INSTRUCTION MANUAL •

C.C.G

INDUSTRIAL & TELEVISION

The POCKETSCOPE

MODEL S-11-A OSCILLOSCOPE

WATERMAN PRODUCTS COMPANY, INC.

PHILADELPHIA 25, PENNA., U.S.A.

INDUSTRIAL TELEVISION **POCKETSCOPE** MODEL S-11-A

Cathode Ray Oscilloscopes have one basic advantage over any other measuring and indicating instrument, and that is the ability to plot a practically instantaneous visual curve of one variable as a function of another. The electron beam of the cathode ray tube provides an indestructible pointer of negligible inertia that practically no limitations exist on movement in either horizontal or vertical plane. Thus, practically any measurement, static or dynamic, whether it is chemical, mechanical, thermodynamic that can produce an electrical impulse, can be made on a Cathode Ray Oscilloscope.

The Industrial and Television **POCKETSCOPE** stands out particularly among Cathode Ray Oscilloscopes, due to many features that make it so complete.

* Identical horizontal and vertical amplifiers for measurement of AC and DC, with sensitivity better than 100 mv. rms/inch from 0 cycles to 200 KC and with fidelity of response to within —2DB; single-ended input with push-pull output; the same polarity of deflection through the amplifiers as with direct connection to deflecting plates; ½ megohm input resistance and 35 mmfd input shunt capacitances at low inputs; 10 megohm input resistance and 10 mmfd input shunt capacitance at high inputs; trace expansion of at least twice screen face without distortion; unusual stability of amplifiers with line voltage variations; variations of input impedances, or manipulation of controls do not bounce the trace of the screen and the trace returns instantly to original position.

* Direct connection to deflecting plates either single-ended or push-pull for either AC or DC measurements with sensitivity of 28 volts rms/inch and fidelity only limited by external connections, as shunt capacitance is only 10 mmfd from each plate to ground and input resistance is 10 megohms from each plate to B+.

* Linear time base oscillator using hard tube, and with range from 3 cycles to 50 KC with blanking of the return trace is optional.

* Intensity modulation amplifier with sensitivity of better than 100 mv/rms per inch for threshold blanking below 500 KC. For direct connections, 1 volt rms is required.

* Synchronization of the sweep either internal vertical, external or line frequency is provided with positive polarity of sync.

* Centering range is at least twice screen face and is operative whether the connection is through the amplifiers or directly to deflecting plates.

* Input may be isolated from the case, at will, so that low side may be connected to the hot DC wise, terminals.

* Weight is only 8¾ lbs., Height 7", Width 5", Depth 11". A functional layout of controls permits ease of operations. A leather handle, retractable light shield, detachable graph screen, outside fuse protection, and mounting feet on bottom and back, contribute a great deal towards convenience of operation.

TECHNICAL DATA

POWER SUPPLY

Input Supply — 105-125 volts, 50-60 cycles AC
Input Consumption — 43 watts at 117 volts, 60 cycles
Fuse Protection — 1 amp., replaceable from the front

OPERATING DATA

	Amplifier with Max. Gain	Direct Connection to Plates
Deflection sensitivity for both vert, and horiz. . . .	*0.1 v, rms/in. *0.28 v peak inverse/in.	*28 v rms/in. *78 v peak inverse/in.
Fidelity for both vertical and horizontal	*—2 db from 0 to 200 KC —6 db at 335 KC (approx.)	Depends upon external connections
Intensity Modulation . . .	0.1 v rms threshold usable for blanking below 500 KC	1.0 v rms threshold usable for blanking
Input	DC or AC, single-ended with 30 db (about 30 to 1) attenuation for high signal inputs	DC or AC, either push-pull or single-ended
Input Resistance	0.5 meg. for low inputs and 10 meg. for high inputs	10 megs. at each plate
Input Shunt Capacitance	35 mmf for low inputs 10mmf for high inputs	10 mmf from each plate to ground
Input Series Capacitance	0.25 mfd, 400 volts	None
Polarity of Deflection . .	+ is ↑ for V input + is → for H input	+ is ↑ for V input + is → for H input
Time Base Oscillator . .	*3 cycles to 50 KC with sweep from left to right	
Blanking	of return trace with internal sweep, optional at will	
Synchronization	Internal, external, or line with positive polarity of sync	
Trace Expansion	*TWICE screen face without distortion	
Centering Range	*TWICE screen face	*TWICE screen face
Input Isolation	Low side is either connected to chassis or isolated with .25 mfd 400 V condenser from B—	Second anode is 165 v above B—, and may be grounded to chassis
Stability	Line voltage variations, variation of input impedances, or manipulations of controls do not bounce the trace off the screen. Unit stabilizes instantly.	

* Rated Values. Factory standards exceed these values.

TUBE COMPLEMENT

6J6 — Vertical input amplifier . . . 6J6 — Vertical output amplifier . . .
6J6 — Horizontal input amplifier . . . 6J6 — Horizontal output amplifier . . .
6J6 — Time base oscillator, blanking, and intensity amplifier . . . .
117Z6/GT — Low and high voltage supply . . . 3MP1 — Cathode ray tube.

OVERALL DIMENSIONS

Height — 7 inches . . . Width — 5 inches . . . Depth — 11 inches . . . Weight — 8¾ lbs.

TERMINALS

ON TOP — 6 binding posts . . . Vertical AC . . . Vertical DC . . . Low Side, common . . . Sync/intensity . . . Horizontal DC . . . Horizontal AC.

Accessible from back — 4 terminals for deflection plates . . . 4 terminals for output amplifier plates . . . 1 terminal for 2nd anode of cathode ray tube . . . 2 terminals for blanking and direct input to intensity modulation . . . 1 terminal for B— . . . 2 terminals for chassis ground.

CONTROLS — from left to right

V input — Slide switch for either high or low input voltages with 30 db attenuation

FUNCTION — 4 position switch — EXT - external sync . . . LINE - power line sync . . . INT - internal sync . . . HOR - horizontal amplifier

H input — Slide switch for either high or low input voltage, with 30 db attenuation. This switch is inoperative electrically when internal sweep is used

V gain — 0.5 megohm volume control for vertical gain

SYNC/INT — 0.5 megohm volume control for sync adjustment and controlling gain of intensity modulation amplifier stage

H gain — 0.5 megohm volume control for horizontal gain

FREQUENCY — Dual potentiometer for fine control of time base frequency. Minimum frequency is on left, or counter-clockwise

RANGE — 6 position switch for selecting time base frequency range — 3 to 15 cycles . . . 15 to 75 cycles . . . 75 to 350 cycles . . . 350 to 2000 cycles . . . 2 to 10 KC . . . 10 to 50 KC

V pos — Potentiometer for setting of trace in vertical plane with at least twice screen diameter

H pos — Potentiometer for setting of trace in horizontal plane with at least twice screen diameter

INTENSITY — Potentiometer with "on-off" switch for power. Rotation to the right, or clockwise, increases intensity of beam

FOCUS — Potentiometer for controlling the line width

PRELIMINARY INSTALLATION AND ADJUSTMENT

1—The setting of the controls is not critical, but as guide, the following procedure is suggested:

CONTROL	POSITION	CONTROL	POSITION
FUNCTION	Any except HOR	RANGE	15-75 Cycles
V Input	LOW	FREQUENCY	Midway
H Input	HIGH	V Pos	Midway
V Gain	Midway	H Pos	Midway
H Gain	Midway	FOCUS	Midway
SYNC/INT	Minimum	INTENSITY	Fully counter clockwise

2—Connect power supply plug to convenient AC outlet, making sure that the supply at the outlet is 110/120 volts, 50/60 cycles, AC.

3—Advance **INTENSITY** control clockwise about midway (thus turning the power on). After a short while, a horizontal line will then be observed upon the screen.

4—Center the line by adjusting H pos and V pos controls.

5—Adjust **FOCUS** control for desired sharpness of line.

6—Readjust both **INTENSITY** and **FOCUS** controls for desired brilliance and line-width.

The preliminary setting is then fully accomplished. Thereupon operate as stated under **OPERATION AND CIRCUIT**, but bear in mind that screen of the tube can become damaged if a small spot of high brilliance is allowed to remain stationary on the screen for any length of time.

OPERATION AND CIRCUIT

The operation of the **POCKET-SCOPE** can be best undertaken if the functions of all controls involved, as well as principles, are fully understood.

The schematic diagram shows the arrangement of the entire circuit.

The Waterman Rayonic 3MP1 Cathode Ray Tube consists essentially of a cathode producing a source of electrons, a number of elements for controlling and focusing a beam of electrons, horizontal and vertical deflecting plates for deflection of the beam, and a luminescent screen for producing visual light from the electronic beam.

To vary spot brilliance the **INTENSITY** control (R49) is used. This control varies the negative bias on grid of 3MP1, thus varying the amount of electrons emanating from the "gun." The power "on-off" switch is ganged with this control.

To vary sharpness of the spot, the **FOCUS** control (R52) is used. This control varies the voltage on the first anode of 3MP1.

Inasmuch as considerable voltage is required on the deflecting plates of the Cathode Ray Tube to swing the beam, voltage amplifiers are provided.

In the S-11-A, both the vertical and horizontal amplifiers are alike, and description of the vertical will suffice for the horizontal as well.

The vertical amplifier uses two duo triode (6J6) tubes. The amplifier tube, (terminals 2-5-7), is DC coupled to the output tube. The output tube, (terminals 2-5-7), is cathode coupled to the other half (terminals 1-4-6). The V Pos control (R8) varies the voltage on grid 6 of V2, while adjustment control (R5) varies the voltage on grid 5 of V2. Variation of astigmatism control (R10) varies voltages on grids 5 and 6 together. When V Pos control is midway, the voltages are such that there is no appreciable voltage between DJ1 and DJ2 and second anode (terminal 11 on back panels); and the spot on luminescent screen is centered vertically. The peaking coil LI is used to improve high frequency response by isolating reflected capacity of V2 on V1. Capacity C2 is used to improve high frequency response by increasing gain of V1 at higher frequencies. The circuit is thus single-ended input and push-pull output. Due to push-pull action, the amplifier is insensitive to power supply variations.

To vary gain, V Gain (R2) is used. It is conventional type of volume control, and has some frequency discrimination. Input binding posts permit either choice of AC or DC inputs, and V input switch (S4) permits use either of high or low level inputs.

Due to the use of two stages with 180° shift in each, the signal on the output has the same polarity as on the input. Thus, positive signal will produce upward motion of the spot.

In the majority of applications, linear time base is used for horizontal deflection. This deflection is provided by a hard tube multivibrator circuit, consisting of one duo triode 6J6 (V5). The linear time base generator produces a saw-tooth wave, the frequency of which is varied by rotation of a dual potentiometer (R34), called **FREQUENCY.** The variation of frequency produced is of an order of 5 to 1. To extend the range from 3 cycles to 50 KC, the **RANGE** selector switch (S1) is used, which changes the capacities in the circuit. Due to the use of 20 to 1 ratio of time constants, the linearity of the sweep is remarkably good. The sweep direction is from left to right. Inasmuch as voltage produced is high, R42, C10 and R18, C9 form a frequency compensated attenuating network. C10 is so adjusted that there is no frequency discrimination for 2 inches of horizontal deflection, although it may be adjusted to any other width.

To lock this linear time base generator, so that a stationary pattern may be observed on the screen, synchronization is used. The **FUNCTION** switch (S2) permits selection of external, line, or internal synchronization. No matter how synchronization is obtained, the very minimum sync voltage to lock the pattern should be used, as otherwise distortion may result in the linear time base. Thus the **INT/SYNC** control (R41) shall be set for minimum. External sync is terminated at J4; line sync is from power supply: internal sync is plate 2 of V2.

Positive pulses during return time of saw-tooth are produced on plate 1 of 6J6. This signal is coupled to the cathode of the Cathode Ray Tube producing blanking during return time. This is so when terminals 12 and 13 on back terminal board are linked.

Upon rotation of the **FUNCTION** switch (S2) to **HOR**, the horizontal input posts are connected to the horizontal amplifier, linear time base generator is made inoperative, and V5 becomes intensity amplifier for modulating the intensity of the beam. Plate of the intensity amplifier is coupled to the cathode of the Cathode Ray Tube, thus positive signal will produce intensification of the beam (terminals 12 and 13 linked).

For direct connections to vertical, the amplifier may be disconnected by removing links between 3-7 and 4-8 on the back terminal board. Terminals 7 and 8 are deflecting plates terminals. CAUTION—use of proper capacities and voltage rating is required for direct connection. Likewise, terminals 1-5 and 2-6 are for horizontal amplifier with terminals 5-6 being the horizontal deflecting plates.

Terminal 12 is capacity coupled connection to the cathode of the Cathode Ray Tube and may be used for direct Intensity Modulation.

The power supply is grounded to the case only at the terminal board (9 and 10). If this link is removed then the case ground can be connected up to 400 volts above circuit ground under test. Likewise, upon removal of the link, the second anode (terminal 11) may be grounded to the case (terminal 9) for direct connection to the deflecting plates.

The power required for the operation is provided by means of 117Z6GT rectifier tube connected as two ½ wave rectifiers. Heater dropping resistor (R46) is used to increase the voltage allowable between heater and cathode. C7 and C21 are filter condensers for removing undesired power line interference.

APPLICATION

The applications of Cathode Ray Oscilloscopes, S-11-A Industrial and Television **POCKETSCOPE** in particular, are so numerous, and their use in every field of science and industry so vast, that all conceivable applications cannot be described in this small space.

Only some of the basic usages are described very briefly. Fundamentally, they fall into the following categories:

1—AC Voltmeter and Ammeter
2—Quality of electrical waves
3—Frequency measurement
4—Phase shift measurement
5—Power measurement
6—Modulation measurement
7—Tracings of curves
8—Adjustment of apparatus

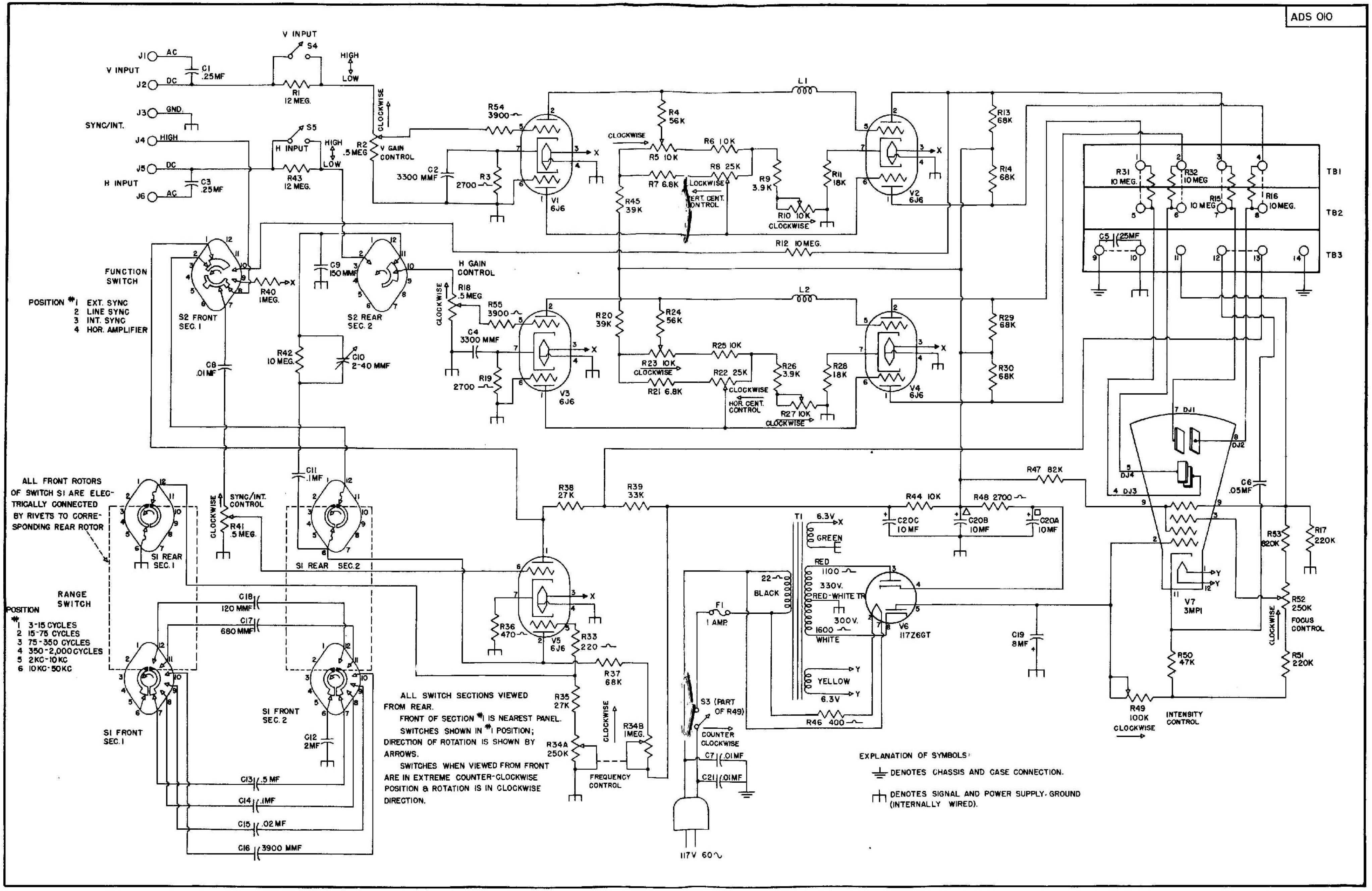
1—AC and **DC VOLTMETER**—Connect the input voltage to the **VERTICAL** input jacks and turn the **FUNCTION** control to **HOR.** Then any input voltage appears as a straight vertical line, whose length is proportional to the input voltage. When the signal is small, the internal vertical amplifier is used, and when it is large, connection is made directly to the vertical deflecting plates. A typical use is as an indicator for determining AC and DC bridge balance.

AC AMMETER—Connect as per **AC** and **DC VOLTMETER,** except that the input is shunted with a low value resistor, across which a voltage is built up proportional to the current.

2—**QUALITY** of electrical waves refers primarily to harmonic distortion, although it may refer, in addition, to the presence of any other wave not in harmonic relation. To examine distortion produced by a simple or complicated network, a signal of desired shape (sinusoidal, square wave, or any other shape) is impressed on the input of the network; the output of the network is connected to the **VERTICAL** input jacks. With the **FUNCTION** switch on **INT**, the pattern of the resultant wave can be seen, and if compared with the original input wave, a deviation or distortion is noted. With little experience, proper interpretation of results may be easily made. A typical use is that of determining distortion produced in an audio amplifier.

3—**FREQUENCY MEASUREMENT** — An unknown frequency can be compared with a known frequency very readily by injecting the unknown on the vertical and the known on the horizontal plates. Set the **FUNCTION** switch in **HOR** position. The resultant pattern depends upon frequency ratio and relative phase. If this ratio approaches a value that can be expressed by simple integers, a definite pattern known as a Lissajous figure is formed. When the ratio of frequencies is in exact integers, the pattern is stationary. Typical Lissajour patterns are shown in Figures 1 and 2. In the first figure, the ratio is 6:1, and in the other, 9:2. If the ratio is nearly, but not exactly in integers, then the pattern weaves. When the forward and return traces do not coincide, the frequency ratio is a number of vertical peaks divided by a number of horizontal peaks; thus, the ratio is 9:2. When the frequency ratio is large, the pattern becomes too complex and a phase splitting arrangement must be used.

A phase splitting arrangement is shown in Figure 3. The Lissajous



ADS 010
V INPUT
J1 AC
J2 DC
C1 .25MF
S4
HIGH
LOW
R1 12 MEG.
SYNC/INT.
J3 GND.
J4 HIGH
S5
H INPUT
J5 DC
J6 AC
C3 .25MF
R43 12 MEG.
R2 .5 MEG
V GAIN CONTROL
CLOCKWISE
R54 3900
C2 3300 MMF
R3 2700
V1 6J6
R4 56K
R5 10K
R6 10K
R7 6.8K
R8 25K
VERT. CENT. CONTROL
R45 39K
R9 3.9K
R10 10K
R11 18K
L1
V2 6J6
R13 68K
R14 68K
R12 10 MEG.
R31 10 MEG.
R32 10 MEG
R15 10 MEG
R16 10 MEG.
C5 .25MF
TB1
TB2
TB3
FUNCTION SWITCH
POSITION #1 EXT. SYNC
2 LINE SYNC
3 INT. SYNC
4 HOR. AMPLIFIER
S2 FRONT SEC. 1
R40 1MEG.
C9 150 MMF
S2 REAR SEC. 2
H GAIN CONTROL
R18 .5 MEG
R55 3900
C4 3300 MMF
R19 2700
V3 6J6
R20 39K
R24 56K
R23 10K
R25 10K
R21 6.8K
R22 25K
HOR. CENT. CONTROL
R26 3.9K
R27 10K
R28 18K
L2
V4 6J6
R29 68K
R30 68K
R42 10 MEG.
C10 2-40 MMF
C8 .01MF
DJ1
DJ2
DJ3
DJ4
ALL FRONT ROTORS OF SWITCH S1 ARE ELECTRICALLY CONNECTED BY RIVETS TO CORRESPONDING REAR ROTOR
S1 REAR SEC. 1
SYNC/INT. CONTROL
R41 .5 MEG.
C11 .1MF
S1 REAR SEC. 2
R38 27K
R39 33K
R47 82K
C6 .05MF
R44 10K
R48 2700
C20C 10MF
C20B 10MF
C20A 10MF
T1
6.3V
GREEN
RED
1100
330V.
RED-WHITE TR
1600
300V.
WHITE
BLACK
22
R53 820K
R17 220K
RANGE SWITCH
POSITION #1 3-15 CYCLES
2 15-75 CYCLES
3 75-350 CYCLES
4 350-2,000 CYCLES
5 2KC-10KC
6 10KC-50KC
C18 120 MMF
C17 680 MMF
R36 470
V5 6J6
R33 220
R37 68K
F1 1 AMP.
V6 117Z6GT
C19 8MF
V7 3MP1
R52 250K
FOCUS CONTROL
R51 220K
R50 47K
R49 100K
INTENSITY CONTROL
S1 FRONT SEC. 1
S1 FRONT SEC. 2
C12 2MF
ALL SWITCH SECTIONS VIEWED FROM REAR.
FRONT OF SECTION #1 IS NEAREST PANEL.
SWITCHES SHOWN IN #1 POSITION; DIRECTION OF ROTATION IS SHOWN BY ARROWS.
SWITCHES WHEN VIEWED FROM FRONT ARE IN EXTREME COUNTER-CLOCKWISE POSITION & ROTATION IS IN CLOCKWISE DIRECTION.
R35 27K
R34A 250K
R34B 1MEG.
FREQUENCY CONTROL
YELLOW
6.3V
R46 400
S3 (PART OF R49)
COUNTER CLOCKWISE
C7 .01MF
C21 .01MF
C13 .5 MF
C14 .1MF
C15 .02 MF
C16 3900 MMF
117V 60~
EXPLANATION OF SYMBOLS:
DENOTES CHASSIS AND CASE CONNECTION.
DENOTES SIGNAL AND POWER SUPPLY GROUND (INTERNALLY WIRED).

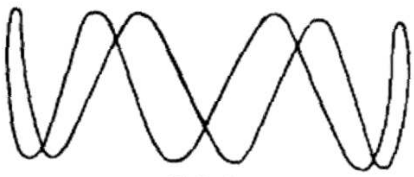


FIG. 1

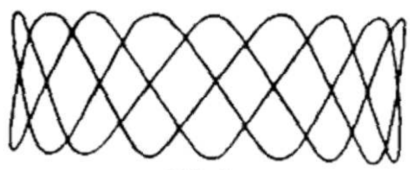


FIG. 2

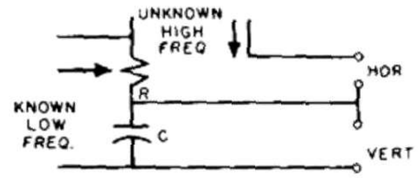


FIG 3

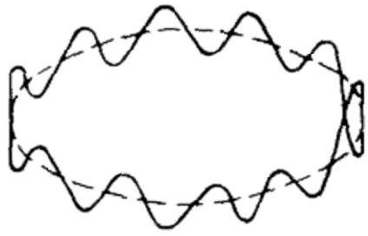


FIG 4

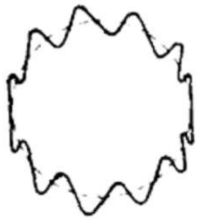


FIG 5

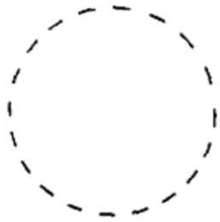


FIG 6

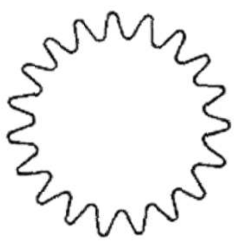


FIG 7

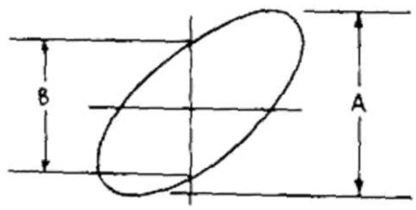


FIG 8

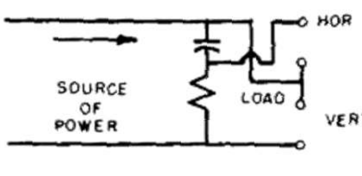


FIG. 9

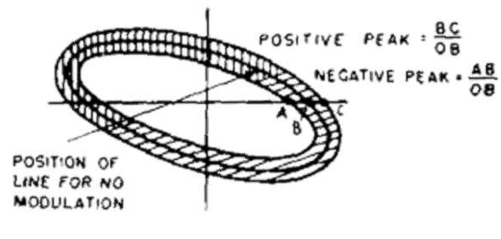


FIG 10

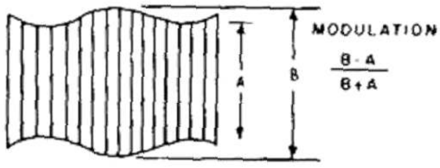


FIG 11

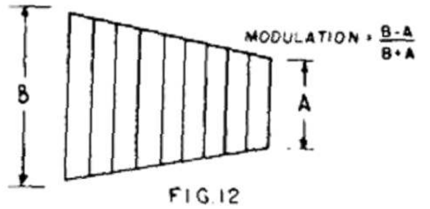


FIG.12

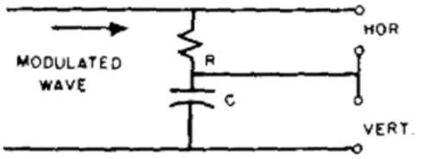


FIG.13

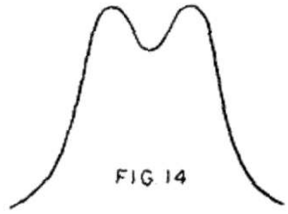


FIG 14

pattern produced is about an elliptical (Fig. 4) or a circular axis (Fig. 5). In general, the axis is elliptical, but it can be made circular by adjusting the value of the resistor.

It is also possible to produce a Spot Wheel pattern by using phase splitting network, with points (a)-(b) shorted, and introducing an unknown frequency on the control grid or cathode of the cathode ray tube. The pattern produced is shown in Figure 6, where the ratio is 19:1.

Another type of pattern may be produced by using the phase splitting network and inserting an unknown frequency on the accelerating plate of the cathode ray tube. The pattern is known as the Gear Wheel pattern, and is shown in Figure 7.

4—PHASE SHIFT MEASUREMENT—By feeding one signal into the vertical and the other into the horizontal input, and keeping the **FUNCTION** switch in **HOR**, an elliptical pattern (Fig. 8) is produced. When the phase shift is zero, the ellipse becomes a straight line. The phase shift is found by formula Sine $\Theta = \pm B/A$, where Θ is the angle of phase shift, A is the vertical distance between the extremes of the ellipse, and B is the length of the vertical centering axis in the ellipse. An interpretation of quadrants must be made.

5—POWER MEASUREMENT—Figure 9 shows the method of connection. R is the load resistor and C is the capacity. The deflection along the vertical axis is proportional to the load voltage, and along the horizontal axis, to the charge on capacity C. The resultant diagram is a closed loop, the area of which is proportional to power. The **FUNCTION** switch should be in **HOR** position.

6—MODULATION MEASUREMENT—There are three methods of measurements: phase splitting method producing an elliptical pattern (Fig. 10), modulated wave envelope (Fig. 11), and the trapezoidal method (Fig. 12).

In the phase splitting method, connection is made as shown in Figure 13; the **FUNCTION** switch must be in **HOR** position. With no modulation, the pattern is a simple ellipse. With modulation, the line widens and with 100% modulation, the eye in the center closes completely.

In the modulated wave envelope method, the modulated wave is connected to the **VERTICAL** plates direct; the **FUNCTION** switch is placed in either **INT** or **EXT.** When it is in **EXT**, the modulating signal is connected to the **SYNC/INT** input and the linear time axis is synchronized with the modulating signal, and with this method, the modulation distortion can readily be observed.

In the trapezoidal method, the modulated wave is connected to the **VERTICAL** plates direct and the modulating wave to the **HOR** input jacks. The **FUNCTION** switch is placed in **HOR** position. With no modulation, only the vertical line is observed. As modulation increases, a trapezoidal pattern is observed, until 100% modulation, when the pattern becomes a triangle. When phase shift or distortion occurs, the upper and lower lines curve depending upon the particular condition.

7—TRACING OF CURVES—Various circuits have been developed for tracings of vacuum tube characteristic curves, hysteresis curves, etc. These are too complex, for inclusion here.

8—**ADJUSTMENT OF APPARATUS**—For alignment of the **IF** and **RF** stages, it is essential that a frequency modulated oscillator be available. The output of the oscillator is connected to the unit under test. With the AVC disconnected, the audio output of the second detector is connected to the **VERTICAL** input jacks. The synchronization signal from the oscillator is connected to the **SYNC/INT** input jacks, with the **FUNCTION** switch in **EXT** position. With proper linear time sweep and synchronization, a stationary pattern results (Fig. 14). This pattern shows the selectivity of the circuit, and thus permits easy adjustment as any change in adjustment changes the pattern.

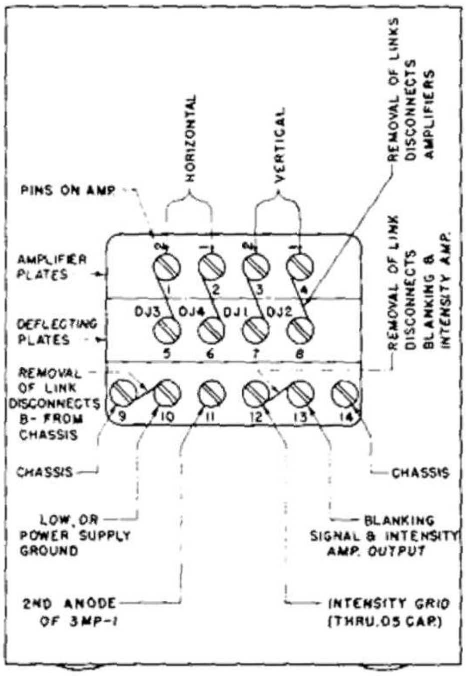
Success in using Cathode Ray Oscilloscopes is largely dependent upon the ability of the operator. By studying carefully the principles and basic applications, operators can become very skillful in using Cathode Ray Oscilloscopes for all kinds of work and find it the most indispensible tool.

The S-11-A Industrial and Television **POCKETSCOPE,** due to its DC feature and low frequency sweep of 3 cycles, extends the use of oscilloscopes for electronic controls, welding equipment, servo-mechanisms, and all types of mechanical, thermal, thermodynamic, and chemical equipment that can be made to produce an electrical impulse.

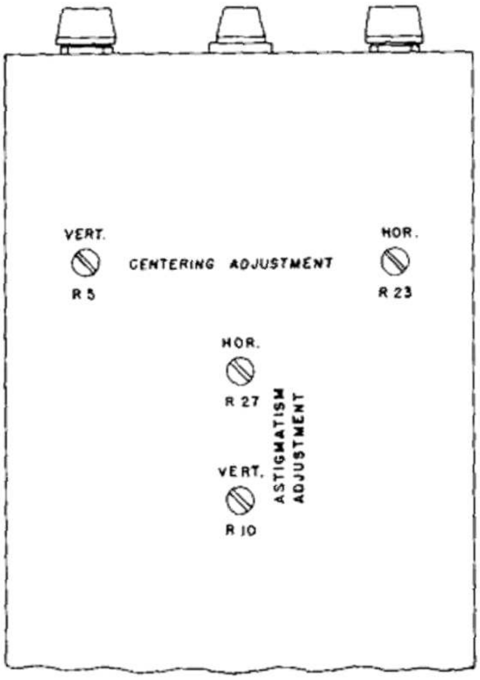
In Welding Service, the operation of thyatrons and ignitrons can be carefully analyzed and studied. Proper adjustments of welding current and duration can be determined. The portability of the unit is such that the Scope can be brought to the work, and not vice versa.

Another useful application of the **POCKETSCOPE** is the study of the bounce of contacts. By connecting the Scope across the contacts and passing heavy current through the contacts, the proper operation of relay contacts may be determined.

Many more applications can be readily made as soon as full working principles are fully understood.



REAR VIEW OF S-11-A
(COVER REMOVED)



BOTTOM VIEW OF S-11-A

MAINTENANCE

Access to the equipment inside may be obtained by removing the screws holding the side plates to the cabinet. The rear terminals are accessible by loosening two back screws and sliding the cover off. The Cathode Ray Tube may be removed by removing the light shield and pulling the tube out.

Under ordinary usage, the life of the tubes is consistent with that obtained in other applications. However, due to DC amplifiers used, it is necessary to balance the unit whenever tubes in either horizontal or vertical amplifiers are changed.

The procedure is as follows: Turn FUNCTION switch to HOR and with V Pos and H Pos controls set midway, adjust R5 so that voltages on terminals 3 and 4 are alike. Adjust R10 until voltages on terminals 3 and 4 are about +165. Readjust R5 to equalize voltages. Repeat likewise for the horizontal amplifier.

The determining factor in life of the Waterman Rayonic 3MPI Cathode Ray Tube is deterioration of the luminiscent screen. It is, therefore, advisable not to leave a bright concentrated spot on the screen. The approach to the limit of useful life is indicated by the inability to obtain satisfactory focus and by the screen becoming streaked and spotted.

The schematic diagram gives the value of all parts, so that resistance and continuity checks can be readily made.

The fastest means of tracing circuit faults is by getting voltage readings at various socket prongs. The table following gives all appropriate voltages measured to ground.

Table of Voltages as per PRELIMINARY INSTALLATION and ADJUSTMENT for 117 volt line 60 cycles.

Pin	V7	V6	V1 & V2	V2 & V4
1	(b)		+50	+165
2	—400	(a)	+50	+165
3	—260	(330)	(6.3)	(6.3)
4	+165	+340	0	0
5	+165	—400	*	+50
6			0	+50
7	+165	(a)	+1.6	+53
8	+165	(330)	*Grid Voltage	
9	+165		(a) AC volts between 2-7	
10			(b) 6.3 AC volts between 1-12	
11	—360		All DC voltages 20K ohms/Volt	
12	(b)		All AC voltages 1K ohms/Volt	

REPLACEMENT PARTS FOR MODEL S-11-A POCKETSCOPE

INSIST UPON FACTORY-TESTED PARTS ON ALL ITEMS MARKED WITH ASTERISK. ALL OTHER STANDARD PARTS MAY BE MORE READILY PURCHASED FROM YOUR REGULAR SOURCES.

SYMBOL	DESCRIPTION	PART NUMBER
C1, C3, C5	Capacitor, .25 mf, 20%, 400 volts, paper tubular	CPA002-254
C2, C4	Capacitor, mica 3300 mmf, 20%, 500 volts	CMA821-332
C6	Capacitor, .05 mf, 600 volts, paper tubular	CPA003-503
C7, C21	Capacitor, .01 mf, 600 volts, paper tubular	CPA003-103
C8	Capacitor, .01 mf, 400 volts, paper tubular	CPA002-103
C9	Capacitor, mica 150 mmf 10%, 500 volts	CMA701-151
C10	Capacitor, variable mica 2.2—40 mmf	*CXA002- 1
C11, C14	Capacitor, .1 mf, 400 volts, paper tubular	CPA002-104
C12	Capacitor, 2 mf, 20%, 150 volts, fixed paper	*CPZ001- 1
C13	Capacitor, .5 mf, 200 volts, paper tubular	CPA001-504
C15	Capacitor, .02 mf, 400 volts, paper tubular	CPA002-203
C16	Capacitor, 390 mmf 10%, 500 volts, mica	CMA721-392
C17	Capacitor, 680 mmf 10%, 500 volts, mica	CMA701-681
C18	Capacitor, 120 mmf 10%, 500 volts, mica	CMA701-121
C19	Capacitor, 8 mf, 450 volts, electrolytic cardboard tubular	CDB003- 2
C20, a, b, c	Capacitor, 10-10-10/450, electrolytic metal can	*CDA016- 1
J1, 2, 3, 4, 5, 6	Binding Post	*ETP001- 1
L1, L2	Coil, peaking 19.5 millihenries	*LRU001- 1
R1, R43	Resistor, 12 Meg. 10%, ¼ or ½ W, carbon	RCY010-126
R2, R18, R41	Potentiometer, .5 Meg. 10% Taper	RVC002- 8
R3, R19	Resistor, 2,700 ohms 10%, ¼ or ½ W, carbon	RCY010-272
R4, R24	Resistor, 56,000 ohms 10%, ¼ or ½ W, carbon	RCY010-563
R5, 10, 23, 27	Potentiometer, 10,000 ohms Linear Taper, 10%	*RVC002- 4
R6, 44, 25	Resistor, 10,000 ohms 10%, ¼ or ½ W, carbon	RCY010-103
R7, R21	Resistor, 6,800 ohms 10%, ¼ or ½ W, carbon	RCY010-682
R8, R22	Potentiometer, 25,000 ohms Linear Taper, 10%	*RVC002- 5
R9, R26	Resistor, 3,900 ohms 10%, ¼ or ½ W, carbon	RCY010-392
R11, R28	Resistor, 18,000 ohms 10%, ¼ or ½ W, carbon	RCY010-183
R12, 15, 16, 31, 32, 42	Resistor, 10 Meg. 20%, ¼ or ½ W, carbon	RCY020-106
R13, 14, 29, 30, 37	Resistor, 68,000 ohms 10%, ¼ or ½ W, carbon	RCY010-683
R17	Resistor, 220,000 ohms 10%, ½ W, carbon	RCC010-224
R33	Resistor, 220 ohms 20%, ¼ or ½ W, carbon	RCY020-221
R34, a, b	Potentiometer, front 250 K, rear 1 Meg. linear dual	*RVB005- 1
R35, R38	Resistor, 27,000 ohms 10%, ¼ or ½ W, carbon	RCY010-273
R36	Resistor, 470 ohms 10%, ¼ or ½ W, carbon	RCY010-471
R39	Resistor, 33,000 ohms 10%, ¼ or ½ W, carbon	RCY010-333
R40	Resistor, 1 Meg. 20%, ¼ or ½ W, carbon	RCY020-105
R45, R20	Resistor, 39,000 ohms 10%, 1 W, carbon	RCD010-393
R46	Resistor, 400 ohms, 5 W, fixed wirewound	*RZF001- 1
R47	Resistor, 82,000 ohms 10%, ½ W, carbon	RCC010-823
R48	Resistor, 2,700 ohms 10%, 1 W, carbon	RCD010-272
R49	Potentiometer, .1 Meg. Linear Taper SPST S3 switch, 10%	*RVC002- 6
R50	Resistor, 47,000 ohms 20%, ¼ or ½ W, carbon	RCY020-473
R51	Resistor, 220,000 ohms 20%, ¼ or ½ W, carbon	RCY020-224
R52	Potentiometer, .25 Meg. Linear Taper, 10%	*RVC002- 7
R53	Resistor, 820,000 ohms 20%, ¼ or ½ W, carbon	RCY020-824
R54, R55	Resistor, 3,900 ohms 10%, ¼ or ½ W, carbon	RCY010-392
S1	Range Switch, 2 wafer, 6P4T Rotary	*SWR010- 1
S2	Function Switch, 2 wafer, 4P3T Rotary	*SWR009- 1
S4, S5	Switch, slide SPST	*SSA001- 1
T1	Transformer, power	*LPU004- 1
V1, 2, 3, 4, 5	Tube, type 6J6	
V6	Tube, type 117Z6/GT	
V7	Tube, type 3MP1	*
W1	Power Cord, AC	WPR001- 2
X1, 2, 3, 4, 5	Tube Socket, Miniature 7 pin saddle	ESR101- 1
X6	Socket, Octal (wafer)	ESR001- 1
X7	Socket, tube duo decal 12 pin	*ESR251- 1
X8	Fuse Holder	EFB001- 1
TB-1	Terminal Board engraved 1-4	*ETB002- 1
TB-2	Terminal Board engraved 5-8	*ETB002- 2
TB-3	Terminal Board engraved 9-14	*ETB002- 4
	Screen, Assembly	*DMA009-A01
	Screen, Plastic	*IPC001- 1
	Screw, Thumb	*HSZ007- 1
	Shield, Miniature Tube	MRT002- 1
	Escutcheon	*MTB004- 1
	Knob, Pointer	NKB001- 1
	Knob, Bar	NKB003- 1
	Strap, Leather	*ILB001- 1
	Stud, Strap	*MSC006- 1