



PRECISION LABORATORY EQUIPMENT

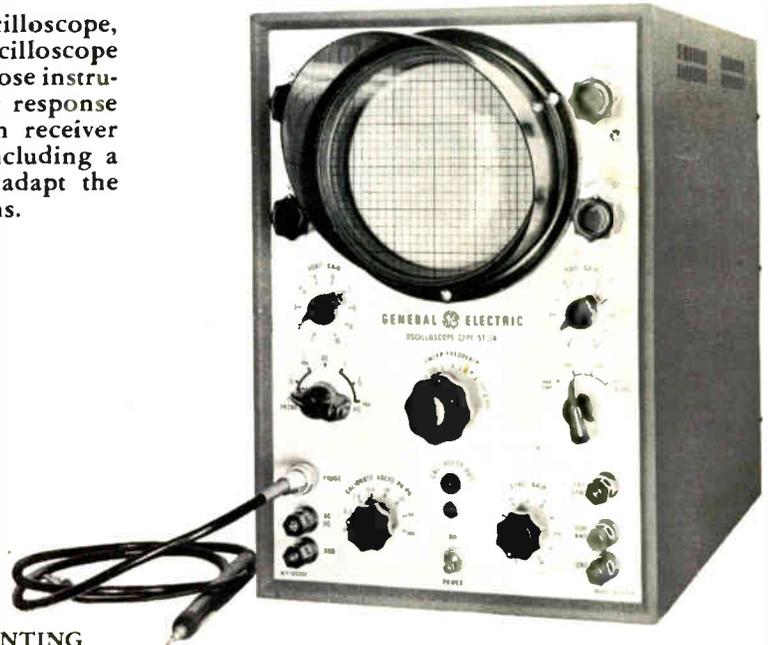
OSCILLOSCOPE

TYPE ST-2A

The General Electric Cathode Ray Oscilloscope, Type ST-2A, is a high quality 5-inch oscilloscope designed to fill the need for a general purpose instrument in laboratories. Its wide frequency response makes it especially useful for television receiver circuit work. Several special features including a DC vertical amplifier are provided to adapt the equipment to a wide range of applications.

FEATURES

- HIGH SENSITIVITY
- EXCEPTIONAL STABILITY
- WIDE FREQUENCY RESPONSE
- DC AMPLIFIER
- EXCELLENT LINEARITY
- LOW CAPACITY INPUT PROBE
(Supplied as Standard Equipment)
- Z AXIS INPUT
- CALIBRATING VOLTAGES PROVIDED
- DEFLECTION PLATES AVAILABLE
FOR DIRECT CONNECTION
- REGULATED POWER SUPPLY
- QUALITY CONSTRUCTION
- SAFETY WINDOW AND RUBBER MOUNTING
FOR CR TUBE



DESCRIPTION

This Oscilloscope is new and modern in design and in circuitry. It is intended to fill a wide range of general laboratory needs. Its size and weight have been held to a minimum consistent with good construction. The cathode ray tube is cradled in rubber and is provided with a $\frac{1}{4}$ " thick safety window. This tube is the new type 5UP1 which provides a very sharp and bright trace.

The controls are conveniently grouped according to their functions. The panel is simplified by the use of a dual control for the sweep oscillator.

The input attenuator to the vertical amplifier has been especially designed for the wide variety of duties that this new oscilloscope will perform. This compensated attenuator will faithfully attenuate voltages by as much as 1000 to 1 without frequency discrimination. There is a probe input for testing circuits that withstand only a minimum of capacitive and resistive loading. Binding posts for both AC and direct current amplifier inputs are provided.

The usefulness of this oscilloscope is greatly enhanced by the ability of the vertical input circuit to handle direct voltages. This direct coupled input is very useful in testing industrial equipment and also finds use in television and other circuits where both a DC and an AC component of voltage are present.

Adequate drive from the deflection amplifiers is available so that it is possible to expand the pattern to several times the diameter of the tube. This permits better observation of short-duration pulses and allows closer observation of parts of a wave pattern.

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Since the output stages of both the horizontal and vertical amplifiers are DC coupled, the positioning controls are positive in their action and the trace responds immediately to any change in the positioning control settings. The amplifier circuits are not prone to overload and when overdriven, the recovery time is very rapid.

Wide frequency response is obtained without recourse to peaked amplifier coupling circuits. Straight resistive coupling is used and there is no positive slope to the frequency response curve, which falls off so gradually that the scope can be used on input frequencies up to 3 mc.

All low-level amplifier and sweep stages are supplied with DC operating potentials from an electronically regulated power supply which allows the oscilloscope to be used under unusually severe power line fluctuations.

To aid in amplitude measurements of voltage under test, a standard voltage source is available from a pin-jack of the front panel. This calibrating voltage may be varied in seven steps—from .3 volts to 300 volts.

The intensity of the cathode ray beam may be modulated from a "Z Axis" input jack which is located on the back, along with the fuse, the power cord, and the astigmatism control. It is seldom necessary to adjust the astigmatism control but its availability is desirable if the 'scope is used at very high intensity levels such as might be required for group demonstrations.

SPECIFICATIONS

(All ratings based on a nominal 117. volt line)

Input Impedance

Vertical

1. AC Input—1 megohm shunted by 36 mmfd.
2. DC Input—1 megohm shunted by 80 mmfd. at maximum gain setting.
3. Probe—1 megohm shunted by 10 mmfd.

Horizontal

10 megohms shunted by 35 mmfd.

Deflection Plates

Vertical—5 megohms shunted by 11 mmfd.
Horizontal—5 megohms shunted by 11 mmfd.

Frequency Response

Vertical Amplifier

Probe and AC—+0, -20% from 20 cycles to 500 KC. (Square Wave response 60 to 40,000 cycles.)
+0, -50% from 20 cycles to 1 megacycle with gradual reduction in response beyond 1 megacycle

DC—+0, -20% from 0 to 500 KC at full gain setting.

Horizontal Amplifier

from 0 to 100 KC at full gain setting to -20% from 20 cycles to 100 KC at any gain setting.

Sensitivity

Vertical

1. AC Input—.015 volts RMS per inch.
2. DC Input—2.0 volts DC per inch.
3. Probe—.20 volts RMS per inch.

Horizontal—.4 RMS volts per inch.

Maximum Input Potential—500 V peak, Vertical or Horizontal.

Deflection Plates—Vertical: 27 V DC per inch.
Horizontal: 33 V DC per inch.

Sweep Range

10 cycles to 100 KC in six overlapping ranges.

Synchronization—internal, external, or power line.

Linearity

Vertical and Horizontal—less than 10% non-linearity at full-scale deflection.

Sweep—Less than 15% non-linearity over 80% of forward sweep.

Calibrating Voltages

Seven AC voltages of power line frequency—.3, 1.5, 3, 15, 30, 150 and 300 volts with $\pm 15\%$ accuracy.

Ambient Temperature

0° to 40° C.

Power Requirements

105-125 volts AC, 50-60 cycle, 100 watts.

Physical Specifications

- 15 1/2 inches—height
- 10 inches—width
- 17 inches—depth
- 43 pounds—weight

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Printed in U.S.A.

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PRECISION LABORATORY EQUIPMENT

SWEEP GENERATOR

TYPE ST-4A

The General Electric Sweep Generator is a high quality equipment designed for use in the development laboratory and for television broadcast and receiver servicing. Using a variable permeability type of linear sweep which is exceptionally wide and is obtained entirely by electronic means, the Generator has no moving components. General specifications recommend it for a wide range of other applications, including educational laboratories and production testing.



High output voltage is available over the entire range of the equipment, with higher output available in the high television channels where it is most needed for head-end development and testing. Beat output is used on the low bands and direct output on the high bands.

The generator covers a frequency range from 4 to 110 mc and 170 to 220 mc. This is accomplished through the use of two oscillators, one of which is swept and tunes through the range of 170 to 220 mc, and the other is unmodulated and tunes through the range 220 to 275 mc.

A five step attenuator and one Vernier attenuator are provided as well as output jacks for horizontal sweep voltage and input for the associated marker generator. Complete double shielding plus double filters on leads entering the oscillator compartment make the leakage low enough so that in combination with the five step attenuator overall full gain response can be observed on the most sensitive television receiver without over-loading.

The unit is supplied in a picture frame type case with the panel slotted so that the equipment can be removed and mounted in the standard 19-inch relay rack. When the unit is rack mounted leakage is unaffected since the case is not a part of the shielding.

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FEATURES

- EXCEPTIONALLY WIDE LINEAR SWEEP.
- WIDE FREQUENCY COVERAGE, covers all broadcast television channels, TV and FM—IF bands.
- GOOD ATTENUATION AND EXTREMELY LOW LEAKAGE.
- ENTIRELY ELECTRONIC, no moving mechanical parts.
- CENTER FREQUENCY CONTINUOUSLY VARIABLE, thereby making the entire scope trace useful.
- HIGH OUTPUT AT THE DESIRED FREQUENCY.
- EASY TO OPERATE, direct reading dials with TV channels marked.
- RETURN SWEEP BLANKING AVAILABLE TO PROVIDE ZERO REFERENCE.
- WIDE RANGE OF PHASE CONTROL over 360°.
- EXTREME MECHANICAL STABILITY.
- USES STANDARD RECEIVING TYPE TUBES.

SPECIFICATIONS

FREQUENCY RANGE: Continuously variable from 4 to 110 mc and 170 to 220 mc.

SWEEP WIDTH: Linear from 500 kc to greater than 15 mc.

OUTPUT VOLTAGE: Greater than 0.1 volts from 4 to 110 mc.
Greater than 0.5 volts from 170 to 220 mc.

OUTPUT IMPEDANCE: 20 to 50 ohms dependent on setting of attenuator.

ATTENUATION: Continuously variable from maximum output to 20 microvolts.

LEAKAGE: Stray fields—less than 10 microvolts induced in a 2-inch loop 6 inches from the case in any direction.

PHASE CONTROL RANGE: Greater than 360 degrees.

POWER REQUIREMENTS: 105-125 volts, 50-60 cycles, 100 watts. Power transformers have double primary and can be connected for operation on 210 to 250 volts.

AMBIENT TEMPERATURE RANGE: 0 to 40° C.

TUBE COMPLEMENT: 2—6J6 Oscillators
1—6J6 Mixer
1—5Y3 Rectifier

PHYSICAL SPECIFICATIONS (OVERALL IN CABINET): Height: 10¾ inches
Width: 19¼ inches
Depth: 10 inches
Weight: 30 lbs.

Front panel slotted for standard 19" relay rack mounting (panel 10½" x 19")

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PRECISION LABORATORY EQUIPMENT

MARKER GENERATOR

TYPE ST-5A



GENERAL  ELECTRIC

MARKER GENERATOR

TYPE ST-5A

The General Electric Marker Generator is a superior quality unit for use in television applications where an accurate source of markers is required to mark specific frequency locations on a tuned circuit response curve when presented on an oscilloscope. This new equipment supplies an entirely new approach for the generation of markers for use with wide band sweeps. The method employed permits the use of one to five markers simultaneously, at the same time permitting complete freedom of the positioning of the bank of markers in the frequency range from 19 to 50 mc. In addition, it supplies accurate markers for the twelve available television channels.

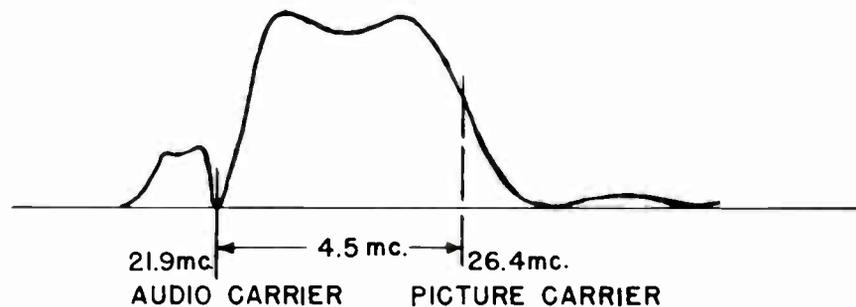
It is designed for exceptionally fast manipulation and has crystal controlled accuracies throughout. Ease of operation, quality construction and outstanding performance recommend this equipment for television development and production line testing. For fast, accurate alignment and servicing of television receivers, it is unsurpassed.

FEATURES

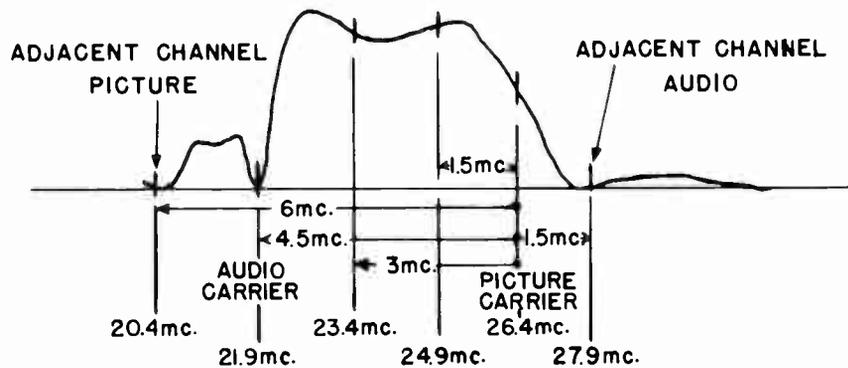
- **SEPARATE CRYSTAL FOR EACH TV CHANNEL**, crystal selected by rotary switch, no tuning required.
- **PICTURE AND AUDIO CARRIER MARKERS AVAILABLE SIMULTANEOUSLY**
- **I.F. RANGES**
 - Continuously variable in three ranges from 19 to 50 mc.
 - Only one dial setting required for complete receiver alignment.
 - Extremely accurate, easily checked against harmonics of the 4.5 mc crystal. The dial has an incremental adjustment for setting to the exact calibration point.
- **PASS BAND AND TRAP CIRCUITS CAN BE ALIGNED IN ONE OPERATION**
- **NO RADIO FREQUENCY OUTPUT**—Markers are not passed through the circuit under test, hence no distortion of the response curve.
- **EASY TO OPERATE**—Direct reading dial and switch selection of channels. Controls are simplified and grouped for ease of operation.
- **STANDBY SWITCHES ALLOW INDIVIDUAL ACTIVATION OF THE MARKERS**
- **THE 4.5 MC CRYSTAL IS AVAILABLE INDEPENDENTLY FOR ALIGNMENT OF INTER-CARRIER SOUND**
- **EXTREME MECHANICAL STABILITY AND GOOD APPEARANCE**

DESCRIPTION

For television maintenance and development work it is to be understood that the Marker Generator is to be used with the General Electric Type ST-4A Sweep Generator and a suitable Oscilloscope (the G-E Type ST-2A is recommended). On I.F. work a response curve is produced by the sweep generator and viewed on the oscilloscope. In this waveform study there are several points of interest and two such points are the sound carrier and picture frequencies. Further it is known that the spacing between these two carriers is specified by the F.C.C. as 4.5 megacycles. To insure maintenance of this exact spacing the Type ST-5A Generator employs a 4.5 mc crystal oscillator to generate a 4.5 mc sideband marker which is, of course, 4.5 mc removed from the picture carrier. This is illustrated as follows:



This same crystal can also operate at 1.5 mc's to supply simultaneously markers spaced at 1.5 mc intervals from the picture carrier for determining band pass and adjacent channel traps. This is represented on the following typical video I.F. response curve:



Crystals are stocked for the picture carrier frequencies of each television channel. The purchaser should designate the channels required at the time of purchase. Additional channels can be added at any time by purchasing the required crystals.

The unit is supplied in a picture frame type case with the panel slotted so that the equipment can be removed and mounted in the standard 19-inch relay rack.

SPECIFICATIONS

PICTURE CARRIER OSCILLATOR

15 position rotary selector switch selects the following 12 crystal controlled frequencies plus 3 tuneable ranges covering intermediate frequencies.

Channel	Crystal Fundamental	Picture Carrier	Crystal Harmonic Used
2	18.416 mc	55.25 mc	3rd
3	20.416 mc	61.25 mc	3rd
4	22.416 mc	67.25 mc	3rd
5	25.75 mc	77.25 mc	3rd
6	20.812 mc	83.25 mc	4th
7	21.906 mc	175.25 mc	8th
8	22.656 mc	181.25 mc	8th
9	23.406 mc	187.25 mc	8th
10	24.156 mc	193.25 mc	8th
11	24.906 mc	199.25 mc	8th
12	25.656 mc	205.25 mc	8th
13	26.406 mc	211.25 mc	8th

Crystal Accuracy—.02%.

IF Ranges—3 Bands: 19 to 27 mc; 27 to 37 mc; 37 to 50 mc; Accuracy .5%.

Dial can be read to .1 mc. Provision has been made for checking calibration against crystal at 4.5 mc intervals. Check points are marked on the dial and a screw vernier for indexing dial at the zero beat point has been provided.

A toggle switch for standby operation enables the operator to remove all markers at will, without disturbing the test circuit response curve.

CRYSTAL MODULATOR

Single crystal ground to operate at the fundamental or third mechanical mode depending upon tuned circuits selected. This is controlled by a 3-position switch that provides the following:

Markers	Dial Calibration	Accuracy
4.5 mc low harmonic (audio carrier)	4.5 mc high harmonic	At 4.5 mc .05%
1.5 mc low harmonic (adjacent channel)		At 1.5 mc .70%

A toggle switch for standby operation allows removal of all markers except picture carrier.

POWER SUPPLY

105-125 volts, 50-60 cycles, 60 watts. Power transformer has double primary and can be connected for 210 to 250 volt operation.

AMBIENT TEMPERATURE RANGE

0 to 40° C.

TUBES

- 1—12AT7 Oscillator, Mixer
- 1—6C4 Sweep Coupling
- 2—0A2 Voltage Regulators
- 2—12AU7 Marker Amplifiers
- 1—6C4 1.5 and 4.5 mc crystal Oscillator
- 1—5Y3 Rectifier

PHYSICAL SPECIFICATIONS (Overall in Cabinet)

- Height: 10 $\frac{3}{4}$ inches
- Width: 19 $\frac{1}{4}$ inches
- Depth: 10 inches
- Weight: 37 pounds

Front panel slotted for standard 19" relay rack mounting (panel 10 $\frac{1}{2}$ " x 19")

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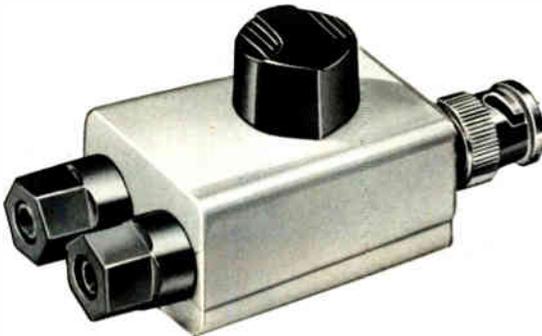
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PRECISION LABORATORY EQUIPMENT

BALANCED OUTPUT ADAPTOR

TYPE ST-8A

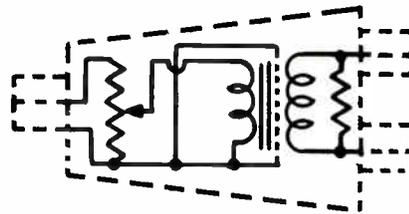


The Balanced Output Adaptor, Type ST-8A, developed for use with the General Electric Model ST-4A Sweep Generator, converts the normally single-ended output of the Sweep Generator to a balanced output for working into a 300 ohm resistive load.

Experience has proven that matching a single-ended signal source with resistors does not always result in a signal source which appears balanced to the receiver under test. Therefore, to assure the correct alignment of head ends, the use of the Balanced Output Adaptor is highly recommended.

The following is a circuit diagram of the Adaptor:

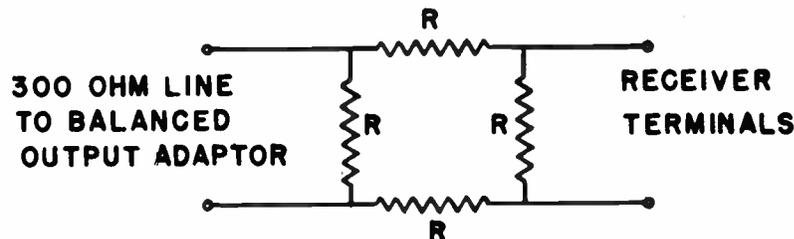
TYPE BNC
CONNECTOR
INPUT



BINDING POST
OUTPUT

The vernier output control, normally incorporated in the output cable of the Sweep Generator, is incorporated in the Adaptor when using balanced output.

The input impedance of many nominally 300 ohm receivers may vary as much as ten to one as the set is tuned through the twelve channels. Since the characteristics of the Adaptor may vary when the load departs from 300 ohms, the use of the following resistive pad is suggested:

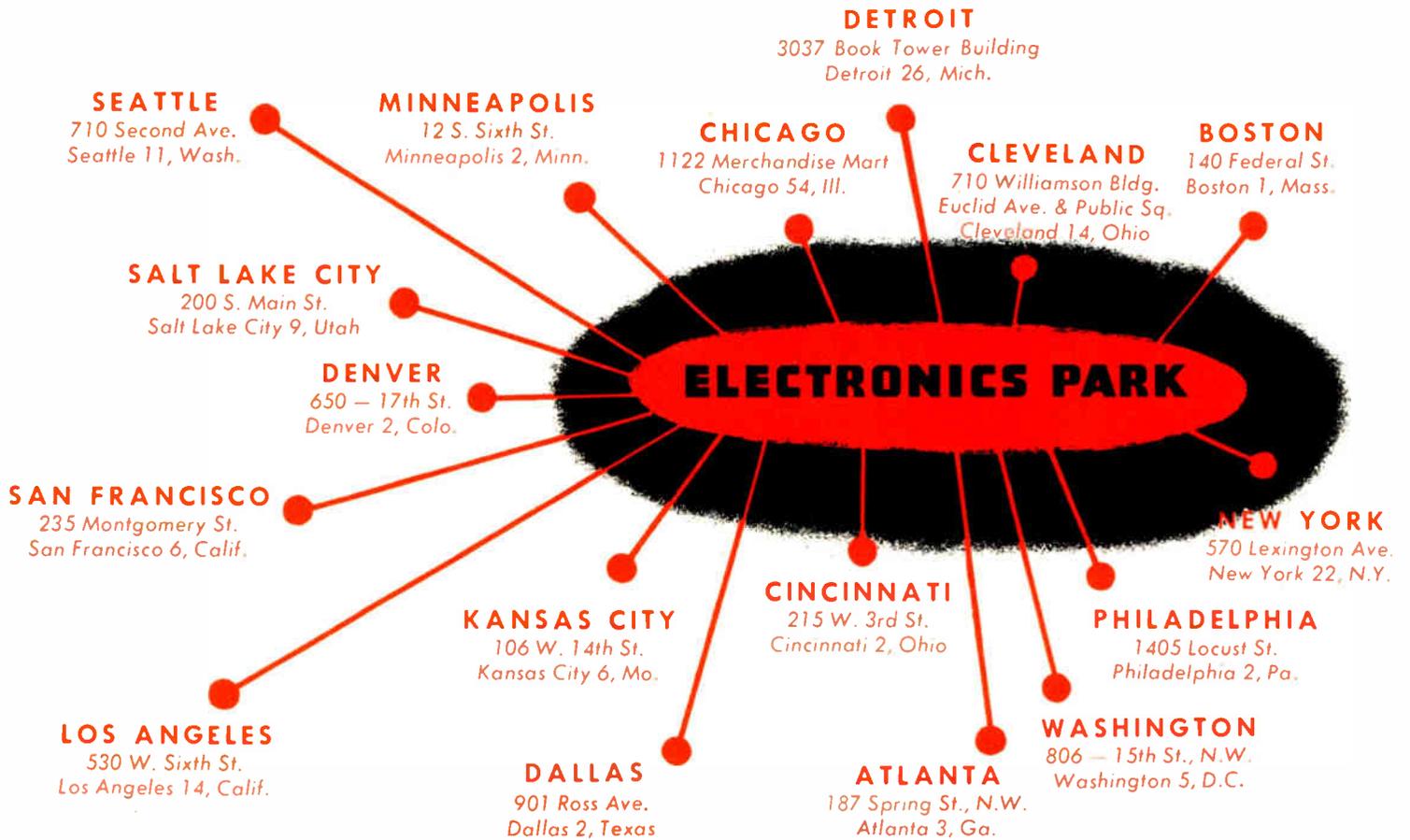


The above pad should be located as close as possible to the head end input terminals. $R = 430$ ohm $\frac{1}{2}$ watt composition resistors soldered to form as small a square as possible. 300 ohm twin lead should be used to connect the Adaptor to the pad.

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