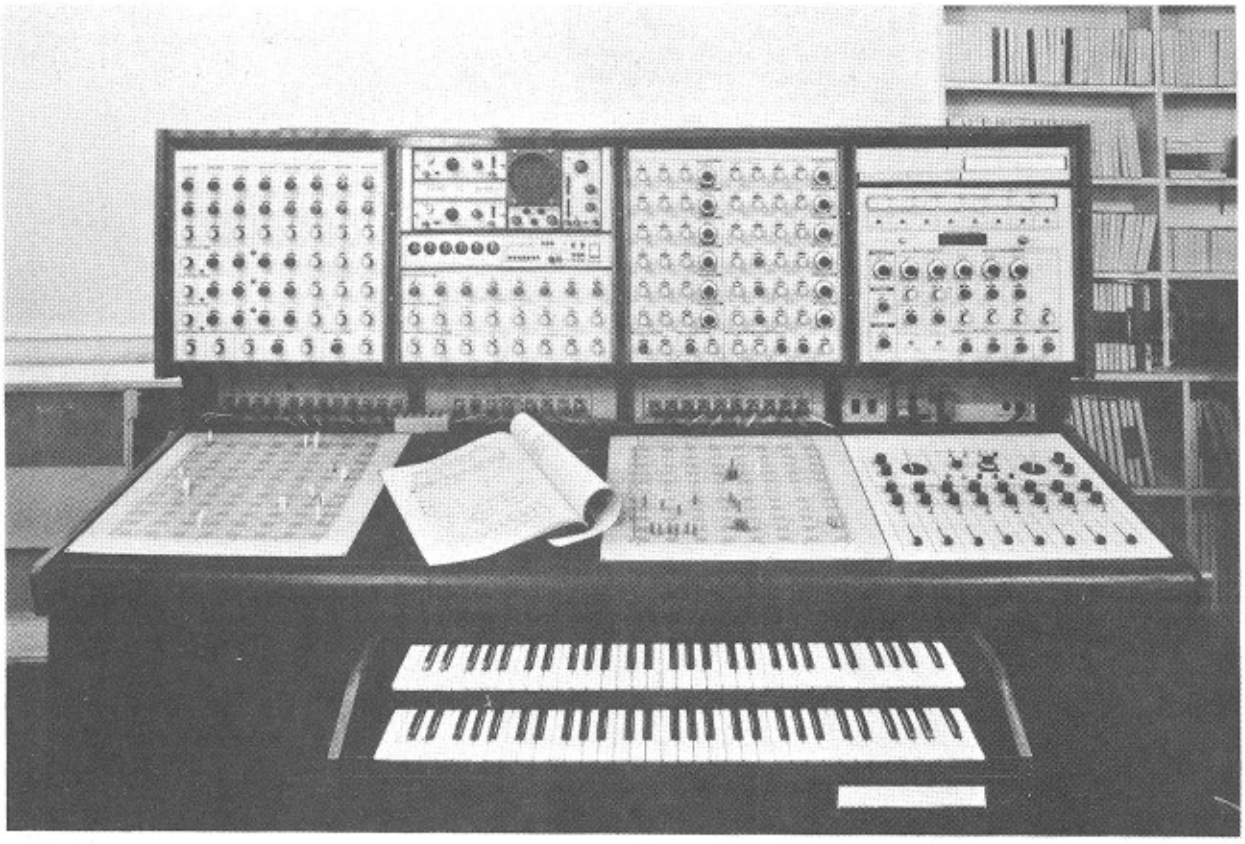
One can compose music with a range of tonal qualities, but cannot write this down in conventional musical notation, although it can be written in terms of instrument settings. It was never possible to write the composition of, say, a trumpet sound on a conventional music score, but one can write this electronically in terms of the values of the constituents; so in this way, the actual nature of a sound can be put in black and white so that someone else can recreate the same sound and this has never before been possible.

Clearly the facilities of a synthesiser relate to its use. An amateur experimenter may not need the many duplicated oscillators, noise sources, amplifiers and treatments which are called for by a professional musician or composer. So it is useful that simple modules can be made or bought and added to as required. One must have at least one good tape recorder for the weakness of all synthesisers of low cost is that they have no storage facilities; all work involves short-term events and constant re-recording.

Most if not all modern synthesisers are voltage controlled; that is, the conduction properties of the transistors are set by applied d.c. voltages; in this way, several advantages follow at once, the principal ones being linearity of signal with applied voltage change; low impedance of control circuits; and complete absence of hum pick up because one does not trail base (or grid) circuits out from the main apparatus. Hundreds of feet of signal control cable can in this way be run out.

Voltage control is also convenient for a keyboard, since at no time would the voltage across any part of the system exceed about 30V. By controlling the frequency

***The Synthi 100 synthesiser made by EMS of London has almost unlimited facilities for sound synthesis and serious composition. It has provision for storage and immediate recall of sounds devised. Compare the elaborate patch panels with that of the VCS3 synthesiser.***



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## SA25-SA35-SA100

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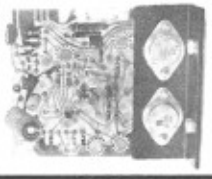

THESE THREE MODULES HAVE ENJOYED UNPARALLELED SUCCESS DURING THE FIRST FEW MONTHS OF THEIR BEING MADE AVAILABLE TO THE GENERAL PUBLIC. WE ARE PLEASED TO ANNOUNCE THAT WE CAN NOW OFFER FAST DISPATCH ON MOST OF OUR ADVERTISED ITEMS, INCLUDING THESE THREE MODULES.

**SA25 £2·95** carr. free

25 WATTS R.M.S. 7 transistors, 7 diodes.

**SA35 £4·45** carr. free

35 WATTS R.M.S. 7 transistors, 7 diodes

**SA100 £10·90** carr. free

100 WATTS R.M.S. 11 transistors, 6 diodes

ALL THREE MODULES HAVE OPEN AND SHORT CIRCUIT PROTECTION, AND THE SA100 IS PROOF AGAINST OVER-DISSIPATION AND FAULTY INDUCTIVE LOADS.

ONLY ADVANCED DESIGN TECHNIQUES MAKE THESE EXTRAORDINARILY LOW PRICES POSSIBLE.

### BRIEF SPEC. FOR ALL THREE MODULES

| | |
|---|---|
| Freq. response | 15–40,000Hz ±1dB |
| Distortion | 0·2% at 1kHz |
| Loads | 4 to 16 ohms |
| Quiescent current | 15mA |
| Noise | Better than −75dB |
| Supply voltage | 25–45V, SA25/35<br>40–70V, SA100 |
| Size | 4½in × 4in × 1in (SA100)<br>4in × 3in × 1in (SA25, SA35) |

Circuits, connecting instructions and application data are supplied free with all modules.

### POWER SUPPLIES FOR THE SA25/35 and SA100 AUDIO MODULES

**PS45** Stabilised module for 2 SA25's or two SA35's, **£35·0**, carr. free

**MT45** Transformer for above, heavy duty, **£2·85**, carr. 20p

**MT30** Transformer for unstabilised supply complete with rectifier diodes mounted, **£3·50**, carr. 20p

**PU70** Unstabilised supply for one or two SA100, **£6·75**, carr. 40p

**PS70** Stabilised supply module for one or two SA100's, **£4·90**, carr. free

**MT70** Transformer for PS70, **£4·90**, carr. 40p

ALL MODULES ARE BUILT ON GLASS FIBRE P.C. BOARD

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### 120 WATT HEAVY DUTY MODULE

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Featuring a rugged class A driver stage, this module will run from all our mixers etc., and most other makes of mixer. It delivers 120W into an eight ohm load and employs 4 TO3 can (115W) output transistors.

**SPECIFICATION**

| | |
|---|---|
| Power output | 120W into 8 ohms |
| Freq. response | 30–30,000Hz ± 2dB |
| Input sensitivity | 200mV into 10K |
| Construction | Fibreglass board |
| Size | 8in × 4in × 4in (5in with supply) |

Low distortion parallel push–pull output stage.

### SINGLE CHANNEL SOUND/LIGHT CONVERTER

This compact and reliable unit operates from amplifiers with outputs from 5–100W. Does not impose a heavy load on the amplifier, or, if connected in the wrong polarity, cause any damage, as with some units.

Operation is simplicity itself and the unit is fully fused. The unit is supplied to function from bass notes but may easily be converted to respond only to treble or mid-range notes by the addition of components costing less than 5p.

**£8·90** carr. free

### THREE CHANNEL SOUND TO LIGHT UNIT

Handling the total of 3,000W (3kW) this unit is unique for its price in that not only bass middle and treble but also master controls are provided. Two amplifier sockets eliminate the need for split leads, etc. Supplied in tough white steel case with a blue stelevtite hooded cover. Fully guaranteed.

**£19·75** carr. 30p

### SAXON STEREO CONTROL UNIT


**£15·80** carr. 30p

MONO VERSION **£6·50**, carr. 20p

(As illustrated left. S.A.E. details. 9V operation)

OUTPUTS UP TO 1V RMS

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½in × 3in × 4in deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, headphone selector and volume, microphone volume, bass, treble, mains on/off. **THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCOTHEQUE AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE.**

### COMPLETE AMPLIFIERS

**THE CS 100. £34·90** carr. free

This versatile unit is now available in a black vynide case and so represents even better value than ever, delivering speech and music powers of up to 100W R.M.S. and continuous sine wave outputs of 70W. Two individually controlled inputs with wide range bass and treble controls. Ideal for small groups, D.J's, etc.

**The SAXON 100. £48·50**, carr. free.


With an R.M.S. output of 120W speech and music, 100W continuous power, four individually controlled F.E.T. input stages and wide range bass and treble controls, this amplifier has established itself as a unit offering quality and reliability at low cost.

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12in 25W 8/15 ohms **£5·95**, carr. 30p. 15in 50W 8/15 ohm, **£14·50**, carr. 50p.
12in 40W 15,000 gauss magnet system 8/15 ohm, **£11·50**, carr. 40p.

**A.K.G.** microphones suitable for disco, group or general P.A. use
D11DHL r.r.p. £11, our price **£9·45** post free.
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# ORGAN KITS

**Build your own Electronic Organ, if you want the best value for your money. Yes you really save over 50% and get the best and up-to-date designs. There are four models to choose from.**

★ Portable—4 octave keyboard with 10 voices, 3 pitches—vibrato, at **£103·00**, P/P £1·50.

★ Console—5 octave keyboard with 10 voices, 3 pitches . Keyboard can be split into solo and accompaniment. Vibrato built in amplifier and 50 watt 12" Goodmans speaker at **£167·00**, P/P £5·00.

★ Console—2 x 4 octave keyboards and 13 note pedal board, 29 voices, Vibrato, Delay Vibrato, Sustain Reverberation, Precussion, Wah Wah, etc. at **£406·00**. Carr. paid on complete kit U.K. only.

★ Console—2 x 5 octave keyboards and 32 note pedal boards, 32 voices. Vibrato, Delay Vibrato, Sustain Reverberation, Precussion, 3 Couplers, etc., at **£572·55** carr. paid on complete kit U.K. only.

We regret H.P. facilities are not available, but components can be bought separately. Trade and overseas enquiries welcomed. Send 25p for latest catalogue.

Please call in for demonstration. Business hours: 10 a.m. to 7 p.m. Monday to Saturday. Thursday closed.

## ELVINS ELECTRONIC

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# BUILD A Voltage-Controlled SYTHESISER using Dewtron

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## Professional Modules

These modules are as used in our synthesiser which was recently on demonstration at the British Musical Instrument Trade Fair.

For details see our PROJECT X advert. on page 982 of this issue Practical Electronics.

**D.E.W. LTD.**

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### WAH-WAH PEDAL KIT (Illustrated)

**Kit comprises a SELECTIVE AMPLIFIER MODULE KIT to convert the FOOT VOLUME CONTROL PEDAL (as photo) to Wah-Wah operation. Amplifier module £1·75, pedal unit £5·13, COMPLETE KIT £6·50 add 38p for assembly of module, but please note we cannot supply kits fully built.**

**REVERBERATION UNIT KIT. For dimension effect. Connects between sound source, mic., etc., and amplifier. Battery powered. COMPLETE KIT £9·50 (excluding case £7·50). Assembled and tested £12·50.**

**VIBRATO UNIT KIT. Foot pedal unit with variable speed and depth controls. COMPLETE KIT £5·25.**

**SEND 15p for the WILSIC PLANS BOOK, with full details of these kits; circuits, drawings and price lists.**

LATEST CATALOGUE 5p (stamps)

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of an oscillator by adjustment of the base voltage from a resistor chain contacted by playing keys, intervals other than those of the equally tempered scale can be produced. This is very useful for exploring the possibilities of the quarter or tenth tone scale—or other subdivisions. This is an approach to the continuous or gliding scale, available on certain instruments like the violin or trombone, but only to a very limited extent; there is no limit to electronic glissando.

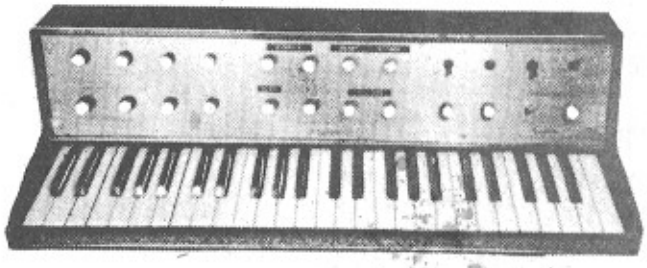
Synthesisers have envelope controls; the overall shape of a waveform is called its envelope. By altering the rate at which the wave starts, or stops, or both, profound changes in the character of the sound emerge. One could thus determine, for instance, if it would be a good thing to make the attack of a 'cello longer or shorter, by simply feeding the pick up on the 'cello into the envelope shaper circuit. These methods have been used on the continent to try to improve the properties and characteristics of some instruments of the orchestra.

Then there are noise generators. Electronic noise is very controllable and can be useful to augment the impact of certain musical effects. It is also valuable to imitate storm, rain or wind and for this latter purpose can be coloured by a tone superimposed, rather like the sound of wind in telegraph wires. In short, if the synthesiser has enough parameters, almost any musical or abstract array of waveforms can be achieved and recorded; and there are commercial examples of disc records based on purely electronic sound.

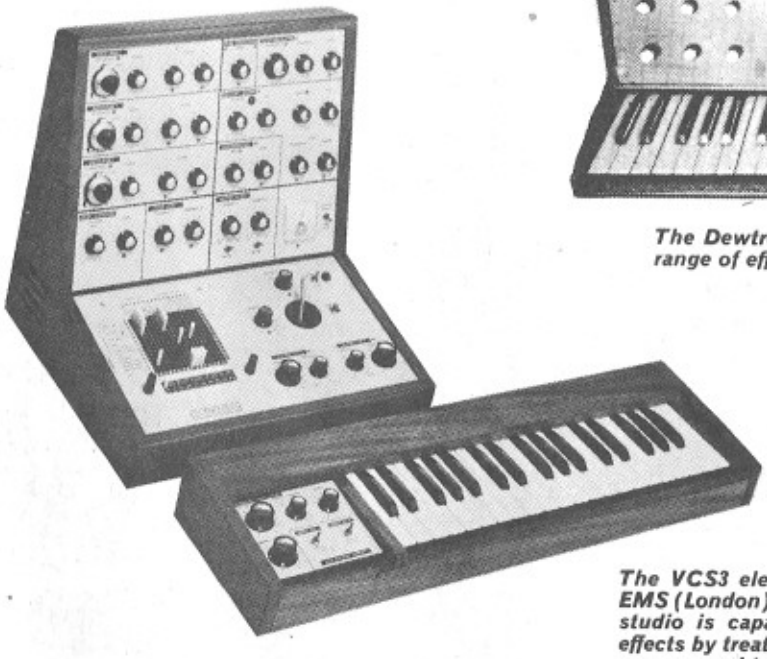
Today there are many synthesisers on the market; most have similar parameter facilities, but some are much easier to patch or cross-connect than others. As experience was gained in their use, controls became simpler and more accurate. The one time room full of gear became a table-top unit as we can see in the illustration of the EMS portable synthesiser.

The ultimate in versatility is the Synthi 100, as used by the BBC and other broadcasting authorities, and made by EMS of London. It has storage facilities and quite elaborate compositions can be realised and performed on it. There is provision to call up anything previously recorded, erase or add to it, and play it at any time. In short, it has all the facilities one could reasonably demand.

Supplement cover picture by courtesy of St. Giles Music Centre.

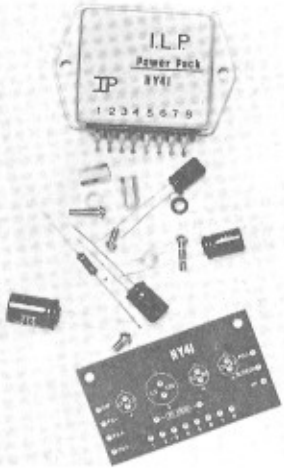


*The Dewtron synthesiser which combines a whole range of effects in a simplified unit.*



***The VCS3 electronic music synthesiser produced by EMS (London) Ltd. This small scale voltage controlled studio is capable of producing a great many sound effects by treatment of three oscillatory sources. Signal sources and treatments are labelled down the left-hand side of the patch board. These may be connected in any permutation to the signal input and control input listed along the top by simple jack plugs. Effects produced can then be applied to the keyboard if required.***

# I.L.P. (Electronics) Ltd




## THE HY41

The HY41 supersedes the popular HY40 introduced by ILP last year. This highly improved module achieves true High Fidelity with a dramatic reduction in distortion (typically 0.05% at 1KHz into 8 ohms!) and is electronically and mechanically compatible with the HY40.

With this important improvement the HY41 retains all of the quality characteristics found in the earlier version and P.C. board, Resistor, Capacitors, Hardware Mountings and comprehensive manual are included in the basic kit. No further components are required to construct a complete power amplifier of extremely high performance sufficiently versatile to provide power not merely for Hi-Fi but also for public address systems and industry.

The free manual gives a full circuit diagram of the HY41 and its various applications including a complete stereo amplifier.

Like its predecessor the HY41 is based on conventional and proven circuit techniques developed over recent years.

**OUTPUT POWER:** British Rating 40 WATTS PEAK, 20 watts R.M.S. continuous.
**LOAD IMPEDANCE:** 4–16 ohms.
**INPUT IMPEDANCE:** 30K ohms at 1KHz.
**VOLTAGE GAIN:** 30db at 1KHz

**TOTAL HARMONIC DISTORTION:** less than 0.15% (typical 0.05%) at 1KHz.
**FREQUENCY RESPONSE:** 5Hz–50KHz ± 1db.
**SUPPLY VOLTAGE:** + 22.5volts D.C.
**SUPPLY CURRENT:** 0.8 amps maximum.

PRICE: inc. comprehensive manual, P.C. board, five extra components and P. & P.:–
**MONO: £4.90** **STEREO: £9.80**

## UNIQUE HYBRID PRE-AMPLIFIER

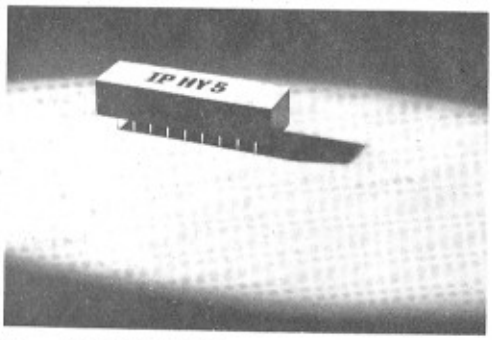
The HY5 has rapidly established a position in the WORLD as the sole hybrid pre-amplifier to contain all feedback and equalization networks within an integrated pre-amplifier circuit.

Supplied with the HY5 are two stabilizing capacitors and by the addition of volume, treble and bass potentiometers it is ready for use.

Internally the HY5 provides equalization for almost every conceivable input, the desired function is achieved by use of a multi-way switch or by direct interconnection.

Two distinctive features of the HY5 are its inbuilt stabilization circuit, allowing it to be run off any unregulated power supply from **16–25** Volts and a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo pre-amplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY41 and PSU45 forms a completely intergrated system.



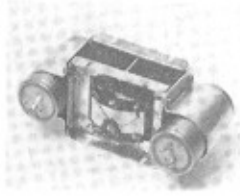

**INPUTS**
Magnetic Pick-up (within ±1db RIAA curve) 2mV. 47K Ω
Tape Replay (external components to suit head). 4mV. 47KΩ
Microphone (flat) 10mV. 47K Ω
Ceramic Pick-up (equalized and compensatable) 20–2000mV. variable.
Tuner (flat) 250mV. 100K Ω
Auxiliary 1 250mV. 47K Ω
Auxiliary 2 2–20mV. 100K Ω

**OUTPUTS**
Main Pre-amp output 500mV.
Direct tape output 120mV.

**ACTIVE TONE CONTROLS (Baxendall)**
Treble + 12db.
Bass + 12db.
**INTERNAL STABILIZATION**
Enables the HY5 to share an unregulated supply with the Power Amplifier.
**SUPPLY VOLTAGE**
**16–25 volts**

**SUPPLY CURRENT**
6mA approx.
**OVERLOAD CAPABILITY**
better than 26db on most sensitive input infinite on tuner and auxl.
**OUTPUT NOISE VOLTAGE:** 0.5mV.

PRICE: **MONO: £3.60** **STEREO: £7.20**



## POWER SUPPLY PSU45

The versatile P.S.U.45 is designed to supply your HY41's +HY5's in stereo or mono format.

**Specification**

Input: 200–240 Volts.
Output: ± 22.5 Volts at 2 amps.
Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

PRICE: **£4.50 inc. P. & P.**

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