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ELECTRICAL MEASUREMENTS AND THEIR INDUSTRIAL APPLICATIONS



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NEW ADAPTORS FOR VHF- AND UHF-TV COAXIAL TRANSMISSION LINES

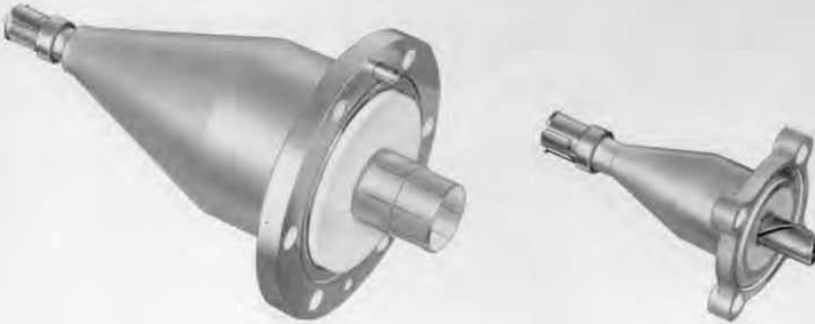


Figure 1. (Left) Type 874-QU3 Adaptor to 3 1/8-inch rigid line, and (right) Type 874-QV2A Adaptor to 1 1/8-inch rigid line.

For measurements of the standing-wave ratio and impedance of television transmitting antennas, adaptors are necessary to connect general-purpose measuring instruments to the large rigid lines used in the antenna system. Two new low-reflection adaptors from General Radio TYPE 874 Coaxial Connectors to 1 5/8" VHF Coaxial Line and 3 1/8" UHF Coaxial Line now make it possible to utilize the advantages of the General Radio TYPE 874 line of coaxial elements and of associated instruments in both VHF- and UHF-TV transmitting applications. With these adaptors, the TYPE 874-LB Slotted Line and the TYPE 1602-B Admittance Meter can be used for impedance and standing-wave ratio measurements, the TYPE 1021-A

Standard Signal Generators for bandwidth and attenuation measurements, the TYPE 1208-A and 1209-A Oscillators for low-power excitation of circuits and antennas, and the various combinations of TYPE 874 components for matching transformers, diplexers, detectors, etc. The low-reflection and hermaphroditic features of the TYPE 874 Connectors and the electrical smoothness of these new adaptors make them well suited for use in television transmitting measurement applications where very low VSWR's are required to prevent ghosts.

UHF ADAPTOR

The TYPE 874-QU3 UHF Adaptor is designed to make the connection be-

COVER PHOTO

Measuring standing-wave ratio on a u-h-f television transmitting antenna (Channel 56) with the Type 1602-B U-H-F Admittance Meter. The base of the admittance meter has been removed in order to mount the instrument directly on the Type 874-QU3 Adaptor.

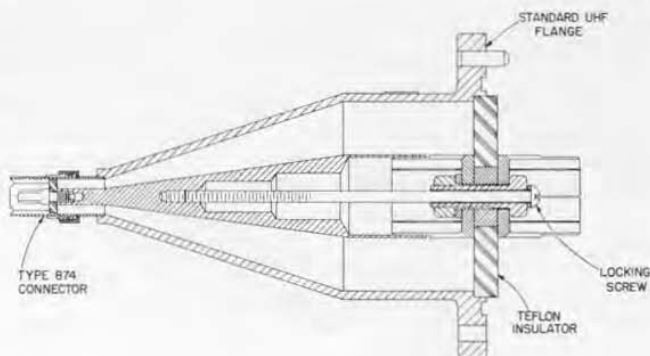
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Figure 2.
Cross section of
Type 874-QU3
Adaptor to 50-ohm,
 $3\frac{1}{8}$ -inch
rigid line.



tween circuits fitted with General Radio TYPE 874 Connectors and standard $3\frac{1}{8}$ " 50.0-ohm UHF coaxial transmission line. The transition between the two lines is made by means of a tapered section of line as shown in Figure 2. This adaptor is provided with a RETMA standard flange and anchor terminal as shown in Figure 1, and the anchor terminal is made captive to the tapered inner conductor by means of a 4" screw whose head is visible at the center of the anchor terminal. The anchor terminal can be removed and the adaptor used as female element if the locking screw is removed. However, caution must be exercised when the adaptor is used in this connection, as the long tapered section is then supported at one end only.

The electrical characteristics of this adaptor are excellent. Figure 3 shows the standing wave introduced into a flat 50 ohm line by a pair of typical adaptors connected back to back. The measured values include the effects of the two pairs of TYPE 874 Connectors shown in the sketch in the figure.

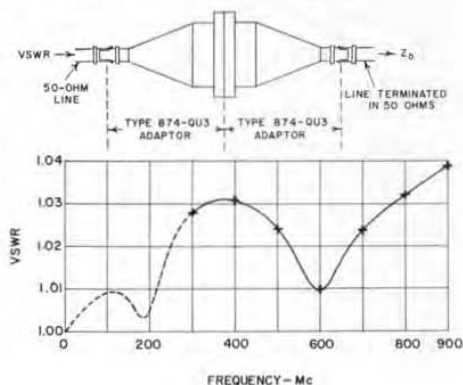
For standing-wave-ratio and impedance-measurement applications, the best results are obtained with the meas-

uring instrument connected directly to the adaptor terminals, since reflections produced by intermediate sections of line and connectors are eliminated. In field applications of the TYPE 1602-B UHF Admittance Meter, the instrument can be completely supported by the adaptor as shown if the base of the admittance meter is removed (*see cover photo*).

VHF ADAPTOR

In the VHF band, the old standard 51.5-ohm $1\frac{5}{8}$ " coaxial line is still widely used. The TYPE 874-QV2A Adaptor, shown in Figure 1, makes the transition

Figure 3. Voltage-standing-wave ratio of Type 874-QU3 Adaptor as a function of frequency.



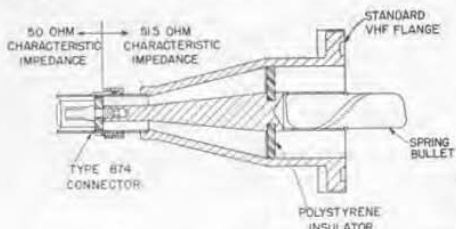


Figure 4. Cross section of the Type 874-QV2A Adaptor to 51.5 ohm, 1 $\frac{1}{4}$ -inch rigid line.

between this type of line and General Radio Type 874 Connectors. A tapered section of line is again used for the transition element. However, since the TYPE 874 line has a 50.0-ohm characteristic impedance and the VHF line has a 51.5-ohm characteristic impedance, a small reflection is produced at the junction. In the adaptor, the change in characteristic impedance is made directly behind the polystyrene insulator in the TYPE 874 Connector, as shown in Figure 4.

When the TYPE 1602-B Admittance

Meter is used to measure either admittance or standing-wave ratio, using the null method with the meter connected directly to the end of the adaptor, the length of the 50 ohm line is so short that it has a negligible effect on the measurements over the VHF-TV band (less than .015 effect on the VSWR at 200 Mc when the VSWR is near unity and proportionately less at lower frequencies). Measurements can also be made with maximum accuracy using the voltage-ratio method with minor modifications.

The reflection introduced by the adaptor in addition to that introduced by the change in characteristic impedance produces less than a 1.02 VSWR on a flat line over the VHF-TV band.

The adaptors just described enable the television engineer to make wider applications of a large number of very useful existing devices and thus simplify his measurement problems.

— R. A. SODERMAN

SPECIFICATIONS

Net Weight: Type 874-QU3, 5 $\frac{1}{4}$ pounds.
Type 874-QV2A, 1 $\frac{1}{4}$ pounds.

Over-all Length: Type 874-QU3, 9 $\frac{1}{8}$ inches.
Type 874-QV2A, 4 $\frac{3}{4}$ inches.

Type		Code Word	Price
874-QU3	Adaptor to U-H-F, 3 $\frac{1}{8}$ "', 50.0 ohm Rigid Line...	COAXYULTRA	\$87.00
874-QV2A	Adaptor to V-H-F, 1 $\frac{1}{4}$ "', 51.5 ohm Rigid Line...	COAXYVERRA	46.00

BRIDGE MEASUREMENTS IN THE COLLEGE LABORATORY

The efficient operation of a college electronics laboratory for student use requires the permanent installation of certain major items of equipment. Such apparatus as vacuum-tube bridges, Q meters, impedance bridges, and the like, which are so frequently required as accessories to experiments, should be available without the necessity of setup.

This does not mean that a student should be deprived of the opportunity to make his own setups. It does mean that a worthwhile experiment, whose subject is a vacuum-tube bridge, may require assembling the necessary components but, when a certain amplifier experiment requires a knowledge of tube parameters, a bridge should be available



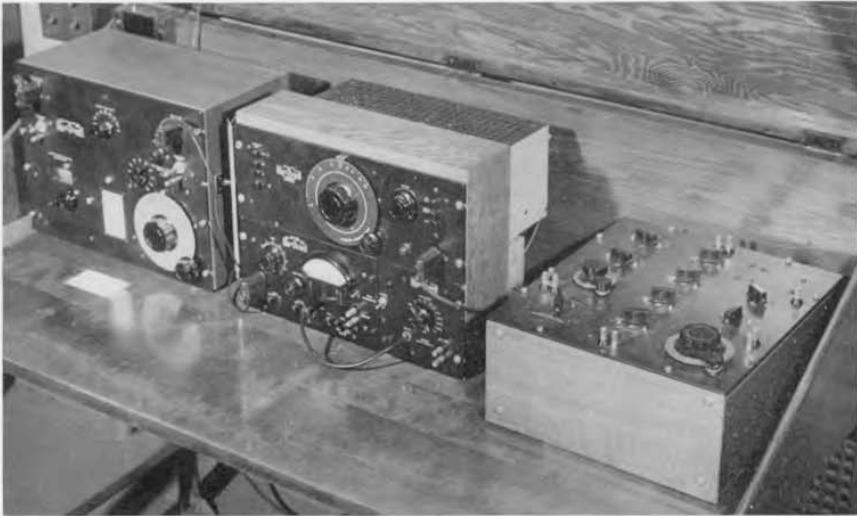


Figure 1. View of audio-frequency capacitance and inductance bridges with generator and detector in the Electronics and Communication Laboratory at The Cooper Union.

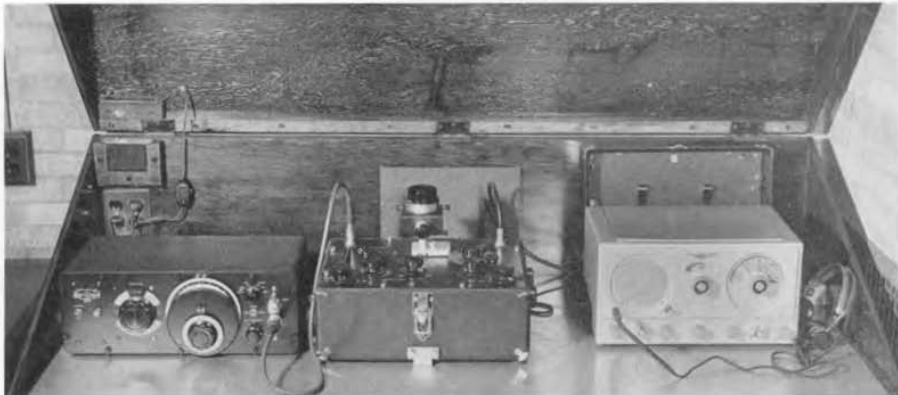
already set up with power supplies, tone source, and detector.

The accompanying photographs show some of the permanent installations which have been found useful in the Electronics and Communication Laboratory of the Electrical Engineering Department at The Cooper Union. The severe dust and dirt conditions of a metropolitan location have led to the use of the hinged, counterbalanced

wooden covers which also provide mechanical protection of the enclosed equipment.

The apparatus in Figure 1 consists of the General Radio TYPE 716-C Capacitance Bridge, TYPE 667-A Inductance Bridge, TYPE 1302-A Oscillator, and TYPE 1231-BRFA Amplifier and Null Detector with Filter. In Figure 2 are the TYPE 821-A Twin-T Impedance-Measuring Circuit, TYPE 1330-A Bridge

Figure 2. The Type 821-A Twin-T Impedance Measuring Circuit at The Cooper Union. A metal shield covers the table top, and equipment is protected from dust and other damage by the hinged cover.



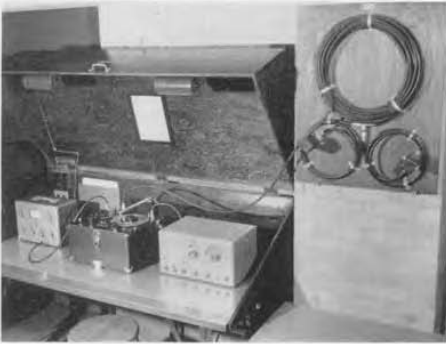


Figure 3. View of equipment for the measurement of cable characteristics at 12 Mc with the Type 916-A Radio-Frequency Bridge.

Oscillator, and National NC-57 Receiver used as null detector. Among the uses to which the 716-C and 821-A are put is the measurement of dielectric constant and dissipation factor by means of the TYPE 1690-A Dielectric Sample Holder which appears in Figure 2.

Shown in Figure 3 are the General Radio TYPE 916 Radio-Frequency Bridge, RCA WR-67A Oscillator, and National NC-57 Receiver. This inexpensive oscillator has, with occasional calibration, been satisfactory for this bridge. One experiment performed with this equipment makes use of the cable circuit attached to the wall. This consists of a long line of RG-8/U which branches at a tee junction to two short lengths of RG-11/U, one terminated by a capacitive-resistive and the other by an inductive impedance. The circuit is matched at the tee at 12 Mc. The sending-end impedance is measured over a substantial range centered about this frequency. The cable characteristics are measured on samples, and verifying computations performed from this information and the termination constants.

Figure 4 shows an installation built

Figure 4. The setup for antenna measurements at very-high and ultra-high frequencies with the Type 1602-A U-H-F Admittance Meter. The cone antenna under measurement is shown at the extreme upper left of the photograph. The special adjustable line can be seen at the front of the test bench.





around the TYPE 1602-A U-H-F Admittance Meter. The usual unit oscillators, mixer, and the like are provided, with a Hallicrafters receiver as 30-Mc detector. It was desired particularly to use this equipment for antenna impedance measurement. For this purpose, a ground plane of moderate size was mounted above an instrument cabinet at a sufficient height so that antennas under test are little affected by persons moving about the laboratory. A special connector constructed from a TYPE 874-EL Ell is inserted at the center of the ground plane. This connector includes a solenoid-operated switch for remotely short-circuiting the transmission line at the base of the antenna. The line is made of brass tube and rod with the central conductor supported by polystyrene screws.

A useful accessory to this equipment is the special constant-impedance adjustable line which can be seen to the right of the admittance meter. This is built up of two TYPE 874-LK Units. The principal purpose of this device is to increase the adjustable length for use between 100 and 500 Mc. A rack-and-pinion drive makes its operation particularly convenient, and the dangling patch cord of the single unit is eliminated.

Various antenna models equipped with banana plugs can be conveniently connected. Typical student data taken on a cone antenna are reproduced in Figure 5.

In the conduct of this experiment as

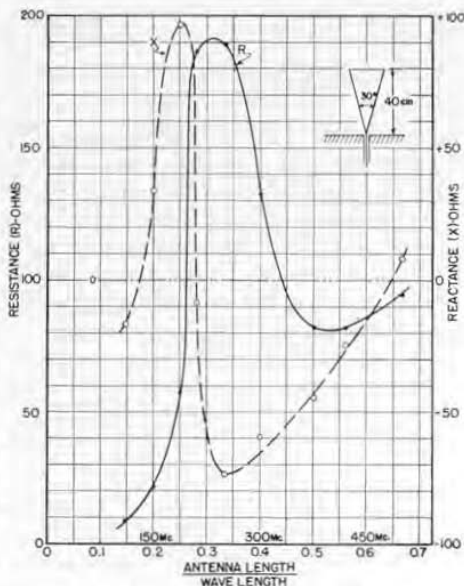


Figure 5. Typical student data taken on the cone antenna of Figure 4.

with many others performed in this laboratory, the student is provided with a minimum outline of instruction. An adequate analysis of results is considered the real essential of his laboratory report, and he is expected to a considerable extent to decide for himself just what matters are worthy of analysis. This is in accord with a general Department philosophy which attempts to avoid leading the student through his work "by the nose," and makes a modest effort to anticipate the day close by when the student will no longer have a patient instructor at his elbow.

—JESSE B. SHERMAN

The author of the foregoing article is Professor of Electrical Engineering at The Cooper Union. We are grateful to Professor Sherman for his courtesy in making this material available to EXPERIMENTER readers.

—EDITOR

**MISCELLANY**

RECENT VISITORS from overseas to the General Radio plant and laboratories — Mr. D. G. Lindsay, Engineer, Amalgamated Wireless, Ltd., Sydney, Australia; Professor Eric Lofgren, Royal Technical University, Stockholm, Sweden; Mr. Karl G. Roström, Engineer, Saab Aircraft Co., Linköping, Sweden; Mr. Arnfinn Lykaas, Forsvarets Forskningsinstitut, Oslo, Norway; Mr. O. Waldo Villafant, Mechanical Engineering Department, University of Puerto Rico; Mr. N. Shimomura, Chief Radio Engineer, Tokyo Shibaura Electric Co., Ltd., Japan; Professor Koji Sato, Tokyo University, Japan; Mr. Karno Watanabe and Mr. Kirokuro Hosada, of the Furukawa Electric Co., Ltd., Japan.

SPEAKERS — At the National Electronics Conference Luncheon, Chicago, September 30, H. B. Richmond, Chairman of the Board, General Radio Company, on "Opportunities and Responsibilities of Employment in the Electronics Field."

At the West Coast I.R.E. Convention, San Francisco, August 21, R. A. Soderman, Engineer, on "Measurement Problems in V-H-F and U-H-F Antenna Systems."

At the August 24th meeting of the Portland, Oregon, Section, I.R.E., Paul K. McElroy, Design Engineer, on "What Does Current Standardization Mean to You?"

LEWIS M. LYONS

It is with great regret that we note the death, following a long illness, of Mr. Lewis Lyons, a partner of the firm of Claude Lyons, Ltd., who have represented us in Great Britain for many years. Mr. Lyons managed the Liverpool offices and warehouse of the firm with an efficiency and effectiveness that will be missed both by ourselves and our friends overseas. His place is being taken by Mr. A. G. Kneen, the secretary and a director of the firm.

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