"Because the automated Series 2400 was my natural choice."

So says Ruth Low, owner of Riverside Recordings, which has now grown through three generations of Soundcraft consoles. "Regular clients like producer Alan Tarney need state of the art facilities at a reasonable cost. And that's important for attracting new clients too."

Alan Tarney likes the atmosphere at Riverside. After all, he's been recording there for 5 years now. As a writer and musician he enjoys the creative freedom the 2400 gives him, without imposing its own sound. And it's important for him to be able to work easily with the console to get his ideas straight onto tape.
Clean up your masters!

By the time you read this, Compact Disc players will just be appearing in the UK shops. Our sister magazine, Hi-Fi News & Record Review, seems to have managed to assemble around 120 different players which will soon be enticing us to dip into our pockets for the chance to enjoy music which, by rights, should be virtually identical to that heard in the studio control room when the master was played back. Various people we know have been playing with them and, with one or two exceptions, they've been pleased with the hardware and what it offers. They haven't, however, been quite so enthusiastic about the software: not because there isn't any (there is in fact quite a lot) and not because the manufacturing process is not quite together yet (by all accounts, it is) but because of the quality of the recordings which are being transferred. Common demo discs seem to have been originated as early as 1977, when the chances of multitrack digital recording being available would have been very small, and even stereo systems were in their early days. There is no doubt that modern digital mastering systems have a significant edge on those available even a couple of years ago, but even this isn't quite the problem. What is noticed is imperfections, often in the multitrack master, which show up on the disc: modulation noise on exposed piano passages; tape hiss coming up at the beginning of tracks. A number of things which never mattered before are now being shown up in all their unmistakable glory. Disc after disc, recording after recording has been listened to critically, and found wanting. It may prove to be a problem when conventional recordings are remastered for CD release.

Some have pointed out, quite rightly, that the best we can expect with such recordings is a good replica of what was heard in the control room. "At least," one composer has said to me, "we will be certain that the consumer will be hearing what we heard. There won't be all the problems with pressing faults, surface noise, etcetera and wata, that alone is a great advance, isn't it?" Of course, it is. The trouble is that some recordings are revealing problems which were previously masked by the analogue transfer and manufacturing processes. The result will be Compact Discs which vary widely in perceived quality between recordings.

All this is compounded by rather dubious labelling. 'Digitally Mastered' can mean rather too many things, as can 'Digitally Recorded', just 'Digital', and all the other things that record companies have, and will, put on their records. Obviously, any Compact Disc has got to have some kind of 'digital recording' process involved somewhere along the line, or it wouldn't be a CD. But do any of these terms tell you, unambiguously, how the recording was made? Basically, no. The record could have been recorded on a digital multitrack (in which case mixing analogue would seem to be rather unlikely); it could have been recorded multitrack analogue and the mix recorded digitally; or it could just have been an ordinary analogue tape transferred to digital to make the disc. There are several possibilities, all of which could be claimed to be 'digital', although some are more digital than others. It is difficult to see how these different methods could be classified so that the listener knew what to expect, and even if there was an obvious method, I can't see the majority of record companies using it. Up to now, we have been used to a 'digital' flash on a record sleeve being used to help sell analogue pressings. Soon, that will be turned on its head: 'digital' will be obligatory, and you simply won't be told 'how digital' a recording is, because any admission of an analogue component will be a pointer to less than maximum quality - or at least it will be interpreted as such.

The next problem is, of course, that this situation will continue until every album is recorded and mixed digitally. This will not be for a few years. Until then, artists, producers and engineers will have to be ultra-critical in the studio, at every stage of the recording process. This is likely to be both time-consuming and expensive, and most people will already consider themselves to be critical enough.

We may have lumbered ourselves with a domestic technology that will be difficult to match professionally. There are already those who say domestic hi-fi speakers are generally better than studio monitors. Now we are faced with a whole domestic setup that is capable of better quality than the vast majority of studios. It will be a trap that will cost a good deal of money to get out of, at just the time when we don't have any. 

Oops.

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<th>TAPE RECORDERS</th>
<th>Week</th>
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<td>Dolby C N R 4-track</td>
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<td>Fostex Graphic EQ</td>
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<tr>
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<td>Roland Rhythm Composer</td>
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**Pro-Audio, Cologne**
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<th>Description</th>
<th>Price</th>
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<tr>
<td>1</td>
<td>Model TR16 16 track - 2 inch</td>
<td>£4500</td>
</tr>
<tr>
<td>2</td>
<td>Model TR24 24 track - 2 inch</td>
<td>£6000</td>
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<td>3</td>
<td>Model TR2 2 track - ½ inch</td>
<td>£1500</td>
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<td>4</td>
<td>Model SM24'16'2 console</td>
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<td>5</td>
<td>Model ML24'24 24 into 24 in line console with patch bay</td>
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Correction

Goodness-knows-how-it-happened dept: under the heading of Drawer in the January issue effects product guide, we unfortunately gave the wrong company name for the UK distributor – correct address and phone number though. The correct company title should be Recording Maintenance Services. Our apologies for any difficulties this may have caused.

There are also two other corrections to be made to recently published product guides. Firstly, the brand B&K Audio does not apply any more and products listed as such in the December ‘82 and January ‘83 issues should read Aphex, although all other information is correct.

Finally, the UK distributor for the Valley People Maxi-Q should of course be FWO Bauch Ltd, 49 Thetford Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27502, and not as stated.

Act of God

The producer from a local public radio station had arranged to record a program of organ music at a downtown church. The church was happy to let the station use the organ as long as recording was done during normal working hours and the doors to the church were left unlocked so the public could see the church. (It was the tourist season and the church was something of an attraction.)

The organ was the only instrument of its kind in the entire area and, pressed to meet a deadline, the producer agreed. Appropriate signs were placed and with areas barricaded or roped-off this very long, inside, the session started. Surprisingly things went reasonably well for a time, but one particular piece had suddenly become very difficult to get through. The summer sun was slowly causing the organ to go out of tune and frustration was running high. On what seemed like the millionth take of this very long piece, the producer’s luck turned. The organist was playing well, the organ seemed all right, blaring at the top of its lungs, when the main door to the church silently swung open and a tall, dark figure slipped in with a blaze of sunlight. Immedi-
ately the producer jumped up to see who had come in and signal him to keep quiet and remain still. With the doors closed, it was clear that this gentleman, dressed for the dead of winter, was quite old and had obviously been a long time on his luck. Looking directly at the producer, the man ambled down the aisle at a snail’s pace as the producer wildly waved his arms trying to get the old man to stop.

Despite the loudness of the organ, footsteps could now be clearly heard on the tape and as the organist turned into the homestretch, the producer shouted for the musician to stop. As the organist looked down from the loft to see what the commotion was, the old man reached the mic stand. Passing a moment, he looked at the producer with great cow eyes and said softly, “I don’t mean you no harm, mister”. The producer shook his head in understanding as the old man, having stated his intentions, slowly walked to the back of the church to sit down and rest.

People

* David Neal has been appointed marketing manager at Audio Kinetics (UK) Ltd.

Shure UK changes

Shure Electronics Ltd, the UK distributor for Shure products, have announced (the restructuring of their distributors and offices throughout the UK. Shure Electronics was a subsidiary of the US parent company and set up in 1961 by US Shure as they did not feel that there was a suitable existing company to handle their products. The changes announced bring the UK into line with the rest of the world where distribution is always handled by independent local firms who are aware of their market and its specialisations.

As from November 15th 1982 distribution of Shure products was transferred to HW International. We understand that although changes are to be made in the future, the address, telephone number and most of the staff remain as with Shure.

Canford Audio trade counter

By the time this is published Canford Audio should have opened a London trade counter at 10 Warren Street, London W1. Phone: 01-380 1125. Provisional opening date was mid-January and the vast majority of their stock will be available over the counter giving central London another useful supplier.
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There are lots of production limiters out there. Old favorites. Pretenders to the throne. The competition is fierce. So, when Orban set out to design a new production limiter, we knew it had better be superior.

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Spin Time tape timing

For anyone using semi-pro machines such as Revox A77s, B77s or Teac A-3440s, for professional applications, the major drawback is not usually quality but the need to rely on their rather inadequate mechanical tape counters that normally count in reel revolutions rather than real time. For those occasions when you need to estimate the amount of tape used and the running time left, a mechanical tape counter is not the most useful device.

Spin-Time is a self-contained unit designed to clip on to the side of one such machine and give a five digit LED readout of the tape position in hours, minutes and seconds up to 99h, 59min and 59s. The unit itself is about 2½ in wide and so does not stick out from the side of the machine any more than the overhead of a 10½ in reel. Normal tape machine operation is preserved with the only difference being the need to include the aluminium idler wheel of the Spin-Time in the tape path. The counter is coupled to a dual photo transistor measuring the rotation of the strip encoded idler wheel. It is capable of operating at any tape speed between 3½ in/s and 30 in/s by the use of internal jumpers and the chosen two most common speeds are available to be switched on the top of the unit. There is a top panel switch to reverse the tape count so that timings may be made in rewind.

The Spin-Time is also capable of a return-to-zero function if interfaced with the tape recorder. In the case of the A77 and B77, this just means connecting it to the remote sockets where it is also able to derive its power requirements. Interfaces for other machines are being added as they are developed. The power requirements of the unit are +17 to ±5 VDC and it is internally regulated. A suitable power supply is available as are a number of other versions of the Spin-Time such as an assembly for direct attachment to the existing transport and the soon to be added slave remote control and time displays.

New Bel products

Bel Electronics have several interesting items that were launched at the last APBS exhibition. Firstly there is a new 24/16/2 modular mixing console with 4-band EQ including two sweep mid sections, three aux sends and the facility to use the monitor section as extra line inputs on mix-down. The Bel active DI box with instrument and amplifier inputs and 20 dB switchable pad, XLR-type sockets and stereo jack socket outputs. Powering is by 9 V battery or 48 V phantom power.

Bel are also now manufacturing a range of studio wall boxes with female XLR-type sockets and stereo jack sockets in two sizes. Special units may also be made to order.

Lastly the 16-channel version of the Bel BCM noise reduction system has been redesigned and is now 16 separate modules in one 3 U 19 in rack mounting case.

Bel Electronics, Don Larking Audio Sales, 29 Guildford Street, Luton, Beds. LU1 2NQ, UK. Phone: 0582 450066. Telex: 825488.

Lexicon's new Prime Time

The Prime Time II, Model 95, is an enhanced version of the original, widely-used unit, offering all the functions of the original plus improved A/D and D/A conversion, input overload protection, longer delay times (up to 1.92 s standard, 7.7 s with optional memory expansion), multiple-waveform modulation with a unique sweep display, regeneration effects and a clock output. The last is particularly interesting: a pulse output subdivides the delay period for synchronized delay loops, facilitating its use as a metronome or for driving rhythm generators, etc. Repeats can thus be made to fall exactly on the beat.


EMS Synthi 100 update

Danaconics have released information on the extensive alterations and improvements that have been made to the EMS Synthi 100 which they currently have in production. Design emphasis has apparently been placed on more recent technology.

All 12 oscillators have been completely redesigned giving greater stability and better tracking. They are also now identical each having switch selection of voice or LF operation with individual outputs of sine, sawtooth, pulse or triangle waveforms with level control. All the filters are now 24 dB/octave types having been redesigned for improved tracking and stability. The three envelope shapers now have VC delay, attack, decay, sustain and release. Microprocessors have been incorporated for keyb scanning and a separate unit for the sequencer.

As well as the integral spring reverb facility, an analogue delay line has been incorporated. Patch boards have been extended to allow more facilities to be programmed and finally, all input and output lines are now balanced giving working levels up to ±16 dBm.

Datavonics Ltd/EMS, Westminster Road, Wareham, Dorset BH20 4SP. Phone: 09295 6311. Telex: 418480.
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Hello Hendon

February 7th

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Write it everywhere
MODERN hi-fi cassette recorders are capable of a level of quality not too far distant from 7½ in/s open-reel 2-track on ¼ in. As a result, and because it is a fact that while not everyone has a reel-to-reel recorder at home, virtually everyone has a cassette recorder available at home or in the record company office, the cassette recorder has long been a feature of the copy room, if not the control room itself. Cassette machines are a convenient way of giving band members, producers and even engineers, copies of rough mixes to take away, and they are a useful medium for presenting to the record company to justify the weeks their clients are spending in your studio, if you hold with the idea of giving anyone important a rough mix at all? Add to that the fact that, while of useful quality, cassettes are generally regarded (except in special cases) as being of insufficient quality for cutting, and you have a medium which is both useful and protects the studio from the not unheard-of problem of non-paying customers releasing records cut from copy tapes because you wouldn’t give them the masters.

Any old cassette machine isn’t really good enough, however. The right machine needs to have a combination of factors in its favour. You need the right functions, the right technical capabilities, even the right shape for the machine to be truly useful in the studio environment. We will consider these requirements in some kind of order and try and come up with a general specification which will be useful in selecting a machine.

Shape

Surprisingly, shape is quite an important consideration. There are not that many flat surfaces in control rooms which have not already been allocated to synthesisers, places to write out track sheets, or places where producers like to twiddle their thumbs during the session. So the long, low top-loaders once so common in homes all over the world are generally cut as far as studio use is concerned. Luckily, the current fashion in hi-fi is for front-loading machines of quite compact size. Some – the Tascam 1/22 for example – have rack-mount kits available, and this is a viable means of mounting a machine if there is rack space available. Alternatively, rack-mount ‘ears’ can often be made up by the maintenance department to do the job. Generally a strip of L-section aluminium can be cut to the height of the machine and holes drilled to suit; if the machine is much less than 19 in wide, a rectangular hole can be cut without too much difficulty in a blanking panel, and the machine mounted into it. The alternative not to be recommended is placing the machine on top of an ancillary unit in the rack, resting on the unit below. The top of a large signal preamplifier may seem attractive, but cassette recorders are generally quite heavy and their presence may well restrict ventilation holes in the unit below. In short, this common practice may cause considerable mechanical or electronic damage. If it really proves impossible to rack-mount the machine properly, you could place it on a raised surface at the bottom of the rack, the disadvantage being that it will therefore be too low to operate easily.

Some manufacturers, notably Tandberg (TCD 330/440A) and Nakamichi in some cases, make recorders which are designed to be optionally wall-mounted. This offers what is perhaps the best of all possible worlds. Cables can be run behind the wall-covering, laid in amongst the Rockwool or whatever, and all you need are a couple of battens with reasonable strength mounted to the wall to which the machine can be attached. The Tandbergs, for example, have a pair of ‘keyhole’ slots on the rear which allow the machine to be slotted on to a couple of wall-fixed screws. Care should be taken here, however: if the screws stick out of the wall too far, it is possible for one of them to cause internal damage to the recorder, as I know to my cost. My Tandberg's capstan motor is driven off a 110V winding on the mains transformer, or at least it was, until one of the screws open-circuited the winding! The basic concept, however, if executed carefully, enables the machine to be found a place completely out of the way in otherwise dead space. It can look nice there too, if you don’t have trailing leads. It is generally difficult otherwise to wall-mount a recorder, as the depth of most front- or top-loaders is such that a good deal of strain is placed on a wall-mounting shelf’s brackets, but try it if you know of a particularly ingenious method of fixing to walls. Remember to leave room for the connectors at the back!

Tape types

If you have a number of cassette recorders, or a busy studio, it will be well worth buying tape in bulk. Most of the tape manufacturers also produce cassettes and they will do good deals with you if you order the cassettes in sufficient numbers, along with your reel-to-reel requirements. For most purposes, Type I (ferro) tapes are quite sufficient, and all recorders will accept them. They are also the cheapest and most common tapes you can buy, but remember that there are some very nasty ones about. The quality does need to be...
good enough for you to be able to discern things in the mix, the HF end being particularly important. It is particularly tempting to buy discounted unheard-of tapes in your local hi-fi store, even if they are cheaper than anywhere else.

A fair number of people will ask for better tape than that which has Type I, and it is worth having a superior type on hand for such applications, and you can mark them up more on the reel, but they will be more expensive. You may, optionally, as all the engineers will invariably use them without telling you. Metal tape is probably overkill, and there is thus no real reason to install machines with metal capability unless the machine has other attributes which warrant the extra expense. Ferrichrome (Type III) tapes seem to be a little out of favour these days, too, but the superior type to stock is probably a Type II ('CrO₂') variety, although some of the newer 'pseudochrome' formulations are said to have a smaller conversion figure over conventional CrO₂ types. It should be noted, however, that there is quite a wide variation in bias requirements between different manufacturers and types.

Once you have found one you like, stick to it or you will be forever lining up machines, and cassette recorders are often more fiddily than studio machines (see later).

Another thing to watch here is machines with automatic tape selection. You put the tape in the machine, and it is up to the tape housing to tell it what type the cassette is, and switches bias and EQ accordingly. This would be a great idea if everyone could agree on where the notches should be. Almost everyone agrees that Type II notches should be next to the 'write-protect' knockouts on the rear of the housing. Most are still in disagreement about metal (Type IV) tapes. Some manufacturers place the notches near the centre of the rear of the housing; others place them along the side. Some have no notches at all. The most insidious cases are those where a manufacturer has just decided to fit notches in the housing and there is still old stock which doesn't have any. In addition, it may well be that you will want to override automatic sensing from time to time, so best not to have it in the first place.

Heads

Three heads are better than two for studio operation, without a doubt. Apart from the fact that lining-up is, at the very least, tedious on a 2-head recorder, separate record and replay heads at least allow you to know how much worse the off-tape signal is than you would like. Apart from that, with the exception of sync capability, the reasons for choosing a 3-head machine over a 2-head variety are the same as they are for mastering recorders. Personally, I would have said that 3-head machines were obligatory for studio applications. All engineers (and other studio staff) have a fatal fascination for A/B comparisons and it will keep their minds at rest if the facility exists. Additionally, the fact that record heads are ideally different from replay heads is even more true with cassette recorders, and those which offer the extra head are probably better in other ways too.

Line-up

Like reel-to-reel machines, cassette machines need a lineup from time to time, too. In fact, they probably need one more often, although it is perhaps not so important that they get it. With this in mind, a studio cassette recorder should have some degree of access to the record and play level calibration, EQ and bias, preferably at the front panel. Some machines offer automatic or semi-automatic line-up for the selected tape type. This may be as complex as on the new Alpaga, which places sets of zones on tape and twiddles itself correctly before rewinding to the front of the zones and placing itself into record-pause; alternatively, there may be 'default' bias and EQ positions which may be modified with front-panel twiddlers in conjunction with a calibration switch. This is implemented in a particularly interesting way on the Sony TCR-81 and later models in the range. A switch is set to either 'bias' or 'EQ', and the presents are adjusted until both meters read zero. It does assume that left and right channels are similar (which might be true on good tape) but despite its rather primitive principles (you adjust bias with two zones, one on each channel, until they balance, rather than so-many dB over), it gives consistently good results. Some Aiwa machines have a similar system. Overall, these facilities are probably a good investment, as they allow you plenty of leeway, and they have the disadvantage that they can be twiddled inadvertently by passing tape-ops or bored band members.

Other than simple bias and EQ lineups, azimuth is a vital consideration, and should be easily accessible for adjustment. Unfortunately, there are no fewer than five 'correct' azimuth settings recommended by various manufacturers and tape makers, and it's difficult to know which is which. Their test-tapes vary accordingly, too. You will have to decide this for yourself by whatever criteria you think fit: generally, the azimuth setting should be such that tapes recorded in the studio sound right on your personal machine at home (which might, however, be aligned to the reverse criteria). With three heads, the problem is compounded. Lock the replay head azimuth screw with the perennial nail varnish or other locking compound if everybody can agree on its setting, and then, of course, reference the record head setting to it. Unfortunately, there is sufficient asymmetry between the two halves of a cassette housing for the record head azimuth on a 3-head machine to be right on one side and wrong on the other, so adjustment is a good idea for each side. A 10kHz tone from the desk will normally be sufficient, although some machines (eg the Tandberg recorders) have a built-in oscillator and 'test' switch for this purpose. The difference may be quite a surprise. Unfortunately, replay-head azimuth is not going to be the immutable constant assumed in the previous paragraph. The first band who want to check the demo before they go out to record will demonstrate this quite conclusively. The test-tape is thus absolutely necessary. A rather less reliable but perhaps even more non-available of a test-tape is to record a cassette of white noise as the first thing you do after the machine is plugged in for the first time, using the tape to twiddle replay azimuth for maximum top end by ear after subsequent readjustment. This seemingly crude method is sometimes incredibly useful and passably accurate. At least, as originators of cassettes, the studio has a chance to define the replay azimuth settings of their clients' cassette recorders. Everyone I know — including myself — has gone through a number of cassette machines in their time, and has a library of cassettes with different recorded azimuth requirements. They have therefore all twiddled their azimuths habitually for years and an extra twiddle will not hurt them. Record companies are a different matter, however, as the A&R man may get quite the wrong impression of your studio if he plays your tape with the wrong setting. Better, therefore, to ask him to give you a quick cassette copy of a track from a record in his office for you to align to, thus avoiding unnecessary loss of credibility in these difficult times. Again, adjust for best HF replay.

Another cause of embarrassing incidents like that referred to above is misalignment of Dolby level. We will talk about noise reduction later, but for now let us consider the omnipresent Dolby-B. Time was when there were outboard Dolby units which had plenty of twiddlers on them to enable you to set the settings just right. Names like Kellar may come to mind here. Unfortunately, almost every cassette machine this side of Alpha Centauri now has an inbuilt NR system, and many of them are only capable of alignment if you have a capacity for psycho-kinetic adjustment of invisible and inaccessible twiddlers which would make Uri Geller insanely jealous.
Cassette machines

Rather more luckily, they are today generally right. In the old days, the chances of your Dolby level being anything like anybody else's was something like 10:1, but now things are better, which is just as well as you still couldn't adjust it even if you wanted to. It is a long time since I have seen a cassette recorder with record cal, let alone replay, as a front-panel control. For the consumer, this is fine, because no pre-recorded cassette known to man is more robust than a Dolby level, and whatever it is, it certainly isn't 185nW/m or anything familiar like that. It is a Great Unknown which it would be embarrassing to discuss further. I have long since given up trying to persuade people to put Dolby tone on pre-recorded cassettes. In the studio, however, it is far more embarrassing. There can be few, if any, who don't have the 'muffled replay' which results from the wrong Dolby calibration, or the immense hiss which results when you switch the Dolby off, the latter being a real shock, hoping it will sound better. A quick tone on the front of the tape will at least give you an excuse if the needle never reaches the 'double D' symbol on the meter scale labelled 'Dolby cal' or with the 'Double-D'. They are probably all supposed to be at the same absolute level, but relatively speaking, they are all over the place. Some have them at zero VU (or dB or whatever arbitrary and misleading units the meter is calibrated in), while others have them at +3, +5, -3, something else, or whatever. It is a fairly good bet that where the manufacturer puts the Dolby mark there is some moderately arcane relationship to the available headroom. Thus, my trusty Tandberg, which has its Dolby mark somewhere off the unreadable left-hand end of the scale, around minus infinity, is capable of recording cassettes which will saturate the heads of any normal domestic recorder and overload the replay amps just as surely as LR-56 recorded at +4 TD (remember those days?). The Tandberg has loads of headroom. Machines with the Dolby mark at zero, in deference to some assumed reference level having true validity, are quite satisfactory, and this particular setup is increasingly common. The machines to watch, however, are those which have the Dolby mark at +3 or higher: they can tend to run out of 'oomph', especially on studio material, which has a lot of transients.

Metering

Much in vogue at the moment are LCD or LED bar meters, which are, of course, capable of the most absurd response. They can have attack times so fast that a standard PPM has not had time to twitch, although they are generally sluggish somewhat. Other forms of metering are those based on analogue meters, which may pretend to be VU meters but usually aren't, or may pretend to be peak reading, looking like VU meters. These usually aren't either. Then there are the combination types, ranging from VU-style meters with peak LEDs which flash when the recorded level exceeds -20, up to the ultra-confusing Aiwa double meters which offer peak and VU simultaneously and have the facility for infinite peak hold which makes them look as if the needles are stuck. I don't believe that you will find a cassette machine which has a real PPM, although there may be some which approximate to real VU metering. In any event, a studio cassette machine needs peak indication of some sort, even if it's only a peak LED. Masters have very fast transients and will over-record very easily, even if you are squashing them to a degree which would make you think that US radio stations had a wide dynamic range. Even if you would never have anything other than VU's on your console, you should have peak indication on the cassette recorder, because transients that your Studer can happily cope with may cause saturation on cassette, particularly at the top end and on bass transients (notably bass and snare drums). Consider meters along with the position of the Dolby mark discussed above, bearing in mind that headroom is peculiarly important. Even some alleged 'studio' type cassette machines fall down here and will distort horribly during seemingly innocuous passages which will leave you peaking at -10 and worrying whether you will hear the string section over the noise level. All the things that you learned about recording when you thought it was just a hobby will come back to haunt you with a vengeance, because even a modern cassette machine still owes a lot more to the 3½ in/quarter-track portable you had years ago than it does to your ¼-in mastering machine. Cassette recorders are capable of excellent results, but only if you are kind to them, and headroom is one of the areas in which kindness is obligatory. It is easy for studio people, used to being annoyed with the shortcomings of studio tape recorders, to forget this fundamental difference.

Noise reduction

Just as there are fashions in studio noise reduction, so there are in cassette recorders. You once had the choice of Dolby-B or nothing, and although you may have heard from some people that Dolby-B is better than Dolby-A in terms of changing the sound, you may have had experience with early Dolby machines which either drifted out of alignment in the course of an album side or were never aligned correctly in the first place, and thus never had the chance to find out, as you always left it switched off. Today, all that has changed. Dolby are very good at ensuring that a manufacturer using the system (hereinafter referred to as 'the Licencee') does it properly. But now there is greater choice, too. You can have Dolby B, Dolby-HX, Dolby C, dbx and nothing. Sometimes there is an extra NR system known as 'ext', which means that you didn't buy it, or forgot to plug it in. There are some modern cassette recorders which have more than one type available, and give you interesting chances to compare them, and I have often wondered whether the NR manufacturers actually like this idea very much. There is a Technics machine on the market (alas with only two heads) which only costs £160 and offers Dolby B and dbx as well as 'out', and even switches miraculous new meter scales into view depending on your selection. With dbx in, a whole new scale springs into view, calibrated up to +18 in bright glowing red, and this would be marvellous if anyone who ever used your studio also had dbx. Regrettably, everyone else's machines have dbx in the `ext' (haven't bought one) position. Instead, they all have Dolby B alone. So, whatever exotic noise reduction system you wish to use on your own cassettes, you must have Dolby B for your clients, or at least Dolby B replay so that you can play back tapes that bands bring into the studio, or that engineers like to listen to at 110dB SPL (see 'levels', later) while maintenance are trying to find out why track 19 has gone intermittingly noisy on sync replay. Dolby HX is a useful variant on this: as you no doubt know, HX is a variant of Dolby B which fiddles the bias on record (replay is straight B) to make the top end better. This means that you will be able to use up that box of Supa-Clear Ferrox Gammu Oxide Wundertone cassettes that you bought as a job lot against my earlier advice, without your more aged clients noticing that they are only flat up to 3.4kHz. Some machines, regrettably, only sound decent with any tape in the HX position, but despite this HX is basically a good idea, apart from the feeling that it is
The funny-looking mike that's taken very seriously.

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For details of available models, including the new 3LV tie clip microphone, prices and suggestions for further applications of the PZM microphone, just telephone Mike Silverston on 01-961 3295.
Cassette machines

Cassette machines cheating somewhat. Comments that your maintenance department may make about it doing funny things to the bass end when it modifies the bias for the top end should be ignored.

Dolby C is available on some machines, and as an add-on 'ext' box, from some manufacturers offers more dB of noise reduction than good old 'B'. As to its efficacy in a studio cassette recorder, we can think of no case we consider bad in this application: very nice, but not many people have got it yet. The basic rule, then, is Dolby B for certain, HX if you like the rest of the machine, and any other secondary system should be chosen if you like the machine without it, and a straw poll of your engineers indicates that a given system is prevalent (if your home hi-fi dealers do not, bring it to your engineers' consensus, modify your decision accordingly).

Levels and interfacing

An annoying feature of almost every cassette recorder is that they do not present their inputs and outputs to the world at a level consistent with any other machine in the building. (Technics and Fostex users should avoid reading this sentence). They talk to the world at a level of about -10 dB, which is far enough removed from 0.777 V to make it impossible to play a cassette back at normal monitoring levels without patching it into a pair of channels. This may be a good thing in a sense, but it also means that when you put a machine on the desk and the output from the desk will bend the meters unless you have the level controls don at such a low setting (eg. 1) that the pots mis-track badly and have a nasty habit of turning themselves off if you breathe on them. There is also the added difficulty that the average socket on the back of the cassette recorder is either a so-called RCA phono plug or an infamous DIN plug, whose soldering makes the preparation of a 64-way multicore with XLRs on one end and a massive Cinch connector on the other seem positively inviting to the average maintenance engineer. Neither will such connectors be balanced, unlike the patchbay they will have to talk to, and neither will the plugs be obtainable from your usual suppliers (if your usual suppliers are XY Components, substitute for the above, 'will only be obtainable in packets of 200 at exorbitant prices' -- although you will get them the next morning).

Luckily, help is at hand with all these little problems of Life. More than one manufacturer produces a box which will drop the level going in by 10dB and boost the level coming out, and will also have the right sockets on its business end. In some cases, the phrase 'more than one manufacturer' may mean your maintenance engineer, in which case he will make it with flying leads to the cassette machine constructed from cannibalised hi-fi leads to avoid soldering RCA phono plugs or DINs, thus proving that a box with a couple of op-amps and a handful of resistors in it is easier to make than a 64-way multicore, which will now have to wait until next week. As a result, you will not be able to commission the new effects rack until after he comes back from holiday, and you will lose 14 clients (have you considered going into real-time cassette duplicating?).

Seriously, though, it is worth investing in a 10dB level-shifting box to interface between the console mix output and the cassette ins, and the cassette outs back to a spare stereo replay input on the board. At our studio we have a pair of the Technics cassette recorders (plus a tuner/timer, which enables producers to tape programmes with their hands on them without every-one else having to leave) referred to earlier, interfaced with a Bantam patchbay taking the same leads as the console uses for patching. The console mix output is additionally normalised to the input of machine A, while its output is normalised back to a spare replay input on the master module, extra machines and a record deck with RTS phono preamp (in the same rack) being patchable as required. This seems to be about the best way of doing things, even if you need to derive an extra output for it. Since they were installed, they have seen a good deal of use. And, to be fair, XY Components do in fact supply the right plugs, and very high quality ones they are too, in packs of five.

Other features

You can get a number of cassette machines which have a whole load of extra goodies on them, like double-speed (3/4 in./s, and I wonder what Philips think of it) and varispeed. There are also multitrack models aimed at the AV market which also record normal cassettes, and these may be a good investment if you offer such facilities. Variable and double-speed options, however, although they may be useful for something, may be more of a hindrance than a help. Varispeeds can get misadjusted, and double speed, while offering exceptional quality, is only compatible with multitrack home studios and other people with the option as well, so it may never see any use. Indeed, as with studio recorders, there is much to be said for cassette machines which you can line up and use, with as few extraneous knobs and buttons as possible, as the more controls there are, the more likely they are to be in the wrong position when you discover this fact after you have done six cassettes for the band at 4.30 am and try to play one of them back. Apart from such options there is a point in considering a remote control, if you can put it near the other machines' transport controls, and there should be a good timer with a return-to-zero so that you can wind back to the right place when you discover that the record level is too high, without having to switch a large number of switches on the console or making numerous patches to check your place (you will doubtless run out of patchcords anyway, which will result in dismantling that great stereo effect and forgetting how you did it, which will be a pity, as during the playback you are transferring to cassette, the lead vocalist - who was out of the room during the mix - will point out that you used the wrong track during the second verse, where he sang the wrong words, and you will have to do the mix again: (this will also be at 4.30 in the morning, and generally just after you have zeroed the desk and put the multi-track tape away).

Conclusions

There are a wide variety of cassette recorders which will find a useful place in the studio. Some manufacturers make special versions for professional applications, and these generally have much to commend them. The machine should be robust and reliable - solenoid rather than mechanical transport controls will be a significant advantage here - and should be capable of being mounted on the wall or in a rack, and should be permanently wired into the system so that it is easily accessed when needed. Levels should be matched if the machine does not like line level (some machines are designed this way) or it will be a source of continual annoyance. Bias and EQ should be accessible, as should Dolby calibration (funkley). Dolby B should be fitted, plus HX if you like. The machine should have some sort of peak indication and plenty of headroom, and should be capable of taking at least Type I and Type II tapes, of which stocks should be available. Don't skim on tape quality. Azimuth should be capable of alignment, and the machine should have three heads.

Last, but not least, it is worth noting that some professional equipment manufacturers also make cassette recorders, some of which they aim at the 'professional' market. They have generally done a good job, and there may be advantages in terms of price and backup. Try them first.
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Focus, London

When Hermann Goering & Co were desperately trying to flatten London during the Blitz, this area business was back in the early 40's, power stations were obviously a prime target. So much so that the London Electricity Board decided that it might be a good idea to plan and build an emergency power station for the very necessary business of keeping the South London hospitals going. They found a site in Sanctuary Street, just five minutes walk from London Bridge, tucked away behind the Borough tube station. The new building was intended to be bomb-proof, so a high percentage of the total area was underground, and the walls varied in thickness between 18 in and 2 ft 6 in. The LEB vacated that building some 12 years ago, but it wasn't until five years later that Dave Meyers and John Worsley stumbled across it after a two-year search in the London area for suitable studio premises.

As owners of Tangerine Studios in Dalston, London, they were familiar with the Clodagh Rodgers hit Jack In A Box, Dave and John had already achieved moderate success, the most notable product of the studio being Bill Withers' What's Making You Cry? It's You. However, London was where they wanted to be, and they reckoned the old power station was tailor made for a recording studio. They called it Vineyard, after the tiny cul-de-sac that skirts the building on three sides, and set about creating a production company that was in a league of its own.

Many artists passed through the studio in this period including NincBelow Zero, Level 42, Rocky Sharp and the Kesleys, Ann Stuart, etc, but eventually the man with the same cut-price war as most other lesser known London studios when the recession began to snap at the proverbial shoes.

Vineyard's hourly rental was half what it had been two years previously, so it was time for drastic action.

John Worsley decided to pull out and devote his energies to songwriting, but Dave had other ideas for Vineyard. He noticed that most of the more up-market, and not to mention highly priced, studios were riding out the recession on the backs of big-selling album artists who book for long periods. It also occurred to him that sparse studio time could be more profitably used for recording artists signed to your own label.

Around this time, Dave met producer Barry Andrews, and Phil Lowery, Island Records' head of promotion for eight years. The three decided to start their own label with a view to the label and the studio growing side-by-side.

The studio is in the underground section of the building, and the main area measures 30 x 25 ft with a ceiling height of 18 ft. Acoustic treatment is minimal with just a few Rockwool panels breaking up the natural stone surface that gives the studio a fairly live sound. There are three separate booths off the main area, each measuring around 9 x 7 ft, one being a live room, and another housing the studio's sedita Bechstein grand. A good selection of around 40 mics is available and Tannoy Golds handle studio fold-back. Also in this area are the tape store and workshop, and access is via one flight of stairs down from the street.

The 17 x 14 ft control room is situated directly above the tape store and workshop and its large windows looks directly down into the main studio area. The 40-channel TSM desk stands at 90° to the window, and in a fairly recent acquisition for Focus. For three years previously they were the proud owners of a Trident A-Series, a desk that is very popular in America. Dave thinks it's because they're big, "our mixer was actually 11 ft long!" Dave reckons he had calls every week from studios in the States trying to buy his desk, and in the end representatives from Cherokee studios turned up on his doorstep. It seems Cherokee already had five A-Series desks in their multi-studio facility, and all were completely tied up for months ahead. Meanwhile, they had been offered six months' album work for a top flight artist and reckoned they would build yet another studio specifically for this purpose, if they could only acquire the console to go in it. Cherokee made their offer and Dave couldn't refuse, "and the money we made on the desk helped to finance the building; you need a bit of luck now and again!" Apparently, the last A-Series desk is in Europe, and Dave wouldn't mind betting that there's a bunch of Cherokee lying in ambush just waiting to take that last scalp home.

The other pride and joys of the control room are the Urei 815 monitors that both Dave and freelance engineer 'Sweepie' Durden-Hollamy are passionately in love with. They're also very keen on the new David Viz Orlando mini-speakers which, according to 'Sweepie', beat the opposition hands down—"Auratone's are audible!" Tape machines include a Lyrec 24-track with automatic, Studer A80 and B67 machines, and a Royn for tape delay. There's also a list of processing gear as long as your arm that includes names like AMS, Bel, Marshall, dbx, Rebis, Lexicon, EMT, Kepe, and soon.

Recent visitors to the refurbished studios have included the Pinkies, Blonde on Blonde and Dollar. "Sound-wise, I know we've got it now," says Dave. Other full-time members of staff include assistant engineer John Smith and tape-op Tania Collier, who also brews the odd cup of coffee in the studio kitchen. Between the kitchen and the large reception area lies the all-important lounge, complete with pool table, comfy seating, TV and upright jukebox.

The Focus Records offices are upstairs, where Jeana Rattic takes care of label administration. At the time of writing, Dave had two acts signed to the label: Legator, formed by ex-Rubettes drummer John Richardson, and Perfect Zebras, a kind of Ultravox-cum-Talking Heads outfit. Though they've had some success in Europe, Legator's Red Indian-style single Human Being's has suffered from a lack of airplay in the UK. According to Dave, one play on radio sold 1,000 copies the next day, but that was all they got. Both bands have singles and albums out on the Focus label, and these are distributed in the UK by Virgin and in the rest of the world via Polygram. Dave is quietly confident and reckons the label is doing very well: "I think we'll break the Zebras eventually. They've just started gigging and we've got some European dates coming up."

Oh, one final detail I nearly forgot. According to Dave, the LEB built their emergency power station on the site of the tortuous chamber that belonged to the old Clink prison. Apparently one or two of the inmates who perished therein pop back for a visit every now and then, and scare the life out of everyone at the studio. Engineer 'Sweepie' Durden-Hollamy reckons that a couple of spooky sounds have actually appeared on tape, and Dave adds: "Things have happened that really scare you when you're working here all night. I just don't understand it, and I don't believe in bloody ghosts!"

Focus Studios, Sanctuary Street, London SE1. Phone: 01-403 0007.

Roger Phillips

Streeterville, Chicago

In an inconspicuous brown-4-storey building off (and underneath) Chicago's Michigan Ave., Dave and John had decided one of the most successful recording studios in the Midwest. Streeterville Recording Studios is a sprawling, incredibly busy complex of five stories that has somehow entrenched in just about every aspect of audio, entertainment and communications, from rock albums, to commercials, to educational multimedia and beyond.

The wide variety of work that comes through Streeterville's doors reflects Chicago's status as one of the blues and R&B capitals of the world, as well as being one of the nation's corporate and advertising centres. Clients such as United Air Lines, RCA, McDonald's, Pizza Hut, RC Cola, Marlboro, and Schlitz, to name just a few, keep the studio busy day by day. Evenings are filled with bookings for rock bands, blues bands, chamber ensembles, and orchestras. The label of Chicago's lively music scene.

Streeterville set up shop at the present location in 1968, in association with a radio and TV production company, Chicago's KSHI, and minimal with the walls were used for cut-price recording. The original facility consisted of a 16-track music room with Enough room for 40 pairs of headphones, a live room and two production studios with 4- and 8-track capabilities. The next ten years were spent expanding the facility and establishing Streeterville as a vital part of Chicago's vast production scene. "I watched the growth of the recording media in Chicago over the years," says studio manager Dolan as "and I realised that we needed to expand. In 1979, we chose Perception Inc.-George-Augspurger and Jack Edwards—to design two new 24-track rooms, a live room, and the mixing suite, which includes a 10-man sweetening booth." Music 1 was rebuilt a year later.

"The concept behind the expansion," says Dolan, "had to reflect the diversity of our clientele. We needed versatile but compatible rooms which could be used simultaneously or independently. These factors are used to their fullest advantage when we have 'staggered-calls' sessions, which are prevalent in our commercial work. For a Budweiser lime commercial for example, I recorded the rhythm tracks in Music II, large orchestra overdubs in Music I, and vocals and dialogouds in the Suite, all in the same day."

"Needless to say, it was essential that the room changes be made very smoothly. While the engineers were still being laid down, the assistant engineer was setting up for an overdub of 16 strings, 10 horns, and sax reeds in the large studio. I also duplicated the cue mixes, monitor..."
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Streeterville cont'd
mixes, and external patches on the console. This allowed the producer up to eight tracks of the rhythm section, and enabled him to walk into the second room with the musicians all ready. I have found that these room changes not only save time and create more available studio time, but they also can rejuvenate the personnel and the overall spirit during long sessions.  

For more conventional long sessions in one room, both Music I and Music II have lounges, kitchens, and shower facilities.   

Recording consoles today in all the above rooms in the Suite, a 4023C in Music I, a 2824 in Music II and a 4032B in the Suite. Music I and II are equipped with a large complement of outboard gear that includes Cain Brumby, Kepex, digital delay lines from MXR, Lexicon and Eventide, UREI limiters, Pultec and Orban equalizers, and a number of these plus a few additional goodies, like a Lexicon Prime Time, a Scamp rack with auto-panter, and Harrison's Autopet automated mixing system. The three studios have 3M M79 24-track tape decks, and in Music I there is also an MCI JH-24 for multitrack transfers and, in conjunction with a BXT SMPTE synchronising system, a 45-track d/cx 2/6/6 noise reduction is used in the rooms, and the Suite also has 24 channels of Dolby. Sentry III monitors with White 8\(^{th}\) octave equalisation and, of course, Auratones, are to be found in all three rooms, and the Suite has an additional pair of Tannoy 12s and space for any supplementary monitor equipment.  

The two production studios, which are used for voiceovers for radio and TV, multimedia presentations, slide films, and educational projects, use MCI and Scully 4-track decks, although the studio is at present considering some changes. All of Streeterville's 2-track and mono machines are Studer B67s.  

The microphone collection is what you might expect from a studio of Streeterville's size. Included are plenty of Neumanns, new and old AKG's, Sennheisers, Beyers, Shures, a set of Crown PZMs, and a PML stereo valve mic.  

The studio owns five EMT reverberators—two 246s and three 146s, some of which date back far as 1959. There is also a breathing collection of musical instruments, much of which lives in a corridor between Music I and Music II. There are Steiner and Yamaha grand pianos, a honky-tonk upright, a Wurlitzer and two Rhodes electric pianos, an original Clavinet, a Hammond B3, a Musser celeste, a Dowd 2-manual harpsichord, and synthesizers from Moog, Prophet and Oberheim, along with vibes, marimba, xylophone, tympani and chimes.  

Sony TV monitors and 14\(^{th}\) video decks are used throughout the facility for referencing tracks for television work, and the studio is looking towards getting involved in video sweetening. "Any studio of our size and with our style of work must gear itself up to combining video and audio," says Dolan. "We're looking forward to doing a heavy amount of video sweetening, and potentially video mixing, in the Suite in the next year or so.  

Streeterville's extensive post-production services include fast but high-quality 16mm and 35mm mag transfers, mono and stereo dubs in all track formats, and cassette duplication. There is also a very specialised mass-duplicating system for 1/4 in tape which is used by Sears, True Value Hardware and other major accounts.  

There are ten engineers on staff at Streeterville, three production mixers, two assistants and one tech. All of the mixers are capable of doing any of the work, which can be very beneficial in dealing with the needs of the diverse clientele. "We do a lot of speed sessions around here," says engineer Fred Breitberg, "and the temperament for doing that kind of work separates the men from the boys. Mixing a tape is the easy part. How not to turn a client off is something else." There are also four full-time office personnel.  

As evidenced by the amount of activity at the studio when we visited, the Streeterville staff works hard, but they also play hard. That can be attributed to the well-stocked pinball machine in the lobby. "We have six or seven of the top players in the city," proclaims Steve Sanders, "but we will challenge any other team, any time, any place." And that's not just pinball.  

Streeterville Studios, 161 East Grand Avenue, Chicago, Illinois 60611, USA. Phone: (312) 644-1666. Paul D Lehrman
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Inside the PCM-F1

Tony Faulkner

The arrival on the audio scene last year of Sony's low cost 16-bit digital audio processor raised many questions for most of us professionally engaged in sound-recording. Up until the F1, discussion of PCM audio remained an academic one for most studios, unless they were intent on a 'pioneering' spirit of embracing expensive new technology which took their fancy or there was some long-term commitment to the Compact Disc project.

The original concept behind this article was to outline a series of modifications to the PCM-F1 in order to make it more readily suitable for professional applications and requirements, rather in the same way as the original Studio Sound Revox mods published some years ago by Angus McKenzie. After many weeks of research, I decided to approach the project with a greater degree of caution, rather than following Adam & Eve's example of taking a bite from the apple in the enthusiasm of the moment.

In sonic terms, the PCM-F1 in conjunction with a good quality video recorder can produce sound favourably comparable with that from a well-aligned conventional analogue reel-to-reel machine running at 15in/s or 30in/s and costing several times the price. Differences are in my experience audible, with the digital system showing improvements in pitch/speed stability, lack of hiss, smoothness and extension of bass, with the analogue system (on first generation) showing occasionally sweeter low-level quality and a more friendly overload characteristic. In practice, though, analogue recordings degenerate with copying, however carefully done, and this is not a problem with a digital master which remains in pristine condition unless there is a major problem with the video recorders. Measurement and audition of the PCM-F1 yields results to put the fear of God into the hearts of most manufacturers of analogue tape and tape-machines, and it is plain to see that the future will hold many shocks and surprises for those companies entrenched in the old technology.

Unfortunately, Sony PCM-F1 recordings are not directly compatible with those done on the 1600/1610 or the JVC systems, and this means that editing cannot be carried out directly with the precision necessary for more demanding commercial jobs such as classical music recording. Accurate digital editing can be done using the existing electronic editing suites developed by JVC, Matsushita, Sony, Soundstream, Denon or Mitsubishi, but this has to be achieved at present by transferring the F1 recordings to the other digital systems via an analogue conversion. Although the quality loss will be arguably small, it is obviously preferable to do any transfers in the digital domain, avoiding the effects of repeated bandwidth filtering and compounded quantisation errors.

The F1 uses a coding according to the EIAJ consumer digital audio format (modified slightly to accommodate 16-bit resolution rather than the original 14-bit laid down) and it is only possible currently to do direct editing by playing the F1 recording through a Sony PCM100 which has all of the electronic interfacing required to decode the top 14 bits of the F1 recording, unfortunately disregarding the bottom two least significant bits. Investigation of the workings of the Sony PCM-F1 reveals that, internally, the digits are moved around the various signal-processing areas in a format bearing more than a passing resemblance to the coding within the PCM1610, Sony PCM100, Sony DA100 editor, and for that matter the CDP-101 Compact Disc player.

This format is shown in Fig 1 and is basically a serial stream of data starting with left-channel MSB down to left-channel LSB followed immediately by right-channel MSB down to right-channel LSB followed
immediately by left-channel MSB, ad infinitum. Synchronised with this stream is a word-clock where the level is high to indicate left-channel, and low to indicate right-channel. In addition to this word-clock there is a DC line used to indicate the presence or absence of audio pre-emphasis (50us-150us). One’s immediate reaction is to reach for the RS Components catalogue and improve a circuit board to convert this internal Sony data-format into a form directly interfaceable with other digital equipment.

As technically feasible as such modifications obviously is, in my considered opinion it is most unadvisable unless one is highly confident about what one is doing, and equally enlightened about the internal workings of digital audio, to avoid serious potential pitfalls. The Sony Corporation are adamant in not recommending modification of the PCM-FI (presumably for fear of warranty damage and the event of problems), and it is their avowed intention to make no professional machines based on the EIAJ format. Harmonia Mundi in Freiburg, West Germany, advertise a service to transcode PCM-FI recordings to PCM1610 format for editing, and RTW of Cologne intend to demonstrate a commercial add-on unit for the FI to facilitate digital-to-digital interfacing with the 1610 at AES Eindhoven during March. At this stage, I think modification for digital recording is not advisable in the FI is best left to the few rather than as a general practice.

It is apparent that for a studio to go over to Sony PCM-FI for stereo mastering must be regarded as an interim measure only. The complications of editing and transcoding to other formats will inevitably limit the widespread adoption of the system unless some manufacturer other than Sony comes up with a fully professional compatible unit incorporating the interfacing and editing facilities required for studio work. Nonetheless, at its price, the FI offers a unique opportunity for studios to taste the benefits of digital recording with a top quality hi-fi recorder capable of embarrassing most studio recorders, without the risk of laying out vast sums of money on technology which will probably be out of date within months of delivery! The use of standard video recorders means that any studio going into PCM-FI technology will have gear which can be used for video work as well, and this also ensures a reasonable second-hand resale value for the recorders when the time comes in a couple of years. This is an important feature of the FI, which is still a long-term professional-standard digital audio recorder readily available for a limited period of five years using pseudo-video output PCM converters, I have reached a number of conclusions. In my experience, the potentialiable of problems to malfunction of the digital converters can be counted on the fingers of one hand: defective PSU burned out, after ever well over 100 albums and recording a location many miles from home. Any dropout problems I have encountered have been tracked to a faulty switch of the power supply.)

For the same reason, the state of repair of the recorders (especially head-wear), I believe that by far the greatest obstacle in the way of achieving excellent results with the PCM-FI is the use of domestic Betamax and VHS recorders which are simply not robust enough for professional applications. Used with well-maintained U-matic recorders and good tape, the FI will perform phenomenally well, but with anything less, I have encountered occasional difficulties. The error-correction circuitry incorporates the FI is remarkably powerful indeed, but some of the signal disturbances present in video dropouts (particular disturbances in time-domain, rather than just temporary loss of signal) cause havoc and ask too much of the medium. I always take a small black-and-white TV monitor on recording sessions which is hooked up to the video output of the tape-machines in order to observe any irregularities, and on the occasions I have taken any domestic recorder I have been shocked by some signal disturbances I have seen. I know of two studios who bought PCM-FIs’ and used them with the ‘Ferguson from under the reply’, and have had some serious troubles in the field. All of the Sony and JVC editors I have seen work with U-matic tape-machines only. U-matic is the standard medium for Compact Disc mastering and is a very well established format for industrial video, so I believe this is the only sensible choice for serious PCM-FI recording unless some transportable务 of the little SL-F1 Betamax makes it irresistible. Many of the commercially available U-matic are dual standard (NTSC/PAL), and we have decided to enter the stage as to which standard to adopt, and it is only really necessary to carry out one monitor modification to ensure compatibility of recordings. This modification concerns the record head-cross point of the U-matic recorder. All of the original Sony digital audio editing installations to date utilise the expensive BUV type broadcast-standard U-matic recorders, and these machines often take exception to replaying video recordings made on small low-band industrial U-matic recorder (2630, 2631, 2800, 2850, 2860, 5630, 5800, 5850, etc). The incompatibility arises because the broadcast BUV has its record-head switch-point set to a slightly different point in the TV waveform, and when confronted with a recording made with the head-cross in what it considers the wrong place to ‘correct’ the irregularity and this causes a dropout. With rotary-head recorders, there has to be a point somewhere in the TV waveform where the signal switches from one head to the other, and the modification required is a simple screwdriver internal electronic preset adjustment easily carried out by a qualified industrial video supplier or servicing agent to shift the record head-cross into the same position as a broadcast BUV recorder. Transcoding your PCM-FI recordings to PCM1610 format for editing or transfer to Compact Disc will almost definitely require some kind of U-matic set-up, and almost equally certainly utilising BUVs, so you might as well ensure complete video compatibility from the start.

The audio circuitry of the PCM-FI does not require extensive modification for professional applications—as although standard audio interconnection is via consumer-type phono sockets, there are no insuperable problems with level interfacing. The audio line input shows no clipping problems, despite its domestic high sensitivity, and this is because it is essentially a passive attenuator pad feeding directly thereafter onto the main level front panel control. Those committed to audiophile modifications may choose to bypass the mic-line input selected two, and feed the input direct to the low-pass filter driver via appropriate level-setting, but I do not consider such a modification any great priority at this time, and it is probably the best answer is to purchase, from a hi-fi store, a moulded headphone splitter lead (one stereo jack plug to two separate Jack sockets, usually intended for feeding two pairs of headphones from one socket) and then to chop off the two line-sockets and substitute XLR male 3-pin sockets appropriately wired so that one is connected to the off-lead (the mic jack). The earths can be connected to the signal-low and ground pins of both XLR’s. The headphone amplifier is of high quality, and when set to the 0dB attenuator position (ie maximum) gives a perfectly compatible studio console level. Input levels can be set to give unity gain in to-out, and one is effectively operating ‘business as ususal’ only with the digital recorder in circuit (via XLR-to-phono leads for input, and head- phone-jack-to-phono leads for output).

Setting record-levels for digital recording is important and to this end Sony have incorporated fast-reading LED meters in the PCM-FI which are much more helpful than most desk VU’s and PPM’s. In my experience it is best to forget about the meters on one’s desk (assuming that the operating levels have been set up appropriately), and to use the internal meters of the FI. The sound quality of the FI degrades slightly (particularly at high frequencies) as the level reaches peak modulation, and I would recommend leaving the last few decibels as headroom rather than succumbing to the temptation of wrapping the meters around the end-stop until

![FIG 1](https://www.americanradiohistory.com)
PCM-FI

clipping is audible. The FI has internal presets for the meters on the main side-channels (engraved L and R) and I recommend making the meters 2 or 3dB more sensitive to discourage over-recording. In addition to the horizontal green LED level display there is a red 'over' light which comes on when you are on the brink of clipping (it lights when the record-coder detects a signal corresponding to all '1's in the data). When recording tapes, the red 'over' light will not indicate an overmodulated tape unless the front 'copy' switch is set to 'on', since the record and replay circuits are strictly isolated unless copying is in progress. The isolation of A/D and D/A circuitry can be most useful if you want to prepare an equalised copy of a digital master-tape. It is not possible at present to equalise FI tapes in the digital domain, so one connects the audio line-output of the FI into the line-input of the desk - equalisation of the recording may be carried out (monitoring the output of the desk) and then the output of the desk is fed to the line input of the FI. The FI meters will continue to read the original un-equalised source-recording, since they cannot be selected to read the input signal, but the record-circuitry will process the equalised signal from the desk and it can be recorded on a second video-recorder. This process has to be carried out with the 'copy' switch set to off and with the video feed to the playback machine disconnected, since you are not asking the mode to a straight one-to-one copy: it is being presented instead with a new analogue signal from the desk for recording. The low noise and flat response of the FI system mean that overdubs can be carried out in similar fashion by bouncing from one U-matic to the other via the mixer adding extra tracks on each pass. Copying from one U-matic to the other for 1:1 digital-to-digital transfers could not be much easier, but it is important always to use the 'copy' function of the FI rather than do straight video-video copying which can produce clicks and crackles if the error-correction facility of the PCM-FI is not taken advantage of.

On the back-panel of the PCM-FI there are three video interconnection sockets. One is a video return for playback, and the others are for feeds to two recorders. In standard 'copy' mode both output lines are live and it is possible to make parallel recording with two decks (a wise precaution when making irreparable live concert recordings where a recorded tape dropout would be disastrous). In 'copy on' mode only the second 'copy' socket is functional, since the presence of the 'copy' signal at the video-input of the master-playback recorder could cause problems if the machine employed a playback servo system and tried to 'chase its tail' in a signal-loop.

Until the arrival of Sony's PCM-FI there was no particular problem of video standard compatibility, since apart from a few hand-built PAL prototype consumer converters from Sharp, Akai and Technics, all of the PCM adaptors operated in accordance with the Japanese and US TV standards of 525 lines/60 fields. Since the Sony PCM-FI is aimed primarily at the consumer audiophile market, it was decided to introduce two versions: one NTSC-525 lines/60 fields compatible, and the other PAL-625/50 fields compatible. Fortunately Sony have spared us one half of the standardisation problem since on playback the PCM-FI PAL and PCM-FI NTSC both recognise and replay either video format, with 'copy' outputs as determined by the particular model. So if you are presented with an NTSC-525 lines/60 fields tape you can play it back on your dual-standard U-matic (such as VO2630 or VO5630), through your PAL FI, and make a copy in 'copy' mode to PAL-625/50 fields formats. The choice of which system to buy is difficult for European studios since on the one hand PAL is useful to interconnect with standard domestic and industrial equipment, and yet all of the editing and transfer suites presently operating utilise NTSC/EIA format. Within the PCM-FI the electronic differences between the PAL and NTSC models are not great, although the PAL one includes some extra components which facilitate the different 'read' and 'write' clock frequencies required. My own solution was to buy a PAL model, and perform a simple internal modification in order not to give an NTSC output unless a simple jumper connection is shifted and a switch moved. In this way I use the FI nearly always in NTSC mode, but if I have to give a listening copy on, say, a PAL Betamax tape, then I can swap the jumper connection over and do the copy straight off. The master-clocks and therefore sampling rates of PAL and NTSC models are very slightly different (PAL f0 = 44100Hz; NTSC f0 = 44056.94Hz), but this only results in a speed error of 0.1% which is less than the replay speed error of LP analogue tape on a tape-deck set up for standard play tape! In practice this means that my NTSC recordings are played back on a standard NTSC set-up, but it is worth remembering that the Philips and Sony Compact Disc players both operate at a sampling rate of 44·1kHz, and any recordings will therefore run at correct speed. In order to make the PAL/NTSC changeover relatively speedy I have made the operation two-fold: firstly, the 16-bit/14-bit resolution switch has been rewired to select 60 fields/50 fields and secondly the phase-lock-loop in the master-clock section is jumpered in or out of circuit by connecting J502 for PAL or J501 for NTSC (see Fig 2a). I do not consider that the 14-bit/16-bit resolution switch serves any useful purpose for most professional applications since it should always remain in 16-bit, and this switch operates by feeding or not feeding a +·5V DC signal into pin 2 of IC534 which is a bus driver for setting IC508, the main data processor, in the recording section. This bus driver also controls the 50/50 fields setting or the record data processor and is normally fixed.
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PCM-F1

permanently (−5V for PAL) but by reconnecting the 14/16-bit switch to pin 4 of IC534 instead of pin 2, the function is changed appropriately (Fig 2b).

The huge reduction in cost of the PCM-F1 compared with previous adaptors comes from the domestic consumer market orientation and the mass-production of specially designed A/D and D/A converters and data processing integrated circuits. The converters employ a dual-ramp technique, offering fast conversion combined with good stability and resolution close to the 16-bit specification. In order to give optimal performance the data input to the D/A converter has to be very smoothly clocked and I suspect that the use of less-than-ideal domestic consumer video cassette decks might impair the ability of the D/A converter to operate at its best, because of clock-jitter stretching the system to its limit.

There are several presets within the PCM-F1, but with the exception of the meter FSD adjustment they are probably best left alone. The DC offset prior to A/D conversion (RV103/RV203—Fig 3) can be adjusted to advantage with some samples, and is achieved by attaching a black and white TV monitor to the video output and adjusting the presets to make the appropriate vertical bar stay as close as possible to the critical midpoint between all black and all white with no audio signal applied to the input. This adjustment should be carried out after the PCM-F1 has been switched on for at least 10 minutes, and can be a source of aggravation since it has to be carried out with the case removed and replacing the case changes the setting! The offset itself will not degrade the quality unless very badly out of adjustment, but cosmetically it is disconcerting to see the bottom LEDs of a PCM-F1/0 sensing the offset on replay of a transcoded tape since they operate in digital domain and sense DC. Fig 4 shows the method of disassembly to access the innards for adjustment.

There has been much discussion about the audibility of low-pass filters and it is a shame Sony did not opt for Philips' elegant solution of oversampling to reduce the audibility of the filter following the D/A converter. But although I suspect the input filtering does not sound quite as sweet as it might, it is nonetheless a remarkably clean, accurate sound at a very acceptable price, and will undoubtedly bring a large number of studios into the Digital Age with a jolt, setting the stage for the next generation of studio equipment. It is alarming how the transparency of digital sound exposes the hisses and hums we have all been happy to put up with for years, and the new technology should bring the soldering irons and oscilloscopes out to track the faults from the old ancillary gear!
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CX confusion

There's some interesting news on the CX front. CBS has now sold a million CX discs in America. But it's thanks to a pretty tricky play. The discs are single inventory releases and identified as CX by a tiny logo at the bottom corner on the back of the sleeve. There's no noise to explain what CX is or what it does. So a million people have bought CX discs, without knowing it. Sales of these CX discs have been helped because CBS has encoded mainly popular titles, from artists like Shakin' Stevens, Julio Iglesias, Barry White and the Goombay Dance Band. Also, owning up internally that 20 DB of compression isn't compatible, CBS is now using only 15 DB of compression when the incompatibility is most likely to be noticeable. You can just about get away with the replay of 20 DB encoded material on non-CX equipment if you store it with a narrow dynamic range pop-music in the first place. But on classical music, you only can't raise quiet passages by 20 DB and not notice. Hence the compromise at 15 DB compression on wide dynamic range material. It's unclear who encoded this phrase "compatible". Perhaps he's now left the company and is working in a Siberian salt mine. If not, he deserves to.

In Europe, the marketing push is concentrated in Germany. In Deutschland, hi-fi enthusiasts love knobs, dials and add-on units so they are receptive to CX decoders. What's more, Germany is the home of Telefunken, the ailing giant electronics company that had launched a mechanical digital audio disc system in competition with laser compact Disc. When Telefunken's mechanical Mini Disc failed (merely) the company looked for something, anything, other than Compact Disc. Its subsidiary, Teldec, had already developed the Direct Metal Mastering technique for cutting analogue discs so Telefunken decided to back CBS Compact Disc at the Dusseldorf Hi-Fi Show in autumn 1982. Telefunken showed a record player with CX circuits built in. There's little doubt that a CX disc, correctly decoded, can produce good results. But so can dbx discs!

On the video front, CX is making some headway. RCA has adopted the system to improve the sound on its stereo videodisc system. In both the USA and Japan, CX is now standard for LaserVision. It was adopted because there were problems in America in getting a good signal-to-noise ratio off NTSC format videodiscs. The best they could get was 55 DB which isn't really good enough for the hi-fi sound promised from LaserVision. But, because of that same old compatibility problem, the compression was reduced from 20 DB to 14 DB.

The big question a year ago was whether Philips would adopt CX (at LaserVision in Europe. I put the question to Philips when we visited the Blackburn LaserVision disc pressing plant long before the system was launched in Europe. Let's say it right from day one, I said, 'It's a good idea, but don't create a muddle on the market.' I was assured that CX wouldn't be used for LaserVision in Europe. Thanks to the PAL system, and better pressing techniques, Philips was getting a 65 DB signal-to-noise ratio from LaserVision discs, so it didn't need noise reduction.

There was a limited launch of LaserVision in Britain in May 1982. The national launch followed in October. Then, in November, Pioneer announced that it, too, was going to sell LaserVision players in Europe. We will also, said Pioneer, be selling LaserVision discs pressed at our plant in England. And yes, you've guessed it, the Pioneer player has CX circuits built-in and the Pioneer discs will be CX-encoded. What on earth is happening? I asked Philips. The answer was predictable. At some unspecified time in the future, the Philips pressing plant in Blackburn will start producing CX discs. Also at some unspecified time in the future Philips will start selling players with CX decoders built in. Until then, anyone buying a LaserVision disc from Blackburn will get no-CX disc. Anyone buying a disc from Pioneer will get a CX disc. Anyone buying a current Philips player will get no CX circuits. Anyone buying a Pioneer player now, or a Philips player later, will get switchable CX. So there's now exactly the kind of confusion on the market that could so easily have been avoided.

A CX disc played on a non-CX player will sound unnaturally compressed. Philips argue that this could be useful where the original material is of wide dynamic range, for film soundtrack, in particular, where the sounds very much like a tailor-made justification for a commercial 'cock-up'. There's certainly no possible justification for what an ordinary disc will sound like when replayed by an inferior expansion, through a CX decoder. And this will happen, because people who have CX decoders built into their Pioneer LaserVision players will probably leave them all the time. After all, if you've paid for the last couple of years in the audio business. There's no problem, both Pioneer and Philips said, because CX is "compatible".

Too loud to be real—too real to be quiet

The public has now forgotten what live sound sounds like. When the Count Basie Band, Ella Fitzgerald and Oscar Peterson appeared recently at the Royal Festival Hall, their glorious live sound was piped through a pair of ageing Altec PA bins, one each side of the stage. For the Silk Cut Jazz Festival at the Barbican Centre, the sublime sound of Peggy Lee was blasted out from the stage by rock speaker stacks. Some of the audience complained that they had only paid to hear one performance at a time. I'm lucky. Near where I live in North London there are a couple of places where I can hear music truly live. One is at the old building called Burgh House, in the centre of Hampstead, and the other is the small theatre of University College School, also in Hampstead. They are places where you can hear concerts of all kinds of music and whenever possible don't use any amplification at all.

One recent UCS concert featured four piano players who were chosen for their quite different musical styles. Each pianist played flowery classical suites, Dave Lee played standards, Michael Garrick rambled melodically and Johnny Parker remembered rags, boogie and Jelly Roll Morton. The piano at UCS is a Bluhm concert grand, freshly tuned for each concert. The hall holds around 200 people and has a pretty live acoustic. So the grand sounds pretty loud. Mikes were used, but only for announcements and recording. During the interval I overheard a lovely conversation. "Oh, it's so loud," said one lady, "I really hurt my ears." "Yes, mine too," said her friend rubbing her ears and gritting her teeth, "it's all that amplification they will insist on using these days."

BFBS 'spoiler'

More on the CBS anti-taping system. What a pity EMI and the BPI didn't talk to BFBS, the British Forces Broadcasting Service, before deciding (in late 1976) that it wasn't worth testing a signal trigger system of the type now being proposed by CBS (see February issue). BFBS engineers now tell me that they have been using a noise system for as long as they can remember. It works like this.

BFBS programmes in London, copies the tapes many times over and sends them off to BFBS radio stations around the world. If there's more than one reel of tape, they put a very tight 25 Hz notch in the audio signal at the end of the first tape. A pulse in the notch is sensed to start a second recorder when the first tape is running out. The trailing edge of the pulse stops the first machine and winds the tape off. A steep filter keeps the pulses off. This system works reliably and doubtless all round the world other radio stations and studios are using similar notch-processing systems.

Does anyone know of a system that notches in the mid frequency band (around 3 or 4 kHz) as first proposed by Murray Crosby, and now proposed by CBS, but rejected by the BPI and EMI as unworkable in the mid '70s?

I suppose there couldn't be any connection between EMI's rejection of the idea and the fact that at that time the company was still making live radio tapes.

Agony I

Will the promised return of Music While You Work on BBC Radio 2 be live? It used to be, and a few of the bands got very over-confident towards the end. They'd hang out in the pub round the corner until the very last minute, then they'd make a carefully timed dash to the studio, sit down and start reading just as the on-air light went on. One day the inevitable happened. The pub clock wasn't as fast as usual. Over the pub radio a bunch of musicians heard the familiar sounds of the MWWY signature tune played by the novel combination of trombone, violin and engineer deeping on drums.

Agony II

Since I started wondering in print why there is still no Blumlein biography, I have received some very curious and entertaining phone calls. First there was a threatening call in an odd pseudo-American accent. Then there was a series of calls from the same voice but this time clumsily disguised as a half-dead Charles Aznavour. It was offering to sell me Blumlein diaries. Then there was the same voice sounding like a pseudo-American half-dead Maurice Chevalier. It's all good clean fun and on wet evenings when there's nothing on television I replay the taped I made of each call for light entertainment. The sad thing, however, is that none of this pantomime behaviour does anything to secure Alan Blumlein his rightful place in the history of electronics.

BARRY FOX

STUDIO SOUND, MARCH 1983

46
THE FUTURE CHOICE

CALREC - always at the forefront of audio technology - are pleased to announce the impending launch of the Mark IV Soundfield Microphone, arguably the most fundamental advance in microphone technology since Blumlein's invention of the near co-incident pair.

The latest Mark of this famous genre incorporates many worthwhile improvements in both performance and facility and a professional user price of £2,000 complete.

It is anticipated that demand will exceed production in the first few months and prospective purchasers are invited to contact their national Calrec distributors now to avoid disappointment.

CALREC - the choice of professionals worldwide.

Calrec Audio Limited, Hangingroyd Lane, Hebden Bridge, West Yorkshire HX7 7DD. Tel: 0422 842159. Telex: 51311.
This product guide only contains audio tapes suitable for professional analogue or digital mastering purposes. Audio tapes for cassette duplication, audio cartridges and hi-fi applications are excluded. The standard unit under the tape width columns is a 10 1/2 in reel.

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Long play version of LX50B
Low noise
Version of LX35B without back treatment
Facilities:
The MR-3 is supplied complete with integral patchbay and varying frame sizes to accommodate up to 56 input channels.

Each input module has a full 24-track output-assign matrix and three bands of parametric Eq, with a high pass filter and optional variable 'Q' on each band.

In addition, each module offers six auxiliary sends and a direct assign button for multitrack recording.

Major console status changes are effected with one-button ease. Six modes of operation are available including two new statuses for broadcast and video post production.

The standard VCA faders enable the operator to establish VCA groups when recording and mixing. The console is prepared for rapid installation of three proven automation systems: Melkust, Allison and Harrison's own Auto-set.

The Harrison MR-3. High on Features, Low on Price.

You can never afford to buy cheaply. What you must do these days is buy economically.

Recognising this, Harrison has developed the MR-3 music desk. High on impressive features, but not on cost, the MR-3 represents excellent value and a unique opportunity to invest in Harrison performance.

In other words the MR-3 guarantees maximum efficiency in 24-track recording.

The Harrison MR-3. Underpriced it may be, undermade it's not.

To find out more about the Harrison MR-3 contact F.W.O. BAUCH at the address below.
For the purposes of this product guide, we have included those machines that have been specifically designed or reserved for professional use as well as a selection of models from the hi-fi field that may be suitable for less demanding requirements. Due to space and marketing techniques that prevail in consumer electronics, some of these models may not be available throughout the world or may differ in model numbers. In addition, this guide is far from exclusive in these areas and so perhaps it should be treated more as a guide to which manufacturers are worthy of investigation.

AIWA (Japan)
UK: AIWA (UK) Ltd, 163 Dukes Road, Acton, London W3 0SY. Phone: 01-963 1672.
USA: AIWA America Inc, 35 Oxford Drive, Moonachie, New Jersey 07074. Phone: (201) 440 5920.

AD3800: 3 heads; Dolby B & C; metal tape capability; auto bias and EQ; auto demagnetiser.

Other models AD3700, AD3500.

AKAI (Japan)
UK: Akai (UK) Ltd, Haslemere Heathrow Estate, Silver Jubilee Way, Parkway, Hounslow, Middlesex TW8 8NF. Phone: 01-837 6381.
USA: Akai America Ltd, 800 W Artesia Boulevard, P.O. Box 6010, Compton, California 90220. Phone: (213) 537-3839.

Gx-F91: 3 heads; Dolby B & C; auto bias; direct transport; electronic tape counter; LCD readout; tape head front cover panel leaves only transport controls visible; metal tape capability.

Also Gx-771.

ALPAGE (Japan)
UK: Howland West International, Eccleston Road, Maldenstone, Kent ME15 6AU. Phone: 0622 59881.
AL-300: 3 heads; Dolby B; metal tape capability; adjustable bias; Dolby level; varispeed; remote control as standard.

Also AL-80.

ASC (West Germany)
USA: ASC Electronics & Services Ltd, 2031 Lyme Street, London NW1. Phone: 01-485 0943.

AS 3000: 3 heads; High Com noise reduction with Dolby B replay; varispeed; peak level fluorescent meters; through transport; 3 motors; remote control; auto EQ and bias facility.

FOSTEX (Japan)
UK: Bandvine Ltd, 8 East Barnet Road, New Barnet, Hertfordshire EN4 8RW. Phone: 01-440 9221. Telex: 25769.
USA: Fostex Corporation of America, 15431 Blackburn Avenue, Norwalk, California 90650. Phone: (213) 2921-1112.

Model 250: not a standard cassette machine but a 4-track recorder with integral 4-channel mixer. Tape speed 3 in/s, Dolby C noise reduction and varispeed. Also Model 250AV.

HITACHI (Japan)
UK: Hitachi Sales (UK) Ltd, Hitachi House, Station Road, Hayes, Middlesex UB3 4DR. Phone: 01-848 8787.
USA: Hitachi Sales Co, 401 West Artesia Boulevard, Compton, California 90220. Phone: (213) 537-8383.

D2200M: direct drive motors, Dolby B & C 3 heads, metal tape capability, bargraph metering with HF peak indicators, electronic tape counter with elapse time display; auto bias and EQ adjustment.

Other models are D3300M, DE99, DE66, DE65.

JVC (UK)
USA: JVC Corp, 41 Slater Drive, Emwood Park, New Jersey 07407. Phone: (201) 794-3900.

DD-99: 3 heads; Dolby B & C and ANRS, auto bias, EQ and sensitivity; electronic display with two memories, tape time counter and direct drive motor; metal capability.

Other models DD-77, DD-66 and KD-655.

NAKAMICHI (Japan)
UK: National Sound Systems Ltd, Unit 7, Greycaire Road, Watford WD2 4SB. Phone: 0923 36740. Telex: 522545.
USA: Nakamichi USA Corp, 1101 Colorado Avenue, Santa Monica, California 90401. Phone: (213) 451-5510. Telex: 652625.

1000ZX: 3 heads, auto azimuth, bias and EQ calibration, internal oscillator, memory store, Dolby B, remote control.

Other models: ZX-9, 7002ZX, 7002XZ, ZX-7, LX-5.

NEAL (UK)
Lee James Electronics Ltd, Unit 21, Royal Industrial Estate, Blackett Street, Jarrow, Tyne & Wear NE32 3HR. Phone: 0962 899379.
320: 3 heads; 3 motors; full calibration facilities; internal oscillator; Dolby B & HX; mechanical tape counter, peak reading analogue meters, metal capability, remote ready, 19 in rack mount.

Also 330 and 340.

SONY (Japan)
UK: Sony (UK) Ltd, Pyrene House, Sunbury Crescent, Sunbury-on-Thames, Middlesex, TW16 7AT. Phone: 0239 785764.

TC-FX1010: 3 heads; Dolby B & C; all touch sensitive controls; fluorescent bargraph display; auto set-up; 24 hr automated; metal capability; electronic tape display.

Also TC-K555.

STUDER/REVOX (Switzerland)
Studer Instruments AG, Alhardsstrasse 150, CH-8105 Regensdorf. Phone: 01 480.29.60. Telex: 58449.

UK: FWQ Bauch Ltd, 49 Theobalds Street, Woodford, Hertfordshire WD6 4RZ. Phone: 951-0937. Telex: 057761.

Studer A710: cassette machine for studio use. Rack mounting with 4 motors, microprocessor control, Dolby B and C noise reduction, 24 hr timer, with switch functions, audio interface for pro levels and fader start etc. Revox B710 very similar but with fewer studio Suitable features.

TANDBERG (Norway)
UK: Tandberg Ltd, Reeve Road, Leeds LS11 8JG. Phone: 053274844. Telex: 557611.
USA: Tandberg of America Inc, Labriola Court, Armonk, New York 10504. Phone: (914) 725-9150. Telex: 173357.

TC 3014: 4 heads; 3 motor servo-controlled transport; real time tape counter with revolution counter display, self calibrating operation, Dolby B & C; full manual bias adjustment.

Also TC 3004, TC 404A.

TEAC/TASCAM
UK: Harman International (UK) Ltd, Mill Street, Slough, SL2 5JD. Phone: 0753 76911. Telex: 849069.
USA: Teac Corporation of America, 7237 Telegraph Road, Montebello, California 90640. Phone: (213) 726-0303. Telex: 677014.

Tascam 122 and Teac C-3X: 3 heads; 2-speed; rack mounting; Dolby B & C noise reduction; 24 hr timer with switch functions; mechanical tape counter; metal capability, VU meters.

Also V-60, 244 (4-channel recordermixer), 133, VR-6X, VR-9SXR.

TECHNICS (Japan)
UK: National Panasonic (UK) Ltd, 300-318 Rath Road, Slough, Berkshire SL1 6BJ. Phone: 0753 345222. Telex: 3547552.
USA: Panasonic Co, One Panasonic Way, Secaucus, New Jersey 07094. Phone: (201) 348-7000.

RS-M275X: 3 heads; dbx, Dolby B & C noise reduction; dbx disc decode facility; 3 bargraph meters with peak hold; real time counter; fine bias adjustment; auto tape selection.

Also RS-M620.
"Untwisting all the chains that tie the hidden soul of harmony."

Knowledge is the key to unequalled audio equalisation — and Klark-Teknik's DN60 Audio Spectrum Analyser is a rack-mounted, laboratory standard instrument that provides instantly usable information for an enormous range of applications. With continuous measurement and display of signal levels at 30 points across a broad audio spectrum from 25Hz to 20kHz, this cost-effective microprocessor-based analyser sets new standards of accuracy to the audio professional's vocabulary.

For easy equalisation, the 30 measurement frequencies of the DN60 exactly match the control frequencies of our latest two-channel DN30/30 equaliser. Add the inexpensive RT60 Reverberation Decay Analyser and a calibrated measuring microphone. It is a tough but compact rack-mounted instrument with easy operation and superb readability, and it is tested rigorously to Klark-Teknik's usual high standards, with a long burn-in period to ensure maximum reliability on the road and in the studio.

**ALL THESE USES!**
- Tape recorder alignment
- Room acoustical analysis
- Microphone loudspeaker design and testing
- Reverberation checks
- Continuous system quality control
- Audio components research and development
- Fast semi-automatic production testing
- Selective noise level checks and environmental analysis
- Quality assurance for VTR audio channels
- Broadcast programme quality monitoring
- Music content analysis and level monitoring
- Level optimisation in disc cutting

**THE PERFECT EQUALISER**
Klark-Teknik's new DN30/30 dual-channel Graphic Equaliser gives fingertip control at precisely the 30 measurement frequencies displayed on the DN60.
CX - an approach to

John Roberts

We as a magazine have not been entirely kind to CBS’ CX noise reduction system, our main complaint not being with the system itself (which as an encode/decode system appears to have some significant advantages) but with the way it has been marketed, in particular the suggestion inherent in the name CX (‘Compatible Expansion’) that encoded records are ‘listenable’ without a decoder. To give the other point of view, we asked John Roberts, a CX licensee, to discuss the system, how it works, and his experiences.

By now you have no doubt heard of CX, the disc noise reduction system developed by CBS. For some years now studios have been able to create master recordings with dynamic ranges well in excess of what can be captured in vinyl. If the recording engineer doesn’t limit the dynamics of a master recording, the cutting engineer may have to. While the CX system is a 2:1 compander (similar to dbx), the amount of noise reduction has been intentionally limited to 20dB. More than 20dB of compression would raise the noise floor of anything that the quietest master unacceptably above the surface noise of the record. This is important because one of the design considerations for the CX system is that the record be listenable when played back without decoding. Along that line the compresor control circuitry has been well-designed to minimize audible side effects even when not decoded (more details later).

No one really expects the encoded disc to sound as good as the properly decoded version; after all, it is compressed more than 20 dB. What is hoped is that the CX encoding can take the place of some of the compression/limiting often applied by the cutting engineer and/or the record producer. In fact, the cutting engineer should never have to do more than set the cutting level for a 0dB reference and let it rip.

The recording engineer has a somewhat more difficult task. At present there are not many encoders available, so the best one can do is deliver the most dynamic master tapes and hope for the best. As more encoders become available, the compressed version can be monitored during mixdown; just as most studios use a pair of extra loud range speakers to test the mix for listening over low cost systems. This will require some discipline as that much compression switched in and out will sound fairly severe.

There will be some recordings that just don’t work with 20dB of compression, like most classical pieces. Paradoxically, classical recordings have the most to gain from another 26dB of dynamic range (20dB down and 6dB peak expansion). I have heard some spectacular classical demo pressings.

Fortunately, popular music is much more tolerant of compression, and while I’ve yet to hear one I prefer compressed—some can sound quite decent. There may even be cases where the encoded format is desirable, such as playback in an automobile providing background music, or even listening to music in your parlour at less than ‘live’ sound pressure levels. What good is 90dB dynamic range if you can’t hear the bottom 40dB over street noise?

Stand-alone decoders are currently available for about $100, with the price expected to drop sharply as more manufacturers build the decoders into their new equipment. (Hitachi has reduced the CX system to a single $1.80 IC.) Records require no additional processing and will cost no more than standard releases.

How it works

CX is essentially a wideband 2:1 companding system referenced to a nominal 0dB level of 3.54cm/sec. Signals applied to the input of the encoder between +12dB and -40 dB are compressed 2:1. Signals above +12dB and below -40dB pass through at 1:1. The 20dB of compression at low level dramatically improves signal-to-noise performance, while the 6dB of compression above 0dB reduces the modulation levels that must be cut into the record. While CX is generally considered a wideband (flat) system, there is a roll-off in the gain control circuitry of -6 dB/octave below 100Hz. This has the effect of overcompressing low frequencies during encode, with a complementary over-expansion of low frequencies during playback. This reduces preamp (main) hum and turntable rumble even more than the 20dB of wideband noise reduction provided to the rest of the signal.

The gain control voltage is derived by first full wave rectifying both channels and then sensing the greater of the two (peak). This control signal is then run through a smoothing filter with a 0.9ms attack time and 9ms release time. In the following stage the control signal is processed by four different time constants. For low steady-state distortion, the control signal is averaged by a 2s RC lowpass. This network is paralleled by three other networks which use diode thresholds to switch in faster attack or release time constants. For large signal drops, the release time is 200ms, fast enough to avoid audible pumping. When the control voltage falls to within a diode drop of the new signal level it gracefully switches back to the 2s time constant for minimum distortion. The other two time constants are related to the fast attack circuitry. Similar to the release circuitry a 30ms attack time constant is switched in whenever the control signal is more than a diode drop above the control voltage. In parallel to these is a high pass circuit with a 30ms time constant also switched in by a diode threshold.

The leading edge of a sharp transient will be passed by the high pass network, while the 30ms low pass will change the control voltage quickly but without excessive distortion.
combined network realises a 1ms overall attack time for transients, 30ms attack time for large increases, 200ms release time for large decreases and a 2s steady-state time constant. Both left and right channels are driven by this one control voltage to avoid any wandering of the stereo image with compression.

While this combination of time constants gives a reasonably benign compression, I expect the results will still require listening to the encoded signal during mixdown.

Where now?
My guess is no better than anyone else's on how widely CX will be accepted. CBS has signed most major record labels to the system, and hi-fi manufacturers are already building CX chips into their new receivers. Stand-alone decoders have been around for almost two years now.

CX is presently being used on Laserdisc and CED with CBS actively lobbying for the use of CX in the new (US) stereo TV standards now being discussed.

Despite these gains, CX has yet to be widely accepted by the engineers and producers who 'make the records'. The major criticism seems to be one of sound quality. A large part of the sound quality issue is semantic or political debate over 'Compatible Expansion' (CX). As CBS has learned, to nobody's surprise, it is impossible to make any kind of music sound good to audio professionals with an extra 26 dB of compression on top of the finished product, especially in side by side listening tests to the original full range (decoded) recording. It is most unfortunate that the debate has stalled upon the sound quality of the non-decoded record, as it completely ignores the potential benefits. The hardware costs to implement the system are quite reasonable and there are no incremental software costs.

Murphy and the demodulator
While I was not involved—or even present—at early CX demonstrations, I have heard several reports describing variable sound quality. While this is pure speculation on my part, 'Murphy' has had plenty of opportunity to lay down his Law.

During the early development stages of CX, CBS used 500Hz as a low frequency breakpoint in the control chain. There were several pressings cut with this old time constant before changing over to 100Hz. (Note: Laserdiscs still use 250Hz. I know there are some of these demos floating around because I have a few myself. Should an unlucky demonstrator play back a 500Hz recording on a 100Hz decoder, the upper bass region will be unnaturally compressed.

Another potential source of difficulty for our fearless demonstrator is alignment of 0dB levels. While CBS has stated that alignment is not critical (± a few dB), I hope their demonstrators don't believe that. Their logic that 0dB level alignment is not critical is based upon the benign nature of the CX compression. If non-decoded compression sounds OK, how bad can a few dB mismatch be? Well, if the playback expansion window doesn't match up with the encode compression window, you only get the 'compatibility compression' at one end. At the other end you get some very non-compatibility expansion. Anyone who has ever listened to dbx decode on a non-encoded tape has an idea of how nasty 1.2 single-ended expansion can sound!

The third way a demonstration can go wrong has nothing to do with set-up. As I mentioned earlier, classical recordings are the latest compatible with CX while being the most in need of noise reduction. In early CX pressings of classical master tapes, the tape hiss after 20dB of compression became very noticeable. Somebody got the brilliant idea of only compressing the signal 15dB during encode, while maintaining the 20dB of expansion on playback. This does make the encoded disc a bit more listenable (5dB less tape hiss), but at the expense of playback dynamics. That 1.2 single-ended expansion we were trying to avoid by proper calibration will now always occur over a 5dB window at -30dB. This rather severe expansion occurring where it does is rather anachronistic, considering current recordings causing unnatural instrument and room decays. So if you happen to have a CX decoder with a 15/20dB switch on it, please leave it in the 20dB mode.

The above scenarios describe things that could go wrong, in addition to Murphy's usual bag of tricks (like mislabelled records). When properly decoded a correctly-encoded recording, CX does exactly what it's supposed to do. The record surface noise disappears and you hear music instead of just a recording.

Although over a million CX pressings have been shipped, the CX case has not been well argued by software. While I have heard any number of plausible CX records (typically re-releases) that work fine, I've yet to hear the definitive classic that properly showcases CX at its best. Gasparo, a small Nashville label, has cut some very clean recordings but unfortunately their choice of material, mostly chamber music, is a bit esoteric for mass appeal.

As it will still be quite a while before digital playback displaces the analogue disc in the mass market, I feel CX offers a smooth transition to, not a substitute for, 'all-digital' systems.

Author's Note: I am a CX listener and have been convinced by the good engineers at CBS Technology Center into believing that CX is an excellent noise-reduction system. They've got me so convinced that I became a licensor, and sell a lot of box CX record decoders (Phoenix Systems). I have yet to be convinced otherwise. My customers are also enthusiastic about the CX systems. By far the most frequent comment I get from them is 'where can they find more CX records? What should I tell them?'
MANUFACTURER'S SPECIFICATION

Transport mechanism: 4-motor dual capstan drive for Compact Cassettes; two DC spooling motors controlled by microprocessor; two capstan shafts individually driven by quartz controlled MDD motors.

7-segment display: 4-digit tape counter switchable to time clock.

Tape speed: 4.16cm/s (1.6 in/s) ±0.3%.

Wow and flutter (as per DIN 45507) IEC 368: 0.1% with C60 and C90 cassettes.

Start time: maximum 0.1s to rated wow and flutter.

Usable cassettes: C66 to C120, specified data guaranteed up to C90 only.

Winding times: approximately 45s for C60; approximately 65s for C90.

Noise reduction systems: Dolby B and Dolby C processors in the recording/reproducing channels, switchable MPX filter.

Tape selection: IEC I - Ferric; IEC II - chrome IEC IV - metal; AUTO - automatic sensing of coded cassettes.

Playback equalization: 3180 ±120µs, IEC I; 3160 ±70µs, IEC II and IV.

Recording level: 200mWb equals 0dB on peak level meters.

Distortion at 315Hz, 0dB (K3): IEC I better than 1.0%; IEC II better than 1.5%; IEC IV better than 1.5%.

Frequency response (measured via tape at -22dB; noise reduction off): IEC I 60Hz to 14kHz ±2dB, 30Hz to 16kHz ±3dB; IEC II and IEC IV 60Hz to 14kHz ±2dB, 30Hz to 18kHz ±3dB. With Dolby B/C on (measured with pink noise and a spectrum analyzer - IEC I 30Hz to 10kHz ±3dB, IEC II and IEC IV 30Hz to 14kHz ±3dB).

S/N referred to 3% distortion weighted as per IEC/II: IEC I 55dB without NR, 64dB with Dolby B, 69dB with Dolby C, IEC II 57dB without NR, 65dB with Dolby B, 71dB with Dolby C, IEC IV 54dB without NR, 66dB with Dolby B, 72dB with Dolby C.

Separation at 1kHz: better than 40dB.

Bias and erase frequency: 105kHz.

Erasure (measured with IEC IV tape): better than 70dB at 1kHz, Dolby off.

Inputs: symmetrical, floating; minimum impedance 50kΩ -3 and 45s for specified data.

Input level for 200mWb/s/m: calibrated +4dBu (0dBu = 0.775 V) (range -3 to +31dBu), uncalibrated, sensitivity can be increased 10dB.

Outputs: symmetrical, floating; output impedance less than 50Ω (30Hz to 20kHz).

Output level for 200mW/s/m: calibrated +4dBu (R1 = 600Ω), range -3 to +14dBu, uncalibrated, level can be increased 10dB, maximum +21dBu.

Voltage selector: 100/120/140/200/220/240VAC (voltage selector) ±10%, 50Hz to 60Hz, maximum 55W.

Fuse: 100V to 140V, 500mA. 200V to 240V, 250mA.

Weight: 10.4kg (22lb 15oz).

Dimensions: (wxdxh) 19.6 x 13.85m (483 x 151 x 332mm).

Manufacturer: Willi Studer, CH-8105 Regensdorf, Althardstrasse 30, Switzerland.

UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire, WD6 4RZ.


THE Studer A-710 cassette recorder is the professional version of the Revox B-710 machine, its functions being mostly identical. However the A-710 includes an audio interface board which provides floating transformer coupled inputs and outputs capable of handling professional signal levels into appropriate impedances. The other main differences are that the professional version excludes the low level microphone inputs and has different interface connections allowing fader start etc. In addition the unit is provided with ears for mounting into a standard 19in rack.

At the centre of the front panel is the front loading cassette transport of unusual design. The cassette is simply pushed on to the transport face where it is located against two steel guide posts by two spring loaded arms which grab the bottom of the cassette. This system gives a very...
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positive cassette location as the top of the cassette is also located against a reference by a third spring loaded arm.

The drive mechanism is of a 4-motor design with separate left and right spooling motors and twin capstan motors—a common technique for digital cassette control. This provides almost complete isolation between the sections of tape by the hubs and the tape passing the heads in addition to providing accurate tension control across the heads. Both capstans are directly driven by the motors which are phase locked to a crystal reference by means of 75-segment tachos in the motors.

The pinch rollers and the heads (plus other features) are mounted on a head carriage in the form of an alloy casting which is hinged about 2in behind the cassette. Movement of the carriage from the disengaged position to the operating position is by means of a large solenoid with a damping dashpot. The pinch rollers are mounted on spring loaded arms and the springs have screw adjusters to set the pinch roller pressure.

On the left end of the carriage, the ferrule erase head enters the left-hand hole in the cassette next to the left-hand pinch roller. The record and replay heads which are close together are inserted at the centre of the cassette, the two heads having conventional spring loaded azimuth adjustment with the replay head having a U-shaped tape guide. Before the second capstan an optical end of tape sensor is located in the hole before the pinch roller.

The pay-off and the take-up motors are both controlled by the microprocessor via D/A converters, the motors having speed sensors which feed the microprocessor.

Additional features of the transport are a plunger-operated microswitch which tells the microprocessor that a cassette is inserted, and three lever-operated switches which sense the holes in the top of the cassette for record inhibit and either IEC type II (chrome) or type IV (metal pigment) tape.

On the front panel, all tape drive functions are controlled by the microprocessor including tape location and timing functions. To the left of the front panel, a horizontal row of six pushbuttons controls the tape movement with appropriate interlocking being achieved by the microprocessor. Normal play, fast wind, stop and record buttons are provided together with a pause button which for some reason only operates in the record mode. A useful and unusual feature is that when the tape is rewound, it does not remain on the transparent leader but automatically advances to the coated section of the tape so that recording or replay can begin immediately.

Below these pushbuttons are four toggle switches. The power switch has an on position and a standby/remote control position, the latter position being used with the internal timer to enter the record or replay modes; more about this later. The second switch allows the audio outputs to be derived either from the input or from tape in the replay or record modes. The other two switches select the Dolby B or Dolby C functions and switch noise reduction on/off.

The remaining feature to the left of the unit is a 4-digit, 7-segment display with three momentary pushbuttons. The first of these switches the display between time of day (with am/pm indication) and tape location which is unfortunately not in terms of tape time. The second pushbutton is a 'run up' button used to set the display in either mode, the indication automatically advancing when this button is depressed. Thirdly the set-zero button sets the tape indicator to zero or the clock display to 12:00 am without altering the real time clock—this function is associated with the timed record/replay facility which we will come to shortly.

To the top right of the front panel are twin horizontal peak level meters in the form of segmented displays, the upper segments above 0dB indication being wider than the lower levels. Above 0dB (corresponding to 20mW/m) there are eight increments each corresponding to 1dB. Below 0dB the increments are 1dB down to −6dB with the remaining ten increments providing indications down to −30dB. Small annunciators to the right of the level display indicate whether Dolby is on, if the multiplex filter is switched in and if the automatic tape type (IEC I, II or IV) selector is switched on.

Below the level indicators, two pairs of co-axial potentiometers set the input and output levels when two locking pushbutton switches are set to the 'NULL' positions. Nearby a ¼" stereo headphone jack with a single level pot provides headphone monitoring.

A strip above the front panel features hinges down to gives access to the controls for the timer functions, tape type selection and a slide switch for inserting the multiplex filter. Four inter-locking buttons select IEC I (feric), IEC II (chrome) or IEC IV (metal pigment) tape settings with a fourth button allowing automatic selection with 'coded' cassettes.

To the left a 3-position slide switch selects normal operation or timer operation with the options of time replay or timer record when the unit enters replay or record automatically at a preset time.
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DeltaLab
To use the timer, the power switch is set to
standby/remote when the tape transport mech-
anism is disengaged. The clock is then set to the
desired start and stop times using set, start and
stop pushbuttons and the timer switch set to
replay or record as desired. The transport then
automatically switches into replay or record at the
desired times and subsequently disengages and
reverts to standby at the preset stop time.

A further feature is that instead of time the
buttons may be used to set start and stop tape
positions with the tape recycling over a preset
section—this feature can also be used to search
for a preset tape location.

Rear panel features of the A710 include four
XLR audio input and output connectors together
with an IEC power connector, properly ident-
ified power fuse and voltage selector.

A 4-pole DIN connector is provided for faster
start in addition to a +10V output for relay
operation at programmed starts. A further
10-pole DIN connector is provided for remote
controls, this providing control of all tape
movement functions including record and pause
by means of normally-open pushbutton switches.
In addition, a remote toggle switch can select
tape/source monitoring and the fader start
connection is duplicated.

Within the unit, access to all components is
good and the tape transport can be readily
removed from the chassis for major servicing.
All printed circuit boards plug in and many
integrated circuits are socketed. However
the boards lack component identifications but the
very good servicing manual incudes board
layouts and full circuits for the Revox B-710
version. A supplement provides information on
the differences between the Studer A-710 and the
Revox B-710 versions and it is understood that a
separate manual will be forthcoming for the A-
710.

All alignment controls take the form of
skeleton presets, six of which are located on the
bias oscillator board for the adjustment of
left/right bias for the three tape types. Twelve
further presets on the record amplifier board set
left/right record equalisation and level for the
tape types with two controls setting the
metering levels.

These controls are common with the domestic
versions, the professional input/output board
having additional input and output level
controls.

Frequency response
The replay frequency response was checked using
BASF ferrite and chrome calibration cassettes for
the 120µs + 3180µs ferrite equalisation and the
70µs + 3180µs chrome and metal pigment
standards.

In the ferric setting the two channels matched
within ±0.5 dB above 315 Hz with the individual
channels being within ±1 dB from 125 Hz to
18 kHz, no adjustment of replay equalisation
being available in either setting.

In the chrome/metal setting the two channels
were effectively identical but there was a
significant high frequency boost to the extent of
2 dB at 10 kHz and 2.5 dB at 12.5 kHz.
Examination of the replay amplifier time
constants suggested that this unwanted boost
may have been associated with an incorrect ratio
between the ferric and chrome time constants.

The frequency response from the line inputs to
the line outputs in the input monitor mode is
shown in Fig. 1 which shows a 1 dB boost at
15 kHz which remained irrespective of output
loading.

To the left is a set of charts showing the
frequency response in the ferric setting using
TDK MA-R tape. The leftchannel is shown in
the metal setting using TDK MA-M.

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the metal setting using TDK MA-M.
THE FIRST CASSETTE DECK DESIGNED FOR THE STUDIO

The cassette is playing a growing role in the professional sound field. In recording studies it is the media for producers' and artists' take-home dubs and for general demos. And in the broadcast studio it is being used more and more for recorded spors in place of the traditional "carts.

Now there's actually a cassette deck that has been designed specifically for such demanding studio applications—the TASCAM 122. It is rack mountable (standard EIA dimensions) and offers internal Dolby B/HX noise reduction and patch points for an external dbx noise reduction processor, full bias and EQ calibration capability, a pair of front-panel line inputs in addition to rear-panel terminals for fast access even in a rack, and the overall quality, reproduction accuracy and reliability that TASCAM is famous for.

The TASCAM 122: the professional cassette deck.
In the record/playback mode without Dolby the frequency response 'as found' for various tape types was measured at a fluxivity 20dB below 250nWb/m. Fig 2 shows the results for the two channels in the ferric setting using the recommended TDK type OD tape both channels showing a virtually identical performance.

Fig 3 shows the same results using an IEC II reference tape in the chrome setting with a slight imbalance between channels, but still a good performance extending to 2dB at 20kHz. This could however be improved with adjustment of the record amplifier settings.

In the metal setting using TDK MA-R tape, there was again a slight imbalance between the two channels but a better overall response as shown in Fig 4. In all cases the low frequency response was remarkably free from 'head bumps'.

Fig 5 and Fig 6 show the rather restricted range of the record equalisers for respectively ferric and metal tape, however, the available range of bias was quite adequate in both cases.

In order to demonstrate the advantages of metal tape over ferric tape and to demonstrate the accuracy of the Dolby tracking, the frequency response was plotted at a fluxivity of 250nWb/m and at 10dB increments below to 30dB. For ferric tape Fig 3 shows severe tape saturation above 6kHz at 250nWb/m and 10kHz at 10dB down. Comparison with Fig 8 for metal tape shows no saturation at this level and a far better performance at 250nWb/m.

Similar frequency response plots with Dolby B and Dolby C in circuit show any mis-tracking which would be associated with incorrect alignment of the Dolby levels. Ferric TDK OD tape was used to produce Fig 7 without Dolby, Fig 9 with Dolby B and Fig 10 with Dolby C. Comparison of these plots shows that as expected low level frequency response errors increase with Dolby, the degree of actual mis-tracking being minimal.

Noise and distortion

Noise, reference a fluxivity of 250nWb/m, was initially measured for the machine alone without tape for the 120µs + 3180µs and 70µs + 3180µs equalisations with and without the Dolby B and C in operation. Subsequently noise was measured with tape recorded on the machine with bias alone to give an indication of the margin between machine noise and typical tape noise using TDK OD, SA and MA-R cassettes.

With the exception of the unweighted noise the two channels were virtually identical so only one channel is quoted. This is the worst channel for unweighted noise, the better channel giving an improvement of 2 to 3dB with tape irrespective of the Dolby circuits.

As can be seen from Table 1 the margin...
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Alpine AL-300

The AL-300 is not a studio bred machine at all but one of those obscure items: a hi-fi type machine with certain features that make it a potential contender for a variety of professional applications. These features include a closed loop dual capstan transport, three heads, remote facility, varispeed and fine bias adjustments. In common with any hi-fi type machine and in particular most Japanese models, it also possesses loads of features that will be of virtually no identifiable use to the professional while acting as a very convenient feature to be found in the fingers. The machine, however, has to be accepted as a package and as there are no options other than the subsequent use of a soldering iron and opening the cassette housing, a hopeless situation precludes rack mounting, although it would require rather more than just fixing 'ears' to the side panels due to the lightweight construction of the side panels and the rear position of weights such as the mains power transformer. External dimensions of 17½in wide and 4½in in height with depth of 12in do not preclude rack mounting either, but it's just not as easy as it might be.

Front panel is fairly typical of the average brushed metal hi-fi design and may even be considered somewhat dated in appearance. It does, however, have a reassuring solidity about the controls, and their action together with the front panel, itself being ¾in thick, that suggests a slightly more robust design than the 'average'. Controls to the left of the transport include two large push buttons for power and cassette eject and a rotary pot for varispeed control. With the power applied there is illumination behind the cassette housing and the panel meters that remains in all modes. Pressing the eject button opens the cassette housing door which swings open being hinged at the bottom. The eject button is locked unless the transport is in the stop mode. The action of the door is mechanically damped with an intricate system of springs, serrated rotating cogs and a paddle wheel using wind resistance as damping that works quite well. The tape heads face upwards and the cassette to be loaded is inserted between the rotating guides in the door, tape downwards. As the door is pushed in, the drive motor for the capstans starts running and the capstans rotate when the halfway closed position is reached. These remain running all the time a cassette is loaded. If the door is shut with no cassette loaded the motors start but cut out when the door actually closes. Surprisingly, all the transport functions are operative with the door in this closed enough position to run the motor. In practice this presents no problems and can actually be a useful visual method of checking the transport function without a cassette loaded.

Previous experience of vertical leaders with upwards-facing heads has made me wary of the vast amounts of dust and oxide debris that can accumulate around the crucial transport areas with a little help from gravity. After following the discipline of shutting the door immediately the cassette was loaded or unloaded has meant that the unit was still clean enough not to need any more than head cleaning after 12 months use. Frequent use of the cleaning requires the removal of the door but this is a 10 second job that needs only finger pressure to unscrew the two knurled screws in the door and the clear panel and metal frame of the door come free. This gives full cleaning access although azimuth controls are not accessible and would appear to require rather more dismantling of the transport than one would care to undertake without the workshop manual.

The varispeed control offers a range of ±10% on the standard cassette speed of 1 ¾ in/s. This is only operative in the play mode, being bypassed in record. The travel of the control has a centre detent at the 0 position and this enables the user to be sure that it is switched out, but due to the small size and location of the control it is quite possible to leave it in. As it is locked out on record, no nasty errors can really be made but for operators benefit an LED indicator could be useful.

The transport mode selected is indicated by a row of LEDs below the cassette housing door. These are green for all modes except red for record with there being no indication of stop.

The transport controls are on an angled ledge below this. They are all feather-touch, non-latching miniature switches. The output of these switches feeds a logic control circuit and all modes are allowed in any order with no trouble. All the standard modes are included with the addition of pause, which will hold a play or record mode untill pushed a second time. While in this mode the capstans are disengaged. To enter the record mode, both play and record have to be pressed.

Perhaps the major feature of the AL-300 is its removability. The control panel may be simply pulled away from the front and mounted remotely. Supplied with the AL-300 is a suitable lead of about 16ft long with 8-pin DIN connectors at either end. This panel may even be removed from the AL-300 while it is still running and the selected mode will remain operative. It can be console-mounted quite easily.

To the right hand side of the transport lie the remaining controls. Tape position is indicated by a 3-position mechanical counter with a reset button. This has a reasonable degree of accuracy, although should not be too closely relied upon after a period of fast winding. Below this are three switches with indicators for auto rewind and memory. Auto play when selected puts the tape in play mode after having rewound to the top of the cassette; auto rewind sets the transport into rewind at the top of the cassette and sets the memory stores position 000 from the tape counter and will either stop the tape at 000 when memory is selected or enter auto play if that is also selected.

This leads to the recommended calibration switch that also illuminates a red warning LED to the left of the meters. This feature may have certain useful applications when copying to eliminate unwanted counts and take announcements from the top 10 or 15 tracks.

Continuing on the bottom row on controls, there is a stereo headphone jack socket that is positioned electronically just before the main outputs and so follows the selected monitor mode. The headphone volume is set by the main output level control. This socket can deliver 2mW into 8Ω. However, this may be rather low for monitoring properly if the main output control is set at less than maximum.

There then follows a pair of low impedance jack mic sockets (with mono facilities on US models) and the tape timer control. The AL-300 has no internal timer but using this slide switch the machine may be set so that when mains power is applied to the unit by an external timer, it will enter either the record mode or play depending on what has been selected.

The AL-300 can handle all four of the common tape types (I, II, III, IV) with the selection being made by a four-position rotary switch just to the right of the cassette door. This switches the equalisation as well as setting the approximate bias levels for that type of tape. More precise bias adjustment is available in the form of two small rotary controls to the right of the tape timer selector giving ±10% adjustment. These are individual settings for left and right channels and there is a centre detent position on the travel for the preset positions. If the adjustments are left in the detent position, good, average results are obtained from most brands of tape in all tape classes. For more precise settings, the AL-300 has internal oscillator tones for bias adjustment (104 Hz) and Dolby calibration (400 Hz) and will return to the recommended calibration methods later but it is interesting to note that the bias levels on the calibration is almost always too high for the optimum bias setting and adjustments normally consists of reducing the bias levels.

The AL-300 is equipped with Dolby B. When
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66  STUDIO SOUND, MARCH 1983
The bookhand is good on the operational aspects and covers points arising out of the techniques, but contains no information on circuitry or other technical features. Far more informative in this respect is the sales brochure which at least includes a schematic diagram. A little gentle persuasion would, I suspect, actually extract a workshop manual from the distributors and this may be worthwhile as the construction makes it appear repairable by the studio technical department, himself.

The transport
As with all three head cassettes systems there are problems as to where the heads can be fitted so that they will have access to the tape through the Compact Cassette frame. Alpago have adopted the combined record/replay head as being the best solution so far. Although the switch allowing tape to head contact that this design brings (only one pressure pad on the cassette) the transport is a closed loop dual capstan type enabling constant tape-to-head contact across the heads. The transport uses two motors, one for tape wind and the other for capstan drive. The speed differential between the two capstans necessary for the closed loop system is achieved by the use of a drive band from the motor running around two large spindles of differing diameters, which in turn drive the capstans. The capstans and pinch wheel assembly is solenoid operated and at rest is approximately 1/4 in from the operating position. Pressing any of the transport modes switches shows that the transport is rather 'clunky' as the solenoids pull the drive into the cassette. This does actually take some getting used to after quiet some units, although it is not stated exactly what these are. As I was running the line input level just below maximum in most cases and altering the master level control where left and right levels had to be altered with no chance of an error.

Metal is in the form of the two input level concentric knaps very difficult to turn equally as there is no friction at all between the two knobs sections and it depends entirely on friction pressure on both ears. I soon found that I was running the line input level just below maximum in most cases and altering the master level control where left and right levels had to be altered with no chance of an error.

Medium to medium-sized UV type meters behind the front panel. The fixed mains power cable and the mains input are situated below maximum. The least powerful types when well used can be the most informative.

The AL-300 is a machine to be seriously considered for general studio duties and copying. It is not a fully-fledged studio machine but has good recording features that may well have studio application and the capability of making very good cassette copies on ferric and chrome tape. A further attraction must be the reasonable price when compared to a dedicated professional machine.

Keith Spencer-Allen
**Tascam 122**

The Tascam 122 cassette recorder is part of the 'Teac Production Products' range of equipment, and would appear to be aimed at the 'home studio' market as a mastering recorder. However, it would also be a likely contender for the studio control room or copying suite.

In essence, the 122 is a 'special' version of the Teac C-3X up-market domestic cassette recorder, the primary obvious difference being the inclusion of a second line input on the front panel instead of a mike input.

The 122 is an impressive-looking machine, almost 6in high and 19in wide (rack-mount 'ears' are provided, most usefully). Considering the front-panel from left to right, we find a push-on, push-off power switch above a 3-position 'memory' switch, operating in conjunction with the tape position indicator to offer either stop-zero or play-from-zero options, plus off. Below this is a headphone level control giving up to 100mW into 8Ω, with associated 1/4″ stereo jack socket.

To the right of this control strip is the cassette loading window, a tinted plastic panel which hingers smoothly down on pressing the 'Eject' button. The panel is also removable for transport cleaning and alignment, although, as if often the case, it is somewhat easier to remove than to replace. The transport itself has a single-capsian, DC servo-controlled drive system with a second motor for the reels, and features the type of 3-head configuration generally found on Japanese machines, namely a combined record-replay 'double head' with the two gaps quite close together. This approach avoids a number of nasty problems that can arise with separate heads, namely variation of azimuth between record and replay heads, and doubtful tape-to-head contact at the record head, where it does not have the benefit of a pressure-pad within the cassette. It does, however, mean that the head assembly has to be a very compact piece of engineering, as the gaps must be very close together to allow both to benefit from the pressure-pad's action.

The transport controls take the form of a panel to the right of the cassette well consisting of seven electronic controls and one mechanical button (eject). The buttons controlling tape motion handle: record enable (pressed with the play button in the usual way, or in conjunction with pause); record mute, which removes audio from the record head during recording until cancelled by the play or pause buttons; pause, which unusually is released by pressing play; rewind and fast forward; play (really a 'transport forward' button); and the stop button. These controls are much like calculator keys in feel, with a positive action. Record, rec mute and pause have associated LEDs which indicate if they have been enabled, and the buttons are colour-coded for easy recognition. Above the controls is a 3-digit mechanical counter with reset button, which is about as accurate as such devices normally are.

Next to the right are two large analogue meters labelled 'VU' and calibrated from -20 to +5 with a fair degree of scale expansion around the -3 to +3 mark. There is no indication of Dolby reference level; it appears to be 0VU. The meters have a useful peak LED fitted which flashes for a reasonable length of time on peaks.

Below the meters are three knurled aluminium knobs with skirts calibrated 0–10, the left-hand pair handling left and right record levels and the...
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right-hand knob controlling the stereo output level. This latter is placed before the metering in the usual way. A novel feature of the record level control is that whilst they adjacent rather than dual-concentric, they are mechanically ganged together such that both rotate when either one is turned. They may be adjusted individually, however, by holding one and turning the other, overcoming the friction ganging. As a result, the left and right input levels can be tracked together with any desired amount of left-right imbalance. This is a similar system to that used on the Uher CR 240, with the difference that the latter machine has a slide switch to engage or disengage the ganging.

Beneath these controls we find the area in which the 122 differs from the C-3-X: a secondary line input via a pair of 1/4" mono jacks which has the same specifications as the other line input accessed via the rear panel; next to this is a bias/recording level control. Below this is a noise reduction switch - 3-way selector, offering Dolby B, Dolby HX, and off. The 'off' position activates a set of eight phono sockets on the rear panel which may be used to connect an optional dbx unit: the machine will operate as an optimum preamplifier with Type C-3X suffered from the same oddities.
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Compact Cassette. Do Philips get upset about it?

Trying a number of different Type II tapes in an effort to see what the machine was actually lined up for seemed to indicate that the factory-set values were about right for TDK SA-X tape, with a bias level slightly higher than the recommended value for Type II (which suits SA-X tape fine).

The front-panel presets were adjusted for TDK SA-X according to the instructions in the manual, which recommends the use of a 6.3kHz tone and biasing to 1.5dB over peak (0.5dB for metal tape). I felt it rather a pity that there was not a simple test oscillator built into the machine. I guess it would be asking too much to expect some kind of semi-automatic lineup (as found on the Sony TCK-81 and some Aiwa machines); after all, you don't expect such bells and whistles on a mastering machine, do you? There is an optional Teac test-tone oscillator (TO-8) which offers three frequencies, 6kHz, 6kHz, and 12.5kHz, at two levels, -30 and -10dB.

Fine bias adjustment was performed, again as recommended, by alternating 12.5kHz and 400Hz for flattest response. The record level was also set up, and the result of all this work was a setting which was absolutely identical to the Type II preset! I was still not happy with the HF end, however, and tried setting up the bias by recording white noise and adjusting for maximum top end off-tape. In fact, it was a matter of finding a bias setting which gave the best A/B, as the quality of the noise changed quite markedly with bias level. Adjusting for the best source/tape comparison led to a setting which yielded the same results as doing it properly, whatever that tells us.

The innards of the machine were examined briefly, revealing a rather better than usual Japanese standard of construction, but I would not have called it the simplest machine to fix. If the service manual is as good as is usual from this manufacturer, it should be reasonably easy to locate components and adjustments, but this was not supplied with the review machine so it is difficult to say. Modern manufacturers are exceptionally good at getting a lot of circuitry into a small volume, but this brings its penalties on occasion in terms of maintenance access. I have seen far worse, though.

Conclusions

This is a very nice cassette recorder. I enjoyed using it, despite having to think about how to get out of the pause mode, and the machine is well-constructed and robust, able to stand the rigours of studio life. It has very positive transport controls, and rewinds acceptably quickly (about 90s for a C-60). In addition, the unit can be rack-mounted and remotely controlled. In general, the recording quality is very good, and the machine overall conforms to many of the criteria which I consider important in a cassette machine for the studio (see page 28).

I also find it a rather frustrating recorder as well. I do feel that it should be possible to improve the top end–although it is fine with Dolby HX selected, it manages an HF response which some other machines don't need HX to obtain (I own one of them), and this is a little disturbing. More worrying is the way it overloads on Type II tapes at a level below what I would have thought it should.

I do not understand this at all: all I know is that there is a C-3X installed in a copy room in central London which does exactly the same thing. The owners of said machine have had it for some months, and they like it a lot. They find the HF end quite acceptable, using it in HX mode all the time, and I don't think they ever use other than Type I tapes on the machine. So perhaps I am being a little over-critical. I just feel that here is a recorder (or two, because you should think about whether the C-3X or the 122 would be the best choice) which has so many excellent things about it, it is very nearly ideal. It just falls down, inexplicably, in a couple of areas which are quite out of keeping with the rest of the machine and its pedigree. Unfortunately, those two points could be important.

I would say, overall, that the verdict is 'Very good, but could have done better'. A worthy contender: check it out and see what you think.

Richard Ellen
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**Itam Sigma mixer**

**MANUFACTURER'S SPECIFICATION**

*Inputs*
- Microphone: impedance 1kΩ, electronically balanced. Available gain 15 to 60dB (without 20dB pad).
- Line and echo returns: impedance 12kΩ unbalanced. Sensitivity adjustable -20dBm to +6dBm for 0dBm at insert send (preset to 0dBm).
- Insert returns: impedance 2.5kΩ, 0dBm.
- Tape returns: impedance 10kΩ (multitrack returns), 15kΩ (2 track returns). Sensitivity +4dBm = 0VU.

*Groups and stereo outputs*
- Monitor feed auxiliary sends: level at onset of clipping at 1kHz +20dBm into 600Ω, +22dBm into 10kΩ. Source impedance 150Ω unbalanced. Level (0VU + 4dBm = 0.5dB).
- Channel insert sends: source impedance 100Ω, 0dBm.

*Performance*
- Noise: residual noise at output, nothing routed, group fader down - 96dB. Residual noise at output nothing routed, group fader up - 88dB.
- Noise: referred to input, line < -80dBm (0dB gain).
- Crosstalk: < -83dB at 1kHz.
- Distortion: < 0.015% total harmonic distortion at +20dBm output into 600Ω at 1kHz, < 0.03% total harmonic distortion at +20dBm output into 600Ω at 1kHz.
- Frequency response: 20Hz to 20kHz, +0.5dB, -1dB (equalisation flat). Distortion and frequency response figures measured between line input and group output.
- Dimensions: 1365 x 890 (max) x 280mm (max) (whd) (Width for 16 input channel version).
- Manufacturer: Industrial Tape Applications, 1–7 Harrowdene Avenue, London NW1 6LE, UK.

**THE Itam Sigma mixer is a reasonably priced desk intended for use by musicians in conjunction with multitrack recorders such as the Itam 1610 16-track.**

In the normal configuration there are 16 input channels, each of which may be routed to eight buses in addition to four cue buses and a dedicated stereo bus.

As standard, two echo return modules are fitted each handling two channels with the same routing possibilities as the input modules except for the cue sends which are restricted to buses 1 or 2 plus buses 3 or 4. Two spare spaces in the desk may be occupied by additional input or echo return modules which may be added at any time.

Eight output modules are fitted each acting as a group to which the buses are fed and passed to the group fader. Each output module handles two channels to and from tape designated normal and auxiliary. In practice the 'normal' setting deals with tracks 1 to 8 and the 'auxiliary' tracks 9 to 16. A switch by the group fader feeds the group output to either the normal or auxiliary feed to tape. Each track has its own monitoring section enabling the signal from tape to be panned into the stereo buss or fed to cue buses 1 and 3. Similarly the group output can be panned into the stereo buss or fed to cue buses 1 and 3.

The final type of module, the master module, contains the stereo output with its metering, master controls, talkback and a test oscillator.

The complete mixer is based on a lightweight metal frame into which the modules are secured by two self-tapping screws, a potted surface being provided at the front of the mixer. Interconnection between the modules is by means of a daisy chain arrangement of ribbon cables with insulation displacement connectors which plug into the modules.

At the rear are XLR connectors for the microphone inputs with all other inputs and outputs with the exception of the remote power supply being unbalanced ¼-in jack connections. The leads from the rear connectors secure to the printed circuit boards with pin connectors.

The power supply is fully enclosed in a metal case with one end having the IEC power input connector, a properly identified 20mm power fuse and further fuses and indicator LEDs for the ±15V and 48V supplies. Within the power supply a toroidal transformer feeds the voltage stabilisers located on a single printed circuit board with a second transformer being used for the 48V phantom microphone supplies.

None of the printed circuit boards had component identifications and the operating manual contained little servicing information, but apparently a better manual is currently being produced including circuits.

Overall the standard of mechanical and electronic construction was to a satisfactory standard but it would be good to see better identification of the internal connectors which could well be keyed to prevent incorrect alignment.

From the point of view of operation, all controls were clearly identified by white markings on the chocolate brown front panels with the use of coloured knobs ensuring quick control identification. Possibly the use of further coloured knobs on the equaliser potentiometers would ease operation further.

**Input modules**

Starting from the top of the module there is a phantom power on/off toggle switch followed by locking pushbuttons for a microphone 20dB pad and phase reverse. These are followed by a self-illuminating mike/line switch, the microphone gain potentiometer with a 60dB range and a screwdriver-operated line sensitivity control.

From here the middle section of the module is occupied by the filter and equaliser controls with locking switches for the high pass and low pass filters and also an equalisation in/out switch which does not affect the filters.

The equalisers comprise treble and bass equaliser potentiometers plus the mid-frequency equalisers covering the ranges 530Hz to 7kHz and 170Hz to 2kHz with their separate frequency and cut/boost potentiometers.

There follow send level controls for the four cue buses with a pre/post fade switch for cues 1 and 2 and a separate switch for cues 3 and 4. The pre-fade signal to the cues is fed before channel muting and the insert point but after the equalisers.

Below this are the panpot and self-illuminating pushbuttons for pre-fade listen and on/off, the latter having a green warning LED nearby. Also in this area is a red LED which gives a channel overload warning derived from four locations in the channel, line in level, microphone in level, post equaliser and panpot feed.

Above the Audiofad fader (cheaper faders being optional) are nine output routing pushbuttons which allow feeds to any pair or pairs of odd and even numbered group modules plus the stereo buss. The final feature is the mute buss switch which allows the mute switch on the master module to mute any combination of input modules.

**Echo return modules**

Each of these modules contain two identical channels which receive their inputs from the rear panel echo return jacks. The echo return signal then feeds to cue level potentiometers and the echo return fader.

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inputs varied from 4.7kΩ for the tape and auxiliary returns to 10.4kΩ for the echo returns, 4.7kΩ being on the low side for interfacing with some semi-professional equipment.

At the headphone output the maximum level was $+22 \text{ dB} \cdot \text{V}$ with the source impedance varying with the level setting but remaining adequately low for most types of headphone.

Similarly, the impedance of the oscillator output varied with the level setting being 225Ω at the maximum output level of $+20.3 \text{ dB} \cdot \text{V}$ and rising to $1.2k\Omega$ at mid gain setting. With the switched attenuator in circuit the maximum level fell to $-26.5 \text{ dB} \cdot \text{V}$ from a source impedance of 100Ω which is suitable for testing microphone inputs.

**Frequency response**

The overall frequency response from the microphone inputs to the group outputs was flat from 20Hz to 20kHz with sensible high and low frequency roll-offs as shown in Fig 1 with the equalisers and filters out of circuit.

Insertion of the high and low pass filters produced Fig 2 which shows the filters to have attenuations of 12dB/octave with the $-3\text{ dB}$ points occurring at 106Hz and 7.8kHz—that latter being considered far too low a frequency.

Putting the equalisers in circuit at their nominal flat position gave a frequency response deviation in the order of $\pm 1\text{ dB}$ from 20Hz to 20kHz as shown in the plot marked zero in Fig 3 which also shows the performance of the bass equaliser at its extreme settings and half-way settings. A similar plot for the treble control is shown in Fig 4, both controls having a sensible range but the law of the treble control being rather cramped about its mid-position.

The mid 1 and 2 equalisers had a very similar performance (other than frequency range) Fig 5 showing the frequency range of the mid 2 equaliser with the mid 1 equaliser going from 530Hz to 7kHz. Both the frequency controls and the cut/boost controls had a good law, a typical cut/boost characteristic being shown in Fig 6.

The frequency response of other inputs and outputs was entirely satisfactory as were various combinations of routing.

**Noise**

Noise referred to the microphone inputs loaded with 200Ω was good at $-124\text{ dBm}$ band limited 20Hz to 22kHz or $-126.5\text{ dBm}$ A-weighted with no hum problems.

Table 1 shows the noise in the group outputs with the group shut, open with no routing, and routed to one or four line inputs at 10kΩ gain with the equalisation out. Inserting the equalisers with their controls in the nominal flat position degraded the channel noise by 1dB in all the figures.

This shows a generally satisfactory performance for the group outputs. However, the basic noise of the stereo output and the monitor outputs was similar and higher as shown in Table 2.

Allowing for the signal handling capability, there is a more than adequate dynamic range under these conditions and no other noise problems were encountered.

**Distortion**

Harmonic distortion was measured at various levels from the microphone inputs and the line inputs to the group outputs and found to be generally insensitive to input/output levels below clipping. Fig 7 shows a typical performance from the microphone input driven at $-20\text{ dBm}$ with

![Graph showing frequency response](image1)

![Graph showing mid 2 equaliser range](image2)

![Graph showing typical mid cut/boost characteristic](image3)

**Table 1**

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>Shut</th>
<th>Open</th>
<th>Noise dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>22Hz to 22kHz RMS</td>
<td>-100</td>
<td>-94</td>
<td>-89</td>
</tr>
<tr>
<td>A-weighted RMS</td>
<td>-108</td>
<td>-99</td>
<td>-83</td>
</tr>
<tr>
<td>CCIR-weighted RMS</td>
<td>-100</td>
<td>-90</td>
<td>-79</td>
</tr>
<tr>
<td>CCIR-weighted quasi-peak</td>
<td>-95</td>
<td>-86</td>
<td>-73</td>
</tr>
</tbody>
</table>

**Table 2**

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>Noise dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>22Hz to 22kHz RMS</td>
<td>-79</td>
</tr>
<tr>
<td>A-weighted RMS</td>
<td>-75</td>
</tr>
<tr>
<td>CCIR-weighted RMS</td>
<td>-75</td>
</tr>
<tr>
<td>CCIR-weighted quasi-peak</td>
<td>-76</td>
</tr>
</tbody>
</table>
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the gain set for an output of +4dBm, the line input giving a similar performance. At maximum microphone gain there was some increase in harmonic distortion with the second harmonic predominating as shown in Fig 8.

Twin tone intermodulation distortion was also checked to the CCIF method using tones separated by 70Hz and found to be very good, remaining around 0.01% right up to 200kHz.

Other matters
The pan controls were not found to be satisfactory as their operation had little effect about the centre position and jumped the stereo image near the extremes of rotation where there was a sudden switch-off of one channel.

Having informed the manufacturers, they suggested a lower value of control which certainly improved the operation. Crosstalk across the channel faders was as shown in Fig 9 leading to the necessity of switching unwanted channels off in some circumstances. On the other hand the crosstalk when routing one input module to group 1 with the adjacent module to group 2 (a severe test) gave the good results shown in Fig 10.

Metering when switched to the VU meter mode was such that the start of the red indications corresponded to +2dBm output with the rectifier characteristic being something like the required 'average'. The rise time to 0.6VU was close to the 300ms requirement of a VU meter, but the fall time was on the long side at 450ms as opposed to the normal 300ms.

When switched to the PPM mode the meters had a peak rectifier characteristic with zero indication corresponding to +3dBm output. The rise time was found to be quite fast at 10ms with the fall time increasing to 1.7s.

The brilliance of the LEDs in the meters was not satisfactory in high ambient light levels and also being flat on the module's panel the visibility was not particularly good.

The overload indicators in the input modules were found to be very good, being extremely fast in action, operating on one cycle of 10kHz tone, with the hold time giving good visibility.

Finally, the internal oscillator was investigated, the sinewave output being within +0.1/-0.5dB reference 1kHz over the full frequency range from 15Hz to 29.7kHz with useful calibrations. As is common with low distortion circuits there was annoying bounce at low frequencies, but the harmonic distortion was good at 0.03% third harmonic at 100Hz falling to less than 0.005% at 1kHz and 10kHz.

When using the squarewave mode the rise and fall times were 2.5μs with the mixer being free from ringing. The 'pulse' output for checking phase took the form of an asymmetrical squarewave.

Summary
The ITAM Sigma mixer is a versatile unit at a very reasonable price. The available routing is sometimes rather complicated and 'driving lessons' are needed to take advantage of the available facilities. However the basic facilities are completely straightforward.

As has been seen, the mixer has some shortcomings in its present form, but the manufacturer has taken the criticisms seriously and intends to put the faults right.

Overall, the electronic performance was to a good standard with the mechanical construction being satisfactory but fairly basic as one might reasonably expect in view of the low cost.

Hugh Ford
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Fabec AE1025 driver amp

MANUFACTURERS SPECIFICATION

DC parameters
Supply voltage: ±18V max.
Supply current: max ±25mA typically ±10mA.
DC offset at output: typically 20mV. Max 60mV balanced, 65mV unbalanced.

Audio specification for supply voltages ±12V to ±18V and ambient temperatures 0 to 50°C.
Min output level for less than 0.15% THD 20Hz to 15kHz for ±18V supply +28dBV balanced into 10kΩ, +22dBV unbalanced. +21dBm balanced into 600Ω, +19dBm unbalanced. For ±12V supply +25dBV balanced into 10kΩ, +19dBV unbalanced. +19dBm balanced into 600Ω, +16dBm unbalanced.

Total harmonic distortion at 2.5V peak to peak input (20Hz to 15kHz): typically 0.03%, maximum 0.1%.
Small signal bandwidth: balanced typically 0.1%.
Input impedance: balanced typically -1Ω at 250kHz, -3Ω at 50kHz, min 200kHz and 400kHz respectively. Unbalanced typically -1Ω at 100kHz, -3Ω at 200kHz, min 85kHz and 150kHz respectively. Power bandwidth for the onset of slew rate limiting into 10kΩ: balanced typically 150kHz, min 90kHz. Unbalanced typically 100kHz, min 75kHz.
Output noise A weighted: balanced typically -90dBV max -86dBV. Unbalanced typically -86dBV max -86dBV.
Balanced-unbalanced level deviation: typically 0.3Ω, max 0.9Ω.

Manufacturer: Fabec AB, Gothenburg, Sweden.
Worldwide: Gotham Audio Corporation, 741 Washington Street, New York, NY 10014, USA.

The Fabec AE1025 is a thick film hybrid circuit intended for driving unbalanced or balanced lines with the output being insensitive to the symmetry of the load.

Being encapsulated in a package about 50 x 10 x 18mm it is much smaller and lighter than any form of output transformer and also takes less space than output stages constructed from discrete components as few external components are required.

Two inputs are available to the input buffer amplifier, a virtual earth input and a high impedance input, the former being an inverting input. Gain is controlled by a single external resistor which is in the feedback loop of the input buffer stage.

The input stage feeds positive and negative output driver stages which feed and load sensing and DC servo stage which controls the output stages.

The only other external components required are a capacitor to control the time constants of the DC servo loop and coupling or decoupling capacitors as required by the desired circuit configuration.

Inputs and outputs
The input impedance using the virtual earth input is theoretically equal to the value of the input resistor, but in practice the input has a small additional impedance as the virtual earth is not perfect. Measurement of the impedance of the virtual earth showed it to vary with the gain setting being at 1kHz 3.3Ω at 12dB gain or 5.3Ω at 16dB gain. The relation between the impedance and frequency was such that the impedance increased at 6dB/octave with increasing frequency.

Overall gain is controlled by the value of the output resistor and the value of the feedback resistor with a minimum available gain of 12dB. In practice the overall gain into 600Ω was found to be 0.27dB higher than the theoretical gain when working at theoretical 12dB and 16dB gains.

The impedance of the voltage input was found to be 100kΩ in parallel with 7.5pF with the gain depending upon the termination of the current input and the feedback resistor. With the gain set for 12dB the gain of the voltage input with the current input open circuit was found to be 11.47dB.

At the outputs the impedance was insensitive to the setting being 47Ω in the balanced mode or 44/46Ω for the outputs in the unbalanced mode with the unused output grounded.

In this respect the amplifier is very unusual as it can handle highly asymmetrical loads with little change in gain. For instance, when working balanced into 600Ω the gain changed +0.24dB when one leg was grounded and -0.34dB when the other leg was grounded.

The DC offset at the outputs always remained less than 30mV with the actual offset varying with the output load and configuration.

Using a ±18V supply the maximum output levels for less than 0.1% individual harmonic distortion were as shown in Table 1 for the balanced and two unbalanced outputs with the unused output grounded.

Frequency response and noise
Fig 1 shows the frequency response at 16dB gain for the balanced and unbalanced outputs which are not the same at very high frequencies. Working at 12dB gain the frequency response at 0dBm and +12dBm balanced outputs is shown in Fig 2. At lower levels the -1db point was at 175kHz and -3dB point at 420kHz which is not very different from the plotted response at +12dBm outputs.

With the output feeding into 10kΩ the response improved with the -1db point at 315kHz and the -3dB point at 690kHz working balanced or 90kHz and 200kHz respectively unbalanced.

Noise was measured at the output with the gain set to 12dB with little difference being noted at 16dB gain but with significant differences between the unbalanced outputs (see Table 2).

Distortion
The total harmonic distortion at the balanced output was measured at various output levels...
Technical Information Series

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Modular Design
Meyer Sound reinforcement loudspeakers are designed as modular systems: full-range building blocks which offer the flexibility to meet a wide variety of demands. This means, for example, that the same product which serves for live music reinforcement in a 500-seat club can be used to make a large array for voice reinforcement in a 15,000-seat sports arena. Finally, since the array retains the performance of the modular unit with which it is made, its characteristics are predictable.

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For the professional in the field, dependable real-world performance is the ultimate goal. At Meyer Sound, we direct our efforts toward making that goal more achievable. If you would like more information on the theory behind our arrayable systems, and how these systems can be made to work for you, call or write us today.

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into loads of 10kΩ and 600Ω with the supply rails set to ±18V. The input resistor was 10kΩ and the gain was set to 12dB (see Table 3).

When working unbalanced the positive output has a distortion very close to that when working balanced with distortion at the negative output consistently 6dB higher.

Intermodulation distortion to the CCIF twin tone method using tones separated by 70Hz was measured at various levels with 10kΩ and 600Ω loads and found to vary little with load or level below the maximum output, the plots in Fig 3 being typical of the performance.

Other matters

The squarewave performance was excellent when working into resistive or capacitive loads with no overshoot or droop. Rise and fall times were symmetrical at 800ns working into 600Ω or 600ns into 10kΩ balanced.

Working balanced the slew rate was very fast at 25V/µs and there was no triangulation of sinewaves within the audio band at any level.

Summary

The Fabec AE1025 driver amplifier offers a respectable performance in a very small space. It further has the advantage of being a summing amplifier when required in addition to having a separate high impedance input.

It was completely tolerant of load conditions behaving much the same way as an isolating transformer with assymetrical loads.

Hugh Ford

TABLE 1

<table>
<thead>
<tr>
<th>Load</th>
<th>Balanced</th>
<th>Unbalanced +</th>
<th>Unbalanced -</th>
</tr>
</thead>
<tbody>
<tr>
<td>600Ω</td>
<td>balanced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600Ω</td>
<td>unbalanced +</td>
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<td>10kΩ</td>
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TABLE 2

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>Balanced at 1kHz</th>
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<tr>
<td>A-weighted RMS</td>
<td>+27.1dBV</td>
<td>+21.1dBV</td>
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<tr>
<td>CCIR-weighted RMS</td>
<td>+25.1dBV</td>
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<td>CCIR-weighted quasi-peak</td>
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TABLE 3

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<thead>
<tr>
<th>Frequency</th>
<th>+22dBm into 10kΩ</th>
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<tbody>
<tr>
<td>1kHz</td>
<td>&lt;0.002%</td>
<td>&lt;0.0045%</td>
<td>&lt;0.01%</td>
<td>&lt;0.01%</td>
<td>&lt;0.002%</td>
<td>&lt;0.0045%</td>
<td>&lt;0.024%</td>
</tr>
<tr>
<td>10kHz</td>
<td>0.0045%</td>
<td>0.0035%</td>
<td>0.06%</td>
<td>0.06%</td>
<td>0.0045%</td>
<td>0.0035%</td>
<td>0.024%</td>
</tr>
<tr>
<td>15kHz</td>
<td>0.0065%</td>
<td>0.004%</td>
<td>0.06%</td>
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Hugh Ford

fig 2. Fabec Driver Amp Frequency Response at 0dBm and 12dBm Balanced Output

fig 3. Fabec Driver Amp IM at +10dBm Output

Conclusion

The Fabec AE1025 driver amplifier offers a respectable performance in a very small space. It further has the advantage of being a summing amplifier when required in addition to having a separate high impedance input.

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<td>&lt;0.002%</td>
<td>&lt;0.0045%</td>
<td>&lt;0.024%</td>
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<tr>
<td>10kHz</td>
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<td>0.0035%</td>
<td>0.06%</td>
<td>0.06%</td>
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