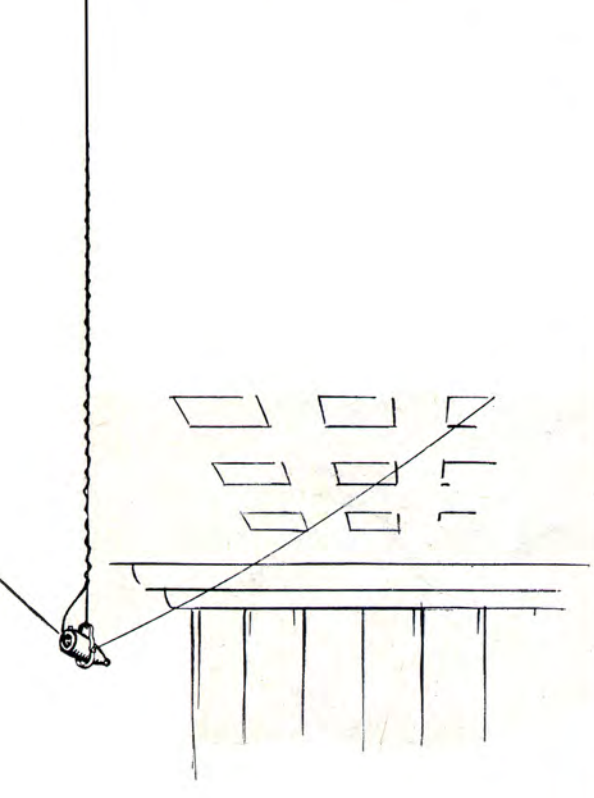
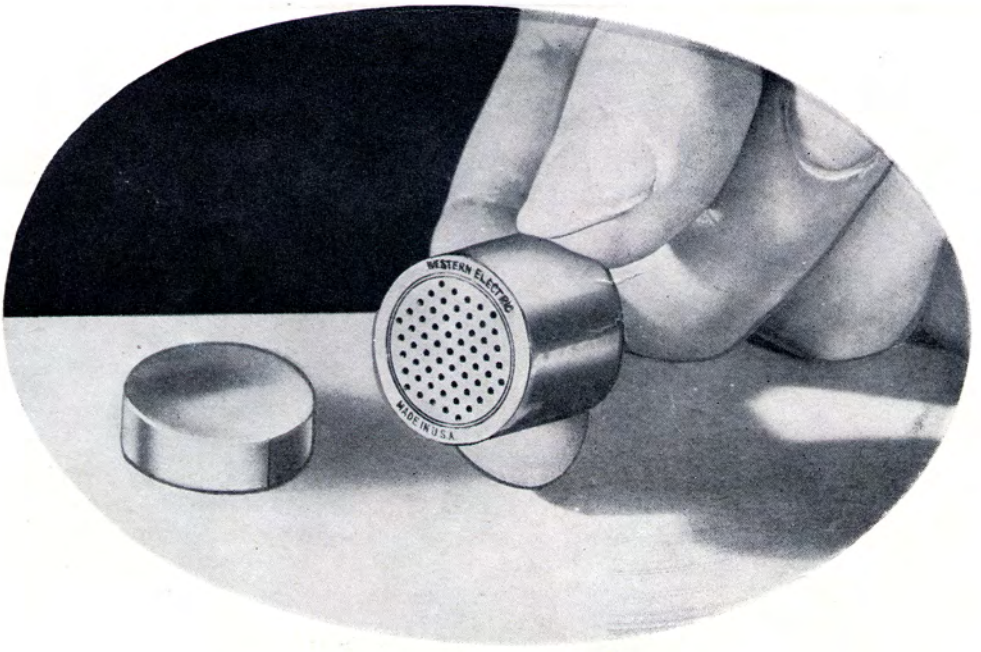
Western Electric

Improved

640AA CONDENSER MICROPHONE and RA-1095 AMPLIFIER



Broadcast Program Pick-Up and Laboratory Standard Applications



640AA CONDENSER MICROPHONE

Tops for FM

Copyright, 1946 Western Electric Company, Incorporated

Western Electric

640AA

Condenser Microphone

The Western Electric 640AA Condenser Microphone offers numerous distinctive advantages both to the acoustic technician and to the broadcast studio engineer.

As a laboratory instrument this microphone incorporates the most recent technical advances in the precision measurement of sound intensity over a wide range of temperature and humidity conditions. Accurate, scientific production tests of other sound instruments such as receivers, loudspeakers and microphones may also be obtained through its use.

In the broadcasting field, when associated with its companion RA-1095 Amplifier, the 640AA Microphone provides a means for ultra-faithful program pick-up especially in auditoriums or in large studios which have proper acoustical characteristics for use of the remote single microphone pick-up technique. This application is particularly effective where orchestras or similar large groups are involved. The combination can readily be used with standard studio equipment since, for a sound field pressure of 1 dyne/cm² (sound level of +74db), a net supplementary gain of approximately 60db is adequate to raise its output to a line level of +8 vu.

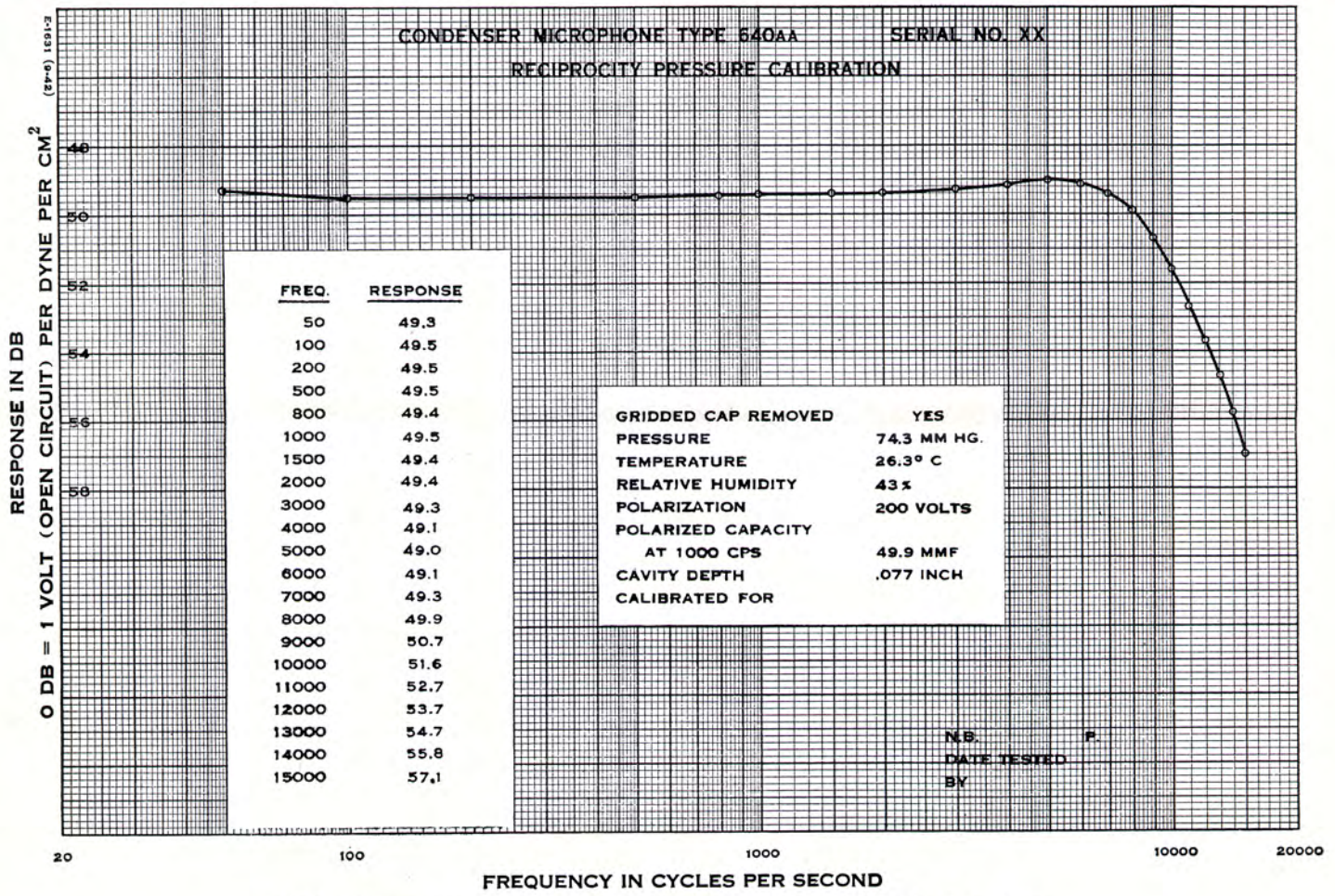
In most applications the small size of the 640 type microphone is a pronounced advantage in that "point pick-up" performance is approached and field disturbances resulting from the presence of the microphone is minimized. Phase distortion is negligible because of the high resonant frequency of the stretched diaphragm.

DESCRIPTION

The 640AA Condenser Microphone is furnished in a bright metal, cylindrical housing approximately 1″ in diameter and 1″ long. It is similar to its predecessor, the 640A Microphone, except for improved stability with respect to time, temperature and humidity.

For laboratory and test applications, the order should specify that the unit be supplied calibrated. This calibration will be in accordance with procedures established by the U. S. Bureau of Standards, Cruft Laboratories and Bell Telephone Laboratories, Inc. The 640AA has features which compensate for the variations in viscosity of air with temperature, making the instrument response relatively free from variation with temperature.

The microphone is provided with a removable grid over the face of the diaphragm to afford mechanical protection under normal program pick-up conditions. For measuring applications it is usually desirable to remove this grid, since all calibrations are made with the grid removed. In the event it should be necessary to leave the grid on in this type of application, suitable correction factors can be determined at the point of use by making the required frequency runs with and without the grid.



NOTE: Tabulated values are measured points through which a smooth curve has been drawn.

Figure 1—Typical Pressure Calibration Chart of 640AA Condenser Microphone

CALIBRATED MICROPHONES

640AA Condenser Microphones can be ordered calibrated by the "Reciprocity Pressure Response Calibration Method". This method is described in a monograph by Dr. Richard K. Cook of the U. S. Bureau of Standards, published in Bureau of Standards pamphlet RP-1341 and in the Journal of Research of the National Bureau of Standards, Vol. 25, 1940.

A chart (see Figure 1) is supplied with calibrated microphones, which, in addition to the pressure response curve and the points of calibration on which it is based, shows the conditions under which the calibration was obtained and gives the polarizing capacity at 1000 cps. Also, a free-field correction curve is supplied, which, when applied to the pressure calibration gives the free-field calibration for 0° sound incidence. In order for the calibration to apply exactly, the instrument should be used under conditions identical to those under which it was calibrated. Suitable correction factors can, of course, be determined at the point of use if these conditions must be altered.

The pressure response characteristic shown in Figure 1, which is applicable only to measurements in small chambers is approximately constant to 6000 cycles per second and then falls off uniformly to the extent of 10 db at 15000 cps.

The pressure response level in the 50 to 6000 cycle range with 200 volts polarizing potential is approximately 49.5 db below 1 volt (open circuit per dyne/cm²).

FREQUENCY RESPONSE

The free-field response characteristics of the 640AA Microphone in combination with the

RA-1095 Amplifier are shown in Figure 2. The difference in shape above 1000 cycles per second between the zero degree free-field curve, and the pressure calibration shown in Figure 1, is due almost entirely to diffraction effects which result when the microphone (640AA mounted on an RA-1095 Amplifier) is placed in a free sound field, and not to the amplifier which has practically no effect on the shape of the response characteristics. The range covered, it will be noted, is admirably suited to the highest quality AM or FM program transmission requirements. With the line of sound approach normal, or perpendicular to the plane of the diaphragm, (0 degrees), the response is approximately constant for sounds in the frequency range between 50 and 1000 cycles per second. Above 1000 cps the response rises gradually to a maximum of about 8 db at 8000 cps, then drops uniformly to a level which at 15000 cps is roughly equal to that at 1000 cps.

As illustrated in Figure 2, the response of the 640AA Microphone varies somewhat in the higher frequencies depending on the direction from which the sound wave approaches the diaphragm. For sound 30 degrees off normal incidence, the 8000 cycle maximum is reduced about 1 db. For sound 60 degrees off normal this level is reduced about 3½ db and for sound 90 degrees off normal about 7 db. The steepness of slope for frequencies around 10,000 cycles increases slightly with the degree of variation from normal incidence.

MOUNTING

In mounting the 640AA Microphone, it is important that its associated amplifier be arranged mechanically so as to preserve as nearly as possible the freedom from distortion of the sound field which is inherent in the small physical proportions of the microphone element.

The RA-1095 Amplifier described on page 7 may be used for laboratory or production testing. Where especially constructed amplifiers are used in place of the RA-1095 Amplifier, it is essential that connections between the microphone and the first stage of vacuum tube amplification be short and of low capacitance as compared to the capacitance of the microphone; otherwise the sensitivity of the instrument is reduced and its frequency characteristic altered. The lead to the grid circuit also should be well shielded electrically to prevent noise pick-up from interfering electric and magnetic fields.

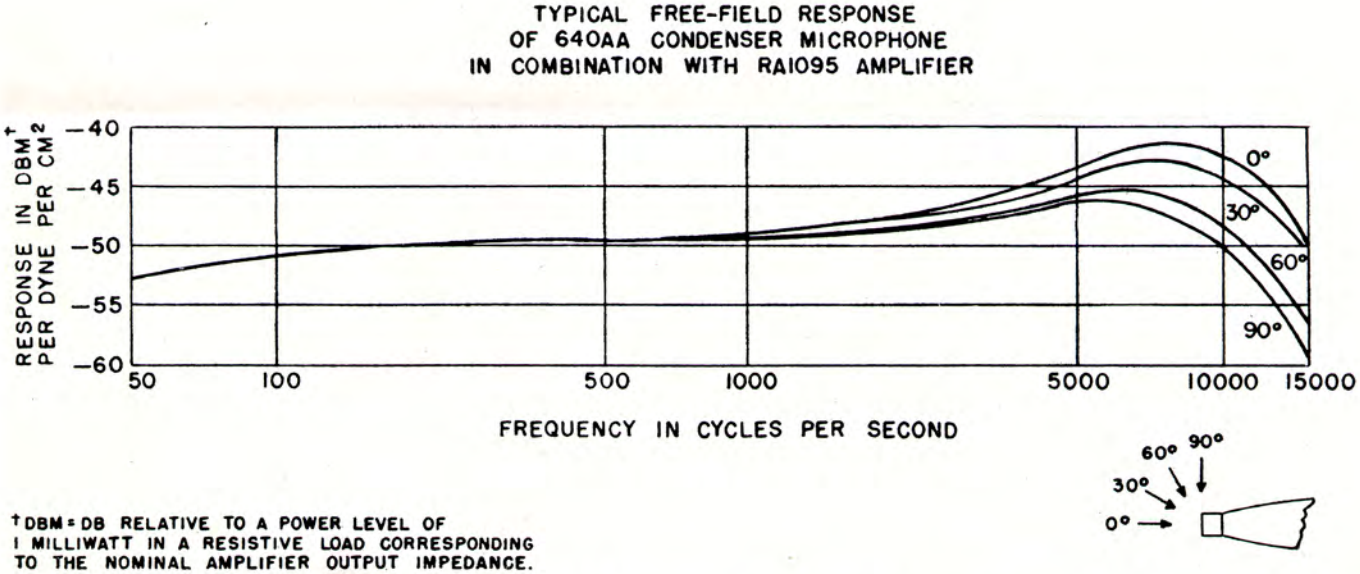


Figure 2—Typical Free-Field Response Curve of the 640AA Microphone Mounted on the RA-1095 Amplifier.

For free-field pick-ups such as are common in broadcasting applications, the small, bullet shaped Western Electric RA-1095 Amplifier described on the following pages serves ideally both as a mounting for the 640AA Microphone and as a means of providing the unit with first stage amplification and polarizing voltage.

Where a microphone boom or other similar device is used to direct the microphone toward a given sound source, the amplifier should be shock-mounted by means of soft springs or rubber supports to isolate the elements from possible mechanical vibrations which are likely to produce noise.

640AA MICROPHONE
TYPICAL ELECTRICAL AND MECHANICAL CHARACTERISTICS

Frequency Characteristic: Pressure Response: see Figure 1.

Free-field Response: see Figure 2.

Output Level: Approximately 49.5 db below 1 volt (open circuit) per dyne/cm² with 200 volts d-c polarizing potential.

Output Impedance: Essentially that due to its capacitance which is approximately 50 mmf. to 60 mmf.

Operates Into: Grid circuit of closely associated vacuum tube amplifier (such as Western Electric RA-1095 Amplifier).

Polarizing Voltage: 220 volts d-c maximum from well regulated quiet supply.

CAUTION: Polarizing voltage exceeding 220 volts should not be applied as higher voltages may damage the instrument.

Dimensions: Cylindrical shape approximately 1″ diameter and 1″ long.

Weight: Approximately 1½ ounces.

Mounting: For optimum signal-to-noise the microphone should be closely associated with the first stage of amplification and preferably mounted in the structure containing this amplifier.

External Connection: The 640AA Microphone is especially designed to mount on the RA-1095 Amplifier. It has a spring mounted plunger and male base threads for providing connection to the amplifier. When associated with another type of amplifier, the microphone should be connected to the grid of the vacuum tube by means of a short, well-shielded, low capacitance lead to the center contact at rear of instrument. The cylindrical shell of the microphone should be connected to the grounded side of the grid circuit thereby serving as a shield for the inner components.

Protection: Provided with a dust cap for each end of the cylinder when instrument is not in use.

RA-1095 Amplifier

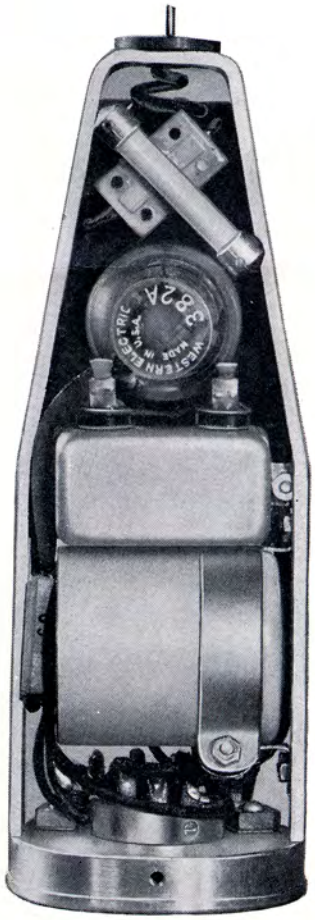
The Western Electric RA-1095 Amplifier is a small, single stage amplifying unit developed especially for use with the 640 type Condenser Microphone. Shaped like a long range military projectile, this amplifier is approximately 7¾" long by 2½" in diameter and weighs only 1¾ lbs. All components are housed in a removable spun metal casing which is normally finished in bright chromium but can be obtained in a non-reflecting dark aluminum wrinkle gray.

A threaded recess at the pointed end of the housing permits screwing the 640AA Microphone securely in place so that the two units present an unbroken surface offering the least possible disturbance to the surrounding sound field.

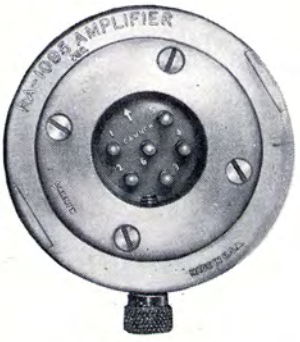
The screw mounting and case of the amplifier form the grounded side of the circuit. The high potential side of the circuit is completed to the 640 type microphone by means of a spring-mounted plunger in the center of the housing recess which connects with a center contact on the microphone.

The output level of this efficient combination for a given sound field is about 28 db higher than that of a standard high quality studio microphone, and the signal-to-noise ratio compares favorably. The frequency response characteristic of the amplifier is such as to assure optimum results from the use of the 640AA Microphone as an ultra-faithful pick-up device. The free-field frequency response characteristics for the combination are shown in Figure 2, Page 5.

The amplifier is furnished complete with a selected 382A vacuum tube of the familiar "door knob" type which has no base; the terminals are pins anchored in the glass envelope. The tube is supported in a hole in the main chassis frame with its leads soldered so that the glass shoulders rest firmly against the mounting detail.



RA-1095 Amplifier with Cover Removed



Base of Amplifier Showing 6 Prong Socket

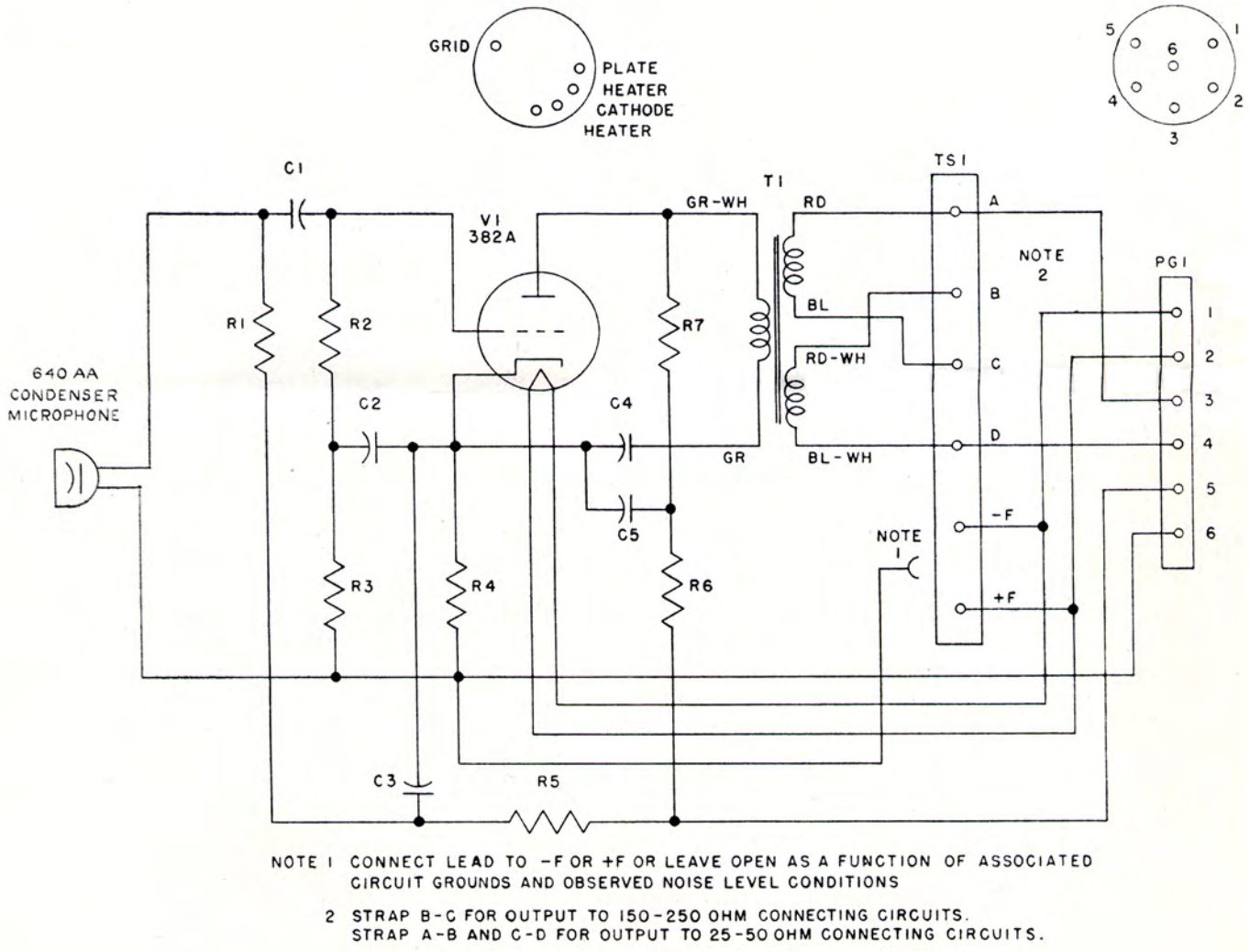


Figure 3—Schematic of RA-1095 Amplifier

POWER SUPPLY

To operate the RA-1095 Amplifier, 150 milliamperes at 6.3 volts d-c are required for the heater or filament circuit and approximately 3 milliamperes at 220 volts d-c are required for the plate and microphone polarization supply. For maximum noise-free operation both sources of power should be extremely quiet.

Plate and polarizing supply voltages of less than 220 volts may be used but at a sacrifice in the microphone response level. The loss in the microphone sensitivity will be directly proportional to the decrease in polarizing potential from 220 volts.

Note: Voltages in excess of 220 volts should not be applied to the amplifier plate circuit when the 640AA Microphone is attached as higher voltages may damage the microphone. If power is to be supplied from an unregulated rectifier, precautions should be taken against over-voltage.

Connections for plate and filament supply as well as for the program circuit leads are made through a standard 6 prong recessed male socket in the base of the amplifier, as shown in Figure 3. The Cannon 6 hole female plug, P6-11, manufactured by the Cannon Electrical Development Co., Los Angeles, California, will fit

this socket. A thumb screw is provided in the base of the amplifier so that pressure may be applied to the socket to hold these connections firm and allow suspension of the microphone and amplifier by means of the cord.

TERMINAL CONNECTIONS

A row of terminals arranged alphabetically is provided on the inside of the RA-1095 amplifier base to permit strapping for different impedance conditions. This row of terminals marked TS-1 is shown on the schematic drawing (Figure 3). The amplifier case is designed to slip easily off the narrow end of the chassis frame to allow ready access to these connections.

For connecting the amplifier to a 25-50 ohm circuit, terminal A should be strapped to terminal B and terminal C should be strapped to terminal D. For connection to a 150-250 ohm circuit, the previous connections should be removed and terminal B should be strapped to terminal C. The wire which carries the cathode return and ground connection to the filament supply circuit (see note 1 on Figure 3) should be connected either to the —F or + F terminal, whichever may be found to give the lowest noise level conditions when the amplifier is connected to the succeeding circuits. The ground connection should not conflict with grounds on the external power supply.

MOUNTING

It is recommended that a vibration isolation mounting be used with the RA-1095 in order to minimize microphonic disturbances. A suitable mounting of this type can be obtained from our nearest distributor.

MAINTENANCE

Other than occasional vacuum tube replacements, very little maintenance is required for the RA-1095 Amplifier. The high impedance elements in the microphone coupling mesh are impregnated with moisture resistant compound to minimize noise difficulties due to moisture. The amplifier should be placed in a desiccator after it has been subjected to severe moisture exposure. Both the amplifier and the 640AA Microphone should of course be protected from dust and corrosive fumes when not in use.

RA-1095 AMPLIFIER
TYPICAL ELECTRICAL CHARACTERISTICS

Frequency Characteristic: See Curve Figure 2 (microphone and amplifier in combination).

Output Level: Approximately -29.5 dbm with the 640AA Microphone in a sound field of 10 dynes/cm² or -49.5 dbm in a 1 dyne/cm² sound field.

Signal-to-Noise Ratio: Approximately 40 db at an output level of -49.5 dbm (0-15,000 cycle band).

Distortion: Less than one percent at -3 dbm output level.

Operates from: 640AA Condenser Microphone.

Output Impedance: Designed to be used with equipment having rated source impedance of 25-50 or 150-250 ohms.

Power Supply: (Quiet sources required for both filament and plate power).

Filament: 6.3 volts, 150 milliamperes, direct current.

Plate: 220 volts maximum, 3 milliamperes, direct current.

CAUTION: Plate voltages exceeding 220 volts should not be applied when the 640 type microphone is attached, as higher voltages may damage the microphone.

Dimensions: Approx. 7¾" long, 2½" diameter.

Weight: Approx. 1¾ pounds.

External Connections: Through 6 prong socket in base of amplifier. (Use Cannon 6 hole female plug P6-11)

Mounting: Suspend from socket cord or use shock mounting hanger to fit user's microphone boom or other suspension mounting.

640AA CONDENSER MICROPHONE
RA-1095 AMPLIFIER

Features

Small size improves fidelity, approaches "ideal" of "point pick-up."

This microphone facilitates precision measurement of sound intensity over wide range of temperature and humidity conditions when used as a laboratory instrument.

In combination with the RA-1095 Amplifier, it is especially adaptable for ultra-faithful program pick-up in auditoriums or large studios.

Especially effective for single microphone pick-up technique for large orchestras, choral or similar groups.

Compact

Tops for FM

DISTRIBUTOR IN THE UNITED STATES

GraybaR
ELECTRIC COMPANY

Executive Offices: 420 Lexington Avenue, New York 17, N. Y.

ALABAMA
Birmingham

ARIZONA
Phoenix

ARKANSAS
Little Rock

CALIFORNIA
Los Angeles
Oakland
Sacramento
San Diego
San Francisco

COLORADO
Denver

CONNECTICUT
Hartford
New Haven

DELAWARE
Wilmington

DIST. OF COLUMBIA
Washington

FLORIDA
Jacksonville
Miami
Orlando
Tampa

GEORGIA
Atlanta
Savannah

IDAHO
Boise

ILLINOIS
Chicago
Peoria

INDIANA
Evansville
Hammond
Indianapolis

IOWA
Davenport
Des Moines

KANSAS
Wichita

KENTUCKY
Louisville

LOUISIANA
New Orleans

MAINE
Portland

MARYLAND
Baltimore

MASSACHUSETTS
Boston
Springfield
Worcester

MICHIGAN
Detroit
Flint
Grand Rapids
Lansing

MINNESOTA
Duluth
Minneapolis
St. Paul

MISSISSIPPI
Jackson

MISSOURI
Kansas City
St. Louis

NEBRASKA
Omaha

NEW HAMPSHIRE
Manchester

NEW JERSEY
Newark

NEW YORK
Albany
Buffalo
New York
Rochester
Syracuse

NO. CAROLINA
Asheville
Charlotte
Durham
Winston-Salem

OHIO
Akron
Cincinnati
Cleveland
Columbus
Dayton
Toledo
Youngstown

OKLAHOMA
Oklahoma City
Tulsa*

OREGON
Portland

PENNSYLVANIA
Allentown
Harrisburg
Philadelphia
Pittsburgh
Reading

RHODE ISLAND
Providence

SO. CAROLINA
Columbia

TENNESSEE
Chattanooga
Knoxville
Memphis
Nashville

TEXAS
Amarillo
Beaumont
Corpus Christi
Dallas
Fort Worth
Houston
San Antonio

UTAH
Salt Lake City

VIRGINIA
Richmond
Roanoke
Norfolk

WASHINGTON
Seattle
Spokane
Tacoma

WISCONSIN
Milwaukee

*Sales Office

A NATIONAL ELECTRIC SERVICE

DISTRIBUTOR FOR CANADA AND NEWFOUNDLAND

Northern Electric
COMPANY LIMITED

General Offices: 1620 Notre Dame Street, W.

Plant: 1261 Shearer Street,
Montreal, P. Q., Canada

TWENTY-FIVE BRANCHES FROM COAST TO COAST

3-G-47-45C Printed in U.S.A. WECO-T2221C

BELL TELEPHONE LABORATORIES
INCORPORATED

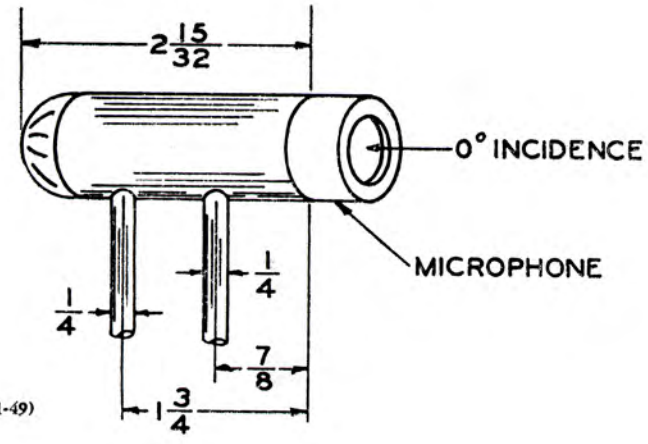
Microphone Serial No. 1148

W.E. 640AA CONDENSER MICROPHONE RECIPROCITY PRESSURE CALIBRATION

(in db relative to 1 volt (open circuit) per dyne per cm²)

Frequency cps	*Free Field Corrections db 0°	90°	Pressure Cal. db
100	0.0	0.0	-51.2
200	0.0	0.0	-51.2
500	0.0	0.0	-51.2
800	0.1	0.0	-51.2
1000	0.3	0.0	-51.1
1500	0.7	0.0	-51.1
2000	1.2	0.1	-51.0
3000	2.4	0.4	-50.7
4000	3.8	0.8	-50.3
5000	5.2	1.2	-50.1
6000	6.6	1.7	-50.0
7000	7.8	2.1	-50.2
8000	8.8	2.0	-50.8
9000	9.2	1.4	-51.7
10000	9.4	0.5	-52.8
11000	9.4	—0.6	-54.0
12000	9.2	—1.7	-55.1
13000	8.9	—3.2	-56.2
14000	8.4	—4.8	-57.6
15000	7.9	—6.6	-58.8

* Conditions for Free Field Corrections
- Grid Removed
- Progressive Plane Wave
- Temperature 25°C
- Pressure 750 mm. H_g
- Mounting — as shown below



Conditions of Test
- Pressure (mm. H_g) 758
- Temperature (°C.) 26
- Rel. Hum. (%) 24
- Polarization (Volts) 200
- Polarized Cap. at 1 kc (mmf.) 53.8
- Cavity Depth (inches) 0.077

Date Tested 3-13-51
By M.S.H.
Approved M.S.H.

E-7325 (1-49)