

# ENG INF

No. 15 – Winter 1983/84 **The Quarterly for BBC Engineering Staff** Please circulate

## Queens Award Received



*Peter Rainger (DDE) is presented to Her Majesty's Lord Lieutenant of the County of Surrey, The Rt. Hon. The Lord Hamilton of Dalzell KCVO, MC, JP, watched by Bryce McCrerrick (DE), on the occasion of the presentation of the Queens Award for Technology.*

On 6 January, Her Majesty's Lord Lieutenant of the County of Surrey, The Rt. Hon. The Lord Hamilton of Dalzell, KCVO, MC, JP presented the Queen's Award to Industry to the BBC's Director of Engineering, Bryce McCrerrick, in the presence of the Director General, Alasdair Milne, and other members of the BBC's Senior Management.

The presentation took place at a short ceremony at Research Department at Kingswood Warren in Surrey. The award has been made jointly to the BBC Engineering Directorate and the IBA's Engineering Division for their pioneering work on the development and transmission of Teletext.

Bryce McCrerrick, on receiving the award from the Lord Lieutenant paid tribute to the many people in several BBC departments who have done so much to make Teletext a success at home and abroad.

Immediately following the presentation, Bryce McCrerrick presented Peter Rainger, DDE; Stan Edwardson, Head of Carrier Systems Section; and John Chambers, Head of Special Projects Section at Research Department, to the Lord Lieutenant. It was Peter Rainger who, as Head of Designs Department, first laid the framework of the Teletext system in 1970 and became one of its co-patentees in 1972. At that time, Stan Edwardson was Head of Special Projects Section of Research Department and was involved in the early pioneering work.

Responsibility for teletext development was later taken over by John Chambers, the present Head of Special Projects Section, who was author of the Teletext technical specification, published in 1976. He has taken charge of the most recent Teletext technical developments involving improved and extended graphics and characters, and the transmission of tele-software on Ceefax.

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## Editorial

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There has been considerable speculation in the national press that the BBC is about to drop or shelve its plans for DBS, or that the satellite should, perhaps, be shared with the IBA. Until negotiations with Government, IBA, and industry are concluded it is unlikely that a decision about the future of DBS will be made.

In the meantime, let it not be forgotten that other new broadcast services are being developed all the time. We reported the start of the telesoftware service in our last edition, and it is emerging that the service has applications beyond the direct downloading of computer programs. For example, a telesoftware adapter, and BBC micro computer can "grab" Ceefax pages such as meat and vegetable prices, and these can be used in a fixed disc-based program involving the preparation and costing of menus. It will soon be possible to embed Telesoftware programs into the teletext element of video discs; as a learning aid this will have considerable potential for students of subjects like botany or biology - observe the picture, and then answer some questions on the subject!

Elsewhere in this edition you will read of the Radio Teleswitching agreement with the Electricity Council. This new service will use phase modulation on the long wave transmitter to adjust the national energy consumption. The long wave data service could be extended for ships at sea, for advance gale-warnings to supplement the present shipping forecasts. For skiers and climbers, advance warning of gales and snow-storms could perhaps prevent the tragic loss of life so recently witnessed in Scotland and elsewhere. An allied service is that of vhf radio-data or RDS (Radio Data Systems) currently being transmitted experimentally from Wrotham on the network radio services. Sweden is already equipped to transmit this service, and Germany is currently equipping all its transmitters for a full scale field trial. Clearly the hard work on both these projects by the BBC Engineers concerned is just beginning to be seen, although there is a long way to go before the

services are fully available to the public.

### Stereo tv

There is considerable pressure from both the trade and the public for stereo sound with television. The results of a field trial in South Wales of dpsk system are reported elsewhere, and have encouraged engineers to try out the system in the London area from Crystal Palace. One of the problems with any new service is that of compatibility, and if you are in the service area of CP and would like to take part in the compatibility tests, you can assist by filling in the questionnaire shortly to be published in Ariel. Valuable data can be obtained by your co-operation, and this is especially true for people who watch one of the CP dependent relays. Similarly it will be interesting to know the effects on the dpsk signal when it has been re-played through a video-recorder - no excuse now for not watching, since you can pre-set the recorder for periods when you are out at work!

### 405—line closures

The beginning of the year saw the closure of some more of the old 405—line vhf television transmitters. By this time next year they will all be gone, and the frequencies lost to broadcasting forever. Various figures were produced as to the use made of this service, and it was thought perhaps that up to 70,000 people could be deprived of a television service altogether when the last transmitter closed. To help these viewers, captions have been injected at most of the main 405—line stations, inviting viewers to contact the BBC so that they could be advised on the alternative services available, if any. The response from the captions has been about 600 letters so far, of which 400 were in areas which are already served by 625—line uhf transmitters. With only two more main station areas to be covered in this way, it would seem that there are only a few hundred households who will be unable to receive any off-air signal at all. Since these are likely to be in the most remote parts of the United Kingdom, we can draw the conclusion that the other 69,000 odd either do not watch television at all, or that "rural de-population" has been

going on faster than the planners know!

### About Eng Inf

Whilst on the subject of Eng Inf, perhaps it is time to pay credit to all the people who help to put it together. To the engineers who provide the stories, thank you for your help and co-operation; to my secretary and the other EID secretaries who laboriously feed the stories into the composing typewriter, thank you for your patience. To the EID graphic designers who make sure the copy is straight and the captions are not transposed, thank you for your efforts. To Print Unit at Wood Norton for designing our new front cover, and for rushing the magazine through the steaming presses, thank you. Finally to you, the readers, thank you for not spotting all of our mistakes!

Alan Lafferty

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## Transmitters Opened

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The following transmitters have opened, or changed since October:

### uhf tv

Biggin Hill	Kent
Blaenau Gwent	Gwent
Bruernish (Western Isles)	Highland
Buckfastleigh	Devon
Burrington	Avon
Castlebay (Western Isles)	Highland
Castleberg	County Tyrone
Copley	West Yorks
Cwmgors	West Glamorgan
Dawlish	Devon
Easter Compton	Avon
East Grinstead	West Sussex
Giga Island	Strathclyde
Llanuwchllyn	Gwynned
Lorton	Cumbria
Moneymore	County Tyrone
Pierowall	Orkney Isles
Tomatin	Highland
Tonyrefail	Mid-Glamorgan
Torteval	Channel Isles
Uig	Highland

### vhf radio

Durriss	Kincardine
Sutton Coldfield	Midlands
Tullich	Royal Deeside
Wharfedale	West Yorkshire

### Local Radio

Alsagers Bank (stereo)	R. Stoke
Heathfield	R. Sussex

## Compact Discs in Radio Broadcasting

Gramophone records have been an important part of radio broadcasting since the 1930's when the record industry became well established. Early recordings suffered from poor quality, and were only really suitable for the transmission of speech. Over the years there have been considerable improvements in the quality of the discs, but the recent introduction of Compact Discs, represents a fundamental departure from the principles which have lain behind all versions since Edison's Cylinder phonograph. Launched commercially in March 1983, BBC Radio have been using Compact Discs in regular programmes since September. But what are these new discs, and why such a marked improvement?

Compact discs carry a digital audio signal, coded as a 16bit linear pcm format. The 12cm diameter disc is made from transparent plastic, with an aluminium reflective coating, sealed with a protective lacquer. Stamped into the disc is a spiral track with pits only 5  $\mu\text{m}$  wide, 0.1  $\mu\text{m}$  deep and varying between 1 to 3  $\mu\text{m}$  long at a track pitch of 1.6  $\mu\text{m}$ . The variation in length of the pits, and the 'land' between them, contains the digital pcm information in the recorded signal. A laser beam is focused to 1  $\mu\text{m}$  and directed through the transparent side of the disc onto the reflective track via an accurate optical system. A prism directs reflected laser light onto a photo detector. Thus when the laser sees the 'land' part of the disc it reflects the light back; when it sees the pit part, the light is scattered and very little passes to the photo-detector.

The detected light pulses thus correspond to the original stamping, and reproduce the digital pcm signal. To obtain the digital signal recorded on the disc, the original audio signal is sampled at a rate of 44.1 kHz to an accuracy of 16 bits per audio channel. Extra bits are added to provide error correction and synchronisation, and to allow for "control and display" information. The final bit rate is 4.32 Mbits/sec. At present the eight sub-code channels (which are decoded from the



*Compact Disc players, centre left, in Radio 3 Continuity suite, Broadcasting House*

"control and display" bits) are not fully utilised, although two of these channels provide information on the length of each track, total playing time, disc identification, and the location of the "pause" area between tracks. Unlike their vinyl counterparts, the disc is scanned at a constant velocity from the centre to the outside. Using the synchronisation information contained in the track, the speed of rotation of the disc on the player changes progressively from 500 to 200 rpm as the laser tracks from the inside to outside. Since there is no physical connection between the disc and the laser, there is no transmitted microphony, and the player is relatively insensitive to shock and vibration; this also means that there is no wear on the disc or pick-up, and no degradation with time. The discs themselves, pocket sized, contain up to sixty minutes playing time without the need to "turn-over" halfway through. The end result is a reproduction system with low signal-to-noise, a very wide dynamic range, and effectively total channel separation.

At present Radio Networks are equipped with six Sony CDP-101 players, two permanently installed in the Radio 3 Continuity, and four more machines for general broadcasting use. These have been used in programmes such as the Anne Nightingale show on Radio

1, and the Kenny Everett show on Radio 2.

Listening tests so far have shown significant differences between the different players and even between two samples of a single type. Not only does the overall sound quality vary, but also the ability to conceal errors on the disc. But perhaps the most significant observation to be made so far is the susceptibility of the system to scratches and fingermarks on the disc surface. In contrast with much of the early publicity, Compact Discs must be handled with reasonable care.

Operationally the Compact Disc system has created a few problems. Since the disc cannot be seen once it is inserted in the player, and there is a distinct lack of noise until the sound track is actually reached, some operators have had doubts that the system is actually working. (With conventional players or tape machines there is always a tell-tale low level of noise or tape-hiss.) The temptation to increase the levels until a noise can be heard, results in a burst of high level programme material when the track is reached!

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## A new look at Moorside Edge



*The old and new masts at Moorside Edge*

The mf transmitting station at Moorside Edge, near Huddersfield has recently been re-engineered by a team of engineers from mf section, TCPD. The new transmitters and aerials replace old equipment, some of which had been in service since 1931 when the station first opened, and other equipment which was installed in 1941. As a result of the new fully-automatic installation, listeners to Radio 1, (1089 kHz), Radio 2, (909 kHz) and Radio 3 (1215 kHz) in Lancashire, Yorkshire and part of the North Wales coast will receive better medium wave reception, particularly after dark when foreign interference is at its worst.

Nine Marconi B6034 50 kW transmitters have been installed with the associated switching and combining units; three for R1, four for R2, and two for R3. Each transmitter uses two air cooled tetrodes in the output stages, with af modulation applied to the screen grid. Incorporating Doherty-modulation in the transmitter, the overall transmitter efficiency is 60%, a considerable improvement on the 35% achieved with the old equipment.

The four transmitters for the Radio 2 service are fed into a quadruplexer specially designed by TCPD and Marconi to achieve the 200 kW output power. The

unit is capable of handling various combinations of transmitters, and incorporates a power splitter that allows output powers in the range 2:1 to 5:1 to be fed to the directional aerial system.

Standby power for the station is provided by an 800 kW diesel alternator set. Manufactured and installed by Mirrless, it is designed to be fully automatic. In common with many other stations, waste heat from the R2 transmitter, which is a 24 hour service, is used to heat the buildings.

The new aerial system at Moorside Edge comprises two 152.4m (500 ft) mast radiators (D and E), with two four-wire anti-phase aerials strung from each of them. The D mast radiator has been completely re-built in a new position, to provide a better signal in a westerly direction towards Liverpool, and to put an appropriate null in the direction of the Continent. The mast is designed to carry 50 kW of the Radio 2 service, with the 150 kW Radio 1 transmitters feeding the anti-phase aerials. Similarly the older E mast is designed to carry 150 kW of the Radio 2 service with the 100 kW Radio 3 transmitters feeding the anti-phase aerials. The mast radiators are capable of acting as an omni-directional reserve for each other, with reserve facilities for R1 and R3 being provided by the opposite anti-phase aerials, at half power. The aerial matching networks for R2 were designed by TCPD, whilst those for R1 and R3 were manufactured by C & S Antennas Ltd. Because of the number of electrical storms in this part of Yorkshire, and the susceptibility of the mast-stay insulators to arc-over, a special ultra-violet detection system is being installed that will detect arcing on the mast stays, and suppress the transmitter HT until the arcs are extinguished.



*The new Marconi B6034 Radio 2 transmitters at Moorside Edge*

# Labelling Digital Audio Recordings

Looking ahead to increasing use of digital audio recording, the BBC in close co-operation with Willi Studer A.G., has proposed a format for the inclusion of digital 'labels' in such recordings.

The labels could carry a wealth of operational information such as programme duration, serial number, time and date of origin, and editing cues; together with technical information such as audio wordlength, mono/stereo, signal compression characteristics, and level and balance settings. Also possible would be commercial data such as copyright details and perhaps keys for protection against unauthorised copying.

It will, of course, be important that the digital labels remain attached to their parent recordings, and they will accordingly be capable of re-recording and transmission as post-production operations require. A high degree of error protection is incorporated. The labels would be carried in the 48 kbit/s users' data channel of the recently-proposed AES/EBU Digital Audio Interface. The proposed format is a simple and flexible one which could be readily applied to a wide variety of operational requirements.

The proposals were described in detail in a joint BBC/Studer presentation at the 74th AES Convention held in New York.



## LATE NEWS:

### C-MAC CONFIRMED FOR DBS

In a Commons reply on 19 January, the Home Secretary Leon Brittan confirmed the adoption of the C-MAC system and the French packet sound system.

## 140 Mbit/s YUV transmission



Nick Wells, Research Department, demonstrates 140 Mbit/s YUV coding to Bryce McCrerrick, DE.

In a continuing series of digital transmission field trials the BBC has sent component-coded television signals through a 140 Mbit/s British Telecom circuit linking London to Birmingham. It is believed to be the world's first transmission of YUV Component signals that were sampled in accordance with CCIR Recommendation 601 but sent, without significant loss of picture quality, at a sufficiently reduced bit rate to be accommodated within the standard fourth-order multiplex rate of 140 Mbit/s (strictly 139.264 Mbit/s).

BBC 1 and BBC 2 television signals, in PAL coded form, together with other services, are already being transmitted in an extended field trial through the 140 Mbit/s London/Birmingham link (see Eng Inf No. 14). It is expected that such transmission will be used for many years to form a major part of the distribution of television signals to the BBC's terrestrial broadcasting stations.

However, there will eventually be a requirement for the point-to-point digital transmission of component-coded television signals when studio centres have evolved to all-digital operation. Moreover, international exchanges will also be based on digital component coding according to the CCIR Recommendation. It is with these future requirements in view that Research Department has embarked on a programme of experimental work to achieve efficient and technically adequate digital transmission of component-coded signals.

These first transmissions use the whole of the 140 Mbit/s capacity for one component-coded signal together with two high-quality stereo sound signals coded using the NICAM-3 system. Further work will be aimed at bit rate compression to 53 Mbit/s to produce equipment that can be used interchangeably with the PAL codes in the existing 68 Mbit/s system. An ultimate target will be to achieve good quality transmission of YUV signals within the third-order multiplex rate of 34.368 Mbit/s, although it is recognised that this presents a considerable technical challenge.

### Systems Details

Component video signals coded in accordance with CCIR Recommendation 601 require a basic bit rate of 216 Mbit/s. This results from 8-bit quantising together with sampling frequencies of 13.5 MHz for the luminance component (Y) and 6.75 MHz for each of the chrominance components (U,V).

To achieve transmission within 140 Mbit/s, and to provide capacity for the sound channels, the video bit rate is reduced by removal of the line-blanking intervals, and the use of differential pulse-code modulation (dpcm) so that only 6 bits per sample are required. Simple previous-sample prediction is adequate for dpcm coding of the U,V components but a more complex algorithm involving several samples in both the same line and the previous line of the same field, is required for the luminance predictor.

## Stereo Sound with Television



The growing interest in adding stereo sound to television signal has presented a challenge to BBC engineers. How can this be done in a compatible manner so that existing receivers continue to work and the picture and sound signals are free from interference? The problem has been studied worldwide and a number of solutions proposed.

Research Department have been investigating possible systems including proposals from Japan and Germany. Eng Inf No. 12 in the Spring of last year reported on over-air tests from the Crystal Palace transmitter and concluded that while the addition of a second frequency modulated carrier could provide a largely satisfactory stereo sound service with terrestrial television, a digitally modulated second sound carrier might prove to be a more attractive alternative.

A preference for the digital approach was confirmed by recent over-air tests from the Wenvoe transmitter in South Wales. The signals transmitted were similar to those used in some earlier satellite tests reported in a 1980 IBC Conference paper. The Wenvoe area was chosen for the tests because the nearby mountains can produce severe multipath propagation and it was important to establish that the digital sound signal could be received satisfactorily in such conditions.

These tests gave very encouraging results. The effect of multipath

was found to be very small and the digital signal provided excellent stereo quality, even in areas of extremely low signal strength for which the picture was very impaired by noise. Also the additional signal travelled satisfactorily through the five-station relay chain that is used to feed one of the remote valleys.

The conclusion, therefore, is that we have a fully viable digital system, with a bit rate of about 700 kbit/s (sufficient for 2 high quality sound signals), and using phase modulated carrier set at about  $-20$  dB and separated by about 6.55 MHz from the vision carrier, i.e. just above the main sound carrier.

Before formally proposing a system of this type, it will be necessary to make quite sure that it will not give rise to problems of compatibility with the very wide range of monophonic television receivers in use. A further full scale compat-

ibility trial on BBC 2 from Crystal Palace is therefore being planned subject to Home Office agreement for the first half of 1984. Discussions with Industry, the IBA, and the Home Office are also being initiated in order to achieve an agreed UK standard.



*The additional transmission equipment installed at Wenvoe, for the two-channel sound with television experiment.*

## ETD Training Tapes

Technical Operations Training at E.T.D. has produced a set of three VHS video tapes with accompanying booklets on Camera Operations. Originally the tapes were produced to replace on station presentations to BBC Engineers who are required to carry out camera work in addition to other duties. However, experience has shown that there is a wider interest in the tapes and these are now being made available to outside

organisations at the following prices:-

Tape 1 £93.15  
Tape 2 £137.43  
Tape 3 £93.15

E.T.D. can supply a complete set of the three tapes and books for internal use at £150.00. Orders should be addressed to Manager, Admin, & Finance, E.T.D.



## Radio Teleswitching agreement



*Alan Plumpton, Deputy Chairman of the Electricity Council signs the Radio Teleswitching agreement with Peter Rainger, (DDE).*

The BBC and the Electricity Council recently signed a contract that allows the Electricity Supply Industry to use the BBC's low-frequency transmitters for a new system of national tariff control and load switching, known as Radio Teleswitching. Alan Plumpton, Deputy Chairman of the Electricity Council said, "The new system will help to make optimum use of our generating capacity, so that energy can be saved, and the best use made of the power network."

Using the Radio 4 (UK) low-frequency (200 kHz) transmitters at Droitwich, Burghead and Westerglen, which have nearly nationwide coverage, the system superimposes an inaudible data signal by phase-modulating the main carrier of the transmitters. Because of the narrow-band nature of the data-signals, the Radio Teleswitching system can be used in the areas such as basements or steel framed buildings where the field strength from the transmitters is too low for normal reception. Thus the low-frequency transmitters are ideal for this type of service.

The data signals are received and decoded by Radio Teleswitching receivers installed in consumers' premises, where they can initiate the switching of tariff controlled appliances such as storage or water heaters as required. This will allow the Electricity Supply Industry more flexibility to smooth peak demands and hence avoid the need

for excess generating capacity. The Radio Teleswitching equipment could replace the conventional time-switch used with a two rate meter.

Speaking about the system, Peter Rainger (DDE), said, "The data signals do not impair reception of the normal Radio 4 programmes and, since costs are being borne by the Electricity Supply Industry, the Teleswitching service will not be a burden on the licence-payer. We understand the system will be of benefit to both the country as a whole and to the individual. We are also assured the consumer will have the freedom of choice. In the circumstances where no other transmission system can be used, the Corporation is pleased to co-operate. The provision of such a service is subject to the normal processes of authorization."

The data signals originate from a message assembler located at Broadcasting House. Information from the Central Electricity Generating Board (CEGB) is used to key data onto one channel of the message assembler, and the resultant waveform is sent to the transmitters. The data waveform is a 50 baud bi-phase signal giving an effective 18 bit/second useful data rate that phase-modulates the 200 kHz transmitter carrier by  $\pm 22$  degrees. The absence of dc in the modulating waveform maintains the overall accuracy of the transmitter frequency, which is derived from a rubidium frequency-stand-

ard. The remaining data channels on the message assembler are currently not used, although there are plans for an experimental data service for the transmission of information such as gale warnings, weather or shipping forecasts; the service is expected to have a sufficiently large coverage to include coastal waters.

The Radio Teleswitching system was developed by engineers, Derek Wright and Andrew Lyner from Research Department, in co-operation with the Electricity Council. It has been undergoing experimental evaluation for the last four years. The results confirm that there is no interference to the Radio 4 programmes normally carried by the low-frequency transmitters.

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### Campbell Swinton Monograph

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The Royal Television Society have produced a monograph about the life of A A Campbell Swinton, (1863–1930) an early television pioneer.

The idea of a television system based entirely on electronic principles occurred to Alan Archibald Campbell Swinton a quarter of a century before it was finally realised by EMI and adopted by the BBC Television Service in the mid 1930s. 'Distant electric vision' was only one of many subjects which interested this prolific self-educated inventor and experimenter. By profession a leading electrical engineer (and author, while still an apprentice, of a successful textbook on electric lighting), he was also a pioneer in the field of X-ray photography and cathode ray bombardment. He also provided the crucial introduction to the Post Office for a young Italian whose work was to revolutionise communications: Guglielmo Marconi.

In this first of a series of Royal Television Society illustrated monographs, T H Bridgewater examines the life and achievements of the man who fills an important early niche in the history of television.

For those interested the monograph costs £1.50.

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# Waveforms with SLUG

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Engineers in Designs Department have produced a programmable colour bar generator that incorporates a line-up waveform that will remove adjustment inaccuracies associated with colour television monitors in studios, (as recommended by the SMPTE in their document ECRI - 1978). Known as "SLUG" (Saturation Line-Up Generator), the new equipment allows quick and accurate visual alignment of the monitor's decoder phase and saturation controls. Present alignment methods require alteration and subsequent re-adjustment of the brightness and contrast controls, which is unnecessary when the SLUG waveform is used.

## Conventional Alignment

In television studios, and on outside broadcasts, colour picture monitors are currently aligned using a number of different waveforms. First there is a composite waveform which consists of a four step grey-scale plus a black and white bar waveform, known as PLUGE - (Picture Line-Up Generator). This is used to adjust the monitor brightness by measuring the level using a photometer to adjust the contrast until the white signal reaches a luminance intensity of 89 candelas per square metre.

Should a monitor's integral PAL decoder require alignment, it is then fed with a 100% saturated colour bar signal, and the (monitor) decoder's phase and saturation controls are adjusted. This last operation is a cause of misalignment, because the colour bar pattern is not ideal for this purpose, and it is necessary to re-adjust the brightness and contrast controls. For phase errors, it is normal to observe the "Hanover bar" pattern,

which is most apparent on the cyan or magenta bars and adjust for minimum visibility. The red and green drives to the monitor tube are then switched off, and the brightness control is adjusted until the remaining blue bars are just visible; if the brightness of the display is too high, the contrast control has subsequently to be adjusted.

The decoder saturation control is then adjusted, whilst simultaneously observing the extreme left and right hand bars to equalise their luminance intensity. These bars correspond to the white and blue bars of the standard colour bar display. Re-adjustment of the contrast control may be necessary during the saturation adjustment. Finally the brightness and contrast controls are reset using a suitable PLUGE waveform.

The need for maladjustment during the line-up is the result of different levels of the ambient lighting, and the fact that the luminance comparisons are not made on adjacent areas of the display tube. The result can be wide variations in the final setting of the saturation control.

## Alignment using SLUG

The SLUG waveform when displayed on a colour monitor takes on the appearance of a tartan pattern, since the picture is divided into a number of horizontal bands. In the first of these the colour bars are in the normal sequence, but in the next band the order is reversed so that all the bars having a blue component are aligned vertically.

Using SLUG the alignment procedure is simplified. The red and green drives are, once again,

switched off, and the middle two vertical bars made up from cyan/magenta squares, are again adjusted for minimum Hanover bars and "twitter". Either of the two remaining vertical blue bars are then observed and the decoder saturation adjusted until the vertical bars segments are of uniform luminance intensity.

The advantage of using a SLUG waveform now becomes apparent. There has been no maladjustment of other controls, luminance intensity comparisons are made on adjacent areas of the same colour, and the resultant accuracy of adjustment has become substantially independent of the ambient lighting levels. During field trials at Television Centre and on Outside Broadcast vehicles, it has been found that the SLUG waveform has removed the adjustment variations between operators. The display pattern is similar to that observed in the past with standard coded colour bars, and this has helped to overcome operator unfamiliarity with the new display. The programmable colour bar generator (code number GE6/560) produces a wide range of colour bar patterns all at 100% saturation and amplitude, as well as the SLUG waveform. The new design has been made available to British Industry to manufacture under licence.

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## Safety at Work

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The Engineering Management Safety Committee issued the third edition of its Code of Practice No. 1 'Safety in Electrical and Electronic Maintenance and Development' in November last year. It lays down the safety procedures in laboratories and workshops for staff called upon to carry out maintenance, testing and development on electronic or electrical equipment, work on live equipment - including anyone who needs to adjust internal controls.

The Code of Practice looks at the safety aspects of mains power supplies, test equipment, work on live equipment, work positions and environment.

It is essential reading for everyone working in technical areas.

Copies can be obtained from your line manager, or from Martin Nutt in Engineering Secretariat.