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POSSIBLY THE MOST useful equipment reviews are those of power amplifiers. Since the requirements are fairly well-defined, something vague about a straight wire with gain and a little self-inductance, it's a relatively simple matter to see how far a brushed aluminium black box goes towards realising such a goal. And then to pass judgement.

Again, small-signal modules have quite specific aims, within some overall scheme. Again, argument centres on the relative weight of mutually opposed parameters, such as noise and distortion, and which compromise is more satisfactory. Nevertheless, different methods of achieving an end do not concern the practical balance engineer; he is simply concerned that a required performance is maintained.

Difficulties creep in when more than two black boxes are involved, because they can be arranged in different ways. Disagreement follows. Some people always want to do things differently, which is unfortunate since it prevents attitudes sitting comfortably still. Since all possibilities could only be catered for by some sort of permutation-review, it's necessary to generalise. Too bad if anyone objects to the application to him.

Microphones are a problem. Like music and other irrelevant things, subjective effects remain uncodified and any discussion can only be sustained by a good vocabulary and a certain familiarity. And, in common with arts criticism, a pungent, eloquent smoke screen is often more effective than careful, sincere comment.

The most tiresome comments on mics and their use come from the purists. But we must distinguish between the theoretician (who, contrary to popular belief, stands or falls by the success of his propositions and cannot be confounded by 'the practical man' if he has done his sums right) and the witless plagiarist (who either has only two mics anyway or has trouble in hearing all he is supposed to through less than 18, even with ph).

Naturally, a little arrogance goes a long way.

Crossed pair taking issue with multomic, and vice versa, is an ultimately unrewarding spectacle; and the extreme polarisation that used to characterise such arguments seems to have softened. But the virtue of such debate was in providing points of reference in the fog of practical technique, which acknowledges no basic principles unless they lead to good results in a specific situation. It isn't helped by some record critics who ought to know better (who either has only two mics anyway or has trouble in hearing all he is supposed to through less than 18, even with ph).

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Next month, survey and reviews of straight wires.
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So often when a recording engineer wishes to choose a microphone for a particular purpose, it is more a question of what is made available to him than what is the best mic for the job. In many cases studio managers have chosen microphone types with only limited applications for use by engineers. For example, one London studio originally had available only two types of microphone, moving coil and capacitor, both being fixed cardioid. Several dozen of these were bought from a single manufacturer, and engineers soon grumbled at the limited choice.

**IDEALLY MICROPHONES SHOULD be chosen purely on a performance basis but frequently, for prestige reasons, a studio will buy, for example, Neumann, for some application where an AKG microphone might be a better alternative. Some types of microphone seem to be associated only with particular sections of the recording world. For example, Sennheiser rife microphones are used almost exclusively by film and TV studios, although in the last year or so the BBC and IBA have been introducing them for news coverage. Only recently has BBC sound radio started using them at Oxford, for instance, to obtain more presence in special conditions. Often it will need just one well-known engineer to start using a new microphone for that model to become widely accepted and used.**

There has been a great deal of actual microphone techniques, and although I personally prefer to use the minimum number of microphones possible, ideally only two, nevertheless for a particular recording because of acoustic conditions in some locations one may have to use a very large number, even for classical music. A hall having too much short-term reverberation can produce a sound quality, with a single stereo pair, which can only be described as boring and without the wash, while on the other hand to use more than a single pair in the Royal Albert Hall, or even Ely cathedral, is only necessary if the forces being recorded are not appropriately balanced internally, or if one is working with a producer who wants to create an effect for a gramophone record, rather than attempting to reproduce reality. Often such an effect is more exciting, even if it offends the purist, but nevertheless many engineers will not give simple techniques a try. On the other hand, I have heard ‘semi-professional’ engineers with modest equipment, perhaps consisting of one stereo microphone and one professional tape recorder, becoming arrogant, and claiming that anyone using more than a single pair for stereo is always wrong. My reply would be: let him try to make a recording of a large orchestra in the new Hove Town Hall, or the De Montfort Hall in Leicester, with its serious flutter problems.

Choosing the right microphone must become an art and not a science, a personal opinion and not a text book matter, and should become an engineer’s personal choice, and not company policy. In spite of this, there are clearly some basic rules in choosing microphones, which are all important, and to observe them may well create problems so severe that no amount of knob twiddling can repair the damage done by making a wrong decision.

Although capacitor microphones have now become a mainstay in most studios, the moving coil cardioids remain very popular. Ribbon mics are still being made, but in decreasing quantities, though this doesn’t mean they are unsuitable for use today. The polar diagram of an STC 4038 ribbon is almost perfectly bi-directional at all frequencies. Many engineers like to use this polar diagram to allow a ribbon mic to pick up brass instruments on the main axis while excluding loud percussion instruments on the side. Because these microphones have a very flat response up to 10 kHz or so and then fall off rapidly they are often liked by engineers for use with woodwind when a close capacitor type might over-emphasize breathiness. Although such breathiness can be reduced by equalisation, I have always felt that there is something about the sound of a ribbon mic which is very ‘musical’. Often, I have been asked by a professional violinist to use a ribbon rather than a capacitor for a solo pick-up. Beware, though; the ribbon microphone’s enormous magnet can damage master tapes and even unrecorded tapes, by introducing a dc magnetisation which cannot easily be erased.

Almost all ribbon mics are purely bi-directional, although the RCA Varacoustic had a shallow walled screened microphone cable and microphone preamplifiers in the control desk having a low inherent noise. They give an output some 20 dB lower than the average capacitor type, and some control desks will not have sufficient gain for them, when they are used for recording very quiet speech sounds. However, they can give high output levels without distortion, and moving coil cardioids in particular are useful for close miking pop groups. Since these obtain the cardiod microphone diagram acoustically, they are often prone to handling noises, and in any case the polar diagram can change if the shank of the microphone isobstructed by a hand, or by a clamp covering the air holes. I have found some types rather prone to shock damage; in particular the AKG D292 used to have very fine wires connecting the treble and bass diaphragms to the cross-over unit (this has since been improved). These wires broke very easily, and so in general use often required maintenance. Nevertheless, the AKG D292 seems more robust in this respect, although the internal wiring is similar. Interwoven screened cables are particularly suitable for moving coil and ribbon mics, but they should not be run close to any mains wiring. Some microphones are available with either Cannon-type connectors or DIN ones. The DIN plugs are much more difficult to wire up, and are less reliable, so I would advise sticking to Cannon terminals. Many of the mics are available with either socket.

Capacitor mics must be handled with care and stored if possible in a reasonably warm environment where the humidity can be kept low. If stored for any length of time they should be switched on some hours before use.

**The right mic for the job**

ANGUS MCKENZIE
in a warm place to remove any moisture from the diaphragm. In this way noise and rumble can be kept to a minimum. Capacitor microphones fall into three groups—those having single polar diagrams, those having switchable polar diagrams on the microphone, and those having the polar diagram controllable remotely. The first type includes the well-known Neumann KM84, the AKG 451/452 series, the Calrec 1080 series, and various models made by Schoeps, Sennheiser, STC, Pearl etc. Of these, the Neumann KM84 has a very low inherent noise and a wide frequency response without peaks and a good cardioid. When bought in small quantities, however, it is an expensive microphone. The AKG range has two types of amplifier body, one for 9.5V phantom powering, and the other for the more conventional 48V. There seems to be virtually no difference in the performance of the amplifiers, but the first type is suitable for use with the AKG battery power box using a PP3 battery, which also contains a 1:1 isolating transformer. A number of different heads are available to suit most purposes.

The CK1 capsule is an acoustic cardioid and is rather more noisy than many other types, although it sounds very smooth. It is particularly useful for close miking, and the cardioid pattern is fairly well maintained at different frequencies. The CK2 capsule, an omni one, is my personal favourite for speech recording. It has an exceptionally fine pattern at all frequencies and a very flat and uncoloured response. The CK5 capsule has a built-on wind shield incorporating bass cut, and is particularly useful for pa work, whereas the CK5 is a hyper-cardioid capsule having a 20 cm plug-on stem. The CK9 is a rifle-type microphone head having high directivity at higher frequencies. AKG can also supply a swivel adaptor type AS1 which allows the capsule to be pointed in any direction relative to the amplifier body. This allows two capsules to be mounted at a 110° included angle with their amplifiers running parallel and strapped to each other for stereo. Short and long extension tubes VR1 and 2 are available so that the capsule can be several feet above a vertical amplifier body, perhaps on stage, so that the mic itself becomes almost unnoticeable from a distance.

The AKG 414 capacitor mic is normally supplied to work off 9.5 to 12V phantom powering, but can be driven from a 48V phantom supply, provided that resistors of approximately 5.6k ohms are used to feed the supply to each leg in the microphone input of the mixer. The resistors should be of 1W rating and the phantom supply should be well capable of giving the extra current required without any extra ac ripple. The 414 has four switchable polar diagrams, omnidirectional, bi-directional, normal cardioid and hyper cardioid. The last position is most unusual on a mic not remotely controllable, but is nevertheless used probably more often than omni or bi-directional by most people used to the AKG.

The position was added at the request of the BBC and other professional users when its predecessor, the 412, first appeared. The Neumann U87 has three polar diagrams (missing out hyper-cardioid), is larger than the AKG, but also has provision for internal battery operation which is most convenient. A comparison between these two mics is included in this issue. Remotely controllable polar diagram mics seem temporarily to be a little out of fashion, although I cannot understand why. I have found it a great convenience to be able to change a polar diagram in a control room as an audience perhaps fills a concert hall more than expected. By remotely altering polar diagrams and using stereo widening and narrowing in a control desk, an equivalent to physically altering the angle between the capsules can almost be obtained, which probably could not be done during a live performance. The Neumann SM89 and other stereo coincident capsule microphones all have remotely controllable diagrams, and their capsules can be set at any angle relative to each other. AKG will be introducing an updated fet CK4, and Pearl and Sennheiser are also making stereo models. Although the convenience of having one stereo mic cannot be underestimated, it is probably better, because of flexibility, to use two separate mics in close proximity, provided that remote control facilities are not of great importance. Remote control unfortunately adds quite a considerable amount to the cost, although an advantage is the availability of switchable polar diagrams in steps between the more usual ones. Although most bi-directional patterns are
held over a wide frequency range by various microphones, some mics exhibit slight bass loss. At very high frequencies the diagram falls inwards slightly. Cardioid microphones vary greatly in their pattern performance at different frequencies, and I have noted that the AKG D292 seems to be particularly good in the middle, pretty good in the bass, but gets rather narrow at the extreme top end. Cheaper moving coil cardioids normally tend to lose their pattern at lower frequencies, although they become highly directional at high frequencies; this can often be useful. A number of users have found that the U87 bass cardioid is not too good, and have preferred the AKG 414.

A good low frequency cardioid is important when it is required to cut rumble out of the microphone pick-up, particularly in TV studios or large concert halls.

A good high frequency cardioid performance is particularly important when cardioid microphones are to be used in pairs for stereo, since a narrowing of lif polar diagrams tends to exaggerate width at high frequencies, thus giving incorrect positioning to sound slightly left and right of centre. Whereas sounds at the edges will appear very lifelike, a tendency to dullness in the centre will also be noticeable. This effect is exaggerated as the angle between the mics is increased, and frequently reaches an absurdity when the microphone capsules are back to back. This technique is nevertheless used sometimes with considerably more ambience is required in the general sound, when good mono compatibility is important, and when degradation of stereo image is acceptable. I prefer to use small capsule cardioids, for the accuracy of image is very important, and will remember the excellent positioning obtained from the Neumann SM2 stereo microphone, which is unfortunately no longer available. This microphone, though, seemed to have rather an apparent bass loss when used in bi-directional polar diagrams.

Bearing in mind the excellent sounds that can be obtained from two cardioids in close proximity, with an included angle of 110° or so, some enterprising manufacturer might make a simple stereo cardioid model having one rotatable capsule. Although it would be preferable for it to be a capacitor type, a moving coil could give good results, although it might have rather an odd shape in order to preserve the polar diagrams at all frequencies (which incidentally would have to be achieved by acoustic means). While discussing polar diagrams, I would like to disagree with the practice of some recording organisations in using a multitude of omnidirectional microphones to obtain stereo balance. The path difference at low frequencies can give very strange cancellations and additions, and accurate positioning at high frequencies can only be achieved by the use of further mics. Recordings made with this type of technique seem to reproduce with a very "woolly" bass and lack real positional definition; such positional clarity as exists is forced by multi-miking.

For those concerned in comparisons I would like to suggest comparing the stereo sound obtained by the BBC at St John's, Smith Square, London, in which they normally use coincident mics, with that achieved by the commercial companies in the same venue. Omni mics also pick up more rumble than directional ones, and this can become very wearing when listening to records on good quality equipment.

The choice of capacitor microphone powering

Originally, when capacitor microphones were valve powered, separate mains power supplies were needed, and multicore cable connected the mics to the power supply. Now that virtually all capacitor mics have fet pre-amplifiers in them and include, in the mic head, means of converting lower voltages to the necessary high ones, for polarisation purposes, it becomes possible to power directly from the control desk. Although the most popular system, known as phantom powering, supplies positive dc to the microphone head on both audio leads with a dc return via the screen, a few other systems are in use.

Sennheiser, among others, send positive dc on one audio leg and negative on the other, and the screen purely prevents hum, rf and static pick-up. The disadvantage of course is the possibility of a disaster occurring on accidental phase reversal coupled with failure of protection components, but nevertheless the system offers some important advantages. Since in a normal phantom power microphone the dc returns along the screen of the mic cable, any slight oxidation in connectors or screening can produce rectification of any rf in the vicinity, and thus cause quite serious interference. Although this can sometimes be eradicated by using 1:1 transformers near the microphone, with centre taps shorted together, and decoupled from screen, there is always a danger. In addition, a complete break in the screening will render the microphone inoperative, and this unfortunately happens rather frequently with some types of connector. I have had, for example, a lot of trouble with the AKG 412 and 411 connectors, and I cannot see why these cannot be changed to Cannons. The a/b powering system is usually 12V, and even if the screen becomes disconnected the mic will still work, although hum might be noticeable. The screen, if connected well to the microphone chassis, seems to give an improved rf screening, which is quite important when working near transmitters. Since there are tens of thousands of these around—both professional and amateur—the danger should not be underestimated. For example, Decca at their West Hampstead studios had continual trouble with local radio amateurs before a mutual understanding was reached. With trepidation, I must add that I am also a radio amateur, but I hope I have never caused such interference.

The choice between 48V and 9.5V phantom powering is difficult, but basically rests on the ease with which 48V power supplies can be made ripple-free, and the fact that 48V microphones draw only a minimal current, as against the advantages of 9.5V mics being operated in an emergency by battery power supplies run from easily available PP3s. Future FMUs, however, distribute a useful Pearl 48V power supply at a very reasonable cost, which uses two 24V batteries in series. We usually take these out on mobiles in case of any phantom supply fault on the desk. Most 9.5V capacitor mics obtain their internal ht from an rf oscillator driven from the 9.5V input, the oscillator transformer secondary supplying adequate voltage at low current to a rectifier smoothing circuit. Such mics can therefore have quite a high polarising voltage available, whereas some 48V mics are limited to that voltage for polarisation. The practice of using negative 12V phantom power supplies as used by one or two Continental firms is unfortunate; I can see no purpose in it, and any confusion can be serious.

Frequency response

Whereas moving coil microphones tend to
be rather peaky towards the higher end of their response, and often have a bass response tailing off before the ribbon can be expected. This is much smoother but lacks extreme top. Capacitor mics are almost always much smoother throughout, but seem to have very definite shelf boosts from 1 kHz or so up to 10 kHz.

In general, the Neumann range seems to have such presence boost, whereas AKG mics are much flatter. Nevertheless, the Neumann KM84 is one of the flattest mics available. A shelf boost can sometimes be useful to achieve a special effect, and was originally designed to offset high frequency losses in air when mics were used at greater distances. Over the years, however, engineers have used mics close to the source to simulate the sound of an instrument, and often have a bass response boost to achieve this. The art lies in knowing when such boosts are no longer necessary since they can be introduced in a different form in a control desk.

Unfortunately it is much more difficult to take away a shelf boost than to give presence lift, since removal of the boost means a fairly precise and opposite shelf which may be difficult to set by ear. This phenomenon is so important that it is worth quoting an example which I remember from a technical recording book. A very beautiful harpsichord had to be recorded, a reproduction of an original instrument, in a central London church. Both a Neumann SM59 stereo mic and a pair of AKG 414s were put out approximately 3m from the instrument; subjectively both musicians and my recording team agreed that the AKG reproduced the sound more accurately. In that situation the 414s were supposed to be the best instrument with a natural sweetness, whereas the Neumann sounded twangy and hard. The latter also seemed to bring up action noise; even introducing various hf shelves did not help. Then the AKG 414s were moved close to the source, and the shelf shelf cut was introduced it became very difficult to bring up the 15 kHz end of the response adequately and steeply enough. Although clearly a far more comprehensive equalizer would have done the trick, it seems hardly reasonable to be forced to take graphics along to live recording sessions.

The very latest mics to be designed by all good manufacturers seem to be considerably quieter, but I can remember 15 years ago having a good AKG C12 which, although flatter in response, was some 8 dB noisier than my Neumann U47s. Some capacitor mics seem to have a seriously coloured extreme top, but as this seems to be a matter of opinion, potential users should try various types, especially on massed strings. For such an assessment a loudspeaker with very low coloration must be used, and probably the best known examples are the Quad electrostatics and Spendor BCIs. A fair indication, however, can be gained from a good pair of electrostatic headphones, such as the better models made by Stax and Kors. On low frequencies many capsules obtaining their polar diagram acoustically seem to exhibit a loss, and a comparison between capsules on the chart will soon show up any differences. Remember too that multi-polar diagram mics usually exhibit bass loss in their bi-directional positions. Unfortunately this loss has a tendency to be rather more than 6 dB at off-shalow angles. In general, however, even forget, however, that an extended bass response below 30 Hz can cause problems in disc cutting, and cassette tape duplication.

Microphone sensitivity
Up to 34 dB difference in output has been measured between the very highest sensitivity capacitor microphones and some moving coil and ribbon types. Remember that a microphone having a very high output may well clip internally at high sound pressure levels. The control desk to which the microphone is connected must be capable of accepting very high levels. At least 15 dB should be held in hand on the control desk between the maximum level registered from the mic and the clipping level of the amplifier, since many sounds have what is termed an extremely high crest factor, this representing a maximum noise level to the wave form. Muted brass instruments sound very much quieter than they actually peak, and one example of a capacitor mic that can easily 'domesticate' recording equipment is the STC 4135 which has an output level of approximately −50 dBm for a sound pressure level of only 74 dB. Singers closer than to a metre to this microphone can cause distortion, and a output impedance of 200 ohms the attenuator sounded extremely clipped when I tried it during some tests for this magazine a few years ago. Clearly, this microphone had too much gain in the pre-amp. Some mics may have switchable attenuator pads which are before the fat and allow them to be used close to very loud instruments. Most Neumann mics have such pads, and now most microphone manufacturers are introducing them.

Some capacitor mics have a lower output, such as the earlier models of Calrec 1050, only being 10 dB or so higher than dynamic types. Noisy microphone amplifier input stages will not have their input noise level shown in the specifications; therefore the Neumann mics should not be used with them. Great care should be taken in choosing capacitor mics for use with any input impedance increasing equipment, since almost certainly such equipment has been designed to be used with dynamics, and capacitors will be likely to cause overloading. Note that for almost all capacitor mics having a nominal input impedance the attenuator pad should have approximately 1000 ohms input impedance bridging the mic, and an output impedance of not higher than around 200 ohms.

Output impedance
As a rule in British studios, 200 ohm impedance mics should be selected for use with input stages having an input impedance of 1000 ohms. Most microphones will work satisfactorily into 600 ohms, but some models having their output impedance increasing at low frequencies, or having a variable impedance, may show response irregularities. 60 ohm mics should be used for mixers having an input impedance of 200-300 ohms. Make sure, however, that the impedance stated for the mixer is not the impedance of the microphone for which it has been designed.

There seems to be little point in having microphone preamplifiers with an input impedance higher than 1.5k ohms, although it is arguable that some mics might possibly give slightly less output distortion at very high levels when more lightly loaded. Some tape recorders, such as the new Revox 700 and the Nagra 45 have high output impedances on the mic sockets, and this virtually discourages the use of dynamic microphones with the Revox because of noise problems, and of low output capacitor microphones with the Nagra because of insufficient mic gain. However, the Nagra noise may be simply modified (details from Hayden Laboratories).

Noise levels
Whereas moving coil and ribbon microphones require the quietest microphones, amplifiers into the control desk, capacitor types all have an inherent noise produced by their head preamplifiers. Capacitor mics in current use very widely in equivalent noise, the quietest being most of the Neumanns, the AKG range and the Sennheiser range, while the noisiest appear to be the Neumann KM84, the AKG 451 and C12A, and some Pearl models. The very quietest mics are only needed, however, when they are used at a considerable distance from the sound source, or when amplifying quieter sounds such as speech, clarinets, church organs and distant musical instruments. Although I have experienced no fundamental noise problems with the AKG C12, and the 414, I have never had any trouble with the 414 or microphones in the Neumann range. Some Schoeps microphones have just come to hand (see Reviews), and these have proved to be most promising. The larger Sennheiser rifless mics, like all other mics in the range, are rf frequency modulation types having a very low noise, and are extremely useful for spotting distant instruments to give a little point in having them. If rifless mics are a requirement, I recommend that severe bass cut is introduced with care in stereo placement since at lower frequencies rifless mics lose directionality and mixing them in flat could cause phase problems at low frequencies.

Price considerations
The most expensive mics are frequently not the best for a particular job, but as a rule it is probably more useful to buy microphones in threes or more switchable polar diagrams, rather than those which are not switchable. If a number of microphones is to be bought, I suggest including at least one stereo one in addition to some pure cardios. I recommend moving coil types and generally useful as a standby, and many balances like microphones such as the Beyer M109 hyper-cardioid ribbon and STC 4058 pure ribbon. It also seems unwise to stick to only one manufacturer, since each maker has his own forte. Ruggedness and appearance are also important. Finally, but certainly not least important, is the recording engineer's own personal preference for a particular type.

Footnote: just before sending in this article I have heard that AKG are shortly producing a new 414 head connector coming out on an XLR socket rather than a multi-pin. This will be a great blessing, and is a result of many complaints by users about the unreliability of the present connector. The D202 has been developed and is available as a more reliable internal chokes, and some of the fine wiring has been made more reliable.
### Survey: Microphones

**ADAstra**
Adastra Electronics Ltd, Unit N22, Cricklewood Trading Estate, Claremont Rd, London NW2 1TU. Phone: 01-452 6288/9.

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**AKG**
AKG Akustische Und Kino-Gerate GmbH, A-1150 Vienna, Brunhildengasse 1, Austria.


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<td>C O N/A .8 mV/µB</td>
<td>Condenser capsule.</td>
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<td>CK5</td>
<td>C C N/A .95 mV/µB</td>
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<td>CK9</td>
<td>C H C N/A 1.1 mV/µB</td>
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<td>Polar response switchable—inc.</td>
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<td>C414E</td>
<td>V .5 mV/µB</td>
<td>£173</td>
<td>Studio Lavaliere tie pin.</td>
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**BEYER**
Eugen Beyer, Electrotechnische Fabrik, D71 Heilbronn, Thereseinstrasse 8, PO Box 170, Germany. Phone 07131 823490.

**UK agents:** Beyer Dynamic (GB) Ltd, 1 Clair Rd, Haywards Heath, Sussex. Phone 0444 5003.

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**CALREC**
Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge, Yorkshire HX7 1DD. Phone: 0422 64-2159.

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**KEY**


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**CONDOR**
Condor Electronics Ltd, 100 Coombe Lane, London SW20 0AY. Phone: 01-946 8033.

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<th>Model</th>
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<td>CM956C</td>
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**CBIC**
Self powered preamp, cannon fitting for above series.

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<td>CM2015C</td>
<td>C C 1k</td>
<td>.6 mV/µB</td>
<td>£54.70</td>
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**CONDOR**
Condor Electronics Ltd, 100 Coombe Lane, London SW20 0AY. Phone: 01-946 8033.

<table>
<thead>
<tr>
<th>Model</th>
<th>Impedance</th>
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<tr>
<td>CM903C</td>
<td>C O N/A</td>
<td>4 mV/µB</td>
<td>POA</td>
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<tr>
<td>CM986C</td>
<td>C C N/A</td>
<td>4 mV/µB</td>
<td>POA</td>
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<tr>
<td>CM951C</td>
<td>C C N/A</td>
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<td>POA</td>
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<tr>
<td>CM956C</td>
<td>C C N/A</td>
<td>4 mV/µB</td>
<td>POA</td>
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**CONDOR**
Condor Electronics Ltd, 100 Coombe Lane, London SW20 0AY. Phone: 01-946 8033.

<table>
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<tr>
<th>Model</th>
<th>Impedance</th>
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<tr>
<td>EM182</td>
<td>E O 600</td>
<td>120 dB</td>
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<td>EMA7</td>
<td>E O 50k</td>
<td>100 dB</td>
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<td>EM9/2</td>
<td>E C 1k</td>
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<tr>
<td>EM9/3</td>
<td>E C 1k</td>
<td>80 dB</td>
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</tr>
<tr>
<td>EM9/4</td>
<td>E O 1k</td>
<td>60 dB</td>
<td>£12</td>
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**EAGLE**
Eagle International, Precision Centre, Heath Park Drive, Wembley HA0 1SU. Phone: 01-933 0144.

<table>
<thead>
<tr>
<th>Model</th>
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<tr>
<td>PRO M10</td>
<td>C 600</td>
<td>60 dB</td>
<td>£32</td>
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<tr>
<td>PRO M15</td>
<td>C 600</td>
<td>60 dB</td>
<td>£35</td>
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<tr>
<td>PRO M25</td>
<td>C 600</td>
<td>70 dB</td>
<td>£37.40</td>
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**ELECTROVOICE**
Electrovoice Inc, 600 Cecil St, Buchanan, Michigan 49107. UK agents: Special Products Division, Gulf Europe Ltd, Brighton BN2 4JJ. Phone: 0273-66271.

<table>
<thead>
<tr>
<th>Model</th>
<th>Impedance</th>
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<tr>
<td>654A</td>
<td>M O 150</td>
<td>140 dB</td>
<td>Broadcast, report.</td>
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<tr>
<td>200</td>
<td>M O 150</td>
<td>140 dB</td>
<td>Low cost bass effect.</td>
</tr>
</tbody>
</table>

**NEUMANN**
George Neumann & Co, 71 Heilbronn/Neckar, Fleinerstrasse 29, Postfach 2120, Germany.

**UK agents:** FWO Bauch Ltd, 49 Theobald St, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091.
KEITH SLAUGHTER: "Playback and recording automatically includes the appropriate noise reduction unit."

PETER SULLIVAN: "Capacitor microphones are used to provide high quality signals for talkback and foldback circuits."

GEORGE MARTIN: "The channel amplifiers have sufficient equalisation to meet all advanced recording techniques."

BILL PRICE: "There are 32 input channels mixing down to 24 groups for multi-track recording."

JOHN BURGESS: "With the Neve unit we can produce high quality quadraphonic tapes for disc or film sound tracks."

Who's Who in sound know what's what when it comes to a sound recording system. Only the best is good enough for AIR Studios. Which is why they chose Neve. This 32 input, 24 track quadrophonic music recording console was specially designed to fit AIR's most advanced studio at Oxford Circus. It looks magnificent. The results speak for themselves.

Neve internationally sound people

**PHILIPS**

Pye Business Communications Ltd, Cromwell Rd, Cambridge CB1 3HE. Phone: 0223-45191.

- **EL5042** MC O 200 12 mV/µB £47.50 QD adaptor.
- **LB9006** MC C 200 14 mV/µB £33 Two way system.
- **LB9010** MC O 200 16 mV/µB £36

**ROSS ELECTRONICS**

Ross Marks Ltd 32 Rathbone Place, London W1P 1AD. Phone: 01-569 7112.

- **RE325** MC C 600 -64 dB £60.66 Dual impedance.
- **RE330** MC C 600 -58 dB £101.06 Dual impedance.
- **RE335** MC C 600 -57 dB £110.06 Dual impedance.
- **RE345** MC C 600 -72 dB £12.75 Anti-pop.
- **RE360** EI O 600 -62 dB £13.59 FET preamp/HP7 cell.
- **RE365** EI C 600 -60 dB £14.91 FET preamp/HP7 cell.

**SCHOEPS**

Feldon Audio Ltd 126 Great Portland St, London W1N 5PH. Phone: 01-569 4314.

- **CM5540U** C C 1k 1.3 mV £113 if filter.
- **CM5441U** HC 1k 1.3 mV £115 polar response sw.
- **CM5550U** O/C 1.2 mV or £133 1.5 mV
- **CM5580U** V 1k 1.0 mV £146 stereo coincident.
- **CM5600U** CO 2.0 mV £306 stereo coincident.
- **3U** Cardioid version of 3U £119.50 stereo coincident.
- **34U** As 34U with if filter £122 stereo coincident.
- **331U** Hyper-cardioid version £123 stereo coincident.
- **CMT5301U** V 1k £112 stereo coincident.
- **CMT42** O 1.5 mV £112 polar response sw.
- **CMT44** C 1k 1.5 mV £112 polar response sw.
- **CMT440** As CMT44 with if filter £114 polar response sw.
- **CMT441** Hyper-cardioid version £115 polar response sw.
- **35U** O/C 1k 1.92/3 mV £135 polar response sw.
- **36U** V 1k £153 polar response sw.
- **CM545** C O/C 1k 1.4/7 mV £128 polar response sw.
- **CM546** V 1k 1.0 mV £150 polar response sw.
- **CM5520U** C O 1k 1.3 mV £153 polar response sw.
- **CM5540U** Cardioid version of 35U £108 polar response sw.
- **CM560T** C O 1k 1.4 mV £155 polar response sw.
- **CM564T** C 1k 1.4 mV £156 polar response sw.
- **CM5640T** C C 1k 1.4 mV £156 polar response sw.
- **CM641T** HC 1k 1.4 mV £156 polar response sw.
- **MK2** O 600 1.2 mV £156 capsule.
- **MK3** C O 600 1.0 mV £156 capsule.
- **MK4** C C 600 1.2 mV £156 capsule.
- **MK40** C C 600 1.8 mV £156 capsule.

**SCHNEP**

AB Pearson Mikrofonlaboratorium, Knuutgatan 6, S265 00 Astorp, Sweden. Phone: 042-51520.

UK agents: Allofrope Ltd, 90 Wardour St, London W1V 3LE. Phone: 01-437 1892/3.

**VIRUS**

- **KM38** C O 200 1.0 mV/µB £91.72 Pressure unit.
- **KM44** C C 200 1.0 mV/µB £38.83 Pressure gradient.
- **KM58** C C 200 1.0 mV/µB £38.83 Roll off 12 dB i 50Hz.
- **KM68** C VS 200 .8 mV/µB £149.74 -10 dB after switch.
- **KM585** C VS 200 .8 mV/µB £149.73 -10 dB after switch.
- **UM7** C VS 200 .8 mV/µB £151.85 Rolloff 200 Hz.
- **U471et** C C 150 .8 mV/µB £140.78 -10 dB after switch.
- **SM69et** C VS 150 1.8 mV/µB £392.75 Tandem transducers for coincident.
- **KMA C S 800 £87.45 Studio Lavaliere.**

All the above are for use with phantom powering from 48V dc.

**PEARL**

AB Pearl Mikrofonlaboratorium, Knuutgatan 6, S265 00 Astorp, Sweden. Phone: 042-515 20.

UK agents: Allofrope Ltd, 90 Wardour St, London W1V 3LE. Phone: 01-437 1892/3.

**D4415** MC HC 200 -91 dB POA Windshield, anti-pop.
- **LD18** MC O 200 -74 dB POA Small size.
- **RD16** MC C 200 -70 dB POA High output.
- **RD24** MC C 200 -74 dB POA High performance.
- **HM45** MC O 200 -76 dB POA Studio Lavaliere.
- **CL3** EL O 200 POA Tie clip studio mic.

**34 STUDIO SOUND, JANUARY 1975**
Above: Peerread switches

Above: Philips LBB 9005/06

Left L to R: Ross RE 345 & RE 350

MK41  C  HC  600  1.3 mV  POA  Capsule.
MK5   C  O/C  600  1/1.2 mV  POA  polar response sw.
MK6   C  V   600  V  POA  various polar responses.

SENHEISER
Senheiser Electronic, 3002 Bissendorf/Hann, Germany.
Phone: 05130-8011.
UK agents: Hayden Laboratories Ltd, Hayden House, 17
Chesham Rd, Amersham, Bucks HP6 3AG. Phone:
0290-5311.

MD411U  MC  HC  200  –52 dBm  £69  Treble/bass switch.
MD421UH MC  C   200  –52 dBm  £40.50  Bass atten. switch.
MD431UH MC  C   200  –56 dBm  £39  Anti-boom.
MD21N  MC  O   200  –52 dBm  £29.80  Robust.
MD214U3 MC  O   200  –58 dBm  £50.35  Lavalier studio mic.
MD211U  MC  O   200  –56 dBm  £53.80  40-20 kHz ±2.5 dB.
MKE201 El  O   1.5k  –92 dBm  £32.05  5.6 V internal battery.
MKE401  El  SC  1.5k  –21 dBm  £31.40  5.6 V internal battery.
MKH110T RC SC  200  –32 dBm  £130  12V phantom.
MKH110R RC R   200  –26 dBm  £130  12V phantom.
MKH110L RC L   200  –26 dBm  £130  12V phantom.
MKH110R  RC O   2k  –32 dBm  £133  8V phantom power.
The MKH110 is intended for instrumentation in the range from 0.1 Hz to
20 kHz. As such, a three volt dc offset exists on the output.

SHURE
Shure Electronics Ltd, Eccleston Rd, Maidstone, Kent
ME15 6AU. Phone: 0622-59881.

SM58  MC C  150  –79.5 dB  £165  Boom mounting.
SM5C  MC C  50  –84 dB  £173.40  100 Hz Hi-pass.
SM7   MC C  150  –79.5 dB  £148.80  Boom mounting.
SM3   MC C  150  –81 dB  £99  Hum buck, anti-pop.
SM6   MC C  200  –76 dB  £159.99  Stand, extended bass.
SM57  Hand held SM56.  £48.80
SM58  MC C  200  –76 dB  £82.40  Shock proofed.
SM33  R  SC  150  –81 dB  £97.20  Stand.
SM51  MC O  Low  –82 dB  £46.20  Studio Lavalier.
SM69  MC O  Low  –81.5 dB  £31.80  Anti-pop.
SM76  MC C  150  –87.5 dB  £78  Extended response.
SM50  MC C  150  –78.5 dB  £59.40  Robust.

Most of the above are dual impedance.

Unidyne IV series
MC C  H/L .13 mV/µB  From about £39.
Unidyne III series
MC C  H/L .12 mV/µB  From about £34.
Unidyne II series
MC C  V  .12 mV/µB  From about £34.

Unisphere I
MC C  150 .14 mV/µB  From about £38 to £75.

Unisphere B series
315  R  B  H/L  £40.30
300  R  B  H/L  £36.60
579SB MC O  Low .1 mV/µB  £29.40
578  As 579SB

576  MC O  150 .94 mV/µB  Extended response.

SONY
Sony Showroom, 134 Regent St, London W1. Phone:
01-439 3874.

ECM22P El  C  250 1.5 mV  £59.95  600 ohm alternative.

STC
Hampstead High Fidelity, 91 Heath St, Hampstead,
London NW3. Phone: 01-435 6377.

4038  R  B  300  –85 dB  For levels to 125dB
4021  MC O  300  –80 dB  Studio and acoustic
4104  R  C  300  –80 dB  Noise cancel, lip
4115  R  C  300  –85 dB  Broadcast

TURNER
Millbank Electronics Group, Uckfield, Sussex TN22 1PS.
Phone: 0825-4166.

2203  MC O  150  –57 dB
2293  MC C  150  –57 dB

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The journalists have learned, according to one source, that between 250 and 300 freelance journalists—one third of the freelances who work for ORTF—and about 200 of the 1050 contract journalists will be made redundant. The journalists say that ORTF is not overstuffed, that the company has fewer journalists working for it than the BBC and the number is about the same as countries such as Italy, Poland and Yugoslavia. 'It has become very smart, very chic to say that we are overstuffed,' said one, 'but what people forget is that we have 23 provincial centres in France and only seven centres overseas, which account for about 400 journalists. We have about 150 working in external broadcasting. Another thing is that in France, cameramen are counted as journalists, but they are not in England. There are three channels as well as all the regional centres, which means more than 200 cameramen.'

The external broadcasting service will disappear entirely when the new régime begins on January 1. Journalists were not measured when, on October 24, the director general of the French commercial radio station Europe One, M Maurice Siegel, was sacked and strike leaders announced that their action would continue 'for as long as necessary' beginning on the following Tuesday.

The splitting of ORTF into separate competing sections was announced by Jacques Chirac, the French Prime Minister, as part of the new President M Giscard d'Estaing's clean sweep, six weeks after he came to office. There would be three television stations and three radio stations plus an audiovisual research institute. As we reported in September ORTF has lost £15.1 million in the last two years. A colour version of 'The Sleeping Beauty', for example, was shown in black and white after the budget for the production had been overspent by £85,000. D'Estaing had promised before the election that, if elected, he would give the problems of ORTF top priority. He was as good as his word. Indeed he acted so swiftly that opposition to the move was in disarray. This opposition includes the trade unions, the press and the left.

They have opposed the plan on the basis that the government wish to destroy the state monopoly and set up a third channel dependent on advertising which would, they say, 'be the death of French culture, not to say deprive the press of advertising'. When the bill to authorise the dismemberment of ORTF was introduced more than 100 amendments were tabled. Speaking in the debate M Chirac said the government wanted a free and democratic radio and television which were the property of no one, subject to no private interest, but at the service of the whole. 'We think that the state monopoly is the best guarantor of the independence of a public service, but it must not be a sort of comfortable protection against competition.'

Four state companies would be set up, he said, run by boards of six members. Two of the boards would be representatives of the state, one a member of parliament, and there would be one each from the press, the staff and the arts and literature. Three of these companies would each control one of the television channels and the fourth would be responsible for the radio. Each company would be responsible for its budget and programmes. A fifth company would 'administer the actual technical means of broadcasting' and a sixth would be responsible for 'heavy' cultural production, for which it would be financed from public funds, for supplying programmes to the three television and the radio channels in competition with commercial programme makers.

The bill was approved on July 25 by 290 votes to 183 after some heated exchanges when the left tried to block the bill, which was then sent to the senate for approval.

According to reports, workers in ORTF do not think the new system will be financially successful. As far as advertising revenue goes the old organisation was limited to 25 per cent of its revenue, the rest having to be made up by the licence.

It seems, however, that the ORTF had a great deal of difficulty in bringing the amount of advertising up to the 25 per cent limit.

The unrest should be seen against the background of a general feeling of insecurity in France, trade unionists being particularly well placed to face up to the government's economic policies as strong as some of its opponents may find it hard to identify with socialists who have deserted their political base in the wake of the government's dramatic economic policies.

Mr Len Young
THE DEATH HAS BEEN ANNOUNCED of Mr Len Young, the well known and respected chairman of Vitavox, at the age of 71.

Mr Young, who founded his company in 1931, was considered one of the great pioneers of the sound manufacturing industry; his avowed aim was always to produce the best sound equipment available. Since it was founded, his firm has gone from strength to strength and now exports to 34 countries.

Mr Young was a founder-member of the APAE.

Low cost level meter
PARTRIDGE ELECTRONICS, the sound mixing equipment company, have introduced a new level meter to their range of products. Described as 'a peak reading vu meter', this instrument operates as a vu meter with a faster than normal rise time. This unit, which uses a Bax-Simpson movement, produces a 0 dB reading with 0 dBm line level. Power requirements are 24V at 4 mA. This meter claims to fill the gap between the conventional vu and the expensive ppm system of metering. Price is £8.32 from Partridge Electronics Ltd, 21/25 Hart Road, Benfleet, Essex SS7 3PB. Phone: 03745-3256.

Compact broadcast console
NEVE HAVE ANNOUNCED a new 20 channel broadcast console arranged into four groups with two outputs. This desk, designated type 5301, was first shown at the London IBC and is claimed to be one of the most compact units of its type in the world. Taking up a mere 1.2m of space, the desk is available with a rack-mounted patch bay for use with db vehicles; the other model has integral patch bay and furniture surround for tv studios etc. Rupert Neve & Co Ltd, Cambridge House, Melbourne, Royston, Herts. Phone: 0763-60776.

Electronic music mag with a difference
A NEW ORGAN, under the editorship of Jacob Meyerowitz, intends to put music back into the expression 'electronic music'. To be called 'Analogue Sounds', his magazine...
The quarterly issues will comprise four distinct parts: method, procedure, medium and process. The first two parts concern themselves with the parameters of music, its theory and practice. The last two sections may be split up and bound to make four reference volumes. Published in the USA, the annual subscription (four issues) is $15.145 West 55th Street, Apt. 6F, New York, NY 10019, USA.

Three level sequencer

ELECTRONIC MUSIC LABORATORIES of Vernon, Connecticut have added a new three level by 16 step sequencer, the EML 490, to their range of synthesiser products. Of modular construction, this unit will enable functions such as vc envelope generators, vco, vca and vc filters with three programmed voltages for every note in a 16 note sequence. To create longer sequences, further memory boards (type EML416) may be added; alternatively, they can operate in parallel to provide more functions per step.

To create a stepped synthesiser within a synthesiser, an EML401 module may be added to the basic 490. It contains two vcos with phase lock facility, a vc filter, a vc envelope generator, a modulator and vca. A separate power supply is available. This sequencer would operate within the framework of an exciting range of products given the Electronic Music Laboratories Inc, P.O. Box H-4, Vernon, Connecticut 06066.

Radio Idi

CIC, A division of the Cetec Corporation of America, has recently announced the signing of a contract to supply broadcasting equipment to the Republic of Uganda. Valued at E175,000, the shopping basket includes broadcast studio mixers, disc consoles, tape recorders, etc.

Sparta Electronic Corporation, another subsidiary of Cetec, is to supply much of the equipment which will form the basis of the Ugandan external broadcast service controlled by General Idi Amin VC (self-awarded). Cetec Inc, 13035 Saticoy Street, North Hollywood, California, USA.

Phone: 213-875 1900. For the UK: Computer Equipment Company Ltd., Shaftesbury Street, High Wycombe, Bucks HP11 2NA. Phone: 0494-37529.

Bigger Theatre Projects Group

STAGEOUND LTD, the sound company founded by the late Bill Walton, has become part of the Theatre Projects Group. TPG say that the facilities of Stagesound are entirely complementary to their own interests, and it is hoped that the addition will provide a more efficient dubbing and editing service to the educational and industrial training sector. Theatre Projects Group, 10 Long Acre, London WC2 9LN. Phone: 01-230 5411.

Mixing with the knobs

SIFAM, TRADITIONAL PRODUCERS of meters to the electronics industry, have announced their entry into a new market with a range of collet fixing knobs. The company spent two years researching the range of knobs available in diameters of 11, 15, 21 and 29 mm. The series has been designed so that a smaller knob will fit within the fixing recess of the next size up enabling use as a concentric pair. Manufactured in several colours, most of the range is available ex stock. Sifam Ltd, Woodland Road, Torquay, Devon TQ2 7AY. Phone: 0803 63822.

I/r Hallam

RADIO HALLAM, the group awarded the franchise to operate the local radio service for the Sheffield and Rotherham area, started broadcasting on October 1. In common with the IBA charter, the investors in the new radio company represent a wide range of local interests including Sheffield Newspapers, Trident Television, several trade unions, employers such as Delta Enfield Cables and a host of other people. Of passing interest is the board of directors; the youngest member, managing director and station manager Bill MacDonald, is 46; the others, all local dignitaries, are very much more advanced in years. If a crime is committed in the Sheffield district, the miscreant stands a good chance of being brought before the board of Radio Hallam; three out of eight of the directors are magistrates.

This fact aside, Radio Hallam promises to be successful under Bill MacDonald's affable direction. The average age of the operating staff is about 28, rather less than that of the board of directors. The personality of the station embodies the form of Keith Skues, programme director, general factotum—and by his own definition—"dogsbody". Keith, who has an impressive track record from the halcyon days of pirate radio, is responsible for defining much of the station's attitude of late. Hallam, as well as presenting some of the programme output in person. In the latter task, he is helped by ex BFN, Lux, Bebo and Pinky & Peanut's Roger Moffat.

In common with other independent local radio stations, Hallam spreads its interests over a wide range. The programmes of radio stations, Hallam will be full of local events. According to Bill MacDonald, much local interest revolves around sport; there are six football clubs in the service area which may help to focus local interest on Radio Hallam by providing extended ob cover of the matches. To give a sense of community spirit to those people who don't like football, Bill intends to present local talent sporting programmes (please call Bill, not us). When the station is on air, the station transmits on medium wave and in vhf using circular polarisation; this type improves the standard of reception on fm portable radios that use a vertical rod aerial. The station transmits from Tipton Hill on 95.2 MHz, and from Skew Hill on 1546 kHz. When the station is switched to vhf, situated at Rotherham, the expected coverage of Radio Hallam will be about 660,000 people.

Counting pennies

SOME GOOD NEWS FOR USERS OF impulse counters; Kynmore, who manufacture a large range of impulse counters, have lowered their own prices by 25% for six months in their range. This has been brought about by rationalisation of the product line leading to cheaper production costs. Kynmore Engineering Co Ltd, 19 Buckingham Street, London WC2. Phone: 01-839 2371.

Costly Classic

A CASSETTE TAPE which promises "performances that are indistinguishable from disc or open reel" must be very expensive. The New Classic Cassette range from 3M is the cassette, which obtain their claimed performance by FeOx/CaO dual coating technology, cost £2.16 rpf for the C90 size. At the launching reception for the Classic range, 3M stated that they would ensure that their product went on to the retail market at the full recommended price. Recording Materials Division, 3M United Kingdom Ltd, 3M House, Wigmore Street, London W1A IET. Phone: 01-486 5522.

AES Convention

WITH AROUND FIVE months until the AES convention at the Court Hotel, London all the stands for the exhibition have been taken and nearly half the number of papers needed have been accepted. If successful this London convention in London will prove interesting from a number of points of view. The first is that the number of papers has been restricted so that more than two will be read at any one time. The second is that there has been a rejection rate of around 60 per cent of those submitted. The rejected papers were not, however, not sufficiently novel in content, or merely public descriptions of commercial ventures.

Some lectures will be an hour long and some half an hour, to allow a proper time for each paper according to the needs of each. This move towards an American AES, which has proved very conservative in its approach to this convention, as to others. But they were even more upset when the programme directors told them that all the papers would have to be presented with a preprint for distribution to delegates, that the preprints would be available in a single bound volume and, worst of all, that this volume would be presented to all delegates to the convention. It looks as if London's first convention may, after all, prove a dog's body.
on each of the fees would make a significant difference, he said, but he thought it better that the colour licence fee should be increased more. He quoted Denmark’s licence fee as £42.57 and Holland’s as £17, which he said was one of the lowest in Europe.

He said that the corporation had been making economies, ‘though you can fiddle around with minor economies the only way you can make major ones is by cutting programmes. The sort of thing we could develop is that it is too got to do to get into. You can make cuts in hours —that sort of thing’. That would be the situation if the fee were not increased.

He said that direct financing might be a great deal more trouble-some for a government but it would be a great deal more trouble for the BBC: ‘As long as you have a licence fee you preserve a degree of independence not so easy to preserve if you are financed directly. One way or another you are much more potentially subject to government intervention.’ He was in favour of index-linking of the licence fee to the cost of living.

His remarks were made off the cuff, and the BBC echo and a copy of them is not available. However, for a speech made to the Royal Television Society in Birmingham, copies were made available to the press. There was an expressed anxiety that the independence of the BBC might be eroded. Its independence rested on freedom from government control, which ensured that listeners trusted what you broadcast, and kept internal editorial freedom, avoiding an attachment to right or left or to any pressure group.

Speaking of accusations of bias he said that they were not equally balanced between right and left: ‘Instead, when there is a Conservative government the complaints are mainly of left wing bias, and when there is a Labour government of right wing bias.’

‘If we are as we try to be,’ he continued, ‘scrupulously impartial, it inevitably follows that we are likely to annoy the party in power more than the party in opposition . . . It has been suggested to me once or twice by civil servants . . . that the process of government has now become so difficult that the media in general and the BBC in particular while reporting impartially, should learn, if only slightly, towards Government . . . But I am clear that this is an impossible request.

The licence fee was a guarantee of the BBC’s independence, he said, although many objections were raised to it. He thought it was good value for money, and that politicians had talked themselves into thinking that rises in the licence fee were unpopular. ‘In times of high inflation it is likely to need raising rather frequently . . . the fee has in fact remained static for nearly four years and must be the only thing in Britain that has.’

Speaking of alternative means of financing he said there were many objections to pay-as-you-view, though he did not say what these were. Advertising too had objections, one of which there was not enough to go round. ‘Our war is quite simply that direct government finance would slowly, perhaps almost imperceptibly, but very surely erode our independence.’ One has to be a ‘very saintly payer of the piper not to wish to call the tune, and there are very few saints around. The plain fact is that government is responsible for what is done with government money.

A week later Sir Michael made a widely publicised lunchtime speech to BBC staff. He said that the responsibility for programmes must rest with the people who make them. Although the government were the custodians of the public interest in broadcasting they could not possibly see and evaluate all the 100,000 hours of programmes that the BBC put out nationally every year. ‘Who, I wonder, would indoctrinate the censors and would what do to the confidence and self respect of the programme makers? I shudder to think.’

The week of the first speech ended with a question about the future of broadcasting being asked on ‘Any Questions?’ but, mercifully and by the sheerest coincidence, Marghanita Lasky, who is on the Annan Committee, was on the panel to answer it. She exhorted listeners to write to the committee telling them what they thought on the subject. Lord Wintlesham has also said his piece on the independence of the BBC. This spontaneous burst of loyalty to the corporation may be not unconnected with the fact that the Annan committee takes its last evidence at the end of the year, only a few weeks away. More of the kind may be expected.

**News**

**New premises for expansion**

**HELIOS ELECTRONICS**, the mixing console manufacturers, have moved to larger premises situated at Brownells Lane, Feltham, Middlesex TW13 7ER. The new phone number is 01-890 0087/89. By way of welcome, Helios recently received an order for three broadcast consoles to be delivered to Mainos tv, part of the Finnish broadcasting network.

**Solid state 250W fm transmitter**

AVAILABLE IN TABLE TOP FORMAT, the DFM-250-SS fm power amplifier from Sintronic develops a claimed 250W from completely solid state circuitry. The unit is said to meet the relevant CCIR and FCC standards for broadcast transmitters when used with a low power exciter/drive. The manufacturers recommend their own DFM-10 unit for use with the amplifier. Intended for fm use only, amplifier operates under class C conditions at a constant power level and duty cycle. Broadcast/Communications Division, Singer Products Company Inc, One World Trade Center, Suite 2265, New York, NY 10048, USA.

**Windlesham**

LORD WINDLESHAM, 42, leader of the Conservative opposition in the House of Lords, has joined ATV as a full time joint managing director. The other joint managing director is Mr Bruce Gyngell, formerly deputy managing director of ATV Network Ltd, and now also deputy chairman of ATV.

Lord Windlesham, who joined ATV in November after announcing his decision following the Conservative defeat during the election, made a speech just after his appointment praising the BBC for having established an independent system of broadcasting in this country: ‘All broadcasters should be concerned about the principle of independence, and any new arrangements for financing the BBC should be made only after many weeks away. More of the kind may be expected.

Lord Windlesham joined Associated Rediffusion in 1957 where he was executive producer on documentaries. He was made a director in 1965. In 1967 he joined Grampian where he was managing director and controller of programmes until 1970, when he joined the Heath government as Minister of State at the Home Office. In 1972 he moved to the Northern Ireland office. He became leader of the Conservative peers in June 1973, having served on Westminster City Council from 1958 to 1962. He delivered a Granada Guildhall lecture in 1974 on politics and broadcasting.

**Low cost open headphones**

BEYER DYNAMIC HAVE recently introduced a low cost open headphone onto the British market. Although the phones look very flimsy (which also implies that they are very light), they are claimed to be very tough and capable of taking much abuse. A very brief listening test indicated that the sound quality was much higher than the £7.83 price tag would suggest. On the subject of microphone stands, Beyer said that they intended to import the Konig and Meyer range from West Germany, Beyer Dynamic (UK) Ltd, 1 Clair Road, Hayward's Heath, Sussex. Phone: 0444 51003.

**Direct drive turntable unit**

POWERED BY A 20 pole direct drive servomotor, the SRC77 turntable from Sansui is claimed to provide ‘state-of-the-art’ performance. The quoted short term speed stability is 0.035% with a rumble figure better than -60 dB. The tone arm is also new; it is fitted internally with the turntable and is said to do all the things that a good tone arm is supposed to do. Other
Independent Local Radio

TWO MORE INDEPENDENT local radio stations have taken to the air: Swansea Sound, who started regular broadcasting on September 30, and Radio City who likewise commenced on October 21. Swansea Sound (managing director Charles Brabham) fields a board of directors whose makeup is best described as obscure; this may well reflect the local nature and integrity of the station.

Radio City, which broadcasts to the Liverpool area, is made up of enterprising scousers such as Ken Dodd and Carla Lane under the managing directorship of Terence Smith, a well-known journalist.

US standard for amplifiers

AS A RESULT of a recent ruling by the US Federal Trade Commission, power output ratings claimed for amplifiers used in domestic and in-car entertainment products must now conform to a fixed format. The new regulation, effective November 4, requires the output rating to be given in rms watts per channel, both channels driven, together with the corresponding frequency response, load impedance and total harmonic distortion specified at that rating.

RAI

THE HEAD of Italian Radio and Television, Signor Ettore Bernabei, has resigned. The news that he would do so was leaked by the company he is to join, Italstat, a construction firm, only days before journalists, politicians, writers and civil rights campaigners were to march on RAI Headquarters on September 20. We understand from RAI's office in London that he would continue in office as general manager until the organisation's charter expires on November 30, 1974.

The London office of RAI would make no comment on the reasons for Bernabei's unpopularity and would make no statement on reports that he used autocratic and unorthodox methods, or that he used the state radio and television service as a source of political patronage and nepotism, or that he ran up huge deficits. He was said to have encouraged political control of the RAI's output, controlling news and documentary programmes so that social problems would be glossed over but politicians' activities would be covered in full. Little coverage would be given to political scandals, riots or the soaring cost of living.

The close of November marked the end of a troubled period for RAI. In July Italy's constitutional court ruled that RAI's monopoly of radio and television was illegal. The state had no right to ban cable television and private relay stations beaming foreign television services, but a state monopoly could be constitutional only if it guaranteed free, impartial and representative information. 'These are now lacking,' they said. The Italian government had banned cable television in 1973 and the decision contributed to the downfall of the coalition government led by the Christian Democrats under Signor Andreotti. In June this year the dismantling of private relay stations beaming programmes from Switzerland and Austria was ordered but Telebelsa, a Turin cable television company, appealed against the decision, and others followed suit.

During the recent campaign for a referendum on divorce the RAI service was accused of bias.

RIAA equaliser

DESIGNED FOR BROADCASTING, the Stereo Disc Amplifier from Surrey Electronics provides amplification, equalisation and filtering of signals from magnetic pickup cartridges. The unit is claimed to meet the full IBA specification for disc preamp equipment; the quoted noise figures are -58 dB referred to 0 mV input to produce an output level of 0 dBm. The 18 dB/octave filters cover 54 Hz and 10 kHz; the low pass circuit is switchable on the front panel for surface noise reduction. The unit is self powered from standard ac lines through an assembly mounted in a rigid diecast box. Signal lines connect via lockable DIN sockets.

Already in service with several UK stations, the Stereo Disc Amplifier is available ex-stock from Surrey Electronics, The Forge, Lucks Green, Cranleigh, Surrey GU6 7BG. Phone: 04866 5997.

Console for radio and TV

INTENDED MAINLY for TV broadcast use, the new 16 input Robbins/Fairchild mixing console claims to be suitable for radio applications. Construction is modular — ie op amps are used throughout—providing the possibility of further system expansion at a later date. Standard features of the model 1632 are two output channels for separate studio and control room monitoring, c/w muting relays, a headphone output from the control room monitor, a cue channel with built-in speaker, talkback facilities for two studios etc, wire-wound faders and illuminated push button switching. There is a range of pre- 

Cassette tape

CLAIMED TO POSSESS a performance equal to chromium dioxide formulations, the new ferric oxide X7600 cassette from EMI costs only 90p (C60). EMI state that the frequency response extends from 25 Hz to 15 kHz without giving the recording level at which this figure was obtained. EMI, Blyth Road, Hayes, Middlesex. Phone: 01-573 3858.

Tandberg instrumentation recorder

THE AGENCY DIVISION of Farnell Instruments has announced the availability of Tandberg's new four channel fm carrier tape recorder model TIR 116. This is lightweight portable recorder using 6.25 mm tape at speeds of 2.37, 9.5 and 38 cm/s. The tape carrier response is from dc to 5 kHz at the highest speed. A cft monitor displays the channel deviation of all four channels simultaneously; in addition, one channel may be used for vocal comments. Farnell Instruments Ltd, Sandbeck Way, Wetherby, Yorkshire LS22 4DH. Phone: 0937-3541/6.

PCB mounting frames

SPECIAL INTEREST to manufacturers of modular pcb systems, the Scanbe mounting assemblies offer a complete card stacking file for standard or wire wrap cards. Standard card guides are 15 cm long, arranged in 43 cm rows at 1.2 cm spacings holding up to 34 cards per file. Sold as a complete unit, connector mounting bars, end plates and full assembly instructions are included. Tekdata (Trading) Ltd, 18a Canal Lane, Tunstall, Stoke on Trent, Staffs ST6 4PA. Phone: 0732-811711.

Indian horns

VITAVOX, WELL KNOWN manufacturers of cinema sound equipment, has received an order for 300 S3 pressure units to be delivered to a major Indian sound reinforcement company. This is the largest Indian order ever received by Vitavox; the company claims that this represents a major breakthrough for loudspeaker marketing in India. Vitavox Ltd, Westmoreland Road, London NW9 9RJ. Phone: 01-204 4234.

Dekko

DEKKO FILMS and Dekko Sound services of Boston, Mass, have moved to New Studio designed by the acoustical engineering firm of Bolt, Beranek and Newman situated at 295 Huntington Ave. In the finest traditions of our colonial cousins, the new studio is described as ‘floating, soundproof, acoustically correct and perfectly isolated’. Dekko equipped the studio with a Magnatech sound system offering full editing facilities, and with audio visual dubbing equipment capable of working directly with magnetic film soundtracks. Small run cassette duplication is also offered. Dekko Films Inc, 295 Huntington Ave, Boston, MA. 02115. USA. Phone: 617-536 6160.

New QS decoder

USING CUSTOM IC chips, the QS 100 VARIATION decoder from Sansui is said to offer a similar standard of performance to the professional QS 4 model at a much reduced cost. The new decoder claims a wide dynamic range, a high degree of inter-channel cessing modules (compressors, equalisers etc) available for use with the desk. The basic unit costs $9,995. Robins/Fairchild, 75 Austin Blvd, Commack, Long Island, NY 11725 USA. Phone: 516-543 5200.
**NEWS**

separation and a creditable 0.05% distortion. In addition, the unit provides 'hall' and 'surround' synthesised effects.

Heart of the unit is a series of integrated circuits developed for Sansui by the Hitachi Corporation. The first of the series (HA1327) constitutes the phase discriminator; the second (HA1328) is the matrix with the third (HD3103P) being an fet array providing control. At the present, the chips are available in sample quantities to original equipment manufacturers from the following Hitachi offices: Hitachi America Ltd, Chicago Office, 111 East Wacker Drive, Chicago, Illinois 60601, USA. Phone: 312-644 6565. Europe: Hitachi Ltd, 4 Dusseldorf, Immermann Strasse 15, West Germany. Phone: 0211-251185.

Chipping Norton Studios

**STEPping out** or the railway carriage at Kingham station, the first sounds heard emanated from chicken pecking about on the platform; the rural ride to the village of Chipping Norton, deep in the heart of Oxfordshire, was nearly over. A four mile taxi ride in a mud splattered motorcar completed the journey. One glance at the exterior of Chipping Norton Studios indicates that the building was once the village school complete with bell to exhort its pupils to lessons.

The iconoclasts that built the studio from the former seat of parochial learning are Mike and Richard Vernon, record producer and finance man respectively. Mike, who created one of the first progressive record companies in the 'Blue Horizon' record label, doesn't take part in the day to day running of the studio; although he produces most of his records at Chipping Norton, he leaves it to Dave Grinstead et al to keep the tape spools turning. Dave, who started his chosen career as a tape operator with Decca, looks after the technical aspects of studio life, sharing the session balancing work with Barry Hammond.

Chipping Norton Studio is 16 track; the MCI recorder is fed from a 18 input Trident 'B' series desk which, according to Dave, will soon be changed for a quad-wired 24 input 'A' series console. A pair of Quad powered JBLs provide monitoring in the compact control room which appears to give very acceptable acoustic properties with regard to unwanted resonances etc. The rectangular studio has length to breadth ratio about two to one, slightly unusual but entirely satisfactory from an operating point of view.

The longest wall runs parallel to the control room having a large window let into the same wall to enable a wide view of the floor. When asked about traffic noise from lorries grinding up the steep hill outside the building, Dave Grinstead pointed out that they don't make schools like this one anymore. Indeed, the walls are reminiscent of a medieval keep in their thickness; mineral fibre blocks exclude any residual noise; walls and ceiling are lined with this dense, fireproof material. As expected, the floor is of solid concrete construction. At one end of the room resides a Yamaha grand piano, at the other a large drum booth with the greater part of a spare drum kit stowed on the roof.

Mastering arrangements are handled by two Scully quarter-inch tape machines; the MCI multi-track master operates from the control desk through 16 Dolby A361 noise reduction units leaving an extra four in reserve for mastering. Other control room fixtures include an AKG floor standing reverb unit, an EMT stereo echo plate and Universal Audio compressor/limiters. The layout of the control console seems well thought out with the most frequently used controls within easy reach of the operator, this was borne out by watching the techniques during a recording session. Richard Vernon's young offspring present in the control room at this time, proved that the acoustic isolation between this room and the studio left nothing to be desired.

One of the best and most imaginative features in this rustic setting is the relaxation and accommodation facilities afforded to visiting clients. The upstairs classrooms have been converted into a self-contained flat of spacious proportions. The studio provides a communal lounge and cooking areas together with separate bedrooms housing up to 14 bodies in very comfortable surroundings. Dave Grinstead, appropriately, lives in the erstwhile headmaster's house next door to the studio. The village of Chipping Norton offers all the benefits of rural life; this includes a first rate public house serving genuine bitter straight from the wood. The village seems the perfect backdrop to a very happy recording studio.

**Portable Dolby**

DESIGNED FOR USE with the Nagra IV, the DNR series of portable noise reduction units from Future Film Developments can be adapted to operate with other machines. The Dolby processor is based on 'A' type noise reduction modules cat. no. 22 which are activated...
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THE FOLLOWING list of Complete Specifications Accepted is quoted from the weekly Official Journal (Patents). Copies of specifications may be purchased (50p) from the Patent Office, Orpington, Kent BR5 3RD.

October 2
1374179 Sony Corporation.
Magnetic tape recording and/or reproducing apparatus.
1374224 Eastman Kodak Co.
Cartridges for strip material.
1374234 Olympus Optical Co Ltd.
Electrical attachment devices.
1374293 Sony Corporation.
Video signal reproducing systems.
1374309 Pioneer Electronic Corporation.
Protective circuit.
1374456 Hitachi Ltd.
Post deflection focusing type colour cathode ray tube.
1374502 RCA Corporation.
Method of radio frequency sputter etching.
1374521 Crosfield Electronics Ltd.
Image reproducing methods and apparatus.
1374539 Nippon Gakki Seiko KK.
Tone-source device.
1374540 Philips Electronic & Associated Industries Ltd.
Automatic gain control.
1374560 Tokyo Keiki, KK.
Slot array antenna with flare.
1374567 Telefonaktiебolaget L. M. Ericsson.
Double reflector antenna arrangement.
1374571 Riacho, KK.
Testing of recording and reproducing equipment.
1374580 Smiths Industries Ltd.
Electrically-operated display devices.
1374624 Agence Nationale De Valorisation de la Recherche.
Electrical filters enabling independent control of resonant or transition frequency and of band-pass especially for speech synthesisers.
1374674 Sony Corporation.
White balance control system.
1374731 Pioneer Electronic Corporation.
Tape player.
1374735 ITT Creed Ltd.
Telegraph transmission apparatus.
1374741 Saint-Gobain Industries.
Window pane having a radio antenna.
1374974 Agfa-Gevaert.
Device for recording images.

October 9
1375060 Coulter Electronics Ltd.
System for displaying a data distribution curve on a 100% scale irrespective of the quantity of data sampled.
1375176 Defense, Secretary of State for, Semiconductor devices.
1375223 Rockwell International Corporation.
System for composition of symbols.
1375240 Eastman Kodak Co.
Motion picture cartridges.
1375353 Nippon Gakki Seiko KK.
Musical instruments.
1375388 General Electric Co.
Projection systems.
1375526 Felten & Guilleaume Kablewerke AG.
Capacitor equalising box for balanced low-frequency communication cables.
1375604 Decca Ltd.
Correction of instability in film projection.
1375618 Burroughs Corporation.
Line generator for CRT display system.
1375638 Western Electric Co Inc.
Electromagnetic wave frequency conversion devices.
1375645 Rank Organisation Ltd.
Television picture correction.
1375664 International Business Machines Corporation.
Transversal filter equaliser.
1375680 International Standard Electric Corporation.
Antenna array arrangements.
1375782 Sansui Electric Co Ltd.
Signal transmission system.

October 16
1375906 Sumitomo Electric Industries Ltd.
Radomes.
1375919 Viennatone Horgerate Produktionsfirm.
Telephones.
1375925 Bosch Fernsehanlagen GMBH.
Television apparatus.
1376006 Akion Industries Inc.
Magnetic disc-type recording mechanisms.
1376046 Siemens AG.
Radio receiving antenna systems.
1376059 Philips Electronic & Associated Industries Ltd.
Amplifier circuit.
1376072 Knight, B. E.
Instruments of the guitar family.
1376083 Hofmann, U.
Circuit arrangement for recording binary signals on magnetisable storage media.
1376093 Matsushita Electric Industrial Co Ltd.
Sampling modulation system for an electronic musical instrument.
1376100 International Business Machines Corporation.
Magnetic recording heads.
1376125 Southern Communications Ltd.
Tape recording and/or replaying apparatus.
1376128 Plessey Co Ltd.
Systems for monitoring mains electrical power supplies.
1376158 Hitachi Ltd.
Pattern generating device and method of recording a generated pattern.
1376189 Xerox Corporation.
Mask for facsimile scanning apparatus.
1376220 Matsushita Electric Industrial Co Ltd.
Cathode ray tube having index strip electrode.
1376260 Omron Tatsushi Electronics Co.
Magnetic memory unit.
1376296 RCA Corporation.
Secam decoder.
1376335 Agence Nationale De Valorisation De La Recherche.
Electrostatic transducers for converting electrical signals into ultrasonic signals and vice versa.
1376357 Thomson-CSF.
Method of telecommunication via satellite and systems using this method.
1376371 Eastman Kodak Co.
Apparatus for directing strip material from a roll.
1376414 Standard Telephones & Cables Ltd.
Electro acoustic-transducers.
1376433 Absalom, R. R.
Electric sound-producing device.
1376441 Kodak Ltd.
Thermographic film.
1376455 Brown, S. G., Communications Ltd.
Telecommunications headsets.
1376465 Matsushita Electric Industrial Co Ltd.
Colour image pick-up system using strip filter.
1376517 Price, E. E.
Electro-optical display system.
1376548 Bosch Fernsehanlagen GmbH.
Voltage reduction circuit.

October 23
1376611 Tricoire, J.
Thermographic sheet.
1376616 Seneca Plastics Ltd.
Optical display system.
1376651 Mullard Ltd.
Device for generating sound waves.
1376652 International Computers Ltd.
Magnetic transducers and to methods of manufacture thereof.
1376670 Luxor Industrie AB.
Driving mechanism for the turntable of record players.
1376707 Matsushita Electric Industrial Co Ltd.
Record apparatus.
1376757 General Electric Co.
Stereophonic decoder circuit arrangements.
1376799 Philips Electronic & Associated Industries Ltd.
Image display cell.
1376832 Philips Electronic & Associated Industries Ltd.
Electro-acoustic transducer.
1376907 Western Electric Co Inc.
Single tube colour cameras.
1376954 Philips Electronic & Associated Industries Ltd.
Line amplifier.
1376984 International Computers Ltd.
Magnetic circuits.
1377021 Philips Electronic & Associated Industries Ltd.
Signal receiver for receiving signals of different frequency.
AKG have a new electronic Time Delay Unit TDU 7202. These units will be demonstrated throughout the country, early 1975. Ring AKG for details and in the meantime a booklet is available on request.

We don't know too much about all this gear really, but, we do give you all the literature at Exhibitions and we are such a success ………. I wonder why? See you at the AKG stand; AES Convention, APRAE Exhibition, and APRES Exhibition.

*Because they are wise and sweet and have such such big ears. Peter Eardley.

Their versatile C451 is a winner and ever so popular on Television.

AKG now have a range of ELECTRET Microphones including the NEW CE.10 miniature Lavalier.

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AKG now have a range of ELECTRET Microphones including the NEW CE.10 miniature Lavalier.
Video recording of still pictures

This invention takes the form of a normal TV set with conventional circuitry, display tube and controls; but a secondary, slave tube, with a fibre optics face plate is also used, the inner surface of the face plate being coated with a phosphor. This slave tube is housed out of sight within the set but is under the influence of all the normal set controls. Thus the picture on the slave tube should match the picture on the main display tube.

As shown in Fig. 2, the slave tube 25 directs an electron beam on to the inner surface of face plate 26 and a recording medium 21 (such as film) is pressed by pressure pad 46 against the plate 26. Thus the film is exposed to radiation emitted from the video image to record a desired single frame. The film 21 is fed to the slave tube for exposure from a store roll 31, and after exposure is passed through a processor 36. The film with the processed image is turned through 90° at 44 and fed out through a letter-box slot in the front of the set. Synchronisation between the feed rate of the film 21 and the sweep rate of the flying spot on the face plate 26 is unnecessary because the film is fixed by the pressure pad during the recording operation. Fig. 1 shows the set as seen by an operator, with the main display tube at 13 and the developed film 21 emerging from the slot 19.

FIG. 2

FIG. 1

STUDIO SOUND, JANUARY 1975

1377033 Polaroid Corporation. Apparatus for processing electrical pulses in TDM systems.
1377089 Matsushita Electric Industrial Co Ltd. Stereophonic reproducing system.
1377138 Matsushita Electric Industrial Co Ltd. Four channel arrangements.
1377178 Hanlon, T. F. Apparatus for reproducing a colour image from colour image information coded on black and white film.
1377227 Standard Telephones & Cables Ltd. Telephone headset.
1377262 Sperry Rand Corporation. Communication systems.
1377334 Bendix Corporation. Communication system with at least one repeater station using the same carrier frequency.
1377351 Victor Co of Japan Ltd. Miniature tape cartridges.
1377374 Pessey Co Ltd. Apparatus for reproducing electrical pulses in TDM systems.
1377378 Pioneer Electronic Corporation. Record-changer spindle.
1377426 Messerschmitt Bolkow Blohm GmbH. Method of and apparatus for photographing a subject by line scanning.
1377447 RCA Corporation. Apparatus for replicating magnetic recordings.
1377531 Varian Associates. Network for pulling a microwave generator to the frequency of its resonant load.
1377543 Sony Corporation. Decoding systems for colour television receivers.
1377583 British Aircraft Corporation Ltd. Communication systems.
1377670 Compagnie Honeywell Bull. Disc memory units.
1377684 Telecommunications Radioelectriques Et Telephoniques. Data-transmission filter.
1377770 Sato, S. Apparatus for visual projection and sound reproduction.
1377792 International Computers Ltd. Cathodochromic information display.
1377796 Singer Co. Synchronised film transport electronics for telecine systems.
1377814 Bachmann, M. E. Transcription control for cassette tape player or the like.
1377859 Telemat Inc. Colour television encoder modulator.
1377870 Matsushita Electric Industrial Co Ltd. Rotary head type magnetic recording and reproducing apparatus.
1377884 Ricoh, KK. Magnetic recording and reproducing arrangements.
1378035 Siemens AG and Telefonbau und Normalzeit GmbH. Transmission of asynchronous information in a synchronous serial time division multiplex.
1378036 Peak Technologies Ltd. Microwave radiation monitor.
1378114 Nippon Electric Co Ltd. Antenna system.
Quadraphonic loudspeakers

SO FAR EMI Ltd have been issuing quadraphonic records made in the CBS SQ system, and there has been no sign of any independent EMI activity on the surround sound front. BP1,348,643 from EMI still doesn’t show whether the company have any home-grown matrix system up their sleeve, but disclosures their interest in a quite new approach to providing sum and difference pseudo-quadraphonic surround sound.

An ordinary stereo amplifier is used to reproduce two-channel recordings. As is now well known, conventional stereo recordings, and matrix recordings in particular, contain additional information which is there for the taking. Such additional information is usually extracted by phase shift or resistance networks at the amplifier, but the EMI proposal is that the loudspeakers themselves be used to decode the information. This they achieve by providing each loudspeaker with two drive coils each operating on the same diaphragm but having different numbers of turns.

In fig. 1 the left-hand channel output terminals 15, 16 feed series connected coils 10, 6, 12 and 8 of loudspeakers three, one, four and two (arranged as shown in fig. 1) and the right-hand channel output terminals 13, 14 feed series connected coils 9, 5, 11 and 7 of the same loudspeakers. The two coils of each speaker are wound in different senses and/or have different numbers of turns. Thus, the front right loudspeaker one has its coils 5 and 6 acting on the diaphragm in additive sense, as do coils 11 and 12 of front left loudspeaker four. Rear right loudspeaker two has coil 8 in subtractive sense with respect to its coil 7 and rear left loudspeaker three has coil 9 in subtractive sense with respect to coil 10.

EMI suggest that the output signal voltage from the right channel should be distributed between coils 5 and 9 in the proportions .707 and .293 and in similar proportion between the coils 7 and 11. Likewise the output from the left channel is distributed between coils 10 and 6 and between coils 12 and 8, also in the proportions of .707 and .293. These proportions are best attained by using coil turns in the ratio 2.4 to 1. This arrangement means that the signals applied to the loudspeakers are as follows:

Loudspeaker one (right front) .707R+.293L —R+.41L
Loudspeaker two (right rear) .707R—.293L —R—.41L
Loudspeaker three (left rear) .707L—.293L —L—.41R
Loudspeaker four (left front) .707L+.293L —L+.41R

Although the signal addition and subtraction is usually achieved by winding the coils in different turns in different directions, the same effect can of course be achieved by winding the coils in similar directions and connecting them in opposite senses.

Aquatic loudspeakers

THE RANK Organisation in BP1,348,535 proposes some extremely interesting ideas on loudspeaker cabinet damping. As is well known, a light cabinet suffers from panel resonances which may colour the loudspeaker tone; brick or concrete cabinets are free from such resonance but are often impractical. The Rank patent claims that loudspeaker cabinets of which the walls are formed from liquid-filled containers offer the best of both worlds.

A loudspeaker cabinet is built as a skeleton frame rather like a fish tank without glass. The side, rear, top and bottom panels are all liquid-filled double-walled containers which can be slotted into the skeleton. While the panels are empty the cabinet is relatively light and portable. When the panels are filled it is very heavy. The filling liquid can be water (with anti-freeze to prevent rupture in the winter) or any other liquid that proves suitable.

It is maintained that liquid-filled panels have a very high sound-damping factor and thus in many ways behave acoustically as concrete or brick structures. The presence of water inside a loudspeaker cabinet also provides a convenient on-the-spot means of cooling the voice coil jacket. In fig. 1 loudspeaker two is connected by conduits 6 to a water-filled rear wall 3 of the cabinet 1.

All this prompts me to wonder what results would be obtained from an infinite baffle-type loudspeaker virtually filled with liquid as an acoustically damping medium (with of course some insulation to protect the diaphragm and speech coil).

Adrian Hope

AGONY COLUMN

The American record producer would insist on having his little joke at the expense of his protégés. Of note was one occasion where he persuaded a well-known Anglo-Saxon drummer that his Yank counterparts got ‘a nice bass drum sound’ by overdubbing a separate track of the bass drum played by kneeling down and hitting it with boxing-gloved hands. Dutifully, at the next session the enlightened drummer turned up sporting a pair of boxing gloves. Polite laughter was heard in the control room as he spent the next three takes grovelling on the floor smashing the bass drum before realising that he had been had.

A well-known fuhrer of studios and record companies is alleged to exhibit legendary meanness towards his underlings. It is also said that he seems to be badly informed about matters musical and electronic. Driven to desperate measures, an impoverished engineer offered the latter-day Scrooge a tape recorder for sale that was his only worldly possession, saying that the purchase of the instrument would do wonders for the fuhrer’s turnover. Of course, the machine went back home with the enginee without moment that the cheque was received. In due course, the engineer became impecunious once more. This time, our friend went to the great man and suggested that if he had two machines, the studio could do great things in stereo... ‘another’ machine was purchased.

The session was going quite well, despite the big line up. There was a fairly aimable atmosphere anyway, but the bar helped, and lunchtime had taken its toll. Due to the arrangement of the studio, the percussionist was forced to play his gong over his shoulder, so that he could watch the conductor’s waving and hit it at the appropriate moment. Unfortunately, he missed the conductor’s relatively subtle indications to play more quietly, and didn’t look like responding in the immediate future, so the fixer crept discreetly round behind him to tell him. In the meantime, the musician had swayed rather more than was good for his playing; consequently, when the next stroke was played, it was just as lousy as before except that it was the fixer’s face that made the sound.
Going solo: There must be a strong motivation for a man to forsake the comforts of PAYE, pension contributions, sick pay, entitlement to Unemployment Benefit, paid holidays and all the little luxuries a good employer should provide, to go on his tod as an independent contractor. But there is a growing trend for recording engineers to do just that, to go 'freelance'. What personal advantages can there be in adopting such a course? It is said that to be self-employed can offer a modicum of relief from the burden of income tax. Accurate claims can be made for items of expenditure which would not be allowed to someone in regular employment. An eminent record producer was quoted that his friendly local Tax Inspector passed a claim for the cost of exotic deodorants made on the grounds of essential use in the hot, stuffy atmosphere of control rooms. Be that as it may, it doesn't seem really credible that intelligent, sober, level-headed fellows like recording engineers would jack in good jobs for the sake of a bottle of tax-deductible after-shave. Surely there must be something more to it than that. After all, 'Tax advantage' thing is a bit insubstantial. Admittedly it can be proved that, by not having to pay tax on the earnings of Year 1 until some time in Year 2, or later if the pace of the exchange of query letters can be kept up, then the balance banked until some time may be subject to tax but at a still more remote time. There are those who make a hobby of that sort of thing and jolly good luck to them, but unless one is earning a enormous amount of money it hardly seems worth all the bother. Recording engineers do not, on the whole, earn enormous amounts of money. If they really are in full command of all the skills they should have, then their contribution to a successful recording is often grossly under-priced. Can that be the reason for engineers going free-lance? Whatever the reason, it is an interesting trend of some significance when taken in context with a parallel development in the success of the ACIT's recent recruiting drive among recording studio staff, until now traditionally non-Union. When a gap appears between management and worker, the Union is always there to fill it with, perhaps, some of the workers who have gone free-lance.

Stand and speakers: Very good to hear in all the gloom depressing the audio market that Tannoy and Keith Monks Audio have come back from the Tokyo Trade Fair clutching some really juicy orders won against heavy competition. If the goods/quality/time/price ratio is right and a high level of customer service is offered, then business can still be done by those making the effort.

Revelation: Remember the shock sensation story of the bugging of Transport House around last election time? There was this man bristling with 'aerials' parked in Smith Square, see, and this guy, nosier than most, creeps up to the back and presses his face against the window to eavesdrop another guy, inside the van, crouched over some apparatus and warning a pair of cans. Inside guy spots nosey outside, appears to panic, and the van takes off in a cloud of dust and old manifestos. Instant reaction was, should we limit the speed of an Olympic hurdler—guys with the cans has been listening in on secret's phone calls subtly coded like 'Keep it warm, luv. I shall be home late' with is that you, Smith? What are the odds? To be relayed to SMERSH? Nonsense, nothing of the kind. The simple truth is that the guys in the van had been doing a bit of crafty pirate-ing on a recording being made at St. John's, Smith Square, and thought the face at the window to be an honest, hard working studio should get itself involved with.

What are the wild waves saying?: Brother in the air again! The frequencies are getting crowded. And now, horror of horrors, listeners in Tirana are being denied Tony Blackburn's jokes (they should be so lucky!) because BBC Radio One is on 247 metres which is precisely the same wavelength as Albania's capital city. 1948 saw the last handout of wavelengths with the UK and France getting the best choice. Germany was left with that new VHF system rather on a 'let 'em have it, it won't last' philosophy. Since then radio has grown both in number of stations and in radiated power. A number of 'emergent' nations use radio for propaganda (so what's new?) and if they find a station already on their self-chosen wavelength causing interference, then the policy seems to be to push up the power by a few Kws. If everyone would be content with VHF and with AM at reasonable power which didn't annoy the neighbours all would be well, but when national prestige is at stake, patient reasonableness becomes a scarce commodity. Attempts to sort out the confusion are being made by the members of the European Broadcasting Area meeting in Geneva. One fairly certain outcome seems to be that the UK have will have to surrender some medium wave AM channels. Trouble is that our VHF channels are already rather crowded with public services, like the police, ambulance, fire, refuse collectors, and all sort of unidentifiable people. Never mind, the changeover, if and when it comes, could give a much-needed boost to VHF radio sales.

Wearing heads: A studio buys a new tape machine. The purchase price is entered in the books under capital expenditure and the sum is depreciated over a certain period. That is until, at the end of the last financial year, the book value of the machine is nil. A new machine is purchased with the money that has been allowed for by the process of depreciation thus the end of year. That is the theory but the practice is complicated by the increase in price of the replacement machine over the original depreciation period. Thus, the original machine was bought for £x and the new one will cost £y. At the same time the money itself has depreciated at an annual rate currently standing at more than 17 per cent. So many financial men are strongly advocating the general adoption of "inflation accounting" and have their most persuasive argument. This is where things are apt to get a mite complicated and should be discussed with a good accountant. But a point arose the other day in discussion with a very good accountant indeed, which linked round the importance of a client giving his professional advisers complete and precise instructions. A tape machine can be treated as a homogeneous unit for accounting purposes, depreciated as a unit and finally written off as a unit. This presupposes that all parts of the unit wear out at the same rate but they don't. Replacements of the odd component during the lifetime of the unit is unnecessary because it can be allowed for in the maintenance budget. But suppose some part of the unit has to be renewed which will cost as much as 50 per cent, not of the current book value of the unit but of the whole replacement cost of the unit. What then? The part in question was a multi-track headblock costing a tidy sum particularly to a studio already hard pressed for cash, and no separate provision had been made for such expenditure. The accountant didn't know that headblocks wear out more quickly than tape machines and why should he if no one had thought to tell him. So the problem arose of having to find some hundreds of pounds in a hurry and unexpected because the performance of the headblock in question had not even been properly logged. It only goes to show what can happen in studios where the management hasn't got it together.

Footnote: If recording engineers do go freelance in any numbers then, presumably, studios would treat them as casual labour, employ them on an ad hoc basis and be able to cut overheads to the bone in consequence.
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NEUMANN U87i CAPACITOR MICROPHONE

By Angus McKenzie and Tony Faulkner

MANUFACTURERS’ SPECIFICATION

Acoustic operation: pressure gradient transducer
Output into 1 kΩ: omni, 0.8 mV/µbar; cardioid, 0.5 mV/µbar; figure-of-eight, 1 mV/µbar.

Recommended load: 1 kΩ or greater (250 Ω or greater).

Nominal impedance: 200Ω (50Ω).

Capacitor capacitance: 2 x approx 53 pF.

Self-noise: approx 26 dB to DIN 45 406.

Sound pressure to 0.5% harmonic distortion at 40 Hz, 1 kHz and 5 kHz: without pad greater than 200 µbar→120 dB; with pad greater than 600 µbar=130 dB.

Phantom power requirement: 44V to 54V.

Current: 400 µA.

Price: £150

Manufacturers: Georg Neumann & Co, 71 Heilbron/Neckar Fleinerstr 29, Postfach 2120, Germany.

UK distributors: FWO Bauch, 49 Theobald Street, Boreham Wood, Herts.

The Neumann U87 is very well established in many of the London studios, as well as around the world. It was described as 'the most reliable mic we have come across' by one studio we telephoned to compare notes before completing this survey.

The microphone is the largest of those under test (200 mm long and 56 mm in diameter) and also the heaviest (over 400g). Although this makes life difficult for light-fingered visitors to the studio, it also provides a potential source of inconvenience with boom-stands on full-reach (particularly the smaller variety).

The U87i is the fet version of the U87 (which is still widely used) and has switching for figure-of-eight, cardioid and omni-directional polar patterns — no hypercardioid (cottage-loaf). The mic can be internally powered with two batteries, which could be of great convenience, and a battery state meter is incorporated in the body. The batteries are automatically switched on as soon as the U87 stand-adapter/ head cable is connected, by means of a micro-switch depressed by the connecting plug which

recording the same material with the three microphones as close as possible to each other on to separate tracks of a 38 cm/s Dolby A tape. Subsequently we listened back to the tapes on our Spendor BC3 monitor loudspeakers, switching from one microphone to another — without any of us knowing which mic was which, and noting various remarks. Some of the results came as something of a surprise, since on more than one occasion we all preferred microphones which previous opinions might have ruled out of court.

The choice of which microphone to use for which material is, we feel, too often left to preconceived ideas and we hope our comments in this comparison will at least provide scope for experimentation by adventurous engineers. All of the microphones offer more or less the same facilities, and are in the same price bracket as each other — indeed all are very fine microphones well worthy of their reputations.

AM/TF

bought and simply use any normal XLR to XLR microphone connecting cable. A wind-screen is available at a modest price (WS7) which is a sponge sleeve and seemed to function quite adequately with fairly close speech, although it may not be completely satisfactory for the uncommon application of outdoor recording.

Apparently the U87 circuit has recently been modified to improve overload margins — but inspection of the current circuit indicated no current feedback around the single fet since the source was decoupled by means of a 20 pF capacitor to earth, which might contribute to intermodulation distortion.

The circuit design incorporates a -10 dB switch for sensitivity, which is effected by means of a 560 pF capacitor connected in parallel with the microphone capsule itself; this reduces the input to the gate of the fet. There is also a bass roll-off switch on the body of the microphone which cuts the response at 100 Hz by four to five db and at 50 Hz by around eight dB according to the published specification. As mentioned earlier, the basic
the U87 is down in top in both cardioid and omni functions, and this could prove disappointing if relying on the corss-patch for the main balance of, say, an orchestra—where the centre of the stereo image would lack treble definition.

As far as applications are concerned, the U87 seems well suited to most applications, particularly percussion and brass. We were not all that happy with the strings, where the quality seemed somewhat hard and brittle. In general we preferred other microphones for strings, such as the Neumann KM64 or AKG C414, but this is very much a matter of taste—with particular reference to one's choice of monitor loudspeaker. There seemed to be something of a 'nasal' presence boost, which might sometimes be desirable, particularly with some makes of monitor speaker—but we did not altogether like it.

The quality on brass was most vivid, and very clear without being clinical. There was again something of a nasal colouration, but in this case it flattened the sound to advantage. We would put this down to a combination of the resonant frequency of the large capsule, and to the shape of the mic case. Our reservations regarding the string quality can be extended to the use of the Neumann U87 for harpsichord and piano recordings, where we would again prefer one or two other microphone types, unless one likes a nasal quality for some specific reason of production. The coloration seemed by no means easy to equalize out; it was much easier to make another mic sound like the U87 than it was to make the Neumann sound acceptably different.

On voice, the U87 showed very high clarity—sibilants were exaggerated a little, but the overall quality was very good. Although the sound from the mic did not sound as faithful to speech as some other makes, the effect of enhanced clarity and presence could be of some advantage. Extending the idea of using the U87 for voice, we used the mic for a recording session in a church in Surrey where we were recording a small madrigal group. The U87 again showed very good clarity, but this time the coloration, which aided intelligibility in speech, did not enhance the vocal quality of the choir and gave it rather a hard tone.

All in all, we are impressed by the microphone, whose performance in our studio makes it clear why it is so widely employed in recording studios. However its characteristic sound does not flatter everything it meets. On speech, percussion and brass it can be recommended to most potential users—but for strings, choirs, piano etc, we found it rather 'hard' and as such not universally applicable. The microphone was most reliable and robust all the time we had it in our recording set-up, and remarks from other London studios would do much to confirm the U87's reputation as a consistent, sturdy microphone which always works. Obviously there are sometimes minor problems as well as other mics, but the usual problems of rf breakthrough and noise-chattering seemed totally lacking.

AKG C414 CAPACITOR MICROPHONE
By Angus McKenzie and Tony Faulkner

MANUFACTURERS' SPECIFICATION

Type: pressure gradient receiver (twin capacitor condenser microphone capsule with fet preamplifier).

Frequency range: 20 to 20 kHz.

Directional characteristic: switchable pair selection of cardioid, omni-directional, figure-of-eight and hypercardioid.

Sensitivity at 1 kHz: 0.6 mV/bar.

Capsule capacity: 2 x 100 pF.

Impedance (20 to 20 kHz): less than 200 ohms.

Load impedance: greater than 500 ohms.

Operating voltage: 9V.

Universal phantom powering: 9-25V (within the range 13V to 9V dc with proportionately decreased sensitivity).

Current consumption: less than 5.5 mA (DIN 45 596).

Unweighted noise level: 3 V eqf.

Equivalent noise level: 21 dB SPL (0.6 mV/bar CCITT-C DIN 45 406).

Manufacturers: Akustisches U. Kino Gerate Gmbh, A-1150 Vienna 15, Brunnhildengasse 1, Austria.

UK distributors: AKG Equipment Ltd, Earlley House, 182-184 Campden Hill Road, London W8 7AS.

The AKG C414 microphone is the fet transistor version of the C124 nuviator microphone which is well known, particularly in broadcast-circles. We have two C124's, two C414's and two C415's in all the mobile recording unit, and we have always been very satisfied with their performance. The C414 has not the same following as the Neumann U87 in London studios, and we feel this is not obviously explicable—since it has several extra points in its favour, as well as a good overall performance.

The microphone itself is considerably smaller than the U87 (about 11 mm long) and is also considerably lighter (200g). The casing does not appear as robust as that of the Neumann. In common with the U87, the C414 requires a special head-cable with its own stand-adaptor—which in the case of the AKG employs a Cannon six-way connector (like the C124) that, regretfully, in our experience is occasionally unreliable, particularly with metal fretting. We understand from AKG in London that there is a modification available to make the C414 into a standard three-way XLR connector which will be of great advantage. Nonetheless, even with the six-way Cannon mic connector, the cable can be supplied terminated in a standard XLR connector.

The C414 has switched for four pole diagrams—cardioid, omni-directional, figure-of-eight and hypercardioid (cottage-loaf, i.e. half-way between cardioid and figure-of-eight). The inclusion of hypercardioid is most useful, offering more flexibility in applications (such as particularly encountered in broadcasting) where one employs just a very few microphones for an overall balance of, say, an orchestra and the overall pickup of hall ambience has to be controlled in the main balance. The mic is xy phantom-powered from any voltage between 7.5V and 52V, with the provision of suitable feed resistors in the power supply for different voltages as recommended by AKG; used on 48V the C414 draws a fairly high current.

The C414 is compatible with most x/y phantom systems normally encountered, and can be used with the 9V battery units also supplied by AKG for use with the C411 series. One problem with the use of the battery power supply has been the increase in microphone self-noise as the voltage from the battery nears the 'knee' of the Zener diode incorporated in the power circuitry of the C414. With a new battery, the microphone is quiet; as the battery volts drop, the noise increases a little, and then it returns to its low level after the battery voltage has dropped further. A sturdy windshield (W11) is available from AKG and seems to perform quite satisfactorily.

AKG in London say that there are plans to introduce a modified circuit to improve overall margins further—with more feedback, and incorporating a bass-roll-off provision in due course. Early models of the C414 did have problems with rf breakthrough in unfavourable situations, but we understand this has received prompt attention and that the performance is now markedly better and will be improved further on the introduction of the new XLR
A KG C414

The microphone circuit incorporates a 2 MHz oscillator for obtaining the 60 V dc polarizing voltage for the capsule from the incoming phantom volts. The 2 MHz oscillator is half-wave rectified and stabilized for the low current required. The microphone head amplifier circuit is basically an fet source follower driving an emitter-follower, which in turn drives the output transformer via an electrolytic decoupling capacitor. In the case of the C414 the source of the fet is not bypassed by a capacitor (contrary to the U87) and we feel this could help reduce intermodulation distortion.

The self-noise of the C414 did not seem quite as low as that of the U87, but we can see few occasions where it might cause difficulty since it was still in the 20 phons region and was very good (in fact the quietest in the A KG range).

The overall frequency response was, subjectively, very wide, with an extended bass response which could be either an advantage or a disadvantage depending on application. A suspension mount would get rid of most potential problems, as would a high-pass filter setting such as may be found on professional microphone amplifiers. This extended bass was most suitable for organ recordings and also for orchestras—although it would bring out rumble in some locations, which could easily be cut out with a suitable filter as previously mentioned. This low end presented rather a problem for speech application, where it gave the voice a strange detached sound—the low end did not seem to ‘belong’ to the top end. Nonetheless, the quality was good and a little equalization helped.

The polar diagrams seemed excellent, as discovered last year when we carried out some experimental recordings in an anechoic chamber. Although the C414 has a large capsule (2.5 cm) in common with the U87, it does not appear to exhibit such a significant loss of treble off-axis, and a condenser pair gives a very convincing stereo image. The microphone incorporates a useful –10 dB sensitivity switch.

As far as the accuracy of reproduction, and ‘sweetness’ of sound is concerned, the A KG C414 was very good. The string tone was very pleasing and flattering, as was the quality on piano and harpsichord. String tone seems the forte of the C414, and we would have no shame in recommending it, if only for this application.

The rumble pick-up was clearly evident when we came to play back our madrigal singers test recording made in a Surrey church, which suffers a little from distant if rumble from Heathrow Airport. However, the vocal quality had a pleasing warmth which was lacking on the U87.

On orchestral recordings, the C414 microphones always seem to give a clean top, which is subjectively very pleasant—and the string tone makes it a most apt choice for this application. The brass quality lacks the vividness and presence of the U87, but was by no means failing, and for any recording engineer who wants to try a different sound the A KG C414s are well worthy of investigation. The treble response greatly enhanced the quality of guitar and harpsichords, although it gave speech quality rather exaggerated sibilance.

Concluding

Generally speaking, we are very happy with the A KG C414, and we have, as stated earlier, several in our recording set-up which are used a great deal. We have used four in a coincident cardioid ‘cluster’ for quadraphony with great success—our only reservations are mainly concerned with mechanical robustness, particularly of the six-pin Cannon stand-adaptor/connector, and with the speech quality which was a little boomy and ‘tizzy’ before equalizing.
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SCHOEPS CMT 36 AND CMT 56 CAPACITOR MICROPHONES

By Angus McKenzie and Tony Faulkner

MANUFACTURERS' SPECIFICATION

Frequency range: 40 to 16 kHz.
Directional characteristics: (mechanical adjustment) cardiod, figure-of-eight, omni.
Output level (1 kHz in cardioid): —8 dBV/10 dynes/cm².
Sensitivity (1 kHz in cardioid): 1.2 mV/dyne/cm².
SPL at 0.5%: 128 dB spl for CMT36; 126 dB spl for CMT56.
Equivalent noise loudness level (CCITT): 26 dB spl approx CMT36; 25 dB spl approx CMT56.
Noise voltage (CCITT): —106 dBV approx CMT36; —110 dBV approx CMT56.
Source impedance: approx 20 ohms symmetrical CMT36; approx 200 ohms symmetrical CMT56.
Load Impedance: greater than 5000 ohms.
Phantom power: 120 V (CCITT): 44-52V CMT56.
Current: approx 8.5 mA CMT36; approx 650 µA CMT56.

Price: £1195, £1417.
Manufacturers: Schalltechnik Dr-Ing. Karl Schoeps, 75 Karlsruhe 41, Spitalstrasse 20, Postf. 410970, Germany.
UK distributors: Felden Audio, 128 Great Portland Street, London W1N 5PH.

The Schoeps range of capacitor microphones has not apparently received the interest and acclaim in the UK it has had elsewhere in the world (partly in the USA and parts of Europe) and our tests would indicate a certain injustice.

Both microphones are similar in appearance and facilities offered, with some internal electronic differences. The Schoeps is a pencil microphone similar in size to a Calrec CM1050 or AKG C452, only it is a side-shot microphone it picks up from the sides, rather than from the top.

It employs standard XLR three-pin conenction, and offers cardioid, omni-directional and figure-of-eight polar patterns. These are not obtained by means of changing the polarization of a double-diaphragm (the technique employed by the Neumann U87 and AKG C414); they are achieved mechanically by the twist of the mic cap, which has click-positions for each pattern.

The first difference between the CMT36 and CMT56 is the powering. Both employ phantom powering, the CMT36 operating nominally on 9-12V (although we are advised it will function on 48V with suitable feedback should reduce intermodulation distortion in the amplifier. The sound quality of the CMT36 and CMT56 did not appear to differ particularly in any of our tests; indeed we were most enthusiastic about both in all of them.

The general impression gained from all the comparisons was one of extreme flatness without any particular coloration. The polar diagrams were admirably good, particularly that of the figure-of-eight; on one recording session we used just a pair of these microphones in coincident figure-of-eight configuration (90° à la Blumlein) and the reproduction was most impressive. Listening on headphones provoked turning around on several occasions, convinced that someone was talking—but it was the microphones!

When we replayed the recording made of the mdriggs, the sound was very smooth and all of the words were very clear, without excessive rumble from London Airport, and with a very good extreme top. A distinct lack of intermodulation distortion was evident, and was most refreshing.

The stereo definition with a single pair of these microphones put many a multi-microphone balance to shame, and the placement was most convincing in terms of front and back of sound-stage. It seems to us that the Schoeps is very widely applicable since it does not seem to have any particular sound of its own other than a great sense of clarity. This feature means that the sound it gives can be 'curve-bent' to requirement. The string tone was very clear and true although it lacked the 'flattering' C414 sound, and the brass was also very clear, although it lacked the vividness of the U87—but we feel that mic channel equalization could change this situation.

As must now be clear, we are very enthusiastic about the Schoeps microphones—their flatness gives a great deal of scope to the creative engineer. As they have not established themselves firmly in the UK it is not easy to make comments regarding long-term reliability—but our brief experience does not indicate any likely problems. One UK user, Bob Woolford, told us of only one difficulty he had with them—a while ago he was recording out-of-doors on an island off Spain with them, and a late night session broke off at 4 am for a break. When he returned, the microphones were behaving far from healthily—this turned out to be rather large volumes of dew! When the dew was wiped off carefully, all was well again.

The choice of which microphone to use is a most interesting one, and this survey has made us very keen to try different microphones in...
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FOR 7 or 8
plus a couple
of
echo returns...

...but how
about when you
get to 16 or 24
or even 32?.....
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infallable?
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On Easter Sunday 1964 the medium airwaves suddenly and illegitimately carried the voice of Simon Dee saying 'Good morning ladies and gentlemen' this is radio Caroline broadcasting on 199, your all-day music station'. Ten years later, almost to the day, Piccadilly Radio started legitimately broadcasting in Manchester. It was an eventful decade for British radio.

RADIO CAROLINE was the first of the score of pirate stations that were doomed to eventual extinction under the axe of the 1967 Marine Offences Laws. Piccadilly Radio was the fifth of the projected three-legal independent local radio stations made possible by the Sound Broadcasting Act of 1972 and the Independent Broadcasting Act of 1973. Without the good ship Caroline and all who sailed on her, there would have been no Radio Clyde, no Capital, no LBC, no Radio Clyde, no Birmingham—nothing but the BBC. So it is fitting that a fair number of the engineers, disc jockeys and entrepreneurs who received a bailed handshake under the 1967 Act are now employed by or running Britain's legal commercial radio stations.

They are giving the BBC national and local stations a hard run for their money; although Broadcasting House gleefully promotes its audience rating figures that seemed favourable to them, it had to ask Capital's Kenny Everett to call off his listeners after Kenny invited them to phone into the BBC with their comments on these ratings. To put it another way, it is just not possible that a station like Capital—with the Everett and Cash morning shows, plenty of good music and a bottomless pit of new ideas for programmes and promotions—will not make considerable inroads into BBC Radios One and Two and Radio London listening figures. And when the great British Public becomes used to the idea of an all news station, it is not probable that they will wait patiently for a BBC bulletin when LBC is offering continuous news. Radio Clyde has not only brought stereo radio to Glasgow for the first time ever (neither BBC national nor local radios had a pilot tone to offer up there) but it has brought truly local news reports. As James Gordon, managing director of Radio Clyde, told the IPA Society recently, Glaswegians are not particularly concerned about hearing what traffic conditions are like in London. Don't laugh, he said, as we laughed. That is what BBC radio has been offering us.

After the awful hiccup when I tried to write up Capital Radio soon after it went on the air (and failed through what turned out to be some missing links in the PR chain) I have been back to Euston Tower several times and been made to feel very welcome each time. Most of the teething troubles, both off and on air, seem to have disappeared and I would think that the one lesson to be learned from the launch of LBC and Capital is that starting a radio station from scratch in four months may be physically possible (both LBC and Capital made their deadlines) but it is as pointless an exercise as climbing Everest with one leg strapped behind your back.

On arrival at the railway station, the first thing I saw were vast posters on the platforms advertising Piccadilly on 261. I was directed without problems to the radio station building, which is in the Piazza of the à la mode Piccadilly Plaza shopping and hotel complex in the centre of Manchester. The lack of problems wasn't surprising because the Piccadilly Radio offices are not exactly hidden. Along the edge of the Piazza stretches what must surely be the largest advertising poster in the UK, if not the world. 24m high and 600m long, it runs round the entire south-west corner of the building. It may not be modest but I'll bet it gets people tuning in.

Upstairs in the studios I met Geoffrey White, the chief engineer, along with his assistant Philip Thompson and two engineers from the IBA northern area who just happened to be there on a routine visit. This was particularly fortunate because it enabled me to talk (and thus now write) not only about the Piccadilly station itself, but also about more general matters of reception on medium wave and vhf in the north of England.

As emerged from the Capital article and subsequent correspondence and research, there is no consistent policy of co-sitting BBC and ILR transmitters. This should present no real problem on the medium-wave bands, but on the vhf bands (and especially in stereo, where a good signal strength is necessary for hiss-free reception) problems can and will arise if a listener has a directional aerial sited on a BBC station and another station sharing the ILR transmitter. A tangled web of good and not-so-good reasons explain why co-siting is not possible and, in a nutshell, the problem can be summed up as follows:

Because local radio is local rather than national (as are BBC One, Two, Three and Four) separate services must be transmitted to cover separate small city areas all over the country. Because there are just not enough medium wave and vhf wavelengths to go round, some different stations must share the same wavelengths. In order that the transmissions from one local station shall not break through into the transmissions from another station using the same wavelength, the aerial systems used must be directional (ie transmit the power just where it is needed and nowhere else) and sufficiently low power to fall short of the area covered by a station with a shared wavelength. For instance Glasgow Radio Clyde has been allocated the same vhf frequency as Swansea (95.1 MHz). The Manchester vhf frequency 97.0 MHz is shared by Tyneside-Wearside, with Cardiff 261 MHz with the medium wave with LBC (permanent frequency), Glasgow, Birmingham and Plymouth. The extent to which stations share the same wavelength gives some idea of the fine balance of power that must be struck to keep the intended area satisfactorily and insufficient strength to crash in on another station. Whereas the BBC uses both horizontal and vertical polarisation techniques to enhance separation between shared vhf stations, the IBA has adopted circular polarisation for vhf on all independent stations (this gives improved results for portables and car sets operating with simple whip aerials). Thus there can be no isolation of ILR stations by polarisation characteristics. So far the directionality of the IBA aerials, the transmission powers used and the physical spacing of the transmitters on shared wavelengths has produced no real co-channel interference problems. But of course, the number of ILR stations in operation is still in single figures and it is anyone's guess how successfully the system will work in practice, if and when the eventual target of 60 separate stations is reached.

The best thing we can all do is keep our fingers crossed and hope that the IBA theory works out in practice, is local
television now transmit on vhf from shared aerials, there is no such rationalised scheme of sharing between BBC national and local radio and the ILR transmitters. The result, as we have seen, can be exclusion of the ILR signal by a directional aerial lined up on the BBC mast. When the BBC started to realise its plans for 40 local BBC radio stations, the laws to set up commercial radio had not been passed and thus there were no firm plans for any ILR stations. Of course any farsighted planner worth his salt would have known that commercial radio would eventually come to this country, but in the absence of any such foresight, the BBC was left to its own devices and naturally started to transmit local radio from the national or regional BBC vhf transmitters (Wrotham in Kent for London, and Holme Moss for Manchester). Because the regional transmitters were intended to saturate large areas of the country rather than just city centres, they were usually miles away from the service area and thus the local radio stations needed to put out a fair amount of power to reach their intended city audiences (Radio London uses 16.5 kW erp for mono vhf transmissions from Wrotham). Listeners sited their receiver aerials on the BBC transmitters and as often as not used directional multi-element arrays to exclude interference and unwanted reflections. When the IBA engineers started to look round for suitable sites for their transmitters (which, remember must transmit with low power to cover just a selected city area with no interference to other city stations on shared wavelengths), there were very few locations where aerial-sharing between the IBA and BBC would have worked for local transmissions. As a result we have the IBA transmitters popping up all over the country, usually miles from the nearest BBC transmitter, thus by virtue of parallax inevitably out of line with many receiver roof aerials carefully aimed at the Beeb's stalks. In such cases 'a wet piece of string' would serve better as an aerial to receive IBA radio than an extensive multi-element directional array.

So far, many people listen to local radio on portable sets fitted with a simple whip aerial so that the different location of the transmitters is of little consequence. The problems in practice will only make themselves fully felt when more listeners start to listen to local radio in vhf stereo via directional roof aerials sited on the BBC transmitter. Then the relatively low signal strength will manifest itself as a thoroughly unpleasant hiss. It may well be years before sufficient people start listening in stereo to realise that they can't do so without rethinking and reorganising their aerial system. When that time comes listeners may be excused some resentment over the inability of the BBC, the IBA and the Ministry of Posts and Telecommunications of several years ago who could not then muster sufficient foresight, forethought and cooperation to plan for a future of local BBC and commercial radio. They may also wonder why the Government and local planning authorities have made it possible for developers to build skyscraper blocks in our cities (thereby making transmission and reception in those cities even more difficult) but still have the right to refuse space on their roofs for aerials to transmit local city radio and similar services.

I raised some of these points at Manchester City Hall and gather that, as yet, there have been no problems encountered with regard to reception. The fm transmissions radiate from Saddleworth with 2 kW erp (the medium wave transmissions are from Ashton Moss, ten or 12 miles off the city centre, also at 2 kW erp). Tests made by Geoffrey White suggest that the planned and intended 60 dB (1 mV per meter) contours are being met. Both the fm and medium wave transmitter systems are highly directional, the latter having four out of line masts to produce the necessary nulls.

The medium wave signals are piped to Ashton Moss via Post Office land lines but, in the special case of Manchester, the signals to the fm transmitter at Saddleworth are carried by a pair of uhf links operating from aerials on the Piccadilly Radio building roof. The signals are sent up as a stereo pair (on 934 and 938 MHz) with encoding at the transmitter. This facilitates circuit tests—one leg can be fed and the other checked, even during transmission. The Marconi transmitters, which operate unattended, remain permanently on except when servicing is necessary. The transmitters have some power in reserve but it is unlikely that this can ever be used because the Manchester signals would then interfere with Manx radio on the Isle of Man.

There seems to be some tacit back-scratching between the IBA and the Manchester station, which has so far avoided what could be an awkward source of mutual interference.

Piccadilly Radio went on the air on the predicted date (April 2) after a year's planning. Geoffrey White and Philip Birch first started working out the station details in April 1973, having been given a clean slate to build it from scratch. The premises which they were able to obtain are almost too good to be true. Around 10,000 square feet of empty space was available in the Piccadilly Plaza; while at his previous job as technical consultant with the Granada Group, he worked full-time to shape the station. Geoffrey White seems almost obsessively tidy, with an abhorrence for trailing cables and untidy wiring. The result is that the station (although not yet quite finished) is remarkably free of clutter. It is clear that this is no happy accident. For instance, before the channels for the cables were let into the floors, full-scale plywood mock-ups of the control desks were built and positioned exactly in their intended positions to place the channels just where they are needed. The use of mock-ups also enabled the designers to be sure that operators would be able to reach what they wanted to reach when they finally sat down and went on the air. As opening day approached, the three-day week hit the station, but all concerned are very proud that they finally met the deadline.

Piccadilly is staffed by about 75 people, of which eight are engineers, some from the BBC and some ex-IBA. In keeping with the philosophy behind local radio, many of the station shares are owned by local newspapers, including the Bolton Evening News and the Rochdale Observer. Other shares are owned by Granada. The idea behind offering local
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radio shares to local newspapers is, of course, to compensate those newspapers for the likely loss in advertising revenue. the picadilly radio rates seem reasonable. a 30s spot, for instance, costs £4 between 1 am and 6 am, £10 between 7 pm and 1 am, £22 between 2 pm and 7 pm and £34 between 6 am and 2 pm. the station put together its own id jingle package under the production of bob snyder with the music of john cameron (of cc5 fame). some of the adverts on the air are produced outside, but a fair number are produced by picadilly radio.

costs vary between a minimum of £10 for a simple announcement on cartridge to £200 or more for a special production with original music. picadilly currently has plans to build a special jingle studio to handle the fair amount of work which is coming in from local advertisers; some of the home-grown adverts that i heard, both at the studio and on my portable radio in manchester over the following weekend, are very reasonable indeed. there seems to be more effort to inject humour into adverts in manchester than in london, which if it works can be highly successful and if it does not work can be exasperatingly embarrassing. i didn’t hear anything in the latter category possibly due to the station policy of refusing to broadcast anything really bad; on the whole listening to the station is a fairly pleasant experience. true a few of the news broadcasts jarred a bit, and this is one area where any amateurism shows. over the years we have grown used to hearing the bbc news readers pronounce everything correctly and

never fluff a line. when the commercial stations have matched the bbc (the broken biscuit company as they like to call it), then commercial radio will have really arrived. capital and lbc, incidentally, have greatly improved their newsreading recently.

picadilly radio is adamant that it wants a station image, not an image of individuals. thus although their two top disc jockeys, roger (twiggie) day and steve metcalfe, are both pretty flamboyant personalities, the names of the game is to make picadilly instantly recognisable as picadilly within a few minutes of tuning in. they have nine hours a day of needle time, by must have to use it all, probably largely due to the three-hour shutdown. but the station may eventually go 24-hour. there seems to be rather less phone-in than on the london stations; picadilly policy here is to use an expert in radio and encourage listeners to phone in with questions rather than opinions. if the anchor-man in the studio-senses that the caller has something worth saying, he then draws the caller out. this way, in theory at least, listeners are spared opinionated lectures from boring callers.

there are ten phone lines into the studios (with the possibility of hitching-up another seven if necessary), these being fed straight through to the consoles, each caller being given and told his line number. the broadcaster has a series of numbered buttons corresponding to numbered lights which show up how where calls are available. for instance on line 1, he can punch straight through to the caller on line one etc. there is also facility for conference calls if necessary. so far picadilly is not routinely using the 7s tape delay which the iba insists upon for use all when necessary. general policy seems to be to attempt the programme live, for with delay there is always the risk of confusion due to the delay of the received programme on the caller’s radio. but the broadcast can always switch to delay when trouble is brewing. the switch-over is usually handled by the use of 7s jingles to inject the necessary blocks of time. perhaps just as effective is the tape delay system which (i am assured was the invention of a certain mr goebbels in germany way back in the thirties) is the rather simpler ‘black list’.

the switchboard operators soon learn to recognise the names, and even the voices, of callers who have already proved themselves better left hanging on an empty line than allowed on to the air to bore or abuse listeners. i am reliably assured that one whole vast family is already on the radio station’s black list, but no one will tell me what it was that they did in the first place to get there.

most of picadilly’s output is in stereo with only the telephone calls, sports broadcasts and emergencies switched over to mono. in an effort to check quality, geoffrey white and his team sat in shifts for 24 hours and recorded everything the station put out in stereo, monitoring the levels on their own meters of a neve desk. one thing they found out bothered them, and i’ve been asking around and find that they are not the only ones who have noticed the phasing problem with cartridge machines. the problem is that the cartridges themselves are essentially fairly cheap plastic items which carry a stereo recording and cue tones on a continuous loop of tape. all is well with the cartridge system until the two stereo channels are summed to provide a mono signal (either at the transmitter or in a receiver). when summing takes place any differences in phase between the two stereo channels will cause unpleasant audible phasing effects and this means that the azimuth alignment of the heads on all the machines used for recording and playback must be accurately compatible.

unfortunately it is emerging that in practice this is very hard to achieve. the problem is eased if so-called ‘stereo phase’ cartridges (which are precision made and cost around twice as much as ordinary cartridges) are used, but there is still no guarantee that the man who recorded the tape (eg in an ad agency) has used a machine with correctly aligned heads. geoffrey white was even able to show me with lissajous figures on an oscilloscope how the phasing of a cartridge will change as it is used. listeners on portable radio are unlikely to be bothered by phasing effects on the commercials, but as serious listening to the commercial stations increases, so will the chances of people wondering why the programme they are listening to sounds odd. and as commercials are what commercial radio is all about, this is something that can certainly not be swept under the carpet.

picadilly has a total of four stations and two control rooms arranged in square format and surrounded by a perimeter of offices and corridors (in many respects very similar to capital in london). the two control rooms double as recording studios when the great breakfast run and ride their own programmes; the equipment shows no signs of compromise. spender bc iiiia speakers are used in the music studio and kef monitors in all the control rooms. the speakers are mounted in a rather clever way. steel rods run up through the ceiling to fibreglass hangers on the floor of the storey above. the speakers are bolted to these rods and thereby are isolated from the studio floor and walls leaving the floor free from cumbumbers and preventing feedthrough from room to room. the desks used are neve with akg d802 and c431 and shure mikes. characteristic of geoffrey white’s meticulous planning is the provision of a phantom power source for a condenser mike at all mike positions. the turntables used are emt 298s in the studios and garrett 301s with orforn arms and shure cartridges in the listening rooms. the tape machines are bias for editing and leevers-rich throughout in the studios. a touch of neve limiting is used on fm transmission with off-air monitoring by mcmartin receivers for fm and a trio on medium wave. all programmes are logged on chilton loggers running at 2.375 cm/s and churning out two tapes a day. the tapes are then kept for three months before re-use.

isolating the studios from outside sound proved something of a problem for two reasons. firstly, the physical construction of the building was not suitable to allow the provision of airtight boxes for the little busy main road runs alongside the building outer wall. the fairly complicated answer was to use a suspended lattice ceiling with lead sheets hanging as curtains down the inside of the studio walls, in cavities bounded by plaster. a series of listening rooms was built along the length of the cavity wall and these open on to a corridor. the corridor then opens on to

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Dear Sir, Your 'Silly Question' (Cleanfeed, October '74 issue) about 'A' hiring out an acoustically controlled room at top rates to 'B', whose subsequent discomfiture and fiscal disadvantages appear to be in need of repair, deserves a less than silly answer—but not, I counsel, in the form of a High Court writ.

A large number of studios charge top rates without having competent acoustic design applied to the areas involved or to the air-conditioning system. My partnership spends a surprising amount of time trying to retrieve these situations which should never have arisen in the first place. Some are irretrievable. Not infrequently the advice we have given to eager 'A's is not to build the studio complex at all, or to do it somewhere else. This earns us very little thanks and no fees from 'A' but does save prospective 'B's from predictable disasters.

But you asked what action 'B' should take. He ought to check out 'A's studio facilities first. Of course he did this in the case you cited, but chose an expensive and unwarranted way of doing it, ending up with a useless master tape. A better method would be to ask 'A' for a report of the acoustics and sound insulation of his studio including the relevant data: reverberation curves, measured background noise levels, and so on. If 'A' can't provide that 'B' should go elsewhere, thereby saving time and money. I sympathise with all the disconsolate 'B's everywhere. Now that I've written this, however, 'B's should recognise in future that they could hardly claim 'A's to their reputation as record producers'. If they can't be bothered to read this and act upon it what kind of reputation do they have that could suffer damage? Consider this little parable: a friend of mine owns a decaying 80-year-old house in grave danger of collapse. Within can be found, by looking hard through the gloom, a few musky threadbare rugs and an occasional rotting stick of 'furniture'. He proposes to hire it out as a luxury furnished house at extortionate rates that would enable one to live at the Hyatt Regency Hotel in San Francisco instead. I asked him what qualifications this ruin had to earn the title 'luxury'. 'The rent', he said.

Yours faithfully, Sandy Brown, Sandy Brown Associates, Architects and Acousticians, 12 Conway Street, London WIP 5HP.

Dear Sir, The review published in the November STUDIO SOUND of our Yamaha NS 690 raises some interesting points. Since the speaker was submitted for review, the price of the NS 690's has been reduced to £219.95 a pair, and I am sure that had the reviewer been aware of this (we forgot to tell him in time) his criticisms on a cost-performance basis would have been less severe.

To some extent this situation is due to geography and I am certain that if the reviewer had been based in Tokyo, where Spendor BG1s, KEF 104s and others cost in excess of £300 a pair, and Yamaha NS 690s are only £180 a pair, a different picture would have emerged. Possibly a review on neutral ground would be the answer. Possibly Calcutta.

Thank you for letting me air this view in your column.

Yours faithfully, Malcolm Kays, Natural Sound Systems Ltd, Strathcona Road, North Wembley, Middlesex.

Dear Sir, In your introduction to the October issue of STUDIO SOUND under the heading 'Glossary of Terms' you refer to the need for definitions of technical terms.

We agree. In fact the APRS issued such a glossary to its members in 1967 and are in the process of updating it for inclusion in the new APRS Handbook, due for publication in 12 to 15 months time.

Those who have points of view they wish to have considered should write to the Co-ordinating Editor, John Borwick, B.Sc., Ridge Cottage, Hill Road, Haslemere, Surrey.

Yours faithfully, E. L. Masek, Secretary of the APRS, 23 Chestnut Avenue, Chorleywood, Hertfordshire WD3 4HA.

Dear Sir, We at Neve were very pleased to read your article in the November STUDIO SOUND giving details of a visit by John Dwyer to the Decca Studios in Paris — Société Française du Son.

So that the record is straight we would like to correct one or two small inaccuracies in the article. The channel equalisation units referred to are not of course 108 but the well-known Neve 1081, which has been acclaimed throughout the world as one of the most sophisticated high performance channel amplifiers available.

The reference to transformers below the photo on page 38 is a little misleading since some of the information is missing. The hum actually arose in the foldback circuits external to the console and not within it as the article suggests.

Finally, good luck to STUDIO SOUND, a very interesting and well-produced magazine.

Yours faithfully, Peter Moody, Rupert Neve & Co Ltd, Cambridge House, Melbourne, Royston, Hertfordshire.

Sorry, and thank you—Ed

Greek TV troubles

The Greek election campaign is (November) causing problems for Greek television services. Greece has two television stations one of which is run by the Greek armed forces. For the first time, television is being used for election campaigning and the Prime Minister, Mr. Karamanlis, has allowed the parties equal time, on the state radio and television stations, but the army station will not be used for campaigning. The right wing mains maintain that it would be intolerable for communists to sully the screens of armed forces television by appearing on them. The opposition have said that the government has bowed to pressure from the military establishment and that the armed forces station is answerable to no-one.

Audio show

This year's Audio Festival and Fair, organised by Industrial and Trade Fairs Ltd, was held from October 28 to November 3 in the Grand Hall, Olympia. The show, sponsored by the Sunday Mirror, attracted 83,000 fee-paying audiophiles. The show, sponsored by the Sunday Mirror, attracted 83,000 fee-paying audiophiles. A spokesman for Thorn, one of this year's non-paying exhibitors, said that they could 'spend the money better elsewhere'. His comments were echoed by a press officer for the massive Rank Radios International Group, another retractor; he further stated that the group would look to the provincial fairs for future promotional venues.

Another reason given by manufacturers for their reticence to exhibit, stemmed from the 'fiasco of last year's show' alluding to the sight of carpenters and electricians completing stands a day after the show had been declared officially open. Generally exhibitors stated that they were favourably impressed with the organisation of this year's fair but wished that the show had been better supported by other manufacturers; the gallery above the main floor remained but half full.
A SIX WAY MINIATURE STEREO MIXER OFFERING ON EACH CHANNEL
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MIXERS CAN BE LINKED TO INCREASE AVAILABLE CHANNELS
AKG CK9
GUN MICROPHONE
By John Fisher

Fig. 1 shows the frequency response of the preamplifier alone, when fed via a source impedance of 600 ohms in series with 27 pF, which is the nominal capacitance of the condenser capsules. It is to be seen that the response in the 'flat' position is sufficiently flat over the audio frequency spectrum, but in the two bass cut positions there is a little boost just above the cut-off frequency. Whilst the manufacturer does not mention this in the specification, it is probably a desirable characteristic; however, it is noted that in the maximum cut position the attenuation is less than that specified.

Because the preamplifier is only intended to operate with the AKG series of condenser capsules, it was not felt appropriate to measure other aspects of its performance on its own for the purposes of this review, and consequently measurements of noise and gain were done for the complete system.

Noise of the complete system was determined as an equivalent sound pressure level of 22 dB(A), with the preamplifier set for a flat response. Such a performance is remarkably good and well within the manufacturer's figures.

Sensitivity at 1 kHz was found to be 0.96 mV for 74 dB SPL (equivalent to 1 microbar) which is close to the related sensitivity.

The frequency response performance, which is shown for four different angles of incidence in Fig. 2, must be regarded with some caution, as the plots were obtained under conditions that were not perfectly anechoic. However, the characteristics shown reflect the general pattern of the microphone's performance where at zero degrees incidence the frequency response is largely flat to greater than 18 kHz and a rapid but smooth fall-off in treble occurs as the angle of incidence is increased. The front to back performance was found to be very good over the complete audio spectrum.

The output impedance of the assembly was measured at under 300 ohms at frequencies up to 5 kHz, from where it rose to 500 ohms at 16 kHz. Whilst this characteristic is quite acceptable for normal purposes, the impedance at high frequencies is somewhat higher than the specification suggests and could be troublesome in exceptional circumstances.

Finally, the current drawn by the system at 9V was measured as 1.7 mA quiescent, which means that between 200 and 300 hours' life can be expected from a PP3 size battery driving the system, as is the case with the optional type B46E power unit.

Hugh Ford

MANUFACTURER'S SPECIFICATION
CK9 Gun
Frequency range: 30 to 18 kHz.
Directional characteristic: lobe.
Sensitivity at 1 kHz: 1.1 mV/µbar (-59 dBV).
Equivalent noise level: 24 dB with filter CCITT-C/DIN 45 400.
Weight net: 480g.
Dimensions: 810 mm long x 53 mm diameter.

MANUFACTURER'S SPECIFICATION
C 451EB preamplifier
No-load amplification: 0.47 ±0.5 dB (feeding via 27 pF condenser and load of studio amplifier > 3 000 ohms).
Impedance, 20 to 20 kHz: <200 ohms.
Operating voltage: 9V dc.
Universal phantom powering: 9-22V dc.
Current consumption: ≤5.5 mA to DIN 45 596.
Frequency range: 5 to 30 kHz.
Bass attenuator built in: Flat or -7 dB at 50 Hz or -20 dB at 50 Hz switchable.
Unweighted noise level: 3.6 µV off in flat response setting.
Equivalent noise level: 21 dB weighted to CCITT-C/DIN 45 450 in flat response setting.
Price: £36.00 for gun; £72.00 for preamplifier.

Introduction
THERE HAVE BEEN many attempts to produce the perfect ultra-directional microphone, otherwise known as gun, shotgun or rifle microphone. Very few have been entirely successful, though many have proved useful in particular applications.

The gun microphone has become familiar over the years in film work, where the microphone must be kept out of camera shot, in television, in news reporting, sound effects recording/broadcasting and more recently in sound reinforcement. The majority of gun microphones have been dynamic types, though a number of capacitor gun microphones and
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SALISBURY 3746
other highly directional devices have been produced.

There have been several main approaches to the ultra-directional microphone, including the use of bundles of tubes of various lengths ahead of the transducer, use of slotted tubes, multiple apertures etc, to produce interference and/or phase-shints for sound coming from off axis without effect, hopefully, on sound coming along the axis of the microphone (see Roërtson, ‘Microphones’ (Iliffe) Ch.11, and Burroughs, ‘Microphones: Design and Application’ (Sagonore) p73 et seq). There have also been a number of horn/lens arrangements, and the parabolic reflector.

The AKG CK9 capsule, part of the CMS modular range, is a capacitor type fitted with a slotted interference tube, and has been developed from a familiar professional cardioid microphone capsule.

Operating principles

The CK9 capacitor capsule, developed from the more familiar CK1 capsule used in the CK41 and CK430 microphones, was designed for high directivity, independent of frequency, in the smallest dimensions possible. It uses a combination of interference and pressure gradient principles. At high frequencies, directivity is achieved mainly by interference between sound waves entering laterally through holes along the length of the tube. At low frequencies, directivity is obtained by a large pressure gradient and phase shift; low frequencies have access to the rear of the microphone diaphragm via three small apertures, a loading cavity and the backplate of the capsule proper. In fact, to simplify things a great deal, the CK9 appears very similar in construction to the standard CK1 capsule with the addition of the front tube and with three of the four sets of apertures behind the diaphragm blanked off. The result is an increase in directivity from three for a cardioid to approximately ten mid-band for the CK9—in other words, while a cardioid would pick up about a third of the random sound or reverberation that an omni-directional microphone of the same axial sensitivity would, the CK9 picks up only about one-tenth at mid frequencies. The effect is that of apertures behind the diaphragm blanked off.

The amplifier supplied with the CK9 was powered from a supply of 9 to 52V, and incorporates a three-position switch with two additional items.
bass-cut positions and one flat position. The bass roll-off frequencies are 75 and 150 Hz, and the positions give respective attenuations of zero, seven and 20 dB at 50 Hz (manufacturer's figures). The equivalent noise level of the amplifier is degraded nominally by 1 dB in the bass-cut positions. The 'E' version is XLR compatible; a similar ('C') version is DIN compatible. The battery unit has a 9V battery and transformer to provide powering independent of the mains; a standard PP3 battery gives a nominal operating life of 40 hours, and while the consumption of the microphone amplifier is only some 2 mA at 9V, any significant fall in supply below 9V reduces the sensitivity.

Construction

I must confess here and now that I regard the CK9, like the Sennheiser MKH815, as one of the most beautiful pieces of audio engineering, visually, that are about. The CK9 is a long, slender matt-black tube, with a matt-black end enclosed in a matt silver ring, and with a matt silver stripe running almost the full length. Into this fits the even more slender, sand-blasted nickel-plated amplifier unit, about half of which projects from the tail of the CK9 to accept the connector. It seems a shame to obscure this elegant and yet totally unobtrusive design in a windshield!

Raptors over, down to facts. The CK9 incorporates a ceramic electrode and embossed metal diaphragm for stability with age, temperature and humidity. The interference tube/capsule assembly is some 610 mm long, 23 mm in diameter. The interference apertures (in the silver stripe) are three rows of square perforations of side 1 mm, over a length of 495 mm. The diaphragm appears to be situated at the end of the rows of perforations, and the three rear apertures, each about 13 mm across by 2 mm, are centred about 10, 14 and 18 mm behind the last of the interference holes. Behind these again are the factory-fitted retaining grub screws for the capsule, and the remainder of the tube is the sheath for the front part of the Caster amplifier, which screws on to the standard capsule mounting inside the sheath.

This raises two of my few criticisms: when the amplifier is screwed home, it is not possible to alter the setting of the bass attenuator without unscrewing the amplifier from the CK9, thus temporarily disabling the microphone, and it is thus not possible to compare instantly the effect of the attenuator in and out. While this may to some extent be a good thing in that it may discourage fiddling and also prevent accidental operation of the switch (though it would be quite a feat to operate it accidentally, it is so small and well recessed), if the switch has to be reset in the field it does mean unscrewing the unit, and consequent extra wear on and risk of damage to the capsule thread. I can't say I am entirely happy about regular screwing and unscrewing of that fine thread, having heard the odd unhappy tale about damage to capsule threads in the past. One is not, however, obliged to unscrew the units unless one wants to alter the bass setting, so the two could normally be set up as one unit and left.

A soft carrying case is provided, in addition to a rigid tubular transit housing, but the foam plastic which comes round the CK9 will scarcely accommodate the extra length of the amplifier, though the case will at a (firm) push. The amplifier comes with its own padded and foam-lined case. The CK9 also comes with its own axial response curve as measured by AKG.

The C151EB amplifier is 18 mm in diameter and 136 mm long overall (10 mm shorter in the C version). The amplifier, built around a printed circuit panel running most of the length of the housing, contains an fet bipolar impedance converter driving a centre-tapped output transformer; this allows phantom powering via the two cores of the screened cable which carry the balanced audio output. The amplifier also

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**Allotrope Limited**

- 90 Wardour Street, London W1V 3LE.
- Telephone: 01-437 1592. Telex: 21924.

U.K. Representatives for:

**AB Pearl Mikrofonlaboratorium - Sweden**, Microphones & accessories.

**HES Electronics - Brussels**, TSV series telephone balancing units, and studio equipment.

**Inovonics Incorporated - Campbell California U.S.A.**, Audio electronics.

contains a small hf oscillator and rectifier unit to provide the necessary polarizing voltage for the capsule; suitable filters to remove supersonic frequencies are incorporated in the output from the amplifier.

Since the CK9 is part of the AKG CMS range, it can alternatively be used with the C431C or C488E amplifiers (DIN and XLR respectively), which are designed for phantom powering over a limited range of supply voltage (40-54V) and take both amplifier supply (0.5 mA) and polarizing voltage direct from the phantom supply. This makes the combination less suitable for battery operation and hence for portable or mobile work, however. Also, the equivalent noise level of the amplifier is nominally some 3 dB higher (weighted) than that of the C431C or E, which may prove troublesome when working well back from a sound source or with quiet sounds. Mechanically the two amplifier versions are similar.

As mentioned earlier, the C451EB amplifier supplied incorporates a switched bass attenuator, which is useful in removing rumble and handling noises, and wind noise, in mobile, boom or outdoor applications. The switch is set back in a narrow slot halfway up the body of the amplifier; it must be adjusted by levering with a fine screwdriver or similar implement, and there are three distinct click settings as well as clearly engraved markings. A tight-fitting plastic skirt around the lever minimises the risk of objects entering the amplifier housing.

The inside of the amplifier case is threaded at one end to accept the fine thread used on the capsules of the CMS range; the other end is fitted with the appropriate male XLR (or DIN) fitting.

### Performance

**General**

Tests were carried out over a period of several weeks to assess subjectively the performance of the CK9/C451 combination, with and without windshield, under a variety of conditions. A number of other capacitor microphones were used for comparative purposes, and listening tests were carried out using Spendor BC1 and other high-quality loudspeakers.

No operating instructions were provided, but it was felt that the extensive information provided by the data sheets accompanying both CK9 and C451EB rendered further instruction largely unnecessary. The battery power unit supplied was used throughout and was found very convenient to use, though it is quite easy to forget to switch off at the power supply if the microphone is not disconnected after use.

### Voice and guitar

As part of the limited music tests, recordings and comparisons were made of a singer with his own guitar accompaniment in a fairly reverberant acoustic. Excellent results were obtained with the capsule end of the CK9 about 2.5m away from the performer. The voice was largely uncoloured and the character and attack of the guitar were well maintained, while the resulting recording sounded fairly dry; an omnidirectional microphone used at the same range produced a very live sound that verged on bathroom quality.

With the microphone moved in to about 1.5m from the performer it became possible to introduce substantial amounts of general noise and disturbance in the room, other than on the axis of the microphone, before hum of these sounds became obtrusive, illustrating the potential of this microphone for reinforcement of performers without their being tied to hand mics or obscured by stand mics.

It came somewhat as a surprise to find just how excellent the sound from on axis was, with no concession to the microphone being a special-purpose unit. Background snoring and hiss were always commendably low, and no temperamental troubles were experienced even on quite cold or humid days.

### Sound quality

Sound quality was assessed both using live/relayed comparisons and live/recorded comparisons on speech tests, and limited music tests. Performance was assessed both indoors and outdoors; outdoor assessments included performance in windy conditions, under moving and hand-held conditions, and with and without windshield.
**VIDEO RECORDER GUIDE**

<table>
<thead>
<tr>
<th>Make &amp; Model</th>
<th>Tape Size</th>
<th>Colour</th>
<th>B &amp; W</th>
<th>Mains</th>
<th>Portable (Battery)</th>
<th>Slow Motion</th>
<th>Time Lapse</th>
<th>General</th>
<th>Compatibility Code</th>
<th>Price &amp; Code</th>
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<tr>
<td>IVC 705P (P/C)</td>
<td>1''</td>
<td>(o)</td>
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<td>o</td>
<td>Will play 525 line 60Hz tapes, 2 audio tracks, stop frame, studio quality.</td>
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<td>A 1988 mono (2270) colour</td>
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<td>o</td>
<td>o</td>
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<td></td>
<td>A 1481 mono (1760) colour</td>
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<tr>
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<td>o</td>
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<td></td>
<td>A 2547 mono (3049) colour</td>
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<td>IVC 811P (P/C)</td>
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<td>(o)</td>
<td>o</td>
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<td>IVC 701P</td>
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<td>o</td>
<td>Insert edit, 2 audio, stop, frame.</td>
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<td>o</td>
<td>Ultra high quality, broadcast options.</td>
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<td></td>
<td>A 7518 to 2079</td>
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<tr>
<td>IVC 100</td>
<td>1'' cartridge</td>
<td>(o)</td>
<td>o</td>
<td>o</td>
<td>2 audio channel high performance cartridge loading.</td>
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<td>A 48a</td>
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<td>o</td>
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<td>o</td>
<td>(o)</td>
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<td>B 368</td>
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<td>o</td>
<td>(o)</td>
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<td>o</td>
<td>o</td>
<td>Includes hand held camera, mic., mains/charger unit.</td>
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<td>JVC CR 5000</td>
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<td>o</td>
<td>Remote control option, 2 audio tracks, player only.</td>
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<td>C 694</td>
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<td>o</td>
<td>o</td>
<td>High quality, audio dub.</td>
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<td></td>
<td>B 350</td>
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<td>National NV 3040E</td>
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<td>o</td>
<td>o</td>
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<td>B 485</td>
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<tr>
<td>National NV 3030E</td>
<td>1''</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>Insert edit, Audio dub.</td>
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<td></td>
<td>B 535</td>
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<td>National NV 1070</td>
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<td>o</td>
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<tr>
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<td>1''</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>Includes camera, mic., mains charger unit.</td>
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<td>National NV 5125</td>
<td>1''</td>
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<td>o</td>
<td>o</td>
<td>Cartridge loading, stop, frame, auto repeat.</td>
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<td>B 595</td>
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<tr>
<td>National NV 5000</td>
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<td>o</td>
<td>o</td>
<td>Complete with off air tuner, monitor, auto colour lock.</td>
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<td></td>
<td>C 800</td>
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<tr>
<td>Shibaden 610</td>
<td>1''</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>Audio dub, variable speed playback.</td>
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<td></td>
<td>B 380</td>
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<td>Shibaden 610 KD</td>
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<td>o</td>
<td>o</td>
<td>o</td>
<td>Insert &amp; assembly edit.</td>
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<td></td>
<td>B 620</td>
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<tr>
<td>Shibaden 620</td>
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<td>o</td>
<td>o</td>
<td>o</td>
<td>Audio dub, variable speed playback.</td>
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<td>B 585</td>
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<td>o</td>
<td>o</td>
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<td>o</td>
<td>o</td>
<td>6, 12, 24, 48 hours record.</td>
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<td>B 810</td>
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<td>cartridge</td>
<td>o</td>
<td>o</td>
<td>Cartridge loading.</td>
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<td>o</td>
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<td>o</td>
<td>o</td>
<td>o</td>
<td>High resolution.</td>
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<td>B 890</td>
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<tr>
<td>Sony AV 3420</td>
<td>1''</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>High resolution, complete with camera, mic., mains/ battery charger.</td>
<td></td>
<td></td>
<td>B 810</td>
<td></td>
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<tr>
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<td>o</td>
<td>o</td>
<td>o</td>
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<td>D 745</td>
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<tr>
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<td>o</td>
<td>o</td>
<td>o</td>
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<td>1''</td>
<td>(o)</td>
<td>o</td>
<td>o</td>
<td>Studio quality, insert &amp; assembly edit, still frame, colour &amp; remote option.</td>
<td></td>
<td></td>
<td>E 1850</td>
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<td>Sony VO 1200</td>
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<td>cassette</td>
<td>o</td>
<td>o</td>
<td>PAL/NTSC playback, auto repeat search, 2 audio channels.</td>
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<td></td>
<td>C 640</td>
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<td>Sony VO 1810</td>
<td>1''</td>
<td>cassette</td>
<td>o</td>
<td>o</td>
<td>PAL record/playback, NTSC playback, 2 audio channels, search, auto repeat.</td>
<td></td>
<td></td>
<td>C 735</td>
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</tbody>
</table>

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AKG CK9

Obviously there are limitations of movement, and the 1.5m is about the closest distance practical for this arrangement in order to preserve the balance between voice and guitar. Used closer on voice alone, the microphone discriminated quite well against the guitar (acoustic) provided the mic was inclined upwards from in front of the performer so that the soundbox of the guitar was towards the least sensitive direction of the microphone at low frequencies. In practice it is a little more difficult to position the microphone for reinforcement of the guitar as it becomes rather hard to avoid changes in balance and sound quality with movement.

Voice

As an extension of the above, tests with close singing were carried out. No problems or vices were encountered provided the singer remained reasonably on axis and did not approach closer than about 8 cm from the end of the mic. Off-axis sound was slightly light but otherwise clean and free from any apparent nasties.

Musical box

In order to examine whether the CK9's complicated arrangement of tube, slots, damping materials etc produced any nasty effects on transient sounds, as from a musical box or the like, comparisons and recordings were made using a small musical box, with great care that the reproduced sound was at the same level as the original, and that in the case of the recordings the A-B test was made with the musical box and speaker in as nearly as possible the same position in the listening room; listening was carried out at various distances. The results were quite remarkably good and very much better than similar tests with another less complex capacitor microphone. The sound was clean, bright and without unnatural tizz or fuzz of any kind. There were no reservations except that it is most important that the sound should originate on the microphone at 105° or less, if it was surprising how the quality was 'shaded'.

Piano

The piano is possibly not the first instrument that springs to mind when considering applications of the gun microphone, but I felt it would be interesting to see just how well piano could be recorded (in mono) using the CK9, in view of its satisfactory performance on other material so far.

Apart from a slight lack of bass at the bottom, quality was remarkably good. A recording made at approximately 5m in a live room sounded quite dry on replay, except right in the bass where the tail in directivity was not entirely balanced by the falling response, and where raising the bass to compensate made matters worse. However the exercise did show just how good the results could be should the need arise.

Birdsong

A number of outdoor recordings of birdsong and other sounds, natural and unnatural, were made. These included, as well as birds, the sounds of active bees, passing helicopters, cars and aircraft, children at play, distant lawn-mowers, telephones etc; in fact a fair package of general sound effects. All reproduced convincingly; on a still day there was no need for the windshield and with care handling noise and transmitted rumble were minimal. This and similar gun microphones are being used for natural history recordings by a number of professionals, particularly those connected with natural history films; this is to be expected in view of the excellent sound quality obtained, the standard of construction and pedigree of the instrument, and the ease with which it is possible, getting this from its unobtrusive appearance. On the other hand it must be remembered that many sounds in nature are quite quiet, as too are distant sounds such as cricket ball hitting stumps, so signal-to-noise ratios can become a problem. The background noise of the CK9/C451 system is very low, but nevertheless there comes a point at which a distant sound is just too quiet for a satisfactory signal-to-noise ratio to be obtained.

A gun mic can discriminate against ambient noise, but not against its own amplifier noise; unlike the old parabolic reflector arrangement there is virtually unity gain in the direction in which the microphone is pointed, by comparison with the basic cardioid. At frequencies where the diameter of a parabolic reflector is substantially greater than the wavelength of the incident sound, a considerable improvement in the output results through focussing of the sound on to the microphone, which can be an omnidirectional or cardiod type according to the relative importance of signal level and narrow angle of pickup. Against this, there are the disadvantages of poor directivity at low frequencies and variations in frequency and polar response at middle and higher frequencies (Robertson—'Microphones', Ch. 11). Nevertheless, there are instances where a good, quiet cardiod such as the basic CK1/C451 combination, in conjunction with a suitable reflector, may be more appropriate where appearances can be traded for signal.

Polar response

Mention has already been made of the apparent rapid cut-off in theSter off axis, and the club-shaped design characteristic for the polar response over a wide frequency range. Some speech tests were therefore carried out to supplement the observations under various headings above with regard to the subjective polar response over the speech band. These were in turn supplemented with similar tests using the musical box, which showed up rather more clearly the narrowing of the response lobe at high frequencies.

At 15° off axis, the output from the musical box was noticeably dullest; at 30° off axis, speech and musical box were both down in level, particularly in the off axis, and with cardiod top. At angles beyond that it was easier to get meaningful results with speech than with the musical box, which is fairly quiet in any case. Minimum output in the speech band seemed to occur at about 120° to the main axis of the microphone, and output was still very well down at 180°.

Next, to investigate the effect of the interference slot on the polar response around the microphone, it was mounted fairly low on a stand, facing upwards from a well-carpeted surface. The speaker then walked sideways in a circle around the microphone, speaking at a constant angle of about 45° to the main axis. Taking the interference slot as reference, the top apparently reached a maximum at about 180° to the slot, ie with the interference slot out of sight behind the microphone. The effect was slight, however, and I would doubt very much that it would ever be of much consequence.

Popping

The popping problems associated with some microphones on close speech or singing are unlikely to be encountered with this one if only because of its likely uses. A possible exception is during radio or television interviews in a crowded area, where the gun mic might be held over the heads of the crowd towards the interviewee and might either accidentally be swung too close or come close to some other speaker (it would be very bad policy to use the microphone within a few centimetres of a person in the majority of sound reinforcement applications). It was found that close speech at about 5-8 cm from the front of the tube would produce some popping, but the problem is completely removed by use of the windshield and is very unlikely to be a serious one.

Wind noise

The microphone was used successfully out of doors on a calm day without the need for windshield or fluff filters. A moderate breeze caused some noise, however, and a strong wind a fair amount of blowing, as is to be expected. AKG supply a polyurethane foam windshield (type W109) which covers almost the full length of the CK9 and offers a claimed attenuation of 20 dB to wind noise. They also supply and recommend the Rycote windshield (see below), designed for use with the CK9 and similar slimline gun microphones; this proved entirely successful in coping with all winds at our test site.

Handling noise

On the whole the microphone proved relatively free from handling noise, though handling was much improved by the compliant mounting in the Rycote windshield. The attenuation of rumble and bumps was helped by the use of the 75 Hz filter, without seriously degrading the response.

The rubber backgrip H7 may also be used to reduce handling noise in conjunction with the windshield or a fixed stand grip for the microphone.

Bass filter

The C451EB amplifier supplied with the CK9 was the version incorporating switched bass filter from 75 and 150 Hz, giving 0, 7 and 20 dB attenuation at 50 Hz in addition to the design attenuation of low frequencies.

Most listening tests were carried out with the switch in the flat position. The 75 Hz turn-over position was found useful in reducing handling bumps and rumble, without affecting speech quality; it did not cope significantly with wind rumble, for which the 150 Hz setting was better and the windshield very much better still. Obviously the 150 Hz position could be useful under adverse conditions of noise and rumble, but where possible the 75 Hz setting would be preferable if the flat setting cannot
be used. If the switch, which is obscured by the end of the CK9 tube, is to be left set, I would feel inclined to position at the 75 Hz turnover for general use as a compromise, as the 150 Hz setting normally makes speech sound a little thin. Obviously this is a matter for personal experiment, however, and for musical purposes the bass loss would have to be borne in mind; on the other hand for birdsong recording etc the bass loss could be an asset in reducing distant traffic rumble etc from the outset.

An external bass filter type KF 1E (~30 dB at 30 Hz ref 100 Hz) is also available.

Residual noise
To those who know the C451 family of microphones it will come as no surprise that the background noise of this combination is very low and allows considerable flexibility in use. Moreover, regardless of noise measurements and weighted/unweighted figures, the microphone sounds quiet—what is this if there is, smooth and its spectrum makes it unobtrusive.

No hum problems were encountered, even when using the output unbalanced. The source impedance is below 200 ohms, and long balanced leads may be connected without problem. It is very unlikely that distortion would ever be a problem.

Summary
The CK9/C451 combination gun microphone is a beautifully made and finished device. It produces sounds of a very high quality, with low background noise levels as well as low ambient noise levels. The axial frequency response is smooth, and the slight rise from extreme bass to the top end, some 8 dB in all, produces the effect of a clear and balanced sound in conditions of high ambient noise or reverberation without making the instrument unusable for music purposes. Its speech performance is particularly good. The microphone offers a high degree of discrimination against off-axis sounds, and though this discrimination is not wholly independent of frequency the polar response is well maintained over a wide range; discrimination is considerably better than on many earlier and present designs of gun microphone and the deficiencies are to some degree mitigated by the slight tilt of the axial frequency response. In conjunction with the other accessories available, the CK9 is a most useful component in the CMS range from AKG and offers great flexibility in use.

In addition to what one might call the traditional uses of the gun microphone—hand-held outdoors, boom-mounted indoors and out—high quality gun microphones are now being used in high quality sound reinforcement and for stage pick-up in the theatre, where it may be necessary to place a microphone by the edge of footlights or even in the pit while discriminating against nearby (orchestral) sounds. On the strength of my own experience with this microphone, I would expect this to be a growing use of the gun mic where—as in this case—the microphone's performance will enable this to be done satisfactorily. The CK9 has the bonus of being inconspicuous, and beautiful if you do spot it.

B 46 Battery unit
The B46C is a small, solid, matt-nickel finished unit, approximately 35 mm square by 114 mm long (142 mm including XLR female termination), with a captive screened-twin lead providing a balanced output via an isolating transformer. The transformer is centre-tapped on the input side to provide 9V phantom powering for the microphone via the balanced signal leads and the microphone output transformer. There is a recessed slide switch in the case to switch the supply on and off, with an engraved red dot for 'on'. A single large non-capitive bolt, which can be turned easily with a 3/8 piece, enables the inner part of the unit to be slid out to exchange the 9V PP3-type battery or equivalent Mallory TR145X cell. The battery supply is decoupled. A similar unit designated B46C is available with DIN connector for use with the appropriate leads and amplifier. The unit is intended to supply one microphone only.

Rycote windshield
The Rycote windshield intended for use with the CK9 assembly is a long, white sausage-shaped affair, fitted with a detachable handle. Externally, the windshield is made of a stiff, coarse white plastic mesh, with large spaces between the cross-members of the mesh. The two ends are rounded, and the hemispherical ends are coupled to the long tubular section with grey plastic rings. The ring at the tail end of the shield is split, and a cunning hole-and-pimple plus velcro tape arrangement allows the end to be removed and replaced easily in order to fit the microphone inside; there is a small double slot provided for the microphone cable to emerge through this ring, and the cable is gripped quite well by this arrangement when the microphone is in position. Inside, there is another reinforcing ring at the middle, and the inside of the plastic mesh is lined with thin white brushed nylon or some similar material. A reinforcing strip of plastic along part of the length of the shield carries the bolts for fastening the detachable wooden handle, as well as the compliant rubber mountings for the nylon grips that hold the microphone. Slipping the microphone in and out of these is quite easy once the knack is acquired. The microphone is positioned so that neither the front nor back of the CK9/C451 unit rubs on the fabric at the end of the windshield.

In use the windshield was found to be completely effective in moderate winds and when swinging the microphone unduly rapidly. Unfortunately, there were no gale-force winds during the period of test. The windshield also helped cut down handling noise and rumble considerably, because of the compliant mounting inside. However the varnished wooden handle did give rise to some scuffling noises, which were completely eliminated by using the AKG H7 pistolgrip, for which the end of the wooden handle carries a threaded insert. The balance of the combination is good for easy handling and rapid pointing and, if anything, is improved by use of the H7 as well.

Comparative tests were tried with the windshield on and off the microphone, to see whether there was any detectable affect on sensitivity or frequency response. The effect on speech was very subtle, if any, and I would strongly recommend the use of the Rycote windshield with the CK9 for outdoor or handheld use.
The use and performance of the various accessories supplied with the CK9/C451EB for the microphone have been dealt with in the body of the field trial, and I shall confine myself here to brief descriptions.

**H7 Pistol grip**

The H7 pistol grip is intended for use in conjunction with the CK9 and either the Rycote windshield or the AKG SA70/3 stand adaptor. The pistol grip is moulded in a semi-flexible rubbery material, which reduces the transmission of rumble and bumps, and produces less finger movement noise than the wooden handle of the Rycote windshield does without the H7. The finish is matt black. A useful extra. 

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**SENHEISER MKH 815T**

By John Fisher

**THE TESTING OF** the microphone was necessarily fairly basic, for as with other electroacoustic transducers there is always some doubt as to what extent the measured results correlate with the subjective performance. The sensitivity was found to be 5 mV using the DIN standard powering arrangement for a sound pressure level of 74 dB sp1 at 1 kHz (equivalent to 1 microbar) which is within the upper limit of the manufacturer's specification allowing for measurement errors. Because of this high sensitivity the microphone is capable of delivering up to half a volt at high sound pressure levels, so considerable care must be exercised to make certain that the microphone amplifier being used is capable of handling such a high level without overload; if necessary attenuators can be inserted in the microphone line without excessive loss in signal to noise ratio.

As shown in fig 1, the microphone's impedance is less than 20 ohms between 500 Hz and 20 kHz, so capacitive loading by very long microphone cables will have negligible effect upon the frequency response, the recommended microphone amplifier input impedance being greater than 200 ohms.

The noise performance of the microphone was found to be extremely good, the equivalent sound pressure level of the internal noise being only 22 dB(A). Taking into account the high sensitivity, this means that very good noise performance can be achieved even if rather poor microphone amplifiers are used!

Instead of plotting a polar diagram of the frequency response, fig. 2 shows the response on axis, and at three different angles off axis. These curves were obtained under conditions which were not perfectly anechoic and must therefore be treated with some caution; however, they do show the pattern of the microphone characteristics. It is to be seen that on axis the microphone has a rising characteristic at high frequencies which I believe to be a desirable characteristic for a gun microphone, and also a fall off at very low frequencies which was found to make the microphone very tolerant of 'handling noise'.

A very rapid fall-off occurs at middle and high frequencies with mild orientations off axis with a pronounced dip around 8 kHz, but provided that the microphone is aligned within say ±15° this does not present any problem.

Finally, on the powering side, the microphone current drain was found to be 6.7 mA into the DIN standard power arrangement of two 180 ohm resistors being fed by 12V. This requirement is met by such recorders as the Nagra IV, and for other applications Sennheiser manufacture a variety of powering devices.

Hugh Ford

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**MANUFACTURER'S SPECIFICATION**

**Studio directional microphone**

**Connector socket:** 3 pin standard to DIN 41 924.

**(Type MKH 815 T-U : 3 pin Cannon XLRF.)**

**Dimensions:** 19 mm dia, 550 mm long.

**Weight:** approx 370g.

**Frequency response:** 50 to 20 kHz

**Operating principle:** Interference line.

**Directional characteristic:** lobe.

**Sensitivity at 1 000 Hz:** 4 mV/µbar ±1 dB; 40 mV/ Pa ±1 dB.

**Impedance:** approximately 20 ohms symmetrical floating.

**Nominal load:** + 7200 ohms.

**Signal to noise ratio to DIN 45 590 ref 1 N/m²:** 74 dB.

**Maximum sound pressure level:** 150 µbar.

**Operating voltage:** 12 ±2V.

**Current drawn:** approx 6 mA.

**Temperature range:** -10°C to +70°C.

**Manufacturer:** Sennheiser Electronic, 3002 Bissingen/Hann, West Germany.

**UK distributor:** Hayden Laboratories Ltd, Hayden House, 17 Chesham Road, Amersham, Bucks.

Introduction

THIS MICROPHONE CAME for review at the same time as another gun microphone, the AKG CK9/C451EB combination from their modular range of capacitor microphones. To avoid unnecessary repetition I refer to the
An earlier Sennheiser gun microphone design is described in some detail, along with others, in A. E. Robertson's standard work 'Microphones'; it was a moving coil type, some 200 cm long. Another design, by Western Electric, was some 150 cm long, and it is interesting to see how a similar or better directivity, coupled with other improvements in performance, has been achieved in much smaller dimensions in the current generation of gun microphones, following the general trend with microphones as a whole.

Operating Principles

Like the AKG gun microphone, the Sennheiser MKH815T uses a capacitor capsule as the transducer, and an interference tube to increase the directivity. In other words, a slotted tube is coupled to the front of the capsule, and while sound entering from straight ahead passes down the tube largely unimpaired, sound striking the microphone from the side enters via the various apertures along the length of the tube and arrives at the capsule out of phase with sound from the same direction which has entered the front of the tube; the result is a cancellation or interference between these out-of-phase waves and a reduced or zero output. The effect is dependent on angle and frequency, and at low frequencies the microphone is increasingly dependent on sound reaching the rear of the diaphragm to provide directivity, as in a conventional cardioid design. The general effect is to produce a single large lobe in the direction in which the tube is pointed; the lobe becomes narrower at high frequencies but pickup from the rear may also increase. The aim is normally to provide high directivity over the speech band at least.

In other respects, however, there are a number of interesting differences between the AKG and Sennheiser designs. The Sennheiser is not modular; designed as a single unit with transducer and amplifier in one housing. Furthermore, unlike the AKG design which uses an et front end and a dc polarizing voltage, the Sennheiser microphone uses rf techniques to obtain the audio output, allowing the voltage across the capsule to be kept down to some 10V ac, with a number of obvious advantages as regards humidity, etc, as long as the rf technique is as good as the fet amplifier in other respects such as noise level and linearity.

The Sennheiser circuit uses an 8 MHz crystal controlled oscillator, which feeds a discriminator tuned by the capacitance of the capsule. The resultant audio output is amplified, buffered and filtered. The output impedance of the amplifier is low, which makes for non-critical impedance matching, and the output is at a rather higher level than is normal with professional capacitor microphones; it can indeed be used (unbalanced) to feed the auxiliary input of a Revox recorder.

There have been two schools of thought about the use of rf circuits in capacitor microphones. One advocated rf circuits because with careful design and adjustment they offered low noise levels and avoided some of the problems of high-voltage, high-impedance circuits; the other complained that the stability of the circuits, particularly under tv lights and in hot, humid atmospheres, was not good enough to ensure that satisfactory performance was maintained. Doubtless the inclusion of a crystal oscillator indicates that some care has been taken to provide the necessary stability. It would be very difficult, however, in a field trial of this kind, to simulate accurately and adequately over a sufficient period the adverse conditions under which such a microphone might be used; beyond saying that no problems were encountered in the course of testing, no comment can be made or should be implied from this field trial on the long-term performance of the microphone under extreme conditions; nor should this caveat be taken as implying that the microphone will not be satisfactory under those conditions.

The use of rf techniques rather than the conventional high impedance input removes the need for a very-high input impedance amplifier, removes the danger of arcing as the voltage applied to the capsule is low, removes the tension on the diaphragm due to the polarizing voltage on a conventional capsule system, removes the need for special high-value resistors and low-noise fets or nuvistors in the amplifier circuits, and keeps impedances in the amplifier low; the floating supply system removes the need for an output transformer while allowing the dc supply to be carried by the twin audio leads in a similar way to phantom powering, but without a dc flow through the screen (which has been known to cause noise on certain microphones).

It should be noted that the A-B powering technique used by the Sennheiser is not directly compatible with phantom powering; a number of readers may be more familiar with phantom powering than A-B powering to DIN 45595, and accordingly the method of connection for floating and unbalanced inputs is shown in fgs. 1 and 2 respectively.

Alternatively, a battery adaptor type MZA 6-2 is available; this takes a stack of nine Mallory RM 615 or 58 mercury cells and screws directly to the output connector of the MKH815T; a similar unit is available for connection to the Cannon terminated version of the microphone; other units available are two mains supplies, a matching unit if filter for connection to Nagra inputs, a rumble filter and an adaptor for powering from 12-48V phantom supplies (MZA 50 P-O and MZA 50 P-O for DIN and Cannon XLR versions respectively). None of these units was supplied with the review microphone, but I would expect the battery unit to be a most useful extra for mobile work.

Construction

The MKH815T is visually a very beautiful piece of engineering. It is slightly slimmer and shorter than the AKG gun microphone, partly because of its integrated design. Sound enters the front of the interference
Sound quality was assessed using live-replayed concerts of various programmes and limited comparisons on speech, and limited music tests. Performance General Tests were carried out over a period of several weeks to assess subjectively the performance of the MKH 815T as a highly directional microphone, under a variety of conditions. Other capacitor microphones were used for comparative purposes, including the AKG CK9 unit; listening tests were carried out using Sennheiser BCI and other high-quality loudspeakers.

A small booklet accompanies the microphone in its padded wooden case, and provides all the necessary information with regard to powering and connection; the microphone is supplied with its own axial frequency response curve as measured by Sennheiser. On the review sample the hf response in the 8-15 kHz region, as measured by Sennheiser, appeared to be just outside the manufacturer's specified tolerance for rise in output in this region; similarly at the lf end the bass roll-off started earlier but was better maintained at the extreme than implied by the manufacturer's published nominal curve (though measuring conditions are likely to influence the lf readings in particular). The general sound produced by the microphone suggested that there was indeed a definite rise in output at high frequencies, and while this gave a clear sound it was not always quite as natural as sound obtained with other microphones, among them the CK9 gun mic.

The general impression was of a slight lack in bass, combined with a noticeable rise in output at high frequencies; the sound produced was very acceptable under adverse conditions, but given better conditions the sound of the CK9 unit was felt to be a more natural balance and to be preferred. The output from the Sennheiser could of course be 'tamed' externally by an active or passive unit to reduce the hf output if desired, and this would have a small bonus in reducing the hf content of the residual noise of the microphone.

Speech
As with the AKG gun unit, particular attention was paid to speech tests, for the same reasons. The sound was always clean and clear, with a slight incisive edge which was more apparent on some voices than others. Female speech tended to show an emphasis of consonants, in particular the sibilants, more than male speech. The effect was of a slight brightness and sparkle on speech which sounded artificial by comparison with the original, without the harshness associated with the presence (or inherent) bumps in the performance of other microphones. The hf rise is certainly more steep than the slight rise or tilt found with the AKG microphone, and bears out the manufacturer's pen trace which indicates a rise in response of approximately 2 dB at 5 kHz and 7 dB at 8-15 kHz; I have seen no measurements to confirm these figures, at the time of writing, but fiddling with tone and filter controls suggests that the figures are of about the right order. The slight fall in bass response was not generally noticeable on male speech, particularly in noisy or reverberant surroundings; with the hf rise approximately removed, the sound quality on speech was almost indistinguishable from that obtained with the CK9.

Musical box
Direct comparisons and recordings made with both a small musical box were quite revealing in some respects. On axis the sound was slightly over-sharp, 'ticky' or 'white', to use some very subjective descriptions. Off-axis the sound of the musical box was rapidly muffled as the angle relative to the axis increased; the fall in top was noticed at about 10-15° off axis and the sound was distinctly muffled by about 45°, by comparison with what it had been and with the original.

Once again the on-axis sound could be made more nearly like the original by approximately removing the hf rise with tone and filter controls, though the improvement was less easily detected than with speech; the remaining differences between the original and reproduced sound were quite subtle, however, and must in part be due to other links in the reproducing chain.

Music tests
Limited music tests were carried out using singer with guitar, piano, and voice alone. Both guitar and voice acquired an edge or brightness that was not characteristic of the original; it would be perfectly acceptable in many folk or pop music recording contexts, and is not necessarily a criticism of the microphone. It is mentioned here as a pointer to the kind of sound quality to be expected from an uncorrected microphone of this kind; it must again be said that this edge was not one that would be likely to prove objectionable or particularly obtrusive, but it does show up on direct comparisons with the original. Unlike the sharp peaks in some microphones, it is the kind of smooth and broad rise in response that can if necessary be at least partially corrected if such correction is not considered detrimental in the original choice of the microphone.

In other respects voice and guitar reproduced well, and a respectable balance of both was obtained at about 2.5 m in fairly reverberant surroundings; when the capsule part of the microphone was about 1.5 m away, about the closest that would give a reasonable balance, the microphone was reasonably tolerant of noise and disturbance from well off axis. A singing voice on its own showed up a slightly husky edginess. No particular problems were encountered with the singer on axis, provided the singer kept at least 20 cm from the front of the microphone. Puffs of breath produced quite a good pop at closer ranges. No distortion problems were encountered, but it is quite easy to run into microphone amplifier distortion at the mixer or recorder in view of the relatively large output from the microphone—again, it is easy enough to attenuate the output.

Piano reproduced quite respectably via the MKH 815T; it was felt preferable to tolerate the slight loss of lower bass rather than accentuate the reduced hf discrimination in reverberant surroundings.

Outdoor sounds
In addition to speech tests undertaken out of doors over long absorbent grass (my best excuse yet not to cut the paddock) recordings were made of birdsong, insects, the sounds of trees in a gale, passing aircraft, cars, etc. All were well reproduced and many proved quite convincing. No peculiarities or vices were revealed, and the microphone handled well.

Polar response
Attention has already been made of the microphone's ability to discriminate against unwanted off-axis sounds, and of the more marked loss of high frequencies off-axis. The polar response was investigated a little further using speech and musical box tests. Comparisons were also made between the performance of the Sennheiser and AKG gun microphones.

The overall impression was that the directivity of the MKH 815T and the CK9 were fairly similar; if anything the Sennheiser is slightly less directive than the other, but we found it difficult to be positive on this score, and no doubt slight differences in the respective microphones' polar patterns at different frequencies would account for this uncertainty and give conflicting impressions on different kinds of programme material. At 10-15° off axis little change was noticed on speech, but a just perceptible loss of high frequencies was noted when testing with the musical box. At 30° off axis a signal fall off was noticed on both speech and musical box; output was appreciably down by 45°, the musical box sounding quite distant, and rejection between 90° and 180° was very good. Allowing for the slightly greater output at
high frequencies on the MKH815T than on the AKG CK9 (on axis), the sound quality and directivity appeared fairly comparable, the main difference if any appeared to be at around 30° to the axis, where the fall-off in LF seemed more rapid on the Sennheiser than the AKG, but where the AKG seemed marginally more discriminating across the speech band. In other words, the Sennheiser microphone appeared to give a very slightly broader angle of acceptance for speech than did the AKG, with a slightly more rapid initial fall in output at higher frequencies than with the AKG at angles off the axis, and a more noticeable change in quality from the extra brightness on axis to the restricted response off axis. At low frequencies the directivity of the two makes of microphone was subjectively similar. To assess the effect of the slot on the polar response of the microphone about the main axis, the microphone was mounted on a stand pointing upwards, and speech tests were carried out with the voice moving in a circle around the microphone. There appeared to be little variation in speech quality, except that on sounds coming from directly behind the microphone—this is, with the apertures out of sight for the person speaking—there was a reduction in top, just enough to dull the sound slightly; curiously, this seemed to be the opposite effect to that noticed when a similar test was carried out with the CK9 gun tube. The head of the person speaking made an angle of approximately 30° to the microphone; insufficient tests were carried out to ascertain whether the effect was maintained or reversed at slightly different angles, and since it was relatively slight and unlikely to be of too much consequence in practice, I would not attach too much weight to the importance of this observation, mentioning it only as a matter of interest.

Bass filters
The bass response of the microphone is fixed, and falls slightly below 150 Hz, with no adjustment provided on the microphone. As mentioned earlier, a plug-in attenuator for use between power unit output and mixer/amplifier input is available, giving a reduction of approximately 6 dB at 100 Hz and 15 dB at 50 Hz. LF filters are also incorporated in the adaptors available for connecting the microphone directly to Nagra inputs. In practice it was remarkable how well the microphone handled and behaved out of doors without additional filtering at low frequencies.

Residual noise
The background noise was found to be very low. Because of the relatively high output level from the microphone, noise in the input amplifier of the recorder or mixer used with it is unlikely to prove troublesome. No hum or ripples were encountered during the tests, and the absence of an output transformer in the microphone may help avoid possible problems of induced hum.

Very rarely was background hiss apparent, except when using the microphone for capturing birdsong or the like on certain occasions. It is not easy to say whether the residual noise level of the Sennheiser MKH815T or the AKG CK5/CK9 combination is lower, but due account is taken of levels and matching, but my impression is that the signal-to-noise ratio obtained must be of about the same order, there is slightly more high frequency output in the hiss from the MKH815T than in the hiss from the AKG microphone, and this makes it that little bit more noticeable. However, the noise performance of both microphones is very good and the higher signal level from the MKH815T could certainly be an advantage in some cases; on no occasion did music or speech testing with there any apparent distortion from the sound levels encountered, and one is unlikely to be recording trumpets at a few centimetres range with this kind of microphone.

Ambient noise
Ambient noise levels achieved, in and out of doors, were good confirmation of the directivity of the microphone, and the noise itself seemed reasonably balanced in spectrum. Out of doors the ambient noise is of course dependent on the direction in which the microphone is facing—quite an amount of rustle may be picked up when the microphone is pointed towards trees, near silence when pointed towards the sky, and this produces quite marked changes when following a bird, for instance.

Popping
Please refer to my comments on this in the CK9 review. Checks on popping were made with the MKH815T. Speech very close to the capsule proper could produce popping, and speech at moderate levels some 6-8 cm from the front of the interference tube also caused it. This became very severe at 3-5 cm from the front of the tube, and the effect was much more violent at the closer range than when a similar test was carried out with the CK9 for comparison. Use of the windshield should eliminate most such problems, but of course the slim lines are lost.

Wind noise and movement
Perhaps one of the most outstanding features of the MKH815T appeared to be its good behaviour in wind and when moved violently; it would tolerate being swung through the air much more rapidly than I can imagine any sane boom operator doing, and when taken out into a gale that removed branches from a large bee tree the microphone behaved quite remarkably well: true, there was some low frequency rumble, but at quite a low level, much lower than most ordinary cardioids were to produce under those conditions, that very much lower in level than produced by the AKG gun mic under those same conditions. There had been no convenient gale at the time of carrying out the windshield tests on the CK9, but when the microphone was flown on the trees during the typing of this report I seized the opportunity of a little more testing. Recordings made with the MKH815T, without windshield, were perfectly intelligible under these conditions and could probably have been cleaned up satisfactorily with a steep high-pass filter, while recordings made at the same time with the CK9 unit were so badly blasted as to be totally unintelligible and to cause anxiety for the welfare of the listening loudspeakers! A windshield would obviously have improved things considerably for both microphones (rain stopped play) but I was very impressed at the unshielded performance of the Sennheiser microphone.

Sennheiser can supply a foam windshield (MZW 815) or a windshield which appears to be similar to the Rycote one supplied by AKG for use with the CK98 unit, but the latter, their version of the latter (MZW 804) is water resistant, and claimed reduction of wind noise is 26 dB as against 16 dB for the foam type. Pistol grips and shock mounts are available for use with the microphone and windshields, but neither windshields nor mounts were supplied for review with the microphone.

Handling noise
Even without the shock mounts which are available, the MKH815T handled remarkably well, with a minimum of thumps, rumble and chuffing. As on wind noise, it scored over the AKG microphone on these counts. Ideally, though, one would use one of the compliant shock mounts, but in an emergency a reporter could use the microphone as it stands.

Case
The microphone comes in a rigid, padded and lined case with a hinged lid; a piece of foam or the like is necessary to stop the microphone sliding up and down the recess, which is the full length of the box. The case is not really designed to accommodate a lead. While it provides quite good protection, for the...
**Sennheiser MKH 815T**

microphone in transit, the hinges are a little flimsy and one had come adrift by the time the review microphone had done its rounds and reached me. This is a minor detail on an otherwise well finished and produced article.

**Summary**

In appearance the microphone is extremely elegant, small enough not to be conspicuous, and is beautifully finished.

It produces high quality sounds with low background noise levels and low ambient noise levels. Although there is some emphasis of extreme top, the sound is clean and the spectrum of the indirect sound picked up is subjectively well balanced.

For naturalness of sound, I would not consider the MKH815T quite the equal of the AKG microphone on two scores: the substantial rise in h/f output, and the apparently slightly more directional characteristic of the MKH815T than the C89 at the highest frequencies. On the other hand it must be pointed out that the h/f rise on axis can at least be reduced to perfectly acceptable amounts for purist purposes by external equalization; for many purposes the response would be perfectly acceptable, and perhaps desirable as it stands, and over the range of frequencies that are important for intelligible speech the angle of pickup appears to be very slightly greater than that of the AKG microphone, which could have advantages in certain situations. The noise performance was considered similar to that of the AKG microphone subjectively with possibly a slightly more tony hiss from the MKH815T.

In terms of flexibility, the AKG microphone scores on the grounds of its modular construction, but for many people this may be balanced by the better wind and handling performance of the Sennheiser. With the appropriate windshields there should be little to choose between them normally, but the Sennheiser seems basically more immune.

I would not attempt to pick a 'better buy' from these two microphones—and there are, after all, a number of others to be considered—when shopping around—since the gun microphone is a specialist microphone and it is the specialist's particular needs that will, or should be allowed to, dictate the final choice. It can, however, be fairly said that where a highly directional microphone is required, whether for hand, boom or fixed use, indoors or outdoors, for film work, sound reinforcement or sound gathering, this microphone should be considered as a serious contender.

**Radio Manchester**

another string of offices with double-glazed windows looking out over the traffic below. One can imagine with a shudder the sound leakage problems that would have arisen if Piccadilly Radio had been put together in a four-month rush like the London stations, without time to think out the best way of isolating the studios from the noise of the outside world.

Like Capital, Piccadilly Radio has no shortage of exciting plans for the future. The portable New PSM 12-2 used for outside broadcasts will be built into Control Room 2 and a new mixer brought in for the new studio intended for home-grown jingle production. Also a new portable desk is being designed for permanent availability on outside broadcasts. This will be ganged with a discotheque system of broadcast quality so that Piccadilly DJs can go out to local halls and clubs and broadcast live disco sessions. An extensive range of portable Uehlers, radio telephones, uhf walkie-talkies and a radio car mean that if the Bomb drops on Manchester, it will be well covered by Piccadilly. If the worst comes to the worst, a reporter can phone in from a call box and be punched through to one of the holding lines on the studio control desks.

After a month on the air, Piccadilly had NIP carry out a dipstick survey to give them an idea of how many adults (over 15) were listening to their station in Greater Manchester. The results suggest 1.2M, and whether this is accurate or over-optimistic should emerge from the full diary survey which is already being planned. Certainly, local radio advertising seems to work in Manchester. One local shoe shop bought 21 short spots over a weekend for a half-price shoe sale. At 9 o'clock on Monday morning there were 500 people queuing outside.

One national newspaper, that shall be nameless, is certainly none too keen on Piccadilly. After the station gave away track suits with Piccadilly Radio lapels to the Lancashire cricket team, the paper ran a picture showing them training in smart outfits rather than in the usual sloppy sweaters. The same paper made sure that the Piccadilly Radio logo badges had been dutifully and carefully airbrushed out to avoid publicity for the radio station. Somehow I doubt that silly incidents like that will detract from the long-term success of Britain's commercial radio stations. But whether in the long-term the economic climate, the cracklingly high IBA transmitter rentals, and the large number of fresh stations due to open over the next few years will enable the broadcasters to make a profit, is quite another matter. Only time will tell that particular story.

**Schoeps CMT 36-56**

for strings and piano, and the Schoeps for a predictably flat sound that can be 'bent' to whim with equalizers.

The technical performance of all of the microphones matched their individual reputations on the whole—the Neumann U87 and the Schoeps microphones both had marginally lower noise than the AKG C114 but there was little in it. The Schoeps microphones at -58 dBV for 74 dBV gave 4 dB more output (1 KHz octave filtered pink noise) than the Neumann U87 at -62 dBV which in turn gave a further 4 dB more than the AKG C414, at -66 dBV.

When choosing a microphone to buy, the more modest fixed polar diagram microphones should not be forgotten (such as Neumann KM54, AKG C452 or Calrec CM1050) which start at a fraction of the price of the three variable polar micros. When we carried out these comparison tests, a Calrec CM1050 stick cardioid capacitor mic was included on one occasion—and did very well against its more expensive colleagues, although it obviously lacks the flexibility of variable polar pattern.

**Agony Column**

Following the normal routine, it was requested that a reference acetate be cut of the new album by a rising superstar; the tapes had appeared from America and were awaiting processing. The afternoon was boring, and a fairly dubious lady singer's album was lying around in line for similar treatment. The lathe's varipitch was not working, although fortunately when this happened (often) the resulting grooves were very steady and certainly the tolerances were well within the manufacturer's specification. After more than twice the usual time needed for the job, for cutting two parallel grooves is an exciting task, it was sent upstairs to the house producer. After about half the time taken normally, he rang down complaining that there was some appalling woman on the disc who didn't sound at all like a superstar. Up went the engineer, put on the disc and, as a toss of a coin might have it, out came the superstar. Exit engineer, leaving house producer in some confusion. The next phone call took longer, but said the same; and there the joke ended, because the chances against were 71 anyway and couldn't be stretched that much farther.

In the most calm and dignified voice at 0.05 am on August 11 last year, Radio 3 vhf: 'This is the Open University and that was the signature tune at the wrong speed'.
TEAC 3340
The Teac A 3340 professional model is a very high quality, 4 track (separate) recorder, operating at 7½ and 15 i.p.s., with full built-in sel-sync facility. Potential 8 input source (4 line and 4 mic) incorporating separate mixing controls on front panel. In stock.

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STUDIO AND PROFESSIONAL USERS

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NETT PROFESSIONAL PRICE ON APPLICATION

SCOTCH 207 at very competitive prices

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NETT PROFESSIONAL PRICE £175 + VAT

REW Audio Contracts are able to offer the following microphones at professional prices (subject to stock) to bona-fide pro users.

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Advertisements for this section must be pre-paid. The rate is 8p per word, minimum 80p. Box Nos. 20p extra. Semi-display rates on application. Copy and remittance for advertisements in FEBRUARY 1975 issue must reach these offices by 18th DECEMBER 1974 addressed to: The Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA.

NOTE: Advertisement copy must be clearly printed in block capitals or typewritten. Replies to Box Nos. should be addressed to the Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality.

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