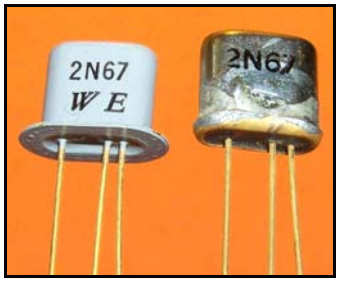
TRANSISTOR MUSEUM™

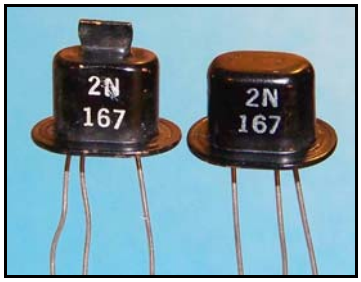
HISTORY OF TRANSISTORS

SPECIAL COLLECTION OF HISTORIC GERMANIUM TRANSISTORS USED IN DIGITAL COMPUTERS FROM THE 1950s/1960s

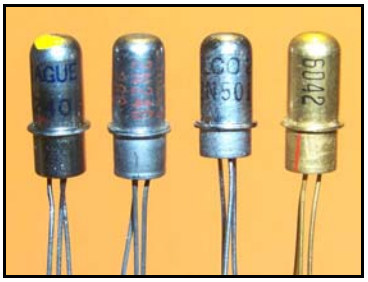
INCLUDED ARE FUNCTIONAL VINTAGE SAMPLES OF THESE HISTORIC GERMANIUM TRANSISTORS:



2N67

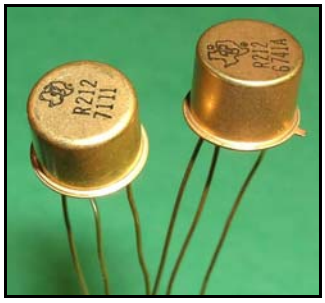


2N167



2N240/2N501

2N404



R212

154

ABOUT YOUR HISTORIC GERMANIUM COMPUTER TRANSISTORS

The transistors supplied with this publication have been selected to provide a broad historical overview of the transistor device types that formed the technological basis for the development of modern digital computers. Beginning with the invention of the transistor at Bell Labs in 1947, it was recognized that the performance advantages offered by this new technology could be utilized in digital computer circuits. Moreover, the vacuum tube based computers of the day, such as Univac, had established an early market presence for the commercial and military use of digital computers, but the limitations of vacuum tube technology precluded broader market acceptance. Transistor technology developed rapidly throughout the 1950s and 1960s, and digital computer circuitry was a primary focus for each of the successive, higher performance device types. The germanium transistors supplied with this publication represent the fundamental device types developed during this time frame for digital computer use. Silicon transistors and integrated circuits became common computer elements beginning in the late 1960s. This first publication deals exclusively with germanium transistors, which were the first transistor type to be used in commercial and military computers.

The included germanium computer transistors are:

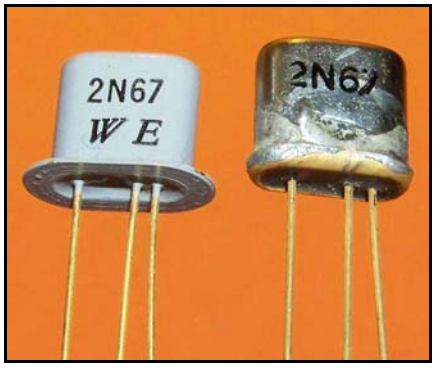
1. **2N67 Western Electric Point Contact**
2. **2N167 General Electric NPN Grown Junction**
3. **2N240 Philco PNP Surface Barrier (SBT)**
   & 2N501 Philco PNP Micro Alloy Diffused (MADT)
4. **2N404 RCA PNP Alloy Junction**
5. **R212 Texas Instruments PNP Alloy Junction**
6. **154 IBM NPN Diffused Base/Mesa**

Each type above is supplied in a packet with appropriate labeling. All transistors are clearly marked and are vintage 1950s – 1960s, and each of these historic transistor types was developed originally for electronic switching and timing functionality as required for digital computers.

This Transistor Museum ™ publication has been prepared for:

David Laws
Semiconductor Special Interest Group,
Computer History Museum,
1401 N. Shoreline Blvd.,
Mountain View, CA 94043

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Transistor Size (1/2" L X 1/8"W X 5/16" H)
Date Code on Right Unit 450 (1954, Week 50)
Date Code on Left Unit 652 (1956, Week 52)

Cardboard Outer Package with Inner Matchbook Style Mounting

WESTERN ELECTRIC 2N67

TYPE
Germanium Point Contact Triode

USAGE
Computer/High Speed Switch

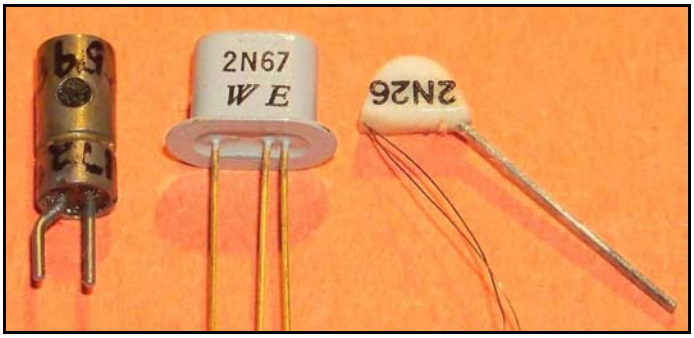
DATE INTRODUCED
1954

CASE STYLES
Metal Prototype Hand Soldered (Early)
Metal Hermetically Sealed
Ruggedized (Later)

AVAILABILITY
Rare (Limited Production in Mid 1950s)

HISTORIC NOTES
The transistor was invented at Bell Labs in late 1947, and announced to the public in June 1948. This first transistor technology was known as "point contact", a term which referred to the construction process of two pointed wires or contacts that were physically pressed down onto a germanium block. These first transistors were sensitive to any mechanical shock that caused internal movement. Point contact technology was quickly superseded by more stable and manufacturable transistor types, such as grown junction and alloy junction; however, Bell Labs/Western Electric continued limited work on the original point contact technology, and had developed a physically stable version of this device type by the mid 1950s. The 2N67 is an example of a "ruggedized" point contact transistor that was developed with mechanically ruggedized features – this device was intended for severe military use. As with all Western Electric transistors, the 2N67 was not sold commercially, but was used for phone company and military applications. Western Electric discontinued manufacture of point contact transistors (with limited exceptions for replacement purposes) in the early 1960s.

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Shown above are three Western Electric point contact transistors that illustrate the major case styles used for these unique devices from the 1950s. At left is a type A1729, which illustrates the standard metal cartridge style case. This metal cartridge is similar to the style used for the first point contact transistor (Type "A") to be manufactured by Western Electric in 1952. At right is a type 2N26, which uses a plastic bead style case. The plastic bead case technology was developed primarily for research purposes and was not produced in large quantities. The 2N26 in the photo is dated 4-54. At center is a 2N67 dated 652. The 2N67 is a point contact triode in a hermetically sealed metal case. Electrically, it is similar to the 2N26 and is housed in a robust metal case with mechanical features such that it is considered suitable for severe military use.

WECO 2N67
Page 2

2N67 Computer Facts

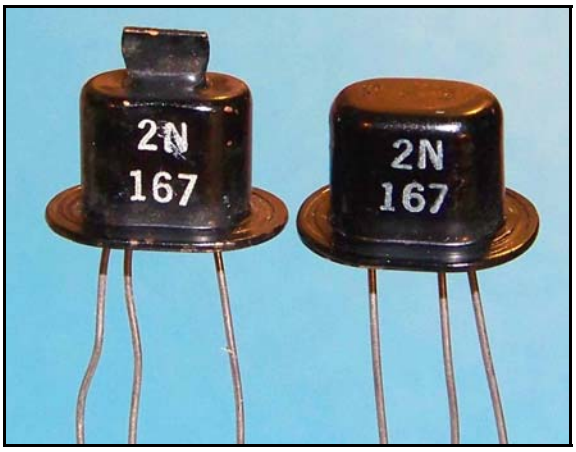
[1] Used by Bell Labs in early transistorized computer circuits.
[2] Originally released in 1954.
[3] Low volume production in mid-late 1950s.
[4] Robust design and packaging to enable point contact use in severe military applications.
[5] Examples of computers using the 2N67: Flyable TRADIC.

2N67 Additional References

[1] "Technical Data Semiconductor Devices", Western Electric Company, January 1956.
[2] Homer Coonce Oral History, Transistor Museum, http://www.transistormuseum.com
[3] Brown, L. C., "Flyable TRADIC: The First Airborne Transistorized Digital Computer", *IEEE Annals of the History of Computing*, Vol. 21, No. 4, 1999.
[4] Irvine, M. M., "Early Digital Computers at Bell Telephone Laboratories", *IEEE Annals of the History of Computing*, July-Sept, 2001.

Shown at right is a T-4 circuit pack, which was the basic logic building block developed for the Flyable TRADIC computer by Bell Labs in the mid 1950s. The module size is 2 1/2" X 1 3/8" X 3/8". Note that all components are mounted in the sealed module, except for the 2N67 transistor. This approach was used in order to ensure adequate cooling for the transistor and also to facilitate repair or replacement of failing 2N67 transistors. Bell Labs built two Flyable TRADIC computers - see reference [3].

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Transistor Size (1/2" L X 1/4"W X 1/2" H)
"Bath-Tub" Oval Case
Date Code on Left Unit 048 (1960, Week 48)
No Date Code on Right Unit

Plastic Tube Packaging Used by GE in Mid to Late 1950s

GE 2N167/2N167A

TYPE
Germanium NPN Grown Junction

USAGE
Computer/Industrial

DATE INTRODUCED
1955

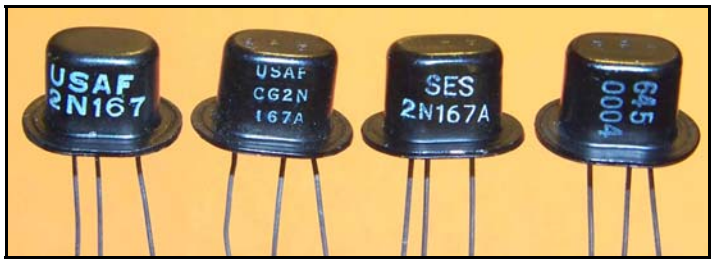
CASE STYLES
Black Metal with Pinched Top (Early)
Black Metal with Flat Top (Later)

AVAILABILITY
Common (High Volume Production)

HISTORIC NOTES

General Electric was an industry leader in germanium technology throughout the 1950s. The first GE junction transistors were introduced in late 1953 (PNP alloy junction devices, labeled as 2N43/44/45). Within the next couple of years, GE developed a variety of additional types, including the grown junction 2N167, introduced in 1955. This was a high reliability switching transistor and was used in digital computers and by the military. The 2N167 was one of the first reliable germanium computer transistors available to the industry and found wide spread acceptance for many years. Early solid state computers and digital switching circuits used 2N167 transistors. The 2N167A was introduced in 1960 as a mechanically "ruggedized" version of the 2N167 (same electrical specs). GE also developed USAF versions of the 2N167 and 2N167A. The 2N167/167A was produced well into the 1960s with millions of units sold. The high reliability aspects of this device allowed GE to charge a premium price; $6.45 each in the 1960 Lafayette Radio Semiconductor catalog.

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Shown above are four 2N167 related transistors. As mentioned previously, the 2N167 was qualified for use by the US Air Force. Note the "USAF" nomenclature on the two left transistors – the first is a standard 2N167, while the second is the "ruggedized" 2N167A type. Although GE was the original developer and primary supplier of the 2N167 transistor, there were several second-source suppliers. This was largely a replacement activity for military use. The "SES" 2N167A shown above was manufactured by the Semitronics Corporation in NY. The rightmost unit above is a "house numbered" version of the 2N167 – this device uses the CDC company proprietary transistor numbering system, and likely was manufactured by GE for use in CDC computers from the late 1950s, prior to the large scale use of silicon transistors or integrated circuits in commercial computers.

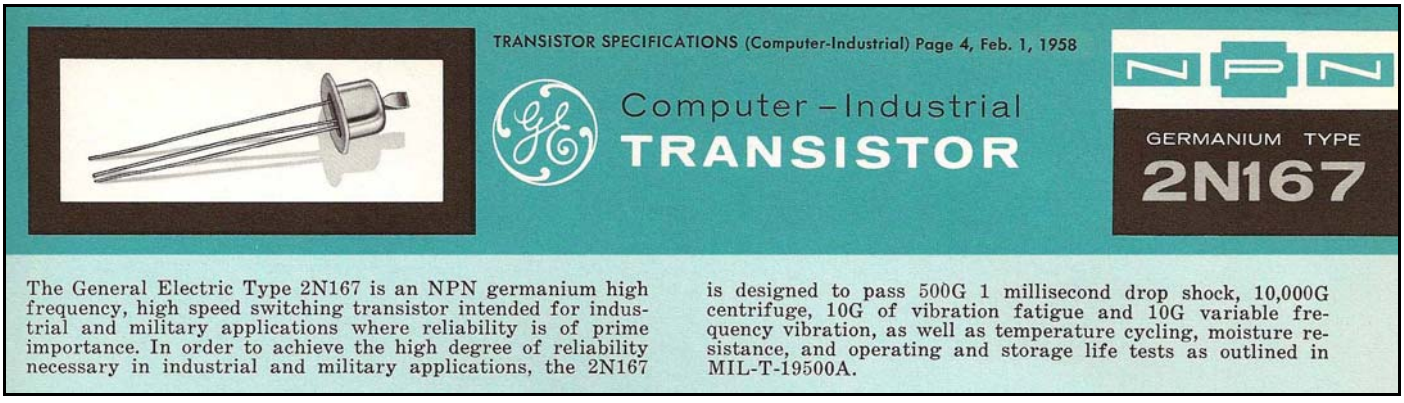
GE 2N167/2N167A
Page 2

2N167 Computer Facts

[1] Widely used germanium grown junction computer transistor in the 1950s/1960s.
[2] Originally released by GE in 1955.
[3] Qualified for use by the US Air Force.
[4] High volume production for many years.
[5] Robust design and packaging, with many remaining units still functional. Includes the "ruggedized" 2N167A version.
[6] Examples of computers using the 2N167: EDVAC Electronic Variable Automatic Computer.

2N167 Additional References

[1] "GE Transistor Manual", First Edition, General Electric Semiconductor Products Department, Syracuse N.J., 1957.
[2] Dr. Robert Hall Oral History, Transistor Museum, http://www.transistormuseum.com
[3] "A Third Survey of Domestic Electronic Digital Computing Systems", Martin H. Weik, Ballistic Research Labs, Report No. 1115, March 1961.



TRANSISTOR SPECIFICATIONS (Computer-Industrial) Page 4, Feb. 1, 1958

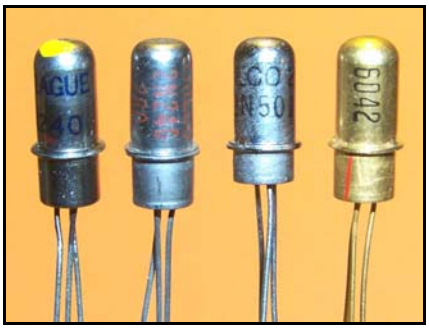
Computer – Industrial
TRANSISTOR

NPN
GERMANIUM TYPE
2N167

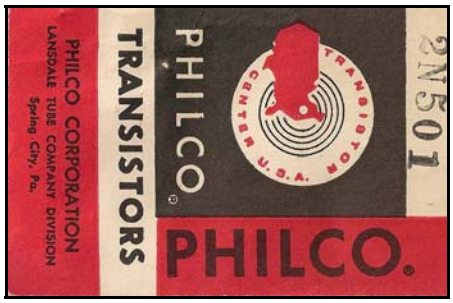
The General Electric Type 2N167 is an NPN germanium high frequency, high speed switching transistor intended for industrial and military applications where reliability is of prime importance. In order to achieve the high degree of reliability necessary in industrial and military applications, the 2N167 is designed to pass 500G 1 millisecond drop shock, 10,000G centrifuge, 10G of vibration fatigue and 10G variable frequency vibration, as well as temperature cycling, moisture resistance, and operating and storage life tests as outlined in MIL-T-19500A.

Shown above is a section of the 1958 GE specification sheet for the 2N167. The original "spec" sheet for the 2N167 was published in 1955, coincident with the introduction date for this device. Note the "pinched-top" exhaust tube shown in the illustration - the first GE transistors were all manufactured with this case style, which reflects the use of an exhaust tube to establish a vacuum inside the metal case. Early GE transistors were manufactured to very high quality standards, and were among the first to be qualified for military use.

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Transistor Size (1/8" OD X 3/8")
Classic "Bullet-Shaped" TO-24
Typical Date Code 6042 (1960 Month 42)



Paper Envelope Style Packaging

2N240 SBT/2N501 MADT

TYPE
Germanium PNP
Surface Barrier (2N240)
Micro Alloy Diffused Base (2N501)

USAGE
Computers and Digital Logic

DATE INTRODUCED
Early to Mid 1950s

CASE STYLES
Silver or Gold Metal
(Classic "Bullet-Shaped" Case)B

AVAILABILITY
Common (High Volume Production)

HISTORIC NOTES
Philco was an early manufacturer of transistors, starting in 1953/54 with the famous Surface Barrier type (SBT). This used a unique electrochemical etching process during manufacture that allowed for an extremely thin germanium base layer, which in turn allowed the transistor to operate at very high frequencies (20 to 30 MHZ). This operating frequency was substantially higher than that of alloy junction transistors of the time – Philco sold millions of these transistors in the 1950s. Further improvements to this basic technology led to the MAT (Micro Alloy Type, such as 2N393) and the MADT (Micro Alloy Diffused Base, such as the 2N501). With each of these enhancements to the basic electrochemical etching manufacturing process, the resultant transistor junction base regions could be made thinner, and ever higher operating speeds could be attained. Philco was the industry leader in high speed germanium transistors throughout the 1950s, and was able to charge premium prices for these devices – for example, the 2N240 was priced at $9.75 in the 1957 Lafayette Radio catalogue. Sprague became the major second source supplier for Philco transistors in the late 1950s and sold these devices for many years, into the 1970s.

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery

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

2N597.....for use in 200-300 kc computers, $f\alpha_b$ over 3 mc
2N598.....for use in 300-400 kc computers, $f\alpha_b$ over 5 mc
2N599.....for use in switching circuits faster than 400 kc, $f\alpha_b$ 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 mμ sec, fall time 4 mμ sec

Shown above are sections of an ad from the Oct 10, 1958 Electronics magazine. At this time, Philco (and second source Sprague) were supplying the highest speed transistors available for commercial computer manufacturers. Philco and Sprague maintained this leadership position throughout the 1950s, until other high speed transistor types (graded-base/drift, and mesa) became readily available from other companies. Note also in this ad that silicon transistors (2N496) were becoming available.

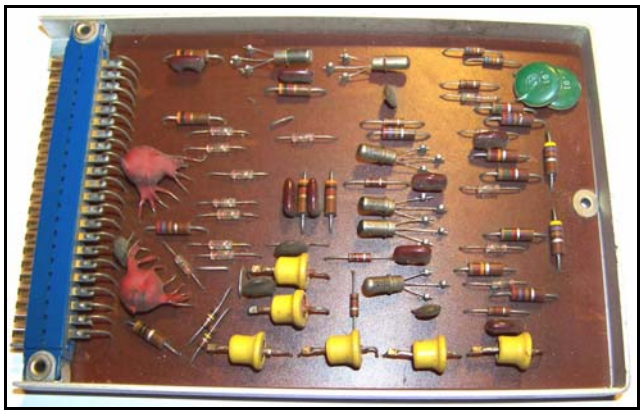
2N240 SBT/2N501 MADT
Page 2

2N240/2N501 Computer Facts

[1] Early commercial transistor technology with very high switching speeds.
[2] Originally released by Philco in the early 1950s, and later second sourced by Sprague.
[3] High volume production for many years.
[4] Basis for pioneering academic computers (TX series) and commercial computers (Transac).
[5] Examples of computers using the 2N240/2N501 : TX-0 and TX-2.
(Note Philco proprietary # L-5122 is equivalent to the 2N240 and L-5134 is equivalent to the 2N501.

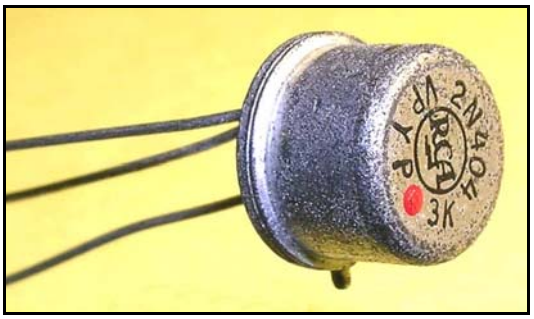
2N240/2N501 Additional References

[1] "A Discussion of the Circuitry used in the Lincoln TX-2 Computer", Jonathan R. Fadiman, Report 6D-2631, Lincoln Labs, Oct 1, 1958.
[2] Earls, Alan R., "Images of America – Digital Equipment Corporation",Acadia Publishing, 2004.
[3] Bell C.G., J. Craig Mudge, John E. McNamara, "Computer Engineering", Digital Equipment Corp, 1978.

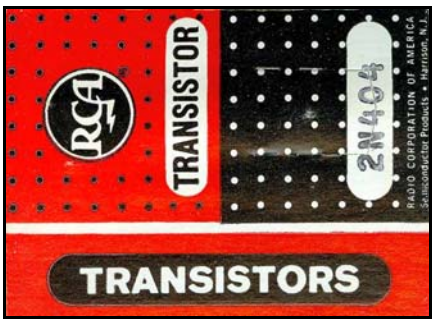


Shown above is an early DEC "Building Block" circuit board similar to the TX-0 and TX-2 technology. This is a flip-flop using Sprague transistors from 1959 (2N393s).

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Transistor Size (1/4" OD X 1/2")
Original TO-9, Later TO-5
Date Code 3K (1963 Month 11)



Plastic Bubble Pack on Reverse Side

RCA 2N404

TYPE
Germanium PNP Alloy Junction

USAGE
Computers and Digital Logic

DATE INTRODUCED
1957

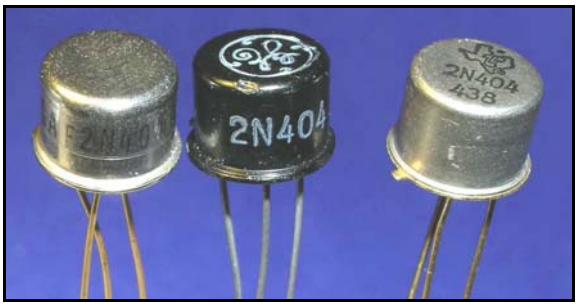
CASE STYLES
Black or Silver Metal

AVAILABILITY
Common (High Volume Production)

HISTORIC NOTES

The RCA introduced the 2N404 in 1957, and this device was one of the first of a series of highly successful germanium computer transistors developed by RCA throughout the late 1950s. Dr. Adolph Blicher managed the RCA group responsible for the 2N404, building on his earlier work at the Radio Receptor company where he developed the RR156 computer transistor. The 2N404 was soon adopted an as "industry standard" and sold in the millions, with multiple companies producing equivalent devices (Raytheon, Sylvania, Tungsol, TI, GE, General Instruments, and others). Related transistors include the 2N269 (electrically equivalent to the 2N404, but using a different case), the 2N404A (which is a higher current/voltage version of the 2N404) and the USAF 2N404 (qualified for military use). The 1957 Lafayette Radio catalog lists the RCA 2N404 price as $5.64, which was quite expensive for the time. The 1960 Lafayette Radio Semiconductor Directory lists the 2N404 as available from multiple companies (RCA, GE, Raytheon and Sylvania) for between $2.50 and $3.00. The 2N404 continued to be available throughout the 1960s/70s. The 2N404 remains in use today by hobbyists and experimenters, primarily as an audio or general purpose transistor – this modern usage is a fitting tribute to a classic germanium device, introduced over 50 years ago!

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Shown above are three 2N404 transistors, dated from the early 1960s, and made by different manufacturers - General Instrument (GI) at left, GE in the middle, and Texas Instruments at right. The 1966 EDN Semiconductor Annual Eight Edition lists a total of ten active 2N404 manufacturers. This broad manufacturing base attests to the widespread use of the 2N404 at that time. Also shown above is the packaging for the RCA 2N404 supplied to the US Air Force in 1961.

RCA 2N404
Page 2

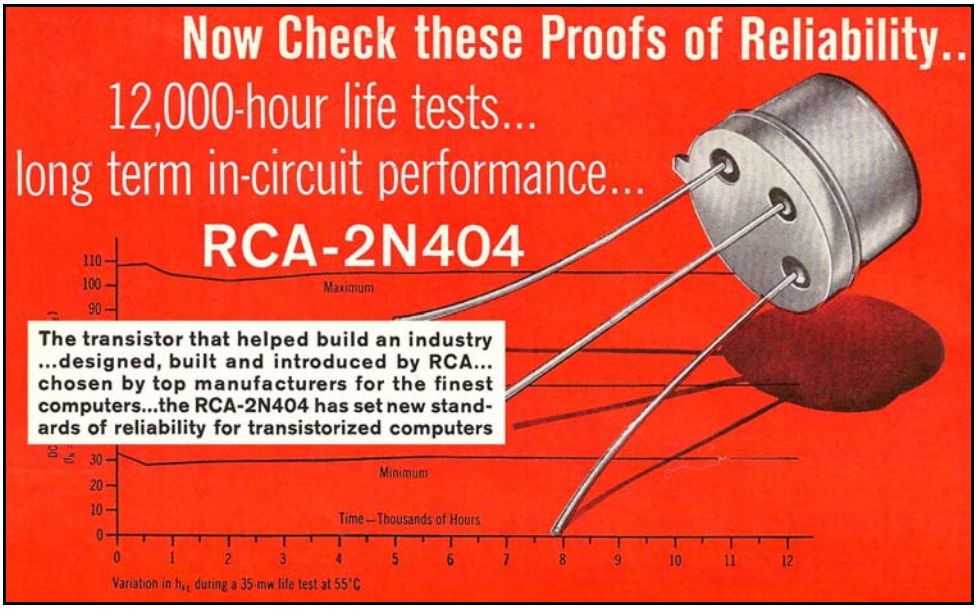
2N404 Computer Facts

[1] Most widely used germanium alloy junction computer transistor in the 1950s/1960s.
[2] Originally released by RCA in 1957, and later second sourced by multiple companies.
[3] Qualified for use by the US Air Force.
[4] High volume production for many years.
[5] Robust design and packaging, with many remaining units still functional.
[6] Examples of computers using the 2N404: Burroughs D 203 and Libratrol 1000.

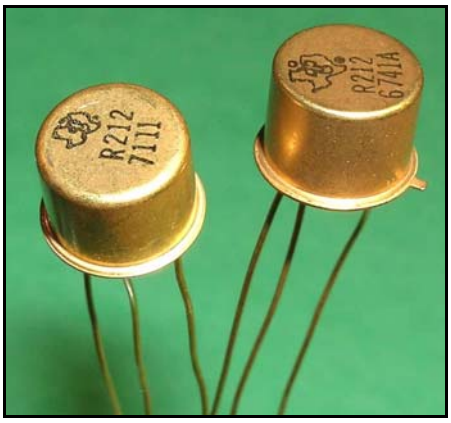
2N404 Additional References

[1] "RCA Semiconductor Products", Radio Corporation of America, Semiconductor and Materials Division, Somerville, N.J., 1959.
[2] Dr. Adolph Blicher Oral History, Transistor Museum, http://www.transistormuseum.com
[3] "A Third Survey of Domestic Electronic Digital Computing Systems", Martin H. Weik, Ballistic Research Labs, Report No. 1115, March 1961.

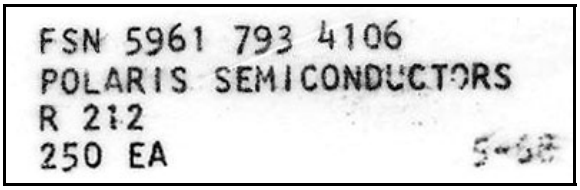
At right is a section of a full page ad from the May 1960 edition of the Proceedings of the IRE (Institute of Radio Engineers). The ad is intended to demonstrate the high reliability aspects of the 2N404, showing stable performance up to 12,000 life test hours. Since the 2N404 had been first introduced in 1957, it is likely that this life test data was developed using some of the original RCA devices. Note the ad insert claiming: "the transistor that helped build an industry…"



TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Transistor Size (1/4" Diameter X 1/4"H)
Standard T0-5 Case
Date Codes 7111 (1971) and 6741A (1967)



Stamped Box ID for TI R212 Polaris Transistors

TEXAS INSTRUMENTS R212

TYPE
Germanium PNP Alloy Junction

USAGE
Polaris Missile Guidance Computer

DATE INTRODUCED
Late 1950s

CASE STYLES
Gold Plated Metal

AVAILABILITY
Rare (Polaris Program Specific)

HISTORIC NOTES

By the mid 1950s, transistor technology had matured to the extent that the military was interested in utilizing these unique devices in "mission-critical" defense programs. One of the first documented large scale military uses of transistors was the Polaris missile program, which was initiated in 1956 when the Navy began funding a program to develop a ballistic missile that could be launched from a submerged submarine. The inertial guidance computer carried onboard each Polaris missile was developed at the MIT Instrumentation Laboratory, and these first versions used discrete transistor components, such as the R212, while later systems, including the Apollo Guidance Computer, used integrated circuits as this technology became available. Hundreds of Polaris missiles were produced until 1972, when the Poseidon missile was deployed as a replacement. Texas Instruments was a major supplier of semiconductors for the Polaris program, beginning with germanium transistors in the 1950s and ICs in the 1960s. There is a wealth of informative literature documenting the Polaris guidance computer program authored by Eldon C. Hall, who managed this work at MIT - see references [2] and [3].

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery

GERMANIUM TRANSISTORS
COMPUTER

Type	Case Type*	Pc w	BV CBO	Ic	hfe	fab mc	NET 1-99	NET 100-999
2N395	X	.150	—30	—250	20†	4.5	3.10	1.95
2N396	X	.150	—30	—250	30†	8.0	4.75	2.95
2N397	X	.150	—30	—250	40†	12.0	8.10	5.05
2N705	U	.150	—15	—50	25†	250	28.00	17.50
2N1046	K	15w	—80	—3a	70†	12	22.20	13.90
2N1093	X	.150	—30	—250	50†	8.0	4.80	3.00
2N1302**	S	.300	25	300	20	4.5	3.50	2.20
2N1303	S	.300	—30	—300	20	4.5	3.05	1.90
2N1304**	S	.300	25	300	40	8	4.50	2.80
2N1305	S	.300	—30	—300	40	8	4.50	2.80
2N1306**	S	.300	25	300	60	12	6.25	3.90
2N1307	S	.300	—30	—300	60	12	6.25	3.90
2N1308**	S	.300	25	300	80	20	8.90	5.55
2N1309	S	.300	—30	—300	80	20	8.90	5.55

Shown above is a section of the 1960 Lafayette Radio Semi-Conductor Directory listing the basic performance specifications and cost of the TI germanium computer transistor line. The R212 is not listed in this commercial catalogue, since this device was manufactured primarily for military use. However, the key performance specifications for the R212 (frequency, gain, power handling and current capability) are closely matched to the 2N13XX line of alloy junction devices shown in the chart above. The additional manufacturing process controls and testing activities required by the R212 program likely resulted in a very consistent and highly reliable transistor.

TEXAS INSTRUMENTS R212
Page 2

R212 Computer Facts

[1] One of the first germanium transistor types to be used in large scale "mission critical" military programs.
[2] Characteristics based on a Navy procurement specification and acceptance program to ensure consistent performance.
[3] High volume production from multiple vendors, including TI, Tung-Sol and RCA.
[4] Examples of computers using the R212: Polaris Inertial Guidance Computer.

R212 Additional References

[1] "Discontinued Transistor D.A.T.A. Book", D.A.T.A. Inc., 1975.
[2] Hall, Eldon C., "Journey to the Moon: The History of the Apollo Guidance Computer", AIAA, 1996.
[3] Hall, Eldon C., "From the Farm to Pioneering with Digital Control Computers: An Autobiography", *IEEE Annals of the History of Computing*, April-June, 2000.

TI was one of the transistor companies qualified to supply R212 devices for the Polaris program. At right is a photo of a section of a cardboard carton of 250 R212 transistors, all with date code of 6741 (1967, week 41). A sample of these transistors has recently been tested. All tested samples were functional and all tested samples exhibited similar performance. An impressive achievement for germanium transistors made over 40 years ago.

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery

Transistor Size (1/8" OD X 3/16")
Standard TO-18
Date Code 6132 (1963 Week 32)

Section of Cardboard Box Packaging for 200 Type 154 Transistors. Overall Box Size = 10 3/4" X 3 1/2" X 2". Individual Transistors Not Labeled, and Not Packaged Individually.

IBM TYPE 154

TYPE
Germanium NPN Double Diffused Mesa

USAGE
IBM Stretch and System 7000 Series Computers

DATE INTRODUCED
1959

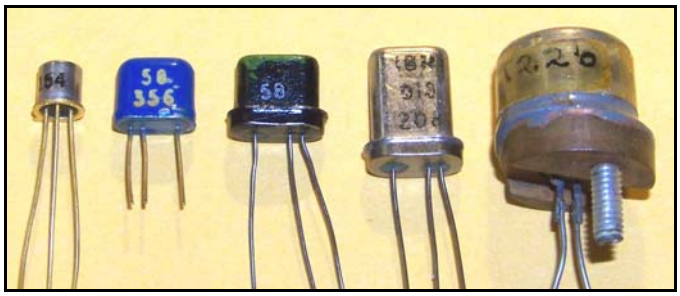
CASE STYLES
Silver Metal TO-18
Bulk Packaged Devices Not Labeled

AVAILABILITY
Rare (Low Volume Production)
Used in IBM Computers in Early 1960s

HISTORIC NOTES

IBM began investigating transistor technology soon after the initial Bell Labs/Western Electric public announcement of the transistor in June 1948 - see reference [1]. As with the rest of the industry, the first IBM experimental transistors were of the point contact type. By the 1950s, IBM transistor technology had developed sufficiently to support the release of the first commercial IBM transistorized product, the model 608 calculator. IBM engineers continued to improve the in-house transistor technology and began quantity manufacture of germanium transistors in the mid to late 1950s (Bob Slade, personal communication). IBM management determined to exit the transistor manufacturing business in the early 1960s, in order to devote more resources to the primary business of computer design and manufacture. The last germanium transistor type to be manufactured by IBM was the Type 154, released in 1959. This device used leading edge technology for the time (double diffused mesa) and provides a unique example of IBM's engineering expertise from the late 1950s.

TRANSISTOR MUSEUM™
Historic Transistor Photo Gallery



Shown above are representative IBM germanium transistors manufactured in the 1950s and 1960s. A type 154 is shown at far left for size comparison. The three middle units (types 58 and 018) are all alloy junction devices, manufactured in the 1950s and used initially on the first commercial IBM transistorized product, the 608 calculator, released in 1957. At right is an experimental IBM device, called a "thyratron transistor" which is a combination point contact and alloyed junction device designed to handle the heavy current requirements for firing solenoids. Note that IBM transistors released for production were all identified by numeric model numbers, such as 018 and 58. This process continued during the 1950s and early 1960s, when IBM was still in the transistor manufacturing business, and also was applied to the numbering scheme used with external transistor vendors when IBM exited the transistor manufacturing business in the 1960s.

IBM TYPE 154
Page 2

IBM TYPE 154 Computer Facts

[1] Last germanium transistor to be manufactured by IBM.
[2] Originally developed by IBM in 1959.
[3] Based on leading edge 1950s transistor technology (double diffused mesa) designed to compete with other high speed transistor technologies (SBT/MADT and drift).
[4] Low volume production.
[5] Examples of computers using the Type 154: IBM Stretch and IBM System 7000 series.

IBM TYPE 154 Additional References

[1] Bashe Charles J., Lyle R. Johnson, John H. Palmer, Emerson W. Pugh, "IBM's Early Computers", The MIT Press, 1986.
[2] Hannon Yourke Oral History, Transistor Museum, http://www.transistormuseum.com
[3] Ed Thelen's excellent website on early computing technology:
http://ed-thelen.org/comp-hist/index.html

At right is a photo of an IBM computer circuit card from the 1960s. This physical style of circuit board is known as SMS (Standard Modular System) and was used on most IBM transistor computers from the 1960s. This particular board is dated from the mid 1960s, after IBM had exited the transistor manufacturing business. The transistors on this board were provided by either Motorola or Texas Instruments.