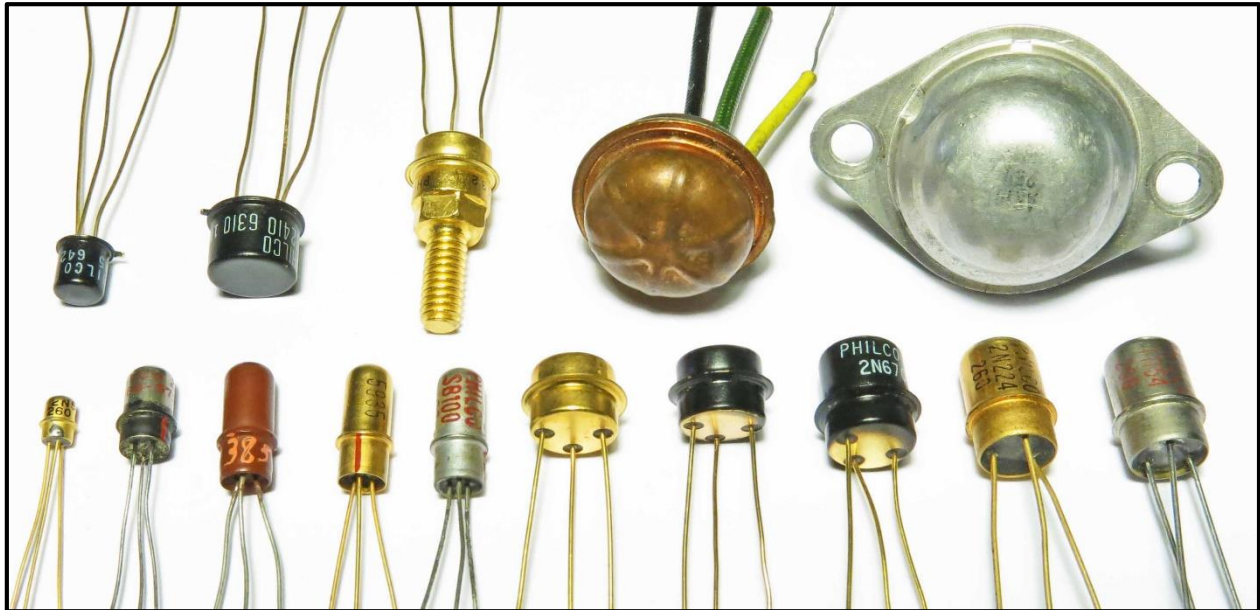


TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



Early Philco Transistors: Philco was one of several large mid-century electronics firms that moved quickly into the newly evolving world of germanium transistor technology - other successful companies of similar market presence included GE, Raytheon, RCA, and Sylvania. In the 1950s, Philco was highly diversified across multiple product lines, including appliances, consumer electronics such as TVs and radios, vacuum tubes, military systems, transistors and computers. Philco's entry into the transistor market began in the early 1950s with PNP germanium alloy audio devices. Examples included the miniature 2N47, shown second from left in the bottom row above, and the later micro-miniature M1 style, shown at far left. These devices were intended for use in hearing aids and other small consumer products. Philco's major and most successful transistor product line began with the SBT (Surface Barrier Transistor) which used a unique precision etch manufacturing process to produce very high frequency switching and RF devices. These first SBTs were developed by Philco in the mid-1950s under a U.S. Army Signal Corps contract. Examples of early Philco SBTs are shown at lower left, beginning with the brown painted "3851" Signal Corps prototype SBT, followed by the gold plated 2N240 and the silver SB100, dated 1955. A unique aspect of these Philco early SBTs was the use of a proprietary "bullet-shaped" metal case, later defined as JEDEC TO-24, which was a successful Philco implementation of a hermetically sealed case. Continued improvements to the precision etch process by Philco supported the rapid development of new higher performance types, including the MAT (Micro Alloy Transistor) and the MADT (Micro Alloy Diffused-base Transistor). These high speed devices were ideally suited for military and commercial applications, including computers, satellites and RF equipment, and were sold in the millions throughout the 1950s. In addition to improvements in transistor technology, Philco also developed a broad range of unique case shapes and styles, many of which are shown above. The transistor types, including SBT, MAT, MADT, and alloy junction were combined with the many different case styles to produce an extensive list of successful transistor model numbers available from Philco (many shown in the photo above). Philco was very successful with the high speed transistor types produced by the precision etch process, but was not a major presence with germanium power transistors (examples shown at top right), or silicon transistors.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

Highest Frequency Transistor...
Commercially Available Today!
Typical F_{max} 50 megacycles

PHILCO S-B-T (Surface Barrier Transistor)

Available now! . . . in quantity . . . Philco Surface Barrier Transistors are opening entirely new fields for design engineers . . . are being incorporated in high frequency units *now in production!* Commercial, industrial and military thinking is swinging over fast . . . to complete transistorization.

Philco has gained a wealth of experience in the practical application of Surface Barrier Transistors. Put this experience to work for you. Make the Philco S-B-T a part of your forward looking plans—now.

For complete technical information on the PHILCO SB Transistor write to: LANSDALE TUBE COMPANY A Division of PHILCO CORPORATION LANSDALE, PENNA.

FEATURES

- Lowest Power Consumption
- Hermetically Sealed Resistance-Welded Metal Case with Leads Sealed in Glass
- Long Life and Reliability of Operation
- Uniform Characteristics Insured by Controlled Processing and Complete Testing
- Extremely Low Collector Cut Off Current for Stable Operation
- Extremely Low Output Capacitance for Ease of Neutralization

Early Philco SBT Transistors: As shown by the March 1956 Teletech ad above, Philco was eager to advertise the commercial availability of its new SBT high frequency transistor technology. Performance up to 50 MC positioned the SBT as the industry leader in high speed operation, and Philco was able to provide these transistors in quantity to the military and to computer manufacturers for evaluation and commercialization purposes. These first SBTs were marketed by Philco as model SB100, and examples of early historically important transistorized computers using the SB100 were the ORDVAC, TRADIC and LARC. With the introduction of the SB100, Philco became the leader in high speed transistor technology, and maintained this lead for almost a decade with the follow on MAT and MADT types.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



PHILCO SURFACE BARRIER TRANSISTOR GERMANIUM TYPE SB-100

FEATURES

- Most Efficient High Frequency Transistor Available
- Lowest Power Consumption
- Hermetically Sealed Resistance Welded Metal Case with Leads Sealed in Glass
- Long Life and Reliability of Operation
- Uniform Characteristics Insured by Controlled Processing and Complete Testing
- Extremely Low Collector Cut Off Current for Stable Operation
- Clearly Marked Lead Orientation
- Designed to Meet Typical Military Environmental Conditions

APPLICATIONS

The Philco type SB-100 is a hermetically sealed surface barrier transistor designed for use as a general purpose IF and RF oscillator or amplifier at frequencies up to 30mc, as a wide band video amplifier, and as a switching transistor at switching frequencies as high as 1.5mc. The polarities of the emitter and collector voltages are similar to those of PNP junction transistors. The tinned flexible leads may be soldered or welded directly into the circuit or they may be clipped and used with standard plug-in sockets.

SPECIFICATIONS

ELECTRICAL

Maximum Ratings*

Collector Voltage (Common Emitter)** -4.5 volts
 Collector Current -5ma
 Collector Dissipation (at 40°C) 10mw

* Maximum ratings indicate limiting values above which transistor life and/or performance may be impaired. Connection of the transistor to a suitable heat sink will insure best performance when operating at maximum power ratings.

** Voltage at which the common emitter output impedance with open base is 1/2 of the typical value measured at $V_c = -3$ volts and $I_c = -0.5$ ma.

Typical Characteristics (at 25°C)

Collector Voltage, V_c -3.0 volts
 Collector Current, I_c -0.5ma
 Common Emitter Current Amplification, h_{fe} 20
 Common Base Output Impedance, $\frac{1}{h_{ob}}$ 400,000 ohms
 Common Base Input Impedance, h_{ib} 70 ohms
 Extrinsic Base Resistance-Collector Capacitance

Product, $r_b' C_c$ 800 $\mu\mu$ secs. (1500 $\mu\mu$ secs. max.)

Common Base Output Capacitance (Shell grounded), C_o 3.5 $\mu\mu$ f
 Collector Cutoff Current

(measured at $V_c = -3.0$ volts), I_{co} 0.5 microamperes
 Maximum Frequency of Oscillation, f_{max} 45mc (30mc min.)

Alpha cutoff frequency, f_{α_b} , can be calculated using the equation:

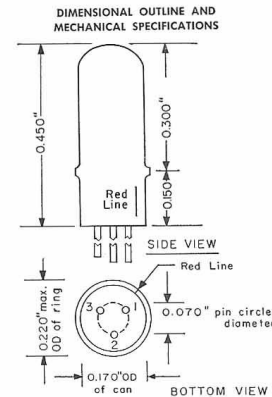
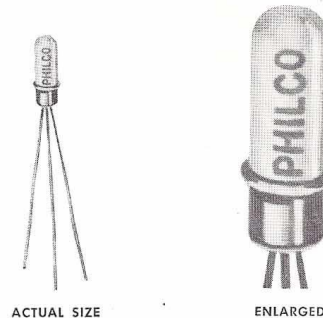
$$f_{\alpha_b} = \frac{30r_b' C_c (f_{max})^2}{a}$$

f_{α_b} in megacycles
 f_{max} in megacycles

Form Number LTC 283 4-56

Philco reserves the right to modify the design for reasons of improved performance

Printed in U.S.A.



$r_b' C_c$ in micro micro seconds
 a is the low frequency common base current amplification factor

NOTE: Accidental application of large voltage surges to transistors may alter their characteristics. Such surges may be derived from soldering irons and test equipment operating from 110VAC lines. As a precaution against this, test equipment should be carefully grounded and gun type soldering irons are recommended. The use of isolation transformers is also a satisfactory safeguard.

MECHANICAL

Base: 0.016" tinned flexible leads. Emitter lead length 1.45" min.

Collector and base lead length 1.50" min. on a 0.070" dia. circle.

Terminal Connections: (red line adjacent to lead #1)

Lead #1—Collector

Lead #2—Base

Lead #3—Emitter

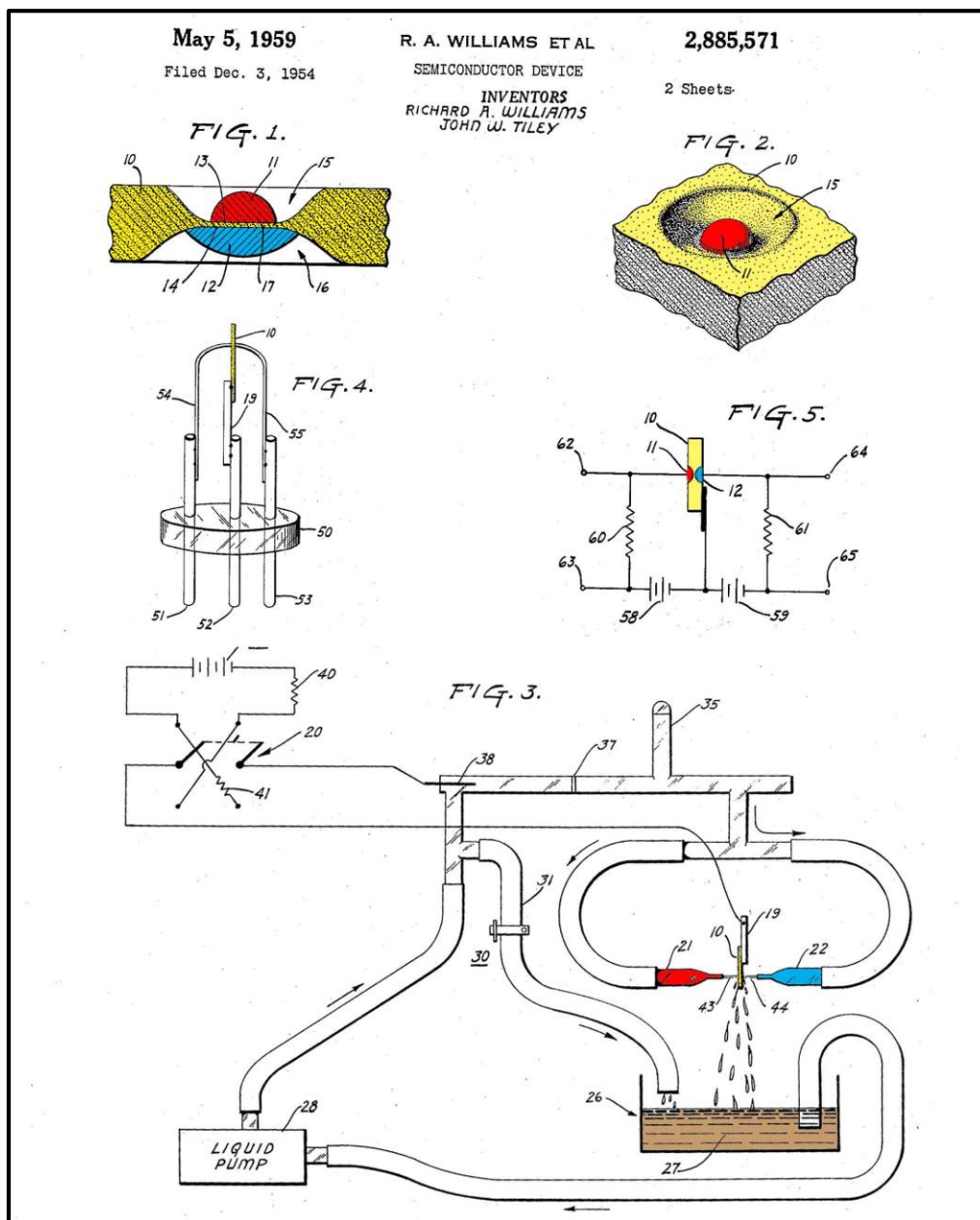
Mounting Position: Any

PHILCO CORPORATION LANSDALE, PENNSYLVANIA
Lansdale Tube Company Division

1956 Philco SB100 Transistor Data Sheet: This April 1956 SB100 data sheet documents very early performance data for commercial SBT technology. Note the claimed 45 MC maximum (30 MC minimum) frequency specification here, compared with the 50 MC specification from the TeleTech ad shown on the previous page. As Philco engineers gained more experience with the precision etch process, it's likely that better performance and greater consistency was achieved for these unique devices.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

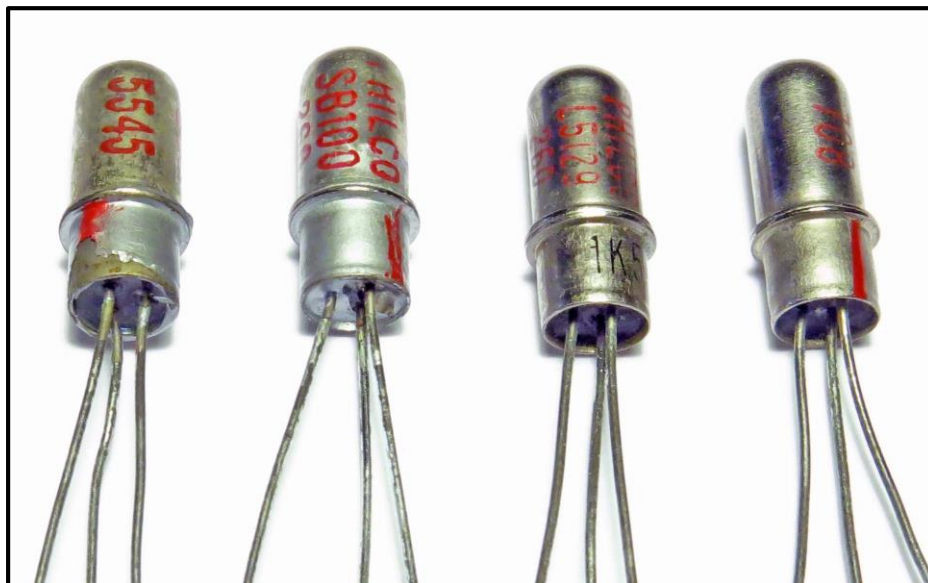
PHILCO



The Philco Precision Etch Transistor Patent: The scan above is a stylized composite of the drawings associated with Philco patent 2,885,571, filed by Richard Williams and John Tiley in 1954. The unique construction of SBT transistors are documented in this patent. For example, Figure 1 is a cross sectional view of an SBT transistor - the yellow highlighted area is an N Type germanium die (base connection), and the red and blue areas are respectively the emitter and collector areas of the transistor. Figure 3 illustrates the chemical electrolyte etching equipment designed to precision etch the emitter and collector "wells" into the germanium die, thereby creating a very thin base layer, and resulting high frequency performance. This patent also provides is an excellent discussion of the differences between the SBT and the other existing transistor types of the time - point contact and junction.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



SB100: The SB100 model number was used by Philco to designate its first general purpose Surface Barrier Transistor (SBT) for fast switching and high frequency use. This historic device was manufactured using the unique Philco precision etch process, and was especially well suited for applications such as computers. Produced first in 1955, the SB100 was the highest frequency transistor commercially available and was supplied to the military and the computer industry for circuit evaluation and product design. The SB100 transistors shown above and included in this kit are very early production units (1955 week 45) supplied to the U.S. Navy by Philco. These first units are somewhat crudely made (note the uneven plating process on the case and leads for these units) and reflect the startup nature of the Philco SBT production facilities. SB100 transistors were expensive and sold for \$6 each in 1957.

L5129: In addition to the industry standard "2N" numbering sequence, Philco also used a variety of in-house and preproduction numbering systems for 1950s device identification. Often these non-standard devices were made available to industry for evaluation or production purposes prior to JEDEC approval of the corresponding "2N" type. The L5129 transistors shown above and included in your kit are dated 1957 and are a preproduction type corresponding to the 2N240 SBT. These particular transistors are from a batch provided by Philco to Burroughs for use in the Atlas guidance computer. Burroughs also used this transistor type in the Model D 204 Submarine Computer. Note the improved plating process and general appearance of these 1957 transistors, compared with the 1955 SB100s shown above.

TRANSISTOR MUSEUM Historic Semiconductor Data Device ID: <u>Philco SB100 transistor</u> Type: <u>Germanium PNP surface barrier</u> Case Color/Style: <u>Silver "bullet" TO-24</u> Vintage/Date Code: <u>1950s</u> Use: <u>High frequency computer switch</u> Notes: <u>1st surface barrier transistor (SBT) available for general use. Historic device.</u>
--

TRANSISTOR MUSEUM Historic Semiconductor Data Device ID: <u>Philco L5129 transistor</u> Type: <u>Germanium PNP surface barrier</u> Case Color/Style: <u>Silver "bullet" TO-24</u> Vintage/Date Code: <u>1950s</u> Use: <u>High speed computer transistor</u> Notes: <u>Early prototype version of 2N240. Rare - used in Atlas guidance computer.</u>

TRANSISTOR MUSEUM™



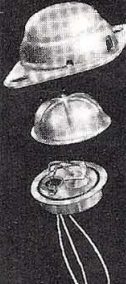



HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

FOR RELIABLE PERFORMANCE,
STABILITY OF OPERATION AND LONG LIFE

PHILCO *Transistors*

Proven performance of Philco Hermetically Sealed Transistors has made them the basis for design in commercial and military applications where reliability is the major consideration. Philco transistors range from the world's smallest germanium transistors now in production to silicon transistors with excellent performance at temperatures from -60°C to $+150^{\circ}\text{C}$. The following are some of the available Philco transistor types:

 <p style="text-align: center;">ACTUAL SIZE</p>	<p style="text-align: center;">Low Level Transistors</p> <p>2N207, 2N207A and 2N207B—Germanium PNP Alloy Junction Transistor ... world's smallest transistor in production. Useful in any low level audio application such as hearing aids where size is an important consideration.</p>	 <p style="text-align: center;">ACTUAL SIZE</p>	<p style="text-align: center;">Medium Power Transistors</p> <p>2N223, 2N224, 2N225, 2N226, 2N227—Germanium PNP Alloy Junction Transistor for portable radio output stages, medium power switching, servo-amplifiers and other applications where medium power must be handled at low frequencies.</p>		<p style="text-align: center;">Power Transistors</p> <p>T1040, T1041—Germanium PNP Alloy Junction Power Transistor with low thermal drop designed for audio output stages, power switching, servo-amplifier output stages and other applications where high power must be handled.</p>
 <p style="text-align: center;">ACTUAL SIZE</p>	<p style="text-align: center;">High Frequency Transistors</p> <p>Surface Barrier Types 2N128 and 2N129—Surface Barrier Transistors for critical military applications, produced to meet MIL-T-12679A (SigC) military requirements.</p>	 <p style="text-align: center;">ACTUAL SIZE</p>	<p style="text-align: center;">High Speed Switching Transistors</p> <p>2N240—Germanium Surface Barrier. High Speed switching transistor with response time in the low millimicrosecond range. Made the basis for design of both military and commercial computers where speed and reliability are essential.</p>	 <p style="text-align: center;">ACTUAL SIZE</p>	<p style="text-align: center;">Silicon Transistors</p> <p>T1025, T1159—PNP High Speed Silicon Transistors for computers and amplifiers operating at high ambient temperatures. These transistors feature low saturation voltage.</p>

All Philco transistors are hermetically sealed to insure long life. In addition to the above types, Philco produces a wide range of transistors designed for special applications in accordance with customer requirements. The Philco Micro Alloy Transistor is already in pilot production and tentative specifications and design quantities are available. New and exciting transistor types, such as the Philco Micro-Alloy Diffused Base Transistor, are now in development. In keeping with our policy, specifications will be made available as soon as these units reach pilot production and are available in design quantities.

More Transistors from Philco in 1956: The above scan from a 1956 Philco advertising brochure illustrates the expanding range of transistor types developed since the initial SB100 SBT was released. In addition to a variety of alloy junction types (top row), Philco also developed several new and improved SBTs (2N128, 2N129 and 2N240), and the first Philco silicon transistors (T1025, T1159). These latter types were all manufactured using the precision etch process.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



Now Available...

FIRST HF TRANSISTORS
now in production, meeting
Army Signal Corps Standards



A wide variety of military equipment, once impossible to transistorize due to frequency limitations of available transistors, is now being developed with Philco Surface Barrier Transistors.

PHILCO SBT
SURFACE BARRIER TRANSISTORS
(Type 2N128 and 2N129)

Meet MIL-T-12679A Military requirements

Check These Features

- High frequency performance
- Extreme reliability
- Uniformity of characteristics
- Rigid quality control
- Minimum battery drain
- Low leakage currents
- Low operating voltage
- Absolute hermetic seal
- Meet MIL-T-12679A Military requirements

Now available for large volume military and industrial applications . . . the high frequency Philco Surface Barrier Transistors that were developed for the Army Signal Corps to meet the stringent requirements of field use in military electronics equipment. Advanced precision techniques used in fabricating the Philco Surface Barrier Transistors make possible rigidly controlled automatic manufacture with its resultant uniformity, reliability and high volume production. These reliable transistors point the way to new fields in transistorization. Make these reliable high frequency Philco Surface Barrier Transistors part of your forward looking plans.

For complete technical information on these High Frequency transistors write
Dept. TT, LANSDALE TUBE CO., Lansdale, Pa. A DIVISION OF PHILCO CORP.

Philco Transistors and the U.S. Army Signal Corps: A FY-1954 Sig C Production Engineering Measure contract, awarded by the Signal Corps to assure availability of specific military items, included a contract with Philco for initial production of high frequency surface barrier transistors, with the result that the 2N128, 2N299 and 2N300 SBTs were developed. The December 1956 Teletech ad shown above documents the availability of reliable and high performance SBTs from Philco specifically designed to meet rigid military requirements developed by the Signal Corps. The 2N128 was widely used for many years in computer and RF applications. Initial units were quite expensive, and listed for \$9 each in 1957.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

Now Available!

PHILCO Silicon Transistors

With These Outstanding Advantages:

- Excellent performance at Temperatures from -60°C to $+140^{\circ}\text{C}$
- Collector Saturation Voltage of 0.1 Volt or Under
- Maximum Frequency of Oscillation in the 15 Megacycle Range.

Unmatched performance and reliability! Characteristics assured by extensive life tests under typical operating conditions. Philco PNP Silicon Transistors make practical complete transistorization of military and commercial circuits —where high ambient temperatures are encountered.

Philco Silicon Transistors are now in pilot production and immediately available for initial design work. Specify Type T-1025 for amplifier, oscillator and low level general purpose applications and Type T-1159 for high speed switching applications.

FEATURES

- HIGH TEMPERATURE PERFORMANCE • VERY LOW LEAKAGE CURRENT
- HIGH SPEED • SUITABLE FOR DIRECT COUPLING
- LOW SATURATION VOLTAGE • ABSOLUTE HERMETIC SEAL



PNP Silicon
Surface Alloy
Transistor

Characteristics of Types T-1025 and T-1159
($T_c = 25^{\circ}\text{C}$)

Characteristic	Condition	Typical Value
Current Amplification Factor, h_{fe}	$V_{CE} = -6\text{ v}$ $I_E = 1\text{ ma}$	18
Output Capacitance, C_{cs}	$V_{CE} = -6\text{ v}$ $I_C = 1\text{ ma}$	7 μpf
Maximum Oscillation Frequency, f_{max}	$V_C = -6\text{ v}$ $I_E = 1\text{ ma}$	15 mc
Cutoff Current, I_{cso} or I_{sso}	V_{CB} or $V_{EB} = -10\text{ v}$	0.001 μa

Maximum Power Dissipation—150 mw
Maximum Collector Voltage—T-1025-25 v
T-1159-10 v

Early Philco Silicon Transistors: Texas Instruments was the first company to commercialize silicon transistors, with the introduction of the 900 series product line in late 1954. Philco was also developing silicon transistors during this timeframe, and announced the availability of pilot production units in late 1956. The above ad appeared in the December 1956 Teletech magazine, and highlights the limited availability of the first Philco silicon transistors, the T-1025, registered with JEDEC in 1957 as the 2N354 and the T-1159, registered with JEDEC as the 2N355. Unlike the TI silicon transistors, which were NPN grown junction devices, the Philco silicon transistors used the precision etch process and were designated as SAT, or Surface Alloy Transistors. Due to the high demand by the military for silicon transistors and the manufacturing difficulties encountered by industry with this new technology, the early units were very expensive, with the T-1025 selling for a whopping \$46.50 in 1957. Note that Philco often used in-house model numbers, such as T-1025, for transistor types not registered as a "2N" type. Philco continued to develop silicon precision etch transistors, and in 1957 released the 2N495 and 2N496 types, which met Sig C requirements. Industry-wide silicon transistor technology continued to improve over the next decade, with mesa and planar types, which obsoleted the earlier junction and precision etch devices.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

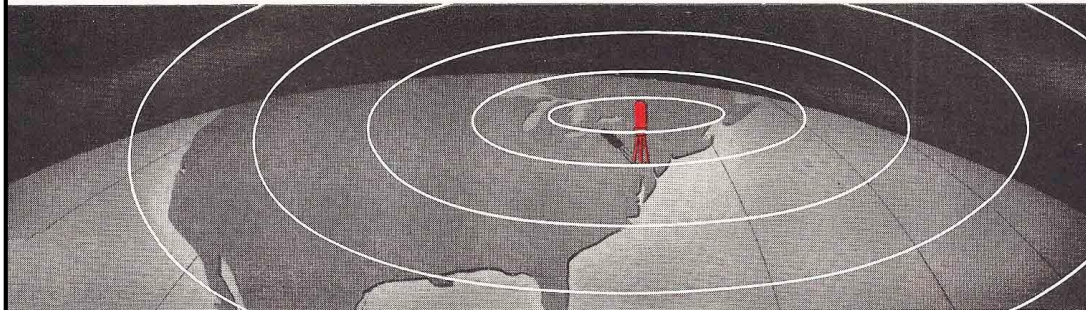


Philco Transistor Center, USA: Based on the success of the precision etch process and an industry leadership position in high frequency SBTs, MATs and MADTs, Philco was prepared to invest heavily in the facilities and equipment required for volume production of transistors. Shown at top is a 1956 Philco advertising photo highlighting the opening of the new Transistor Center U.S.A. facility in Spring City, PA. The accompanying text states: *"For the first time, the dream of the electronics industry comes true.... made possible by many years of Philco pioneering, research and production of semiconductors. Philco's great new transistor plant at Spring City, Pa. is designed for and dedicated to the mass production of reliable transistors. It's the greatest development in transistor history. A complete plant, housing the most advanced transistor manufacturing equipment and utilizing entirely new production methods, is now in mass production at Spring City, Pa. We call it Philco Transistor Center, U.S.A. - and, that's exactly what it is. From this plant come the world's finest transistors - unmatched in quality and reliability."* This new facility was constructed in an old hosiery mill located at 501 South Main St in Spring City (see reference 6 at the end of this chapter) and was designed for the very high volume production of Philco transistors, up to 25 million total by the early 1960s. Philco frequently referred to its Transistor Center U.S.A. in ads and catalogues of the time and in promotional material, such as the paperweight shown above.

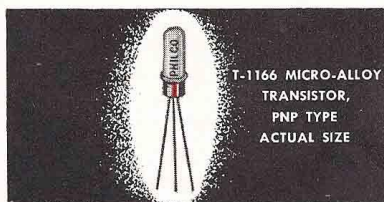
TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

F-I-a-s-h!...from Transistor Center, U.S.A.



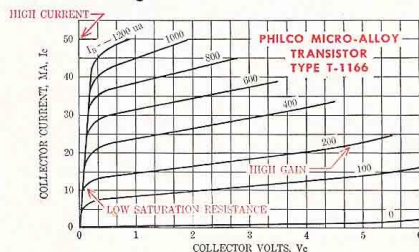
Announcing a new transistor class . . . The PHILCO Micro-Alloy Transistor (MAT)*



. . .world's first production transistor with exceptionally high frequency and high gain . . . plus low saturation resistance!

CHECK THESE UNEQUALLED FEATURES

- Excellent High Speed Switching characteristics.
- Low Saturation Voltage (low impedance)
- Excellent high frequency amplification.
- Excellent low-level amplifier over entire frequency range from D.C. to Megacycles.
- Exceptionally Long Life (hermetically sealed)
- Permits high speed computer design with Fewer Stages.



This newest development from Philco Transistor Center features the characteristic high frequency response obtainable with extremely precise base width control. Designed for low voltage operation, the new MAT transistor is especially well suited for high speed applications where low saturation resistance (reduced power consumption) is necessary.

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.

A special short-alloying cycle, combined with precise electro-chemical production techniques (pioneered and developed at Philco Transistor Center for production of SBT), results in the micro-alloy contact for exceptionally high injection efficiency. This new process assures higher gain, and permits operation at higher current. Beta linearity is excellent over the entire range of operating currents . . . up to 50 milliamperes.

**Patent Applied For*

Philco MAT Transistors: Following the original SBT, one of the first improved transistor types developed by Philco using the precision etch process was the Micro Alloy Transistor (MAT). As noted in the March 1957 ad shown above, the MAT transistor added an alloyed indium emitter electrode to the basic SBT technology, with a resulting device that achieved high gain and high currents at high frequencies. This technology is described in Philco patent 3,032,484 filed in 1959 by Donald Sanders. The most famous and widely used MAT transistor was the 2N393 (development type T-1166), which was sold in very large quantities and was used in such historic computers as the Sylvania MOBIDIC and ATACC, and the GE 312.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



A Complete Line of COMPUTER TRANSISTORS

Only Philco offers a complete line of specially designed computer transistors. Here are the best transistors for all phases of logic circuitry, read-in and read-out equipment, core-drivers, storage and switching devices.

Philco transistors are being used by all leading computer manufacturers, especially where millimicrosecond speeds are needed. A leading University has proven Philco transistor reliability in actual computer circuits

over tens of millions of transistor service hours.

All Philco transistors are hermetically sealed to insure maximum service life. Available in production quantities from the factory. Also available "off the shelf" in quantities 1 to 99 from your local Philco transistor distributor. When you think of TRANSISTORS . . . think of PHILCO FIRST.

MEDIUM FREQUENCY, MEDIUM POWER ALLOY JUNCTION TRANSISTORS (250 mw) (in TO-9 package)

- 2N597** for use in 200-300 kc computers, $f_{\alpha c}$ over 3 mc
- 2N598** for use in 300-400 kc computers, $f_{\alpha c}$ over 5 mc
- 2N599** for use in switching circuits faster than 400 kc, $f_{\alpha c}$ over 12 mc

MICRO-MINIATURE TRANSISTOR

- 2N536** high gain switching transistor, 20v maximum V_{CE} , DC beta typically 150

HIGH FREQUENCY, HIGH GAIN (MICRO ALLOY) TRANSISTOR (MAT)

- 2N393** combines high frequency response with high gain for general purpose, high frequency applications and switching circuits, typical f_{max} 60 mc

HIGH FREQUENCY SILICON TRANSISTOR (SAT)

- 2N496** high speed silicon switch for speeds up to 5 mc characterized by extremely low saturation resistance.

HIGH FREQUENCY SURFACE BARRIER TRANSISTOR (SBT)

- 2N240** switching transistor, typical $f = 60$ mc

MICRO ALLOY DIFFUSED-BASE TRANSISTOR (MADT)

- 2N501** extremely high speed switch; typical rise time 12 μ sec, fall time 4 μ sec

BILATERAL ALLOY JUNCTION TRANSISTOR

- 2N462** high gain ($h_{FE} = 45$ in both directions), high voltage (40v) unit for applications where current reversal is desired

POWER TRANSISTORS

- 2N353** 40 volt, 30 watt power transistor
- 2N386** 60 volt, 37.5 watt power transistor
- 2N387** 80 volt, 37.5 watt power transistor
- 2N589** 100 volt, 37.5 watt power transistor

PHILCO'S NEWEST FAMILY OF MEDIUM- AND HIGH-POWER SWITCHING TRANSISTORS

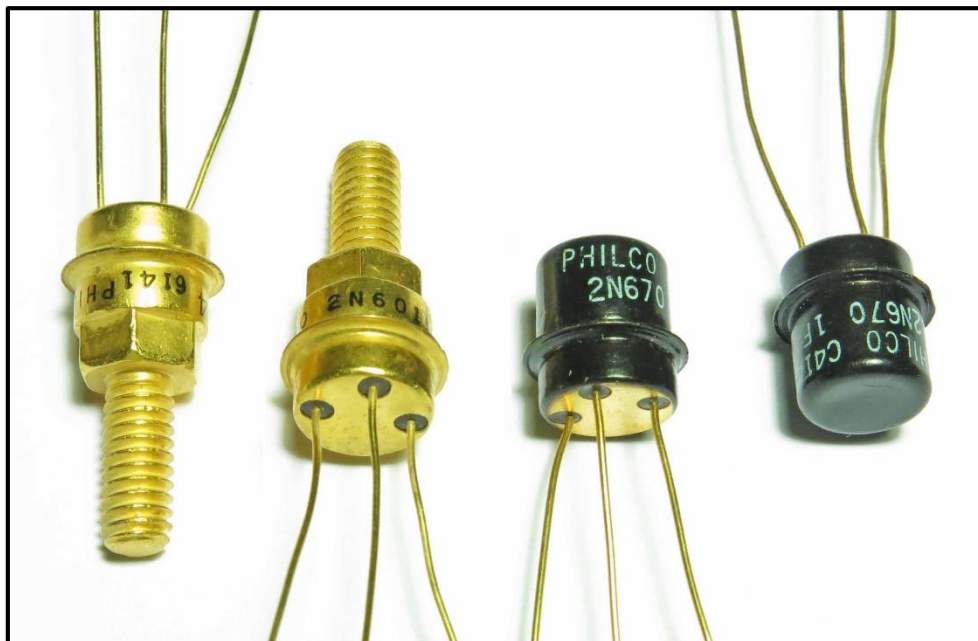
- 2N670** 300 mw, 2 amp pulse amplifier, in TO-9 type package
- 2N671** 40 volt, 1 watt pulse amplifier in case with mounting stud and JEDEC E3-51 base
- 2N672** 40 volt, 0.75 microsecond high frequency switching transistor
- 2N673** 40 volt, 1 watt, stud mounted switching transistor
- 2N600** stud mounted $\frac{3}{4}$ watt high speed power switch ($f_{\alpha c}$ and 5 MC)
- 2N601** stud mounted $\frac{3}{4}$ watt high speed power switch ($f_{\alpha c}$ and 12 MC)

Make Philco Your Prime Source For All Transistor Information And Prices. Write Dept. E-1058

Philco Computer Transistors: By late 1958, as noted above, Philco was heavily marketing its transistor product line to the computer industry. With an extensive range of performance characteristics, and a broad listing of types, Philco was well positioned to address the device requirements of digital computers under development at that time. With high volume production capability at the Transistor Center U.S.A. factory and new higher frequency transistor types based on the precision etch process, Philco was the dominant supplier of germanium computer transistors in the late 1950s.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



2N600/601: Philco's precision etch transistors achieved very high switching speeds and were very useful for digital computer and RF applications. The power handling capabilities of these transistors was adequate for low current and voltage circuits, but these devices were not capable of medium or high power switching. In the late 1950s, Philco added a number of transistors to their commercial lineup, including several alloy junction types that were designed to operate in higher power circuits. The 2N600/2N601 series of transistors (above left) were intended for high current pulse and digital circuitry, such as memory core drivers. These transistors used a unique "stud-mounted" metal case, designated TO-31, that allowed heat-synching for great power handling capabilities. The 2N601 offered switching speeds up to 12 MC, while to 5MC 2N600 was available to meet Navy and Sig C military specifications.

2N670: Another power alloy junction transistor, the 2N670 shown above right, was registered with JEDEC by Philco in March 1959. This transistor provided medium power handling capabilities with a high voltage range, and was intended for low-speed, high-voltage pulse amplifiers and switching circuits where peak currents may be very high. The 2N670 used a unique tall version of the standard TO-9 case style. As noted earlier, Philco developed a broad range of proprietary and unusual transistor case styles, and the types illustrated by the 2N600/2N610 and the 2N670 devices are some of the most unusual examples.

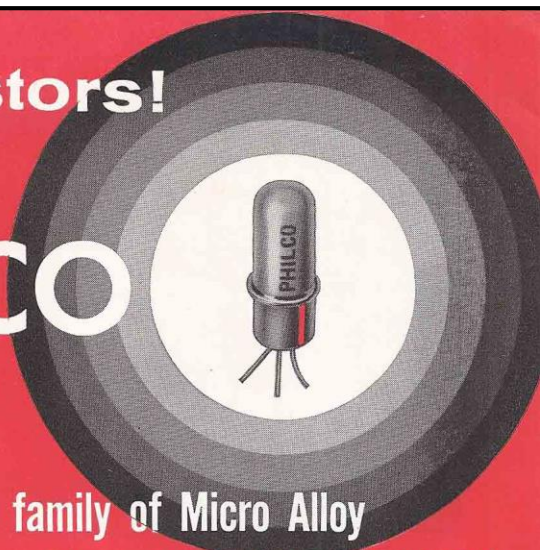
TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Philco 2N600/2N601 transistor
Type: Germanium PNP alloy junction
Case Color/Style: Gold metal TO-31
Vintage/Date Code: Early 1960s
Use: Med-high frequency power switch
Notes: Unique stud-mounted TO-31 case.
Designed for high current pulse digital use.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Philco 2N670 transistor
Type: Germanium PNP alloy junction
Case Color/Style: Black metal TO-9 (tall)
Vintage/Date Code: Early 1960s
Use: High voltage and current power switch
Notes: Unique tall version of TO-9 case.
High voltage pulse amp and current switch.

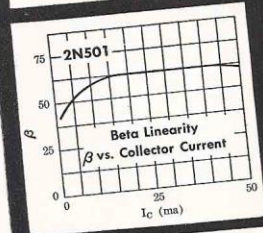
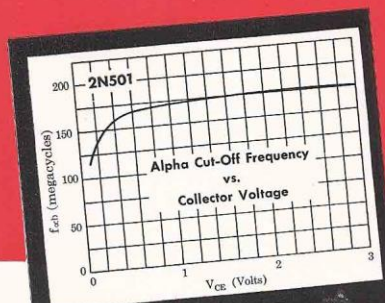
TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

VHF Transistors! First From PHILCO



New family of Micro Alloy Diffused-base Transistors (MADT)*



- Rise, Storage, Fall Time in Low μ sec Range
- High Oscillator efficiency at 200 mcs
- Amplifier gains of 10 db at 200 mcs

Here is a major breakthrough in the frequency barrier . . . a new family of *field-flow* Micro Alloy Diffused-base Transistors. Philco MADT's extend the range of high gain, high frequency amplifiers; high speed computers; high gain, wideband amplifiers and other critical high frequency circuitry.

MADT's are available to various voltage and frequency specifications for design of high performance transistorized equipment through the entire VHF and part of the UHF spectrum. These transistors range in f_{max} from 250 mc to as high as 1000 mc. MADT gains are typically 10 db at 200 mc and greater than 16 db at 100 mc. A low cost general purpose unit is available which will deliver typically 18 db at 50 mc and 32 db at 10 mc.

Make Philco your prime source of information for high frequency transistor applications.

Write to Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa., Dept. C-958

MADT FAMILY APPLICATIONS DATA				
TYPE*	f_{max}	Power Gain	Oscillator Efficiency	Class of Use
2N499	250 mcs (min)	10 db at 100 mcs	25% at 100 mcs (min)	oscillator and amplifier to 100 mcs
2N500			25% at 200 mcs (min)	oscillator to 400 mcs
2N501	Ultra high-speed switch typical $t_r = 12 \mu$ sec; (18 max.); $t_s = 7 \mu$ sec; (12 max.); $t_f = 4 \mu$ sec; (10 max.). In circuit with current gain of 10 and voltage turnoff.			
2N502†	500 mcs	10 db at 200 mcs		amplifier to 250 mcs
2N503†		11 db at 100 mcs (min)		amplifier to 100 mcs
2N504	50 mcs	46 db at 455 KC		high gain IF amplifier

*Available in voltage ratings up to 35V.
†In JEDEC TO-9 Case (widely known as JEDEC 30 Case).

*Trademark Philco Corporation for Micro Alloy Diffused-base Transistor

Philco MADT Transistors: Another improved transistor type developed by Philco using the precision etch process was the Micro Alloy Diffused-base Transistor (MADT). Using the semiconductor diffusion techniques originally developed at Bell Labs, Philco MADT transistors were able to perform at extremely high frequencies, and were well suited for switching and VHF applications. The above 1958 ad announced the availability of several new MADT transistors and provided some detail regarding the MADT process. This technology is described in Philco patent 3,096,259 filed in 1959 by Richard Williams. 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 MADT types were widely used in 1950s and 1960s computer, military and industrial switching and high frequency applications.

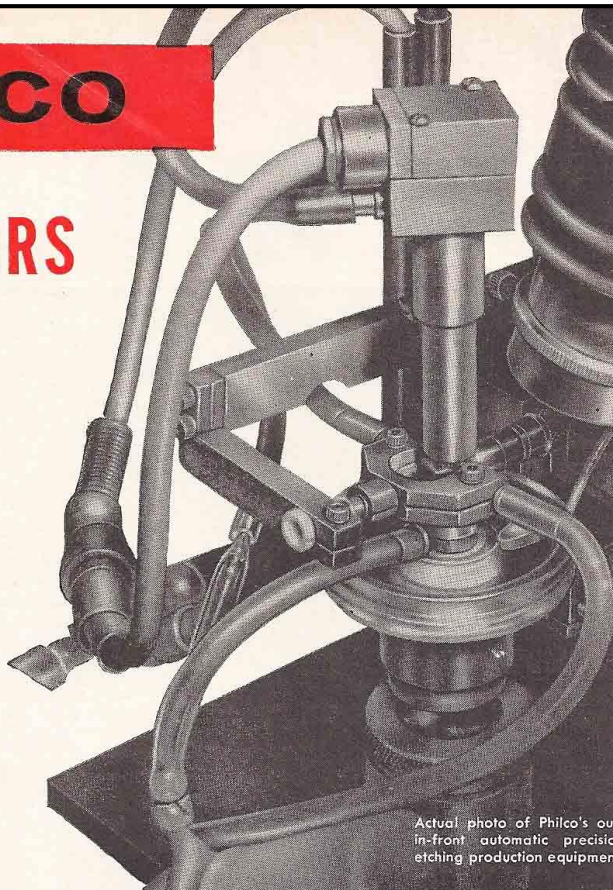
TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

First from **PHILCO**

MADT* TRANSISTORS CONTROLLED IN DESIGN AND MANUFACTURE ...

*to meet your exact
circuit requirements
... NOT SELECTED!*



Actual photo of Philco's out-in-front automatic precision etching production equipment

*Trademark Philco Corporation for Micro Alloy Diffused-base Transistors

New VHF-UHF Transistors available in unlimited quantities – at realistic prices!

NOW, TRANSISTOR CENTER, U. S. A., offers a new family of MADT (field flow) transistors in unlimited quantities. Here are precision transistors which greatly expand the design potentials of high-gain, high frequency amplifiers; high speed computers; high-gain, wideband video amplifiers; and other critical high frequency circuitry.

Due to Philco's exclusive electrochemical manufacturing process, MADT's are *controlled not selected*. The electrodes are precisely placed in the graded field to produce the exact characteristics you require. MADT's are available immediately in unlimited quantities. Quantities 1 to 99 available "off-the-shelf" from your local franchised Philco Industrial Transistor Distributor.

MADT FAMILY APPLICATIONS DATA

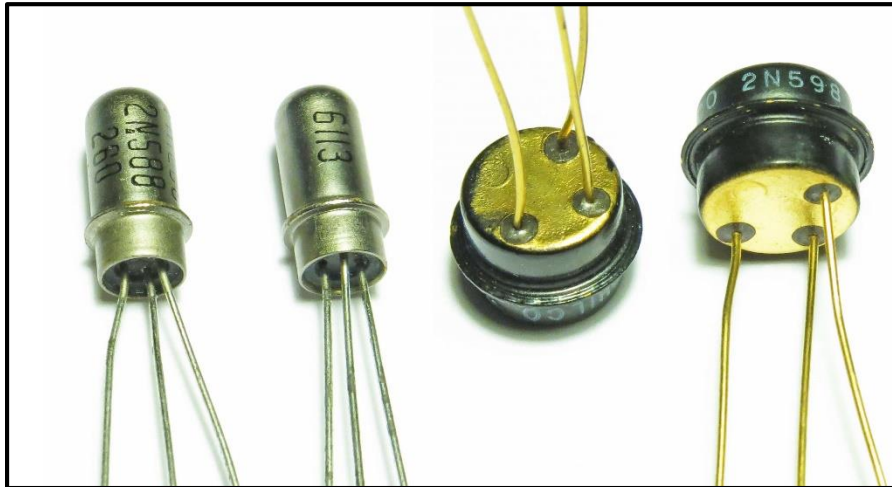
TYPE*	f _{max}	Power Gain	Oscillator Efficiency	Class of Use
2N499	320 mc	10 db at 100 mc		amplifier to 125 mc
2N500			45% at 200 mc	Oscillator to 350 mc
2N501	Ultra high-speed switch typical t _r = 9 μsec; (18 max.); t _f = 9 μsec; (12 max.); t _f = 7 μsec; (10 max.) in circuit with current gain of 10 and voltage turnoff.			
2N502†	800 mc	11 db at 200 mc		amplifier to 250 mc
2N503†	420 mc	12.5 db at 100 mc		amplifier to 175 mc
2N504	50 mc (min.)	46 db at 455		high gain IF amplifier
2N588	250 mc	14 db at 50 mc		Oscillator and amplifier to 80 mc

*Available in voltage ratings up to 35 V and dissipation ratings to 50 mw at 45°C.
†In JEDEC TO-9 Case (Widely known as JEDEC 30 Case).

Philco MADT Transistors in Unlimited Quantities: By 1959, the Philco Transistor Center was able to produce large quantities (1 - 99 available "off-the-shelf" according to the ad above) of the high performing MADT transistor types. Note the partial view above of the etching machine, with hoses, valves and jets used to electrochemically process each MADT transistor. The exclusive electrochemical precision etching process allowed Philco to manufacture transistors with highly controlled performance characteristics. Philco was "on a roll" in the late 1950s with many new MADT types added to the computer product lines.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



2N588: In May 1959, Philco registered a series of its new MADT transistor types with JEDEC with the following "2N" types documented: 2N499, 2N500, 2N501, 2N501A, 2N502A, and the 2N588. These high frequency transistors were intended for the rapidly expanding computer and VHF/UHF market, and the individual types listed provided a broad range of performance characteristics and case styles. The tentative data sheet provided by Philco with the JEDEC registration identified the 2N588 as "The 2N588 is a hermetically, germanium MADT field flow transistor for use in amplifiers and oscillators at frequencies up to 50 MC." As shown above left, the 2N588 used the classic "silver bullet" TO-30 case style. Listed at \$6 in 1959, the 2N588 was one of least expensive MADTs available. The 2N588 units included in this kit are dated from the early 1960s and should perform well as a general purpose medium speed amplifier.

2N598: Although best known for its unique precision etch transistor technology, Philco did manufacture the industry standard germanium alloy junction device types as well. Initially targeted for audio applications, such as hearing aids and radios, Philco developed a more complete range of these types that were suitable for low speed computer use. For example, Philco registered the 2N598 (shown above right) with JEDEC in 1959 with the following description: "The 2N598 is a germanium PNP junction transistor designed for use in medium frequency, medium power computer and communications applications. The 6.5 MC minimum cutoff frequency insures good operation in 300 to 400 kc switching circuits. The type features high beta, good beta linearity, and a cold welded case. The 2N598 is made with a rugged internal construction for high reliability and is stabilized by 100 hours of prebaking at 100 C." The 2N598 listed for less than \$6 in 1959, and was a good choice for computer designers for low speed switching circuits.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Philco 2N588 transistor
Type: Germanium PNP MADT
Case Color/Style: Silver "bullet" TO-30
Vintage/Date Code: 1950s/1960s
Use: High frequency amplifier/oscillator
Notes: One of the first MADTs available.
Used as low cost general pupose amplifier.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Philco 2N598 transistor
Type: Germanium PNP alloy junction
Case Color/Style: Black metal TO-9
Vintage/Date Code: 1950s/1960s
Use: Low speed medium power switch
Notes: Rugged high reliability computer
device for 300 to 400 KC switching use.


TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

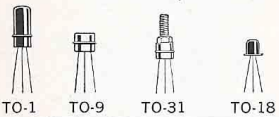
PHILCO

IN THE MOST EXACTING APPLICATIONS

PHILCO MADT®

SWITCHING TRANSISTORS





In TO-1 CASE:
2N501—Ultra high speed switch
2N501A—Military version of 2N501

In TO-9 CASE:
2N1204—Ultra high speed, high current switch
2N1495—High voltage, high speed, high current switch
2N1499A—High speed, low cost switch (MIL version available)
2N1500—Ultra high speed switch (MIL version available)
2N1754—Very low cost, high speed switch

In TO-31 CASE:
2N1494—High power version of the 2N1204

In TO-18 CASE:
2N768—Ultra high speed switch for very low power circuits
2N769—World's fastest switch
2N779A—Ultra high speed switch—very high beta
2N846A—Ultra high speed switch

The Industry's Strongest Record of PERFORMANCE and RELIABILITY


In high-speed computers, control systems, guidance systems and many other critical military and industrial switching applications, Philco's patented high-frequency Micro Alloy Diffused-base Transistors are used more widely than any other type. There are many reasons for this broad acceptance. Philco MADTs are available in a full range of types, each designed and produced to tight specifications for specific applications. They are manufactured by Philco's patented Precision-Etch* process on the world's first fully-automatic transistor production lines . . . under rigid quality control. Philco MADTs have proved their outstanding performance capabilities and reliability in *billions of transistor hours of actual field operation* . . . far more than any other type of transistor.

There is a Philco MADT to meet your requirements . . . offering the advantages of cadmium junctions for cooler operation . . . low collector capacitance . . . low saturation voltage . . . high beta with good linearity . . . excellent frequency response . . . low hole storage time . . . and excellent temperature stability.

PHILCO®

Famous for Quality the World Over

LANSDALE DIVISION, LANSDALE, PENNSYLVANIA



Many Philco MADT Transistors: By the early 1960s, Philco had developed a very broad range of high speed MADT transistors for computer use. Note in the March 1961 ad above that various case styles and performance characteristics were available. Since the mid-1950s, when the first MADTs were developed by Philco, these types of transistors had logged billions of hours of actual field operation, with an impressive claim for reliable operation. The circuit board shown at top in the ad is an illustration of a circuit board from the Philco Transac computer, which used Philco MADT transistors.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

COMPARE THIS HIGH-SPEED, LOW-COST SWITCH WITH ANY OTHER



**Philco's Improved
2N1499A MDT®**

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65 to +100°C
Collector Voltage, V_{CB}	-20 volts
✓ Collector Voltage, V_{CES}	-20 volts
✓ Collector Current, I_C	-100 ma
Total Device Dissipation at 25°C	60 mw

ELECTRICAL CHARACTERISTICS (T = 25°C)

Static Characteristics	Min.	Typ.	Max.
Collector Cutoff Current, I_{CBO} ($V_{CB} = -5v$) ..		1	3 μ a
✓ Collector Cutoff Current, I_{CBO} ($V_{CB} = -5v, T = 55^\circ C$)			18 μ a
✓ Collector Breakdown Voltage, BV_{CBO} ($I_C = -25 \mu$ a)	20		volts
✓ Collector Breakdown Voltage, BV_{CES} ($I_{CS} = -25 \mu$ a)	20		volts
DC Current Amplification Factor, h_{FE} ($V_{CE} = -0.5v, I_C = -40$ ma)	20	50	
✓ DC Current Amplification Factor, h_{FE} ($V_{CE} = -0.3v, I_C = -10$ ma)	30	70	
Base Input Voltage, V_{BE} ($I_C = -10$ ma, $I_B = -1$ ma)	0.25	0.32	0.40 volt
Collector Saturation Voltage, $V_{CE(SAT)}$ ($I_C = -10$ ma, $I_B = -1$ ma)		0.12	0.20 volt
Collector Saturation Voltage, $V_{CE(SAT)}$ ($I_C = -10$ ma, $I_B = -0.5$ ma)		0.15	0.25 volt
✓ Base Input Voltage, V_{BE} ($I_C = -10$ ma, $I_B = -0.5$ ma)			0.34 volt
Dynamic Characteristics			
Output Capacitance, C_{ob} ($V_{CB} = -6v$)		1.5	3 pf
Rise Time, t_r ($V_{CB} = -5v, I_C = -10$ ma, $I_{BI} = -2$ ma)	25	60	nsec
Minority Carrier Storage Time Constant, τ_s ($K's$) $I_B = -1$ ma	100	120	pcb/ma
✓ Gain Bandwidth Product, f_T ($V_{CE} = -3v, I_C = -5$ ma)	100		mc

✓ Checks indicate specification improvements

Immediately available in quantities 1-999 from
your Philco Industrial Semiconductor Distributor

Now with New, Tighter "Specs"

In high-speed switching circuits, this Philco MADT has a long record of reliable performance. It has always been manufactured to meet rigid specifications . . . not selected as a fall-out device.

Now . . . the 2N1499A is being produced to still tighter specifications, making it far more versatile and permitting greater freedom in circuit design.

New high current rating makes it suitable for line drivers, blocking oscillators, etc. Higher amplification factor (h_{FE}), makes NOR circuit design much easier. V_{BE} and $V_{CE(SAT)}$, guaranteed at 2 drive conditions, give tight control for all saturated circuit designs.

For logic circuits operating at rates up to 10 mc, it will pay you to get the facts on the improved Philco 2N1499A. Compare it . . . you'll find it impossible to beat in performance, reliability, versatility and price. Write Dept. E3361.

PHILCO
Famous for Quality the World Over®

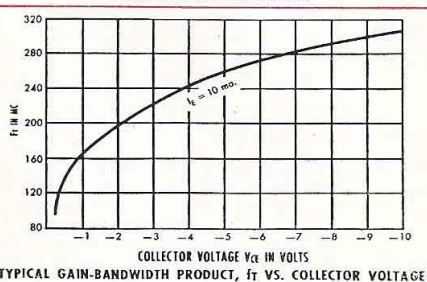
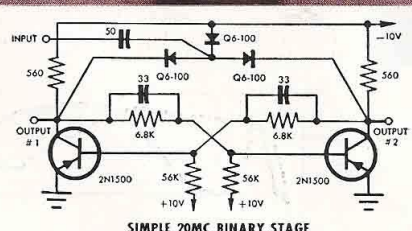
Philco 2N1499A Transistor: Building on its industry lead with high speed transistors, Philco introduced an improved version of the 2N1499A MADT in the early 1960s, as noted in the ad above. This device offered impressive performance and was advertised as a "high-speed, low-cost switch". The 2N1499A was used widely in logic and switching applications in the 1960s, including for example in the Type 24 Serial Drum Storage System which provided auxiliary storage for the DEC PDP-1, PDP-4 and PDP-7 computers. Military versions of the 2N1499A were also available and were used extensively in critical military applications.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



PHILCO ANNOUNCES
NEW
ULTRA HIGH-SPEED SWITCHING TRANSISTOR
WITH CADMIUM ELECTRODES
...IN TO-9 PACKAGE



New MADT* 2N1500 Provides Increased Power Dissipation

Here is another Philco "break-through" in the design and manufacture of high frequency, ultra high-speed switching transistors! This new Micro Alloy Diffused-base Transistor (MADT*) uses cadmium electrodes in place of indium. The higher thermal conductivity of cadmium insures cooler-running junctions for any given power dissipation and provides an extra margin of safety as added assurance of reliable performance.

The new 2N1500 offers the designer these important advantages:

- 100° C maximum junction temperature
- low collector capacitance
- high Beta and excellent Beta
- linearity with temperature and current
- low hold storage time (Typical: 7 mμsec)
- low saturation voltage

In electrical characteristics, the 2N1500 is similar to 2N501, which has been thoroughly field-proven in many military and industrial computer applications. It is manufactured on Philco's exclusive fully-automated production lines to the highest standards of uniformity. For complete specifications and applications data, write Dept. SC-460.

PHILCO®

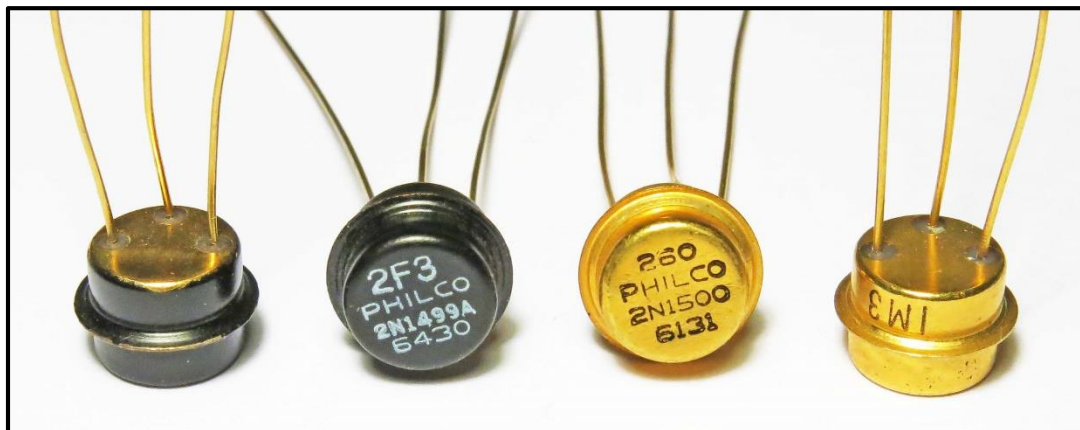
LANSDALE DIVISION / LANSDALE, PENNSYLVANIA



Philco 2N1500 Transistor: For the ultimate in switching performance, Philco developed the "ultra high-speed" 2N1500 MADT with exceptional switching speed up to 20 MC. Tentative data sheets were available in 1960 and the ad above appeared in April 1960 issue of Semiconductor Products magazine. This device was used in historically important early transistorized computers, including the 1961 Packard Bell PB250.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



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 and related types. The registration text for the 2N1499 is based on the associated tentative data sheet which 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". Note that Philco was continuing to improve the precision etch manufacturing process and soon offered an improved version of this transistor, designated 2N1499A, which greatly increased the original switching speed, from 5MC to 10 MC. The 2N1499A was marketed as a "high-speed, low-cost switch".

2N1500: When introduced in 1960, the 2N1500 was likely the highest switching speed computer transistor generally available, with advertised performance up to 20 MC. This was an important feature for computer manufacturers and Philco was eager to capture this market. The March 1960 tentative data sheet for the 2N1500 states in part: "The 2N1500 is a hermetically sealed, germanium Micro Alloy Diffused-base Transistor (MADT) specifically designed for very high speed switching applications. Reliable operation of the 2N1500 in switching circuits has been achieved at speeds in excess of 20 megacycles. An important feature of this transistor is the excellent high frequency response at very low collector voltages. This characteristic is made possible by techniques which place the collector in the diffused region of the base". The exceptional high speed performance of the 2N1500 was well received by computer and switching circuit designers and the device found immediate use in computers (the Packard Bell PB250) and in logic design (the Harvard University Cyclotron).

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Philco 2N1499A transistor
Type: Germanium PNP MADT
Case Color/Style: Black metal TO-9
Vintage/Date Code: 1960s
Use: 10 MC saturated switch
Notes: High speed version of the 2N1499.
Popular low cost MADT computer switch.

TRANSISTOR MUSEUM
Historic Semiconductor Data
Device ID: Philco 2N1500 transistor
Type: Germanium PNP MADT
Case Color/Style: Gold metal TO-9
Vintage/Date Code: 1960s
Use: Very high frequency 20 MC switch
Notes: Early 1960s high speed "champ".
Used in Packard Bell PB250 computer.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

PHILCO Transistors operate

51,614,343

SERVICE HOURS*

in High-Speed Computer Circuits

with only 8 Failures!‡




Total Transistor Service Hours To Date	Total Transistors	Total Failures‡	Report
1,068,111	99	0	ELECTRONICS, Oct. 1, 1957, pg. 167
5,460,000	600	1	ELECTRONICS, Oct. 1, 1957, pg. 167
1,250,000	125	0	PHILCO REPORT, Feb. 10, 1959
16,000,000	10,192	2	WJCC REPORT, Feb. 1957
8,640,000	8,000	2	PHILCO REPORT, Feb. 12, 1959
19,196,232	18,601	3	PHILCO REPORT, Nov. 19, 1958

‡Failures due to all causes including human error.
*Documented service hours in these six computers only. Total transistors hours in similar circuits are many times this amount.

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA



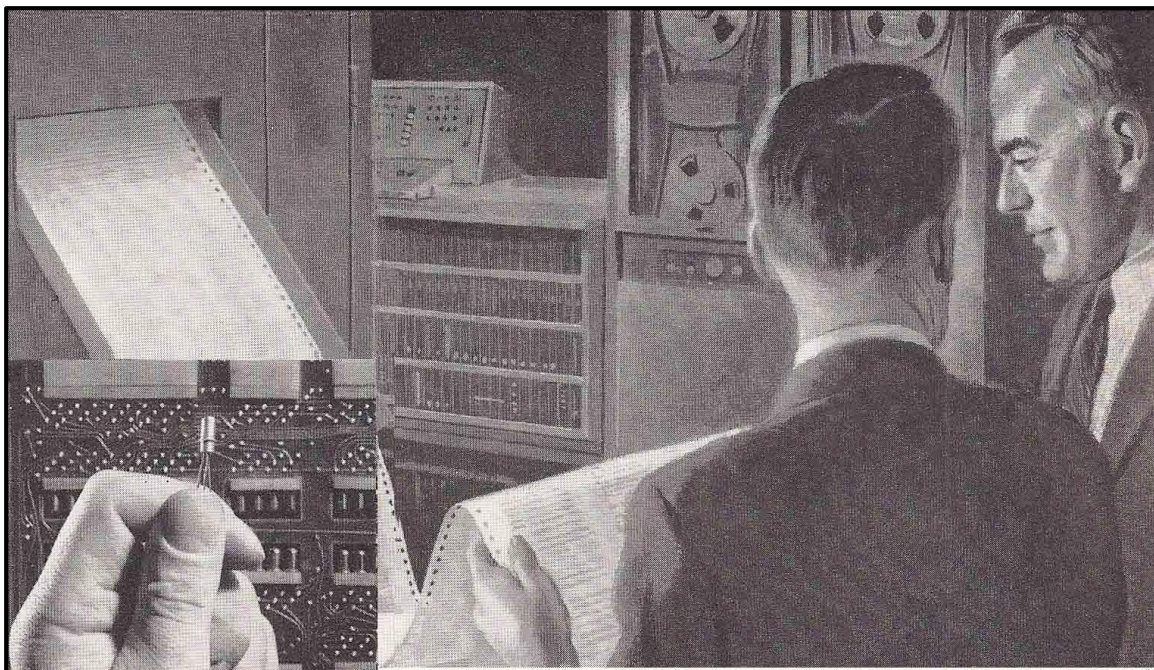
Carefully documented reports now reveal that Philco electro-chemical transistors have amassed more than fifty-million hours of operation in six computers under actual field conditions. Here is proof of the outstanding performance and reliability that electronics engineers and designers have come to expect from Transistor Center, U.S.A. Of course, these transistors are still operating in their original high speed computer switching circuits . . . extending service life data on these transistors beyond the limits of any previously published information.

When you think of transistors, think first of Philco. Make Philco your prime source for all transistor information.

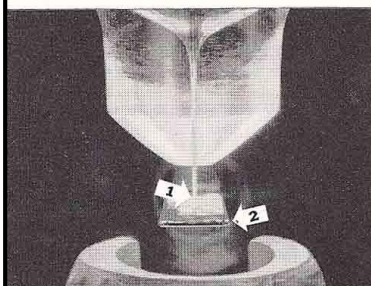
Reliable Philco Computer Transistors: This 1959 ad documented an important milestone in the reliable use of Philco germanium precision etch for commercial computers. In the published reports that presented the actual failure rate data, Philco assessed the performance of its transistors in six computers actually used in the field. The results were impressive, with over 51,000,000 service hours logged for the six computers during 1957 and 1958, with only eight documented Philco transistor failures. This level of transistor reliability was more than acceptable for commercial computers. As was also common for computers developed in the 1950s and 1960s, transistor logic was implemented with "pluggable" circuit boards so that any component failures could be quickly repaired with an easily replaced board.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



THE HEART OF THE COMPUTER is this circuit board containing Philco Transistors. In a single large-scale computer there are 800 similar circuits, using over 50,000 Philco Precision-Etch Transistors.



EXCLUSIVE PHILCO PRECISION-ETCH PROCESS in operation on world's first automatic transistor production lines, designed and built by Philco. Electrochemical jet stream (1) etches tiny depression on surface of germanium blank (2) with tolerance controlled by infrared rays to 1/150 the thickness of a human hair.

PHILCO patented

PRECISION-ETCH* TRANSISTORS

lead the way to faster data processing

Philco Precision-Etch Transistors have revolutionized electronic data processing. In the world's first fully-transistorized large scale computers, they make possible speeds beyond human comprehension . . . to update an inventory of half a million items in 20 minutes . . . to compute a 10,000 man payroll in less than 5 minutes . . . to solve countless business and scientific problems in a matter of seconds! Matching their fantastic speeds are the amazing reliability and long life of Philco Transistors, which have operated millions of hours without failure. They are used by almost every important manufacturer of transistorized computers . . . and in missiles, satellites, communications, control systems and entertainment products.

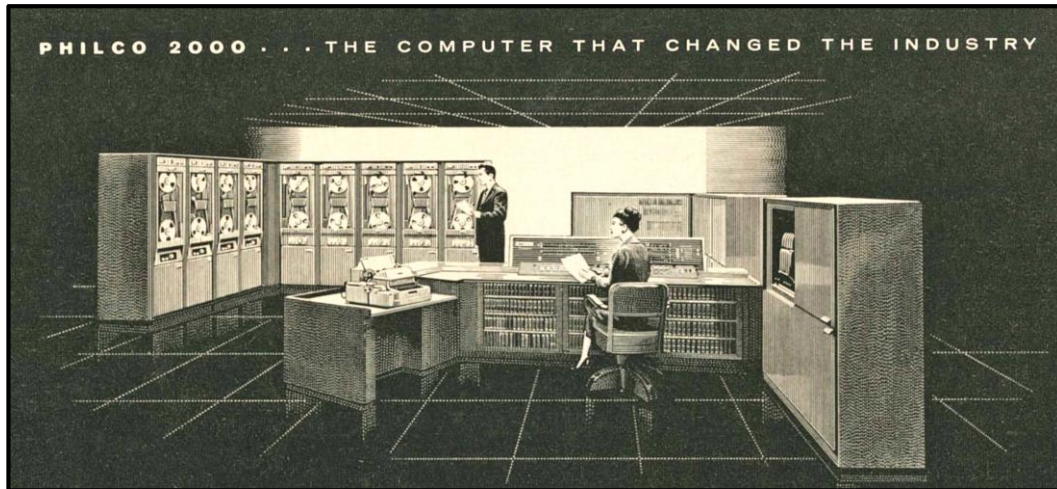
SPECIFY PHILCO Transistors in all electronic equipment you buy . . . or build.
CONSULT PHILCO for information or assistance in transistorizing your product.

PHILCO/LANSDALE DIVISION, Lansdale, Pa.

Philco Transistors and Philco Computers: Although not directly stated in this 1960 ad, and based largely on the success of its transistors, Philco made a major financial investment in developing its own line of commercial digital computers, beginning in the late 1950s with the historic Transac. Note the hand holding a Philco transistor with transistorized circuit cards in the background. As stated in the text, some of these large scale computers used tens of thousands of individual transistors, and Philco was very successful in supplying these transistors for its own computers and to other computer manufacturers.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



Outmodes vacuum tube systems for large-scale data processing!

New PHILCO *Transac*

...WORLD'S FIRST ALL-TRANSISTOR MANAGEMENT "BRAIN"

A black and white photograph of the Philco Transac computer system. A man in a suit is seated at a desk, looking at a document. The desk is equipped with a typewriter and other office equipment. In the background, there are several large, metal cabinets housing the computer system. The floor is dark with a grid pattern.

HANDLES BUSINESS, SCIENTIFIC AND MILITARY DATA PROCESSING

Actually years ahead in solving toughest management problems...

Philco Develops the Transac: Introduced in late 1957, the Transac S-2000 was Philco's first entry into the rapidly expanding market for large scale commercial computer systems. As suggested by the ads above, the Transac system was quite expansive, with multiple bays of equipment, and was positioned by Philco as the "world's first all-transistor management brain". Depending on the specific hardware configuration, each Transac computer system required up to 50,000 individual transistors, and Philco's Transistor Center U.S.A. was fully capable of producing such quantities of high speed precision etch devices. Note that several other 1950s transistor companies, including GE, RCA, and Sylvania, also entered the computer market with systems that used large numbers of transistors produced by each company.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

ANOTHER BREAKTHROUGH IN PRODUCT DESIGN
MADE POSSIBLE BY PHILCO TRANSISTORS

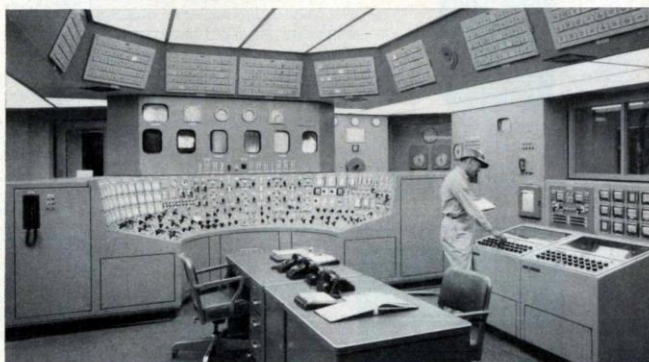


**IN THIS NEW LN 3000
COMPUTER . . .** developed by Philco
under joint agreement with Leeds & Northrup
Company . . . over 1200 MADT Transistors
are used. LN 3000 Computers are sold by
Leeds & Northrup as part of their complete
control systems and are among the most compact
and reliable process computers available.

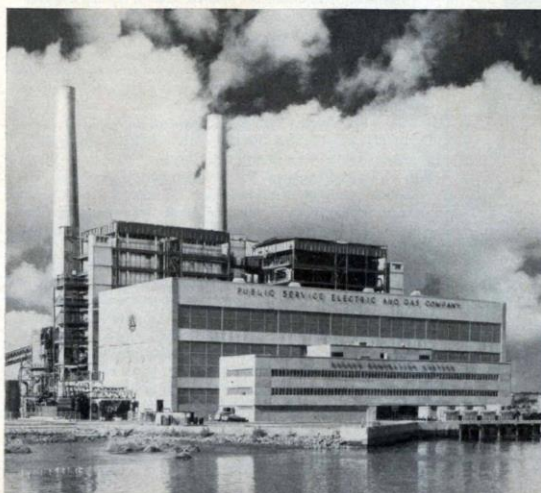


**SMALL
WONDER**

THIS TINY PHILCO TRANSISTOR
is the famous MADT_® (Micro Alloy
Diffused-base Transistor), developed and
manufactured by Philco. It is used
extensively in computers for switching
electric current at tremendous speeds.



FOR AUTOMATIC PROCESS CONTROL this new computer is applicable
in many industries . . . including electric power, metals,
chemicals, petro chemicals and ceramics. The first LN
3000 will soon be installed in this modern control center
to calculate the performance of the generating units.



IN THIS GIANT POWER PLANT . . . the Bergen
Generating Station of the Public Service Electric and
Gas Company, at Ridgefield, N.J. . . . the LN 3000 will
calculate equipment performance and aid in more
efficient production of electricity for one of the nation's
busiest industrial areas.

This is another major electronic achievement made
possible by Philco Transistors. Specify Philco Transistors
in all electronic equipment you buy . . . or build.
Consult Philco for information or assistance in transistorizing
your product.

LANSDALE DIVISION • LANSDALE, PENNSYLVANIA

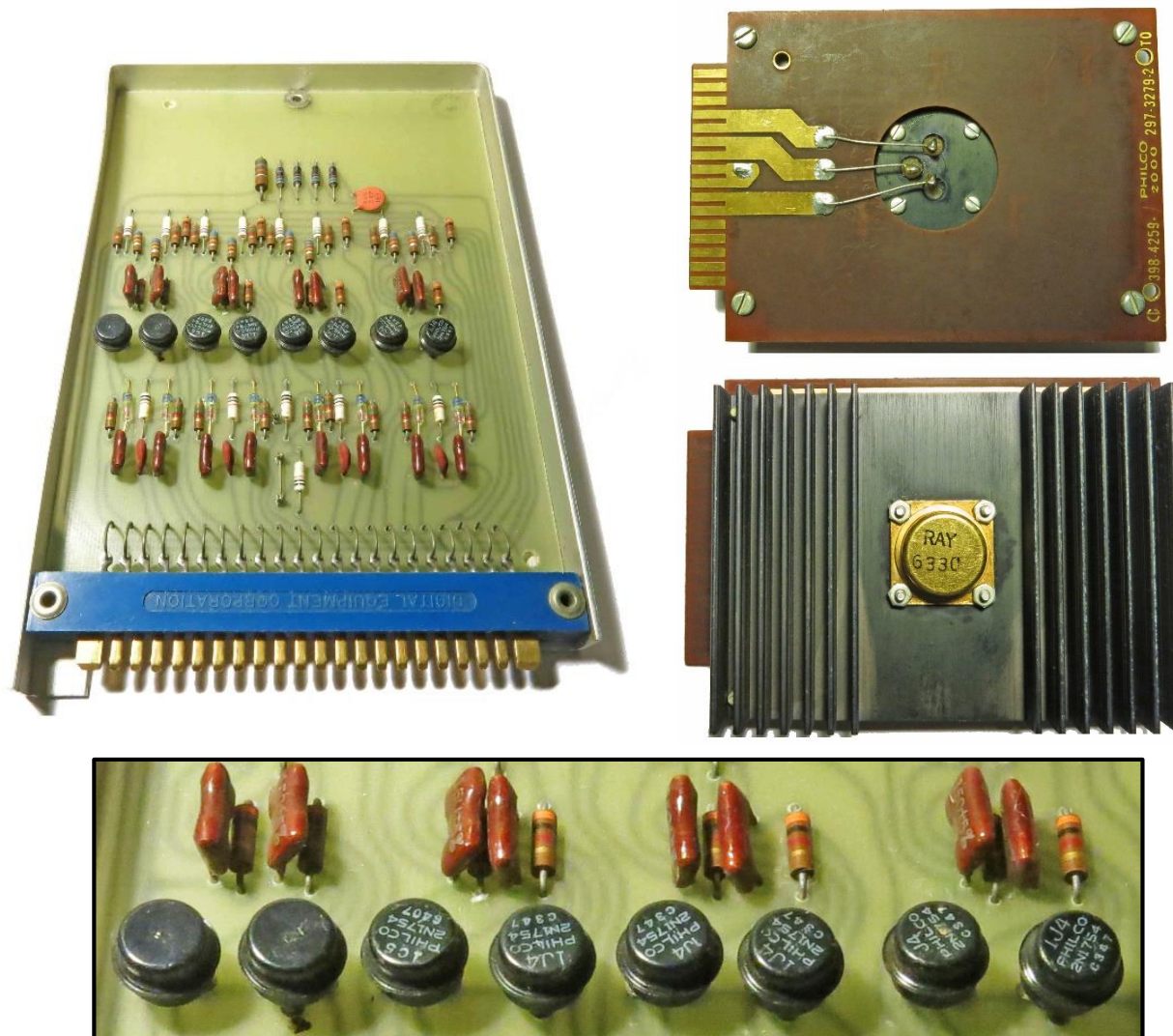


PHILCO
Famous for Quality the World Over

Real Time Process Control with MADT Transistors: The very high speed performance characteristics of Philco's MADT transistors were the basis for the development of small scale commercial computers intended for use as automated process control systems for such industries as electric power, metals, chemicals, petro chemicals and ceramics. As noted in the 1960 ad above, Philco partnered with Leeds and Northrup to design and manufacture the LN 3000 process control computer. Containing only 1200 MADT transistors, this unique real-time computer was an ideal application for the fast Philco transistors.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO



1960s Transistorized Computer Circuit Boards: At upper left is a photo of one of the circuit board types used in historic 1960s DEC PDP computers. This particular module is a type 4215 Four Bit Counter DEC System Building Block, consisting of four flip-flop circuits, and used in the PDP-4 and PDP-5 computers. Note that eight Philco 2N1754 MADT transistors were used in the module (enlarged view above). Also shown above, at upper right, is a circuit board from the Philco Transac 2000 computer. This module uses a Raytheon silicon power transistor, dated 1963. Although Philco had developed a comprehensive line of 1950s/1960s high speed germanium computer transistors, based on the precision etch process, and used throughout the computer industry, Philco was not an active presence in silicon transistor development. As a result, the Transac computers contained tens of thousands of Philco germanium transistors, as well as smaller numbers of silicon transistors manufactured by other companies.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

COMPUTER NAME AND MANUFACTURER	COMMENTS AND HISTORICAL IMPORTANCE	TYPES & QUANTITIES OF PHILCO TRANSISTORS USED
<u>SYSTEM BUILDING BLOCKS</u> DEC	One of the first commercial products from Digital Equipment Corp (DEC). These modules were 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.	Each digital module circuit board was approximately 4.5" by 7" and used germanium transistor circuitry. Most modules used fewer than 20 transistors, including MAT (2N393) and MADT (2N1754).
<u>LARC</u> Remington-Rand Univac	The Univac LARC (Livermore Advanced Research Computer) was designed in the late 1950s to provide exceptional performance for scientific calculations at the Lawrence Livermore lab. The computer used all solid state design and magnetic core memory to achieve very high speed operation.	62,000 total transistor count including 57,000 SBT (SB100), with fewer MADT (2N501) and alloy junction (2N597). Small numbers of transistors from other companies were also used.
<u>MOBIDIC</u> Sylvania	MOBIDIC (Mobile Digital Computer) was developed by Sylvania under contract from the U.S. Army Signal Corps. The 1959 MOBIDIC A was the first large scale fully transistorized general purpose computer delivered to the Army. A military truck/trailer was required to house and move the operational computer.	The MOBIDIC series of Army computers included several models (A, B, C, D and 7A). All used Eccles-Jordan flip-flop circuits, with up to 30,000 MAT transistors (2N393) for the system.
<u>TRANSAC</u> Philco	Philco entered the large scale commercial computer market with the Transac S-2000 in late 1957. Additional versions of the Transac line were built, including the models 210, 211 and 212, until Philco withdrew from the general purpose computer field in 1965.	The first Transac, Model S-2000, was a very large scale computer system, using over 40,000 SBTs. Later models were upgraded to use the faster MADT types.

Philco Transistors in Historic 1950s/1960s Computers: Philco high speed germanium transistors from the late 1950s/early 1960s were used in many of the pioneering and historic computers developed at that time. This was because the Philco SBT, MAT and MADT transistors were among the fastest switching devices available and a major design goal for these transistorized computers was computing speed. The table above highlights the importance of these Philco transistors in several early historically significant solid state computers.

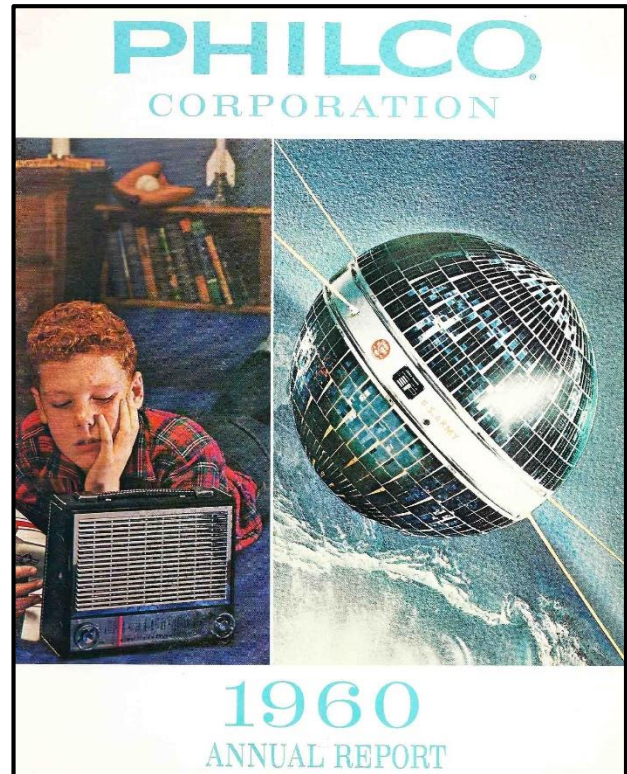
TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

Production of 25 Millionth Transistor Celebrated by Philco



Colonel Douglas O. Toft, Deputy Commanding Officer, U.S. Army Signal Supply Agency, Philadelphia holds 25 millionth transistor produced by Philco, which was presented to him by firm vice president, William J. Peltz (right). Philco's initial transistor production got underway in 1955 with the assistance of the U.S. Signal Corps support. The firm makes transistors on the industry's only fully automated lines under patented processing techniques and has also licensed four other companies to manufacture Philco transistors.



A Technology Powerhouse is Bought by Ford Motor Company and Exits the Transistor Business

The 1960 Annual Report well summarizes the broad range of products available from Philco, including radio/TV/phonographs, refrigerators/freezers/air conditioners, ranges, laundry equipment, radar, missiles, transistors, computers and microwave/communications equipment. Shown above are examples of some of these Philco products. The October 1961 edition of *Philco News* (upper left) highlighted the impressive milestone of 25,000,000 Philco transistors produced. Although overall sales were substantial (over \$400,000,000 in 1960), Philco's financial results were in decline at this time and the company registered a significant loss of \$1,605,000 in the first quarter of 1961. The Philco board of directors agreed to a buy-out by Ford Motor Company to be completed by November of 1961, at which time Philco became a wholly owned subsidiary of Ford. The Philco transistor manufacturing organization (Lansdale Division) did not fare well with the Ford takeover, and Philco exited this business in 1963.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

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

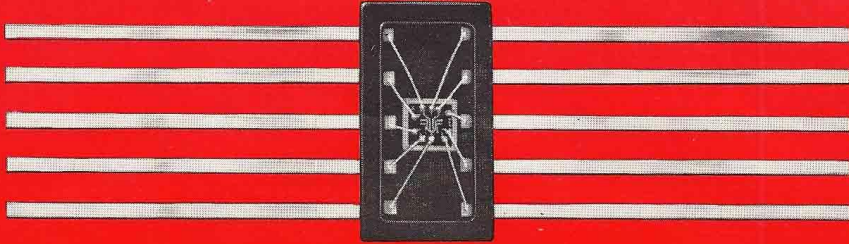


SPRAGUE
THE MARK OF RELIABILITY


Sprague Continues Volume Production of Precision Etch Transistors: In the 1950s, Philco had licensed four other companies to manufacture its unique line of precision etch transistors - these second source companies included Sprague, CBS, Motorola and General Transistor. Sprague was by far the highest volume second source manufacturer of Philco licensed transistors. When Philco exited the transistor manufacturing business in 1963, Sprague continued to expand 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 precision etch.

TRANSISTOR MUSEUM™ HISTORIC GERMANIUM COMPUTER TRANSISTORS


PHILCO



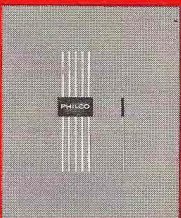
**PHILCO MICROLOGIC AND MILLIWATT MICROLOGIC
now in a flat pack**



ENLARGED TOP VIEW



ENLARGED SIDE VIEW



ACTUAL SIZE (1/4" x 1/8" nom.)

**Industry's most-widely-used Microelectronic Circuit Family
is now available in the industry's most-wanted package!**


- Now, designers have the option to specify any of sixteen Philco integrated circuits in a new, all-glass flat package as well as in TO-5.
- This new glass "Flat Pack" provides designers all the convenience and reliability of Philco integrated circuitry plus the flexibility of a greatly reduced package mass. The new, high-density Flat Pack facilitates use with multi-layer circuit boards.
- The new Philco all-glass Flat Pack features a true hermetic glass-to-glass fused seal, oven-fused by a controlled time-temperature process to eliminate all undue thermal stresses. Leads are gold-clad alloy 52.
- Design quantities of the following Philco Micrologic and Milliwatt Micrologic* circuits

are now available in the new glass Flat Pack from your nearest Philco Microelectronics Distributor:

<p>MICROLOGIC PL 900 Buffer PL 901 Counter Adapter PL 904 Half Adder PL 905 Half-Shift Register PL 906 Half-Shift Register without inverter PL 914 Dual Two-Input Gate PL 915 Dual Three-Input Gate PL 916 J-K Flip-Flop</p>	<p>MILLIWATT MICROLOGIC PL 908 Modulo 2 Adder PL 909 Gated Buffer PL 910 Dual Two-Input Gate PL 911 4-Input Gate PL 912 Half Adder PL 913 Type D Flip-Flop PL 921 Gate Expander PL 939 Dual Three-Input Gate</p>
--	---

*Philco Micrologic and Milliwatt Micrologic circuits are manufactured using the Planar Epitaxial Process through a cross-licensing agreement with Fairchild Camera and Instrument Corporation.

■ For more information write Dept. E61564



MICROELECTRONICS OPERATION

PHILCO®

A SUBSIDIARY OF *Ford Motor Company*

LANSDALE DIVISION, LANSDALE, PA.

Philco Microelectronics: Ford's acquisition of Philco in 1961 coincided with substantial changes in the semiconductor industry. Silicon technology was rapidly replacing germanium, and industry advances were dominated by new semiconductor technology leaders on the West Coast, including Fairchild. Philco Ford established the general offices for its new Microelectronics Division in Santa Clara, Ca - right in the heart of what would be known as Silicon Valley. Through licensing of Fairchild IC technology, as noted in the mid-1960s ad above, Philco Microelectronics moved quickly into this new technology and marketed a comprehensive line of integrated circuits. By 1968, the company expanded its product line to include MOS and bipolar ICs, MOS Fets and epoxy encapsulated silicon transistors. Gone were the earlier germanium SBTs, MATs and MADTs which had established Philco as the premier 1950s high speed transistor company.

TRANSISTOR MUSEUM™

HISTORIC GERMANIUM COMPUTER TRANSISTORS

PHILCO

Additional References for Philco Transistor History

1) The Computer History Museum, online at computerhistory.org and located at 1401 N Shoreline Blvd. Mountain View, CA 94043, has been established to preserve and present for posterity the artifacts and stories of the Information Age. There are many webpages at the CHM site that offer substantial historic information about Philco transistors and computers. Examples include:

[DEC SYSTEM BUILDING BLOCKS](#) [LARC COMPUTER](#) [MOBIDIC COMPUTER](#) [TRANSAC COMPUTER](#)

2) Ed Thelen's large collection of webpages is one of the most useful internet resources available on computer history. We have used this information extensively in developing the Transistor Museum research documentation on computer transistors. Use this link as a good entry point into Ed's amazing site: [Ed Thelen Site - 1961 BRL Third Survey of Domestic Electronic Digital Computing Systems](#)

3) Patent [2,885,571](#) filed by Richard Williams and John Tiley in 1954 is the first Philco SBT patent.

4) Patent [3,032,484](#) filed by Donald Sanders in 1959 is the first Philco MAT patent.

5) Patent [3,096,259](#) filed by Richard Williams in 1960 is the first Philco MADT patent.

6) The [Spring-Ford Historical Society Facebook](#) page has unique photos and commentary about the Philco Transistor Center Building which opened in 1956 at 501 S. Main Street in Spring City, Pa.

7) The original and most informative industry publication describing the emerging Philco SBT technology is the five part series of articles published in the December 1953 Proceedings of the IRE. The article titles and authors, all Philco engineers and scientists, are shown here:

[The Surface-Barrier Transistor: Part I- Principles of the Surface-Barrier Transistor](#)

by W. E. Bradley.

[Part II - Electrochemical Techniques for Fabrication of Surface-Barrier Transistors](#)

by J. W. Tiley and R. A. Williams.

[Part III - Circuit Applications of Surface-Barrier Transistors](#)

by J. B. Angell and F. P. Keiper.

[Part IV - On the High-Frequency Performance of Transistors](#)

by R. Kansas.

[Part V - The Properties of Metal to Semiconductor Contacts](#)

by R. F. Schwarz and J. F. Walsh.

This Philco section of the Historic Germanium Computer Transistors Research and Collecting kit has included a number of observations, statements and conclusions regarding the early history of Philco transistor development. This Transistor Museum material has been based on a review of multiple highly informative publications and websites devoted to this topic. Because of the historical importance of Philco transistors to the early development of solid state computers, the amount of research information available is substantial. For those interested in further research into early Philco transistors, the references shown above are an excellent starting point.