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ELECTRICAL MEASUREMENTS AND THEIR INDUSTRIAL APPLICATIONS

Also IN THIS ISSUE

RADIO RECEIVER TESTS WITH TYPE 732-A DISTORTION AND NOISE METER

These receiver characteristics can be measured quickly and accurately with the TYPE 732-A Distortion and Noise Meter.

(1) Signal/noise ratio.
(2) Distortion *versus* power output. Distortion *versus* carrier output. Distortion *versus* per cent modulation.
(3) Audio and over-all frequency characteristics.
(4) Acoustic howl.
(5) Output at given distortion level.
(6) Over-all noise curves *versus* carrier input.
(7) AVC characteristic.
(8) Modulation hum and hum output.
(9) Whistle output at 2d and 3d harmonics of IF.
(10) AFC measurements.
(11) Two signal cross-talk.

• In the selection of instruments for radio receiver testing, the distortion and noise meter is sometimes overlooked, probably because it was originally designed for use in broadcasting stations, yet this instrument

FIGURE 1. Panel view of the TYPE 732-A Distortion and Noise Meter

is one of the most convenient and rapid means available for making many of the standard IRE tests on receivers.

Although the normal input to the distortion and noise meter is a modulated r-f wave, an alternate input circuit is provided for measuring audio-frequency systems, as is shown in the schematic diagram of Figure 2.

The operation of the instrument is evident from this diagram. If we disregard the r-f input circuit, the essential elements are a 400-cycle high-pass filter, a calibrated attenuator, a high-gain amplifier, and a direct-reading vacuum-tube voltmeter.

The amplifier has a flat frequency characteristic which makes it possible to measure the frequency characteristics of receivers, and the high gain of the amplifier permits the use of the instrument as a sensitive vacuum-tube voltmeter.

All measurements of distortion and noise require only a simple calibration adjustment which is determined by the nature of the test being made, after which readings are taken directly from the meter scale. For most of the tests specified at the beginning of this article, the distortion and noise meter is direct reading in the quantities specified on manufacturers' test sheets.

DISTORTION—NOISE—HUM

For the tests listed on page 1, the audio input jacks of the distortion and noise

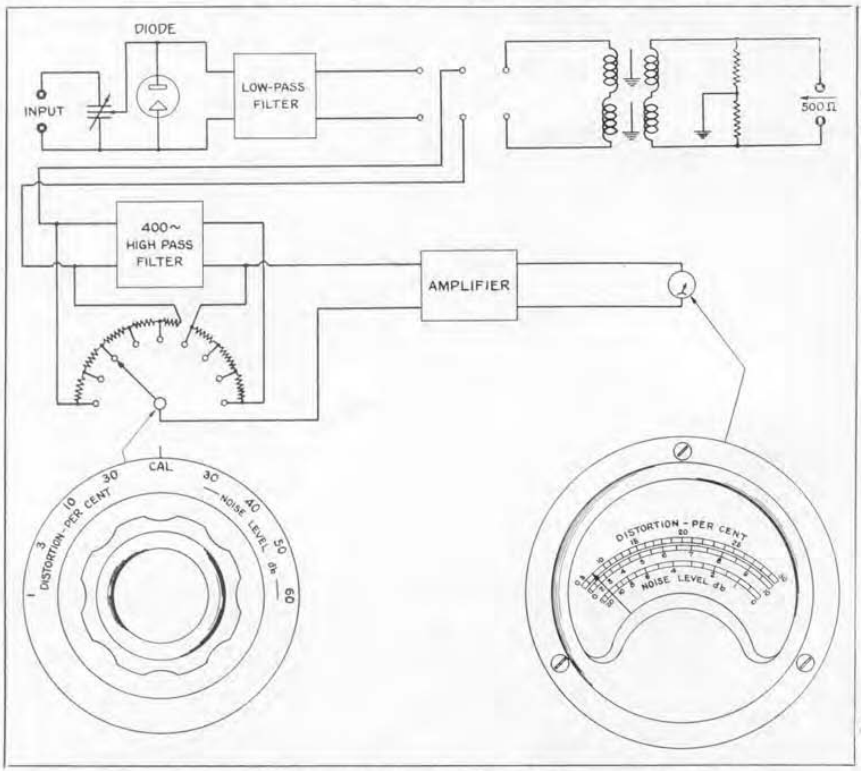


FIGURE 2. Functional Schematic Diagram of the Distortion and Noise Meter

meter are connected across the loudspeaker voice coil or across a dummy load which replaces the voice coil. The receiver is excited by a standard-signal generator modulated at 400 cycles. Percentage distortion under various operating conditions is read directly from the meter.

The high sensitivity of this instrument as a voltmeter is extremely useful in hum and noise measurements. For instance, the hum across the voice coil resistance may be as low as 2 or 3 millivolts. To measure this, the calibration adjustment is made at a convenient value such as one volt. Hum is then read in decibels below one volt and can easily be converted to a voltage ratio. The frequency of the calibrating voltage is usually 400 cycles, since most standard-signal generators have 400-cycle modulation. The amplifier in the distortion and noise meter, however, is sufficiently flat to permit the use of other audio frequencies.

AVC CHARACTERISTIC

The wide range of voltage measurement is also an advantage in AVC measurements. A typical inexpensive receiver may have an AVC ratio of 20 : 1 for an input range of 1000 : 1, and it may overload at voice coil inputs above one watt. With a 3-ohm voice coil resistance, the AVC measurement must be taken at an output level below the overload point of 1.73 volts. If the volume control is set to give this voltage for the high value of carrier input, the voltage at the other extreme is $\frac{1.73}{20}$ or 0.086 volts across the voice coil resistance. Therefore, accurate low-level voltage readings as provided by this meter are necessary.

FIDELITY

The response characteristic is flat over the audio-test range, and, consequently, the instrument can be used for fidelity measurements. The results are read directly in decibels from the attenuator dial and meter scale, avoiding db calculations from voltage readings.

ECONOMY

In keeping with the trend towards lower manufacturing costs and precise production measurements, measuring equipment, capable of increasing accuracy and lowering testing time, is required. The TYPE 732-A Distortion and Noise Meter offers a means for achieving this manufacturing objective.

— L. E. PACKARD

This article is based in part upon data supplied by Messrs. L. J. Hartley and C. R. Miner of the Radio Receiver Engineering Department, General Electric Company. Their assistance is gratefully acknowledged.

TYPE 759-P8 CONNECTOR

We have received a number of requests for plugs which will fit the microphone mounting of the TYPE 759-A Sound-Level Meter. These are useful in connecting vibration pickups and other accessories, and also for connection to electrical circuits, such as telephone lines, for the measurement of circuit noise level.

This plug is now available from stock and is known as TYPE 759-P8 Connector.

SPECIFICATIONS

Dimensions: (Length) 1½ inches; (diameter) ¾ inch.

Net Weight: 1½ ounces.

Type	*Price*
759-P8	**$1.00**

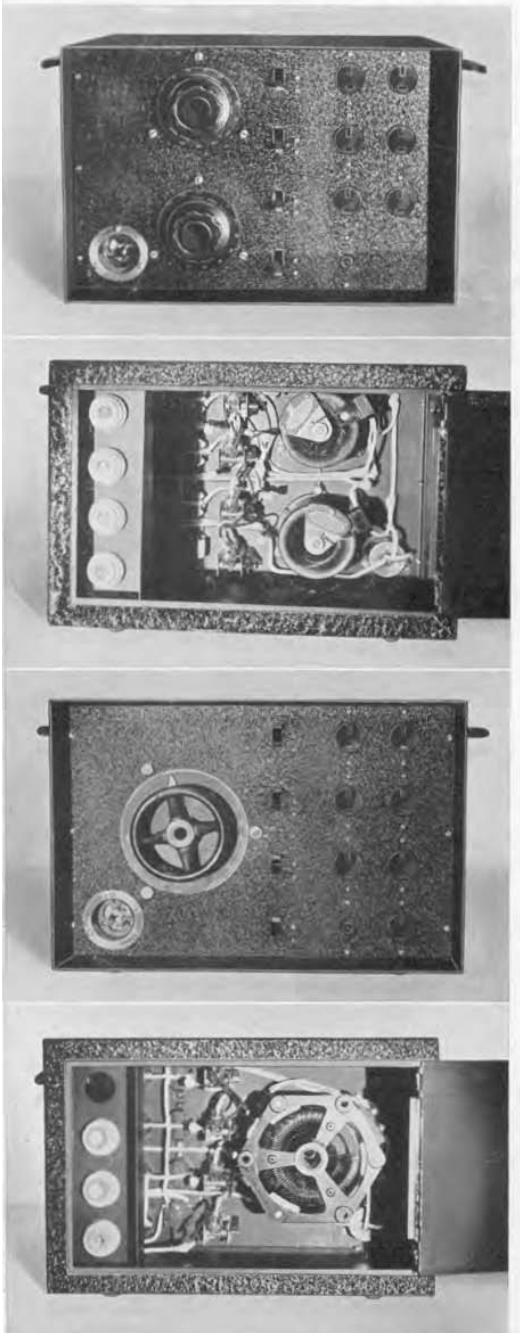
PORTABLE STAGE-LIGHTING CONTROL

by

RICHARD B. LEWIS AND

LEROY T. HERNDON, JR.

(Glendale, California, Junior College)



● **GLENDALE JUNIOR COLLEGE** dramatic productions are presented in a classroom theater and also in larger school theaters apart from the Junior College buildings. Usually the outside engagements provide for no stage-lighting control. To meet the need for complete, flexible stage-lighting control at low cost, a set of four portable dimmer boards have been the solution, both for production within the school and when "on tour." Built in small units to reduce weight and for greater portability, these boards were comparatively low in cost. Each unit measures, in outside dimensions, 12 x 12 x 18 inches, and weighs under 50 pounds.

Three control units have been built using as dimmers two 850-watt TYPE 200-CU Variacs each. The other unit uses one 2000-watt TYPE 100-K Variac. These auto-transformer dimmers provide complete light control from full-up to black-out on any size load up to the capacity of the dimmer.

To insure noiseless operation, 25-

FIGURE 1. Panel and rear interior views of the two lighting control units. The unit shown in the upper two photographs uses two TYPE 200-CU Variacs; that shown in the lower two photographs uses a single TYPE 100-K. A panel layout of the first unit is shown on page 6.

Protecting doors, which can be seen at the right of the rear views, are used at the back of each unit. Both panels are portable, and carrying handles can be seen at the ends of the cabinets.

ampere mercury switches, in specially designed mountings, have been used throughout. Each unit has a master switch and three switches for individual circuits. At the top of each board one switch controls two receptacles not on dimmers. Each 850-watt dimmer is in circuit with two receptacles, controlled by one switch. The 2000-watt dimmer has five receptacles on two switches.

The interior is completely accessible through a steel door which forms the rear of each unit. A sheet steel angle in the left inside rear corner provides a separate compartment and serves as the mounting for the fuse receptacles (metal-sign sockets).

An important feature of these units that has proved very useful is the possibility for proportional control of lighting units by using the output from the 2000-watt board to feed a board containing two 850-watt dimmers.

Before constructing these units, an experimental board was assembled using two 850-watt Variacs and one 2000-watt Variac. Those were mounted in an old standard steel junction box with tumbler switches, standard outlets, a four circuit fuse box, and a 30-ampere outside

FIGURE 3. This experimental board uses one TYPE 100-K and two TYPE 200-CU Variacs. The total cost of parts for this assembly, in addition to the Variacs, was only $5.

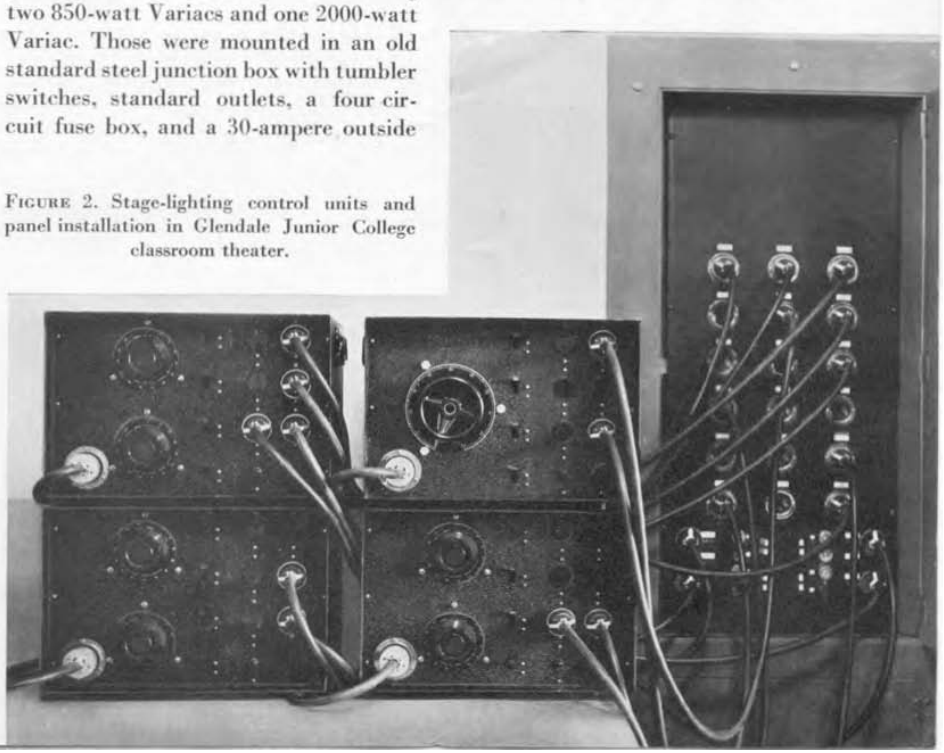


FIGURE 2. Stage-lighting control units and panel installation in Glendale Junior College classroom theater.

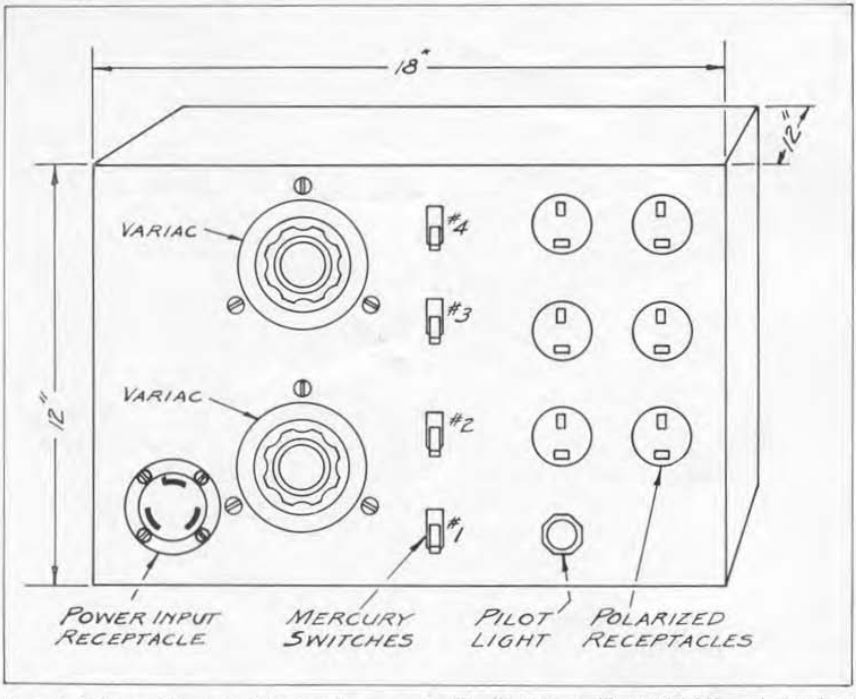


FIGURE 4. A panel layout of the two-dimmer unit. The Variacs are TYPE 200-CU, each rated at 850 watts. The lower switch is a master for the entire board. The output of each Variac is controlled by a switch and has two outlets. The top switch connects the two outlets at the top of the board directly to the a-c line. The power input receptacle is a 3-wire "Twist-Lock" type, providing a ground circuit for the board. The pilot light (lower right) glows when current enters the board.

switch for a master. Costing a little over five dollars for parts in addition to the dimmers, this unit proved the usefulness of such a board, and the low cost indicates how basic lighting control can be within the reach of producing groups with limited budgets.

The accompanying illustrations show the experimental board and the new units.

These boards were designed by L. T. Herndon, Jr., and R. B. Lewis, instructors in Glendale (California) Junior College, and L. R. Salisbury, '38, with the advice of Robert T. Philp, Superintendent of Buildings, and John W. Munn, Head Electrician, Glendale City schools. The mercury switches, polarized output receptacles, and "Twist-Lock" input receptacles are of standard design and can be obtained from a number of manufacturers.

SHIELDED CONNECTORS FOR A-C MEASUREMENTS

● AS MORE precise electrical measurements are attempted, previously negligible errors become more important, making it necessary to refine methods and apparatus if correct results are to be obtained.

Capacitive pickup is a well recognized source of errors in measuring circuits, especially in audio- and radio-frequency bridges. These errors result from voltages induced in the leads and apparatus by electrostatic fields. Shielding of equipment and leads is an effective means of minimizing such pickups. Concentric cables, with the outer conductor kept at ground potential, serve as excellent shielded leads. For most work, no particular precautions need be taken to shield the ends and standard General Radio TYPE 274 Plugs and Jacks may be used. One such convenient lead assembly is the TYPE 274-NC.*

For highly precise work more effective shielding is necessary. The TYPE 274-NE Shielded Plug and Cable provides this shielding. It differs from the TYPE 274-NC in having both ends capped with metal castings which are connected to the outside conductor of the concentric cable and which shield the terminals.

In addition to having shielded caps, the new TYPE 274-NE Shielded Plug and Cable employs a higher grade of insulation than has been previously used. At 1000 cycles, the capacitance of the three feet of cable which is used is about 150 $\mu\mu$f and the power factor is only 0.016. The d-c insulation resistance of the cable itself is about 500,000 megohms when measured at 90 volts.

The TYPE 274-ND Shielded Plug Assembly, which is used as the terminals for the TYPE 274-NE, has a piece of low-loss yellow bakelite as its insulating material. Therefore, the d-c resistance of the plug alone is greater than 1,000,000 megohms and its power factor is but 0.01 at 1000 cycles. The capacitance of the plug alone is about 3 $\mu\mu$f.

Both the TYPE 274-NE Shielded Plug and Cable and the TYPE 274-ND Shielded Plug Assembly are now stocked for immediate shipment.

— MARTIN A. GILMAN

*See Catalog J, page 159.

Type	*Description*	*Code Word*	*Price*
274-ND	Shielded Plug Assembly	STAPLUGDOG	$1.50
274-NE	Shielded Plug and Cable	STAPLUGEYE	4.00

FIGURE 1. Photograph of the shielded plug and cable. TYPE 274-NE Shielded Plug and Cable consists of the two shielded terminals, as shown, connected by three feet of shielded cable. TYPE 274-ND Shielded Plug Assembly is one double terminal plug with shield. In the photograph the method of construction is shown by the disassembled terminal at the right.

I. R. E. CONVENTION

● **THE TWENTY-SIXTH ANNUAL CONVENTION** of the Institute of Radio Engineers was held at the Hotel Pennsylvania in New York on the sixteenth, seventeenth, and eighteenth of June.

The attendance figures materially exceeded any previously reached and the general atmosphere indicated that there is no mental depression among radio engineers.

An unusually rich program of papers covered a very wide range of subjects, including the considerable attention to television developments which has featured all recent technical programs.

There were two General Radio contributors to the technical program — Mr. L. B. Arguimbau, who delivered a paper on the "Application of Quartz Crystals to a Wave Analyzer," which dealt with his development work on the crystal filter used in the General Radio Wave Analyzer, and Dr. W. N. Tuttle, who gave a resume of "Bridged-T and Parallel-T Null Circuits for Measurements at Radio Frequencies."

The display of technical apparatus and parts which has featured these meetings in recent years was unusually attractive. A good many displays of parts and component materials illustrated the continued progress in refinement of details. The General Radio Company showed a large number of instruments, including several new developments which will be placed on the market during the late summer and early fall. Descriptions of these will appear in forthcoming issues of the *Experimenter*.

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