Second Breakdown in Semiconductor Devices - A Bibliography
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Second Breakdown in Semiconductor Devices –
A Bibliography

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## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Organization of the Bibliography</td>
<td>2</td>
</tr>
<tr>
<td>3. Index to Subject Matter, Reference Tabulation and Key Word Assignments</td>
<td>4</td>
</tr>
<tr>
<td>4. Index to Authors</td>
<td>11</td>
</tr>
<tr>
<td>5. Footnotes to Bibliography</td>
<td>15</td>
</tr>
<tr>
<td>6. Bibliography</td>
<td>16</td>
</tr>
</tbody>
</table>
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Harry A. Schafft

Almost 200 references with appropriate key words are listed which provide, it is believed, a comprehensive coverage of the literature of second breakdown in transistors and other semiconductor devices from 1958 through much of 1967. A representative list of earlier papers dealing with what appears to be second breakdown in point-contact and p-n junction diodes is also included. The indexes consist of an author index and an index to subject matter with reference tabulations and with key word assignments.

Key Words: bibliography, semiconductor devices, transistors, diodes, second breakdown, thermal breakdown, device reliability, failure modes, failure mechanisms.

1. Introduction

Second breakdown is generally recognized as a mode of operation in bipolar devices whose initiation is characterized by an apparently spontaneous decrease in voltage to a low sustaining voltage and a simultaneous constriction of current. Its occurrence can cause circuit malfunction and device damage. Thornton and Simmons in 1958 first reported the phenomenon in transistors, calling it a "new high current mode of transistor operation." They suggested that the occurrence of this mode was responsible for the mysterious failures that were observed in certain applications.

A full understanding of the nature and initiating mechanisms of second breakdown has still not been achieved despite the existence of the problem for these many years and despite the many workers who have been involved in the problem. The conditions that make a transistor more susceptible to second breakdown are usually those which are typical of higher power and higher frequency transistors. The problem has therefore grown, with the increase in transistor power and frequency capabilities, from one which was initially of little more than academic interest to one which has come to be of critical importance in the design, fabrication, testing, and application of a wide range of transistor types. As a result there has been a proliferation of papers on the subject to the point where it is believed that a bibliography of publications on second breakdown will now be of assistance to those concerned with the problem.

Under some operating conditions a decrease in voltage and a current constriction occur in diodes which is suggestive of second breakdown in
transistors. English, in 1963, proposed that the same phenomenon occurs in both types of devices. In 1965 Agatsuma et al. saw a similar effect in n+-n-n+ structures which led them to the generalization that second breakdown is a phenomenon that can occur in any semiconductor device. This bibliography includes therefore those papers from 1958 through much of 1967 which appear to deal with second breakdown in transistors, diodes and other structures. Considerable effort has been made to search the published literature (including many of the "trade" journals) to make the bibliography on second breakdown during this period as comprehensive as possible. A few company application notes, theses, and contract reports have also been included. Any suggestions regarding additions or corrections would be appreciated.

A number of papers are also included which were published prior to and a few years after Thornton and Simmons' paper that describe a similar voltage drop in point-contact and p-n junction diodes, usually referred to in that period as thermal breakdown or a turnover phenomenon. For convenience in the construction of this bibliography, these phenomena will also be called second breakdown. The selection in this group of earlier papers is meant to be representative rather than complete.

2. Organization of the Bibliography

Each reference is given a "name" which consists of a sequence of two digits, a letter and, if needed, another digit. The first two digits indicate the year of publication and the letter is the first letter of the first author's surname. The last digit is added to distinguish those references that would otherwise have the same "name." No rule was used in the assignment of this digit. The references in the bibliography are arranged according to their "names." The "names" are grouped first by year then in alphabetical order by letter and, if required, in numerical order by the last digit.

The subject matter covered by the references are divided into eight main topics some of which are divided into sub-topics. All topics are defined briefly and assigned key words in the Index to Subject Matter, Key Word Assignments, and Reference Tabulation. Also included in the Index is a tabulation of the reference "names" by the appropriate topics and sub-topics.

Appropriate key words are arranged in a column just below each reference in the bibliography. The key word for each main topic is capitalized while the key words for the sub-topics follow in lower-case, except for a few letter symbols. If no key words follow then the reference deals with all the sub-topics under the given main topic. If the reference contains an extensive review of earlier work in its introduction or discussion sections then the key word, SURVEY, will follow the others listed. A survey paper will have only one main keyword, i.e., SURVEY, followed by appropriate minor key words.

If second breakdown is not the major subject of the reference then the journal citation is followed by the symbol, (-). When those parts that do deal with second breakdown can be conveniently identified in
these papers then the journal citation is followed by the appropriate page, table or figure numbers in parenthesis.

Journal abbreviations follow those of Science Abstracts if they are contained therein. Otherwise, the abbreviations in the Chemical Abstracts List of Periodicals are used. One exception is made in the case of the Institute of Electrical and Electronics Engineers, which is abbreviated IEEE. For those publications which are not listed and where confusion might arise, no abbreviations are made.

The "name" assignments used in this bibliography are the same as those used in a survey paper [1] except for the following, where the "name" used in the survey paper is in parenthesis: 66C(66C1), 65F(66F), 65S4(66S9), 66B4(66B5), 66F(66F2), 66H(66H4), 66S(66S10), 67S2(66S).

The author gratefully acknowledges the helpful comments and suggestions of the many people who were consulted about the format of this bibliography.

I. Theory of or comments relevant to THEOREY

65W, 66J

1. initiating mechanisms. mechanisms

65J, 65W, 66J

a. critical triggering temperature. trigger temperature

51B, 53T, 54K, 54L, 55K, 59Y, 59Y1,
63B1, 63E, 63F, 63K1, 63S2, 64M, 64M1,
64R2, 64W, 64A, 65J, 65R, 65W, 65A2,
66J, 66K, 66W

b. lateral thermal instability. instability

63B, 63S, 63S1, 63S4, 64S, 65G1, 65J,
65S1, 65W, 66B2, 66F, 66J, 66S6, 67M2,
67S, 67S2

c. thermal effects excluding items

a and b. thermal

49B, 51B, 52B, 54L, 57M, 57T, 60B, 60T,
620, 62S, 63B1, 63E1, 63S2, 64F, 64M1,
64R1, 65H4, 65J, 65T, 65W, 66F1, 66J,
66K, 660, 66S5, 66T, 66T1, 66W, 67W

d. "pinch-in" effect. pinch

58T, 60L, 61T, 62S, 62W, 62W2, 63S2,
64W3, 65J, 65J1, 65W, 66G, 66J, 66T1,
66W, 67S, 67S2

e. free charge carrier effects. charge carriers

55K, 59Y, 60L, 61T, 63S2, 64S2, 65J,
65J1, 65W, 66E, 66G, 66J, 66S, 67H2,
67S
f. non-thermal effects excluding items d and e. non-thermal

60B, 60L1, 61T, 62S, 63M, 64P2, 64R,
64R1, 65J, 65W, 66H2, 66J, 66L, 66S5,
66W, 67H2, 67S2

g. interactions of the above mechanisms. interaction

60B, 65J, 65W, 66J, 66P, 66S2, 67S2

2. the physical state or electrical characteristics of the device while in second breakdown. SB state

53T, 57M, 57T, 58T, 59Y, 60B, 60T, 61T,
620, 62S, 63B1, 63E, 63E1, 63S, 63S1, 64M,
64M1, 64P2, 64R2, 64S, 65H4, 65W, 66E,
66E1, 66J, 66K, 66S2, 66S6, 66W

II. Electrical characteristics associated with second breakdown. CHARACTERISTICS

1. of particular devices.

a. bipolar transistors. transistor

55K, 58K, 60F, 60L, 60L1, 61G, 61T,
62H1, 62I, 62M1, 62S, 62W2, 63B, 63B1,
63D, 63E1, 63F, 63K, 63K1, 63M, 63S,
63S1, 63S2, 63S3, 63S4, 64A, 64H, 64M,
64M1, 64M4, 64N, 64P2, 64R, 64R1, 64R2,
64R3, 64S, 64S1, 64S2, 65A1, 65B, 65B1,
65F, 65G, 65G1, 65H, 65H5, 65H6, 65P,
65R, 65R2, 65R3, 65S2, 65S4, 65T, 65T1,
66A1, 66A2, 66B2, 66C, 66F, 66F1, 66G,
66H1, 66J, 66K, 66L, 66L1, 66N1, 66N3,
660, 66P, 66P1, 66R, 66R1, 66S1, 66S2,
66S4, 66S5, 66S6, 66S7, 66S8, 66T,
66T1, 66V, 67E, 67G, 67H2, 67K, 67M,
67M2, 67N, 67S, 67S2, 67S4, 67W

b. p-n junction diodes. diode

57M, 57T, 59Y, 59Y1, 60T, 620, 63B1,
63E, 63E1, 63F, 64M, 64M1, 64P2, 64R1,
64W, 65C, 65F, 65H4, 66E, 66E1, 66F1,
66K, 66R, 66S6
c. **point-contact diodes.**


d. **MOS transistors.**

66A4

e. **p-n-p-n type structures.**

65S1

f. **n⁺-n⁻-n⁺ or equivalent type structures.**

64F, 65A, 65A1, 66A2, 67H2

2. **during the development of second breakdown,**

a. **for rectangular pulsed operating conditions.**


b. **for other than rectangular pulsed and a variety of swept operating conditions.**


3. **during second breakdown where**

a. **a single continuous V-I characteristic is observed.**

49B, 53T, 57M, 57T, 58T, 59Y, 60T, 51T, 620, 63B1, 63E, 63E1, 63S, 63S1, 63S3, 64P2, 64R1, 64S, 65G, 65H6, 65P, 66E, 66E1, 66J, 66K, 66S1, 66S2, 66T1
b. multiple voltage levels are observed:
49B, 63E1, 64M1, 64N, 64P2, 65G, 66A3,
66E1, 66F1, 66J, 66N1, 66S2,

4. observed by measurement techniques which
are discussed in detail or which are
original.
58T, 59Y, 62S, 64A, 64S1, 65T, 66J, 66N3,
66S4, 66S5, 66S6, 66T, 66T1, 67G

5. of oscillations observed prior to or
during second breakdown operation.
49B, 55K, 59Y, 62M1, 64M, 64M4, 65H4,
66A3, 66E, 66G, 66L1, 66S4, 67S2

6. used as indicators of second breakdown
iminence.
63S, 63S1, 63S4, 64M4, 64S, 64S1, 65B,
66N1, 66R, 66S4, 66S6, 66S8, 66V, 67S

7. as they are affected by
a. resistive ballasting.
65G1, 65R2, 65S4, 65T1, 66B2, 66N1,
66R1, 66S6, 66S7, 66S8, 67S

b. device design excluding resistive
ballasting.
58T, 60L1, 61T, 62H1, 62W2, 63B, 63B1,
63S, 63S1, 63S4, 64M, 64R, 64R1, 64R2,
64R3, 64S, 64S1, 65B1, 65G1, 65H, 65H5,
65R2, 65R3, 65S1, 65T, 66A, 66B2, 66E,
66E1, 66G, 66H1, 66J, 66K, 66N1, 66P,
66R, 66R1, 66S1, 66S2, 66S5, 66S6, 66S7,
66T1, 67E, 67H2, 67K, 67M2, 67S, 67S2,
67W

c. internal current distributions.
58T, 59Y1, 62S, 62W2, 63B, 63E1, 63F,
63S, 63S1, 63S3, 64A, 64R1, 64R2, 64S,
64S1, 65G1, 65P, 65R2, 65R3, 65S4, 65T,
66B2, 66N1, 66P, 66S1, 66S2, 66S6,
66S7, 66V, 67M2, 67S2, 67W
d. design deficiencies and material defects.------defect

51B, 58T, 61T, 62S, 63D, 63E1, 63K,
63K1, 63M, 63S, 63S1, 63S2, 63S3,
63S4, 64S, 65B1, 65C, 65F, 65S1, 65T,
66L, 66P, 66S1, 66S2, 66S6, 67S2, 67W

e. nuclear radiation.-----------------------------radiation

64H, 64R3, 66C

f. a magnetic field.-----------------------------magnetic field

63E1, 65G

g. surface arcs spanning a p-n junction.--------arc

63E, 63E1

III. Observations made prior to or during second breakdown of------------------------OBSERVATION

66S6

1. the thermal impedance or internal temperature of the device.------------------------temperature

53T, 57T, 59Y, 59Y1, 60T, 63E2, 63F, 63F1,
63K1, 63S, 63S1, 63S4, 64B1, 64M, 64R,
64R1, 64R2, 64S, 65A, 65H3, 65H4, 65P1,
65R, 65T, 65A2, 66P1, 66R, 66S4, 66S6,
66T, 66T1, 67H1, 67N, 67P, 67W1

2. the light emission from the device.----------light

57T, 60T, 63E, 63E1, 63H, 64P2, 65H6, 65V,
56A4, 66E1, 66S6

3. the internal current distribution via an intermediary sensor.--------------------------current distribution

62T, 63E2, 63F, 63F1, 63M, 63S, 63S1, 63S3,
63S4, 64B1, 64M2, 64S, 65G, 65H3, 65P1,
65R2, 65S4, 66A2, 66N, 66P, 66P1, 66S2,
66S6, 66S8, 67H1, 67N, 67P
IV. Precautions in the use of devices in circuits.

59L, 60L1, 61G, 62H, 62T, 62M, 62W1, 63C, 63H1, 63L, 63M1, 63W, 64B, 64B3, 65F1, 64G, 65M3, 64M4, 64P, 64P1, 64S1, 64S3, 64W1, 64W2, 65B, 65H, 65H5, 65S, 65S2, 65T1, 65W1, 66B, 66B1, 66C, 66F, 66M, 66N2, 66R2, 66R3, 66R4, 66S, 67G, 67M, 67S, 67S4, 67T, 67V

V. Specifications of transistor operations free of second breakdown.

62G, 63C, 63G, 63M1, 64B2, 64B3, 64G, 64S1, 65B, 65R3, 65S, 66B1, 66N2, 66S, 66V, 67T

1. Specifications for forward base drive

operation.-----------------------------F


2. Specifications for reverse base drive

operation.-----------------------------R

62G, 62H, 63C, 63G, 63L, 63M1, 63N, 63W, 64B, 64B2, 64B3, 64G, 64M4, 64P1, 64S1, 64S3, 64W2, 65B, 65R1, 65R3, 65S, 66B1, 66F, 66N2, 66S, 66S4, 66V, 67T, 67V

3. Specifications for open base operation.----------O


4. Precautions and use of published specifications.-----------------------------use

61G, 62G, 63C, 63G, 63M1, 64B, 64B2, 64B3, 64G, 64S1, 64S3, 65B, 65R3, 65S, 66B, 66B1, 66N2, 66S, 66V, 67E, 67T
5. testing or test sets for developing or checking specifications.------------------------test

61G, 62G, 62H, 63C, 63D, 63G, 63L, 63M1, 63N, 63W, 64B, 64B2, 64B3, 64G, 64M4, 64P1, 64S1, 64S3, 64W2, 65B, 65R1, 65R3, 65s, 66B, 66B1, 66B3, 66F, 66N2, 66S, 66S4, 66V, 67E, 67T, 67V

VI. Effects of second breakdown operation on the physical structure or the electrical characteristics of the device.------------------------DAMAGE

58T, 61G, 61T, 620, 62S, 63B1, 63D, 63E1, 63F, 63S2, 64P, 64R3, 64S, 65H, 65H1, 65H2, 65H4, 65H5, 65H6, 65S1, 65T, 66E, 66F1, 66H, 66H1, 66L, 66S1, 66S5, 66S6, 67S, 67S3, 67S4

VII. Circuit applications for second breakdown.----------APPLICATION

58T, 63B1, 63E1, 66B4, 67H

VIII. Survey or extensive review of--------------------------SURVEY

66S3, 67S1

1. theory (topic I).-------------------------------theory

62S, 63E1, 66S3, 67M1, 67S1

2. electrical characteristics (topic II).-----------------characteristics

62S, 63E1, 65S, 66S, 66S3, 67S1

3. specifications (topic V).------------------------specifications

65S, 66S, 66S3, 67M1, 67S1
4. Index to Authors

A
Abrahám, A., 57T, 60T
Agatsuma, T., 64A, 65A, 65A1, 66A, 66A1, 66A2
Aldrich, R. W., 60L
Anupyl'd, A. Yu., 66A3
Asakawa, T., 66A4

B
Ballard, J. W., 64B1
Balthasar, P. P., 65B, 66B, 66B1
Barton, F. A., 66R3
Beaudouin, J., 65S1
Bendix, 64B2
Benzer, S., 49B
Bergmann, F., 63B, 66B2
Billette, R., 63M
Billig, E., 51B, 52B
Bizard, R., 64B3
Bloomquist, J. C., 66B4
Bolvin, R., 64B, 66B3
Bond, P. R., 63B1
Bond, R. A., 66B4
Borofsky, A. J., 65B1
Bowman, W. C., 66C
Brouillette, J. W., 60L
Brown, H. E., 66B4
Burgess, R. E., 60B

C
Caldwell, R. S., 66C

Carley, D. R., 65R2
Chalagné, P., 64B3
Chang, J. J., 64W
Chang, Z. F., 63C
Chu, T. L., 65C
Corazza, M., 66N3

D
Domingues Novo, D., 66N3
Dougal, A. A., 64F, 66F1
Doversberger, K. W., 63D

E
Egawa, H., 66E
Electronics, 63E2
Electro-Technology, 67E
English, A. C., 63E, 63E1, 66E1
Englund, J. W., 62W1
Ernick, F. G., 67K

F
Faust, Jr., J. W., 65F
Feoktistov, Yu. F., 65G
Ferry, D. K., 64F, 66F1
Fleming, D. C., 65B1
Folsom, J. A., 66C
Ford, G. M., 63F, 64F1
Forrest, N. L. N., 60F
Frazier, H. D., 63F1
French, J. C., 62S, 63S2, 63S3 65S, 66S2, 66S3
Fujinuma, K., 66F

G
Gamble, F. R., 64P2
Gerstner, D., 63B, 66B2, 65G1, 67G
Ghandi, S. K., 60L
Goryunov, N. N., 65G
Greenburg, R., 61G, 62G, 63G, 64G
Grutchfield, H. B., 66G

H
Haitz, R. H., 63S, 63S4, 65H4
Hakim, E. B., 63H, 64H, 64R, 64R2, 64R3, 65H, 65H1, 65H2, 65H5, 65H6, 65R66H1, 66R, 67H
Halavacek, A. R., 60L1
Hamakawa, Y., 59Y, 59Y1
Hamiter, L., 67H1
Hardway, H. L., 63M1
Hardy, G. F., 67S2
Harman, G. G. 66H2
Hartz, R. S., 62H
Henisch, H. K., 53T
Hermann, K., 63H1
Hilibrand, J., 62H1
Hlavacek, A. R., 60L1
Holonyak, Jr., N., 60L
Holschwandner, L. H., 66S5
Hooper, W. W., 63S4, 65S3
Howarth, D. W., 63H3
Hower, P. L., 67H2
Hubner, K., 65S1

Huenemann, R. G., 66H
Hughes, K. A., 66N

I
Intermetall, 62I

J
John, H. F., 65F
Jordan, Jr., W. F., 59L
Josephs, H. C., 65J, 65J1, 66J

K
Kannam, P. J., 65C, 67K
Khurana, B. S., 66K
Kikuchi, M. 54K, 55K
Kocsis, M., 63K, 63K1
Kohisa, T., 64A, 65A

L
Laracuente, F. A., 67N
Lee, J. S., 63L
Le Gall, J., 66S7
Lempicki, A., 54L
Lesk, I. A., 60L
Lewis, E. T., 66L
Lin, H. C., 59L, 60L1
Lohrmann, D. R., 66L1

M
Mano, K., 65T, 66T, 66T1
Marino, J., 67K
Marshall, S. L., 67M1
Mathews, J. W., 62M
Matyckas, S., 66M
Matz, A. W., 57M
McSherry, L. K., 65H, 65H2, 65H5
Melchior, H., 64M, 64M1
Miller, E. A., 67M2
Miller, J., 64M3, 64M4
Miller, R. P., 62M1
Minton, R., 67M
Morey, R. F., 63M1
Morrison, S. R., 63M
Moutoux, T. J., 66G
Mueller, O., 64M2
Naborowski, J. G., 63N, 64N
Neve, N. F. B., 66N
Newman, R. A., 66N2
Nienhuis, R. J., 66N1
Novo, D. Domingues, 66N3
Nowakowski, M. F., 67N
Oda, H., 66O
Oka, H., 62O
Oshima, S., 62O
Ovechkin, Yu. A., 65G
Partridge, J., 64P
Perkins, C., 65P
Peterman, D. A., 65P1, 66P, 66P1, 67P
Pisarcik, D. A., 64P1
Plumlee, H. R., 66P, 66P1
Portnoy, W. M., 64P2
Power, H. M., 63E
R
RCA, 65R3
Reddi, V. G. K., 67H2
Reich, B., 63H, 64H, 64R, 64R1, 64R2, 64R3, 65H, 65H2, 65H5, 65R, 66R, 66R1, 66R2
Resch, W., 65R1
Richards, N. G., 66R3
Rogers, J. D., 66R4
Rosenzweig, R., 65R2
Ruggles, Jr., R. L., 66S1
S
Savchenko, A. M., 65G
Scarlett, R. M., 63S, 63S1, 63S4, 64S, 66S6, 67S2
Schafft, H. A., 62S, 63S2, 63S3, 65S, 66S, 66S1, 66S2, 66S3, 67S1
Schenck, J. F., 67S3
Schiff, P., 64S1, 64S3, 66S4
Schneer, G. H., 66S5
Schroen, W., 64S, 65S1, 65S3, 66S6
Schwuttke, G. H., 66S1
Seneret, J., 65S2
Shockley, W., 63S, 63S1, 63S4
Simmons, C. D., 58T
Smith, H. S., 67S4
Stankovo, A. V., 65G
Steffe, W., 66S7, 67S
Stickler, M. G., 64S2
Stickler, R., 65F
Stolnitz, D., 65S4, 66S8
Strutt, M. J. O., 64M, 64M1
Sugano, T., 66K
Sugiyama, A., 64A, 65A
Sulway, D. V., 66N

T
Takagi, K., 65T, 66T, 66T1
Tarui, Y., 54K, 55K
Tatum, J. G., 65T1
Tauc, J., 57T, 60T
Thire, J., 61T
Thornton, C. G., 58T
Thornton, P. R., 66N
Tipple, P. M., 53T
Tokuyama, T., 62T
Tolkacheva, Ya. A., 65G
Tsubouchi, N., 66A4
Turner, C. R., 63C, 67T

V
Vahle, R. W., 66V, 67V
Van Wyk, J. D., 65V

W
Wang, W., 64W
Weitzsch, F., 62W, 64W3, 65W, 66W
Wheatley, C. F., 62W1, 63W, 64W1, 64W2, 65W1, 67W
Wiesner, R., 62W2

Winkler, R. H., 67W1
White, B. H., 60L1
Wilson, R. L., 66S4
Wolff, K., 64W3
Wood, C., 54L
Workman, W., 67P
Wormser, J. J., 66R4

Y
Yamaguchi, J., 59Y, 59Y1
Yanai, H., 66K
5. Footnotes to Bibliography

[1] This and the other papers so footnoted do not deal directly with second breakdown but may nevertheless be of some interest.

6. Bibliography
1949 -- 1961

49B Benzer, S.
HIGH INVERSE VOLTAGE GERMANIUM RECTIFIERS
THEORY: thermal.
CHARACTERISTICS: point contact, pulsed, swept, SB, multiple levels, oscillations.

51B Billig, E.
APPLICATION OF THE IMAGE-FORCE MODEL TO THE THEORY OF CONTACT
RECTIFICATION AND OF RECTIFIER BREAKDOWN
THEORY: trigger temperature, thermal.
CHARACTERISTICS: point contact, thermal.

52B Billig, E.
EFFECT OF MINORITY CARRIERS ON THE BREAKDOWN OF POINT CONTACT
RECTIFIERS
THEORY: thermal.
CHARACTERISTICS: point contact, pulsed, swept.

53T Tipple, P. M., and H. K. Henisch
THERMAL EFFECTS AT POINT CONTACT DIODES
THEORY: trigger temperature, SB state.
CHARACTERISTICS: point contact, pulsed, SB.
OBSERVATION: temperature.

54K Kikuchi, M., and Y. Tarui
TRANSIENT PHENOMENA IN THE BACKWARD DIRECTION OF GERMANIUM CRYSTAL
RECTIFIERS
THEORY: trigger temperature.
CHARACTERISTICS: point contact, pulsed.

54L Lempicki, A., and C. Wood
OBSERVATIONS ON A FORM OF BREAKDOWN IN GERMANIUM DIODES
THEORY: trigger temperature, thermal.
CHARACTERISTICS: point contact, pulsed, swept.

55K Kikuchi, M., and Y. Tarui
STEP AND OSCILLATION PHENOMENA IN THE COLLECTOR OF A-TYPE
TRANSISTORS
THEORY: trigger temperature, charge carriers.
CHARACTERISTICS: transistor, point contact, pulsed, oscillations.
57M Matz, A. W.  
**THERMAL TURNOVER IN GERMANIUM P-N JUNCTIONS**  
**THEORY:** thermal, SB state.  
**CHARACTERISTICS:** diode, pulsed, SB.

57T Tauc, J., and A. Abraham  
**THERMAL BREAKDOWN IN SILICON P-N JUNCTIONS**  
**THEORY:** thermal, SB state.  
**CHARACTERISTICS:** diode, swept, SB.  
**OBSERVATION:** temperature, light.

58T Thronton, C. G., and C. D. Simmons  
**A NEW HIGH CURRENT MODE OF TRANSISTOR OPERATION**  
**THEORY:** pinch, SB state.  
**CHARACTERISTICS:** transistor, swept, SB, measurement, design, current distribution, defect.  
**DAMAGE**  
**APPLICATION**

59L Lin, H. C., and W. F. Jordan, Jr.  
**EFFECT OF TRANSIENT VOLTAGES ON TRANSISTORS**  
**PRECAUTIONS**

59Y Yamaguchi, J., and Y. Hamakawa  
**HIGH ELECTRIC FIELD EFFECTS IN GERMANIUM P-N JUNCTION**  
**THEORY:** trigger temperature, charge carriers, SB state.  
**CHARACTERISTICS:** diode, pulsed, SB, measurement, oscillations.  
**OBSERVATION:** temperature.

59Y1 Yamaguchi, J., and Y. Hamakawa  
**BARRIER TEMPERATURE AT TURNOVER IN GERMANIUM P-N JUNCTIONS**  
**THEORY:** trigger temperature.  
**CHARACTERISTICS:** diode, point contact, current distribution.  
**OBSERVATION:** temperature.

60B Burgess, R. E.  
**NEGATIVE RESISTANCE IN SEMICONDUCTOR DEVICES**  
**THEORY:** thermal, non-thermal, interaction, SB state.

60F Forrest, N. L. N.  
**AVALANCHE CARRIER MULTIPLICATION IN JUNCTION TRANSISTORS AND ITS IMPLICATIONS IN CIRCUIT DESIGN**  
**CHARACTERISTICS:** transistor, swept.
A CATEGORIZATION OF THE SOLID-STATE DEVICE ASPECTS OF MICROSYSTEMS ELECTRONICS
THEORY: pinch, charge carriers.
CHARACTERISTICS: transistor.

Lin, H. C., A. R. Hlavacek, and B. H. White
TRANSIENT OPERATION OF TRANSISTOR WITH INDUCTIVE LOAD
THEORY: non-thermal.
CHARACTERISTICS: transistor, swept, design.
PRECAUTIONS

Tauc, J., and A. Abrahám
DER ELEKTRISCHE DURCHSCHLAG AN P-N ÜBERGANGEN IN SILIZIUM
THEORY: thermal, SB state.
CHARACTERISTICS: diode, swept, SB.
OBSERVATION: temperature, light.

Greenburg, R.
BREAKDOWN VOLTAGE IN POWER TRANSISTORS
CHARACTERISTICS: transistor, swept.
PRECAUTIONS
SPECIFICATIONS: F, O, use, test.

Thire, J.
LE PHÉNOMENE DE PINCIMENT SUR LES TRANSISTORS DE PUISSANCE EN COMMUTATION
THEORY: pinch, charge carriers, non-thermal, SB state.
CHARACTERISTICS: transistor, pulsed, swept, SB, design, defect.

Greenburg, R.
RELIABILITY OF GERMANIUM POWER TRANSISTORS
IEEE WESCON Convention Record, vol. 6, pt. 5.2, pp. 1-5, 1962. (-)
SPECIFICATIONS

Hartz, R. S.
STOP TRANSISTOR FAILURES IN MAGNETIC-DEFLECTION CIRCUITS
PRECAUTIONS
SPECIFICATIONS: R, test.
62H1 Hilibrand, J.
TRANSISTORS FOR HIGH POWER AT HIGH FREQUENCY

CHARACTERISTICS: transistor, swept, design.

62I Intermetall
KOLLEKTOR - DURCHBRUCHERScheinungen IN LEISTUNGSTRANSISTOREN

CHARACTERISTICS: transistor, swept.

PRECAUTIONS

62M Mathews, J. W.
TRANSISTOR FAILURE MODES IN HIGH POWER SWITCHING OPERATION

PRECAUTIONS

62M1 Miller, R. P.
DEPENDENCE OF POWER TRANSISTOR FAILURE ON THEIR ENERGY CHARACTERISTICS

CHARACTERISTICS: transistor, pulsed, swept, oscillations.

620 Oka, H., and S. Oshima
BREAKDOWN IN SILICON POWER DIODE

THEORY: thermal, SB state.

CHARACTERISTICS: diode, pulsed, swept, SB.

DAMAGE

62S Schafft, H. A., and J. C. French
SECOND BREAKDOWN IN TRANSISTORS

THEORY: thermal, pinch, non-thermal, SB state.

CHARACTERISTICS: transistor, pulsed, swept, measurement, current distribution, defect.

DAMAGE SURVEY: theory, characteristics.

62T Tokuyama, T.
METHOD FOR VISUALIZING THE DISTRIBUTION OF CURRENT IN ALLOYED GERMANIUM p+-n JUNCTIONS

OBSERVATION: current distribution.

62W Weitzsch, F.
ZUM EINSEHNURFFEKT BEI TRANSISTOREN DIE IM DURCHBRUCHSGEBIET BETRIEBEN WERDEN

THEORY: pinch.
Wheatley, C. F., and J. W. Englund
RELIABILITY CONSIDERATIONS IN THE APPLICATION OF POWER TRANSISTORS TO CONSUMER PRODUCTS

PRECAUTIONS

Wiesner, R.
DAS VERHALTEN DES TRANSISTORS BEI GROSSER AUSSTEUERUNG
Nachrichtentech. Z., vol. 15, pp. 323-332, July 1962. (pp.331-332)

THEORY: pinch.
CHARACTERISTICS: transistor, pulsed, swept, design, current distribution.

- 1963 -

Bergmann, F., and D. Gerstner
THERMISCH BETINGTE STROMEINSCHNURUNG BEI HOCHFREQUENZ - LEISTUNGSTRANSISTOREN (EIN BEITRAG ZUM PROBLEM DES SECOND BREAKDOWN)

THEORY: instability.
CHARACTERISTICS: transistor, design, current distribution.

Bond, P. R.
SECONDARY BREAKDOWN IN TRANSISTORS

THEORY: trigger temperature, thermal, SB state.
CHARACTERISTICS: transistor, diode, pulsed, SB, design.

DAMAGE
APPLICATION

Chang, Z. F., and C. R. Turner
CHARACTERIZATION OF SECOND BREAKDOWN IN SILICON POWER TRANSISTORS

PRECAUTIONS
SPECIFICATIONS

Doversberger, K. W.
HIGH-POWER DYNAMIC LIFE TESTS OF TRANSISTORS

CHARACTERISTICS: transistor, defect.
SPECIFICATIONS: test.

DAMAGE

English, A. C., and H. M. Power
MESOPLASMA BREAKDOWN IN SILICON JUNCTIONS

THEORY: trigger temperature, SB state.
CHARACTERISTICS: diode, swept, SB, arc.
OBSERVATION: light.
63E1 English, A. C.
MESOPLASMAS AND SECOND BREAKDOWN IN SILICON JUNCTIONS
THEORY: thermal, SB state
CHARACTERISTICS: transistor, diode, pulsed, swept, SB, multiple levels, current distribution, defect, magnetic field, arc.
OBSERVATION: light.
DAMAGE
APPLICATION
SURVEY: theory, characteristics.

63E2 Electronics
PHOSPHORS TRACE HEAT FLOW PATTERNS
OBSERVATION: temperature, current distribution.

63F Ford, G. M.
COLLECTOR TO Emitter BREAKDOWN RELATED TO THERMAL RUNAWAY IN HOMOGENEOUS BASE GERMANIUM POWER TRANSISTORS
THEORY: trigger temperature.
CHARACTERISTICS: transistor, diode, pulsed, swept, current distribution.
OBSERVATION: temperature, current distribution.
DAMAGE

63F1 Frazier, H. D.
TEMPERATURE DEPENDENT FLUORESCENT PAINTS A GRAPHIC DISPLAY OF TEMPERATURE DISTRIBUTION
OBSERVATION: temperature, current distribution.

63G Greenburg, R.
GETTING BOTH RELIABILITY AND ECONOMY IN POWER-TRANSISTOR CIRCUITS
Electronics, vol. 36, pp. 54-57, May 24, 1963. (-)
SPECIFICATIONS

63H Hakim, E. B., and B. Reich
LIGHT EMISSION FROM SILICON TRANSISTOR JUNCTIONS
OBSERVATION: light.

63H1 Hermann, K.
SELECTING TRANSISTORS FOR COIL DRIVERS
PRECAUTIONS

63K Kocsis, M.
INFLUENCE OF NONUNIFORM BASE-WIDTH ON TRANSISTOR FAILURES
CHARACTERISTICS: transistor, pulsed, defect.
63K1 Kocsis, M.
ZUSAMMENHANG ZWISCHEN INHOMOGENER BASISDICKE UND ZERSTORUNG DES LEGIERTEN TRANSISTORS
Tungsram Technische Mitteilungen, no. 8, pp. 317-335, January 1963.
THEORY: trigger temperature.
CHARACTERISTICS: transistor, defect.
OBSERVATION: temperature.

63L Lee, J. S.
SWITCHING INDUCTIVE LOADS WITH TRANSISTORS
PRECAUTIONS
SPECIFICATIONS: R, test.

63M Morrison, S. R., and R. Billette
COMMON EMITTER BREAKDOWN
THEORY: non-thermal.
CHARACTERISTICS: transistor, defect.
OBSERVATION: current distribution.

63M1 Morey, R. F., and W. L. Hardway
POWER TRANSISTOR SAFE OPERATING AREAS
PRECAUTIONS
SPECIFICATIONS

63N Naborowski, J. G.
MODULATED GENERATOR TESTS TRANSISTOR BREAKDOWN

63S Scarlett, R., W. Shockley, and R. H. Haitz
THERMAL INSTABILITY AND HOT SPOTS IN JUNCTION TRANSISTORS
Physics of Failure in Electronics, M. F. Goldberg and J. Vaccaro, Eds.
THEORY: instability, SB state.
CHARACTERISTICS: transistor, pulsed, SB, indicator, design, current distribution, defect.
OBSERVATION: temperature, current distribution.

63S1 Scarlett, R. M., and W. Shockley
SECONDARY BREAKDOWN AND HOT SPOTS IN POWER TRANSISTORS
THEORY: instability, SB state.
CHARACTERISTICS: transistor, pulsed, SB, indicator, design, current distribution, defect.
OBSERVATION: temperature, current distribution.
CHARACTERISTICS OF SECOND BREAKDOWN AND TRANSISTOR FAILURE
Schafft, H. A., and J. C. French
THEORY: trigger temperature, thermal, pinch, charge carriers.
CHARACTERISTICS: transistor, defect.

SECOND BREAKDOWN; EFFECTS OF BASE DRIVE AND STRUCTURAL DEFECTS
Schafft, H. A., and J. C. French
CHARACTERISTICS: transistor, SB, current distribution, defect.

THERMAL INSTABILITY IN EXTENDED TRANSISTOR AND THERMISTOR STRUCTURES
Shockley, W. R. M. Scarlett, R. Haitz, and W. Hooper
THEORY: instability, SB state.
CHARACTERISTICS: transistor, pulsed, indicator, design, current distribution, defect.

DESIGN FACTORS FOR TRANSISTORIZED TELEVISION DEFLECTION CIRCUITS
Wheatley, C. F.
PRECAUTIONS
SPECIFICATIONS: R, test.

AN ASPECT OF SECOND BREAKDOWN IN TRANSISTORS
Agatsuma, T., T. Kohisa, and A. Sugiyama
CHARACTERISTICS: transistor, pulsed, swept, measurement, current distribution.

SPECIFYING THE BEST TRANSISTOR FOR POWER INVERTERS
Bolvin, R.
PRECAUTIONS
SPECIFICATIONS: R, use, test.

DETECTION AND PREDICTION OF MALFUNCTION OF ELECTRONIC COMPONENTS
Ballard, J. W.
BY CONTACT THERMOGRAPHY
OBSERVATION: temperature, current distribution.
SAFE OPERATING AREAS OF BENDIX DIFFUSED ALLOY POWER DARLINGTON AND GERMANIUM POWER TRANSISTORS IN POWER SWITCHING AND DC APPLICATIONS
Bendix Corporation Application Note, pp. 1-6, September 15, 1964.

UTILISATION DES TRANSISTORS DE PUISSANCE COSEM EN AMPLIFICATION ET COMMUTATION
Compagnie générale des Semi-conducteurs Application Note, pp. 1-21, 1964(?).

THERMAL PINCHING AT LOW FIELDS IN N-TYPE GERMANIUM

DETERMINING MAXIMUM RELIABLE LOAD LINES FOR POWER TRANSISTORS
Motorola Application Note AN137-R1, pp. 1-15, November 1964.

THE EFFECTS OF NEUTRON RADIATION ON SECONDARY BREAKDOWN

SECONDARY BREAKDOWN IN TRANSISTORS

ON THE INITIATION OF SECOND BREAKDOWN IN DIODES AND TRANSISTORS
Scientia Electrica (Switzerland), vol. 10, pp. 139-141, April 1964.

INTERNAL THERMAL FEEDBACK IN FOUR-POLES ESPECIALLY IN TRANSISTORS
64M3 Miller, J.
AVOIDING STORAGE-TIME PUNCH-THROUGH IN SATURATED PUSH-PULL CIRCUITS

PRECAUTIONS

64M4 Miller, J.
SWEEP TEST PICKS BEST TRANSISTORS TO BAR INDUCTIVE LOAD DAMAGE
CHARACTERISTICS: transistor, swept, oscillations, indicator.

PRECAUTIONS
SPECIFICATIONS: R, test.

64N Naborowski, J. G.
POWER-TIME VOLTAGE TESTING OF TRANSISTORS
Electronic Indust., vol. 23, pp. 147-151, May 1964. (Fig. 7)
CHARACTERISTICS: transistor, multiple levels.

64P Partridge, J.
ON THE EXTRAPOLATION OF ACCELERATED STRESS CONDITIONS TO NORMAL
STRESS CONDITIONS OF GERMANIUM
Physics of Failure in Electronics, vol. 2, RADC Series in
AD 434 329 [2] (pp. 217-225)

PRECAUTIONS

64P1 Pisarcik, D. A.
DEVELOPMENT TOWARD OPTIMIZING POWER SEMICONDUCTOR DESIGN

PRECAUTIONS
SPECIFICATIONS: R, test.

64P2 Portnoy, W. M., and F. R. Gamble
FINE STRUCTURE AND ELECTROMAGNETIC RADIATION IN SECOND BREAKDOWN

THEORY: non-thermal, SB state.
CHARACTERISTICS: transistor, diode, swept, SB, multiple levels.

OBSERVATION: light.

64R Reich, B., and E. B. Hakim
MAXIMUM COLLECTOR VOLTAGE AND SECONDARY BREAKDOWN IN TRANSISTORS

THEORY: non-thermal.
CHARACTERISTICS: transistor, design.

OBSERVATION: temperature.

64R1 Reich, B.
NEW ASPECTS OF SECOND BREAKDOWN IN TRANSISTORS

THEORY: thermal, non-thermal.
CHARACTERISTICS: transistor, diode, swept, SB, design, current distribution.

OBSERVATION: temperature.
64R2 Reich, B., and E. B. Hakim
TRANSISTOR CHARACTERIZATION AND DERATING FOR SECOND BREAKDOWN
THEORY: trigger temperature, SB state.
CHARACTERISTICS: transistor, swept, design, current distribution.
OBSERVATION: temperature.

64R3 Reich, B., and E. B. Hakim
TRADING OFF RADIATION RESISTANCE AND SECOND-BREAKDOWN PERFORMANCE
CHARACTERISTICS: transistor, design, radiation.

64S Scarlett, R. M., and W. Schroen
LOCALIZED THERMAL EFFECTS IN SILICON POWER TRANSISTORS
[2]
THEORY: instability, SB state.
CHARACTERISTICS: transistor, pulsed, SB, indicator, design, current distribution, defect.
OBSERVATION: temperature, current distribution.

64S1 Schiff, P.
PREVENTING SECOND BREAKDOWN IN TRANSISTOR CIRCUITS
CHARACTERISTICS: transistor, pulsed, swept, measurement, indicator, design, current distribution.
PRECAUTIONS
SPECIFICATIONS

64S2 Stickler, M. G.
SECOND BREAKDOWN PHENOMENA IN TRANSISTORS
THEORY: charge carriers.
CHARACTERISTICS: transistor.

64S3 Schiff, P.
SECOND BREAKDOWN IN TRANSISTORS UNDER CONDITIONS OF CUTOFF
RCA Application Note SMA-30, pp. 1-12, July 1964.
PRECAUTIONS
SPECIFICATIONS: O, R, use, test.

64W Wang, W., and J. J. Chang
MAXIMUM PULSE-CURRENT RATINGS AND THERMAL RUNAWAY TEMPERATURES FOR
SILICON DIODES
THEORY: trigger temperature.
CHARACTERISTICS: diode, pulsed.
64W1 Wheatley, C. F.
DESIGN CONSIDERATIONS FOR TRANSISTORIZED TELEVISION DEFLECTION CIRCUITS PART I

PRECAUTIONS

64W2 Wheatley, C. F.
DESIGN CONSIDERATIONS FOR TRANSISTORIZED TELEVISION DEFLECTION CIRCUITS PART II

PRECAUTIONS

SPECIFICATIONS: R, test.

64W3 Wolff, K., and F. Weitzsch
RECHNUNGEN ZUM EINSCHNURREFFECT BEI TRANSISTOREN

THEORY: pinch

- 1965 -

65A Agatsuma, T., T. Kohisa, and A. Sugiyama
TURNOVER PHENOMENON OF N+NN+ PLATE CONTACT SILICON DEVICE AND SECOND BREAKDOWN IN TRANSISTORS

THEORY: trigger temperature.
CHARACTERISTICS: n+-n-n+, swept.
OBSERVATION: temperature.

65A1 Agatsuma, T.
THE SECOND BREAKDOWN V-I CHARACTERISTICS IN THE TRIPLE DIFFUSED SI TRANSISTOR
CHARACTERISTICS: transistor, n+-n-n+, pulsed, swept.

65B Balthasar, P. P.
SELECTING SWITCHING CIRCUIT TRANSISTORS

CHARACTERISTICS: transistor, indicator.

PRECAUTIONS

SPECIFICATIONS

65B1 Borofsky, A. J., and D. C. Fleming
DESIGN AND PROCESS CONTRIBUTION TO INHERENT FAILURE MECHANISMS OF MICROMINIATURE ELECTRONIC COMPONENTS FOR MINUTEMAN II
Presented at the Physics of Failure in Electronics Symposium (Co-sponsored by the Rome Air Development Center and the Illinois Institute of Technology), Chicago, November 1965. (-)

CHARACTERISTICS: transistor, design, defect.
65C Chu, T. L., and P. J. Kannam
FAILURE OF LARGE-AREA EPITAXIAL-DIFFUSED SILICON DEVICES
Presented at the Physics of Failure in Electronics, (Co-sponsored
by the Rome Air Development Center and the Illinois Institute of
Technology), Chicago, November 1965. (-)
CHARACTERISTICS: diode, defect.

65F Faust, J. W., Jr., H. F. John, and R. Stickler
THE ROLE OF MICRODEFECTS IN SILICON STARTING MATERIALS AS QUALITY
REDUCING FACTORS IN SEMICONDUCTOR DEVICES
Presented at the Physics of Failure in Electronics Symposium,
(Co-sponsored by the Rome Air Development Center and the Illinois
Institute of Technology), Chicago, November 1965. (-)
CHARACTERISTICS: transistor, defect.

65G Goryunov, N. N., Yu. A. Ovechkin, A. M. Savchenko, A. V. Stankova,
Ya. A. Tolkacheva, and Yu. F. Feoktistov
INVESTIGATION OF THE SECONDARY BREAKDOWN PHENOMENON IN TRANSISTORS
CHARACTERISTICS: transistors, pulsed, SB, multiple levels, magnetic field.
OBSERVATION: current distribution.

65G1 Gerstner, D.
HF-LEISTUNGSTRANSISTOREN - NEUE ENTWICKLUNGEN MIT TECHNIKEN DER
MIKROELEKTRONIK
THEORY: instability.
CHARACTERISTICS: transistor, ballast, design, current distribution.
SPECIFICATIONS: F, O.

65H Hakim, E. B., L. K. McSherry, and B. Reich
SOLDER BALL FORMATION IN SILICON ALLOY TRANSISTORS
CHARACTERISTICS: transistor, design.
PRECAUTIONS
DAMAGE

65H1 Hakim, E. B.
TRANSISTOR-SURFACE ANALYSIS AFTER SECONDARY BREAKDOWN
DAMAGE

65H2 Hakim, E. B., L. K. McSherry, and B. Reich
SOLDER BALL FORMATION IN SILICON ALLOY TRANSISTORS
IEEE International Electron Devices Meeting, Washington, D. C.,
October 1965.
DAMAGE

65H3 Howarth, D. W.
A SIMPLE TECHNIQUE FOR THE DIRECT OBSERVATION OF TEMPERATURE
DISTRIBUTION IN MICROELECTRONIC STRUCTURES
Presented at the Physics of Failure in Electronics Symposium,
(Co-sponsored by the Rome Air Development Center and the Illinois
Institute of Technology), Chicago, November 1965. [1]
OBSERVATION: temperature, current distribution.
65H4 Haitz, R. H.
MECHANISMS CONTRIBUTING TO THE NOISE PULSE RATE OF AVALANCHE DIODES

THEORY: thermal, SB state.
CHARACTERISTICS: diode, swept, oscillation.

65H5 Hakim, E. B., L. K. McSherry, and B. Reich
SOLDER BALL FORMATION IN SILICON ALLOY TRANSISTORS

CHARACTERISTICS: transistor, design.

65H6 Hakim, E. B.
HOT SPOT MESOPLASMA FORMATION IN SILICON PLANAR TRANSISTORS
Presented at the Physics of Failure in Electronics Symposium,
(Co-sponsored by the Rome Air Development Center and the Illinois
Institute of Technology), Chicago, November 1965.

CHARACTERISTICS: transistor, SB.

65J Josephs, H. C.
A SIMPLE MODEL FOR SECOND BREAKDOWN

THEORY: mechanisms.

65J1 Josephs, H. C.
The EFFECT OF FREE CHARGE ON COLLECTOR MULTIPLICATION

THEORY: pinch, charge carriers.

65P Perkins, C.
BREAKDOWN PHENOMENA IN SILICON SEMICONDUCTOR DEVICES
Semiconductor Prod. Solid State Technol., vol. 8, pp. 32-37,
February 1965. (pp. 36-37)

CHARACTERISTICS: transistor, swept, SB, current distribution.

65P1 Peterman, D. A.
THERMOPHYSICS OF SILICON POWER TRANSISTORS
Presented at the Physics of Failure in Electronics Symposium,
( Co-sponsored by the Rome Air Development Center and the Illinois
Institute of Technology), Chicago, November 1965. (-)

OBSERVATION: temperature, current distribution.

65R Reich, B., and E. B. Hakim
AN EXPLANATION OF THE ENERGY DEPENDENCE OF SECONDARY BREAKDOWN IN
TRANSISTORS

THEORY: trigger temperature.
CHARACTERISTICS: transistor, swept.
OBSERVATION: temperature.
65R1  Resch, W.
POWER RATING OF TRANSISTORS FOR PULSED OPERATION

65R2  Rosenzweig, R., and D. R. Carley
DESIGN OF A VHF POWER TRANSISTOR WITH SECOND-BREAKDOWN PROTECTION
IEEE International Electron Devices Meeting, Washington, D. C.,
October 1965.
CHARACTERISTICS: transistor, ballast, design, current distribution.
OBSERVATION: current distribution.

65R3  RCA
HOMETAXIAL-BASE SILICON POWER TRANSISTORS
CHARACTERISTICS: transistor, pulsed, swept, design, current distribution.
SPECIFICATIONS

65S  Schafft, H. A., and J. C. French
BREAKDOWN CHARACTERISTICS OF SEMICONDUCTOR MATERIALS
PRECAUTIONS
SPECIFICATIONS
SURVEY: characteristics, specifications.

65S1  Schroen, W., J. Beaudouin, and K. Hubner
FAILURE MECHANISMS IN HIGH POWER FOUR-LAYER DIODES
Physics of Failure in Electronics, vol. 3, RADC Series in
AD 617 715 [2] (pp. 295-398)
THEORY: instability.
CHARACTERISTICS: p-n-n-n, design, defect.
DAMAGE

65S2  Seneret, J.
UTILISATION DES TRANSISTORS DE PUISSANCE EN VHF
CHARACTERISTICS: transistor, swept.
PRECAUTIONS

65S3  Schroen, W., and W. W. Hooper
FAILURE MECHANISMS IN SILICON SEMICONDUCTORS
Shockley Research Labs., Palo Alto, Calif., Final Rept., Contract
AF30(602)-3016, March 1965.  AD 615 312 [2] (pp. 1-125)
THEORY: instability, SB state.
CHARACTERISTICS: transistor, diode, pulsed, design, defect.
OBSERVATION: temperature, current distribution.
DAMAGE

65S4  Stolnitz, D.
ELIMINATION OF FORWARD-BIASED SECOND BREAKDOWN BY RESISTIVE BALLASTING
OF SILICON POWER TRANSISTORS
Presented at the Physics of Failure in Electronics Symposium,
(Co-sponsored by the Rome Air Development Center and the Illinois
Institute of Technology), Chicago, November 1965.
CHARACTERISTICS: transistor, ballast, current distribution.
OBSERVATION: current distribution.
TRANSIENT JUNCTION TEMPERATURE RISE AND FAILURE ENERGY OF TRANSISTORS

THEORY: thermal.
CHARACTERISTICS: transistor, pulsed, swept, measurement, design, current distribution, defects.

OBSERVATION: temperature.
DAMAGE

CIRCUIT IMPROVEMENTS UTILIZING THE NEW RESISTOR STABILIZED VHF POWER TRANSISTOR

CHARACTERISTICS: transistor, ballast.

PRECAUTIONS

RECOMBINATION EMISSION FROM SILICON TRANSISTORS

OBSERVATIONS: light.

ZUR THEORIE DES ZWEITEN DURCHBRUCHS BEI TRANSISTOREN

THEORY SURVEY: theory.

DESTRUCTIVE CIRCUIT MALFUNCTIONS AND CORRECTIVE TECHNIQUES IN HORIZONTAL DEFLECTION

PRECAUTIONS

SECOND BREAKDOWN PHENOMENON OF POINT CONTACT NN+ SI WAFERS

CHARACTERISTICS: point contact, pulsed, swept, design.

A CHARACTERIZATION TECHNIQUE FOR SECOND BREAKDOWN IN GE ALLOYED JUNCTION TRANSISTORS

CHARACTERISTICS: transistor, swept.
SPECIFICATION: 0.
Agatsuma, T.

**TURNOVER PHENOMENA IN NPN SILICON DEVICES AND SECOND BREAKDOWN IN TRANSISTORS**


**THEORY:** trigger temperature.

**CHARACTERISTICS:** transistor, n⁺-n-n⁺, pulsed, swept.

**OBSERVATION:** temperature, current distribution.

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Anupyld', A. Yu.

**ON SECOND BREAKDOWN AND RELAXATION OSCILLATIONS IN POINT-CONTACT DIODES**


**CHARACTERISTICS:** point contact, pulsed, swept, multiple levels, oscillations.

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Asakawa, T., and N. Tsubouchi

**SECOND BREAKDOWN IN MOS TRANSISTORS**


**CHARACTERISTICS:** MOS, swept.

**OBSERVATION:** light.

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Balthasar, P. P.

**AVOID POWER TRANSISTOR FAILURE! USE THESE APPLICATION-ORIENTED GUIDELINES TO ESTABLISH THE DEVICE'S SAFE OPERATING AREA (SOAR)**


**PRECAUTIONS**

**SPECIFICATIONS:** F, use, test.

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Balthasar, P. P.

**CUT TRANSISTOR-REPLACEMENT COSTS DUE TO DEVICE FAILURE. USE SAFE-OPERATING-AREA PRINCIPLES TO DESIGN POWER-TRANSISTOR SWITCHING CIRCUITS**


**PRECAUTIONS**

**SPECIFICATIONS**

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Bergmann, F., and D. Gerstner

**SOME NEW ASPECTS OF THERMAL INSTABILITY OF THE CURRENT DISTRIBUTION IN POWER TRANSISTORS**


**THEORY:** instability.

**CHARACTERISTICS:** transistor, ballast, design, current distribution.

**SPECIFICATIONS:** F, 0.

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Bolvin, R.

**SECOND-BREAKDOWN TESTING NEED NOT BE DESTRUCTIVE**


**SPECIFICATIONS:** 0, test.

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Brown, H. E., R. A. Bond, and J. C. Bloomquist

**AVALANCHE TRANSISTORS DRIVE LASER DIODES HARD AND FAST**

66C Caldwell, R. S., W. C. Bowman, and J. A. Folsom
MECHANISM FOR RADIATION-INDUCED LATCHUP IN A MICROCIRCUIT

CHARACTERISTICS: transistor, radiation.

PRECAUTIONS

66E Egawa, H.
AVALANCHE CHARACTERISTICS AND FAILURE MECHANISM OF HIGH VOLTAGE DIODES

THEORY: charge carriers, SB state.
CHARACTERISTICS: diode, pulsed, SB, oscillations, design.

66E1 English, A. C.
PHYSICAL INVESTIGATION OF THE MESOPLASMA IN SILICON

THEORY: SB state.
CHARACTERISTICS: diode, SB, multiple levels, design.

OBSERVATION: light.

66F Fujinuma, K.
TRANSISTOR FAILURE BY SECONDARY BREAKDOWN

THEORY: instability.
CHARACTERISTICS: transistor, pulsed, swept.

PRECAUTIONS
SPECIFICATIONS: R, test.

66F1 Ferry, D. K., and A. A. Dougal
INPUT POWER INDUCED THERMAL EFFECTS RELATED TO TRANSITION TIME BETWEEN AVALANCHE AND SECOND BREAKDOWN IN P-N SILICON JUNCTIONS

THEORY: thermal.
CHARACTERISTICS: transistor, diode, pulsed, multiple levels.

DAMAGE

66G Grutchfield, H. B., and T. J. Moutoux
CURRENT MODE SECOND BREAKDOWN IN EPITAXIAL PLANAR TRANSISTORS

THEORY: pinch, charge carriers.
CHARACTERISTICS: transistor, pulsed, oscillations, design.

66H Huenemann, R. G.
TRANSISTOR DEGRADATION FOLLOWING SECOND BREAKDOWN

DAMAGE
66H1 Hakim, E. B.
THE APPLICATION OF MOLYBDENUM CONTACTS FOR IMPROVED SECOND BREAKDOWN PERFORMANCE
CHARACTERISTICS: transistor, design.
DAMAGE

66H2 Harmon, G. G.
AVALANCHE RADIATION FROM THE BULK OF LONG, THIN, FORWARD-BIASED P*-P-N+ SILICON DIODES
THEORY: non-thermal.

66J Josephs, H. C.
ANALYSIS OF SECOND BREAKDOWN IN TRANSISTORS USING A SIMPLE MODEL
CHARACTERISTICS: transistor, swept, SB, multiple levels, measurement, design.

66K Khurana, B. S., T. Sugano, and H. Yanai
THERMAL BREAKDOWN IN SILICON P-N JUNCTION DEVICES
THEORY: trigger temperature, thermal, SB state.
CHARACTERISTICS: transistor, diode, swept, SB, design.

66L Lewis, E. T.
A PHYSICAL EXPLANATION OF SECONDARY BREAKDOWN IN TRANSISTORS
THEORY: non-thermal.
CHARACTERISTICS: transistor, swept, defect.
DAMAGE

66L1 Lohrmann, D. R.
PARAMETRIC OSCILLATIONS IN VHF TRANSISTOR POWER AMPLIFIERS
CHARACTERISTICS: transistor, oscillations.

66M Matyckas, S.
RF POWER TRANSISTORS IN VEHICULAR RADIO COMMUNICATIONS EQUIPMENT
PRECAUTIONS

66N Neve, N. F. B., D. V. Sulway, K. A. Hughes, and P. R. Thornton
THE SCANNING ELECTRON MICROSCOPE AS A MEANS OF INVESTIGATING SECOND BREAKDOWN AND SIMILAR PHENOMENA
OBSERVATION: current distribution.
66N1 Nienhuis, R. J.
SECOND BREAKDOWN IN THE FORWARD AND REVERSE BASE CURRENT REGION
CHARACTERISTICS: transistor, pulsed, multiple levels, indicator, ballast, design, current distribution.

66N2 Newman, R. A.
SAFE OPERATION WITH HIGH VOLTAGE TRANSISTORS
PRECAUTIONS
SPECIFICATIONS

66N3 Novo, D. Domingues, and M. Corazza
DISPOSITIF D'ETUDE DU PHENOMENE DE DEUXIEME AVALANCHE DANS LES TRANSISTORS (STUDY OF SECONDARY BREAKDOWN IN TRANSISTORS)
CHARACTERISTICS: transistor, pulsed, measurement.

66O Oda, H.
THE AREA OF SAFE OPERATION OF TRANSISTORS FOR SWITCHING OPERATION
THEORY: thermal.
CHARACTERISTICS: transistor, pulsed.
SPECIFICATIONS: F.

66P Peterman, D. A., and H. R. Plumlee
INFRARED MICRORADIOMETER STUDIES OF OPERATING POWER TRANSISTORS
THEORY: interaction.
CHARACTERISTICS: transistor, design, current distribution, defect.
OBSERVATION: current distribution.

66P1 Plumlee, H. R., and D. A. Peterman
ACCURACY OF JUNCTION TEMPERATURE MEASUREMENT IN SILICON POWER TRANSISTOR
CHARACTERISTICS: transistor.
OBSERVATION: temperature, current distribution.

66R Reich, B., and E. B. Hakim
SECONDARY BREAKDOWN THERMAL CHARACTERIZATION AND IMPROVEMENT OF SEMICONDUCTOR DEVICES
CHARACTERISTICS: transistor, diode, swept, indicator, design.
OBSERVATION: temperature.
66R1 Reich, B.
ADVANCES IN DISCRETE SEMICONDUCTOR DEVICES
Semiconductor Prod. Solid State Technol., vol. 9, pp. 19-26,
February 1966. (pp. 20-21)
CHARACTERISTICS: transistor, ballast, design.
SPECIFICATION: F, 0.

66R2 Reich, B.
FACTORS AFFECTING TRANSISTOR FAILURE
PRECAUTIONS

66R3 Richards, N. G., and F. A. Barton
APPLICATION OF OVERLAY TRANSISTORS TO SOLID STATE MOBILE EQUIPMENT
PRECAUTIONS

66R4 Rogers, J. D., and J. J. Wormser
SOLID-STATE HIGH-POWER LOW-FREQUENCY TELEMETRY TRANSMITTERS
PRECAUTIONS

66S Schafft, H. A.
AVOIDING SECOND BREAKDOWN
Presented at the XIIIth International Scientific Congress on
Electronics, sponsored by Rassegna Internazionale Elettronica,
PRECAUTIONS
SPECIFICATIONS
SURVEY: characteristics, specifications.

66S1 Schafft, H. A., G. H. Schwuttke, and R. L. Ruggles, Jr.,
SECOND BREAKDOWN AND CRYSTALLOGRAPHIC DEFECTS IN TRANSISTORS
CHARACTERISTICS: transistor, pulsed, SB, design, current distribution, defect.

66S2 Schafft, H. A., and J. C. French
SECOND BREAKDOWN AND CURRENT DISTRIBUTIONS IN TRANSISTORS
THEORY: interaction, SB state.
CHARACTERISTICS: transistor, pulsed, SB, multiple levels, design, current
distribution, defect.
OBSERVATION: current distribution.

66S3 Schafft, H. A., and J. C. French
A SURVEY OF SECOND BREAKDOWN
September 1966.
SURVEY
66S4 Schiff, P., and R. L. Wilson
DETECTION TECHNIQUES FOR NONDESTRUCTIVE SECOND BREAKDOWN TESTING
CHARACTERISTICS: transistor, measurement, oscillations, indicator.
OBSERVATION: temperature.

66S5 Schneer, G. H., and L. H. Holschwandner
SECOND BREAKDOWN AND DEGRADATION IN GERMANIUM ALLOY JUNCTIONS
THEORY: thermal, non-thermal.
CHARACTERISTICS: transistor, swept, measurement, design.

66S6 Schroen, W., and R. M. Scarlett
SECOND BREAKDOWN IN SIMPLIFIED TRANSISTOR STRUCTURES AND DIODES
THEORY: instability, SB state.
CHARACTERISTICS: transistor, diode, pulse, measurement, indicator, ballast, design, current distribution, defect.

66S7 Steffe, W., and J. LeGall
THERMAL SWITCHBACK IN HIGH F_t EPITAXIAL TRANSISTORS
CHARACTERISTICS: transistor, ballast, design, current distribution.

66S8 Stolnitz, D.
EXPERIMENTAL DEMONSTRATION AND THEORY OF A CORRECTIVE TO SECOND BREAKDOWN IN SI POWER TRANSISTORS
CHARACTERISTICS: transistor, swept, indicator, ballast.
OBSERVATION: current distribution.

66T Takagi, K., and K. Mano
TRANSIENT TEMPERATURE RISE OF P-N JUNCTION AND ITS APPLICATION FOR THE DETERMINATION OF THE ALLOWABLE POWER OF TRANSISTORS
Scientific Reports of the Research Institute of Tôhoku University, B - (Electrical Communication), vol. 18, pp. 29-47, January 1966.
THEORY: thermal.
CHARACTERISTICS: transistor, pulsed, measurement.
OBSERVATION: temperature.

66T1 Takagi, K., and K. Mano
TRANSIENT JUNCTION TEMPERATURE RISE AND SECOND BREAKDOWN IN TRANSISTORS
THEORY: thermal, pinch.
CHARACTERISTICS: transistor, pulsed, SB, measurement, design.
OBSERVATION: temperature.
Vahle, R. W.
GERMANIUM TRANSISTOR RATINGS FOR SECOND BREAKDOWN RELIABILITY

CHARACTERISTICS: transistor, indicator, current distribution.
SPECIFICATIONS

Weitzsch, F.
A DISCUSSION OF SOME KNOWN PHYSICAL MODELS FOR SECOND BREAKDOWN

THEORY: trigger temperature, thermal, pinch, non-thermal, SR state.

Electro-Technology
POWER TRANSISTORS

CHARACTERISTICS: transistor, design.
SPECIFICATIONS: F, use, test.

Gerstner, D.
SCHUTZMASSNAHEM GEGEN DEN 2. DURCHBRUCH IN LEISTUNGTRANSISTOREN

CHARACTERISTICS: transistor, swept, measurement.
PRECAUTIONS

Hakim, E. B.
SECOND BREAKDOWN GIVES FAST PULSES

APPLICATION

Hamiter, L.
INFRARED TECHNIQUES FOR THE RELIABILITY ENHANCEMENT OF MICROELECTRONICS

OBSERVATION: temperature, current distribution.

Hower, P. L., and V. G. K. Reddi
AVALANCHE SECOND BREAKDOWN IN TRANSISTORS

THEORY: charge carriers, non-thermal.
CHARACTERISTICS: transistor, n⁺-n-n⁺, design.

Kannam, P. J., F. G. Ernick, and J. Marino
SECONDARY BREAKDOWN CAPABILITY OF EPITAXIAL TRANSISTORS

CHARACTERISTICS: transistor, design.
67M Minton, R.
DESIGN TRADE-OFFS FOR R-F TRANSISTOR POWER AMPLIFIERS
EE The Electronic Engineer, vol. 26, March, 1967. (-)
CHARACTERISTICS: transistor, swept.
PRECAUTIONS

67M1 Marshall, S. L.
SECOND BREAKDOWN IN TRANSISTORS
SURVEY: theory, specifications.

67M2 Miller, E. A.
ANALYSIS OF THERMAL INSTABILITIES IN POWER TRANSISTOR STRUCTURES
THEORY: instability.
CHARACTERISTICS: transistor, pulsed, design, current distribution.

67N Nowakowski, M. F., and F. A. Laracuente
INFRARED PINPOINTS SECOND BREAKDOWN BEFORE FAILURE
CHARACTERISTICS: transistor, swept.
OBSERVATION: temperature, current distribution.

67P Peterman, D., and W. Workman
INFRARED RADTOMETRY OF SEMICONDUCTOR DEVICES
OBSERVATION: temperature, current distribution.

67S Steffe, W. C.
SECONDARY BREAKDOWNS IN POWER TRANSISTORS AND CIRCUITS
THEORY: instability, pinch, charge carriers.
CHARACTERISTICS: transistor, swept, indicator, ballast, design.
PRECAUTIONS
DAMAGE

67S1 Schafft, H. A.
SECOND BREAKDOWN - A COMPREHENSIVE REVIEW
SURVEY

67S2 Scarlett, R. M., and G. F. Hardy
SECOND BREAKDOWN IN SILICON POWER TRANSISTORS AT HIGH COLLECTOR VOLTAGE
THEORY: instability, pinch, charge carriers, non-thermal, interaction.
CHARACTERISTICS: transistor, swept, oscillations, design, current distribution, defect.
67S3 Schenck, J. F.
PROGRESSIVE FAILURE MECHANISMS OF A COMMERCIAL SILICON DIODE
Physics of Failure in Electronics, vol. 5, RADC Series in Reliability
T. S. Shilliday and J. Vaccaro, Ed., 1967, pp. 18-35. AD 655 397
[2] (pp. 20-21)

DAMAGE:

67S4 Smith, H. S.
SWITCH HIGH LOADS WITH POWER TRANSISTORS BY KNOWING ALL ABOUT
SECONDARY BREAKDOWN, DEVICE SELECTION, AND METHODS OF ANALYSIS AND
DESIGN
Electronic Design, vol. 15, pp. 224-233, August 16, 1967. (pp. 225-
229)
CHARACTERISTICS: transistor, pulsed, swept.
PRECAUTIONS
SPECIFICATIONS: F.
DAMAGE:

67T Turner, C.
CARL TURNER OF RCA EXPLORES SELECTION OF SECOND-BREAKDOWN-RESISTANT
TRANSISTORS
PRECAUTIONS
SPECIFICATIONS

67V Vahle, R. W.
SECOND-BREAKDOWN TESTS FOR GERMANIUM-TRANSISTOR RELIABILITY
PRECAUTIONS
SPECIFICATIONS: R, test.

67W Wheatley, C. F.
THERMAL REGENERATION IN POWER-DISSIPATING ELEMENTS
EE, The Electronic Engineer (formerly Electronic Industries),
vol. 26, pp. 54-60, January 1967. (pp. 59-60)
THEORY: thermal.
CHARACTERISTICS: transistor, design, current distribution, defect.

67W1 Winkler, R. H.
THERMAL PROPERTIES OF HIGH-POWER TRANSISTORS
OBSERVATION: temperature.
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