

AMPEX

Marconi MARK VII color camera chain



HIGH SENSITIVITY

produces excellent color pictures at low black and white levels

reduces studio costs for additional lighting and air conditioning to make Mark VII "the best buy" in color cameras

increases station income by allowing indoor, remote and other programming formerly limited to monochrome

UNPARALLELED RESOLUTION

provides sharp, crisp color or monochrome pictures day-after-day

provides 100% modulation at 400 lines even in low light levels

LOW-NOISE

44dB signal-to-noise over 5MHz bandpass in the luminance channel

SUPERB COLOR FIDELITY

result of four-tube design, advanced electronics, superior optics and unique Color Balance Control

EXTREMELY STABLE

operates day-after-day week-after-week without continual readjustment

MARK VII...

the most advanced camera
in color television

☐ Tilting, removable viewfinder displays local or remote signals . . . can be used as a monitor on remote locations

☐ Uses any zoom lens currently available or likely to be developed . . . plus any fixed focus or special purpose lens suitable for I.O. format

☐ Optical system incorporates a unique scatter mask to remove all unwanted light

☐ Images on all four Plumbicon tubes are formed in the same polarity . . . to enhance stability

☐ Tubes are removable without disturbing yokes . . . to preserve optical alignment during tube replacement

☐ Camera can be operated up to 2,000 feet from Camera Control Unit and still meet published specifications

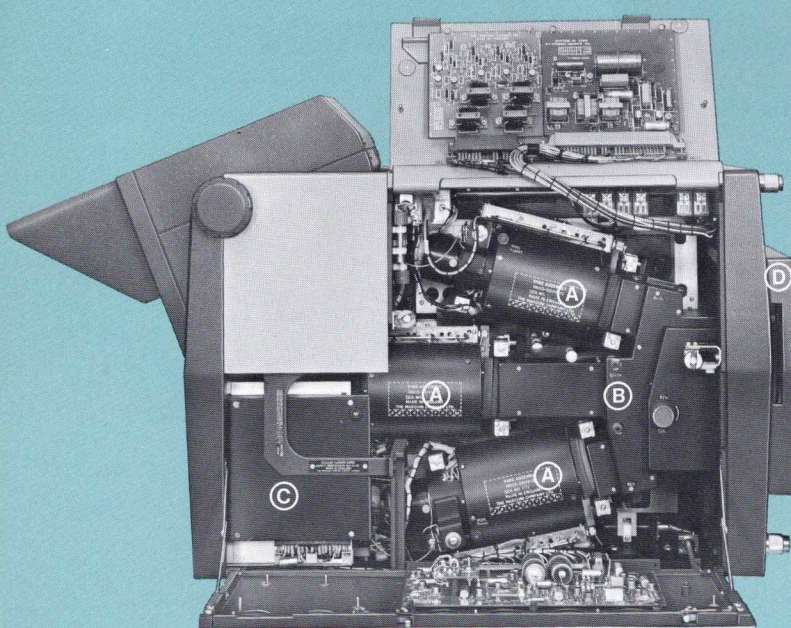
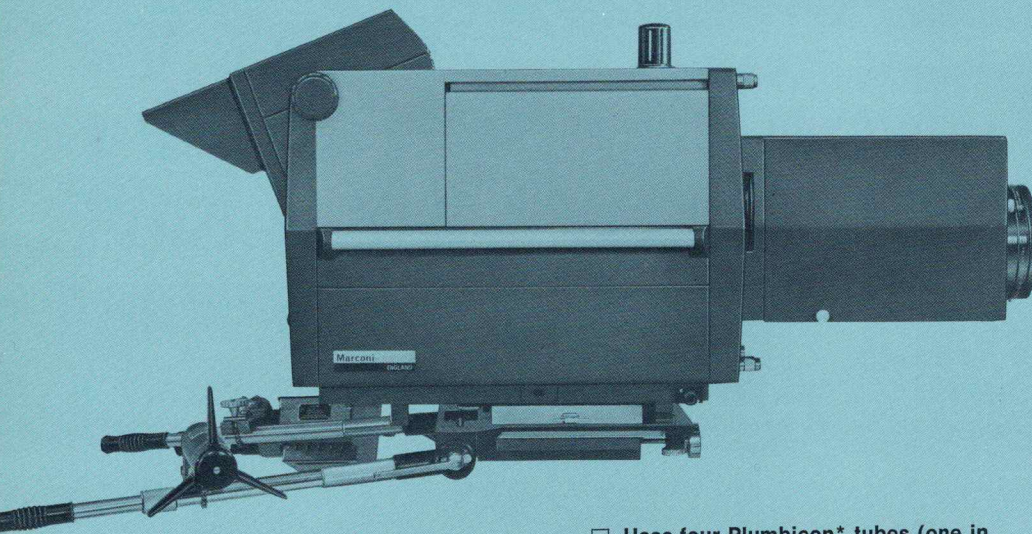
☐ All elements of the camera, control unit and power supply are modular and easily reached for servicing

☐ Comprehensive "GO/NO GO" metering and test signals are built into camera chain

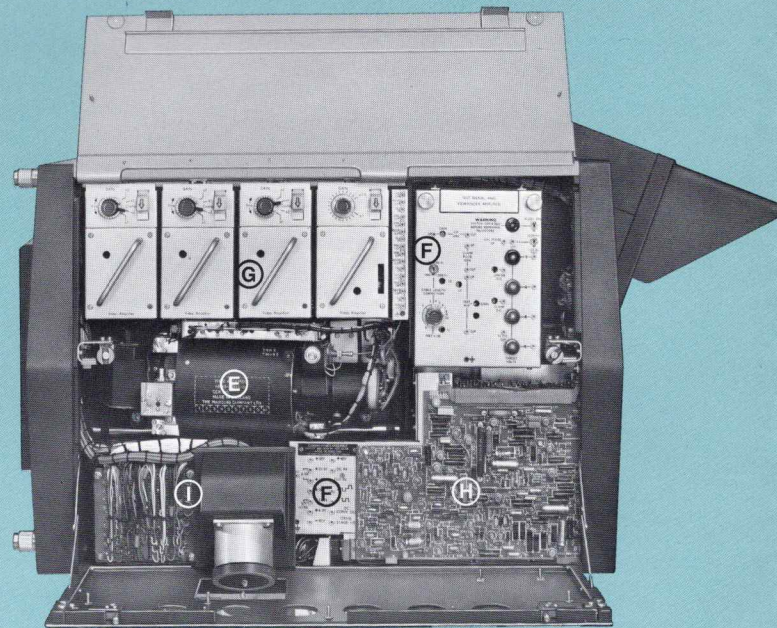
☐ Uses four Plumbicon* tubes (one in luminance channel, three in color channels) for high sensitivity with low-noise

☐ True "HANDS OFF" color operation . . . remote iris/black level allows control room adjustment of several cameras . . . joystick color balance allows color matching of cameras and compensation for color temperature variations

☐ Camera's compactness, lightness and fully tilting viewfinder provide unparalleled operator convenience



Open right side view of Mark VII; shows (A) green, red and blue color tubes, (B) optical system enclosure, (C) horizontal scan unit and (D) filter wheels.



Open left side view of Mark VII; shows (E) luminance tube, (F) waveform and power test points, (G) video amplifiers, (H) plug-in power unit and (I) cable termination board.

GENERAL DESCRIPTION

A Mark VII camera chain consists of the following basic units: Camera, Camera Cable, Camera Control Unit, Remote Control Panel and Power Supply. In addition to these, an optional Color Balance Control is available. A further optional feature of the Mark VII system is a Vertical Aperture Corrector.

The main structural frame of the camera itself is made from milled magnesium alloy plates — providing great strength and rigidity with minimum weight. Side covers hinge open to give access to the camera's circuits and optical system. The majority of circuits in the camera are of etched board construction — and can be easily removed for servicing. Camera yokes are fully shielded and arranged almost parallel. This enables optimum registration to be maintained and minimizes the adverse effects of magnetic fields.

A utility output on the camera provides power for test equipment, lights, prompting devices, etc. Two pairs of headset jacks are provided for use by the cameraman; additional headphone jacks are provided for crew or floor manager.

SENSITIVITY AND COLOR FIDELITY

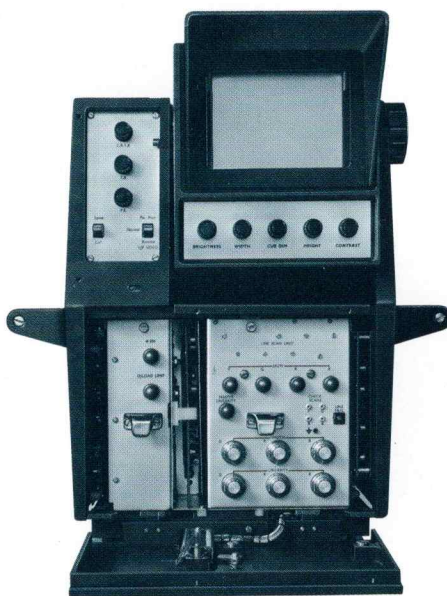
High sensitivity and color fidelity in the Mark VII are mainly due to use of four Plum-bicon tubes — three in the color channels, one in a separate luminance channel. The separate luminance channel may be used independently for monochrome operation; the result is a high-quality, high-sensitivity black and white camera.

The advantages in having a separate tube for luminance are well known. They are, briefly, that a high-quality luminance signal is obtained (both for the color and compatible black and white picture) that is not dependent on image registration. In addition, the dominating influence of the separate luminance signal on the reproduced luminance in the picture greatly reduces the visibility of tube blemishes and similar errors originating in color channels. Excellent color pictures are obtained at full lens apertures (f4) in light levels as low as 40 foot-candles. At this light level, the signal-to-noise of the chain is equivalent to that of a standard 4½ inch image orthicon camera. For complete sensitivity test performance, see the specifications.

OPERATIONAL CONVENIENCE

Operation of the Mark VII camera is exceptionally easy. Compactness and lightness, combined with simplified controls like "Master Gain," make it as simple to operate as a monochrome camera. "Hands off" design has eliminated all but the basic controls of focus and zoom.

A unique tilting viewfinder allows the operator to have a bright, clear view at all times. It can be locked by friction clamps to suit the height of the cameraman and camera position — and may be detached and operated up to 30 feet from the camera. It uses a 7 inch rectangular tube with high-light brightness of 200 foot-lamberts — ample brightness to compete with any lighting conditions. A 3-position switch on the viewfinder allows selection of three displays: (1) camera luminance channel (normal display), (2) monitor picture from control center, (3) picture from an external source. Provisions in the Camera Control Unit allow mixing of camera and external source pictures for precise camera alignment on special effects.



OPTICS

The Mark VII is designed for lenses with an image orthicon format; complete optical flexibility is achieved by a relay optical system. Any television zoom lens or any fixed-focus lens, with an I.O. format, may be used. Control of zoom and focus may be by manual or fully servoed operation. A unique feature of the Mark VII servo system is a "shot box" that provides selection of any five preset zoom positions together with wide angle and narrow angle conditions. An additional button provides a return to the twist grip demand control. On-air shot changes, pre-selected for the required angle, may be made at any required rate; a single switch is used to select the chosen speed.

The camera's internal optics are sealed in a dust-proof enclosure and mounted on an optical bed plate. A unique scatter mask, fitted to the relay lens at the front of the enclosure, removes all unwanted light to en-

hance color fidelity. An adjustment of position is provided to compensate for varying back focal distances in differing types of zoom lens, and to permit a wide range of focusing when using fixed focal length lenses. Two filter wheels, at the front of the optical assembly, provide correction for large light and color temperature variations. These filter wheels are located between the external objective lens and field lens.

Past the field lens, a luminance-chrominance light-splitting prism surface passes reflected light to the luminance tube and transmitted light to the chrominance tubes. An interesting feature of this surface helps make efficient use of incoming light. It serves, simultaneously, as the light-splitting prism and luminance spectral response-trimming filter — so only part of the incoming light required for the correct spectral response is passed to the luminance tube. Additional light is thus available for the color tubes.

For black-and-white operation a fully reflecting surface is moved into position in place of the luminance-chrominance light-splitting surface so that all the incoming light passes to the luminance tube.

ELECTRONICS

Extreme stability in the Mark VII results from use of ultra high-grade, solid-state components throughout. Such circuit features as specially designed thin-film modules on a glass substrate, metal-film resistors, tantalum capacitors, silicon transistors and helical potentiometers contribute significantly to the "hands off" capability of the chain. Once registration and color balance adjustments are made, they remain rock steady through all operating conditions.

In day-to-day operations, the camera and its controlling elements will meet all specifications after a 25 minute warm-up. Rehearsal quality pictures are available only five minutes after turn-on. If the camera chain was in perfect alignment during the previous period of operation, no readjustment of set-up controls is necessary to begin the new operating day.

During long-term operation of the Mark VII, readjustment of set-up controls should not be required more than once each week for normal operation. For complete details on long-term stability see the specifications.

CAMERA CONTROL UNIT

The Mark VII Camera Control Unit provides all camera engineering controls on a dual panel; the top portion contains set-up controls, the bottom portion operational controls. This front panel hinges down for easy access to plug-in electronics modules located behind it. Normal procedure with the highly stable Mark VII C.C.U. is to first set

up all engineering controls—then switch complete control of the chain to the Remote Control Panel.

To ensure "hands off" operation, all four video channels are very closely matched. Special circuit techniques, including extensive use of thin-film circuitry, have been employed in all video amplifiers, particularly for gamma correction. These provide highly stable color balance between channels without adjustment.

Set-up controls on the engineering panel are laid out in a logical sequence. The top row includes set-up controls for monochrome operation; the four rows of controls below these are for luminance, green, red and blue channels in color operation. A group of operational controls at the bottom of the panel may be operated locally or remotely via "local/remote" switch. These controls are:

Iris	Camera On/Off
Master Black	Beams On/Off
Master Gain	On-Air Cue
Normal/Overscan	

Additional operational controls can be remote if considered necessary. By means of two switch groups (one for pictures and one for waveforms), selected test signals can be fed to external picture and waveform monitors. Each Mark VII C.C.U. has self-contained, GO/NO GO color-coded metering for rapid set-up and alignment of the chain. Other built-in alignment features are: polarity reversal, calibration waveform generator, bridging switches for use with gray scale generator, preset corrections for cable length and aperture.

POWER SUPPLY

The Mark VII power supply mounts in standard 19" racks at up to 100' distance from the Camera Control Unit. Mechanical construction is of hybrid form, with transformers on a chassis pan and circuit modules in a plug-in subframe. A switching arrangement compensates for voltage drop when various lengths of cable are used. For critical voltages, zener diodes (providing reference voltages for the regulators) are enclosed in a thermostatically controlled oven.



Mark VII Power Supply

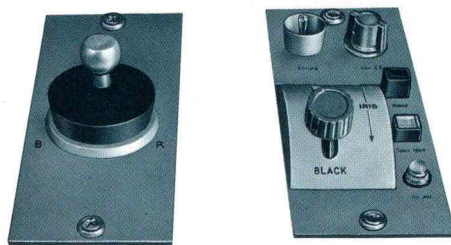
CABLES

Two types of cable are used to connect the Mark VII camera and Camera Control Unit: a heavy cable with large conductors for lengths up to 2,000 feet; a lighter, smaller cable for studio installations. Both cables use the same end connectors and may be intermixed.

REMOTE CONTROL PANEL

The simplified Operational Control Panel of the Mark VII chain may be mounted in any console to provide the ultimate in "hands off" color camera control. The basic control combines a quadrant lever for Iris Adjustment with a rotating knob for Master Black.

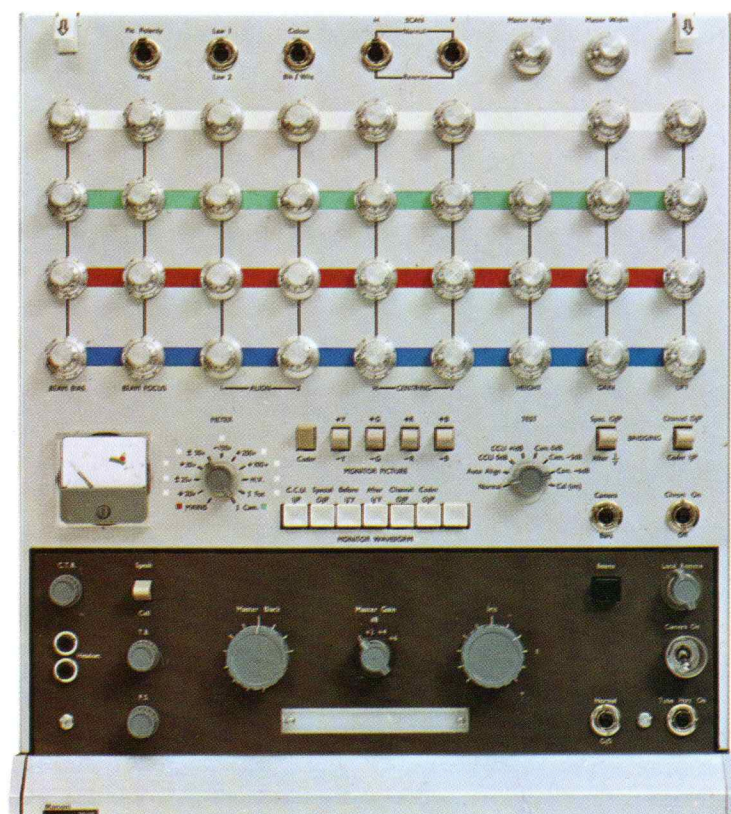
Adding the unique Mark VII Remote Color Balance Unit puts the final touch on the "hands off" system. It can match color from camera-to-camera and make correction for minor variations in color temperature. Color balance with this control does not affect individual dual channel gain settings. It uses a special arrangement of potentiometers to correct the relationship between Green, Red and Blue—and ensures that the algebraic sum of G-R-B is always unity. A single joystick controls the three potentiometers via a central pivot arranged between three equally spaced balls. The Remote Color Balance panel is marked with G-R-B, positioned as a color triangle. The joystick is free to move in any direction within the triangle and can be returned to its precise, original position at any time to restore the original color balance.



Remote Color Balance Unit and Operational Control

MARK VII OPTIONS

Vertical Aperture Correction is easily installed in the luminance channel of the Mark VII chain. Unlike systems that derive correction from a single color, the Mark VII's luminance unit corrects the whole picture irrespective of color. The unit mounts in a standard 19-inch rack and makes use of high frequency delay lines and piezo-electric transducers. The delay lines are in a temperature controlled oven to ensure stability of the delay. A control for correction is provided on the front panel.



Mark VII Camera Control Unit

MARK VII SPECIFICATIONS

Input Pulses:

Bridging input for horiz. drive, vert. drive, mixed blanking, mixed sync — between 1.5 and 8V

Resolution:

Modulation at 400 lines is 100% with aperture correction

Gamma Correction:

Adjustable between 0.4 and 1.0

Operating Standards:

525-line 30-frame or 625-line 25-frame standards; selection made by a local switch

Short Term Stability:

All requirements of the specifications are met after 25 minutes of applied power, assuming a previously adjusted and aligned camera is turned on from a cold start. Ambient temperature must be within 20°C of that when initial set-up was made. No adjustment of set-up controls are necessary during normal operational periods, within a temperature range of 20°C. Rehearsal quality pictures are available 5 minutes after power is turned on

Long Term Stability:

Readjustment of set-up controls is not required more than once each week with normal operation. Drift measured in each channel, after the prescribed warm-up period, is no more than the following during eight hours of continuous operation (excluding variations due solely to phototubes):

- overall gain $\pm 5\%$
- gain variation between channels 2%
- black level $\pm 2\%$ of 0.7V
- black level variation between channels 0.25%
- resolution $\pm 1\text{dB}$ at 400 lines
- registration 0.1% of picture width

Sensitivity and Signal-to-Noise Ratio:

Test Conditions: 150 foot-candles of 3000°K incident illumination on 60% reflectance gray-scale test card. Minimum luminance channel signal current of 0.22 μA (with lens aperture at f/8 and average luminance Plumbicon sensitivity of 380 $\mu\text{A/L}$)

- luminance channel depth of modulation: at least 40% at 400 lines per picture height
- luminance channel peak video signal to rms noise over 5MHz bandwidth: not less than 44dB measured in a flat channel
- typical color channel signal currents: Green, 0.08 μA ; Red, 0.03 μA ; Blue, 0.035 μA
- signal-to-noise in coloring channels is such that the noise from these channels makes no significant contribution to overall noise in the final picture; typical values over a 1.5MHz bandwidth: Green, 35dB; Red, 27dB; Blue, 28dB

Power:

100–125 and 200–250VAC in 5% steps, 48–60Hz, 600–800VA consumption depending on cable lengths

Dimensions:

	Height	Width	Depth	Weight
Camera	19 $\frac{1}{16}$ "**	18 $\frac{3}{8}$ "	27 $\frac{7}{8}$ "†	156 lbs†
Camera Control Unit	19 $\frac{1}{4}$ "	19"	22"	117 lbs
Power Supply	8 $\frac{3}{4}$ "	19"	21"	108 lbs
Remote Operational Control Unit	8 $\frac{1}{8}$ "	3 $\frac{1}{4}$ "	5 $\frac{1}{2}$ "	2 lbs
Remote Color Balance Unit	8 $\frac{1}{8}$ "	3 $\frac{1}{4}$ "	8 $\frac{3}{4}$ "	5 lbs
Rank-Taylor-Hobson VP Lens	10"	8 $\frac{3}{4}$ "	15 $\frac{1}{4}$ "	25 lbs

* including viewfinder † excluding lens and viewfinder

**unretouched
monitor photos
show
MARK VII
sensitivity**



Picture in 40 foot-candle light level



Picture in 150 foot-candle light level

**color touch-up
with unique
MARK VII
color balance
unit**

Actual, unretouched monitor photos at the right demonstrate the unique Mark VII color balance control. In the first picture shown, the camera is optimized with joystick in the central position. Successive photos demonstrate the degree of color correction possible by rotating the control through a complete 360° arc.



Joystick in neutral, center position.



Joystick moving through extreme green position.



Joystick moving through extreme red position.



Joystick moving through extreme blue position.

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