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Damage Analysis Modified TRAC Computer Program (DAMTRAC)

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G. Baker Copy

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May 1975

THIS WORK WAS PERFORMED IN SUPPORT OF
THE ARMY MULTIPLE SYSTEMS EVALUATION PROGRAM.

U.S. Army Materiel Command
HARRY DIAMOND LABORATORIES
Adelphi, Maryland 20783

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A computer program tailored for EMP damage analysis of solid-state circuitry has been developed by modifying the existing TRAC network analysis program. Modification of the TRAC diode and transistor models to include breakdown parameters and the addition of a semiconductor device parameter library have greatly simplified the analyst's task. An added feature is a subroutine that automatically calculates the amplitude and duration of transient power dissipated in circuit components.

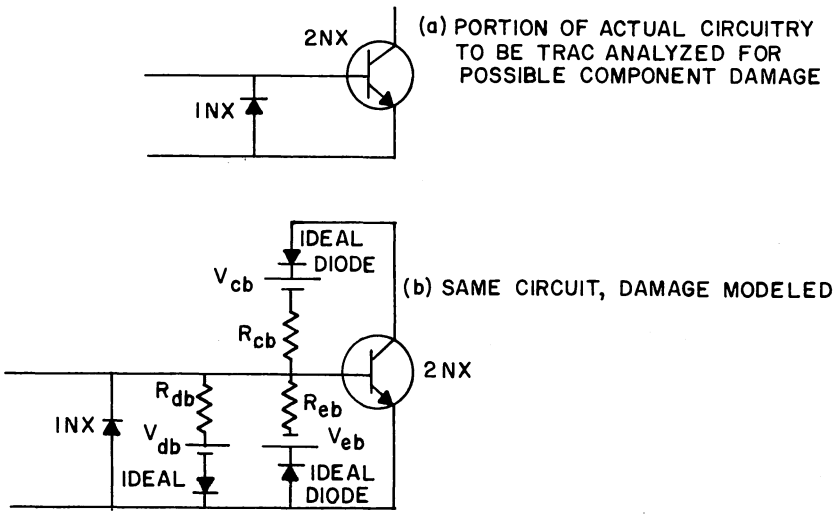
CONTENTS

FIGURES

1. GENERAL DESCRIPTION AND JUSTIFICATION OF MODIFICATIONS

A computer program tailored for EMP damage analysis of solid-state circuitry has been developed by modifying the existing TRAC network analysis program. This report is intended to supplement the TRAC user manual,[1] and assumes that the reader is familiar with the TRAC circuit analysis program. A free-form input version of TRAC is used by DAMTRAC. (This version of TRAC was devised by HDL staff member, B. H. Audet.) DAMTRAC is programmed for use with CDC 6000 series computers.

In the past, damage analysis by TRAC was performed by redrawing the circuitry under consideration and inserting additional "ghost" branches to handle p-n junction behavior under reverse bias conditions. A damage-modeled diode and transistor circuit is pictured in figure 1.



V_{db} - diode breakdown voltage

V_{eb} - emitter base breakdown voltage

V_{cb} - collector base breakdown voltage

R_{db} - diode breakdown bulk surge impedance

R_{eb} - emitter base bulk surge impedance

R_{cb} - collector base bulk surge impedance

Figure 1. Schematic diagram of diode and transistor, old model.

[1] *Johnson, E. D. et al, "Transient Radiation Analysis by Computer Program (TRAC)," Vol I & II, AD836683, June 1968, Autonetics Division of North American Rockwell Corp, Anaheim, CA.*

For every actual p-n junction, a parallel ghost branch consisting of series resistor, voltage source, and ideal diode was inserted. The rationale for this model is that the ghost branch conducts only when a junction's breakdown voltage is exceeded, shunting current flow around the real junction and simulating breakdown avalanche. This is a viable model for isolated diode and transistor junctions, but problems arise when the modeled semiconductors are incorporated into actual networks as evidenced by the simple circuit under consideration. Notice in figure 1b that V_{db} may cause the transistor emitter base and collector base junctions to be forward biased, so that the transistor may be dissipating considerable d-c power, even in its quiescent state. The floating voltage sources also cause errors in calculated circuit response because damage-modeled components deviate from their intended operating points. To model the two-component diode transistor circuit, nine additional components must be introduced. For larger networks, insertion of ghost branches is extremely time-consuming.

The DAMTRAC program allows the analyst to enter circuit topology directly from the schematic diagram with no modifications. Not only is circuit programming made easier, but DAMTRAC--by eliminating floating voltage sources--significantly increases the fidelity of the computer representation of actual circuit response. Elimination of ghost branches also cuts program execution time considerably, making DAMTRAC less costly to run. These improvements are realized by augmenting the TRAC semiconductor models to include reverse breakdown behavior. This behavior is accomplished essentially by causing the slope of the junction I-V curve to equal the reciprocal of the bulk surge impedance when the junction bias becomes less than breakdown voltage.

For convenience in running the modified TRAC2 program, permanent files of diode and transistor parameters have been created on MERDC CDC 6600. The files are random-access (word addressable) files using the industry standard identification codes of the devices as name indices. Each name index references a record (9 words long for diodes, 20 words long for transistors) that contains the standard TRAC parameters plus device breakdown parameters. The user has the capability of reading from, or adding to, the files in course of running the modified TRAC2 program. For major updates to the files, editing routines are available from the office originating this report. The semiconductor library, in addition to cutting programming time, eliminates much duplication of effort and provides consistent data for given semiconductor devices.

The unmodified TRAC2 program allows the user two methods of describing grounded voltage sources: either analytically as a

time-function equation inserted in subroutine TRAEQ, or numerically as a series of time-amplitude data points. The complex waveforms associated with EMP-induced voltages in antennas and transmission cables are not easily described analytically, and the 15-data-point numerical description allowed by TRAC2 are inadequate for accurate representation of EMP-induced pulses. The DAMTRAC program will now handle digitized time functions described by up to 1000 ordered pairs.

An additional program time-saving capability, particularly for analysis of multitransistor networks, is DAMTRAC's GAUSS subroutine which calculates the peak and half-width of EMP-induced power pulses appearing in circuit components. For multiple pulse power waveforms, the subroutine chooses the pulse that is most damaging, based on maximum Wunsch-Bell model damage product value ($P_{peak} t^{1/2}$).

The results of a survey of Army Systems electronics semiconductor damage data are presented as appendix A of this report.

2. PROGRAM USAGE

Data are entered in TRAC2 fashion with the following exceptions.

2.1 Semiconductor Entry

Diodes and transistors are entered using a new file access format. To insert a transistor or diode into the network analysis and simultaneously add the semiconductor parameters to the DAMTRAC file, the following card format is used.

DIODES: _D(N_a,N_c) - id/A

__IS,MD,RDL,CDO,VDBI,TD,IPPD,BRKVOL,DAMNK

TRANSISTORS: _T(N_b,N_c,N_e)=PNP-id/A

__HFEN,HFEI,TN,TI,ICS,MC,CCO,VCBI,RCL,IES,ME,

__CEO,VEBI,REL,IPPC,IPPE,BRCVOL,BREVOL,DAMNC,DAMNE

It should be noted that the first 7 diode parameters and first 16 transistor paramenters are identical in sequence and numerical value to the device TRAC parameters. The DAMTRAC diode and transistor models require the additional breakdown parameters summarized below.

DIODES	DAMTRAC VARIABLE NAME
Breakdown Voltage	BRKVOL (n)
Bulk Surge Impedance	DAMNK (n)

TRANSISTORS	DAMTRAC VARIABLE NAME
Breakdown voltage, collector branch	BRCVOL (n)
Breakdown voltage, emitter branch	BREVOL (n)
Bulk surge impedance, collector branch	DAMNC (n)
Bulk surge impedance, emitter branch	DAMNE (n)

These are program variables that may be used in auxiliary equations. For example, to refer to the bulk surge impedance of diode No. 3, DAMNK(3) would be used.

The device id may be 1-10 alphanumeric characters. If a device's id is already on file, the old record will be overwritten with the new data.

To cause the program to read a device's parameters from the DAMTRAC file, the following card format is used.

DIODES: $\_D(N_a,N_c)$ - id/R

TRANSISTORS: $\_T(N_b,N_c,N_e)$=PNP-id/R

(Of course, the transistor may be NPN.)

The character "R" indicates that parameters are to be read from the file, and no parameters should follow on data cards.

The DAMTRAC program does not insert default parameters as does TRAC2. To insert default parameters, read 1NDUMMY or 2NDUMMY from file. A printout of devices presently on file appears in appendix B.

2.2 GAUSS Subroutine

Subroutine GAUSS scans output plots for maxima, divides the plot into time regions about each maxima, and prints out the maximum value and time half-width of each peak. The subroutine is particularly valuable for use with time history plots of power dissipated in semiconductors. To call the GAUSS subroutine, the following card is entered with the piece-part deck:

GAUSS = n

The character "G" must appear in column 1. The subroutine searches for the "n" most damaging peaks on any graph were $1 \leq n \leq 5$. For most applications n=1 suffices. Imbedded blanks and extraneous characters before the "=" are ignored.

Appendix C contains a detailed description of the numerical techniques employed by this routine and the significance of the output.

2.3 Additional TRAEQ Variables

To predict semiconductor damage in a circuit, the power dissipated in each p-n junction must be examined for amplitude and duration. Because the likelihood of semiconductor damage is usually much greater under reverse bias, a separate reverse junction power program variable is indispensable. DAMTRAC automatically calculates the power dissipated in all network semiconductor junctions. These powers may be examined by plotting the following variables:

PWCRRV(n) Diode #n power dissipated under reverse bias

PWCRFD(n) Diode #n power dissipated under forward bias

PWTCRV(n) Transistor #n collector-base power dissipated under reverse bias

PWTERV(n) Transistor #n emitter-base power dissipated under reverse bias

PWTCFD(n) Transistor #n collector-base power dissipated under forward bias

PWTEFD(n) Transistor #n emitter-base power dissipated under forward bias

2.4 Expanded Time Varying Source Description Capability

2.4.1 Source-Data Handling

This laboratory has been consistently describing EMP-induced pulses by machine-controlled digitization of oscilloscope traces. Depending on the complexity of a particular trace and the degree of accuracy required, as many as 800 to 900 points may be used to describe a single trace. It was considered desirable that DAMTRAC be modified to accept such digitization data, so that the accuracy of the program's analysis would not be limited by user ability to describe transient voltages.

An interpreted form of the digitization data is normally stored at MERDC CDC 6600 computer center on magnetic tape. The modifications in DAMTRAC were designed with such tape files in mind, but the file device type is not restricted to magnetic tape. Digitization data may be input from a card-reader file, permanent disc file, or any other type of file that may be readily copied to the appropriate logical unit within the DAMTRAC job. It is emphasized that permanent data files should be copied to a local file rather than assigned directly by an ATTACH or REQUEST command. The logical file TAPE7 that contains the digitization data performs several functions within the program, and will be written on after digitization data have been read.

Input of source description data to the program begins when program FREE encounters a piece-part specificiation data card indicating that voltage source description information is to be read from file. FREE reads two records containing file identification information from the file on logical unit 7, then calls subroutine DGSRCE.

Subroutine DGSRCE reads the time-amplitude ordered values from logical unit 7 and checks the ordering of time points to insure that the described function is never double-valued. In the event of double values occurring, points are deleted in the double-valued time region, the first-read points in the time region being retained. If more than 500 points remain after satisfying the time-order criterion, the data are divided into 499 time regions and points are deleted until no more than one point remains in each time region. On completion of data editing, DGSRCE stores the data and certain control variables in labeled common for access later in the program.

In the event that an end-of-file is encountered prematurely on logical unit 7, an informative diagnostic is printed and execution continues, using either the voltage source values input after the source specification card, or the analytic function specified in subroutine TRAEQ.

When program FREE encounters an EXECUTE data card, logical unit 7 is rewound and an end-of-file written so that the unit may be used later in program execution.

In the original TRAC2 program, the current amplitude and slope values of source voltage were defined in the main program from data points input after a source piece-part specificiation card. If an analytic function describing the source had been specified in subroutine TRAEQ, a redefinition of values took place when TRAEQ was called by subroutine ELMTS. A modification to ELMTS now causes the values to be redefined in terms of the digitization data after the call to the time function section of TRAEQ.

If the value of program time exceeds the maximum time on the digitized trace, execution of the program continues, using the amplitude and slope values defined in TRAEQ or the main program.

In addition to the above described capability, DAMTRAC is now capable of reading up to 39 points describing a source from data cards following a source specification card, as opposed to the 15 points allowed by TRAC2.

2.4.2 Accessing the Expanded Source Description Capability

To access the expanded source description capability, a file containing digitization data must be copied to local file TAPE7 before loading of the program. Magnetic tapes and permanent disc files should not be assigned directly to TAPE7 through ATTACH or REQUEST commands, as TAPE7 is a multipurpose unit that is written on in the course of DAMTRAC execution. Sample appropriate job control commands are listed in appendix D.

The file should contain information in the following format.

One record containing up to 80 alphanumeric characters serving as a file label,

One record containing an integer constant indicating how many ordered pairs follow, and

One record containing as many ordered pairs as were specified (in the order-time, amplitude). Up to 1000 pairs may be read. All records on the file should be the result of unformatted binary writes.

The user causes DAMTRAC to access this file by a data card reading:

```
_Sn=DIGITIZED DATA/F, PRINT
```

Column one must be blank and the character S must appear in column two; n is an optional identifying integer, and F is a scale factor by which the amplitude values read from file will be multiplied. The letter P following the scale factor causes the filed data to be printed before and after editing by DGSRCE. The key characters after the equals sign are D and /. Thus, the card may read:

```
_S=D/F
```

One or more ordered pairs of values should follow this card in standard TRAC2 format. These values serve as dummy definitions of the source.

No more than two sources may be described using filed data. If two sources are specified to be read from file, the program expects to find information for the second source immediately after the information for the first source on logical unit 7.

To take full advantage of the detailed source description, the value of end-time specified in TIME REGIONS should be no greater than the maximum time on the digitized trace. The value of maximum delta time should be $\leq 1/500$ of the end-time. As digitized traces are usually more complex in the early-time region, it may be advantageous to specify more than one time region for the trace, values of delta time for the early-time region being $<< 1/500$ of the maximum trace time. Inspection of the trace data should indicate appropriate time region and delta-time values.

3. SAMPLE RUN

The sample run included on the following pages demonstrates use of the program. Notice particularly the simplicity of the junction power auxiliary equations on the first page of the printout (subroutine TRAEQ). Also note on the last page of printout (p. 31) where the printout of junction-power amplitude and duration appear. The damage analyst needs only to turn to the last page of a circuit run output to assess possible component damage. To determine damage, the damage product of a power pulse may be compared with the damage constant (K_D) of the device in question, or the amplitude and half-width may be plotted as a point on the device damage curve. The circuit investigated for damage appears schematically in figure 2. Junction stress is predicted to be most critical at the diode junction under reverse bias.

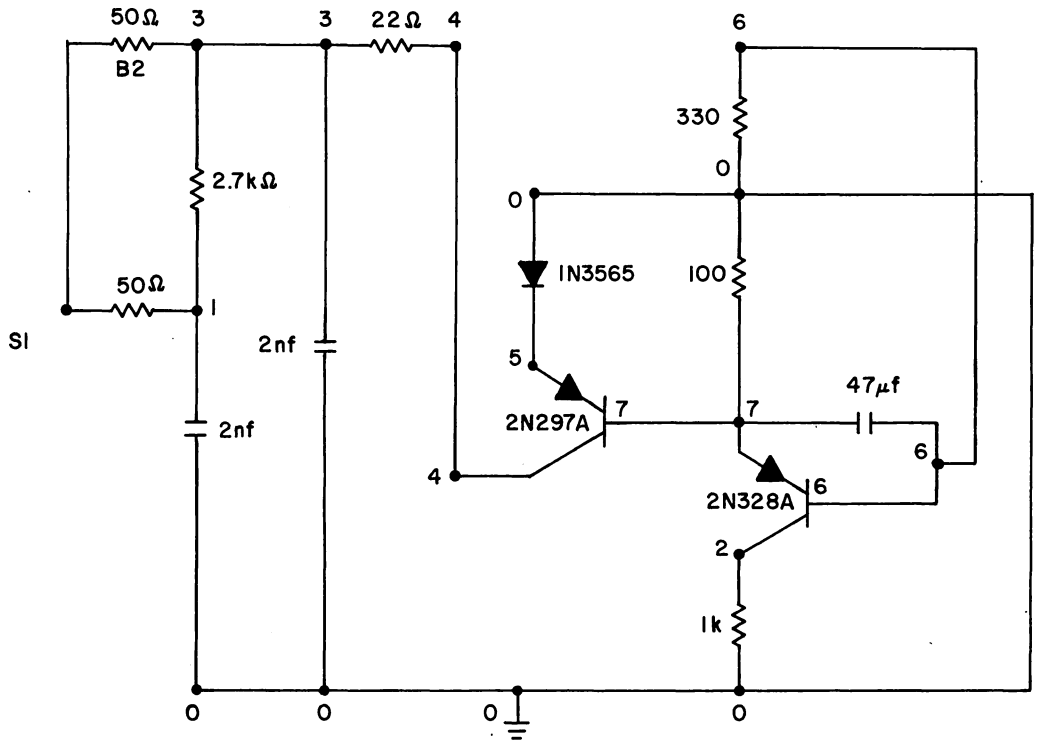


Figure 2. Circuit to be analyzed for semiconductor damage.

SAMPLE RUN

```
74/74   OPT=1                          FTN 4.1+PSR367     08/01/74  10.11.47.

      C     SUBROUTINE TRAEQ                                                  TRAEQ000
            SUBROUTINE TRAEQ(KK4)                                             TRAEQ010
            INTEGER ERR
            COMMON/GAMMA/PWCRFD(30),PWCRRV(30),BRKVOL(30),DAMNK(30)
  5         COMMON/DELTA/PWTEFD(30),PWTERV(30),PWTCFD(30),PWTCRV(30)
            COMMON/ALPHA/A(100),E(19,16,2),H(100,100),D,T(100),V(240),AL(50),
           1BV, CT(11,2), DI(30), DM, DR(30), DV(30), E1(20), E2(19),         TRAEQ070
           2TE,TI,TO,VS(20,5),V1(240),V2(240),BCI(30),
           3BCR(30),BCV(30),BEI(30),BER(30),BEV(30),DIP(30),EP1(20),EP2(20),  TRAEQ090
 10        4QCR(30,7),SI1,TEX,TE1,TOD(19),TOP,TO1,VER(9),AAAA(60),BCDT,       TRAEQ100
           5BCIP(30),BCUR(290),BEIP(30),DTIM,GRSP,                           TRAEQ110
           7PPIC(30), PPID(30), PPIE(30), PWCR(30), PWTR(30), QTAN(30,16),    TRAEQ120
           8RMAG, TE11, TOL1, TOL2, TOT2, TO11, VAL1(200), VAL2(200),        TRAEQ130
           9VAL3(200), BCDT1, BCUR1(290), PPIC1(30), PPID1(30), PPIE1(30),    TRAEQ140
 15        ASYMB1,SYMB2,TITLE(9),TOLPL,TOMIN,ST(19,2),ABC,                    TRAEQ150
           *EQ4,COND(30,5),CONP(200,5),CONT(30,5),ERR,IAW,JSJ,IDC,NCUT,
           BKTOT, IBC, NAW, ITOT, KTOT1, NV, NG, JJ, N3B, NBRAN, NBLOCK,     TRAEQ170
           CITOT1, JUJ, N2B, ISTRK, ISYM4, NZ, ND, NBB, NVM, NCR, NNNN1, ICP, TRAEQ180
           DIPRINT, NTPLP, NPP(60), NOP(4), NA, NZ1, ND1, JJJ, KE, NTR,       TRAEQ190
 20        EIFGDTC, JV, IPX, NA1, NT, NB, N1B, JCAT, NCORE, JVJ, NP, IPLCON,  TRAEQ200
           FISYM3, NP1(10,2), JG(19)                                          TRAEQ210
            COMMON/BETA/VP(5000),XP(700),TF(350)                              TRAEQ220
            ERR=2
            GO TO (9000,9003,9002,9001), KK4                                  TRAEQ230
 25   9000 CONTINUE                                                          TRAEQ240
      C     PART 1 - MATRIX AND TIME FUNCTION EQ@S. AFTER THIS CARD.          TRAEQ250
      C     RETURN                                                            TRAEQ260
      9003 CONTINUE                                                          TRAEQ270
      C     PART 2                                                            TRAEQ280
 30         RETURN                                                           TRAEQ290
      9002 CONTINUE                                                          TRAEQ300
      C     PART 3                                                            TRAEQ310
            RETURN                                                            TRAEQ320
      9001 CONTINUE                                                          TRAEQ330
 35   C     PART 4 - AUXILIARY EQUATIONS AFTER THIS CARD.                     TRAEQ340
            V(10)=PWCRFD(1)
            V(11)=PWCRRV(1)
            V(12)=PWTCFD(1)
            V(13)=PWTCRV(1)
 40         V(14)=PWTEFD(1)
            V(15)=PWTERV(1)
            V(16)=PWTCFD(2)
            V(17)=PWTCRV(2)
            V(18)=PWTEFD(2)
 45         V(19)=PWTERV(2)
            RETURN                                                            TRAEQ350
            END                                                               TRAEQ360
```

```
*
INITIAL CONDITIONS=*1
AUXILIARY EQUATIONS=10
TIME REGIONS
  4N,350N
 R1(S1,3)=50
 R2(2,0)=1K
 R3(S1,1)=50
 R4(3,1)=2.7K
 R5(3,4)=22
 R6(7,0)=100
 R7(6,0)=330
 C1(1,0)=2N
 C2(3,0)=2N
 C3(7,6)=47U
 D1(0,5)=1N3565/A
  9.42P,1.3,2.40+11,4P,.850,.1U,.1=3,26,20
 T1(7,4,5)=PNP=2N297A/A
  10,5,.37U,1.59U,5N,.994,.141N,.5,10M,5N,.994,.141N,.5,10M,.001,
  10U,60,9,30,73
 T2(6,2,7)=PNP=2N328A/A
  10,5,.2=4,.159=3,6N,.994,.212N,.5,.1+8,6N,.994,.141=8,.5,.1+8,
  1=3,1=5,50,20,124,16
 S1=*,H
   1,0,.5,40N,
          1K,60N,=810,70N,380,75N,=940,80N,880,85N,=750,110N,
  1250,130N,=630,145N,880,165N,=310,175N,1K,190N,=130,215N,0,220N
PRINT/500
PLOT/1
    S1
   10
   11
   12
    N13
    N14
    N15
    N16
    N17
  N18
  N19
GAUSS=3
EXECUTE
```

```
  TRAC2, RELEASE1 HDL- NOVEMBER 1971 RUN AT MERDC(STAUDHAMMER)  MAY 1972

    0  NO. OF NONSTANDARD PARAMETERS
    7  NO. OF NODE UNKNOWNS
   10  NO. OF AUX. UNKNOWNS
    0  NO. OF PARAMETER SWITCHES
   -1  INITIAL CONDITIONS
       (-2=PREV, -1=CALC, 0=ZERO, 1=READ V, 2=READ VEI, 3=READ V-CALC)
    1  NO. OF TIME FUNCT. AND GRD. VOLT. SOURCES
    1  RATIO OF CALC. PTS. TO PLOTTED PTS.
  500  RATIO OF PLOTTED PTS. TO PRINTED PTS.(0=PRINT INITIAL & FINAL CALC. ONLY
    0  PHASE PLANE PLOTS? 1=YES
    0  PROGRAM I.C. CHECK
       (-1=I.C. ONLY, 0=HALT FOR P.E., 1=CONTINUE FOR P.E.)
PLOTS OF ITEMS VS TIME
  NAME      NO.
 NODE        10
 NODE        11
 NODE        12
 NODE        13
 NODE        14
 NODE        15
 NODE        16
 NODE        17
 NODE        18
 NODE        19
```

SAMPLE RUN

NO.	MAXIMUM DELTA TIME	END TIME
1	.400000E-08	.350000E-06
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	0.
10	0.	0.

TEMPERATURE= .30000E+03

TIME FN.(GRD. VOLT. SOURCE) NO. 1 LAST VALUE HELD

PT.NO.	VALUE	TIME
1	.10000E+01	0.
2	.94000E+03	.400000E-07
3	-.87500E+03	.650000E-07
4	.25000E+03	.850000E-07
5	-.37500E+03	.950000E-07
6	.75000E+03	.120000E-06
7	-.44000E+03	.135000E-06
8	.62000E+02	.145000E-06
9	-.50000E+03	.165000E-06
10	.44000E+03	.190000E-06
11	-.31000E+03	.210000E-06
12	0.	.225000E-06
13	-.19000E+03	.240000E-06
14	.38000E+03	.260000E-06
15	0.	.280000E-06

RESISTORS

PART NO.	NODE F	NODE T	BRANCH NO.	BRANCH CURRENT	RESISTANCE
1	S 1	3	1	0.	.50000E+02
2	2	GROUND	2	0.	.10000E+04
3	S 1	1	3	0.	.50000E+02
4	3	1	4	0.	.27000E+04
5	3	4	5	0.	.22000E+02
6	7	GROUND	6	0.	.10000E+03
7	6	GROUND	7	0.	.33000E+03

CAPACITORS

PART NO.	NODE F	NODE T	BRANCH NO.	BRANCH CURRENT	CAPACITANCE	SERIES RESISTANCE	SHUNT RESISTANCE
1	1	GROUND	8	0.	.20000E-08	.10000E+00	.10000E+10
2	3	GROUND	9	0.	.20000E-08	.10000E+00	.10000E+10
3	7	6	10	0.	.47000E-04	.10000E+00	.10000E+10

DIODE NO. 1 BRANCH BRANCH

NODE A	NODE C	NO.	CURRENT									
GROUND	5	11	0.	IS	.9420E-11	MD	.1300E+01	RDL	.2400E+12	CD	.4000E-11	
				VDBI	.8500E+00	TD	.1000E-06	IPP	.1000E-03	BV	.2600E+02	BSI .2000E+02

TRANSISTOR NO. 1 PNP TYPE 2N2974

NODE B	NODE C	NODE E									
7	4	5					BRANCH CURRENT NO.	12	IB= 0.		
							NO.	13	IC= 0.		
HFE N	.1000E+02	HFE I	.5000E+01	T N	.3700E-06	T I	.1590E-05				
ICS	.5000E-08	MC	.9940E+00	CCD	.1410E-09	VCBI	.5000E+00	RCL	.1000E+08		
IES	.5000E-08	ME	.9940E+00	CED	.1410E-09	VEBI	.5000E+00	REL	.1000E+08		
IPPC	.1000E-02	IPPE	.1000E-04	BRCVOL	.6000E+02	BREVOL	.9000E+01				
BSIC	.3000E+02	BSIE	.7300E+02								

TRANSISTOR NO. 2 PNP TYPE 2N3284

NODE B	NODE C	NODE E									
6	2	7					BRANCH CURRENT NO.	14	IB= 0.		
							NO.	15	IC= 0.		
HFE N	.1000E+02	HFE I	.5000E+01	T N	.2000E-04	T I	.1590E-03				
ICS	.6000E-08	MC	.9940E+00	CCD	.2120E-09	VCBI	.5000E+00	RCL	.1000E+08		
IES	.6000E-08	ME	.9940E+00	CED	.1410E-08	VEBI	.5000E+00	REL	.1000E+08		
IPPC	.1000E-02	IPPE	.1000E-04	BRCVOL	.5000E+02	BREVOL	.2000E+02				
BSIC	.1240E+03	BSIE	.1600E+02								

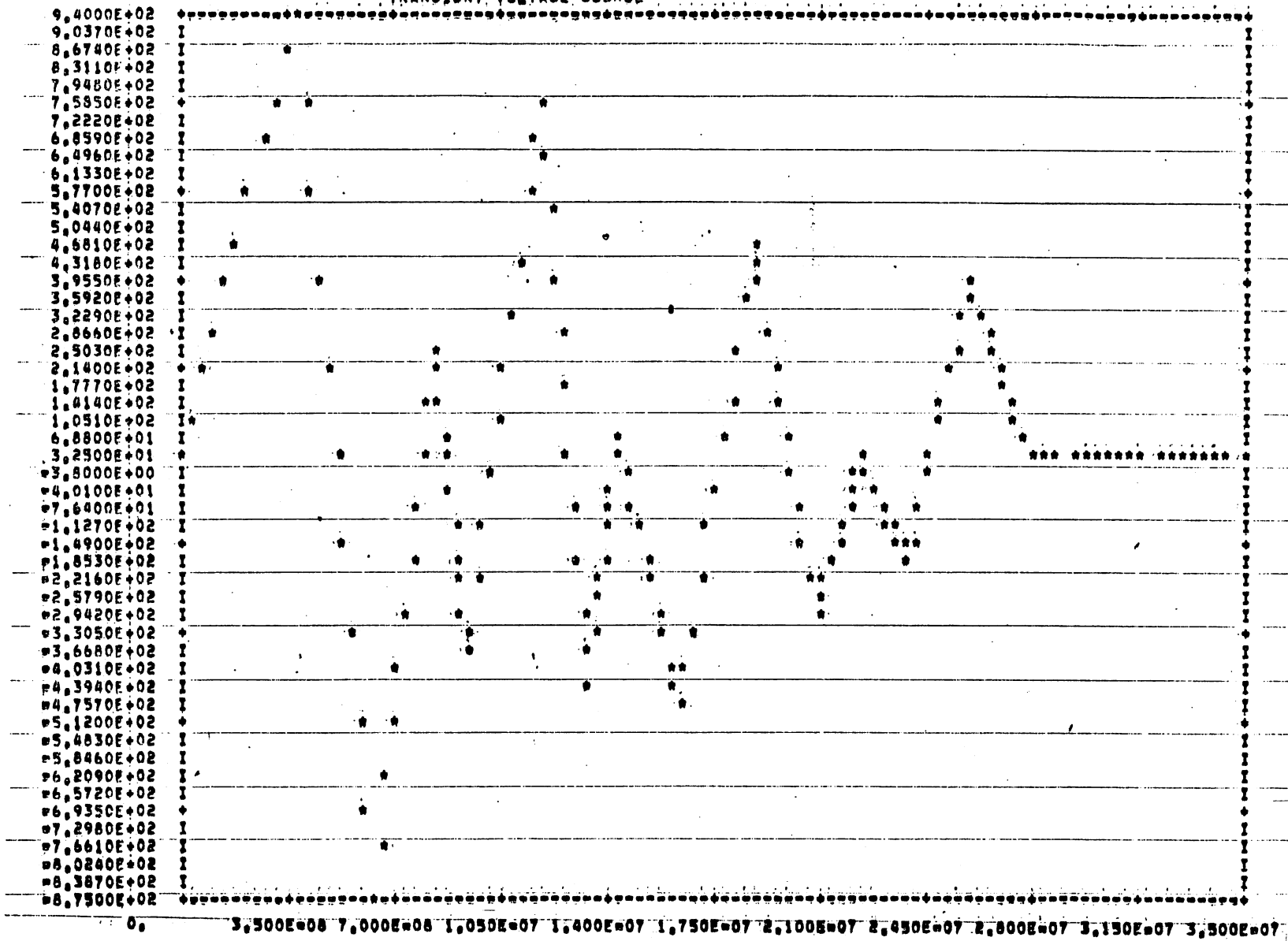
```
INITIAL CONDITIONS
TIME= 0.                    DELTA TIME= 0.                    H-P GEN. FN.= 0.
TIME FNS. AND GRD. VOLT. SOURCES
   1   .10000E+01
UNKNOWNS
   1   .99657E+00   2   .31979E+00   3   .81148E+00   4   .72702E+00   5   .72231E+00   6   .38622E-01
   7   .34021E+00   8   0.           9   0.           10  0.           11  .89781E-11   12  0.
  13   .14845E-02  14   .10135E-10  15   0.          16   .89917E-04  17  0.
BRANCH CURRENTS
   1   .37704E-02   2   .31979E-03   3   .68554E-04   4  -.68553E-04   5   .38389E-02   6   .34021E-02
   7   .11704E-03   8   0.           9   0.           10  0.           11  -.12430E-10  12  -.38389E-02
  13   .38389E-02  14  -.11704E-03  15  -.31979E-03
MAXIMUM DELTA TIME=    .400000E-08      START TIME=  0.                  END TIME=     .350000E-06
```

```
TIME=  .400000E-08     DELTA TIME=  .400000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
   1   .94900E+02
UNKNOWNS
   1   .30179E+01    2   .18273E+01    3   .28089E+01    4   .22347E+01    5   .22299E+01    6   .15462E+01
   7   .18478E+01    8  0.            9  0.            10  0.            11   .89781E-11   12  0.
  13   .14849E-02   14   .47462E-11   15  0.            16   .89916E-04   17  0.
BRANCH CURRENTS
   1   .18416E+01    2   .18273E-02    3   .18376E+01    4  -.77419E-04    5   .26099E-01    6   .18478E-01
   7   .46853E-02    8   .18376E+01    9   .18158E+01   10   .41331E-03   11  -.11084E-02   12  -.24991E-01
  13   .26099E-01   14  -.42720E-02   15  -.18273E-02
TIME=  .400000E-07     DELTA TIME=  .400000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
   1   .94000E+03
UNKNOWNS
   1   .16723E+03    2   .11908E+03    3   .15631E+03    4   .11952E+03    5   .11950E+03    6   .11880E+03
   7   .11911E+03    8  0.            9  0.            10  0.            11   .55863E+03   12  0.
  13   .68468E-02   14   .41826E-02   15  0.            16   .15488E-03   17  0.
BRANCH CURRENTS
   1   .15674E+02    2   .11908E+00    3   .15455E+02    4  -.40439E-02    5   .16721E+01    6   .11911E+01
   7   .36001E+00    8   .15451E+02    9   .14006E+02   10   .97966E-01   11  -.12155E+03   12  -.16702E+01
  13   .16721E+01   14  -.26204E+00   15  -.11908E+00
TIME=  .650000E-07     DELTA TIME=  .250000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
   1  -.87500E+03
UNKNOWNS
   1   .12594E+03    2   .75046E+02    3   .98603E+02    4   .75510E+02    5   .75474E+02    6   .74768E+02
   7   .75088E+02    8  0.            9  0.            10  0.            11   .18670E+03   12  0.
  13   .19113E-01   14   .13180E-01   15  0.            16   .28330E-03   17  0.
BRANCH CURRENTS
   1  -.19472E+02    2   .75046E-01    3  -.20019E+02    4  -.10126E-01    5   .10497E+01    6   .75088E+00
   7   .22657E+00    8  -.20029E+02    9  -.20512E+02   10   .18635E+00   11  -.10142E+03   12  -.10525E+01
  13   .10497E+01   14  -.40221E-01   15  -.75046E-01
TIME=  .850000E-07     DELTA TIME=  .200000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
   1   .25000E+03
UNKNOWNS
   1   .51902E+02    2   .19397E+02    3   .25864E+02    4   .19862E+02    5   .19827E+02    6   .19119E+02
   7   .19438E+02    8  0.            9  0.            10  0.            11   .14055E-08   12  0.
  13   .20857E-01   14   .14348E-01   15  0.            16   .27331E-03   17  0.
BRANCH CURRENTS
   1   .44827E+01    2   .19397E-01    3   .39620E+01    4  -.96440E-02    5   .27282E+00    6   .19438E+00
   7   .57936E-01    8   .39523E+01    9   .42195E+01   10   .17340E+00   11  -.11074E-02   12  -.27172E+00
  13   .27282E+00   14   .11546E+00   15  -.19397E-01
TIME=  .950000E-07     DELTA TIME=  .100000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
   1  -.37500E+03
UNKNOWNS
   1   .39316E+02    2   .10855E+02    3   .14599E+02    4   .11319E+02    5   .11286E+02    6   .10577E+02
   7   .10895E+02    8  0.            9  0.            10  0.            11   .97094E-09   12  0.
  13   .21109E-01   14   .14473E-01   15  0.            16   .26057E-03   17  0.
BRANCH CURRENTS
   1  -.77920E+01    2   .10855E-01    3  -.82863E+01    4  -.91542E-02    5   .14911E+00    6   .10895E+00
   7   .32051E-01    8  -.82955E+01    9  -.79319E+01   10   .16397E+00   11   .27501E-02   12  -.15186E+00
  13   .14911E+00   14   .13192E+00   15  -.10855E-01
```

```
TIME=  .135000E-06      DELTA TIME=  .150000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1  -.44000E+03
UNKNOWNS
  1   .85302E+02   2   .46957E+02   3   .61866E+02   4   .47423E+02   5   .47392E+02   6   .46679E+02
  7   .46996E+02   8  0.           9  0.           10  0.           11   .50693E+02  12  0.
 13   .23428E-01  14   .15955E-01  15  0.           16   .24460E-03  17  0.
BRANCH CURRENTS
  1  -.10037E+02   2   .46957E-01   3  -.10506E+02   4  -.86800E-02   5   .65647E+00   6   .46996E+00
  7   .14145E+00   8  -.10515E+02   9  -.10685E+02  10   .15043E+00  11  -.72374E+02  12  -.65837E+00
 13   .65647E+00  14   .94759E-02  15  -.46957E-01
TIME=  .145000E-06      DELTA TIME=  .100000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1   .62000E+02
UNKNOWNS
  1   .60553E+02   2   .28072E+02   3   .37194E+02   4   .28540E+02   5   .28509E+02   6   .27795E+02
  7   .28112E+02   8  0.           9  0.           10  0.           11   .35762E+01  12  0.
 13   .24265E-01  14   .16499E-01  15  0.           16   .24389E-03  17  0.
BRANCH CURRENTS
  1   .49612E+00   2   .28072E-01   3   .28945E-01   4  -.86514E-02   5   .39337E+00   6   .28112E+00
  7   .84227E-01   8   .20294E-01   9   .11141E+00  10   .14874E+00  11  -.12673E+02  12  -.39342E+00
 13   .39337E+00  14   .64516E-01  15  -.28072E-01
TIME=  .165000E-06      DELTA TIME=  .100000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1  -.50000E+03
UNKNOWNS
  1   .72018E+01   2  -.11495E+01   3  -.13171E+02   4  -.68317E+00   5  -.70883E+00   6  -.14266E+01
  7  -.11116E+01   8  0.           9  0.           10   .85684E-02  11  0.           12  0.
 13   .23299E-01  14   .15487E-01  15  0.           16   .22393E-03  17  0.
BRANCH CURRENTS
  1  -.97366E+01   2  -.11495E-02   3  -.10144E+02   4  -.75456E-02   5  -.56764E+00   6  -.11116E-01
  7  -.43230E-02   8  -.10152E+02   9  -.91614E+01  10   .13007E+00  11   .55106E+00  12   .16588E-01
 13  -.56764E+00  14   .13440E+00  15   .11495E-02
TIME=  .190000E-06      DELTA TIME=  .500000E-09          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1   .44000E+03
UNKNOWNS
  1   .48748E+01   2  -.12797E+01   3   .67344E+00   4  -.82273E+00   5  -.81013E+00   6  -.15569E+01
  7  -.12452E+01   8  0.           9  0.           10   .19757E+00  11  0.           12   .12880E-01
 13  0.           14  0.           15   .21904E-01  16   .18614E-03  17  0.
BRANCH CURRENTS
  1   .87865E+01   2  -.12797E-02   3   .87025E+01   4  -.15561E-02   5   .68008E-01   6  -.12452E-01
  7  -.47178E-02   8   .87009E+01   9   .87201E+01  10   .95527E-01  11  -.86458E-01  12  -.18450E-01
 13   .68008E-01  14   .10024E+00  15   .12797E-02
TIME=  .210000E-06      DELTA TIME=  .200000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1  -.31000E+03
UNKNOWNS
  1   .12140E+02   2  -.12295E+01   3   .26696E+01   4  -.77145E+00   5  -.77406E+00   6  -.15066E+01
  7  -.11973E+01   8  0.           9  0.           10   .68482E-01  11  0.           12  0.
 13   .49653E-02  14  0.           15   .26410E-02  16   .16517E-03  17  0.
BRANCH CURRENTS
  1  -.62534E+01   2  -.12295E-02   3  -.64428E+01   4  -.35075E-02   5   .15641E+00   6  -.11973E-01
  7  -.45655E-02   8  -.64463E+01   9  -.64063E+01  10   .72152E-01  11  -.17418E+00  12   .17768E-01
 13   .15641E+00  14   .76717E-01  15   .12295E-02
TIME=  .225000E-06      DELTA TIME=  .150000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1  0.
UNKNOWNS
  1  -.10011E+02   2  -.12519E+01   3  -.14885E+02   4  -.79711E+00   5  -.79145E+00   6  -.15291E+01
  7  -.12212E+01   8  0.           9  0.           10   .10415E+00  11  0.           12   .25585E-02
 13  0.           14  0.           15   .10586E-01  16   .15116E-03  17  0.
BRANCH CURRENTS
  1   .29769E+00   2  -.12519E-02   3   .20022E+00   4  -.18050E-02   5  -.64034E+00   6  -.12212E-01
  7  -.46336E-02   8   .19842E+00   9   .93984E+00  10   .57250E-01  11   .62224E+00  12   .18098E-01
 13  -.64034E+00  14   .61884E-01  15   .12519E-02
TIME=  .240000E-06      DELTA TIME=  .150000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1  -.19000E+03
UNKNOWNS
  1  -.22511E+02   2  -.12732E+01   3  -.21755E+02   4  -.82230E+00   5  -.80676E+00   6  -.15504E+01
  7  -.12438E+01   8  0.           9  0.           10   .16765E+00  11  0.           12   .15077E-01
 13  0.           14  0.           15   .24290E-01  16   .14023E-03  17  0.
BRANCH CURRENTS
  1  -.33649E+01   2  -.12732E-02   3  -.33498E+01   4   .28022E-03   5  -.95147E+00   6  -.12438E-01
  7  -.46982E-02   8  -.33495E+01   9  -.24137E+01  10   .44594E-01  11   .93306E+00  12   .18409E-01
 13  -.95147E+00  14   .49292E-01  15   .12732E-02
TIME=  .260000E-06      DELTA TIME=  .500000E-09          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1   .38000E+03
UNKNOWNS
  1  -.14979E+01   2  -.12851E+01   3   .75126E+01   4  -.83845E+00   5  -.81464E+00   6  -.15624E+01
  7  -.12571E+01   8  0.           9  0.           10   .22832E+00  11  0.           12   .29470E-01
 13  0.           14  0.           15   .40660E-01  16   .12856E-03  17  0.
BRANCH CURRENTS
  1   .74497E+01   2  -.12851E-02   3   .75700E+01   4   .22277E-02   5   .37959E+00   6  -.12571E-01
  7  -.47344E-02   8   .75723E+01   9   .70679E+01  10   .31004E-01  11  -.39818E+00  12   .18590E-01
 13   .37959E+00  14   .35738E-01  15   .12851E-02
TIME=  .280000E-06      DELTA TIME=  .200000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1  0.
```

SAMPLE RUN

```
UNKNOWNS
  1   .33788E+02   2  -.11841E+01   3   .27905E+02   4  -.73181E+00   5  -.73215E+00   6  -.14613E+01
  7  -.11571E+01   8   0.           9   0.           10  .17643E-01   11  0.           12  .28449E-03
 13   0.          14   0.           15  .81200E-02   16  .12105E-03   17  0.
BRANCH CURRENTS
  1  -.55811E+00   2  -.11841E-02   3  -.67577E+00   4  -.21789E-02   5   .13017E+01   6  -.11571E-01
  7  -.44283E-02   8  -.67795E+00   9  -.18576E+01   10  .20700E-01   11  -.13189E+01   12  .17183E-01
 13   .13017E+01  14   .25128E-01   15  .11841E-02
TIME=  .350000E-06      DELTA TIME=  .400000E-08          H-P GEN. FN.=  0.
TIME FNS. AND GRD. VOLT. SOURCES
  1   0.
UNKNOWNS
  1   .15725E+02   2   .66167E+01   3   .91006E+01   4   .70733E+01   5   .70679E+01   6   .63399E+01
  7   .66454E+01   8   0.           9   0.           10  0.           11  .30483E-09   12  0.
 13   .66531E-02  14   .66887E-03   15  0.           16  .13164E-03   17  0.
```


TRANSIENT VOLTAGE SOURCE
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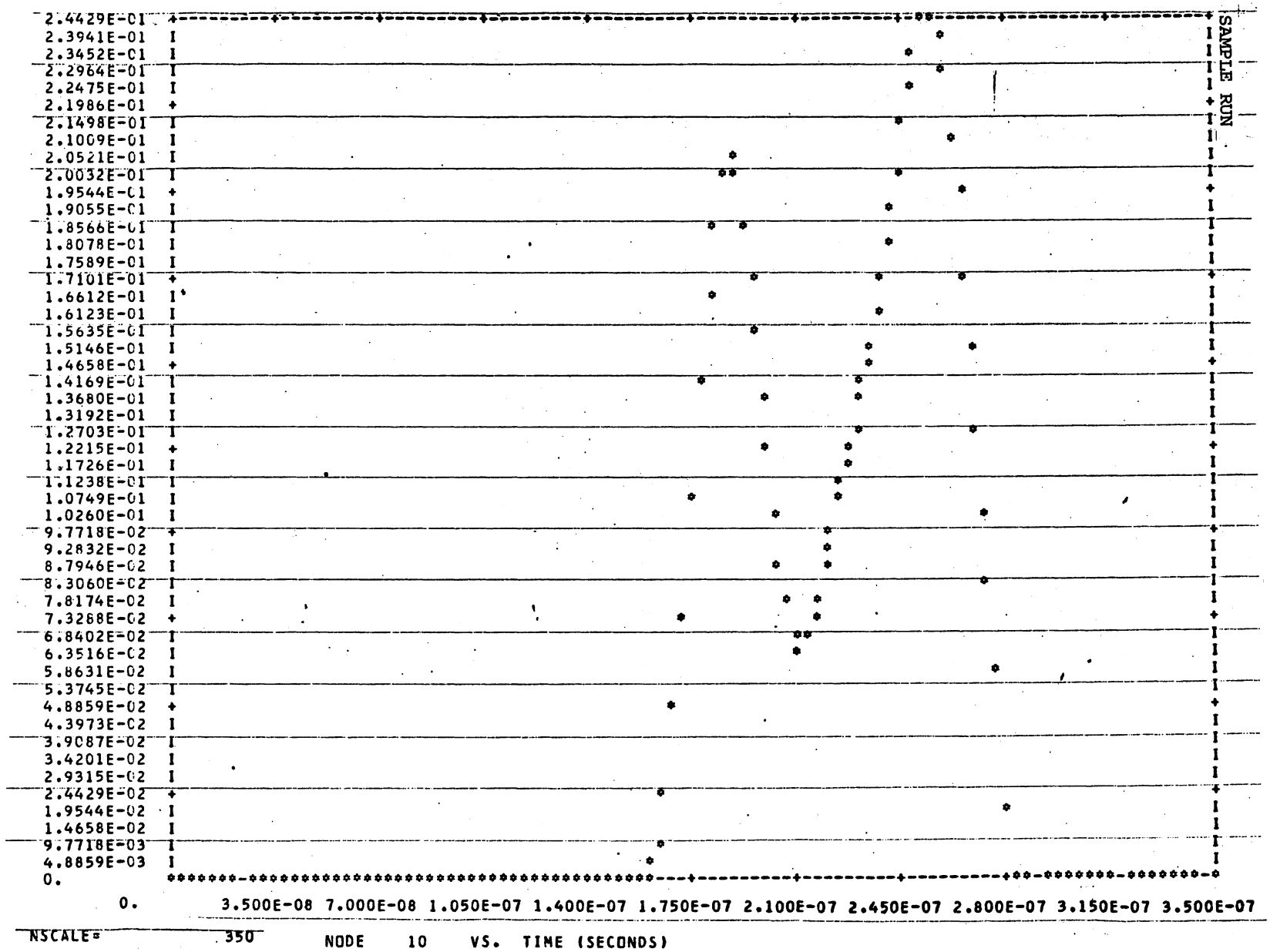
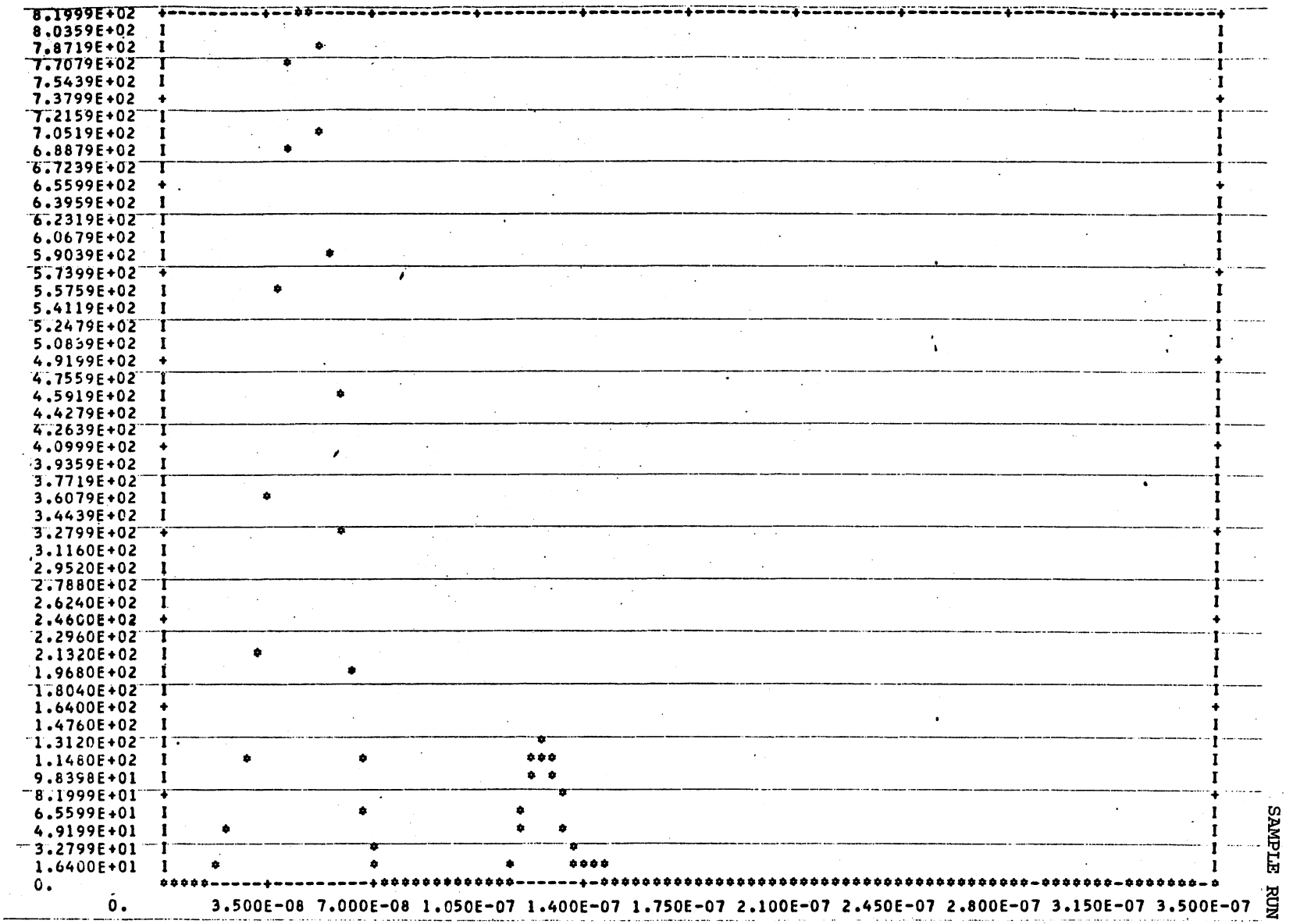
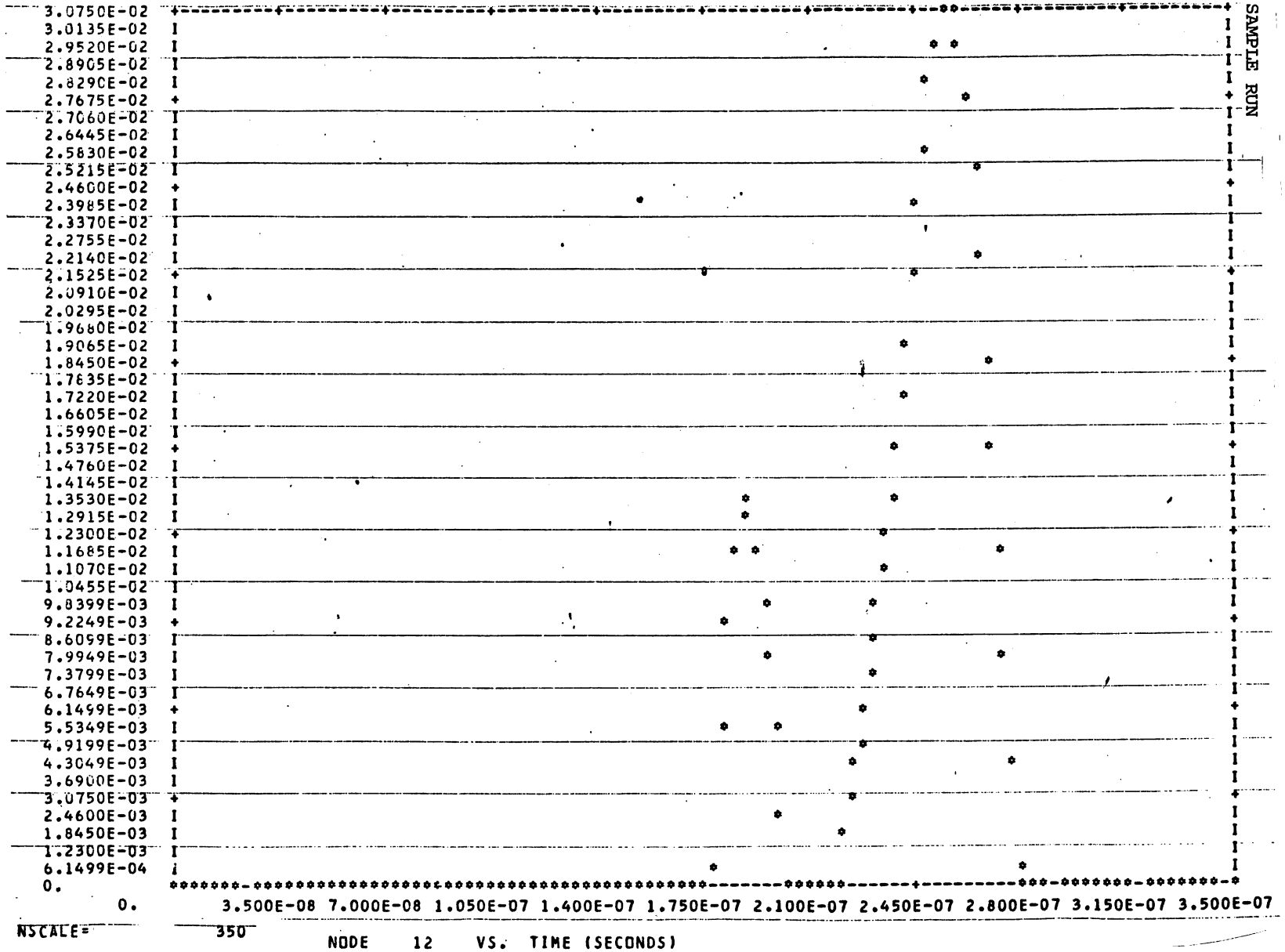
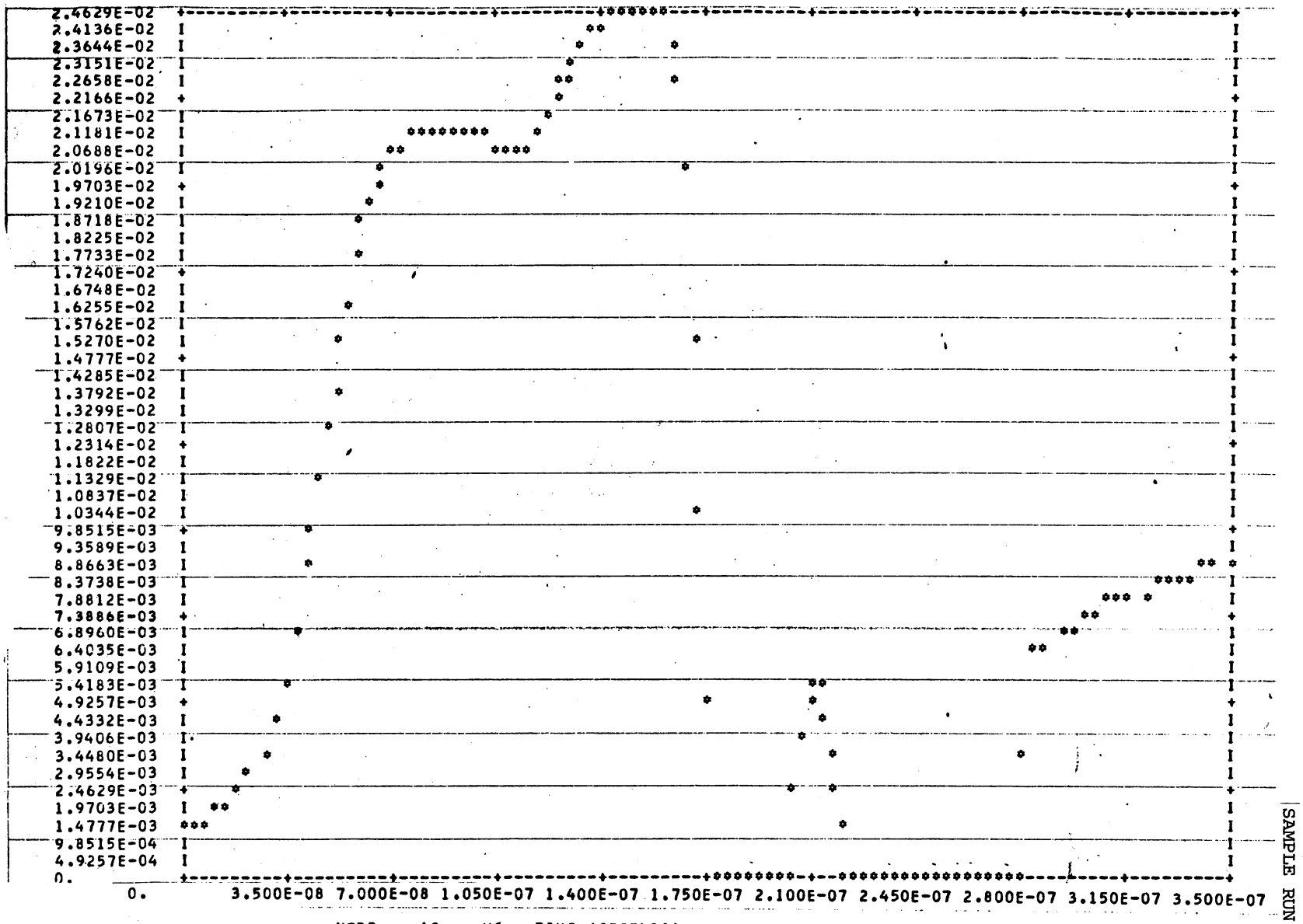
9.0370E+02
8.6740E+02
8.3110E+02
7.9480E+02
7.5850E+02
7.2220E+02
6.8590E+02
6.4960E+02
6.1330E+02
5.7700E+02
5.4070E+02
5.0440E+02
4.6810E+02
4.3180E+02
3.9550E+02
3.5920E+02
3.2290E+02
2.8660E+02
2.5030E+02
2.1400E+02
1.7770E+02
1.4140E+02
1.0510E+02
6.8800E+01
3.2500E+01
*3.8000E+00
*4.0100E+01
*7.6400E+01
*1.1270E+02
*1.4900E+02
*1.8530E+02
*2.2160E+02
*2.5790E+02
*2.9420E+02
*3.3050E+02
*3.6680E+02
*4.0310E+02
*4.3940E+02
*4.7570E+02
*5.1200E+02
*5.4830E+02
*5.8460E+02
*6.2090E+02
*6.5720E+02
*6.9350E+02
*7.2980E+02
*7.6610E+02
*8.0240E+02
*8.3870E+02
*8.7500E+02
0.
3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
NSCALE= 274 SOURCE 1 VS. TIME (SECONDS)

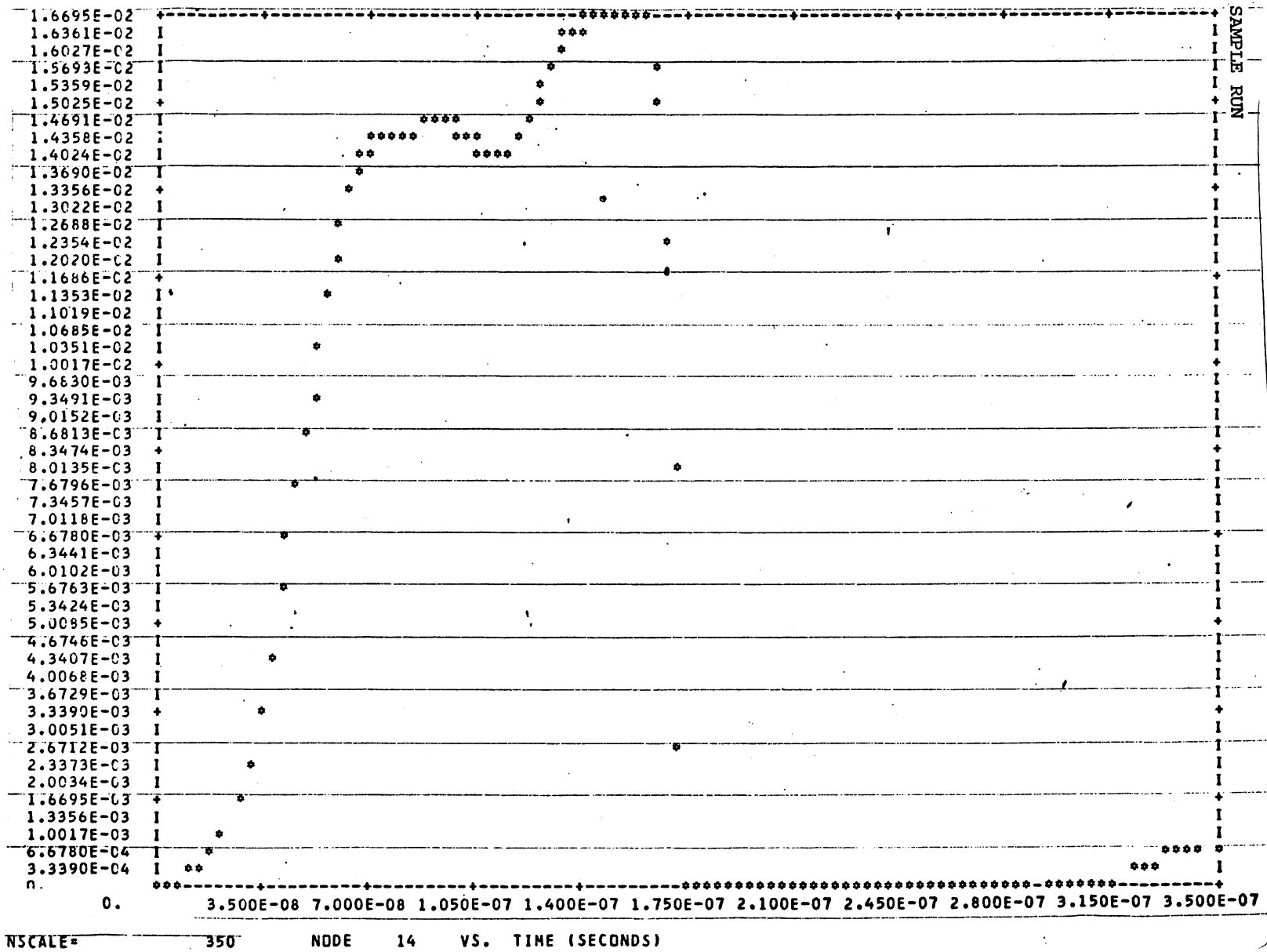
SAMPLE RUN

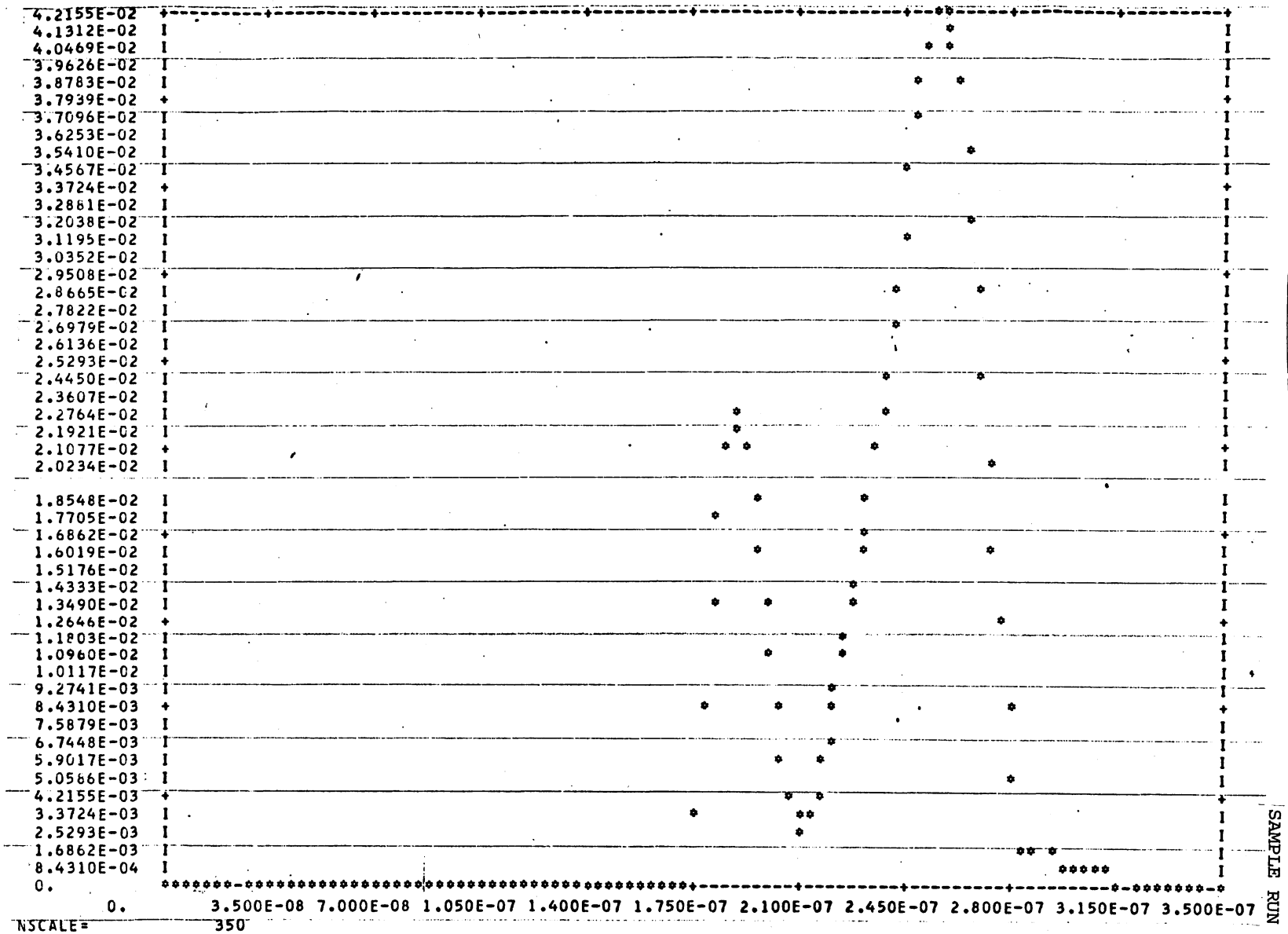

SAMPLE RUN
2.4429E-01
2.3941E-01
2.3452E-01
2.2964E-01
2.2475E-01
2.1986E-01
2.1498E-01
2.1009E-01
2.0521E-01
2.0032E-01
1.9544E-01
1.9055E-01
1.8566E-01
1.8078E-01
1.7589E-01
1.7101E-01
1.6612E-01
1.6123E-01
1.5635E-01
1.5146E-01
1.4658E-01
1.4169E-01
1.3680E-01
1.3192E-01
1.2703E-01
1.2215E-01
1.1726E-01
1.1238E-01
1.0749E-01
1.0260E-01
9.7718E-02
9.2832E-02
8.7946E-02
8.3060E-02
7.8174E-02
7.3288E-02
6.8402E-02
6.3516E-02
5.8631E-02
5.3745E-02
4.8859E-02
4.3973E-02
3.9087E-02
3.4201E-02
2.9315E-02
2.4429E-02
1.9544E-02
1.4658E-02
9.7718E-03
4.8859E-03
0.
0. 3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
NSCALE= 350 NODE 10 VS. TIME (SECONDS)


8.1999E+02
8.0359E+02
7.8719E+02
7.7079E+02
7.5439E+02
7.3799E+02
7.2159E+02
7.0519E+02
6.8879E+02
6.7239E+02
6.5599E+02
6.3959E+02
6.2319E+02
6.0679E+02
5.9039E+02
5.7399E+02
5.5759E+02
5.4119E+02
5.2479E+02
5.0839E+02
4.9199E+02
4.7559E+02
4.5919E+02
4.4279E+02
4.2639E+02
4.0999E+02
3.9359E+02
3.7719E+02
3.6079E+02
3.4439E+02
3.2799E+02
3.1160E+02
2.9520E+02
2.7880E+02
2.6240E+02
2.4600E+02
2.2960E+02
2.1320E+02
1.9680E+02
1.8040E+02
1.6400E+02
1.4760E+02
1.3120E+02
1.1480E+02
9.8398E+01
8.1999E+01
6.5599E+01
4.9199E+01
3.2799E+01
1.6400E+01
0.
0. 3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
NSCALE= 350 NODE 11 VS. TIME (SECONDS)
SAMPLE RUN


SAMPLE RUN
3.0750E-02
3.0135E-02
2.9520E-02
2.8905E-02
2.8290E-02
2.7675E-02
2.7060E-02
2.6445E-02
2.5830E-02
2.5215E-02
2.4600E-02
2.3985E-02
2.3370E-02
2.2755E-02
2.2140E-02
2.1525E-02
2.0910E-02
2.0295E-02
1.9680E-02
1.9065E-02
1.8450E-02
1.7835E-02
1.7220E-02
1.6605E-02
1.5990E-02
1.5375E-02
1.4760E-02
1.4145E-02
1.3530E-02
1.2915E-02
1.2300E-02
1.1685E-02
1.1070E-02
1.0455E-02
9.8399E-03
9.2249E-03
8.6099E-03
7.9949E-03
7.3799E-03
6.7649E-03
6.1499E-03
5.5349E-03
4.9199E-03
4.3049E-03
3.6900E-03
3.0750E-03
2.4600E-03
1.8450E-03
1.2300E-03
6.1499E-04
0.
0. 3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
NSCALE= 350
NODE 12 VS. TIME (SECONDS)
NO MORE PEAKS


2.4629E-02
2.4136E-02
2.3644E-02
2.3151E-02
2.2658E-02
2.2166E-02
2.1673E-02
2.1181E-02
2.0688E-02
2.0196E-02
1.9703E-02
1.9210E-02
1.8718E-02
1.8225E-02
1.7733E-02
1.7240E-02
1.6748E-02
1.6255E-02
1.5762E-02
1.5270E-02
1.4777E-02
1.4285E-02
1.3792E-02
1.3299E-02
1.2807E-02
1.2314E-02
1.1822E-02
1.1329E-02
1.0837E-02
1.0344E-02
9.8515E-03
9.3589E-03
8.8663E-03
8.3738E-03
7.8812E-03
7.3886E-03
6.8960E-03
6.4035E-03
5.9109E-03
5.4183E-03
4.9257E-03
4.4332E-03
3.9406E-03
3.4480E-03
2.9554E-03
2.4629E-03
1.9703E-03
1.4777E-03
9.8515E-04
4.9257E-04
0.
0.
3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
SAMPLE RUN
NSCALE= 350
NODE 13 VS. TIME (SECONDS)

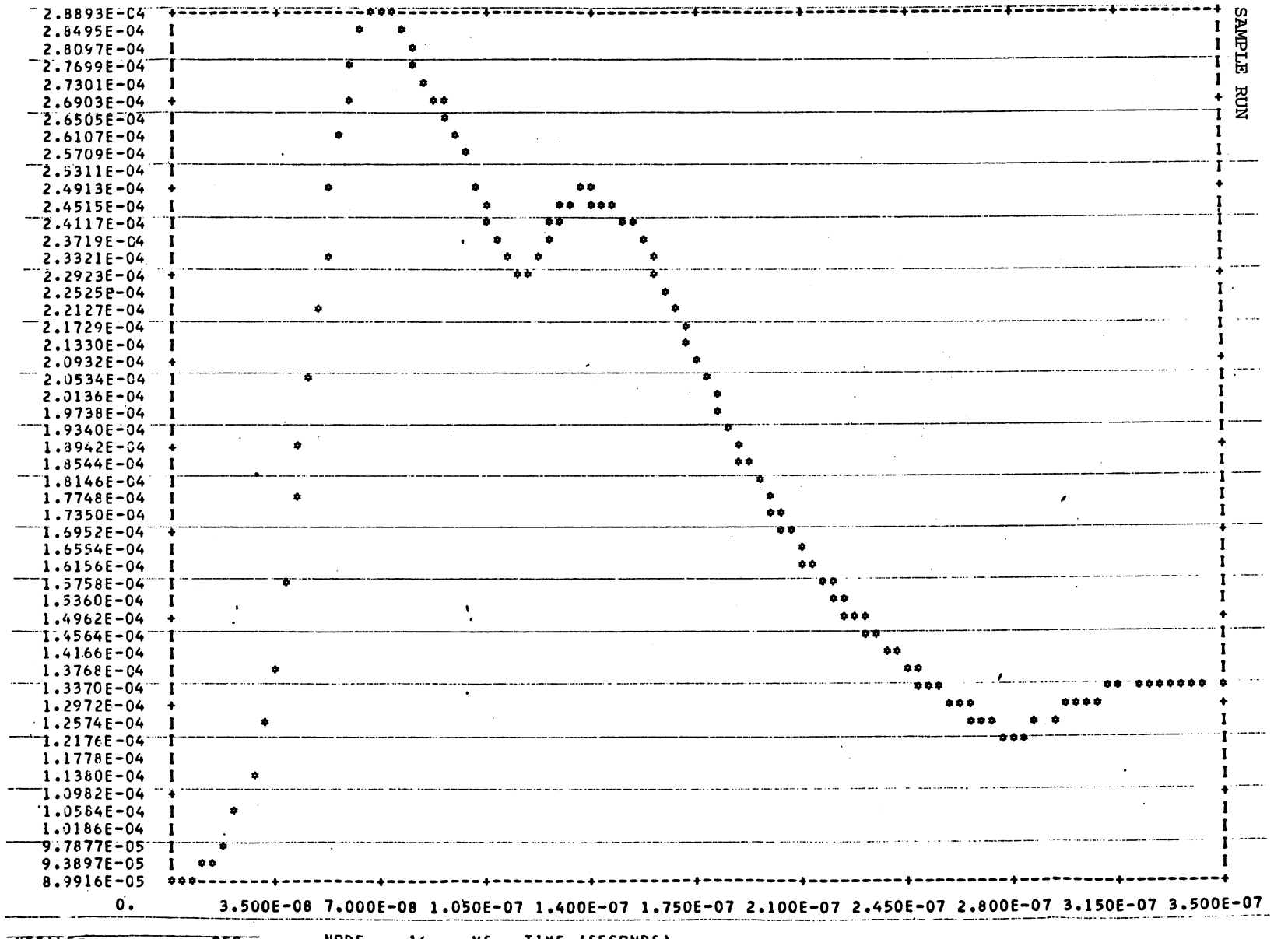

SAMPLE RUN
1.6695E-02
1.6361E-02
1.6027E-02
1.5693E-02
1.5359E-02
1.5025E-02
1.4691E-02
1.4358E-02
1.4024E-02
1.3690E-02
1.3356E-02
1.3022E-02
1.2688E-02
1.2354E-02
1.2020E-02
1.1686E-02
1.1353E-02
1.1019E-02
1.0685E-02
1.0351E-02
1.0017E-02
9.6830E-03
9.3491E-03
9.0152E-03
8.6813E-03
8.3474E-03
8.0135E-03
7.6796E-03
7.3457E-03
7.0118E-03
6.6780E-03
6.3441E-03
6.0102E-03
5.6763E-03
5.3424E-03
5.0085E-03
4.6746E-03
4.3407E-03
4.0068E-03
3.6729E-03
3.3390E-03
3.0051E-03
2.6712E-03
2.3373E-03
2.0034E-03
1.6695E-03
1.3356E-03
1.0017E-03
6.6780E-04
3.3390E-04
0.
0. 3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
NSCALE= 350 NODE 14 VS. TIME (SECONDS)



NSCALE= 350

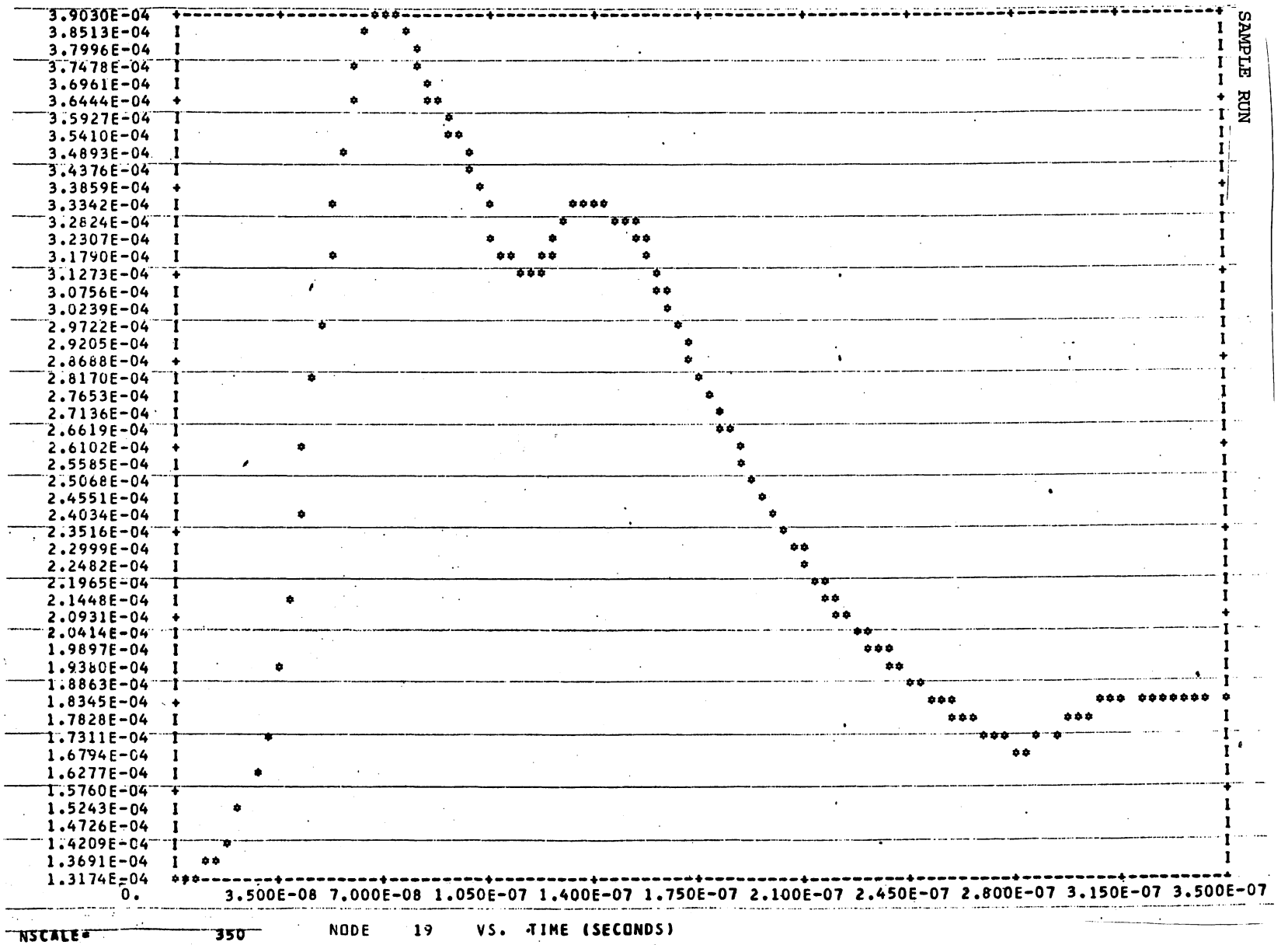
NODE 15 VS. TIME (SECONDS)

NO MORE PEAKS


2.8893E-04
2.8495E-04
2.8097E-04
2.7699E-04
2.7301E-04
2.6903E-04
2.6505E-04
2.6107E-04
2.5709E-04
2.5311E-04
2.4913E-04
2.4515E-04
2.4117E-04
2.3719E-04
2.3321E-04
2.2923E-04
2.2525E-04
2.2127E-04
2.1729E-04
2.1330E-04
2.0932E-04
2.0534E-04
2.0136E-04
1.9738E-04
1.9340E-04
1.8942E-04
1.8544E-04
1.8146E-04
1.7748E-04
1.7350E-04
1.6952E-04
1.6554E-04
1.6156E-04
1.5758E-04
1.5360E-04
1.4962E-04
1.4564E-04
1.4166E-04
1.3768E-04
1.3370E-04
1.2972E-04
1.2574E-04
1.2176E-04
1.1778E-04
1.1380E-04
1.0982E-04
1.0584E-04
1.0186E-04
9.7877E-05
9.3897E-05
8.9916E-05
SAMPLE RUN
0.
3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
NSCALE= 350 NODE 16 VS. TIME (SECONDS)

```
NO PRINTER PLOT
THE Y VALUE IS    0.
                                NODE    17    VS.  TIME (SECONDS)
NSCALE=              350
NO MORE PEAKS
```

```
NO PRINTER PLOT
THE Y VALUE IS    0.
                                NODE    18    VS.  TIME (SECONDS)
NSCALE=              350
NO MORE PEAKS
```


SAMPLE RUN
3.9030E-04
3.8513E-04
3.7996E-04
3.7478E-04
3.6961E-04
3.6444E-04
3.5927E-04
3.5410E-04
3.4893E-04
3.4376E-04
3.3859E-04
3.3342E-04
3.2824E-04
3.2307E-04
3.1790E-04
3.1273E-04
3.0756E-04
3.0239E-04
2.9722E-04
2.9205E-04
2.8688E-04
2.8170E-04
2.7653E-04
2.7136E-04
2.6619E-04
2.6102E-04
2.5585E-04
2.5068E-04
2.4551E-04
2.4034E-04
2.3516E-04
2.2999E-04
2.2482E-04
2.1965E-04
2.1448E-04
2.0931E-04
2.0414E-04
1.9897E-04
1.9380E-04
1.8863E-04
1.8345E-04
1.7828E-04
1.7311E-04
1.6794E-04
1.6277E-04
1.5760E-04
1.5243E-04
1.4726E-04
1.4209E-04
1.3691E-04
1.3174E-04
0.
3.500E-08 7.000E-08 1.050E-07 1.400E-07 1.750E-07 2.100E-07 2.450E-07 2.800E-07 3.150E-07 3.500E-07
NSCALE= 350 NODE 19 VS. TIME (SECONDS)

DAMAGE PRODUCT

		PEAK	AMPLITUDE	HALFWIDTH	RANKING CONST	RANK	LCHNL	MAX CHNL	RCHNL
NODE	10	3	.244E+00	.419E-07	.500E-04	1	.213E-06	.256E-06	.280E-06
NODE	10	2	.202E+00	.292E-07	.346E-04	2	.106E-06	.190E-06	.213E-06
NODE	10	4	.176E-01	.400E-08	.112E-05	3	.280E-06	.282E-06	.286E-06
NODE	11	1	.820E+03	.255E-07	.131E+00	1	0.	.500E-07	.830E-07
NODE	11	3	.116E+03	.140E-07	.138E-01	2	.103E-06	.128E-06	.164E-06
NODE	11	2	.226E-08	.113E-07	.240E-12	3	.830E-07	.890E-07	.103E-06
NODE	12	2	.307E-01	.317E-07	.548E-05	1	.206E-06	.258E-06	.282E-06
NODE	12	1	.130E-01	.156E-07	.162E-05	2	0.	.190E-06	.206E-06
NODE	13	2	.246E-01	.116E-06	.838E-05	1	0.	.156E-06	.180E-06
NODE	13	4	.865E-02	.607E-07	.213E-05	2	.222E-06	.350E-06	.350E-06
NODE	13	3	.542E-02	.115E-07	.581E-06	3	.180E-06	.212E-06	.222E-06
NODE	14	3	.167E-01	.113E-06	.560E-05	1	.400E-08	.156E-06	.177E-06
NODE	14	4	.669E-03	.194E-07	.932E-07	2	.177E-06	.350E-06	.350E-06
NODE	14	1	.101E-10	.187E-08	.439E-15	3	0.	0.	.400E-08
NODE	15	2	.422E-01	.383E-07	.825E-05	1	.212E-06	.258E-06	.322E-06
NODE	15	1	.220E-01	.213E-07	.321E-05	2	0.	.190E-06	.212E-06
NODE	16	2	.289E-03	.188E-06	.125E-06	1	.400E-08	.710E-07	.286E-06
NODE	16	4	.133E-03	.664E-07	.342E-07	2	.286E-06	.334E-06	.350E-06
NODE	16	1	.899E-04	.400E-08	.569E-08	3	0.	0.	.400E-08
NODE	17	0	0.	0.	0.	1	0.	0.	0.
NODE	18	0	0.	0.	0.	1	0.	0.	0.
NODE	19	2	.390E-03	.190E-06	.170E-06	1	.400E-08	.710E-07	.286E-06
NODE	19	4	.183E-03	.665E-07	.472E-07	2	.286E-06	.334E-06	.350E-06
NODE	19	1	.132E-03	.400E-08	.833E-08	3	0.	0.	.400E-08

SAMPLE RUN

APPENDIX A
DAMAGE DATA SURVEY
ARMY ELECTRONICS SEMICONDUCTORS
TESTED PRIOR TO
JUNE 1974

For the EMP damage analyst's convenience, a pool of devices for which some parameters are available has been gleaned from available damage study reports and tabulated on the following pages. The references below are cited in the survey.

(1) BDM Final Report, Vol 1, BDM-375-69-F-0168, Apr 69, prepared by D. C. Wunsch and L. Marzitelli.

(2) BDM Final Report on Semiconductor Damage Study, Phase II, BDM/A 66-70-TR, Jun 70, prepared by J. Singletary and D. C. Wunsch.

(3) BDM Final Summary Report on Semiconductor Damage Study, Phase II, BDM/A-84-70-TR, Feb 71, performed under contract DAAK02-67-C-0168.

(4) EMP Effects on Components, J. R. Miletta, Preprint.

(5) DNA-EMP Handbook, Vol 11, DNA 2114H-2, Nov 71. Chapter 13

(6) D.A.T.A. Book - Diode & SCR.

(7) D.A.T.A. Book - Transistor.

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN23BC					.0009	(5) 13-77		X
IN23RF					.00094	(5) 13-77		X
IN23WE					.00029	(5) 13-77		X
IN25					.026	(5) 13-77		X
IN34A	1-2000;s=9 Fwd; 1=2,s=12	(4) 4.24	60.	(5) 13-77	.014	(5) 13-77	III-36 (2) III-107 (3) II-9,III-	X
IN39A			230.	(5) 13-77	.006	(5) 13-77		X
IN39B			200.	(5) 13-77	.006	(5) 13-77		X
IN43B			70.	(5) 13-77	.005	(5) 13-77		X
IN63			100.	(6) 216-66				✓
IN64			25.	(5) 13-77	.041	(5) 13-77		X
IN67A			80.	(5) 13-77	.003	(5) 13-77		X
IN69			70.	(5) 13-77	.005	(5) 13-77		X
IN69A	4200	(4) 4.25	70.	(5) 13-77	.005	(5) 13-77		X
IN81			10.	(5) 13-77	.003	(5) 13-77		X
IN82A	30	(4) 4.19	5.	(5) 13-77	.0007	(5) 13-77	(1) 3.12	X
IN91			100.	(5) 13-77	.0055	(5) 13-77		X
IN100			80.	(6) 215-67				✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN128			40.	(5) 13-77	.005	(5) 13-77		X
IN140			80.	(6) 215-76				✓
IN191			90.	(5) 13-77	.005	(5) 13-77		✓
IN198*			80.	(5) 13-77	.024	(5) 13-77		X
IN248A			50.	(5) 13-77	40.	(5) 13-77		X
IN 249B			100.	(5) 13-77	40.	(5) 13-77		X
IN250			200.	(5) 13-77	40.	(5) 13-77		X
IN250B			200.	(5) 13-77	80.	(5) 13-77	(1) 3.16	X
IN251*			40.	(5) 13-77	.03	(5) 13-77		X
IN253*	174	(4) 4.19	95.	(5) 13-77	86.	(5) 13-77	(1) 3.20	X
IN254			190.	(5) 13-79	3.5	(5) 13-77		X
IN260			30.	(5) 13-77	.0027	(5) 13-77		X
IN270*			100.	(5) 13-78	.022	(5) 13-78		X
IN270A	≅3400; s≅22 fwd:16	(4) 4.25						X
IN276			100.	(5) 13-78	.0055	(5) 13-78		✓
IN277*			125.	(5) 13-78	.027	(5) 13-78		X
IN279			32.	(6) 211-52				✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN295A			40.	(5) 13-78	..005	(5) 13-78		X
IN320			500.	(5) 13-78	1.2	(5) 13-78		X
IN332			400.	(5) 13-78	3.5	(5) 13-78		X
IN333			400.	(5) 13-78	1.5	(5) 13-78		X
IN335			300.	(5) 13-78	1.5	(5) 13-78		X
IN337			200.	(5) 13-78	1.5	(5) 13-78		X
IN338*			100.	(5) 13-78	18.3	(5) 13-78	(1) 3.24	X
IN341			400.	(5) 13-78	3.5	(5) 13-78		X
IN342			400.	(5) 13-78	1.5	(5) 13-78		X
IN346			200.	(5) 13-78	1.5	(5) 13-78		X
(DIC) IN429	34.2	(1)	6.2	(5) 13-78	.6	(5) 13-78	(1) 3.28	X
(HOF) IN429	1.9	(1)	6.2	(5) 13-78	.6	(5) 13-78	(1) 3.28	X
(TI) IN457*	Rev=620 Fwd=.4	(4) 4.25	70.	(5) 13-78	12.	(5) 13-78		✓
(CDC) IN457			70.	(5) 13-78	12.	(5) 13-78		✓
IN458*			150.	(5) 13-78	.5	(5) 13-78		X
IN459	830	(4) 4.19	200.	(5) 13-78	.59	(5) 13-78	(1) 3.36	✓
IN459A	3.6	(1)	200.	(5) 13-78	.96	(5) 13-78	(1) 3.41	X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN461*			35.	(5) 13-78	.24	(5) 13-78		X
IN462*			80.	(5) 13-78	.05	(5) 13-78		X
IN466			3.5	(5) 13-78	.78	(5) 13-78		X
IN467			4.1	(5) 13-78	.78	(5) 13-78		X
IN468			4.9	(5) 13-78	.78	(5) 13-78		X
IN470			7.1	(5) 13-78	.78	(5) 13-78		X
IN474A			5.8	(4) 13-78	.219	(5) 13-78		X
IN482A	760	(4) 4.19	36.	(5) 13-78	.96	(5) 13-78	(1) 3.46	X
IN483A			70.	(5) 13-79	.3	(5) 13-79		X
IN483B			80.	(5) 13-79	.3	(5) 13-79		X
IN484A			130.	(5) 13-79	.45	(5) 13-79		X
IN484B			130.	(5) 13-79	.3	(5) 13-79		X
IN485			180.	(5) 13-79	.3	(5) 13-79		X
IN486B			225.	(5) 13-79	.29	(5) 13-79		X
IN487Z			300.	(5) 13-79	.3	(5) 13-79		X
IN488			380.	(5) 13-79	.3	(5) 13-79		X
IN536	NO FAILURE	(1)	50.	(5) 13-79	1.	(5) 13-79	(1) 3.52	X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN537*	130	(4) 4.19	100.	(5) 13-79	.51	(5) 13-79	(1) 3.53	X
IN538,m**			200.	(5) 13-79	1.	(5) 13-79		X
IN539	l≃810; s≃8.8	(4) 4.25	300.	(5) 13-79	1.	(5) 13-79		X
IN540*	94	(4) 4.19	400.	(5) 13-79	.93	(5) 13-79	(1) 3.54	X
IN547*			600.	(5) 13-79	12.1	(5) 13-79		X
IN560			800.	(5) 13-79	.625	(5) 13-79		X
IN561			1000.	(5) 13-79	.625	(5) 13-79		X
IN562			800.	(5) 13-79	1.8	(5) 13-79		X
IN619			10.	(5) 13-79	.36	(5) 13-79		X
IN622			150.	(5) 13-79	.347	(5) 13-79		X
IN625			30.	(5) 13-79	.164	(5) 13-79		X
IN625A			20.	(5) 13-79	.045	(5) 13-79		X
IN643			200.	(5) 13-79	.44	(5) 13-79		X
IN643A			200.	(5) 13-79	.1	(5) 13-79		X
IN645*	l≃1100; s≃8.7	(4) 4.25	225.	(5) 13-79	2.8	(5) 13-79	(1) 3.63	X
IN645Y								✓
IN645Z								✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN646			300.	(5) 13-79	2.29	(5) 13-79		X
IN646W								✓
IN646X								✓
IN646Y								✓
IN646Z								✓
IN647*	s=17.2; s=fwd=5.2	(4) 4.25	400.	(5) 13-80	2.8	(5) 13-80	(1) 3.64	✓
IN648*			500.	(5) 13-80	2.8	(5) 13-80		✓
IN649*	NO FAILURE	(1)	600.	(5) 13-80	2.9	(5) 13-80	(1) 3.65	X
IN649W								✓
IN649X								✓
IN649Y								✓
IN649Z								✓
IN658			120.	(5) 13-80	.92	(5) 13-80		✓
IN660			100.	(5) 13-80	.44	(5) 13-80		✓
IN661			200.	(5) 13-80	.41	(5) 13-80		✓
IN662			100.	(5) 13-80	.29	(5) 13-80		X
IN663			100.	(5) 13-80	.44	(5) 13-80		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN676			100.	(5) 13-80	.27	(5) 13-80		X
IN689			600.	(5) 13-80	1.1	(5) 13-80		X
IN691			80.	(5) 13-80	.418	(5) 13-80		X
IN692			100.	(5) 13-80	.5	(5) 13-80		X
IN695			20.	(6) 228-33				✓
IN702A	.51	(4) 4.19	2.6	(5) 13-80	1.	(5) 13-80	(1) 3.74	X
IN703A			3,5	(5) 13-80	1.	(5) 13-80		X
IN704A			4.1	(5) 13-80	1.	(5) 13-80		X
IN705A			4.8	(5) 13-80	.91	(5) 13-80	(1) 3.75	X
IN706*			5.8	(5) 13-80	.288	(5) 13-80		X
IN709A			6.2	(5) 13-80	.78	(5) 13-80		X
IN710			6.8	(5) 13-80	.78	(5) 13-80		X
IN711A	1.9	(1)	7.5	(5) 13-80	2.1	(5) 13-80	(1) 3.82	X
IN712			8.2	(5) 13-80	.78	(5) 13-80		X
IN714A			1o.	(5) 13-80	.78	(5) 13-80		X
IN715A			11.	(5) 13-80	.78	(5) 13-80		X
IN718A			15.	(5) 13-80	.1	(5) 13-80		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN719A			16.	(5) 13-80	.1	(5) 13-80		X
IN721A			20.	(5) 13-80	.35	(5) 13-80		X
IN725A			30.	(5) 13-81	.349	(5) 13-81		X
IN729			43.	(5) 13-81	.07	(5) 13-81		X
IN746A*			3.3	(5) 13-81	1.1	(5) 13-81		X
IN747A*			3.6	(5) 13-81	1.1	(5) 13-81		X
IN748A*			3.9	(5) 13-81	1.1	(5) 13-81		X
IN749			4.3	(5) 13-81	1.1	(5) 13-81		X
IN750A			4.7	(5) 13-81	1.1	(5) 13-81		X
IN751A			5.1	(5) 13-81	1.1	(5) 13-81	(1) 3.87	X
IN752A**			5.6	(5) 13-81	1.1	(5) 13-81	(1) 3.88	X
IN753A*	.4	(4) 4.19	6.2	(5) 13-81	1.2	(5) 13-81	(1) 3.89	X
IN754A*			6.8	(5) 13-81	.63	(5) 13-81		X
IN755A**			7.5	(5) 13-81	.63	(5) 13-81		X
IN756A**			8.2	(5) 13-81	.63	(5) 13-81		X
IN757A			9.1	(5) 13-81	.63	(5) 13-81		X
IN758A**			10.	(5) 13-81	.63	(5) 13-81		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN759A			12.	(5) 13-81	.63	(5) 13-81		X
IN761			4.9	(5) 13-81	1.8	(5) 13-81		X
IN762			5.8	(5) 13-81	1.8	(5) 13-81		X
IN763			7.1	(5) 13-81	1.8	(5) 13-81		X
IN763-Z			7.0	(5) 13-81	3.	(5) 13-81	(1) 3.96	X
IN766A			12.8	(5) 13-81	1.8	(5) 13-81		X
IN767			15.8	(5) 13-81	1.8	(5) 13-81		X
IN769-3			26.	(5) 13-81	2.	(5) 13-81		X
IN769A			23.5	(5) 13-81	1.8	(5) 13-81		X
(ITT) IN816	20; Fwd=10	(4) 4.25	26.	(5) 13-81	1.5	(5) 13-81	(1) 3.99	X
(TEC) IN816	374.5	(1)	26.	(5) 13-81	1.5	(5) 13-81	(1) 3.99	X
IN817			200.	(5) 13-81	.46	(5) 13-81		X
IN821			6.2	(5) 13-82	.577	(5) 13-82		X
IN823*	.79	(4) 4.19	6.2	(5) 13-82	1.8	(5) 13.82	(1) 3.10	X
IN845			200.	(5) 13-82	.365	(5) 13-82		X
IN890			60.	(5) 13-82	.357	(5) 13-82		X
IN903			20.	(6) 227-95				✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN908			40.	(6) 231-86				✓
(CDC)IN914*			100.	(5) 13-82	.85	(5) 13-82		✓
(GE) IN914			100.	(5) 13-82	.85	(5) 13-82		✓
(CDC-JAN) IN914			100.	(5) 13-82	.85	(5) 13-82		✓
(FSC)IN914			100.	(5) 13-82	.85	(5) 13-82		✓
(TI-JANTX) IN914			100.	(5) 13-82	.85	(5) 13-82		✓
(CDC-JANTX) IN914			100.	(5) 13-82	.85	(5) 13-82		✓
(TI)IN914	40.	(4) 4.25	100.	(5) 13-82	.85	(5) 13-82		✓
(UNK)IN914			100.	(5) 13-82	.85	(5) 13-82		✓
IN914B			75.	(6) 237-100				✓
IN916			100.	(5) 13-82	.44	(5) 13-82		X
IN933			100.	(5) 13-82	.014	(5) 13-82		X
IN933J	2@ formula ~~TEST DATA~~ INVALID (1)		100.	(5) 13-82	.1	(5) 13-82	(1) 3.10	X
IN936			9.	(5) 13-82	.14	(5) 13-82		X
IN936A,B			9.	(5) 13-82	7.	(5) 13-82		X
IN937			9.	(5) 13-82	.824	(5) 13-82		X
IN938B			9.	(5) 13-82	7.	(5) 13-82		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN939			9.	(5) 13-82	.824	(5) 13-82		X
IN939A			9.	(6) 158-96			(1) 3.112	X
IN939B			9.	(5) 13-82	7.	(5) 13-82		X
IN956B	2.5; Fwd ≈.37	(4) 4.25						X
IN960B			9.	(5) 13-82	1.	(5) 13-82		X
IN961B			10.	(5) 13-82	1.	(5) 13-82		X
IN963B*			12.	(5) 13-82	1.	(5) 13-82		X
IN964B			13.	(5) 13-82	1.	(5) 13-82		X
IN965B*			15.	(5) 13-82	1.	(5) 13-82		X
IN967B	1.9	(4) 4.19	18.	(5) 13-82	.73	(5) 13-82	(1) 3.117	X
IN968B			20.	(5) 13-82	1.	(5) 13-82		X
IN969B			22.	(5) 13-82	1.	(5) 13=82		X
IN970B			24.	(5) 13-82	1.	(5) 13-82		X
IN972B			30.	(5) 13-82	1.	(5) 13-82		X
IN973B			33.	(5) 13-82	1.	(5) 13-82		X
IN974B			36.	(5) 13-82	1.	(5) 13-83		X
IN975B			39.	(5) 13-83	1.	(5) 13-83		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN976B			43.	(5) 13-83	1.	(5) 13-82		X
IN977B			47.	(5) 13-83	1.	(5) 13-83		X
IN979B			56.	(5) 13-83	1.	(5) 13-83		X
IN981B	15	(4) 4.19	68.	(5) 13-83	1.4	(5) 13-83	(1) 3.121	X
IN983B			82.	(5) 13-83	1.	(5) 13-83		X
IN987A,B			120.	(5) 13-83	1.	(5) 13-83		X
IN995			15.	(6) 227-27				✓
IN1095	59.0	(1)	500.	(5) 13-83	.9	(5) 13-83	(1) 3.55	X
IN1096			600.	(5) 13-83	.9	(5) 13-83		X
IN1118			400.	(5) 13-83	11.392	(5) 13-83		X
IN1124A			250.	(5) 13-83	7.985	(5) 13-83		X
IN1126A			500.	(5) 13-83	14.	(5) 13-83		X
IN1184			100.	(5) 13-83	31.5	(5) 13-83		X
IN1199A			50.	(5) 13-83	15.	(5) 13-83		X
CE IN1200*	900; Fwd≃.05	(4) 4.25	100.	(5) 13-83	62.32	(5) 13-83		X
(MUT) IN1200	110	(4) 4.25	100.	(5) 13-83	62.32	(5) 13-83		X
IN1201			150.	(5) 13-83	62.32	(5) 13-83		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
(GE) IN1202*	64; Fwd≃.09	(4) 4.25	200.	(5) 13-83	21.	(5) 13-83		X
(MUT) IN1202	65; Fwd≃.1	(4) 4.25	200.	(5) 13-83	21.	(5) 13-83		X
IN1202A	s=11.6; sFwd=12	(4) 4.25	200.	(6) 275-29				X
IN1204A*			400.	(5) 13-83	46.106	(5) 13-83		X
IN1206			600.	(5) 13-83	62.32	(5) 13-83		X
IN1217			50.	(6) 248-110	5.8	(5) 13-83		X
IN1222B			400.	(5) 13-83	2.563	(5) 13-83		X
IN1317A			19.	(5) 13-83	.19	(5) 13-83		X
IN1319A			28.	(5) 13-83	.19	(5) 13-83		X
IN1342A			100.	(5) 13-83	38.4	(5) 13-83	(1) 3.125	X
IN1348A			200.	(5) 13-83	1.827	(5) 13-83		X
IN1367			47.	(5) 13-83	34.	(5) 13-83		X
IN1583			200.	(5) 13-84	11.391	(5) 13-84		X
IN1585			400.	(5) 13-84	3.5	(5) 13-84	(1) 3.129	X
IN1614*			200.	(5) 13-84	.38	(5) 13-84		X
IN1615			480.	(5) 13-84	.666	(5) 13-84		X
IN1693			200.	(5) 13-84	3.2	(5) 13-84		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN1695			400.	(5) 13-84	3.2	(5) 13-84		X
IN1731			1500.	(5) 13-84	3.2	(5) 13-84		X
IN1733A			3000.	(5) 13-84	11.3	(5) 13-84		X
IN1770A			9.1	(5) 13-84	14.2	(5) 13-84	(1) 3.133	X
IN1773A			12.	(5) 13-84	1.9	(5) 13-84		X
IN1780A			24.	(5) 13-84	1.9	(5) 13-84		X
IN1783			33.	(5) 13-84	21.3	(5) 13-84	(1) 3.134	X
IN1818RA			16.	(5) 13-84	4.3	(5) 13-84		X
IN1823C,A			27.	(5) 13-84	4.3	(5) 13-84		X
IN1828C			43.	(5) 13-84	4.3	(5) 13-84		X
IN1834			75.	(5) 13-84	33.8	(5) 13-84		X
IN1835A			82.	(5) 13-84	4.3	(5) 13-84		X
IN1836C			91.	(5) 13-84	4.3	(5) 13-84		X
IN1904			100.	(5) 13-84	28.	(5) 13-84		X
IN1909			200.	(5) 13-84	6.8	(5) 13-84		X
IN2037			12.8	(5) 13-84	.05	(5) 13-84		X
IN2154			50.	(5) 13-84	20.	(5) 13-84		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN2158			400.	(5) 13-84	21.5	(5) 13-84		X
IN2164			9.4	(5) 13-84	2.3	(5) 13-84		X
IN2199								✓
IN2483			400.	(5) 13-84	2.1	(5) 13-84		X
IN2610			100.	(5) 13-84	2.6	(5) 13-84		X
IN2611			200.	(5) 13-85	2.6	(5) 13-85		X
IN2613			400.	(5) 13-85	2.6	(5) 13-85		X
IN2615			600.	(5) 13-85	2.6	(5) 13-85		X
IN2789			400.	(5) 13-85	40.	(5) 13-85		X
IN2795			150.	(5) 13-85	40.	(5) 13-85		X
IN2796			200.	(5) 13-85	400.	(5) 13-85		X
IN2808			10.	(5) 13-85	249.	(5) 13-85		X
IN2818			20.	(5) 13-85	249.	(5) 13-85		X
IN2823B*			30.	(5) 13-85	249	(5) 13-85		X
IN2824			33.	(5) 13-85	156.	(5) 13-85		X
IN2826B			39.	(5) 13-85	249.	(5) 13-85		X
IN2844B			160.	(5) 13-85	15.	(5) 13-85		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN2846B*			200.	(5) 13-85	15.	(5) 13-85		X
IN2862			400.	(5) 13-85	2.8	(5) 13-85		X
IN2864			600.	(5) 13-85	2.8	(5) 13-85		X
IN2929A	(tunnel 0.9 diode)	(1)	1.	(5) 13-85	.073	(5) 13-85	(1) 3.139	X
IN2930			.74	(5) 13-85	.196	(5) 13-85		X
IN2970B			6.8	(5) 13-85	15.	(5) 13-85		X
IN2976B			12.	(5) 13-85	15.	(5) 13-85		X
IN2979B			15.	(5) 13-85	15.	(5) 13-85		X
IN2984B*			20.	(5) 13-85	15.	(5) 13-85		X
IN2985B,RB			22.	(5) 13-85	15.	(5) 13-85		X
IN2986B			24.	(5) 13-85	15.	(5) 13-85		X
IN2987B			25.	(5) 13-85	15.	(5) 13-85		X
IN2988B			27	(5) 13-85	15.	(5) 13-85		X
IN2989B			30.	(5) 13-85	15.	(5) 13-85		X
IN2991B			36.	(5) 13-86	15.	(5) 13-86		X
IN2995B			47.	(5) 13-86	15.	(5) 13-86		X
IN2997B			51.	(5) 13-86	15.	(5) 13-86		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN3001B			68.	(5) 13-86	15.	(5) 13-86		X
IN3008B			120.	(5) 13-86	15.	(5) 13-86		X
IN3015B			200.	(5) 13-86	33.84	(5) 13-86		X
IN3016B			6.8	(5) 13-86	19.5	(5) 13-86	(1) 3.144	X
IN3017B			7.5	(5) 13-86	1.9	(5) 13-86		X
IN3019B			9.1	(5) 13-86	1.9	(5) 13-86		X
IN3022B			12.	(5) 13-86	1.9	(5) 13-86		X
IN3024*			13.	(5) 13-86	1.9	(5) 13-86		X
IN3025B*			16.	(5) 13-86	1.9	(5) 13-86		X
IN3026B			18.	(5) 13-86	1.9	(5) 13-86		X
IN3027B			20.	(5) 13-86	1.9	(5) 13-86		X
IN3028B			22.	(5) 13-86	1.9	(5) 13-86		X
IN3029B			24.	(5) 13-86	1.9	(5) 13-86		X
IN3030B			27.	(5) 13-86	1.9	(5) 13-86		X
IN3031B			30.	(5) 13-86	1.9	(5) 13-86		X
IN3033B*			36.	(5) 13-86	1.9	(5) 13-86		X
IN3035B			43.	(5) 13-86	1.9	(5) 13-86		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN3037B			51.	(5) 13-86	1.9	(5) 13-86		X
IN3040B			68.	(5) 13-86	1.9	(5) 13-86		X
~~IN3041B~~			~~75.~~	~~(5) 13-86~~	~~1.9~~	~~(5) 13-86~~		~~X~~
IN3047B	s=7; l=1.2 FWD4.2	(4) 4.25	130.	(6) 202-23				X
IN3051B			200.	(5) 13-86	1.9	(5) 13-86		X
IN3064*	5	(4) 4.25	75.	(5) 13-86	.02	(5) 13-86		X
IN3070			200.	(5) 13-86	.365	(5) 13-86		X
IN3071			200.	(6) 244-50				
IN3157			8.4	(5)13-87	.625	(5) 13-87		X
IN3189			200.	(5) 13-87	10.	(5) 13-87		X
IN3190			600.	(5) 13-87	4.1	(5) 13-87		X
IN3560			.475	(5) 13-87	.038	(5) 13-87		X
IN3561			.475	(5) 13-87	.038	(5) 13-87		X
IN3582A			11.7	(5) 13-87	.35	(5) 13-87		X
IN3600*	5 For & Rev	(4) 4.25	50.	(5) 13-87	.18	(5) 13-87	(2) III 8-11 (3) III-10	X
IN3605			40.	(6) 231-89				✓
IN3666	7:1;Fwd=1.8	(4) 4.25	80.	(6) 239-86				X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN3669			70.	(6) 237-16				✓
IN3821			3.3	(5) 13-87	1.947	(5) 13-87		X
IN3828A			4.2	(5) 13-87	1.95	(5) 13-87		X
IN3893			400.	(5) 13-87	6.41	(5) 13-87		X
IN3976			200.	(5) 13-87	132.	(5) 13-87		X
IN4001			50.	(6) 255-33				✓
(MOT) IN4003	200	(4) 4.25	200.	(6) 272-19				✓
(TRW) IN4003	130	(4) 4.25	200.	(6) 272-19				✓
IN4005	120	(4) 4.25	600.	(6) 306-28				✓
IN4006			800.	(6) 318-48				✓
IN4148*			75.	(6) 238-2				✓
IN4241			6.	(5) 13-87	33.84	(5) 13-87		X
IN4245			200.	(5) 13-87	2.4	(5) 13-87		X
IN4249*			1000.	(5) 13-87	2.4	(5) 13-87		X
IN4312			150.	(5) 13-87	.116	(5) 13-87		X
IN4370			2.4	(5) 13-87	.625	(5) 13-87		X
IN4816			50.	(5) 13-87	6.8	(5) 13-87	(1) 3.148	X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
IN4817			100.	(5) 13-87	6.8	(5) 13-87	(1) 3.148	X
IN4820			400.	(5) 13-87	10.	(5) 13-87	(1) 3.148	X
IN4823			100.	(5) 13-87	.208	(5) 13-87		X
IN4989			200.	(5) 13-87	14.33	(5) 13-87		X
			M I S C .					
IN99			80.	(6) 215-65				X
(JANTX) IN935B			9.	(6) 158-82				X
IN941B			11.7	(6) 164-68				X
IN2990B			33.	(6) 184-160				X
IN3154			8.4	(6) 157-84				X
IN3611* (JANTX)			200.	(6) 273-30				X
IN4460-IN4482			6.2	(6) 149-201				X
(JANTX) IN4942			200.	(6) 244-87				X
(JANTX) IN4954-IN4975			6.8	(6) 152-167				X
(JANTX) IN5186			100.	(6) 241-54				X
10630127-1							(1) 3.448-9	X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
2N43A			5.	45.	(5) 13-89	.28	(5) 13-89		X
2N117			1.	45.	(5) 13-89	.15	(5) 13-89		X
2N118			1.	45.	(5) 13-89	.15	(5) 13-89		X
2N128			10.	10.	(5) 13-89	.017	(5) 13-89		X
2N158*			30.	60.	(5) 13-89	.499	(5) 13-89		X
2N174			60.	80.	(7) 4202				✓
2N176				40.	(5) 13-89	.46	(5) 13-89		X
2N189				25.	(5) 13-89	.17	(5) 13-89		X
2N190				25.	(5) 13-89	.58	(5) 13-89		X
2N243			1.	60.	(5) 13-89	.05	(5) 13-89		X
2N244			1.	60.	(5) 13-89	.05	(5) 13-89		X
2N263			1.	45.	(5) 13-89	.38	(5) 13-89		X
2N264				45.	(5) 13-89	.36	(5) 13-89		X
2N270	l=107; s=18	(4) 4.25	(7)1542 12.						X
2N274			.5	35.	(5) 13-89	.0076	(5) 13-89		X
2N279A				45.	(5) 13-89	.047	(5) 13-89		X
(MOT) 2N297A	l=190; s=9.5	(4) 4.25	40.	60.	(5) 13-89	.499	(5) 13-89		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
(RDX) 2N297A	73; Fwd=12	(4) 4.25	40.	60.	(5) 13-89	.499	(5) 13-89		X
2N315			20.	20.	(7) 1065				✓
2N328A*	s=16; l=480	(4) 4.25	20.	50.	(7) 2294				X
2N329A	1150	(4) 4.19	20.	50.	(5) 13-89	.21	(5) 13-89	(1) 3.246-7	✓
2N332			1.	45.	(5) 13-89	.45	(5) 13-89		X
2N333			1.	45.	(5) 13-89	.32	(5) 13-89		X
(GE) 2N335A	13	(4) 4.19	1. (2N335A) 4.	45.	(5) 13-89	.55	(5) 13-89	(1) 3.252	X
(TI) 2N335A	11; Fwd=13	(4) 4.25	1. 2N335A 4.	45.	(5) 13-89	.55	(5) 13-89	(1) 3.252	X
2N336*	10 for &rev	(4) 4.19; 4.24	1.	45.	(5) 13-89	.55	(5) 13-89	(1) 3.252-3 (2) III-22-26 (3) III-13	X
2N336A	10.1	(1)	4.0	45.	(7) 3093			(1) 3.254	X
2N336X									✓
2N336Y									✓
2N337			1.	45.	(5) 13-89	.12	(5) 13-89		X
2N338			1.	45.	(5) 13-89	.12	(5) 13-89		X
2N339			1.	55.	(5) 13-89	2.	(5) 13-89		X
2N341			1.	125.	(5) 13-89	1.	(5) 13-89		X
2N343	5.7	(4) 4.19	1.	60.	(5) 13-90	.047	(5) 13-90	(1) 3.261	X

VRC-46

VRC-46

VRC-46

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N343A			1.	60.	(5) 13-90	.05	(5) 13-90		X
2N356			20.	20.	(7) 1983				✓
2N357			20.	20	(5) 13-90	.05	(5) 13-90		X
2N359			6.	25.	(5) 13-90	.04	(5) 13-90		X
2N 375	230	(4) 4.19	40.	80.	(5) 13-90	1.02	(5) 13-90	(1) 3.265-6	X
2N384			.5	40.	(7) 816				✓
2N385			15.	25.	(7) 2079				✓
2N388*			15.	25.	(5) 13-90	.084	(5) 13-90		X
2N389	NO FAILURE	(1)	10.		(5) 13-90	2.14	(5) 13-90	(1) 3.275	X
2N393*			6.	6.	(7) 58				✓
2N395			20.	30.	(5) 13-90	.09	(5) 13-90		X
2N398			50.	105.	(7) 212				✓
2N404*			12.	25.	(5) 13-90	.05	(5) 13-90		✓
2N404V									✓
2N414			20.	30	(7) 1251				✓
2N424A			10.	80.	(5) 13-90	10.	(5) 13-90		X
2N457			20.	60.	(7) 3854				✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N463			50.	60.	(5) 13-90	6.6	(5) 13-90		X
2N480			2.	45.	(5) 13-90	.132	(5) 13-90		X
2N489									X
2N489A	160;Fwd≅190	(4) 4.25							X
2N490			60.	58.	(5) 13-90	1.	(5) 13-90		X
2N491			60.	58.	(5) 13-90	1.	(5) 13-90		X
2N495A	1400	(4) 4.19	20.	25.	(5) 13-90	.7	(5) 13-90	(1) 3.279	X
2N497			8.	60.	(5) 13-90	.8	(5) 13-90		X
2N498	4.2	(4) 4.19	8.	100.	(5) 13-90	.8	(5) 13-90	(1) 3.283	X
2N525			15.	45.	(5) 13-90	.3	(5) 13-90		X
(GE) 2N526*	250	(4) 4.19	15.	45.	(5) 13-90	.39	(5) 13-90	(1) 3.289-90	X
(MOT) 2N526	15;Fwd≅5.7	(4) 4.25	15.	45.	(5) 13-90	.39	(5) 13-90	(1) 3.289-90	X
2N527			15.	45.	(5) 13-90	.3	(5) 13-90		X
2N537			1.	30.	(5) 13-90	.012	(5) 13-90		X
2N538			28.	80.	(5) 13-90	.5285	(5) 13-90		X
2N539A			28.	80.	(5) 13-90	6.	(5) 13-90		X
2N540			28.	80.	(5) 13-90	.5285	(5) 13-90		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
2N542			2.	30.	(5) 13-90	.18	(5) 13-90		X
2N551			6.	60.	(5) 13-91	.16	(5) 13-91		X
2N576A	18	(4) 4.19	15.	40.	(5) 13-91	.023	(5) 13-91	(1) 3.296	X
2N585			20.	25.	(7) 2006				✓
2N587			40.	40.	(5) 13-91	.14	(5) 13-91		X
2N595				20.	(5) 13-91	.012	(5) 13-91		X
2N597			45.	45.	(7) 1564				✓
2N598	160;Ewd=30	(4) 4.25	30.	35.	(7) 1574b				✓
2N618	410	(4) 4.19	40.	80.	(5) 13-91	.88	(5) 13-91	(1) 3.267	X
2N645									✓
2N652A			30.	45.	(5) 13-91	.118	(5) 13-91		X
2N656			8.	60.	(5) 13-91	.2	(5) 13-91		X
2N657*	3.2	(1)	8.	100.	(5) 13-91	.66	(5) 13-91	(1) 3.300-1	X
(TI) 2N657A	1.9	(1)	8.	100.	(5) 13-91	1.07	(5) 13-91	(1) 3.302-5	X
(GE) 2N657A	16.1	(1)	8.	100.	(5) 13-91	1.07	(5) 13-91	(1) 3.302-5	X
2N682			(6)363-23 — 50.(SCR)			.33	(5) 13-91		X
2N685	INSUFFICIENT DATA	(1)	(6)375-87 — 200.(SCR)		∴	1.4	(5) 13-91		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
2N687			(6) 375-87 300.(SCR)			11.7	(5) 13-91		X
2N690			(6) 396-107 600.(SCR)			3.1	(5) 13-91		X
2N696*			5.	60.	(5) 13-91	1.0	(5) 13-91		X
2N697*			5.	60.	(5) 13-91	.2	(5) 13-91		✓
2N699	6.6	(1)	5.	120.	(5) 13-91	.25	(5) 13-91		X
2N703			5.	25.	(5) 13-91	.08	(5) 13-91		X
2N705			3.5	15.	(7) 1610				✓
2N706B*			(2N706B 3. 5.)	25.	(5) 13-91	.0075	(5) 13-91		✓
2N706A			5.	25.	(7) 2930				✓
2N708			5.	40.	(5) 13-91	.03	(5) 13-91		X
2N711A									✓
2N717			5.	60.	(5) 13-91	.13	(5) 13-91		X
2N718			5.	60.	(5) 13-91	.13	(5) 13-91		✓
2N718A			7.	75.	(5) 13-91	.35	(5) 13-91		X
2N720A			7.	120.	(7) 3121				✓
2N722			5.	50.	(7) 2479p				✓
2N726			5.	25.	(5) 13-91	.021	(5) 13-91		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N730			5.	60.	(5) 13-91	.164	(5) 13-91		X
2N736	2.4	(1)	5.	80.	(5) 13-91	.1	(5) 13-91	(1) 3.233-4	X
2N738	18; s≃5.4; Fwd 1≃1.5≃3.6	(4) 4.25	5.	125.	(7) 30798				X
2N743			5.	20.	(7) 2964				✓
2N756A			6.	60.	(5) 13-92	.32	(5) 13-92		X
2N757			6.	45.	(5) 13-92	.032	(5) 13-92		X
2N760			8.	45.	(7) 3104b				✓
2N760A	35	(4) 4.19	8.	60.	(5) 13-92	.034	(5) 13-92	(1) 3.329	X
2N797			20.	25.	(7) 2008				✓
2N834			5.	40.	(5) 13-92	.03	(5) 13-92		✓
2N835			3.	25.	(7) 2970				✓
2N859			25.	40.	(5) 13-92	.18	(5) 13-92		X
2N869A			5.	25.	(5) 13-92	.009	(5) 13-92		X
2N910			7.	100.	(5) 13-92	.218	(5) 13-92		X
2N912			7.	100.	(5) 13-92	.07	(5) 13-92		X
2N914*			5.	40.	(5) 13-92	.04	(5) 13-92		✓
2N915			5.	70.	(7) 2999K				✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N916			5.	45.	(5) 13-92	.043	(5) 13-92		✓
2N917			3.	30.	(5) 13-92	.004	(5) 13-92		X
2N918			3.	30.	(5) 13-92	.004	(5) 13-92		✓
2N927	2819	(1)	70.	70.	(5) 13-92	.1	(5) 13-92	(1) 3.334	X
(TI) 2N930*	37	(1)	5.	45.	(5) 13-92	.046	(5) 13-92	(1) 3.338	X
(FSC) 2N930			5.	45.	(5) 13-92	.046	(5) 13-92	(1) 3.338	X
2N930A	23.9	(1)	6.	60.	(5) 13-92	.02	(5) 13-92	(1) 3.342	X
2N955A									✓
2N964			2.5	15.	(7) 1173g				✓
2N976			2.	15.	(7) 742c				✓
2N1016B	6.2	(1)	25	100	(5) 13-92	1.6	(5) 13-92	(1) 3.347	✓
2N1037			20.	50.	(7) ss96				✓
2N1039*	285.1	(1)	20.	60.	(5) 13-92	1.4	(5) 13-92	(1) 3.351-2	✓
2N1045-1			20.	100.	(5) 13-92	.55	(5) 13-92		X
2N1048			6.	120.	(5) 13-92	3.9	(5) 13-92		X
2N1049			6.	80.	(5) 13-92	3.9	(5) 13-92		X
2N1050			6.	120.	(5) 13-92	6.082	(5) 13-92		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
2N1069			9.	60.	(5) 13-92	9.3	(5) 13-92		X
2N1099	139.4	(1)	40.	80.	(5) 13-92	1:	(5) 13-92	(1) 3.358	✓
2N1115	14.4	(1)		20.	(5) 13-92	.38	(5) 13-92	(1) 3.363	X
2N1116A	2.9	(1)	6.	60.	(5) 13-92	.98	(5) 13-92	(1) 3.367	X
2N1118			10.	25.	(5) 13-93	.19	(5) 13-93		X
2N1121	15	(4) 4.27							X
(TEC) 2N1132*	4.3	(1)	5.	50.	(5) 13-93	.23	(5) 13-93	(1) 3.372-3	✓
(MOT-JAN) 2N1132	e+≃2.3 c+≃.7	(4) 4.25	5.	50.	(5) 13-93	.23	(5) 13-93	(1)3.372-3	✓
(TI-JAN) 2N1132	e+≃3.9 c+≃.6	(4) 4.25	5.	50.	(5) 13-93	.23	(5) 13-93	(1)3.372-3	✓
(FSC) 2N1132	e+≃2.4 c+≃.6	(4) 4.25	5.	50.	(5) 13-93	.23	(5) 13-93	(1)3.372-3	✓
2N1132A	l≃2.7; s≃18 Fwd≃1.4	(4) 4.25	5.	60.	(7) 2486v				X
2N1136B				100.	(5) 13-93	18.4	(5) 13-93		X
2N1150			1.	45.	(5) 13-93	.18	(5) 13-93		X
2N1154			1.	50.	(5) 13-93	21.	(5) 13-93		X
2N1156			1.	120.	(5) 13-93	18.	(5) 13-93		X
2N1184*			20.	45.	(5) 13-93	.471	(5) 13-93		✓
2N1204	l≃96; Fwd≃1 .45 s≃50; Fwd s≃3.8	(4) 4.25	4.	20.	(7) 1455				X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N1212			10.	60.	(5) 13-93	13.129	(5) 13-93		X
2N1225*			.5	40.	(7) 817				✓
2N1289									✓
2N1301									✓
2N1303			25	30.	(5) 13-93	.087	(5) 13-93		X
2N1304			25.	25.	(7) 2071				✓
2N1306			25.	25.	(7) 2096				✓
2N1307			25.	30.	(7) 927c				✓
(GIC) 2N1308	1=46; 2=62; Fwd=10	(4) 4.25	25.	25.	(5) 13-93	.084	(5) 13-93		✓
(TI) 2N1308	1=550; 2=68 Fwd=35	(4) 4.25	25.	25.	(5) 13-93	.084	(5) 13-93		✓
2N1309			25.	30.	(5) 13-93	.087	(5) 13-93		X
2N1342			5.	150.	(7) 3362d				✓
2N1445			8.	120.	(5) 13-93	.5	(5) 13-93		X
2N1458			15.	80.	(5) 13-93	.5285	(5) 13-93		X
2N1469			40.	40.	(5) 13-93	.65	(5) 13-93	(1) 3.379	X
2N1480			12.	100.	(5) 13-93	5.5	(5) 13-93		X
2N1481			12.	60.	(5) 13-93	2.2	(5) 13-93		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
2N1483			12	60.	(5) 13-93	3.633	(5) 13-93		✓
2N1485*			12.	60.	(5) 13-93	4.1	(5) 13-93		X
2N1486			12.	100.	(5) 13-93	5.	(5) 13-93		X
2N1489			10.	60.	(5) 13-93	12.3	(5) 13-93		X
2N1490			10.	100.	(5) 13-93	12.3	(5) 13-93		X
2N1499			2.	20.	(7) 47a				✓
2N1506			4.		(7) 4640y				✓
2N1564			5.	80.	(5) 13-93	.56	(5) 13-93		X
2N1565			5.	80.	(5) 13-93	.11	(5) 13-93		X
2N1566			5.	80.	(5) 13-93	.11	(5) 13-93		X
2N1596	INSUFFICIENT DATA (SCR)	(1)	(6)366-74 100.SCR			.94	(5) 13-93	(1) 3.220	X
2N1602	INSUFFICIENT DATA (SCR)	(1)	(6)374-49 200.SCR			.40	(5) 13-94	(1) 3.225	X
2N1613*	2; Fwd 1≃.1; s≃3	(4) 4.25	7.	75.	(5) 13-94	.27	(5) 13-94		✓
2N1615			8.	100.	(5) 13-94	.553	(5) 13-94		X
2N1642	16.8	(1)	30.	30.	(5) 13-94	.13	(5) 13-94	(1) 3.383	X
2N1700			6.	60.	(5) 13-94	4.134	(5) 13-94		X
2N1701			6.	60.	(5) 13-94	4.5	(5) 13-94		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N1709			4.	75.	(7) 4729b				✓
2N1711	Rev=4.3; Fwd=1.8	(4) 4.25	7.	75.	(5) 13-94	.36	(5) 13-94		✓
2N1722	1.6	(1)	10.	175.	(5) 13-94	54.5	(5) 13-94	(1) 3.388	X
2N1751			2.5	80.	(5) 13-94	1.05	(5) 13-94		X
2N1753			5.	30.	(5) 13-94	.039	(5) 13-94		X
2N1772A			(6)367-94 100.SCR			.651	(5) 13-94		X
2N1776A			(6)381-17 300.SCR			1.584	(5) 13-94		X
(TI) 2N1777A	12	(4) 4.19	(6)386-59 400.SCR			.46	(5) 13-94	(1) 3.230-1 (2) III-109 (3) II-11	X
(GE) 2N1777A	50;Fwd=3	(4) 4.24	(6)386-59 400.SCR			.46	(5) 13-94	(1) 3.230-1 (2) III-109 (3) II-11	X
2N1871A			(6)365-52 60.SCR			1.1	(5) 13-94		X
2N1890			7.	100.	(5) 13-94	.27	(5) 13-94		X
2N1893	10	(4) 4.19	7.	120.	(5) 13-94	.4	(5) 13-94	(1) 3.393-4 (2) III-27-31 (3) III-14	✓
2N1900			5.	140.	(7) 4980m				✓
2N1916@						2.22	(5) 13-94		X
2N2015			10.	100.	(5) 13-94	26.462	(5) 13-94		X
2N2035			10.	80.	(5) 13-94	3.633	(5) 13-94		X
2N2048			2.	20.	(7) 1166				✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
2N2060			7.	100.	(5) 13-94	.21	(5) 13-94		X
2N2087			5.	120.	(7) 3312A				✓
2N2102*			7.	120.	(5) 13-94	.77	(5) 13-94		X
2N2156			25.	45.	(5) 13-94	.471	(5) 13-94		X
2N2188*			2.	40.	(7) 888b				✓
2N2192			5.	60.	(7) 3359m				✓
2N2198	5; Fwd≃3	(4) 4.25	7.	80.	(7) 3201a				X
2N2218A			6.	75.	(5) 13-94	.264	(5) 13-94		X
2N2219*			5.	60.	(5) 13-94	.3	(5) 13-94		X
2N2219A			6.	75.	(5) 13-94	.264	(5) 13-94		X
(TI) 2N2222	7.2	(4) 4.19	5.	60.	(5) 13-95	.1	(5) 13-95	(1) 3.400 (2) III-32-36 (3) III-15	✓
(MOT) 2N2222			5.	60.	(5) 13-95	.1	(5) 13-95	(1) 3.400 (2) III-32-36 (3) III-15	✓
(FSE) 2N2222	9; Fwd≃4	(4) 4.19;4.21	5.	60.	(5) 13-95	.1	(5) 13-95	(1) 3.400 (2) III-32-36 (3) III-15	✓
2N2222A			6.	75.	(5) 13-95	.1	(5) 13-95		X
2N2223A			7.	100.	(5) 13-95	.21	(5) 13-95		✓
2N2243			7.	120.	(7) 3359W				✓
2N2270			7.	60.	(5) 13-95	.5	(5) 13-95		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N2297	9.2	(4) 4.25	7.	80.	(7) 3361c				X
2N2323	3.2	(4) 4.25							X
2N2346	INSUFFICIENT DATA (SCR)	(1)	(6) 366-106 100.SCR			3.2	(5) 13-95	(1) 3.236	X
2N2368			4.5	40.	(7) 3025				✓
2N2369			4.5	40.	(7) 3025 e				✓
2N2369A			4.5	40.	(5) 13-95	.03	(5) 13-95		X
2N2411			5.	25.	(7) 2417				✓
2N2417			30.	35.	(5) 13-95	.549	(5) 13-95		X
2N2432			15.	30.	(5) 13-95	.189	(5) 13-95		X
2N2453	REV=7.5 Fwd=1	(4) 4.25	7.	60.	(7) 28058				X
2N2481			5.	40.	(5) 13-95	.099	(5) 13-95		✓
2N2484			6.	60.	(7) 2993v				X
2N2509			7.	125.	(5) 13-95	.126	(5) 13-95		X
2N2516			8.	80.	(5) 13-95	.209	(5) 13-95		X
2N2538			5.	60.	(7) 3410a				✓
2N2563			20.	100.	(5) 13-95	.55	(5) 13-95		X
2N2605			6.	60.	(7) 2480X				X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
2N646			30.	35.	(5) 13-95	.72	(5) 13-95		X
2N2656			5.	25.	(7) 2999m				✓
2N2695			4.	25.	(7) 2437				✓
2N2708			3.	35.	(5) 13-95	.018	(5) 13-95		✓
2N2727	1 For & Rev	(4) 4.25	10.	200.	(7) 3449a				X
2N2784*			4.	15.	(7) 2974b				✓
2N2801	3; For 1.5	(4) 4.25	5.	50.	(7) 2502a				✓
2N2808									✓
2N2845			5.	60.	(7) 2999n				✓
2N2857			2.5	30.	(5) 13-95	.018	(5) 13-95		X
2N2887			4.	100.	(7) 4751c				✓
2N2894A*			(2N2894A 4. 4.5)	12.	(5) 13-95	.03	(5) 13-95		✓
2N2904A			5.	60.	(5) 13-95	.221	(5) 13-95		X
2N2905			5.	60.	(5) 13-95	.221	(5) 13-95		✓
2N2906	6.6	(1)	5.	60.	(5) 13-95	,044	(5) 13-95	(1) 3.405	X
2N2906A			5.	60.	(5) 13-95	.221	(5) 13-95		X
2N2907A*	5 For & Rev	(4) 4.24	5.	60.	(5) 13-95	.1	(5) 13-95	(2) III-38-41 III-110 (3) II-12,III-16	✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N2920	16	(4) 4.24	6.	60.	(5) 13=95	.04	(5) 13-95	(2) III-38-41 (3) III-110 III-17	X
2N2996*			3.	15.	(5) 13-95	.01	(5) 13-95		X
2N3014			5.	40.	(5) 13-95	.02	(5) 13-95		X
2N3017			4.	100.	(7) 4075n				✓
2N3050			5.	25.	(5) 13-95	.01	(5) 13-95		X
2N3053*			5.	60.	(5) 13-96	.721	(5) 13-96		X
2N3054			7.	90.	(5) 13-96	3.633	(5) 13-96		X
2N3055*			7.	100.	(5) 13-96	20.084	(5) 13-96		X
2N3069									X
2N3118			4.	85.	(5) 13-96	.53	(5) 13-96		X
2N3119			4.	100.	(7) 4645				✓
2N3217			15.	15.	(5) 13-96	.126	(5) 13-96		X
2N3227			6.	40.	(7) 3022a				X
2N3235			7.	65.	(5) 13-96	20.	(5) 13-96		X
2N3240			8.	160.	(5) 13-96	1.5	(5) 13-96		X
2N3244			5.	40.	(7) 4495h				✓
2N3251			5.	50.	(5) 13-96	.143	(5) 13-96		✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N3252			5.	60.	(7) 4663p				✓
2N3283			.5	25.	(7) 743c				✓
2N3287			3.	40.	(7) 2818a				✓
2N3308			3.	30.	(5) 13-96	.12	(5) 13-96		X
2N3309			3.	50.	(7) 4659f				✓
2N3384				30.	(5) 13-96	.094	(5) 13-96		X
2N3436				50.	(5) 13-96	.488	(5) 13-96		X
2N3440*			7.	300.	(5) 13-96	1.75	(5) 13-96		X
2N3499			6.	100.	(7) 4604d				✓
2N3546			4.5	15.	(7) 2441b				X
2N3570			3.	30.	(7) 2827f				X
2N3585			6.	440.	(5) 13-97	5.278	(5) 13-96		X
2N3633			4.	15.	(7) 2975c				✓
2N3636	1	(4) 4.25	5.	175.	(7) 4498				X
2N3708			6.	30.	(5) 13-96	.507	(5) 13-96		X
2N3725			6.	80.	(7) 3413a				X
2N3777			8.	100.	(5) 13-96	2.	(5) 13-96		X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
2N3785			5.	50.	(5) 13-96	.012	(5) 13-96		X
2N3819			25.	25.	(5) 13-96	.22	(5) 13-96		X
2N3823			30.	30.	(5) 13-96	.228	(5) 13-96		X
2N3828			3.	40.	(7) 2961s				✓
2N3902			5.	400.	(5) 13-96	43.35	(5) 13-96		X
2N3907			6.	60.	(5) 13-96	.165	(5) 13-96		X
2N3960			4.5	20.	(7) 3075m				X
2N4037			7.	60.	(5) 13-96	.045	(5) 13-96		X
2N4260			4.5	15.	(7) 2269k				X
2N4392									X
2N4416*									X
2N4656A									X
2N5109			3.	40.	(7) 4640n				X
									✓
									✓
									✓
									✓

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE E-B	BREAKDOWN VOLTAGE C-B	REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
TM21			200.		(5) 13-88	18.	(5) 13-88		X
TM27			200.		(5) 13-88	20.	(5) 13-88		X
TM84			800.		(5) 13-88	11.	(5) 13-88		X
TM124			1200.		(5) 13-88	11.	(5) 13-88		X
UT242			200.		(5) 13-88	2.6	(5) 13-88		X
UT254	l=640; s=115; fwd=.3	(4) 4.25							✓
UZ110									X
UZ130									X
Type3102									X
Type 4501									X
Type 5420									X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
AMZ			50.		(5) 13-87	1.4	(5) 13-87		X
CSD2559									X
CTP632									X
D4330			30.		(6) 434-10	.001	(5) 13-87		X
DA54-1	9.3	(3)						(2) III-13-16 III-108 (3) II-10, III-11	X
DJXR-936								(2) III-18-21 (3) III-12	X
FD300			125.		(5) 13-87	.18	(5) 13-87		X
FD700									X
FD839									X
G129	DATA FAULTY	(1)							X
HA709	35	(4) 4.25							X
HDA1001									X
LN75497	0.9	(1)				1.9	(5) 13-96		X
LN75638	1.2	(1)				2.3	(5) 13-96		X
MC267G									X
MC351G									X
MC355G									X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
MIS17019/2-1								(1) 3.410	X
MIS17039/1-1								(1) 3.416-7	X
MIS1781/1-1								(1) 3.423	X
MIS17186								(1) 3.428-9	X
MIS17240								(1) 3.434	X
MIS17331						.1	(5) 13-96	(1) 3.439	X
MIS17409/1-1								(1) 3.443	X
PS5332									X
PS10245	1.1	(1)							X
Q25AH									X
Q85AH									X
R227075497								(1) 3.452	X
R227075638								(1) 3.453	X
RA239									X
RD211									X
RD220									X
RD221									X

DEVICE	BULK Z	REFERENCE	BREAKDOWN VOLTAGE		REFERENCE	DAMAGE CONSTANT	REFERENCE	DAMAGE CURVE	TRAC PARAM
			E-B	C-B					
S2676									X
SG22						.23	(5) 13-87		X
SG5598									X
SLD10EC			10,000		(5) 13-87				X
SM692-1	l=450; s≈70; fwd≈3	(4) 4.25							X
SN7311									X
SV138	4.7	(1)							X
SV1035			26.		(5) 13-88	1.71	(5) 13-88		X
SV2092						2.6	(5) 13-88		X
SV2183						2.6	(5) 13-88		X
SW1115									X
SW3042	INSUFFICIENT DATA (SCR)	(1)				.1	(5) 13-97		X
SZ744									X
T1482			5.	20.	(5) 13-96	.21	(5) 13-96		X
T1487			6.	80.	(5) 13-97	4.5	(5) 13-97		X
TIXM101			3.	15.	(5) 13-97	.01	(5) 13-97		X
TM7			70.		(5) 13-88	20.	(5) 13-88		X

APPENDIX B
A LISTING OF SEMICONDUCTOR DEVICES ON FILE AS OF 19 FEBRUARY 1975

Diodes and transistors for which bulk surge impedance values were not available have been assigned a typical value of 21 ohms.

BATCH UPDATED 02/17/75 TODAY IS 02/19/75

**********CONTROL DESK HOURS OF OPERATION**********

**********EFFECTIVE FEBRUARY 18, 1975**********

MON THRU FRI 0830 - 2100

**********BUILDING HOURS OF OPERATION**********

MON THRU FRI 0730 - 2100

****

*********E F F E C T I V E 3 F E B 7 5**********

MERDC WILL NO LONGER HAVE A PICK UP AND a DELIVERY SERVICE

****

------- BEGIN FILE -------

	HFEN	HFEI	TN	TI	ICS	MC	CCD	VCBI	RCL	IES
	ME	CED	VEBI	REL	IPPC	IPPE	C-BBDV	E-BBDV	BULKZC	BULKZE
2NDUMMY	.100E+03	.100E+01	.100E-08	.100E-06	.100E-10	.100E+01	.100E-10	.750E+00	.110E+09	.100E-12
	.100E+01	.500E-10	.750E+00	.100E+09	.100E-02	.100E-04	.600E+02	.500E+02	.210E+02	.210E+02
2N1016B	.287E+02	.749E+01	.203E-06	.176E-05	.822E-09	.111E+01	.175E-08	.700E+00	.100E+08	.278E-09
	.102E+01	.400E-09	.100E+01	.100E+08	.100E-02	.100E-04	.100E+03	.250E+02	.210E+02	.620E+01
2N1016E	.160E+02	.479E+01	.329E-06	.240E-05	.187E-09	.103E+01	.185E-08	.700E+00	.100E+08	.670E-10
	.972E+00	.391E-09	.800E+00	.100E+08	.100E-02	.100E-04	.100E+02	.250E+02	.210E+02	.620E+01
2N1016	.952E+02	.500E+01	.208E-06	.167E-05	.876E-09	.111E+01	.150E-08	.700E+00	.100E+08	.273E-09
	.102E+01	.400E-09	.100E+01	.100E+08	.100E-02	.100E-04	.100E+03	.250E+02	.210E+02	.620E+01
2N1037	.900E+01	.900E+01	.531E-06	.159E-05	.100E-05	.994E+00	.919E-10	.500E+00	.100E+08	.100E-05
	.994E+00	.141E-09	.500E+00	.100E+08	.100E-02	.100E-04	.500E+02	.200E+02	.210E+02	.210E+02
2N1039	.100E+02	.500E+01	.199E-04	.159E-03	.600E-08	.994E+00	.212E-09	.500E+00	.100E+08	.600E-08
	.994E+00	.141E-08	.500E+00	.100E+08	.100E-02	.100E-04	.600E+02	.200E+02	.210E+02	.285E+03
2N1099	.840E+01	.220E+01	.652E-06	.103E-05	.223E-13	.130E+01	.120E-08	.600E+00	.100E+08	.660E-13
	.190E+01	.150E-08	.600E+00	.100E+08	.100E-02	.100E-04	.800E+02	.400E+02	.210E+02	.139E+03
2N1132	.560E+02	0.	.796E-08	.318E-07	.400E-11	.139E+01	.592E-10	.936E+00	.100E+08	.396E-11
	.142E+01	.406E-10	.163E+01	.100E+08	.100E-02	.100E-04	.500E+02	.500E+01	.210E+02	.430E+01
2N1184	.680E+02	.747E+01	.769E-07	.150E-06	.113E-04	.968E+00	.240E-09	.400E+00	.100E+08	.812E-05
	.023E+00	.200E-09	.400E+00	.100E+08	.100E-02	.100E-04	.450E+02	.200E+02	.140E+03	.200E+03
2N1225	.300E+02	.350E+00	.962E-08	.112E-06	.540E-06	.111E+01	.310E-11	.400E+00	.100E+08	.123E-06
	.105E+01	.330E-11	.500E+00	.100E+08	.100E-02	.100E-04	.400E+02	.500E+00	.210E+02	.210E+02
2N1289	.200E+02	.900E+01	.398E-08	.159E-07	.600E-08	.994E+00	.141E-10	.500E+00	.100E+08	.600E-08
	.994E+00	.141E-10	.500E+00	.100E+08	.100E-02	.100E-04	.600E+02	.500E+02	.210E+02	.210E+02
2N1301	.150E+02	.500E+01	.455E-08	.159E-07	.102E-09	.994E+00	.170E-10	.500E+00	.100E+08	.102E-09
	.994E+00	.141E-10	.500E+00	.100E+08	.100E-02	.100E-04	.600E+02	.500E+02	.210E+02	.210E+02

2N1304	.700E+02 .151E+01	.500E+01 .845E-11	.199E-07 .140E+01	.796E-07 .100E+08	.350E-06 .100E-02	.149E+01 .100E-04	.253E-10 .250E+02	.140E+01 .250E+02	.100E+08 .210E+02	.343E-06 .210E+02
2N1306	.100E+03 .151E+01	.500E+01 .845E-11	.133E-07 .140E+01	.796E-07 .100E+08	.350E-06 .100E-02	.149E+01 .100E-04	.253E-10 .250E+02	.140E+01 .250E+02	.100E+08 .210E+02	.343E-06 .210E+02
2N1307	.100E+03 .151E+01	.500E+01 .592E-11	.133E-07 .140E+01	.796E-07 .100E+08	.350E-06 .100E-02	.149E+01 .100E-04	.253E-10 .300E+02	.140E+01 .250E+02	.100E+08 .210E+02	.343E-06 .210E+02
2N1308	.150E+03 .151E+01	.500E+01 .845E-11	.796E-08 .140E+01	.796E-07 .100E+08	.350E-06 .100E-02	.149E+01 .100E-04	.253E-10 .250E+02	.140E+01 .250E+02	.100E+08 .210E+02	.343E-06 .620E+02
2N1342	.431E+02 .992E+00	.500E+00 .370E-10	.156E-08 .800E+00	.333E-06 .100E+08	.168E-12 .100E-02	.105E+01 .100E-04	.170E-10 .150E+03	.800E+00 .500E+01	.100E+08 .210E+02	.205E-13 .210E+02
2N1401G	.100E+03 .994E+00	.500E+02 .141E-08	.199E-04 .500E+00	.159E-03 .100E+08	.600E-08 .100E-02	.994E+00 .100E-03	.212E-09 .600E-02	.500E+00 .200E+02	.100E+08 .210E+02	.600E-08 .285E+03
2N1401	.100E+03 .994E+00	.500E+02 .141E-08	.199E-04 .500E+00	.159E-03 .100E+08	.600E-08 .100E-02	.994E+00 .100E-03	.212E-09 .600E-02	.500E+00 .200E+02	.100E+08 .124E+03	.600E-08 .285E+03
2N1483	.100E+02 .994E+00	.900E+01 .247E-09	.127E-06 .500E+00	.159E-05 .100E+08	.698E-14 .100E-02	.994E+00 .100E-04	.247E-09 .600E+02	.500E+00 .120E+02	.100E+08 .210E+02	.698E-14 .210E+02
2N1485	.796E+02 .105E+01	.369E+01 .230E-09	.592E-07 .900E+00	.370E-06 .100E+08	.457E-11 .100E-02	.968E+00 .100E-04	.780E-09 .600E+02	.800E+00 .120E+02	.100E+08 .210E+02	.162E-10 .210E+02
2N1486	.796E+02 .105E+01	.369E+01 .230E-09	.592E-07 .900E+00	.370E-06 .100E+08	.457E-11 .100E-02	.968E+00 .100E-04	.780E-09 .100E+03	.800E+00 .120E+02	.100E+08 .210E+02	.162E-10 .210E+02
2N1499	.200E+02 .137E+01	.200E+01 .707E-11	.796E-08 .500E+00	.159E-07 .100E+08	.100E-05 .100E-02	.137E+01 .100E-04	.424E-11 .200E+02	.500E+00 .200E+01	.100E+08 .210E+02	.100E-05 .210E+02
2N1506	.286E+02 .101E+01	.350E+00 .155E-09	.812E-09 .900E+00	.334E-06 .100E+08	.117E-12 .100E-02	.101E+01 .100E-04	.460E-10 .600E+02	.800E+00 .400E+01	.100E+08 .210E+02	.382E-13 .210E+02
2N158	.286E+02 .101E+01	.300E+00 .155E-09	.812E-09 .900E+00	.334E-06 .100E+08	.117E-12 .100E-02	.101E+01 .100E-04	.460E-10 .600E+02	.800E+00 .300E+02	.100E+08 .210E+02	.382E-13 .210E+02
2N1613	.800E+02 .121E+01	.500E+01 .544E-10	.177E-07 .713E+00	.796E-08 .100E+08	.400E-10 .100E-02	.119E+01 .100E-04	.259E-10 .750E+02	.168E+01 .700E+01	.100E+08 .210E+02	.388E-10 .200E+01
2N1709	.250E+02 .105E+01	.250E+00 .420E-09	.154E-08 .100E+01	.110E-05 .100E+08	.315E-11 .100E-02	.111E+01 .100E-04	.102E-09 .750E+02	.800E+00 .400E+01	.100E+08 .210E+02	.208E-12 .210E+02
2N1711	.135E+03 .267E+01	0. .113E-09	.227E-08 .500E+00	.796E-08 .100E+08	.100E-07 .100E-02	.249E+01 .100E-04	.354E-10 .750E+02	.500E+00 .700E+01	.100E+08 .210E+02	.500E-08 .430E+01
2N1717	.800E+02 .100E+01	.230E+01 .196E-09	.684E-08 .800E+00	.137E-06 .100E+08	.360E-11 .100E-02	.111E+01 .100E-04	.581E-10 .100E+02	.800E+00 .600E+01	.100E+08 .210E+02	.320E-12 .210E+02
2N1722	.330E+02 .108E+01	.490E+00 .550E-08	.122E-06 .100E+01	.164E-05 .100E+08	.912E-10 .100E-02	.114E+01 .100E-04	.175E-08 .175E+03	.100E+01 .100E+02	.100E+08 .210E+02	.618E-09 .160E+01
2N174	.550E+02 .121E+01	.500E+01 .100E-08	.159E-05 .100E+01	.159E-04 .100E+08	.100E-03 .100E-02	.119E+01 .100E-04	.110E-08 .800E+02	.100E+01 .600E+02	.100E+08 .210E+01	.989E-04 .210E+02
2N1893	.370E+02 .992E+00	.900E-01 .320E-10	.195E-08 .800E+00	.414E-06 .100E+08	.303E-12 .100E-02	.968E+00 .100E-04	.780E-12 .120E+03	.900E+00 .700E+01	.100E+08 .210E+02	.729E-13 .100E+02
2N1900	.136E+03 .102E+01	.137E+01 .700E-08	.169E-08 .800E+00	.108E-05 .100E+08	.232E-10 .100E-02	.102E+01 .100E-04	.180E-08 .140E+03	.700E+00 .500E+01	.100E+08 .210E+02	.160E-10 .210E+02
2N2048	.250E+02 .994E+00	.900E+01 .707E-11	.612E-09 .500E+00	.159E-07 .100E+08	.400E-08 .100E-02	.994E+00 .100E-04	.212E-11 .200E+02	.500E+00 .200E+01	.100E+08 .210E+02	.400E-08 .210E+02
2N2060	.100E+01 .101E+01	.200E+00 .660E-10	.800E-09 .800E+00	.617E-06 .100E+08	.120E-12 .100E-02	.108E+01 .100E-04	.348E-10 .100E+03	.900E+00 .700E+01	.100E+08 .210E+02	.260E-12 .210E+02

2N2087	.200E+02 .994E+00	.900E+01 .990E-10	.106E-08 .500E+00	.318E-08 .100E+08	.162E-11 .100E-02	.994E+00 .100E-04	.170E-10 .120E+03	.500E+00 .500E+01	.100E+08 .210E+02	.486E-13 .210E+02
2N2102	.483E+02 .104E+01	.320E+00 .440E-09	.284E-09 .900E+00	.484E-06 .100E+08	.116E-11 .100E-02	.104E+01 .100E-04	.103E+01 .120E+03	.800E+00 .700E+01	.100E+08 .210E+02	.285E-12 .210E+02
2N2187	.330E+02 .995E+00	.610E+00 .540E-11	.194E-08 .800E+00	.683E-08 .100E+08	.567E-12 .100E-02	.107E+01 .100E-04	.780E-11 .300E+02	.700E+00 .300E+02	.100E+08 .210E+02	.567E-13 .210E+02
2N2188	.800E+02 .182E+01	0. .141E-10	.177E-08 .500E+00	.318E-07 .100E+08	.100E-04 .100E-02	.182E+01 .100E-04	.226E-11 .400E+02	.500E+00 .200E+01	.100E+08 .210E+02	.100E-04 .210E+02
2N2192	.195E+03 .921E+00	.700E+01 .390E-10	.816E-09 .900E+00	.105E-06 .100E+08	.949E-12 .100E-02	.102E+01 .100E-04	.210E-10 .600E+02	.800E+00 .500E+01	.100E+08 .210E+02	.131E-12 .210E+02
2N2219	.150E+03 .101E+01	.201E+01 .253E-10	.484E-09 .900E+00	.111E-06 .100E+08	.485E-13 .100E-02	.992E+00 .100E-04	.182E-10 .600E+02	.100E+01 .500E+01	.100E+08 .210E+02	.566E-13 .210E+02
2N2222	.136E+03 .964E+00	.230E+01 .232E-10	.549E-11 .900E+00	.274E-06 .100E+08	.370E-13 .100E-02	.101E+01 .100E-04	.137E-10 .600E+02	.900E+00 .500E+02	.100E+08 .210E+02	.930E-14 .720E+01
2N2223	.748E+02 .101E+01	.200E+00 .590E-10	.158E-08 .800E+00	.617E-06 .100E+08	.178E-11 .100E-02	.108E+01 .100E-04	.330E-10 .100E+03	.900E+00 .700E+01	.100E+08 .210E+02	.108E-12 .210E+02
2N2243	.899E+02 .977E+00	.314E+01 .670E-10	.959E-09 .800E+00	.265E-06 .100E+08	.753E-13 .100E-02	.977E+00 .100E-04	.300E-10 .120E+03	.800E+00 .700E+01	.100E+08 .210E+02	.563E-13 .210E+02
2N2270	.100E+02 .994E+00	.900E+01 .247E-09	.127E-06 .500E+00	.159E-05 .100E+08	.698E-14 .100E-02	.994E+00 .100E-04	.247E-09 .600E+02	.500E+00 .700E+01	.100E+08 .210E+02	.698E-14 .210E+02
2N2368	.425E+02 .977E+00	.100E+01 .490E-11	.293E-09 .100E+01	.225E-07 .100E+08	.400E-11 .100E-02	.120E+01 .100E-04	.820E-11 .400E+02	.100E+01 .450E+01	.100E+08 .210E+02	.511E-14 .210E+02
2N2369	.450E+02 .104E+01	0. .258E-11	.318E-09 .106E+01	.318E-08 .100E+08	.226E-09 .100E-02	.165E+01 .100E-04	.263E-11 .400E+02	.110E+01 .450E+01	.100E+08 .210E+02	.499E-14 .210E+02
2N2411	.286E+02 .982E+00	.410E+00 .560E-11	.676E-09 .900E+00	.524E-07 .100E+08	.175E-14 .100E-02	.982E+00 .100E-04	.530E-11 .250E+02	.800E+00 .500E+01	.100E+08 .210E+02	.606E-15 .210E+02
2N2481	.578E+02 .944E+00	.200E-01 .550E-11	.403E-09 .800E+00	.336E-08 .100E+08	.186E-11 .100E-02	.105E+01 .100E-04	.400E-11 .400E+02	.800E+00 .500E+01	.100E+08 .210E+02	.895E-14 .210E+02
2N2538	.115E+03 .944E+00	.150E+01 .190E-10	.347E-09 .900E+00	.240E-06 .100E+08	.600E-12 .100E-02	.108E+01 .100E-04	.690E-11 .600E+02	.800E+00 .500E+01	.100E+08 .210E+02	.120E-13 .210E+02
2N2656	.952E+02 .968E+00	.100E+01 .430E-11	.396E-09 .900E+00	.330E-06 .100E+08	.300E-13 .100E-02	.102E+01 .100E-04	.580E-11 .250E+02	.800E+00 .500E+01	.100E+08 .210E+02	.485E-14 .210E+02
2N2695	.615E+02 .992E+00	.800E+01 .450E-10	.905E-09 .800E+00	.551E-07 .100E+08	.360E-13 .100E-02	.102E+01 .100E-04	.190E-10 .250E+02	.900E+02 .400E+01	.100E+08 .210E+02	.132E-13 .210E+02
2N2708	.500E+02 .992E+00	.850E+00 .120E-11	.157E-09 .900E+00	.266E-07 .100E+08	.131E-13 .100E-02	.114E+01 .100E-04	.150E-11 .350E+02	.900E+00 .300E+01	.100E+08 .210E+02	.160E-15 .210E+02
2N2784	.810E+02 .110E+01	.170E+00 .124E-11	.159E-09 .100E+01	.299E-07 .100E+08	.364E-09 .100E-02	.165E+01 .100E-04	.147E-11 .150E+02	.100E+01 .400E+01	.100E+08 .210E+02	.794E-14 .210E+02
2N2801	.952E+02 .992E+00	.780E+00 .650E-10	.386E-09 .100E+01	.482E-08 .100E+08	.178E-12 .100E-02	.992E+00 .100E-04	.490E-10 .500E+02	.800E+00 .500E+01	.100E+08 .210E+02	.333E-13 .300E+01
2N2808	.228E+02 .944E+00	.130E+01 .900E-12	.134E-09 .100E+01	.249E-07 .100E+08	.902E-14 .100E-02	.111E+01 .100E-04	.130E-11 .600E+02	.100E+01 .500E+02	.100E+08 .210E+02	.417E-16 .210E+02
2N2845	.500E+02 .992E+00	.150E+00 .460E-11	.588E-09 .900E+00	.156E-07 .100E+08	.245E-10 .100E-02	.133E+01 .100E-04	.900E-11 .600E+02	.900E+00 .500E+01	.100E+08 .210E+02	.235E-13 .210E+02

2N2857	.215E+01 .101E+01	.244E+01 .136E-09	.121E-08 .800E+00	.124E-06 .100E+08	.111E-12 .100E-02	.102E+01 .100E-04	.688E-10 .300E+02	.800E+00 .250E+01	.100E+08 .650E+02	.800E-14 .160E+02
2N2887	.483E+02 .104E+01	.320E+00 .440E-09	.284E-09 .900E+00	.484E-06 .100E+08	.116E-11 .100E-02	.104E+01 .100E-04	.103E-09 .100E+03	.800E+00 .400E+01	.100E+08 .210E+02	.285E-12 .210E+02
2N2894	.700E+02 .150E-01	0. .344E-11	.531E-09 .108E+01	.318E-08 .100E+08	.211E-11 .100E-02	.149E+01 .100E-04	.389E-11 .120E+02	.101E+01 .400E+01	.100E+08 .210E+02	.940E-12 .210E+02
2N2905	.133E+03 .960E+00	.140E+01 .180E-10	.478E-07 .100E+01	.464E-07 .100E+08	.442E-13 .100E-02	.101E+01 .100E-04	.145E-10 .600E+02	.800E+00 .500E+01	.100E+08 .210E+02	.982E-14 .210E+02
2N2907	.216E+03 .968E+00	.420E+01 .210E-10	.498E-09 .100E+01	.355E-07 .100E+08	.148E-12 .100E-02	.143E+01 .100E-04	.260E-10 .600E+02	.100E+01 .500E+01	.100E+08 .210E+02	.221E-13 .500E+01
2N297A	.100E+02 .994E+00	.500E+01 .141E-09	.370E-06 .500E+00	.159E-05 .100E+08	.500E-08 .100E-02	.994E+00 .100E-04	.141E-09 .600E+02	.500E+00 .900E+01	.100E+08 .300E+02	.500E-08 .730E+02
2N297	.100E+02 .994E+00	.500E+01 .141E-09	.370E-06 .500E+00	.159E-05 .100E+08	.500E-08 .100E-02	.994E+00 .100E-04	.141E-09 .600E+02	.500E+00 .400E+02	.100E+08 .730E+02	.500E-08 .730E+02
2N2996	.286E+02 .982E+00	.410E+00 .560E-11	.676E-09 .900E+00	.524E-07 .100E+08	.175E-14 .100E-02	.982E+00 .100E-04	.530E-11 .150E+02	.800E+00 .300E+01	.100E+08 .210E+02	.606E-15 .210E+02
2N3013	.630E+02 .992E+00	.250E+00 .801E-11	.197E-09 .900E+00	.760E-08 .100E+08	.160E-11 .100E-02	.125E+01 .100E-04	.348E-11 .400E+02	.900E+00 .500E+01	.100E+08 .210E+02	.427E-14 .210E+02
2N3017	.803E+02 .102E+01	.459E+01 .480E-09	.128E-08 .900E+00	.897E-05 .100E+08	.864E-12 .100E-02	.992E+00 .100E-04	.170E-09 .100E+03	.900E+00 .400E+01	.100E+08 .210E+02	.800E-12 .210E+02
2N3053	.100E+02 .994E+00	.900E+01 .247E-09	.127E-06 .500E+00	.159E-05 .100E+08	.698E-14 .100E-02	.994E+00 .100E-04	.247E-09 .600E+02	.500E+00 .500E+01	.100E+08 .210E+02	.698E-14 .210E+02
2N3055	.108E+03 .992E+00	.600E+00 .160E-10	.594E-09 .100E+01	.225E-06 .100E+08	.693E-12 .100E-02	.105E+01 .100E-04	.240E-10 .100E+03	.100E+01 .700E+01	.100E+08 .210E+02	.535E-13 .210E+02
2N3119	.803E+02 .992E+00	.459E+01 .220E-10	.125E-09 .900E+00	.136E-07 .100E+08	.120E-11 .100E-02	.108E+01 .100E-04	.140E-10 .100E+03	.700E+00 .400E+01	.100E+08 .210E+02	.818E-13 .210E+02
2N315	.100E+02 .994E+00	.500E+01 .141E-10	.318E-07 .500E+00	.159E-06 .100E+08	.400E-08 .100E-02	.994E+00 .100E-04	.198E-10 .200E+02	.500E+00 .200E+02	.100E+08 .210E+02	.400E-08 .210E+02
2N3244	.115E+03 .102E+01	.210E+01 .550E-10	.496E-09 .100E+01	.501E-07 .100E+08	.102E-12 .100E-02	.992E+00 .100E-04	.430E-10 .400E+02	.800E+00 .500E+01	.100E+08 .210E+02	.171E-12 .210E+02
2N3251	.166E+03 .968E+00	.680E+00 .480E-11	.259E-09 .900E+00	.486E-07 .100E+08	.119E-12 .100E-02	.108E+01 .100E-04	.650E-11 .500E+02	.900E+00 .500E+01	.100E+08 .210E+02	.402E-14 .210E+02
2N3252	.823E+02 .968E+00	.800E-01 .550E-10	.494E-09 .900E+00	.370E-08 .100E+08	.284E-11 .100E-02	.105E+01 .100E-04	.140E-10 .600E+02	.800E+00 .500E+01	.100E+08 .210E+02	.516E-13 .210E+02
2N328A	.100E+02 .994E+00	.500E+01 .141E-08	.199E-04 .500E+00	.159E-03 .100E+08	.600E-08 .100E-02	.994E+00 .100E-04	.212E-09 .500E+02	.500E+00 .200E+02	.100E+08 .210E+02	.600E-08 .160E+02
2N3283	.125E+02 .968E+00	.260E+00 .620E-11	.288E-09 .500E+00	.227E-07 .100E+08	.200E-07 .100E-02	.161E+01 .100E-04	.130E-11 .250E+02	.500E+00 .500E+00	.100E+08 .210E+02	.460E-08 .210E+02
2N3287	.240E+02 .968E+00	.138E+01 .190E-11	.663E-09 .100E+01	.993E-06 .100E+08	.535E-13 .100E-02	.114E+01 .100E-04	.180E-11 .400E+02	.100E+01 .300E+01	.100E+08 .210E+02	.948E-15 .210E+02
2N329A	.490E+02 .992E+00	.410E+00 .280E-10	.862E-07 .800E+00	.407E-05 .100E+08	.190E-11 .100E-02	.133E+01 .100E-04	.960E-10 .500E+02	.800E+00 .200E+02	.100E+08 .210E+02	.214E-13 .210E+02
2N3309	.330E+02 .968E+00	.180E+01 .240E-10	.398E-09 .100E+01	.836E-08 .100E+08	.653E-13 .100E-02	.105E+01 .100E-04	.160E-10 .500E+02	.100E+01 .300E+01	.100E+08 .210E+02	.855E-14 .210E+02
2N335	.771E+02 .105E+01	.111E+01 .570E-10	.254E-08 .100E+01	.242E-06 .100E+08	.160E-10 .100E-02	.137E+01 .100E-04	.100E-10 .450E+02	.800E+00 .100E+01	.100E+08 .210E+02	.292E-11 .130E+02

2N336X	.771E+02 .105E+01	.111E+01 .570E-10	.254E-08 .100E+01	.242E-06 .100E+08	.160E-10 .100E-02	.137E+01 .100E-04	.100E-10 .600E+02	.800E+00 .500E+02	.100E+08 .210E+02	.292E-11 .210E+02
2N336Y	.771E+02 .213E+01	.111E+01 .570E-10	.513E-08 .100E+01	.242E-06 .100E+08	.160E-10 .100E-02	.137E+01 .100E-04	.100E-10 .600E+02	.800E+00 .500E+02	.100E+08 .210E+02	.640E-08 .210E+02
2N336	.771E+02 .213E+01	.111E+01 .570E-10	.513E-08 .100E+01	.242E-06 .100E+08	.160E-10 .100E-02	.137E+01 .100E-04	.100E-10 .450E+02	.800E+00 .100E+01	.100E+08 .210E+02	.640E-08 .100E+02
2N3375 T	.800E+02 .121E+01	.500E+01 .544E-10	.177E-07 .713E+00	.796E-08 .100E+08	.400E-10 .100E-02	.119E+01 .100E-04	.259E-10 .650E+02	.168E+01 .400E+01	.100E+08 .370E+02	.388E-10 .910E+00
2N3440	.800E+02 .182E+01	0. .141E-10	.177E-08 .500E+00	.318E-07 .100E+08	.100E-04 .100E-02	.182E+01 .100E-04	.226E-11 .300E+03	.500E+00 .700E+01	.100E+08 .210E+02	.100E-04 .210E+02
2N3486	.260E+03 .944E+00	.147E+01 .190E-10	.179E-09 .900E+00	.434E-07 .100E+08	.504E-12 .100E-02	.108E+01 .100E-04	.148E-10 .600E+02	.900E+00 .500E+01	.100E+08 .210E+02	.783E-14 .210E+02
2N3499	.108E+03 .992E+00	.600E+00 .160E-10	.594E-09 .100E+01	.225E-06 .100E+08	.693E-12 .100E-02	.105E+01 .100E-04	.240E-10 .100E+03	.100E+01 .600E+01	.100E+08 .210E+02	.535E-13 .210E+02
2N3509	.153E+03 .968E+00	.264E+00 .348E-11	.129E-09 .900E+00	.117E-07 .100E+08	.407E-13 .100E-02	.101E+01 .100E-04	.295E-11 .400E+02	.900E+00 .600E+01	.100E+08 .210E+02	.297E-14 .210E+02
2N3553	.341E+02 .101E+01	.534E+01 .104E-09	.265E-08 .800E+00	.387E-07 .100E+08	.197E-13 .100E-02	.104E+01 .100E-04	.294E-10 .650E+02	.800E+00 .400E+01	.100E+08 .210E+02	.136E-12 .210E+02
2N356	.150E+02 .994E+00	.500E+01 .141E-10	.531E-07 .500E+00	.199E-06 .100E+08	.400E-08 .100E-02	.994E+00 .100E-04	.198E-10 .200E+02	.500E+00 .200E+02	.100E+08 .210E+02	.400E-08 .210E+02
2N3632	.151E+02 .102E+01	.254E+01 .121E-09	.197E-08 .800E+00	.983E-07 .100E+08	.538E-12 .100E-02	.110E+01 .100E-04	.693E-10 .650E+02	.800E+00 .400E+01	.100E+08 .210E+02	.767E-14 .210E+02
2N3633	.249E+03 .968E+00	.100E+00 .160E-11	.558E-10 .900E+00	.128E-09 .100E+08	.740E-13 .100E-02	.108E+01 .100E-04	.240E-11 .150E+02	.100E+01 .400E+01	.100E+08 .210E+02	.830E-14 .210E+02
2N3723A	.160E+02 .386E-01	.805E+00 .739E-10	.944E+03 .750E+00	.402E+04 .100E+08	.112E-10 .100E-02	.116E+02 .100E-04	.224E-10 .100E+03	.730E+00 .600E+01	.100E+08 .210E+02	.170E-12 .210E+02
2N3723B	.130E+02 .107E+01	.500E-01 .648E-10	.418E-08 .800E+00	.314E-08 .100E+08	.101E-09 .100E-02	.117E+01 .100E-04	.130E-10 .100E+03	.100E+01 .600E+01	.100E+08 .210E+02	.140E-11 .210E+02
2N3723C	.173E+02 .106E+01	.107E+01 .760E-10	.312E-08 .800E+00	.377E-07 .100E+08	.696E-11 .100E-02	.119E+01 .100E-04	.134E-10 .100E+03	.800E+00 .600E+01	.100E+08 .210E+02	.508E-12 .210E+02
2N3723D	.113E+02 .101E+01	.761E+00 .165E-10	.303E-08 .850E+00	.346E-07 .100E+08	.417E-13 .100E-02	.107E+01 .100E-04	.776E-11 .100E+03	.780E+00 .600E+01	.100E+08 .210E+02	.468E-14 .210E+02
2N3723E	.108E+02 .112E+01	.717E+00 .626E-10	.513E-08 .800E+00	.317E-07 .100E+08	.110E-09 .100E-02	.119E+01 .100E-04	.984E-11 .100E+03	.800E+00 .600E+01	.100E+08 .210E+02	.251E-11 .210E+02
2N3723F	.134E+02 .101E+01	.778E+00 .604E-10	.324E-08 .800E+00	.281E-07 .100E+08	.571E-11 .100E-02	.114E+01 .100E-04	.962E-11 .100E+03	.800E+00 .600E+01	.100E+08 .210E+02	.322E-12 .210E+02
2N3828	.240E+02 .102E+01	.210E+01 .180E-10	.288E-07 .800E+00	.406E-07 .100E+08	.140E-12 .100E-02	.102E+01 .100E-04	.680E-11 .400E+02	.750E+00 .300E+01	.100E+08 .210E+02	.310E-13 .210E+02
2N3866A	.850E+01 .104E+01	.230E+01 .142E-10	.886E-09 .860E+00	.474E-07 .100E+08	.102E-13 .100E-02	.106E+01 .100E-04	.756E-11 .550E+02	.820E+00 .350E+01	.100E+08 .210E+02	.559E-14 .210E+02
2N3866B	.520E+01 .105E+01	.200E+01 .156E-10	.131E-08 .860E+00	.417E-07 .100E+08	.165E-13 .100E-02	.108E+01 .100E-04	.806E-11 .550E+02	.820E+00 .350E+01	.100E+08 .210E+02	.644E-14 .210E+02
2N3866C	.660E+01 .104E+01	.241E+01 .151E-10	.122E-08 .860E+00	.273E-07 .100E+08	.637E-12 .100E-02	.131E+01 .100E-04	.736E-11 .550E+02	.780E+00 .350E+01	.100E+08 .210E+02	.725E-14 .210E+02
2N3866D	.710E+01 .101E+01	.340E+01 .165E-10	.877E-09 .850E+00	.436E-07 .100E+08	.233E-13 .100E-02	.107E+01 .100E-04	.776E-11 .550E+02	.780E+00 .350E+01	.100E+08 .210E+02	.491E-14 .210E+02

2N3866E	.830E+01 .990E+00	.500E+01 .174E-10	.870E-09 .850E+00	.169E-07 .100E+08	.960E-14 .100E-02	.106E+01 .100E-04	.805E-11 .550E+02	.800E+00 .350E+01	.100E+08 .210E+02	.202E-14 .210E+02
2N3866F	.102E+02 .101E+01	.430E+01 .161E-10	.729E-09 .870E+00	.286E-07 .100E+08	.320E-12 .100E-02	.114E+01 .100E-04	.760E-11 .550E+02	.800E+00 .350E+01	.100E+08 .210E+02	.275E-13 .210E+02
2N3866	.100E+01 .105E+01	.100E+00 .103E-09	.810E-09 .850E+00	.161E-07 .100E+08	.139E-12 .100E-02	.980E+00 .100E-04	.570E-10 .550E+02	.800E+00 .350E+01	.100E+08 .210E+02	.126E-12 .210E+02
2N388	.150E+03 .151E+01	.500E+01 .845E-11	.796E-08 .140E+01	.796E+09 .100E+08	.350E-06 .100E-02	.149E+01 .100E-04	.253E-10 .250E+02	.140E+01 .150E+02	.100E+08 .210E+02	.343E-06 .210E+02
2N393	.100E+02 .994E+00	.900E+01 .141E-10	.318E-08 .500E+00	.159E-06 .100E+08	.104E-09 .100E-02	.994E+00 .100E-04	.849E-11 .600E+01	.500E+00 .600E+01	.100E+08 .210E+02	.104E-09 .210E+02
2N404	.600E+02 .121E+01	.900E+01 .283E-10	.398E-07 .500E+00	.159E-06 .100E+08	.500E-06 .100E-02	.121E+01 .100E-04	.283E-10 .250E+02	.500E+00 .120E+02	.100E+08 .210E+02	.500E-06 .210E+02
2N4209A	.401E+02 .103E+01	.133E+01 .271E-11	.137E-09 .850E+00	.108E-07 .100E+08	.561E-13 .100E-02	.115E+01 .100E-04	.268E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.256E-14 .210E+02
2N4209B	.429E+02 .103E+01	.132E+01 .271E-11	.117E+11 .850E+00	.797E-08 .100E+08	.562E-13 .100E-02	.115E+01 .100E-04	.268E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.256E-14 .210E+02
2N4209C	.455E+02 .107E+01	.155E+01 .271E-11	.108E-09 .850E+00	.790E-08 .100E+08	.165E-13 .100E-02	.107E+01 .100E-04	.302E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.102E-13 .210E+02
2N4209D	.441E+02 .105E+01	.130E+01 .264E-11	.127E-09 .900E+00	.102E-07 .100E+08	.566E-12 .100E-02	.115E+01 .100E-04	.268E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.511E-14 .210E+02
2N4209E	.430E+02 .112E+01	.124E+01 .256E-11	.117E-09 .950E+00	.941E-08 .100E+08	.831E-10 .100E-02	.119E+01 .100E-04	.280E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.235E-11 .210E+02
2N4209F	.436E+02 .101E+01	.150E+01 .269E-09	.978E-10 .900E+00	.840E-08 .100E+08	.417E-11 .100E-02	.114E+01 .100E-04	.268E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.307E-12 .210E+02
2N4209	.580E+02 .113E+01	.880E+00 .276E-11	.147E-09 .800E+00	.693E-08 .100E+08	.549E-14 .100E-02	.104E+01 .100E-04	.286E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.345E-13 .210E+02
2N4251A	.183E+03 .120E+01	.192E+02 .499E-11	.448E-10 .850E+00	.285E-08 .100E+08	.337E-10 .100E-02	.148E+01 .100E-04	.404E-11 .150E+02	.750E+00 .450E+01	.100E+08 .210E+02	.101E-11 .210E+02
2N4251B	.172E+03 .106E+01	.175E+02 .521E-11	.457E-10 .850E+00	.265E-08 .100E+08	.338E-13 .100E-02	.106E+01 .100E-04	.412E-11 .150E+02	.850E+00 .450E+01	.100E+08 .210E+02	.402E-13 .210E+02
2N4251C	.170E+03 .119E+01	.184E+02 .492E-11	.447E-10 .800E+00	.285E-08 .100E+08	.148E-13 .100E-02	.101E+01 .100E-04	.358E-11 .150E+02	.750E+00 .450E+01	.100E+08 .210E+02	.251E-12 .210E+02
2N4251D	.159E+03 .107E+01	.160E+02 .480E-11	.487E-10 .100E+01	.311E-08 .100E+08	.393E-13 .100E-02	.102E+01 .100E-04	.352E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.372E-13 .210E+02
2N4251E	.179E+03 .107E+01	.190E+02 .453E-11	.517E-10 .900E+00	.361E-08 .100E+08	.453E-13 .100E-02	.107E+01 .100E-04	.352E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.362E-13 .210E+02
2N4251F	.212E+03 .102E+01	.207E+02 .480E-11	.488E-10 .100E+01	.343E-08 .100E+08	.566E-13 .100E-02	.108E+01 .100E-04	.358E-11 .150E+02	.800E+00 .450E+01	.100E+08 .210E+02	.161E-13 .210E+02
2N457	.100E-02 .994E+00	.100E-04 .141E-09	.600E+02 .500E+00	.200E+02 .100E+08	.210E+02 .100E+02	.210E+02 .500E+01	-0. .370E-06	.500E+00 .159E-05	.100E+08 .500E-08	.500E-08 .994E+00
2N526 T	.100E+02 .994E+00	.900E+01 .707E-11	.159E-08 .500E+00	.796E-08 .100E+08	.600E-08 .100E-02	.994E+00 .100E-04	.424E-11 .450E+02	.500E+00 .150E+02	.100E+08 .210E+02	.600E-08 .250E+03
2N526	.100E+02 .994E+00	.900E+01 .707E-11	.159E-08 .500E+00	.796E-08 .100E+08	.600E-08 .100E-02	.994E+00 .100E-04	.424E-11 .450E+02	.500E+00 .150E+02	.100E+08 .210E+02	.600E-08 .210E+02

2N598	.250E+02 .994E+00	.100E+02 .283E-10	.284E-07 .500E+00	.318E-06 .100E+08	.180E-07 .100E-02	.994E+00 .100E-04	.283E-10 .350E+02	.500E+00 .300E+02	.100E+08 .210E+02	.180E-07 .160E+03
2N600 T	.100E+02 .994E+00	.900E+01 .707E-11	.159E-08 .500E+00	.796E-08 .100E+08	.600E-08 .100E-02	.994E+00 .100E-04	.454E-11 .350E+02	.500E+00 .300E+02	.100E+08 .600E+03	.600E-08 .430E+03
2N645	.100E+02 .994E+00	.900E+01 .707E-11	.265E-08 .500E+00	.159E-07 .100E+08	.799E-09 .100E-02	.994E+00 .100E-40	.707E-11 .600E+11	.500E+00 .500E+11	.100E+08 .210E+02	.799E-09 .210E+02
2N657	.100E+02 .994E+00	.900E+01 .247E-09	.127E-06 .500E+00	.159E-05 .100E+08	.698E-14 .100E-02	.994E+00 .100E-04	.247E-09 .100E+03	.500E+00 .800E+01	.100E+08 .210E+02	.698E-14 .320E+01
2N696	.200E+02 .994E+00	.500E+01 .707E-10	.159E-08 .500E+00	.177E-08 .100E+08	.400E-16 .100E-02	.994E+00 .100E-04	.495E-10 .600E+02	.500E+00 .500E+01	.100E+08 .210E+02	.400E-16 .210E+02
2N697	.200E+02 .994E+00	.500E+01 .707E-10	.159E-08 .500E+00	.177E-08 .100E+08	.400E-16 .100E-02	.994E+00 .100E-04	.495E-10 .600E+02	.500E+00 .500E+01	.100E+08 .210E+02	.400E-16 .210E+02
2N705	.250E+02 .183E+01	0. .639E-11	.106E-08 .300E+00	.603E-07 .100E+08	.100E-04 .100E-02	.163E+01 .100E-04	.137E-10 .150E+02	.300E+00 .350E+01	.100E+08 .210E+02	.100E-04 .210E+02
2N706A	.300E+02 .267E+01	0. .849E-11	.796E-09 .500E+00	.159E-07 .100E+08	.100E-07 .100E-02	.248E+01 .100E-04	.424E-11 .250E+02	.500E+00 .500E+01	.100E+08 .210E+02	.500E-08 .210E+02
2N706	.899E+02 .992E+00	.120E+00 .560E-11	.188E-09 .900E+00	.128E-07 .100E+08	.737E-12 .100E-02	.111E+01 .100E-04	.450E-11 .250E+02	.100E+01 .300E+01	.100E+08 .210E+02	.101E-13 .210E+02
2N711A	.125E+02 .994E+00	.900E+01 .141E-10	.106E-08 .500E+00	.159E-07 .100E+08	.667E-11 .100E-02	.994E+00 .100E-04	.849E-11 .600E+02	.500E+00 .500E+02	.100E+08 .210E+02	.667E-11 .210E+02
2N718A	.759E+02 .980E+00	.202E+01 .385E-10	.760E-09 .900E+00	.167E-05 .100E+08	.150E-12 .100E-02	.103E+01 .100E-04	.274E-10 .750E+02	.800E+00 .700E+01	.100E+08 .210E+02	.320E-13 .210E+02
2N718	.823E+02 .968E+00	.326E+01 .370E-10	.761E-09 .900E+00	.192E-05 .100E+08	.130E-12 .100E-02	.102E+01 .100E-04	.250E-10 .600E+02	.800E+00 .500E+01	.100E+08 .210E+02	.324E-13 .210E+02
2N720A	.699E+02 .968E+00	.330E+01 .780E-10	.148E-08 .100E+01	.323E-05 .100E+08	.121E-12 .100E-02	.992E+00 .100E-04	.320E-12 .120E+03	.900E+00 .700E+01	.100E+08 .210E+02	.659E-13 .210E+02
2N722	.640E+02 .105E+01	.100E+01 .290E-10	.768E-09 .100E+01	.120E-06 .100E+08	.360E-12 .100E-02	.111E+01 .100E-04	.150E-10 .500E+02	.800E+00 .500E+01	.100E+08 .210E+02	.406E-13 .210E+02
2N743	.490E+02 .108E+01	.400E+01 .460E-11	.441E-09 .900E+00	.432E-07 .100E+08	.149E-13 .100E-02	.102E+01 .100E-04	.530E-11 .200E+02	.800E+00 .500E+01	.100E+08 .210E+02	.326E-13 .210E+02
2N760	.539E+02 .980E+00	.120E+00 .790E-11	.446E-09 .100E+01	.152E-07 .100E+08	.389E-10 .100E-02	.129E+01 .100E-04	.420E-11 .450E+02	.700E+00 .800E+01	.100E+08 .210E+02	.323E-12 .210E+02
2N797	.200E+02 .994E+00	.500E+01 .566E-11	.265E-09 .500E+00	.159E-08 .100E+08	.337E-09 .100E-02	.994E+00 .100E-04	.566E-11 .250E+02	.500E+00 .200E+02	.100E+08 .210E+02	.337E-09 .210E+02
2N834	.627E+02 .944E+00	.720E+01 .900E-11	.453E-09 .800E+00	.492E-07 .100E+08	.114E-13 .100E-02	.102E+01 .100E-04	.730E-11 .400E+02	.900E+00 .500E+01	.100E+08 .210E+02	.132E-14 .210E+02
2N835	.340E+02 .992E+00	.100E+00 .720E-11	.903E-09 .900E+00	.500E-07 .100E+08	.120E-12 .100E-02	.105E+01 .100E-04	.500E-11 .250E+02	.800E+00 .300E+01	.100E+08 .210E+02	.360E-14 .210E+02
2N914	.260E+02 .992E+00	.110E+00 .590E-11	.366E-09 .800E+00	.119E-07 .100E+08	.262E-12 .100E-02	.105E+01 .100E-04	.470E-11 .400E+02	.900E+00 .500E+01	.100E+08 .210E+02	.654E-14 .210E+02
2N915	.107E+03 .968E+00	.330E+00 .710E-11	.515E-09 .900E+00	.446E-06 .100E+08	.375E-10 .100E-02	.143E+01 .100E-04	.460E-11 .700E+02	.800E+00 .500E+01	.100E+08 .210E+02	.666E-14 .210E+02
2N916	.916E+02 .992E+00	.350E+00 .730E-11	.505E-09 .900E+00	.389E-06 .100E+08	.193E-12 .100E-02	.111E+01 .100E-04	.670E-11 .450E+02	.900E+00 .500E+01	.100E+08 .210E+02	.495E-14 .210E+02
2N918	.438E+02 .102E+01	.100E+01 .190E-11	.176E-10 .100E+01	.225E-07 .100E+08	.320E-14 .100E-02	.102E+01 .100E-04	.240E-11 .300E+02	.100E+01 .300E+01	.100E+08 .210E+02	.165E-14 .210E+02

2N930	.340E+02 .992E+00	.100E+00 .720E-11	.903E-09 .900E+00	.500E-07 .100E+08	.120E-12 .100E-02	.105E+01 .100E-04	.500E-11 .450E+02	.800E+00 .500E+01	.100E+08 .210E+02	.360E-14 .370E+01
2N955A	.166E+03 .105E+01	.400E+00 .430E-11	.895E-10 .500E+00	.429E-08 .100E+08	.805E-05 .100E-02	.108E+01 .100E-04	.600E-11 .600E+02	.400E+00 .500E+02	.100E+08 .210E+02	.181E-06 .210E+02
2N964	.104E+03 .108E+01	.100E+01 .250E-11	.426E-09 .500E+00	.550E-08 .100E+08	.144E-05 .100E-02	.108E+01 .100E-04	.320E-11 .150E+02	.500E+00 .250E+01	.100E+08 .210E+02	.350E-06 .210E+02
2N9726A	.179E+03 .103E+01	.177E+01 .883E-11	.219E-09 .800E+00	.134E-07 .100E+08	.172E-11 .100E-02	.122E+01 .100E-04	.993E-11 .100E+02	.750E+00 .100E+02	.100E+08 .210E+02	.422E-13 .210E+02
2N9726B	.123E+03 .106E+01	.137E+01 .872E-11	.248E-09 .800E+00	.139E-06 .100E+08	.363E-11 .100E-02	.127E+01 .100E-04	.981E-11 .100E+02	.750E+00 .100E+02	.100E+08 .210E+02	.807E-13 .210E+02
2N9726C	.138E+03 .121E+01	.202E+01 .872E-11	.248E-09 .800E+00	.134E-06 .100E+08	.807E-11 .100E-02	.133E+01 .100E-04	.935E-11 .100E+02	.750E+00 .100E+02	.100E+08 .210E+02	.423E-13 .210E+02
2N9726E	.175E+03 .975E+00	.150E-01 .833E-11	.199E-09 .900E+00	.296E-08 .100E+08	.169E-10 .100E-02	.114E+01 .100E-04	.101E-10 .100E+02	.800E+00 .100E+02	.100E+08 .210E+02	.221E-13 .210E+02
2N9726F	.988E+02 .101E+01	.178E+01 .864E-11	.386E-09 .900E+00	.115E-06 .100E+08	.390E-12 .100E-02	.114E+01 .100E-04	.984E-11 .100E+02	.800E+00 .100E+02	.100E+08 .210E+02	.253E-13 .210E+02
2N976	.800E+02 .122E+01	.200E+01 .490E-11	.177E-09 .862E+00	.318E-08 .100E+08	.110E-05 .100E-02	.122E+01 .100E-04	.269E-11 .150E+02	.665E+00 .200E+01	.100E+08 .210E+02	.114E-05 .210E+02
--------	END OF FILE	--------								

BATCH UPDATED 02/17/75 TODAY IS 02/19/75

**********CONTROL DESK HOURS OF OPERATION**********

**********EFFECTIVE FEBRUARY 18, 1975**********

MON THRU FRI 0830 - 2100

**********BUILDING HOURS OF OPERATION**********

MON THRU FRI 0730 - 2100

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*********E F F E C T I V E 3 F E B 7 5**********

MERDC WILL NO LONGER HAVE A PICK UP AND @ DELIVERY SERVICE

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------- BEGIN FILE -------

	IS	MD	RDL	CDD	VDBI	TD	IPPD	VB	BULK Z
1NCRAP	.123E+04	.123E+04	.123E+04	.123E+04	.123E+04	.123E+04	.123E+04	.123E+04	.123E+04
1NDUMMY	.100E-08	.200E+01	.100E+10	.110E-10	.750E+00	.100E-07	.100E-03	.144E+03	.210E+02
1NFD100	.110E-07	.214E+01	.200E+07	.112E-11	.800E+00	.746E-06	.100E-03	.500E+02	.210E+02
1NFD600	.460E-08	.184E+01	.160E+10	.224E-11	.800E+00	.100E-05	.100E-03	.750E+02	.210E+02
1NFD700	.515E-10	.161E+01	.500E+09	.718E-12	.104E+01	.708E-09	.100E-03	.300E+02	.210E+02
1NPS760	.260E-08	.155E+01	.560E+09	.212E-11	.800E+00	.120E-06	.100E-03	.150E+03	.210E+02
1NSD500	.397E-13	.100E+01	.570E+06	.141E-08	.500E+00	.159E-04	.100E-03	.400E+03	.210E+02
1NSG5250	.320E-08	.173E+01	.170E+10	.201E-11	.800E+00	.205E-06	.100E-03	.500E+03	.210E+02
1NUR205A	.117E-11	.119E+01	.115E+11	.104E-09	.800E+00	.326E-06	.100E-03	.500E+02	.210E+02
1NUR205B	.660E-11	.116E+01	.860E+10	.110E-09	.800E+00	.236E-06	.100E-03	.500E+02	.210E+02
1NUR205C	.398E-10	.128E+01	.190E+10	.845E-10	.820E+00	.300E-06	.100E-03	.500E+02	.210E+02
1NUR205D	.562E-10	.141E+01	.930E+10	.116E-09	.900E+00	.453E-06	.100E-03	.500E+02	.210E+02
1NUR205E	.209E-10	.124E+01	.890E+10	.108E-09	.850E+00	.305E-06	.100E-03	.500E+02	.210E+02
1NUR205F	.707E-10	.134E+01	.710E+10	.119E-09	.850E+00	.208E-06	.100E-03	.500E+02	.210E+02
1N100	.250E-05	.263E+01	.100E+07	.707E-12	.500E+00	.159E-08	.100E-03	.800E+02	.210E+02
1N1200	.178E-08	.179E+01	.100E+11	.100E-11	.900E+00	.100E-06	.100E-03	.100E+03	.900E+03
1N1202	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.200E+03	.640E+02
1N1204A	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.400E+03	.110E+00
1N1313A	.426E-13	.106E+01	.170E+11	.260E-09	.850E+00	.215E-06	.100E-03	.875E+01	.210E+02

1N1313B	.209E-13	.103E+01	.128E+11	.412E-09	.850E+00	.194E-06	.100E-03	.875E+01	.210E+02
1N1313C	.105E-13	.102E+01	.253E+11	.249E-09	.850E+00	.261E-06	.100E-03	.875E+01	.210E+02
1N1313D	.100E-12	.101E+01	.196E+11	.291E-09	.800E+00	.230E-06	.100E-03	.875E+01	.210E+02
1N1313E	.100E-12	.101E+01	.150E+11	.249E-09	.800E+00	.257E-06	.100E-03	.875E+01	.210E+02
1N1313F	.500E-12	.107E+01	.800E+10	.402E-09	.800E+00	.249E-06	.100E-03	.875E+01	.210E+02
1N1315A	.708E-13	.108E+01	.250E+11	.200E-09	.900E+00	.217E-06	.100E-03	.128E+02	.210E+02
1N1315B	.330E-12	.112E+01	.260E+11	.211E-09	.900E+00	.115E-06	.100E-03	.128E+02	.210E+02
1N1315C	.660E-13	.111E+01	.140E+10	.401E-09	.900E+00	.263E-06	.100E-03	.128E+02	.210E+02
1N1315D	.436E-12	.114E+01	.700E+10	.242E-09	.900E+00	.129E-06	.100E-03	.128E+02	.210E+02
1N1315F	.725E-13	.106E+01	.250E+11	.211E-09	.900E+00	.159E-06	.100E-03	.128E+02	.210E+02
1N140	.287E-11	.990E+00	.160E+06	.283E-10	.500E+00	.159E-06	.100E-03	.800E+02	.210E+02
1N1482	.100E-12	.100E+01	.100E+08	.100E-08	.100E+01	.100E-11	.100E-03	.470E+01	.700E-01
1N1614	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.200E+03	.210E+02
1N191	.125E-14	.990E+00	.400E+06	.700E-12	.500E+00	.159E-07	.100E-03	.900E+02	.210E+02
1N2199	.200E-08	.171E+01	.100E+10	.283E-11	.500E+00	.227E-07	.100E-03	.144E+03	.210E+02
1N270	.124E-05	.167E+01	.500E+06	.113E-11	.500E+00	.318E-07	.100E-03	.100E+03	.210E+02
1N273A	.195E-05	.144E+01	.282E+07	.926E-12	.500E+00	.102E-07	.100E-03	.320E+02	.210E+02
1N273B	.275E-05	.159E+01	.246E+07	.764E-12	.500E+00	.105E-07	.100E-03	.320E+02	.210E+02
1N273C	.340E-05	.166E+01	.300E+07	.105E-11	.550E+00	.541E-08	.100E-03	.320E+02	.210E+02
1N273D	.357E-05	.186E+01	.440E+07	.778E-12	.500E+00	.702E-08	.100E-03	.320E+02	.210E+02
1N273E	.331E-05	.172E+01	.450E+07	.782E-12	.550E+00	.578E-08	.100E-03	.320E+02	.210E+02
1N273F	.282E-05	.154E+01	.160E+07	.933E-12	.500E+00	.665E-08	.100E-03	.320E+02	.210E+02
1N276	.560E-06	.194E+01	.800E+06	.500E-12	.600E+00	.650E-08	.100E-03	.100E+03	.210E+02
1N277	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.125E+03	.210E+02
1N279	.124E-05	.167E+01	.380E+07	.283E-10	.500E+00	.318E-07	.100E-03	.320E+02	.210E+03
1N2823B	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.300E+02	.210E+02
1N2846B	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.100E-06	.100E-03	.200E+03	.210E+02
1N3024	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.130E+02	.210E+02
1N3025B	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.160E+02	.210E+02
1N3027B	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.100E-06	.100E-03	.200E+02	.210E+02
1N3033B	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.100E-06	.100E-03	.360E+02	.210E+02
1N3034	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.100E-06	.100E-03	.390E+02	.210E+02
1N3064	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.400E-08	.100E-03	.750E+02	.500E+01
1N3071	.910E-08	.194E+01	.450E+10	.150E-11	.100E+01	.800E-06	.100E-03	.200E+03	.210E+02

1N338	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.100E+03	.210E+02
1N3565	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.260E+02	.200E+02
1N3600	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.100E-06	.100E-03	.500E+02	.500E+01
1N3605	.377E-08	.196E+01	.486E+10	.857E-12	.126E+01	.579E-08	.100E-03	.400E+02	.210E+02
1N3611	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.200E+03	.210E+02
1N3669	.130E-09	.138E+01	.110E+07	.230E-10	.800E+00	.464E-06	.100E-03	.700E+02	.210E+02
1N4001	.800E-08	.184E+01	.640E+09	.130E-10	.100E+01	.119E-05	.100E-03	.500E+02	.210E+02
1N4003	.420E-08	.176E+01	.200E+11	.230E-10	.100E+01	.682E-05	.100E-03	.200E+03	.160E+03
1N4005	.620E-08	.184E+01	.120E+10	.360E-10	.100E+01	.148E-04	.100E-03	.600E+03	.120E+03
1N4006	.800E-08	.184E+01	.820E+10	.250E-10	.100E+01	.619E-05	.100E-03	.800E+03	.100E+03
1N4148	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.100E-06	.100E-03	.750E+02	.210E+02
1N4249	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.100E+04	.210E+02
1N457	.740E-11	.136E+01	.270E+11	.560E-11	.850E+00	.491E-06	.100E-03	.700E+02	.210E+02
1N458	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.150E+03	.210E+02
1N459A	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.200E+03	.360E+01
1N459	.580E-10	.141E+01	.200E+13	.120E-10	.800E+00	.584E-06	.100E-03	.200E+03	.830E+02
1N461	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.350E+02	.210E+02
1N462	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.800E+02	.210E+00
1N482A	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.360E+02	.760E+03
1N537	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.120E-05	.100E-03	.100E+03	.300E+02
1N538M	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.200E+03	.210E+02
1N538	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.200E+03	.210E+02
1N540	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.400E+03	.940E+02
1N547	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.100E-06	.100E-03	.600E+03	.210E+02
1N600	.100E-12	.100E+01	.100E+08	.100E-08	.100E+01	.100E-11	.100E-03	.470E+01	.700E-01
1N63	.287E-12	.990E+00	.100E+07	.141E-09	.500E+00	.159E-06	.100E-03	.100E+03	.210E+02
1N645B	.520E-09	.164E+01	.850E+09	.246E-07	.800E+00	.186E-05	.100E-03	.225E+03	.210E+02
1N645Y	.520E-09	.164E+01	.270E+11	.220E-11	.800E+00	.186E-05	.100E-03	.225E+03	.870E+01
1N645Z	.520E-09	.164E+01	.270E+11	.130E-11	.800E+00	.186E-05	.100E-03	.225E+03	.870E+01
1N645	.452E-09	.162E+01	.413E+11	.130E-10	.800E+00	.166E-05	.100E-03	.225E+03	.870E+01
1N646W	.220E-09	.143E+01	.310E+11	.160E-10	.100E+01	.963E-06	.100E-03	.144E+03	.210E+02
1N646X	.100E-07	.226E+01	.310E+11	.160E-10	.100E+01	.153E-05	.100E-03	.144E+03	.210E+02
1N646Y	.220E-09	.143E+01	.310E+11	.160E-10	.100E+01	.704E-06	.100E-03	.144E+03	.210E+02
1N646Z	.100E-07	.228E+01	.310E+11	.160E-10	.100E+01	.112E-05	.100E-03	.144E+03	.210E+02

1N647	.160E-08	.176E+01	.420E+11	.770E-11	.100E+01	.864E-06	.100E-03	.400E+03	.172E+02
1N648	.280E-08	.184E+01	.580E+11	.660E-11	.100E+01	.664E-06	.100E-03	.500E+03	.210E+02
1N649W	.140E-10	.115E+01	.360E+11	.120E-10	.900E+00	.326E-05	.100E-03	.144E+03	.210E+02
1N649X	.760E-07	.258E+01	.360E+01	.120E-10	.900E+00	.733E-05	.100E-03	.144E+03	.210E+02
1N649Y	.140E-10	.115E+01	.360E+11	.860E-11	.900E+00	.326E-05	.100E-03	.144E+03	.210E+02
1N649Z	.760E-07	.258E+01	.360E+11	.860E-11	.900E+00	.733E-05	.100E-03	.144E+03	.210E+02
1N649	.452E-09	.162E+01	.413E+11	.130E-10	.100E+01	.300E-05	.100E-03	.600E+03	.210E+02
1N658	.390E-08	.176E+01	.610E+10	.180E-11	.100E+01	.150E-06	.100E-03	.120E+03	.210E+02
1N659	.140E-10	.115E+01	.560E+09	.212E-10	.800E+00	.890E-07	.100E-03	.500E+02	.210E+02
1N660	.480E-08	.182E+01	.990E+09	.340E-11	.900E+00	.324E-06	.100E-03	.100E+03	.210E+02
1N661	.824E-16	.990E+00	.200E+08	.382E-11	.500E+00	.318E-08	.100E-03	.200E+03	.210E+02
1N695	.780E-06	.155E+01	.320E+06	.700E-12	.600E+00	.144E-07	.100E-03	.200E+02	.210E+02
1N706	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.580E+01	.210E+02
1N711A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.750E+01	.190E+01
1N746A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.330E+01	.210E+02
1N747A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.360E+01	.210E+02
1N748A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.390E+01	.210E+02
1N752A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.560E+01	.210E+02
1N752	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.560E+01	.210E+02
1N753A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.620E+01	.400E+00
1N753	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.620E+01	.400E+00
1N754A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.680E+01	.210E+02
1N755A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.750E+01	.210E+02
1N756A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.820E+01	.210E+02
1N756	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.820E+01	.210E+02
1N758A1	.420E-13	.110E+01	.220E+10	.538E-09	.900E+00	.126E-06	.100E-03	.100E+02	.210E+02
1N758A2	.790E-14	.101E+01	.100E+11	.358E-09	.900E+00	.266E-06	.100E-03	.100E+02	.210E+02
1N758A3	.630E-14	.101E+01	.980E+10	.395E-09	.900E+00	.180E-06	.100E-03	.100E+02	.210E+02
1N758A4	.160E-13	.103E+01	.940E+10	.366E-09	.900E+00	.143E-06	.100E-03	.100E+02	.210E+02
1N758A5	.160E-13	.103E+01	.890E+10	.369E-09	.900E+00	.249E-06	.100E-03	.100E+02	.210E+02
1N758A6	.180E-13	.105E+01	.650E+10	.337E-09	.900E+00	.238E-06	.100E-03	.100E+02	.210E+02
1N758A	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.100E+02	.210E+02
1N758	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.100E+02	.210E+02
1N816W	.942E-11	.130E+01	.240E+12	.400E-11	.850E+00	.100E-06	.100E-03	.260E+02	.200E+02

1N823	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.620E+01	.790E+00
1N903	.760E-11	.136E+01	.120E+11	.130E-11	.800E+00	.423E-07	.100E-03	.200E+02	.210E+02
1N908	.520E-08	.192E+01	.890E+07	.120E-11	.800E+00	.495E-07	.100E-03	.400E+02	.210E+02
1N914B1	.851E-08	.202E+01	.460E+09	.114E-11	.100E+01	.328E-08	.100E-03	.750E+02	.210E+02
1N914B2	.110E-07	.209E+01	.550E+09	.128E-11	.850E+00	.341E-08	.100E-03	.750E+02	.210E+02
1N914B3	.110E-07	.205E+01	.560E+09	.960E-12	.100E+01	.357E-08	.100E-03	.750E+02	.210E+02
1N914B4	.100E-07	.203E+01	.480E+09	.118E-11	.950E+00	.364E-08	.100E-03	.750E+02	.210E+02
1N914B5	.115E-07	.204E+01	.570E+09	.123E-11	.950E+00	.263E-08	.100E-03	.750E+02	.210E+02
1N914B6	.155E-07	.206E+01	.630E+09	.119E-11	.950E+00	.287E-08	.100E-03	.750E+02	.210E+02
1N914B	.870E-09	.161E+01	.110E+07	.240E-11	.900E+00	.133E-06	.100E-03	.750E+02	.850E+02
1N914	.158E-08	.168E+01	.154E+10	.120E-11	.900E+00	.159E-07	.100E-03	.100E+03	.400E+02
1N963B	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.120E+02	.210E+02
1N965B	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.150E+02	.210E+02
1N967B	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.180E+02	.190E+01
1N973B	.139E-12	.112E+01	.100E+19	.100E-17	.900E+00	.100E-06	.100E-03	.330E+02	.210E+02
1N995	.730E-06	.143E+01	.400E+07	.566E-11	.500E+00	.253E-07	.100E-03	.150E+02	.210E+02

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APPENDIX C
GAUSS SUBROUTINE DESCRIPTION

The GAUSS subroutine was created to calculate the amplitude and duration of power dissipated in circuit components. The criteria of the maximum amplitude and the time width at half maximum of power peaks may be applied in conjunction with empirical power-time damage curves to determine the probability that the circuit element will be damaged.

Admittedly, the criteria used in deciding what constitutes a peak are somewhat arbitrary. The method used by the GAUSS subroutine for dividing a waveshape into peaks is outlined below:

(a) Starting at the point of maximum amplitude, if another peak is encountered before the value falls to one-half the maximum value, the peak is considered part of the main peak. The search is continued until a minimum is found that is lower than that of the half-power point (see fig. C-1). The region between these minima on either side of the maxima constitutes a peak.

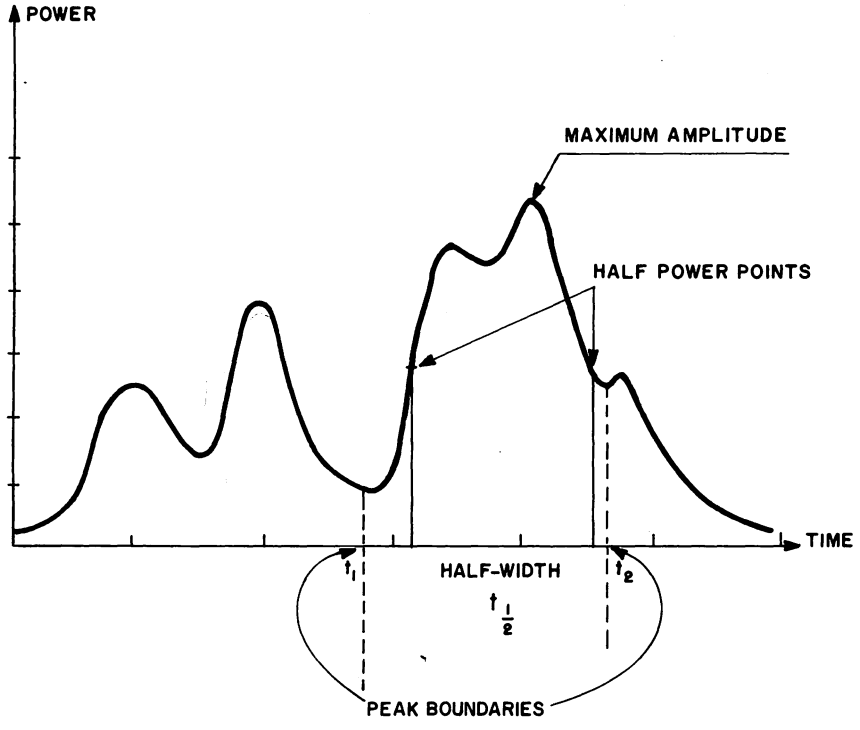

Figure C-1. Heuristic waveform.

(b) The area used for the highest peak is then deleted and a search made of the rest of the peaks for the second highest. (It should be noted that the half-maximum point is determined relative to the amplitude of the peak under consideration.) This process is continued until N peaks have been found where N is selected by the user. If no more peaks exist, the search will stop automatically.

(c) The half-width is found by using

$$t_{1/2} = \frac{\int_{t_2}^{t_1} P(I)\ \Delta t(I)}{P_{MAX}}$$

For each peak where P(I) is the power at each value of time, $\Delta t(I)$ is the spacing of the channels, and P_{MAX} is the maximum value for the peak under consideration.

(d) The major peaks are then ranked in importance according to the size of their K value, where

$$K(I)=P_{MAX}\sqrt{t_{1/2}}\ .$$

Inputs to the GAUSS subroutine come from the TRAC independent and dependent variable arrays TF(I) and XP(J), respectively. The TF contains time values and XP contains the value of the dependent variable, be it voltage, current, or power associated with each TF value. The dimension of TF is 350. The dimension of XP is 700 but TRAC uses only the first 350 entries for item versus time plots. The program takes the arrays and first finds the points where the derivative $\partial(XP)/\partial(TF)$ is zero and stores them as maxima or minima in arrays "MAX" and "MIN." When all maxima and minima have been found, the program will search for the highest maximum and store the value as VALMAX which corresponds to the output AMPLITUDE.

From the highest peak, the program looks at minima on both sides to find the closest minimum that is below the half-power point on the curve. To do this, MBAC and MFOR are used as increments to move through the array of minimums. Knowing the minimum that occurs before the first half-power point, a starting indicator MINKA is set on that channel. The process is repeated on the other side of the peak and MINKA 1 is set as a termination indicator. The area along the time axis of the first peak is then deleted from consideration. A search of the other maxima

is made to find the next highest. The process is repeated until all peaks have been found or until N peaks have been found where N is specified by the user.

If the left or right side of the graph is reached without finding a half-power point, an error message of LEFT OVERFLOW or RIGHT OVERFLOW will be printed, and the first or last channel will be used as the boundary.

As each peak is analyzed, the data are stored in a group of arrays. A subroutine called HAFWID is called for each peak in order to compute half width and the ranking constant. The arrays are the following:

AMPL(I)	Contains the value of the amplitude.
VALK(I)	Contains the "K" value.
THAF(I)	Contains the half width.
IRBOUN(I)	Contains the right boundary.
IMAX(I)	Contains the channel number of the maximum.
ILBOUN(I)	Contains the left boundary.
INUM(I)	Contains the peak number from left to right.

After these data are accumulated for all peaks, the program prints a table of the calculated data following the TRAC plots. The output of the subroutine appears in ten columns, the last two of which give the plot identification such as NODE 10 or SOURCE 3. The first seven--in the order they appear--are peak, left channel, maximum channel, right channel, amplitude, half width, ranking constant. PEAK gives the peak number counting from the left side of the graph. It should be noted that the subroutine may count peaks that exist but are invisible because of the scale of the graph. LCHNL and RCHNL denote the position of the left and right boundaries of the particular peak under examination. MAX CHNL gives the time position of the maximum of the peak.

The values of AMPLITUDE, HALFWIDTH, and DAMAGE PRODUCT $\left(P_{max}\sqrt{t_{1/2}}\right)$ are displayed in the next three columns. The eighth column gives the rank of the peak determined by the magnitude of the damage product compared with other peaks on the same graph.

Figure C-2 displays the flow of subroutine GAUSS3.

APPENDIX C

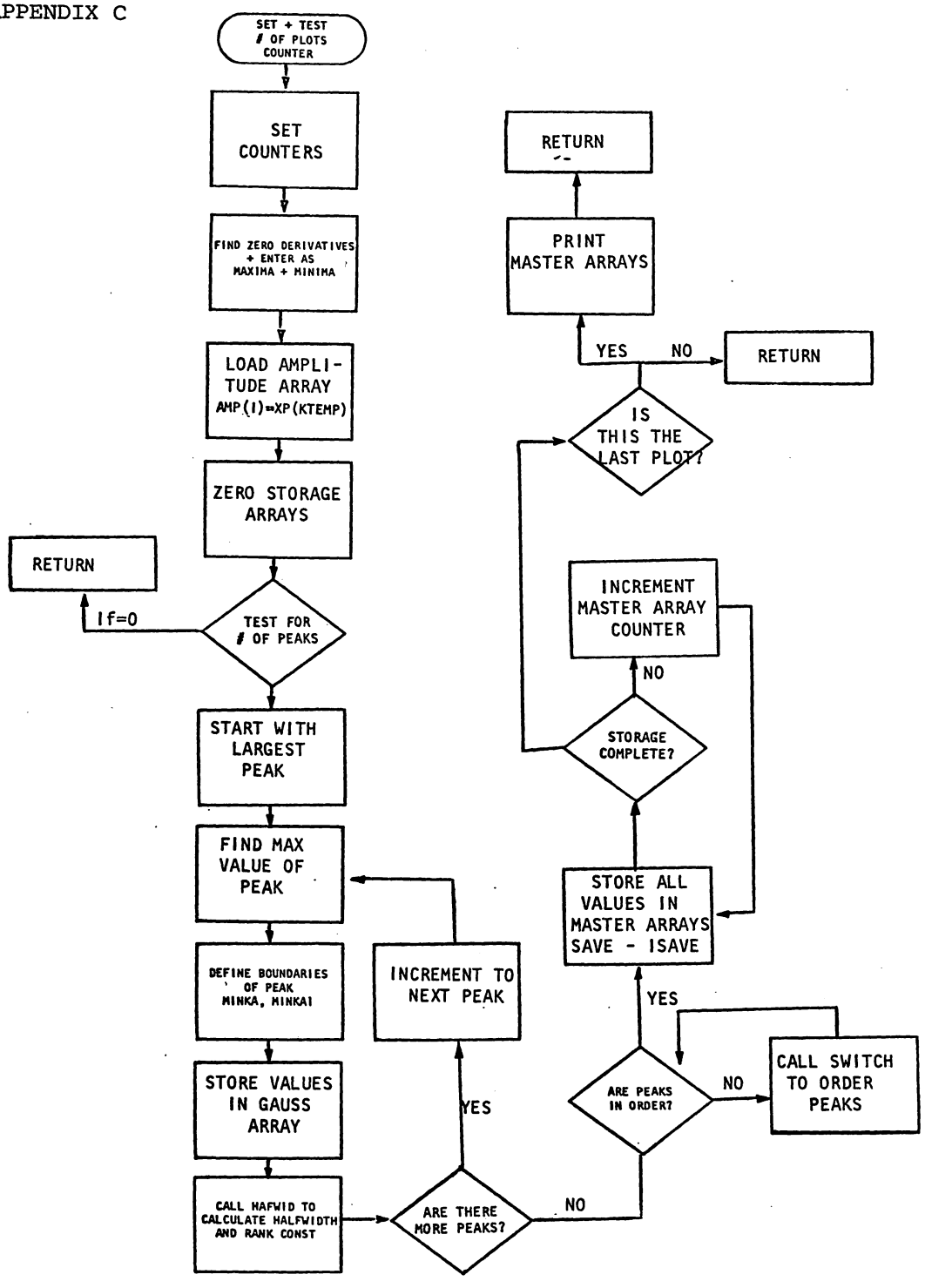

Figure C-2. Subroutine GAUSS3.

APPENDIX D
SCOPE CONTROL CARD STRUCTURE FOR DAMTRAC USAGE
(OVERLAY VERSION)

```
JOB.

TASK.

1{ ATTACH,F1,OVERTRAC,ID=EM71604,PW=MSEPP,MR=1.
   ATTACH,SUBTRAC,SUBTRAC,ID=EM71604,PW=MSEPP,MR=1.
   LIBRARY(SUBTRAC)

   ATTACH,TAPE11,DIODES,ID=EM71604,PW=ADM1,ADM2,ADM3,ADM4,ADM5.
   ATTACH,TAPE12,TRANS,ID=EM71604,PW=ADM1,ADM2,ADM3,ADM4,ADM5.
2{ EXTEND(TAPE11)
   EXTEND(TAPE12)
   REQUEST,F3,HI,VSN=nnn.    (NORING)
   COPYBF,F3,TAPE7.
   REWIND,TAPE7.

3{ FTN,A,R=1.

4{ EDITLIB(USER,L=TRASH)
   LIBRARY(F2)

   MAP(PART)
   LOAD(F1)
5{ NOGO.
   TRAC.
   EXIT.

   7/8/9

   {TRAEQ deck}

   7/8/9

   LIBRARY(F2,NEW)
   REWIND(LGO)
6{ ADD(*,SUBTRAC,LIB)
   ADD(*,LGO)
   FINISH.
   ENDRUN.

   7/8/9

   {Data Deck}

   6/7/8/9
```

APPENDIX D

1. Attach program files, declare SUBTRAC to be a library file.

2. All cards in this section are optional. Attach the transistor and diode data files, and request that these files be extended to allow program directed writes. Attach a magnetic tape containing voltage source description data, and copy this tape to logical file TAPE7.

3. Compile subroutine TRAEQ, place binary output on LGO.

4. Read and execute the library directives in Section 6. Declare a local file F2 to be a library file.

5. Load the overlays contained on file F1 into a file TRAC, producing a partial map. Execute the program on file TRAC.

6. Library directives: combine the programs contained in SUBTRAC and LGO into a single library file, F2.

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