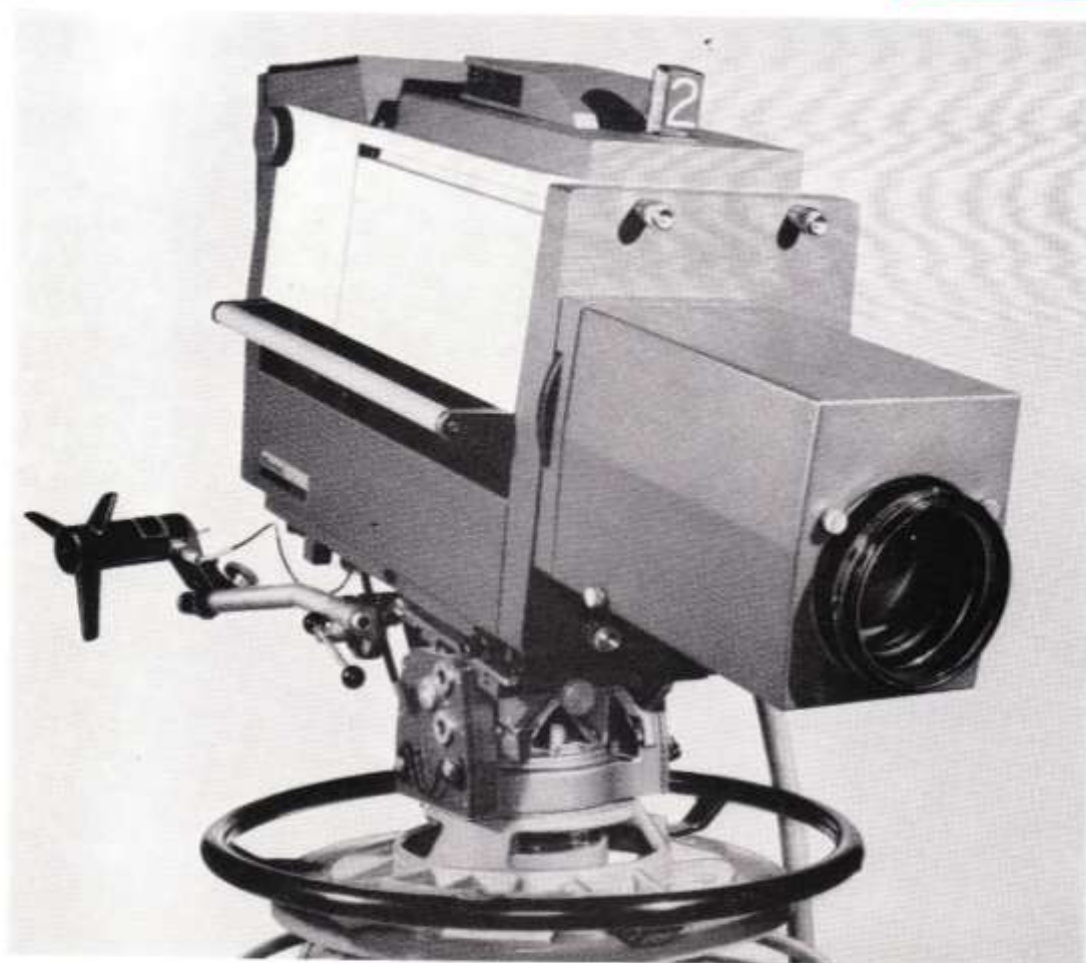


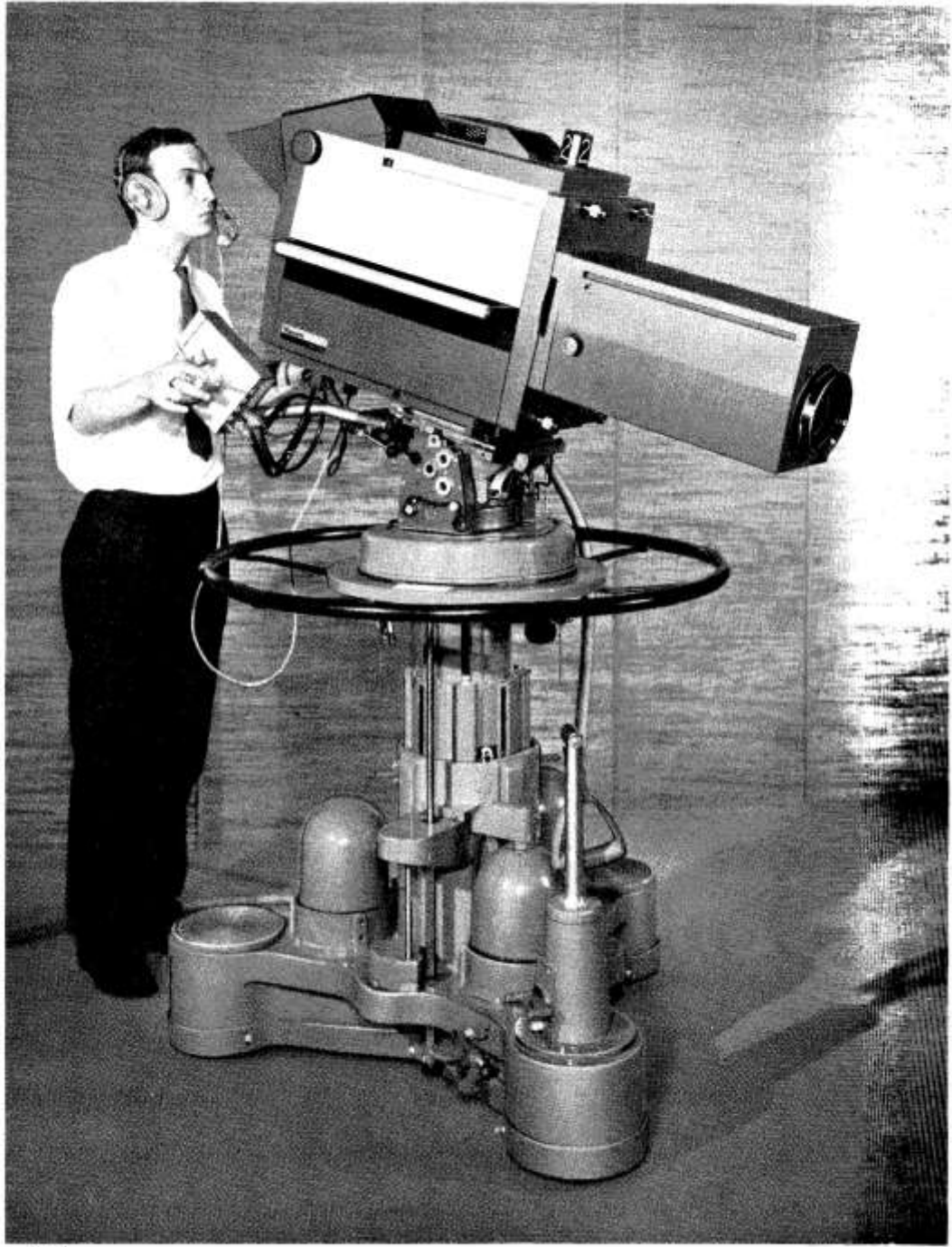
Mark VIIB Colour Camera Channel

B 3205



MARCONI

BROADCASTING



B1450

All Solid State

Four tube, fully screened yokes

Interchangeable zoom or fixed lenses

Up to 610 metres (2000 feet) of camera cable

Outstanding stability

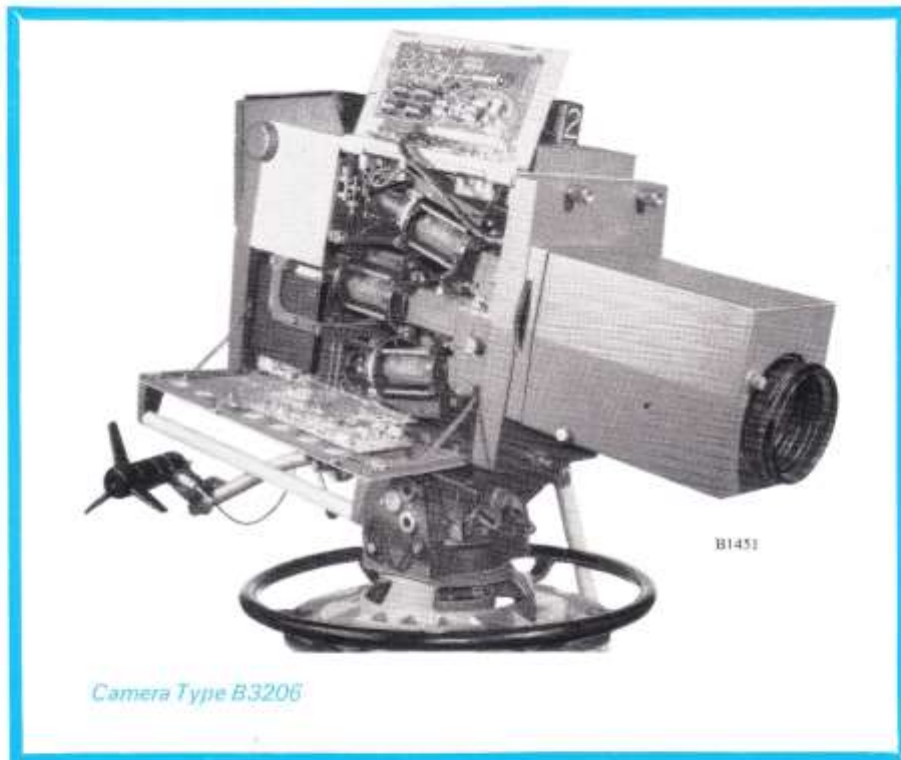
Excellent sensitivity

Tilting, demountable, viewfinder

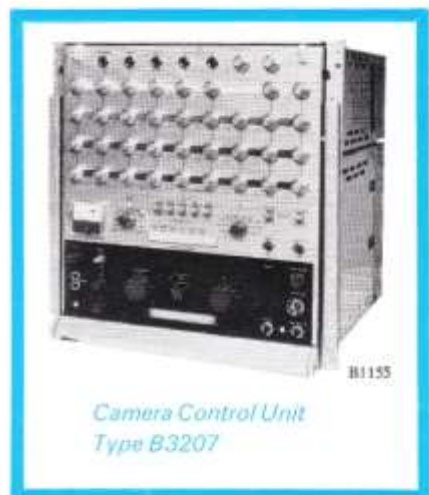
Rapid changeover to monochrome

Rapid warm up

Lightweight, compact



Camera Type B3206



Camera Control Unit
Type B3207



Power Supply Unit Type
B3210

Since the Mark VII colour camera was successfully introduced in 1965 it has been progressively improved. Continuous research coupled with the results of widespread operational experience has enabled the addition of refinements using the latest techniques. The value of this has been proved time and again by the reputation the camera has gained for producing the best colour pictures, in studios and exhibitions alike.

New features, Field Effect Transistors in every head amplifier, new yokes of lightweight design, the inclusion of a cooling fan on every camera, level-dependent aperture correction, maintain the Mark VII quality as the best available. The performance specification has been re-written and still sets the standard for colour television cameras.

The four-tube layout ensures that the compatible black and white picture is truly of the highest quality, an important matter today when few viewers are equipped for colour viewing. Small registration errors are less noticeable on colour pictures from a four-tube camera than from a three-tube camera, and lower quality tubes can be used for the colouring channels of a four-tube camera.

The choice of the Plumbicon* tube, which has now become virtually the standard tube for colour cameras, greatly facilitates both colour matching and registration. The use of this linear tube enables operation in very-low light levels by the exchange of signal to noise ratio.

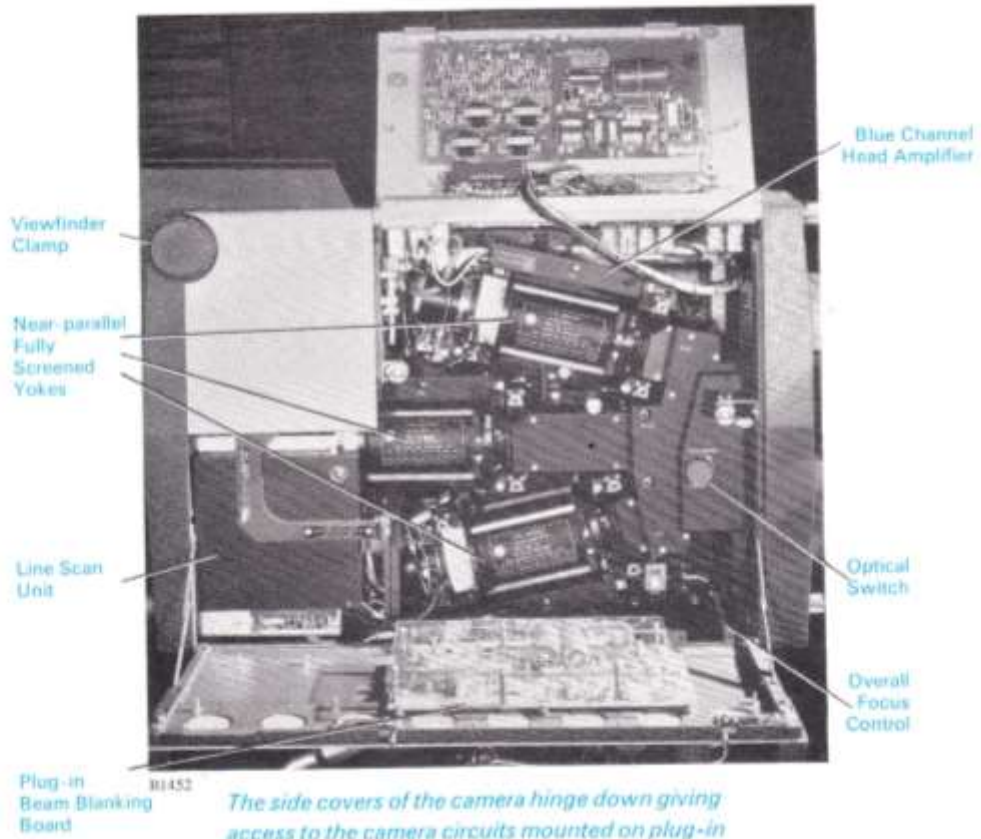
Great importance has been attached to flexibility in the variety of lenses, zoom or fixed, that can be used for studio or outside broadcast use. The Mark VII uses image orthicon lenses and thus may be equipped from the exceptionally wide range of high performance lenses already made for this format.

High stability is of basic importance for colour camera channels. The continued production of top quality pictures depends entirely on adequate circuit stability. The Marconi Company pioneered 'hands-off' working with black-and-white cameras and has developed several special techniques to ensure that this can be standard Mark VII practice.

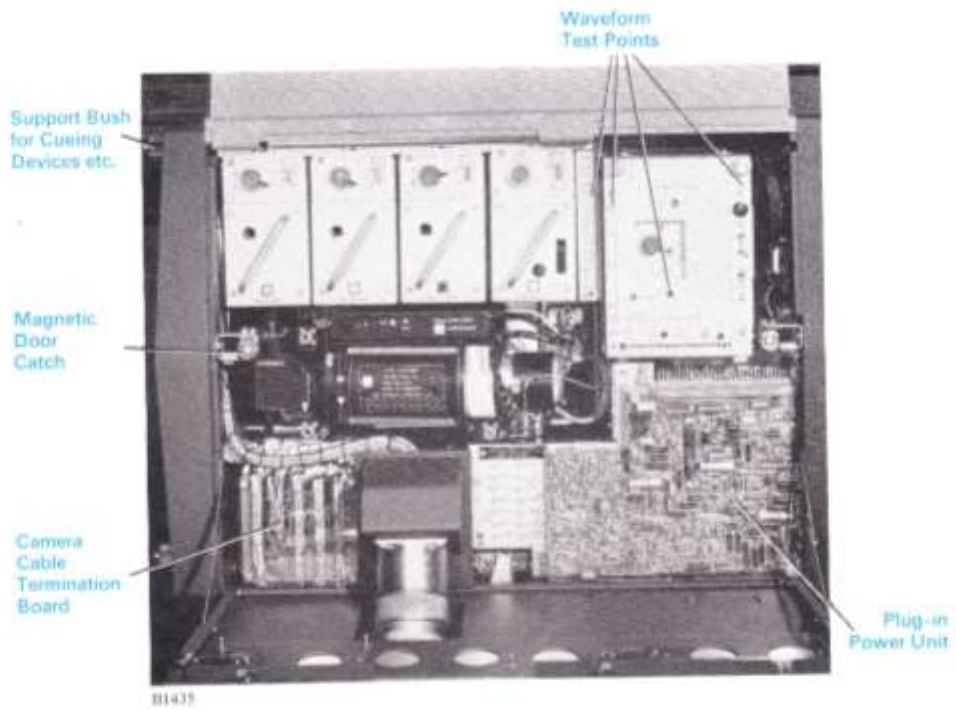
The camera circuits use entirely solid state devices for signal processing. Thermionic tubes are retained only for two power supply functions, and of course the pick up tubes and viewfinder kinescope.

The camera may be switched for 525 or 625 line standards so the output may be coded for NTSC, PAL or SECAM transmission. Full black and white sensitivity is obtained by use of an optical switch, if light level outdoors falls too low for colour working.

*Registered Trade Mark Philips Gloeilampenfabrieken



The side covers of the camera hinge down giving access to the camera circuits mounted on plug-in printed-wiring boards and to the optical system



Equipment

The basic Mark VII Colour Camera Channel, Type B3205, comprises:

- Camera Type B3206
- Camera Viewfinder Type B3102
- Camera Control Unit Type B3207
- Operational Control Panel Type B3208
- Power Supply Unit Type B3210
- Optional*
- Colour Balance Control Unit Type B3209
- Two Dimension Aperture Corrector Type B3371

Camera Type B3206

This camera successfully combines superb performance and simplicity of operation. Cameraman controls have been reduced to those for zoom and focus of the lens and for talkback and viewfinder. All other operational controls are remotod to the vision engineer position where they are housed on small console mounting panels. The Mark VII is now lighter than ever before, and the design features of demountable viewfinder and lens, separate lens controls and ideally placed carrying handles, ensure ease of handling and storage for studio and outside broadcast work.

The standard camera works on up to 610 metres (2000 ft) of TV - 2090 cable.

The main structural framework of the camera is made of milled magnesium alloy plates, which provide great strength and rigidity with minimum weight. The illustrations opposite show how the side covers hinge to give full access to the circuits and optical system. Almost all the active circuits are contained on plug-in printed boards or modules, servicing leads enable these to be removed from the camera assembly with power applied, for adjustment and servicing.

The pick-up tube yokes are fully screened and arranged physically to be almost parallel to each other so that excellent registration can be achieved and maintained despite the effects of external magnetic fields.

Eyelights or soldering irons can be powered from the fused utility mains outlet on the camera. A separate composite video output is also provided, this can feed studio floor monitors, or can be especially useful when cameras are used on powered cranes.

Headset jack sockets are provided for use by the cameraman, and one further headset and one headphone outlet are supplied for use by the camera crew or floor manager.

A test input socket is provided on the camera to enable accurate overall checks of the camera channel response to be made.

Lenses

The camera uses any standard television zoom lens designed for use with an image orthicon format.

This flexibility in the choice of lenses is achieved by the use of a relay optical system. The zoom lens packages, normally supplied with the Mark V image orthicon camera, are fully interchangeable.

Control of the zoom focal length can be provided either by normal manual crank or twist grips, or by a servo-control system. A particular feature of the servo system is the 'shot box' enabling a number of preset positions to be preselected. Immediate return to twistgrip demand control is always possible. On-air shot changes, preselected for correct angle, may be made at normal or slow speed. A single potentiometer controls the speed.

The Mark VII camera can also be adapted to take a single fixed focus lens, focus adjustment being available to accommodate a near object distance of under 70.0 cm (28 in.) for all fixed lenses of up to 12.7 cm (5 in.) focal length and a near object distance of 180 cm (6 ft.) for a lens of 20.3 cm (8 in.) focal length.

Optical System

The whole of the optical system is mounted on a fixed plate enclosed by a dust-proof cover. Details of the optical arrangement of the camera are shown opposite. Movement of the whole optical bedplate permits focusing adjustments to be made for fixed lens and zoom back focus tolerances.

Two filter wheels are mounted between the external objective lens and the field lens of the camera relay system, one for major light variations and the other for colour temperature correction. Behind this field lens, a light-splitting prism is mounted. This surface reflects a portion of the light into the luminance tube of the camera and transmits the remainder to the colour tubes. An important feature of this surface is that it reflects only that amount of light which is necessary to provide the correct signal in the luminance tube. The maximum available light is thus transmitted to the colour tubes.

This transmitted light is split into its red, green and blue components by prism type dichroic surfaces. The three colour components pass from the

dichroic system through colour trimming filters and relay lens into the three colouring camera tubes.

For black-and-white operation a fully reflecting surface is moved into position in place of the luminance/colouring light-splitting surface. This surface, which is controlled by a simple mechanical switch, passes all the incoming light to the luminance tube.

Sensitivity

The sensitivity of the Mark VII is excellent and coded colour pictures can be obtained at full aperture with illumination levels of 30 foot-candles.

Acceptable pictures with reduced signal-to-noise ratio can be obtained at light levels hitherto thought unusable for colour working. The operational control panel of the Mark VII is fitted with a master gain control, which enables the chosen balance between light level and signal-to-noise ratio to be made as an operational adjustment, while at the same time maintaining a satisfactory colour balance.

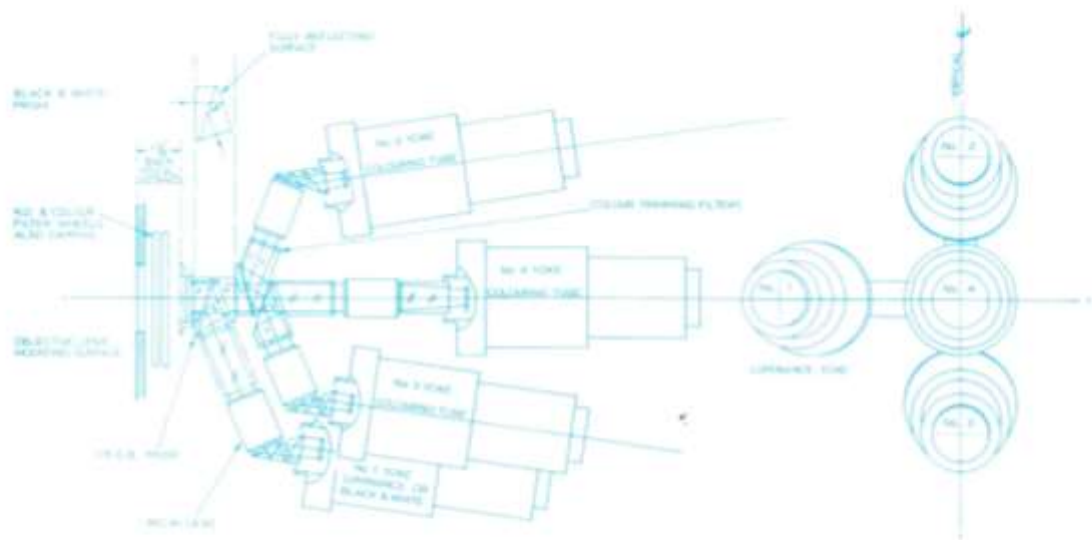
Tilting Viewfinder Type B3102

The viewfinder fitted to the Mark VII colour camera is identical to that used in the Mark V and Mark VI black-and-white cameras. It can be locked by friction clamps to suit the height of the cameraman and the camera position. The viewfinder may be detached and operated away from the camera over a cable up to 9 metres (30 ft.) long.

The viewfinder uses an 18 cm (7 in.) rectangular tube with a highlight brightness of 2150 lumens/metre² (200 foot lamberts). It is thus well able to compete with bright studio lighting, but a viewing hood can be provided for operation in areas where high ambient light may be a problem. Cue lights are provided on both sides of the viewfinder tube towards the top of the picture.

Controls for brightness, contrast, height and width are mounted below the screen. A further preset control within the viewfinder can be set to

give a high-frequency boost to aid the focusing of the camera. A three-position switch is fitted at the rear of the camera for selection of the signal to be displayed on the viewfinder. This can be either the luminance channel signal, the signal selected by the monitor picture switch at the camera control unit or a signal from an external source. The luminance signal is displayed in normal operation, and the monitor signal can be used for setting-up adjustments. The external signal is fed into a socket at the camera control unit, where a further switch gives the choice of either displaying the external signal alone, or mixed with the luminance signal. These external signal facilities are primarily intended to help the cameraman align his camera picture in precise relationship to the picture from another camera, as is often necessary for special effects.

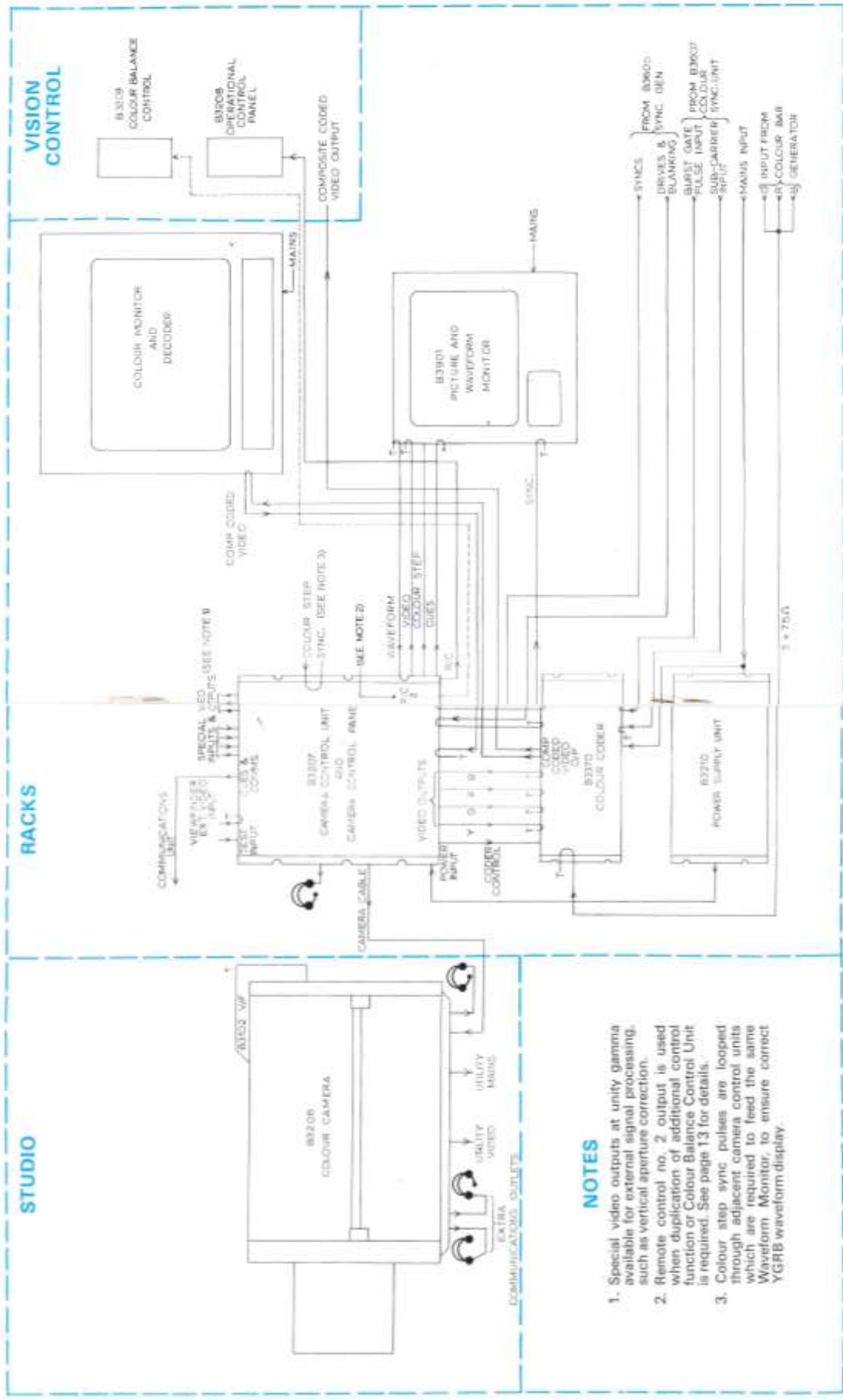


Arrangement of the optical system

BEAM VIEW OF OPTICAL SYSTEM AS IMAGED IN THE CAMERA

X1105/1





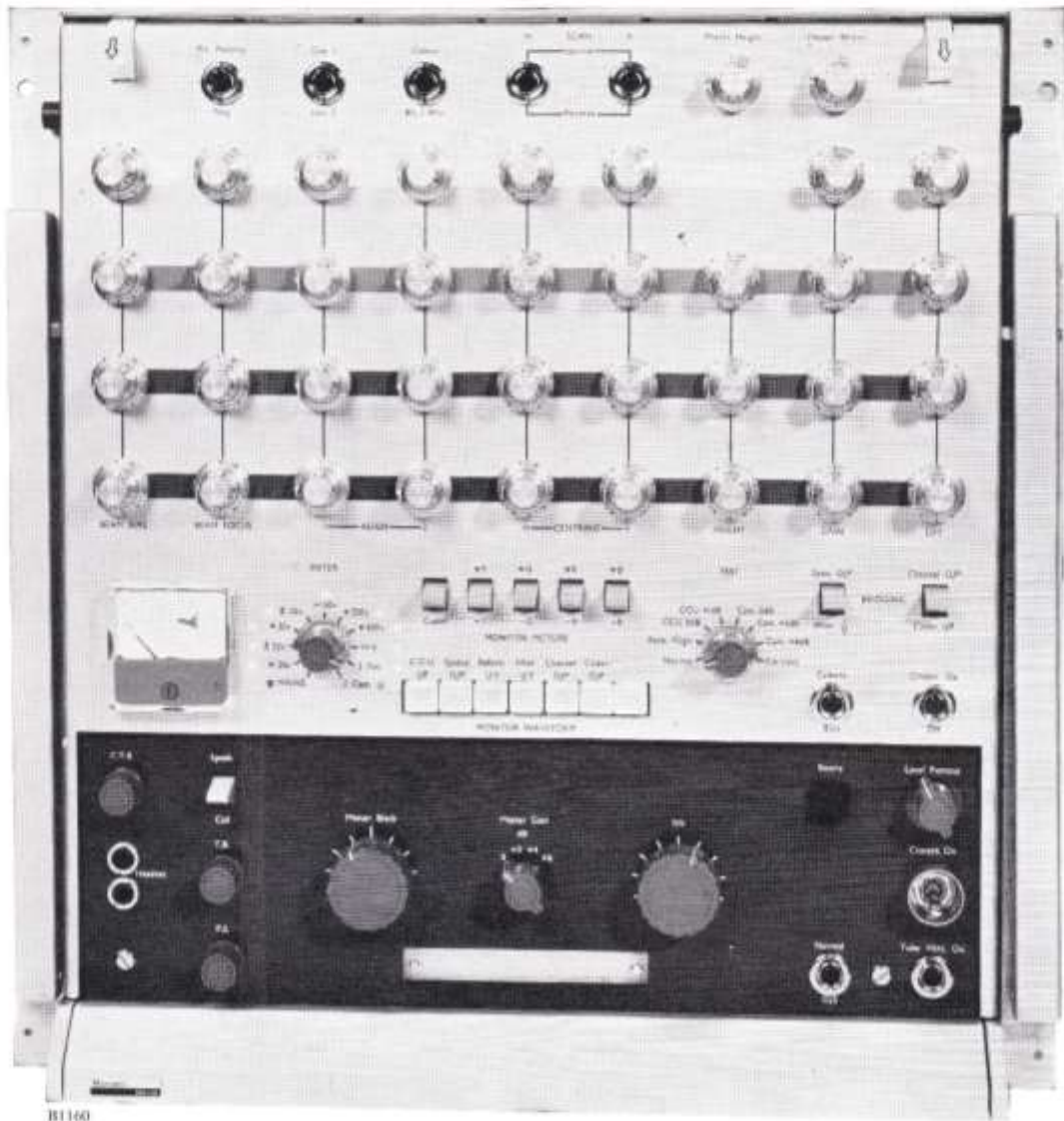
NOTES

1. Special video outputs at unity gamma available for external signal processing, such as vertical aperture correction.
2. Remote control no. 2 output is used when duplication of additional control function or Colour Balance Control Unit is required. See page 13 for details.
3. Colour step sync pulses are looped through adjacent camera control units which are required to feed the same Waveform Monitor, to ensure correct YGRB waveform display.

VISION CONTROL

RACKS

STUDIO



The front panel of the camera control unit which contains the engineering controls. These controls are set out in a logical setting-up sequence

Camera Control Unit Type B3207

The Camera Control Unit is suitable for mounting in a 48 cm (19 in.) rack or console. Video and pulse processing circuits are built on the printed wiring boards and are attached to modules which slide into the case. The front panel of the unit contains the engineering controls and this is arranged to hinge down to allow the modules to be extracted.

The stability of the channel is such that the engineering controls can first be adjusted to set up the channel, and control is then switched to the operational control panel.

With 'hands off' operation, all four video chains have to be matched very closely. Special circuit techniques, including the extensive use of thin-film circuits, have been employed to ensure that all the video amplifiers, and in particular the gamma correction in each video chain, are matched with a high degree of stability to ensure that the colour balance is maintained without adjustment.

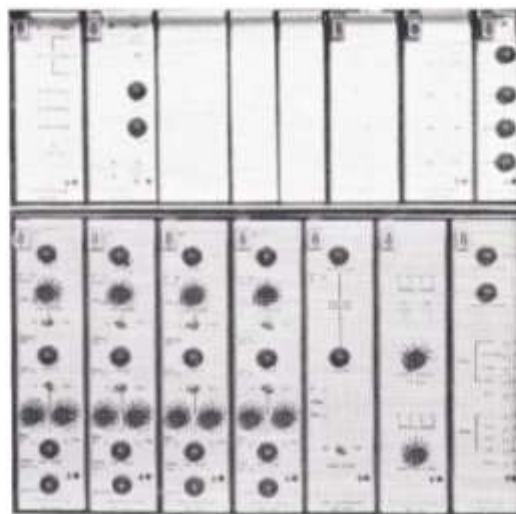
The layout of the controls on the Engineering Control Panel is in logical setting up sequence and is shown opposite. The top row includes the controls for black-and-white operation. Then follow four rows of similar controls beginning with those for the luminance channel and one each for the green, red and blue channels.

At the bottom is a group of operational controls. A local/remote switch is provided which enables these controls to be switched to a remote position. The controls on the Operational Control Panel are as follows:

Iris	Camera On/Off
Master Black	Beams On/Off
Master Gain	On-air cue
Normal Stand-by	

Provision is also made to remote additional controls in those cases where it is considered desirable. The additional facilities are as follows:

Control Room Talk-back Level
Talk-back Level
Programme Sound Level
Talk-back and Call Camera Key Switch
Horizontal Scan Reversal
Vertical Scan Reversal
Colour/Black and White
Gamma Laws one or two (the laws may be independently preset between 0.4 and 1)
Colour Balance Controls: GRB Gains
GRB Black Level



B1161

The front panel of the camera control unit hinges down to give easy access to the modules

The Colour Balance Control Unit takes the form of a second remote mounted panel of similar dimensions to the Operational Control Panel. The Unit provides fine adjustment of GRB gains and it is fully described on page 16.

To ensure that full performance can be readily obtained under operational conditions, comprehensive facilities are provided for the monitoring of signals to aid the setting-up. By means of two independent groups of switches on the camera control unit control panel, one for picture and one for waveform display, the desired signals may be selected and fed out to a picture and waveform monitor, type B3901.

Facilities are provided for easy and accurate adjustment of the channel and the monitoring facilities include independent signal polarity reversal to facilitate alignment. A meter is provided to enable a ready examination of the important potentials employed in the camera channel. The scale is marked in coloured bands, similar bands being marked against each meter switch position. The voltage or current reading is correct if the meter pointer lies within the appropriate band on the meter scale.

An internal calibration waveform generator is also provided in the camera for use in setting the head amplifier gains for the desired tube signal current. This is also controlled by the camera control unit test switch.

A further facility, which greatly aids the rapid setting-up of equal gains and amplitude characteristics in the four channels, is the provision of 'bridging' switches. Used in conjunction with a grey scale, the corresponding circuit points in the four channels are joined together, and any

difference in signal levels can be easily seen on the waveform monitor or on a colour monitor.

Aperture and cable length correction are provided as preset controls on the front of the C.C.U. Loss Corrector and Filter module.

A rear panel behind the module frames carries all the connectors for the interconnecting cables. This is hinged and can be lowered so that the internal wiring of the camera control unit is accessible for maintenance.

Power Supply Unit Type B3210

The power supply unit is designed to mount in a 48 cm (19 in.) rack at a distance of up to 30 metres (100 ft.) from the camera control unit. The construction is of a hybrid form with the transformers mounted on a 48 cm (19 in.) pan chassis and the

circuit modules arranged to plug into a sub-frame forming part of the whole assembly. A switch is provided which compensates for voltage drop when varying lengths of camera cable are used up to 610m (2000 ft).



Power Supply Unit, Type B3210, with front cover removed

Camera Cable

To ensure that the flexibility of the camera is not restricted by an unnecessarily large camera cable, particular attention has been paid to this aspect of design.

The operation of the camera 610 metres (2000 ft.) from the camera control unit demands the use of a cable with conductors large enough to keep the various adverse effects of temperature and voltage drop from affecting the camera channel

stability. For studio use however, a lighter more flexible cable can be used between the camera and the outlet boxes on the studio walls. To suit both situations therefore two camera cables are available. A light, small diameter cable is recommended for use at the camera; for laying in ducts and for use where long lengths of cable are required a heavier cable is available. The connector used is common to both cables.

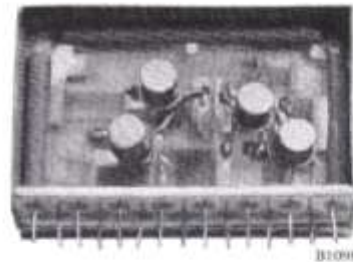
Circuit Details

The extensive use of silicon transistor amplifiers with large amounts of negative feedback has enabled a performance and stability to be obtained that is considerably better than that possible with thermionic valves. In most cases the loop gain is sufficient for the net gain to be almost solely determined by the resistors forming the feed back network. This emphasises the need to employ resistors having stable characteristics.

Under these circumstances, it is essential to use resistors with a low temperature coefficient of resistivity, to achieve absolute stability. Where it is also necessary to achieve a high relative stability, as for example in the relative amplification of the four camera video channels, the variation in temperature coefficient between individual resistors must be small. In many circuit positions high-grade metal-film resistors are used, having temperature coefficients of about ± 10 parts per million per deg. C. Considerable use is made in the camera and camera control unit of small circuit modules in which the circuit is formed by the thin-film deposition technique on a glass substrate. This process developed by The Marconi Company yields highly stable resistors having a temperature coefficient of 10 parts per million per deg. C. The complete assemblies are enclosed in a small metal case measuring $4.1 \times 2.8 \times 1.4$ cm ($1.6 \times 1.1 \times 0.6$ in.). Over 60 of these modules are used in the colour camera channel, half of which are of one type, a multi-purpose video amplifier.

Variable control resistors, particularly those associated with image registration, must be both electrically and mechanically stable and of adequate resolution. Therefore helical multiturn potentiometers

with low temperature coefficients of resistance are used for a number of the more critical setting-up controls.



A small circuit module in which the circuit is formed by the thin-film deposition technique on a glass substrate

Tantalum electrolytic capacitors are employed in the majority of circuits so that the camera channel can provide full performance over the ambient temperature range of -10 to 40°C . Less expensive aluminium electrolytic capacitors suffer from a loss in capacitance and a considerable increase in series resistance at the lower temperatures. These are used in less demanding positions, particularly where large values of capacitance are necessary.

Optional Units

Colour Balance Control

Earlier, mention was made of the remote GRB Gain Control facility. Lighting requirements for colour are more stringent than for monochrome because the colour temperature of light incident on the picture subject affects the final colour fidelity. Ideally this incident light would always be precisely controlled. In practice many factors, such as reflection from coloured objects, and shadows, complicate studio lighting.

To maintain accurate colour reproduction the relative gains of the chrominance channels may need to be adjusted. Hitherto the normal method of adjustment was by setting individual channel gains, this caused loss of all reference to the original settings.

With the exclusive Marconi Colour Balance Control Panel a special arrangement of the potentiometers ensures that the correct relationship between

Green, Red and Blue is always maintained. A single control knob is used and it is coupled to a plate centrally pivoted. In the plane of this central pivot are arranged three equally spaced balls which are in turn coupled to three potentiometers to maintain the desired relationship. The control panel is marked with G-R-B, positioned as a colour triangle. The knob is free to move in any direction within the triangle, it can be returned to its central position at any time to restore the original colour balance.

To add remote Colour Balance Control to a standard Mark VII channel:

- (i) Replace a shorting board in the Camera Control Unit (CCU) by a plug-in amplifier board.
- (ii) Replace the 50 way shorting plug at the rear of the CCU by a remote control cable.
- (iii) Connect the cable to the Colour Balance Control Panel.



B1163

Two Colour Balance Control Panels and two Operational Control Panels mounted in a desk.

Vertical Aperture Correction Unit

With a four-tube colour camera it is easy to include vertical aperture correction in the luminance channel. Unlike systems which derive correction from a particular colour, vertical aperture correction in the luminance channel corrects the whole of the picture irrespective of the colour.

The camera control unit inputs are designed to accept external units such as a vertical aperture corrector.

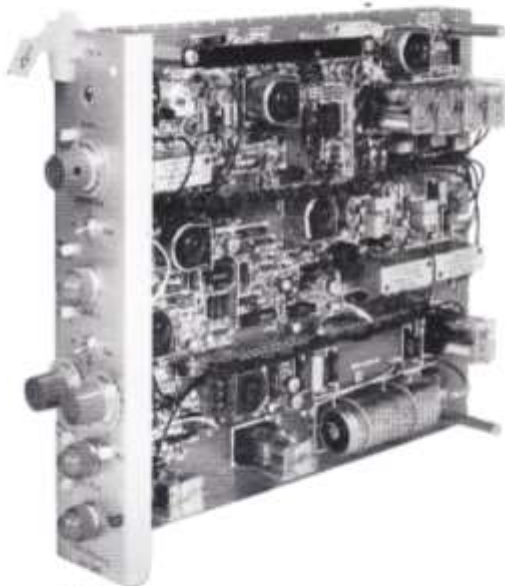
The unit is self-contained and suitable for mounting in a 48 cm (19 in.) rack. High frequency ultrasonic delay lines are used with piezo-electric transducers. The delay lines are in a temperature controlled oven to ensure the stability of delay.

A control of correction is provided on the front panel enabling optimum picture quality to be obtained.

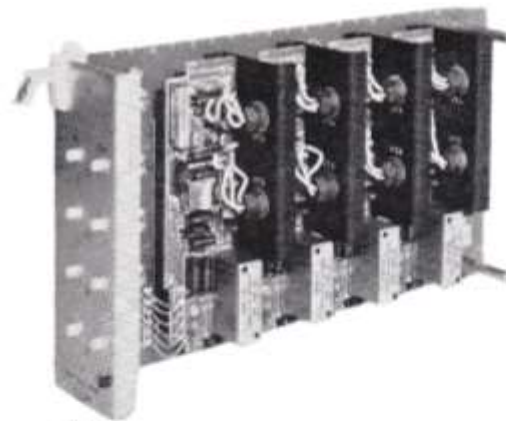
Ordering Information

WHEN ordering please state:

- (1) Length and type of camera cable required.
- (2) Number of sets of module extension boards required.
- (3) If test charts are required.
- (4) Is a set of printed wiring board tools required.
- (5) Is a fixed lens adaptor required.
- (6) Is a colour coder required.
- (7) Is a picture and waveform monitor required.
- (8) Is a 48 cm (19 in.) cabinet rack required.
- (9) Television standard and system employed.
- (10) Mains voltage on which the equipment is to operate.
- (11) What zoom or fixed lenses are required. If zooms, are they to be servo or manual.
- (12) Are range extenders $\times 1\frac{1}{2}$, or $\times 2$ wanted.
- (13) Camera cue light designation required, i.e. Cam 1, Cam 2, Cam 3, etc.
- (14) If additional handbooks are required.
- (15) If spares are required.
- (16) Is a friction head and tripod required.
- (17) How many headsets and headphones are required.
- (18) Is remote colour balance control required.
- (19) Is a two dimension aperture correction unit required.*
- (20) Type of plumbicons to be used (separate or integral mesh).



B1164



B1165

Two typical plug-in modules used in the Camera Control Unit.

Data Summary

- Mains Input:** Transformer with split primary, tapped for 100–125 V and 200–250V in 5% steps, 50–60 Hz. Consumption 600–800 VA (depends on cable length).
- Pulses Input:** Bridging input for line drive, field drive, mixed blanking and mixed sync, between the limits of 1.5 and 8V.
- SEE PAGES 10 AND 11 FOR CHANNEL INTERCONNECTION DETAILS.

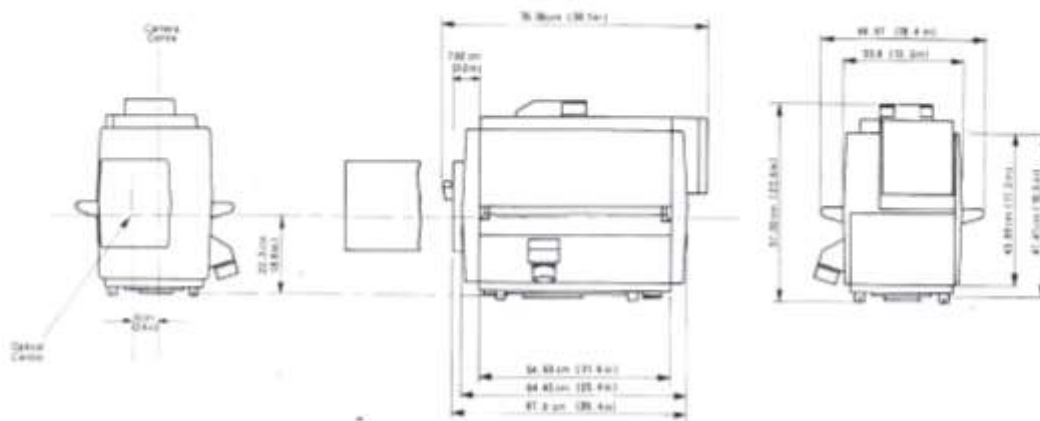
PERFORMANCE

- Resolution:** Modulation depth at 400 lines per picture height, 100% with aperture correction.
- Gamma Correction:** Adjustable between 0.4 and 1.
- General Stability:** The outputs remain stable with constant illumination for mains surges of $\pm 6\%$ of the nominal value. The camera channel will meet this performance specification at temperatures between -10°C and $+40^{\circ}\text{C}$. Performance is stable for any ± 10 degrees within these limits. Registration and colour balance are maintained with sufficient accuracy to permit 'hands off' operation under normal studio operating conditions.
- Camera cable:** One camera cable with single quick release multiway connectors.
- Sensitivity:** With incident illumination of 1600 Lux (150 foot-candles) and peak scene reflection of 60%, the lens set to standard aperture of $f/8$, typical values of signal-to-noise ratio are
- a) Luminance channel (5 MHz bandwidth) 45 dB
 - b) Green channel (1.5 MHz bandwidth) 42 dB
 - c) Red channel (1.5 MHz bandwidth) 36 dB
 - d) Blue channel (1.5 MHz bandwidth) 38 dB
- (These figures measured when aperture correction is not in use.)
- Registration:** With average high quality pick-up tubes, all four rasters can be registered to:
- 0.1% in Zone A
 - 0.25% in Zone B

DIMENSIONS

	HEIGHT	WIDTH	DEPTH	WEIGHT
Camera:	See diagram on page 19			
Camera control:	49 cm (19½ in.)	48 cm (19 in.)	56 cm (22 in.)	52.2 kg (115 lb)
Operational control panel:	20.5 cm (8¼ in.)	8.3 cm (3¼ in.)	14 cm (5½ in.)	0.9 kg (2 lb) (including mating socket)
Power supply:	22 cm (8½ in.)	48 cm (19 in.)	53.3 cm (21 in.)	51.7 kg (114 lb)
Colour Balance Control Unit:	20.5 cm (8¼ in.)	8.3 cm (3¼ in.)	22 cm (8½ in.) (overall) 15.3 cm (6 in.) (below panel including connector)	2.27 kg (5 lb) (approx.)

Camera Dimensions



Weights

Camera:	66.8 kg.	(147 lb.)
Viewfinder:	8.6 kg.	(19 lb.)
Total	75.4 kg.	(166 lb.)

NOTE: The information contained herein is subject to confirmation at the time of ordering.

TD-3-B3205



The Marconi Company Limited

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MEMBER OF GEC-MARCONI ELECTRONICS LIMITED