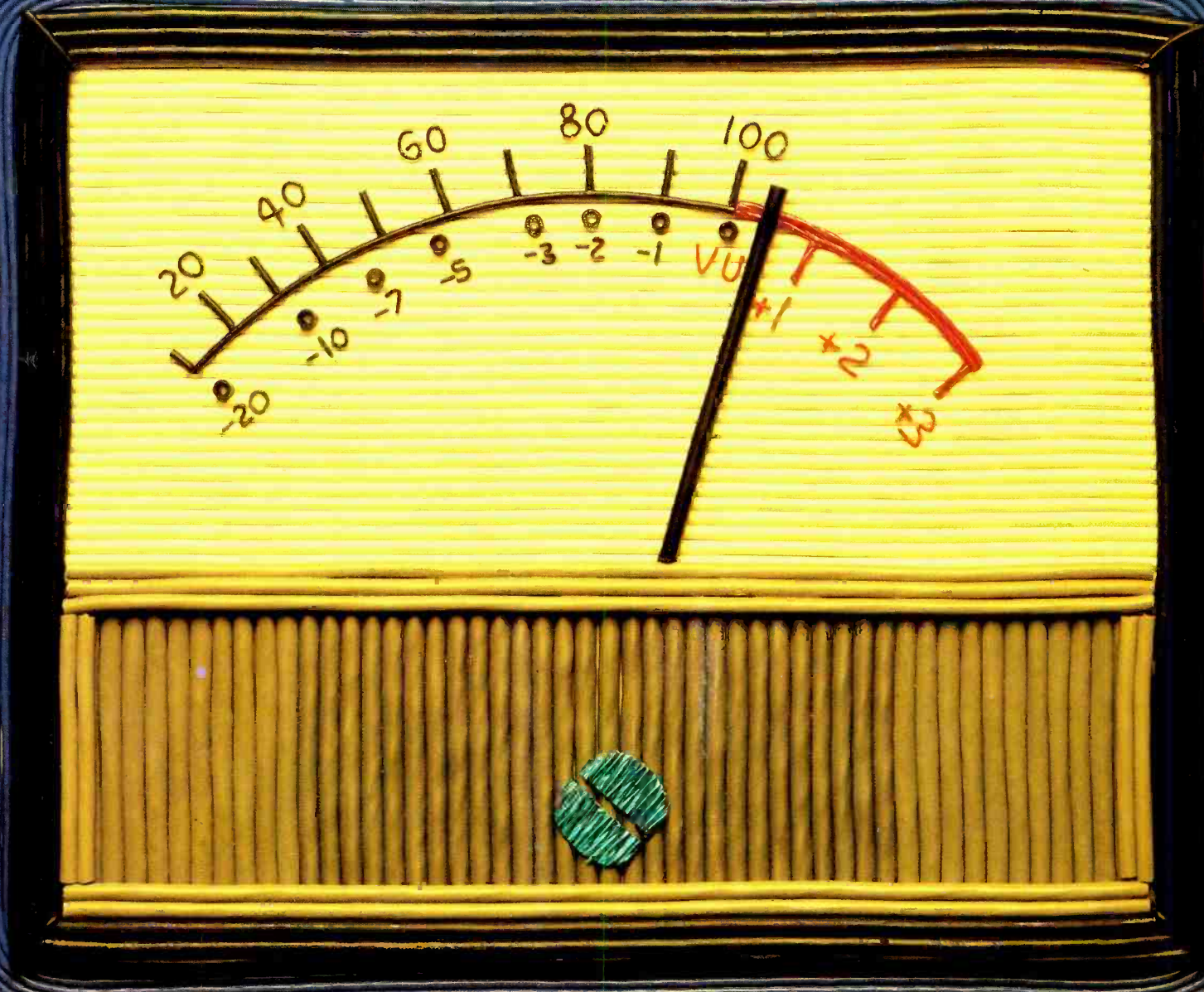
August 1985 £1.50

STUDIO SOUND

AND BROADCAST ENGINEERING

A LINK HOUSE PUBLICATION



TEST EQUIPMENT
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INTERCONNECTION

WE'VE GONE TO GREAT LENGTHS TO MAKE SERIES 600 THE ULTIMATE 16 TRACK CONSOLE.

The new Series 600 has been designed as the universal 16 track console. From ½" personal recording facilities to the professional 2" studio standard.

In analogue recording, the tape is the weakest link. Therefore, it's vital that whatever you put onto the tape is of the highest quality – whichever tape format you use.

½"

At Soundcraft we've used all our latest technology in circuit design to ensure that the performance of Series 600 outshines any other 16 track console.

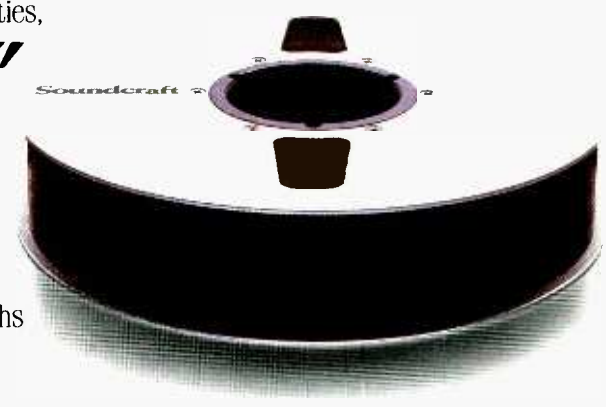
We've included internal line matching links and switches which enable the user to re-set the console from the professional +4dBu standard to –10dBV for ½" and 1" multitrack.

1"

In addition to 16 equalised monitor channels which are separate from the input modules, Series 600 includes 16 LED bargraph meters, switchable peak/VU, plus two conventional VU meters on the mix buses.

Four auxiliary sends on each channel can be routed to six auxiliary buses. And the master module contains extensive monitoring facilities, including access to three two track sources for playback.

2"



All line inputs and outputs (except input channel direct out) are balanced, utilising Neutrik XLR connectors. An external 19" rack mounting power supply allows for clean and stable DC voltages to the console.

Series 600 also incorporates many more features than you'd expect from a console so reasonably priced.

So, whichever tape format you use, you should go to great lengths to ensure your console is a Soundcraft Series 600.

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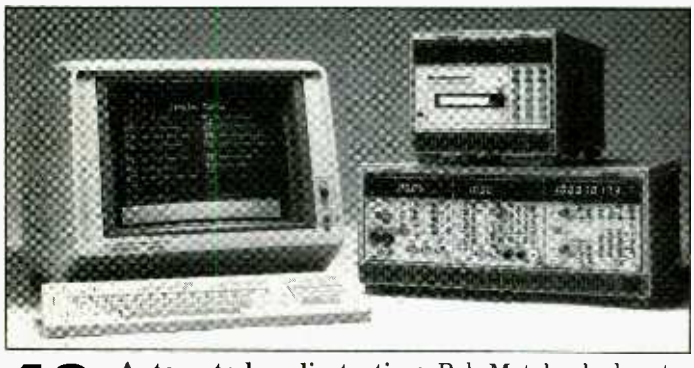

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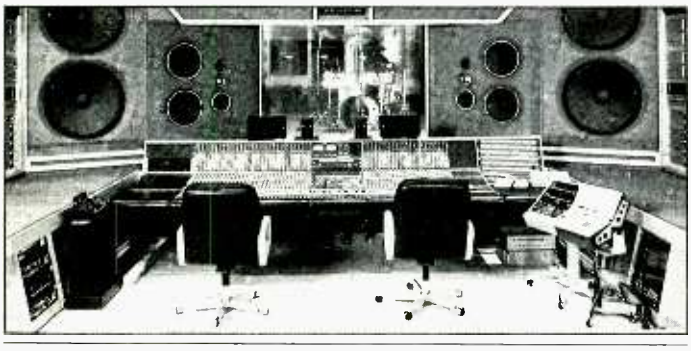

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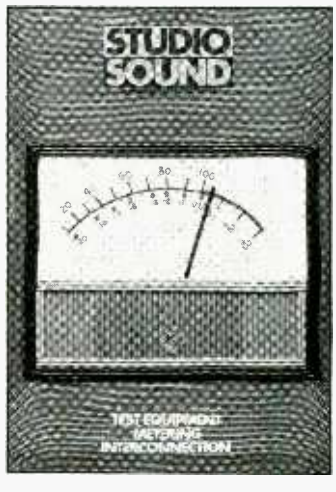

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Publisher and consultant to APRS for Studio Sound's Producer's Guide to APRS Members 1984/85

August 1985 Number 8
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■ **DRAWMER DS201** 2 channel stereo linkable noise gate, frequency conscious keying with adjustable attack, hold and decay controls.

■ **KLARK TEKNIK DN780** Now available, new digital reverb offering choice of simulated plate, hall, chamber, or room settings. 39 presets and 50 available stores.

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■ **LEXICON 224XL** The ultimate digital processor featuring all hyperthetical reverb programs plus many effects and split programs. LARC Remote/control, 60 stores.

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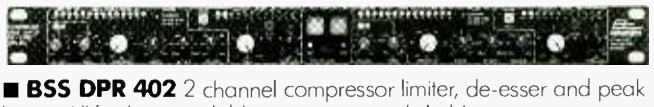
■ **DRAWMER DL221** 2 channel, stereo linkable compressor/limiter, variable threshold, ratio, attack release, separate peak limiter, VU and gain reduction display.



■ **BSS DPR 402** 2 channel compressor limiter, de-esser and peak limiter. All facilities available at once, stereo linkable.

■ **DBX166** 2 channel dynamics processor featuring gating, over-easy compression, gain reduction LED display.

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EDITORIAL

EDITORIAL

This month's comment from Keith Spencer-Allen

Developments in testing

Trying to avoid the phrase 'Golden Age' when explaining a period of fast moving innovation and change is difficult. There is also a huge amount of truth in the saying that 'Golden Ages' are never the present time. So what I should refer to our current experiences as, I will leave open for discussion. There are vast changes happening and many more about to happen that will leave the face of pro-audio very different by the end of the decade. I am not just referring to the fact that we have two signal media running parallel and an ever growing choice of software media, but the changes that are taking place in all fields—even those bastions of slow change—the topics featured in this issue.

On the subject of test equipment, we have chosen to concentrate on automated test equipment. Due to the cost of such equipment, it has often had little application outside of industrial and research use. This is now changing thanks to the staircase pattern to product development (along) and cost (down) and some of the advantages of such equipment are becoming possible for larger studios. Checking complete mixing consoles for faults over night while unattended and other such uses will be welcomed in facilities where downtime is just too expensive. Robert Metzler's article is a summary of what is currently available in the field and then a brief look at how his own company is tackling aspects of automated testing in their new *System One*. There is always great danger in publishing such an article written by a manufacturer within that field, however I feel that Mr Metzler has been very fair in his survey. This article has *not* set a precedent however, except when we cover areas which have no knowledgeable authors other than manufacturers. There are other developments in test equipment that we have not covered in this issue although we have articles in preparation that will appear later in the year leading into practical measurements and tests to illustrate their value. This includes the Crown *Tecron* and Meyer *SIM* Systems.

Also in this issue, Rod Duggan advocates an approach to installation and wiring based upon the system as a complete entity rather than a collection of independent interfaces. One of the areas that he touches on is that of cable, or more particularly linear-crystal oxygen-free types. Within the hi-fi press—certainly in the UK—it is commonly stated that vast improvements occur from the use of such cables (although I have noticed the inverse view recently being stated). While I am prepared to admit that improving the purity of the conductor within a cable must be beneficial, the actual benefits of using such a cable must depend on what was used before—almost anything will be better than twin-flex for speakers. We have made some casual experiments with such cables and I feel that it is too early to comment yet. I am told that it is on long cable runs that the difference is most noticeable. It would seem to me that the only way that it would be possible to really see any improvement in sound quality would be to completely rewire your signal chain. Therefore you have to believe that there is something in it before you check to see if really there is, which is not really very scientific. If you feel the expense is warranted then go ahead and use such cables but where do you stop? Do you have to rewire microphone and mixer innards etc? I am sitting firmly on the fence ready to be influenced by facts and practical experience that can be demonstrated clearly. Wild improvement claims I feel are suspect.

We are also in the process of checking out a contact fluid that is non-conductive although is claimed to improve electrical conduction between two contacts. I have heard solid claims from respected sources about the worth of this fluid and are prepared to persevere. Initial experiments with audio contacts at all signal levels have proved interesting although inconclusive. (What this really means is that subjectively we may have detected a slight improvement in the use of the fluid and more extensive use of the fluid at all signal junctions is probably the next correct subjective action. We are however understandably reluctant to leap into this before we know the long term aspects of this fluid on contacts.) It has however improved my TV reception noticeably following a squirt in the aerial socket so we must follow through.

Can you imagine such a topic of discussion even a few years ago?—which takes me back to my opening point. A great deal has changed so fast that we are now almost prepared to believe in magic.□

STUDIO SOUND
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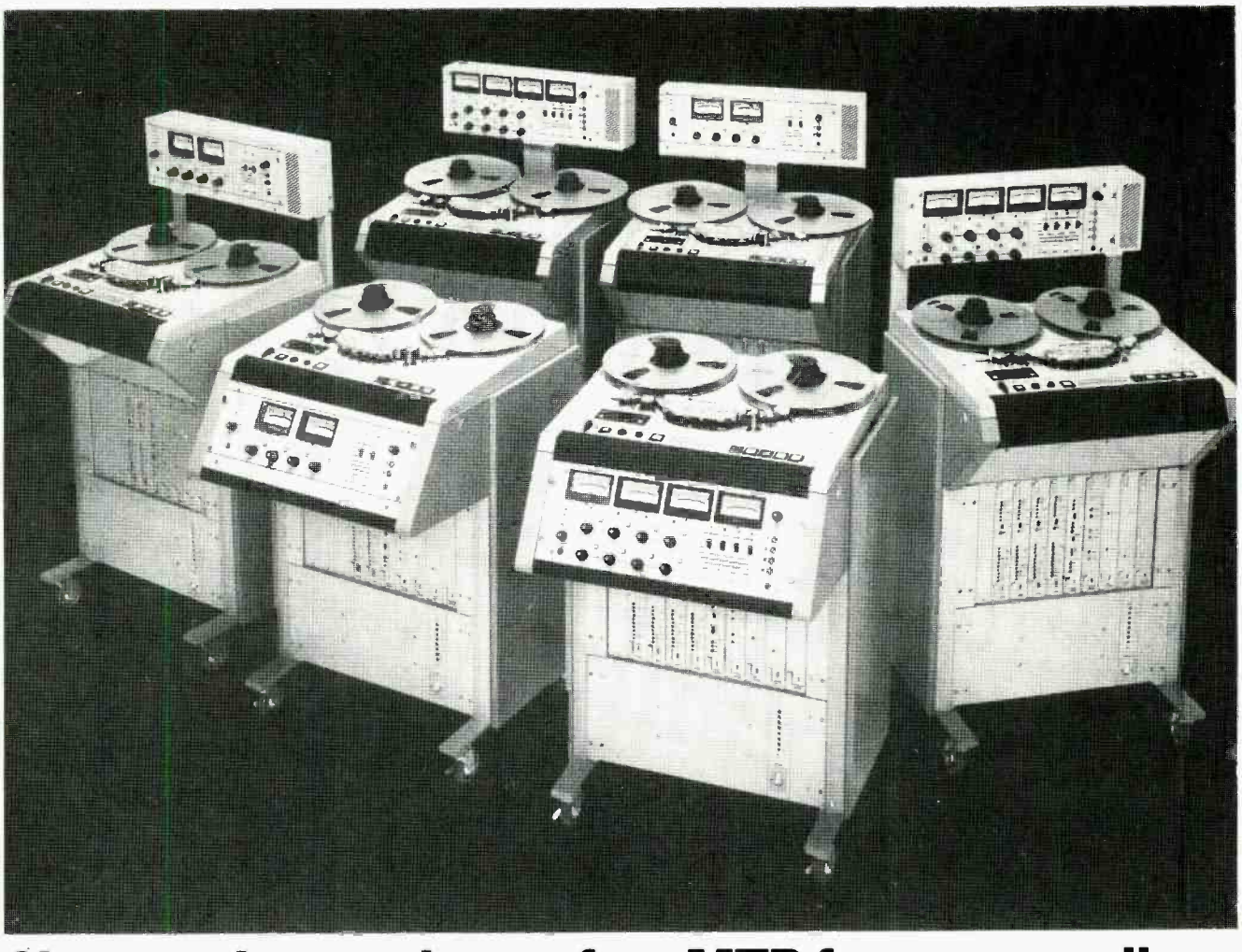

How to choose the perfect MTR for your studio.

Whilst the Otari MTR90 multitrack steals the limelight, there are dozens of other MTRs for specialised, precision mastering.

To begin with, there's the 10 or 12 family, depending on whether you want normal or extended capacity reels. *(2)*

You then choose two, three or four tracks. A choice between standard mastering, the added facility of centre track time code, or a four channel machine for cassette or specialist applications. *(6)*

The MTR12 stereo versions also give you the choice of running quarter or half inch tape. *(8)*

Your last easy decision is between a low profile or overbridge style cabinet. *(16)*

Now get started on the accessories.

There are three types of remotes. A ten memory brain, a simple search version and transport functions only. *(48)*

Isolating options are next. Plug in high performance transformers are available on both inputs and outputs. *(144)*

And if you intend to run locked to time code then the high speed read processor card or the tally interface may well come in useful. *(432)*

Finally, there's yet another custom PCB which lets you operate the transport controls via an RS232 interface. *(864)*

With nearly a thousand versions to choose from, it's reassuring to know that our expertise with Otari helps us help you find exactly the model for your application.

It goes without saying that the performance of these recorders is state of the art.

We have discovered that the MTR series performs tight in on spec. So whenever we deliver a machine we send along an engineer for final comissioning and line up.

Our technical expertise with these tape recorders has resulted in Turnkey becoming the recommended agent for service.

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Exclusive signal processing from Turnkey, a file of facts you should have at your fingertips

Some of these brand names will be familiar, others may be new. All represent highly innovative signal processing, now available only direct from Turnkey.

Aphex As well as their psychoacoustic aural exciter, the Compellor has gained reputation as an intelligent compressor. It delivers smooth, undetectable level control, increased loudness and auto gain-riding.

Deltalab Research The legendary Effectron delays are exclusive to Turnkey. Directly selectable effects and modulation are offered in four versions.

Studio Technologies The AN1 stereo simulator is a new effect which has received praise in reviews and from major studios. An effect once applied, is hard to do without.

Symetrix Precision processing from a state of the art manufacturer. Products include compressor, single ended noise reduction and hybrid telephone interface.

DOD Electronics Popularly priced Effects, and in particular, a wide range of graphic equalisers, from 15 to 31 band. Limiter, reverb and digital delay also.

Ashly Equalisers are this company's forte. Precision crossovers now avaialble.

Call Tony Williams for a copy of our exclusive processing file - or to arrange a demonstration or demoloan of any product.

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Packages from Soundcraft, Systems from Turnkey

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And of course the deal.

Because as well as offering the same price as buying the package direct, we'll put together the best deal we can for anything else you need to get your system up and running. Total savings, buying this way are often dramatic.

Our experience with Soundcraft products is unequalled. Our knowledge of their products and our long relationship means that any problems are solved with speed.

The Producer System shown below offers the most cost effective, two inch format sixteen track in the market today.

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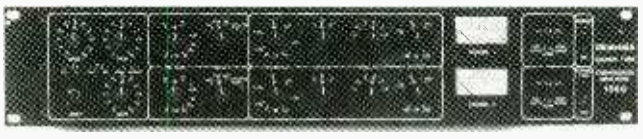
The lengths some manufacturers go to to sell you their dynamic processing.

The techniques of automatic gain control have been refined over the years. Quality circuits which perform with minimum noise and distortion abound.

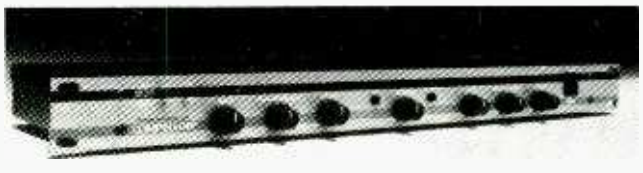
So its not surprising that manufacturers seek unique ways to attract your custom.

At Turnkey, we stock at least nine different models. Each with something different to offer.



Drawmer first appeared with an intelligent noise gate with sidechain processing. In the wake of its success their DL221 also became a sales leader as a result of extra facilities. The sidechain access for ducking or de-essing is featured. - with the capability to monitor this signal. A unique bi-directional LED disaplay, offers level or gain reduction display in two colours.

Most recently a new compressor features an old component - the vacuum tube. The smooth overload characteristics are featured in a unique, equalised front end design. A unique 'round' sound for sale.



Aphex have gone almost completely the other way by eliminating controls on their stereo Compellor product.

The control circuits include analog computers which constantly analyse the input signal, varying complex control charcteristics sent to a single VCA per channel.

Set the input level, and the mix balance between compression and leveling. The Compellor will then provide complete dynamic control - smooth inaudible compression, increased loudness, freedom from constant gain riding and the desired density - all automatically.

Its unique circuitry enhances transient qualities making even heavy processing undetectable.

MXR and **Fostex** both manufacture stereo compressors employing PWM technique. This is a fast switching circuit which actually chops our energy from the signal. The result is excellent low frequency performance.

There is none of the waveform distortion associated with many conventional fast attack circuits. Both feature continuously variable attack and release, ratio selection, plus the added bonus of a noise gate built into the Fostex product.

Rebis offers a complete, rack frame system, which their compressor fits.

This, the most compact and most economical of all the professional compressors has variable attack, release and ratio. Stereo link swith and LED indication are all featured on this narrow module.

The Rebis processing rack is the best way to buy an extensive array of effects.

dBx are the pioneers in level sensing as used in their noise reduction systems. Their range of compressors features an 'Over Easy'®, soft knee characteristic making them extremely smooth to use. Both the 160 & 165 have 'Infinity Plus' compression, providing negative gain control for 'dynamic reversal' effects.

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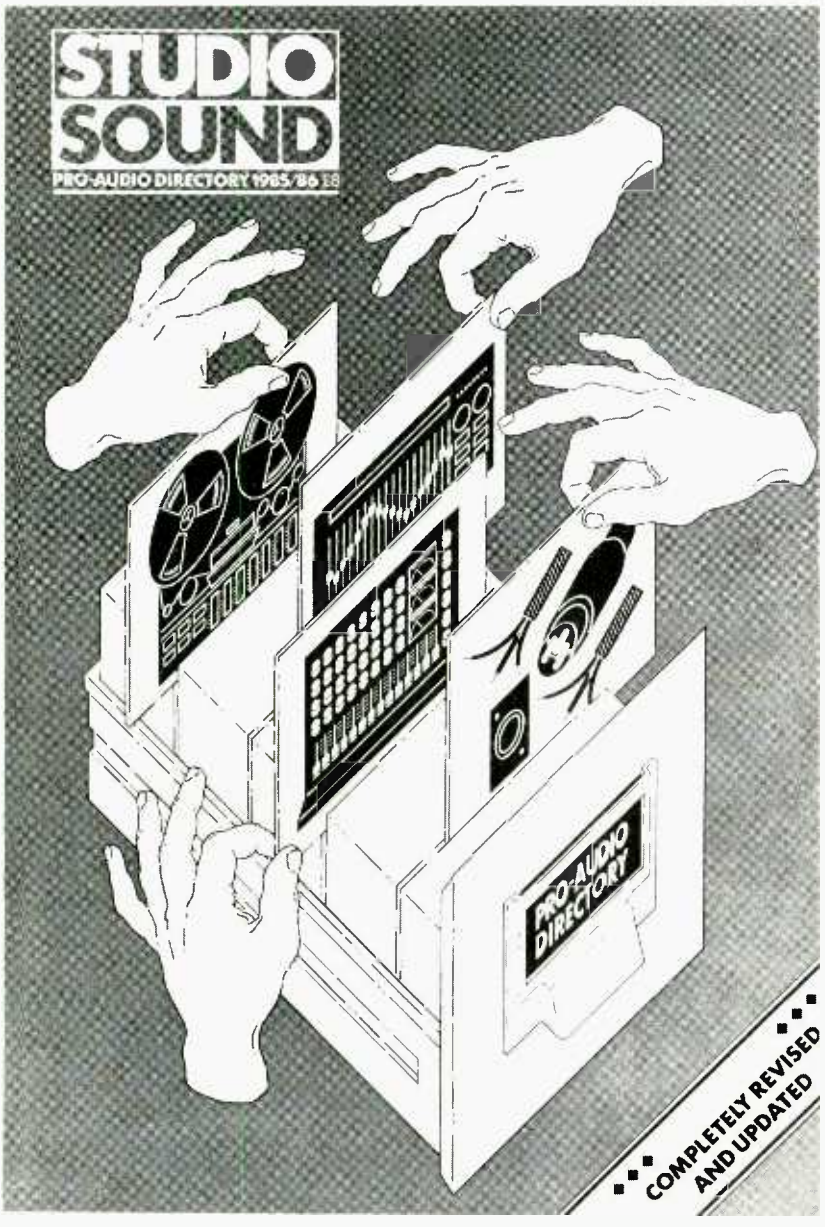

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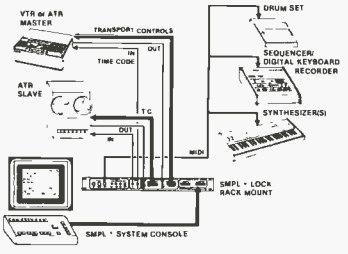

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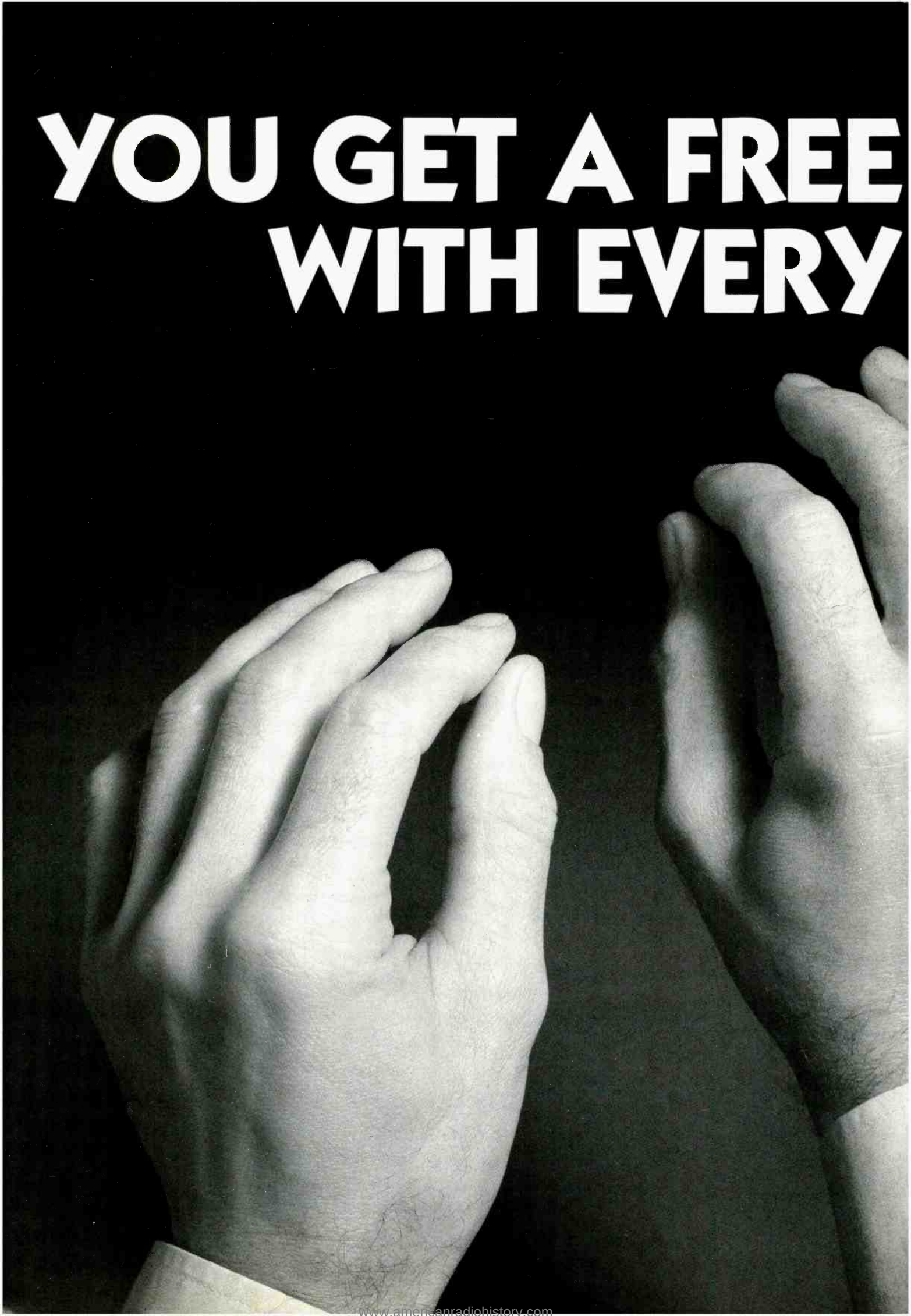

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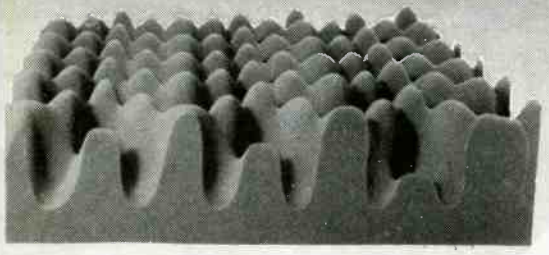

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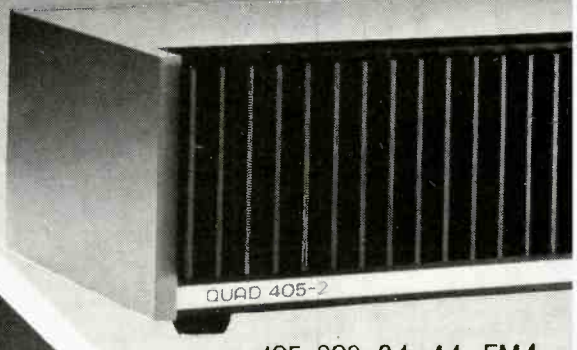

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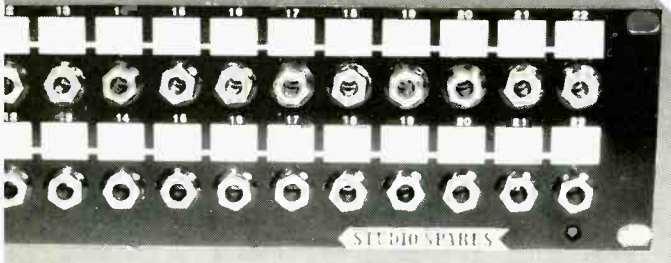

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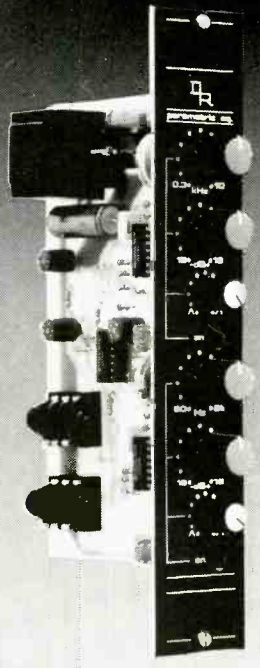

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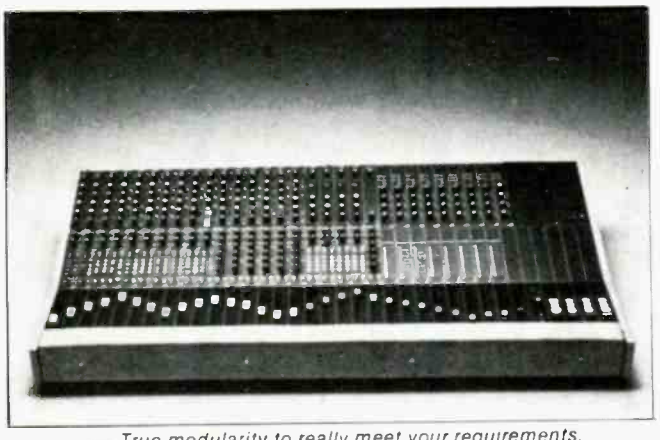

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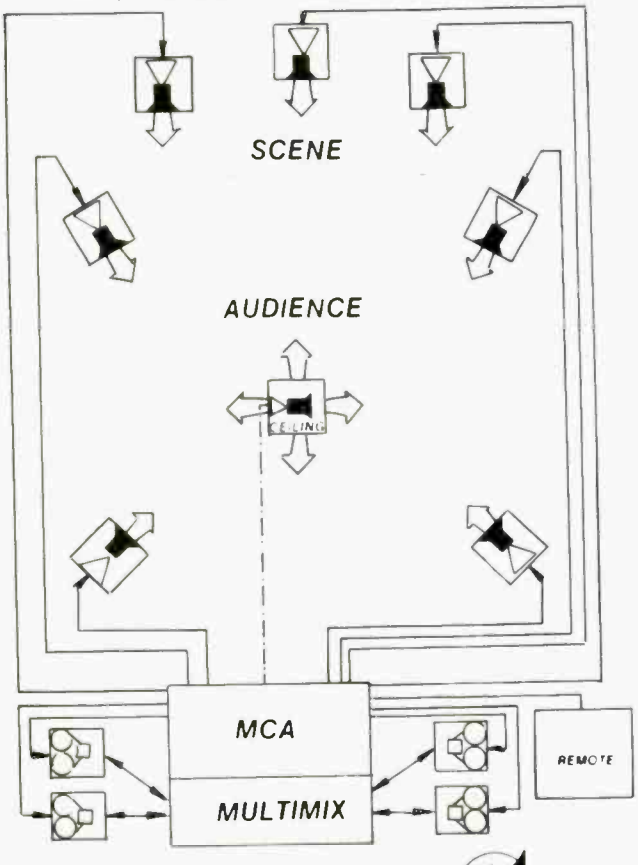

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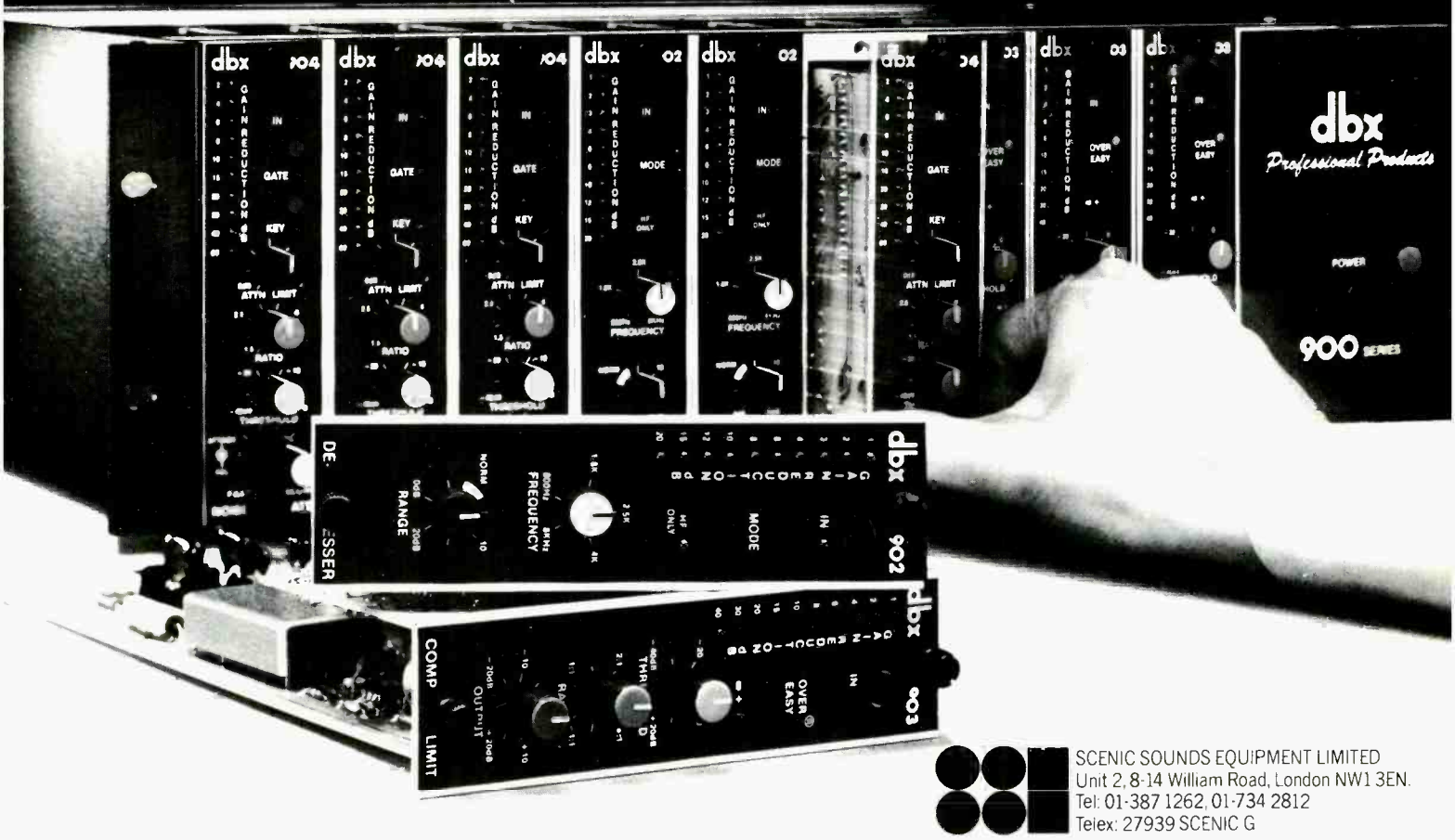

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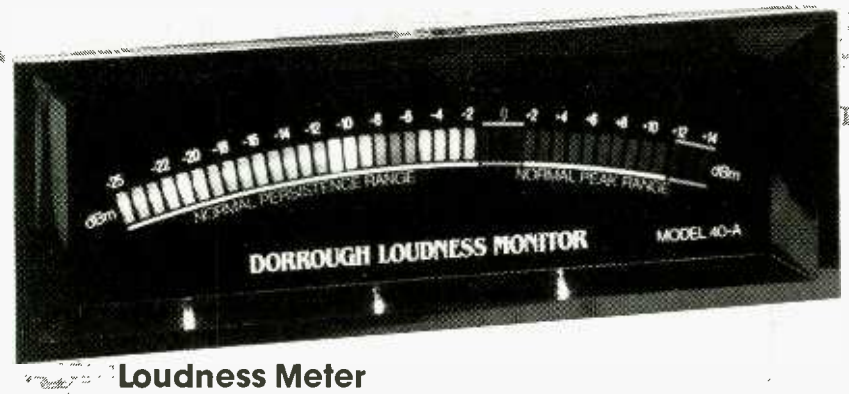

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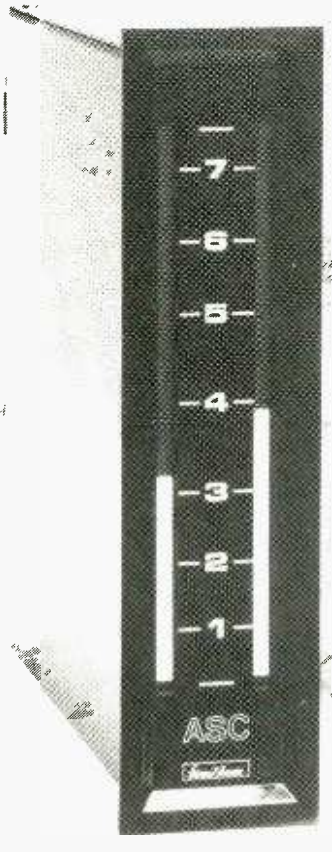

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DIARY

Contracts, APRS, advice

APRS Producers' Guild

The inaugural meeting of the APRS Producers' Guild was held in April when a wide range of subjects including digital technology, education and training, and aspects of the producer's relationship with artists and record companies was discussed.

The meeting was attended by producers Tony Swain, Steve Jolley, Mike Vernon, Robin Millar, Alan Parsons, Gus Dudgeon, Rupert Hine and Phil Wainman (who is also a member of the APRS Executive) and other Executive members Simon White (Marquee Studio) and Bob Hine (BASF). It was decided that future membership would be by invitation.

The first group of new members includes Colin Thurston, John Eden, Alan Winstanley, Pip Williams, Peter Collins, Trevor Horn, Hugh Padgham and Terry Britten.

The agreed purpose of the Guild is "to present a unified body with the strength to influence other producers and record companies, also manufacturers and studios to establish, maintain and improve standards".

Bob Hine has been elected chairman: "The intention is that the Guild's attitude will be positive, never negative. The members want a strong united voice when talking to the record industry, but they do not in any way want to destroy the rapport they already have with the industry."

Affiliated to the APRS, the Guild is administered by the Association's Secretariat.

The concept of such an organisation was first mooted almost two years ago but it was at APRS 84 that the first moves were made when producers who attended the exhibition were invited to respond to a questionnaire.

Contracts

- Dolby Laboratories in the US sold its 100th *SP-24* multitrack noise reduction unit to Digital Despatch rental group of Soundcastle Recording in Los Angeles. Dolby claim there are currently 350 *SP-24* units in use worldwide.
- London City Dubbing Theatres has awarded a contract to Swiss manufacturer Sondor for 12 *OMA3* dual gauge magnetic film recorders and reproducers, 3-, 4- and 6-track machines which are used with 35 mm and EBU.

Sondor also supplied *A-Libra* machines to its second studio in India, owned by Jaynanta Mukerji.

- Audio Kinetics has installed a third *Q.Lock* synchroniser at Battery Studios, London and two more to TVS.
- Lifecycle Productions Inc is installing a permanent sound system at the newly refurbished Apollo Video and Entertainment Center in New York and will include full audio for concert sound, multitrack recording and audio for live television.
- Newly opened Media Music's 24-track studio in Brixton, London is based round Soundcraft *TS-24* console and Soundcraft 24-track recorder.
- Carnegie Hill Studios, New York, recently installed an Amek *Angela* console fitted with ARMS computer, supplied by Martin Audio.
- Sountec Studios, Norwalk, Connecticut has refurbished its Studio A. Major new items of equipment include a custom Neve *8058* console and Otari *MTR-90 MkII* 24-track and *MTR-10 MkII* 2-track recorders with Dolby.
- Quad has supplied 40 *ESL-63* loudspeakers to Philips in Holland for use of all its classical music recording work. The *ESL-63* was first shown at the Hamburg AES in March and has been developed for the extra demands placed on recording quality by CD.
- Neve contracts include their 20th console into Nashville: Sound Emporium have taken delivery of a Neve *8128* with *NECAM 96* moving fader automation system: Pacific Audio in Canton ordered a similar package: *51* series consoles were ordered by ABC film studios in Australia and Anglia TV's new post production suite. The Federal Broadcasting Corporation of Nigeria has purchased 14 *Neve 5432* consoles to be used in local studios and the Services Sound and Vision Corporation which provides material for British Forces overseas has ordered six *5322* consoles.
- Ulster Television placed an order with FWO Bauch for two complete video tape editing suites including Studer *900* series console, *961* console, *A800* and *A810* tape recorders and *A710* cassette recorders.

Lightning may damage magnetic recordings

I have a shrewd suspicion that very few tape archives are protected against the effect of lightning strikes upon magnetic recordings. You may think this thought is a little far-fetched but a friend of mine who has an archive of several thousand tapes had his house struck with some interesting results.

Clearly it was a pretty heavy hit as part of the central heating system ended up at the far end of his garden. Most of his tape archive survived with little damage, but some previously valuable tapes are now useless.

Tapes had been stored next to what is thought to be a coaxial television down lead. Clearly a strike to the television antenna can produce a hefty current in the down lead before it evaporates and this current was sufficient to partially erase tapes near the down lead. As might be expected the erasure is cyclic with the winding diameter on the reel.

Tapes stored further from the down lead did not suffer erasure but it appears that the print through has increased substantially and is quite intolerable in some instances.

In this instance the danger area around the down lead appears to have been a radius of about 2 ft (600 mm). Logically the danger area around heavier conductors which can carry heavier currents could be significantly larger.

Just how can tapes be protected from this very serious threat to large and valuable archives?

The obvious first option would be to fit lightning conductors and store the tapes well away from the grounding conductors. How far 'well away' is I do not know but 30 ft (10 m) might be enough.

Further precautions include keeping tapes well clear of any conductor which might be energised by a lightning strike. Such conductors are electrical wiring of any type, water pipes, drain pipes, steel reinforcement in the building, etc.

A final thought is that storing magnetic recordings in metal racks might not be such a good idea, lightning takes some very peculiar paths and might jump across the racks.

It would be most interesting to hear of any other experiences of the effect of lightning strikes upon magnetic recordings, just think what would happen if the Inland Revenue data bank was struck! **Hugh Ford**

I would further add that we would be interested in information on any experiences with lightning and professional recording equipment that any readers might like to share—Ed.

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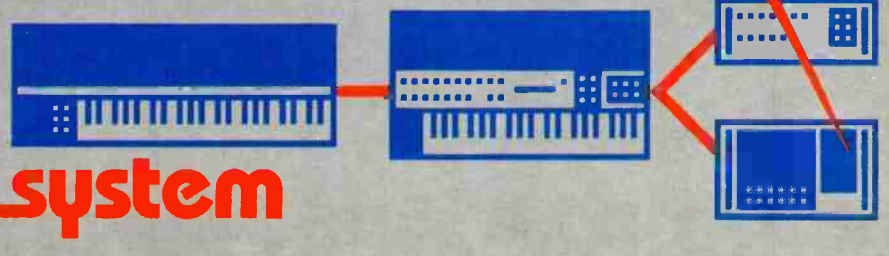

DIARY

Contracts, events, in brief

Contracts

● SSL have recently supplied an *SL4000E* with *Total Recall* to RAK Studios, London for installation in Studio 3; and an *SL4000E* with *Total Recall* and plasma metering to PWL, Pete Waterman's production company private 2-studio complex. Platinum Australia studio in Victoria completed a studio rebuild with newly installed SSL console and Studer machine. Other SSL contracts have included an *SL4000E* for Skyline in New York city with studio computer and *Total Recall*. Built into the producer's desk are vintage Neve and API equalisers.

The BBC have placed orders for computer-assisted audio consoles for two new stereo control vehicles. Each SCV will be fitted for simultaneous broadcast as well as recording with the *SL4000E* and studio computer, Otari *MTR90* 24-track machines, Dolby noise reduction and three Studer *A80* 2-tracks.

Sound Ideas Studios, New York City has completed installation of an *SL6000E* series stereo video system in Studio B.

Counterpoint Studios, New York, have installed two SSL stereo Video Systems *SL6000E* with studio computer and *Total Recall*.

● Soundtracs contracts for their *CM4400* digital routing console to date include Theater Am Turn and Video Tec in Frankfurt; SAV Studio, Aviolec, Thomas Dolby, Steve Glen, Hot Knights and Richard Harvey in London; Charles Lane Studios, New York; Samichael Studio, Malaysia; Fantasy, Tennessee; Studio Ladan, Sweden and SM-Studio, Finland.

● Philips Multi-channel Reverberation sound system will be installed in the newly refurbished Saalbau, a municipal auditorium in West Germany's Neustadt an der Weinstrasse.

● Audio FX, having recently acquired the Electric Keyboard Company, provided Art Garfunkel with a complete control room in the vestry of St Paul's church, Wimbledon, London, consisting of a TAC *Matchless* mixing console, AMS reverb and monitoring foldback. This enabled them to overdub the church choir on to an Art Garfunkel/Jimmy Webb Christmas album. A complete studio was also supplied for *Wham in China* with a TAC *Matchless* and two Otari *MTR90* machines.

● Tele-cine's newly installed film to tape transfer suite features the Bosch *FDL60* ccd/digital telecine and *FRP60* film reproduction programmer, has recently been equipped with two Lexicon *1200* audio time expander/compressors. They can now expand or compress the running time of film material which has to be transferred to tape to fill an exact slot, with 2-channel pitch compensation which is important when both the final and M&E or stereo tracks are required on the transmission tape master.

● Unique Recording in New York have added Quantec *QRS* room simulator and a fourth Otari *MTR90 MkII* 24-track recorder to their equipment list.

● Turbosound has supplied the new house speaker system for the Grand Ole Opry complex in Nashville, Tennessee. The system, installed by Spectrum Sound of Goodlettsville, Tennessee, consists of nine *TMS-1* cabinets, seven *TMS-4* cabinets and two custom-built mid/high frequency enclosures to provide rear upper balcony fill.

● Harrison Systems are supplying a 24-input *PRO-7* audio console system for the US Pavillion at Expo '85 in Tokyo. The console will be used in the computer-controlled electronic music presentation which has been prepared and will be presented by the University of Buffalo under the auspices of the US Information Agency.

● Gateway Studios, London recently added a Bel *BD80* digital delay processor with CV input, Roland SMPTE facility, Bechstein grand piano and *Q.Lock*.

● Performances of Andrew Lloyd Webber's *Requiem* at Westminster Abbey, London used a sound system which incorporated Tannoy *Wildcat Leopard* and *Lynx* units, the system being required to enhance the natural sound of the live instruments within the Abbey.

In brief

The APRS Studio Link Up, featured in June's APRS column, is now in operation. The Viewdata service is operated through Prestel and gives booking information. It is open only to APRS members, who may buy pages to list their facilities and availability. There is also a message board. Further information from GWV, Manfield House, 376 Strand, London WC2R 0LF. Tel: 01-379 5523...Artisan Sound Recorders has been purchased by the Latorre family of El Paso, Texas. Fernando Latorre, spokesman for the family made the announcement that William Rogers would be appointed general manager and Greg Fulginiti would be director of mastering. The new company will continue to operate under the name of Artisan Sound Recorders... John Deacon, bass player in Queen, has opened a 24-track studio in North London with partner Henry Crallan: Milo Studios. The installation includes Amek *Angela* 28/24 in-line console and Studer *A80* and *A810* tape machines... The Independent Labels Advisory Service (ILAS) has been set up as a replacement for the ILA, acting as a bridge between individuals, independent labels and major organisations. ILAS, 52 Woodgrange Road, London E7. Tel: 01-519 5658...Granta Windings offers a rapid service manufacturing OEM transformers; computer-aided design enables them to provide a quote within 24 hr and to construct and despatch a sample shortly after that. Granta Windings Ltd, Earith Road, Willingham, Cambridge CB4 5LS, UK. Tel: 0954 60861 ...Original Equipment Manufacturers Agreement between Philips and Tesla Bratislava, Czechoslovakia has been signed under which Philips will supply compact disc players and VHS video recorders to Tesla this year. This is the first step in a 5-year plan to deliver equipment, modules and know-how to Tesla.

Odyssey refit

Odyssey recording studios in London has completed a major refit to Studio Two.

The studio incorporates an RPG Diffuser Systems acoustic diffuser which has not been used in Europe before, plus a Solid State Logic *6000* series console.

On the video front, Odyssey have recently installed Barco monitors.

Alpha Audio distribution

A third distribution centre for Sonex acoustical foam has been opened by Alpha Audio Acoustics in north Las Vegas. The new warehouse will serve the West Coast accounts, augmenting existing facilities in Richmond, Virginia and St Paul, Minnesota. This will reduce the shipping costs to those accounts by as much as a half.

ITA/Ursa Major

ITA, UK distributor of Ursa Major effects, has reached an agreement with Ursa Major to supply and market the units at a set stable price which is unaffected by the fluctuations of the pound vs dollar.

ITA is also setting up a dealer network for Ursa Major all over the UK. Any interested dealer should contact Dave Cottam at ITA on 01-748 9009.

Forthcoming events

● October 8 to 10, Internepcon, Brighton, UK.

● October 13 to 17, AES Convention, New York, USA.

● March 4 to 7, 1986, AES Montreux, Switzerland.

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DIARY

DIARY

Addresses, agencies, people

Gateway-Rebis combine on course

Gateway studio and Rebis are collaborating to make Gateway multitrack courses available at Rebis' premises near Wolverhampton, bringing the course to the Midlands for the first time. Discussions are under way to currently expand the range of courses available.

Other Gateway courses held in London include weekly courses in recording and synthesiser programming and weekend workshops on subjects such as service, DX programming, Fairlight and Synclavier work.

Address changes

- Shone Sound Ltd is now located at Carlisle Road, Manningham, Bradford, West Yorkshire BD8 8BD. Tel: (0274) 491481.
- Norwich-based A/V distributor Sound Marketing has moved to 10 Capitol House, Heigham Street, Norwich. Tel: (0603) 667725. New facilities include training, project management, cassette copying, equipment hire and service.
- The engineering and manufacturing facility of Inovonics Inc has relocated to larger premises in Santa Cruz, California. This coincides with a restructuring of the company's marketing and distribution policies, which is handled completely by Marcom Inc in the US, Canada, Mexico and Central and South America. Overseas sales are handled through the factory itself: 1305 Fair Avenue, Santa Cruz, CA 95060, Tel: (408) 458-0552.
- California-based Rubber Dubbers Inc has moved to 626 Justin Ave, Glendale, CA 91201, tel: (818) 241-5600, where the new facility is equipped with an 1800 ft² high speed Foley/ADR stage capable of creating room ambience to match any production set sound. With many different surfaces: dirt, rock, parquet, iron, sand and water, computer automation allows full diversity of room acoustics.
- ACO Pacific Inc has moved to 2604 Read Avenue, Belmont, CA94002, USA. Tel: (415) 595-8588.

Electro Sound Seminar

The 1985 Electro Sound Seminar will be on Applications for Better Quality Cassettes and is being held at the Hyatt, Union Square, San Francisco, August 20 to 23.

More details are available from Electro Sound Inc, 160 San Gabriel Drive, Sunnyvale, CA 94086. Tel: (408) 245-6600.

Agencies

- Sanken has appointed Stage Theater en Studiotechniek as sole Netherlands agent for the *CU-41* double condenser microphone and its accessories. Enquiries are invited and loans may be arranged for evaluation.
Stage Theater en Studiotechniek, Nieuwegein, The Netherlands. Tel: 03402-65780. Telex: 76428.
- Menlo Scientific, Berkeley, California has been appointed as US agent for the Japanese Bodysonic Company's line of professional low frequency transducers (for seating), floor panels and associated signal processor/amps that use bone conduction to radiate the tactile perception of sound. Menlo Scientific, 39 Menlo Place, Berkeley CA 94707, USA. Tel: (415) 528-1277.
- Recently established Prom-Audio Belgium NV (part of Prom-Audio Holland) represents Fostex personal multitrack, Soundtracs and Sixmix consoles, Annis demaggers and magnetometers, *C-Ducer* microphones and Posso reels and accessories in Belgium. Prom-Audio Belgium NV, Av de Stalingradlaan 61, 1000-Brussels. Tel: 02-512 35 90.
- Meyer Sound has appointed three new dealers in the US: Sounds Good Audio, Lansing, MI; TD Audio, Montclair, NJ; and Sound Genesis, San Francisco, CA.

Breaking the 12 in world record

Ryker Records has broken the world record for the shortest time from live performance to the finished 12 in record being on sale: 10 hr 22 min.

At the Merseyside Alive '85 Jamboree held in Liverpool, the Iconoclasts were recorded live by Station House Studios. The tape was flown by helicopter to London's Trident Studios cutting room where Ray Staff cut the lacquers.

The journey continued by helicopter to Leicester for lacquers processing to stampers and finally back to Ryker Records factory and the presses. Records were flown across to the scene of the Jamboree where bands were still playing.

People

- Soundcraft Electronics (UK) has made three new appointments. Barrie Hozier has moved into the role of general manager whilst maintaining his existing function as financial director. Manufacturing management is now by John Child, including all the technical and administrative aspects of manufacturing.

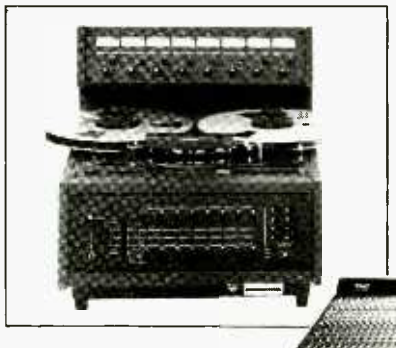
Following the departure of Kate Charters, marketing co-ordination is now with Claire Finch who previously worked in the sales department.
- Munro Associates has expanded its team, Ann Riden joins administration and Christopher Trowell becomes architectural assistant. Ann joined the company after spending many years on the sales team at HW International and before that, Shure Electronics (UK).
- Crown International Inc has appointed Patti Smith as purchasing agent, with responsibilities including scheduling and ordering as well as assisting the purchasing manager in development.
- Mathew S Ceterski, formerly in marketing and sales management with Sony Corp of America has moved to Recortec Inc as vice-president marketing.
- AKG has appointed J While as national sales manager (previously northern area sales manager) with responsibility for professional and hi-fi sales. Malcolm McLachlan has joined the company as sales/office supervisor.

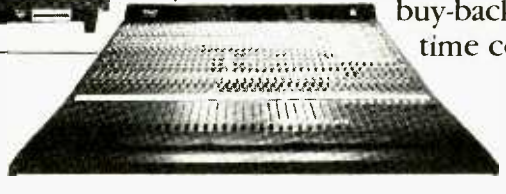
Newly appointed southern area sales representative for professional products is R Barducci. He previously worked for Hayden Laboratories, 3M and AEG Telefunken where he was involved with system design as well as sales. Immediately prior to joining AKG he was at Jacob's Studios in Surrey.
- Larry Shank has joined Tecron, division of Crown International Inc as a *TEF* salesman. Coming from a computer background he is responsible for marketing of the *TEF 10* systems analyser/computer, the *TEF* technology and the co-ordination of the markets.
- Crown appointments include Ed Weidenhaft as assistant controller and Michael D Moon as information systems manager.
- Kim Person has been appointed staff engineer at Alpha Audio, Richmond, Virginia. Previously she was running her own studio which Alpha installed.
- David Walker is director of operations and development, overseeing marketing and development of product and product lines as well as marketing the *Boss* computer-controlled editor Sonex and Alpha Acoustics products.
- P N Bone and H S Bishop have retired from Shone Sound in Bradford although they will continue to act as consultants for studio design. All correspondence should, however, be addressed to Gordon Kaye at the new Bradford office (see address changes).
- David Rohl, music writer/producer, has recently become artistic director of Media Music, London; Bernard McKenna is managing director and Rafael Panko is chairman.

Modern recording techniques have evolved greatly in sophistication in recent years. Technology allows today's writers and musicians to create and process new and complex sounds with greater ease than ever before.
For the time being at least, however, the heart of the recording studio remains the mixing console and the multitrack recorder. ITA has been supplying tailored system "packages" for more than ten years to every part of the industry, and we can offer the widest range of studio systems for all applications, be they 8, 16, 24 – or more – tracks.

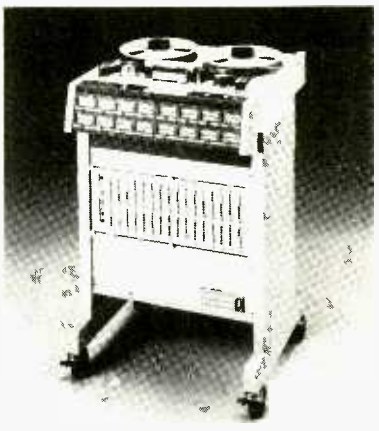
SERIOUS SYSTEMS FOR SERIOUS USERS.

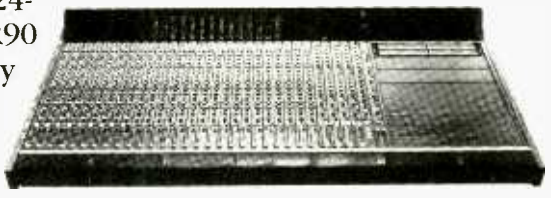
Certain equipment combinations have shown themselves to be particularly effective in operation and reliability, for a variety of different applications.
The three systems below are high-quality packages for the serious user:
8-TRACK: For writers, arrangers, and in-house video units we think the range of Scorpion mixers from TAC compliments the Otari Mk. III-8 perfectly.





16-TRACK: The new Otari MX70 1″ 16-track will change a lot of peoples' minds about 2″-versus-1″; with the TAC Matchless console, it makes a highly effective and versatile system. The MX70, in common with all Otari's multitracks, comes with a full syncroniser interface, making locking sound-to-video quick and simple.
24-TRACK: For the serious 24-track studios, the Otari MTR90 Mk. II is far and away the only logical choice of recorder. With the Amek Angela in-line console, an unbeatable





THE HEART OF THE SYSTEM.

combination of superb engineering, operational ease and flexibility is the result – at a sensible price.
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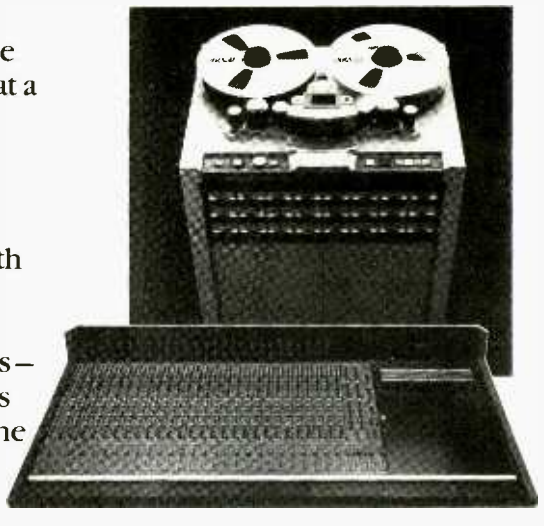

For more information on these, or any other studio systems, call us on 01-748 9009.

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1 Felgate Mews, Studland Street, London W6 9JT. Telephone: 01-748 9009. Telex: 21897.

DIARY

Business, literature, advice

Digital interconnections

Interconnection of digital processors, like the Sony PCM *F1*, and video recorders, like the Sony *SLF1*, is awkward to organise so that one can instantly use the desired facility of the many available. One needs playback from either VTR, record on either, record on both at once, playback on one and record on the other (allowing analogue overdubbing or processing) and digital copying from one VTR to the other. All this can be accomplished by plugging and unplugging the various connections but this is tedious and unreliable. Permanently connecting the processor and the two VTRs to a bank of six latch release push buttons instantly and reliably gives a choice of nine facilities (see diagram).

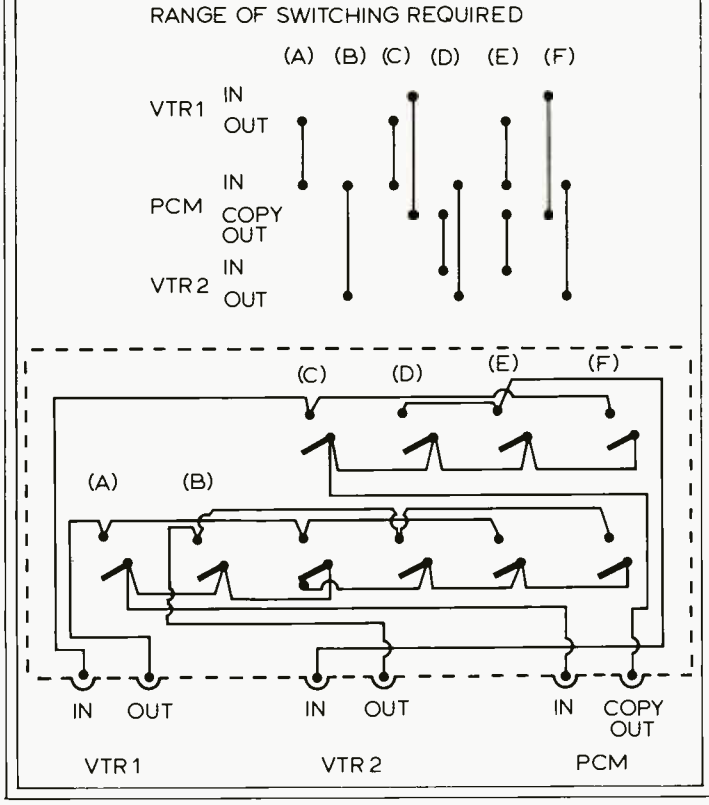
Counting E and F as two facilities each (ie analogue copying with the option of digital copying with the Processors Copy Out switch operated) produces eight facilities. The ninth option is simultaneous recording on both VTRs if C and D switches are both latched in the operated mode. A special wiring connection allows monitoring off VTR 1 only.

Six latch release pushbuttons—two with single-make contacts, three with double-make contacts and one with a changeover and a make—are needed. A diecast box and six phono sockets complete the housing arrangement. To ensure reliability when on location I have replaced the phono sockets and plugs throughout my installation. In a fixed studio installation where there is no need of regular plugging and unplugging the phono sockets which exist on the Sony equipment and its leads will prove reliable.

Mike Skeet

For further information (and if demand exists, finished units) contact Mike Skeet at Whitetower Records, 44 Challacombe, Furzton, Milton Keynes MK4 1DP, UK. Tel: 0908 502836.

(A) Playback VTR 1; (B) Playback VTR 2; (C) Rec/Play VTR 1; (D) Rec/Play VTR 2; (E) Play VTR 1/Rec VTR 2 (digital copy option); (F) Play VTR 2/Rec VTR 1 (digital copy option).



Auditronics acquires Tapecaster

Tapecaster TCM Inc of Rockville, Maryland which manufactures tape cartridge recorders, reproducers and loaders, has been acquired by Auditronics. Auditronics feel that the Tapecaster products will complement their own line of broadcast consoles. Auditronics Inc, 3750 Old Getwell Road, Memphis, TN 38118, USA. Tel: (901) 362-1350. Telex: 533356.

Literature received

- US studio directory of facilities equipped with Sony PCM *3324*, published by Sony which will be updated regularly. Copies available from *PCM-3324 Directory*, Sony Professional Audio Division, One Sony Drive, Park Ridge, NJ 07656, USA.
- The 1985 *BPI Yearbook* comprising a statistically-based annual report on the UK record industry and including facts and figures relating to the selling of records and tapes. Copies are available from the BPI office (£5 plus £1.25 p&p), Roxburghe House, 273/287 Regent Street, London W1R 7PB.
- Harris Electronics (London) has an updated full colour 12-page catalogue of their TMK range of test instruments including insulation testers, digital line earth loop impedance testers plus full range of analogue and digital multimeters, and more.

A free copy is available from Harris Electronics (London), 138 Grays Inn Road, London WC1X 8AX, UK. Tel: 01-837 7937.

- From MK Electric a 10-page colour brochure containing full technical information on the MK range of residual current operated circuit breakers (RCBs) as well as a section on the effects of electric current on the human body together with guidance on the correct choice of RCB for different applications.

Intended for industrial users and specifiers of RCBs as well as installers, copies are available from Marketing Services Dept, MK Electric Ltd, Shrubbery Road, Edmonton, London N9 0PB, UK. Tel: 01-803 3355.

Harrison and Westlake team up again

Harrison Systems and Westlake Audio have renewed their dealer relationship. Westlake Audio Professional Sales will represent Harrison's complete range of audio consoles. As a result of the agreement, Westlake Audio's new Studio D is equipped with Harrison and an order has been placed for the first of Harrison's new *Series Ten* totally automated console systems.

Aosis for Barry Blue

Singer/songwriter Barry Blue purchased Aosis Studios in London about six months ago and a refit and redesign under the direction of Andy Munro is now completed. It incorporated the installation of a Harrison *32/32* automated console, Otari *MTR90 MkII* 24-track and *MTR12* ½ in and ¼ in machines, and the Roger Quested designed soft dome monitors.

Arbiter back with Fender

Arbiter Musical Instruments has acquired the business of CBS Fender UK along with the distribution rights for the UK, Ireland and Benelux territories for the entire Fender musical instruments and sound equipment range.

Arbiter was associated with Fender in the '60s and will be operating from Fender House, Jeffreys Road, Enfield, Middx EN3 7HE. Tel: 01-805 8555.

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NEW PRODUCTS

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MonSter and uniVUer

The Real World Technologies Group *uniVUer* is a stereo metering system used in conjunction with a TV monitor. Either VU or PPM ballistics can be specified and the on-screen display is superimposed over the television picture. The *uniVUer* is compatible with both NTSC and PAL systems and according to the manufacturer will not degrade the signal even when used with the most expensive video monitor. Horizontal and vertical size and position are adjustable and a black frame can be switched on around the display to enhance visibility.

The Mono-Stereo Coherency Evaluator, or *MonSter* as it is known is a stereo phase energy bargraph display primarily intended for use where mono compatability is important. A single row of 15 colour-coded LEDs scaled from −15 to +3 indicates coherence through to phase cancellation. With the input filtering switched out the unit can be used to measure point source phase during microphone placement, transmission system frequency sweeps and tape machine head alignment. When the *MonSter* is used in conjunction with *uniVUer* the on-screen display will indicate phase/polarity errors.

The Real World Technologies Group Inc, 130 McCormick Ave, Suite 109, Costa Mesa, CA 92626, USA. Tel: (714) 957-1061.

Numark SA-110 power amplifier

The Numark *SA-110* delivers an FTC-rated 55 W/channel into 8 Ω, 60 W into 4 Ω, both channels driven. It may also operate in bridged mode for mono, delivering 120 W into 8 Ω.

The amplifier's features include: protection against shorted speakers, clipping and 'power on' transients: 5¼ in LED-arc meters with x1/x0.1 range button and brightness selector; light weight and small size (2 U of rack height); front panel level controls and speaker system on/off buttons and dual headphone jacks.

Singer Products Company Inc, 875 Merrick Avenue, Westbury, NY 11590, USA. Tel: (516) 683-3000.

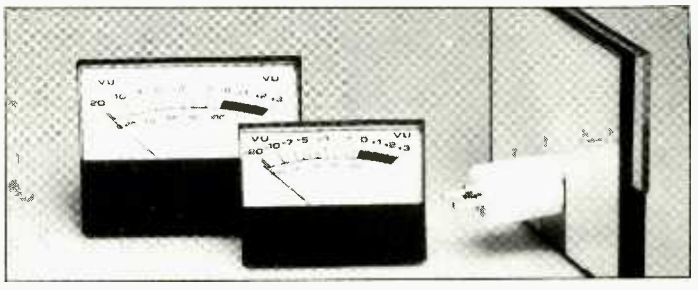
Aphex Series 500 modules

Aphex has created a new range of modules which provides a simple, high-quality method of audio control and distribution. All the modules are built on 2.75×3.30 in cards with a 15-pin edge connector and a power supply requirement of ±15 V.

The model *505* card is a universal VCA using the 1537A chip. It features a balanced input and multiple, buffered control ports. The model *506* input card is a servo balanced input stage with jumper selectable gain, tunable common mode rejection and a low impedance single-ended output. Model *507* is a servo balanced output stage that can be used single-ended or balanced and the *508* card is a resistor network that converts the *507* to four sets of isolated balanced outputs making it suitable for use as a distribution amplifier.

A model *509* extender card is also available and is suitable for all series *500* cards.

Aphex Systems Ltd, 13340 Saticoy St, North Hollywood, CA 91605, USA. Tel: (818) 765-2212.
UK: Atlantex Music, Brent View Road, London NW9 7EL. Tel: 01-202 4155.



Modutec panel meters

US manufacturer of analogue panel meters, Modutec, who are part of the Measurement Division of Thorn EMI, stock over 4,000 different types of meters at their European MOD Centre at Altrincham.

Their range includes inexpensive moving magnet meters to full spec ANSI shockproof taut band meters. Most meters feature Modutec's 'translit' illumination which provides a clear uniform density of lighting. Failed bulbs can be easily replaced without having to dismantle the meter.

Modutec can also supply single and double display bargraphs and their complete digital meter—*Big Little DPM*—is available as a 2 V or 200 mV device. Shortly to be offered is a clock module version.

Modutec Inc, 18 Marshall Street, Norwalk, CT 06856, USA. Tel: (203) 853-3636.
UK: Modutec, Atlantic Street, Altrincham, Cheshire WA14 5DB. Tel: 061-941 7001.

B & B Systems' Imagescope

B & B Systems Inc has recently introduced a rack mounted stereo display system. Known as the *Imagescope* it is 3U high and uses a CRT to indicate the relative levels and positioning of a stereo soundstage. A graticule indicates relative level and positions for left, centre, right and mono signals. In addition to controls for intensity, focus and power on/off, calibration and scaling can be adjusted on the front panel. The manufacturer suggests the *Imagescope* be used for monitoring phase, perspective, separation and balance.

Among the other metering systems available from B & B Systems is the *AM-1 Stereoscope*. This is designed to indicate both peak and average left and right levels, phase and SMPTE timecode errors. Also available are the *AM-2* and the *AM-3*. The *AM-2* is a simpler version of the *AM-1* and comes without timecode or switched peak level ranges. The *AM-3* is a 3 meter version of the *AM-2*.

The *MP-4* is a 4-way meter system that can be configured according to your own requirements. Available with any combination of peak or VU meters the *MP-4* can also be supplied with custom lettering.

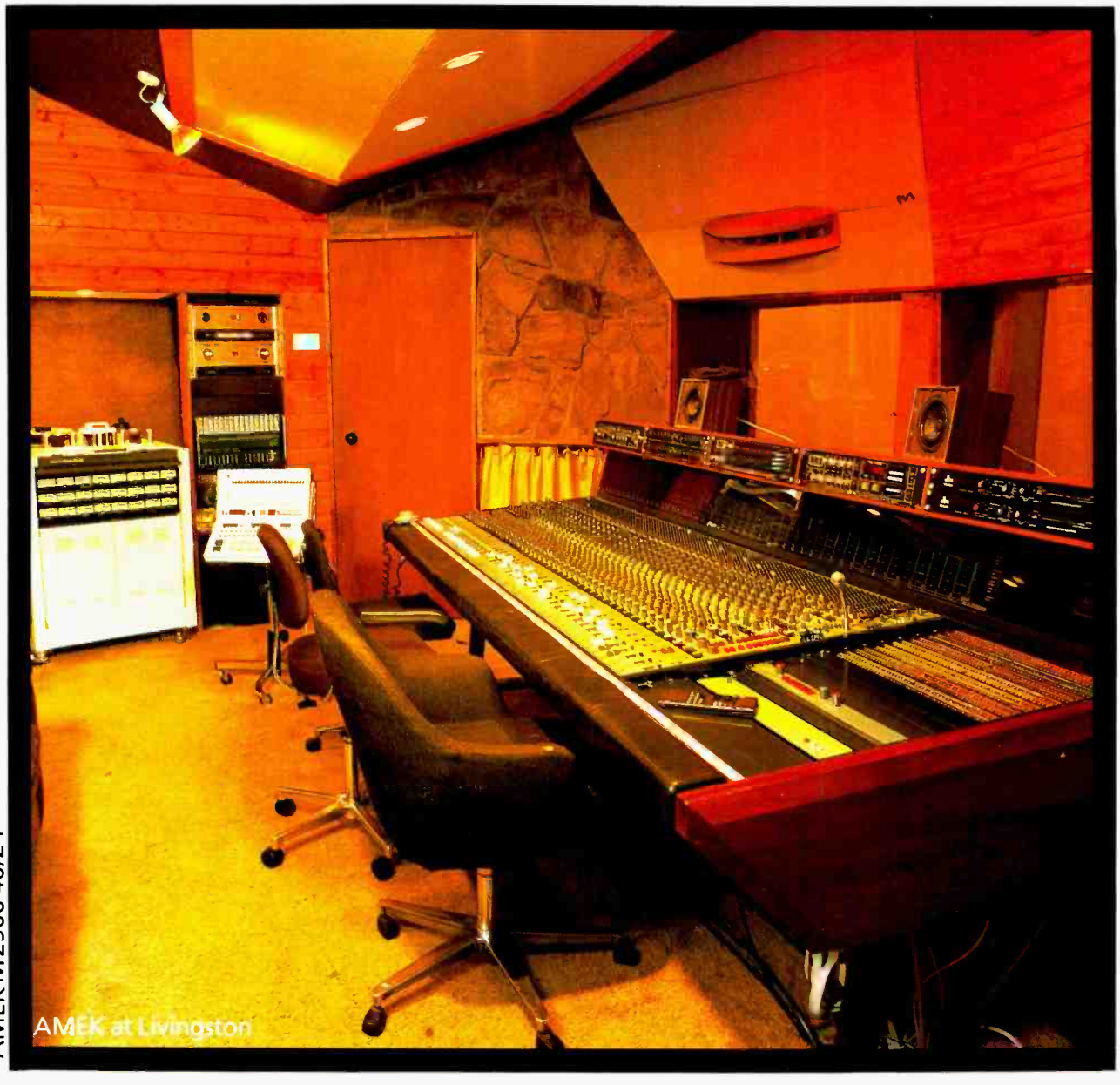
B & B Systems Inc, 28111 Avenue Stanford, Valencia, CA 91355, USA. Tel: (805) 257-4853.

UREI 809 studio monitor

The model *809* Time Align studio monitor is a 300 mm version designed specifically to mimic the sound quality, stereo imaging and coverage characteristics of the larger model *813* while allowing near-field monitoring for a more optimum direct/reverb ratio sound field with solid bass performance.

Power rating is 100 W with a sensitivity of 93 dB SPL. Overall each speaker weighs 34 kg and measures 23×16½×13½ in. As with other UREI monitors, mirror imaged pairs are available for stereo applications.

UREI, JBL Inc, 8500 Balboa Boulevard, PO Box 2200, Northridge, CA 91329, USA. Tel: (818) 893-8411. Telex: 674993.
UK: Harman (Audio) UK Ltd, Mill Street, Slough SL2 5DD. Tel: 0753 76911. Telex: 849069.



AMEK M2500 46/24

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Jerry Boys,Livingston Studios

Now available – the world's most advanced mixing computer from AMEK/GML with ultra-fast motorized faders, twin 68000 processors and Winchester disk storage. The AMEK PM01 Parametric Equalizers may be purchased in Rack-mounting form.

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1985

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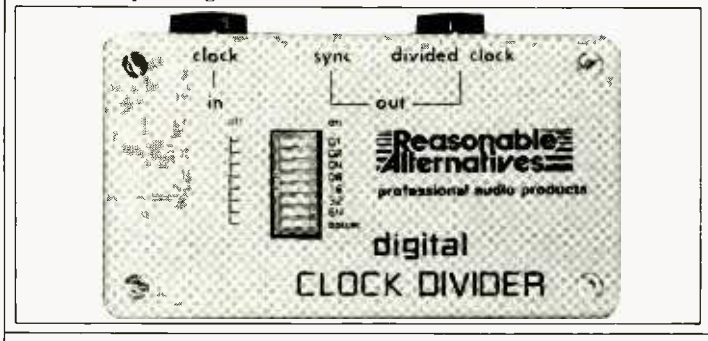
Digital clock divider

The Reasonable Alternatives digital clock divider will take a clock signal and divide by 1, 2, 4, 8, 32 or 64. This will allow previously incompatible units, using different clock rates, to be synchronised. The divider also provides an output similar to that at a Roland 'sync' jack, and will supply the +5 V run/stop voltage that Roland devices require. The divider has a 'divide by 1' mode. In this position, a unit with a clock rate of 24 pulses per quarter note can run a Roland product, which also requires 24 pulses per quarter note, but needs a run/stop voltage of +5 V. By using the 'divide by 1', the clock rate will not be changed, but the +5 run/stop voltage will be provided at the DIN output.

On a digital delay line with an external clock input, the delay can be made to repeat 'in time' to a sync track or drum machine when the divider is used to synchronise the clock rates.

The unit is housed in a light grey 2½ in × 4½ in ABS plastic box, with an 8-position DIP switch to select the division ratio. The clock input and output are on ¼ in jack sockets, and the Roland-type sync signal is on a 5-pin DIN socket, as is the +5 V run/stop connection. The unit is powered by a 9 V battery.

Reasonable Alternatives, PO Box 733, Cranford, NJ 07016, USA. Tel: (201) 549-2100.



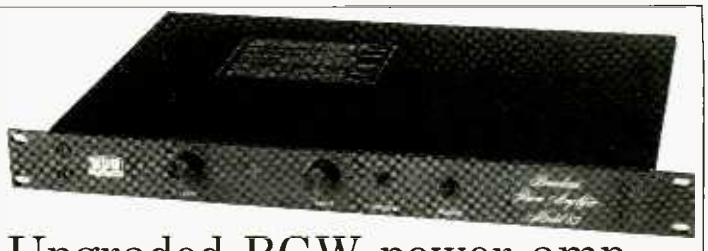
AXE KT-1000 synchroniser

The AXE *KT-1000* is a microprocessor-based programmable digital metronome/synchroniser that will store up to 50 different user-programmable tempos. The *KT-1000* allows you to program a tempo to run for a specific number of beats; automatically start each tempo from SMPTE coded video tape, film or audio tape; generate metronome pulses and automatically control MIDI-equipped devices including accelerations and retards thus maintaining perfect sync.

The *KT-1000* can also be programmed to go from one tempo to another automatically, including accelerating and retarding within a specific number of beats. An RS-232C computer interface is provided and through the Save and Load facility, user programs can be stored on tape or on a special non-volatile AXE Memory Card.

Tempos can be entered into the synchroniser either in beats per minute or in frames per beat. Four frame formats are available—Film, EBU, NTSC Drop Frame and NTSC. Duration can be either total number of beats or a specific length of time. Accuracy is claimed to be 1/100 s.

Artists X-ponent Engineering, PO Box 2331, Menlo Park, CA 94025, USA. Tel: (415) 365-5243.



Upgraded BGW power amp

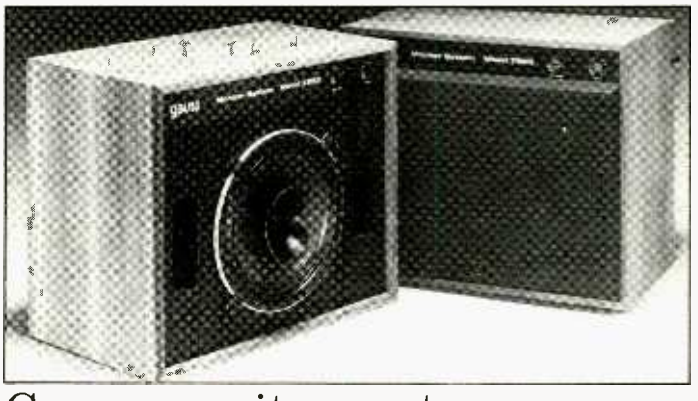
BGW Systems Inc has upgraded its *Model 85* series rack mounted power amplifiers. The new *Model 85* now delivers 35 W per channel into 8 Ω. The new amps also feature improved noise characteristics, and an anodised brushed aluminium front panel. A new low feedback discrete circuit design is claimed to result in exceptionally natural sound coupled with the elimination of transient intermodulation distortion. A toroidal power transformer allows the unit's low size, weight, stray field and acoustic noise.

Three versions of the *Model 85* are available. The *Model 85* has unbalanced inputs on ¼ in jacks. The *85-01* has electronically balanced inputs on XLR-type connectors, with a guaranteed 70 dB common mode rejection. The *85-06* has transformer inputs that provide 15 k Ω input impedance: this version also uses XLR-type connectors.

Other features of the *Model 85* series include welded steel construction for robustness and RFI shielding. Modular construction should make servicing easier. A mono bridge switch allows high power single channel operation. All three amplifiers have detented front panel gain controls and a headphone jack. Transient-free circuitry is said to prevent speaker pops or extraneous noise.

BGW Systems Inc, 13130 South Yukon Avenue, Hawthorne, CA 90250, USA. Tel: (213) 973-8090.

UK: Theatre Projects Services Ltd, 10 Long Acre, London WC2E 9LN. Tel: 01-240 5411.



Gauss monitor system

Cetec Gauss has announced a new single-point source studio monitor. The model *7258* measures 24×19½×29 in and uses the 200 W co-axial drive unit originally introduced last year. Frequency response is claimed to be 35 Hz to 18 kHz with a 30°H×30°V pattern at 2 kHz. Sensitivity at 1 m is 95 dB.

Attenuation and roll-off controls are fitted as standard, the attenuation control being a high frequency balance control with a range of +3 dB to off and the roll-off control adjusting high frequencies in the 6 to 15 kHz band 0 to −12 dB.

According to the manufacturer the speakers are claimed to give superior stereo imaging without the need for specially matched pairs.

Cetec Gauss, 9130 Glenoaks Blvd, Sun Valley, CA 91352, USA. Tel: (213) 875-1900.

UK: Cetec International, Unit 15, Northfield Industrial Estate, Beresford Avenue, Wembley. Middx. Tel: 01-900 0355.

The new Sony mic and its pen friends

Sony Lavalier microphones have a long established reputation for quality, performance, serviceability and reliability throughout the broadcasting and entertainment industry.

And now, that reputation will be enhanced by the introduction of a new generation of Lavalier microphones providing superior performance and a wider range of applications.

Of special importance is the new ECM-77. This unit is so small (only 5.6mm in diameter), and lightweight (only 1.5 grams), that it will fit snugly into the pocket using a standard size pen clip. Despite its size it has a frequency response from 40Hz to 20KHz.

Further, the wide range of accessories ensures that these microphones are the most versatile, compact and easy to use units available.

The Range

ECM-77	Available in silver and black. Ultra compact and lightweight. Omni-directional.
ECM-66	Available in silver and black. Uni-directional.
ECM-55	Available in silver and black. Omni-directional.
ECM-44	Available in silver and black. Omni-directional.

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Sony Broadcast Ltd.
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Hampshire RG21 2LA
United Kingdom
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International +44 256 55 0 11
Telex 85 84 24
Fax G2/G3 (0256) 474585

Sony Pro-Audio

For more information, send the coupon to:

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W PRODUCTS

W PRODUCTS

Equipment, modifications, options, software

Valley People model 440 processor

The model *440* is a single-channel device offering the convenience of a peak limiter, a high quality compressor/expander package and a Dynamic Sibilance Processor section, each controlling a common VCA. Sophisticated coupling allows the *440* to simultaneously limit, compress, expand and eliminate high frequency components in sibilance.

Threshold, attack time, ratio and release time are all continuously variable, though the latter three parameters are optimised in the Auto mode for one-control operation. The compressor also features an interactive expander control to reduce residual noise that might otherwise be 'pumped up' or accentuated by the compression process. The limiter section features fast attack characteristics (1 μs/dB or less typically), variable threshold and release and a fixed 60:1 ratio.

The Dynamic Sibilance Processor detects and cancels only the coherent and objectionable portions of the sibilant sound. By cancelling rather than equalising these components in the signal chain the de-esser doesn't colour or affect the tonal balance of the accompanying mixed programme material.

Using special control intercoupling the model *440* processor acts essentially as a compressor following a fast peak limiter. For critical applications the limiter section can be linked to a 'safety clipper' in order to eliminate any extremely fast transients which might escape the limiter.

Barrier strip connectors with electronically balanced inputs and outputs are provided as standard.

Valley People Inc, PO Box 40306, 2817 Erica Place, Nashville, TN 37204, USA. Tel: (615) 383-4737.

UK: Scenic Sounds Equipment Ltd, Unit 2, Comtech, William Road, London NW1 3EN. Tel: 01-387 1262.

JBL power amplifiers

Two new power amplifiers from JBL are the *6230* and the *6260*. Built by UREI Electronics and designed to complement the existing range of JBL sound reinforcement loudspeakers and electronics, both amplifiers employ discrete circuitry to provide a fast slew rate allowing the amplifiers to produce their full output at the extremes of the audible range.

The JBL *6230* and the *6260* are rated at 150 W/channel and 300 W/channel respectively.

High reliability and full system protection is claimed with the adoption of several fail-safe measures. These include temperature sensing, current limiting under adverse loads and relay protection during power up/power down phases and fault conditions.

The new amplifiers have also been designed to withstand the rigours of touring. Built on a 14 gauge steel chassis the internal components are adequately spaced for ease of service and the internal wiring has been kept simple in order to minimise service problems in the field. Optional accessories include an attenuator security cover and 70 and 100 V transformer panels.

● An even higher powered version of the aforementioned, the 600 W/channel *6290*, has just been released in the US. This is a dual mono amplifier with separate power supplies and cooling fan. Its other specifications are identical to the *6230* and *6260*.

JBL Inc, PO Box 2200, 8500 Balboa Boulevard, Northridge, CA 91329, USA. Tel: (818) 893-8411.

UK: Harman (Audio) UK Ltd, Mill Street, Slough, Berks SL2 5DD. Tel: 0753 76911.

MIDI switching from JL Cooper Electronics

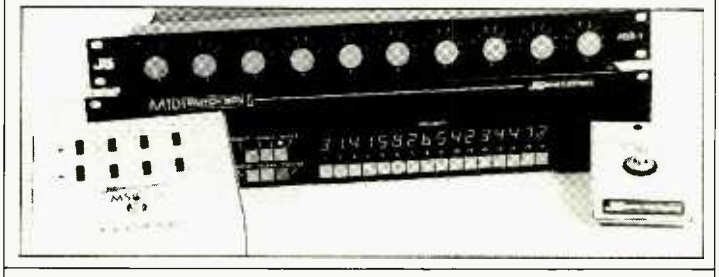
Designed to alleviate the problem of constantly plugging and un-plugging cables when using MIDI equipment, JL Cooper Electronics has developed four new MIDI switch boxes.

The *MSB-1* is a 19 in rack-mountable unit allowing up to eight sources to be routed to 10 separate destinations. Also rack-mountable is the *MSB-2* which can accommodate up to eight inputs with 16 destinations. Routing is controlled by an internal microprocessor. Status is displayed on the front panel and an internal battery powered memory can store up to 16 different 'patch' configurations.

Two smaller, foot-controlled units, the *MSB-3* and *MSB-4* are also available. The former allows switching of two inputs to four destinations and the latter is a simple MIDI on/off box.

Also available is a MIDI lighting controller, *MLC-1*, and a MIDI interface for the Oberheim *DSX*.

JL Cooper Electronics, 1931 Pontius Avenue, West Los Angeles, CA 90025, USA. Tel: (213) 473-8771.



In brief

Oberheim Electronics: has released a new MIDI-equipped synthesiser. Dubbed the *Matrix 12* it has 12 independently programmable voices each of which is composed of two oscillators. The 5-octave keyboard has velocity and release velocity, and is divisible into six user-programmable zones. The *Matrix 12* has 100 single and 100 multi-patch memory locations which stores, for example, details of panning, MIDI channels, volume and transposition of each voice... **Oberheim Electronics:** has just announced the *DX Stretch*, an add-on to the *DX* drum machine. Features include a MIDI Out port, Punch In/Punch Out, Cue Tempo, Record Countdown, Drum Output Enable/Disable, Programmed Click and selective loading of songs, sequences via an improved cassette interface... **Otari:** the long-anticipated *EC101* synchroniser module for the *MTR90-II* is now available in the UK. The *CB121* remote controller will be supplied with the *EC101* modules inclusive in the price... **Recortec:** has announced a new super high-speed bin-loop emulator cassette duplicating system. Duplication ratios of ×64 and ×128 are available and Recortec's *BLE* system provides duplicated pancakes or reels for loading into C0 cassettes by conventional cassette loading equipment... **Musicomp:** has announced the *SIF* Interface, a 19 in rack-mounted unit which allows control of Sony *PCM 3324* track remotes from any SSL *4000* or *6000* series desk. Musicomp, 2nd Floor, 60 Tavistock Rd, London W11 1AW... **Applied Research & Technology:** new software has been announced for all *01* and *01A* digital reverbs. The *2.4* software update claims to have improved all rooms in both smoothness and character. There is now a total of 49 user pre-sets which can be used either as seven pre-sets for seven different uses or seven pre-sets for seven applications. The *2.4* includes all previous software updates for the *01* and *01A* including the *2.3* version of 10 ms steps of pre-delay.□

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Lexicon Inc, 60 Turner Street, Waltham, MA 02154, USA.
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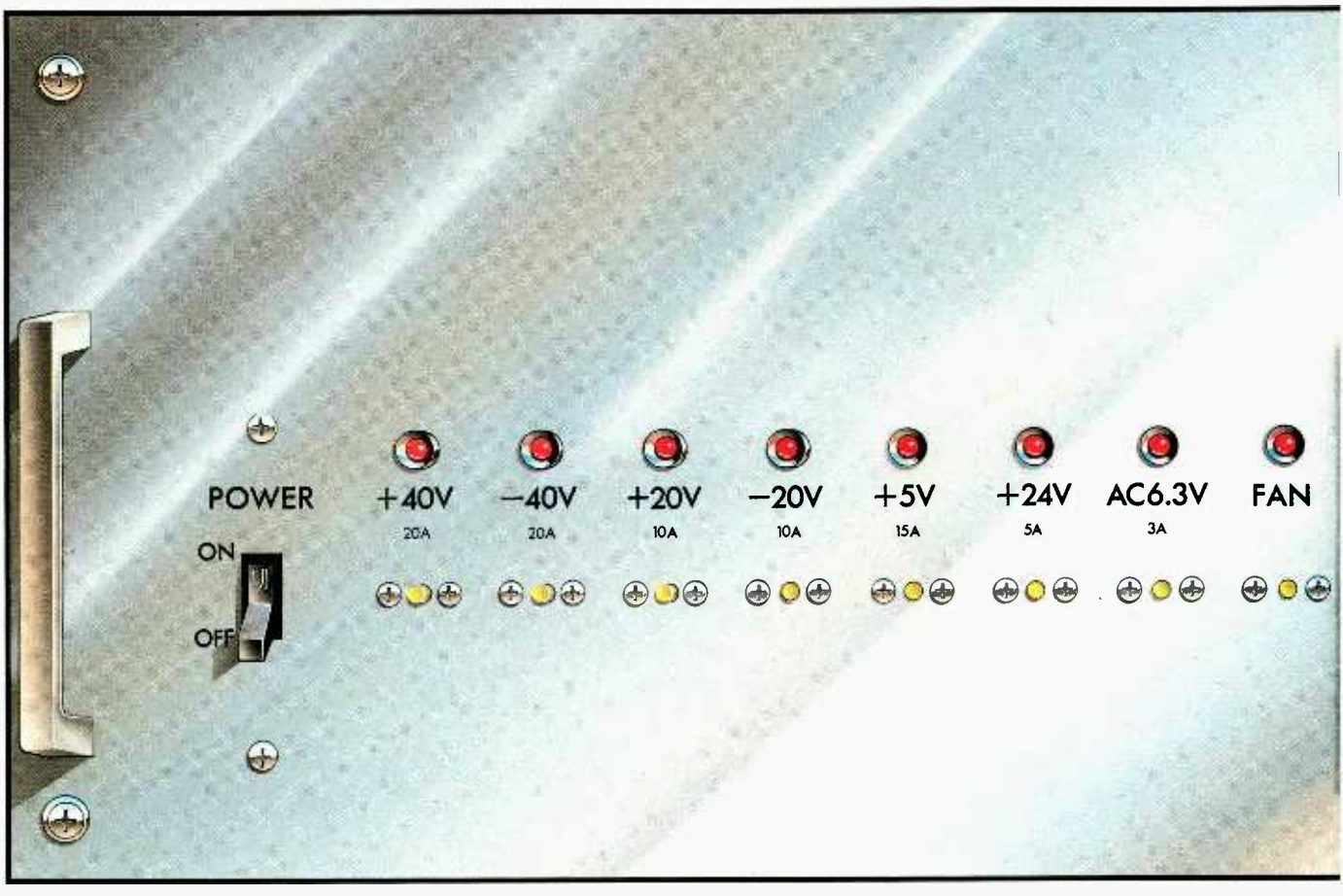

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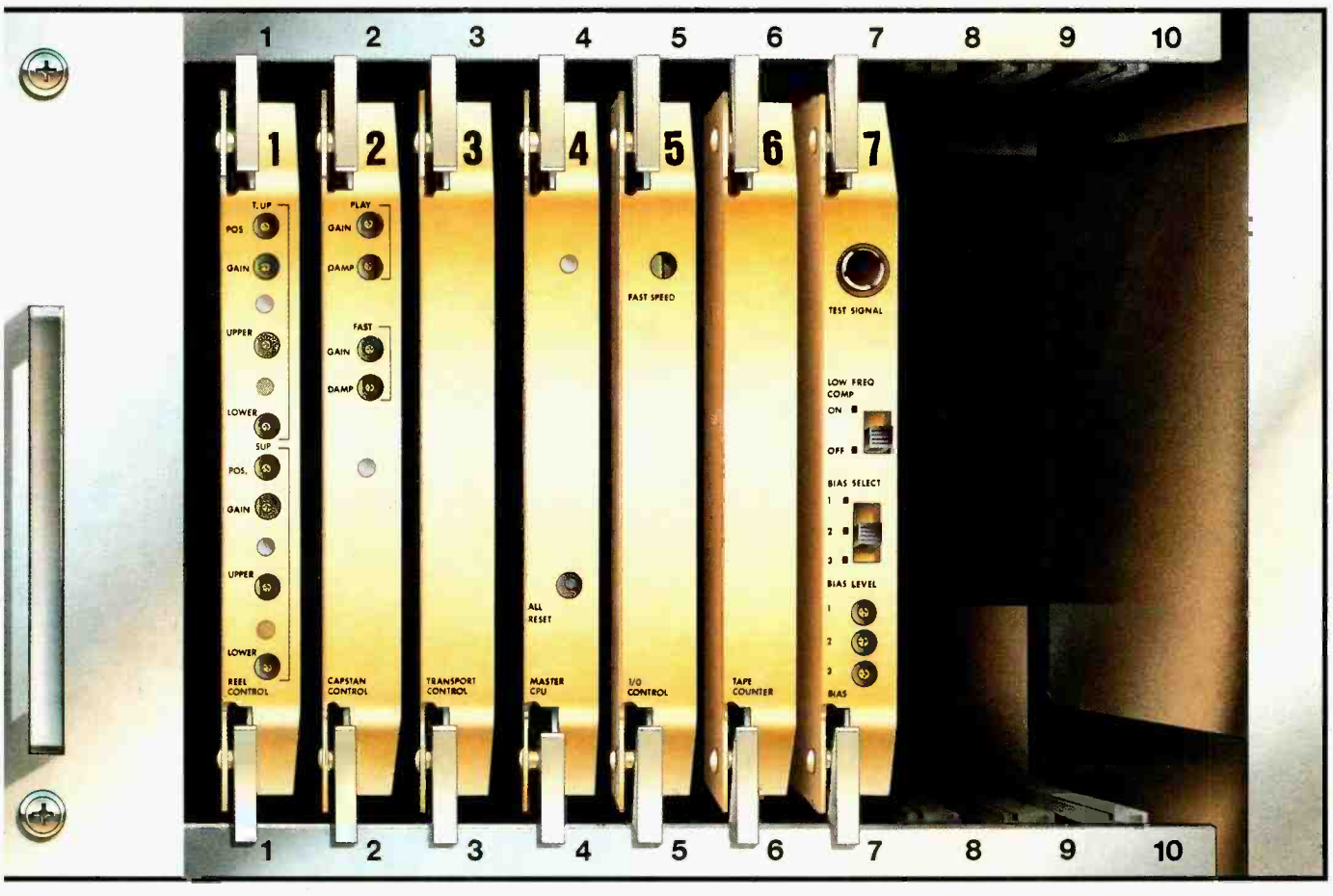

You're holding a picture of the MTR90's most remarkable feature.

A hole.

To be precise, the hole is located in circuit board slots 8, 9 and 10 on the Otari MTR90 Mk.2's transport and CPU cardframe.

That's the part of the MTR90 that does all the thinking.

On a mere seven cards is contained all the information the MTR90 Mk.2 user needs to create perfect master recordings, with microprocessor control to achieve ultra-fast, split second accuracy and total ease of operation.

But it says a great deal for Otari's vision that despite everything that seven cards can do, they've left space for ten.

What could the other three slots contain? An integral synchroniser? Something even more advanced?

The answer is that those slots will control the features that Otari users will be demanding from their MTR90s in 1986. Or 1987. Or 1990.

Those spare three cardframe slots may be empty now. But to Otari users, they're the future of multitrack.

Because the most important thing about that hole is the fact that Otari are looking into it.

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For more information on the MTR90 Mk. 2 Series or other Otari products, contact Turnkey Studio Systems, Brent View Road, London NW9 7EL. Telephone: 01-202 4366
Industrial Tape Applications, 1 Felgate Mews, Studland Street, London W6 9JT. Telephone: 01-748 9009

LETTERS

LETTERS

Readers' comments

Letters should be marked 'For Publication' and sent to The Editor, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, Great Britain.

DSP and data storage

Dear Sir, I have just read Barry Fox's article titled 'DSP *Facts' in the May issue Mr Fox is showing his ignorance by suggesting that Neve should have used a Winchester hard disk for data storage on the* DSP *console.*

Floppy disks are a replaceable medium and were surely employed for this reason. Hard disks, although faster in data and access transfer, are more suitable for storing larger amounts of data than the DSP *needs to store. They are also non-removeable and have to be backed up (usually to floppy disks or tape streamer). After an initial load, all data transfer will take place from that half megabyte of on-board RAM anyway, which will again be an order of magnitude faster than a fixed disk.*

Yours faithfully, Robin Freeman, Piusplein 40, 5038WN Tilburg, Holland.

The editor replies

I think that Barry's original piece should be taken in the spirit that it was written, ie not too seriously.

Factor life

Dear Sir, I enjoyed reading about my talk with Terry Nelson in your December 1984 issue. It is always fun to discover how distillations of raw data vary among interpreters. Unfortunately, a few errors and misimplications crept in. I should like to correct them, as they affect other people.

First, the Steve Katz who co-founded Eventide was not the Steve Katz of Blood Sweat and Tears, but rather an entirely different Steve Katz, of Dolby, Star Wars, and other cinematic adventures. The audio industry, and indeed the world, has an abundance of Steves Katz, and we should endeavour to keep them separate.

Second, the article states, correctly, that Eventide is 'responsible for many innovations in the recording industry as far as special effects are concerned. . .', and implies that I am personally responsible for those innovations. Eventide is a company, and as such is composed of many individuals, of which I am only one. By far the most work on our Harmonizer *line of special effects devices, and on our* SP2016 *digital signal processor was done by Anthony Agnello, our vice-president of engineering. Many other engineers have over the years also contributed to our unique product line, and I don't deserve the entire credit in fact, nor do I desire it by implication.*

I do, however, appreciate the observation 'eyes flash with demoniacal glee'. I've been working on it for years, and I'm glad somebody noticed.

Yours faithfully, Richard Factor, President, Eventide Inc, One Alsan Way, Little Ferry, NJ 07643, USA.

Tape speeds

Dear Sir, With reference to David A Pickett's interest in the tape speed of the BTR1 *(Letters, March) gossip has it that a secondary task of General Montgomery was to get to the Hamburg broadcasting station to seize one of the infernal recording machines. This enabled instant permanent recording and copies thereof and resulted in broadcasting of speeches and other propaganda under seemingly impossible circumstances.*

This machine was the Magnetophon, the father of the BTR. *One was rushed to Hayes and copied precisely. Its speed was around 77 cm/s and a full reel ran for 30 min.*

It is significant that since then, speeds and quality have fallen.

Yours faithfully, Wm A Jamieson, 51 Morrell Street, Maltby, Rotherham, South Yorkshire S66 7LH, UK.

DIY suggestion

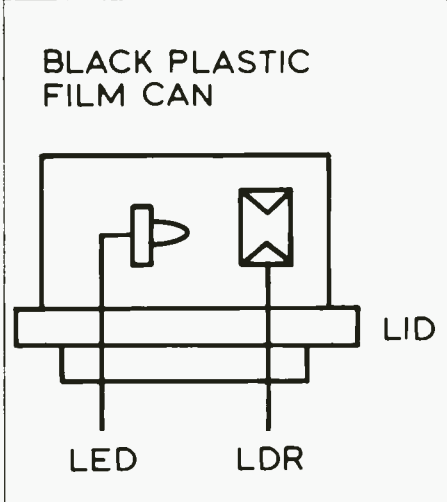
Dear Sir, I am running a 4-track studio and have been reading Studio Sound *for some time. Maybe my following little idea could be interesting to some of your readers who also make their own electronics.*

For several purposes it is necessary to build an optocoupler with a light-emitting diode or lamp and light dependent resistor (LED or LDR). The problem with this combination has always been adequate housing, which has to be absolutely light tight, and with mechanical and electrical insulation. I have found a solution at low or zero cost, which is easily done within a short time.

Black plastic film cans, which come with 24×36 mm photo-film can easily be modified. The lid is the base of the optocoupler: simply make four holes with a needle for the legs of LED and LDR the right distance apart, put them through and fix with one glue drop on the back. The rest of the can is the cover of this combination, it can be shortened with scissors if required and closed back on to the lid.

The complete optocoupler looks like a tiny cylinder-hat, and legs can be bent to each measure, as the weight is very low. It can stand on its own feet.

Yours faithfully, Klaus-Dieter Mundt, Kupferdamm 93, D2000 Hamburg 72, West Germany.



LETTERS

LETTERS

Sutton Sound corrections

Dear Sir, It was very good of Janet Angus to do such a good piece on us (May Studio Sound, *pages 62-63), but I would like to correct one or two points.*

Firstly, although in the body of the text she refers to our offices in Westbourne Grove, our old address is given at the foot of the article.

The 9ft Concert 'D' grand piano—Dame Myra Hess's favourite instrument which she kept at home—was indeed purchased from her estate by the City Music Society, and the rehearsal Bechstein is 6ft 6in.

Finally I don't think I suggested that the Neumann KM83 *microphone was a particularly new model.*

Yours faithfully, Mark Sutton, Managing Director, Sutton Sound Ltd, 111a Westbourne Grove, London W2 4UW, UK.

Disc cutting remembered

Dear Sir, Just a simple note to express my appreciation for an outstanding article on Hazel Yarwood at Abbey Road (May issue). I believe her philosophy about disc cutting may be shared by many, certainly including myself.

It has been seven years since I last lowered a cutting stylus to a lacquer surface but clearly Hazel's words about the disc cutter's personal involvement with each project and her reverence for the equipment struck a chord with me.

Yours faithfully, William C Wysock, President, Professional Sound Systems, 2527 Treelane Avenue, Monrovia, CA 91016, USA.

Rejecting conformity

Dear Sir, Having committed myself to conceiving and constructing a studio in the summer of 1983 it was an opportunity to provide a facility that was to look and sound new. This was very much a strong reaction against the 'hotel lobby look', the conformity that we have become used to seeing and using.

Despite the well-documented problems inherent in Eastlake's 'have tape will travel' approach to studio design uniformity, studio owners still attempt to copy this approach, whether big or small. They perhaps forget that even slight variations in monitor set-ups and other equipment will invariably alter the sound of the room.

Nothing, of course, will counter the nebulous factor of the human ear or human preference. Typically a client will comment, 'Your JBL 4350s sound different to those at studio X.' Similar comments about Eastlake/TAD systems have also been heard.

Thankfully, the reaction has been anything but neutral to the new studio's wedge-shaped control room and triangular studio area. Artists, producers and engineers alike react favourably to its functional 'hi tech' styling. It is free of (quote your editorial) 'so many combinations of thick pile carpet, timber and curtains'. Free, too, of any stone or pine walls or beige-coloured hessian.

We were not entirely free of opposition, however: during construction many asked where these very ingredients were to appear. When faced with the reply 'nowhere', they complained that it would never sound right, whatever that 'right' was to be.

The results of the finished studio have turned out as intended and excellent. I am satisfied that the rejection of conventional materials has still produced pleasing results.

Yours faithfully, A E McGrail, Terminal 24 Recording Ltd, Unit 4, 9A Amelia Street, London SE17 3PY, UK. □

AUTOMATED AUDIO TESTING

Bob Metzler argues the case for automated testing and describes instruments available including his own Audio Precision System One

Automated testing has been common in some segments of the electronics industry for 15 years, but has had little impact on most audio people until recently. The difficulties of providing automation at adequate performance levels for critical audio applications are finally being overcome, and costs are becoming reasonable enough for many audio workers to consider test automation for the first time.

Since 'automatic' may be a rather loose term nowadays, let's define what it will mean here. Automatic audio testing can perform a complete test, or set of tests, according to predefined instructions, and store or present the test results in a desired format. It does this without operator assistance except for that required to set up the device under test and make connections between it and the test equipment.

Why automate?

For speed: audio test equipment can acquire data five to 50 times faster than manual test gear, thus shortening test times or providing more complete data in the same time.

Expedition of data analysis, or even performance of analysis automatically: automatic equipment can present test data in graphical form for quick analysis, or compare to limits and make go/no-go decisions.

Better documentation: printed or magnetically-stored test documentation is accomplished quickly and cheaply.

To eliminate drudgery: automation frees the engineer for more creative work.

Tests can be performed by people with lower skill levels (trained people are becoming both more expensive and harder to find).

To provide control: humans have bad days, skip things, exercise judgement variably, and sometimes say they did things even when they didn't. Automatic test systems don't.

Why hasn't everyone?

Entry costs into automated audio testing are higher than manual. Automated test instruments cost more than manually operated instruments with similar performance capabilities. The controller (computer) adds still more cost (though it does seem that many people already have them these days). The result is that the total cost of automated audio test equipment plus computer can range from 1.5 to 2 times the cost of manual equipment for a personal computer-based system, to 3 to 6 times the cost of manual equipment for IEEE-488-based systems. One normally expects to recover this initial cost by time saved in testing, and perhaps via lower salary levels necessary in production test applications.

Software cost is the highest of all if traditional programming approaches are required. This may be somewhat hidden and is often omitted from a hasty cost projection if you plan to do it yourself instead of hiring someone to do it, but the costs are real nonetheless. Man-weeks to man-months of programming effort are typically required depending on the type of device to be tested.

Automation has typically involved performance tradeoffs. Many automated audio test systems lack the residual distortion levels and low noise performances of their manual

TABLE 1 Generator comparison

	Amber 5500	Audio Precis Sys 1	Hewlt Packrd 8903A	Sound Tech 3100A	Tech Proj MJS401	Tektrnx SG5010	Wandel Gltrmn NFA-1
Min frequency (Hz)	10	10	20	1	10	10	15
Max frequency (kHz)	100	200	100	102	150	163.8	60
Max output into 600 (dBm)	30	30	12	30.6	30	28	26
Max output into 150 (dBm)	30	30	NS	30	30	28	26
Max open-circuit volts	24.5	26.6	6	28.6	24.5	21.2	15
Min output into 600 (dBm)	−70	−70	−68	−90	−70	−72.5	−70
THD @ max output (dB)	−80	−102	−80	−100	−94	−100	−80
Flatness 20-20 kHz (dB)	0.1	0.05	0.06	0.1	0.05	0.1	0.15
Level accuracy (dB)	NS	0.1	0.2	0.2	0.1	0.2	0.25
Level resolution (dB)	0.1	0.05	0.3	0.05	0.1	0.05	0.1
Freq accuracy (%)	NS	0.05	0.3	0.03	NS	0.01	0.003
Freq resolution	0.1%	0.005%	0.3%	0.01%	1.0%	4.5 dig	0.5 Hz
SMPTE IMD	YES	TBI	NA	YES	TBI	YES	NA
Twin-tone IMD	YES	TBI	NA	NO	TBI	YES	NA
Burst	NA	NA	YES	YES	NA	YES	NA
Squarewave	NA	NA	NA	YES	YES	YES	NA
600 Ω source	YES	YES	YES	YES	YES	YES	YES
150 Ω source	YES	YES	NA	YES	YES	YES	YES
⩽50 Ω source	YES	YES	NA	YES	YES	YES	YES
Number of output channels	2	2	1	2	2	1	2

TABLE 2 Analyser comparison

	Amber 5500	Audio Precis Sys 1	Hewlt Packrd 8903A	Sound Tech 3200A	Tech Proj MJS401	Tektrnx AA5001	Wandel Gltrmn NFA-1
Freq meas error (%)	0.005	0.005	0.004	0.01	0.002	NA	0.001
Freq meas resolution (digits)	4.5 dig	5 dig	5 dig	5 dig	4 dig	NA	5 dig
Ampl meas error (dB)	0.2	0.1	0.2	0.1	0.2	0.2	0.25
Ampl meas resolution	0.01 dB	0.01 dB	3.5 dig	4 dig	analogue	3.5 dig	NS
Flatness 20 Hz-20 kHz (dB)	NS	0.05	NS	0.1	0.2	0.1	0.15
Resid noise 80 kHz BW (dBu)	−100	−108	−88	−101	−112**	−108	−115**
Full system BW (kHz)	500	500	500	NS	500	300	270
Crest factor	3	7	3	20	12*	3	3
Number of detectors	3	4	2	4	4	2	3
Number of lowpass filters	2	3	2	4	2	2	1
Number of highpass filters	1	3	1	3	2	2	1
Common mode reject ratio (dB)	NS	70	60	60	70	50	60
Phase meas error (deg)	NA	2	NA	1	NA	NA	1
Phase meas resolution (deg)	NA	0.1	NA	1	NA	NA	1
THD meas error (dB)	1	0.5	1	1	NS	1	NS
THD meas residual (dB)	−80	−95***	−80	−100	−94	−90***	−80
SMPTE IMD residual (dB)	NS	TBI	NA	−100	TBI	−90	NA
Twin tone IMD resid (dB)	NS	TBI	NA	NA	TBI	−95	NA
Wow & flutter	NA	TBI	NA	NA	NA	NA	YES
Number of input channels	2	2	1	2	2	1	2
Bandpass mode	YES	YES	NA	YES	YES	NA	YES

TBI: to be introduced in 1985
NA: not available
NS: not specified
THD measurement residual specification for fundamentals from 20 Hz to 20 kHz in 80 kHz bandwidth
**MJS401D* crest factor specified at 12 dB below full scale
** Bandwidth for noise specification 22 kHz
*** Total system residual, generator & analyser

counterparts, due to the inclusion of noisy logic and microprocessors in a box where sub-microvolt noise levels can set performance floors. It is also a difficult design task to provide computer-variable analogue control elements with adequately low distortion.

What's available?

This article will principally discuss general purpose, flexible automated audio test equipment for professional applications. These instruments are able to do audio stimulus and measurements over a wide range of user-selectable frequencies and levels. They have most or all of the features necessary for professional audio applications, including balanced output generators, balanced input analysers, and residual distortion and noise levels no higher than 0.01% (−80 dB). Those currently offered or to be available by 1985 year-end are:

- Hewlett-Packard *8903A*, introduced in (approximately) 1980.
- Tektronix *SG 5010-AA 5001*, introduced in 1983.
- Wandel & Goltermann *NFA-1*, introduced in 1983.
- Amber *5500*, introduced in 1983-84.
- Technical Projects *MJS401D*, IEEE-488 option and oscillator introduced in 1984-85.
- Audio Precision *System One*, introduced in 1985.
- Sound Technology *2000* and *3000* series, introduced in 1985.

There are also more specialised audio test instruments, tailored to specific applications and not offering fully flexible control of stimulus frequency or of measurement modes at all frequencies. Examples include the Sound Technology *1510A*, principally oriented toward tape machine testing, and units from Ortofon, RE and others. These instruments will not be covered here in depth due to their narrower range of application.

Automated audio test instruments developed principally for telecommunications circuit testing tend to have inadequate residual distortion performance for critical professional applications, particularly in light of the performance levels of 16-bit digital audio equipment. Still others lack balanced capability and are thus unsuitable for most recording or broadcast-related applications. These instruments will only be further discussed where they represent a noteworthy example of a particular instrument architecture.

Similarities

In all the instruments listed, though all are microprocessor-based, signal generation and analysis are accomplished by analogue circuitry controlled by digital interfaces from a computer. They make measurements in a conventional fashion—RC oscillator, AC voltmeter, and notch filter for total harmonic distortion. Architectures are analogue (though differing greatly in detail from manufacturer to manufacturer) because A/D and D/A technology is not yet adequate for the combination of −80 to −100 dB performance with bandwidths beyond 100 kHz of most of these instruments.

Their modes and parameters can be set up, and their data taken, by a computer. All can offer, via a connected computer, some kind of paper hard copy and magnetic media data storage. They all offer balanced input and output capability, although the many design approaches lead to significant performance trade-offs in areas of maximum output level, floating capability, degree of balance versus frequency, and common mode noise coupling. All make level and total harmonic distortion measurements; all but the Hewlett-Packard also offer intermodulation distortion testing or plan to by the end of 1985. All but the H-P have selectable source impedances with 150 Ω and a near-voltage-source in addition to the older standard of 600 Ω.

Differences

Measurement capability: Just as in a comparison of manual instruments, measurement capability and performance varies from supplier to supplier. In the units listed, guaranteed maximum noise levels (80 kHz bandwidth) vary from a high of 30 μV to a low of 3 μV. Residual distortion floors range from 0.01% to 0.001%, maximum generator output levels from +12 dBm to +30 dBm, detector types from 2 to 4, and selectable filter types from 2 to 6.

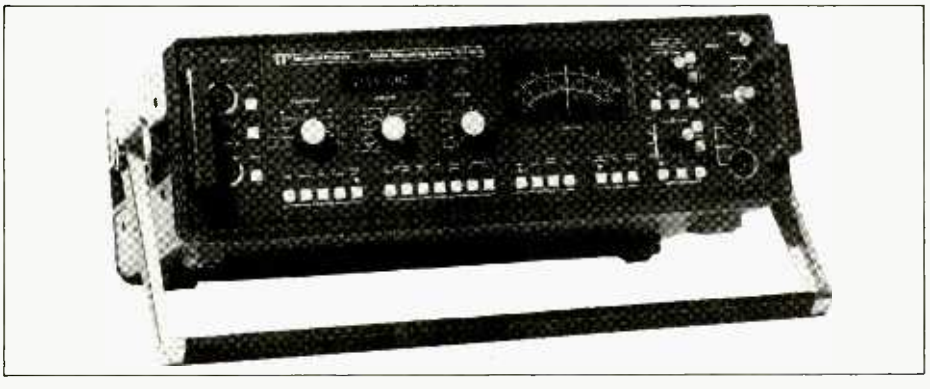
Tables 1 and 2 compare the electrical performance specifications and features which are most important to most users. All those instruments listed previously are covered; the specifications for the new Sound Technology instruments are preliminary.

Computer instrument connection: The computer-to-instrument connection for all but one of the units listed is IEEE-488. RS-232 is optionally available in several cases. Audio Precision's *System One* uses an 8-bit parallel bus from a personal computer. Combinations are also available; many computers have both IEEE-488 and RS-232. A personal-computer-based instrument may also have a 488 card plugged into the PC and thus operate IEEE-488 instruments via that bus.

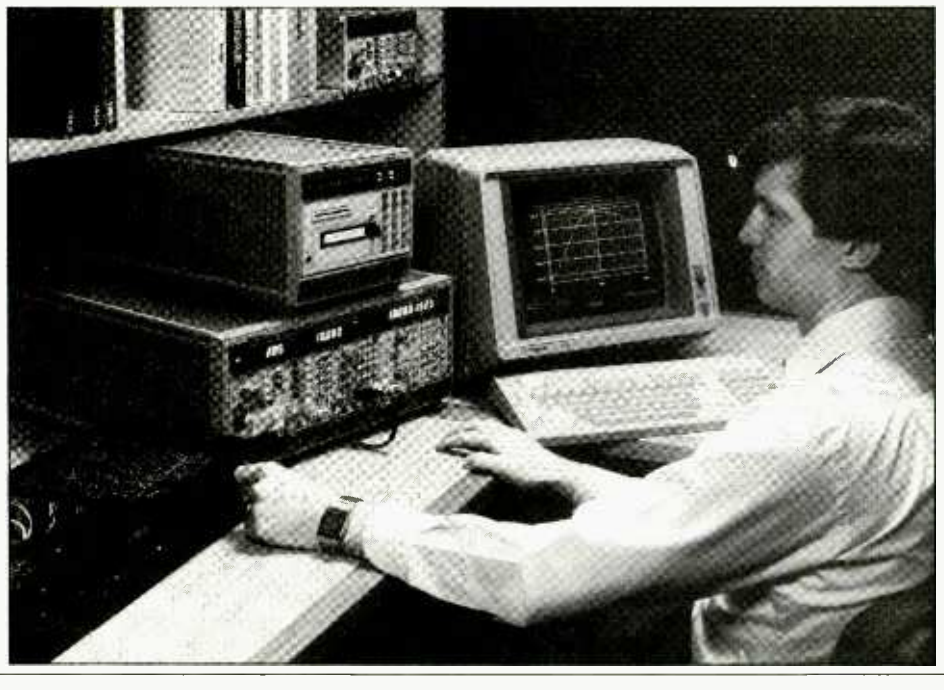
The biggest advantage of IEEE-488 is that is a standard hardware bus with a wide range of compatible instruments available—power supplies, RF and microwave equipment, pulse and function generators, transient digitisers, precision DC voltmeters, and so forth. Test systems can be configured from several suppliers' instruments and for almost any conceivable measurement requirement.

A major disadvantage of IEEE-488 is that there is no dominant IEEE-488 computer, operating system, language, or set of protocols. Because of this non-standardisation and the high expenses of ▷

Technical Projects audio measuring system MJS 401D



MP 2902 audio measuring package from Tektronix which includes the SG 5010 programmable oscillator



AUTOMATED AUDIO TESTING

software development, no IEEE-488 equipment supplier offers a significant software library or other assistance usable across the popular IEEE-488 controller types. There is also no standardisation of the software command codes required to set up automated audio instruments, or in the formats of the data sent by the instruments to the computer. No vendor suggests that his instrument will work without software modification in a system designed for another instrument. The purchaser of IEEE-488 instruments and an independently-selected computer/controller is thus necessarily pushed into generating his own software by conventional programming techniques.

Computer and software standardisation: Lack of computer and software standardisation is not limited to IEEE-488-compatible equipment. There is relatively little standardisation between different computer models of any class or even between versions of a language such as BASIC. The closest thing to a standard to emerge in the computer industry is the IBM Personal Computer and its clones. Even though no IEC, DIN, or IEEE document makes it official, the fact that over 2,500,000 units of IBM PCs and compatibles are sold in a year creates a de facto standard. General-purpose software (word processors, spread sheets, data base management) for the IBM PC is readily available, powerful, and inexpensive. Compatible peripheral devices such as dot matrix printers are also easily purchased. For these reasons, a strong movement toward IBM PC-based products has developed in the test and measurement industry during the past two years. Audio Precision's *System One* is the first exploitation of that movement in the audio field.

What about the IBM PC as an IEEE-488 controller? Is it possible to have the best of both worlds by combining the official instrument industry standard bus with the de facto computer standard? Third-party IEEE-488 interface cards which plug into the PC are available; the National Instruments card is widely used and is now sold by IBM. Unfortunately, the IBM PC is not as effective in 488 control as the dedicated units made by Hewlett-Packard, Tektronix, Fluke, and others. The PC has no IEEE-488 commands in its operating system or in Microsoft BASIC, requiring more effort and more code from the programmer. There is no provision for the computer to respond to requests for service (interrupts) from the 488 instruments. The 64 kbyte addressable memory constraint of Microsoft BASIC is quite restrictive for most real life applications. If IEEE-488 instrument control is the central objective, the higher cost of dedicated 488 controllers is probably justified by reduction of programming effort.

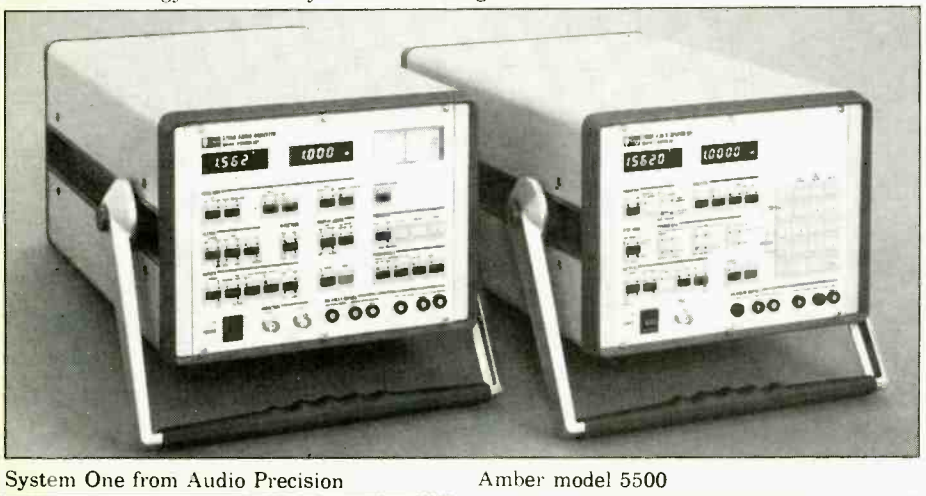
Approach to programming: Perhaps the most significant difference among the various types of automatic audio test equipment lies in the manufacturer's approach to helping the user create the instructions which will run the system in its automatic operation.

The conventional programming approach is where the instrument manufacturer furnishes documentation of the instrument command set and data formats, usually with short program examples in some dialect of BASIC, and the user writes the code for his application. The programming environment is different from the usage environment, often with the instruments not even being connected. The programming task focuses on IEEE-488 bus protocols, data types, instrument commands, array definitions and manipulations, string manipulations, program flow commands such as GOSUB, FOR-NEXT, and IF-THEN, moves and draws if graphic output is desired, or other forms of output formatting when tabular results are needed. If efficiency is required, a compiled language will normally be used which then requires re-compilation after each de-bugging step. However, many IEEE-488 controllers and interface cards do not support compiled languages. The skills required are essentially independent from audio engineering skills. On the positive side, the conventional approach is almost infinitely flexible in the hands of a competent programmer. All the units listed support the conventional programming approach and some of them offer additional alternatives.

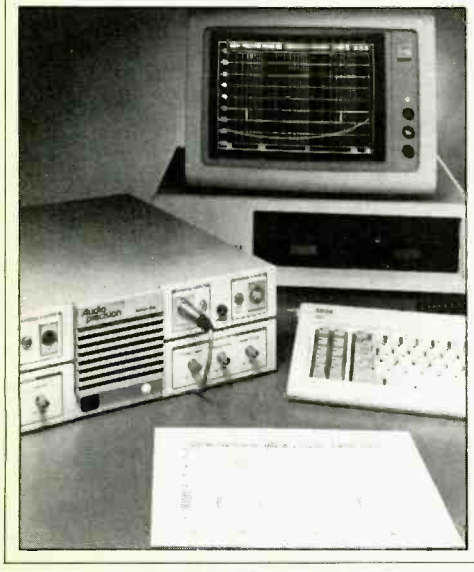
Test procedure generators are programs which write programs. They typically start with a menu and ask the user to answer a series of questions and make choices. They are totally sequence-oriented and deal with step numbers. They commonly operate via a create mode to generate a procedure, an edit mode when it is necessary to go back and change a previously-generated step, and an execute mode to run a test. They can be thought of as a reversal of the conventional programming approach; the machine programs the test engineer until it gets an acceptable response. Procedure generators can be quite effective at generating code for standard applications, even when the user is not a trained programmer. They are much less flexible than conventional programming. Test procedure generators are offered by Tektronix, and Wandel & Goltermann's menu selection approach has some attributes of a procedure generator combined with stored setups.

The stored set-ups and keystroke-selected generator sweeps method is typically limited to control of the oscillator in frequency or amplitude sweeps (actually a series of steps) with a constant time per step, and to restoration of previously-stored analyser panel set-ups. Step time is normally set for the expected worst-case settling time of the analyser and device under test, since the analyser and generator are not coupled. When the oscillator sweeps, the ▷

Sound Technology 3200A analyser and 3100A generator

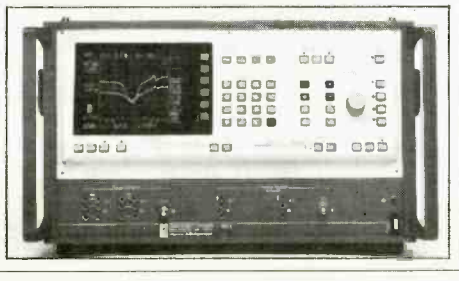


System One from Audio Precision



Amber model 5500

Wandel & Goltermann's NFA-1



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AUTOMATED AUDIO TESTING

companion analyser typically can either drive an analogue plotter (with pre-printed grid paper and the usual alignment and sensitivity calibration considerations) or a data-logging printer, so flexibility at the analyser-data output end is limited and the results may not be graphic.

Keystroke approaches do not normally support decisions and branching based on measurements, nor do they usually allow feedback of information from the analyser to the oscillator in order to adjust any of its parameters. The H-P *8903A*, Tektronix *SG 5010-AA 5001* and Sound Technology *2000/3000* series offer this technique as one of their programming methods, and Amber now offers a new external sweep control unit for the *5500* which works in conjunction with the stored set-ups in the main instrument. Stored set-ups are also an implicit part of this soft panel approach:

The soft panel-oriented approach with sweep technique represents the instrument panel on the screen of a computer, and closely couples the functions of the generator, analyser, and computer. It's first implementation is in Audio Precision's *System One* where it basically adds a new panel (sweep and display control) to the traditional generator and analyser panels which most of us have used all our careers. The generator panel and analyser panel set up all stimulus and measurement parameters, and units of measure. The sweep panel permits selection of amplitude or frequency to be swept (or of measurements versus time), log or linear sweep and number of steps, selection of which one or two measurement parameters are to be displayed (distortion, phase, or amplitude with flat, bandpassed, or notched processing) and selection of graphic display co-ordinates.

There is no required sequence and no edit, create, or execute mode; a sweep can be run at any time, interrupted, changed in any way and re-started, saved to disk whenever it appears that it might be used again, brought back from disk and run or further modified and stored under the same or another name. When sweeps are run, real-time graphs of the results replace the set-up panels on the computer display screen. A settling function determines when the analyser and device under test are sufficiently settled to measure, then permits the generator to step to the next frequency or level. The set-up procedure is unstructured and natural. Any number of these tests can then be strung together to create a complete procedure. Acceptance limits can be added for go/no-go tests.

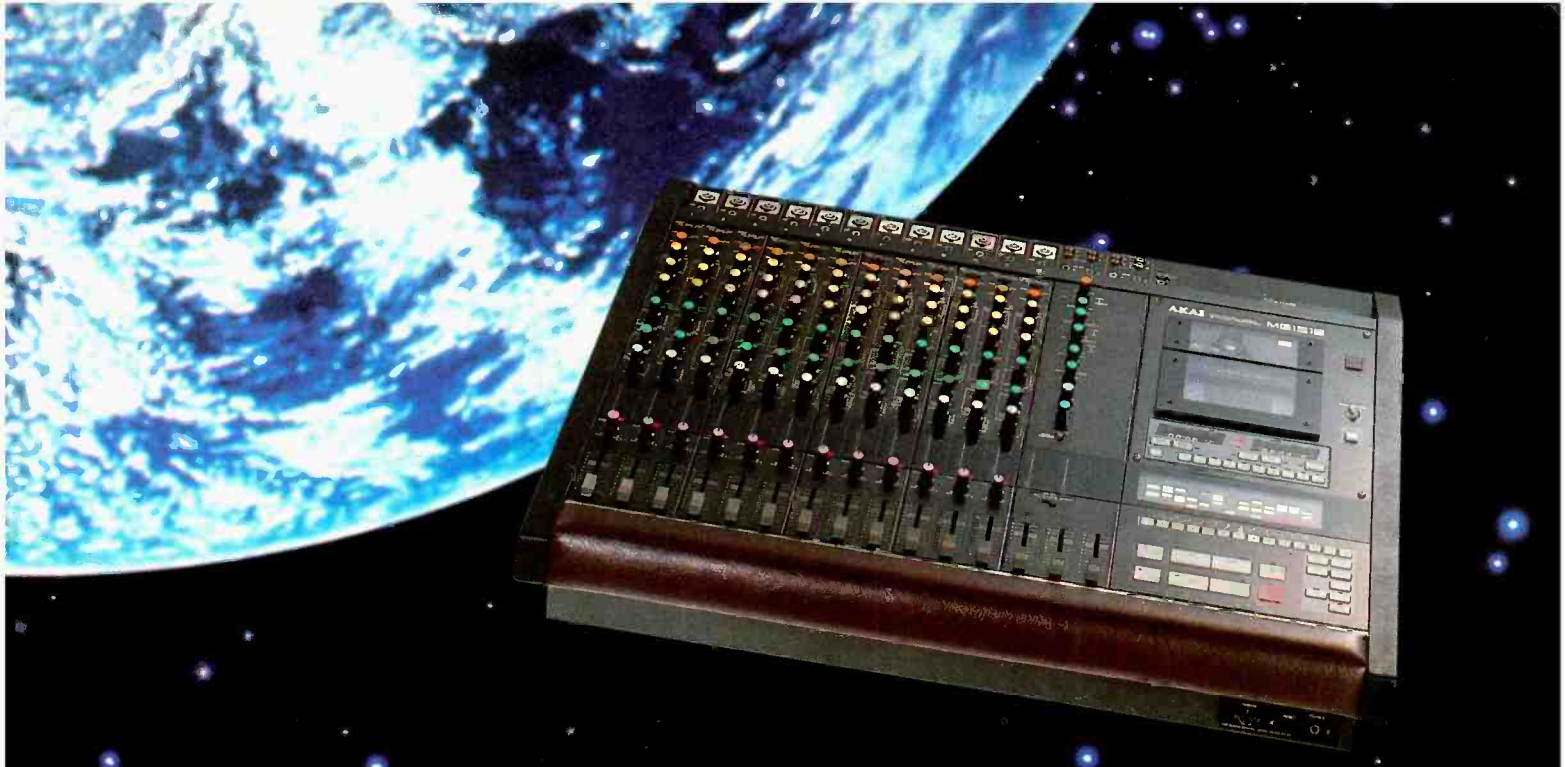
Location of computing power and user interface: All the instruments described contain at least one microprocessor and all can work with external computers. Some are designed principally to work stand-alone from their built-in computer and keyboard (Wandel & Goltermann *NFA-1* from the general-purpose list, and the more specialised Sound Technology *1510A* and Schmidt Telecommunications *SZ 340*). Others have limited semi-automation, typically in the form of generator sweeps, when used as stand-alones. The H-P, Tektronix, Sound Technology *2000/3000*, and Amber units qualify in this category; they must be run from computers for full automation. Only one, the Audio Precision unit, must have an external computer connected.

Data validity: During manual audio testing, the instrument user takes the responsibility of assuring that data is valid with respect to measurement dynamics. The user waits until the analogue meter needle settles before he notes down the reading. If it never settles, he averages out the meter excursions. Computers have to be taught to take similar precautions. Automated analysers are capable of rapidly streaming out useless numbers while the preceding portions of the analyser are still unsettled. The analysers from H-P, Tektronix and Audio Precision offer internal software which delays the delivery of a reading until it is settled. The Tektronix and Audio Precision units offer user control of the parameters of this delay until settled algorithm to suit various test conditions. Several other manufacturers plan to offer this capability in later software releases.

When evaluating automated audio tester speed claims, be sure the speed numbers quoted will provide data which matches steady-state readings made on the same device under test. Constant-time-per-step sweepers without information flow from analyser back to generator either waste time at higher frequencies where settling is typically faster, or furnish bad data due to stepping too fast for settling at lower frequencies. Even a step time which varies with frequency cannot handle all situations, since many devices to be tested (compressors, expanders, etc) have their own settling times which may be longer than those of the test equipment.

Architecture for measurement of split or spread systems: Examples of split and spread audio systems include separated broadcast studios and transmitters, broadcasting networks, and microwave, telephone, and satellite communication links. End-to-end automated tests require some sort of communications between the ends. Most of the equipment listed can support spread system testing with a computer and automated instrument at each system node, plus inter-computer data communication via modems and data comm links (usually RS-232). For one-way end-to-end tests, such as from a broadcast studio to transmitter, Sound Technology's *2000/3000* series and the Tektronix and Audio Precision modular systems have some potential economic advantage since their generators and analysers can be physically separated.

Sound Technology also has a unique capability, inspired by Recommendation R27 of the European Broadcasting Union. The Sound Technology generator can intersperse test tones with frequency-shift-keyed control signals down the audio path being tested; these control signals can control the distant analyser's panel settings and, for ▷



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THE MG1212 RECORDER/MIXER

If you're looking for a complete recording system – combining multitrack recorder and mixer into one – then look no further. You've found it in the AKAI MG1212.

Imagine a unique ½" cassette tape – the first of its kind – offering no less than 12 audio tracks (with dbx noise reduction) plus special sync and internal control tracks, with the ease and simplicity of a home video recorder. A sophisticated on-board autolocator with pinpoint accuracy. And much more. it's already exciting.

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But now imagine both these units – ½" 12-track recorder and mixer – together in the same machine. The result is a unique, compact, integrated package that no-one else can match. Its all-in-one concept eliminates tiresome multitrack wiring looms and brings you flexibility, versatility, ease of use and sensational sounds.

It's that special combination of versatility and ease of use that gives the MG1212, and the whole AKAI Micro Studio System, the edge. If you're looking for a new creative experience, AKAI's got your sound.

For stockists see facing page.

AKAI

A new world of sound creation

AUTOMATED AUDIO TESTING

example, change it from level to distortion measurement modes or change filter selections. A data logging printer at the analyser could then record test results.

How you might use automated audio testing

Consider yourself wrapping up a recording or mixdown session at 3am with another due to start at noon. Patch the cables of an audio routing switcher which is part of your automated audio test system into the mixing desk inputs and outputs, set the faders and equalisers to a predetermined position, press the start button, and go home. Long before you come back in, the system will have completed a thorough checkout of frequency response, distortion, and noise on each channel plus crosstalk in every possible combination. The data will have been compared to acceptable limits which you programmed in, and only exceptions will have been printed out. A quick scan of the print-out tells you to stay away from channel 9 until there's time to fix it, so you can launch into the next session with a high degree of confidence that the board doesn't have any surprises lurking.

The station manager—whether you're in a commercial or non-commercial broadcasting operation—will be happy to learn that your full system on-the-air proof of performance will interrupt normal programming for only a minute or two instead of the two hours it formerly required. You'll be more confident knowing that your middle-of-the-night test data won't be jeopardised by the human errors common at those hours. The computer will never read the meter on the '1' full scale when it should have read the '3' scale, and it will never accidentally leave the 22 kHz lowpass filter in the circuit even though it is attempting to measure harmonic distortion with a 15 kHz tone. Of course, the final results will be graphed and printed almost instantly—and you can store away your French curve in the same place you put the slide rule a few years ago.

As a production test engineer or manager for a manufacturer, automation assures you that the quality assurance tests are being done *exactly* the way you specified, regardless of which operator is doing them and whether or not it's almost time for coffee break. The operator needs only assembly or clerical skills (and wage levels) instead of technician skills, while still turning out thoroughly-tested products 10 times faster than your manual procedures.

In a tape duplication facility with dozens of machines, you can run a fast automated performance measurement on every machine every week or month. Then, ask the computer to sort back through the previous tests on that same machine and determine whether the rate of deterioration with time should cause you to change your preventive maintenance or replacement schedules.

As a design engineer, a test system lets you quickly and systematically evaluate the results of a change you just made in a prototype. When you're putting your prototypes through temperature, humidity and shake-rattle-and-roll tests, your automatic tester will make those thousands of measurements and give you printed, annotated results in graphic format.

In summary, an automated audio tester can function much like a fast, accurate, reliable test assistant who follows your instructions faithfully, never takes breaks, and can be had for the amount imperfect human assistants earn in a few months.□

Soft panels, close coupling and a personal computer

The Audio Precision *System One* is probably the largest departure from traditional automated audio testing approaches (if anything can be traditional in a five year old field). It might be classified as standard personal computer-based, closely coupled, soft panel-orientated architecture.

No knobs, switches or displays

Our design philosophy was driven principally by the fact that IBM builds personal computers at the rate of 2,000,000 per year while audio test instruments are normally built by the hundreds. The resulting economies of manufacturing scale pointed us away from duplicating any functions which could be performed more economically and effectively by a personal computer. Thus the following functions were allocated to a PC:

control (keyboard and mouse);
display (CRT monitor);
computation;
data and program storage (floppy or hard disk drives); and
hard copy (via dot matrix printers or graphics plotters).

Non-duplication of personal computer resources not only provided an economical solution from a manufacturing cost standpoint, but gave much shorter time-to-market since the personal computer functions had already been designed by the computer, peripheral and software operating system manufacturers. This approach also leads to great future flexibility, where totally new functions may be added or existing functions used in new ways just by distributing a floppy disk.

System costs approach manual instruments

This makes the *System One* the least expensive approach to automated testing. The IBM Personal Computer and compatibles are extremely low-priced for the performance and the system has avoided the (typically) 20% of instrument cost which normally goes into a front panel and its support microprocessor system. The result is that instrument plus computer cost only about 1½ to 2 times the cost of manual instruments of comparable performance.

Bundled software

The extensive software bundled into the *System One* makes it extremely fast and easy to use. Selection of a single, standard computer which can be inexpensively purchased by anyone, allowed the software designers to put all their effort into one comprehensive, well-structured, optimised package instead of diluting their efforts to provide a bit of support for five or 10 different computers, languages, and operating systems. Of possible interest is the fact that the code was written principally in C, a modular language permitting division of the task and a team approach to the large project. Languages such as BASIC, Pascal and Forth would have been unsuited to a project of this magnitude. The source code consists of over 16,000 lines, which compiles to about 200 kbytes. C, as a fast, efficient compiled language, contributes greatly to system speed as compared to typical BASIC programmed systems.

When you're not testing audio . . .

The personal computer also has many non-audio-testing uses which are readily implemented due to the availability of inexpensive mass-market software for word processing, engineering circuit analysis, data base management, and spread sheets—due again to the huge market for standard computers and software.

Measurement performance

Though not intrinsically due to the personal computer, soft-panel architecture, *System One* also attained performance specifications which would be noteworthy even in a manually operated unit with no computer bus. The guaranteed residual distortion specification (generator and analyser combined) of 0.001% from 50 Hz to 5 kHz and 0.0018% from 20 Hz to 20 kHz is one example. Residual noise is guaranteed to be no greater than 1.5 μV in a 22 kHz bandwidth and 3 μV in an 80 kHz bandwidth. The generator guaranteed output specification of +30 dBm at 0.0008% distortion at 30 Hz (fully floating via Deane Jensen transformer) is another leading specification. These kinds of numbers, combined with the ability to make a 16-point swept measurement of both frequency response and harmonic distortion to specified system residual levels in less than 10 s, is performance suitable even for high-volume testing of edge-of-the-art products such as 16-bit digital audio systems.□

STUDIOFILE

STUDIOFILE

SAV Studios, London

How do you recover from a fire which totally destroys your studio? The only thing you can do is accept the fact that it has happened and get on with working like hell to build another one as quickly as possible. This is the story of SAV studios.

Owned by Tony Frossard and Marc Lacome, SAV started life as a 4-track studio in Cricklewood in 1974. At that time their main work was A/V presentation soundtracks. Having progressed to 8-track in 1978, they finally moved to their present location, 10 minutes walk from London's Kings Cross station to set up a 16-track studio based around a Soundcraft console and machine.

Today their business encompasses television and radio commercials and programmes, films and A/V presentations which they produce in their 2-studio (24 and 16-track) complex.

Last July their world temporarily collapsed when the building caught fire. At the time they housed some of their equipment under the floor and an electrical fault developed. Tony surmises that the air conditioning system must have been taking the smoke out since they had no sooner settled themselves with a pint in the corner pub when the studio was swallowed up in flames. "We were halfway through a training programme for the Royal Navy at the time and everything was lost—all the sound effects and everything. The Navy's comment was to the effect 'don't imagine we're going to lay on another NATO just for your perishing sound effects!' They were quite good about it really."

During the following six months, whilst rebuilding the studio, Tony and Marc made a valiant effort to retain their clientele, taking work into other studios and, to their relief, there is only one client who has not come back to them.

Looking at the situation positively, SAV had an opportunity, albeit perhaps ill-timed, to create a completely new facility. They now have two studios instead of one, and have totally changed their equipment. The most obvious change is that whereas there used to be a large recording area and smaller control room, they have been able to adopt the more contemporary large control room. "Ninety per cent of our work is from keyboards. We only use the studio for vocals, voiceovers, acoustic guitars and brass," explained Tony, and so there was obviously not much requirement for space.

Control Room One

Apart from the more basic characteristics of the new Studio One, they have provided underground storage for master tapes in the concrete floor, terrified of history repeating itself and destroying all their tapes.

Acoustic Design was the company which had built the original studio and having learnt from that experience, the new studios were built along similar principles. Studio One's control room is approximately 18×16 ft with a ceiling height of around 8 ft. Starting from the ground upwards, the floor is floated on 3 ft 6 in brick sections, 4 ft³ for density, on top of which they laid timber joists/1 in chipboard/joists/chipboard and finally carpet.

They took rather an unusual approach to their design: "We wanted to have an interesting shape because people spend a long time in the room and therefore it must be interesting and comfortable. A lot of our clients could quite easily get what they need in our 16-track studio upstairs, but they prefer to pay the extra money to work in here because it is a nicer room. So here we have all these hard surfaces and we just sorted out the acoustics afterwards."

There are certainly several not necessarily acoustically essential angles in the walls which are mostly Ash veneer. At the back of the room there is an acoustic trap which extends a short distance along the ceiling and also into the rear of the side walls. "This way we absorb all the reflections and yet have a room which is a bit different."

The control room is to the left of the console and the window is also angled. The walls are 4 ft deep and filled with Rockwool with a stud frame and chipboard.

"We're having a slight design problem with the doors: they are filled with just over a ton of sand and we had the hinges specially made. They were guaranteed to bear the weight of 5 ton, but they don't! But we're working it out..."

Equipment wise, SAV put a lot of work into researching the most appropriate for their facilities with a definite view of where the A/V industry is headed. "OK, so what we wanted was an SSL but we couldn't afford it," Tony grins, "so we went to see several console manufacturers. Todd Wells at Soundtracs showed us round their factory, which is not, I think, something they normally like to do, and we were very impressed with what we saw. Although it is the low cost end of the market they seemed to be looking to the future with automation."

The mixing console they finally went for was the Soundtracs *CM4400* with computer automation. "This desk is already semi-automated—you can store up to 30 patch programs, and it is interfaced with the *Q.Lock*. Later this year we will have real-time SMPTE: the desk, multitrack and video will all understand SMPTE so you will be able to program information in advance."

Since the installation, Soundtracs has been working closely with SAV in their development programme in order to become fully conversant with the needs of an A/V production studio.

The mixer is housed in a purpose built wooden console, flanked on the left by effects, and on the right—a producer's table. Ancillary equipment includes a Bel *BD80* digital delay processor, AMS *RMX16* digital reverb, Symetrix compressor/gates and dbx *150* noise reduction. Microphones include AKG *CK414*, *C451* and *D12* and Neumann *U87*.

SAV chose a Lyrec *TR532* 24-track machine based on the fact that they had had one before and liked it very much. "Although strictly speaking, the machine isn't fast enough for automation purposes it is very reliable. It is quite robustly built—like a tractor. You can have the most awful things wrong with it and still get through a session when some machines would have just stopped working!"

Other tape machines include an Otari *MX5050* 4-track, Tascam *X1000M* 2-track and *122* cassette machines, Sony PCM *701*, JVC *BR6400TR* VHS machine and Sony U-matic. There is also a Technics turntable. Monitoring is on Lockwood *Majors* (driven by RCA amps) and Auratones. Foldback is powered by Quad amplification.

"The reason why we use a 4-track machine instead of one with centre-track timecode is that it is more versatile. We use tracks 1 and 2 for stereo, track 3 as an auxiliary and track 4 for timecode."

Studio One's recording area is 16×14 ft with a contoured wooden ceiling and Rockwool/chipboard walls. SAV's 'environment' ideas are once again apparent in that the grey carpet is complemented with black fabric covering the table and chairs, subtly lit with carefully placed spotlights.

On the floor above, Studio Two is where the original facilities were, although the control room and studio have ▷

WHO'S USING SOUNDTRACS CM4400?

Steve Glen chose the CM4400 for his studio 'The Chateau'. Some of the artists which benefitted from his songs and productions are: Hot Chocolate, Sad Cafe, Suzi Quatro, Phil Fearon & Galaxy, Bucks Fizz and Roger Daltry. Steve's experience in recording led him to the obvious choice, the CM4400.

SAV Studios using the CM4400 in a commercial situation, Tony Frossard and Marc Lacome use the 'Q' Lock Events Controller to trigger the 30 routing patches of the CM4400 speeding up complicated mixes often used in their type of work.

Richard Harvey owner of the Snake Ranch Studios. Richard chose the CM4400 for his own private studio. He found the internal computer which can be used to route and mute the equalized section of the monitors, as well as the channels, into the mix made the CM4400 the most advanced console available even at 3 times the price.

Blue Weaver As a member of the Bee Gees, Blue has recorded in studios all around the world and definitely knows what he wants from a mixing console. Blue uses a Fairlight Computer Synthesizer and finds the CM4400 not only complements his electronic instruments but also has a great sounding E.Q. for the vocal overdubs.

The CM4400 features:
Internal computer allowing 30 different mixes to be pre-programmed.
Pre-programmed triggerable routing patches.
RS 232 Interface for personal computer to display routing.
Up-dateable software.
The CM4400 is always up-to-date.

THE CM4400 BY

SOUNDTRACS

affordable quality

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STUDIOFILE

swapped places. Designed for the more budget conscious client, the centrepiece is an Allen & Heath *2416* with *EX8* add-on channels. "We chose the Fostex *B16* with dbx because we didn't like their Dolby C," explained Marc, and being budget conscious there is less ancillary gear. A Yamaha *R1000* digital reverb is accompanied in the rack by an Audio+Design equaliser. "We are planning on putting a *Q. Lock* in here as well." There are two Tascam *X1000M* machines and monitoring is on Tannoy *Oxfords*.

This studio is used mainly by the budget end of the video market as well as for radio commercials, A/V soundtracks and music demos. The control room is 12×14 ft with an odd-shaped alcove in one rear corner which bends around the stairwell: "We had to do it like this to soundproof the room from the stairs—and that's just the shape it turned out."

The walls consist of alternate pegboard and plain board to achieve alternate absorption/reflection and are covered over in rust and grey coloured stage felt. The recording area is, if anything, deader than that in Studio One: "It's best that way. You can avoid getting that awful 'BBC-type' sound to the voice."

Looking to the future Tony and Marc's main criteria for choosing equipment were time saving and quality. "What we wanted from the Soundtracs was to spend more time typing than thumb turning switches. We don't want to have great lists of how we did things. At the moment we've only got 30 patches which, quite honestly, you can use up in next to no time," and this is why Soundtracs is using SAV as their guinea pig. The console operates in conjunction with a Commodore *64* computer and Soundtracs is developing a new interface which will overcome the fact that at the moment the desk is speaking to the computer but the computer is not speaking to the desk which means that the desk doesn't actually know where it is timewise.

It does, however, enable up to 38-track video dubbing, because the computer controls the slave, the *B16* machine

SAV, continued

and the Lyrec multitrack, locking them together. The 24-track is interfaced with the *Q.Lock* and thus "you can go on adding tracks to the 24-track ad infinitum. We can also store tracks on PCM ad infinitum. In addition the turntable is '*Q.Lock*ed' and although there are different off-sets for all the different machines, as long as we are aware of what they are it's OK."

In this way editing becomes simplified, "We never cut tapes here: we just make a note of the timecode, mark it in the script, type those times into the *Q.Lock* and then the machine goes on automatically. It means you don't have to worry about whether it worked or not because you can just play it and adjust as necessary.

"We can also keep storing alternative tracks. You can have a completely full 24-track, slave the PCM so that you get first generation slave and thus you can use as many alternative tracks as you like.

"PCM is a very cheap storage medium—only £5 a cassette. We have stored hundreds of percussion sounds and we can trigger them off the Bel *BD80* memory. We have stored three hours of Simmons sounds for example; we also stored the sound of the fire escape being hit: when we recorded a New Man commercial we couldn't find exactly the right drum sound and the guy ended up out on the fire escape with a stick! It sounded great.

"We must also explain our 'mix as you lay' method of working here. We don't use the monitor section of the desk at all. You are listening to the end product as you go along. With the dbx we can have all the 24-tracks up all the time and you can't hear them and this speeds up the recording process to such an extent that you can do a complete TV commercial in half a day.

SAV's eyes are focused firmly on the future, their working methods and design ideas well ahead of many comparable studios and the calibre of client seen regularly at their facility only goes to strengthen this image. The *Q.Lock/CM4400* combination enables them to provide computer controlled search and positioning of effects allowing every element of a soundtrack to be precisely lined or moved frame by frame, a facility essential in the fast moving commercial world of A/V production.

Finally a word of warning: if, like me, you turn up in Harrison Street in search of number 26, do not be thrown by the fact that the only functioning doorbell at that austere building belongs to the Masectomy Association! Just make a note now that what you are seeking is actually situated through the iron gates to your left.

Janet Angus

SAV Studios Ltd, 26 Harrison Street, London WC1H 8JG, UK. Tel: 01-278 7893.

Studio Two

Future Plans for the CM4400

We spoke to Todd Wells of Soundtracs who explained in more detail how SAV are utilising their Soundtracs *CM4400* at the moment and what they have been working to achieve hopefully by this summer.

"At SAV their fundamental task is video production. The standard *CM4400* is being used to trip between the memories. In simple terms, for example, if they have a video of some promo, anything, what they do is lay the audio track which they sync to the video, say, in English.

"Now perhaps they want several versions of the same video with audio in different languages: Spanish, German, French, etc. At the moment, because of the limitations of the *CM4400* they are forced to set up, eg channel one routed to master memory one (with audio in English); channel two routed to master memory two (French), etc, and they do this using the *Q.Lock*: they set up the video and run the programme in English (channel one) and at the end of the audio and video the *Q.Lock* rewinds the video and will trip the memory, closing channel one and opening channel two and the whole thing will run again.

"It is a fairly crude but very cost effective way of doing it. Now they want to be able to do it without the use of the *Q.Lock*, reading the timecode off the video. This is what we have been working on with them and hopefully some time soon the *CM4400* will be able to read the timecode and automatically open and close the channels, and instead of having to write in the memory, you will just have to give the SMPTE timecode for the opening and closing."

Installation of the pre-production unit, as Todd says, is planned for early summer and, "As a spin-off from this we are also developing automated muting, for the *CM4400*.

Soundtracs (UK), Soundout Laboratories Ltd, 91 Ewell Road, Surbiton, Surrey KT6 6AH, UK. Tel: 01-399 3392. ▷

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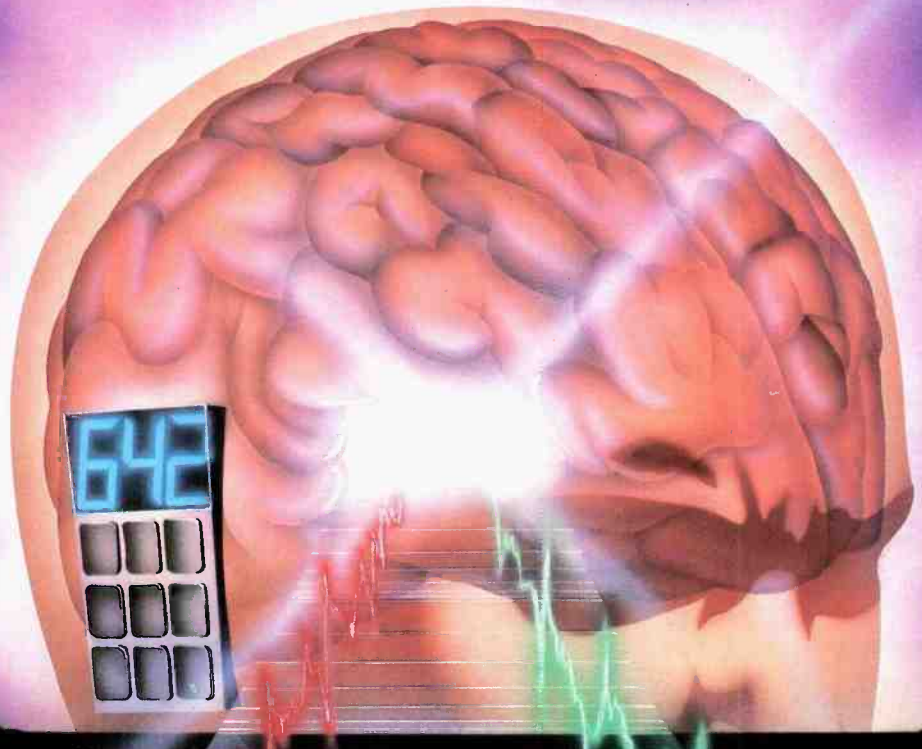

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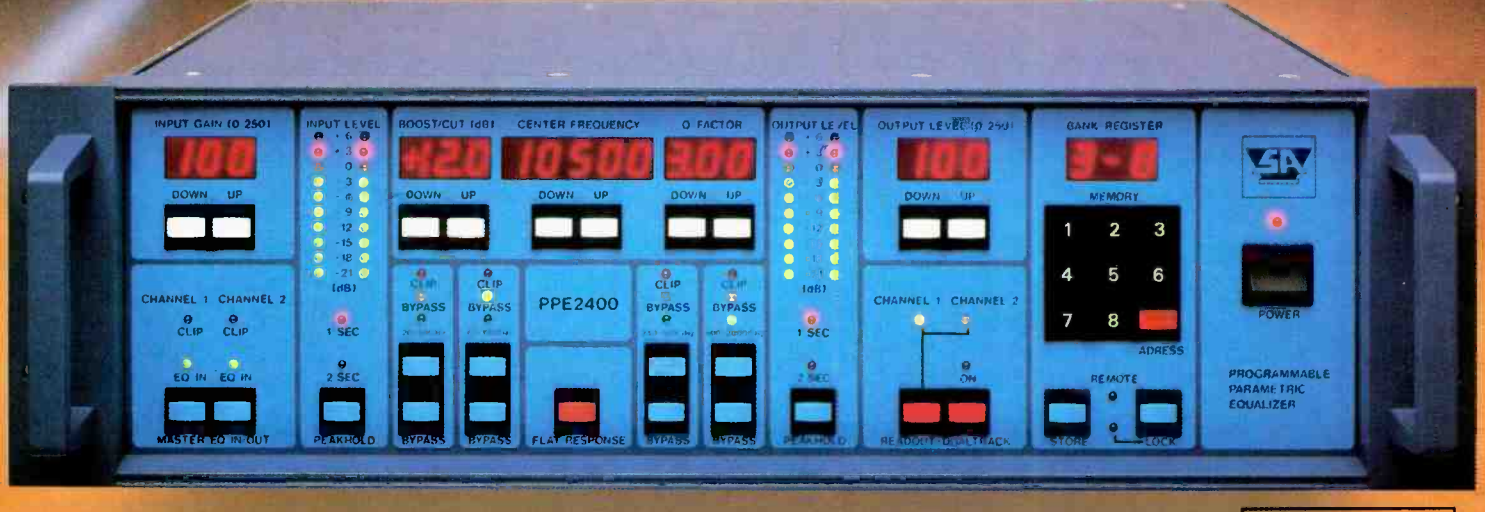

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STUDIOFILE

STUDIOFILE

Star Studio, Hamburg

Ralf Arnie's musical career dates back to his release from a Russian POW camp in 1949 when he abandoned his original plans to study medicine and turned to his hobby, music, to make a living. Joining a publishing company as a lyric reader, he had his first release in 1951, which was also a hit. This was later followed by his adaption of *Memories are made of this* which he produced with Freddy Quinn and which became a runaway hit with 2½ M single sales in Germany alone—still an unbroken record. Further successes were the million selling German versions of *Ramona* by the Blue Diamonds and *Kaymos* by Vicky Leandros. And what about the famous *Tulips from Amsterdam*?

"This dated back to when I was trying to get my compositions recorded. I had a friend in the publishing business so I went along with some songs. We played them all through and the result was pretty discouraging—they were all too American sounding. 'Haven't you got anything else?' they asked. All I had was this very typical waltz that I had done for fun . . ."

Being a successful composer/producer led Ralf Arnie to found his own publishing company in 1960 and four years later he was the first publisher in Germany to have his own demo studio. This was then upgraded in 1970 to professional status and in 1972 Ralf became a Eurovision song contest winner with *Aprés toi* sung by Vicky Leandros.

At the same time, Ralf Arnie was chiefly responsible for the development of the 'Hamburg scene' with his interests ranging from easy-listening through to techno-rock, as evidenced by his involvement with Kraftwerk, Udo Lindenberg and NEU. Other artists he has worked with as writer/publisher include Julio Iglesias, Nana Mouskouri, Paul Anka, Rita Pavone, Caterina Valente, Demis Roussos and the list goes on.

He has also maintained a long standing unwritten business relationship and friendship with the top German comedian, Otto, with sales of ½ M for each album.

However, on the studio front, things were not so rosy and decision time was looming. The original studio was installed in a residential area, which put limits on working hours. Especially with neighbours just waiting to phone the police at the slightest noise after one second past 10.00 at night! For husband and wife team Ralf and Jenny, two courses of action lay open: either sell the expensive studio gear and build just a small private demo room or go the other way and rebuild in suitable premises where neighbours would be the least of their worries. For business reasons it was decided to locate the new studio in Hamburg itself. Jenny Arnie explains:

"The advantages of being near the city centre, with all that entails, were greater to us than building a studio out in the country. The studio was to be both a composing tool for Ralf and a commercial venture for outside clients. Being city based just seemed the best way to do things."

As many studio owners will know, finding the right premises can be difficult and after much searching the prospective studio builders heard that the old Teldec studios were up for lease. The location was right and there was plenty of room to move, but it was obvious that some heavy rebuilding was going to have to be done if the studio was to be designed to modern standards. The Arnies then heard about Tres Virgos Studios in California, the first *LEDE* studio to be built from the ground up following the designs of Chips Davis. There then followed the usual flurry of phone calls and visits to the respective sides of the Atlantic until the decision was made to build the first Chips Davis *LEDE* studio in Europe.

"We felt we were taking a risk as a lot of people are still wary of the *LEDE* concept but after having seen and heard Tres Virgos Studio we were sure we had made the right decision. It was very important for us to know that what we were hearing in the control room was what was going on in the studio or on tape. Also, when the final mix left the studio, there would be no unpleasant surprises!"

The new Star Studio saw the light of day at the end of 1984 after some arduous building work and the well known 'will it ever be finished' syndrome! Willing to put themselves on the line, the studio was the scene for the Syn-Aud-Con workshop prior to the Hamburg AES and was also able to announce their first No. 1 hit in Germany with *You're My Heart, You're My Soul* by Modern Talking.

Jenny and Ralf Arnie

Star Studio is situated about 10 minutes from the city centre with unloading access directly into the main studio. In order to ease parking problems, Star have rented a block of spaces in a parking area two minutes' walk away.

The control room is both spacious and functional, with the benefit of a high ceiling which avoids the closed in feeling. "Chips would have liked to make the ceiling higher but this meant altering the basic structure of the building which would have caused too many problems," explained Jenny. In accordance with *LEDE* principles, the room is completely symmetrical, with the basic geometry having been marked out by laser! "The site foreman was a master carpenter and furniture maker," went on Jenny, "and he used these techniques for the construction, resulting in very close tolerances regarding the specified dimensions."

The dead end of the room is finished with a padded fabric and a carpeted floor, while the live end consists of wood panelling interspersed with floor-to-ceiling polycylindrical diffusers covered with a rough plastic or vinyl material and parquet flooring. In addition to the mixing console there is a separate producer's/arranger's desk on a small dais behind the mix position. Vision into the studio is very good with a long 'wrap-around' control room window that is well recessed to avoid unwanted reflections.

Star's main concern was whether to keep the existing gear or change it. "We had an automated MCI *500* series that we were very pleased with and we felt reluctant to part with it. Jerry Jacob from Tres Virgos suggested that we modify it as per their own and we went along with the idea."

One of the many *LEDE* criteria is that the audio path from microphone transducer to the master recorder/monitoring be totally phase and polarity coherent. Modifications to the console included the replacement of all line input transformers with balanced op amps featuring a very low output impedance assuring proper matching in all console statuses and the replacement of the VCAs with Aphex VCA cards.

Other 'hot-rodding' involved matching console and channel functions for truly optimised performance. As with Tres Virgos Studio, the entire audio system was assembled piece by piece to ensure phase continuity and freedom from earth problems. Though this can be fairly painstaking, Star feel that the time spent is fully justified by the results.

Monitoring consists of a 4-way system from Art Electronic of Canada that uses cone drivers for each frequency band, resulting in a very smooth sound. The system is extremely powerful and allows plenty of headroom for peaks. During the course of my visit I played with a multitrack recording of an orchestra with no EQ, going from soft to very loud. The balance and tonal quality of the mix remained identical, meaning that the ▷

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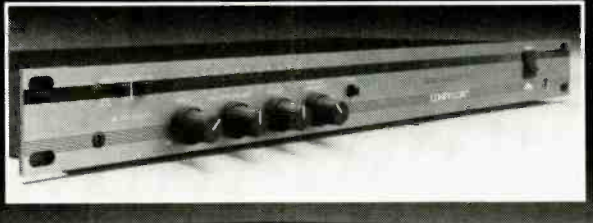

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STUDIOFILE

room was not being excited in a way to produce colourations and that the monitoring system was being consistent over the power range used. In short, it worked! Stereo imaging along the console was very stable and there was hardly any noticeable 'splash' from the console surface. Nearfield monitoring is by Auratones.

The rest of the control room equipment includes an MCI *JH-24* multitrack, Telefunken *M15* and *M10* master machines and a Nakamichi cassette deck. Dolby NR is available throughout.

A twin movable rack houses the effects department which includes a host of DDL's from Eventide, Roland and Ashly, EMT and Barth modules for compression, limiting and EQ, three Barth pitch shifters, Kepex *II*s and *Gain Brains*, EXR exciter and UREI limiters. Reverberation and echo devices include EMT mono and stereo plates, AKG *BX20*, EMT *250*, Lexicon *224XL* and Roland *Space Echo*. There is also a large natural echo chamber hidden away. In addition to the studio gear, Star also have a wide range of musical instrument effects units for all the usual—and not so usual—sounds required today and have a good direct interface for electric instruments to the console with a Trace Elliott preamp system.

There is plenty of seating space at the back of the room so that the production people can work in peace.

Moving on to the studio, the first impression most definitely is the space. The full ceiling height is about 10 m brought down to 8 m by Decca but now the false ceiling height is around 5 m. Though it appears flat, it is not parallel with the floor and is composed of a suspended and floating construction of acoustic tiles with lots of insulation piled up on top of it.

The studio wall construction is a room within a room (the original building was a large cinema) and features a completely asymmetric floor plan, with the area nearest to the control room having parquet flooring and the rest being carpeted. The 'screen' end of the studio has a central absorbent surface flanked on either side by polycylindricals with the rest of the construction being a mixture of brick wall and various resonator/absorption modules.

Star continued

The control room

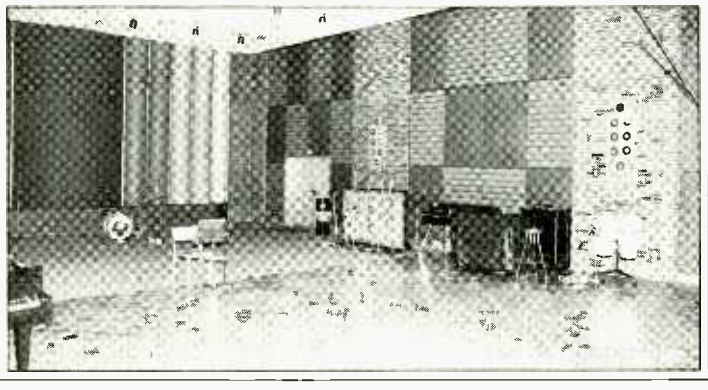
The studio floor area is 210 m^2 and for a room of this size the acoustics are surprisingly controlled with shorter than average reverberation time. However, on listening to the unequalised tape, it was evident that the sound is very rich and smooth over the frequency range. Jenny explained that the studio has a collection of diffuser planels that can be suspended at will from the ceiling but that they have had no call to use them yet. As well as the obvious advantages when recording orchestras and large formations, the controlled acoustics make the studio eminently suitable for recording rock bands live—just set up, turn up and go.

Star Studio has plenty of room for expansion with the area outside the inner shell. As it is, this space provides storage and an additional recording or separation area. As a point of interest, one is able to see here the successive ceilings and construction work marking the three periods in the building's career.

Here is what may be one of the only LEDE isolation or drum booths in existence. With a floor area of 17 m^2 and a volume of 55 m^3 there is more than enough room for the largest drum kits or even small wind and string ensembles. Visual contact with the studio is good with a video link to the control room. The sound in the room is very pleasant on speech and the size of the room means that long overdub sessions should not be claustrophobic.

Star has a comprehensive microphone list with models from Neumann, Schoeps, Crown *PZM*, Electro-Voice, AKG, Sennheiser, Beyer and Shure. The instrument collection is also considerable with Steinway Baby Grand, upright piano, Yamaha *CP-70*, Rhodes, Hammond, *B3* with Leslies, clavinet, vibes, guitars, Ludwig drums, percussions, etc. Studio monitoring is provided by a pair of Lockwoods.

Star's studio area



"During the building work, a burst pipe, due to the cold, caused the Steinway to be soaked with water. As we were going to get a concert grand to replace it we were not too worried about it—and, after all, it was insured. However, one of the technicians from Steinway felt it would be worth restoring the piano. They literally took it completely apart and rebuilt it piece by piece—and it has never sounded better! It was a completely different instrument. Needless to say, we kept it and the grand will have to wait."

Apart from the usual recreation and kitchen facilities, Star also have a well equipped editing and copy room, complete with Soundcraft console and a clutch of Telefunken ¼ in and ½ in master machines, cassette decks and turntables.

After a period of frustration and certain inactivity, Ralf Arnie is now back in the swim and raring to go, both as composer and producer. Ideally, Jenny and Ralf would like to see studio time split fairly equally between in-house and outside productions. Other areas waiting to be explored are video post-production and film scoring. The studio is large enough for the largest orchestras and the installation of projection facilities would certainly present no difficulties.

Star have already had quite a few visitors to the studio since opening their doors including René Kollo, Vicky Leandros, Melanie Holliday, Christian Anders and others. It now remains to be seen whether Hamburg will increase in importance as a recording centre: certainly the city has a lot to offer (apart from the more widely publicised attractions) and provides a pleasant change of scenery and pace. As Jenny Arnie put it, "Hamburg combines the best of village and city atmospheres; everyone is friendly but they also mind their own business!" Not a bad combination when you think about it.□

Terry Nelson

Star Studio, Osterstrasse 124, D-2000 Hamburg 20, West Germany. Tel: (040) 40 10 54.

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Sound Modelling Program, the long-awaited user-sampling option, offers 20 seconds of sampling at a 25KHz sampling rate with 12 bit resolution. Six different modes of sampling including programs for slow, normal and fast decay analyse the amplitude envelope of the digitised sound to ensure optimum sound quality. Other programs cater for non-compressed sounds and speech. Samples may be edited, looped and adjusted for volume and pitch.

Macattach Communications package interfaces the 250 to the Apple Mackintosh. The software currently available for this package provides off-line storage, keyboard setups, sequences and samples made using the Sound Modelling Program.

Version 2 Software improves user programmability and allows stereo delay effects to be programmed as part of a keyboard set-up. Variable brightness and five modes of transposition may be added to create dramatic effects. The 12 track sequencer gains comprehensive editing facilities, error correction, looping in record mode and any of the 12 tracks may now be assigned to play an external MIDI device.

The arrival of these new enhancements makes the Kurzweil 250 a digital keyboard unique in its price range and further enhances the astounding realism of the sounds it produces.

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Recording industry observations by Richard Elen

Electronic communication for the studio industry

The recent announcement by the APRS of the setting up of a studio availability system—Studio Linkup—on the British Prestel Viewdata service marks an interesting move for UK studios.

SPARS members in the United States on the other hand have been using the IMC electronic mail system for some time (note at this point that as a consultant for IMC and some Viewdata companies, I'm not in the slightest bit unbiased) where they have their own bulletin board system, electronic mail and now, following a grant from 3M, an on-line database system covering studio equipment and facilities.

While domestic computer systems are common in the UK, there doesn't appear to be the penetration of business computer systems into UK studios there is in the USA. This, according to one APRS committee member, is the main reason why the APRS have not adopted the E-Mail system as their counterparts in the USA have done—although a fair number of studios have come on to the system independently of the APRS. Instead, the Viewdata service satisfies a need without requiring hardware at the studio end. It does, however, rely on the record companies having Prestel sets to access the pages which they probably have.

The system has already been covered in the APRS column in *Studio Sound* in greater detail. In basic terms it works like this. APRS member studios pay an annual fee to cover the pages containing their booking availability. All they do is call Gwynne Williams Viewdata—the company organising the scheme—and phone through their availability.

BPI member record companies can pay a subscription to become members of the Prestel Closed User Group containing the pages, and they can access the information at will. Then they just call the studio to book the time.

The idea has grown out of GWV's existing and highly successful systems for conference and theatre applications, and it makes a lot of sense to any APRS members. They don't need any gear unless they want to buy a Prestel adaptor or terminal to check their pages, and it costs them £100 per year per page—including unlimited updates. And most record companies probably have a Prestel set somewhere in the building—they use them to get the charts as soon as they appear. All a BPI member company has to do is pay the £250 membership fee—the same as they would to set up five IDs on the IMC system.

The GWV system is virtually ideal—especially as far as cost-effectiveness is concerned—for the purpose of checking studio time possibilities. But Prestel has its limitations. Britain was the first country to utilise large scale computer-based telephone networking and the Prestel system was how they did it. It was developed from a system designed to check room occupancy in hotel chains: the idea was that an unskilled operator could simple key in a page number—Prestel is based on a large number of 40-character×24-line pages with rudimentary block graphics and colour capability—and access the data. The data is sent from the remote computer at a relatively high speed—1200 baud—but you send data to it at the slow, Telex speed of 75 baud. This is the CCITT V23 standard—it's designed for electronic

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information systems where you ask, and it gives you the data. It isn't, because of the speed, very interactive, and although Prestel has more recently introduced a form of electronic mail, it's a real pain to use. Indeed, alphanumeric keyboards on Prestel terminals are a recent innovation.

A system which is based upon the calling down of pages by entering their number, and allows pre-formatted response frames which allow the entry of small quantities of data into a preset form, is ultimately rather limiting, especially when you consider the space limitation on a page (sending a message of more than one frame is quite complex) and the speed of sending. The result is simple: you don't send long messages. There's also the likelihood of quite complicated routing between menus to enable you to access pages when you don't know their number.

This is not a limitation for Studio Linkup, but it is if you want to do anything else in the electronic communications field. In fact, many commentators believe that Prestel would have folded if it had continued to rely on its previous clients (it is widely used in the financial sector, where rapid access to pages of stocks and shares data with the minimum of keystrokes is a prime requirement).

What saved it was the introduction of Micronet (now Prestel Microcomputing), a special user group for home micro users, which took off and is now a major client area. The sudden availability of add-on kits for cheap microcomputers also meant that it was no longer necessary to have a special terminal for Prestel, which was many business people's previous complaint.

But even if you can hook up your Apple or IBM PC to Prestel, there's still the page size limitation and the speed, so it is hardly surprising that for messaging-based, more interactive purposes the more conventional networks like Dialcom (Telecom Gold in the UK) have taken off. For example, once you have taken into account the fact that a Prestel response frame will include your address and account number, plus formatting, you may only have nine or so lines left—that's 360 characters. A typical computer screen of 80 characters by 24 lines has 1,920.

You can get into the IMC network (which uses Dialcom in the USA, Europe and Australasia and is accessible via national and international data networks from virtually any developed country) at 75/1200 baud V23 if you like. It is much more common to find subscribers using 1200/1200, or the cheaper compromise, 300/300 baud.

Once on the network, you can make use of a wide range of interactive facilities including E-Mail of course, but also covering database management, publishing, bulletin boards and the like. That's why all the major industry magazines and their contributors are on the system along with almost 3,000 companies and people in other aspects of the pro-audio industry.

The Studio Linkup system is a great idea, and if it encourages computer usage in British studios it'll be even better. It is unfortunate, however, that British studios will be using a different network from everybody else. But getting your computer on-line to both systems is simply a matter of adding a free or inexpensive piece of software so there is every possibility of both systems co-existing in the UK, each suited to its own applications. The secret is to use the right system for the job and not to expect one system to excel at applications it wasn't designed for.□

INTERIOR MOTIVES

Janet Angus compares the views of four studio designers on interior design

Interior design is not a subject which would necessarily figure highly in the about-to-be-studio-owner's mind. He is far more likely to be preoccupied with the latest and greatest mixing console/monitoring system/tape machine/digital effects and how to divide his budget up between them. He would probably think that having paid good money for professional acoustic advice/design, he had done his bit for the world studio environment campaign. This is not necessarily the right conclusion, and could possibly be seen as rather short-sighted to say the least, as it is against his own interests.

Everything costs so much, and many studio owners are loath to splash out on the artistic side of their design. It is not always clear just what the designer's contribution has been, or more accurately what he has done that you couldn't have done for yourself.

Interior design has not been resisted solely by the recording industry. In the UK especially, it has only recently claimed full attention from businesses right across the board. Scandinavia and Italy have been aware of the importance of interior design for many years, but industry in Britain is just catching on to the fact that looking good is nine tenths of being good. Image with good solid technical/business back-up is the complete formula.

In the recording studio today, high technology equipment not only costs a fortune but also looks as though it did and the surroundings should reflect this. Many studios are using the same equipment and so there is an added need for a different, individual style to create a unique environment. This is one way to attract custom.

Although a lot of UK-based acoustic designers have been working with interior designers for quite a while now, they still meet a certain amount of resistance from their clients. There is a slight nervousness, probably produced by financial considerations, of departing from the norm. There is a theory that the reason so many studios retain that unadventurous rather boring look referred to variously as 'that American barn', 'that American Holiday Inn' and that 'American motel' look, is that they know it works. They have seen it work the world over, and here is the designer trying to tell them that it's passé; they should spend a bit extra and do something tantamount to outrageous in their eyes.

Acoustic designers, on the other hand, appear to be welcoming interior designers into their fold with open arms. Creating a new design makes the work instantly more rewarding, more interesting; working with new materials and new ideas provides a challenge.

Edward Veale, Neil Grant, Andy Munro and David Hawkins are all committed to the interior design concept to varying degrees and were all more than ready to discuss the subject, bringing in their associated designers to add their points of view.

Eddie Veale has been advocating the use of interior design throughout his 15 year long career. Back in 1972 Trident were venturing into video with Trilion and when they acquired the Brewer Street Trilion premises they decided on radical changes employing interior design to promote business and attract clients. They were very conscious that their clientele were the media and that their service had to be correspondingly upmarket. The John Michael Group, a major design company, was brought in to work with Eddie on the preview theatres and other areas which required acoustic control. Encouraged by the results, the directors instructed Eddie to generate schemes for the refurbishment of the Trident Studios in St Anne's Court. "They tended to work to exceedingly high standards using warm and appealing materials to create comfort and familiarity. Trident was rewarding in terms of attention to detail more than innovation in materials. A problem which should never be overlooked in terms of materials is their durability and ease of maintenance (ie how to keep it clean) and therefore there is a tendency to use materials which have already proven themselves."

In 1974 Eddie was commissioned by Jerry Bron to work on the Roundhouse studios and Bronze Records office accommodation to create a corporate image to be carried throughout the group of companies. This forward thinking view of the company image was quite innovative at the time and is only recently becoming recognised by the majority of companies within the recording industry.

Eddie Veale's reasons for working with interior designers include the fact that there is a team of people who come in with a fresh approach, from a different background. He appreciates their keenness on introducing new materials and ideas, making his job more interesting. The designer is always looking for new ideas and exploring new ideas and encouraging the client to accept the new ideas. "It is much easier for us to get the client excited about some wonderful new equipment rather than about spending a bit of money on making the studio look beautiful!

"So many studios want to do what has been proven by someone else and is therefore safe because they know it has worked. Clients as a rule ignore interior design and just somehow assume that it is going to happen. When faced with it they are fretful of the possible cost. It is short-sighted because they will spend hundreds and thousands of pounds on equipment which, if it then doesn't look good, they will not be taking full advantage of its potential. Local Radio and TV stations are rewarding clients in this respect because they are more conscious of image. The sales force tend to show people around and use the studios and offices as a sales point, so looking good is very important. They need good looking, effective designs."

Eddie's most recent and possibly most adventurous project has been for Sarm, working in conjunction with design company XL—in particular designers Gary Knibbs and Tom Watkins.

The XL design approach is quite radical, totally uninfluenced by anything that has gone before. They explore new materials with enthusiasm and incorporate daring features in their design. The basic design principle is still, however, one of overall cohesion. The theme for Sarm West was simply blue. Everything should be blue, and many of the surfaces are similar and complement each other. Right through to the kitchen crockery the theme is adhered to religiously, apart from Studio 3 which was intended as a sort of playroom for Trevor Horn. Its popularity however, has led to it being available for some commercial use as well.

Eddie Veale's approach to the design is to try to avoid fettering the interior design at the outset by laying down lots of prerequisites. "In the initial brief I outline the technical parameters for the studio, ie where equipment can be located and any constraints on the placing of equipment (for example the mixing console), positions for service panels, air conditioning and lights, etc. I identify the sorts of shapes that would be useful from an operational and acoustical point of view for the space under consideration. Then the designer goes away and creates ideas for the building. If they then have ideas about changing shapes, etc, that's fine and we can talk about whether they are feasible or not.

"We work together dovetailing our requirements for acoustics and technical services. Once these details are agreed we will separate and they will complete their specifications for materials and fixings which they wish to use. These we will dovetail into the building contract as a coherent set of drawings to be used by the building contractor and then we (Eddie Veale) will supervise the building works."

Sarm West's 'visual joke' in Studio One

Sarm West's Studios One and Two bear witness to the blue theme. Recent additions to Studio One include the installation of three isolation booths with varying (and variable) acoustical properties. The blue surfaces range from painted wooden panelling, to blue fabric, to painted blue mirror tiles to corrugated iron. The live booth has been designed to create the effect of being inside a swimming pool (the information 'deep end' and a ladder painted on the wall tends to help you realise where you are supposed to be). The reverberation time is variable between approximately 1.25 s and 3.3 s. Eddie specified a hard material which was required to diffuse the signal at the top of the room and Gary Knibbs came up with corrugated iron. Each piece is separate to prevent ringing and they are properly damped. The ceramic tiles serve to enhance the swimming pool effect. Studio One also contains what Gary refers to as a 'visual joke': the control room is fronted with a mock temple fascia which looks extraordinarily out of place. The object here was to create visual impact.

Studio Three was intended as an electronic music studio to satisfy the needs of Trevor Horn and his specification to XL was that he wanted a space ship, and this is exactly what he got. The most striking thing about the room is that it is all black, the wall surfaces being broken up with *Linelit* plastic tubing which fluoresces under ultra-violet light. Gary Knibbs was provided with an SSL schematic circuitry which he emulated with his design.

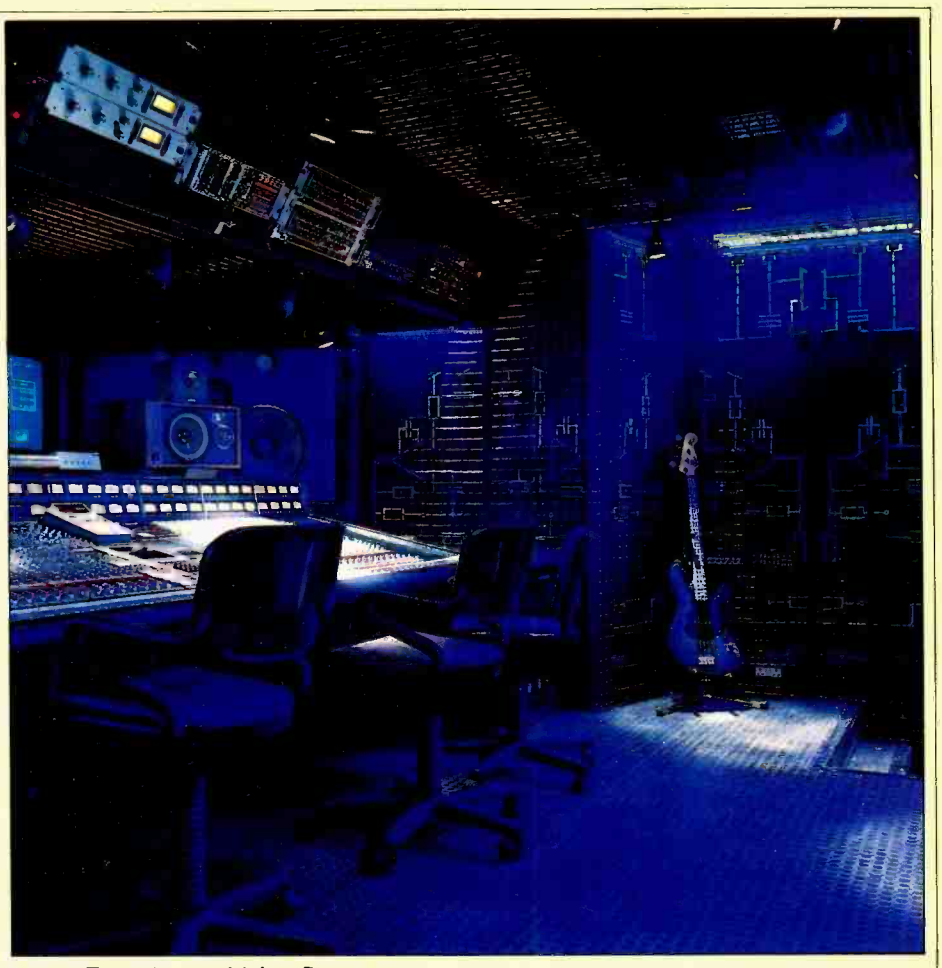
"Since ultra-violet light was required, care had to be taken to make sure that the levels used were sufficiently low to avoid erasure of EPROMs. In fact, the lighting system generally is low voltage using several tracks, with a sophisticated switching system controlled from the mixing console. This enhances the visual aspect as well as the working environment.

"As many of the surfaces in there are black there is a very low level of light reflection. Therefore it is important to have a large number of light sources with flexibility of where they are directed and how they are operated."

The XL spray-on finishes (or suspended paint as they like to call it) were taken across London to Sarm East Studio which was given a facelift to bring it up to the same standard as its sister. Everything from the front door down was redone. The ceilings received particular attention as more light was introduced incorporating a large number of small lights as opposed to strategically placed large and usually hot ones. Small low voltage lighting brightens up the machine room and reception area improving the working environment.

The image is very similar to that created at Sarm West except that this time it is all high tech: shades of black, grey and white—very smart and unbasement-like.

"Studios used to take their identity from their particular equipment. In present day studios, so much of the equipment is common, such as the SSL mixing console, that when you walk into a studio, if you could cut off the room, you could be just about anywhere. Nowadays, a great deal more emphasis has to be placed on the room decor to get originality and individuality."



Studio Three 'space ship' at Sarm West

Sarm West's Studio One with three isolation booths and swimming pool effect

The challenge of using new materials is one that Eddie welcomes although they do require more work since they must be assessed and measured for their acoustical performance. Having been to all the trouble of finding successful new materials he feels it would be all too simple to just sit back and incorporate these in subsequent designs since it reduces both the work and the possibility of things going wrong, "But I think if you are going to do your best you should not rely on past achievements."

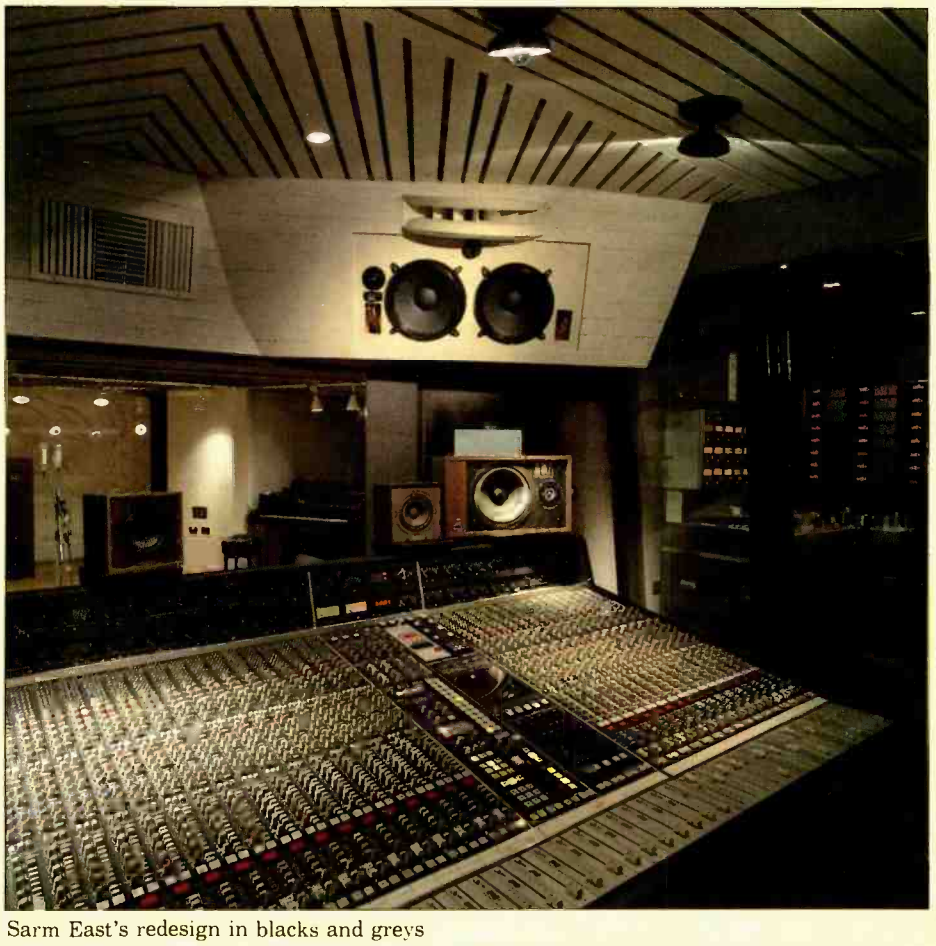
Sarm's owner Jill Sinclair brought XL in on the studio design having successfully used their creative talents in ▷

INTERIOR MOTIVES

the design of her own home. They now find themselves involved in almost every aspect of the business including all the artwork for Frankie Goes to Hollywood and the Art of Noise and the design of a complete office block intended to house all the companies.

Gary Knibbs is a very successful and daring young designer who at 25 is quite happy to break all the rules. "Trevor Horn told me he wanted a space ship so I gave him one and people like working there because it is fun, although it is a bit small. Everyone says a small room should be white, so I broke all the rules. I don't care."

He feels that over the years somehow acoustics have managed to create an almost reverent aura of mystery around them and people have used this as an excuse not to experiment. "I'm building a studio at the moment using all stainless steel and chrome. It will be bright and clean and interesting. Sarm East needed to be very unbasement-like—bright and interesting. You can use all sorts of different materials, you just have to learn about the various properties of various materials. In the studio you need an absorbent material and a reflective one: you could have my trousers and this filing cabinet door. A studio doesn't need to be York stone and cork tiles in order to work properly, and I can't stand bare wood! It makes it more interesting I think; you always have to be doing something new—you are only as good as your last job."



Sarm East's redesign in blacks and greys

XL created the Sarm corporate image when they first took over the old Basing Street premises: letterheads, advertisements, logos, brochures, offices and studios. "Blue was the colour that was chosen and that was it. Before, Basing Street was orange and brown—very oppressive and boring.

"There is no point in designing a fabulous studio if there is a piece of paper lying around (say a track sheet) that looks awful. You have to look at everything. In order to achieve this the client has to have the insight to see that need. A corporate image is not something that people are necessarily aware of, it simply makes a company look slicker. Image is something that should receive a lot more attention in the studio business. The studio industry is a very high technology business these days and it should have a contemporary look with longevity.

"In a studio, if you are sitting looking at the same wall all the time, isn't it more interesting to look at something that someone has put some thought into as well? Like the live booth with its swimming pool design.

Sarm went along with all our ideas because they have a saying that goes: 'you don't have a dog and bark yourself'."

Working with Eddie Veale, the XL designers have learnt about the properties which materials are required to have: "There is a certain weight of fabric which you can use because the soundwaves have to be able to pass through them; for example these trousers would be no good but perhaps my shirt would.

"Another consideration is that the design must work on a long term basis, and it has to be strong. A studio has to be bomb-proof, and also, I think, quite sexless. Everything, including the fixtures and fittings, the hi-fi, the TV, everything must be good."

XL worked very closely with Eddie throughout the project—they had regular meetings, co-ordinating every aspect of each other's jobs. The Sarm East facelift gave Gary more or less a free hand although he was under pressure not to upset the acoustics, and he worked closely with Eddie to keep control over the materials used.

"In Sarm East I sprayed everything in sight and the wood panelling was either stained or sprayed. Sarm East is a part of the Sarm empire, but it is another building and it is in another part of town and so I used the same design but a different colour. Having Eddie Veale on hand as an instant advisor was really important.

"When we started spraying in Sarm West, the carpenters on site were disgusted! There we were spraying all their woodwork with these industrial finishes that people are more used to seeing in toilets. It was a bit of a struggle getting the builders to accept all our ideas and we had some terrific arguments," Gary grinned. "By the time we did Sarm East, everyone was used to us and we did the whole thing in eight weeks.

"A good relationship like the one we have with Sarm means that they come back to us for everything, including their Christmas cards. We don't want to jump from studio to studio; we want to build up a good client list and do thorough work. We don't want to impose our style on anyone, we want them to come to us because they like our work."

Neil Grant's company employs its own interior designer: Jacky Ellis, with whom they have been working for the past 12 months or so. Neil's reasons for bringing Jacky's services in were that he realised they did not have the specialist expertise for interior design although they were technically qualified to design and predict acoustic spaces. Having come under commercial pressure to produce interior work of a high quality they decided to do something about it.

"Studios had always looked to us like late '60s American Holiday Inns, and it seemed so illogical to spend so much on the equipment and neglect the interior design, using timbers and fabrics, etc, chosen at the whim of a client whose taste was not necessarily terribly reliable," explained Neil.

The way they work now is to present the studio acoustic design alongside a decor presentation which will contain samples of ceramics, tiles, flooring, colours, racks and photos of the equipment so that the client can make a choice. "I also believe that the design should be based very much on the client's own taste, so we have a meeting where they will describe what they like. Billie Currie for instance likes ceramics, so we are basing his studio on that and others like timbers. So we accumulate ▷

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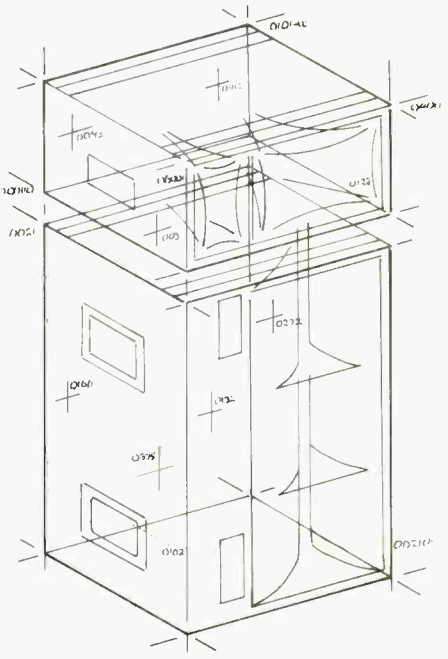

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INTERIOR MOTIVES

their comments, prejudices and opinions and then Jacky prepares a list of materials and we will reject any that we cannot use for acoustical reasons."

Materials which Jacky has introduced have been mainly different types of fabric, and they have also crossed over to using some metal, including mild steel diffusers with many varied finishes on them. Projects have included Studio Two at Odyssey, the remix room at Utopia, Swanyard in Islington, Chipping Norton and the Tape Gallery (A/V). "Video people seem to be more conscious of the comfort and ambience of a facility. They are more sympathetic, as are people who are having studios designed for their own homes.

"I also think it is an awareness which we bring to the project. Old studios were such a mix of things: two or three different types of hardwood, two or three different types of fabric, a bit of stone, etc, and none of it was properly integrated and co-ordinated. We work very closely, with the client as a third party; some we get right straight away and some we have to keep going back with new ideas. But the most frustrating thing is that they all know what they *don't* like, but don't know what they *do* like!

"Control rooms are changing dramatically in their function and in what is required of them environmentally. Also, although they must look pleasing, they must look as if as much thought, time, care and money went into them as in building the console or tape machine."

For Jacky Ellis's part, she feels very strongly about the corporate image idea of taking the design right through from the front door. She sees the interior designer as a professional person whose aim is to tie together all the elements of decoration, furniture, furnishings and lighting with a consistent design language, to create an atmosphere and mood appropriate to the activity taking place. In a recording studio this would be combined with the right element of reflective and absorbent surfaces to provide live and dead areas as dictated by the acoustic designer and which cannot be affected by the aesthetics.

"Consequently, in the past, this has led to the American motel-type stone and wood panelling thrown up in no particular co-ordination and with no consistent theme. The interior designer's role is to select, liaising closely with the acoustic engineer, a range of materials which co-ordinate in texture and colour and are in tune with the very sophisticated design of the equipment available today.

"This approach, carried throughout the design from the moment one enters the building, through reception rooms, corridors, meeting rooms and offices to create the co-ordination common to all good design. Careful mood matching ambiences appropriate to the activity by varying the lights and colours.

"So far there has been a certain resistance from the client, but in the end they have always been very pleased with the result. Considering the outlay for the total package and equipment it is really worthwhile to give a totally different character by paying a bit more and getting it right. It immediately gives an appearance of quality which doesn't become instantly outdated, and will bring in customers straight away."

Munro Associates, more often than not, will deal with the interior design in-house as part of their overall service. Roger D'Arcy, the firm's architect also looks after the interior design and offers advice on fabrics, colours and materials all of which may be overridden by acoustic considerations.

When working on a project overseas they will work in conjunction with a local architect in order to capture the appropriate style for a particular country. The recently completed Puk Studios in Denmark, for instance, they describe as looking like a sauna, incorporating rather more wooden finishes than they would normally have used.

"We try to tailor the design to suit the client. We will discuss everything with the client all the way down."

At the company's offices a stock of materials is kept to aid the client in his selection. They, too, are finding that they are using a rapidly expanding range of materials.

"The most difficult thing is fabrics, because they tend to be available only in large quantities and it is therefore very difficult to get hold of a good range of readily available fabrics. You usually end up finding something from the fashion industry and you breathe a huge sigh of relief, only to discover the following year that it has totally disappeared."

A current project is a new studio at the Roundhouse, where Munro Associates are covering up all the natural materials used with different tones of one fabric and incorporating high-tech metal fittings.

"Everyone wants studios to look like those American barns, and we try to discourage that. Control room requirements these days are for quite a lot less bass trapping and this change of requirements itself is affecting the design.

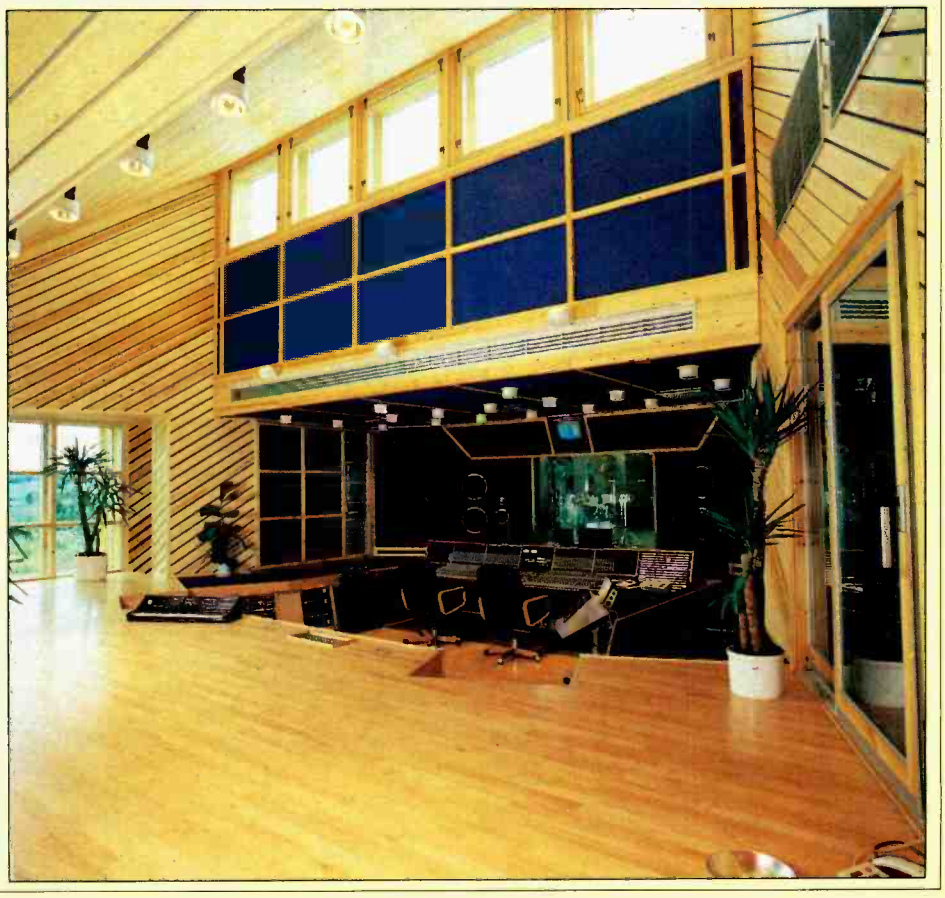
"At the Roundhouse we are using painted blockwork to get a more industrial feel. We are trying to create a lighter, clear cut design. Everyone should have a unique design. We are pushing people to have bigger budgets for the design and they are starting to bring in trendy builders and designers although, of course, we would rather do it ourselves!

"We don't see interior design as simply choosing finishes. It is not skin deep. If possible we encourage the client to take it through the building with coffee rooms and computer rooms, etc."

The way Munro Associates set about designing is to firstly allocate the acoustically correct amount of accommodation. This will generate ideas of general form of the room which is designed acoustically in terms of space and location of surfaces. Next is the identification of areas where acoustics are not that critical.

At this stage they will find out what their client's tastes are, be they luxurious or industrial for example; whether they want a total design or something freer; should the area itself be interesting and colourful or should it act ▷

Puk's decoration in Denmark is light and airy



INTERIOR MOTIVES

as a backdrop—very simple and subtle to offset the equipment?

"There are two approaches: you either go for the room or to enhance the equipment. At Aosis Studios in London, for instance, we did what I call a Toytown design because it is all primary colours. It is a very vibrant room to be in; fresh, light and airy. Both ways are appropriate, you just have to find the right one for you.

"I think we are tending to make them lighter and brighter. For example, the introduction of daylight is becoming increasingly important. Puk Studios are very Scandinavian; a large airy space where daylight is dominant. Studio equipment can so often be varied and visually untidy, and so we try to use a limited range of materials for finishes. Another Danish project currently in hand is for Werner Studios in Copenhagen, working with a Danish architect. At the last minute we suddenly had to redesign the roof because the client had been to see Puk and decided they wanted more daylight."

Munro Associates are trying more and more to let the form and materials of the shells determine the aesthetic of the room; instead of trying to lose all the acoustic surfaces behind finishes; they are exposing the geometric shapes dictated by the acoustic treatment itself and using them for visual effect.

David Hawkins of Eastlake seems to be the most recent convert, and his enthusiasm is overwhelming as he conducts a tour around Imagination in Covent Garden. Imagination are themselves a design company who deal in massive accounts including all the below-the-line advertising for Ford motors. Being a design company, their own image is of the utmost importance, and they looked to designer Tom Law for inspiration.

The design theme is carried throughout their considerable premises, taking in board rooms, offices, art studios, presentation rooms, the corridors, "even the dustbins have the logo" marvels David, and also taking in, obviously, their own recording facilities.

"I welcome the opportunity to work with a designer," emphasised David. "They tie in the appearance of the whole building. A lot of people imagine that an acoustic designer would resent somebody coming in and taking over the artistic policy, but I think it's a terrific idea. When Imagination took over their premises, they spent another £1M straight away just on the interior decor and it's absolutely spectacular. It is a really integrated theme from the front door handles to the dustbins."

At the time Tom Law had his own company, Tom Law Associates, but he did such a good job that Imagination bought his firm and integrated it with themselves.

Eastlake will often suggest that a client should use an aesthetic designer: "There are two ways of making a studio spectacular: sheer size or sheer style, and a professional designer can create style often better than we can. I am probably going to sound like a real hick now but when I heard in concept some of the things Tom Law wanted to do, I had grave reservations about how it would look at the end of the day. But designing and visualising is the guy's job, and it is absolutely spectacular."

Tom Law consulted very closely with Eastlake on the acoustical requirements they had on every surface in the recording areas. He prepared materials that he would like to use and asked about their suitability, and then he very firmly suggested the colours.

"The timber he specified was Japanese Ash which he stained grey and which I thought would be terrible! But at the end of the day I had to concede that it was very impressive.

"We tend to be a bit traditional and conservative and I particularly, have an affection for attractive and sometimes exotic hardwoods—it's a bit of a quirk I suppose. Left to my own devices I tend to concentrate on those when there are more pop/art finishes which I would overlook.

"At Sarm, I gather, even the teacups were incorporated in the design. That sort of meticulous overview is what a design company is so good for. I don't think any acoustical studio designer would resent being brought into one of those overall concepts."

Over at Imagination, Tom Law based his design around the SSL console which they chose, although they only work 8-track, for its reputation as an upmarket console. The studio colours are therefore influenced by this, not only in colour, but also by being high-tech. Everything is shades of grey or black with a small but striking relief produced by blue beading in various points around the rooms. We only had access to the main studio, but I gather the other facilities are along the same theme.

The Japanese Ash panels are covered with a semi-transparent grey stain; the chairs are black and grey; the grey cotton curtains along the back wall were chosen by Tom, who also found an acoustically transparent grey fabric with which to cover the ceiling and monitors. Eastlake did a lighting plan and Tom chose the fittings.

Even the reference monitors are painted grey. The studio floor covering is a tough vinyl called *Chromine* and the skirtings are, unusually, carpeted rather than wood which is very practical.

The grille frames on which the wall fabric is mounted are set at 30° angles to the floor, and the joints are staggered. "We would have tended to just put them upright, straight up and down, but Imagination said that if you do it like this it will make the room look wider—and it does."

For Tom's part: "I can design anything providing I can run to a 'David' to sort out the technical side and resolve all those problems. I keep a tight control on the visual side; David's job was to design and build the studios while we controlled how it looks using David's judgement and technical input, and it has turned out to be a very successful project.

"With something as technical as a studio there is no reason why it shouldn't look nice as well. And in return you can see the difference in the impression, response, enthusiasm and excitement of the user as they arrive here. It doesn't matter on what level you do it—people do not enjoy squalor and chaos. Studios should not be intimidating, they should be thoughtfully put together buildings.

"David is not simply an acoustic designer. He has the ability to see the visual language and interpret it and, frankly, very little was changed."

Studio design and interior design it must be concluded are destined to walk inextricably hand in hand, and it will be interesting to watch the changes sparked off by the equipment itself, as technology alters the use to which facilities are put.□

Imagination in London is finished in cool greys and blacks

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INTERCONNECTION AS A SYSTEM

Designing the right system will help cut down those unwelcome noises. Incompatibility can also be the cause of problems. An orderly approach is recommended by Rod Duggan (Totalsystems)

Studio installation has changed somewhat since the days of simply *XLR*s and jackfields, with perhaps a few machine remotes fitted into the console. Companies like SSL have introduced the concept of the console as the heart of a control room, with peripheral equipment controlled by and informing, the console's control system.

This works fine if all manufacturers can build compatibility into their equipment, but it only needs one incompatible item to prevent the whole integrated control room becoming a reality.

Unfortunately, this is more likely as equipment becomes technically sophisticated and design is entrusted to engineers who have probably never even seen a working studio. More and more we are finding the necessity of *interface* being involved with installation in order for the customer to realise the full potential of new studio systems. In addition to wiring costs for a new installation, there will now probably be extra costs that should be allowed for possible interface units.

An alternative is to plan the installation carefully before placing purchase orders, and find out precisely what won't work with what, then exert pressure on the relevant manufacturers before finalising the purchase, to provide compatible equipment. Otherwise interface units, being 'one-off' will prove to be expensive, and their need will only be appreciated at the time the budget is starting to overrun. This problem will be readily appreciated by anyone who's tried to work a Sony *PCM-3324* with an SSL or Neve console. An interface is on its way, but it has taken over two years of customer demands to make it a reality.

Systems approach

The amount of items used together in the modern studio has increased rapidly over the previous few years, whether it be effects, keyboards/synthesisers, or control equipment such as synchronisers, remotes or editors. To cope with the reliable and correct interconnection of all this equipment and to allow the various reconnections, reconfigurations and removals necessary if today's expensive units are to earn their keep, a new approach to studio technical design is needed. The whole must be treated as an integrated system rather than separate add-on units, and after installation must be thoroughly tested as a system.

All too often manufacturers will say their equipment is tested and working correctly, and the wiring team will confirm their wiring is to the highest standards—but the customer is left with all sorts of problems euphemistically called 'teething troubles'. These can be eliminated completely if the system is checked thoroughly *after* installation. For example, the correct complete earthing arrangements for a full system cannot be safely predicted, even though rules and guidelines exist for this, nothing can be guaranteed until a full check with scope and level meter has been made.

The large Neve consoles of the early and mid 70s were built and tested with a nominal earthing arrangement, and only at the final stage of testing was the earthing inside the console reconfigured to produce the best possible figures to meet the test specifications.

Electronic balancing

Over the past few years, significant improvements in phase response, high level distortion, low frequency response and economy, have been made by the use of electronically balanced transformerless inputs and outputs. A notable exception was the Harrison console outputs where a transformer was used with an op-amp feeding the signal back to the driver stage thereby including the transformer within the feedback loop. The outputs performed with the quality of transformerless circuits but with the benefit of transformer isolation. However, conventional electronically balanced inputs and outputs are not so tolerant as transformers to inconsistencies in wiring and earthing.

A good illustration of this point is the studio which was using the electronically balanced *PCM-3324*, complaining that the machine had poor crosstalk. Being new technology, and the fact that the old MCI machine had always worked fine in the same position, the *PCM-3324* was the first suspect. The symptom was full bandwidth crosstalk on all 24 return channels of the console. A point to note when examining crosstalk is that if it sounds 'toppy' (worse at high frequencies) then the signal is coming in through a capacitive source—across switch contacts or parallel unscreened motherboards. If 'flat' across the frequency range then the crosstalk is arriving through a resistive source—cable or contact resistance, bad earthing.

Cables between machine and console were removed until only one existed. Crosstalk was still there, 10 dB down from the relevant channel and on all 24 return channels of the console. A wire from the Dolby frame to the console metalwork cured the problem entirely but still the customer found it hard to believe the *3324* was not at fault, after all, his MCI had been working for years with no problems like that. So transformers and the floating isolation they provide can hide earthing problems that electronically balanced outputs cannot.

Checking the system

This is most important, none of this sending music down every channel and seeing if it comes up on the right meters, sometimes even before the rest of the system has been installed. Neve developed the best system I've come across for checking out audio systems, and also the best test waveform (**Fig 1**). An asymmetrically clipped sine wave that has a flat top offers most of the advantages of squarewave testing that Ted Fletcher described in his recent article (How to check if it sounds good . . ., June 1985). And it looks very odd when it's upside down. So this waveform can show phase problems (wiggly top), frequency response problems (tilt and sharpness of flat part), gain problems (size of waveform), relative equaliser performance (reshaping of flat part), and polarity/out of phase connections (upside down or not).

Every path in the system should be checked with this waveform to maintain continuous phase and continuity throughout from the microphone panels to all the outputs. Then an oscilloscope and level meter can be used to look at the noise from the system, instability and hum being the common problems. At this stage, noisy op-amps can be detected that were going to blow during your first few sessions. Crosstalk can be seen and minimised (some console manufacturers won't like this) and your expensive monitor drivers can be spared full power

signals around BBC Radio 4 long wave frequency that would make the voice coils visible through the cones. Incidentally, FM Acoustics recommend monitoring the output of their amps on an oscilloscope as standard procedure in their installation.

A typical problem

When I worked at The Mill, we had a strange problem with the Auratones, they would buzz occasionally and wouldn't sound right sometimes—but never predictably. The fault had been there for some years, but as it only happened occasionally, it was no great distraction and also difficult to trace. An oscilloscope on the speaker terminals showed the problem, the Crown *D60* was unstable and oscillating at radio frequencies. This was traced to the output leads being unscreened and in close proximity to the input leads. For an amplifier that has a frequency response from DC to Ultra-Violet, it had no problem finding a frequency that it liked so much it held on to it. Screening the output leads cured the problem. This is not usually necessary but shows that you should not assume a system works because you have followed good wiring practice—always check thoroughly.

Monitor connections

Monitoring systems seem to attract the most bizarre problems. Quite often the cable used looks as though it was stolen from a welding set. The terminals on the amplifier then have such tiny holes that most of the cable conductors have to be left out then what's left is soldered, inserted, and screwed down. Within days, the solder relaxes under pressure, and within weeks it oxidises over the surface. So the power amplifier that has been carefully designed to have a source impedance of typically 40 mΩ has to deliver several amps of various frequencies through a thin piece of semiconducting lead oxide waggling loose in its terminal. Choose carefully the right gauge terminals for the amplifier and cable used. Crimped spade terminals offer a large surface area for good conduction, and are available in many sizes to suit cable and connector variations.

The cable has to conduct high currents at high frequencies, so it has to be fat enough to cope, but there's no need to go overboard here as difficulties will arise fitting it into the connectors. Also it may be worth checking wiring inside the cabinet—sometimes of telephone extension calibre. If my experiences with some JBC monitors are anything to go by, while you're in there check the relative phasing of the drive units in each cabinet. You might be making a few changes and be pleasantly surprised at the improved imaging, and both speakers will sound similar.

Cabling

All professional cable I've come across is of excellent quality, the only differences being in ease of stripping and preparation. There are a few special cables that overcome specific problems however and two are described here.

I've always kept an eye on the hi-fi market: they can occasionally turn up improvements that escape the relatively conservative professional market.

They have had Linear Crystal Oxygen Free cable for some years and now several professional manufacturers and recording engineers are using it. It starts off as high purity oxygen free copper, which is then heated for several days at 900°C in Argon gas. The crystals grow in this treatment, so when the copper is drawn into cable the crystal boundaries are very few and far between. Coming via the hi-fi market it has been credited with some strange magical properties. The important thing to realise is that it doesn't cause as much degradation over long runs as ordinary copper does. Remember, it may be good but it isn't going to defy Ohm's Law, even if it is made from altar crucifixes and forged on a full moon. Now we have digital recorders, high level distortion in a system is easy to avoid. Low level distortion is now the thing to beat, and careful choice of cabling runs and cable can minimise this.

If you've ever had guitarists playing in the control room with the amp miked up in the studio, then you will know the loss of 'bite' or high frequencies caused by a long stage lead running down the corridor. This is because the high impedance output is loaded down by the capacitance of the cable at high frequencies. Using DI boxes back to back is usually worse. There is, however, a very low capacitance cable that cures this problem, and is sold by RS Components as 'car aerial extension leads' in packs of three 3 m lengths. You will have to chop the plugs and capacitors off, and carefully solder the central core which is like fusewire and very fiddly, but several of these in series carefully installed in the trunking produces a very satisfactory if unconventional long guitar lead.

Control cables are on the increase and many are appearing in studio installations, for video machines, timecode, MIDI control, transport controls, synchronisers, etc. Even more will appear as equipment tends to be designed into equipment rooms, away from the main control room. This brings the flexibility of having different locations using common equipment without physically moving it, and keeps noisy fan cooled items and clanking video machines away from the control room, assisting the low noise floor necessary for monitoring to digital standards. These control cables should all be screened, and if possible, double compartment earthed steel trunking used for cable runs. Put analogue audio and video cables one side, control and digital cables the other side.

For digital audio data, the AES/EBU format uses 3-pin *XLR*-type connectors for the interconnection of balanced digital data with both left and right channels alternating. Cable should have an impedance of 90 to 120 Ω and be twin screened. A variety called Twinax is ideal here, being 105 Ω and low loss. As polarity is irrelevant, there is no pin 2 or 3 hot dilemma.

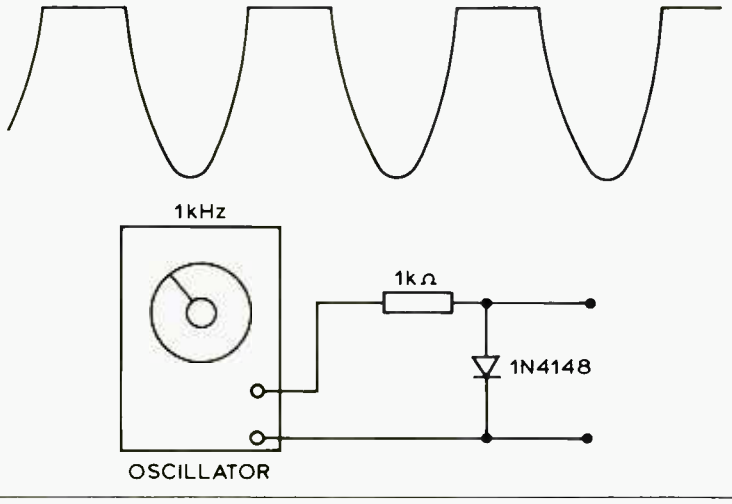
Connectors

Many new connectors are appearing in studios that didn't used to be there, perhaps the most prolific now is the BNC connector. These all look similar but the varieties are numerous. 75 Ω and 50 Ω types are physically different and shouldn't be mixed. Each type comes in different sizes for various diameters of cable, then you can get solder or crimp variety. Forget the solder variety and invest in a crimper—they are expensive, but life is so much easier with it, and you will be making quite a few leads with it. BNC leads 'walk' even faster than *XLR*-type leads, and you can even take the time out to tidy up the *DAE-1100* rats nest by making shorter leads and fitting strain reliefs at the same time, improving the reliability of the leads. Verospeed stock a wide range of coloured strain reliefs so you can colour code your installation and save yourself the migraine when you have to re-connect the *DAE-1100* quickly in the middle of a session.

The old ones are best

If your installation isn't quite up to scratch, and a customer asks why the monitors are humming, tell them it's because they've forgotten the words—or that they need a wash. There must be someone who hasn't heard it yet and it gets it over with quickly.□

FIG. 1 ASYMMETRICAL TEST WAVEFORM



BUSINESS BUSINESS

Barry Fox investigates the facts behind the industry news

Pulling the plug

The high spot of the Government press conference called to discuss the copyright Green Paper and proposal for a tape levy, was a head-on collision between the Minister responsible Geoffrey Pattie, and Bill Johnstone, of *The Times*.

Johnstone asked a not unreasonable question: "If there is a levy that will legitimise home taping of records from the radio, what price the money which the radio stations already pay the record industry for the privilege of plugging new releases?"

Pattie was obviously out of his depth and fudged. Johnstone persisted but never got a straight answer because Pattie threw a huff. "This is *my* press conference and I run it my way."

By an interesting coincidence, Radio 1 Controller Derek Chinnery retired a couple of weeks later. He took the opportunity to rail at the Musicians' Union and Phonographic Performance Ltd (PPL) over their needle time restrictions. Then new Controller Johnny Beerling had something to say and between them they spilled some interesting beans on pricing. Every time a 3½ min pop single is played, the BBC pays out £25 to the PPL. It also has to pay the PRS at the rate of 2% on licence income. That works out at £14.4 million a year. So the total cost to the BBC of playing a pop single is nearly £60. The record industry would be lost without these radio plugs. Witness the industry pluggers who spend their lives trying to persuade producers and DJs to play their singles. Witness the old payola scandals.

The record industry is now trying to persuade the Government that the promised tape levy of 10% on audio, and 5% on video, is not enough. But if the record industry gets a higher levy, to compensate for sales lost through taping off-air, then the radio stations could well propose lower needle time payments.

Have you the right time, please?

If you want to know the time ask a chip.

By now everyone must know that British Telecom has re-recorded its speaking clock, using a BT employee who won £5,000 for his voice after a six month competition between 5,000 entrants. Yawn. But behind all this PR puff there is some interesting technology.

The first speaking clock, introduced in July 1936, used rotating glass discs to store the sound of TIM, just like a film soundtrack. In 1963 the Post Office switched to magnetic drums. Four heads read four tracks, one for 'At the third stroke', another for hours, another for minutes, another for seconds. The pips have been generated by an optical device at the end of the drum shaft. Now the new voice is going into ROM.

For his £5,000 prize Brian Cobby did just two ½ hr sessions at BT's city HQ. He read 60 announcements into a Shure *SM81* condenser mic feeding a Revox *B77* running at 7.5 in/s without noise reduction. All the phrases began with the same words "At the third stroke it will be", even though BT only needed one recording of that phrase. Cobby found that he needed a smooth run into the hours, minutes and seconds phrases that followed. Most of these phrases were recorded several times to give a better bridge between all possible combinations. Also although BT's speaking clock is still a 12 hr clock, the library of phrases will also cope with a 24 hr readout.

The analogue recording was converted to PCM, by sampling at 8 kHz and coding in 8 bit words to give a data rate of 64 kbit/s and standard telephone bandwidth of 300 Hz to 3.4 kHz. The samples were then stored in a PROM controlled by an Intel *8085* microprocessor and quartz clock. The clock tells the processor what phrases to pull out and how to patch them together.

BT guarantees time accuracy of 50 ms a day. But in practice it is 5 ms. The speaking clock is checked every 60 s by a hard wire connection with the National Physical Laboratory's atomic clock at Rugby. This has a caesium tube with a natural resonant frequency of 9 GHz which is divided down and used in the feedback loop of a conventional crystal oscillator to give accuracy of 1 s in every 10,500 years.

Any studio interested in tightening up on its overtime rates, can always tune in to the same atomic clock at Rugby. It transmits timecode 24 hr a day on 60 kHz, 2.5 MHz, 5 MHz and 10 MHz.

Case report

Need a good solid carrying case for equipment? Try the London Graphic Centre opposite Covent Garden tube station in London. They have surely the best range of low cost aluminium photo-equipment carrying cases.

No, I haven't got shares in the company or their casemakers. I bought one, and after hard use the plastic handle broke. In this day and age, when nothing ever seems to be replaceable, I reckoned the case would be a write-off. Not so. The Covent Garden shop put me on to the casemakers—Bellboy of Camden Town. They apologised and did a free repair. You don't often find service like that any more.

(Strange how experiences can differ. I bought a case from the same store two years ago and the handle fell off. When I enquired about spares I was told to forget it and buy a new case—Ed.)

BUSINESS BUSINESS

Turning a deaf ear

Expect some reports out soon, or perhaps they are already out, which reassure people that they are unlikely to go deaf through listening to music through headphones from a portable stereo system. One report is from the UK Health and Safety Executive and Nottingham University. The other comes from Southampton University, those wonderful people who, in the '70s produced that infamous and still-secret report on spoilers for the BPI.

The gist of both new reports is that although you *can* damage your ears with excessively loud sound through headphones played over a long period, not many people are likely to suffer. Some of the scare stories of recent years stem from widespread dislike of portable stereos, because of the nasty scratchy sound which leaks out of the headphones and annoys everyone within earshot.

All the researchers I have spoken with are agreed on one thing: very little scientific work has been done in this field. So no one really knows for sure whether the trend over the last 20 years or so, of louder concert and disco amplification, and then louder personal listening, has made any impact on the overall condition of the public's hearing.

In fact, a lot of good scientific work *has* been done over at least the last 20 years. Every time someone applies to join the BBC as a studio manager (now radio sound assistant) they are put through a hearing test by a Corporation medical officer. There are eight medical centres, two in London and six in the provinces. Around 1,000 people a year are tested and the BBC keeps all the records.

If these files were analysed they could give a valuable fix on any trend towards widespread hearing loss in the public. Everyone who applies to join the BBC is likely to be young and interested in music. They come from all over the country, all classes and creeds. So the hearing test records could be valuable data. Consider the possibility of re-checking ears after a period of years and comparing with the original tests.

I spoke with both Nottingham and Southampton Universities. Neither knew of the BBC data. Nor did other hospitals which specialise in hearing loss. I spoke with a senior BBC medical officer who told me he had, on occasions, thought about doing something with the data but had never had time. Also he had reservations, because the tests have been done by different people on different equipment over the 10-year period. Nevertheless it is a safe bet that the BBC tests will have been responsibly and sensibly carried out. The BBC doesn't bodge. Sometimes a job applicant is turned down simply because of the results of these hearing tests. It would be monstrous if they were being carried out in a sloppy fashion.

Some BBC engineers now believe that the number of otherwise ideal applicants being turned down is on the increase, and that this points to a general trend towards hearing loss among young people who listen to loud music. The BBC medical officer acknowledges that his department has come across some evidence of this over recent years but he does not believe it is firm enough evidence to point to a definite trend. Maybe, maybe not. There is only one way to find out—by data analysis.

It would be unfair for the BBC, already strapped for money, to have to pay for the work. But if the Health and Safety Executive has money to spend on commissioning a university to produce a report on leisure noise, and the university bemoans the lack of hard scientific data available on some areas like personal listening, then surely the HSE should think seriously about funding a study of the BBC's data bank of hearing tests.□

AUTOMATION AND THE VCA

Robin Bransbury of Audio Kinetics discusses the VCA's impact on automation

In the field of console automation, there has been a great deal of development in computer technology to improve the speed and reliability of data-storage. We have moved away from the very unsuitable medium of direct data recording on the master tape to using media which are essentially designed for error checked data recording. However, when looking at the devices which actually use this now highly reliable data, ie the elements which actually control the sound, there are only four solutions available to the console manufacturer:

- Digital control of digitised audio;
- Digital control of analogue audio;
- Motorised controls;
- DC control of a VCA.

Of these approaches, by far the most complex is the first with the sound waveforms converted into digital representations and where the patterns so formed are manipulated in real-time to give new patterns which correspond to the same audio signal but with some parameter, for example the level, changed.

The second technique, in terms of level control, involves using multiplying D/A converters operating on the audio signal in its analogue form where gain control is produced by small step changes in attenuation.

The third approach of motorised control gives the single obvious advantage of instant level presentation and, when used with a dual track fader element, the knowledge that the signal is passing through a purely passive control device. However, as with any electro-mechanical system, there are serious reliability questions still to be answered. There is also the quite severe power engineering problem of providing the heavy start and stop currents for multiple arrays of electronically ganged motorised controls.

The final type of control technique uses one or other form of VCA and this is under discussion here.

Fig 1 shows the circuit of a classic complementary symmetry VCA which in one form or another is in wide use in several types of equipment from the simple limiter-compressor to the large console automation system.

Fig 3 shows the published circuit of a basic class A VCA (not what's actually in the package). It was designed around eight years after the first circuit but uses the same basic principle.

Class A v Class AB

Typical distortion curves of two classic bipolar VCAs which use log/anti-log techniques are shown in **Fig 2.** As we can see, the distortion produced depends largely on both input and output levels and frequency of the signal being handled.

If the circuit is operated in Class A, where none of the devices comprising the central bridge of transistors (usually referred to as the 'core') switches off, the distortion tends to be mostly even order and can be nulled by balancing the handling of the signal. When close to overload, (one quarter of the bridge of devices starting to switch fully off), higher even and odd harmonics begin to predominate and these cannot be removed by balancing. The distortion/frequency curve is, however, relatively flat rising at about 20 dB/decade with rising frequency. The turnover point when using reasonably fast devices is at about 5 kHz so we would expect distortion to be roughly 10 times its LF value at 50 kHz.

We have assumed here that the operational amplifiers used in the circuit still have substantial forward gain for all frequencies of interest and for modern devices designed for audio duty this is usually so. It is important, however, to ensure that the devices selected can cope with the demands made on them and that the quite difficult compromise of stability at widely varying feedback ratios does not lead to over compensation particularly of the input stage. This robs the amplifier of its forward gain and produces an HF distortion breakpoint which is very much lower than indicated in the figure.

Overall, Class A operation gives a reasonably predictable distortion performance which overloads at the input stage in a fairly pleasing and aurally expected manner. Actual clipping does not take place at the input until extremes of current are demanded which the preceding stage would be quite unable to provide and this sets the effective limit to signal excursions for the VCA when used for fader replacement duty where there is a pre-fade stage.

Ever since its launch in the mid '70s, the original dbx *202* module has profoundly changed console design and although most design engineers have not been particularly happy with the performance offered (once they came to analyse it in the role of an attenuator only); compared to the then available alternatives, (saturated transistors, diode bridges, FETs and LDRs), the dbx VCA represented the first really manageable means of remote control of audio by electrical means and can be said to have effectively launched console automation.

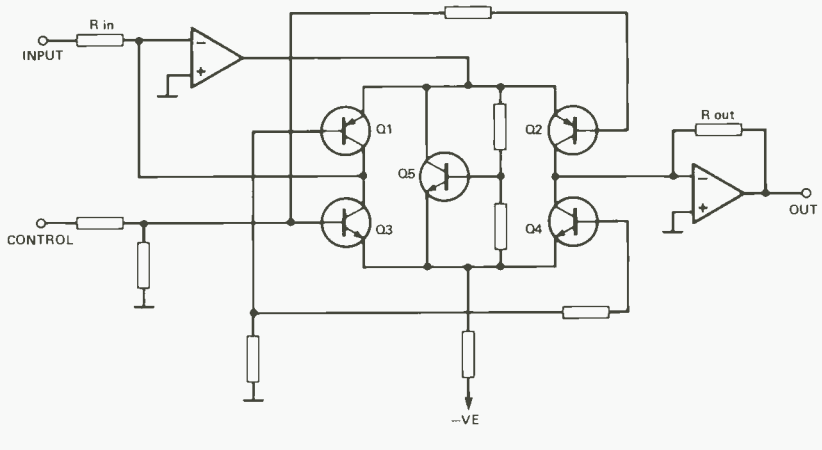
It can be quite amusing to speculate on the situation in this industry if David Blackmer's original work had never taken place. Almost all audio engineers would have had to become expert in the fields of mechanical and servo-mechanical design because, until the rise of all digital methods, we would have been stuck with motorised controls and the constant battle to keep electro-mechanical devices running reliably even when drenched in wine, coffee, cola drinks and other substances legal and illegal.

Even so, the arguments against VCAs have been many. It is a device which relies for its operation on the rather unsatisfactory technique of open-loop matching of semiconductor devices which are very difficult to diffuse on a common substrate.

The phrase 'open-loop' is important because audio engineers are very well accustomed to working with very non-linear devices and large quantities of negative feedback to linearise them.

With current VCA topology, it is not possible to apply linearising feedback directly. We therefore have to rely primarily on device matching with a good deal of subsequent tweaking to get satisfactory performance by removing the last vestiges of imbalance between devices.

FIG. 1



The lack of common substrate is another serious problem because, transistor parameters vary so widely with even small changes in junction temperature. As we are trying to attain perfect matching, we really require the almost identical junction temperatures found within the confines of a well designed single chip; however, there are very severe problems in the manufacture of a truly complementary symmetry single chip VCA which have prevented its implementation throughout all the years the circuit has been known.

The original version of the log/anti-log VCA was designed to operate in Class AB1 mode. There is a small bias current flowing through the bridge of Q1-4, set up by the Vbe multiplier Q5. This bias keeps the devices just conducting under no signal conditions and is great enough to ensure that, for small input current excursions, none of the core devices actually switches off. However, for quite modest input currents, the top (Q1 and Q2) and bottom (Q3 and Q4) halves of the circuit start to operate independently, each switching off as the polarity of the input reverses.

As long as the devices are reasonably well matched for HF gain versus collector current, the tendency for the even harmonics to rise strongly with frequency can be ameliorated but never completely eliminated.

At very low currents, as the top or bottom half is near switch-off, the log/anti-log relationship begins to break down because of secondary terms which have been neglected in the classic relationship used in the design of the circuit. Of prime importance, is the effect of speed on the relationship which becomes a significant factor.

If we choose devices carefully, we can still measure good log/anti-log agreement at currents down in the nanoamp range as long as their rate of change is kept low enough. If we raise the rate of change of current, we find that the agreement becomes less and less perfect. Storage time in the base region causes anomalies so that a device in the input loop (Q1 or Q2) which should be turning off quicker and quicker as its base emitter voltage diminishes, is still conducting far more current than it should be. All would be well if the relevant output device (Q3 or Q4) was doing the exact opposite but, by the time the output side knows about it, the moment when correction was required has passed.

Anyone who has worked on Class B power amplifiers in the early days knows this problem well, the symptoms and their results are virtually identical; we find low and mid frequency crossover distortion caused by mismatches at the origin where one device takes over from the other and this symptom gets increasingly worse as the frequency rises as storage time effects predominate.

The large germanium alloy transistors which were pressed into service in those days were quite incapable of good performance below quite large currents and above modest speeds. As we reduce collector currents, silicon planar devices show just the same problem. The Class AB VCA therefore has a strongly rising frequency/distortion characteristic and a turnover frequency around 1 kHz or below.

Worse than this, the order of the harmonics goes up so that rather than finding substantial 3rd and a little 5th, we can find crossover distortion's classic spectrum of stong components up in the 9th and 11th region. It has been shown that the nastiness factor of distortion is closely related to both the level and order of the components involved. The effect of distortion seems to be proportional to the product of the level and order so even small levels of high orders are as nasty as proportionally high levels of the low orders.

Class B operation, however, has one other facet as anyone who has been unfortunate enough to be in the immediate vicinity of a transistor radio with a failing battery can witness: it provides highly effective noise gating. When the broadcast contains quiet bits, the speaker falls silent with an occasional grating croak to show that the set is on. Whereas, especially on AM bands, a fresh battery shows the set to be very noisy.

Considering the VCA's input stage (in common with most transistor circuits) the noise produced by the stage depends on collector currents in the active devices. For low noise, low current is needed. The Class AB VCA has the remarkable property of instantaneously adjusting the collector currents in sympathy with the signal passed so that for no input, the noise is at a minimum. As the input level rises, the noise rises proportionally but as there is signal present, it masks the noise.

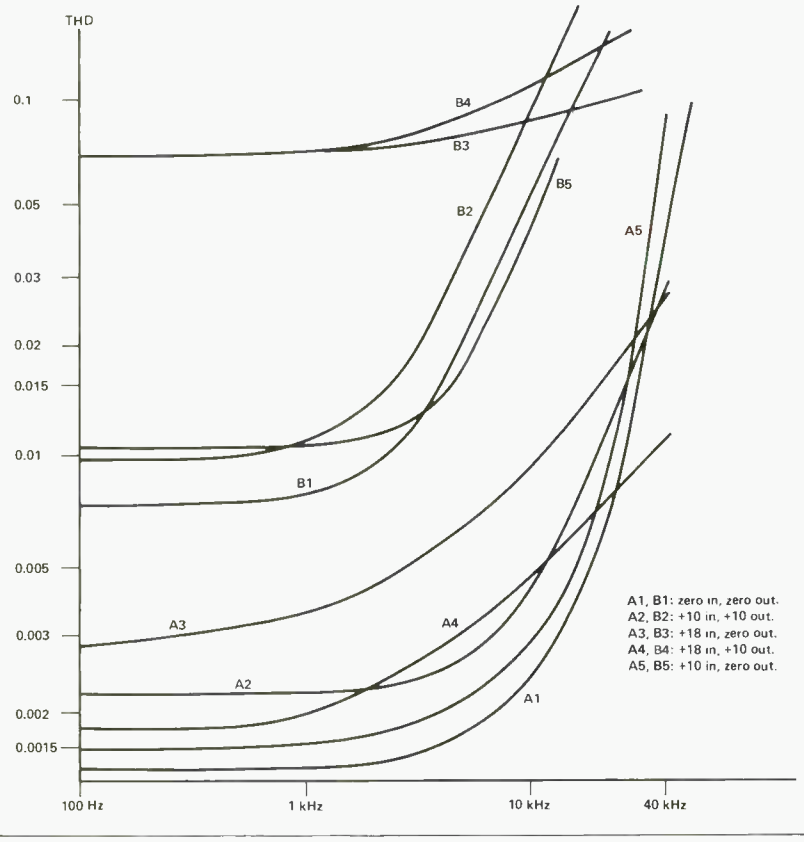
Checking the recovered waveform from a distortion bridge shows up this effect very clearly. The noise modulation can be clearly seen but, unless the input noise really is excessive, the masking effect of the signal makes it difficult to hear. As masking is an inherent property of hearing, it is difficult to believe the claims by some researchers that the very low levels of noise modulation found in Class AB VCA's are as audible as some studies suggest. It is important to realise that the sidebands of noise modulation are so diffuse that the energy present at any one frequency is extremely low especially in the presence of a dominant audible signal. On tone, however, the effect is very visible on the recovered distortion bridge output which may give us a clue to why it is thought to be so profoundly important to the committed audio purist.

Returning for a moment to our Class A VCA, **Fig 3,** the bias through the core is set by the total current flowing through the core with a smaller surplus taken by the central balance pot. The sum of the currents flowing through the two halves of the bridge is arranged to be greater than the peak signal current which needs to be handled by any of the devices, hence the device is biased into Class A conditions. However, because all devices are always on, the noise gating effects disappear, along with a good deal of the nastiness factor of the distortion spectrum. The output contains the full noise output of both input and output stages with the signal which previously masked the noise now replaced by inaudible DC current with no masking properties at all.

To improve the Class AB VCA, we would need devices which are fast enough to establish reliable log/anti-log performance at the vanishingly small currents available at the zero-crossing point.

Since h_{fe} is almost directly proportional to collector current in the

FIG. 2



AUTOMATION AND THE VCA

range of currents under consideration, to preserve reasonable transistor behaviour at or near the vanishingly small currents that flow as the input crosses the zero axis, we would need to be using either very fast gold doped switching devices which leak abominably (and often very noisily) or very small geometry devices designed essentially for UHF duty rather than optimised for audio use.

Since good log performance depends partly on very low leakage, gold doping is obviously out. As far as the use of UHF devices is concerned, while they might solve some of the low level problems at and about the axis, we must also bear in mind that the current handling capacity of a transistor is, to a first approximation, determined by its active area. So we would be swapping small benefits at low levels for much greater problems at high levels.

The compromise usually adopted is to use reasonably fast high gain silicon planar devices originally designed for use in audio driven and medium power stages. (Various experiments have been done with larger and smaller devices the results of which are quite interesting.) Mention of the word 'stability' to those colleagues who have played around with very small geometry devices will raise a wry smile. To those who have not: experiments with such devices are constantly dogged by apparently inexplicable phenomena which can almost always be put down to oscillation at frequencies so far outside our normal domain that standard issue test equipment is totally useless even as a guide to its presence.

In the final analysis, the optimum VCA would be Class A with automatic adjustment of the operating point for any level of signal through the device. For low levels, the device would operate in the A part of the Class AB1 transfer characteristic. At higher levels, the operating current would be adjusted to maintain Class A operation by some external means.

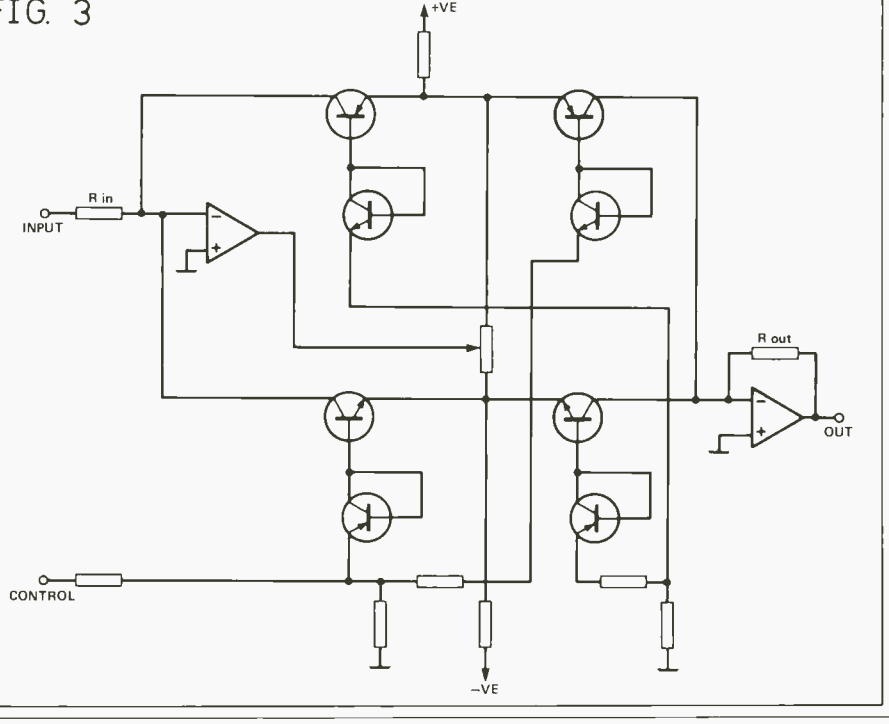
In the limit, when there is no input signal, the collector current would need to be reduced to a minimum which prevents low level HF signals from suffering distortion. In practice, the low level current could be that needed to give the required noise performance whilst providing the benefits of Class A operation when the input signal rises.

In a way, such a VCA would be working in the inverse of Class AB operation so that, although it never in fact reaches Class B, one could think of it as 'Class BA' when describing the genre. However, whilst such a design would have very significant advantages when compared to either of its precursors, the adjustment of the operating point should never be allowed to cause any significant change in the standing output voltage or distortion trim setup otherwise we may introduce another form of envelope dependent interference into the output waveform.

This last stricture would mean that the classical methods of balancing VCAs need a good deal of revision. Unless the devices are matched or balanced both NPN to NPN, PNP to PNP and now, NPN to PNP for both sides, changes in operating point can and will introduce non-symmetrical changes in the working conditions of the quarters of the bridge resulting in some highly undesirable effects.

If it were possible to somehow isolate the AC and DC balance of the core devices in a way that balances the devices for all conditions of signal, bias and control drives, then we would be some of the way towards implementing the circuit but, put mildly, this would be tricky as we now have an extra variable to consider and one which has a profound effect on the setting up of the circuit at a very wide range of conditions. For each new condition, we need an extra testing step and, as many test engineers will vouch, setting up VCAs is enough of a nightmare already.

FIG. 3



Passing on to another serious problem with Class A VCAs—control voltage modulation—the effects of Class BA working would be highly beneficial once we have found the right balancing technique. In the much used Class A VCA (**Fig 3**) any imbalance in the conduction of the bias current through the upper and lower halves of the bridge force current into one or other inverting input. The imbalance current will be a function of junction temperature differences, bias current and the amount of control signal so that if the bias current and the junction temperature differences can be reduced, the imbalance current goes down in sympathy.

One of the functions of DC control is to group VCAs together and control them from a single fader. As can be imagined, with a poorly set up VCA system, it is virtually impossible to ensure that a group mute or solo in place, selected during a quiet passage will not cause objectionable 'thumps' in the mix, especially as all faders have their outputs combined and each contributes a similarly interfering signal.

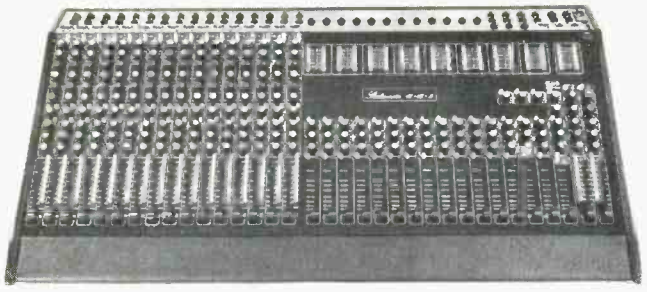
The rectifier for the bias current adjustment would also require very careful selection. In theory, it should be a true ideal peak rectifier so that any incoming peak signal of either polarity is given adequate bias current. This would, however allow, isolated low energy spikes to switch on the bias and give a rather disturbing noise modulation which, because it is no longer synchronous with a masking signal, would now be highly perceivable. The rise time would, therefore, need to be a carefully tailored compromise between fast action and response to small area spikes. The decay time similarly needs to be chosen so that the ear's AGC action never allows the noise from VCAs which were carrying high level to be perceived. The matching of the ear's reaction time suggests a syllabic rate for the fall time. This would, however, be bound to affect the much lower frequencies found in music so we would need to resort to some of the attack-hold-release techniques found in modern compressors.

In the end, the optimum values would probably have to be chosen by experiment. The distortion on the lowest frequency has to be measured and the fall time adjusted so that the effect would be just measurable (an increase which was just visible on the recovered distortion waveform should be satisfactory). Then a toneburst generator could be used to listen to the VCA and adjust the rise time so that the recovery of the ear does not perceive the noise modulation. Finally many types of music would need to be listened to while noting the settings found best and the average of rise and fall taken for comparison.

The VCA does not clip in the classical manner, it overloads gently with hard clipping in the circuit itself way beyond the overload margin of the preceding stage. This feature of the VCA would work very much in favour of the Class BA stage because it limits the required speed of reaction of the rectifier. The level of TIM present in an initial ▷

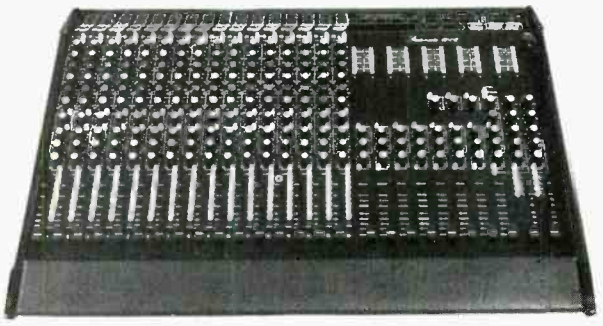
STUDIOMASTER

16-16-2



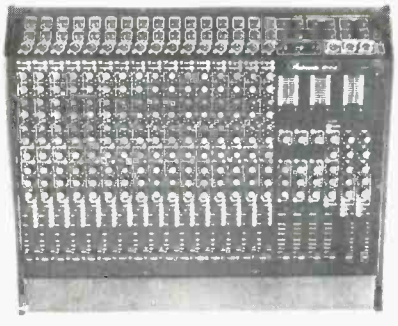
The 16/16/2 is designed to complement budget 16-track recorders. It features its own external P.S.U. which can supply even a fully expanded 16/16/2 (a 32/16/2!). All mic. channels have 48V Phantom Power, parametric E.Q. network, and 3 auxiliary sends. Full 16 channel monitoring is included in the 16/16/2 package. 12 segment 2 colour bargraphs are fitted to the 16 sub-mix stages and the master output which is also fitted with 3 band E.Q. As well as optional expander modules for the mic. channels, a double patch bay is available.

16-8-2



The 16/8/2 is compatible with 8-track recorders and has all the versatility of the 16/16/2, like optional expander modules for the mic. channels (an extra 16 mic. channels may be fitted without altering the unit's P.S.U.) and a double patch bay. Mic. channels feature 48V Phantom Power, parametric E.Q. network, 3 auxiliary sends and 90mm faders. Full monitor and foldback systems are included. Master outputs have 3-band E.Q. and 2 colour 12 segment bargraphs. These bargraphs are also fitted to the 8 sub-mix stages. Applications for the 16/8/2 include small 8-track studio mixing and live sound reinforcement.

16-4-2



The 16/4/2 is the mixer that the 16/8/2 and 16/16/2 developed from and consequently contains all their superb features. It is expandable to 32/4/2 on its existing P.S.U. and a patch bay is also available. Mic. channels have parametric E.Q. network, 48V Phantom Power, 3 auxiliary sends and 90mm faders. Full monitor and foldback systems, 3-band E.Q. on the master outputs and 2 colour 12 segment bargraphs are all supplied on the 16/4/2. Uses of this mixer include live sound reinforcement and for use with 4 track recorders in small studios.

6-2-1

The STUDIOMASTER 6-2-1 mixing console offers features and performance normally obtainable from mixers costing twice the price. Mic. channels feature three band e.q., effects and monitor sends as well as the usual gain and pan controls. 2 colour, 12 segment bargraphs allow monitoring of channels, auxiliaries and both stereo and mono sum outputs. This outstanding specification makes the 6-2-1 ideal for sub-mixing, P.A. and recording.

Mosfet 500

With distortion not exceeding 0.005% (1kHz sinewave at 200 watts/4ohms) this amplifier provides reliable amplification of outstanding fidelity in all applications. The extensive protection circuitry ensures failsafe protection against D.C., thermal overload and short circuit conditions. The front panel carries LED indication allowing instant monitoring of the amplifier's operational status. The Mosfet 500 is ideally suited to all professional applications requiring medium power, accurate reproduction.

Mosfet 1000

This high power amplifier delivers twice the power of the MOSFET 500 with the same 0.005% distortion (1kHz sinewave at 400 watts/4 ohms). This amplifier has already proved itself under the most stressful of applications and is fast becoming the standard against which all other amplifiers are measured. The Mosfet 1000 delivers high power with total fidelity in all applications.

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transient can be roughly gauged by running the circuit without moving the operating point with an input level around the expected peak of a transient and measuring the distortion. Alternatively, we could measure the compression or expansion of a train of high level spikes with the sliding bias disabled and then enabled.

A Class BA VCA would have an enormous advantage over previous technologies in terms of both idle channel noise and distortion but, the important point to note is the requirement, using standard trimming techniques, for matching between PNP and NPN devices in addition to the normal NPN:NPN and PNP:PNP matches we are used to.

On the face of it this is very difficult indeed but recent researches show that it is not only possible, but fairly simple; if we can tolerate an additional trimming pot to set up the new structure.

From the X-ray micrographs, we can investigate the internal structure of various VCAs in common use. **Fig 4** shows the internal structure of the *EGC101*. We can see that the array consists of a small PCB with the track side uppermost which has 8 epoxy transistors soldered to it. The leads point downwards and are substantial copper wires which will conduct thermal transients into the body of the resin coat and therefore upset the thermal balance of the array if there is a large area of copper foil on any of the pads on the user's PCB on to which the leads of the device are mounted.

AUTOMATION AND THE VCA

This structure will only work well in class A and derivative designs as the amount of thermal coupling between the junctions is minimal, the sources of thermal perturbation many and the thermal capacity of the array, quite large.

Fig 5 shows the structure of the *TA101*, which is a derivative of the first array. Here, some attempt has been made to improve the thermal coupling over the previous device.

FIG 4

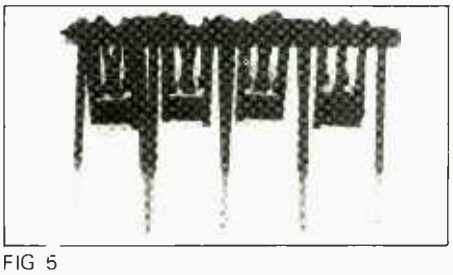
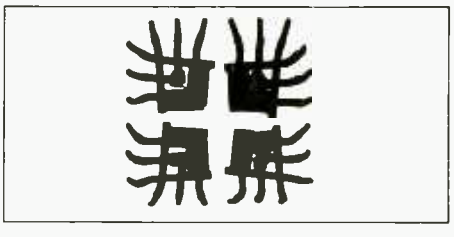


FIG 5



The stucture consists again of small epoxy devices which have been slightly ground down to reduce the amount of epoxy B between the chip and the outside world. These ground down devices are then potted in resin with pairs of opposite polarity each placed on top of its complement and separated from each other by at least a millimetre of not very conductive epoxy B. The total thermal capacity for this array is around a quarter of the *EGC101*. The coupling provided by simple proximity will be nowhere near as good at that of the very high conductivity of the collector flag of the transistors' leadframe but at least some attempt has been made to link the devices. If this array is compared with mounting the devices on a high conductivity substrate or, of course, co-diffusion on the same piece of silicon then we can see that there are several orders of magnitude difference in the thermal linking coefficient between the cottage industry version, and the purpose designed device.

One important consideration to bear in mind when using the device is that the collector tabs on which the chips are mounted have a direct metal connection to the outside world. This means that any transients induced on the collector leads will have a greater influence on the thermal balance of the chips than the proximity effect through the epoxy left after grinding down the devices. The all important parameter to consider is

Integrated PNP transistor in VCAs

Apart from the classic complementary symmetry VCA circuit, there are a number of important alternative topologies, most of which are specifically designed to avoid the use of PNP transistors in the gain cell.

The need to avoid integrated PNP devices can be appreciated when the processes required to make devices usable in log/anti-log circuitry are studied.

Linear circuits have traditionally been fabricated on P type substrates. This topology is the best choice for most purposes because, if the substrate is tied to the most negative point in the circuit, it becomes an automatic reverse biased diode between the collector of an NPN transistor and the substrate. However, to make a simple vertical PNP device, one has to use the P type substrate itself as the collector region. This connection obviously limits the usefulness of the resulting transistor.

With a P type substrate, NPN devices are easy to fabricate. If we want a high gain device, in principle, all we have to do is to make a reasonably deep collector diffusion, a very thin base diffusion on top then a well distributed emitter diffusion on top of that.

The major process parameters are defined by time, temperature, dopant type and concentration. Using the same masks, we can experiment until a satisfactory recipe for a device is found.

But to make a PNP device which does not have its collector directly in the substrate, we have to resort to the lateral PNP device. In the lateral device, the electrodes are formed by placing masked diffusions side by side where mechanical linewidth becomes the determining factor in junction geometry. We can no longer rely on process tweaking alone to obtain the required final result, to improve the performance, we now also have to change the actual outline of the masks. We will, however, always be stuck with the fact that current has to flow sideways through the minor axis of the device which can never give the kind of performance available in a transistor where the layers are on top of each other and current flow is through the major axis.

In the end, without impractical design rules, the resulting devices are very much less than perfect. In fact, most lateral PNP devices have a beta of between 1 and 5, which is very dependent on collector current peaking sharply and falling away to vanishingly small values over only two to three decades of current.

Looking back at the structure of the classic NPN-PNP gain cell, we can see that we require very perfect transistors none of which can have its collector buried in the substrate because the commoned emitters of the NPN devices must assume the most negative potential. The transistors have to have the highest possible gain which has to be usable over at least four decades of collector current.

There are ways of making circuits with vertical devices of both polarities, we would start with a substrate of either polarity and grow a thin oxide layer over it and on to this is grown an epitaxial layer of doped silicon. Where there is to be a transistor of inconvenient polarity, its collector area is isolated by removing the epi layer down to the underlying oxide. This method of 'Dielectric Isolation' is a little more tricky to control than the alternative 'Silicon on Sapphire' technique but uses very much cheaper raw materials.

Suppose we start with P wafer, and grow a P type epi layer; after isolation, we would run an N type diffusion for the PNP bases and NPN collectors. Then there is a cycle of P type dopant which forms the NPN bases and the PNP emitters. Then there will be an N type cycle for the NPN emitters.

This may sound relatively simple except for the problem that we would be attempting to make collectors for the NPN at the same time as we are trying to make bases for the PNP.

To obtain good gain, we require the thinnest possible base region and to make the process workable, we need a reasonable depth for the collector.

the exclusion of unequal relative heating of areas of copper track soldered to the leads carrying the collectors of the individual chips.

One amusing aside is that transistors with a much thinner covering of epoxy are available from Ferranti under the *E-line* trademark. If these had been used, one of the more tedious manufacturing operations might have been avoided.

Looking now at **Fig 6** we can see that the dbx *215x* series is a single chip design. The chip area at 65 by 75 thou is respectably small for a special product linear. As can be appreciated, the immensely tight thermal coupling between the elements will be several orders of magnitude better than the discrete arrays.

Apart from the substrate flag, the thermal conductivity of the bondleads connecting the chip to the leadframe is vastly smaller than the very thick leadframes holding the devices in the discrete array. There is, however, one minor point which might be borne in mind, the isothermal centre of the chip has not been orientated through the centre of the substrate lead (pin 5) so a strong thermal transient on the lead can give an appreciable shift in the balance of the chip. In comparison with the discrete array however, this is a minor effect but may explain the lingering presence of thermal effects in a wholly integrated device. It seems a pity that a single sided, committed die-attach area lead frame was used on this device because an ordinary dip frame with a central spine could have been used which would have had no high conductivity unbalanced path to the outside world.

Interestingly, although this device is marketed by dbx, the originators of the complementary symmetry log/anti-log VCA, it appears to be an all NPN design with most of the chip area devoted to large transistors which form the central gain control core and thermally linked bias network.

The last device, the *SSM2013*, (see **Fig 7**) is even more thermally symmetrical still, there is no direct lead frame path to the outside world because an uncommitted frame has been used and the ground connection is via a bond lead.

In many ways, these devices show an evolutionary trend, from the six metal can transistors in an alumina heat link of the early dbx *202* to the wholly integrated designs of the last two examples.

None can be considered truly ideal yet as the totally integrated complementary symmetry design has, as yet, not been implemented. The process problems inherent in doing this are outlined in the note but, with the steady rise in use of ion implant dielectric isolated technology, the final goal could be in sight.

The VCA has had its champions and its total opposition from various parts of the industry. No one can seriously doubt that the impact of the VCA will continue to grow with the new breed of analogue assignable consoles which economically cannot exist without them. It may be that some of the performance claims for early VCAs which did not take into account the special problems of using the device as the main channel attenuator, have coloured customers' attitudes to what, these days can have a performance indistinguishable from a passive control element.

The vast majority of recently recorded material has had part or all of the signal sources processed by VCAs in one form or another and they continue to aid the engineer to improve his product in applications from the humble compressor to the full blown automation system. With the rise in digital recording, their performance has had to improve and recent developments have moved the onus of quality away from the VCA to other parts of the recording chain. □

FIG 6

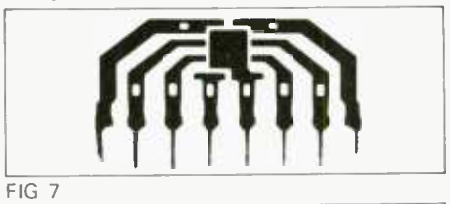
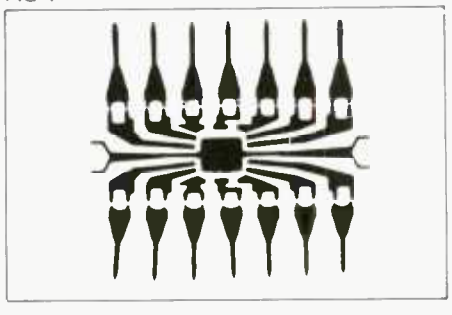


FIG 7



With this we would end up with PNPs with enormous bases and useless gain or NPNs so thin we would never be able to form reasonable electrodes in the depth allowed.

Furthermore, the devices we are trying to make should have, as closely as possible, the same general structure and geometry. Thus we are left with the problem that we have to form similar polarity electrodes on different diffusions, thus putting up the number of separate steps. With thermal diffusion each run of oxidise, mask, strip, clean and diffuse produces degradation of the electrodes formed before. The device would end up with difficult to predict performance, and wide differences between the performance of different batches.

The heat used to drive the dopants into the wafer also drives existing diffusions deeper so as each further diffusion is done, the previous layers take up different positions and become more dispersed. Added to this, we have to take into account the considerable difference in mobility of the different dopant molecules through the lattice. It is a tribute to persistence of diffusion engineers that many of the early integrated circuits came into being. With the number of variables involved in getting each layer to end up where it is required, countless unsuccessful attempts at finding the correct diffusion 'recipe' must have been needed before working parts were obtained.

There is, however, another diffusion technique which solves some of these problems, it is called 'ion-implant' and relies on the fact that we can give dopant molecules the energy they require to enter the lattice not by simple heat but by accelerating them in an electrostatic or electromagnetic field along the lines of the particle accelerators used in atomic physics.

The technique has the added benefit that we can actually purify the dopants as they are deposited by using the mass spectrograph technique. In the ion implant diffusion module, the target wafers are placed in an evacuated chamber and a source of the dopant is placed at a high potential and heated. The hot dopant molecules are ionised by the strong local electrostatic field and can now be focused into a beam using electrostatic lenses, much as happens in a CRT.

The beam is accelerated up to the required energy to penetrate the lattice of the target using synchrotron techniques. When a magnetic field is placed across the emerging beam, an impure source of ions will be deflected according to the atomic mass of the element concerned and the beam will spread into distinct bands, each made up of different mass ions. If we then direct only that part of the emergent beam with the correct mass towards the target, we can obtain a stream of high energy, very high purity ions with just the right characteristics to give the diffusion profile we require. As can be appreciated the major benefit of this technique is that control of the diffusion parameters can be much greater than thermal technology.

The one great advantage provided by ion implant is that the wafer itself is not strongly heated so the diffusion layers stay very much where they are implanted throughout the diffusion cycle. For the long job of epitaxial growth, and sometimes the initial collector diffusion, thermal will be used but for critical layers, ion implant then takes over.

Clearly, ion implant provides almost the ideal solution for the fabrication of integrated circuits which require very precise control of layer structure or where very tight design rules are used to pack more devices into a chip.

The drawback is of course cost; both capital and running costs are several times that of standard thermal diffusion. It is now becoming commonplace to use 4, 5 and 6 inch diameter wafers for circuits with mass sales. Each of these wafers can hold thousands to hundreds of thousands of devices, and scores of wafers can be loaded into each thermal diffusion module. Contrast this production capacity with the very limited usable target area of an implanter and we can see why the technique is only used substantially on high value circuits where the vastly increased manufacturing cost is warranted by a high sale price. □

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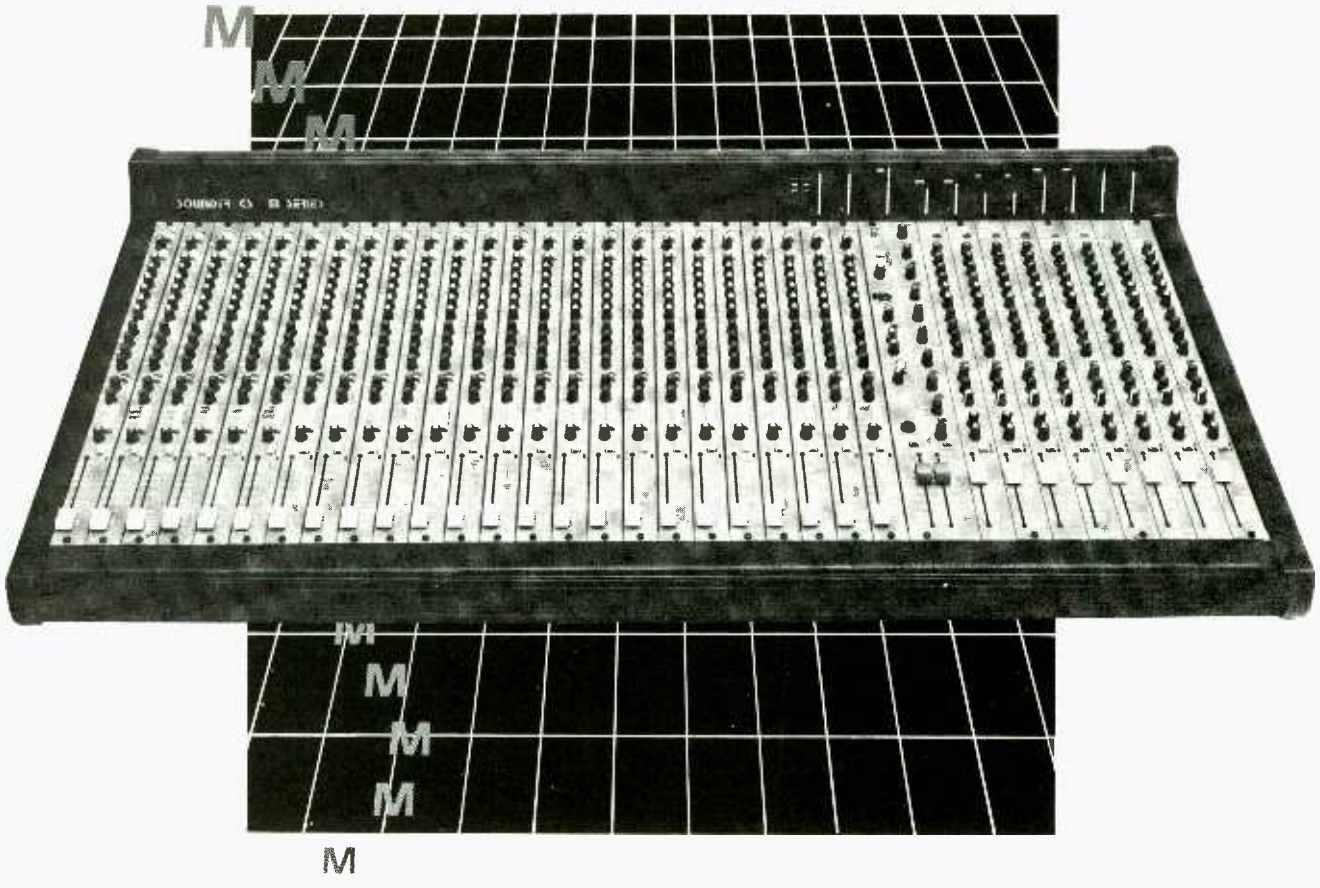

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Replies to Box Nos. should be addressed to the Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality. **SEX DISCRIMINATION ACT 1975:** No job advertisement which indicates or can reasonably be understood as indicating an intention to discriminate on grounds of sex (e.g. by inviting applications only from males or only from females) may be accepted, unless (1) the job is for the purpose of a private householder or (2) it is in a business employing less than six persons or (3) it is otherwise excepted from the requirements of the Sex Discrimination Act. A statement must be made at the time the advertisement is placed saying which of the exceptions in the Act is considered to apply.

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SERVICES

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Rapid supply of high quality blank bulk cassettes C1-C120

5 screw C-Zero – no minimum or maximum order.

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COMPREHENSIVE FACILITIES
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VAT No. 336 2323 19

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CLASSIFIEDS

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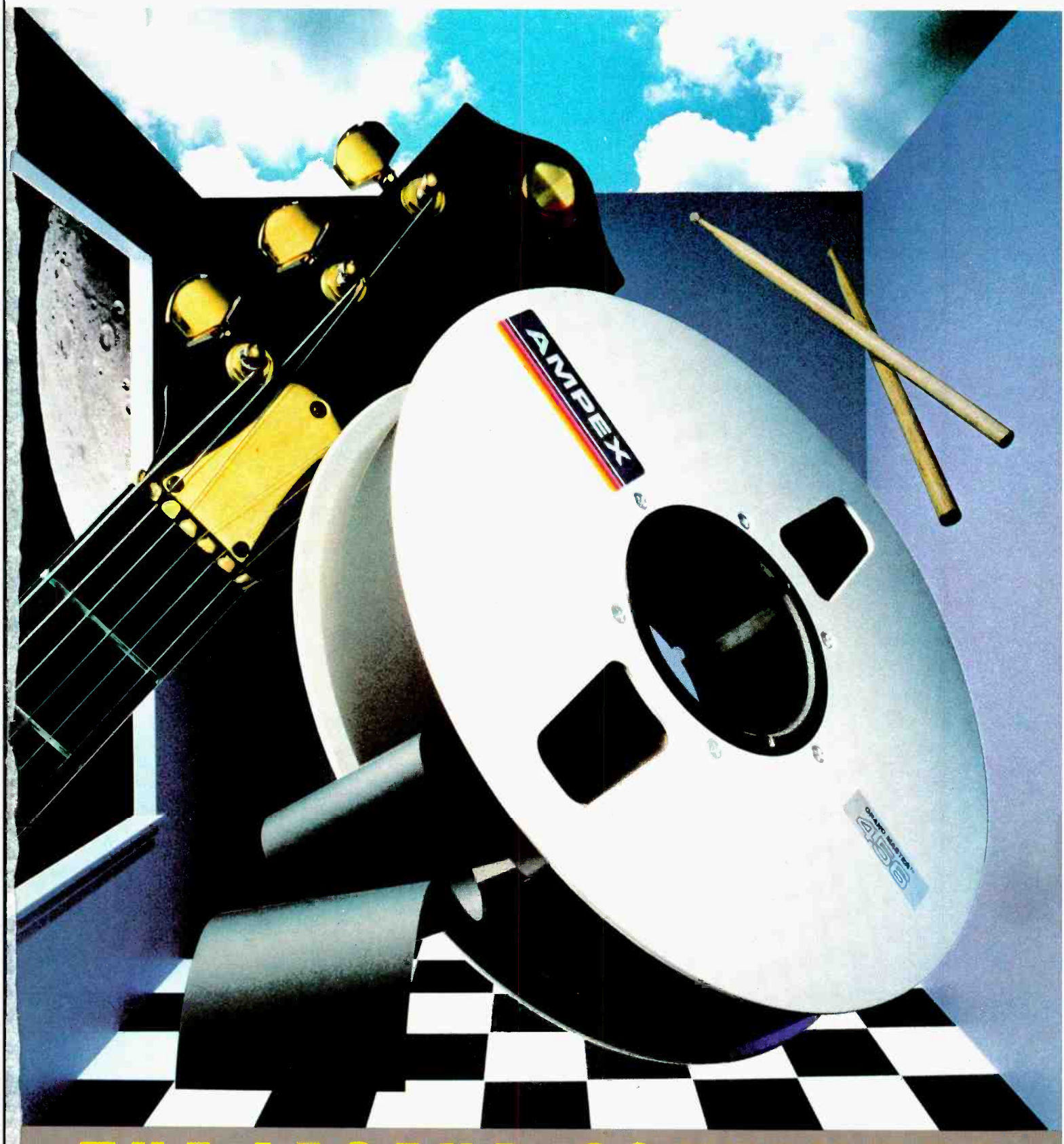

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