1959 SOLID-STATE CIRCUITS CONFERENCE

IRE—AIEE—U. of P.

Advance Program

Thursday and Friday—February 12 and 13, 1959

Irvine Auditorium and University Museum,

University of Pennsylvania

and the Hotel Sheraton, Philadelphia, Pa.

REGISTRATION: **Hotel Sheraton—*Wednesday, February 11, 1959*—6:00 P.M.-10:00 P.M.**

Irvine Auditorium—*Thursday, February 12, 1959*—8:00 A.M.-9:00 A.M.

Irvine Auditorium—*Friday, February 13, 1959*—8:00 A.M.-9:00 A.M.

Cosponsored by: IRE Professional

MORNING SESSIONS

THURSDAY, FEBRUARY 12, 1959

SESSION I: Solid-State Microwave Electronics I — Irvine Auditorium—9:00 A.M.-12:00 Noon

Chairman: E. D. Reed, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

1.1: Amplification By Nonlinear Reactance: A Survey
A. Uhlir, Jr., Microwave Associates, Inc., Burlington, Mass.

The principles of operation of uhf variable-reactance diode amplifiers will be reviewed, and methods for utilizing minimum loss-control diodes will be discussed. Systems tests show these diode amplifiers to be very satisfactory in dynamic range, bandwidth and stability; noise figures of about 1 db are obtained.

1.2: Low-Noise 400-Mc Reactance Amplifiers
P. P. Lombardo, Applied Electronics Department, Airborne Instruments Laboratory, Mineola, N. Y.

This paper describes a balanced version of a 400-mc reactance amplifier which has been designed and tested under several modes of operation. These include the sum frequency, 2-port and 1-port difference frequency modes. Noise figure, bandwidth, and gain measurements are described. Construction details of the various amplifier configurations are discussed.

1.3: Nonlinear-Reactance (Parametric) Traveling-Wave Amplifiers for UHF
R. S. Engelbrecht, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

The application of ("varactor") semiconductor diodes in parametric traveling-wave amplification will be described. The capabilities with regard to bandwidth (over 25%), pumping power (about 10 milliwatts) and noise figures (equivalent input noise temperatures 50° to 100° K) for experimental amplifiers designed for uhf will be presented.

1.4: Large-Signal Characteristics of Three-Frequency Cavity Parametric Amplifiers
K. L. Kotzebue, Stanford University, Palo Alto, California

The large-signal saturation characteristics of three-frequency negative-resistance type parametric amplifiers utilizing resonant circuits have been analyzed yielding values for the saturated power output as an amplifier, and power output as an oscillator as a function of applied pump power. Experimental large-signal data of a three-frequency microwave parametric amplifier are presented showing good agreement between theory and experiment.

1.5: Multiple Frequency Parametric Devices
Hsiung Hsu, Electronics Laboratory, General Electric Co., Syracuse, N. Y.

Single stage parametric amplifiers and converters can be designed to perform functions of multi-stage devices. Several examples will be described and analyzed such as a regenerative non-inverting up-converter having higher gain than frequency ratio, parametric amplifiers for signal frequency higher than pump frequency, and tunable devices with fixed output frequencies.

SESSION II: Memory Techniques — University Museum—9:00 A.M-12:00 Noon

Chairman: R. H. Baker, MIT, Lincoln Laboratory, Lexington, Mass.

2.1: Twistor Buffer Store
K. Preston, Jr., and Q. W. Simkins, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

This paper reports on the development of a twistor buffer store having a capacity of thirty 22-bit words. The store is completely transistor driven. Reading, writing, or both reading and writing may be performed in any 4 microsecond period. The speed limitations of the twistor are discussed, as well as some of the limitations on the size of twistor stores.

2.2: Impulse Switching of Ferrites
R. E. McMahon, MIT, Lincoln Laboratory, Lexington, Mass.

Impulse switching of ferrites has allowed memory cycle times of less than .5 microsecond to be achieved. The important characteristics of impulse switching as well as the limitations will be described. The future use and applications of this mode of operation will also be discussed.

2.3: Ferrite Apertured Plate Memories
C. S. Warren, RCA, Camden, N. J.

It will be the purpose of this paper to highlight some of the problems associated with the design of ferrite apertured plate memories. A brief description will be given of both coincident current and linear selection type memories using ferrite plates. Data will be presented on actual memory systems, which have been evaluated, to show what relative advantages can be achieved using ferrite plates.

2.4: Superconducting Memory
C. J. Kraus, IBM, Kingston, N. Y.

The principles of a trapped flux, superconducting multiple layer film memory will be covered and test results of an operating plane will be discussed. The advantages and disadvantages of this type of memory, based on actual test data, will be presented. In addition, critical problems of superconducting film evaporation control will be discussed.

2.5: Thin Magnetic Film Memories
E. E. Bittmann, Research Center, Burroughs Corp., Paoli, Pa.

Small random access memories, using deposited magnetic films, 2000Å thick, 3/16" diameter, where driving and sensing circuits have been transistorized, will be described. Memory cycle time is 1 microsecond, film switching time .1 microsecond and sense output signal 5 mv. Memory plane wiring configurations, which are not noise sensitive, have been selected.

LUNCH: 12:00 Noon to 1:15 P.M.—University Museum

Formal Opening of Conference: 1:30-2:35 P.M.—Irvine Auditorium

Introductory Comments—*J. A. Morton,* Chairman of Conference
Welcoming Remarks—*G. P. Harnwell,* President, University of Pennsylvania
Invited Address—*M. J. Kelly,* President of Bell Telephone Laboratories, Inc.

AFTERNOON SESSION

SESSION III: Applications of New Devices I — Irvine Auditorium—2:45-5:15 P.M.

Chairman: A. P. Stern, Electronics Laboratory, General Electric Co., Syracuse, N. Y.

3.1: Hall-Effect Devices: A Survey
W. J. Grubbs, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

This paper will present the results of a survey of about twenty Hall-effect devices, including the gyrator, isolator, circulator, spectrum analyzer and analog multiplier. Semiconductor materials will be discussed in terms of what type of material is most desirable and how currently available materials limit the usefulness of these devices.

3.2: Superconductive Electronic Circuits: A Survey
D. A. Buck, MIT, Cambridge, Mass.

This survey will discuss the possibilities of exploiting the unusual electrical and magnetic properties of superconductors in configurations, which offer attractive power and memory capacity advantages for digital computer applications. New techniques describing how a miniature complete printed circuit can be fabricated in a single operation will be proposed.

3.3: Proposed New Cryotron Geometry and Circuits
R. K. Richards, Consulting Engineer, Wappingers Falls, N. Y.

A proposal covering a cryotron geometry, formed with a set of concentric superconductors, which offers potential advantages, notably much higher speed of operation, will be offered. A new set of cryotron logical circuits will be described. Complex logical functions such as those involving "don't care" conditions can be derived in a more straight-forward manner than with previous circuits.

3.4: An Electro-Optical Shift Register
T. E. Bray, Electronics Laboratory, General Electric Co., Syracuse, N. Y.

This paper describes an electro-optical shift register composed of electroluminescent and photoconductive elements only. An analysis of the basic electro-optical regenerative connection will be presented which yields useful design criteria for the shift register. Attributes and limitations of this circuit will be given.

3.5: Miniaturized Ceramic Filters
S. W. Tehon, Electronics Laboratory, General Electric Co., Syracuse, N. Y.

Highly stable piezoelectric ceramics provide narrow bandpass filters with small volume, excellent selectivity and low insertion loss. This paper describes a design technique based on the use of image parameters which permits control of impedance, bandwidth and shape factor through use of equivalent electromechanical circuits. The design method is illustrated by a specific impedance transforming if filter which is typical and encountered in miniaturizing communication systems.

The 1959 Solid-State Circuits Conference

oup on Circuit Theory . . . AIEE Committee on Electronics . . . IRE Philadelphia Section . . . AIEE Philadelphia Secti

THURSDAY, FEBRUARY 12, 1959 — AFTERNOON SESSIONS

SESSION IV: Linear Circuits — University Museum—2:45-5:15 P.M.

Chairman: Robert Mayer, Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

4.1: A New Approach to the Design of Low Drift DC Amplifiers

J. P. Warren, Transitron Electronic Corp., Wakefield, Mass.

This paper describes the application of a new low-level silicon transistor which permits considerable drift reductions, particularly of current (e.g., ±.05 millimicroampere per °C). Both voltage and current amplifiers, in which cancellation of the important transistor changes with temperature is approached over wide temperature ranges, will be considered.

4.2: Design of a Transistorized 1.5-Megabit Analog-to-Digital Encoder

C. P. Villars, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

The design of a seven-digit binary network encoder will be discussed. Emphasis will be placed on accurate signal measurement at high speed. Specific factors discussed will be (1) Accuracy of references; (2) comparator design using non-regenerative and regenerative gain, and (3) timing of the feedback loop. These considerations will be illustrated in the design of a practical encoder.

4.3: A New Method of Automatic Gain Control for HF and VHF Transistor Amplifiers

W. F. Chow and H. Lazar, Electronics Laboratory, General Electric Co., Syracuse, N. Y.

This paper describes a new agc-circuit which permits control of signals whose dynamic range is greater than the signal handling capacity of the first stage. The circuit consists of back-biased silicon junction diodes in a bridge configuration which has a very large control range but requires practically no control power.

4.4: Broadband Transistor Video Amplifiers

W. E. Ballentine and F. H. Blecher, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

A technique for designing broadband transistor video amplifiers using diffused base types of transistors will be described. The design method will be illustrated by a six-stage amplifier which provides an insertion voltage gain of 40 db between 50-ohm terminations, flat within ± one db for frequencies between 20 kc and 200 mc.

4.5: Wide-Band Transistor Distributed Amplifiers

L. H. Enloe and P. H. Rogers, Applied Research Laboratory, University of Arizona, Tucson, Arizona

This report is concerned with a form of emitter degeneration which directly exchanges gain for bandwidth and raises the input impedance for constant -k distributed amplifier realization. Another distributed amplifier configuration, with a monotonic frequency response, is synthesized from the complementary admittance to transistor input. Experimental results for a 250-mc amplifier will be presented.

6:00-7:30 P.M.: Cocktail-Buffet Dinner—Sheraton Hotel

8:00 P.M.: Informal Discussion Sessions—Sheraton Hotel

E. 1: Logic Circuits—Moderator, B. J. Yokelson, Bell Telephone Laboratories, Murray Hill, N. J.

E. 2: Memory Techniques—Moderator, R. H. Baker, MIT, Lincoln Lab., Lexington, Mass.

E. 3: High Frequency Linear Techniques—Moderator, J. G. Linvill, Stanford University, Stanford, Calif.

E. 4: Solid-State Microwave Electronics—Moderator, Hubert Heffner, Stanford University, Stanford, Calif.

E. 5: Microminiaturization—Moderator, Rudolph Cypser, IBM, Poughkeepsie, N. Y.

E. 6: Reliability of Semiconductor Devices—Moderator, W. D. Rowe, Westinghouse Electric Corp., Buffalo, N. Y.

E. 7: High Power Techniques—Moderator, R. L. Bright, Westinghouse Electric Corp., Pittsburgh, Pa.

E. 8: DC Amplification and Temperature Stability—Moderator, S. K. Ghandi, Electronics Lab., General Electric Company, Syracuse, N. Y.

FRIDAY, FEBRUARY 13, 1959 — MORNING SESSION

SESSION V: Applications of New Devices II — Irvine Auditorium—9:00 A.M.-12:00 Noon

Chairman: P. M. Thompson, Defense Research Telecommunications Establishment, Ottawa, Canada

5.1: Silicon Controlled Rectifier Inverters

H. R. Lowry, T. P. Sylvan, and D. V. Jones, Semiconductor Products Dept., General Electric Co., Syracuse, N. Y.

This paper will describe the use of 16-ampere silicon-controlled rectifiers in various inverter circuits with emphasis on commutation requirements, firing conditions and load restrictions. A number of novel solid-state device firing circuits for silicon-controlled rectifiers will also be described and typical performance figures for practical inverter circuits are given.

5.2: Applications of PNπN Triode Switches

V. H. Grinich and I. Haas, Fairchild Semiconductor Corp., Palo Alto, California

The characteristics and switching applications of a developmental diffused silicon PNπN triode will be discussed. The device is capable of handling 80 ampere—500 millimicrosecond pulses with rise and fall times in the order of 150 millimicroseconds and 300 millimicroseconds, respectively, at 1-kc prf. The switching mechanisms, frequency and power limitations and the characterization of the device parameters will be discussed.

5.3: Some Circuit Applications of the Field Effect Current Limiter

E. I. Doucette, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

The usual non-linear behavior of the field effect current limiter can be used to perform many diverse and useful functions. Those to be described include: Current regulation, frequency independent ac-dc discrimination, isolation, ac switching, wave shaping and clipping, timing circuits for threshold devices, digital-to-analogue encoding and step-function generation.

5.4: Circuit Applications of Stepping Transistors

E. F. Kovanic, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

This paper will describe some circuit configurations of the stepping transistor, the solid state equivalent of a gas-stepping tube. The transistor characteristics will be discussed, as well as circuits yielding outputs for every stage or for every two stages of the device. Methods of increasing the voltage output and of recycling will be presented.

5.5: Integrated Devices Using Direct Coupled Unipolar Transistor Logic

J. T. Wallmark, RCA Laboratories, Princeton, N. J. and S. M. Marcus, RCA Defense Electronic Products Div., Camden, N. J.

A logic system using directly coupled unipolar transistor elements will be described. By integration of groups of these elements in one piece of semiconductor, extremely compact form is obtained with a packing factor as much as 1000 times higher than that found in advanced microminiature circuits of today.

..University of Pennsylvania

MORNING SESSION

FRIDAY, FEBRUARY 13, 1959

SESSION VI: Switching Circuits I

University Museum—9:00 A.M.-12:00 Noon

Chairman: A. W. Lo, RCA Laboratories Div., RCA, Princeton, N. J.

6.1: A Comparison of Amplifying Devices of the Emitter-Control-Collector Variety: A Survey

E. O. Johnson, RCA Laboratories Div., RCA, Princeton, N. J.

The comparative signal amplifying and information handling capabilities of transistors (unipolar, bipolar and analogue) and vacuum devices (grid-controlled and beam deflection tubes) of the emitter-control-collector type will be described in a very simple, yet general, manner in terms of charge control, charge storage and charge motion.

6.2: Twistor Store-High Current, High Speed, Non-Saturating Transistor Drivers

G. F. Abbott, Jr., Bell Telephone Laboratories, Inc., Murray Hill, N. J.

In the design of the access circuitry for twistor stores, it has been found that drivers of current capacities up to ¾ ampere, producing 2-microsecond pulses with rise and fall times of the order of 100-200 millimicroseconds and possessing current regulations of the order of ±5% have been required. A series of nonsaturating circuits which was designed to fill this need is the subject of this paper.

6.3: A New All-Magnetic Logic System Using Simple Cores

D. C. Engelbart, Stanford Research Institute, Menlo Park, Calif.

A method will be described whereby simple magnetic cores, wired into all-core networks (no diodes, resistors, capacitors), and driven by appropriate clock currents, can transfer binary information states from core to core with stable gain characteristics, and can possess facility for logical manipulation.

6.4: Transistor Pulse Circuits for 160-Mc Clock Rates

W. J. Giguere, J. H. Jamison and J. C. Noll, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Part A—Pulse Regeneration: Circuits have been developed to regenerate high speed digital signals that have been distorted by noise in transmission and band limited amplification. Particular circuits include: (1) A bistable flip-flop; (2) a dc-restoring amplifier, and (3) a reshaping and retiming gate.

Part B—Parallel-to-Serial Multiplexing: Sixteen synchronous 10-mc signals are interleaved in time by transistor gates to produce a regenerated and timed output at 160 mc.

6.5: Hyperfast Diffused-Silicon Diode and Transistor for Logic Circuits

E. G. Rupprecht, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey and H. J. Patterson, P. Miller, Bell Telephone Laboratories, Inc., Allentown, Pa.

A new diode and transistor, which represent major advances for logic circuits, are in manufacture. These devices offer great circuit speed plus the usual advantages of diffused-silicon junction units. Logic circuits, using these devices, that achieve economic and reliable operation with propagation delays of 20 to 300 millimicroseconds will be described.

LUNCH: 12:00 Noon to 1:15 P.M.—University Museum

SESSION VII: Solid-State Microwave Electronics II

Irvine Auditorium—1:30 P.M.-4:00 P.M.

Chairman: J. B. Angell, Philco Corp., Philadelphia, Pa.

7.1: Solid State Maser Amplifiers and Their Applications: A Survey

R. H. Kingston, MIT, Lincoln Laboratory, Lexington, Mass.

The gain-bandwidth product and noise temperature of typical cavity and traveling-wave masers will be derived. Maser performance may be characterized by the negative Q and negative temperature of the crystal. These are determined by the paramagnetic material, the orientation of the rf and dc magnetic fields, the bath temperature and the pumping and amplifying frequencies.

7.2: A Reentrant Resonant-Ring Maser Cavity

J. W. Meyer, MIT, Lincoln Laboratory, Lexington, Mass.

Microwave circuit design problems for cavity type solid-state masers will be reviewed and typical cavities described. A new circuit, wherein the signal circuit is a circular reentrant cavity and the circumferential part of the cavity forms a waveguide ring resonant at the pumping frequency, will be detailed. Experimental characteristics will be discussed.

7.3: A Unilateral Three-level Maser Employing a Ruby-Loaded Comb-Type Structure

R. W. De Grasse, E. O. Schulz-DuBois and H. E. D. Scovil, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

General properties and performance characteristics of a unilateral traveling-wave solid-state maser will be given. The device uses a ruby-loaded comb-type structure. Performance data include forward gain, reverse attenuation, dynamic range for both cw and pulsed signals, bandwidth, electronic tuning range and noise temperature.

7.4: Solid-State Microwave Power Source

M. M. Fortini and J. Vilms, Philco Corp., Philadelphia, Pa.

Conversion attenuation versus harmonic number for diodes run in various modes and diode characteristics for optimum conversion will be discussed. A microwave solid-state system, employing a transistor driving a diode multiplier, which has generated 10 milliwatts at 2000 mc with good efficiency, will be described.

7.5: Parametric Sub-Harmonic Oscillators

F. Sterzer and W. R. Beam, RCA Laboratories Div., Princeton, N. J.

Subharmonic oscillators using variable capacitance diodes have been constructed. These oscillators, when driven by a 4000-mc source, produce oscillations at 2000 mc, in either of two different stable phases. Applications to fast binary scalers and random number generators will be discussed.

AFTERNOON SESSIONS

SESSION VIII: Switching Circuits II

University Museum—1:30 P.M.-4:00 P.M.

Chairman: P. F. Pittman, Westinghouse Electric Corp., Pittsburgh, Pa.

8.1: Inverted Phototransistor as a Switched Modulator

K. H. Beck, Jr., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

An alloyed junction phototransistor operated in the inverted connection may have its light sensitivity gated electrically by a simple switching circuit. The leakage current is very nearly independent of the switching operation. Based on these facts, it will be shown that a light-determined ac output, essentially unaffected by dark current variations, can be obtained without using modulated light or thermal-compensating elements.

8.2: A Transistor Power Converter-Amplifier

D. A. Paynter, Electronics Laboratory, General Electric Co., Syracuse, N. Y.

Signal amplification along with power conversion can be obtained in a novel power converter which utilizes both the switching and linear gain properties of the converter switching transistors. The common-emitter, common-base, and common-collector configurations of the power converter-amplifier will be discussed, and some examples of its use as a combined power converter-regulator employing either series regulation or high efficiency switch-type regulation will be indicated.

8.3: Physical Principles of Avalanche Transistor Pulse Circuits

D. J. Hamilton, J. F. Gibbons and W. Shockley, Stanford University, Palo Alto, California

From a simple physical model of the avalanche transistor, a theory has been developed which permits accurate calculation of the significant aspects of its transient performance. The theory has been applied to a relaxation oscillator which embodies many of the features common to avalanche pulse circuits.

8.4: Electrodeposited Twistor and Bit Wire Components

S. J. Schwartz and J. S. Sallo, Magnetic Research Dept., The National Cash Register Co., Dayton, Ohio

Electrodeposition of twistors has been accomplished and similar elements requiring no external stressing (bit wire) have also been prepared. Some features of these materials are switching speeds of less than 100 millimicroseconds, temperature stability, high signal-to-noise ratios, and transistor operation. Linear selection and coincident current memories have been prepared.

8.5: Rotational Remagnetization of Thin Films

Herbert B. Callen, Consultant to Remington Rand Univac Division, Sperry Rand Corp., Philadelphia, Pa.

The internal circuitry of a thin ferromagnetic film will be described from the physical viewpoint. The signal propogates in spin waves, the ferromagnetic analogues of the familiar wave-guide modes. The resistance arises from the coupling of the spin-waves to the phonons or heat modes. The influence of the sample shape on the frequency of the spin-waves and on the spin-wave-to-phonon coupling can be pictorialized in a simple intuitive fashion.

1959 SOLID-STATE CIRCUITS CONFERENCE

Scope of Conference

THE 1959 Solid-State Circuits Conference will feature eight sessions devoted to broad advances in the field of solid-state device applications and circuits. Forty papers will be offered covering new magnetic and semiconductor devices and circuits for digital storage and logic. Also presented will be a number of survey reports on low-temperature electronics, microwave masers and parametric amplifiers.

INFORMAL DISCUSSION SESSIONS, conducted by leaders in the solid-state field, will be held on Thursday evening to provide registrants an opportunity to discuss logic circuits, memory, high-frequency linear techniques, solid-state microwave electronics, microminiaturization, reliability, high-power techniques and dc amplification.

A 112-PAGE TECHNICAL DIGEST, containing substantial abstracts and a complement of illustrations of every technical paper, will be furnished without charge to every registrant.

Location

THE CONFERENCE will be held on the campus of the University of Pennsylvania in the Irvine Auditorium and in the University Museum.

IRVINE AUDITORIUM is located at the northwest corner of 34th and Spruce Streets; the University Museum is just east of the southeast corner of 34th and Spruce Streets, Philadelphia, Pennsylvania. Central Philadelphia is easily reached by bus route 42 and the 30th Street station of the Pennsylvania Railroad is less than a mile from the University Campus.

THE INFORMAL Thursday evening sessions will be held in the Sheraton Hotel.

Accommodations

THE SHERATON HOTEL, 1725 Pennsylvania Boulevard (in central Philadelphia), Conference headquarters, has reserved a block of rooms for those attending the Conference. Offices of most major airlines are within one-half block of the hotel; several are in the lobby of the hotel. Railroads to all points are convenient to the hotel; ample indoor parking facilities are available via an underground concourse.

The Cocktail Party and Buffet Dinner will be held at the Sheraton on Thursday evening.

Luncheons on Thursday and Friday will be served to a limited number in the University Museum. For those who do not wish to attend the luncheons or buffet dinner, there are a number of fine restaurants in the area.

Registration

REGISTRATION AND HOTEL reservation forms are enclosed with this Conference announcement. Additional forms may be obtained from Harris Colehower, General Electric Co., 3198 Chestnut St., Philadelphia 4, Pa.

CONFERENCE FEES ARE:

	Advance—Before Feb. 5, 1959	At Conference—or After—Feb. 5, 1959
Registration, Member AIEE-IRE:	$6.00	$8.00
Non-Member:	8.00	10.00
Thursday Lunch:	2.75	3.25
Friday Lunch:	2.75	3.25
Cocktail Party:	2.50	3.00
Buffet Dinner:	6.50	7.00
Combination Cocktail Party and Buffet Dinner:	8.50	9.50

Full-time students will be registered free of charge for the technical sessions.

All technical sessions will start promptly at 9:00 A.M. on Feb. 12 and 13. To avoid delays in registration and to assist the local arrangements committee, advance registration and meal purchases are strongly recommended.

Program Committee

Chairman: A. P. Stern, Electronics Lab., General Electric Co., Syracuse, N. Y.

Secretary: L. D. Wechsler, Electronics Lab., General Electric Co., Syracuse, N. Y.

Members:

- J. R. Anderson, Stanford Research Institute, Menlo Park, Calif.
- J. B. Angell, Philco Corp., Philadelphia, Pa.
- R. H. Baker, MIT, Lincoln Lab., Lexington, Mass.
- F. H. Blecher, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
- T. H. Bonn, Remington-Rand, Univac, Philadelphia, Pa.
- D. A. Buck, MIT, Cambridge, Mass.
- E. G. Clark, Research Center, Burroughs Corp., Paoli, Pa.
- R. J. Cypser, IBM, Poughkeepsie, N. Y.
- S. C. Feng, Remington-Rand Univac, Philadelphia, Pa.
- H. Heffner, Stanford University, Palo Alto, California
- E. O. Johnson, RCA Laboratories Div., RCA, Princeton, N. J.
- J. G. Linvill, Stanford University, Palo Alto, Calif.
- A. W. Lo, RCA Laboratories Div., RCA, Princeton, N. J.
- J. C. Logue, IBM, Poughkeepsie, N. Y.
- D. H. MacPherson, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
- R. Mayer, Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
- J. W. Meyer, MIT, Lincoln Lab., Lexington, Mass.
- P. F. Pittman, Westinghouse Corp., Pittsburgh, Pa.
- A. K. Rapp, Philco Corp., Philadelphia, Pa.
- E. D. Reed, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
- C. F. Spitzer, Lockheed Aircraft Co., Palo Alto, Calif.
- P. M. Thompson, Defense Research Telecommunications Establishment, Ottawa, Canada.

1959 SOLID-STATE CIRCUITS CONFERENCE

National Committee

Chairman: Jack A. Morton, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Secretary: Tudor R. Finch, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Treasurer: James B. Williams, Philco Corp., Philadelphia, Pa.

Program Committee Chairman: Arthur P. Stern, Electronics Lab., General Electric Co., Syracuse, N. Y.

Public Relations Co-Chairmen: Lewis Winner, Consultant, New York City, N. Y., and
Franklin H. Blecher, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Local Arrangements Committee Chairman: E. Gary Clark, Research Center, Burroughs Corp., Paoli, Pa.

Editor, Digest of Technical Papers: Robert F. Cotellessa, College of Engineering, New York University, New York 53, N. Y.

Sponsors Advisory Committee:

Chairman: Murlan S. Corrington, RCA-Victor TV Div., Camden, N. J.

IRE-PGCT Rep.: Anthony B. Giordano, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

AIEE-CE Rep.: Arthur P. Stern, Electronics Lab., General Electric Co., Syracuse, N. Y.

IRE Philadelphia Section Rep.: Isaac L. Auerbach, Auerbach Electronics Corp., Narberth, Pa.

AIEE Philadelphia Section Rep.: Robert Mayer, Brown Instrument Div. Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

University of Pennsylvania Rep.: John G. Brainerd, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.