Norelco® PC-70 Plumbicon Camera... the television camera that sees eye to eye with the viewer





Now the PC-70…
newest generation of the 3-tube Plumbicon camera that revolutionized color television


Norelco
2

The new Norelco PC-70 Plumbicon Camera is the most advanced television color camera in operation today. Two of the three major networks already use this new generation camera for their prime time color shows, having selected it after the most comprehensive engineering evaluation. Dozens of individual stations also compared, then chose the PC-70 over all other cameras available. So did two of the largest videotape producers in the country. Altogether, well over 200 Norelco cameras were in service throughout the United States by the spring of 1967.

Why the swing to Norelco? Because the Norelco 3-tube Plumbicon Color Camera produces a sharper, truer picture than any other. Because it is inherently simpler, therefore more reliable, easier to operate and maintain.

Here is why the PC-70 Plumbicon Camera Chain represents the highest state of the art in television today. . . .



The Plumbicon* Award-winning achievement in tube technology

The Plumbicon image tube is recognized as a major contribution to electro-optical science. For its development, Dr. E. F. de Haan, a director of N. V. Philips Research Laboratory, was awarded the 1966 David Sarnoff Gold Medal by the Society of Motion Picture and Television Engineers.

And in 1967, the National Academy of Television Arts & Sciences awarded an "Emmy" to Philips, citing the Plumbicon tube as an "Outstanding achievement in Engineering Development." During the nationally televised program June 4, Pieter van den Berg accepted the trophy on behalf of N. V. Philips.



Before the advent of the Plumbicon, the pick-up tubes in almost universal use in professional television cameras fell into two classes: the image orthicon and the vidicon. Of course, both are still in wide use today, despite certain drawbacks peculiar to each.

The Plumbicon is based, like the vidicon, on the principle of photoconduction. However, its superior performance as a professional color broadcasting tool lies in its target, a large area P-I-N photo-diode light sensing mechanism. This gives it significant electrical advantages, including an extended linear transfer characteristic, no discernible dark current and very small photoconductive lag.

*Registered trade mark for television camera tubes.



A brief comparison of the Plumbicon Camera and the Image Orthicon Camera

Noise

The primary source of noise in the video signal from an image orthicon camera is the tube itself. It is typically coarse and easily discernible. On the other hand, essentially no noise is generated by the Plumbicon tube. In a Plumbicon camera, the primary source of noise is the input circuit of the first amplifier stage, but it is fine grain and visually far less disturbing than that of an image orthicon. Plumbicon cameras are characterized by extremely quiet pictures as compared to the familiar grainy and noisy pictures of image orthicon cameras.

Resolution

Resolution means the capability of the camera to resolve detail. This is often called image sharpness. It is fundamentally determined by the pick-up tube characteristics. A picture appears sharper to the eye when transitions between adjacent areas in the image are accentuated.

The PC-70 produces a "snappy" picture through the use of electronic edge enhancement. Here, the great advantage is that it does so without the unwanted halo effect common to image orthicon pictures. This technique, generally referred to as contour enhancement, is discussed in detail in a later section.

Tube Life

Plumbicon tubes are still delivering excellent picture quality after 3,000 hours of operation. Also important is their satisfactory maintenance of both resolution and sensitivity with extended use. Further, they don't become mismatched as they age, and can be replaced one at a time. Thus, useful service life compares favorably with that of the vidicon, and is far better than the image orthicon which normally shows a steady deterioration of performance throughout its life.

How many tubes? Three's company . . . four's a crowd

The first widely used color television cameras—many of them still in use today—utilized three image orthicon pick-up tubes. Since this was over a decade ago, they also utilized vacuum tubes in their circuitry rather than transistors. The heat generated by these vacuum tubes caused the deflection system associated with each pick-up tube to drift. This resulted in misregistration which impaired the sharpness of both the monochrome and the color picture. Since most home receivers at that time were monochrome it was imperative that the misregistration-through-drift problem be overcome in the monochrome picture.

To circumvent the drift problem, some manufacturers decided to add a fourth channel to the three existing chrominance channels. This fourth channel provided a separate black-and-white picture, independent of the chrominance channels and the possibility of misregistration.

Of course, it also added to and complicated camera construction and design, and brought about more involved procedures of set-up, operation and maintenance.

Philips engineers and scientists, then deep in the developmental stages of a new color camera, realized that the drift problem could be solved—not simply circumvented—by the use of reliable and stable transistor circuits being introduced in electronics at that time. Thus, the new transistor technology was utilized to develop a three-tube system that avoided the needless disadvantages of four-tube systems.

When the first Norelco Plumbicon cameras, the fruition of years of intensive research, were introduced at the 1965 NAB exhibit, thousands of broadcasters saw for the first time color television pictures which were breathtakingly beautiful.

The acclamation of the Norelco camera signaled other manufacturers to develop cameras using the Plumbicon tube. They incorrectly assumed, however, that the familiar picture "snap" of monochrome image orthicon cameras could best be achieved by the addition of a fourth Plumbicon.

And so, while most color cameras designed after the 1965 NAB exhibit were based upon the use of Plumbicon tubes, they were also designed with four channels.

Philips, understanding that picture sharpness had nothing to do with the number of added pick-up

tubes but was a result of the fundamental difference between the image orthicon and the Plumbicon (a target with edge effect versus a photo conductor), recognized that the desired "snap" in a Plumbicon camera could be achieved only by the use of electronic edge enhancement. The answer: "Contours-out-of-green"—the PC-70's unique Contour Enhancer . . . completely contained in two plug-in modules that occupy spaces formerly used by spare modules in the Camera Control Unit. In a later section (page 14) you will find a detailed description of "Contours-out-of-green."

These three important facts are now generally acknowledged:

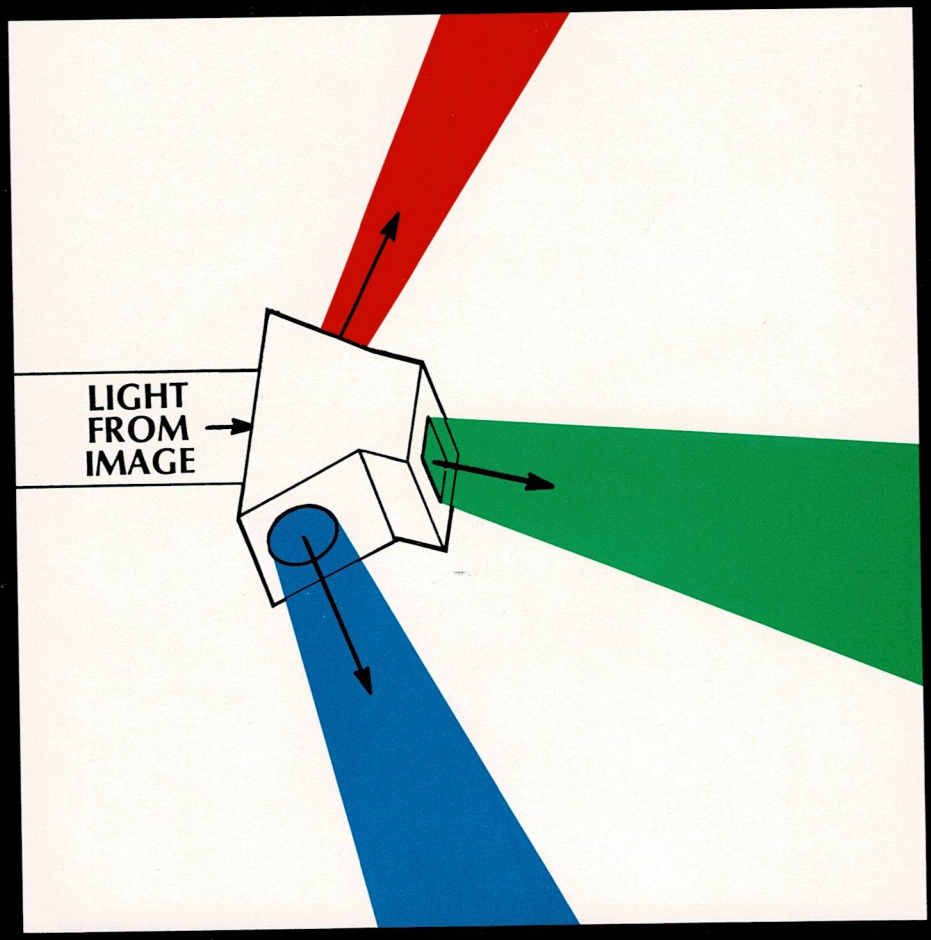
- There is no significant difference in the degree of misregistration that can be tolerated in the color pictures of three-tube and four-tube cameras.

- Even when properly registered, four-tube Plumbicon cameras have no increased resolution or snap over three-tube Plumbicon cameras. In fact, various versions of contour enhancers (or vertical aperture compensators) have been developed and have been added by broadcasters to their four-tube Plumbicon cameras. Four-tube cameras using an image orthicon in the luminance channel and three vidicons in the chrominance channels do have the desired snap, but suffer from excessive noise, poor colorimetry resulting from the difference in transfer characteristics between the vidicons and the image orthicon, and from the vidicon's shading, lag and dark current.

- Four-tube cameras are unnecessarily complicated, and these complications mean poorer picture quality. Its complexities begin with the fact that the incident light must be split four ways. This calls for additional optics. More optics mean less resolution. Obviously, too, the light that goes to the Y channel is not available to the RGB channels. This creates lag, often noticeable when a light object moves against a dark background.

The four-way light split also gives rise to problems of excessive flare and spurious reflections. A still further drawback is that color shading introduced by four-way optics requires for its elimination up to 16 shading controls on the camera. And, more circuitry means more to go wrong—less reliability. Last, and very important, four-tube cameras have proven to be more difficult to set up and operate.


Norelco


LIGHT
FROM
IMAGE

A Fresh Approach to Color Camera Design

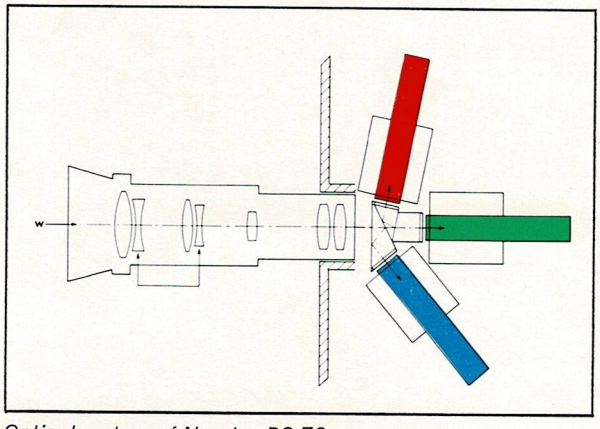
The Plumbicon tube has provided design engineers with a new key component whose characteristics are especially suited to color television broadcasting. Philips engineers, taking advantage of the Plumbicon's unique features, developed a color camera which represents a fresh approach to basic camera design.

Unique Optics

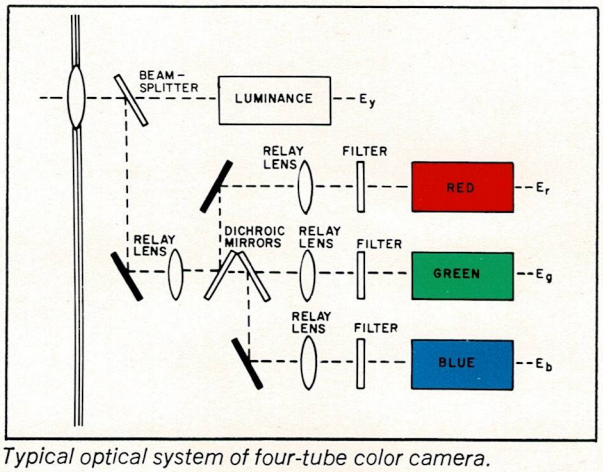
The Norelco color separation system, for example, utilizes innovations that distinguish this camera from others, including those that employ Plumbicon tubes.

In typical 4-tube optical systems light sharing is accomplished by a combination of beam splitter, relay optics and an array of dichroic mirrors. These unwieldy arrangements require long light paths and take up a great deal of space. They are optically inefficient and introduce image degradations. With the patented Norelco color splitting system dichroic layers are integral with, and enclosed within, a single sealed assembly of small prisms. Color trimming filters on the exit faces of prisms provide suitable color characteristics (in conjunction with the spectral separation curves of the dichroic layers and the spectral response of the Plumbicon tubes).

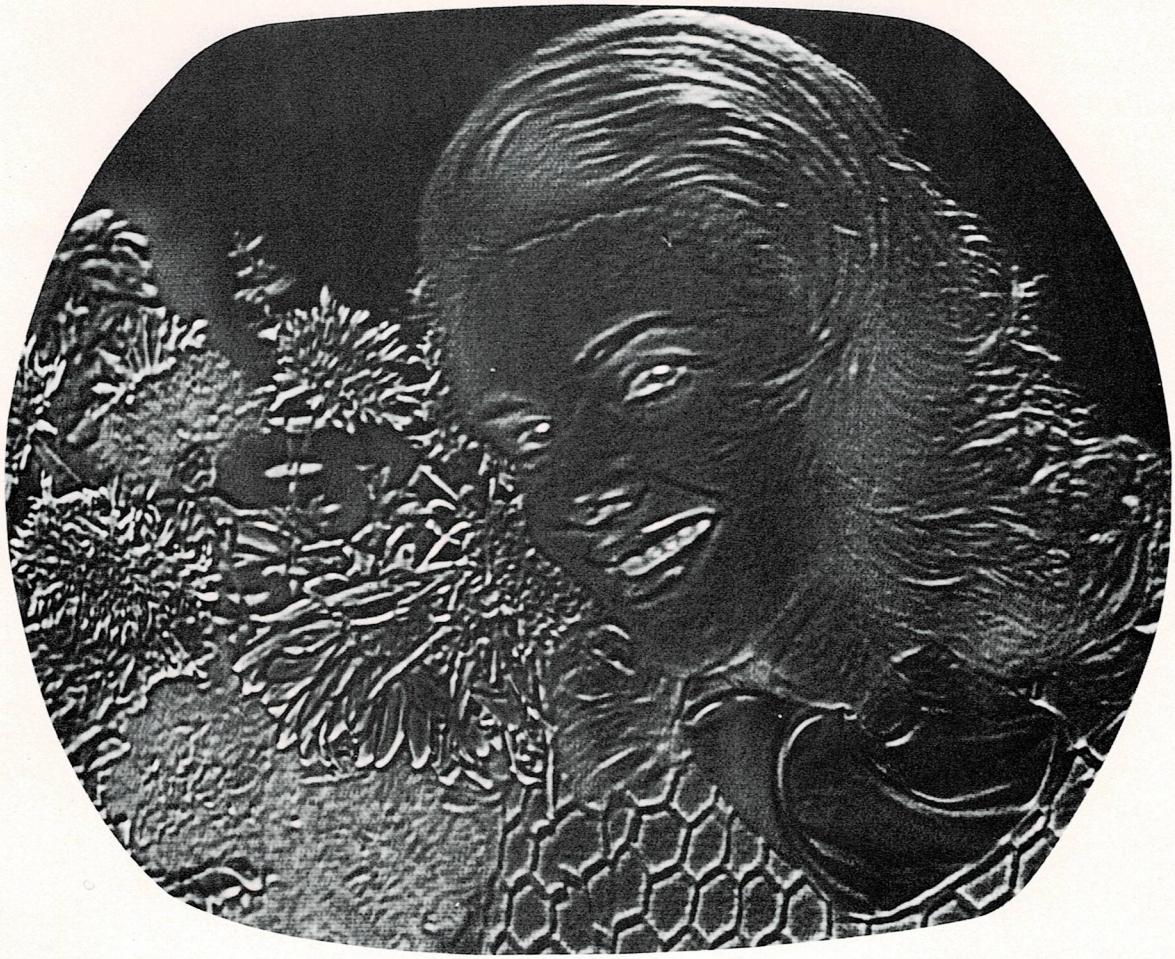
A Plumbicon tube positioned at each of the red, green and blue exits of the beamsplit has an antihalation face plate which prevents light reflected back from the sensitive layer from generating an unwanted signal and impairing image quality. Each Plumbicon is carried in an identical yoke assembly which is independently adjustable to center and align the tube on the optical axis. Each yoke also provides precise adjustment for rotating the scanned area for angular registry.



Optical system of Norelco PC-70 three-tube color camera.



Typical optical system of four-tube color camera.



These unretouched photographs, directly from monitors, tell the story:

First, we took a picture off our black-and-white monitor of the contour signal alone (above). Derived from the green channel and matrixed to all three channels, the contour signal increases the contrast and emphasizes both edges of every transition in the scene. Finally, we photographed the color monitor (above right), with "contours-out-of-green." Now you have it! Lifelike sharpness, with minute detail clearly defined.



CONTOURS-OUT-OF-GREEN

The Norelco 3-tube Plumbicon Color Camera delivers the most lifelike picture in television today. It matches the visual discrimination of the human eye more closely than any other camera.

And now, with its unique contour enhancement, the PC-70 produces a picture of dramatic sharpness that cannot be duplicated by a 4-tube camera without contour enhancement.

"Contours-out-of-green," an exclusive Philips engineering achievement, accomplishes this sharpness without any of the drawbacks that accompany 4-tube camera systems. It does not require an extra tube and the resulting complexities of setup and operation. It does not divert light from the chrominance channels.

"Contours-out-of-green" sharpens *all* edges, not just half of them, both horizontally and vertically—eliminating any possibility of bas-relief, one-sided illumination effect. It is one more reason why the PC-70 is the one camera that sees eye to eye with the viewer.

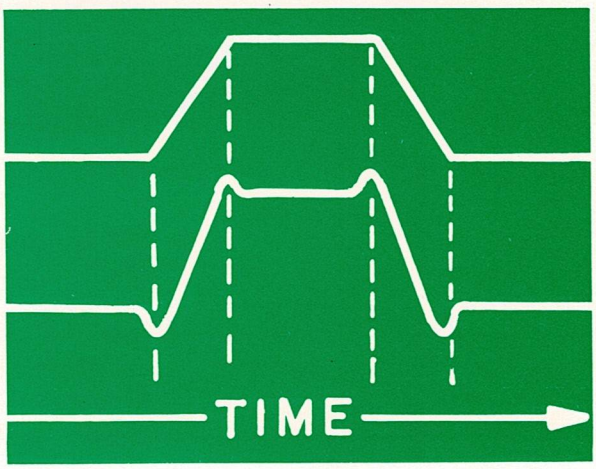
"Contours-Out-of-Green"

Another unique engineering contribution embodied in the Norelco PC-70 Camera is the "Contours-out-of-green" technique for emphasizing the line of demarcation between adjacent image areas.

As the name implies, the full contouring signal, *both horizontal and vertical, is fed to all three channels.* The contour signal is derived from the green channel rather than from the Y channel because the former is superior in terms of signal-to-noise ratio; the "Contours-out-of-green" technique is remarkably free of noise.

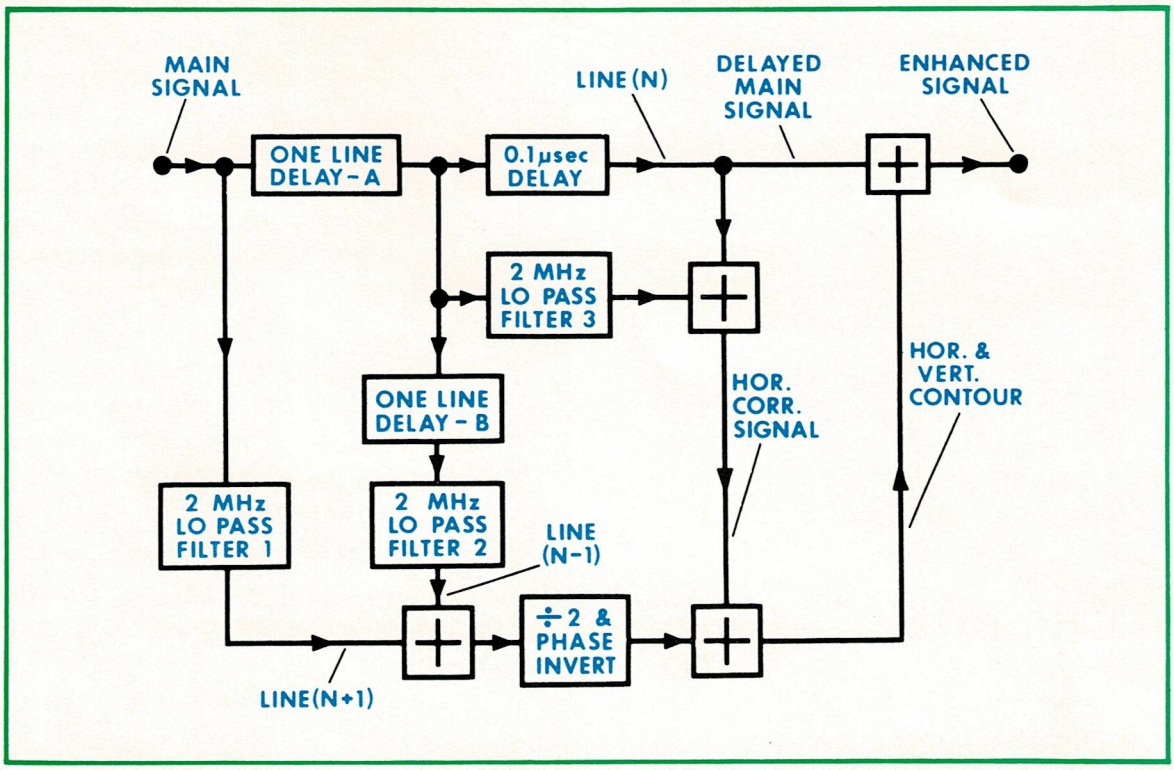
The aperture correction circuitry occupies only a small portion of the Camera Control Unit and is fully integrated into the video circuitry. Unlike a fourth image tube, with its adverse influence on camera head design, no space at all is taken up in the camera head itself.

The contouring signal modifies the leading and trailing edges of a video impulse so that a negative dip and a positive overshoot occur respectively at the bottom and top of a positive going impulse on both the rising and falling excursions.

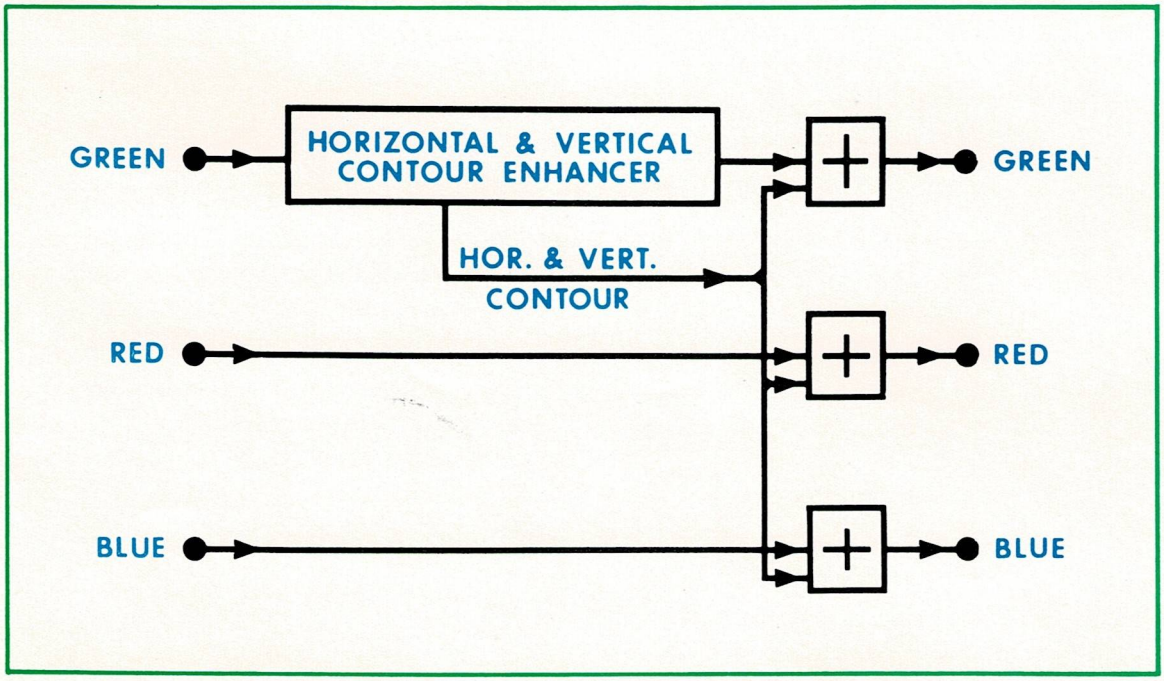


Similarly, for a negative impulse a positive overshoot and a negative dip occur at the top and bottom of both the falling and rising edges.

Increased excursions of the leading and trailing edges occur in the same time as without contouring, resulting in faster rise and fall times from one signal to the other. At the same time, white going information acquires a slight contrasting black outline, and black going information has a slight contrasting white outline. Fine detail contrast is improved and boundaries of large areas are accentuated. Importantly, even with restricted receiver bandwidths which reduce the effect of horizontal contouring, the vertical contouring is fully preserved since it is a low frequency signal.



HORIZONTAL AND VERTICAL CONTOUR ENHANCER



CONTOURS-OUT-OF-GREEN

It should be noted that while simple vertical aperture compensation also adds a certain amount of "snap" to the television picture, Norelco "Contours-out-of-green" has the additional major advantage of greatly improving the allowable tolerance to any misregistration which may exist because *its contour signal is applied separately to each of the three channels.* Thus, the contour signal on the encoded output is actually independent of misregistration.

Another advantage of this system is that it contours both edges of a transition—not just one. With single-line one-edge compensation, a picture often has the bas-relief effect of being illuminated from either the top or bottom, similar to a base-illuminated glass sign with engraved lettering as seen, for example, at bank teller windows.

To insure pictures of the highest quality, *each Norelco camera is provided with its own built-in contour enhancer.*

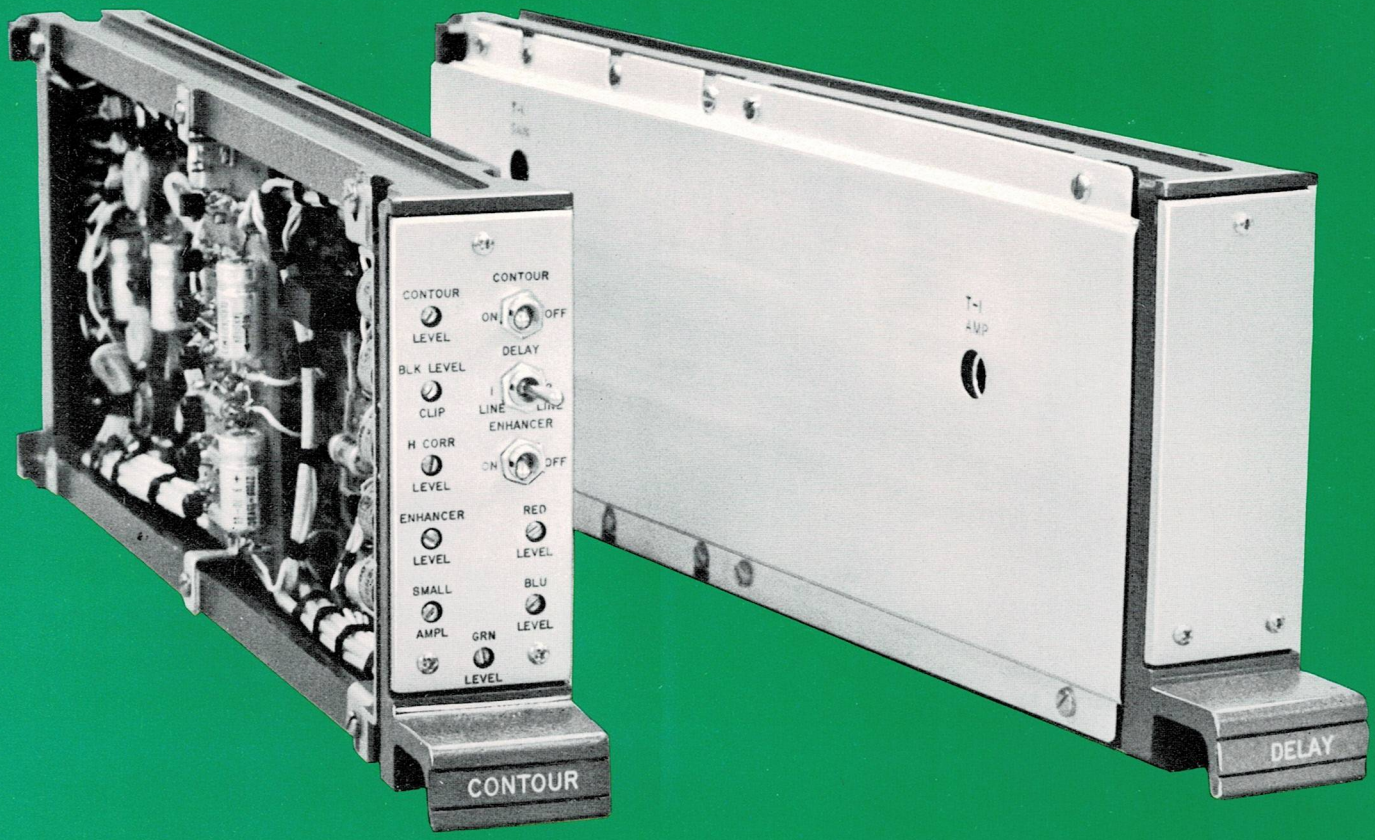
For economic reasons it is also possible to employ variations of this technique. An example would be to place a single unit at the output of a studio video switcher to apply vertical aperture compensation to the encoded signal of the "on air" camera only. These systems have disadvantages:

First, each camera is slightly different. It should have its own setting of vertical aperture compensation, just as it has horizontal aperture compensation. With only one unit at the switcher output, some cameras would tend to be over-compensated and others under-compensated.

Film chains and video tape recorders which may be connected to the same switcher also require different amounts of contour enhancement.

Double compensation in a video tape recorder—that is, at the camera output while recording and then again at the recorder output during playback—can produce objectionable over-compensation.

Finally, insertion of the contour signal into each of the camera channels can be achieved only when each camera has its own individual contour enhancer as does the Norelco PC-70.


CONTOUR
CONTOUR
LEVEL
ON
OFF
DELAY
BLK LEVEL
CLIP
LINE
ENHANCER
H CORR
LEVEL
ON
OFF
ENHANCER
LEVEL
RED
LEVEL
SMALL
AMPL
BLU
LEVEL
GRN
LEVEL
CONTOUR
DELAY

The Norelco PC-70 Color Camera . . . designed and built for years of trouble-free performance

The Norelco PC-70 Plumbicon color camera is specially designed to insure the utmost in ease of operation and maintenance, plus reliable, trouble-free performance for years to come.

The complete camera head, less lens, weighs only 110 pounds. The manual lens system weighs less than 30 pounds. Power consumption is only 375 watts.

It features solid state design with plug-in printed circuit modules in both the camera head and the camera control unit. In the camera control unit, where modules may be handled more often, each module is made up of a printed circuit card mounted on a rugged cast aluminum frame. Each module utilizes a keyed Blue Ribbon connector with a protective shield to prevent incorrect module insertion and protect against the possibility of connector damage.

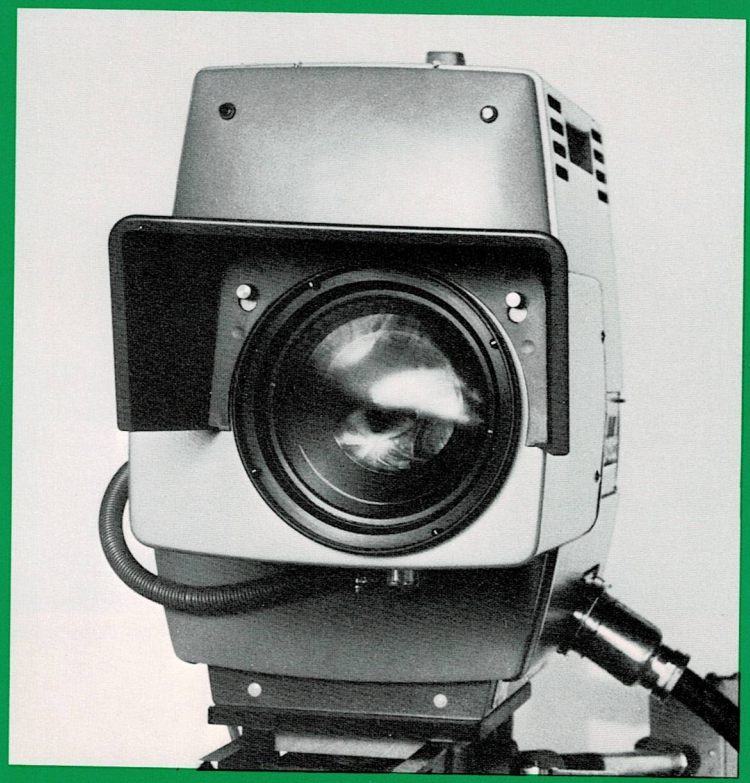
Maximum operational and maintenance flexibility is provided by the modular concept. For example, in the event service or troubleshooting is required, modules can be readily switched between cameras and between video channels in a given camera.

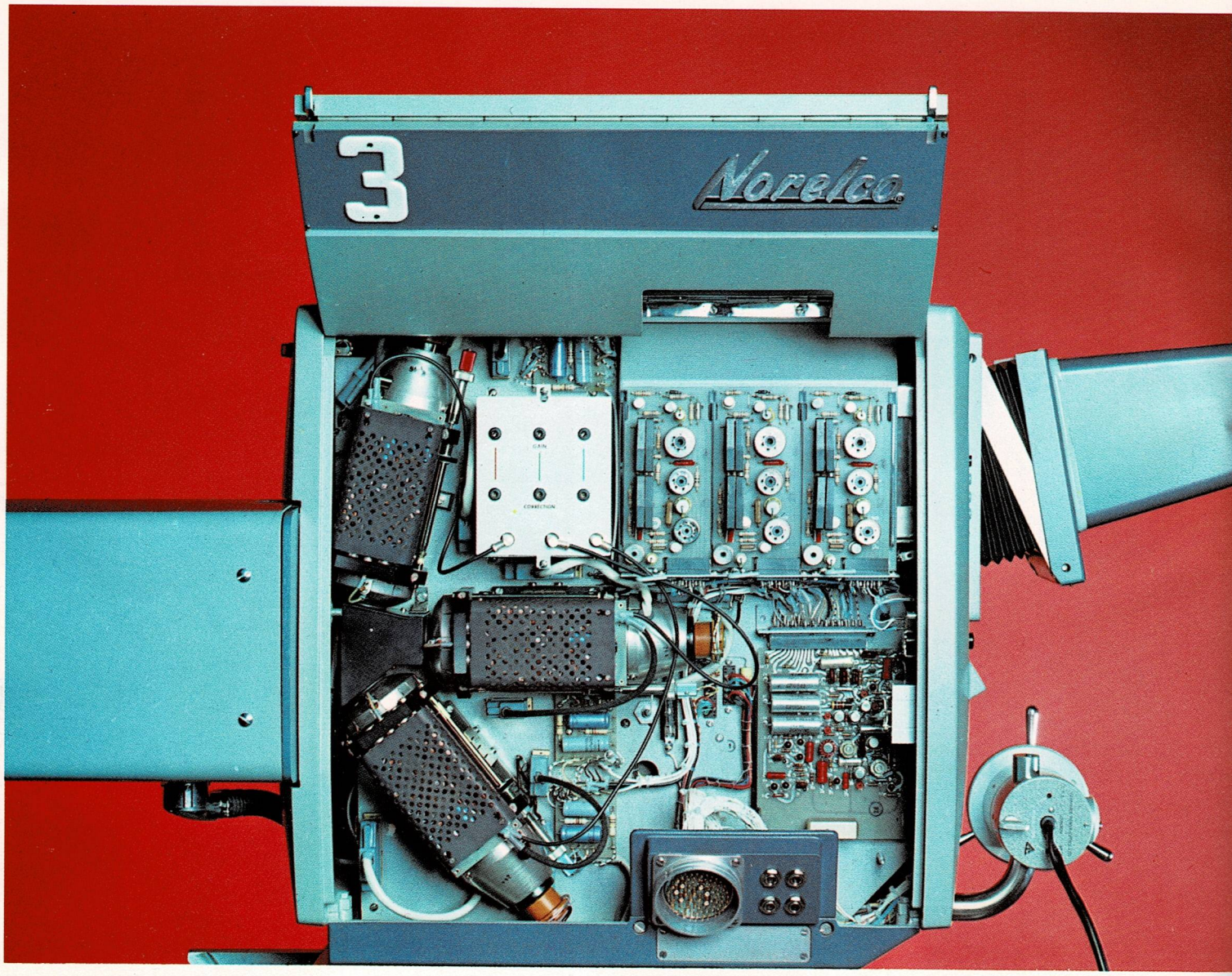
This modular concept includes power supplies, each of which in the CCU is contained in its individual module. In addition, the circuitry of each module is completely accessible—even during operation—through the use of module extenders available with each camera.

Mechanical stability and the precision alignment of the optical system are insured, even when the camera is subjected to severe shock or vibration, because the camera head is structured entirely from cast aluminum.

Esthetically, the camera will retain its strong, smooth appearance for years to come. No sheet metal is used. Even the camera doors are of sturdy cast aluminum. The PC-70 will never get that dented, sheet metal look characteristic of so many cameras in operation today. As an indication of the "heft" of the cast aluminum camera head, it should be pointed out that these castings comprise about forty pounds of the 110-pound camera head.

Color separation is accomplished by a system contained entirely in the ingenious sealed single block





Camera head, left side open.

shown on page 10. Because relay lenses, field lenses and dichroic mirrors have been completely eliminated in this patented system, trouble with the beam split and future adjustment is eliminated—permanently.

All setup controls have been eliminated from the camera head. Since they are all at the camera control unit, camera setup on the PC-70 is a one-man job, and is performed in the quiet control room. Thus it will never be necessary to perform setup in a noisy, hectic studio or at a remote pick-up in the rain or cold. Of course, setup is quicker.

Spared the fourth tube, you have one less of everything to adjust and maintain. Moreover, only three tubes, not four, will need periodic replacement.

The Camera Control Unit, consisting of the Electronics Unit, Registration Panel and Operating

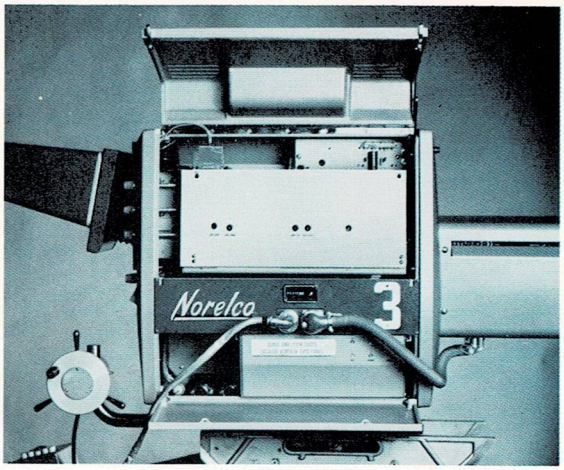
Camera head, right side open, showing swing-out viewfinder.

Panel, is designed for maximum flexibility of arrangement. It can be configured to fit into either console or rack, depending upon individual requirements.

Built-in test provisions include push button check of power supplies, calibration and alignment signals, and front panel test points.

The camera head is also equipped with a swing-out viewfinder (picture above) which clearly exposes all components and assemblies for rapid service capability.

Color matching of all cameras can only be done by the video control operator, since only he—and not the cameraman—can see the color pictures from all cameras. The PC-70 gives the video control operator all the controls he needs to do this most important job.



Lenses for the PC 70

The PC-70 Zoom lens can be supplied with either mechanical (often called manual) or servo controls for Zoom and Focus. In either case, iris operation is servoed from the control point. (This is necessary because the iris serves as the basic video level control.)

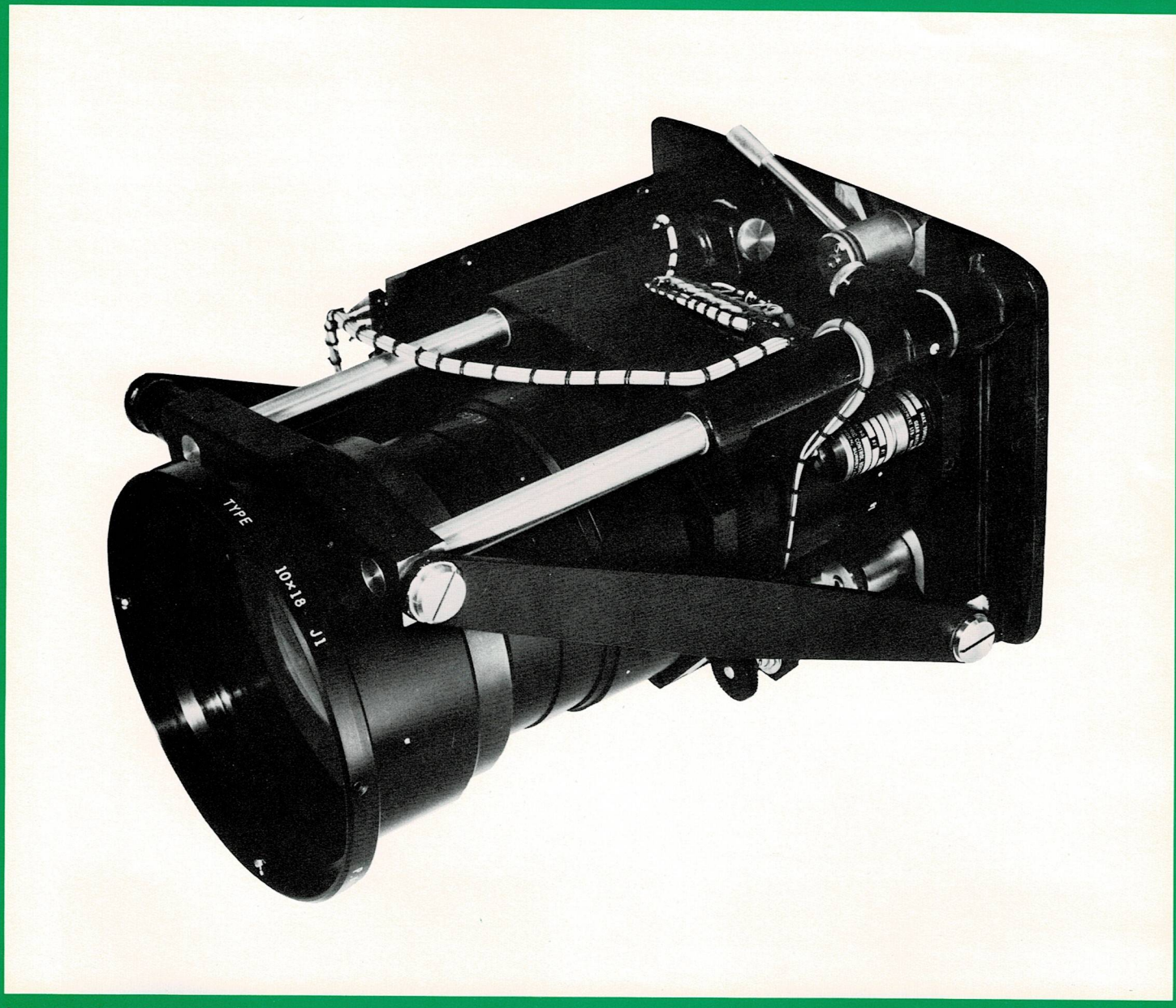
For general purpose use in either the studio or field, the standard PC-70 Zoom lens is an f/2.2 Angenieux 10x18J1 with a variable focal length of 18 to 180 mm. The PC-70 also accepts the Taylor-Hobson f/2, Varotal IX with a focal range of 21 to 210 mm, as well as the f/2.1 Schneider Mark I with a variable focal length of 18 to 200 mm. For specifications on these general-purpose lenses and on other special-purpose lenses, range extenders and close-up adapters, see chart.

For the servoed version Zoom lens system, preset fixed focal lengths (field angles) selected by individual push-buttons are available as an optional accessory.

The back focus of the lens is designed to accommodate the filter wheel and the beam splitting prism between the rear element of the lens and the image plane of the Plumbicon tube. Because of the optical geometry, no relay lens is required. The standard complement of filters consists of: Cap, Clear, Tiffen No. 85 (color), Tiffen No. 85/ND.3 (color and neutral density) and ND.6 (neutral density).

Zoom Lenses Technical Data

Description	Main Application	Closest Focusing Distance	Relative Aperature	Focal Length Range Plumbicon mm	Plumbicon inches	I.O. Equiv. mm	I.O. Equiv. inches
Angenieux 10x18J1 10:1 Zoom Lens	Studio-Field	36"	f/2.2	18-180	0.71-7.1	36-360	1.4-14
X1½ Range Extender	Field	36"	f/3.3	27-270	1.06-10.6	54-540	2.12-21.2
X2 Range Extender	Field	36"	f/4.4	36-360	1.4-14	72-720	2.8-28
X2½ Range Extender	Field	36"	f/5.5	45-450	1.77-17.7	90-900	3.5-35
X3 Range Extender	Field	36"	f/6.6	54-540	2.1-21	108-1080	4.2-42
Close Up Adapter	Studio	23"	f/2.2	18-180	0.71-7.1	36-360	1.4-14
Angenieux 12x50 12:1 Zoom Lens	Field	144"	f/4.5	50-600	2.0-24	100-1200	4.0-48
Angenieux 18x27.5	Field	120"	f/2.2	27.5-325	1.1-13	55-650	2.2-26
			f/2.2-f/3.2 varies linearly	325-500	13-20	650-1000	26-40
Angenieux 10x14.5	Studio (Wide Angle)	28"	f/2.2	14.5-145	.58-5.8	29-290	1.14-11.4
Schneider Mark I	Studio-Field	27.3"	f/2.1	18-200	0.71-8.0	36-400	1.44-16.0
RTH Varotal IX SP 10:1 Zoom Lens	Studio-Field	72"	f/2.0	21-210	0.8-8.0	42-420	1.6-16
X2 Range Extender	Field	72"	f/4.0	42-420	1.66-16.6	84-840	3.3-33
X2½ Range Extender	Field	72"	f/5.0	52.5-525	2.0-20	105-1050	4.0-40



Angenieux Zoom Lens 10x18J1, f/2.2, with manual zoom and focus, servo iris. Lens carriage and bed assembly allow focal length range extenders to be installed or removed in seconds without removing lens from camera. When desired, the lens itself can be removed from the camera in seconds. This is extremely useful during transport or storage.

Modular, all solid state Camera Control Unit

The all solid state Camera Control Unit is designed to achieve maximum installation flexibility. It is of rugged plug-in modular construction for mounting in a standard 19" rack. The Operating Panel and Registration Panels are separate and remotely operable from the Electronics Unit. A single meter on the power control module provides measurement of power line A.C. and all major supply voltages in the Camera Control Unit.

Waveform and voltage test points and setup controls are located on the front panel of individual modules.

The Electronics Unit houses the "Contours-out-of-green" circuitry, miniature encoder with color bar generator and waveform monitor switch.

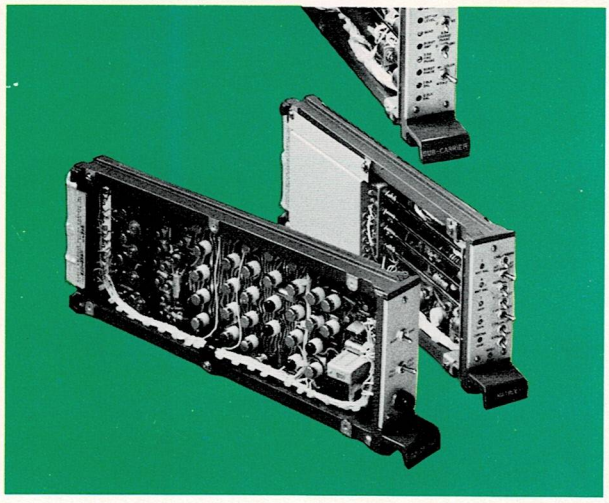
The Registration Panel houses all controls necessary for proper geometric registration of the video signals plus target, beam and focus for each Plumbicon, and switches to select appropriate signals to the local monochrome picture monitor.

The Encoder

The Encoder and color bar test circuits are packaged in modules which plug into the camera control unit, taking no additional rack space. Micrologic and microcircuits are employed throughout. Integrated circuits and reed relays have reduced the size of the original transistor encoder by a factor of ten and allowed the addition of control circuits, color bar generator and test circuits. The new test circuits allow accurate adjustment of I and Q channel gain, quadrature and burst phase with only a waveform monitor. The ability to check the alignment of the Encoder without reference to a vectorscope greatly simplifies setup and reduces the amount of required test equipment. The color bar module is normally operated only during test, thereby conserving power and reducing the possibility of extraneous pulses coupling into camera video.



Compact installation—Four rack-mounted PC-70 Camera Control Units.



Encoder for the PC-70 consists of three modules which plug into Camera Control Unit.

The Norelco PC-70 Plumbicon Color Television Camera is perfect for field use, too

Significant features and characteristics account for the fact that the PC-70 stands alone in its adaptability to both studio and field use. For example:

- Light weight and rugged durability—Powerfully designed aluminum castings for the camera head mean protective strength and minimum weight. Even camera doors are of cast aluminum; no sheet metal is used. The complete camera head, less the lens, weighs only 110 pounds.
- Capability for handling wide contrast ranges—Superior gamma circuits result in excellent reproduction of detail in shadows, while exclusive yoke coils to aid in beam landing account for the PC-70's excellence in the handling of highlights and speculars.
- Sleek design and compact dimensions facilitate handling and make the PC-70 a good-looking, unobtrusive guest at outdoor events. It takes little room and does not block spectators' vision.
- Plug-in cable compensation unit makes possible field operation at a distance of 2000 feet from the Camera Control Unit with no degradation of picture quality and at greater distances with only minimal degradation. The PC-70 is designed for studio operation with up to 1000 feet of camera cable.
- Lens can be quickly and easily removed from camera and carried separately.
- Special long focal length lenses—either the Angenieux 12x50 with a variable focal length of 50-600 mm (IMO equivalent 4-48") or the Angenieux 18x27.5 with a variable focal length of 27.5 to 500 mm (IMO equivalent 2.2-40").
- Camera setup controls at the Camera Control Unit means that cameramen do not have to setup camera in rain or freezing weather or in otherwise difficult environments.
- Small-dimension, all solid state Camera Control Unit takes little space and is designed for flexible arrangement in rack or console. The electronic unit is just 15¾" high and the Operating Panel and Registration Panel are each 5¼" high.
- Plug-in module design concept of camera head and CCU is a major advantage in mobile use. Not only does it provide for easy maintenance and service, but it enables you to quickly interchange one set of modules between two permanently installed CCU frames . . . in effect, creating camera chains for studio and mobile use without purchasing entire chains for both.



Football coverage—Norelco PC-70 with Angenieux 12x50 long focal length zoom lens.

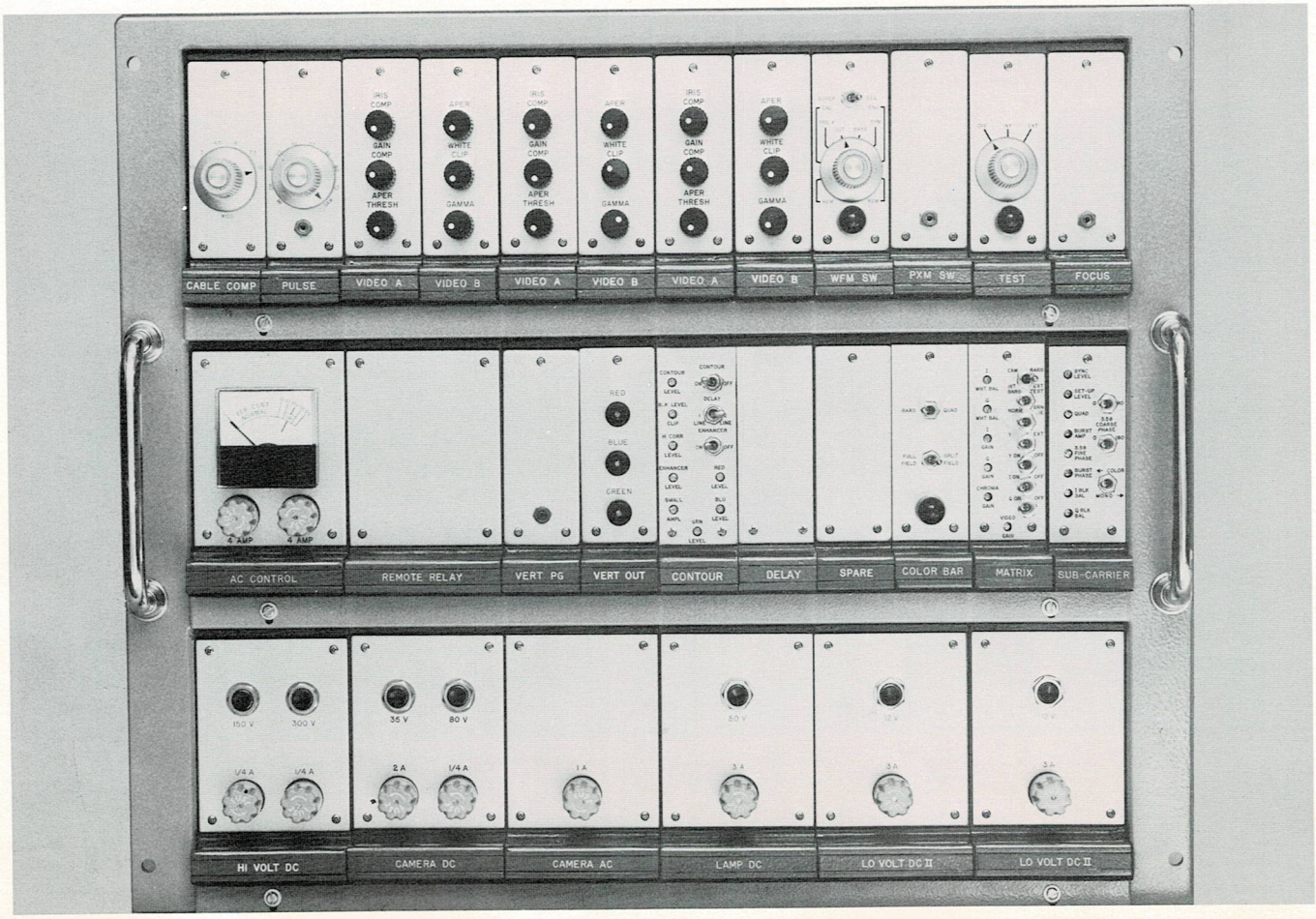
CONTROLS

The PC 70's Camera Control Unit is the last word in functional simplicity, ease of operation and maintenance.

Electronics Unit

Control	Function
CABLE COMP. Module	
Rotary	Cable compensation in 6 steps up to 1000 ft. (2000 ft. optional)
PULSE Module	
Switch	Selection of pulses at test jack
VIDEO A Module	
Iris Comp	Stabilize black level for iris variations
Gain Comp	Stabilize black level for gain variations. Compensates for black level shift when video levels change
Aper Thresh	Sets level for amplitude dependent aperture correction
VIDEO B Module	
Aper	Sets the amount of aperture correction
White Clip	Sets white clip level
Gamma	Adjusts amount of gamma
WFM Switch Module	
Super Seq	Selects sequential or super imposed display
Function Switch	Selects waveform monitor video
TEST Module	
Rotary	Selects between camera video, internal sawtooth and external test signal

ENCODER MATRIX Module	
Cam/Bars	Camera or color bar input selector
Int. Bars/Ext. Test	Selects external input
Norm/Grn. Tie	Connects R-B inputs to G input
Y/Ext.	Connects Y matrix input to external Y signal
Y on/off	Y signal switch
I on/off	I signal switch
Q on/off	Q signal switch
I wht. Bal.	White balance, I channel
Q wht. Bal.	White balance, Q channel
I Gain	Sets amplitude of I channel
Q Gain	Sets amplitude of Q channel
Chroma Gain	Sets overall chroma amplitude
Video Gain	Sets composite video amplitude
ENCODER SUB-CARRIER Module	
3.58 Course Phase	
0/90	Provides 0° or 90° subcarrier phase shift
0/180	Provides 0° or 180° subcarrier phase shift
Color/Mono	Color or black & white selector
Sync. level	Sets sync amplitude
Set-up level	Sets black level
Quad	Adjusts subcarrier phase shift between I & Q modulator inputs
Burst Amp	Controls burst amplitude
3.58 Fine Phase	Provides 90° fine adjustment of subcarrier phase
Burst Phase	Shifts burst to desired vector axis
I Blk. Bal.	Black balance, I channel
Q Blk. Bal.	Black balance, Q channel
COLOR BAR Module	
Bars/Quad	Selects color bars or quadrature burst phase display
Full Field/Split Field	Full or split screen display



CONTOUR Module

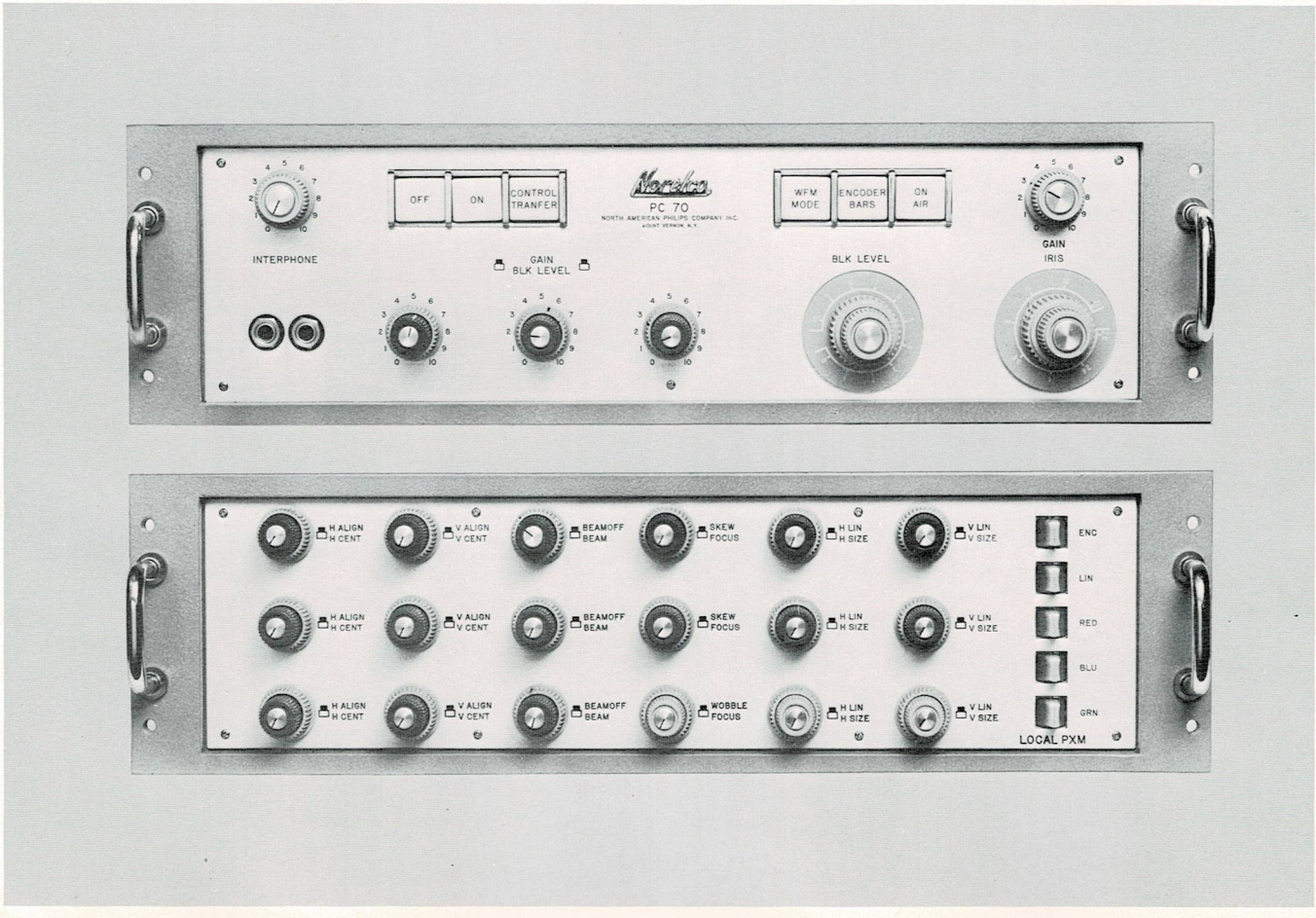
1-Line—2-Line Toggle Switch	Selects bottom line or top and bottom line correction
Contour Amplitude	Adjusts contour signal level
Horizontal Correction	Controls amount of horizontal correction
Black Level Clip	Removes unwanted luminance information
Contours on-off	Turns the Contour signal on or off.
Red Level	Adjusts amount of Red Enhancement
Red Enhancer on-off	Turns Red Enhancer circuit on or off
Small Amplitude Control	Adjusts range of red enhancement
Level Controls Red, Blue and Green	System output gain controls

Operation Panel

Control	Function
BLK Level R-B-G	Controls individual RBG black level
Gain R-B-G	Controls individual RBG gain
BLK Level (Master)	Controls RBG black level simultaneously
Gain (Master)	Controls RBG gain simultaneously
Iris	Controls lens aperture
Audio	Adjusts volume of interphone amplifier
Interphone Jacks	Provides output connection for headphones
OFF (Push-button)	Shuts off power to all operating supplies
ON (Push-button)	Applies AC power to power supplies
Control Transfer	Transfers control to remote operation unit
WFM Mode	RBG or encoder output to waveform monitor
VF MIX	Applies external video to viewfinder
ON AIR	Indicates when camera is on air

Registration Panel

Control	Function
H Align R-B-G	Horizontal alignment current through yoke
H Cent R-B-G	Horizontal centering
V Align R-B-G	Vertical alignment current through yoke
V Cent R-B-G	Vertical centering
Target R-B-G	Controls target voltage
Beam ON-OFF R-B-G	Beam voltage switch
Beam R-B-G	Beam voltage control
Skew R-B	Adjusts amount of skew in RB Channels
Focus Master G (only)	Sets electromagnetic focus RBG channels
Focus R-B	Sets electrostatic focus RB channels
H Lin R-B-G	Linearize horizontal sweep
H Size R-B-G	Adjusts horizontal sweep amplitude
V Lin R-B-G	Linearize vertical sweep
V Size R-B-G	Adjusts vertical sweep amplitude
ENC PXM KEY	Encoded output on local picture monitor
LIN PXM KEY	Crosshatch on local picture monitor and viewfinder
RED PXM KEY	Red video output on local picture monitor
BLU PXM KEY	Blue video output on local picture monitor
GRN PXM KEY	Green video output on local picture monitor



Circuit Description

Video Circuits

The first preamplifier is mounted directly to the yoke assembly to reduce stray capacitance and r-f pick-up.

Inverse feedback is used to stabilize the circuit gain so that normal 3 to 1 differences in input stage amplification factor have only slight effect on the gain. An output gain control in each second preamplifier balances the gain to improve noise immunity in the camera cables.

Sweep Circuits

Three identical horizontal sweep circuits are contained in the Camera Head. DC controls in the Camera Control Unit independently change the linearity of each channel by using feedback amplifiers. Centering controls are also completely independent. Registration, better than 50 nanoseconds at 11 points in the picture format, is attained by using the same regulated power supplies for each of the DC control functions and limiting their ranges. Drift and temperature changes are compensated by the linearity correction circuits.

Dynamic Focus

A dynamic focus generator applies a parabolic correction voltage to each of the Plumbicon tubes to improve beam landing and corner focus.

Video Processing

Video is processed in two modules identified as "Video A" and "Video B" in each color channel of the Electronics Unit. Input is provided for an internally generated calibration sawtooth or external video input to check amplifier performance. Also, sine-square or multi-burst signals can be used at this input. A camera cable corrector stage is included to correct the frequency-amplitude characteristic of various lengths of cable used between the Camera and Camera Control Unit. A cable length switch is provided on the front panel of the "cable comp" module to allow ease of adjustment.

Compensation pulses are added to the video in a pulse cancellation circuit to cancel spurious camera signals generated during the blanking interval. An additional variable amplitude clamp pulse is added to the video to compensate for black level shift due to flare introduced by the zoom lens, the amount of black level stabilization required being determined by an integrator circuit.

The Video B Module has an amplitude-dependent or threshold type aperture corrector, adjustable from the Video A Module, which varies the aperture threshold level from zero to ninety IEEE units. Another control is provided to vary the degree of aperture compensation between a 5% boost at 5 mc and a maximum camera video modulation depth of 150% at 5 mc. Blanking adder and clamp circuits form a part of the aperture circuit.

The last processing stage is the gamma corrector. It is variable over a range of 0.4 to 1. This stage employs a high conductance planar epitaxial silicon diode with a nearly perfect logarithmic characteristic. Since the diode characteristics are not dependent on signal level, gamma is not influenced by different black level settings.

Sweep and Regulator Circuits

Three identical vertical sweep amplifiers for the three deflection yokes are located in the "Vert Out" module of the Electronics Unit. The amplifiers use a common sawtooth input and generate small linearity correction signals through integration circuits.

The focus regulator located in the "Focus" module of the Electronics Unit uses a differential amplifier and current driver which is referenced to a temperature compensated zener diode. A slow speed focus wobble of about three cycles per second facilitates pickup tube beam alignment.

Power Supply Circuits

The Electronics Unit power supplies are each self-contained and provide for 117 and 220 volt operation.

One module is provided for AC control and contains a line voltage monitoring meter. A relay in the "AC Control Module" switches the meter to each of the eight power supplies, and a pushbutton mounted on each supply enables monitoring the selected output. All of the power supplies can be checked very rapidly by this method.

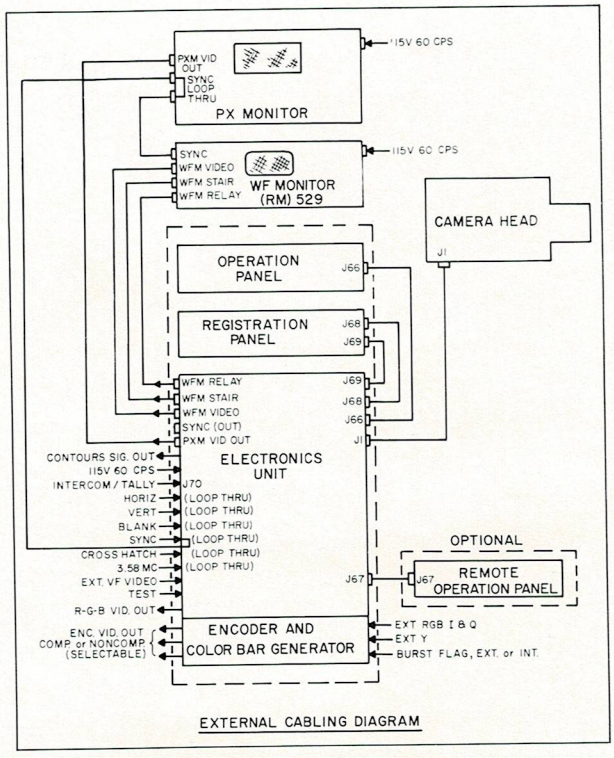
The Electronics Unit contains four regulated power supplies—two identical low voltage supplies, "Low Volt DC," and the 150/300 volt supply, "Hi Volt DC." One low voltage supply provides a negative 12 volts while the other provides a positive 12 volts for the bulk of the transistor circuitry.

The 150/300 volt power supply is contained in a single unit. Short circuits have no effect other than fuse burn-out.

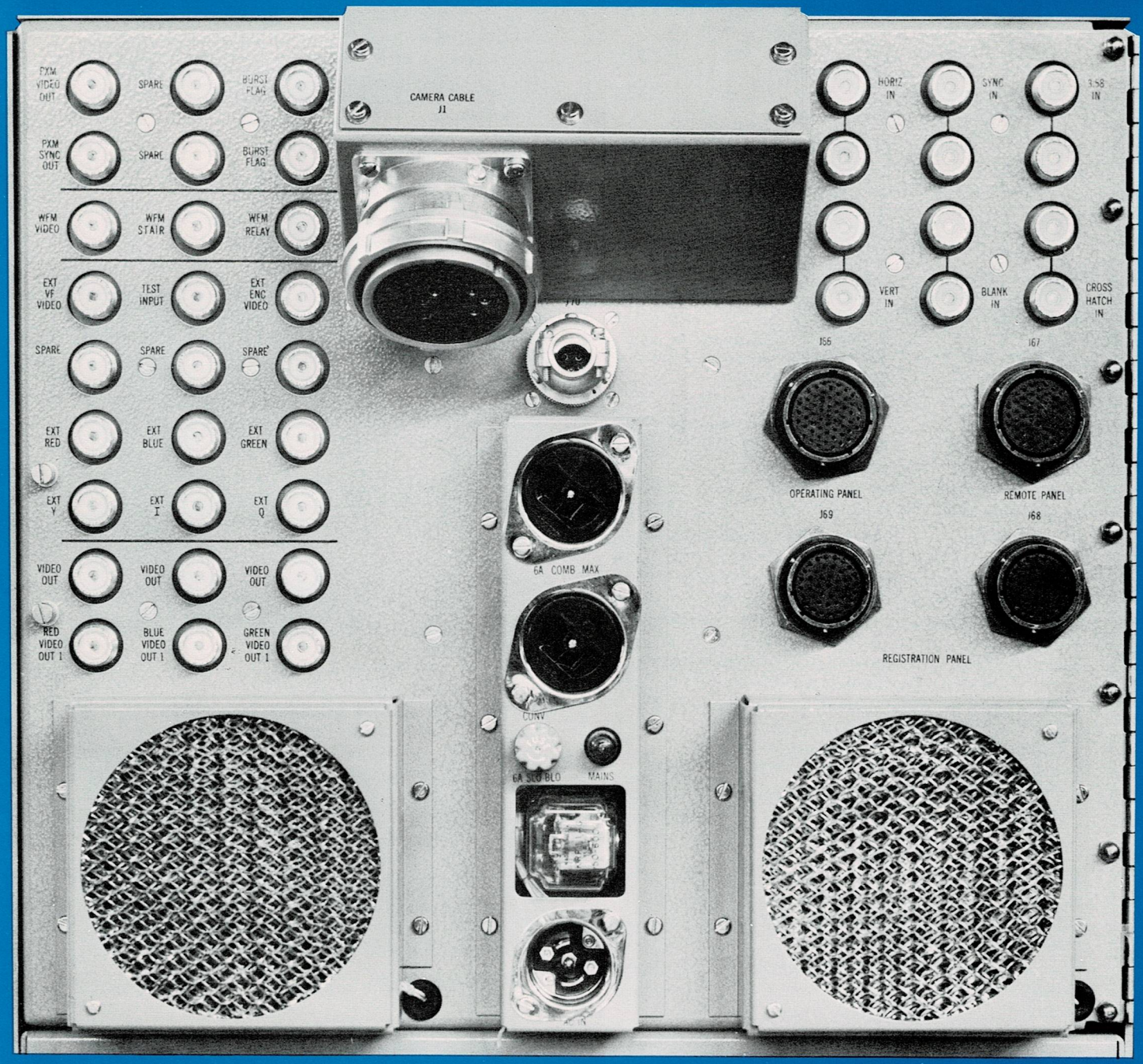
The remaining power supplies, located in the "Camera DC Module," provide filtered, unregulated DC to the camera cable for regulation in the camera. A separate supply "Lamp DC" is used for the tally and lamp circuits to eliminate the problems which can be caused by heavy intermittent loads of the tally lamps.

Other Circuits

The "Pulse Module" provides the necessary timing, clamping and blanking for the sweep and video circuits. A selector switch and test point are provided on the front of the module to monitor the various outputs.



EXTERNAL CABLING DIAGRAM



Rear view of PC-70 Electronics Unit.

Specifications

General

Scanning System	EIA, 525 lines, 60 fields per second or 625 lines, 50 fields per second
A.C. Power Input, less picture and waveform monitors	105-117-130 volts, 60 cycles, 375 watts or 210-234-280 volts, 50 cycles, 375 watts
Picture Monitor (Conrac CZB)	180 watts
Waveform Monitor (Tektronix RM529)	80 watts
Sensitivity	Color reproduction holds below 10 ft. candles incident illumination; 125-250 ft. candles scene illumination for studio quality pictures
Viewfinder Display Size	6 inch picture diagonal
Viewfinder Brightness	Better than 100 ft. Lamberts
Camera Cable Comp.	Field use up to 2000 ft. with option cable comp module; can be used for greater lengths with some picture degradation; studio use up to 1000 ft.
Camera Cables	Standard single cable or optional two BIWC Type TV 33N

Video Inputs

Horizontal Drive	4.0±2.0 volts negative peak-to-peak across 75 ohms
Vertical Drive	4.0±2.0 volts negative peak-to-peak across 75 ohms
Composite Blanking	4.0±2.0 volts negative peak-to-peak across 75 ohms
Composite Sync	4.0±2.0 volts negative peak-to-peak across 75 ohms
External Signal to Viewfinder and Picture Monitor	0.7 volt, non-composite across 75 ohms
Cross-hatch to Viewfinder and Picture Monitor	0.7 volt, non-composite across 75 ohms

Video Outputs (RGB)

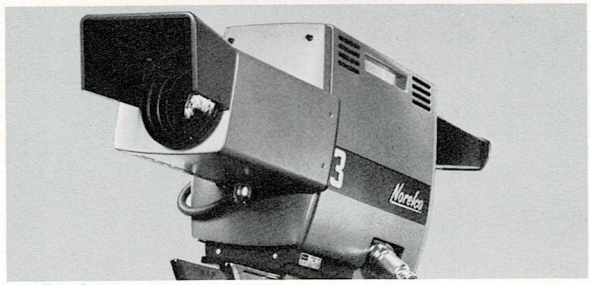
Video 1 Video 2 Video 3	1 volt, non-composite across 75 ohms, to encoder or other external use
Video 4 Video 5 Video 6	1 volt, non-composite across 75 ohms; spare

All necessary Picture and Waveform Monitor feeds, 1 volt, non-composite

Picture Quality

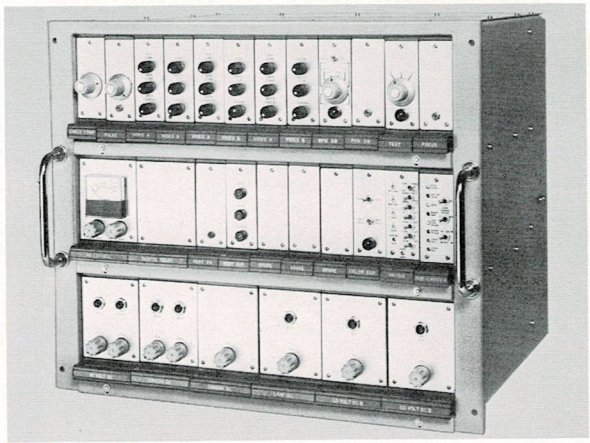
Horizontal Resolution	100% modulation at 400 TV lines in center in Y channel.
Limiting Horizontal Resolution	600 TV lines in center Y channel
Signal-to-Noise Ratio (Peak signal to rms noise)	Better than 42 db over 5 mc/s bandwidth in Y channel
Amplitude Transfer Characteristic	Adjustable to any value between 0.45 and 0.95
Scanning Linearity	.5% within a circle having a diameter equal to picture height; less than 2% elsewhere

Weights and Dimensions



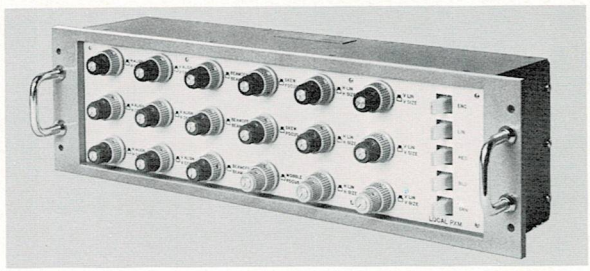
PC-70 Camera

Height	19¼ inches
Width	14 inches
Length	35 inches including lens; 20½ inches without lens
Weight	110 pounds excluding lens; (less than 140 pounds with manual drive lens)



Electronics Unit

Height	15¾ inches
Width	19 inches
Depth	18½ inches (including connectors)
Weight	100 pounds



Registration Panel

Height	5¼ inches
Width	19 inches
Depth	4 inches (excluding connectors)
Weight	7 pounds



Operating Panel

Height	5¼ inches
Width	19 inches
Depth	4 inches (excluding connectors)
Weight	6 pounds

Model PC-70 Plumbicon Color TV Broadcast Camera System

Catalog No.	Description
611401	Plumbicon Color Camera Head with operating set of three 55875 RBG Plumbicon Tubes, Lens Control Mounting Bar
612751	Camera Control Unit, consisting of:
612501	Operating Panel with 6 ft. cable
612745	Registration Panel with 2—6 ft. cables
612798	Electronics Unit, containing the following modules:
612846	Delay module
612839	Contour Enhancer module
612670	Waveform Monitor Switch module
612686	Color Bar Generator module
612775	Encoder Matrix module
612784	Encoder Sub-Carrier module
612302	Cable Compensation module
612311	Pulse module
612303	Video A Red module
612303	Video A Blue module
612303	Video A Green module
612852	Video B3 Red module
612852	Video B3 Blue module
612852	Video B3 Green module
612310	Video Switch (PXM SW) module
612650	Test module
612318	Focus module
612314	AC Control module
612332	Remote Relay module
612312	Vertical Oscillator and Skew (vert PG) module
612313	Vertical Output module
612315	High Voltage DC Power Supply (150/300V) module
612323	Camera DC Power Supply (35/80V) module
612324	Camera AC module
612387	Lamp DC module
612737	Low Voltage DC 11 Power Supply (12V) module
612737	Low Voltage DC 11 Power Supply (12V) module
612319	Spare module
616500	Angenieux Zoom lens, 10x18J1, f/2.2, manual zoom, focus, servo iris
616280	Zoom Hand Control—Manual
616285	Focus Hand Control—Manual
616501	Range extender X1½ f/3.3, for Angenieux 10x18J1
616502	Range extender X2 f/4.4, for Angenieux 10x18J1
616503	Range extender X2½ f/5.5, for Angenieux 10x18J1
617070	Standard single camera cable 100 ft.
612588	Module Extender—Single Module
612593	Module Extender—Double Module
CZB12/R	Conrac 14" Professional Monitor Partial Solid State
RM 529	Tektronix Waveform Monitor Solid State
134-0049-00	Connector for RGB Control of RM 529
MCH-3	Houston-Fearless Cradle Head
PD-3	Houston-Fearless Counter Balance Pedestal

Options and Accessories

Angenieux Zoom Lenses

616000	Angenieux Zoom Lens, 10x18J1, f/2.2, servo zoom, focus, iris
616200	Angenieux Zoom lens, 12x50, f/4.5, servo zoom, focus, iris
616600	Angenieux Zoom lens, 12x50, f/4.5, manual zoom & focus, servo iris
616520	Angenieux Zoom Lens, 18x27.5, f/2.0, manual zoom & focus, servo iris
616515	Angenieux Zoom Lens, 10x14.5, f/2.2, manual zoom & focus, servo iris

Hand Controls for Angenieux Zoom Lenses

613110	Zoom Hand Control—Servo (for all Angenieux servo zoom)
613120	Focus Hand Control—Servo (for all Angenieux servo focus)
616280	Zoom Hand Control—Manual (for all Angenieux manual zoom)
616285	Focus Hand Control—Manual (for all Angenieux manual zoom)

Range Adapters for Angenieux Zoom Lenses

616120	Range Extender X1½, f/3.3 for 616000 Angenieux 10x18J1 with servo zoom, focus, iris
616110	Range Extender X2, f/4.4 for 616000 Angenieux 10x18J1 with servo zoom, focus, iris
616100	Range Extender X3, f/6.6 for 616000 Angenieux 10x18J1 with servo zoom, focus, iris
616510	Closed-up adapter with ray shield for both 616500 and 616000 Angenieux 10x18J1 lens.

Schneider Lens

616525	Schneider Mark 1, f/2.1, manual zoom, focus, servo iris
616280	Zoom Hand Control—Manual
616285	Focus Hand Control—Manual

Taylor-Hobson Lens

616300	Taylor Hobson, Varotal 1X Zoom lens 10x20, f/2.0, servo zoom, focus, iris
616320	Zoom Hand Control with preset-servo
616310	Focus Hand Control—servo
613625	Power Unit
617054	Shipping Container
616330	Range Extender X2, f/4.0 for Taylor Hobson 10x20
616340	Range Extender X2.5, f/5.0 for Taylor Hobson 10x20

Plumbicon Tubes

55875R	Plumbicon Tube—Red
55875B	Plumbicon Tube—Blue
55875G	Plumbicon Tube—Green

Color Camera Cables & Connectors

617070	100 ft. Standard Single Camera Cable
601700	Two 50 ft. Camera Cables TV-33
601710	Two 100 ft. Camera Cables TV-33
TV 33N	Bulk Cable, Neoprene Jacket
616561	Control Cable for remote Operating Panel with connectors (specify length)

Other Accessories

612600	Operating Panel Remote (requires control cable #612561)
MCH 3	Houston-Fearless Cradle Head
HFCH	Houston-Fearless Cam Head, with wedge adapter plate
PD-3	Houston-Fearless Counter Balance Pedestal
617052	Shipping Container for 616000 Angenieux 10x18J1 and accessories
617053	Shipping Container for 616200 Angenieux 12x50 and mounting assembly
617050	Shipping Container Camera Head
617051	Shipping Container CCU Modules
617075	Off-Use Protective Cover for PC-70 camera
617080	Rain Cover for PC-70 camera

Norelco

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