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The Mark IXB – an update for the Mark IX colour camera

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Summary A new version of the Mark IX colour television camera, the Mark IXB, employs a microprocessor in the automatic control system. In addition, the motor-driven potentiometers used in the Mark IX have been replaced by solid-state latching digital-to-analogue convertors. The system provides automatic registration and automatic balance at white and black.

The Mark IXB also includes the option of Automatic Beam Reserve (ABR) as an alternative to Highlight Overload Protection (HOP) for control of scene highlights. ABR avoids the cost of special tubes.

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Born in 1921, Norman Parker Smith obtained his B.Sc degree in Glasgow and, after a period of service in the RAF, joined The Marconi Company in 1946. His early service was as a member of the Advanced Development Group on Colour Television, and apart from seven years as Chief Development Engineer, Closed-Circuit Television, he has been associated with broadcast equipment development engineering and is now Technical Manager, Studio Engineering, a position he has held since the formation of Marconi Communication Systems Limited in 1973.

Introduction

Launched in 1978 with a hard-wired automatic control system, the Mark IX is now available as the Mark IXB with a microprocessor control system based on an Intel 8085A. In addition, the motor-driven potentiometer-type controls of the original Mark IX have been replaced by completely solid-state latching DACs. Another feature is the option of Automatic Beam Reserve (ABR) which is offered as an alternative to Highlight Overload Protection (HOP) for the control of scene highlights.

The description of the Mark IXB which follows covers only the newly-introduced features, and for a full description of other aspects of the camera the reader is referred to articles in earlier issues of this journal.[1–7]

Automatic registration system

The new 'Auto Reg' module is shown in figure 1. The system uses the standard Mark IX diascope pattern for the measurement of errors (figure 2) and operation of the automatic registration control from either the local or remote control panel will initiate the following sequence of events.

1) Self-Test routine and diascope

Self-test is an optional facility selectable by a link change. If selected, both microprocessor and memory are checked prior to advancing to Step 2. At the same time the setting-up pattern, shown in figure 2, is projected direct into the front of the prism block and on to the targets of the three camera tubes.

2) Auto balance

The camera is white-balanced for the colour temperature of the diascope lamp, the amplitudes of the green, red, and blue video signals being adjusted to a set level. These settings are stored independently of the normal video gain control settings so that operational colour balance is not disturbed by the registration sequence.

3) Coarse registration

The horizontal errors in the red and green and the blue and green images are first measured using the left-hand and right-hand vertical bars. The error is measured in terms of clock pulse intervals with a clock period of 200ns. The errors at the two points on the raster are used to calculate the necessary width and centring changes, which are then applied.

Vertical errors are similarly measured using the upper and lower sloping edges of the pattern. The error is again assessed in terms of clock pulse intervals using the horizontal scan, and the necessary corrections are calculated and applied.

On conclusion of the coarse registration, the errors are less than 200ns.

4) Fine registration

The red and blue images are first moved to a datum on one side of the green reference image, and are then moved across green in 10ns steps to find the point at which they coincide. This procedure is averaged over several scans to minimize the effects of noise, allowing the residual errors to be determined and the corrections calculated to an accuracy of 20ns. On conclusion of the fine registration the errors at the four inspection points are less than this value.

5) Uncap

On completion of the above sequence the diascope pattern is removed and the camera returned to normal operation.

Size correction

The Adjust-Size control is provided to compensate for any differences between the image sizes produced through the zoom lens and those produced by the diascope. The single front

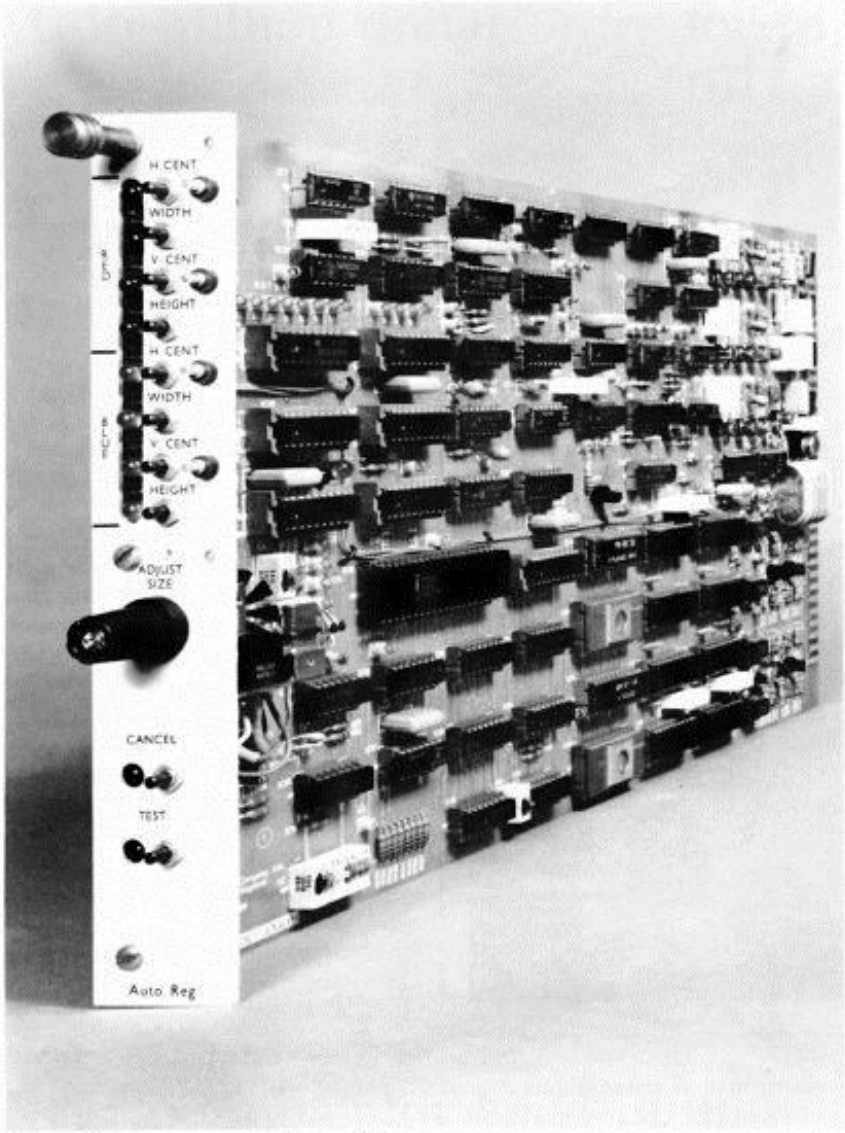

Fig.1. The new auto-registration module

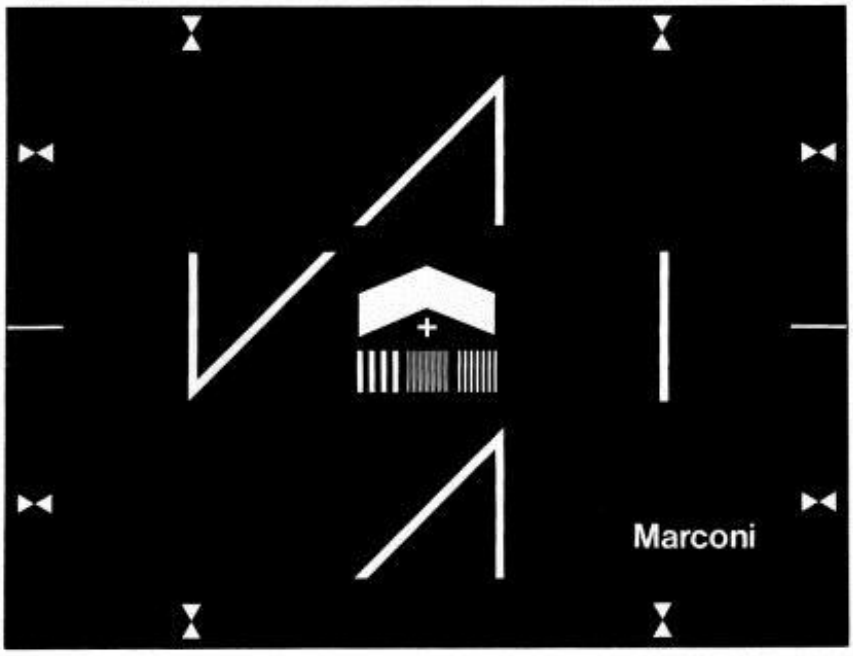

Fig.2. Diascope setting-up pattern

panel control can be assigned to any of the eight functions indicated on the front of the module, that is: H, centring and width, V, centring and height, for either red or blue. This control is an 'optopot', which generates pulses by rotation of a segmented disc in front of two light sources. A pair of associated optical sensors produce 'up' or 'down' pulses according to the direction of rotation.

The appropriate function is selected by push button and the selection is confirmed by the corresponding l.e.d indicator. After use, the optopot may be rendered inoperative by means of the Cancel button.

The offsets introduced by the Adjust-Size control are stored and automatically introduced on subsequent use of the automatic registration sequence.

Manual adjustment

If it is wished to adjust any of the registration parameters manually, the optopot can be used in the same way as described above.

L.E.D indicators

In addition to indicating the function selected for control by the optopot, these indicators flash when the control reaches the end of its range.

Automatic balance

The new 'Auto Bal' module is shown in figure 3.

White balance

In order to balance the camera correctly for the colour temperature of the scene illuminant the camera must be focused on a reference white object. The white object must be placed in the centre of the picture within the framed area shown on the viewfinder. Operation of the white balance control first adjusts the lens iris to bring the green video level to 90% of peak white and therefore safely clear of the clipping level. Red and blue gains are then adjusted in turn to make the levels in the three channels equal.

Progress of the balance process is indicated by l.e.d indicators which show red for 'low' and green for 'high' in the red and blue channels. On reaching balance, the two indicators flash and extinguish when the whole procedure is finished.

Black balance

In the case of black balance all three channels are set to a reference, twin

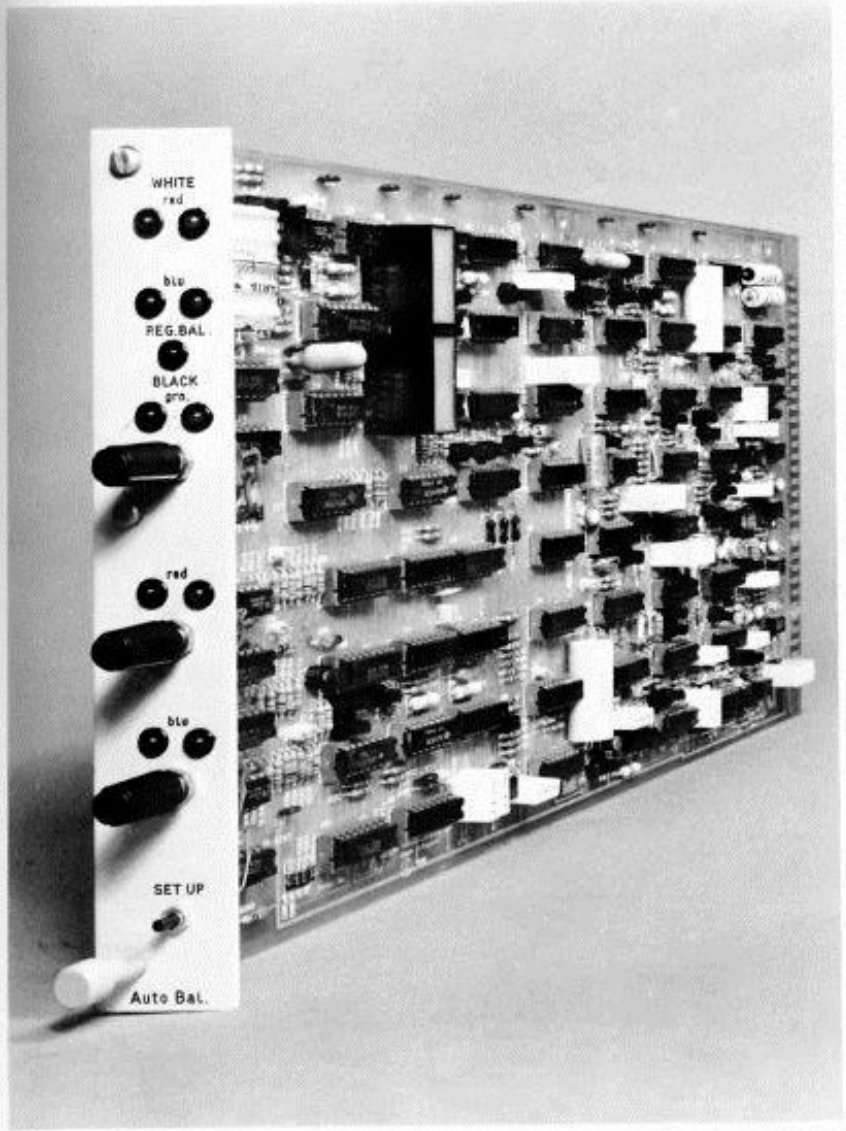

Fig.3. The new auto-balance module

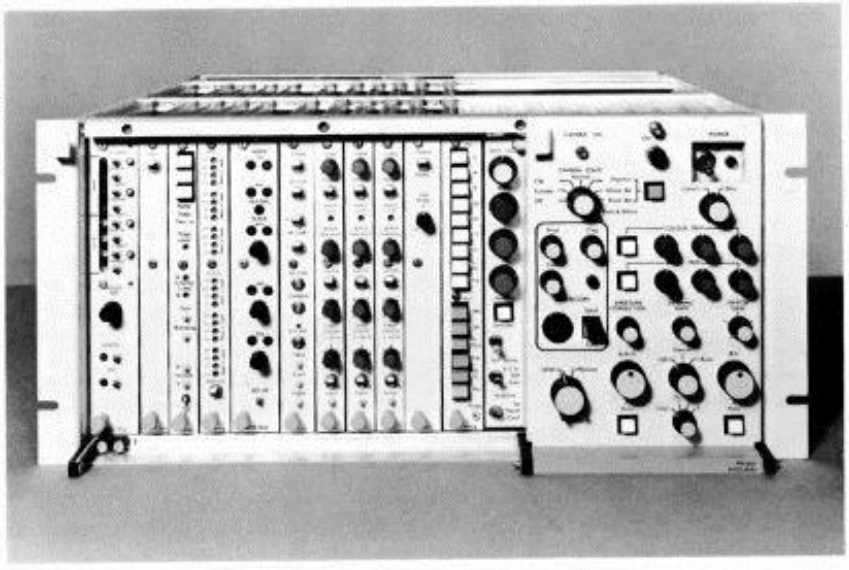

Fig.4. The Mark IXB Camera Control Unit

lamps being used to indicate 'high' and 'low' during the black balance procedure in exactly the same way as for white balance.

As in the case of the Mark IX, individual control of light bias is provided for each tube, and the three knobs on the front of the module are provided to compensate approximately for the differing levels of light bias, thus avoiding the requirement for excessive range in the automatic system.

Automatic Beam Reserve

A further feature of the Mark IXB is the provision of an ABR option as an alternative to the existing Mark IX HOP system. The HOP (or ACT) system, for eliminating the comet-tail effect which can result when scene highlights exceed the value which can be handled by the camera tube at normal beam setting, is now well established. The system does, however, involve the use of special tubes.

The more recent technique of Automatic Beam Reserve is based on the use of a standard camera tube, thus avoiding the extra cost of HOP/ACT tubes. This is of particular value since the need to deal with highlights often arises for a relatively small fraction of the total operating time.

To make use of ABR, the HOP printed board in the camera head is replaced by the ABR board, and links are changed to provide the different connections required between the board and the camera tube.

The principle of operation is very simple and is based on sensing the output level from the tube and automatically controlling the level of beam current so that it is safely above the value needed to handle the maximum scene highlight brightness. For this purpose the head amplifiers each have an additional output taken from before the video clipper. After suitable processing, a control voltage is derived which is fed to the control grid of the camera tube. To preserve optimum resolution over the whole picture area, the beam is only increased above the normal setting in the actual highlight areas, and the control circuit operates at approximately 1MHz bandwidth.

Using standard tubes, the system is capable of handling highlights up to three stops above normal exposure, but even above this level the effects of highlight overloads are much less severe than would occur if a fixed beam setting were used.

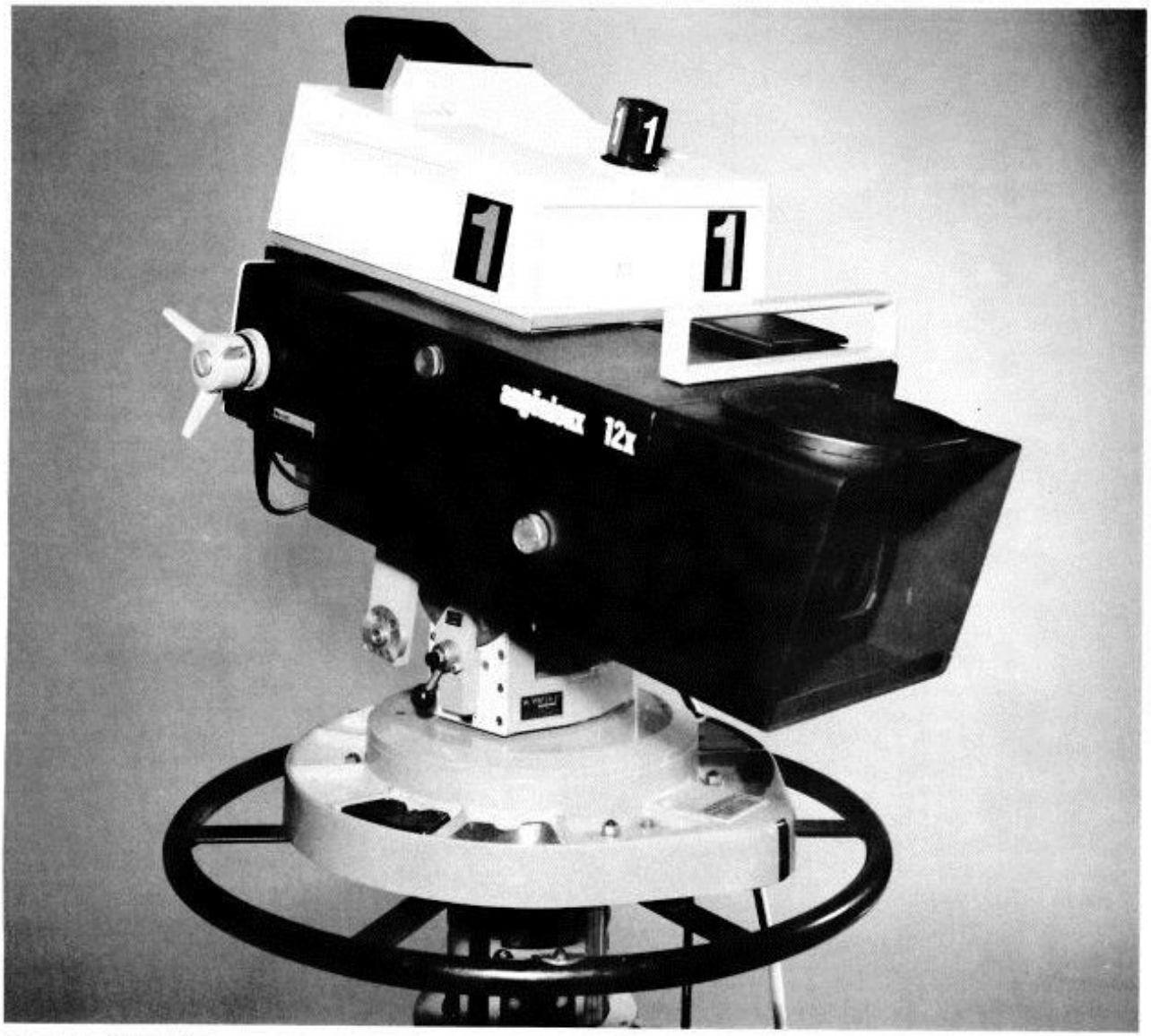

Fig.5. The Mark IXB camera

References

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RÉSUMÉ

Une nouvelle version de la caméra de télévision en couleurs Mark IX, la Mark IXB, comporte un microprocesseur dans le dispositif de commande automatique. Par ailleurs, les potentiomètres motorisés employés dans le Mark IX ont été remplacés par des convertisseurs numériques-analogiques à enclenchement transistorisés. Le système assure le cadrage automatique et l'équilibrage automatique en noir et blanc.

La Mark IXB comporte aussi l'option ABR (Automatic Beam Reserve – Réserve Automatique de Faisceau) en remplacement de HOP (Highlight Overload Protection – Limiteur d'Intensité des Blancs) permettant de régler l'intensité des blancs des zones les plus éclairées. ABR évite l'achat de tubes spéciaux.

ZUSAMMENFASSUNG

Bei der neuen Version der Farbfernsehkamera Mark IX, dem Modell Mark IXB, wird im Rahmen des automatischen Bedienungssystems ein Mikroprozessor benutzt. Ausserdem wurden die bei Mark IX vorhandenen Servo-Potentiometer durch Verklinkungs-DA-Wandler in Festkörperbauweise ersetzt. Das System umfast automatischen Passer sowie Schwarzweissabgleich.

Als Alternative zu HOP (Highlight Overload Protection) bietet die Mark IXB ausserdem die Möglichkeit von ABR (Automatic Beam Reserve) zur Kontrolle der Szenenhelligkeit. Durch Automatic Beam Reserve werden Kosten von Spezialröhren gespart.

RESUMEN

Una nueva variante de la cámara de televisión de color Mark IX, la Mark IXB, emplea una micro-unidad central de proceso en el sistema de control automático. Además, los potenciómetros accionados por motor empleados en la Mark IX han sido reemplazados por convertidores analógico-digitales de enganche de estado sólido. Los sistemas proporcionan registro automático y equilibrio automático en blanco y negro.

La Mark IXB incluye también la opción de reserva de haz automático (Automatic Beam Reserve) como una alternativa a Highlight Overload Protection (HOP) para control de los brillos máximos de escena. La Automatic Beam Reserve (ABR) evita el costo de tubos especiales.