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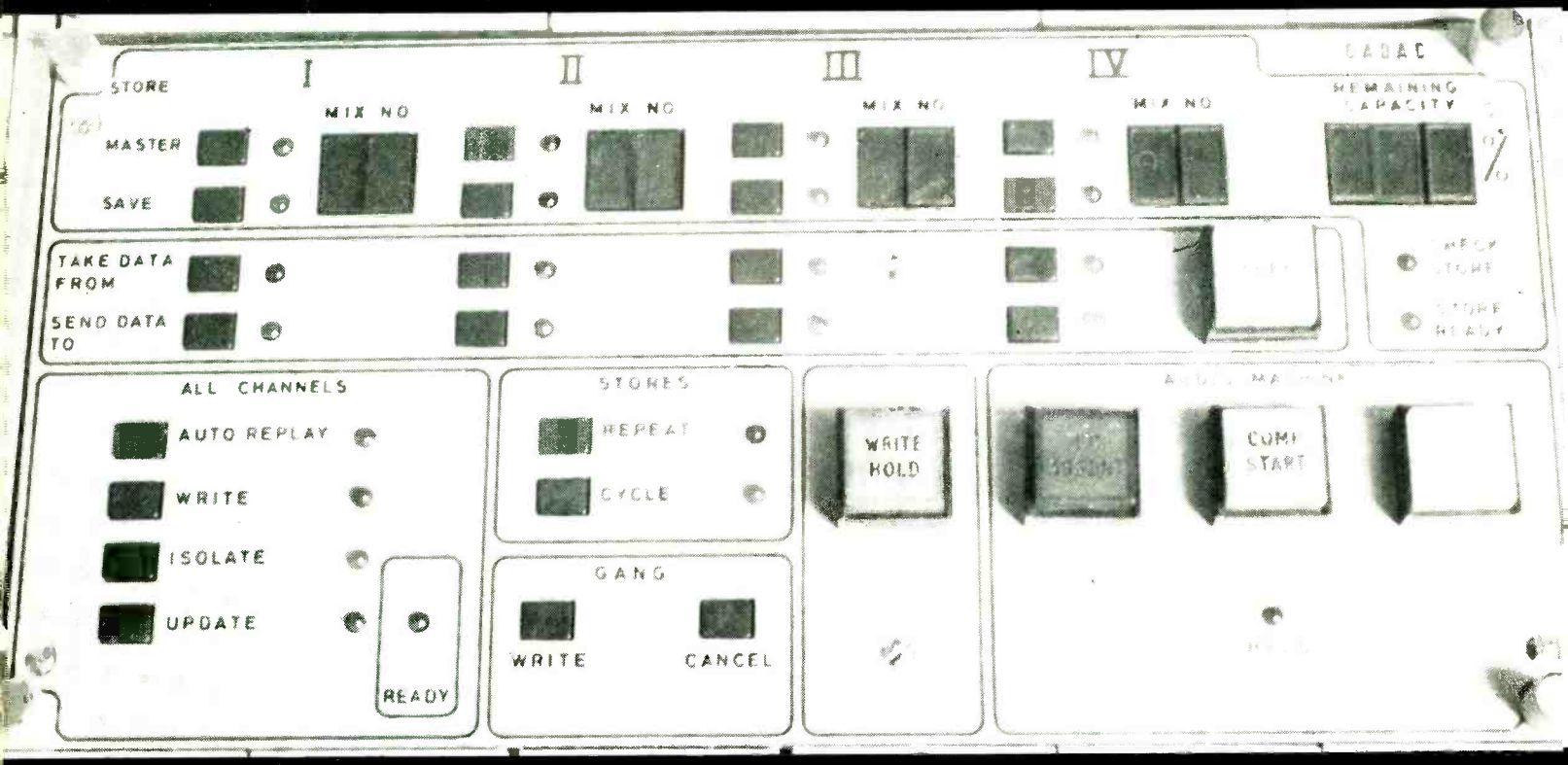

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TECHNICAL EDITOR FRANK OGDEN
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THE LINK HOUSE GROUP
Editorial and Advertising Offices:
LINK HOUSE, DINGWALL AVENUE, CROYDON CR9 2TA, ENGLAND
Telephone: 01-686 2599
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studio sound

AND BROADCAST ENGINEERING

Pure coincidence ?

With mic technique, it's not always wise to come off the fence and become a strict adherent to either close miking or crossed pair. Such polarisation usually indicates partial loss of sight of the final objective, a *pleasing interpretation* of a musical scenario. Further, it tends to show a lack of experience in practical recording.

For instance, no intensity of commitment could justify the Blumlein approach in the vicinity of a motorway or the flight path into an airport whereas, perhaps, the atmospherics and ambience of a Marlboro Medium Tar cough might be permitted. Conversely, some things are just too big for close miking even though a lot of recording channels may be used. In this case, many crossed pairs can create a series of stereo images of the individual instrument sections which together make up a larger crossed pair picture.

Practical recording technique has always been an empirical science usually defying established doctrines; the best known engineers have never been doctrinaire. They make decisions on experience rather than esoterics. After all, strict phase relationships may be important but can be discounted provided it sounds ok when the mono button is pressed, assuming the mix was right for stereo in the first place . . . open mind instead of closed technique.

APRS & Co. Ltd.

This year, 19 manufacturing members of the Association of Professional Recording Studios will go to Paris to exhibit their wares at the 56th AES exhibition and, deservedly, do well as a result. Nobody would, or should, resent this—for too long British equipment manufacturers have suffered the constraints of a strongly parochial attitude towards their own craft. Indeed, it seems a shame that more of the manufacturing membership of the APRS didn't go along with the others to market an advanced technology *par excellence*.

What is less understandable concerns the basic dichotomy (or lack of it) between the manufacturing and recording aspects of the APRS. Which particular ethnic group does the organisation provide for? Without doubt, certain members among its ranks deserve nothing but credit for propagating degrees of intelligence within the recording industry. For instance, John Borwick's engineer refresher course at Surrey University, accepting the limitations of five days, earns nothing but praise for its aims. Communication is education and should constitute a fundamental concept of the Association.

From a functional aspect, the APRS should recognise its role as a communicative body rather than be mostly pre-occupied with the interests of its manufacturing members; they should be termed a separate entity and organised accordingly, even within the ranks of the AES which would seem to be an organisation better suited to their needs.

The APRS should serve the recording industry rather than its peripherals.

contents

MARCH 1977 VOLUME 19 NUMBER 3

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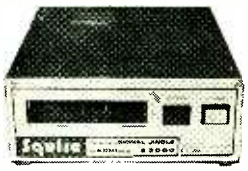

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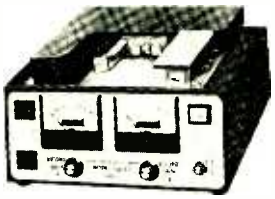

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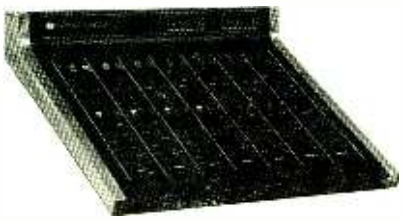

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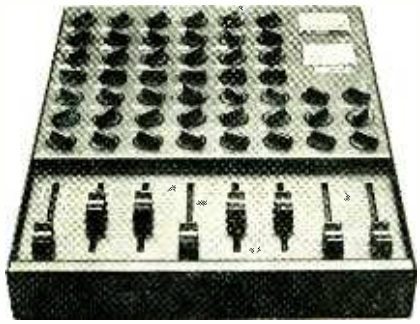

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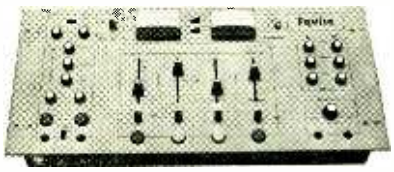

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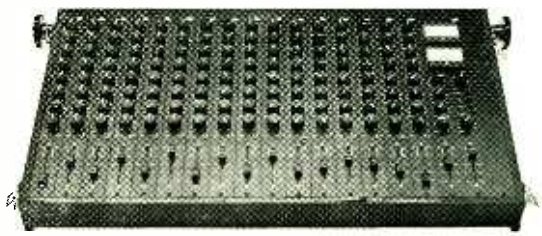

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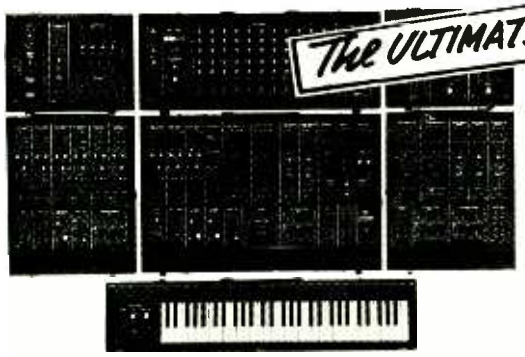

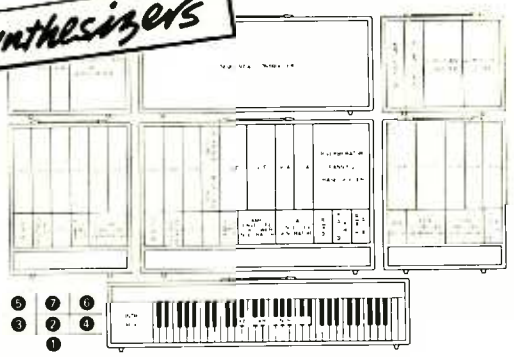

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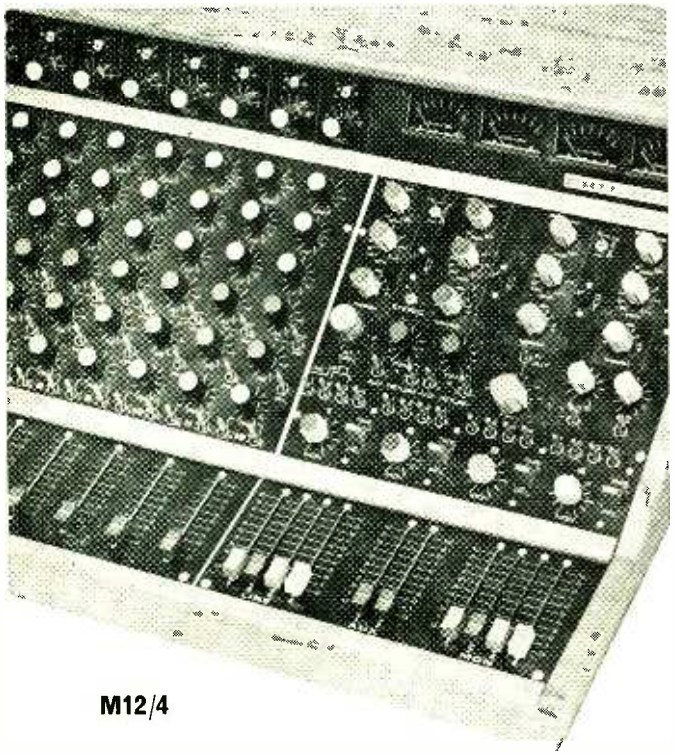

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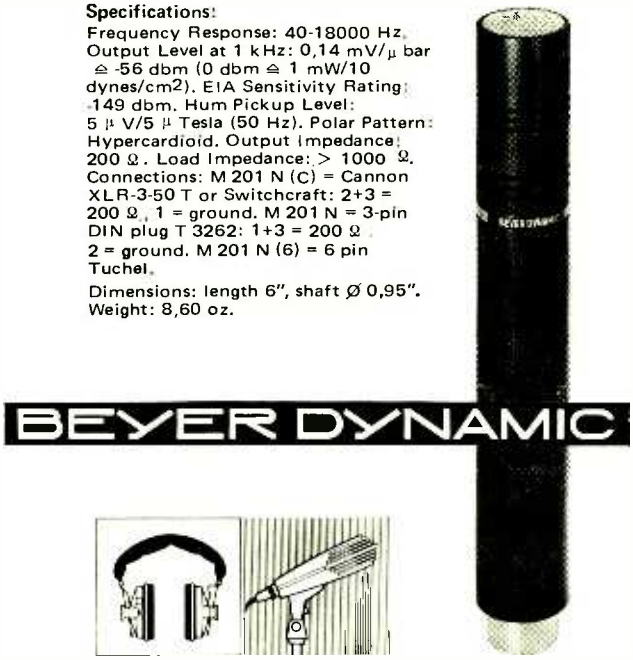

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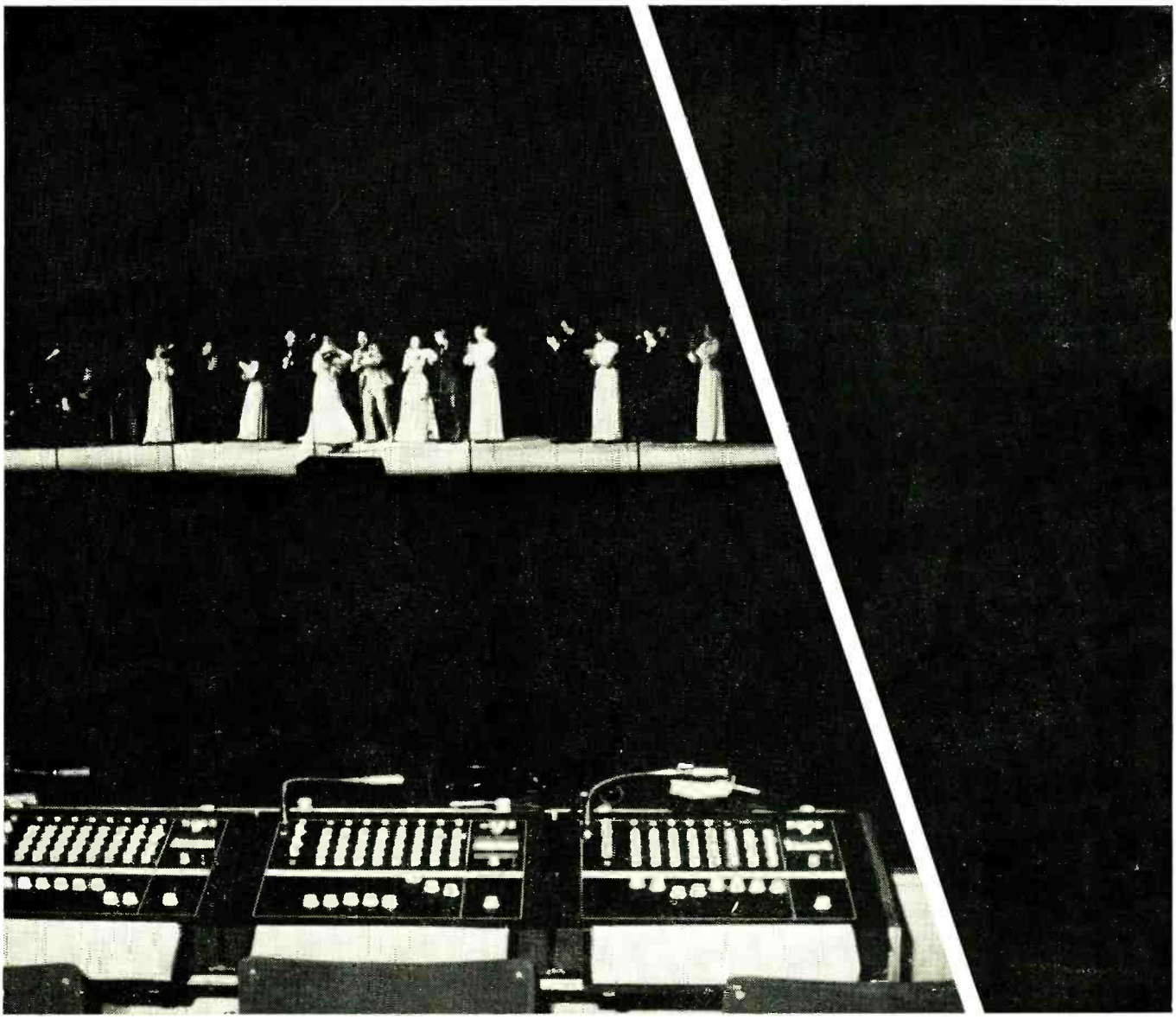

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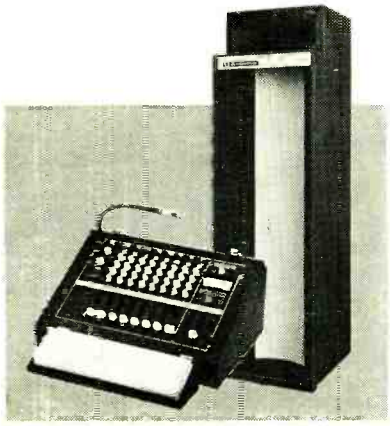

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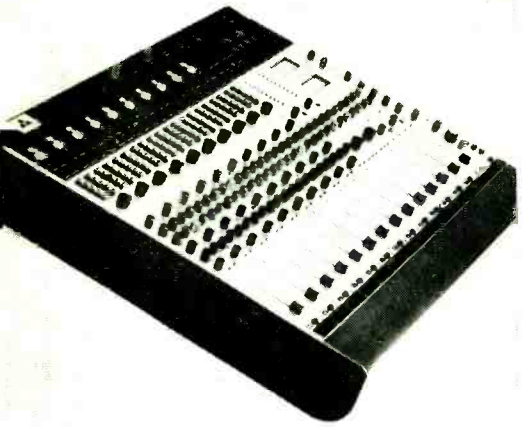

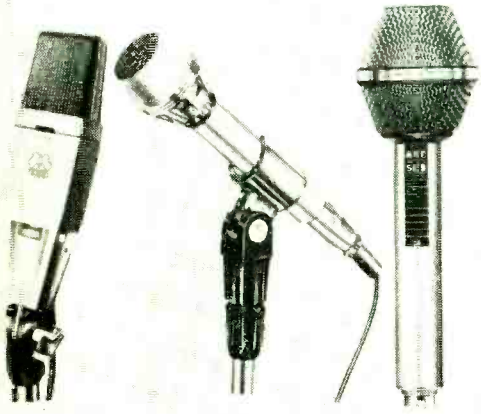

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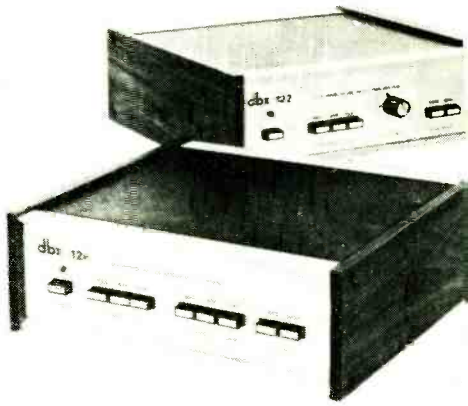

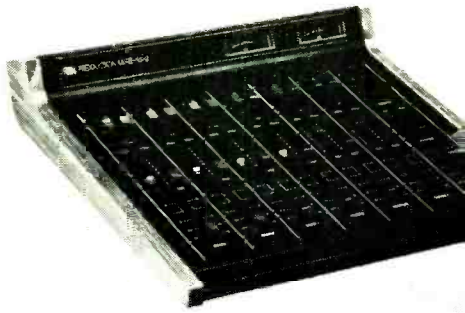

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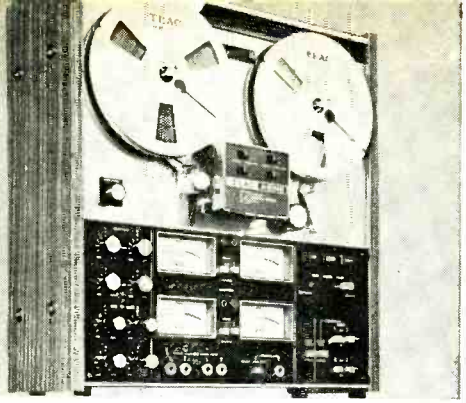

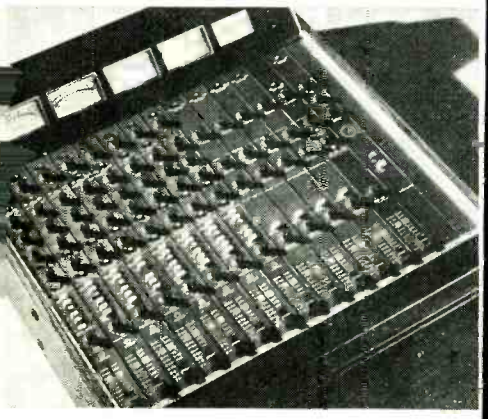

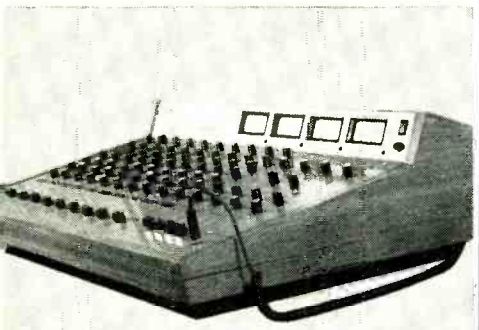

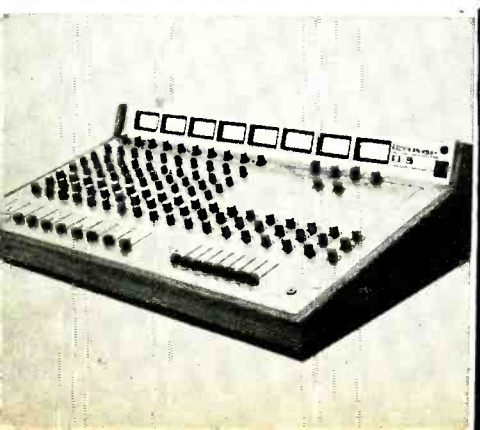

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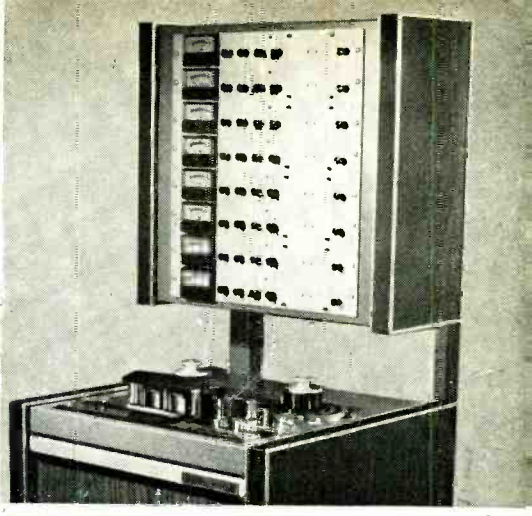

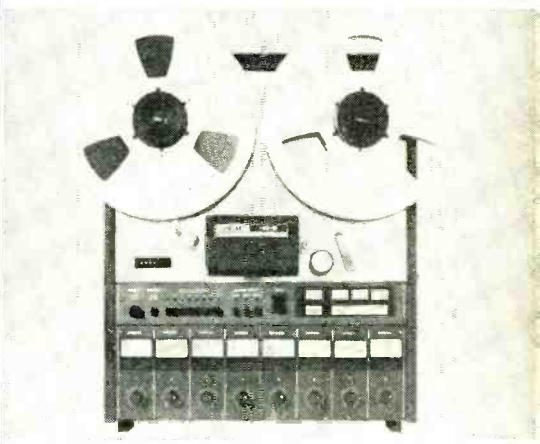

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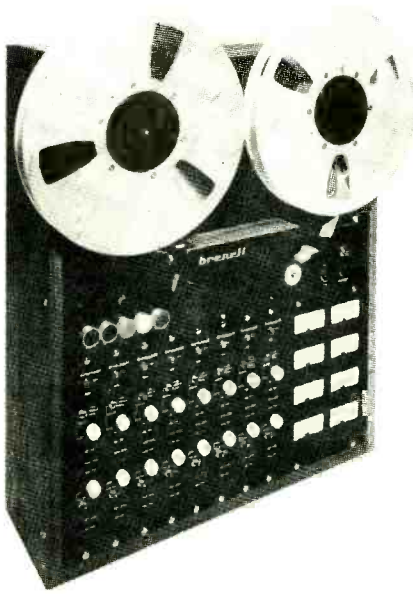

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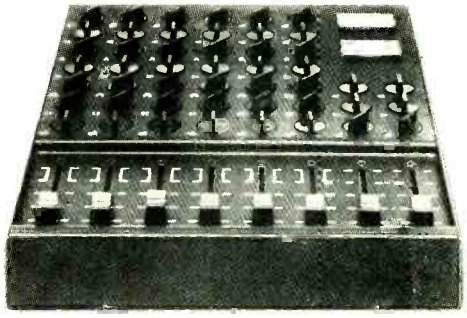

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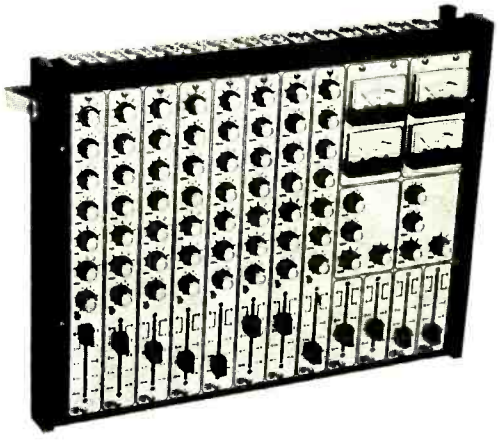

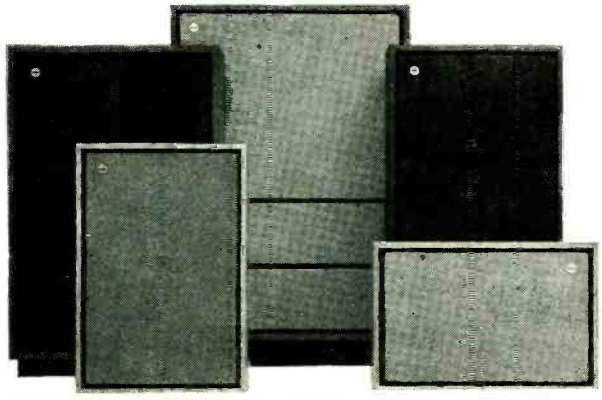

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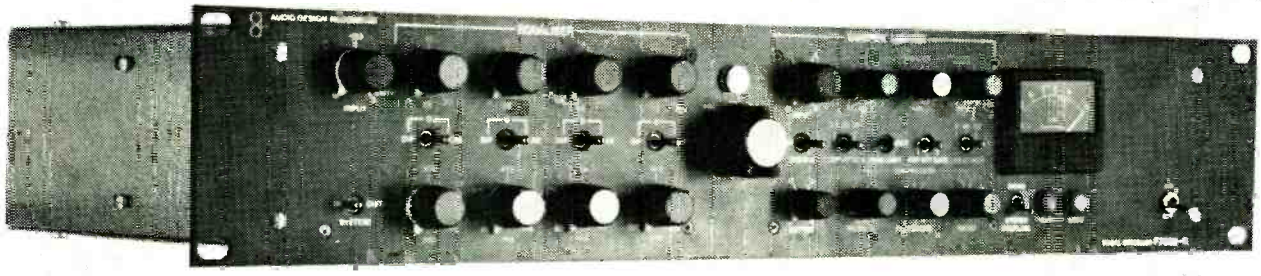

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The equaliser improves signal quality; the compressor improves mean level; the expander in gating mode attenuates noise during pauses, and the limiter controls peaks.

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The sky's the limit, or at least the creative ability of the artist and the engineer is. With vocals, or indeed any signal source, you can get very exciting sounds.

The Vocal Stresser is basically the F760X Compex-Limiter and the E900 Sweep Equaliser integrated as one, with all functions switch-selectable.

For instance, the equaliser can be switched out of the system and used as a separate unit, accessible through its own input/output from a different channel.

Or switched before or after the Compex-Limiter or even in its side chain.

The benefits of these three modes are considerable.

Used before, you get maximum signal conditioning and still maintain critical overload control.

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And in the side chain, the equaliser becomes an extension of both the threshold and compressor controls, making them particularly sensitive to chosen frequency bands.

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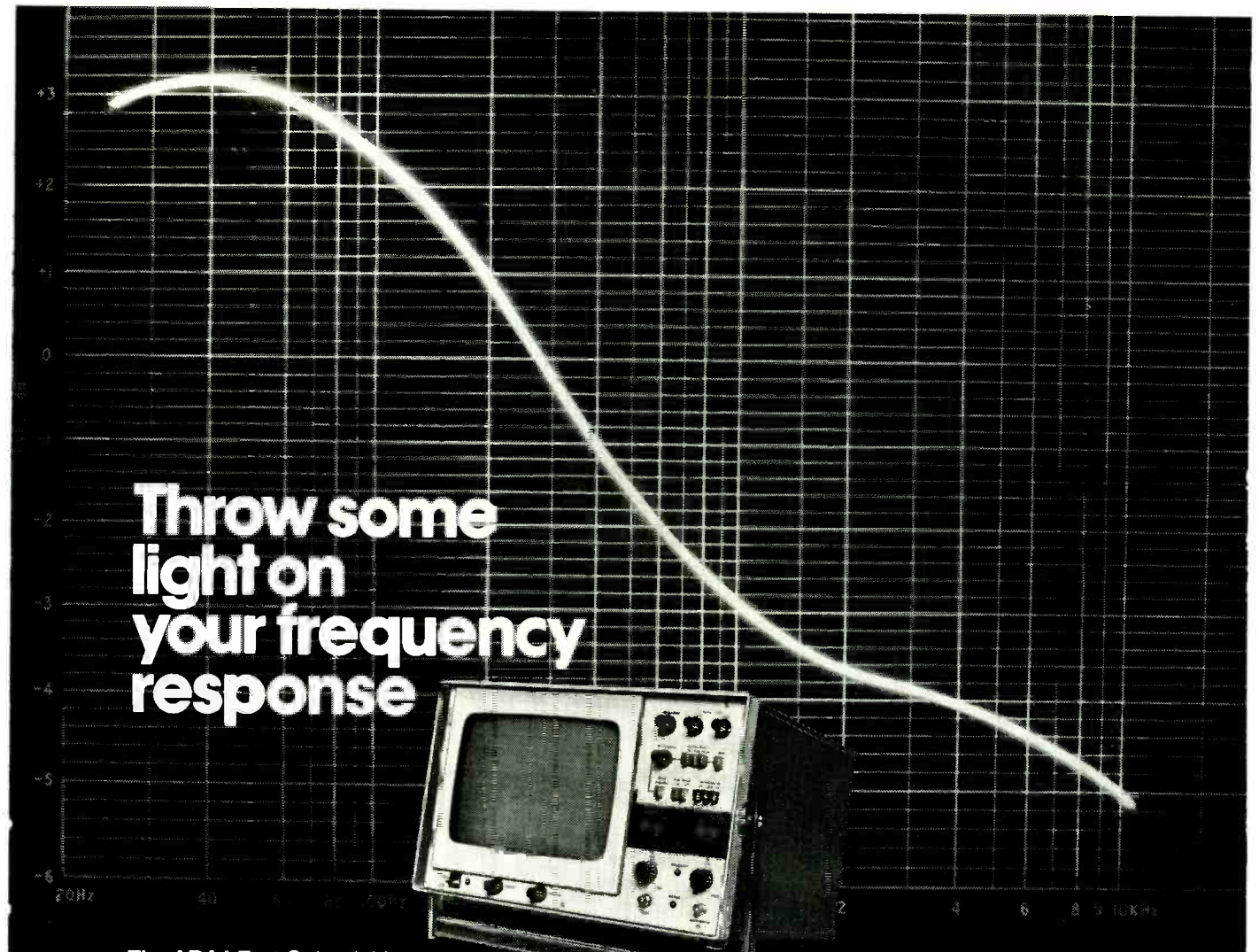

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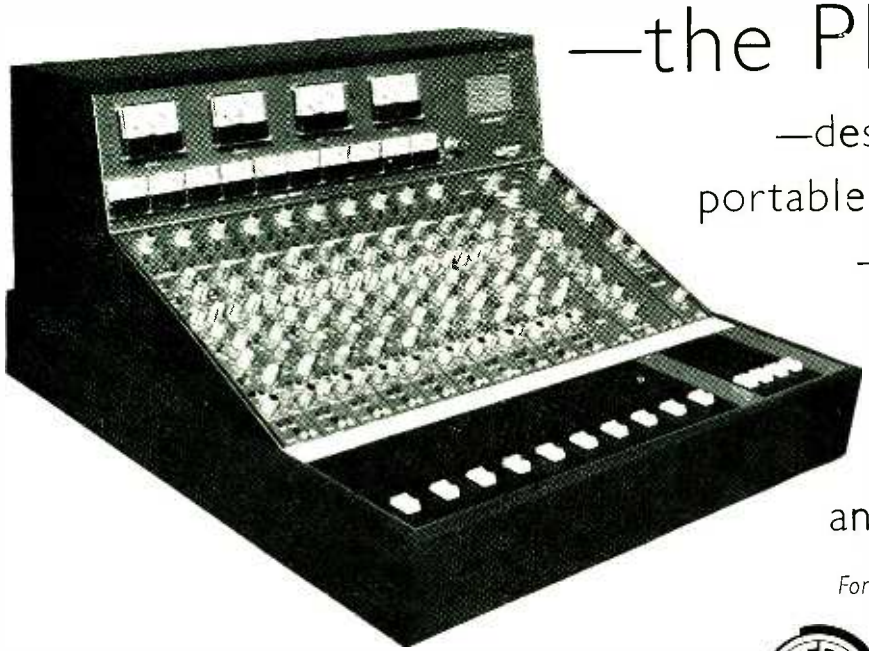

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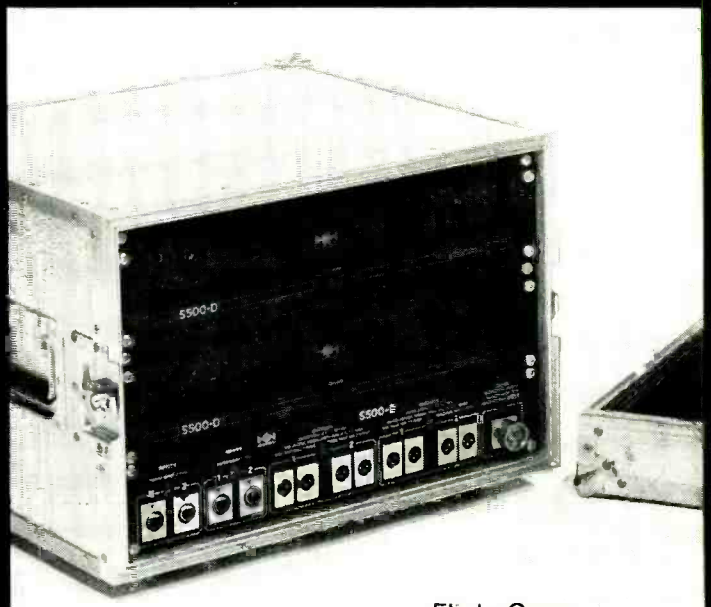

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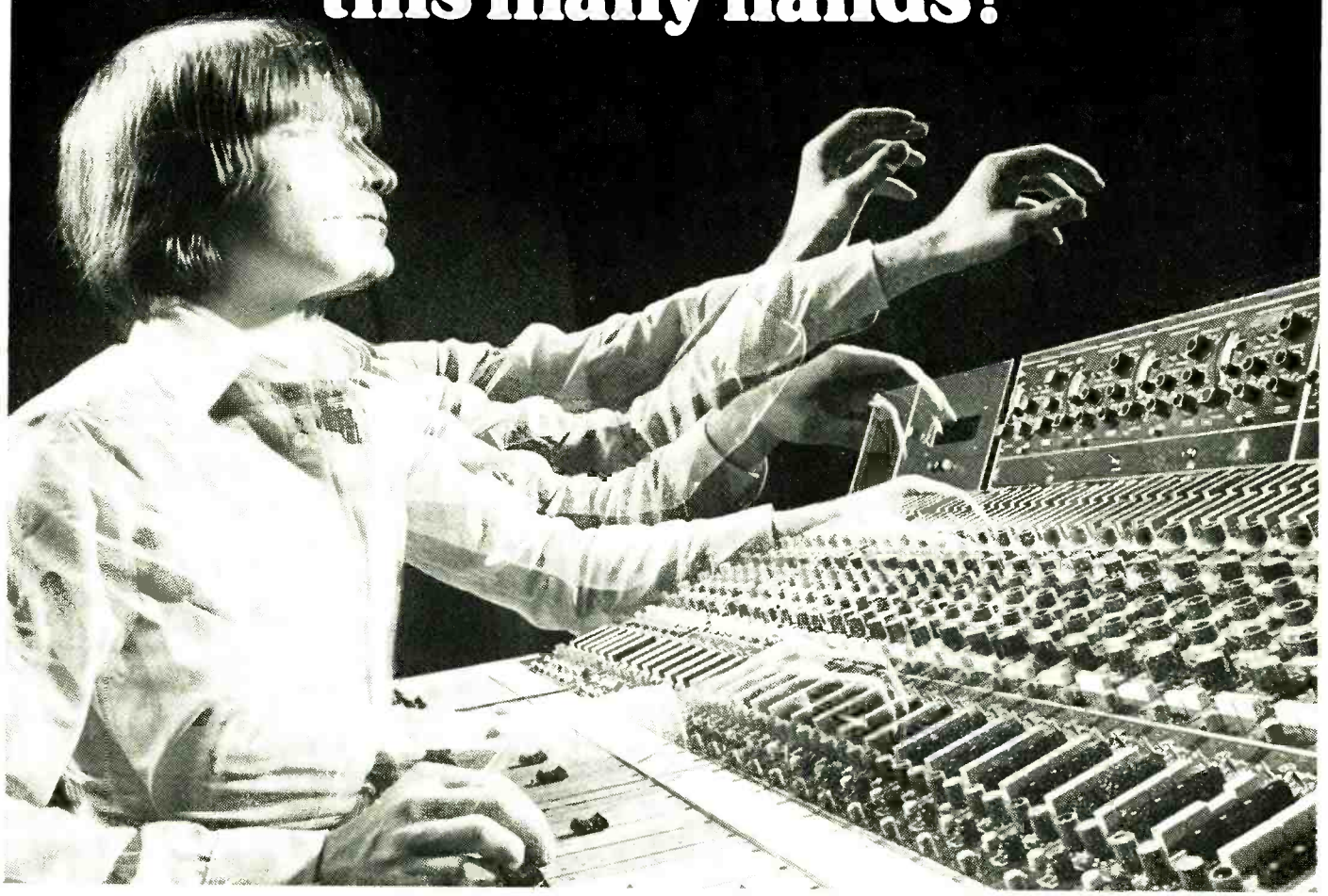
Geoff Emerick
Did you ever think you'd have this many hands?



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news

Amcron equaliser

This company now manufactures a stereo equaliser 'for professional use'. The *EQ2* features 11 bands of parametric eq spread from 20 to 20k Hz with up to ±15 dB of control. It also incorporates an unusual, if not unknown, facility. Each band has a control allowing ½-octave variation of centre frequency.

Balanced inputs offer either unity of +10 dB gain; leds are provided to monitor and indicate overload. Claimed frequency response is within 0.1 dB from 20 to 20k Hz with im distortion of below 0.01% at rated output of 2.5V.

Macinnes Laboratories Ltd, Macinnes House, Carlton Park Industrial Estate, Saxmundham, Suffolk IP17 2NL.
Phone: 0728-2262/2615.

Small Studer mixer

Studer has introduced a modular construction mixer allowing incorporation of up to 12 modules. These may comprise of either eight inputs and four masters or 11 inputs and one master; naturally, any combination in between is feasible.

It occupies the same space as an *A67* tape machine. It contains rechargeable batteries giving five hours of continuous use. It can also be conventionally mains powered, or it may be run from an external 12V car battery using an internal dc to dc convertor.

Designated type *169*, each input section features balanced input, hi, lo and mid eq, pfl and solo switching. Modules also carry reverberation and foldback lines. The stereo version with twin ppms costs £3500.

FWO Bauch Ltd, 49 Theobald Street, Borehamwood, Herts WD6 4RZ.
Phone: 01-953 0091.

Trident change of address

The January survey of multitrack mixers contained an incorrect address for Trident Audio Developments Ltd. The entry should have read:

Sales office: 36/44 Brewer Street, London W1. Phone: 01-439 4177.

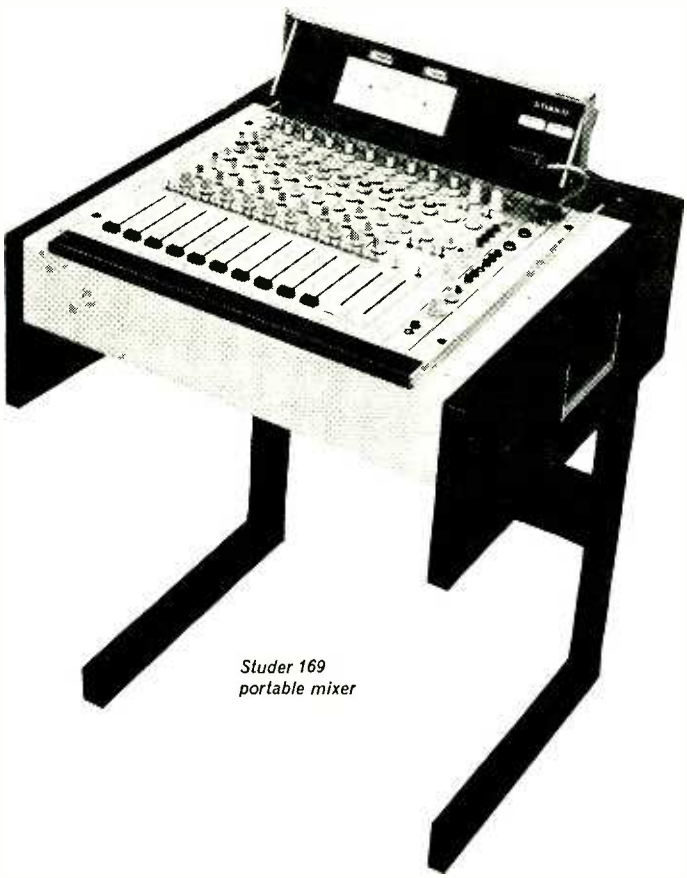
Factory address: Shepperton Studios, Squires Bridge Road, Shepperton, Middlesex. Phone: 09328-60241.

US agent (West Coast): Studio Maintenance Service, 2444 Wilshire Blvd, Suite 211, Santa Monica, Ca 90403, USA. Phone: (213) 990 5855.

Haggis

After eight weeks of non-activity in the recording scene, Craighall Studio is now back in operation after the completion of major alterations. The control room has been completely redesigned, and the floor lowered by three feet to give a larger cubic capacity. A new Neve *8058* Sound Console has been installed—the first to be commissioned in a UK studio—with facilities for 24 inputs and 24 outputs and quadraphonic mix-down. Sound monitoring is by JBL speakers and ancillary equipment includes an auto phase unit.

In the studio area, a balcony has been built to accommodate ten musicians, enlarging the total capacity to 30 performers. The mobile unit has been very active with a seven day session in Munster, Germany just completed, where a live recording of massed bands and choirs was recorded for the German Red Cross.



Studer 169 portable mixer

Matrix H — the best so far?

It's nice to know that the British Broadcasting Corporation spends our licence money on things other than turgid soap box drama such as *The Brothers* and famed BBC tea. The Corporation's engineering research department, after experimenting with matrix A, B, C, etc, has hit on the H variation which seems to be aurally the best matrix system so far devised.

It is almost certainly the most workable; the strongest feature of Matrix H concerns the claimed compatibility with *both stereo and mono*. This was convincingly shown at a recent system demonstration organised by designer David Meares using 'H' encoded discrete quad material from the tape vaults of the BBC. He acknowledges that this isn't perhaps the fairest way since it precludes the use of existing quad system material for a/b comparison purposes. However, he did state that no special recording techniques were used to produce the discrete four channel master tape; mic placement 'optimisation' would clearly have been impossible with many of the demo examples since some had been recorded before the inception of Matrix H.

The men from the BBC stated that they developed their own matrix system because all the existing concepts were inadequate *for broadcast use*. Carrier systems, such as CD-4 and UD-4, were ruled out because of transmission bandwidth limitations. QS was excluded solely through lack of mono compatibility; everyone agreed that it was capable of very good quad performance and excellent stereo compatibility but things tended to disappear when mixed to mono. SQ was regarded with little enthusiasm for both quad and mono performance although it offers good stereo. Any 4:3:4 system was discounted because the cost of small market volume tuners would be prohibitive since three channel transmission equipment requires more than just a simple decoder, connected to the detector output.

Matrix H represents a hybrid approach using the BBC's own encoding phase vectors and a logic decoding system 'mainly based on a commercial variable matrix decoder' believed to bear more than a passing resemblance to the Sansui *Variomatrix*. If the Corporation decides to adopt Matrix H for regular quad/stereo transmissions (and this is nowhere to being decided) then it will simply publish details of the matrix characteristic for use by anyone without payment of licence fee.

As demonstrated, Matrix H represents a real broadcasting advance enabling both four channel ping pong and rather more useful ambience. Sound images could be and were located solidly in almost any position except the side where they became very diffused, appearing to come from high overhead.

The BBC played an extract from the Britten opera *Paul Bunyon*. The solidity of the aural stage was quite remarkable, forming a semi-circle around the listener. If anything, images were almost too strong; at one point it seemed that the cast, walking around, must inevitably collide with musicians in the orchestra pit. Still, subtler mic technique should solve that.

Frank Ogden

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For full information or a demonstration of any of the Orban price-performance leaders, contact:
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NEWS

MFB Studio speaker

Philips, normally known for its dedication to the consumer market, has introduced a motional feedback loudspeaker aimed specifically at studio monitoring applications.

Using a tri-amplified array, the *545* 100W unit produces a claimed 108 dB spl measured at 1m. The power amplifier electronics, housed within the speaker enclosure (70 litres) incorporates a 50W bass amp/driver utilising the mfb correction principle, a 35W mid range amp/dome driver and a 15W hf amp/dome driver combination. All three amplifiers and their associated drive units feature electronic cutouts in the event of excessive power dissipation. Input is balanced line with both DIN and Cannon plugs as standard fittings.

The mfb principle used in conjunction with the bass driver is fairly well known. Philips use a piezoelectric transducer element attached to the bass cone centre which continually monitors acceleration of the cone assembly. The output from this is differentiated to yield positional information which is then compared with the input signal in a simple comparator. The difference signal produced drives the bass amp/driver combination.

The manufacturers state that the main advantage derives from the reduced distortion produced at high level, low frequencies. Further, the system claims to extend the bass response further down the frequency range to a point not normally associated with the actual enclosure size used.

A brief demonstration of the *545* speakers proved fairly convincing as to system operation. However, this was a subjective impression without any kind of reference point, but even so . . .

They cost about £670 each. Philips Electrical Ltd, Century House, Shaftesbury Avenue, London WC2H 8AS. Phone: 01-437 7777.

Automatt

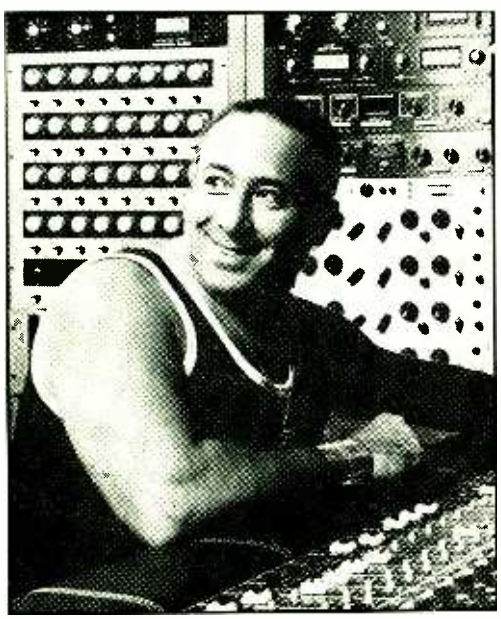
Situated in San Francisco, it provides both coffee and studio time. It also claims to be the first studio in the world to interface an Allison *Memory Plus* automation system with a Harrison *4032* mixing desk.

David Rubinson—once fired by Capitol Records in 1964—built the studio as a logical extension to his recording and record production interests; Fred Catero, long time buddy and constant engineering companion, will head the engineering staff. As such, the operating company is called David Rubinson & Friends Inc.

They describe their studio as 'not gigantic'; rather, they refer to it as 'small and intimate allowing complete interchange between and among the various people involved in recording'. One of the most interesting features is musician foldback system. Designed by Eric Porterfield of CBS, it uses a special four track headphone cue arrangement enabling each and every musician in the studio to mix his own cue balance. This means that any and everyone may make his own mix of all the relevant inputs potentially supplied to the foldback cans; he doesn't need to rely on a compromise balance selected by the session engineer. Very unusual. . .

The studio address is: The Automatt, 827 Folsom Street, San Francisco, Ca 94107, USA. Phone: (415) 777 9230.

David Rubinson & Friends Inc.



Fred Catero of Automatt smiling

RCA custom consoles

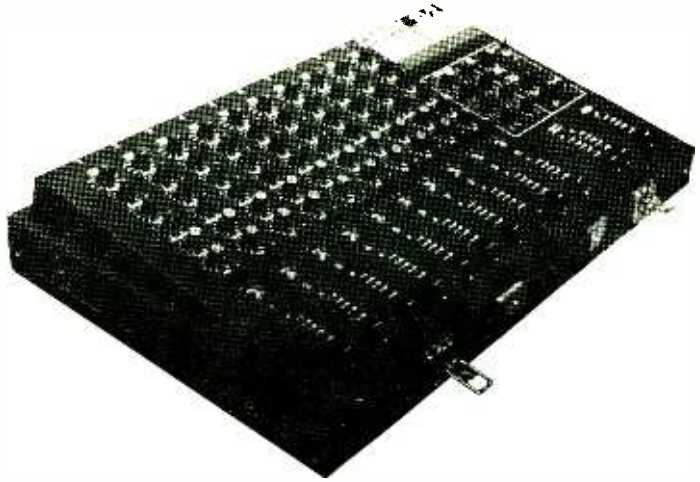
A new booklet is available which provides detailed information on the RCA *BC-50* custom audio modular self build mixing system. It includes instructions intended to help potential users self design desks to individual specifications within the standard ordering framework. It describes each of the modules and the submodules that are combined to form either a mono or stereo broadcast mixing system.

The booklet, RCA catalogue number *3J5924-1*, is available from RCA Broadcast systems, Audio/Radio Equipment, Building 2/5, Camden, NJ 08102, USA.

NAB 77

The annual convention of the National Association of Broadcasters will take place at the Shoreham Americana Hotel and Sheraton Park Hotel, Washington DC from March 27 to 30, 1977. Reports suggest that there will be about 200 exhibitors at the accompanying exhibition.

In the States, the contact phone number is (202) 293 3500. In the UK, the US trade enquiry service should be able to help. Phone: 01-499 9000.



This Canary 10/2 mixer costs only £255

New Canary for £255

Canary Mixing Desks Ltd has introduced a 10/2 portable mixer for use by either small bands for live performance, or in small scale recording applications.

It features 10 low impedance balanced inputs, three band eq on all channels, foldback and echo send/channel, pfl, panning, master vu meters and master eq. There is a headphone monitoring facility. The unit is housed in a flight case complete with power supply and costs £255.

Cannons will set you back a further £25.

Canary Mixing Desks Ltd, 17 West Hill, Wandsworth, London SW18 1RB. Phone: 01-870 7722.

Response plot

The UREI response plotter is now available in the UK from FWO Bauch Ltd. The model *200* is relatively low cost and is said to provide high resolution plots from a variety of audio equipment at high speed.

It consists of a basic mainframe housing a Hewlett-Packard high resolution 51 cm/s chart recorder. A plug-in electronics module provides swept frequency and signal reception facilities covering the range 20 to 20k Hz. Sweep time is adjustable from 15s to 20 minutes using a vernier control, or preset times of 15, 30, 60, and 120s. In addition to sweep, frequencies may be manually selected or calibrated against spot tones.

The unit claims an important design feature in that automatic rate sensing slows down the sweep rate when amplitude excursions become very involved; this has the effect of increasing the resolution of the instrument where it matters. Further, it optimises the time taken for a complete sweep.

Specifications include a 0.05 dB resolution from 20 to 20k Hz with a claimed 64 dB dynamic range.

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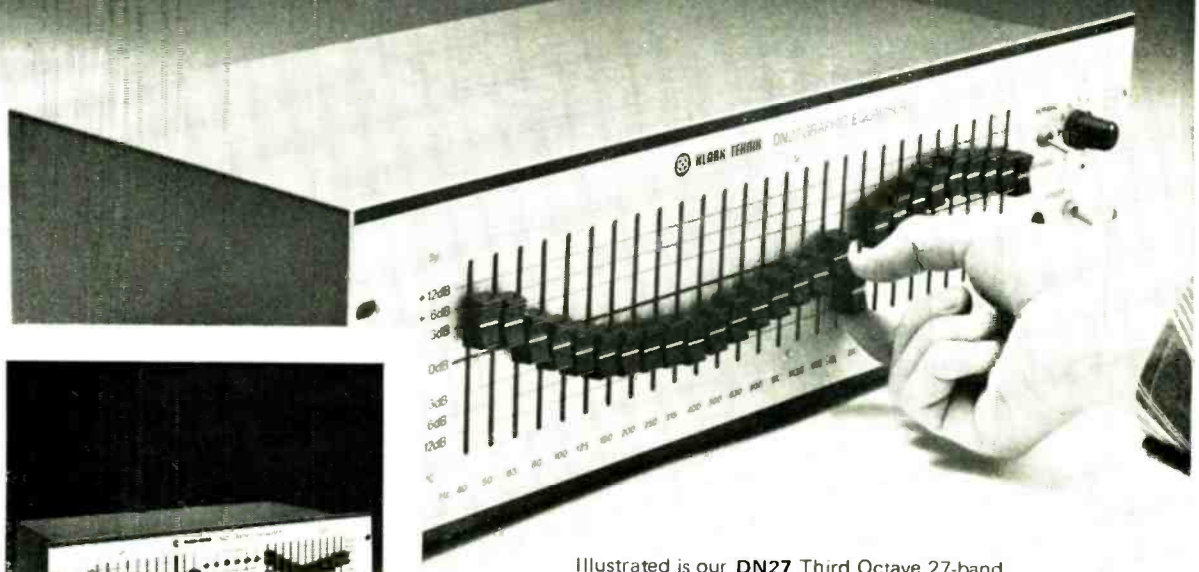
they have...

PERFECTION AT THEIR FINGERTIPS



Illustrated is our **DN27** Third Octave 27-band **Graphic Equaliser.** Also shown is our DN22, dual-channel, 11-band unit. Both have many technical plusses which our literature describes.

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NEWS

Both metric and imperial scaling can be pushbutton selected with the chosen scale being shown by leds. United Recording Electronics Industries, 11922 Valerio Street, North Hollywood, Ca 91605, USA. Phone: (213) 764 1500.
UK: FWO Bauch Ltd, 49 Theobald Street, Borehamwood, Herts. Phone: 01-953 0091.

Partridge change of address

Partridge Electronics has moved to a temporary address although the present telephone number remains the same:
Partridge Electronics, Homestead, Canvey Road, Canvey Island, Essex.

Erecting a Marquee . . .

Tom Hidley of Eastlake Audio was asked by Marquee Studios to finish off and revamp the new remix suite in November following rather harrowing scenes with others involved during the erstwhile construction work.

He arrived in England on November 16; after signing contracts, the Eastlake crew started work on the 22nd. Work was completed by Eastlake on December 12 with the finishing touches being put by Marquee's Jerry Browse by December 15. The result is a 24-track room equipped with a small overdub facility. The desk is an MCI *542* with 36 input channels and 32 outputs.

Fresh Air

Amidst the gentile tinkling of champagne glasses, AIR studios opened their No. 3 equipped with the new NECAM system manufactured by Neve. This is undoubtedly a first for the studio already well known for not being slow with systems technology.

Naturally such an auspicious occasion produced a considerable number of clichèd words from many people, several of which came from Air Chairman George Martin: 'NECAM is the logical step in our continual aim to be at the forefront of technological developments in the sound industry and to provide the best recording facilities available anywhere . . . NECAM is another first for AIR. Before choosing it, we looked at all the automated systems on the market and decided that it offered the most flexibility and efficiency to the mixdown process.'

Much the same sentiment was echoed by another, less well known person who left his glass in the path of a servo-controlled fader: 'Christ!' Fortunately, it was empty.

The Neve NECAM system needs little further introduction (see STUDIO SOUND, May 76, p14) and tends to overshadow the other lavish facilities which make up Studio 3. The basic desk is a 30/24 with servo faders: you could hardly tell by looking that it wasn't the standard Neve product. This must come as an advantage to unaccustomed NECAM users. There are no less than six tape machines: two Ferrograph *Studio 8* for special effects, a 3M 24-track master and three Studer *A80R* for reduction. To go with these, there are 36 Dolby channels.

Other equipment includes Tannoy monitors, Crown *DC300A* amps, Eventide *Harmonizer*, *Delay* and *Flanger*, two UA and eight Neve compressor/limiters, a complete Audio and Design *Scamp* system as well as a couple of Klark Teknik graphic equalisers.

Not bad for one control room.

Marquee remix; L to R: Gery Collins, Tom Hidley, John Eden, Pip Williams, David Hawkins and Simon White

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Where you can also take the opportunity to look over the Allen & Heath Mod II mixer. It's offered with the tape deck in a uniquely priced package deal.

Or for more information call Andrew Stirling 340 3291.

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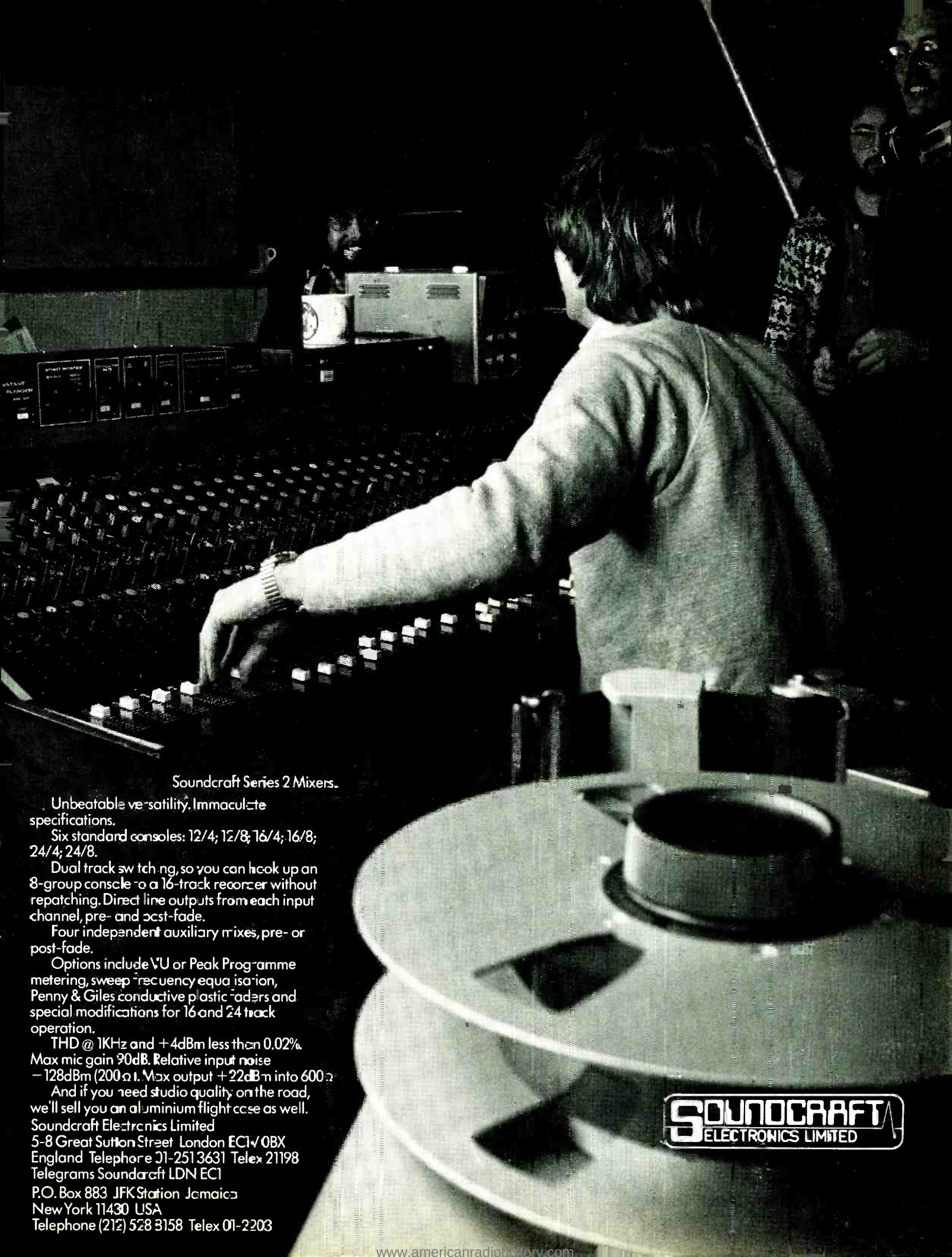

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The Cadac approach to automated mixing

ROBIN BRANSBURY*

The design philosophy behind the new system.

*CADAC (LONDON) LTD.

THE concept of automation in sound recording is not new. As far back as 1939, RCA were working on methods of tying the audio chain of film soundtrack recorders to the frame count along the piece of film concerned. Surprisingly, almost all aspects of modern computer-assisted mixing were used in such early applications; even voltage controlled amplifiers using variable μ valves were incorporated.

During the war years, though, the entertainment industry remained very largely static; the use of analogue data storage for flight simulation developed by leaps and bounds and a good many techniques exploited then find application in present-day technology.

During 1959-60 Teldec (Telefunken-Decca) conceived the idea of motorised control elements as a means to automatically adjust gain, equalisation and disc cutting commands using a system of optical pick-off from the master tape in an attempt to achieve the elimination of human error in disc cutting and tape copying. Polygram introduced a system of recording desk data on the master tape in 1971 which used a high frequency data stream recorded *between* audio tracks. This system was never commercially exploited outside the company; it is installed and used in Polygram studios at Paris and Hilversum.

The ill-fated Olive company managed to get a system of desk automation running before they closed in 1973. The first commercial exploitation of automated mixing as a package for fitting in mixing consoles was the Allison system which was relatively successful in terms of sales. Since the concept was so new to those customers who installed the system, they were content to overlook the inevitable drawbacks which were found on the early models and cheerfully nursed the system along, getting some very presentable results.

Information theory

The main problems experienced in the early days of commercial automated mixdown systems using the audio machine for data storage find their root in information theory. In one form, it states that the amount of error-free information passed in unit time through any communication channel depends on the applicable signal-to-noise factor of that channel. If the information is transmitted at a level which is effectively infinite compared with the background noise, then obviously complete intelligibility should result. However, if the channel is momentarily broken for any reason, this may coincide with an important data character which may be lost or degraded in some way. Alternatively, when the information is sent at an infinitely slow rate compared with the rate of the disruptions on the channel, once again perfect intelligibility should result.

This far the boundary conditions have been set out; the real world lies somewhere in between.

Taking the level of transmission first; all dedicated magnetic data recorders record their signals at full medium saturation. The current passed through the record head windings is sufficient to produce magnetic saturation in the coating even if this is spaced away from the gap by small quantities of dirt, grease or dust, and even when the area of medium concerned was previously saturated in the opposite polarity. No erasure of previous information is needed nor is bias used. Obviously this technique is not applicable to audio recorders unless the data track is spaced a very long way away from a used audio track and the record amplifier beefed up considerably, otherwise crosstalk of data to audio tracks is inevitable and full medium saturation will not be achieved.

If the amount of information per unit time is severely limited so that the influence of dropouts is negligible, then the audio machine can be used with a low-level data signal removing the crosstalk problem. However this gives a data capacity so low as to be unsuitable for anything except the logging of simple switch closures and slow level changes due to the limited number of data characters stored in unit time.

If all these limitations are true then one may ask how any of the many audio machine-based systems worked at all. The answer lies in the phrase 'perfect intelligibility'. If a certain error rate is allowed then the data rate can be speeded up considerably. The important factor to consider now is the minimisation of the impact of such data errors.

Data rate

To memorise the settings of the controls of a system, each control must create a signal which tells the outside world where it is at any one moment. In audio consoles, the safest signal to use is a voltage which varies at the fairly slow rate of the control's movement and constitutes a dc level when that control is static. For recording as a digital signal, the dc level is converted to a digital word in an a to d (analogue to digital) converter. This is a device capable of producing proportionally ascending steps of voltage, each step recognisable as a set of digital 0's 1's with a binary numerical value equal to the instantaneous level of the incoming signal. These can now be stored as data. If several channels are to be processed, each one can be given a distinct binary code which is called its 'address', and prefixes the stored data. An 8-bit binary code on eight parallel wires gives 256 different combinations. If 256 different levels of 256 different controls have to be stored, each one can be represented by two 8-bit words or *bytes:* one for the address and the other for the data.

To store bytes on a data recorder, they must be converted

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from parallel signals on eight wires to serial signals on one track so that the signal on wire number one is the first pulse encountered in the data stream and so on. In the reverse direction, when the data stream is replayed, it is first reorganised to parallel form and, assuming that the address arrives first, that address activates a d to a converter which recreates a dc level appropriate to the digital word which follows.

To estimate the rate of data generation, the mode of processing must be considered. If each of 256 controls must be encoded once per second and each must be encoded to 8-bit accuracy (256 possible levels), the data rate will be:

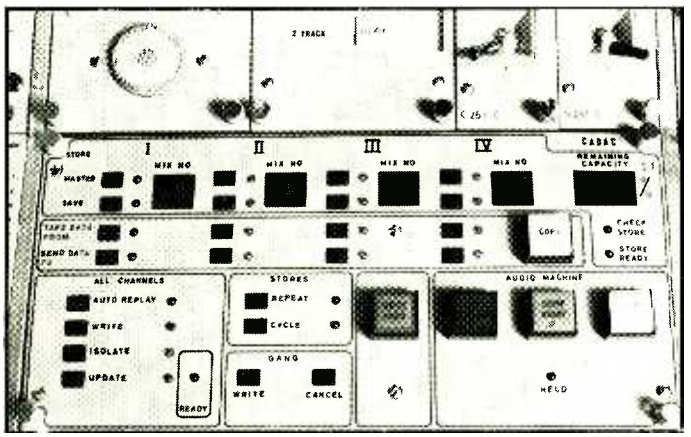
$$\left.\begin{array}{l}\text{256 functions as 8 bit address}\\ \text{and 8 bits data}\end{array}\right\} = (8 \times 256) + (8 \times 256)$$
$$= 4096 \text{ bits/s}$$

If the scanning must be done at 100 times/s so that continuous control movement can be regenerated as a virtually continuous replica, the data rate will be 409 600 bits/s. Clearly, such high data rates just aren't on. Even assuming that the data can be recorded by using a special code which only requires the same bandwidth as the data rate itself, ten scans/s is still going to require 40 kHz bandwidth.

More reasonably, supposing 16 controls are scanned at ten times/s, the data rate will be:

$$\left.\begin{array}{l}\text{16 functions}\\ \text{10 scans/s}\\ \text{4 bits address}\\ \text{8 bits data}\end{array}\right\} = 10 \times \{(4 \times 16) + (8 \times 16)\}$$
$$= 1920 \text{ bits/s}$$

So it should be possible to record 16 control status on an audio



machine with a reasonable error rate even using a quite low recording level. In fact, using good quality tape on a machine in perfect alignment where the face of the tape is never allowed to come into contact with any contaminant, error rates of 1 in 10^6 bits should be possible, ie one should expect only one bit to go awry in one million bits of recording. Thus on a 16-function array, scanned 10 times/s, only one error should occur in 8.7 minutes of data recording.

$$\frac{1\,000\,000}{1920} \text{ seconds/error} = 520.8 \text{ seconds/error} = 8.7 \text{ mins/error}$$

If the error concerned is the least significant digit in one of the data words for the control level then it will go mostly undetected. If, however, an open function's address is confused with that of a closed one, then the error will be very noticeable indeed since the system then opens another channel. However, one thing is certain: errors will occur and all that can be done is to minimise their impact.

By adding check bits to the data byte, some of the data errors can be eliminated. If the number of '1's in the byte are counted and a further bit added at the end, which is one if the count is odd and 0 if the count is even, then the calculation may be performed again on the replayed data, and bytes ignored if the check shows that an error has occurred. Parity checking, as this technique is called, reduces the incidence of errors quite dramatically and only introduces a certain roughness of control movement owing to erroneous information not being passed through.

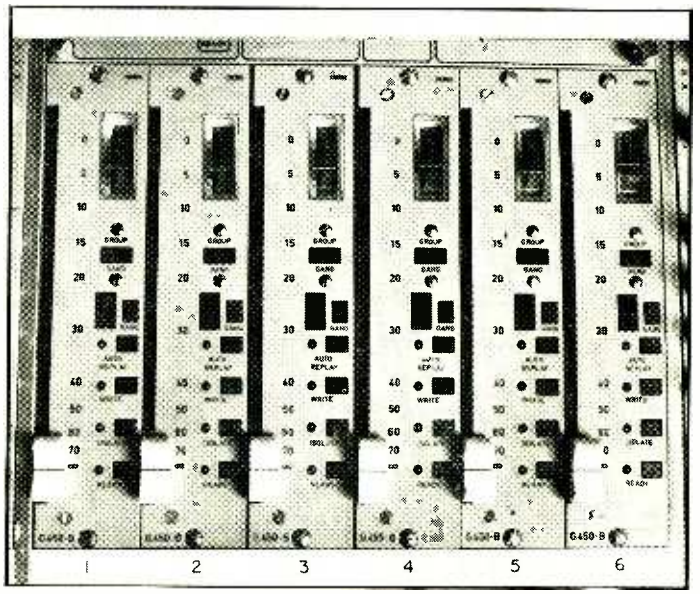
Data storage

The remarks about keeping the audio machine scrupulously clean and aligned and not allowing the tape to be touched, if ignored, can have quite disastrous consequences because low recording levels must be used. Dust and dirt adhering to grease cannot be recorded through, resulting in increased error rates. This problem dogged the early automation systems; some recording studios are not renowned for cleanliness and some do not align machines as often or as accurately as they should. The results of poor data track error rate are sometimes fairly pernicious; fades, initially recalled as smooth, progressively become rougher as more data is lost, quick cuts to remove mistakes can stop occurring altogether or stay down much longer than previously programmed. The quick cure for these problems was to increase the data record level, often to peak and beyond, while ping ponging nearby audio tracks away from the heavy crosstalk areas around the data tracks.

Other methods of nullifying data faults were tried. The simplest of these is to send all the recalled data back through the d to a converter, smooth out any roughness in the dc produced by lowpass filtering and then take the smoothed dc back through the a to d converter for subsequent storage. This technique was used on a number of automation systems produced during the early 1970's. On the face of it, the technique does produce smoother recalled control action and, as long as the number of generations the data track goes through is severely limited, the delay produced by slowing the rate of change the data can cause will not be immediately noticeable. If a complicated mix is attempted with several updating runs it must be borne in mind that *all* previous data will be delayed by the a to d/d to a conversion and that recently recorded data will in fact lead old data in time.

Basic information theory still holds with the analogue smoothing types of systems and, as shown above, 16 functions to 8-bit accuracy is still the practical limit for reasonably error-free data storage on the master tape, assuming regular maintenance and highly circumspect tape handling.

To increase the number of functions handled, the only practical solution was to record the data at saturation, or use a slaved data machine via a synchroniser. This last solution was finally adopted by a number of studios who had bought early automation systems either as packages or as inbuilt facilities. The only problem with the slave machine technique was that the machine usually used was in less than optimum condition for data storage, tending to be an old valved 4-track dug out from the cellars, or a semi-professional machine pressed into service and often quite incapable of reliable data recording as such. To understand why 34▶



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a proper data recorder was not usually bought, one must realise that a studio's automation system had by then given so much trouble and caused so many heated and vitriolic arguments between producers and engineers that spending any more money on the system was regarded as useless, and maintenance staff had to use what was available.

The further thinking equipment manufacturers quickly began to realise that the promise of expansion of the very simple early systems to accommodate many more functions simply was not going to be possible and totally different solutions to data storage problems would have to be sought. Any computer engineer looking at the early methods of data storage adopted would, and probably did, raise eyebrows of surprise finding that media with error rates, which he would find totally unacceptable, were being used to store quantities of data that were quite astonishing.

The first and most important task was to reduce the enormous volume of data. During a mix, several controls are unused or set and largely forgotten. Real time storage requires that the status of all controls be known, stored and recalled at any instant. Even using master tape storage it would be possible to slowly scan all functions during a lead-in to the material to be mixed and then only record those changes which occurred afterwards. Such a degree of data compression would ensure almost error-free operation. The only snag is that the material must always be started from the beginning to ensure that the picture built up at any instant reflects all the changes that have taken place up to that point. No one seemed very keen on a system that had to run through ten minutes of playback simply to get the coda just right. But the idea was, in principle, a viable proposition. All that was left was to find a store agile enough to be able to run through all the changes that led to the desk status at any instant when that instant was selected on the master tape. Further the store must be portable and non volatile.

Four candidates for the medium were proposed; each has its benefits and disadvantages. Reel-to-reel data tape is the first but must be discounted simply on cost grounds, in that a computer grade reel-to-reel mechanism is not available at a reasonable price. Nor are they particularly quiet owing to the use of pneumatic loop storage. Data cassette is a real possibility in that using two mechanisms in interactive mode, one recording new data while the other replays the previous attempt, does provide a fairly agile store. The only drawback is either that of capacity or error rate. Tape guidance in cassettes is still a problem in that, given the very confined space around the head assembly, there is no room for high precision tape guides of sufficient length to ensure complete absence of wander. Medium utilisation tends to be rather low for this reason; recording density is kept down so that a reasonable error rate is obtained. At this point it should be remembered that the store must be as near perfect as possible since an error made early in the build-up of the desk's status may not be corrected later, and in the extreme be carried through. This apparent fault does have one good point: such errors when they occur are obvious and, thus, easy to correct rather than being cumulative or ephemeral as described above.

The third candidate was the true data cartridge with inbuilt drive mechanism designed and made by 3M. Machines to drive *DC 300* cartridges were rather expensive, and to use two mechanisms in interactive mode becomes prohibitively expensive. On the available drive mechanisms researched, the speed of the tape movement is also kept as low as possible to protect the medium which, although a very wise precaution, tends to make the store rather sluggish in response to search commands. The error rate and capacity are reasonable in that four data tracks can safely be stored per cartridge, each track taking the data from about 20-30 minutes of mixing time. The error at this density although not quoted on the literature appears to be around 1 in 10^8 from interpretation of claims made. The criticisms of the cartridge were mostly aimed at the available drive mechanisms. Owing to speed limitations on search and shuttle modes, it was found that some fairly surprising techniques had to be used to keep the master tape and cartridge in close sync. One system proposed a synchronising code which could be read by the housekeeping circuitry in the storage processor even when the tape was being spooled fast. In order to do this, all the replay amplifiers in the tape machine had to be modified to increase their hf response. Alternatively a dedicated wide replay bandwidth guide track cleared by ping-ponging before mixdown was done on tapes from outside. Spooling had to take place in contact with the replay head and special cut circuitry added to those tracks which were not involved with the timecode track.

It is not known if such a system has ever been implemented but the fast spooling of high energy tape across heads is not particularly likely to lengthen head life owing to the uneven wear that usually results. The other major drawback of using any single data store which does not run in real time is that of anachronism. Supposing 30m of data tape are used to memorise the intro of a piece of material and, while listening through the middle section, it is realised that two or three overdubs are going to be necessary; the middle is left and the end is worked on consuming another 30m of data tape. Since the controls were not moved during the middle section, no data is stored, so the data tape contains the beginning and end without any room for the middle. Assuming that the middle section has been left because it is complicated and will consume around 100m of data tape, it is unclear how the first try at memorising it can be done when the 30m of store containing the ending's data are well passed and must be tacked on the new end to maintain real time sync, even though the start of the 30m end piece is 100m back down the tape. Obviously if a second mechanism is used the problem of anachronism cannot occur since the present store will carry on while the previous store waits to produce its data at the right moment. Altogether the data cartridge is a most useful device and will be used extensively when the price and flexibility of mechanisms allow.

The final candidate for storage is the floppy disc system developed by IBM as a convenient means of non volatile high agility store. The point about the disc is that the same information keeps being made available so, if an error is found in the last try at replaying it, assuming a reasonable buffer store (enough for say 10s mixing), the disc can look at the same data 60 times to estimate the possible data faults that could have occurred before the erroneous data has to be used. The processing circuitry that lays the data on the disc performs a set of calculations which result in a certain digital word being written into store just after each block of mixing and address data has been memorised. When this data is recalled, the same calculations are performed again and if there are any disagreements the entire block is dumped and read again (just like parity checking but over a longer block of data). The most likely cause of such an error is a small particle of dirt on the disc surface which will be wiped off before the next attempt at reading. If the contaminant is grease, it may take several passes to clear the fault, hence the use of at least a 10s buffer.

In many ways the construction of a disc store mechanism is more complex than a cartridge drive. However, owing to an enormous price battle for supremacy in the disc store market, unit prices are in fact extremely low. For these reasons it is obvious that on price and performance grounds, disc storage is vastly preferable to any other. The only remaining problem is capacity. The original IBM format for applying data to the disc is immensely wasteful in that large gaps are left to indicate the start and end of pieces of data, and the dividing up of the disc into storage areas is accomplished by information pre-recorded on the disc. Although the format suited IBM, it does not suit the automated mixdown process. A floppy disc can hold over three times the IBM standard capacity by intelligent use of the medium, and stores which use the extended format are now available. It is interesting to note that the three most recent entries into the console automation field all use disc stores.

Mnemonic mixing at Cadac

Under consideration for some years (see STUDIO SOUND May '72), Cadac's programme to convert a standard audio console to voltage-controlled operation was realised in March 1976. Initial studies prior to that date had shown that most of the systems already on the market had serious drawbacks in several areas.

The first and most basic problem to be solved was that of voltage control itself. With one exception all the proposed or available systems used the classic voltage-controlled amplifier whose advantages and disadvantages are too well known to be reiterated here. Suffice it to say that if Cadac had used classic voltage- 36 ▶

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controlled amplifier technology, some aspects of the console's performance would have been affected, and the reputation for quality gained by many years of refinement would have been compromised.

A research programme was launched to find the most suitable method of voltage control which could be economically incorporated in the confined space under a standard fader. The avenues explored included electro-mechanical methods; electro-optical methods, purely digital methods and mixed analogue-digital methods. Each contender offered initial promise and each proved unacceptable for one or many reasons. It should be said also that each method produced interesting spinoffs in related and non-related fields of general studio technology, some of which will become available as products during 1977 and 1978. Finally during a weekend brainstorming session, the answer appeared and the *V-CAT* concept was born.

It may be known that Cadac uses thick film techniques to solve some of the more intractable problems of signal processing in console design. Close liaison with the same thick film engineering facilities led to a unit which fulfils the requirements of voltage-controlled attenuation in a confined space and with minimal impact on the audio path through the gain controlling section.

In the vast expanse of a typical studio console, one may wonder why space for voltage control circuitry is at such a premium. The answer is that to produce a system which can be retrofitted to existing consoles requires the extra circuitry to be packaged in a module that occupies the normal volume allocated to a fader and its connector.

The greatest boon to the designer of this type of circuitry is the cosmos logic series. It consumes next to no power, it is incapable of switching at massive interference generating speed and it can be used to switch both digital and analogue signals with logical commands. Using a simple command buss system to link all the modules together highlights the other valuable property of the series—its high input impedance. Most of the command inputs to modules are simply run in parallel from low current busses. When more than 50 modules have to be driven, without interaction, from any of the command busses, it is not hard to see that a high input impedance at the command input ports is essential. Using the cmos series allowed a very comprehensive logic system to be devised without producing large amounts of heat and buss loading problems.

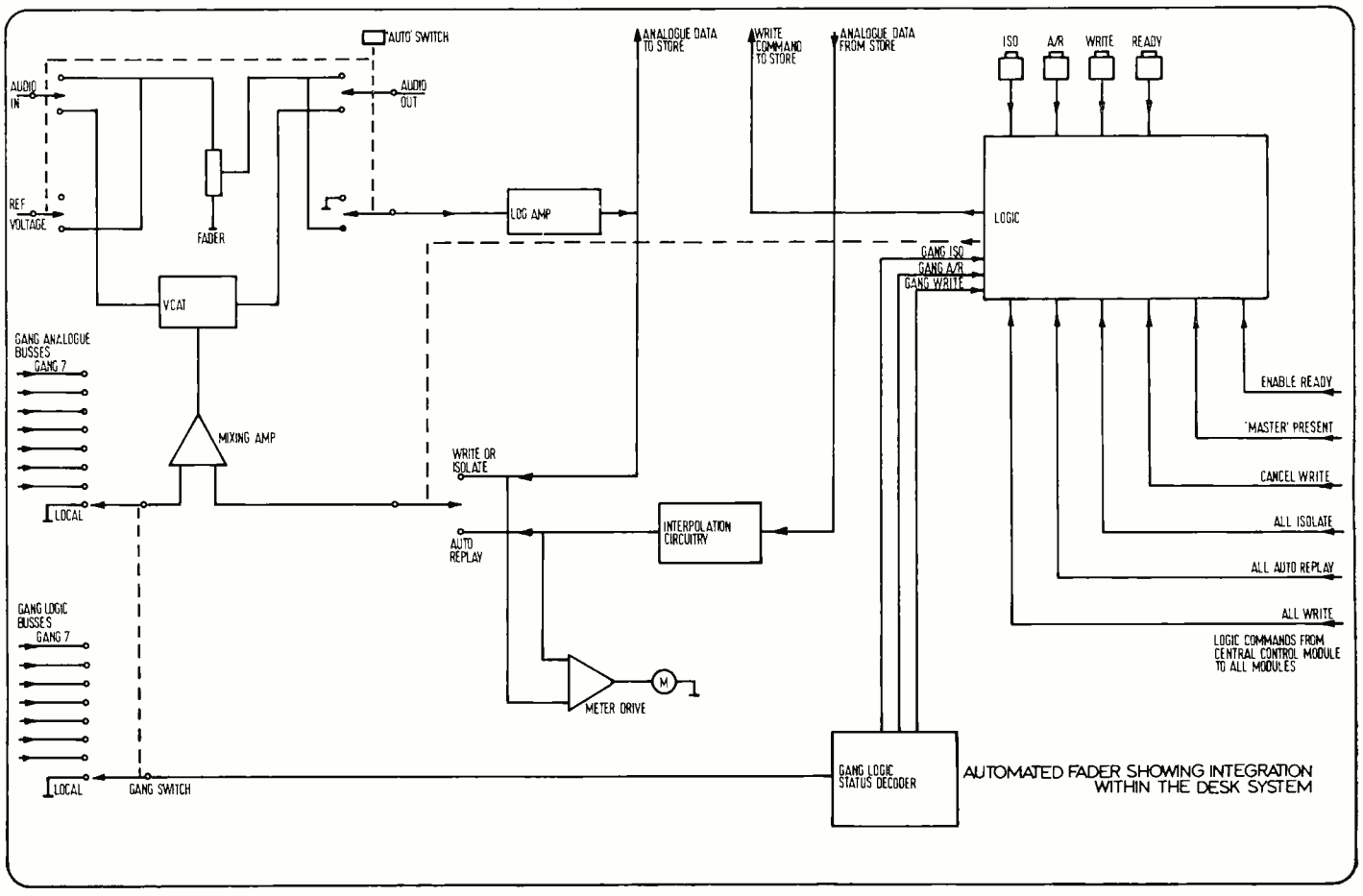
The basic commands are 'ISOLATE' where the fader controls the audio via the *V-CAT* and the voltage corresponding to the fader's position is ignored by the store. 'WRITE' which is identical to isolate except that the position voltage is stored for later retrieval. 'AUTO REPLAY' where the voltage replica of the faders position is used to control the audio passing through the *V-CAT*. Using these three commands, the engineer can rehearse a passage. store the mix created when it is encouraging and then listen to the result.

Each module also has a 'READY' button which allows those modules selected as 'ready' to be placed in 'write' when a central control or a roving switch is closed momentarily. A second switch closure reverts the ready modules to their pre-selected conditions. Other logical inputs to the module cancel any write function at the end of a mix, and allow all modules to be forced into a specified function at once.

Ganging system

To implement the ganging of various faders together so that they may all be moved up and down in perspective, all that is required is to mix a variable external voltage with that provided by the local fader or its stored replica at the *V-CAT* driving busses. This external voltage may be derived from another fader or indeed any external source which is either fixed or varying. Clearly any logic command applied to the source of the ganging information must be similarly applied to those faders which are receiving the information, thus ensuring that the read and write configuration is constant inside a ganged formation.

In theory any fader could be used to supply the variable offset voltage. However, using channel faders could result in confusion in



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that signals passing locally through that fader would be varied in sympathy with the gang condition. Further, the presence of two or more faders sending different gang information would have to be sensed and allowed for. For those reasons separate gang sending faders are provisioned, each hard-wired to separate control busses. Each channel fader can access the various busses from a local push button command alternately counting through the busses in order. An external voltage source can cause each fader to assume a gang status determined by the level applied to an analogue input to the module. An analogue voltage corresponding to the selected gang number is also available from the module for storage purposes.

In practice, to keep the intercommunicating lines between the console and the external store to a minimum, provision is also made to switch the control voltage input/output ports from the *V-CAT* and fader to the gang number send/receive lines, either individually or collectively so that an external analogue store can memorise the desk's ganging status for later retrieval.

In order to simplify the desk wiring, the gang logic status is encoded on to the logic busses as one of 3 dc levels since the three different commands would require two logic lines if simple binary were used. This refinement only comes into its own where a large number of gang busses are incorporated; however, it has made the wiring harness surprisingly simple when only seven gang master faders are incorporated.

The gang logic communication network was designed with two considerations in mind. One is that the number of wires linking the system must be kept to an absolute minimum to allow for retrofitting in the tight space normally available in a console's fader area. The other is that no form of clocking of data can be allowed to occur during a mix since the clock waveform would be bound to be injected into the audio paths unless all data lines were screened, thus adding to the harness bulk.

As a further refinement, the source of offset voltage on the gang sending fader is switchable from local reference to external input. This external input is normally provided by a master gang fader which is accessed by the subsidiary gangs in the same way as the channels access the gang senders. This master line can also be accessed by the channel faders if required. In this way, the entire desk can be faded, channels and gangs, by a single control. The gang faders can be set up to control subgroup audio if required so that both subgroup, gang and channel audio can be faded at once.

Echo returns are also functions which are normally automated and these controls can also access the gang busses, so with echo returns on a local gang and channels on the master gang via sub gangs if required, the direct and reverberant audio can be faded at different rates. While almost all these functions are available by audio routing, the setting up of a gang control path is a great deal easier than setting up the necessary audio path to accomplish the same result.

The other great advantage of ganging is that it allows the engineer to mix from a central position. He can assign remote faders to the central gang senders and control his audio levels from these and the nearby channels without changing the audio assignments he would normally use. Like the man said: 'I have always wanted ten foot long arms and now I've got them'.

In common with most European mixing consoles Cadac normally incorporates a separate monitor mixing bank so that when the session is in progress, a fairly accurate picture of the final mix can be obtained, and a quick check made on the overall balance by a glance at the fader bank. One useful technique borrowed from the Americans is to interchange the monitor and channel faders so that the monitor mix can be controlled, ganged and, most important of all, stored as a basis for automated mixdown later, using the channel faders.

Analogue section

In the module the voltage tapped off the fader is used to control the *V-CAT* when the module is in its 'write' or isolate modes. Since this voltage will be stored digitally via an a to d converter, provision is made to convert the fader's output into a logarithmic function. Most a to d converters operate on a linear ramp where each least significant data bit change is caused by an equal step up or down the input voltage scale. If the fader's output were sent

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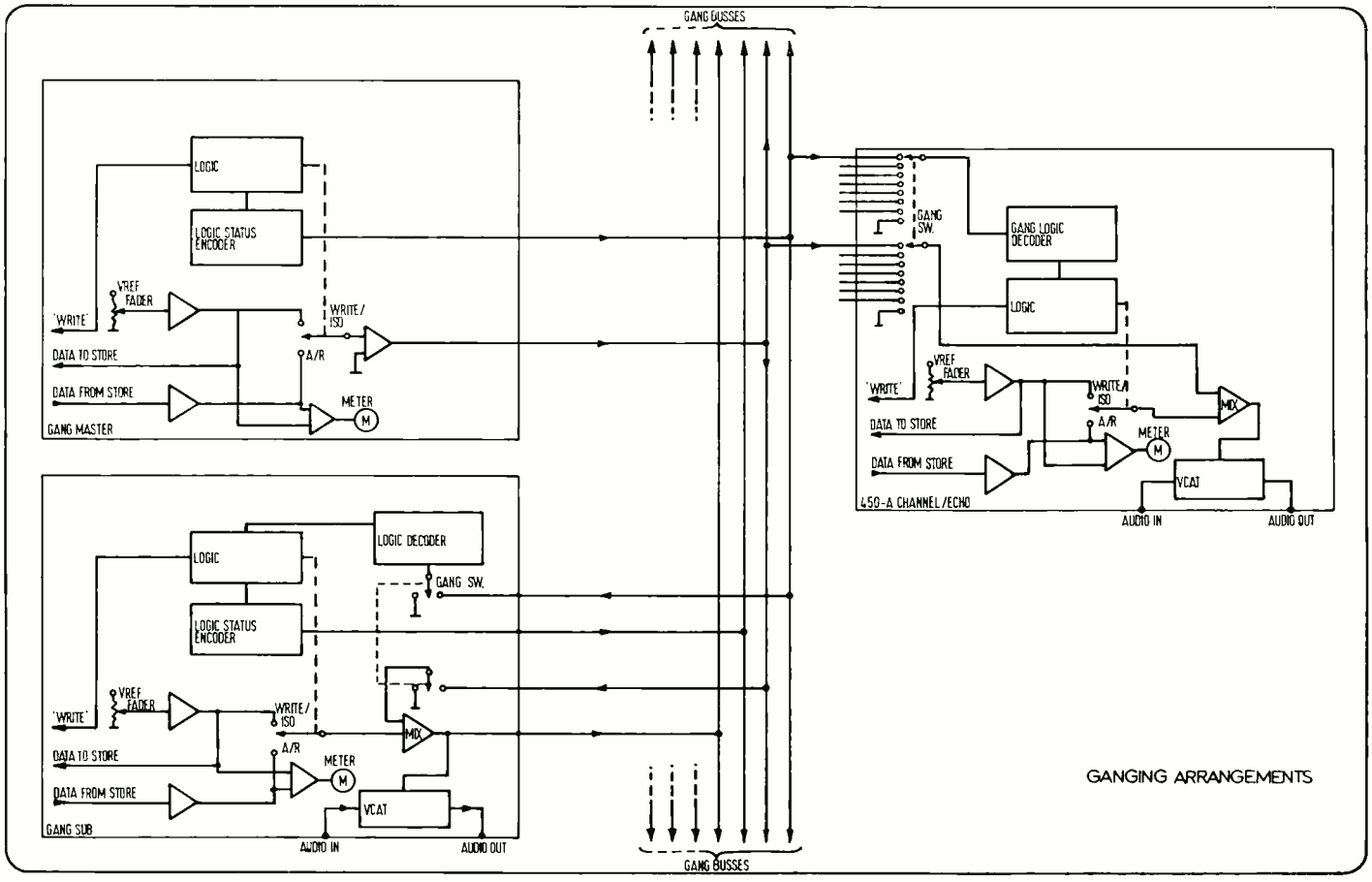

GANGING ARRANGEMENTS

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AES 56th Convention: a preview

Hotel Meridien, Paris
March 1 to 4.
Contact: Titia Bakker
010 31 2154 19911.

We gratefully acknowledge the help given by the AES in compiling this preview.

Measurement

B & K will be showing the following calibration and measurement equipment: *2429* Psophometer, *3923* rotating mic boom, *2971* phase meter, the *1902* intermod measuring sweep analyser and generator, the *4400* gating system, the *4416* response test unit for response measurements on pickup cartridges and other electro-acoustic record/replay devices, and the *2131* digital frequency analyser offering real time octave or third octave. The last two products are both new.

The prize for most ingenious design of any piece of equipment must surely go to **Ivie Electronics** for their *IE-20A* pink noise generator. When used with the *IE-10A* audio spectrum analyser, it provides a complete audio analysis system. The most interesting feature is that each unit can be held in the palm of a hand; fairly amazing when you consider that both can monitor the spectrum from 20 to 20k Hz.

For those wanting a 'quick audio tester', **Laboratoire Electro-Acoustic** of Rueil, France offers 11 different measurement functions selected by a single knob. It combines ldo. distortion set, psophometer and attenuator; it also offers wow and flutter measurement to DIN standards.

NTP are going to show their standard range of vus and ppms with all manner of display formats. They will exhibit a new version of their gas discharge ppm. Designated the *177-100*, it is in a standard module and features 20 dB of additional gain (switchable) peak hold facility and balanced line. There will be vus *177-900* and *177-950;* these possess the same mechanical outlines as type *177-800* but with a gas display. Hopefully, the company will present a prototype of a filter unit containing 27 $\frac{1}{3}$-octave filters for use as an analyser in connection with a multichannel ppm type *377-100*.

Wilmot Breeden will exhibit the **Ferrograph** range of professional tape recorders and the ever increasing number of test equipment products from that company. The *ARA1* displays the gain frequency characteristics of amplifiers, filters, equalisers and tape recorders, etc. on a 27 cm long persistence crt offering a resolution of 0.1 dB. Frequency range is from 20 to 200k Hz. There will also be *RTS2* and *ATU1* test sets on stand.

Microphones

From **AKG** comes the successor to the ubiquitous *D-202*, the *D-222E* two-way cardioid dynamic mic. It features a double transducer

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LIST OF EXHIBITORS

A, B, C: Floor Area D: Demonstration Room

Acousmat Apollo Electronics	B 12	**FM Products**	D 02	**Otari**	D 02
Agfa-Gevaert	C 02	**Freevox**	C 04	**Philips**	C 05
AKG	D 01	**Girardin**	B 08	**Publison Audio Professional**	D 13
Allen and Heath	A 17	**Gotham Export**	A 05	**Pyral**	A 35
Allotrope/Future Film Dev	A 25	**Harrison**	A 26	**Raindirk**	A 32
Amek	C 17	**Helios**	A 18	**Reditec**	D 02
Ampex	C 12	**ITAM**	A 07	**Revox**	A 33
Audio & Design Recording	A 24	**IVIE Electronics**	B 11	**Schlumberger**	C 07
Audio Developments	A 20	**JBL Sound**	D 04 & A 11	**Schoeps Schalltechnik**	A 37
Audio Kinetics	A 02	**JVC**	D 03	**Scully**	D 31
Audiomatic	A 36	**Kajaani oy Electronics**	C 01	**Sennheiser Electronics**	B 10
Audix	B 01	**Klark-Teknik Research**	A 27	**Sensitive Audio**	D 17
BASF	C 09	**Klein and Hummel**	B 05	**Sescom**	A 19
Becker	B 02	**Kudelski-Nagra**	D 15	**Shure**	A 01
Beyer Dynamic	B 03	**Laboratoir Electro Acoustique**	C 14	**Soundcraft Electronics**	D 05
BGW	A 30	**Leevers Rich**	A 16	**Special Audio**	C 03
Bruel & Kjaer	A 34	**LEM Materiel Electro Acoustique**	B 07	**Spectra Sonics**	A 15 & A 21
Cadac	A 12	**Lyrec**	A 13	**Stanford**	C 13
Calrec Audio	B 14	**3M (France)**	A 14	**Stanton Magnetics**	B 13
Capitol Magnetic Products	A 03	**Macinnes (France)**	C 11	**STR**	A 06
Cetec Audio	A 23	**MCI**	A 31	**Studer International**	A 38
dbx	D 06	**Midas**	D 02	**Telefunken**	B 06
Dolby Laboratories	B 04	**Millbank Electronics**	A 09	**Trident Audio Developments**	A 08
Eastlake Audio	A 28	**Neumann**	A 04	**Tweed Audio Electronics**	A 10
Electro-Voice	C 10 & D 07	**Neve**	A 29 & D 16	**Wandel & Goltermann**	C 08
Elipson	D 14	**Nippon Columbia**	D 08	**Wilmot Breedon**	B 09
EMS	D 06	**Nordisk Elektroakustik**	C 16	**Woelke Magnetbandtechnik**	A 22
EMT	A 39	**NTP Elektronik**	A 40	**Zoot Horn**	C 15

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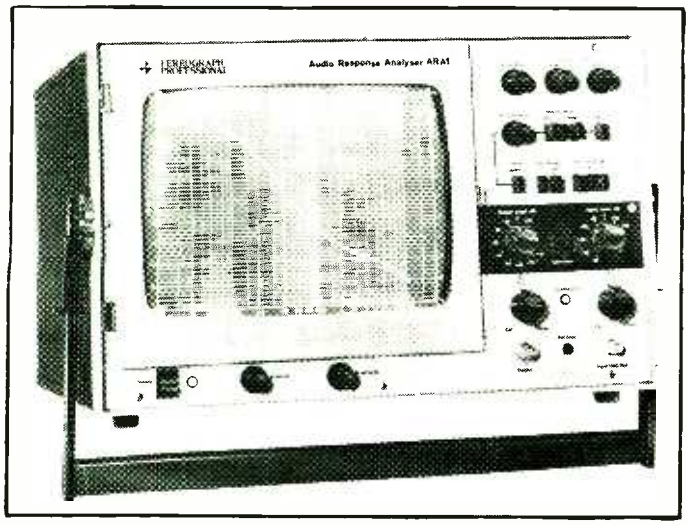


ARA 1 frequency response tracer from Ferrograph Professional

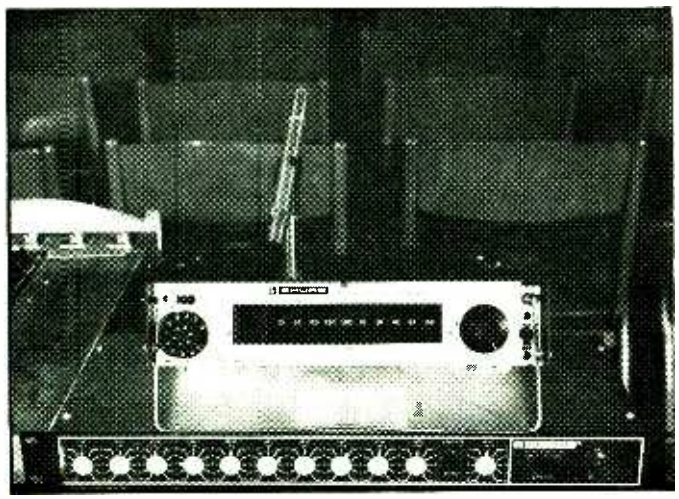
with an associated crossover network at 500 Hz. The rest of the product range remains largely the same.

Beyer Dynamic have two new products. The first is an electrostatic stereo headphone *ET1000* together with power supply *N1000*. The second is a loudspeaker simulating earphone *LSE1*. Unfortunately, there are no further details available.

Calrec are to show examples from the *L* series of broadcast consoles in addition to the standard range of microphones manufactured by that company.

Neumann will show the complete range of microphones including the *QM69* quadraphonic mic and the dummy head *KU80*. Other products at the exhibition will include the *SX74* cutter head for disc mastering, a rumble meter, as well as other ancillary products for the cutting room.

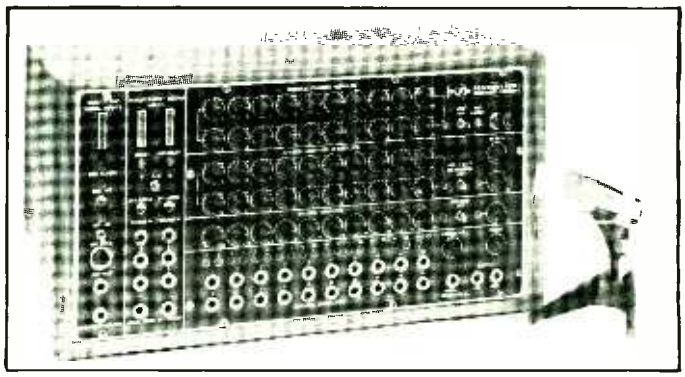
Schoeps manufacture superlative microphones; the entire product range will be shown including a new miniaturised mono mixer with phantom powering. They intend to introduce a stereo mic complete with all accessories.



Shure M615AS audio analyser with frequency response analysing mic ES615 together with the new SR107 audio equaliser

First introduced at the Los Angeles AES, **Shure** will show their new equaliser *M615AS*, which incorporates a pink noise source, octave band analyser and measuring mic. It is intended for use with the *SR107* equaliser for fast room eq for bands on the road. There will be a new stereo cartridge, the *M70B*, which tracks at 3 grams. Shure will also exhibit the full range of microphones.

Normally associated with microphones (which in any case will be present on the stand), **Sennheiser** will present a *VSM 201*

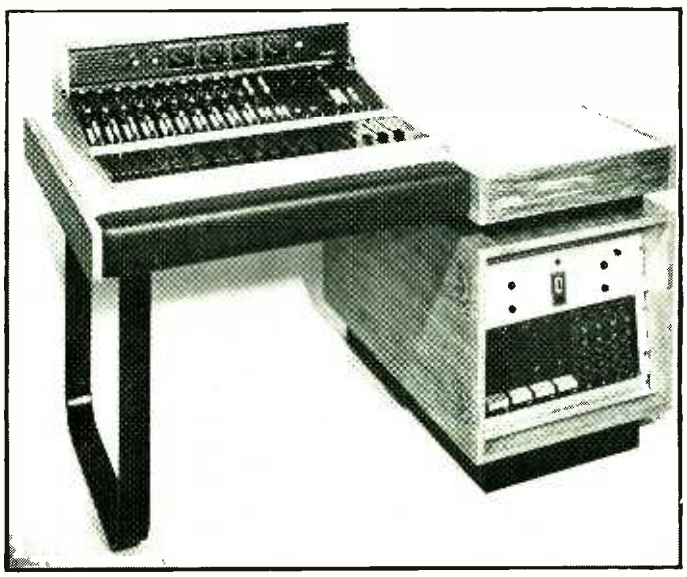


Sennheiser sound effect Vocoder VSM 201

Vocoder. It performs a spectral analysis with a set of filters whereby specific envelopes are formed for each frequency band. The overall loudness is also measured, resulting in a series of integrated voltage envelopes which can control a bank of generators producing either white noise or frequency tones. Since these may be given a frequency offset, speech inputs may be modified both in pitch and tonal quality. The vocoder may also be interfaced with a conventional synthesiser. This stand sounds interesting.

Mixers

Allen and Heath will show their full range of consoles including the new *SD 12/2*. However, the real interest on the A and H



Audio 12 channel 4 group MXT 1000

stand centres around non-mixing products. There is an eight track 25 mm mastering machine, a forward delay limiter and an adt black box. These last items represent a considerable departure for the company's product range.

Amek are showing their *M3000* range of consoles providing either eight, 16 or 24 inputs with four-band parametric eq on each channel. A two thumbwheel routing arrangement offers up to 16 output busses; more than enough for recording applications. Other models on show include the *M2000* series of 16/8/4 format as well as a straight 16/2.

Audio Developments will demonstrate their new *ADO 45 Pico* mixer offering six/two interface, internal rechargeable 12V battery with a dc to dc converter for 24V operation. There is a three-band equaliser on each channel.

Audio Kinetics (UK) Ltd is a company run by Ian Southern of **Sonaplan** fame. It will exhibit a large console 'integrated with a multitrack tape machine'. The *4000* console has 40 inputs with 32

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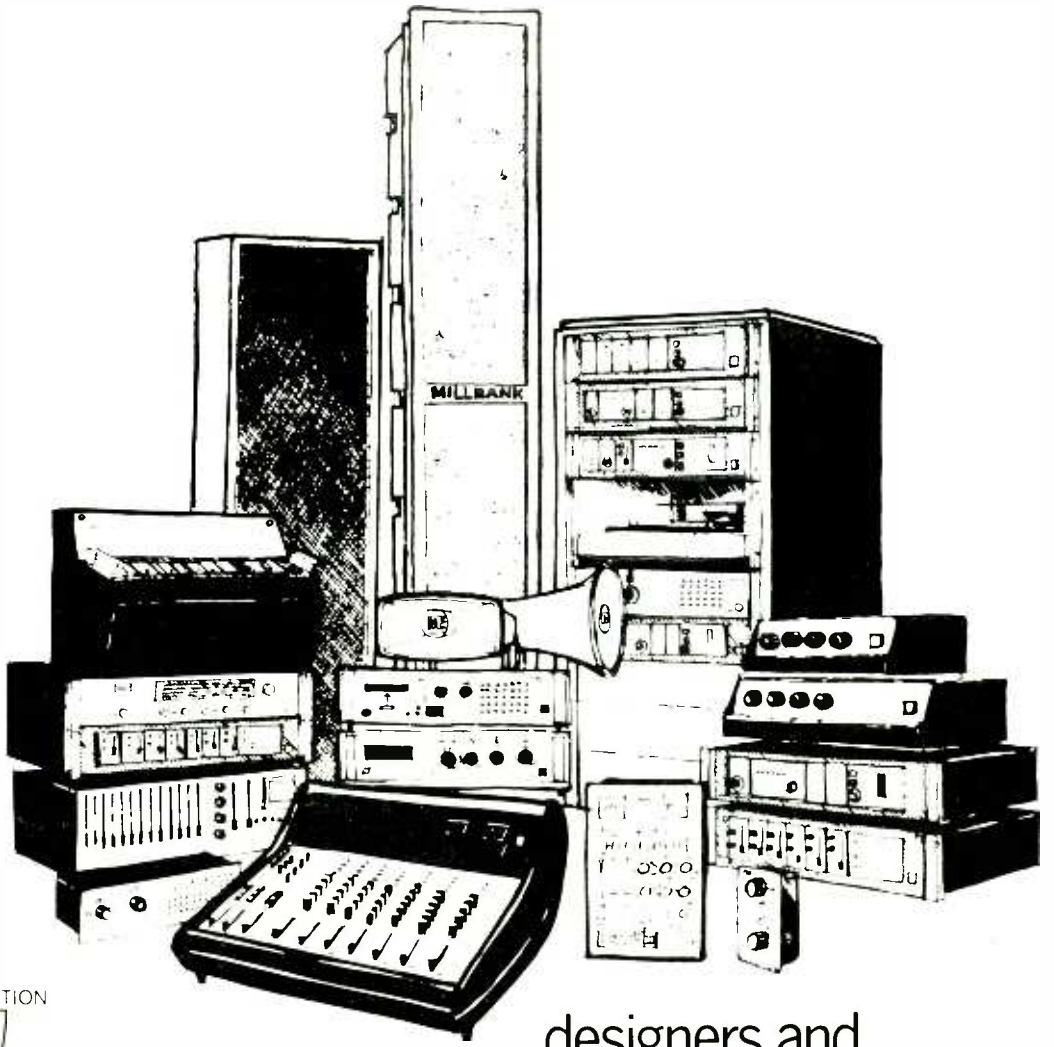
MILLBANK



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group busses and features a vca compressor expander, plus an 11-control parametric equaliser on every channel. Group routing is digitally displayed including the eight vca subgroup. It also features *Supercue*—a cue-switching system operating in conjunction with machine control remotes provided on every channel. This claims to speed up drop ins. The accompanying *4000* series 24-track machine features track cards incorporating the noise reduction controls. As a result, Dolby and dbx modules simply plug in, minimising installation and routine maintenance.

Never short of ingenuity, Southern has created a *learning autolocator* which would seem to offer even more than his own, very comprehensive, *XT14* autolocator. For use with either Studer or 3M machines, it features a microprocessor capable of doing a soft shoe shuffle between up to six aim points, improving its accuracy with every operation.

Audix will be showing an *MXT-100* modular mono pa/broadcast mixer. The *MXT-200* and *800* series of equipment will also be shown.

Naturally, **Cadac** will be showing an example of their desk automation. Fitted with *V-CAT* vca modules, the quad/stereo console has a cmos switched routing arrangement controlled from a central position on the console. The exact routing elected is displayed by a four-figure digital display on each channel. The company will also show a cpu and floppy store for use in conjunction with the console. For further details see page 32.

Cadac have introduced a limiter compressor based on the *V-CAT* module, which will also be shown.

Helios will emphasise their custom-building facilities for recording, sound mixing and broadcast consoles. A particular focus will be given to 'flexibility of approach . . . and a willingness to meet specialised broadcast specifications throughout the world'.

Kajaani Oy, the Finnish console manufacturers, will be showing a Model *10EA* 12 channel input/two output, two foldback broadcast mixer.

MCI will show the well known *JH24* multitracks and the increasingly well known *500* series of automation ready consoles—variously known by some, especially Dag Felner, as the 'Quiet One'.

Neve will have on stand an *8058* 28/24 compact console which will be shipped after the exhibition to the Centre George Pompidou for installation. Probably more important, they won't have a real live NECAM system. Instead, there will be a slide and video tape presentation with Geoff Watts on talk over.

Philips LDC 25 mixing desk at the Centre Pavoissale, Geneva

For the Paris AES, **Philips** will be going heavily on pa installation; sound reinforcement desks will be represented by the *LDC15* and *LDC25*. There will also be ancillary products such as cctv, paging and internal communication, all of which find special application in theatre sound.

Following US philosophy of desk design using all channels as input/output modules, **Raindirk** will show representations from the new *Quantum* range. Available formats are 40, 32 and 24. There will also be a selection of Raindirk *Minis* such as a 10/4, 18/8, etc. The latter features 16 track monitoring.

Soundcraft Series 2 console, Demo room D05

At the last two AES exhibitions, **Soundcraft** have always provided excellent demo facilities for their range of desks. This year should prove no exception. They will be doing 16-track mixdowns through their *series two* console. This is available in several configurations from 12 to 24 inputs/unspecified number of output busses.

Spectra Sonics will show the *610 Complimiter* which is a revised version with new non-glare vu meter, bi-polar power supply and improved electronics. They will have on the stand *1026-26* mixing desk featuring 26 input/output modules; there will also be a small rack-mounted mixer with six switchable inputs.

Trident are to show the *Fleximix* mixer system for either 'budget-conscious studios or high quality pa' which can be expanded from small mono to 40 input/ten output with 24-channel monitoring. These mixers are housed in a flight case. The company will also show the *CB9066* three-band parametric equaliser with high and low pass filters as well as a bank of led meters using ten green and four red leds in column array; together these are claimed to give an indication over nearly 40 dB.

Tweed are showing three mixers: a 10/4 with metering and monitoring on all channels, a 12/2 standard console featuring balanced inputs and outputs, a 20/4 desk specially constructed for Border Television, Carlisle. Also shown will be a *Twin Telephone Hook Up* for live bore in programmes which claims several special features as well as twin power amplifiers and a compressor/limiter.

Zoot Horn will show the *PMR 2* series of mixers which offer equalisation, compression, echo and cue busses and other features.

Power amplifiers and monitors

BGW intend to show a *Model 100* 'professional' amplifier offering 30W/channel into 8 ohms or 44W into 4 ohms. It claims to provide 80W in mono bridge connection. There will also be a high performance domestic preamp and the *500D* power amplifier.

JBL have proved that they can make an amplifier, the *6233*, with the same studio monitoring design standards as the massive *4350* speakers of which the company has sold more than a few. The amplifier claims 300W/channel into 4 ohms with less than 0.05% thd.

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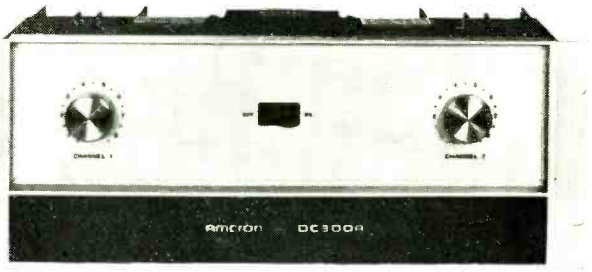

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It uses a switching mode power supply which has brought down both size and weight. For instance, it weighs only 15.7 kg.

Macinnes France are agents for **Amcron** products. Accordingly, they will show the product line of *Crown* power amplifiers, unchanged and familiar to all, as well as the latest addition: an 11-band graphic stereo equaliser *EQ2*. The most interesting feature is a control which offers up to half an octave offset to the centre frequency of each band.

Millbank produces specialised pa gear; one of the company's products include a *PAC system* comprising a single mainframe and slot-in modules to build up custom pa system. Other areas of manufacture include discotheques and leisure products.

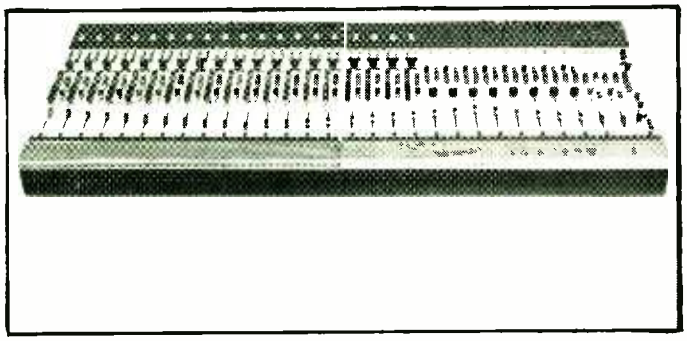
The French company **Sensitive Audio** manufactures a triamplified system of 800W total power; this is type *OBS1*. With that kind of power the company name seems a slight misnomer. Still, it sounds about right for monitoring *music concrète* . . . They also provide acoustical treatment for studios and control rooms, etc—how singularly appropriate.

Stanford of Bruges, Belgium, manufacture audio mixers and power amplifiers for domestic and discotheque use. They also cater for live entertainment. As such, they incorporate phono, mic and tape recorder inputs to the usual unbalanced line impedances. Power amplifier ratings range from 50 to 150W/channel.

Sound processors

Introduced at the last European AES, **Audio Design and Recording** will feature the *Scamp* series of rack modular, low-cost sound processors at his show. There are three major additions: the first is a compressor module *SO1;* the second is led display column; while the third, *SO1*, offers parametric equalisation in three separate sections with overlapping coverage. Also there will be the very versatile *F760-RS* offering compression, expansion and limiting in any combination—very useful.

Dolby will be exhibiting their established product line of noise reduction equipment including the full range of cinema processing equipment. The *CP50* (new model) provides an economic update for cinemas with optical equipment; the *CP100* is a control centre for



Trident Fleximix 19 input—10 mixed output

processing all types of soundtrack.

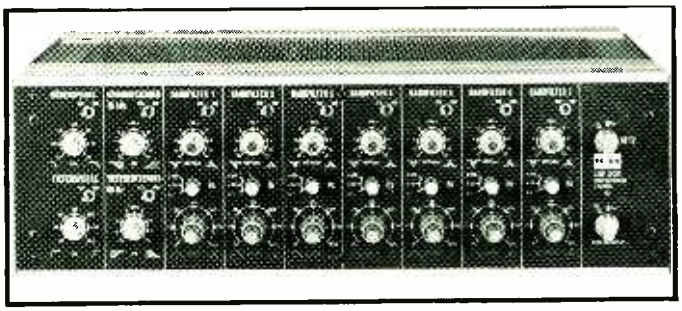
There are no new surprises from **dbx.** They will be showing a 12/24 channel mainframe, *K9-22* dbx replacement for Dolby *Cat 22;* also on show will be *187*, *154*, *192* and *142* units.

Tom Hidley of **Eastlake Audio** will be showing Tom Hidley, while **Scenic Sounds** will exhibit David Hawkins freebie tea shirts as well as the **Marshall** *Time Modulator* and the **MicMix** *Time Warp*. Both the latter units effect the time domain with all the usual implications . . .

EMS will be demonstrating the *Vocoder* as well as the more regular *Synthi* synthesiser products.

From **EMT** there are two products of high interest. The first is the *EMT250* electronic reverb introduced at last year's Zurich AES. The second is the *EMT950* direct drive studio turntable. No further details available.

Klark-Teknik are to reveal, for the first time anywhere, a range of professional digital reverberation and adt units . . . and that's all they're saying about those at the moment. However, there will be the full range of graphic equalisers: *DN27*, *DN22* and the *DN15*. The first two supersede all earlier models while the last is entirely



Klein & Hummel UE200 Equaliser

new. It incorporates a consumer-looking preamp within a dual 11-frequency unit. The quoted performance of all models include: less than 0.01% thd at any slider position; less than –90 dB of noise over the audio bandwidth (20 to 20k Hz) relative to the output.

Klein & Hummel will exhibit a two-channel seven-band parametric equaliser mainly intended for control room equalisation. Each filter can be tuned over the range 15 to 20k Hz. Designated type *UE200*, it features stepless cut/boost and variable skirt shape on each band to enable optimum band interaction.

The same company will also be showing a new tri-amplified monitor speaker, the *O 92*. The total power is about 210W, producing an spl of 105 dB at 2m.

Tape machines and tape

Agfa won't be introducing any new products this year; their display comprises *PEM468* and *PER525* tape.

Ampex will exhibit both the *ATR 100* and *MM1200* mastering machines together with sync and frame tagging **EECO** equipment which provides an interface with vtrs, etc. The range of recording tapes will be shown.

The **Audiomatic Corporation** manufactures duplicating equipment featuring record electronics integrated with the reproduce head assembly. This allows ready interchange without having to go through the usual procedures of electronic alignment at every head change. The company will also show a *Superscope* automatic cassette loader and other accessories.

From **Capitol Magnetics** will be the complete line of professional recording tapes, discs and cartridges. They would draw attention to the properties of their *Formula 19* inevitably high output, low noise back-coated mastering tape.

Cetec are to show their loudspeakers; however, the main exhibit will be a Gauss high speed (64:1) duplicating system which is claimed to dub frequencies up to 14 kHz on to cassette pancakes.

ITAM will show their *805* 12.5 mm eight-track tape machine featuring a variable speed capstan from 17.5 to 53.5 cm/s. It uses plug-in channels and separate sync electronics. They have also introduced a new transport, the *810*. Using 25 mm tape, it offers either eight or 16-track operation. It incorporates dynamic braking, motion sensing, logic control and motor servo, etc.

In addition to the established range, there will be a new *flexible mixer series* providing a mainframe into which any combination of input and output modules may be plugged.

Lecvers-Rich/Bias will introduce the *Proline 2000*. This 6.25 mm machine is said to be a 'highly sophisticated machine designed to satisfy the most discerning user'. It features dc servo-controlled spooling motors, dual dc servo-controlled capstans, and full ttl logic. Standard features include varispeed and electronic tape timer.

In the *Proline 1000* range, the company now manufactures a transportable version; this can be supplied with either servo-controlled or direct drive.

Lyrec are to show both 16 and 24-track tape machines complete with all the usual remotes, etc. A cassette duplication system using a new bin loop master will also be exhibited.

A digital recording system will be shown on the **Nippon Columbia** stand. It uses a pulse code of 14 bits arranged to fit standard tv picture line format. The advantage of doing it this way is that virtually standard vtrs can be used as the recording medium. The system on display will provide 8/4/2 channels of audio as required.

Nordisk of Denmark will be showing a machine capable of playing the BASF *Unisette* to broadcast replay standards. There

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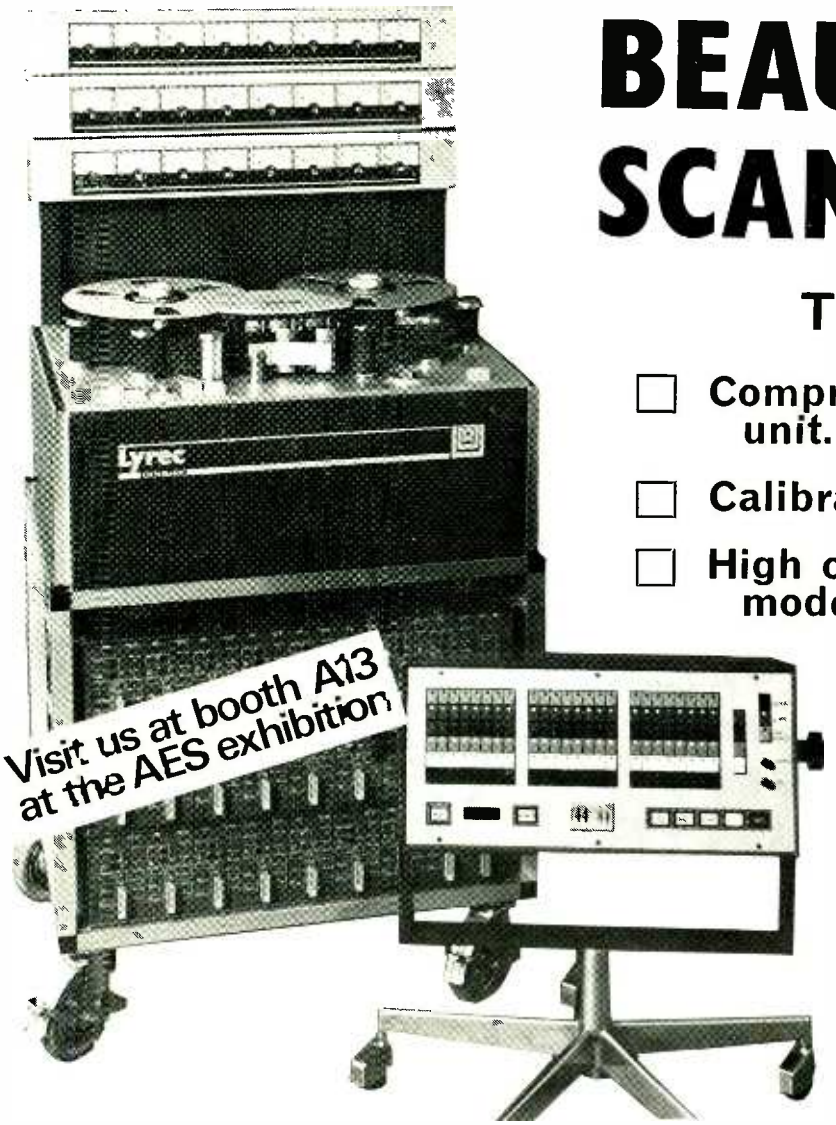
THE "REEL" BEAUTY OF SCANDINAVIA



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AES 56th CONVENTION: A PREVIEW

will also be an automatic information system using *Logmatic* cassette recorders running in variable sequence for applications such as traffic control in airports, etc.

Pyral will show their range of tapes and disc cutting blanks. In addition, there will be two spectrum analysers; one of which offers ten bands on standard octave centres while the other has eight octave bands to 4k Hz and a further six ⅓-octave bands from 6.3 to 20 kHz.

Reditec of Montreuil, Switzerland, are agents for **Otari, Midas** and **FM** products; all the companies will be represented by their various products. Otari tape recorders will be featured as well as a master/slave loop bin duplication set. Three Midas mixers will be shown, the largest of which will be a 30/8. FM display includes two large power amplifiers.

Revox will only be displaying one new product, the *A740* power amplifier. This is a domestic oriented version of the Studer *A68*. Other hi-fi products will also be on show.

This year, **Studer** have gone for the spectacular. They will exhibit a functional broadcast facility comprising a *089* mixing console, an *A80/RC* master machine, EMT turntables, *A68* power amplifiers, off-air tuners, *Loopmatic* and jackfield. There will also be a *169* mixing console, a *tapelock 2000* synchroniser and a pilot decoder.

Woelke manufacture, and will show, magnetic recording heads in all sizes and track formats from 6.25 to 50 mm, one to 24-track. Several products in the range are new this year. Regarding instrumentation, there is an automatic distortion set *ME401* using an auto null system as well as the longer-established *ME102* and *104* wow and flutter test sets.

Miscellaneous

There is a portable Dolby noise reduction system custom-designed for the Nagra *IV* on offer from **Allotrope/Future Film Developments.** These companies also supply a wide range of connectors and cables as well as the Sescom range of modules and transformers.

Gotham Export Corporation are the export agents for **UREI, Switchcraft, Lexicon, MRL, Allison** and **Amber.** Show exhibits include the versatile, low-cost UREI *200* level recorder system incorporating transmit receive modules for automated response plotting. There will also be an Amber *4400* test set (reviewed in STUDIO SOUND February '77).

JVC are running a second house for the Raising of Lazarus; the stand centre point will be the *CD4-50* demodulator for playing CD-4 records. It features delay time controls for fine tuning of separation, noise gate for surface noise and automatic 4-2 switching.

Striking a consumer chord, **Stanton Magnetics** will introduce a new version of their *stereo wafer* headphones with different cushions 'for better isolated listening and better bass response than in the original model'. They will also show a stylus timer to tell you when your needle is getting blunt at the end.

STR stands for Standard Telephon and Radio AG. They manufacture data transmission equipment; on display will be an *Odilog* system which features data preservation in the event of power failure. A vdu shows inputs and terminations. ■

CADAC APPROACH TO AUTOMATED MIXING

direct to the converter, half the available data levels would be consumed by the first 6 dB of fader movement from the top and the difference between −55 and −70 dB towards the bottom of the travel would occupy just one data change. If the changes measured were to be based on a linear scale then a normal a to d converter would be ideal, but decibels are logarithmic and thus, to represent each unit change on an audio signal in decibel form, the voltage step causing that change must have a logarithmically related step size. Thus if the voltage from the fader is converted to a logarithmic scale before sending to the a to d converter, equal digital steps will produce a scale representing decibel or fractional decibel steps, and the cramped-expanded resolution referred to previously is eliminated.

There is another solution to this problem which makes life very much easier for the designer: the control element (vca) is made to respond to its control voltage in a logarithmic manner; ie its gain is expressed in dB per volt of control input). The source of this control is then a linear track fader which is scaled in dB. Thus no log amp is involved and cost is very much reduced since linear faders are also easier to make than audio taper ones.

One of the design parameters laid down for the Cadac voltage controllable console was the provision of a panic button which reinserted the fader into the audio lines if any fault was suspected or found in the system. Obviously, if a linear fader is used in the control chain, this cannot be employed as a level control and so the standard audio taper unit is fitted together with a wide range low noise log amp.

At the store, the data is recorded as fixed values; thus on replay a perfectly smooth control movement will be represented as a series of steps. In order to smooth these out so that the recalled fader does not sound as if it is a switched attenuator, simple integration of the steps or low pass filtering could be used. However, in order to smooth out small steps and still respond quickly to large ones, no one time constant or filter function is found to be exactly right. In fact the CARE system uses three different time constants which are brought automatically into play depending on the form of the step function presented to the analogue voltage control input. The technique of analogue interpolation allows a lower than normal scan rate to be used thus reducing the load on the stores.

As will be recognised by any engineer dealing with inept artistes, a low scan rate may not allow him to cut out mistakes quickly, as the scanning section will ignore the fader he is pulling down so hard while scanning all the others. To overcome this problem, all *CARE* faders are scanned at a high rate which then changes to a low rate as soon as appreciable movement is detected. Thus if a cough, or malediction, has to be removed, the store will respond almost instantaneously but long gentle fades do not fill up the store with masses of data.

Since the detection of movement should be done digitally to be reliable and free of drift, the fast scanning of all channels with the a to d converter must be done. When it was estimated how fast the converter would have to be to complete conversions on all channels during the meagre time allowed, the answer proved expensive. Ferranti has recently started to manufacture a monolithic converter which was cheap enough to allow its incorporation on every channel for d to a duty and fast enough to convert seven channels on a to d in the time allotted; a natural choice for the *CARE* system.

The store

Keeping all the data in its place is managed by a Motorola *6800* microprocessor. Its basic functions are: generation and recognition of timecode information; initiating and regulating the a to d scans and tagging these with the relevant addresses; interleaving the d to a scans and outputting the store data when this matches both the timecode and address reached by the scan; scanning and matching the 'write' command lines to ascertain whether the data received is to be stored; checking the digital data for control movement and checking this movement to see if it is new or continuous, and adjusting its scan rate accordingly. However, the most onerous task occurs when a new mix is started when the ganging must be stored, or set; the desk status stored and set and the timecode just received matched with that available in the store using a directory of store location vs timecodes that it writes for itself.

The details of the software are outside the scope of this article, but it has been found that as long as a separate *6800* manages the stores housekeeping, then one microprocessor can cope with all the routine desk scanning and data shuffling.

The first phase of the programme of voltage control of a Cadac console is now completed and although the whole process has taken a reasonably short time a good deal has been learnt on the application of what is still considered as high technology to the very conservative world of the mixing console. ■

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A question of coincidence

TRYGG TRYGGVASON*

Purist technique raises questions of practical relevance; exponents of a rigid doctrine sometimes forget that a musical interpretation is the final objective.

*UNIVERSITY OF EAST ANGLIA

FOR some time now, I have been concerned that the literary output of theorists discussing microphone techniques for classical music considerably outweighs that of those actually engaged in the art of sound balancing. This concern has been compounded by current thinking, intended to solve the problem of quadraphonic recording and reproduction which appears to have been extended from the analyses of purist stereo recording methods. I consider these analyses to be based on fallacious premises. As a practising balance engineer, I therefore feel that the time has come to question the intellectual validity of the premises of purists teaching the gospel according to Blumlein, in the hope that any errors inherent in it might not be extended into current thinking on how best to use the quadraphonic medium. I have no desire to suggest that the coincident mic system is inherently poor; I use it where appropriate, although not often, and it is possible to achieve excellent results with the method. However, the fundamental attraction of the system to the theorists appears to be its 'purist' adherence to scientific principles—that is, reproducing the sound that would have been heard at some position in a hall or studio at the time of recording. However, a detailed analysis is quite unnecessary; the *scientific* basis of coincident microphone technique collapses without more than a cursory glance at the factors involved. Few would question that the experience of a 'live' concert is electrifying in comparison with the most sophisticated recorded representation. We need only to place a Blumlein Pair at any point in a concert hall, which one might pleasurably have occupied during a concert, and listen to the result via a recording or an amplification system in the control room; I contend from direct experience that there is no basis for comparison, and the reasons are manifold, as I shall try to explain. First, there is a very considerable, and usually ignored, psychological factor inherent in one's evaluation of live music—the sense of occasion, the personality of the musicians, and the ability to *see*. This is a refined extension of the pop concert syndrome—fans go to *see* and partake of some social atmosphere, and the music may barely be heard above the 'ambient' noise. A *recording* made of such an event may have little *musical* value as the music is probably less important than the occasion and the personalities which are dominant. Unless we intend specifically to record, as best we can, such an event—for historic or nostalgic reasons—it is fruitless to apply 'purist' reasoning to the recording of music specifically for record, as the psychological involvement in the event is entirely absent.

We have, therefore, the task of recording music in a medium which cannot possibly do justice to the event. To attempt to recreate the sound field present in a concert hall via two point sources, without the psychological and visual factors, in a completely different room acoustic and environment, is quite impossible—even the concept is ludicrous, without even asking the question as to why every loudspeaker and microphone sounds dramatically different, in spite of close similarities in technical specification. Whatever it is that theoreticians are proving with pages of mathematics on sound localisation etc, it certainly has little to do with the totality of perceived sound. It has been a chronic trait of human intellectual endeavour to presume to force natural phenomena into contrived and formulated comprehensible disciplines of their own making. Thus the rigorous mathematics of sound localisation etc, with which we are inundated are no doubt unchallengeable on *mathematical* grounds, but the most rigorous mathematical proof is worthless unless the premises are correct.

Noting once again my observation that the perceived sound qualities in the control room and live sound are quite at variance with one another, even using first-class equipment, I feel justified in suggesting that the premises *cannot* be correct. Whether the reasons are the psychological ones I have outlined, technological limitations or whatever, these are of little interest to the balance engineer at the time he is required to come up with a satisfactory sound quality in the control room. I am as suspicious of these mathematical justifications as I am of those applied to matrix theory in quadraphonics. Here again we are bombarded by mathematical pyrotechnics telling us, conflictingly, that this or that matrix will sound subjectively best—yet one might be pardoned for a sneaking suspicion that it is impossible to solve two simultaneous equations with four unknowns.

The approach of the balance engineer is to admit that the quality of music heard in the control room *is* different, for whatever reason, and simply to make the best of it. The only premise here is that a rigorous analysis of sound is counter-productive and that an intelligent use of observed phenomena according to logical principles is superior. There is never time during a recording session for scientific rigour, only cause and effect; the variables involved are far too interrelated for mathematical analysis in a reasonable time.

I do not wish to suggest that I am anti-scientific—this is far from being the truth. I am simply saying that in a working recording session of three hours, the variables and their interdependence could keep a computer happily occupied for many hours, even if the relevant information could be defined. These variables, incidentally, extend far beyond sound structure itself; into personalities, psychology and physical factors which would be exceedingly difficult to infer. In short, I am saying that the translation of a performed piece of music in a hall into a recorded piece on record involves a transformation of an event from one medium to another, and the only common factor is the music itself. It seems to me reasonable that a record listener is primarily interested in the music itself, whereas his attendance at the Proms leads to a psychological shift of balance from the music to the sense of occasion, which cannot be captured on record.

What then is wrong with saying that we are attempting to translate a musical phenomenon into a domain in which it alone is master, and using any available device to enhance it in the medium in

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which it is to be appreciated? Is this not better than to enslave ourselves in our contrived and superficial attempts to order the *real* world? For instance, I would suggest that it is entirely possible for two recordings of a piece to exist, one with outstanding positional definition and the other considerably worse in this respect —yet from the point of view of overall quality, the latter may well be far superior. This observation is another illustration of the attempts of scientific dogma to take those factors which are rigorously manipulable out of a phenomenon, and then using these manipulations to form 'conclusions' and 'truths' about the totality. All that has happened is that the analysis has no complete mapping to the phenomenon, because the postulates are unsound.

Returning to the coincident microphone system, we see that the scientific justification is lost because a) it can only be correctly evaluated using headphones rather than loudspeakers because of the crosstalk problem, b) because of the psychological differences already discussed; and c) probably because the overall system cannot accurately reproduce a sound field present in the original location, for some reason. Thus this 'purist' technique is far from being pure in any complete sense, as in any case our ears will tell us. I have never been able to see how a theory can be developed or applied if elements within it are unsound, and it therefore seems that there cannot be any meaningful mathematical analysis of the performance of coincident pairs; we are left with only superficial and doubtful positional location information.

It is important that a balance engineer should have a degree of fluency in physical cause and effect bases, but equally important that he keep the domains of the variables involved in a mathematical representation of these phenomena open. This requires an unusual sensitivity and readiness to extend principles beyond boundaries convenient for mathematical analysis. Data is continually absorbed, but in a diffused sense, as food for the intuition which is the all-important tool enabling the human brain to obtain almost instantaneously a solution to a problem which might occupy a computer for some considerable time. But at the end of the day all manipulations are in the interests of the music itself—no event or occasion. Perhaps I should provoke the purists by asking whether or not it is possible for recorded music to have greater intellectual integrity musically than does a live performance, in which social as well as intellectual factors have considerable play? Therefore, might it not be entirely reasonable to suggest that recorded music, in which technology is put to the service of the music alone, is musically speaking 'purist' even if there is little relationship between the recorded and original sound? All halls, instruments and performances sound different—why then cannot a recorded sound, which is not identical to the original (which it can in any case never be) be a perfectly valid expression of a musical idea? Those of us who care for music, I venture to suggest, do not need to pretend that we are present at a concert when we listen—should we include the coughs and other noises of the audience also?

Yet another anomaly in reasoning remains unquestioned. If the 'purists' are right, we should obtain a very satisfactory sound, in a performance, by placing a coincident pair perhaps 10-20 metres from the orchestra; a position where a listener might be. Yet, for the purposes of gramophone records rather than live broadcast, the recorded sound quality with this method is unsatisfactory and there is general agreement on this. I cannot believe that all recording engineers are misguided deviants from the norm of the populace. I think that a large enough number of people have been involved in recording to represent a reasonable statistical view of what people want to hear in their listening rooms, and almost universally, the microphone distance from the source that is used bears no relation to the average distance of an audience member in a live performance. In classical music, the distance used, from performers to microphone (irrespective of mic technique), probably centres around 3 metres. Where is the relationship between this distance and the audience distance? Yet, under listening room conditions, this order of distance seems to create what most of us seem to consider a 'natural' and aesthetically satisfying sound quality—just another omission in the premises of 'purist' theoreticians which is conveniently forgotten. The reasons, of course, lie in the differences in the two media (live and recorded) which I have already outlined.

It occurs to me that I might have given the impression that engineers formulate balances merely to their own taste, and it may be worth forestalling the predictable sense of outrage that such a suggestion would create. A good engineer formulates his sound quality not only in accordance with his own judgement, but by extending the essential sensitivity that I have described to all those around him—musicians, producers, tape operators and visitors—in order to extract any information that might be useful. The final result is not often obtained as a consequence of unilateral decisions by a recording engineer, if he is other than mediocre—it is the best possible statistical straight line through the sensitivities of all involved. Our subjective evaluations, however, are capricious in the extreme; we may say one day that something is good, and another day that it is bad. This frequently happens with artists, who, without the listening experience of those involved in the recording industry, cannot understand why it is that things sound different in different rooms, with different speakers, and perhaps on different days. Engineers, who are accustomed to collating such data in their minds, are usually able to weave their statistical straight line through such difficulties; yet a single session lying well off the line can be exceedingly problematical.

It seems to me, then, that the qualities of sound on record are a reasonably statistical representation of that which a relatively large group of people have wished to hear—within the limitations of the competence of those who have had to achieve it. What is certainly *not* the case is that a handful of engineers or producers have foisted upon the public a kind of sound which, for some reason, differs radically from that which the record-buying public wishes to hear.

One important observation: the indiscriminate use of multitrack techniques has, it seems, resulted in a depletion of the sensitivity which an engineer must have to take full advantage of all useful factors during a recording. Inevitably there is a tendency to place microphones closer to instruments in order to achieve maximum track separation, with a view to achieving a satisfactory balance later. To some extent this is wise insurance but inherent is also the danger that too much of the aesthetic of the balance is trusted to the resources of technology. This proposes that *any* microphone array can yield a superlative sound quality if enough time is available to manipulate faders and equalisers later. It is not unlikely that coincident microphone adherents may have become more firmly entrenched in their ideological positions, partly as a result of multitrack balances in which the microphone arrays were not optimised at the time of recording.

Forgetting multitracking altogether and considering only a direct stereo mix, very small alterations in the positioning of microphones and/or musicians result in dramatic differences in sound quality; microphone types yield equally dramatic differences. To create, from this amorphous plasma of variables, a multi-mic system which yields a subjectively satisfying result is difficult, but possible, and, in my opinion, superior to a purist stereo microphone recording of the event in most cases. Since I have said that any instrument *cannot* sound in the listening room as it does live, is it not a little pointless to cling to this so-called purism? Is it not more constructive to subjectively evaluate the quality of different microphones and to use them in any way we can devise to obtain the best possible subjective result in each individual case?

But I think the time has come to summarise.

The reproduction of live musical sound sources in a listening room environment, with any accuracy, is currently impossible. We who are involved in making records have therefore but one clear duty to music and that is to transcribe it to a listening room environment in whatever manner we can devise which is most appropriate to it and its appreciation in that environment.

If technology were refined enough to permit it, we might directly transcribe the event in physical terms, and leave it at that though, no doubt, the psychological factors would still cause problems. As it is, technology, analysis and scientific endeavour have consistently failed to provide the essential equipment for 'purism'; we are inundated with technical specifications—both professionally and in the hi-fi market—which tell us little about the performance of the specified device. Our senses, on the other hand, directly comprehend the phenomena, and I see no reason to abandon them merely because we cannot fossilise them in mathematics. In the circumstances, we can hardly be blamed for retreating from the mathematics and science that so elegantly misrepresent real phenomena, and preferring to rely on our own senses, intelligence, and devotion to music. ■

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Survey: power amplifiers

Future surveys include monitor loudspeakers (May) and synthesisers and special effects units (July). Information for survey inclusion should reach this office (address p3) no later than six weeks before the issue publication date.

ACCUPHASE

Kensonic Laboratory Inc, Japan.
UK: Pyser Ltd, 102 College Road, Harrow, Middlesex HA1 1BQ.
Phone: 01-427 2278/9.

M-60
Number of channels: one.
Power output: 450W into 4 ohms, 300W into 8 ohms and 150W into 15 ohms.
Distortion: less than 0.1% at rated power output.
Intermodulation: less than 0.1% at rated power output.
Noise: 100 dB below rated power.
Damping factor: 45.
Rise time: 3μs.
Slew rate: 25V/μs.
Sensitivity: 2V for rated power output.
Power requirements: 117/240V ac.
Dimensions: 482 x 170 x 345 mm.
Weight: 27 kg.

P300
Number of channels: two
Power output: 150W rms, both channels driven, 200W rms into 4Ω.
Nominal output impedance: 8Ω.
Damping factor: 20.
Power bandwidth: 20 Hz to 20 kHz ±0.2 dB at rated power.
Protection: unspecified.
Input impedance: 100 kΩ.
Gain: 1V for rated power output.
Hum and noise: 100 dB below rated output.
Distortion: less than 0.1% thd and im (any level and mixture between 20 Hz and 20 kHz) at rated output.
Other features: produces 'subtle nuances of inner musical fabric which stir and warm the soul with emotion'. Twin vu meters, power limiter control. dV/dT 15V/μs.
Connectors: 'Plenty of input/output terminals'.
Power requirements: 100 to 240V ac. 500W.
Dimensions (whd): 445 x 152 x 355 mm.
Weight: 25 kg.

P250
Number of channels: two.
Power output: 100W rms, both channels driven.
Nominal output impedance: 8Ω.
Damping factor: 20 adjustable.
Power bandwidth: 20 Hz to 20 kHz ±0.2 dB at rated power.
Protection: short circuit cutout.
Input impedance: 100 kΩ.
Gain: 1V for rated power output.
Hum and noise: 94 dB below rated output.
Distortion: less than 0.1% thd and im (any level and mixture between 20 Hz and 20 kHz) at rated output.
Other features: vu meters. dV/dT 15V/μs.
Connectors: 'plenty of input/output terminals'.
Power requirements: 100V to 240V ac.
Dimensions (whd): 445 x 152 x 355 mm.
Weight: 19.5 kg.

ALTEC

See review p74.

AMCRON

Amcron Inc, 1718 West Mishawaka Road, Elkhart, Indiana 46514, USA.
Phone: (219) 294 5571.
UK: Macinnes Laboratories Ltd, Macinnes House, Carlton Park Industrial Estate, Saxmundham, Suffolk IP17 2NL.
Phone: 0728-2262/2615.

D60
Number of channels: two.
Power output: 30W rms both channels driven, 64W rms into 4Ω one channel.
Nominal output impedance: 8Ω.
Damping factor: 200.
Power bandwidth: 5 Hz to 30 kHz ±1 dB.
Protection: not specified.
Input impedance: 25 kΩ.
Gain: 0 dBm nominal for rated output.
Hum and noise: 106 dB below rated output.
Distortion: below 0.05% thd to rated output. Im (SMPTE) better than 0.05% at all levels.
Other features: dV/dT 6V/μs.
Dimensions (whd): 48 x 4 x 20 cm.

D150A
Number of channels: two.
Power output: 75W rms, both channels driven, 100W rms into 8Ω one channel.
Nominal ouput impedance: 8Ω.
Damping factor: 200.
Power bandwidth: 5 Hz to 20 kHz ±1 dB at rated output.
Protection: not specified.
Input impedance: 25 kΩ.
Gain: 1.19V for rated output.
Hum and noise: 110 dB below rated output.
Distortion: below 0.05% to rated output. Im (SMPTE) better than 0.05% to rated output.
Other features: dV/dT 6V/μs.

DC300A
Number of channels: two.
Power output: 150W rms both channels driven.
100W rms/1Ω
500W rms/2.5Ω } one channel only.
200W rms/8Ω
Nominal output impedance: 8Ω.
Damping factor: 200.
Power bandwidth: dc to 20 kHz ±1 dB.
Protection: full output protection.
Input impedance: 10 kΩ.
Gain: 1.75V for rated output.
Hum and noise: 110 dB below rated output.
Distortion: im and harmonic below 0.05% to rated output.
Other features: dV/dT 8V/μs.
Power requirements: 120 to 260V ac.
Dimensions (whd): 48 x 17 x 24 cm.

M600
Number of channels: one.
Power output: 600W rms nominal, 1350W rms into 4Ω.
Nominal output impedance: 8Ω.
Damping factor: 400.
Power bandwidth: dc to 20 kHz ±1 dB at rated power.
Protection: output s/c not specified. Line overvoltage and thermal protection provided.
Input impedance: 25 kΩ.
Gain: 20 dB.
Hum and noise: 120 dB below rated output.
Distortion: better than 0.05% thd and im (SMPTE) to rated power level.

BGW

BGW Systems, PO Box 3742, Beverly Hills, California 90212, USA.
Phone: (213) 391 0320.
UK: Webland International Ltd, Mirabel House, 117/121 Wandsworth Bridge Road, London SW6.
Phone: 01-736 0987.

The company's range includes a series of two channel amplifiers, the *250B*, *500D* and *750A*, rated at 85, 200 and 300W (4 ohms) into 8 ohms both channels driven. Prices are £415, £690 and £797. There are two further models, *1000* and *1500*, available to

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Amcron D150A

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The Amcron Story

1967

1977

In 1967 Amcron (Crown International) introduced the world's first 'Super-Amp'. This was the DC300! It rapidly became a must for all the major recording studios and top bands such as Zeppelin, Jethro Tull and the Moody Blues.

The DC300 set new standards of sound reproduction never previously available for bands or studios, let alone the Audiophile (whoever he is). Coupled with the incredibly rugged construction, and small size of this 600 watts amplifier, it is not surprising that the DC300 became a legend in its time.

The designer of this classic is still in charge of the design work at AMCRON despite rumours that he has moved on to at least five other establishments! Indeed, he has since been responsible for the DC300A, the D150A and all the rest of the AMCRON range of superb power amplifiers.

Now in 1977, the DC300A is 'the' amplifier in all the world's recording studios and is still the only choice for bands such as Zeppelin, Jethro Tull and the Moody Blues, plus quite a few others such as Wings, the Stones, the Rollers, Elton John, 10c.c., Pink Floyd, Barclay James Harvest, The Real Thing and so on . . .

Perhaps this is because the DC300A amplifier offers the following features:

★ Total Harmonic distortion at full power, 1Hz-20kHz below 0.05%

★ I M distortion 0.01 watt to 150 watts into 8 ohms below 0.05%

★ Hum and Noise better than 110db below 150 watts

★ Power Bandwidth +1 db, —0 db from DC to 20kHz at 150 watts into 8 ohms

★ Full 3 year warranty on parts and labour

★ Patented Crown Protection Circuitry requires no circuit breakers or relays

★ Designed to operate into load impedances as low as 1 ohm

★ Manufactured by a company founded in 1946 and represented by the MACINNES people continuously for the last ten years!

MACINNES LABORATORIES LTD.
MACINNES HOUSE, CARLTON PARK INDUSTRIAL ESTATE,
SAXMUNDHAM, SUFFOLK IP17 2NL TEL: (0728) 2262 2615

MACINNES FRANCE S.A.R.L.
45 RUE FESSART,
PARIS 19e
Tel. 203.30.01

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Harrison

Harrison Master Recording Consoles are available through a selected number of factory-trained professional audio distributors. Further information, assistance in system design and service is available from:

AUSTRIA, SWITZERLAND and EASTERN EUROPE:
Studer International AG
Althardstrasse 150
CH-8105 Regensdorf, Switzerland
Tel (01) 840 29 60 Telex 58 489

BENELUX (BELGIUM, THE NETHERLANDS and LUXEMBOURG):
Heijnen B V
Steendalerstraat 56
NL-6940 Gennep, Netherlands
Tel (08851) 1956 Telex 48039

CANADA:
Studer Revox Canada Limited
14 Banigan Drive
Toronto, Ontario M4H 1E9 Canada
Tel (416) 423-2831 Telex 06-23810

DENMARK:
Quali-ti A S
Strandvejen 730
DK-2930 Klampenborg, Denmark
Tel (01) 63 17 11 Telex 16527

FAR EAST (Except Japan):
Studer-Revox Hong Kong Limited
308 Asian House
1 Hennessy Road
Wanchai, Hong Kong B C C.
Tel 5-278571 Telex 84640

FINLAND:
Into OY
Mentollinkatu 11
Helsinki 17, Finland
Tel (90) 171123 Telex 121836

FRANCE:
Studer France
12-14, rue Desnouettes
75015 Paris, France
Tel 533 58 58 Telex 204744

GERMANY:
Franz Vertriebsgesellschaft mbH.
Elektronik, Mess- und Tonstudiotechnik (EMT)
Postfach 1520
D-7631 Lahr 1, West Germany
Tel (07825) 512 Telex 754319

GREECE:
Electronica O E.
9, Valaoritou Street
Athens 134, Greece
Tel: 3619096 Telex 214888

ITALY:
Audio Products International
Via Gaspare Spontini 3
20133 Milan, Italy
Tel (02) 27 38 96 Telex 32402

JAPAN:
Shindenshi Manufacturing Corp.
1-47 Sasazuka Shibuya-Ku
Tokyo, Japan
Tel 03-460-6052

MEXICO:
Ingenieros en Electronica Asociados S.A de C.V.
Alpes 1221
Lomas de Chapultepec
Apdo Postal 41660
Mexico 10 DF
Tel 5-20-91-34 Telex 1775756

SPAIN:
Neotecnica, s a e
Marques de Urquijo, 44
Madrid 8, Spain
Tel 242-0900 Telex 22099

SWEDEN:
ELFA Radio & Television AB
Industrivaegen 23
S-171 17 Solna, Sweden
Tel (08) 730 07 00 Telex 10479

UNITED KINGDOM:
Scenic Sounds Equipment
27-31 Bryanston Street
London W1H 7AB, England
Tel (01) 935-0141 Telex 27939

EXPORT AGENT:
Audio Systems International
146 North Orange Drive
Los Angeles, California 90036
Tel: (213) 933-2210 Telex 698645

FACTORY:
Harrison Systems, Inc
Post Office Box 22964
Nashville, Tennessee 37202
Tel (615) 834-1184 Telex 555133

SURVEY: POWER AMPLIFIERS

special order. All models can be operated in the bridged mode by rear panel switch. Power output ratings are to the stringent FTC regulations.

All BGW amplifiers use crowbar protection circuitry; if the output current is exceeded, a thyristor trips and discharges the power supply. The advantage of this arrangement is that reactive output currents don't distort the output current, ie the output impedance remains low throughout the signal voltage cycle under temporary overcurrent conditions.

BOGEN

Bogen Division, Lear Siegler Inc, PO Box 500, Paramus, New Jersey 07652, USA.
Phone: (201) 343 5700.

TECHCRAFT

A range of transistor amplifiers with the output coupled through a line matching transformer.
Power outputs: 60/125/250W rms.
Number of channels: one.
Output levels: 25, 50 or 70V line balanced or unbalanced. 16V direct, unbalanced.
Input sensitivity: 250 mV for rated output.
Frequency response: ±1 dB 20 to 20k Hz at rated output.
Noise: 86 dB below rated output.
Output regulation: better than 1 dB from no load to max.
Protection: electrical, electronic and thermal.
Power requirement: 105/125V ac or ±24V dc.

TCB-S160

Number of channels: two.
Power output: 80W per channel into 8 ohms, 10 to 20k Hz.
Distortion: less than 0.05% at rated output over the quoted frequency range.
Voltage gain: 20 dB.
Intermodulation: less than 0.05% at any power to rated output.
Weight: 13.7 kg.

The company also manufactures a range of power amplifiers intended for public address. These incorporate integral preamplifiers.

Bose 1801 dual-channel power amplifier

BOSE

Bose Corporation, 100 The Mountain Road, Framingham, Mass 01701, USA.
Phone: (617) 879 7330.
UK: Bose (UK) Ltd, Sittingbourne Industrial Park, Crown Quay Lane, Sittingbourne, Kent.
Phone: 0795-75341.

1801

Number of channels: two.
Power output: 250W into 8 ohms, 400W into 4 ohms per channel, both channels driven.
Distortion: less than 0.25% thd at 250W.
Intermodulation: less than 0.15% at 250W by SMPTE method.
Noise: —100 dB.
Damping: 100 at 1 kHz.
Sensitivity: 1.5V for rated power output.
Weight: 38 kg.

BOZAK

Bozak Inc, Box 1166, Darien, Conn 06820, USA.
Phone: (203) 838 6521.
Export agents: Elpa Marketing International Ltd, Thorens Building, PO Box 1050, New Hyde Park, NY 11040, USA.
Phone: (516) 746 3002.

CMA-1-120

Number of channels: one.
Power output: 120W rms into 8 ohms.
Line: 70V.
Noise: 80 dB below rated output.
Frequency response: within 1 dB 20 to 20 kHz.
Power bandwidth: within 1 dB 30 to 15k Hz.
Distortion: less than 0.5% thd.
Protection: thermal.
Power requirements: can be supplied to 120 or 220V ac standards.
Weight: 25 kg.
Price: $470.

CMA-1-80

Generally as above but 80W rms output. Price $417.

CMA-1-50A

Generally as above but 50W rms output. Price $381.
Most amplifiers are available in two channel format.

DUKANE

Dukane Corporation, International Division, 2900 Dukane Drive, St Charles, Ill 60174, USA.
Phone: (312) 584 2300.

The company manufactures a range of public address amplifiers which feature 25, 50 and 70V output lines.

1A921B

200W rms.

1A911B

100W rms.

1A901B

50W rms.
Distortion: 1.5% thd at rated output.
Frequency response: 20 to 20k Hz ± 1 dB.
Noise: 80 dB below rated output.
Input sensitivity: 0.4V, —6 dB.
Output regulation: better than 1 dB, 0 to full load.

DUNLAP-CLARKE

See review p80

EPICURE

Epicure Products Inc, 1 Charles Street, Newburyport, Mass 01950, USA.
Phone: (617) 462 3181.

EPICURE ONE

Number of channels: two.
Power output: 125W rms per channel, both channels driven between any frequency 20 to 20k Hz into 8 ohms.
Total harmonic distortion: less than 0.2%.

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Intermodulation distortion: typically below 0.03%.
Power bandwidth: 10 to 52k Hz.
Rise time: 1.5 μs.
Damping factor: greater than 100.
Slewing rate: 17V/μs.
Noise: better than 100 dB below full output.
Phase response: less than 15° from 20 to 20k Hz.
Protection: thermal, short and line.
Weight: 26.4 kg.

GALACTRON

Hi-Fi Galactron International, 18 Via Quarto Negroni, 00040 Ariccia (Cecchina), Italy.
UK: Goodmands Loudspeakers Ltd, Havant, Hampshire.
Phone: 070 12-6344.

MK160
Number of channels: four.
Power output: 100W/channel, all four channels driven.
Load impedance: 8 ohms.
Distortion: less than 0.2%.
Intermodulation: less than 0.2%.
Input sensitivity: 0.7V for rated output on each channel, 1.4V in stereo bridging position.
Power requirements: 115/230V ac 560W.
Dimensions: 462 x 235 x 310 mm.
Price: $1059, £660.

HEIL SOUND

Heil Sound Manufacturing, Heil Industrial Blvd, Marissa, Ill 62257, USA.
Phone: (618) 295 3000.

The company manufactures a range of three amplifiers with similar electrical performance differing only in power and price:

OHMEGA 100/200/400
Power output: 75/150/250W per channel, both channels driven into 4 ohm load.
Frequency response: 20 to 20k Hz ±1 dB.
Distortion: 0.1% at rated output at 1 kHz.
Noise: better than 95 dB.
Input level: 0 dB across 10k ohm bridging.
The manufacturer states that the amplifiers use modular construction enabling very quick plug in repairs to units in the field should this be necessary. A repair kit is produced for this purpose.

H/H

H/H Electronic, Viking Way, Bar Hill, Cambridge CB3 8EL.
Phone: 0954-81140.
S500-D
Number of channels: two.
Power output: 340W/4 ohms, 210W/8 ohms, 110W/16 ohms one channel driven.
Bridge power output: 900W/5 ohms, 640W/8 ohms, 400W/16 ohms. All above power outputs are measured at clip point without any reference to distortion performance at the specific load impedances.
Distortion: less than 0.02% 10 to 10k Hz 'at all levels up to clip point'.
Intermodulation distortion: less than 0.02% from 0.1W to 200W into 8 ohms by SMPTE.
Frequency response: within 0.2 dB dc to 20k Hz, dc coupled.
Slew rate: 10V/μs.
Rise time: 10μs.
Noise: 105 dB below 180W into 8 ohms.
Damping factor: greater than 300.
Input: 0 dBm nominal.

Galactron MK 160 stereo/ quadraphonic amplifier

Cooling: forced air.
Weight: 18.2 kg.
Size: 48.3 x 8.9 x 38.6 cm.

TPA 25D
Number of channels: one.
Power output: 30/65/70W into 15/7.5/4 ohms.
Distortion: less than 0.1% from 20 to 20k Hz at load impedances between 7.5 and 15 ohms.
Frequency response: within 0.4 dB over the audio range.
Input: 0 dB nominal.
Noise: 100 dB below rated output.
Damping factor: greater than 100 depending on load.
Slew rate: 10V/μs.

TPA 50D
As above except 60/80/100W power output.

TPA 100D
As above except 100/180/250W power output.
Distortion: less than 0.2%.
Frequency response: within 0.5 dB over the audio range.

H/H Electronic S500D

JBL

James B Lansing Sound Inc, 3249 Casitas Avenue, Los Angeles, Ca 90039, USA.
Phone:
UK: C E Hammond and Company Ltd, 105/109 Oyster Lane, Byfleet, Surrey KT14 7LA.
Phone: Byfleet 41131.

6233
Number of channels: two.
Power output: 200W/channel into 8 ohms, 300W/channel into 4 ohms; both channels driven.
Power bandwidth: 20 to 20k Hz ±0.5 dB all power levels to rated output.
Distortion: less than 0.05% thd, both channels driven at rated output.
Intermodulation: SMPTE method less than 0.05%.
Rise time: 4 μs or less.
Slew rate: greater than 20V/μs.
Damping factor: 40 minimum.
Noise: 100 dB below rated output.
Input sensitivity: 0 dBm.
Connectors: Cannons.
Power requirements: 120/240V ac.
Special features: uses a 2 kW switching invertor power supply.
Dimensions: 13.3 x 48.3 x 46.5 cm.
Weight: 15.7 kg.

MARANTZ

Marantz Inc, PO Box 99, Sun Valley, California 91352, USA.
UK: Audio UK Ltd, Debmarc House, 203 London Road, Staines, Middlesex.
Phone: Staines 50132.

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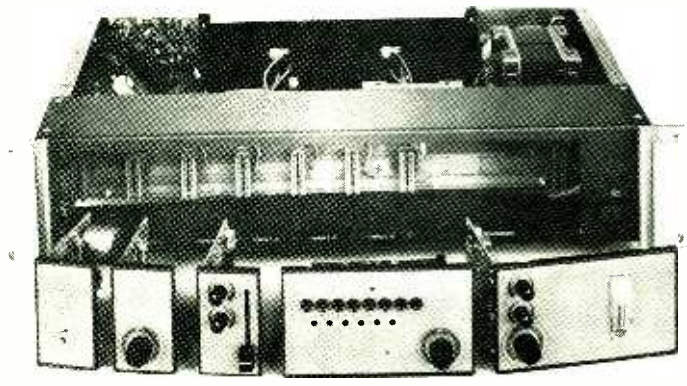


Millbank PAC-System amplifier with front loading inputs removed

www.americanradiohistory.com

The Studer A68 Amplifier – a powerful break with tradition

The Studer A68 is a unique breakthrough in high power amplification for professional use. Its 100 watt per channel (into 8 ohms) power capability is achieved through completely new design concepts which have eliminated transient intermodulation distortion while keeping harmonic distortion below 0.1% at all power levels. The result is a fully professional low distortion amplifier ideally suited to continuous high power operation under arduous studio conditions.

Other features of the Studer A68 include:

- ☐ 100W stereo or 350W mono (into 8 ohms)
- ☐ Fully electronic protection circuitry
- ☐ Low overall feedback for very low distortion
- ☐ Complementary push-pull circuits throughout
- ☐ Standard 19-inch rack mounting size
- ☐ High efficiency power supply amply rated for continuous high power operation
- ☐ Level controls for each channel on the front panel

F.W.O. Bauch Limited

49 Theobald Street, Boreham Wood,
Hertfordshire, WD6 4RZ
Tel: 01 953 0091 Telex: 27502

www.americanradiohistory.com

The company manufactures a range of rather consumer orientated power amplifiers ranging from 75 to 250W/channel. Typical distortion levels are quoted as less than 0.1% thd from 20 to 20k Hz. Price range from £260 to £950.

MILLBANK

Millbank Electronics Group Ltd, Uckfield, Sussex TN22 1PS.
Phone: (0825) 4166.

PAC-SYSTEM

Available with power ratings of 30, 50 and 100W, each with a six input capability. A range of over 30 pre-amplifiers, am/fm tuners and combiners, which front load into the main PAC-System amplifier allow for the requirements of any potential sound installation to be provided for.

MUSTANG

Mustang Communications, Nelson Street, Scarborough, North Yorkshire YO12 7SZ.
Phone: 0723-63298.

SS100 and SS50

Number of channels: one.
Power output: 100W and 50W nominal into 15 ohms. 150W and 80W into 7.5 ohms.
Power bandwidth: within 0.5 dB 10 to 20k Hz into 15 ohms.
Distortion: less than 0.5% in the power spectrum; typically below 0.1% at 1 kHz.
Sensitivity: 0 dBm for rated power.

APRS

THE FOURTH COURSE FOR STUDIO ENGINEERS

WILL BE SEPTEMBER 17-23 1977

PREVIOUS COURSES OVERSUBSCRIBED

Details from

APRS SECRETARY—
E L MASEK
23 Chestnut Avenue,
Chorleywood, Herts, UK
WD3 4HA

Mustang SS50 power amplifier

Noise: 100 dB below rated power output.
Voltage gain: 34 dB.
Protection: electronic current limiting.
Weight: 6 kg.
Options: can be supplied with line matching transformer.
Price: £94 and £70.

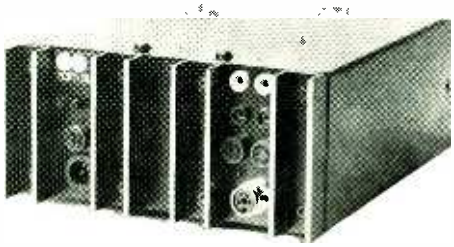
NAIM

NAIM Audio Ltd, 11 Salt Lane, Salisbury, Wiltshire SP1 1DT.
Phone: (0722) 3746.
USA: Audiophile Systems, 5750 Rymarck Court, Indianapolis 46250.
Phone: (317) 849 7130.
Agents in Australia, Holland, Israel, Japan, Scotland and Singapore.

NAP120/160/250

Number of channels: two.
Power output: 40W/50W/70W per channel into 8 ohms, both channels driven.
Distortion (NAP160): less than 0.03% intermodulation distortion products at 35W.
Output offset: less than 40 mV.
Input sensitivity for rated output: between 0 and +6 dB.
Protection: 'will tolerate any load from zero to infinity without damage . . .'
Price: from around £140.

Nairn NAP 120



QUINTESSENCE GROUP

Quintessence Group, Audioworks Division, 1115 'E' Street, Sacramento, Ca 95814, USA.
Phone: (916) 441 5175.

PA II

Number of channels: two.
Power output: 150W/channel, both channels driven into 8 ohms.
Power bandwidth: 74 kHz.
Slew rate: 5V/μs.
Distortion: less than 0.2% thd.
Noise: better than —95 dB.
Damping factor: 107.
Sensitivity: 0 dBm.
Price: $1300, £760.

PA I

Number of channels: two.
Power output: 75W/channel, both channels driven into 8 ohms.
Power bandwidth: 68 kHz.
Slew rate: 8V/μs.
Damping factor: 67.
Noise: better than —95 dB.
Distortion: less than 0.2% thd.
Sensitivity: 1.5V for rated power output.
Price: $600, £350.

Quintessence PA II

QUINTOR

Quintor Electronics Ltd, 57 Shortwood Avenue, Staines, Middlesex TW18 4JN.
Phone: Staines 56935.

Twin 100

Number of channels: two.
Power output: 100W/channel into 8 ohms.
Load impedance: not less than 4 ohms.
Input: 1V rms.
Frequency response: 20 to 20k Hz ±1 dB at rated power.
Distortion: less than 0.1% thd at 1 kHz.
Noise: better than 75 dB below rated output.

RAC

Rugby Automation Consultants, 19 Freemantle Road, Bilton, Rugby CV22 7HZ.
Phone: 0788-810877.

RACAMP 50 and RACAMP 100

Number of channels: one.
Power output: 50/100W rms.
Nominal output impedance: 8/4Ω.
Power bandwidth: 10 Hz to 20 kHz ±1 dB.
Protection: not very clear; some protection of unknown nature provided.
Input impedance: 90 kΩ.
Gain: 420 mV for rated output.
Hum and noise: 76 dB below 50 mW.
Distortion: 0.025% thd at 1 kHz, 0.15% at 12.5 kHz, power level unspecified. Im less than 0.25% (unstated level and mixture).
Power requirements: 240V ac.
Dimensions (whd): 135 x 133 x 254 mm.
Price: £65/£72.
A 50+50W/channel dual *Racamp* 50 is available, price £88.

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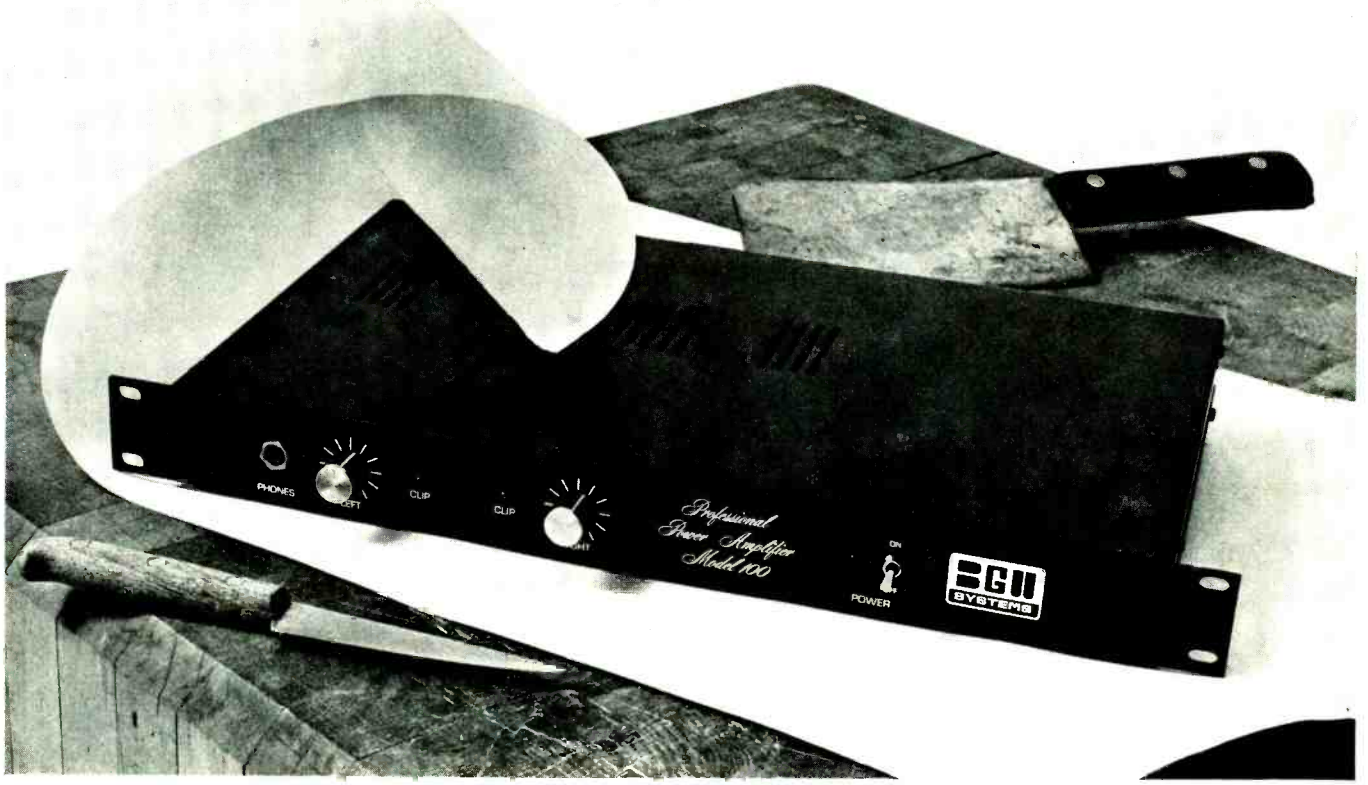
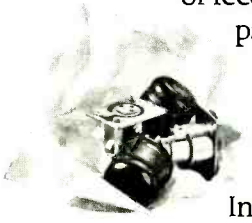
BGW PRIME



BGW is about to whet your appetite with their new Model 100 Stereo Power Amp.

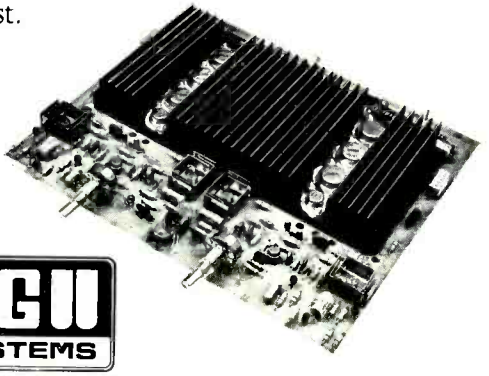
The Model 100 will drive the most difficult loads you can throw at it. Electrostatic headphones and reactive speakers are driven flawlessly due to the 100's unique design. No form of current-limiting is used whatsoever. A precision monitor amp for any application, the modular construction of the 100 means one integrated amplifier circuit board with the biggest heat-sink we could package in 1-3/4" of vertical rack space: 340 square inches of efficient sink. No more thermal shutdowns.



There's a sophisticated "loss-of-feedback" circuit with front panel L.E.D's. Also unique to the 100, the L.E.D's are driven by a one-shot circuit for precise clipping indication. Instantaneous peaks, which get by most amps, are stretched out in our L.E.D. circuit so you can see them.

On the inputs, you can get optional Cannon XLR's and plug-in transformers...and into 8 ohms you get 33 watts per channel, or 80 watts mono. Into 4 you get a meaty 44. The I M distortion is an incredibly low .01%.

It's about time somebody like BGW would mete with the competition. Check out the Model 100. It's just one of six professional prime cuts...of course, all above the rest.



BGW SYSTEMS

BGW Systems 13130 South Yukon Ave., Hawthorne, Ca 90250 (213) 973-8090
In Canada: Omnimedia Corp., 10245 Cote de Liesse, Dorval, Quebec H9P 1A3 (514) 636-9971
Worldwide Export Agents: Telesco International Corp., One Dupont Street South, Plainview, L.I., New York. (516) 433-6210

www.americanradiohistory.com

SURVEY: POWER AMPLIFIERS

RADFORD

Radford Audio Ltd, Ashton Vale Road, Bristol BS3 2HZ, Avon.
Phone: 0272-662301.

ZD 200/100/50
Power output: 150/90/70W per channel into 8 ohms; 250/150/110W per channel into 4 ohms both channels driven.
Distortion: less than 0.004% thd at 1 kHz, rated power 8 ohms.
Noise: 110 dB below rated output.
Sensitivity: 1V for full output.
Intermodulation: less than 0.01% by SMPTE.
Weight: 16/13/11 kg.

Radford ZD 100

SAE

Scientific Audio Electronics Inc, 701 E Macy Street, Los Angeles, Ca 90012, USA.
Phone: 1-213-489-7600.

2400L
Number of channels: two.
Power output: 200W/channel both channels driven.
Distortion: less than 0.05% thd and im.
Noise: 100 dB below rated output.
Slew rate: 40V/μs.
Price: $800

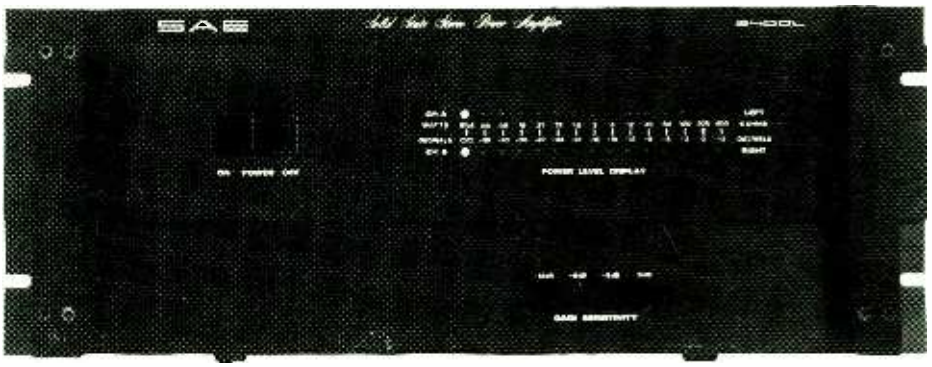
SANSUI

The company manufactures two large power amplifiers rated at 300W/channel and 170W/channel into 8 ohms. Distortion figures are quoted as less than 0.1% and 0.05% thd respectively. These are designated types *BA5000* and *BA6000*.

SPECTRA SONICS

Spectra Sonics, 770 Wall Avenue, Ogden, Utah 84404, USA.
Phone: (801) 392 7531.

700
This is a printed circuit card comprising one of an array of power amplifiers fitting within a 48 cm rack.
Number of channels: up to eight within one rack.
Power output: 60W developed across 4 ohms; modules may be bridge connected to double individual ratings.
Power bandwidth: within 0.3 dB at rated output (4 ohms) dc to 20 kHz.
Total harmonic distortion: less than 0.01% at full output.
Intermodulation: less than 0.1% at full output.
Gain: 21.2 dB.
Signal-to-noise ratio: better than 100 dB below full output, 20 to 20k Hz.
Slew rate: 10V/μs.
Input impedance: 10k ohms.
Phase shift: less than 5°.
Power requirements: ± 30V dc maximum.
Price: $84 per module.



SAE 2400L stereo power amplifier

STUDER/REVOX

Studer International AG, Althardstrasse 150, CH-8105 Regensdorf, Switzerland.
Phone: 01 840 29 60.
US: Willi Studer America Inc, 1819 Broadway, Nashville, Tenn 37203.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham-wood, Herts WD6 4RZ.
Phone: 01-953 0091.

A68 (see review p 68)
Power output: 100W/channel into 8 ohms, 175W/channel into 4 ohms both channels driven. Bridge connected 400W into 8 ohms mono.
Frequency response: within 1 dB from 20 to 20k Hz.
Distortion: less than 0.1% at rated power.
Noise: better than 100 dB.
Damping factor: better than 75.
Weight: 20 kg.
Protection: electronic, crowbar and thermal and dc offset.
Price: £528.

A740
A Revox consumer version of the *A68*. This unit has unbalanced inputs, headphone outputs, etc. It features two front panel signal meters.

SUGDEN

J E Sugden & Co Ltd, Carr Street, Cleckheaton, West Yorkshire BD19 5LA.
Phone: 0274-872501.
USA and Canada: Reference Audio Ltd, 1885 Darling Suite 201, Montreal, Quebec.
Singapore: Atlas Sound Co, b.1/3 U.I.C. Building, 5 Shenton Way, Singapore.
Australia: McGlew & Co Pty Ltd, 34 Pirie Street, Adelaide, South Australia 5001.

P51
Number of channels: two.
Power output: 50W/channel, both channels driven.
Nominal load impedance: 8 ohms.
Distortion: less than 0.05% at rated power output.
Voltage gain: 32 dB.
Damping: in excess of 30.
Noise: greater than 90 dB.
Frequency response: within .75 dB between 30 and 20k Hz.
Rise time: 7 μs.
Protection: current limiting electronic and fuse.
Price: £96.

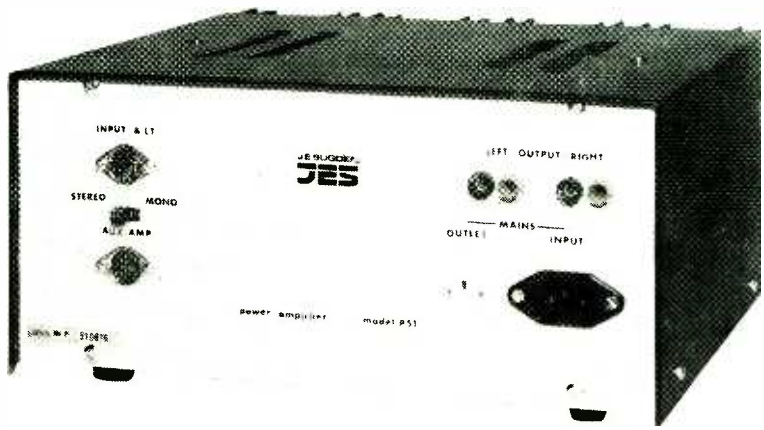
SWTP

South West Technical Products Corporation, 219 West Rhapsody, San Antonio, Texas 78216, USA.

TIGERSAURUS 250
Number of channels: one.
Power output: 250W into 4 ohms; 200W into 8 ohms.
Distortion: better than 0.1% at above power levels.
Intermodulation distortion: less than 0.03%; measurement method unspecified.
Damping factor: over 100.
Noise: better than —95 dB.
Input level: 2V rms.
Power bandwidth: 20 to 20k Hz.

TIGER 207
Number of channels: one.
Power output: 60W into either 4 or 8 ohms with less than 0.05% total harmonic distortion from 20 to 20k Hz.
Intermodulation distortion: less than 0.01%.
Noise: less than —90 dB.
Damping factor: over 100.
Input: 1V rms.

60 ▶



Sugden P51 power amplifier

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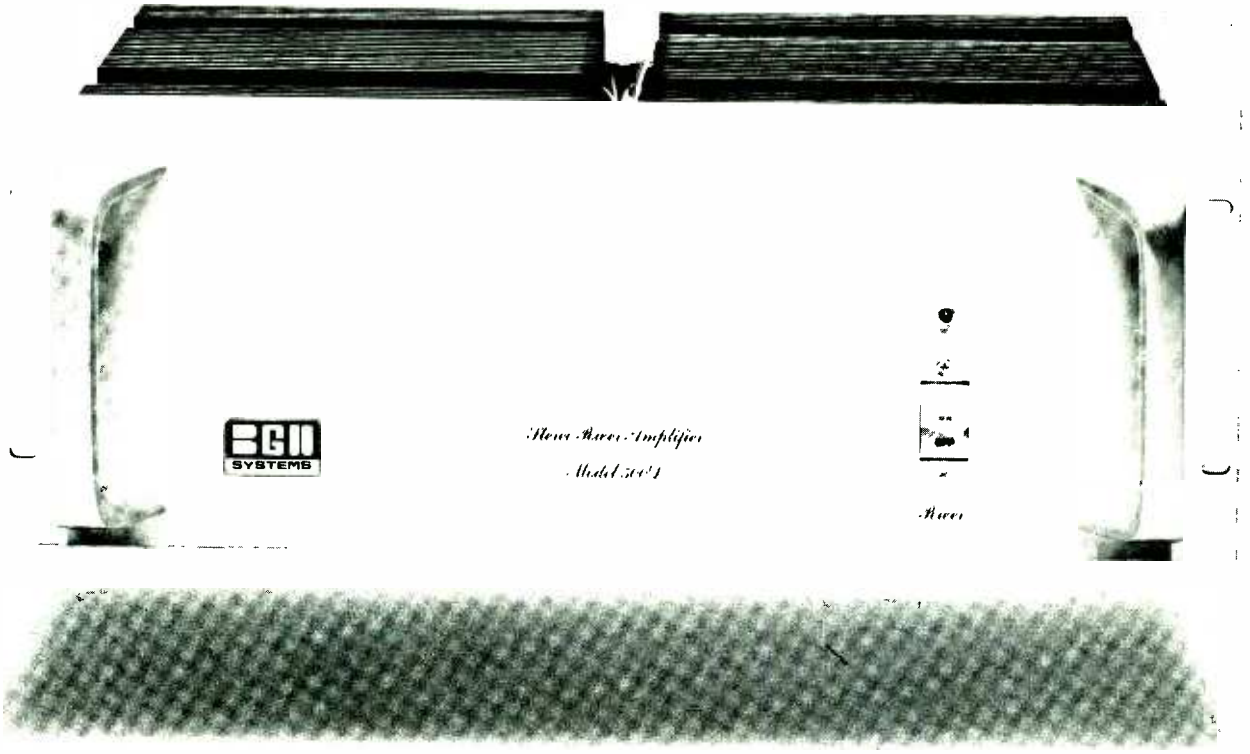
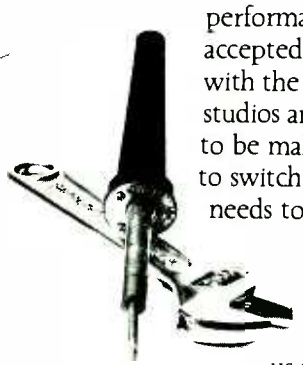
50,000 Miles Parts & Labor.



Tear us apart. Modularly.

We think we're realistic. Despite the rugged and proven design of our amps, we're not perfect. Sometimes they need attention like anybody else's.



This ad is not about performance. We know you've accepted us as the company with the most to offer...more studios and music people seem to be making The Big Decision to switch their power amplifier needs to us.

Setting our better performance aside, a big difference between us and the others is our ease of servicing. Although our three year parts and labor warranty is not unique, our modular design that allows rapid and easy component changeout is. After the 50,000 miles on the road or the equivalent run of tape in the studio, we survive longer because you can keep us around without a lot of hassles.

A BGW amp is a practical, austere looking piece of gear for good reason. In an environment where only the strong survive, you'll be seeing more austere BGW front panels. 50,000 miles later, if the parts and labor are needed, tear us apart, modularly.

Get our information on a full line of power amps and find out why more roadies are lugging our heavy amps and studio engineers love us.

BGW SYSTEMS

BGW Systems 13130 South Yukon Ave., Hawthorne, Ca 90250 (213) 973-8090. In Canada: Omnimedia Corp., 10245 Cote de Liesse, Dorval, Quebec H9P 1A3 (514) 636-9971. Worldwide Export Agents: Telesco International Corp., One Dupont Street South, Plainview, L.I., New York, (516) 433-6210

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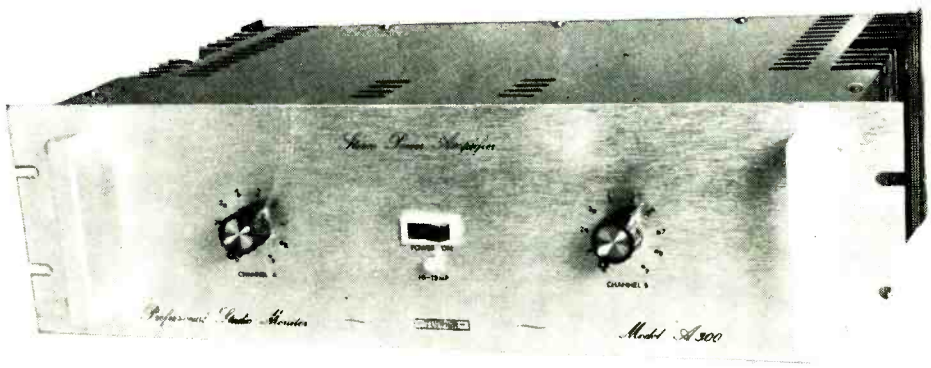
SURVEY: POWER AMPLIFIERS

TELEMATION

TeleMation, PO Box 15068, Salt Lake City, Utah 84115, USA.
Phone: (801) 972 8000.
UK: 293 Regent Street, London W1V 2HR.
Phone: 01-636 9447.

TMA525
This is a modular amplifier for building into consoles and equipment racks. Using balanced 0 dBm line, it produces a maximum of 10W into 8 ohms. The company can provide special racks and power supplies for powering up to six units. Voltage requirements ±18V dc.
Price: $315, £189.



Turner A300 professional stereo amplifier

TURNER

Turner Electronic Industries, 175 Uxbridge Road, London W7 3TH.
Phone: 01-567 8472.

A300
Number of channels: two.
Power output: 150W/channel into 4 ohms, 100W/8 ohms, 60W/15 ohms.
Power output (bridge connection): 300W/8 ohms.
Frequency response: within 0.2 dB over the audio range.
Noise: 110 dB below rated output.
Output impedance: 0.01 ohms from 20 to 400 Hz.
Inputs: +4 dBm.
Distortion: less than 0.01% at rated output into any quoted load condition.
Protection: quite a lot of it.
Weight: 13.5 kg approx.
Size: 483 x 134 x 302 mm.
Price: £395. With vu meters £485.
The company also manufactures amplifiers with other power ratings with (one imagines) similar performance specifications to the above. These are a 250W/channel *A500* at £550 without vu meters and a 100W/channel unit for which no price is yet announced.

YAMAHA

Natural Sound System, Strathcona Road, North Wembley, Middlesex.
Phone: 01-904 0141.

P2200
Dynamic power: 600W + 600W into 4 ohms at 1 kHz, thd of 0.1%.
Frequency response: 5 Hz to 100 kHz +0 —1.5 dB. Standard 48.3 cm rack mounting—equipped with feet for free standing. Equipped with peak programme meter and attenuators.
Price: £492 inc VAT.

Dunlap Clarke Electronics

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Dunlap Clarke DREADNOUGHT 1000 Audio Power Amplifier

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As you know, we have been working with DUNLAP CLARKE in producing a range of Amplifiers and PRE-AMPLIFIERS that sound musical, have good reliability, are rugged, easily serviced, are reasonably priced, that we can sell in Europe.

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A PRE-AMPLIFIER—the M10.

We believe that this list is truly a comprehensive range of amplifiers, from 500w per channel. All amplifiers are designed to work into low impedance loads (2ohms).

For professional use there are three amplifiers in the range that will work exceedingly well.

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ALL the amplifiers are suited for ALL audio uses, but through experience we have found that the latter models will work satisfactory, in all cases.

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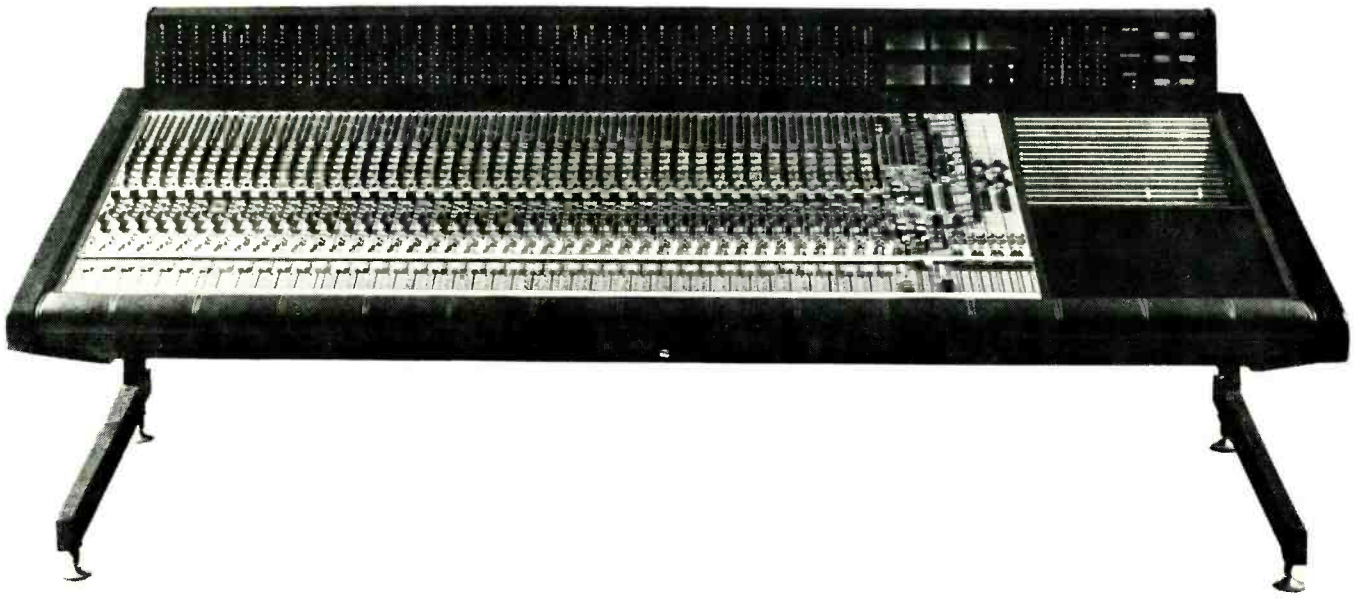
Photograph courtesy CBS Studios, London.



500 SERIES

We are Businessmen who happen to be recording equipment designers. If you run a recording studio and happen to be Businessmen also, then you will be using MCI equipment.

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work

Sun Studio/Thames Valley Broadcasting

Reading, as any statistician will tell you, is the most nationally average place in England. Accepting the challenge, I took a trip to Reading to see what kind of studio enterprises I could find to report.

Sun Recording Services, of Crown Street, Reading, had made the point to us in a letter that although the area of Berks and Bucks around Reading is knee-deep in private recording studios, owned and used by the many musicians and pop stars who have retreated to the area, Sun is just about the only local commercial multitrack studio open to the public. It is a small studio, so far specialising mainly in commercials, cassette duplication and the demo market. But some reasonable names (such as the New Vaudeville Band) have recorded there. And last year Van Morrison, who lives along the river Thames, brought in the likes of Keith Tippett and Vinegar Joe and spent a couple of weeks rehearsing at Sun before moving farther upstream to record at the Manor near Oxford. It is doubtless this, and an obviously busy time with commercials for the local radio station (of which more later), which has given Sun the cash and confidence to plan a major restructure of the terraced house in which the studio is located. The office will be turned into control room, wall knocked down, relax rooms fitted out upstairs, and so on. But for the benefit of other small studios interested in a visit from STUDIO SOUND and a write-up in these pages, it would make more sense to invite and open the doors to the press *after* such a major restructure, rather than *before*. Be that as it may, we did visit Sun, and found the current situation worth a report, albeit mainly on the strength of the very acceptable sound the studio gets from what is, frankly, so far an economy setup.

Also, as director and working engineer, Martin Maynard, points out, the studio relies for its bread and butter on a busy field which we have tended to neglect—the demo market. For this, Sun charges pretty much rock bottom rates—£8 an hour or £80 for a 14-hour day. Also offered is a 'thousand lps for a £1000' deal, whereby a group, for instance touring the northern clubs, can come into the studio, record an lp and have it mixed, cut, and a thousand copies pressed and packed into attractive printed sleeves for the total of £1 each. These can then be sold by the band at gigs, for around £2 a time, with everyone happy over the deal. Indeed, some of the northern clubs are now heavily geared to this kind of promo album exercise. They have special stalls set up in the lobby, and take a percentage cut of the profits from record sales during the gig. This is how the Vaudeville Band came to record at Sun and the results are commendable for the low price.

The equipment in the control room is an Otari 8-track, which cost Sun around £4000 and over which they have no regrets. Only problems so far are an unhappiness of the machine with matt-backed tape, which leaves the tension idler running in the wrong direction after tape direction has been switched. There is also no counter, which seems a curious omission.

Mastering is on Revox *A77* and *A700*, the desk being a heavily modified Allen and Heath. Amongst the future plans is a new, custom-built console designed by Maynard, an engineer with a Post Office background. But again, surely it would have made more sense to ask us along after the new desk was installed?

The demo business is partly bread-and-butter, partly a nightmare, and partly a pleasure. Like any demo studio, Sun get in some appalling no-hope talent who know nothing about recording and even less about music. As one 'manager' for a young lady singer whom he was 'sponsoring' said, when he brought her in to record a demo, 'the young lady's got a very loud voice, so you won't need a microphone'.

As Maynard points out, he and his obviously talented musical partner, Rob Boughton, are able to involve themselves in the business of producing a demo far more than the staff of a comparable studio in London with heavier overheads. 'We don't start charging the moment they come through the door,' says Maynard, 'and we don't pull the plug the moment the money runs out.' On the other hand Sun have found it necessary to explain a few facts of life to some groups, like, for instance, the fact that studio time isn't charged only while the tape is running. When a group is prepared to listen to advice and let itself be produced, Boughton and Maynard are willing to advise and produce. It's easy to forget how totally foreign the whole business of modern music recording is, even to reasonably competent groups who are accustomed only to playing live gigs. One local group, for instance, tried to engineer its own fades by playing quieter and quieter towards the end of each take. The engineer was pushing up the faders in desperation, until he finally realised what was happening.

Some groups, although musically talented, have no knowledge of overdubbing and the kind of special effects that even a relatively simple studio setup like Sun can produce.

I heard one tape, of a group called Gambler, from Swindon, who had listened to Sun's suggestions. As a result four tracks had been produced in one day's recording and a night's mixing, with up to 20 vocals overdubbed by judicious bump-tracking. Especially bearing in mind that the studio as yet has no Dolby or dbx, which makes noise a potential problem, the results are good. And the group just has to be a winner—both group and sound decidedly are above the national average, one might say.

It struck me, while staying at the average Reading Post House, that the new ilr stations are fighting something of an uphill battle. Each hotel room had a bedside loudspeaker piped with a choice of four programmes of sound. There was Radio 2, 3 and 4, and a 'music' channel of pre-recorded wallpaper. But just down the road from the hotel is the transmitter for Thames Valley Broadcasting, and I could only hear its programmes because, like a wise virgin, I had taken my portable trannie with me. Even the local *Evening Post* newspaper doesn't exactly fly the Thames Valley flag. While listing Radios 1, 2, 3 and 4 and BBC Radio Oxford (which in any case shares many of its programmes with Radio 2) in detail, the local commercial programmes were condensed to literally seven words for one day and 14 words the next, including times!

In fact, the paper even gets the station name wrong. The correct title for the Reading ilr station is Thames Valley Broadcasting, not the Radio Thames Valley tag used by the local newspaper. Probably this is something of a hangover from some brisk, bitter wheeling and dealing which put Thames Valley Broadcasting (under programme controller Neil St. J. ffrench-Blake backed by Rupert Murdoch's 'News International') on the air rather than the rival Thames Valley Radio Company which had been engaged in heavy local promotions and right up to the last moment looked likely to get the contract. Be all that as it may, TVB was the eighteenth, or last-but-one, ilr station to go on the air. And it did so with a launching capital of only £220 000. According to ffrench-Blake, and he is happy to be quoted on the point, the station still has money in the bank and has made a trading profit every month since opening. Certainly locals seem to like the station, feeling it is giving average Reading a sense of identity, and the programming is some of the most interesting and adventurous that I have yet heard on a local station.

First and foremost point of interest is the station policy over phone-ins and dedications. In a

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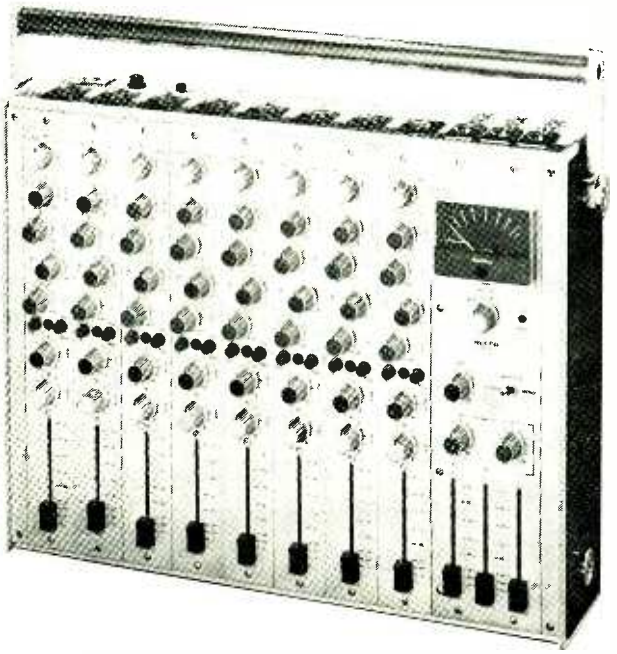
AUDIO DEVELOPMENTS

Hall Lane, Walsall Wood, West Midlands WS9 9AU

Phone 05433-5351

SPECIALISTS IN PROFESSIONAL PORTABLE MIXING



Principal Products:

AD007 MINI Mixer
8/4 battery-powered (with external power option). Modular construction for ease of servicing. MIC or LINE inputs, comprehensive EQ, line up Oscillator, two switched meters and compressor/limiters. Many options including provision for increasing number of inputs to 20 using external unit connected via Extender Socket.

AD031 MICRO Mixer
8/2. 1. Generally as AD007 but smaller. Two main groups remixed to give a third—stereo and mono operation at same time. Oscillator compressors, etc are optional extras with AD031 and many others available (including extension).

AD045 PICO Mixer
6/2 powered by rechargeable battery, XLR or DIN versions available. Both with PHANTOM/TONADER mic powering, VU/PPM meter options only.

AD075 SUPER System
Retains most of features of AD007 and AD031 but each module can be used as input or output, facilitating multitrack working. Modules selected as output groups indentified by LED numerical indicator. 20 module unit can give 19/1, 18/2, 17/3 or 16/4 working, as well as direct in/out on any module. Very flexible and versatile arrangement.

LIST OF AGENTS

M. R. Drott,
Johannesgasse 18,
A-1015 Wien,
AUSTRIA

Studio Centre,
3 Rue Du Telegraphe
75020 Paris,
FRANCE

Dr W. A. Gunther,
Ingenieurburo SIA,
8702 Zollikon, Zurich,
Seestrasse 49-51,
SWITZERLAND

Laboacustica,
Via Muggia 33,
00195 Roma,
Tel: 3595506/386867
ITALY

Sound Techniques,
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HOLLAND

Phillips Electronic Industries Limited,
200 Consumers Road,
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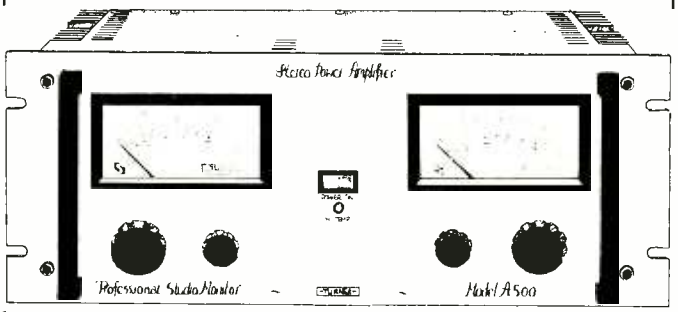
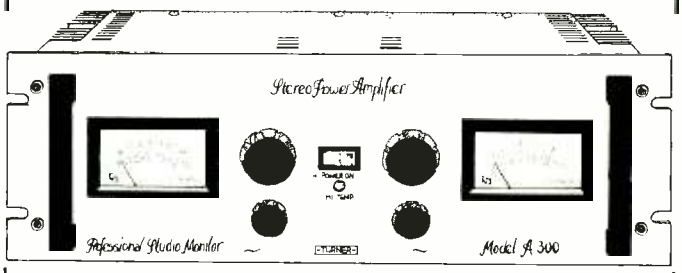
-TURNER-

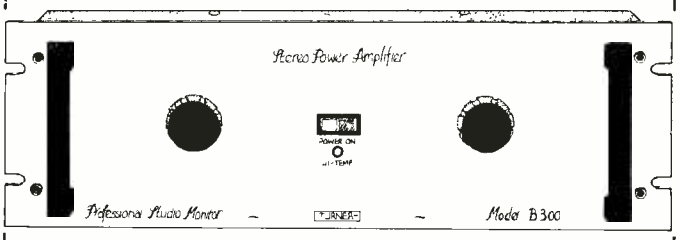
PROFESSIONAL STEREO POWER AMPLIFIERS



Model A500 provides 180 watts per channel into 8 ohms (280 watts per channel into 4 ohms) and is recommended for use in the most demanding studio monitoring or p.a. situation.

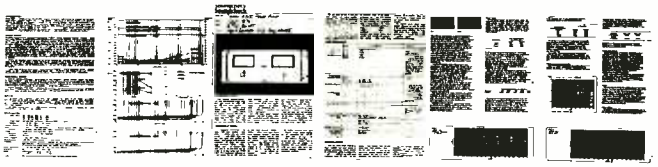


Model A300—the studio standard—provides 100 watts per channel into 8 ohms (150 watts per channel into 4 ohms). As supplied to leading recording studios.



Model B300 is the single power supply version of model A300.

Technical literature available:—



A300 specifications A500 reviewed A300 reviewed

Turner Electronic Ind. Ltd.

175 Uxbridge Road, London W7 3TH.

01-567 8472

www.americanradiohistory.com

word, there aren't any. As DJ, Tony Fox, says, 'dedications mean a lot to the one person involved—but nothing to anyone else.' The nearest the station gets to dedication is allowing Sam from Basingstoke to phone in and say 'Hullo, I'm Sam from Basingstoke', and then partake of a quiz or the like. There's method in this, because it gives a remarkably good dipstick of how and where the station is being received.

The station building is in a converted CD fire engine shed several miles out of the town centre. It's thus modern and virtually custom-built with room for expansion. Controller ffrench-Blake and colleagues originally planned it out using Lego, and the offices off the studios are on two-level open plan. 'My god,' said a retired Air Force officer who visited the station, 'it's like an old Battle of Britain ops room'. At this ffrench-Blake, who sits upstairs in the ops room, immediately had visions of girls downstairs pushing top 40 discs round a table with long sticks. In fact a more common sight, with the studios out of town in somewhat rustic surroundings, is a long-haired dog, waiting while its master makes a broadcast.

To complement the somewhat odd situation of studios out of town, the transmitting aerials are fairly central in Reading. The vhf fm stereo transmissions (0.5 kW erp) seem to carry round the designated area reasonably well, but the medium wave output, with only a measly 100 watts erp) is a real source of concern. The 210 mw frequency is shared with a high power Russian station, and of course almost shared by a certain 208 putting out a megawatt in Luxembourg. So, at night, TVB on the medium wave virtually falls off the end of the transmitter. It seems that Reading was the first ilr station to come on the air after the recent conventions which clamped down on transmitter powers, and thus there is no chance of an upgrading. ffrench-Blake has realistic attitudes to the problems of poor night time reception on medium wave. 'We've got to get people into vhf, but it takes time—we're still Radio 210, not Radio 97.'

The staff also seem generally and understandably irked that BBC Radio Oxford, with 17 kilowatts, comes in decidedly loud and clear. And even Capital encroaches on Reading territory. Without doubt there would be enthusiasm for anything, be it Dolby or whatever, that could push up TVB's effective power.

Thames Valley Broadcasting

With all this in mind, it seems astonishing that the station has so far been so successful. ffrench-Blake puts it down to programming policy that avoids blather and drivel and concentrates on music and useful local information put out by what he regards as a top quality broadcasting team. Certainly the standard of broadcasting is high. Ex-BBC Paul Hollingdale does the morning show, and one morning when I listened ex-BBC Bruce Wyndham was doing a guest broadcast. Out of the total 33 station staff, 12 are broadcasters. Mike Matthews, Tony Fox (ex-LBC) and David Addis are, along with Paul Hollingdale, the 'old hands', with the other eight all new to the field when recruited for the station's opening last March. Notable for absence was Simon Dee, whose recruitment to TVB for a regular show made headlines last autumn—as did his almost immediate walkout. No one seems too anxious to talk about this episode, but it seems to have involved a dispute over whether or not Mr Dee should be expected to interview as well as play music. Understandably there isn't too much talk either about the celebrated occasion last year when another member of the staff decided to quit the service in spectacular fashion, for instance by breaking the taboo of not commenting on the news, and bringing up all the wrong faders. A tape of the occasions is reputed to exist, and is doubtless by now a sound collector's item, along with Harold Wilson's brief encounter with the young Dimbleby and the Trogs' unsuccessful attempts to get it together again in a studio and stop swearing for a few minutes.

Listening to TVB in my hotel room the day after visiting the studios, I recalled one of ffrench-Blake's comments. 'People have got sick of the BBC padded cell approach', he had told me, 'with nothing but drivel to fill in the gaps between music left by their needle time restrictions. We don't drivel, we involve the audience. As a result, 53 per cent of the local listening population tune in to us once a week, and 25 per cent listen five days or more.' At the time I found the figures somewhat hard to believe, but less so after hearing one particular broadcast item. A TVB broadcaster had brought a local conjurer into the studio to perform tricks over the air. 'Oh god!' I thought, but listened out of fatal fascination. Three listeners were invited to phone in and offered a couple of albums for their trouble. The first was asked date of birth, the second told to pick any number, 1 to 1000, and the third to name a card in the pack. In between each call an easy listening album track was played. Although the final outcome was hardly unpredictable (the conjurer with magical precision had written down in advance the correct answer to each question), it's fascination had kept me listening to TVB for at least a quarter of an hour. And of course I'd heard their commercials as well (including, incidentally, one made by William Rushton at Sun). After the conjurer had succeeded with his trick, to the fall-about astonishment of the station broadcaster, the local charity concert at which he was appearing that night got a mention. So that made a total broadcasting score of one free plug for the local conjurer, one free plug for the local charity concert, two free albums for three listeners who got to speak briefly on the air without boring the socks off everyone else, and 15 minutes' compulsive listening to TVB and its commercials for everyone else. I am not saying it's perfect; but it sure as hell beats the sound of Tony Blackburn drivelling.

Adrian Hope

Floyd studio

It is currently fashionable to report in sensational manner on the casualties of Flower Power, Underground Music and the Heavy Rock Sound scene of a few years ago. So it's a safe bet that the popular papers won't quote from the following report on a new studio in Britannia Row, Islington. It's operated by Pink Floyd, four musicians who represent anything but casualties of that era.

I first saw and heard Floyd in the original UFO Club, literally under Tottenham Court Road, just about a decade ago. After several years with the 'underground' tag, they became major EMI recording artists, and hit the jackpot with the *Dark Side of the Moon* lp, recorded at Abbey Road between June 1972 and January 1973. Engineered by Alan Parsons, the album soon became a best seller, and deservedly so. The only mystery is in why it should continue to sell in what appear to be unabated quantities, though one possible explanation is the quadraphonic remix by Alan Parsons, for an SQ release by EMI. There was a time, a couple of years ago, when every quadraphonic demonstration at every audio exhibition seemed to feature the *Dark Side* track, 'Money'. It's even now included in the *Quadrafile* comparison album, where four programme sides are recorded in four competing quadraphonic systems, QS, SQ, CD-4 and UD-4. Perhaps some people now buy the original album to show off their systems.

Whatever the reason for *Dark Side's* success, it has enabled Pink Floyd to do something quite unusual—equip a studio for their own use and run it on a completely *non-commercial* basis.

The 'own studio' syndrome and scenario is now pretty well predictable. A group becomes successful, makes money and grows tired of working in other people's studios; so group builds own studio and happily records in it for a while; goes now off on tour leaving studio empty, but still costing money to maintain and thus comparable to a boat, otherwise known as a hole in the water into which you pour money. Next a magic solution is found. This involves going commercial, and leasing out the studio to earn money. Finally either of two things happens. If the studio is tailor-made to the group, no one else wants to lease it, so the venture is a failure; if commercial leasing is a success, the group can't get in to its own studio and ends up back where it started, paying out cash to tape on someone else's machine.

66 ▶

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The October 1976 edition of "Studio Sound" has a 5-page evaluation of a Studio 8 recorder. Hugh Ford, summarizing his comprehensive report, commented,

"The Ferrograph Studio 8 is by many standards a very cheap studio machine, but its performance and general facilities are by no means in the 'cheap' bracket. Performance figures quoted by Ferrograph do not do justice to this recorder, which is capable of making full use of the latest low noise and high output tapes."

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WORK

But, so far, Floyd have bucked the system and the syndrome.

Although Floyd percussionist, Nick Mason, is at pains to explain that when he says 'I' he usually means 'We, that is Floyd as a group', it is clear that it is he who is mainly responsible for putting the Floyd studio together. It was around three-and-a-half years ago that the group started looking for a London base in which to rehearse and store its masses of stage, sound and lighting equipment. As most of the musicians lived in North London, they looked in North London, but largely without success. Eventually they employed a friend from Regent Poly College days to look for them, and in the fullness of time the three storeys of a Church Hall, once a part of the church of St. Stephen, were revealed unto them in Britannia Row, Islington. The building was bought, and plans laid for a studio. Because this was at a time before *Dark Side of the Moon* had revealed itself as a jackpot and royalties were not yet in full flood, the original plans were to build a cheap studio at a total cost of around a hundred grand. Gradually, as the group's bank balance grew, so did the plans for the studio. But although the final result is lacking for nothing, it is very much tailor-made to the group's requirements. It can for instance be run with a minimum of engineering and maintenance staff. As such it stands a good chance of remaining, as it currently stands, available for the sole use of Floyd whenever they want and need it.

Last year, for instance, between February and September, the group was using it three or four days a week between 11.00 a.m. and 7.00 p.m. to record and mix their new album, *Animals*. So apart from a six-week break in the summer it was in fairly constant use. Mason admits that the group tends to work slowly, not by design or affectation, but by relaxed nature. 'Being prodigal with time,' is his way of putting it.

He does also envisage the possibility of letting other groups use it on free days, but more on a personal introduction than on an 'available for hire' basis.

Already there have been a few visitors, like Arthur Brown (another name from the UFO era) working in the gaps left by Floyd.

With the group members having a predominantly architectural background, dating back to the Poly days, it is no surprise to see the Britannia Row studio austere, rather than plush, and brightly lit, without dimmers or coloured lights. 'Apart from not liking colours and dimmers, I think on the whole they don't get used,' says Mason. 'It's like the craze of domestic dimmers, people install them and then switch all their lights on full anyway.' The walls are bare brick, or more accurately block lignicite, which is a mixture of sawdust and cement. The bare wall look appealed to the architectural eyes of the group, and they had heard that lignicite reflects sound far less than conventional brick. In the event, they found it reflected rather more than claimed or anticipated. But with the help of architect John Corpe and acoustic consultant Ken Shearer they were still able to produce a studio and control room free of unwanted bounce. But the general feel is one of very live acoustic, and there are plans to bring in curtain drapes for the studio walls when the necessity arises. By their own admission, Mason and the rest of the group tended to work on a fairly intuitive basis. They had noticed that some studios sounded good for no particular reason, and were interested in the idea of building a space and seeing how it sounded. But this shouldn't be taken as suggesting that the design was haphazard —the floor is, for instance, a concrete raft floated on rubber for isolation. Even so, Mason acknowledges, with the benefit of hindsight, that if he had known of the existence of Tom Hidley three or four years ago he would have probably sought his advice before work started.

Because of the original low budget, the idea of a Neve desk was abandoned early on. It was also intended to make the studio operable by one engineer with a minimum of fuss and a maximum of convenience. Remember, for instance, that Mason is a performing member of the group for which the studio was designed. It was a

chance discussion with Steven Court over monitoring systems that turned Mason and the group onto the idea of an MCI package. At around a third the cost of custom-made gear, the final package bought was a 24-track machine and desk with autolocate plus a 4-track, plus a 2-track with remote and reset. The MCI desk is ideal for single man operation with its fairly simple equalisation facility; parametrics are used to provide whatever extra is needed for individual channels.

The studio is quad capable, with JBL's at front and rear, but somewhat surprisingly neither the studio nor the group seems particularly quad orientated. The new album is so far scheduled for stereo-only release and will thus be mixed only into stereo. Time will be spent on a quad mix only when the record company asks for it. And the thorny question of which quad system the group would back if given a hand free of record company allegiance? Quite simple. Four track discrete tape was the format envisaged for *Dark Side* and everything else is just compromise of one form or another.

Although a few units of Dolby A were bought for master mixdowns, the main emphasis is on dbx, for which there is full 24-track facility. As Mason points out, this is another advantage of being non-commercial—you can have dbx if you want it. And he wanted it to cut down setting up time. Although ironically the first outside tape to come in was Dolbied, he adds.

And any regrets on choosing dbx rather than Dolby? 'Everyone threatened me with pumping noises,' Mason admits, turning to maintenance and audio engineers Nigel Taylor and Brian Humphries —the only regular studio staff. 'Was it you who threatened me with pumping noises?' In the event no one could remember who had done the threatening, but all agreed that so far there hadn't been any problems. 'And if and when we do find the one odd signal that upsets the system, we can always turn it off for that track.'

Upstairs in the ex-church hall, there's a games room with billiard tables, a store for lighting equipment and another for sound equipment. All the sound and lighting gear is available on hire through the group's Britannia Row Leasing Company. In the basement there is a vast service station for keeping studio and lease equipment up to scratch.

The studio floor is equipped with virtually every keyboard equipment and amplifier type you could wish to find or even dream of, most being duplicated upstairs so that the studio gear can stay in the studio while the stage gear gets knocked about on the road. It's all part of the master plan to make recording a relaxed and trouble-free business. Likewise, the foldback and microphone lines through from the control room to the studio are identified with letters and numbers in the simplest possible manner. This way, one man in the control room can stay put and call unambiguous instructions through to his colleagues in the studio.

'It's been designed with drug-crazed idiots in mind,' says Mason with a grin. But if only to save the popular press a wasted journey out to Islington, I have to report that there isn't a drug-crazed idiot in sight. Just a somewhat austere, beautifully equipped and meticulously maintained working environment, lovingly put together by a member of one of the world's most successful and musically adventurous groups, far more anxious to talk about the exciting adventure of sound techniques and recording than the mundane business of being a pop star. **Adrian Hope**

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reviews

MEASUREMENT OF AMPLIFIER PERFORMANCE

The reviews of amplifiers in this edition of STUDIO SOUND *have employed in the main, traditional measurement methods. That is, the amplifiers have been used to drive passive loads as opposed to loudspeakers which exhibit, to say the least, interesting impedance curves and also have a habit of feeding quite large amounts of energy back into the amplifiers.*

These factors, in addition to the habit of making steady state measurements as opposed to dynamic measurements, account in part for the lack of correlation between measured performance and objective performance. Unfortunately there are large differences between the effective modes presented by loudspeakers so there would not appear to be any 'standard' load which can be used for testing amplifiers. In fact there is much to recommend the little-found practice of making the power amplifier part of the loudspeaker.

Another pit-fall in amplifier measurement is the measurement of total harmonic distortion. Unfortunately, the human ear finds the higher harmonics far more objectionable than the lower order harmonics and odd harmonics more objectionable than even harmonics. Not only does total harmonic distortion measurement fail to give any weighting to compensate for these facts but also the meter characteristics will virtually ignore the pulse type distortion products which are associated with crossover distortion and which are effectively most objectionable.

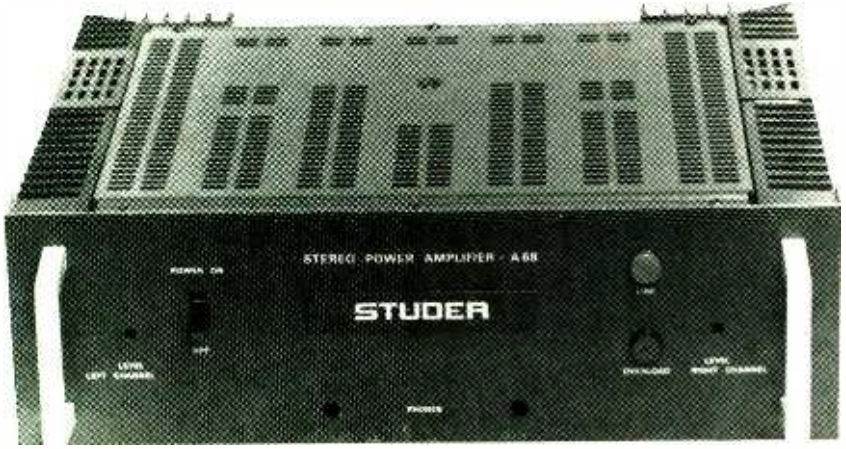
There is evidence that swept twin tone intermodulation measurements show a total correlation with subjective performance but here again one is unable to simulate the load presented by a real loudspeaker and it is known that some amplifiers take exception to rapid changes of load impedance and phase angle with varying frequency.

Studer A68 stereo power amplifier

Hugh Ford

MANUFACTURER'S SPECIFICATION

Nominal power output: (30 Hz to 15 kHz, both channels driven) 100W per channel into 8 ohms; 175W per channel into 4 ohms.
Nominal power output: mono operation 350W into 8 ohms.
Power output: at threshold of limiting: typ 150W into 8 ohms (1% thd one channel only); typ 250W into 4 ohms; typ 400W into 8 ohms mono operation.
Frequency response: 30 Hz to 15 kHz +0, —0.5 dB; 20 Hz to 20 kHz +0, —1.0 dB.
Inputs: balanced, floating.
Input impedance: ≥5 kohms (stereo).
Input sensitivity: 0 dBu...+17 dBu (0 dBu = 0.775V).
Harmonic distortion: less than 0.1% at any output level up to nominal power output (typ 0.05% at 1 kHz).
Signal-to-noise ratio: (unweighted rms reading) better than 100 dB with reference to nominal power output.
Crosstalk: (30 Hz...15 kHz) better than 60 dB (typ 80 dB at 1 kHz).
Damping factor: (30 Hz...15 kHz) better than 75 (typ 250 at 1 kHz).
Level controls: accessible on front panel.
Power requirements: 100, 120, 140, 200, 220, 240V fuse rating 100... 140V: 8A; fuse rating 200... 240V: 4A.
Power requirements: 100W...800W.
Dimensions: 483 x 335 x 133 mm.
Weight: 20kg.
Test conditions: Line voltage 220V. Input voltage +6 dBu (0 dBu = 0.775V). Impedance of signal source 50 ohms.
Price: £528 approx.
Manufacturer: Willi Studer, CH-8105 Regensdorf-Zurich, Switzerland.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire.
US: Gotham Inc. 741 Washington Street, New York NY 10014



THE *A68* power amplifier is a new product from the stable of Willi Studer, and like all his products the standard of engineering has the feel of Swiss precision and considerable forethought which adds so much to the 'quality' of production engineering.

This new power amplifier is clearly aimed at the studio monitor amplifier market, as opposed to the brute force sound re-enforcement market, and the overall specification is sensibly limited to audio frequencies as opposed to the popular range of amplifiers which are designed to deafen bats at 100 kHz!

Having regard for the studio monitor amplifier market, the controls on the amplifier are limited to a screwdriver operated gain control for each channel and the power on/off switch; the remaining front panel facilities including a power on indicator, an overload indicator and two stereophonic headphone jacks.

To the rear, there is an IEC standard power input connector with its associated metric fuse and input voltage selector, all of which are clearly identified. The audio input comprises an *XLR* socket for each of the two channels which have floating inputs, while the audio power outputs are available at large size terminals/banana sockets. While these are not on standard spacing because of their large size, there is a considerable advantage in having good sized connectors.

The remaining facility is a recessed rear panel switch selecting the normal two channel mode, or a bridge connected mode. In the latter, the audio input is from one of the input connectors and the input impedance becomes halved as a result of paralleling the two amplifiers before the input transformer. The audio output is of course from the two 'hot' output terminals and the rated amplifier load becomes 8 ohms.

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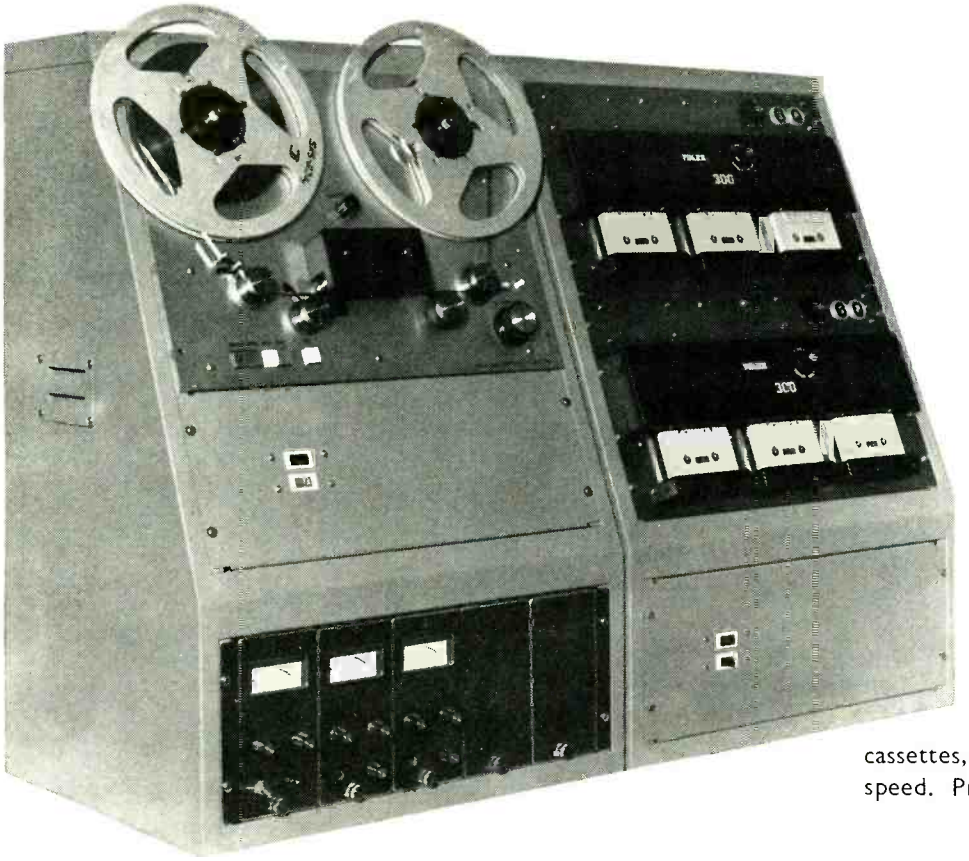

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Mechanically the amplifier is designed for rack mounting into a standard 483 mm rack and is equipped with removable rack mounting 'ears' in addition to two substantial carrying handles. These are fixed to the sides of the amplifier which form a large finned heatsink which extends round the corner to the rear of the amplifier which itself is in the form of a sheet metal panel which houses the rear panel facilities. Similarly the front panel which is in the form of a thick plate is bolted to the heatsinks and forms a substantial box for the electronics.

The electronic components are mounted on six main printed boards, all of which are of good quality and generally uncrowded; however they do not have component identifications, which in spite of clear layout diagrams in the excellent service manual, is a hindrance to servicing. In other respects it is clear that thought has been given to the servicing problem, as not only is access to the boards good, but all connections are by means of *AMP* type slide-on connectors.

The six boards comprise an rf filter board at the audio input (an uncommon feature), a power supply and control board for both channels, and then audio input boards and power output boards for each channel. The latter are mounted adjacent to the power output transistors at the sides of the amplifier, and I was delighted to note that even the leads to the power output transistors were connected by slide-on connectors—this makes it very easy to locate a blown output transistor.

As is to be expected of Studer, the standard of wiring and general tidiness of the layout is beyond reproach with leads and connectors clearly identified—a truly professional unit.

Power output and distortion

As with most power amplifiers the dc supplies to the output stages are not stabilised, so great care was taken to make certain that the incoming mains supply was on the nominal 240V. Likewise the accuracy of loads and the measurement of the output voltage were held to close tolerances.

Total harmonic distortion was measured with the Sound Technology *1700A* meter, but because it is my belief that total harmonic measurement does not tell the whole story so

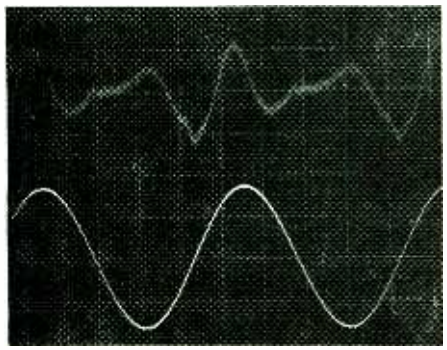
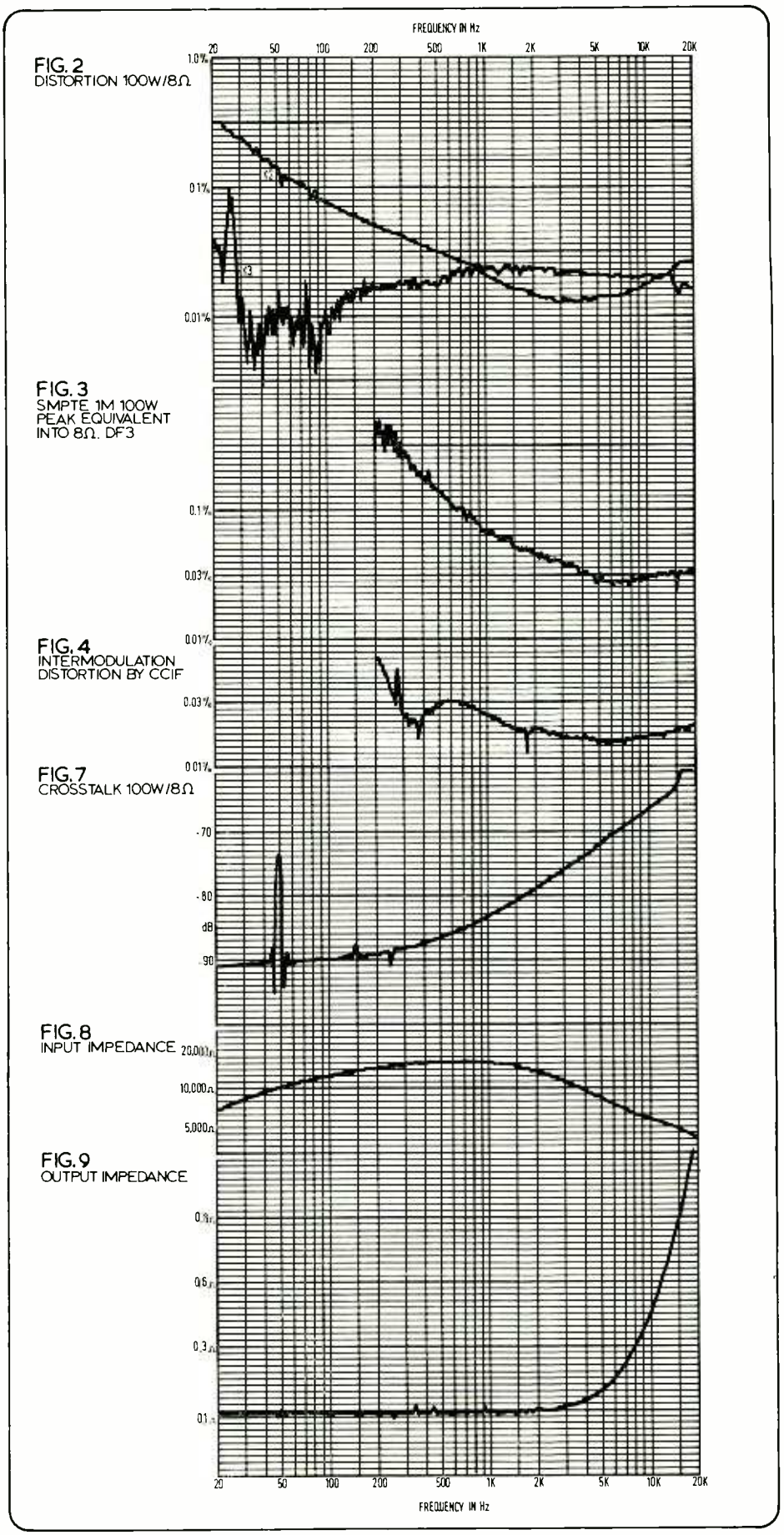


Fig. 1
10 kHz, 100W, both



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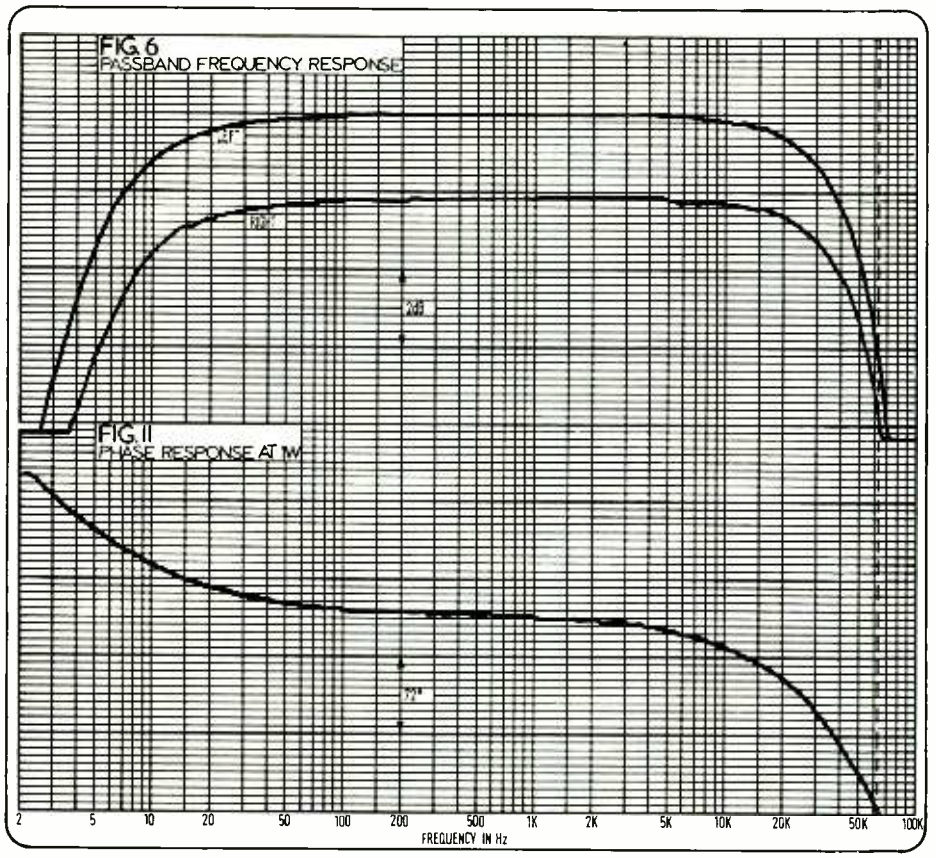
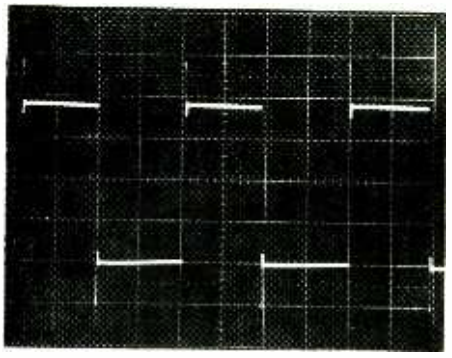


Fig. 5 *1 kHz, 8Ω//2μF*



far as the sound of an amplifier is concerned, individual harmonic products were also measured.

These and the intermodulation distortion in both the twin tone (difference) method and the SMPTE method were plotted with the B & K *1902* distortion measurement control unit allowing swept frequency measurement in conjunction with the B & K *2010* hetrodyne analyser.

Before proceeding with the measurement results, it should be emphasised that this amplifier ran quite remarkably cool under any continuously held sinewave power output, and at any power output level up to waveform clipping. At no time did either of the overload mechanisms come into action, and short of applying a blow lamp I fail to see how the amplifier can over heat! Two protective stages are built in; firstly, when the heatsink temperature reaches 90°C, the power to the drive circuits is removed and the overload lamp illuminated (so we are told). If heating continues to 120°C the amplifier takes emergency action and fires a 'crowbar' thyristor across the main dc supplies, thus blowing the mains fuse.

All that can be done is to take this for granted, as under any practical conditions up to the following power output levels for clipping, there was not a hope of reaching a heatsink temperature of 90°C.

	Total harmonic distortion					
	20 Hz	125 Hz	1 kHz	10 kHz	15 kHz	20 kHz
one channel 4 ohms 250W	0.34%	0.05%	0.06%	0.06%	0.07%	0.07%
one channel 4 ohms 175W	0.28%	0.06%	0.04%	0.03%	0.03%	0.04%
both channels 4 ohms 175W	0.35%	0.08%	0.04%	0.03%	0.03%	0.04%
one channel 8 ohms 150W	0.34%	0.07%	0.05%	0.05%	0.05%	0.07%
one channel 8 ohms 100W	0.28%	0.05%	0.03%	0.03%	0.03%	0.04%
both channels 8 ohms 100W	0.38%	0.07%	0.03%	0.03%	0.03%	0.04%
bridge connected 8 ohms 350W	0.33%	0.07%	0.03%	0.03%	0.04%	0.05%

	Clipping point at 1 kHz	
	Channel 1	Channel 2
Both channels driven into 8 ohms	140W	140W
Single channel driven into 8 ohms	156W	155W
Both channels driven into 4 ohms	225W	227W
Single channel driven into 4 ohms	264W	271W

The measurement of total harmonic distortion at the rated output gave the following results with, in all cases, a very noticeable lack of crossover distortion as shown in **fig. 1** for 100W into 8 ohms at 10 kHz. *(See below)*

Fig. 2 shows the second and third harmonic contents at 100W into 8 ohms, it being seen that for some reason the third harmonic distortion rises at low frequencies; however, as is seen in fig. 1 the more annoying crossover products are at a very low level.

The increase in distortion at low frequencies is confirmed by the intermodulation distortion as measured by the SMPTE method, the results being shown in **fig. 3** for 100W peak equivalent sinewave at 100W into 8 ohms with the low frequency signal set to 60 Hz and an amplitude ratio of 4:1 between the low and high frequency tones.

Intermodulation distortion as measured by the CCIF twin tone method gave more pleasing results as shown in **fig. 4** which represents the swept distortion with a constant difference frequency of 170 Hz, the distortion being generally below 0.03% for any intermodulation product.

Capacitive loading did not at any time show any tendency to instability, but the edges of a fast squarewave overshot as shown in **fig. 5** for a 1 kHz squarewave fed into 8 ohms in parallel with 2μF.

Frequency response and noise

As is to be seen from **fig. 6** the frequency response of the two channels is virtually identical with —3 dB points at around 6 Hz and 45 kHz, thus limiting the passband of the amplifier to audio signals. At rated output power a similar response was obtained without any difficulties with overheating or excessive input power consumption.

Crosstalk related to 100W into 8 ohms was to a very high standard as is shown in **fig. 7** which is a lot better than the manufacturers' specification and notable for the excellent low frequency performance.

Likewise the noise performance was excellent, no doubt partly due to the manufacturers' sense in limiting the passband to the audio spectrum. Unweighted noise over the band 20 Hz to 20 kHz was found to be 105.2 dB below 100W into 8 ohms, with the 'A' weighted rms noise 108.2 dB below this output level.

Mains hum components were insignificant and no other undesirable noise effects were observed.

Inputs and outputs

The maximum input sensitivity for 100W output into 8 ohms was found to be at 1 kHz 565 mV for one channel and 560 mV for the

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STUDER A68

other—very close matching. Operation of the front panel gain controls provided a reduction of sensitivity down to 7V rms and it is felt that some applications might warrant a larger range for the variable controls.

While the input impedance was generally above the rather peculiar rating of 5000 ohms minimum, the variation of input impedance with frequency was excessive as is shown in **fig. 8** and requires care in the selection of the input line impedance. However, operation of the front panel gain controls had little effect upon the input impedance.

On the output end, the output impedance is shown in **fig. 9** which does not give any cause for complaint, and neither did the dc offset at the output which reached a maximum of 45 mV on the worst channel.

The application of a 100 ms asymmetrical tone burst running the amplifier 10 dB into clipping at 1 kHz did not cause any undesirable dc offset or other nasty effects, as is shown by the output waveform shown in **fig. 10**.

Finally the phase shift characteristic as shown in **fig. 11** was excellent within the audio band, with the anticipated phase shift at high frequencies associated with the high frequency roll off in the amplifier. As expected the amplifiers rise time was relatively slow at 7.8 μs with a maximum slew rate of 5.6 V/μs.

Summary

The Studer *A68* appears to be a well built amplifier which runs very cool under any drive conditions; it should therefore be a good amplifier for rack mounting applications where it is required to stack amplifiers for high power systems.

Frequency response and noise did not give any cause for complaint and were excellent, but the third harmonic distortion at low frequencies tended to be on the high side and there are amplifiers which are far better performers for overall distortion.

The only other criticism is the rather low and variable input impedance which could be annoying, particularly when several amplifiers are driven in parallel. ■

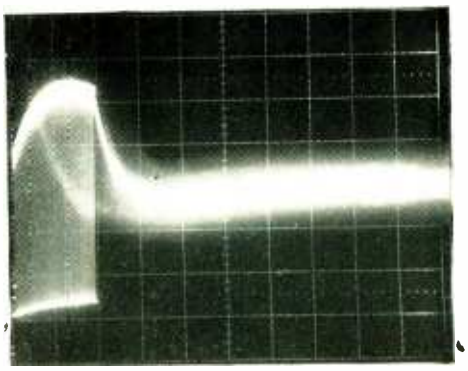
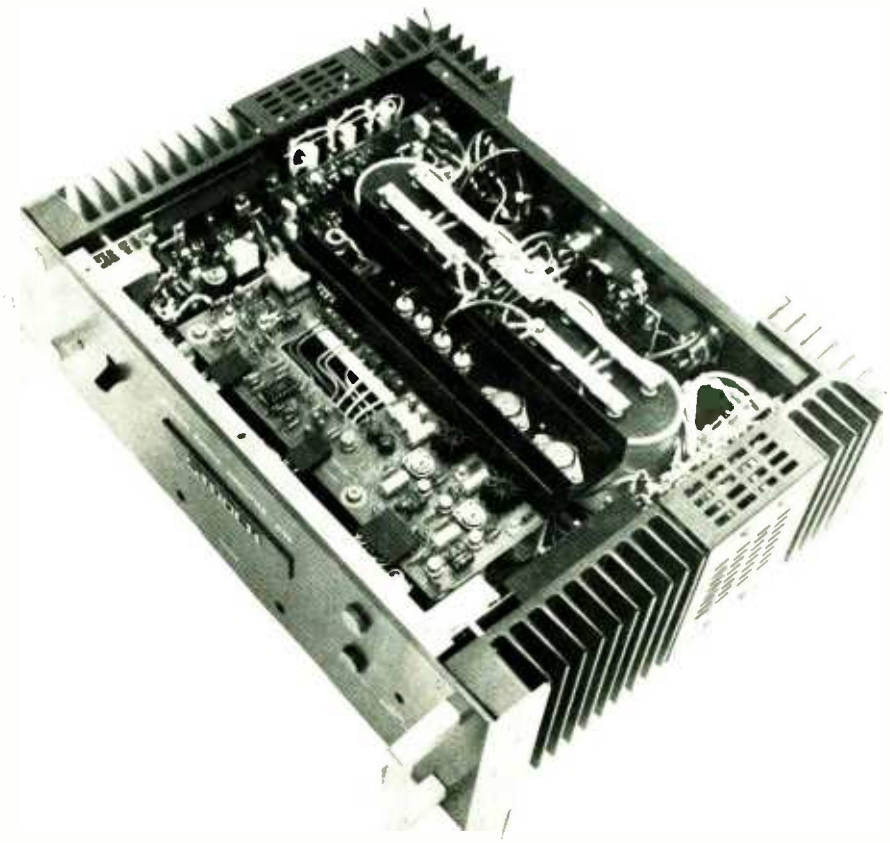


FIG. 10
1 kHz, 10 dB into , 100W, 50 ms/Div



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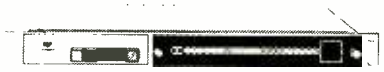
Dolby Laboratories a conçu une unité de réduction du bruit de fond pour chaque type d'utilisation professionnelle

Applications à l'Enregistrement et à la Transmission Professionnels

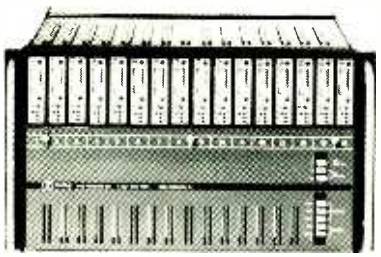
360

Le Dolby 360 est une unité de base du type A pour la réduction du bruit de fond sur un canal, pour codage ou décodage. Cet appareil est utilisé en général comme installation fixe dans le transfert sur disques et aux entrées ou sorties de lignes de transmission. la sélection des fonctions se fait manuellement.



361

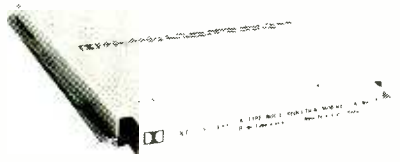
Le Dolby 361 est identique au 360, c'est aussi un réducteur du bruit de fond sur un canal, mais une commutation par relais permet de télécommander ses fonctions à partir d'un magnétophone de studio.



Séries M

Le Dolby M16H Type A est spécialement destiné à l'enregistrement professionnel multipiste. Il comprend 16 unités de réduction du bruit de fond, le tout groupé dans un coffret compact, haut de 10,5 pouces seulement (267 mm). La modèle M8H est une version 8 pistes. Le M8XH peut s'adjoindre à un M16H pour travailler sur 24 pistes.

Modules de Réduction du Bruit de Fond



Cat 22

Le module Cat 22 pour la réduction du bruit de fond est la plaquette de base, utilisée dans tous les appareils de type A. Le Cat 22 est disponible comme pièce détachée ou en grande quantité pour des installations à grande échelle. Une version demi vitesse de ce module, le Cat 40 est également disponible.

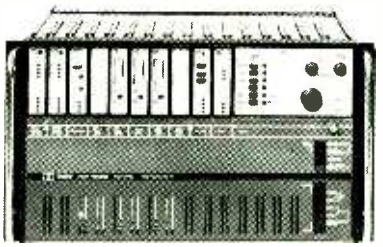
Industrie Cinématographique

364

Le Dolby 364, réducteur de bruit de fond pour le cinéma, est conçu au départ pour être utilisé avec des pellicules en son optique ou magnétique codés selon le caractéristique Dolby A. Le 364 comprend aussi un filtre standard classique pour les bandes conventionnelles, un circuit de nettoyage pour les pellicules usées ou abîmées, et la possibilité de lire des pistes magnétiques avec ou sans système de codage Dolby.

E2

L'équalizer cinéma type E 2 est destiné à être accouplé au 364. Il a été étudié spécialement pour résoudre les problèmes de répartitions des fréquences sonores dans les salles de cinéma. Utilisé conjointement au 364 et à une pellicule à son optique codé en Dolby, le E 2 permet de parfaire l'acoustique de la salle de spectacle sans transformer le matériel déjà existant.



CP100

Le Dolby CP100 Cinema Processor est conçu pour la reproduction des pellicules en tous les formats de son courants et à présent prévoyables, y compris le son optique ou magnétique conventionnel, le son monophonique sur piste optique codée en Dolby, et les nouvelles productions en son stéréo sur piste optique. Jusqu'à trois modules pour la réduction du bruit de fond peuvent être incorporés. Normalement, trois modules pour l'égalisation du théâtre comme utilisé dans le E2, seront inclus. Au total il y a des facilités pour cinque modules pour l'égalisation. En plus, un décodeur tétraphonique externe peut être attaché.

Controleur (Type A)

Cat 35

Le Cat 35 permet la vérification rapide des performances d'un Cat 22 sans démontage de l'unité et sans intervention d'autre matériel de contrôle.

Codeurs Professionnels pour Production de Grande Série

330

Le Dolby 330 pour copie de bandes est une unité de qualité professionnelle possédant les caractéristiques Dolby B (grand public). L'appareil sert à coder les bandes matrices pour la copie à grande vitesse des cassettes, cartouches et bandes "Dolby". Le 330 est un appareil à deux canaux.

334

Le Dolby 334 permet aux stations de radio d'émettre un message code Dolby en modulation de fréquence, selon le procédé du Dolby B. L'appareil réduit également la préaccentuation des hautes fréquences à 25 microsecondes, ce qui rend moins nécessaire la limitation des hautes fréquences et améliore nettement la qualité de la réception.

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Altec power amplifier 9440A

Hugh Ford

MANUFACTURER'S SPECIFICATION:

Type: two-channel basic power amplifier with provision for two optional *15335A* plug-in line transformers for balanced input.

Gain: 55.7 dB with *15335A bridging* 600 ohm line with 8 ohm load. 58.7 dB with *15335A* bridging 600 ohm line with 4 ohm load. 61.7 dB with *15335A* bridging 600 ohm line in bridge (mono) mode with 8 ohm load.

Input sensitivity: 0.6V rms for rated output.

Power output with single channel driven: 200W per channel into 8 ohms from 20 Hz to 20 kHz at less than 0.1% thd. Typically greater than 250W per channel into 8 ohms at 1 kHz at less than 0.01% thd. 400W per channel into 4 ohms from 20 Hz to 20 kHz at less than 0.25% thd. Typically greater than 450W per channel into 4 ohms at 1 kHz at less than 0.05% thd.

Power output with both channels driven: 200W per channel into 8 ohms from 20 Hz to 20 kHz at less than 0.25% thd. 400W per channel into 4 ohms at 1 kHz at less than 0.25% thd.

Power output bridge (mono) operation: greater than 800W into 8 ohms at 1 kHz at less than 0.25% thd.

Im distortion (single channel driven): less than 0.1% from 0.01W to 250W into 8 ohms (60 Hz, 7 kHz, 4:1). Less than 0.1% from 0.01W to 450W into 4 ohms (60 Hz, 7 kHz, 4:1).

Frequency response (direct input): +0.25 dB at 1W (8 ohms) from 20 Hz to 20 kHz. ±3 dB at 1W (8 ohms) from 5 Hz to 100 kHz.

Input impedance: 15 000 ohms (nominal for all inputs).

Load impedance: 4 ohms or greater per channel. 8 ohms or greater in bridge (mono) mode.

Output impedance: less than 0.1 ohm in dual mode at 1 kHz. Less than 0.2 ohm in bridge (mono) mode at 1 kHz.

Signal-to-noise ratio: greater than 100 dB and 20 kHz noise bandwidth; equivalent to 5.5 μV maximum input noise or —103 dBm (600 ohms).

Channel separation: greater than 80 dB at 1k Hz and 8 ohm loads.

Controls: two volume controls, continuously variable. Two meter range switches having 0 dB, —10 dB and —20 dB ranges (ref 0 dB=40V output), one power output switch, to select mode (mono or dual) and clipping power percentage (40% or 100%) in either mono or dual mode. One power on/off switch (primary power).

Indicators: two illuminated meters indicating full wave average output level with ranges of 0 dB, —10 dB and —20 dB (ref 40V output).

Connectors: two Cannon *XLR3-31* input receptacles. Two phone jack input receptacles. Four five-way binding post input jacks. Two phone jack multiple receptacles (to connect additional amplifiers). 1.5m, 3-wire, *16GA* power cord with *NEMA 5-15P* plug. Two ac power receptacles, switched. Total maximum power handling capacity 150W.

Power requirements: 120/240V ac, 50/60 Hz. 100W at zero signal, 850W at $\frac{1}{3}$ rated output (4 ohms) with both channels driven at 1 kHz. 1500W at rated output (4 ohms) with both channels driven at 1 kHz.

Amplifier protection: active output stage with voltage/current limiting and dual voltage-level power supply to reduce power output to 40% of rated output. Control circuitry monitors excessive heat sink temperature, mismatch of load impedance and setting of power output switch.

Load protection: output relay delays turn-on of output power for 5s; provides instant turn-off of output power and removal of load in case of presence of dc voltage in the output.

Operating temperature range: up to +55°C ambient.

Dimensions (hwd): 17.8 x 48.3 x 27.9 cm (without fans).

Weight: 25.6 kg.

Enclosure: rack mount chassis with provision for mounting two accessory fans of heat sink shroud.

Accessories: Altec *15335A* line transformer. Axial fan 11.9 cm, 120V.

Price: £1,000.

Manufacturer: Altec Sound Products Division, 1515 South Manchester Avenue, Anaheim, California 92803, USA.

UK agent: Altec Sound Products Ltd, 17 Park Place, Stevenage, Hertordshire.

AS a basic power amplifier the Altec *9440A* has some unusual features, in that it can be switched to operate in either a twin channel or bridge mode whereby it can drive in excess of 800W into 8 ohms compared with 200W into 8 ohms (or over 400W into 4 ohms) in the dual channel mode.

Furthermore, the front panel switch which provides this facility has two further positions, such that the potential power output can be reduced to 40% of the rated power output in either mode. Additional front panel features include twin illuminated vu meters which are associated with individual meter range switches which permit the meter gain to be increased by 10 dB or 20 dB for monitoring lower power outputs. The final front panel facilities are individual volume controls for each channel and the power on/off switch.

To the rear of the unit the incoming power is via a fixed lead, which like all fixed leads is bound to be the wrong length! A single identified fuse provides protection for the amplifier and the two rear panel switched power outlets which are of the American three-pin variety. An optionally transformer coupled audio input is provided via three-pin *XLR*-type sockets which are unused except when the optional transformers are fitted to octal sockets within the amplifier. In the review sample these were not fitted, in which case the audio input is via two unbalanced 6.35 mm two-pole jack sockets. An uncommon feature is that these sockets are duplicated to provide feeds of audio to additional amplifiers which may be required to work in parallel. However, there is no buffering such that the load on the incoming audio feed is the full amplifier load in parallel.

Finally the power output to the loudspeakers is by four banana socket/terminals which are on the standard 19.05 mm spacing. In the twin channel mode two pairs of these connectors are used, and in the bridge connected mode the two inner connectors provide a balanced mono speaker output.

Mechanically the amplifier is of relatively sturdy construction with a cast (but not particularly thick) front panel joined to a massive, specially cast, heatsink forming the rear panel with sheet steel sides. The front panel is designed for mounting in a standard 483 mm rack and is equipped with two heavy-duty handles for portable use, in which circumstances give good protection to the front panel controls and meters. Similarly the rear panel facilities are well protected, and a cover which can accommodate two cooling fans (optional) protects the heatsink flanges.

Internally the electronics are accommodated

76 ▶

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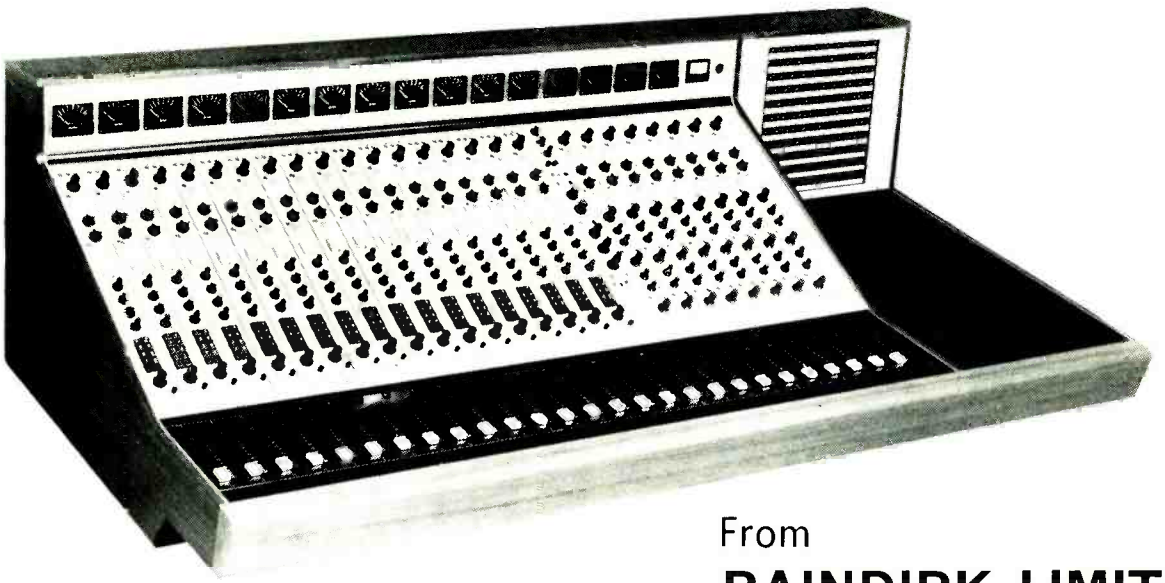

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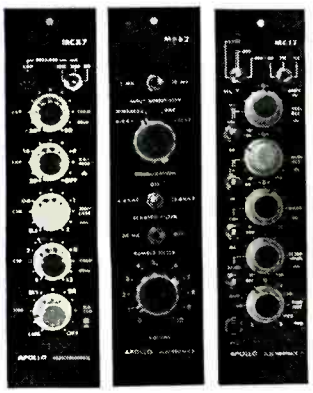

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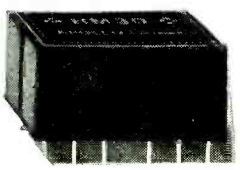

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on five good quality printed boards, one of which is a large 'control' board located behind the front panel, two 'driver' boards located on the side panels and two 'power' boards being soldered to the power transistors on the rear heatsink. While most connections are by connectors as opposed to soldered joints, the rear 'power' boards must be right pigs to service, this not being assisted by a complete lack of component identifications on any of the boards or layout diagrams in the instruction book which is, in other respects, a sensible document.

Power output and distortion

When measuring power output and distortion considerable care was taken to determine the mains voltage and output voltage with accuracy, and a stabilised mains input was used at 240V. As with other high power amplifier measurements, the load was formed from air blast cooled ±0.5% tolerance resistors which have a peak power handling capacity of 6 kW for five seconds!

Total harmonic distortion was measured with the Sound Technology *1700A* meter, which intermodulation products and individual harmonics were determined with the B & K *2010* hetrodyne analyser in conjunction with the new B & K *1902* distortion measurement control unit.

The amplifier's power output capability at the onset of waveform clipping at 1 kHz was found to be as follows:

	channel 1	channel 2
8 ohm load—both channels driven	266W	254W
8 ohm load—single channel driven	275W	296W
4 ohm load—both channels driven	420W	435W
4 ohm load—single channel driven	501W	490W

As is usual with solid state amplifiers the distortion increases very rapidly with increased power around to clipping point, but it was found that distortion remained practically constant as the output power was lowered from the rated output down to very low output powers.

As is shown in fig. 1 the second and third harmonic products remained well below the specification at the rated output of 200W into 8 ohms and the following figures for total harmonic distortion generally confirm the specification:

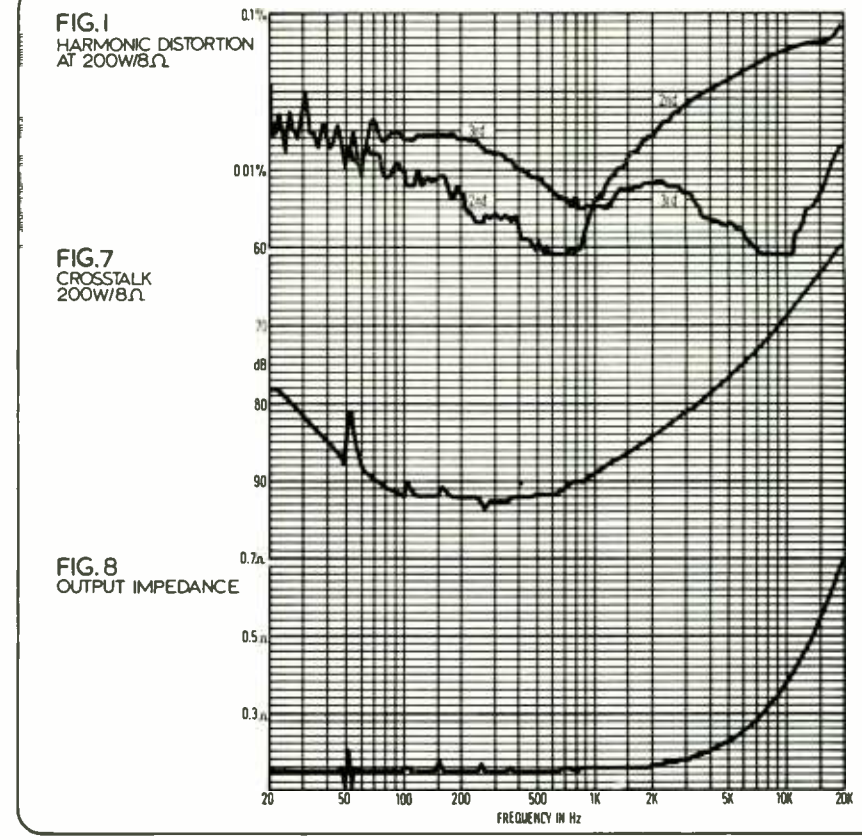
In the bridge connected mode at powers approaching the rated 800W the distortion pattern varied with the frequency of the mains supply, such that the distortion content was cyclic at mains frequency, hence the two figures quoted for low frequency distortion in this mode.

Generally the harmonic content as measured

FIG. 1
HARMONIC DISTORTION AT 200W/8Ω

FIG. 7
CROSSTALK 200W/8Ω

FIG. 8
OUTPUT IMPEDANCE



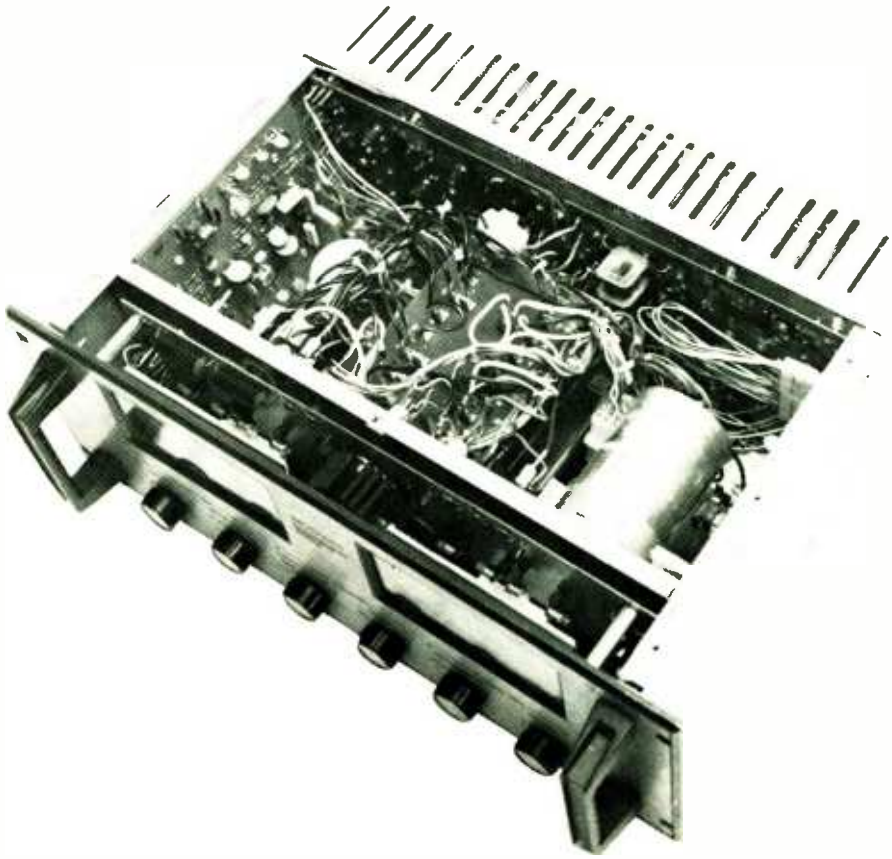


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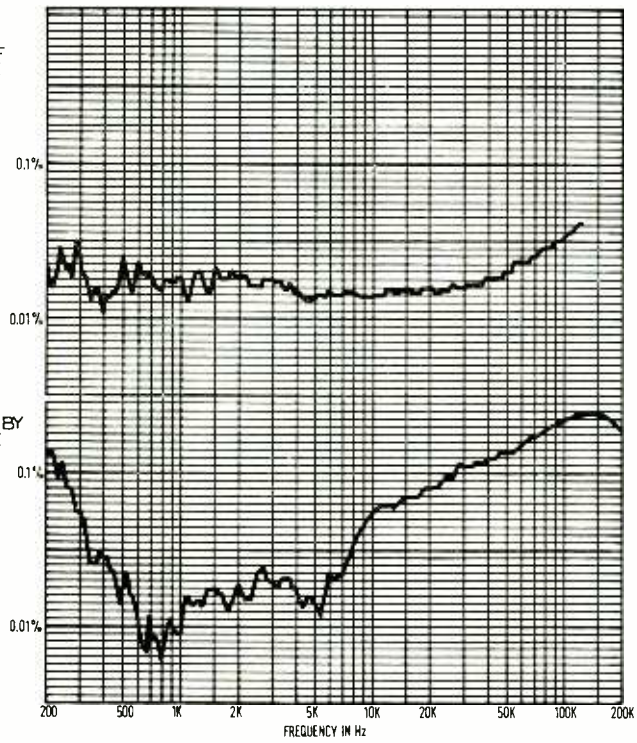
FIG. 3
INTERMODULATION DISTORTION BY CCIF 170 Hz DIFFERENCE TONE

FIG. 4
INTERMODULATION BY SMPTE 60Hz TONE 20W/8Ω



by means of a total harmonic is not particularly meaningful, for as is shown in **fig. 2** crossover distortion can form a large part of the measured result.

At this juncture it must be mentioned that overheating automatically reduced the output power to a nominal 40% (measured as 86W versus 200W); however, the form of power output limiting was found to introduce asymmetrical waveform clipping and furthermore there is no visible warning that the amplifier has overheated and reduced its power capability.

Turning to other forms of distortion, the difference tone intermodulation distortion between 200 Hz and 200 kHz with two tones separated by 170 Hz is shown to be satisfactory

78 ▶

FIG. 2
10 kHz, 200W, 8Ω 0.034% thd

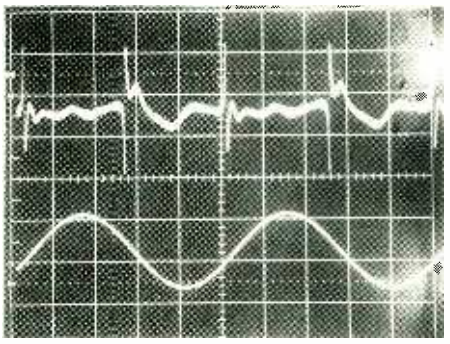
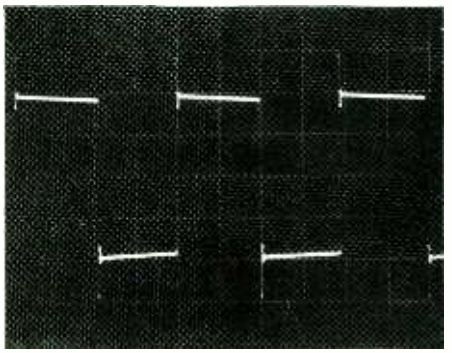


FIG. 5
1 kHz, into 8Ω//2μF,1W



	Total harmonic distortion				
	20 Hz	125 Hz	1 kHz	10 kHz	20 kHz
450W 4 ohms one channel			0.3%		
400W 4 ohms both channels			0.3%		
400W 4 ohms one channel	0.015%	0.015%	0.3%	0.15%	**
250W 8 ohms one channel			0.014%		
200W 8 ohms one channel	0.015%	0.015%	0.015%	0.03%	0.07%
800W 8 ohms bridge connected	0.01/0.05%		0.45%	**	**

***Continuous operation at high frequencies produced a very rapid rise in heatsink temperature and a consequent large variation in distortion performance.*

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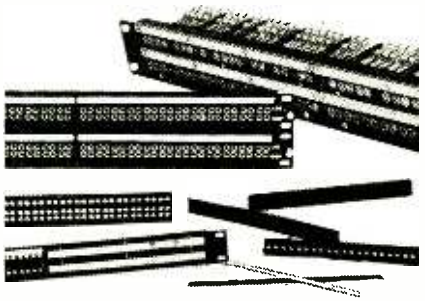

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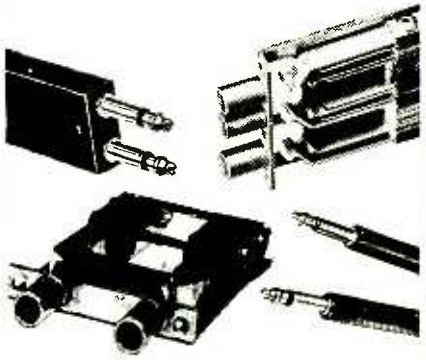

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as in **fig. 3** and similarly the intermodulation distortion by the SMPTE method with a 60 Hz tone and a variable high frequency is shown in **fig. 4.**

The use of capacitive loading did not produce any signs of instability in the amplifier, but did produce a certain amount of overshoot on fast edges as is shown in **fig. 5** which shows the result of feeding a 1 kHz squarewave into a load of 8 ohms in parallel with 2 μF.

Frequency response and noise

Fig. 6 shows the frequency response of the two channels at a power of 1W into 8 ohms, it being seen that the response is within ±0.4 dB from 20 Hz to 20 kHz for either channel. The power response was creditably not far short of this at 200W into 8 ohms. Under this condition the crosstalk between channels was very good as is shown in **fig. 7** which shows that the crosstalk is 80 or 90 dB down at frequencies where it really matters.

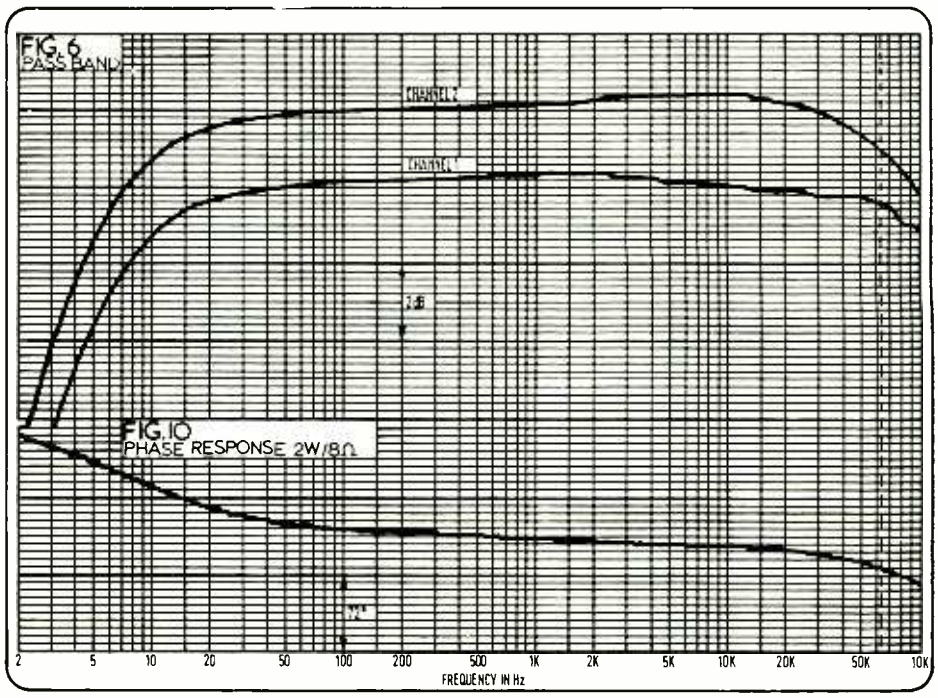
On the noise front the 'A' weighted noise in the output was found to be −101.4 dB below 200W output into 8 ohms, but the unweighted noise over the band 20 Hz to 20 kHz was found to be −91.2 dB as a result of mains hum and its harmonics. However, as the review amplifier was a demonstration unit which had been subjected to considerable use, this figure may well not be typical of the model.

Inputs and outputs

The input sensitivity for 200W into 8 ohms was found to be 523 mV on one channel and 522 mV on the other channel at 1 kHz: remarkably close matching. The input impedance varied from 15 900 ohms at the maximum gain setting to 26 200 ohms at minimum gain, a variation which should not cause any embarrassment when bridging 600 ohm lines.

As is shown in **fig. 8** the output impedance is sensibly constant at 0.05 ohms below 1 kHz, above which it rises to a maximum of 0.7 ohms within the audio band at 20 kHz.

Dc offset at the output reached a maximum of 11 mV which is completely satisfactory, and various tests failed to show any undesirable form of dc in the output under overload conditions, the result of bursting the amplifier into 10 dB of overload with an asymmetrical sinewave being shown in **fig. 9.**

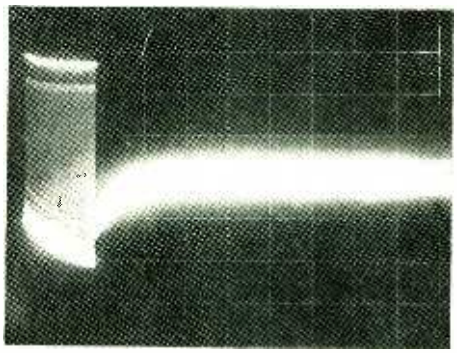


Other matters

Investigations into the qualities of the two vu meters showed that they were not to the ASA standard, but that they needed about the same margin between zero vu and peak signal as the standard instrument. Thus, in normal operation the meter switch should be set to the −10 dB position if the meters are to be used to indicate amplifier overload—no mention is made of this in the instruction book!

As shown in **fig. 10** the overall phase shift in the audio band is respectably small, and outside the audio band there is no cause for concern about stability at high frequencies. A final note is that the rise time was measured as 3 μs, with an associated slew rate of 8 V/μs.

FIG. 9
50 ms/div, 1 kHz



Summary

This amplifier offers a substantial power output, but does not rank amongst the lowest distortion amplifiers. It is, however, well built and should withstand the rigours of mobile and pa use. Clearly the optional cooling fans should be fitted if the maximum power capability is likely to be required, and like amplifiers which use relatively slow output devices, this amplifier takes exception to very high frequency inputs. In this circumstance the mains input requirement goes way up, and leads to very rapid heating, automatic lowering of the output capability and consequent lower output capability without warning.

The input arrangements are unusual with the facility for looping a series of amplifiers together by means of jack leads, and this is a nice feature for pa work, as is the inbuilt facility for switching to bridge (mono) operation.

On the metering side the meters provide a useful facility if they are set to the −10 dB attenuator setting, but my preference is for a peak reading indicator which gives an alarm as overload is approached. ■

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* T. Holman "New Factors in Phonograph Preamplifier Design" JAES Vol. 24 No. 4 May 1976.
1 kHz at 6 mV set for 0dBV.7 output. Loaded 600 ohms.

Distortion
Output 0dBV.7 30Hz—20KHz below noise
Output + 10dBV.7 30Hz—20KHz below noise
Output + 20dBV.7 1KHz —88dB, 0.004%
30Hz—20KHz —82dB, 0.008%

Intermodulation distortion 50Hz + 7KHz, 4:1
Output +10dBV.7—9dB 0.003%, limit of measurement.

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Even harmonic generation -70dB any harmonic

Cartridge impedance interaction on frequency response
High inductance cartridge. Less than 0.2dB

Low frequency response
18dB/octave -3dB at 24Hz
Group delay relative to 1 KHz -15ms at 30Hz

Noise 20Hz—20KHz mean reading meter
Short circuit input -70dBV.7
Cartridge source, 100mH -67dBV.7

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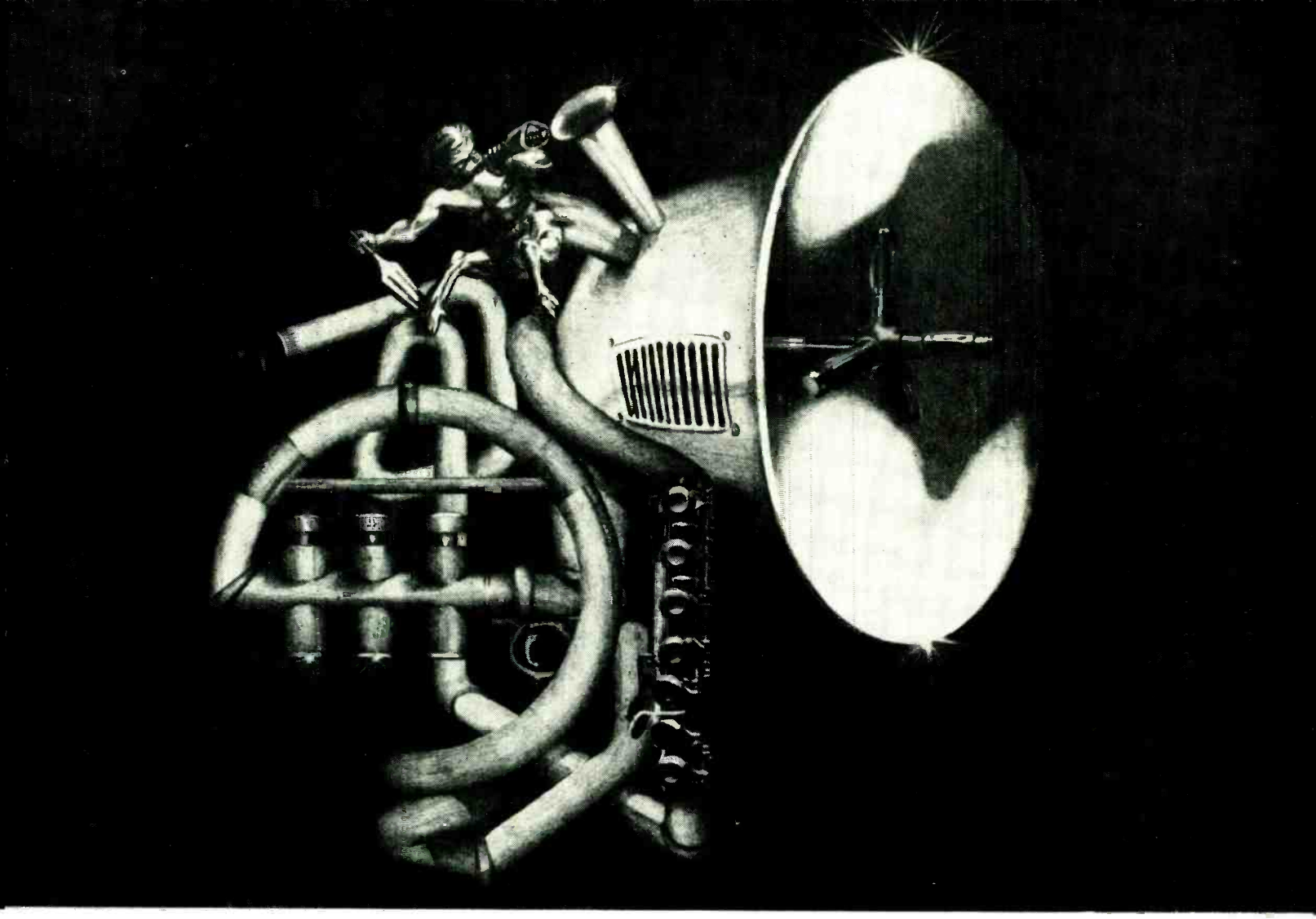

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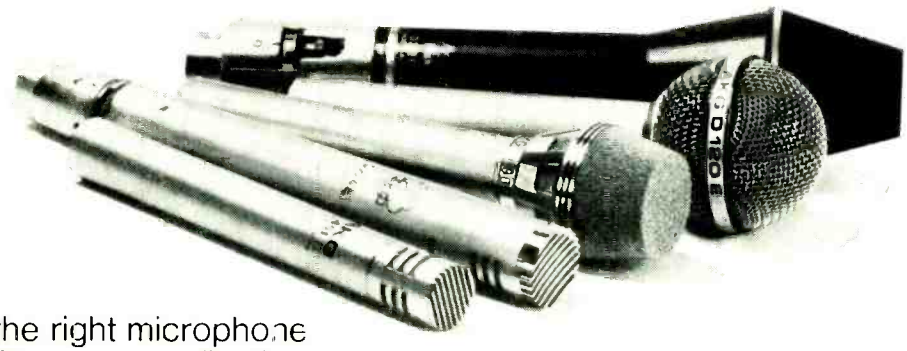

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Dunlap Clarke Dreadnaught 1000 power amplifier

Hugh Ford

MANUFACTURER'S SPECIFICATION

Continuous power output per channel with both channels driven into 8 ohms across 20 to 20 000 Hz at less than 0.25% total harmonic distortion: 250W.
Continuous power output per channel with both channels driven into 4 ohms across 20 to 20 000 Hz at less than 0.25% total harmonic distortion: 500W.
Total harmonic distortion from 0.1W to 250W per channel with both channels driven into 8 ohms across 20 to 20 000 Hz: 0.25% maximum, 0.025% typical.
Intermodulation distortion at 60 and 7000 Hz mixed 4:1 at any power from 0.01W to 250W into 8 ohms: 0.1% maximum, 0.025% typical.
Frequency response: 250W per channel, 20 to 20 000 Hz, -0.5 dB.
Frequency response: at 1W per channel, 20 to 20 000 Hz, ±0.05 dB.
Slew rate: greater than 25 V/μs.
Signal-to-noise ratio: 100 dB minimum.
Load impedance: 2 ohms or greater.
Input impedance: 100 kohms.
Input sensitivity: 1.75V rms for full output.
Power line requirements: 120V ac, 60 Hz · 240V ac 50 Hz.
Power consumption at maximum rated power: 1000W.
Power consumption at idle: 50W maximum.
Temperature rise at full power (fan on low (silent) speed): less than 40°C.
Dimensions (whd): 483 x 178 x 305 mm.
Net weight: 32 kg.
Manufacturer: Dunlap Clarke Electronics, 230 Calvary Street, Waltham, Massachusetts 02154, USA.
UK agent: Exposure Electronics, Richardson Road, Hove. Sussex.

WE were fortunate enough to receive a prototype of the *Dreadnaught 1000* for review (see comments at end) which is the big brother of the *Dreadnaught 500;* this is identical except for having less power output; the *1000* offers 500W per channel into 4 ohms as opposed to the 300W per channel of the *500* model.

The amplifiers are twin channel units without provision for bridge operation, and employ ten output transistors in each output stage. These transistors are mounted on large heatsinks at the sides of the amplifier, there being a cooling fan associated with each side of the amplifier. A three position switch at the rear of the amplifier controls the fan speed between fast, slow and off. In the fast setting the fans were incredibly noisy, generating in excess of 50 dBA spl one metre from the amplifier on the bench, and the slow operation was little better.

While it is felt that for many applications the fans are not necessary, their noise would make the amplifier quite unusable in quiet environments such as a studio control room. Also it is rather surprising that the fan speed has not been thermostatically controlled by the heatsink temperature, as opposed to manual control.

Reverting to the construction of the amplifier, the main body is formed from folded alloy sheet which forms a substantial box on to which is mounted a thick alloy front panel provided with holes for mounting into a standard 483 mm rack. Because of the thin material used for the heatsink fins, some form of mechanical protection is essential for non-racking applications.

Within the amplifier, good quality glassfibre printed boards are used, but no component identifications are provided. There is one fixed board and one plug-in board for each channel in addition to a small board associated with the power supplies.

The internal appearance of the review sample was decidedly scruffy with untidy wiring and liberal use of what appeared to be silicone rubber compound for securing components and locking the two pre-set potentiometers in each channel. Also rather peculiar was the illumination for the two front panel vu meters, this taking the form of two large 'Christmas Tree' type lamps within the amplifier. The vu meters have standard scaling and operate in conjunction with a sensitivity switch for each meter; this providing five positions.

In the normal position the zero vu indication corresponded to maximum sinewave output, with the other positions providing a meter gain of 3 dB, 10 dB or 20 dB and a meter off position. Clearly in view of the ballistics of the standard vu meter the 10 dB gain position should be used for normal operation, but no mention is made of this.

The remaining front panel facilities comprise a level potentiometer for each channel and an illuminated mains on/off switch. The construction of this switch was such that there was a very small clearance between metal parts connected to the chassis and mains wiring; certainly this arrangement would not pass British Standard 415 safety requirements, and I regard this feature as potentially dangerous.

To the rear of the amplifier, there is a fixed mains lead of the self-coiling type as used on telephones, and three imperial size fuses which are properly identified. The audio inputs are by means of the horrible 'phono' socket, which strikes me as most odd for a professional amplifier.

On the other hand the audio outputs are in the form of duplicated terminals/banana sockets all on the standard 19 mm spacing; certainly the duplication of the output terminals will be appreciated in many pa applications.

Power output and distortion

As with all really high power amplifiers, there is a problem of finding a suitably stable load for testing; I use and recommend the 300W metal clad resistors type *HSC300* which are available from the CGS Resistor Co, of Lymington in Hampshire. A suitable set of these resistors and an accurate digital voltmeter for measuring the incoming power line and also the output voltage are ideal for accurate measurements.

Both individual harmonic distortion and total harmonic distortion were measured, but unfortunately the amplifier decided to sacrifice the output transistors in one channel during crosstalk measurements at 250W into 8 ohms, so measurement of distortion with both channels driven does not appear in the following table:

Total harmonic distortion

500W into 4 ohms

20 Hz	125 Hz	1 kHz	10 kHz	20 kHz
**	**	0.02%	0.04%	0.07%

250W into 8 ohms

0.55%	0.37%	0.02%	0.37%	0.64%

1W into 8 ohms

0.50%	0.45%	0.029%	0.37%	0.55%

***At low frequencies into 4 ohms the apparent distortion was affected by high frequency instability.*

Waveform clipping occurred at just over 500W into 4 ohms or 250W into 8 ohms but the amplifier was capable of delivering full power over the audio band from 20 Hz to 20 kHz.

The individual second and third harmonic products with the amplifier driving 250W per channel with both channels driven in shown in **fig. 1** which for some reason does not give good correlation with the total harmonic measurements. However, examination of the individual harmonics at 1W output indicated quite good performance with the third harmonic at a constant 0.03% and the second harmonic generally at a lower level.

Intermodulation distortion was measured by both the SMPTE method and by the swept

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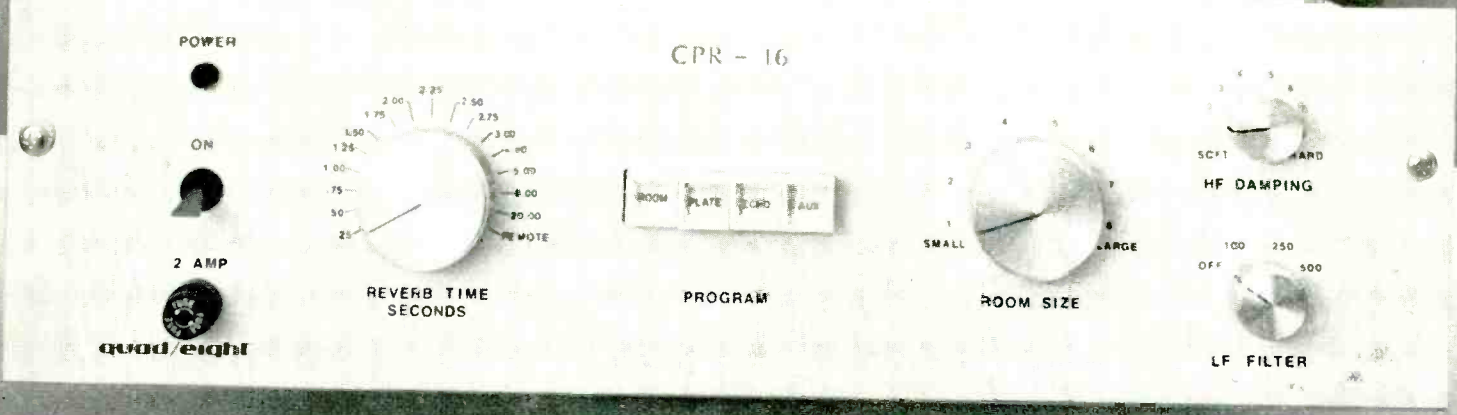

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difference tone method using tones separated by 170 Hz. **Fig. 2** illustrates the difference tone distortion in terms of the odd difference frequency which was the largest product, while **fig. 3** shows the SMPTE method distortion with a 60 Hz tone and a higher frequency tone in the amplitude ratio 4:1.

The crossover distortion situation is shown in **fig. 4** which shows the distortion of a 10 kHz sinewave at 1W into 8 ohms, and I regard this crossover distortion as rather excessive.

While capacitive loading did not generally upset the amplifier, the effect of a 8 ohm in parallel with 2 μF load on a 1 kHz squarewave is shown in **fig. 5**. This shows a fairly substantial overshoot.

I had hoped to double check the above results and also to investigate the performance into other loads, however I have already mentioned that one channel departed this life—this problem was very quickly rectified by the UK agents who showed that it was a quick and simple task to replace output devices, but it is sad to report that subsequently both channels blew-up and there just wasn't time to repeat the servicing exercise. However, it is only fair to report that whilst the output devices failed, no damage occurred to the driver stages—many amplifiers would just go up in smoke with their output transistors shorted.

Frequency response and noise

The overall frequency response into a 8 ohm load is shown in **fig. 6** for both 1W output per channel and 250W per channel and shows that the amplifier can 'deliver the goods' at high powers.

At subsonic frequencies, the protection circuits disenable the amplifier in order to protect loudspeakers, so no useful power output can exist at frequencies which create loudspeaker damage. While this type of protection circuit is generally a good idea, the reset time in this amplifier was about two minutes and it was necessary to remove the mains power to reset the amplifier. This may be all very well in domestic use, but such a procedure can hardly be tolerated in pa and similar work.

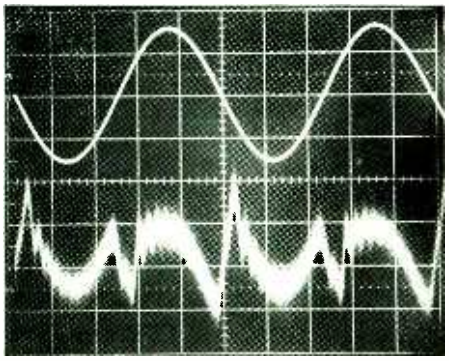
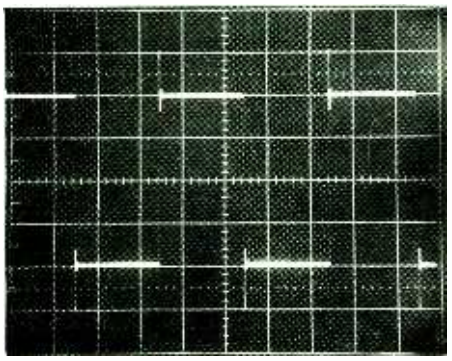


FIG. 4 10 kHz, 1W, 8Ω

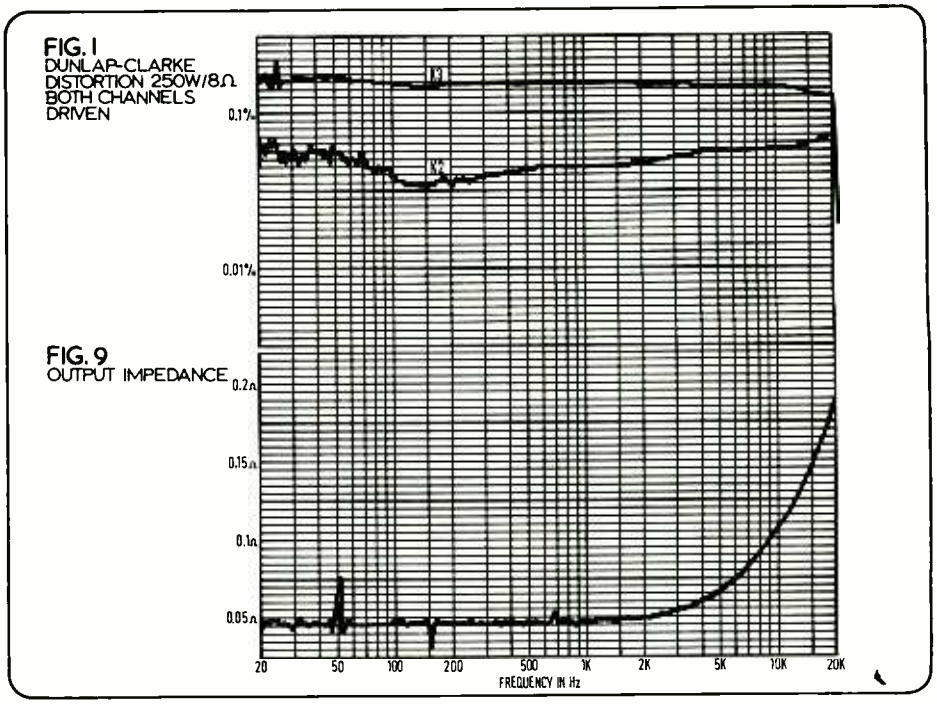
FIG. 5 1 kHz, 8Ω//2μF

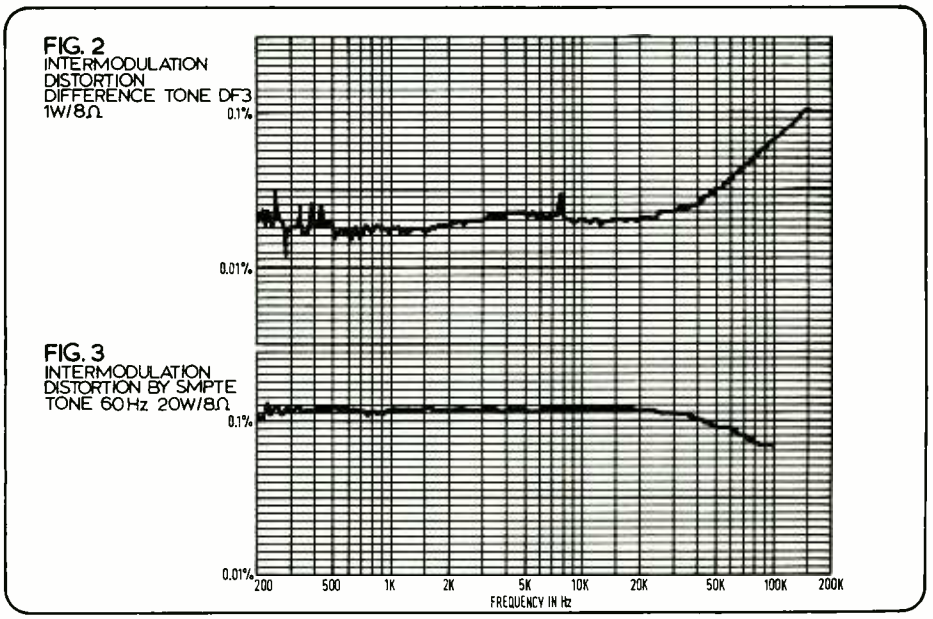


Crosstalk between the two channels was very good as shown in **fig. 7** in relation to 250W into 8 ohms and, having regard to this power output, the noise was also good at —98.7 dB over the band 20 Hz to 20kHz, or —104.6 dB 'A' weighted.

Inputs and outputs

Dc offset at the output was minimal and the amplifier did not do anything untoward on asymmetrical overload, the result of driving the amplifier 10 dB into clipping with an asymmetrical 100 ms burst of 1 kHz being shown in **fig. 8** which illustrates a smooth recovery.





The output impedance as shown in **fig. 9** remained respectably low at all audio frequencies, being a constant 0.05 ohms in the lower audio band.

On the input end the sensitivity for 250W per channel into 8 ohms was found to be 1.703V rms, but unfortunately I did not have the opportunity to measure the input impedance of the unbalanced inputs; while on this subject I would rather have seen provision for a balanced input for professional use.

Other matters

The measurement of the slew rate gave a figure of 12 V/μs which whilst being fast did not correlate with the specification, and rise time at 4 μs tended to confirm the measured slew rate. The overall phase shift as shown in **fig. 10** was unusually small as it needs to be

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having regard to the lack of high frequency roll off.

Checking the twin vu meters showed that, while they were fairly similar to the standard vu meter, the rise time was too slow with resulting under reading; furthermore, the frequency response was appalling at high frequencies and the two meters were different from each other.

In addition the meter attenuator accuracy was poor—but what is the real use of meters on a power amplifier anyway; all that is needed is an indicator for impending overload.

Summary

Ignoring the fact that the amplifier gave up the ghost twice and thus escaped a number of measurements and tortures, it has a very high power capability which is said to extend down to 2 ohm loads.

At no time did it show any tendency to overheat, and unlike many amplifiers its efficiency remained high at the higher audio frequencies where so many amplifiers generate a great amount of heat.

While the measured distortion into resistive loads was not unduly impressive, this is only part of the story and the intermodulation performance suggests that the amplifier may well be good subjectively.

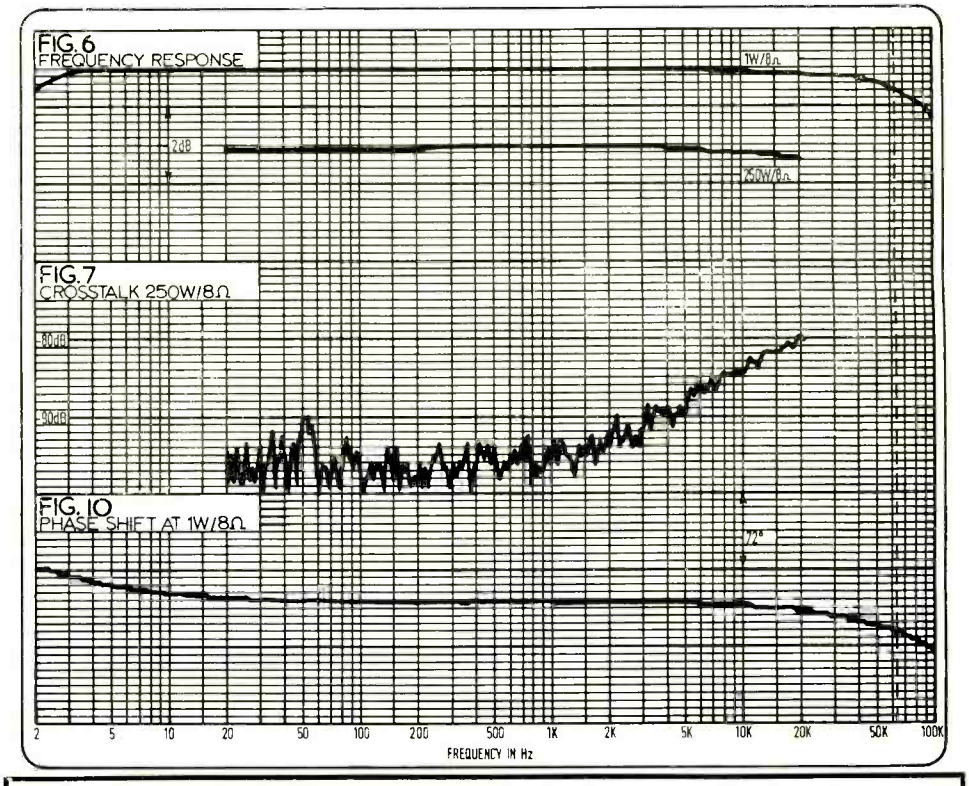
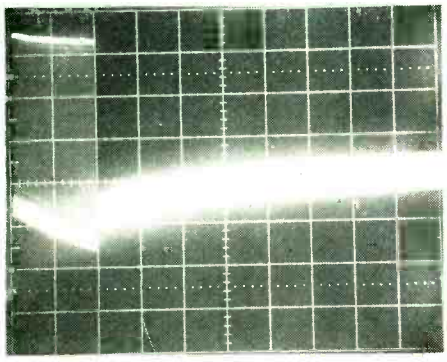


FIG. 8 Waveform showing recovery from 1 kHz asymmetric tone 50 ms/div



The manufacturer makes the following comments about the prototype review sample:

1) The amplifier was *not* designed as a professional amplifier within the strict meaning of the word. The company isn't convinced that the existing circuit is suitable for, perhaps, pa use whereby the existing protection circuit might cause problems. However, studio monitoring applications should encounter no problems.

2) The company is working on an 'early warning' system offering visual indication of incipient shutdown conditions.

3) It makes the point that the review unit has been in service for at least a year prior to the review. For much of this time, it had been 'well used and abused' without any apparent failure.

4) It regrets that one channel went wrong followed subsequently by the other, after repair of the first. This should be laid at the door of the protection circuitry which, on the review model, had been designed for domestic applications. That of the smaller 500 and 250 models should handle any eventuality.

5) The company agrees that the mains switch on the front panel was bad. Production amplifiers have sleeved connections which cannot touch the chassis.

6) During the course of the review, a slight degree of hf instability was noted at low frequencies. This has been remedied resulting in an improvement to the mid range sound.

7) As delivered to Hugh Ford, the amplifier quiescent current had been incorrectly set. On re-adjustment, it gave even better results.

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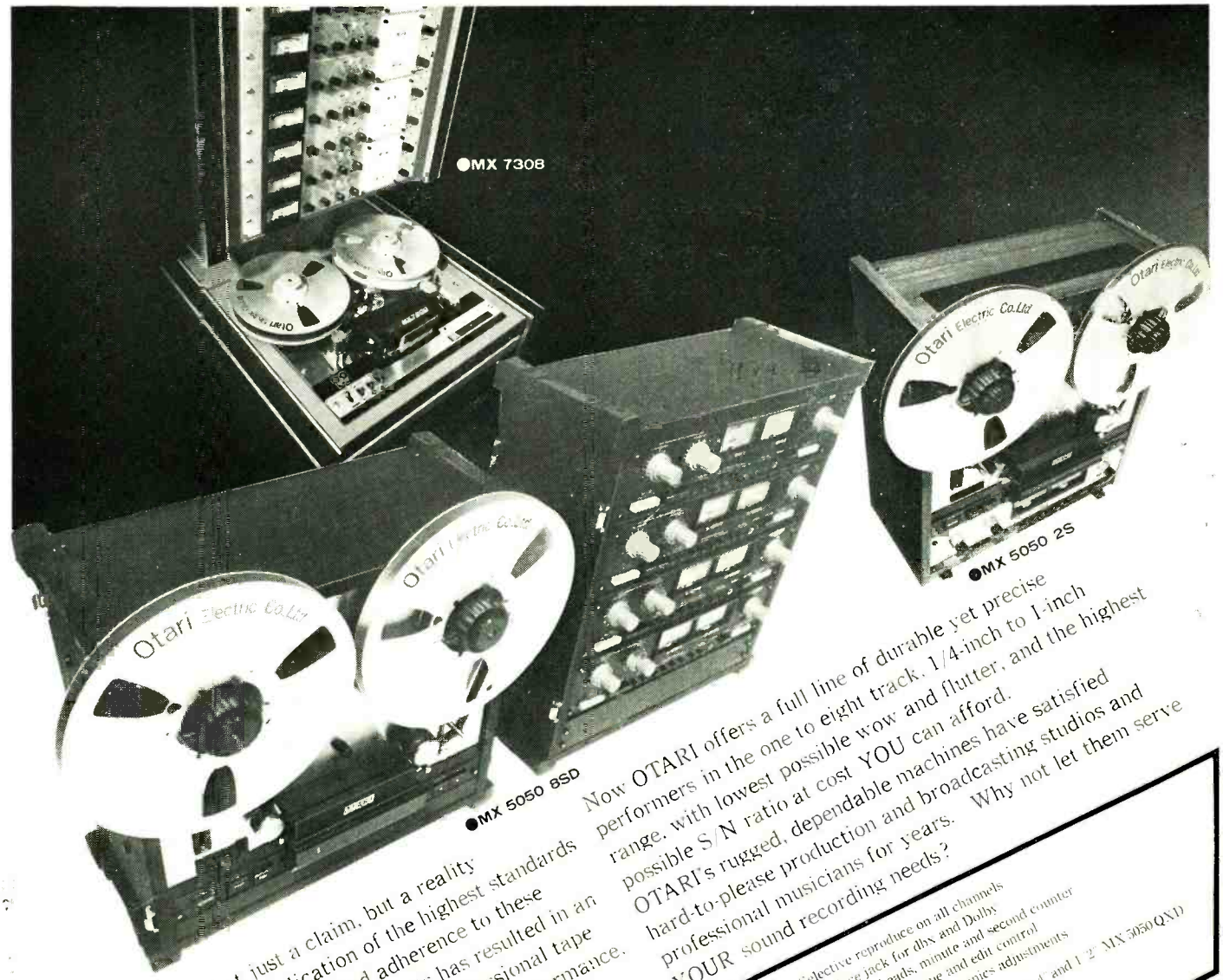

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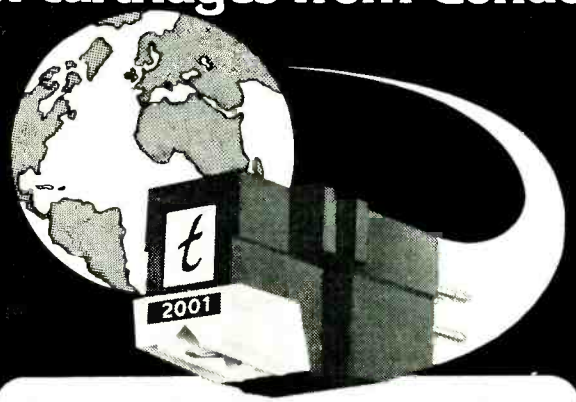

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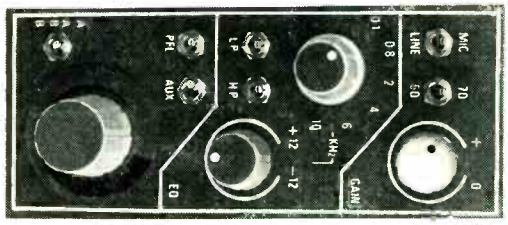

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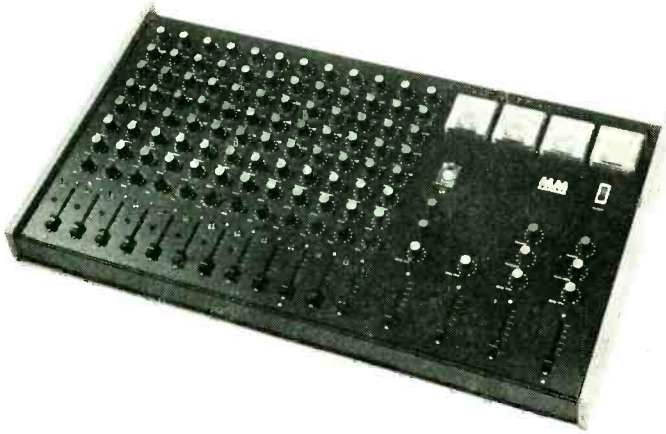

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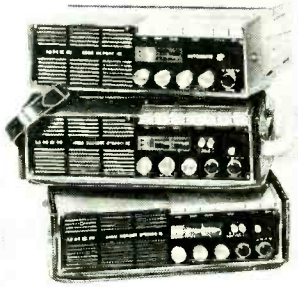

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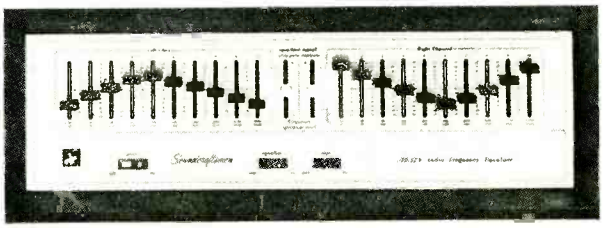

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Note: Advertisement copy must be clearly printed in block capitals or typewritten.

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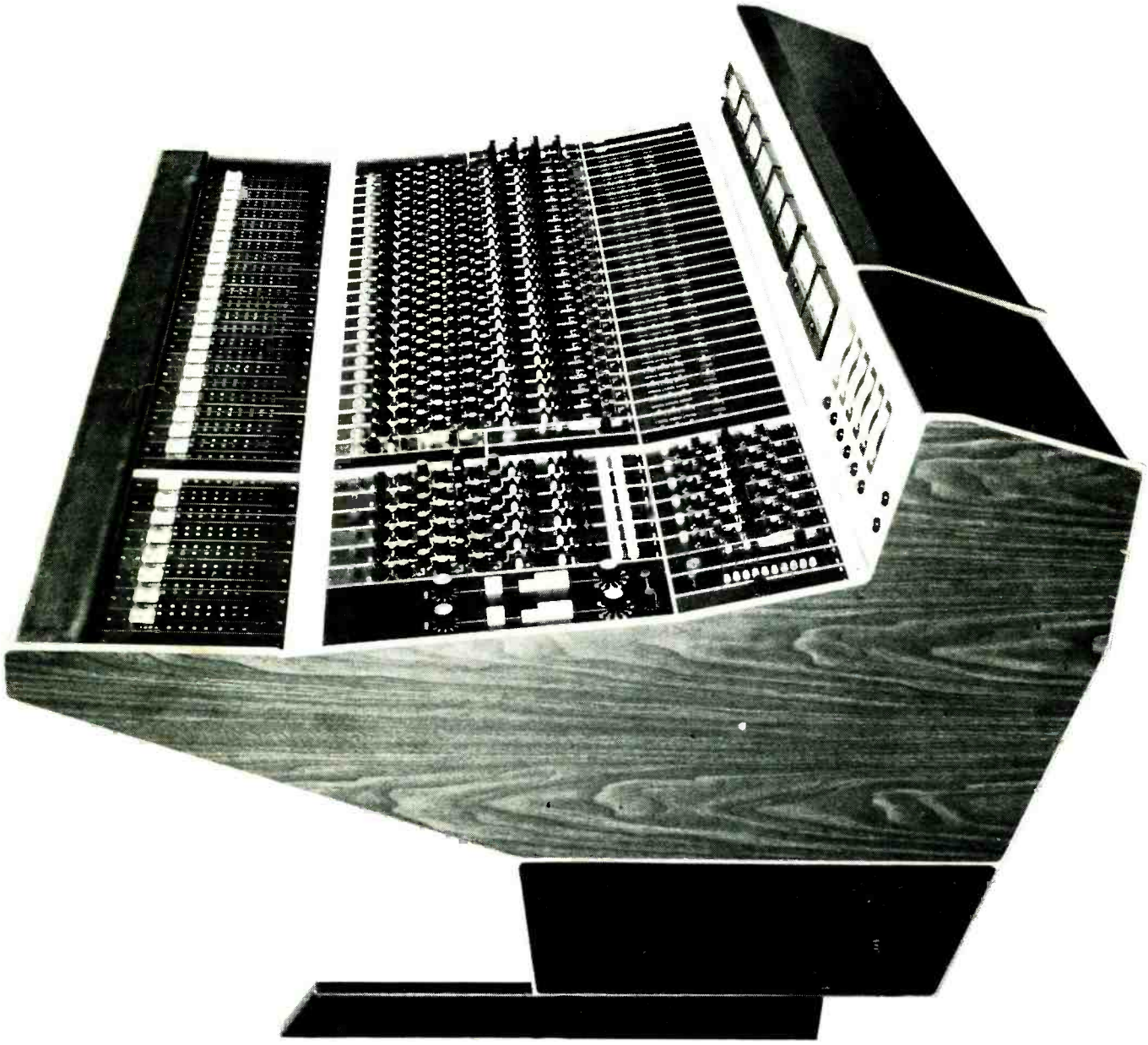

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