GR/TODAY

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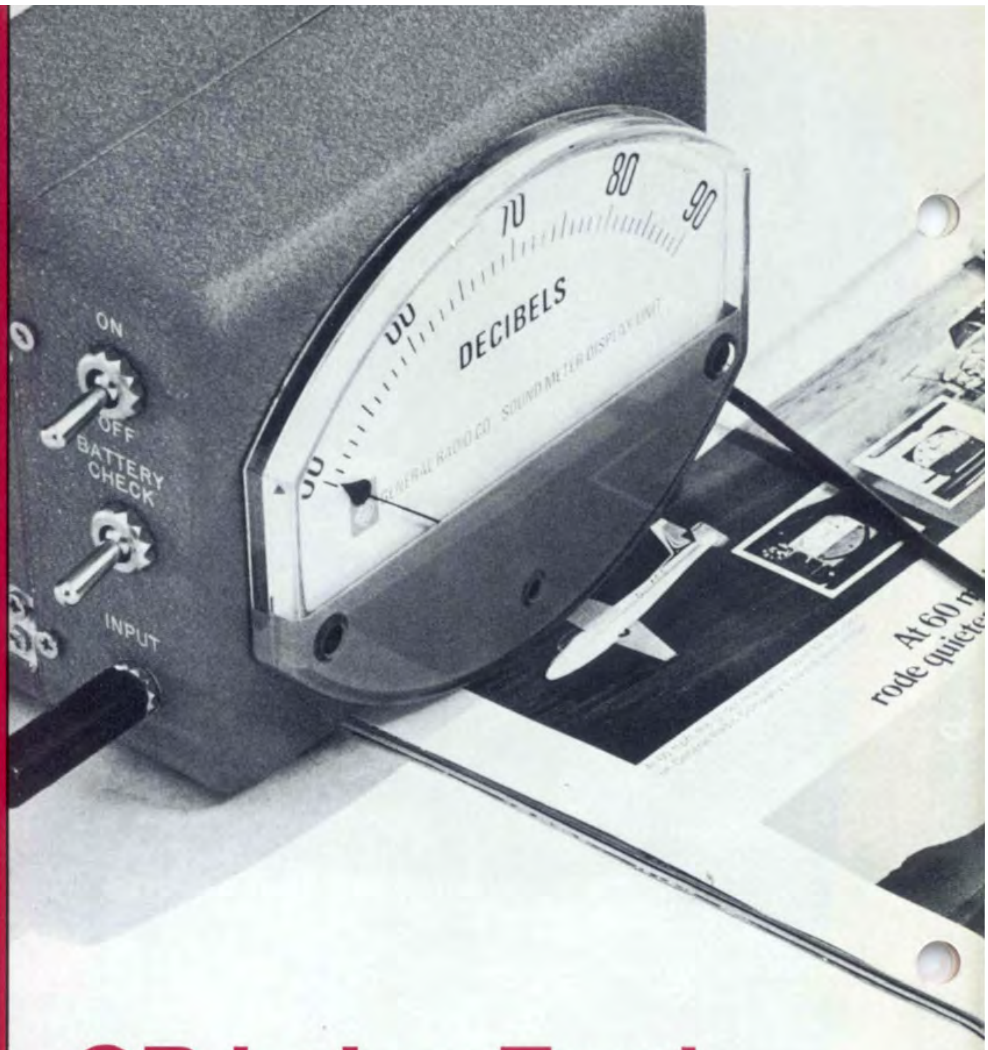
GR/TODAY is mailed without charge to engineers, scientists, technicians, educators, and others interested in electronics. Address all correspondence to Editor, GR/TODAY, General Radio Co., 300 Baker Avenue, Concord, Mass. 01742.



GR helps Ford document quiet-ride advertising claims

"Quiet is the sound of a well-made car," proclaimed Ford Motor Company as the theme of its recent national advertising. And when Ford's advertising agency, J. Walter Thompson Company, New York City, sought a dramatic way to document their claim that Ford cars ride quietly, they turned to General Radio for help in measuring the sound levels in test cars. For GR's expertise in sound measurement and acoustical instrumentation is well known even on Madison Avenue.

Thus far, GR engineers have served as consultants during three different test demonstrations staged by Ford's advertising agency. The tests were filmed for use in television commercials, and two of the three tests were also photographed for use in Ford's national magazine and newspaper advertising campaigns.

In each test, a GR sound-level meter was installed in a new full-size Ford to measure the A-weighted interior sound level as the car was driven over the test run. A second GR sound-level meter was used in two of the three tests for comparative measurements.

Two GR 1565-B meters were used, each connected to a special large-scale display unit calibrated from 50 to 90 decibels to meet the visual reproduction needs of television.

The first test filmed for Ford's advertising was conducted in Chicago in March, 1971. A new Ford was driven in the noisy, heavy traffic of down-

town Chicago with one GR sound-level meter mounted inside the car and the second meter outside the car to obtain comparative readings of interior/exterior noise. The interior sound level (with windows closed) measured 62 dBA, and the exterior sound level 86 dBA.

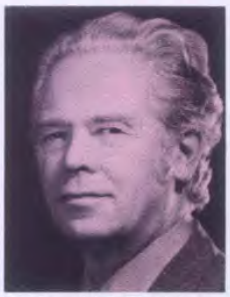
The second test devised by the J. Walter Thompson agency was used to demonstrate that the quietness of a Ford car's ride is undiminished after the car has been subjected to vigorous mechanical vibration for an extended period. This test, conducted in Utah during July, 1972, first measured the sound level inside a new 1973 Ford Galaxie-500 being driven at 60 mph over a quiet road through a corn field. The test car was then mounted on a huge mechanical vibrator used to shake-test rocket engines at the Utah laboratory of Thiokol Chemical Corporation. After 30 hours of shaking on the vibrator, the Ford was again driven over the test road for a comparative reading of interior sound level. The identical before-and-after readings of 65 dBA were used in Ford's advertising as proof of the claim that their car's riding quietness is unchanged after enduring "one million bumps and shakes."

In a third test, conducted in California in July, 1972, the interior sound level of a 1973 Ford LTD was compared with that of an airborne glider. One GR sound-level meter was mounted inside the car and the second meter mounted inside the glider. Both the glider and car were tested at 60 mph. The interior sound level of the Ford LTD measured 65 dBA while the meter of the glider in flight registered 82 dBA.

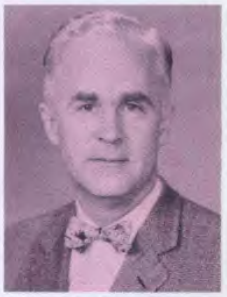
The success of GR engineers in helping document Ford's advertising claims of quietness may lead to other applications for sound-level measurements in Ford's future advertising and sales promotion efforts.

Supervising sound-level measurements used to document advertising claims is just one of the ways that GR has been serving the Ford Motor Company. Like most automobile manufacturers, Ford uses GR sound-measuring and acoustical-analysis instrumentation in the design, engineering, and testing of its cars and trucks as well as their components. One such instrument, a GR 1921 Real-Time Analyzer installed at Ford's Research and Engineering Center, enables Ford engineers to design quieter heating, ventilating, and air-conditioning systems.

GR names new Chairman and officers



Dr. Donald B. Sinclair



William R. Thurston

Steven J. Stadler

Dr. Donald B. Sinclair, who has served as President of General Radio Company since 1963, has been elected Chairman of the Board and Chief Executive Officer of the company. He joined General Radio as an engineer in 1936 and directed the company's technical activities prior to becoming President.

Succeeding Dr. Sinclair is William R. Thurston, who has been appointed President and Chief Operations Officer of General Radio. He previously served as Senior Vice President in charge of the company's business activities.

Steven J. Stadler, presently Treasurer of Grason-Stadler Company, Inc., a wholly-owned GR subsidiary, will move to the parent company as Senior Vice President and Chief Financial Officer. Mr. Stadler succeeds Ivan G. Easton, who will retire this year.

Western Electric orders $450,000 circuit-test system

General Radio Company has been awarded a $450,000 contract by Western Electric Company to build a multistation automatic circuit-test system for production testing of thin-film integrated circuits at Western Electric's North Andover, Mass., plant.

The system is based on the GR "System 2200" family of multistation circuit and component test systems. A software package designed around GR's PL/2200 English-conversational testing language will be included.

Western Electric's new system will automatically test passive impedance parameters, path continuity, and crossover isolation on different types of multiple-circuit substrates prior to the assembly of active circuit elements. The system is configured into a control station with a computer and peripherals for test-program preparation, storage, and transmission, plus four independent computer-controlled test stations.

GR opens three new District Sales Offices

GR's network of District Sales Offices has been expanded by addition of these three new offices:

SAN FRANCISCO, CALIFORNIA

(Covering Alaska, British Columbia, Northern California, Idaho, Montana, Nevada except Clark County, Oregon, Utah, Washington.)

1050 East Meadow Circle
Palo Alto, California 94303

Telephone: 415 948-8233
TWX: 910 373-1203

DALLAS, TEXAS

(Covering Arkansas, Colorado, Louisiana, New Mexico, Oklahoma, Texas, Wyoming.)

777 South Central Expressway
Suite 1-D
Richardson, Texas 75080

Telephone: (Dallas) 214 234-3357
(Houston) 713 464-5112

DAYTON, OHIO

(Covering Indiana, Kentucky, Michigan, Ohio, Western Pennsylvania.)

3300 South Dixie Drive
Suite 120
Dayton, Ohio 45439

Telephone: 513 294-1500
TWX: 810 459-1785

New Concord phone numbers for GR customer communications

To serve GR customers and field personnel more promptly and efficiently, an expanded, more versatile telephone system has been installed within all customer service and marketing groups at our Concord headquarters. New telephone numbers have been specially assigned to these groups for the convenience of outside callers.

From metropolitan Boston call:
646-7409

From all other locations call:
617 369-8770

Since the new system required changing all previous extension numbers as well, any extension numbers you presently have for individuals in customer service or marketing will have to be updated. Please ask for your party's *new* extension when making your first call to the new telephone numbers.

The telephone number of the Boston District Office at Bolton, Mass., remains the same (617 646-0550), as does the company TWX number (710 347-1051).

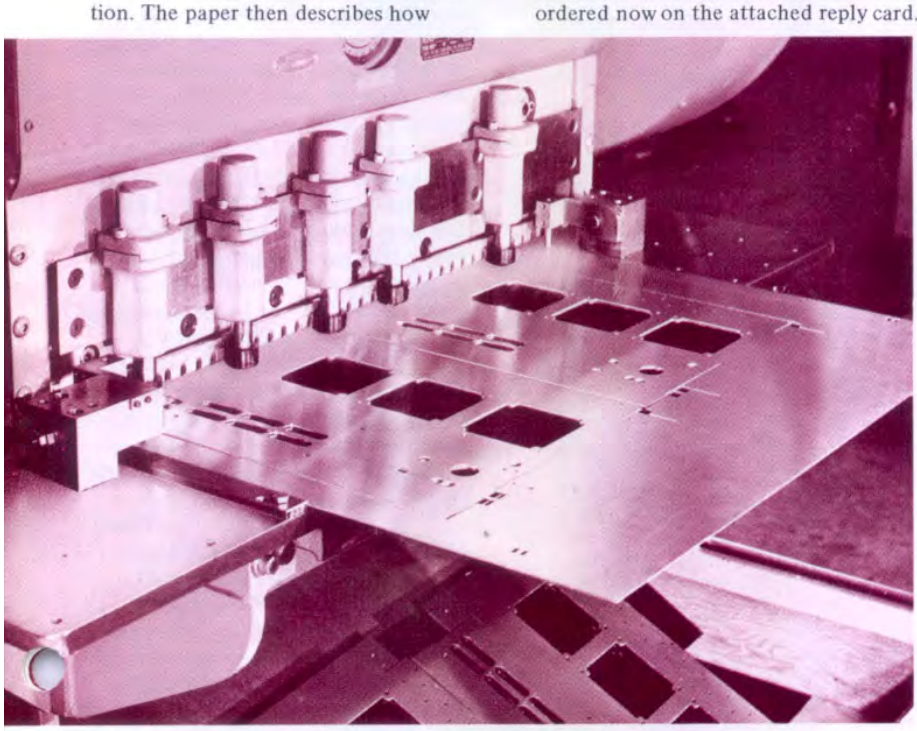
Robert H. Chipman

From GR... innovations in metalworking, too!

Unique computer-optimized fabricating concepts used by General Radio in production of its own sheet-metal parts are the subject of a paper to be presented at the 10th Annual Meeting and Technical Conference of the Numerical Control Society, to be held at New York City in April.

Written by Robert H. Chipman, GR's Manufacturing Engineering Manager, the paper, titled "Sheet-Metal Magic," details first a number of time-and-money-saving innovations developed at GR to speed and simplify sheet-metal fabrication. The paper then describes how these innovations were "married" to a unique software system developed by Techware Computing Corporation (a GR company) to computer-optimize the performance of numerical-control fabricating equipment.

As a result, GR was able to double the output of its NC turret punch presses as well as increase the speed, accuracy, and repeatability of all sheet-metal fabricating operations. Copies of Mr. Chipman's paper, "Sheet-Metal Magic," will not be available until after the presentation in April, but may be ordered now on the attached reply card.



Shearing of sheet-metal parts is accurately completed in a fraction of the time previously required, thanks to new computer-optimized fabricating concepts.

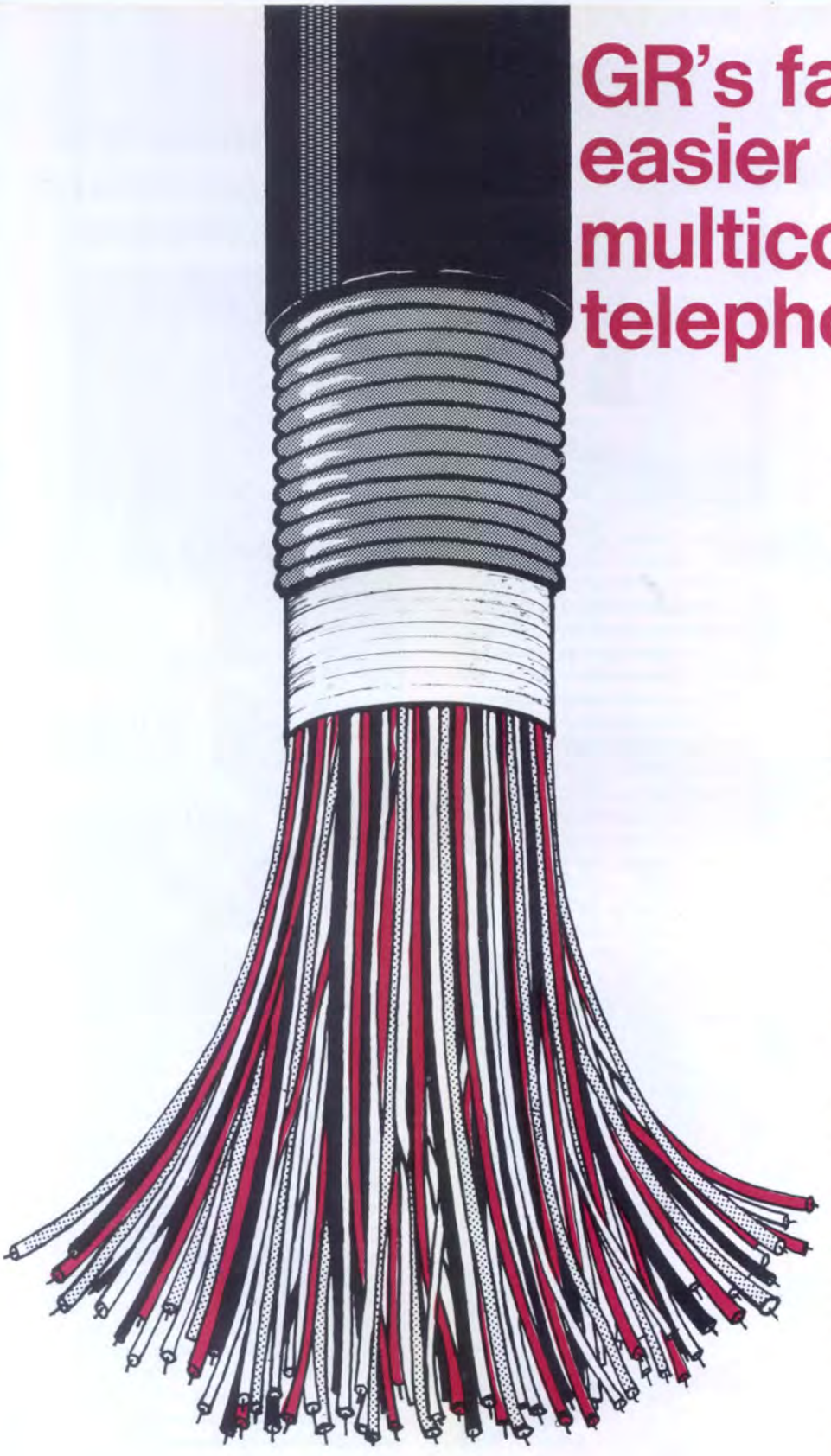
Harold T. McAleer

GR paper included in new IEEE book

A paper titled "A Look at Automatic Testing," by Harold T. McAleer, Manager of GR's Custom Products Operation, is among 31 papers and articles chosen for inclusion in *Semiconductor Memories*, a new 296-page book recently published by the IEEE Press. The book is edited by Professor David A. Hodges of the University of California and is sponsored by the IEEE Computer Society. Each of the 31 papers and articles was previously published in the IEEE *Spectrum*.

Mr. McAleer's paper reviews the state of automation in the testing of electronic components, networks, and circuits. Elements and characteristics of typical test systems, both hardware-controlled and computer-controlled, are described. Paths to follow and pitfalls to avoid in achieving automation are discussed in an effort to help the reader better understand the subject and its broad applications. "How to automate successfully," a major theme in the paper, places emphasis on economic justification.

Prices and ordering information for *Semiconductor Memories*, in both clothbound and paperbound volumes, are available directly from IEEE Press, 345 East 47th Street, New York, N.Y. 10017. Free reprints of Harold T. McAleer's paper, "A Look at Automatic Testing," can be obtained through the reply card in this issue of GR/TODAY.



GR's faster, easier way to test multiconductor telephone cable —

To a manufacturer of multiconductor telephone cables, the testing of cable-pair transmission parameters is a vital but, too often, tedious and costly operation. Particularly since a typical cable may contain up to 1800 pairs of conductors, of which as many as 100 pairs may be selected for parameter test-sampling.

The problem grows even more acute with the increasingly stringent cable-user specifications for transmission efficiency, crosstalk, and noise demanded by today's wire-communications systems. Cable makers are obliged to perform *more* tests of *more* different parameters on *more* sample pairs of conductors than ever before.

Manual methods of connecting, measuring, and test-data evaluating are proving too slow and impractical – not to mention error-prone. For example, measurement of pair-to-pair capacitance unbalance to determine voice-band crosstalk in a typical sample of 100 cable-pairs could involve a staggering total of 4950 two-pair combinations. Even if only 20% of these were physically close enough to warrant testing, that would still require the selection, connection, and measurement of nearly 1000 separate pair combinations!

Since many of the transmission parameter tests on multiconductor cable involve capacitance-based measurements, it was inevitable that General Radio would enter the picture sooner or later. For GR pioneered the development of automatic capacitance bridges – an essential tool for fast, accurate capacitance measurements.

It was in the late 1960's that Western Electric Company, a major producer of multiconductor telephone cable, came to GR with an application for using the then-new GR 1680 Automatic Capacitance Bridge in testing cable-pair transmission parameters. Western Electric had previously been testing its multiconductor cable by time-consuming manual methods, using a

variety of in-house capacitance bridges. Tests on a single reel of cable took hours. And since the resulting data had to be processed off-line, still more time elapsed before meaningful test information was available.

The prototype computer-controlled test system that GR built around its 1680 bridge proved so successful in cut-

automatically!

ting the time and cost of Western Electric's test procedures that additional GR test systems were ordered. From this beginning evolved GR's present family of second-generation computer-controlled automatic cable-test systems.

The GR 1680 Automatic Capacitance Bridge serves to this day as a key element of the newest GR computer-controlled test systems, for it is still unsurpassed for this specific cable-testing application.

By automating nearly every step of multiple-parameter cable testing, the new GR automatic test systems enable measurements to exacting specifications of agencies such as the Rural Electrification Administration to be performed at least ten times faster than with manual methods. And with a thoroughness and accuracy heretofore impossible.

This capability of automatically testing more transmission parameters, faster and more thoroughly than before, has helped astute cable manufacturers reduce production costs while increasing throughput and product quality.

The turnkey automatic cable-testing systems available from GR provide everything including the fanning fixture, minicomputer, teletypewriter, and all necessary software. Designed for minimum operator involvement, the system can be operated by relatively unskilled personnel.

To start the testing sequence, the operator need only answer a few simple program-generated questions, using the teletype keyboard. These may include: number of cable-pairs connected, length of the cable, wire gage, and ambient temperature. This is the extent of the operator's dialogue with the test system. Knowledge of computers or programming is not required.

Even the preliminary operation of connecting individual cable-pairs to the fanning-fixture test clips has been simplified. Each clip is numbered and the connected pair is identified by its clip number in all test-data printouts. Pairs can be connected quickly in random sequence, with no need to fixture them by color codes or in a specified sequence. Fixturing time has been drastically reduced.

Once the automatic testing procedure begins, the operator is free to connect the next reel of cable to a second fanning fixture (a desirable option) in readiness for the next sequence of tests.

Optimum use of testing time is ensured by a computer-programmed automatic check for connection errors on the fanning fixture before the start of parameter tests. Any open circuits, shorts, or split pairs are automatically indicated on the system teletype, and must be corrected by the operator before the test sequence can continue. To further ensure testing confidence, the system automatically performs an internal self-check before and after each measuring sequence.

The basic GR automatic cable-test system provides a printout of statistical data indicating distribution of measurements for three parameters – mutual capacitance, capacitance unbalance to ground, and pair-to-pair capacitance unbalance.

A choice of three test-report modes is offered. The first is the "Summary Only" mode that quickly prints out a normalized histographic tabulation of each measured parameter, together with the average and standard deviations. This is usually sufficient for simple pass-reject production testing.

For a more detailed picture, a "Calculated Parameter" mode gives you a printout of actual parameter values for every pair (instead of just statistics), plus all the data of the "Summary Only" mode. Still greater test-report depth is offered in an "All Measurements" mode in which the measured and calculated values of all parameters are recorded for each cable-pair. These latter two modes are especially useful in evaluating new cable designs and in research and development.

Additional parameter-measuring capabilities may be added to the basic GR automatic cable-test system. These parameters include: mutual conductance, dc conductor resistance and resistance unbalance, and capacitance unbalance to shield.

All of these tests are performed on-line with the system's self-contained minicomputer. In the "Summary Only" mode, a complete test-report printout is delivered in typically less than 25 minutes. This is at least ten times faster than it previously took for manual test procedures. You now get an error-free summary of the cable's performance on the spot – while the cable is still connected and available for further testing and inspection.

Contrast that with semiautomated test systems that require data to be first recorded on punched tape or cards, then forwarded to a remote data-processing center for off-line analysis, then returned to you – sometimes *after* the cable has been shipped. The advantages of GR's fully automatic test systems are even more impressive when contrasted with manual test systems.

The minicomputer used in the GR automatic cable-test system does far more than merely compute. It controls the connection of fixtured cable-pairs to the appropriate instrument terminals for testing in program-controlled sequence, and it controls the measuring instruments. It performs calculations and corrections on the measurement data. And it produces the on-line test report via teletype printout.

continued

Operator initiates testing sequence by answering a few simple program-generated questions using teletypewriter.

continued from p. 7

Once the operator answers the preliminary questions, all of these functions are performed automatically – with no further operator intervention. The GR automatic cable-test system provides speed, accuracy, and measurement versatility as yet unmatched by any other cable-test system.

In designing its cable-test system around the 1680 Automatic Capacitance Bridge, GR has given users two unique advantages. The three-terminal guarded connections of the 1680 bridge prevent stray capacitances in the switching hardware, test fixture, and connecting leads from affecting system accuracy. And the ability of the 1680 to measure a capacitance difference directly, without separate measurements and computations, results in faster, more accurate capacitance-unbalance measurements than otherwise possible.

The highly flexible GR test program adapts to existing test procedures and test formats without disrupting present operations. It can also be easily adapted to test new designs such as aluminum-conductor and low-capacitance cable, as well as to report data in a variety of formats desired by either the cable maker or user. The unique flexibility of the system software package enables users to easily change parameters, tolerance limits, and value groupings (cells) within a parameter.

One of the secrets behind the extremely fast testing time of the GR system is the manner in which pair-to-pair capacitance unbalance tests are made. Every two-pair combination in a 100-cable-pair sample is quickly tested for relative proximity. But to save time, the system is programmed to measure only those combinations close enough to be potentially unbalanced – usually only 10% to 20% of the total 4950 two-pair combinations in the sample. The operator can vary the proximity limit at will, or override it.

As more sophisticated cables are developed for new applications such as picture telephones, the necessary test procedures become more critical. For example, less crosstalk can be tolerated in picture transmission than in strictly-voice transmission. Cables for picture transmission require different manufacturing techniques as well as testing techniques. But General Radio's computer-controlled automatic cable-test systems are ready to meet these new challenges – accurately, quickly, and economically. For they are designed with the future in mind.

Key men behind Austral's new GR test systems: (left to right) Kenneth Stephen, Melbourne General Manager, Warburton Franki; Walter Oetlinger, Service Manager, GR Canada; A. J. Anderson, General Manager, Austral Standard Cables; Allan Baguley, Sales Engineer, Warburton Franki; and Peter Jorrens, Development Engineer, General Radio.

Cable-test area at Austral's Maidstone plant, with new GR system in booth.

Three more automatic cable-test systems for Australia

Installation of the three newest GR automatic cable-test systems in Australia was recently completed for Austral Standard Cables Pty. Ltd., Melbourne. Austral is Australia's largest manufacturer of communications-type cable.

The three GR systems were installed at Austral's plants in Maidstone and Clayton, Victoria, and in Liverpool, New South Wales. With all systems now operational, Austral reports that its cable tests are now being performed faster, more thoroughly and accurately than by previous manual methods.

Austral now obtains more data on more transmission parameters, and has better control over product quality and consistency. As with all GR automatic cable-test systems, the Austral installations are designed for minimum operator involvement, using relatively unskilled personnel.

The versatile GR software package was easily adapted to Austral's existing test procedures. Data can be reported in a variety of formats to satisfy the requirements of the Australian Postmaster General Department, which operates the telephone system in Australia.

Negotiations for these GR automatic cable-test systems were handled by GR's local distributor, Warburton Franki Industries Pty. Ltd., Melbourne.

Monthly abstracts of electromagnetic-measurement articles offered by NBS

The Electromagnetics Division of the National Bureau of Standards is now offering, on a monthly subscription basis, a collection of abstracts and references to current articles on electrical and electronic measurements and standards.

Called the Current Awareness Service, the monthly publication reports articles that have appeared in both U.S. and overseas journals, usually within the previous month. Subject emphasis is on measurement techniques and standards of electromagnetic quantities from dc to millimeter-wave frequencies. Methods of analysis are included as well as selected articles on design, components, instrumentation, automation, and management.

Complete information and subscription rates for the Current Awareness Service are available directly from:

Electromagnetic Metrology
Information Center
Electromagnetics Division
National Bureau of Standards
Boulder, Colorado 80302
Telephone: 303 499-1000, ext. 3951

Local safety-equipment distributors now handling GR sound-measurement products

With industry increasingly involved in sound measurement and noise control since the advent of the Occupational Safety and Health Act (OSHA), interest in local availability of GR sound-measuring equipment has climbed accordingly.

To meet this need, GR has appointed a number of safety-equipment distributors nationwide to handle industrial sales for the broad line of GR sound-level meters, sound-level calibrators, and noise-exposure monitors. Most distributors also handle direct sales of GR's Industrial Hearing-Conservation Program.

These safety-equipment distributors are not merely GR sales representatives, but actual sales outlets with complete stocks of GR sound-measuring instruments for immediate delivery. Check the list below for your nearest source.

GR SOUND-MEASUREMENT PRODUCT DISTRIBUTORS

ARIZONA
Sentinel Safety Supply, Inc.
Phoenix

CALIFORNIA
A.F. Johnson Co., Inc.
Burbank

California Safety and Supply Co.
Santa Clara

Southwest Safety and Supply Co.
San Diego

FLORIDA
Helco Safety Equipment Corp.
Miami

ILLINOIS
Universal Safety Equipment Co.
Chicago

Standard Industrial Products Co.
Peoria

KANSAS
Zink Safety Equipment Co.
Kansas City

LOUISIANA
Delta Safety & Supply Co., Inc.
Baton Rouge, Houma, New Orleans

MASSACHUSETTS
General Equipment Corp.
Medford

MICHIGAN
Averill Equipment Co.
Detroit

MINNESOTA
Continental Safety Equipment, Inc.
St. Paul

NEW YORK
Protective Equipment Supply Co.
Buffalo

OHIO
Twyman-Templeton Co., Inc.
Akron

PENNSYLVANIA
Industrial Products Co.
Philadelphia

National Mine Service Co.
(Distributor to mines only)
Pittsburgh

TENNESSEE
Clement Safety Equipment, Inc.
Memphis

TEXAS
Delta Safety & Supply Co., Inc.
Groves, Houston

WASHINGTON
Rice Safety Equipment Co.
Seattle

GR Chairman keynotes NEREM Solid-State Circuits Conference

Dr. Donald B. Sinclair, Chairman of the Board of General Radio Company, delivered the keynote speech at the Solid-State Circuits Conference of NEREM-72 – the IEEE Northeast Electronics Research & Engineering Meeting held in Boston from October 30 to November 3, 1972.

Speaking on the topic "Perspectives and Prophecies," Dr. Sinclair traced the growth of the electronics industry and cited the revolutionary change that solid-state technology has brought to it. He stressed the role of solid-state technology in the development of integrated circuits and compact, reliable computers – and how this is influencing the future of the electronics industry.

In prophesying the direction of future growth for the semiconductor segment of the electronics industry, Dr. Sinclair felt it would be tied to what is becoming popularly known as pervasiveness. Said Dr. Sinclair, "Pervasiveness, in this sense, means the extension of electronic solutions to non-electronic problems."

He continued, "However, in striving to find non-related uses, the industry now finds itself, to some extent, in the position that has characterized the laser business for so long. It has some dandy solutions looking for problems."

Dr. Sinclair concluded by restating his conviction that, despite these current difficulties, pervasiveness will ultimately guide the semiconductor industry to a future filled with challenges and opportunity.

Robert L. Moynihan

Paper available on new GR 1061 synthesizer

The new GR 1061 Frequency Synthesizer, a programmable frequency source for a broad variety of signal source and measurement needs, is described in a paper titled "A Unique New GR Synthesizer" now available from GR. The paper was originally presented at the Modern Measurement Techniques Seminar sponsored by *Electronic Products* at WESCON 1972. A brief article introducing the GR 1061 appeared in the Autumn, 1972, issue of GR/TODAY.

Written by Robert L. Moynihan, Assistant Product Marketing Manager for High-Frequency Equipment, the paper details applications of the GR 1061 as a local oscillator for transmitters and receivers where spectral purity is important. Its low phase-noise permits optimum signal-to-noise performance in critical measurements.

The GR 1061 is remotely programmable, with a switching time less than 100 μs per digit. This feature is essential in fast-tuned computer-controlled receivers needed for effective signal-intelligence applications arising from today's unprecedented activity in the hf-to-microwave spectrum.

Copies of Mr. Moynihan's paper on the new GR 1061 Frequency Synthesizer may be obtained by requesting paper B-26 on the attached reply card.

Japanese engineers tour GR facilities

Japanese visitors get firsthand details of GR 1792 Logic-Circuit Test System from John Pfaffmann (right), GR Area Manager for Asia and Pacific.

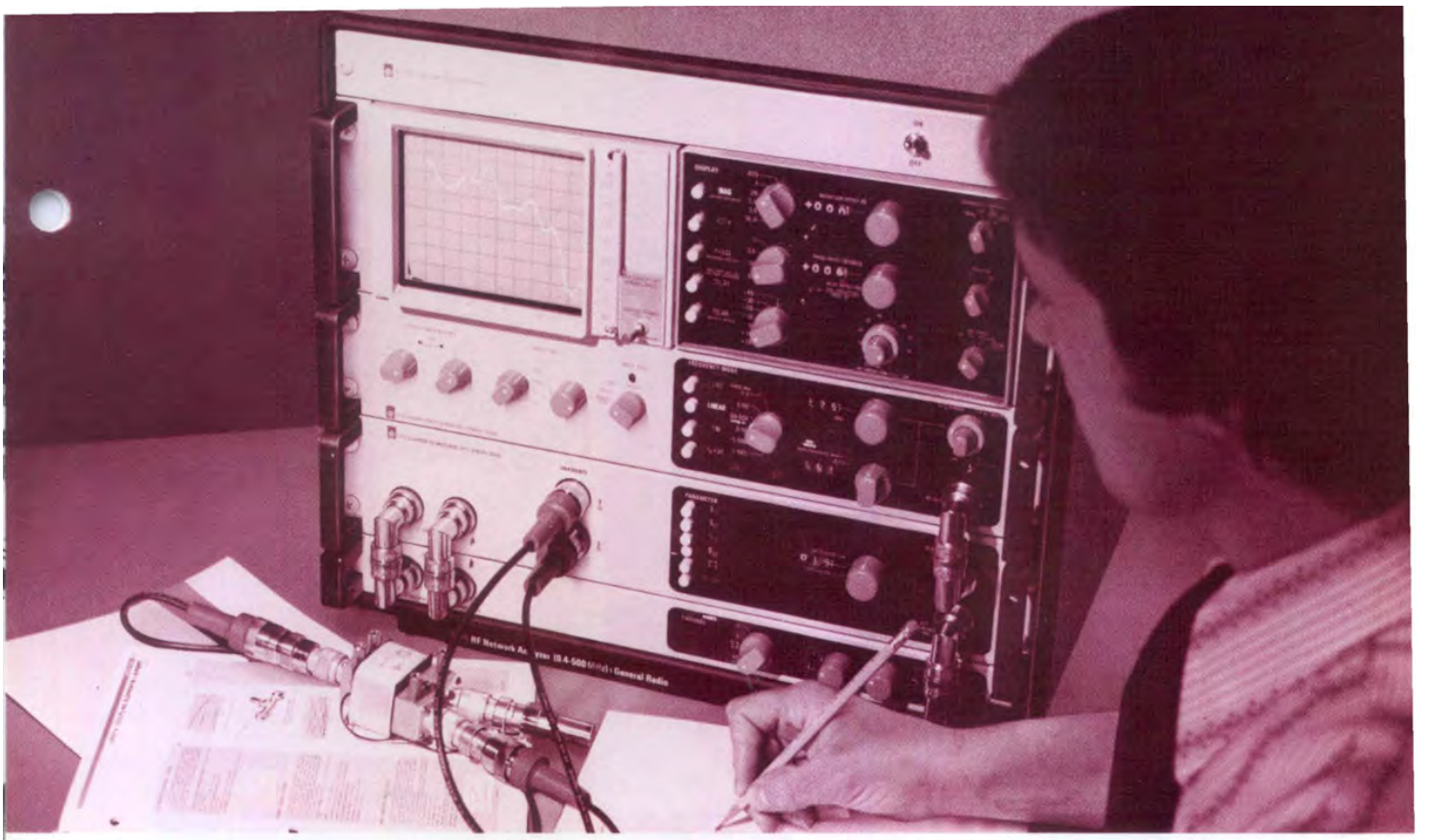
A tour of General Radio's Concord, Mass., headquarters was a key point of interest for a group of eleven Japanese electronic engineers visiting the United States recently.

The group's visit was sponsored by the Japanese chapter of IEEE as part of a regular program of bringing Japanese study-teams to the United States to interchange and discuss engineering ideas and problems of mutual interest. A technically-knowledgeable interpreter accompanies each group.

Some members of the group also explore licensing and joint-venture agreements with American firms, and investigate American equipment for purchase by their companies. A similar group of Japanese engineers who visited the General Radio plant a year ago acclaimed the tour as a highlight of their U.S. trip.

Of special interest to these recent Japanese visitors were GR's capabilities in computer-controlled automated test systems. They were especially impressed by their tour of GR's systems manufacturing center.

As part of this international exchange of technical information and ideas, IEEE/Japan has expressed interest in future reciprocal visits by American engineers to Japanese factories and laboratories.

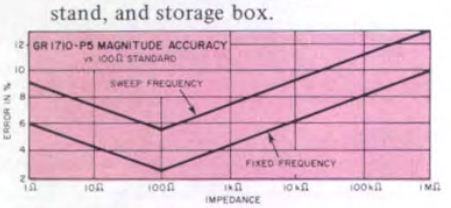


New accessories extend versatility of GR 1710 RF Network Analyzer

The GR 1710 provides a sophisticated yet easily operated system for fast, accurate measurement of magnitude, phase, and group delay of either of two signals relative to a third reference signal. Impedance and immittance measurements are equally simple. These new accessories now extend the usefulness of the GR 1710 still further:

1710-P5 IMMITTANCE PROBE

Permits measurements of impedance from 0.5 ohm to 1 megohm, and admittance from 1 micromho to 2 mhos. Displays magnitude with accuracy of ±3% for decade ranges at fixed frequency; for multidecade ranges see curve. (Add ±3% for sweep frequency.) Displays phase with accuracy of ±1.5° typical for fixed frequency, ±10° for sweep frequency. Polar accuracy same as magnitude. Bias can be applied at rf input for tests of semiconductor devices. Supplied with probe tips and guard, BNC adaptor, 100-ohm standard calibrator, sweep adaptor cable, clip terminals, binding-post adaptor, GR900® adaptor, component test stand, and storage box.



1715 SAMPLING X-Y RECORDER

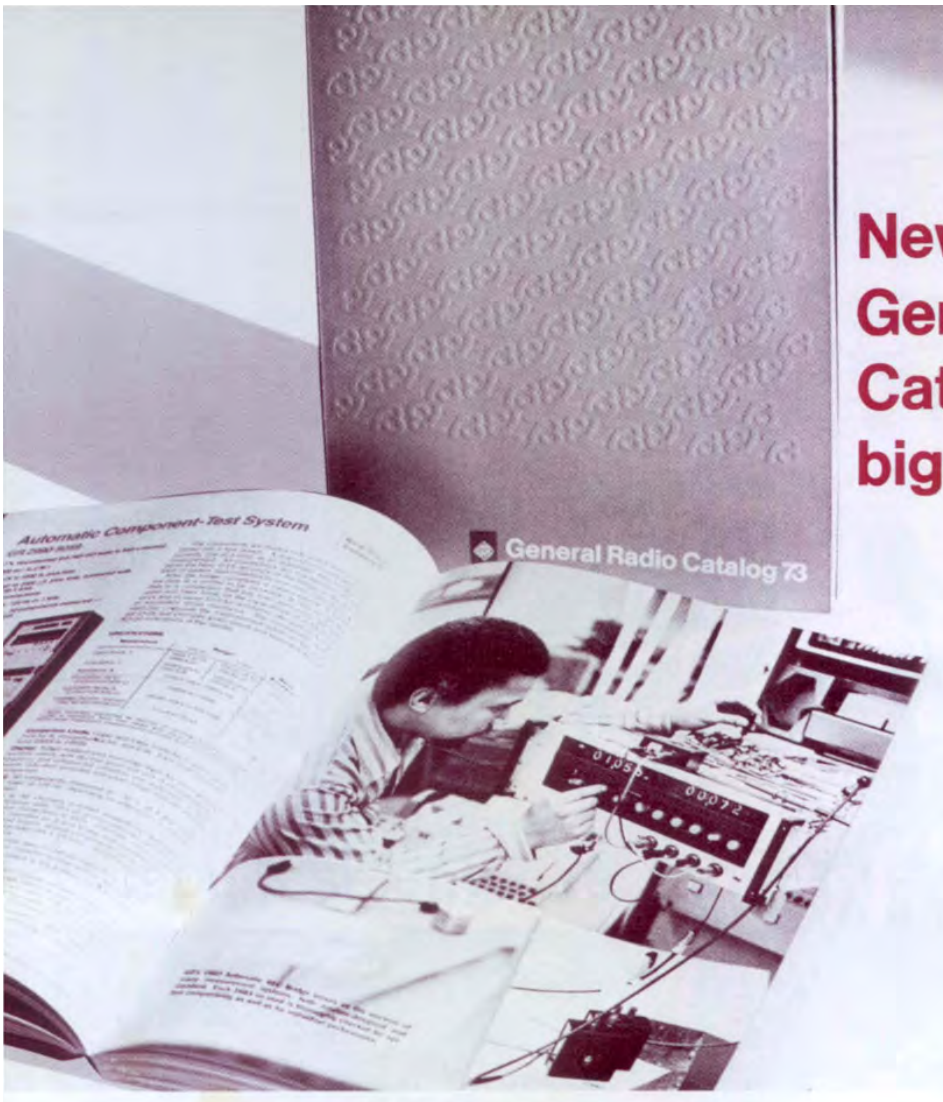
Attaches easily to the 1710 and provides an 8½″ x 11″ or 11″ x 17″ recording of the measurements. Ideal where permanent records are required, such as for statistical analyses or documented performance verification. Sampling feature provides fast, pushbutton recordings of any oscilloscope display, even during very-high-rate analyzer sweeps, and is required for hard-copy group delay plots.

1716 REFERENCE STORAGE UNIT

Stores a reference or zero-line trace in a digital memory so that it may be subtracted from subsequent measurements as a frequency-response correction. For example, a frequency-response flatness of 0.01 dB can be achieved over the full 500-MHz operating band of the 1710 RF Network Analyzer.

1717 COUNTER-MARKER GENERATOR

Provides five continuously adjustable frequency markers on the display oscilloscope or X-Y plotter. Marker frequencies are determined precisely from a built-in digital counter that monitors the output frequency of the 1710 sweep source.



New General Radio Catalog 73 — biggest and best yet!

If you haven't yet received your free copy of the new General Radio Catalog 73, you can request one via the attached reply card. Over two years in preparation, Catalog 73 is the largest, most colorful and information-packed catalog GR has ever published.

The new GR Catalog 73 departs strikingly from previous editions in the graphic appeal of its many four-color illustrations and dramatic photographs of products in use. Within its 360 pages — 40 more than the previous Catalog U — a host of new GR capabilities and product lines are introduced, along with new GR subsidiaries and associated companies. A detailed, color-coded directory of GR's growing network of worldwide sales and service facilities reflects a continuing responsiveness to customer needs.

REGIONAL SALES AND SERVICE FACILITIES

***NEW YORK** • 380 Midland Ave., Saddle Brook, NJ 07662 • Tel: (NJ) 201 791-8990 (NY) 212 964-2722 • TWX: 710 988-2205
***BOSTON** • (Sales) Bolton, MA 01740 • Tel: 617 646-0550 • (Serv) Concord, MA 01742 • Tel: 617 369-8770 • TWX: 710 347-1051
***CHICAGO** • 9440 West Foster Ave., Chicago, IL 60656 • Tel: 312 992-0880 • TWX: 910 221-5486
DAYTON • 3300 S Dixie Drive, Suite 120, Dayton, OH 45439 • Tel: 513 294-1500 • TWX: 810-459-1785
***WASHINGTON, D.C.** • 15 Firstfield Road, Gaithersburg, MD 20760 • Tel: 301 948-7071 • TWX: 710 828-9741
ATLANTA • 7 Dunwoody Park, Suite 115, Atlanta, GA 30341 • Tel: 404 457-2485, (FLA) 813 531-0148
***DALLAS** • 777 So. Central Expressway, Suite 1-D, Richardson, TX 75080 • Tel: 214 234-3357, (HOUSTON) 713 464-5112
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