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The PR2D (Place, Route in 2-Dimensions) Automatic Layout Computer Program Handbook

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TABLE OF CONTENTS

		Page
SUMMARY		1
I.	COMPILING AND LOADING PR2D	1
II.	FLOWCHARTS OF THE MAJOR PR2D FUNCTIONS	2
III.	EXECUTING PR2D	2
IV.	SIMPLIFIED USERS GUIDE FOR PR2D PROGRAM (INPUT DATA)	4
	A. Mode Card (4I2, 16I4) Format	4
	B. Pin Data File (Cards or Tape), Header Data (10A4, 4I4)	7
	C. Cell Pattern Header Card and Pin Data Cards (5I4, 10A4, I4) Format	8
	D. Stop Control Card	8
	E. Element to Pattern Assignment (16I4, 14X, I2) Format	9
	F. Node List	10
	G. Commod Data Cards (4I4, 2A4) Format	10
	H. PR2D Program Format Modifications	11
	I. Execution	13
	J. Design Improvement	13
V.	PR2D MODE AND LAYOUT CONTROL PARAMETER DEFINITIONS	31
VI.	PR2D EXAMPLE DESIGN LAYOUTS	53
	A. N002 — 4-Bit Adder	53
	B. C015 — Programmable Timer	135

LIST OF ILLUSTRATIONS

Figure	Title	Page
1.	PR2D main program flowchart	14
2.	PR2D place executive flowchart	16
3.	PR2D route executive flowchart	19
4.	PR2D artwork executive flowchart	21
5.	PR2D overlay structure	22
6.	Compile and load job setup	23
7.	PR2D source, object modules and load module disc usage	24
8.	N002 — 4 bit adder partitioned logic diagram	25
9.	N002 — PR2D unmodified layout	26
10.	C015 — programmable timer partitioned logic diagram	27
11.	C015 — PR2D unmodified layout	28

THE PR2D (PLACE, ROUTE IN 2-DIMENSIONS) AUTOMATIC LAYOUT COMPUTER PROGRAM HANDBOOK

SUMMARY

Place, Route in 2-Dimensions (PR2D) is a standard cell automatic layout computer program for generating Large Scale Integrated/Metal Oxide Semiconductor (LSI/MOS) arrays, and is one of the software components of the NASA/MSFC Computer Aided Design and Test system (CADAT). The PR2D program source is available from the COSMIC software distribution system.

This material describes the compilation, loading, and execution of the program on a Sigma V CP-V operating system located at NASA/MSFC. This material can also be used as a guide in the conversion and execution of the program at other facilities even if equipped with different data processing systems.

The PR2D computer program is written in FORTRAN IV and consists of 50 FORTRAN source routines including the main program.

One source routine of importance is the input/output routine, which is usually unique to each installation. This routine was called TAPES in the original RCA source but was modified and renamed IOSCR for the Sigma V CP-V installation. The commented source for the routine can be used as a guide in creating an input/output routine for a particular system.

I. COMPILING AND LOADING PR2D

With the CP-V FORTRAN, large programs can only be compiled sequentially from tape, not from disc. Therefore, it is easier to edit the total source (approximately 30 000 card images) on a disc file and then compile and load the program with a batch job that copies the PR2D source file to tape and then compiles from the tape. Loading can be done in the same job or with a separate batch loading job.

Individual routines can be modified by copying them from the total source file into separate source files and editing them individually. The separate source files can be compiled on-line to generate the object modules. A batch load run is made to include the new rather than the old object modules. This procedure works well if changes are limited to a few routines.

II. FLOWCHARTS OF THE MAJOR PR2D FUNCTIONS

Flowcharts of the major functions MAIN (program executive), PLACE (executive routine PLEX 1), ROUTE (executive routine RTEX1), and ARTWORK (executive routine ARTEX1) of the PR2D program are included for aid in understanding or making modifications to the program. The flowcharts for MAIN, PLACE, ROUTE, and ARTWORK are shown in Figures 1, 2, 3, and 4, respectively. A suggested overlay structure for loading PR2D is shown in Figure 5.

Listed in Figure 6 is a job control setup deck to compile and load the PR2D program with the MSFC Sigma V CP-V operating system. Compiling and loading require approximately 45 min of CPU time, with load time being insignificant.

A listing of PR2D related files and PR2D object modules created by the FORTRAN compiler and their sizes in granules (1 granule equals five hundred and twelve 32-bit words) are shown in Figure 7.

The created load module (LMPR2DC) requires 146 granules of disc space and approximately sixty four thousand 32-bit words of memory to run. During a normal computer run, PR2D generates data files along with the artwork output file and requires approximately 1000 granules of temporary disc space for a 200 × 200 mil chip. The temporary disc storage requirements are a function of the design complexity. Execution time can vary from 5 min to 1 h of CPU time determined by the design complexity.

III. EXECUTING PR2D

The input data to PR2D consists of a number of program control parameters, logic pattern assignments, and the interconnecting nets. The program reads the input data, searches a data file (pin data file) for data on

each pattern, generates a placement of the patterns (PLACE), interconnects the patterns (ROUTE), and outputs the artwork for the layout (ARTWORK). Two examples of layouts that have been created with PR2D are included in this material. The first is a 4-bit adder done in silicon on sapphire and the material includes the partitioned logic diagram (Fig. 8), a complete PR2D computer run printout, and the resulting unmodified chip layout (Fig. 9). The second example is a programmable timing circuit done in bulk silicon and the material includes the partitioned logic diagram (Fig. 10), the job control and input data, and the resulting unmodified chip layout (Fig. 11). Table 1 lists the effects on the layout of the C015 Programmable Timer if the number of logic cell rows are varied by PR2D.

With the MSFC CP-V operating system, PR2D control and input data are created with an on-line editor and batched into the job stream.

By way of the PR2D mode control parameters, functions of the program (place, route, etc.) can be executed in steps for flexibility and reduced computer run times. Due to interaction between the layout control parameters, it is best to start with a working set of parameters (from the included examples) and carefully make variations on them. Their impact upon the layout should be observed by plotting. The included PR2D users guide and control parameter definition list describes the format and effects of each user option. Combinations can be found that achieve a desired layout.

The PR2D program outputs a map or printer plot that can be assembled into the final chip layout. All pertinent data with regard to the layout are shown on the map, and a printout of the chip statistics is output.

It has been our experience that modifications are required on the final PR2D layout. These modifications may be as simple as correcting misplaced test transistors, border modifications, or labeling. However, they have included uncompleted ground bridges to the cells and missing wiring segments. It is recommended that the layouts be carefully studied and each net manually checked against the plotted design layout. At MSFC these modifications are currently done with interactive graphics. However, they were done before by manually editing the PR2D artwork output data.

The EXEC (first routine of the source) contains a well commented section describing the functions of the mode control and layout control parameters, and has been included in this material. It is suggested that this be studied

carefully and used in conjunction with the simplified users guide when using the PR2D automatic layout program.

The PR2D program has been used to create numerous random logic arrays in different technologies at NASA/MSFC. While the program is large and complex, it is practical to implement and to learn how to use. It can produce quick turnaround layouts in mature technologies with acceptable device densities for many applications.

IV. SIMPLIFIED USERS GUIDE FOR PR2D PROGRAM (INPUT DATA)

The following paragraphs list various input data and control cards for the PR2D program. (Section IV.H. lists PR2D program format modifications.)

A. Mode Card (4I2, 16I4) Format

The mode card is used to control execution of program functions, control, identification, and debug printing.

1) Mode (1), Starting Function

= 0,1 start with Input function
= 2 start with Place function
= 3 start with Route function
= 4 start with Art function
= 5 start with Manmod function
= 6 error condition

2) Mode (2), Sub-Restart (within Function)

Start with parameter. Can only be used when Mode (1) = Mode (3); primarily used to debug program.

= 0,1 start with first sub-function
= 2 start with second sub-function
= 3 start with third sub-function
= 4 start with fourth sub-function

3) Mode (3), Ending Function

= 1 end after Input function is complete
= 2 end after Place function is complete
= 3 end after Route function is complete
= 4,0 end after Art function is complete
= 5 error condition

4) Mode (4), Sub-Restart (within Function) Stop After Parameter

Can only be used when Mode (1) = Mode (3).

= 1 stop after first sub-function
= 2 stop after second sub-function
= 3 stop after third sub-function
= 0,4 stop after fourth sub-function

5) Mode (5), Chip Identification Number

Must be > 0 and < 1000.

6) Mode (6), Technology Switch

= 1 is for aluminum gate, bonded wire
= 2 is for aluminum gate, beam lead
= 3 is for silicon gate, bonded wire
= 4 is for silicon gate, beam lead
= 5 silicon on sapphire (SOS), bonded wire

7) Mode (7), Pin Data File Control

= 0,1 pin data are from tape
= 2 pin data are from cards and tape
= 3 pin data are from cards

8) Mode (8), Pin Data Validation Keys = n1, n2, n3, n4

n1n2 = revision level
n3n4 = engineering level

9) Mode (9), Chip Design Type

Internally set to 1

10) Mode (10), User Specification of Number of Device Cell Rows

= 0 number of rows determined by linear mils of all active cells
= n user specification of number of row

$$1 < n < 13$$

11) Mode (11), User Specification of Number of Bonding Pads on Each Side of Chip

= 0 program determined
= n user specification

n must be greater than number calculated by program

12) Mode (12), Automatic Change of Specific Constants in Coding

13) Mode (15), Debug Control for Common data

Equal to 1 or 2, print common data after Read of common data from tape
Equal to 2 or 3, print common data after Write of common data to tape

14) Mode (16), Debug Control for Place Function

15) Mode (17), Debug Control for Route Function

16) Mode (18), Debug Control for Artwork Function

17) Mode (19), Debug Control for Manmod Function

18) NEW - Column 80 - Parameter Patch Control

NEW = 1 - next card patches IP(JX)=JY

= 2 - The IP array is replaced by the next IPX words read in format 20I4 from cards which follow. Elements which are blank or zero on the patch cards will not be changed; however, no further patches are permitted.

= 3 - next card patches LIM(JX)=JY

= 0 - no additional patches will be made.

Cards read in modes 1 and 3 will contain the following data in Format 3I4: JX, JY, NEW. The value of NEW read in this field determines the mode in which the next card is to be read.

B. Pin Data File (Cards or Tape), Header Data (10A4, 4I4)

If data are on tape, file cannot be opened unless KEY1, KEY2, and KEY3 are valid. If data are on cards and on tape, new header card will be copied to the new pin data tape (if generated). If header card data are blank, the header data from the old tape will be copied to the new pin data tape. This also applied to the revision date described in B1.

The program will automatically sort pin data by cell pattern number and by pin number within each cell type. If card data and tape data have the same cell pattern number, the program will automatically replace the new card pin data for the old tape pin data.

1) Pin Data File Description (10A4) — Last 8 characters should be date file was generated in nn/nn/nn format.

2) KEY1 — Revision level of data, see Mode (8) data.

3) KEY2 — Engineering level of data, see Mode (8) data.

4) KEY3 — Technology key for data, see Mode (6) data.

5) NEW — The control to generate a new pin data tape.

a) If equal to zero, new pin data file tape will be generated.

b) If greater than zero, a new pin data file tape will NOT be generated.

C. Cell Pattern Header Card and Pin Data Cards (5I4, 10A4, I4) Format

1) The pattern number must be entered on all cards (including header card).

2) The pin number must be zero for header card. The number of pins on each cell is not limited (can be 1 to N). Furthermore, not all pins need to exist and the pins need not be in numerical order.

3) The pin reassignment flag must be zero on header card and on last card of each cell pattern. This last card is used to specify the X/Y limits of that cell.

4) The pin X-coordinate must be zero on the header card. Enter the X-distance of the center of the pin from the origin of the cell in tenths of mils.

5) The pin capacitance must be zero on the header card on reference pin Y-coordinate of cell from cell origin (distance of ground center to cell origin).

6) The cell description data are entered on header card and optionally on pin data cards.

7) The technology code [same value as Mode (6)] must be entered on each and every card.

D. Stop Control Card

The stop control card following last pin data card is used to end reading of pin data file from cards. End of file will terminate reading pin data file from tape. The stop control card can be:

1) A blank card

2) "STOP" entered in columns 25-28 of stop control card

3) "ENDb" or "bEND" entered in columns 25-28 of stop control card.

E. Element to Pattern Assignment (1614, 14X, 12) Format

Element number-pattern-position-row assignment are entered four to a data card. Elements need not be in numerical order or in sequence. That is, the chip may contain N elements and be assigned any unique element number between a and b, where $1 \leq a \leq N \leq b \leq 400$*.

*Because the program automatically generates 1 or more subelements for large cells, $b + N_{sub}$ must be less than or equal to 400.

Element data are generated in sets as follows:

1) Element number

2) Pattern number

3) User specification of fixed order of element in a specified row. (For nonbonding pad rows, all elements of that row MUST be assigned, but their order need not be assigned.)

4) Fixed row specification of element; i.e.,

For ROW = -N, element will be in reverse orientation in row N.
For ROW = N, element will be in normal orientation in row N.
For Row = 0, element is not fixed to any row and will not be assigned to any row which contains any fixed row elements.

Note: If user specifies any nonbonding pad element as fixed in a row, all other elements in that row must also be fixed. Specification of order within a row implies that the row must be specified, but the converse is not true.

The program will terminate reading element/pattern data when an element and corresponding pattern are both zero or when a positive number is entered in columns 79-80 in the last card of these data. Once the element to pattern assignment has been completed, the program will automatically extract those patterns used in the chip design from the pin data file.

F. Node List

The program will stop reading node data when an end of file is read or if columns 77-80 of the last card has a value greater than zero.

1. First Card of Node Card (20I4) Format. This card contains the node weighting factor followed by element pin data in pairs (up to column 76). If a node can be completed in one data card, a node continuation card must be used and the pin for the last element must be the first entry on the continuation card. Columns 73-76 of the node card MUST be zero.

2. Node Continuation Card (8X, 18I4) Format. This card is used to read the pin number of the last element on the previous data card and additional element-pin data in pairs (columns 9-76). Node continuation cards may continue to be used, as required, by making the pin number of the last element on a data card blank and placing the pin number in the first field of the next continuation data card.

G. Commod Data Cards (4I4, 2A4) Format

These data cards are used to modify any data in any array in common. This option can only be exercised (automatically) after common data have been recovered from magnetic tape (READ subroutine).

1) LL1 is the i index of the data in the array being modified.

2) LL2 is the j index (if required) of the data in the array being modified.

3) LL3 is the k index (if required) of the data in the array being modified.

4) LL4 is the number assigned to each array in common:

LL4 = 1 for CHIP (I)
LL4 = 2 for ICAP (I)
LL4 = 3 for INFO (I, J)
LL4 = 4 for IP (I)
LL4 = 5 for IPIN (I, J)
LL4 = 6 for LCS (i)
LL4 = 7 for LIM (I)
LL4 = 8 for MODE (I)
LL4 = 9 for NODE (I)
LL4 = 10 for JART (I, J)
LL4 = 11 for JFAC (I, J)
LL4 = 12 for MAP (I, J, K)
LL4 = 13 for NOD (I)
LL4 = 14 for NR (I, J)

This number is optional. If the array name is entered for ALP variable (see item 7), the program will calculate LL4.

5) LL5 is the new data to be stored in common (for numeric data).

6) BET is the new data to be stored in common (for alpha data).

7) ALP is the first four characters of the name of the array in which data are being changed. This is optional. If the array number is entered for LL4, these data are not required.

H. PR2D Program Format Modifications

The latest modification of PR2D which included the SOS technology requires some input data modifications. In all cases, the data format changes are minor. If old data are to be used with the new program, only a few minor changes are required. The reason for these data format changes is to confine all data between columns 1 and 72. No data are allowed in columns 73 to 80. The following are the changes:

1) MODE Data Card — The new format is (4I2, 16I4).

2) Parameter Modification Cards (INIT) — The effective format is now (I1, I3, 2I4). The actual format is still (3I4). See INIT subroutine for details. I1 and I3 represents V and C in equation IP(IV + C) = New Data. For example, columns 1 to 4 should be:

To Modify	Data	Alternate*
I0 + 10	0b10	7b11
I1 + 10	1b10	7111
I2 + 10	2b10	7151

*(b = space or zero)

That is, the user may enter the IV variable plus the offset constant C to calculate the correct index in the array IP(I), where V = 0, 1, 2, 3, 4, 5, or 6. If the alternate method is used, the user must calculate the correct index (IV + C) for IP(I) and MUST prevent the program from adding the variable V to that index. To prevent the program from adding V, set V = 7.

3) Parameter Modification Cards (COMMOD) — This operates exactly like item 2. The effective format is now (I1, I4, ...). For example:

To Modify	Data*	Alternate*
I0 + 10	0bb10	7b11

*(b = space or zero)

4) Element to Pattern Assignment — The new format is (I6I4, 6X, I2). This change has no effect on the element to pattern data. It only effects the skip data/stop control. These data must now be in columns 71 and 72.

5) Node List — The node list format is now (18I4). Generally, this will require no changes to the node data. The only change is that when there is exactly 9 (17, 25, ...) pins in a node, the pin for that 9th (17th, 25th, ...) element MUST be entered on the next data card. Formally, the program had allowed a nine pin node to be totally contained on one data card. The new program requires the use of two data cards for that nine pin node. Nodes with 2 to 8 pins, 10 to 16 pins, etc. are not effected.

6) Restart Mode — When PR2D is executed in the restart mode, a chip description data card must follow the mode data card in the RESTART mode.

I. Execution

The following are the suggested methods for execution of the PR2D program:

1) The PR2D program should be executed one function at a time. Without exception, the placement function and route function should NOT be executed in the same computer run. The output of the placement function should be examined. Sometimes interchanging two adjacent bonding pads can improve the final chip design. See design improvement.

2) The PR2D program should be executed at least two times using a different placement surface for each run (See Section III). Each resulting chip design should be plotted on a Calcomp plotter.

3) The best chip design (smallest area) (Paragraph IV. B) should be used for the final chip design.

J. Design Improvement

Using the COMMOD method to change data in common, the program can be controlled to generate different placements and make improvements in these placements. Changes to the placement surface will generate these different placements.

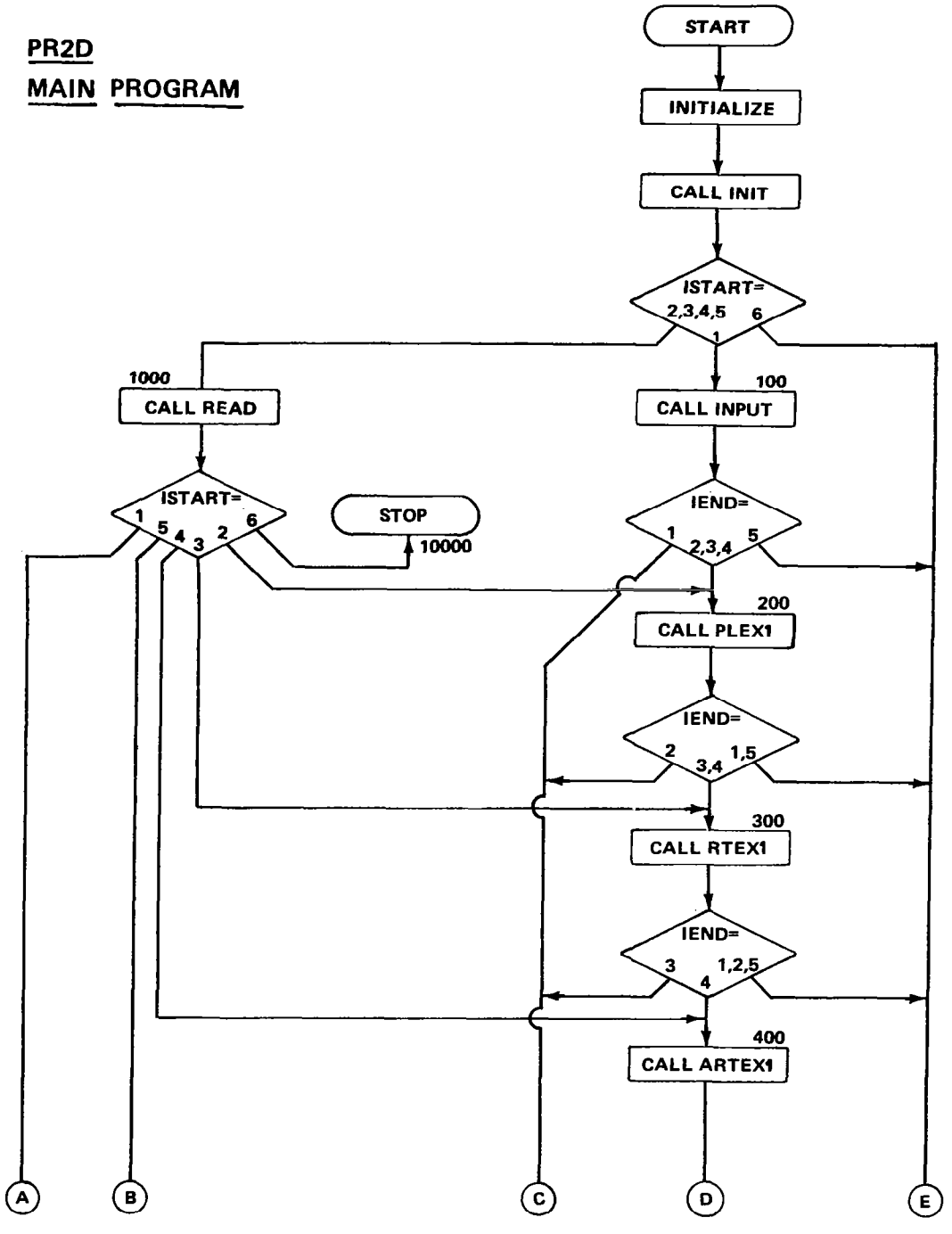

Figure 1. PR2D main program flowchart.

PR2D

MAIN PROGRAM

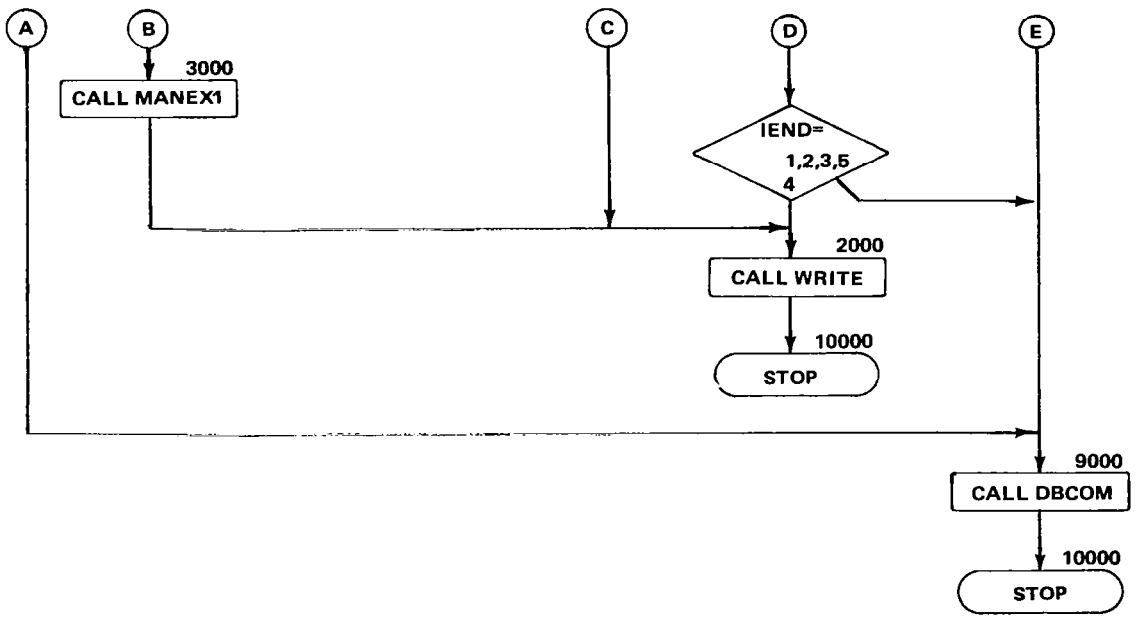

Figure 1. (Concluded).

SUBROUTINE PLEX1

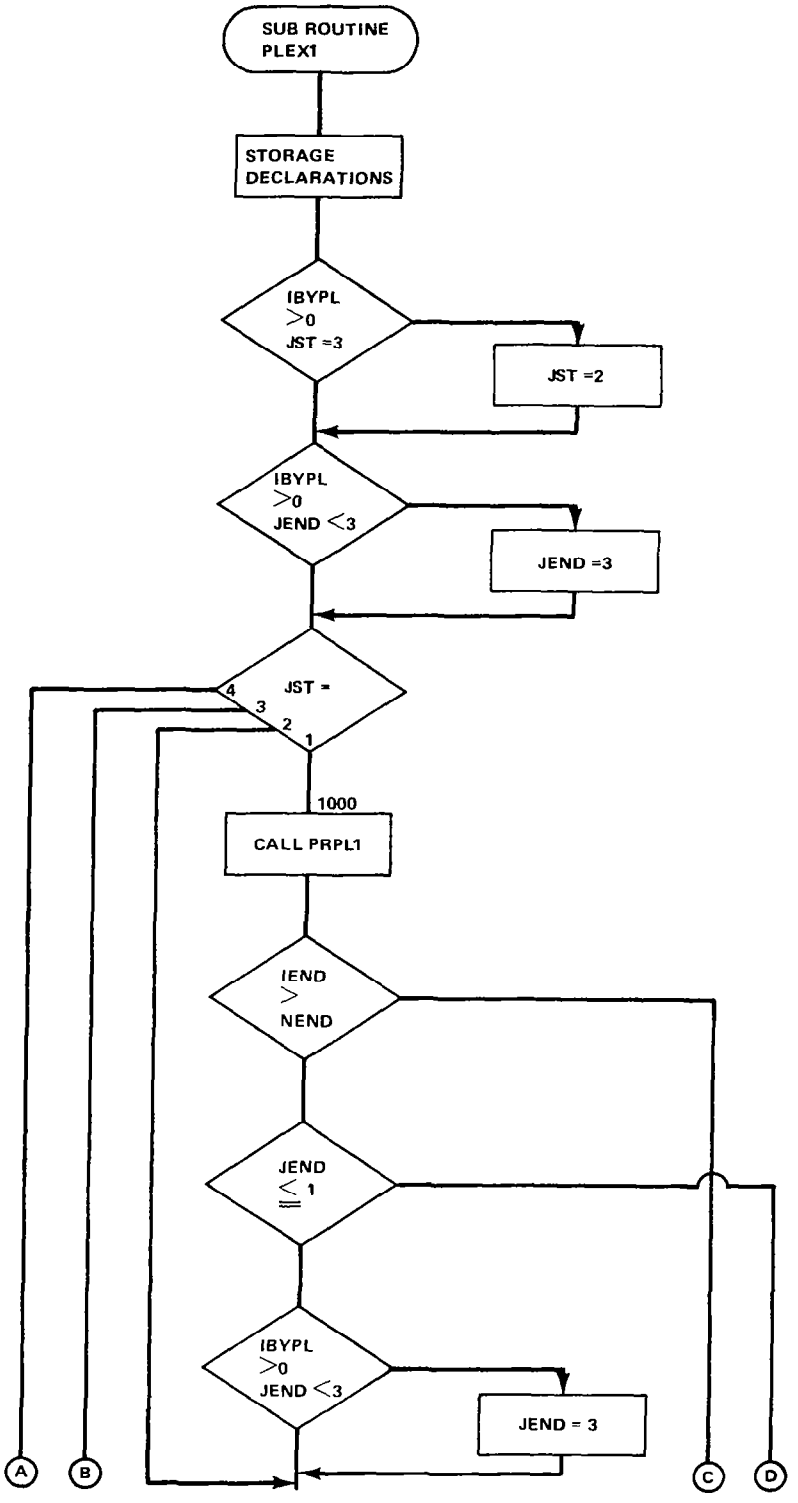

Figure 2. PR2D place executive flowchart.

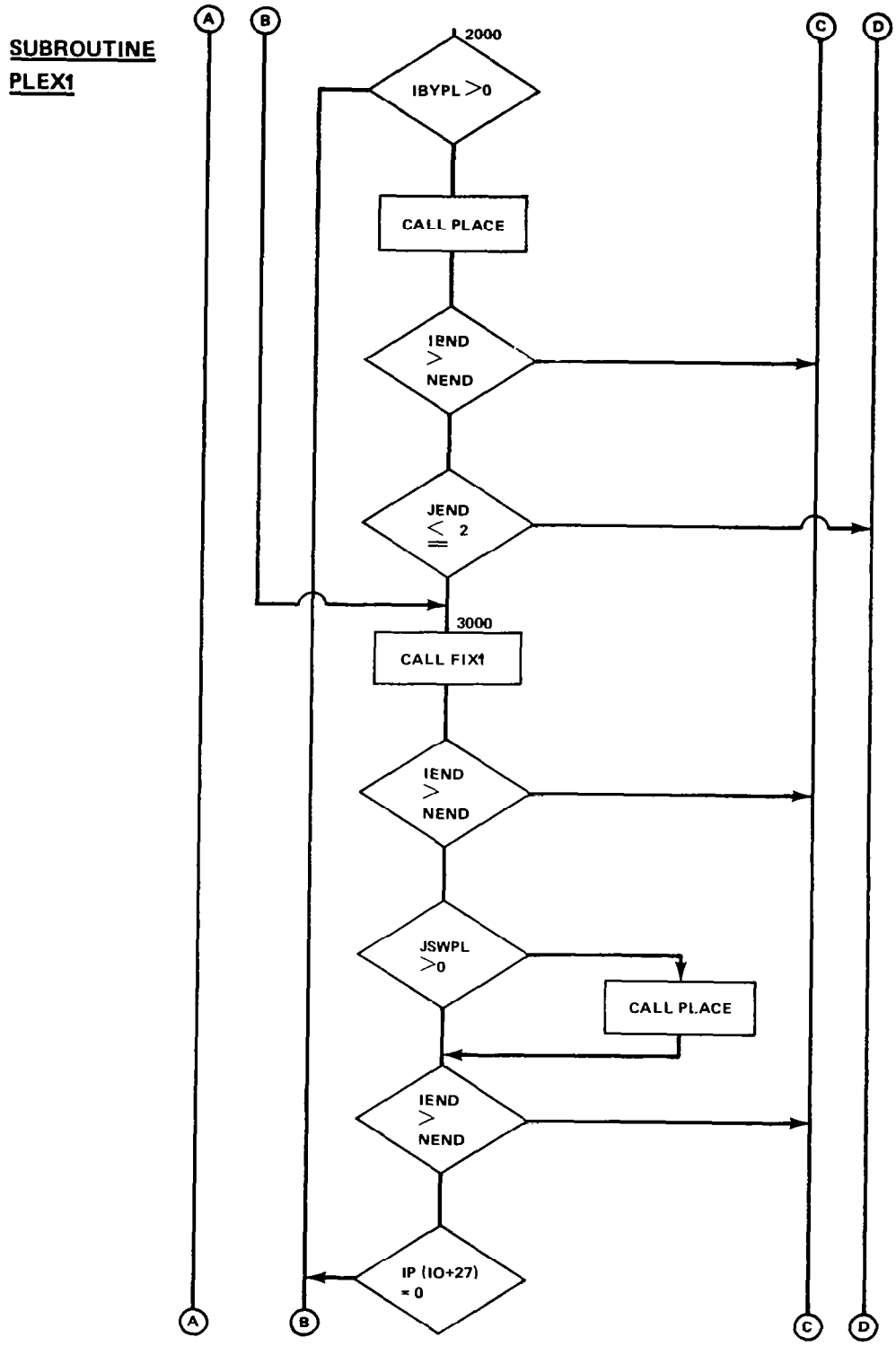

Figure 2. (Continued).

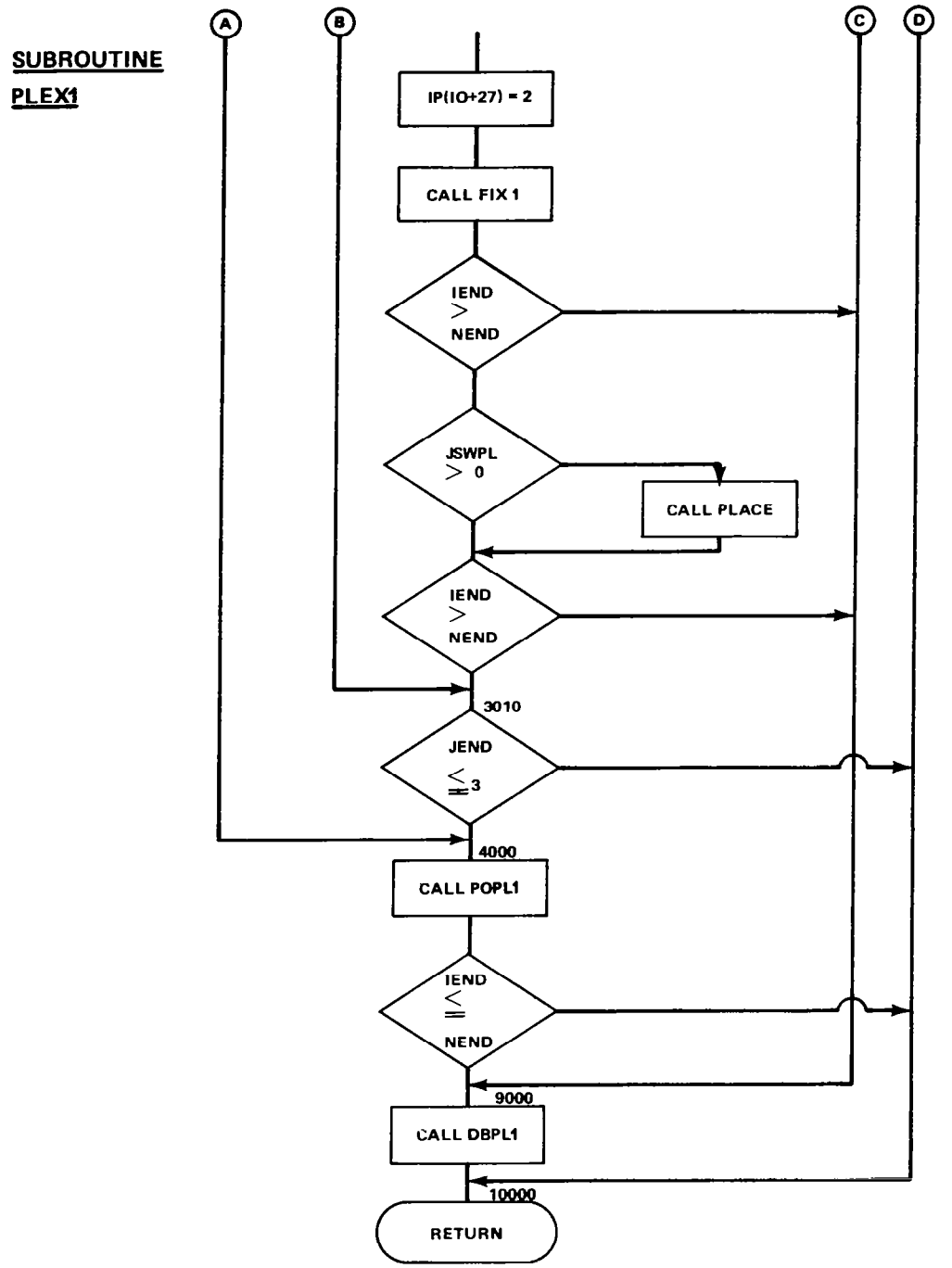

Figure 2. (Concluded).

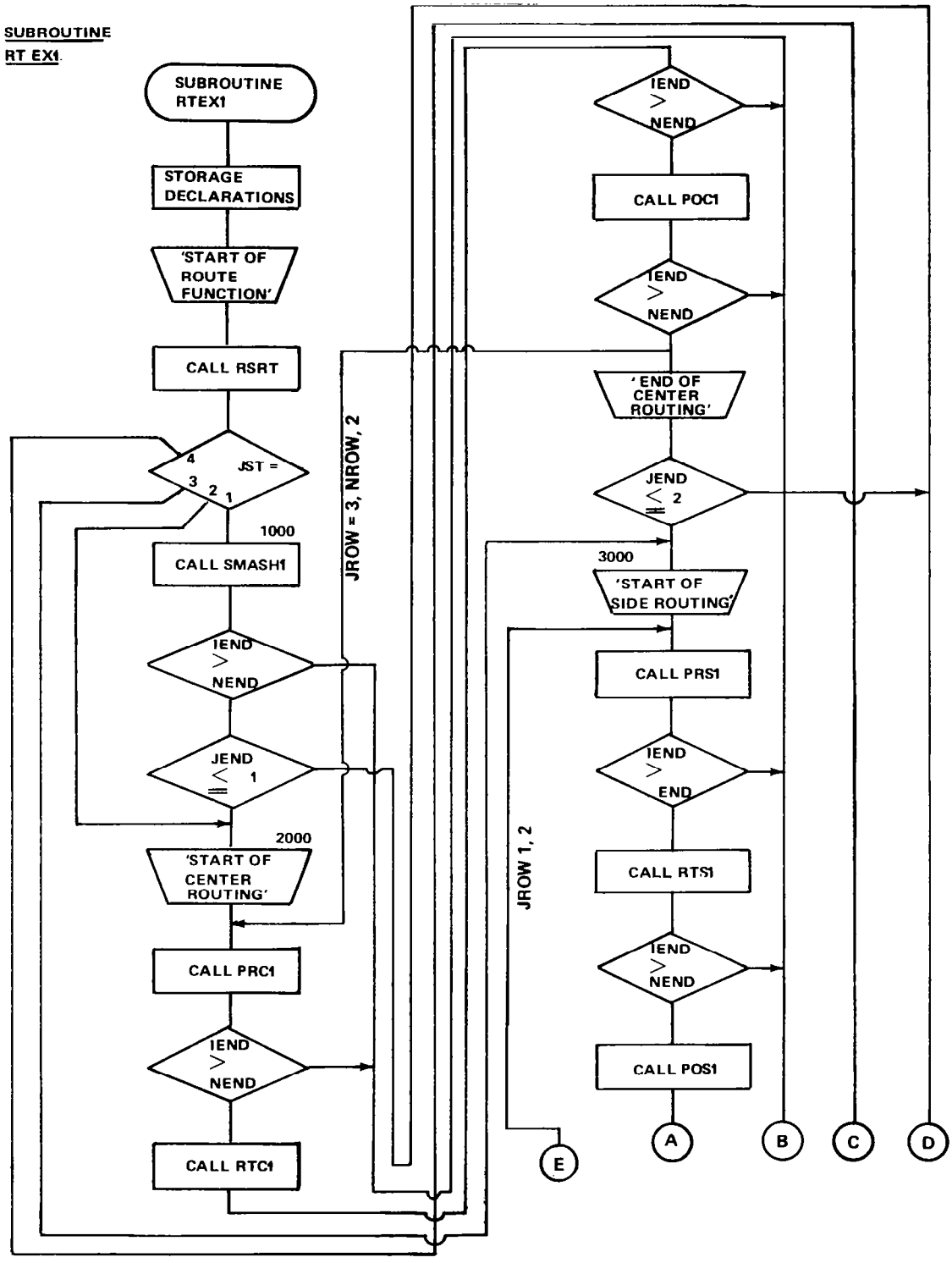

Figure 3. PR2D route executive flowchart.

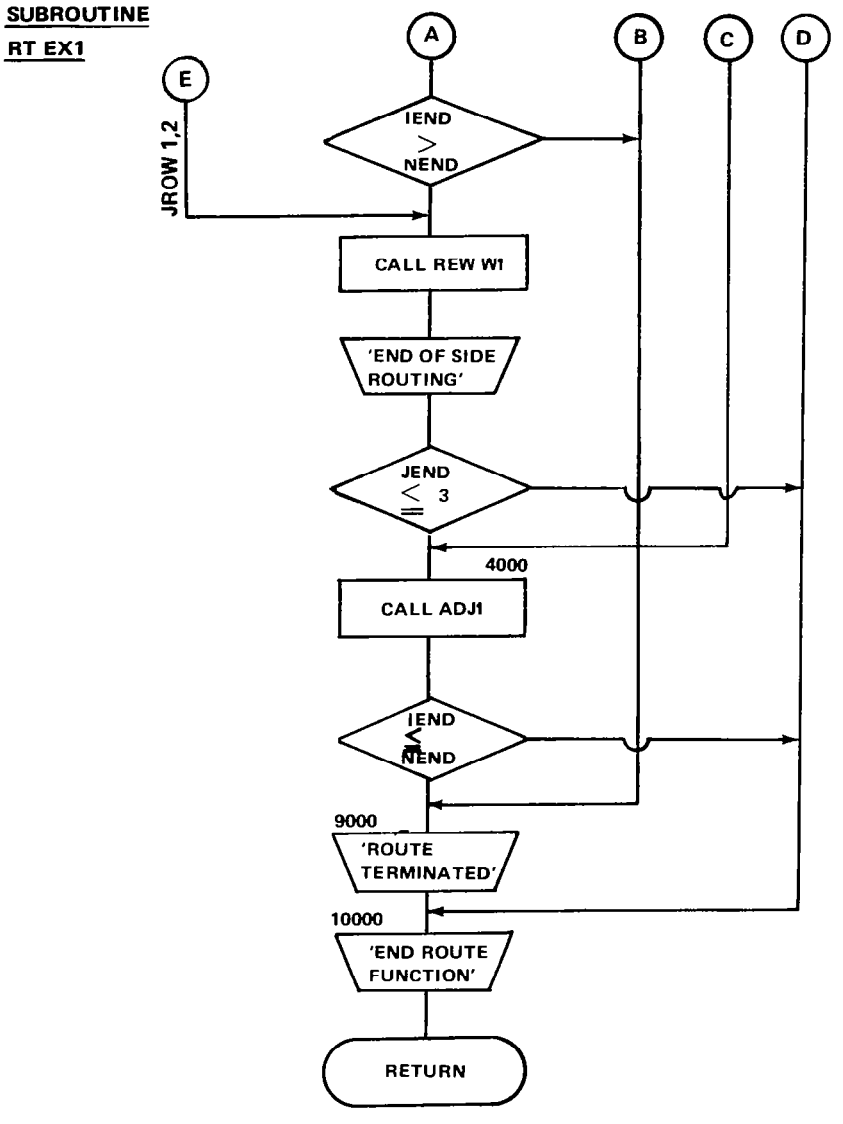

Figure 3. (Concluded).

SUBROUTINE
ARTEX 1

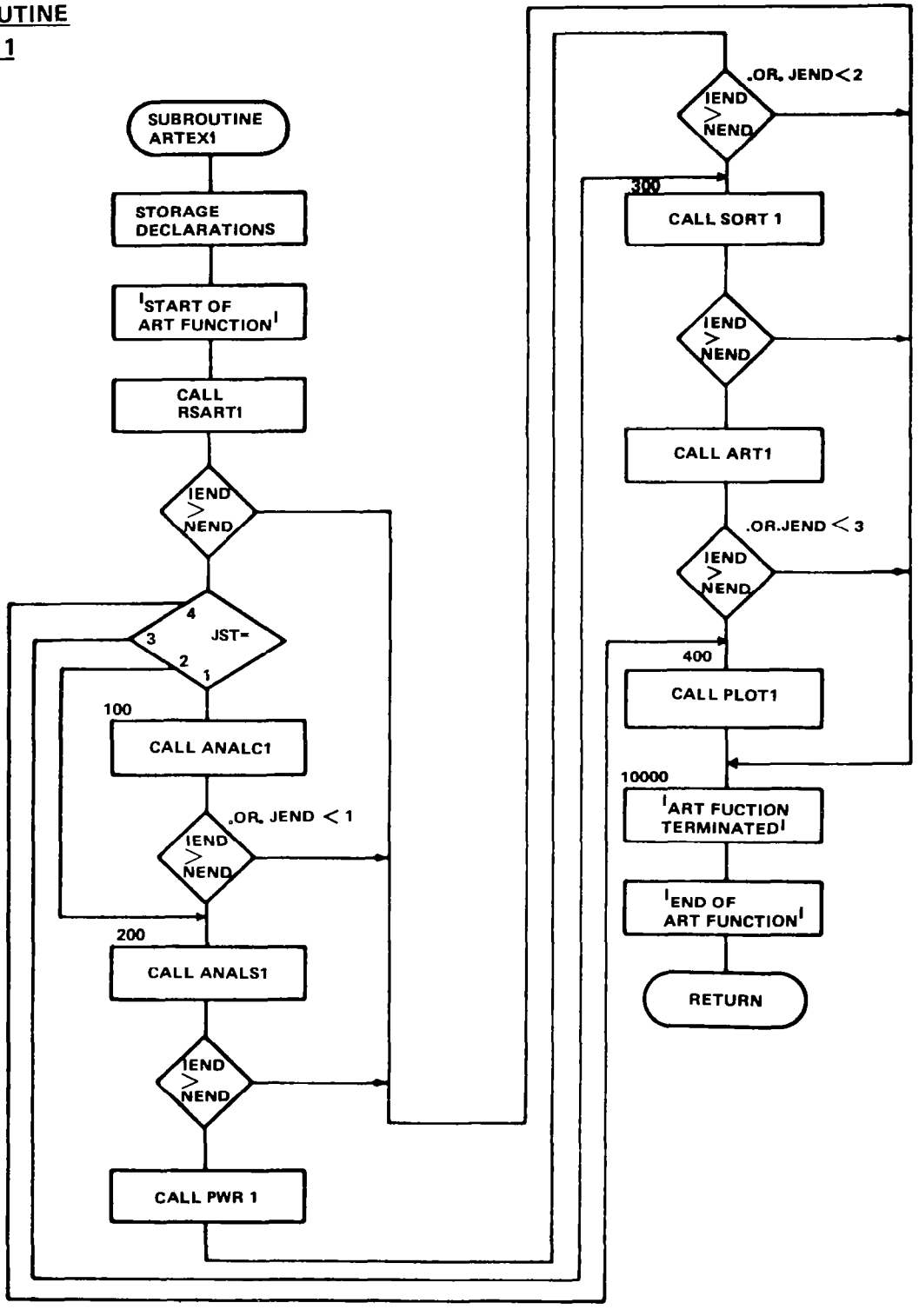

Figure 4. PR2D artwork executive flowchart.

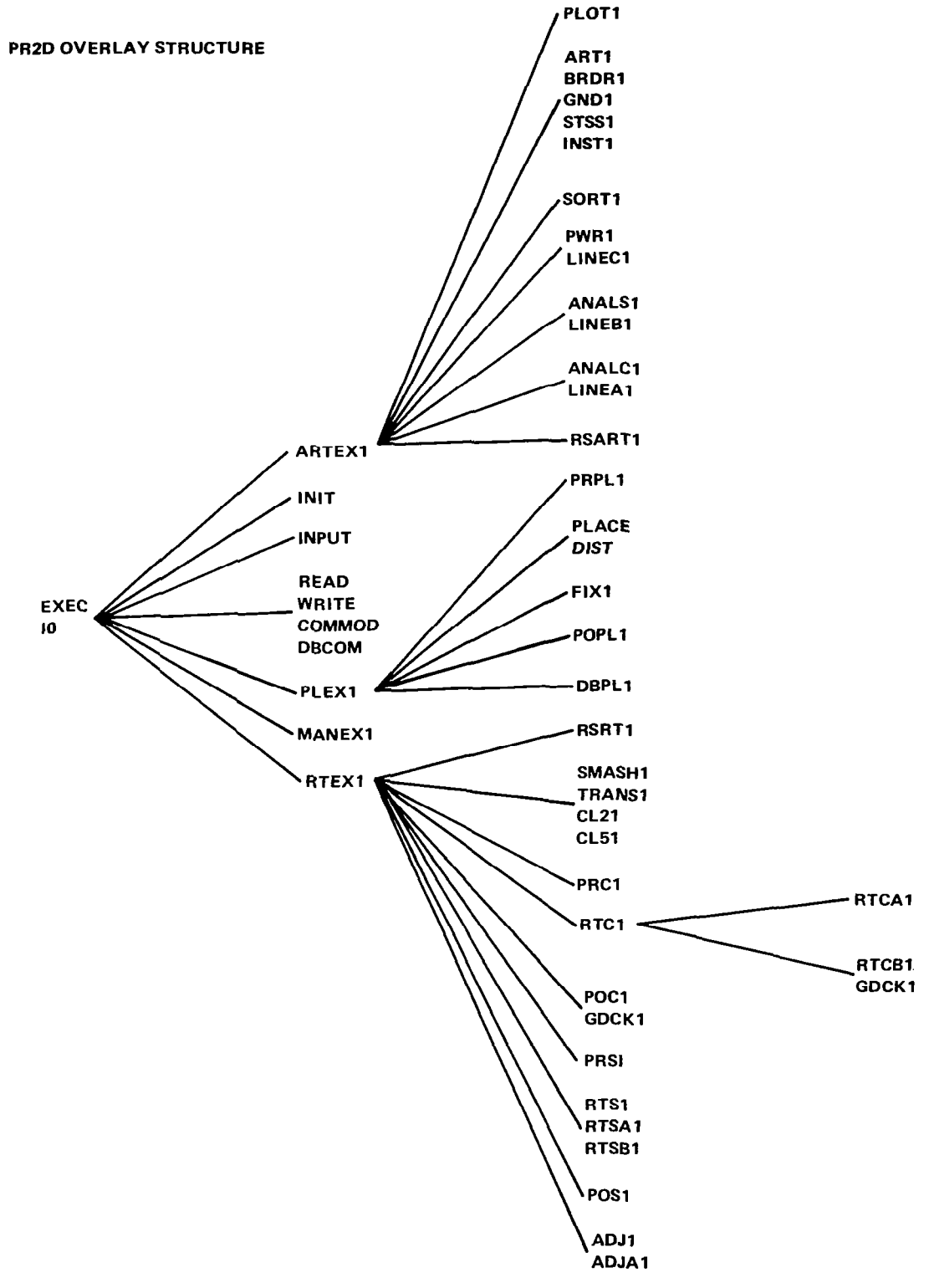

Figure 5. PR2D overlay structure.

```
!JOB PM20,EC45020(BASE/CAD),1
!LIMIT (CORE,72),(TIME,45)
!ASSIGN MISI,(DEVICE,9T),(SN,PM20),(IN)
!ASSIGN MIHO,(FILE,EXEC  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,INIT  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,INPUT ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,READ  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,WRITE ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,COMMOD),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,DBCOM ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,PLEX1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,PRPL1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,PLACE ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,DIST  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,FIX1  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,POPL1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,DBPL1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,RTEX1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,RSRT1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,SMASH1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,TRANS1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,CL21  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIBO,(FILE,CL51  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,GDCK1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,PRC1  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,RTC1  ),(SAVE)
!FORTRAN PS,80
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!FORTRAN PS,80
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!FORTRAN PS,80
!ASSIGN MIHO,(FILE,ANALC1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,LINEA1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,ANALS1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,LINEB1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,PAR1  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,LINEC1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,SORT1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,ART1  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,BRORI ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,GND1  ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,STSS1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,INST1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,PLOT1 ),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,MANEX1),(SAVE)
!FORTRAN PS,80
!ASSIGN MIHO,(FILE,IO),(SAVE)
!FORTRAN PS,80
!EOD
!ASSIGN F11,(FILE,DECODE),(OUTIN)
!ASSIGN F15,(DEVICE,CR405)
!ASSIGN F16,(DEVICE,LP402)
!ASSIGN F110,(FILE,OUTO10),(OUTIN)
!ASSIGN F115,(FILE,OUTO15),(OUTIN)
!ASSIGN F120,(FILE,OUTO20),(OUTIN)
!ASSIGN F125,(FILE,OUTO25),(OUTIN)
!ASSIGN F130,(FILE,DESIGN),(IN)
!ASSIGN F135,(FILE,COMMON1),(OUT),(SAVE)
!ASSIGN F140,(FILE,COMMON),(IN)
!ASSIGN F145,(FILE,SIGACTF),(IN)
!ASSIGN F150,(FILE,SIGACTF),(OUT),(SAVE)
!ASSIGN F155,(FILE,LVITR),(OUT),(SAVE)
!ASSIGN F160,(FILE,LVITR2),(OUTIN),(SAVE)
!LOAD (LVN,LPR20C),(PERM1),(MAP),(PREF),(SL,F),(FF,;
!      (EXEC),(IOBOCRDS),(INIT),(INPUT),(READ),(WRITE),(COMMOD),(DBCOM),;
!      (PLEX1),(PRPL1),(PLACE),(DIST),(FIX1),(POPL1),(DBPL1),(RTEX1),;
!      (RSRT1),(SMASH1),(TRANS1),(CL21),(CL51),(PRC1),(RTC1),(RTCA1),;
!      (RTCB1),(GDCK1),(POC1),(PRS1),(RTS1),(RTSA1),(RTSB1),(POS1),;
!      (ADJ1),(ADJA1),(ARTEX1),(RSART1),(ANALC1),(LINEA1),(ANALS1),;
!      (LINEB1),(PAR1),(LINEC1),(SORT1),(ART1),(BRORI),(GND1),(STSS1),;
!      (INST1),(PLOT1),(MANEX1))
!TREE EXEC=IOBOCRDS-(;
!      INIT,;
!      INPUT,;
!      READ-WRITE-COMMOD-DBCOM,;
!      PLEX1=(PRPL1,PLACE=DIST,FIX1,POPL1,DBPL1),;
!      RTEX1=(RSRT1,SMASH1=TRANS1=CL21=CL51,PRC1,RTC1=(RTCA1,RTCB1=GDCK1;
!            ),POC1=GDCK1,POS1,RTS1=-RTSA1=RTSB1,POS1,ADJ1=ADJA1),;
!      ARTEX1=(RSART1,ANALC1=LINEA1,ANALS1=LINEB1,PAR1=LINEC1,SORT1,;
!            ART1=BRORI=GND1=STSS1=INST1,PLOT1),;
!      MANEX1)
!EOD
```

Figure 6. Compile and load job setup.

GRAN	REC	NAME
4	51	ADJA1
4	55	ADJ1
10	145	ANALC1
5	67	ANALS1
1	8	ARTEX1
3	38	ART1
3	39	BRDR1
2	22	CL21
1	10	CL51
3	34	COMMOD
5	63	DBCOM
2	15	DBPL1
2	15	DEBLOCK
3	45	DIST
1	6	EXEC
6	83	FIX1
1	7	GDCK1
4	51	GND1
8	117	INIT
11	167	INPUT
1	5	INST1
3	34	IO
1	11	LINEA1
1	11	LINEB1
1	11	LINEC1
146	96	LMPR2DC
10	152	MANEX1
4	56	PLACE
1	6	PLEX1
1	6	PLOT1
23	360	POC1
13	202	POPL1
6	93	POS1
3	31	PRC1
6	81	PRPL1
5	70	PRS1
5	139	PR2DCMPLD
1244	30084	PR2DS
4	60	PWR1
2	24	READ
1	11	RSART1
1	9	RSRT1
4	50	RTCA1
7	105	RTCB1
2	17	RTC1
1	12	RTEX1
1	9	RTSA1
4	48	RTSB1
2	28	RTS1
20	325	SMASH1
5	74	SORT1
2	15	STSS1
3	34	TAPES
2	57	TEMP
1	5	TRANS1
3	31	WRITE

Figure 7. PR2D source, object modules and load module disc usage.

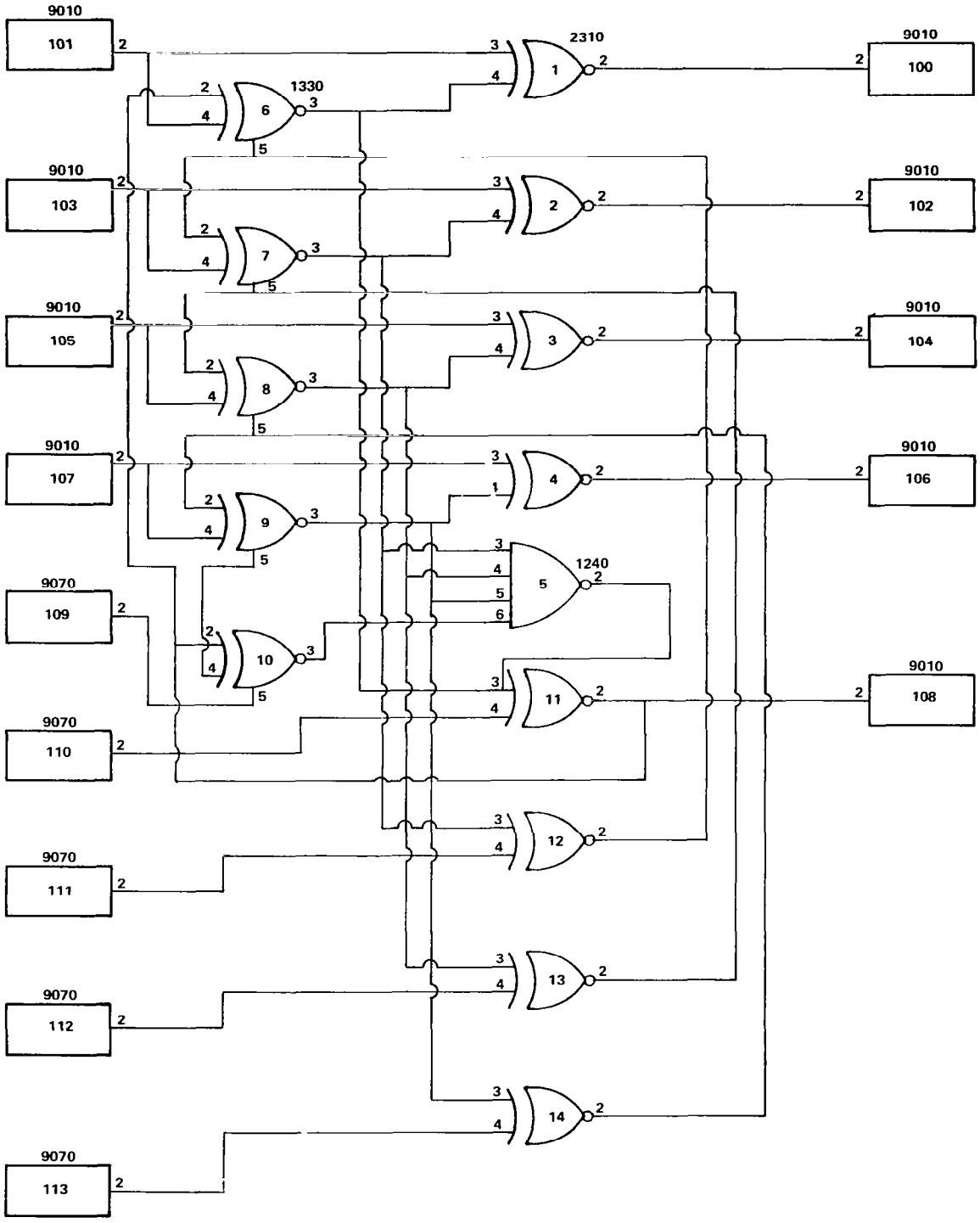

Figure 8. N002 — 4 bit adder partitioned logic diagram.

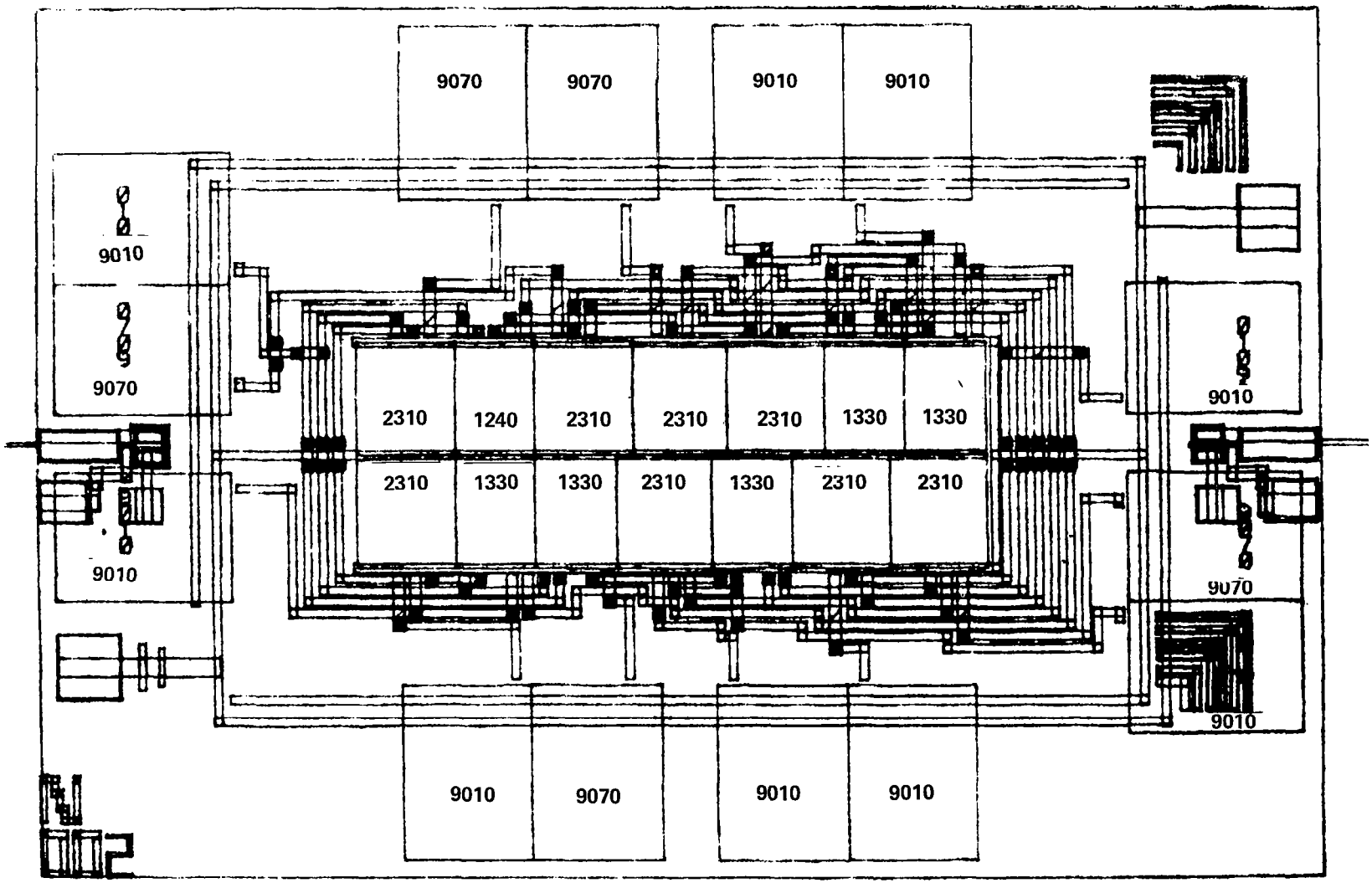

Figure 9. N002 — PR2D unmodified layout.

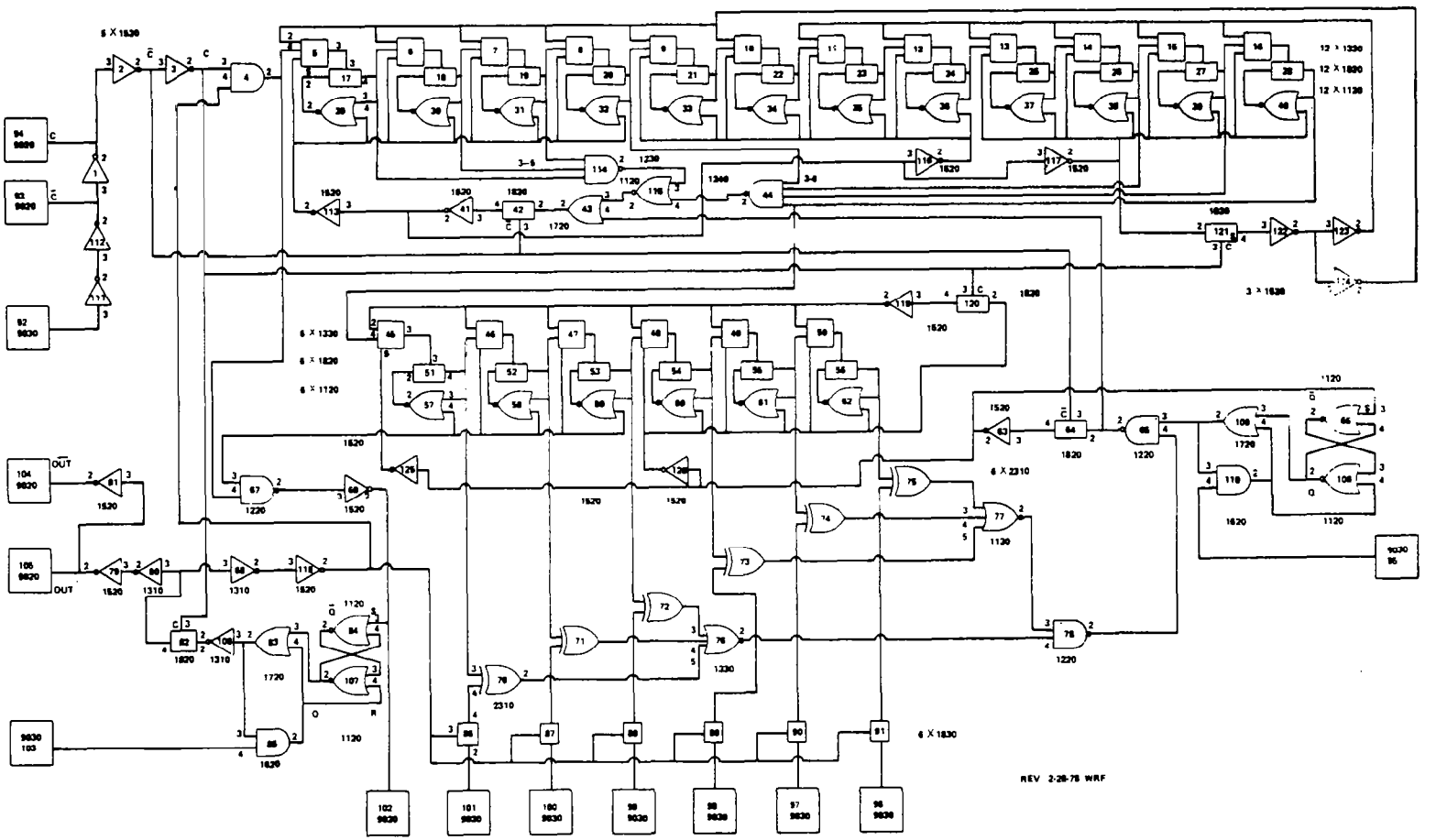

Figure 10. C015 — programmable timer partitioned logic diagram.

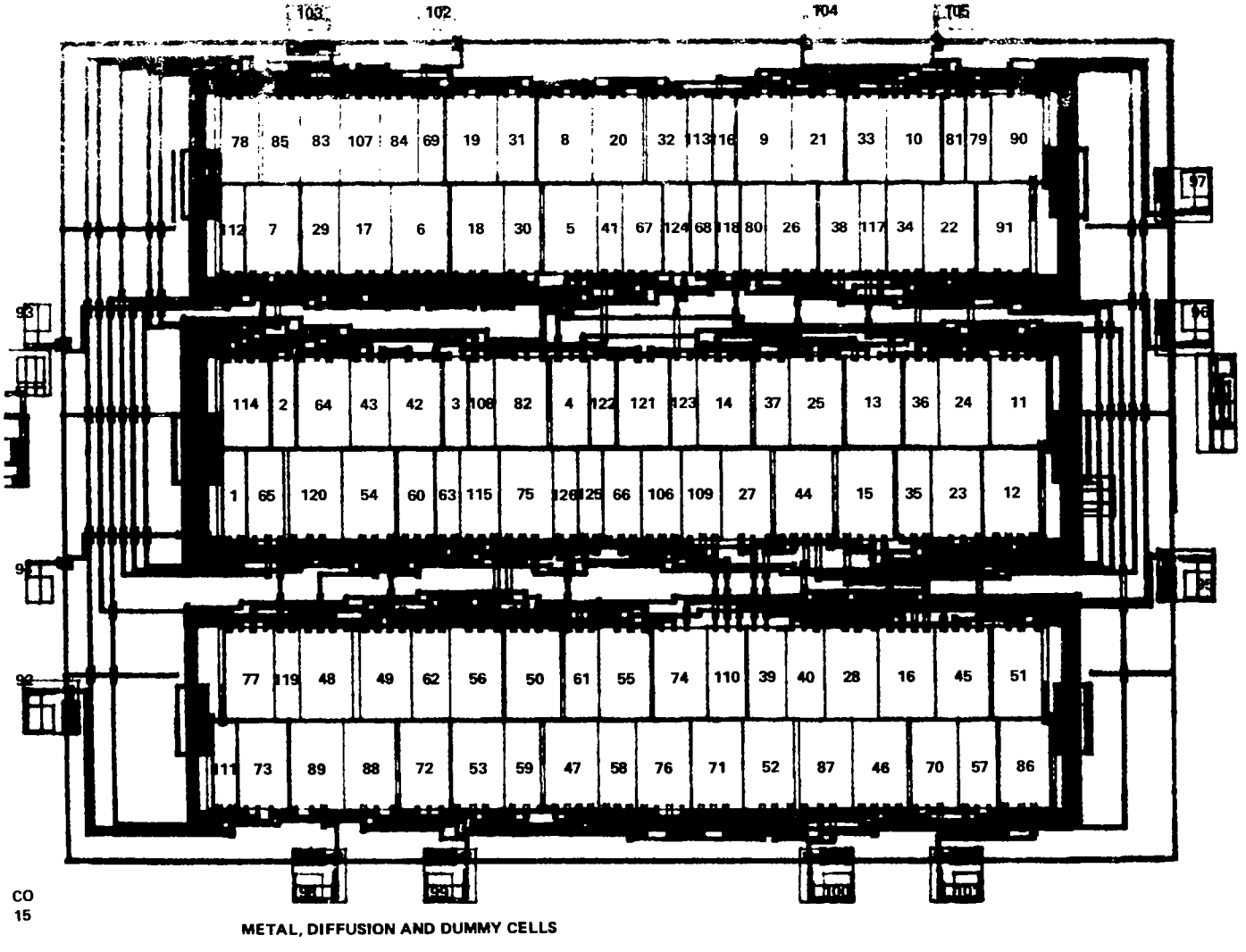

Figure 11. C015 — PR2D unmodified layout.

TABLE 1. EFFECTS OF VARYING THE NUMBER OF LOGIC CELL ROWS ON THE PR2D LAYOUT OF THE C015 PROGRAMMABLE TIMER

Number of Logic Cell Rows	Step and Repeat (X × Y) Dimensions (mils)	Chip Area ($mils^2$)	Longest Cell Row (mils)	Total Cell Row Length (mils)	Cell Area (%)	Bonding Pad Area (%)	Wiring Area (%)	Wiring Effect (%)	Inches of Metal	Inches of Tunnel	Number of Tunnel Ends
5	237 × 156	36 972.0	156.3	761.6	28.8	41.7	29.5	29.5	6.75	0.88	313
PR2D Program Choice											
6	213 × 169	35 997.0	129.4	761.6	29.6	41.5	28.9	59.8	6.46	0.90	379
7	201 × 193	38 793.0	110.7	761.6	27.5	39.9	32.7	51.3	6.96	0.86	371
8	187 × 211	39 457.0	97.9	761.6	27.0	39.6	33.3	48.7	6.88	0.83	421

V. PR2D MODE AND LAYOUT CONTROL PARAMETER DEFINITIONS

```
C                                                                       000 0100
C                                                                       000-0300
C***********************************************************************000 0400
C                                                                       000 0500
C       AUTHOR       : RICHARD NOTO                                     000 0600
C                                                                       000 0700
C       DATE WRITTEN: 1972                                              000 0800
C                                                                       000 0900
C       COMPANY      : RCA CORP.                                        000 1000
C       ADDRESS      : MAIL STOP 10-701                                 000 1100
C                      FRONT & COOPER STS.                              000 1200
C                      CAMDEN, N. J., 08102                             000 1300
C                                                                       000 1400
C       PHONE NUMBER: (609) 963-8000                                    000 1500
C       EXTENSION    : PC6755                                           000 1600
C                                                                       000 1700
C***********************************************************************000 1800
C                                                                       000 1900
C     THE PURPOSE OF THE PR2D PROGRAM IS TO ASSIST IN THE DESIGN OF LSI 000 2000
C     ARRAYS. BASIC DESIGN DATA (ASSIGNMENT OF ELEMENT NUMBERS TO       000 2100
C     PATTERNS AND NODE CONNECTIVITY DATA) ARE TRANFORMED TO ARTWORK    000 2200
C     INSTRUCTIONS. THESE INSTRUCTIONS ARE USED BY THE ARTWRK PROGRAM   000 2300
C     TO GENERATE ARTWORK COMMANDS USED FOR PLOTTING FINAL ARTWORK      000 2400
C     MASKS.                                                            000 2500
C                                                                       000 2600
C     THIS PROGRAM PROVIDES TWO-DIMENSIONAL PLACEMENT OF CELLS ON THE   000 2700
C     PLACEMENT SURFACE AND A TWO-DIMENSIONAL ROUTING OF CONNECTIONS    000 2800
C     AMONG THESE CELLS. EACH SUBROUTINE IS MODULAR AND CAN BE          000 2900
C     REPLACED OR MODIFIED.                                             000 3000
C                                                                       000 3100
C***********************************************************************000 3200
C                                                                       000 3300
C     THE PURPOSE OF THE EXEC PROGRAM IS TO CONTROL THE SEQUENCE OF     000 3400
C     EXECUTION OF THE PR2D PROGRAM. THE EXEC PROGRAM ITSELF HAS BEEN   000 3500
C     KEPT TO MINIMUM SIZE AND ALL FUNCTIONS  ARE OVERLAID AT THE END   000 3600
C     OF EXEC SO THAT THE STORAGE REQUIREMENTS FOR THE PR2D PROGRAM     000 3700
C     WILL BE MINIMUM. THE EXEC PROGRAM IS CONTROLLED BY THE MODE       000 3800
C     PARAMETERS. THESE PARAMETERS SPECIFY THE START AND END OF         000 3900
C     EXECUTION OF THE PR2D PROGRAM. THIS FEATURE IS CALLED "RESTART".  000 4000
C     THIS FEATURE ALLOWS THE USER TO INTERUPT THE OPERATION OF THE     000 4100
C     PR2D PROGRAM AND, IF DESIRED, MAKE CHANGES TO THE DATA STORED     000 4200
C     IN COMMON. ALL INTER-FUNCTION (PL,RT,ETC.) DATA ARE TRANSFERRED   000 4300
C     THROUGH COMMON OR THROUGH MAGNETIC TAPE. THOSE ARRAYS THAT ARE    000 4400
C     NOT IN COMMON ARE ONLY USED WITHIN THAT PARTICULAR FUNCTION.      000 4500
C     IF NON-COMMON DATA MUST BE TRANSFERRED, IT WILL EITHER BE WRITTEN 000 4600
C     TEMPORARILY  TO COMMON OR TO MAGNETIC TAPE.                       000 4700
C                                                                       000 4800
C***********************************************************************000 4900
C                                                                       000 5000
C     RESTART FEATURE:                                                  000 5100
C                                                                       000 5200
C       MODE(1) = ISTART IS THE STARTING FUNCTION PARAMETER.            000 5300
C       (1-2)   = 0, 1 START WITH INPUT  FUNCTION.                      000 5400
C               = 2    START WITH PLACE  FUNCTION.                      000 5500
C               = 3    START WITH ROUTE  FUNCTION.                      000 5600
C               = 4    START WITH ART    FUNCTION.                      000 5700
```

```
C                = 5    START WITH MANMOD FUNCTION.                          000 5800
C                = 6    ERROR CONDITION SWITCH.                              000 5900
C                                                                            000 6000
C       MODE(2) = JST, IS THE SUB-RESTART, WITHIN FUNCTION, START WITH       000 6100
C       (3-4)       PARAMETER. SEE EACH FUNCTION EXECUTIVE FOR               000 6200
C                   DETAILED INFORMATION ON JST.                             000 6300
C                   THIS CONTROL IS ONLY USED FOR DEBUGGING OF THE           000 6400
C                   PROGRAM AND CAN ONLY BE EXERCISED WHEN MODE(1) =         000 6500
C                   MODE(3).                                                 000 6600
C                                                                            000 6700
C       MODE(3) = IEND IS THE ENDING FUNCTION PARAMETER.                     000 6800
C       (5-6)   = 1    END AFTER INPUT  FUNCTION   IS COMPLETE.              000 6900
C                = 2    END AFTER PLACE  FUNCTION   IS COMPLETE.             000 7000
C                = 3    END AFTER ROUTE  FUNCTION   IS COMPLETE.             000 7100
C                = 4, 0 END AFTER ART    FUNCTION   IS COMPLETE.             000 7200
C                = 5    ERROR CONDITION SWITCH.                              000 7300
C                                                                            000 7400
C       MODE(4) = JEND, IS THE SUB-RESTART, WITHIN FUNCTION, STOP            000 7500
C       (7-8)       AFTER PARAMETER. SEE EACH FUNCTION EXECUTIVE FOR         000 7600
C                   DETAILED INFORMATION ON JEND.                            000 7700
C                   THIS CONTROL IS ONLY USED FOR DEBUGGING OF THE           000 7800
C                   PROGRAM AND CAN ONLY BE EXERCISED WHEN MODE(1) =         000 7900
C                   MODE(3).                                                 000 8000
C                                                                            000 8100
C       MODE(5) = ID   IS THE CHIP IDENTIFICATION # (0 < ID < 1000).         000 8200
C       (9-12)  (SEE INPUT, READ & WRITE FUNCTIONS)                          000 8300
C                                                                            000 8400
C       MODE(6) = ITECH, IS THE TECHNOLOGY CONTROL SWITCH,                   000 8500
C       (13-16) = 0,1  IS FOR METAL GATE BONDED WIRE.                        000 8600
C                = 2    IS FOR BEAM LEAD METAL GATE.                         000 8700
C                = 3    IS FOR POLY-SILICON.                                 000 8800
C                = 4    IS FOR BEAM LEAD POLY-SILICON.                       000 8900
C                = 5    IS FOR SOS BONDED WIRE                               000 9000
C                = 6    IS FOR SOS BEAM LEAD.                                000 9100
C                                                                            000 9200
C       MODE(7) = PIN DATA FILE SWITCH.                                      000 9300
C       (17-20) (SEE INPUT FUNCTION).                                        000 9400
C                = 0, 1 PIN DATA ARE FROM TAPE.                              000 9500
C                = 2    PIN DATA ARE FROM TAPE AND FROM CARDS.               000 9600
C                = 3    PIN DATA ARE FROM CARDS.                             000 9700
C                                                                            000 9800
C       MODE(8) = PIN DATA VALIDATION KEYS.                                  000 9900
C       (21-24) = N1, N2, N3, N4. N1N2 IS THE REVISION LEVEL OF DATA.        000 0000
C                                 N3N4 IS THE ENGINEERING LEVEL OF DATA.     000 0100
C                                                                            000 0200
C       MODE(9) = ITYPE, IS CHIP DESIGN.                                     000 0300
C       (25-28) = 0, 1 IS TYPE 1 DESIGN.                                     000 0400
C                                                                            000 0500
C       MODE(10) IS USER SPECIFICATION OF NUMBER OF CELL ROWS.               000 0600
C       (29-32) = 0 PROGRAM DETERMINES NUMBER OF ROWS.                       000 0700
C                = N USER SPECIFIES NUMBER OF ROWS, 1 < N < 21.              000 0800
C                                                                            000 0900
C       MODE(11) IS USER SPECIFICATION OF NUMBER OF BONDING PADS             000 1000
C       (33-36)  ON EACH EDGE OF CHIP. MUST BE > # CALCULATED BY             000 1100
C                PROGRAM                                                     000 1200
C                                                                            000 1300
C       MODE(12) IS SPECIAL CHIP DESIGN CONTROL SWITCH.                      000 1400
C       (37-40)  = 1 IS PARAMETER MODIFICATION OPTION NO. 1.                 000 1500
C                = 2 IS PARAMETER MODIFICATION OPTION NO. 2.                 000 1600
C                = 3 IS PARAMETER MODIFICATION OPTION NO. 3.                 000 1700
C                = 4 IS PARAMETER MODIFICATION OPTION NO. 4.                 000 1800
```

```
                = 5 IS PARAMETER MODIFICATION OPTION NO. 5.                    000 1900
                = 6 IS PARAMETER MODIFICATION OPTION NO. 6.                    000 2000
                = 7 IS PARAMETER MODIFICATION OPTION NO. 7.                    000 2100
                = 8 IS PARAMETER MODIFICATION OPTION NO. 8.                    000 2200
                = 9 IS PARAMETER MODIFICATION OPTION NO. 9.                    000 2300
                                                                               000 2400
      MODE(15) IS A DEBUG CONTROL FOR COMMON DATA PRINT IN READ                000 2500
      (49-52)  AND WRITE.                                                      000 2600
               = 1, 2 PRINT COMMON DATA IN READ FUNCTION.                      000 2700
               = 2, 3 PRINT COMMON DATA IN WRITE FUNCTION.                     000 2800
               = IDBCOM.                                                       000 2900
                                                                               000 3000
      MODE(16) = IDBPL, IS DEBUG CONTROL FOR PLACE FUNCTION.                   000 3100
      (53-56)                                                                  000 3200
                                                                               000 3300
      MODE(17) = IDBRT, IS DEBUG CONTROL FOR ROUTE FUNCTION.                   000 3400
      (57-60)                                                                  000 3500
                                                                               000 3600
      MODE(18) = IDBART, IS DEBUG CONTROL FOR ARTWORK FUNCTION.                000 3700
      (61-64)                                                                  000 3800
                                                                               000 3900
      MODE(19) = IDBMAN, IS DEBUG CONTROL FOR MANMOD FUNCTION.                 000 4000
      (65-68)                                                                  000 4100
                                                                               000 4200
*******************************************************************************000 4300
                                                                               000 4400
********                                                                       000 4500
      *                                                                        000 4600
     ***                                                                       000 4700
      *                                                                        000 4800
                                                                               000 4900
    FOR NON-TWO BYTE INTEGER MACHINES, PULL ALL                                000 5000
        "IMPLICIT INTEGER *2(I-N)" CARDS IN ALL SUBROUTINES.                   000 5100
                                                                               000 5200
    ARRAY:          FUNCTION  EQUIVALENCE:  FUNCTION        COMMON:            000 5300
        RELATED     USED:                   USED:                              000 5400
        ARRAY:                                                                 000 5500
                                                                               000 5600
    AL(JX)          INPUT     NONE          NA              NO                 000 5700
        NONE                                                                   000 5800
    AL(I)           COMMOD    NONE          NA              NO                 000 5900
        NONE                                                                   000 6000
    AL(I,J)         PLOT1     NONE          NA              NO                 000 6100
        NONE                                                                   000 6200
    BETA(JX)        INPUT     NONE          NA              NO                 000 6300
        NONE                                                                   000 6400
    BL(I)           POPL1     NONE          NA              NO                 000 6500
        NONE                                                                   000 6600
    BL(I)           PLOT1     NONE          NA              NO                 000 6700
        NONE                                                                   000 6800
    CHIP(I)         ALL       NONE          NA              YES                000 6900
        NONE                                                                   000 7000
    CL(I)           POPL1     NONE          NA              NO                 000 7100
        NONE                                                                   000 7200
    DES(I,J)        INPUT     NONE          NA              NO                 000 7300
        JPTN(I,J)   INPUT     NONE          NA              NO                 000 7400
    DL(I)           PLOT1     NONE          NA              NO                 000 7500
        NONE                                                                   000 7600
    ICAP(I)         ALL       NONE          NA              YES                000 7700
        NETOT(I)    PLACE     NONE          NA              NO                 000 7800
        NET(I,J)    INPUT     NONE          NA              NO                 000 7900
```

INFO(I,J)	ALL	NONE	NA	YES	000 8000
IZ(I)	DIST	NONE	NA	NO	000 8100
IP(I)	ALL	NONE	NA	YES	000 8200
JPAR(I)	INIT	NONE	NA	NO	000 8300
IPIN(I,J)	ALL	NONE	NA	YES	000 8400
JPIN(I,J)	INPUT	NONE	NA	NO	000 8500
IZ(I)	DIST	NONE	NA	NO	000 8600
INFO(I,J)	ALL	NONE	NA	YES	000 8700
JART(I,J)	ART	LCS(I)	NONE	YES	000 8800
NONE					000 8900
JP(I,J)	PLACE	LCS(I)	NA	YES	000 9000
MAP/KP	PLACE	LCS	NONE	YES	000 9100
JPAR(I)	INIT	NONE	NA	NO	000 9200
IP(I)	ALL	NONE	NA	YES	000 9300
JPIN(I,J)	INPUT	NONE	NA	NO	000 9400
IPIN(I,J)	ALL	NONE	NA	YES	000 9500
JPTN(I,J)	INPUT	NONE	NA	NO	000 9600
DES(I,J)	INPUT	NONE	NA	NO	000 9700
KEL(I,J)	INPUT	NONE	NA	NO	000 9800
NONE					000 9900
KLASS(I,J)	ROUTE	JART	ALL (LCS)	YES	000 0000
NONE					000 0100
KP(I,J)	PLACE	LCS(I)	NONE	YES	000 0200
JP/MAP	PLACE	LCS	NONE	YES	000 0300
KP(I,J)	ROUTE	JART	ALL (LCS)	YES	000 0400
NONE					000 0500
KXY(I,J)	FIX1	NONE	NA	NO	000 0600
NONE					000 0700
LC(I,J,K)	ROUTE/ART	LCS(I)	NONE	YES	000 0800
LS(I,J,K)	ROUTE/ART	LCS(I)	NONE	YES	000 0900
LCS(I)	NONE	JP/MAP/LNAD/KP	PLACE	YES	000 1000
		JART(I,J)	ART	YES	000 1100
		LC(I,J,K)	ROUTE,ART	YES	000 1200
		LS(I,J,K)	ROUTE,ART	YES	000 1300
NONE					000 1400
LCS1(I)	CONTINUATION OF LCS(I)				000 1500
LL(I)	ALL	NONE	NA	NO	000 1600
NONE					000 1700
LIM(I)	ALL	NONE	NA	YES	000 1800
NONE					000 1900
LNAD(I)	PLACE	LCS(I)	NA	YES	000 2000
NONE					000 2100
LODE(I)	READ	NONE	NA	NO	000 2200
MODE(I)	ALL	NONE	NA	YES	000 2300
LS(I,J,K)	ROUTE/ART	LCS(I)	NONE	YES	000 2400
LC(I,J,K)	ROUTE/ART	LCS(I)	NONE	YES	000 2500
LT(I,J)	PRS1	NONE	NA	NO	000 2600
LC	ROUTE/ART	LCS(I)			000 2700
NET(I,J)	INPUT	NONE	NA	NO	000 2800
ICAP(I)	ALL	NONE	NA	YES	000 2900
NETOT(I)	PLACE	NONE	NA	NO	000 3000
NETOT(I)	PLACE	NONE	NA	NO	000 3100
ICAP(I)	ALL	NONE	NA	YES	000 3200
NET(I,J)	INPUT	NONE	NA	NO	000 3300
NOD(I)	ROUTE	NODE(I)	UP TO ROUTE	YES	000 3400
NODE(I)	PLACE	NOD(I)	ROUTE	YES	000 3500
NODE(I)	ALL UP TO ROUTE	NOD(I)	ROUTE	YES	000 3600
					000 3700
NOD(I)	ROUTE	NODE(I)	PLACE	YES	000 3800
NR(I,J)	ROUTE	NONE	NA	YES	000 3900
NONE					000 4000

```
MAP(I,J,K)      PLACE       LCS(I)          NONE            YES         000 4100
    JP          PLACE       LCS             NONE            YES         000 4200
    KP          PLACE       LCS             NONE            YES         000 4300
MODE(I)         ALL         NONE            NA              YES         000 4400
    LODE(I)     READ        NONE            NA              NO          000 4500
                                                                        000 4600
TAPE USAGE IN PR2D PROGRAM:                                             000 4700
SUBROUTINE:   TAPES:                                                    000 4800
                                                                        000 4900
                N   N   N   N   N   N   N   N   N   N   N               000 5000
                0   0   0   0   0   0   0   0   0   0   0               000 5100
                T   T   T   T   T   T   T   T   T   T   T               000 5200
                0   0   0   0   0   0   0   0   0   0   0               000 5300
                1   1   2   2   3   3   4   4   5   5   6               000 5400
                0   5   0   5   0   5   0   5   0   5   0               000 5500
                                                                        000 5600
EXEC                                                                    000 5700
                                                                        000 5800
INIT                                                                    000 5900
                                                                        000 6000
INPUT                       *1              *1  *2                      000 6100
                                                                        000 6200
READ                                    X                               000 6300
                                                                        000 6400
WRITE                           X                                       000 6500
                                                                        000 6600
COMMOD                                                                  000 6700
                                                                        000 6800
DBCOM                                                                   000 6900
                                                                        000 7000
PLEX1                                                                   000 7100
                                                                        000 7200
RSPL1                                                                   000 7300
                                                                        000 7400
PRPL1                                                                   000 7500
                                                                        000 7600
PLACE                                                                   000 7700
                                                                        000 7800
DIST                                                                    000 7900
                                                                        000 8000
FIX1                                                                    000 8100
                                                                        000 8200
POPL1                                                                   000 8300
                                                                        000 8400
DBPL1                                                                   000 8500
                                                                        000 8600
RTEX1                                                                   000 8700
                                                                        000 8800
RSRT1       X           X                                           X   000 8900
                                                                        000 9000
SMASH1                                                              X   000 9100
                                                                        000 9200
TRANS1                                                                  000 9300
                                                                        000 9400
CL21                                                                    000 9500
                                                                        000 9600
CL51                                                                    000 9700
                                                                        000 9800
PRC1                                                                    000 9900
                                                                        000 0000
RTC1                                                                    000 0100
```

```
                                                                    000 0200
    RTCA1                                                           000 0300
                                                                    000 0400
    RTCB1                                                           000 0500
                                                                    000 0600
    GDCK1                                                           000 0700
                                                                    000 0800
    POC1          X          X                                      000 0900
                                                                    000 1000
    PRS1                     X                                      000 1100
                                                                    000 1200
    RTS1                                                            000 1300
                                                                    000 1400
    RTSA1                                                           000 1500
                                                                    000 1600
    RTSB1                                                           000 1700
                                                                    000 1800
    POS1          X                                                 000 1900
                                                                    000 2000
    ADJ1          X1   X1                                        X2000 2100
                                                                    000 2200
    ADJA1                                                           000 2300
                                                                    000 2400
    ARTEX1                                                          000 2500
                                                                    000 2600
    RSART1             X          X                                 000 2700
                                                                    000 2800
    ANALC1             X                                            000 2900
                                                                    000 3000
    LINEA1                        X                                 000 3100
                                                                    000 3200
    ANALS1             X                                            000 3300
                                                                    000 3400
    LINEB1                        X                                 000 3500
                                                                    000 3600
    PWR1                                                            000 3700
                                                                    000 3800
    LINEC1                        X                                 000 3900
                                                                    000 4000
    SORT1                         X                                 000 4100
                                                                    000 4200
    ART1                                                  X1    *2000 4300
                                                                    000 4400
    BRDR1                                                           000 4500
                                                                    000 4600
    GND1                                                            000 4700
                                                                    000 4800
    STSS1                                                 X1    *2000 4900
                                                                    000 5000
    INST1                                                 X1    *2000 5100
                                                                    000 5200
    PLOT1              X                                            000 5300
                                                                    000 5400
    MANEX1                                                          000 5500
                                                                    000 5600
    * IF REQUIRED.                                                 000 5700
    X TAPE IS USED.                                                 000 5800
                                                                    000 5900
*****************************************************************000 6000
                                                                    000 6100
*********                                                         000 6200
```

```
      *                                                                 000 6300
     ***                                                                000 6400
      *                                                                 000 6500
                                                                        000 6600
      ARRAYS IN COMMON:                                                 000 6700
                                                                        000 6800
      IMPLICIT INTEGER   (I-N)                                          000 6900
      INTEGER  *4  ICARD,  ICORE,  IPRT,  JDATA,  JPDF,  KART           000 7000
                                                                        000 7100
      DIMENSION          CHIP(13),      ICAP(400),      INFO(500,7),    000 7200
     1    IP(1000),      IPIN(200,3),   LCS(12000),     LCS1(12000),    000 7300
     2    LIM(300),      MODE(19),      NODE(4000),     NR(1000,7)      000 7400
                                                                        000 7500
      COMMON      ICARD,  ICORE,  IPRT,  JDATA,  JPDF,  KART            000 7600
      COMMON              CHIP,          ICAP,          INFO,           000 7700
     1    IP,             IPIN,          LCS,           LCS1,           000 7800
     2    LIM,            MODE,          NODE,          NR              000 7900
                                                                        000 8000
      COMMON EQUIVALENCE:                                               000 8100
                                                                        000 8200
      EQUIVALENCE                                                       000 8300
     1    (ISTART,MODE( 1)),  (JST   ,MODE( 2)),  (IEND  ,MODE( 3)),    000 8400
     2    (JEND  ,MODE( 4)),  (ID    ,MODE( 5)),  (ITECH ,MODE( 6)),    000 8500
     3                                            (ITYPE ,MODE( 9)),    000 8600
     4                        (IDBCOM,MODE(15)),  (IDBPL ,MODE(16)),    000 8700
     5    (IDBRT ,MODE(17)),  (IDBART,MODE(18)),  (IDBMAN,MODE(19))     000 8800
      EQUIVALENCE                                                       000 8900
     1    (IBYPL ,LIM(  1)),  (ICAPX ,LIM(  2)),                        000 9000
     2    (IDX   ,LIM(  4)),  (IDY   ,LIM(  5)),  (IERR  ,LIM(  6)),    000 9100
     3    (IGD   ,LIM(  7)),  (IGDCK ,LIM(  8)),  (IGDD  ,LIM(  9)),    000 9200
     4    (IGD1  ,LIM( 10)),  (IGD2  ,LIM( 11)),  (INFOX ,LIM( 12)),    000 9300
     5    (INFOY ,LIM( 13)),  (INFOY1,LIM( 14)),  (INFOY2,LIM( 15)),    000 9400
     6    (INFOY3,LIM( 16)),  (INFOY4,LIM( 17)),  (INFOY5,LIM( 18)),    000 9500
     7    (INFOY6,LIM( 19)),  (INFOY7,LIM( 20)),  (IPAD  ,LIM( 21)),    000 9600
     8    (IPAGE ,LIM( 22)),  (IPINX ,LIM( 23)),  (IPINY ,LIM( 24)),    000 9700
     9    (IPINYC,LIM( 25)),  (IPINYR,LIM( 26)),  (IPINYX,LIM( 27)),    000 9800
     A    (IPINYY,LIM( 28)),                      (IPX   ,LIM( 30)),    000 9900
     B    (IROW  ,LIM( 31)),  (ISW1  ,LIM( 32)),  (ISW2  ,LIM( 33)),    000 0000
     C    (IY    ,LIM( 34)),  (IZX   ,LIM( 35)),  (I0    ,LIM( 36)),    000 0100
     D    (I1    ,LIM( 37)),  (I2    ,LIM( 38)),  (I3    ,LIM( 39)),    000 0200
     E    (I4    ,LIM( 40)),  (I5    ,LIM( 41)),  (I6    ,LIM( 42))     000 0300
      EQUIVALENCE                                                       000 0400
     1    (JA    ,LIM( 49)),  (JARTX ,LIM( 50)),  (JARTY ,LIM( 51)),    000 0500
     2    (JARTY1,LIM( 52)),  (JARTY2,LIM( 53)),  (JARTY3,LIM( 54)),    000 0600
     3    (JARTY4,LIM( 55)),  (JARTY5,LIM( 56)),  (JARTY6,LIM( 57)),    000 0700
     4    (JBAD  ,LIM( 58)),                      (JDEBUG,LIM( 60)),    000 0800
     5    (JEL   ,LIM( 61)),  (JELR  ,LIM( 62)),                       000 0900
     6                        (JL    ,LIM( 65)),  (JN    ,LIM( 66)),    000 1000
     7    (JNGG  ,LIM( 67)),  (JNTG  ,LIM( 68)),  (JO    ,LIM( 69)),    000 1100
     8    (JPX   ,LIM( 70)),  (JPY   ,LIM( 71)),  (JROW  ,LIM( 72)),    000 1200
     9    (JRSP  ,LIM( 73)),  (JSL   ,LIM( 74)),  (JSWC  ,LIM( 75)),    000 1300
     A    (JSWPL ,LIM( 76)),  (JSW1  ,LIM( 77)),  (JSW2  ,LIM( 78)),    000 1400
     B    (JSW3  ,LIM( 79)),  (JSW4  ,LIM( 80)),  (JSW5  ,LIM( 81)),    000 1500
     C    (JTDAMN,LIM( 82)),  (JTDAMO,LIM( 83)),  (JTOT  ,LIM( 84)),    000 1600
     D    (JU    ,LIM( 85)),  (JX    ,LIM( 86)),  (JY    ,LIM( 87))     000 1700
      EQUIVALENCE                                                       000 1800
     1                        (KBAD  ,LIM( 95)),  (KDATA ,LIM( 96)),    000 1900
     2    (KLASSX,LIM( 97)),  (KLASSY,LIM( 98)),  (KNODE ,LIM( 99)),    000 2000
     3    (KNT   ,LIM(100)),  (KODE  ,LIM(101)),  (KODEC ,LIM(102)),    000 2100
     4    (KODEG ,LIM(103)),  (KODEM ,LIM(104)),  (KODET ,LIM(105)),    000 2200
     5    (KODEV ,LIM(106)),  (KOUNT ,LIM(107)),  (KPAD  ,LIM(108)),    000 2300
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6     (KPADN ,LIM(109)),  (KPAD1 ,LIM(110)),  (KPAD2 ,LIM(111)),     000 2400
7     (KPAD3 ,LIM(112)),  (KPMX  ,LIM(113)),  (KPMY  ,LIM(114)),     000 2500
8     (KPX   ,LIM(115)),  (KPX1  ,LIM(116)),  (KPY   ,LIM(117)),     000 2600
9     (KROW  ,LIM(118)),  (KSXE  ,LIM(119)),  (KSXL  ,LIM(120))      000 2700
 EQUIVALENCE                                                         000 2800
1     (KSXR  ,LIM(121)),  (KSXT  ,LIM(122)),  (KSX0  ,LIM(123)),     000 2900
2     (KSYB  ,LIM(124)),  (KSYT  ,LIM(125)),  (KTOT  ,LIM(126)),     000 3000
3     (KXLL  ,LIM(127)),  (KXLR  ,LIM(128)),  (KXUL  ,LIM(129)),     000 3100
4     (KXUR  ,LIM(130)),  (KXZ   ,LIM(131)),  (KX1   ,LIM(132)),     000 3200
5     (KX2   ,LIM(133)),  (KX3   ,LIM(134)),  (KYE   ,LIM(135)),     000 3300
6     (KYR   ,LIM(136)),  (KYT   ,LIM(137)),  (KY0   ,LIM(138)),     000 3400
7     (KY1   ,LIM(139)),  (KY2   ,LIM(140)),  (KY3   ,LIM(141)),     000 3500
8     (K50   ,LIM(142)),  (K100  ,LIM(143)),  (K150  ,LIM(144)),     000 3600
9     (K200  ,LIM(145))                                              000 3700
 EQUIVALENCE                                                         000 3800
1     (LCSX  ,LIM(154)),  (LCXC  ,LIM(155)),  (LCXM  ,LIM(156)),     000 3900
2     (LCXRL ,LIM(157)),  (LCXRR ,LIM(158)),  (LCXTL ,LIM(159)),     000 4000
3     (LCXTR ,LIM(160)),  (LCYC  ,LIM(161)),  (LCYM  ,LIM(162)),     000 4100
4     (LCYEB ,LIM(163)),  (LCYET ,LIM(164)),  (LCYRB ,LIM(165)),     000 4200
5     (LCYRT ,LIM(166)),  (LCYTB ,LIM(167)),  (LCYTT ,LIM(168)),     000 4300
6     (LCY0B ,LIM(169)),  (LCY0T ,LIM(170)),  (LE    ,LIM(171)),     000 4400
7     (LEFT  ,LIM(172)),  (LIMINT,LIM(173)),  (LIMX  ,LIM(174)),     000 4500
8     (LINE  ,LIM(175)),  (LIN1  ,LIM(176)),  (LIN3  ,LIM(177)),     000 4600
9     (LLE   ,LIM(178)),  (LNADX ,LIM(179)),  (LROW  ,LIM(180)),     000 4700
A     (LSW1  ,LIM(181)),  (LSW2  ,LIM(182)),  (LSW3  ,LIM(183))      000 4800
 EQUIVALENCE                                                         000 4900
1     (LSW4  ,LIM(184)),  (LSW5  ,LIM(185)),  (LSXC  ,LIM(186)),     000 5000
2     (LSXEL ,LIM(187)),  (LSXER ,LIM(188)),  (LSXLL ,LIM(189)),     000 5100
3     (LSXLR ,LIM(190)),  (LSXM  ,LIM(191)),  (LSXRL ,LIM(192)),     000 5200
4     (LSXRR ,LIM(193)),  (LSXTL ,LIM(194)),  (LSXTR ,LIM(195)),     000 5300
5     (LSX0L ,LIM(196)),  (LSX0R ,LIM(197)),  (LSYB  ,LIM(198)),     000 5400
6     (LSYC  ,LIM(199)),  (LSYM  ,LIM(200)),  (LSYT  ,LIM(201)),     000 5500
7     (LVL   ,LIM(202)),  (LX    ,LIM(203)),  (LXA   ,LIM(204)),     000 5600
8     (LXSN  ,LIM(205)),  (LX1   ,LIM(206)),  (LX2   ,LIM(207)),     000 5700
9     (LX3   ,LIM(208)),  (LX4   ,LIM(209)),  (LY    ,LIM(210)),     000 5800
A     (LYA   ,LIM(211)),  (LYSN  ,LIM(212)),  (LY1   ,LIM(213)),     000 5900
B     (LY2   ,LIM(214)),  (LY3   ,LIM(215)),  (LY4   ,LIM(216))      000 6000
 EQUIVALENCE               (LLX   ,LIM(218)),  (LLX2  ,LIM(219))      000 6100
 EQUIVALENCE                                                         000 6200
1     (MAPX  ,LIM(223)),  (MAPY  ,LIM(224)),  (MAPZ  ,LIM(225)),     000 6300
2     (MAX   ,LIM(226)),  (MAXX  ,LIM(227)),  (MAXX1 ,LIM(228)),     000 6400
3     (MAXY  ,LIM(229)),  (MAXY1 ,LIM(230)),  (MIDX  ,LIM(231)),     000 6500
4     (MIDY  ,LIM(232)),  (MIN   ,LIM(233)),  (MINX  ,LIM(234)),     000 6600
5     (MINX1 ,LIM(235)),  (MINY  ,LIM(236)),  (MINY1 ,LIM(237)),     000 6700
6     (MODEX ,LIM(238)),  (MPAD  ,LIM(239)),  (MROW  ,LIM(240)),     000 6800
7     (MXEL  ,LIM(241)),  (MXEL1 ,LIM(242)),  (MX1   ,LIM(243)),     000 6900
8     (MZA   ,LIM(244)),  (MZB   ,LIM(245)),  (M1    ,LIM(246))      000 7000
 EQUIVALENCE                                                         000 7100
1     (NDXART,LIM(253)),  (NDX1  ,LIM(254)),  (NDX2  ,LIM(255)),     000 7200
2     (NDX3  ,LIM(256)),  (NDX4  ,LIM(257)),  (NEND  ,LIM(258)),     000 7300
3     (NETOTX,LIM(259)),  (NEW   ,LIM(260)),  (NMIX  ,LIM(261)),     000 7400
4     (NNODE ,LIM(262)),  (NNODE1,LIM(263)),  (NOINT ,LIM(264)),     000 7500
5     (NODEX ,LIM(265)),  (NODEX1,LIM(266)),  (NODEX2,LIM(267)),     000 7600
6     (NODX  ,LIM(268)),  (NPAD  ,LIM(269)),  (NPT   ,LIM(270)),     000 7700
7     (NROW  ,LIM(271)),  (NRX   ,LIM(272)),  (NRXM  ,LIM(273)),     000 7800
8     (NRY   ,LIM(274)),  (NRYM  ,LIM(275)),  (NRY1  ,LIM(276)),     000 7900
9     (NRY2  ,LIM(277)),  (NRY3  ,LIM(278)),  (NRY4  ,LIM(279))      000 8000
 EQUIVALENCE                                                         000 8100
1     (NRY5  ,LIM(280)),  (NRY6  ,LIM(281)),  (NRY7  ,LIM(282)),     000 8200
2     (NS    ,LIM(283)),  (NSB   ,LIM(284)),  (NSHX  ,LIM(285)),     000 8300
3     (NSHY  ,LIM(286)),  (NSL   ,LIM(287)),  (NSTART,LIM(288)),     000 8400
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     4    (NSU    ,LIM(289)),  (NX     ,LIM(290)),  (NXL    ,LIM(291)),     000 8500
     5    (NXU    ,LIM(292)),  (NXX    ,LIM(293)),  (NX1    ,LIM(294)),     000 8600
     6    (NYB    ,LIM(295)),  (NYT    ,LIM(296)),  (N1     ,LIM(297))      000 8700
C                                                                            000 8800
C*****************************************************************************000 8900
C                                                                            000 9000
C**********                                                                  000 9100
C         *                                                                  000 9200
C        ***                                                                 000 9300
C         *                                                                  000 9400
C                                                                            000 9500
C     CALL INIT SUBROUTINE TO READ MODE DATA, CLEAR COMMON AND               000 9600
C     INITIALIZE PROGRAM CONSTANTS AND PARAMETERS.                           000 9700
C                                                                            000 9800
      CALL INIT                                                              000 9900
      GO TO (100,1000,1000,1000,1000,9000), ISTART                           000 0000
C                                                                            000 0100
C*****************************************************************************000 0200
C                                                                            000 0300
C     CALL INPUT FUNCTION TO READ IN DESIGN DATA AND PIN DATA.               000 0400
C                                                                            000 0500
C**********                                                                  000 0600
C         *                                                                  000 0700
C        ***                                                                 000 0800
C         *                                                                  000 0900
C                                                                            000 1000
  100 CALL INPUT                                                             000 1100
      GO TO (2000,200,200,200,9000), IEND                                    000 1200
C                                                                            000 1300
C*****************************************************************************000 1400
                                                                             000 1500
**********                                                                   000 1600
         *                                                                   000 1700
        ***                                                                  000 1800
         *                                                                   000 1900
                                                                             000 2000
      CALL PLACE FUNCTION TO GENERATE A TWO DIMENSIONAL PLACEMENT.           000 2100
                                                                             000 2200
  200 IF(ITYPE.EQ.1) CALL PLEX1                                              000 2300
      GO TO (9000,2000,300,300,9000), IEND                                   000 2400
                                                                             000 2500
*****************************************************************************000 2600
                                                                             000 2700
      CALL ROUTE TO GENERATE A TWO DIMENSIONAL ROUTING                       000 2800
      OF NODES ON THE CHIP.                                                  000 2900
C                                                                            000 3000
C**********                                                                  000 3100
C         *                                                                  000 3200
C        ***                                                                 000 3300
C         *                                                                  000 3400
C                                                                            000 3500
  300 IF(ITYPE.EQ.1) CALL RTEX1                                              000 3600
      GO TO (9000,9000,2000,400,9000), IEND                                  000 3700
C                                                                            000 3800
*****************************************************************************000 3900
                                                                             000 4000
      CALL ART TO WRITE ARTWORK INSTRUCTIONS TO THE OUTPUT TAPE.             000 4100
                                                                             000 4200
**********                                                                   000 4300
         *                                                                   000 4400
        ***                                                                  000 4500
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C       *                                                                    000 4600
C                                                                            000 4700
  400 IF(ITYPE.EQ.1) CALL ARTEX1                                             000 4800
      GO TO (9000,9000,9000,2000,9000), IEND                                 000 4900
C                                                                            000 5000
C*****************************************************************************000 5100
C                                                                            000 5200
C     CALL READ TO RECOVER COMMON DATA STORED ON MAGNETIC TAPE. THEN         000 5300
C     GO TO PROPER RESTART FUNCTION.                                         000 5400
C                                                                            000 5500
C*********                                                                   000 5600
C       *                                                                    000 5700
C      ***                                                                   000 5800
C       *                                                                    000 5900
C                                                                            000 6000
 1000 CALL READ                                                              000 6100
      GO TO (9000,200,300,400,3000,10000), ISTART                            000 6200
C                                                                            000 6300
C*****************************************************************************000 6400
C                                                                            000 6500
C     CALL WRITE TO STORE COMMON DATA ON MAGNETIC TAPE.                      000 6600
C                                                                            000 6700
C*********                                                                   000 6800
C       *                                                                    000 6900
C      ***                                                                   000 7000
C       *                                                                    000 7100
C                                                                            000 7200
 2000 CALL WRITE                                                             000 7300
      GO TO 10000                                                            000 7400
C                                                                            000 7500
C*****************************************************************************000 7600
C                                                                            000 7700
C     CALL MANMOD FOR MAKING MANUAL CHANGES TO THE ARTWORK INSTRUCTIONS.     000 7800
C                                                                            000 7900
C*********                                                                   000 8000
C       *                                                                    000 8100
C      ***                                                                   000 8200
C       *                                                                    000 8300
C                                                                            000 8400
 3000 CALL MANEX1                                                            000 8500
      GO TO 2000                                                             000 8600
C                                                                            000 8700
C*****************************************************************************000 8800
C                                                                            000 8900
C     CALL DBCOM TO PRINT OUT COMMON DATA.                                   000 9000
C                                                                            000 9100
C*********                                                                   000 9200
C       *                                                                    000 9300
C      ***                                                                   000 9400
C       *                                                                    000 9500
C                                                                            000 9600
 9000 CALL DBCOM                                                             000 9700
C                                                                            000 9800
C*****************************************************************************000 9900
C                                                                            000 0000
10000 STOP                                                                   000 0100
      END                                                                    000 0200
CSTARTC INIT          VER001 050674     1A                                   000-0100
      SUBROUTINE INIT                                                        000 0200
C                                                                            000 0300
C*****************************************************************************000 0400
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C                                                                       000 0500
C     THE PURPOSE OF THIS FUNCTION   IS TO READ & VALIDATE THE MODE     000 0600
C     PARAMETERS, CLEAR COMMON AND PRESET PROGRAM CONSTANTS AND         000 0700
C     PARAMETERS.                                                       000 0800
C                                                                       000 0900
C***********************************************************************000 1000
C                                                                       000 1100
C     CHIP(IX):                                                         000 1200
C                                                                       000 1300
C          THIS ARRAY IS USED TO STORE CHIP DESCRIPTION DATA.            000 1400
C                                                                       000 1500
C     ICAP(IX):                                                         000 1600
C                                                                       000 1700
C          THIS ARRAY IS USED TO STORE THE NODE CAPACITANCE OF NODE IX.  000 1800
C                                                                       000 1900
C     INFO(IX,IY):                                                      000 2000
C                                                                       000 2100
C          IX IS THE ELEMENT NUMBER ASSIGNED TO A DEVICE.               000 2200
C                                                                       000 2300
C          IY IS USED TO STORE DATA ASSOCIATED WITH ELEMENT IX.         000 2400
C               INFOY1 (=1) IS X-INDEX ON PLACEMENT SURFACE.            000 2500
C               INFOY2 (=2) IS Y-INDEX ON PLACEMENT SURFACE.            000 2600
C               INFOY3 (=3) IN INPUT/PRPL1  USED TO STORE USER          000 2700
C                           SPECIFICATION OF POSITION OF FIXED ELEMENT  000 2800
C                           IN FIXED ROW.                               000 2900
C                           IN PLACE, IS ADDRESS (INDEX) IN LNAD(I)     000 3000
C                           OF LOWER LIMIT OF LIST OF ADDRESSES IN      000 3100
C                           NODE(I) OF THOSE NODES WHICH CONTAIN        000 3200
C                           ELEMENT IX.                                 000 3300
C                           IN ROUTE, IS X-COORD. OF ELEMENT IX.        000 3400
C               INFOY4 (=4) IN PLACE, IS UPPER LIMIT OF ADDRESSES IN    000 3500
C                           LNAD(I).                                    000 3600
C                           IN ROUTE, IS Y-COORD. OF ELEMENT IX.        000 3700
C               INFOY5 (=5) IN PLACE, IS BAD HISTORY COUNTER AND        000 3800
C                           TEMPORARY STORAGE OF CELL WIDTH.            000 3900
C                           IN ROUTE, IS B.P. POSITION #, BY ROW TO     000 4000
C                           LOCATE B.P. IN PROPER POSITION.             000 4100
C               INFOY6 (=6) IS USED TO STORE ROW NUMBER AND PATTERN     000 4200
C                           ORIENTATION.                                000 4300
C                           IN INPUT/PRPL1 USED TO STORE USER           000 4400
C                           SPECIFICATION OF ROW NUMBER OF ELEMENT      000 4500
C                           FIXED IN ROW AND/OR POSITION.               000 4600
C               INFOY7 (=7) IS USED TO STORE ADDRESS OF START OF PIN    000 4700
C                           DATA FOR PATTERN ASSIGNED TO ELEMENT IX.    000 4800
C                                                                       000 4900
C     IP(IX) IS USED TO STORE PARAMETERS USED IN THIS PROGRAM:          000 5000
C        NOTE: ALL MIL VALUES ARE IN 10THS OF MILS,10 = 1.0 MILS.       000 5100
C              EXCEPT FOR LINEAR WIDTH BREAK POINTS WHICH ARE IN MILS.  000 5200
C                                                                       000 5300
C          I0 IS THE STARTING INDEX FOR CONTROL PARAMETERS.             000 5400
C                                                                       000 5500
C               IP(I0   ) IS NUMBER OF I0 DATA.                         000 5600
C               IP(I0+ 1) IS NUMBER OF LINES PER PAGE PRINT CONTROL.    000 5700
C               IP(I0+ 2) IS MAXIMUN NUMBER OF BONDING PADS ON CHIP.    000 5800
C               IP(I0+ 3) IS THE LINEAR WIDTH BREAK POINT FOR  3 ROWS.  000 5900
C               IP(I0+ 4) IS THE LINEAR WIDTH BREAK POINT FOR  4 ROWS.  000 6000
C               IP(I0+ 5) IS THE LINEAR WIDTH BREAK POINT FOR  5 ROWS.  000 6100
C               IP(I0+ 6) IS THE LINEAR WIDTH BREAK POINT FOR  6 ROWS.  000 6200
C               IP(I0+ 7) IS THE LINEAR WIDTH BREAK POINT FOR  7 ROWS.  000 6300
C               IP(I0+ 8) IS THE LINEAR WIDTH BREAK POINT FOR  8 ROWS.  000 6400
C               IP(I0+ 9) IS THE LINEAR WIDTH BREAK POINT FOR  9 ROWS.  000 6500
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C          IP(I0+10) IS THE LINEAR WIDTH BREAK POINT FOR 10 ROWS.    000 6600
C          IP(I0+11) IS THE LINEAR WIDTH BREAK POINT FOR 11 ROWS.    000 6700
C          IP(I0+12) IS THE LINEAR WIDTH BREAK POINT FOR 12 ROWS.    000 6800
C          IP(I0+13) IS SWITCH FOR END-AROUND WIRE SPACING           000 6900
C                    = 1, SPACED AT K100; = 2, SPACED AT K200.       000 7000
C          IP(I0+14) IS TECHNOLOGY DEPENDENT SWITCH FOR GROUND       000 7100
C                    TO CELL ROWS.                                   000 7200
C                    = 1, GROUND BOTH SIDES VIA SHAPE SET.           000 7300
C                    = 2, GROUND BOTH SIDES VIA METAL.               000 7400
C                    = 3, GROUND LEFT SIDE VIA METAL.                000 7500
C                    = 4, SAME AS 3 PLUS VDD ON RIGHT SIDE.          000 7600
C          IP(I0+15) IS THE MAXIMUM LINEAR WIDTH OF ALL CELLS        000 7700
C                    FOR USING THIS PROGRAM.                         000 7800
C          IP(I0+16) IS DESIGN DATA INPUT TAPE DSREF #, NOT030.      000 7900
C                    IF DESIGN DATA ON CARD SET = 5.                 000 8000
C          IP(I0+17) IS COMMON DATA OUTPUT TAPE DSREF #, NOT035.     000 8100
C          IP(I0+18) IS COMMON DATA INPUT TAPE DSREF #, NOT040.      000 8200
C          IP(I0+19) IS PIN DATA FILE INPUT TAPE DSREF #, NOT045.    000 8300
C          IP(I0+20) IS PIN DATA FILE OUTPUT TAPE DSREF #, NOT050.   000 8400
C          IP(I0+21) IS WORK TAPE # 1 DSREF #, NOT010.               000 8500
C          IP(I0+22) IS WORK TAPE # 2 DSREF #, NOT015.               000 8600
C          IP(I0+23) IS WORK TAPE # 3 DSREF #, NOT020.               000 8700
C          IP(I0+24) IS WORK TAPE # 4 DSREF #, NOT025.               000 8800
C          IP(I0+25) IS ARTWORK INST. OUTPUT TAPE # 1 DSREF NOT055.  000 8900
C          IP(I0+26) IS ARTWORK INST. OUTPUT TAPE # 2 DSREF NOT060.  000 9000
C          IP(I0+27) IS FIX1 CONTROL.                                000 9100
C                    = 0, FIX B.P. AND ROWS IN ONE PASS              000 9200
C                    = 1, FIX B.P. ON FIRST PASS, FIX ROWS ON        000 9300
C                         SECOND PASS.                               000 9400
C          IP(I0+28) IS BYPASS CONTROL FOR CONVERTING CENTER         000 9500
C                    TRANSITION TUNNELS, WITH METAL ON BOTH ENDS     000 9600
C                    OF TUNNEL, TO METAL.                            000 9700
C                    IF < 0 AND IP(I4+99) > 0, DO NOT CONVERT AND    000 9800
C                         ROUTE VDD ON CELL ROW.                     000 9900
C                    IF = 0, CONVERT & NO VDD BETWEEN ROWS.          000 0000
C                    IF > 0, NOT CONVERT & PUT VDD BETWEEN ROWS.     000 0100
C          IP(I0+29) IF NUMBER OF LEVELS OF ARTWORK.                 000 0200
C          IP(I0+30) IS BYPASS CONTROL TO FORCE ROWS TO BE           000 0300
C                    EVEN IN FIX1.                                   000 0400
C                    = 0, IF NECESSARY, FORCE ELEM FROM LONG ROW     000 0500
C                         INTO SHORT ROW.                            000 0600
C                    = 1, MOVE ELEM FROM LONG ROW INTO OPEN SLOT     000 0700
C                         OF SHORT ROW.                              000 0800
C                    = 2, BYPASS EQUALIZING ROWS.                    000 0900
C          IP(I0+31) IS TECHNOLOGY DEPENDENT SWITCH FOR GENERATING   000 1000
C                    SECOND LEVEL TUNNELS.                           000 1100
C                    = 0, NO SECOND LEVEL; > 0, GENERATE TUNNELS     000 1200
C                    ON LEVEL IP(I0+31).                             000 1300
C          IP(I0+32) IS TECHNOLOGY DEPENDENT CONTROL FOR SPECIFYING  000 1400
C                    METAL LEVEL.                                    000 1500
C          IP(I0+33) IS TECHNOLOGY DEPENDENT CONTROL FOR SPECIFYING  000 1600
C                    PRIMARY TUNNEL LEVEL.                           000 1700
C          IP(I0+34) IS TECHNOLOGY DEPENDENT BORDER TYPE:            000 1800
C                    = 1, BULK C-MOS BONDED WIRE.                    000 1900
C                    = 2, BULK C-MOS BEAM LEAD.                      000 2000
C                    = 3, POLY BONDED WIRE.                          000 2100
C                    = 4, POLY BEAM LEAD.                            000 2200
C                    = 5, SOS BONDED WIRE.                           000 2300
C                    = 6, SOS BEAM LEAD.                             000 2400
C          IP(I0+35) IS BYPASS CONTROL IN ADJUST TO PREVENT          000 2500
C                    FORCING CHIP TO BE BALANCED.                    000 2600
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            = 0, BALANCE CHIP IN X.                                    000 2700
            = 1, BYPASS ADJA1                                          000 2800
IP(I0+36)  IS BYPASS CONTROL FOR ALTERNATE INPUT PATTERN               000 2900
            OF B.P. ON SIDE OF CHIP                                    000 3000
            = 0, SUBSTITUTE ALTERNATE PATTERN                          000 3100
            = 1, USE SAME PATTERN                                      000 3200
IP(I0+37)  IS POLY TECHNOLOGY FOR LEVEL 10 GUARD.                      000 3300
            = 0, NO SECOND TUNNEL OR SHAPE SET.                        000 3400
            = 1, GENERATE SECONDARY LEVEL OF TUNNELS.                  000 3500
            = 2, GENERATE SHAPE SET FOR NON-CELL AREA.                 000 3600
IP(I0+38)  IS TOP ROW (IF ODD #) GROUND FROM SIDE BYPASS.              000 3700
            = 0, GND ON TOP, BYPASS SIDE GROUND.                       000 3800
            = 1, NOT ON TOP, GENERATE ON SIDES VIA                     000 3900
                 IP(I0+14) PARAMETER.                                  000 4000
IP(I0+39)  IS CONTROL TO FORCE B.P. TO BE RELOCATED ON                 000 4100
            BONDING PAD ROWS, SO THAT ROUTED WIRE WILL                 000 4200
            MAKE POSITIVE CONTACT WITH B.P. PIN.                       000 4300
            = 0, DO NOT MOVE B.P.                                      000 4400
            > 0, ADJUST POSITION OF B.P. (NOT MORE THAN                000 4500
            IP(I0+39) UNITS.                                           000 4600
IP(I0+40)  IS T.E. AT ZERO ROUTING CHANNEL CONTROL.                    000 4700
            = 0, NO T.E. IN ZERO CHANNEL.                              000 4800
            = 1, T.E. FOR CELLS ONLY.                                  000 4900
            = 2, T.E. FOR CELLS & BONDING PADS.                        000 5000
IP(I0+41)  IS ZERO CHANNEL ROUTING CONTROL.                            000 5100
            = 0, NO ZERO CHANNEL ROUTING.                              000 5200
            = 1, ROUTE CLASS 1 AT ZERO CHANNEL.                        000 5300
            = 2, ROUTE CLASS 1 & 2 AT ZERO CHANNEL.                    000 5400
            = 3, ROUTE CLASS 2 AT ZERO CHANNEL.                        000 5500
IP(I0+42)  > 0, IS PAUSE STATEMENT BYPASS.                             000 5600
IP(I0+43)  IS THE LINEAR WIDTH BREAK POINT FOR 13 ROWS.                000 5700
IP(I0+44)  IS THE LINEAR WIDTH BREAK POINT FOR 14 ROWS.                000 5800
IP(I0+45)  IS THE LINEAR WIDTH BREAK POINT FOR 15 ROWS.                000 5900
IP(I0+46)  IS THE LINEAR WIDTH BREAK POINT FOR 16 ROWS.                000 6000
IP(I0+47)  IS THE LINEAR WIDTH BREAK POINT FOR 17 ROWS.                000 6100
IP(I0+48)  IS THE LINEAR WIDTH BREAK POINT FOR 18 ROWS.                000 6200
IP(I0+49)  IS THE LINEAR WIDTH BREAK POINT FOR 19 ROWS.                000 6300
IP(I0+50)  IS THE LINEAR WIDTH BREAK POINT FOR 20 ROWS.                000 6400
IP(I0+51)  IS PLACE SURFACE OPTION CONTROL.                            000 6500
            = 0, C-MOS/SI-GATE OPTION: CXXXCXCXXXC...                  000 6600
            = 1, SOS OPTION: CXXCCXXCCXXCC...                          000 6700
IP(I0+52)  > 0 TEST CELL PIN-TO-PIN MULTIPLE OF K200.                  000 6800
IP(I0+53)  > 0, INTERCHANGE GND/VDD DATA. IF IP(I0+54)                 000 6900
                 > 1, SET IP(I0+53)=1, IF < 2, SET = 0.                000 7000
IP(I0+54)  IS GND/VDD LOCATION CONTROL.                                000 7100
            = 0, GND BELOW CENTER - VDD ABOVE.                         000 7200
            = 1, GND ABOVE CENTER - VDD BELOW.                         000 7300
            = 2, PADS IN CORNNERS. VDD BOTTOM-LEFT, GND                000 7400
                 TOP-RIGHT.                                            000 7500
            = 3, PADS IN CORNNERS. VDD TOP-LEFT, GND                   000 7600
                 BOTTOM-RIGHT.                                         000 7700
IP(I0+55)  > 0, ROUTE SHORTEST CLASS 1 NODES FIRST.                    000 7800
IP(I0+56)  > 0, ROUTE CLASS 2 ON ZERO CHANNEL IF IT IS                 000 7900
                 THE END PIN. BYPASS IF IP(I0+41) > 1.                 000 8000
IP(I0+57)  > 0, BYPASS REROUTE OF LOW-PROFILE METAL.                   000 8100
            BYPASS IF IP(I4+99) = 0.                                   000 8200
IP(I0+58)  > 0, ROUTE SHORTEST CLASS 5 FIRST.                          000 8300
            = 1  B.P. ROWS ONLY                                        000 8400
            = 2  ALL ROWS.                                             000 8500
IP(I0+59)  > 0  IS ODD CELL ROW TO TOP B.P. MODIFIED                   000 8600
            ROUTE (CLASS 2 INSTEAD OF CLASS 3) BYPASS.                 000 8700
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                = 0, EXERCISE                                          000 8800
      IP(I0+60) IS SPECIAL ROUTE FOR CLASS 3 WHERE ROUTE IS            000 8900
                BACK-TO-BACK ROW PLUS B.P. THE OPTION, > 0,            000 9000
                WILL SMASH NODE INTO CLASS 2 + CLASS 6.                000 9100
                > 0, EXERCISE OPTION, WHERE IP(I0+60) IS THE           000 9200
                     NUMBER OF THESE PER SIDE ON ROW PAIR.             000 9300
                = 0, BYPASS.                                           000 9400
      IP(I0+61) > 0, CALCULATE CROSSOVERS FOR EACH NODE.               000 9500
                FOR GROUND VIA TUNNEL, = # EQUIV. CROSSOVERS.          000 9600
      IP(I0+62) IS ALTERNATE LOCATION OF POWER TO B.P.                 000 9700
                SEE IP(I2+19).                                         000 9800
      IP(I0+63) > 0, PRINT UNUSED PIN LIST IN INPUT.                   000 9900
      IP(I0+64) = 0, BYPASS PIN-TO-TAP IN CENTER ROUTING IF            000 0000
                TAP POINT NOT WITHIN ROW LIMITS.                       000 0100
                > 0, BYPASS THIS OPTION.                               000 0200
      IP(I0+65) IS SIDE BONDING PAD ROUTING CONTROL.                   000 0300
                = 0, BYPASS THIS FEATURE.                              000 0400
                = 1, PREVENT ROUTE FROM SIDE B.P. TO BE WITHIN         000 0500
                     PREVEOUSLY ROUTED ROW-TO-ROW ROUTING.             000 0600
                = 2, SAME AS 1 + DISABLE PIN-TO-TAP ROUTE OF           000 0700
                     SIDE B.P.                                         000 0800
                IF > 0, RESET IP(I4+96) = 0.                           000 0900
      IP(I0+66) > 0, LIMIT LOW PROFILE METAL TO START/END IN           000 1000
                     VERTICAL CHANNEL WHICH DOES NOT CONTAIN           000 1100
                     A TUNNEL.                                         000 1200
      IP(I0+67) RE-ROUTE MULTIPLE PINS ON SAME CELL ROW                000 1300
                TO LOWER HORIZONTAL CHANNEL CONTROL.                   000 1400
                = 0, EXECUTE; > 0, BYPASS.                             000 1500
      IP(I0+68) > 0, BYPASS PRINT OF OUTPUT DATA.                      000 1600
      IP(I0+69) = 0, FORCE, IF POSSIBLE, ODD CELL ROW TO               000 1700
                     TOP B.P. (VIA CLASS 2, SEE IP(I0+59))             000 1800
                     TO BE ALL METAL AT CELL ROW.                      000 1900
                     IF IP(I0+59) > 0, RESET IP(I0+69) = 1.            000 2000
      IP(I0+70) IS ROW 3/NROW B.P. ROUTING CONTROL.                    000 2100
                = 0, FORCE ROUTE TO B.P. ORDER AND ROUTE               000 2200
                     SINGLE STEP NOT TO CROSS EACH OTHER.              000 2300
                     DOUBLE STEP IS NORMAL ROUTE.                      000 2400
                IF IP(I4+99) = 0, FORCE IP(I0+70) = 1.                 000 2500
                > 0, BYPASS                                            000 2600
      IP(I0+71) IS CONTROL TO OVERRIDE CERTAIN USER OPTIONS,           000 2700
                SEE INPUT SUBROUTINE.                                  000 2800
                = 0, EXERCISE.                                         000 2900
                > 0, BYPASS THIS CONTROL.                              000 3000
      IP(I0+72) IS EXTERNAL SORT CONTROL.                              000 3100
                = 0, BYPASS.                                           000 3200
                > 0, EXECUTE EXTERNAL SORT OF OUTPUT DATA.             000 3300
                     SEE SORT1 AND ART FUNCTION.                       000 3400
                                                                       000 3500
I1 IS THE STARTING INDEX FOR PLACEMENT PARAMETERS.                     000 3600
                                                                       000 3700
      IP(I1   ) IS NUMBER OF I1 DATA.                                  000 3800
      IP(I1+ 1) IS JRSP SWITCH INITIAL VALUE.                          000 3900
      IP(I1+ 2) IS JSL SWITCH INITIAL VALUE.                           000 4000
      IP(I1+ 3) IS JBAD LIMIT.                                         000 4100
      IP(I1+ 4) IS LIMINT VALUE.                                       000 4200
      IP(I1+ 5) IS LE INITIAL VALUE.                                   000 4300
      IP(I1+ 6) IS FACTOR USED TO DETERMINE LE IF IP(I1+5) ≠ 0         000 4400
      IP(I1+ 7) IS LOWER LIMIT OF LE WHEN IP(I1+5) = 0.                000 4500
      IP(I1+ 8) IS LX SCALING FACTOR.                                  000 4600
      IP(I1+ 9) IS LY SCALING FACTOR.                                  000 4700
      IP(I1+10) IS NMIX VALUE.                                         000 4800
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      IP(I1+11) IS JSWC SWITCH VALUE.                                  000 4900
      IP(I1+12) IS LE INCREMENT VALUE.                                 000 5000
      IP(I1+13) IS LE DECREMENT VALUE.                                 000 5100
      IP(I1+14) IS PLACEMENT PRINT CONTROL.                            000 5200
      IP(I1+15) IS THE BAD HISTORY INCREMENT VALUE                     000 5300
      IP(I1+16) IS THE BAD HISTORY DECREMENT VALUE                     000 5400
      IP(I1+17) IS THE DUMMY NODE (FOR SUBDIVIDED CELLS)               000 5500
                WEIGHTING FACTOR.                                      000 5600
      IP(I1+18) IS NODE WEIGHTING FACTOR FOR INPUT B.P.                000 5700
      IP(I1+19) IS NODE WEIGHTING FACTOR FOR OUTPUT B.P.               000 5800
      IP(I1+20) IS FACTOR USED IN DETERMINING UNIT AREA.               000 5900
      IP(I1+21) IS PRESET UNIT AREA.                                   000 6000
      IP(I1+22) IS USED TO ADJUST ROUNDOFF FACTOR FOR                  000 6100
                SUBDIVISION OF LONG CELLS.                             000 6200
      IP(I1+23) IS PRESET ROUNDOFF FOR CELL SUBDIVISION.               000 6300
      IP(I1+24) IS NUMBER OF UNIT AREAS BETWEEN FACING ROWS.           000 6400
                MUST BE > 1                                            000 6500
      IP(I1+25) IS NUMBER OF UNIT AREAS BACK-TO-BACK ROWS.             000 6600
      IP(I1+26) IS NUMBER OF UNIT AREAS ON LEFT SIDE OF ALL            000 6700
                BACK-TO-BACK ROWS.                                     000 6800
      IP(I1+27) IS NUMBER OF UNIT AREAS ON RIGHT SIDE OF ALL           000 6900
                BACK-TO-BACK ROWS.                                     000 7000
      IP(I1+28) IS NUMBER OF SLOTS RESEARVED FOR PHOTO KEY ON          000 7100
                BOTTOM/TOP B.P. ROWS.                                  000 7200
      IP(I1+29) IS NUMBER OF SLOTS RESEARVED FOR TEST TRAN-            000 7300
                ISTERS ON SIDE B.P. ROWS.                              000 7400
      IP(I1+30) IS DEFAULT AVERAGE CELL WIDTH.                         000 7500
      IP(I1+31) IS JNTG LIMIT CONTROL. JNTG MUST BE GREATER            000 7600
                THAN IP(I1+31) TO ALLOW NEW TRY AT PLACEMENT.          000 7700
      IP(I1+32) IS BYPASS CONTROL ON INTERCHANGE OF ELEMENTS           000 7800
                ON EQUALITY IN PLACE.                                  000 7900
                = 0  EXECUTE INTERCHANGE ON EQUALITY.                  000 8000
                = 1  BYPASS INTERCHANGE ON EQUALITY.                   000 8100
      IP(I1+33) IS ODD CELL ROW EXTRA UNIT AREAS.                      000 8200
                                                                       000 8300
I2 IS THE STARTING INDEX FOR ROUTING PARAMETERS.                       000 8400
                                                                       000 8500
      IP(I2   ) IS NUMBER OF I2 DATA.                                  000 8600
      IP(I2+ 1) IS THE METAL-TO-METAL CHANNEL SPACING ON               000 8700
                THE ROUTING SURFACE.                                   000 8800
      IP(I2+ 2) IS THE PIN-TO-PIN SPACING ON ROUTING                   000 8900
                SURFACE.                                               000 9000
      IP(I2+ 3) IS BONDING PAD TO BONDING PAD SPACING.                 000 9100
      IP(I2+ 4) IS DISTANCE FROM CHIP CENTER TO START OF               000 9200
                BONDING PADS ON HORIZONTAL ROWS OF B.P.                000 9300
                INITIALLY SET = B.P. ORIGIN TO CENTER OF PAD.          000 9400
      IP(I2+ 5) IS DISTANCE FROM CHIP CENTER TO START OF               000 9500
                BONDING PADS ON VERTICAL ROWS OF B.P.                  000 9600
                INITIALLY SET = B.P. ORIGIN TO CENTER OF PAD,          000 9700
                MINUS ADDITIONAL OFFSET FOR TEST TRANSISTOR.           000 9800
      IP(I2+ 6) IS AN ARBITRARY X/Y VALUE OF CENTER OF CHIP.           000 9900
      IP(I2+ 7) IS NUMBER OF TUNNEL CHANNELS TO BE GUARDED.            000 0000
      IP(I2+ 8) IS THE Y-DISTANCE OF THE SIDE GROUND FROM              000 0100
                THE CELL ROW ORIGIN.                                   000 0200
      IP(I2+ 9) IS THE NUMBER OF INDICIES PER STEP USED TO             000 0300
                INTERCONNECT B.P. TO NODE IN ADJUSTMENT                000 0400
                OF CENTER ROUTING SURFACE DUE TO X SHIFT.              000 0500
      IP(I2+10) IS HEIGHT OF CELLS.                                    000 0600
      IP(I2+11) IS Y-DISTANCE FROM ORIGIN OF CELL TO CENTER            000 0700
                OF PIN.                                                000 0800
      IP(I2+12) IS Y-DISTANCE FROM ORIGIN OF CELL TO FIRST             000 0900
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                METAL CHANNEL.                                          000 1000
IP(I2+13)       IS DISTANCE OF FIRST RIGHT END-AROUND VERTICAL          000 1100
                CHANNEL FROM EDGE OF HORIZONTAL CELL ROWS.              000 1200
IP(I2+14)       IS MINIMUM DISTANCE OF FIRST TUNNEL VERTICAL            000 1300
                CHANNEL FROM LAST END-AROUND CHANNEL.                   000 1400
IP(I2+15)       IS THE MINIMUM DISTANCE FROM ORIGIN OF B.P.             000 1500
                TO NEAREST NON-METAL DEVICE (TUNNEL OR CELL).           000 1600
IP(I2+16)       IS Y-DISTANCE FROM ORIGIN OF B.P. TO FIRST              000 1700
                METAL CHANNEL.                                          000 1800
IP(I2+17)       IS MINIMUM NUMBER OF WIRING CHANNELS FOR                000 1900
                CHANGING TUNNEL TO METAL.                               000 2000
IP(I2+18)       IS B.P. SHIFT (CCW) FOR BEAM LEAD TECHNOLOGY.           000 2100
IP(I2+19)       IS Y-DISTANCE FROM B.P. ORIGIN TO HORIZONTAL            000 2200
                GROUND LINE TO CELL ROWS.                               000 2300
IP(I2+20)       IS ADJUSTMENT CONSTANT FOR SIDE ROUTING                 000 2400
                X-INCREMENT. USED TO SQUEEZE SIDE CHANNELS              000 2500
                CLOSER TO EACH OTHER (SHOULD NOT BE GREATER             000 2600
                THAN 1 OR LESS THAN 0).                                 000 2700
IP(I2+21)       IS CORRECTION FOR FIRST SIDE ROUTING CHANNEL.           000 2800
IP(I2+22)       IS CONTROL FOR MINIMIZING CHANNEL SPACING ON            000 2900
                SIDE ROUTING SURFACE. SEE POS1.                         000 3000
                = 0, MINIMIZE.                                          000 3100
                = 1, DO NOT MINIMIZE.                                   000 3200
IP(I2+23)       IS CONTROL FOR CELL REORIENTATION AND PIN               000 3300
                REASSIGNMENT. SEE SMASH1.                               000 3400
                = 0  EXECUTE.                                           000 3500
                > 0  BYPASS.                                            000 3600
IP(I2+24)       IS BYPASS CONTROL ON ORDER OF NROW B.P. ROUTE.           000 3700
                SEE SMASH1.                                             000 3800
                = 0, FORCE ROUTE TO B.P. ORDER.                         000 3900
                = 1, BYPASS THIS FORCED ROUTE ORDER.                    000 4000
IP(I2+25)       IS BYPASS CONTROL POSSIBLE REDUCTION OF CLASS           000 4100
                3 NODE INTO CLASS 2 & 5, WITH POSSIBLE                  000 4200
                SMALLER CLASS 3 NODE SEGMENT.  SEE SMASH1.              000 4300
                = 0, EXECUTE SUBDIVISION OF CLASS 3 NODE.               000 4400
                = 1, BYPASS EXECUTION.                                  000 4500
IP(I2+26)       IS B.P. REPOSITIONING SWITCH (POPL1).                   000 4600
                = 0, BYPASS THIS FEATURE.                               000 4700
                = 1, REPOSITION PADS ON ALL SIDES.                      000 4800
                = 2, ALSO SHIFT ALL PADS ON ROW TOWARD CENTER.          000 4900
                = 3, ALSO INTERCHANGE PADS BETWEEN ROWS.                000 5000
                = 4, SAME AS 1 & 3, BUT NOT 2.                          000 5100
IP(I2+27)       IS BYPASS CONTROL ON LSI PLACEMENT ALGORITHM            000 5200
                WITH RESPECT TO MINIMUM DISTANCE TO NEAREST             000 5300
                NEIGHBOR ALGORITHM. SEE PLACE/DIST.                     000 5400
                = 0, EXECUTE LSI DIST.                                  000 5500
                = 1, EXECUTE MINIMUM DIST. NEAREST NEIGHBOR.            000 5600
                = 2, EXECUTE DRIVER CENTERED LSI DIST.                  000 5700
IP(I2+28)       IS BYPASS CONTROL ON RESORT OF LINE DATA                000 5800
                IN SORT1.                                               000 5900
                = 0, EXECUTE RESORT.                                    000 6000
                = 1, BYPASS.                                            000 6100
IP(I2+29)       IS EXEC/BYPASS CONTROL ON STEP 2B IN POC1.              000 6200
                = 0, EXECUTE FOR ALL CENTER ROWS.                       000 6300
                = 1, EXECUTE ONLY FOR B.P. ROWS.                        000 6400
                = 2, BYPASS.                                            000 6500
IP(I2+30)       IS Y-DISTANCE FROM ORIGIN OF B.P. TO CENTER             000 6600
                OF PIN.                                                 000 6700
IP(I2+31)       IS DISTANCE OF FIRST LEFT END-AROUND VERTICAL           000 6800
                CHANNEL FROM EDGE OF HORIZONTAL CELL ROWS.              000 6900
                IF IP(I0+14) = 3, SET IP(I2+13) = IP(I2+1)              000 7000
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      IP(I2+32) IS MINIMUM NUMBER OF WIRING CHANNELS FOR        000 7100
                CHANGING TUNNEL AT PIN TO METAL. IP(I2+17)      000 7200
                MUST ALSO BE > 0.                               000 7300
      IP(I2+33) IS SPACING CONSTANT USED TO ADJUST FIRST        000 7400
                METAL CHANNEL FROM ODD CELL ROW.                000 7500
                                                                000 7600
I3 IS THE STARTING INDEX FOR ROW RELATED DATA. THESE DATA       000 7700
     ARE STORED ROW BY ROW, IN ROW ORDER. DATA FOR ROW 2        000 7800
     FOLLOWS ROW 1 DATA, ETC.  SAME DATA FOR EACH ROW MUST      000 7900
     BE IN SAME ORDER.IP(I3) IS THE NUMBER OF DATA STORED       000 8000
     FOR EACH ROW. TO EXTRACT, FOR EXAMPLE, DATA ITEM 3         000 8100
     FOR ROW 6,   M3  = I3 + (6-1) * IP(I3) + 3                000 8200
                                                                000 8300
      IP(I3   ) IS THE NUMBER OF INDICIES FOR EACH ROW DATA.    000 8400
      IP(M3+ 1) IS THE Y-COORDINATE OF ROW (X FOR ROW 1/2).     000 8500
      IP(M3+ 2) IS THE NORMAL CELL ORIENTATION FOR ROW.         000 8600
      IP(M3+ 3) IS THE REVERSE CELL ORIENTATION FOR ROW.        000 8700
      IP(M3+ 4) IS THE NO. OF LEFT END-AROUND WIRES FOR ROW.    000 8800
      IP(M3+ 5) IS THE NO. OF RIGHT END-AROUND WIRES FOR ROW.   000 8900
      IP(M3+ 6) IS THE X-INDEX OF LEFT END OF ROW(Y FOR 1/2).   000 9000
      IP(M3+ 7) IS THE X-COORD OF LEFT END OF ROW (Y FOR 1/2).  000 9100
      IP(M3+ 8) IS THE X-INDEX OF FIRST LEFT END-AROUND NODE.   000 9200
      IP(M3+ 9) IS THE X-INDEX OF FIRST RIGHT END-AROUND NODE.  000 9300
      IP(M3+10) IS THE X-INDEX OF RIGHT END OF ROW(Y FOR 1/2).  000 9400
      IP(M3+11) IS THE WIDTH OF ALL CELL ON ROW.                000 9500
      IP(M3+12) IS X-COORD OF FIRST LEFT END-AROUND NODE.       000 9600
      IP(M3+13) IS X-COORD OF FIRST RIGHT END-AROUND NODE.      000 9700
      IP(M3+14) IS OPTION IP(I0+60) COUNTER. IF ROW IS EVEN,    000 9800
                COUNT IS # TO SIDE ROW 1. IF ROW IS ODD,        000 9900
                COUNT IS # TO SIDE ROW 2. SEE OPTION IP(I0+60)  000 0000
                FOR FURTHER DETAILS.                            000 0100
      IP(M3+15) PLACEMENT Y-INDEX OF ROW (X FOR ROW 1/2).       000 0200
      IP(M3+16) PLACEMENT LEFT X-INDEX OF ROW (Y FOR 1/2).      000 0300
      IP(M3+17) PLACEMENT RIGHT X-INDEX OF ROW(Y FOR 1/2).      000 0400
      IP(M3+18) PLACEMENT NON-VALID ROW Y-INDEX.                000 0500
      IP(M3+19) IS X-COORD. OF LAST LEFT END-AROUND NODE.       000 0600
      IP(M3+20) IS X-COORD. OF LAST RIGHT END-AROUND NODE.      000 0700
                                                                000 0800
I4 IS THE STARTING INDEX FOR CHIP/ARTWORK PARAMETERS.           000 0900
                                                                000 1000
      IP(I4   ) IS NUMBER OF I4 DATA.                           000 1100
      IP(I4+ 1) IS X STEP & REPEAT, INCREMENT OF IP(I4+91)      000 1200
      IP(I4+ 2) IS Y STEP & REPEAT, INCREMENT OF IP(I4+91)      000 1300
      IP(I4+ 3) IS ONE HALF WIDTH OF STREET.                    000 1400
      IP(I4+ 4) IS Y-DISTANCE FROM CENTER OF CHIP RESERVED      000 1500
                FOR TEST RESISTOR.                              000 1600
      IP(I4+ 5) IS Y-DISTANCE ABOVE CENTER OF CHIP TO TOP       000 1700
                OF TEST RESISTOR BONDING PAD.                   000 1800
      IP(I4+ 6) IS Y-DISTANCE ABOVE CENTER OF CHIP TO BOTTOM    000 1900
                OF TEST RESISTOR B.P.                           000 2000
      IP(I4+ 7) IS 1/2 WIDTH OF TEST RESISTOR.                  000 2100
      IP(I4+ 8) IS MINIMUM Y STEP & REPEAT FOR PHOTO KEY TO     000 2200
                BE LOCATED WITHIN MASKING BORDER.               000 2300
      IP(I4+ 9) IS WIDTH OF MASKING BORDER.                     000 2400
      IP(I4+10) IS WIDTH OF N+(NOT) INSIDE STREET.              000 2500
      IP(I4+11) IS 1/2 WIDTH/HEIGHT OF PHOTO KEY.               000 2600
      IP(I4+12) IS Y-DISTANCE FROM CENTER OF STREET TO          000 2700
                CENTER OF PHOTO KEY, KEY INSIDE CHIP.           000 2800
      IP(I4+13) IS X-DIST OF GND PAD FROM CENTER OF STREET.     000 2900
      IP(I4+14) IS Y-DIST OF GND PAD BELOW CENTER OF CHIP.      000 3000
                ALSO Y-DIST. CORRECTION FOR IP(I0+54) > 1       000 3100
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IP(I4+15) IS ORIENTATION OF GND PATTERN.                          000 3200
IP(I4+16) IS X-DIST OF VDD PAD FROM CENTER OF STREET.             000 3300
IP(I4+17) IS Y-DIST OF VDD PAD ABOVE CENTER OF CHIP.              000 3400
          ALSO Y-DIST. CORRECTION FOR IP(I0+54) > 1               000 3500
IP(I4+18) IS ORIENTATION OF VDD PATTERN.                          000 3600
IP(I4+19) IS X-DIST OF P-TT FROM CENTER OF STREET.                000 3700
IP(I4+20) IS Y-DIST OF P-TT ABOVE CENTER OF CHIP.                 000 3800
IP(I4+21) IS ORIENTATION OF P-TT PATTERN.                         000 3900
IP(I4+22) IS X-DIST OF N-TT FROM CENTER OF STREET.                000 4000
IP(I4+23) IS Y-DIST OF N-TT ABOVE CENTER OF CHIP.                 000 4100
IP(I4+24) IS ORIENTATION OF N-TT PATTERN.                         000 4200
IP(I4+25) IS X/Y-DIST OF CHIP ALIGNMENT KEYS FROM                 000 4300
          STREET OR FROM EACH OTHER.                              000 4400
IP(I4+26) = 0, CHIP IS SQUARE, > 0 FOR RECTANGULAR.               000 4500
IP(I4+27) IS X-DIST OF RCA PATTERN FROM CENTER OF STREET          000 4600
          IF = 0, BYPASS RCA PATTERN.                             000 4700
IP(I4+28) IS Y-DIST OF RCA PATTERN FROM CENTER OF STREET          000 4800
IP(I4+29) IS ORIENTATION OF RCA PATTERN.                          000 4900
IP(I4+30) IS X-DIST OF ATL PATTERN FROM CENTER OF STREET          000 5000
IP(I4+31) IS Y-DIST OF ATL PATTERN FROM CENTER OF STREET          000 5100
IP(I4+32) IS ORIENTATION OF ATL PATTERN.                          000 5200
IP(I4+33) IS Y-DIST OF 1ST DIGIT ID FROM CENTER STREET.           000 5300
IP(I4+34) IS X-INCREMENT BETWEEN DIGITS OF ID.                    000 5400
IP(I4+35) IS X-OFFSET OF CHIP FROM NORMAL CHIP ORIGIN.            000 5500
IP(I4+36) IS Y-OFFSET OF CHIP FROM NORMAL CHIP ORIGIN.            000 5600
IP(I4+37) IS X-POSITION (ABSOLUTE) OF START OF SYMBOL             000 5700
          DATA FROM LOWER LEFT CORNER STREET CENTER,              000 5800
          MODIFIED BY CHIP SCALE FACTORS.                         000 5900
IP(I4+38) IS Y-POSITION (ABSOLUTE) OF START OF SYMBOL             000 6000
          DATA BELOW LOWER LEFT CORNER STREET CENTER,             000 6100
          MODIFIED BY CHIP SCALE FACTORS.                         000 6200
IP(I4+39) IS 1/2 X-STEP                                           000 6300
IP(I4+40) IS 1/2 Y-STEP                                           000 6400
IP(I4+41) IS HALF WIDTH OF LEVEL 12 BORDER.                       000 6500
IP(I4+42) IS GAP OF VDD LINE TO CROSS GROUND PAD.                 000 6600
IP(I4+43) DISTANCE FROM EDGE OF CELL ROW TO VERTICAL              000 6700
          CHANNEL FOR GROUND.                                     000 6800
IP(I4+44) IS SCALE OF CHIP.                                       000 6900
IP(I4+45) IS SCALE FOR ALL LINE SETS.                             000 7000
IP(I4+46) IS SCALE FOR ALL SHAPE SETS.                            000 7100
IP(I4+47) IS APERTURE NUMBER FOR LEVEL 2 P LINES                  000 7200
IP(I4+48) IS APERTURE NUMBER FOR LEVEL 3 N+ (NOT) LINES           000 7300
IP(I4+49) IS APERTURE NUMBER FOR LEVEL 6 METAL LINES              000 7400
IP(I4+50) IS APERTURE NUMBER FOR LEVEL 6 GROUND LINES.            000 7500
IP(I4+51) IS 1/2 X STEP & REPEAT + X-OFFSET.                      000 7600
IP(I4+52) IS 1/2 Y STEP & REPEAT + Y-OFFSET.                      000 7700
IP(I4+53) IS ARTWORK CODE FOR COMPONENTS (MUST=100).              000 7800
IP(I4+54) IS ARTWORK CODE FOR TUNNELS.                            000 7900
IP(I4+55) IS ARTWORK CODE FOR METAL.                              000 8000
IP(I4+56) IS ARTWORK CODE FOR GROUND.                             000 8100
IP(I4+57) IS ARTWORK CODE FOR VDD.                                000 8200
IP(I4+58) IS RADIUS OF TUNNEL APERTURE                            000 8300
IP(I4+59) IS RADIUS OF GROUND LINE APERTURE.                      000 8400
IP(I4+60) IS NUMBER OF COMPONENTS GENERATED.                      000 8500
IP(I4+61) IS NUMBER OF TUNNEL LINES GENERATED.                    000 8600
IP(I4+62) IS NUMBER OF METAL-LINES GENERATED.                     000 8700
IP(I4+63) IS NUMBER OF GROUND LINES GENERATED.                    000 8800
IP(I4+64) IS NUMBER OF VDD LINES GENERATED.                       000 8900
IP(I4+65)                                                         000 9000
IP(I4+66)                                                         000 9100
IP(I4+67) IS Y-DIST OF CELL VDD FROM CELL ORIGIN.                 000 9200
```

```
IP(I4+68) IS APERTURE NUMBER FOR LEVEL 6 VDD LINES.                  000 9300
IP(I4+69) IS Y-DISTANCE FROM CENTER OF STREET TO CENTER              000 9400
          OF PHOTO KEY, KEY OUTSIDE CHIP.                            000 9500
IP(I4+70) IS DISTANCE OF VDD LINE END POINT FROM GROUND              000 9600
          PATTERN ORIGIN.                                            000 9700
IP(I4+71) IS LEVEL 1 X-OFFSET FOR GROUND SHAPE SET.                  000 9800
IP(I4+72) IS LEVEL 1 Y-OFFSET FOR GROUND SHAPE SET.                  000 9900
IP(I4+73) IS LEVEL 2 X-OFFSET FOR GROUND SHAPE SET.                  000 0000
IP(I4+74) IS LEVEL 2 Y-OFFSET FOR GROUND SHAPE SET.                  000 0100
IP(I4+75) IS LEVEL 3 X-OFFSET FOR GROUND SHAPE SET.                  000 0200
IP(I4+76) IS LEVEL 3 Y-OFFSET FOR GROUND SHAPE SET.                  000 0300
IP(I4+77) IS LEVEL 4 X-OFFSET FOR GROUND SHAPE SET.                  000 0400
IP(I4+78) IS LEVEL 4 Y-OFFSET FOR GROUND SHAPE SET.                  000 0500
IP(I4+79) IS LEVEL 5 X-OFFSET FOR GROUND SHAPE SET.                  000 0600
IP(I4+80) IS LEVEL 5 Y-OFFSET FOR GROUND SHAPE SET.                  000 0700
IP(I4+81) IS CELL-TO-CELL SPACING CONSTANT. CELL                     000 0800
          DESIGN DEPENDENT (CELL-TO-CELL OVERLAP).                   000 0900
IP(I4+82) IS LEFT SIDE END-CAP(CELL DESIGN DEPENDENT)                000 1000
          SPACING CONSTANT. FUNCTION OF                              000 1100
          CELL-TO-CELL OVERLAP.                                      000 1200
IP(I4+83) IS X-DIST OF SIDE GROUND LINE FROM CENTER                  000 1300
          OF STREET.                                                 000 1400
IP(I4+84) IS Y-DIST OF BOTTOM/TOP GROUND LINE FROM                   000 1500
          CENTER OF STREET.                                          000 1600
IP(I4+85) IS X-DIST OF SIDE VDD LINE FROM CENTER OF                  000 1700
          STREET.                                                    000 1800
IP(I4+86) IS Y-DIST OF BOTTOM/TOP VDD LINE FROM                      000 1900
          CENTER OF STREET.                                          000 2000
IP(I4+87) IS X-DIST OF SIDE B.P. ORIGIN FROM CENTER                  000 2100
          OF STREET.                                                 000 2200
IP(I4+88) IS Y-DIST OF BOTTOM/TOP B.P. ORIGIN FROM                   000 2300
          CENTER OF STREET.                                          000 2400
IP(I4+89) IS HALF THE WIDTH OF LEVEL 8 BORDER.                       000 2500
IP(I4+90) IS APERATURE NUMBER FOR SYMBOL DATA.                       000 2600
IP(I4+91) IS STEP & REPEAT INCREMENT                                 000 2700
IP(I4+92) IS BYPASS FOR CHIP KEYS.                                   000 2800
          = 0, GENERATE ALL.                                         000 2900
          = 1, BYPASS IP(I5+16).                                     000 3000
          = 2, BYPASS 15 AND 16.                                     000 3100
          = 3, BYPASS 14, 15 & 16.                                   000 3200
          = 4, BYPASS 13, 14, 15, & 16.                              000 3300
IP(I4+93) IS ATL PATTERN BYPASS.                                     000 3400
          = 0, GENERATE                                              000 3500
          = 1, BYPASS.                                               000 3600
IP(I4+94) IS RTCA1 CONTROL.                                          000 3700
          = 0, SET FOR MINIMUM Y-ROUTE.                              000 3800
          = 1, SET FOR MINIMUM CROSS ON SIDE ROUTE.                  000 3900
IP(I4+95) IS PRINT CONTROL OF "PICTURE" OF CHIP.                     000 4000
          = 0, PRINT                                                 000 4100
          = 1, BYPASS                                                000 4200
IP(I4+96) IS BYPASS CONTROL OF REROUTE OF SIDE B.P.                   000 4300
          IN POS1.                                                   000 4400
          = 0, BYPASS.                                               000 4500
          = 1, EXECUTE.                                              000 4600
IP(I4+97) IS CONTROL FOR EXECUTION OF TONGUE-IN-GROOVE               000 4700
          FIT OF FACING CENTER ROWS.                                 000 4800
          = 0, EXECUTE MINIMUM Y-DIST. BETWEEN ROWS.                 000 4900
          = 1, BYPASS THIS FEATURE.                                  000 5000
IP(I4+98) IS CONTROL FOR GENERATING WIDE TUNNEL SEGMENTS             000 5100
          = 0, BYPASS.                                               000 5200
          > 0, WIDEN SIDE OF TUNNEL BY RADIUS, IP(I4+58),            000 5300
```

```
C                          OF TUNNEL APERTURE, WHEN TUNNEL SEGMENT   000 5400
C                          IS IP(I4+98) UNITS LONG OR LONGER.        000 5500
C              IP(I4+99) IS LOW PROFILE METAL ON ROW FOR POSSIBLE     000 5600
C                        REDUCTION OF TUNNEL LENGTHS.                000 5700
C                        = 0, BYPASS                                 000 5800
C                        > 0, MOVE METAL, IP(I4+99) INDICIES OR      000 5900
C                             WIDER, CLOSER TO CELL ROW.             000 6000
C                        IF = 0, SET IP(I0+57) = 1 AND IP(I0+70) = 1.000 6100
C                                                                    000 6200
C         I5 IS THE STARTING INDEX FOR PATTERN DATA PARAMETERS.      000 6300
C                                                                    000 6400
C              IP(I5    ) IS NUMBER OF I5 DATA.                     000 6500
C              IP(I5+  1) IS THE BASIC INPUT PAD PATTERN NUMBER      000 6600
C              IP(I5+  2) IS THE INPUT PAD PATTERN # FOR SIDE ROWS.  000 6700
C              IP(I5+  3) IS BONDING PAD PATTERN NO. LOWER LIMIT.    000 6800
C              IP(I5+  4) IS LOWER LIMIT FOR OUTPUT BONDING PADS.    000 6900
C              IP(I5+  5) IS PATTERN NUMBER FOR VDD SUBSTRATE TAP.   000 7000
C              IP(I5+  6) IS PATTERN NUMBER FOR TUNNEL END           000 7100
C              IP(I5+  7) IS PATTERN NUMBER FOR PHOTO ALIGNMENT KEY  000 7200
C              IP(I5+  8) IS PATTERN NUMBER FOR END CAP              000 7300
C                         IF = 0, BYPASS END CAP GENERATION.         000 7400
C              IP(I5+  9) IS PATTERN NUMBER FOR GROUND B.P.          000 7500
C              IP(I5+ 10) IS PATTERN NUMBER FOR VDD B.P.             000 7600
C              IP(I5+ 11) IS PATTERN NUMBER FOR P-TEST TRANSISTOR    000 7700
C              IP(I5+ 12) IS PATTERN NUMBER FOR N-TEST TRANSISTOR    000 7800
C              IP(I5+ 13) IS PATTERN NUMBER FOR CHIP ALIGNMENT KEY # 1 000 7900
C              IP(I5+ 14) IS PATTERN NUMBER FOR CHIP ALIGNMENT KEY # 2 000 8000
C              IP(I5+ 15) IS PATTERN NUMBER FOR CHIP ALIGNMENT KEY # 3 000 8100
C              IP(I5+ 16) IS PATTERN NUMBER FOR CHIP ALIGNMENT KEY # 4 000 8200
C              IP(I5+ 17) IS PATTERN NUMBER FOR RCA                  000 8300
C              IP(I5+ 18) IS PATTERN NUMBER FOR ATL                  000 8400
C              IP(I5+ 19) IS PATTERN NUMBER FOR BASIC ID DATA        000 8500
C                                                                    000 8600
C         I6 IS STARTING INDEX FOR CAPACITIVE PARMETERS.             000 8700
C                                                                    000 8800
C              IP(I6    ) IS NUMBER OF I6 DATA.                     000 8900
C              IP(I6+ 1) IS CAPACITANCE PER LINEAR 10TH MIL OF METAL.000 9000
C              IP(I6+ 2) IS CAPACITANCE PER LINEAR 10TH MIL OF TUNNEL.000 9100
C              IP(I6+ 3) IS 1/2 CAPACITANCE OF A TUNNEL END.         000 9200
C              IP(I6+ 4) IS TOTAL LENGTH OF METAL LINES (MAXIMUM = MAX) 000 9300
C              IP(I6+ 5) IS OVERFLOW OF IP(I6+4) = # OF MAX          000 9400
C              IP(I6+ 6) IS TOTAL LENGTH OF TUNNEL LINES (MAXIMUM = MAX)000 9500
C              IP(I6+ 7) IS OVERFLOW OF IP(I6+6) = # OF MAX          000 9600
C              IP(I6+ 8) IS TUNNEL END COUNT                         000 9700
C                                                                    000 9800
C     IPIN(IX,IY):                                                   000 9900
C         THIS ARRAY IS USED TO STORE PIN DATA FOR EACH PATTERN USED 000 0000
C         IN THE DESIGN OF THE CHIP. IX IS A RUNNING INDEX. PIN DATA 000 0100
C         ARE STORED ONE AFTER ANOTHER. THE LAST PIN OF THE PATTERN  000 0200
C         IS A NON-ACTIVE PIN AND SPECIFIES THE X/Y SPAN OF THE PATTERN 000 0300
C         WITH RESPECT TO THE PATTERN ORIGIN. THE REFERENCE PIN (NON- 000 0400
C         ACTIVE) MUST HAVE A PIN REASSIGNMENT OF ZERO. THE FORMAT OF 000 0500
C         THE PIN DATA READ FROM CARDS OR TAPE IS (5I4,10A4,I4). THE  000 0600
C         DATA READ IN ARE: PATTERN NO., PIN NUMBER, PIN REASSIGNMENT 000 0700
C         FLAG, PIN X-COORDINATE FROM PATTERN ORIGIN, PIN Y-COORDINATE 000 0800
C         FROM PATTERN ORIGIN/ PIN CAPACITANCE, PATTERN DESCRIPTION AND 000 0900
C         TECHNOLOGY CODE.                                           000 1000
C                                                                    000 1100
C         FOR THE I PATTERN, STORAGE STARTING AT POSITION IX:        000 1200
C              IPIN(IX,1) IS PATTERN NUMBER FOR I PATTERN.           000 1300
C              IPIN(IX,2) IS # OF PINS IN PATTERN I, ACTIVE PINS + I.000 1400
```

```
C              IPIN(IX,3) INDEX LOCATION OF START OF I+1 PATTERN.          000 1500
C              IPIN(IX+J,1) REASSIGNMENT FLAG FOR PIN J.                   000 1600
C                        FOR REF. PIN MAY BE USED TO INDICATE NUMBER       000 1700
C                        OF DEVICES ON CELL = - # DEVICES.                 000 1800
C                   IPINYR = 1                                             000 1900
C              IPIN(IX+J,2) X-COORDINATE OF PIN J FROM PATTERN ORIGIN.     000 2000
C                   IPINYX = 2                                             000 2100
C              IPIN(IX+J,3) IMPEDANCE OF PIN J / REF. PIN Y-COORD.         000 2200
C                   FOR IMPEDANCE:                                        000 2300
C                   FIRST TWO DIGITS ARE PIN RESISTANCE IN X.X K-OHMS.    000 2400
C                   SECOND TWO DIGITS ARE PIN CAPACITANCE IN .XX PICO-F.  000 2500
C                   IPINYC = 3                                            000 2600
C                   IPINYY = 3                                            000 2700
C                                                                         000 2800
C     LIM(IX):                                                            000 2900
C         LIM(IX) IS USED TO STORE PROGRAM CONSTANTS. SEE EQUIVALENCE     000 3000
C         STATEMENT.                                                      000 3100
C                                                                         000 3200
C     MODE(IX):                                                           000 3300
C         SEE EXEC.                                                       000 3400
C                                                                         000 3500
C     NODE(IX):                                                           000 3600
C                                                                         000 3700
C         NODE(IX) CONTAINS NODE DATA AS WELL AS ELEMENT-PIN CONNECT-     000 3800
C         IVITY AMONG DEVICES FOR THE NODE. ALL NODE DATA ARE STACKED     000 3900
C         ONE AFTER THE OTHER IN THE NODE(IX) ARRAY.                      000 4000
C         AS AN EXAMPLE, SAY THE J NODE HAS A STARTING ADDRESS OF K       000 4100
C         IN ARRAY NODE(IX). THEN:                                        000 4200
C              NODE(K)   CONTAINS THE "OLD" LENGTH OF NODE J.             000 4300
C              NODE(K+1) CONTAINS THE "NEW" LENGTH OF NODE J.             000 4400
C              NODE(K+2) CONTAINS THE ADDRESS OF THE LAST                 000 4500
C                        ELEMENT OF NODE J. SAY THIS IS LOCATION L.       000 4600
C              NODE(K+3) CONTAINS THE WEIGHTING FACTOR FOR NODE J.        000 4700
C              NODE(K+4) THROUGH NODE(L+1) CONTAINS THOSE ELEMENT-PIN     000 4800
C                        CONNECTIVITY DATA (IN ELEM-PIN PAIRS) OF NODE J  000 4900
C              NODE(L+2) IS THE STARTING ADDRESS OF NODE J+1.             000 5000
C                                                                         000 5100
C     ***********************************************************************000 5200
C                                                                         000 5300
C     NOTE:                                                               000 5400
C         IN ORDER TO CHANGE THE UPPER LIMITS OF ANY ARRAY IN THIS        000 5500
C         PROGRAM, EACH AFFECTED DIMENSION STATEMENT MUST BE              000 5600
C         CHANGED AND THE AFFECTED UPPER LIMIT VARIABLES MUST BE          000 5700
C         CHANGED. IN ORDER TO HELP MAKE THESE CHANGES, COMMENT           000 5800
C         CARDS HAVE BEEN WRITTEN AT STATEMENTS SETTING UPPER LIMITS      000 5900
C         OF ARRAYS. THE FORM OF THESE COMMENTS ARE (FOR EXAMPLE):        000 6000
C                                                                         000 6100
C         POSSIBLE OTHER          POSSIBLE OTHER      UPPER     ARRAY     000 6200
C         LIMITS AFFECTED         ARRAYS AFFECTED:    LIMIT:    NAME:     000 6300
C                                                                         000 6400
C         JPX                     JP                  MAPX      MAP       000 6500
C                                                                         000 6600
C*************************************************************************000 6700
C                                                                         000 6800
```

VI. PR2D EXAMPLE DESIGN LAYOUTS

A. N002 — 4-Bit Adder

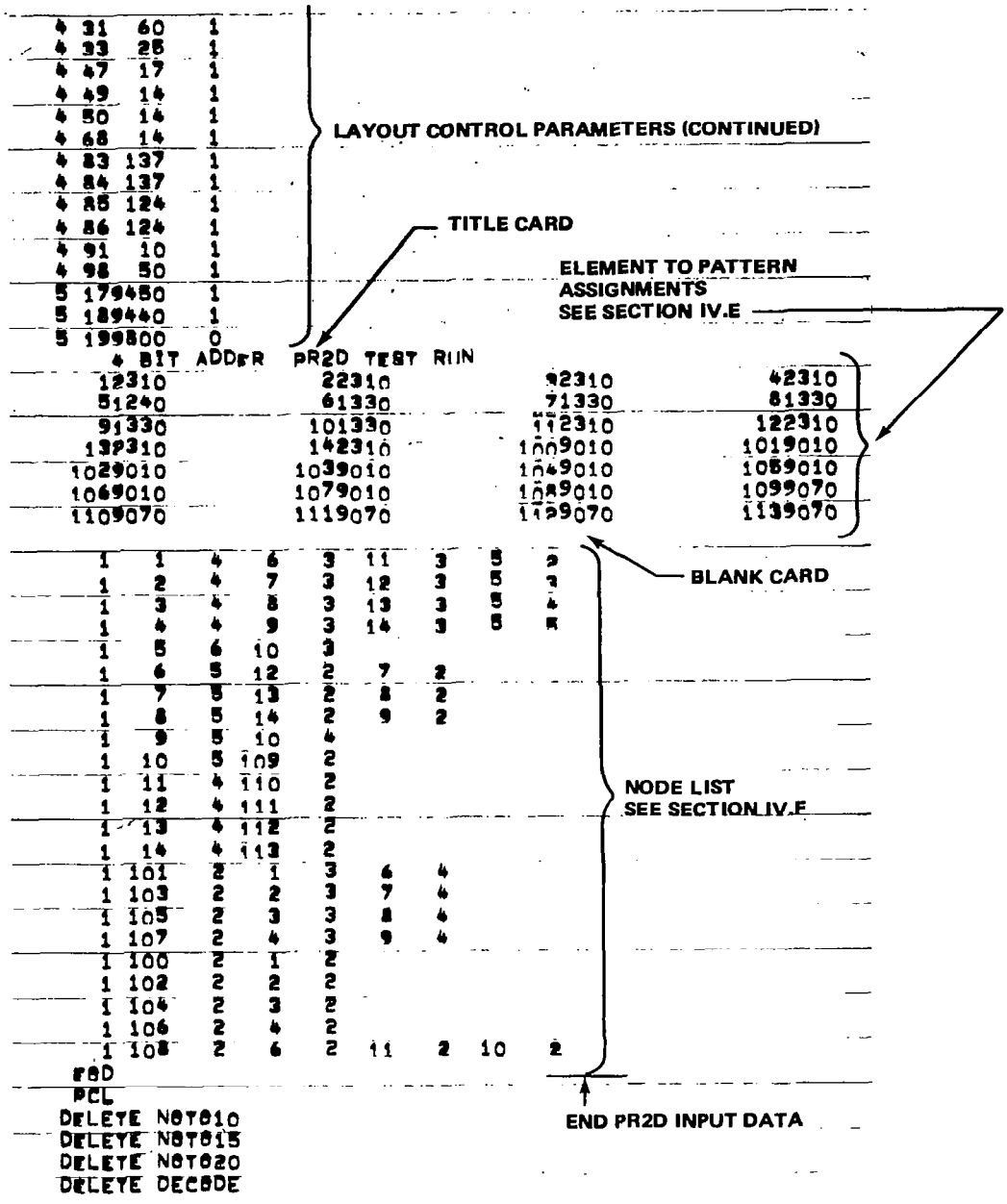
```
 23120 MAY 10,'78 ID=0088
JOB MARTIN,EC45020(BAST/CAD),1
LIMIT (TIME,15),(CORE,60)
ASSIGN F16,(DEVICE,LO)
ASSIGN F11,(FILE,DECODE),(OUTIN),(SAVE)
ASSIGN F15,(DEVICE,CR)
ASSIGN F110,(FILE,NOT010),(OUTIN),(SAVE)
ASSIGN F115,(FILE,NOT015),(OUTIN),(SAVE)
ASSIGN F120,(FILE,NOT020),(OUTIN),(SAVE)
ASSIGN F125,(FILE,NOT025),(OUTIN),(SAVE)
ASSIGN F130,(FILE,DESIGN),(IN)
ASSIGN F135,(FILE,COMON1),(OUT),(SAVE)
ASSIGN F140,(FILE,COMON2),(IN)
ASSIGN F145,(FILE,SOSBWPDF,GOULD),(IN)
ASSIGN F150,(FILE,SOSBWPDFM),(OUT),(SAVE)
ASSIGN F155,(FILE,AWRK1X),(OUTIN),(SAVE)
ASSIGN F160,(FILE,AWRK2C),(OUTIN),(SAVE)
PCL
 COPY N002 TO LP
 JOB MARTIN,EC45020(BAST/CAD),1
 LIMIT (TIME,15),(CORE,60)
 ASSIGN F16,(DEVICE,LO)
 ASSIGN F11,(FILE,DECODE),(OUTIN),(SAVE)
 ASSIGN F15,(DEVICE,CR)
 ASSIGN F110,(FILE,NOT010),(AUTIN),(SAVE)
 ASSIGN F115,(FILE,NOT015),(AUTIN),(SAVE)
 ASSIGN F120,(FILE,NOT020),(AUTIN),(SAVE)
 ASSIGN F125,(FILE,NOT025),(AUTIN),(SAVE)
 ASSIGN F130,(FILE,DESIGN),(IN)
 ASSIGN F135,(FILE,COMON1),(AUT),(SAVE)
 ASSIGN F140,(FILE,COMON2),(IN)
 ASSIGN F145,(FILE,SOSBWPDF,GOULD),(IN)
 ASSIGN F150,(FILE,SOSBWPDFM),(OUT),(SAVE)
 ASSIGN F155,(FILE,AWRK1X),(AUTIN),(SAVE)
 ASSIGN F160,(FILE,AWRK2C),(AUTIN),(SAVE)
 PCL
 COPY N002 TO LP
 END
 RUN (LMN,LMPR2DC,GOULD)
 DATA
 1 1 4 4  02   5   1 101   1   0   0
0  1  50   1
2  4 102   1
2  5  62   1
2 13  12   1
4  1 300   1
4  2 300   1
4  3  25   1
4  9 500   1
4 25 105   1
4 26   1   1
4 27   0   1
4 30  25   1
```

BEGIN PR2D INPUT DATA

MODE CARD
SEE SECTION IV.A

IP(10+1) = 50

LAYOUT CONTROL PARAMETERS
SEE SECTION IV.A (18) AND SECTION V.
FOR FORMAT AND EFECTS OF EACH PARAMETER.


4 31 60 1
4 33 25 1
4 47 17 1
4 49 14 1
4 50 14 1
4 68 14 1
4 83 137 1
4 84 137 1
4 85 124 1
4 86 124 1
4 91 10 1
4 98 50 1
5 179450 1
5 189440 1
5 199800 0
LAYOUT CONTROL PARAMETERS (CONTINUED)
TITLE CARD
ELEMENT TO PATTERN ASSIGNMENTS SEE SECTION IV.E
4 BIT ADDER
PR2D TEST RUN
12310
51240
91330
132310
1029010
1069010
1109070
22310
61330
101330
142310
1039010
1079010
1119070
92310
71330
112310
1009010
1049010
1089010
1129070
42310
81330
122310
1019010
1059010
1099070
1139070
1 1 4 6 3 11 3 5 2
1 2 4 7 3 12 3 5 3
1 3 4 8 3 13 3 5 4
1 4 4 9 3 14 3 5 5
1 5 6 10 3
1 6 5 12 2 7 2
1 7 5 13 2 8 2
1 8 5 14 2 9 2
1 9 5 10 4
1 10 5 109 2
1 11 4 110 2
1 12 4 111 2
1 13 4 112 2
1 14 4 113 2
1 101 2 1 3 6 4
1 103 2 2 3 7 4
1 105 2 3 3 8 4
1 107 2 4 3 9 4
1 100 2 1 2
1 102 2 2 2
1 104 2 3 2
1 106 2 4 2
1 108 2 6 2 11 2 10 2
BLANK CARD
NODE LIST SEE SECTION IV.E
F8D
PCL
DELETE NOT010
DELETE NOT015
DELETE NOT020
DELETE DEC8DE
END PR2D INPUT DATA

```
   DELETE AWRK2C
   END
    EOD
    END
   PCL PROCESSING TERMINATED
```

```
RUN (LMN,LMPR=DC,GOULD)
```

```
                                                        START OF INIT
TWO-DIMENSIONAL PLACEMENT & ROUTING OF LSI CHIPS.

        WRITTEN BY: RICHARD NOTO
        COMPANY   : RCA CORP.
        ADDRESS   : FRONT & COOPER STS.
                    CAMDEN, N. J. 08102
        PHONE NO. : (609) 963-8000
        EXT. NO.  : PC 6755
                                                        PR2D REVISION B, FEB. 1974.

        IP(I0+  1) =    50
        IP(I2+  4) =   102
        IP(I2+  5) =    42
        IP(I2+ 13) =    12
        IP(I4+  1) =   300
        IP(I4+  2) =   300
        IP(I4+  3) =    25
        IP(I4+  9) =   500
        IP(I4+ 25) =   105
        IP(I4+ 26) =     1
        IP(I4+ 27) =     0
        IP(I4+ 30) =    25
        IP(I4+ 31) =    60
        IP(I4+ 33) =    25
        IP(I4+ 47) =    17
        IP(I4+ 49) =    14
        IP(I4+ 50) =    14
        IP(I4+ 68) =    14
        IP(I4+ 83) =   137
        IP(I4+ 84) =   137
```

```
IP(14, 85) =   124
IP(14, 86) =   124
IP(14, 91) =    10
IP(14, 98) =    50
IP(15, 17) =  9450
IP(15, 18) =  9440
IP(15, 19) =  9800
                                        END OF INIT,
                                        START OF INPUT FUNCTION,
```

PIN DATA FOR PATTERNS USED ON CHIP:

PATTERN 1240 #1

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	1	5	0
3	1	15	0
4	1	25	0
5	1	35	0
6	10	45	0
7	-8	50	70

PATTERN 1330 #1

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	1	5	0
3	2	15	0
4	3	35	0
5	10	45	0
6	-6	50	70

PATTERN 2310 #1

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	1	25	0
3	1	35	0
4	10	45	0
5	-5	60	70

PIN DATA FOR PATTERNS USED ON CHIP:

PATTERN 9010 *:

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	10	0
3	0	80	90

PATTERN 9070 *:

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	20	0
3	-2	80	90

ELEMENT TO PATTERN ASSIGNMENT:

ELEM	PTRN	BRD.	ROW	ELEM	PTRN	BRD.	ROW	...							
1	2310	0	0	2	2310	0	0	3	2310	0	0	4	2310	0	0
5	1240	0	0	6	1330	0	0	7	1330	0	0	8	1330	0	0
9	1330	0	0	10	1330	0	0	11	2310	0	0	12	2310	0	0
13	2310	0	0	14	2310	0	0	15	0	0	0	16	0	0	0
17	0	0	0	18	0	0	0	19	0	0	0	20	0	0	0
21	0	0	0	22	0	0	0	23	0	0	0	24	0	0	0
25	0	0	0	26	0	0	0	27	0	0	0	28	0	0	0
29	0	0	0	30	0	0	0	31	0	0	0	32	0	0	0
33	0	0	0	34	0	0	0	35	0	0	0	36	0	0	0
37	0	0	0	38	0	0	0	39	0	0	0	40	0	0	0
41	0	0	0	42	0	0	0	43	0	0	0	44	0	0	0
45	0	0	0	46	0	0	0	47	0	0	0	48	0	0	0
49	0	0	0	50	0	0	0	51	0	0	0	52	0	0	0
53	0	0	0	54	0	0	0	55	0	0	0	56	0	0	0
57	0	0	0	58	0	0	0	59	0	0	0	60	0	0	0
61	0	0	0	62	0	0	0	63	0	0	0	64	0	0	0
65	0	0	0	66	0	0	0	67	0	0	0	68	0	0	0
69	0	0	0	70	0	0	0	71	0	0	0	72	0	0	0
73	0	0	0	74	0	0	0	75	0	0	0	76	0	0	0
77	0	0	0	78	0	0	0	79	0	0	0	80	0	0	0
81	0	0	0	82	0	0	0	83	0	0	0	84	0	0	0
85	0	0	0	86	0	0	0	87	0	0	0	88	0	0	0

ELEMENT TO PATTERN ASSIGNMENT:

ELEM	PTRN	ORD.	ROW	ELEM	PTRN	ORD.	ROW	...							
89	0	0	0	90	0	0	0	91	0	0	0	92	0	0	0
93	0	0	0	94	0	0	0	95	0	0	0	96	0	0	0
97	0	0	0	98	0	0	0	99	0	0	0	100	9010	0	0
101	9010	0	0	102	9010	0	0	103	9010	0	0	104	9010	0	0
105	9010	0	0	106	9010	0	0	107	9010	0	0	108	9010	0	0
109	9070	0	0	110	9070	0	0	111	9070	0	0	112	9070	0	0
113	9070	0	0												

NODE LIST:

NODE NO.	NODE WT.	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN	...
1	1	1	4	4	3	11	3	5	2	
2	1	2	4	7	3	12	3	5	3	
3	1	3	4	8	3	13	3	5	4	
4	1	4	4	9	3	14	3	5	5	
5	1	5	6	10	3					
6	1	6	5	12	2	7	2			
7	1	7	5	13	2	8	2			
8	1	8	5	14	2	9	2			
9	1	9	5	15	4					
10	1	10	5	100	2					
11	1	11	4	110	2					
12	1	12	4	111	2					
13	1	13	4	112	2					
14	1	14	4	113	2					
15	1	101	2	1	3	6	4			
16	1	103	2	3	3	7	4			
17	1	105	2	5	3	8	4			
18	1	107	2	7	3	9	4			
19	1	100	2	0	2					
20	1	102	2	2	2					
21	1	104	2	4	2					
22	1	106	2	6	2					
23	1	108	2	8	2	11	2	10	2	

NODE ERRORS:

END OF INPUT FUNCTION.

START OF PRPL1 SUBROUTINE!

END OF PRPL1 SUBROUTINE.
START OF PLACEMENT!

LENGTH= 12, # INT.= 71,JRAD=2, TOTAL DIST.= 0, # GOOD INT.= 0, # EQU INT = 71

PLACEMENT:

```
  0   0   0 107   0 108   0 109   0 104   0   0   0
  0   0   0   0   0   0   0   0   0   0   0   0 103
  0   0   0   0   0   0   0   0   0   0   0   0   0
102   0   0  11  12  13  14  10   2   8   0   0 105
  0   0   0   4   5   6   7   3   9   1   0   0   0
110   0   0   0   0   0   0   0   0   0   0   0 106
101   0   0   0   0   0   0   0   0   0   0   0   0
  0   0   0 111   0 112   0 113   0 100   0   0   0
```

TOTAL WIRE UNITS BY NODE:

```
  0       0       0       0       0       0       0       0       0       0
  0       0       0       0       0       0       0       0       0       0
  0       0       0
```

LENGTH= 62 # INT.= 128,JREP=2, TOTAL DIST.= 0? # GOOD INT.= 52 # EQU INT = 118

PLACEMENT:

0	0	0	108	0	109	0	104	0	105	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	103
0	0	0	0	0	0	0	0	0	0	0	0	0
101	0	0	12	10	5	1	2	14	4	0	0	106
0	0	0	6	13	11	8	9	3	7	0	0	0
111	0	0	0	0	0	0	0	0	0	0	0	107
110	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	112	0	113	0	100	0	102	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0							

4 BIT ADDER PR2D TEST RUN PAGE NO. 9

LENGTH= 1, # INT.= 344,JRSP=4, TOTAL DIST.= 402, # GOOD INT.= 29, # EQU INT = 152

PLACEMENT:

0	0	0	108	0	109	0	106	0	104	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	107
0	0	0	0	0	0	0	0	0	0	0	0	0
101	0	0	1	6	10	4	9	3	14	0	0	105
0	0	0	11	5	13	12	2	8	7	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	103
110	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	112	0	111	0	102	0	113	0	0	0

TOTAL WIRE UNITS BY NODE:

3	5	7	8	4	8	4	4	1	24
18	24	26	38	8	10	18	24	18	24
24	24	78							

54	667	1	119	2	46	2	47	2	48	2	49	2	50	2	45	2	
55	52	1	45	3	51	3											
56	1031	1	125	2	46	5	57	4	58	4	67	3	47	5	59	4	45 5
57	107	1	46	3	52	3											
58	177	1	51	4	46	4	57	3	70	3							

LENGTH= 0, # INT.= 401,JR=P=4, TOTAL DIST.= 627, # GOOD INT.= 29, # EQU INT = 159

PLACEMENT:

0	0	0	108	0	109	0	106	0	104	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	107
0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	1	6	10	4	9	3	14	0	0	105
0	0	0	11	5	13	12	2	8	7	0	0	0
112	0	0	0	0	0	0	0	0	0	0	0	103
101	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	110	0	111	0	102	0	113	0	0	0

TOTAL WIRE UNITS BY NODE:

10	6	14	15	11	15	5	11	2	36
36	38	24	52	46	24	32	38	6	36
38	38	92							

```
ACTUAL WIRE UNITS =      143      143

TOTAL WIRE UNITS BY NODE:

   5       6       9      10       6      10       5       6       2       3
   3       4       7       6       8       7      11       9       4       3
   4       4      11

                                                                 END OF PLACEMENT.
```

START OF FIX1 SUBROUTINE!

END OF FIX1 SUBROUTINE.

START OF POST-PLACE SUBROUTINE:

Y DIMENSION --->

R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Row # 11

VDD 101 112 108

0 1 11 110

6 5

9 10 13 111

4 12

6 9 2 102

3 8

4 14 7 103

107 113 105 GND

```
ROW # 2.

                                                END OF POST-PLACE SUBROUTINE.
```

START OF ROUTE FUNCTION:

START SMASH1:

CELL RE-ORIENTATION / PIN RE-ASSIGNMENT:

ELEMENT NUMBER	ROW / ORIENT.	PIN WAS	RE-ASSIGNMENT CHANGED TO
2	.5	2	3
		3	2
5	.5	2	5
		5	2
7	.5		
9	.4		
12	.5		
13	.5		

END SMASH1.

START OF CENTER ROUTING:

END OF CENTER ROUTING.

START OF SIDE ROUTING:

END OF SIDE ROUTING.

END ROUTE FUNCTION.

START OF ART FUNCTION;

```
START ANALC1
END ANALC1.
```

START ANALS1
END ANALS1.

```
START PWR1
END PWR1.
```

```
START SORT1
END SORT1.
```

START ART1

ARTWORK INSTRUCTION DATA:

09250	400	*115	0	1
09800	0	0	0	2
09800	20	0	0	3
09820	40	0	0	4
09440	0	35	0	5
29010	307	101	100	6
29070	387	101	109	7
59010	423	101	106	8
59010	503	101	104	9
09210	695	105	0	10
09500	495	144	21	11
09500	575	151	14	12
09500	225	158	19	13
09500	435	158	18	14
09500	235	165	15	15
09500	295	165	15	16
09500	305	165	6	17
09500	385	165	22	18
09500	565	165	4	19
79110	101	172	0	20
09500	355	172	10	21
09500	405	172	4	22
09500	515	172	3	23
19010	699	172	107	24
09500	265	179	23	25
09500	395	179	18	26
09500	435	179	18	27
09500	555	179	8	28
09500	245	186	1	29
09500	275	186	1	30
09500	315	186	23	31
09500	325	186	5	32
09500	345	186	9	33
09500	425	186	9	34
09500	435	186	18	35
09500	455	186	4	36
09500	465	186	8	37
09500	505	186	17	38
02310	200	193	1	39
01330	260	193	6	40
01330	310	193	10	41
02310	360	193	4	42
41330	470	193	9	43
02310	470	193	3	44
02310	530	193	14	45
79010	101	252	101	46

19070	699	252	113	47
09500	169	256	5	48
09500	179	256	23	49
09500	189	256	1	50
09500	602	256	17	51
09500	612	256	8	52
09500	622	256	3	53
09500	632	256	4	54
09500	642	256	6	55
09500	169	270	5	56
09500	179	270	23	57

ARTWORK INSTRUCTION DATA:

09500	189	270	1	58
09500	602	270	17	59
09500	612	270	8	60
09500	622	270	3	61
09500	632	270	4	62
09500	642	270	6	63
39070	101	288	112	64
69010	699	288	105	65
79320	91	290	0	66
19310	709	290	0	67
09500	149	319	13	68
09500	162	326	23	69
09500	179	326	23	70
09500	602	326	17	71
09500	649	326	17	72
09500	149	333	13	73
59310	200	333	11	74
21240	310	333	5	75
29310	370	333	13	76
29310	430	333	12	77
29310	490	333	2	78
59330	490	333	8	79
29330	590	333	7	80
09500	235	340	1	81
09500	275	340	1	82
09500	285	340	3	83
09500	335	340	3	84
09500	395	340	2	85
09500	445	340	2	86
09500	465	340	16	87
09500	555	340	16	88
09500	225	347	23	89
09500	265	347	5	90
09500	295	347	2	91
09500	495	347	7	92
09500	505	347	3	93
09500	525	347	17	94
09500	305	354	4	95
09500	335	354	3	96
09500	345	354	7	97
09500	535	354	8	98
39010	101	368	108	99
09500	245	368	11	100
69100	699	368	0	101
09500	325	375	13	102
09500	385	375	12	103

09500	405	375	6	104
09500	495	375	7	105
09500	585	375	6	106
09500	445	382	2	107
09500	545	382	7	108
09500	575	382	2	109
09500	455	389	20	110
09500	555	396	16	111
09220	695	435	0	112
49070	307	439	110	113
49070	387	439	111	114

ARTWORK INSTRUCTION DATA:

```
    09010        423    439                                              102        115
    09010        503    439                                              103        116
    09250        400    655                                                0        117
                                                  END COMPONENTS                    118
                                                  SYMBOL                            119
      0 -196016H51ATL  2.IVL=1,   4 BIT ADDER  PR2D TEST RUN
                                                  END LEVEL1                        121
                                                  SYMBOL                            122
      0 -196016H51ATL  2.IVL=2,   4 BIT ADDER  PR2D TEST RUN
                                                  END LEVEL2                        124
                                                  LINE SET                          125
  17          10                                                                    126
       1    149    319                                                 13           127
       1    149    333                                                 13           128
       2    169    270                                                  5           129
       2    169    256                                                  5           130
       3    179    256                                                 23           131
       3    179    270                                                 23           132
       4    189    270                                                  1           133
       4    189    256                                                  1           134
       5    225    158                                                 19           135
       5    225    186                                                 19           136
       6    225    340                                                 23           137
       6    225    347                                                 23           138
       7    235    186                                                 15           139
       7    235    165                                                 15           140
       8    245    340                                                 11           141
       8    245    368                                                 11           142
       9    265    347                                                  5           143
       9    265    340                                                  5           144
      10    265    186                                                 23           145
      10    265    179                                                 23           146
      11    295    165                                                 15           147
      11    295    186                                                 15           148
      12    295    340                                                  2           149
      12    295    347                                                  2           150
      13    305    354                                                  4           151
      13    305    340                                                  4           152
      14    305    186                                                  6           153
      14    305    165                                                  6           154
      15    325    340                                                 13           155
      15    325    375                                                 13           156
      16    335    354                                                  3           157
      16    335    340                                                  3           158
      17    345    340                                                  7           159
      17    345    354                                                  7           160
```

18	355	186	10	161
18	355	172	10	162
19	385	165	22	163
19	385	186	22	164
20	385	340	12	165
20	385	375	12	166
21	395	186	18	167
21	395	179	18	168
22	405	172	4	169
22	405	186	4	170
23	405	340	6	171
23	405	375	6	172

ARTWORK INSTRUCTION DATA:

24	435	179	18	173
24	435	158	18	174
25	445	340	2	175
25	445	382	2	176
26	455	389	20	177
26	455	340	20	178
27	495	144	21	179
27	495	186	21	180
28	495	340	7	181
28	495	375	7	182
29	505	347	3	183
29	505	340	3	184
30	515	172	3	185
30	515	186	3	186
31	525	347	17	187
31	525	340	17	188
32	535	340	8	189
32	535	354	8	190
33	545	382	7	191
33	545	340	7	192
34	555	179	8	193
34	555	186	8	194
35	555	340	16	195
35	555	396	16	196
36	565	186	4	197
36	565	165	4	198
37	575	151	14	199
37	575	186	14	200
38	575	340	2	201
38	575	382	2	202
39	585	375	6	203
39	585	340	6	204
40	602	256	17	205
40	602	270	17	206
41	612	270	8	207
41	612	256	8	208
42	622	256	3	209
42	622	270	3	210
43	632	270	4	211
43	632	256	4	212
44	642	256	6	213
44	642	270	6	214
45	162	326	23	215
45	179	326	23	216
46	602	326	17	217
46	649	326	17	218

```
                                                              END LINE SET                     219
                                                              SYMBOL                           220
   0 -196016H51ATL   2.TVL-3,      4 BIT ADDER   PM2D TEST RUN
                                                              END LEVEL3                       222
                                                              SYMBOL                           223
   0 -196016H51ATL   2.TVL-4,      4 BIT ADDER   PM2D TEST RUN
                                                              END LEVEL4                       225
                                                              SHAPE SET                        226
2            10                                                                                227
 1       0      269                                                                            228
 2     -50      269                                                                            229
```

ARTWORK INSTRUCTION DATA:

	3	-50	590		230
	4	850	590		231
	5	850	249		232
	6	800	249		233
	7	800	540		234
	8	0	540		235
				SHAPE SET	236
	8	10			237
	1	0	271		238
	2	-50	271		239
	3	-50	-50		240
	4	850	-50		241
	5	850	271		242
	6	800	271		243
	7	800	0		244
	8	0	0		245
				SYMBOL	246
	0	.196016MS1ATL	2.TVL=5,	4 BIT ADDER PR2D TEST RUN	
				END LEVELS	248
				LINE SET	249
	14	10			250
	1	127	305	13	251
	1	127	308	13	252
	2	127	375	23	253
	2	127	378	23	254
	3	142	375	23	255
	3	142	326	23	256
	4	149	305	13	257
	4	149	319	13	258
	5	149	333	13	259
	5	149	361	13	260
	6	159	242	15	261
	6	159	165	15	262
	7	169	172	5	263
	7	169	256	5	264
	8	169	270	5	265
	8	169	354	5	266
	9	179	347	23	267
	9	179	270	23	268
	10	179	256	23	269
	10	179	179	23	270
	11	189	186	1	271
	11	189	256	1	272
	12	189	270	1	273
	12	189	340	1	274
	13	265	354	5	275
	13	265	347	5	276

14	287	348
14	287	413
15	295	375
15	295	341
16	297	197
16	297	158
17	305	348
17	305	354
18	315	179
18	315	186

11	277
11	278
13	279
13	280
19	281
19	282
4	283
4	284
23	285
23	286

ARTWORK INSTRUCTION DATA:

19	325	186	5	287
19	325	172	5	288
20	335	165	6	289
20	335	179	6	290
21	335	354	3	291
21	335	341	3	292
22	367	413	12	293
22	367	375	12	294
23	367	172	10	295
23	367	197	10	296
24	375	172	6	297
24	375	179	6	298
25	385	165	22	299
25	385	158	22	300
26	395	165	6	301
26	395	172	6	302
27	395	340	2	303
27	395	347	2	304
28	415	354	7	305
28	415	347	7	306
29	425	151	22	307
29	425	158	22	308
30	425	354	3	309
30	425	341	3	310
31	433	413	20	311
31	433	389	20	312
32	433	151	22	313
32	433	197	22	314
33	435	179	18	315
33	435	186	18	316
34	435	341	4	317
34	435	348	4	318
35	455	186	4	319
35	455	172	4	320
36	465	179	8	321
36	465	186	8	322
37	465	348	6	323
37	465	375	6	324
38	475	158	18	325
38	475	151	18	326
39	485	158	6	327
39	485	165	6	328
40	485	382	2	329
40	485	389	2	330
41	495	382	7	331
41	495	375	7	332

42	505	145
42	505	172
43	505	347
43	505	354
44	505	368
44	505	375
45	513	413
45	513	396
46	513	144
46	513	197
47	515	341
47	515	368

4	333
4	334
3	335
3	336
6	337
6	338
16	339
16	340
21	341
21	342
4	343
4	344

ARTWORK INSTRUCTION DATA:

48	525	341	3	345
48	525	354	3	346
49	565	144	18	347
49	565	151	18	348
50	575	389	2	349
50	575	382	2	350
51	602	186	17	351
51	602	256	17	352
52	602	270	17	353
52	602	347	17	354
53	612	354	8	355
53	612	270	8	356
54	612	256	8	357
54	612	179	8	358
55	622	172	3	359
55	622	256	3	360
56	622	270	3	361
56	622	341	3	362
57	632	348	4	363
57	632	270	4	364
58	632	256	4	365
58	632	145	4	366
59	642	158	6	367
59	642	256	6	368
60	642	270	6	369
60	642	375	6	370
61	652	396	17	371
61	652	298	17	372
62	652	235	14	373
62	652	151	14	374
63	659	144	18	375
63	659	145	18	376
64	673	235	14	377
64	673	232	14	378
65	673	145	18	379
65	673	142	18	380
66	495	144	21	381
66	513	144	21	382
67	565	144	18	383
67	659	144	18	384
68	652	151	14	385
68	575	151	14	386
69	565	151	18	387
69	475	151	18	388
70	433	151	22	389
70	425	151	22	390

71	225	148	19	391
71	297	148	19	392
72	385	148	22	393
72	425	148	22	394
73	435	148	18	395
73	475	148	18	396
74	485	148	6	397
74	642	148	6	398
75	673	148	18	399
75	659	148	18	400
76	632	148	4	401
76	505	148	4	402

ARTWORK INSTRUCTION DATA:

77	485	165	6	403
77	395	165	6	404
78	335	165	6	405
78	305	165	6	406
79	295	165	15	407
79	159	165	15	408
80	169	172	5	409
80	325	172	5	410
81	355	172	10	411
81	367	172	10	412
82	375	172	6	413
82	395	172	6	414
83	405	172	4	415
83	505	172	4	416
84	515	172	3	417
84	622	172	3	418
85	612	179	8	419
85	465	179	8	420
86	435	179	18	421
86	395	179	18	422
87	375	179	6	423
87	335	179	6	424
88	315	179	23	425
88	179	179	23	426
89	189	1A6	1	427
89	275	1A6	1	428
90	345	1A6	9	429
90	425	1A6	9	430
91	505	1A6	17	431
91	602	1A6	17	432
92	673	235	14	433
92	652	235	14	434
93	127	242	15	435
93	159	242	15	436
94	673	298	17	437
94	652	298	17	438
95	127	305	13	439
95	149	305	13	440
96	652	396	17	441
96	649	396	17	442
97	162	396	23	443
97	142	396	23	444
98	189	340	1	445
98	275	340	1	446
99	285	340	3	447
99	335	340	3	448

100	395	340
100	445	340
101	465	340
101	555	340
102	602	347
102	525	347
103	495	347
103	415	347
104	395	347
104	295	347
105	225	347
105	179	347

2	449
2	450
16	451
16	452
17	453
17	454
7	455
7	456
2	457
2	458
23	459
23	460

ARTWORK INSTRUCTION DATA:

106	169	354		5	461
106	265	354		5	462
107	345	354		7	463
107	415	354		7	464
108	425	354		3	465
108	525	354		3	466
109	535	354		8	467
109	612	354		8	468
110	622	341		3	469
110	525	341		3	470
111	515	341		4	471
111	435	341		4	472
112	425	341		3	473
112	335	341		3	474
113	295	341		13	475
113	149	341		13	476
114	245	348		11	477
114	287	348		11	478
115	305	348		4	479
115	435	348		4	480
116	465	348		6	481
116	505	348		6	482
117	515	348		4	483
117	692	348		4	484
118	642	375		6	485
118	505	375		6	486
119	465	375		6	487
119	405	375		6	488
120	385	375		12	489
120	367	375		12	490
121	325	375		13	491
121	295	375		13	492
122	142	375		23	493
122	127	375		23	494
123	445	3A2		2	495
123	485	3A2		2	496
124	495	3A2		7	497
124	545	3A2		7	498
125	575	3A9		2	499
125	485	3A9		2	500
126	455	3A9		20	501
126	433	3A9		20	502
127	513	396		16	503
127	555	396		16	504
			END LINE SET		505
			LINE SET		506

14		10			507
	1	99	172	0	508
	1	99	441	0	509
	2	595	193	0	510
	2	595	333	0	511
	3	688	112	0	512
	3	688	441	0	513
	4	122	112	0	514
	4	688	112	0	515
	5	200	193	0	516
	5	595	193	0	517

ARTWORK INSTRUCTION DATA:

```
          6    595    263                                       0        518
          6    688    263                                       0        519
          7    200    333                                       0        520
          7    595    333                                       0        521
          8     99    441                                       0        522
          8    688    441                                       0        523
                                        END LINE SET                     524
                                        LINE SET                         525
     14         10                                                       526
          1    112     49                                       0        527
          1    112    428                                       0        528
          2    701     49                                       0        529
          2    701    368                                       0        530
          3    112     49                                       0        531
          3    701     49                                       0        532
          4    112    263                                       0        533
          4    587    263                                       0        534
          5    112    428                                       0        535
          5    678    428                                       0        536
                                        END LINE SET                     537
                                        SYMBOL                           538
           0 -196016H51ATL  2.TVL-6,   4 BIT ADDER PR2D TEST RUN
                                        END LEVEL6                       540
                                        SHAPE SET                        541
        8        10                                                      542
          1      0    269                                                543
          2    -50    269                                                544
          3    -50    590                                                545
          4    850    590                                                546
          5    850    269                                                547
          6    800    269                                                548
          7    800    540                                                549
          8      0    540                                                550
                                        SHAPE SET                        551
        8        10                                                      552
          1      0    271                                                553
          2    -50    271                                                554
          3    -50    -50                                                555
          4    850    -50                                                556
          5    850    271                                                557
          6    800    271                                                558
          7    800      0                                                559
          8      0      0                                                560
                                        SYMBOL                           561
           0 -196016H51ATL  2.TVL-7,   4 BIT ADDER PR2D TEST RUN
                                        END LEVEL7                       563
```

```
END ART1.
```

CHIP STATISTICS:

X-STEP = 85, Y-STEP = 59

.65 INCHES OF METAL, .10 INCHES OF TUNNEL, AND 77 TUNNEL E

CELL ROW:	LINEAR MILS:	TOTAL LINEAR MILS:
4	39.0	
5	39.0	
		78.0

CHIP AREA SQ. MILS	CELL AREA SQ. MILS	CELL AREA O/O	B.P. AREA SQ. MILS	B.P. AREA O/O	WIRING AREA SQ. MILS	WIRING AREA O/O	WIRING EFFECT SQ. MILS	WIRING EFFECT O/O
5015.0	546.0	10.9	2993.8	59.7	1475.2	29.4	553.4	37.5

PATTERN NUMBER	NUMBER DEVICES	TIMES USED	TOTAL DEVICES
1240	8	1	
1330	6	5	
2310	8	8	
9010	0	9	
9070	2	5	

112

NODE LIST:

NODE NO.	CAP. PF	NODE WT.	ELEM	PIN	ELEM	PIN	ELEM	PIN	...	
1	95	1	1	4	6	3	11	3	5	5
2	143	1	2	4	7	3	12	3	5	3
3	190	1	3	4	8	3	13	3	5	4
4	225	1	4	4	9	3	14	3	5	2
5	115	1	5	4	10	3				
6	258	1	6	R	12	2	7	2		
7	122	1	7	R	13	2	8	2		
8	122	1	8	R	14	2	9	2		
9	24	1	9	R	10	4				
10	25	2	10	R	109	2				
11	41	2	11	4	110	2				
12	40	2	12	4	111	2				
13	97	2	13	4	112	2				
14	65	2	14	4	113	2				
15	86	2	101	2	1	3	6	4		
16	80	2	103	2	2	2	7	4		
17	148	2	105	2	3	3	8	4		
18	99	2	107	2	4	3	9	4		
19	44	2	100	2	1	2				
20	47	2	102	2	2	3				
21	40	2	104	2	3	2				
22	36	2	106	2	4	2				
23	147	2	108	2	6	2	11	2	10	2

CENTER SECTION = 3

ELEM PIN

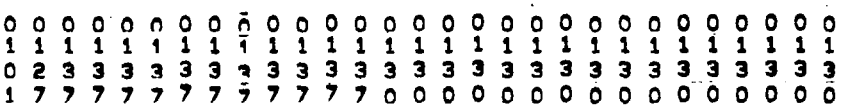
```
                0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
                1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                0 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
                1 7 7 7 7 7 7 7 7 7 7 7 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  169
  175
  185
  195
  205
  215
  225
  235
  245
  255
  265
  275
  285
  297 100   2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
  305
  315
  325
  335
  345
```

355
367 109 2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
375
385
395
405
415
425
433 106 2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
445
455
465
475
485
495
505
513 106 2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
525
535
545
555
565
575
585
595
605
615

625

635

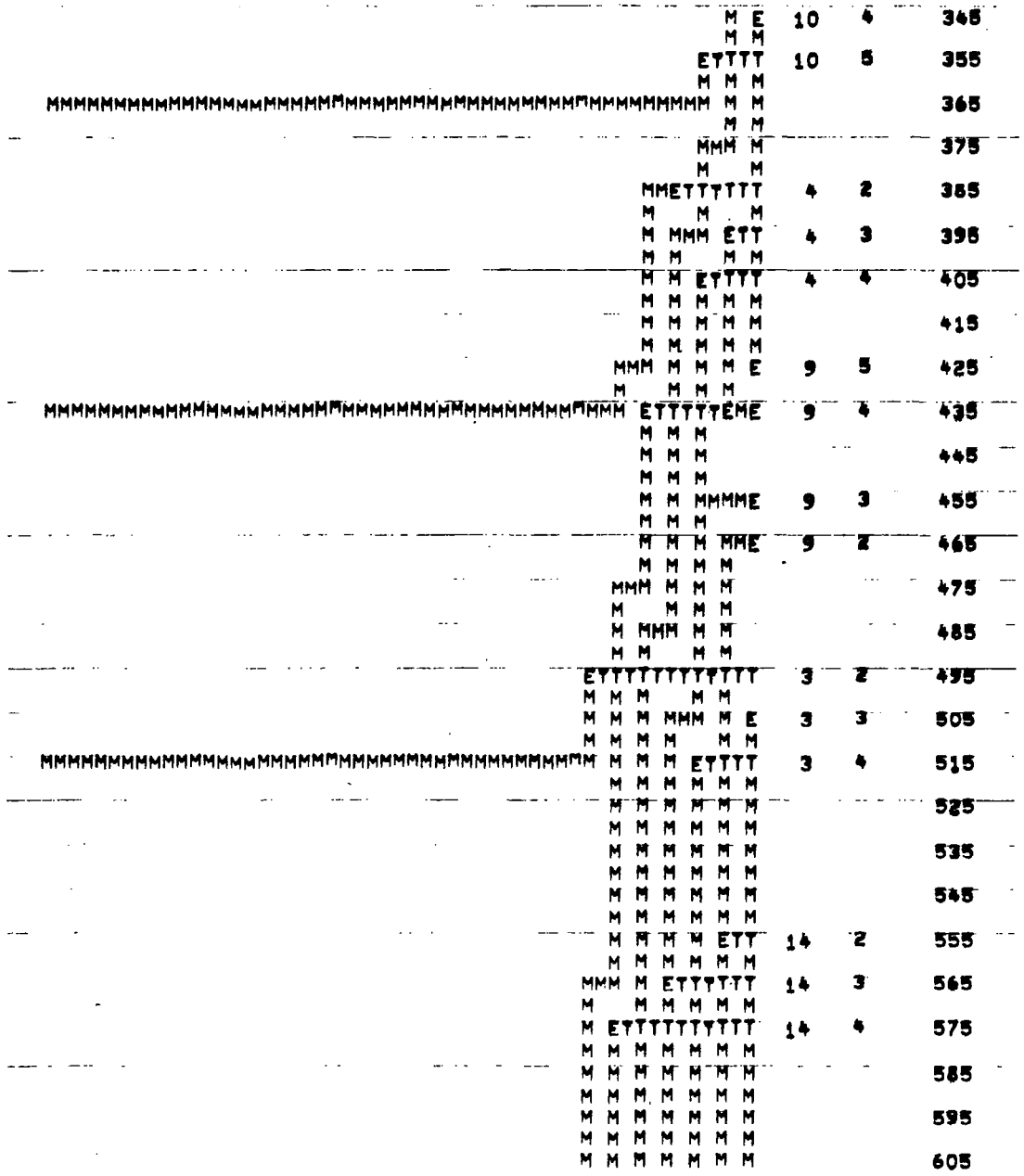
642

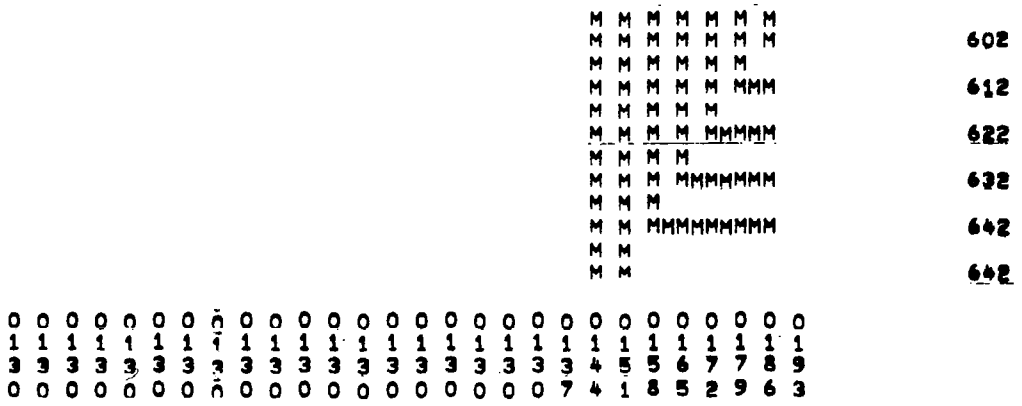


CENTER SECTION # 4

```
                                                     ELEM PIN

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 4 5 5 6 7 7 8 9
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 7 4 1 8 5 2 9 6 3
                                              M                    169
                                              M
                                              M MMMMM              169
                                              M M
                                              M M MMM              179
                                              M M M
                                              M M M M              189
                                              M M M M
                                              M M M M              195
                                              M M M M
                                              M M M M              205
                                              M M M M
                                              M M M M              215
                                              M M M M
                                            ETTTTTTTT   1   2      225
                                            M M M M M
                                            M ETTTTTTT  1   3      235
                                            M M M M M
                                            M M M M E   1   4      245
                                            M M M M M
                                            M M M M M              255
                                            M M M M M
                                            M M M ETT   6   2      265
                                            M M M M M
                                            M M M M E   6   3      275
                                            M M M M
                                            M M M M                285
                                            M M M M
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM ETTTTTTT  6   4      295
                                                M M
                                              ETTTTTTT  6   5      305
                                              M M M
                                              M M MME  10   2      315
                                              M M
                                              M MMMME  10   3      325
                                              M
                                              MMMMM                335
                                                  M
```

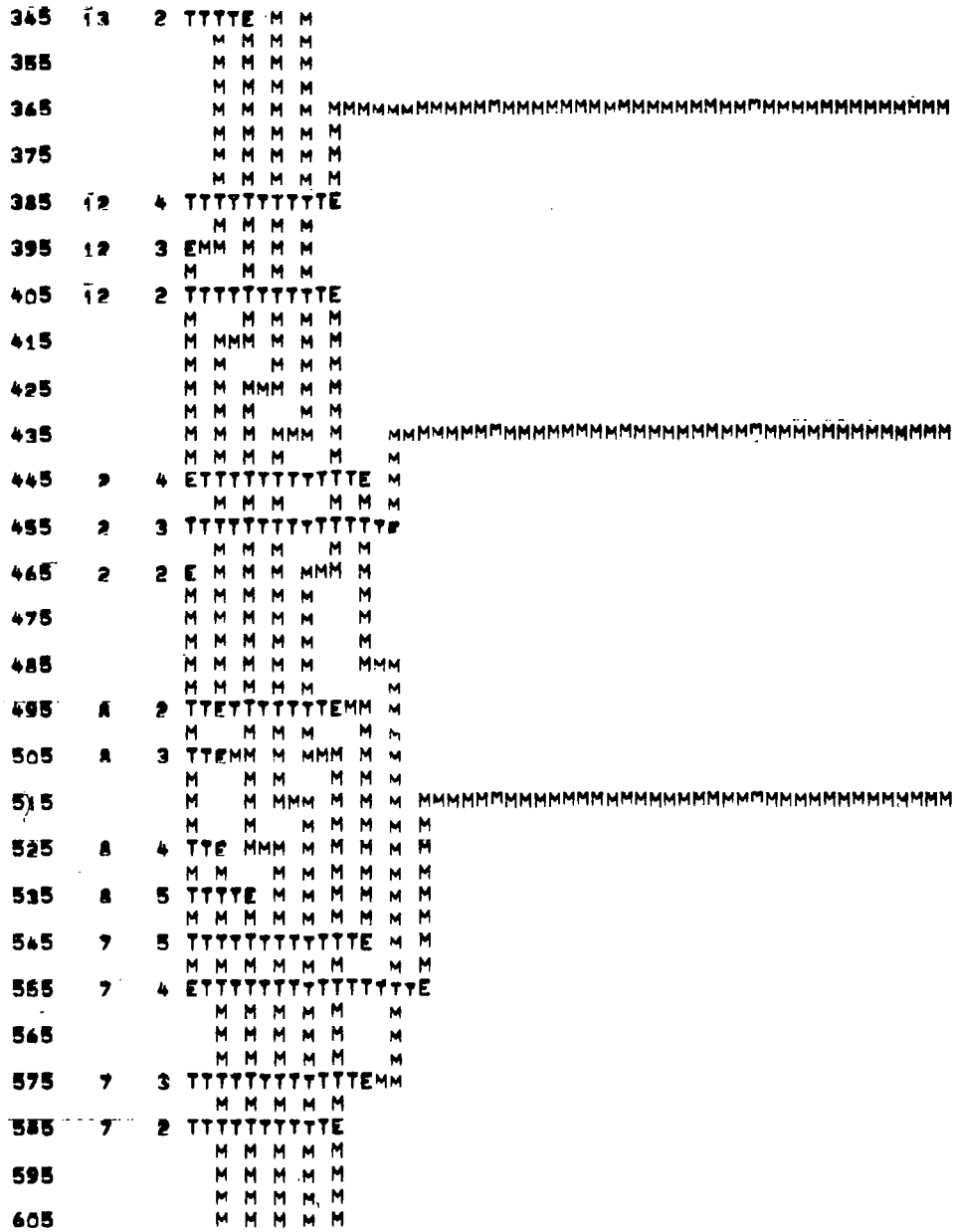

10 4 345
10 5 355
365
375
385
4 2
395
4 3
405
4 4
415
425
9 5
435
9 4
445
455
9 3
465
9 2
475
485
495
3 2
505
3 3
515
3 4
525
535
545
555
14 2
565
14 3
575
14 4
585
595
605


602
612
622
632
642
648

CENTER SECTION = 5

ELEM PIN

```
         0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
         3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
         3 4 4 5 6 6 7 8 R 9 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
         3 0 7 4 1 R 5 2 9 6 3 0 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
169              M
                 M
169        MMMMM M
               M M
179        MMM M M
             M M M
189        M M M M
           M M M M
195        M M M M
           M M M M
205        M M M M
           M M M M
215        M M M M
           M M M M
225  11  2 TTE M M
           M   M M
235  11  3 E   M M
           M   M M
245  11  4 TTTTTTTTF
           M   M M M
255        M   M M M
           M   M M M
265   5  6 TTFMM M M
           M     M M
275   5  5 E     M M
                 M M
285   5  4 E     M MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
           M     M
295   5  3 TTE   MMMMM
           M M       M
305   5  2 TTTTEMMMM M
           M M     M M
315        M M     M M
           M M     M M
325  13  4 TTTTTTTTTTE
           M M     M
335  13  3 ETTTEMM M
             M   M M
```



```
                M M M M M
602           MMM M M M M
                  M M M M
612           MMMMM M M M
                    M M M
622           MMMMMMM M M
                      M M
632           MMMMMMMMM M
                        M
642           MMMMMMMMMMM

642

          0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
          3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
          3 4 4 5 6 6 7 8 8 9 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
          3 0 7 4 1 8 5 2 9 6 3 0 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
```

CENTER SECTION = 6

```
                                                                          ELEM PIN

       0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
       4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3
       7 7 7 7 7 7 7 7 7 7 7 7 7 7 0 0 0 0 0 0 0 0 0 0 0 0 3 9
                                                                                    169
                                                                                    169
                                                                                    179
                                                                                    189
                                                                                    195
                                                                                    205
                                                                                    215
                                                                                    225
                                                                                    235
                                                                                    245
                                                                                    255
                                                                                    265
                                                                                    275
       MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 110    2            287
                                                                                    295
                                                                                    305
                                                                                    315
                                                                                    325
                                                                                    335
```

345
355
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 111 2 367
375
385
395
405
415
425
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 102 2 433
445
455
465
475
485
495
505
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 103 2 513
525
535
545
555
565
575
585
595
605

602

612

622

632

642

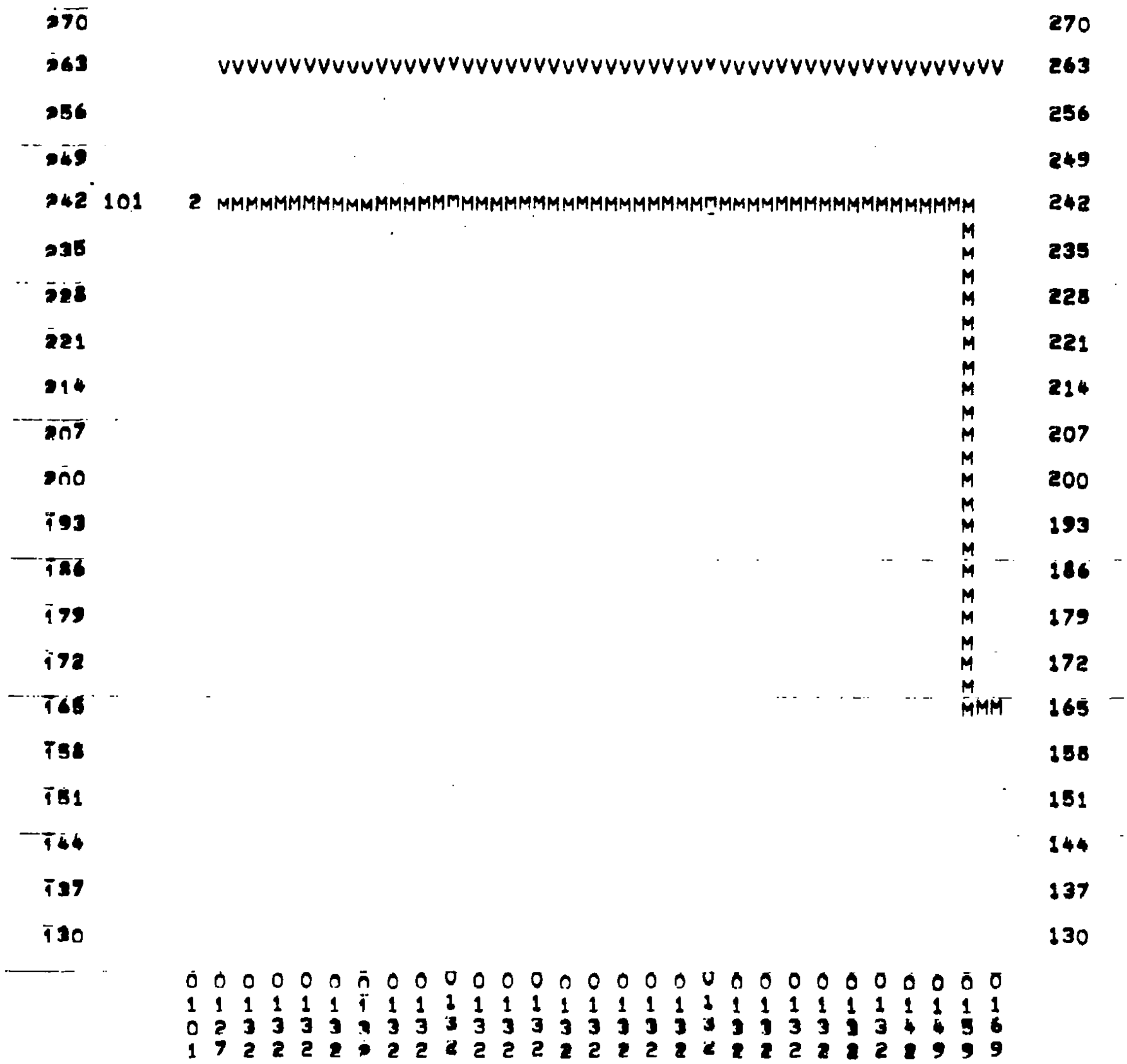
642

```
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3
7 7 7 7 7 7 7 7 7 7 7 7 7 7 0 0 0 0 0 0 0 0 0 0 0 0 3 3 9
```

```
LEFT SIDE, ROW #  1

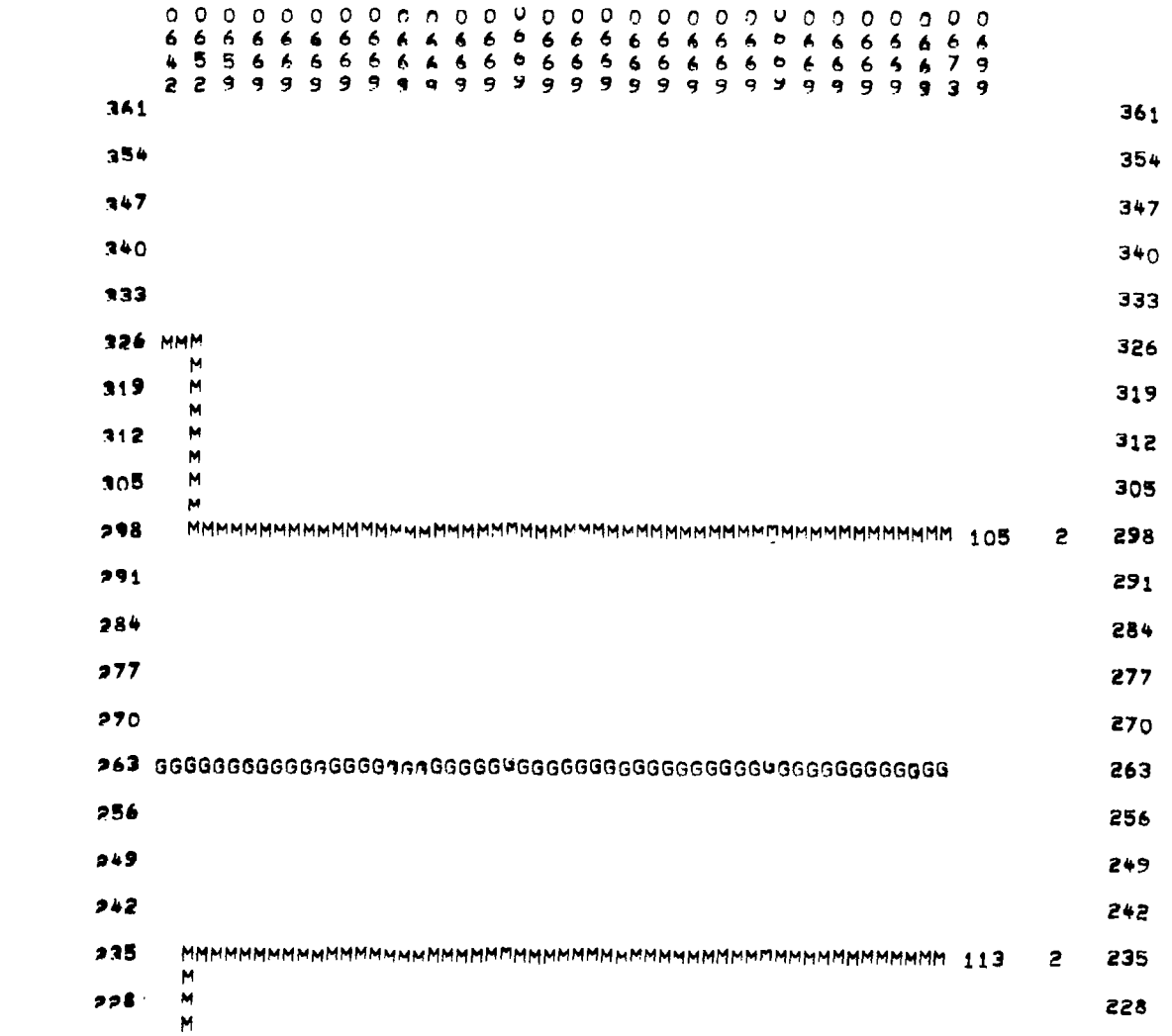
        ELEM PIN

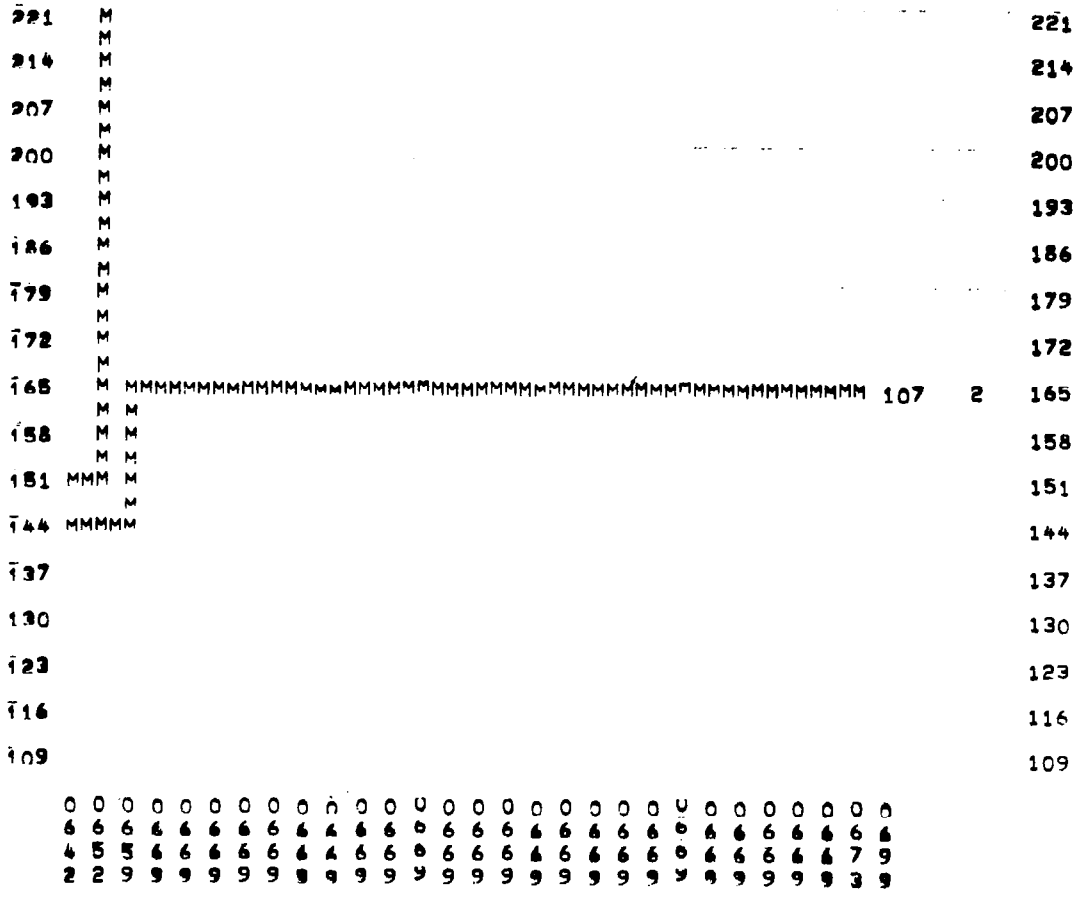
               0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
               1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
               0  2  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  4  4  5  6
               1  7  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  9  9  9
   410                                                                                                   410
   403                                                                                                   403
   396                                                                                                   396
   389                                                                                                   389
   382                                                                                                   382
   375 108     2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM              375
                                                                                          M
   368                                                                                    M              368
                                                                                          M
   361                                                                                    M MMMMM        361
                                                                                          M M
   354                                                                                    M M            354
                                                                                          M M
   347                                                                                    M M            347
                                                                                          M M
   340                                                                                    M M            340
                                                                                          M M
   333                                                                                    M E            333
                                                                                          M T
   326                                                                                    MMTMMMM        326
                                                                                            T
   319                                                                                      E            319
                                                                                            M
   312                                                                                      M            312
                                                                                            M
   305 112     2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM            305
   298                                                                                                   298
   291                                                                                                   291
   284                                                                                                   284
   277                                                                                                   277
```


270
263
256
249
242 101 2
235
228
221
214
207
200
193
186
179
172
165
158
151
144
137
130
0101 0127 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0132 0142 0149 0159 0169

RIGHT SIDE, ROW = 2

ELEM PIN




221
214
207
200
193
186
179
172
165
158
151
144
137
130
123
116
109
107
2
0645 0652 0659 0666 0673 0680 0687 0694 0701 0708 0715 0722 0729 0736 0743 0750 0757 0764 0771 0778 0785 0792 0799 0806 0813 0820 0827 0834 0841 0848 0855 0862 0869 0876 0883 0890 0897 0904 0911 0918 0925 0932 0939 0946 0953 0960 0967 0974 0981 0988 0995

NODE CROSSOVER COUNT:

NODE NUMBER	NUMBER CROSSOVERS
1	7
2	18
3	20
4	22
5	8
6	23
7	15
8	13
9	4
10	2
11	3
12	4
13	5
14	5
15	6
16	11
17	15
18	5
19	4
20	5

NODE CROSSOVER COUNT:

NODE NUMBER	NUMBER CROSSOVERS
22	2
23	9

END OF PLOT.
END OF ART FUNCTION.

START OF WRITE FUNCTION.

START OF DEBUG SUBROUTINE.

CAP(IX)=

I + J	1	2	3	4	5	6	7	8	9	10
0	7	15	20	22	8	23	15	13	4	2
10	3	4	5	5	6	11	15	5	4	5
20	4	2	9	0	0	0	0	0	0	0

NPS(IX,IY)=

I J =	1	2	3	4	5	6	7
1	4	4	4800	4961	0	4	16
2	8	5	5090	5061	0	-5	16
3	9	4	5070	4961	0	4	16
4	7	4	4960	4961	0	4	16
5	5	5	4910	5061	0	-5	1
6	5	4	4860	4961	0	4	9
7	10	5	5190	5061	0	-5	9
8	9	5	5090	5061	0	5	9
9	8	4	5070	4961	0	-4	9
10	6	4	4910	4961	0	4	9
11	4	5	4800	5061	0	5	16
12	7	5	5030	5061	0	-5	16
13	6	5	4970	5061	0	-5	16
14	10	4	5130	4961	0	4	16
100	4	1	4907	4829	1	-3	22
101	1	4	4701	4980	2	-1	22
102	8	8	5023	5167	3	6	22
103	10	8	5103	5167	4	6	22
104	10	1	5103	4849	4	3	22
105	13	6	5299	5016	3	2	22
106	8	1	5023	4829	3	3	22
107	13	2	5299	4900	1	-2	22
108	1	7	4701	5096	4	1	22
109	6	1	4987	4829	2	-3	26
110	4	8	4907	5167	1	-6	26
111	6	8	4987	5167	2	-6	26
112	1	6	4701	5016	3	1	26
113	13	4	5299	4900	2	-2	26

P(I,X)

I \ X	1	2	3	4	5	6	7	8	9	10
0	100	50	120	215	330	480	670	900	1250	1750
10	2400	3200	4100	2	4	10000	5	35	0	45
20	50	10	15	20	25	55	60	0	0	7
30	0	0	6	3	5	1	1	0	1	0
40	1	2	2790	5000	6000	7000	7500	8000	8500	9000
50	10000	1	1	1	2	1	0	0	2	1
60	2	1	55	0	0	2	1	0	0	1
100	40	2	1	2	3	0	2	10	1	6
110	0	1	4	5	1	1	2	4	2	3
120	100	0	5	0	2	0	2	2	0	1
130	100	0	0	0	0	0	0	0	0	0
140	50	7	10	40	98	98	5000	1	20	3
150	70	-7	14	12	10	36	32	4	0	10
160	0	0	0	0	0	0	3	2	0	0
170	-26	11	3	-7	0	0	0	0	0	0
190	20	4701	3	7	0	0	175	4823	0	0
200	225	356	0	0	0	1	2	7	0	0
210	0	5299	6	1	0	0	175	4823	0	0
220	225	356	0	0	0	13	2	7	0	0
230	0	4829	5	2	0	0	82	4820	0	0
240	117	356	0	0	0	1	4	10	0	0
250	0	4921	0	4	3	5	80	4800	78	121
260	119	390	4789	5202	1	4	4	10	3	4769
270	5242	5061	5	2	3	5	80	4800	78	121
280	119	390	4789	5202	1	5	4	10	6	4769
290	5242	5167	0	4	0	0	82	4820	0	0
300	117	356	0	0	0	8	4	10	0	0
310	0	0	5	2	0	0	0	0	0	0
330	0	0	0	4	0	0	0	0	0	0
350	0	0	5	2	0	0	0	0	0	0
370	0	0	0	4	0	0	0	0	0	0
390	0	0	5	2	0	0	0	0	0	0
410	0	0	0	4	0	0	0	0	0	0
430	0	0	5	2	0	0	0	0	0	0
450	0	0	0	4	0	0	0	0	0	0
470	0	0	5	2	0	0	0	0	0	0
490	0	0	0	4	0	0	0	0	0	0
510	0	0	5	2	0	0	0	0	0	0
530	0	0	0	4	0	0	0	0	0	0
550	0	0	5	2	0	0	0	0	0	0
570	0	0	0	4	0	0	0	0	0	0
590	0	0	5	2	0	0	0	0	0	0
610	0	0	0	4	0	0	0	0	0	0
630	0	0	5	2	0	0	0	0	0	0
650	0	0	0	4	0	0	0	0	0	0
680	120	850	590	85	170	150	100	10	9000	500

690	18	30	60	126	0	6	126	0	7	116
700	20	1	116	20	7	105	1	0	0	1
710	25	60	0	45	20	0	0	0	270	425
720	295	0	60	14	80	10	10	17	70	14
730	14	425	295	100	230	360	461	562	5	2
740	117	54	157	11	8	0	0	0	14	90
750	0	3	3	8	8	12	12	3	3	2
760	2	0	0	137	137	124	124	126	126	0
770	16	10	2	0	1	0	0	0	50	5
800	40	9010	9010	9000	9100	9510	9500	9250	0	9100
810	9110	9310	9320	9210	9220	0	0	9450	9440	9800
840	20	2	7	38	6465	0	1009	0	77	0

IPIN(IX,IY)I

I J *	1	2	3
1	1240	7	9
3	1	0	0
4	1	10	0
5	1	20	0
6	1	30	0
7	10	40	0
8	*8	50	70
9	1230	6	16
11	1	0	0
12	2	10	0
13	3	30	0
14	10	40	0
15	*6	50	70
16	2310	5	22
18	1	20	0
19	1	30	0
20	10	40	0
21	*8	60	70
22	9010	3	26
24	10	10	0
25	0	80	90
26	9070	3	0
28	10	20	0
29	*2	80	90

0	0	400	0	0	0	0	10000	0	1	10000
10	0	500	7	1	2	3	4	5	6	7
20	9000	43	200	3	3	1	2	3	0	1000
30	0	1	-1	0	500	1	101	141	191	681
40	801	841	0	0	0	0	0	0	9	4000
50	6	1	2	3	4	5	6	2	0	1
60	0	103	0	0	271	0	29	0	24	100
70	70	3	4	2	1	0	2	2	0	0
80	0	80	56	143	291	81	4	0	0	0
90	0	0	0	0	1	0	100	24	13	8
100	0	100	461	390	230	562	563	0	5167	4701
110	5999	4829	100	70	100	99	24	6	29	2
120	28	1	28	175	225	143	80	119	82	118
130	3	147	2	5185	58	56	59	31	177	213
140	5124	3	7	5	10	0	0	0	0	0
150	0	0	0	12000	100	200	2	198	1	199
160	30	60	2	58	4	56	1	59	3	57
170	28	0	3	300	14	256	57	3	2000	3
180	0	2	1	0	0	15	1	29	3	2
190	30	28	27	29	1	2	28	1	200	400
200	399	8	4600	111	1	288	289	28	5980	4728
210	9	-1	207	399	207	209	0	40	80	0
220	0	0	100	70	1	10000	5290	5237	510	0
230	5000	4998	0	4701	4764	0	0	19	4	5
240	113	113	10	2	4	29	0	0	0	0
250	0	0	303	47	28	29	14	4	400	0
260	0	23	23	401	4000	17	217	4000	14	8
270	6	1000	38	7	7	1	2	3	4	5
280	6	7	4820	3605	-5	255	4800	5	4820	82
290	80	82	3	171	1	399	3	0	0	0

NODF(IX)I

I + 1	1	2	3	4	5	6	7	8	9	10
0	1	1	4	4	2	5	1	101	1	0
10	0	0	0	0	3	0	0	0	0	

NODE(IX) / NOD(IX)I

I + 1	1	2	3	4	5	6	7	8	9	10
0	10	5	11	1	1	4	6	3	11	3
10	5	5	6	6	23	1	2	4	7	3

```
  12    3     5     3    14    9    35    1     3
   8    3    13     3     5    4    15   10    47
   4    4     9     3    14    3     5    2    11
  55    1     5     6    10    3    15   10    65
   6    5    12     2     7    2     5    5    75
   7    5    13     2     8    2    11    6    85
   8    5    14     2     9    2     2    2    93
   9    5    10     4    36    6   101    2    10
 109    2    36     6   109    2    11    4   110
  38    8   117     2    12    4   111    2    24
 125    2    13     4   112    2    52   12   133
  14    4   113     2    46   16   143    2   101
   1    3     6     4    24   14   153    2   103
   2    2     7     4    32   22   163    2   105
   3    3     8     4    38   18   173    2   107
   4    3     9     4     8    8   181    2   100
   1    2    36     6   189    2   102    2     2
  38    8   197     2   104    2     3    2    38
 205    2   106     2     4    2    92   22   217
 108    2     6     2    11    2    10    2     0
                 END OF DEBUG SUBROUTINE.
                 END OF WRITE FUNCTION.
```

```
PCL
DELETE N8T810
** 1 FILES DELETED, 204 GRANULES
DELETE N8T815
** 1 FILES DELETED, 204 GRANULES
DELETE N8T820
** 1 FILES DELETED, 2 GRANULES
DELETE DEC8DE
** 1 FILES DELETED, 1 GRANULES
DELETE AWRK2C
** 1 FILES DELETED, 9 GRANULES
END
PCL PROCESSING TERMINATED
```

```
EOD
```

HONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEY
HONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEY

```
23:40 MAY 10,'78 ID=0088
ELAPSED JOB TIME                00:20:00
PARTITION NUMBER                    12
TOTAL CPU TIME                   5.4609
  PROCESSOR EXECUTION TIME        .0102
  PROCESSOR SERVICE TIME          .0357
  USER EXECUTION TIME            5.4922
  USER SERVICE TIME               .4229
CARDS:  CARDS READ                  91
PAGES:  PROCESSOR PAGES              9
        USER PAGES                  73
CORE:   PEAK CORE(PAGES)           112
        PAGE-MINUTES           619.7688
I/O:    OPERATIONS                2230
        CALS                     17504
FILE SPACE
  AVLBL RAD PERMANENT               64
  NET DISK PERMANENT                53
  AVLBL DISK PERMANENT            1030
RESOURCES ALLOCATED
  CO=120(PAGES)
```

B. C015 — Programmable Timer

```
 08:32 JUL 13,'78 ID=068A
JOB MS01,EC45020(OAST/CAD),1
LIMIT (TIME,30),(CORE,60),(7T,1),(9T,1)
ASSIGN F:6,(DEVICE,LO)
ASSIGN F:1,(FILE,DECODE),(OUTIN)
ASSIGN F:5,(DEVICE,SI)
ASSIGN F:10,(FILE,NOTO10),(OUTIN)
ASSIGN F:15,(FILE,NOTO15),(OUTIN)
ASSIGN F:20,(FILE,NOTO20),(OUTIN)
ASSIGN F:25,(FILE,NOTO25),(OUTIN)
ASSIGN F:30,(FILE,DESIGN),(IN)
ASSIGN F:35,(FILE,COMON1),(OUT),(SAVE)
ASSIGN F:40,(FILE,COMON2),(IN)
ASSIGN F:45,(FILE,MGBWPDFE,GOULD),(IN)
ASSIGN F:50,(FILE,MGBWPDFM),(OUT),(SAVE)
ASSIGN F:55,(FILE,AWRK1X),(OUTIN),(SAVE)
ASSIGN F:60,(FILE,AWRK2C),(OUTIN),(SAVE)
PCL
 COPY C015 TO LP
!JOB MS01,EC45020(OAST/CAD),1
!LIMIT (TIME,30),(CORE,60),(7T,1),(9T,1)
!ASSIGN F:6,(DEVICE,LO)
!ASSIGN F:1,(FILE,DECODE),(OUTIN)
!ASSIGN F:5,(DEVICE,SI)
!ASSIGN F:10,(FILE,NOTO10),(OUTIN)
!ASSIGN F:15,(FILE,NOTO15),(OUTIN)
!ASSIGN F:20,(FILE,NOTO20),(OUTIN)
!ASSIGN F:25,(FILE,NOTO25),(OUTIN)
!ASSIGN F:30,(FILE,DESIGN),(IN)
!ASSIGN F:35,(FILE,COMON1),(OUT),(SAVE)
!ASSIGN F:40,(FILE,COMON2),(IN)
!ASSIGN F:45,(FILE,MGBWPDFE,GOULD),(IN)
!ASSIGN F:50,(FILE,MGBWPDFM),(OUT),(SAVE)
!ASSIGN F:55,(FILE,AWRK1X),(OUTIN),(SAVE)
!ASSIGN F:60,(FILE,AWRK2C),(OUTIN),(SAVE)
!PCL
 COPY C015 TO LP
 END
!RUN (LMN,LMPR2DC,GOULD)
!DATA
 1 1 4 4  15   1   1 102   1   0   0                1                   1
0  1  50   1
0 27   1   1
0 34   1   1
0 53   1   1
0 54   3   1
0 68   1   1
2  3 200   1
2  4  50   1
2  5  50   1
2 26   4   1
4  11000   1
4  21000   1
4  3  50   1
4  9 200   1
4 13 300   1
4 14 260   1
4 16 120   1
4 17 260   1
4 19 170   1
4 20 150   1
```

```
4 22 170    1
4 23 100    1
4 26   1    1
4 27   0    1
4 30 100    1
4 31 100    1
4 33 100    1
4 47  17    1
4 49  14    1
4 50  14    1
4 68  14    1
4 83 210    1
4 84 210    1
4 85 210    1
4 86 210    1
4 87 221    1
4 88 221    1
4 91  10    1
5 179450    1
5 189440    1
5 199800    0
TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78, FELTNER - GOULD
   11520          21520          31520          41620
   51330          61330          71330          81330
   91330         101330         111330         121330
  131330         141330         151330         161330
  171820         181820         191820         201820
  211820         221820         231820         241820
  251820         261820         271820         281820
  291120         301120         311120         321120
  331120         341120         351120         361120
  371120         381120         391120         401120
  411520         421820         431720         441240
  451330         461330         471330         481330
  491330         501330         511820         521820
  531820         541820         551820         561820
  571120         581120         591120         601120
  611120         621120         631520         641820
  651220         661120         671220         681310
  691520         702310         712310         722310
  732310         742310         752310         761130
  771130         781220         791520         801310
  811520         821820         831720         841120
  851620         861830         871830         881830
  891830         901830         911830         929030
  939020         949020         959030         969030
  979030         989030         999030        1009030
 1019030        1029020        1039030        1049020
 1059020        1061120        1071120        1081310
 1091720        1101620        1111520        1121520
 1131520        1141230        1151120        1161520
 1171520        1181520        1191520        1201820
 1211820        1221520        1231520        1241520
 1251520        1261520
   1  1  2  2  3  94  2
   1  1  3 112  2  93  2
   1  2  2  3  3  42  3  64  3
   1  3  2  4  3  82  3 120  3 121  3
   1  4  2  5  4  67  4
   1  4  4 118  2  86  3  87  3  88  3  89  3  90  3  91  3
   1  5  2  6  2   7  2   8  2   9  2  10  2 124  2
```

1	11	2	12	2	13	2	14	2	15	2	16	2	123	2					
1	5	3	17	3															
1	6	3	18	3															
1	7	3	19	3															
1	8	3	20	3															
1	9	3	21	3															
1	10	3	22	3															
1	11	3	23	3															
1	12	3	24	3															
1	13	3	25	3															
1	14	3	26	3															
1	15	3	27	3															
1	16	3	28	3															
1	5	5	6	5	7	5	8	5	29	4	30	4	31	4	32	4	113		
		2																	
1	6	4	17	4	29	3	114	5											
1	7	4	18	4	30	3	114	4											
1	8	4	19	4	31	3	114	3											
1	9	4	20	4	32	3	44	3											
1	9	5	10	5	11	5	12	5	33	4	34	4	35	4	36	4	116		
		2																	
1	10	4	21	4	33	3													
1	11	4	22	4	34	3													
1	12	4	23	4	35	3													
1	13	4	24	4	36	3													
1	13	5	14	5	15	5	16	5	37	4	38	4	39	4	40	4	117		
		2	121	2															
1	14	4	25	4	37	3													
1	15	4	26	4	38	3	44	4											
1	16	4	27	4	39	3	44	5											
1	17	2	29	2															
1	18	2	30	2															
1	19	2	31	2															
1	20	2	32	2															
1	21	2	33	2															
1	22	2	34	2															
1	23	2	35	2															
1	24	2	36	2															
1	25	2	37	2															
1	26	2	38	2															
1	27	2	39	2															
1	28	2	40	2															
1	28	4	40	3	44	6	45	4											
1	41	2	113	3	116	3	117	3											
1	41	3	42	4															
1	42	2	43	2															
1	43	3	115	2															
1	64	2	43	4	65	2													
1	44	2	115	4															
1	45	2	46	2	47	2	48	2	49	2	50	2	119	2					
1	45	3	51	3															
1	45	5	46	5	57	4	58	4	67	3	47	5	59	4	125	2			
1	46	3	52	3															
1	46	4	51	4	57	3	70	3											
1	47	3	53	3															
1	47	4	52	4	58	3	71	3											
1	48	3	54	3															
1	48	4	53	4	59	3	72	3											
1	49	3	55	3															
1	49	4	54	4	60	3	73	3											
1	49	5	50	5	61	4	62	4	48	5	60	4	126	2	120	2			

```
1  50   3  56   3
1  50   4  55   4  61   3  74   3
1  56   4  62   3  75   3
1  51   2  57   2
1  52   2  58   2
1  53   2  59   2
1  54   2  60   2
1  55   2  61   2
1  56   2  62   2
1  63   2  66   3 125   3 126   3
1  63   3  64   4
1  65   3 109   2 110   3
1  65   4  78   2
1  66   2 106   3
1  66   4 106   2 109   3
1  67   2  69   3
1  68   2 118   3
1  68   3  80   3  82   4
1  69   2  84   3 102   2
1  70   2  76   5
1  70   4  86   4
1  71   2  76   4
1  71   4  87   4
1  72   2  76   3
1  72   4  88   4
1  73   2  77   5
1  73   4  89   4
1  74   2  77   4
1  74   4  90   4
1  75   2  77   3
1  75   4  91   4
1  76   2  78   4
1  77   2  78   3
1  79   2 105   2  81   3
1  81   2 104   2
1  82   2 108   2
1  83   2  85   3 108   3
1  83   3 107   2  84   4
1  83   4 107   4  85   2
1  84   2 107   3
1  85   4 103   2
1  86   2 101   2
1  87   2 100   2
1  88   2  99   2
1  89   2  98   2
1  90   2  97   2
1  91   2  96   2
1  92   2 111   3
1 110   4  95   2
1 106   4 109   4 110   2
1 111   2 112   3
1 114   2 115   3
1 121   4 122   3
1 122   2 123   3 124   3
1 119   3 120   4
1  79   3  80   2
!EOD
!PCL
DELETE NOTO10
DELETE NOTO15
DELETE NOTO20
```

```
DELETE NOTO25
DELETE DECODE
DELETE AWRK2C
END
!E00
 END
PCL PROCESSING TERMINATED
```

```
RUN (LMN,LMPR2DC,GOULD)
```

START OF INIT:

TWO-DIMENSIONAL PLACEMENT & ROUTING OF LSI CHIPS.

WRITTEN BY: RICHARD NOTO
COMPANY : RCA CORP.
ADDRESS : FRONT & COOPER STS.
CAMDEN, N. J. 08102
PHONE NO. : (609) 963-8000
EXT. NO. : PC 6755

PR2D REVISION 8, FEB. 1974.

```
IP(I0+  1) =    50
IP(I0+ 27) =     1
IP(I0+ 34) =     1
IP(I0+ 53) =     1
IP(I0+ 54) =     3
IP(I0+ 68) =     1
IP(I2+  3) =   200
IP(I2+  4) =    50
IP(I2+  5) =    50
IP(I2+ 26) =     4
IP(I4+  1) =  1000
IP(I4+  2) =  1000
IP(I4+  3) =    50
IP(I4+  9) =   200
IP(I4+ 13) =   300
IP(I4+ 14) =   260
IP(I4+ 16) =   120
IP(I4+ 17) =   260
IP(I4+ 19) =   170
IP(I4+ 20) =   150
IP(I4+ 22) =   170
IP(I4+ 23) =   100
IP(I4+ 26) =     1
IP(I4+ 27) =     0
```

```
IP(I4+ 30) =   100
IP(I4+ 31) =   100
IP(I4+ 33) =   100
IP(I4+ 47) =    17
IP(I4+ 49) =    14
IP(I4+ 50) =    14
IP(I4+ 68) =    14
IP(I4+ 83) =   210
IP(I4+ 84) =   210
IP(I4+ 85) =   210
IP(I4+ 86) =   210
IP(I4+ 87) =   221
IP(I4+ 88) =   221
IP(I4+ 91) =    10
IP(I5+ 17) =  9450
IP(I5+ 18) =  9440
IP(I5+ 19) =  9800

END OF INIT.
START OF INPUT FUNCTION:
```

PIN DATA FOR PATTERNS USED ON CHIP:

PATTERN 1127

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	12	820
3	1	31	1300
4	1	50	1300
5	-4	60	140

PATTERN 1130

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	10	1180
3	1	29	1710
4	1	48	1710
5	1	67	1710
6	-6	81	140

PATTERN 1220

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	13	1040
3	1	32	1170
4	1	51	1170
5	-4	63	140

PATTERN 1230

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	10	500
3	1	29	1000
4	1	48	1000
5	1	67	1000
6	-6	77	140

PIN DATA FOR PATTERNS USED ON CHIP:

PATTERN 1240

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	10	850
3	1	29	1540
4	1	48	1540
5	1	67	1540
6	1	86	1540
7	-8	96	140

PATTERN 1310

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	10	1200
3	1	29	1800
4	-2	39	140

PATTERN 1330

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	1	13	1370
3	10	32	1340
4	2	51	1370
5	3	70	2320
6	-6	85	140

PATTERN 1520

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	10	1790
3	1	29	3940
4	-2	39	140

PIN DATA FOR PATTERNS USED ON CHIP:

PATTERN 1620

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	13	1270
3	1	32	1170
4	1	51	1170
5	-6	63	140

PATTERN 1720

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	12	1270
3	1	31	1310
4	1	50	1310
5	-6	60	140

PATTERN 1820

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	1	30	500
3	2	49	1000
4	10	73	350
5	-14	84	140

PATTERN 1830

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	1	30	1500
3	2	49	600
4	10	73	1200
5	-10	84	140

PIN DATA FOR PATTERNS USED ON CHIP:

PATTERN 2310

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	13	900
3	1	32	1550
4	1	51	1550
5	-8	80	140

PATTERN 9020

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	1	12	300
3	0	76	80

PATTERN 9030

PIN NO.	RESN FLAG	X DIST	PIN IMP.
1	0	0	0
2	10	12	300
3	0	76	80

ELEMENT TO PATTERN ASSIGNMENT:

ELEM	PTRN	ORD.	ROW	ELEM	PTRN	ORD.	ROW	ELEM	PTRN	ORD.	ROW	ELEM	PTRN	ORD.	ROW
1	1520	0	0	2	1520	0	0	3	1520	0	0	4	1620	0	0
5	1330	0	0	6	1330	0	0	7	1330	0	0	8	1330	0	0
9	1330	0	0	10	1330	0	0	11	1330	0	0	12	1330	0	0
13	1330	0	0	14	1330	0	0	15	1330	0	0	16	1330	0	0
17	1820	0	0	18	1820	0	0	19	1820	0	0	20	1820	0	0
21	1820	0	0	22	1820	0	0	23	1820	0	0	24	1820	0	0
25	1820	0	0	26	1820	0	0	27	1820	0	0	28	1820	0	0
29	1120	0	0	30	1120	0	0	31	1120	0	0	32	1120	0	0
33	1120	0	0	34	1120	0	0	35	1120	0	0	36	1120	0	0
37	1120	0	0	38	1120	0	0	39	1120	0	0	40	1120	0	0
41	1520	0	0	42	1820	0	0	43	1720	0	0	44	1240	0	0
45	1330	0	0	46	1330	0	0	47	1330	0	0	48	1330	0	0
49	1330	0	0	50	1330	0	0	51	1820	0	0	52	1820	0	0
53	1820	0	0	54	1820	0	0	55	1820	0	0	56	1820	0	0
57	1120	0	0	58	1120	0	0	59	1120	0	0	60	1120	0	0
61	1120	0	0	62	1120	0	0	63	1520	0	0	64	1820	0	0
65	1220	0	0	66	1120	0	0	67	1220	0	0	68	1310	0	0
69	1520	0	0	70	2310	0	0	71	2310	0	0	72	2310	0	0
73	2310	0	0	74	2310	0	0	75	2310	0	0	76	1130	0	0
77	1130	0	0	78	1220	0	0	79	1520	0	0	80	1310	0	0
81	1520	0	0	82	1820	0	0	83	1720	0	0	84	1120	0	0
85	1620	0	0	86	1830	0	0	87	1830	0	0	88	1830	0	0

ELEMENT TO PATTERN ASSIGNMENT:

ELEM	PTRN	ORD.	ROW	ELEM	PTRN	ORD.	ROW	ELEM	PTRN	ORD.	ROW	ELEM	PTRN	ORD.	ROW
89	1830	0	0	90	1830	0	0	91	1830	0	0	92	9030	0	0
93	9020	0	0	94	9020	0	0	95	9030	0	0	96	9030	0	0
97	9030	0	0	98	9030	0	0	99	9030	0	0	100	9030	0	0
101	9030	0	0	102	9020	0	0	103	9030	0	0	104	9020	0	0
105	9020	0	0	106	1120	0	0	107	1120	0	0	108	1310	0	0
109	1720	0	0	110	1620	0	0	111	1520	0	0	112	1520	0	0
113	1520	0	0	114	1230	0	0	115	1120	0	0	116	1520	0	0
117	1520	0	0	118	1520	0	0	119	1520	0	0	120	1820	0	0
121	1820	0	0	122	1520	0	0	123	1520	0	0	124	1520	0	0
125	1520	0	0	126	1520	0	0								

NODE LIST:

NODE NO.	NODE WT.	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN	...
1	1	1	2	2	3	94	2			
2	1	1	3	112	2	93	2			
3	1	2	2	3	3	42	3	64	3	
4	1	3	2	4	3	82	3	120	3	121 3
5	1	4	2	5	4	67	4			
6	1	4	4	118	2	86	3	87	3	88 3 89 3 90 3 91 3
7	1	5	2	6	2	7	2	8	2	9 2 10 2 124 2
8	1	11	2	12	2	13	2	14	2	15 2 16 2 123 2
9	1	5	3	17	3					
10	1	6	3	18	3					
11	1	7	3	19	3					
12	1	8	3	20	3					
13	1	9	3	21	3					
14	1	10	3	22	3					
15	1	11	3	23	3					
16	1	12	3	24	3					
17	1	13	3	25	3					
18	1	14	3	26	3					
19	1	15	3	27	3					
20	1	16	3	28	3					
21	1	5	5	6	5	7	5	8	5	29 4 30 4 31 4 32 4 113 2
22	1	6	4	17	4	29	3	114	5	
23	1	7	4	18	4	30	3	114	4	
24	1	8	4	19	4	31	3	114	3	
25	1	9	4	20	4	32	3	44	3	
26	1	9	5	10	5	11	5	12	5	33 4 34 4 35 4 36 4 116 2
27	1	10	4	21	4	33	5			
28	1	11	4	22	4	34	3			
29	1	12	4	23	4	35	3			
30	1	13	4	24	4	36	3			
31	1	13	5	14	5	15	5	16	5	37 4 38 4 39 4 40 4 117 2 121 2
32	1	14	4	25	4	37	5			
33	1	15	4	26	4	38	3	44	4	
34	1	16	4	27	4	39	5	44	5	
35	1	17	2	29	2					
36	1	18	2	30	2					
37	1	19	2	31	2					
38	1	20	2	32	2					
39	1	21	2	33	2					
40	1	22	2	34	2					
41	1	23	2	35	2					
42	1	24	2	36	2					
43	1	25	2	37	2					
44	1	26	2	38	2					
45	1	27	2	39	2					
46	1	28	2	40	2					
47	1	28	4	40	3	44	6	45	4	
48	1	41	2	113	3	116	3	117	3	
49	1	41	3	42	4					
50	1	42	2	43	2					
51	1	43	3	115	2					
52	1	64	2	43	8	65	2			

53	1	44	2	115	4												
54	1	45	2	46	2	47	2	48	2	49	2	50	2	119	2		
55	1	45	3	51	3												
56	1	45	5	46	5	57	4	58	4	67	3	47	5	59	4	125	2
57	1	46	3	52	3												
58	1	46	4	51	4	57	3	70	3								

NODE LIST:

NODE NO.	NODE WT.	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN	...							
59	1	47	3	53	3												
60	1	47	4	52	4	58	3	71	3								
61	1	48	3	54	3												
62	1	48	4	53	4	59	3	72	3								
63	1	49	3	55	3												
64	1	49	4	54	4	60	3	73	3								
65	1	49	5	50	5	61	4	62	4	48	5	60	4	126	2	120	2
66	1	50	3	56	3												
67	1	50	4	55	4	61	3	74	3								
68	1	56	4	62	3	75	3										
69	1	51	2	57	2												
70	1	52	2	58	2												
71	1	53	2	59	2												
72	1	54	2	60	2												
73	1	55	2	61	2												
74	1	56	2	62	2												
75	1	63	2	66	3	125	3	126	3								
76	1	63	3	64	4												
77	1	65	3	109	2	110	3										
78	1	65	4	78	2												
79	1	66	2	106	3												
80	1	66	4	106	2	109	3										
81	1	67	2	69	3												
82	1	68	2	118	3												
83	1	68	3	80	3	82	4										
84	1	69	2	84	3	102	2										
85	1	70	2	76	5												
86	1	70	4	86	4												
87	1	71	2	76	4												
88	1	71	4	87	4												
89	1	72	2	76	3												
90	1	72	4	88	4												
91	1	73	2	77	5												
92	1	73	4	89	4												
93	1	74	2	77	4												
94	1	74	4	90	4												
95	1	75	2	77	3												
96	1	75	4	91	4												
97	1	76	2	78	4												
98	1	77	2	78	3												
99	1	79	2	105	2	81	3										
100	1	81	2	104	2												
101	1	82	2	108	2												
102	1	83	2	85	3	108	3										
103	1	83	3	107	2	84	4										
104	1	83	4	107	4	85	2										
105	1	84	2	107	3												
106	1	85	4	103	2												
107	1	86	2	101	2												
108	1	87	2	100	2												
109	1	88	2	99	2												
110	1	89	2	98	2												

111	1	90	2	97	2		
112	1	91	2	96	?		
113	1	92	2	111	3		
114	1	110	4	95	2		
115	1	106	4	109	4	110	2
116	1	111	2	112	3		

NODE LIST:

NODE NO.	NODE WT.	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN ...
117	1	114	2	115	3				
118	1	121	4	122	3				
119	1	122	2	123	3	124	3		
120	1	119	3	120	4				
121	1	79	3	80	2				

NODE ERRORS:

END OF INPUT FUNCTION.

START OF PRPLI SUBROUTINE:

END OF PRPLI SUBROUTINE.
START OF PLACEMENT:

TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78,   PAGE NO.   11

LENGTH= 32, # INT.=   830,JRSP=2, TOTAL DIST.=   0, # GOOD INT.=   0, # EQU INT =   830

PLACEMENT:

0	0	0	99	0	0	0	98	0	0	0	0	0	0	0	0	0	101	0	0	0	100	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	80	112	2	20	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	113	3	21	39	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	4	22	40	58	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	81	82	83	84	85	86	87	88	89	90	91	106	107	108	109	23	41	59	77	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	114	115	116	117	118	119	120	121	122	123	124	125	126	0	0	42	60	78	110	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	61	79	111	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	103	0	0	0	102	0	0	0	0	0	0	0	0	0	105	0	0	0	104	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78, PAGE NO. 12

LENGTH= 28, # INT.= 1660,JRSP=2, TOTAL DIST.= 0, # GOOD INT.= 0, # EQU INT = 1660

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	100	0	0	0	101	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	47	48	49	50	51	52	53	54	55	56	57	113	3	21	39	117	7	25	43	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	66	67	68	69	70	71	72	73	74	75	76	4	22	40	58	8	26	44	62	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	85	86	87	88	89	90	91	106	107	108	109	23	41	59	77	27	45	63	81	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	118	119	120	121	122	123	124	125	126	0	0	42	60	78	110	46	64	82	114	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	9	10	11	12	13	14	15	16	17	18	19	61	79	111	1	65	83	115	5	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	28	29	30	31	32	33	34	35	36	37	38	80	112	2	20	84	116	6	24	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	102	0	0	0	103	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

LENGTH= 25, # INT.= 2490,JRSP=2, TOTAL DIST.= 0, # GOOD INT.= 0, # EQU INT = 2490

PLACEMENT:

0	0	0	99	0	0	0	98	0	0	0	0	0	0	0	0	0	101	0	0	0	100	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	70	71	72	73	74	75	76	4	22	40	58	8	26	44	62	12	30	48	66	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	0	0	89	90	91	106	107	108	109	23	41	59	77	27	45	63	81	31	49	67	85	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	122	123	124	125	126	0	0	42	60	78	110	46	64	82	114	50	68	86	118	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	13	14	15	16	17	18	19	61	79	111	1	65	83	115	5	69	87	119	9	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	32	33	34	35	36	37	38	80	112	2	20	84	116	6	24	88	120	10	28	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	51	52	53	54	55	56	57	113	3	21	39	117	7	25	43	121	11	29	47	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	103	0	0	0	102	0	0	0	0	0	0	0	0	0	105	0	0	0	104	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78,　　　PAGE NO.　14

LENGTH= 22, # INT.= 3320,JRSP=2, TOTAL DIST.= 0, # GOOD INT.= 0, # EQU INT = 3320

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	100	0	0	0	101	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	107	108	109	23	41	59	77	27	45	63	81	31	49	67	85	35	53	71	89	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	126	0	0	42	60	78	110	46	64	82	114	50	68	86	118	54	72	90	122	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	17	18	19	61	79	111	1	65	83	115	5	69	87	119	9	73	91	123	13	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	36	37	38	80	112	2	20	84	116	6	24	88	120	10	28	106	124	14	32	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	55	56	57	113	3	21	39	117	7	25	43	121	11	29	47	125	15	33	51	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	74	75	76	4	22	40	58	8	26	44	62	12	30	48	66	16	34	52	70	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	102	0	0	0	103	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

```
        TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78,            PAGE NO.     15
 LENGTH=   19, # INT.=    4150,JRSP=2, TOTAL DIST.=       0, # GOOD INT.=     0, # EQU INT =  4150
PLACEMENT:


     0    0    0   99    0    0    0   98    0    0    0    0    0    0    0    0    0  101    0    0    0  100    0    0    0
    92    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0   60   78  110   46   64   82  114   50   68   86  118   54   72   90  122  113   76  108  126    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    93    0    0   79  111    1   65   83  115    5   69   87  119    9   73   91  123   13    4  109    0   17    0    0   95
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0  112    2   20   84  116    6   24   88  120   10   28  106  124   14   32   23    0   18   36    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    3   21   39  117    7   25   43  121   11   29   47  125   15   33   51   42   19   37   55    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0   22   40   58    8   26   44   62   12   30   48   66   16   34   52   70   61   38   56   74    0    0    0
    94    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   97
     0    0    0   41   59   77   27   45   63   81   31   49   67   85   35   53   71   89   80   57   75  107    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   96
     0    0    0  103    0    0    0  102    0    0    0    0    0    0    0    0    0  105    0    0    0  104    0    0    0

 TOTAL WIRE UNITS BY NODE:

        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0
```

TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78, PAGE NO. 16

LENGTH= 16, # INT.= 4929,JRSP=2, TOTAL DIST.= 0, # GOOD INT.= 6, # EQU INT = 4840

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	100	0	0	0	101	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	78	115	5	50	87	119	9	73	72	123	112	4	109	0	108	126	117	63	83	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	65	82	24	88	120	10	28	106	124	14	32	23	0	69	68	17	36	18	22	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	25	43	121	11	29	47	125	15	33	51	42	19	113	46	59	77	55	79	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	26	39	62	12	21	48	66	16	34	52	70	61	38	114	7	40	110	41	122	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	45	44	81	84	49	86	85	35	53	71	89	111	57	58	107	74	56	3	116	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	8	27	2	31	30	67	118	54	91	90	13	80	76	6	64	20	75	37	60	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	102	0	0	0	103	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78, PAGE NO. 17

LENGTH= 13, # INT.= 7926,JRSP=2, TOTAL DIST.= 0, # GOOD INT.= 63, # EQU INT = 6785

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	101	0	0	0	100	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	115	17	77	0	1	53	18	45	57	52	59	33	124	76	46	21	122	125	58	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	72	3	68	23	123	41	11	62	65	78	44	64	5	16	83	70	49	107	71	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	112	8	51	6	34	86	63	66	110	119	121	47	88	75	126	79	28	91	56	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	7	29	111	69	40	55	27	113	120	87	89	118	13	9	67	116	12	50	26	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	114	0	30	2	84	36	43	73	31	48	81	80	10	61	39	74	35	14	25	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	20	42	19	82	60	15	24	106	108	4	54	32	38	90	37	22	117	85	109	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	102	0	0	0	103	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

LENGTH= 10, # INT.= 10486,JRSP=2, TOTAL DIST.= 0, # GOOD INT.= 157, # EQU INT = 7833

PLACEMENT:

0	0	0	99	0	0	0	98	0	0	0	0	0	0	0	0	0	101	0	0	0	100	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	112	111	126	63	18	119	115	57	72	62	47	50	76	74	51	75	56	23	52	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	53	43	120	0	64	70	49	88	108	121	59	4	46	40	86	55	16	58	123	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	60	6	41	48	9	27	66	44	124	89	122	110	87	35	39	91	67	71	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	7	30	78	42	17	114	2	77	15	125	61	45	11	34	85	12	90	37	81	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	73	0	54	3	82	8	118	65	5	84	38	28	33	117	107	22	14	83	13	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	20	31	68	32	29	10	19	113	36	69	80	116	26	79	21	109	25	106	24	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	102	0	0	0	103	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

LENGTH= 7, # INT.= 14934,JRSP=2, TOTAL DIST.= 48, # GOOD INT.= 295, # EQU INT = 9104

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	101	0	0	0	100	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	111	54	0	61	62	48	72	89	75	88	45	58	119	86	27	57	52	51	70	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	55	56	0	53	73	49	50	120	63	47	125	46	76	16	87	122	28	23	39	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	112	1	60	77	2	64	126	74	78	59	71	67	44	40	91	26	123	15	14	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	83	107	30	6	43	5	66	3	20	82	124	4	118	11	121	110	12	35	13	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	18	31	42	114	84	32	69	115	41	65	9	38	34	117	90	37	33	21	25	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	19	17	85	29	108	7	8	22	113	109	10	24	68	106	80	116	36	79	81	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	103	0	0	0	102	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

0	0	0	0	0	30	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0									

LENGTH= 4, # INT.= 18675,JRSP=2, TOTAL DIST.= 421, # GOOD INT.= 427, # EQU INT = 9637

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	100	0	0	0	101	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	62	61	89	50	88	55	53	59	52	45	47	76	51	28	70	87	86	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	111	56	60	73	75	48	49	77	119	72	78	58	46	57	71	40	39	16	27	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	112	2	54	126	43	120	74	65	125	121	44	109	106	123	15	110	23	35	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	108	18	42	64	82	63	3	115	4	66	67	122	25	124	11	14	13	91	12	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	107	30	31	114	7	6	41	5	80	68	118	117	38	26	34	36	37	24	22	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	85	83	29	17	84	19	8	69	113	32	20	116	79	9	10	21	81	90	33	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	103	0	0	0	102	0	0	0	0	0	0	0	0	0	105	0	0	0	104	0	0	0

TOTAL WIRE UNITS BY NODE:

38	0	0	2	0	70	18	12	0	0
0	0	0	0	0	0	0	0	[illegible]	0
4	0	0	0	24	27	0	0	[illegible]	0
39	0	12	3	0	0	0	0	[illegible]	0
0	0	0	0	0	0	12	1	[illegible]	0
0	1	0	3	0	24	0	0	0	0
0	0	0	0	12	0	12	0	0	0
0	0	0	0	1	0	4	0	0	0
12	0	1	0	0	0	0	0	0	0
0	0	0	30	0	21	0	0	0	0
0	12	0	0	0	0	0	0	0	0
0	12	12	2	0	0	0	0	0	0
0									

LENGTH= ' 1, # INT.= 23734,JRSP=3, TOTAL DIST.= 1978, # GOOD INT.= 598, # EQU INT = 9896

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	100	0	0	0	101	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	111	73	89	0	0	88	72	53	59	47	58	52	71	87	46	76	70	86	57	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	112	119	49	48	62	56	50	55	61	77	74	78	110	39	16	28	40	45	51	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	115	120	54	60	63	126	75	125	66	106	65	109	27	44	15	23	35	12	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	114	2	64	43	3	42	67	4	82	122	121	123	14	37	25	13	24	36	11	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	7	29	17	6	18	30	5	108	41	124	68	118	80	26	38	117	22	34	91	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	85	83	107	84	69	19	31	8	20	32	113	116	9	21	33	10	81	79	90	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	103	0	0	0	102	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

82	44	3	19	18	115	31	46	3	0
12	0	0	12	9	9	0	18	1	0
23	20	22	38	57	55	1	19	1	1
77	1	40	18	0	0	0	0	0	0
0	0	0	0	18	0	20	25	20	1
11	21	12	33	0	78	2	11	1	2
18	18	4	39	23	0	3	20	7	2
0	0	0	0	3	14	18	18	0	2
41	0	21	36	0	0	2	0	8	0
17	0	0	75	19	42	17	1	38	38
18	15	1	1	0	36	36	36	36	38
30	6	30	18	19	7	8	0	19	18
14									

LENGTH= 0, # INT.= 24585,JRSP=3, TOTAL DIST.= 2581, # GOOD INT.= 599, # EQU INT = 9932

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	100	0	0	0	101	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	111	73	89	0	0	88	72	59	53	47	58	52	71	46	87	76	70	57	86	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	112	48	119	49	62	56	50	55	61	77	74	78	110	39	16	28	40	45	51	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	115	120	54	60	63	126	125	66	75	106	65	109	27	44	15	23	35	12	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	2	114	64	43	42	3	108	82	4	122	121	123	37	14	25	13	24	36	11	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	7	29	17	6	18	30	5	67	124	41	80	68	118	26	38	117	22	34	91	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	0	85	83	107	84	69	19	31	8	20	32	113	116	9	21	33	10	81	79	90	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	103	0	0	0	102	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

94	58	5	26	26	120	37	53	4	1
19	1	1	19	16	16	1	24	2	1
30	26	29	46	64	62	2	26	2	2
84	2	47	25	1	1	1	1	1	1
1	1	2	1	24	1	27	31	29	1
18	28	13	40	1	110	2	19	1	3
26	23	4	47	31	1	4	29	15	1
1	1	1	1	3	21	25	24	2	4
25	1	28	50	1	2	3	2	9	1
24	1	1	82	24	47	24	2	52	52
1	45	2	2	1	48	48	48	50	52
44	20	44	20	26	14	16	1	27	24
23									

ACTUAL WIRE UNITS = 901 901

TOTAL WIRE UNITS BY NODE:

12	9	5	16	6	50	27	23	4	1
9	1	1	9	6	6	1	4	2	1
20	6	9	16	24	22	2	6	2	2
34	2	17	5	1	1	1	1	1	1
1	1	2	1	4	1	7	21	9	1
8	18	13	30	1	50	2	9	1	3
6	13	4	17	11	1	4	9	5	1
1	1	1	1	3	11	5	4	2	4
15	1	8	5	1	2	3	2	9	1
14	1	1	22	4	17	14	2	6	6
1	15	2	2	1	4	4	4	5	6
7	5	7	10	6	4	6	1	7	4
13									

END OF PLACEMENT.

START OF FIX1 SUBROUTINE:

END OF FIX1 SUBROUTINE.

START OF FIX1 SUBROUTINE:

END OF FIX1 SUBROUTINE.
START OF PLACEMENT:

TIMING CIRCUIT FOR JIM CURRIE, 2-X-76, REV 2-28-78, PAGE NO. 25

LENGTH= 0, # INT.= 25738,JRSP=3, TOTAL DIST.= 2899, # GOOD INT.= 612, # EQU INT = 10037

PLACEMENT:

0	0	0	98	0	0	0	99	0	0	0	0	0	0	0	0	0	100	0	0	0	101	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	111	73	89	0	88	0	72	53	59	47	58	76	71	52	87	46	70	57	86	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	0	77	119	48	49	62	56	50	61	55	74	0	110	39	40	28	16	45	51	0	0	95
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	65	120	54	60	63	115	75	126	125	66	106	109	27	44	15	35	23	12	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	114	2	64	43	42	3	108	82	4	122	121	123	14	37	25	13	36	24	11	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	112	7	29	17	6	18	30	5	41	67	124	68	118	80	26	38	117	34	22	91	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
0	0	78	85	83	107	84	69	19	31	8	20	32	113	116	9	21	33	10	81	79	90	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
0	0	0	103	0	0	0	102	0	0	0	0	0	0	0	0	0	104	0	0	0	105	0	0	0

TOTAL WIRE UNITS BY NODE:

96	130	4	26	26	121	40	51	4	1
21	1	1	18	15	15	1	25	2	1
32	27	29	46	64	65	2	26	2	2
84	2	47	27	1	1	1	1	1	1
1	1	1	1	24	1	27	33	27	1
23	18	8	39	1	106	2	17	2	4
24	25	5	48	30	1	3	26	15	3
1	1	1	1	5	21	35	51	1	2
28	1	29	50	5	2	1	2	5	2
16	1	9	82	30	49	97	75	52	52
1	46	2	2	1	48	48	48	48	52
44	20	44	20	25	74	20	1	26	24
21									

ACTUAL WIRE UNITS = 963 963

TOTAL WIRE UNITS BY NODE:

13	15	4	16	6	51	30	21	4	1
11	1	1	8	5	5	1	5	2	1
22	7	9	16	24	25	2	6	2	2
34	2	17	7	1	1	1	1	1	1
1	1	1	1	4	1	7	23	7	1
13	8	8	29	1	46	2	7	2	4
4	15	5	18	10	1	3	6	5	3
1	1	1	1	5	11	15	11	1	2
18	1	9	5	5	2	1	2	5	2
6	1	9	22	10	19	27	15	6	6
1	16	2	2	1	4	4	4	4	6
7	5	7	10	5	14	10	1	6	4
11									

END OF PLACEMENT.

START OF POST-PLACE SUBROUTINE:

ORIGIN
|
V

X Y D I M E N S I O N ----->

	ROW #								
	3	4	5	6	7	8	9	10	11
	92	94				93		VDD	
						112	78		
X	98	111		1	114	7	85	103	
		73	77	65	2	29	83		
D		89	119	120	64	17	107		
I			48	54	43	6	84		
M	99	88	49	60	42	18	69	102	
E			62	63	3	30	19		
N		72	56	115	108	5	31		
S		53	50	75	82	41	8		
I		59	61	126	4	67	20		
O		47	55	125	122	124	32		
N		58	74	66	121	68	113		
		76		106	123	118	116		
I		71	110	109	14	80	9		
I		52	39	27	37	26	21		
I	100	87	40	44	25	38	33	104	

V		46	28	15	13	117	10		
		70	16	35	36	34	81		
		57	45	23	24	22	79		
	101	86	51	12	11	91	90		105

GND	95	96	97

ROW # 2.

END OF POST-PLACE SUBROUTINE.

START OF ROUTE FUNCTION:

START SMASH:

CELL RE-ORIENTATION / PIN RE-ASSIGNMENT:

ELEMENT NUMBER	ROW / ORIENT.	PIN WAS	RE-ASSIGNMENT CHANGED TO
2	-7		
3	-7		
5	-8		
6	-8		
8	-9		
9	-9		
11	-7		
12	-6		
16	-5		
18	-8		
19	-9		
29	-8		
36	-7		
		3	4
		4	3
37	-7		
40	-5		
41	-8		
43	-7		
44	6		
		3	5
		4	6
		5	3
		6	4
47	-4		
49	-5		
53	-4		
57	-4		

58	-4
61	-5
62	-5

CELL RE-ORIENTATION / PIN RE-ASSIGNMENT:

ELEMENT NUMBER	ROW / ORIENT.	PIN RE-ASSIGNMENT WAS	CHANGED TO
63	-6		
64	-7		
65	6		
		3	4
		4	3
66	-6		
		3	4
		4	3
72	-4		
77	5		
		3	4
		4	5
		5	3
80	-8		
83	9		
		3	4
		4	3
84	9		
		3	4
		4	3
85	-9		
86	-4		
87	-4		
89	-4		
107	-9		
108	-7		
116	-9		
118	-8		
119	-5		
120	-6		
121	-7		

```
123        -7
                                                        END SMASH1.
          START OF CENTER ROUTING:

          END OF CENTER ROUTING.
          START OF SIDE ROUTING:

          END OF SIDE ROUTING.
                                                        END ROUTE FUNCTION.
```

START OF ART FUNCTION:

```
START ANALC1
END ANALC1.
```

```
START ANALS1
END ANALS1.
```

```
START PWR1
END PWR1.
```

```
START SORT1
END SORT1.
```

START ART1

ARTWORK INSTRUCTION DATA:

END ART1.

CHIP STATISTICS:

X-STEP = 213, Y-STEP = 169

6.46 INCHES OF METAL, .90 INCHES OF TUNNEL, AND 379 TUNNEL ENDS.

CELL ROW:	LINEAR MILS:	TOTAL LINEAR MILS:
4	129.4	
5	126.4	
6	126.1	
7	127.4	
8	125.1	
9	127.2	
		761.6

CHIP AREA SQ. MILS	CELL SQ. MILS	AREA 0/0	R.P. SQ. MILS	AREA 0/0	WIRING SQ. MILS	AREA 0/0	WIRING EFFECT SQ. MILS	0/0
35997.0	10662.4	29.6	14930.8	41.5	10403.9	28.9	6226.1	59.8

PATTERN NUMBER	NUMBER DEVICES	TIMES USED	TOTAL DEVICES
1120	4	23	
1130	6	2	
1220	4	3	
1230	6	1	
1240	8	1	
1310	2	3	
1330	6	18	
1520	2	20	
1620	6	3	
1720	6	3	
1820	14	23	
1830	10	6	
2310	8	6	
9020	0	5	
9030	0	9	

750

NODE LIST:

NODE NO.	CAP. PF	NODE MT.	ELEM	PIN	ELEM	PIN	ELEM	PIN	...
1	180	2	1	2	2	3	94	2	
2	283	2	112	2	1	3	93	2	
3	68	1	2	2	3	3	42	3	64 3
4	336	1	3	2	4	3	82	3	120 3 121 3
5	128	1	4	2	5	4	67	4	
6	985	1	118	2	4	4	86	3	87 3 88 3 89 3 90 3 91 3
7	623	1	124	2	6	2	7	2	8 2 9 2 10 2 5 2
8	529	1	123	2	12	2	13	2	14 2 15 2 16 2 11 2
9	124	1	5	3	17	3			
10	94	1	6	3	18	3			
11	163	1	7	3	19	3			
12	23	1	8	3	20	3			
13	23	1	9	3	21	3			
14	174	1	10	3	22	3			
15	106	1	11	3	23	3			
16	156	1	12	3	24	3			
17	34	1	13	3	25	3			
18	115	1	14	3	26	3			
19	39	1	15	3	27	3			
20	98	1	16	3	28	3			
21	413	1	113	2	6	5	1	5	8 5 29 4 30 4 31 4 32 4 5 5
22	230	1	17	4	6	4	29	3	114 5
23	195	1	18	4	7	4	30	3	114 4
24	371	1	19	4	8	4	31	3	114 3
25	553	1	20	4	9	4	32	3	44 5
26	587	1	116	2	10	5	11	5	12 5 33 4 34 4 35 4 36 3 9 5
27	41	1	21	4	10	4	33	3	
28	179	1	22	4	11	4	34	3	
29	82	1	23	4	12	4	35	3	
30	50	1	24	4	13	4	36	4	
31	557	1	117	2	14	5	15	5	16 5 37 4 38 4 39 4 40 4 13 5 121
32	50	1	25	4	14	4	37	3	
33	589	1	26	4	15	4	38	3	44 6
34	195	1	27	4	16	4	39	3	44 3
35	67	1	29	2	17	2			
36	87	1	30	2	18	2			
37	13	1	31	2	19	2			
38	52	1	32	2	20	2			
39	42	1	33	2	21	2			
40	45	1	34	2	22	2			
41	20	1	35	2	23	2			
42	38	1	36	2	24	2			
43	38	1	37	2	25	2			
44	42	1	38	2	26	2			
45	95	1	39	2	27	2			
46	87	1	40	2	28	2			
47	170	1	28	4	40	3	44	4	45 4
48	427	1	41	2	113	3	116	3	117 3
49	150	1	42	4	41	3			
50	43	1	43	2	42	2			
51	254	1	115	2	43	3			
52	157	1	65	2	43	4	64	2	
53	121	1	44	2	115	4			

54	667	1	119	2	46	2	47	2	48	2	49	2	50	2	45	2			
55	52	1	45	3	51	3													
56	1031	1	125	2	46	5	57	4	58	4	67	3	47	5	59	4	45	5	
57	107	1	46	3	52	3													
58	177	1	51	4	46	4	57	3	70	3									

NODE LIST:

NODE NO.	CAP. PF	NODE WT.	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN	ELEM	PIN
59	83	1	47	3	53	3										
60	140	1	52	4	47	4	58	3	71	3						
61	109	1	48	3	54	3										
62	282	1	53	4	48	4	59	3	72	3						
63	105	1	49	3	55	3										
64	316	1	54	4	49	4	60	3	73	3						
65	355	1	126	2	50	5	61	4	62	4	48	5	60	4	49	5	120	2
66	80	1	50	3	56	3										
67	147	1	55	4	50	4	61	3	74	3						
68	176	1	56	4	62	3	75	3								
69	103	1	57	2	51	2										
70	119	1	58	2	52	2										
71	38	1	59	2	53	2										
72	82	1	60	2	54	2										
73	47	1	61	2	55	2										
74	77	1	62	2	56	2										
75	120	1	63	2	66	4	125	3	126	3						
76	223	1	64	4	63	3										
77	252	1	109	2	65	4	110	3								
78	590	1	78	2	65	3										
79	57	1	66	2	106	3										
80	83	1	106	2	66	3	109	3								
81	316	1	67	2	69	3										
82	15	1	68	2	118	3										
83	171	1	82	4	80	3	68	3								
84	69	2	69	2	84	4	102	2								
85	76	1	70	2	76	5										
86	91	1	86	4	70	4										
87	77	1	71	2	76	4										
88	96	1	87	4	71	4										
89	70	1	72	2	76	3										
90	16	1	88	4	72	4										
91	90	1	73	2	77	3										
92	16	1	89	4	73	4										
93	126	1	74	2	77	5										
94	450	1	90	4	74	4										
95	175	1	75	2	77	4										
96	404	1	91	4	75	4										
97	628	1	76	2	78	4										
98	388	1	77	2	78	3										
99	68	2	79	2	105	2	81	3								
100	94	2	81	2	104	2										
101	11	1	108	2	82	2										
102	353	1	83	2	85	3	108	3								
103	108	1	107	2	83	4	84	3								
104	139	1	85	2	107	4	83	3								
105	87	1	84	2	107	3										
106	71	2	103	2	85	4										
107	70	2	101	2	86	2										
108	52	2	100	2	87	2										
109	69	2	99	2	88	2										
110	38	2	98	2	89	2										
111	136	2	97	2	90	2										

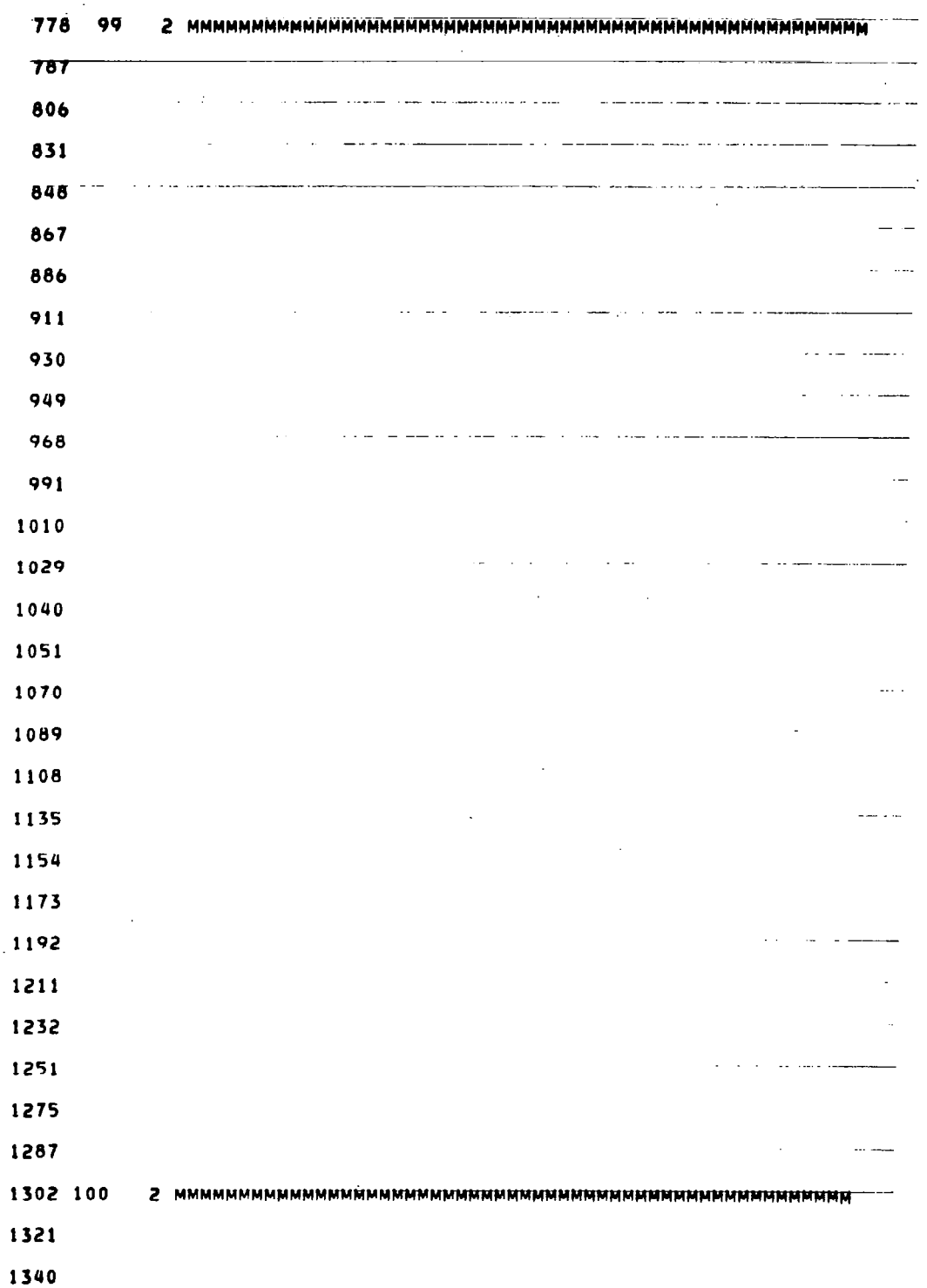
112	100	2	96	2	91	2		
113	132	2	92	2	111	3		
114	177	2	95	2	110	4		
115	132	1	110	2	109	4	106	4
116	370	1	111	2	112	3		

NODE LIST:

NODE NO.	CAP. PF	NODE WT.	ELEM	PIN	ELEM	PIN	ELEM	PIN ...
117	190	1	114	2	115	3		
118	13	1	121	4	122	3		
119	128	1	122	2	123	3	124	3
120	109	1	120	4	119	3		
121	237	1	80	2	79	3		

ENTER SECTION = 3

	ELEM	PIN	0 1 7 1	0 1 6 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 9 9	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5	0 1 8 5
348																														
356																														
375																														
395																														
414																														
437																														
456																														
475																														
489																														
515																														
527																														
539																														
558																														
578	98	2	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
603																														
618																														
637																														
661																														
679																														
701																														
720																														
739																														

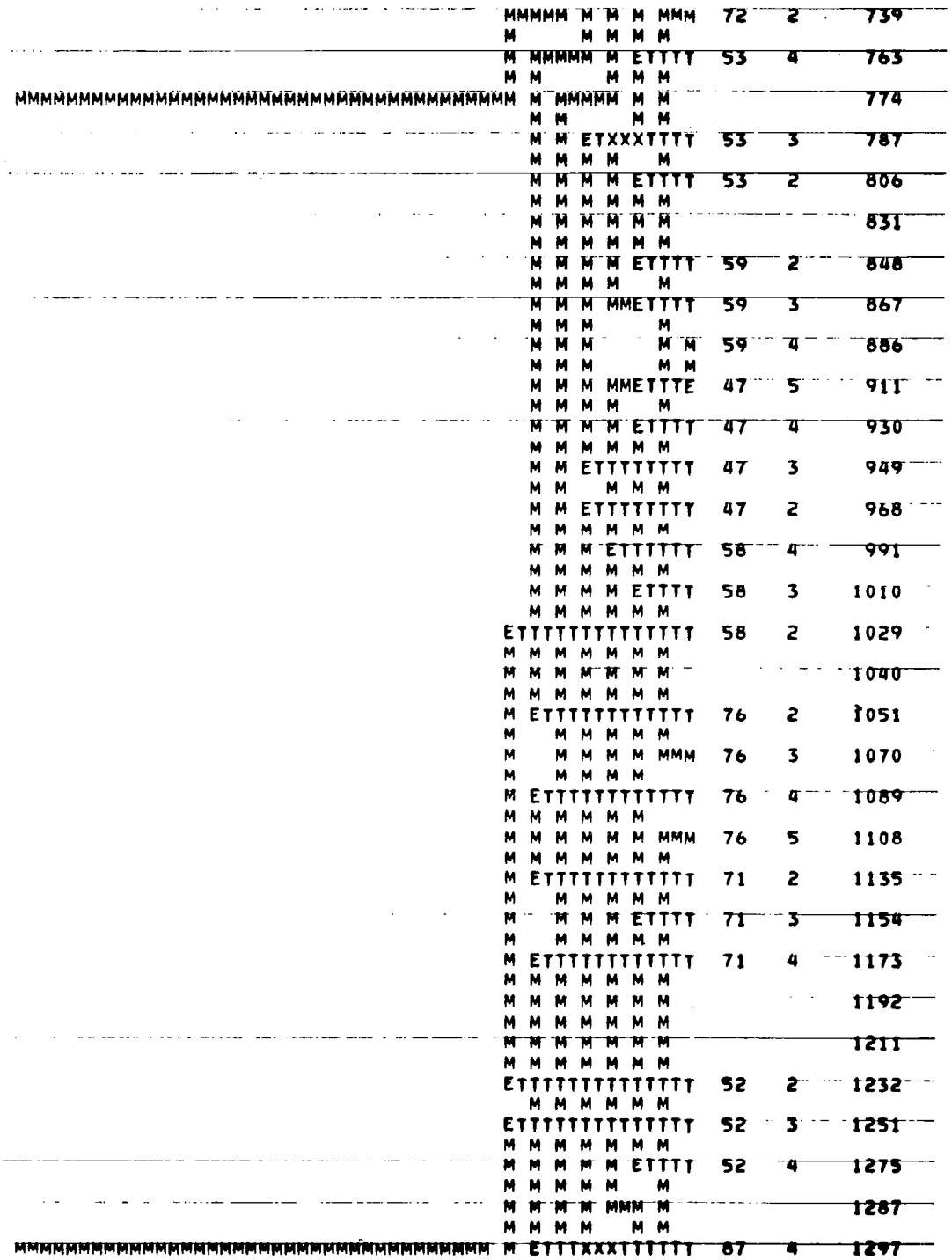

778 99 2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
787
806
831
848
867
886
911
930
949
968
991
1010
1029
1040
1051
1070
1089
1108
1135
1154
1173
1192
1211
1232
1251
1275
1287
1302 100 2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
1321
1340

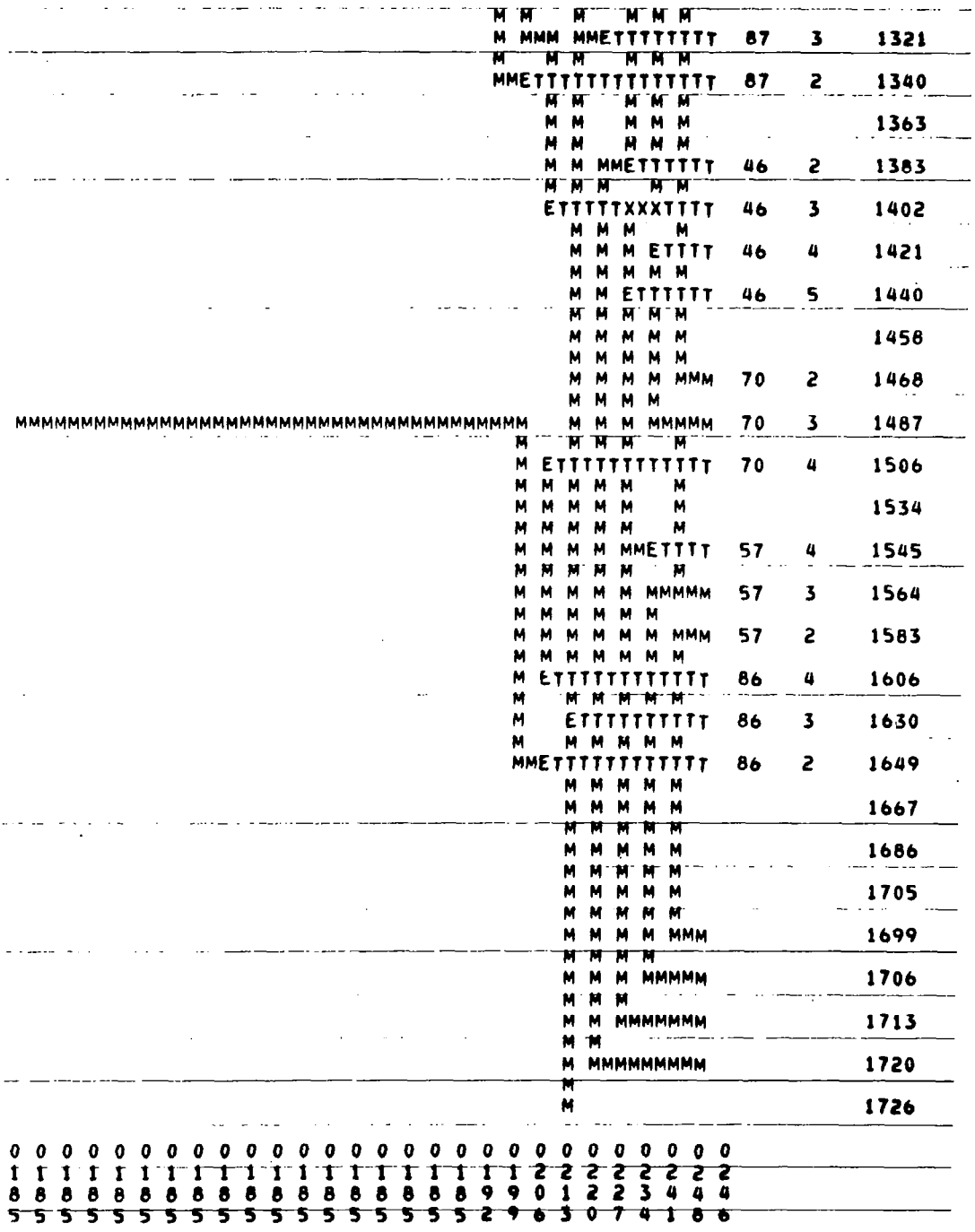
```
1363
1383
1402
1421
1440
1458
1468
1502 101     2 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
1506
1534
1545
1564
1583
1606
1630
1649
1667
1686
1705
1724
1726
               0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
               1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
               7 6 9 9 9 9 9 9 9 9 9 9 9 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
               1 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
```

```
CENTER SECTION =    4

                                                     ELEM PIN

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2
8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 9 9 0 1 2 2 3 4 4 4
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 2 9 6 3 0 7 4 1 8 6
                                        M M M                     348
                                        M M M
                                        M M M MMMMMMM             350
                                        M M M M
                                        M M M M MMMMM             357
                                        M M M M M
                                        M M M M M MMM             364
                                        M M M M M M
                                        M M M M M M               375
                                        M M M M M M
                                        M M ETTTTTTTTT 111   2    395
                                        M M   M M M
                                        ETXXXTTTTTTTT 111   3     414
                                            M M M M
                                            M M M MMM  73   2     437
                                            M M M
                                            M M MMMMM  73   3     456
                                            M M
                                            M MMM MMM  73   4     475
                                            M   M M
                                            MMM M M               489
                                              M M M
                                              M M MMM  89   4     515
                                              M M
                                              M M                 527
                                              M M
                                              M M MMM  89   3     539
                                              M M M
                                            ETTTTTTTT  89   2     558
                                            M M M M
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM M M M               584
                                              M M M
                                              M M M               603
                                              M M M
                                          ETXXXTTTTTT  88   2     618
                                          M M   M M
                                          M M ETTTEMM  88   3     637
                                          M M M M
                                          M M M M MMM  88   4     661
                                          M M M M M
                                          M M M M M               679
                                          M M M M M
                                          M M M M MMM  72   4     701
                                          M M M M
                                          M M M MMMMM  72   3     720
```


72 2 739
53 4 763
774
53 3 787
53 2 806
831
59 2 848
59 3 867
59 4 886
47 5 911
47 4 930
47 3 949
47 2 968
58 4 991
58 3 1010
58 2 1029
1040
76 2 1051
76 3 1070
76 4 1089
76 5 1108
71 2 1135
71 3 1154
71 4 1173
1192
1211
52 2 1232
52 3 1251
52 4 1275
1287
87 4 1297


87 3 1321
87 2 1340
1363
46 2 1383
46 3 1402
46 4 1421
46 5 1440
1458
70 2 1468
70 3 1487
70 4 1506
1534
57 4 1545
57 3 1564
57 2 1583
86 4 1606
86 3 1630
86 2 1649
1667
1686
1705
1699
1706
1713
1720
1726
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2
8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 9 9 0 1 2 2 3 4 4 4
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 2 9 6 3 0 7 4 1 8 6

CENTER SECTION # 5

```
ELEM PIN

                0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
                5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 5
                2 2 3 3 4 5 5 6 7 8 8 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 8
                6 4 1 8 5 2 9 6 3 0 7 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0
  348                   M
                        M
  350             MMMMMMM M E
                        M M V
  357             MMMMM M M V
                      M M M V
  364             MMM M M M V
                    M M M M V
  375               M M M M V
                    M M M M V
  394               M M M M V
                    M M M M V
  414   77    2 TTTTTTTTE V
                    M M M   V
  433   77    3 MMM M M     VVV
                    M M       V
  452   77    4 TTTTTTTTEMM V
                      M M   M V
  471   77    5 MMM M M     M V
                    M M     M V
  495  119    3 TTTTTTTTTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                    M M M     M V
  514  119    2 TTTTTTTTE M V
                      M M M M V
  527               M M M M V
                    M M M M V
  537   48    2 TTTTTTTTE M V
                    M M M M V
  556   48    3 TTTTTTTTTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                      M M M M V
  575   48    4 TTTTTTE M M V
                    M M   M M V
  594   48    5 M M M     M M VVV
                  M M M     M M     V
  624   49    5 TTTTTTE M MMM V
                      M M M M     M V
  643   49    4 TTTTETTTTTE M V
                    M     M M M M V
  662   49    3 TTTTE M M ETTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                      M M M M     M V
  681   49    2 TTTTTTTTE     M V
                      M M M M     M V
  704   62    4 TTTTTTE M     M VVV
                      M M M M     M     V
  723   62    3 TTTTTTTTTTE MMM V
                      M M M M M     M V
```

```
 742   62   2 TTTTTTTTTTTTE M V
                M M M M M M M V
 755            M M M M M M M V
                M M M M M M M V
 774            M M M M M M M V
                M M M M M M M V
 784   56   2 TTTTTTTTTTTTE M V
                M M M M M   M V
 803   56   3 TTTTTTTTTTTTE M V
                M M M M M M M V
 827   56   4 TTTTTTTTTTETTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT
                M M M M   M M V
 851   50   2 TTTTTTTTE   M ETTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT
                M M M M   M   V
 870   50   3 TTTTTTTTTTEMM VVV
                M M M M     V
 889   50   4 TTTTTTTTTTE VVV
                M M M M M V
 908   50   5 M M M M M M V
              M M M M M M V
 933   61   4 TTTTTTETTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                M M   M M V
 952   61   3 TTTTTTTTTTE V
                M M   M M V
 971   61   2 TTTTTTE M M V
                M M M M M V
 983            M M M M M E
                M M M M M V
1002            M M M M M V
                M M M M M V
1013   55   2 TTTTTTE M M V
                M M   M M V
1032   55   3 TTTTE MMM M V
                M   M   M V
1056   55   4 TTTTETTTEMM V
                M M M     V
1080   74   2 MMM M M     V
                  M M     V
1099   74   3 MMMMM M     VVV
                    M       V
1118   74   4 MMMMETTTEMMMM V
                    M     M V
1135                MMM   M V
                      M   M V
1160  110   2 MMMMMMETTTTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                      M   M V
1179  110   3 MMMMMMETTTTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                      M   M V
1198  110   4 MMMMMMETTTE M V
                      M M M V
1211                  M M M V
                      M M M V
1222   39   2 MMMMMMETTTTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                      M M M V
1241   39   3 MMMMMMETTTTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                    M M M M V
1260   39   4 M     M M M M V
              M     M M M M V
1280   40   4 MMMMM M M M M V
                  M M M M M V
1299   40   3 MMETTTTTTTTTTTXXXTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT
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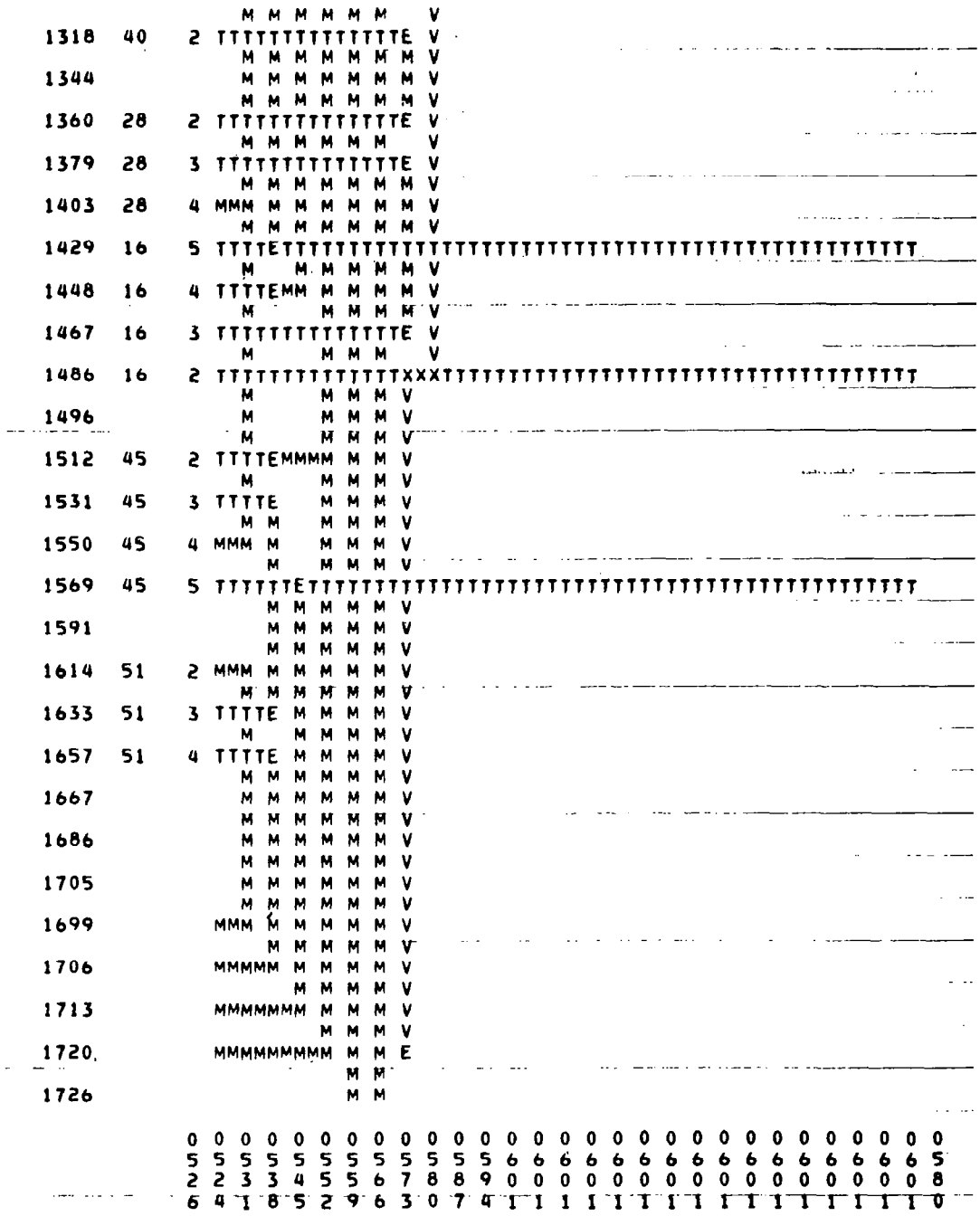

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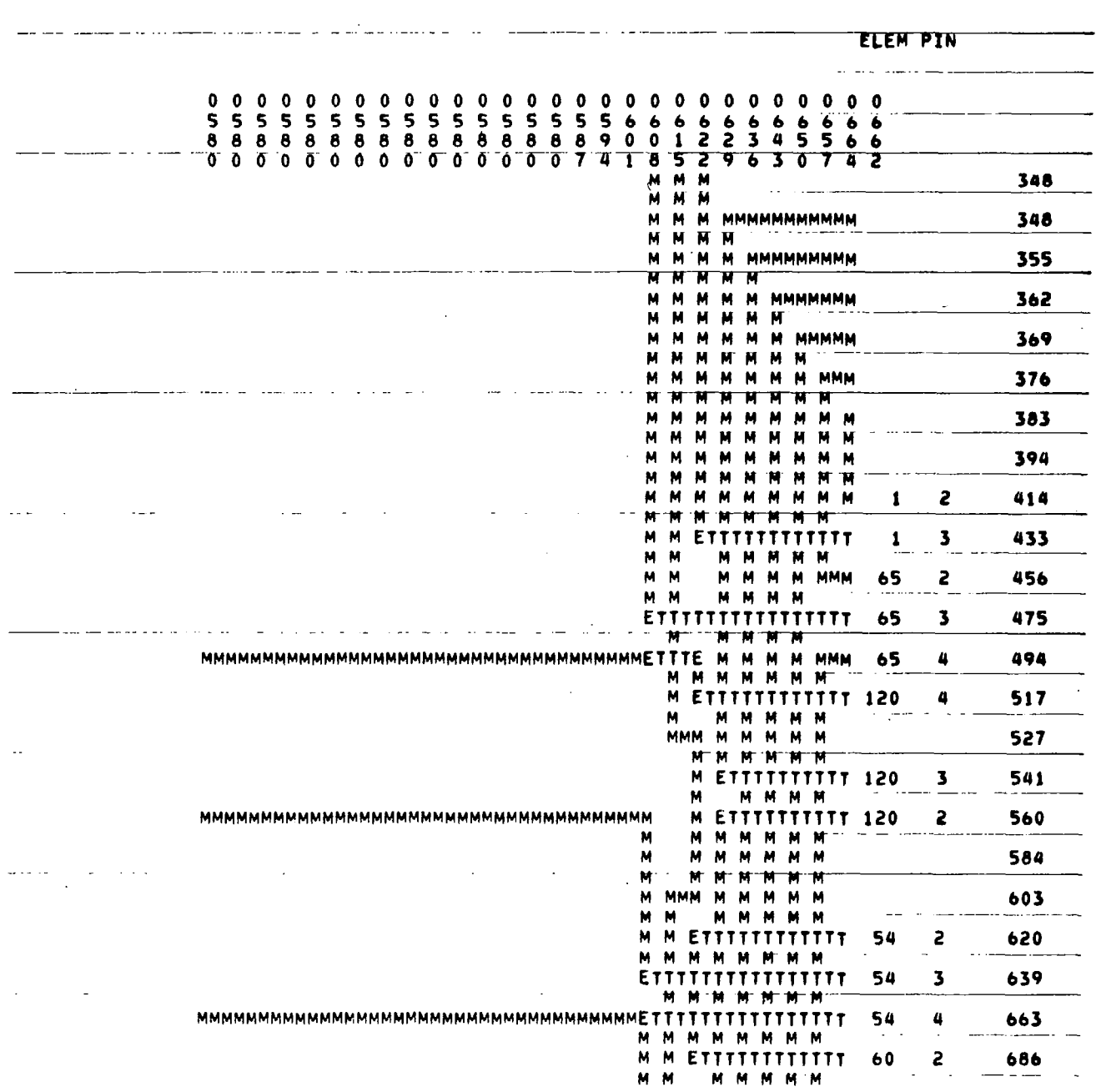

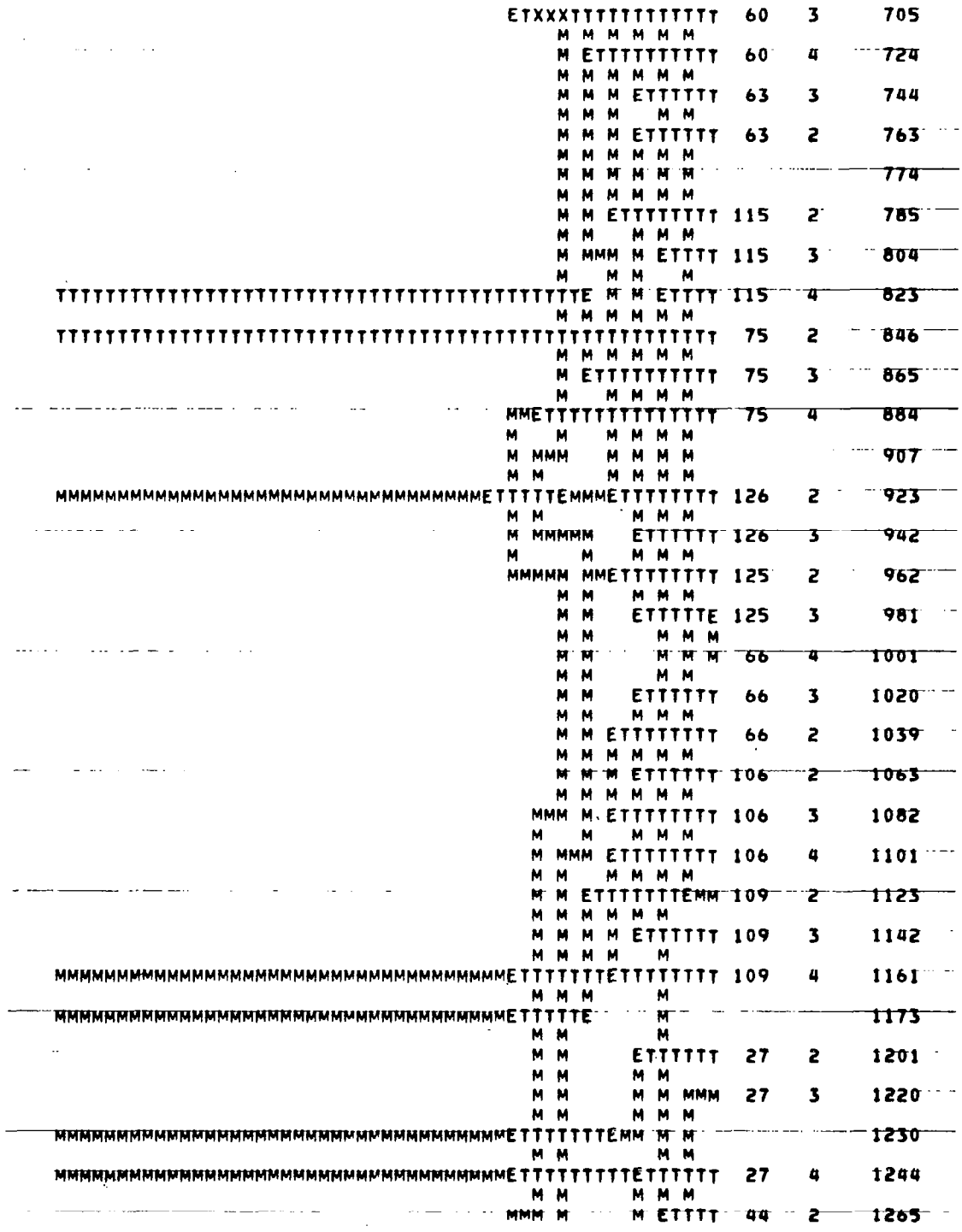
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M M M M M M
M ETTTTTTTTTT 60 4 724
M M M M M M
M M M ETTTTTT 63 3 744
M M M M M
M M M ETTTTTT 63 2 763
M M M M M M
M M M M M M 774
M M M M M M
M M ETTTTTTTT 115 2 785
M M M M M
M MMM M ETTTT 115 3 804
M M M M
TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTE M M ETTTT 115 4 823
M M M M M M
TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT 75 2 846
M M M M M M
M ETTTTTTTTTT 75 3 865
M M M M M
MMETTTTTTTTTTTTTT 75 4 884
M M M M M M
M MMM M M M M 907
M M M M M M
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMETTTTTEMMMETTTTTTTT 126 2 923
M M M M M
M MMMMM ETTTTTT 126 3 942
M M M M M
MMMMM MMETTTTTTTT 125 2 962
M M M M M
M M ETTTTTE 125 3 981
M M M M M
M M M M M 66 4 1001
M M M M
M M ETTTTTT 66 3 1020
M M M M M
M M ETTTTTTTT 66 2 1039
M M M M M M
M M M ETTTTTT 106 2 1063
M M M M M M
MMM M ETTTTTTTT 106 3 1082
M M M M M
M MMM ETTTTTTTT 106 4 1101
M M M M M M
M M ETTTTTTTEMM 109 2 1123
M M M M M M
M M M ETTTTTT 109 3 1142
M M M M M
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMETTTTTTTETTTTTTTT 109 4 1161
M M M M
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMETTTTTE M 1173
M M M
M M ETTTTTT 27 2 1201
M M M M
M M M M MMM 27 3 1220
M M M M M
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMETTTTTTTEMM M M 1230
M M M M
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMETTTTTTTTTETTTTTT 27 4 1244
M M M M M
MMM M M ETTTT 44 2 1265

```
                                    M   M     M   M
                                    M MMM     MMETTTT   44   3   1284
                                    M M           M
TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTETTTTTTTTTTTT  44   4   1303
                                    M M           M
                                  ETTTTTTTTTTTTTTTTTTT  44   5   1322
                                  M M M           M
                                  M M M         ETTTT   44   6   1341
                                  M M M         M M
                                ETTTTTTTTTTTTTETTTTTT   15   2   1364
                                M M M M       M M M
                                M M M M       M M MMM   15   3   1383
                                M M M M       M M
                                M M M M MMMMETTTEMMMM   15   4   1402
                                M M M M M     M
TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTETTTTTEMMMM   15   5   1421
                                M M M M M M   M
                                M M M M M M   M   MMM   35   2   1448
                                M M M M M M   M   M
                                M M M M M M MMM ETTTT   35   3   1467
                                M M M M M M M   M M
TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTE M M M M M M ETTTTTT   35   4   1486
                                  M M M M M M M M M
                                  M M M M M M M M M              1496
                                  M M M M M M M M M
                                  M M M M M M M M M              1515
                                  M M M M M M M M M
                                  M M M M M M M M MMM   23   2   1526
                                  M M M M M M M M
                                  M M M M M M M M MMM   23   3   1545
                                  M M M M M M M M M
TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTE M M M M ETTTT   23   4   1569
                                  M M   M M M M M M
                                  M MMM M M M ETTTTTT   12   5   1595
                                  M   M M M M M M M
                                  MMM M M M M M ETTTT   12   4   1614
                                    M M M M M M   M
                                    M M M M M M ETTTT   12   3   1633
                                    M M M M M M M M
                                    M M M M ETTTTTTTT   12   2   1652
                                    M M M M M M M M
                                    M M M M M M M M              1667
                                    M M M M M M M M
                                    M M M M M M M M              1686
                                    M M M M M M M M
                                    M M M M M M M M              1705
                                    M M M M M M M M
                                    M M M M M M M MMM            1698
                                    M M M M M M M
                                    M M M M M M MMMMM            1705
                                    M M M M M M
                                    M M M M M MMMMMMM            1712
                                    M M M M M
                                    M M M M MMMMMMMMM            1719
                                    M M M M
                                    M M M MMMMMMMMMMM            1726
                                    M M M
                                    M M M                        1726

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6 6
```

8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	9	0	0	1	2	2	3	4	5	5	6	6
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	1	8	5	2	9	6	3	0	7	4	2

CENTER SECTION = 7

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     ELEM PIN

                0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0
                9 9 9 9 9 9 9 9 9 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 9
                4 4 4 5 6 6 7 8 8 9 0 1 1 2 3 3 3 3 3 3 3 3 3 3 3 3 3 9
                2 0 7 4 1 8 5 2 9 6 3 0 7 4 1 1 1 1 1 1 1 1 1 1 1 1 1 6
  348                           M M
                                M M
  348             MMMMMMMMMMMMMM M M E
                                M M M V
  355             MMMMMMMMMMMM M M M V
                                M M M V
  362             MMMMMMMMMM M M M M V
                              M M M M V
  369             MMMMMMM M M M M M V
                            M M M M M V
  376             MMMMM M M M M M M V
                        M M M M M M V
  383             MMM M M M M M M M V
                    M M M M M M M V
  394               M M M M M M M V
                    M M M M M M M V
  414 114     2 TTTTTTE M M M M M V
                    M M   M M M M V
  433 114     3 TTTTTTXXXTTTTTE M V
                    M M M   M M   M V
  452 114     4 TTTTTTTTXXXTTTE M V
                    M M M M   M M M V
  471 114     5 TTTTTTTTTTXXXTTTTTTTEMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                    M M M M M   M M V
  491   2     3 MMM M M M M M   ETTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT
                      M M M M     M V
  510   2     2 MMM M M M M M MMMMM V
                    M M M M M M     V
  531  64     4 TTTTTTE M M M VVVVV
                    M M   M M M V
  555  64     3 MMM M MMM M M V
                    M M M   M M V
  574  64     2 TTTTE M MMM M V
                    M M M M   M V
  584               M M M M MMM V
                    M M M M M   V
  603               M M M M M VVV
                    M M M M M V
  614  43     4 TTTTE M M M V
                    M   M M M V
  633  43     3 TTTTEMM M M V
                    M     M M V
  652  43     2 TTTTE   M M V
                    M M   M M V
  679               M M   M M V
                    M M   M M V
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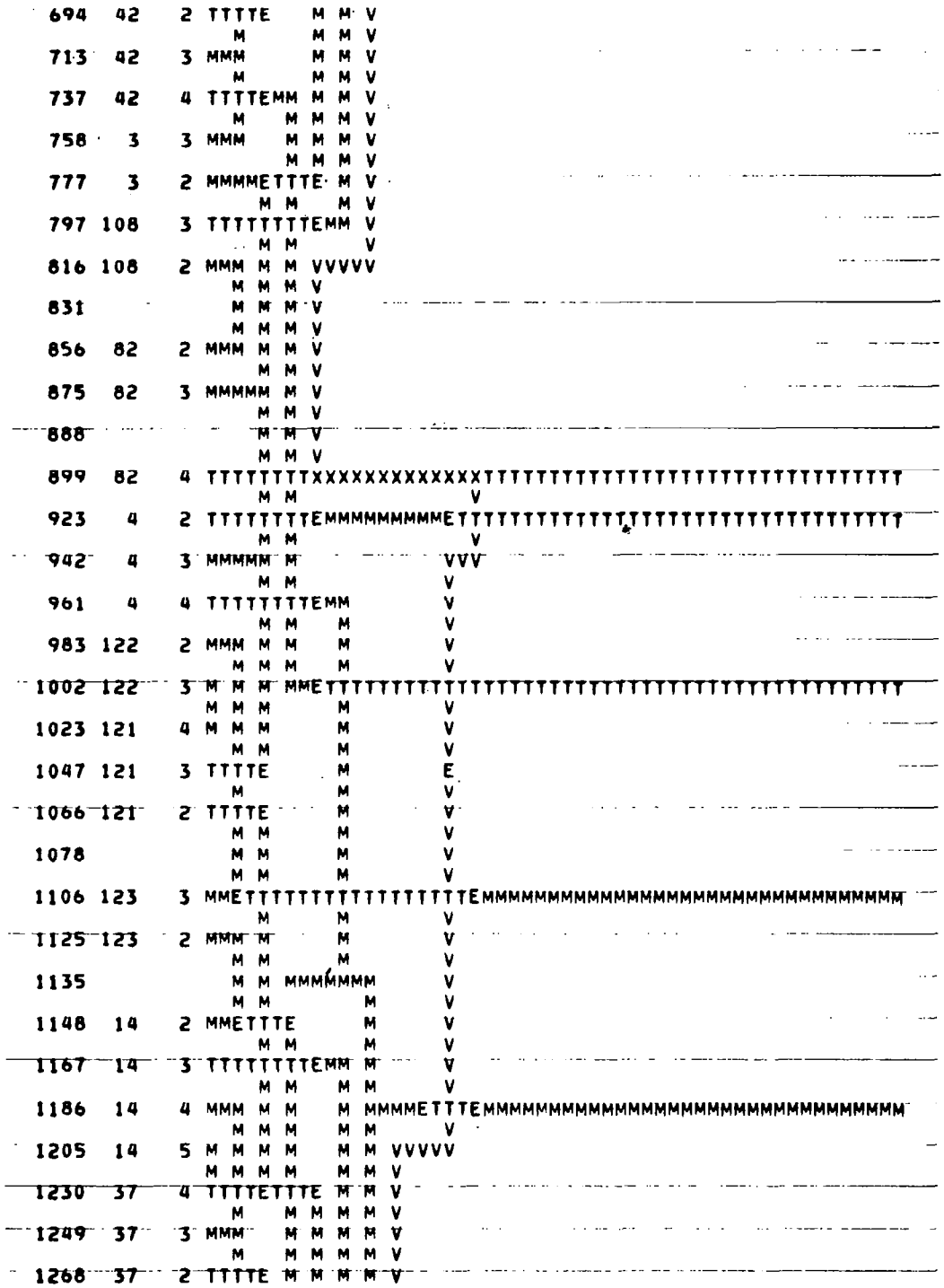

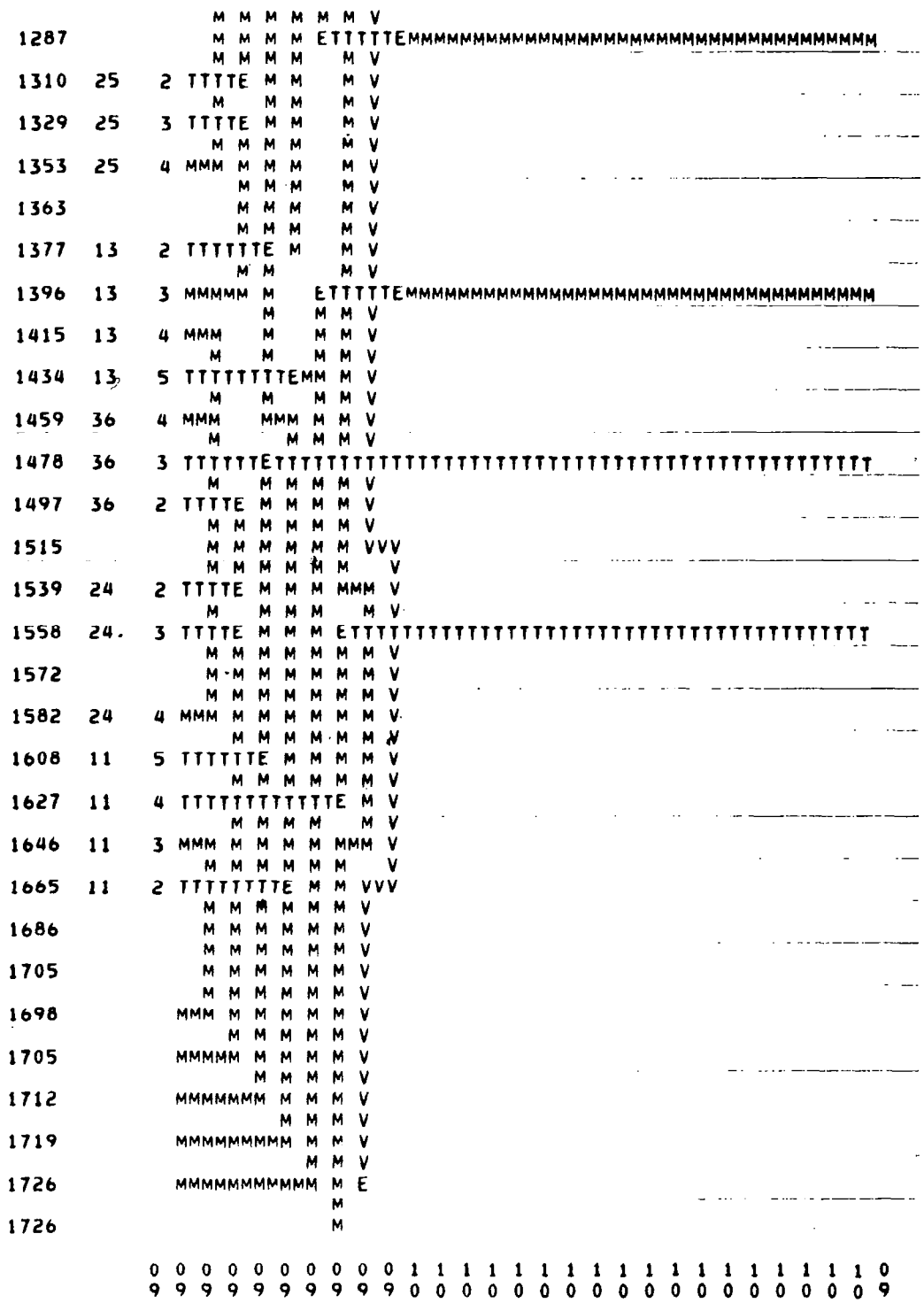

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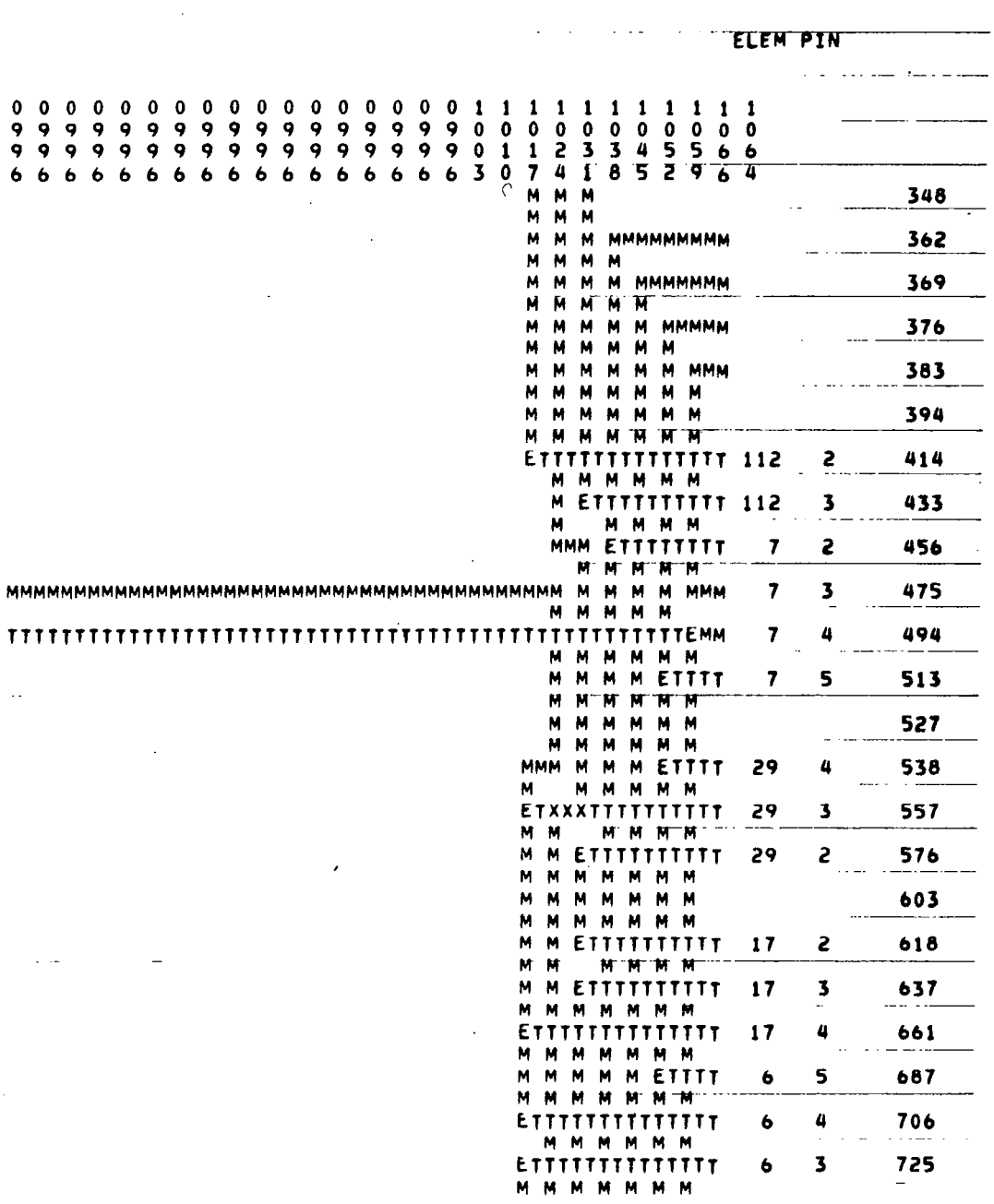
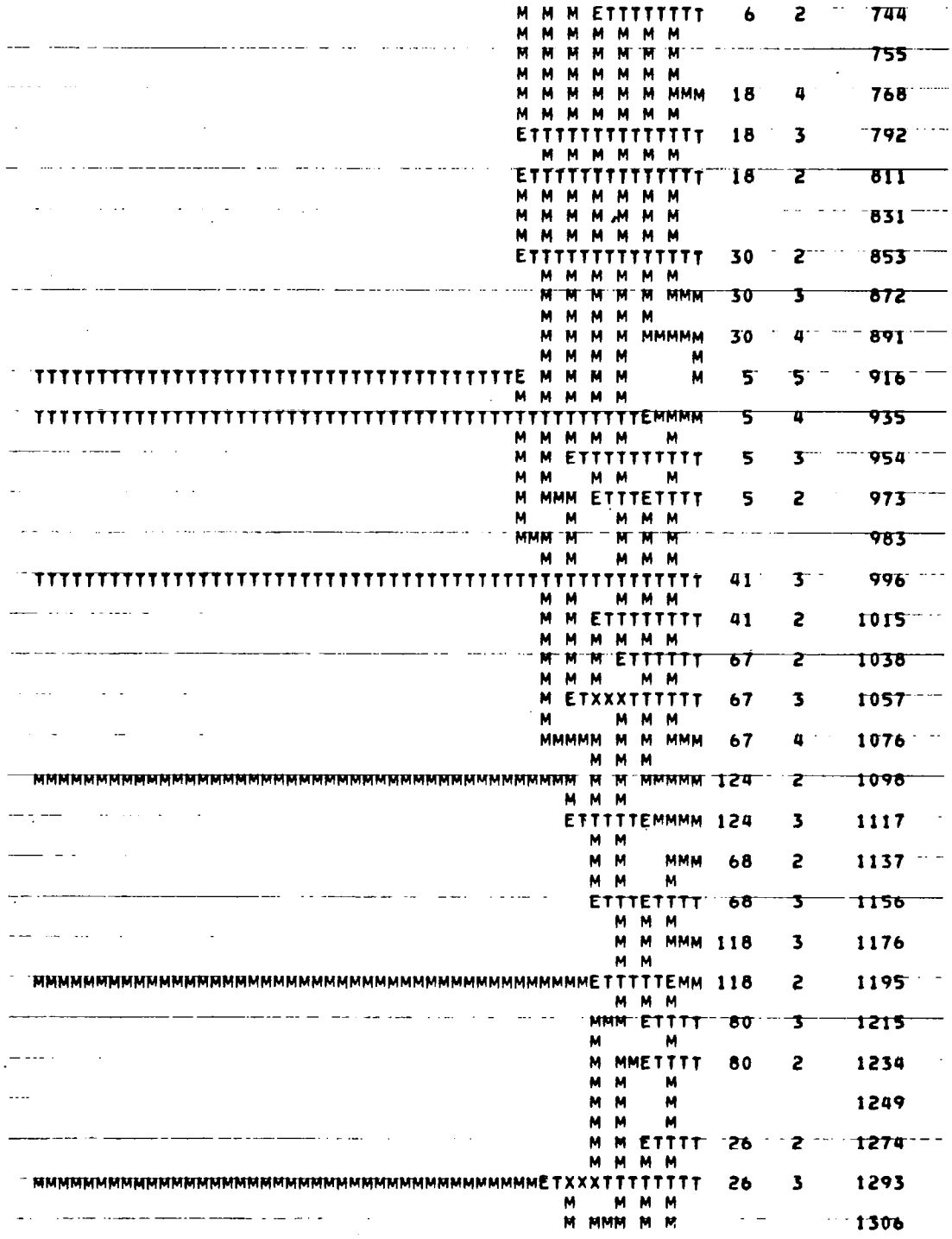
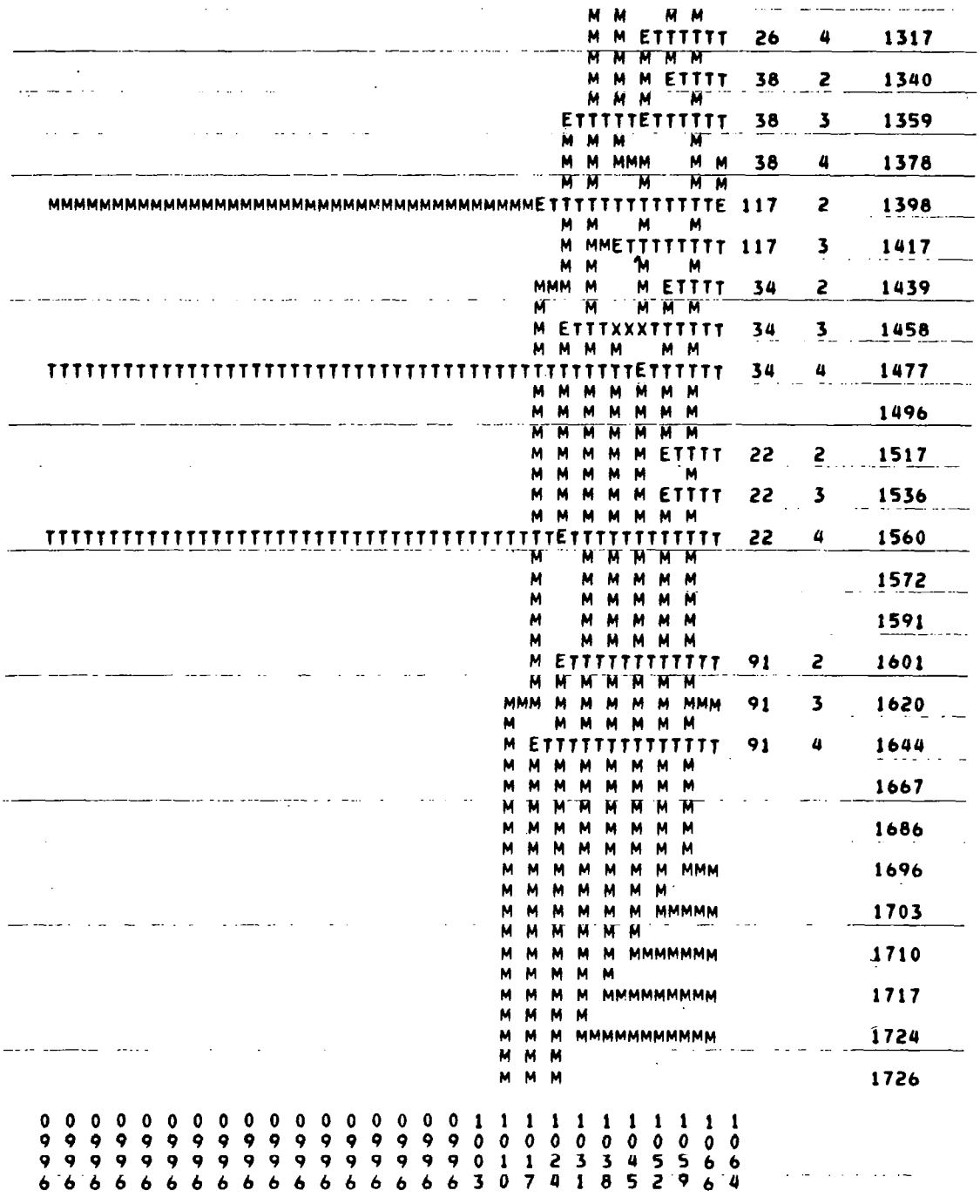
2 0 7 4 1 8 5 2 9 6 3 0 7 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 6

CENTER SECTION = 8




6 2 744
755
18 4 768
18 3 792
18 2 811
831
30 2 853
30 3 872
30 4 891
5 5 916
5 4 935
5 3 954
5 2 973
983
41 3 996
41 2 1015
67 2 1038
67 3 1057
67 4 1076
124 2 1098
124 3 1117
68 2 1137
68 3 1156
118 3 1176
118 2 1195
80 3 1215
80 2 1234
1249
26 2 1274
26 3 1293
1306


26 4 1317
38 2 1340
38 3 1359
38 4 1378
117 2 1398
117 3 1417
34 2 1439
34 3 1458
34 4 1477
1496
22 2 1517
22 3 1536
22 4 1560
1572
1591
91 2 1601
91 3 1620
91 4 1644
1667
1686
1696
1703
1710
1717
1724
1726
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1
9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 0 0 0 0 0 0 0 0 0 0
9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 0 1 1 2 3 3 4 5 5 6 6
6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 3 0 7 4 1 8 5 2 9 6 4

CENTER SECTION = 9

ELEM PIN

```
                1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                3 3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
                4 4 4 5 6 7 7 8 9 9 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                4 2 9 6 3 0 7 4 1 8 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
348                       M M M M M
                          M M M M M
362               MMMMMMMMM M M M M M
                        M M M M M M
369               MMMMMMMM M M M M M M
                      M M M M M M M
376               MMMMM M M M M M M M
                    M M M M M M M M
383               MMM M M M M M M M M
                    M M M M M M M M
394                 M M M M M M M M
                    M M M M M M M M
417  78   2 TTTTTTTTTTTTTTE M M M
                    M M M M M    M M
436  78   3 TTTTTTTTTTTTTTEMM M
                    M M M M M M    M
455  78   4 TTTTTTTTTTTTTTEMMMM
                    M M M M M M
479  85   4 TTTTTTTTTTTTTTEMM
                    M M M M M M    M
498  85   3 TTTTTTTTTTE M    M
                    M M M M M M    M
517  85   2 TTTTTTTTTTTTTTE M
                    M M M M M M M M
527               M M M M M M M M
                  M M M M M M M M
542  83   2 TTTTTTTTTTE M M M
                    M M M M    M M M
561  83   3 TTTTTTTTTTTTTTE M
                      M M M M   M M M
580  83   4 TTTTTTTTTTE M M M MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
                    M M M M M M M
600 107   4 TTTTTTTTTTTTTTE
                    M M M M M M
619 107   3 TTTTTTTTTTTTTTE
                      M M M M M M M
638 107   2 TTTTTTTTTTE M M
                    M M M M M M M
662  84   2 TTTTTTTTTTTTTTE
                    M M M M M M
681  84   3 TTTTTTTTTTE M
                      M M M M   M
700  84   4 M M M M M M   M
                  M M M M M   M
720  69   2 TTTTTTTTTTTTTTE
                      M M M M   M M
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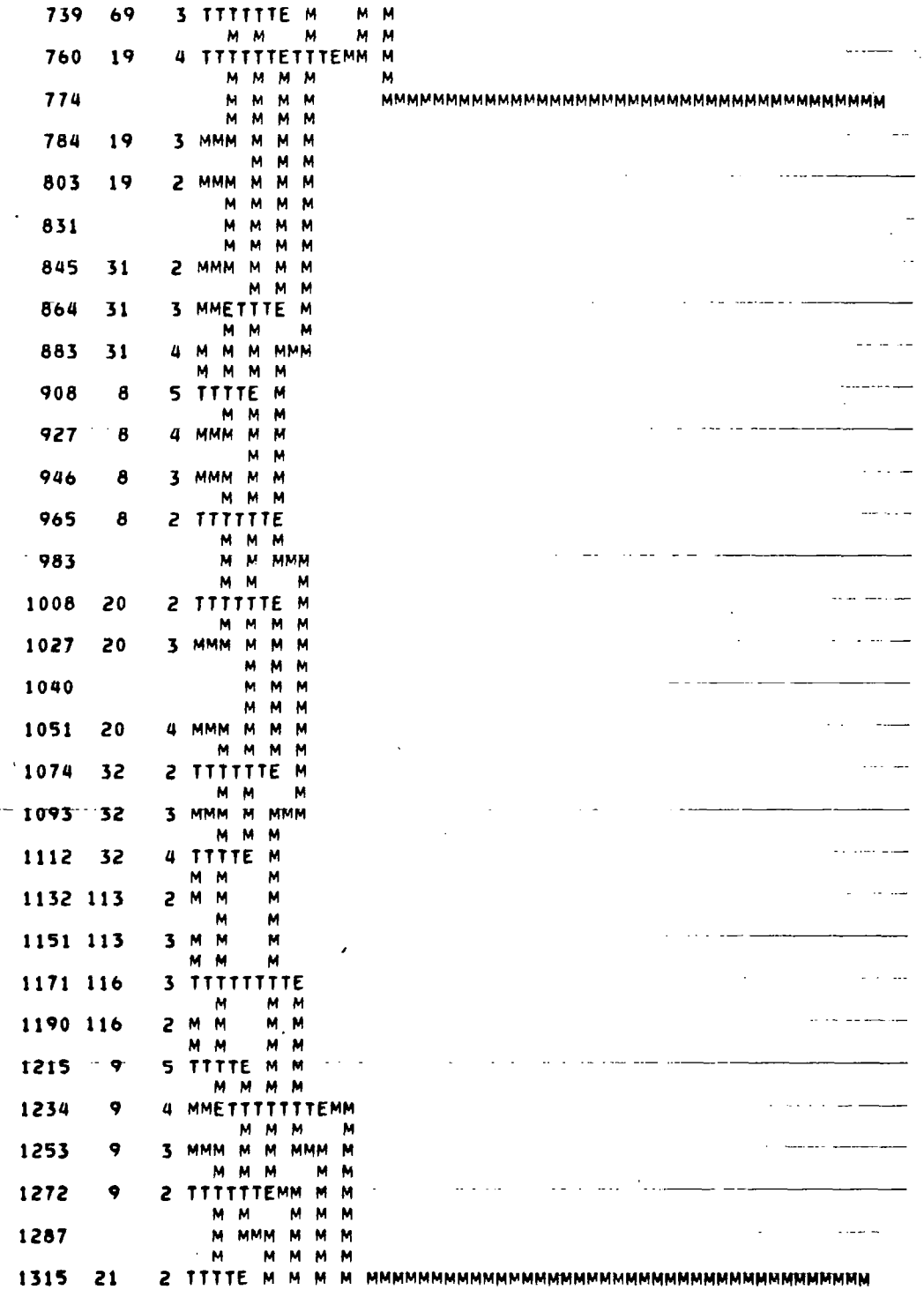
739 69 3 TTTTTTE M M M
M M M M M
760 19 4 TTTTTTETTTEMM M
M M M M M
774 M M M M MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
M M M M
784 19 3 MMM M M M
M M M
803 19 2 MMM M M M
M M M M
831 M M M M
M M M M
845 31 2 MMM M M M
M M M
864 31 3 MMETTTE M
M M M
883 31 4 M M M MMM
M M M M
908 8 5 TTTTE M
M M M
927 8 4 MMM M M
M M
946 8 3 MMM M M
M M M
965 8 2 TTTTTTE
M M M
983 M M MMM
M M M
1008 20 2 TTTTTTE M
M M M M
1027 20 3 MMM M M M
M M M
1040 M M M
M M M
1051 20 4 MMM M M M
M M M M
1074 32 2 TTTTTTE M
M M M
1093 32 3 MMM M MMM
M M M
1112 32 4 TTTTE M
M M M
1132 113 2 M M M
M M
1151 113 3 M M M
M M M
1171 116 3 TTTTTTTTE
M M M
1190 116 2 M M M M
M M M M
1215 9 5 TTTTE M M
M M M M
1234 9 4 MMETTTTTTTEMM
M M M M
1253 9 3 MMM M M MMM M
M M M M M
1272 9 2 TTTTTTEMM M M
M M M M M
1287 M MMM M M M
M M M M M
1315 21 2 TTTTE M M M M MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM


1334 21 3
1344
1358 21 4
1381 33 2
1400 33 3
1419 33 4
1442 10 2
1461 10 3
1480 10 4
1499 10 5
1524 81 2
1543 81 3
1553
1563 79 2
1582 79 3
1610
1622 90 2
1641 90 3
1665 90 4
1686
1696
1703
1710
1717
1724
1726
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
4 4 4 5 6 7 7 8 9 9 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
4 2 9 6 3 0 7 4 1 8 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

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CENTER SECTION =    10

                                                                                ELEM PIN

              1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
              4 4 4 4 4 4 4 4 4 4 4 4 4 4 3 3 3 3 3 3 3 3 3 3 3 3 4 4
              1 1 1 1 1 1 1 1 1 1 1 1 1 1 7 7 7 7 7 7 7 7 7 7 7 7 2 1
              2 2 2 2 2 2 2 2 2 2 2 2 2 2 7 7 7 7 7 7 7 7 7 7 7 7 1 9
                                                                                      348
                                                                                      362
                                                                                      369
                                                                                      376
                                                                                      383
                                                                                      394
                                                                                      417
                                                                                      436
                                                                                      455
                                                                                      479
                                                                                      498
                                                                                      517
                                                                                      527
                                                                                      542
                                                                                      561
             MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 103    2    578
                                                                                      600
                                                                                      619
                                                                                      638
                                                                                      662
                                                                                      681
                                                                                      700
                                                                                      720
```

739

760

MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 102 2 778

784

803

831

845

864

883

908

927

946

965

983

1008

1027

1040

1051

1074

1093

1112

1132

1151

1171

1190

1215

1234

1253

1272

1287

MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 104 2 1302

1334

1344

1358

1381

1400

1419

1442

1461

1480

MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM 105 2 1502

1524

1543

1553

1563

1582

1610

1622

1641

1665

1686

1696

1703

1710

1717

1724

1726

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
4 4 4 4 4 4 4 4 4 4 4 4 4 4 3 3 3 3 3 3 3 3 3 3 3 3 4 4
1 1 1 1 1 1 1 1 1 1 1 1 1 1 7 7 7 7 7 7 7 7 7 7 7 7 2 1
2 2 2 2 2 2 2 2 2 2 2 2 2 2 7 7 7 7 7 7 7 7 7 7 7 7 1 9

```
LEFT SIDE, ROW #  1

      ELEM PIN

            0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 3 3 3
            7 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 9 0 2 3 5 7 9 9 1 3 4
            1 9 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 5 2 0 8 6 4 2 9 7 5 8
1440                                                                     1440
1433                                                                     1433
1426                                                                     1426
1419                                                                     1419
1412                                                                     1412
1405                                              MMMMMMMMMMMMMMMMMMM  1405
                                                  M
1398                                              M MMMMMMMMMMMMMMMMM  1398
                                                  M M
1391                                              M M   MMMMMMMMMMMMM  1391
                                                  M M   M
1384                                              M M   M     MMMMMMM  1384
                                                  M M   M     M
1377                                              M M   M     M MMMMM  1377
                                                  M M   M     M M
1366                                              M M   M     M M      1366
                                                  M M   M     M M
1359                                              M M   M     M M      1359
                                                  M M   M     M M
1352                                              M M   M     M M      1352
                                                  M M   M     M M
1345                                              M M   M     M M      1345
                                                  M M   M     M M
1338                                              M M   M     M M      1338
                                                  M M   M     M M
1331                                              M M   M     M M      1331
                                                  M M   M     M M
1324                                              M M   M     M M      1324
                                                  M M   M     M M
1317                                              M M   M     M M      1317
                                                  M M   M     M M
1310                                              M M   M     M M      1310
                                                  M M   M     M M
1303                                              M M   M     M M      1303
                                                  M M   M     M M
1296                                              M M   M     M M      1296
                                                  M M   M     M M
1289                                              M M   M     M M      1289
                                                  M M   M     M M
1282                                              M M   M     M M      1282
                                                  M M   M     M M
1275                                              M M   M     M M      1275
                                                  M M   M     M M
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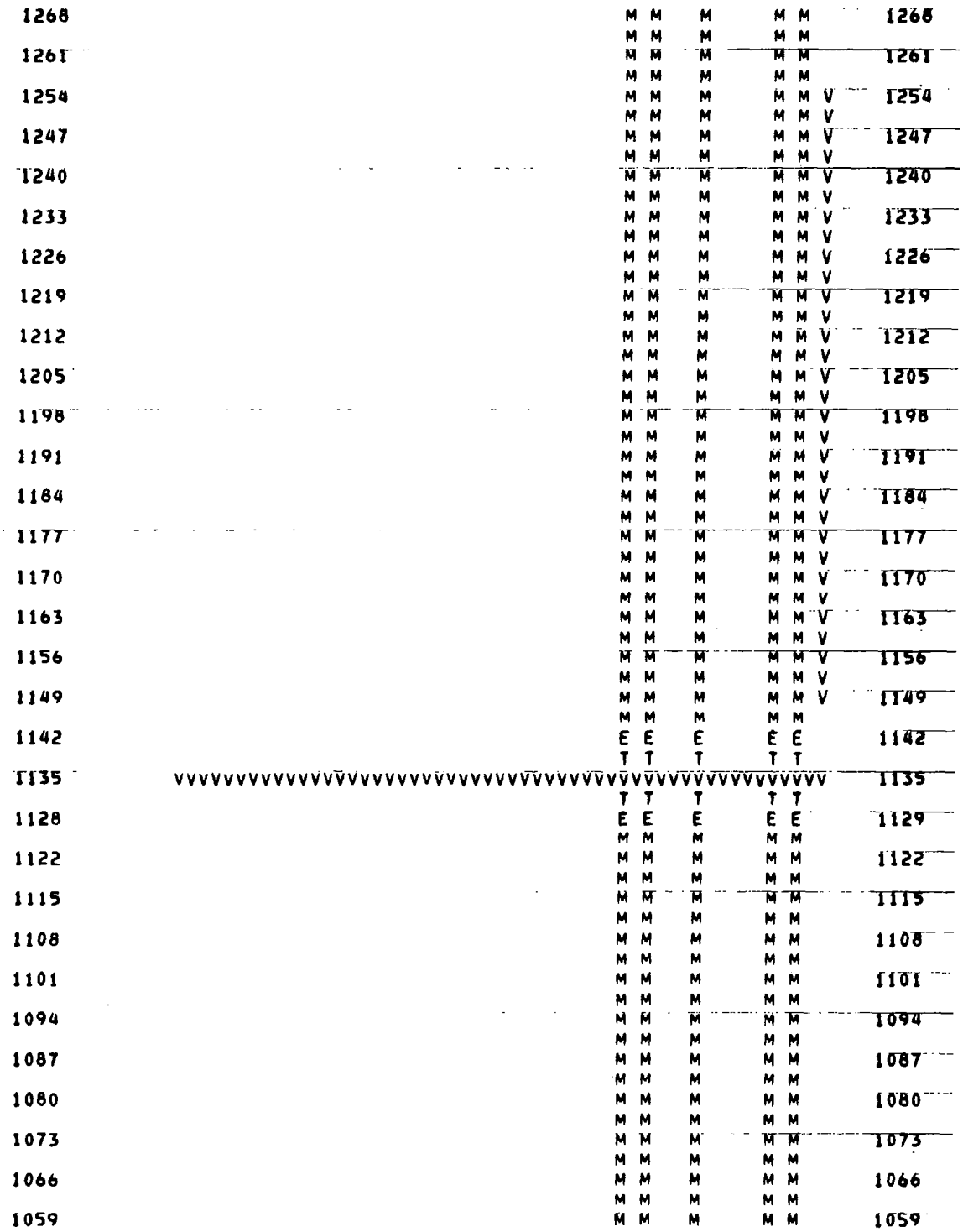
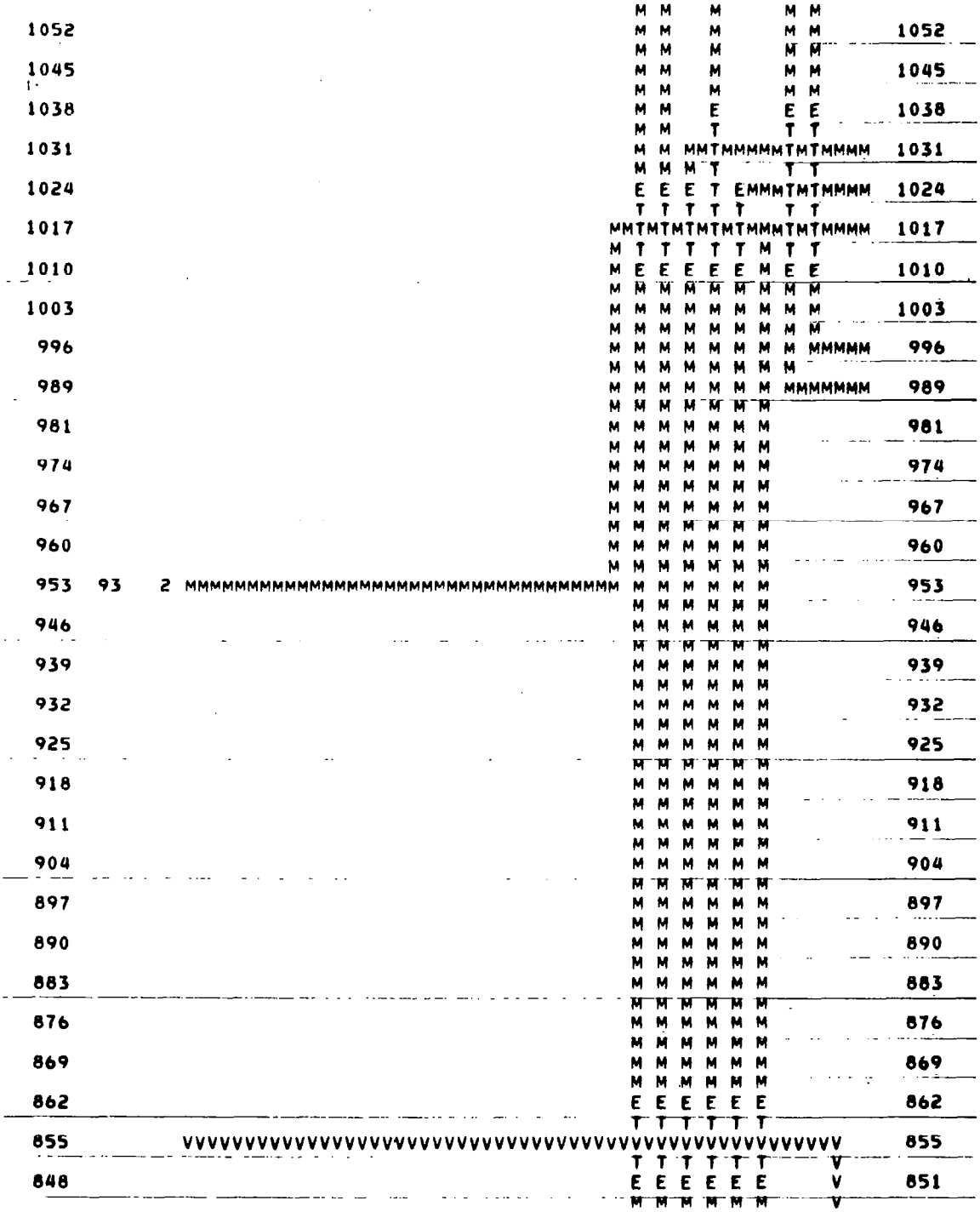

1268
1261
1254
1247
1240
1233
1226
1219
1212
1205
1198
1191
1184
1177
1170
1163
1156
1149
1142
1135
1128
1122
1115
1108
1101
1094
1087
1080
1073
1066
1059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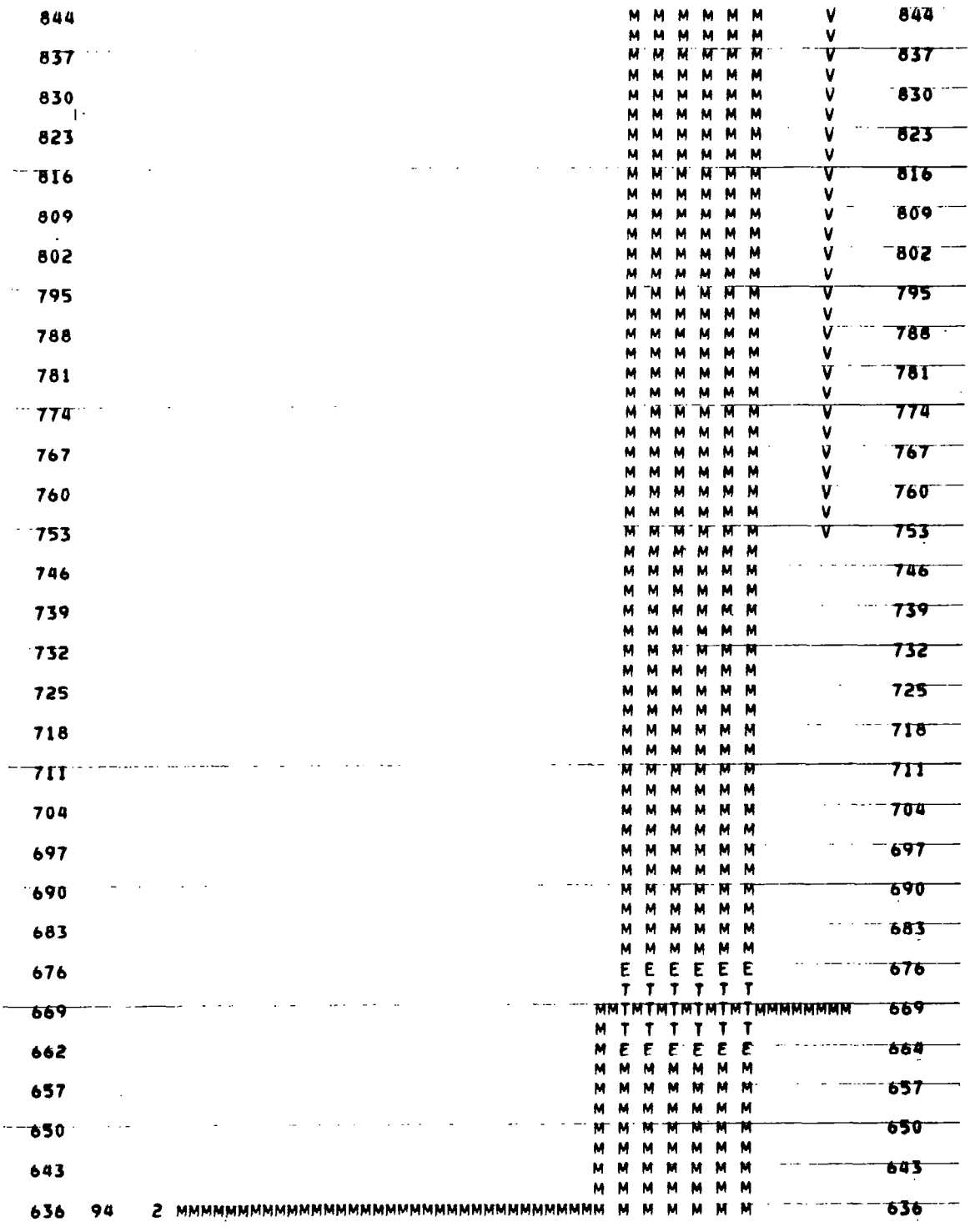
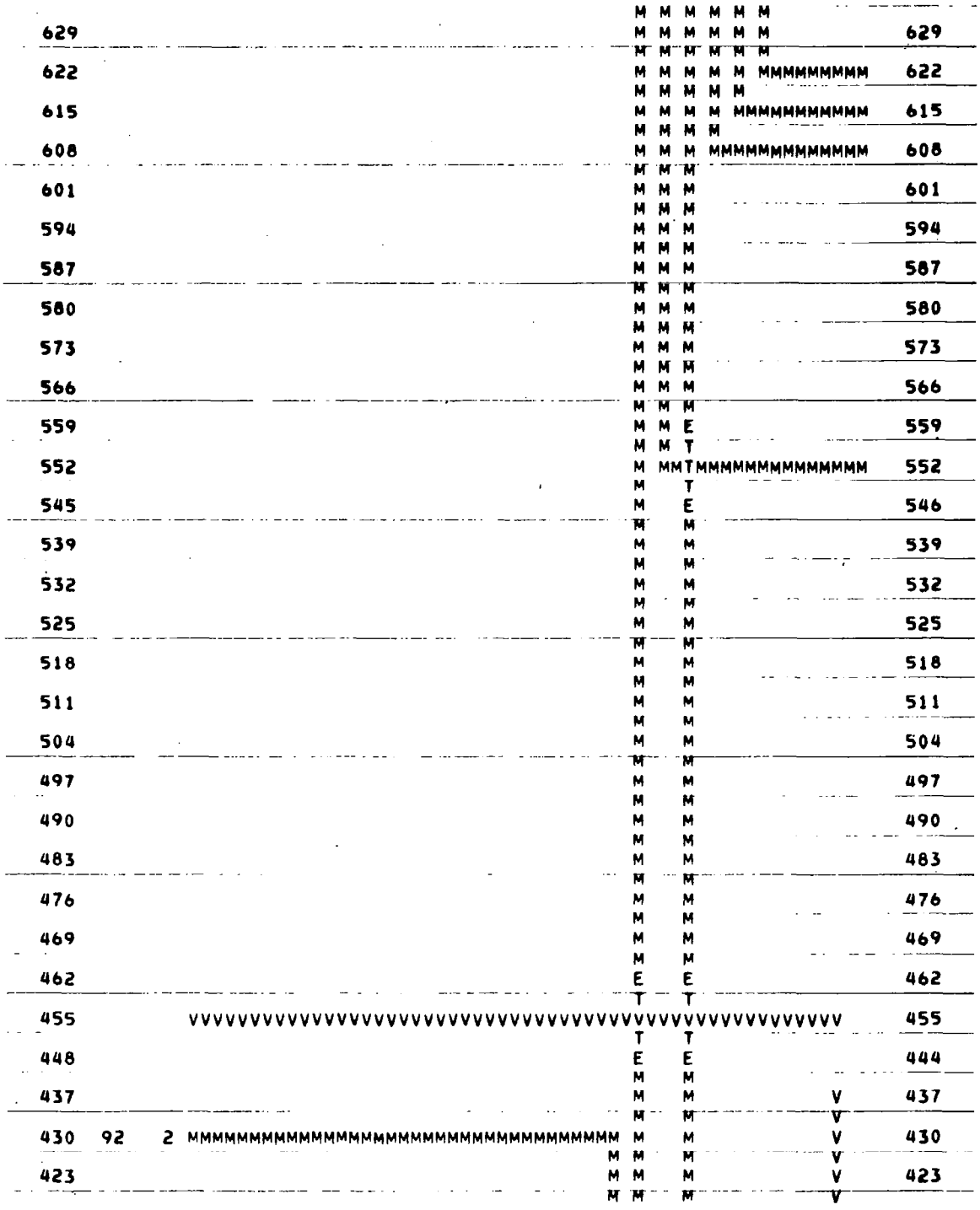
1045
1038
1031
1024
1017
1010
1003
996
989
981
974
967
960
953
946
939
932
925
918
911
904
897
890
883
876
869
862
855
848
93
2


844
837
830
823
816
809
802
795
788
781
774
767
760
753
746
739
732
725
718
711
704
697
690
683
676
669
662
657
650
643
636
94
2


629
622
615
608
601
594
587
580
573
566
559
552
545
539
532
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518
511
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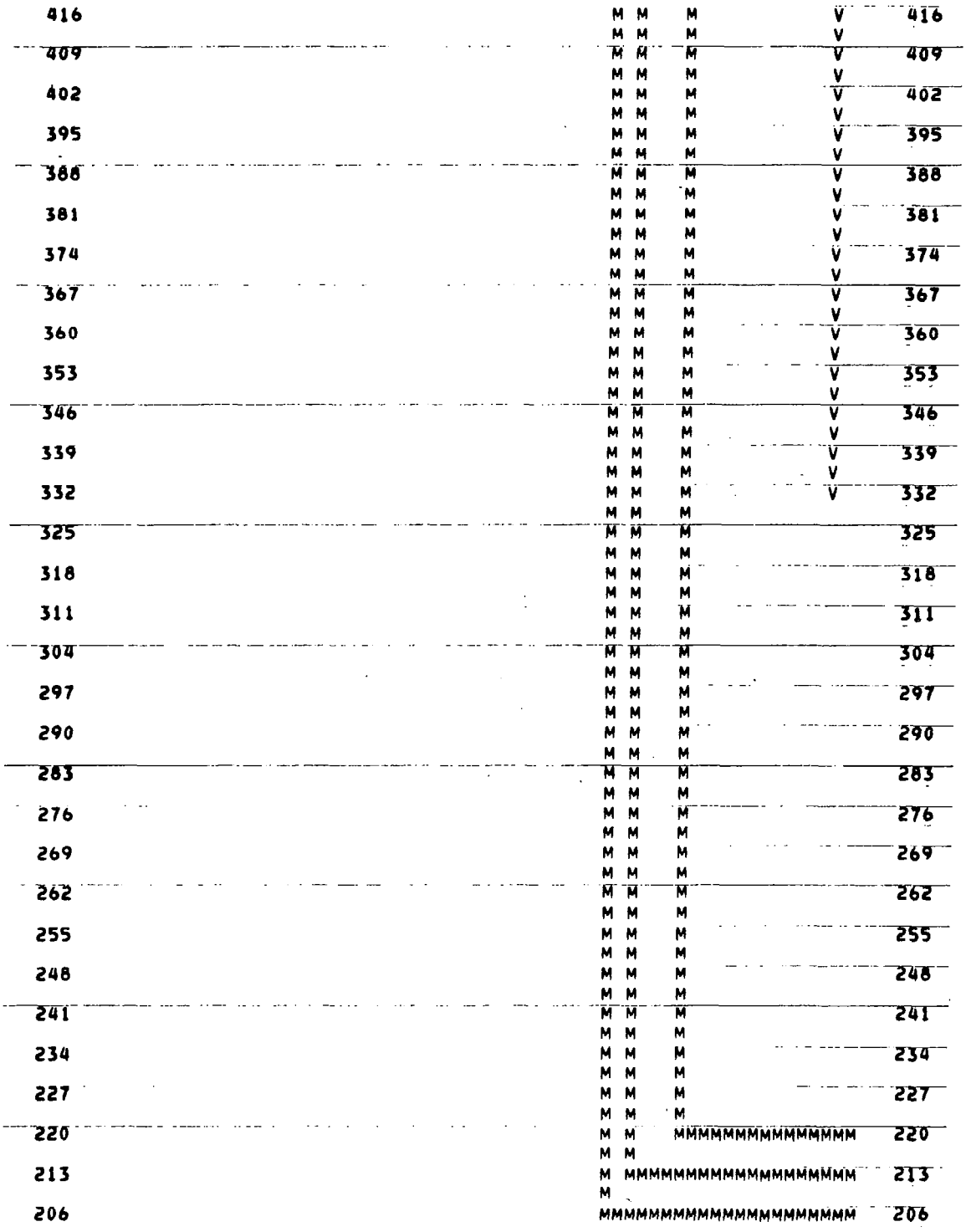
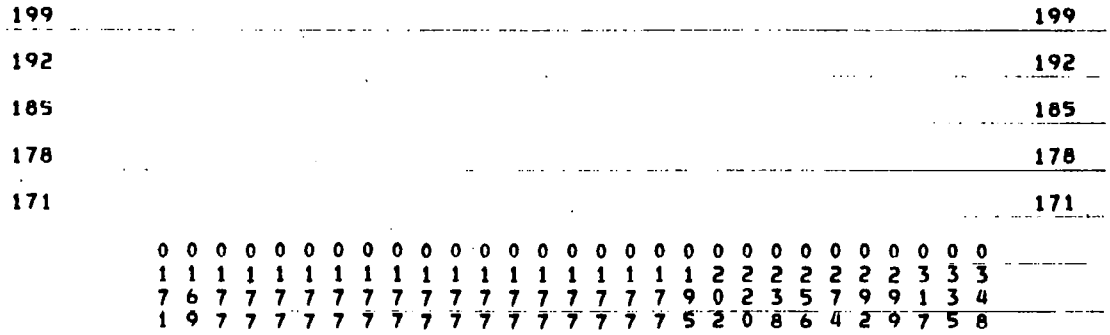
437
430
423
92
2


416
409
402
395
388
381
374
367
360
353
346
339
332
325
318
311
304
297
290
283
276
269
262
255
248
241
234
227
220
213
206


199
192
185
178
171
199
192
185
178
171
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 3 3 3
7 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 9 0 2 3 5 7 9 9 1 3 4
1 9 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 5 2 0 8 6 4 2 9 7 5 8

RIGHT SIDE, ROW = 2

ELEM PIN

```
     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
     7 7 7 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
     2 3 5 7 9 1 2 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 5
     6 9 7 5 3 1 9 6 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 1 9
1433                                                             1433
1426                                                             1426
1419                                                             1419
1412                                                             1412
1405                                                             1405
1398 MMMMMMMMMMMMMMM                                             1398
                   M
1391 MMMMMMMMMMMMM M                                             1391
                 M M
1384 MMMMMMMMMMM M M                                             1384
               M M M
1373           M M M                                             1373
               M M M
1366           M M M                                             1366
               M M M
1359           M M M                                             1359
               M M M
1352           M M M                                             1352
               M M M
1345           M M M                                             1345
               M M M
1338           M M M                                             1338
               M M M
1331           M M M                                             1331
               M M M
1324           M M M                                             1324
               M M M
1317           M M M                                             1317
               M M M
1310           M M M                                             1310
               M M M
1303           M M M                                             1303
               M M M
1296           M M M                                             1296
               M M M
1289           M M M                                             1289
               M M M
1282           M M M                                             1282
               M M M
1275           M M M                                             1275
               M M M
1268           M M M                                             1268
               M M M
```

```
1261            M M M                                                        1261
                M M M
1254    V       M M M                                                        1254
        V       M M M
1247    V       M M M                                                        1247
        V       M M M
1240    V       M M M                                                        1240
        V       M M M
1233    V       M M M                                                        1233
        V       M M M
1226    V       M M M                                                        1226
        V       M M M
1219    V       M M M                                                        1219
        V       M M M
1212    V       M M M                                                        1212
        V       M M M
1205    V       M M M                                                        1205
        V       M M M
1198    V       M M M                                                        1198
        V       M M M
1191    V       M M M                                                        1191
        V       M M M
1184    V       M M M                                                        1184
        V       M M M
1177    V       M M M                                                        1177
        V       M M M
1170    V       M M M                                                        1170
        V       M M M
1163    V       M M M                                                        1163
        V       M M M
1156    V       M M MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM   97   2  1156
        V       M M
1149    V       M M                                                          1149
                M M
1142            E E                                                          1142
                T T
1135    VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVV   1135
                T T
1129            E E                                                          1128
                M M
1122            M M                                                          1122
                M M
1115            M M                                                          1115
                M M
1108            M M                                                          1108
                M M
1101            M M                                                          1101
                M M
1094            M M                                                          1094
                M M
1087            M M                                                          1087
                M M
1080            M M                                                          1080
                M M
1073            M M                                                          1073
                M M
1066            M M                                                          1066
                M M
1059            M M                                                          1059
                M M
1052            M M                                                          1052
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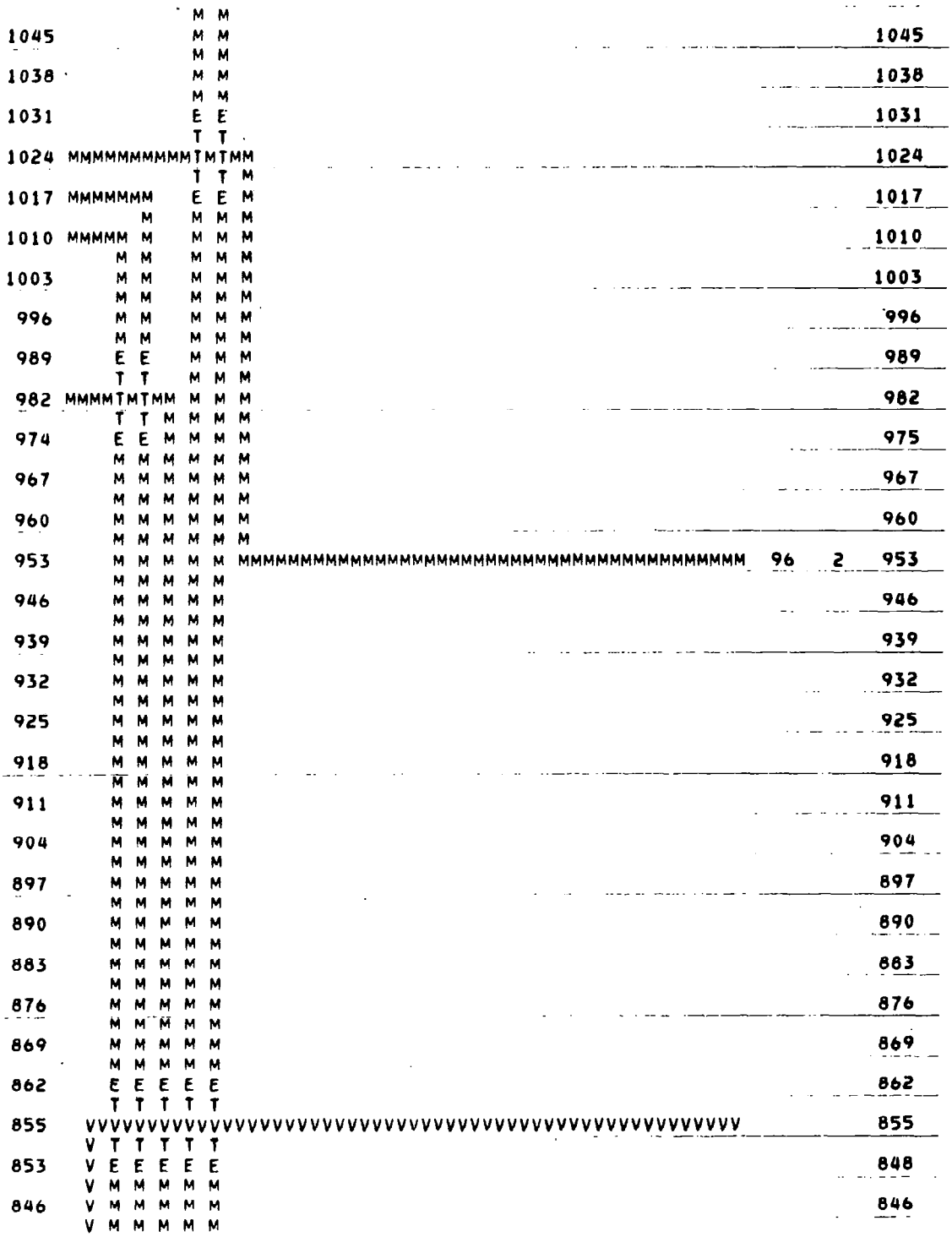
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1038
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1024
1017
1010
1003
996
989
982
975
967
960
953
946
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918
911
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897
890
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876
869
862
855
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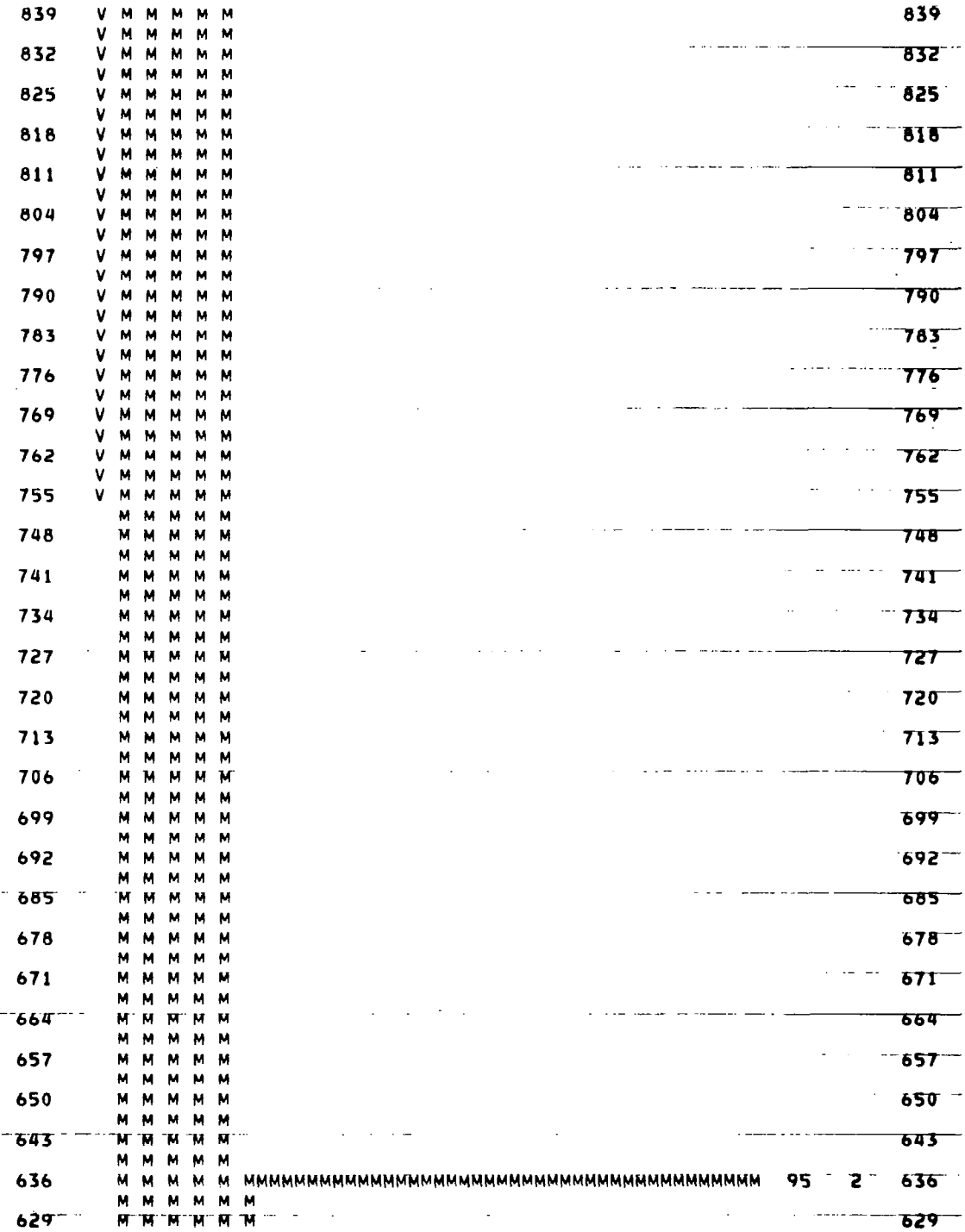
96
2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769
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748
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692
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678
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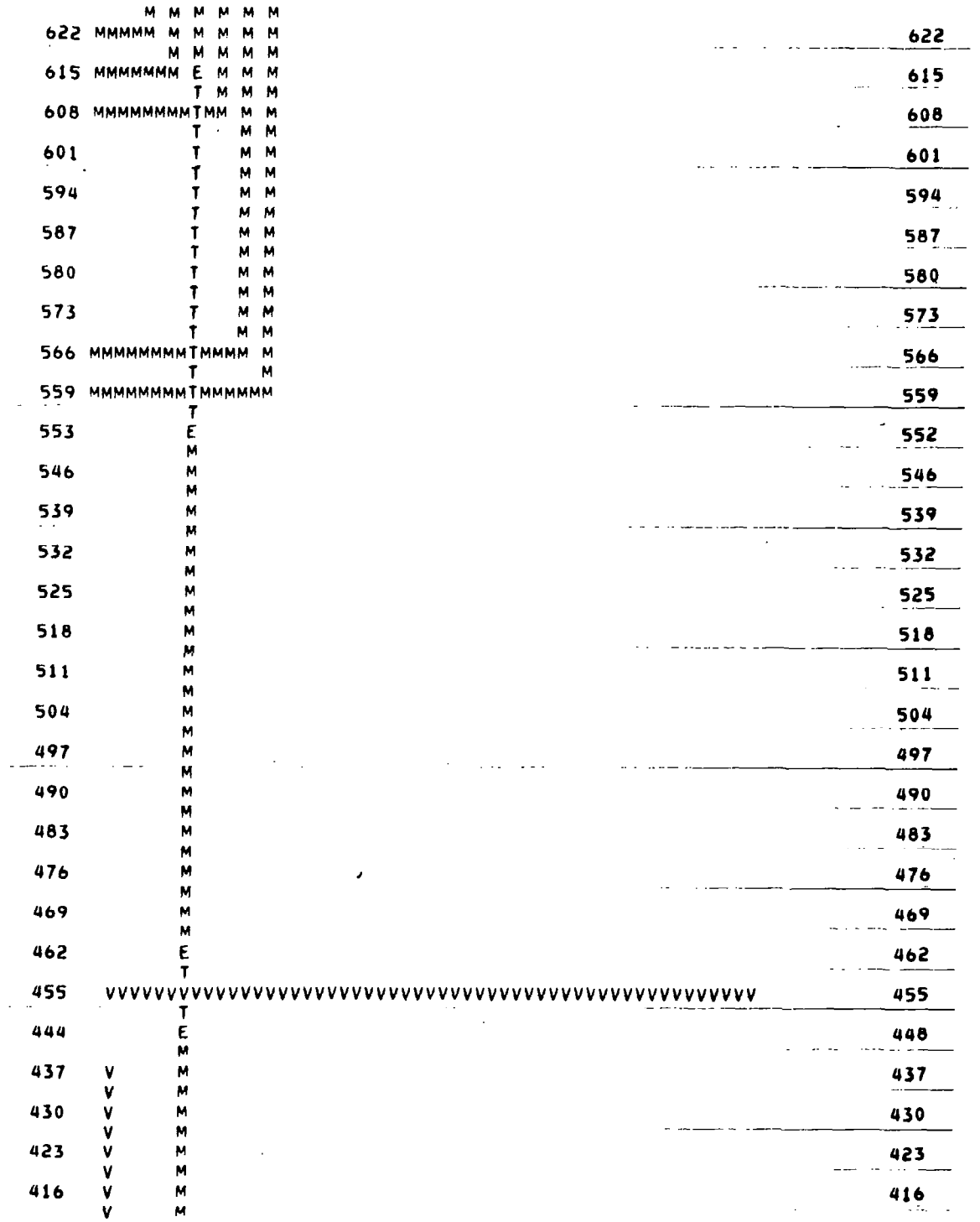
664
657
650
643
636
629
95
2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437
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423
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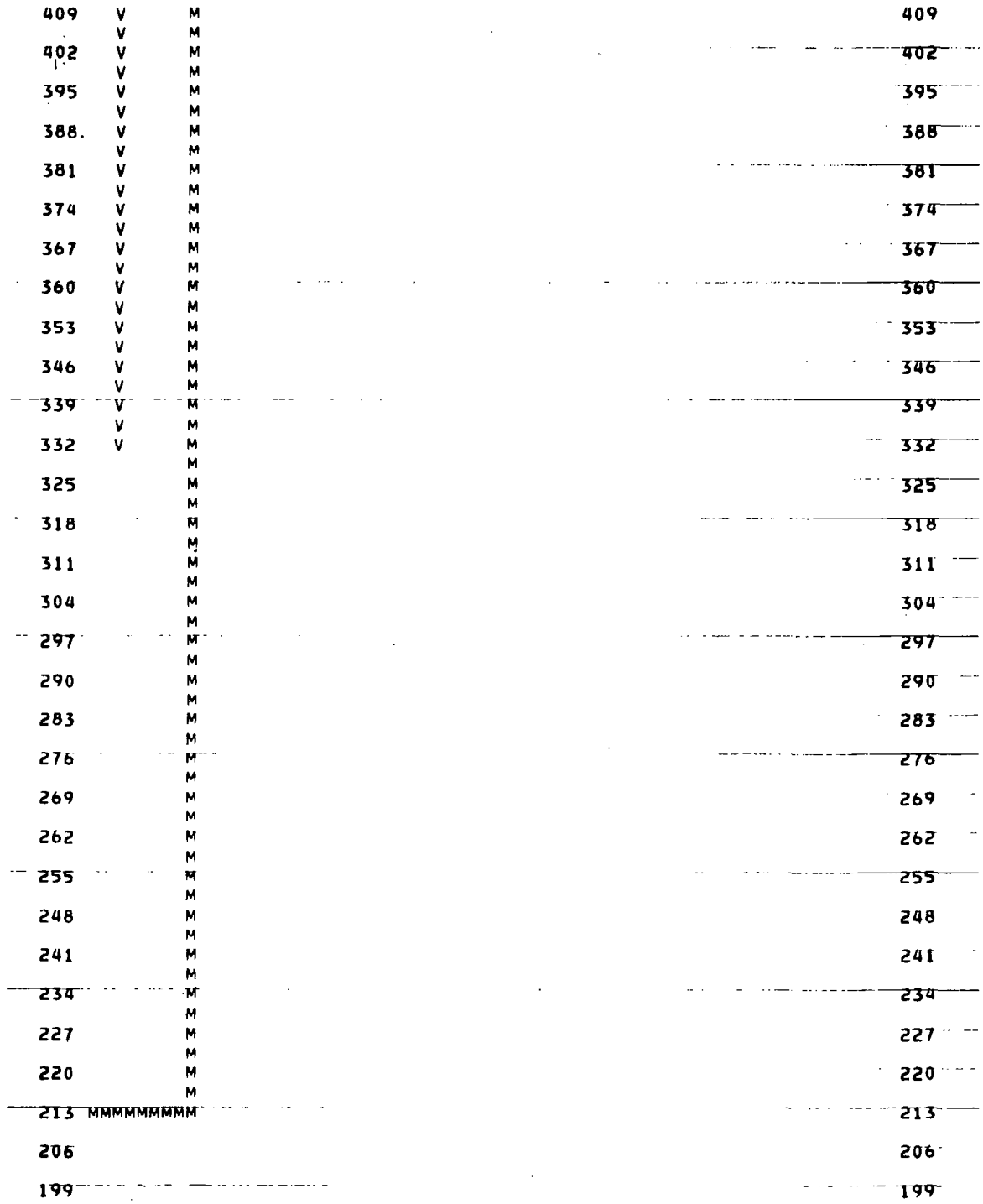
409
402
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388.
381
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367
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269
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255
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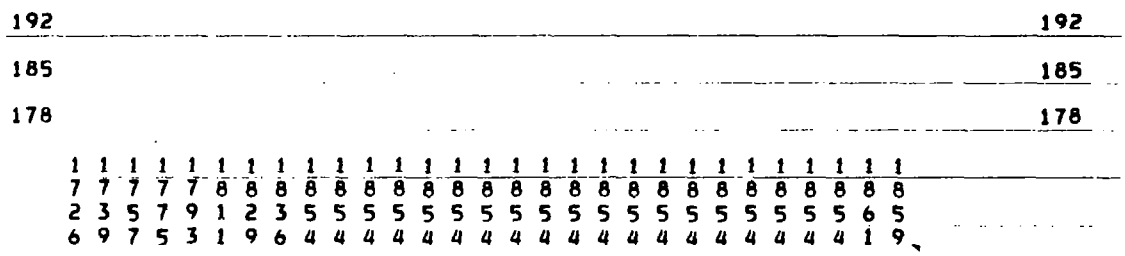
234
227
220
213
206
199
MMMMMMMMM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192
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178
178
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
7 7 7 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
2 3 5 7 9 1 2 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 5
6 9 7 5 3 1 9 6 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 1 9

NODE CROSSOVER COUNT:

NODE NUMBER	NUMBER CROSSOVERS
1	16
2	20
3	7
4	19
5	14
6	60
7	52
8	28
9	14
10	12
11	21
12	2
13	2
14	12
15	7
16	7
17	2
18	9
19	7
20	11
21	42

NODE CROSSOVER COUNT:

NODE NUMBER	NUMBER CROSSOVERS
64	30
65	40
66	10
67	10
68	20
69	6
70	12
71	2
72	12
73	4
74	10
75	12
76	21
77	35
78	16
79	6
80	9
81	40
82	1
83	16
84	5

NODE CROSSOVER COUNT:

NODE NUMBER	NUMBER CROSSOVERS
85	13
86	9
87	9
88	12
89	13
90	0
91	4
92	0
93	24
94	23
95	13
96	23
97	22
98	14
99	4
100	4
101	0
102	21
103	15
104	17
105	12

NODE CROSSOVER COUNT:

NODE NUMBER	NUMBER CROSSOVERS
106	6
107	5
108	5
109	4
110	3
111	5
112	8
113	5
114	12
115	11
116	16
117	19
118	0
119	7
120	11
121	16

END OF PLOT.
END OF ART FUNCTION.

START OF WRITE FUNCTION.

START OF DEBUG SUBROUTINE.

ICAP(IX):

I + I	1	2	3	4	5	6	7	8	9	10
0	16	20	7	19	14	60	52	28	14	12
10	21	2	2	12	7	7	2	9	7	11
20	42	28	28	25	21	35	4	18	5	5
30	34	4	14	15	8	12	0	4	2	4
40	2	2	2	4	7	12	19	27	13	2
50	21	10	19	61	3	75	12	9	6	14
60	13	18	16	30	40	10	10	20	6	12
70	2	12	4	10	12	21	35	16	6	9
80	40	1	16	5	13	9	9	12	13	0
90	4	0	24	23	13	23	22	14	4	4
100	0	21	15	17	12	6	5	5	4	3
110	5	8	5	12	11	16	19	0	7	11
120	16	0	0	0	0	0	0	0	0	0

INFO(IX,IY):

I J =	1	2	3	4	5	6	7
1	4	11	4386	4865	0	6	47
2	5	13	4502	5145	0	-7	47
3	9	13	4769	5145	0	-7	47
4	12	13	4892	5145	0	7	52
5	10	17	4968	5267	0	-8	40
6	7	17	4739	5267	0	-8	40
7	4	17	4425	5267	0	8	40
8	11	19	4960	5547	0	-9	40
9	16	19	5267	5547	0	-9	40
10	19	19	5411	5547	0	9	40
11	22	13	5660	5145	0	-7	40
12	22	11	5647	4865	0	-6	40
13	19	13	5346	5145	0	7	40
14	16	13	5117	5145	0	7	40
15	19	11	5333	4865	0	6	40
16	20	7	5481	4729	0	-5	40
17	6	17	4570	5267	0	8	64
18	8	17	4823	5267	0	-8	64
19	9	19	4815	5547	0	-9	64
20	12	19	4960	5547	0	9	64
21	17	19	5267	5547	0	9	64
22	21	17	5469	5267	0	8	64
23	21	11	5478	4865	0	6	64
24	21	13	5491	5145	0	7	64
25	18	13	5262	5145	0	7	64
26	17	17	5226	5267	0	8	64
27	17	11	5153	4865	0	6	64
28	19	7	5312	4729	0	5	64

29	5	17	4570	5267	0	-8	1
30	9	17	4823	5267	0	8	1
31	10	19	4815	5547	0	9	1
32	13	19	5044	5547	0	9	1
33	18	19	5351	5547	0	9	1
34	20	17	5409	5267	0	8	1
35	20	11	5418	4865	0	6	1
36	20	13	5491	5145	0	-7	1
37	17	13	5262	5145	0	-7	1
38	18	17	5310	5267	0	8	1
39	17	7	5192	4729	0	5	1
40	18	7	5312	4729	0	-5	1
41	11	17	5007	5267	0	-8	47
42	8	13	4646	5145	0	7	64
43	7	13	4646	5145	0	-7	58
44	18	11	5237	4865	0	6	27
45	21	7	5481	4729	0	5	40
46	19	5	5352	4449	0	4	40
47	13	5	4963	4449	0	-4	40
48	7	7	4506	4729	0	5	40
49	8	7	4676	4729	0	-5	40
50	11	7	4820	4729	0	5	40
51	22	7	5566	4729	0	5	64
52	17	5	5184	4449	0	4	64
53	11	5	4818	4449	0	-4	64
54	7	11	4572	4865	0	6	64
55	13	7	4965	4729	0	5	64
56	10	7	4736	4729	0	5	64
57	21	5	5577	4449	0	-4	1
58	14	5	5023	4449	0	-4	1
59	12	5	4818	4449	0	4	1
60	8	11	4656	4865	0	6	1
61	12	7	4965	4729	0	-5	1
62	9	7	4736	4729	0	-5	1
63	9	11	4755	4865	0	-6	47
64	6	13	4586	5145	0	-7	64
65	5	11	4425	4865	0	6	14
66	14	11	5033	4865	0	-6	1
67	12	17	5007	5267	0	8	14
68	14	17	5109	5267	0	8	35
69	8	19	4692	5547	0	9	47
70	20	5	5437	4449	0	4	76
71	16	5	5104	4449	0	4	76
72	10	5	4734	4449	0	-4	76
73	5	5	4406	4449	0	4	76
74	14	7	5049	4729	0	5	76
75	11	11	4815	4865	0	6	76
76	15	5	5023	4449	0	4	7
77	5	7	4386	4729	0	5	7
78	3	19	4386	5547	0	9	14
79	21	19	5535	5547	0	9	47
80	16	17	5226	5267	0	-8	35
81	20	19	5496	5547	0	9	47
82	11	13	4808	5145	0	7	64
83	5	19	4512	5547	0	9	58
84	7	19	4632	5547	0	9	1
85	4	19	4512	5547	0	-9	52
86	22	5	5661	4449	0	-4	70
87	18	5	5352	4449	0	-4	70
88	8	5	4570	4449	0	4	70
89	6	5	4570	4449	0	-4	70

90	22	19	5574	5547	0	9	70
91	22	17	5553	5267	0	8	70
92	1	2	4153	4648	1	-1	86
93	1	18	4153	5148	3	1	82
94	1	7	4153	4848	2	-1	82
95	25	7	5841	4848	2	-2	86
96	25	18	5841	5148	3	2	86
97	25	22	5841	5348	4	2	86
98	4	1	4572	4374	1	-3	86
99	8	1	4772	4374	2	-3	86
100	18	1	5272	4374	3	3	86
101	22	1	5472	4374	4	3	86
102	8	23	4772	5622	2	-10	82
103	4	23	4572	5622	1	-10	86
104	18	23	5272	5622	3	10	82
105	22	23	5472	5622	4	10	82
106	15	11	5033	4865	0	6	1
107	6	19	4632	5547	0	-9	1
108	10	13	4808	5145	0	-7	35
109	16	11	5093	4865	0	6	58
110	16	7	5129	4729	0	5	52
111	4	5	4367	4449	0	4	47
112	3	17	4386	5267	0	8	47
113	14	19	5104	5547	0	9	47
114	4	13	4386	5145	0	7	20
115	10	11	4755	4865	0	6	1
116	15	19	5182	5547	0	-9	47
117	19	17	5370	5267	0	8	47
118	15	17	5187	5267	0	-8	47
119	6	7	4506	4729	0	-5	47
120	6	11	4572	4865	0	-6	64
121	14	13	5078	5145	0	-7	64
122	13	13	4955	5145	0	7	47
123	15	13	5117	5145	0	-7	47
124	13	17	5070	5267	0	8	47
125	13	11	4934	4865	0	6	47
126	12	11	4895	4865	0	6	47

IP(Ix):

I + I	1	2	3	4	5	6	7	8	9	10
0	100	50	120	215	330	480	670	900	1250	1750
10	2400	3200	4100	1	1	5400	5	35	0	45
20	50	10	15	20	25	55	60	2	-1	7
30	0	3	6	2	1	1	1	0	1	0
40	0	0	2790	0	0	0	0	0	0	0
50	0	0	0	1	3	0	1	0	1	1
60	2	1	60	0	0	2	0	0	1	1
100	40	2	1	2	4	0	2	10	1	6
110	0	1	4	3	1	1	2	4	2	3
120	100	0	5	0	3	1	2	2	1	1
130	100	0	0	0	0	0	0	0	0	0
140	50	7	19	200	450	350	5000	2	90	5
150	140	2	5	21	8	26	6	5	0	10
160	1	6	0	0	0	0	4	0	0	0
170	2	21	3	7	0	0	0	0	0	0

190	20	4153	3	7	0	0	121	4445	0	0
200	279	1100	0	0	0	1	2	22	0	0
210	0	5841	6	1	0	0	121	4445	0	0
220	279	1100	0	0	0	25	2	22	0	0
230	0	4374	5	2	0	0	64	4313	0	0
240	131	1300	0	0	0	1	4	22	0	0
250	0	4449	0	4	3	4	66	4367	64	136
260	134	1294	4346	5681	0	5	4	22	4	4332
270	5702	4729	5	2	3	4	67	4386	64	136
280	133	1264	4346	5681	0	7	4	22	8	4332
290	5702	4865	0	4	6	5	67	4386	65	136
300	133	1261	4365	5680	1	11	4	22	10	4330
310	5708	5145	5	2	6	5	67	4386	65	136
320	134	1274	4365	5680	0	13	4	22	14	4330
330	5708	5267	0	4	4	5	67	4386	65	135
340	132	1251	4365	5678	0	17	3	22	16	4344
350	5706	5547	5	2	4	5	67	4386	65	135
360	133	1272	4365	5678	0	19	3	22	20	4344
370	5706	5622	0	4	0	0	64	4313	0	0
380	131	1300	0	0	0	23	4	22	0	0
390	0	0	5	2	0	0	0	0	0	0
410	0	0	0	4	0	0	0	0	0	0
430	0	0	5	2	0	0	0	0	0	0
450	0	0	0	4	0	0	0	0	0	0
470	0	0	5	2	0	0	0	0	0	0
490	0	0	0	4	0	0	0	0	0	0
510	0	0	5	2	0	0	0	0	0	0
530	0	0	0	4	0	0	0	0	0	0
550	0	0	5	2	0	0	0	0	0	0
570	0	0	0	4	0	0	0	0	0	0
590	0	0	5	2	0	0	0	0	0	0
610	0	0	0	4	0	0	0	0	0	0
630	0	0	5	2	0	0	0	0	0	0
650	0	0	0	4	0	0	0	0	0	0
680	120	2130	1690	50	170	150	100	10	2200	200
690	18	30	60	300	260	4	120	260	0	170
700	150	1	170	100	7	50	1	0	30	1
710	100	100	0	100	20	0	0	0	270	1065
720	845	0	60	14	80	10	10	17	70	14
730	14	1065	845	100	220	360	461	562	5	2
740	537	309	733	4	68	0	0	0	14	90
750	0	3	3	8	8	12	12	3	3	2
760	2	1	0	210	210	210	210	221	221	0
770	16	10	0	0	1	0	0	0	0	5
800	40	9030	9030	9000	9100	9510	9500	9250	9600	9100
810	9110	9310	9320	9210	9220	9230	9240	9450	9440	9800
840	20	2	7	38	4638	6	8955	0	379	0

IPIN(IX,IY):

I J =	1	2	3
1	1120	5	7
3	10	3	820
4	1	22	1300
5	1	41	1300
6	-4	60	140

7	1130	6	14
9	10	1	1180
10	1	20	1710
11	1	39	1710
12	1	58	1710
13	-6	81	140
14	1220	5	20
16	10	4	1040
17	1	23	1170
18	1	42	1170
19	-4	63	140
20	1230	6	27
22	10	1	500
23	1	20	1000
24	1	39	1000
25	1	58	1000
26	-6	77	140
27	1240	7	35
29	10	1	850
30	1	20	1540
31	1	39	1540
32	1	58	1540
33	1	77	1540
34	-8	96	140
35	1310	4	40
37	10	1	1200
38	1	20	1800
39	-2	39	140
40	1330	6	47
42	1	4	1370
43	10	23	1340
44	2	42	1370
45	3	61	2320
46	-6	85	140
47	1520	4	52
49	10	1	1790
50	1	20	3940
51	-2	39	140
52	1620	5	58
54	10	4	1270
55	1	23	1170
56	1	42	1170
57	-6	63	140
58	1720	5	64
60	10	3	1270
61	1	22	1310
62	1	41	1310
63	-6	60	140
64	1820	5	70
66	1	21	500
67	2	40	1000
68	10	64	350
69	-14	84	140
70	1830	5	76
72	1	21	1500
73	2	40	600
74	10	64	1200
75	-10	84	140
76	2310	5	82
78	10	4	900
79	1	23	1550

80	1	62	1550
81	-8	66	140
82	9020	3	80
84	1	12	300
85	0	76	80
86	9030	3	0
88	10	12	300
89	0	76	80

LIM(IX):

I + I	1	2	3	4	5	6	7	8	9	10
0	0	400	0	0	4000	0	10000	0	2	10000
10	10000	500	7	1	2	3	4	5	6	7
20	9000	59	200	3	3	1	2	3	0	1000
30	0	1	0	0	500	1	101	141	191	681
40	801	841	0	0	0	0	0	0	9	4000
50	6	1	2	3	4	5	6	2	0	1
60	0	105	0	0	351	0	612	0	44	100
70	70	3	3	2	1	1	2	2	0	0
80	0	104	104	963	371	81	4	0	0	0
90	0	0	0	0	1	0	100	24	94	8
100	0	100	461	360	220	562	3714	0	5622	4153
110	5841	4374	100	70	100	99	24	10	29	2
120	28	1	28	121	279	963	67	133	66	134
130	4	237	0	198	58	56	59	31	112	291
140	5601	3	7	9	19	0	0	0	0	0
150	0	0	0	12000	100	200	2	198	1	199
160	30	60	2	58	4	56	1	59	3	57
170	29	-3	4	300	42	2528	72	8	2000	3
180	0	2	1	0	0	18	1	29	3	2
190	30	28	27	29	1	2	28	1	200	400
200	399	8	3982	124	-1	1425	1426	28	6859	4203
210	8	-1	59	57	58	286	0	40	80	0
220	0	0	100	70	1	10000	5812	5683	1384	0
230	4997	4998	0	4133	4305	-20	0	19	4	9
240	126	126	110	2	4	29	0	0	0	0
250	0	0	1497	48	50	89	112	4	400	0
260	0	121	121	25738	4000	17	1183	4000	14	8
270	10	1000	196	7	7	1	2	3	4	5
280	6	7	4313	3605	-25	682	4370	5	4351	64
290	67	66	3	1689	1	399	3	0	0	0

MODE(IX):

I + I	1	2	3	4	5	6	7	8	9	10
0	1	1	4	4	15	1	1	102	1	0
10	0	0	0	0	3	0	0	0	0	

NODE(IX) / NOD(IX)I

I + I	1	2	3	4	5	6	7	8	9	10
0	96	26	9	2	1	2	2	3	94	2
10	130	30	19	2	112	2	1	3	93	2
20	4	4	31	1	2	2	3	3	42	3
30	64	3	26	16	45	1	3	2	4	3
40	82	3	120	3	121	3	26	6	55	1
50	4	2	5	4	67	4	121	51	75	1
60	118	2	4	4	86	3	87	3	88	3
70	89	3	90	3	91	3	40	30	93	1
80	124	2	6	2	7	2	8	2	9	2
90	10	2	5	2	51	21	111	1	123	2
100	12	2	13	2	14	2	15	2	16	2
110	11	2	4	4	119	1	5	3	17	3
120	1	1	127	1	6	3	18	3	21	11
130	135	1	7	3	19	3	1	1	143	1
140	8	3	20	3	1	1	151	1	9	3
150	21	3	10	8	159	1	10	3	22	3
160	15	5	167	1	11	3	23	3	15	5
170	175	1	12	3	24	3	1	1	183	1
180	13	3	25	3	25	5	191	1	14	3
190	26	3	2	2	199	1	15	3	27	3
200	1	1	207	1	16	3	28	3	32	22
210	229	1	113	2	6	5	7	5	8	5
220	29	4	30	4	31	4	32	4	5	5
230	27	7	241	1	17	4	6	4	29	3
240	114	5	29	9	253	1	18	4	7	4
250	30	3	114	4	46	16	265	1	19	4
260	8	4	31	3	114	3	64	24	277	1
270	20	4	9	4	32	3	44	5	65	25
280	299	1	116	2	10	5	11	5	12	5
290	33	4	34	4	35	4	36	3	9	5
300	2	2	309	1	21	4	10	4	33	3
310	26	6	319	1	22	4	11	4	34	3
320	2	2	329	1	23	4	12	4	35	3
330	2	2	339	1	24	4	13	4	36	4
340	84	34	363	1	117	2	14	5	15	5
350	16	5	37	4	38	4	39	4	40	4
360	13	5	121	2	2	2	373	1	25	4
370	14	4	37	3	47	17	385	1	26	4
380	15	4	38	3	44	8	27	7	397	1
390	27	4	16	4	39	3	44	3	1	1
400	405	1	29	2	17	2	1	1	413	1
410	30	2	18	2	1	1	421	1	31	2
420	19	2	1	1	429	1	32	2	20	2
430	1	1	437	1	33	2	21	2	1	1
440	445	1	34	2	22	2	1	1	453	1
450	35	2	23	2	1	1	461	1	36	2
460	24	2	1	1	469	1	37	2	29	2
470	1	1	477	1	38	2	26	2	24	4
480	485	1	39	2	27	2	1	1	493	1
490	40	2	28	2	27	7	505	1	28	4
500	40	3	44	4	45	8	33	23	517	1
510	41	2	113	3	116	3	117	3	27	7
520	525	1	42	4	41	3	1	1	533	1
530	43	2	42	2	23	13	541	1	115	2
540	43	3	10	8	551	1	69	2	48	8

550	64	2	8	8	559	1	44	2	115	4
560	39	29	577	1	119	2	46	2	47	2
570	48	2	49	2	50	2	45	2	1	1
580	585	1	45	3	51	3	106	46	605	1
590	125	2	46	5	57	4	58	4	67	3
600	47	5	59	4	45	5	2	2	613	1
610	46	3	52	3	17	7	625	1	51	4
620	46	4	57	3	70	3	2	2	633	1
630	47	3	53	3	4	4	645	1	52	4
640	47	4	58	3	71	3	24	4	653	1
650	48	3	54	3	25	15	665	1	53	4
660	48	4	59	3	72	3	5	5	673	1
670	49	3	55	3	48	18	685	1	54	4
680	49	4	60	3	73	3	30	10	705	1
690	126	2	50	5	61	4	62	4	48	5
700	60	4	49	5	120	2	1	1	713	1
710	50	3	56	3	3	3	725	1	55	4
720	50	4	61	3	74	3	26	6	735	1
730	56	4	62	3	75	3	15	5	743	1
740	57	2	51	2	3	3	751	1	58	2
750	52	2	1	1	759	1	59	2	53	2
760	1	1	767	1	60	2	54	2	1	1
770	775	1	61	2	55	2	1	1	783	1
780	62	2	56	2	5	5	795	1	63	2
790	66	4	125	3	126	3	21	11	803	1
800	64	4	63	3	35	15	813	1	109	2
810	65	4	110	3	51	11	821	1	78	2
820	65	3	1	1	829	1	66	2	106	3
830	2	2	839	1	106	2	66	3	109	3
840	28	18	847	1	67	2	69	3	1	1
850	855	1	68	2	118	3	29	9	865	1
860	82	4	80	3	68	3	50	10	875	2
870	69	2	84	4	102	2	5	5	883	1
880	70	2	76	5	2	2	891	1	86	4
890	70	4	1	1	899	1	71	2	76	4
900	2	2	907	1	87	4	71	4	5	5
910	915	1	72	2	76	3	2	2	923	1
920	88	4	72	4	16	6	931	1	73	2
930	77	3	1	1	939	1	89	4	73	4
940	9	9	947	1	74	2	77	5	82	22
950	955	1	90	4	74	4	30	10	963	1
960	75	2	77	4	49	19	971	1	91	4
970	75	4	97	27	979	1	76	2	78	4
980	75	15	987	1	77	2	78	3	52	12
990	997	2	79	2	105	2	81	3	52	12
1000	1005	2	81	2	104	2	1	1	1013	1
1010	108	2	82	2	46	16	1023	1	83	2
1020	85	3	108	3	2	2	1033	1	107	2
1030	83	4	84	3	2	2	1043	1	85	2
1040	107	4	83	3	1	1	1051	1	84	2
1050	107	3	48	8	1059	2	103	2	85	4
1060	48	8	1067	2	101	2	86	2	48	8
1070	1075	2	100	2	87	2	48	8	1083	2
1080	99	2	88	2	52	12	1091	2	98	2
1090	89	2	44	14	1099	2	97	2	90	2
1100	20	10	1107	2	96	2	91	2	44	14
1110	1115	2	92	2	111	3	20	20	1123	2
1120	95	2	110	4	25	5	1133	1	110	2
1130	109	4	106	8	74	14	1141	1	111	2
1140	112	3	20	10	1149	1	114	2	115	3
1150		1	1157	1	121	4	122	3	26	8

```
1160     1167   1   122   2   123   3   124    3    24   4
1170     1175   1   120   4   119   3    21   11  1183   1
1180       80   2    79   3     0   0     0    0     0   0
                              END OF DEBUG SUBROUTINE.
                              END OF WRITE FUNCTION.

*STOP* 0
```

```
PCL
DELETE NOTO10
.. 1 FILES DELETED, 305 GRANULES
DELETE NOTO15
.. 1 FILES DELETED, 305 GRANULES
DELETE NOTO20
.. 1 FILES DELETED, 4 GRANULES
DELETE NOTO25
.. 1 FILES DELETED, 140 GRANULES
DELETE DECODE
.. 1 FILES DELETED, 1 GRANULES
DELETE AWRK2C
.. 1 FILES DELETED, 9 GRANULES
END
PCL PROCESSING TERMINATED
```

EOD.

```
HONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELL
HONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELLHONEYWELL

09:56 JUL 13,'78 ID=068A
ELAPSED JOB TIME                    01:24:00
PARTITION NUMBER                           7
TOTAL CPU TIME                     14.3803
  PROCESSOR EXECUTION TIME          .0121
  PROCESSOR SERVICE TIME            .0494
  USER EXECUTION TIME              13.4790
  USER SERVICE TIME                 .8399
CARDS:  CARDS READ                       231
PAGES:  PROCESSOR PAGES                   11
        USER PAGES                       139
TAPES:  DRIVES ALLOCATED                   2
CORE:   PEAK CORE(PAGES)                 112
        PAGE.MINUTES                    1497
I/O:    OPERATIONS                      4040
        CALS                           35036
FILE SPACE
  AVLBL RAD PERMANENT                     64
  NET DISK PERMANENT                     154
  AVLBL DISK PERMANENT                  2834
NUMBER OF SWAPS                           78
RESOURCES ALLOCATED
  7T=  1 9T=  1 CO=120(PAGES)
```

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16. ABSTRACT

Place, Route in 2-Dimensions (PR2D) is a standard cell automatic layout computer program for generating Large Scale Integrated/Metal Oxide Semiconductor (LSI/MOS) arrays. It is one of the components in the NASA/MSFC Computer Aided Design and Test system (CADAT). The program has been utilized successfully for a number of years in both Government and private sectors but until now has been undocumented. This material describes the compilation, loading, and execution of the program on a Sigma V CP-V operating system located at the NASA/MSFC Electronics and Control Facility. This material is also intended to aid in the conversion and running of the program on other data processing systems.

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