4215

INSTRUCTIONS AND APPLICATIONS

Artificial Voice Type 4215

This instrument is an acoustically well-defined sound source, which may be used for free-field measurements as well as for measurements under constant sound pressure conditions.

- Accelerometers
- Acoustic Standing Wave Apparatus
- Artificial Ears
- Artificial Voices
- Audio Frequency Response Tracers
- Audio Frequency Spectrometers
- Audio Frequency Vacuum-Tube Voltmeters
- Automatic A. F. Response and Spectrum Recorders
- Automatic Vibration-Exciter Control Generators
- Band-Pass Filter Sets
- Beat Frequency Oscillators
- Complex Modulus Apparatus
- Condenser Microphones
- Deviation Bridges
- Distortion Measuring Bridges
- Frequency Analyzers
- Frequency Measuring Bridges
- Hearing Aid Test Apparatus
- Heterodyne Voltmeters
- Level Recorders
- Megohmmeters
- Microphone Accessories
- Microphone Amplifiers
- Microphone Calibration Apparatus
- Noise Generators
- Pistonphones
- Polar Diagram Recorders
- Preamplifiers
- Precision Sound Level Meters
- Recording Paper
- Strain Gage Apparatus and Accessories
- Surface Roughness Meters
- Variable Frequency Rejection Filters
- VHF-Converters
- Vibration Pick-ups
- Vibration Pick-up Preamplifiers
- Wide Range Vacuum Tube Voltmeters

BRÜEL & KJÆR

Nærum, Denmark . Phone 80 05 00 . Telegrams: BRUKJA, Copenhagen

ARTIFICIAL VOICE

Type 4215

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Contents

Description.

General.

The Artificial Voice Type 4215 is designed for use in laboratories and production lines where a well defined sound source is required, and covers the frequency and pressure range that is normally covered by the human voice. The apparatus is of cylindrical shape, and it differs from the artificial voices normally used for telefon measurement by its provision for automatic regulation of the sound level. It consists of a small loudspeaker mounted in a metal housing, provided with a coupler and with sockets for the mounting of a regulating microphone with Cathode Follower.

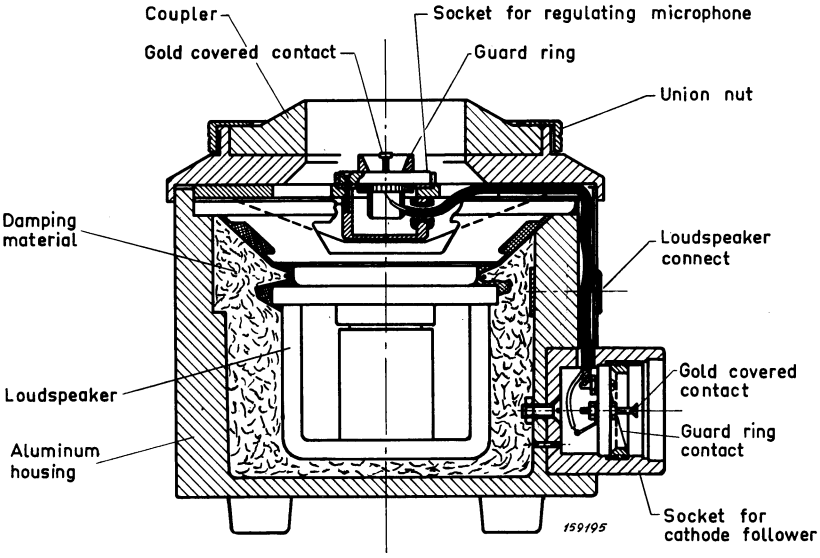


Fig. 1. Sectional view of the Artificial Voice.

Description.

The sound producing element of the Artificial Voice is a small, dynamic type loudspeaker, the diameter of which is 90 mm. It is mounted in an aluminum housing with rigid walls and of cylindrical shape, as shown in Fig. 1. In front of the loudspeaker is placed a special coupler (mouth opening) which is made removeable, in order to make it possible for the user to insert couplers for particular purposes. The coupler is fastened by means of a union ring, which can also be used to fasten a tightning ring, thus ensuring an airtight connection to the microphone under test.

The special coupler supplied with the Artificial Voice has an opening diameter of 38 mm. It may be used for measurements under constant sound pressure conditions (provided that the microphone can be mounted airtight to the opening) as well as for free field measurements.

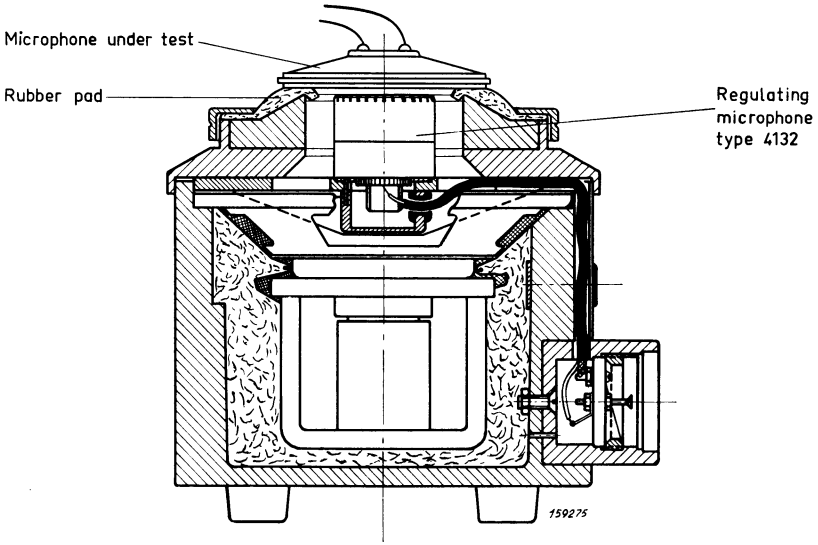


Fig. 2. Artificial Voice with regulating microphone and test object mounted for pressure calibration.

In the opening is placed a socket for mounting of a regulating microphone, i.e. the standard Condenser Microphone Cartridge Type 4132. As seen from Fig. 2, the front of the microphone cartridge is exactly in level with the opening of the coupler, whereby is obtained a sound pressure regulation in the very front of the Artificial Voice. By employing the B & K standard microphone the sound pressure can be kept constant to within 2 db in the frequency range 100 c/s to 7 kc/s.

The socket which is placed in the mouth opening is connected to another socket placed on the side of the housing. To this socket a Cathode Follower

Type 2612 or 2613 can be fastened. By means of a screened cable the cathode circuit potential of the cathode follower is connected to the guard ring seen on Fig. 1 whereby the input to ground capacity of the cathode follower is reduced to a minimum. The centre, spring loaded contact in both sockets are covered with gold to ensure the best possible electrical connection and low noise conditions.

When used with the control microphone the apparatus is essentially a constant sound pressure source*) with an extremely low internal impedance, equivalent to a constant voltage generator in electrical circuitry. The sound pressure is constant in the mouth opening and along the axis of symmetry of the artificial voice when no reflections are present.

The use of the Artificial Voice under closed condition does not offer other problems than those encountered through wave motions in the coupler volume, and those due to leakage to the outside. The coupler volume should consequently be kept small and too much leakage may be avoided through a light and simple packing between the test object and the Artificial Voice. The packing is easily obtained by the use of a foamed rubber pad (see Fig. 2). The two small holders on side of the housing normally offer a convenient support for a spring arrangement used to keep the test object in place if this is desireable.

To provide frequency independent regulation at higher frequencies the sensitive part of the test object should be placed as close to the regulating microphone as possible. Thereby the same sound pressure level is present at both microphones. At a frequency of 5000 c/s f. ex. the wavelength λ in air will be approximately 6.8 cm. The distance between the diaphragm of the regulating microphone and the sensitive part of the test object should now be $<< \lambda/4 \sim 1.7$ cm. The pressure response curve shown in Fig. 3 is obtained with a distance of 0.6 cm between the two diaphragms.

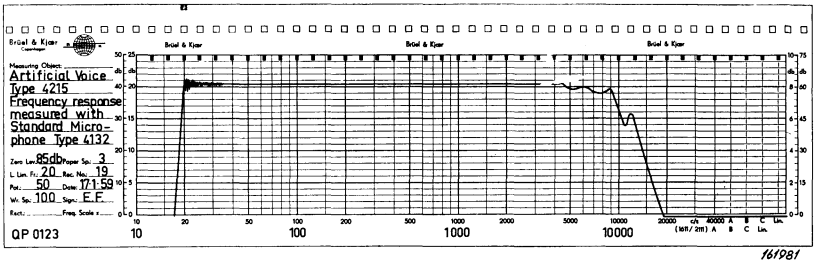


Fig. 3. Typical pressure response curve of the Artificial Voice with regulating microphone employed.

*) A constant sound pressure source is here defined as a source which, by means of automatic regulation, keeps constant the sound pressure in front of itself when the frequency and the load is varied.

The Artificial Voice may also be used under closed conditions, but without regulation. The pressure response curve without regulation is shown in Fig. 4.

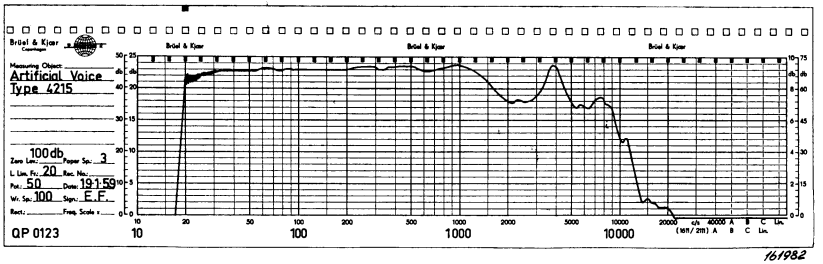


Fig. 4. Pressure response curve of 4215 without regulation (regulating microphone inserted but not used for regulation).

Free field measurements can furthermore be very conveniently carried out by means of the Artificial Voice. When the regulating microphone is employed, the frequency response of the Artificial Voice is flat within the limits given by the pressure response of the regulating microphone.
The output pressure will, however, be inversely proportional to the variation in sensitivity of the regulating microphone. The free field correction for the

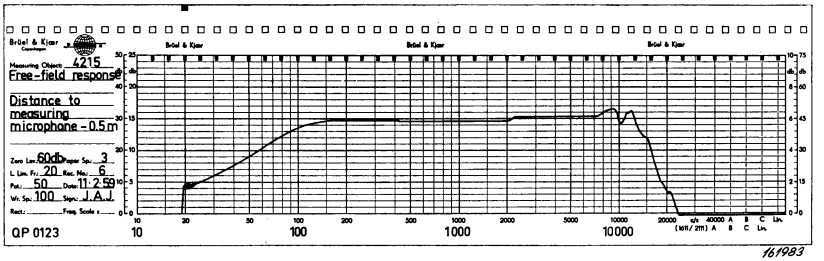


Fig. 5. Free field response of Type 4215 with regulating microphone employed.

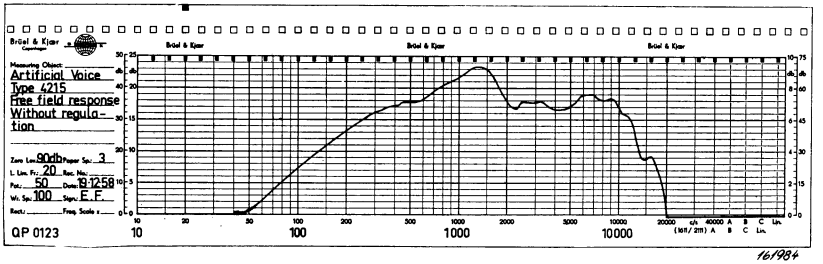


Fig. 6. Free field response without regulation (microphone inserted, but not employed).

Microphone Cartridge Type 4132 with protection grid for 180° incidence is less than 1 db up to 9 kc/s, thus giving a free field response of the Artificial Voice as shown in Fig. 5. (Further information about the free field correction of the microphone is found in the instruction manual Type 4131-32 and in the B & K Technical Reviews No. 1 and 2 1959).

In Fig. 6 the free field response is shown for the Artificial Voice used without regulation.

When measuring close talking microphones such as those used in telephone

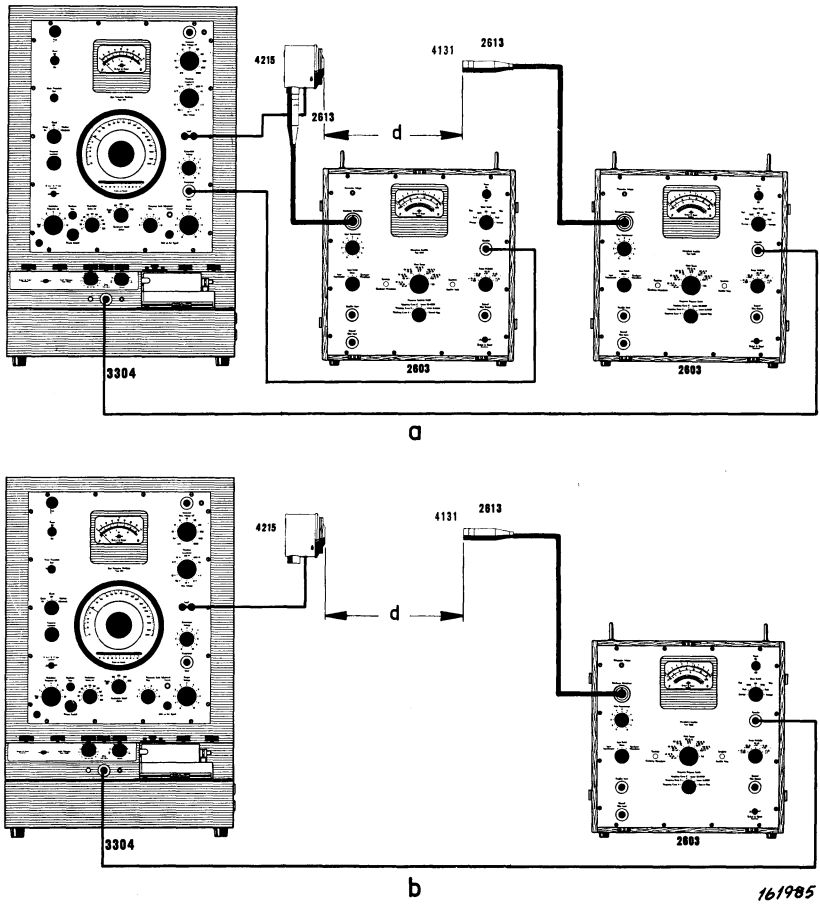


Fig. 7. Measuring arrangements used to obtain the curves shown in Fig. 5 and 6 respectively.

systems and megaphones, the distance between the mouth opening and the microphone is so small that interaction between the nearfields around the test object and the Artificial Voice will influence the frequency response. The influence on the sound pressure in the mouth opening caused by a cylindrical obstacle with a diameter of 40 mm and placed in a distance of 4 cm from the opening does not exceed ± 2 db at frequencies below 5000 c/s. (This counts *with* regulation as well as *without* regulation).

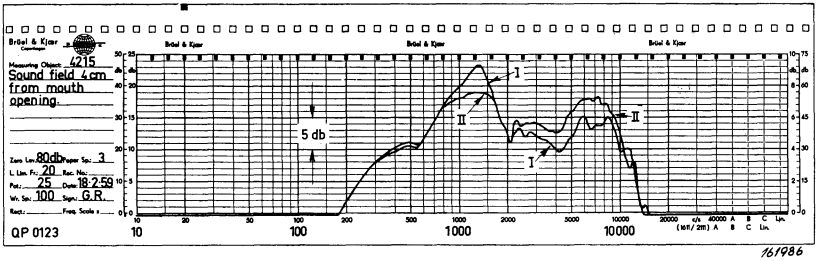


Fig. 8. Curve showing the influence of a 24 mm microphone with flat front placed in a distance of 4 cm from the mouth opening. Curve II shows the frequency response as taken with the 24 mm microphone and curve I shows the frequency response as obtained with a microphone which has negligible effect on the sound field.

In Fig. 8 is shown the influence of a 24 mm microphone with flat front placed in a distance of 4 cm from the mouth opening.

Fig. 9 shows the variation in frequency response with distance as measured with the above mentioned 24 mm microphone (B. & K. Type 4131).

The curve shown in Fig. 10 indicates the decrease in sound pressure level

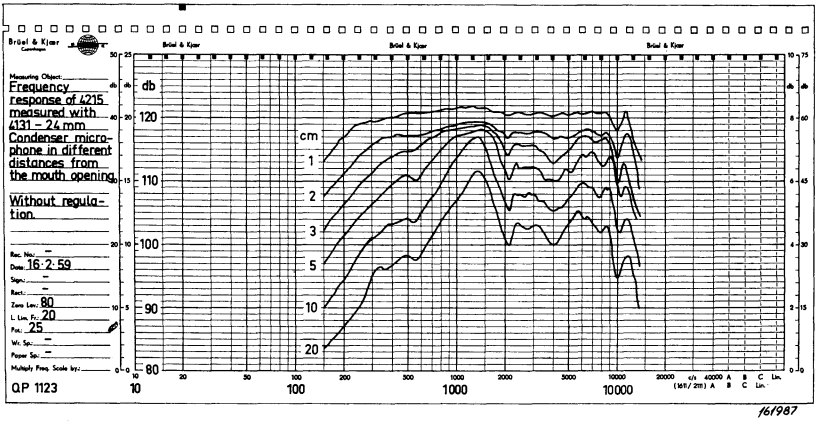


Fig. 9. The variation of the frequency response with distance when measuring the nearfield with the above mentioned 24 mm microphone.

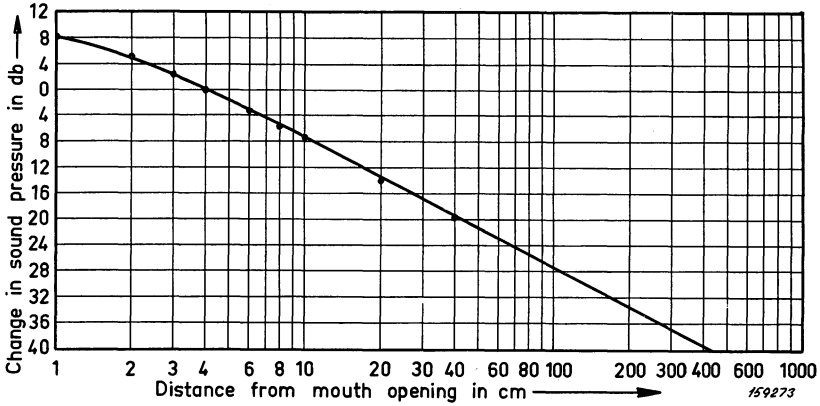
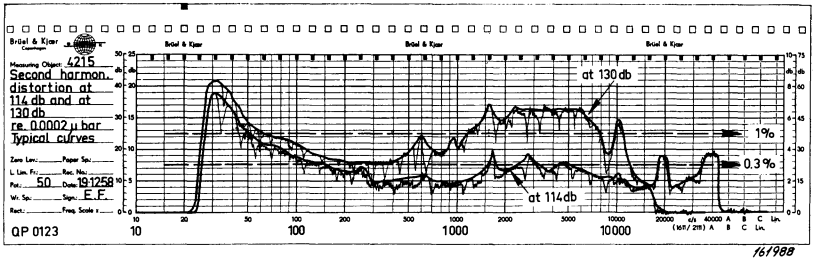


Fig. 10. The variation in sound pressure as a function of distance. Measured with a microphone which has negligible effect on the sound field.



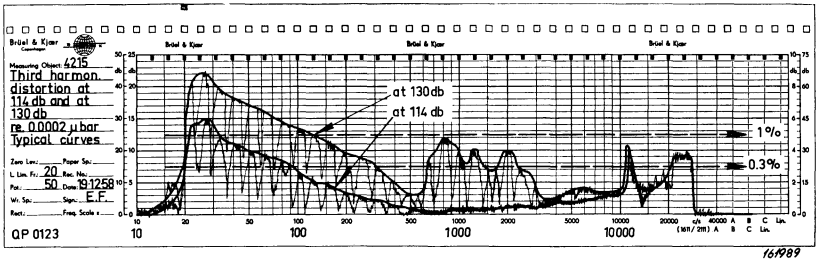


Fig. 11. Distortion generated in the Artificial Voice at sound pressures of 1 mbar ond o.1 mbar.
a) 2nd harmonic distortion.
b) 3rd harmonic distortion.

for increasing distance to the mouth opening. The measurement is carried out at 1ooo c/s and with a small microphone (B & K Type 4134) having negligible effect on the sound field.

Fig. 11 shows the distortion generated in the Artificial Voice at high sound pressures compared to the fundamental signal.

Operation.

General.

As mentioned under "Description" the Artificial Voice may be used for measurements under pressure conditions as well as for free field measurements.

Typical applications for the Artificial Voice used under pressure conditions are the testing of microphones for oxygen masks, testing of silencers, exhaust pipes, air inlets etc.

Applications for free field measurements are testing of normally handheld microphones and semiprofessional microphones for tape recorders, intercommunication systems, public address systems, dictating machines, free-field laboratory testing of hearing aids and microphones for the 100—7000 c/s frequency range.

The Artificial Voice Type 4215 is intended for use in conjunction with the Automatic Frequency Response Recorder Type 3304, which consists of a B.F.O. Type 1014 and a Level Recorder Type 2305. An arrangement is

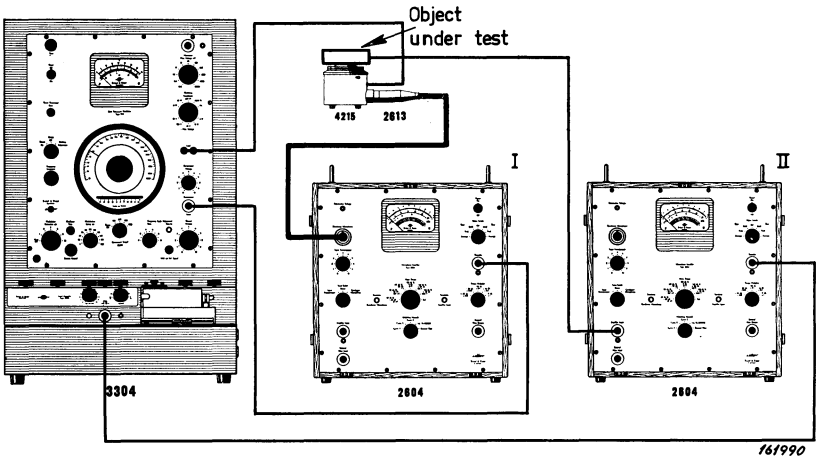


Fig. 12. Measuring arrangement for recording the frequency response of small microphones.

shown in Fig. 12 where the Microphone Amplifier Type 2604*) is used as a "Compressor Amplifier", which, when properly adjusted, enables the sound pressure level at the opening of the Artificial Voice to be read off directly from the indicating meter. For amplification of the test signal another Microphone Amplifier Type 2604 is used, featuring the advantage of a rapid and easy sensitivity calculation of the microphone under test (see page 13).

Recording the Frequency Response of Microphones.

The measuring set-up shown in Fig. 12 is arranged for measurements under constant sound pressure conditions, but may just as well be used for free field measurements. The microphone under test can then be mounted a short or longer distance away from the Artificial Voice, depending on the application. (For the influence on the sound pressure see page 8).

The sound pressure at the diaphragm of the test object will decrease with the distance according to the curve shown in Fig. 10 and the amplification of the amplifiers must consequently be increased. The operation procedure given below can be used in both cases.

Before the measurement is carried out, the instrument should be adjusted as follows:

Type 1014 (The B.F.O. of Type 3304):

Adjust the frequency scale zero point as described in the instruction manual for Type 1014. Then set the control knobs as follows:

"Compressor speed": "100".

"Output Voltage": "0".

"Compressor" Input Terminal: Connected to the output of Type 2604 (I).

"Compressor Voltage": Approximately 5 on the control knob marking.

"Load" Terminals: Connected to the loudspeaker terminals of Type 4215.

"Impedance" switch: 6 ohms.

Frequency Dial: 1ooo c/s.

The "Magnetic Clutch", "Modulation Frequency", "Modulation Swing" and the "Attenuator" control knobs should be set to their "off" or "zero" positions. The remaining control knobs should not be touched after the zero setting is carried out.

Type 2305 (The Level Recorder part of Type 3304).

Insert the potentiometer (50 db) and the recording paper Type QP 0123—0223 or 0323 and then set the control knobs as follows:

"Potentiometer Range": 50 db.

"Rectifier Response": R.M.S.

"Lower Limiting Frequency": 20 c/s.

"Writing Speed": 100 mm/sec (large figures).

"Power" switch: on.

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*) The Microphone Amplifiers Type 2604 may be substituted by Type 2603 without any change in the operation procedure.

"Motor" switch: on.
"Paper Drive" switch: start and forward.
"Paper Speed": 3 mm/sec (small figures).
10 : 1 Gear Lever: outer position.
"Input Attenuator": 0.
"Input Potentiometer": 10.
"Input" terminal: Connected to the "Output" terminal of Type 2604(II).

Type 2604 (I):

Adjust the screw-driver operated potentiometer marked "Sensitivity, Condenser Microphone" as described in the Instruction Manual Type 2604 with respect to the sensitivity of the regulating microphone.
Then set the control knobs as follows:
"Input Switch": "Condenser Microphone".
"Input Potentiometer": Any position.
"Condenser Microphone" Input Terminal: Connected to the regulating microphone of the Artificial Voice.
"Range Multiplier": "0 db (x1)".
"Meter Switch": "R.M.S. (Fast)".
"Power" Switch: "On".
"Meter Range": "100 db (1 V)".
"Weighting Network": "Linear 10—200ooo c/s".

Type 2604 (II):

Adjust the sensitivity of the amplifier as described under "operation" in the instruction manual for Type 2604. Then set the control knobs as follows:
"Input Switch": "Direct".
"Input Potentiometer": Any position.
"Range Multiplier": "0 db (x1)".
"Meter Switch": "R.M.S. (Fast)".
"Power" Switch: "On".
"Meter Range": "100 db (1 V)".
"Weighting Network": "Linear".

When the instruments are adjusted as described above, the actual measurement can take place.

1. Place the microphone to be tested in front of the acoustical coupler of the Artificial Voice. The microphone should fit airtight to the coupler, eventually mounted by means of a piece of foam rubber, when pressure conditions are desired.
2. Connect the output leads of the microphone under test to the input jack of the Microphone Amplifier Type 2604 (II).
3. Turn the Output Voltage" knob of the B.F.O. to maximum.
4. Rotate the "Compressor Voltage" knob of Type 1014 until the meter pointer of the Microphone Amplifier Type 2604 (I) deflects to the 10 db mark on the db scale.

A sound pressure level of 110 db re 2×10^{-4} μbar is then obtained in front of the microphone.

(If a sound pressure level of f. inst. 90 db is required, the "Meter Range" switch of Type 2604 (I) is set to 80 db SPL. The sound pressure level is then 80 db + 10 db (read off from the scale) = 90 db. When low sound pressure levels are desired, the loudspeaker should be connected to the Attenuator Output of the B.F.O., in order to make the compressor circuit work in the middle of its working range, see also the instruction manual for Type 1014).

The movement of the meter pointer of 1014 should preferably fall within —10 db to +10 db on the meter scale of the oscillator when the frequency scale is scanned.

5. Adjust the range switches on the Type 2604 (II) until a suitable deflection of the Level Recorder stylus is obtained (f. ex. around 40 db).
6. Scan the frequency range of Type 1014 to make sure that the stylus deflection of the Level Recorder is well within the width of the recording paper for all frequencies. Otherwise re-adjust the amplification of Type 2604 (II) or adjust the "Input Potentiometer" and "Input Attenuator" knob on the Level Recorder.
7. Set the frequency dial of the B.F.O. to 20 c/s.
8. Set the "Magnetic Clutch" to "On".
9. Adjust the Recording Paper until the writing arm indicates 20 c/s, by turning the grooved finger wheel.
10. Start the Level Recorder by means of the "Single Chart" press button. The frequency range is now automatically scanned, and the frequency response curve of the microphone under test is recorded on the frequency calibrated paper.

Determination of Microphone Sensitivity.

The sensitivity of the microphone under test can be determined very conveniently during coupler measurements when the sound pressure level at the opening of the Artificial Voice is adjusted to 74 db SPL which is equal to 1 μbar or to 134 db SPL which is equal to 1 mbar. With the sound pressure level set to 74 db the range switches of the microphone amplifier 2604 (II) is adjusted until a suitable deflection is obtained on the meter. The mV reading on the meter scale in conjunction with the "Meter Range" and "Range Multiplier" switches then directly indicates the sensitivity of the microphone being tested in mV per μbar.

The Automatic Frequency Response Recorder Type 3304 shown in Fig. 12 can, if desired, be replaced by the Audio Frequency Response Tracer Type 4707, which features a rapid visual check of the microphone response curve.

This might be especially convenient when the measuring arrangement is used in production line test systems. The operation procedure is similar to the one described above, except for the settings of the Automatic Frequency Response Recorder Type 3304. For the operation of the A.F. Response Tracer Type 4707, set the control knobs as follows:

Adjust the frequency scale zero point as described in the instruction manual Type 4707. Then proceed as follows:

"Condenser r.p.m.": "3", "6" or "12" r.p.m.

"Compressor Speed": "Slow".

"Compressor Voltage": 10 on the control knob marking.

"Compressor Input": Connected to the output of Type 2604 (I).

"A.F. Output Voltage": "0".

"A.F. Output" socket: Connected to the loudspeaker terminals of Type 4215.

"Attenuator": "6 ohms, 5 volts".

"Tracer Input" socket: Connected to the output of Type 2604 (II).

"Lower Limiting Frequency": "20 c/s".

"Tracer Input Voltage": Should be adjusted to give a suitable zero level, f. ex. 10 mV.

Turn the "AF Output Voltage" knob fully clockwise and adjust the "Compressor Voltage" knob till a suitable output level is obtained.

Specification

Frequency Response (with regulating microphone): Linear to within ± 2 db from 100 c/s to 7ooo c/s (see Figs. 3 and 5).

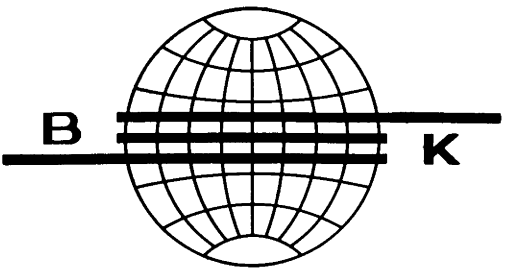
Max. Sound Pressure Level: 115 db for free-field measurements, 4 cm from mouth opening. Approx. 130 db for measurements under constant sound pressure conditions. (db re 2×10^{-4} μbar). Obtained when connected to B.F.O. Type 1014, 6 Ω output terminals.

Distortion: Less than 1 % at 1ooo c/s at sound pressures lower than 115 db re o.0002 μbar.

Mouth Opening: Diameter of aperture is 38 mm (1.5"). May be used for measurements under constant sound pressure conditions as well as for free field measurements.

Power handling capacity: 3 Watt.

Dimensions: Height 10.5 cm (4¼")„ Diameter 10.5 cm (4¼"). Weight: 2 kg (4 lbs.).



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