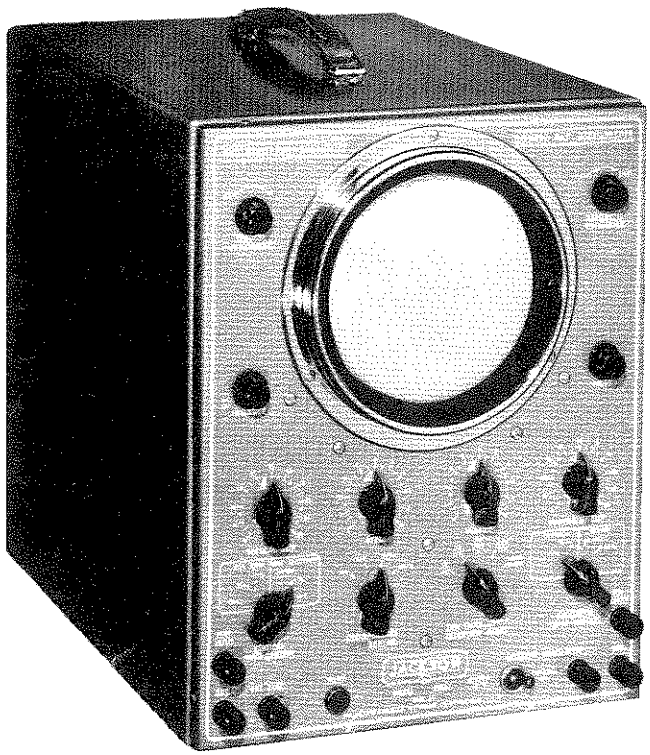
JACKSON *Radio Testing Equipment*

# MODEL CRO-I

## WIDE BAND – HIGH SENSITIVITY
## CATHODE RAY OSCILLISCOPE



# OPERATING INSTRUCTIONS

SERIAL No. _____

THE JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO, U.S.A.

# INSTRUCTIONS FOR USING THE

# JACKSON CATHODE-RAY OSCILLOSCOPE MODEL CRO-1

Your new Jackson Oscilloscope is a fine test instrument suitable for laboratory use as well as radio and television servicing. It's extreme sensitivity has been combined with an extremely wide band response, the first time such a combination has been available in one oscilloscope. As a result you will find it of exceptional value in all your radio and television service work, or in the design of such equipment.

What Is the Oscilloscope? Primarily, the Cathode-Ray Oscilloscope is a measurement and observation instrument for alternating current voltages. It differs from other methods of alternating voltage measurement in that it permits observation of the waveform of the voltage, while at the same time giving the opportunity of determining the amplitude of the voltage. Some oscilloscopes may also be used for the measurement of direct current voltages, but their advantages for such work in radio and television servicing are not usable, and if not used correctly the application of DC to the deflection plates of a CR tube may prove damaging.

The features which distinguish one brand of 'scope from another are generally found in the design of the amplifiers and the sweep oscillator. Band width and sensitivity are both products of amplifier performance. The CR tube itself is generally capable of showing frequencies far higher than can be successfully amplified by the usual 'scope amplifier. However, high frequencies are usually of such low amplitude that their observation is dependent upon some form of amplifier which will boost these frequencies to sufficient amplitude to be observed. The sensitivity of CR tubes is quite low. The usual AC voltages encountered in radio and television servicing could not be observed if it were not for the amplifiers in the scope. Consequently, a scope is judged not by the CR tube it uses but by the design of its amplifiers.

The vertical amplifier of your Jackson Oscilloscope has a sensitivity of .018 RMS volts-per-inch. This means that 18 millivolts will deflect the beam on the CR screen one inch from its normal position. You will find your Jackson 'scope usable with frequencies up to 5 megacycles, with an essentially flat response from 20 cycles to 4 megacycles.

## Where Should the Oscilloscope be Used

There are certain phases of radio and television servicing where the Oscilloscope is either indispensable or of great value. In TV and FM alignment it is a "MUST". In many phases of AM servicing such as signal tracing, visual alignment or audio testing you will find it a great profit-maker for it permits more accurate servicing in much less time. Some of the uses of the 'scope are as follows:

## Television Servicing

- Front end alignment
- Picture IF alignment
- Sound IF alignment
- Observation of waveforms in sync circuits
- Audio alignment
- Observation of composite picture signal

Radio Servicing

RF Alignment
Oscillator Alignment
IF Alignment
Discriminator Alignment (FM)
Audio Alignment
Signal Tracing

Amplifier Servicing

Frequency Response Measurement
Phase Shift Determination
Distortion Checks
Phase Inverter Circuit Checks
Hum Measurements
Signal Tracing

Miscellaneous Applications

Auto Radio Vibrator Testing
Hum and Ripple Checks in Power Supplies
Frequency Determinations
Study of Waveforms
Transmitter Adjustment

Of course, there are many more applications, but we will concern ourselves primarily with those uses involved in Radio, TV service work.

## THE CRO-1 CONTROLS AND THEIR USE

In order to become thoroughly familiar with your Jackson Oscilloscope let's go over the instrument noting the use of each control. For this purpose, place your 'scope on the bench alongside this instruction book.

Graduated 'Scope Screen - The clear plastic screen in front of the CR tube is graduated in vertical and horizontal lines. Each division represents 1/10 of an inch. The half and full inch lines are marked .5, 1.0, 1.5 etc. The "zero" lines are the heavy lines which intersect at the center of the tube. The graduated screen is held in the rubber tube collar by small projections at the top, bottom and either side. The screen is flexible and may be removed and replaced as desired.

Plug the line cord into a source of 110 volts, 50-60 cycles AC. Note that the line cord plug is of the fused type. If at any time the 'scope fails to operate, check the line cord fuses.

THE LINE SWITCH AND INTENSITY control are located to the left of the bottom of the CR tube. Turn clockwise which will turn the instrument on. THE PILOT LIGHT at the bottom of the front panel should now glow. Allow about thirty seconds for the instrument to warm up. The HORIZONTAL GAIN CONTROL and VERTICAL GAIN CONTROL should both be turned to Zero. Now turn up the Intensity control until a small green spot appears on the 'scope screen. DO NOT INCREASE THE INTENSITY BEYOND THAT POINT WHERE THE SPOT FIRST BECOMES VISIBLE. A HIGH INTENSITY SPOT KEPT IN ONE PLACE ON THE SCREEN FOR ANY PERIOD OF TIME CAN CAUSE A BURN ON THE INTERIOR SCREEN SURFACE AT THAT POINT. Adjust the FOCUS control for the smallest spot.

Adjust the VERTICAL POSITIONING CONTROL and HORIZONTAL POSITIONING CONTROL according to the directions indicated over these controls until the

spot is centered on the tube back of the intersection of the heavy horizontal and vertical grid lines, on the plastic screen.

The 'scope is now ready for use. Let's consider the observation of a simple waveform, such as the 60 cycle alternating current which appears as a capacity effect when the human body is located near house mains. For this purpose set the Vertical Gain Control to about 25 and the Horizontal Gain Control to about 25. Set the SYNC. control at about 7. Set the Vernier Control at "0". Set the VERTICAL INPUT CONTROL on position 100 on the High Sensitivity side. Set the SYNCHRONIZING INPUT CONTROL on "Int.". Set the SAW-TOOTH SWEEP FREQUENCY RANGE control at the first or 20/100 position. Set the HORIZONTAL INPUT CONTROL AT "Sweep" on the "Internal" side. Set the INTENSITY MODULATION SWITCH at its "External Off" position.

Now touch your finger to the metal portion of the binding post labeled VERT. INPUT. You will probably notice that three cycles of a sine wave will appear on the face of the CR tube. If the wave is not stationary, move the VERNIER control until a stationary pattern appears. With the controls set as they are, three cycles indicate that the Saw-Tooth oscillator in the scope is set at 20 cycles. (The input wave to the vertical deflection plates is known to be 60 cycles divided by the three waves equals 20 cycles)

Move the Vertical Gain Control, noting how the pattern increases or decreases in height. Set the Vertical Input Control to 10. This increases the sensitivity of the vertical amplifier and results in a much higher pattern. Turn down the Vertical Gain Control to reduce the height of the pattern. Now turn the Vertical Input Control to "1" on the High Sensitivity Range. This provides maximum sensitivity and will require turning down the Vertical Gain Control even further. Similarly the Wide Band Range provides maximum sensitivity on number "1" position and least sensitivity on number 100 position.

It is important to use only that sensitivity range required to give the correct picture on the CR tube. Using too high a sensitivity for a given input voltage may result in overloading the vertical amplifier which will give a distorted waveform. The Vertical Input control range should be chosen so the Vertical Gain control is always used above 15 on the calibration.

The use of most of the controls will now appear fairly obvious. There are a few, however, where further explanation will be of value.

The Internal Saw-Tooth Oscillator

For most observations the input voltage is fed to the vertical amplifier. For observation purposes this input voltage must be swept across the face of the tube by a saw tooth wave. This wave is generated within the Oscilloscope by a special Oscillator, the frequency of which is controlled by the SAW-TOOTH SWEEP FREQUENCY RANGE switch which gives a coarse frequency selection, and the VERNIER Control which is a fine frequency adjustment. The resulting pattern on the surface of the CR tube may then be steadied by the adjustment of the SYNC. control.

When using the internal Saw-Tooth Oscillator, the HORIZONTAL INPUT CONTROL should be set at "Sweep" on the Internal Side. When set at 60 cycles this control provides a 60-cycle sine-wave sweep which is used mainly for special applications.

The use of the SYNCHRONIZING INPUT CONTROL is fairly obvious. When the internal Sweep is being used this switch is set at "INT." When an external Synchronizing Voltage is applied to the "EXT. SYNC." binding posts, the input control is set at EXT.

When the internal saw-tooth oscillator is being used, and a synchronizing voltage of either 60 cycles or 120 cycles is desired, setting the Synchronizing Input Control to the 60 cycle or 120 cycle position will help to lock the internal oscillator at either of these two frequencies. This is especially helpful when pre-setting the 'scope for a 60 cycle or 120 cycle sweep before applying a signal to the vertical binding posts. Note that the Saw-Tooth Frequency Range and Vernier Controls must be set approximately to the desired sweep.

The EXTERNAL positions on the Horizontal Input Control determine the sensitivity of Horizontal Amplifier when an external voltage is applied to the Horizontal Input Posts. Number 1 position is the most sensitive. The 60 CYCLE position on the INTERNAL side of the Horizontal Input Control provides a 60 cycle internal Sine Wave Sweep, and is useful for frequency comparison purposes when the frequency of the voltage applied to the Vertical Input Posts is believed to be some multiple of 60 cycles. This position is also useful in showing phase relationships between an external 60 cycle source applied to the Vertical Binding Posts, and the Internal 60 cycle voltage of the 'scope.

The INTENSITY MODULATION SWITCH has two positions. To the left it provides a 60 cycle internal modulating voltage directly on the grid of the CR tube. This is useful in certain types of observation since one-half the observed wave will appear considerably brighter than the other half. In the External Off position, no grid modulation is provided unless an external modulation voltage is applied to the binding posts.

BINDING POSTS: There are three binding posts at the left side of the instrument and three at the right side. The bottom binding posts at the extreme left and right are marked GND and are the ground posts for all types of inputs. These ground posts are connected directly to the chassis of the 'scope. The post marked VERT. INPUT is used when applying an external voltage through the Vertical Amplifier. It is used in connection with the GND located under it. The EXT. SYNC. post is for applying an external synchronizing voltage and is used with the GND post located to the left of it. The HOR. INPUT post is used when applying an external voltage to the Horizontal Amplifier such as when using the Synchronizing Voltage supplied by a TV or FM Sweep Generator. The GND post under it is used as the ground connection. The INTENSITY MODULATION Post is used when applying an external pulse for marker purposes direct to the Grid of the CR tube. It is used with the GND post located to the right of it.

DIRECT CONNECTIONS: It is possible to apply AC voltages direct to the deflection plates of the CR tubes through blocking capacitors without

going through the amplifier. This is accomplished through binding posts on the rear of the instrument. There are two sets of terminal strips. The horizontal strip is located on the same side of the instrument as the Horizontal Input Binding Posts. The Vertical Strip is located on the same side as the Vertical Input Binding Posts. Each terminal strip has four screw connections. The first two screw terminals are connected by a jumper, and the second two are similarly connected by a jumper. To make a direct connection, through blocking capacitors, disconnect both jumpers, and connect the external voltage to the two center screw terminals of the strip being used. Be sure to replace the jumper wires when the test is concluded.

Note that even when the amplifiers are not being used, connection is made to the deflecting plates through blocking capacitors. Thus only AC voltages may be applied to the deflection plates. In Radio and Television servicing it is not advantageous to apply DC voltages to the 'scope. Furthermore, it would be necessary to disconnect the spot positioning potentiometers in order to make DC measurements.

IMPORTANT NOTE: The Model CRO-1 is an extremely sensitive high impedance indicating device. In its sensitive position static voltage may be indicated by merely bringing the hand close to the vertical input binding post. Likewise, the use of unshielded leads in connecting the oscilloscope to high impedance circuits will cause static pickup to be superimposed upon the signal under observation. Best practice indicates that shielded leads be used for all measurements.

Strong magnetic fields in close proximity to the instrument may also cause deflection of the pattern. It should not be located near large transformers or other sources of strong magnetic fields.

## CRO-1 SET UP FOR TYPICAL TESTS

| TYPE OF TEST | AUXILIARY EQUIPMENT REQUIRED | VERTICAL INPUT CONTROL | SYNCHRONIZING INPUT CONTROL | SAW-TOOTH SWEEP FREQUENCY | HORIZ. INPUT CONTROL | VERTICAL BINDING POSTS | HORIZONTAL BINDING POSTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| TV FRONT END, IF OR TRAP ALIGNMENT | TV SWEEP GENERATOR | HIGH SENSITIVITY | NOT USED | NOT USED | EXTERNAL 1 OR 10 | TV SET OUTPUT SIGNAL | SWEEP GENERATOR CRO OUTPUT | FOLLOW SET AND GENERATOR SERVICE INSTRUCTIONS |
| TV SYNC CIRCUIT OBSERVATION | NONE | HIGH SENSITIVITY | 60 CYCLES | 60 CYCLES | SWEEP | TV SET SYNC SOURCE | NOT USED | SEE RECEIVER SERVICE DATA |
| TV COMPOSITE SIGNAL | NONE | WIDE BAND | INT. | APPROX. 7875 CYCLES | SWEEP | GRID FINAL VIDEO AMP. OF TV SET | NOT USED | CORRECT PATTERN SHOWS SYNC PULSES AND VIDEO SIGNAL |
| FM-AM VISUAL ALIGNMENT | FM OR AM SIG. GENERATOR | HIGH SENSITIVITY | NOT USED | NOT USED | EXTERNAL 1 OR 10 | AM OR FM SET SIGNAL | SWEEP GENERATOR CRO OUTPUT | FOLLOW RECEIVER SERVICE DATA AND GENERATOR INSTRUCTIONS |
| SIGNAL TRACING | RF SIGNAL GEN. CRO PROBE | HIGH SENSITIVITY | INT. | MOD. FREQ. OF SIGNAL GEN. | SWEEP | JACKSON SIGNAL PROBE | NOT USED | PATTERN SHOULD BE SAME AS GENERATOR MODULATING VOLTAGE |
| FREQUENCY COMPARISON | SOURCE OF FREQUENCIES TO BE COMPARED | HIGH SENSITIVITY | NOT USED | NOT USED | EXTERNAL 1 OR 10 | KNOWN FREQUENCY | UNKOWN FREQUENCY | CORRECT PATTERN IS A LISSAJOUS FIGURE |
| PHASE RELATIONSHIP 60 CYCLE VOLTAGES | NONE | HIGH SENSITIVITY | NOT USED | NOT USED | 60 CYCLES | EXT. VOLTAGE BEING TESTED | NOT USED | |
| PHASE RELATIONSHIP 2 EXTERNAL VOLTAGES OF SAME FREQUENCY | NONE | HIGH SENSITIVITY | NOT USED | NOT USED | EXTERNAL 1 OR 10 | 1ST EXTERNAL VOLTAGE | 2ND EXTERNAL VOLTAGE | |
| AUDIO FREQUENCY TESTS | AUDIO SIGNAL GENERATOR | HIGH SENSITIVITY | INT. | GENERATOR FREQUENCY | SWEEP | AUDIO AMP. OUTPUT OR TEST POINT | NOT USED | |
| AUDIO FREQUENCY SQUARE WAVE TEST | SQUARE WAVE GENERATOR | HIGH SENSITIVITY | INT. | GENERATOR FREQUENCY | SWEEP | AUDIO AMP. OUTPUT OR TEST POINT | NOT USED | |

## PARTS LIST

| REF. SYM. | | | | |
|---|---|---|---|---|
| R1 | RESISTOR | CARBON | 62000 | OHM |
| R2 | " | " | " | " |
| R3 | " | " | 27000 | " |
| R4 | " | " | 3.3 | MEGOHM |
| R5 | POTENTIO. | " | 2 | " |
| R6 | RESISTOR | " | 1 | " |
| R7 | " | " | 500000 | OHM |
| R8 | " | " | 47000 | " |
| R9 | " | " | 3.3 | MEGOHM |
| R10 | " | " | " | " |
| R11 | " | " | " | " |
| R12 | " | " | " | " |
| R13 | POTENTIO. | " | 250000 | OHM |
| R14 | " | " | " | " |
| R15 | RESISTOR | " | 100000 | " |
| R16 | " | " | 3.3 | MEGOHM |
| R17 | " | " | 1 | " |
| R18 | " | " | " | " |
| R19 | " | " | .47 | " |
| R20 | " | " | " | " |
| R21 | " | " | 27000 | OHM |
| R22 | " | " | " | " |
| R23 | " | " | " | " |
| R24 | " | " | " | " |
| R25 | " | " | 2700 | " |
| R26 | " | " | " | " |
| R27 | " | " | " | " |
| R28 | " | " | " | " |
| R29 | " | " | " | " |
| R30 | " | " | 470000 | " |
| R31 | " | " | " | " |
| R32 | " | " | 200 | " |
| R33 | " | " | 1 | MEGOHM |
| R34 | " | " | " | " |
| R35 | " | " | 3900 | OHMS |
| R36 | POTENTIO. | " | 10000 | " |
| R37 | RESISTOR | " | " | " |
| R38 | " | " | 47000 | " |
| R39 | " | " | 10000 | " |
| R40 | POTENTIO. | " | 10000 | " |
| R41 | RESISTOR | " | 1 | MEGOHM |
| R42 | " | " | 33000 | OHM |
| R43 | DUAL POT. | " | 1 | MEGOHM |
| R44 | RESISTOR | " | 100000 | OHM |
| R45 | " | " | 33000 | " |
| R46 | " | " | 47000 | " |
| R47 | " | " | 470 | " |
| R48 | POTENTIO. | " | 250000 | " |
| R49 | RESISTOR | " | 1 | MEGOHM |
| R50 | " | " | 100000 | OHM |
| R51 | " | " | .47 | MEGOHM |
| R52 | " | " | 1 | " |
| R53 | " | " | 47000 | OHM |
| R54 | " | " | 1.3 | MEGOHM |
| R55 | " | " | .13 | " |
| R56 | " | " | 15000 | OHM |
| R57 | " | " | 1 | MEGOHM |
| R58 | " | " | 47000 | OHM |
| R59 | " | " | " | " |
| R60 | " | " | 470000 | " |
| R61 | " | " | 51000 | " |
| R62 | " | " | 47000 | " |
| R63 | " | " | " | " |
| R64 | " | " | 750 | " |

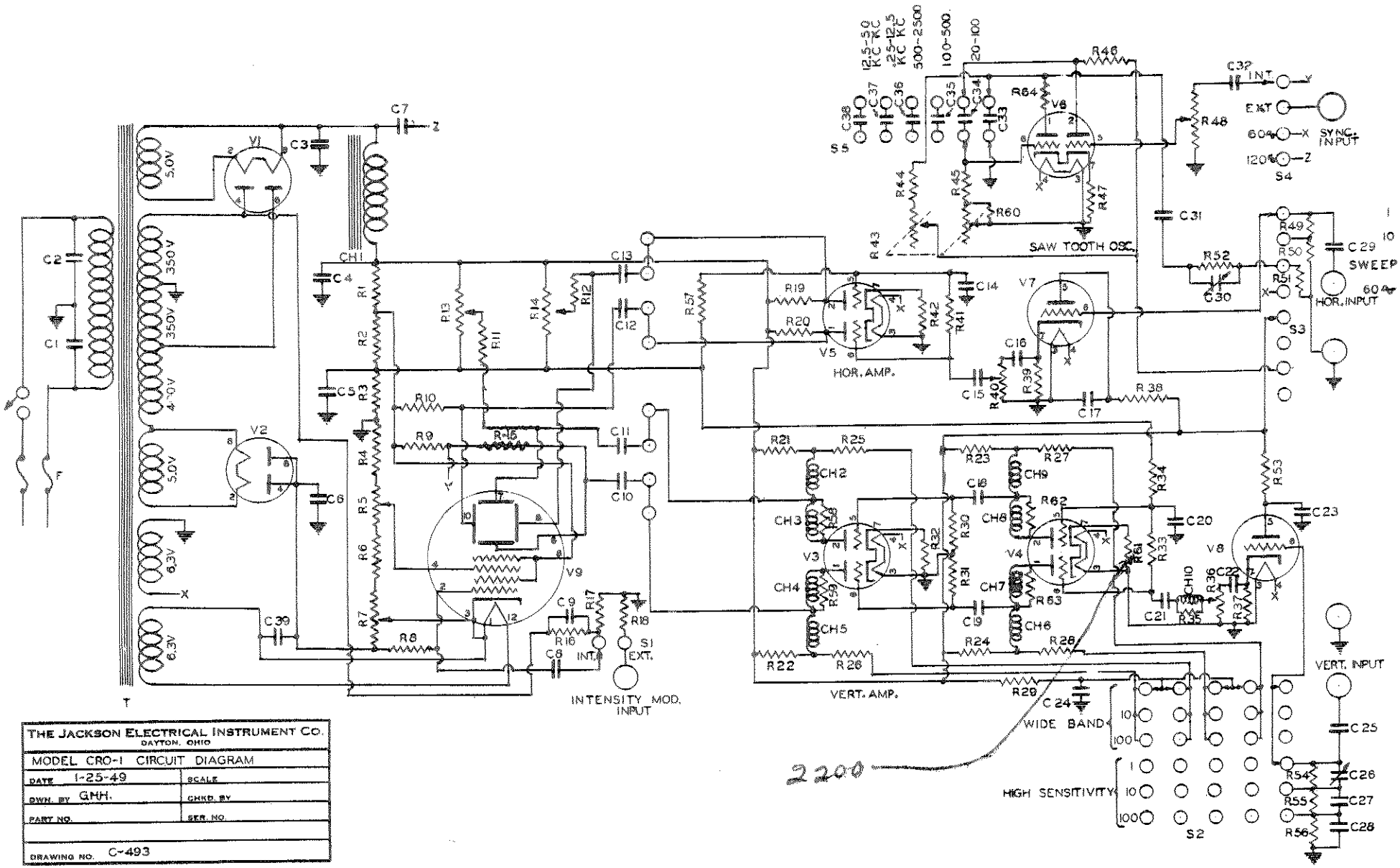
| REF. SYM. | | |
|---|---|---|
| C1 | CAPACITOR | PAPER .1 MF 400V. |
| C2 | " | " " " " |
| C3 | " | ELECTROLYTIC 10 MF 450V. |
| C4 | " | " " " " |
| C5 | " | " " " " |
| C6 | " | OIL FILLED .5 MF 2000V. |
| C7 | " | PAPER .1 MF 400V. |
| C8 | " | OIL FILLED .005 MF 2000V. |
| C9 | " | MICA .005 MF |
| C10 | " | PAPER .1 400V. |
| C11 | " | " " " |
| C12 | " | " " " |
| C13 | " | " " " |
| C14 | " | ELECTROLYTIC 10 MF 450V. |
| C15 | " | PAPER .5 MF 400V. |
| C16 | " | ELECTROLYTIC 25 MF 25V. |
| C17 | " | " 10 " 450V. |
| C18 | " | PAPER .5 MF 400V. |
| C19 | " | " " " " |
| C20 | " | ELECTROLYTIC 10 MF 450V. |
| C21 | " | PAPER .5 MF 400V. |
| C22 | " | ELECTROLYTIC 25 MF 25V. |
| C23 | " | " 10 " 450V. |
| C24 | " | " " " " |
| C25 | " | PAPER .25 MF 400V. |
| C26 | " | CERAMIC ADJ. 1-3.5 MMF |
| C27 | " | MICA 10 MMF |
| C28 | " | " 250 " |
| C29 | " | PAPER .25 MF 600V. |
| C30 | " | MICA ADJ. 3-30 MMF |
| C31 | " | PAPER .5 MF 400V. |
| C32 | " | " .1 " " |
| C33 | " | " .25 " " |
| C34 | " | " .05 " " |
| C35 | " | " .01 " " |
| C36 | " | " .002 " " |
| C37 | " | MICA 400 MMF |
| C38 | " | " 80 " |
| C39 | " | PAPER .5 MF 400V. |

| | | |
|---|---|---|
| S1 | SWITCH | TOGGLE S.P.D.T. |
| S2 | " | 6 POS. NO. 8-96 |
| S3 | " | 2 CIR., 4 POS. |
| S4 | " | 1 CIR., 4 POS |
| S5 | " | 5 POS NO. 8-97 |

| | | |
|---|---|---|
| T | TRANSFORMER | POWER NO. 14-59 |

| | | |
|---|---|---|
| CH1 | CHOKE | FILTER 15 HY. NO. 14-46 |
| CH2 | " | R.F. 100 UHY ON 3.3 MEG CARBON |
| CH3 | " | " " " " R58 |
| CH4 | " | " " " " R59 |
| CH5 | " | " " " " 3.3 MEG CARBON |
| CH6 | " | " " " " " " " |
| CH7 | " | " " " " R63 |
| CH8 | " | " " " " R62 |
| CH9 | " | " " " " 3.3 MEG CARBON |
| CH10 | " | " 60 " " R35 |

| | | |
|---|---|---|
| V1-V2 | VACUUM TUBE | TYPE 5Y3GT |
| V3-V4-V5-V6 | " | " 6J6 |
| V7-V8 | " | " 6C4 |
| V9 | CATHODE RAY TUBE | TYPE 5UP1 |




| THE JACKSON ELECTRICAL INSTRUMENT CO. DAYTON, OHIO | |
|---|---|
| MODEL CRO-1 CIRCUIT DIAGRAM | |
| DATE 1-25-49 | SCALE |
| DWN. BY GHH. | CHKD. BY |
| PART NO. | SER. NO. |
| | |
| DRAWING NO. C-493 | |