OPERATOR'S MANUAL

SIMPSON COLORSCOPE MODEL 458

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SIMPSON ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44, Illinois, ES 9-1121
Long Distance Dial 312
In Canada, Bach-Simpson, Ltd., London Ontario

1-63-N-WP-Rev. 1

Printed in U.S.A.
1-115522

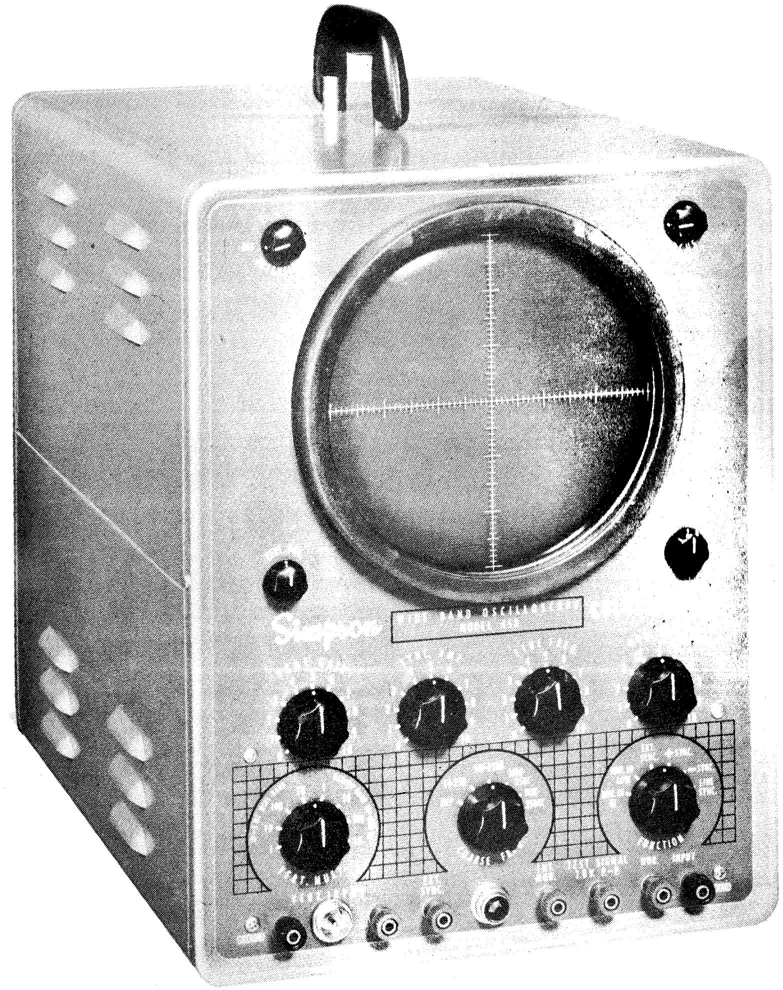


FIG. 1. SIMPSON COLORSCOPE, MODEL 458, FULL RESPONSE AT 5 MC, AND HIGH SENSITIVITY AT 300 KC PROVIDE COMPLETE FLEXIBILITY FOR TV SERVICE.

APPLICATIONS

The Simpson COLORSCOPE* Model 458 is a versatile 7-inch oscilloscope with 5 Mc/300kc bandwidth designed for *both* color and monochrome TV service.

The *adjustable bandwidth* and *sensitivity* permit an unusually wide range of applications in TV service, as well as in general-purpose electronic work. The Simpson COLORSCOPE Model 458 is also useful for *FM* and *AM radio service, for alignment, vibrator waveform tests, signal tracing, and power supply checks; in industrial electronic applications for maintenance and trouble-shooting of electronic welding controls, high speed measurements, phase determinations, watch timing, vibration and dynamic pressure analyses; in allied fields such as architecture for reverberation investigations and stress measurements; in high fidelity audio work, for distortion analysis, balance checks, and intermodulation tests; in the transmitting station for modulation measurements, impedance measurements, and signal monitoring.*

Schools find the Simpson COLORSCOPE Model 458 ideal for use in laboratories because of its moderate cost and high performance.

COLOR BURST

Good reproduction of synchronizing pulses with *accurate rendition of the color burst* is a prime consideration in choosing an oscilloscope for color-TV applications. Full response at burst frequency, with good phase response is assured by properly *compensated wide-band vertical amplifier stages.* Because high sensitivity is also required for signal-tracing procedures and for alignment of low-gain circuits such as are in front ends,

*Trade Mark

the Simpson COLORSCOPE Model 458 is provided with a *sensitivity-boost* switch, to increase the gain of the vertical amplifier by a factor of 3 at a bandwidth of 300 kc.

COMPENSATED STEP ATTENUATOR

The input signal to the COLORSCOPE Model 458 is first applied to a compensated step attenuator, which permits coarse control of the signal level without frequency or phase distortion. The step attenuator is of the decimal type, which facilitates measurement of *peak-to-peak* voltage values. A reference calibrating voltage of 1.0 peak-to-peak volts is available at a front panel terminal.

VERNIER VERTICAL ATTENUATOR

A vernier vertical attenuator is also provided for *continuous control* of the signal voltage; the vernier attenuator is designed as a cathode follower after the input preamplifier. The following two stages in the vertical channel are arranged as push-pull amplifiers, to provide phase inversion and *balanced deflection* to the cathode-ray tube. These latter stages are also arranged to provide a choice of wide-band operation at reduced gain, or high-sensitivity operation at reduced bandwidth. The sensitivity ratio is approximately 3 to 1 (40 to 15), with a maximum sensitivity of 15 mv per inch. The use of balanced deflection minimizes astigmatism with its accompanying defocussing at the edges of the screen, which occurs when single-ended deflection is utilized.

OFF-SCREEN VERTICAL DEFLECTION

When used in the high-sensitivity mode, the vertical amplifier provides off-screen vertical deflection; when used in the wide-

band mode, vertical deflection should be limited to an excursion of approximately four inches. The vertical-amplifier signal can be used to synchronize the horizontal sweep oscillator with either a *positive-going* or a *negative-going pulse,* which facilitates tight locking of patterns such as composite video waveforms. Alternatively, external synchronization can be utilized, or 60-cycle displays can be locked at power-line frequency by suitable setting of the sync-selector switch.

60 CYCLE SINE WAVE SWEEP TERMINALS

Terminals are provided for application of a 60-cycle sine-wave sweep from an external source, such as from a sweep generator.

MODULATING VOLTAGE TO CRT GRID

A terminal is also provided for application of a modulating voltage to the grid of the cathode-ray tube for intensity modulation of the scope beam. Direct access is not provided to the deflection plates, inasmuch as the response of the vertical amplifier makes such expedients unnecessary for any usual application of the instrument.

FOR BEGINNERS

Operating controls of the COLORSCOPE Model 458 are conventional, and are not described in detail, as these functions are extensively discussed in most oscilloscope textbooks. However, beginners sometimes become confused by overload situations caused by *misadjustment of the vertical step attenuator* with respect to the applied input signal.

Since the step attenuator drives the grid of the first vertical amplifier stage, while the vernier attenuator operates in the cathode-follower circuit following the first amplifier stage, it is apparent that overload of the first stage can be avoided only by reduction in the setting of the step attenuator, and not by reduction in the setting of the vernier attenuator.

OVERLOAD CAUSED BY IMPROPER ATTENUATOR SETTINGS

This is a source of confusion to the beginner, who may understandably assume that functions of the step and vernier attenuators are completely equivalent. A good operating rule is to work the step attenuator at the lowest position, and the vernier attenuator at the highest position to properly accommodate the input signal voltage.

SYNC SELECTOR POLARITY

When a composite video signal is being viewed, the sync pulses may extend in either a positive or a negative direction. The setting of the *sync-selector switch* should correspond to the polarity of the pulses, to obtain most satisfactory sync lock. The composite video signal can usually be locked to the best advantage by using the EXT SYNC function of the instrument, and placing a wire from the EXT SYNC post into the field of the deflection yoke or the field of the picture-tube screen.

ACCESSORY PROBES

Accessory probes, such as low-capacitance, demodulator, and capacitance-divider probes, may be used to extend the operating range of the instrument. In general, the operator should endeavor

to make tests across a low-impedance circuit point. A *shielded input cable* can be connected at a *low-impedance point* in the circuit under test, without disturbing the circuit operation as a result of the capacitance of the shielded cable. *Open test leads* can also be used satisfactorily across *low-impedance circuit points,* since stray fields which may be picked up by the open leads produce a very small voltage drop across the low impedance.

TESTS AT HIGH IMPEDANCE POINTS

On the other hand, if a test must be made at a *high-impedance point* in a circuit, it becomes necessary to use a shielded cable to the scope to avoid excessive *pick-up of stray fields,* and a *low-capacitance probe* must be used with the input cable to minimize the amount of capacitance which is shunted across the high-impedance point. Other operating precautions are noted in the application section.

OVERLOAD PRECAUTION

When the band switch of the Simpson COLORSCOPE is set to the 5.0-Mc position, the vertical deflection should be limited to an excursion of approximately four inches. Otherwise, limiting and distortion of the peaks of the waveform may be encountered.

PROBE KIT - Model 739

For use with Model 458 Oscilloscope, includes low capacity probe, voltage doubler, detector, 100:1 voltage divider and dual direct-resistive. (Isolation) Complete with 4 probes, plastic roll, and operator's manual.

BURST DISPLAYS

The Simpson COLORSCOPE Model 458 has full gain at 3.58 Mc for proper display of the *color subcarrier burst* on the back porch of the horizontal sync pulse. Fig. 2 illustrates typical burst displays as observed in practical test work. The burst is first encountered in demodulated form at the output of the picture detector, as a component of the composite video signal. The

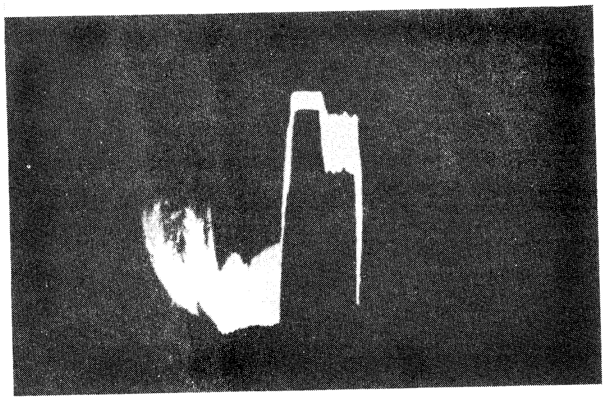


FIG. 2A. THE COLOR-SUBCARRIER BURST APPEARS FUZZY WHEN THE SIGNAL IS OBTAINED FROM A RECEIVER CIRCUIT, INSTEAD OF FROM A SYNC GENERATOR. THIS IS CAUSED BY THE NOISE VOLTAGES AND CROSS-BEATS WITH THE SOUND SIGNAL. INDIVIDUAL CYCLES OF THE BURST ARE INDISTINGUISHABLE UNDER MOST CONDITIONS.

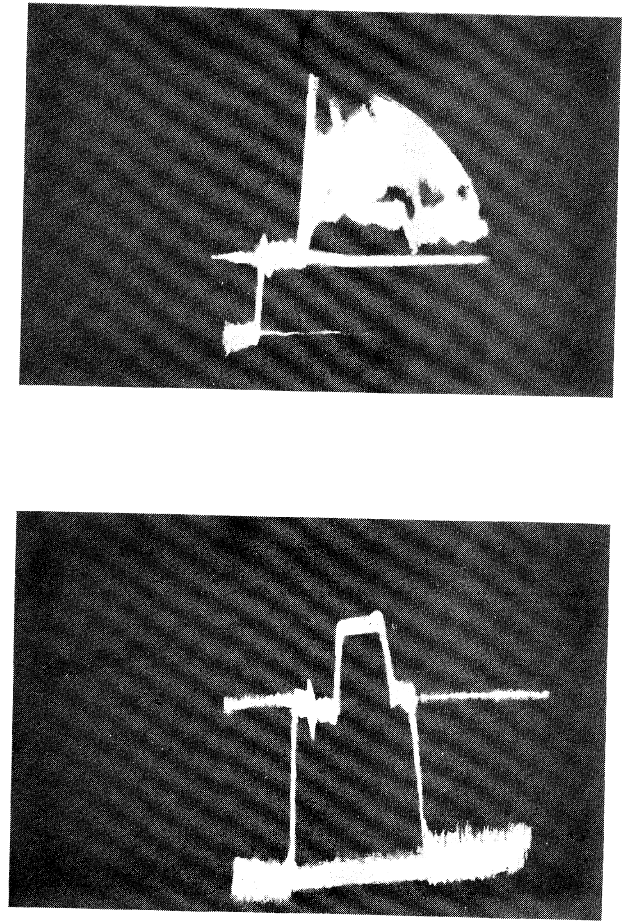


FIG. 2B. TWO DISPLAYS WHICH MAY BE CONFUSED WITH BURST; (ABOVE) 920-CPS BEAT BETWEEN SOUND CARRIER AND COLOR SUBCARRIER; (BELOW) TRANSIENT ON BACK PORCH OF HORIZONTAL SYNC PULSE DURING MONOCHROME TRANSMISSION AT COLOR-TV STATION.

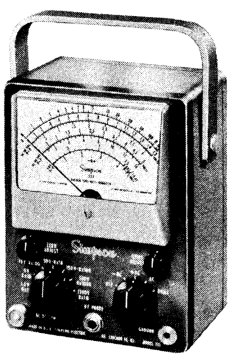
burst voltage can be *traced step-by-step* from this point through the color-sync circuits, for purposes of troubleshooting. The peak-to-peak voltage of the burst at the picture detector is typically 0.5 volt.

PEAK-TO-PEAK VOLTAGE MEASUREMENTS

Measurement of the peak-to-peak voltage value of the composite video signal, or of any of its component voltages can be rapidly accomplished by calibrating the vertical amplifier of the instrument with the calibration voltage source which is provided. Alternatively, the *Simpson Model 311* can be used for direct comparison and measurement of a wide range of peak-to-peak voltage values. Fig. 3 shows the external appearance of the Model 311.

MODEL 311 - AC/DC VTVM

Model 311 is the most advanced vacuum tube volt-ohm-meter in its field which features: High DC input impedance (22.0 megohm). This reduces circuit loading and permits measurements in high impedance circuits. Direct readout of RMS and peak to peak values. Excellent accuracy for low DC voltage measurements in transistorized circuitry.



VOLTAGE RANGES - SIZE: 7½" X 5-5/8" X 5½" NET WEIGHT: 5 LBS. DC: 0-1V;5V;15V;50V; 150V; 1500V; (22 MEG. Ω INPUT IMPEDANCE). PP: 0-4V; 14V; 140V; 400V; 1400V; 4000V MIN. 2.2 MEGΩ INPUT IMPEDANCE AF: 0-1.5; 5V; 15V; 150V; 500V; 1500V. (30 CYCLES TO 100KC ±5%). RF: 1.5V; 5V; 15V; 50V; 150V; WITH PROBE (50 CYCLES TO 100 MC 0-150 VRMS)

FIG. 3. EXTERNAL VIEW OF SIMPSON OSCILLOSCOPE CALIBRATOR. MODEL 276

RESISTANCE RANGES - 1KΩ (10Ω center); 10KΩ (100Ω center); 100KΩ (1KΩ center); 1 megΩ (10KΩ center); 10 megΩ 100KΩ center); 100 megΩ (1 megΩ center); 1000 megΩ (10 megΩ center).

FREQUENCY RESPONSE - ±5% to 100 kc (with RF probe, usable to 250 mc).

LINE VOLTAGE - 105/125 v, 50/60 cycles.

ACCURACIES
DC VOLTS: ±3% of full scale. AC VOLTS: ±5% of full scale.
DC RESISTANCE: ±3% of arc length (resistance).

readily determined by measurement with an accurate VTVM as such

readily determined by *measurement with an accurate VTVM* as such as the *Simpson Model 303, and Simpson Model 311. (See Figures 3 and 4C).*

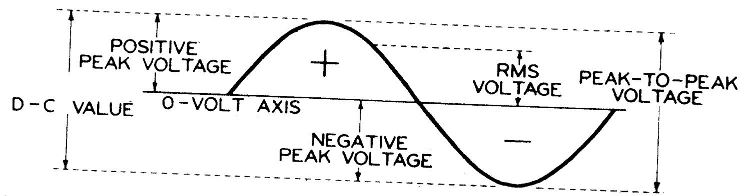


FIG. 4A. A SINE WAVE, WITH IMPORTANT COMPONENT VALUES INDICATED. THE PEAK-TO-PEAK VOLTAGE IS EQUAL TO THE COMPLETE EXCURSION FROM THE POSITIVE PEAK TO THE NEGATIVE PEAK.

THE POSITIVE-PEAK VOLTAGE IS EQUAL TO THE NEGATIVE-PEAK VOLTAGE, AND EITHER PEAK VOLTAGE IS EQUAL TO ONE-HALF OF THE PEAK-TO-PEAK VOLTAGE. THE RMS VOLTAGE IS EQUAL TO 0.707 OF THE PEAK VOLTAGE, OR. THE RMS VOLTAGE IS EQUAL TO 0.354 OF THE PEAK-TO-PEAK VOLTAGE. THE AVERAGE VALUE OF THE WAVEFORM IS ZERO. THE PEAK-TO-PEAK VOLTAGE IS EQUAL TO 2.83 TIMES THE RMS VOLTAGE.

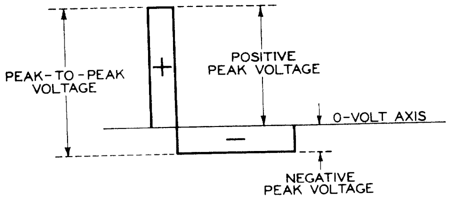
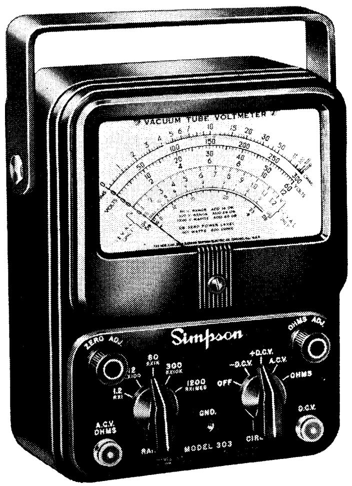


FIG. 4B. A PULSE WAVEFORM WITH IMPORTANT COMPONENT VALUES INDICATED. NOTE THAT THE POSITIVE-PEAK VOLTAGE IS NOT EQUAL TO THE NEGATIVE-PEAK VOLTAGE. HOWEVER, THE POSITIVE AREA OF THE WAVEFORM IS EQUAL TO ITS NEGATIVE AREA. THE SUM OF THE POSITIVE-PEAK AND NEGATIVE-PEAK VOLTAGES IS EQUAL TO THE PEAK-TO-PEAK VOLTAGE. SUCH A NON-SINUSOIDAL WAVEFORM HAS AN AVERAGE VALUE OF ZERO.



USE IT AS AN ELECTRONIC DC VOLTMETER, OHMMETER, AC OR AF VOLTMETER, RF VOLTMETER (WITH ACCESSORY PROBE), OUTPUT METER, AND FOR OTHER APPLICATIONS.

RANGES:

DC VOLTS:	1.2-12-60-300-1200
AC VOLTS:	1.2-12-60-300-1200
AF VOLTS:	1.2-12-60
RESISTANCE:	0 TO 1000 MEGOHMS IN 5 RANGES
DECIBELS:	−20 TO +63 DB IN 5 RANGES
RF VOLTS:	20 VOLTS MAXIMUM
FREQUENCY RESPONSE:	FLAT 20 KC TO 100 MC

FIG. 4C. SIMPSON VACUUM TUBE VOLTMETER MODEL 303

FIGURE 4 RELATIONSHIPS

The basic relations between d-c, peak-to-peak, rms, and average voltages are shown in Fig. 4. It should be noted that *peak-to-peak values correspond to d-c values;* e.g., if 3 volts d-c is applied across the vertical-input terminals of the scope, the beam will undergo a transient deflection of 3 peak-to-peak volts. It should be noted also that the *rms values of a-c voltage indicated by service voltmeters apply only to sine waves;* non-sinusoidal waveforms can be practically specified only in terms of peak-to-peak voltage values. Although a non-sinusoidal wave-form will have some corresponding value of rms voltage, this rms value is is difficult to determine, and is of no practical importance in service work. Since a sine-wave voltage can be readily specified in terms of either rms voltage or peak-to-peak voltage, *the sine waveform provides the most convenient transition* from rms values indicated by a voltmeter to the peak-to-peak values utilized in scope voltage measurements.

ZERO VOLT AXIS

Note that the zero-volt axis shown in Figs. 4A and 4B represents the a-c zero-voltage level, and *is identified as the resting position of the scope trace* when no input signal is applied. Since the COLORSCOPE Model 458 is an a-c scope, the d-c volts zero level does not appear on the scope screen, but can be readily determined by *measurement with an accurate VTVM* as such as the the *Simpson Model 303, and Simpson Model 311. (See Figure 3 and 4C).*

The Simpson COLORSCOPE Model 458 is also useful to check the operation of the I and Q or R-Y and B-Y synchronous detectors, and the operation of the matrices. For these checks, it is most convenient to utilize a *COLOR-BAR GENERATOR* which provides the NTSC color-difference signals: ±I, ±Q, ±(R-Y), and ±(B-Y), and ±(G-Y). Fig. 5 shows a typical spectrum of *color-difference signals,* and the resulting scope patterns which are obtained when the circuits indicated are in proper operating condition. The significant points in the patterns are the *nulls:* i.e., ±I must null through the Q channel, ±Q must null through the I channel; ±(R-Y) must null at the output of the blue video amplifier and at the output of the green video amplifier; ±(G-Y) must null at the output of the red video amplifier and at the output of the blue video amplifier; ±(B-Y) must null at the output of the red video amplifier and at the output of the green video amplifier.

DISPLAY OF CHROMINANCE RESPONSE CURVES

When chrominance frequency-response curves, such as shown in Fig. 6, are to be displayed on the scope screen, it is preferable to use the 300-kc position of the band switch. Although the bandwidth of the response curve shown in Fig. 6 is from 2.1 to 4.2 Mc, it does not follow that the COLORSCOPE is called upon to accommodate this range of frequencies in order to display the curve. Note that the curve has been demodulated by means of a demodulator probe. After demodulation, the envelope frequencies only are applied to the scope; these frequencies are relatively low in value, and correspond in a general way to the frequencies contained in a 60-cycle square wave. The *demodulator probe* which is used in this test should have the characteristics of the SIMPSON MODEL 740A PEAK-TO-PEAK HIGH-FREQUENCY PROBE.

DISPLAY OF R-F AND I-F RESPONSE CURVES

The Simpson COLORSCOPE Model 458 is used in the conventional manner to display r-f and i-f response curves. In these applications, it is preferable to use the 300-kc position of the band switch. To obtain a *sharp and definite marker indication,*

as shown in Fig. 8, it is often necessary to use a 50,000-ohm filtering resistor between the scope and the signal take-off point in the receiver. This arrangement of series resistance working into the shunt capacitance of the shielded input cable provides a *low-pass filter action* which attenuates the higher beat frequencies and sharpens the marker indication. The Simpson Model 743A Probe is useful for this application.

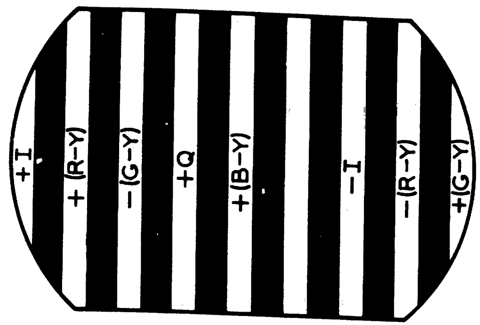


FIG. 5A. A TYPICAL COLOR-DIFFERENCE SPECTRUM FROM A COLOR-BAR GENERATOR. ON THE SCREEN OF THE PICTURE TUBE, THESE COLOR-DIFFERENCE BARS APPEAR AS FOLLOWS: +I, ORANGE; +(R-Y), BRIGHT RED; -(G-Y), MAGENTA; +Q, REDDISH BLUE; +(B-Y), BLUE; -I, CYAN; -(R-Y), BLUISH GREEN; +(G-Y), GREEN.

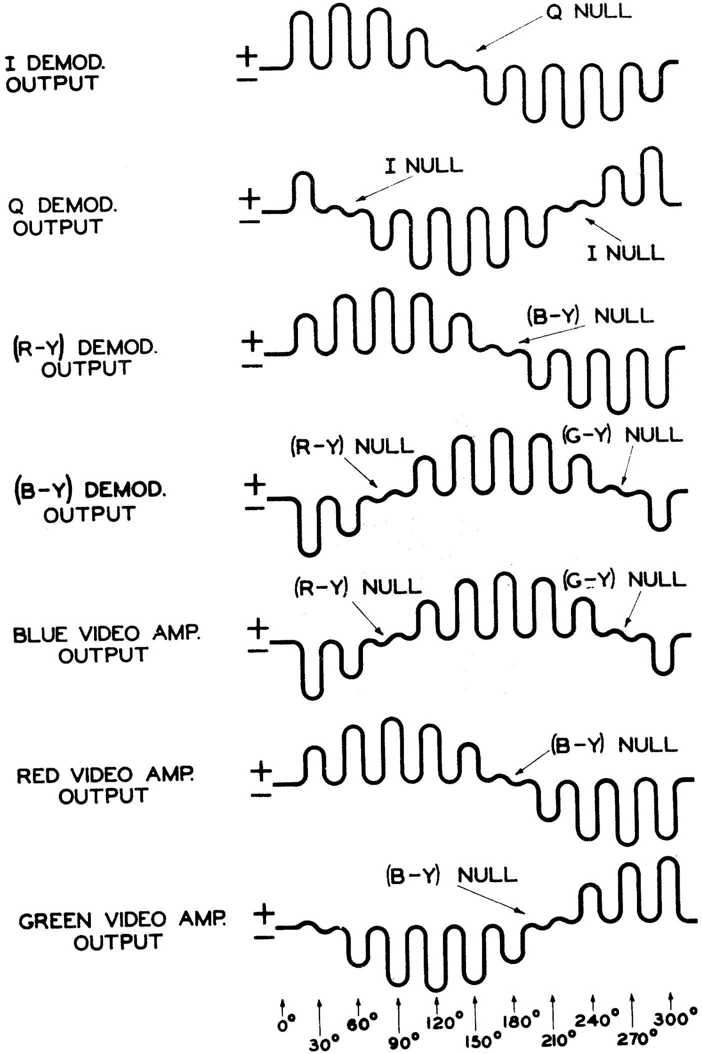


FIG. 5B. HOW COLOR-DIFFERENCE BAR SIGNALS APPEAR ON SCOPE SCREEN, AND NULL WHEN CIRCUITS ARE OPERATING PROPERLY.

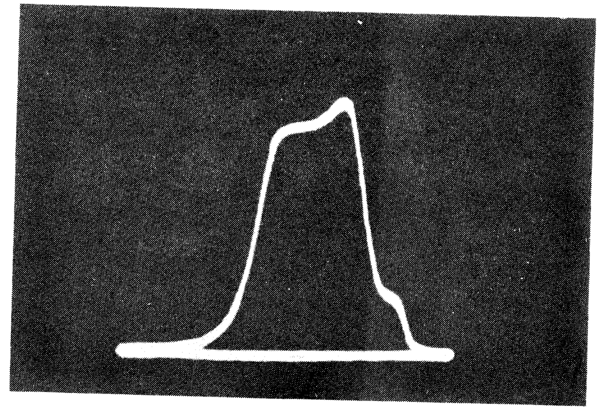


FIG. 6. TYPICAL RESPONSE OF THE FIRST CHROMA AMPLIFIER. THIS AMPLIFIER DIFFERS FROM A MONOCHROME VIDEO AMPLIFIER IN THAT THE RESPONSE IS OF THE BANDPASS TYPE, RATHER THAN OF THE LOW-PASS TYPE. THE PASS BAND EXTENDS FROM 2.1 TO 4.2 MC, IN ORDER TO FILTER OUT A MAXIMUM OF MONOCHROME INFORMATION AND TO PASS A MAXIMUM OF CHROMA INFORMATION TO THE I AND Q DEMODULATORS.

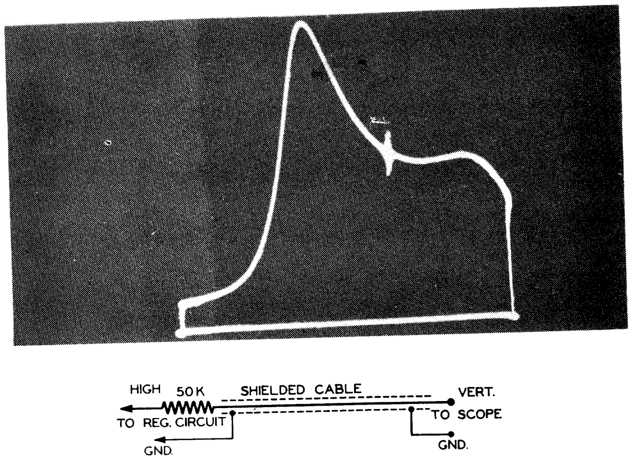


FIG. 8. (ABOVE) SHARP AND DEFINITE MARKER INDICATION OBTAINED WHEN MARKER IS PROPERLY FILTERED. (BELOW) SERIES RESISTOR WORKING INTO SHIELDED CABLE PROVIDES DESIRED MARKER FILTERING.

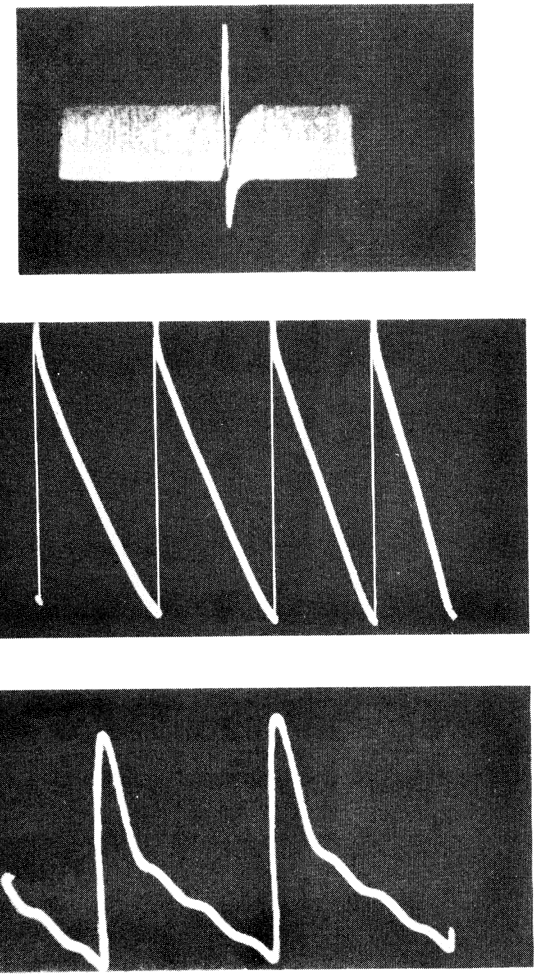


FIG. 9. TYPICAL WAVEFORMS ENCOUNTERED DURING THE COURSE OF TROUBLESHOOTING THE SYNC AND SWEEP CIRCUITS. WAVEFORM SHAPES ARE COMPARED WITH THE SPECIFIED WAVESHAPES IN THE RECEIVER SERVICE MANUAL, AND THE PEAK-TO-PEAK VOLTAGES OF THE WAVEFORMS ARE MEASURED.

TROUBLESHOOTING SYNC AND SWEEP CIRCUITS

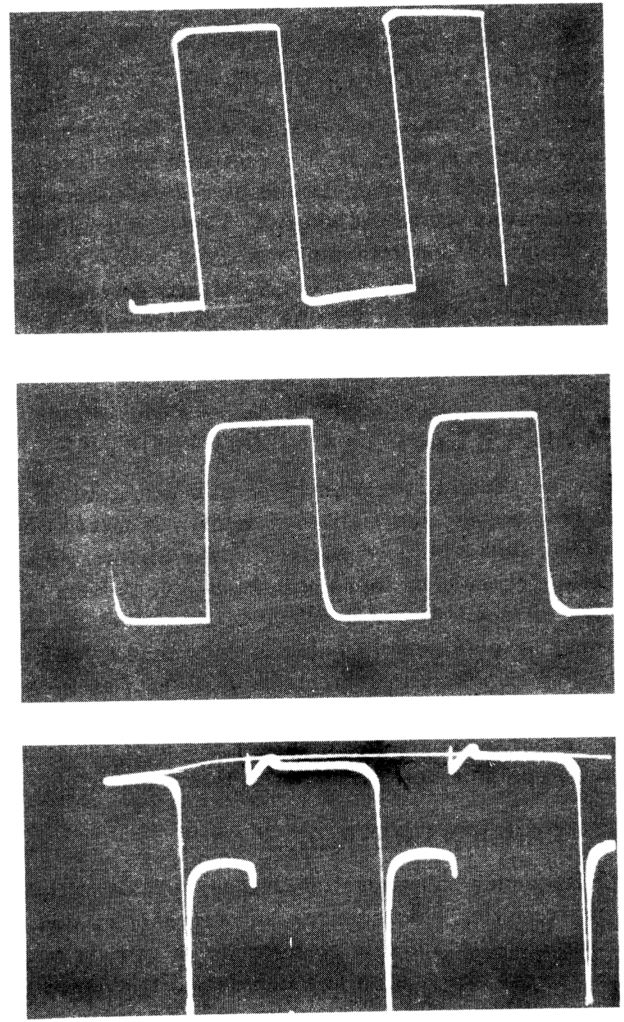
Troubleshooting of sync and sweep circuits is facilitated by the COLORSCOPE because of its wide-band characteristics, which permit reproduction of waveforms such as illustrated in Fig. 9 with negligible distortion. The peak-to-peak voltages of any waveforms can be readily measured, as has been discussed above.

TO IDENTIFY PROPER WAVE SHAPE

Patterns are checked for *proper wave shape;* i.e., the wave shape observed on the scope screen is compared with the wave shape specified in the receiver service manual. *Peak-to-peak voltages* measured on the scope are likewise compared with specified values. In general, trouble is indicated in a sync or sweep circuit when the waveform voltage departs by more than 20% from the specified value. Of course, waveform voltage measurements must be made with rated line voltage (117 volts) applied to the receiver.

SQUARE-WAVE CHECKS OF VIDEO CIRCUITS

It is generally recognized that the ability of a receiver to reproduce a high-quality image depends, not only upon the uniformity of frequency response, but also upon the *transient response* of the receiver. The transient response of a circuit is usually checked by means of a *square-wave test.* Typical square-wave responses are shown in Fig. 10.



A

B

C

FIG. 10. SQUARE-WAVE RESPONSES. (A) SLIGHT TILT IN REPRODUCED SQUARE WAVE; (B) DIAGONAL CORNER ROUNDING; (C) ASYMMETRICAL OVERSHOOT.

WHY SQUARE-WAVE CHECKS ARE NECESSARY

Since there is a definite relation between frequency response and square-wave response, it is sometimes asked why square-wave checks should be made in addition to frequency-response tests. The reasons are as follows: (1) The relationship between frequency response and transient response is *not simple,* even for a single video stage. (2) Practical receiver arrangements utilize cascaded stages, in which it is almost *impossible to predict* the transient response with accuracy, upon the basis of the frequency responses of the individual stages.

CHROMA AMPLIFIER FOR A RISING RESPONSE

To provide an illustrative example of this situation, it may be observed that the r-f and i-f response of a receiver often has less response than would be desired at the high-frequency end. Manufacturing economies frequently impose less than the optimum number of tuned stages, so that the ideal over-all response curve cannot be obtained. In order to compensate for this deficiency insofar as possible, the chroma amplifier may be adjusted for a *rising response* at the high-frequency end. Insofar as frequency response alone is concerned, the signal circuits may be adjusted to provide uniform output in this manner.

RINGING TRANSIENT RESPONSE

However, frequency compensation brings with it a non-linear phase characteristic, which causes an *overshooting and ringing* transient response. A suitable compromise is usually necessary between frequency attenuation and transient distortion. For such tests, square-wave modulation provides definitive test results.

PHASE MEASUREMENTS BETWEEN TWO SIGNAL VOLTAGES

Although a square-wave test usually provides the quickest information concerning the phase characteristic of a circuit, it is sometimes desired to *measure exactly* the phase-angle difference between two signal voltages. For example, the high-fidelity audio worker may wish to measure the phase shift through a feedback loop. In such case, the input from the loop can be applied to the horizontal amplifier of the COLORSCOPE, and the output from the loop can be applied to the vertical amplifier.

SPECIAL SCOPE DISPLAYS

An elliptical pattern then appears on the scope screen, as shown in Fig. 11, and the deflection A divided by the deflection B gives the sine of the phase angle. Or, the phase angle is given by the inverse sine of A/B. Fig. 12 shows special displays of general interest.

ANTENNA AND FRONT-END IMPEDANCE MEASUREMENTS

Conditions of impedance match or mismatch, and measurement of the standing-wave ratio on a lead-in can be readily determined by means of the COLORSCOPE and sweep generator; tests can be made of antenna impedance, front-end impedance, interference-filter characteristics, etc. Because of space limitations, interested readers are referred to "TV TROUBLESHOOTING & REPAIR GUIDEBOOK," VOL. II, published by John F. Rider.

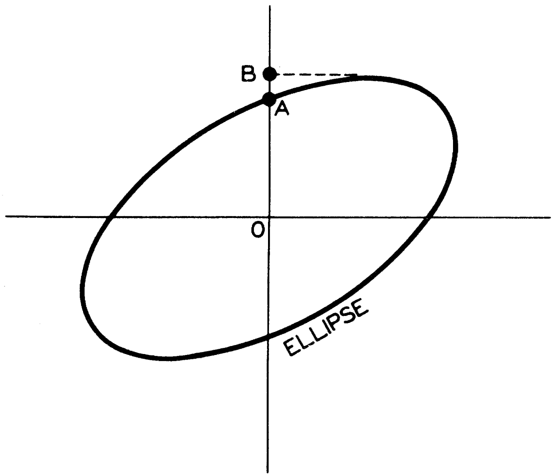
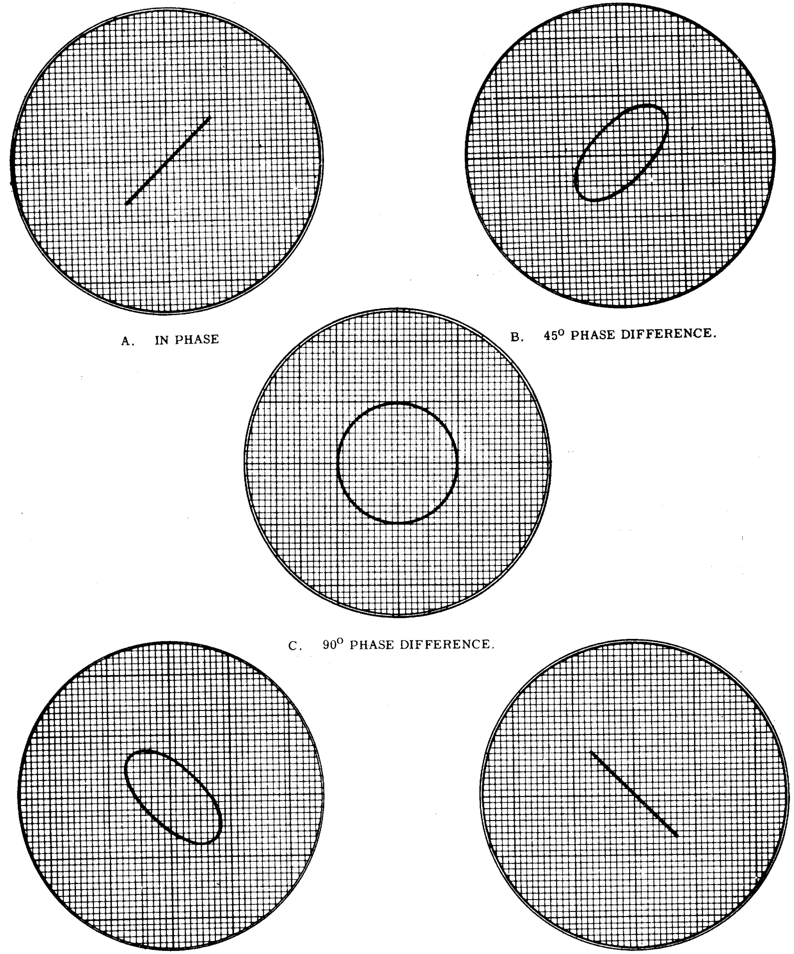


FIG. 11. WHEN ONE SINE-WAVE SIGNAL IS APPLIED TO THE VERTICAL AMPLIFIER OF THE SCOPE, AND ANOTHER SINE-WAVE SIGNAL IS APPLIED TO THE HORIZONTAL AMPLIFIER OF THE SCOPE, AN ELLIPTICAL PATTERN APPEARS ON THE SCOPE SCREEN. THE PHASE ANGLE BETWEEN THE TWO VOLTAGES IS EQUAL TO SIN^{-1} A/B, WHERE A IS THE DISTANCE OA AND B IS THE DISTANCE OB. THE MEASUREMENT IS INDEPENDENT OF THE SIGNAL VOLTAGES AND OF THE AMPLIFIER GAINS.



A. IN PHASE

B. 45° PHASE DIFFERENCE.

C. 90° PHASE DIFFERENCE.

D. 135° PHASE DIFFERENCE.

E. 180° PHASE DIFFERENCE.

FIG. 12. LISSAJOU FIGURES SHOWING PHASE RELATIONS.

INDUSTRIAL ELECTRONIC APPLICATIONS

Applications of the COLORSCOPE in industrial electronics includes hydraulic tests, vibration and pressure tests, engine analysis, ignition checks, combustion analysis, watch timing, power-line fault location, dynamic balance tests, relay transit time measurements, high-speed (bullet, etc.) measurements, lens testing, acoustic determinations, checking of electronic control devices, testing of camera-shutter operation and photo-flash equipment, production quality of razor blades, soft drinks, and sheet thickness, measurements of torque, strain, vapor pressure, humidity, etc., etc.

FOR FURTHER DATA

For further treatment of such applications, the reader is referred to "ENCYCLOPEDIA OF CATHODE-RAY OSCILLOSCOPES AND THEIR USES," by John F. Rider, and to the extended bibliographical references which are noted.

APPLICATIONS IN THE TRANSMITTING STATION

The numerous applications of oscilloscopes in transmitting stations are discussed on the amateur level in the "ARRL HANDBOOK," published by the American Radio Relay League, and on the engineering level in the oscilloscope encyclopedia noted above.

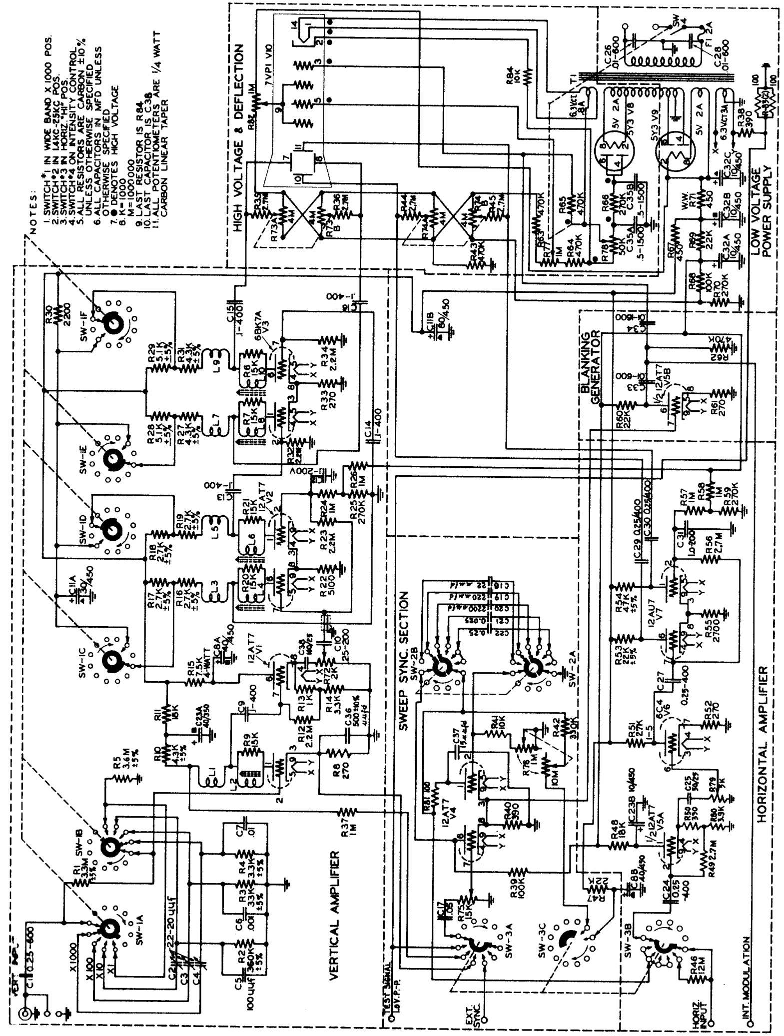


FIG. 13. SIMPSON COLORSCOPE MODEL 458, SCHEMATIC DIAGRAM

TABLE OF COMPONENT PARTS

SYMBOL NO.	DESCRIPTION	SIMPSON PART NO.
C1	Capacitor, 0.25 μf, 600 v	1-112920
C2	Capacitor, trimmer	1-115573
C3	Capacitor, trimmer	1-115573
C4	Capacitor, trimmer	1-115573
C5	Capacitor, 100 μμf, 500 v, ceramic	1-113912
C6	Capacitor, 1000 μμf, 500 v, ceramic	1-115462
C7	Capacitor, 0.01 μf, 500 v, disk	1-115385
C8a,b	Capacitor, 40-40 μf, 450 v, electrolytic	1-115725
C9	Capacitor, 0.1 μf, 400 v	1-113901
C10	Capacitor, 0.25 μf, 200 v	1-114718
C11a,b	Capacitor, 80-30 μf, 450 v, electrolytic	1-115508
C12	Capacitor, 0.1 μf, 200 v	1-114400
C13	Capacitor, 0.1 μf, 400 v	1-113901
C14	Capacitor, 0.1 μf, 400 v	1-113901
C15	Capacitor, 0.1 μf, 400 v	1-113901
C16	Capacitor, 0.1 μf, 400 v	1-113901
C17	Capacitor, 0.05 μf, 400 v	1-112969
C18	Capacitor, 22 μμf, 500 v, ceramic	1-115503
C19	Capacitor, 220 μμf, 500 v, ceramic	1-113854
C20	Capacitor, 2200 μμf, 500 v, ceramic	1-115502
C21	Capacitor,0.025 μf, 400 v	1-116069
C22	Capacitor, 0.25 μf, 200 v	1-114718
C23a,b	Capacitor, 10 μf @ 450 v, 40 μf @ 350 v, electrolytic	1-113963
C24	Capacitor, .25 mfd - 400 v	1-113901
C25	Capacitor, 50 μf, 25 v, electrolytic	1-116001
C26	Capacitor, 0.01 μf, 600 v	1-115504
C27	Capacitor, .25 μf, 400 v	1-113901
C28	Capacitor, 0.01 μf, 600 v	1-115504
C29	Capacitor, .25 μf, 400 v	1-113901

C30	Capacitor, .25 μf, 400 v	1-113901
C31	Capacitor, 1.0 μf, 200 v, electrolytic	1-116990
C32a,b,c	Capacitor, 10-10-10 μf, 450 v, electrolytic	1-113962
C33	Capacitor, 0.01 μf, 600 v	1-115504
C34	Capacitor, 0.01 μf, 1600 v	1-115505
C35	Capacitor, 0.5-0.5 μf, 1500 v, oil filled	1-115500
C36	Capacitor, 500 μμf, 500 v, ceramic	1-115945
C37	Capacitor, 15 μμf, 500 v, ceramic	1-115464
C38	Capacitor, 100 μf, 25 v, electrolytic	1-115507
R1	Resistor, 3.3 M ±5%, ½ w	1-115947
R2	Resistor, 360 K ±5%, ½ w	1-115950
R3	Resistor, 33 K ±5%, ½ w	1-115949
R4	Resistor, 3.3 K ±5%, ½ w	1-115948
R5	Resistor, 3.6 M ±5%, ½ w	1-115951
R6	Resistor, 15 K ±10%, ½ w	1-111678
R7	Resistor, 15 K ±10%, ½ w	1-111678
R8	Resistor, 270 ohms ±10%, ½ w	1-115386
R9	Resistor, 15 K ±10%, ½ w	1-111678
R10	Resistor, 4.3 K ±5%, 1 w	1-115753
R11	Resistor, 18 K ±10%, 1 w	1-115491
R12	Resistor, 2.2 M ±10%, ½ w	1-114683
R13	Resistor, 1 K ±10%, ½ w	1-111689
R14	Resistor, 3.3 K ±10%, ½ w	1-114225
R15	Resistor, 7.5 K ±10%, 7 w	1-115582
R16	Resistor, 2.7 K ±5%, 1 w	1-115805
R17	Resistor, 2.7 K ±5%, 1 w	1-115805
R18	Resistor, 2.7 K ±5%, 1 w	1-115805
R19	Resistor, 2.7 K ±5%, 1 w	1-115805
R20	Resistor, 15 K ±10%, ½ w	1-111678
R21	Resistor, 15 K ±10%, ½ w	1-111678
R22	Resistor, 5.1 K ±5%, 1 w	1-115495
R23	Resistor, 2.2 M ±10%, ½ w	1-114683
R24	Resistor, 1 M ±10%, ½ w	1-113952
R25	Resistor, 270 K ±10%, ½ w	1-115497
R26	Resistor, 1 M ±10%, ½ w	1-113952

TABLE OF COMPONENT PARTS

R27	Resistor, 4.3 K ±5%, 1 w	1-115753
R28	Resistor, 5.1 K ±5%, 1 w	1-115495
R29	Resistor, 5.1 K ±5%, 1 w	1-115495
R30	Resistor, 2.2 K ±10%, 1 w	1-113930
R31	Resistor, 4.3 K ±5%, 1 w	1-115753
R32	Resistor, 2.2 M ±10%, ½ w	1-114683
R33	Resistor, 270 ohms ±10%, ½ w	1-115386
R34	Resistor, 2.2 M ±10%, ½ w	1-114683
R35	Resistor, 2.7 M ±10%, ½ w	1-114779
R36	Resistor, 2.7 M ±10%, ½ w	1-114779
R37	Resistor, 1 M ±10%, ½ w	1-113952
R38	Resistor, 390 ohms ±10%, ½ w	1-115946
R39	Resistor, 100 K ±10%, ½ w	1-113949
R40	Resistor, 390 ohms ±10%, ½ w	1-115946
R41	Resistor, 10 K ±10%, ½ w	1-111671
R42	Resistor, 330 K ±10%, ½ w	1-113950
R43	Resistor, 470 K ±10%, 1 w	1-115492
R44	Resistor, 2.7 M ±10%, ½ w	1-114779
R45	Resistor, 2.7 M ±10%, ½ w	1-114779
R46	Resistor, 12 M ±10%, ½ w	1-113953
R47	Resistor, 22 K ±10%, 1 w	1-114347
R48	Resistor, 18 K ±10%, ½ w	1-113943
R49	Resistor, 2.7 M ±10%, ½ w	1-114779
R50	Resistor, 330 ohms ±10%, ½ w	1-115960
R51	Resistor, 27 K ±10%, 2 w	1-115957
R52	Resistor, 270 ohms ±10%, ½ w	1-115386
R53	Resistor, 22 K ±5%, 1 w	1-115959
R54	Resistor, 47 K ±5%, 1 w	1-115958
R55	Resistor, 2.7 K ±10%, ½ w	1-113942
R56	Resistor, 2.7 M ±10%, ½ w	1-114779
R57	Resistor, 1 M ±10%, ½ w	1-113952
R58	Resistor, 1 M ±10%, ½ w	1-113952
R59	Resistor, 270 K ±10%, ½ w	1-115497
R60	Resistor, 22 K ±10%, 1 w	1-114347
R61	Resistor, 270 ohms ±10%, ½ w	1-115386
R62	Resistor, 470 K ±10%, ½ w	1-114227

TABLE OF COMPONENT PARTS

R63	Resistor, 470 K ±10%, 1 w	1-115492
R64	Resistor, 470 K ±10%, 1 w	1-115492
R65	Resistor, 470 K ±10%, ½ w	1-114227
R66	Resistor, 270 K ±10%, 1 w	1-115726
R67	Resistor, 450 ohms ±10%, 7 w	1-115489
R68	Resistor, 100 K ±10%, ½ w	1-113949
R69	Resistor, 22 K ±10%, 2 w	1-115956
R70	Resistor, 270 K ±10%, ½ w	1-115497
R71	Resistor, 450 ohms ±10%, 7 w	1-115489
R72	Potentiometer, 2 K ±20%, ¼ w, Vertical Gain Control	1-115723
R73	Potentiometer, dual 4 M-4 M ±20%, Vertical Position Control	1-115486
R74	Potentiometer, dual 4 M-4 M ±20%, Horizontal Position Control	1-115486
R75	Potentiometer, 15 K ±20%, ½ w, Synchronous Amplifier Control	1-116800
R76	Potentiometer, dual 1 M-10 M ±30%, Fine Frequency Control	1-115485
R77	Potentiometer, 1 M ±20%, ¼ w, Focus Control	1-115473
R78	Potentiometer, 50 K ±20%, ¼ w, Intensity Control	1-115487
R79	Potentiometer, 5 K ±20%, ¼ w, Horizontal Gain Control	1-115484
R80	Resistor, 3.8K ±10%, ½ w	1-113045
R81	Resistor, 100 ohms ±10%, ½ w	1-115348
R82	Potentiometer, 1 M ±20%, ½ w, Astigmatism Control	1-115473
R83	Resistor, 100 (2 Req.) ±10%, ½ w	1-111940
R84	Resistor, 10 K, ±10%, ½ w	1-111671
SW1	Switch, VERTICAL MULTIPLIER	1-115510
SW2	Switch, COARSE FREQ	1-115512
SW3	Switch, HORIZONTAL FUNCTION	1-115511
SW4	Switch (Part of R78)	
V1	Tube, 12AT7	1-115466
V2	Tube, 12AT7	1-115466

V3	Tube, 6BK7A	1-115728
V4	Tube, 12AT7	1-115466
V5	Tube, 12AT7	1-115466
V6	Tube, 6C4	1-113975
V7	Tube, 12AU7	1-114083
V8	Tube, 5Y3	1-114671
V9	Tube, 5Y3	1-114671
V10	Cathode Ray Tube, 7VP1 or 7JP1	1-115518
PL1	Pilot lamp, #47	1-113747
L1	Peaking coil, fixed	1-115378
L2	Peaking coil, variable	1-115379
L3	Peaking coil, fixed	1-115378
L4	Peaking coil, variable	1-115379
L5	Peaking coil, fixed	1-115378
L6	Peaking coil, variable	1-115379
L7	Peaking coil, fixed	1-115378
L8	Peaking coil, variable	1-115379
L9	Peaking coil, fixed	1-115378
L10	Peaking coil, variable	1-115379
	Transformer, power	1-116008
	Bezel, Cathode Ray Tube	1-115636
	Fuse, 2 amp 3AG	1-112911
	Knob, 1¼"	1-115548
	Knob, ¾"	1-115648
	Graticule	1-115743
	Graticule Retaining Ring	1-115637
	Connecting Cable	10-830074

ASTIGMATISM CONTROL

The astigmatism control helps to maintain an equal illumination at all points on the face of the cathode ray tube. To adjust it, connect a wire from the CALIBRATED PEAK-TO-PEAK terminal, on the front panel, to the vertical input. Set the vertical multiplier at X10. Adjust the vertical gain control and the horizontal gain control for a good sine wave with approximately four inches deflection. Set intensity and focus controls for the clearest trace. Then adjust the astigmatism control for sharpest trace over the entire pattern.

VERTICAL MULTIPLIER (STEP ATTENUATOR)

There are three adjustable trimmer capacitors which are used in conjunction with the vertical multiplier switch circuit. They are capacitors C2, C3, and C4. They are located inside the oscilloscope on the left hand side of the chassis mounting bracket, and are immediately behind the front panel. Fig. 14 shows that the top control is C2; the center is C3; and the lower one is C4. Capacitor C2 corrects the frequency response of the vertical amplifier when the vertical multiplier is in its X10 position. Capacitor C3 is for the X100 position, and C4 is for the X1000 position.

To adjust these trimmers, connect the output of a square wave generator, set at 1000 cycles, to the vertical input of the oscilloscope. With the vertical multiplier set at its X10 position, adjust the output from the square wave generator and the vertical gain in the oscilloscope for a satisfactory 4-inch pattern. Then adjust capacitor C2 for the best *flat top* trace, such as shown in Fig. 15. Repeat this procedure for the X100 position (adjusting C3) and for the X1000 position (adjusting C4).

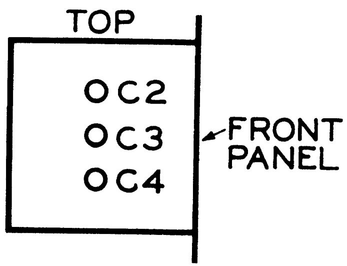


FIG. 14. LOCATION OF THE TRIMMER CAPACITORS USED TO ADJUST FREQUENCY RESPONSE FOR THE VERTICAL AMPLIFIER.

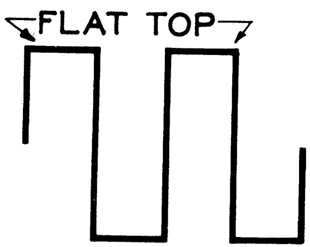


FIG. 15. SAMPLE SQUARE WAVE TRACE WHICH INDICATES RESPONSE CHARACTERISTICS OF THE VERTICAL AMPLIFIER CIRCUIT.

Vertical Amplifier Frequency Response	
Wide Band Position	
From 20 cycles/sec to 4.5 mc/sec	flat within ±1 db
From 10 cycles/sec to 5.0 mc/sec	flat within ±2 db
Full response at the Burst Frequency (3.58 mc/sec)	
Narrow Band Position	
From 20 cycles/sec to 200 kc/sec	flat within ±1 db
From 10 cycles/sec to 300 kc/sec	flat within ±2 db
Rise Time (Wide Band Position)	less than 0.05 microsecond
Vertical Deflection Sensitivity	
Wide Band Position	40 millivolts R.M.S./inch (Minimum)
Narrow Band Position	15 millivolts R.M.S./inch (Minimum)
Horizontal Amplifier Frequency Response	
From 20 cycles/sec to 200 kc/sec	flat within ±1 db
From 10 cycles/sec to 300 kc/sec	flat within ±2 db
Horizontal Deflection Sensitivity	
Horizontal Input "Hi"	115 millivolts R.M.S./inch (Minimum)
Horizontal Input "Low"	1.4 volts R.M.S./inch (Minimum)
Z-axis Sensitivity (Voltage to blank beam)	less than 4.0 volts R.M.S.
Calibrating Voltage (at 117.5 VAC input)	1.0 Volt ± 10%, P-P
Maximum Signal Input Voltage	600 volts peak
Input Resistance (Minimum)	3.3 megohms ±10%
Input Capacitance at 5 megacycles/sec	20 $\mu\mu f$ ±10%
Sweep Freq. Range	14 cycles/sec to 250 kc/sec
Power Consumption (at 117.5 VAC input)	80 watts ±10%
Case Dimensions (Overall)	11" wide x 14½" high x 16¾" deep
Net Weight	29 lbs.

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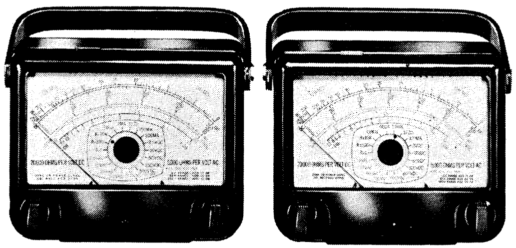

FEATURES

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