THE GENERAL RADIO
EXPERIMENTER

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IN THIS ISSUE

Random-Noise Generator
Fuel-Gage Tester
Seminars
Personnel Changes

THE GENERAL RADIO

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COVER

The Type 1429-A Fuel-Gage Tester (TTU-68/E) in operation at an Air National Guard Base.

A NEW GENERATOR OF RANDOM ELECTRICAL NOISE

Noise, to the electronics engineer, presents two contrasting aspects. In the one, it limits the realizable performance of electronic devices and communication channels; in the other, it presents him with a test signal, which has, for many measurements, properties that are more useful than those of a single-frequency signal.

Broad-band electrical noise is often called random noise, because it has a random, or Gaussian, distribution of amplitudes as a function of time. When used as a test signal, it also usually has a uniform spectrum level over its specified frequency range. The random-noise signal, embracing a wide range of frequencies and having a randomly varying instantaneous amplitude, closely approximates the signals normally encountered in many electronic circuits and particularly in busy communication systems.

The properties of random noise were discussed in a previous article,[1] which described the Type 1390-A Random-Noise Generator. This instrument has, during the past several years, been applied to an unusually wide variety of instrumentation problems. This wide use has led to a number of suggestions for improvement, many of which have been incorporated in a new model, the Type 1390-B, shown in Figure 1. The most important of these are:

(1) The noise output spectrum has been extended to lower frequencies than in the earlier instrument (see Figure 3).

(2) The new cabinet is small, convenient for bench use, and yet is readily adapted by means of panel extensions to relay-rack mounting.

(3) The power-supply hum in the output has been reduced to negligibility.

(4) A built-in output attenuator has been added.

(5) The necessary warm-up time delay is provided by an automatic thermal relay.

(6) The stray external noise field has been markedly reduced.

The instrument still supplies the high output level in three bands (5 c to 20 kc, 5 c to 500 kc, and 5 c to 5 Mc) that makes the earlier model so widely useful. In fact, it has been found possible to raise the specifications on maximum output of the lowest band to at least 3 volts

Figure 1. Panel view of the Type 1390-B Random-Noise Generator.

and the next band to 2 volts, while the highest band output remains at 1 volt.

APPLICATIONS

Before describing the new instrument in further detail, let us review briefly a number of its uses. These usually depend on one or more of the following characteristics of the output of the noise generator:

(1) The signal is similar to many that occur in practice.

(2) It follows a definite statistical pattern.

(3) It has a broad frequency spectrum.

The uses can be grouped in four main categories: electrical measurements; acoustical measurements; environmental tests with high-level acoustic noise; and tests with random vibration.

One of the main uses of the earlier model has been as a *signal source for measurements*, among them:

Frequency response of loudspeakers.[2,3]

Intermodulation and cross-talk tests on multi-channel communications systems.[4,5,6]

Over-all calibration of systems.[7]

Simulation of impulse-noise characteristics of telephone-line noise.

Resonance tests.[8]

Tests on servo amplifiers.

Noise interference tests on radar.

Noise source for radar target simulator.

Dynamic range tests on electronic equipment.

Measurement of the rms and peak response characteristics of meters.[9]

Noise signal for electronic countermeasures equipment.

Evaluation of noise in transistors.

Setting levels on carrier equipment.

Study of simulated non-linear systems by correlation methods with an analog computer.

Use as an element of an electronic probability generator.[10]

There are many uses in *acoustic measurements* where the noise source drives a loudspeaker, among them:

Measurements of reverberation time.[11,12]

Reverberant field calibration of microphones.

Reverberant testing of acoustical properties of materials.[3]

Measurements of sound attenuation in ducts.

Testing of silencers for aircraft and air conditioning systems.

Room acoustic tests.[3]

Frequency response measurements of rooms and microphones.[3]

Testing the sound transmission of walls, panels, and floors.[3]

Hearing tests.[13]

Masking measurements.[13]

In a third group of uses, the random-noise generator drives a loudspeaker to produce *high-level acoustic noise* for the fatigue testing of structures.[14,15,16,17] A particular application is in the design of missiles. Without a design based on these tests, the missile can fail in flight as a result of the high level of random noise impinging on its surface.

In a new and important category of use, the Type 1390-B Random-Noise Generator supplies the signal for a power amplifier *to drive a vibration shaker*. The shaker is used for structural tests of components[18] and assemblies of rocket or jet-engine-driven structures and for microphonic tests of vacuum tubes. Jets and rockets generate vibration that is random in nature, and the logical approach is to test with a random vibration. The test methods have developed rapidly, and there is already a book devoted to the subject.[19] The procedures

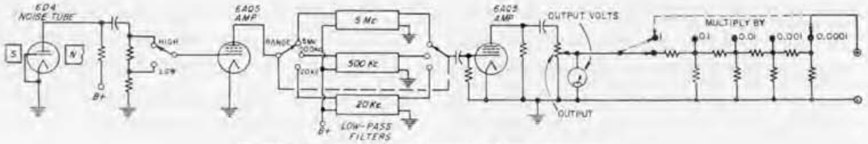


Figure 2. Elementary schematic of the generator.

and analysis of results are not simple, however, and there is some controversy regarding the method and its relation to testing with a swept sine-wave excitation.

In the classroom and laboratory, the noise generator has been used to demonstrate some of the properties of noise. Those who have been accustomed to sine-wave signals find it a new experience to try to handle noise signals. Since noise signals are now commonly encountered and measured, it is helpful to have a controlled source that can be used to familiarize one with the techniques of measurement.

DESCRIPTION OF THE GENERATOR

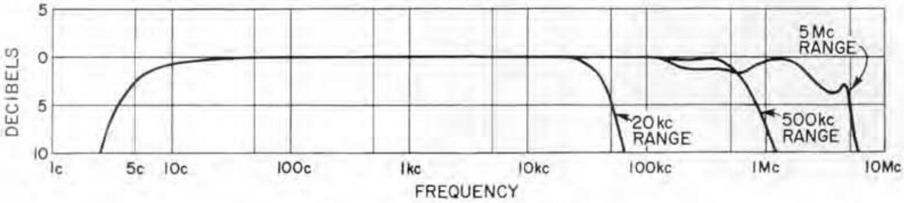
The original source of noise in this instrument is a gas-discharge tube with a transverse magnetic field applied.[20] This gas tube has a comparatively high noise output, which is amplified in a two-stage amplifier. Between these stages the noise spectrum is shaped to provide three output ranges to 20 kc, to 500 kc, and to 5 Mc. The high-frequency ends of these ranges are the same as in the earlier model, but the low-frequency performance has been improved.

Improved Low-Frequency Output

The output at low frequencies has been increased by changes in the time constants in the coupling circuits. The plot of the typical spectrum in Figure 3 shows that the output is down less than 3 db at 5 cycles per second, as contrasted with 10 db in the earlier model.

One of the problems encountered in producing this improvement came in devising a suitable technique for measuring the low-frequency output. This problem was happily solved by the use of the new Type 1554-A Sound and Vibration Analyzer.[2] The nature of this problem illustrates one of the characteristics of noise that is most apparent when measurements are made at low frequencies. Some years ago, when we tried to measure the low-frequency response of the earlier noise generator at frequencies down to 2½ cps on the Type 762-B Vibration Analyzer, we found the fluctuations of the pointer on the instrument were so large that we could not readily arrive at a suitable long-time average level. Calculations show that even for the wider band (5%) on that instrument it would be necessary to average over about a 6-minute period to have a 90% chance of being within ±1 db of the long-time average level.[21] For the third-octave band of the Type 1554-A Sound and Vibration Analyzer, the required time is reduced by a factor of 5.

Figure 3. Typical spectrum of the noise output.



The pointer still fluctuates considerably at these low frequencies, but the measurement becomes a reasonable one with the new analyzer. With a still wider bandwidth it is possible to obtain a quicker result, but then the resolution in terms of the range of frequencies measured becomes poorer. The one-third octave is an excellent compromise bandwidth.

What this problem illustrates is that the accuracy of measurement of level depends upon the bandwidth used and the time devoted to the measurement. Furthermore, the accuracy can be expressed only in terms of a probability figure. Although the concept is old and is not restricted to measurement of noise, the dependence is readily observed in low-frequency measurements of noise, but is usually not apparent in ordinary measurements with higher frequency sine-wave signals.

Attenuator and Reduced Leakage

To reduce and control the output voltage for low-level tests with the A-model it was necessary to use a separate attenuator. The output system on the new instrument consists of a continuous control, followed by a 4-step attenuator of 20 db per step. Metered levels from over 3 volts down to below 30 microvolts are conveniently obtained. When the attenuator is used, the output impedance remains essentially constant as the level is varied by the continuous output control.

This low-level output obtainable from the attenuator necessitated a reduction in the noise field radiated from the instrument at high frequencies. This reduction has been accomplished by additional filtering in the power-line leads in the instrument and by a change in the measuring circuit so that the meter is bypassed to ground.

New Cabinet

When an instrument is used on the bench, it is customary to have it horizontal. Often, however, a tilted position permits the meter to be read more conveniently. In the new cabinet shown in Figure 4 this tilted position is made possible by the extendible legs near the panel.

For relay-rack mounting, wings are supplied to extend the panel to relay-rack width as shown in Figure 5. Thus the user can have the convenience of a small bench instrument for experimental work and yet readily mount it in a rack if the instrument becomes part of a relatively permanent test rack.

ACKNOWLEDGMENT

The new cabinet was developed by H. C. Littlejohn and M. C. Holtje. The electrical circuit redesign was worked out by R. J. Ruplenas.

— A. P. G. Peterson

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Figure 4. Extendible legs allow instrument to be used in a tilted position.

Figure 5. Panel extensions are furnished to adapt the instrument for relay-rack mounting.

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SPECIFICATIONS

Frequency Range: 20 kc: spectrum level is uniform from 20 cps to 20 kc within ±1 db. 500 kc: spectrum level is uniform from 20 cps to 500 kc within ±3 db. 5 Mc: spectrum level is uniform from 20 cps to 500 kc within ±3 db and from 500 kc to 5 Mc within about ±8 db. Noise energy is also present beyond these limits. The level is down about 3 db at 5 cps.

Output Voltage: Max. open-circuit output is at least 3 volts for 20-kc range, 2 volts for 500-kc range, and 1 volt for 5-Mc range.

Typical Spectrum Level (with one volt output): 20-kc band: 5 mv for 1-cps band. 500-kc band: 1.2 mv for 1-cps band. 5-Mc band: 0.6 mv for 1-cps band.

Output Impedance: Source impedance for max. output is approx. 900 ohms. Output is taken from a 2500-ohm potentiometer. Source impedance for attenuated output is 200 ohms. One output terminal is grounded.

Waveform: Noise source is a gas tube that has good normal or Gaussian distribution of amplitudes for narrow ranges of the frequency spectrum. Over wide ranges the distribution becomes less symmetrical because of dissymmetry introduced by the gas tube. Appreciable clipping occurs on the 500-kc and 5-Mc ranges.

Voltmeter: Rectifier-type average meter measures output. It is calibrated to read rms value of noise.

Attenuator: Multiplying factors of 1.0, 0.1, 0.01, 0.001, and 0.0001. Accurate to ±3% to 100 kc, within ±10% to 5 Mc.

Accessories Supplied: Power cord, spare fuses, extensions for relay-rack mounting.

Mounting: Metal cabinet.

Power Supply: 105 to 125 (or 210 to 250) volts, 50 to 60 cps.

Power Input: About 50 watts.

Tubes Supplied: 6D4(1), 6AQ5 (2), 3-4 (1), 115-NO3OT (1).

Dimensions: Width 12¾ in., height 7½ in., depth 9¾ in. Panel height for 19-inch relay-rack mounting is 7 inches.

Weight: 12 lb. bench mounting.

Type		*Code Word*	*Price*
1390-B	**Random Noise Generator**	BUGLE	**$295.00**

A NEW, SMALLER, LIGHTER AIRCRAFT FUEL-GAGE CALIBRATOR

Four years ago[1] the first TYPE MD-1 Field Variable Capacitance Tester was announced as being on the shelves available for sale. The ink was hardly dry on this announcement when, in consonance with the current passion for making everything smaller, we were urged to redesign it into a smaller package.

This development was undertaken after negotiation with potential users determined the nature of the minor changes, acceptable to them, that would result in the desired size reduction. As so often happens in a redesign aimed only at size and weight reduction, the cost of making the equipment actually increased somewhat.

In Figure 1 you may see side by side the old and the new testers, noting the difference in size and mechanical arrangements. Volume has been reduced 30%, weight 15%. The older instrument was called the General Radio TYPE P-579, while the new one is the TYPE 1429-A.

In essence the redesign was accomplished by the use of a smaller variable capacitor in the main simulating section and by more efficient use of space within both the instrument case and the transit case. The main or left-hand variable capacitor has a linear Δ C of 200 $\mu\mu$f. Its range is expanded to that of the 1100-$\mu\mu$f TYPE 722 Variable Capacitor it replaces by a switch that adds five steps of solder-sealed-silvered-mica capacitors of 200 $\mu\mu$f each, thus filling in between the steps of the 1000-$\mu\mu$f-per-step switch.

Opportunity was taken to make several changes in the transit case:

1. The cable stowage compartment, originally larger than it needed to be, was moved from the rear to one end of the transit case, occupying much less room.
2. Case was painted a bright yellow to make it more readily visible around an airport.
3. The change in the case proportions made it practical to move the handle up to the top, where it belongs, and this, in turn, makes possible the elimination of one set of rubber feet. A commercially available vinyl-

Figure 1. View of the old and new testers side by side to show the difference in size.

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[1] P. K. McElroy, "A Calibrator for Aircraft Fuel Gages," *General Radio Experimenter*, 30, 4, September, 1955.

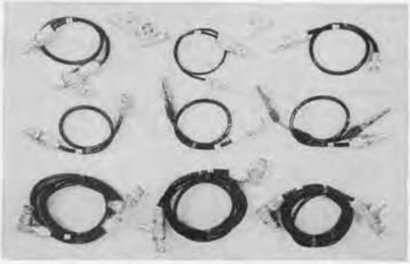


Figure 2. Connectors to fit many types of fuel gages are furnished with the tester.

coated handle makes carrying more comfortable and cuts several pounds off the weight.

Figure 2 shows the connecting cables and tee adaptors supplied with the Type 1429-A. These are exactly the same as those supplied with the older Type P-579. This is in conformity to an ARDC decision that it is impractical to try to keep up to date this group of adaptors supplied with the tester, because of the fast proliferation of requirements as new systems keep coming into use. Not only is the new miniature coax-connector series used with military aircraft a factor, but at least as much complication is caused by the fact that every lot of commercial planes is likely to have its own peculiar combination of manufacturer, individual and totalizing indicators, and hence special cable harness for attaching to the tester.

These other specific adaptors, either simple fittings or cables, or complicated cable harnesses, are available from the manufacturers of the fuel-gage systems actually used in each particular aircraft. Identification of the adapting equipment needed will be found in "-2 Technical Orders" for military aircraft or in the instruction manuals for commercial and civilian aircraft.

Qualification testing of the Type 1429-A to the same requirements as the Type P-579 (Type MD-1) has been completed at WADC and the military designation "TTU-68/E Tester, Fuel Quantity Gage, Variable Capacitance Field" assigned to the instrument. Because of the several superiorities above described of the new tester over the old one, the Type MD-1 will be superseded by the Type TTU-68/E.

Type 1429-A (TTU-68/E) Field Variable Capacitance Testers are currently available for commercial or military use and can be supplied with or without Government inspection at our plant. Detailed specifications follow.

Figure 3. Panel view of the Fuel-Gage Tester.

SPECIFICATIONS

Capacitance Range: Main capacitor continuously variable linearly from 20 to 220 μμf, thence by switched steps of 200 μμf to 6220 μμf. Compensating capacitor continuously variable linearly from 10 to 210 μμf.

Accuracy: Capacitance of the main variable air capacitor is indicated by dial reading within ±0.5% or ±0.75 μμf, whichever is greater. Corresponding figures for the compensating variable air capacitor are ±1.5% or ±0.5 μμf, whichever is greater. Switched capacitors are accurate to ±0.5%.

Correction Chart: A correction chart laminated between plastic sheets for mechanical and climatic protection is supplied, giving corrections at multiples of 10 μμf for the variable capacitors and at each switch position for the stepped capacitors. When these corrections are applied, the capacitance is correct to plus or minus 0.1% or 0.15 μμf, whichever is greater.

Maximum Voltage: 500 volts peak.

Dielectric Supports: Plates of low-loss steatite support the stator assembly; glass-bonded-mica washers support the rotor.

Dielectric Losses: Almost negligible for the air capacitors, since solid insulation is largely outside the electric field. Not over 0.001 for the switched silvered-mica capacitors.

Temperature Coefficient of Capacitance: For small temperature changes, approximately +0.002% per degree Centigrade for air capacitors, +0.0035% for mica ones.

Backlash: Less than one-third division (out of 2,000), corresponding to 0.02% of full-scale value. If the desired setting is always approached in the direction of increasing scale reading, no error from this cause will result.

Terminals: Three special, keyed, coaxial connectors, the center one of which is connected to both rotors.

Mounting: All capacitors and a renewable desiccant cartridge are mounted on an aluminum panel and enclosed in a moisture-sealed aluminum cabinet. The latter is shock mounted in an aluminum transit case with handle. The case contains a compartment to hold nine connecting cables and three tee adaptors.

Dimensions: (Height) 10½, (width) 17½, (depth) 10½ inches, over-all.

Weight: 28¾ pounds.

Type		*Code Word*	*Price*
1429-A	**Fuel-Gage Tester**	GAGER	**$900.00**

CORRECTION (*December Issue*): The carrying case listed as supplied with the Type 1554-A Sound and Vibration Analyzer is available on special order only. It is not supplied as a standard accessory.

ACCURATE FUEL GAGES DEPEND UPON ACCURATE CAPACITANCE STANDARDS

The fuel-quantity gages used on modern airplanes are accurate electrical devices employing servo-balanced, 400-cycle capacitance bridges to give an automatic indication of the quantity of fuel in the tanks. These gages are adjusted, calibrated, and periodically tested in terms of three-terminal capacitance standards, which are assembled into a convenient package for use in the field. The testers, in turn, are checked against precise capacitance bridges, the final link in a carefully designed program that assures fuel-gage reliability by leaving nothing to chance.

Accurate capacitance standards, maintained by the manufacturers of testers and bridges, are at the heart of this program. General Radio Company, leader in supplying laboratory capacitance standards, has for many years furnished the standards upon which the program depends. Fuel-gage testers, Type MD-1 and later Type TTU-68/E (described above), have been supplied to both military and civilian activities.

Another of this company's products in the aviation field, the Type TTU-24/E Capacitance Bridge, which is used to check the calibration of the testers, has an interesting history.

Because General Radio engineers felt that for this purpose a better bridge was needed than those currently being procured, the company decided to develop one, not on contract, but with its own funds. This was done; the development was completed in about a year. The new bridge, although of a different design from that called for by Air Force specifications, meets the same requirements and, at the same time, is smaller, lighter, and more accurate. Its capacitance range is greater and it has a number of convenience features.

Evaluation tests by the Air Force resulted in the assignment of the military designation, TTU-24/E. This bridge was described in the February, 1958, issue of the *Experimenter*.

SEMINAR ON STANDARDS, CALIBRATIONS, AND MEASUREMENTS

Standards of inductance and capacitance were among the earliest products manufactured by the General Radio Company 45 years ago and have continued to be an important part of our business ever since that time. Of equal interest and importance to us have been the design and manufacture of the bridges, by whose means these standards can be put to practical use in impedance measurement.

The rapid growth of the electronics industry, particularly in defense contracts, has pointed up the necessity of uniform standards and uniformity of measurement procedures. The basic standards of the nation are the responsibility of the National Bureau of Standards. To them, all other standards are referred. General Radio calibrations, for instance, are all traceable to NBS calibrations.

Measurement procedures must be a matter of common agreement. Uniformity of procedure is necessary in order that the results of all laboratories

John Hersh of the General Radio Engineering Staff discusses inductance measurements at the seminar.

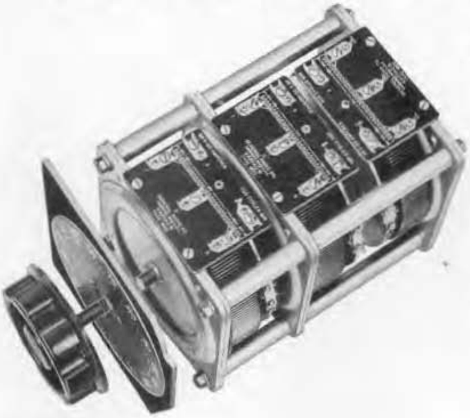
may agree; refinement of method assures maximum accuracy. The General Radio Company, as a leading supplier of both standards and bridges, is in an excellent position to implement the cooperation between agencies that will achieve these goals.

To this end we have recently completed a seminar on the low-frequency standardization of inductance and capacitance which was attended by twenty-three representatives from sixteen different U. S. and Canadian government calibration laboratories, including the National Bureau of Standards and the National Research Council (Canada). The three-and-one-half-day seminar included seven lectures on the design, construction, and use of standards of inductance and capacitance; five two-hour workshop sessions in measurement practice; two informal group dinners; and a session on criticism, evaluation, and future trends.

Both those who attended and those who conducted the seminar feel that the effort was a complete success and that a definite foundation has been laid for cooperation between laboratories and for uniformity of measurement methods. Certainly we at General Radio have derived from the seminar fully as much as those who attended. We hope that it will be possible to conduct other seminars in the future.

M-MODEL 400-CYCLE VARIAC® AUTOTRANSFORMERS

In the interest of improved delivery schedules and manufacturing economics, M-type (400 cycle) Variac assemblies are now basically the same as W-type (50-60 cycle) Variac assemblies. Except for their lower weight, reduced axial length, and militarized finish, the M-model Variacs exactly duplicate the W-model line. The principal difference will be noticed in M gangs, where the practice of assembling two coils back-to-back on a single base has been abandoned in favor of the practice, standard on W gangs, of having a separate base for each coil. This practice allows ganging of units with a minimum of modifications and special parts, with resultant lower costs and more rapid deliveries.



Users of M-type Variac® auto transformers, who may be "frozen" into the older designs, can still obtain the older design on a special order basis. We do seriously suggest, however, that, wherever possible, substitution of the new standard design will be to your advantage.

SEMINAR HELD FOR OVERSEAS REPRESENTATIVES

Since its founding in 1915, the General Radio Company has had an international market for its products. Our customers abroad have been well served by some twenty resident representatives and almost as many sub-agencies located all over the world. Many of these have been associated with us for over twenty-five years.

The growing complexity of electronic instruments, resulting in a need for person-to-person communication with our overseas representatives, led to the organization of a seminar for the exchange of information, questions, and ideas.

With the enthusiastic and competent help of GROENPOL, our representatives for the Netherlands, the first seminar was held in Amsterdam, November 2 to 7, 1959, with that organization acting as our hosts.

The seminar schedule included 10 hours of technical lectures, 21 hours of practical instruction at 7 simultaneously operating workshops, and 4 hours of general discussion. Some $25,000 worth of the latest General Radio instruments were used in the workshops. The GR team consisted of three engineers: R. W. Frank, P. J. Macalka, and W. R. Thurston, reinforced by D. B. Sinclair, Vice-President and Chief Engineer, who stopped there en route to a scientific meeting in Hungary.

The participants at the Seminar included members of the technical sales staffs of most of our European representatives and from India and Israel as

Front row, left to right, Binetti, Belotti, Lara, Danziger, Motwane, Mrs. Nyman, Berlin, Myrseth; _second row,_ Clementz, Nüsslein, Nyman, Frank, Smith; _third row,_ Bhat, Love, Robert, Buys, Steur, Sablon, Van Gent; _on stairs at rear,_ Steinkühler, Macalka, Watson, Rietbergen, Thurston, Teir, Lyons, Korte, Sinclair.

well. The total attendance at the technical lectures was 26; the "workshops" were attended by 20 sales engineers.

Among those present were:

Belgium — **S. A. Multitechnic** Messrs. K. Sablon, P. Steur

England — **Claude Lyons Limited** Messrs. E. Lyons, N. Love, A. Smith, D. Watson

Finland — **K. L. Nyman** Mrs. E. Nyman, Messrs. K. Nyman, K. Teir

France — **ETS. Radiophon** Messrs. P. Fabricant, M. Berlin, J. Robert

Germany — **Dr. -Ing G. Nüsslein** Dr. -Ing G. Nüsslein

Holland — **Groenpol Industrial Sales Company** Messrs. W. L. Rietbergen, B. A. Geerlings, P. van Gent, A. Korte, A. Buys, H. Steinkühler

India — **Motwane Private Limited** Messrs. N. Motwane, V. Bhat

Israel — **Landseas Eastern Company** Mr. R. Danziger

Italy — **ING. S. & DR. Guido Belotti** Dr. G. Belotti, Mr. C. Binetti

Norway — **Maskin - Aktieselskapet Zeta** Mr. I. Myrseth

Spain — **AD. Auriema, Inc.** Mr. A. Lara Saenz

Sweden — **John C. Lagercrantz** Mr. U. Clementz

This seminar was so successful that consideration is being given to repeating it at regular intervals and at various locations, to permit convenient attendance by representatives from all areas.

SALES-ENGINEERING PERSONNEL CHANGES

MYRON T. SMITH, Sales Manager of the General Radio Company, has been appointed its Director of Sales. WILLIAM R. SAYLOR, manager of the Los Angeles district office, is appointed Sales Manager to succeed Mr. Smith.

Mr. Smith, after graduation from the Massachusetts Institute of Technology in 1931 with the degrees of SB and SM in Electrical Engineering, came with General Radio as a development engineer, changing later to sales engineering. After opening and managing the New York and the Los Angeles district offices, he was appointed Sales Engineering Manager in 1944 and Sales Manager in 1948.

Mr. Saylor, also a graduate of MIT with the degrees of SB and SM in Electrical Engineering in 1937, came to General Radio as a development engineer after three years with General Electric Company and three years as instructor in electrical engineering at MIT. His interests later shifted to sales and application engineering, and in 1954 he was appointed manager of General Radio's newly opened Washington office. He became manager of the Los Angeles district office in 1957.

JOSEPH E. BELCHER succeeds Mr. Saylor as manager of the Los Angeles district office. An engineering student of Lowell Institute of the Massachusetts Institute of Technology, Mr. Belcher also studied business management at Northeastern University. He came to the General Radio Company in 1942 and from 1944 to 1946 was in the U. S. Navy.

William R. Saylor

Joseph E. Belcher

Myron T. Smith

After a few years in the calibration laboratory, he became Service Engineer in 1952 and in this capacity has become known to users of General Radio equipment all over the country. He has also actively supervised the operation of exhibits of GR instruments both at technical conventions and on the road. He transferred his activities to the Sales Engineering Department in 1959.

NEW SALES ENGINEERS

We have welcomed lately three new members to our sales engineering staff.

Howard O. Painter, who received his B.S. in Electrical Engineering from Worcester Polytechnic Institute in 1958, worked briefly as an engineer in the Hartford Electric Light Company, then spent two years with Uncle Sam's Signal Corps. After an extensive training program in various General Radio departments, he will settle into the Advertising Department, working on promotional material.

David S. Nixon, Jr., received his B.A. from the University of Connecticut, spent two years as a lieutenant in the Air Force, and received his S.B. and S.M. in Electrical Engineering at M.I.T. in 1959. His cooperative work at M.I.T. was with the Philco Corporation. After his training course, his first assignment

Howard O. Painter

David S. Nixon, Jr.

John R. Ross

will be in the Sales Engineering Department at the Home office.

John R. Ross, who has recently joined the Sales Engineering Staff of our Los Angeles office, holds a B.S. in Electronic Engineering from California State Polytechnic College. His later experience was at Bendix Aviation Corporation, working on radar design and development. He is at present working toward his M.S. degree at U.C.L.A.

His first assignment at General Radio is to assist in setting up the new service facility at our Los Angeles office. Later, he will devote full time to Sales Engineering.

1960 CONFERENCE ON STANDARDS AND ELECTRONIC MEASUREMENTS

The second national Conference on Standards and Electronic Measurements, co-sponsored by the National Bureau of Standards, The Institute of Radio Engineers' Professional Groups on Instrumentation and Microwave Theory and Techniques, and the American Institute of Electrical Engineers, will be held June 22–24, 1960, at the National Bureau of Standards Laboratories, Boulder, Colorado.

The 1960 Conference will provide a broad review of recent developments. Six sessions are planned on the following subjects:

(1) Current and Future Problems in Electronic Standards: Traceability of calibrations to National Standards, anticipated requirements, and overcoming adverse environments.

(2) Direct-Current and Low-Frequency Standards and Calibrations: Current, voltage, power, resistance, impedance, and attenuation.

(3) Methods of Measurement for Materials: Complex permittivity and permeability, tensor permeability, and tensor conductivity.

(4) Frequency and Time Standards: Molecular, atomic, and quartz standards; measurement and utilization.

(5) Microwave Standards and Calibrations: High and low power, phase shift, impedance, attenuation, and noise.

(6) High-Frequency Standards and Calibrations: Voltage, current, power, impedance, attenuation, phase shift, and field strength.

The General Chairman of the 1960 Conference is Ivan G. Easton, General Radio Company, West Concord, Massachusetts.

National Bureau of Standards personnel associated with the conference are W. D. George, Co-Chairman; George E. Schafer, Chairman of the Technical Program; and James Brockman, Chairman of Local Arrangements Committee. Further information can be obtained from Mr. Brockman at the National Bureau of Standards, Boulder, Colorado.

General Radio Company

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