

# TRANSISTOR MUSEUM™

# HISTORY OF CRYSTAL DIODES

## VOLUME 1

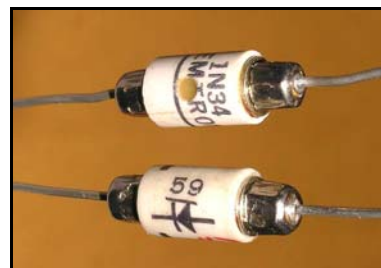
## 1950s GERMANIUM RADIO DETECTORS

Special Collection of Historic Diodes  
Designed for the Historian, Engineer,  
Experimenter, Researcher and Hobbyist

INCLUDED ARE CLASSIC EXAMPLES OF EACH OF  
THESE HISTORIC 1950s GERMANIUM DIODES:



CBS 1N81



KEMTRON 1N34



SYLVANIA 1N34A

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Transistor Museum™

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by Jack Ward

# ABOUT YOUR HISTORIC GERMANIUM CRYSTAL DIODES

Crystal diode technology can be traced back to the early 1900s, when hand-adjusted silicon detectors were first used with the new wireless devices to detect radio signals. Within a few years germanium/galena “cat-whiskers” were being used by amateur radio enthusiasts and in early commercial radios. Vacuum tube detectors largely replaced the use of these early crystal diode devices in most applications, until the widespread use of radar in WW II required high frequency, low noise detector/mixer diodes. Millions of silicon crystal diodes, such as the 1N21, were manufactured in the 1940s for military radar use. Sylvania pioneered the use of germanium for diodes, with the introduction in 1946 of the 1N34 – the first commercial germanium crystal diode.

**Volume 1 of The History of Crystal Diodes** includes historic examples of three germanium crystal diode types which are similar in performance and construction to the original 1N34. Below is a summary of the included diodes:

**KEMTRON 1N34:** From the 1950s, this ceramic-cased 1N34 represents a close copy of the original 1N34 from Sylvania. Of additional importance is the fact that KEMTRON is a little-known but historically significant diode company.

**Sylvania 1N34A:** From the 1940s and 1950s, the 1N34A represents a major advance by Sylvania in diode technology, and that is the use of a hermetically-sealed glass case for the device. This approach is still in use today.

**CBS/Hytron 1N81:** From the 1950s, the 1N81 is a unique device, manufactured by a major company (CBS) that was very active in mid-century semiconductor work, but exited the business in the early 1960s. The brown plastic case style of the 1N81 represents an early, but short-lived diode technology that was obsolete within a few years.

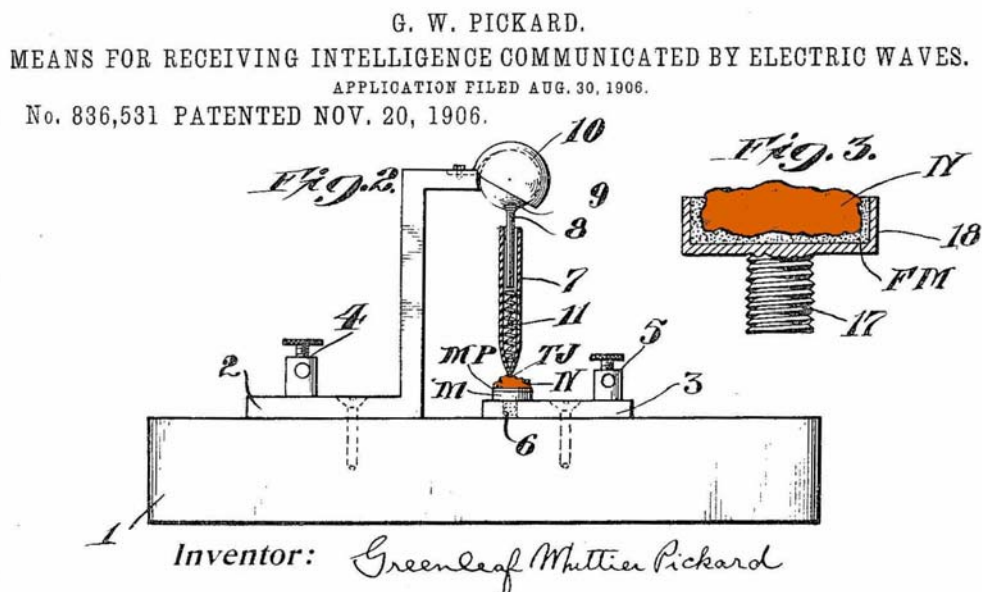
You'll receive one of each type above, supplied in a display package with appropriate labeling. All the diodes are clearly marked with type identification numbers and are vintage 1950s. Your diodes have been tested and function electrically as diodes, and should perform as designed in original circuit applications such as crystal radio circuits. However, due to the possible effects of age and storage conditions, no guarantees can be made about overall device performance.

The Transistor Museum™ is a virtual museum that has been developed to help preserve the history of the greatest invention of the 20<sup>TH</sup> century – the TRANSISTOR. Please visit the museum at: <http://www.transistormuseum.com>

# THE FIRST CRYSTAL DETECTORS

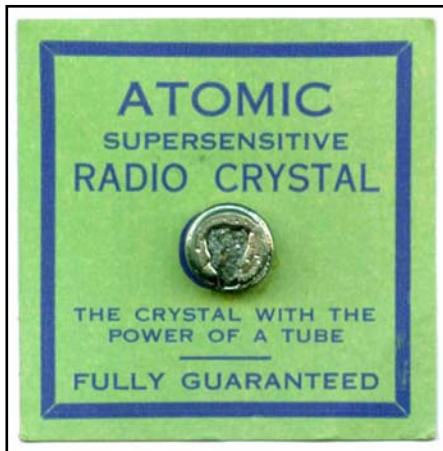
One of the earliest patents for crystal detector technology was granted in 1906 to Mr. G.W. Pickard of Amesbury, Massachusetts. A section of this patent (#836531) is shown below. As stated in this patent, "The invention relates to means for receiving intelligence communicated by electric waves". Further explanation by Mr. Pickard provides a clear description of the construction and operation of what would soon be known as the "cat's whisker" crystal detector. For several decades, into the 1930s, 1940s and 1950s, the cat's whisker crystal detector was used by radio manufacturers and electronics hobbyists as a key component in radio circuits. (See reference [1] for Tom Lee's excellent article, which provides a detailed discussion of early crystal diode technology. Also see references [2] and [3]).

Although the cat's whisker crystal detector could be made to operate, there were some basic limitations with this device that limited its continued and widespread use. As described in the Pickard patent, and further illustrated below, the crystal detector required manual adjustment of a mechanical point (the "cat's whisker") that was pressed down on to a crystal, and then was adjusted to find a "hot spot" on the crystal that provided the best radio wave detection. The sharp point of the "cat's whisker" would sometimes physically move out of the best performance area of the crystal, and would require frequent re-adjustment. Because of the erratic performance of the cat's whisker, commercial radio companies began using vacuum tube diode detectors in the 1920s and the cat's whisker remained primarily as an historical curiosity and hobbyist device.

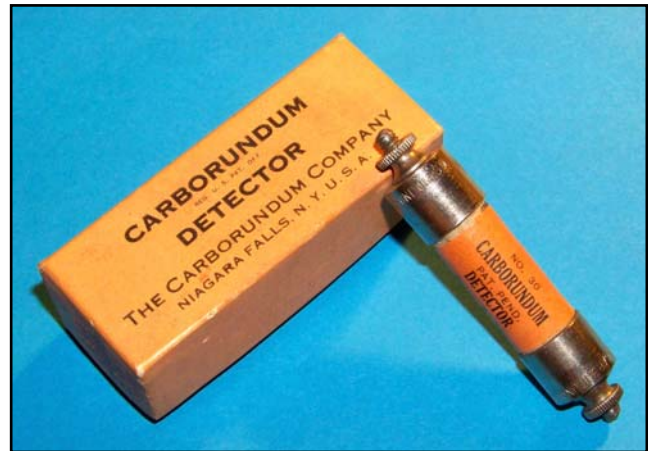


Shown above is a section of G.W. Pickard's 1906 patent of a silicon crystal (Fig 3) used with a metal spring-loaded "cat's whisker" (Fig 2) and adjusted to detect radio waves. This is one of the first U.S. patents of a crystal diode detector.

# THE FIRST CRYSTAL DETECTORS



(A)



(B)



(C)



(D)

Shown above are photos of various commercial and hobbyist crystal diode detectors from the 1920s through the 1950s. As discussed earlier, during this timeframe, most commercial radio manufacturers were using vacuum tube detectors, due to the "hand-adjusted" and sometimes erratic behavior of the "cats whisker" crystal technology. Note also the use of different semiconductor elements, such as galena, carborundum, silicon and the mysterious "Atomic" crystal. Manufacturing dates for the above devices are (A) 1950s, (B) (C) and (D) 1920s/1930s, and finally, the first commercial crystal diode (1N34) shown at the bottom of photo (D) is from the mid 1940s - be sure to include historic devices such as these in your research and collection.



# WHAT'S INCLUDED WITH YOUR HISTORIC GERMANIUM CRYSTAL DIODES

ONE EACH OF THESE CLASSIC 1950S  
GERMANIUM RADIO DIODES:

**KEMTRON 1N34      SYLVANIA 1N34A**  
**CBS/HYTRON 1N81**

EACH DIODE IS STORED IN A UNIQUE  
TRANSISTOR MUSEUM DISPLAY ENVELOPE

THIS BOOKLET CONTAINS TRANSISTOR  
MUSEUM PHOTOGALLERY DOCUMENTATION  
WITH DETAILED PHOTOGRAPHS AND  
HISTORICAL RESEARCH ABOUT YOUR DIODES

ALL PRINTED MATERIAL IS CONTAINED IN  
ARCHIVAL QUALITY SHEET PROTECTORS AND  
ENCLOSED IN AN EXPANDABLE BINDER

YOU'LL ALSO RECEIVE ADDITIONAL  
TRANSISTOR MUSEUM DISPLAY ENVELOPES  
AND STORAGE SHEETS TO ASSIST IN  
EXPANDING YOUR OWN HISTORIC DIODE  
RESEARCH AND DEVICE COLLECTION

Transistor Museum™

History of Crystal Diodes Volume 1 - PAGE 4

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# SUGGESTED NEXT STEPS FOR THE HISTORIAN, ENGINEER, EXPERIMENTER, RESEARCHER AND HOBBYIST

**Research a Specific Company or Type of Diode:** After you've started a basic collection of early diode types, an excellent next step would be to expand your collection with emphasis on a particular historic company of interest or a specific type or number range of devices. For example, the earliest commercial diodes were labeled with a 1NXX numbering system, such as 1N34, and a suggested research strategy might be to identify and collect the complete range of devices from 1N21 to 1N100. Another approach might be to collect the complete range of known "1N" types from a pioneering diode company, such as Sylvania, Kemtron, or CBS/Hytron.

**Expand Your Historic Diode Collection:** Adding to the historic germanium diodes included in this Volume 1, an excellent next step would be to research, locate and acquire examples of the many types of historic devices developed in the 1940s, 1950s, 1960s and 1970s. Building your own personal collection of a well-researched variety of devices important to the history of diode technology could provide immense educational value for years to come. Use the included Transistor Museum display envelopes to get started!

**Build a Modern Replica of an Early Kit or Historic Construction Article Project:** With the wealth of historic documentation now available (for example, review a copy of Popular Electronics magazine from the 1950s), it is possible to build a modern version of a historic kit or vintage construction article project. We have provided two historic crystal diode radio examples in this booklet (see pages 9 and 10), and you can find many more vintage project articles in readily available books and magazines.

**Check Back Often at: [TRANSISTORMUSEUM.COM](http://TRANSISTORMUSEUM.COM)**

The Museum continues to expand and you'll find detailed research, photos, Oral Histories, and material to assist you in this exciting field of semiconductor history.

# LEARNING MORE ABOUT YOUR HISTORIC GERMANIUM CRYSTAL DIODES

1N34	AMPEREX, ELECTRON RESEARCH INC, CANADIAN GENERAL ELECTRIC COMPANY LTD, GENERAL ELECTRIC CO, GENERAL INSTRUMENT CORP, ITT SEMICONDUCTORS, KEMTRON ELECTRON PRODUCTS, OHMITE MANUFACTURING, PHILIPS ELECTRON DEVICES LIMITED, SEMI-ELEMENTS, TRANSITRON ELECTRONIC CORP
1N34A	AMPEREX, COSEM, ELECTRON RESEARCH INC, CANADIAN GENERAL ELECTRIC COMPANY LTD, GENERAL ELECTRIC CO, GENERAL INSTRUMENT CORP, HITACHI LTD, HUGHES SEMICONDUCTOR DIVISION, HUGHES INTERNATIONAL, ITT SEMICONDUCTORS, KEMTRON ELECTRON PRODUCTS, MISTRAL, NEW JAPAN RADIO CO LTD, NUCLEONIC PRODUCTS CO, OHMITE MANUFACTURING, PHILIPS ELECTRON DEVICES LIMITED, SEMI-ELEMENTS, SYLVANIA, TRANSITRON ELECTRONIC CORP
1N81	COSEM, ELECTRON RESEARCH INC, CANADIAN GENERAL ELECTRIC COMPANY LTD, GENERAL ELECTRIC CO, HUGHES SEMICONDUCTOR DIVISION, ITT SEMICONDUCTORS, KEMTRON ELECTRON PRODUCTS, MISTRAL, NUCLEONIC PRODUCTS CO, OHMITE MANUFACTURING, SESC, SEMI-ELEMENTS, SYLVANIA, TRANSITRON ELECTRONIC CORP

Since initial production in the 1940s and 1950s, the 1N34, 1N34A and 1N81 diodes continued to be manufactured for many years. This long standing production is indicative of the widespread use of these devices in commercial and military products. The above chart is a comprehensive list of manufacturers of these diodes, as documented in 1966 (see reference [5]). Note that the original developer of the famous 1N34 (Sylvania) was no longer making this device in 1966. Corporate success and production varied substantially through the decades of early semiconductor history, and lists such as the above would likely look very different when developed for different production dates.

# LEARNING MORE ABOUT YOUR HISTORIC GERMANIUM CRYSTAL DIODES

## BIBLIOGRAPHY OF EARLY CRYSTAL DIODE REFERENCE MATERIAL

This bibliography provides additional information regarding the material that has been referenced in your booklet. These publications are no longer in print, but you should be able to find them through online auctions or online vintage book sellers. All are highly recommended and provide a comprehensive view of crystal diode history and technology.

- [1] Lee, Thomas H., *The (Pre-) History of the Integrated Circuit: A Random Walk*, IEEE Portal, Solid State Circuits Society, Spring 2007. Comments: Tom Lee's article on the semiconductor antecedents of integrated circuit technology provides a comprehensive and very readable account of the first crystal detectors, beginning with Braun's work in the 1870s and including an extensive discussion of wireless (radio) detectors of the early 1900s. Also provided is an excellent bibliography related to crystal diode history. Highly recommended reading! You can access this article on the web as follows: Go to IEEE.org and use the search string - "Tom Lee IC History".
- [2] Kilpatrick, David G. and Dittrich, William A., *Diode Reference Book*. Philadelphia: M. W. Lads Publishing Co. 1965. Comments: This is a little known diode reference text, and is a "must-have" for those interested in mid-century diode technology. You'll find a comprehensive listing of all available diode types, and much additional information such as a listing of manufacturers, basic diode circuits and a brief history of diodes.
- [3] Conti, Theodore., *Metallic Rectifiers and Crystal Diodes*. New York: John F. Rider Publisher, Inc. 1958. Comments: This is a useful and informative volume covering crystal diode history, technical descriptions, photos and detailed specifications - all documented from a mid 1960s perspective.
- [4] *The Radio Amateur's Handbook*. Published by the American Radio Relay League. , West Hartford, CT. Comments: Beginning publication in the 1920s, this Handbook has been the "master reference" for amateur radio operators. Each annual edition documents ongoing progress in the field of electronics. The 1956 edition provides a comprehensive list of available crystal diode types from that time period.

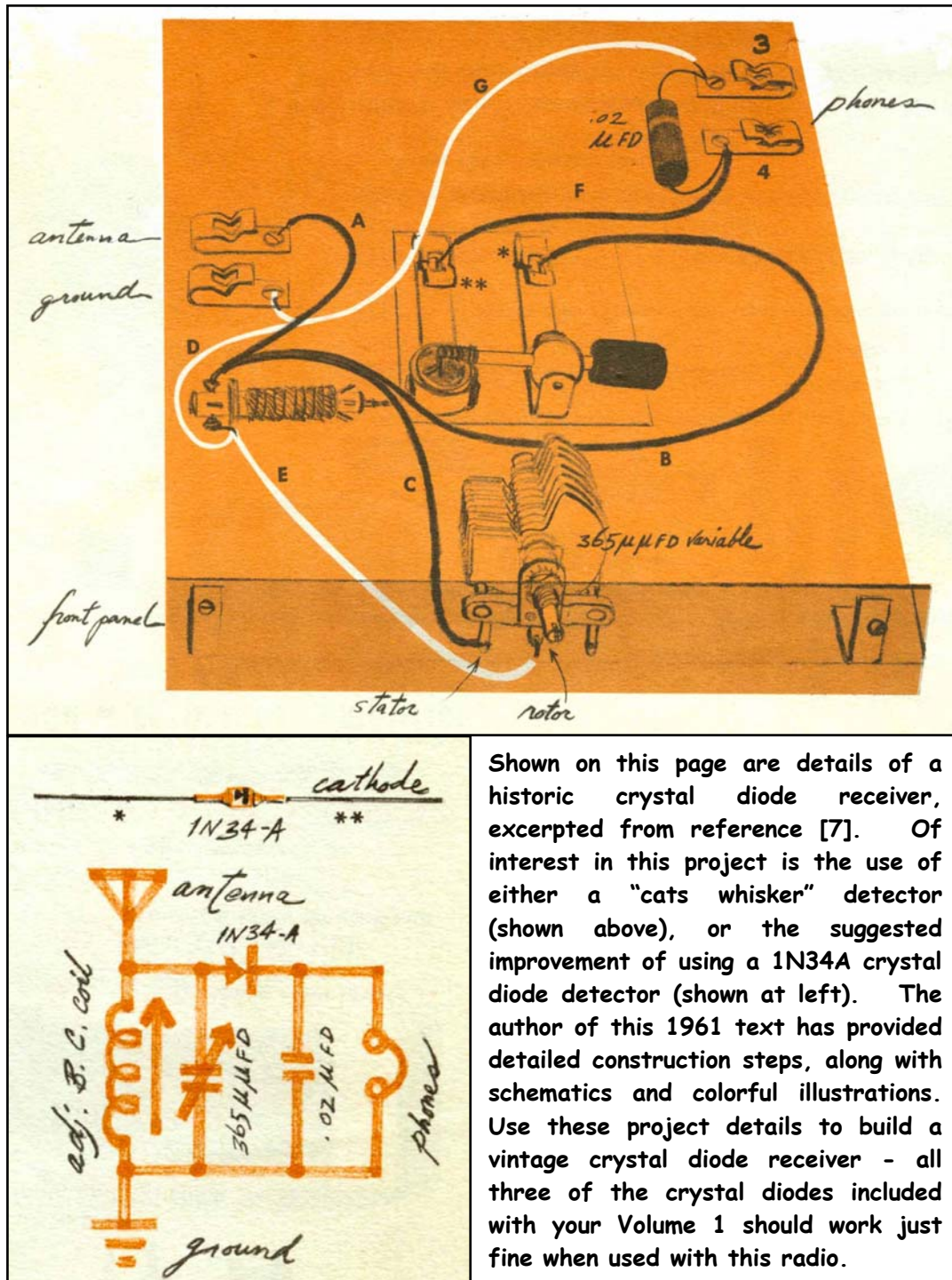


# LEARNING MORE ABOUT YOUR HISTORIC GERMANIUM CRYSTAL DIODES

## BIBLIOGRAPHY OF EARLY CRYSTAL DIODE REFERENCE MATERIAL (Continued)

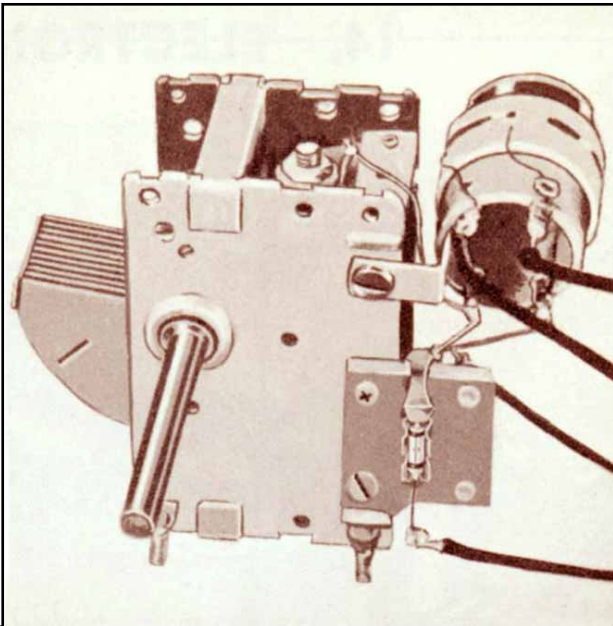
- [5] ***Semiconductor Diode and Silicon Controlled Rectifier Characteristics Tabulation.*** D.A.T.A. series published by Derivation and Tabulation Associates, Inc. Orange NJ. Comments: To quote from the 17<sup>th</sup> edition, 1966 "This tabulation is designed to report comprehensively on what is presently being produced (throughout the free world) in this specific component field". Annual editions of the D.A.T.A. series were likely the most comprehensive listing of component specifications published in the 1950s, 1960s and 1970s. The diode series provided extensive technical information, including type numbers, performance parameters, outline drawings and manufacturer's information. The 13<sup>th</sup> edition (April 1964) was more than 500 pages.
- [6] ***Transistor Substitution Handbook.*** Howard W. Sams and Co. Fourth Edition, January 1963. Comments: Although primarily intended to provide a list of transistor substitution types, included is a comprehensive list of crystal diode substitutions. This is very useful information for documenting early crystal diode history.
- [7] Smith, Joseph A., ***Fun Time Radio Building.*** Children's Press, 1961. Comments: If you were a young hobbyist and wanted to build a radio circuit in the 1960s, you may have used this book. Designed to assist young engineers in constructing simple circuits, there is frequent use of crystal diode technology. In addition, there is basic use of vacuum tubes and transistors.
- [8] ***Crystal diode Company-specific literature.*** Comments: Most crystal diode manufacturers from the 1950s and 1960s published a variety of literature regarding the specifications and use of their crystal diodes. Particularly active in the early days were Sylvania and CBS, with multiple publications from each company. An example is: ***Electronic Shortcuts for Hobbyists***, published by Sylvania Electronics Products Inc, - various editions dated from the 1940s and 1950s. This volume contains 24 crystal diode circuit applications, as well as Sylvania crystal diode specifications. Company-specific literature such as this volume can be very useful when documenting early crystal diode history.

# LEARNING MORE ABOUT YOUR HISTORIC GERMANIUM CRYSTAL DIODES

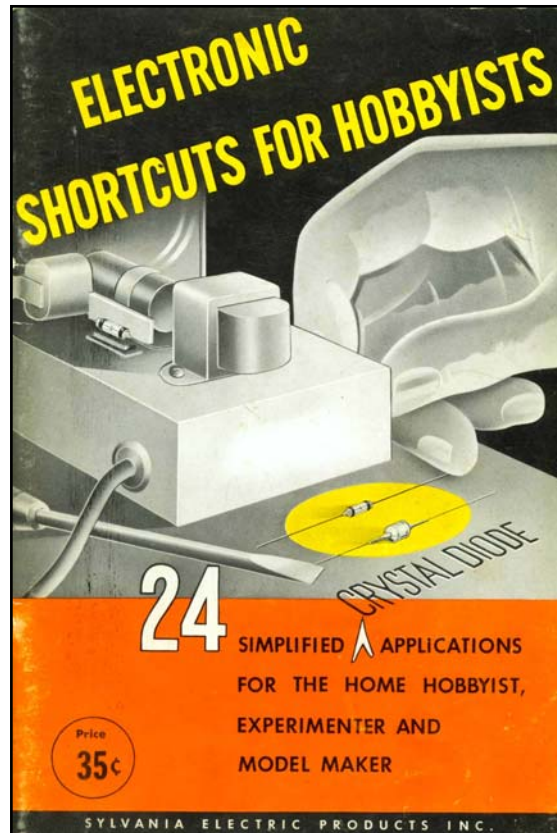


Shown on this page are details of a historic crystal diode receiver, excerpted from reference [7]. Of interest in this project is the use of either a "cats whisker" detector (shown above), or the suggested improvement of using a 1N34A crystal diode detector (shown at left). The author of this 1961 text has provided detailed construction steps, along with schematics and colorful illustrations. Use these project details to build a vintage crystal diode receiver - all three of the crystal diodes included with your Volume 1 should work just fine when used with this radio.

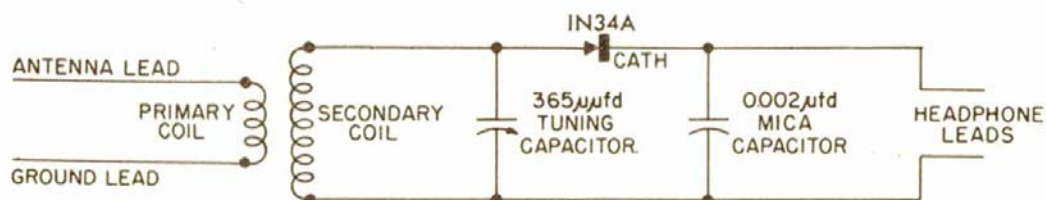
# LEARNING MORE ABOUT YOUR HISTORIC GERMANIUM CRYSTAL DIODES



As noted in reference [8], many of the early crystal diode manufacturers, such as Sylvania, CBS, and Raytheon published a variety of literature regarding the specifications and use of their crystal diodes. Particularly active was Sylvania, which began publication of this type of material in the mid 1940s. Shown on this page are sections of a crystal diode radio project from the early 1950s booklet, "Electronic Shortcuts for Hobbyists". An illustration of the radio is shown above, with the 1N34A diode in the foreground. The schematic is shown below.



This miniature crystal set covers the entire standard broadcast band. Headphones connected to it should have a resistance rating of at least 2000 ohms. Do not use crystal type headphones. When loudspeaker operation is desired, the output leads may be connected directly to an audio amplifier with a 500,000-ohm  $\frac{1}{2}$ -watt carbon resistor connected between the latter's input terminals.



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# BUILDING YOUR OWN COLLECTION OF HISTORIC GERMANIUM CRYSTAL DIODES

Shown below is an example of one approach to building your own collection of historic germanium diodes. This list is based on a 1950s CBS-Hytron company publication, "Crystal Diode Manual, Third Edition". Using this list (continued on the next page), you can build your collection one historic company at a time!

CBS TYPE	USE	NOTES	IN MY COLLECTION?
1N34	General Purpose	First germanium crystal diode type	Yes - Kemtron
1N34A	General Purpose	Early glass cased version of 1N34	Yes - Sylvania
1N35	Matched Pair 1N34A	Rare dual-diode assembly	
1N38/38A	High Reverse Voltage	Glass/plastic case	
1N39/39A	High Reverse Voltage	Plastic case	
1N40	Quad (4 1N34's)	Mounted in a vacuum tube base	
1N48	General Purpose Detector	CBS schematic as FM discriminator	
1N51	General Purpose	CBS schematic as AM detector	
1N52	General Purpose	Glass/plastic case.	
1N54	General Purpose	CBS schematic as AVC circuit	
1N54A	General Purpose	Glass/plastic case	
1N55 1N55A	General Purpose High Reverse Voltage	Glass/plastic case	
1N55B	General Purpose High Reverse Voltage	Plastic case	
1N56/56A	High Conduction	Glass/plastic case	
1N58/58A	High Reverse Voltage	Glass/plastic case	

# BUILDING YOUR OWN COLLECTION OF HISTORIC GERMANIUM CRYSTAL DIODES

(Continued)

This is the continuation from the previous page of the list of germanium diodes available from CBS-Hytron in the 1950s (this list shows all available CBS germanium diodes with a "1N" number less than 1N100). As suggested before, use this list to research and collect all the diodes documented in the historic literature.

CBS TYPE	USE	NOTES	IN MY COLLECTION?
1N60	Video Detector	Very commonly used as detector in AM radios	
1N63	General Purpose	Glass/plastic case	
1N64	Video Detector	Glass/plastic case	
1N65	General Purpose	Glass/plastic case	
1N67	General Purpose	Plastic case	
1N67A	General Purpose	Glass case	
1N69	General Purpose JAN (Army/Navy)	Plastic case	
1N70	General Purpose JAN (Army/Navy)	Plastic case	
1N71	Quad (4 1N56's)	Mounted in a vacuum tube base	
1N73	Quad (4 General Purpose)	Mounted in a vacuum tube base	
1N74	Quad (4 General Purpose)	Mounted in a vacuum tube base	
1N75	General Purpose	Glass/plastic case	
1N81	General Purpose JAN (Army/Navy)	Plastic case	Yes - CBS



# BUILDING YOUR OWN COLLECTION OF HISTORIC GERMANIUM CRYSTAL DIODES



Shown at right is a macro photograph of seven 1950s/60s germanium crystal diodes, chosen to represent the range of case styles, colors, types and manufacturers that could be the basis for expanding your collection. Beginning at left: National Union 1N51, Sylvania 1N58A, Radio Receptor 1N51, Raytheon CK705/1N34, International Rectifier 1N52, Transistron 1N54 and Hughes 1N61. Each of these companies and specific diode types can be further researched using the references provided with your book - a great way to document your expanding collection!

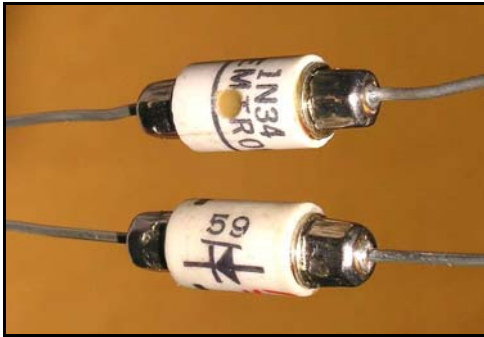


Crystal diode technology, devices and related antecedents span over a century, from the first "cat's whisker" crystal detectors developed in the early years of the 20th century to the more robust commercial crystal diodes, beginning with the Sylvania 1N34 developed in the mid 1940s. As shown in the photos above, these unique semiconductors have been marketed by a variety of different companies, packaged in colorful and graphically appealing containers, and manufactured in a broad range of plastic, glass and ceramic cases. The devices, packaging and specifications for crystal diodes documented in this book are just a starting point for those interested in researching this fascinating technology. The Photo Gallery descriptions of your diodes (beginning on the next page), and the display envelopes included at the rear of the book, have been provided as a first step for documenting and expanding your collection of these marvelous and historic devices.

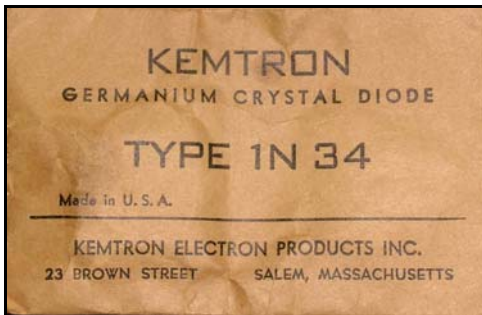
CHECK BACK OFTEN AT [TRANSISTORMUSEUM.COM](http://TRANSISTORMUSEUM.COM)  
YOU'LL FIND ADDITIONAL HISTORICAL SEMICONDUCTOR MATERIAL FOR YOUR RESEARCH

# TRANSISTOR MUSEUM™

## Historic Transistor Photo Gallery



Diode Size (3/16" Diameter X 3/8" L)  
Date Code "59" - Most Units Have No Date



3 1/2" X 2 1/4" Foldover Paper Packaging  
[See Page 2 for More Kemtron Diode Photos](#)

### KEMTRON 1N34 GERMANIUM CRYSTAL DIODE

#### TYPE

Germanium Point Contact Diode

#### USAGE

General Purpose

#### DATE INTRODUCED

1950s

#### CASE STYLES

White Ceramic

#### AVAILABILITY

Rare (Production Limited to 1950s/1960s)

### HISTORIC NOTES

The 1N34 germanium crystal diode had been originally introduced by Sylvania in 1946, and soon became a large commercial success. Into the 1950s and 1960s, many electronics manufacturers began to offer their own versions of this device. KEMTRON was one of those companies to "second-source" the 1N34. Shown above at top left are examples of the KEMTRON 1N34; note the white ceramic case, which is similar in style to the original case style used by Sylvania in the 1940s. The paper packaging for the device is also shown, and lists the address for KEMTRON as Salem, Massachusetts. Little is known about KEMTRON, which did not advertise extensively in electronic publications and apparently did not offer much in the way of product documentation. It is possible that KEMTRON was formed by ex-Sylvania employees, who were familiar with diode technology. (Note that an early Sylvania semiconductor facility was located close by in Woburn, Massachusetts). KEMTRON manufactured a variety of germanium and silicon diodes into the 1960s - the manufacturing facility was sold to the city of Newburyport in 1980 and demolished in 1981. KEMTRON diodes are truly unique and represent a classic technology, manufactured by a little known and historic company.

# TRANSISTOR MUSEUM™

## Historic Transistor Photo Gallery



Shown above are three examples of KEMTRON diode packaging. Topmost is a military package, dated 1963, for 1N34. The cardboard box is dated 1953 and contains a 1N43 diode. The bottom paper packaging was used in the latter 1950s for diodes such as the 1N34 and 1N56. Of interest is the enlargement shown above which apparently documents the corporate move of KEMTRON from Salem to Newburyport Massachusetts.



### KEMTRON 1N34 GERMANIUM CRYSTAL DIODE

Page 2

AVAILABILITY OF TRANSISTORS					
COMPANY	MONTHLY PRODUCTION CONTACT	JUNCTION	DELIVERY TIME CONTACT	JUNCTION	REMARKS
Federated Semi-Conductor Co., New York, N. Y.	...	...	...	...	Sample lots available in May, 1952
General Electric Syracuse, N. Y.	800	...	6-8 wks.	Not quoting	Sample lots Junction type Oct.-Nov. 1952
Kemtron Salem, Mass.	...	...	...	...	Sample lots Point contact Sept. 1952
RCA Harrison, N. J.	400	...	4-6 wks.	...	Sample lots Junction type Oct.-Dec. 1952
Radio Receptor New York, N. Y.	200	...	4-8 wks.	...	
Raytheon Newton, Mass.	1,000	...	4 wks.	Not quoting	Sample lots Junction type Nov.-Dec. 1952
Sylvania Boston, Mass.	...	...	...	...	Sample lots Point contact Aug. 1952
Western Electric New York, N. Y.	6,000	Less than 100	4-8 wks.	Not quoting	

#### KEMTRON Transistors?

The above chart was shown in the July 1952 issue of the Radio Electronics magazine and was intended to provide a summary of transistor production at this early time in transistor history. Note the mention of KEMTRON in the third row, with the claim that sample lots of point contact transistors would be available in Sept 1952. It would have been technically possible for KEMTRON engineers to fabricate point contact transistors, since the technology and required materials were similar to the manufacture of germanium point contact diodes, such as the 1N34. However, there is no known documentation of KEMTRON transistors, so the effort may have terminated prior to commercialization. Shown are left are three examples of KEMTRON germanium diodes (1N43, 1N56 and 1N34).

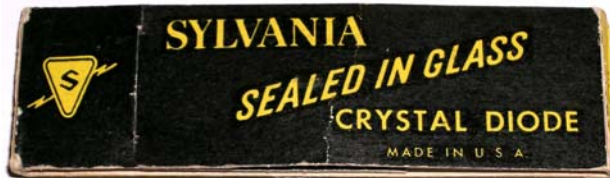


# TRANSISTOR MUSEUM™

## Historic Transistor Photo Gallery



Diode Size (1/8" Diameter X 1/4" L)  
No Date Code



4" X 1 1/4" Foldover Cardboard Packaging

[See Page 2 for More SYL 1N34A Diode Photos](#)

### SYLVANIA 1N34A GERMANIUM CRYSTAL DIODE

#### TYPE

Germanium Point Contact Diode

#### USAGE

General Purpose/Hobbyist

#### DATE INTRODUCED

Late 1940s

#### CASE STYLES

Glass Large (1940s-1950s)

#### AVAILABILITY

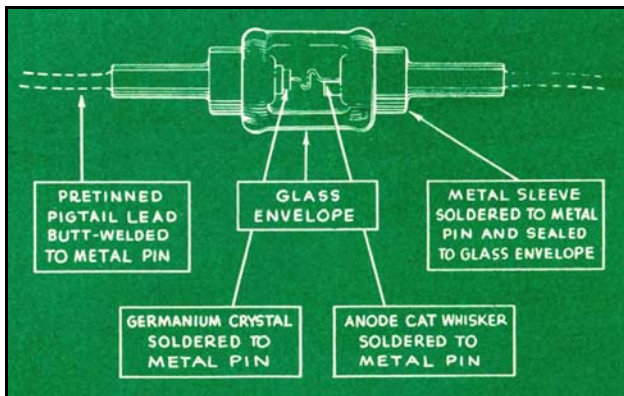
Common (Large Scale Commercial Use)

#### HISTORIC NOTES

Sylvania introduced the first commercial germanium crystal diode in 1946, with the famous 1N34. This was a general purpose diode that found widespread use in numerous commercial and hobbyist applications. Sylvania expanded this successful line of devices with additional types, such as the 1N38, 1N39, 1N40 thru 1N42, and 1N54 thru 1N58. These first Sylvania diodes used large white ceramic cases. By 1949, Sylvania began to offer smaller, lighter weight versions of these diodes with hermetically sealed glass cases - these newer devices were designated with the letter "A" following the original device number, so that the 1N34A was the glass-cased version of the original ceramic-cased 1N34. The glass diodes were a commercial success, and Sylvania continued to produce even smaller devices throughout the 1950s. The 1N34A is a rugged, high performing germanium diode, electrically equivalent to the original 1946 1N34 diode, and useful in a wide variety of historic and modern applications. Although manufactured over 50 years ago, most 1N34A Sylvania diodes are still functional, and will provide quite excellent results when used in circuit applications of the time, such as the classic crystal diode AM radio receiver built by thousands of engineers and hobbyists since the 1950s.

# TRANSISTOR MUSEUM™

## Historic Transistor Photo Gallery



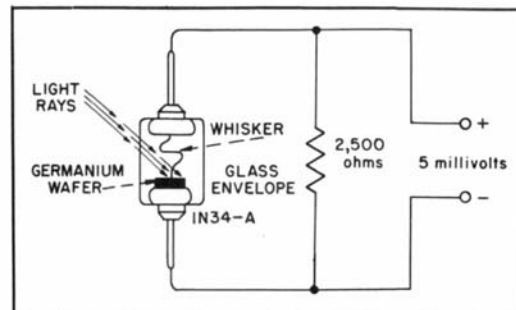
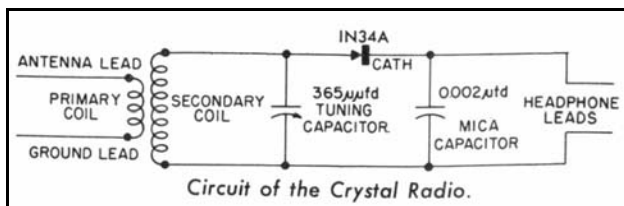
### SYLVANIA 1N34A GERMANIUM CRYSTAL DIODE

Page 2



### SYLVANIA GERMANIUM DIODES *Sealed in Glass* TYPES 1N34A and 1N58A

Sylvania Electric now offers two new germanium crystal diodes--the 1N34A and the 1N58A -- made moisture proof by a unique hermetically sealed glass cartridge construction. The new glass crystals have the same electrical ratings as corresponding ceramic diode types.



### Sylvania 1N34A

The two scans shown at upper left are from a 1949 Sylvania specification sheet for the newly released 1N34A germanium diode. Note the detailed drawing showing construction of the glass case and internal components. Additional text stresses the advantages of the smaller, lighter-weight devices, while still maintaining equivalent electrical performance to the original ceramic-cased 1N34. The photo at top right shows the differences between the original 1N34 case style (shown with green lettering as was used by Sylvania in the 1940s) compared with the more modern glass-cased 1N34A. The two schematics shown above are copied from the 1951 Sylvania publication, "Electronic Shortcuts for Hobbyists", which documented 24 crystal diode circuit applications. The radio schematic is a real classic, easy to build and capable of excellent AM reception. The photocell circuit illustrates a unique advantage of a glass case (allows light to activate the germanium), when compared to the opaque ceramic-cased 1N34.

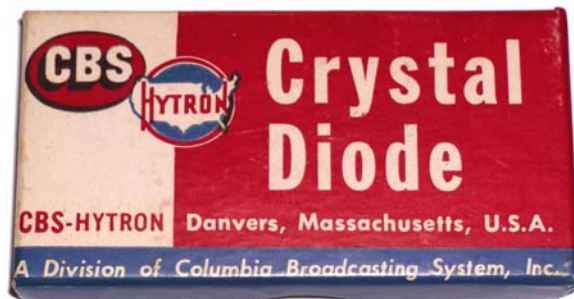


# TRANSISTOR MUSEUM™

## Historic Transistor Photo Gallery



Diode Size (1/4" Diameter X 3/8" L)  
Date Code on Similar Units (1959)



3" X 1 1/2" X 3/8" Cardboard Box with  
Removable Lid

[See Page 2 for More 1N81 Diode Photos](#)

### CBS HYTRON 1N81 GERMANIUM CRYSTAL DIODE

#### TYPE

Germanium Point Contact Diode

#### USAGE

General Purpose/Military

#### DATE INTRODUCED

Early 1950s

#### CASE STYLES

Brown phenolic plastic

#### AVAILABILITY

Rare (Production Limited to 1950s)

### HISTORIC NOTES

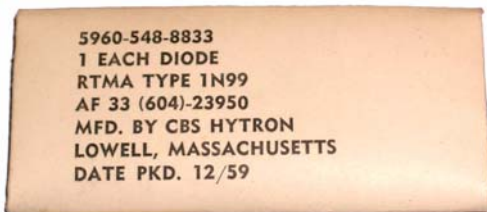
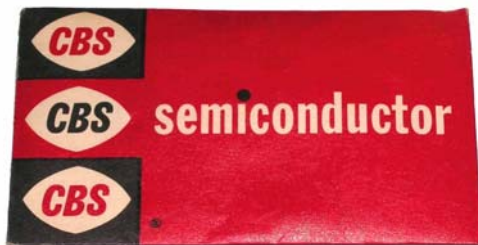
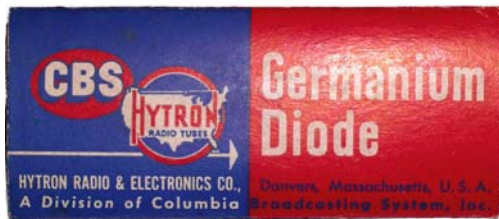
By the late 1940s, the germanium crystal diode market was expanding into the hundreds of thousands of units annually, largely to support the growth of the TV receiver market. Several large vacuum manufacturers became leaders in diode production, including Sylvania, General Electric and Raytheon. Other smaller electronics companies entered this market, including CBS Hytron, a company formed when CBS purchased a small vacuum tube company (Hytron) in order to establish a presence in the semiconductor manufacturing field. CBS was offering a complete range of germanium diodes (and transistors), beginning early in the 1950s. Most of these products were based on device types and technologies created by larger, more research oriented companies. For example, CBS was one of many companies to offer a "1N34" germanium diode, based on the universally popular device developed by Sylvania in the mid 1940s. The 1N81 diode had been developed initially by General Electric in 1950, primarily to support the military need for a rugged, general purpose germanium diode. CBS was one of several companies to provide second-sourcing for the 1N81, and introduced their version in 1952. These are excellent general purpose diodes, rugged and reliable, and can be used in most circuits interchangeably with the 1N34.

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### CBS HYTRON 1N81 GERMANIUM CRYSTAL DIODE

Page 2

At left are photos of additional CBS semiconductor packaging styles from the 1950s. The top package is a "matchbook" foldover style from 1954, and contains a brown phenolic plastic 1N64. The center package has a snapped opening tab, and contains a small glass 1N64. The lower package is a "matchbook" foldover style, and contains a small glass 1N99. Most CBS 1950s semiconductors are easily recognizable from the unique and colorful packaging used by this notable company.

CBS DIODES					
	Min. PIV MA @ 1V	Fwd. INV ua	Max. INV ua	Uses	Net 1-.99 100, UP
1N34A	75	5	50	G P	.45 .30
1N35	75	7.5	10	M P	1.80 1.20
1N38/A/B	120	4-25	6	High Rev V	.90 .60
1N39A (P)	225	5	65	High Rev V	3.75 2.50
1N48	85	4	833	G P Det	.33 .22
1N51	50	2.5	1660	G P	.33 .22
1N52	85	4.0	150	G P	.90 .60
1N54/A	75	5	7	G P	.90 .60
1N55/A	170	4	300	High Rev V	1.87 1.25
1N56/A	59	15	300	High Cond	.98 .66
1N58/A	120	5	600	High Rev V	.90 .60
1N60	30	3	67	Vid Det	.50 .33
1N63	125	4	50	G P	1.27 .85
1N64	20	—	200	Vid Det	.50 .33
1N65	85	2.5	200	G P	.53 .35
1N67/A (G)	100	4	5	High Rev R	1.07 .71
1N68/A (G)	130	3	625	High Rev V	1.20 .80
1N69/A (P)	75	5-25	30	G P	.48 .32
1N70/A (P)	125	3-25	25	G P	.71 .47
1N75 (G)	125	2.5	50	G P	.90 .60
1N81/A (P)	50	3.25	10	G P	.87 .57

Suffix P—Plastic Case; G—Glass Case; GP—General Purpose; MP—Matched Pair; Rev—Reverse; V—Volts; Det—Detector; Cond—Conduction; Vid—Video; R—Resistance;

This is a section of the "CBS Transistors and Diodes" page of the 1960 2<sup>nd</sup> edition of the Lafayette Radio Semiconductor Directory. Although offering a wide range of germanium products (including the 1N81) in this catalog, CBS soon exited the semiconductor business.



EVOLUTION OF CASE STYLES

Shown above are three examples of the evolving case styles of 1N81 throughout the 1950s. At left is an early 1950s GE device, which is somewhat crudely made and not hermetically sealed. The CBS device (from the mid 1950s) has a very robust phenolic plastic case, suitable for military use. At right is a modern 1960s hermetically sealed glass device from Transistron.

# BUILDING YOUR OWN COLLECTION OF HISTORIC GERMANIUM CRYSTAL DIODES

If you've enjoyed this web-based pdf version of this History of Crystal Diodes Publication, visit the Transistor Museum Store to purchase a hardcopy version, which also includes packaged examples of all three historic diodes as shown below, as well as additional storage/display envelopes for own collection.

[http://www.semiconductormuseum.com/MuseumStore/MuseumStore\\_Index.htm](http://www.semiconductormuseum.com/MuseumStore/MuseumStore_Index.htm)

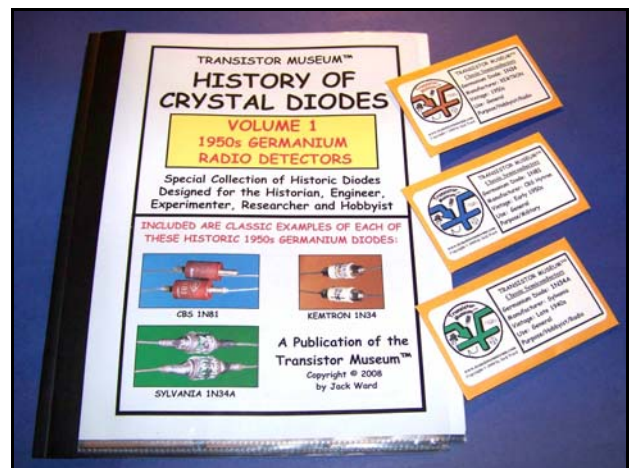


## HISTORY OF CRYSTAL DIODES VOLUME 1

Shown at left is a photo of the booklet, opened to the rear section, which contains the storage sheets for the three diodes in display envelopes and the six additional display envelopes provided to assist you in building your own historic diode collection.



Shown above is a photo of the two types of display envelopes you'll receive. The lower envelope contains one of the three historic diodes (the 1N81 is shown) and the upper envelope is one of six empty display envelopes provided for your own use with future research material. All nine display envelopes can be stored securely in the rear section of the binder.



Your historic diodes, photos, descriptive text and storage envelopes are contained in the expandable three-ring report binder as shown above. The display envelopes are securely stored in plastic sheet holders at the rear section of the booklet. Archival quality sheet protectors are used for storage of all pages. For size comparison, three display envelopes for your historic diodes are shown above, next to the completed Volume 1 binder.

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History of Crystal Diodes Volume 1 - BACK PAGE INSERT  
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