

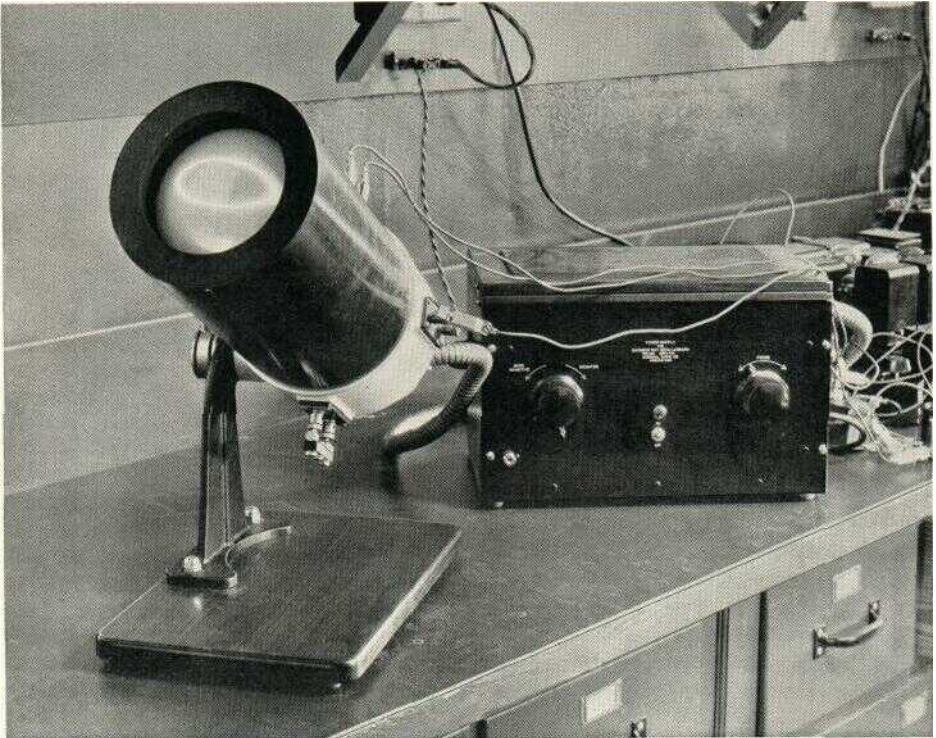
CATALOG SUPPLEMENT F-303 MAY, 1931

GENERAL RADIO COMPANY CAMBRIDGE A, MASSACHUSETTS

ELECTRICAL and RADIO



LABORATORY APPARATUS



Brilliant images are obtained with this new cathode-ray oscillograph. From an unretouched photograph

CATHODE-RAY OSCILLOGRAPH

THE cathode-ray oscillograph is a well-known and justly popular laboratory tool for the observation and recording of phenomena, especially where high frequencies and very short time intervals are involved. Because the "moving element" is a beam of cathode rays or electrons, it is inherently more suitable for most purposes than oscillographs of the string or moving-coil types. Distortions due to inertia

PLEASE FILE WITH CATALOG F, PARTS 1 AND 2

and resonance effects encountered in vibrating mechanical elements are absent and, since the rays are usually deflected by electrostatic means, the power sensitivity is much higher.

The General Radio cathode-ray oscillograph has the following notable features, several of which are unique:

BRILLIANT IMAGES

PATTERNS are unusually brilliant—bright enough to be easily seen and photographed in daylight. In one demonstration they were visible in all parts of a hall seating 200 people. Photographs of instantaneous single-trace transients can be taken.

COMPLETE ALTERNATING-CURRENT OPERATION

ALL the supply voltages are taken from the 110-volt line—no batteries.

FOCUSING

INSTEAD of depending on filament-current adjustments, or on external magnetic fields, the initial focusing is accomplished by changing the potential of a cylindrical electrode surrounding the cathode. A small spot, less than one millimeter in diameter, is obtained at the greatest anode voltage used, 2500 volts.

LONG TUBE LIFE

THE cylinder used for focusing also prevents destruction of the filament by ionic bombardment. Tubes usually last more than 1000 hours, especially since the power supply and tube mounting are designed to minimize the danger of accidental breakage or burnout.

LOW-CAPACITANCE DEFLECTING PLATES

PLATE terminals are brought out through separate glass arms on the tube. The capacitance between either pair of plates is less than 1.5 mmf

HIGH-FREQUENCY RESPONSE

Since the capacitance between plates is low, and since the initial focusing of the beam does not depend upon the gas content of the tube, this oscillograph can be used at very high frequencies. Even at 30 megacycles per second the envelope patterns are fairly good, especially when the time axis is obtained by the use of a rotating mirror.



The General Radio Cathode-Ray Oscillograph for table mounting. At the left is the TYPE 496-AM Power-Supply Unit; at the right, the TYPE 497-A Tube Mounting containing the tube

THREE COMPONENT PARTS

ALTHOUGH the General Radio oscillograph is a complete equipment, it is, for convenience in cataloging, considered to consist of the following three components:

- a. The TYPE 478-A Cathode-Ray Oscillograph Tube is the heart of the instrument. It is listed separately to facilitate ordering replacements.
- b. The TYPE 497-A Tube Mounting is the support for the tube, providing a means for holding the tube in position, for making connections to it and for protecting it against breakage.
- c. The TYPE 498-A Power-Supply Unit supplies all the voltages necessary to operate the tube from the 110-volt alternating-current supply.

For the complete table-mounting oscillograph, the following material should be ordered:

1—TYPE 478-A Cathode-Ray Oscillograph Tube	\$95.00
1—TYPE 497-A Tube Mounting	75.00
1—TYPE 496-AM Power-Supply Unit.	110.00
COMPLETE EQUIPMENT	\$280.00

TYPE 478-A CATHODE-RAY OSCILLOGRAPH TUBE

THIS tube is of the so-called hot-cathode, low-voltage type, employing a hot filament and an anode voltage which is low as compared with the oscillographs associated with the names of Braun and of Dufour. Provision is made for deflecting the electron beam with the electric field between two pairs of small condenser plates, but, if proper arrangements are made, magnetic deflecting fields may be substituted. Patterns appear on a fluorescent screen at the end of the tube, the material of which was selected to yield the maximum of visual and photographic brilliance.

The cathode-ray tube used in the General Radio oscillograph was developed by Manfred von Ardenne and is manufactured by him in Germany.

Operating Principles:

The operating principle of the tube is simple. Electrons emitted by the oxide-coated filament are drawn toward the high-potential anode, thus acquiring a velocity sufficient to pass through a hole in it and strike a fluorescent screen on which a spot of light appears. A negatively charged cylinder around the filament serves to concentrate the electrons into a small beam.

Between the anode and the fluorescent screen, the electron beam passes between the plates of two very small condensers, so arranged that an electric field between one pair causes a deflection of the beam (and the spot) in a direction perpendicular to the deflection caused by a field between the other pair. These are the deflecting plates across which the voltages to be observed are impressed. When alternating voltages are applied, the spot traces figures like those represented in the accompanying sketches. These are the fundamental patterns upon which more complicated uses of the cathode-ray oscillograph are based.

Construction:

The cutaway view on page 5 shows in detail the arrangement of the electrodes within the tube. From top to bottom they are: the two pairs of deflecting plates, the anode and the filament surrounded by the focusing cylinder.

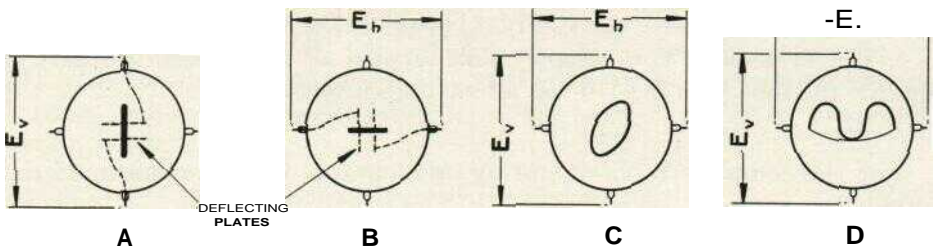
Brilliance:

Patterns are brilliant and easily visible even in broad daylight.

Photographs may be taken of single transits of the spot across the screen at velocities up to 400 inches per second with an $f4.5$ lens, a plate as fast as the Eastman Hyper-press and an anode voltage of 2000 volts. This lens and plate would, for instance, record one transit of a spot moving fast enough to complete a 2-inch (diameter) circle in $1/60$ th of a second. A faster lens or plate would increase the permissible velocity correspondingly. Photographs at



The Cathode-Ray Oscillograph Tube



Fundamental cathode-ray oscillograph patterns. Alternating voltages may be applied to the vertical or horizontal deflecting plates as in A and B. Pattern C results when E_v and E_h are applied simultaneously, the frequencies f_v and f_h being the same. If E_h is derived from a "linear sweep circuit," and E_v is derived from an alternating voltage, the wave shape of E_v appears in Pattern D. The true wave shape of E_v can also be obtained from Pattern A with a moving film camera or a rotating mirror

CATHODE-RAY OSCILLOGRAPH

much greater velocities may be obtained by allowing the spot to repeat the pattern several times.

Voltage Sensitivity:

Over the normal range of anode voltages, 500-2500 volts, the voltage sensitivity is a linear function of anode voltage, being about one volt per millimeter at 500 volts, and 5 volts per millimeter at 2500 volts. The greater the anode voltage, the greater the brilliance and the lower the sensitivity.

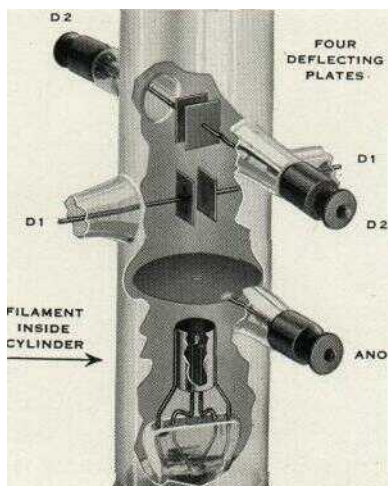
Terminals:

Terminals for the deflecting plates and the anode are brought out of the tube through glass arms. This construction materially lowers the inter-electrode capacitance and eliminates insulation troubles in the anode circuit. Connections to the filament and focusing cylinder are brought out to the plug-type base.

Power Supply:

The following values of voltage, which may best be obtained from the TYPE 496-A Power-Supply Unit, are required: filament, 0.7 volt, 1.5 amperes, approximately, the exact value being marked on each tube; anode, 500-2500 volts direct current, 50-100 micro-amperes; focusing cylinder, 50-400 volts direct current, no current when properly adjusted. The maximum anode voltage recommended is 2000 volts, but this may be increased to 2500 volts for short periods in order to obtain additional brilliancy.

Capacitance of either pair is less than 1.5 mmf Even at frequencies of 30 mega-cycles



Electrode Structure in the Cathode-Ray Oscillograph Tube

cycles per second, the envelope patterns are fairly good, especially when the radio-frequency deflection is used in one direction only and the time axis obtained with a rotating mirror or a moving film camera.

Mounting:

The tube is intended to be mounted in the TYPE 497-A Tube Mounting described below.

Dimensions:

The diameter of the fluorescent screen is 4.5 inches. For other dimensions, see the description of the TYPE 497-A Tube Mounting.

Weight:

1 pound.

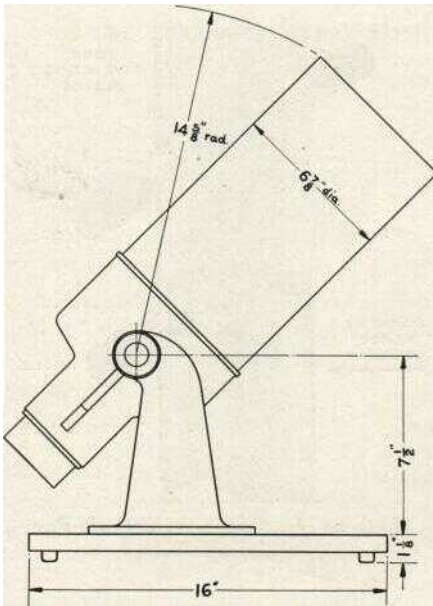
	<i>Code Word</i>	<i>Price</i>
478-A	APPLY	\$95.00

TYPE 497-A TUBE MOUNTING

(FOR CATHODE-RAY OSCILLOGRAPH)

THIS is a universal mounting for holding the tube in any desired position and for making connections between the tube and the TYPE 496-A Power-Supply Unit (see page 3 for illustration). It has a number of features which facilitate the use of the oscillograph, make for convenience in operating and prolong the life of the tube by minimizing the danger of accidental burnout or breakage. Terminals are provided for connecting the voltages to be analyzed.

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Profile View of Complete Tube Mounting
(to scale)

Construction:

The unit consists of an aluminum casting carried on a horizontal shaft attached to a bracket which, in turn, is bolted to a walnut base large enough to provide the necessary stability. The casting contains the tube socket and an adjustable three-arm clamp for holding the tube securely in place, and it may be swung about the horizontal axis and locked in any desired angular position as shown in the accompanying profile drawing.

Attached to the casting and surrounding the tube is a protecting cylinder of bakelite, which serves the double purpose of excluding extraneous light and of preventing accidental breakage of the tube.

Mounting:

The supporting bracket may, if desired, be removed from the base and mounted on

the under side of a table, on a relay rack panel or in any other convenient manner. For most purposes, however, the standard wooden base will be found entirely satisfactory. A suitable panel for adapting the instrument to rack-mounting is described under "TYPE 497-P Accessories."

Terminals:

All power-supply wiring between the tube and the power-supply unit is carried in a 5-foot flexible shielded cable, on one end of which is the tube socket and on the other, the special plug base which fits the corresponding jack plate in the power-supply unit. This cable is supplied as regular equipment with the tube mounting.

Binding posts are mounted at the top and side of the tube mounting, to which the voltages to be analyzed may be connected by means of standard TYPE 247-M Plugs. Provision is made for short circuiting either or both pairs of deflecting plates and for using them either with or without grounded terminals.

For some purposes it is often desirable to introduce voltages in series with the power supply to the anode. To facilitate this, two terminals are provided at the bottom of the unit. These are normally short circuited, and, since they are at ground potential, their exposure introduces no hazard.

Accessories:

The unit is supplied complete with the shielded cable but without the cathode-ray oscillograph tube.

Dimensions:

See the accompanying sketch. The base is 9 1/8 inches wide.

Weight:

17 1/2 pounds, without the tube.

<i>Type</i>	<i>Code Word</i>	<i>Price</i>
497-A 	ARBOR	\$75.00

CATHODE-RAY OSCILLOGRAPH

TYPE 497-P

ACCESSORIES

FOR those users who wish to adapt the cathode-ray oscillograph for mounting on a standard 19-inch (TYPE 480) relay rack, we can supply a suitable drilled panel to which the supporting bracket of the tube mounting may be attached. The bakelite protecting tube then extends through the front of the panel as shown in the photograph of the rack-mounting model.

When mounted on a relay rack, the tube mounting should be separated by at least 7 inches from the power-supply unit to minimize the effect of stray magnetic fields on the cathode-ray beam.

Terminals:

Three sets of binding posts are provided on the front of the panel to which are attached wires for making connections to the terminals on the tube mounting.

Weight:

11 1/2 pounds.

Type ___

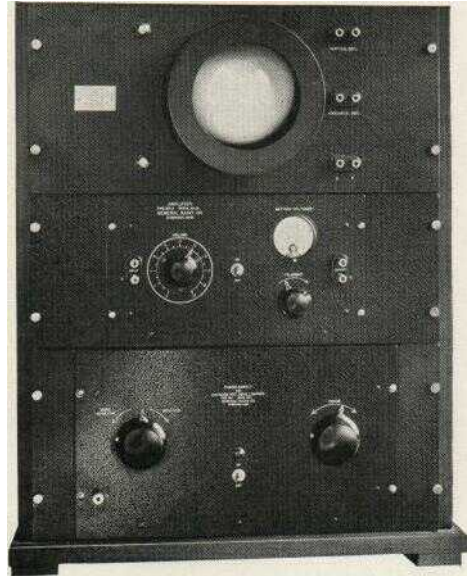
497-P1

Code Word

AMEND

Price

\$12.00



The rack-mounting Oscillograph with a TYPE 514-AR Amplifier. The latter instrument was, in this set-up, used to amplify one of the voltages being analyzed

Dimensions:

Panel, 19 x 8³/₄ x 1/4 inches. When assembled, the viewing tube extends 6 7/8 inches in front of the panel, other parts extend 13 7/8 inches behind it.

TYPE 496-A POWER-SUPPLY UNIT

(FOB CATHODE-RAY OSCILLOGRAPH)

THE power-supply unit is a complete solution to the voltage supply and control problem for the TYPE 478-A Cathode-Ray Oscillograph Tube, wherever a 110-volt alternating-current source is available. It contains every feature desirable for convenience and safety. It eliminates the possibility of burning out the tube due to accidental contact of high voltages with the filament circuit.

There are only two principal controls and these are placed on the panel within easy reach. One adjusts the brilliancy and the sensitivity of the tube by changing the anode voltage, the other adjusts the focus of the electron beam by changing the voltage applied to the focusing cylinder. A third control, the filament rheostat (and its associated

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ammeter), is placed inside the cabinet, out of the way, because once set it need never be changed during the life of the tube.

Safety for the user is an important design feature since anode potentials as high as 2500 volts are employed. High voltage terminals cannot be exposed except when the tube is removed from the socket or when the cover of the power-supply unit is raised. Both of these operations open the low-voltage input circuit to the high-voltage supply and make access to dangerous voltages an impossibility. The safety switches do not, however, interrupt the filament-supply circuit.

Power Supply:

105-115 volts, 50 or 60 cps. alternating current. An ON-OFF switch and a pilot lamp are mounted on the panel.

Output Voltages:

Sufficient to operate TYPE 478-A Cathode-Ray Oscillograph Tube.

Terminals:

A receptacle is placed on the right end of the cabinet for the 110-volt input. Output voltages are delivered to a jack plate inside the cabinet, which fits the plug plate on the connecting cable supplied with the tube mounting.

Tubes:

One 280-type and one 866-type are required. Neither is supplied with the unit.

Mounting:

Everything is carried on an aluminum panel finished in black crackle lacquer which, in turn, is mounted in a polished walnut cabinet.

A rack-mounting instrument is described below under "Alternative Mounting."

Accessories:

A 7-foot cord, fitted with attachment plugs for making connections to the power supply, is furnished.

Dimensions:

Panel, 15 x 8 3/4 inches; overall cabinet size exclusive of carrying handles, width 15 1/4, height 9 5/8, depth 9 1/2 inches.

Weight:

30 pounds.

<i>Type</i>	<i>Code Word</i>	<i>Price</i>
496-AM Cabinet Mounting	ARGON	\$110.00

TYPE 496-A POWER-SUPPLY UNIT

(ALTERNATIVE MOUNTING)

THE power-supply unit may, if desired, be supplied for mounting in a standard 19-inch (TYPE 480) relay rack. To do this we supply, instead of the cabinet, a pair of panel extensions for increasing the panel length to 19 inches. A brass shield takes the place of the cover of the cabinet, the raising of which opens the safety switch referred to in the preceding description.

The instrument itself is identical with the TYPE 496-A Power-Supply Unit previously described.

Dimensions:

Panel size, with panel extensions, 19 x 8 3/4 x 1/4 inches.
Overall depth, behind panel, 8 1/2 inches.

Weight:

21 1/2 pounds.

<i>Type</i>	<i>Code Word</i>	<i>Price</i>
496-AR For relay-rack mounting	ANNEX	\$100.00