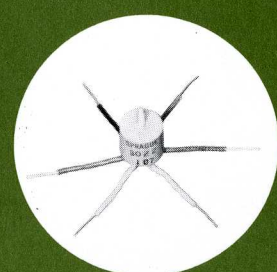
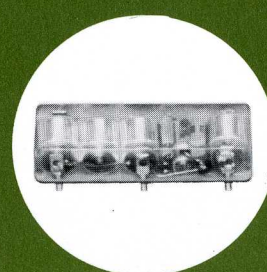
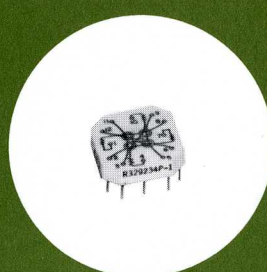


SPRAGUE SPECIAL PRODUCTS DIVISION



NORTH ADAMS, MASSACHUSETTS



SPRAGUE

SPECIAL PRODUCTS

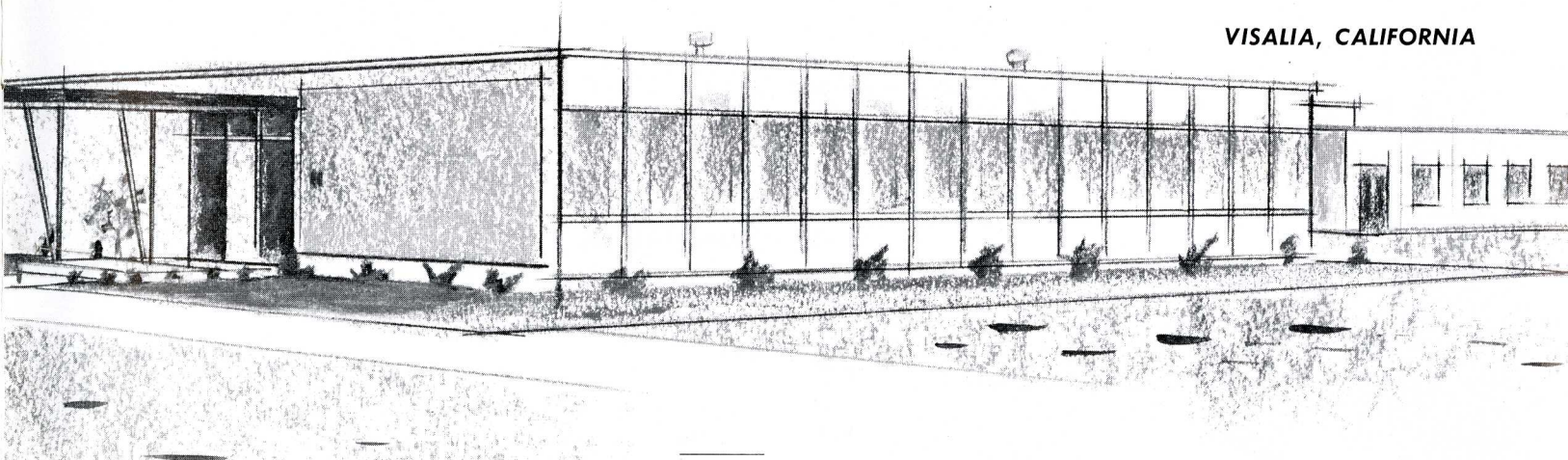
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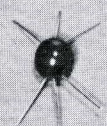
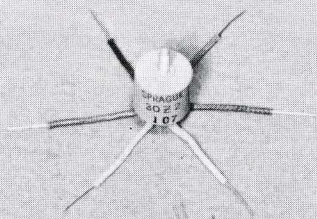
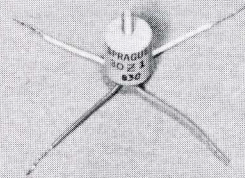
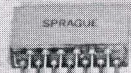
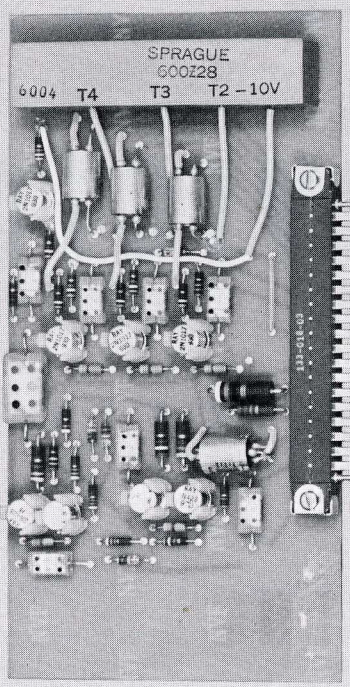
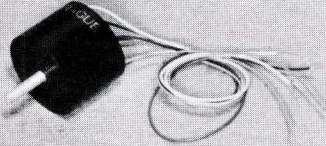
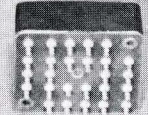
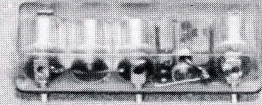
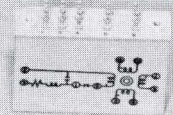
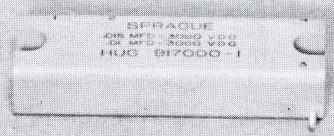
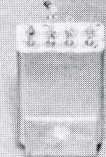
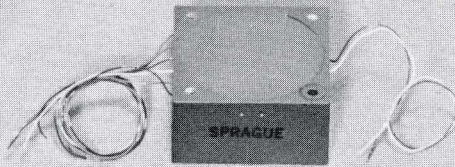
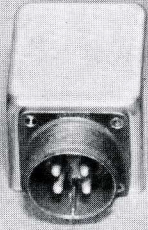
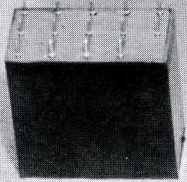
S P R A G U E E L E C T R I C C O M P A N Y
EXECUTIVE OFFICES: NORTH ADAMS, MASSACHUSETTS

PRIMARY PRODUCT LINES

SEMI-CONDUCTOR LOGIC CIRCUITS	SEMI-CONDUCTOR CURRENT DRIVERS
COMPUTER PULSE TRANSFORMERS	MAGNETIC CORE LOGIC CIRCUITS
MAGNETIC SHIFT REGISTERS	BLOCKING OSCILLATOR TRANSFORMERS
SENSE AMPLIFIER TRANSFORMERS	MATRIX SWITCH CORE TRANSFORMERS
DECADE AND BINARY COUNTERS	PRECISION DECADE INDUCTORS
PRECISION INDUCTORS	DIGITAL-VISUAL INDICATOR CIRCUITS
MAGNETIC CORE INFORMATION STORAGE SYSTEMS	

VISALIA, CALIFORNIA





Since its founding in 1926, the Sprague Electric Company has grown to become one of the major factors in the American electronic components industry. It is by far the largest manufacturer of all types of capacitors and has achieved a position of leadership in the production of many other components. These include such diversified items as resistors; electro-chemical transistors, including surface barrier, micro-alloy, and micro-alloy diffused-base types; pulse-forming networks; high temperature magnet wire; interference filters; ceramic-base printed networks; toroids; pulse and switching transformers; magnetic shift registers; packaged component assemblies; and computer logic modules. Today, Sprague Electric is widely recognized as a pioneer in successfully building reliability and quality into these highly essential components. As the electronics industry continues its rapid expansion, the company continues to create components of the many types needed for a growing number of diversified end uses, and establishes modern manufacturing facilities to produce these new items.



SPECIAL PRODUCTS DIVISION

The Special Products Division of the Sprague Electric Company was established in 1958 in order to better serve the technically complex requirements of the electronics system and end equipment industries. The goal of the division is the development and manufacture of the complex components and assemblies used for advanced communications, data processing, and control electronic equipment requiring specialized design and performance testing in functional use circuits.

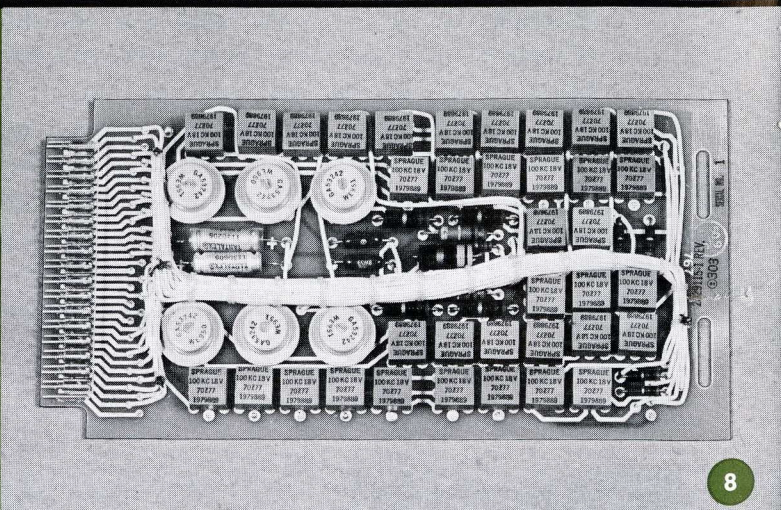
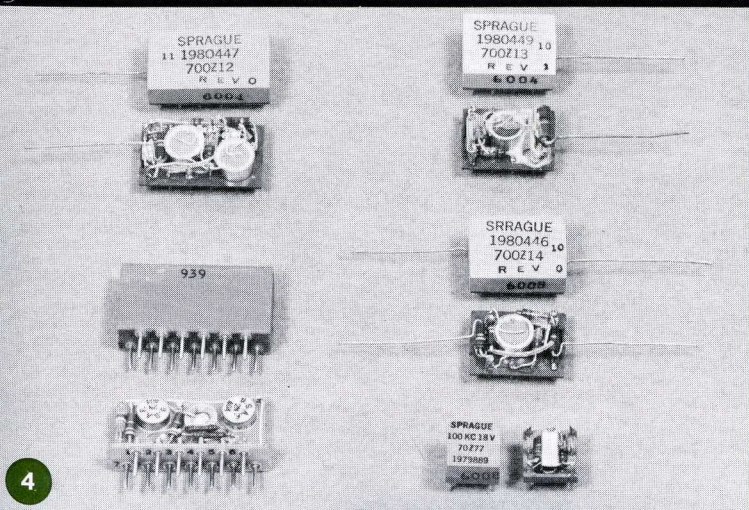
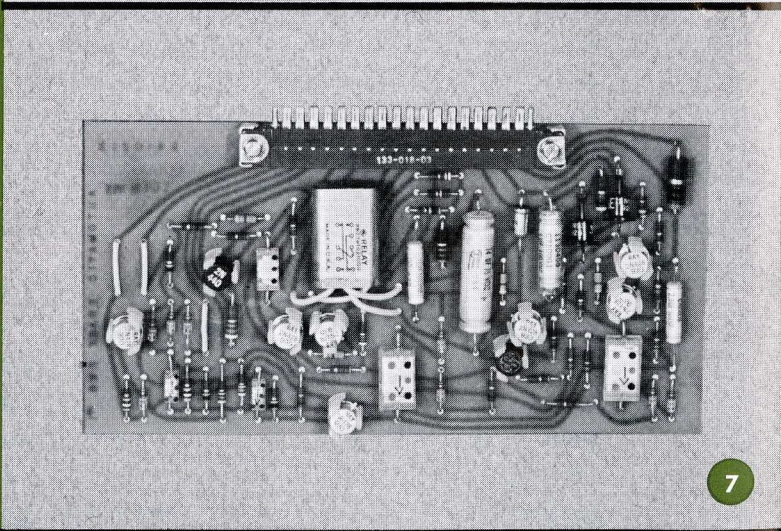
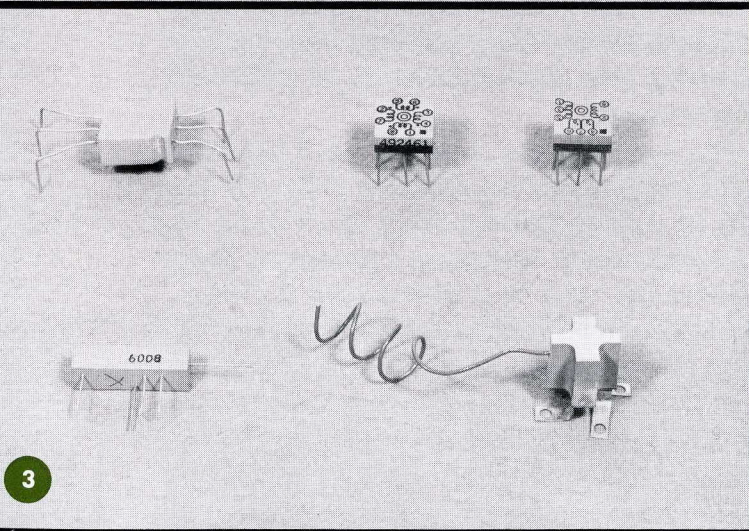
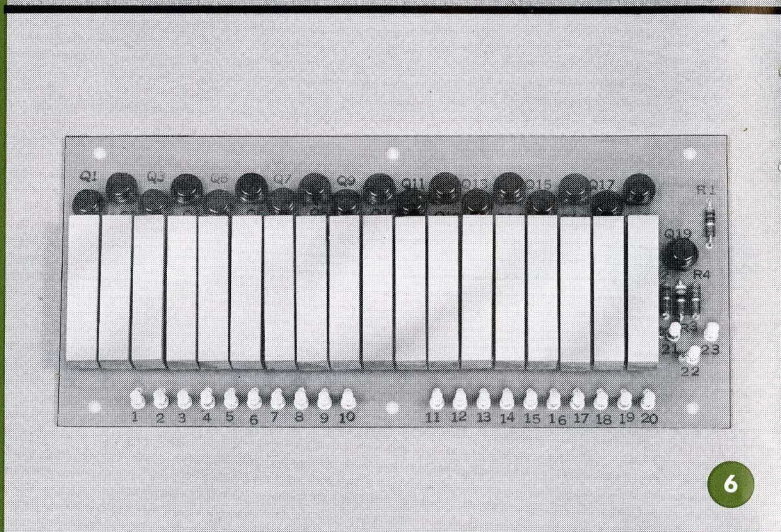
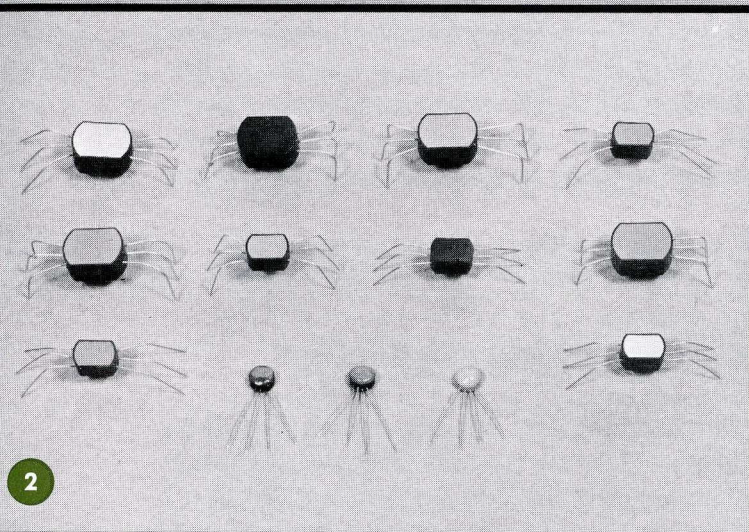
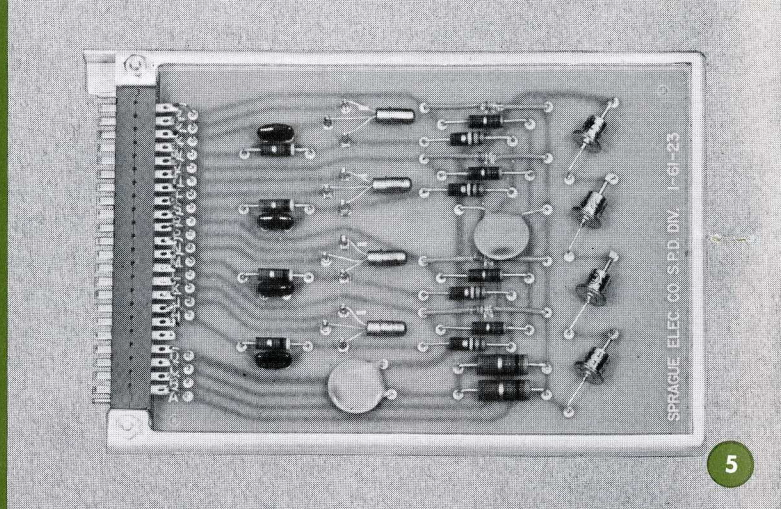
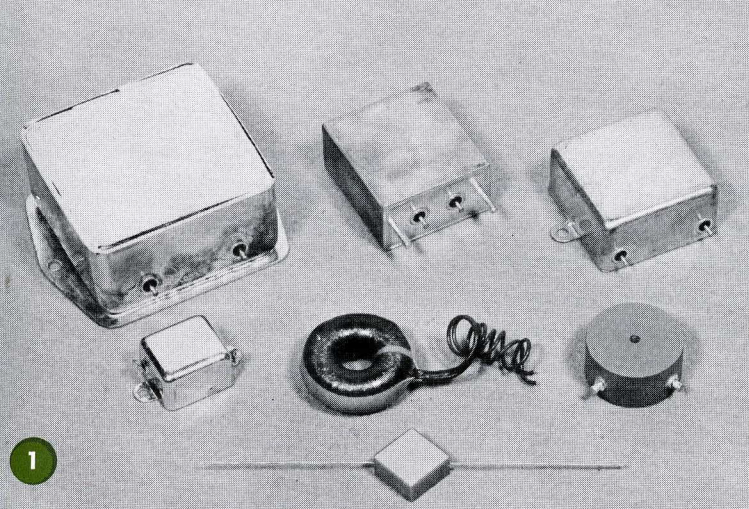
Because of this fundamental difference in the character of products, Sprague created its Special Products Division as an independent operation to specialize in such technically complex items, especially in digital applications. The Special Products Division is capably staffed by selected personnel chosen for their training, abilities, and experience in the field of magnetic components, functional subassemblies, semiconductor and magnetic logic circuits and packaging conventional components.

To provide efficient nation-wide service, engineering and manufacturing facilities are located both in the east and in the far west. Sprague's Union Street plant in North Adams, Mass., with more than 40,000 sq. ft. of space,

is the headquarters for the Special Products Division. Here are housed the main electronic development and packaging laboratories as well as air-conditioned performance test areas where uniformity of temperature and humidity facilitate the standardization of precision measurements.

The western plant is at Visalia, California, in the heart of the San Joaquin Valley. It consists of a modern one-story 22,000 sq. ft. air-conditioned structure containing both engineering and manufacturing facilities. Transportation facilities from this plant to all parts of the United States are excellent.

Both the East and West coast facilities are unusually extensive and versatile. Engineering and production units have been equipped with comprehensive electronic test equipment in order to make possible end performance testing of a nature considerably more complex than is usually available in the industry. In addition, the background experience of many members of the technical staff of the Special Products Division in the field of individual components assures an intelligent application of all circuit elements, both cased and uncased, into complex functional assemblies.



THE PRODUCT LINE

The primary product lines of the Special Products Division are tabulated on the title page. In addition to those listed, the division has design, manufacturing, and test capabilities on both passive and active digital assemblies and packages. Many items produced are custom engineered for a particular end use in prototype or production quantities. Therefore, your own requirements may not be illustrated in the typical examples given here.

The products are used in many industries. Data processing equipment manufacturers will find the wide variety of individual magnetic components as well as the building blocks and sub-systems of magnetic and transistor logic circuits designed and tested to most exact application conditions. Versatile packaging techniques employed permits use of fundamental component elements and circuits in a wide selection of end equipment structures.

Figure 1 shows typical sizes of precision inductors manufactured by the Special Products Division. These inductors, normally supplied to a $\pm 1\%$ tolerance, are available in a wide selection of core materials and degrees of stabilization which, combined with special winding techniques, allow choice of Q as well as current carrying capabilities for any particular inductance value. Open, encapsulated, and hermetically sealed constructions are available.

Figure 2 shows samples of standard encapsulated pulse transformers. These units described in detail in engineering bulletins, are available in a wide variety of two winding, three winding, and center tapped constructions. The standard line is complemented by encapsulated plug-in and wire board designs as well as various hermetically sealed packages to the same electrical specifications.

In Figure 3 is shown a collection of specially designed transformers whose physical config-

urations are tailor-made for end use where standard constructions will not fit.

Figure 4 shows a collection of digital modules custom engineered by Sprague with complete performance testing in end use circuits. These modules, normally encapsulated in epoxy resin, are suited to plug-in and printed wire board applications. Properly designed and processed modules will meet rigorous environmental test conditions.

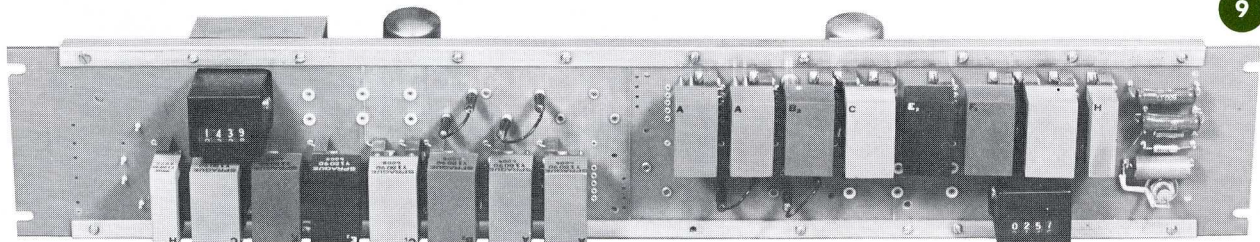
Figure 5 shows semiconductor logic boards in the standard plug-in design. This line of proprietary circuits can be used to build up a great variety of systems and sub-systems. The standard line is based on a five mc operating frequency. In addition to the pluggable units, any of the circuits may be packaged in miniature modular form for special end applications.

Figure 6 is illustrative of a custom designed shift register array, including complete driver circuitry. This core-transistor circuit is also specially designed to meet particular system requirements for speed, output and voltage levels.

Figure 7 is illustrative of digital circuits designed by a customer with parts procurement, assembly including dip soldering and final performance testing by the Special Products Division. These assemblies are based on semiconductor circuitry.

Figure 8 shows a magnetic logic circuit containing 36 shift register bits along with driver circuitry mounted on plated-through hole wire boards. Each shift register bit occupies 1/10 cu. inch and is of the core-diode variety.

Figure 9 depicts a prototype model of a combined semiconductor magnetic circuit custom designed and fabricated by Sprague to meet input and output conditions specified by the customer. This particular unit, with a multiplicity of semiconductor inputs and magnetic counters, gives high accuracy of count under a wide variation of input pulse conditions.



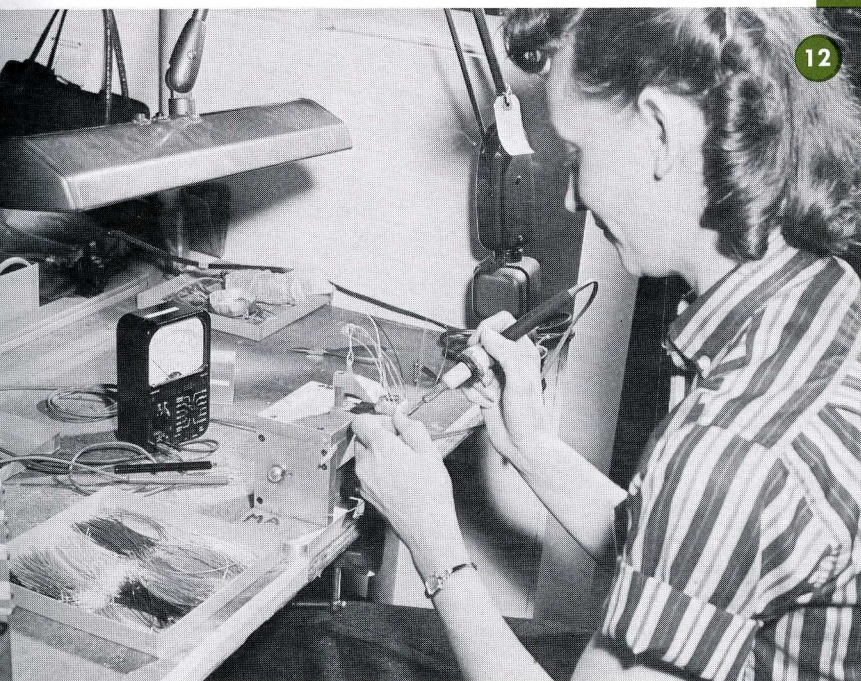
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FIG. 10—A portion of one of the core winding departments.



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FIG. 11—Bobbin winding equipment for prototype transformer production.



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FIG. 12—Assembly of multi-winding cores requires experienced solderers.

MANUFACTURING FACIL

FIG. 13—A general view of the North Adams manufacturing area.



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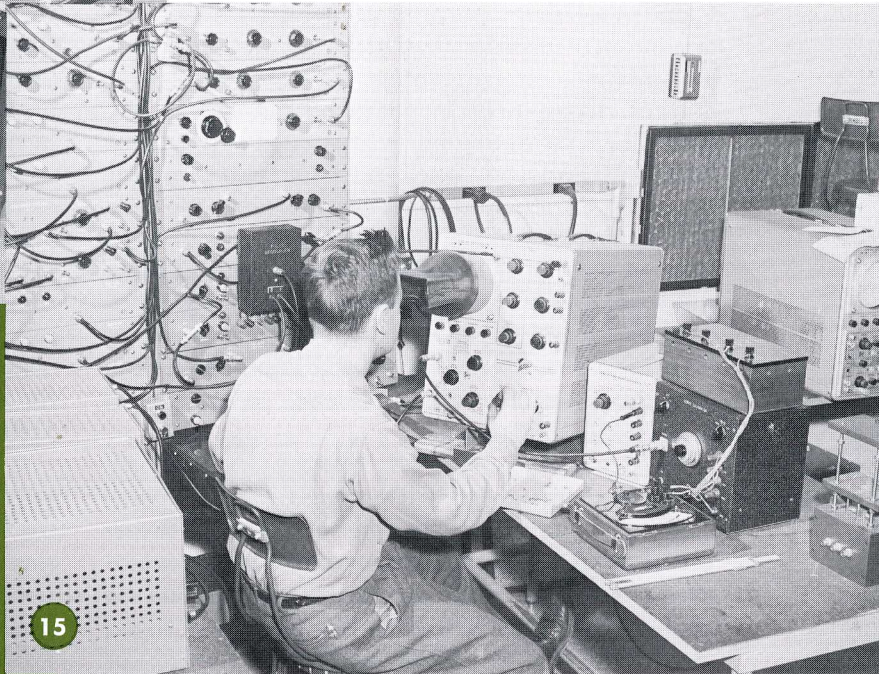


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FIG. 14—Manufacturing performance test setup for logical devices conducted on 100% basis. Temperature and humidity controlled.

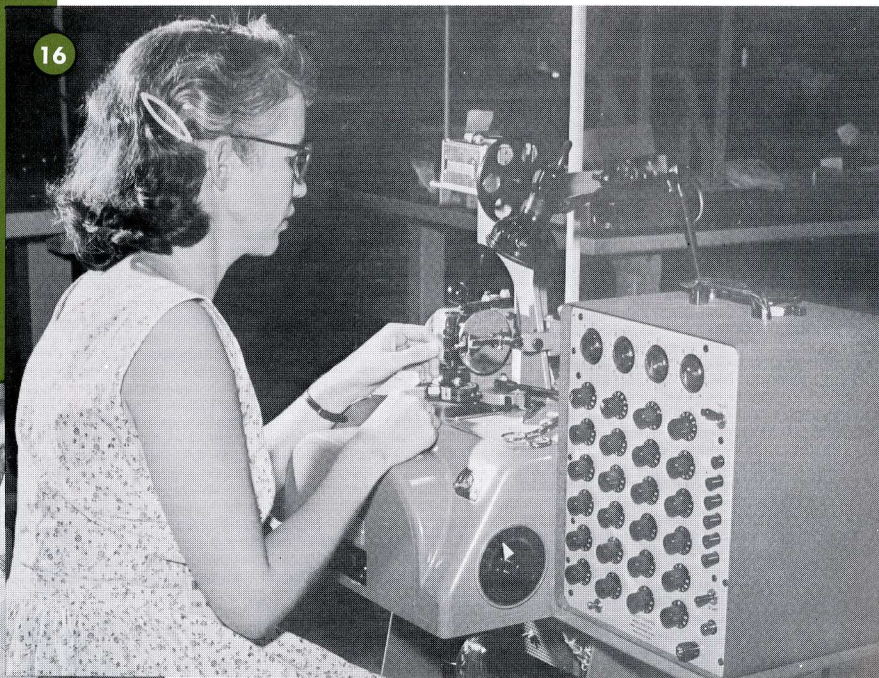
CTURING ITIES

FIG. 15—Core testing is also carried out by the manufacturing department.



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FIG. 16—Close-up of typical toroidal core winding machine



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FIG. 17—A continuous curing oven was developed and constructed for controlled runs of encapsulated products.

DEVELOPMENT AND ENGINEERING

The development and engineering laboratories of the Special Products Division are housed in 5,000 sq. ft. of modernized floor-space in the North Adams plant, and in similar facilities in Visalia, California. Major portions of these areas are air-conditioned in order that accurate measurements may be made on temperature-sensitive circuits and devices. Equipment is provided throughout the laboratory for supplying regulated d-c power as well as 60 and 400 cycles and 1 kilowatt of power up to 10 kc. Pulse sources are available for generating fast risetime waveforms with low or high source impedances. Used in conjunction with these pulse generators are a number of pulse logic systems for simulating the actual performance conditions which the Special Products Division devices and subassemblies will experience in their final equipment applications.

Measurements are made using a wide variety of modern precision meters and oscilloscopes. Calibration standards for time and voltage measurements are used on a day-to-day basis to maintain agreement with customers throughout the country. Particular attention has been given to the development of precision equipment needed for the detailed basic studies of magnetic materials

and semiconductor devices under pulse conditions. In conjunction with the magnetic material studies, electronic integrators and flux calibrators have been advanced in design and capability consistent with the trend toward faster switching and lower signal levels. Special attention has been given to measurement of semiconductor devices switching including equipment for determining performance in the nanosecond region.

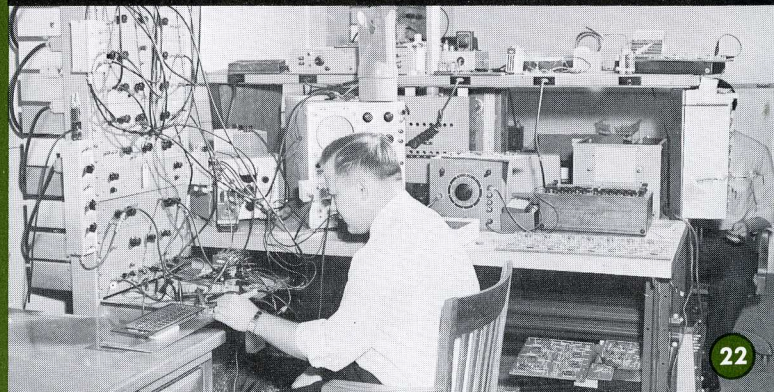
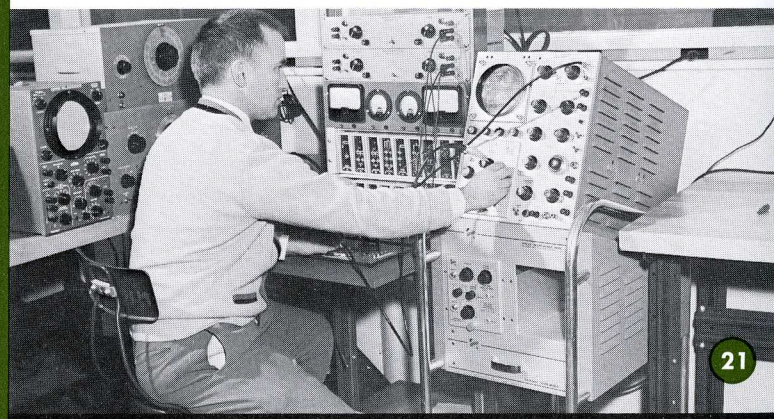
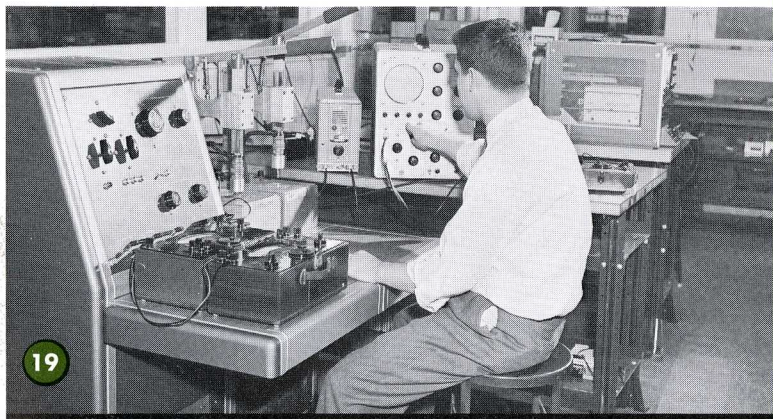
The laboratories are staffed with a versatile group of engineers whose educational backgrounds are in physics and electronics and whose professional experience encompasses magnetic materials, semiconductors, transistors, and magnetic switching devices, logic circuitry, systems design, pulse transformers, power transformers, inductors, and the overall circuit problems associated with the application of these solid state concepts.

This equipment and talent is directed toward developing new technical ideas and products for the division and, in addition, performing the custom design engineering necessary for the product lines. In the latter engineering responsibility, a great deal of time is spent marginal checking designs of subassemblies and complex devices before they are released to production and to the customer.

FIG. 19—Advanced reactor core studies are accomplished by means of equipment designed and constructed by the Special Products Division. Fig. 20—The laboratory bobbin tape core measuring equipment shown below has resulted from the basic philosophy of core testing developed in

Special Products Division laboratories and established many of the measurement standards for the industry.

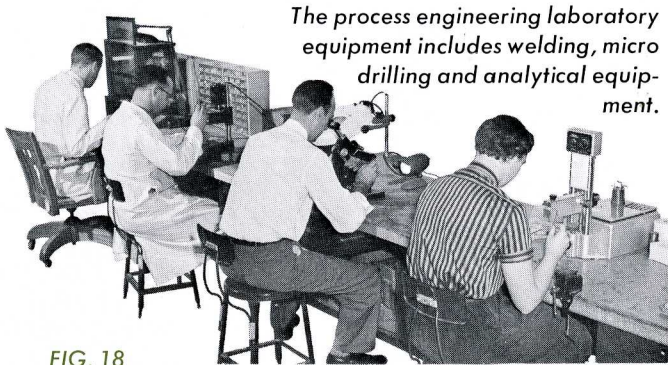
FIG. 21—High speed digital assemblies are tested in semiconductor systems circuits. FIG. 22—Sub-system designs are developed and prototypes tested in the laboratory by experienced solid state circuit engineers.



PROCESS ENGINEERING

Recognizing that the solution to many electronic problems resides in novel approaches to packaging of components into a final configuration adopted to a particular end use, the Special Products Division maintains a process engineering laboratory to supplement the electronic development and engineering efforts. The process laboratory, which occupies 4,000 sq. ft. of space modernized for this purpose in the North Adams plant, is staffed with chemists and mechanical engineers with many years of experience in the electronic component industry.

Here, major efforts are devoted to development and evaluation of resin materials, whose properties



The process engineering laboratory equipment includes welding, micro drilling and analytical equipment.

FIG. 18

are tailor made for end use environmental requirements. For example, a continuing program for the development of high temperature non-flammable encapsulated resins is maintained, with test facilities providing for high temperature weight loss measurements, flammability and humidity characteristics, and thermal conductivity.

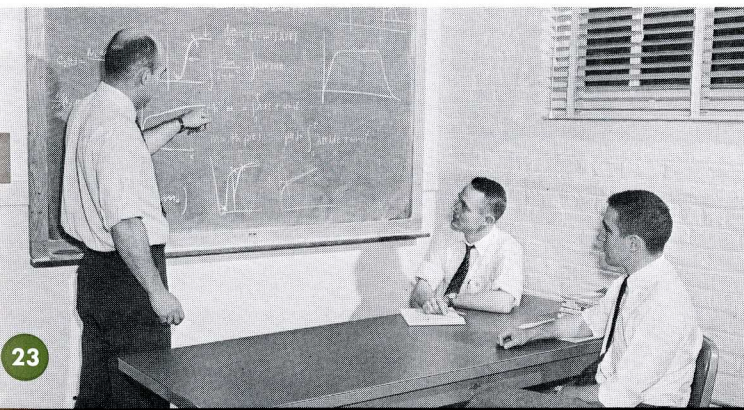
In conjunction with the fabrication of new packages specifically designed for customer requirements, a facility is maintained for the pilot production of resin housings with intricate and special shapes. Other facilities include photographic and chemical processing equipment needed for rapid construction of experimental and prototype etched wire boards for specific customer circuits.

The process engineering laboratory is also equipped to conduct welding studies to supplement development work on solder and crimped termination arrangements.

Chemical facilities are included for precise evaluation of various electronic materials such as wire insulation, molding resins, plating materials, and related elements necessary for the design and production of wholly reliable functional electronic components and assemblies.

FIG. 23—Advanced development programs are supported by theoretical studies of materials and device facts. FIG. 24—Engineering work in the laboratory provides performance characteristics and outlines problem areas.

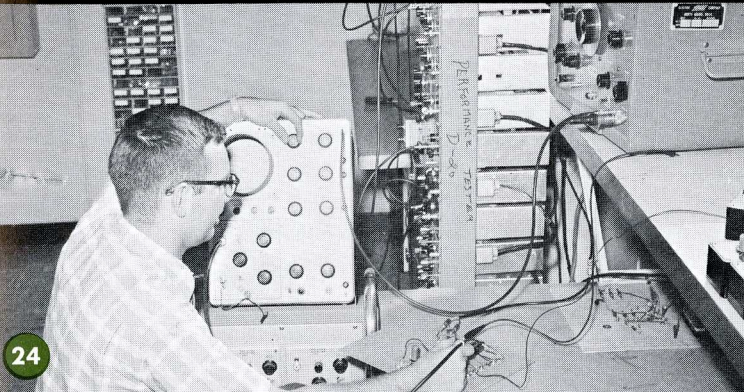
FIG. 25—Discussions with technical marketing, electronic engineering, production engineering and manufacturing representation speed solution to customer problems. FIG. 26—Management decisions on manufacturing approaches are based on recommendations from engineering, quality control and production departments.



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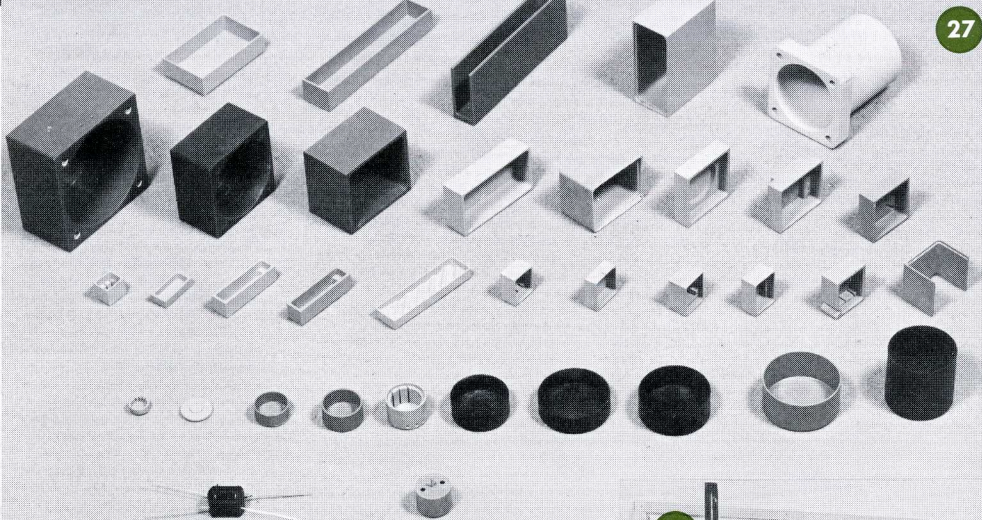
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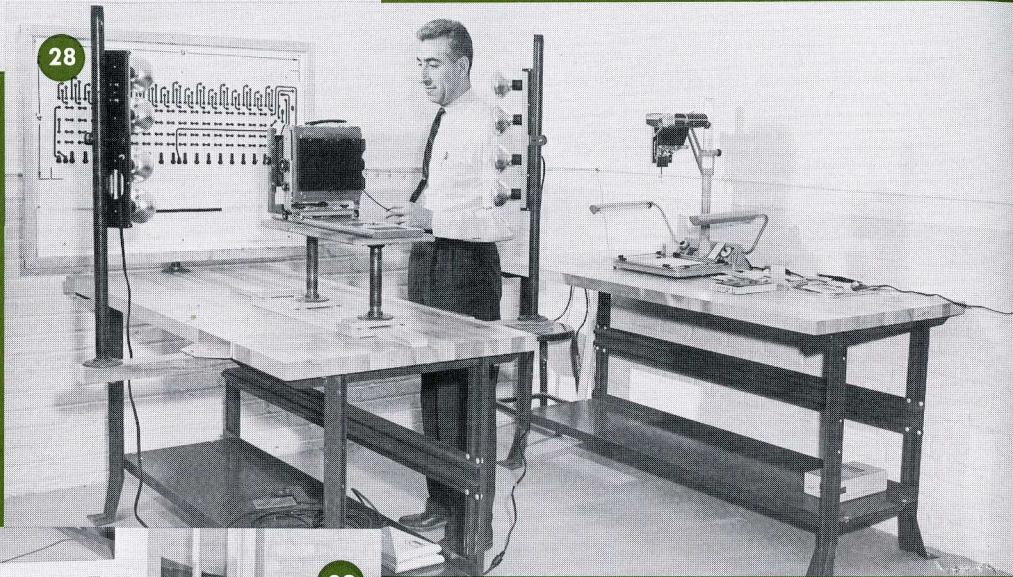
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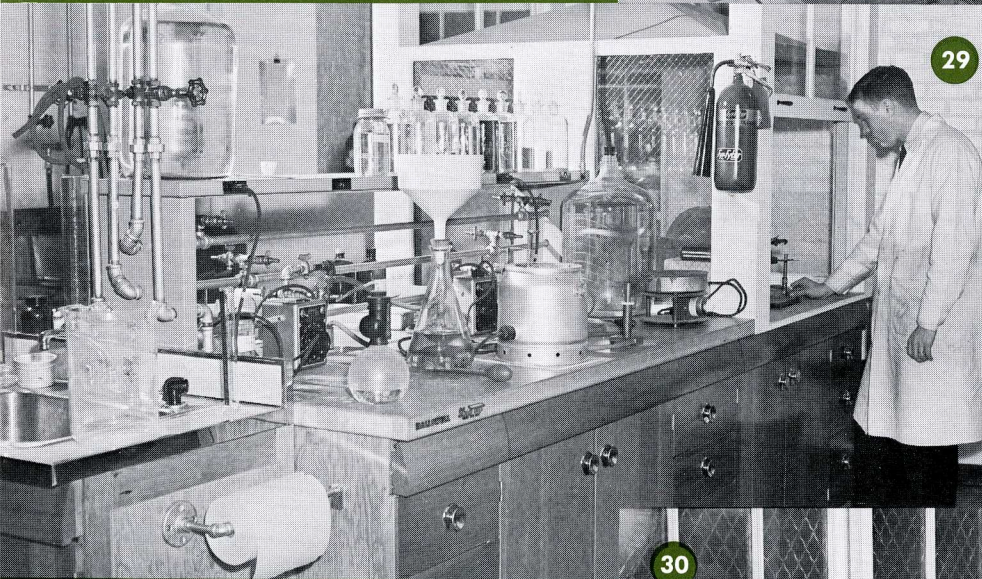
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FIG. 27—Specially shaped housings are designed and produced in various colors of epoxy resins to meet unique customer requirements.

FIG. 28—A photographic laboratory is maintained for prototype etched wire board activities.



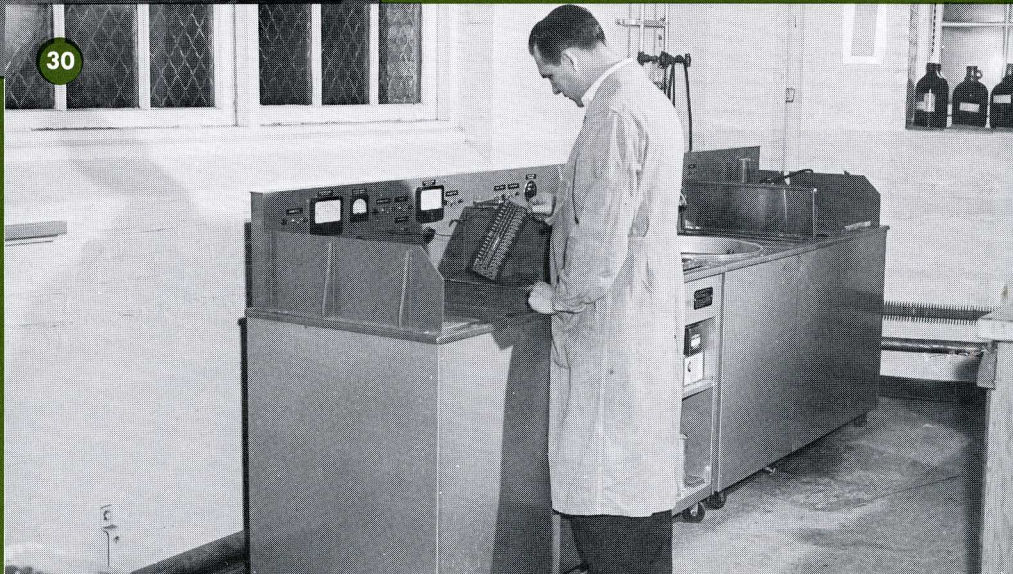
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FIG. 29—Chemical facilities permit studies on materials used in development and production.

FIG. 30—A pilot etched wire board facility is maintained for rapid fabrication of prototype circuits.



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PRODUCT ENGINEERING

The Product Engineering Department is responsible for the specifications to which all items are produced. The section analyzes customer drawings, specifications and requirements, and issues detailed manufacturing and testing instructions and drawings to the Production Department. This section is staffed with specialists in materials selection, layout, good construction practices, and military spec-

ification requirements. Up-to-date information about new materials, new design and testing techniques and new production processes is collected constantly from the laboratories in the Special Products Division, from elsewhere in the Sprague Electric Company, and from many sources outside the company. Absolute control is maintained for customer drawing changes and new requirements.

QUALITY CONTROL

The Quality Control group is operated administratively separate from both manufacturing and engineering departments. It is composed of three sections: incoming material inspection, check inspection, and quality control engineering.

INCOMING MATERIAL INSPECTION

This group inspects and tests all purchased material and parts in accordance with drawings and specifications prepared by the Specification Engineering section. Only by this careful and thorough control of all materials can Sprague's dependability of performance be assured to the ultimate user of the finished product.

CHECK INSPECTION

Although the Production department performs critical inspections at many stages of assembly and electrically tests 100% of the product, the Check Inspection group independently inspects and tests every lot at five stages of completion in accordance with MIL-STD-105A sampling plans. Check Inspection is independent of the influence of production, may stop the manufacture of any product at any point in the line when quality deficiencies are discovered, and can order rework or scrapping of the product affected. Finished products cannot be shipped without Check Inspection clearance. The group has its own gages, measuring instruments and electronic test equipment, and can perform every inspection or test required by the specifications. A resi-

dent Navy inspector performs surveillance inspection throughout the North Adams facility and arranges government source inspection when required after Check Inspection has passed the shipment.

Environmental and life testing, when required for lot acceptance, is coordinated by this section with the Sprague environmental testing laboratories.

QUALITY CONTROL ENGINEERING

The Quality Control Engineering section reviews the results of the inspection groups, summarizes inspection records and points out the need for corrective action whenever analysis of statistical information shows a trend of unusual rejection rates. This section arranges for testing and approves for purchase all new components and materials. It plans and executes product testing programs, including environmental and life tests, to prove out new product designs and to acquire reliability information for the use of the Specification Engineering section in specifying materials and construction practices.

The environmental testing laboratories maintained by Sprague Electric Company are approved by the Signal Corps, the Air Force, and ASES for in-plant testing.

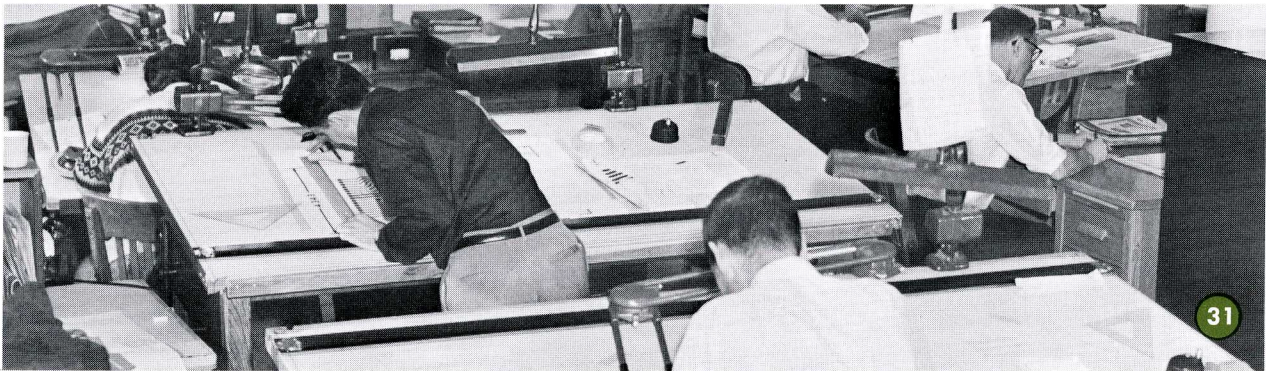
Quality Control also administers a program of regular calibration of all electronic test equipment used in the manufacturing and engineering facilities. Each piece of gear is tagged and a separate record maintained on its calibration and use history.

MANUFACTURING FACILITIES

The manufacturing facilities in North Adams and Visalia are equipped for flexible high quality production of a wide variety of products of the types previously described. Manufacturing equipment includes arrays of toroidal winding machines, continuous flow soldering equipment, and welding equipment, punching, riveting and pin-setting facilities for wire terminal board manufacture and a wide variety of other equipment. The production lines include extensive electronic test equipment, permitting testing of not only continuity and fixed parameters, but also actual

fundamental performance testing in customer end circuits. This performance testing is normally done on a 100% basis to assure satisfactory operation of each part in the end equipment. Our customers have found it possible to go to a tight AQL inspection level as a result of the production and check inspection procedures of the Sprague Special Products Division.

The production department maintains semiconductor, magnetic core and other test equipment used to select and grade components on a 100% piece basis for critical designs.



GENERAL OPERATIONS

The division management, marketing, specification, quality control, and manufacturing units are headed by technically trained personnel to complement the electronic development and engineering staff.

The Special Products Division operates as an integrated division of the Sprague Electric Company with all operating functions centralized in the East Coast and West Coast facilities. Purchasing, receiving, and incoming inspection of materials are handled directly in the two plants. Inventory stockrooms, as well as scheduling and material control activities necessary to the expedited manufacture of rush items are maintained at each of the plants.

Product engineering facilities for physical design of end products and maintaining of necessary files of customer drawings and requirements are also located in each facility.

Technical application engineering and marketing services are included in the division responsibilities and a highly trained staff is available to assist in solution of customer problems and to participate in long range end equipment design considerations.

★ ★ ★

In addition to the operating elements of the Special Products Division, the central research laboratories of the Sprague Electric Company support the development and engineering programs of the division. Special problems involving metallurgy, solid state physics, microanalytical techniques, complex material analysis, etc. may be referred to these research laboratories for solution. The equipment includes x-ray diffraction, x-ray fluorescent spectroscopy, infra-red spectroscopy and emission spectroscopy installations.

HOW THE SPECIAL PRODUCTS DIVISION CAN SERVE YOU

SEMI-CONDUCTOR LOGIC CIRCUITS	SEMI-CONDUCTOR CURRENT DRIVERS
COMPUTER PULSE TRANSFORMERS	MAGNETIC CORE LOGIC CIRCUITS
MAGNETIC SHIFT REGISTERS	BLOCKING OSCILLATOR TRANSFORMERS
SENSE AMPLIFIER TRANSFORMERS	MATRIX SWITCH CORE TRANSFORMERS
DECADE AND BINARY COUNTERS	PRECISION DECADE INDUCTORS
PRECISION INDUCTORS	DIGITAL-VISUAL INDICATOR CIRCUITS
MAGNETIC CORE INFORMATION STORAGE SYSTEMS	

The Special Products Division will be glad to work with you on projects of the types described in this brochure by any one of several approaches, including the following:

- A.** Supply *standard* Sprague digital components and functional building blocks to apply to your system requirements with minimum cost and short delivery time.
- B.** Supply prototype and/or production quantities of digital components or assemblies of *your* design. This service includes procurement and inspection of all component parts necessary for the work.
- C.** Custom design, engineering and production of digital components and assemblies to meet your *special* requirements. In these cases, it is desirable that details of your end use circuits be made available to permit optimum design and establishment of marginal limits.
- D.** Repackaging of *your* operational designs to reduce volume, lower costs and/or improve reliability.
- E.** Provide a complete service in assisting *you* to arrive at optimum digital system design through:
 - 1) Theoretical analysis of new component concepts, specifically as applied to solid state phenomena relating to systems needs.
 - 2) Systems analysis to recommend the use of either semiconductor or magnetic logic units for maximum performance and minimum cost.

If you have a problem in which our assistance will be helpful, please feel free to call the Sprague sales office nearest you. The information will be forwarded to one of the two Special Products Division facilities for comment. Should technical negotiations be necessary, arrangements will be made for a digital product specialist to visit you for engineering level discussions and decisions.

Sales prices, order and delivery information should be obtained by your purchasing department through the Sprague sales organization. Comprehensive engineering bulletins and data sheets on the product lines are available. To obtain specific product literature, call or write to the Sprague sales office nearest you. You will automatically receive subsequent technical revisions and up-dating literature as published.



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St. Louis 8, Missouri
JEfferson 5-7239

Sprague Electric Company
3603 Lemmon Avenue
Dallas 19, Texas
LAKeside 1-9971

Sprague Electric Company
12870 Panama Street
Los Angeles 66, California
UPton 0-7531 or EXmont 8-2791

Mr. William Rutt
123 Middle Neck Road
Great Neck, L. I., New York
HUnter 2-8160

ABM Sales Company
10116 Puritan Avenue
Detroit 38, Michigan
UNiversity 2-1300

H. M. Richardson Company
9 East 22nd Street
Minneapolis 4, Minnesota
FEderal 6-4078

Maitland K. Smith Company
208 14th Street, N.W.
Atlanta 13, Georgia
TRinity 5-8031

Maitland K. Smith Company
117 North Keystone Drive
Clearwater, Florida
Phone: 3-98021

Maitland K. Smith Company
3133 Woodcliff Circle
Birmingham 13, Alabama
TRemont 9-7197

R. G. Bowen Company, Inc.
721 South Broadway
Denver 9, Colorado
RAce 2-4641

R. G. Bowen Company, Inc.
2228-A San Mateo Blvd., N.E.
Albuquerque, New Mexico
ALpine 5-4603

R. G. Bowen Company, Inc.
463 East Third Street, South
Salt Lake City 11, Utah
EMpire 3-4528

William J. Purdy of Calif.
312 Seventh Street
San Francisco 3, California
UNDerhill 3-3300