

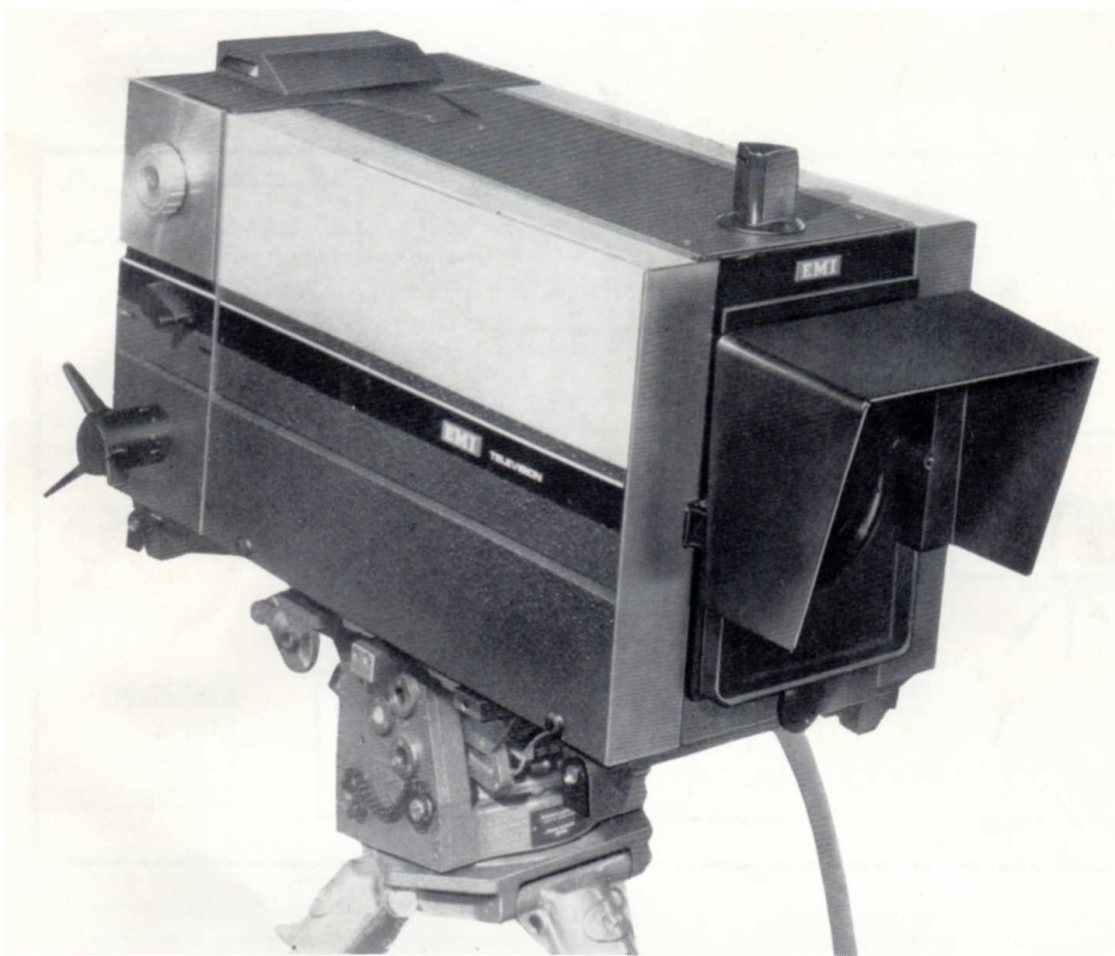


**Broadcast Equipment Division**  
EMI Electronics Limited

## **Colour Camera Channel Type 2001**

The solid-state Colour Television Camera Channel Type 2001 produces high quality broadcast television signals on 525 or 625 line standards. The signals from its four lead oxide vidicon pick-up tubes are processed to produce three signal outputs

R', G' and B' for direct application to standard NTSC, PAL or SECAM colour television encoders, and to standard RGB colour picture monitors.



### **FEATURES**

Separate luminance tube reduces colour registration problems, and ensures crisp colour picture

Excellent compatible black and white performance

Optimum contrast and resolution through lightweight direct imaging optics

Pre-aligned prism assembly eliminates optical adjustment

Colour fidelity is ensured by four-signal to three-signal matrix

Interchangeable zoom lens packages provide variety of viewing angle ranges

Integral zoom lens packages simplifies balancing of camera

Built-in but detachable shot box located near focus handle

Very good signal-to-noise ratio

Modern styling, low weight and compact size, ideal for studio or O.B. use

Solid-state technique gives low power consumption and reliability

Short setting up time with exceptional stability and 'hands off' operation

Up to 2,000 ft (600 metres) of camera cable can be used

Electronic viewfinder uses 7 inch (18 cm) diagonal rectangular cathode ray tube of high brilliance and resolution

Tilting electronic viewfinder can be detached and operated 33 feet (10 metres) away from camera

Three isolated non-composite outputs of each of the R', G' and B' signals

Two isolated non-composite outputs of the luminance signal

Plug-in circuit boards for ease of servicing

## CONSTRUCTION

The basic units of the camera channel are :

Colour Camera Type 2001

Zoom Lens Package Type 2011 or 2012

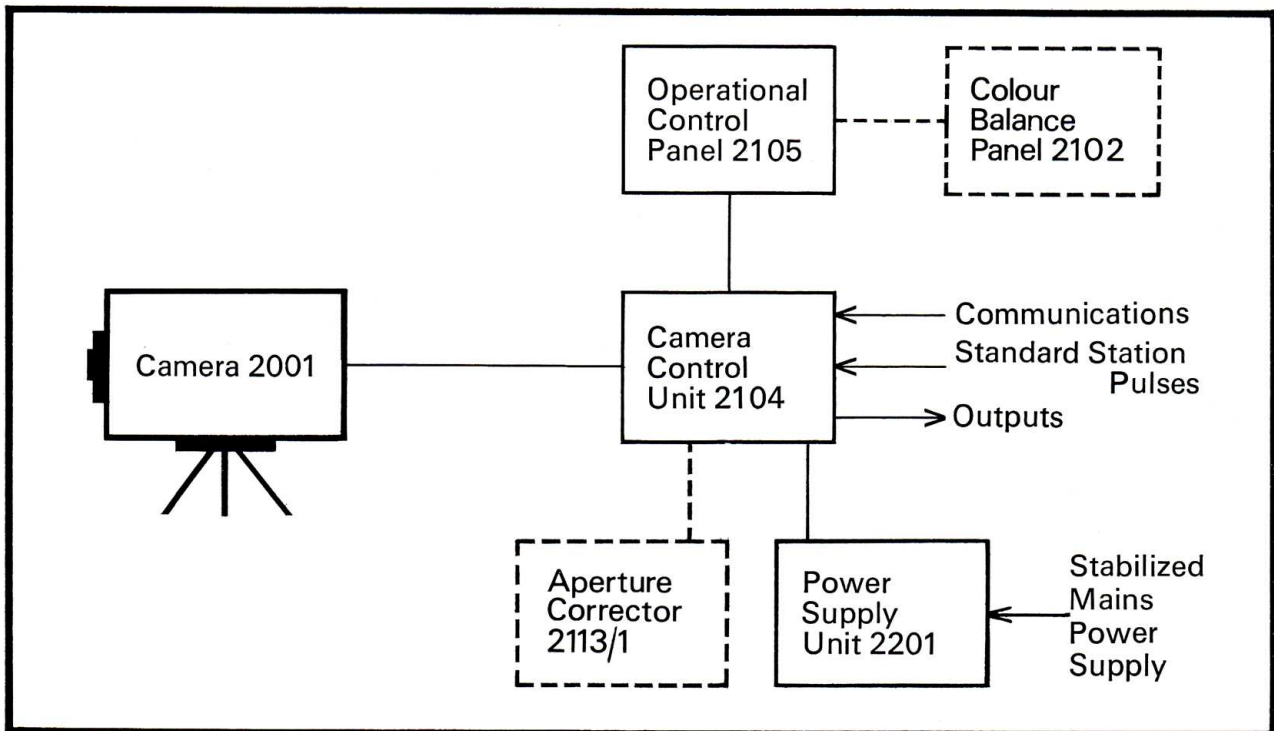
Camera Control Unit Type 2104

Power Supply Unit Type 2201

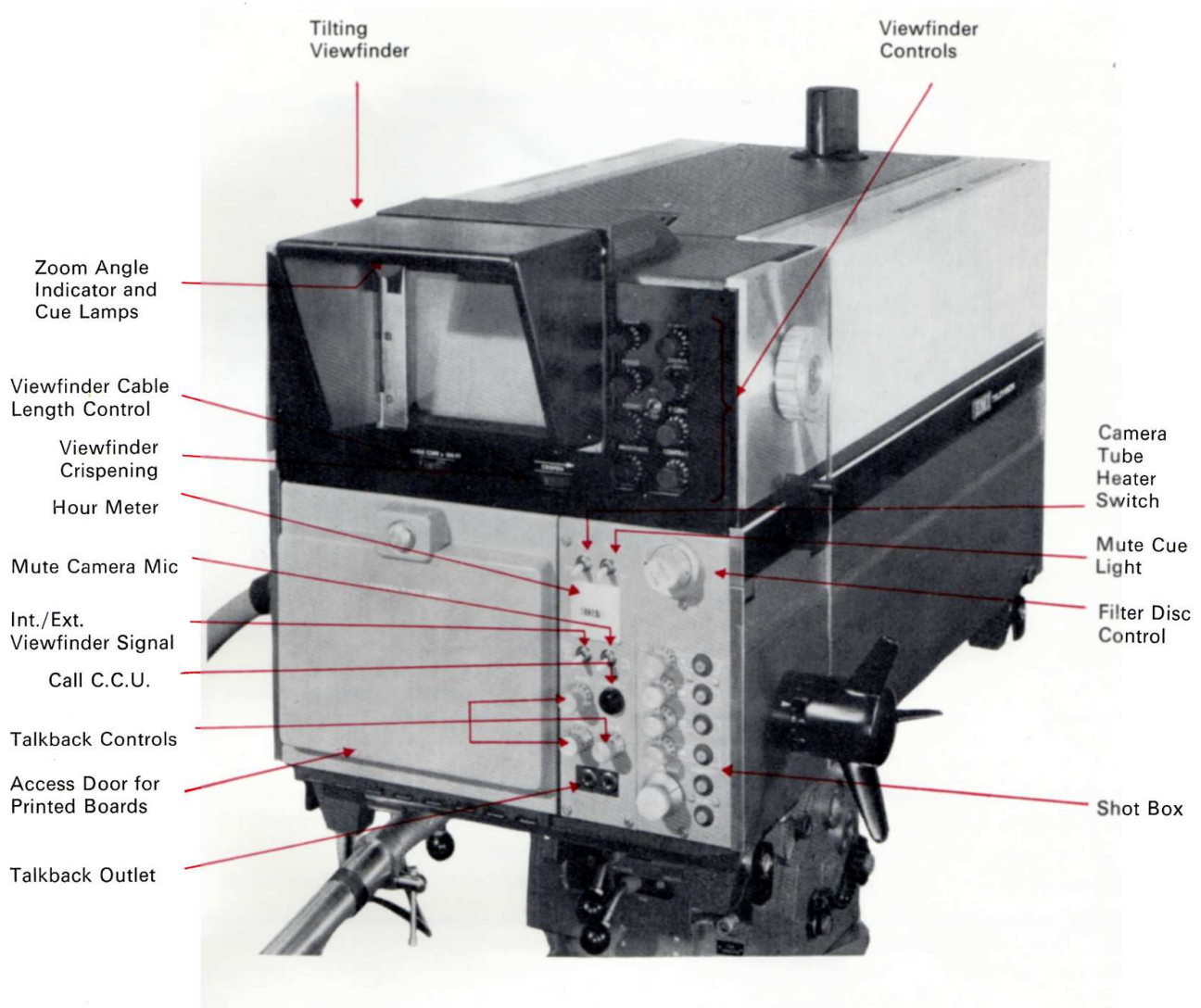
Operational Control Panel Type 2105

Colour Balance Panel Type 2102 (optional extra)

Aperture Corrector Type 2113/1 (optional extra)



## COLOUR CAMERA TYPE 2001



The Colour Camera Type 2001 provides the known superior performance of separate luminance channel design.

The framework is constructed of aluminium alloy and has a high quality textured finish in tones of grey and black. Hinged side covers permit easy access to the sub-units. Electronic circuits, optical unit and zoom lens are assembled into a unified and well styled compact design.

A red cue lamp is mounted on top of the camera and is easily visible from all directions. Twin cue lamps are provided in the viewfinder. Space is available on the side of the camera for station identity and camera-number signs. The camera can be mounted on a pan and tilt head by means of a standard Vinten wedge. A series of tapped holes (0.375 in dia) are provided in the wedge to facilitate mounting the camera on U.S.A. type tripods. Strong carrying handles are provided which can be retracted out of sight when not in use. Provision is made for mounting a visual prompter.

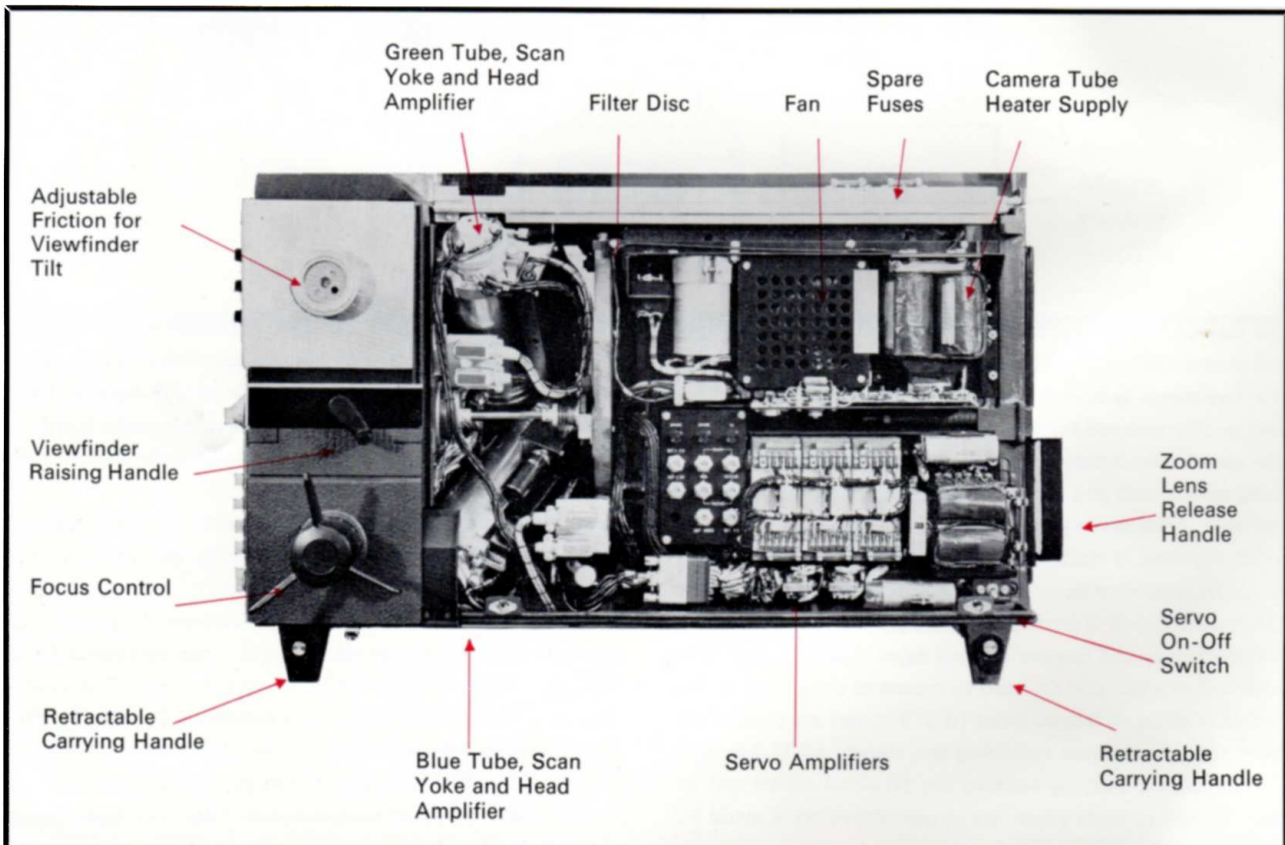
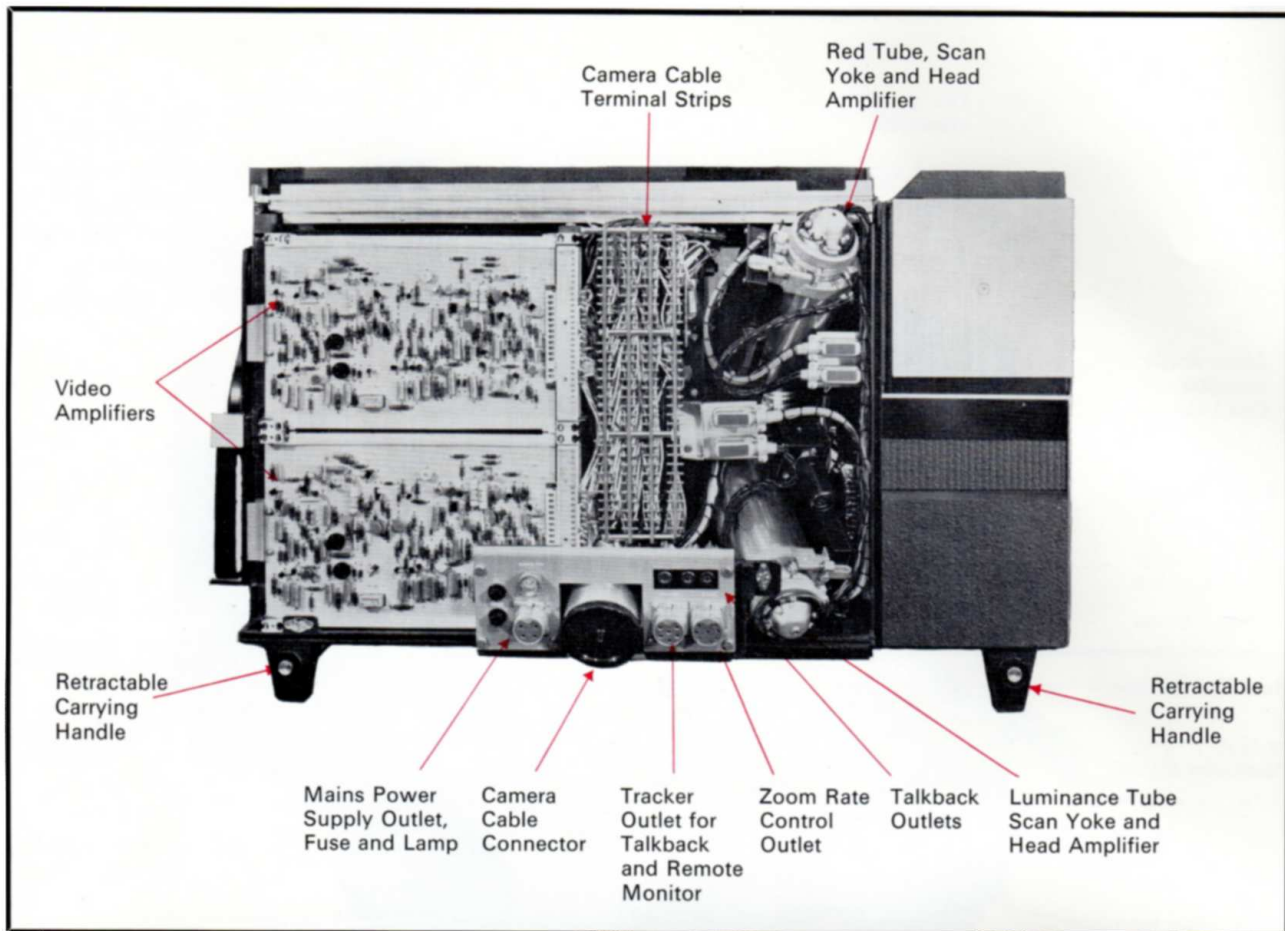
A socket on the side of the camera provides viewfinder video signal, camera talkback and on-air cues for the tracker's moni-

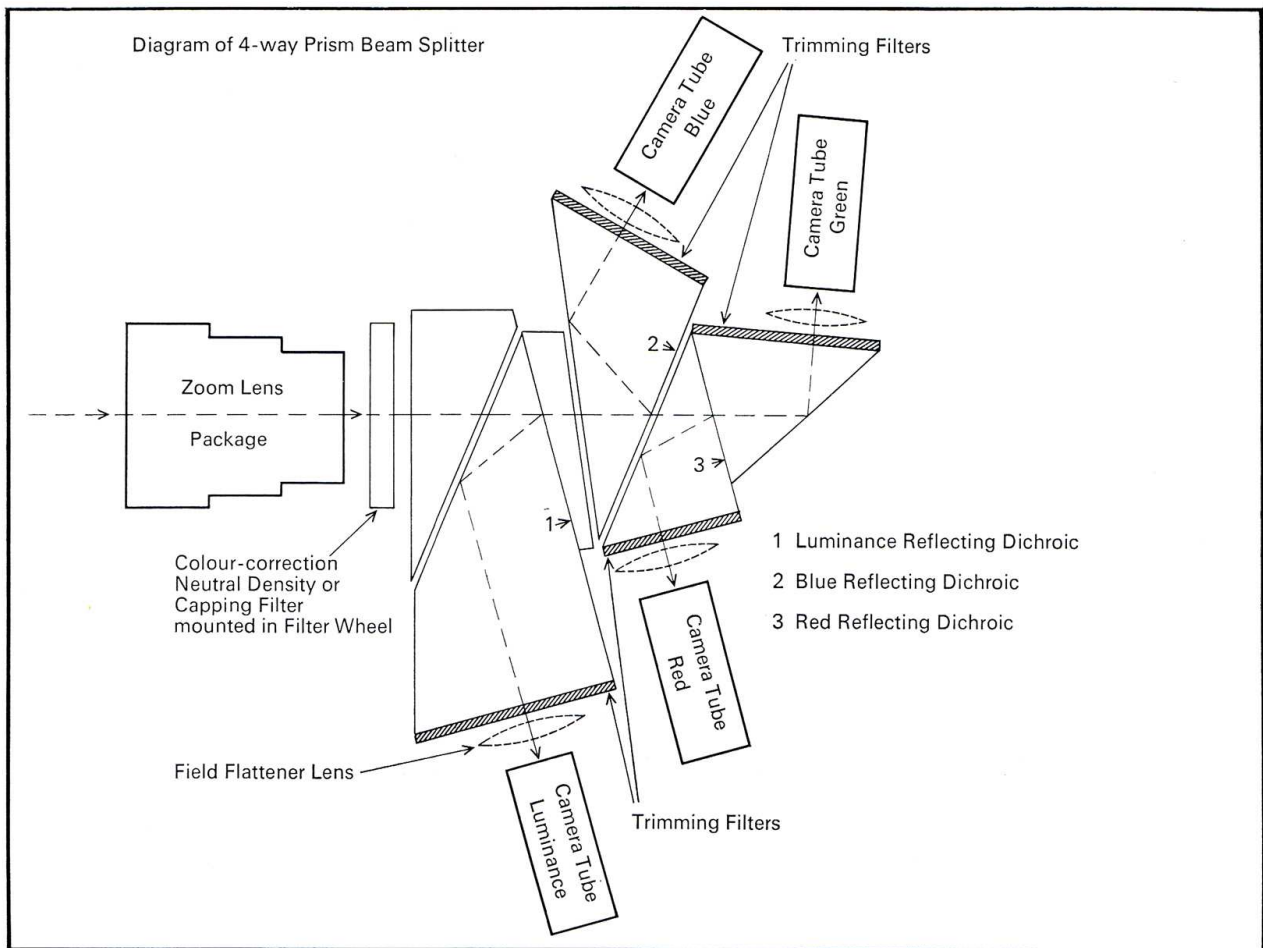
tor. Cameraman's talkback outlet and controls are on the back of the camera. A mains supply socket is provided on the side of the camera (1.0 A). This can be used for an 'eye-light' and can be controlled from a lighting console since this outlet is fed via a separate connector on the rear of the Camera Control Unit 2104.

The camera cable, which may have a length up to a maximum of 2,000 feet (600 metres), is connected to the camera on the left-hand side.

The tilting viewfinder derives its supplies from the camera but is otherwise a self-contained unit, and it can be removed and operated up to 33 feet (10 metres) from the camera. The monochrome picture is produced on a flat-faced 7-inch (18 cm) diagonal rectangular cathode ray tube giving a high resolution display with sufficient brightness to permit the use of an implosion and X-ray proof neutral density filter. Alternative types of viewfinder hood can be easily attached. A meter is provided to indicate the setting of the zoom lens.







The optical arrangement of the camera consists fundamentally of a zoom lens the light from which enters a beam-splitting prism assembly which is arranged by means of dichroic surfaces to separate the light into the four lead oxide vidicon pick-up tubes, giving respectively luminance, red, green and blue signals. This gives the advantages of direct imaging optics and since relay systems are not used, a saving in weight is achieved. The zoom lens package is detachable from the camera for ease of transportation and to permit the use of alternative zoom lenses having different characteristics.

The Colour Camera 2001 can be supplied with alternative zoom lens packages.

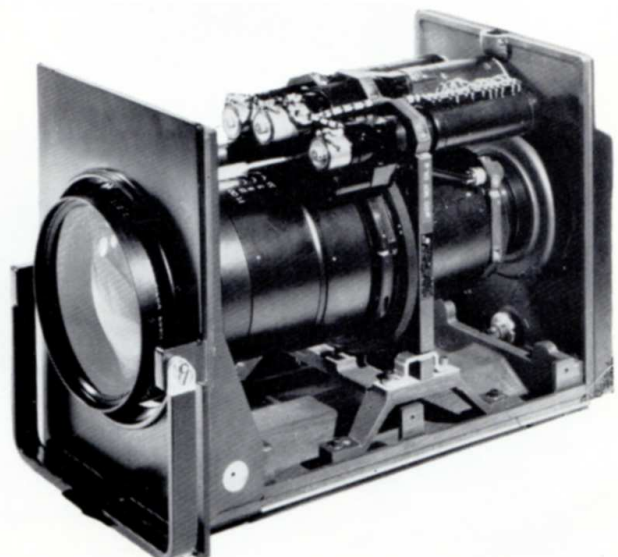
The Type 2011 (Angenieux 10 × 18 J3) has a maximum aperture of  $f/2.2$  and a minimum focusing distance of 3 feet (0.9 metres) and angles of view of  $5^\circ$  to  $50^\circ$  (horizontal). This lens has been designed especially for use in conjunction with the four way beam splitter prism. To obtain optimum resolution, field flattener lenses are inserted in front of each pick-up tube. The Type 2012 (Angenieux Type 12 × 50 mm), with maximum aperture of  $f/4.5$ , has a minimum focusing distance of 13 feet (4 metres) and covers angles of view of  $1.8^\circ$  to  $18^\circ$ . The Type 2014 (Angenieux 18 × 27½) has a maximum aperture of  $f2.2$  and a minimum focusing distance of 10 feet (3 metres) and angles of view of  $2^\circ$  to  $31^\circ$  (horizontal).

The Type 2015 (Angenieux 10 × 18 K31) with maximum aperture of  $f2.2$  has a minimum focusing distance of 16 inches (0.4 metres) and covers angles of view of  $5^\circ$  to  $50^\circ$  (horizontal). The three function zoom servo amplifiers are contained within the camera. Removal of one type of zoom lens and replacement by another type can easily be carried out in a few minutes.

A zoom rate twist grip is mounted on the camera panning handle and provides servo-operated zoom control. A preset zoom position control (shot box) is built into the rear of the camera

adjacent to the focus control. With this a number of zoom positions can be preset, the selected positions then being automatically obtained by operation of push-buttons. A meter indicates the zoom setting. Servo-focus is operated from the focus handle located in the normal position on the right-hand side of the camera. The servo-operated iris may be controlled from the CCU or remotely from the Operational Control Panel.

An eight-position manually-operated filter wheel is provided for insertion of colour filters, neutral density filters, and/or for 'capping-up'.



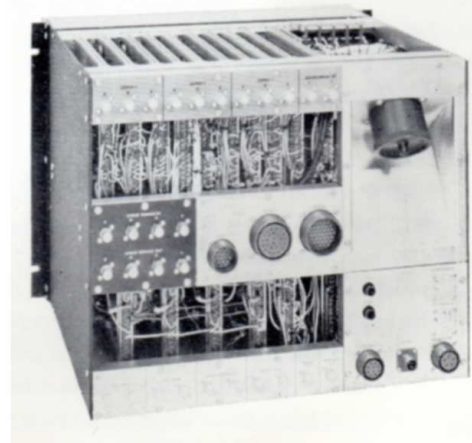
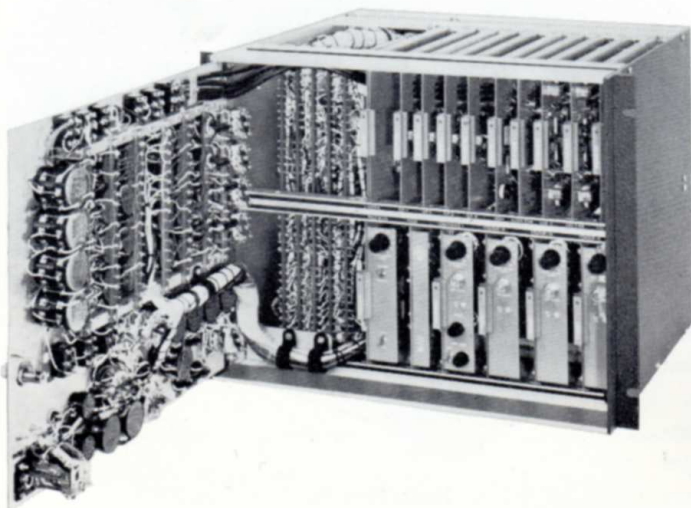
Zoom Lens Package Type 2011



## CAMERA CONTROL UNIT TYPE 2104

The Camera Control Unit 2104 is designed for standard 19-inch (48 cm) rack mounting. It has a control panel hinged at the left-hand side; this permits easy access to the rear of the panel and to the plug-in circuit boards. The printed circuit boards are mounted vertically, giving excellent convection cooling. Board extenders ease servicing of these boards and the unit is designed so that all normal servicing can be done from the front.

The camera cable and other interconnecting cables enter the unit from the rear.



## OPERATIONAL CONTROL PANEL TYPE 2105

The Operational Control Panel 2105 is a compact unit designed for remote 'hands-off' operation of the camera and carries only those controls necessary for programme operation. A number of these panels can be mounted side-by-side on a vision control desk for control by one operator.

Iris and Master Black controls are combined in a joystick control. Movement of the knob in a quadrant mode operates the iris servo. Rotation of the knob controls master black.

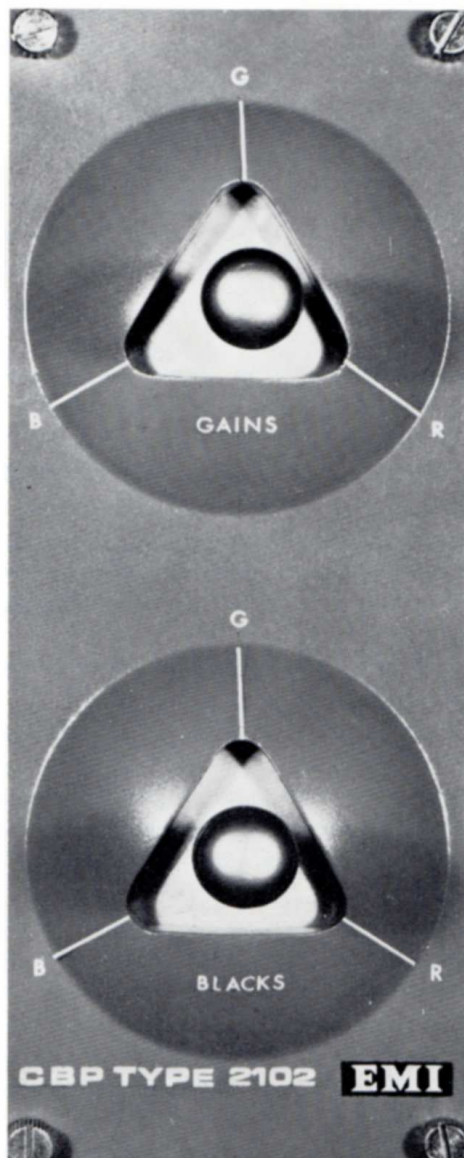
The operator's hand on the joystick control depresses a micro-switch for preview monitor selection. A coarse iris adjustment is provided by an edge-control, calibrated in mean f numbers, located adjacent to the joystick. The two controls can be moved simultaneously so that the coarse iris setting can be adjusted on-air without disturbing the picture signal.



## COLOUR BALANCE PANEL TYPE 2102 (optional extra)

The Colour Balance Panel 2102 has two joystick controls. One enables gain to be altered in the red, green, or blue channels while maintaining overall gain constant, the other enables black level to be altered in the red, green, or blue channels.

With these controls colour balance can be easily adjusted when changes occur in lighting conditions. The joystick controls can readily be returned to the neutral position. Microswitches are depressed by the operator's hand on the controls for preview monitor selection.





## POWER SUPPLY UNIT TYPE 2201

The 19-inch rack mounting Power Supply Unit 2201 provides the nine stabilised voltage supplies and one stabilised current supply required for the channel.

Two printed boards are used for high voltage supplies and the constant current supply.

The six remaining supply boards are identical and adapt their function to the sockets into which they are plugged.

Depending upon the function required, these boards can provide 18V, 28V, or 40V, at currents ranging up to 2A, and stabilities better than 0.1% as applicable.

They incorporate remote sensing to cope with PSU-CCU connecting cables up to 100 feet (30 metres) and camera cables up to 2,000 feet (600 metres) in length, with no readjustment of the voltages needed.

All the supplies are fully protected against inadvertent overload and short circuit; the voltages return to their usual value on removal of the fault condition.



## CIRCUITS

### CAMERA 2001

The electronic sub-units in the camera, including scanning circuits, pulse circuits and pre-amplifiers, are of plug-in design and are readily accessible for replacement.

The channel amplifiers in the camera carry out the following processes:

- Low noise pre-amplification

- Low-pass band filtering to reduce noise and crosstalk

- Individual R.G.B. channel gain controls (controlled from CCU) for equality balance

- Master gain control. Range 18dB with tracking accurate to 0.1dB (controlled from CCU)

- Clamping and limiting

- Outputs to camera cable

Built-in test and bridging facilities are included, and are remotely operated from the camera control unit, so that test signals can be passed through the entire video processing chain of the channel.

Precision scanning and focus yokes in conjunction with highly stabilised scanning and pick-up tube supplies ensure maximum stability and accuracy of geometrical registration. Comprehensive screening is provided so that the camera can be operated in high magnetic fields without significant deterioration of picture quality. All principal registration adjustments are remotely controlled from the CCU.

Voltage sensing circuits are provided to maintain stable supply

voltages at the camera independent of cable length.

Extensive use is made of stage-by-stage and overall negative feedback techniques together with special quality components to ensure long-term stability against mains supply variations and temperature changes.

The camera also includes three servo-amplifiers for lens iris, focus and zoom, and a stabilised d.c. heater supply for the pick-up tubes heater.

The viewfinder provides a brilliant sharply-focused high-contrast picture, achieved by the use of a stable 15 KV final anode supply derived from the horizontal deflection circuit and a high level output from the video amplifier. The scanning yoke is designed for excellent picture geometry and the tube is fully screened against high external magnetic field intensities. H.F. loss correction for up to 2,000 feet (600 metres) of camera cable is provided on the viewfinder. Electrical controls to centre the picture are included. Contrast and Brightness controls are easily accessible.

The viewfinder input signal, which is selected by the camera operator, can be either:

- a) The luminance signal

OR

- b) An external signal fed to the CCU. Also during setting up the viewfinder may be fed with the same signal as the monochrome picture monitor.



## CAMERA CONTROL UNIT 2104

The circuits perform the following functions:

- Cable loss correction
- Variable and level dependent aperture correction
- Signal amplification
- Black-level clamping
- Gamma correction
- Four-signal to three-signal matrixing
- Peak limiting and blanking
- Low-impedance output isolating amplification
- Monitor signal switching
- Field scan generation
- Alignment current stabilisation

Special circuit design techniques have been employed to ensure long-term operational stability. The four signals from the camera; **Y** (luminance), **R** (red), **G** (Green) and **B** (blue) enter the CCU at 0.7 V level and pass through the processing stages for camera-cable loss correction, amplification, black-level clamping, and aperture correction (luminance only). The four signals are next processed in a four-signal to three-signal matrix to produce three signals **R'**, **G'**, **B'**, which can be applied directly to RGB monitors and/or standard colour encoders. This matrix ensures that, unlike in the so-called Livingston process, the colour fidelity is not degraded by the use of a separate luminance tube. The process is as follows. The narrow band **R**, **G** and **B** signals are matrixed to produce a signal  $y = 0.3R + 0.59G + 0.11B$ , which is then gamma-corrected to form  $y^{\frac{1}{\gamma}}$ . The gamma corrected luminance signal  $Y^{\frac{1}{\gamma}}$  and the gamma-corrected signal  $R^{\frac{1}{\gamma}}$  are then matrixed with  $y^{\frac{1}{\gamma}}$  to form the red output signal  $R' = R^{\frac{1}{\gamma}} + Y^{\frac{1}{\gamma}} - y^{\frac{1}{\gamma}}$ . Since at low frequencies  $Y^{\frac{1}{\gamma}}$  and  $y^{\frac{1}{\gamma}}$  are equal,  $R' = R^{\frac{1}{\gamma}}$  plus the high frequency components of  $Y^{\frac{1}{\gamma}}$ . The green and blue signals **G'** and **B'** are formed in similar matrixes. Three independent non-composite outputs of each of these colour signals are provided at 0.7V standard picture level into 75 ohms.

Monitor points permit inspection of the signals at various stages of the processing. A comprehensive switching arrangement allows a variety of signals to be fed to picture monitor, waveform monitor and the camera viewfinder.

The front of the CCU carries controls enabling the entire setting up of the channel from this position. Once these have been adjusted the only controls which may require attention

during a programme are Lens Iris, Master Black Level and possibly Master Gain. The controls on the panel are as follows:

For pick-up tube supplies (G, R, B, Y):

**Beam Current, Focus, Alignment 1, Alignment 2, Beams Off, Focus Rock On-Off.**

For pick-up tube registration (G, R, B, Y):

**R, B, Y and Master Scan Height, R, B, Y and Master Scan Width, Overscan On-Off, G, R, B, Y, Vertical Centre and Horizontal Centre.**

For signal circuits:

**G, R, B, Y Black Levels; G, R, B and Master Gains, switch for Set Blacks, Normal, Calibrate and Test, Test and Calibration Level (nanoamps) bridging for Gamma In and Output 2.**

For talkback:

**Headset Jack, Producer Gain Control, Camera, Operator Gain Control, Camera Operator Call Button and Camera Operator Calling Indicator Lamp.**

For viewfinder and monitors:

**Viewfinder: Normal or as Picture Monitor**

**Select Signal: G, R, B, Y, G', R', B', Y out Switch**

**Picture Monitor Reference: -G, Off**

**Waveform Monitor Reference: Y, Off**

**Waveform Monitor: As Selected, Highest Output**

For programme operation:

**Local or Remote Switch**

**Iris**

**Black Level**

**Gamma: Linear, 1, 2, 3**

**On Air Cue lamp**

For Y signal:

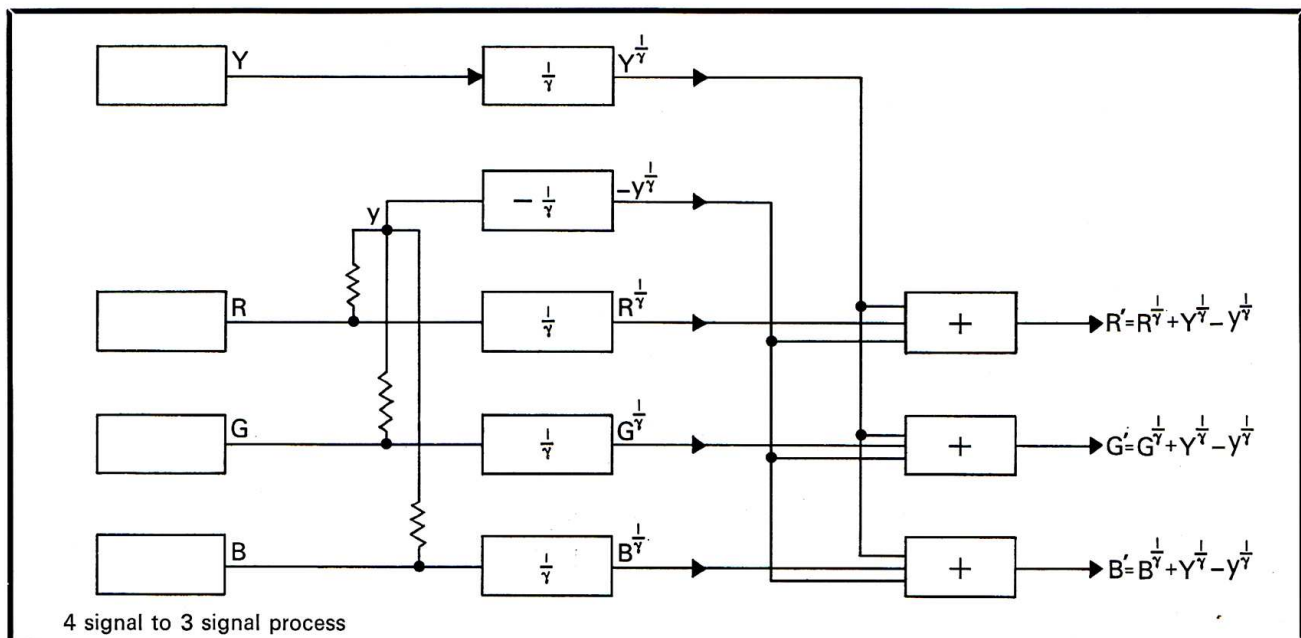
**Normal or Three-Tube**

For Power:

**Mains: On-Off Switch**

**Camera AC: On-Off Switch**

**Power Supply: On-Off Switch with indicator lamp**



# DATA SUMMARY

## Systems

525 lines (I.R.E./E.I.A.)  
60 fields/second  
625 lines (C.C.I.R./O.I.R.T.)  
50 fields/second

## Pick-up Tubes

Four lead oxide vidicons

## Power Input

100V to 125V r.m.s. 50 Hz to 60 Hz single phase  
OR

200V to 250V r.m.s. 50 Hz to 60 Hz single phase

Permitted variation:  $\pm 5\%$

Consumption: 500 VA (not including utility outlet)

Power Factor: 0.9

Hour counter:

If 60 Hz supplies are used, a 60 Hz hour counter is available to replace the 50 Hz hour counter

## Channel Outputs

Three independent non-composite outputs each of R' G' and B' at standard level (0.7V picture) into 75 ohm loads

Two independent non-composite outputs of the luminance signal

## Isolation between outputs:

better than 48dB at 1.0 MHz  
better than 40dB at 3.5 MHz  
better than 30dB at 5.0 MHz

## Pulse Inputs

Mixed sync, mixed blanking, line and field drive at  $-1.5V$  to  $-6V$ . All pulse inputs are high impedance and may loop in and out

## External Signal Input

Accepts standard level composite video signal for feeding to viewfinder. Can accept non-composite video signal if required

## Communications

Producer (input): 0.4V to 1.5V into greater than 2000 ohms

Programme sound (input): 0.4V to 1.5V into greater than 2000 ohms

Camera talkback (output): 750 mV into 600 ohms

Input and output signals are balanced

## Sensitivity

With incident illumination at 3000°K, of 150 ft/candles and 60% reflectance, lens aperture f/4, target potential 25V, and tube sensitivity 350 $\mu$ A/lumen, then the signal/noise ratio is not less than 42dB measured with bandwidth of 5.5 MHz, excluding gamma correction and aperture correction.

## Frequency Amplitude Response (Luminance)

With zero aperture correction

For 200 ft (60 m) of camera

cable: Flat within  $\pm 0.25$ dB to 5.5 MHz

For 2000 ft (600 m) of

camera cable: Flat within  $\pm 1.5$ dB to 5.5 MHz

Variable (phase corrected) aperture correction is available in the luminance channel.

## Frequency Amplitude Response (Colour Channels)

For up to 2000 ft (600 m) of

camera cable:  $-3$ dB  $\pm 0.5$ dB at 1.6 MHz

## Low Frequency Response

The tilt on a 50 Hz square wave is less than 0.25% of the square wave amplitude per millisecond

## Resolution

Depth of modulation at 5 MHz, 100% with aperture correction at the centre of the picture

## Colour Registration

Within a circle having a diameter equal to  $0.8 \times$  picture height (Zone I):  $< 0.05\%$

Within a circle having a diameter equal to the picture width (Zone II):  $< 0.2\%$

Outside Zone II:  $< 0.4\%$

Of picture height

These figures refer to a set of selected lead oxide vidicon pick-up tubes for the Y, R, G and B channels adjusted after a warm up time of 30 minutes

## Operating Temperature Range

The camera channel performs to specification over  $\pm 10^\circ\text{C}$  within the ambient temperature range of  $0^\circ\text{C}$  to  $+40^\circ\text{C}$

## Magnetic Interference

A change of orientation of the camera axis with respect to the earth's magnetic field causes negligible change of registration

## Viewfinder

At highlight brightness of 200 foot-lamberts, fine picture details and scan raster lines are clearly visible over the whole picture. The viewfinder is normally supplied with a 35% neutral density filter which reduces the highlight brightness to approximately 70 foot-lamberts.

Regulations of the 15KV final anode supply is such that there is negligible change of picture and scanning spot size over the full range of modulation. Geometry errors are no greater than 1.5% within a circle of diameter equal to picture width, and no greater than 2% outside that circle.



**Overall Dimensions and Weight**

	Height	Width	Length	Weight
Camera 2001	15 in	15 in	29 in including zoom lens	160 lb excluding zoom lens but including servo amplifiers
	380 mm	380 mm	737 mm	73 Kg
Zoom Lens Package 2011				48 lb
				22 Kg
Zoom Lens Package 2012				73 lb
				33 Kg
Camera Control Unit 2104	14 in	19 in	17 in	50 lb
	355 mm	484 mm	434 mm	22.5 Kg
Power Supply Unit 2201	14 in	19 in	14 in	70 lb
	355 mm	484 mm	355 mm	31.5 Kg
Operational Control Panel 2105	6.125 in	3.25 in	5 in	6 lb
	155 mm	83 mm	127 mm	2.7 Kg
Colour Balance Panel 2102	8.06 in	3.25 in	5 in	6 lb
	205 mm	83 mm	127 mm	2.7 Kg

**Connectors**

	Fixed	Mating
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**Camera**

Camera Cable Plug	G101/110/62 P3	BICC	
Auxiliary mains	EP-4-17S	Cannon	EPCG-4-16
Zoom rate control	EP-8-17S	Cannon	EPCG-8-16
Tracker outlet	EP-6-17S	Cannon	EPCG-6-16

**Camera Control Unit**

Stabilised mains input	EP-4-14S	Cannon	EP-4-11IC
Auxiliary mains input	EP-3-14S	Cannon	EP-3-11IC
Talkback selector	MS3102A-18-1S	Cannon	MS3106B-18-1P
Communications	MS3102A-20-27P	Cannon	MS3108B-20-27S
Operational Control Panel	MS3102A-28-12S	Cannon	MS3108B-28-12-P
Power Supply Unit	MS3102A-18-11S	Cannon	MS3106B-18-11P
Power Supply Unit	MS3102A-28-21P	Cannon	MS3108B-28-21S
Low Voltage Supply Outlet	MS3102A-10SL-3P	Cannon	MS3106B-10SL-3S
Coaxial Connectors	BNC/31-GB-105-1	Amphenol	BNC/31-321
Camera Cable Socket	G101/110/62/S3	BICC	

**Power Supply Unit**

CCU	MS3102A-18-11P	Cannon	MS3108B-18-11S
CCU	MS3102A-28-21S	Cannon	MS3108B-28-21P

**Operational Control Panel**

CCU	MP134	McMurdo	MS134
Colour Balance Panel	MS118	McMurdo	MP118

## SCHEDULE OF EQUIPMENT

### 1 Basic camera channel comprising:

a Colour Camera Type 2001	1	up to 400 ft (122 m )	as required
b Zoom Lens Package Type 2011		or	
incorporating Angenieux 10 × 18 J3 lens	1	BIW Light Weight Camera Cable (Neoprene sheath and demountable connectors) Type 490N (OB or studio floor application up to 400 ft (122 m ) )	as required
or			
Zoom Lens Package Type 2012		or	
incorporating Angenieux 12 × 50 mm lens	1		
or			
Zoom Lens Package 2014		BICC Heavy Duty Camera Cable (PVC sheath and moulded connectors) Type G/101/112/62 or with demountable connectors Type D/G/101/112/62 (Wall or duct fitting over 400 ft (122 m ) )	as required
incorporating Angenieux 18 × 27½ lens			
or			
Zoom Lens Package 2015			
incorporating Angenieux 10 × 18 K31, 16" lens			
Other Zoom Lens Packages are available			
c Camera Control Unit Type 2104	1	or	
d Power Supply Unit Type 2201	1		
e Operational Control Panel Type 2105	1	BIW Heavy Duty Camera Cable (PVC sheath and demountable connectors) Type 2090P (Wall or duct fitting over 400 ft (122 m ) )	as required
f CCU/Power Supply Unit inter-unit cables (25ft) (7.6 m)	set of 2		
g OCP/CCU inter-unit cable (25ft) (7.6 m)	1	or	

### 2 Ancillary equipment for camera channel:

a BICC Light Weight Camera Cable (PVC sheath and moulded connectors) Type G/101/110/62 or with demountable connectors Type D/G/101/110/62 (Wall or duct fitting up to 400 ft (122 m ) )	as required	BICC Heavy Duty Camera Cable (PCP sheath and moulded connectors) Type G/101/113/62 or with demountable connectors Type D/G/101/113/62 (OB or studio floor application over 400 ft (122 m ) )	as required
or		b Headsets	3
BIW Light Weight Camera Cable (PVC sheath and demountable connectors) Type 490P (Wall or duct fitting up to 400 ft (122 m ) )	as required	c Headphones	1
or		d Viewfinder Hood	1
BICC Light Weight Camera Cable (PCP sheath and moulded connectors) Type G/101/111/62 or with demountable connectors Type D/G/101/111/62 (OB or studio floor application		e Lead oxide vidicon camera tubes	4
		f Colour Balance Panel Type 2102	1
		g Aperture Corrector Type 2113/1	1
		<b>3 Recommended additional items:</b>	
		a Camera Pedestal	1
		b Pan and Tilt Head with wedge adaptor plate	1
		c Diascope	1
		d Mains Supply Stabiliser	1

## ORDERING INFORMATION

When ordering please state:

- 1 Your equipment requirements by quoting from the Schedule of Equipment
- 2 Which of the following zoom lens packages is required: Type 2011, Type 2012, Type 2014, Type 2015, or other types
- 3 The supply voltage and frequency from which the equipment will be used
- 4 Camera cable requirements
- 5 The distance between camera control unit and power supply if inter-unit cable required is longer than 25 ft (7.6 m)
- 6 The distance between camera control unit and operational control panel if inter-unit cable required is longer than 25 ft (7.6 m)

www.tvcameramuseum.org



### EMI Electronics Ltd Broadcast Equipment Division

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