SPRAGUE

Sprague Germanium Transistors: Sprague Electric was founded in 1926 as Sprague Specialties by Robert C. Sprague as a startup company manufacturing electrical parts, including a "Midget" radio capacitor, which was the foundation of what would become one of the world's most successful electronic component suppliers. Sprague was a major industrial suppler to the WWII effort, including crucial components for the proximity fuzes that helped win the war. Sprague also supplied special energy storage capacitors that were an essential part for the nuclear weapons program after the war. To build on its leadership position as a component manufacturer (primarily capacitors), Sprague was one of the first 26 U.S. companies that purchased a license from Western Electric to manufacture transistors. The Sprague semiconductor research effort began in 1952, and the first commercialized semiconductor product was a ruggedized germanium point contact transistor. This device was identified internally as Type 5A and was later listed with JEDEC as the 2N159 (See above left for an early Type 5A and the next page for details of the 1956 JEDEC listing). The key factor influencing Sprague's emergence as a major supplier of germanium transistors was the mid-1950s licensing agreement that authorized Sprague to manufacture the high speed line of transistors that had been developed by Philco, including the original Surface Barrier Transistor and the later MAT and MADT technologies. Shown above, to the right of the Type 5A, are various Sprague transistors from the 1950s/1960s manufactured under the Philco license. The most recognizable of these devices are the "bullet-shaped" proprietary case style types originally developed by Philco as well as the more industry standard TO-18 and TO-5 cases at far right. Sprague produced millions of these Philco-licensed transistors and became the primary supplier when Philco exited the high performance germanium transistor business in 1963. Sprague continued to manufacture a comprehensive line of the original Philco licensed transistors well into the 1970s, and, in addition, developed its own line of silicon transistors and integrated circuits. All Sprague transistors are easily identifiable either by the "Sprague" name or the "Circled 2" graphic stamped on the transistor case.

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SPRAGUE

ISSUE OF FEBRUARY 14, 1955 **PRELIMINARY ISSUE** (2N159)

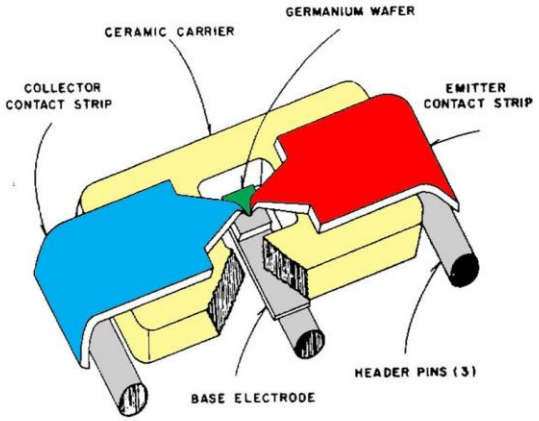
SPRAGUE

GERMANIUM POINT CONTACT
TRANSISTORS

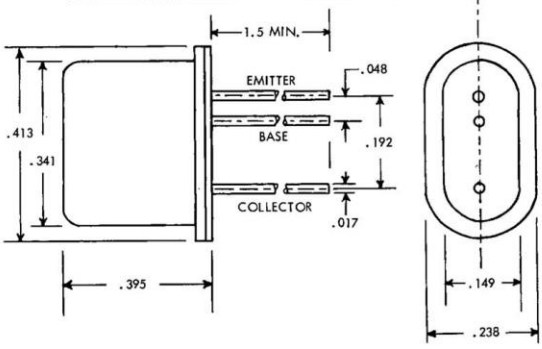
TYPE NO.
5A
Page 1 of 6 pages

DESCRIPTION

Sprague point contact transistors embody an advanced mechanical design giving extreme rigidity with resultant immunity to mechanical shock and vibration. They are recommended for pulse and computer application where a rapid switching action is desired. The superior mechanical stability of the Sprague point contact transistor is obtained by using pointed, flat, contact springs fixed to a ceramic carrier as indicated in Figure 1.



Construction of Sprague Point Contact Transistor Type 5A



SPRAGUE ELECTRIC COMPANY
NORTH ADAMS, MASSACHUSETTS

The First Sprague Transistors: Shown above are excerpted sections from the first JEDEC transistor listing filed by Sprague. The type 5A/2N159 was a ruggedized point contact device, constructed using advanced mechanical design. This device was commercialized by Sprague but very few units were sold – by the mid-1950s, point contact transistor technology had been obsoleted by better performing types including grown junction, alloy junction and surface barrier. The Sprague 5A/2N159 is a truly unique and historic device that represents a well-engineered design approach to the first transistor type available.

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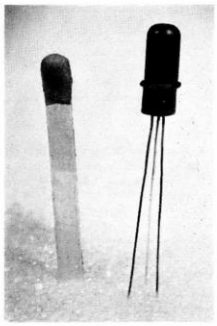
SPRAGUE

Sprague to Produce Philco Surface-Barrier Transistor

SPRAGUE LOG
SPRAGUE ELECTRIC COMPANY NORTH ADAMS, MASSACHUSETTS
VOLUME XVIII JANUARY, 1956 NO. 5



Pictured is the Philco Surface-Barrier transistor that Sprague will soon begin to manufacture. Its size may be compared to the ordinary paper match next to it.

1956 began with a note of long term optimism for the Sprague Electric Company as it was announced that an agreement had been reached between Sprague and the Philco Corporation under which Sprague is licensed to produce the Philco Surface-Barrier transistor, the only transistor currently available for use in high speed computers. Such computers are in continually increasing demand for industrial and military use. In the latter field, particularly, they are essential for improvement of navigation, missile-guidance and weapons-control assemblies.

Importance of the Sprague-Philco agreement in the electronic world lies in the fact that it will provide for the first time two independent manufacturing sources for an identical high-frequency transistor. Under the agreement, both firms are privileged to exchange research and development data as well as production and testing techniques, on devices in the entire field of semi-conductors.

"For our company," Mr. Robert C. Sprague, Chairman of the Board, said, "the agreement makes possible valuable additions to our already extensive line of components for the entertainment and communications industries and for the military."

Mr. Sprague pointed out that Sprague Electric, under licenses from the Western Electric Company, has carried on during the past three years a well-established development program in the semi-conductor field.

He explained:

"We began activity in this field early in 1952 and have had under way an active research and engineering program. We have developed several semi-conductor devices which are already through the pilot-plant stage.

"In this program we have emphasized development of a germanium fused-junction transistor capable of efficient operation at frequencies up to three megacycles We also plan to start manufacturing these units during 1956."

We will begin the production of these units by the middle of this year and it is significant that it will mean employment for approximately 250 people by the end of the first 12 months of operation. At the time of this writing, no decision had been made as to where the transistor plant will be located.

Transistors are fast becoming the component wonder of this electronic age. Our own research, coupled with our license to produce the Philco transistors, will assure our Company of an important place in this expanding market.

Along with the plans for the production of these units, the announcement was made that John M. Puppolo will assume production responsibility for this operation.

Mr. Puppolo was born in North Adams and is a graduate of Drury High School and Wentworth Institute. He joined Sprague Electric in 1934 and has held positions as Foreman and Superintendent until his recent assignment. Mr. Puppolo is a past president of the Sprague Electric Management Club.

Mr. Puppolo has always been active in civic affairs having been a member and chairman of the city Recreation Board and an active participant in the activities of St. Anthony's Church. Mr. Puppolo is married to the former Lena A. DelDebbio of North Adams and they have one child, John Michael, 13 years old.

Also employed by Sprague are two brothers of Mr. Puppolo—David, who is in the Specifications Engineering department and Henry in the Wire Coating Lab on Brown Street.

Sprague Becomes Philco Licensee: The Sprague in-house newsletter from January 1956 announced the agreement with Philco Corporation under which Sprague was licensed to manufacture the Philco Surface-Barrier transistor. This agreement established Sprague as a major producer of high performance high speed germanium transistors well into the next decade.

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SPRAGUE

surface barrier transistors from SPRAGUE

IN VOLUME PRODUCTION *Now!*

For general high frequency applications, and for high speed computer switching circuits, design around Sprague surface barrier transistors. They are available now in production quantities from a completely new, scrupulously clean plant, built from the ground up especially to make high quality semi-conductor products.

The four transistor types shown are the most popular. Orders for these units are shipped promptly. What's more, surface barrier transistors are reasonably priced. High quality and excellent electrical characteristics make them an economical solution to many difficult circuit requirements.

Sprague surface barrier transistors are fully licensed under Philco patents. All Sprague and Philco transistors having the same type number are manufactured to the same specifications and are fully interchangeable. You have *two* sources of supply when you use surface barrier transistors!

SPRAGUE®
the trademark of reliability

TRANSISTORS • RESISTORS • MAGNETIC COMPONENTS
CAPACITORS • INTERFERENCE FILTERS • PULSE NETWORKS
HIGH TEMPERATURE MAGNET WIRE • PRINTED CIRCUITS

Sprague Produces Philco Computer Transistors: This September 1957 ad documents the early results of Sprague's 1956 commitment to manufacture surface barrier transistors under license from Philco. This impressive result in achieving volume production of multiple surface barrier transistor types in such a short timeframe highlights Sprague's corporate commitment to this effort and substantial manufacturing resources and competence (note the reference to the "completely new, scrupulously clean plant, built from the ground up"). In the next few years, Sprague expanded this volume production to include new improved transistor types from Philco such as MAT and MADT.

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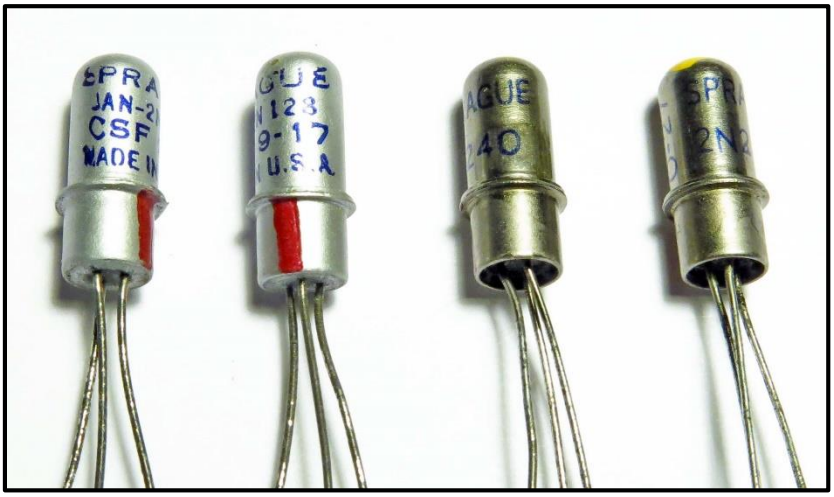

2N128: Developed by Philco under contract with U.S. Army Signal Corps in 1954, the 2N128 was the first surface barrier transistor to meet rigid military specifications. In 1956, Philco began to offer this device in large volume shipments for field use in military electronics equipment. Advertised features of the 2N128 included high frequency performance, extreme reliability, uniformity of characteristics, minimum battery drain, low leakage current and operating voltage, and absolute hermetic seal. The military needs for this unique device represented a potentially large and profitable market and Sprague was able to ramp up their production of the 2N128 very soon after entering the 1956 Philco second source licensing agreement. As shown above, the Sprague 2N128 transistor included in this kit is from an early 1959 production lot and was designated JAN (Joint Army Navy) to indicate conformance to military standards. The U.S. Army ORDVAC computer was an early application of the 2N128 transistor.

2N240: The 2N240 was another high performing surface barrier transistor and was introduced by Philco in 1957. As with the 2N128, Sprague followed shortly with their own version of this device, announcing availability in late 1957. The 2N240 was intended specifically for use in computers, with a fast response time in the millisecond range to give reliable operation up to 20 MC in switching circuits. Because of excellent switching characteristics, the 2N240 (and its in-house numbered equivalent devices, the L5122 and L5129) saw widespread use in a number of early transistorized computers, including the Burroughs D-204 and the Lincoln TX-2. The 1959 Allied Radio catalog listed the 2N240 for $7.35. The Sprague 2N240 devices in this kit are dated from the 1960s.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague 2N128 transistor
Type: Germanium PNP surface barrier
Case Color/Style: Silver "bullet" TO-24
Vintage/Date Code: 1950s/1960s
Use: High frequency computer switch
Notes: 1st U.S. Army SBT. Sprague units qualified for JAN Joint Army/Navy use.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague 2N240 transistor
Type: Germanium PNP surface barrier
Case Color/Style: Silver "bullet" TO-24
Vintage/Date Code: 1950s/1960s
Use: High speed 20 MC computer switch
Notes: Improved SBT used widely in early computers, including Lincoln TX-2.

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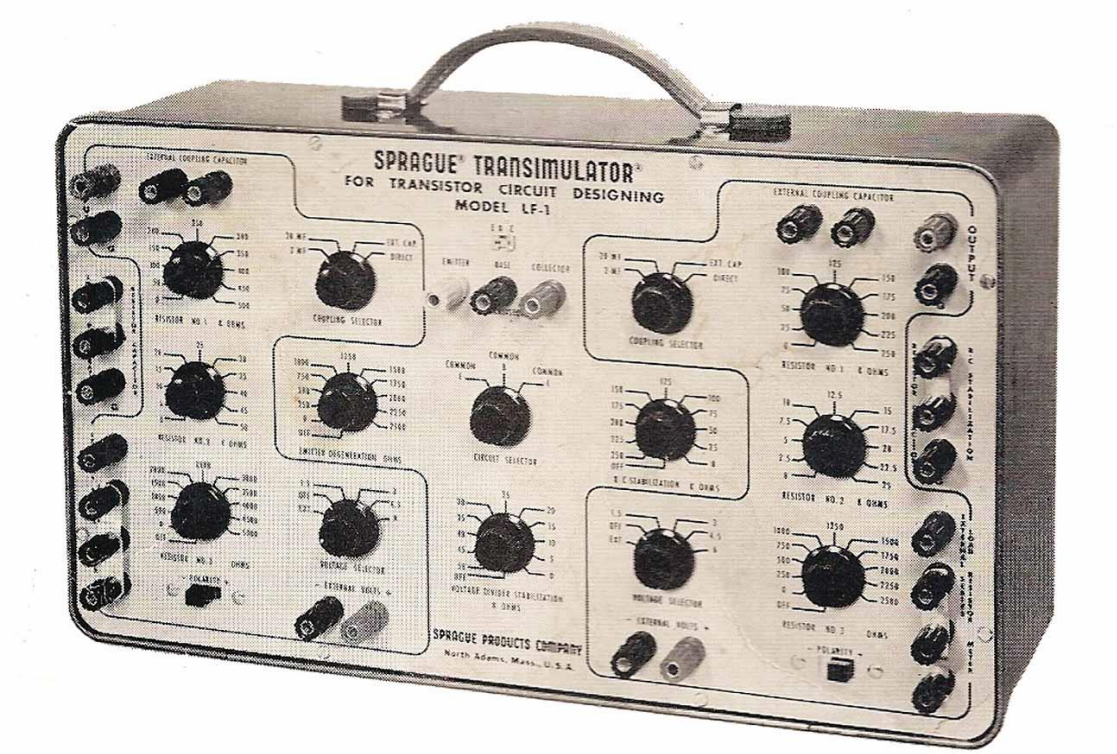

The Sprague Transimulator: In 1957 Sprague developed and sold a unique type of transistor test equipment, shown above and marketed as the "Transimulator", which was intended to be used by circuit developers interested in characterizing transistor performance. At this time in transistor history, there was still much to be learned by circuit designers who were familiar with vacuum tube circuit design but who had little or no transistor experience. According to the Transimulator Operating Manual, *The Model LF-1 Transimulator is an instrument designed basically to eliminate the breadboard stage in the design of low and medium power transistor circuitry. With it, one may simulate all types of amplifier stages short of high power audio output as well as multivibrator, switching, phasing, Class A and B push-pull and many others when using cross-coupled Transimulators. The Transimulator may also be used to permit the selection of individual transistors for best performance with established circuit parameters or for "incoming inspection" tests of transistors in a particular circuit as well as for general demonstrations of the effect of varying parameters when used as a classroom aid in teaching. The range of possible circuit configurations includes those utilizing PNP, NPN and Surface Barrier Transistors.* Sprague must have expended considerable resources in the development and marketing of this test equipment, and further supported this effort with U.S. patent 3,005,953, which was filed in September 1957 by the company. The patent provides a detailed description of the design and use of the transistor tester and includes construction details and front panel graphics that closely parallel the commercialized tester. The Sprague Transimulator undoubtedly deserves a place in the annals of transistor history – this is an unusual commercialized device that allowed the performance characterization of individual transistors, at a time when semiconductor manufacturing processes were not well understood or controlled and it was often necessary to test each transistor to determine operating characteristics.

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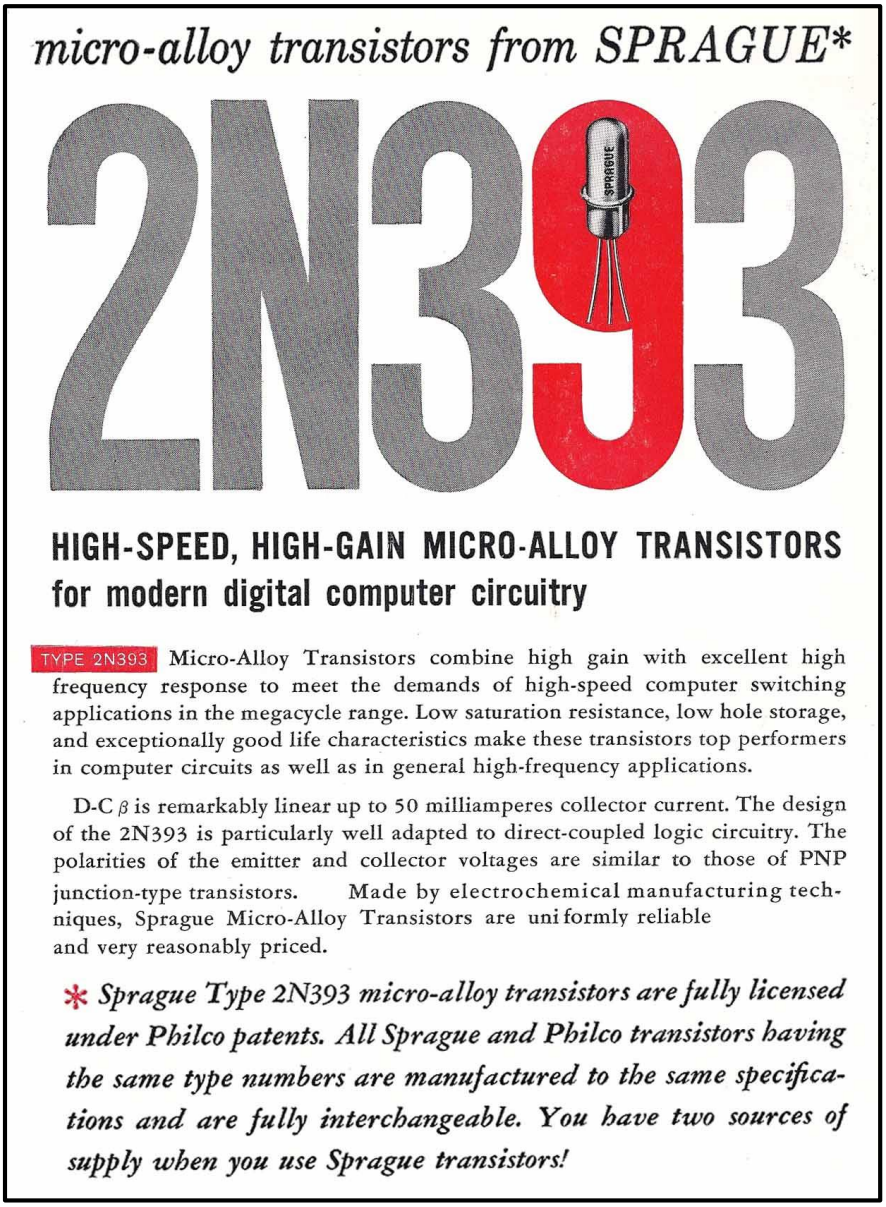

*micro-alloy transistors from SPRAGUE**

2N393

HIGH-SPEED, HIGH-GAIN MICRO-ALLOY TRANSISTORS for modern digital computer circuitry

TYPE 2N393 Micro-Alloy Transistors combine high gain with excellent high frequency response to meet the demands of high-speed computer switching applications in the megacycle range. Low saturation resistance, low hole storage, and exceptionally good life characteristics make these transistors top performers in computer circuits as well as in general high-frequency applications.

D-C β is remarkably linear up to 50 milliamperes collector current. The design of the 2N393 is particularly well adapted to direct-coupled logic circuitry. The polarities of the emitter and collector voltages are similar to those of PNP junction-type transistors. Made by electrochemical manufacturing techniques, Sprague Micro-Alloy Transistors are uniformly reliable and very reasonably priced.

* *Sprague Type 2N393 micro-alloy transistors are fully licensed under Philco patents. All Sprague and Philco transistors having the same type numbers are manufactured to the same specifications and are fully interchangeable. You have two sources of supply when you use Sprague transistors!*

Sprague 2N393 MAT Transistor: After the introduction of surface barrier transistors, Philco continued to make improvements to the types of high speed devices that could be manufactured using the precision etch/electrochemical etching technology. In 1957, Philco announced a new transistor type, the Micro-Alloy Transistor (MAT), which offered higher speed and higher current handling capabilities than the SBT. The 2N393 was the most widely used MAT transistor and was a big seller for Philco. As with the earlier SBT types, Sprague soon followed with its own 2N393 MAT, and promoted this high performing device as shown in the late 1950s ad above.

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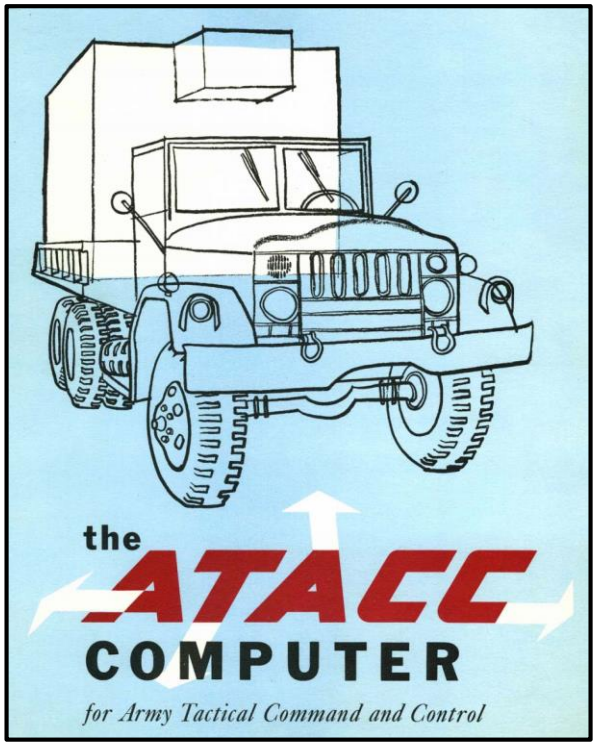

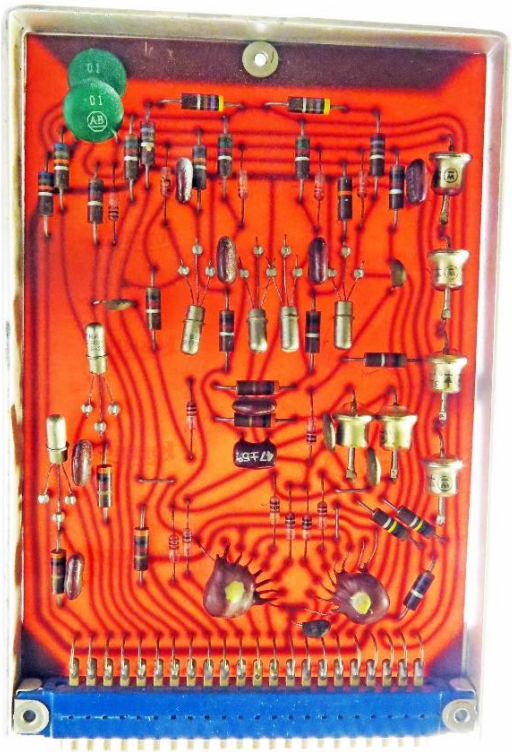

2N393 Transistors for Computer Use: The 2N393 Micro-Alloy Transistors manufactured by Philco and Sprague were widely used in late 1950s and 1960s computers and related digital circuitry. For example, the 1963 ATACC computer, developed by Sylvania for the U.S. Army, was constructed with over 10,000 2N393 transistors. The ATACC Systems Manual provides a detailed technical discussion regarding the suitability of the MAT transistor for this application, including costs, susceptibility to nuclear radiation damage, and proven performance in computers of similar design including the MOBIDIC models A, B, C, D and 7A, the Sylvania 9400, the BASICPAC, the TX-0 and the TX-2. The 2N393 was manufactured in large quantities by both Philco and Sprague, and because of the widespread use in military data processing equipment, Sprague continued to provide this device well into the 1970s, long after Philco had ceased production of precision etch transistors. The circuit board shown at upper right is a DEC System Building Block, Type 1201, which is a Flip Flop computer module. This circuit uses six Sprague 2N393 transistors all of which have 1959 date codes. The System Building Blocks were the first commercial products from Digital Equipment Corp (DEC) and consisted of a coordinated set of transistorized circuit boards used for building and testing computer systems. Typical modules were the Flip-Flop, Logic Gate, Clock and Pulse Amplifier. The early 1960s DEC PDP minicomputers were constructed using these digital modules. The 2N393 and other Philco/Sprague MAT and MADT transistors were used extensively in these modules.

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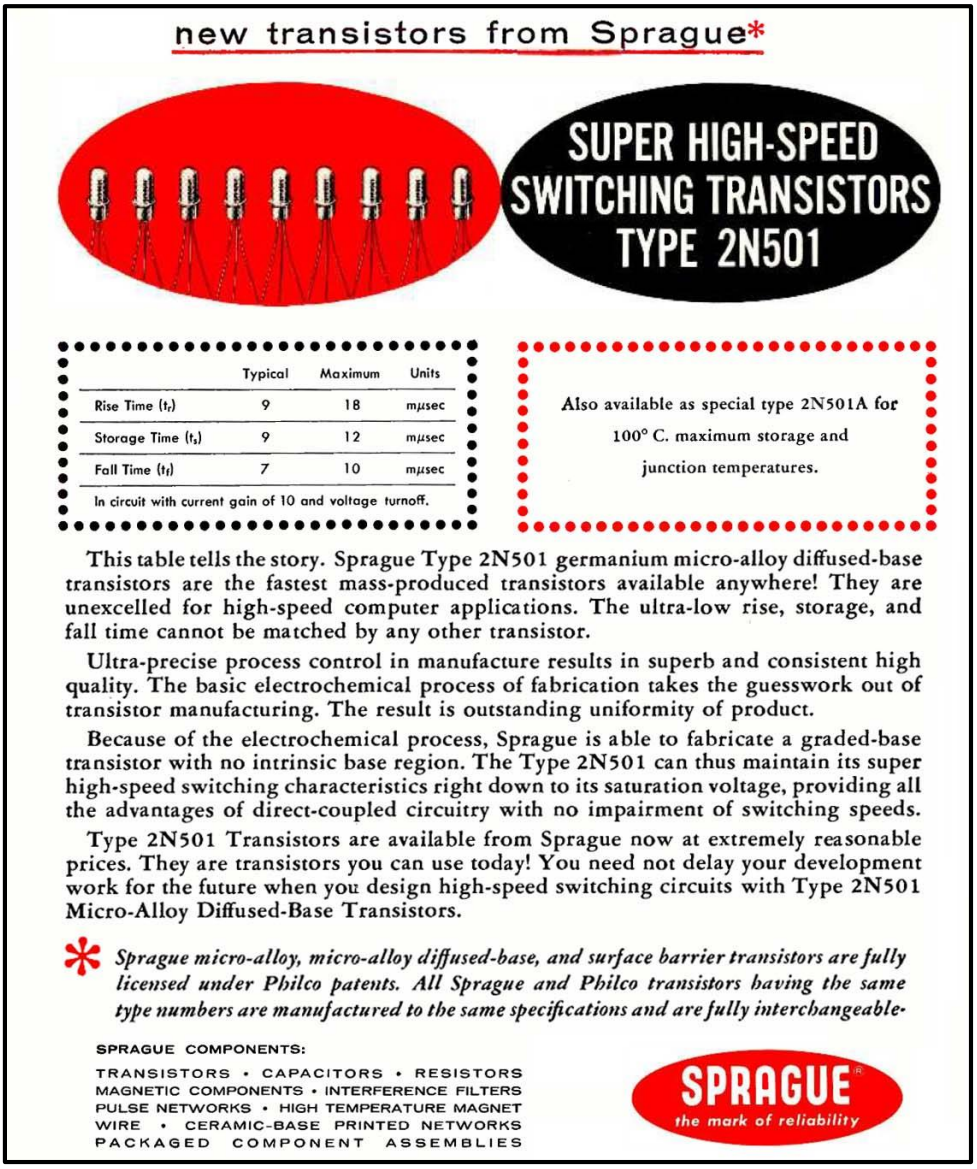

new transistors from Sprague*

SUPER HIGH-SPEED SWITCHING TRANSISTORS TYPE 2N501

	Typical	Maximum	Units
Rise Time (t_r)	9	18	mμsec
Storage Time (t_s)	9	12	mμsec
Fall Time (t_f)	7	10	mμsec

In circuit with current gain of 10 and voltage turnoff.

Also available as special type 2N501A for 100° C. maximum storage and junction temperatures.

This table tells the story. Sprague Type 2N501 germanium micro-alloy diffused-base transistors are the fastest mass-produced transistors available anywhere! They are unexcelled for high-speed computer applications. The ultra-low rise, storage, and fall time cannot be matched by any other transistor.

Ultra-precise process control in manufacture results in superb and consistent high quality. The basic electrochemical process of fabrication takes the guesswork out of transistor manufacturing. The result is outstanding uniformity of product.

Because of the electrochemical process, Sprague is able to fabricate a graded-base transistor with no intrinsic base region. The Type 2N501 can thus maintain its super high-speed switching characteristics right down to its saturation voltage, providing all the advantages of direct-coupled circuitry with no impairment of switching speeds.

Type 2N501 Transistors are available from Sprague now at extremely reasonable prices. They are transistors you can use today! You need not delay your development work for the future when you design high-speed switching circuits with Type 2N501 Micro-Alloy Diffused-Base Transistors.

* *Sprague micro-alloy, micro-alloy diffused-base, and surface barrier transistors are fully licensed under Philco patents. All Sprague and Philco transistors having the same type numbers are manufactured to the same specifications and are fully interchangeable.*

SPRAGUE COMPONENTS:

TRANSISTORS • CAPACITORS • RESISTORS
MAGNETIC COMPONENTS • INTERFERENCE FILTERS
PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS
PACKAGED COMPONENT ASSEMBLIES

SPRAGUE the mark of reliability

Sprague 2N501 MADT Transistor: In 1958 Philco announced another improved transistor type developed with the precision etch process – this very high speed type was identified as Micro Alloy Diffused-base Transistor (MADT). Using the semiconductor diffusion techniques originally developed at Bell Labs, MADT transistors extended the range of high gain, high frequency amplifiers, suitable for high speed computers and other critical high frequency circuitry. Philco MADT transistors were the dominant "high speed" transistors until the early 1960s, when diffused base mesa transistors from Motorola, Texas Instruments and Fairchild became available. Philco developed a broad range of performance specifications and resulting "2N" transistor types using MADT technology. The Philco 2N501 was one of the first MADTs available and was widely used in the computer industry. Sprague soon developed a comprehensive set of second sourced MADTs. The above April 1959 ad highlights one of Sprague's first MADT offerings, the 2N501, and summarizes the high frequency performance attributes of this transistor.

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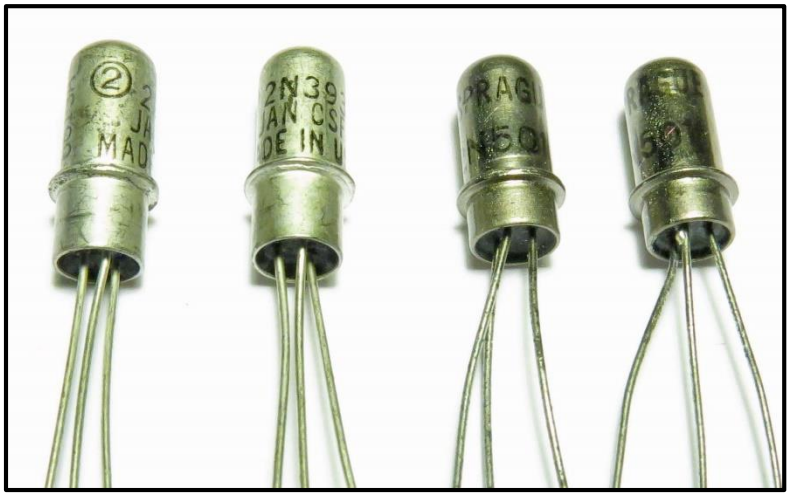

2N393: Philco registered the 2N393 with JEDEC on December 2, 1957. This device was one of the first of the Micro-Alloy Transistors (MAT) which were developed with improvements to the original SBT electrochemical manufacturing process. As described in Philco literature: "A special short-alloying cycle, combined with precise electro-chemical production techniques (pioneered and developed at Philco Transistor Center for production of SBTs), results in the micro-alloy contact for exceptionally high injection efficiency. To combine high gain at high currents with high frequency response, the new MAT transistor employs a gallium doped alloy junction for the emitter electrode". The 2N393 was especially designed for switching applications up to 50 MC. The design was particularly well adapted to direct coupled computer logic circuits. Sprague introduced their version of the 2N393 in 1958. This was a very popular high speed switching transistor and was used in many computers of the time, including MOBIDIC. The 2N393 was produced for many years by Sprague, well into the 1970s. The 2N393 transistors in this kit (see above left) are JAN devices from the 1960s.

2N501: Philco registered the 2N501 with JEDEC on May 4, 1959. This device was one of the first of the Micro-Alloy Diffused-base Transistor (MADT) types, which were developed following the original SBT and MAT electro-chemical transistor types. The 2N501 was specifically designed for very high speed switching applications. Philco noted that reliable operation of the 2N501 in switching circuits was achieved at speeds in excess of 20 MC. Sprague introduced their version of the 2N501 in 1959 and promoted this high speed device as "The fastest mass-produced transistors available anywhere" and "They are unexcelled for high-speed computer applications". The 2N501 was used in many historic computers, including the MIT TX-2 and the Univac LARC. The 2N501 transistors in this kit (see above right) are from the 1960s.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague 2N393 transistor
Type: Germanium PNP Micro-Alloy
Case Color/Style: Silver "bullet" TO-24
Vintage/Date Code: 1950s/1960s
Use: High speed 50 MC computer switch
Notes: Best known and most popular MAT. Produced for two decades, into the 1970s.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague 2N501 transistor
Type: Germanium PNP MADT
Case Color/Style: Silver "bullet" TO-1
Vintage/Date Code: 1950s/1960s
Use: Very high speed computer switch
Notes: 1959 high speed "leader". Special slim-line TO-1 case. Very widely used.

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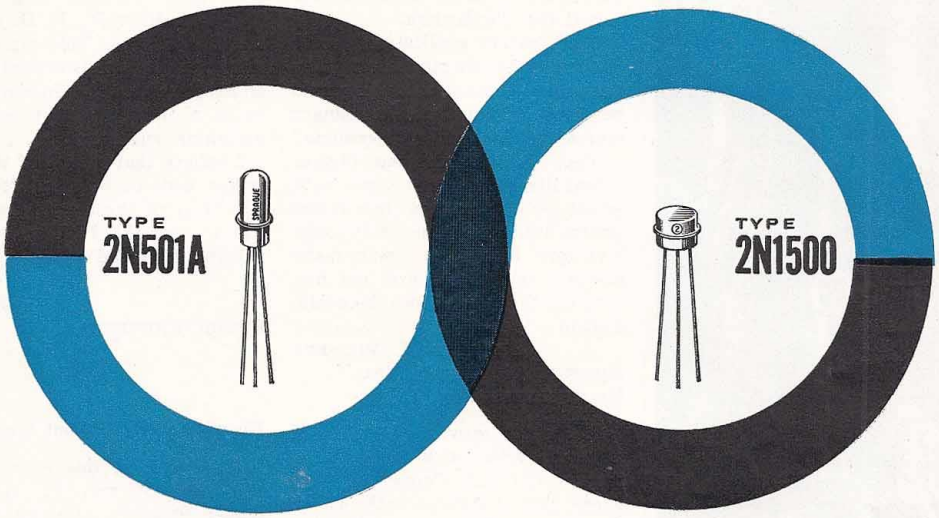
SPRAGUE

Proven ultra-high-speed transistors

by SPRAGUE



the reliable switching characteristics of the field-proven 2N501A are now available in the TO-9 case to meet equipment needs

- The well known slim-line Type 2N501A Micro-Alloy Diffused-base Transistor, extensively used in critical military, industrial, and commercial applications, is now joined by the 2N1500, in its low-height TO-9 case.
- The electrical characteristics of the 2N1500 are identical with those of the 2N501A. Both of these ultra-high-speed switching transistors will operate reliably at speeds up to 20 megacycles. They feature excellent high frequency response at very low collector voltages, a characteristic made possible by the placement of the collector in the diffused region of the base.
- A precise, controlled-etching process makes it possible to maintain high frequency characteristics down to saturation voltage. Therefore, you can realize all the advantages of direct-coupled circuitry with no loss in switching speed.
- Sprague MADT* Transistors are now manufactured with cadmium junctions, providing an extra safety margin. Effects of high temperature, the major destructive factor with transistors, are minimized by the superconductivity of cadmium, assuring cooler operation and greater reliability.

Continued Rollout of 2nd Sourced Philco Transistors: When introduced by Philco in 1960, the MADT 2N1500 was likely the highest switching speed computer transistor generally available, with advertised performance up to 20 MC. The 2N501A was electrically identical but was packaged in the more familiar slim-line case. With this exceptional high speed performance, and greater reliability achieved with the use of cadmium transistor junctions, these transistors were well received by computer designers. Sprague quickly followed Philco with a 1961 release of both these transistors, and promoted the advantages of these types with ads as shown above.

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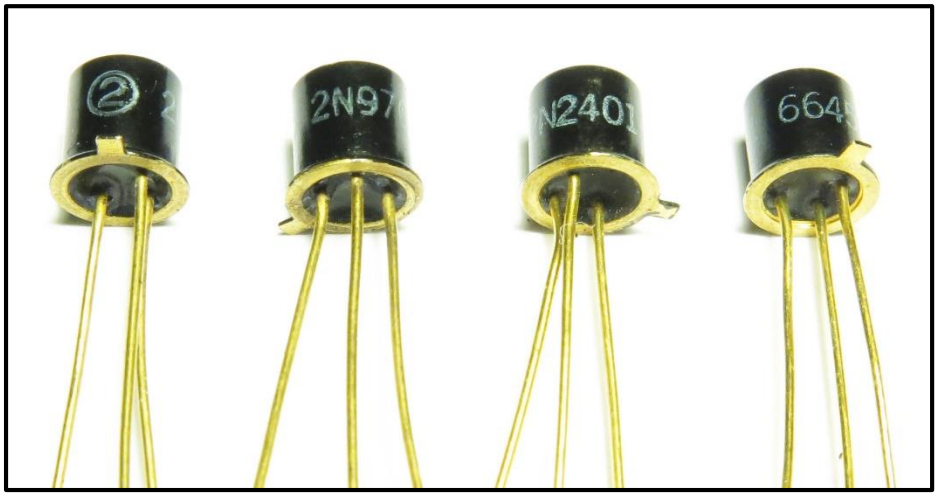

2N976: Philco continued to develop additional MADT transistors throughout the late 1950s and into the early 1960s. Philco announced the 2N976/2N977 MADT series in 1961, and Sprague followed with their version of these devices by 1964. The Philco July 1961 tentative data sheet states the following: "The 2N976 is a hermetically sealed, germanium Micro Alloy Diffused-base Transistor (MADT) designed for extremely high speed switching applications. Reliable operation of the 2N976 has been achieved at speeds in excess of 100 MC". Device characteristics make the 2N976 suitable for all low-level, high-frequency logic circuits. Note that the 2N976 uses an industry standard TO-18 metal case, and Sprague units, as shown above, are typically painted black and stamped with the "Circled 2" Sprague logo. Pre-commercial prototypes of the 2N976 were used in the MIT FX-1 computer.

2N2401: The 2N2400/2N2401/2N2402 series of Philco MADT transistors followed a similar history as the 2N976, except that the release date was slightly later (March 1962 Philco release date and 1964 Sprague release date) and the performance exhibited lower switching speed, but greater radiation resistance. The Philco March 1962 tentative data sheet states the following: "The 2N2400, 2N2401 and 2N2402 are hermetically sealed, germanium Micro Alloy Diffused-base Transistors (MADT) specifically designed for high speed switching applications. Operation of the 2N2402 can be achieved at speeds up to 20 MC. The very thin base width of the 2N2400 series make them exceptionally radiation resistant. This latter feature, radiation resistance, was a key factor in the use of the 2N2400 series of transistors in military computer applications. As with the 2N976 types, the Sprague 2N2401, shown above right, was supplied in a black painted TO-18 case.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague 2N976 transistor
Type: Germanium PNP MADT
Case Color/Style: Black metal TO-18
Vintage/Date Code: 1960s
Use: Extreme speed 100 MC switch
Notes: Mature MADT device performance suited for low-level very high speed logic.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague 2N2401 transistor
Type: Germanium PNP MADT
Case Color/Style: Black metal TO-18
Vintage/Date Code: 1960s
Use: High speed 20 MC computer switch
Notes: Mature MADT device performance with radiation resistance for military use.

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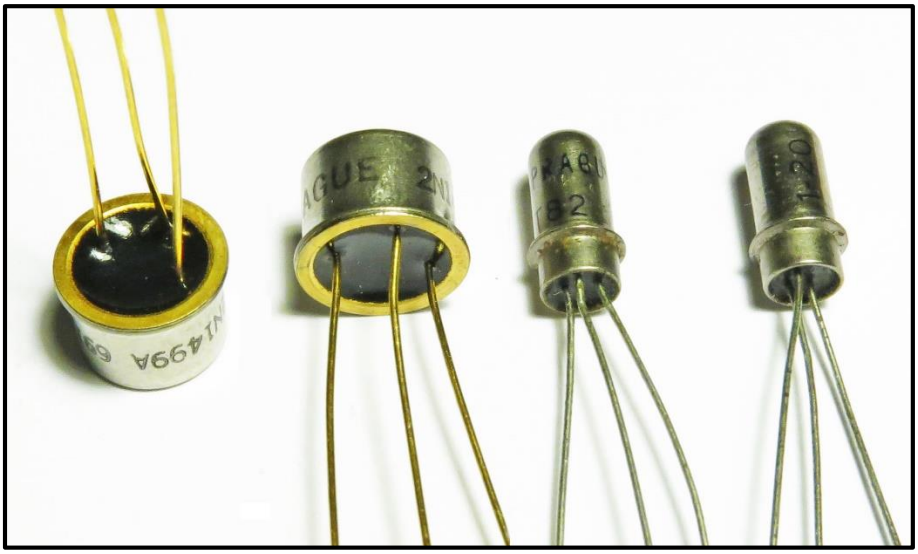

2N1499A: In May 1960, Philco registered several new high frequency transistors with JEDEC. This was a very active time for Philco, which was rapidly expanding its lead in commercial switching transistors with new MADT types. The Philco tentative data sheet for the 2N1499 reads in part: "The 2N1499 is a hermetically sealed, germanium Micro Alloy Diffused-base Transistor (MADT) designed for use in saturated switching circuits. The 2N1499 is capable of switching at frequencies in excess of 5 megacycles. It is intended to be used in high-speed commercial computers, data processing and automation equipment. The very thin base width of the 2N1499 makes it exceptionally radiation resistant. The TO-9 package is cold welded for high reliability". Philco soon offered an improved version of this transistor, designated 2N1499A, which doubled the original switching speed, from 5MC to 10 MC. The 2N1499A was marketed as a "high-speed, low-cost switch". The Sprague version of the 2N1499A included in this kit is dated from the late 1960s and uses a TO-5 case (see above left).

RT82: The production yields for 1950s/60s germanium transistor manufacturers were often low, with resulting quantities of "fallouts" of devices that did not meet specifications, but were still functional. Some companies would sell these production "fallouts", usually as specially marked hobbyist grade devices offered at a reduced price. Three companies were most active in this area - Raytheon (with the CK722), GE (with the 2N107/2N170) and Sylvania (with 2N229). Sprague also developed a line of low cost experimenter transistors, and these most likely were manufacturing "fallouts". The Sprague RT82, shown above right, sold for about 60¢ in 1965, while the comparable production quality 2N1742 MADT rf amplifier sold for almost $3.00. Sprague continued the "RT" line of low cost transistors into the 1970s.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague 2N1499A transistor
Type: Germanium PNP MADT
Case Color/Style: Silver metal TO-5
Vintage/Date Code: 1960s
Use: 10 MC saturated switching
Notes: Inexpensive transistor with good performance for data processing systems.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Sprague RT82 transistor
Type: Germanium PNP MADT
Case Color/Style: Silver "bullet" TO-1
Vintage/Date Code: 1960s
Use: General purpose high frequency
Notes: "Fallout" device used in hobbyist and experimenter projects. Very low cost.

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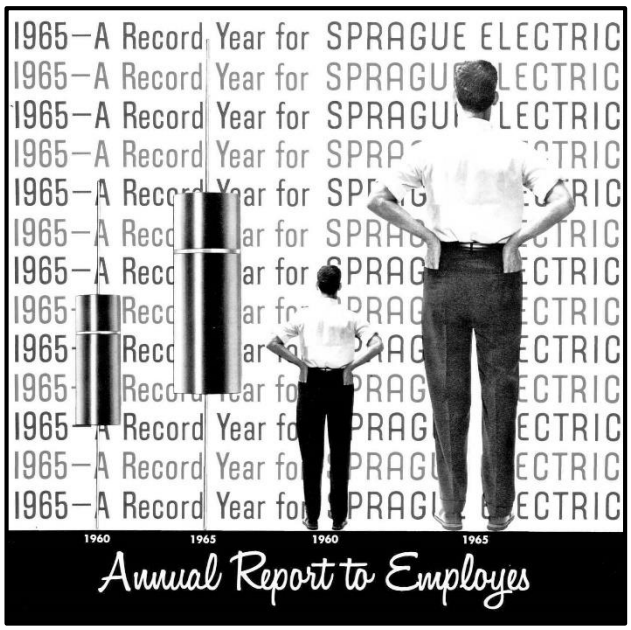
Sprague Electric is taking immediate steps to significantly increase its production capability for electrochemical processed transistors in Concord, according to a recent announcement by Ernest L. Ward, President. The Company has taken this step in the light of recent announcements by the Philco Corporation, a subsidiary of the Ford Motor Company, that Philco will discontinue the manufacture of this type of semiconductor. Market research indicates that a substantial need will continue for these unique high-speed, high-frequency devices. The continuous process advancements which have been made in electro-chemical transistors at Sprague Electric have had universal acceptance, starting with the ECDC core driver in 1960, the ECDC logic transistor in 1961, and earlier this year, the ECDC power amplifier. At the WESCON Show in August of this year, the Company announced the availability of 71 new transistor types, which included high-performance silicon epitaxial planar transistors, a full line of communications MADT transistors, a family of ECDC power amplifiers, a line of symmetrical transistors, and a very complete line of MADT/ ECDC switches.



During 1965 sales of transistors increased, especially our line of SEPT® Silicon Epitaxial Planar Transistors which was expanded by the addition of a number of new types. Good progress was made, also on increasing production of planar transistors. Production of Silicon Integrated UNICIRCUITS® for several important military and space programs will be in large-scale production when the new plant is in operation. Our Silicon Monolithic UNICIRCUIT® line has been expanded to include additional digital circuits in the medium and high speed ranges employing resistor-transistor, diode-transistor and transistor-transistor logic systems of the most advanced design. "THIRD GENERATION" COMPUTERS: The Semiconductor Division expects to become increasingly involved in supplying components for the commercial computer industry. With the introduction of the so-called "third generation" of commercial data processing systems, which are currently going into volume production, a number of new approaches to computer circuit fabrication have been developed.

Sprague Semiconductors in the 1960s: Beginning with the widely publicized 1956 licensing agreement with Philco, Sprague became a high volume manufacturer of the SBT, MAT and MADT high speed germanium transistors. These devices were used extensively by the military and industry and sold in the millions of units through the 1960s. As noted above left in an excerpted 1963 inhouse publication, Sprague became the primary supplier of these types of transistors when Philco unexpectedly anounced its withdrawal from this market. Spague's commitment to large scale transistor production was expanding during this timeframe, with the availability of 71 new transistor types announced at the 1963 WESCON show. Sprague was also investing in silicon technology with a proprietary line of Silicon Epitaxial Planar Transistors (SEPT) and integrated circuits (UNICIRCUITS), with expected markets in space, military and Third Genration Computers. Sprague's planned growth as a major semiconductor supplier appeared to be on track in the mid-1960s, when the 1965 Annual Report announced the construction of a new semiconductor plant in Worcester Ma and, for the first time in corporate history, sales exceeded $100,000,000 and company-wide employment passed the 10,000 mark.

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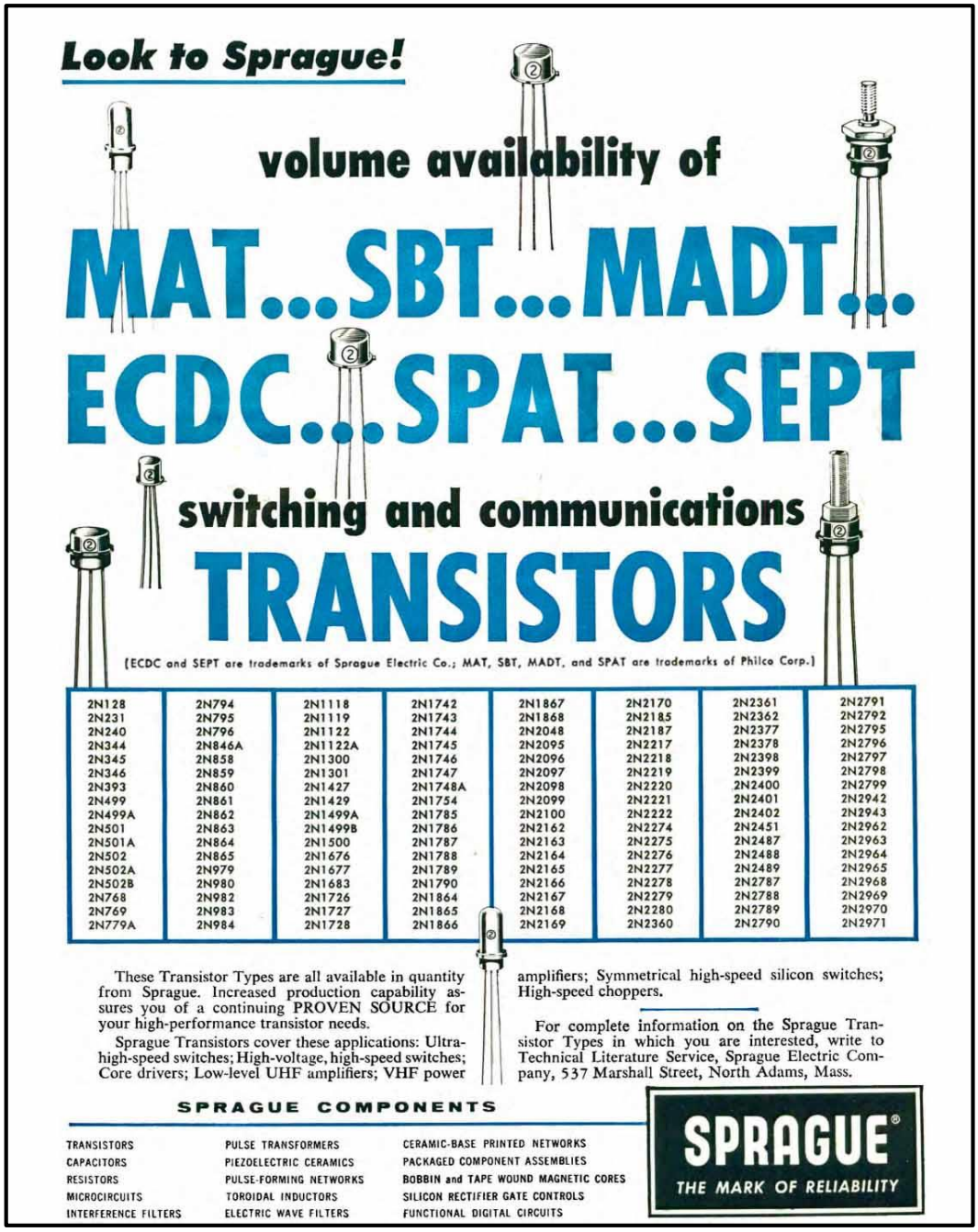

Look to Sprague!

volume availability of

MAT...SBT...MADT...

ECDC...SPAT...SEPT

switching and communications

TRANSISTORS

[ECDC and SEPT are trademarks of Sprague Electric Co.; MAT, SBT, MADT, and SPAT are trademarks of Philco Corp.]

2N128	2N794	2N1118	2N1742	2N1867	2N2170	2N2361	2N2791
2N231	2N795	2N1119	2N1743	2N1868	2N2185	2N2362	2N2792
2N240	2N796	2N1122	2N1744	2N2048	2N2187	2N2377	2N2795
2N344	2N846A	2N1122A	2N1745	2N2095	2N2217	2N2378	2N2796
2N345	2N858	2N1300	2N1746	2N2096	2N2218	2N2398	2N2797
2N346	2N859	2N1301	2N1747	2N2097	2N2219	2N2399	2N2798
2N393	2N860	2N1427	2N1748A	2N2098	2N2220	2N2400	2N2799
2N499	2N861	2N1429	2N1754	2N2099	2N2221	2N2401	2N2942
2N499A	2N862	2N1499A	2N1785	2N2100	2N2222	2N2402	2N2943
2N501	2N863	2N1499B	2N1786	2N2162	2N2274	2N2451	2N2962
2N501A	2N864	2N1500	2N1787	2N2163	2N2275	2N2487	2N2963
2N502	2N865	2N1676	2N1788	2N2164	2N2276	2N2488	2N2964
2N502A	2N979	2N1677	2N1789	2N2165	2N2277	2N2489	2N2965
2N502B	2N980	2N1683	2N1790	2N2166	2N2278	2N2787	2N2968
2N768	2N982	2N1726	2N1864	2N2167	2N2279	2N2788	2N2969
2N769	2N983	2N1727	2N1865	2N2168	2N2280	2N2789	2N2970
2N779A	2N984	2N1728	2N1866	2N2169	2N2360	2N2790	2N2971

These Transistor Types are all available in quantity from Sprague. Increased production capability assures you of a continuing PROVEN SOURCE for your high-performance transistor needs.

Sprague Transistors cover these applications: Ultra-high-speed switches; High-voltage, high-speed switches; Core drivers; Low-level UHF amplifiers; VHF power amplifiers; Symmetrical high-speed silicon switches; High-speed choppers.

For complete information on the Sprague Transistor Types in which you are interested, write to Technical Literature Service, Sprague Electric Company, 537 Marshall Street, North Adams, Mass.

SPRAGUE COMPONENTS

TRANSISTORS	PULSE TRANSFORMERS	CERAMIC-BASE PRINTED NETWORKS
CAPACITORS	PIEZOELECTRIC CERAMICS	PACKAGED COMPONENT ASSEMBLIES
RESISTORS	PULSE-FORMING NETWORKS	BOBBIN and TAPE WOUND MAGNETIC CORES
MICROCIRCUITS	TOROIDAL INDUCTORS	SILICON RECTIFIER GATE CONTROLS
INTERFERENCE FILTERS	ELECTRIC WAVE FILTERS	FUNCTIONAL DIGITAL CIRCUITS

SPRAGUE®
THE MARK OF RELIABILITY

Sprague Expands Production of Philco's Germanium Transistor Types: When Philco exited the germanium transistor manufacturing business in 1963, Sprague expanded its production capabilities for these devices. Because of the millions of high performance Philco transistors sold to industry and the military, Sprague found a ready market for its Philco style transistors well into the 1970s. The February 1964 ad above from the IEEE Spectrum magazine highlights Sprague's commitment to continued volume availability of the original Philco SBT, MAT and MADT transistors, as well as newer silicon types using the Philco precision etch process.

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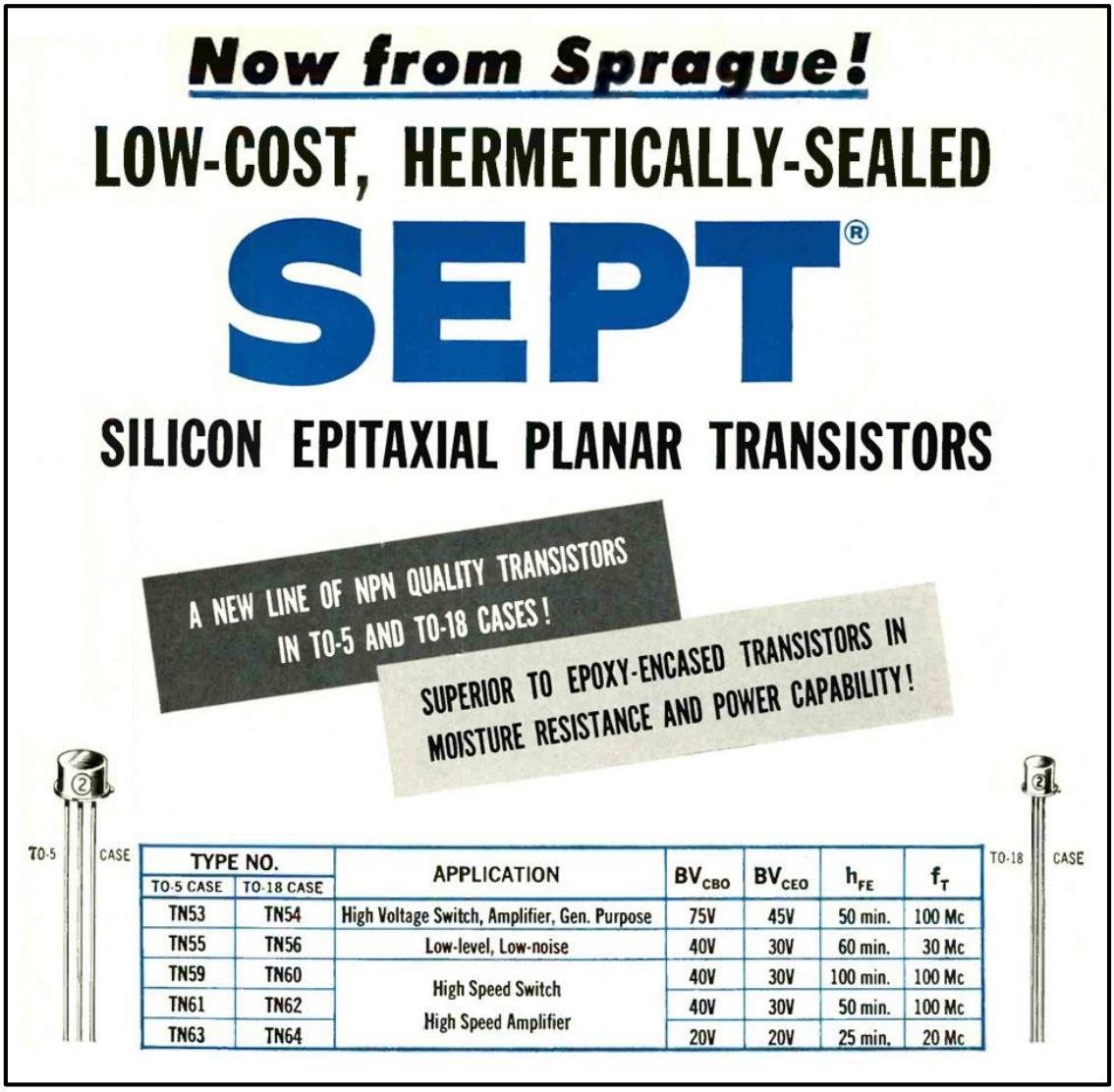

Now from Sprague!

LOW-COST, HERMETICALLY-SEALED

SEPT®

SILICON EPITAXIAL PLANAR TRANSISTORS

A NEW LINE OF NPN QUALITY TRANSISTORS IN TO-5 AND TO-18 CASES!

SUPERIOR TO EPOXY-ENCASED TRANSISTORS IN MOISTURE RESISTANCE AND POWER CAPABILITY!

TO-5 CASE

TYPE NO.		APPLICATION	BV_{CBO}	BV_{CEO}	h_{FE}	f_T
TO-5 CASE	TO-18 CASE					
TN53	TN54	High Voltage Switch, Amplifier, Gen. Purpose	75V	45V	50 min.	100 Mc
TN55	TN56	Low-level, Low-noise	40V	30V	60 min.	30 Mc
TN59	TN60	High Speed Switch	40V	30V	100 min.	100 Mc
TN61	TN62	High Speed Amplifier	40V	30V	50 min.	100 Mc
TN63	TN64		20V	20V	25 min.	20 Mc

TO-18 CASE

Sprague Enters the Silicon Era: Although Sprague's primary transistor business was based on manufacturing SBT/MAT/MADT high speed germanium transistors under license from Philco, Sprague did establish its own silicon semiconductor product lines in the 1960s and into the 1970s, including planar transistors and integrated circuits. This effort required substantial resources, including a newly built IC plant in the mid-1960s, as well as continued R&D work in silicon technology. The May 1965 ad above highlights a major product announcement for some of Sprague's first modern silicon transistors, based on the epitaxial planar technology, which would have been competitive with existing devices from industry leaders such as Fairchild, Texas Instruments and Motorola. Through the 1970s and 1980s, the Sprague semiconductor business was involved in multiple corporate ownership changes and evolving product lines. In 1990, this business was sold to Sanken Electric Ltd. Of Japan and renamed Allegro Microsystems. A comprehensive account of Sprague's historical semiconductor accomplishments can be found in *Sprague Electric: An Electronic Giant's Rise, Fall and Life After Death*, by John L. Sprague, 2015, CreateSpace Independent Publishing Platform, North Charleston, SC.

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