

MODEL ES-550

GENERAL SPECIFICATIONS

THE PRECISION MODEL ES-550 CATHODE RAY OSCILLOGRAPH IS A WIDE BAND EXTRA-HIGH SENSITIVITY INSTRUMENT INTENDED FOR USE IN DESIGN, RESEARCH, AND SERVICE LABORATORIES FOR COLOR TV ANALYSIS AS WELL AS FOR GENERAL PURPOSE VISUAL CIRCUIT TEST AND ALIGNMENT.

THE CAREFULLY DESIGNED FUNCTIONS OF THE MODEL ES-550, COUPLED WITH UNUSUALLY HIGH SENSITIVITY PUSH-PULL VERTICAL AND HORIZONTAL AMPLIFIER CIRCUITS AND LARGE CATHODE-RAY TUBE SCREEN AREA, PARTICULARLY ADAPT THE ES-550 TO RAPID AND EFFICIENT TELEVISION AND FREQUENCY-MODULATION ALIGNMENT PROCEDURES, AND PROVIDE VIRTUALLY DISTORTIONLESS DISPLAY OF NON-SINUSOIDAL WAVEFORMS ENCOUNTERED WHEN TROUBLE-SHOOTING TV SYNC AND SWEEP CIRCUITS.

PRECISION MODEL ES-550 PROVIDES THE LABORATORY ENGINEER AND THE MODERN SERVICE TECHNICIAN WITH AN INVALUABLE VISUAL ANALYSIS TOOL COMBINING STREAMLINED MANIPULATION WITH AN UNUSUAL NUMBER OF VERSATILE ADVANCED PERFORMANCE FEATURES, OUTLINED BELOW:

1. PUSH PULL VERTICAL AMPLIFIER: - SINUSOIDAL FREQUENCY RANGE - 10 CYCLES TO 5 MEGACYCLES. RESPONSE IS WITHIN 1 DB TO 3.5 Mc AND WITHIN 3 DB AT 5 MEGACYCLES. INPUT IMPEDANCE IS 2 MEGOHMS IN PARALLEL WITH APPROXIMATELY 20 MMFD.
2. VERTICAL SENSITIVITY: - .010 VOLT (10 MILLIVOLTS) RMS PER INCH. 10 MILLIVOLTS RMS WHICH IS EQUIVALENT TO 28 MILLIVOLTS PEAK-TO-PEAK WILL PRODUCE A DEFLECTION OF ONE INCH OR MORE ON THE CATHODE-RAY-TUBE SCREEN WHEN THE VERTICAL GAIN CONTROL IS SET TO MAXIMUM AND THE VERTICAL ATTENUATOR SWITCH IS IN THE "X1" POSITION. THIS UNUSUALLY HIGH VERTICAL SENSITIVITY PERMITS DIRECT ALIGNMENT AND/OR ADJUSTMENT OF LOW GAIN CIRCUITS AND PROVIDES FOR EXAMINATION OF MINUTE SIGNAL LEVELS.
3. VERTICAL-INPUT STEP ATTENUATOR: - CALIBRATED VERTICAL-SENSITIVITY ATTENUATOR SYSTEM, OF THE COMPENSATED RESISTANCE-CAPACITANCE WIDE BAND TYPE. VIRTUALLY NO FREQUENCY OR PHASE DISTORTION. IN THREE STEPS (x100, x10, x1).
4. CATHODE FOLLOWER VERTICAL-INPUT CIRCUIT: - PERMITS THE USE OF LOW-IMPEDANCE VERNIER VERTICAL-GAIN CONTROL ASSURING STATED VERTICAL AMPLIFIER RESPONSE, REGARDLESS OF GAIN SETTING.
5. PUSH PULL HORIZONTAL AMPLIFIER: - 10 CYCLES TO 1 MEGACYCLE. RESPONSE IS WITHIN 1 DB TO 1 MEGACYCLE AND WITHIN 3 DB AT 2 MEGACYCLES. INPUT IMPEDANCE IS 2 MEGOHMS SHUNTED BY APPROXIMATELY 20 MMFD. HORIZONTAL SENSITIVITY, 100 MILLIVOLTS (.100 VOLT) RMS PER INCH.
6. HORIZONTAL INPUT STEP ATTENUATOR: - FULL COMPENSATED DECADE TYPE. CATHODE FOLLOWER INPUT.
7. BUILT-IN, DIRECT READING PEAK-TO-PEAK VOLTAGE CALIBRATOR: - FACILITATES APPLICATION OF SCOPE AS A DEPENDABLE HIGH IMPEDANCE VTVM. ESPECIALLY USEFUL IN NARROW PULSE MEASURING TECHNIQUES.
8. VERTICAL PHASE-REVERSING SWITCH: - PERMITS INVERSION OF PATTERNS. (PARTICULARLY USEFUL IN INTERPRETATION OF TV VIDEO-IF AND SIMILAR PATTERNS, WHEREIN MANUFACTURERS' SERVICE DATA ILLUSTRATE OSCILLOSCOPE FIGURES IN A PARTICULAR DIRECTION.) THE REVERSING CIRCUIT HELPS TO ELIMINATE CONFUSION BY DUPLICATING PUBLISHED POSITIONING OF RESPONSE CURVES.
9. INTERNAL LINEAR SAWTOOTH HORIZONTAL SWEEP: - FROM 10 CYCLES PER SECOND TO 100 KILOCYCLES. A COMPENSATED MULTIVIBRATOR CIRCUIT AFFORDS UNUSUALLY LINEAR SAWTOOTH-SHAPED SWEEP-ACTUATING POTENTIALS. LINEAR WITHIN 10% ON ALL RANGES, EXCEPT HIGH-FREQUENCY END OF 16K TO 100K RANGE AT WHICH LINEARITY IS WITHIN 20% AT 2" DEFLECTION.
10. WIDE-RANGE HORIZONTAL-PHASING CONTROL: - PERMITS SUPERPOSITION OF DUAL-TRACE PATTERNS IN FM, TV, OR SIMILAR RESPONSE PATTERN ANALYSIS.
11. QUADRUPLE SYNCHRONIZATION SELECTION: - PROVIDES FOR EXTERNAL, INTERNAL NEGATIVE, INTERNAL POSITIVE, AND LINE SYNCHRONIZATION. AUTOMATIC INTERNAL SYNCHRONIZATION ELIMINATES NEED FOR MANUAL SYNC-LOCK ADJUSTMENTS. 30 CPS AND 7875 CPS SYNCHRONIZED SWEEP FOR TV SYNC PULSE ANALYSIS.
12. INTERNAL LINE FREQUENCY BEAM MODULATION: - A PHASE-CONTROLLED VOLTAGE IS AVAILABLE WITHIN THE INSTRUMENT. A SWITCH PERMITS THE BEAM-MODULATION VOLTAGE TO BE TURNED OFF. THE "BLANKING PHASE" CONTROL FACILITY ALSO PROVIDES FOR CLEAN DISPLAY OF HORIZONTAL OR VERTICAL SYNC PULSES.

13. EXTERNAL BEAM-MODULATION FACILITY:- PERMITS APPLICATION OF EXTERNAL VOLTAGES FOR MEASUREMENT OF PULSE DURATION, RISE TIME, OR SPECIAL BLANKING VOLTAGES.
14. ALL 4 DEFLECTION PLATES DIRECTLY AVAILABLE AT REAR WITH FULL BEAM CENTERING FACILITIES.
15. TUBE COMPLEMENT:-
 ONE 12AV7 "V" INPUT CATHODE FOLLOWER AND AMPLIFIER.
 ONE 6U8 "V" AMPLIFIER AND PHASE SPLITTER.
 TWO 6CL6 PUSH-PULL VERTICAL OUTPUT.
 ONE 6U8 "H" INPUT CATHODE FOLLOWER AND AMPLIFIER.
 ONE 6C4 "H" PHASE SPLITTER.
 ONE 12BH7 PUSH-PULL HORIZONTAL OUTPUT.
 ONE 12AV7 WIDE-RANGE, LINEAR SWEEP, MULTI-VIBRATOR.
 ONE 6BH6 AUTO-SYNC AMPLIFIER.
 ONE 12AU7 INTERNAL RETRACE BLANKING AMPLIFIER.
 ONE 0A2 VOLTAGE REGULATOR.
 ONE 5V4 LOW VOLTAGE RECTIFIER.
 TWO 1V2 HIGH VOLTAGE RECTIFIERS.
 ONE 5CP1/A CR TUBE
16. BUILT-IN LINE FREQUENCY PHASING AND BLANKING CONTROLS.
17. USES 5CP1/A FIVE INCH CR TUBE, DESIGNED FOR HIGH SENSITIVITY, HIGH INTENSITY, CATHODE RAY OSCILLOGRAPHY.
18. HIGH-CONTRAST, FILTER TYPE, CALIBRATING GRAPH-SCREEN WITH ADJUSTABLE ILLUMINATION.
19. EXTRA-HEAVY-DUTY, RUGGED CHASSIS CONSTRUCTION. CONSERVATIVELY RATED COMPONENTS.
20. HEAVY-GAUGE ROUND-CORNERED STEEL CABINET WITH FINE-GRAIN MODERN WRINKLE FINISH.
21. DEEP-ETCHED, HEAVY-GAUGE SATIN-FINISH ALUMINUM PANEL, RESISTANT TO MOISTURE AND WEAR.
22. FULLY LICENSED UNDER PATENTS OF A.T. AND T., RCA AND W.E. Co's.

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INTRODUCTION

THE CATHODE-RAY OSCILLOGRAPH HAS LONG BEEN A VALUABLE TOOL TO THE ELECTRONIC CIRCUIT-DESIGN ENGINEER AND ADVANCED COMMERCIAL TECHNICIAN. HOWEVER, THE ADVENT OF THE BROAD-BAND CIRCUIT IN COMMERCIAL TELEVISION AND FM RECEIVERS HAS EMPHASIZED THE OSCILLOGRAPH AS A MOST IMPORTANT AND NECESSARY ADJUNCT TO THE MODERN RADIO SERVICE TECHNICIAN'S COMPLEMENT OF ELECTRONIC TEST INSTRUMENTS. FURTHERMORE, THE MODERN TV RECEIVER IS REplete WITH NON-SINUSOIDAL WAVEFORM GENERATORS, WAVE-SHAPING CIRCUITS, AND AMPLIFIERS. SUCH WAVEFORMS ARE CHARACTERIZED BY SHAPE AND BY POSITIVE PEAK, NEGATIVE PEAK, AND PEAK-TO-PEAK VOLTAGES. THE CATHODE-RAY OSCILLOGRAPH IS THE ONLY INSTRUMENT WHICH YIELDS COMPLETE WAVE FORM AND VOLTAGE ANALYSIS.

FOR GENERAL PURPOSE SERVICE APPLICATIONS INVOLVING MONOCHROME TV AND THE MAJORITY OF INDUSTRIAL APPLICATIONS, A VERTICAL BANDWIDTH OF APPROXIMATELY 500 KILOCYCLES IN AN OSCILLOSCOPE IS MORE THAN SUFFICIENT. ALL BROAD BAND SWEEP ALIGNMENT PROCEDURES, AND STANDARD MONOCHROME AND COLOR TROUBLESHOOTING TECHNIQUES CAN BE ADEQUATELY ACCOMODATED BY A 500 Kc SCOPE.

HOWEVER IN THE SPECIALIZED CASE OF COLOR TV THE COMPLETE ALIGNMENT AND SET-UP PROCEDURE REQUIRES THE DIRECT AND INDIRECT OBSERVATION OF THE 3.58 MEGACYCLE "BURST" SIGNAL. FOR THESE IMPORTANT APPLICATIONS AND FOR OTHER WIDE BAND INDUSTRIAL AND LABORATORY USES, THE MODEL ES-550 WITH ITS 5 MEGACYCLES PERFORMANCE SPECIFICATION BECOMES ANOTHER INDISPENSIBLE ITEM IN THE LINE-UP OF PRECISION TEST EQUIPMENT.

FUNCTIONS AND DESCRIPTION OF PANEL CONTROLS

1. "INTENSITY" CONTROL AND POWER ON-OFF

INITIAL CLOCKWISE ROTATION OF THIS CONTROL ACTUATES THE POWER SWITCH AND TURNS THE INSTRUMENT ON. FURTHER ROTATION OF THE CONTROL (AFTER THE INSTRUMENT HAS HEATED) WILL CONTROL THE BRIGHTNESS OR "INTENSITY" OF THE CATHODE RAY TUBE TRACE.

IMPORTANT NOTES:

- A. ALWAYS ADJUST THE "INTENSITY" CONTROL TO MINIMUM BRIGHTNESS CONSISTENT WITH GOOD VISIBILITY IN ORDER TO EXTEND THE LIFE OF THE CATHODE-RAY TUBE.
- B. NEVER ALLOW A SMALL SPOT OF HIGH INTENSITY TO REMAIN ON THE SCREEN MORE THAN MOMENTARILY; IF THIS PRECAUTION IS NOT OBSERVED, DISCOLORATION OR BURNING OF THE SCREEN WILL RESULT.

2. "FOCUS" CONTROL

THIS CONTROL ADJUSTS THE "SHARPNESS" OF FOCUS OF THE OSCILLOGRAPH TRACE. A NEW POSITION OF "FOCUS" MAY BE REQUIRED EACH TIME THE "INTENSITY" CONTROL IS READJUSTED. IT SHOULD ALWAYS BE REMEMBERED THAT THERE IS AN INVERSE RELATIONSHIP BETWEEN PATTERN INTENSITY AND FINENESS OF TRACE. ACCORDINGLY ALWAYS SET INTENSITY TO MINIMUM REQUIRED POSITION.

3. "V POSITION" AND "H POSITION" CONTROLS

THESE CONTROLS PERMIT THE INITIAL LOCATION OF THE CATHODE-RAY BEAM TRACE AT A CENTRAL (OR ANY OTHER DESIRED) LOCATION ON THE FACE OF THE TUBE. THROUGH USE OF THESE CONTROLS THE BEAM MAY BE CENTERED ON THE SCREEN (USUAL PROCEDURE), OR THE OPERATOR MAY LOCATE THE BEAM AT PRACTICALLY ANY POINT ON THE SCREEN FACE AS MAY BE REQUIRED IN SPECIAL APPLICATIONS.

4. "SWEEP SELECTOR" (APPLIES TO HORIZONTAL DEFLECTION ONLY)

- A. "LINE" POSITION:- WITH THE SWITCH SET TO THE "LINE" POSITION, A SMALL VOLTAGE OF THE SAME FREQUENCY AS THAT POWERING THE OSCILLOGRAPH IS APPLIED THROUGH THE HORIZONTAL AMPLIFIER TO THE HORIZONTAL DEFLECTION PLATES OF THE CATHODE-RAY TUBE, THUS SWEEPING THE BEAM BACK AND FORTH IN A HORIZONTAL DIRECTION AT THE SAME RATE AS THE POWER-LINE FREQUENCY.
- B. "EXT.SW." POSITION:- WITH THE SWITCH SET TO "EXT.SW." POSITION, THE INTERNAL HORIZONTAL SWEEP SYSTEM IS DISCONNECTED, PERMITTING THE APPLICATION OF EXTERNAL HORIZONTAL SWEEP VOLTAGE THROUGH THE HORIZONTAL AMPLIFIER TO THE HORIZONTAL DEFLECTION PLATES OF THE CRT. USE THE "HORIZ." AND "GND" POSTS AT THE LOWER RIGHT CORNER OF THE ES-550 PANEL FOR INJECTION OF EXTERNAL SWEEP VOLTAGES.

- C. THE NEXT 5 POSITIONS PERMIT THE OPERATOR TO SELECT INTERNAL LINEAR HORIZONTAL SWEEP VOLTAGES AT FREQUENCIES FROM APPROXIMATELY 10 CPS TO 100 KILOCYCLES. THE FREQUENCIES INDICATED ON THE PANEL ARE INTENDED FOR USE AS A GUIDE ONLY; THEY DO NOT NECESSARILY REPRESENT EXACT FREQUENCY CALIBRATIONS.
- D. THE "TV VERT" AND "TV HOR" POSITIONS SUPPLY AUTOMATICALLY STABLE SYNC CONTROL FOR VIEWING TV VERTICAL OR TV HORIZONTAL SIGNAL DISPLAY.
5. THE "SWEEP VERNIER" CONTROL PERMITS THE OPERATOR TO ADJUST THE INTERNAL HORIZONTAL SWEEP VOLTAGE FREQUENCY TO POINTS WITHIN THE APPROXIMATE RANGES INDICATED ON THE "SWEEP SELECTOR" SWITCH.

SPECIAL NOTE: RE USE OF SAWTOOTH SWEEP IN TV-FM ALIGNMENT

FIELD EXPERIENCE INDICATES THAT ALTHOUGH THE INTERNAL LINEAR SWEEP FUNCTION OF ES-550 CAN BE USED TO DISPLAY A VISUAL ALIGNMENT CURVE, THIS PROCEDURE IS NOT RECOMMENDED TO THE BEGINNER, INASMUCH AS CONFUSION FREQUENTLY ARISES FROM MULTIPLE PATTERNS AND SKIPPING OF SYNC LOCK.

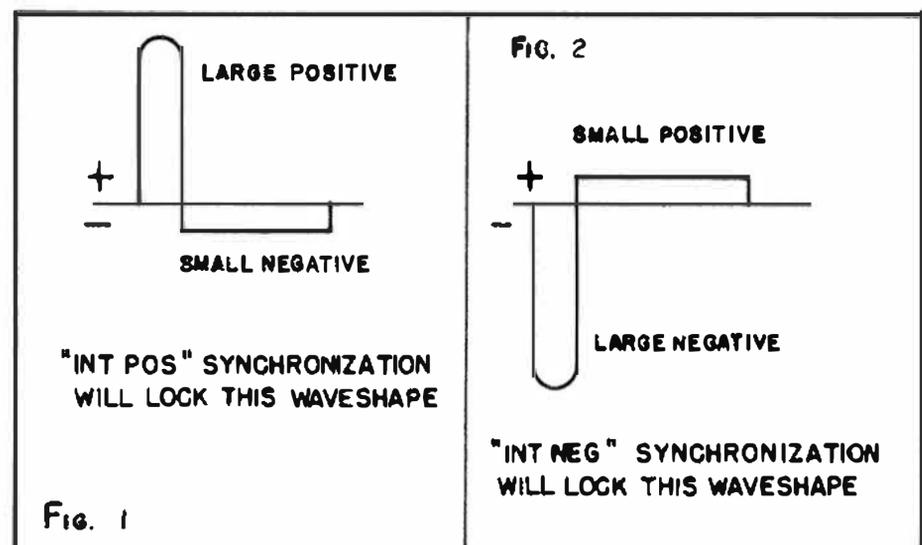
SPECIAL NOTE: RE SELECTION OF HORIZONTAL SWEEP METHODS IN TV AND FM ALIGNMENT

IN THE ALIGNMENT OF FM AND TV RECEIVERS BY MEANS OF A WIDE-RANGE SWEEP-SIGNAL GENERATOR, TWO OPTIONAL METHODS ARE AVAILABLE FOR OBTAINING HORIZONTAL SWEEP.

- A. THE FIRST METHOD USES THE "LINE" POSITION OF THE "SWEEP SELECTOR", AND THE "LINE PHASE" CONTROL OF THE ES-550 TO OBTAIN A SUPERIMPOSED STATIONARY DOUBLE TRACE WAVESHAVE PATTERN.
- B. THE SECOND METHOD USES THE "EXT.SW." POSITION OF THE "SWEEP SELECTOR" AND THE PHASING CONTROL OF THE SWEEP GENERATOR, THE HORIZONTAL SWEEP VOLTAGE BEING SUPPLIED BY THE SWEEP GENERATOR. A SUPERIMPOSED DOUBLE TRACE PATTERN WILL ALSO BE OBTAINED USING THIS METHOD.
6. "SYNC SELECTOR" SWITCH
- (1) WITH THIS SWITCH SET TO "EXT." POSITION, THE OSCILLOGRAPH PATTERN MAY BE "LOCKED" OR FIXED MOTIONLESS IN POSITION (STATIONARY PATTERN) BY MEANS OF AN EXTERNAL SYNC VOLTAGE APPLIED TO THE "EXT.SYNC" JACK AND "GND" BINDING POST.
- (2) WITH THIS SWITCH SET TO THE "-INT." OR TO THE "+INT." POSITION, A PORTION OF THE SIGNAL OR VOLTAGE APPLIED TO THE VERTICAL DEFLECTION PLATES AUTOMATICALLY PROVIDES INTERNAL SYNCHRONIZATION OF THE OSCILLOGRAPH PATTERN.

NOTE:

AS ILLUSTRATED IN FIGS. 1 AND 2, NON-SINUSOIDAL WAVEFORMS MAY OCCASIONALLY HAVE A LARGE NEGATIVE VOLTAGE AS COMPARED TO THE POSITIVE VOLTAGE (AND VICE VERSA). IF THE POLARITY OF THE SYNCHRONIZATION CIRCUITS IN THE SCOPE WAS NOT SELECTABLE FROM THE 'SCOPE PANEL, A WAVEFORM OF THE TYPE ILLUSTRATED IN FIG. 3 COULD BE SYNCHRONIZED ONLY BY ITS RELATIVELY SMALL POSITIVE PEAK. IN SUCH A CASE, INSUFFICIENT VOLTAGE WOULD BE AVAILABLE FOR SYNCHRONIZATION AND AN UNSTABLE PATTERN WOULD RESULT. THE ES-550 THEREFORE LOGICALLY PROVIDES SYNCHRONIZATION POLARITY SELECTION PERMITTING THE OPERATOR TO OBTAIN SYNC FROM EITHER THE POSITIVE OR NEGATIVE PEAK OF WAVEFORMS TO BE OBSERVED.



- (3) WITH THIS SWITCH SET TO THE "LINE" POSITION, A PORTION OF THE POWER-LINE VOLTAGE PROVIDES SYNCHRONIZING VOLTAGE. THE "LINE" SYNCHRONIZATION POSITION IS ADVANTAGEOUSLY USED IN MOST CASES WHEREIN THE REPETITION RATE OF THE SIGNAL IS INTEGRALLY RELATED TO THE POWER-LINE FREQUENCY. MORE STABLE PATTERNS ARE OBTAINED IN MANY CASES, BECAUSE OF THE SINE-WAVE SHAPE AND UNIFORMITY OF THE LINE-SYNC VOLTAGE.

NOTE: THE MODEL ES-550 FEATURES AUTOMATIC INTERNAL HORIZONTAL SYNC LOCK.

7. "V. GAIN" AND "H. GAIN" CONTROLS

THESE CONTROLS VARY THE OVER-ALL GAIN OF THE "V" AND "H" AMPLIFIERS AND THEREBY PERMIT THE OPERATOR TO ADJUST THE VERTICAL AND HORIZONTAL SIZE (RESPECTIVELY) OF THE OSCILLOGRAPH PATTERN.

8. "V. ATTENUATOR" AND "H ATTENUATOR" SWITCHES

THESE 3 POSITION SWITCHES PERMIT THE OPERATOR TO SELECT ONE OF THREE ATTENUATION STEPS IN BOTH THE HORIZONTAL AND VERTICAL AMPLIFIERS, CONTINUOUSLY ADJUSTABLE THRU USE OF THE "V" OR "H" GAIN CONTROLS.

WITH THE "V GAIN" CONTROL SET TO MAXIMUM, THE VERTICAL SENSITIVITY OF THE SCOPE IS:

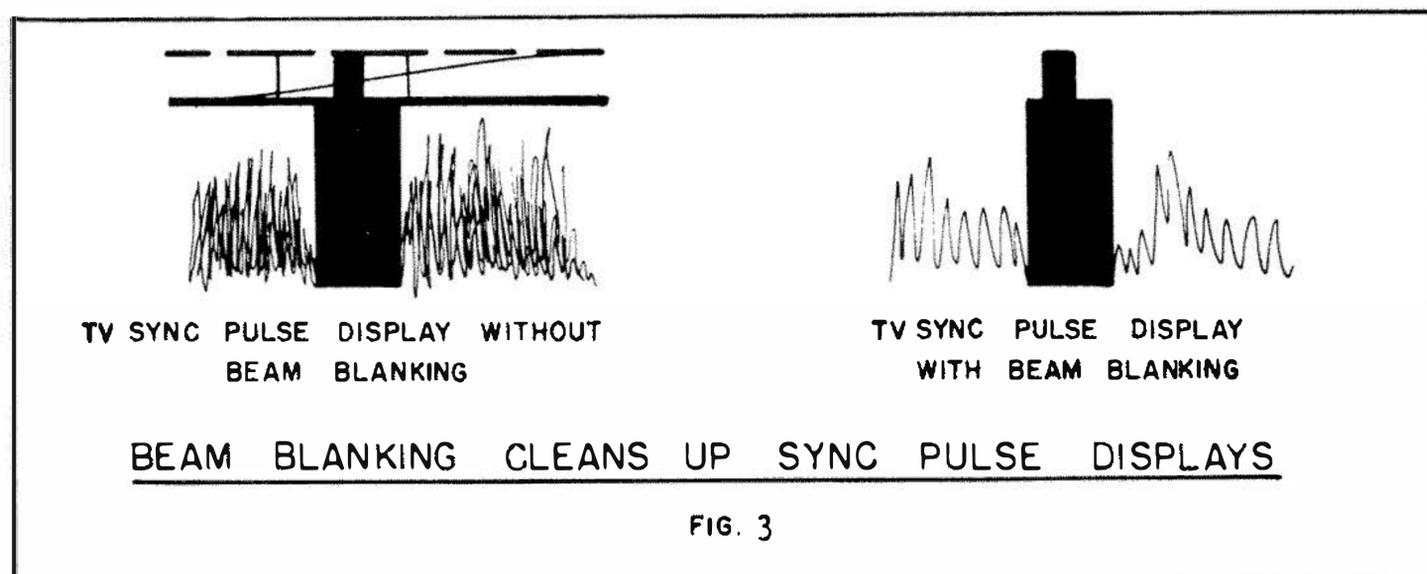
x1 POSITION 10 MILLIVOLTS RMS PER INCH OR BETTER (28 MILLIVOLTS PEAK-TO-PEAK)
 x10 POSITION 100 MILLIVOLTS PER INCH (280 MILLIVOLTS PEAK-TO-PEAK)
 x100 POSITION 1.0 VOLT PER INCH (2.8 VOLTS PEAK-TO-PEAK)

WITH THE "H GAIN" CONTROL SET TO MAXIMUM, THE HORIZONTAL SENSITIVITY OF THE SCOPE IS:

x1 POSITION 100 MILLIVOLTS RMS PER INCH (280 MILLIVOLTS PEAK-TO-PEAK)
 x10 POSITION 1.0 VOLT PER INCH (2.8 VOLTS PEAK-TO-PEAK)
 x100 POSITION 10.0 VOLTS PER INCH (28 VOLTS PEAK-TO-PEAK)

9. 60 CYCLE "BLANKING PHASE" CONTROL

THIS CONTROL WHEN TURNED FROM ITS "OFF" POSITION APPLIES AN INTERNALLY PHASEABLE, 60 CYCLE VOLTAGE TO THE CONTROL GRID OF THE CRT. THIS PROVIDES 60 CYCLE Z AXIS MODULATION OR "INTENSITY MODULATION". ROTATION OF THIS CONTROL ADJUSTS THE PHASE OF THE BLANKING VOLTAGE AS REQUIRED. A USEFUL SERVICE APPLICATION OF THIS FUNCTION IS THE BLANKING OR INTENSIFICATION OF TV SYNC SIGNALS TO OBTAIN A CLEAN DISPLAY OF COMPLEX PULSES - SEE FIG. 3. THIS FUNCTION CAN ALSO BE USED TO ELIMINATE ONE OF THE DUAL PATTERNS WHICH MAY BE OBTAINED IN THE ALIGNMENT OF TV AND FM RECEIVERS.

10. "LINE PHASE" CONTROL

THIS PHASING CONTROL OPERATES A BRIDGE-TYPE RESISTANCE-CAPACITANCE NETWORK WHICH PERMITS THE OPERATOR TO VARY THE PHASE OF THE SINE-WAVE SWEEP VOLTAGE INTERNALLY FED TO THE HORIZONTAL AMPLIFIER OF THE SCOPE (WHEN USING THE "LINE" POSITION OF THE SWEEP SELECTOR SWITCH). THE PHASE SHIFT IS ADJUSTED WITH RESPECT TO THE SIGNAL VOLTAGE BEING APPLIED TO THE "VERTICAL" POST OF THE INSTRUMENT. THE NATURE OF MANY SWEEP-SIGNAL GENERATORS AND INDEPENDENT FREQUENCY MODULATORS ARE SUCH THAT THEIR USE IN THE EXAMINATION OF RESPONSE-CURVE CHARACTERISTICS PRODUCES A DOUBLE-PATTERN ON THE SCREEN OF THE OSCILLOGRAPH. SHOULD THE PARTICULAR SWEEP GENERATOR BEING USED LACK PROVISIONS FOR ADJUSTMENT OF THE OUT-OF-PHASE PATTERNS WHICH USUALLY OCCUR, THE "PHASING" CONTROL USED IN CONJUNCTION WITH THE "LINE" POSITION OF "SWEEP SELECTOR" PERMITS SUPERIMPOSITION OF THE TWO OSCILLOGRAPH PATTERNS.

NOTE: IF THE "BLANKING PHASE" CONTROL IS TO BE USED TO ELIMINATE ONE OF THE AFOREMENTIONED TRACES, THE FOLLOWING PROCEDURE SHOULD BE USED: WITH THE "BLANKING PHASE" CONTROL IN THE "OFF" POSITION, SUPERIMPOSE THE TWO TRACES USING EITHER THE SWEEP GENERATOR'S PHASE CONTROL OR THE "LINE PHASE" CONTROL OF THE ES-550 (DEPENDENT UPON WHICH HORIZONTAL SWEEP METHOD IS BEING USED). THEN ROTATE THE "BLANKING PHASE" CONTROL UNTIL ONLY ONE TRACE IS VISIBLE. (REDUCE "INTENSITY" CONTROL AS REQUIRED.)

11. VERTICAL POLARITY REVERSING SWITCH

THIS SWITCH HAS TWO POSITIONS. MARKED "NORMAL" AND "REVERSE". THIS FEATURE IS VERY USEFUL IN INTERPRETATION OF TV VIDEO IF, AND SYNC OR SWEEP WAVEFORMS. WHEREIN MANUFACTURER'S SERVICE NOTES ILLUSTRATE PATTERNS IN A SPECIFIC DIRECTION. THE OPERATOR CAN DUPLICATE THE POSITIONING OF SERVICE DATA PATTERNS, THEREBY ELIMINATING A COMMON SOURCE OF CONFUSION.

12. "EXT. SYNC." JACK

WHEN AN EXTERNAL SYNCHRONIZING VOLTAGE IS TO BE USED. THE "SYNC SELECTOR" SWITCH IS SET TO "EXT." AND THE EXTERNAL SYNC VOLTAGE IS APPLIED TO THE "EXT.SYNC." JACK.
NOTE: MAXIMUM SYNC VOLTAGE IS 15 VOLTS PEAK-TO-PEAK.

13. "BEAM MOD." JACK

APPLICATION OF EXTERNAL AC VOLTAGES TO THE "BEAM MODULATION" JACK WILL INTENSITY-MODULATE THE CRT BEAM, RESULTING IN SEQUENTIAL BLANKING AND INTENSIFYING OF THE TRACE. THE NUMBER AND POSITION OF THE DISCONTINUITIES IN THE TRACE DEPEND UPON THE FREQUENCY AND PHASE OF THE BLANKING VOLTAGE. USES OF THIS FUNCTION INCLUDE THE MEASUREMENT OF UNKNOWN FREQUENCIES. OTHER APPLICATIONS INCLUDE MEASUREMENT OF PULSE DURATION. AND MEASUREMENT OF THE TIME OF RISE OF A WAVEFRONT.

14. "VERT." - "GND." TERMINALS

ALL SIGNALS OR A.C. VOLTAGES TO BE EXAMINED ON THE CRT SCREEN IN THE USUAL FASHION (USING THE INTERNAL VERTICAL AMPLIFIERS OF THE OSCILLOGRAPH) ARE CONNECTED TO THESE TERMINALS.

15. "HOR" - "GND." TERMINALS

THE HORIZONTAL AMPLIFIER WITH ITS FULLY COMPENSATED DECADE ATTENUATOR AND CATHODE-FOLLOWER INPUT LENS ITSELF TO MANY SPECIALIZED APPLICATIONS WHEREIN FAITHFUL REPRODUCTION OF EXTERNAL SIGNALS IN THE HORIZONTAL AMPLIFIERS ARE REQUIRED. IN SUCH CASES WHEREIN IT IS DESIRED TO USE AN EXTERNAL HORIZONTAL SWEEP VOLTAGE. THE "SWEEP, SELECTOR" SWITCH IS SET TO "EXT.SW." AND THE EXTERNAL VOLTAGE IS APPLIED TO THE "HOR.-GND." POSTS.

16. "P-P VOLTAGE" DIAL

THE "P-P CAL. VOLTAGE" DIAL IS USED IN CONJUNCTION WITH THE "P-P CAL." PUSH BUTTON AND THE "V ATTENUATOR" SWITCH TO PERMIT DIRECT PEAK-TO-PEAK VOLTAGE READINGS OF BOTH SINE AND COMPLEX WAVEFORMS. SEE PAGE 9 FOR DETAILED INSTRUCTIONS FOR USE OF THE 550 IN P-P MEASUREMENTS.

17. DIRECT DEFLECTION PLATE CONNECTIONS TO THE CATHODE-RAY TUBE

DIRECT CONNECTIONS MAY BE MADE TO EITHER OR BOTH THE HORIZONTAL OR VERTICAL DEFLECTION PLATES OF THE CRT BY UTILIZING THE TERMINAL STRIP AT THE REAR OF THE INSTRUMENT. (FOR ACCESS TO THE DEFLECTION PLATE, LOOSEN THE TWO COVER-PLATE SCREWS AND ROTATE THE COVER PLATE TO ONE SIDE). BEFORE MAKING CONNECTIONS, FIRST LOOSEN THE LINK SCREWS WHICH CONNECT TO THE APPLICABLE CRT DEFLECTION PLATES (AS INDICATED ON EXTERNAL ETCHED BACK SERIAL PLATE). ROTATE THE LINK RETAINING SCREW TO HOLD THE LINK IN PLACE. (LINK WILL NOW BE IN A HORIZONTAL POSITION.) ACCESS CAN NOW BE MADE TO THE HORIZONTAL OR VERTICAL PLATES WITH EFFECTIVE ISOLATION FROM ANY INTERNAL CIRCUIT LOAD. BEAM CENTERING CAN STILL BE ACCOMPLISHED AS USUAL EVEN WITH LINKS OPEN.

18. "SCALE ILLUMINATION" CONTROL - TO VARY BRILLIANCE OF GRATICULE IN RESPECT TO TRACE AND/OR EXTERNAL LIGHTING CONDITIONS.

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EXAMPLE OF BASIC OPERATION

WITH THE "INTENSITY" CONTROL IN THE "OFF" POSITION, INSERT THE LINE PLUG INTO A 110-120V, 50-60 CYCLE AC OUTLET, UNLESS THIS INSTRUMENT HAS BEEN SPECIFICALLY FURNISHED FOR OTHER VOLTAGE AND/OR FREQUENCY.

CAUTION: DO NOT ATTEMPT TO OPERATE YOUR MODEL ES-550 WITH THE INSTRUMENT REMOVED FROM ITS METAL CASE, INASMUCH AS DANGEROUSLY HIGH VOLTAGE POINTS ARE EXPOSED UNDER THESE CONDITIONS.

- (A) ROTATE THE "INTENSITY" CONTROL TO THE APPROXIMATE MID-POSITION.
- (B) SET THE "BLANKING PHASE" CONTROL IN THE OFF POSITION.
- (C) AFTER THE INSTRUMENT HAS WARMED UP, SET THE SWEEP SELECTOR SWITCH TO "10 TO 63" CPS, THE "V GAIN" CONTROL TO "0" AND THE "H GAIN" CONTROL TO APPROXIMATELY #5.
- (D) ADJUST THE "INTENSITY" AND "FOCUS" CONTROLS TO OBTAIN A SHARP MEDIUM-BRIGHTNESS HORIZONTAL TRACE.
- (E) ADJUST THE VERTICAL AND HORIZONTAL "POSITION" CONTROLS UNTIL THE TRACE LOCATES IN A CENTRAL POSITION.
- (F) SET "SCALE ILLUMINATION" CONTROL TO REQUIRED DEGREE OF BRIGHTNESS.
- (G) SET THE FOLLOWING CONTROLS AND SWITCHES AS FOLLOWS:
 - 1. "SYNC SELECTOR" SWITCH TO "+INT" POSITION.
 - 2. "V. ATTENUATOR" SWITCH TO "x100".

NEXT TO OBSERVE A SIMPLE SINUSOIDAL WAVEFORM, APPLY 110-120 VOLT 50-60 CPS LINE VOLTAGE TO THE VERTICAL AND GROUND TERMINALS.

ROTATE THE "V GAIN" CONTROL UNTIL THE SINUSOIDAL WAVE SHAPE OCCUPIES A REASONABLE HEIGHT ON THE SCOPE SCREEN.

ROTATE THE "SWEEP VERNIER" CONTROL UNTIL THE PATTERN BECOMES STATIONARY. NOTE THAT THE NUMBER OF COMPLETE CYCLES TO BE OBSERVED DEPENDS UPON THE SETTING OF THE "VERNIER" CONTROL.

NOTE: IF THE "SYNC SELECTOR" SWITCH IS NOW SWITCHED TO "-INT" IT WILL BE NOTICED THAT THE PATTERN MOVES HORIZONTALLY 180 ELECTRICAL DEGREES, INDICATING THAT SYNCHRONIZATION IS BEING EFFECTED THRU USE OF THE NEGATIVE HALF CYCLE.

OTHER VOLTAGES AT OTHER FREQUENCIES MAY NEXT BE APPLIED TO THE "VERT." TERMINALS OF THE ES-550 IN ORDER THAT THE OPERATOR MAY BECOME MORE FAMILIAR WITH THE MANIPULATION OF THE BASIC CONTROLS OF THE SCOPE.

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APPLICATION NOTES

1. IT IS EXTREMELY IMPORTANT TO REALIZE THAT SELECTION AND USE OF TEST LEADS OR PROBES BETWEEN THE VERTICAL INPUT OF THE 'SCOPE AND THE CIRCUIT UNDER TEST CAN SIGNIFICANTLY AFFECT THE TEST RESULTS OBTAINED. FOUR MOST USEFUL TYPES OF OSCILLOSCOPE PROBES HAVE BEEN DEVELOPED AND MADE AVAILABLE AS A COMPLETE SET DESIGNATED AS "PRECISION SERIES SP-5 OSCILLOSCOPE TEST PROBE SET".

OSCILLOSCOPE TEST PROBE SET: THIS SET CONTAINS THE FOLLOWING FOUR PROBES:-

- (A) THE HIGH-IMPEDANCE-LOW CAPACITY PROBE (TYPE SP-5A) IS REQUIRED FOR TESTS IN RELATIVELY HIGH IMPEDANCE CIRCUITS BEING ANALYZED, THEREBY EFFECTIVELY CONVERTING THE INPUT OF THE 'SCOPE FOR GENERAL PURPOSE HIGH IMPEDANCE TESTING. IT IS FREQUENCY-COMPENSATED TO PERMIT FAITHFUL SCOPE REPRODUCTIONS OF HIGH-HARMONIC-CONTENT PULSES SUCH AS TV HORIZONTAL AND VERTICAL SYNC PULSES. THE PROBE IS ALSO DESIGNED TO BLOCK DC COMPONENTS FROM REACHING THE INPUT OF THE SCOPE. IT COINCIDENTALLY REDUCES THE OVERALL SENSITIVITY OF THE SCOPE BY A FACTOR OF 10

- (B) THE CRYSTAL-DEMODULATOR PROBE (TYPE SP-5B) PERMITS THE SCOPE TO BE USED TO EXAMINE THE MODULATION COMPONENTS OF AN OVERALL RF SIGNAL. FOR EXAMPLE, THE TV STATION TRANSMITS A COMPOSITE TV VIDEO SIGNAL WHICH CONSISTS OF AN RF CARRIER MODULATED BY PICTURE INFORMATION PLUS BLANKING AND ASSOCIATED SYNC PULSES. THE MODULATED RF MUST BE RECTIFIED (DEMODULATED), BEFORE APPLICATION TO THE OSCILLOSCOPE, SO THAT THE INFORMATION CONTENT MAY BE VIEWED.

THIS PROBE CAN ALSO BE GENERALLY EMPLOYED TO TRACE MODULATED CARRIERS IN MOST COMMUNICATION CIRCUITS AND SYSTEMS.

- (C) THE RESISTIVE-ISOLATING PROBE (TYPE SP-5C) FINDS USEFUL APPLICATION IN VISUAL ALIGNMENT PROCEDURES. THE NAME OF THE PROBE INDICATES ONE OF ITS ESSENTIAL FUNCTIONS, NAMELY, TO ISOLATE THE CIRCUIT UNDER TEST FROM THE OSCILLOSCOPE CABLE AND SCOPE INPUT CIRCUIT.

IN ADDITION, THIS PROBE ALSO SERVES AS A SHIELDED LOW-PASS FILTER TO SHARPEN BROAD MARKER PIPS WHICH MIGHT OTHERWISE MASK IMPORTANT PORTIONS OF RESPONSE TRACES.

- (D) THE SHIELDED DIRECT PROBE (TYPE SP-5D) PROVIDES CONVENIENT DIRECT TEST FACILITIES, NOT ASSOCIATED WITH ANY INTERVENING CIRCUIT COMPONENTS. THIS DIRECT PROBE IS TO BE EMPLOYED IN SUCH CIRCUITS WHEREIN THE CABLE CAPACITY IS NOT IMPORTANT. SUCH CIRCUITS USUALLY ARE RELATIVELY LOW IN IMPEDANCE AND/OR ARE INVOLVED WITH LOW FREQUENCIES.

THIS TEST PROBE SET FIND CHIEF APPLICATION IN TV TESTING AND ANALYSIS AND IS AVAILABLE AS A SEPARATE ACCESSORY TEST SET AT YOUR FAVORITE RADIO AND TV DISTRIBUTOR.

SPECIFIC APPLICATION INSTRUCTIONS FOR USE OF EACH PROBE ARE INCLUDED IN THE INSTRUCTION BOOK ACCOMPANYING EACH SP-5 TEST SET.



APPLICATION OF THE OSCILLOGRAPH AS AN AC PEAK-TO-PEAK HIGH IMPEDANCE VOLTMETER

IN THE ANALYSIS OF BOTH SINUSOIDAL AND NON-SINUSOIDAL VOLTAGE IT IS IMPORTANT TO KNOW BOTH MAGNITUDE AND WAVEFORM OF THE UNKNOWN VOLTAGES. THE OSCILLOSCOPE IS OF COURSE INVARIABLY USED TO DETERMINE WAVE SHAPE; YET IN MANY APPLICATIONS, (PARTICULARLY TELEVISION), MANY PEOPLE ATTEMPT TO USE A VTVM WITH A PEAK-TO-PEAK INDICATING PROBE TO OBTAIN VOLTAGE READINGS, INSTEAD OF AN OSCILLOSCOPE.

THE OSCILLOSCOPE IS, HOWEVER, INHERENTLY FAR SUPERIOR TO THE PEAK-TO-PEAK VTVM FOR RELIABLE MEASUREMENT OF MANY NON-SINUSOIDAL VOLTAGES ENCOUNTERED IN TELEVISION ANALYSIS. AN APPRECIABLE NUMBER OF TV VOLTAGES INCLUDE VERY NARROW PULSE COMPONENTS (OF LOW ENERGY CONTENT) TO WHICH THE USUAL PEAK-TO-PEAK VTVM WILL NOT RESPOND PROPERLY. THE 'SCOPE HOWEVER CAN DISPLAY SUCH COMPONENTS, YIELDING TRUE PEAK-TO-PEAK READINGS.

* * * * *

THE ES-550 CATHODE RAY OSCILLOGRAPH FEATURES A DIRECT READING PEAK-TO-PEAK CALIBRATED SCALE WHICH PERMITS THE OPERATOR TO QUICKLY DETERMINE THE MAGNITUDE OF THE UNKNOWN WAVE FORM IN TERMS OF PEAK-TO-PEAK VOLTAGE AS FOLLOWS:-

*VOLTAGE MEASUREMENTS USING THE DIRECT PROBE OF THE SP-5 PROBE SET.

1. APPLY THE UNKNOWN VOLTAGE DIRECTLY TO THE VERTICAL INPUT OF THE OSCILLOGRAPH USING THE DIRECT SP-5D PROBE.
2. SELECT A "V. ATTENUATOR" POSITION ("x100, x10, x1") WHICH WILL YIELD A GOOD SIZE PATTERN ON THE SCOPE FACE WITH THE "V GAIN" CONTROL SET BETWEEN APPROXIMATELY 2 AND 8 OF THE "0-10" "V GAIN" CALIBRATIONS.
3. ROTATE THE "V GAIN" CONTROL UNTIL THE WAVE-FORM OCCUPIES A CONVENIENT NUMBER OF VERTICAL CALIBRATIONS AS MEASURED ON THE GRATICULE. (10 VERTICAL CALIBRATING LINES IS SUGGESTED.)
4. NEXT, DEPRESS THE "P-P CAL" PUSH BUTTON (WITHOUT DISTURBING THE "V GAIN" AND "V ATTENUATOR" KNOBS) AND ROTATE THE "P-P CAL VOLTAGE" KNOB UNTIL THE SEMI-SQUARE WAVE PATTERN OCCUPIES THE SAME CONVENIENT NUMBER OF VERTICAL CALIBRATIONS ON THE GRATICULE AS NOTED IN STEP 3 ABOVE (10 VERTICAL LINES).

IMPORTANT NOTE: THE "P-P RANGE" SWITCH SETS THE RANGE OF THE "P-P CALIBRATING VOLTAGE" TO ONE OF THREE VOLTAGE RANGES, NAMELY:

0 - .05 VOLT, 0 - .5 VOLT OR 0 - 5 VOLTS

5. IF THE SEMI-SQUARE WAVE VOLTAGE IS EITHER TOO LARGE OR TOO SMALL FOR CONVENIENT ADJUSTMENT FOR THE "PEAK-TO-PEAK CALIBRATING VOLTAGE" KNOB, THE "P-P RANGE" SWITCH SHOULD BE SET TO WHICHEVER ONE OF THE THREE (.05, .5 OR 5) RANGES PRODUCES A CONVENIENT SETTING ON THE "PEAK-TO-PEAK CALIBRATING VOLTAGE" SCALE.

NOTE: ALL READINGS ON THE "P-P CALIBRATING VOLTAGE" SCALE ITSELF ARE DETERMINED BY THE SETTING OF THE "P-P RANGE" SWITCH. FOR EXAMPLE: IF THE "P-P RANGE" SWITCH IS SET TO ".05" THE "PEAK-TO-PEAK" SCALE IS READ AS "0 TO .05". IF THE "P-P RANGE" SWITCH IS SET TO .5, THE "PEAK-TO-PEAK CALIBRATING VOLTAGE" SCALE IS READ AS "0 TO .5", ETC.

6. TO READ THE UNKNOWN VOLTAGE IT IS NECESSARY TO MERELY MULTIPLY THE READING ON THE "PEAK-TO-PEAK CALIBRATING VOLTAGE" SCALE BY THE "V. ATTENUATOR" FACTOR.

*VOLTAGE MEASUREMENTS USING THE LOW CAPACITY (10 TO 1) PROBE OF THE SP-5 SET

SAME AS STEPS 1 THRU 6 ABOVE EXCEPT THAT THIS PROBE AUTOMATICALLY EXTENDS THE CALIBRATED RANGE BY A FACTOR OF 10. (A FINAL P-P READING OF 10 VOLTS, FOR EXAMPLE, WITH THE DIRECT PROBE, WOULD BE READ AS 100 VOLTS IF THE LOW CAPACITY PROBE WERE USED).

* * * * *

EXAMPLES OF PEAK-TO-PEAK READINGS

<u>NUMBER READ ON "P-P CAL. VOLTAGE" DIAL</u>	<u>"P-P RANGE" SWITCH</u>	<u>"V-ATTENUATOR" SWITCH</u>		<u>RESULTANT P-P VOLTAGE OF UNKNOWN WAVE FORM</u>
2	5V	x100	=	200 VOLTS
2	.5V (NOTE - IN THIS CASE THE 2 IS READ AS .2)	x100	=	20 VOLTS
3	.05V	x100	=	3.0 VOLTS
3	5V	x10	=	30 VOLTS
4	.5V	x10	=	4.0 VOLTS
4	.05V	x10	=	.4 VOLTS
4	5V	x1	=	4.0 VOLTS
5	.5V	x1	=	.5 VOLTS
5	.05V	x1	=	.05 VOLTS

TO SUMMARIZE THE OPERATION OF THE CALIBRATING VOLTAGE FACILITIES OF THE ES-550 USING THE SP-5D DIRECT PROBE OF THE SP-5 PROBE SET:-

1. APPLY THE UNKNOWN VOLTAGE, SETTING THE "V ATTENUATOR" SWITCH AND THE "V GAIN" CONTROL SO THAT THE PATTERN OCCUPIES A FIXED REFERENCE LEVEL ON THE SCOPE MASK. (10 VERTICAL CALIBRATING LINES IS SUGGESTED.)
2. PRESS THE "P-P CAL" BUTTON (WITHOUT DISTURBING THE "V GAIN" OR "V ATTENUATOR" SETTINGS).
3. WITH THE BUTTON HELD DEPRESSED, SET THE "PEAK-TO-PEAK CALIBRATING VOLTAGE" KNOB SO THAT THE RESULTING SEMI-SQUARE WAVE FORM OCCUPIES THE SAME REFERENCE LEVEL AS JUST OBTAINED ABOVE. (USE THE "P-P RANGE" SWITCH TO PERMIT A SETTING OF THE "PEAK-TO-PEAK CALIBRATING VOLTAGE" CONTROL SOMEWHERE BETWEEN NUMBERS 1 AND 5, IF POSSIBLE).
4. READ THE CALIBRATING VOLTAGE SCALE AS "0-.05, 0-.5 OR 0-5 VOLTS" DEPENDING UPON WHERE THE "P-P RANGE" SWITCH WAS SET.
5. TAKE THIS READING ON THE "PEAK-TO-PEAK" SCALE AND MULTIPLY IT BY THE SETTING OF THE "V ATTENUATOR" SWITCH AS DESCRIBED PREVIOUSLY.
NOTE THAT THE LOW CAPACITY SP-5A PROBE EXTENDS THE OVERALL VOLTAGE RANGE BY A FACTOR OF 10.

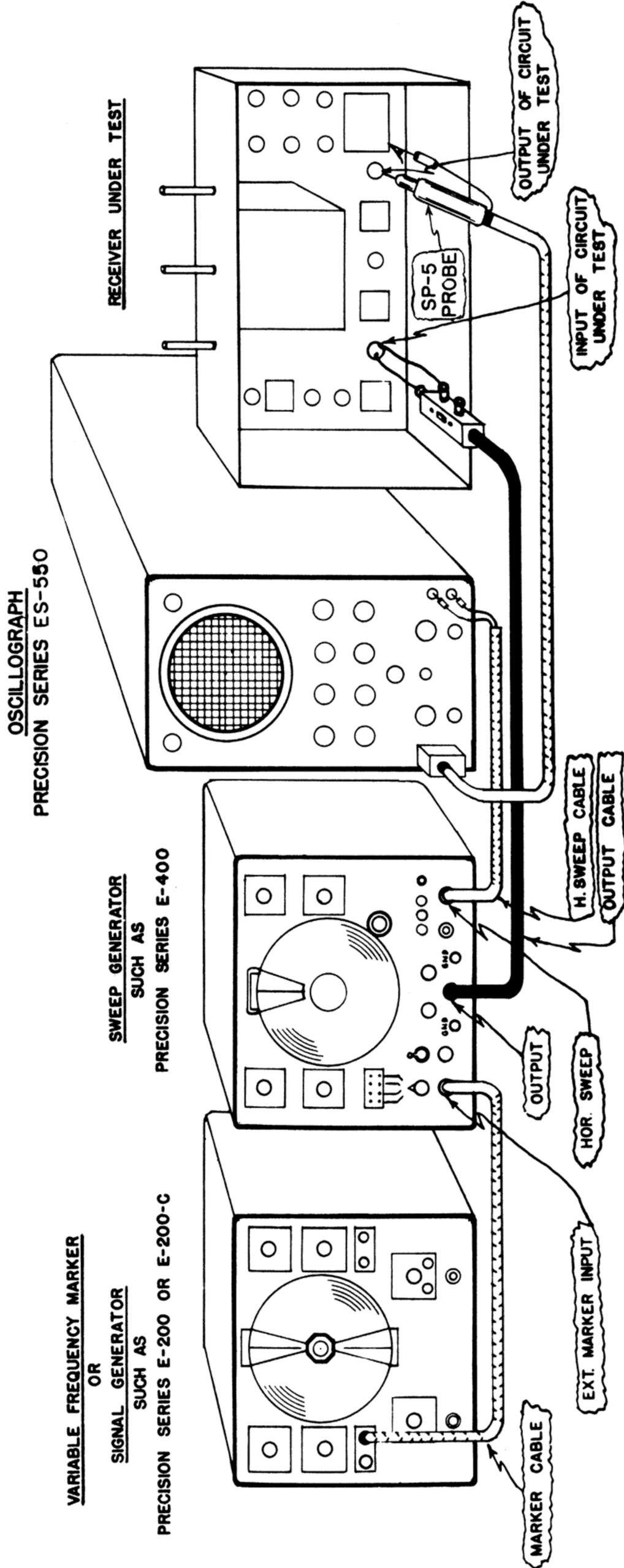
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TYPICAL APPLICATION OF THE ES-550 TO THE ALIGNMENT OF A BROAD BAND AMPLIFIER SUCH AS THE IF STAGES OF AN FM RECEIVER.

THE OSCILLOGRAPH, SWEEP GENERATOR AND OPTIONAL MARKER GENERATOR ARE SET UP AND INTER-CONNECTED AS TYPICALLY ILLUSTRATED IN FIG. 4 PAGE 10A.

1. THE OUTPUT OF THE CIRCUIT UNDER TEST (THE VOLTAGE DEVELOPED ACROSS THE RECEIVER LIMITER GRID RESISTOR IN THIS CASE) CONNECTS TO THE OSCILLOGRAPH THRU USE OF THE SP-5C RESISTIVE ISOLATING PROBE.
2. THE "HOR." AND "GND." POSTS OF THE OSCILLOGRAPH ARE CONNECTED TO THE "HORIZONTAL SWEEP" CONNECTIONS ON THE SWEEP GENERATOR PANEL. WHEN SUCH IS DONE, THE "SWEEP SELECTOR" SWITCH OF THE OSCILLOGRAPH MUST BE SET TO THE "EXT.SW." POSITION.

Fig. 4 TYPICAL SETUP FOR VISUAL ALIGNMENT WITH "PRECISION" SERIES ES-550 OSCILLOGRAPH



SUPPLEMENTARY NOTES

1. FOR IF ALIGNMENT USE THE SP-5C ISOLATING PROBE AT THE VIDEO 2ND DETECTOR OUTPUT. FOR ALIGNMENT OF INDIVIDUAL IF STAGES THE SP-5B DEMODULATOR PROBE MAY BE APPLIED TO THE PLATE OF THE INDIVIDUAL F. M. IF TUBES.
 2. IT IS DESIRABLE TO CONNECT A "GND" TERMINAL OF THE OSCILLOGRAPH PANEL TO THE GROUND TERMINALS OF OTHER INTERCONNECTED TEST INSTRUMENTS AND ALSO TO THE GROUND OF THE CIRCUIT UNDER TEST. (USE METALLIC BRAID FOR ADDITIONAL GROUNDING CONNECTIONS WHEREVER POSSIBLE.)
 3. DO NOT ATTEMPT TO OPERATE THE ES-550 WITH THE INSTRUMENT REMOVED FROM ITS METAL CASE: THE HIGH VOLTAGE SUPPLY GENERATES DANGEROUSLY HIGH POTENTIALS.
- BIBLIOGRAPHY
- "CATHODE RAY TUBE AT WORK" BY RIDER
 "TELEVISION SIMPLIFIED", "FM SIMPLIFIED" BY KIVER
 "RIDER'S TELEVISION MANUAL" BY RIDER
 "RADIO DATA BOOK" BY BOLAND AND BOYCE
 TECHNICAL TRADE JOURNALS, SUCH AS
 "RADIO MAINTENANCE", "RADIO SERVICE DEALER", "SERVICE",
 "SUCCESSFUL SERVICING", "RADIO-ELECTRONICS", "RADIO NEWS",
 ETC.

NOTE: THE PRECEDING PROCEDURE (USING THE SINUSOIDAL HORIZONTAL SWEEP VOLTAGE PROVISIONS OF THE SWEEP GENERATOR TO HORIZONTALLY SWEEP THE OSCILLOGRAPH BEAM) WILL USUALLY PRODUCE A SUPERIMPOSED DOUBLE-TRACE PATTERN.

3. THE CONTROLS OF THE SWEEP GENERATOR AND OPTIONAL MARKER GENERATOR ARE ADJUSTED IN ACCORDANCE WITH THE SWEEP GENERATOR INSTRUCTION MANUAL.
4. THE OSCILLOGRAPH'S "INTENSITY" CONTROL IS ADVANCED CLOCKWISE, TURNING THE INSTRUMENT ON.
5. THE "SWEEP SELECTOR" SWITCH IN THIS EXAMPLE IS SET TO "EXT.SW."
6. THE "FOCUS" AND "INTENSITY" CONTROLS ARE ADJUSTED TO GIVE SHARPEST POSSIBLE TRACE ON THE OSCILLOGRAPH SCREEN AND "SCREEN ILLUM" CONTROL IS ADJUSTED TO GIVE DESIRED AMOUNT OF GRATICULE ILLUMINATION COMMENSURATE WITH LIGHTING CONDITIONS.
7. THE VERTICAL AND HORIZONTAL CENTERING CONTROLS ARE ADJUSTED TO LOCATE THE PATTERN AT THE CENTER OF THE SCREEN.
8. THE "V. GAIN" AND "H. GAIN" CONTROLS ARE ADJUSTED TO OBTAIN SUITABLE PATTERN HEIGHT AND WIDTH.
9. IF THE PATTERN IS INSUFFICIENTLY HIGH WHEN THE "V. ATTENUATOR" SWITCH IS SET TO THE "X100" POSITION, AND THE "V. GAIN" CONTROL SET TO MAXIMUM, THE "X10" OR THE "X1" SETTING OF THE "V. ATTENUATOR" SWITCH MAY BE USED.
10. AFTER HAVING OBTAINED THE OSCILLOGRAPH PATTERN AS DESCRIBED ABOVE, SWITCH IN THE "BLANKING PHASE" CONTROL. ADJUST THIS CONTROL TO OBTAIN A SINGLE TRACE OF UNIFORM BRIGHTNESS. IT MAY BE NECESSARY TO REDUCE THE "INTENSITY" CONTROL SETTING TO OBTAIN A MEDIUM-INTENSITY PATTERN UNDER THESE CONDITIONS. THIS ADJUSTMENT ALSO PERMITS REDUCTION OF ANY RESIDUAL "BLANKED" TRACE. THE "FOCUS" CONTROL MAY REQUIRE MINOR RE-ADJUSTMENT TO PRODUCE MAXIMUM SHARPNESS OF TRACE. (IF THE SWEEP GENERATOR INCORPORATES RETURN TRACE BLANKING, THE "BLANKING PHASE" CONTROL NEED NOT BE USED).

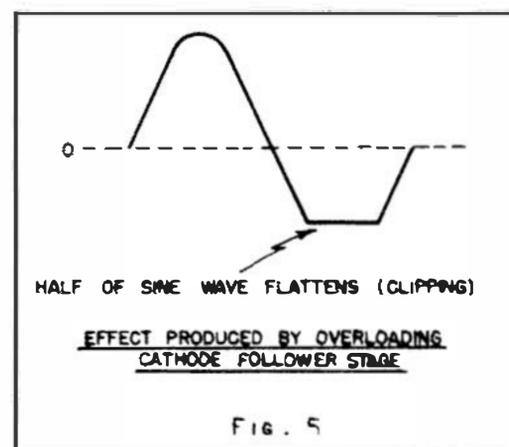
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OVERLOAD NOTE

OPERATORS SOMETIMES ENCOUNTER OVERLOAD DIFFICULTIES BY ATTEMPTING TO DISPLAY HIGH-LEVEL SIGNALS WITH THE "V. ATTENUATOR" SWITCH IN THE "X1" POSITION, AND THE "V. GAIN" CONTROL NEAR ZERO. NEVER SET THE "V. ATTENUATOR" SWITCH TO A LOWER POSITION THAN ACTUALLY NEEDED. FIG. 5 ILLUSTRATES THE SHAPE THAT A SINE WAVE ASSUMES WHEN EXCESSIVE VOLTAGE IS APPLIED TO THE VERTICAL AMPLIFIER IN THE "X1" POSITION. THIS IS DUE TO OVERLOADING IN THE CATHODE FOLLOWER STAGE, THE RESULT OF WHICH IS CLIPPING. IT IS RECOMMENDED THAT THE FOLLOWING APPROXIMATE VOLTAGE LIMITS BE USED IN ORDER TO PREVENT THIS CONDITION FROM OCCURRING.

IN THE:-

- X1 POSITION 4V. R.M.S. MAX.
- X10 POSITION 40V. R.M.S. MAX.
- X100 POSITION 400V. R.M.S. MAX.



EXAMPLE OF USE IN COLOR TV

THE BASIC APPROACH TO VISUAL TROUBLE-SHOOTING AND ALIGNMENT OF COLOR TV RECEIVERS IS IDENTICAL TO THE PROCEDURES USED IN BLACK AND WHITE TV. IN THE CASE OF COLOR HOWEVER THE SCOPE'S VERTICAL BANDWIDTH MUST BE SUFFICIENT TO DISPLAY THE 3.58 MEGACYCLE OSCILLATOR AND COLOR "BURST" SIGNALS. THE MODEL ES-550 HAS BEEN SPECIFICALLY DESIGNED TO MEET AND EXCEED THIS SPECIFICATION.

THE ES-550 IS OTHERWISE NO MORE COMPLICATED IN APPLICATION THAN A STANDARD BANDWIDTH SCOPE SUCH AS PRECISION MODEL ES-520.

THE PROCEDURE FOR ALIGNMENT OF COLOR RECEIVERS AS SET FORTH BY THE RECEIVER MANUFACTURER USUALLY CALLS FOR ACCURATE MARKING OF VIDEO I.F. RESPONSE WAVEFORMS AND CAREFUL ALIGNMENT ADJUSTMENTS THEREIN: HOWEVER THE ROLE OF THE SCOPE IN THESE APPLICATIONS IS AS UNCOMPLICATED AS IN BLACK AND WHITE TV. (IT IS IMPORTANT TO NOTE THAT THE SET MANUFACTURER WILL REQUIRE THE USE OF A DIODE PROBE OR DEMODULATION PROBE SUCH AS IS INCLUDED IN PRECISION SP-5 PROBE SET.)

THE WIDE BANDWIDTH OF THE ES-550 COMES INTO USE IN THE FOLLOWING APPLICATIONS:1. COLOR AFC ALIGNMENT:

THE COLOR BURST INPUT INDUCTANCE AND THE BURST AMPLIFIER TRANSFORMER IS ADJUSTED FOR MAXIMUM DC OUTPUT OF THE PHASE DETECTOR, IN A TYPICAL COLOR CHASSIS. AT THIS POINT THE MANUFACTURER USUALLY RECOMMENDS THAT THE SHAPE OF THE BURST SIGNAL BE OBSERVED, AND MAY NOTE THAT THE SHAPE OF THE BURST SHOULD NOT CHANGE WHILE ROTATING THE HORIZONTAL HOLD CONTROL OVER THE SYNC RANGE.

2. 3.58 Mc TRAP ADJUSTMENT:

IN A TYPICAL SET THIS TRAP APPEARS IN THE PLATE CIRCUIT OF THE 1ST VIDEO AMPLIFIER. IT MAY BE ALIGNED BY FEEDING A SWEEP SIGNAL TO THE GRID OF THE 1ST VIDEO AMPLIFIER TUBE AND BY ADJUSTING THE 3.58 Mc POINT ON THE RESPONSE CURVE OBTAINED BY APPLYING THE SCOPE AND DEMODULATION PROBE TO THE OUTPUT OF THE 2ND VIDEO AMPLIFIER.

AS A SIMPLER ALTERNATIVE PROCEDURE, (IF A COLOR BAR SIGNAL IS AVAILABLE), THE WIDE BAND 550 SCOPE MAY BE APPLIED TO THE PICTURE TUBE GRIDS (USING PRECISION SP-5A PROBE) AND THE 3.58 Mc TRAP ADJUSTED FOR MINIMUM COLOR SUB-CARRIER INDICATION IN THE VIDEO SIGNAL.

3. OBSERVATION OF THE BURST SIGNAL AT THE VIDEO 2ND DETECTOR.

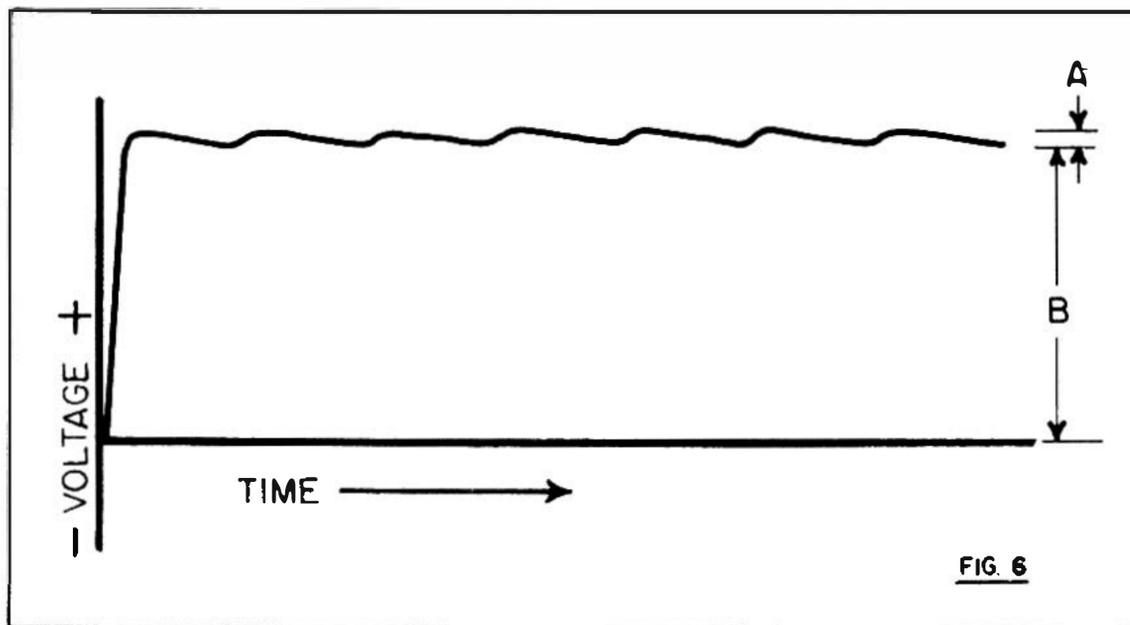
WITH THE SCOPE AND LOW CAPACITY PROBE APPLIED TO THIS OUTPUT OF THE VIDEO 2ND DETECTOR, THE COMBINATION OF HORIZONTAL SYNC PULSE AND 3.58 Mc BURST SIGNAL WILL BE OBSERVED DURING A COLOR TRANSMISSION. RELATIVE PROPORTIONS OF BURST-TO-SYNC PULSE HEIGHT CAN BE CHECKED AGAINST SET MANUFACTURERS' DATA.

FURTHER WIDE-BAND APPLICATIONS MAY BE NOTED IN THE DETAILED MANUFACTURER'S ALIGNMENT AND TROUBLESHOOTING DATA.

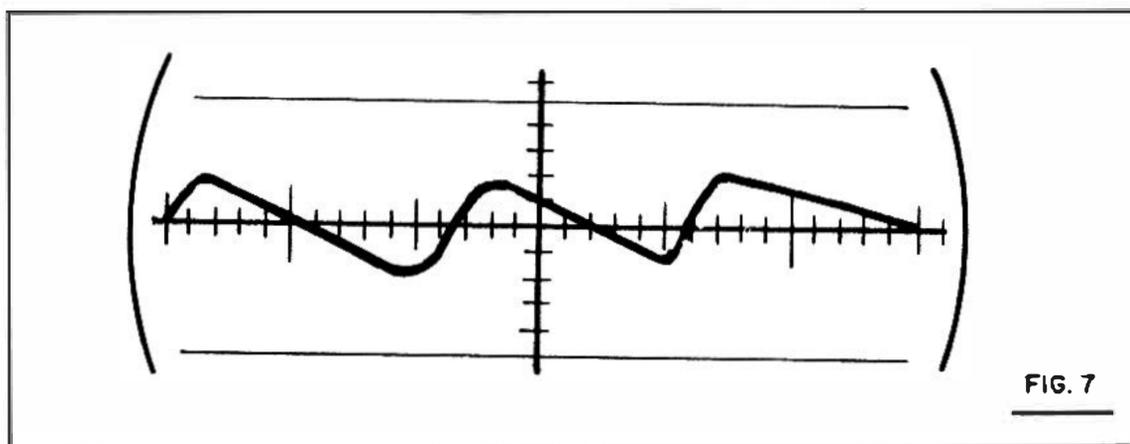
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COMPOSITE DC AND AC VOLTAGES

THE MOST IMPORTANT FUNCTION OF A COMMERCIAL CATHODE RAY OSCILLOSCOPE IS THE ANALYSIS OF AC WAVE-SHAPES. HOWEVER CERTAIN AC POTENTIALS MAY BE A PART OF A COMPOSITE AC AND DC POTENTIAL. AS A SIMPLE EXAMPLE, THE VOLTAGE ACROSS THE INPUT FILTER CONDENSER OF A POWER SUPPLY WILL BE A DC VOLTAGE UPON WHICH IS SUPER-IMPOSED AN AC RIPPLE. SEE FIG. 6



THE VOLTAGE IS ACTUALLY A DC VOLTAGE WHICH IS VARYING IN MAGNITUDE AS A RESULT OF THE CHARGE AND DISCHARGE ACTION OF THE FILTER. THE RIPPLE POTENTIAL "A" IS HOWEVER AN ALTERNATING VOLTAGE IN ITSELF AND WILL AFFECT THE RECEIVER CIRCUITS AS AN ALTERNATING VOLTAGE. IF THIS D.C. POTENTIAL WITH ITS SUPERIMPOSED RIPPLE IS APPLIED TO THE INPUT TERMINALS OF THE 'SCOPE THE PATTERN OBTAINED WILL APPEAR AS IN FIG. 7.

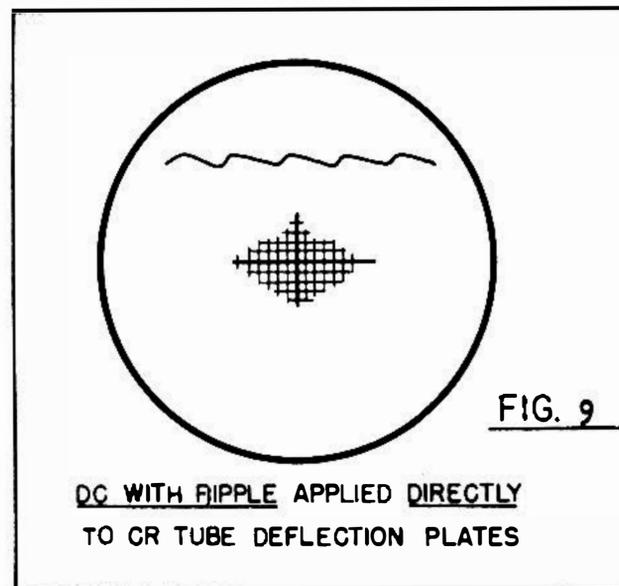
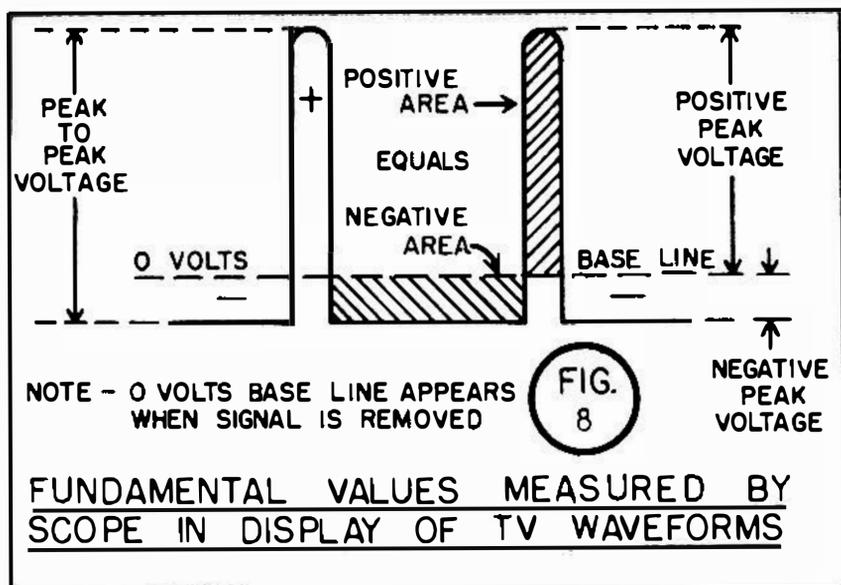


IT IS IMPORTANT TO NOTE THAT THE DC PORTION OF THE TOTAL POTENTIAL IS NOT DISPLAYED BY THE 'SCOPE. DC POTENTIALS ARE BLOCKED BY THE SERIES INPUT CAPACITOR OF THE 'SCOPE AND BY THE CAPACITY COUPLING EMPLOYED BETWEEN THE AMPLIFIER STAGES OF THE 'SCOPE.

OBSERVATION OF AC AND DC COMPONENTS

IF IT IS DESIRED TO OBSERVE BOTH THE DC AND ITS SUPERIMPOSED AC COMPONENT, (WITH THE PROPER RELATION TO THE ZERO VOLTAGE AXIS), THE VOLTAGE SHOULD BE CONNECTED DIRECTLY TO THE DEFLECTION PLATES OF THE CR TUBE (SEE PAGE 6).

THE DC BLOCKING OF THE AMPLIFIER STAGES IS THUS ELIMINATED, AND THE AC COMPONENT WILL APPEAR ABOVE THE HORIZONTAL BASE-LINE OF THE CROSS HATCH MASK TO AN EXTENT DETERMINED BY THE MAGNITUDE OF THE DC COMPONENT. SEE FIG. 9



THE RELATIVE MAGNITUDE OF THE POSITIVE AND NEGATIVE CYCLES OF A NON SINUSOIDAL VOLTAGE WAVEFORM DEPENDS UPON THE SHAPE AND PROPORTIONS OF THE WAVEFORM.

AS AN EXAMPLE:- WITH NO SIGNAL APPLIED TO THE 'SCOPE, ADJUST THE HORIZONTAL 'SCOPE TRACE TO COINCIDE WITH THE MIDDLE HORIZONTAL LINE OF THE CORSS HATCH MASK.

IF A SINUSOIDAL VOLTAGE IS NOW APPLIED TO THE 'SCOPE, THE POSITIVE PORTION OF THE SINE WAVE WILL EQUAL THE NEGATIVE PORTION.

IF, HOWEVER A NON-SINUSOIDAL VOLTAGE OF THE SHAPE INDICATED IN FIG. 8 IS NEXT APPLIED, THE POSITIVE AND NEGATIVE PORTIONS WILL BE REVEALED AS STRIKINGLY UNEQUAL.

THE CONCLUSION TO BE DRAWN FROM THIS DISCUSSION IS AS FOLLOWS:

"THE AC OSCILLOSCOPE ALWAYS PORTRAYS A NON-SINUSOIDAL VOLTAGE AS IT WILL BE TRANSMITTED THROUGH AC COUPLED CIRCUITS IN ACTUAL EQUIPMENT."

* * * * *

1. DISPLAY OF CLEAN SYNC PULSES

IT SHOULD BE OBSERVED THAT THE "BLANKING PHASE" CONTROL PERMITS THE OPERATOR TO OBTAIN A CLEAN HORIZONTAL SYNC PULSE, OR A CLEAN VERTICAL SYNC PULSE, AS ILLUSTRATED IN FIG. 3 PG. 5. IN THIS APPLICATION, THE SYNC PULSE IS DISPLAYED IN THE NORMAL MANNER, AND THE "BLANKING PHASE" CONTROL IS THEN ROTATED AS REQUIRED TO DISPLAY THE PULSE WITHOUT INTERFERENCE.

2. RETRACE BLANKING

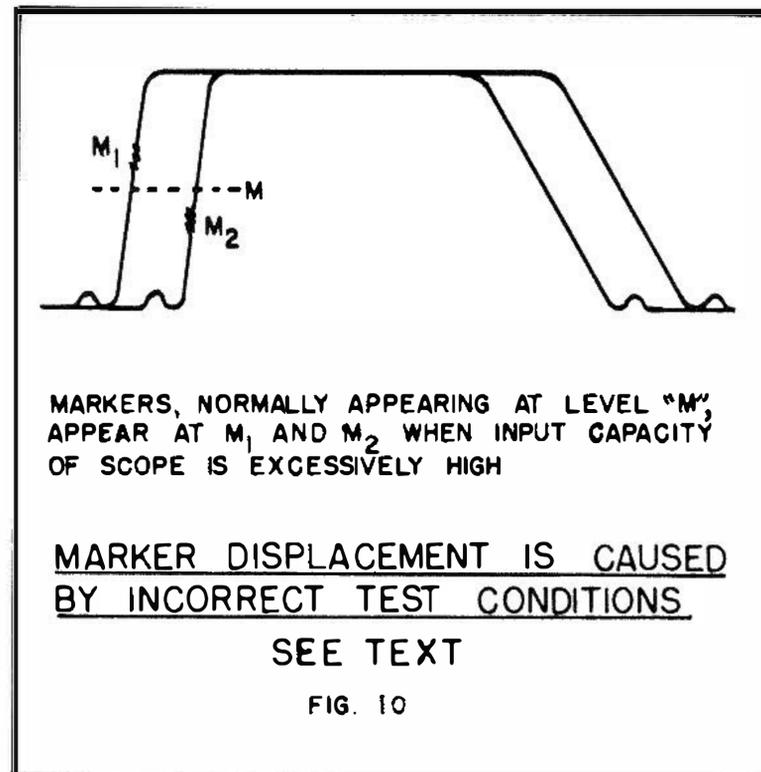
RESIDUAL TRACE (RETRACE) WHICH IS USUALLY ACCENTUATED AT THE HIGHER SWEEP FREQUENCIES, IN MANY COMMERCIAL SCOPES, IS BLANKED OUT IN THE ES-550 THROUGHOUT THE COMPLETE HORIZONTAL SWEEP RANGE.

3. APPARENT DISPLACEMENT OF MARKER PIPS OBTAINED IN VISUAL ALIGNMENT

UNDER SOME CONDITIONS, THE OPERATOR MAY OBSERVE THAT THE MARKER APPEARS HIGHER UP ON THE TRACE THAN ON THE RETRACE, AS SHOWN IN FIG. 10 WHEN USING 60-CYCLE SINE-WAVE SWEEP IN ALIGNMENT WORK.

IT WILL BE OBSERVED THAT THE MARKER "DISPLACEMENT" APPEARS GREATER ON THE STEEPER PORTION OF THE CURVE, AND BECOMES LESS AS THE SWEEP WIDTH IS REDUCED. FURTHERMORE, THE "DISPLACEMENT" BECOMES GREATER AS THE EXTERNAL INPUT CAPACITANCE TO THE 'SCOPE IS INCREASED.

THIS "DISPLACEMENT" APPEARS BECAUSE EXCESSIVE INPUT CAPACITANCE INCREASES THE DECAY TIME FOR STEEP WAVEFRONTS BEYOND PERMISSIBLE LIMITS. AS A RESULT, THE ELECTRON BEAM IN THE CRT LAGS THE DETECTOR VOLTAGE, AND FALSE INDICATION IS OBTAINED ON THE 'SCOPE SCREEN.



4. HORIZONTAL SPREAD OF MARKER PIPS OBTAINED IN FM AND TV VISUAL ALIGNMENT

IF THE EXTERNAL INPUT CAPACITY TO THE 'SCOPE IS QUITE LOW, MARKER PIPS ON FM OR TV RESPONSE CURVES MAY APPEAR QUITE BROAD, PARTICULARLY ON HORIZONTALLY FLAT PORTIONS OF THE WAVESHAPE UNLESS AN ISOLATING PROBE SUCH AS PRECISION SP-5C IS USED.

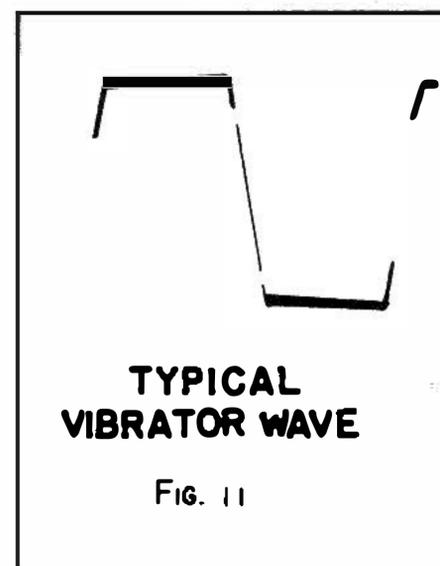
5. ADJUSTMENT OF POWER-SUPPLY VIBRATORS:

DURING OPERATION IN THE RADIO RECEIVER, OR IN A SUITABLE TEST JIG, AN OSCILLOGRAPHIC TEST OF THE WAVEFORM ACROSS THE PRIMARY OF THE VIBRATOR TRANSFORMER SHOULD DISPLAY A SHAPE SIMILAR TO THAT OF FIG. 11. BREAKS, PIPS, AND DIPS IN THE WAVESHAPE INDICATE VARIOUS CONTACT TROUBLES WHICH SHOULD BE CORRECTED AS REQUIRED.

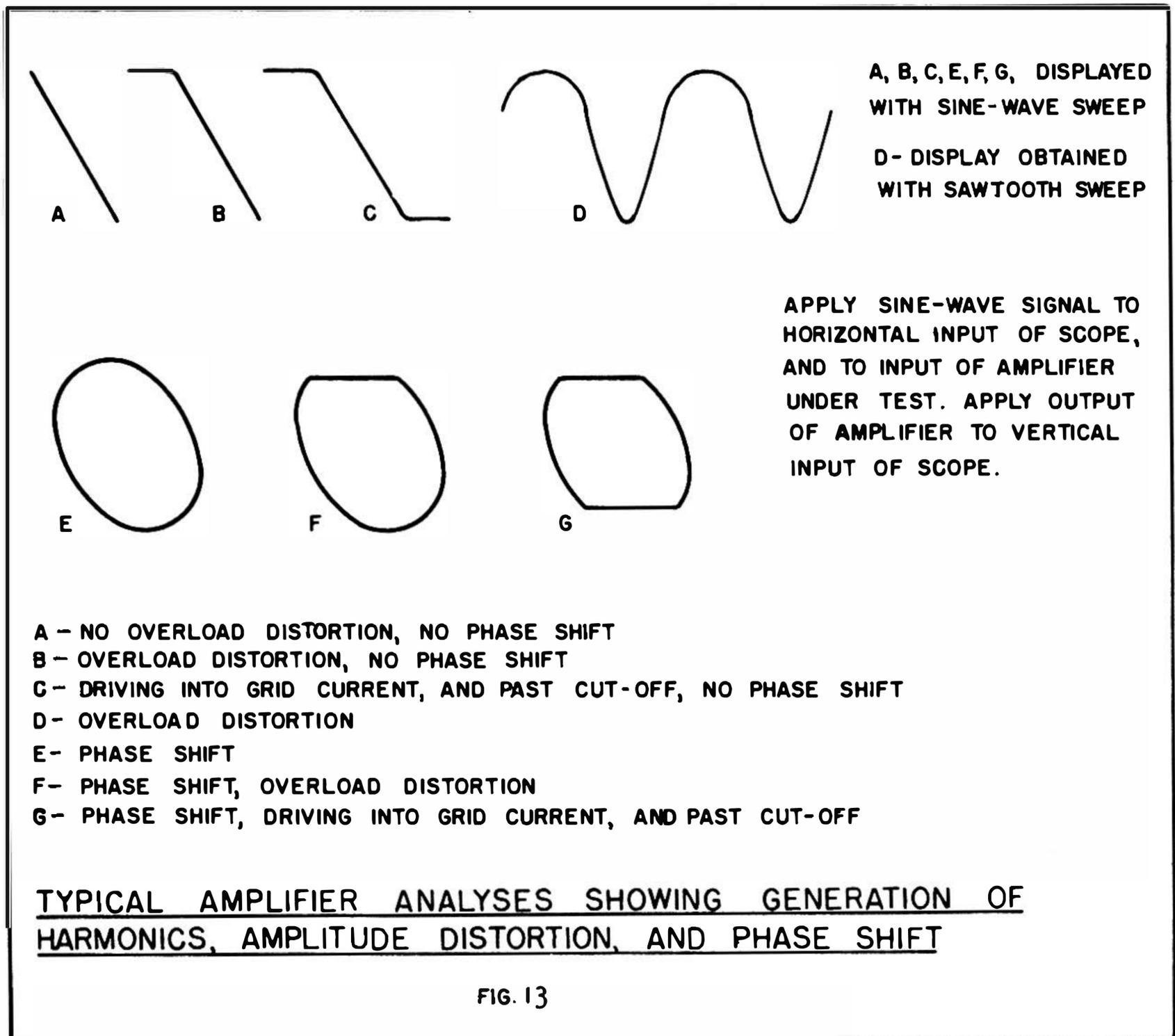
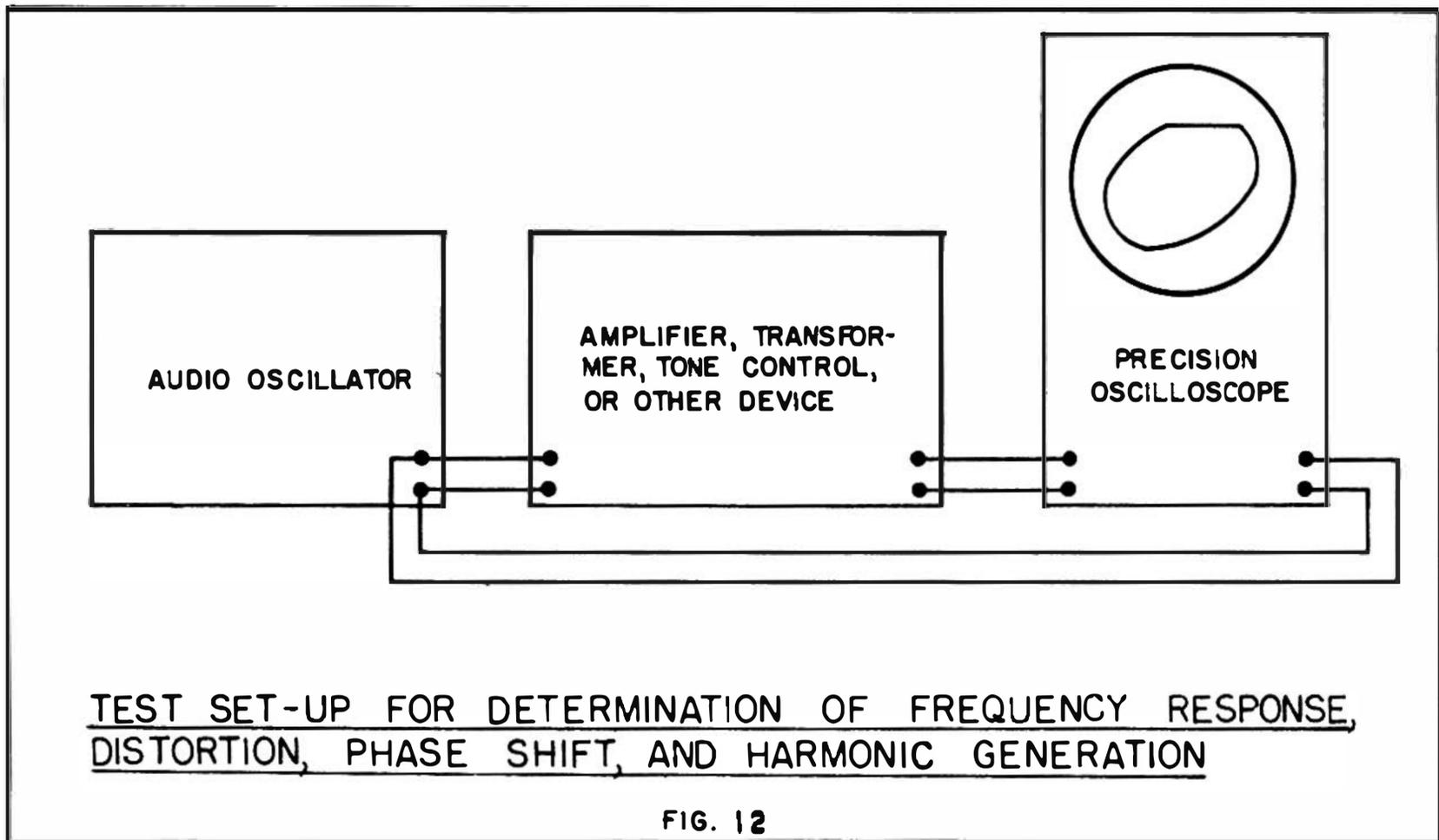
6. AUDIO AMPLIFIER AND COMPONENT ANALYSIS

THE ES-550 IS ALSO VALUABLE IN CHECKING THE PERFORMANCE OF THE AUDIO SECTION OF A RECEIVER. FOR THIS PURPOSE, AN AUDIO OSCILLATOR IS USED IN A TEST SET-UP, AS SHOWN IN FIG. 12. THE WAVEFORMS SHOWN IN FIG. 13, NEXT PAGE, ILLUSTRATE:

- (A) NO DISTORTION AT THE FREQUENCY OF TEST, AND NO PHASE SHIFT; (B) OVERLOAD DISTORTION DUE TO LIMITING OR DRIVING BEYOND CUT-OFF; (C) OVERLOAD DISTORTION DUE TO LIMITING ACTION AND DRIVING BEYOND CUT-OFF; (D) SHOWS THE SAWTOOTH-SWEPT DISPLAY OF "B", WHICH IS OBTAINED BY SINE WAVE SWEEP; (E) PHASE SHIFT; (F) PHASE SHIFT PLUS OVERLOAD DISTORTION.



(SEE NEXT PAGE)

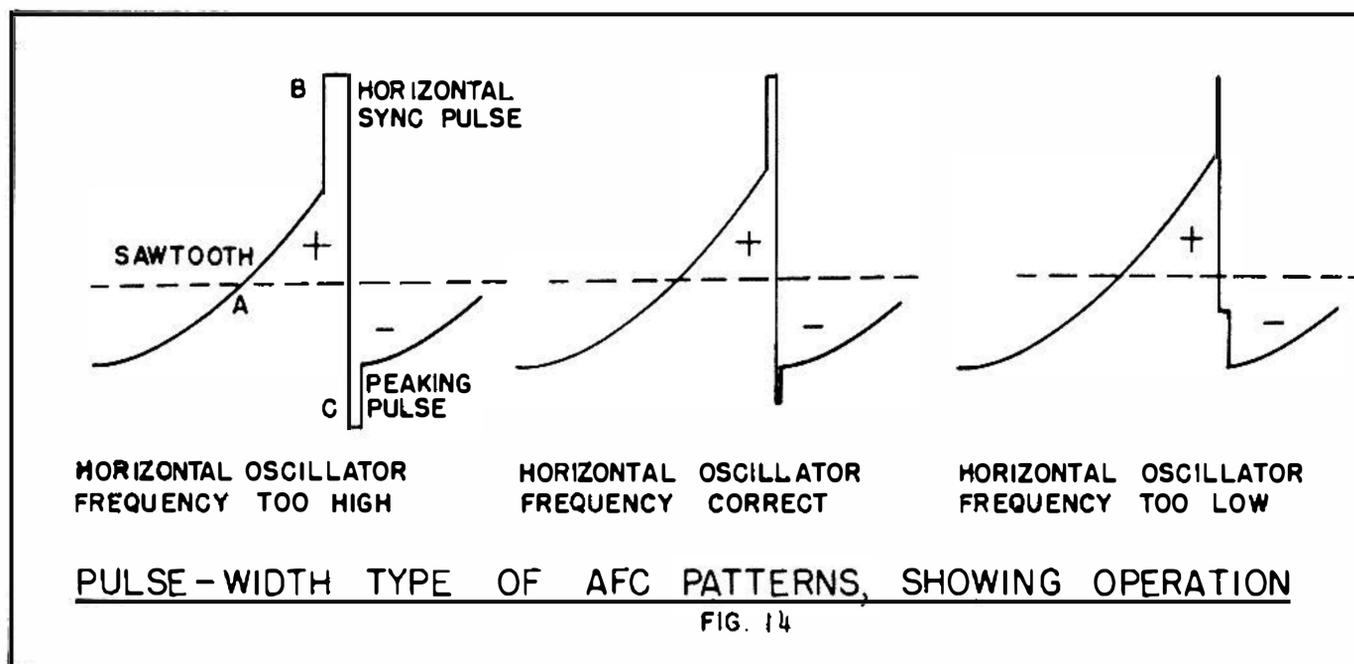


7. ADJUSTMENT OF SYNC CIRCUITS

PROPER ADJUSTMENT OF THE THREE MAIN TYPES OF SYNC CIRCUITS IS GREATLY FACILITATED BY USE OF THE OSCILLOGRAPH. THESE ARE BRIEFLY REVIEWED IN ORDER:

- A. **PULSE-WIDTH TYPE OF SYNC-CONTROL CIRCUIT:** AS SHOWN IN FIG. 14 THIS TYPE OF AFC SYSTEM UTILIZED THREE SIGNAL COMPONENTS COMPRISING THE "SAWTOOTH" A, THE POSITIVE SYNC PULSE B, AND A NEGATIVE PEAKING PULSE C. AS THE ADJUSTMENTS OF THE CIRCUIT ARE CHANGED, IT WILL BE OBSERVED THAT THE POSITIVE PEAK OF THE WAVE IS ABOUT 50% MAXIMUM.

SPECIAL NOTE: A TV STATION MUST BE TUNED IN DURING THE TIME THIS ADJUSTMENT IS MADE.



- B. **PULSE-AND-SAWTOOTH TYPE OF SYNC-CONTROL CIRCUIT:** FIG. 15, PAGE 18, ILLUSTRATES TYPICAL CONTROL CIRCUIT WAVEFORMS. THE ADJUSTMENTS ARE MADE TO EQUALIZE THE PULSES AT THE POSITIVE AND NEGATIVE PEAKS OF THE SAWTOOTH WAVE.
- C. **SINE-WAVE AND PULSE TYPE OF SYNC-CONTROL CIRCUIT:** TYPICAL WAVEFORMS ARE SHOWN IN FIG. 16, PAGE 18. THE SYNC TRANSFORMER IS ADJUSTED TO PHASE THE PULSES ON THE SINE WAVES AS SHOWN IN THE INSET.

THERE ARE ALSO LESS-COMMON TYPES OF AFC CIRCUITS FOR HORIZONTAL SYNC STABILIZATION; IN THESE CIRCUITS THE OPERATOR WILL ALSO FIND THE 'SCOPE A MOST VALUABLE TOOL. THE MANUFACTURER'S SERVICE DATA SHOULD BE CONSULTED TO DETERMINE THE PROPER WAVEFORM INDICATION.

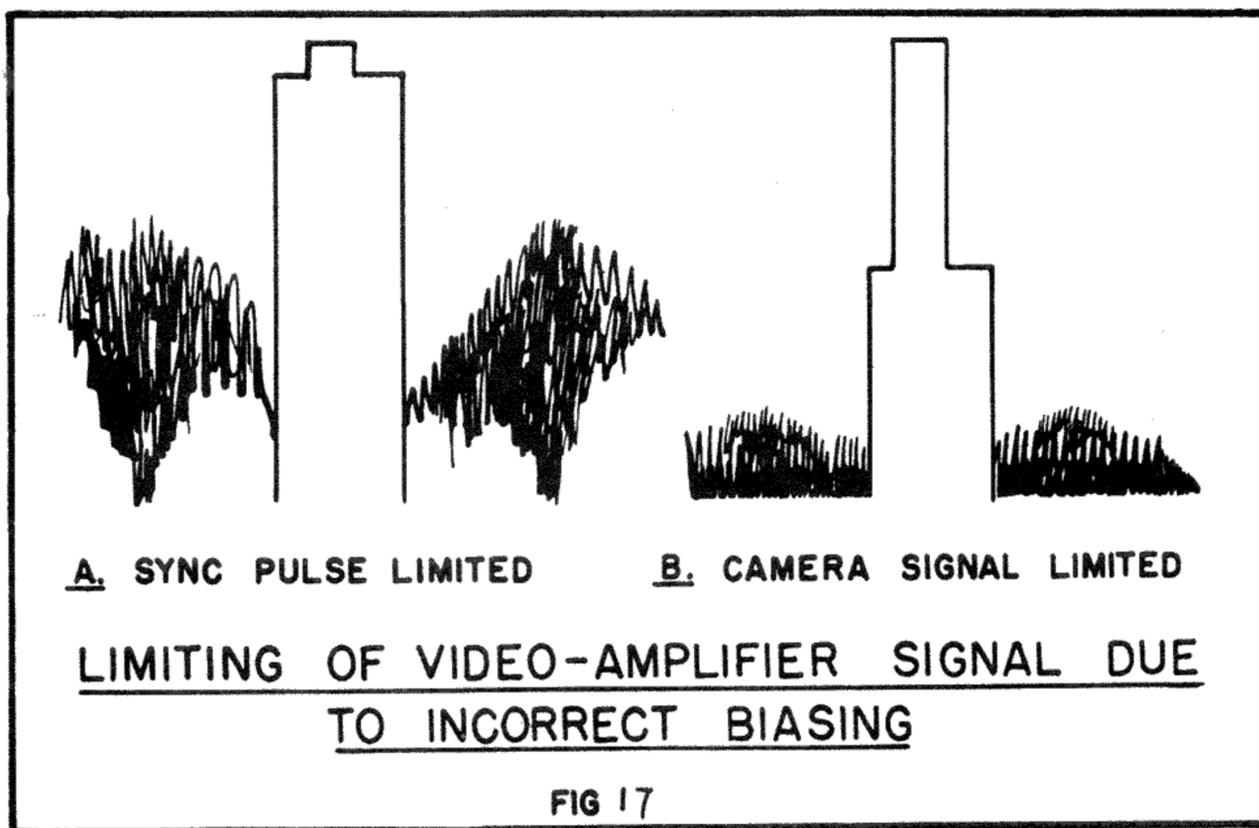
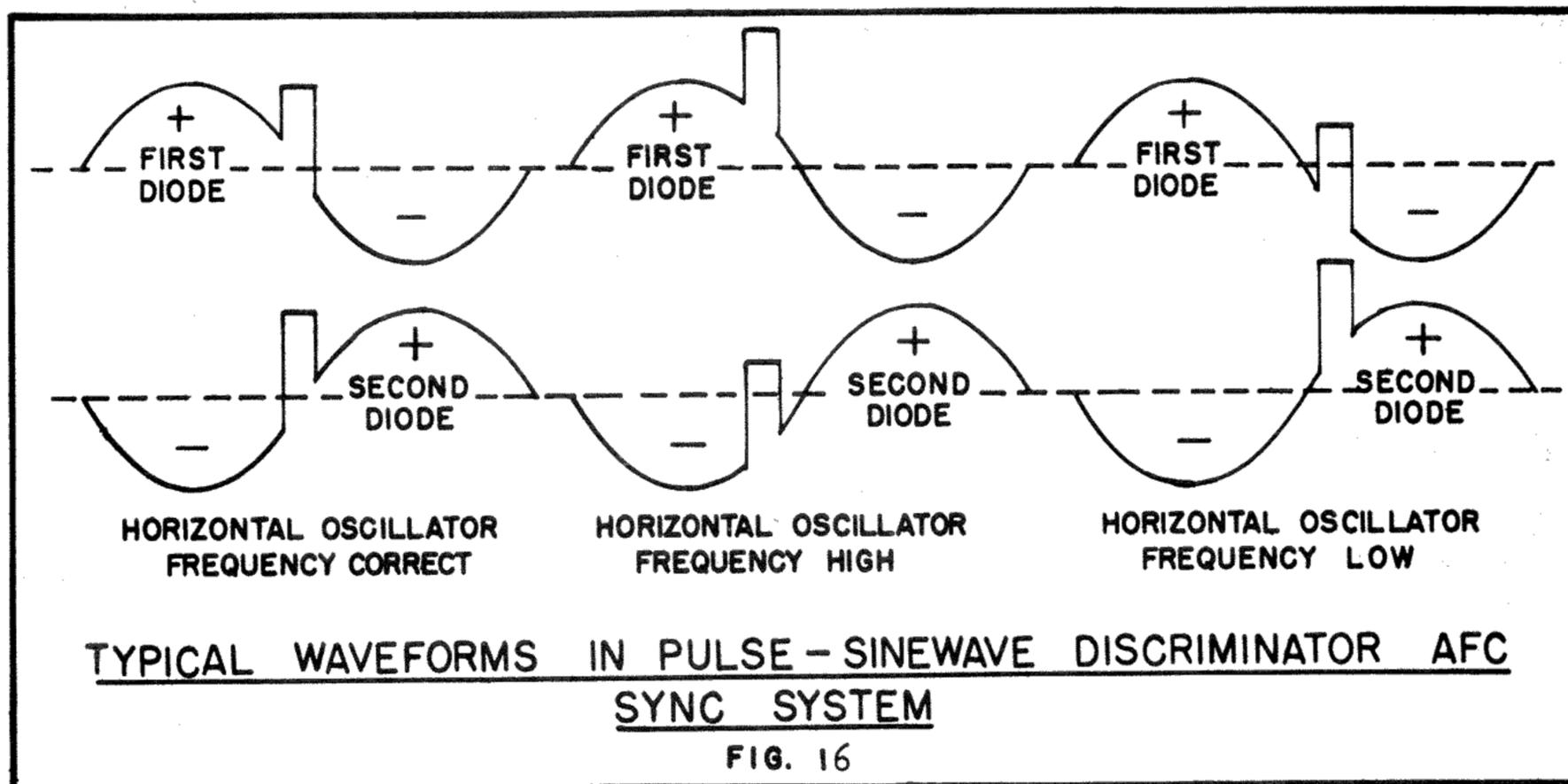
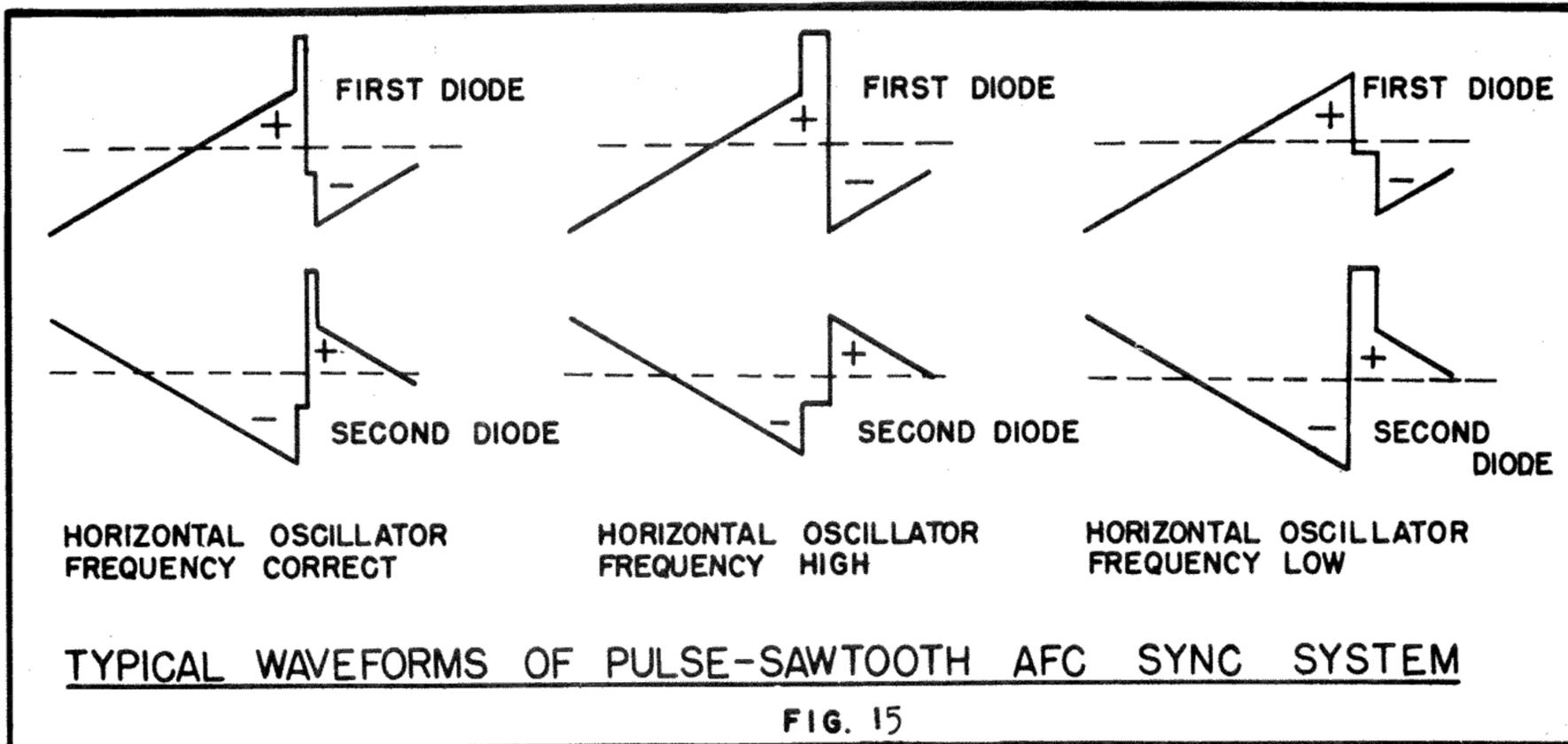
8. TROUBLESHOOTING BUZZ AND HUM:

BECAUSE 60-CYCLE BUZZ IN THE SOUND IS A COMMON TROUBLE COMPLAINT, THE OPERATOR CANNOT AFFORD TO OVERLOOK THE UTILITY OF THE 'SCOPE IN THIS APPLICATION.

REMEMBER THAT IN THE AUDIO SECTION, YOU WILL USE A DIRECT CABLE TO THE 'SCOPE, OR PERHAPS THE 10-TO-1 PROBE. HOWEVER, IN THE HIGH-FREQUENCY SECTIONS OF THE RECEIVER, YOU WILL USE A SIGNAL-TRACING PROBE. (SP-5B).

USE 60 CYCLE LINE SWEEP FOR THIS ANALYSIS, AND FAMILIARIZE YOURSELF WITH THE DISPLAY OF HUM AND PULSES: HUM DUE TO SINE-WAVE VOLTAGES WILL APPEAR AS AN ELLIPSE ON THE SCREEN. THE WIDER THE ELLIPSE, THE GREATER THE HUM. BUZZ WILL APPEAR AS DISCONTINUITY IN THE BASE LINE (OR ELLIPSE IF HUM IS ALSO PRESENT). BUZZ MAY APPEAR AS A SAWTOOTH OR TRIANGLE, OR AS A PIP.

TRACE THE SPURIOUS SIGNAL OR SIGNALS BACK TO THEIR SOURCE, USING SUITABLE PROBES. IF THE BUZZ IS WEAK, USE FULL GAIN ON THE 'SCOPE. NOTE THAT THE PHASE CONTROL OF THE 'SCOPE CAN BE USED TO OBTAIN THE MOST FAVORABLE DISPLAY OF THE SIGNAL.



BUZZ IS SOMETIMES CAUSED BY RECEIVER OVERLOADING. TO CHECK THIS POSSIBILITY, OBSERVE THE COMPOSITE VIDEO WAVEFORM AT THE SOUND-TAKEOFF POINT, USING THE 10-TO-1 PROBE. HORIZONTAL SYNC PULSES, SEEN WHEN USING A 15,750-CYCLE SAWTOOTH SWEEP, SHOULD APPEAR UNDISTORTED, AND NOT LIMITED OR CLIPPED AS SHOWN IN FIG. 17A. LIKEWISE, THE CAMERA SIGNAL SHOULD NOT SHOW EVIDENCE OF LIMITING, AS SHOWN IN FIG. 17B.

* * * * *

MAINTENANCE NOTES

THE HIGH VOLTAGE POWER SUPPLY IN YOUR ES-550 IS A SOURCE OF DANGEROUSLY HIGH POTENTIALS. NEVER ATTEMPT INDISCRIMINATE ADJUSTMENTS OR REPAIRS TO THE CHASSIS OF THE MODEL ES-550 WITH THE LINE CORD CONNECTED TO THE POWER SOURCE.

IN CASES WHEREIN THE INSTRUMENT DOES NOT APPEAR TO BE ENERGIZED OR POWERED WHEN THE LINE CORD IS INSERTED INTO THE POWER LINES (AND WITH THE "INTENSITY" CONTROL ADVANCED CLOCKWISE), THE 3AG FUSE SHOULD BE EXAMINED FOR BURN-OUT. THE FUSE IS MOUNTED BEHIND THE ETCHED BACK SERIAL PLATE AS INDICATED.

NEVER REPLACE A BURNED FUSE UNTIL THE CONDITION WHICH CAUSED THE FUSE BURN-OUT HAS BEEN CORRECTED. IF IT BECOME NECESSARY TO REMOVE THE INSTRUMENT FROM THE CASE, THIS CAN BE DONE BY REMOVING THE 12 PANEL SCREWS, THE 3 CHASSIS-HOLDING SCREWS AT THE REAR OF THE CASE, AND 2 SCREWS ON THE BOTTOM OF THE CASE.

NOTE 1: TEST LEADS ARE NOT FURNISHED WITH THE MODEL ES-550. THERE ARE SO MANY DIVERSIFIED APPLICATIONS FOR A CATHODE-RAY OSCILLOGRAPH THAT IT WOULD BE ESSENTIALLY IMPOSSIBLE TO SUPPLY ANY ONE SET OF LEADS WHICH WOULD BE UNIVERSALLY USEABLE.

NOTE 2: NEVER APPLY VOLTAGES HIGHER THAN 400 VOLTS RMS TO THE ES-550 INPUT CONNECTING TERMINALS WITHOUT USING AN ADDITIONAL EXTERNAL SERIES ISOLATING CAPACITOR. (APPROXIMATELY .5 MFD. CAPACITY AND OF PROPER VOLTAGE RATING).

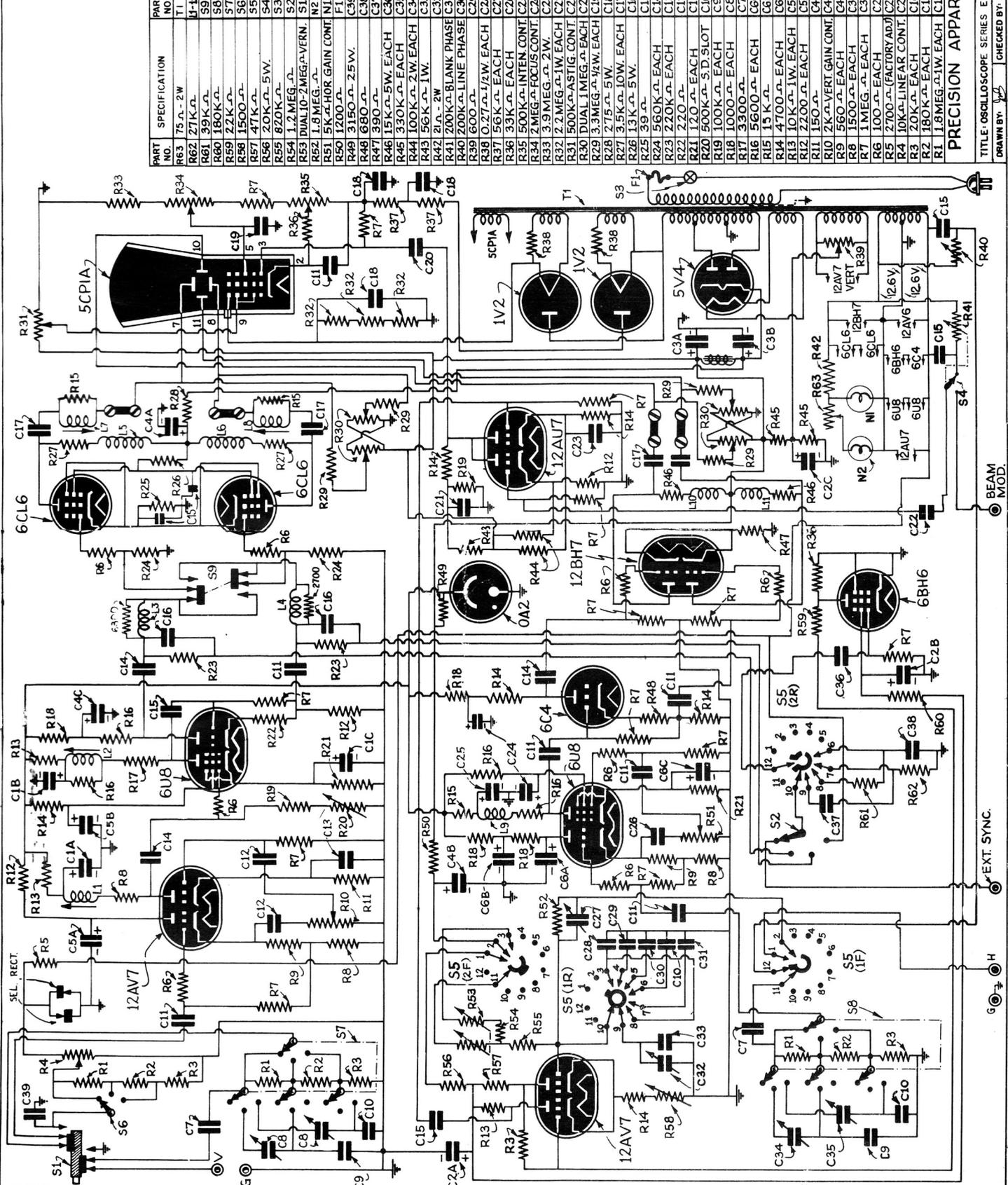
IN ALL CASES WHERE FAULTY OPERATION OF THE INSTRUMENT IS SUSPECTED THE SERVICE DEPARTMENT OF PRECISION APPARATUS., SHOULD FIRST BE CONSULTED. SHOULD THE SERVICE DEPT. RECOMMEND RETURN OF THE INSTRUMENT TO THE FACTORY, THE COMPLETE INSTRUMENT SHOULD BE CAREFULLY PACKED IN A WELL PADDED, STRONG CORRUGATED SHIPPING CARTON AND ADDRESSED TO PRECISION'S SERVICE DEPT.

IMPORTANT NOTE: THE ORIGINAL PACKING OF THE MODEL ES-550 IS ADMIRABLY SUITED FOR THIS PURPOSE.

IMPORTANT: IF AT ANY TIME THE MODEL ES-550 IS TO BE RETURNED TO THE FACTORY FOR REPAIR, A COMPLETE DESCRIPTION OF SUSPECTED FAULTY OPERATION, AS NOTED BY THE OPERATOR, MUST ACCOMPANY THE INSTRUMENT. THE MORE DETAILS SUBMITTED TO THE SERVICE DEPARTMENT OF PRECISION, THE MORE QUICKLY AND EFFICIENTLY THE INSTRUMENT CAN BE REPAIRED AND RETURNED. IT IS VERY IMPORTANT THAT THIS DESCRIPTION OF SUSPECTED FAULTY OPERATION BE GIVEN IN UNUSUALLY EXACT DETAIL DUE TO THE FACT THAT IN MANY CASES, FAULTY OPERATION CAN BE TRACED TO DIFFICULTIES IN OTHER ITEMS OF TEST EQUIPMENT AND/OR IMPROPER ANALYSIS OF RESULTS OBTAINED.

YOUR MODEL ES-550 OSCILLOGRAPH IS A RELATIVELY CRITICAL AND DELICATE INSTRUMENT, DO NOT ATTEMPT ANY MAJOR REPAIRS BEFORE CONSULTING THE SERVICE DEPARTMENT OF PRECISION APPARATUS.

PRECISION APPARATUS
Division Of Dynascan Corporation
1801 W. Belle Plaine
Chicago, Illinois 60613



PART NO.	SPECIFICATION	PART NO.	SPECIFICATION
R63	75 Ω - 2W	T1	POWER TRANSFORMER
R62	27K Ω	U-1	PEAKING COILS
R61	39K Ω	S9	POLARITY REV. SW.
R60	180K Ω	S8	H. ATTENUATOR SW.
R59	22K Ω	S7	V. ATTENUATOR SW.
R58	1500 Ω	S6	P-P RANGE SW.
R57	47K Ω	S5	RANGE SELECTOR SW.
R56	20K Ω - 5W.	S4	BLANK PHASE SW.
R55	620K Ω	S3	LINE SW ON INT. CONT.
R54	1.2 MEG. Ω	S2	SYNC. SELECTOR SW.
R53	DUAL 10-2 MEG. Ω - VERN.	S1	P-P CAL. PUSHBUTTON
R52	1.8 MEG. Ω	N2	№47 PILOT LAMP
R51	5K Ω - HOR. GAIN CONT.	N1	№47 PILOT LAMP
R50	1200 Ω	F1	15 AMP. FUSE
R49	3150 Ω - 2.5W.	C39	18000 MMFD.
R48	680 Ω	C38	3300 MMFD.
R47	390 Ω	C37	270 MMFD.
R46	15K Ω - 5W. EACH	C36	0.33 MFD. - 600V.
R45	330K Ω - EACH	C35	4-30 MFD. - TRIMMER
R44	100K Ω - 2W. EACH	C34	4-30 MFD. - TRIMMER
R43	56K Ω - 1W.	C33	500 μmf
R42	2.1 Ω - 2W	C32	120-620 μmf TRIMMER
R41	200K Ω - BLANK PHASE	C31	1000 μF - MFD.
R40	200K Ω - LINE PHASE	C30	0.068 - MFD.
R39	600 Ω	C29	0.043 - MFD.
R38	0.27 Ω - 1/2W. EACH	C28	0.2 - MFD.
R37	56K Ω - EACH	C27	4-30 MFD. TRIM (SINGLE)
R36	33K Ω - EACH	C26	100 MFD. - 15V.
R35	500K Ω - INTEN. CONT.	C25	8 MFD. - 150V.
R34	2 MEG. Ω - FOCUS CONT.	C24	40 MFD. - 150V.
R33	3.9 MEG. Ω - 2W.	C23	180 μmf
R32	2.2 MEG. Ω - 1W. EACH	C22	0.1 - MFD. - 600V.
R31	500K Ω - ASTIG. CONT.	C21	0.2 - MFD. - 250V.
R30	DUAL 1 MEG. Ω - EACH	C20	0.2 - MFD. - 1600V.
R29	3.9 MEG. Ω - 1/2W. EACH	C19	1.006 - MFD. - 1600V.
R28	2.75 Ω - 5W.	C18	0.4 - MFD. - 1500V. EACH
R27	3.5K Ω - 10W. EACH	C17	0.22 - MFD. - 400V. EACH
R26	13K Ω - 5W.	C16	8 μmf. MICA EACH
R25	39 Ω	C15	0.1 - MFD. - 200V. EACH
R24	560K Ω - EACH	C14	0.22 - MFD. - 200V. EACH
R23	220K Ω - EACH	C13	500 MFD. - 6V.
R22	220 Ω	C12	250 MFD. - 15V. EACH
R21	120 Ω - EACH	C11	0.47 - MFD. - 200V. EACH
R20	500K Ω - 5-D. SLOT	C10	1000 MMFD. EACH
R19	100K Ω - EACH	C9	82 MMFD. EACH
R18	1000 Ω - EACH	C8	4-30 MMFD. DUAL TRIM.
R17	3300 Ω - EACH	C7	0.25 - MFD. - 600V. EACH
R16	5600 Ω - EACH	C6	500 MFD. - 6V.
R15	15K Ω	R15	15 MFD. - 150V.
R14	4700 Ω - EACH	C6A	40 MFD. - 150V.
R13	10K Ω - 1W. EACH	C5B	40 MFD. - 150V.
R12	2200 Ω - EACH	C5A	40 MFD. - 150V.
R11	150 Ω	C4C	40 MFD. - 150V.
R10	2K Ω - VERT. GAIN CONT.	C4B	20 MFD. - 450V.
R9	560 Ω - EACH	C4A	30 MFD. - 450V.
R8	1500 Ω - EACH	C3B	40 MFD. - 450V.
R7	1 MEG. Ω - EACH	C3A	40 MFD. - 450V.
R6	100 Ω - EACH	C2C	5 MFD. - 450V.
R5	2700 Ω - (FACTORY ADJ.)	C2B	10 MFD. - 450V.
R4	10K Ω - LINEAR CONT.	C2A	10 MFD. - 450V.
R3	20K Ω - EACH	C1C	500 MFD. - 6V.
R2	150K Ω - EACH	C1B	15 MFD. - 150V.
R1	1.8 MEG. Ω - 1W. EACH	C1A	15 MFD. - 150V.

TITLE: OSCILLOSCOPE SERIES ES-5508 SCHEMATIC
DRAWN BY: J.F. DATE: 2/11/59
CHECKED BY: J.F.

PRECISION APPARATUS

BEAM MOD.

EXT. SYNC.

S5 (2F)

S5 (1F)

S6

S7