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#### REGULARS

Editorial: Keith Spencer-Allen asks are our standards slipping?

- **18** Diary: In brief—Stolen equipment—People—Dolby SR progression—Forthcoming events—Agencies— Contracts—Test equipment for hire—Power crazy—Ray Dolby receives OBE—Technical Projects update—Stirling Audio and ITA union— Software updates
- 27 New products: BSS signal distribution system– Sennheiser MKH 20 mic–Tascam professional range–Studer A820 multitrack–JBL/UREI 7922 digital delay–Orban Programmable Mic Processor–Seck 242 console
- **36** Studiofile: Clifton Studios, York–Fifth Floor Productions, Cincinnati

**Business:** Barry Fox reminds us of the history of the proposed tape levy

#### REVIEWS

68

Applied Research & Technology DR1 digital reverb system: A user report by Dave Foister

**RE Instruments RE201 dual channel audio analyser:** A technical evaluation by Hugh Ford



#### SPECIAL FEATURES

**Recording in Scandinavia:** Introducing our series on international recording, Janet Angus visits Scandinavia

42

An automated test set: Burkhard Braach of Wandel & Golterman describes the development of the NFA-1

60 Test tapes and discs: A guide to available tapes and discs

**62** CD test discs: Hugh Ford appraises CD test discs which are commercially available

#### FEATURES



4

**Opera on the road:** Jim Betteridge was at Luciano Pavarotti's Wembley concert. This was part of a world tour in which Pavarotti sung to unusually large audiences

56 In perspective: Comment on synthesised music from Martin Polon, US columnist

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# E D I T O R I A L E D I T O R I A L

This month's comment from Keith Spencer-Allen

#### Don't shoot the messenger

Editors of trade magazines such as this are allowed occasionally to be smug and self opinionated—it's one of the perks of the job. We are just far enough removed from the real life world that we are writing about that we have a freedom to comment and make almighty pronouncements in highly moral tones. And of course we are able to live without the financial burden that our words imply.

Sometimes, though, thoughts need to be aired even though it is probably the last thing that the financially stressed studio owner wants to hear and if I were in his shoes I would most likely be sticking pins in an effigy of this editor.

Studios have always to compete for business although rarely to the degree that is common today. We are not just competing with the studio down the road but also the studio offering climatic or financial inducements from the other side of the world. In general, a little competition is beneficial provided that absolute standards are not lowered in an effort to reduce costs. This is unfortunately what we are seeing a great deal of right now and I have to say that this is a very bad step.

A professional recording studio is seen by the layman as a place where engineers, producers and musicians spend many hours perfecting sounds and music with an attention to detail that is fabulous. Studio equipment is also meant to be far in excess of domestic equipment in terms of performance so that the maximum fidelity is captured in the record/tape/ CD and the more money the consumer spends on their hi-fi the more musical sounds they extract. This stopped necessarily being the case several years ago and as yet as an industry we haven't been generally sussed.

Domestic systems have developed in leaps and bounds to the point that pro gear has to be that much better to meet consumer standards. One area vital to this end is the maintenance of equipment in peak operating condition, however, the industry seems to be heading in quite the opposite direction such that the studio with a staffed maintenance department is a rarity.

We have touched on these problems before. It is undeniably true that equipment reliability has improved and there are fewer pieces of equipment around that need nurse-maiding in quite the same way as was often the norm in days past. The trend to rely on the manufacturer or dealer for service is hardly the attitude for a so-called professional industry. The role of modern maintenance should be to squeeze maximum performance from equipment by ensuring that it meets and exceeds original spec. This is the attitude that we need to fulfil the possibilities presented by the new generation of musical software. The dusty battery-powered oscillator in the corner is not the image we should aim to project. Also the trade organisations should be strengthening their attitude to this area rather than condoning the running down of the studio maintenance capability.

At a time when there is a gradual uniformity of approach



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New readers: Link House Publications plc, Link House, Dingwall Avenue, Croydon CR9 2TA, UK, Tel: 01-686 2599. Free subscriptions: Controlled in studio design, equipment and other facilities almost on a global basis, competitively-minded studios could be using aspects of maintenance in their marketing approach. Although this may be rather foreign to many, it could work if presented in the right way. It also has the advantage of being cheaper than most of the other areas of equipment competition. OK it may mean a new member of staff but a compromise is making itself available, in the form of automated testing systems—systems that allow complete multitracks to be checked out, or consoles or other equipment simply by connecting all the interfaces to the test system and just running the program. It may be that you only need to hire the services of a new breed of freelance maintenance engineer who just sets up the automated equipment and leaves it running to return a couple of hours later when the automated test equipment can be interrogated for problems. This is not a far flung future-most of the capabilities are here now. They are also far more expensive than you are used to paying for your maintenance and servicing. They are, however, much cheaper than competing with the studio down the road in terms of digital multitracks or mixing consoles. Marketed in the right way such attention to equipment care could become a powerful tool, eg how would you react to the following fictitious sales copy?

XYZ studios now offer you even less for your money. Our studios are fully equipped with some of the best equipment that money can buy. We have recently taken a new approach that ensures that this equipment is still the best equipment that money can buy at the start of every session. What is the point in spending heavy bucks on expensive studio time if the end quality of your recording is a matter of chance. We believe that you should get what you pay for-less distortion, less noise, less deviation from the manufacturer's specification—that is less of everything you don't want and just what you do. Before every session our automated test systems run diagnostics on every major item of equipment in the studio to verify full performance on every session. Should you wish to do so these performance measurements will be available for inspection during the sessions—your guarantee that when you are paying for the best that is what you are getting. Where else can you be sure of that? And why not?

# And around the world in several issues

This month sees the start of a series that will focus on specific countries and areas around the world—looking at their recording industries and other influences that make that area the way it is. Although we now have most areas of the world covered, we would still like to hear from people who have a detailed understanding of a specific area to contribute to this series. I hope this series will also emphasise the international nature of our industry and show that competition comes from the most unlikely places.

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C10-C19	26p	24p	22p	33p	31p	30p	36p	35p	34p	C15	36p	34p	32p
C20-C29	28p	27p	25p	35p	34p	33p	42p	41p	40p	C20	38p	37p	36p
C30-C39	31p	29p	27p	38p	35p	34p	46p	45p	44p	C 30	44p	40p	38p
C40-C49	33p	31p	29p	42p	40p	39p	52p	51p	50p	C45	46p	42p	40p
C50-C59	36p	35p	34p	50p	48p	46p	60p	59p	58p	C60	52p	46p	44p
C60-C69	38p	37p	35p	54p	53p	52p	66p	65p	64p	C90	60p	56p	52p
C70-C89	46p	42p	41p	72p	70p	68p	84p	82p	80p	C120	76p	72p	70p
C90-C95	48p	43p	42p	74p	72p	70p	90p	88p	86p	Above prices include Inlay Cards, Side Labels. Library Case. The product is supplied overwrapped			
Library Cases	6½p	6р	5p	6½p	6р	5p	6½ p	6р	5р				

All prices exclude VAT. Orders of £80 (ex VAT) Carriage Paid. Small orders add £4 P&P



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## DIARY DIARY

People, events, services

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OEM users on a royalty-free

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about televising the '87

on February 9th at the

Negotiations with the BBC

co-ordinator and has

offering two days free holiday

400 hotels within the EEC) for

two people to all purchasers of

five hi-fi headphones from the

offer lasts until January 31st,

1987, and further details can

dealers...Preparations for the 1987 British Record Industry

Awards are well in hand. Don

responsibility for all aspects of

Awards-which will take place

Grosvenor House Hotel, Park

completion...Turbosound has

Lane, London-are close to

opened a new purpose-built

factory at Capel in Surrey.

Turbosound a much greater

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The new factory gives

has resulted in shorter

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Audio Rents can assist

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downward slope expansion.

The CRL 2200 will be

#### In brief

AHB (Allen & Heath Brenell Ltd) has won a British Design Centre Award for the CMC 24 computer assisted mixing system. The CMC was selected by the Design Council on the basis of its appearance, style, innovative computing system, reliability and safety when used in home recording applications...The latest Journey LP, recorded at The Plant and Fantasy Studios in California used more than 4,000 ft of Monster high performance cable. Prolink cable was used for mic and instrument connections and Powerline 2 was used to hook up all the guitar amplifiers... Valley Audio has opened up a new professional sales and service department in Atlanta, Georgia. Negotiations have been completed for an Atlanta merger with Ridge Nye of Interface Audio who will run the new facility. The new Valley Audio branch office can be reached at PO Box 467278, Atlanta, GA 30346, USA. Tel: (404) 252-7968...Circuit Research Labs (CRL) has recently announced the takeover and ownership of the SSM 2200 integrated circuit. The IC, now known as the CRL 2200, contains a new patented noise reduction system. CRL has previously acquired the ownership of pending patent rights to the Dynafex circuitry through purchasing the assets of Micmix Audio Products of Dallas. The 16-pin IC is a single channel, single-ended noise reduction system employing variable bandwidth

Stolen equipment

Horizon Studios in Coventry, UK received an unwelcome visit during a night in late October and the following equipment was stolen: Yamaha RX11 drum machine; QX1 sequencer; DX7 keyboard and TX7 FM tone generator; Simmons electronic drum kits SDS/8 and SDS/9; Status bass guitar; red Aria Esprit and Tokai *Strat* type guitars; Trace-Elliott *AH500* and *GP11* amplification; and mics—a pair of Neumann *KM86*s and an Electro-Voice *RE20*, all three of which were boxed. Any information regarding their whereabouts would be gratefully received by Paul Craddock at Horizon on Coventry 0203 21000.

#### People

• JBL Professional has appointed Hector Martinez market manager. Previously with JBL as technical services co-ordinator (1972-77),

#### Dolby SR progression

At the AES Exhibition in Montreux, Dolby Laboratories created a stir by announcing its new Spectral Recording system (SR). Since then, it has been busy ensuring that it has the capacity to meet the demand and that the quality and consistency of the product meet the company's standards. Inevitably this takes time as well as care, and Dolby has been delighted at the continuing high level of interest in the system, despite the wait for delivery of the first production units.

Demonstrations of *SR* have now been given in several countries, and modules are being delivered to customers in quantity. This article tells the story of what has been happening meanwhile behind the scenes.

#### Landmarks

For Dolby, 1986 proved to be a year of landmarks. At the start of the year, the San Francisco headquarters moved from its original address at 731 Sansome Street to newly refurbished premises at 100 Potrero Avenue. Then came the unveiling of SR at AES. Later in the year, Dolby's London factory was completely refurbished and extensively reequipped to provide nearly 5,000 ft<sup>2</sup> of modern assembly and test areas. At the time of IBC '86 in Brighton, Dolby reported the number of A-type noise reduction units (the original noise reduction system on which Dolby Laboratories first built its name and reputation 20 years ago) had just passed the 100,000 channel mark, a very significant landmark for any manufacturer of professional equipment and a reflection of the enduring benefits of A-type noise reduction.

These events were by no means unrelated. The new SRsystem boards had been designed to plug into most of the existing A-type mainframes, giving immediate access to the new technology, at minimum cost, for the users of the earlier Dolby system. At the same time, production of the new signal processing system needed both increased capacity and faster testing to meet what proved to be a quite overwhelming level of demand.

The first demonstrations of SR created great interest not only among the music recording studios at which it had been aimed but also among broadcasters and television facilities. It offered them greatly improved recorded quality using existing analogue recording equipment, in terms of useful dynamic range and transparency of sound, without the cost and inconvenience of changing to digital techniques. Indeed, for many applications Dolby SR offers quality equal to or better than that offered by 16 bit PCM.

To achieve this, in a system which does not introduce its own processing artifacts and problems of sharp overload on recorded transients, requires much more complex signal analysis and control circuitry than with the earlier processors: the new boards contain some 1,300 components. Consequently, to maintain consistency, reliability and the tight specification laid down for SR, while achieving a production output of SR modules twice that previously achieved for A-type boards, very stringent and largely automatic assembly and test procedures had to be devised.

#### Manufacturing processes

Automated assembly and testing are by no means new developments for Dolby. As long ago as 1971, a projectorbased component insertion system was introduced for the Å-type Cat No 22 module. It was way ahead of the field and allowed assembly staff to achieve packing densities that were exceptional at that time. The system has since been developed further and is still in use, rivalling automatic insertion for cost effectiveness in many applications.

Dolby Laboratories also moved into automated testing early on; the first computerbased tester was designed and built by its own production engineering department in 1975. This has since been developed commercially by an ex-Dolby engineer as the *Micro* 



# We're on the move

We've all come a long way in ten years.... And while many of you have enjoyed successful projects and opened up bigger and better studios, we've had an increasing struggle against decreasing space, landlords, motor traders, rag traders and so forth in our delightful premises in New Crescent Works.

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From **3rd November 1986** we shall be trading from our new headquarters in Scrubs Lane offering expanded facilities for both demonstrations and servicing, a much larger digital editing suite, as well as far greater levels of comfort for staff and visitors alike. Our enormous new show room will allow us to demonstrate complete 24 track studio systems, 16 track audio-visual packages and the very latest in digital recording technology. Additionally we will have our usual permanent demonstrations of the very best in home studio recording systems, video equipment, amplifiers, CD players, signal processors, mics, monitors - in fact everything you might need. So to make sure you don't lose us and we don't lose you, please make a note of our new address and telephone number. Here's to the next ten....

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### DIARY DIARY

People, events, services

ATE tester, one of which is currently in use for function tests on a range of Dolby products, such as the 24-track multitrack A-type units and the CP-55 cinema processor; it carries out a check of all functions in about 6 min.

More experience of automated testing was also gained when in 1978 the company purchased the first of its Racal *Rebate RTL-1* autotest units for in-circuit component testing—the first company in Europe to have this equipment.

It was with SR specifically in mind that auto-insertion equipment was introduced three years ago by Dr Ray Dolby for the assembly of a number of boards, including those for the CP-55 cinema processor. Though the equipment was relatively lightly used for this purpose, it provided valuable production experience prior to the start of the SR programme, where manual assembly would have been totally impractical and uneconomic.

#### SR assembly

The new Dolby SR boards have 85% of components autoinserted; the rest—which are components that do not lend themselves to auto-insertion, such as tantalum capacitors, heatsinks, switches, etc—are added manually. Boards for the USA and Canada are finished and individually tested in San Francisco, the remainder in the London factory.

The Cat No 280 module consists of two densely-packed boards, with covers and edgeconnectors, while the Cat No 431 is a single board carrying all the components. After assembly, each board is subject to an in-circuit component test, which checks for open and short circuits and polarity, as well as the values of most components to within 1%. The board is then soak-tested at over 50°C ambient temperature for a minimum of 12 hours before being re-tested in a similar manner to guarantee complete stability.

While the performance of early SR boards was checked using seven lengthy individual manual verification stages, a system of five automated verification stages (involving static, dynamic and pulse tests) has been introduced for production efficiency. These stages include automatic selection of 88 resistors to 0.1 dB accuracy.

#### Automatic testing

The automated testing of *SR* modules is carried out on customised Marconi and Tektronics equipment. In the former, each component is tested in-circuit via about 400 probes, which make contact with the circuit board as it is held in place on the test bed by vacuum. Function tests are carried out using special software developed for the Tektronics test stations.

After the selected resistors have been inserted the boards are auto-verified. Each board is then independently checked on an auto-tester produced by Dolby Laboratories, the Cat No 356. This tester and a manual back-to-back performance tester, Cat No 357, are commercially available

Boards then have edge connectors and covers added, are checked electrically and cosmetically, and passed to final Quality Assurance. This department samples the product output as an independent check, in addition to the 100% check before any module leaves the production line, and provides a long term performance record on all products. It tests all aspects of performance, including temperature stability and mechanical tolerances, against the published specification. The module then passes to

finished goods for shipment.

#### Investment

The investment in test equipment alone has been nearly £1/2 million. To this must be added, of course, the considerable investment there has been in time spent in training, and in refurbishment to make the factory a more productive environment in which to work. Dolby Laboratories believes this high level of expenditure in setting up the SR programme is well justified, because it is confident of as long a future for SR as the 20 and more years already enjoyed by A-type noise reduction.

Although the introduction of automatic testing and alignment has taken time, and has delayed the release of production SR modules, it has been worthwhile. It has greatly increased production capacity; it avoids operator error, always carrying out every single test with 'full attention' as there are no fatigue or distraction factors involved. With identical automatic test systems and equipment being used in both London and San Francisco, the performance of units from the two sources is completely indistinguishable. Great care has also gone into increasing still further the reliability of circuitry, using computer analysis of all failures to highlight potential problems. (Incidentally, the A-type boards have a mean-timebetween-failure rate of over 25 years.)

At the start of assembly of

Manual insertion of components into SR boards,



each SR board, a bar-code strip is applied to the 'route card', the board's individual record of all assembly and test procedures. The bar-code number matches the serial number of the unit. The record of each individual board's history and performance will be held on file for some years as an aid to long term quality control.

The demand for *SR* units has been such that Dolby is now, for the first time in its history, contemplating shift working, seven days a week. The production of their equipment still has to continue as usual alongside the new products. Staff have had to be trained to establish and maintain test programmes to deal with the complexity of the system, placing considerable demands on skilled test engineers.

The manufacture of Dolby SR modules in San Francisco is the first major step towards increasing Dolby Laboratories' manufacturing capacity. Hitherto, San Francisco has been the centre for research, development, licensing and US sales, together with production of some circuit boards. Finished units have normally been produced in the UK. However, Dolby Laboratories has already built up substantial experience in splitting manufacture between London and San Francisco with some of its cinema products: boards for the CP-55 Dolby Stereo cinema processor have for some while been assembled in the USA and married with other boards in London that have been produced in the UK. All development of jigs and test programmes has also been carried out jointly between London and San Francisco, to benefit to the full from the experience of both.

Due to the overwhelming demand for *SR* boards from the music, film and broadcast industries, the decision was taken at an early stage that manufacturing for the North American market would largely be carried out within the USA. Meanwhile the sale, manufacture and service of *SR* modules, as well as most other Dolby professional products, for all other countries will continue from the UK base in London.

⊳

# Low-cost digital audio comes of age.

The Sony PCM series has now been available for several years. In this time recording and broadcast organisations, government, educational and industrial establishments, as well as individual users have all acknowledged the unique value of these units, and made them a new standard. It is the superlative quality of Sony PCM digital, coupled with extremely low cost that has brought about this professional acceptance of the range. This is borne out by the number of new ancilliary products from other manufacturers, that have further increased the flexibility and versatility of the range Examples of these products are the 'CLUE' logging and editing system from HHB, as well as various interfaces which allow digital communication with the PCM 1610.

policy towards these products. Accordingly they have upgraded them from the domestic catalogue, and, realising the need for professional support and all that that entails, have appointed HHB as specialist dealers to represent them in the pro-audio market.

We are proud to announce this appointment, and happy to assure our customers of continued availability of the PCM range. The re-instatement of the PCM production line has been very largely due to pressure from end-users, who are after all the motivating force in the audio world. So if you are involved with audio recording and are still unfamiliar with Sony digital, then you owe it to yourself to call HHB – the No. 1 name in Digital Audio.

Sony has acknowledged that this acceptance by professional users necessitates a change of

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## DIARY DIARY

People, events, services

#### Forthcoming events

January 16 to 18 Winter NAMM International, Convention Center, Anaheim, California March 10 to 13 82nd AES Convention, London March 28 to April 1 NAB Convention, Dallas, Texas April 13 to 16 Acoustics '87,

Management Centre, Portsmouth Polytechnic May 19 to 21 Sound-Comm '87, Business Design Centre, London June 24 to 26 APRS '87,

Olympia 2, London September 3 to 7 21st Sim-Hifi Ives, Milan, Italy

#### Agencies

• Quested Monitoring Systems has appointed the following agents: (USA) Apogee Electronics Corp, Santa Monica; (Japan) Soundcraft Japan Ltd, Tokyo; (Hong Kong) Audio Consultants, Kowloon.

• Audio Kinetics has appointed Stirling/ITA as a dealer for the *MasterMix* console automation system. Stirling will be offering *MasterMix* on Trident, Soundcraft and Amek consoles as well as retrofits for many other models. • Audio Kinetics has appointed Raper & Wayman as agents for the Pacer chase synchroniser. Film-Tech Electronics Ltd will distribute the Pacer in Wales. • Soundcraft Electronics Canada Inc has announced the debut of its new subsidiary, the Imaginative Marketing Group (IMG/GMI), which is dedicated to the marketing of non-Soundcraft products in Canada. The first products to be marketed are Aries consoles and Electrospace signal processing equipment.

#### Contracts

• FWO Bauch has received an order from the BBC for the installation of a VT and film post-production area in Manchester. The installation will include the Albrecht film scanner, sepmags and VFS control system.

• Four production facilities selected by CMX as Beta test sites for the CASS-1 have purchased their systems. These are Century III, Boston; Studio Tempo, Montreal; One Pass Productions, San Francisco and Streeterville, Chicago. Wisseloord Studios in Hilversum, Holland has recently installed a Soundtracs CM4400 console with CMS2 automation. The console, which was packaged with a Mitsubishi X850 digital recorder was supplied by Professional Audio Centre of Eindhoven.

• Solar Sound Studio in Halifax, Nova Scotia has recently taken delivery of a Soundcraft Saturn multitrack recorder and Digital Music System has placed an order for a Saturn and TS-24 console. DMS currently operates a preproduction suite equipped with a Soundcraft series 600 console and SCM 762 24X MkIII. • Audio International, has recently supplied a 51-input, 48-track Amek Angela console to Water Melon Studios in Milan.

• The Royal Academy of Dramatic Art (RADA) has recently taken delivery of a Graff cassette duplicating system. The system is installed in the main sound recording studio at RADA.

• Solid State Logic has been chosen by Lucasfilm Ltd to provide a new range of film audio consoles and studio computers for the new Technical Building at George Lucas' Skywalker Ranch near San Francisco. The contract is worth \$1.4 million.



For the music studio owner, no decision is more critical than choosing a console. Both financially and creatively, the success of your operation may well depend on the capabilities and quality of the system you select, and the company that supports it. Clear reason, we suggest, to consider the SL 4000 E Series Master Studio System from Solid State Logic. But certainly not the only reason.



Consider, for instance, that only SSL has builtin track remotes on every channel, integrated with the industry's most versatile monitor fader and foldback facilities. Or that SSL alone provides pushbutton signal processor routing for each channel's noise gate and expander, compressor/limiter, high and low pass filters, and parametric equaliser bfree audio subgrouping

plus switchable phantom power, patchfree audio subgrouping, AFL and PFL monitoring, fader start for external devices,

and stereo modules with balance and Image Width controls.

Consider that SSL makes the industry's only comprehensive studio control system — with integral synchronisation of

up to five audio/video machines, concise English commands,



tape location by timecode, foot/frames, cue numbers or key words, and complete session list management. And that SSL alone offers extensive fader, group and mute automation and mix manipulation *plus* optional programmable parametric equalisation and panning, multi-repeatable Events Control, and Automatic Dialogue Replacement.

## DIARY DIARY

People, events, services

#### Test equipment for hire

Hamilton Rentals the large UK computer hire company has created a new division specialising in test and measurement equipment and microprocessor development systems. The new division, which is to be known as Rentech, has begun with an inventory of specialist electronic equipment worth more than £2 million and expects to double this figure within 12 months.

Among the equipment available are products from Tektronix, Hewlett-Packard, Intel, Motorola, Zilog, Bruel & Kjaer, Schaffner, Fluke,

#### Power crazy

Visiting engineer who is very serious (and a little humourless) seems to like finding fault and who is unhappy with the sound of NS10 speakers driven by  $2 \times 100$  W amp: "I want to Dranetz and others. Hamilton is also undertaking to obtain anything else wanted which might not be held in stock. Information on products is listed in a 'red book' which is available.

Rentech aims to provide complete service support with customers able to phone direct technical application engineers at any time. Field service engineers will also make regular calls to customer sites.

Hamilton Rentals Ltd, Hamilton House, North Circular Road, London NW10 7UB, UK. Tel: 01-961 6777.

power them with a BGW 750." Tape op, who is a little cheesed off with said engineer: "I've got a Honda 750, will that do?"

Long stony silence.

#### Ray Dolby receives OBE

Dr Ray Dolby, founder and chairman of Dolby Labs, is to become an Officer of the Most Excellent Order of the British Empire. Since he is an American citizen the OBE will be an honorary award and carries no title.

#### Technical Projects update

Further to our news item in the November issue we now have further details on the purchase of Technical Projects by Neutrik and Canford Audio. Neutrik will use the former Technical Projects facilities as an extension of their own factory and manufacture the units, specifically the 401 series, under its full responsibility. The Isle of Wight factory is now re-organised and streamlined employing a number of the original technical projects development and production team. Most of the research and development will remain at the Neutrik factory in Liechenstein.

Neutrik will be responsible

throughout the world for marketing and service which they will do through their own agents or through the original Technical Projects agents in certain countries.

Canford Audio, which has already been marketing the intercommunication equipment as a distributor will now be fully responsible for the development, national and international marketing and service of this product range from their factory in Washington, Tyne & Wear.

Washington, Tyne & Wear. In the UK, Eardley Electronics will market the former Technical Projects measuring equipment and will also be responsible for after sales service.



Then consider that SSL's Studio Computer alone goes beyond mixing automation to provide Total Recall<sup>TM</sup> a unique system, completely independent of the audio path, which stores all I/O module settings after each session. The new TR AutoScan function makes

it faster than ever to recreate headphone and monitor mixes, equalisation, or entire console setups with quarter dB accuracy and rapid verification. And SSL alone offers data-compatibility with more than 300 installations — in over 80 cities around the world.

Finally, consider a company whose record of practical innovation, ongoing development and in-depth technical support has earned repeat orders from many of the world's toughest customers — a company that other manufacturers use as a standard for comparison. We join them in urging you to compare. Our 40 page colour brochure on the SL 4000 E Series is a good place to start. It's yours for the asking, and it just might make your difficult decision a whole lot easier. Clear reason, may we suggest, to write or call us today.

#### **Solid State Logic**

Begbroke, Oxford, England OX5 1RU • (08675) 4353 200 West 57th Street • New York, New York 10019 • (212) 315-111 6255 Sunset Boulevard • Los Angeles, California 90028 • (213) 463-4444

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#### The New Westar+

Need bells and whistles? The new Westar+ High Performance Music Recording Console is the only console available today with the combination of a field expandable frame design, plug-in equalizer options (4 types). 3 levels of automation option, 8 auxiliary sends, 4 different fader options (Manual, VCA. TBA and IDF), and technical and sonic performance second to none.

#### **Studio Requirement**

With cost effective digital processing consoles scheduled to be available by1990, the profit oriented studio today needs a reliable high performance analog console to match the sonic qualities of the new digital recorders like the Mitsubishi X-850. The Westar+ is such a console system, at a price the studio can pay back by the time digital consoles become reality.

#### Studio Economics

Investing over \$400.000 in a digitally controlled analog console does not make sense economically, nor can such a console match the processing and automation power of the future digital consoles. The cost effective choice today is the Westar+

#### Westar Studios

Westar consoles are already proven in service at leading studios around the world. in the U.S., Canada, Japan, Scandinavia, Austria, W Germany, Colombia and England For studios not intimidated by "the fashion console of the month." the Westar+ is the intelligent choice.

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mation system, providing storage on floppy diskettes of an unlimited number of mixes and off line editing of mix data. The Compumix PC comes complete with IBM XT compatible PC (with Dual floppy and 20 MB Hard Disk), Mitsubishi 13" color graphics monitor. custom and standard keyboard, and all cables and software. Compumix PC is probably the most cost effective high performance automation

system available today, and a perfect fit for Westar+



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#### Stirling Audio and ITA union

Stirling Audio Systems and ITA have joined forces to create Stirling/ITA a new company designed to offer a wide array of expertise and service to their customers. Mick Boggis of ITA will be joining the board of Stirling/ITA as Technical Sales Director. According to Andrew Stirling the union has been endorsed by all Stirling and ITA's suppliers.

"Each company has its own strengths," explained Andrew Stirling, "ITA has an excellent technical base and strong associations with professional musicians, universities and institutes. Stirling Audio Systems has built an excellent reputation in the industry for service and marketing and financial skills as our dynamic growth over the past 12 months shows. We'll be able to package and promote the engineering skills of ITA—and that'll give us a level of customer support that no-one else will be able to match. The union really is the best of both worlds."

Place, London NW6, UK. Tel: 01-625 4515.

standard program ROMs the

#### Software updates

• Audio Kinetics has released the promised update for the Eclipse audio editor. Among the improvements are additional commands including Wait which will suspend operation of the Eclipse until either a specific timecode value is reached, a given amount of time has elapsed or a predesignated key is pressed. Other new features include online loop editing mode and a display facility for the event memories. The menus have been reconfigured for easier understanding and several new options have been added.

• Eventide has announced revisions to the *SP2016* effects processor/reverb. The internal ROM program storage capacity has been increased and is now standard on all new models. A retrofit board is available for earlier units. By relocating unit's top mounted ROM sockets are freed for additional optional ROMs such as the Vocoder, Stereo Synthesis, Auto Panner or software from third party suppliers such as First Order Effects. A new MIDI interface board is also available for the *SP2016* which puts program selection and parameter control under MIDI command. This board is also available as a retrofit item.

• Version 2.0 software is now available for the Fostex 4030 rack mounted synchroniser and 4035 controller. The new update provides faster and more accurate location of cue points and offers a 'second level' suite of commands providing more functions such as play to park and speed display.

#### People

• 3M's UK Magnetic Media Division has appointed Joe Clerkin as marketing manager. He will be responsible for sales and marketing of 3M's Scotch tapes to the broadcast and professional video industry. Clerkin reports to Chris Hobbs general marketing manager for all Scotch audio and video tape products.

• John Grumbridge has been appointed general manager of Martin Audio. Grumbridge was previously with Audio Kinetics and Simm-Watts. • Altec Lansing has appointed Bob Rodgers as senior project engineer of electronics. Rodgers, previously with Micmix Audio Products, holds Bachelor degrees in science and mathematics and has two patents issued in his name. • Chris Braclik has joined the Teac Corp London office as product and marketing manager for Tascam. Braclik will be responsible for European dealer support and product feedback and can be contacted on 01-409 0681.

• Mick Anderson has joined Entec Sound & Light as PA/sound manager. Anderson was formally with Concert Sound and was responsible for production and the running of all rigs.





Russ Ballard Emile Conde Tony Clarke Thomas Dolby Eurythmics Meyer Eshell Phil Fearon Dave Foster Fabbricci Brothers Steve Glen Heaven 17 John Hiseman Thor Klep Pete Jostins Kane Kramer Mike Leslie John Lees Stavros Logaridis

Rod Argent

Jose Navarez Paul Roberts Joe Palmer Tony Prince Jonny Pearson Roy Rainey Tom Robinson Ray Russell Chris Stone Ramon Sanchez David Steel Brooke Tricket Hei Taire Pierre Tubbs Tony Visconti David Voorhouse John Verity Blue Weaver Sean Wallis

#### AND THESE COMPANIES..



Ambiance Studios Arcantide Ltd Arcadia Ltd Arnies Shack Alaska Studios Abbotts Studios Avocado Music The Cabin Cold Storage Studio **Chestnut Studios** Channel 5 **Craighall Studios** CBS Denmark Street Studios Druid Studios Datavision Fairmorn Studios F2 Studios The Globe Studio Hobo Heartbeat Studios Impulse Studios Jam Studios Kiln Farm Movement A/V

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#### NEW PRODUCTS P D



#### JBL/UREI 7922 digital delay

The 7922 is a high resolution digital delay with 50 kHz oversampling to minimise phase distortion and improve sound transparency. The unit has two independently adjustable outputs that simplify elemination of echoes and alignment of acoustic centres of drive units within a single speaker array.

In the high resolution mode the 7922 can be controlled in 10  $\mu$ s steps (equivalent to  $\frac{1}{8}$  in) up to a maximum delay of  $327 \ \mu s$  (more than 350 ft). The linear phase anti-aliasing filters are designed to create no more than  $\pm 5^{\circ}$  of phase

shift in the 20 Hz to 20 kHz audio pass band.

The 7922 features a special LED display for easy adjustment of signal level for optimum signal to noise and headroom control and the front panel also features a Safe facility to prevent tampering

with delay settings. The unit is fitted in a 1U high rack mountable case.

#### **JBL Professional**, 8500 Balboa Boulevard, Northridge, CA 91329, USA. Tel: (818) 893-8411.

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

#### Orban Programmable Mic Processor

Preliminary details show this new unit includes mic preamp, 3-band parametric EQ, compressor, de-esser, gating and ducker. Up to 32 different control set-ups can be held in memory for instant recall. The EQ section provides variable frequency, bandwidth and boost/cut specifically for precise voice enhancement. The gate is switchable for use as a noise or a compressor gate.

The PMP features a high quality mic preamp and the effects send and return connections have programmable return levels for easy integration of effects units. Store, Recall and

Seck 242 console

The Seck 242 is a slimline

electronically balanced inputs

+10 dBm and an additional

Three-band EQ is standard

with the midrange sweepable

from 330 Hz to 6.5 kHz. The

high EQ is set at 11 kHz and

25 dBm overload margin.

the low at 45 Hz.

with a range from -55 dBm to

stereo console with 24

Compare buttons provide instant access to the 32 user programmable control set-ups. Current settings of control parameters are indicated on . the digital display. A bargraph display shows input, output or gain reduction levels, the memory is protected by internal batteries and a security code lock prevents tampering.

Orban Associates Inc, 645 Bryant Street, San Francisco, CA 94107, USA. Tel: (415) 957-1063.

UK: Scenic Sounds Equipment Ltd, Unit 2, 12 William Road, London NW1 3EN. Tel: 01-387 1262.

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Soundcraft SCM 762 MKIII

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Soundcraft Saturn with Total Remote

Each channel has two prefade and two post-fade sends and a pre-EQ insert point to cater for extra limiting, delay, etc, on any individual input. A stereo solo bus is provided on

all inputs and the four master sends and returns. Metering of the stereo output is via a

12-section bargraph. All connections are on the top of the board and the 242 is fitted with a carrying handle which rotates to provide a comfortable working angle.

UK: Turnkey, Brent View Road, London NW9 7EL. Tel: 01-202 4366.

**USA:** Connectronics Corporation, 652 Glenbrook Rd, Stamford CT 06906. Tel: (203) 324-2889.

29 Guildford Street, Luton, Beds, LU1 2NQ Telephone Luton (0582) 450066 Telex 825488 DONLAR

# PRODUCTS

Equipment, modifications, options, software

#### BSS signal distribution system

Brooke Siren Systems has recently introduced the MSR-604 signal distribution system, which is in the form of four independent channels of operation in a 1 U rack mount box. On the front panel each channel contains an electronically balanced XLR input and two transformer balanced outputs. The rear panel contains two electronically balanced XLR feeds and independent switches for phantom power on/off and 10 dB of switched gain, all per channel. Power comes from a separate 1 U power supply, MSR-602 which will power up to 10 MSR-604s. The advance literature

envisages the rear panel feeds as normally providing the feeds for front-of-house and stage monitor mixers while the front panel outputs would feed any recording facilities in use at the same time.

One clever feature is the way that the gain of the channel may be switched remotely from the front-ofhouse mixing console's phantom switch. Brooke Siren Systems Ltd, 202-208 New North Road. London N1 7BL, UK. Tel: 01-226 0099 USA: Klark-Teknik Electronics Inc, 30B Banfi Plaza North, Farningdale, NY 11735. Tel: (516) 249-3660.

#### Sennheiser MKH 20 mic

The Sennheiser MKH 20 P 48 is an omnidirectional microphone using RF circuitry. It has a transformerless balanced output and has been specifically designed for digital recording. Maximum SPL is quoted at 134 dB, 142 dB with the -10 dB pad. Slight directivity at high frequencies makes it possible to vary the frequency response by moving the mic off axis. Further adjustment is possible with the high frequency boost switch.

The MKH 20 is claimed to have high linearity and low

inherent noise with an equivalent sound pressure of 10 dB (DIN 45 500 curve A RMS) or 21 dB (CCIR 468). Rated impedance is 160  $\Omega$ , min load impedance 1 k $\Omega$ . Sennheiser Electronic KG, D-3002 Wedemark, West Germany. Tel: 05150/583-0. UK: Hayden Laboratories Ltd, Havden House, Chiltern Hill, Chalfont St Peter, Bucks SL9 9BS. Tel: 0753 888447. **USA:** Sennheiser Electronic Corp (NY), 48 West 38th Street, New York, NY 10018. Tel: (212) 944-9440.

#### Tascam professional range

Released at the Los Angeles AES was news of three new Tascam products: ATR-80/24 24-track analogue multitrack recorder, ES-50 synchroniser and M-600 series modular mixer.

The ATR-80/24 is a 2 in machine offering 'seamless', noiseless punch in/out, contourless sync and repro heads and a heavy duty power supply. Using an inbuilt microprocessor a special rehearse feature is provided for previewing edits without affecting the master. It features 14 in reel capability, up to 375 in/s fast wind speeds, high torque, reduced mass PLL capstan motors and back up memory for tape time, pitch control and amplifier setting. Complementing the ATR-80/24 is the M-6000

series mixers. The new 16 bus consoles feature either stereo or mono input channel strips (24 to 32) and 16- or 32-channel monitoring. Eight aux channels are provided as standard Monitor channels feature balanced line level inputs, EQ and Aux systems. They are similar to the input channels and can be used as additional inputs or effects returns.

Also at the show was the new ES-50 synchroniser. Teac Corp, 3-7-3 Naka-cho, Musashino, Tokyo. Tel: 0422 53-1111. UK: Harman Audio (UK) Ltd, Mill Street, Slough SL2 5DD, Berks. Tel: 0753 76911. USA: Teac Corp of America, 7733 Telegraph Road, Montebello, CA 90640. Tel: (213) 726-0303.



#### Studer A820 multitrack

This new 24-track analogue recorder is designed to accept 14 in reels and is convertible between 1 and 2 in. Insertion of the headblock automatically resets the appropriate electronics. New motors and a sophisticated servo system allow spooling speeds up to 50 ft/s and extremely fast location of cue points. The capstan motor has its own dedicated microprocessor for smooth starts and gentle tape handling. Three tape speeds are standard, as is reverse play. Transport keys are user programmable with a choice of over 40 functions assignable from the internal software library.

Virtually all the internal audio electronics are under digital control with simultaneous automatic alignment of all 24 channels. Digital memories store alignment parameters for two tape formulations as well as for 8-, 16- and 24-track headblocks.

The A820 has extensive facilities for over-riding auto settings when alternative calibration of specific

parameters is required. All revised settings can be stored in the system memory.

The A820 includes new high output amorphous heads and switchable Dolby HX Pro, advanced phase compensation circuits and special  $\bar{D}/A$ converters to optimise erase current on each track. Noise reduction cards (Dolby SR, Dolby A or telcom) can be fully integrated and NR levels stored digitally with the other internal parameters.

The metering and channel selection overbridge is connected to the transport deck via a serial interface allowing the overbridge to be connected up to 300 ft from the transport via a single 4-way cable.

Studer International AG, Althardstrasse 150, CH-8105, Regensdorf, Switzerland. Tel: 01 840.29.60.

UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091. USA: Studer Revox America Inc, 1425 Elm Hill Pike, Nashville, TN 37210. Tel: (615) 254-5651.

# The New Business Machine

Running a business efficiently and profitably is a difficult enough job. Any new tool that will help to achieve profit and encourage new business has to be a good investment. The new STUDER A820 Multi-track is your New Business Machine. Working economies derive from benefits like:

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Installation costs are reduced. The A820 is the first multi-track to incorporate Dolby A/SR or Telecom NR processors.

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Eliminates time wasted lining up between sessions by on-board storage of all alignment data including NR levels.

#### New Amorphous Metal Heads

Dramatic reduction in head wear coupled with a higher output to give better S/N ratio.

#### PCB Compatibility

The audio electronics of the A820 Multitrack use the well established PC Boards of the A810, A812, A820 family.

#### Removable meter bridge

Efficient use of serial communication means that the complete metering package and channel selection can be relocated within easy reach of the engineer.

#### The new STUDER A820 Multitrack offers:

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Full serial communication EBU/SMPTE bus compatible; 3 speeds 7.5, 15 and 30 ips including Dolby HX PRO; Compact size; Low power consumption – No fans; High resolution bar graph metering with expandable scale for alignment.

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1 Canfield Place, London NW6 3BT. Telephone 01-625 4515 Fax. 01-372 6370. Tlx. 946240 CWEASY G Ref No. 19014280

# RECORDING IN SCANDINAVIA

uring the last year or so, the Scandinavian countries have suddenly made the rest of the world sit up and acknowledge their existence in the audio

world. It must be confessed that they have not previously been taken seriously, more through an external ignorance of their talents and facilities than a reflection on them.

Sweden came to the fore a while back if only through the publicity generated by Abba. On the serious technical front, however, it has been Denmark --the smallest of the four countries--which has really taken the rest of the world by surprise. As a result Norway, Sweden, and to some extent Finland have enjoyed a certain amount of reflected glory.

To be fair, for the most part the various studios have been keeping pace with the rest of Europe as well as they could, bearing in mind their relatively small populations and hence low sales figures, and therefore capital.

The music industry is gathering momentum throughout Scandinavia. Top flight recording facilities are emerging, enabling native musicians to gain experience of the sophisticated equipment which has been pouring into studios the world over. Bands such as Norwegian Aha have shown us that they are not all lumberjacks singing Norwegian country and western ditties. Finland has yet to show the European charts a thing or two but a lot of that can be attributed to a huge language barrier.

Top studio facilities have meant that producers and engineers, particularly English, have been prepared to move in, bringing with them their knowledge and expertise.

Broadcasting, everyone is convinced, will very soon have a profound effect on the industry. It's all a bit of a muddle at the moment. In Denmark for example, having been content for many years with a single state-owned television broadcasting channel, an independent second channel was set up for a trial period. The independent channel was to be used for local television. In Copenhagen

#### Janet Angus describes the recording industries in the Scandinavian countries. This introduces a series of articles that will look at local markets

this was called Weekend Television and was sponsored by various bodies including Nordisk Film (makers of the first ever talking picture) and various newspapers and media companies. Unbelievably this was a non-commercial channel, therefore no revenue was to be had for the sponsors during the trial period. Banking on the fact that having financed the setting up of the experiment, equipping studios with very expensive broadcasting equipment, the government could not close the project down at the end of the period, the sponsors poured their money in, hoping eventually to cash in when the project was approved and

eventually went commercial. Unbelievably the experiment came to an end amidst total confusion as the government body was unable to make up its mind. The stations shut down, the personnel were made redundant, and a lot of very expensive equipment just sat there. Fortunately, the situation has been resolved, and broadcasting will resume in 1987.

There is a lot of resistance around Scandinavia to commercial broadcasting. Most countries are or have been running experiments in expanding their radio and television services. A country which only has one television channel, and that only broadcasting a few hours a day, is obviously missing out on a lot of the communication which the rest of Europe is enjoying. The lack of competition has also meant that the standard of broadcasting is not perhaps as high as it could be. The facilities are there, but the incentive to be imaginative and creative is not as strong as it is, for example, in the UK.

It has also meant that other countries provide a lot of viewing via satellite. It is quite common for blocks of flats to have satellite receiving facilities. This in turn means that commercial TV is brought in from other countries.

Most people in the business believe it is inevitable. A long history of socialist governments has kept the commercial 'bandits' away, but the conservative parties are gaining strength and around Scandinavia there is a quiet confidence that life is about to catch up with the



⊳

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communications revolution because, of course, commercial broadcasting means revenue which means increased technology resources as well as more scope for broadcasting as a medium.

#### Finland

Finland surprisingly is out on its own in this matter. For some reason, Finland is all too easily overlooked as it is rather out of the way, a bit too close to the USSR perhaps for comfort, but technologically they are miles ahead of their Scandinavian brothers. The first cellnet telephones were in Finland, for example, and as for commercial media-the most widely read national daily newspaper gives its entire front page over to advertising!

Commercial radio and television are therefore strong, a fact which is reflected in the type of work the studios can attract. Although in area Finland is larger than Britain, its population is a mere 4<sup>3</sup>/<sub>4</sub> million so the record-buying public is obviously not tremendously large. Nobody these days would consider bringing out a single. When asked what a number one single needs to sell, the reply was 25! In other words, nobody does it anymore.

The single largest problem which faces the industry in all the Scandinavian countries must be money. With a numerically small record buying public spending money on home produce as well as on UK, USA and other European imports, resources are very tight. And yet in order to compete, and this they do fiercely, they must somehow get together the money required to professionally equip 24-track (at least) studios. It is an absolute mystery how they manage to survive. If the studio rates were realistically high they would force artists to go to other countries where resources are better.

For the most part then the top studios have been established for many years, built up gradually until they are now competing with the rest of Europe and even attracting foreign work.

Finland alas is still restricted almost exclusively to its home market although two SSL-equipped facilities have emerged over the last 12 months. Most of the studios are recording Finnish bands, with a very small percentage of work coming from nearby Sweden. Part of Finland is of course Swedish speaking which is just as well because unless you are Hungarian, you will

## RECORDING IN SCANDINAVIA

be absolutely lost with the Finnish language and the man in the street generally won't speak a word of English. In the audio business however, they are necessarily more outgoing and English is spoken very well. The facilities are on a par with professional London studios. Genelec of course make their speakers there. Companies such as Faziola export their musical instruments. The country is absolutely dripping with music!

Record sales, however, are on a slow decline. The small buying market means that CD has been extremely slow to pick up. Takomo studios in Helsinki explained that a Finnish CD would not really have much priority at a pressing plant since it was such a small order, making it extremely difficult for record companies to produce. In the Summer of 1985 when the UK was experiencing the great CD take off, there were precisely two Finnish CDs in existence, and they were not recorded digitally. It is hard enough to keep analogue equipment up to the minute, without having to invest in digital.

Video is strong and most of the six 24-track studios concentrate in this area. An annual television competition for which bands must submit finished master tapes generates a nice bit of music work during August and September but on the whole there isn't that much about. In 1985 the record I Dingo sold 150,000 copies—the highest ever figure, starting a quasi Beatlemania hysteria amongst 12 to 14-year-old girls! That figure is once in a lifetime. and unless Finnish studios can start to attract outside work it is difficult to see how they are going to invest in the digital age.

#### Sweden

Sweden, by way of contrast, is very keen on the compact disc. There are many 24-track studios, of varying degrees of professionalism, and the variety of work is encouraging. In the eyes of the outsider Sweden has always appeared to be pretty go ahead and a relatively thriving audio industry seems to support this. The population figure of 8 million obviously helps and the live music scene is very strong. A rapidly expanding video market is impatiently awaiting commercial television. The 'pop promo' is more popular here because there are the financial resources to produce them. Satellite television once again brings commercial television into the home and the industry is confident that it will not be long before they can get going on the home market.

The music industry as a whole has been gaining strength in Sweden, with the setting up of its own exhibition at which major manufacturers, including Fairlight and Fostex, saw fit to launch new products into Europe. One is suspicious whether it was intended more as a quiet testing of the waters than a major launch attempt but nevertheless seeds are there for an increasingly strong position in the market.

The Swedish market is more comparable to the UK, the main difference being that although the studios of various levels are thriving it is still predominantly a home market.

#### Norway

Moving across to Norway, here we have a country that was doing very nicely thank you when they discovered their oil. The country thrived, the standard of living enjoyed by all was incredibly high, and yet the socialist thinking prevailed which kept commercial broadcasting very definitely off the air.

Community broadcasting is where their experiments have been taking place. For example, in Oslo no less than 10 local radio stations share three frequencies. Most of the staff are voluntary, the stations relying on a small grant and generous donations in order to survive.

Opinion is high that the possibility of a conservative government is fast becoming a reality, and with it will come commercial broadcasting. The present government is apparently virtually 50/50 conservative/socialist and at any election it could easily swing either way.

Meanwhile, a population of 4 million isn't enough to feed a hungry recording industry. With almost exclusively native customers, the Norwegian studios compete fiercely. They have suffered from the 'home studio revolution' in that small studios have set themselves up with low budget equipment and cost conscious record companies have been quite happy to put their bands into such facilities to record masters. This has meant that, to my knowledge, the large studios have not really invested in major equipment in recent years, as the capital is not coming in. In order to attract work prices must be kept down. And yet equipment costs them dearly, cutting and pressing costs are no less for them than in the UK and so the vicious circle goes on.

Come the revolution, commercial broadcasting is seen to be the expected saviour. Record companies should be more willing to spend money on videos when there is a proper outlet for them. In the current climate it is really not worth their while. You make a video, present it to the television station and they may or may not decide to broadcast it. There is no other outlet for it.

Commercial video, a term which encompasses product videos, company profile videos, staff training videos, etc, are an increasingly big thing over much of Scandinavia. This type of communication is fast becoming recognised for its effectiveness and a lot of studios are relying on this type of non music industry related work to survive. Naturally they eagerly look forward to a time when pop videos are as important a part of the music industry as in most other European countries.

The Norwegian record companies seem to have passed the buck somewhat in that the number of artists they finance up front is decreasing annually. It is normal these days for a band to finance its own recording and then, if they are lucky, sell the finished product. This has put an enormous strain on the studios, since a lot of these musicians don't actually manage to come up with their finances. Rosenborg Studios in Oslo, when they were at their prime as a Polygram facility, were recording 40 to 50 albums a year. The big record companies nowadays seem to be commissioning only one or two This has moved the financial burden on to the studios. Rosenborg are trying to concentrate on video to get them through this period. Studio owner Svein Sundby sadly described the studio industry's prospects as being "Bleaker than I have ever seen in my 30 years." He feels that many young bands are trying

to emulate UK and other European bands, and while not having any particular success, they are also killing the market for native music.

The standard of living presumably accounts for the fact that such a small market should favour the compact disc. So much so that 1987 will see the building of a CD factory in Rjukan by Egva, previously manufacturers of C-0s. The CD has caught on much faster than was expected and taken the industry a little bit unawares. Classical and jazz music are often recorded on F1 but the studios themselves do not have the financial resources to invest in multitrack digital. The Oslo based studios, facing the reality of the CD factory, are currently discussing whether they would be able to get together and co-operate on the joint purchase of digital recording equipment which they could then all use.

The oil crisis is yet to take its toll on the industry, but the major factor really will be decided at the next government election.

#### Denmark

Not many people are unaware of this country audiowise. Puk Studios in Jutland, it must be said, are largely responsible for this. By building a very

large, unusual recording facility which also took risks (Calrec UA8000 music console and enormous monitoring system, the like of which no record producer had ever seen in his life) Puk deliberately set out to make the world sit up and take notice of Denmark, and more specifically them. A year later and they had built a second identical facility, this time with SSL console to accommodate those who prefer that system of working. Both studios were kitted out with every conceivable piece of outboard gear as well as Fairlights, Synclaviers, you name it. it's there. Then there was the problem of the digital multitrack. In order to match the Mitsubishi in Studio One, a second was ordered but some people prefer Sony. 'Oh well', they said, 'let's get those as well. Oh and we seem to have 64 tracks of Mitsubishi, we'd better get three Sony 24-tracks to make it the same.' Well, that sort of behaviour leaves the rest of the studio world gaping in disbelief. The investment at Puk in such a brief time doesn't bear thinking about but it was necessary to make the rest of the world even contemplate going to Denmark to record. And it has been very successful. They set out to

ensnare foreign business and

have succeeded 100%.

Other Danish Studios have also come to the fore in the last year or so. Sweet Silence Studio in Copenhagen has for many years attracted a certain amount of foreign business but that was largely due to owner Freddie Hansen's experience and reputation outside Denmark.

Facilities such as Werner Studios, and now Sweet Silence too, have also been spending money on new top flight facilities, no doubt spurred on by Puk. The top studios, having raised their standards, provided the incentive for other studios also to move up, leaving a gap in the demo market which is rapidly being filled with small studios springing up all over the place. Previously an almost exclusively native market, the major studios have moved into the business of foreign bands and record companies and the home market is finding a new niche.

Werner explained their problem: the Danish record companies do not have very much money to invest in studio time. The population of 5½ million does not support an industry which contains several digital multitrack studios. The bands therefore cannot take their time recording in the studio and are

in and out again pretty quick thank you very much. If you turn your studio over to a foreign band for three or four months, your local market is going to go elsewhere, and unless you manage to sustain the foreign custom you are sunk.

It is a gamble which has to be taken, and as Puk has demonstrated, can certainly pay off.

The factor common throughout the Scandinavian countries seems to be the pinning of hopes on commercial broadcasting to breathe new life into a struggling industry which lacks local financial support, while looking to gain an increasing stake in the world recording market.

More and more bands and producers these days are prepared to travel in order to find 'different' facilities. In an age of electronic sampling where so many studios have the same equipment and produce the same sounds, new environments, both acoustic and physical can make all the difference.

Whether the rest of Scandinavia is hot on the heels of Denmark remains to be seen but you would be hard put to find more comfortable and more attractive countries to work in.



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For the last two years a studio has been sitting on the northern edge of York pushing heap after heap of literature out to potential customers. Anyone who has had dealings with Clifton Studios will know. Brochures, price lists, special offers...something will eventually arrive. That's the way this studio is run. The regular arrival of tantalising brochures may be frustrating to penniless musicians but this studio is determined to find new customers and succeed where others have failed.

Several eyebrows must have been raised when Clifton opened, on what must have been a rather sparsely populated industrial estate. But Dave Wright and Ken Ather successfully launched the studio. Ken left after the first year to run a publishing company and Craig Hume, who came to Clifton as a trainee engineer, has become the second director. Nowadays, Dave and Craig do most of the engineering with four assistant engineers available to help out.

But Clifton Studios is far more than just a recording studio. Dave and Ken went into the business in a big way. Along with recording services the place also offers music

#### Clifton Studios, York

publishing, design and manufacture of equipment, repairs, rehearsal rooms, insurance, equipment hire, cassette duplication and record pressing. It's on a small scale compared to the big city boys but this must be one of the best ways to start from scratch and make it viable, whilst still offering value for money. Do the lot, at a price the locals can afford.

From the information in Clifton's brochure it's clear that Dave has been as dedicated in the past to performing as he is now to recording. He has toured extensively both at home and abroad as well as recording for the BBC and ITV. Dave also has considerable technical knowledge. Having studied Acoustics with Music and, after gaining his electronics qualifications, he worked in industrial electronics as well as for top amplification manufacturers and PA hire companies around the country.

In this sort of organisation the quality of the recording is vital—it's the cornerstone on which everything else is built. So what was Dave's approach when it came to designing and equipping the studio? It was as practical as Clifton's sales drive is commercial. A lot of thought has been put into the construction of the rehearsal rooms and control room but that little bit extra was used when it came to the studio and booth. Dave obviously knew exactly what he wanted when the studio was started and is very pleased with the result.

The studio has been designed with flexibility in mind as is required when aiming to satisfy the recording needs of a wide variety of musical styles. As well as fixed, tuned absorbers, full range absorbers have been installed in both the studio and rehearsal rooms and these are fixed to rails which enables them to be placed in any required position, or to be removed completely if so desired.

The recording area measures  $22 \times 17 \times 18$  ft with the ceiling sloping down to 14 ft at the far side. The basic construction is of the live end/dead end type with the live end having Rockwool-filled polycylindrical diffusers and bass absorbers with a hardwood floor running the width of the room. The rest of the area is carpeted and headphone sockets have

been fitted at convenient positions around the studio. The acoustic treatment is completed by a suspended, Rockwool-lined ceiling. The 18 in gap, together with the tiles used, provides excellent bass absorption.

One of Clifton's two rehearsal rooms has also been wired to act as an extra recording area; both rehearsal rooms have been acoustically treated with fixed narrow band and removeable full range absorbers as in the main studio.

With the studio laid out in this manner Clifton gets the best of both worlds as far as acoustics are concerned, so it can cater for the variety of work that a rural studio expects.

The control room is compact and separated from the studio by the ever popular glass sliding doors which provide good visual contact to 90% of the recording area. The studio is using an Allen and Heath Brenell System 8 16/16 and although this has been in use since the studio opened two years ago Dave is looking at a larger desk to get more channels, better EQ and computer control. The studio uses a Fostex B-16 for multitracking with the stereo mastering being done on a Revox B77. Monitoring is handled by Tannoy Super Reds driven by Quad 405s; Auratones are being used for

desk top referencing. An isolation booth used for drums, acoustic guitar or vocals stands within the main studio area and measures  $10 \times 11 \times 9$  ft. The walls and ceiling in the booth are lined with material padded with Rockwool making the booth extremely absorbent. Sliding glass doors have again been used for access as they give the separation required with good visual contact.

The studio has a comprehensive collection of outboard equipment including Roland, Yamaha and Alesis digital reverbs, Yamaha, Roland and DeltaLab digital delays, Drawmer and Fostex gates and compressors, and Yamaha and Roland sampling, graphics, stereo chorus, exciters, and filters.

They have an extremely good selection of mics including ribbon mics and old



36 Studio Sound, January 1987
# 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.
A STATE OF STATE	Omni-directional.
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# STUDIOFILE STUDIOFILE

AKG valve (tube) condensers. Other names represented in their microphone department are Sennheiser, Shure, Crown, Audio Technica, Milab, Reslo, Calrec, Neumann and Beyer.

But Dave is well aware that there is more to a recording studio than a list of equipment. One area of recording that he is concerned about is the ability of the man sitting behind the desk. As one of their leaflets says: 'It is not unknown, in some studios, for the engineer to be wellversed in the technology of the control room but to have little understanding of the problems and strain experienced by the musician who is trying to aim for perfection in the studio. Conversely, some studios are staffed by ex-musicians whose working knowledge of the equipment is scant.' How true.

On top of everything else Dave organised a course in the principles of recording, which is designed to give comprehensive knowledge of the equipment used in a modern recording studio. No doubt the students also gained a valuable insight into how a musician feels in the studio.

Clifton's two trainee engineers worked for a year as assistants during which they, along with six other independent trainees, received 40 full days tuition (two days per week for 20 weeks) in the principles of recording. The course was supported by comprehensive background notes and included lectures, demonstrations and practical experience, during which the trainees studied and used various individual pieces of equipment.

Dave's commitment to this method of producing efficient and understanding engineers is shown by his plans to organise another, more concentrated weekend course in recording principles. This concern about, and concentration on, the quality of service offered to the customer is as important at grass roots level as it is higher up the scale and has been neglected for too long by many small studio owners. The capabilities of, and the sound quality produced by, a studio is obviously important but the studios who take care of their customers are the ones who will survive, especially at this

## Clifton, continued

level where competition is rapidly growing stronger. The care that Clifton shows

towards its customers must be one of the major reasons why they are still in business. I would doubt that many studios could start from scratch in the recession-racked north of England, in which local musicians have had little money spare for recording sessions and still have their heads above water after two years.

During the studio's short life it has handled work for Radio 1 and 2, BBC TV, Channel 4, *The Tube*, Virgin, EMI and several independents. The bulk of the work done is cassette albums for a wide selection of pro and semi-pro bands, although the studio has also produced jingles, voiceovers, video soundtracks,

training material and demos. Clifton have found the customers and kept them. Indeed over half the customers who use Clifton's rehearsal facilities also end up recording there which shows the advantages of a complex offering so many musical services under one roof. And not only do these customers use the recording facilities, some return to Clifton even after trying better established, 24-track studios in the surrounding area.

Clifton's design for flexibility has brought the studio a large

variety of work and some of it has brought with it unusual problems for the engineers. A local renaissance group The York Waits recorded an album at Clifton using an incredible selection of old, traditional instruments such as crumhorns, shawms, English and Flemish bagpipes, 6 ft high recorders and a contraption called a schreierpfeiffe. As most engineers know, folk musicians want to hear their instrument's sound reproduced perfectly and The York Waits were no exception. But Dave had a problem-what was a schreierpfeiffe supposed to sound like?

He had to spend a lot of time in the studio simply listening to the weird and wonderful sounds produced by these instruments before even attempting to record them. This attention to detail isn't found too often in new studios who are trying to get themselves established, and where the recording is being done at rock bottom prices. That extra effort on the part of the engineer often seems to be lacking, leaving the finished recording without the professional touch that can make all the difference.

Dave, however, knows what recording and music are all about and he's prepared to put in that extra effort. Clifton's commercial, business-like approach to attracting customers with mail shots, special offers and brochures is well and truly justified as their services are obviously value for money and well worth selling. **Tony Draper** Clifton Studios, 46 Auster Road, North York Trading Estate, Clifton, York YO3 8XA, UK. Tel: 0904 642761.

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Dead End of main studio showing isolation booth and moveable absorbers



38 Studio Sound, January 1987

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# STUDIOFILE STUDIOFILE

The Fifth Floor Recording Studio is situated, yes, on the fifth floor of a warehouse type building which has seen better days. It is a stone's throw from downtown Cincinnati and the Ohio River, across which is Kentucky. Kentucky is Blue Grass country and only a few hour's drive away is Nashville. Potentially then, one might expect a country flavouring.

Not at all. In order to see how the music business operates in the States, you have to understand that just about every medium sized town boasts at least one local TV station and many radio stations. Catchment areas for many records are local, each town being a microcosm of the nationwide picture. Coupled with this there is an industrial base which generates video and audio/visual business; not to mention indigenous and visiting musicians requiring facilities. A good multitrack studio can capture a large proportion of this market.

On entering the building one isn't immediately hit by its splendour but apparently the building has recently been purchased and the new owner intends to 'spend money on it'. It must be said though that whatever decor is apparent, or coffee machines available, or pool tables, etc, the final product is a length of PVC some ¼ in wide with a delicate magnetic pattern engrained in it. This is where a studio will live and die.

Around 1970 Richard Goldman 'rolled in' from Los Angeles, which must be in excess of 2,000 miles away, liked Cincinnati, and "just stayed here".

Fifth Floor Productions, in its embryonic form, was opened around that time as a rock 'n' roll rehearsal studio. This quickly developed, with the help of some innovative ideas like live radio transmissions, into a basic recording facility and remained 2-track until about 1973. Progression up the track multiples scale continued until 1978 when the company went 24-track, consolidating credibility along the way with involvement in some 'name band' projects. Ably helped by his wife, Ellen, the business became well established.

The studio was designed by John Storyk, a well known

## Fifth Floor Productions, Cincinnati

New York based designer, and was constructed inside the existing shell of the building. The floor was raised 6 in above the original wooden flooring to accommodate a sand in-fill. The studio/control room partition consists of a 1 in plaster and steel mesh overlay, with 6 in of glass fibre followed by plasterboard and carpet. The construction framework stretches to the joists of the floor above, and the supports for the main control room speakers are hung from these joists. The outside walls are insulated with 6 in of glass fibre followed by a 12 in cavity, then a plasterboard/glass fibre sandwich finished off with a carpet covering. In the voiceover studio there are additionally four extra layers of plasterboard. This, Rich explained, was to keep the adjacent freeway definitely on the outside!

The upwards soundproofing is thin but most effective. It is as thick as a piece of paper. This is the lease which contains a clause stating that the upstairs occupant must not make a noise! An ingenious saving in construction costs, and according to Rich it works admirably!

The studio area itself is about  $20 \times 25$  ft. Not big, but this area is found to service the clientele well. It is also fairly dead acoustically. Incidentally, the office area serves as a particularly good location for recording a 'live' drum sound. All in all the studio area is fairly typically wood cladded with the familiar browns and beiges.

The control room, where all the hardware is housed, is at first sight also fairly typical with its wood cladding. Until you take a closer look at the desk. Richard is convinced that this desk, made by a small American company and called a Sphere Eclipse 'A', is at least part of the reason why his clients return. The desk has some interesting features. It has 28 inputs and 24 outputs but first and most important, Rich says he and his customers find the desk very 'musical' and easy on the ears whilst faithfully reproducing what is asked of it. Secondly it has a novel EQ section, which looks very much like a graphic equaliser on every channel! Thirdly it has one of the first generation automated mixdown systems, and although fairly fundamental works very well-even after 8 years in service.

The immediately visible part of the auto mixdown system is the VDU and keyboard which is situated a couple of feet above the console to the right. The processor only operates on the fader levels and is controlled by a timecode track on the main machine. It cannot be used as a device for configuring different sessions or for operating on switching, routing or EQ, etc., although the software allows any size of 'grouping'. The levels are shown on LED indicators to the left of each fader. Above the faders are the 8-segment LED status indicators which can also be used to indicate track assignment.

As far as Rich knows, very few of these consoles were made. The layout and particularly the level and status indicators clustered around the faders are rather pleasingly perspectived. And although not classically handsome it is ergonomically, very comfortable.

Again the control area is not spacious but large enough to work—even with a few keyboards in evidence. The room is thoughtfully laid out if there are perhaps too many harsh edges and hard, uncovered surfaces, particularly the floor but this is not an acoustic criticism.

Again fairly typically, the business falls into two clear sections: records and work coupled to visuals. These are split roughly 50/50. Talking to Richard it was obvious that his main love was for records, productions that must stand up by themselves, not being enhanced by pictures. However he is stimulated by a future of high quality music and sound being increasingly required as part of an essentially visual production.

Of the record business, about 80% of the work involves direct injection, and it is thought this percentage will creep up. To enhance his record involvement Rich was considering a partnership with a musician expert in the art of operating a Fairlight.

Fifth Floor Productions also operates syncing equipment to facilitate the other 50% of the business. This includes music for advertising, voiceovers, music for TV and radio. Most of the audio sweetening and voiceovers are carried out in the 8-track room where mixing to ¾ or 1 in video format is achieved using the Audio Kinetics *Q-Lock*. Film music business is now also beginning to come in.

They put together a very attractive portfolio giving all details of the business. Apart from being sent on request, they also make sure it appears where it will do most good, and is therefore sent by direct mail to advertisers. This is often followed up by personal contact.

TV producers are another target, and general industry involvement often facilitates the meeting and continuation of such contacts. Conventional adverts are occasionally used but are not seen as the prime means for generating work.

Of course, musical milestones are a good way to at least get a foot in the door. Among Fifth Floor's album credits are a platinum and gold albums for Midnight Star,



# STUDIOFILE STUDIOFILE

and Zapp and Roger. Major companies also entrusting work to Fifth Floor include Warner Brothers, Arista, United Artists, Columbia, Atlantic and there are unreleased album credits for Prince and Barry Manilow.

Richard discussed the future in some depth. He felt quite threatened by some developments like the Fairlight with their amazing repertoires of tricks but suggested that this power properly harnessed could be enhanced by multitrack recording, and studios and production companies could greatly benefit by access to one driven by an expert. Thus he would succeed in turning something which he considered to be a threat into a potential asset

As with many other facilities in the USA Richard has seen a future lying in the attention television companies/producers have been paying to sound, including an increasing TV output which is broadcast in stereo. He feels, as with the

making of programmes, the achievement of high quality

## The hardware

### Studio A

Sphere Eclipse A console, automated with digital faders MCI JH-24, Studer B67 and Technics 10A02 stereo recorders MCI JH-110 video machine and Sony ¾ in VCR Audio Kinetics Q-Lock Monitoring: UREI 813 Time Aligned, Yamaha NS10M, Auratone, JBL 4310 with BGW 500 power amp Ancillary equipment: UREI ½-octave graphic EQ; Lexicon 224 digital reverb, Prime Time and PCM 42 digital delays; Echoplate; Orban 622B parametric EQ; Eventide H-910 Harmonizer; Cooper Time Cube; UREI LA3A and 1176LN comp/limiters; dbx 160 comp/limiter 902 de-esser and 26-channel NR; Aphex CX1 comp/exp and EQ-2 Kepex noise gates Microphones: Neumann, Shure, Electro-Voice and AKG Instruments: Steinway 7 ft 4 in grand piano, Fender Rhodes, Rogers drums, various percussion Studio B Speckmix Mk II 16/8 console Otari MX 5050 Mk III, Tascam 34 ¼ in 4-track, Studer B67 and Otari MX 5050B stereo recorders Monitoring: Sony TA-F55, JBL 4411, Auratone and McIntosh 500 amplifier Ancillary: MXR 01 digital reverb. Orban 4244 com/lim/de.

Ancillary: MXR 01 digital reverb, Orban 424A com/lim/deesser, DeltaLab ADN 1024 digital delay Microphones and video equipment as Studio A sound is an art that will not be learned overnight, and as such the companies are using established sound facilities. Hence Fifth Floor have the necessary synchronisation equipment to cater for this. He also sees the continuation of popular music spawning its own video output as a benefit to the industry.

On the question of digital, Richard felt that, at present, there is probably not the support for a fully digital facility in Cincinnati, although Fifth Floor do hire in digital stereo machines for mastering. He is also concerned that the standards war is not yet over and like many others would be concerned about the long term value of his investment. But he listens carefully to what his clientele says and so keeps track of trends in available hardware. Paul James Fifth Floor Productions, 517 West Third Street, Cincinnati, OH 45202, USA. Tel: (513) 651-1871.

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**Studio Equipment Distribution** 

Burkhard Braach of Wandel & Golterman describes the philosophy behind the development of the NFA-1 audio test set

> sually, maintenance work on audio-studio equipment is boring and long-winded: every one of the numerous input modules of the mixer requires the same range of tests, each channel of a multitrack

machine needs the same adjustment procedure. For this reason, efforts have long been made to try to automate the tests, although this does not always lead to a saving in time and money. The automated equipment which makes the fastest tests is usually the most difficult to program, making the obtaining of single manual results both time consuming and frustrating. Putting together a test system from IEEE bus controlled instruments and a central computer is no real solution either as the complete system is not usually easy to move. Tests on location mean that the convenience of automation and VDU graphics can no longer be enjoyed. This situation prompted Wandel & Goltermann to develop a universal audio test set with built-in computer and VDU as a stand-alone instrument with IEEE bus controllable functions.

The *NFA-1* is an all-in-one instrument with the following features:

• Wideband section for level and automatic frequency response measurements;

- Selective level meter for crosstalk, spectrum and distortion analysis;
- Frequency and phase meter;
- Prequency and phase meter;
   Psophometric noise level meter;
- Wow & flutter and rumble noise analyser;

Single- and multi-tone signal generator.

Of course, it could not be expected that this versatility would be available in a handy 'pocket' tester but compared with the monster piles of equipment which would normally be needed, the *NFA-1* is compact.

In manual mode, the right test is selected with a maximum of three keystrokes. Instrument settings which are specific for a particular type of test are displayed on the VDU screen and can



Frequency response of a tape recorder, obtained through the use of a normal calibration test tape. Automatic speech suppression ensures clean results.

AN



Rapid frequency response measurement using the 17 tone signal. Here the results are expressed as gain vs frequency.



Wow & flutter vs time: the 'normal' W&F measurement with peak hold (WFm) and drift (Dav) also displayed. Special feature: 'flat' weighting with 1 kHz frequency limit.



Sigma measurement to IEC standards.



be altered using the softkeys even during a measurement, so that the effects are immediately visible. The more general (and therefore less often altered) settings can be called up on to the screen using the auxiliary parameter key. Input and output selection (single or dual channel), generator level and frequency can be set at all times using the keypad. Scaling for the screen graphics can be made before, during or after the measurement is taken, as the actual measurement range is automatically correctly selected independently, and guarantees that the result obtained is valid.

0

nce a particular set of control settings has been made, this can be stored as a so-called 'set-up'. The set-up memory has a back-up power source, and holds up to 50 complete instrument settings. This

means that most routine measurements can be called up and run on location, even without the help of an external computer.

Tape recorder measurements are used here as a detailed example. No other item of studio equipment has more moving parts (and hence wear and tear) than the tape deck, which means that this is the unit which requires the most attention. For the moment, however, we will ignore the mechanical side.

Reproducing section alignment: one calibration test tape, one test mode— 'electrical' adjustment starts with the

 $3 \mbox{rd}$  order harmonic distortion vs output level for a tape recorder.



The W&F spectrum of a semi-professional tape recorder: W&F = 0.090% at cursor position frequency of 830 Hz.



calibration test tape: nominal level, azimuth, and frequency response. All these tests can be made in 'wideband level vs measured frequency' mode. The level (both channels) as well as the phase are measured and plotted correctly against the frequency axis on the screen. A special feature here is speech suppression: the NFA-1 distinguishes between steady (valid) and fluctuating (invalid) signals, so that spot frequency test tapes with interposed speech passages can also be used to clearly determine the frequency response. As long as the test tone is present, measurements are repeated continuously, the previous values obtained being overwritten, so that it is very easy to adjust the treble equalisation in this way.

The adjustment of the record circuits is the most exacting of all the maintenance work that needs to be done. This involves not only the head azimuth alignment but first of all the HF bias setting must be made, as this influences level, frequency response, quiescent noise, and distortion. Unfortunately, maximum sensitivity does not correspond with minimum noise and distortion, meaning that the best setting is always a compromise. The following method is often used: record a 10 kHz signal at low level (eg 20 dB down on maximum drive level) and, starting from the minimum value, gradually increasing the bias current until the sensitivity is reduced by 3 dB after exceeding the maximum, or any other value depending on tape type and tape speed. Where

Static characteristic of a compressor/limiter with 'soft knee' and expander functions, expressed as input level vs output level. Measured using 'wide band vs generator level' mode.



Run-up for a studio turntable. Overshoot of the drive regulator after approx 0.3 s, tonearm resonance of approx 10 Hz (damped after 1 s) and record wobble (warp) of approx 0.5 Hz are all clearly visible.



necessary, the individual factors can be checked separately, ie noise, distortion and frequency response characteristics can be optimised.

Noise measurement is always important when the bias symmetry and the DC modulation noise must be balanced out. With the *NFA-1* it is not only possible to make weighted and unweighted noise measurements to CCIR recommendations but with the addition of a notch filter (1 kHz, optional) it is also possible to determine the AC modulation noise.

The distortion measurement can also be included as part of the bias adjustment: 2nd order harmonic distortion for adjusting the symmetry, 3rd order harmonic distortion for setting the bias signal amplitude. 'Distortion vs measured level' mode, in which the generator runs through a succession of level steps, is used to show the relationship between level and distortion from well below the nominal level to well above the defined drive limit (for example at 3% total 3rd order harmonic distortion). It is also possible to determine the MOL (maximum output level) using 'level vs level' mode. (The MOL is more a property of the tape used than of the tape recorder itself.)

> requency response can be determined in two different ways. One possibility is to make a wideband level measurement, during which the generator steps through the sequence of

irequencies corresponding to the IEC test tape, these being stored in a fixed value table, or through any other sequence of frequencies set by the user via the parameter entry keyboard. A programmable wait period compensates for the rec/rept signal delay. This means that test tapes can be put together which have much shorter running times than normal.

Fast frequency response measurement with multi-tone signal is the second, and perhaps more elegant, method. Here the generator provides all 17 of the IEC test tape frequencies simultaneously, which are then measured selectively. In MAN setting, it is thus possible to make measurements for as long as required at one frequency (say 10 kHz) and make adjustments. Problems of synchronisation between recording and playback are basically non-existent using this method. AUTO STEP is used to refresh the complete frequency sequence.

Naturally, crosstalk and erase levels can also be measured using the selective section of the *NFA-1*.

Signal paths and amplifiers are handled in exactly the same way in principle. One could almost say that electronically switched signal paths are just designed for automatic measurements, as are mixers which have electronically controlled set-ups. Manual mode is more likely to be used for the many special non-linear devices, such as measuring the frequency response of equalisers, or the amplification characteristics of compressors, limiters and expanders, or both parameters for deessers, noise gates and effects units.

A two tone signal is available for distortion measurements on band-limited systems, allowing difference-tone measurements to be made at the upper limits of the transmission range using the selective section of the *NFA-1*.



easurement accessories often seem to be makeshift affairs but this is not the case with the sound recorder measurement section option. This device was conceived as an

integral part of the *NFA-1*, and converts the instrument into a wow and flutter analyser which not only permits extensive automation of measurements on drive systems but also offers a wide range of valuable methods for fault detection and limitation, some of which are entirely new.

Of course, the *NFA-1* can be used as a 'normal' W&F meter: graphics display of speed fluctuations, numerical display of drift on the VDU. The weighting factors (weighted, flat, wow, flutter) and the rectifier characteristics are selected automatically according to the standard

# AUTOMATED TEST SET

chosen for measurement (DIN/IEC, which is the same as CCIR, ANSI and AES; NAB and JIS). This wide range of standards is a help to those who have large numbers of different items of equipment to maintain, all of which are to be tested according to different standards, and to manufacturers of equipment which is intended for worldwide export, as it simplifies the final QA procedure considerably.

The wow and flutter statistical (sigma) method was introduced by EMT over 10 years ago and has in the meantime proved successful. Peak values of W&F, regardless of magnitude, are ignored if they occur for less than 32% (1 sigma)/5%



Telephone 01-954 2366 Telex 934150 Fax 01 954 9504 Contact Ralph Dunlop or Jon Ridel at turnkey for further information - Telephone: 01-202 4366 discrete interference lines, it is possible to home in on the defective part directly. The *NFA-1* captures the spectrum by means of fast Fourier transform. With a maximum frequency range of up to 1 kHz it is not only possible to check the pole frequencies of all synchronous motors but also of most direct drives. On the other hand, the maximum resolution of 0.25 Hz in the range 0 to 10 Hz makes it possible to distinguish record or platter wobble from the ellipticity of the record at 33% RPM. This is very useful, since for

(2 sigma)/0.3% (3 sigma) of the total

measurement time. This method has

value measured over a period of 5 s.

documentation, production final QA

convenience for automatic

and so on.

since been incorporated into the IEC 386 standard which recommends the

determination of the 'weighted' 2 sigma

The NFA-1 provides all three sigma

values simultaneously, which is a great

procedures involving a go/no-go decision,

he graphical display of frequency

deviation density is, in contrast,

a great help for the service

immediately whether the

causes of which would be worth tracing.

trouble is offered by the spectral display

of W&F. From the frequencies of the

fluctuations are random or

The quickest overview of the sources of

discrete, periodic faults, the

engineer. It allows him to see

accurate W&F measurements, the test record must be accurately centred. Fader-controlled starting: a transient

effect can be measured. The run-up time can be measured directly using the sound recorder measuring section. The W&F tolerance used as parameter is entered numerically. The item under test is started automatically via a relay contact at the same time as the measurement is started. Not only is the run-up time displayed numerically but also the shape of the run-up sequence is shown graphically for the first time. This offers an excellent opportunity for fault tracing: speed regulator overshoot, chassis and tonearm resonances are all immediately visible from the graphics display.

Rumble noise measurements using the sound recorder measurement section are similar to W&F measurements: the normal weighted or unweighted rumble measurements according to DIN or NAB are extended by a FFT analysis up to 100 Hz or selective measurements up to 20 kHz and above. Increased rumble and W&F values often have the same causes: hunting of synchronous motors, the tacho frequencies of DC controlled motors, idler wheels and so on. Excitation of tonearm resonances cannot be excluded either.

## Documentation of results

This is simple to arrange if the *NFA-1* is computer controlled via the IEEE bus. It is not only possible to call up the numerical values of results but also the graphics, for example a specific spectral line of interest can be isolated. It is also possible to drive an (optional) IEC bus controlled plotter, even without an external computer. The video display of results can also be printed out in its entirety by connecting a video plotter directly to the video output.

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But while the MX70 sets new standards for flexibility, the men at Otari have stuck rigidly to tradition.

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For more information on the MX70 or other Otari products, contact Industrial Tape Applications, 1 Felgate Mews, Studland Street, London W6 9JT. Telephone: 01-7489009 Stirling Audio Systems Ltd., 1 Canfield Place, London NW6 3BT. Telephone: 01-6254515

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# New sounds only change what we hear.



## New approaches to ambience, imaging and sampling

The new 480L digital effects system from Lexicon was created to produce more accurate room simulations. However, within its innovative software and hardware are possibilities that extend far beyond the limits of realism: combinations of plate, gated and ambient reverbs, unique cascaded time-based effects, sampling. Personal settings can be stored and transported on RAM cartridges.

Controlled from the familiar LARC, the 480L's multiple high speed processors operate in several configurations. Samples can be processed with reverb and time-based effects, all in the digital domain. Two control rooms can use one 480L. Or two 480Ls can be connected through their digital I/O ports. A 480L can even be connected to a 224XL and both units operated from a single LARC.

## Moving forward by looking back

The 480L is a generation beyond other digital processors in both hardware and software. Yet many of its advances were conceived in centuries-old con-

cert halls. Close analysis uncovered basic flaws in the usual digital techniques of ambient simulation.

In real halls, the rate of the first 15 dB of decay is crucial to the perception of spaciousness and ambience. For many listening positions, this initial decay is longer than the measurement of total reverb time would suggest. To emulate these fine old halls, it is necessary to control the initial decay independently of the overall reverb time.

## Hall programs of unprecedented realism

The initial reverb envelope defines apparent room size and ambience to the ear. In real spaces, this buildup and decay is gradual, with a complex, nonexponential profile. The use of digital pre-delays does increase apparent room size, but adds unnaturally defined attacks that make the sound artificial. The 480L's SHAPE and SPREAD parameters emulate the complex profile of natural reverb. SHAPE affects the contour of the reverb envelope, while SPREAD controls the time factor for that contour. When balanced with SIZE (reverb density) and RT60 MID, SHAPE and SPREAD create deep, warm, spacious ambience without excessive decay times.

# Only new ideas change the way we listen.



## Now we have a clearer picture.

The 480L's innovative SHAPE and SPREAD controls continuously adjust the diffused reverb profile to match the ideal ambience characteristics of a real hall — with uniquely natural pre-delay.



## Digital processing for digital production

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317 St. Paul's Avenue, Jersey City, NJ 07306/U (201) 653-2383 Telex 285261 GEXCI uring the late summer of 1986, the internationally renowned tenor Luciano Pavarotti played several concerts in Europe continuing a series of over 25 such concerts staged in North America. Pavarotti took opera

out of the small audience capacity opera houses and presented it on a large scale to multiple thousands—rock concert sized audiences of 10,000 and over.

To make this concept work-solo tenor with full orchestra-in such large venues has required extremely careful planning and precise execution. It has also seen a collaboration of a quite unusual type. The sound system was designed by Roger Gans, sound designer for the San Francisco Opera House. The sound was balanced by James Lock of Decca Recordings who has a long standing working relationship with Pavarotti in the recording studio. The speaker systems used were all Meyer designed and manufactured and used in conjunction with the Meyer developed Source Independent Measurement (SIM) room analysis/correction process that aids removal of acoustical resonance problems within acoustical spaces.

The European concerts were, however, different in that rather than ship systems and personnel from the US Autograph Sales, European distributor for Meyer Sound, in particular David Solari, took overall technical responsibility for the concerts as well as providing all the front end hardware including mixing console, equalisers and SIM analysis equipment. Autograph subcontracted Richard Leinard's Sound Hire company to provide the bulk of the sound system; including Schoeps mics, multicore system, amplifiers, speakers and flying hardware. Sound Hire and Autograph have had a long history of working with Richard Leinard having a fairly unusual high precision approach to live sound. Their task was to complete the concerts and match the achievements of the US sound team with their two and a half years experience right from the first European concert with no discernible change in quality.

The featured concert of this article is the Wembley Arena show which was the sixth that this team had undertaken. Earlier shows had been in Turin, Genoa, a slight detour to Peking for two concerts—one of which was unscheduled but organised in response to the success of the first although this time in the massive Great Hall of the People— Munich, Wembley then back to Italy for two concerts in Pesaro. Not all these venues were of the same size and the size of the systems used varied considerably although they all followed the basic principles laid out here.

## Wembley concert

It is surprising how easily the might and splendour of an orchestra such as the RPO can be all but lost when placed in the vast hanger-like surroundings of Wembley Arena. On first impressions at rehearsals performer and venue seemed rather mismatched. If classical orchestral music needs some degree of intimacy to bring it fully to life in live performance, then opera could be argued to have an even higher need of personal contact

# **OPERA** ON THE ROAD

## Jim Betteridge at Pavarotti's European concerts

between performer and audience. From the rear of Wembley Arena there was precious little visual contact with the stage and the acoustic output of this fine orchestra was weak and indistinct, and very much at the affect of the boomy, resonant room.

Later, members of the audience could be heard commenting on the four translucent octagonal plates that stood lollipop-like on stands along the front of the stage, and the two more that stood behind them further upstage. These 3 ft wide plates were acting as boundaries for six Schoeps Boundary Layer Microphones-the Schoeps equivalent of the Ameron PZM (Pressure Zone Microphone). The plates had been designed by Roger Gans, sound system designer for the San Francisco Opera. They were made from a form of ABS plastic used in the construction of riot shields and well regarded for its extraordinary strength and flexibility Perspex had been tried but was found to gradually crack at screw points. The octagonal shape was entirely cosmetic. These plates were mounted on sturdy metal stands custom built to the specifications of PA hire company, Sound Hire. Sound Hire also supplied all the microphones on stage which were exclusively Schoeps at the request of James Lock (Pavarotti's recording engineer for many years who has also acted as balance engineer for virtually all of the singer's large arena performances). Sound Hire MD, Richard Leinard, commented that he liked the Schoeps transducers for their off-axis linearity which was particularly important for this application. In addition to the six *BLM*s there were a number of local Schoeps MK4 condenser mics and a pair of Schoeps MK41s used on extension tubes (a less intrusive alternative to ordinary mic stands) for Pavarotti's vocal mics. These are similar to the MK4s but were used in preference for their hypercardioid polar response pattern useful in discouraging feedback from the monitors. On other occasions

MK4s had been used in place of the BLMs but it had been agreed that a more natural, open sound could be achieved with the boundary mics.

## Speaker system

The speaker system, all hired in from Sound Hire, was originally bought through Autograph Sales and was basically the same system used for all the European Pavarotti concerts. Sound Hire is apparently unique in England for working exclusively with Meyer speakers and has also been responsible for supplying Meyer systems to a number of major acts in the rock/pop world. This system, designed by Roger Gans, comprised a single forward-facing central speaker cluster flown approximately 16 ft in front of the stage, and a pair of subbass bins positioned left and right under the stage. There was also audience seating to the sides and rear of the stage and so 10 ft out from the three remaining faces, centrally positioned, were flown individual side and rear clusters to cover those areas. Although the format of the clusters is generally kept the same, it is of the utmost importance to ensure the flying height and angling of the various sections of the clusters is such that even coverage is

The flown speakers at Genoa represent the setup at most of the concerts





Mixing position at Wembley complete with FFT, EQ rack and computer

achieved throughout the auditorium without significant hot spots at physical crossover points. It's also very important that the speakers are aimed at the audience as much as possible to make use of their absorptive qualities and to keep reflected sound to a minimum thus ensuring the maximum possible direct/reverberant ratio.

The flying hardware was custom built partly by Pro Media, the American PA company who had been handling the Pavarotti concerts in the States, and partly by Sound Hire. The main system was configured from three types of Meyer speaker enclosures, all components of which are Meyer designed: the MSL-3 is a biamplified unit containing two 12 in LF cone drivers in a proprietary horn-loaded vented enclosure and a single HF compression driver with a 70° horn passively crossed over to a VHF tweeter array. The UPA-1 is a smaller biamplified system containing two 12 in LF cone drivers in a vented enclosure plus an HF compression driver with a 90° horn. The 650-R2 sub-bass cabinet contains two 18 in cone drivers in a large vented enclosure and takes the response of the system down to 30 Hz. For earlier concerts the foldback had consisted entirely of two on-stage UM-1 monitor wedges in front of Pavarotti's rostrum each containing a single 12 in cone driver plus a 60° hornloaded HF compression driver. This arrangement still left singer and orchestra feeling isolated from the sound reaching the audience, something that anyone who's ever stood behind a large PA stack will understand, and so a UPA-1 was mounted on the rear of the main cluster to give the performers a sense of perspective within the room (this technique had been well established by the time of the Wembley concert). ORCHESTRA PERSONNEL AND MIC LAYOL

- OR	60FEET
40 FEET	PERC         TIMPS         C-MAGING ROOMS           (MAL)         MORNEG ROOMS         TRUMPETS           2NO VIOLINS         MARINE RASSOURS         O'ROMBONES           2NO VIOLINS         MARINE RASSOURS         O'ROMBONES           0000         0000         0000         O'ROMBONES           0000         0000         0000         0000         O'ROMBONES           0000         0000         0000         0000         O'ROMBONES           0000         0000         0000         0000         I'MARINE           0000         0000         0000         0000         I'MARINE           0000         0000         0000         0000         I'MARINE           0000         0000         0000         I'MARINE         I'MARINE           0000         0000         0000         I'MARINE         I'MARINE           0000         0000         I'MARINE         I'MARINE         I'MARINE           0000         0000         I'MARINE         I'MARINE         I'MARINE           0000         0000         I'MARINE         I'MARINE         I'MARINE
1.4	MEYER UM-1 MONITORS

 SYSTEM OUTPUT CONFIGURATION

 INVERTIGUE ARENA)

 MONTOR

 OUTANA

 STRADO

 OTANA

 MARTER

 MARTER

 MARTER

 STRADO

 STRADO

The entire speaker system was driven as eight sub-systems.

Main front-facing cluster Long throw: two rows of five MSL-3s mounted with their HF horns together to provide a 30° vertical and 100° horizontal dispersion. Main downfill: a single row of four MSL-3s suspended from the bottom of the long throw system. Final downfill: four UPA-1s suspended below the main downfill. Sidefills Left and right clusters of four MSL-3s. Left and right clusters of four UPA-1s suspended below the MSL-3s. Rearfill

Rear cluster of four MSL-3s

Rear cluster of four UPA-1s suspended below the MSL-3s Foldback

A single *UPA-1* mounted on rear of the main cluster plus two *UM-1* wedges on stage.

### Amplifier racks

To the side of stage was a long row of flightcased amp racks. One of the things Autograph has done in connection with Meyer in Europe is to standardise the packaging for all the systems they supply. This means that although purchasers can, within a set of performance criteria, choose their own make of power amp, Autograph will rack them and set-up and lock-off the system's gain structure to give optimum performance. Such a modular approach assures complete consistency whilst allowing flexibility and interaction and the sustem.

interchangeability within the system. There were three types of amp rack, one for each type of speaker in use. The MSL-3s were driven by M3 racks containing two Crest 4000 power amps (250 W into 8  $\Omega$ ) and a Meyer M3 processor which comprises a 2-way active crossover plus frequency and phase correction circuitry. Contained in the same rack was the more recently introduced Meyer TC3 delay which accurately time aligns the super-tweeters mounted at the front of the speaker cabinets with the rest of the MSL-3 system. The TC3s are intended to improve imaging and provide a smoother top end response and are offered by Autograph as an option for systems

		-
SYSTEM (PESARO )	OUTPUT CONFIGURATION	
STEREO	5BAND	
MATRIX OUTPUT TO	CP-10	MICONTROLLERS 1x UPA-1
THEATRE	S BAND	2 CREST AMPS TX UPA-1
	CPAN	
MONITOR	SBAND	MICONTROLLERS 2× UM -1
OUT AUX1	CP-10	2 CREST AMPS
MIXER	MASTER EQ -	
	SBAND SBAND SBAND	
MAIN OUT -	CP-10 CP-10 CP-10	
	CP-10 ATTENUATION	MICONTROLLER 10 XMSL - 3
	AND ROUTING	TC3 CORRECTION MAIN LONG
		10 CREST AMPS THROW
		M3 CONTROLLER 4 MSL - 3
-	SBAND CP-10	TC3 CORRECTION - MAIN
	CC 10	4 CREST AMPS DOWNFILL
	5 BAND	2 CREST AMPS
DELAY	CP-10	MT CONTROLLER 1 CREST AMP
DELAY	SBAND CP-10	MT CONTROLLER 1 CREST AMP
LINE	SBAND CP-10	MTCONTROLLER 1 CREST AMP
DELAT	CP-10	M1 CONTROLLER 1 CREST AMP 2 X UPA - 1 SIDE STREET VIA GIOR- DANO BRUNO
	5 BANO	MI CONTROLLER I CREST AMP
1		

where very high fidelity is considered particularly important. M1 racks, virtually identical in form to the M3s, were used to power the UPA-1s and the UM-1s with each rack containing two Crest 4000 power amplifiers and two M1 controllers again providing a 2-way crossover plus frequency, phase correction and speaker protection circuitry. The sub-bass cabinets were driven by an RS-02/S rack with a B2 controller and two Crest 4000 power amplifiers. Each controller incorporates SpeakerSense driver protection circuitry which, through a connection from the power amplifier output, monitors the continuous power applied to the loudspeakers and limits the amplifier input signal if the safe operating limits of the drivers are being exceeded. Each frequency band of each cabinet, with the exception of the VHF tweeters on the MSL-3s, was driven by a separate channel of a power amp. Each subwoofer was also driven from one channel of a power amp.

The system was powered by a single phase of a 3-phase 32A isolating transformer fitted with three quick fit connectors allowing easy cross-plugging between phases in case of failure or mains borne interference on any particular phase. With programme of such wide dynamic range the smallest hum or buzz is very noticeable and a good deal of work had been done to keep lighting cable runs separate from sound lines in order to keep thyristor noise to an absolute minimum.

## Front end

The mixing console was a Cadac 30/10 custom built for Autograph Sound Recording and used extensively for their West End theatrical productions. Although it was equipped with comprehensive equalisation, a hi-fi approach was taken where the signal path between the microphones and the inputs to the room correction equalisers was kept as simple and as flat as possible, thus virtually no correction was used on a channel-by-channel basis. Though it was not used at Wembley, a Klark-Teknik DN780 digital reverb unit had been kept available throughout the tour at the desk position so that, when necessary, a little liveness could be injected into particularly dry venues.

All system equalisation was achieved with Meyer CP-10 parametric equalisers each of which offered two channels of 5-band, fully parametric, correction: 20 to 200 Hz, 60 to 600 Hz, 200 Hz-2 kHz, 600 Hz to 6 kHz, 2 to 20 kHz. These offered 15 dB of boost or cut with a bandwidth continuously adjustable between 0.1 and 1.1 octaves. Each channel also has an HPF and LPF giving 5 dB/octave attenuation above 500 Hz and below 5 kHz respectively. The flexibility of the equalisers over that of a standard graphic is important because when attempting to create a precise corrective curve it is necessary to respond accurately to room modes that can be anywhere between one and perhaps to octave wide. Peaks or dips narrower than to octave are apparently not very audible and are normally the result of a local cancellation rather than a general response of the room and,

therefore are not normally corrected for. The CP-10 is referred to as a 'complementary phase' equaliser. Effective equalisation of resonant systems such as loudspeakers in rooms, requires exact matching of antiresonance circuitry. Only by introducing anti-resonance precisely tuned to complement and cancel the existing resonance can the user create significant subjective and measurable improvements. The CP-10 is designed so that an extreme EQ setting in one channel can be matched and corrected by the second channel with minimal distortion or phase shift.

The SIM technique as used by Autograph for the Pavarotti concerts incorporates an adaption of a facility that has been available with dual channel FFT analysers for some years. By feeding a reference signal into one channel and a second signal into the other, the difference between the two can be accurately displayed in real time on the FFT screen as a transfer function. By comparing the output of the mixing console with the output of the speakers measured at various points around the room, a series of transfer functions can be derived for the different areas of the room showing its amplitude/frequency and phase/frequency characteristics. Any serious aberrations can then be corrected for by means of complementary frequency/phase equalisation. The reference signal can be anything providing sufficiently wide, consistent spectral content to allow comprehensive analysis. Thus, in addition to cyclic noise, it is possible to use music as a test source allowing analysis to continue unobtrusively throughout a performance.

Having flattened the room as far as possible, there is nothing to stop the engineer putting his favourite pair of graphics in the line and introducing his or her own personal stamp of creative colouration, although this was not the case at the Pavarotti concert.

The experience had little in common with that of attending a concert in an average concert hall and one missed the visual contact and strong acoustic presence of the orchestra but the system and the resultant sound was very impressive-rather like a good recording. There is no way a single monophonic cluster will ever come near to reproducing the intricate phase relationships experienced when sitting in the front stalls of a smaller auditorium listening to the exclusively acoustic output of an orchestra but perhaps the point is that the system did make the concert possible and produced very good results that the audience was extremely happy with. It's difficult to imagine a better job being done by any other system, although of course it's very hard to compare. If the ears of James Lock and Roger Gans are to be believed, and they both have wide experience of sound and opera, the Meyer system and SIM, stands well ahead of the competition. It will be very interesting to see if it can be applied effectively to other types of music in the future.

## Interviews

David Solari is managing director of Autograph Sales, distributors for Meyer

## **OPERA** ON THE ROAD

Sound products in Europe. Previously in charge of sales and marketing for console manufacturer Midas Audio Systems, he first came into contact with Meyer Sound over six years ago. Subsequent involvement with sound designer Abe Jacob and theatre hire company Autograph Sound Recording on *Cats* in London, which was also the first major Meyer Sound installation in England, led to the formation of Autograph Sales Ltd in 1982. He has been present at all the European Pavarotti concerts and here talks about Meyer products and their use at the Pavarotti concerts.

Roger Gans is with the San Francisco Opera as their sound system designer and was asked to design the system that is now touring with Luciano Pavarotti to

## great critical acclaim. David Solari

"Autograph became involved with this project when Pavarotti decided to bring his concert programme to Europe. He had been performing in large American auditoriums for more than two years and over the course of that time system designer, Roger Gans, and Pavarotti's balance engineer, Jimmy Lock, had been working in conjunction with a Californiabased hire company, Pro Media, to perfect the system. They had to make the decision whether to ship the entire system over to Europe, thus ensuring the same high quality, or have a second system put together in Europe to the same specifications. They decided on the latter and so we became involved.

"Roger's design is a system based around a central cluster with additional side and rear clusters that are used as needed, and this arrangement has been flexible enough to fit into all of the arenas we've worked in with Pavarotti.

## Autograph's technique

The *SIM* technique as used by Autograph for the Pavarotti concerts incorporates an adaption of a facility that has been available with dual channel FFT analysers for some years. By feeding a reference signal into one channel of the analyser and the same signal after it has passed through the system to be measured into the other, the difference between the two signals can be very accurately displayed in real time on the FFT analyser's screen as an amplitude/frequency or phase/frequency transfer function. By doing a transfer function between the output of the mixing console and the sound field of the speakers at various points in the room, it is possible to see the response of the room. If any serious abberrations exist they can then be corrected by means of complementary phase equalisation, the results of which can be confirmed as the corrections are made. The reference signal can be anything providing sufficiently wide, consistent spectral content to allow comprehensive analysis. Thus, in addition to cyclic noise, it is possible to use music as the test source allowing analysis to continue unobtrusively throughout a performance.

The system is made up of several components, some of which are off the shelf, others custom made. The heart of the system is a Hewlett-Packard 3582A spectrum analyser. This is interfaced to the sound system by a switch/interface box that was built by Autograph Sales. The box can be quickly connected in to the show system using two multicore cables. Signals are passed to special input buffers that isolate the measurement system from the outside world so there is no possibility of any disturbance in the sound caused by the measurement system. Phantom power and preamps for the measurement microphones are also provided.

The various combinations of signals necessary for room and equaliser measurements are switches to the analyser inputs by another section of this box. As it is necessary to compensate for the path delay between the speaker and the measurement microphone, the box also switches a delay line into the reference signal path as needed. The analyser is connected to a Hewlett-Packard Integral PC that acts as its controller. Under menu driven software control, the analyser is configured for the various measurements the operator wishes to make. Tasks that require several steps have been automated to keep lost time and errors to a minimum. The controller is also able to store traces from the analyser so that they can be compared with fresh traces during the show or installation, and also stored on disk for future study. All of this makes for quick and accurate measurements. The whole system is packaged for safe transit and easy set-up.

The speaker system is broken into several natural subsections in order to make its alignment practical. The first is the main array (the two high by five wide set of MSL-3s). A good place for the measurement microphone is found in the seats at the back of the hall and close to the axis of the array. The main system is then equalised for best response. Then the area covered by the first downfill array (the four wide array of MSL-3s) is checked, and with the main array on, is turned up and equalised.

Using the same technique, the second downfill (the four wide array of UPA-IAs) is added to the main and first downfill. At this point the coverage of the complete main system is checked for uniformity of sound pressure and frequency response. After all adjustments to the main system are complete, the side and rearfill systems are added by checking the response and level, and optimising using gain and equalisation. At the completion of the adjustments, the system is checked for uniformity throughout the hall and re-adjusted if necessary. The remarkable results achieved are due to the combination of the quick high resolution measurements possible with the FFT analyser and the way the complementary phase equalisers react with the arrays and the room.



One of the most important disciplines we apply to the Pavarotti system in particular is that the system design doesn't vary, each component is kept in different loudspeaker sections from the console area. The system incorporated our standard amplifier packaging which again helps maintain consistency. But all these things were discussed and approved by Roger before we went ahead.

"The reason we decided on a standard packaging format for control electronics/amplifier/loudspeaker interface right from the beginning was to reduce as many of the unknowns and uncertainties of loudspeaker use and improve overall consistency and reliability, and that's been an important part of making possible what we're doing with Pavarotti and SIM in general. With modular systems which are still quite popular, hire companies can buy systems in component parts and put them together themselves. It's a kind of DIY approach which can work say for a permanent installation providing it's under the control of an excellent designer-and that the funds are there. In the real world contracts unfortunately often have to go to the bid that comes within budget, and accurate custom design from scratch is bound to be very expensive. But for a touring rig it's completely different. The system needs to be easily transportable, quickly and safely flown and there isn't the time to do exhaustive tests, calculations and systems re-configuration to achieve the end result, you generally have less than half a day to set everything up in each new venue. So apart from the use of the Meyer full-range speakers with integrated control electronics which we knew performed well, we wanted to be able to guarantee that all of our systems would always work properly. If someone didn't like the way they sounded it wasn't because they had used an unsuitable amplifier or connected part of the system out of phase, or whatever. Although there was a great deal of resistance to this total packaging idea at first, the benefits of it have dissolved any fears our clients might have had. If a company needs to sub-hire extra equipment they can be confident in simply putting the two systems side by side, plugging them in and switching on. They know that it will all go together easily and that it will work properly. "Most of our UK PA customers send

"Most of our UK PA customers send their systems back to us about once a year for a full service which means a very high level of reliability and performance. We have over 225 MSL-3s and 800 UPA-1s in constant use throughout Europe, 50% of which are over two years old, and still our return driver rate is below 3% overall.

"Although there are other all-in-one full range systems available, no other company has done so much research into what happens when a number of cabinets are coupled together, and how different size systems should be constructed to achieve certain results. A single cabinet may perform well but when coupled to one or more other cabinets its response may become unpredictable. With Meyer you can build up arrays that are specified simply, and

## **OPERA** ON THE ROAD

they work. You know if you build a given array, that within a given coverage area there will be a flat response and a minimum of combing. You can take a single *MSL-3* and measure it with an analyser, then couple a second cabinet the display will simply jump 6 dB over the entire frequency range. With the ability to build arrays with predictable responses coupled with very high consistency we are now in a position to concentrate our effort on how best to use the system for a given situation.

"So with the Pavarotti concerts we know we have a set system that we can rely on to perform well in any arena. Now, with the more accurate equalisation techniques and the CP-10 complementary phase parametric equalisers we have a means of controlling the system in the room to a degree previously impossible and so we've largely removed another block in the way of us doing what we really want to do which is to allow the artist to perform in large auditoriums without the system being apparent. We're nowhere near doing perfect sound, nobody is, but we're getting closer. The allusion has been made that what we're trying to do now is make it look like a good film, it's still something artificial but at least all the reels are in the right order and the film doesn't jump around.

A single cabinet may perform well but when coupled to one or more others its response may become unpredictable. With Meyer you can build up arrays that are specified simply, and they work

"This whole concept was well proved during the short series of concerts in Europe. First of all a very discerning client was able to come over here and pick-up a system identical in performance to equipment they had previously used in the USA. Secondly, I think Roger would agree that although we only did seven concerts in Europe this year the variation of venues and hence need for flexibility in the use of the system was greater than they had experienced in the two years they had been working in the USA. Most of the venues in the USA were large arenas that used the full system as employed in Wembley. Only three of the European venues, Wembley, Munich Olympiapark and Genoa Palasport were large enough

to employ the full system. At our first concert in Turin, Italy, and the two concerts in Beijing, China, the side and rear clusters were not used and the system consisted of a scaled down version of the centre cluster, with only five MSL-3s as the main system and four UPA-1As underneath as downfills. In these smaller venues (3,000 to 4,000 seats) the system was obviously used more as a classical reinforcement system, although its value was amply demonstrated by switching it off during rehearsal to dispel any doubts the promoters might have had.

"In Beijing we were glad that the original design provided for more than adequate headroom. Originally we were to provide the scaled down system for a concert at the People's Exhibition Theatre (capacity 3,000 approx) followed 10 days later by a piano recital with Pavarotti at the same venue. Due to the incredible excitement generated by the first concert a second concert was rescheduled at the last minute in the Great Hall with a larger capacity of 8,000 people, which was a great honour as the Chinese said it was the first time a Western performer had appeared there. We had no time to even think about bringing in additional equipment but aided by a good natural acoustic the concert was a huge success

"For the final concert in Pesaro, Roger had to return to the USA to fulfil commitments at the San Francisco Opera. This left me with the problem of adapting the system for use in an outdoor venue as the concert was to be held in the piazza at the centre of the old town. The stage was placed against one wall at the back of the piazza, so the large main cluster was used to provide 180° horizontal coverage. The first problem was how to fly the main cluster, the only possibility being a jib crane with a 40 m boom that could support over 2,000 kg at a minimum height of 15 m from the ground at near full extension. Other special requirements were a removable weatherproof shelter for the console area, secure positions for amplifier racks and power distribution, and ensuring multiway cables were protected so that motorbike traffic in the square during set-up days couldn't run over them. Things like AC power and security for the equipment obviously are more complicated than usual and needless to say there had never been a production like this in Pesaro before so we were breaking new ground. "On top of all this, Pavarotti had

decided after an open air concert last year at his home town in Modena that he wanted the people standing in the side streets leading off the square to also be able to hear him clearly. It was therefore decided after Jimmy Lock's first survey in April that delay loudspeakers would be provided for all of the piazza's main side streets. These loudspeakers were carefully positioned at least 3½ m high and aimed and arrayed to minimise reflections from the walls of the narrow streets and give smooth coverage for as long a distance as possible. Each position was independently analysed and equalised following measurements at each side street position with only the main

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system on to determine isolation and delay time settings. At the last minute we were asked to provide an additional stereo feed to a small theatre off the square fitted with a large video screen. Two spare UPA-1s on stands were used and again were independently analysed and equalised and driven from a stereo mix derived from the Cadac's matrix outputs. "We also had to deal with a TV crew

"We also had to deal with a TV crew producing a live broadcast of the concert for Italy and a video. Besides the usual problems of interface with their sound equipment, the director felt the *BLM* plate microphones spoiled his camera shots, and we had to explain at great length why they were necessary for the concert.

"Ambient noise is always a problem but outdoors in the middle of a town offers possibilities never normally encountered. There was a fountain in the centre of the square that the TV people wanted on during the concert so they could get suitably atmospheric shots through the water, etc. At a previous concert by another artist in the piazza the fountain was left on, obstructing sight lines for many people and making it very hard to hear. A suitable compromise was reached in the end where the fountain was on up until the concert started and restarted during the interlude, which required the installation of some additional plumbing. We also had to insist that a generator truck producing a very loud 50 Hz resonance be replaced, as I pointed out at the time if our system had been producing anywhere near that much hum there would have been a serious problem. "In the end the whole experience was

"In the end the whole experience was very valuable. It was an interesting challenge to work with such a diverse team of people to combine the equipment and techniques of classical recording with modern sound reinforcement, and I look forward to future projects."

## **Roger Gans**

"I do sound design for the San Francisco Opera, and there are many different odd special effects or off stage things that need to be amplified a little bit. And then we have events from time to time that actually need a sound system. What got us going was that we (the SFO) sponsored a Pavarotti show which was too big to go into our Opera House and so was to be done in the 7,000 or 8,000 seater Civic Auditorium down the street. My assignment was to come up with a system to work with that and I used a central cluster of Meyer, although it was a different array to the one we use today I'd been using a Meyer system at the Opera house previously and it had always been key to the whole operation. There may possibly be better sounding loudspeakers out there somewhere but for the kind of work we're doing we really need it to be rugged, reliable and predictable and Meyer does that.

"What we're trying to do with the SIM ideas is really quite simple. There's a difference or a lack of communication between studio people and live sound people. It's funny, there seems to be some sort of mystique about PA work, as if it's some kind of black art. Everyone has their little tricks to make things

## **OPERA** ON THE ROAD

work but generally it's not approached very scientifically at all. What we're trying to do is approach it very scientifically, to identify the problems and solve them, that's really what it's all about. We want to continually improve the system, get it cleaner and cleaner until eventually we can make the size of the room disappear and the whole sound system disappear so that it's just Pavarotti. I think that one of the problems is that not many people have an artistic goal to go after with their PA system. We're pretty fortunate that we have this sort of artist to work with; I mean the strength of his voice means that we have virtually no problems with separation between him and the orchestra, or gain before feedback, etc. We do have the same problems with the monitors that everyone else does but in a very minor way. He keeps wanting them

What SIM does mean is that we don't have to have a known test source anymore...we can use whatever's coming out of the console and compare it

turned up and it starts to colour the sound on stage; you can't get away from that.

"Every time a new technique comes along people tend to jump on it and say 'Oh, this is it, this'll solve all my problems, it's magic', but there's no such thing, it's always a compromise working situation. This system will do a great job, it'll go flat up to 20 kHz but that's not what we want, we want it to sound 'right'. The machine won't tell you how to make the judgements to achieve that, you have to make the judgements.

"The thing you have to remember is that none of these things is ever absolute. Wembley is a good example in that we pretty well flattened out the system but we couldn't change the character of the room, the sound was still there and people recognised it. So, you really can't get away with it completely, no matter what you're doing, I guess. What SIM does mean is that we don't have to have a known test source anymore, like pink noise or swept tones, we can use whatever's coming out of the console and compare it. That, to me, is the real power of the thing. It finally gets rid of the sound engineer's big excuse: 'Okay, so we can tune the room but what about when the people come in?' Now we can just keep tuning it all the time.

"The quality of the Meyer hardware is crucial to the whole concept. It wouldn't work without the complementary phase EQs. We've found some rooms where we've had to do 30 dB cuts at one frequency, which is horrendous, and you'd never attempt that sort of thing by ear or with more standard equipment. But if you've got an FFT sitting there telling you that's what's going on . . . and the results are finally what makes the big difference. To me all these things are just tools to do the job, to reach an artistic end, make the sound better. We're always trying to improve the system, trying to streamline the operation so that we have time to experiment with some of the things we're using now. The way new products and techniques are arrived at is often in reaction to a complete disaster or when something isn't working, but I'd rather not wait for that!"

On an artistic level did Roger think opera could really work in arenas the size of Wembley and bigger, where visual contact with the performer must be limited.

'Well, that's a decision that has to be made. What we've tried to do is make it so that the sound source is identified with Pavarotti and the orchestra on stage. In some rooms you can get a more intimate feeling by increasing the relative levels between different sections of the arrays but it's always a sourcefront thing. Someone at Wembly came to me and asked if we could turn up the speakers at the back because the sound was too far upfront but that's the way it is, there are no speakers at the rear of the hall. Eventually, if we get it right, you'll just see the orchestra and hear the sound naturally. It's an in-line thing both aurally and visually."

With a full concert orchestra capable of SPLs in excess of 100 dB sitting some distance from the speaker cluster, is there a delay effect at certain points in the auditorium?

"The cluster is generally flown about 16 ft from the front of the stage, give or take a few feet, and it is a case of fitting the sound of the speakers in to complement the sound of the orchestra itself. There is an effect down the front that you might hear the speaker cluster and then the live sound. That's why I say it's always a compromise but given that arena the number of people with that particular problem would have been minimal. People buy seats down at the front for different reasons, the sound is actually much better towards the back but then you can't see Pavarotti. Deciding the best place to sit is always a bit of a dilemma and it really depends on what you're going there for.

"It's never going to sound like a real orchestra in the same way that a recording is never going to sound like a real orchestra. Whenever you do something with transducers, somebody has to make a decision. You have to decide how that sound's going to come out in two dimensions. That's what we're doing, we're still making those decisions, and we're continually making little adjustments here and there, even though the basic system stays the same. I'm very excited about how the system is improving and what we'll be able to achieve in the future."



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Comment from Martin Polon our US columnist

Over several very good bottles of Samuel Adams (real beer is returning slowly to American drinking habits), a humorous story is told. A famous recording engineer passes on to the Big Recording Studio In The Sky, after a long and productive life behind the console. He reports to the traffic department, where St Peter is busy trying to keep up with a harrowing production schedule. St Peter turns to him and says, "I'm glad you're here. We have more sessions on tap than I know what to do with. Elvis has been complaining. We have classical orchestras rehearsing in three studios. Our complex has over 40 studios, mixing suites, post-production rooms, etc. It's so busy.

The engineer is then given a tour of the facilities. They are incredible. Stateof-the-art equipment throughout. In the largest of all the studios in the complex, a tour of the control room reveals a caped, brooding figure standing in the shadows; this ominous presence is at the window looking out—visible only in profile. They stand hushed for several moments, observing the great presence. The engineer is taken aback. "That looks like Phil Ramone." St Peter turns and comments. "No, it's not. It's God trying to do Phil Ramone's job."

I must wonder if a current trend in the business of recording audio would make such stories part of an ancient and very dead history. The presence of a great producing talent to shape the way music is recorded and pointed towards the market place may be a happening of the past. The electronic studio and its attendant technology of the synthesised and synthesiser studio has changed the face of the recording industry and popular music as well. It is both a fascinating and an awe inspiring observation that the computer revolution has had more impact on the music and audio industry than on any other part of our social and cultural fabric. Music has undergone more change than banking or newspapers. Despite pointed predictions to the contrary, banks have evolved from key punch to computer banking terminals but still deal in tangible paper money and newspapers use computers in composition and typesetting but still end up printed on paper. Yet in the world of music, the computers are used to create the music, compose it, synthesise it, modify it, synchronise it, record it, play it back and even to appear on stage in concert to perform it.

Computer music has replaced much of the reliance on conventional acoustical instruments and acoustic recording with stored 'samples' of a given instrument that are emulated in the digital domain to create a performance. It is not electronic music that is the issue for that is a new medium opening up enormous vistas for musical exploration. It is the one to one replacement of a conventional instrument and musician by a sample

# On history and the decline and fall of various empires

and a computer. Beyond that, one can find computer programs that actually 'conform' crude rhythms and melodies into accomplished pieces of music and then 'record' these works without any reference to an acoustic environment.

What I, and many like me, find confusing about all this is that the consuming public has released conventional music without a fight. The 'sample' is as good as the 'real thing?'-at least for popular music, television and in the film. No such release of convention has taken place in banking or newspapers; in fact, just the opposite has occurred. The public has resisted technological change and insisted on tangible and conventional money and newspapers in lieu of 'cashless banking' and 'videotext newspapers'.

The untroubled acquiesence to musical synthesis by the listening public comes at a time of increased quality for audio equipment used in the home. In the United States and Europe, the percentages of separate component systems and high quality package or rack systems have doubled and doubled again over the last 10 years. Similar gains in quality 'portable' systems have been made. The compact disc has opened up previous limitations in dynamic range and record quality. Statistics in the United States show that sales of quality rack, component and compact audio systems have increased from 5,168,000 units in 1980 to 6,500,000 units in 1986. Similarly, sales of compact disc players have grown from zero to 2,300,000 units during the same time period.

Yet with this greatly improved hardware and software for listening, the acceptance rate of 'cloned' music has risen dramatically. In the areas of film and television-where computerised performance has taken over from live musicians nearly half of all soundtracks produced-the quality of reproduction in the home and in the movie theatre has never been better. With high fidelity home stereo TV set sales approaching 25% of the total sold in the US and with new theatres being built and old ones reequipped worldwide, musical reproduction of video and film has never been more accurate.

It is as though the so-called electronic studio has become the musical symbol of the computer revolution in our society. It has become synonomous with a revolution in music making, where human creation has often been replaced with computer improvisation and the electronic musical cloning of fixed samples of various instruments. It seems the new technologies have at times led us to make music from the hands and not from the heart. If we had the ability to choose samples from dozens of different performers playing numerous varieties of a given acoustic instrument then these criticisms of the cloning process could certainly be partially blunted. But the relative sameness of some of the music made via computer is a topic greatly discussed in music schools and by music critics in today's newspapers.

That this change has entered the mainstream is confirmed by no less a creature of popular culture than the comic strip. A trendsetting American comic strip called Doonesbury by Garry Trudeau has attacked hypocrisy and change with targets ranging from President Reagan's policies to the yuppification of daily life. A recent Sunday morning strip seen in hundreds of newspapers around the world, focused on the computerisation of music in the studio for millions of readers. In this particular strip, the featured artist shows up at a recording session expecting a back up of live performers. The producer explains the real musicians are too expensive. When the artist enquires about horns, percussion and strings the producer answers, "Get real, Jim." Drummers are extinct. And with the Emulator, I got horns out the kazoo...I got strings on a floppy that'll give you diabetes, Jimbo.'

The cost factor is often quoted as the primary justification for the replacement of session musicians with a sampler and a floppy disk. At no less than four seminars during 1986 that focused on the future of the recording studio and the acoustical recording environment, the unsolicited justification of economics kept rising along with the topic of synthesised music created from samples. One film producer put synthesis and sampling in perspective. "I can buy one talented musician-composer-conductor in place of the 40 other talents I used to employ for scoring."

Another economic factor is the inability of up and coming popular composers to perform their works with live musicians. "I could never afford live performance," said one composer. "I started to perform my works with a synthesised version of a live group. Now when I perform, I always use the electronics because I got into the habit of doing it that way and I see no reason to change. Every performance is letter perfect."

This change in the way some music is made and recorded has impacted the existing studio market place in several ways. Certainly, the home studio has been able to thrive with the cost of an elaborate studio session providing the funds to purchase a goodly portion of a complete home studio set-up. Synthesised tracks at high levels can be recorded on analogue recorders and smaller consoles with little degradation. A major league studio with a £1 million investment (\$1,500,000) in digital tape machines and the current high technology console cannot compete with a basement studio that charges one quarter the rate for studio time, when the business is simply that of bringing electronic tracks together. The basement studio is owned by two young men who have spent five years of their lives frying potatoes in beef tallow at McDonalds to finance their 'home' studio. The basement is the willing gift of 'Mum' and 'Dad' who gladly sustain their prodigy underfoot, as it were.

The elaborate acoustical and electronic advantages of the major studio are lost on much of the activity involved in creating a synthesised record if only in terms of studio time needed with any mixing, editing, etc, being done in the computers of the synthesiser, MIDI boxes, resolvers, samplers, etc. The savings in time are obvious but so are the savings in cost.

Who the listeners are for sampled and synthesised music is precisely the issue that the electronic entertainment industry seems to be ducking. It is as though the line from the Don McLean song, 'The day the music died' was clearly prophetic of the past, present and future of the popular music industry. The current success of synthesised and sampled popular music on records, as film scores and in television shows is frequently quoted by those who are determined to prove that we don't even need acoustic musicians and acoustical recording in today's popular culture.

What fascinates me in my role as a demographer (kind of a statistical alchemist) is that the 'wunderkind' of and after World War II, those selfsame 'babyboomers' we hear so much about, have reached an awesome prominence in the social fabric of the Western World. They comprise the prime affluent market and their numbers are shifting the median age of populations upwards all over Western Europe and North America. This group was weaned on big band and swing-spent the teenage years reaching their maturity with the 'new' rock and roll and rhythm and blues. Well adjusted to jazz and very accepting of classical music as they age, this grouping today has broad and eclectic musical preferences and the affluence to support those tastes. Advertising agencies court this 'bulge' in the population as the most desirable. Yet this grouping has shown significant resistance to synthesised and sampled music. That resistance can be measured via several recent studies but also by rejection of popular records, network television viewing and theatrical film going by the over-30s of the West. It would be naïve to lay all blame at the door of the electronic replacement of human music making in these endeavours but that there is a

connection is confirmed in interview after interview.

Now, let me make this point perfectly clear (as my old buddy R Nixon would say!) I am an animal of the commercial market place. I can accept the musicality of electronic synthesis and sampling. I enjoy much of the best of it and I believe it has allowed more improvisation and musical invention than in any time in our musical history. But it should be a part of a balance encompassing all kinds of music and performance.

When an accomplished artist such as Stevie Wonder tours with a synthesiser, the keyboard is more than just a tool-it becomes a part of the virtuoso. On a recent tour the horns, strings, brass and flute needed for backup are supplied by Mr Wonder and his two accompanists on keyboard. No artist works harder than Stevie Wonder to create and polish the richness and tonality of the sounds that go with his performances. One is reminded of the pioneering work of Wendy Carlos in creating hundreds of instruments and tonalities from the electronic musical 'dictionary' of the synthesiser and sampler. This kind of music making is timeless and has appeal to all listeners; witness the success of Switched On Bach.

But, I earn my keep as a forecaster of technology and its impact on the social fabric of the Western World (and you thought I got rich writing this column). I am just plain worried that if we abandon the principles of acoustic music and acoustic recording in favour of computer synthesis and sampling done primarily for the sake of economics, we are never going to be able to place in perspective this absorption of music by the computer. If we bring up several generations which have never heard a real drum set in the hands of a frenetic drummer or heard a guitarist performing in the acoustic mode, they may never feel the need for music made with those kinds of instruments. Similarly, if these generations become accustomed to the computer recording of samples without live acoustical interaction, the need for recording studios could continue to diminish beyond its current threshold. What is most frightening is the prospect of computers writing popular music that is then performed and recorded by the self-same computer. No human being is needed except to listen and even that is not clear. Let's not lose the 'mix' in popular music.

We need the growth of technology but to increase creativity of performance and the recording process. We do not need it as a purely economic tool to cut production costs associated with music making. The world music industry has already cast aside the LP record in the name of 'progress'; let's think twice before we abandon the convention of acoustic recording of live acoustical performances for popular music.



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# TEST TAPES AND DISCS

## A guide to test tapes and discs available which are suitable for studio use

## Agfa-Gevaert

Agfa produces a variety of  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1 and 2 in frequency test tapes with studio applications. The majority of tapes are to IEC/DIN standards but there are two NAB standard tapes available (2 in/7<sup>1</sup>/<sub>2</sub>;  $\frac{1}{4}$  in/15 in/s). All  $\frac{30}{15}/7^{\frac{1}{2}}$  in/s tapes are recorded at  $\frac{320}{15}$  nWb/m, the only exception being the 2 in/15 in/s tape which is recorded at 185 nWb/m. Currently Agfa is gradually changing over to English speaking idents on their test tape range as existing stock is replaced.

#### Agfa-Gevaert AG, D-509, Leverkusen, West Germany.

**UK:** Agfa-Gevaert Ltd, 27 Great West Road, Brentford, Middx TW8 9AX. Tel: 01-560 2131.

USA: Agfa-Gevaert Inc, 275 North Street, Teterboro, NJ 07608. Tel: (201) 288-4100.

## Ampex

In addition to professional video test tapes (1 in and Quad format) Ampex produces a number of audio test tapes. These include ¼ and ½ in NAB and IEC 7½/15 in/s alignment tapes; level test tapes (700 Hz at 185 nWb/m) at 7½ and 15 in/s (¼ in only) and a full range of 2 in (NAB, IEC, AES) and 7½ and 15 in/s 1 in alignment tapes. With the exception of ½ in tapes (which are all full track) most test tapes can be obtained in either full or multitrack configurations. **Ampex Corporation, Audio-Video Systems Division, 401 Broadway, Redwood City, CA 94063-3199, USA. Tel: (415) 367-3888.** 

**UK:** Ampex International, Magnetic Tape Division, Acre Road, Reading RG2 0QR. Tel: 0734 875200.

## BASF

In addition to manufacturing the current IEC Primary Reference cassettes for the IEC Type I and Type II standards, BASF produces a wide selection of test tapes for studio applications. All the standard calibration tapes are recorded to 320 nWb/m. Tapes are available in 2, 1, 1/2 and 1/4 in widths recorded at either 30, 15 or  $7\frac{1}{2}$  in/s to either IEC/DIN or IEC/NAB standards. Frequency range is 31.5 Hz to 18 kHz with the exception of the 2 in/30 in/s and ¼ in/15 in/s short calibration tapes which have a frequency response of 63 Hz to 16 kHz. BASF also produce ¼ in stereo test tapes (15 and  $7\frac{1}{2}$  in/s) and a  $\frac{1}{4}$  in azimuth test tape. BASF AG, Carl Bosch Strasse 38, D-6700 Ludwigshafen, West Germany. Tel: 0621 601.

UK: (Test Tapes only): Stanley Productions, 147 Wardour Street, London W1. Tel: 01-439 0311, 01-437 5472, 01-734 4411.

**USA:** BASF Systems Inc, Crosby Drive, Bedford, MA 01730. Tel: (617) 271-4000.

## Bruel & Kjaer

B&K produces three test records for specific measurement applications. The QR 2009 features log frequency sweeps from 20 Hz to 20 kHz at -10 dB (ref 10 cm/s RMS). Tracks include right channel only, left only, L+R and L-R. Two bands of each sweep are included. The  $QR \ 2010$  is a stereo test record containing a wide variety of test signals for various applications. Overall frequency response is 5 Hz to 45 kHz and there are tests for distortion, wow, polarity, crosstalk and rumble. The QR2011 pink noise test record is designed for testing complete replay systems under actual listening conditions. Tests include calibrating the system, frequency response, phase (individual and entire system), resonance checks and room distribution of wide range signal. Bruel & Kjaer A/S, DK-2850 Naerum, Denmark. Tel: 02 80 05 00. UK: Bruel & Kjaer (UK) Laboratories Ltd, Harrow Weald Lodge, 92 Uxbridge Road, Harrow, Middx HA3 6BZ. Tel:

01-954 2366. USA: Bruel & Kjaer Instruments Inc, 185 Forest Street, Marlborough MA 01752. Tel: (617) 481-7000.

## CBS

The CBS Technology Center has recently introduced a brand new set of test records-the CTC professional series. These new discs effectively replaced the earlier STR technical series during August of last year. The new series consists of five direct cut discs: the CTC-300 phonograph test record, which is designed for use in measuring frequency response, crosstalk, resonance, polarity, compliance and tracking ability of cartridges; the CTC-310 distortion test record; the CTC-350 turntable and tone arm test record; the CTC-330 studio test record and the CTC-340 acoustical test record. The latter two discs are designed for the evaluation of complete systems. The CTC-330 was developed to assist in evaluating the performance of audio disc playback equipment and provides the range of frequencies and levels necessary to measure sensitivity, frequency response, separation, phase and turntable speed. The CTC-340 is intended for use when measuring an

entire system, including the loudspeakers. CBS Technology Center, 227 High Ridge Road, Stamford, CT 06905. Tel:

## MRL

(203) 327-2000.

Magnetic Reference Laboratory has more than 160 calibration tapes. In addition to standard tapes MRL also produces special test signals which either include longer lengths of standard signals or any combination of standard signals. Test signals available include multifrequency tapes, fast or slow swept frequency response, broadband pink or white noise and a 3150 Hz tone for flutter and speed measurements. Duration of test signals is usually 6 min although 16, 32, 64 and 90 min versions of some signals are available. Reference fluxivity is generally 200 nWb/m although 250 and 320 nWb/m reference levels are available as standard items on IEC 71/2 and 15 in/s tapes. The complete range includes 7½, 15, 30 in/s tapes recorded on all standard widths to NAB, IEC and/or AES standards. All standard test tapespeeds are recorded full width, fringing compensated with the exception of the <sup>1</sup>/<sub>4</sub> in tapes which are full width but non fringing compensated.

Magnetic Reference Laboratory, 229 Polaris Avenue, Suite 4, Mountain View, CA 94043, USA. Tel: (415) 965-8187.

UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091.

## STL

Standard Tape Laboratory produces a range of professional calibration tapes including reproduce alignment, pink noise, sweep, azimuth, level set and flutter/speed. Equalisation and programme level tapes are produced to AES, NAB and IEC standards with standard levels of 185 nWb/m or optional elevated level of 260 nWb/m for the NAB, AES versions; 320 nWb/m for IEC tapes. All tape speeds are available. Recording studio calibration tapes are recorded with no fringing compensation.

STL has recently introduced a new series of NAB/IEC 30, 15 and 7½ in/s test tapes with an extended frequency response.

Standard Tape Laboratory Inc, 26120 Eden Landing Road, # 5 Hayward, CA 94545, USA. Tel: (415) 786-3546.

## Webber

Webber produces <sup>1</sup>/<sub>4</sub>, <sup>1</sup>/<sub>2</sub> and 1 in NAB and IEC calibration tapes recorded at 7<sup>1</sup>/<sub>2</sub>, 15, 30 in/s and 2 in tapes recorded at 15 and 30 in/s. All test tapes are recorded on Ampex 406 and supplied on 10<sup>1</sup>/<sub>2</sub> in reels. Standard flux levels are 200 or 320 nWb/m. Test tapes recorded to different flux levels can be produced to special order.

#### Webber Tapes, Warehouse Road, Hamstreet, Ashford, Kent TN26 2JJ. Tel: 0233 73332.

UK: Pangbourne Musical Distributors Ltd, PO Box 19, Stratford-upon-Avon, Warwickshire CV37 6SA. Tel: 0789 68579



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## Hugh Ford appraises CD test discs which are commercially available

n order to test or evaluate compact disc players it is essential to have suitable pre-recorded discs available. These should be designed not only for checking the audio reproduction as such but also to act as a cheap and very high quality signal source for

other purposes. Useful functions would be not only for the line-up of equipment but also for checking programme meters, wow and flutter meters and many other tasks requiring special wave forms. Another aspect is the checking of the capabilities of the servo systems in players and the performance of the error correction systems.

As far as I am aware no test discs are available for checking the servo systems which depend upon the flatness of discs for the focus servo and the run-out for the tracking servo. The 0.1 mm tolerance of the centre hole means that the tracking servo must cope with at least this tolerance (0.1 mm represents over 60 tracks!) so this is a pretty important performance parameter as is the ability to cope with warped discs.

Turning to the capabilities of the error correction mechanism, Philips originally produced two discs known as test sample 4 and test sample 4A. These are now superseded by two new discs known as test sample 5 and test sample 5A which are sold by Philips as a two disc set.

Test samples 5 and 5A are, from a technical point of view, almost identical to the original pair 4 and 4A but the simulated fingerprint on test sample 5A is a later version of that on test sample 4A.

Test sample 5 is a series of 24 musical excerpts with no intentional errors. The pauses between excerpts vary between 0 and 8 s and some excerpts use index numbers up to seven. Test sample 5A has an identical musical content.



however, it contains three types of intentional defects on specified tracks, a simulated fingerprint, calibrated black dots on the readout side and an interruption in the information layer which is also calibrated.

The instruction sheet states that any CD player should be able to replay the fingerprint and the smallest of the other defects with no trouble. The dimensions of the black dots are 300, 500, 600 and 800  $\mu$ m and those of the interruption in the information layer 400, 500, 600, 700, 800 and 900  $\mu$ m. In theory a defect less than 2400  $\mu$ m should be corrected by a player if the full error correction strategy is implemented (which it isn't with few possible exceptions) many players read this test disc with no trouble.

There are therefore two shortcomings of the test sample 5A: one, it should have larger calibrated defects so that the user can determine the point of failure of any player, two, some of the defects are buried in sibilant material which obscures errors should they occur or make one imagine that one has heard errors. It is my opinion that a test disc for evaluating the error correction should contain very low level signals if any.

The table on the right shows the general contents of all the commercial discs of which I am aware. Some of these discs are available in good shops whilst others (for reasons better known to their manufacturers) have a distinctly restricted circulation.

As most of the test tracks are digitally recorded their amplitude should be precisely stated; I have checked a number of discs and found the amplitudes stated to be exact. What is not always precise is the frequency of the tones which are generally within one part in  $10^4$  from disc to disc. Both the

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- ★ Vcc + 14.5 35V
- ★ Floating input
- ★ High frequency version for high speed copying

Also new is PPM8 to IEC 268-10 Type I with -50/+6 dB scale. Suits wide dynamic range digitial material.

SURREY ELECTRONICS LTD The Forge, Lucks Green, Cranleigh Surrey GU6 7BG. Telephone 0483 275997 Sony and the Technics discs have statements regarding frequency accuracy and these discs agree with each other to within better than one part in  $10^8$ .

Basically the choice between the test discs is a question of the type of signal you require. For instance, some discs have swept tones suitable for synchronising with Bruel & Kjaer level recorders, some have various types of

Disc make Type number Remarks	CBS/Sony 48DG-3 No sample to hand
Reference level	L+R 1 kHz
Other levels	0 to -90 dB
Phase check	L+R L-R music
L/R check	Probably none
Frequency swee <mark>p</mark>	20 Hz-20 kHz -20 dB L+R
Spot frequency	20 Hz-20 kHz L+R -20 dB
Emphasis test	None
Infinity zero	None
CCIF IM test	None
SMPTE IM test	None
Squarewave	None
Toneburst	31.5-11025 Hz
Impulse	None
Amplitude sweep	None
Phase linearity	
Noise	White, pink, octave bands 31.5-16 kHz
Raised cosine	None
3150 Hz tone	None
Other tests	Warble tone, music
Tone accuracy	*
No. of tracks	26

tone burst, etc. In fact, there are more subtle differences between the discs which probably result from the precise relationship between the audio frequency and the sampling frequency. None of the discs is accompanied by any information on this subject which I suspect makes very significant differences to some measured parameters such as distortion.			<ul> <li>CBS/Sony 48DG-3: I believe this disc to be available in Japan.</li> <li>Denon Columbia 38C39-7147: in the UK this should be available in good record shops.</li> <li>Otherwise Hayden Labs Ltd, Hayden House.</li> <li>Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG.</li> <li>Japan Audio Society CD-1: I believe this disc to be available in Japan.</li> <li>Philips Disc 3, 5 and 5A: available in the UK from Philips Service, 604 Purley Way, Waddon, Croydon CR9 4DR.</li> <li>PolyGram DHFI9-410741-2: not from PolyGram</li> </ul>			this is obtainable from Vereinigte Motor Verlage GmbH & COKG, Postfach 1042, D-7000 Stuttgart 1, West Germany. Sony Test CD1 and Test CD3: not generally available; restricted to certain outlets. Technics CD Test Disc 1 (SH-CD001): available in the UK from National Panasonic Ltd, 308-318 Bath Road, Slough, Berks SL1 6JB. Hi-Fi News HFN003: available in the UK from Hi-Fi News, Link House, Dingwall Avenue, Croydon CR9 2TA.□		
Denon Colur 38C39-7147 Available	CD-1	Philips Disc 3 410 055-2 Available; see text for discs 4/4A+5/5A	PolyGram DHF19 410741-2 No sample to hand	YEDS 2	Sony Disc 3 YEDS 7 Available	Technics SH-CD001 Available	33C39-7441	Hi-Fi News HFN 003 Test disc by Denon
L/R 1001 Hz	L+R 1 kHz	L/R 997 Hz		L+R 1 kHz	L+R 1 kHz	L+R 1 kHz	L/R 1001 Hz	L. R. L+R, L-R. 1001 Hz - 15 dB
-15, -16, -1 -20, -24, -4 -60 dB	.8, -10, -20 dB 10,	-1, -6, -12, -24, -60, -80, -90 dB		-1, -3, -6, -10, -20, -60, -90 dB	-1, -3, -6, -10, -20, -60, -90 dB	-1, -3, -6, -10 then 10 dB steps to -90 dB	20 dB sweep 60 dB to 0 dB 1 dB/0.5 s	0 dB, -15 dB. -16 dB, -18 dB. -20 dB, -40 dB. -60 dB
L+R L-R vo	ice L <mark>+R</mark> L-R noise	None	Noise	None	None	None	L+R L-R speech	L+R. L-R. Speech and tone
Speech	Noise	None		None	None	Noise	Speech	L, <mark>R speech &amp; tone</mark>
20 Hz·20 kHz - 20 dB L/R 1 kHz start 5 s/8ve 5 Hz·22.05 k - 15 dB L+R 1 kHz start	20 Hz·20 kHz -20 dB L/R L+F 0 dB L+R 4·125 Hz -20 dB L+R	20 Hz-20 kHz 0 dB L/R 1 kHz start 16.7 s/decade		None	None	None	5 Hz to 22.05 kHz L+R -15 dB 1 kHz start 16.7 s/decade	20 Hz-20 kHz L, R -20 dB 5 Hz -22 05 kHz L+R -15 dB 1 kHz start 16.7 s/decade
21.5, 100, 100 9999, 19999 I L/R 0 dB 40, 100, 315, 3149, 6301, 9 15999, 17999 19999 Hz L + 0 dB 100, 1001, 99 L+R - 20, -4 -60 dB	łz 0 dB 1001, 999, R 9 Hz	41, 101, 997, 3163, 6363, 10007, 16001, 19001, 19997 Hz L/R 0 dB		100, 200, 500, 1 k, 5 k, 7 k, 10 k, 16 k, 20 k Hz L+R 0 dB	500, 1 k, 5 k, 7 k.	20, 50, 100, 200, 500, 1 k, 2 k, 5 k, 10 k, 12 k, 15 k, 18 k, 20 kHz L+R 0 dB	None	L. R 20 Hz 0 dB L+R 0 dB 40 Hz, 100, 315, 1001, 3150, 6300, 10 k, 16 k, 18 k & 20 kHz. L+R 0 dB, 315, 3150 & 10 kHz
20 Hz-20 kHz -20 dB Sweep+start	L/R None	None	None	1 <mark>, 5, 16 kHz</mark>	1, 5, 16 kHz	1 <mark>, 5, 16 kH</mark> z	In silence	In silence
Emphasis On	/off None	Emphasis Off	Emphasis On/off	Emphasis Off	Emphasis On/off	Emphasis On/off	Emphasis On/off	Emphasis On/off
11/12 kHz 0 d L+R, -10 dB		Sweep 300-20000 Hz DIFF=70 Hz L/R+1 kHz START 0, -10, -20, -30dB	14/15 kHz L/R -0.5 dB L+R -10.5 dB	$\frac{19/20 \text{ kHz } \text{L} + \text{R } 0}{-10 \text{ dB}}$	19/20 kHz L+R 0, -10 dB	19/20 kHz L+R	None	L, R, L+ <mark>R</mark> , -10 dB, 11+12 kHz
250/8020 Hz L/R 4:1 -10 L+R		60+7 kHz 4:1 L/R 0, -20 dB	None	400+7 kHz 4:1 L+R 0, -10 dB	4 <mark>00+7 kHz 4:1</mark> L+R 0, -10 dB	50+7 kHz 400+7 kHz 4:1 L+R	None	None
100 Hz L+R -10dB	None	100, 400, 1002, 5512 Hz L+R Full scale	None	100, 1 kHz L+R	100, 1 kHz L+R	100, 1 kHz L+R -10 dB	None	L+R, -15 dB, 100 Hz
1001 Hz L+R -20 dB, 401, 4000 Hz, 0 dB on/off	1001, 20-11025 Hz	401, 4001 Hz, -10 dB on/off	400 Hz 5 types 1 Hz with, without 3150 Hz, -60 dB	None	None	400/4 kHz L+R -10 dB	None	L+R, l kHz
<mark>3 t</mark> ypes	Yes	2 types L/R	None	None	None	None	None	L+R pulse
100, 1001, 9999 Hz, 1 dI	None 3/0.5 s	997 Hz 0-100%, in 5 s	4 <mark>00 Hz, Fad</mark> e out	None	None	None	1001 Hz L+R -60 dB to 0 dB 1 dB/0.5 s 1001 Hz start	None
401 Hz Swee 0-360° at 6°/	p * 5s	401 Hz in-out, 200/2 k and 200/20 k crossover aligned	None	None	None	None	401 Hz sweep 0-360° at 6°/0.5 s	None
White, pink, octave+½-oct bands, ISO c	White, pink, octave+5-octave entres bands 31.5-16 kHz	Pink	Pink, Yellow, Green L+R	None	None	White L+R -32 dB	White -20 dB L+R	White & pink -20 dB L+R %-octave, L 25-16 kHz, octave R 31.5-16 kHz
	Yes	None	None	None	None	L+R - 10 dB	None	None
None			N	None	None	None	None	L+R 0 dB
None L+R -20 dB	None	L+R 0 dB	Yes					
	t FFFF/0000 at ano 22.05 kHz, pip test, pistol shot	L+R 0 dB	Music, warble tone, FFFF/0000, level meter, wow+flutter, meter tests	None	Optical, mirror, multi-burst, duty cycle, track numbers 42-99	20 kHz Speed test	Music at -20 dB, -40 dB & -60 dB, 12 music tracks	22.05 Hz FFFF/0000, 12 music tracks
L+R -20 dB FFFF/0000 a 22.05 kHz, pi at -20, -40,	t FFFF/0000 at ano 22.05 kHz, pip test, pistol shot		Music, warble tone, FFFF/0000, level meter, wow+flutter,	None 0.0000001%	multi-burst, duty cycle, track	20 kHz Speed test	-40  dB & -60  dB,	FFFF/0000, 12

Notes: \* - no data available; L+R - left and right channels together; L/R - left and right channels alternated



## Levy lowdown

The eye-catching campaign by the tape manufacturers ('The needy...the greedy') was a last ditch attempt by the tape manufacturers to turn the Government off the idea of putting a levy or tax on blank tape. The aim was to generate some heat and make MPs think twice about losing votes from the young. It worked. The Queen made no mention of a Copyright Bill in her speech to open Parliament.

It's worthwhile to give a factual rundown on the story so far because the record industry says it is "disappointed but not disheartened". It is pressing on with the lobby for a levy. The Department of Trade and Industry says "We have no intention of dropping the bill." There is talk of a Private Member's Bill along similar lines.

In this debate there is very little common ground; except perhaps that some people tape some records and that sometimes they are their own, sometimes they are borrowed instead of bought and sometimes they are unavailable for purchase anyway.

In the late 1970s the record industry, led by their trade body the British Phonographic Industry, ran an extraordinarily clumsy, high profile campaign in favour of a levy to compensate for this. They 'guesstimated' figures which purported to show how much the industry was losing through home taping and then used those figures to 'prove' that a heavy levy was just.

Anyone, like myself, who dared to question the BPI's guesstimates was written off as the enemy—someone who wanted people to steal copyright and bring about the downfall of the record industry. Reminders that the record industry has squandered fortunes in better times got even deeper under their skin. Anyone trying to put the point that people were morally entitled to protect their fragile LP collection by copying what they had bought, met the blank stare of a religious pervert.

In September 1980, the BPI persuaded the Mechanical Copyright Protection Society to drop its voluntary licence scheme which had let people pay a few pounds a year for a clear conscience to copy their own records. It was tough luck on the industry that *The Times* columnist Bernard Levin regularly bought a licence and was then refused one, with a suggestion that he lobbied for a levy. Levin went into print with a blistering attack on the record industry.

In 1981 the BPI was talking of £2 on a C-90 cassette. At the same time the BPI was also talking technical rubbish about spoilers. Nothing could get through their thick skulls that there is no technology which will prevent a dedicated copier from copying, unless both ends of the hardware-software chain are designed with blocking in mind. "I'm not technical," a spokesman for the BPI's Technical Committee told me when I tried to ask questions.

In July 1981, the inevitable happened. The Government published a Green Paper on copyright reform and rejected the idea of a levy. Whitehall had rightly recognised taxing tape as a sure-fire vote loser. But they wanted to be seen as sympathetic to the record industry. They took advantage of the BPI's technical naïveté and promised support for a spoiler if they could come up with one.

The second Government Green Paper, published in February 1985, did a U-turn and said yes to a levy on both audio and video tape. So what happened to turn Whitehall round?

For a start the BPI wised up. It acknowledged that a press campaign in the early 1980s, which had rich pop stars in adverts whining for more money, had been a mistake. The BPI stopped offering the public guessed statistics as factual evidence and instead spent time and money lobbying MPs in private. Most important of all, most of the BPI stopped talking about spoilers.

At the same time the hi-fi hardware industry did something incredibly stupid. The Japanese latched on to the idea of double cassette decks which allow tapeto-tape dubbing. Sharp was one of the first. In 1982 Aiwa started selling a double deck which taped at four times the normal speed by running the tapes at twice normal speed and taping both sides of the cassette at the same time. The BPI objected and in April 1984, Aiwa withdrew. Then Amstrad ran provocative adverts which just about told people how to copy tapes and ended up in a high court battle with the BPI.

With double speed double decks the norm it became harder and harder for tape companies and their trade body, The Tape Manufacturers' Group, to argue that cassettes are not used to infringe copyright. But after the February 1985 Green Paper had said yes to a levy, Prime Minister Margaret Thatcher told her Cabinet that she did not like the idea of a levy because it would lose votes. And over recent years she has needed all the votes she can get. Leon Brittan worried too, until he resigned over the Westland affair and was replaced by Paul Channon who didn't.

After much to-ing and fro-ing, with deliberate Government leaks to Fleet Street designed to test public reaction, the Government finally, in April last year, published its White Paper on Intellectual Property and Innovation. This was a commitment to change the law.

The WP covered a wide range of topics, including legal reform to make patenting cheaper and hive the Patent Office off from the Civil Service. But what grabbed the record and tape industries was the firm proposal that there should be a levy on blank audio tape. It applied only to tapes of 35 min or longer. This exempted cassettes used for dictation, computer data or interviews. It wouldn't apply to video tapes, even though these can now be used to record hi-fi audio. It also wouldn't apply to open reel tapes. But there is room for change later. The WP promised that the maximum levy would be pegged at 10% and there would be no chance of raising it without fresh legislation. This was intended to stop the record industry continually nagging for increases. The blind would get a refund.

The music industry's response was predictable. Everyone was pleased to see the Government agreeing in principle but not too keen on what they saw as a low percentage rate pegged to retail price rather than recording time. The 35 min bottom limit was also unpopular. A lot of LPs are padded with dross and the best tracks will fit nicely on a 34 minute tax-free tape.

The BPI and Music Copyright Reform Group, which represents music publishers and writers, were disappointed and there was no mention of rental. A compact disc makes the ideal medium for rental: it is virtually immune from scratches and dust so lasts for a very long time. Several firms offer CDs on hire now for as little as 7p a day. 'Try before you buy' urged one advertisement in *The Gramophone* magazine.

The Royal National Institute for the Blind objected because it believed blind tape users would be burdened with the problem of claiming a rebate for tapes they had bought. The TMG commissioned a survey by NOP Market Research which, says the TMG, found that more than half of blank tape recording time is used to record an individual's own records—on which a copyright fee has already been paid. A further 18% of home taping time is used to record radio broadcast material-on which a copyright fee has also been paid. Hence the TMG's advertising campaign last June which publicly threw a different insult at the record industry every day for 10 days. In between the insults it argued "heavy tape buyers buy five times as many records" and "the vast majority of tape buyers record material on which they have already paid a copyright fee". There is now a new anti-levy group—'The Home Taping Rights Campaign'.

Meanwhile I have noted something subtle about the press releases which have been coming through from hi-fi companies on cassette tape decks. There is no going back now on double decks. When a punter buys a cassette deck he or she expects a double deck, preferably with high speed dubbing. The Japanese have now dropped the word 'dubbing'. The new range of twin cassette decks from Technics don't offer high speed dubbing, they offer high speed 'editing'.

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IDIOS

## **REVIEW REVIEW** A user report by Dave Foister

s the roles of musician and engineer continue to merge down 5-pin DIN leads, products are appearing whose benefits can be exploited by both: studio toys designed to interface directly with

musical instruments. The DR1 digital reverberation system from ART, featuring Performance MIDI, is one of the latest of these.

As a straightforward stereo digital reverb the DR1 stands up very well. with 21 distinct reverb and effects algorithms (all described as rooms) and full programmability of all major parameters. Reverb algorithms include five plates, five rooms and five halls, all quite distinct, and the manual gives almost poetically graphic descriptions of the rooms these represent. For each algorithm the decay time, pre-delay, diffusion, HF damping and reverb/dry mix are adjustable, all alterations being made via a pushbutton incrementor system. So keen are ART to provide an uncluttered front panel that the parameter buttons all have two functions, with 2-colour LEDs to indicate the status. Niceties include a minimum decay setting allowing dynamic control of reverb time-with this set lower than the basic decay time, loud input signals progressively reduce the reverb timeand a button marked Kill/Inf whose function can be programmed into each setting, allowing the reverb to be killed (although the early reflections can be left in if desired) or held indefinitely.

The straight reverb effects range from the quirky to the spectacular, with many highly realistic halls and rooms in between. For instance, I used a modified Medium Hall on solo classical violin—a fairly stringent test—and the result was completely convincing.

Special reverb effect rooms include reverse reverb and gated reverb, both fully variable and programmable. A further room sets the DR1 up as a straightforward DDL with a maximum delay of a second, with separate taps for left out, right out and feedback delays, while another creates drone and 'percussive flange' effects. These sound a little like the old cardboard tube, except that the pitch of the percussive flange is driven off an envelope triggered by the input signal. The final room, new on the current software revision, is a dedicated flanger/chorus set-up, with independent base delay and sweep width settings for the two channels, which sweep in opposite directions. All these non-reverb



effects are eminently usable and a useful bonus on an already impressive reverb. The only slight drawback is that for nonreverb rooms the front panel controls are all assigned completely different functions (such as HF Damping becoming Sweep Speed in the flanger mode), necessitating reference to the manual before an effect can be set up. ART provides a plastic-coated reference card with the unit's functions clearly listed but if that gets lost you could be stuck.

Another small niggle is the fact that the Kill Dry switch, which mutes the direct signal through the DR1, is on the rear panel, making it inaccessible when the unit is in a rack. For straightforward reverb use this isn't a problem but if chorus is required on one channel of the desk, it can't be added at the channel break points as the direct signal can't be switched back in. This switch could usefully have been on the front or even programmable for each setting.

The programmability is comprehensive and straightforward. There are 40 factory presets showing the whole range of algorithms and functions; there's even a demo routine where the unit cycles through its settings to show itself off. In addition there are 100 user programmable memories, each of which can be individually locked to prevent over-writing important and often used settings.

What makes this unit particularly noteworthy is its MIDI capability, which ART claims is the most comprehensive implementation available on a reverb unit. The most obvious aspect is the fact that the memories can be remotely selected via MIDI program numbers; any number can be assigned to any of the 140 presets so that selecting a new patch on a synthesiser can automatically select the desired *DR1* setting. Program number changes could also be stored in a MIDI sequencer so that new presets could automatically be called up on cue



during a mix. The *DR1*'s MIDI Program Table can also be used to set up sequences of effects which can be stepped through using a footswitch or a front panel button.

MIDI can also be used to slave together two DRIs, to dump individual settings or complete memory contents from one to another, or for computer control—presumably this could be used to store memories when all 100 are full as there is no cartridge or cassette data interface.

But perhaps the most important aspect of the MIDI implementation is its Performance MIDI facility, which puts reverb parameters under the direct real time control of the MIDI input. Any two parameters can be assigned to virtually any two MIDI controllers, from footswitches to breath controllers, from note numbers to velocity and aftertouch information. For the keyboard player this makes the DR1 effect part of the synthesiser sound with, for instance, reverb time under the control of the Mod Wheel or reverb amount responding to key velocity. Setting this facility up is a little fiddly but extremely versatile-the DR1's response to MIDI input values can be scaled from -128 to +128—and is fully programmable in memory. The potential this interface offers both on stage and in the studio is clearly enormous. I used it in conjunction with various MIDI keyboards, and effect changes which would have been extremely tricky any other way became a natural part of performance. Obviously these parameter changes could also be stored in a MIDI sequencer sync'd to tape, allowing all kinds of automated effects tweaking during mixing.

The DR1 comes with a full function wired remote, although as you need to be able to see the unit's front panel to know what the remote is doing (the remote has no display) it's a bit of a poser's luxury. The unit is, of course, software based so its facilities can be updated when new chips become available from ART. The audio specifications confirm the aural impression—A/D conversion is 16 bit and reverb bandwidth is a respectable 14 kHz—and every aspect of its performance is excellent, particularly bearing in mind the price.

MIDI is coming of age, growing out of its basic role of connecting two synthesisers together; now it is capable of providing the musician with detailed, expressive, real time control over the complete sound production and processing chain and the engineer with new and innovative ideas for imaginative automation-assisted mixing. The ART DR1 is at the leading edge of this trend and should be checked out by both. Manufacturer: Applied Research & Technology, 215 Tremont Street, Rochester, NY 14608, USA. UK: Turnkey, Brent View Road, London NW9 7EL.

# A technical report by Hugh Ford



reviously known as Radiometer, R E Instruments has been producing instrumentation for many years and is no newcomer to the field of audio measurements although the RE 201 is its first

multi-purpose microprocessor controlled audio instrument.

When fitted with all options the unit includes a signal generator capable of producing sine waves, CCIF or SMPTE type intermodulation test wave forms, TIM (transient intermodulation distortion) wave forms and multitone sinewaves including up to eight frequencies. All these wave forms are digitally synthesised with the frequency range generally being from 10 Hz to 25 kHz but extending to 1 Hz in the sine wave mode. In addition there is a sine wave reference tone facility which provides a low distortion output specified at 0.0015% which is about 10 dB below the distortion of the normal sine wave function.

The analyser section is based on an FFT (fast fourier transform) analyser and can measure wide band or selective level with average, RMS, true peak and CCIR recommendation 468 peak rectifier characteristics in addition to a limited capability of measuring DC.

When measuring noise or wide band level the available bandwidth is wide with a variety of weighting filters being incorporated. These include CCIR, CCIR/ARM, A-weighted and CCITT filters which do not apply to professional audio equipment as such. Selective measurement as used for measuring the various distortion wave forms produced by the generator are limited to an upper frequency of 25 kHz with the 2nd to 9th order distortion products being selectable provided they lie below 25 kHz.

Further facilities provide SINAD (Signal to Noise And Distortion) measurement from 20 Hz to 25 kHz, frequency measurement which includes drift from 3150 Hz or 3000 Hz or deviation in Hz or % from a preset reference frequency. Similarly phase may

## Audio Generator Signal modes: sinewave, 1 kHz reference tone

	Signal modes: sinewave, I Kriz reference tone.	_
	SMPTE DIN intermodulation, difference frequency	
	distortion, transient intermodulation, multitone,	
	off (0 V, 600 $\Omega$ impedance).	St
	Frequency accuracy: ±20 PPM.	P
	Output level range: 0.8 mV peak to 8.87 V peak,	R
	EMF (-62.7 dBu to 18.2 dBu) higher output	C
	available upon request.	N
	Output level resolution: 0.1 dB.	G
	Flatness (ref 1 kHz): ±0.1 dB.	C
	Level accuracy: ±0.1 dB+flatness.	D
	Output circuit: two balanced floating outputs,	pl
	transformerless, short circuit protected.	ĺΜ
	<b>Output impedance:</b> 600 $\Omega \pm i\%$ , others available	C
	upon request.	ex
	<b>Connectors:</b> isolated BNC, others available upon	l Ir
	request.	L
	Interface capabilities IEEE488-1978 BUS	N
	Subset implemented: SH1, AH1, T6, L4, SR1,	M
I	RL1, PP1, DCO, DT1, CO EIA RS-232C.	(2
I	Capabilities: screen dump to printer, dump and	Se
I	load of mangurament and/or signal definitions	

load of measurement and/or signal definitions. Baud rates: 300 to 9600 baud.



be measured as absolute phase or relative to a reference.

In the case of electromechanical devices the measurement of wow and flutter can be performed to IEC, JIS or NAB standards with the  $2\Sigma$  results being displayed as per IEC recommendations. Also turntable rumble measurements are performed to the A- and B-weighted IEC98A or DIN recommendations.

The 4U rack-mountable instrument is of solid construction and fitted with recessed carrying handles at its sides. As it is modular further facilities may be fitted later as desired. Furthermore, being software-controlled it is very simple to update the instrument as software becomes available.

The front panel contains a 9 in green phosphor CRT display to the left and three sets of momentary pushbuttons to the right. There are no analogue controls. On the right there is a block of eight function pushbuttons identified as F1 to F8 which correspond to a possible eight blocks of inverse video at the bottom of the CRT display; a set of 12 input keys numbered 0 to 9 (with a decimal point) and a key which is identified Enter and Exit the latter being a shifted function obtained from the third block of 16 pushbuttons-I will come to the functions of these later.

Below the CRT and keypad area is the power on/off switch and the input/output connectors in the form of balanced connections. These, can be at XLR connectors or isolated BNCs and other options are available. A further multiway connector is for the optional external keyboard which duplicates all the front panel pushbuttons. At the rear all connections are recessed

for protection. The upper part of the rear panel is a grille and air filter through

MANUFACTURER'S SPECIFICATION

top bits: 1, 1.5 or 2 bit. arity: odd, even or none. E memory bus apabilities: control or other RE products. umber of setups: 100. P10 apabilities: control of user supplied products. escription: 20 bit programmable TTL outputs us load pulses. lonitor output apabilities: composite video signal to drive sternal CRT monitors. **npedance:** 75  $\Omega$ . evel: 2.3 peak. on-volatile memory capacity **easurement definitions:** 10 per measurement 0 level measurements). equences: 20, each consisting of up to nine surements Audio generator signals: 100.

which cooling air is driven by a very quiet fan. Power is input via an IEC connector next to which is a locked voltage selector switch and properly identified AC and DC fuses.

Isolated BNC connectors duplicate the front panel left and right inputs and outputs with a 2-pin BNC style connector for the DC input and a further BNC socket providing a composite video output for an external monitor which may operate to 50 Hz or 60 Hz standards.

All internal functions may be controlled and data input/output via the IEEE computer interface the address of which is controlled from the front panel keyboards, the interface being at the IEEE standard Amphenol connector.

Further communication with the outside world is available at three 25-way 'D' connectors fitted with spring clip type locks. One of these is an RS-232C digital interface used for dumping the screen to a printer or input/output of other data, the baud rate up to 9600 baud and the stop bits and parity being input from the front panel keyboards.

A general purpose input/output interface provides a maximum of 20 TTL level outputs together with trigger pulses which are selected during the instrument set-up and suitable for controlling external devices such as tape recorders. The third connector is a special interface called the RE memory bus which is contrived for controlling other products from RE Instruments such as RF signal generators and stereo generators.

### Instrument operation

WEIGH

SINAD

DC W&F

Upon switch-on the instrument proceeds through a self check mode after which the various sections of the instrument checked are displayed for a short time, followed by a display of the options fitted and their software versions. After this the only information remaining in the display is the reverse video blocks

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SIGNAL

Multitone signals: 10, each consisting of up to eight components. Setups: 100, containing paired measurements and signals, memory bus setting and GP10 output. Physical characteristics Height: 221.5 mm (8.72 in). Width: 440 mm (17.32 in). Depth: 570 mm (22.44 in). Net weight: 24 kg (52.91 lb). Shipping weight: 31 kg (68.34 lb). Power requirements Consumption: 150 VA. Line frequency: 47.5 Hz to 63 Hz. Line voltage: 90 V to 130 VAC, 190 V to 260 VAC. Environment Environment Operation: 5°C to 40°C (41°F to 104°F). Storage: -40°C to 70°C (-40°F to 160°F). Humidity: 20% to 80%, non-condensing. Manufacturer: RE Instruments AS, Emdrupyej 26, DK-2100 Copenhagen OE, Denmark. UK: RE Instruments Ltd, Sherwood House, High Street, Crowthorne, Berks RG11 7AT.

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corresponding to the eight soft keys. In addition other functions are indicated on the 16 pushbutton keypad.

The shift key alternates between white markings on all keys and red markings on some keys such as the LOCAL and TEST functions in this area and the EXIT key in the numeric area with the red LED being illuminated when shifted. Selecting the LEARN mode is used for entering test conditions into the instrument and making sequences of tests.

Before proceeding to the learn mode pressing the INT key simultaneously with the arrow right or arrow left keys sets the display intensity which is, like all stored information, remembered in a battery backed memory. Pressing the COPY button dumps the current display to the printer via the RS-232 interface.

Entering the learn mode displays the following in reverse video at the bottom of the display, corresponding to the eight soft keys F1 through F8.



At this stage pressing the SYSTEM key displays the current IEEE address, RS-232 interface conditions and CRT refresh rate which may be 50 Hz or 60 Hz.

The desired parameter is selected with the arrow up/down keys which move the flashing arrow in the display (above left) which in this case is selecting the IEEE address which may be entered into the [] in the bottom line from the numeric keypad. In other cases such as the baud rate the reverse video in the bottom of the display will give a selection to be entered from the eight soft keys. Pressing store then stores the complete display in memory.

All displays are edited in this fashion with the BASIC parameters setting providing a reference of frequency, impedance and phase for relative measurement in addition to allowing multipliers to be entered for the DC measurement facility where external attenuators may be used to increase the range beyond the fixed  $\pm 16$  V range with 0.125 V resolution.

A very irritating feature of numeric entries is that sometimes the instrument reverts to an existing figure if out-ofrange data is entered, alternatively it sometimes accepts out-of-range data until the STORE button is pressed by which time several out-of-range entries may have been made. The display in use then reappears with a flashing > against the first erroneous entry.

The output from the generator section is set by pressing the SIGNAL key which produces a display saying ENTER SIGNAL NUMBER []. The procedure is to enter the number of one of the 100 signal stores (0 to 99) from the numeric keypad and to press ENTER. This

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# R E V I E W R E V I E W





produces something like the display on the left which allows adjustment of the signal type, frequency, level as EMF or into the entered load and allows the left and right outputs to be individually adjusted for output level and load. In addition the outputs may be grounded or fed from the variable frequency generator or the 1 kHz low distortion sine wave source.

Once the desired parameters have been entered using the cursor keys and the numeric keypad the signal number may be entered and the STORE button pressed to store the desired conditions in the battery backed memory. Pressing the softkeys, SHOW steps sequentially through the signal stores.

Measurements are set-up in a similar way by first pressing the FUNCT followed by the key corresponding to the desired type of measurement and the measurement number-there being 10 possible measurement set-ups for each type of measurement. Depending upon the type of measurement the set-ups include the channels to be measured. measurement frequencies, distortion product orders, averaging over a number of measurements up to 99, measurement duration, etc. In many cases the type of units displayed may also be selected, such as dB or % for distortion or V, dBm, W, dB relative to the reference of % relative to the reference in the case of level

At this stage the instrument may beused by selecting the desired signal number (0 to 99) and the desired measurement set-up (10 for each type of measurement). However it is now possible to chain up to nine measurements of any type into sequences of up to nine different measurements, there being 10 sequence stores each of which may be run with a single keystroke.

À further step is to use the SETUP facility, there being 100 setup stores each of which may be entered with a measurement (10 set-ups per type of measurement) or sequence to be performed (10 sequences of up to nine measurements), the generator signal number (0 to 99) and one/off data for each of the 20 GP10 bus lines.

Once these learning processes have been entered, provided that you remember or list the entered data, operation of measurements requires the minimum of keystrokes. To perform a single measurement it is necessary to press SIGNAL and enter the signal number (0 to 99) to set-up the generator. The desired type of measurement is then pressed, say THD, and then enter the measurement setup number (0 to 9). The measurement is then performed and the data presented on the display.

Alternatively one may press the shift key followed by one of the numeric keys (0 to 9) to perform a sequence of up to nine measurements in a sequence using

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# R E V I E W R E V I E W

a single type of generator signal. Whilst this is a very quick way of making spot measurements, it is not possible to plot graphical data without using a computer as a controller. The displayed data may, however, be dumped to a printer via the RS-232 interface with a single keystroke, the speed of the dump being controlled by the printer's speed with the printed format being identical to that on the display.

It is also possible to dump to a printer or computer connected to the RS-232 interface the contents of all memories or just the generator memories, the set-up memories or the sequence memories. This data, in the form of alphanumeric strings, can then be stored and fed back at a future date to give a rapid set-up of the instrument. Alternatively the set-up data can be fed from one instrument to another without the use of a computer.

### Inputs and outputs

The audio inputs in parallel at the front and rear had an impedance of  $645 \text{ k}\Omega$ and  $650 \text{ k}\Omega$  in parallel with 95/105 pF for the two channels with the common mode rejection shown in **Fig 1** not being particularly good.

Whilst the maximum specified input level of 22 V peak is far too low for some measurements, such as those on high power amplifiers and some professional line level audio equipment, the practical upper limit varies with the function in use. Overload is displayed as a warning on the display with this occurring at 22 VRMS when measuring level, 12.5 VRMS when measuring separation or at various other levels.

> Frequencies 1 kHz+ 1.1 kHz 10 kHz+10.1 kHz

19 kHz + 20 0 kHz

DF2

< 0.005%

< 0.005%

< 0.01%

DF3 <0.005%

<0.010% <0.01%

At the audio outputs the source

impedance was approximately  $20.5 \Omega$  for both channels with the output levels matching to within 0.02 dB at 1 kHz. The design of the electronically balanced output was such that only a minor shift in level occurred if either side was grounded. In the review sample the maximum available output was generally +24.0 dB.7 V with the minimum level being -56.8 dB.7 V, both being limited for some applications.

Whilst the output in the intermodulation distortion modes gave a warning if the maximum of about  $\pm 16$  V was approached it was possible to clip the output stages with the TIM waveform without warning.

If an excessive level was specified the display showed PARAMETER LIMIT EXCEEDED as it did if too low a level was specified. It was then necessary to enter a new level—it would be nicer if the instrument automatically inserted the nearest available level.

The video output delivered a 1 Vp-p waveform into 75  $\Omega$  with negative syncs, the actual frame rate being 50.14 Hz or 60.17 Hz for the nominal 50 Hz and 60 Hz settings. The GP10 interface was also satisfactory giving levels of +0.15 V to +4.93 V from a source approximating 200  $\Omega$ . Finally the input impedance of the DC inputs was found to be 999.3 k $\Omega$ and 1,000.9 k $\Omega$ .

### Generator section

The generator being of the synthesised type using a look-up table all frequencies are locked to the internal crystal clock frequency. Thus the frequency error is constant and was found to be far out of specification but stable. At switch-on a

> Total even order 0.005%

0.0025% 0.0058%  $10~\rm kHz$  tone measured  $9.9995450~\rm kHz$  decreasing to  $9.9995422~\rm kHz$  after  $10~\rm min$  and then not drifting further than  $9.999529~\rm kHz.$ 

Flatness of the output was checked over the full frequency range at various output levels from +10 to -50 dB and found to be very good within +0.02/-0.0 dB reference 1 kHz with the output level relative to 0 dB being within 0.04 dB over the full range. Absolute level accuracy at 0 dB at 1 kHz was +0.08 dB high for both channels.

According to the setting of the generator to read dB or VP (Volts Peak) the output delivered is the actual RMS voltage or a peak-to-peak wave form twice the VP setting, however, this did not apply to the TIM wave form outputs where the level readings were confusing.

Harmonic distortion in the outputs was the same for both channels with the third harmonic predominating at 0.003%below 10 kHz where it fell to <0.0003%and remained low at higher frequencies. The second harmonic content varied with frequency but always remained below the third harmonic. Total harmonic distortion plus noise band limited to 22 kHz was 0.0044% below 10 kHz mainly consisting of harmonically related products as shown in Fig 2 for a 1 kHz wave form.

In the special 1 kHz low distortion mode the total harmonic plus noise content fell to 0.0010%/0.0012% for the two outputs at +10 dB.7V out with the second harmonic being <0.0002% and the third harmonic 0.0005% for both channels—a very good performance.

The CCIF intermodulation waveform was checked at a number of frequencies with the performance being better than specification. The results shown in **Table** 1 were typical.

In the SMPTE mode all intermodulation products were below 0.01% with the Audio Precision System One indicating a total distortion content

 $\triangleright$ 

FIG.2 RE 201 FIG.1 RE 201 1kHz SIGNAL HARMONICS COMMON MODE REJECTION ZERO LEVEL -110dB ZERO LEVEL -100dB TT 10dB RIGHT INPUT LEFT INPUT 10 dB 100 200 500 2 k 5k 10 k 20k 50) 20 50 1k 200 500 1k 2k 5k 10 k 20k FREQUENCY Hz FREQUENCY Hz

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# R E V I E W R E V I E W

of 0.0084% using 60 Hz+7 kHz in the usual 4:1 amplitude ratio.

Using the same system the residual TIM distortion measured 0.021% in either the TlM30 or TIM100 outputs. Finally, the multi-tone output amplitudes were found to be within the accuracy of individual sinewave outputs.

### Level and noise measurements

In the wide band modes the absolute level accuracy was within 1% at levels above 1 mV input below which there is the normal degradation as the input signal level approached the instrument's noise floor. The latter was measured for various conditions and found to be good as shown in Table 2.

In all unweighted modes the lower frequency limit was 5.6 Hz for -0.5 dB falling to -1 dB at 5 Hz and to -3 dB at 3 Hz. In the RMS25, AVERAGE and QUASI-PEAK modes the upper frequency limit for -0.5 dB was 26.42 kHz falling to -1 dB at 26.72 kHz and -3 dB at 27.4 kHz above which there was a very rapid roll-off. In the RMS75 and the PEAK modes the upper limit for -0.5 dB was 110.7 kHz falling to -1 dB at 147 kHz and -3 dB at over 200 kHz.

Out of the many available weighting curves the three IEC weightings, the CCIR weighting and the rumble Bweighting were accurately checked and found to be very well within the recommended tolerances, indeed the worst error found in the noise weightings was only 0.3 dB up to 16 kHz.

The RMS rectifier indicated true RMS with negligible errors up to a crest factor of 10, similarly the AVERAGE response was entirely satisfactory. The CCIR QUASI-PEAK performance had difficulties, however, this is not uncommon in digital instruments. In fact the performance was far adrift from the CCIR standard with the instrument completely failing to comply with all the tests involving isolated bursts of 1 kHz sine wave from 1 to 200 ms duration. Similarly, trouble was experienced with the 5 ms bursts of 5 kHz tone at the rate of 100 per second but the performance was satisfactory for 2 and 10 bursts/s.

### Selective measurements

The measurement of selective level, harmonic distortion and both forms of intermodulation distortion is restricted to frequencies between 20 Hz and 25 kHz thus the applications of the instrument are limited. For instance, it is not possible to measure the third harmonic of fundamentals above 8.33 kHz, however, the effective selectivity is such that very low levels may be measured.

Measured levels of harmonics were accurate to within 1 dB down to -80 dB (0.01%) at 0 dB.7 V input with the instrument's residual varying with input level but not with frequency. At +10 dB input the residual was in the order of -110 dB increasing linearly with decreasing input level.

Whilst in the harmonic mode the analysis frequency may be preset or track automatically; in the selective level mode it must be preset. It is then possible to specify virtually any analysis effective bandwidth, the penalty for narrow bandwidths being a long measurement time.

The measurements of SMPTE and CCIF types of intermodulation distortion were limited by the instrument's

TABLE 2

	Inherent
Measurement	noise (dB.7V)
RMS25	-101.0 dB
RMS75	-97.1 dB
Average	~102.2 dB
Quasi-peak	-99.2 dB
A-weighted RMS	-107.2 dB
CCIR-weighted quasi-peak	-99.8 dB
CCIR ARM	- 105.3 dB
	1

residual which was relatively independent of input level. In the CCIF mode the residual second and third order products were both about 0.013% with the total products in the SMPTE mode being around 0.03%. Clearly these figures severely restrict the suitable applications.

Whilst the TIM measurement does not use a narrow band measurement technique, the residual distortion reading of 0.19% is far too high for many applications and an order of magnitude higher than some other instruments.

### Phase and frequency

Stable phase readings were obtained at input levels >20 mVRMS for frequencies between 20 Hz and 75 kHz with errors less than 1°. Increasing frequency beyond the specified range to 200 kHz only led to phase errors of 2°.

No warnings were found in the phase measurement function such that erroneous readings may be displayed resulting from too low an input level or the frequency being out of range. Similarly frequency readings were accurate, subject to the resolution of the display and the inaccuracy of the internal crystal already mentioned. Like phase measurement, however, no warnings are given when operating outside the instrument's specified range and erroneous results may be displayed.

### SINAD

SINAD, like harmonic distortion, may be measured in either a fixed frequency mode or a tracking mode when the instrument tunes to the incoming signal frequency. In either mode, the SINAD measurement is not a notch type measurement but a high pass measurement with a characteristic as shown in **Fig 3** for a frequency of 1 kHz. The instrument's residual varied with incoming frequency and level with the residual at 10 mV being about -50 dB



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decreasing linearly with incoming level up to about 1.5 VRMS input where the residual increases 20 dB and again falls linearly with an increase in incoming level. The actual switching point is subject to hysteresis.

Subject to these factors a minimum residual of -94 dB was recorded at 1 kHz or -97 dB at 10 kHz with the accuracy at higher levels being within 0.5 dB.

### Wow and flutter

Three wow and flutter ranges exist, 10%, 1% and 0.01%. These are not autoranging, which is irritating at times and for some reason all ranges were subject to locking-up at a maximum unweighted reading of 5.8% on the 10% range and pro-rata on the other ranges. Residual wow and flutter of the complete system was less than 0.0008% IEC weighted or 0.0016% unweighted with the calibration accuracy being within 1.3% of full scale worst case which is to a good standard.

The frequency response of the weighting filters and the 200 and 500 Hz filters is shown in **Fig 4** where both the low pass filters have a low frequency -3 dB point at 0.5 Hz which is the commonly accepted frequency. The actual weighting curve was within the IEC, NAB and JIS standards with a reasonable margin.

Checking the effective dynamics of the metering with the unidirectional frequency bursts specified in the IEC recommendation showed the instrument to be within the requirements—an area where many digital instruments have difficulties.

### Bus control

With the exception of the system parameters which include the IEEE address and the RS-232 interface parameters, all manually controllable features may be addressed via the IEEE interface. IEEE commands consist of alpha characters in the form of mnemonics which may be abbreviated to two alpha characters followed by parameters separated by delimiters which by default are commas. For instance the following instruction sets the audio generator so that both channels deliver multitones at 60 Hz, 1, 10 and 16 kHz with the 10 and 16 kHz tones 20 dB below the 1 kHz tone.

#### OUTPUT 710; "AS,0,2" OUTPUT 710; "AG.60,100,1000,100, 10000,10,16000,10"

AS is the abbreviated mnemonic for AUDIOS, which stands for AUDIO generator Select, with the 0 setting both channels and the 2 selecting single or multitones as opposed to the 1 kHz reference or TIM. In the second line AG is short for AUDIOG, the audio generator command followed by frequency, relative level repeated as desired in the case of multitones.

Service requests are coded in hexadecimal to cover errors, warnings, measurements ready and status with the warnings being those normally displayed on the screen. Up to 100 set-ups may be stored and a special command allows the programmer to inspect set-ups for debugging.

Further instructions allow the screen to be addressed directly, the display being 16 lines each of 32 characters always in upper case in addition to which limited graphic symbols are available. Absolute or relative addressing is provided. An extension of this feature is to be able to display analogue meters on the screen.

These displays are in the form of bargraphs which may be annotated using the direct screen addressing facility with the ability to display two large meters with 256 segment resolution, four small meters with 128 segment resolution or a combination of one large and two small meters. This is a useful facility for setting such things as tape recorder bias but the same results could easily be achieved by direct screen addressing. This also has the facility for normal or inverse video and for producing blinking displays.

### Software

Without the use of a controller and suitable software the RE 201 is restricted to producing numerical results for individual tests or from the ten available sequences each capable of up to nine separate tests obtained from the 100 set-ups. These results may of course be dumped via the RS-232 interface but the instrument is not capable of producing graphical data, looking for out of limits results or accumulating test results. It follows that software is a vital ingredient for the system and anyone who has experience of writing programs for IEEE interfaced equipment knows how time consuming it is to write and debug them.

Fortunately RE Instruments will provide some software which currently embraces a plotting facility to drive an IEEE compatible plotter which accepts the Hewlett Packard GL command set, a tape and tape recorder test program, a spectrum analysis program and a special program for lines testing to the EBU Recommendation R27-1982 which requires the *RE 201* to generate FSK coded signals.

I do not propose to go into details of these programs but the tape and tape recorder test program is probably of most interest and the most complete of the selection. This program automatically measures 2- and 3-head recorders for replay and record/replay frequency response, output level, phase errors, channel separation and distortion whilst indicating if any parameters are outside preset limits.

As the program stands the only pause for recorder adjustment is for setting bias using the meter display on the *RE 201* with no pauses for adjusting equalisation. Results are printed or plotted on the system printer.

A mechanical properties section of the program measures speed and wow and flutter and also does a spectrum analysis of a 2 kHz tone over a 150 Hz bandwidth.

The tape test program does a comprehensive evaluation of tape at a fixed bias including noise, frequency response, erasure, modulation noise and maximum output level in terms of harmonic and intermodulation distortion.

The length of these programs gives some idea of the time required to program the *RE 201* via the IEEE interface, the tape and tape recorder program consisting of 3229 lines of BASIC and the REPLOT program which simply allows plotting of functions versus frequency or level occupies 2400 lines of BASIC.

### Summary

Because of the complex nature of this instrument I have been unable to cover many of the features and have omitted quite a large number of details relating to individual measurements.

Overall the *RE 201* is capable of relatively fast measurements to a good accuracy and can handle complex test routines under bus control with little operator intervention, however, as with other IEEE instrumentation, writing programs is a time consuming and therefore very expensive operation.

When used without a controller the ability to chain measurements into sequences is a valuable feature as is the ability to dump the tabulated results to a printer via the RS-232 interface. I do, however, feel that the instrument's inability to plot graphic data without the use of a controller is a severe restriction.

Whilst pre-programmed sequences may be fine for production testing the use of the instrument for general purpose laboratory work involves too much button pressing and the form of data displayed means that the nature of the current measurement and current generator signal is not immediately available.

On the credit side the documentation supplied with the instrument including an operation and a technical manual are both comprehensive and to an excellent standard.

The sting in the tail is the price. An *RE 201* with all options installed without a printer or controller is around  $\pounds 16,000.$ 

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★ Another new product launched recently is the BOKSE SM— 9 SMPTE/EBU Event Controller, which among many other things can synchronise midi sequencers to tape using SMPTE time code. As long as your midi sequencer is implemented with Midi/Song Position Pointer (such as the Atari/Pro 241) there is no need to taboriously rewind the tape to the beginning every time to dropin or remix one section. Price: £720

The best drum machine ever to come out of Japan is now on demonstration in our Stockport Showroom. The KORG DDD-1. It does everything as well as sampling, tuning, midi, etc., etc., Price £599

★ We have secured some fabulous deals this month with Allen & Heath on System Eights and CMCS. They are all superceded models ie, the System 8s are Mk I's and the CMCs are Mk I's. However, they all carry the usual 12 month warranty etc. Just look at these incredible prices: System 8 1616 £1,450. CMC16 16.8:2 £1,395. CMC24 24:16:2 £1,950.

★ By the time this advert is published, we should have taken delivery of the new Roland DEP5, their attempt at cornering the digital multi-tx market. Features include 16 bit digital reverb, digital delay, chorus and parametric EQ — all programmable. "Very nice" you might say, but what about the SPX-90 — it does ten times as many effects. "An yes, but not at the same time!" All in sumptuous stereo £587

Looks like Roland are back with avengence on the sequence front. The MC500 is here at last. Very easy to use 5 track mid isequencing with full editing capabilities 25,000 note internal storage integral 3 · 5" disk drive storing 100 songs of 100,000 notes. Now in stock £799. If you've teen looking for ways in which to generate many different FM synth sounds there look

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### **INDEX TO ADVERTISERS**

INDEX TO ADVENTISENS
APRS12AMS Industries PLCOBCACO Pacific Inc8Akai55AKG81Amek Ltd33Ampex (UK)IBCApplied Microsystems Ltd79Applied Research & Technology39Audio & Design84Audio Engineering85Audio Service Co73, 80, 90Avcom Systems Ltd12
Battery Studios
Court Acoustics Sales Ltd
Don Larking Audio   .25, 27     Eardley Electronics   .11, 15     Electrospace Developments Ltd   .11     Ernest Turner   .16
Future Film Developments Ltd
Gateway
H H Electronics Ltd72H W International (Shure).7HHB Hire & Sales.19, 21Hayden Laboratories.71Hilton Sound.10
Keydial Ltd12
Lexicon
Mitsubishi Pro Audio24Mosses & Mitchell Ltd79MS Audiotron16Music Labs Group Ltd57
Neve Electronics Labs
Otari
Palmer AV Systems80Pangbourne Musical Distributors15Platinum66Professional Audio Ltd77
Rane Corporation61RCA Records & Tapes79Rebis Audio14Rycote82
SED41SAJE13Scenic Sounds Equipment69, 83School of Audio Engineering8Solid State Logic22, 23Sonifex82Sony Broadcast Ltd37
Sound Hire
Trad Sales & Services
Wandel & Goltermann

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