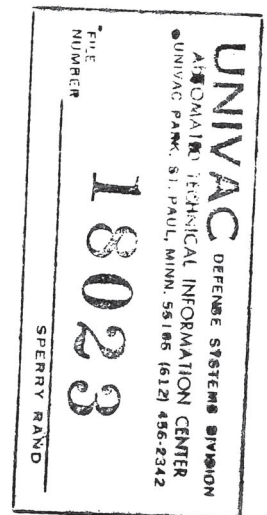


**INDICATES**

(INtegrated DIagnostic and CArd TEst

System)

**USER'S GUIDE**



**COMPUTER AIDED TECHNOLOGY**

PX 10258

REV F

8-1-80

### 3.0 LOGIC INTERCONNECTION DATA PREPARATION

The logic description and pin-to-pin configuration data is written up utilizing the standard INDICATES Logic Module Coding Form shown in Figure 2. The sample data corresponds to the logic network example in Figure 3. Each module description begins with a MODULE or Part Number Card followed by any number of optional description cards. Pin-to-pin logic configuration data for each module begins with a CONFIG card followed by the logic interconnection cards. An END in columns 1-3 or a master space card terminates the logic interconnection deck.

**3.1 Module Card** - MODULE in columns 1-6, and an 8 character maximum module identifier beginning anywhere after column 7 which is blank. An optional dash and two or three digit revision number may follow the module identifier. Optional free format description cards follow the MODULE card.

**3.1.1 Part Number Card** - The part number card follows the basic format specified on the first image of the DAFFCAT output. This card if used, passes through PGX untouched except for columns 19-24 which contains the word MERGED, columns 43-57 which will contain the date and time of generation, and column 80 which will be replaced with a 1.

**3.2 Configuration Card** - CONFIG in columns 1-6 and either ECL or TTL designation beginning anywhere after column 7 which is blank. If neither is specified, TTL will be assumed. The CONFIG marks the end of the optional description cards, and the beginning of the logic interconnection cards. The ECL designation causes all unneeded input card pins to be initialized in a low state.

**3.3 Logic Interconnection Cards** - Logic interconnection cards are accepted in free format with one or more spaces separating each field and subfield.

Field 1 will contain one of the following types of information:

1. For standard catalog package types as denoted in Attachment A, a 5 character package identifier consisting of a 3 character package location beginning with an alpha and any valid 2 digit package output pin. The use of execute options allows the package location to range from 1 alphabetic to 2-11 alphanumeric characters. See 3.4, item 6.
2. For NAN, NOR, AND, OR functions, a 5 character package identifier consisting of a 3 character package location beginning with an alpha and a 2 digit alphanumeric gate output. The use of execute options allows the package location to range from 1 alpha to 2-11 alphanumeric characters. See 3.4, item 6.
3. A 5 character wired OR function of the form WYYXX where YYXX is any alphanumeric and W is any alpha. The use of execute options allows WYY to range from 1 alphabetic to 2-11 alphanumeric characters. See 3.4, item 6. Note, that if the execute options are used, the wired OR must be unique within this eleven character, alphanumeric range.
4. A numeric output pin, 3 digits maximum.
5. A numeric test point, 2 digits maximum.

Field 2 will contain one of the following package types:

1. A standard catalog package type as denoted in Attachment A.
2. OUT for a module output pin.
3. SSO for any module output pin on which the user wishes to flag single shot pulses.



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4. TPT for a test point.

5. NAN, NOR, AND, OR, WOR, WAN, ZZZ, TRN to describe an appropriate function. (An AND-OR type function must be represented as individual AND and OR functions. However, caution should be exercised not to duplicate unique gate names. See Figure 3).

Field 3 is optional. It is defined as a maximum of twelve characters to be used for individual processing options. The field must begin with an alpha character, and only one option may be present per READIN card; however, multiple option cards may be used for each package. All option cards for cataloged packages may contain Field 4 fanin sets. Noncataloged packages may have only one card containing fanin sets, but additional option cards without fanin data are acceptable. The following Field 3 options are currently available:

D Followed by an exponential number, n.nn±nn provides actual output or single-shot delay time in seconds. Each output of a package may have a different delay. the cataloged delay time will be used for outputs having no delay option. Any real life delay time greater than 600 nano seconds will for internal simulation purposes be rounded down to 600 nano seconds or 60 units of delay. Example: D2.00-08 is 20 nano seconds or 2 units of delay.

DELAY This optional card is used to change the delays on a gate. After DELAY, actually in Field 2, there is either one, two, or four delay values. If four are present, it will be translated into Min. Rise, Max. Rise, Min. Fall, & Max. Fall times. If only two are present, the first value is Min. & Max. Rise, and the second is Min. & Max. Fall times. If only one is present, it will be used in all four delay fields. The delay values are an exponential number, Dn.nn±nn, providing output delay time in seconds. Each output of a package may have a different delay. The cataloged delay time will be used for outputs having no delay option. Example: D2.00-08 is 20 nano seconds or 200 units of delay since the basic unit of time is one tenth of a nanosecond.

SV SV stands for Scaled Vendor which is followed by a 1-10 alphanumeric character vendor name. This option is used during design verification simulation to scale up or down the minimum/maximum rise and fall times contained on the device catalog for the component identified by the 3-character package type. This scaling occurs, however, only for the chip or cell locations which use the SV option. To use the SV option, a data element PGXDATA must exist in the same program file as the preprocessor program. Each data card is free format with the two terms being separated by at least one space. The first term is identical in format to the SV option, and the second 4-digit term identifies the scaling factor. For example:

SV74H74 60 ( 60% of catalog times - faster)  
SV7474 100 (100% of catalog times - no change)  
SV74L74 400 (400% of catalog times - slower)

V Followed by a 1-8 alphanumeric character package equivalent which overrides the General Radio tester driver program equivalent. Example: VSN74H00 where SN7400 is the overriding equivalent.

NOFAULT The circuits on which NOFAULT is used will have no failures assumed. If the device is a multiple circuit chip, each circuit must be coded individually. If NOFAULT is used with a common logic gate, only the specified gate will have no failures.

Field 4 is used for fanin data and will vary according to the package type (Field 2) being described. If more than one line of fanins is necessary, Fields 1 and 2 are repeated before continuing fanin data. Fanin



data for the various package types are as follows:

1. For standard catalog package types, the fanin data consists of a package input pin number followed by one of the following types of inputs:
  - a) Package location (3 characters beginning with an alpha) and actual package output pin (2 digits). The use of execute options allows the package locations to range from 1 alpha to 2-11 alphanumeric characters. See 3.4, item 6.
  - b) Numeric card input pin (3 digits maximum).
  - c) Wired OR function of the form WYYXX where YYXX is any alphanumeric and W is any alpha. The use of execute options allows WYY to range from 1 alphabetic to 2-11 alphanumeric characters. See 3.4, item 6.
  - d) HIGH, HI, H, VLT, UNU representing the highest voltage level.
  - e) LOW, LO, L, GND representing the lowest voltage level.
  - f) Test point input of the form TPTXX where XX is a two digit numeric.

Any input pins of the package which are not listed will be considered unused. An unused input is subsequently treated as having a HIGH input. The input pin fanin pairs may be continued on another line; however, an input pin fanin pair cannot be split between two lines.

2. For AND, OR, NAN, NOR the fanin data consists of the number of fanins that follow on this card only and then a list of the inputs of the types previously described. Inputs which have no logical effect, such as voltages, grounds or tied inputs may be omitted.
3. For WOR, WAN, the fanin data consists of the number of fanins that follow on this card and then a list of the inputs of the types previously described.
4. For OUT, SSO, TPT the fanin data consists of the package location (3 character beginning with an alpha) and actual package output pin (2 digits) or wired OR gate that the output pin or test point comes from.
5. For TRN the fanin data consists of a variable number of three input sets where the first input is data and the last two are the enables.
6. For ZZZ there must be two inputs. The first input listed is the enable line. The second input is the data input line.

**3.4 Processing Notes** — Following are some items of necessity and interest which should be considered when preparing the logic interconnection data due to program design:

1. The preprocessor (PGX) drops out unused logic gates, but only those gates internal to a package. Therefore, the user must eliminate unused logic gates where they are not considered part of a package. In Figure 3, gate U15A4 is not written up and gate U1508 is coded as having only one input. However, since U1508 is package type D22, the input data may have been written:

U1508 D22 10 4 9 3 13 LOW 1 LOW

In this case, the preprocessor would eliminate gate U15A4.



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2.	<p>Undefined package pins are assumed to have a HIGH input. Therefore, line 6 would not be necessary.</p> <p>3. No faults are assumed on wired ORs, and if necessary a wired OR may be defined on multiple data cards. The format of each data card is the same with the wired OR name being followed by WOR, the number of inputs defined on this card, plus the input drivers.</p> <p>4. Only one output pin and one test point are allowed per chip output pin. Multiple output pins can be accounted for by utilizing additional wired OR gates with a duplicated input.</p> <p>5. PGX generates an additional gate for each card input pin designated CPXXX where XXX is the card input number. This accounts for open and shorted card input pin failures and also guarantees that all card input pins will at least be toggled.</p> <p>6. The following PGX execute options are available with the @XQT card:</p> <p>F — Will only generate the equations necessary for design verification simulation.</p> <p>Q — Will inhibit package expansion for the delay calculation program.</p> <p>R — Will force package expansion for all components as required for design verification simulation.</p> <p>X — Will cause a program abort to occur if a card pin is used both as an input and output.</p> <p>M — Will provide an on-line cross-reference printout between the catalog gate names within a MACRO model and the new gate names assigned by the preprocessor program.</p> <p>Y — Provides a test point bias of 300.</p> <p>Z — Provides a test point bias of 112.</p> <p>If neither of these two options is used, a test point bias of 200 is assumed, thus test point 14 becomes I/O pin 214. A specific test point bias can be specified by utilizing an optional TPBIAS card preceding the MODULE card — TPBIAS in columns 1-6 and the bias number starting in column 8.</p> <p>W — Calculates 3 character, internal package locations based upon user package locations in the form <u>nnnann</u> where <u>nnn</u> and <u>nn</u> are numeric and <u>a</u> is alphabetic.</p> <p>V — Assigns 3 character, internal package locations (A01-Z99) to each unique 1-11 alphanumeric user package location.</p> <p>U — When used in conjunction with the 'W' option, it calculates wired OR locations according to the nnnann format. When used in conjunction with the 'V' option, it assigns locations as each wired OR is encountered. If the U option is not used, wired OR locations with 'V' or 'W' present will be assigned after all other package locations.</p> <p>7. Comments may be embedded anywhere within the topology equations. The # character denotes a comment, and anything remaining on the data card will be ignored. The comment may be on a data card by itself, or it can be added to the end of a logic equation.</p>		
3.5	Output — The output from the INDICATES preprocessor is a printed listing containing the logic		

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interconnection data, informational and/or diagnostic messages, and a summary of card pins which are inputs, outputs, or both. (See Section 6 for messages.) A list of user package locations and their internal package locations is provided if execute options V or W was used. LPP module and LPP module/READIN save the same information in \*\*TRAN images immediately following the last user description card. The information is thus available on subsequent DAFFCAT tapes for data conversion.



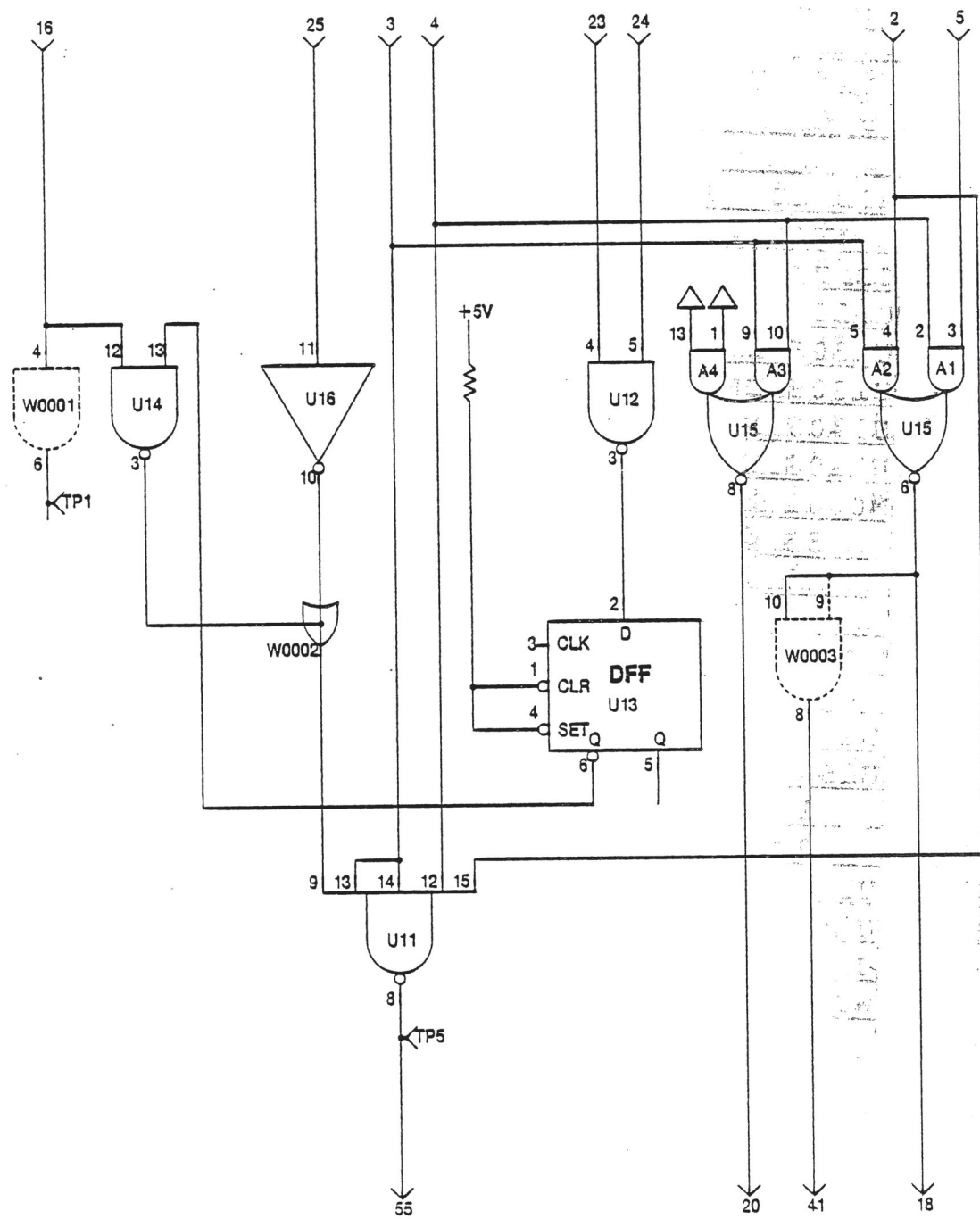
**SPERRY UNIVAC**

INDICATES LOGIC MODULE CODING FORM

PKG LOC & OUTPUT CHIP PIN	PKG TYPE	OPTIONS	FANINS (INPUT PIN & FANIN)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46			
<b>MODULE 6137701</b>			
<b>THIS IS AN EXAMPLE OF LOGIC DATA INPUT</b>			
<b>CONFIG</b>			
U1203	NAN		2 23 24
U1306	DFF		1 HIGH 2 U1203
U1306	DFF		3 UNU 4 HIGH
U1403	NAN		2 U1306 16
U1108	NAN		4 2 3 4 W0002
W0001	WOR		1 16
55	OUT		U1108
1	TPT		W0001
5	TPT		U1108
W0002	WOR		2 U1403 U1610
U1506	NOR		2 U15A1 U15A2
U15A1	AND		2 4 5
U15A2	AND		2 2 3
18	OUT		U1506
20	OUT		U1508
U1508	NOR		1 U15A3
U15A3	AND		2 4 3
U1610	NAN		1 25
W0003	WOR		2 U1506 U1506
41	OUT		W0003
U1108		DELAY	D1.00-09 D1.50-09
<b>END</b>			

Logic Data Input Example

Figure 2



Logic Network Example

Figure 3





#### 4.0 INDICATES OPERATION

The INDICATES program is designed to operate in a batch or interactive/on-line environment. Differences between the two operations are discussed in subsequent sections.

**4.1 Cataloging the Program/MSI Catalog** — The INDICATES program and IC/MSI catalog are usually sent out on a magnetic tape as Files 1 and 2 respectively written on 9 track 1600 BPI and should be cataloged according to the runstream in Figure 4. The runstream may be varied accordingly to account for existing files or to secure the files. In any event, all subsequent runstreams in this document assume that the program has been cataloged as INDICATES\*PF. and the IC/MSI catalog has been cataloged as INDICATES\*CATALOG.

1. @RUN RUNID,acct.#,INDICATES
2. @CAT,P PF,F//POS/10
3. @ASG,A PF.
4. @CAT,P CATALOG,F//POS/5
5. @ASG,A CATALOG.
6. @ASG,TJ TAPE,U9V, reel#
7. @COPIN TAPE.,PF.
8. @COPY TAPE.,CATALOG.
9. @FIN

**RUNSTREAM TO CATALOG PROGRAM  
AND IC/MSI CATALOG**

**Figure 4**

**4.2 Batch Run Operation** — The basic runstreams to execute the INDICATES program (see Figures 5 and 6) are generally applicable to both the batch mode and interactive mode of operation. There are, however, a few minor differences between the two. The first difference occurs on cards 7 and 8 of the initial runstream. The INDICATES preprocessor program is performing many validity checks on the interconnection data, and if any illegal condition is encountered, a runstream abort flag is set. During batch running, runstream cards 7 and 8 interrogate this abort flag, and if the flag is nonzero, the runstream is terminated before execution of the INDICATES program. In the interactive mode these two cards are unnecessary because the user is monitoring the output of the preprocessor program.

The second area of difference between batch and interactive running is the optional ASSIGN card. The ASSIGN card may be used in batch to insure that the correct request is made for the input and output tape locations. In the interactive mode, INDICATES will ask the user for this information during program execution.

The ASSIGN card is used to inform INDICATES of user desired tape numbers or drum file names needed during program execution and can only precede the control card. The ASSIGN card can be used in either batch or demand mode although its primary use is in batch mode runs. The general format of the ASSIGN card begins with the characters ASSIGN in columns 1 thru 6 with a space in column 7 followed by up to three pairs of information (INDICATES unit name and user drum file names or tape numbers) each pair separated by at least one space. The INDICATES unit names are TAPE1, TAPE2, DRUM1, DRUM2 and ELTFIL. The order of the pairs of information is not important and only that information which is necessary is required (i.e. TAPE1—NONE is not required).

**TAPE1.** TAPE1 is the input tape for a continuation run from tape. The tape will be assigned by the program if not previously assigned by the user. The tape number may be up



to six alpha-numeric characters.

TAPE2. TAPE2 is the output tape if desired. TAPE2 will be assigned by the program when the program is ready to write the tape and if not previously assigned by the user. The tape number may be up to six alpha-numeric characters.

DRUM1. DRUM1 is the name of a user supplied drum file that contains restart data for use on a continuation run. The drum file name may be up to twelve alpha-numeric characters. (May be used in batch or demand).

DRUM2. DRUM2 is the name of a drum file that is to be used to write the DAFFCAT output and restart data for later use on a continuation run. The drum file name may be up to twelve alpha-numeric characters. If the drum file is not cataloged a file by the name specified will be cataloged. (May be used in batch or demand).

ELTFIL. ELTFIL is used to inform the program of the name of the drum file in which the DAFFCAT (no restart data is placed in this file) is to be placed, in element file format. The drum file name may be up to twelve alpha-numeric characters. The element name will be generated from the name on the MODULE or PART NUMBER card. (May be used in batch or demand).

Example.

```
@XQT INDICATES*PF.INDICATES/ATG
ASSIGN TAPE1 EC15 TAPE2 HEO2
CONTRL module# (options)
```

4.2.1 Initial Run — Figure 5 shows the runstream for the initial run. The program has a ten minute total run time buffer which must be included in the total estimated time on the @RUN card. In order to avoid confusion when many jobs are submitted together, it is recommended that the project field on the @RUN card be unique for each job, usually the module number of the card being run. In addition, the DAFFCAT output tape is dynamically assigned by the program as TAPE2. Therefore, the service request card for the batch computer run must identify the tape number to be used for TAPE2.

Following the runstream control cards the user must provide various types of information: the logic interconnection data as previously described in Section 3.0, the CONTRL card options as described in Section 4.2.3, and the input test patterns as described in Section 4.2.4. Execute options are also available on both cards 5 and 9. Execute options for card 5 were described in Section 3.4 item 6, and the following options are available on card 9:

- A — will on simple logic cards produce a minimal test list.
- B — will provide an activity printout of the test pattern.
- G — will eliminate unknown gates from the DAFFCAT STATEH table.
- H — allows testing for high impedance fails and listing them on DAFFCAT.
- L — will generate and read low density tapes.
- M — will generate and read medium density tapes.
- N — assigns a nine track tape unit.
- S — assigns a seven track tape unit (system standard).
- T — will eliminate nonharmful transients.
- W — will provide a debug printout for component algorithms.
- X — will generate a DAFFCAT tape with 48 card images per block.

- Y - will place the gate level equations on the DAFFCAT tape.
- Z - will provide debug printouts for automatic test generation.

INDICATES will normally self-initialize such that no test pattern input data is required. Initialization occurs when the output states of all the gates are known. Exceptions requiring manual initialization are 1) the card contains logic constraints such that an INITIL card is necessary (see Section 4.2.4) or 2) the program ceases to make progress after pattern 19, i.e., the number of unknown gates is not decreasing. The foregoing conditions require that the user set up all input pins for as many patterns as required to initialize the card.

INDICATES is also restricted to running only those modules containing packages for which software algorithms have been developed or which are expanded in terms of the basic gates NAN, NOR, OR, AND or devices already contained on the catalog. Attachment A, the catalog device list, identifies with an asterisk those packages for which algorithms are available. Packages which are expanded in terms of the basic gate types are denoted by EXP, and packages which are modeled in terms of existing devices are denoted by MAC. Normally, algorithms are required for sequential type packages such as counters, shift registers or flip-flops if no similar device is available. Combinatorial packages such as multiplexers and decoders are handled as expandable type packages. If a software algorithm is required for a new package, it may be first entered into the program as an EXP or MAC type package such that automatic test generation, although quite restricted, is still possible for a module containing the package. When a software algorithm is subsequently developed, the package can be removed as an expandable or macro type device.



1. @RUN,/T RUNID,acct.#,project,est.time
2. @ASG,A INDICATES\*PF.
3. @ASG,A INDICATES\*CATALOG.
4. @ASG,T LPP,F//POS/2
5. @XQT,(options) INDICATES\*PF.PGX
6. Logic interconnection data cards
7. @TEST TE/0/T3
8. @JUMP DONE
9. @XQT,(options) INDICATES\*PF.INDICATES/ATG
10. ASSIGN (optional card)
11. CONTRL Module# (options)
12. Test pattern input data as required
13. END TESTS
14. @PMD,EA
15. @DONE:FIN

*INDICATES RUNSTREAM  
INITIAL RUN  
Figure 5*

1. @RUN,/T RUNID,acct.#,project,est.time
2. @ASG,A INDICATES\*PF.
3. @XQT,(options) INDICATES\*PF.INDICATES/ATG
4. ASSIGN (optional card)
5. CONTRL Module# CONTINUE (options)
6. Test pattern input data as required
7. END TESTS
8. @PMD,EA
9. @FIN

*INDICATES RUNSTREAM  
CONTINUE RUN  
Figure 6*

4.2.2 Continuation Run — Figure 6 shows the runstream for the continuation run. A ten minute total run time buffer must be included in the total estimated time on the @RUN card. In order to avoid confusion when many jobs are submitted together, it is recommended that the project field on the @RUN card be unique for each job. The input tape for a continuation run is the output tape of the previous run. Input and output tapes are dynamically assigned by the program as TAPE1 and TAPE2 respectively. Therefore, the service request card for the computer run must identify the tape numbers to be used for TAPE1 and TAPE2. Following the runstream control cards the user must again provide two types of information: the CONTRL card options as described in Section 4.2.3 and the input test patterns as described in Section 4.2.4. All execute options and restrictions that were applicable on the initial run also apply on the continuation run.

INDICATES is designed to checkpoint/restart from either mass storage or magnetic tape. If magnetic tape is the storage media, follow the procedures previously described however, if the user wishes to use mass storage, a few minor changes to the runstreams on Figures 5 and 6 are necessary. If a file name of INPUT is assigned before executing the INDICATES/ATG program, this file will be used as the input media rather than tape. Likewise, if a file name of OUTPUT is assigned before executing the INDICATES/ATG program, this file will be used as the output media. These files may be temporary, catalogued, or secured but it is the responsibility of the user to save these files for future program execution. If the user does not wish to call the file names INPUT/OUTPUT, first assign the file and then perform a @USE relationship between INPUT/OUTPUT and the user's file name. Input/output medias may be mixed, tape in — mass storage out or vice versa. The determining factor is whether or not a file name of INPUT/OUTPUT is assigned before program execution. The optional ASSIGN card may also be used to get the proper relationships to these files. (see section 4.2).

4.2.3 CONTRL Card Run Options — Following are the CONTRL card options which control the operation of the INDICATES system during program execution:

(1) ALL —

The module under test must be initialized before diagnostic printouts are generated. Initialization occurs when the output states of all gates are known. Without the ALL option, diagnostics will be generated utilizing all gates and output pins that are known stable. If the tester is capable of masking out unknown card output pins, trouble-shooting during a lengthy initialization sequence will be much easier if the ALL option is not used.

(2) MANUAL —

Only those patterns which are input via the test input data cards will be simulated, and the run will be terminated after the END TESTS card is read. Absence of the MANUAL option will enable automatic test generation after the END TESTS card.

(3) VERIFY —

Validate the input test sequence with no faults applied. The program will merely simulate the input test patterns and generate the correct output response.

(4) HDR —

Provides a PRINTBIG heading in a specific format before the DAFFCAT printout during interactive running. The user will be asked to provide information such as



NAME, EXTENSION, MAIL STATION and PLANT LOCATION. If the HDR option is not used, a standard PRINTBIG heading will be provided for remote @SYMS.

(5) CONTINUE -

Restart the run using the output tape or mass storage file of a previous run. This option is always present on a continuation run and omitted on an initial run.

(6) TRAN -

Skip transient analysis, race detection and illegal chip usage checks on the first input pattern of this run. An apparent harmful condition produced by an input pattern normally terminates a run at that point. If however, the user determines that the condition is not harmful or unavoidable because of logic delays or some other reason, this option will allow the pattern to be simulated. If a race condition is occurring, the oscillating gates will be set to the unknown state. Subsequent patterns which produce a harmful condition will terminate the run at that point.

(7) PRTRAN -

Print transients and illegal chip usages generated by each input pattern but do not terminate the run. This option exists for special case situations where the user desires to override the transient analysis termination.

(8) TOTFLT -

Simulate and generate diagnostics for all failures including the internal gates of MSI packages and internal ROM bit locations. The normal mode of operation without TOTFLT will simulate and generate diagnostics only for failures on the chip input and output pins.

(9) PRPART -

Print only the part of the DAFFCAT output consisting of the test patterns for this run and the undetected failures.

(10) PRLAST -

Print only the last test pattern of the DAFFCAT output and the undetected failures.

(11) QUERYxxx -

Demand mode only. In the automatic test generation mode, INDICATES will inquire after each XXX patterns whether or not the user wishes to continue. Negative response changes INDICATES to the manual mode allowing the user to abort the run or to continue with manual patterns. XXX may range from 1-999 and must be left-justified, e.g., QUERY1bb, QUERY10b, QUERY100.

(12) PATTERNxxxx -

In the automatic test generation mode, INDICATES will cease processing after the

XXXX pattern has been completed. A DAFFCAT tape will be generated and the restart data will be saved. XXXX may range from 1-9999 and must be left-justified, e.g., PATTERN1bbb, PATTERN10bb, PATTERN100b, PATTERN1000.

(13) PERCENTxx -

In the automatic test generation mode, INDICATES will cease processing after XX percent of the faults have been detected. A DAFFCAT tape will be generated and the restart data will be saved. XX may range from 1-99 and must be left-justified, e.g., PERCENT1b, PERCENT10.

(14) CYCLExxxx -

The CYCLE option is used to modify the units of time simulated before INDICATES decides an oscillatory condition is present. A typical application of this option would be to increase the cycle time to allow the effects of multiple single-shot firings to settle out. XXXX may range from 1-9999 and must be left-justified, e.g., CYCLE300b. The system standard cycle time is 200 units.

(15) INITIAL -

Forces automatic test generation to concentrate on module initialization. Fault diagnostics will be provided during the initialization sequence.

(16) ALLGATE -

All gates in the high state, including gates internal to a package, will be listed in the DAFFCAT STATEH table.

(17) NOGATE -

The STATEH table will be eliminated from DAFFCAT.

(18) INTSTOP -

Automatic test generation will halt upon module initialization.

(19) RNDFLTxxxx -

Selects faults at random from the total fault set. The user selects the number of unique faults to simulate. In demand an alternate print file will be generated called STATFILE, which is a statistics sheet about the random selection. XXXX may range from 1 to the number of unique faults and must be left justified e.g., RNDFLT100b. If RNDFLT is used on the initial run without a parameter, INDICATES will terminate through a closeout sequence immediately after the network builds. The user can then randomly select faults on the continuation run.

(20) METHOD -

This option places on DAFFCAT the fault method such as, OUTPUT STUCK HIGH, along with the normal fault dictionary PRINT SENSE information.

## (21) NOTAPE -

This option specifies that an output tape or drum file will not be generated.

## (22) BOPTIONxxx -

This option allows the user to obtain activity printout starting at pattern xxx.

## (23) INITMXxxx -

With this option INDICATES will cease processing if initialization has not been completed after the number of patterns specified by xx. A DAFFCAT tape will be generated and the restart data will be saved. If xx is left blank, a default of 20 patterns is assumed, i.e. INITMX and INITMX20 are equivalent.

## (24) TCOUNT -

This option is useful if this test list is to be used for transition counting. The STATEH tables of DAFFCAT will be modified such that the output values of wired gates will be imposed on the gates driving the wired gate.

## (25) GIVEUPxxxx -

In ATG mode, INDICATES will terminate test generation if 1% of the remaining faults are not detected after xxxx consecutive test patterns.

## (26) LOWINIT -

The LOWINIT input card causes all unneeded input card pins to be driven low during initialization. This is desirable for ECL logic types. This card is not necessary for ECL logic if an ECL is included on the CONFIG card.

4.2.4 Test Pattern Input Data Cards - The test pattern input data cards allow the user to supply manual inputs to the program for the module under test. The data card type is in columns 1-6 and the data is free form between columns 8-78 with at least one space separating data fields. Data on STIMUL cards may be continued on to the next card by adding a C following the last data field, repeating STIMUL, and listing the additional data. For some card types, the data fields themselves may not be split between two cards. The following data card types are recognized by the program:

## (1) STIMUL -

The user defines card input pin states by listing pins to be driven high followed by any combination of the following three options.

1. L or 0 followed by pins to be driven low.
2. Z followed by pins to be driven to high impedance. Please note that any bi-directional pin to a wired net must be driven to high impedance before any device on that net can be selected.
3. U followed by pins to be driven to an unknown state.



If followed by a P option, all other pins remain as previously defined. Data followed by the M option denotes that the remaining pins are to be defined by the program. If an option is not present, the M option will be assumed therefore, for strictly manual tests the P option must be used. S may be used instead of STIMUL, however if S is used only 72 columns of data will be accepted by the program. Comments may be used after the STIMUL card options. A typical test pattern data input would be:

```
STIMUL 14 21 L 16 18 C
STIMUL 43 2 P
STIMUL 16 L 14 P
STIMUL 14 P
```

```
PATTERN 1
PATTERN 1
PATTERN 2
PATTERN 3
```

(2) OBSERV NONE -

The OBSERV NONE card is normally used in conjunction with the INITIL card to provide for a correct initialization sequence. This card can also be used to suppress strobing by the tester and diagnostic generation for any test pattern. The OBSERV NONE card must precede the STIMUL card for which it was intended.

(3) INITIL -

Defines the initial states for network gates listing names of gates at a high followed by an L or zero (if any gates at a low) followed by the names of gates at a low. This card is used for a package in which its inputs are dependent upon its current output state, but there is no means external to the package to determine its output. Example:

```
INITIL U0410 L U0412
```

(4) NOTRAN -

Specifies network gates for which transient analysis is always eliminated. Example:

```
NOTRAN U2103
```

(5) DEFINE -

Used to load the contents of a ROM cell. The element name of the ROM cell as defined on the MSI catalog is followed by a series of address locations and values in octal separated by at least one space. The address and value pairs cannot be split between cards. Example:

```
DEFINE U04AA 00 241 01 000
DEFINE U04AA 02 311 03 277
```

DEFLOW is the same as DEFINE except that the data fields will be complimented before being loaded in the prom address.

(6) DEEPROM -

If the TOTFLT option on the CONTRL card is used, DEEPROM cards may be used to identify unused portions of ROM in which failures should not be assumed. The

DEPROM cards are input immediately after the CONTRL card and must be terminated with an END card. The format is similar to DEFINE with pairs of addresses and values except the one bits of the values identify the unused bits of the addresses. Again, the address and value pairs cannot be split between cards. Example:

```
DEPROM U04AA 00 112 01 377
DEPROM U04AA 02 000 03 100
```

(7) FIXPIN -

Define card input pins which are to remain fixed during program execution until released by LAXPIN. The user must assure that the pin values are in the proper state defined by the FIXPIN card either as a result of the previous test pattern or by a following STIMUL card. Pins to be held high are listed followed by an L or zero (if any lows), then pins to be held low. Example:

```
FIXPIN 14 L 7
STIMUL 14 L 7 M
```

(8) LAXPIN -

Defines previously fixed card input pins which are to be unrestrained. Example:

```
LAXPIN 14
```

(9) ABORT -

Initiates a close out sequence to generate a DAFFCAT tape and to save restart data.

(10) SETOPT -

Dynamically sets execute options as specified by the user. See Section 4.2.1 for a description of the options. A typical usage would be to set the B option to turn on the test list activity printout. Example:

```
SETOPT B
```

(11) CLROPT -

Dynamically clears execute options as specified by the user. Example:

```
CLROPT B
```

(12) DELAY -

Dynamically changes the delay for the specified gate. The format for the delay parameter is identical to the delay option available on the interconnect data, e.g., Dn.nn±ee (see Section 3.3). This parameter should be in real life delay which the program will adjust to correspond to INDICATES delay. To change the pulse duration of a single-shot, the internal delay gate of the device must be specified on the DELAY card. Examples:

DELAY U0101 D2.00-08  
· DELAY U05E1 D3.00-07

(13) REPEAT -

Defines the number of times a subsequent test sequence should be simulated. A maximum of 100 STIMUL cards will be accepted between REPEAT and END REPEAT. Continuation of a pattern between cards is allowed, but each such card contributes to the overall count. Thus, the last card in the pattern sequence may not have a continuation character. Transmission of an ABORT card between REPEAT and END REPEAT will result in a normal termination with the generation of a DAFFCAT tape, and none of the repeating patterns in the current sequence will be simulated before writing the tape. If a card other than STIMUL or ABORT is transmitted between REPEAT and END REPEAT, the card will be ignored, but the user may continue to transmit the rest of the repeating sequence. If a transient or illegal condition occurs during the simulation of a repeated sequence in the batch mode, simulation ceases and a DAFFCAT tape is generated. In the remote mode, control is returned to the user and the repeated sequence is discontinued. Following is an example of a sequence to be repeated 10 times:

```
REPEAT 10
STIMUL L 25 P
STIMUL 25 P
END REPEAT
```

(14) END REPEAT -

Defines the end of a repeated test sequence.

(15) PAUSE -

A test generation command to halt automatic test generation and return control back to the user if all of the specified conditions are fulfilled. In the batch mode a DAFFCAT tape will be generated, and in the demand mode the user can enter any of the normal user commands. Once control is returned back to the user all PAUSE commands are eliminated. Multiple PAUSE commands may be used however, each shall be treated independently and if any are true ATG will stop. The following format of the PAUSE command is identical to that of the INITIL card:

```
PAUSE U0119 U1205 U1309 L U2005 U1308 CP015
```

(16) GRAYCD -

A test generation aid to index through a gray code count sequence for a specified set of module input pins. The GRAYCD command examines the current values on the pins and commences gray code counting from that point on until the desired count is reached. The module input pins must be arranged on the GRAYCD card with the most significant pin being on the left and the least significant pin being on the right. This command is normally used to index through the address lines on semiconductor memories. Optional STIMUL patterns may be present between the GRAYCD



command and the subsequent END GRAYCD command, and if present, these patterns will be generated between each gray code count. Following are two examples of GRAYCD commands and the count sequences they will generate:

GRAYCD 7 9 10  
END GRAYCD

STIMUL L 7 9 10 P	000
STIMUL 10 L 7 9 P	001
STIMUL 9 10 L 7 P	011
STIMUL 9 L 7 10 P	010
STIMUL 7 9 L 10 P	110
STIMUL 7 9 10 P	111
STIMUL 7 10 L 9 P	101
STIMUL 7 L 9 10 P	100

GRAYCD 1 2  
STIMUL 5 P  
STIMUL L 5 P  
END GRAYCD

STIMUL L 1 2 P
STIMUL 5 P
STIMUL L 5 P
STIMUL 2 L 1 P
STIMUL 5 P
STIMUL L 5 P
STIMUL 1 2 P
STIMUL 5 P
STIMUL L 5 P
STIMUL 1 L 2 P
STIMUL 5 P
STIMUL L 5 P

(17) END GRAYCD -

Defines the end of a gray code test sequence. Normally the GRAYCD command will count through the entire gray code sequence however, if the user wishes to halt the sequence on a specific count, the END GRAYCD command may contain the standard high/low pin value notation to identify the final count sequence. Following is an example of an END GRAYCD command which contains the terminal gray code count:

END GRAYCD 7 9 L 13 15

(18) BURST -

Defines the number of times a subsequent test sequence should be simulated. BURST is similar in format to the REPEAT command but differs in that fault simulation is not performed during the BURST sequence until the last test pattern, resulting in an extremely fast simulation process. Normal DAFFCAT will be eliminated during the BURST sequence, and only the BURST commands will be retained. See Figure 8

for a sample output. The BURST command is designed for testers with a clock or repeat capability, and since degraded diagnostics may occur during execution, it should only be used to reduce long functional test lists. The following example will simulate a sequence of 16 pulses:

```
BURST 16
STIMUL 14 P
STIMUL L 14 P
END BURST
```

(19) END BURST -

Defines the end of a BURST sequence.

(20) CYCLE -

Dynamically changes the units of time simulated before INDICATES decides an oscillatory condition is present. The format of this command is CYCLE in columns 1-5 followed by a numerical cycle time starting in column 7. Example:

```
CYCLE 300
```

(21) BOOLEQ -

Used to define the function of PLA or GATE ARRAY devices in terms of Boolean equations. All BOOLEQ cards are free format from card columns 1-78. The following examples illustrate the format of BOOLEQ cards under a number of different situations.

```
BOOLEQ U04AA F0 = (A1.A2) + (A3.A4)
```

is an example of a BOOLEQ card to define the F0 output of gate U04 as the Sum of Products (A1 AND A2) OR (A3 AND A4).

```
BOOLEQ U04AA F0=(A1.A2)+(A3.A4)
BOOLEQ U04AA F0=+(A1 . A4)
```

is an example of a BOOLEQ continue cards. F0 output of U04 is defined as the Sum of Products (A1 AND A2) OR (A3 AND A4) OR (A1 AND A4).

```
BOOLEQ U04AA F1* = (A1*.A2.A3.
BOOLEQ U04AA F1* = A4) + (A1.A3)
```

is an example of a term being defined on two cards. The first card ends with an operator. The second card starts with an A input. The \* following any F or A denotes the compliment. F1 of U04 is defined as follows. F1 NOT = (A1 NOT AND A2 AND A3 AND A4) OR (A1 AND A3).

```
BOOLEQ U04AA F2 = 0
BOOLEQ U04AA F3 = 1
```

are examples of forcing a particular logic state on the output of the PLA or GATE ARRAY.

BOOLEQ U05AA F0 = (A1 + A2).(A3 + A4)

is an example of Product of Sums notation.

It must be noted that all outputs from a PLA or GATE ARRAY must be defined in order, starting with the F0 output. If an output is not used it must still have an equation to define it; such as F8 = 0.

(22) FLTSIM -

The program will print the gate level simulator activity for the fault identified on the FLTSIM card. Example:

FLTSIM U0101 OUTPUT STUCK LOW  
FLTSIM U0101 INPUT FROM CP012 STUCK HIGH

(23) END FLTSIM -

Terminates the printing of simulator activity.

(24) CLOCK -

The CLOCK card is used to inform ATG that certain pins of a module are to be used as clock pins. If ATG wants to change the state of one of these pins it does it in a BURST 1 manner, always leaving the clock pin in its inactive state as defined by the CLOCK card. The format of the CLOCK card is CLOCK starting in column 1 followed by clock pins with inactive state high, followed by L followed by clock pins with inactive state low. CLOCK cards must be used before test pattern 1. If the first test pattern is supplied via the STIMUL card, the pins identified on the CLOCK card must start in the inactive state. On subsequent STIMUL cards clock pins must be changed with BURST commands. The following example defines pin 3 as a clock with inactive state high and pin 2 as a clock with inactive state low.

CLOCK 3 L 2

(25) CLOCKS -

The CLOCKS input data card provides the user with a means of defining the active state for clock pins. The program will monitor and reject any test pattern in which more than one of the specified clock pins is in its active state. The example below lists all the high active clock pins (6, 7 and 8), followed by L (or 0), then all the low active clock pins (22). A maximum of 10 clock pins may be defined on the CLOCKS card.

CLOCKS 7 6 8 L 22

(26) CLOCKT -

The CLOCKT input card is a switch requesting transient analysis even if only one input



pin changes.

(27) CLOCKD -

The CLOCKD input card terminates checking of active clock phases (CLOCKS) and resets CLOCKT switch.

(28) SDELAY -

The SDELAY input card defines any single-shot delay times which require the tester to pause before sensing the output values. This time is required to allow effected outputs to stabilize to the expected values. The following is an example of the SDELAY card:

SDELAY C0106 10 USEC

Field

1. Must be SDELAY
2. Is the name of the single-shot device
3. Is the number of units (6 field characters max.)
4. Is the unit definition

Unit Definitions

- a. NSEC = nanoseconds
- b. USEC = microseconds
- c. MSEC = milliseconds
- d. SEC = seconds

(29) END TESTS.-

This card is used to start the Automatic Test Generation (ATG) phase of INDICATES. After this card is transmitted the program will not return control to the user until one of the following conditions has been met: ATG has exhausted the resources available to it, the card has 100% failure detection, the program has used all but 10 min. of the total time on the run card or the user transmits @@X C as described in section 4.3.3.

(30) ATGGET -

A maximum of 10 chip outputs can be specified on the ATGGET card with all outputs desired high listed first followed by L followed by all chip outputs desired low. Transmission of this card followed by END TESTS will cause ATG to attempt to generate patterns to achieve the desired states. The program will return to the user with a message indicating success or nonsuccess. ATGGET transmitted with no other data will clear previous ATGGET commands. Example:

ATGGET U0101 U0102 L U0103 U0104

(31) ATGON -

During ATG mode ATGON instructs ATG to generate test patterns to detect faults only on the chip locations specified. This command is exclusive of ATGOFF. Transmission of ATGON with no other data or transmission of an ATGOFF card will clear previous ATGON commands. Example:

## ATGON A01 B01 B02

## (32) ATGOFF -

During ATG mode ATGOFF instructs ATG not to generate test patterns to detect faults on the chip locations specified. This command is exclusive of ATGON. Transmission of ATGOFF with no other data or transmission of an ATGON card will clear ATGOFF commands. Example:

ATGOFF A01 B01 B02

## (33) //EDIT -

The //EDIT command is used to call the INDICATES EDITOR. This can be very useful in such things as updating an element containing STIMUL patterns from inside an INDICATES run. The file with the element to be edited must be assigned. If the element does not exist, the editor will ask if a new one is to be created. Example:

//EDIT TEST.RUNSTREAM

4.3 Demand Mode Operation - The demand mode of operation is essentially the same as the batch mode of operation with the following exceptions:

- Tape mount responses are required.
- Conditions which normally abort are recoverable.
- Additional demand mode user options are available.

4.3.1 Demand Mode Responses - For general information on demand mode processing, the user is referred to UP-4144 Rev. 3, UNIVAC 1100 Series Systems PRM, Chapter 12, Demand Processing.

The runstreams shown in Figures 5 and 6 are generally applicable to the demand mode. The initial runstream is identical through statement 6, but statements 7 and 8 are no longer necessary since at this point the program will print out one of the following two messages:

PGX COMPLETED

PGX IN ERROR, REMAINING EXECUTIONS TO BE OMITTED

Upon receipt of the first message, the run may be continued. If the second message is received, the logic interconnection data must be corrected before continuing. After transmission of the @XQT card which initiates the INDICATES program, the program will print the following message:

TRANSACTION FILE NAME - IF NONE DESIRED, KEY IN NO

The program is requesting the name of the file to use as a transaction file. The name may be any valid Exec 8 file name. Absence (transmit only an SOE) of a name implies that transaction file processing is not desired. In the case of an error while using the transaction file the file will be internally disabled and normal usage of the program will continue. The program would then print the following message:

TRANSMIT ASSIGN(ASSIGN) OR CONTROL(CONTRL) CARD

The user may now transmit the optional ASSIGN card. (See Section 4.2 for usage and proper format).

The user must then transmit the CONTRL card with the module number and appropriate options. If the CONTINUE option was used and magnetic tape is the input media, the program would then print the message:

IF USING TAPE1, TYPE REEL (COL. 1-4) LABEL (COL. 7-18).  
IF NOT, NONE (COL. 1-4).

The user must then transmit the input tape number and label. If magnetic tape is the output media, the program would then print the message:

IF USING TAPE2, TYPE REEL (COL. 1-4) LABEL (COL. 7-18).  
IF NOT, NONE (COL. 1-4).

Again, the user must transmit the output tape number and label unless no output is desired in which case the appropriate response is NONE. If this is a continuation run, the program would print the message:

REQUESTING ----- FROM OPERATOR. WAIT FOR RESPONSE

Followed by:

TAPE MOUNT RESPONSE: -----  
TRANSMIT GO, NO, REPEAT OR REPEAT THEN REEL (COL. 7-12) AND LABEL (COL. 13-24)

The user must then transmit one of the following options:

GO - Will request assignment of the tape.  
NO - Will terminate the run.  
REPEAT - Will again request the same tape from the operator.  
REPEAT - With reel and label will request a different tape.

When the GO command is transmitted, the program will print the message:

----- ASSIGNED

The program is ready to accept test pattern input data for either an initial or continuation run when it prints the message:

TRANSMIT NEXT INTEST CARD OR ABORT

The user can then transmit the test pattern input data cards described in Section 4.2.4 or the additional demand mode data cards described in Section 4.3.2. After each data card is processed, the program will request transmission of the next data card. Transmission of ABORT will terminate the program and immediately initiate the closeout sequence, which makes the DAFFCAT tape and saves the restart data. The closeout sequence is also initiated if the current run time is within ten minutes of the maximum run time limit or if the last MANUAL input pattern is completed. Upon initiation of the closeout sequence, the program will print appropriate termination messages, and check if the output file was preassigned. If the output media is tape or an already used drum file, INDICATES will ask the user to confirm the output file assignment. If the output file is an unassigned tape, the following message will be printed:

REQUESTING ----- FROM OPERATOR. WAIT FOR RESPONSE



Followed by:

TAPE MOUNT RESPONSE: -----  
TRANSMIT GO, NO, REPEAT, REPEAT THEN REEL (COL. 7-12) AND LABEL (COL.  
13-24).

The user must again transmit one of the options as previously defined. When the GO command is transmitted, the program will print the message:

----- ASSIGNED

After the DAFFCAT tape is generated and the restart data saved, the program will print the message:

DO YOU WANT DAFFCAT LISTED? RESPOND ONE OF THE FOLLOWING: FULL  
PART LAST NO

The user must then transmit one of the following options:

FULL - A complete DAFFCAT listing is desired.  
PART - A listing of only the test patterns from this run and the undetected failures is desired.  
LAST - Only the last test pattern and the undetected failures is desired.  
NO - No printout of the DAFFCAT tape is desired.

If one of the first three options is transmitted, a second request will appear:

WHAT PRINTER SITE?

Whatever response the user transmits will be used directly in the @SYM statement. If it is not important which main printer to use, PR may be transmitted. After the appropriate action has been started, the program will print:

DAFFCAT LISTING TO ----- BEGUN

When the @SYM is completed or if the NO response was given, the program will print a summary of times used in the major subroutines followed by the message:

INDICATES TEST GENERATION SYSTEM DONE

This concludes the run and the @FIN card may be transmitted to terminate the job.

4.3.2 Demand Mode Data Cards - The test pattern input data cards described in Section 4.2.4 are applicable in the demand mode. In addition, the following data card types are also available to the remote user:

a) PERCENT -

The program will print the percent of failures thus far detected by the test list and the last test pattern number.

b) UNKNOWN -

The program will print the gate names which are in the unknown state.

c) STATE -

The program will print the logic value states of the gates listed on the STATE card where L is a logic low, H is logic high, Z is high impedance, U is a logic unknown. By using the double characters AA or NN, the user can observe all internal gate values of a chip model or merely the chip output pin values. All card input pins can be observed with CPNNN. Following is a typical example of a STATE card:

STATE A0414 U2101 B29AA C30NN CPNNN

d) CONTRL TRAN -

This data card eliminates hazard detection checks for one pattern in the remote mode exactly as the TRAN option eliminates these checks for one pattern in the batch mode. If a harmful condition is produced by the user, the program will reject this pattern and indicate to the user the problem area. If however, the user determines that the condition can be overridden, transmission of this card followed by the retransmission of the STIMUL card will allow the test pattern to be simulated. The CONTRL TRAN card can be used as many times as desired.

e) NOFAIL - or (NOFAIL PARAM<sub>1</sub> ... PARAM<sub>n</sub> -)

This card is used to report undetected failures and can be used as often as required. If the first form is used, the program will immediately request a second data card with the following message:

SUBMIT NODE NAMES, COLUMN 1, 6 CHAR. BOUNDED

The user may then respond with any of the following three alternatives:

- ALL - Provide a complete list of all undetected failures.
- AAAXX - A chip location (AAA) followed by (XX) to provide a list of all undetected failures for the specified chip location.
- AAANN - Up to twelve 6 character gate names to provide a list of all undetected failures for the gates specified.

The second form of the NOFAIL card is handled in the same manner, but it requires only one transmit by a demand user.

4.3.3 Interrupt Capability - When INDICATES is being executed from a demand terminal, it can be interrupted at any time. To interrupt INDICATES processing, merely transmit @@X C. Once the interrupt is registered by the 1100 executive, the program will respond with:

KILL(K) OR INTERRUPT ONLY (I)

If the user transmits K, the program will terminate in error. If the user transmits I, the program will continue to process its current activity until it reaches the end of an accepted test pattern at which time the program will return to the user with the message:

## TRANSMIT NEXT INTEST CARD OR ABORT

If a BURST command is in process, the program may be interrupted, but control will not return to the user until completion of the BURST sequence.

NOTE: Do not transmit more than one @@X C command before responding to the KILL OR INTERRUPT message or the only recourse will be to KILL the execution. If

**\*WAIT—LAST INPUT IGNORED\***

is not seen after transmitting @@X C the interrupt will be processed after printing all of the queued output.

4.4 INDICATES Output — The output of the INDICATES program is a DAFFCAT/SAVE tape and an optional listing of the DAFFCAT tape.

4.4.1 DAFFCAT/SAVE Tape — The output tape consists of two files. The first file is the actual DAFFCAT data and is generated by an 1100 assembly language program. It is a field data, card image format containing 14 words per card image and 3 or 48 card images per record. The second file is the restart data which is also generated via an 1100 assembly language program. This file is essentially a core dump onto tape.

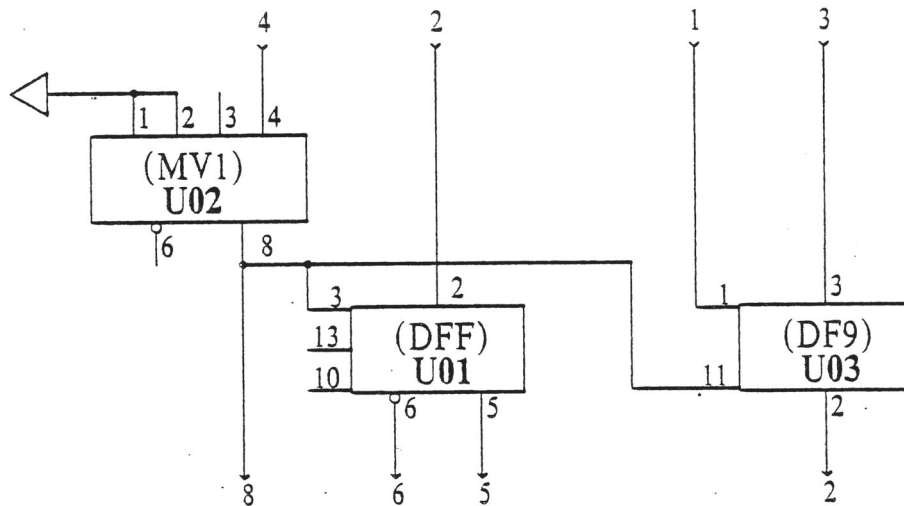
4.4.2 DAFFCAT Listing — Figure 8 shows a DAFFCAT listing for the sample circuit and the test patterns shown in Figure 7. Following is a description of this data:

- (1) The printed circuit card identifier is the first line consisting of the module number in columns 3-10 and 28-35 and the revision number in columns 12-13 and 37-38, all right-justified. Any entry in column 80 indicates that a comment card follows.
- (2) Comment cards follow the module identifier. Any entry in column 80 implies that another comment card follows.
- (3) After the last comment card follows the logic interconnection data cards as described in Section 3.3. An END terminates the equation file data.
- (4) INPIN identifies all the input pins to the module.
- (5) OUTPIN identifies all the output pins from the module.
- (6) NAMES identifies all chip output pins.
- (7) Test pattern data consisting of:
  - (a) Test pattern number followed by a list of the module input pins that are at a logic high. Pins that should be driven with a high-impedance are preceded with a Z. Unlisted pins are interpreted to be at a logic low.
  - (b) A list of module output pins that are a logic high, high-impedance or are unknown. An X preceding a pin number indicates that pin is unknown, a Z preceding a pin number indicates that pin is in the high-impedance state. Additionally, an X is placed after the last output pin listed if a tester no strobe condition is desired (generated by



OBSERV NONE data card and/or module is not initialized when using the ALL option). A + or - preceding a pin number indicates that the output pin was defined as an SSO output, and a single-shot pulse is propagating to the module pin during the applied test pattern.

- (c) Names of the chip output pins which are at a logic high state followed by the name of any chip output which is unknown and identified as such by a preceding asterisk. Chip output pin variables which are not listed are interpreted to be a logic low state. Note, that a single-shot firing during a test pattern is indicated by a + preceding the single-shot gate name although the gate itself may stabilize at a logic low. A Z preceding a gate name indicates that the output of that gate is in the high-impedance state.
  - (d) Sets of failing module output pins followed by a list of potential faulty gates and the logic values which should be present on the gates. Since the first three characters of the gate names identify the package location, it should be noted that failure isolation will normally be made to fewer replaceable packages than the number of potentially faulty gates.
- (8) STOP after the last test pattern diagnostic data.
  - (9) A list of undetected failures. Note, that if an asterisk precedes the initial element listed in an undetected failure message, the identified fault causes a race condition within the logic, and INDICATES has simulated but will never detect this failure.
  - (10) A percent effectiveness of the test list indicating number of failures detected and number of failures simulated.
  - (11) A percent effectiveness on the chip level. Chips determined to have been insufficiently tested to verify its presence on the assembly under test will be flagged with \*.



Logic Diagrams

Figure 7

INDICATES LOGIC MODULE CODING FORM

**Figure 7 (cont.)**



CODE IDENT	SPECIFICATION NUMBER	SHEET	4-24	REVISION	F
90536	PX10258				

123456	MERGED	123456	MMDDYY	HHMMSS	1
	MSI VERSION	111679			1
TEST TO PRODUCE SAMPLE OUTPUT					1
TPBIAS	200				1
CONFIG	TTL				
U0105	DFF 2 2 3	U0208			
U0206	MV1 1 LOW 2 LOW 4 4				
U0302	DF9 1 1 3 3 11	U0208			
2 OUT	U0302				
5 OUT	U0105				
6 OUT	U0106				
8 SSO	U0208				
END					
DATA TTL					
TESTS					
INPIN	1	2	3	4	
OUTPIN	2	5	6	8	
NAMES	U0105	U0106	U0208	U0302	
1 INPUT	1	2			
OUTPUTZ	2X	5X	6	X	
STATEH	ZU0302				*U0105 *U0106 *U03A1 *U03A2
2 INPUT	1	2	4		
OUTPUTZ	2	5+	8		
STATEH	U0105	+U0208	ZU0302		
FAIL	5	6			
PRINT	U0106	SENSE L	U0105	SENSE H	CP002 SENSE H
FAIL	2				
PRINT	CP001	SENSE H	U0302	SENSE H	
FAIL	8				
PRINT	U0208	SENSE L			
3 INPUT	1	2	4		
BURST	2				
STIMUL	L	4	P		
STIMUL	4	P			
END BURST					
OUTPUTZ	2	5+	8		
STATEH	U0105	+U0208	ZU0302		
STOP					
UNDETECTED FAILURES					
ELEMENT	CP001	OUTPUT STUCK	HIGH		
ELEMENT	CP002	OUTPUT STUCK	HIGH		
ELEMENT	CP003	OUTPUT STUCK	LOW		
ELEMENT	CP003	OUTPUT STUCK	HIGH		
ELEMENT	CP004	OUTPUT STUCK	LOW		
ELEMENT	CP004	OUTPUT STUCK	HIGH		
ELEMENT	U01P3	INPUT FROM	U0208	STUCK	HIGH
ELEMENT	U0105	OUTPUT STUCK	HIGH		
ELEMENT	U0106	OUTPUT STUCK	LOW		
ELEMENT	U0208	OUTPUT STUCK	LOW		
ELEMENT	U03PB	INPUT FROM	U0208	STUCK	HIGH
ELEMENT	U0302	OUTPUT STUCK	HIGH		
27% TESTS MADE ( 6 OUT OF 22).					
U01	* 33%	( 2 OF 6)	TESTS		
U02	* 33%	( 1 OF 3)	TESTS		
U03	20%	( 1 OF 5)	TESTS		
DSD=INDICATES,PGX REV(2.050180) =USERS GUIDE(PX10258) REV,D LAST UPDATE 050180					
CONTRL	123456	ALL			
DATE	MMDDYY	TIME	HHMMSS		
END DAFFCAT	123456	DATA DUMP			

Sample DAFFCAT Listing  
Figure 8

4.5 Utility Routines — Two utility routines exist that will process the DAFFCAT tape and provide post INDICATES information.

4.5.1 CONVERT Routine — The CONVERT routine (see Figure 9 for the sample runstream) will generate and list the STIMUL patterns that were used to generate the DAFFCAT tape in terms of changing module input pins. These test patterns will have a sequence number after the STIMUL card option. Several execute options are also provided with the routine to enhance user flexibility:

- B — Eliminates the online printing of STIMUL patterns.
- E — Eliminates the generation of the element DAFFCAT.EDIT.
- F — Does not free OLDTAPE upon completion of CONVERT.
- O — Will list OBSERV cards in terms of changing output pins.
- P — Will generate an element DAFFCAT.STIMUL with test patterns.
- Q — Will generate an element DAFFCAT.EDIT with no other processing taking place.
- R — Will write a DAFFCAT element to tape in 3 or 48 card image blocks.
- S — Builds DAFFCAT.module/STIMUL of STIMUL/OBSERV cards.
- Z — After first CONVERT, @ADD DAFFCAT.EDIT replaces OLDTAPE.

4.5.2 DAFFSTAT Routine — The DAFFSTAT routine will provide statistics about the fault dictionary regarding percent, and the number of fault entries to N chip isolation plus the average fault isolation. See Figure 10 for the runstream.

CODE IDENT  
90536

SPECIFICATION NUMBER  
PX10258

SHEET 4-26

REVISION F

1. @RUN,/T RUNID,acct.#,project,est.time
2. @ASG,A INDICATES\*PF.
3. @ASG,T DAFFCAT,F//POS/10
4. @ASG,TJ OLDTAPE,T,reel#
5. @XQT,(options) INDICATES\*PF.CONVERT
6. @FIN

**CONVERT RUNSTREAM**  
**Figure 9**

1. @RUN,/T RUNID,acct.#,project,est.time
2. @ASG,A INDICATES\*PF.
3. @ASG,T DAFFCAT,F//POS/10
4. @ASG,TJ OLDTAPE,T,reel#
5. @XQT INDICATES\*PF.DAFFSTAT
6. @FIN

**DAFFSTAT RUNSTREAM**  
**Figure 10**



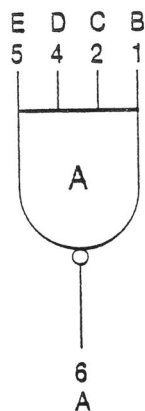
## 5.0 CATALOG PACKAGE ADDITIONS/MODIFICATIONS

**5.1 IC/MSI Catalog** — The IC/MSI catalog is a mass storage file containing the logic description and interconnection data of individual IC/MSI packages. This data, in conjunction with the logic description and interconnection data for the module, is utilized by the INDICATES preprocessor to generate the equation files necessary for test generation and simulation.

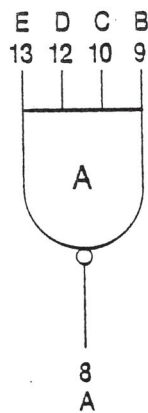
For automatic test generation, devices can be entered into the INDICATES system through either modeling techniques or with a software algorithm. For combinatorial devices modeling is sufficient however, for sequential components for which no existing device is similar, a software algorithm is recommended. These algorithms are generated by DSD personnel and are denoted on the devices list by an asterisk.

**5.1.1 Package Definition and Modeling** — In order to add a new package to the catalog, the following procedures must be followed:

- a) Assign to the device a unique, three character package type identifier that contains at least one alpha character. The following package types are system defined and cannot be used: SSS ROM NAN OR AND ILL WOR ZZZ RAM RRR WAN PLA TRN
- b) Draw a picture of the package and assign gate letters to the output and input pins. For an IC, the picture would be the basic gate symbol. The output gate letter is A and the input gate letters are assigned in alphabetical order starting with B for each circuit in the package, see Figure 11. For an MSI, the picture is a rectangle with outputs on the right side and bottom, inputs on the top and left side. Outputs for each circuit are first assigned alphabetically starting with A at the upper right corner, continuing down the right side and across the bottom. Inputs are then assigned alphabetically continuing from where the outputs left off. Start at the upper right corner, continuing across the top and down the left side. Do not use letters I and O, see Figure 12 for an example.

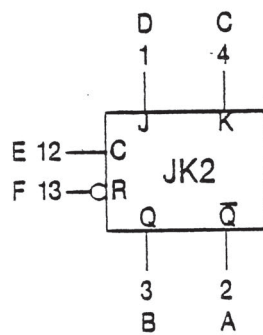


Circuit 1

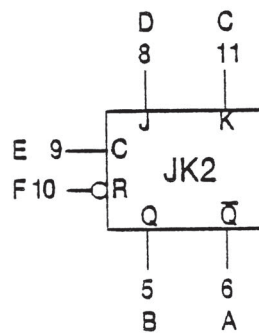


Circuit 2

IC Picture, Gate Letter and Name Assignment  
TI SN7420  
Figure 11



Circuit 1



Circuit 2

MSI Picture and Gate Assignment  
TI SN74107  
Figure 12