INSTRUCTION MANUAL

Model V-7

COLOR GENERATOR

AND

VECTORSCOPE

LECTROTECH, INC.

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I. INTRODUCTION

The MODEL V-7, Color Generator and Vectorscope is the most advanced instrument for color service ever offered the service technician.

The basic stability of a color bar generator is directly related to the stability of the timer (frequency divider) circuits. The timer circuits of the MODEL V-7, in its color bar section, are of the most advanced design. These circuits are all solid state and use silicon unijunction transistors. The use of silicon devices provides complete dependability of operation over a wide temperature range. With time, components will age, causing the timer circuits to drift. Should this happen to your instrument, the timer circuits can be reset in minutes, using the built-in cathode ray tube. With this technique, it is no longer necessary to use any external equipment and complex procedures or to return the unit to the factory, such as is required with conventional color bar generators.

"Dial-A-Line", an exclusive feature of LECTROTECH'S MODEL V-7, enables the technician to select a horizontal line width from less than 1 scanning line wide, to as many as 4 or 5 lines wide. Any line width is now a fingertip adjustment to satisfy the individual choice of each technician.

A gun-killer, is built into the instrument for ease of convergence.

Undoubtedly the most advanced feature of the MODEL V-7, is the exclusive Vectorscope. The concept of phase relationships to color has always been difficult to understand. This is true because there has never been available to the technician an instrument to actually see this relationship. The Vectorscope, when used in conjunction with the keyed rainbow pattern, shows the phase of each color bar with respect to burst, including the all important R-Y and B-Y signals. It is now possible to accurately center the hue range control, to precisely and simply check demodulator alignment, to determine equality of gain of red and blue amplifier channels. It is a powerful tool that instantaneously provides complete information on the performance of the color circuits in a color TV receiver. Connection of the Vectorscope to the color set is made by plugging the adapter socket into the base of the CRT in the receiver.

With all of these features, it is clear that the MODEL V-7 will be a basic servicing and set up instrument for years to come.

II. CONTROLS AND CABLES: WHAT THEY DO

A. FRONT PANEL CONTROLS

Place the LECTROTECH MODEL V-7 generator in front of you.

1. Power Switch

Located at the bottom center of the panel is the power switch. It is a three position switch, with the left hand position being OFF. When advanced to the center position, the instrument is in STAND-BY. Filament voltage is applied to the tubes in the instrument but no B+ is applied. When the switch is advanced to the extreme right, the instrument is ON and operating. The pilot light located at the upper right hand side of the instrument will glow in the ON position only.

2. Pattern Switch

The Pattern Switch is the main function selector of the instrument and has five positions. They are: Cross-Hatch, Dots, Vertical Lines only, Horizontal Lines only and Color.

3. Video Level Control

Just below the pattern switch is the Video Level Control. When this control is fully counter-clockwise, the video output signal is zero. When the control is advanced fully clockwise, the video output signal is at a maximum and represents approximately 2 volts P-P.

4. Video Polarity Switch

Located just below the video level control is the Video Polarity Switch. When the switch is in the upper position, the video output sense is sync positive and when the switch is down, or in the bottom position, the video polarity is sync negative.

5. Color Level Control

This control sets the level of color information in the composite video signal, and is calibrated at three points. They are: Minimum, Normal and Maximum. The normal position, represents the signal level for 100% modulation.

6. Horizontal Line Adjust

Just to the left of the color level control is the Horizontal Line Adjust control. This control adjusts the number or in effect, the thickness of the horizontal line. When the control is fully counter-clockwise, there are NO horizontal lines. As the control is advanced in a clock-wise direction, the number of horizontal lines will increase to a maximum of three or four. With the white line of the knob pointed vertically you will display approximately one horizontal line.

7. Intensity Control

The Intensity Control adjusts the brightness of the cathode ray tube display which is used for the Vectorscope and for the self-adjusting function.

8. Focus Control

Located just below the intensity control is the Focus Control. This control adjusts the focus of the trace that appears on the cathode ray tube. The tube will be close to proper focus when the knob marker line is pointed vertically.

9. Vertical Position

The Vertical Positioning Control adjusts the position of the trace that appears on the cathode ray tube in the vertical axis. The trace will be approximately centered vertically when the white line on the knob is pointed in the vertical direction.

10. Horizontal Position

The Horizontal Positioning Control adjusts the position of the trace on the cathode ray tube in a horizontal direction. The trace will be approximately centered horizontally when the white marker line on the knob is pointed vertically.

11. Gun-Killer Switches

Located just below the horizontal and vertical positioning controls are three slide switches marked R, B and G, representing red, blue and green. These switches deactivate the guns of the color kinescope. When the switches are in the upper or ON position, the guns are operating normally. When a switch is depressed, it turns OFF its particular gun. For example: if only the red gun were to remain active, then both the blue and green switches must be down to the OFF position.

B. RECESSED CONTROLS

There are eight recessed controls which are acccessible from the outside of the instrument. There are two controls located on the right hand side of the cabinet and five controls located on the left hand side of the cabinet, plus one switch accessible through the door in the rear cable compartment. The positions of these controls are indicated in Fig. 1. A copy of Fig. 1 is also located on the rear of the case for convenience when the instruction manual is not available.

1. RF Frequency Adjust

This is the rear of the two control on the right hand side of the instrument. See Fig. 1. The instrument as delivered from the factory is adjusted for Channel 4. The RF Frequency Adjust trimmer will permit the instrument to operate on either Channels 3 or 5 with proper

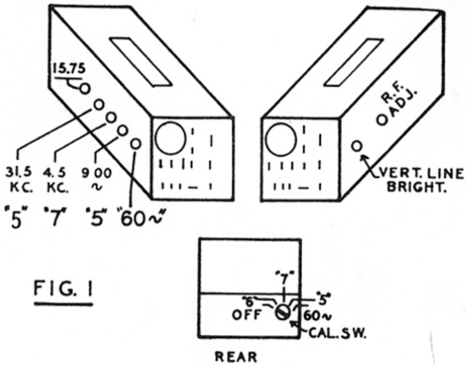


FIG. 1

adjustment. For Channel 3, turn the trimmer clock-wise and for Channel 5, turn the trimmer counter clock-wise.

2. Vertical Lines Brightness Adjust

The Vertical Line is an extremely fast signal, having many high frequency components. Differences in receiver frequency response will cause the intensity of the vertical lines to differ from those of the horizontal lines. Adjustment of the receiver contrast control and fine tuning will also affect this relationship. This control is made available so that regardless of the TV set characteristics or adjustment of brightness and contrast, it is always possible to obtain equal brightness of the vertical and horizontal lines. The horizontal line brightness is increased as the trimmer is rotated in a clock-wise direction and will decrease when rotated in a counter clock-wise direction.

3. Calibrate Switch

The Calibrate Switch is located on the right hand side of the rear of the instrument and is accessible when the cable compartment is open. The shaft is slotted for screwdriver switching and has five positions. They are: OFF, 5, 7, 5 and 60 cycle. The OFF position full counter clock-wise, is the normal position and must be in this position in order to use the Vectorscope. 5, 7, 5 and 60 cycle positions are the positions that are used when timer adjustment is necessary and the numbers indicate the number of images that must appear on the cathode ray tube for each of these positions. This will be explained in detail in a later section.

4. 31.5 KC Adjust ("5")

This control is adjusted when the calibrating switch is in the number "5" position and is adjusted for 5 cycles of sine wave on the cathode ray tube face.

5. 4.5 KC Adjust ("7")

This control is adjusted when the calibrate switch is in the number "7" position and is adjusted for 7 images on the screen of the cathode ray tube.

6. The 900 Cycle Adjust ("5")

The 900 Cycle Adjust is adjusted when the calibrate switch is in the number "5" position and is adjusted for 5 images on the cathode ray tube.

7. 60 Cycle Adjust

This control is adjusted when the calibrate switch is in the 60 cycle position and is adjusted so that 1 cycle of 60 cycle sine wave appears stationary on the cathode ray tube.

8. 15.75 Adjustment

This is the 15.75 Adjustment and sets the horizontal frequency of the MODEL V-7. This is adjusted on the face of a TV receiver for an in-sync horizontal pattern.

C. CABLES

There are four cables which exit from the cable compartment at the rear of the instrument. They are as follows:

1. RF Cable

This cable makes connection to the antennas terminals of the TV set and provides an RF signal of approximately 0.1 volts to the antenna terminals of the TV receiver. In the event that a ground loop or standing wave occurs, as evidenced by a 60 cycle hum bar floating through the picture, ground one side of the antenna terminal to receiver chassis or shift the position of the RF cable to eliminate the ground loop or standing wave.

2. Ground Lead

This is the black test lead with a black alligator clip on the end. This must be connected to receiver chassis ground and used whenever the gun-killer and Vectorscope function is to be employed. It is also used as the ground return for the video signals.

3. Video Cable

This is the red test lead cable, with a red alligator clip on the end. This is used for reproducing at video, the various patterns available from the MODEL V-7 Vectorscope. It is DC isolated and can be connected anywhere in the receiver that will accept this signal.

4. Vectorscope Connecting Leads

The Vectorscope connecting leads are the three leads color coded Red, Green and Blue. These leads have the same color coded insulators and terminate in lead piercing Alligator Clips. These leads connect to the respective Red, Green and Blue Control Grid Leads of the receiver Kinescope. Their function is to bring into the Model V-7 the necessary signals for operation of the Vectorscope and the gun killer. NOTE: The black or ground lead MUST be connected to receiver chassis ground for the gun killers and Vectorscope to work properly. Connection to the Kinescope Control Grids can be made by clipping the Red Alligator Clip to the Red Grid Test Point on the receiver chassis. You may also use the Lead Piercing function of the Alligator Clip and connect directly to the solid Red wire on the Kinescope socket. Do the same for the Blue and Green Grids. The Lead Piercing feature of the Alligator Clips make it easy to connect the Model V-7 to any receiver regardless of the type Kinescope being used. You are not restricted to connection of the V-7 due to different Kinescope Tube Basing arrangements.

III. SIMPLIFIED OPERATING INSTRUCTIONS

By following the simple instructions outlined below, the V-7 Generator can be placed in operation and produce its patterns on a TV receiver. Detailed instructions will take place in following sections.

1. Connect RF cable to antenna terminals of receiver.
2. Connect color socket assembly to receiver kinescope.
3. Connect ground lead (black lead) to receiver chassis ground.
4. Set Pattern Selector switch to crosshatch position.
5. Set Gun-Killer switches to ON position.
6. Set remaining controls so that the white indicator line on the knobs are vertical.

7. Turn on the receiver.
8. Turn on the V-7 Generator.
9. Tune receiver to Channel 4.
10. Fine tune receiver and adjust brightness and contrast as needed for best crosshatch.
11. Adjust Vertical Lines Brightness on right side of MODEL V-7, if needed for equal brightness of vertical and horizontal lines.
12. Adjust Horizontal Line Adjust for desired horizontal line width.
13. Rotate Selector switch through its remaining positions.
14. Fine tune receiver with the V-7 Generator in the color position for best color bars. Advance receiver contrast control for sharpest bar pattern.
15. Turn receiver color control to minimum. Center dot on V-7 CRT with positioning controls. Slowly advance color control on receiver and observe the Vectorscope. Center the trace on the Vectorscope, and increase receiver color control until the vectors are of the proper size. For cleanest vector, turn receiver brightness to minimum and adjust receiver horizontal hold for sharpest trace. Fig. 2 shows the vector display of a properly adjusted receiver.

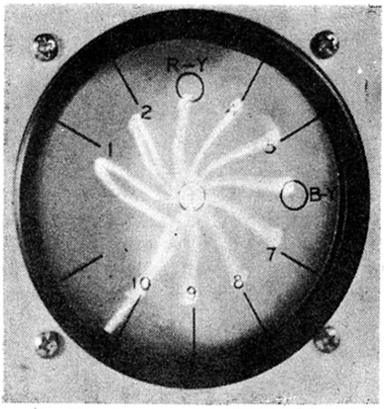


Fig. 2

IV. HINTS ON OBTAINING THE BEST CROSSHATCH AND DOT PATTERN

The actual use of the crosshatch and dot patterns for the convergence of color TV receivers is fairly well known. It is not the purpose of the section to explain the convergence process, but to provide more detailed instructions in the exact use of the generator to produce the best possible patterns for these adjustments. The actual convergence procedures vary, from manufacturer to manufacturer. At any time that a question may arise as to the proper procedure for a given receiver, it is always wise to refer to the manufacturers' instructions.

The one common denominator for all receivers is the need for an absolutely stable, well defined, crosshatch and dot pattern. The MODEL V-7 provides such a pattern.

The recommended size of the vertical and horizontal line used to form the crosshatch pattern varies considerably. Since there is disagreement as to the best size of vertical and horizontal line, the MODEL V-7, provides operating adjustments, which enable the service technician to select any desired width of line.

The horizontal line in the MODEL V-7, is formed by a one shot multivibrator, whose delay time is variable, by means of the front panel control marked Horizontal Lines Adjust. When this control is in the full counter clockwise direction, the horizontal line disappears. As the control is rotated clockwise, horizontal lines will appear on the face of the receiver.

See Fig. 3. As the control is rotated further clockwise, the horizontal lines will meet and join, forming a bright horizontal line one scanning line wide. See Fig. 4. As the control is rotated further clockwise, the thickness of the line will increase from one scanning line wide to as many as three or four. It is therefore possible, for the technician to select that thickness of line which satisfies his own individual taste.

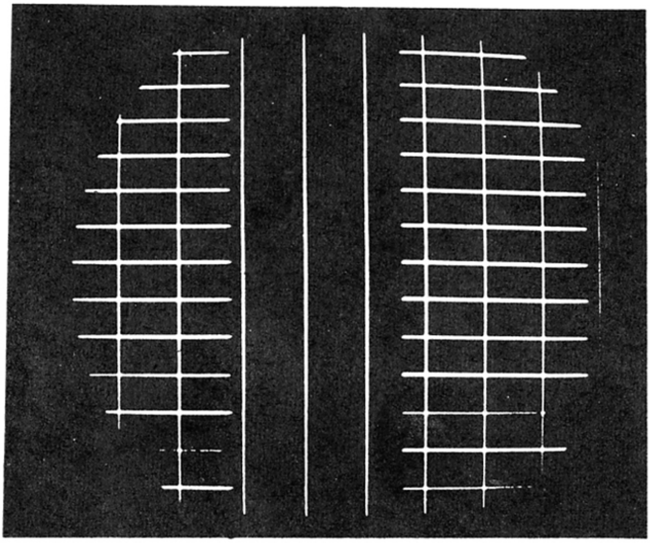


Fig. 3

The width of the vertical line is a different story. It is produced by a pulse, whose rise and fall time is extremely fast and has components of frequency in the upper megacycle region. This very fast pulse is necessary in order to produce a thin vertical line. The amplitude or brightness of this vertical line is adjustable by means of the control located

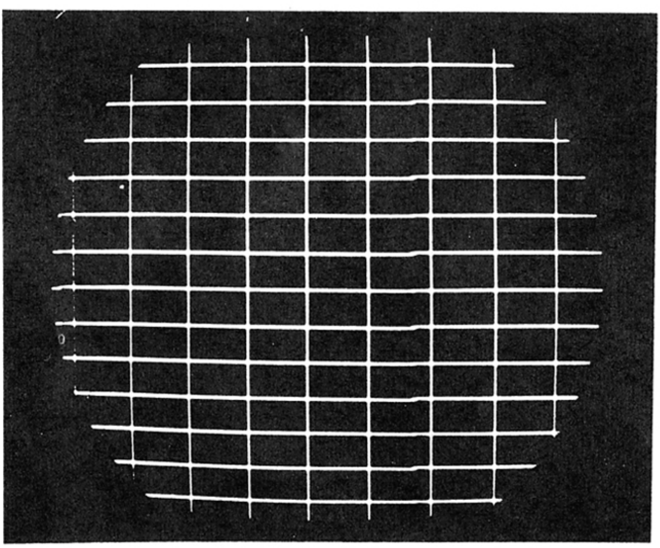


Fig. 4

on the right hand side of the instrument designated as Vertical Lines Brightness Control. Equality of brightness can be accomplished by observing the crosshatch pattern and adjusting the Vertical Lines Brightness Control, until they appear equal in intensity. See Fig. 4. The thinnest vertical line will occur when the brightness control of the TV receiver is reduced to a low value. Since the vertical line consists of very high frequency information, small changes in receiver frequency response, will cause the brightness of this line to vary from set to set. In fact small changes in fine tuning and contrast control adjustment will also cause this relationship to change. The best way to tune the pattern in, is to do the actual tuning in the color position. You will find a setting of the fine tuning, which will cause the color pattern to break up, to go out of sync and possibly lose color. As you rotate the fine tuning control, the pattern will suddenly appear, come in sync and be clear and sharply defined. At the same time color will occur. This is close to the proper setting for the best crosshatch pattern.

If the Chroma Control on the receiver is advanced, some color may appear along the edge of the vertical lines. If this should be observed, turn receiver chroma control to minimum.

The Dot Pattern is produced from the same information that produces the crosshatch, except that a clipping level is established so that video information is allowed to pass only when a vertical and horizontal line intersect. It is this amplitude discrimination which produces the dots. If there is inequality in brightness between vertical and horizontal lines, the dot pattern will show a trace of a white connecting line between the dots. This can either be adjusted out by reducing the brightness on the receiver, or lowering the Vertical Lines amplitude control located on the right hand side of the cabinet. From the preceding discussion, it is clear that there are many variables, which will affect the crosshatch pattern as viewed on a color TV receiver. The brightness, contrast, and fine tuning controls will generally be all the adjustment required in order to properly display this pattern.

V. GUN KILLER

The Gun Killer is a useful tool when performing convergence adjustments. The ability to turn a gun on and off during convergence enables the technician to more easily evaluate the degree of mis-convergence between the various guns. The gun killer eliminates the necessity for constantly mis-adjusting the background and screen controls to accomplish the same purpose.

The only electrical requirement for gun killing is to shunt the grid of the particular gun to ground with a 100K resistor. In the Model V-7 the grid connections are brought into the instrument by means of the three color leads (Red, Green, Blue) that terminate in Lead Piercing Alligator Clips. These wires must be connected to the color Kinescope Grids for both the gun killing functions and when using the Vectorscope. Fig. 5 shows the Alligator Clip Lead connected to a Color Kinescope.

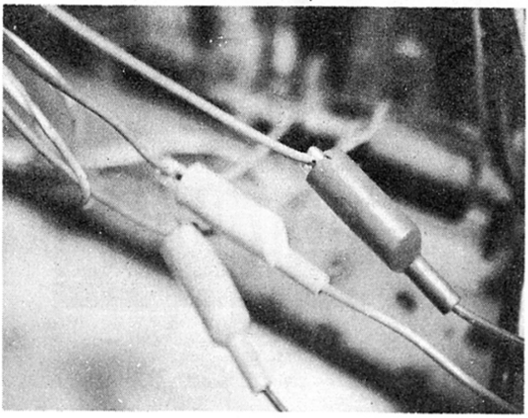


Fig. 5

These three wires bring the Red, Green, and Blue grid connections to their respective switches on the front panel of the V-7. When a switch is thrown to the off position, a 100K resistor is shunted from that grid to ground. This bias's off that grid.

Each switch operates independently of the others and they may therefore be used in any desired combination.

VI. THE KEYED RAINBOW COLOR PATTERN

The keyed rainbow color pattern is fast becoming the industry standard for trouble-shooting color receivers. Most instruction manuals supplied by the set manufacturers' use the keyed rainbow in their receiver waveform charts.

Its main advantage lies in the fact that it produces a color bar every 30 degrees from burst. It is the simplest of all color bars to use and is inherently accurate since it does not require critical delay lines, that require adjustment. The accuracy of the keyed rainbow signal is dependent only upon the stability of a crystal and this can be extremely accurate.

The operating principle behind the generation of this pattern is quite simple. A highly stable crystal oscillator operating at a frequency of 3.563795 is the source of the color signal. The receiver phase locks on this signal during the horizontal blanking period. The receiver oscillator frequency is 3.579545. Note that the difference between these two frequencies is 15,750 cycles, the horizontal scanning frequency. Since phase lock occurs at the beginning of each horizontal line, the offset color signal appears to the receiver as a color signal whose phase changes 360 degrees during each horizontal scanning period. This results in a rainbow pattern that starts in a yellowish color and varies continuously and smoothly through the reds to the magentas, then to the blues and finally to the cyans and greens. The rainbow pattern itself is not particularly useful since there are no discrete colors.

If we now gate this color signal at a frequency 12 times higher than the horizontal sweep frequency (189 KC), 12 color bars will result. Since the phase of the color signal changes 360 degrees during each horizontal line and we have divided this into 12 equal parts, each part or each color bar is 30 degrees apart. We now have discrete color bars that are useful for color servicing.

In the actual color signal, one of the bars is blanked out and one bar acts as the burst signal to the receiver. This leaves a total of 10 visible color bars. This color signal is shown in Fig. 6, where the oscilloscope sweep circuit is 15,750 cycles.

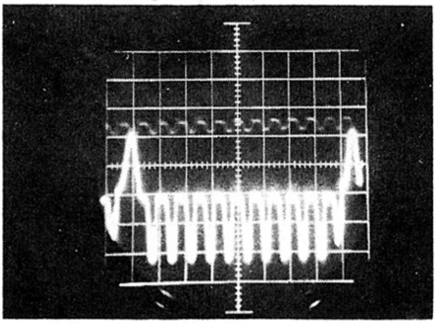


Fig. 6

Since each bar is of uniform amplitude, but shifted in phase by 30 degrees from the preceding bar, this can be seen as a vector display as shown in Fig. 7. Note that as a result of the keyed signal all of the important signals occur that are vital to color servicing. They are R-Y, B-Y I, Q, plus the reds, greens and blues.

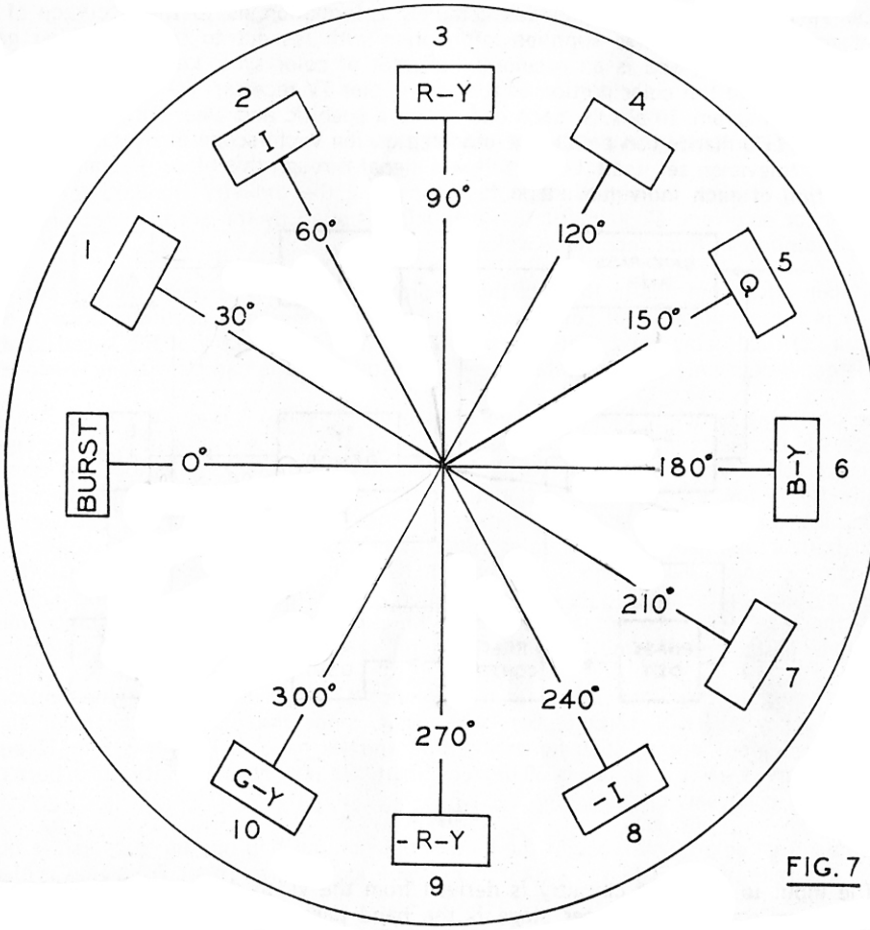


FIG. 7

VII. USE OF THE VECTORSCOPE

Since the concept of a vectorscope is relatively new to the service industry, it would be well to delve into a color TV receiver and examine each of the stages in a typical block diagram to clearly understand their function and the contribution that they make to a vector display. The Vectorscope is not only a powerful tool for analyzing troubles in color receivers as we know them today, but will become even more valuable in the future when the one gun tube begins to appear on the consumer market.

It is fundamental to the color TV system, that each color in the spectrum that can be reproduced by the Broadcast station represents a 3.58 megacycle signal, delayed in phase from a burst or reference signal, by a given number of degrees. For example: the color blue represents a signal that is delayed in phase from the reference or burst signal by approximately 210 degrees. The color green represents a signal delayed in phase from burst by approximately 300 degrees. This is shown in a vector display in Fig 7. This is the vector display for a keyed rainbow signal and is the type of display you will see on the vectorscope when connected to a TV receiver receiving this keyed rainbow pattern. It is the accuracy of these phase delays that determines how accurately a color set can reproduce the true colors transmitted to it. The Vectorscope is inherently a zero error device and relies only upon the accuracy of the demodulators and color amplifiers in the receiver. Therefore with a known accurate transmitted signal and a zero error indicator the only possible source of trouble that can occur must lie in the demodulator circuits, which of course, are in the TV receiver. These are the circuits that we wish to examine.

The Vectorscope not only provides complete information as to the accuracy of the color demodulators, but also supplies information with respect to color amplifier gains, accuracy of matrixing and is an excellent indicator of color sync. Let us examine Fig. 8, a block diagram of the color portion of a modern color TV receiver. We find that there are shown on the diagram, 10 blocks. Each one serves a specific and clear cut function, whose accuracy of performance can be clearly indicated on the Vectorscope display or on the face of the color television set itself. Let us follow a signal through this block diagram to explain the operation of each individual stage.

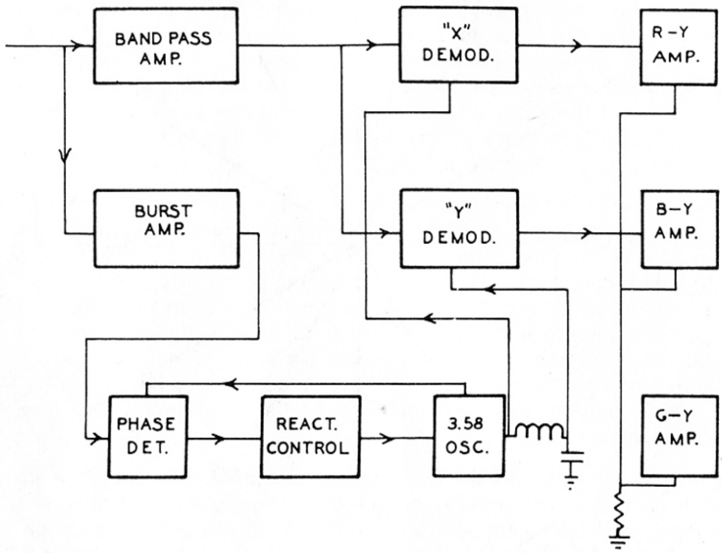


Fig. 8

The input to the color circuitry is derived from the video detector. This video signal passes to two stages. The upper stage is the band pass amplifier, whose function is to extract only the color information from the composite video signal. The output of this stage therefore, has present only 3.58 megacycle color information. There is no sync or black and white information present at this point. The output of the band pass amplifier is then fed to the X and Y demodulators.

These X and Y demodulators are so named, since they do not demodulate at precisely 90 degrees. The output of the X and Y demodulators in turn feed the R-Y amplifier and the B-Y amplifier and by means of matrixing through a common cathode resistance, the G-Y amplifier. It is interesting to note, that regardless of the type of demodulator, that is, be it X and Y or R-Y and B-Y or I. & Q., we always recover R-Y, B-Y and G-Y, since these are the signals which are acceptable to the red, blue and green guns of the kinescope. The output of the R-Y demodulator, B-Y demodulator and G-Y demodulator are applied to their respective red and blue and green grids. A "Y" signal is applied to the common cathode. The Y signal is the black and white or brightness signal. The net affect to the picture tube is that the R-Y is converted to a red signal, which represents the original red information in the transmitted picture and a blue signal is applied to the blue grid representing the blue of the original transmitted picture and the same situation applies to the G-Y or green amplifier.

Since the color signal fed to the X and Y demodulators consists of side bands only, we must reinsert a carrier, in order to properly demodulate or detect. This carrier must not only be of the correct frequency, but must also be of the proper phase. The reinjected carrier is supplied by the 3.58 oscillator in the receiver and you will note that the X demodulator receives its signal directly from the oscillator whereas the Y demodulator receives its signal from the junction of L and C, a phase shift network. This network provides the necessary phase shift in order to demodulate at the correct angles.

Since the 3.58 oscillator is crystal controlled, this partially takes care of the frequency requirement. In order to maintain the proper phase of the carrier, this oscillator is in turn compared to the original transmitted signal and phase locked. The net result is that the output of the 3.58 oscillator in the receiver is of precisely the same frequency and precisely the same phase as the original transmitted burst or reference signal.

Let us see how his is accomplished. The signal from the video detector not only feeds the band pass amplifier, but also feeds the burst amplifier. The burst signal is contained on the back porch of the horizontal sync pulse of the transmitted signal. The burst amplifier is turned on by means of a high level pulse from the horizontal flyback system of the receiver. The output of the burst amplifier, therefore consists only of information present during the horizontal blanking period, which is the burst signal. This burst signal is fed to a phase detector where it is compared with a sample of the RF signal from the 3.58 oscillator in the receiver. If there is a difference in frequency or phase, a correction voltage is developed which feeds a reactance control tube which in turn restores the 3.58 oscillator of the receiver to the proper frequency and phase.

We will now determine the contribution of each of these stages to the performance of a color set. If the band pass amplifier were inoperative, no color information would be present on the face of the kinescope. If the burst amplifier were inoperative, or there was a defect in the phase detector or reactance control tube, color information would be present on the face of the kinescope, but it would not be synchronized, and you would find the color running through the picture in a manner similar to an out of sync horizontal condition. Black and white would remain in sync and appear perfectly normal, but the color would be randomly floating through the picture. We can conclude that at any time that we have an out of sync color condition, that the trouble must lie in the burst amplifier, the phase detector or the reactance tube.

If either of the demodulators are not working properly or are totally inoperative, this would result in no output or improper output from the particular demodulator. If the X demodulator were not working properly we would see no red or R-Y vector on the Vectorscope. If the Y demodulator were inoperative, we would see no blue vector or B-Y vector on the face of the Vectorscope. While it is true that an inoperative demodulator might be relatively easy to diagnose, a demodulator working at the wrong phase angles could be extremely difficult. The Vectorscope will immediately tell you whether the demodulator is demodulating properly and if it is demodulating, whether it is producing signals of the proper phase angle. The R-Y, B-Y and G-Y amplifiers do nothing more than amplify the red, blue and green signals. There are certain requirements, however, for these stages. They must have uniform gain between them. This is not an easy measurement to make, the Vectorscope, however, will immediately tell whether the color difference amplifiers, as they are called are operating with uniform gain. This can be determined by observing the length of the vectors that appear on the Vectorscope.

VIII. CONNECTING AND ADJUSTING THE VECTORSCOPE

Step 1. Connect the Model V-7 to the TV receiver as you would to obtain a cross-hatch pattern. Connect Ground Lead and Alligator Clip Leads to proper Kinescope Grids. See Fig. 9.

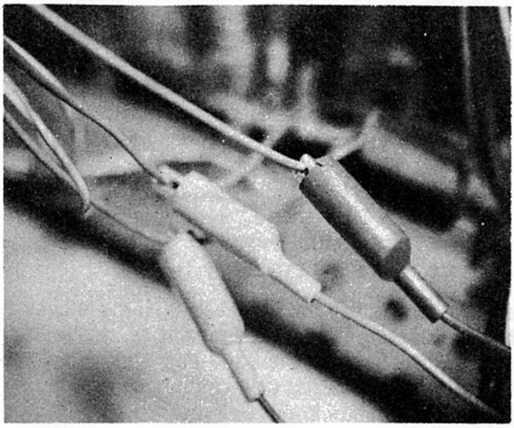


Fig. 9

Step 2. Using an unused channel and with the Model V-7 selector switch in the color position, fine tune receiver for best pattern display. This will occur at the point where the fine tuning just tunes the pattern in. As the fine tuning is rotated in one direction the pattern will break up and go out of sync and as the fine tuning is rotated in the opposite direction the pattern will come into sync. It is this point that is the optimum setting for the fine tuning control. Improper fine tuning setting will produce a vector display as shown in Fig. 10. Adjust the chroma control and hue range control for a proper color pattern. The best pattern will occur when the contrast control on the receiver is advanced since each color bar rides on a brightness pedestal.

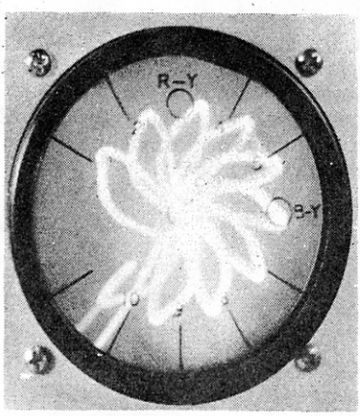


Fig. 10

Step 3. After a proper color bar pattern is tuned in reduce the chroma control on the receiver to minimum. Set the Color Level control on the Model V-7 to normal.

Step 4. Adjust vertical and horizontal positioning controls on the Vectorscope to place the area of brightness in the center of the display, in the circle in the center of the graticule.

Step 5. Slowly advance the color level control on the receiver until the vectors begin to appear. Increase the level until the vectors are of such a length that they just drop into the R-Y and B-Y circles. Adjust the tint or hue control so that the third bar is in the middle of the R-Y circle. The sixth bar should now occur within the confines of the B-Y circle or lie along a line connecting the B-Y circle to the center. A correct display is shown in Fig. 11.

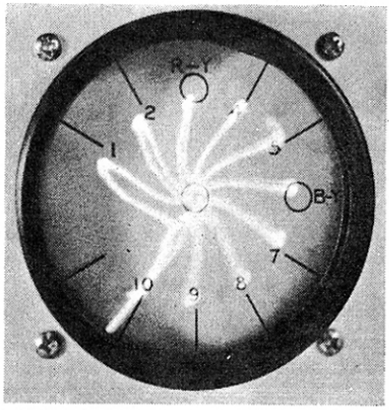


Fig. 11

IX. INTERPRETING TROUBLES WITH THE VECTORSCOPE

This section is devoted to describing various defects that might occur in a color receiver and the vector display that will result because of such defects. All photographs displayed taken directly from the Model V-7 CRT. An RCA color set was used to simulate the troubles shown.

The vector patterns may vary slightly from set to set and particularly from manufacturer to manufacturer. The specific areas of importance on the vector patterns are the ends of the vectors which represent angular displacement and the center of the pattern which must be placed into the center circle of the graph on the face of the CRT, via the Horizontal and Vertical controls on the front of the V-7.

The vectors on the RCA sets all have approximately the same length. This is not true on Motorola and Zenith. The R-Y vector on Motorola is longer than the B-Y vector while Zenith is just the opposite. It is recommended that the vector displays for all of the color sets be observed on known good sets. In this way the technician will become familiar with the exact display that each set will produce. Any departure from the normal will then indicate trouble and can be diagnosed in accordance with the following discussion.

Let us examine a receiver where the complaint is no color. The vector display for this particular receiver is shown in Fig. 12. To the customer it appeared as if there was no color

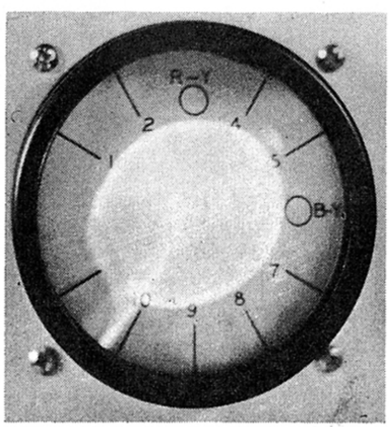


Fig. 12

while in fact color was present but was out of sync. The rotating vector which appears as a solid mass of green is the result of lack of color sync. This immediately pinpoints the trouble to the following stages. See Fig. 8. The band pass amplifiers are working since there is color present on the Kinescope. This is also true of the demodulators and color difference amplifiers. We also know that since there is color present the receiver 3.58 Mc. oscillator must be working. The trouble must therefore be in the Burst Amplifier, Phase detector, or reactance control. The vector scope has located the trouble to one of three stages. A few simple checks can determine which stage is bad. Let us examine the reactance control tube first. Since the reactance control tube will respond to a D.C. voltage on its grid and change the frequency of the 3.58 osc. a bias supply with an adjustable Positive and Negative voltage will cause the color to change frequency, and if carefully adjusted, will actually make the color stand still as if it were in sync. If this voltage causes the frequency to change the reactance control circuit is working. If we now examine the output of the burst amplifier and see the presence of burst then the trouble must lie in the phase detector. We have arrived at the specific circuit by the process of elimination.

Another trouble that may occur is the complaint of improper color. This is usually most evident on skin tones which are the hardest to duplicate. The vector display for this complaint is shown in Fig. 13. This display shows the 3rd bar which is the R-Y signal set into the R-Y circle with the hue range control. Note that the 6th bar which is B-Y and should

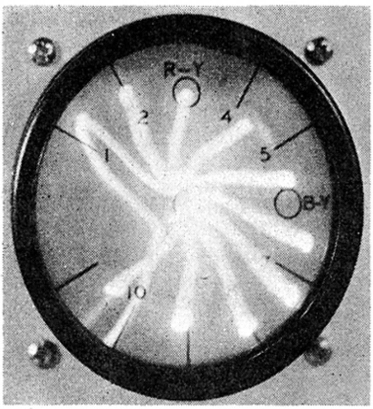


Fig. 13

be in line with the B-Y circle is actually half way between B-Y and the 7th bar. This represents a demodulation error of 15 degrees. This is a large enough error to give improper color especially on skin tones. This difficulty is corrected by demodulator alignment. If the Hue range control is approximately centered then adjust the B-Y demodulator adjustment to shift the B-Y vector so that it falls into the B-Y circle. If the receiver does not have variable demodulator adjustments then check the fixed phase shift network for defective components of components that may have changed value. After alignment the vector display should appear as shown in Fig. 11.

Another problem that may occur is the Hue range control not being centered making it impossible to get the proper colors. Fig. 14 shows a vector display where the Hue control is turned full clockwise and Fig. 15 shows the display with the Hue control full counter-clockwise. Observe that in Fig. 15 the third bar does not quite make the R-Y circle and that in Fig. 14 the third bar is a full 40 degrees from its proper location. It is obvious that it is not possible to get the Third bar in the R-Y circle for any setting of the Hue control and the set requires centering of this control. This is the extreme case. It is equally possible for the hue control to be able to position the 3rd bar into the R-Y circle but be close to the end of its range. Under these conditions it may be possible to get proper color on one station camera and not on another since there can be a phase change between cameras and certainly this can occur between stations. This is a condition that must be corrected in order to prevent a repeat call on the set.

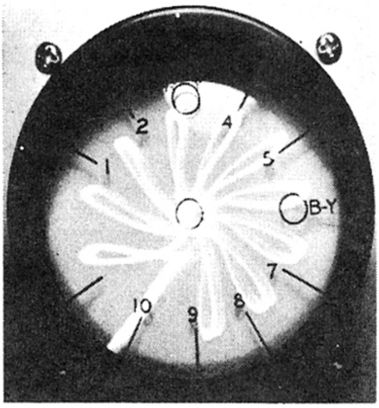


Fig. 14

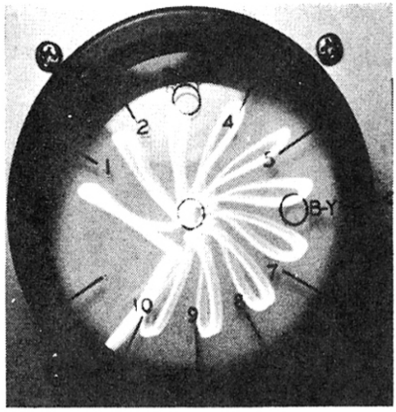


Fig. 15

Weak color is another possible complaint frequently heard. This complaint can be caused by the set and may also be caused by a poor antenna. The set can readily be checked since the color output of the Model V-7 is calibrated by means of the front panel Color Level control. In the Normal position of this control, Modulation represents 100%. If the vector display appears as shown in Fig. 16 the receiver does not have enough color gain. Since all the vectors are reduced by the same amount the trouble must be in a stage that is common to all colors. This would most likely be the band pass amplifiers. Voltage checks of this stage will locate the defective component.

The trouble in a receiver that is represented by the vector display shown in Fig. 17 is particularly interesting. Experience tells us that this particular set normally has vectors of approximately equal length. In Fig. 17 the R-Y vector is materially reduced in length. This would indicate the R-Y amplifier has low gain and the picture would have a deficiency in

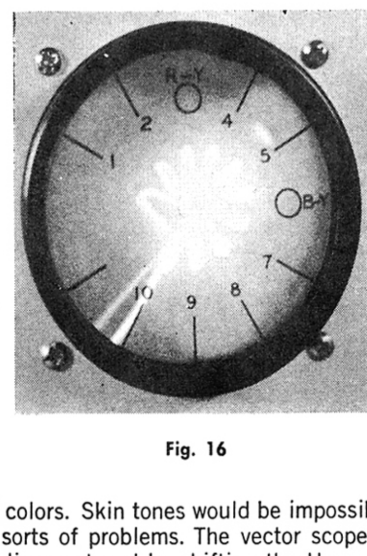


Fig. 16

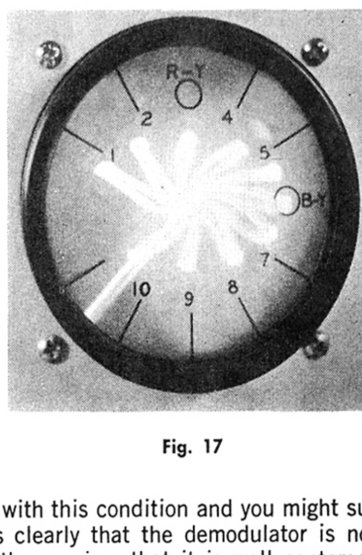


Fig. 17

red colors. Skin tones would be impossible to get with this condition and you might suspect all sorts of problems. The vector scope indicates clearly that the demodulator is not out of alignment and by shifting the Hue control of the receiver that it is well centered. The trouble must clearly be low gain of the X demodulator or R-Y amplifier.

If a receiver had the complaint of lack of greens in the picture the vector display would again pinpoint the trouble. If the vector display was normal as shown in Fig. 11 then by process of elimination the trouble must lie in the G-Y amplifier. Since the 9th and 10th bars line up on the vector scale for these bars all of the information is present in the receiver to produce greens. Actual failure of the set to reproduce these colors must occur in the G-Y amplifier.

The last trouble is the case where there is no blue information in the picture whatsoever. The vector display for this problem is shown in Fig. 18. Note the complete lack of vectors in the blue area of the display. The presence of R-Y information tells us that the oscillator

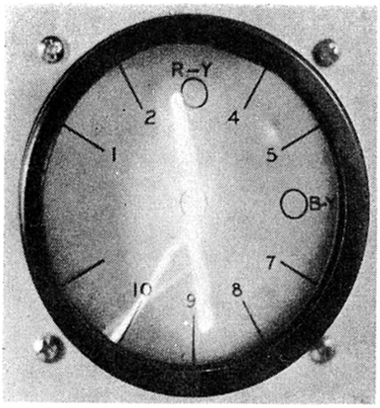


Fig. 18

and reactance control circuits are working since the color circuits are in sync. The trouble must lie in the B-Y amplifier or the Y demodulator. A few voltage checks should easily locate which component is bad.

From the preceding examples it is clear that the vector scope is a most powerful tool for accurately diagnosing color set trouble. While the use of a vector scope is not the only way to trouble shoot color sets it is certainly the most accurate and fastest technique available. Experience with other makes of sets and the displays peculiar to them will make this instrument most valuable to the service technician for both installation and service.

X. SELF CALIBRATION OF TIMER CIRCUITS

If the internal frequency dividers circuits should require adjustment, it will become evidenced by a jittery or waving and distorted crosshatch pattern. To reset the timer circuits, the following procedure should be followed step by step.

Step 1. Pattern selector switch to crosshatch position.

Step 2. Horizontal lines adjust control in mid-position, with the white line on the knob pointed vertically.

Step 3. Calibrate Switch 1 notch clockwise to the "5" position.

Step 4. Center trace on screen of CRT and advance brightness and adjust focus for clean display.

Step 5. Adjust the 31.5 KC or "5" control for 5 cycles of sine wave. Note one cycle is partially consumed by retrace. This is shown in Fig. 19. Set the control to the center of the range over which the pattern is in sync.

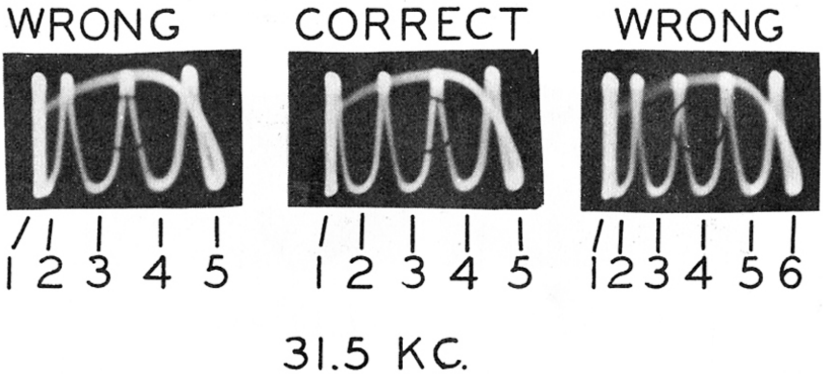


Fig. 19

Step 6. Rotate calibrate switch 1 Notch clockwise to the "7" position. The screwdriver slot should point vertically. Adjust 4.5 KC or "7" control for 7 bars on the face of the CRT. This is shown in Fig. 20. Set the control to the center of the range over which the pattern is in sync.

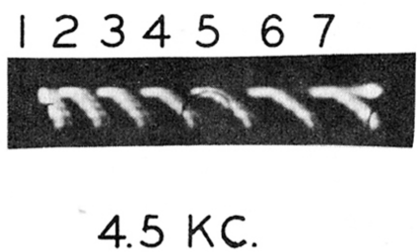
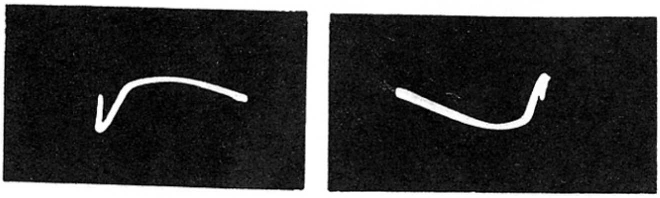


Fig. 20

Step 7. Rotate the calibrate switch 1 Notch clockwise to the "5" position. Adjust the 900 cycle or "5" control for 5 bars. This is shown on Fig. 21. Set the control to the center of the range over which the pattern is in sync.

Fig. 21

Step 8. Rotate the calibrate switch clockwise to the 60 cycle position. This is as far as the switch will rotate. Adjust 60 cycle control so that the pattern appears stationary on the CRT. Depending upon the phase in which the system locks in, the 60 cycle pattern may appear normal or may be shifed to the left or right. This is shown in Fig. 22, where several possible combinations are shown. Set the control to the center of the range over which the pattern is in sync.



60 ~ 60 ~

Fig. 22

Step 9. With the MODEL V-7 connected to a TV receiver, either black and white or color, adjust 15.75 frequency control until horizontal sync is obtained. Set the control to the center of the range over which the pattern is in sync. Put V-7 Pattern Selector to Color position and advance Color Level control to maximum. If horizontal goes out of sync, readjust 15.75 control. Return pattern switch to crosshatch. Rotate Calibrate Switch fully counter clockwise to the OFF position

Step 10. Rotate the Cal switch to the 60 cycle position which is fully clockwise and with the MODEL V-7 connected to a variac, reduce the line voltage to 70 volts. The sine wave should remain in sync from 70 volts to 135 volts. All of the previously mentioned adjustments are identified in Fig. 1 and are also identified on the control position label on the rear of the carrying case. They are marked as to their frequency 31.5, 4.5, etc., and below each frequency designation is the number of bars that should appear on the face of the CRT for a properly adjusted system.

XI. THEORY OF OPERATION

The MODEL V-7 Color Bar Generator and Vectorscope is of straight forward design employing the latest circuit techniques for high reliability operation. Reference is made to the block diagram of the V-7 and to the schematic diagram enclosed with the instruction manual.

The heart of the instrument is the frequency divider or timer chain, which originates with a 189 KC crystal controlled oscillator. The output of this satge, feeds in three directions. One output of Q-1 feed to Q-2, the Vertical Line Shaper. The Vertical Line Amplitude Control is a trimmer capacitor in series with the base of Q-2 and provides a means of adjusting the level of signal to this stage. The output of Q-2, the vertical line shaper, feeds to the pattern selector switch. A second output of Q-1, the 189 KC oscillator, feeds Q-3, the 189 KC shaper. This stage serves as a buffer between the crystal oscillator and the 31.5 KC oscillator.

The output of Q-3, sychronizes Q-4 on a division ratio of 6. The output frequency of Q-4 is therefore 31.5 KC. These 31.5 KC pulses are in turn used to sychronize Q-5. Q-5 is a 4.5 KC oscillator. The output of Q-5, then feeds Q-6, the 900 cycle oscillator. Q-6 feeds in two directions. A pulse derived from Base 2 of Q-6 is used to trigger Q-8 and Q-9, which form a 900 cycle flip flop. Another output of Q-6, is used to synchronize the 60 cycle oscillator Q-7. The output of Q-7 provides vertical sychronizing information and is fed to the input of Q-12, the sync mixer stage.

Refer back to Q-1, the 189 KC oscillator. The third output of Q-1, is used to sychronize Q-11, the 15.75 KC oscillator. This represents a division ratio of 12. The output of Q-11 also feeds to the base of Q-12, the sync mixer stage. The output of the sync mixer stage is a composite sync signal consisting of both vertical and horizontal sychronizing information.

Q-4, Q-5, Q-6, and Q-7 are silicon unijunction frequency divider stages. Because they are silicon, they are relatively immune to temperature variations and by virtue of the characteristics of the unijunction transistor, its frequency divisions stability is relatively independent of external circuit paramaters. To insure complete voltage independence, the plus 18 volt supply operating these stages is voltage regulated.

Q-4, the 31.5 KC divider, has a division ratio of 6 and when using the built-in self calibrating technique, 6 cycles of sine wave must appear on the scanning tube. This adjust is accomplished by means of the 5 K pot that appears in the emitter of this device. Q-5, the 4.5 KC oscillator, represents a division ratio of 7 from the 31.5 KC source. When using the self-calibrating technique, the 5 K pot in the emitter of Q-5 is adjusted for 7 bars on the face of the CRT. Q-6, the 900 cycle oscillator, represents a division ratio of 5. The 5 K pot in the emitter of this stage is adjusted for 5 bars on the face of the CRT. Q-7 represents a division ratio of 15 from the 900 cycle source. Rather than count 15 bars, the output of Q-7 is compared to 60 cycles from the AC lines. When the pattern appears to be standing still, the proper frequency has been reached. This adjustment is made by means of the 5 K pot in the emitter of Q-7. Q-11, the 15.75 oscillator represents a division ratio of 12. Adjustment of this stage is accomplished by means of the 5 K pot in the emitter of Q-11 and is adjusted for a horizontal in-sync condition on a TV receiver.

Reference was previously made to Q-8 and Q-9, as a 900 cycle flip flop. For each pulse that appears at the base of Q-8, 1 pulse appears at the collector of Q-9. The pulse width is variable, by means of the potentiometer in the base return of Q-9. This is the Horizontal Line Adjust Control and controls the pulse width or in effect, the number of horizontal lines. The output of the 900 cycle flip flop, is fed to the input of the pattern selector switch. So far, we have only 2 inputs to the pattern switch, one is the 900 cycle pulse, which represents horizontal lines and the other is the 189 KC signal, which represents vertical lines.

V-1A, is the 3.563 megacycle oscillator, which forms the offset sub-carrier color signal. The output of this stage is fed to Q-10, which is the color keyer. The base signal receives a 189 KC sine wave from Q-1. The drive is sufficiently hard, to either saturate or cut off the Q-10, depending upon the polarity of the signal. When in a saturated condition, the collector of Q-10 is effectively ground and therefore no color information appears at the output. When Q-10 is cut off, the collector rises to a high impedance and the full color signal is then present. This is taken off through a 1 K potentiometer, which is the color level control. This potentiometer in turn, feeds the pattern selector switch. Now we have present at the input of the pattern selector switch all the signals necessary to feed to the modulator. We have vertical lines, horizontal lines and color information. The pattern selector switch selects the proper signals and applies voltages to the necessary circuits, to perform the funcitons of each of its ifve positions. The Dot function is accomplished by means of diode D-6, which merely shifts the clipping level to allow video to pass, when the sum of vertical and horizontal lines are present. This results in a dot pattern. The output of the pattern selector switch feeds the modulator. This is the composite video signal made up of the output of the pattern selector switch and the output of Q-12, the sync mixer. V-3A, is the RF oscillator, whose frequency is adjustable over channels 3, 4, and 5. Output is taken from the cathode of this oscillator tube and fed to the diode modulator. The output of the diode modulator results in a fully modulated RF signal at either channel 3, 4 or 5. A second output is taken from the modulator, which is the composite video stage. The output of this stage appears on a cable available in the rear cable compartment.

The Gun-Killer consists of three slide switches, which when turned to the OFF position, shunts the grid of the color picture tube in a TV receiver to ground with a 100 K resistor. The input to the vectorscope consists of a signal from the red grid of the color picture tube and the signal from the blue grid to the color picture tube, applied to the horizontal and vertical delection plates of the CRT respectively. The calibrate selector switch, is used to sample the sweep voltage that appears at the emitter of either Q-4, Q-5, Q-6 or Q-7, depending upon the position of this switch. In the OFF position, the vectorscope signals are fed o the CRT.

The output of the calibrate selector switch, is fed to V-1B, a saw generator, which supplies the necessary sweep voltage to the horizontal deflection plates of the CRT V-2.

The vertical deflection plates signals for V-2 are derived directly from the emitter of Q-4, Q-5, Q-6 or Q-7, without any intermediate amplification. When the calibrate selector switch is in number 6 position, we are examining the division ratio of the 31.5 KC multivibrator and its control is adjusted for 6 cycles on the face of the tube. When the switch is then rotated to the 7 position, we are examining the division ratio of Q-5, the 4500 cycle oscillator. In this position, we should see 7 bars on the face of the picture tube. When the switch is rotated to the 5 position, we are examining the division ratio of Q-6, and the conrtol in the emitter of this stage is adjusted for 5 bars on the face of the CRT. When we rotate the switch to the sine wave position, we are comparing the output frequency of Q-7 to a 60 cycle sine wave. Coincidence of these 2 frequencies is obtained by adjusting the control in the emitter of Q-7. Anytime that the calibrate selector switch is used, it must always be returned to the OFF or counter clockwise position in order to restore operation of the Vectorscope.

The high voltage power supply is a voltage doubler circuit, consisting of diodes D-1 and D-2. The output of this supply, is minus 600 volts with respect to ground. This voltage is applied to the cathode of V-2, the cathode ray tube. A tap on the transformer feed diode D-3, which acts as a half wave rectifier, and provides 125 volts DC, which is used to power the vacuum tube circuitry in the MODEL V-7. This 125 volts is dropped through a series dropping resistor and the diode D-4, an 18 volt zener diode. This regulated 18 volts is used to operate all the semi-conductor circuitry in the color bar generator and vectorscope.

The pilot light is generized by the voltage drop across the brightness control of the cathode ray tube. The pilot light serves not only its primary function, but also regulates the grid cathode voltage of the cathode ray tube for maximum stability.

XII. MAINTENANCE

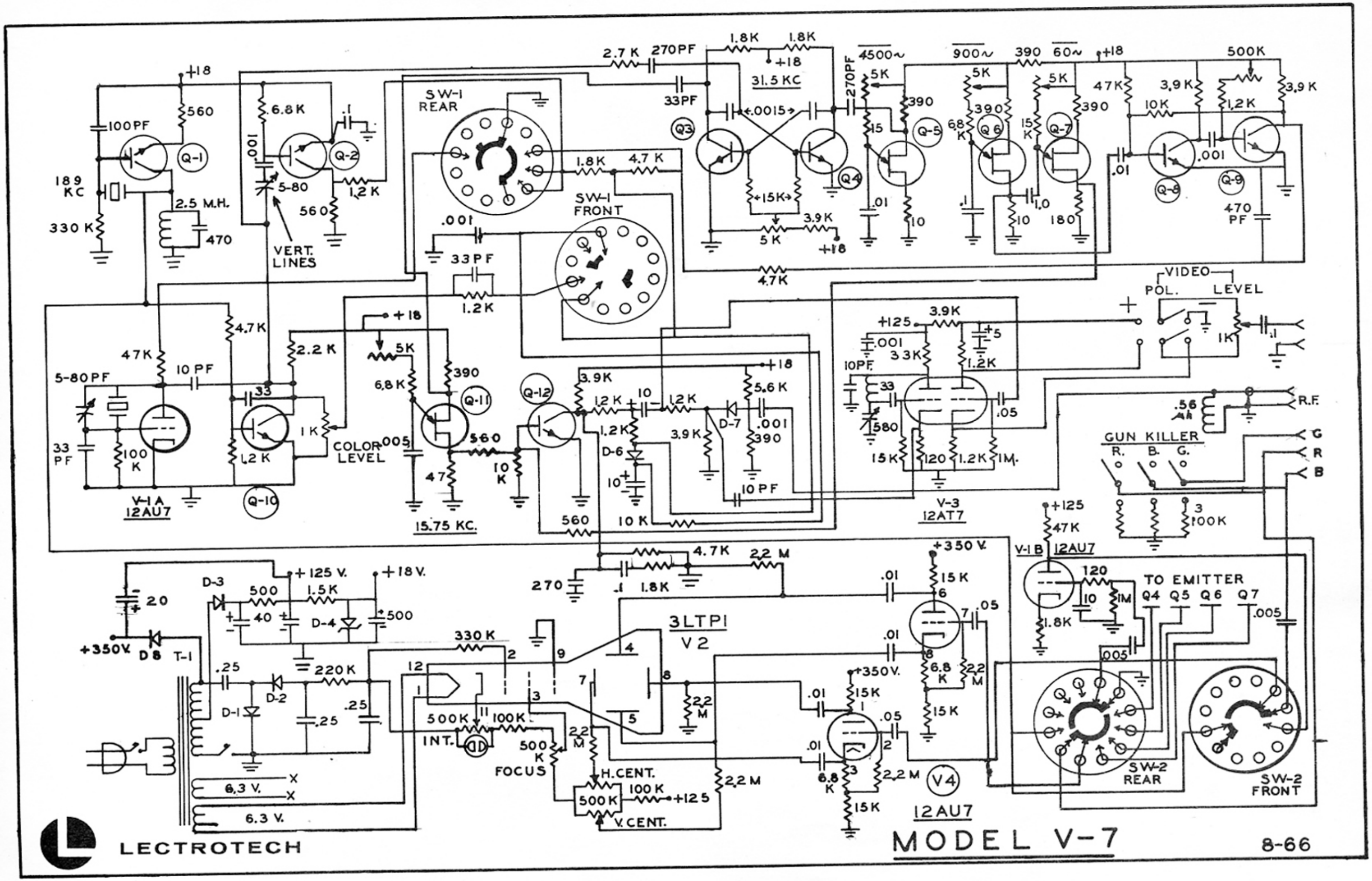
The MODEL V-7 Color Generator and Vectorscope is constructed of the finest materials. In general, miantenance will consist solely of a possible tube replacement. The balance of the circuits, being of solid state design, will require a minimum of attention.

To replace the tubes in the V-7, the chassis must be removed from the cabinet. To remove the chassis remove the 6 Phillips Head screws located around the outer edge of the panel. DO NOT REMOVE THE 4 SCREWS AROUND THE PICTURE TUBE BEZEL.

Remove the 2 No. 8 screws on the bottom of the cabinet centered between the two rear rubber feet. The chassis will now slide out.

Either of the two tubes may be replaced without affecting any of the adjustments in the V-7.

Replacement parts may be ordered from the factory by supplying the necessary description of the part and its circuit location.



MODEL V-7
LECTROTECH
8-66
Q-1
189 KC
330 K
100PF
560
+18
2.5 M.H.
470
Q-2
6.8 K
.001
.1
5-80
1.2 K
560
VERT. LINES
SW-1 REAR
SW-1 FRONT
1.8 K
4.7 K
.001
33PF
1.2 K
2.7 K
270PF
33PF
1.8 K
+18
31.5 KC
Q3
Q4
.0015
15K
3.9 K
5 K
4.7K
4500~
270PF
5K
390
15
Q-5
.01
10
900~
Q 6
68 K
.1
390
60~
15 K
Q-7
1.0
180
47K
3.9 K
10K
500K
1.2 K
Q-8
Q-9
.001
470 PF
VIDEO
POL.
LEVEL
1K
R.F.
.56 μh
GUN KILLER
R. B. G.
3 100K
G
R
B
5-80PF
47K
10 PF
33 PF
100 K
V-1A 12AU7
4.7K
2.2 K
33
1 K
COLOR LEVEL
Q-10
5K
6.8 K
390
Q-11
.005
560
47
10 K
15.75 KC.
Q-12
3.9K
1.2 K
10
D-6
D-7
5.6 K
.001
390
10 PF
10 K
+125
.001
3.3K
3.9K
5
1.2K
10PF
33
580
15K
120
1M.
.05
V-3 12AT7
V-1B 12AU7
47K
120
10
1M
1.8K
TO EMITTER
Q4 Q5 Q6 Q7
.005
SW-2 REAR
SW-2 FRONT
+125 V.
+18 V.
D-3
500
1.5K
40
D-4
20
+350V.
D8
T-1
.25
D-1
D-2
220K
330 K
500K
100K
INT.
500 K
FOCUS
2.2 M
H. CENT.
500K
V. CENT.
6.3 V.
4.7K
2.2 M
270
1.8K
3LTP1
V2
+350 V.
15 K
6
7
.05
8
6.8 K
2.2 M
1
2
3
V4
12AU7

WARRANTY

LECTROTECH, INC., warrants that each instrument manufactured by it shall be free from defects in material and workmanship under normal use and service.

LECTROTECH's obligation under this warranty shall be limited to the repair or replacement without charge, of any instrument which shall be returned to the factory or an authorized service station prepaid, within 1 year of its purchase new, from a franchised LECTROTECH distributor, and which in the opinion of LECTROTECH or its authorized service station is indeed defective.

This warranty is expressly in lieu of all other warranties expressed or implied and all other obligations or liabilities on LECTROTECH's part, and LECTROTECH neither assumes nor authorizes any other person to assume for it any other liability in connection with its products.

The warranty card supplied with each product must be filled out and mailed within five days of purchase to validate the above warranty.

LECTROTECH INC.

Engineers and Manufacturers of Electronic Products

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