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EUROPEAN ATOMIC ENERGY COMMUNITY - EURATOM

APACHE :

ANALOG PROGRAMMING AND CHECKING SYSTEM PROGRAMMERS GUIDE

by

G. BUCCARI (*), G.P. DEL BIGIO (*), A. GERANZANI (**)
and P. SANGERMANO-WOOD (*)

(*) Euratom
(**) Praxis

1966

Joint Nuclear Research Center
Ispra Establishment - Italy

Scientific Information Processing Center - CETIS

Contracts EURATOM/PRAXIS CALCOLO SpA, Milan (Italy)
Nos. 026-62-2 CETI, 031-63-3 CETI, 035-64-3 CETI, 038-65-3 CETI

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SUMMARY

This manual is a guide to the APACHE (Version IV) for the IBM 7090. It has been written to aid system programmers who wish to study the logic and organisation of the program.

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Introduction

This system Programmers Manual is intended as a guide to the internal structure and logic of the Apache program. It is not intended to be an exhaustive detailed description.

The guide is relevant to APACHE Version IV level 1.

Section 1 gives a short summary of the hardware used at the Euratom data processing centre. Detailed information of the conversions carried out on the ADIOS system are available on request.

Section 2 is a first introduction to the structure of Apache, giving in a summarised form a description of the work carried out by each Link. and the execution paths which are followed.

Section 3 is for reference and contains a condensed description of each routine, first in alphabetical order by routine, then with a significant words index. It is hoped that the latter will we useful to any programmer wishing to change some aspect of Apache in that he can see immediately the routines that treat that subject.

Section 4 is a more detailed description of the main logic sections of APACHE. Here we have tried to explain the reasons behind the treatment, as well as giving a guide to the mechanics of the programming.

Section 5 describes the parts of the program that every installation will probably have to change to adapt the Apache System to their use. e.g. tape numbers, description of patch panel. Listings of the relevant parts of the program are given so that changes can be made by installations which do not have the Apache Symbolic tape.

Section 6 and Section 8 describe the tables and tape records that are used throughout the Apache to pass information from one link to another. Section 7 describes the information words and the descriptive codes used.

Section 9 gives the format of the punched cards produced by Apache to be used with the converted ADIOS system and SATANAS.

Section 10 lists all diagnostics which may be printed out on or off line. The list includes diagnostics due to errors in the internal structure, and diagnostics which inform the writer of an Apache problem of errors in his input statements.

Section 11 shows a problem example passed through the 7090 with the console switches 1 and 5 ON. This causes extra information, which is labelled on the listing, to be printed out at different stages of the execution.

Section 12 is for reference and shows the inter-relation of routines; 12.1 is a listing of the CHAIN TABLE as used for APACHE version IV level 2 and shows the routines called by each chain; 12.2 is a list of all routines with their transfer vectors; 12.3 is the inverse of 12.2, that is a list of all routines with the routines that they are called by; 12.3 lists the names of secondary entries to routines referred to their main entry.

Addenda

Level 2 corrections

Flow Chart LINK 33

The blocks "BETA GIVEN", "ZBETA, CALCULATE VALUE OF BETA" are placed between the blocks "WRITE TABLE VETT ON INTERMEDIATE TAPE" and "OPTION NOADDR"

Section 6.9

TPOM(4,J) becomes:

decrement : Total summers with impose of summer

address : Total summers available

TPOM(5,J) becomes:

decrement : Total summers used as networks

address : Total summers used.

1. HARDWARE

1.1 DIGITAL

The APACHE system has been used at the EURATOM data processing centre on an IBM 7090.

It reqires the use of seven tapes: input, output, binary cards output and four intermediate tapes, two on one channel and two on another.

1.2 ANALOG

1.2.1 PACE

The APACHE was written primarily for the EAI analog computer, PACE 231R, but can be used for other analog computers (see 5.1).

The EURATOM scientific data processing center is equiped with three PACE 231R consoles. The capacity of the installation is:

238 operational amplifiers
- 135 integrators
- 90 summers
- 103 invertors

510 potentiometers
- 450 automatic setting
- 60 hand setting

74 independent multipliers
- 48 high accuracy
- 16 servo control
- 10 electronic

5 XY	paper recorders	
2	eight channel paper recorders	
1	punched tape, input-output system	(ADIOS)
1	punched card, input-output system	(ADIOS - IBM 026)
1	semi automatic patching system	(SATANAS)

The APACHE program has been used in this installation for up to three consoles. It is written for a maximum of six consoles.

1.2.2 CRESSIDA (Couplage Reversible Statique Digital Analogue)

The Cressida system consists of an IBM 026 perforator coupled to an ADIOS (Automatic Digital Input-Output System), and enables punched cards output from the digital computer to be used as input to the analog computer.

The ADIOS is originally a punched tape input-output system for the PACE 231R. Besides tape, it has a direct entry push button system, and a typewriter for output.

The coupling with the IBM 026 has been designed in such a way that punched cards, prepared by the APACHE, are read by the 026, and the information sent as signals to the ADIOS where it is interpreted and used to:

a) control the ADIOS modes
b) control the modes of the analog computer
c) set the pots
d) interrogate elements and send back the output voltage value to the 026 where it is punched on cards.

A sequencer controls the timing of the operations for the ADIOS and 026. Control switches allow the ADIOS and 026 to be used independently for their original functions. The punched cards are an optional output of the APACHE and are described in 9.1.

1.2.3 SATANAS (Semi-AutomaTic ANAlog Setting)

The SATANAS consists of a matrix of light indicators over which can be placed a panel of the PACE 231R.

The SATANAS cards (see 9.2) contain the x y coordinates of each pair of holes in the panel which must be connected. These cards are read by the IBM 026 previously mentioned and through memories and transcodifiers the indicators corresponding to these coordinates are illuminated.

2. <u>CONDENSED DESCRIPTION OF CONTROL LOGIC (LINK BY LINK)</u>

2.1 System Flow Chart

CHART APACHE

APACHE GENERAL FLOW CHART

FLOWCHART PAGE 1

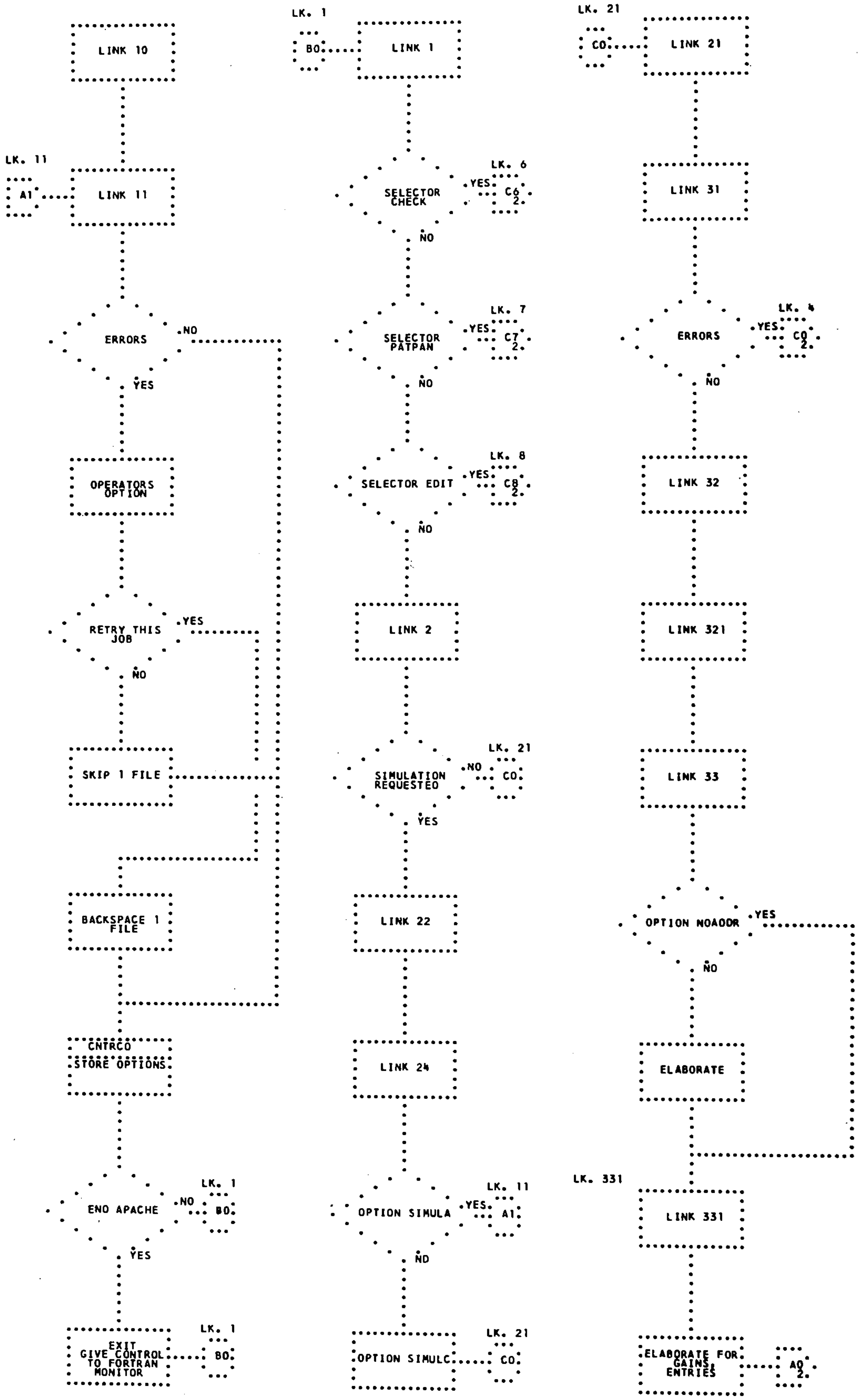
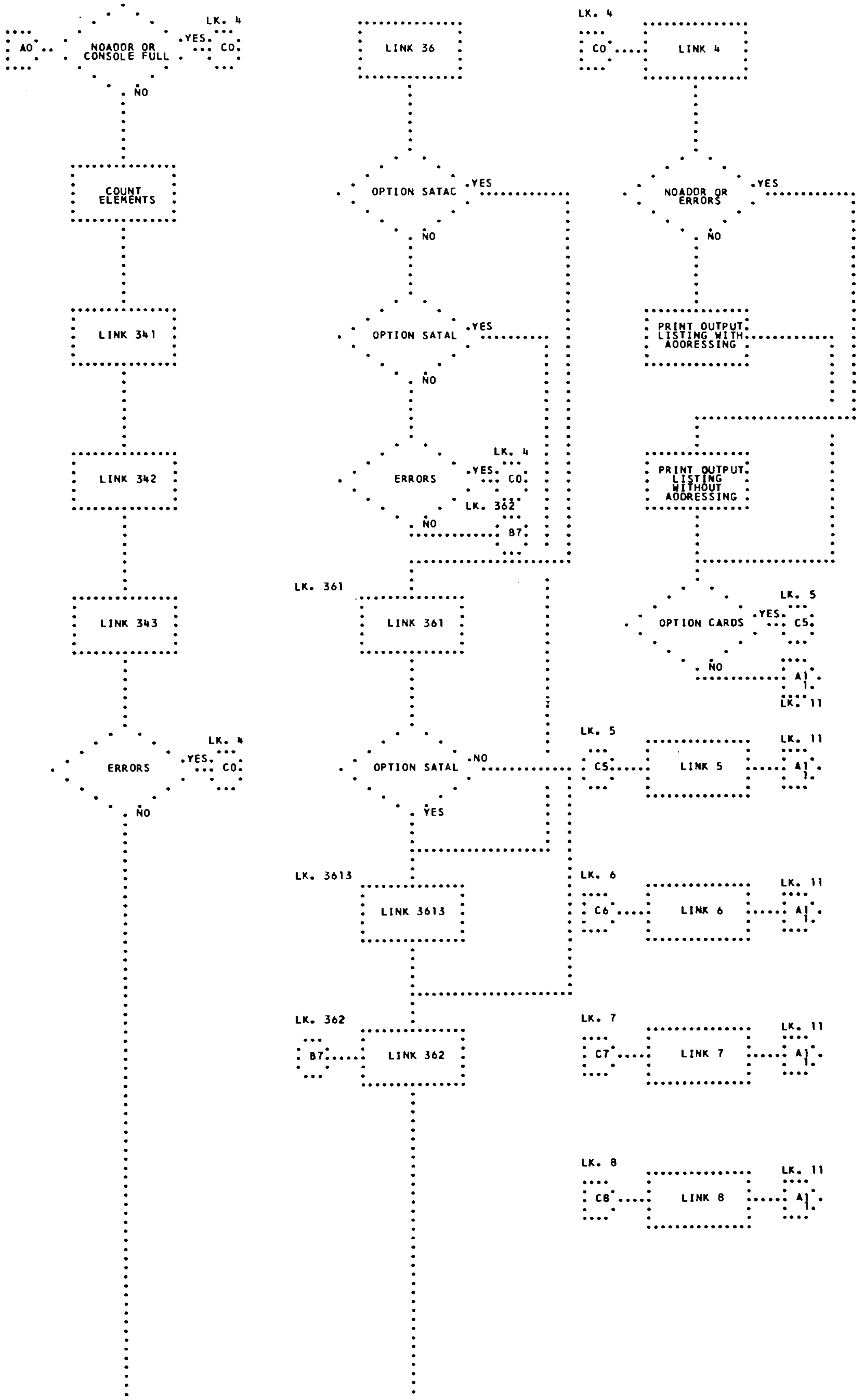


CHART APACHE

APACHE GENERAL FLOW CHART



2.2 LINKS

The Apache Monitor

LINK 10

This Link is executed only in case of cold start, or re-start after a system failure.

It sets up the tape allocation and, if input is on-line, it performs a card-to-tape operation.

LINK 11

This Link is executed after the processing of an Apache program is completed, or in case of machine errors.

It processes control cards and gives control to LINK 1.

The Compiler

LINK 1

Reads the Apache program from the input tape and constructs the SYMBOL TABLE (6.1).

Recognises DICTIONARY STATEMENTS (BETA, REF, CONSOLE SELECT, AVAILABLE CONSOLES, MULTIPLIER, VARIPLOTTER, RECORDER, OMIT, PRINT, DO) and SELECTORS (COMMENTS, PARAMETERS, VARIABLES, EQUATIONS, IMPOSE, OMIT, CHECK, PATPAN, EDIT, END). The selector EQUATION applies also to COMPARE, SWITCH, DFG and RESOLVER which are considered in that context as NON-DICTIONARY statements. (See flow chart)

If the first statement of an APACHE program is not a SELECTOR then the selector COMMENT is automatically assumed.

Constructs the relevant ID-RECORDS (8.1). If some COMPOSITE-VARIABLE was defined, generates the corresponding equation.

If requested gives control to the CHECK program (LINK 6), the PATPAN program (LINK 7) or the APACHE EDITOR (LINK 8).

LINK 2

For each equation of the APACHE program constructs the corresponding W-RECORD (see 8.2).

In addition processes the following statements:

AVAILABLE CONSOLES
OMIT
IMPOSE
CONSOLE SELECT
VARIPLOTTER
RECORDER
DO
PRINT

If a differential equation is of order greater than one, the corresponding differential auxiliary equations are generated.

If simulation is requested gives control to LINK 22 otherwise to LINK 21.

LINK 21

Performs the transformation of equations to standard form and constructs the corresponding EQM-RECORD.
(4.2 and 8.3)

If necessary generates non-linear auxiliary equations.

All initial conditions of variables appearing on the LHS of an equation are also computed.

The execution time of this LINK varies greatly, depending on the order in which the programmer writes the algebraic equations.

This can be explained by the following example. Suppose the following algebraic equations appear in an APACHE program:

$$
\begin{aligned}
x &= \ldots + y + \ldots \\
y &= \ldots + z + \ldots \\
z &= \ldots + w + \ldots \\
w &= 3
\end{aligned}
$$

Since the compiler processes one equation at a time, the IC of X cannot be determined before the IC of Y is, etc. The computation of all the IC's would then require four re-executions of LINK 21 (at the 1st the IC of w is computed, at the 2nd the IC of z, etc.); whereas only one pass would have been required if the equations were written in the following order:

$$w = 3$$
$$z = \ldots + w + \ldots$$
$$y = \ldots + z + \ldots$$
$$x = \ldots + y + \ldots$$

See also LINK 342.

LINK 31

Attributes the invertors to the variables using a process of minimisation for the following types of equations:

a) Linear
b) Differential
c) Zero
d) Comparators
e) Manual switches

In other cases attributes an invertor according to a prefixed scheme (4.3).

Attributes to each variable the sign with which it will be output from its main element.

Constructs tables of MULTIPLICATION TERMS (6.3) and writes them on tape for LINK 321.

Constructs and inserts equations for invertors.

LINK 32

Loads into the memory the information relative to the panels of the 231R PACE, using the subroutine PANEL as constructed by LINK 7 (5.3).

LINK 321

Loads tables of MULTIPLICATION TERMS. Treats records OMIT, counts available analog elements and constructs table TPOM. (6.9) Treats all records IMPOSE, placing information relative to IMPOSE in SYMBOL TABLE and MULTIPLIER TABLES, (6.4).

LINK 33

Calculates number of multiplier "boxes" of all types required and controls agains number available. Continues construction of MULTIPLIER TABLES.

Calculates BETA if not given.

LINK 331

Controls gains of the equations and reduces entries to combinations of pot, gain 1 and gain 10. (4.4)

Allocates a console number to each variable, taking account of AVAILABLE CONSOLES and CONSOLE SELECT. Counts the number of elements required, and controls against totals of available elements in TPOM (4.5. 6.6).

If consoles are filled before all variables are allocated a console number, LINK 4 is called.

LINK 341

Sets the strategies for addressing (4.6, 5.5).

Attributes the integrators by partition if required.

Lengthens the equation records by the addition of the analog record. (8.4) Writes in record information relative to IMPOSE and partition of the integrators.

LINK 342

By successive passes of the equation records, allocates to each variable the address of an element on the 231R panel, with a criterion of proximity of the elements. (5.5) the time of execution of this link varies greatly with the order in which the equations are written, as for LINK 21, though the optimum order here is exactly the reverse of the optimum order for LINK 21. The programmer is advised to arrange his equations in the optimum order for LINK 342 if the addressing phase of the APACHE is to be used, and to arrange his equations in the optimum order for LINK 21 only if the addressing phase is not required.

LINK 343

Following phase of addressing for recorders, variplotters and IC pots of resolvers. If there has been any preceding error calls the output listing link, LINK 4. Otherwise calls next link.

LINK 36

Concluding phase of addressing. Allocates invertor addresses, identifies necessary trunks and gives trunk addresses.

If option SATAC calls LINK 361, if option SATAL, LINK 3613, if no option, no errors, LINK 362, if no option, but errors, LINK 4.

LINK 361

Passes the equation records once to count the number of times each variable is used, from this calculates the number of TIEPOINTS. In a second pass the SATANAS CARDS are punched. (4.7, 9.2)

LINK 3613

Carries out the same work as 361 except that instead of SATANAS CARDS a list of PATCH-PANEL CONNECTIONS is written.

LINK 362

Completes ANALOG RECORDS for the output listing. Constructs equations for buffer invertors and trunks. Signals signs of equations in EQM record.

LINK 4

Writes the main output list of the APACHE program, that is the lists of parameters and variables, equations and cross-references.

It is executed even in case of program errors.

LINK 5

Punches as output the following decks of cards:

POT SETTING
READ-OUT
NETWORK (9.1)

THE CHECK PROGRAM

LINK 6

Performs the static-check of an APACHE program (4.8). The values of the voltages read out by means of the READ-OUT cards are compared with values calculated, using the NETWORK cards as description of the circuit.

The Simulator

LINK 22

Performs the same operations as LINK 21 except that for each equation a 7090 program is generated and written onto an intermediate tape.

Auxiliary equations are not generated.

The output tape of LINK 2 is saved so that it is possible to re-enter LINK 21 of the compiler if compilation is also requested.

The SYMBOL TABLE is also saved to be used by LINK 24 for integration.

LINK 24

All 7090 programs generated by LINK 22 are assembled in order to obtain a single subroutine for the computation of derivatives, which is needed by the integration routine (4.9).

PRINT statements are also compiled in order to obtain an output-routine which is called after each integration step.

A digital integration of the problem is then performed using the routine INT.[1]

Control is given to LINK 21 if an APACHE compilation is also requested or to LINK 11 to process the next APACHE program.

PATCH PANEL (PATPAN)

LINK 7

From input cards containing coded information describing the 231R panels in use, prepares and punches a subroutine PANEL which is used as a normal subroutine and called by LINK 32.

LINK 7 is called by the selector PATPAN (5.3).

----

[1] RW INT, Adams-Moulton, Runge-Kutta Integration 704 FORTRAN SAP Language Subroutine SHARE distribution 602.

THE APACHE EDITOR

LINK 8

Is executed whenever the APACHE system is modified. It updates the APACHE MASTER TAPE and constructs a FORTRAN INPUT TAPE which contains the modified version of APACHE.

Control is then given to the FORTRAN MONITOR in order to obtain the new APACHE SYSTEM TAPE.

See 4.10 for a detailed description of the editing process.

2.3 Flow Charts of links

CHART APACHE

APACHE FLOW CHART LINK 10

FLOWCHART PAGE 1

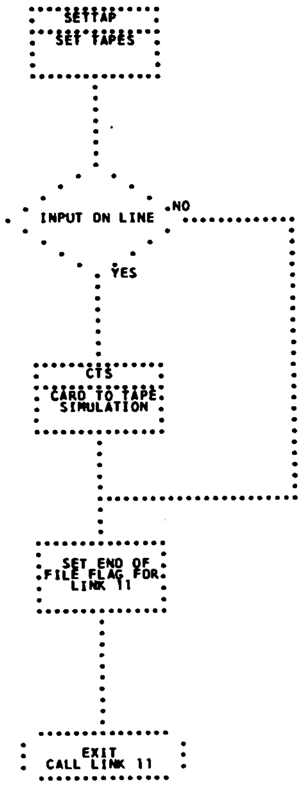


CHART APACHE

APACHE FLOW CHART LINK 11

FLOWCHART PAGE 1

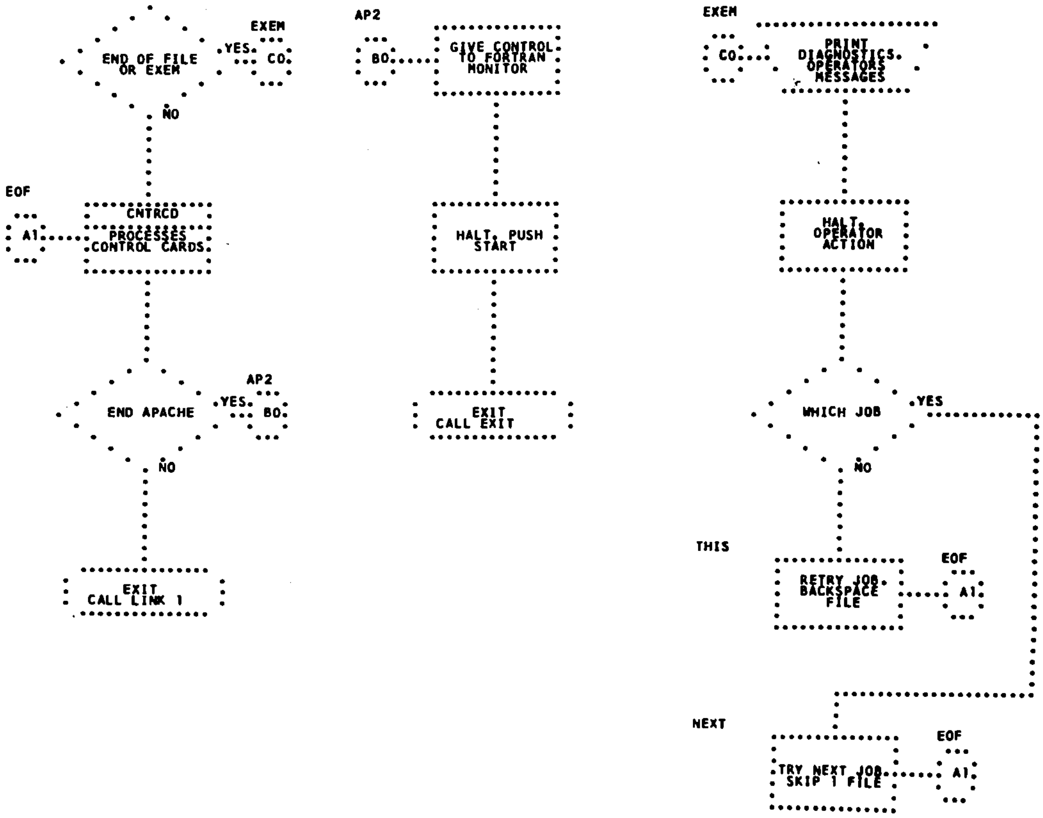


CHART APACHE

APACHE FLOW CHART LINK 1 FLOWCHART PAGE 1

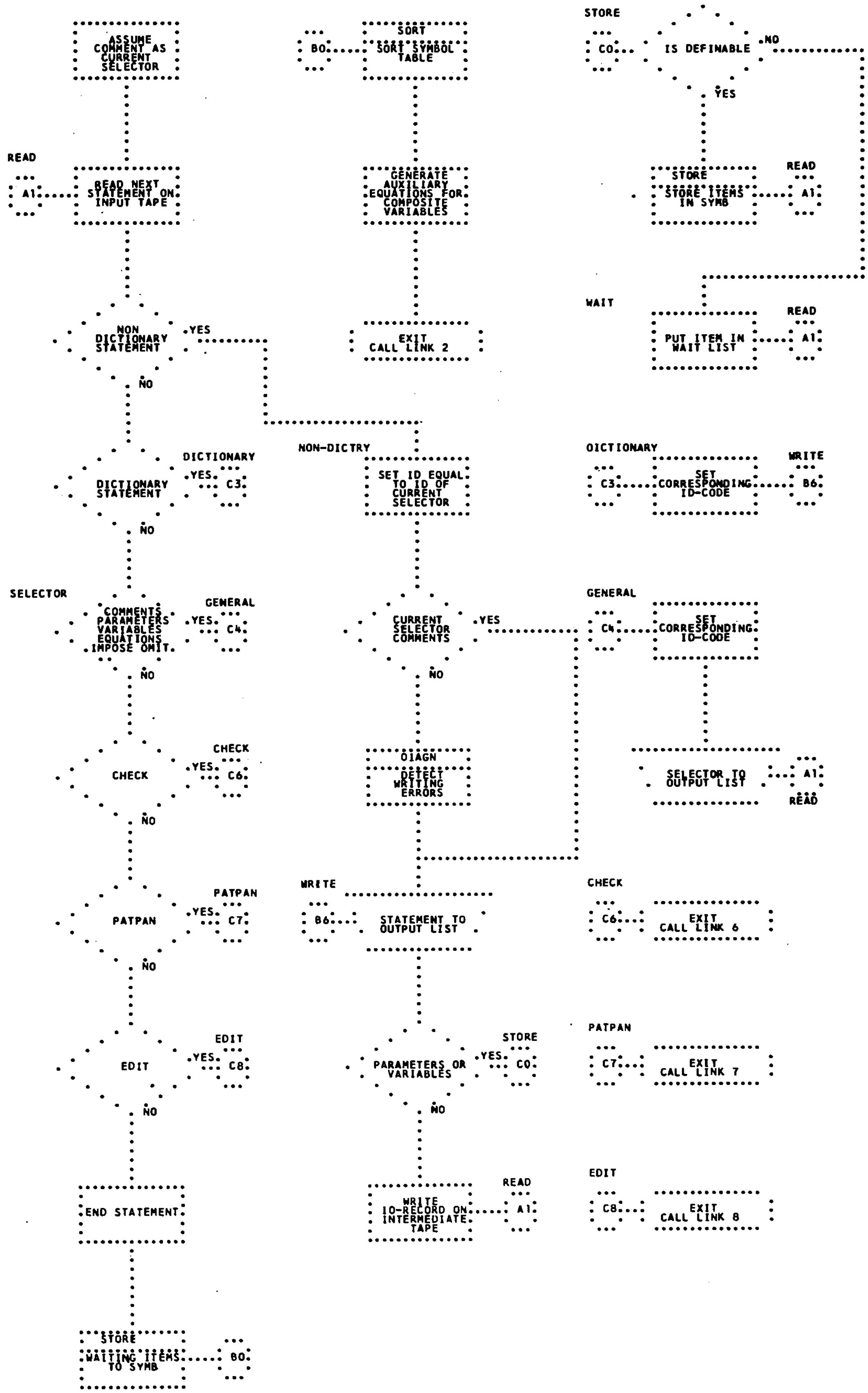


CHART APACHE

APACHE FLOW CHART LINK 2

FLOWCHART PAGE 1

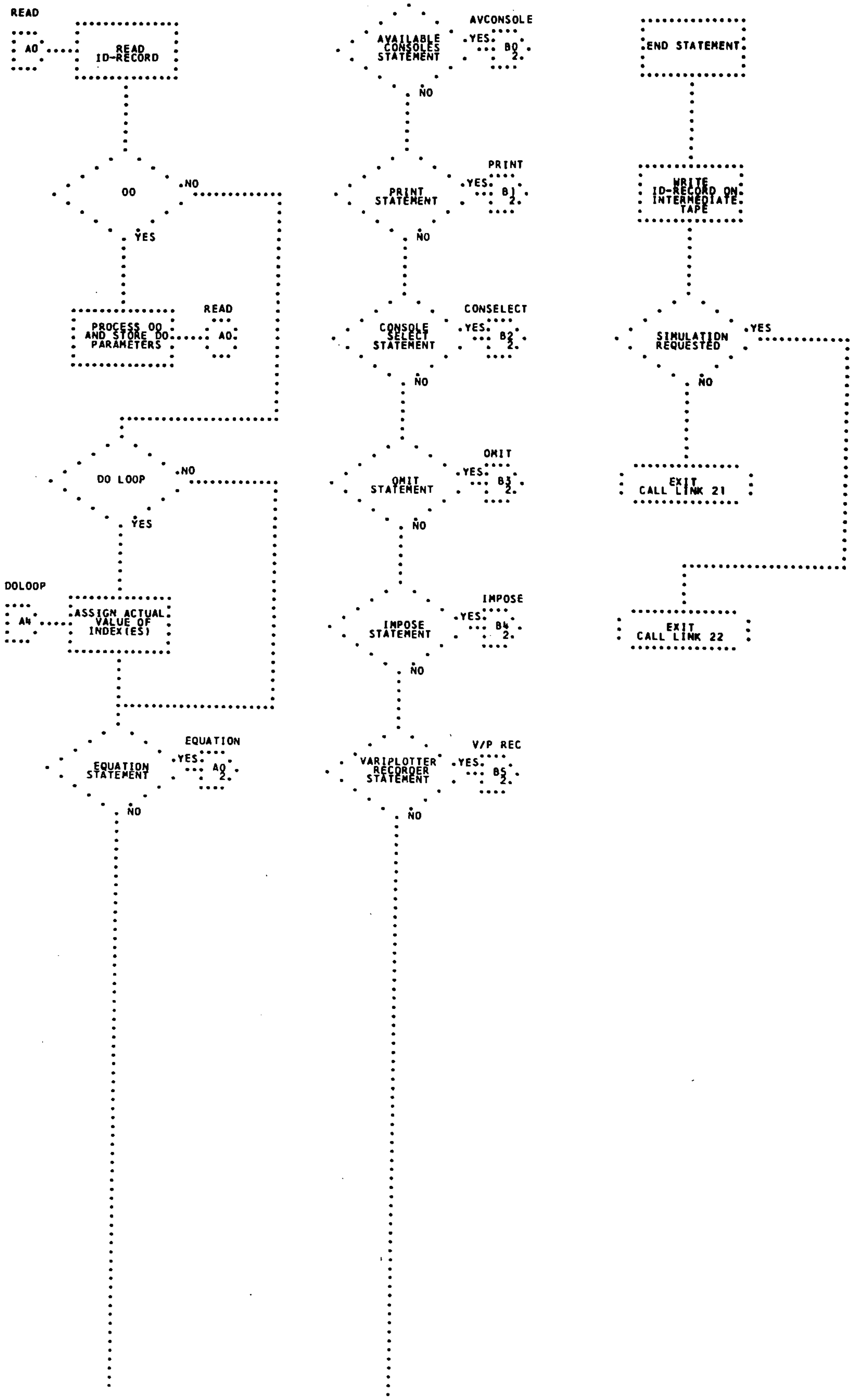
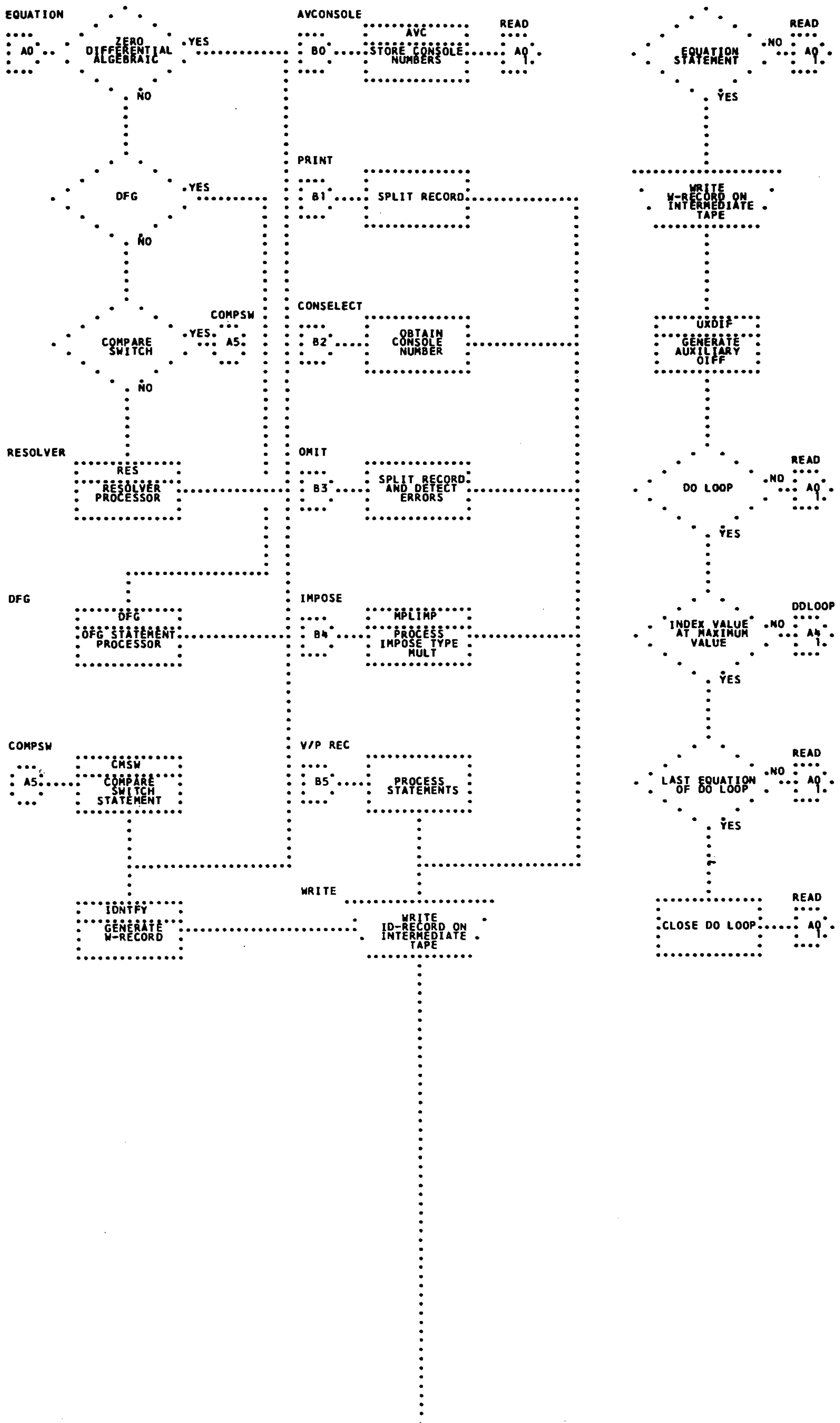


CHART APACHE

APACHE FLOW CHART LINK 2 FLOWCHART PAGE 2



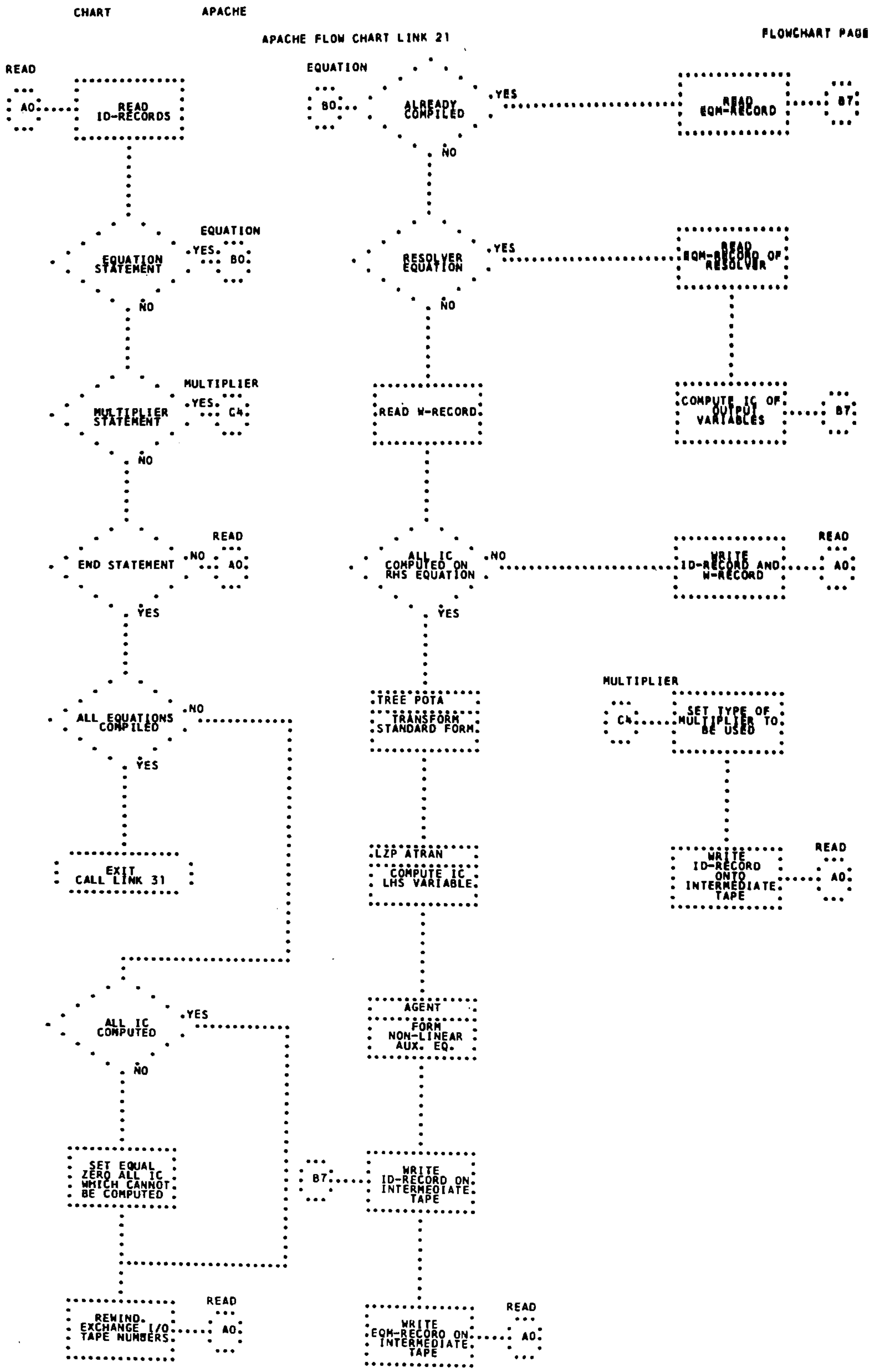


CHART
APACHE
APACHE FLOW CHART LINK 21
FLOWCHART PAGE
READ
A0
READ ID-RECORDS
EQUATION
B0
ALREADY COMPILED
YES
NO
READ EQM-RECORD
B7
EQUATION STATEMENT
YES
EQUATION
B0
NO
RESOLVER EQUATION
YES
NO
READ EQM-RECORD OF RESOLVER
MULTIPLIER STATEMENT
YES
MULTIPLIER
C4
NO
READ W-RECORD
COMPUTE IC OF OUTPUT VARIABLES
B7
END STATEMENT
NO
READ
A0
YES
ALL IC COMPUTED ON RHS EQUATION
NO
YES
WRITE ID-RECORD AND W-RECORD
READ
A0
MULTIPLIER
C4
SET TYPE OF MULTIPLIER TO BE USED
ALL EQUATIONS COMPILED
NO
YES
TREE POTA
TRANSFORM STANDARD FORM
EXIT CALL LINK 31
LZP ATRAN
COMPUTE IC LHS VARIABLE
WRITE ID-RECORD ONTO INTERMEDIATE TAPE
READ
A0
ALL IC COMPUTED
YES
NO
AGENT
FORM NON-LINEAR AUX. EQ.
SET EQUAL ZERO ALL IC WHICH CANNOT BE COMPUTED
B7
WRITE ID-RECORD ON INTERMEDIATE TAPE
REWIND. EXCHANGE I/O TAPE NUMBERS.
READ
A0
WRITE EQM-RECORD ON INTERMEDIATE TAPE
READ
A0

CHART APACHE

APACHE FLOW CHART LINK 22 FLOWCHART PAGE 1

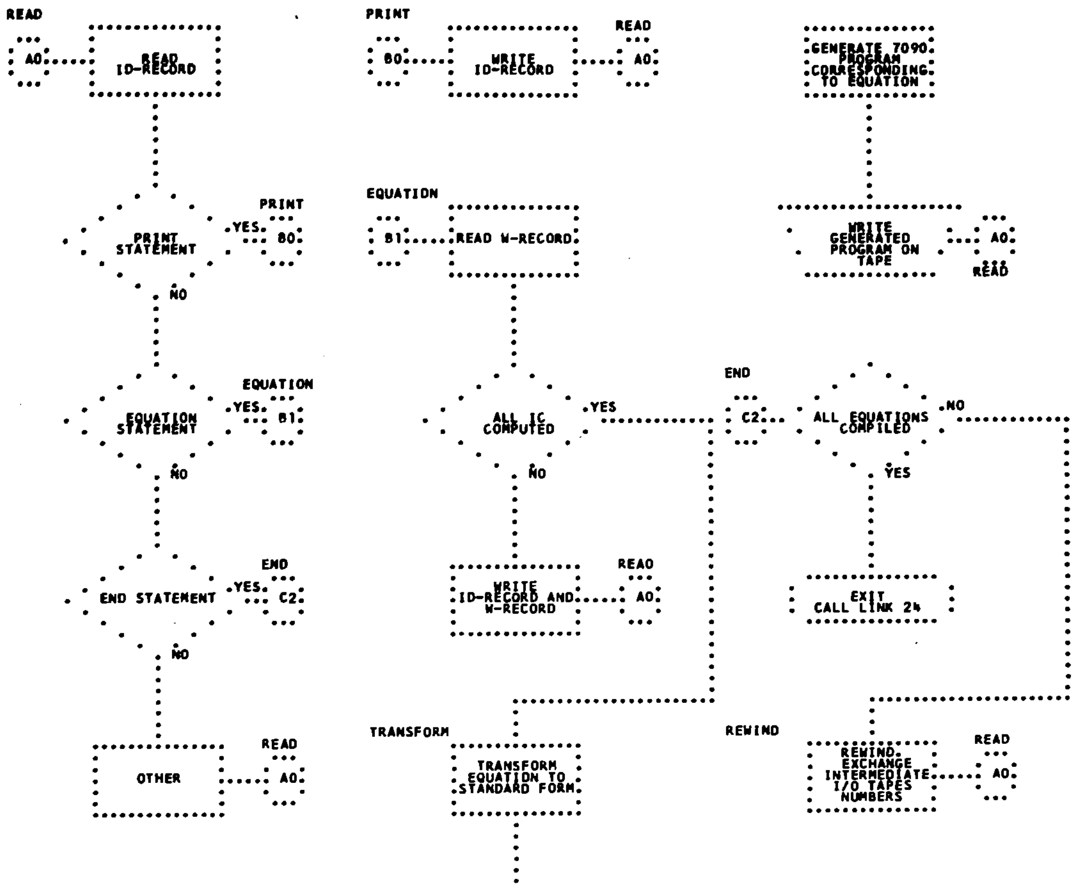


CHART APACHE

APACHE FLOW CHART LINK 24

FLOWCHART PAGE 1

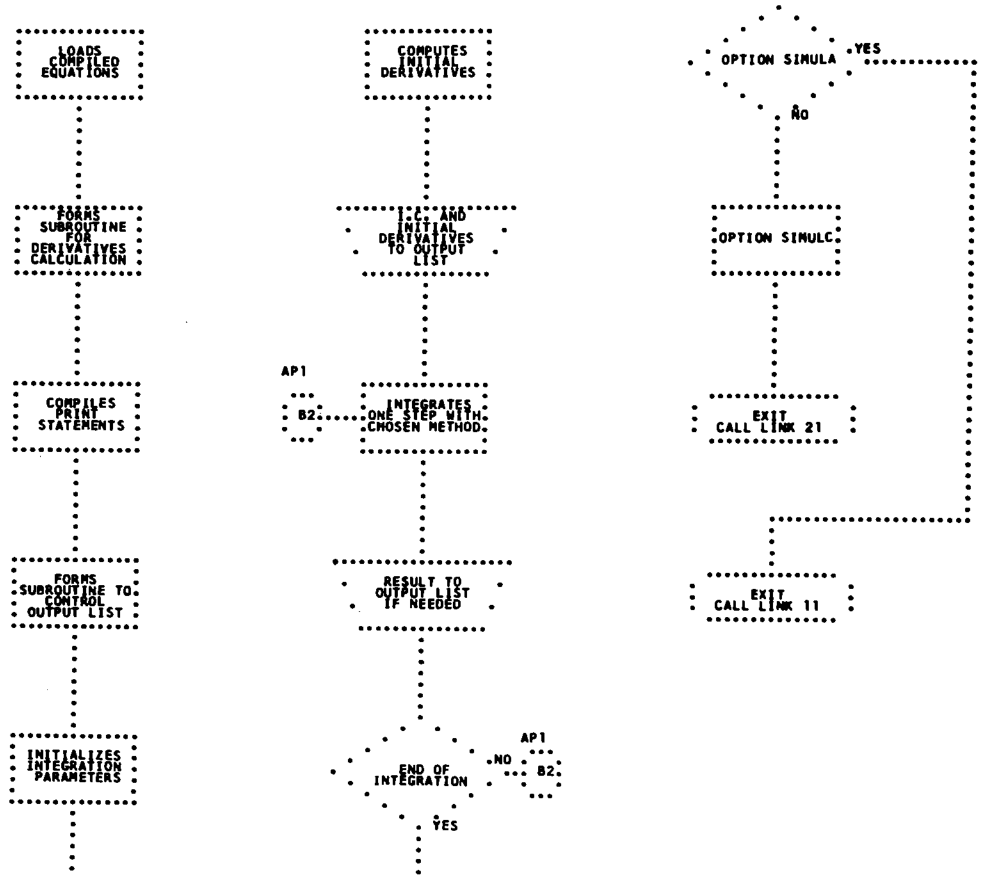


CHART APACHE

APACHE FLOW CHART LINK 31 FLOWCHART PAGE 1

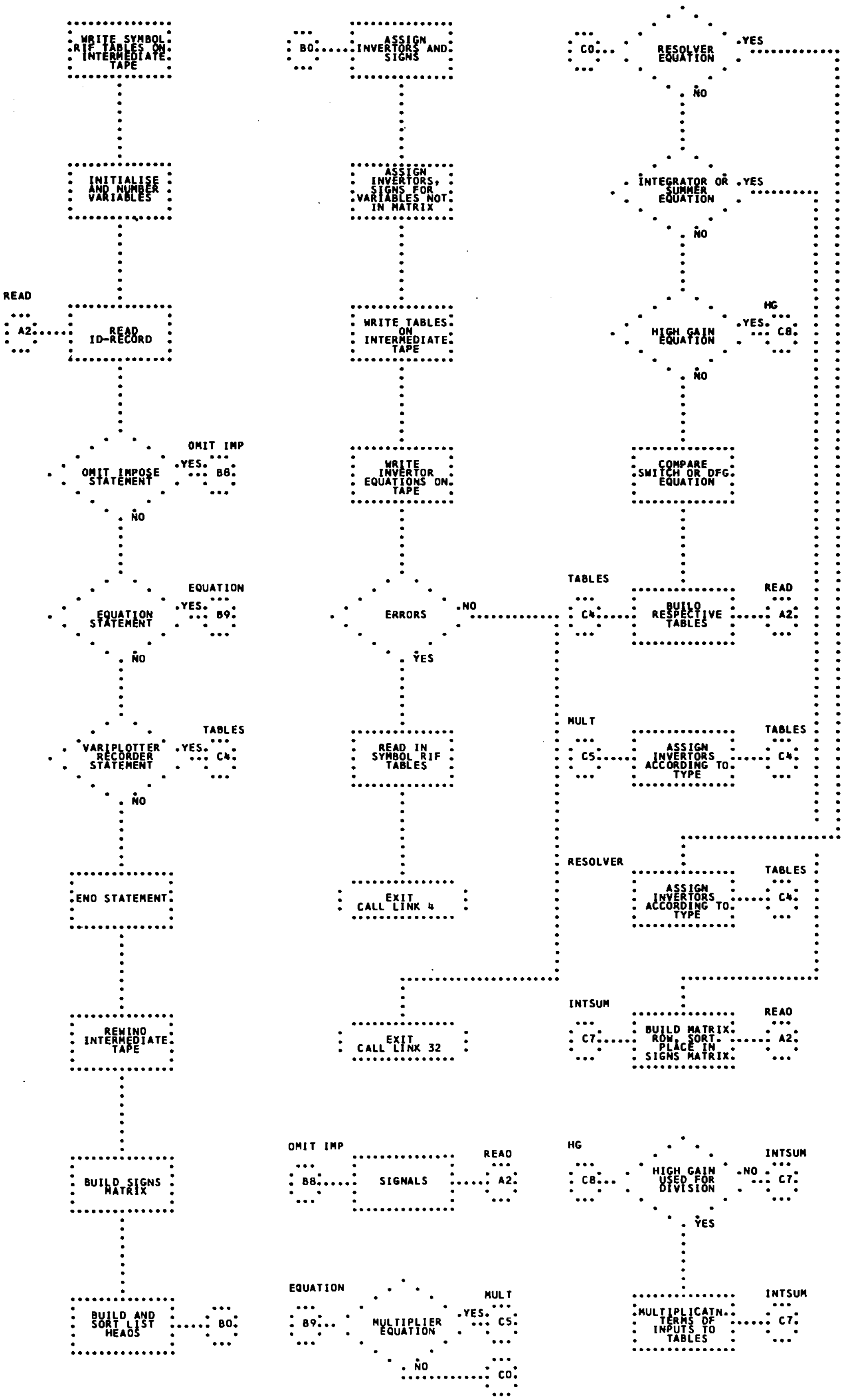


CHART APACHE

APACHE FLOW CHART LINK 321

FLOWCHART PAGE 1

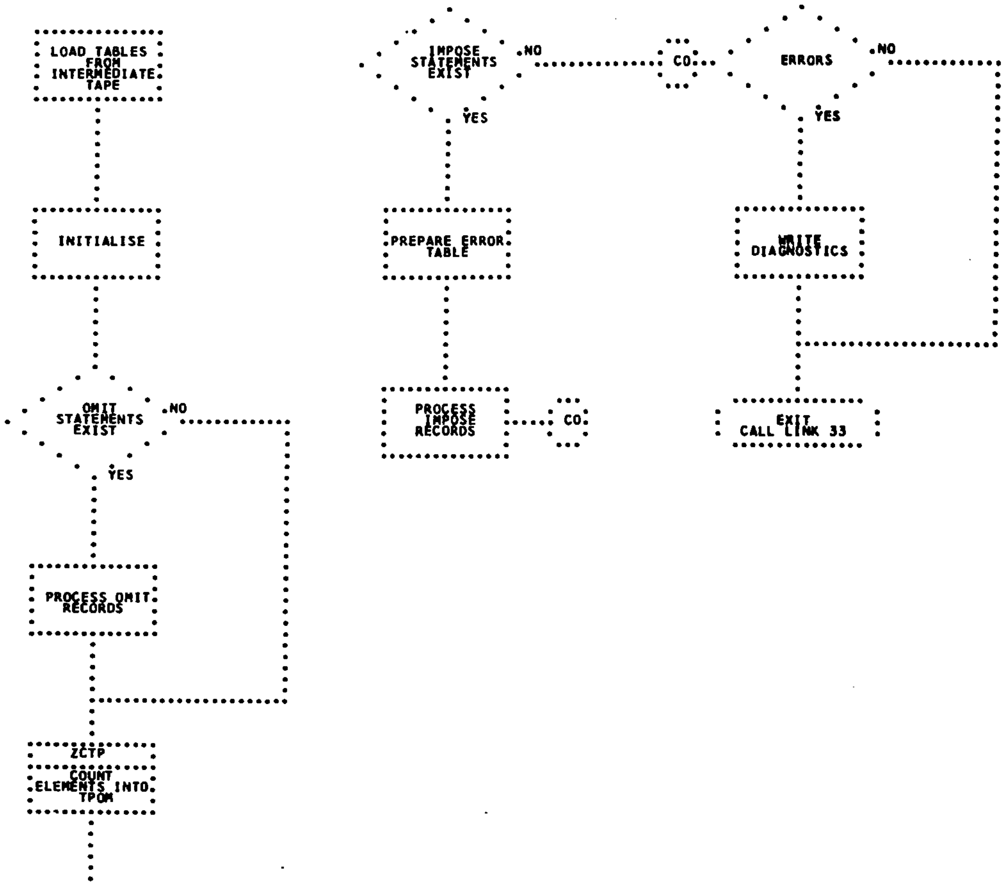


CHART APACHE

APACHE FLOW CHART LINK 33

FLOWCHART PAGE 1

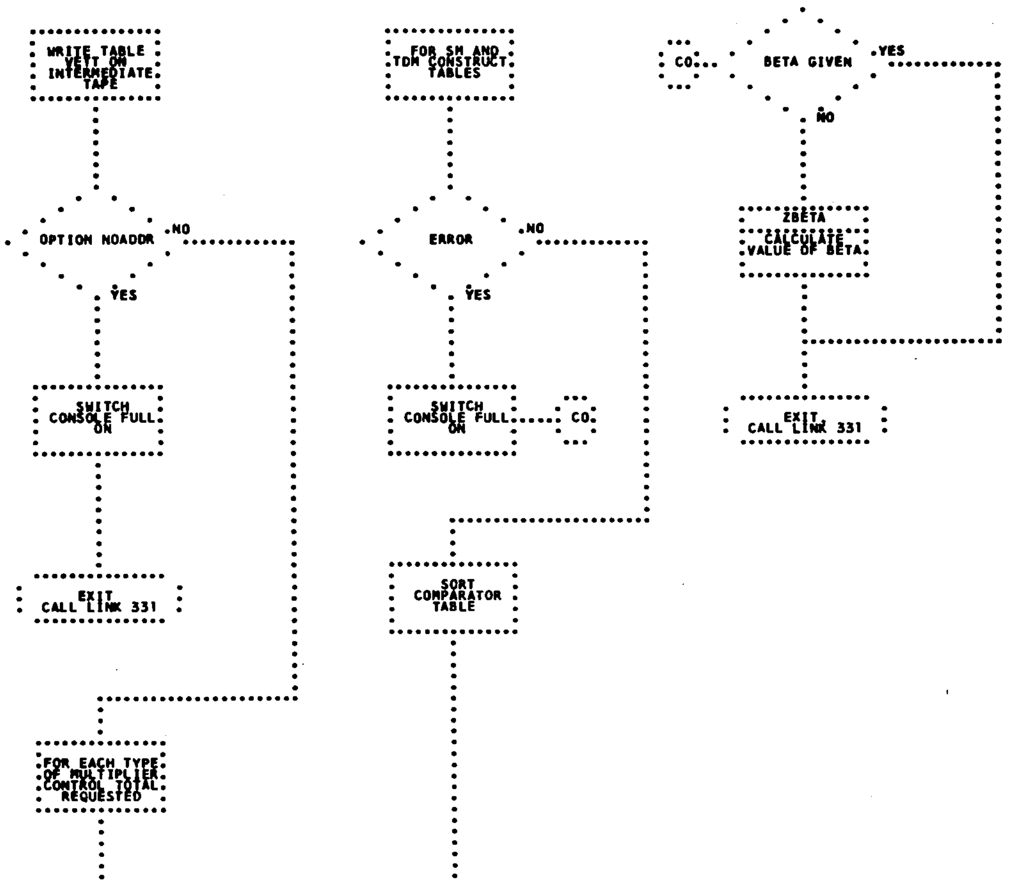


CHART APACHE

APACHE FLOW CHART LINK 331

FLOWCHART PAGE 1

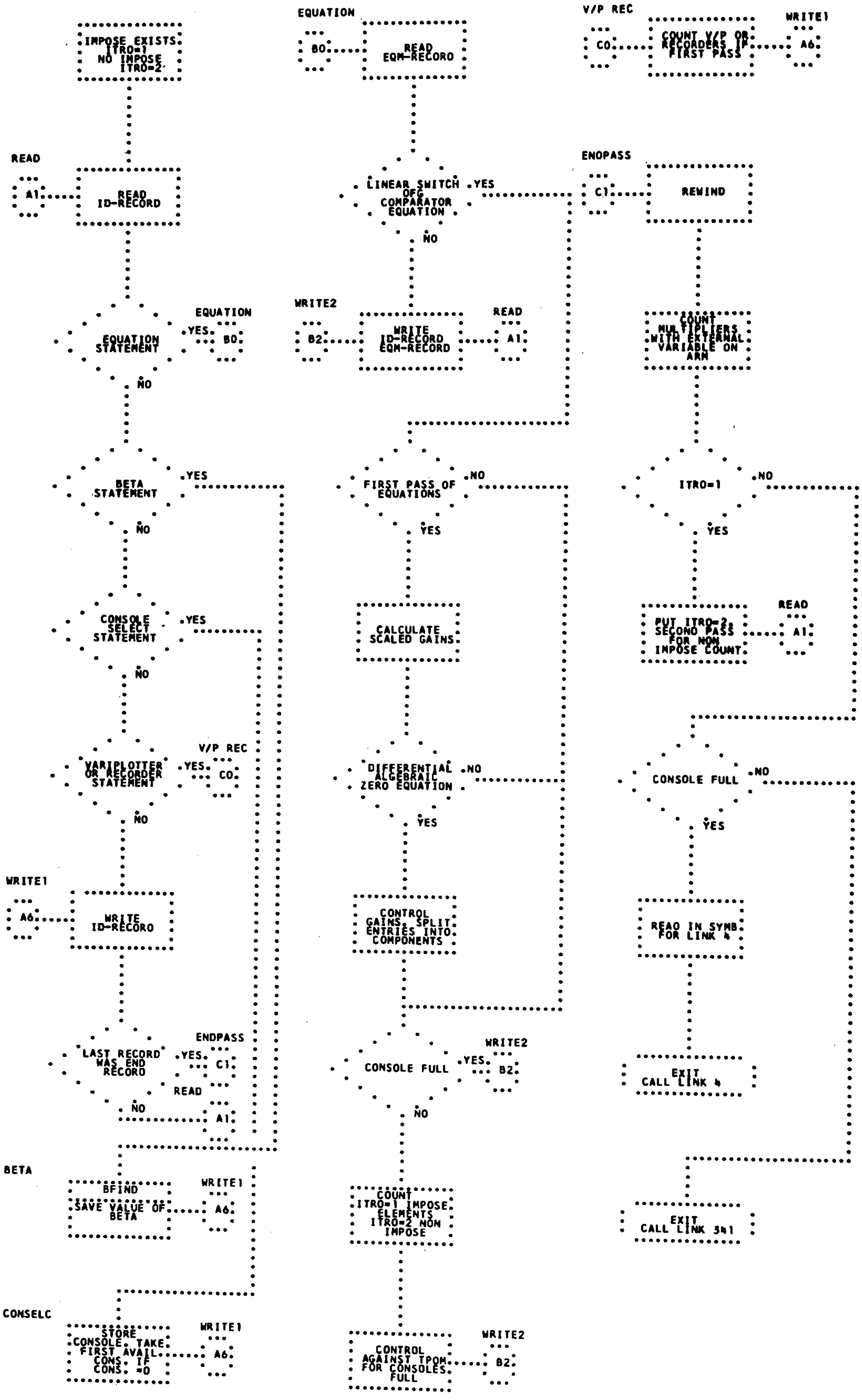


CHART APACHE

APACHE FLOW CHART LINK 341 FLOWCHART PAGE 1

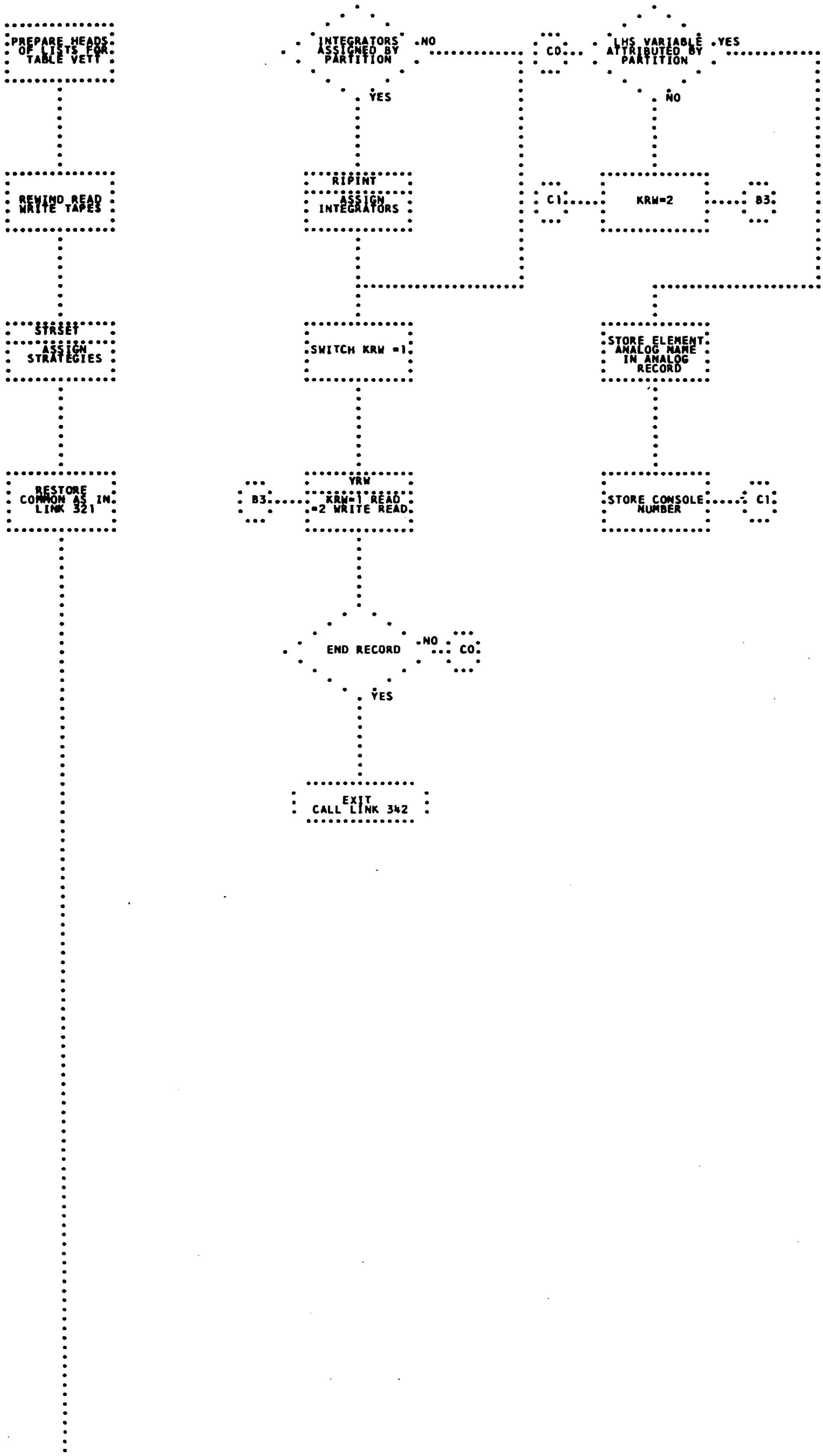


CHART APACHE

APACHE FLOW CHART LINK 342

FLOWCHART PAGE 1

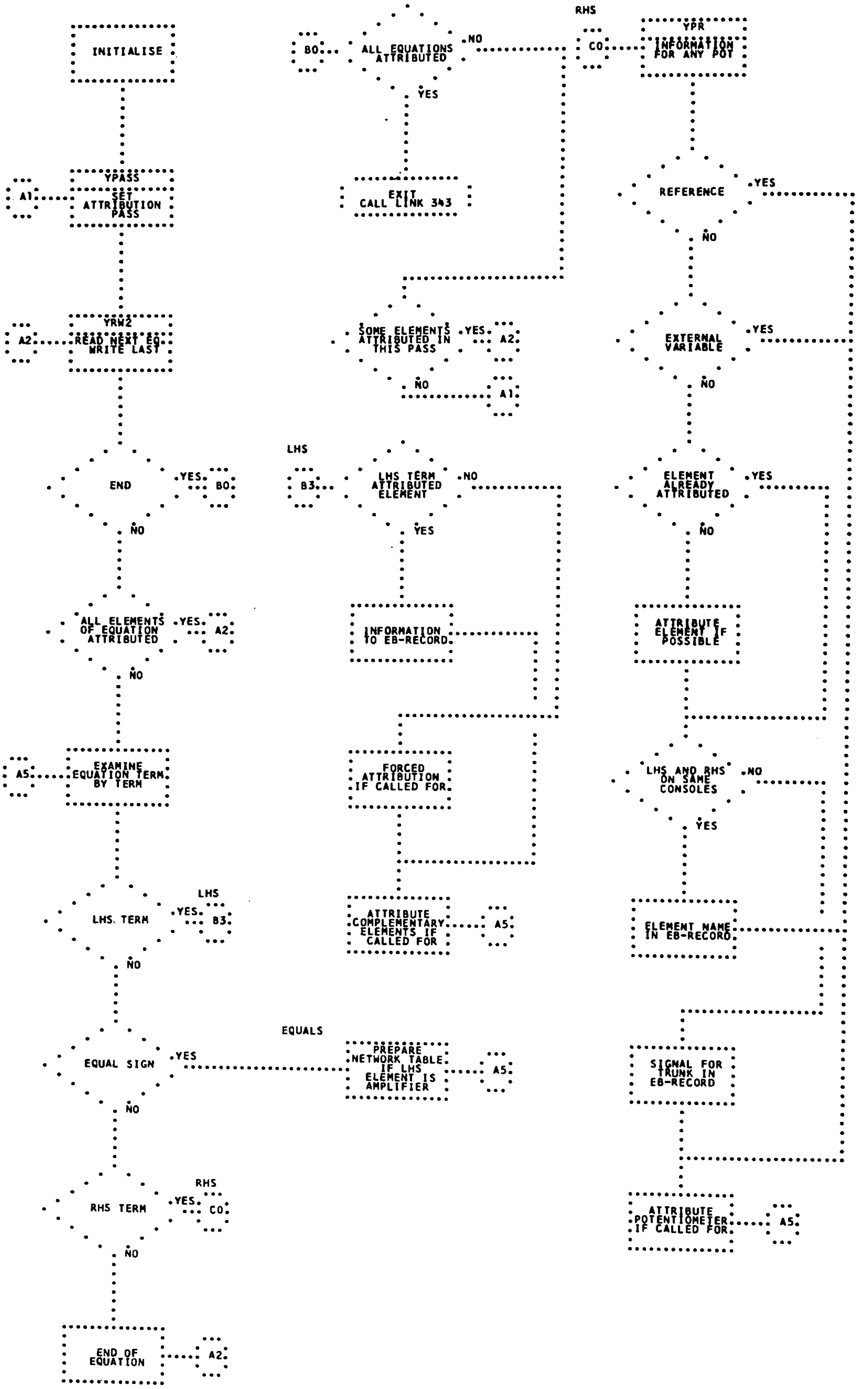


CHART APACHE

APACHE FLOW CHART LINK 343

FLOWCHART PAGE 1

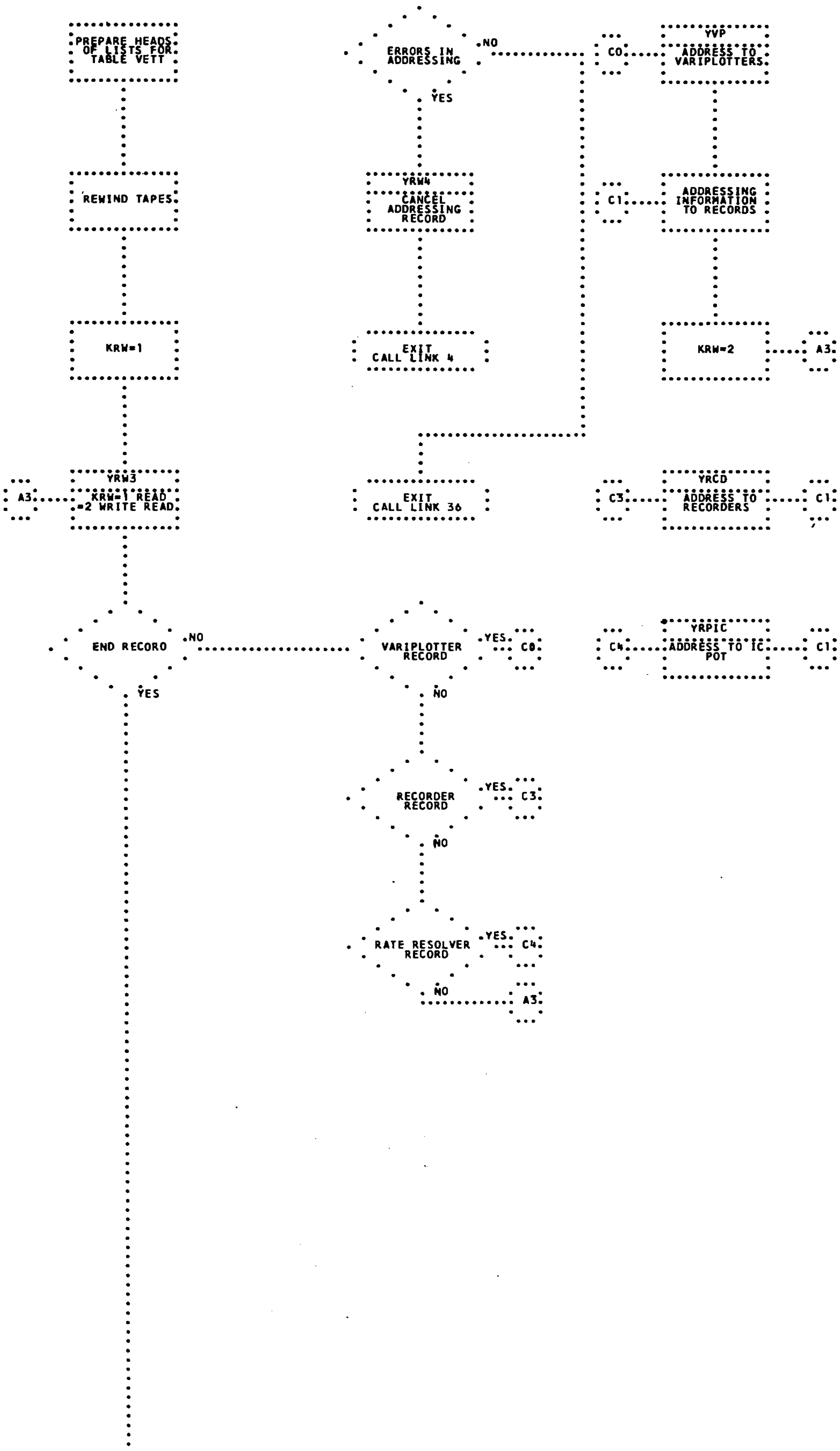


CHART APACHE

APACHE FLOW CHART LINK 36

FLOWCHART PAGE 1

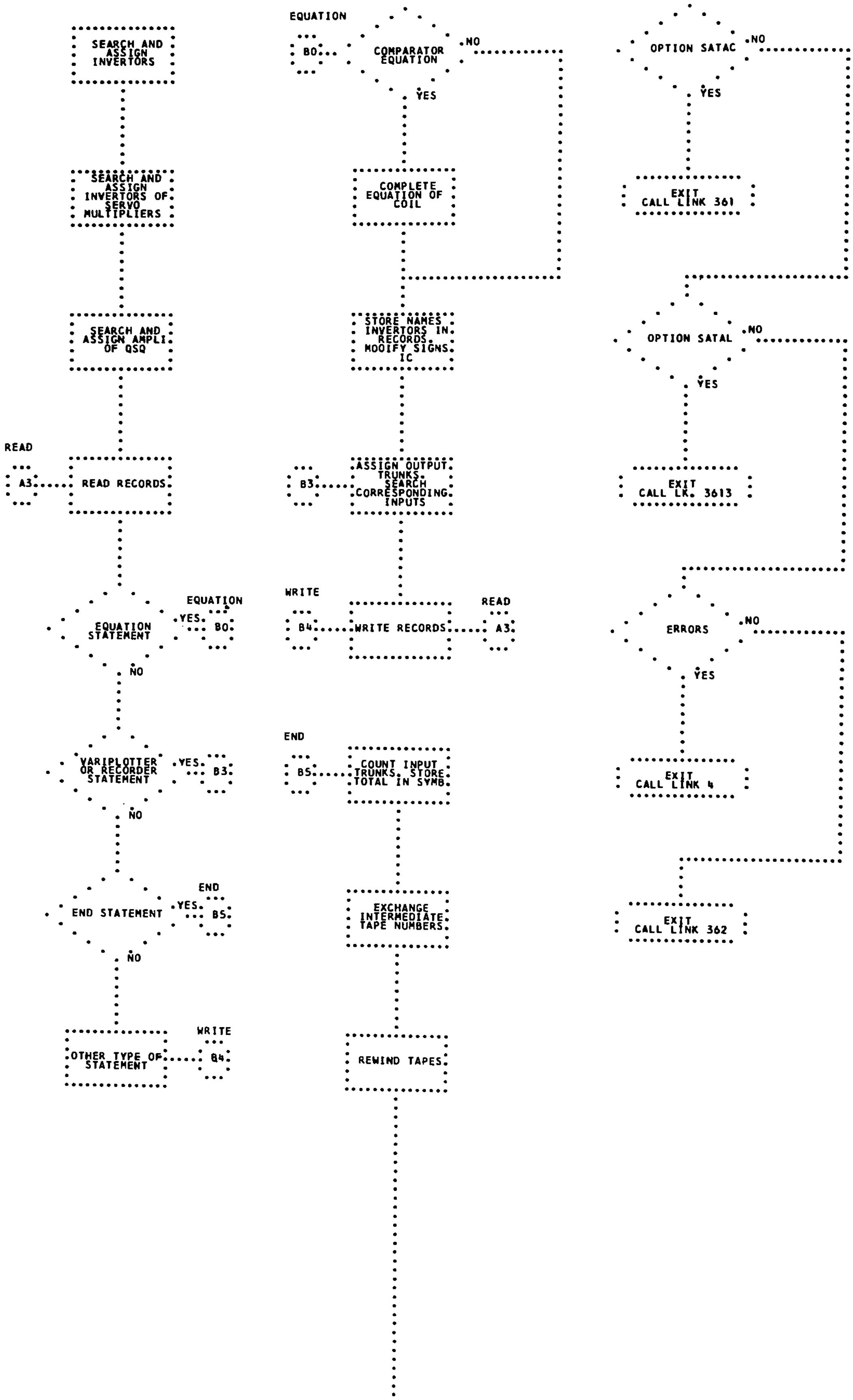


CHART APACHE

APACHE FLOW CHART LINKS 361 3613

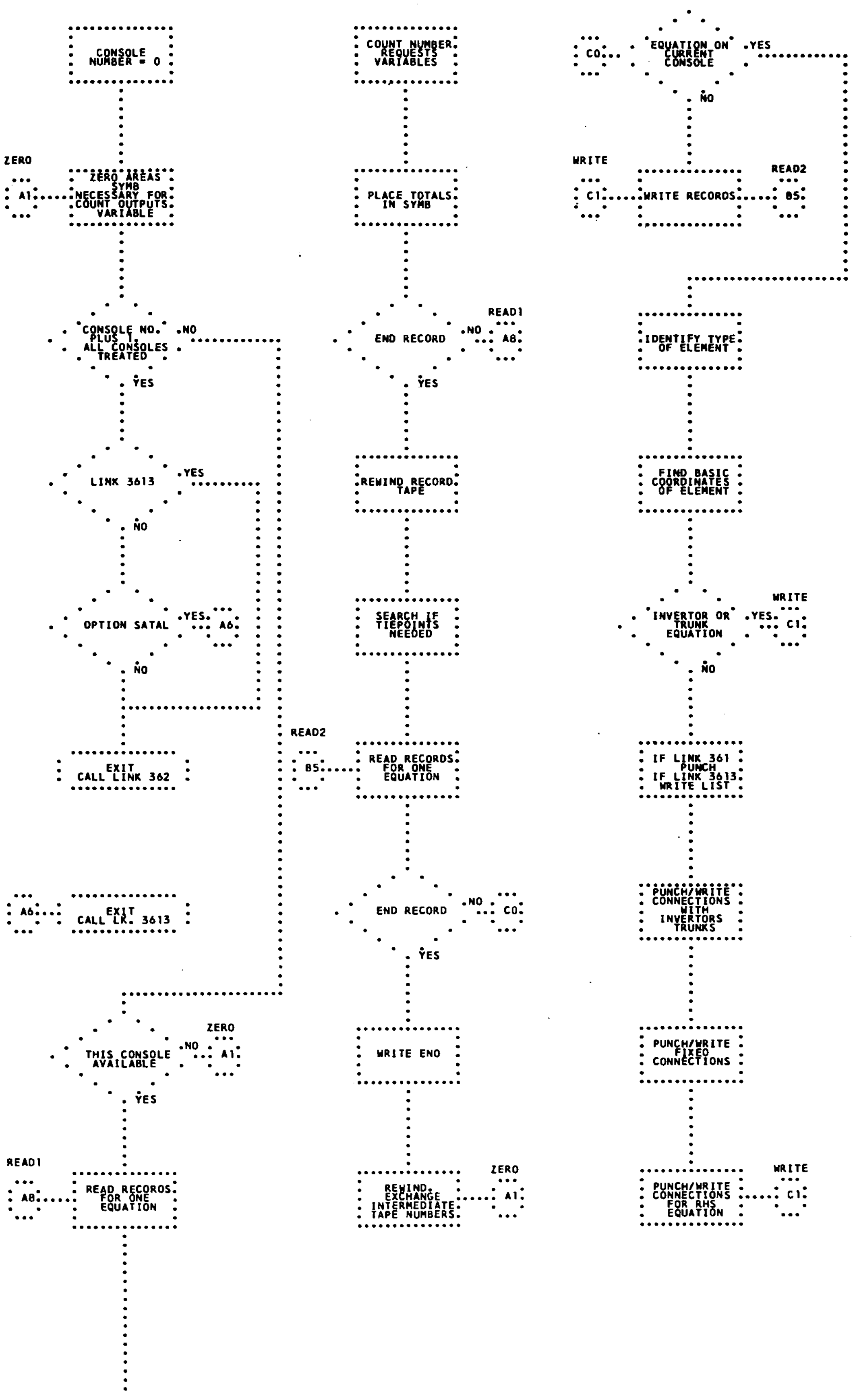


CHART APACHE

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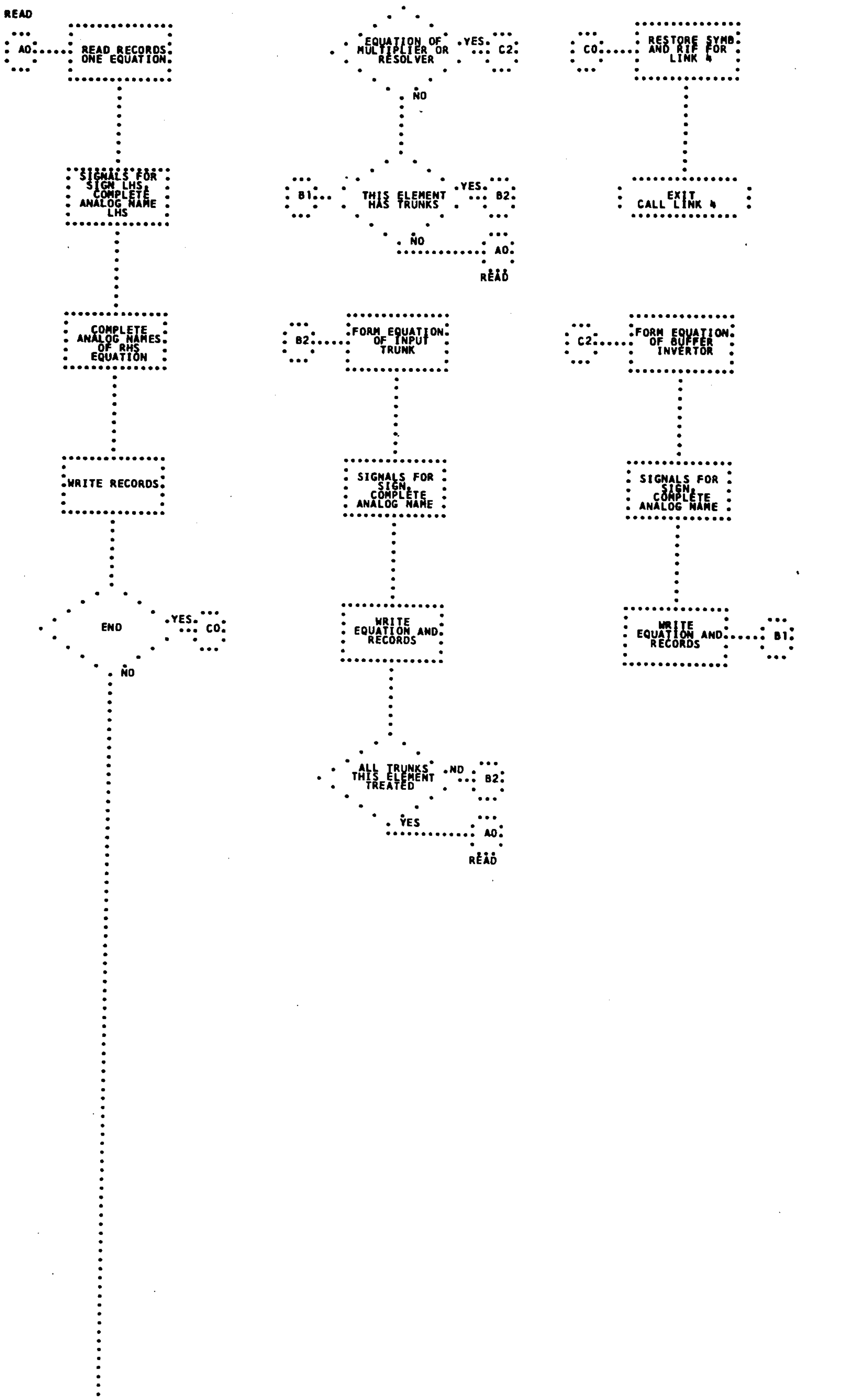


CHART APACHE

APACHE FLOW CHART LINK 4

FLOWCHART PAGE 1

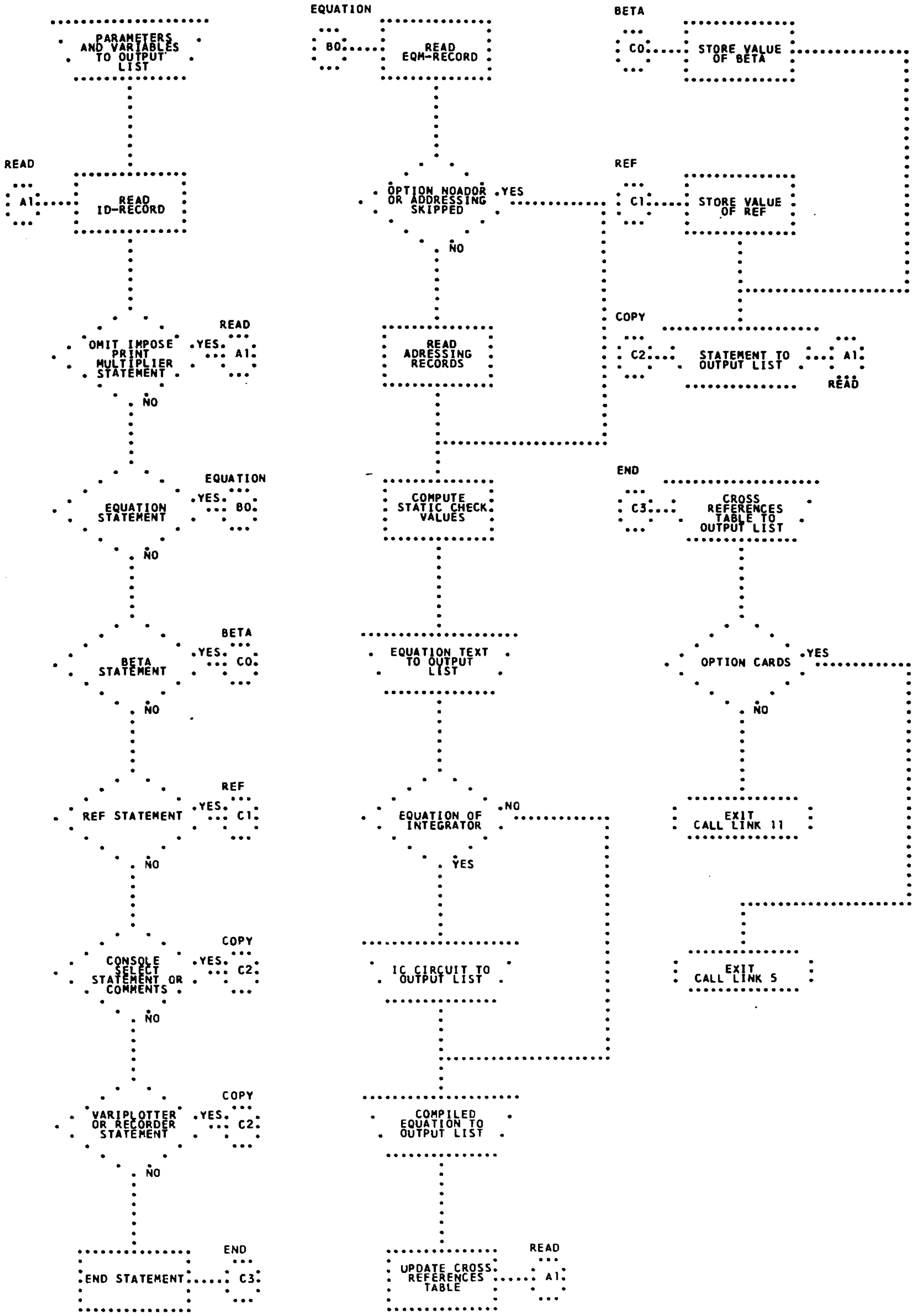


CHART APACHE

APACHE FLOW CHART LINK 5

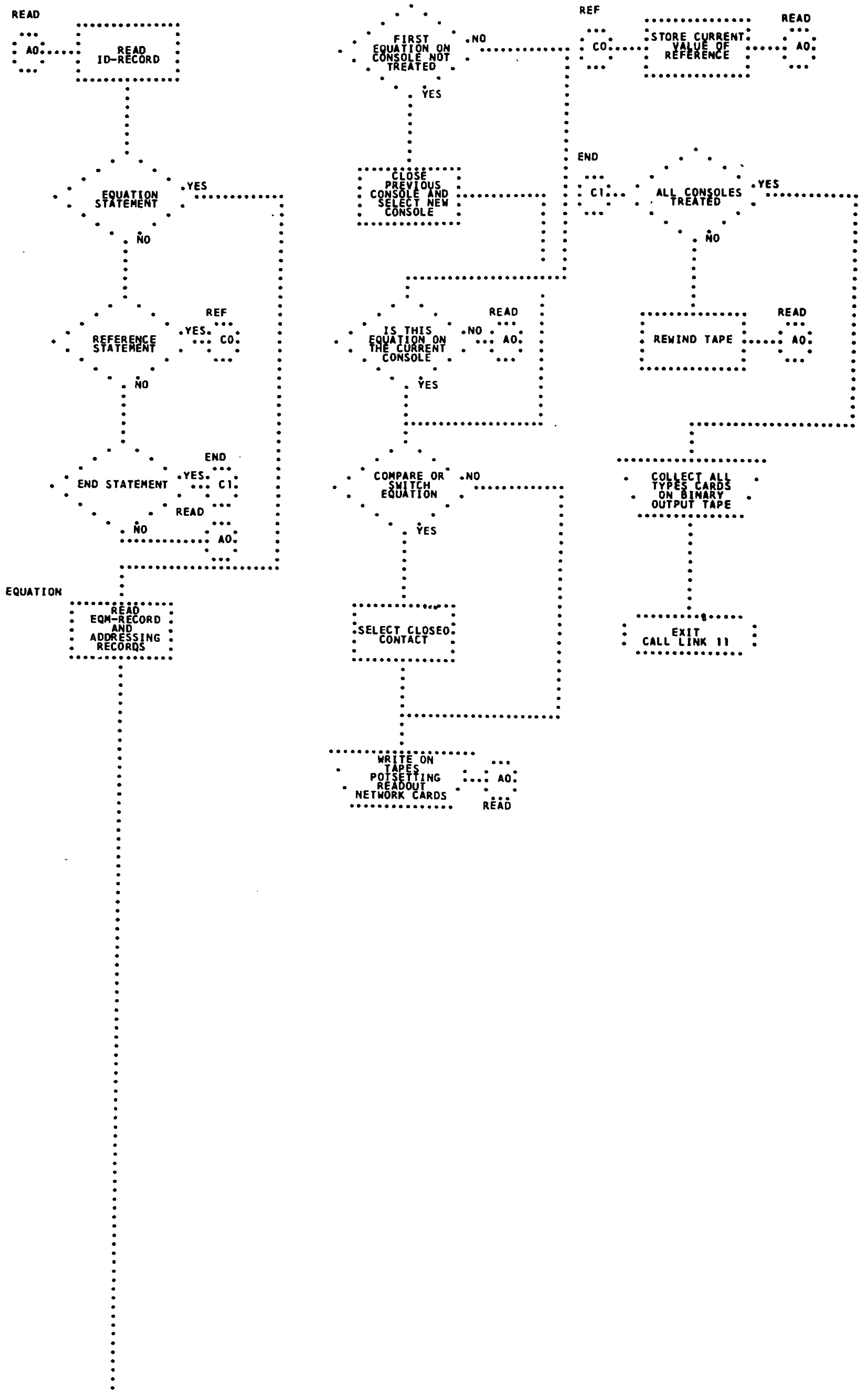


CHART APACHE

APACHE FLOW CHART LINK 6

FLOWCHART PAGE 1

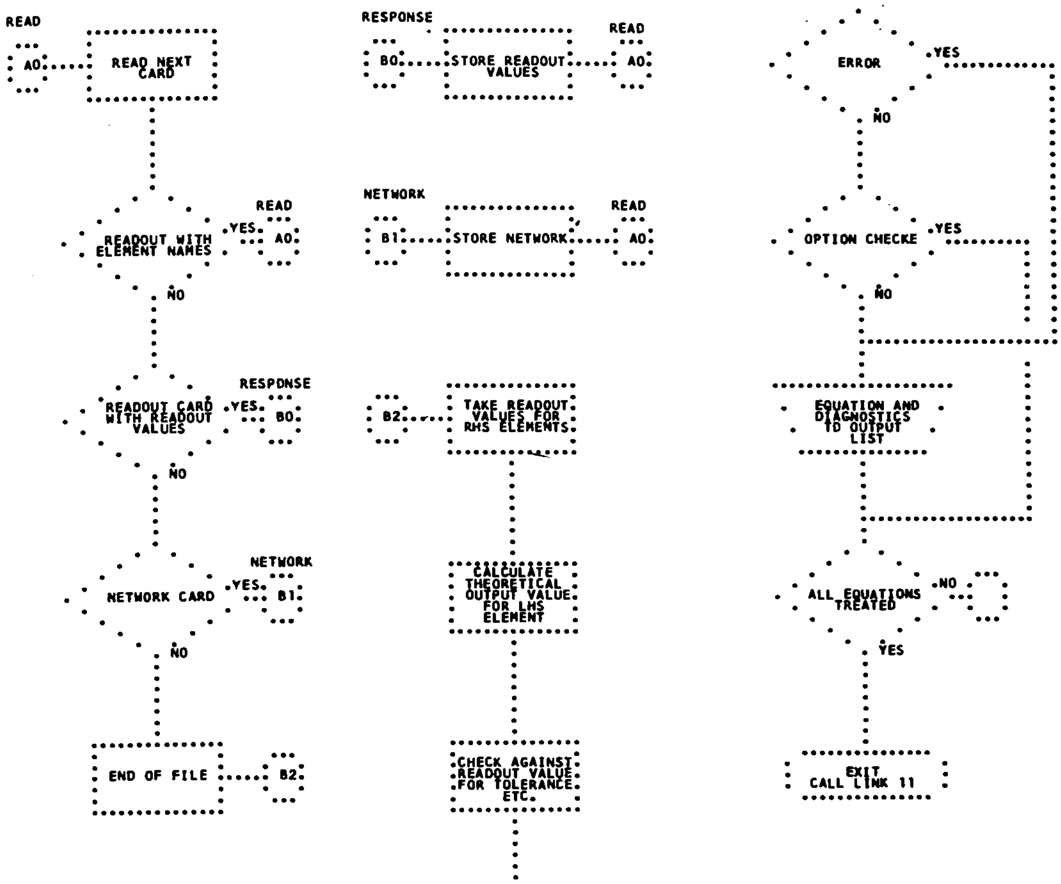
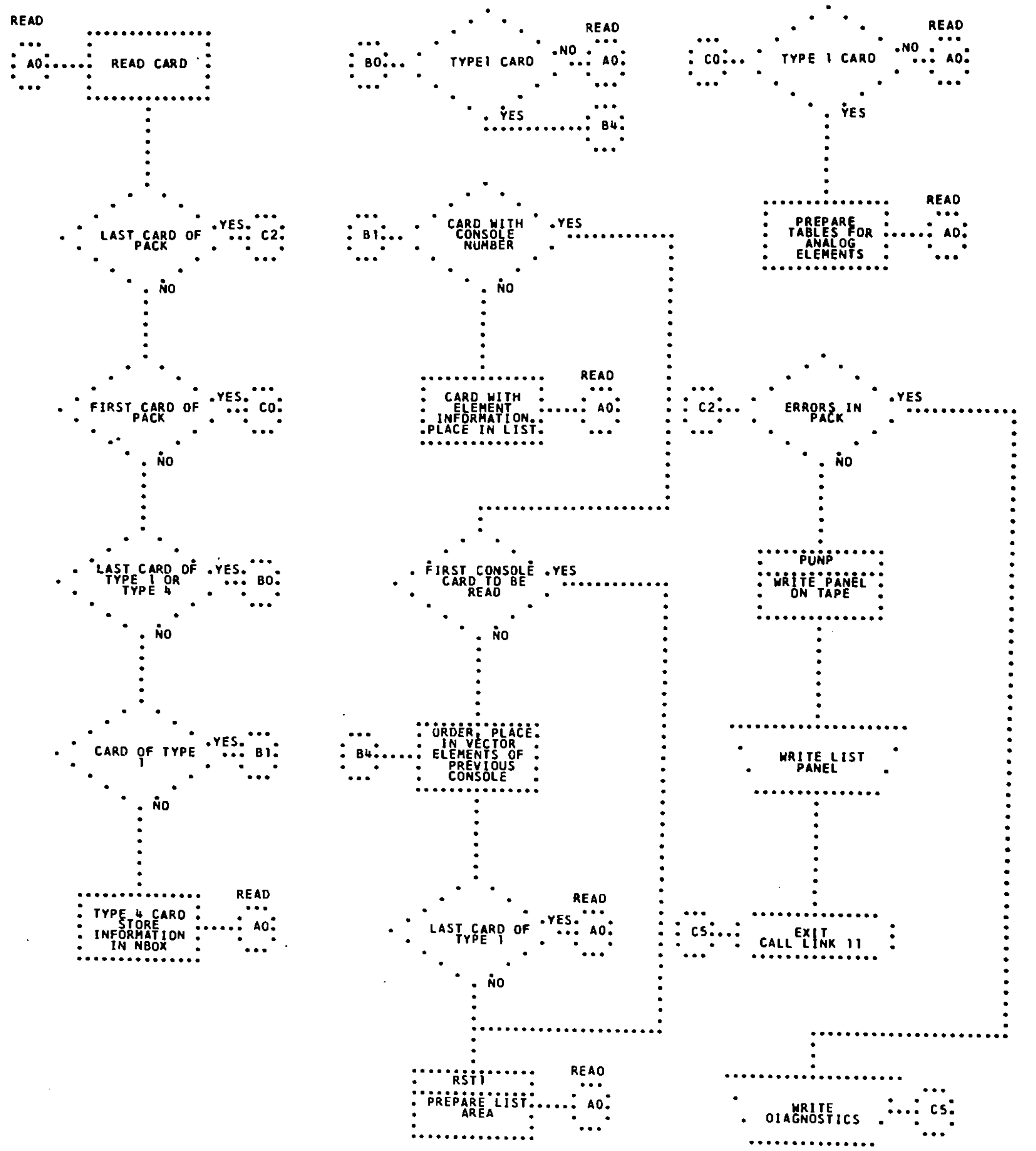


CHART APACHE

APACHE FLOW CHART LINK 7

FLOWCHART PAGE 1



3. SUMMARISED DESCRIPTIONS OF ROUTINES

3.1 Summarised descriptions of routines in alphabetical order by routine

ACCUNT	DUMMY ROUTINE
ACOMPL	ATTRIBUTES AUXILIARY ELEMENTS TO LEFT HAND SIDE VARIABLE
ACOUNT	COUNTS AMPLIFIERS WITH ASSOCIATED POTS AND AUXILIARY NETWORKS
ACTW	MODIFIES ADDRESSES . SERVICE ROUTINE
ADDA	ADDS AND SUBTRACTS INTEGERS . SERVICE ROUTINE
ADR	FINDS ADDRESS OF A FORTRAN SYMBOL . SERVICE ROUTINE
AFSIS	INSERTS GP-CODE IN SYMBOL TABLE
AFTER	INSERTS IN A LIST A VECTOR OR ANOTHER LIST
AGENT	GENERATES NON-LINEAR AUXILIARY EQUATIONS
AIMP	IMPOSE FOR AMPLIFIERS
AMPUSC	SUPPLIES SATANAS COORDINATES FOR AMPLIFIER OUTPUTS
AMRIC	FINDS AND OCCUPIES INVERTOR OF DFG 10 SEGMENTS
ANR	OBTAINS THE ADDRESS OF THE NEXT ELEMENT IN A TWO DIMENSIONAL LIST
APCW1	FINDS THE PRECEDING OR SUCCEEDING ELEMENT IN A LIST . USED WITH T ABLE VETT
APR	OBTAINS THE ADDRESS OF THE PRECEDING ELEMENT IN A TWO DIMENSIONAL LIST
ARRIV	SUPPLIES SATANAS COORDINATES OF OUTPUTS
ARRIX	SUPPLIES OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
ARRPOT	SUPPLIES OUTPUT AND INPUT SATANAS COORDINATES FOR POTS
ARRPOX	SUPPLIES OUTPUT AND INPUT CONNECTIONS OF POTS FOR PANEL CONNECTIO NS LIST

AST	LOADS AMPLIFIER INFORMATION FOR TABLE VETT
ATERM1	FORCED ATTRIBUTION OF AMPLIFIERS TO LEFT HAND SIDE VARIABLE
ATRAN	COMPILES ARITHMETIC EXPRESSIONS . GENERATES A 7090 PROGRAM EQUIVALENT TO A GIVEN EXPRESSION . SUPPLEMENTARY ENTRIES ARE SUPPLIED TO SELECT ONE OF THE VARIOUS ROUTINES WHICH LOCATE THE OPERANDS OF THE EXPRESSION
ATRIN	WRITES ONTO AN INTERMEDIATE TAPE THE COMPILED EQUATIONS . USED WITH THE SIMULATOR
ATTINV	ASSIGNS INVERTORS WHEN REQUESTED
AUXREC	SUPPLIES EQM-RECORD FOR NON-LINEAR AUXILIARY EQUATIONS
AUXT	RECOGNISES IF A VARIABLE IS AN AUXILIARY VARIABLE
AVC	STORES THE CONSOLE NUMBERS GIVEN IN THE AVAILABLE CONSOLES STATEMENT
AVER	CALCULATES MEAN VALUE
AZZS	ZEROS WORD IN SYMBOL TABLE
BASCO	SUPPLIES BASIC COORDINATES FOR EACH ANALOG ELEMENT
BDC	CONVERTS FLOATING POINT BINARY NUMBER INTO BCD INTEGER OR FLOATING
BFIND	CONVERTS VALUE OF BETA READ FROM RECORD INTO FLOATING POINT
BLANK	RECORD PACKING ROUTINE
BLD1	TRANSFORMS A SEQUENTIAL VECTOR INTO A LIST FORM VECTOR WHEN SUBLISTS ARE NOT PRESENT . USED FOR TABLE VETT
BRECHT	SUPPLIES ADDRESS IN SYMBOL TABLE OF VARIABLE IF ALREADY STORED . IF NOT STORES NEW VARIABLE IN SYMBOL TABLE
BUILD	TRANSFORMS A SEQUENTIAL VECTOR INTO A LIST FORM VECTOR

BUPPA	CONSTRUCTS THE NAME OF THE MEAN VALUE OF A PERTURBED VARIABLE
CANAP	CONVERTS ANALOG ELEMENT CODES FROM ANALOG TO APACHE NAME
CANAP2	CONVERTS ANALOG ELEMENTS CODES FROM APACHE TO ANALOG NAME
CHAIN	APACHE SYSTEM CHAIN ROUTINE
CIMP	IMPOSE FOR COMPARATORS
CLCT1	CONSTRUCTS THE COLUMN HEADER WORDS OF SIGNS MATRIX
CLETS2	SEARCHES A VARIABLE IN SYMBOL TABLE
CMCOIL	MAKES HIGHEST GAIN TO COIL = 1 AND COMPENSATES FOR ANY DIFFERENCE IN THE SCALING FACTORS OF THE ENTRIES TO COMPARATORS
CMGAIN	ORDERS COMPARATOR TABLE CUBB
CMSW	SPLITS EQUATIONS OF COMPARATORS OR SWITCHES INTO SEVERAL EQUATION S CORRESPONDING EACH TO A CONTACT
CNFR	BOOLEAN COMPARE . SERVICE ROUTINE
CNTRCD	STORES SIGNALS FOR OPTION CARDS
CNVRT	CONVERTS CARDS IMAGES TO A BCD RECORD
COLLIN	MAKES CONNECTION BETWEEN MAIN ELEMENT AND ITS INVERTOR
COLLIX	SUPPLIES CONNECTION BETWEEN MAIN ELEMENT AND ITS INVERTOR FOR PAN EL CONNECTIONS LIST
COMCON	FOR MAIN ELEMENT INCREASES TOTAL OF OUTPUTS REQUIRED BY ONE IF EN TERS AN INVERTOR
COMMN	LOADS INFORMATION COMMON TO ALL ANALOG ELEMENTS FOR TABLE VETT
COMPDO	SUBSTITUTES THE CURRENT VALUE OF THE RECURSIVITY PARAMETER IN A S TATEMENT SUBJECT TO A DO LOOP

COMPOT	CONTROLS GAINS TO COMPARATOR CONTACTS
COMUSC	SUPPLIES SATANAS COORDINATES FOR COMPARATOR OUTPUTS
COMUX	SUPPLIES COMPARATOR OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
CONDIN	MAKES CONNECTIONS RELATIVE TO IC CIRCUIT
CONDIX	SUPPLIES CONNECTIONS RELATIVE TO IC CIRCUIT FOR PANEL CONNECTIONS LIST
CONMOL	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR MULTIPLIERS NOT SERVO MULTIPLIERS
CONMOP	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO QUARTE R SQUARE HIGH ACCURACY OR ELECTRONIC MULTIPLIERS OR RESOLVERS
CONSM	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR SERVO MULTIPLIERS
CONSP	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO SERVO MULTIPLIERS
CONTAM	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS
COOR	SUPPLIES BASIC COORDINATES FOR EACH ANALOG ELEMENT
COPY	TAPE COPYING ROUTINE USED IN EDITOR
COPYCT	READS AND COPIES THE CHAIN TABLE IN EDITOR PHASE
CORD	SORT ROUTINE
CORD1	ORDERS ANALOG ELEMENT TABLE VETT
CORVE	ORDERS VECTORS OF ANALOG ELEMENTS FOR TABLE VETT
CRIT1	COMPARE ROUTINE FOR ROUTINE SORT

CSEL	GENERATES POT SETTING , READ OUT , NETWORK CARDS
CTPOM	CONTROLS IN TABLE TPOM IF GIVEN ELEMENT AVAILABLE
CTS	LOADS INPUT ONTO INPUT TAPE IF ON-LINE
CVRT	CONVERSION OF INTERNAL CODES
DAN	DO STATEMENT PROCESSOR
DAUX	DUMMY ROUTINE USED IN SIMULATOR
DBCV	CONVERTS BCD NUMBERS INTO FLOATING POINT NUMBERS
DEFINE	DEFINES A PART OF A LIST AS A NEW LIST
DFG	DFG STATEMENT PROCESSOR
DFGUSC	SUPPLIES SATANAS COORDINATES FOR DFG OUTPUTS
DFGUX	SUPPLIES DFG OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
DIAGN	DETECTS WRITING ERRORS IN PROGRAM STATEMENTS
DLAST	EXTRACTS THE N-TH ELEMENT PRECEDING THE CURRENT ONE IN A LIST
DNEXT	EXTRACTS THE N-TH ELEMENT FOLLOWING THE CURRENT ONE IN A LIST
ELIST	CONSTRUCTS LIST HEADERS FOR CONSTRUCTION OF TABLE VETT
EMFAB	CONSTRUCTS TABLE TTD FOR ELECTRONIC MULTIPLIERS
END	END OF LIST TEST
ENDMS	PRINTS ON-LINE END OF EDITOR MESSAGES
ENDMS3	PRINTS ON-LINE END OF EDITOR MESSAGES
ENTDFG	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR DFG
ENTDFX	SUPPLIES DFG FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LI ST

ENTHAM	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR HIGH ACCURACY MU LTIPLIERS
ENTHAX	SUPPLIES HIGH ACCURACY MULTIPLIER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
ENTQSQ	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR QUARTER SQUARE M ULTIPLIERS
ENTQSX	SUPPLIES QUARTER SQUARE MULTIPLIERS FIXED AND INPUT CONNECTIONS F OR PANEL CONNECTIONS LIST
ENTSER	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR SERVO MULTIPLIER S
ENTSEX	SUPPLIES SERVO MULTIPLIER FIXED AND INPUT CONNECTIONS FOR PANEL C ONNECTIONS LIST
ENTSW	SUPPLIES INPUT SATANAS COORDINATES FOR SWITCH
ENTSX	SUPPLIES SWITCH INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
ENTTDV	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR ELECTRONIC MULTI PLIERS
ENTTDX	SUPPLIES ELECTRONIC MULTIPLIERS FIXED AND INPUT CONNECTIONS FOR P ANNEL CONNECTIONS LIST
EONA	FINDS ANALOG ELEMENT IN ANALOG ELEMENT TABLE VETT
EONERR	ERROR ROUTINE FOR OMIT
ERASEL	ERASES A LIST
ERASES	ERASES A PART OF A LIST
EREAD	TAPE READING ROUTINE FOR EDITOR
ERR	ERROR SIGNAL FOR ROUTINE RST1
ERR2	ERROR SIGNAL FOR ROUTINE BLD1

ERRAD1	ERROR IN COD1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7
ERRAD2	ERROR IN COD2 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7
ERRCD1	ERROR IN COD3 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7
ERRCD2	ERROR IN ADR1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7
ERRIT	ERROR SIGNAL FOR ROUTINE PYTAG
ERRNUS	ERROR ROUTINE FOR OMIT
ESR	SEARCHES ENTRY PSEUDO-OPERATION IN FAP PROGRAMS FOR EDITOR
EST	LOADS ELECTRONIC MULTIPLIER INFORMATION FOR TABLE VETT
EWB	SELECTS FOR EACH TYPE OF ELEMENT ROUTINE TO CONSTRUCT TABLE VETT
EXITA	APACHE SYSTEM EXIT ROUTINE
FDUMP	APACHE SYSTEM DUMP ROUTINE
FFG1	STORES SIGNAL IN WORD . SERVICE ROUTINE . (NOT USED)
FEG2	STORES SIGNAL IN WORD . SERVICE ROUTINE . (NOT USED)
FIMP	IMPOSE FOR DFG
FLAG	GIVES GP-CODE FOR NON-LINEAR AUXILIARY VARIABLES
FMPY	PERFORMS THE ALGEBRAIC DEVELOPMENT OF THE MULTIPLICATION OR THE D IVISION OF TWO EXPRESSIONS
FPG	COUNTS THE NUMBER OF TRUNKS NECESSARY FOR A MAIN ELEMENT AND ITS INVERTOR . STORES THE TOTAL IN SYMBOL TABLE
FST	LOADS DFG INFORMATION FOR TABLE VETT
FTDC	CONVERTS FLOATING POINT BINARY NUMBERS INTO FLOATING POINT BCD
FTDIC	CONVERTS FLOATING POINT BINARY NUMBERS INTO BCD INTEGERS

GHST	LOADS RESISTANCE AND CAPACITY INFORMATION FOR TABLE VETT
HMFAB2	COUNTS TOTAL OF HIGH ACCURACY MULTIPLIERS REQUIRED
HMOUT	TRANSFERS INFORMATION IN TABLE THAM FOR HIGH ACCURACY MULTIPLIERS
HTOL	SHIFTS MEMORY AREA HIGH TO LOW . SERVICE ROUTINE
HUBSOR	SORTS TABLE HUBB USED FOR HIGH ACCURACY MULTIPLIERS
ICOUNT	COUNTS INVERTORS
IDEQ	EXTRACTS KTYPE-CODE
IDNTFY	IDENTIFIES AND GIVES E-CODE TO EACH OPERAND AND OPERATOR OF EQUATIONS . RECOGNISES AND COMPUTES VALUES OF PARAMETRIC EXPRESSIONS . BUILDS W-RECORDS
INDEX	CALCULATES THE NUMBER OF WORDS BETWEEN TWO ADDRESSES . SERVICE ROUTINE
INPSC	PROCESSES PRINT STATEMENTS FOR SIMULATOR
INT	INTEGRATION ROUTINE USED IN SIMULATOR
INVUSC	SUPPLIES SATANAS COORDINATES FOR INVERTOR OUTPUTS
IOST	LOADS INPUT AND OUTPUT TRUNK INFORMATION FOR TABLE VETT
ISPEQ	GIVES KTYPE-CODE TO DFG , SWITCHES , COMPARATORS , RESOLVERS
IUS	SUPPLIES INTER-AMPLIFIER CODE FOR USE IN SATANAS
JOIN	USED BY ROUTINE AFTER TO JOIN TWO ELEMENTS OF TWO DIFFERENT LISTS
KST	LOADS REFERENCE AND GROUND INFORMATION FOR TABLE VETT
LCMP	LIST COMPARE
LCPY	DUPLICATES A LIST

LELLA2	TRANSFORMS A TWO DIMENSIONAL ARRAY INTO A TWO DIMENSIONAL LIST FO RM ARRAY
LGP	EXTRACTS GP-CODE FROM SYMBOL TABLE
LINO	PERFORMS INDIRECT STORE . SERVICE ROUTINE
LINO1	REPLACES IC , MAX VALUE OR SCALE FACTOR CELL IN SYMBOL TABLE WITH NEW VALUE
LOADER	LOADS COMPILED EQUATIONS AND BUILDS SUBROUTINE DAUX FOR SIMULATOR
LOOK	SYMBOL TABLE LOOK-UP ROUTINE
LSCAN	COUNTS THE NUMBER OF VARIABLES WHICH APPEAR IN A BRANCH OF A LIST FORM EQUATION
LSHR	LOGICAL SHIFT SERVICE ROUTINE
LST	LOADS LIMITERS INFORMATION FOR TABLE VETT (NOT USED)
LTOH	SHIFTS MEMORY AREA LOW TO HIGH . SERVICE ROUTINE
LZP	PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM V ARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND S CALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS
LZP2	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PAR AMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COM PUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS
MELEM	TESTS IF A VARIABLE IS OUTPUT ON A GIVEN CONSOLE
MPLIMP	PROCESSES THE IMPOSE STATEMENTS WHICH DEFINE A TYPE OF MULTIPLIER
MST	LOADS SERVO MULTIPLIER INFORMATION FOR TABLE VETT
MULTCD	EXTRACTS M-CODE

NAME	EXTRACTS THE NAME OF A PARAMETER OR VARIABLE FROM THE SYMBOL TABL E . CONVERTS ALL FLOATING POINT BINARY NUMBERS WHICH APPEAR INTO BCD NUMBERS
NAME1	EXTRACTS THE NAME OF A PARAMETER OR VARIABLE FROM THE SYMBOL TABL E
NEBB	DUMMY ROUTINE
NST	LOADS TIEPOINT INFORMATION FOR TABLE VETT
NUAMP	IDENTIFIES WHETHER AMPLIFIER IS SUMMER OR INTEGRATOR
NUMUSC	SUPPLIES TOTAL OF OUTPUTS AVAILABLE ON PATCH PANEL FOR EACH ELEME NT
OMITA	OMIT FOR AMPLIFIERS
OMITG	GENERAL OMIT ROUTINE
OMITN	OMIT FOR TIEPOINTS
ORV	ORDERS VECTORS OF ANALOG ELEMENTS FOR TABLE VETT
PAL	INDIRECT CLEAR AND ADD . SERVICE ROUTINE
PANEL	CONSTRUCTED BY LINK 7 CONTAINS DATA OF ALL PATCH PANELS OF INSTAL LATION IN MACHINE CODE
PARAD	COMPUTES THE VALUES OF THE DO PARAMETERS , INITIAL VALUE , MAXIMU M VALUE , AND STEP . USED FOR DO LOOPS IN EQUATIONS
PARAD1	COMPUTES THE VALUES OF THE DO PARAMETERS , INITIAL VALUE , MAXIMU M VALUE , AND STEP . USED FOR DO LOOPS IN PARAMETER OR VARIABLE D EFINITIONS
PARSE	SEARCHES PARAMFTERS IN SYMBOL TABLE
PERT	RECOGNISES IF A VARIABLE IS A PERTURBED VARIABLE
PHEAD	FOR SIMULATOR WRITES LABELS CORRESPONDING TO AN OUTPUT LINE AS SP ECIFIED IN PRINT STATEMENT

PINCO	SUBTRACT ROUTINE FOR ADDRESSES . SERVICE ROUTINE
PINTA	SYSTEM ERROR DIAGNOSTIC ROUTINE
PLACE	PLACES NEW INFORMATION IN AN ELEMENT OF A LIST
POTA	TRANSFORMS EQUATIONS TO THE STANDARD FORM
PREMG	PRINTS ON-LINE ERROR MESSAGES AND RESTART PROCEDURES FOR EDITOR
PREPR	SIMULATOR PRINT STATEMENT PRE-PROCESSOR . IDENTIFIES ITEMS OF THE STATEMENT AND GIVES DIAGNOSTICS
PRIGI	COMPLETES EB-RECORDS
PRIGO	CALCULATES TOTAL OF OUTPUTS REQUIRED FROM A MAIN ELEMENT OR ITS I NVERTOR ON ANY CONSOLE
PRINT	ON-LINE PRINTING ROUTINE
PRINTT	DUMMY SUBROUTINE FOR SIMULATOR
PRIOEM	PRINTS ON-LINE IO-MESSAGES AND RESTART PROCEDURES FOR EDITOR
PST	LOADS POTENTIOMETER INFORMATION FOR TABLE VETT
PSYMB	APACHE SYSTEM TEST
PUNCH	WRITES ON TAPE POT SETTING , READ OUT , NETWORK CARDS
PUNCHC	PREPARES SATANAS CARDS
PUNP	WRITES FAP ROUTINE PANEL ON TAPE
PYTAG	FINDS ON PATCH PANEL UNUSED ANALOG ELEMENT NEAREST TO A GIVEN ELE MENT
QIMP	IMPOSE FOR HIGH ACCURACY MULTIPLIERS
QSFAB	CONTROLS TOTAL OF QUARTER SQUARE MULTIPLIERS REQUIRED

QST	LOADS HIGH ACCURACY MULTIPLIER INFORMATION FOR TABLE VETT
QS1	IMPOSE FOR QUARTER SQUARE MULTIPLIERS
QS2	IMPOSE FOR QUARTER SQUARE MULTIPLIERS
RCRDER	PROCESSES RECORDER STATEMENTS
READ	READS BCD CARDS FROM INPUT TAPE
REFSER	SUPPLIES SATANAS COORDINATES FOR REFERENCE AND GROUND
RES	PROCESSES RESOLVER STATEMENTS
RESCAP	COUNTS CAPACITIES AND RESISTANCES
RESCP	COMPUTES IC OF VARIABLES OUTPUT FROM RESOLVERS
RESET	CONNECTS THE CELLS OF THE LIST PROCESSING STORAGE
RESFAB	CONTROLS TOTAL OF RESOLVERS REQUIRED
RESTA	SUPPLIES AND WRITES REFERENCE AND GROUND IN PANEL CONNECTIONS LIS T
RES1	IMPOSE FOR RESOLVERS
RES2	IMPOSE FOR RESOLVERS
RETI	CHOOSES AMPLIFIER TO BE USED AS AUXILIARY NETWORK
RETURN	RETURNS TO A FIXED ADDRESS IN MAIN PROGRAM IN CASE OF ERROR
RFC	GROUPS COMMON FACTORS IN EQUATIONS REDUCED TO THE STANDARD FORM
RICALT	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONTA M
RICALW	FINDS WHETHER ENTRY TO ELEMENT COMES FROM MAIN ELEMENT OR ITS INV ERTOR AND INCREASES TOTAL OF OUTPUTS FOR MAIN ELEMENT OR INVERTOR

RICHEL	ADDING ROUTINE . SERVICE ROUTINE
RICHIN	ADDING ROUTINE . SERVICE ROUTINE
RIPINT	ATTRIBUTES THE INTEGRATORS BY PARTITION
RISY	OBTAINS THE RIF-TABLE CELL CORRESPONDING TO A GIVEN VARIABLE
RLA	ORDERS ANALOG ELEMENT TABLE VETT
RNEL	FINDS TYPE OF ANALOG ELEMENT IN TABLE VETT
RNLST	FINDS LIST HEADER FOR TABLE VETT
RRH	OBTAINS THE ADDRESS OF THE ROW OR COLUMN HEAD IN A TWO DIMENSIONA L LIST
RSH	SHIFT SERVICE ROUTINE
RST1	CONNECTS CELLS OF LIST PROCESSING STORAGE WHEN SUBLISTS ARE NOT P RESENT . USED FOR TABLE VETT
RSYMB	SEARCHES INFORMATION RELATIVE TO A GIVEN VARIABLE IN SYMBOL TABLE
RUTLET	READING ROUTINE FOR INTERMEDIATE TAPES . USED BY LINKS 36 361 361 3 362
RUTWR	WRITING ROUTINE FOR INTERMEDIATE TAPES . USED BY LINKS 36 361 361 3 362
SATAM	SUPPLIES SATANAS COORDINATES OF FIXED CONNECTIONS FOR AMPLIFIERS INCLUDING CAPACITIES
SATAX	SUPPLIES FIXED CONNECTIONS AND CAPACITIES FOR AMPLIFIERS IN PANEL CONNECTIONS LIST
SBST	SUBSTITUTES THE CURRENT VALUE FOR A SIGMA OR PI RECURRENCE PARAME TER
SCARTO	CONTROLS VALUE OF COEFFICIENTS

SCST	LOADS SWITCH AND COMPARATOR INFORMATION FOR TABLE VETT
SEARCH	IDENTIFIES AND GIVES E-CODE TO A GIVEN SEQUENCE OF CHARACTERS
SECMEA	SUPPLIES INPUT SATANAS COORDINATES FOR TERMS ON RIGHT HAND SIDE O F LINEAR EQUATION
SECMEX	SUPPLIES INPUT CONNECTIONS FOR TERMS ON RHS OF LINEAR EQUATIONS F OR PANEL CONNECTIONS LIST
SETIC	PLACES THE COMPUTED IC IN SYMBOL TABLE
SETTAP	ALLOCATES TAPES
SHL	SHIFT SERVICE ROUTINE
SIGMAP	DEVELOPS SIGMA AND PI EXPRESSIONS
SIGN	DETERMINES THE SIGNS OF ALL VARIABLES APPEARING IN LINEAR EQUATIO NS AND DECIDES WHICH NEED AN INVERTOR
SIMIN	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONMO L AND CONSM
SIPLUS	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONMO L AND CONSM
SKIP	TAPE SKIPPING ROUTINE FOR EDITOR
SLIST	DEFINES A LIST AS A SUBLIST OF AN ELEMENT WHICH IS ALREADY A SUBL IST HEAD
SLIST1	DEFINES A LIST AS A SUBLIST OF AN ELEMENT WHICH IS NOT A SUBLIST HEAD
SLTRA	SUB LIST HEAD TEST
SMFAB	PRELIMINARY STAGE OF CONSTRUCTION OF TABLE TSM FOR SERVO MULTIPLI ERS
SMOUT	TRANSFERS INFORMATION IN TABLE TSM FOR SERVO MULTIPLIERS

SMPVOC	COMPLETION OF CONSTRUCTION OF TABLE TSM FOR SERVO MULTIPLIERS
SMVAR	SYMBOL TABLE LOOKUP FOR VARIABLES AFFECTED BY IMPOSE OF A TYPE OF MULTIPLIER
SM1R	IMPOSE FOR SERVO MULTIPLIERS
SM2R	IMPOSE FOR SERVO MULTIPLIERS
SM3R	ATTRIBUTES SERVO MULTIPLIERS
SNEXT	SEE DNEXT AND DLAST . LIST PROCESSING
SORT	SYMBOL TABLE SORT
SPCH	USED BY SUBROUTINE SYMBOL TO DETECT SPECIAL CHARACTERS
SPLIT	RECORD SPLITTING ROUTINE
STABLE	FINDS GP-CODE IN SYMBOL TABLE FOR VARIABLES IN MULTIPLIER TABLES
STAM	WRITES A LINE IN PANEL CONNECTIONS LIST
STATN	EXTRACTS STATEMENT NUMBERS
STAVA	PREPARES NAME OF VARIABLE FOR PANEL CONNECTIONS LIST
STMV	STORES IN SYMBOL TABLE VARIABLES AFFECTED BY A TYPE OF MULTIPLIER IMPOSE
STORE	STORES PARAMETERS AND VARIABLES IN SYMBOL TABLE
STRING	TRANSFORMS A LIST INTO A SEQUENTIAL VECTOR
STRSET	SETS ADDRESSING STRATEGIES
SUMJON	SUPPLIES SATANAS COORDINATES FOR AUXILIARY NETWORKS AND RESISTANC ES
SUMJOX	SUPPLIES CONNECTIONS FOR AUXILIARY NETWORKS AND RESISTANCES FOR P ANEL CONNECTIONS LIST

SWGAIN	CONTROLS GAINS TO SWITCH CONTACTS . ENTRY TO COUNT ROUTINE FOR SW ITCHES
SWUSC	SUPPLIES SATANAS COORDINATES FOR SWITCH OUTPUTS
SWUX	SUPPLIES SWITCH OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
SYMBOL	PROCESSES PARAMETERS AND VARIABLES
SYRES	SEARCHES A VARIABLE IN SYMBOL TABLE
TAB	CONSTRUCTS SYMBOL AND SUBROUTINE CALL FOR TYPES OF ANALOG ELEMENT S TO BE USED FOR TABLE VETT
TAB2	CONSTRUCTS REFERENCE TABLE FOR ALL ANALOG ELEMENTS
TCM1	CONSTRUCTS COMPARATOR TABLE FOR COIL
TCM2	CONSTRUCTS COMPARATOR TABLE FOR CONTACTS
TDEC1	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM
TDEC2	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM
TDEC3	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM
TDEC4	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM
TDEC5	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM
TDVUSC	SUPPLIES SATANAS COORDINATES FOR ELECTRONIC MULTIPLIER OUTPUTS
TDVUX	SUPPLIES ELECTRONIC MULTIPLIERS OUTPUT CONNECTIONS FOR PANEL CONN ECTIONS LIST
TEST	BOOLEAN COMPARE . SERVICE ROUTINE
TEX	PREPARES MESSAGE FOR WRITING OF PANEL CONNECTIONS LIST
TIDEN	EXTRACTS FROM SYMBOL TABLE ALL INFORMATION RELATIVE TO PARAMETERS AND VARIABLES NECESSARY FOR OUTPUT LIST

TIEPO	CONTROLS TOTAL OF OUTPUTS FOR EACH ELEMENT AND ATTRIBUTES TIEPOIN T WHEN NECESSARY TAKING ACCOUNT OF TRUNKS . PUTS ADDRESSING INFOR MATION FOR TIEPOINTS IN SYMBOL TABLE
TIEUSC	SUPPLIES SATANAS COORDINATES OF OUTPUT AND INPUT FOR TIEPOINTS
TIEUX	SUPPLIES TIEPOINT INPUT AND OUTPUT CONNECTIONS FOR PANEL CONNECTI ONS LIST
TIMP	IMPOSE FOR ELECTRONIC MULTIPLIERS
TNEWT2	SEARCHES A VARIABLE IN SYMBOL TABLE
TRAN	CONSTRUCTS PSEUDO INSTRUCTIONS IN FAP FROM TABLE VETT
TRB	EQUATES TWO SYMBOLS . SERVICE ROUTINE
TREE	TRANSFORMS EQUATIONS INTO LOGICAL TREE FORM
TRUKIN	SUPPLIES SATANAS COORDINATES FOR CONNECTION BETWEEN MAIN ELEMENT AND/OR ITS INVERTOR AND INPUT TRUNK
TRUKIX	SUPPLIES CONNECTIONS FOR INPUT TO TRUNK FROM MAIN ELEMENT OR INVE RTOR FOR PANEL CONNECTIONS LIST
TRUTI	STORES TRUNKS FLAG IN SYMBOL TABLE
TST	TESTS IF AN OPERATOR IS PLUS OR MINUS
TSW	CONSTRUCTS TABLE FOR SWITCHES
TT1	CONSTRUCTS THE COLUMN AND ROW HEADERS OF THE SIGNS MATRIX
TYPE	GIVES NL-CODE FOR NON-LINEAR AUXILIARY VARIABLES
USCITE	SUPPLIES SATANAS COORDINATES OF OUTPUT FOR ELEMENTS NOT TIEPOINTS
USCIX	SUPPLIES OUTPUT CONNECTIONS FOR ELEMENTS NOT TIEPOINTS FOR PANEL CONNECTIONS LIST
UXDIF	GENERATES DIFFERENTIAL AUXILIARY EQUATIONS

VADD	DETERMINES THE ADDRESS OF THE IC OF A VARIABLE
VAR	EXTRACTS FROM SYMBOL TABLE THE IC AND SCALE FACTOR OF A VARIABLE
VARN	ASSOCIATES A NUMBER WITH EACH VARIABLE IN THE SYMBOL TABLE
VCOM	DETERMINES IF THE VARIABLE ENTERING A COMPARATOR COIL NEEDS AN IN VERTOR
VECT	PREPARES VECTORS FOR EACH TYPE OF ANALOG ELEMENT FOR TABLE VETT
VEREB	FINDS THE INVERTOR ASSIGNED TO A GIVEN VARIABLE
VERNA	DETERMINES THE AVAILABLE INVERTOR NEAREST TO A GIVEN ELEMENT
VFL	EXTRACTS VECTOR FROM LISTS FOR TABLE VETT
VHAM	COORDINATES THE ROUTINES VHAMM AND VHAMD FOR HIGH ACCURACY MULTIP LIERS
VHAMD	DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF HIGH ACCURA CY MULTIPLIERS USED FOR DIVISION
VHAMM	DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF HIGH ACCURA CY MULTIPLIERS USED FOR MULTIPLICATION
VLIN	ATTACHES TO EACH VARIABLE THE SIGN WITH WHICH IT OUTPUTS FROM ITS MAIN ELEMENT
VLV	STORES THE ERROR LEVEL
VOC1	EXTRACTS THE CONTENTS OF IC , MAX VALUE OR SCALE FACTOR CELLS FRO M SYMBOL TABLE
VPX	STORES IN SYMBOL TABLE THE VALUE OF PARAMETRIC EXPRESSIONS
VQSQ	DETERMINE THE SIGN OF INPUT AND OUTPUT VARIABLES OF QUARTER SQUAR E MULTIPLIERS
VRPLOT	PROCESSES VARIPLOTTER STATEMENTS

VSM	COORDINATES THE ROUTINES VSMN AND VSMS . DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF SERVO MULTIPLIERS USED IN DIVISION
VSMN	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF NORMAL SERVO MULTIPLIERS
VSMS	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF PLUS OR MINU S SERVO MULTIPLIERS
VTDV	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF ELECTRONIC M ULTIPLIERS
VVV	GENERATES INFORMATION FOR CROSS-REFERENCES FOR OUTPUT LIST
WFORM	USED BY ROUTINE WWF IN CONSTRUCTION OF SIGNS MATRIX
WLPD	LIST PROCESSING ERROR ROUTINE
WMNS	MESSAGE WRITING ROUTINE
WRITE	TAPE WRITING ROUTINE FOR EDITOR
WRNV	APACHE SYSTEM TEST
WRQIN	WRITES INVERTOR EQUATIONS
WRTST	APACHE SYSTEM TEST
WWF	CONSTRUCTS AN ELEMENT OF THE SIGNS MATRIX
XCMAT	PUTS COMPARATOR EQUATIONS INTO SIGNS MATRIX
XCRIC	SUPPLIES COIL AND INPUT SATANAS COORDINATES FOR COMPARATORS
XCRIX	SUPPLIES COMPARATOR COIL AND INPUT CONNECTIONS FOR PANEL CONNECTI ONS LIST
XENTRY	REDUCES ENTRIES OF AMPLIFIERS TO COMPONENT POTS AND GAINS . ASSIG NS AUXILIARY NETWORKS , ENTRY RESISTANCES
XGAINS	CONTROLS AND MODIFIES GAINS TO AMPLIFIERS , ASSIGNS DIFFERENT VALUES OF CAPACITIES

XNSA	CONSTRUCTS STATEMENT NUMBERS
XOCEL	SUPPLIES SATANAS COORDINATES FOR RESOLVER OUTPUTS
XOCEX	SUPPLIES RESOLVER OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
XREWIN	READ WRITE ROUTINE USING BUFFERS
XSMAT	PUTS SWITCH EQUATIONS INTO SIGNS MATRIX
XSRIC	SUPPLIES SATANAS COORDINATES FOR INPUTS TO RECORDERS AND VARIPLOT TERS
XSRIX	SUPPLIES RECORDER AND VARIPLOTTER INPUT CONNECTIONS FOR PANEL CON NECTIONS LIST
XYZR	OBTAINS INFORMATION ABOUT A GIVEN VARIABLE . SERVICE ROUTINE
YAMP2	ATTRIBUTES AMPLIFIERS TO RIGHT HAND SIDE OF EQUATION
YCOMP	ATTRIBUTES COMPARATORS
YCRIC	SEARCHES IN COMPARATOR TABLE
YHAM	ATTRIBUTES HIGH ACCURACY MULTIPLIERS
YITKCR	FINDS INPUT OR OUTPUT TRUNKS OF A GIVEN VARIABLE
YITKR	ON REQUEST OF AN OUTPUT TRUNK BLOCKS THE CORRESPONDING INPUT TRUN K
YKERR	ERROR SUBROUTINE FOR ADDRESSING
YOCEL	OCCUPIES AN ANALOG ELEMENT USING ROUTINE PYTAG
YPASS	ACCUMULATES TYPES OF ELEMENTS TO BE ATTRIBUTED IN EACH ADDRESSING PASS
YPR	ATTRIBUTES POTS AND NETWORKS FOR RIGHT HAND SIDE VARIABLES
YQS2	ATTRIBUTES QUARTER SQUARE MULTIPLIERS

YRCD	ATTRIBUTES RECORDERS
YRES	ATTRIBUTES RESOLVERS
YRPIC	ATTRIBUTES IC POT FOR RECTANGULAR RATE RESOLVERS
YRV	SEARCHES UNUSED ANALOG ELEMENT OF A GIVEN TYPE IN ANALOG ELEMENT TABLE VETT
YRW	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 341
YRW2	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 342
YRW3	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343
YRW4	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343
YSM2	ATTRIBUTES SERVO MULTIPLIERS
YSRIC	SEARCHES IN SWITCH TABLE
YSW	ATTRIBUTES SWITCHES
YSYW	STORES ADDRESSING INFORMATION IN SYMBOL TABLE
YTDM	ATTRIBUTES ELECTRONIC MULTIPLIERS
YTK2	ASSIGNS TRUNKS
YVP	ATTRIBUTES VARIPLOTTERS
YYY	LOGICAL OR OF A MASK TO A GIVEN ADDRESS . SERVICE ROUTINE
ZBETA	CALCULATES VALUE OF BETA WHEN NOT GIVEN
ZCDIV	FOR ZERO FUNCTIONS REDUCES TO 1 GAINS WITH IMPOSE GAIN1
ZCOMP	COUNTS COMPARATOR AND ASSOCIATED POTS AND INVERTORS
ZCTP	COUNTS AVAILABLE ANALOG ELEMENTS AND CONSTRUCTS TABLE TPOM

ZC1	CONTROLS COUNT OF AMPLIFIER AND ASSOCIATED ELEMENTS . CALLS ACOUNT ICOUNT RESCAP
ZC2	CONTROLS ALL COUNT ROUTINES FOR MULTIPLIERS AND RESOLVERS
ZC3	COUNTS SERVO MULTIPLIERS AND ASSOCIATED INVERTORS
ZC5	COUNTS SIGN INVERTORS FOR OUTPUTS OF MULTIPLIERS
ZC7	GIVES NUMBER OF NEXT POSSIBLE CONSOLE FOR COUNT
ZEM3	COUNTS ELECTRONIC MULTIPLIERS AND ASSOCIATED INVERTORS
ZEXTR	COUNTS MULTIPLIERS WITH EXTERNAL VARIABLE ON ARM
ZHAM3	CONTROLS COUNT ROUTINES FOR HIGH ACCURACY MULTIPLIERS
ZHMD	COUNTS HIGH ACCURACY MULTIPLIERS USED FOR MULTIPLICATION OR DIVISION . CONSTRUCTS TABLE THAM
ZHQD	UNUSED ROUTINE FOR HIGH ACCURACY MULTIPLIERS
ZHRT	UNUSED ROUTINE FOR HIGH ACCURACY MULTIPLIERS
ZQINV	GENERATES INVERTOR EQUATIONS
ZQS3	COUNTS QUARTER SQUARE MULTIPLIERS WITH ASSOCIATED AMPLIFIER AND INVERTORS AND CONSTRUCTS TABLE TSM FOR QUARTER SQUARES
ZREC	APACHE SYSTEM TEST
ZRES	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF RESOLVERS
ZSC	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR RESOLVERS
ZSCX	SUPPLIES RESOLVER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST
ZSW	COUNTS SWITCH AND ASSOCIATED POTS
ZSW5	COUNTS INVERTORS ASSOCIATED WITH SWITCHES

ZYF1	ATTRIBUTES DFG
ZYF2	ATTRIBUTES DFG
ZZCW	COMPLETES EB-RECORDS
ZZDFG	COUNTS DFG AND ASSOCIATED INVERTORS
ZZPN	SYSTEM ERROR DIAGNOSTIC ROUTINE FOR LINKS 36 AND 361
ZZRECO	COUNTS RECORDER CHANNELS
ZZRES	COUNTS RESOLVERS AND ASSOCIATED INVERTORS AND POTS
ZZVP	COUNTS VARIPLOTTERS
ZZZLST	PUNCHES SATANAS CARDS
ZZZPX	SYSTEM ERROR DIAGNOSTIC ROUTINE FOR LINK 3613
ZZZZ	COMPLETES EB-RECORDS
ZZZZZE	CONSOLE FULL DIAGNOSTIC ROUTINE USED IN LINKS 36 361 3613

3.2 Summarised descriptions of routines

KWIC index by significant word

WORDS INDEXED

ALGEBRAIC DEVELOPMENT
ALGEBRAIC EQUATION
ALGEBRAIC EQUATIONS
AMPLIFIER
AMPLIFIERS
ANALOG ELEMENT
ANALOG ELEMENTS
ARITHMETIC EXPRESSION
ARITHMETIC EXPRESSIONS
ATTRIBUTED
ATTRIBUTES
ATTRIBUTION
AUXILIARY ELEMENT
AUXILIARY ELEMENTS
AUXILIARY EQUATION
AUXILIARY EQUATIONS
AUXILIARY NETWORK
AUXILIARY NETWORKS
AUXILIARY VARIABLE
AUXILIARY VARIABLES
BASIC COORDINATES
BETA
CAPACITIES
CAPACITY
CARDS
CHAIN TABLE
COMPARATOR
COMPARATORS
CONSOLE
CONSOLES
CONVERSION
CONVERTS
COUNT
COUNTS
CROSS-REFERENCES
DFG
DO
DUMMY
E-CODE
EB-RECORD
EDITOR
ELECTRONIC
EQM-RECORD
ERROR
ERRORS
GAIN
GAINS
GAIN1
GP-CODE
GROUND
HIGH ACCURACY
IC
ID-CODE
IMPOSE
INTEGRATOR
INTEGRATORS
INVERTOR
INVERTORS
KTYPE-CODE
LEVEL ZERO
LINEAR
LIST
LISTS
LOGICAL TREE
M-CODE
MAIN ELEMENT
MAIN ELEMENTS
MAX VALUE
MEAN VALUE
MEAN VALUES
NETWORK
NL CODE
NL-CODE
NON-LINEAR
OMIT
ON-LINE
OPERATOR
OPTION

OUTPUT LIST
OUTPUT-LIST
PANEL CONNECTIONS
PARAMETRIC EXPRESSION
PARAMETRIC EXPRESSIONS
PARTITION
PATCH PANEL
PATCH PANELS
PERTURBED VARIABLE
PERTURBED VARIABLES
PI
POT SETTING
POTS
PRINT
PRINTING
PRINTS
QUARTER SQUARE
READING
READ OUT
READS
RECORD
RECORDER
RECORDERS
REFERENCE
REFERENCES
RESISTANCE
RESISTANCES
RESOLVER
RESOLVERS
RIF-TABLE
SATANAS
SATANAS COORDINATES
SCALE FACTOR
SCALE FACTORS
SCALING FACTOR
SCALING FACTORS
SERVICE ROUTINE
SERVO
SIGMA
SIGN
SIGNS
SIGNS MATRIX
SIMULATOR
SORT
SPECIAL CHARACTERS
STANDARD FORM
STATEMENT NUMBER
STATEMENT NUMBERS
STATEMENT
STATEMENTS
STRATEGIES
SUMMER
SUMMERS
SWITCH
SWITCHES
SYMBOL TABLE
SYSTEM
TAPE
TAPES
TIEPOINT
TIEPOINTS
TOTAL OF OUTPUTS
TPOM
TRUNK
TRUNKS
VALUE OF COEFFICIENTS
VALUES OF COFFICIENTS
VARIPLOTTER
VARIPLOTTERS
VETT
W-RECORDS
WRITES
WRITING

ALGEBRAIC DEVELOPMENT	PERFORMS THE ALGEBRAIC DEVELOPMENT OF THE MULTIPLICATION OR THE DIVISION OF TWO EXPRESSIONS	FMPY
ALGEBRAIC EQUATIONS	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS	LZP2
ALGEBRAIC EQUATIONS	PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS	LZP
AMPLIFIER	SUPPLIES SATANAS COORDINATES FOR AMPLIFIER OUTPUTS	AMPUSC
AMPLIFIER	LOADS AMPLIFIER INFORMATION FOR TABLE VETT	AST
AMPLIFIER	IDENTIFIES WHETHER AMPLIFIER IS SUMMER OR INTEGRATOR	NUAMP
AMPLIFIER	CHOOSES AMPLIFIER TO BE USED AS AUXILIARY NETWORK	RETI
AMPLIFIER	CONTROLS COUNT OF AMPLIFIER AND ASSOCIATED ELEMENTS . CALLS ACOUNT ICOUNT RESCAP	ZC1
AMPLIFIER	COUNTS QUARTER SQUARE MULTIPLIERS WITH ASSOCIATED AMPLIFIER AND INVERTORS AND CONSTRUCTS TABLE TSM FOR QUARTER SQUARES	ZQS3
AMPLIFIERS	COUNTS AMPLIFIERS WITH ASSOCIATED POTS AND AUXILIARY NETWORKS	ACOUNT
AMPLIFIERS	IMPOSE FOR AMPLIFIERS	AIMP
AMPLIFIERS	FORCED ATTRIBUTION OF AMPLIFIERS TO LEFT HAND SIDE VARIABLE	ATERM1
AMPLIFIERS	OMIT FOR AMPLIFIERS	OMITA
AMPLIFIERS	SUPPLIES SATANAS COORDINATES OF FIXED CONNECTIONS FOR AMPLIFIERS INCLUDING CAPACITIES	SATAM
AMPLIFIERS	SUPPLIES FIXED CONNECTIONS AND CAPACITIES FOR AMPLIFIERS IN PANEL CONNECTIONS LIST	SATAX
AMPLIFIERS	ATTRIBUTES AMPLIFIERS TO RIGHT HAND SIDE OF EQUATION	YAMP2
AMPLIFIERS	REDUCES ENTRIES OF AMPLIFIERS TO COMPONENT POTS AND GAINS . ASSIGNS AUXILIARY NETWORKS , ENTRY RESISTANCES	XENTRY
AMPLIFIERS	CONTROLS AND MODIFIES GAINS TO AMPLIFIERS , ASSIGNS DIFFERENT VALUES OF CAPACITIES	XGAINS
ANALOG ELEMENT	SUPPLIES BASIC COORDINATES FOR EACH ANALOG ELEMENT	BASCO
ANALOG ELEMENT	CONVERTS ANALOG ELEMENT CODES FROM ANALOG TO APACHE NAME	CANAP
ANALOG ELEMENT	SUPPLIES BASIC COORDINATES FOR EACH ANALOG ELEMENT	COOR
ANALOG ELEMENT	ORDERS ANALOG ELEMENT TABLE VETT	CORD1
ANALOG ELEMENT	FINDS ANALOG ELEMENT IN ANALOG ELEMENT TABLE VETT	EONA
ANALOG ELEMENT	FINDS ON PATCH PANEL UNUSED ANALOG ELEMENT NEAREST TO A GIVEN ELEMENT	PYTAG
ANALOG ELEMENT	ORDERS ANALOG ELEMENT TABLE VETT	RLA

ANALOG ELEMENT	FINDS TYPE OF ANALOG ELEMENT IN TABLE VETT	RNEL
ANALOG ELEMENT	PREPARES VECTORS FOR EACH TYPE OF ANALOG ELEMENT FOR TABLE VETT	VECT
ANALOG ELEMENT	OCCUPIES AN ANALOG ELEMENT USING ROUTINE PYTAG	YOCEL
ANALOG ELEMENT	SEARCHES UNUSED ANALOG ELEMENT OF A GIVEN TYPE IN ANALOG ELEMENT TABLE VETT	YRV
ANALOG ELEMENTS	CONVERTS ANALOG ELEMENTS CODES FROM APACHE TO ANALOG NAME	CANAP2
ANALOG ELEMENTS	LOADS INFORMATION COMMON TO ALL ANALOG ELEMENTS FOR TABLE VETT	COMMN
ANALOG ELEMENTS	ORDERS VECTORS OF ANALOG ELEMENTS FOR TABLE VETT	CORVE
ANALOG ELEMENTS	ORDERS VECTORS OF ANALOG ELEMENTS FOR TABLE VETT	ORV
ANALOG ELEMENTS	CONSTRUCTS SYMBOL AND SUBROUTINE CALL FOR TYPES OF ANALOG ELEMENTS TO BE USED FOR TABLE VETT	TAB
ANALOG ELEMENTS	CONSTRUCTS REFERENCE TABLE FOR ALL ANALOG ELEMENTS	TAB2
ANALOG ELEMENTS	COUNTS AVAILABLE ANALOG ELEMENTS AND CONSTRUCTS TABLE TPOM	ZCTP
ARITHMETIC EXPRESSIONS	COMPILES ARITHMETIC EXPRESSIONS . GENERATES A 7090 PROGRAM EQUIVALENT TO A GIVEN EXPRESSION SUPPLEMENTARY ENTRIES ARE SUPPLIED TO SELECT ONE OF THE VARIOUS ROUTINES WHICH LOCATE THE OPERANDS OF THE EXPRESSION	ATRAN
ATTRIBUTED	ACCUMULATES TYPES OF ELEMENTS TO BE ATTRIBUTED IN EACH ADDRESSING PASS	YPASS
ATTRIBUTES	ATTRIBUTES AUXILIARY ELEMENTS TO LEFT HAND SIDE VARIABLE	ACOMPL
ATTRIBUTES	ATTRIBUTES THE INTEGRATORS BY PARTITION	RIPINT
ATTRIBUTES	ATTRIBUTES SERVO MULTIPLIERS	SM3R
ATTRIBUTES	CONTROLS TOTAL OF OUTPUTS FOR EACH ELEMENT AND ATTRIBUTES TIEPOINT WHEN NECESSARY TAKING ACCOUNT OF TRUNKS . PUTS ADDRESSING INFORMATION FOR TIEPOINTS IN SYMBOL TABLE	TIEPO
ATTRIBUTES	ATTRIBUTES HIGH ACCURACY MULTIPLIERS	YHAM
ATTRIBUTES	ATTRIBUTES POTS AND NETWORKS FOR RIGHT HAND SIDE VARIABLES	YPR
ATTRIBUTES	ATTRIBUTES RECORDERS	YRCD
ATTRIBUTES	ATTRIBUTES QUARTER SQUARE MULTIPLIERS	YQS2
ATTRIBUTES	ATTRIBUTES AMPLIFIERS TO RIGHT HAND SIDE OF EQUATION	YAMP2
ATTRIBUTES	ATTRIBUTES IC POT FOR RECTANGULAR RATE RESOLVERS	YRPIC
ATTRIBUTES	ATTRIBUTES COMPARATORS	YCOMP
ATTRIBUTES	ATTRIBUTES SWITCHES	YSW
ATTRIBUTES	ATTRIBUTES VARIPLOTTERS	YVP

ATTRIBUTES	ATTRIBUTES ELECTRONIC MULTIPLIERS	YTDM
ATTRIBUTES	ATTRIBUTES RESOLVERS	YRES
ATTRIBUTES	ATTRIBUTES SERVO MULTIPLIERS	YSM2
ATTRIBUTES	ATTRIBUTES DFG	ZYF1
ATTRIBUTES	ATTRIBUTES DFG	ZYF2
ATTRIBUTION	FORCED ATTRIBUTION OF AMPLIFIERS TO LEFT HAND SIDE VARIABLE	ATERM1
AUXILIARY ELEMENTS	ATTRIBUTES AUXILIARY ELEMENTS TO LEFT HAND SIDE VARIABLE	ACOMPL
AUXILIARY EQUATIONS	GENERATES NON-LINEAR AUXILIARY EQUATIONS	AGENT
AUXILIARY EQUATIONS	SUPPLIES EQM-RECORD FOR NON-LINEAR AUXILIARY EQUATIONS	AUXREC
AUXILIARY EQUATIONS	GENERATES DIFFERENTIAL AUXILIARY EQUATIONS	UXDIF
AUXILIARY NETWORK	CHOOSES AMPLIFIER TO BE USED AS AUXILIARY NETWORK	RETI
AUXILIARY NETWORKS	COUNTS AMPLIFIERS WITH ASSOCIATED POTS AND AUXILIARY NETWORKS	ACOUNT
AUXILIARY NETWORKS	SUPPLIES SATANAS COORDINATES FOR AUXILIARY NETWORKS AND RESISTANCES	SUMJON
AUXILIARY NETWORKS	SUPPLIES CONNECTIONS FOR AUXILIARY NETWORKS AND RESISTANCES FOR PANEL CONNECTIONS LIST	SUMJOX
AUXILIARY NETWORKS	REDUCES ENTRIES OF AMPLIFIERS TO COMPONENT POTS AND GAINS . ASSIGNS AUXILIARY NETWORKS , ENTRY RESISTANCES	XENTRY
AUXILIARY VARIABLE	RECOGNISES IF A VARIABLE IS AN AUXILIARY VARIABLE	AUXT
AUXILIARY VARIABLES	GIVES GP-CODE FOR NON-LINEAR AUXILIARY VARIABLES	FLAG
AUXILIARY VARIABLES	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS	LZP2
AUXILIARY VARIABLES	PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS	LZP
AUXILIARY VARIABLES	GIVES NL-CODE FOR NON-LINEAR AUXILIARY VARIABLES	TYPE
BASIC COORDINATES	SUPPLIES BASIC COORDINATES FOR EACH ANALOG ELEMENT	BASCO
BASIC COORDINATES	SUPPLIES BASIC COORDINATES FOR EACH ANALOG ELEMENT	COOR
BETA	CONVERTS VALUE OF BETA READ FROM RECORD INTO FLOATING POINT	BFIND
BETA	CALCULATES VALUE OF BETA WHEN NOT GIVEN	ZBETA
CAPACITIES	COUNTS CAPACITIES AND RESISTANCES	RESCAP

CAPACITIES	SUPPLIES FIXED CONNECTIONS AND CAPACITIES FOR AMPLIFIERS IN PANEL CONNECTIONS LIST	SATAX
CAPACITIES	SUPPLIES SATANAS COORDINATES OF FIXED CONNECTIONS FOR AMPLIFIERS INCLUDING CAPACITIES	SATAM
CAPACITIES	CONTROLS AND MODIFIES GAINS TO AMPLIFIERS , ASSIGNS DIFFERENT VALUES OF CAPACITIES	XGAINS
CAPACITY	LOADS RESISTANCE AND CAPACITY INFORMATION FOR TABLE VETT	GHST
CARDS	STORES SIGNALS FOR OPTION CARDS	CNTRCD
CARDS	CONVERTS CARDS IMAGES TO A BCD RECORD	CNVRT
CARDS	GENERATES POT SETTING , READ OUT , NETWORK CARDS	CSEL
CARDS	ERROR IN COD1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRAD1
CARDS	ERROR IN COD2 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRAD2
CARDS	ERROR IN COD3 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRCD1
CARDS	ERROR IN ADR1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRCD2
CARDS	WRITES ON TAPE POT SETTING , READ OUT , NETWORK CARDS	PUNCH
CARDS	PREPARES SATANAS CARDS	PUNCHC
CARDS	READS BCD CARDS FROM INPUT TAPE	READ
CARDS	PUNCHES SATANAS CARDS	ZZZLST
CHAIN TABLE	READS AND COPIES THE CHAIN TABLE IN EDITOR PHASE	COPYCT
COMPARATOR	ORDERS COMPARATOR TABLE CUBB	CMGAIN
COMPARATOR	CONTROLS GAINS TO COMPARATOR CONTACTS	COMPOT
COMPARATOR	SUPPLIES SATANAS COORDINATES FOR COMPARATOR OUTPUTS	COMUSC
COMPARATOR	SUPPLIES COMPARATOR OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	COMUX
COMPARATOR	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS	CONTAM
COMPARATOR	LOADS SWITCH AND COMPARATOR INFORMATION FOR TABLE VETT	SCST
COMPARATOR	CONSTRUCTS COMPARATOR TABLE FOR CONTACTS	TCM2
COMPARATOR	CONSTRUCTS COMPARATOR TABLE FOR COIL	TCM1
COMPARATOR	DETERMINES IF THE VARIABLE ENTERING A COMPARATOR COIL NEEDS AN INVERTOR	VCOM
COMPARATOR	PUTS COMPARATOR EQUATIONS INTO SIGNS MATRIX	XCMAT

COMPARATOR	SUPPLIES COMPARATOR COIL AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	XCRIX
COMPARATOR	SEARCHES IN COMPARATOR TABLE	YCRIC
COMPARATOR	COUNTS COMPARATOR AND ASSOCIATED POTS AND INVERTORS	ZCOMP
COMPARATORS	IMPOSE FOR COMPARATORS	CIMP
COMPARATORS	MAKES HIGHEST GAIN TO COIL = 1 AND COMPENSATES FOR ANY DIFFERENCE IN THE SCALING FACTORS OF THE ENTRIES TO COMPARATORS	CMCOIL
COMPARATORS	SPLITS EQUATIONS OF COMPARATORS OR SWITCHES INTO SEVERAL EQUATIONS CORRESPONDING EACH TO A CONTACT	CMSW
COMPARATORS	GIVES KTYPE-CODE TO DFG , SWITCHES , COMPARATORS , RESOLVERS	ISPEQ
COMPARATORS	SUPPLIES COIL AND INPUT SATANAS COORDINATES FOR COMPARATORS	XCRIC
COMPARATORS	ATTRIBUTES COMPARATORS	YCOMP
CONSOLE	STORES THE CONSOLE NUMBERS GIVEN IN THE AVAILABLE CONSOLES STATEMENT	AVC
CONSOLE	TESTS IF A VARIABLE IS OUTPUT ON A GIVEN CONSOLE	MELEM
CONSOLE	CALCULATES TOTAL OF OUTPUTS REQUIRED FROM A MAIN ELEMENT OR ITS INVERTOR ON ANY CONSOLE	PRIGO
CONSOLE	GIVES NUMBER OF NEXT POSSIBLE CONSOLE FOR COUNT	ZC7
CONSOLE	CONSOLE FULL DIAGNOSTIC ROUTINE USED IN LINKS 36 361 3613	ZZZZZE
CONVERSION	CONVERSION OF INTERNAL CODES	CVRT
CONVERTS	CONVERTS FLOATING POINT BINARY NUMBER INTO BCD INTEGER OR FLOATING	BDC
CONVERTS	CONVERTS VALUE OF BETA READ FROM RECORD INTO FLOATING POINT	BFIND
CONVERTS	CONVERTS ANALOG ELEMENT CODES FROM ANALOG TO APACHE NAME	CANAP
CONVERTS	CONVERTS ANALOG ELEMENTS CODES FROM APACHE TO ANALOG NAME	CANAP2
CONVERTS	CONVERTS CARDS IMAGES TO A BCD RECORD	CNVRT
CONVERTS	CONVERTS BCD NUMBERS INTO FLOATING POINT NUMBERS	DBCV
CONVERTS	CONVERTS FLOATING POINT BINARY NUMBERS INTO FLOATING POINT BCD	FTDC
CONVERTS	CONVERTS FLOATING POINT BINARY NUMBERS INTO BCD INTEGERS	FTDIC
CONVERTS	EXTRACTS THE NAME OF A PARAMETER OR VARIABLE FROM THE SYMBOL TABLE . CONVERTS ALL FLOATING POINT BINARY NUMBERS WHICH APPEAR INTO BCD NUMBERS	NAME
COUNT	CONTROLS GAINS TO SWITCH CONTACTS . ENTRY TO COUNT ROUTINE FOR SWITCHES	SWGAIN
COUNT	CONTROLS COUNT OF AMPLIFIER AND ASSOCIATED ELEMENTS . CALLS ACOUNT ICOUNT RESCAP	ZC1

COUNT	CONTROLS COUNT ROUTINES FOR HIGH ACCURACY MULTIPLIERS	ZHAM3
COUNT	CONTROLS ALL COUNT ROUTINES FOR MULTIPLIERS AND RESOLVERS	ZC2
COUNT	GIVES NUMBER OF NEXT POSSIBLE CONSOLE FOR COUNT	ZC7
COUNTS	COUNTS AMPLIFIERS WITH ASSOCIATED POTS AND AUXILIARY NETWORKS	ACOUNT
COUNTS	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO QUARTER SQUARE HIGH ACCURACY OR ELECTRONIC MULTIPLIERS OR RESOLVERS	CONMOP
COUNTS	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO SERVO MULTIPLIERS	CONSP
COUNTS	COUNTS THE NUMBER OF TRUNKS NECESSARY FOR A MAIN ELEMENT AND ITS INVERTOR . STORES THE TOTAL IN SYMBOL TABLE	FPG
COUNTS	COUNTS TOTAL OF HIGH ACCURACY MULTIPLIERS REQUIRED	HMFAB2
COUNTS	COUNTS INVERTORS	ICOUNT
COUNTS	COUNTS CAPACITIES AND RESISTANCES	RESCAP
COUNTS	COUNTS SERVO MULTIPLIERS AND ASSOCIATED INVERTORS	ZC3
COUNTS	COUNTS HIGH ACCURACY MULTIPLIERS USED FOR MULTIPLICATION OR DIVISION . CONSTRUCTS TABLE THAM	ZHMD
COUNTS	COUNTS QUARTER SQUARE MULTIPLIERS WITH ASSOCIATED AMPLIFIER AND INVERTORS AND CONSTRUCTS TABLE TSM FOR QUARTER SQUARES	ZQS3
COUNTS	COUNTS COMPARATOR AND ASSOCIATED POTS AND INVERTORS	ZCOMP
COUNTS	COUNTS AVAILABLE ANALOG ELEMENTS AND CONSTRUCTS TABLE TPOM	ZCTP
COUNTS	COUNTS SIGN INVERTORS FOR OUTPUTS OF MULTIPLIERS	ZC5
COUNTS	COUNTS ELECTRONIC MULTIPLIERS AND ASSOCIATED INVERTORS	ZEM3
COUNTS	COUNTS MULTIPLIERS WITH EXTERNAL VARIABLE ON ARM	ZEXTR
COUNTS	COUNTS RESOLVERS AND ASSOCIATED INVERTORS AND POTS	ZZRES
COUNTS	COUNTS INVERTORS ASSOCIATED WITH SWITCHES	ZSW5
COUNTS	COUNTS SWITCH AND ASSOCIATED POTS	ZSW
COUNTS	COUNTS DFG AND ASSOCIATED INVERTORS	ZZDFG
COUNTS	COUNTS RECORDER CHANNELS	ZZRECO
COUNTS	COUNTS VARIPLOTTERS	ZZVP
CROSS-REFERENCES	GENERATES INFORMATION FOR CROSS-REFERENCES FOR OUTPUT LIST	VVV
DFG	FINDS AND OCCUPIES INVERTOR OF DFG 10 SEGMENTS	AMRIC

DFG	DFG STATEMENT PROCESSOR	DFG
DFG	SUPPLIES SATANAS COORDINATES FOR DFG OUTPUTS	DFGUSC
DFG	SUPPLIES DFG OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	DFGUX
DFG	SUPPLIES DFG FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTDFX
DFG	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR DFG	ENTDFG
DFG	IMPOSE FOR DFG	FIMP
DFG	LOADS DFG INFORMATION FOR TABLE VETT	FST
DFG	GIVES KTYPE-CODE TO DFG , SWITCHES , COMPARATORS , RESOLVERS	ISPEQ
DFG	ATTRIBUTES DFG	ZYF1
DFG	COUNTS DFG AND ASSOCIATED INVERTORS	ZZDFG
DFG	ATTRIBUTES DFG	ZYF2
DO	SUBSTITUTES THE CURRENT VALUE OF THE RECURSIVITY PARAMETER IN A STATEMENT SUBJECT TO A DO LOOP	COMPDO
DO	DO STATEMENT PROCESSOR	DAN
DO	COMPUTES THE VALUES OF THE DO PARAMETERS , INITIAL VALUE , MAXIMUM VALUE , AND STEP . USED FOR DO LOOPS IN EQUATIONS	PARAD
DO	COMPUTES THE VALUES OF THE DO PARAMETERS , INITIAL VALUE , MAXIMUM VALUE , AND STEP . USED FOR DO LOOPS IN PARAMETER OR VARIABLE DEFINITIONS	PARAD1
DUMMY	DUMMY ROUTINE	ACCUNT
DUMMY	DUMMY ROUTINE USED IN SIMULATOR	DAUX
DUMMY	DUMMY ROUTINE	NEBB
DUMMY	DUMMY SUBROUTINE FOR SIMULATOR	PRINTT
E-CODE	IDENTIFIES AND GIVES E-CODE TO EACH OPERAND AND OPERATOR OF EQUATIONS . RECOGNISES AND COMPUTES VALUES OF PARAMETRIC EXPRESSIONS . BUILDS W-RECORDS	IDNTFY
E-CODE	IDENTIFIES AND GIVES E-CODE TO A GIVEN SEQUENCE OF CHARACTERS	SEARCH
EB-RECORD	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR MULTIPLIERS NOT SERVO MULTIPLIERS	CONMOL
EB-RECORD	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR SERVO MULTIPLIERS	CONSM
EB-RECORD	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS	CONTAM
EDITOR	TAPE COPYING ROUTINE USED IN EDITOR	COPY

EDITOR	READS AND COPIES THE CHAIN TABLE IN EDITOR PHASE	COPYCT
EDITOR	PRINTS ON-LINE END OF EDITOR MESSAGES	ENDMS
EDITOR	PRINTS ON-LINE END OF EDITOR MESSAGES	ENDMS3
EDITOR	TAPE READING ROUTINE FOR EDITOR	EREAD
EDITOR	SEARCHES ENTRY PSEUDO-OPERATION IN FAP PROGRAMS FOR EDITOR	ESR
EDITOR	PRINTS ON-LINE ERROR MESSAGES AND RESTART PROCEDURES FOR EDITOR	PREMG
EDITOR	PRINTS ON-LINE IO-MESSAGES AND RESTART PROCEDURES FOR EDITOR	PRIOEM
EDITOR	TAPE SKIPPING ROUTINE FOR EDITOR	SKIP
EDITOR	TAPE WRITING ROUTINE FOR EDITOR	WRITE
ELECTRONIC	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO QUARTER SQUARE HIGH ACCURACY OR ELECTRONIC MULTIPLIERS OR RESOLVERS	CONMOP
ELECTRONIC	CONSTRUCTS TABLE TTD FOR ELECTRONIC MULTIPLIERS	EMFAB
ELECTRONIC	SUPPLIES ELECTRONIC MULTIPLIERS FIXED AND INPUT CONNECTIONS FOR PANNEL CONNECTIONS LIST	ENTTDX
ELECTRONIC	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR ELECTRONIC MULTIPLIERS	ENTTDV
ELECTRONIC	LOADS ELECTRONIC MULTIPLIER INFORMATION FOR TABLE VETT	EST
ELECTRONIC	SUPPLIES SATANAS COORDINATES FOR ELECTRONIC MULTIPLIER OUTPUTS	TDVUSC
ELECTRONIC	SUPPLIES ELECTRONIC MULTIPLIERS OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	TDVUX
ELECTRONIC	IMPOSE FOR ELECTRONIC MULTIPLIERS	TIMP
ELECTRONIC	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF ELECTRONIC MULTIPLIERS	VTDV
ELECTRONIC	ATTRIBUTES ELECTRONIC MULTIPLIERS	YTDM
ELECTRONIC	COUNTS ELECTRONIC MULTIPLIERS AND ASSOCIATED INVERTORS	ZEM3
EQM-RECORD	SUPPLIES EQM-RECORD FOR NON-LINEAR AUXILIARY EQUATIONS	AUXREC
ERROR	ERROR ROUTINE FOR OMIT	EONERR
ERROR	ERROR SIGNAL FOR ROUTINE RST1	ERR
ERROR	ERROR SIGNAL FOR ROUTINE BLD1	ERR2
ERROR	ERROR IN COD1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRAD1
ERROR	ERROR IN COD2 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRAD2

ERROR	ERROR IN COD3 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRCD1
ERROR	ERROR IN ADR1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRCD2
ERROR	ERROR SIGNAL FOR ROUTINE PYTAG	ERRIT
ERROR	ERROR ROUTINE FOR OMIT	ERRNUS
ERROR	SYSTEM ERROR DIAGNOSTIC ROUTINE	PINTA
ERROR	PRINTS ON-LINE ERROR MESSAGES AND RESTART PROCEDURES FOR EDITOR	PREMG
ERROR	RETURNS TO A FIXED ADDRESS IN MAIN PROGRAM IN CASE OF ERROR	RETURN
ERROR	STORES THE ERROR LEVEL	VLV
ERROR	LIST PROCESSING ERROR ROUTINE	WLPD
ERROR	ERR SUBROUTINE FOR ADDRESSING	YKERR
ERROR	SYSTEM ERROR DIAGNOSTIC ROUTINE FOR LINK 3613	ZZZPX
ERROR	SYSTEM ERROR DIAGNOSTIC ROUTINE FOR LINKS 36 AND 361	ZZPN
ERRORS	DETECTS WRITING ERRORS IN PROGRAM STATEMENTS	DIAGN
GAIN	MAKES HIGHEST GAIN TO COIL = 1 AND COMPENSATES FOR ANY DIFFERENCE IN THE SCALING FACTORS OF THE ENTRIES TO COMPARATORS	CMCOIL
GAINS	CONTROLS GAINS TO COMPARATOR CONTACTS	COMPOT
GAINS	CONTROLS GAINS TO SWITCH CONTACTS . ENTRY TO COUNT ROUTINE FOR SWITCHES	SWGAIN
GAINS	CONTROLS AND MODIFIES GAINS TO AMPLIFIERS , ASSIGNS DIFFERENT VALUES OF CAPACITIES	XGAINS
GAINS	REDUCES ENTRIES OF AMPLIFIERS TO COMPONENT POTS AND GAINS . ASSIGNS AUXILIARY NETWORKS , ENTRY RESISTANCES	XENTRY
GAINS	FOR ZERO FUNCTIONS REDUCES TO 1 GAINS WITH IMPOSE GAIN1	ZCDIV
GAIN1	FOR ZERO FUNCTIONS REDUCES TO 1 GAINS WITH IMPOSE GAIN1	ZCDIV
GP-CODE	INSERTS GP-CODE IN SYMBOL TABLE	AFSIS
GP-CODE	GIVES GP-CODE FOR NON-LINEAR AUXILIARY VARIABLES	FLAG
GP-CODE	EXTRACTS GP-CODE FROM SYMBOL TABLE	LGP
GP-CODE	FINDS GP-CODE IN SYMBOL TABLE FOR VARIABLES IN MULTIPLIER TABLES	STABLE
GROUND	LOADS REFERENCE AND GROUND INFORMATION FOR TABLE VETT	KST
GROUND	SUPPLIES SATANAS COORDINATES FOR REFERENCE AND GROUND	REFSER

GROUND	SUPPLIES AND WRITES REFERENCE AND GROUND IN PANEL CONNECTIONS LIST	RESTA
HIGH ACCURACY	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO QUARTER SQUARE HIGH ACCURACY OR ELECTRONIC MULTIPLIERS OR RESOLVERS	CONMOP
HIGH ACCURACY	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR HIGH ACCURACY MULTIPLIERS	ENTHAM
HIGH ACCURACY	SUPPLIES HIGH ACCURACY MULTIPLIER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTHAX
HIGH ACCURACY	TRANSFERS INFORMATION IN TABLE THAM FOR HIGH ACCURACY MULTIPLIERS	HMOUT
HIGH ACCURACY	SORTS TABLE HUBB USED FOR HIGH ACCURACY MULTIPLIERS	HUBSOR
HIGH ACCURACY	COUNTS TOTAL OF HIGH ACCURACY MULTIPLIERS REQUIRED	HMFAB2
HIGH ACCURACY	IMPOSE FOR HIGH ACCURACY MULTIPLIERS	QIMP
HIGH ACCURACY	LOADS HIGH ACCURACY MULTIPLIER INFORMATION FOR TABLE VETT	QST
HIGH ACCURACY	DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF HIGH ACCURACY MULTIPLIERS USED FOR DIVISION	VHAMD
HIGH ACCURACY	COORDINATES THE ROUTINES VHAMM AND VHAMD FOR HIGH ACCURACY MULTIPLIERS	VHAM
HIGH ACCURACY	DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF HIGH ACCURACY MULTIPLIERS USED FOR MULTIPLICATION	VHAMM
HIGH ACCURACY	ATTRIBUTES HIGH ACCURACY MULTIPLIERS	YHAM
HIGH ACCURACY	COUNTS HIGH ACCURACY MULTIPLIERS USED FOR MULTIPLICATION OR DIVISION . CONSTRUCTS TABLE THAM	ZHMD
HIGH ACCURACY	CONTROLS COUNT ROUTINES FOR HIGH ACCURACY MULTIPLIERS	ZHAM3
HIGH ACCURACY	UNUSED ROUTINE FOR HIGH ACCURACY MULTIPLIERS	ZHQD
HIGH ACCURACY	UNUSED ROUTINE FOR HIGH ACCURACY MULTIPLIERS	ZHRT
IC	MAKES CONNECTIONS RELATIVE TO IC CIRCUIT	CONDIN
IC	SUPPLIES CONNECTIONS RELATIVE TO IC CIRCUIT FOR PANEL CONNECTIONS LIST	CONDIX
IC	REPLACES IC , MAX VALUE OR SCALE FACTOR CELL IN SYMBOL TABLE WITH NEW VALUE	LIN01
IC	PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS	LZP
IC	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS	LZP2
IC	COMPUTES IC OF VARIABLES OUTPUT FROM RESOLVERS	RESCP
IC	PLACES THE COMPUTED IC IN SYMBOL TABLE	SETIC

IC	EXTRACTS FROM SYMBOL TABLE THE IC AND SCALE FACTOR OF A VARIABLE	VAR
IC	DETERMINES THE ADDRESS OF THE IC OF A VARIABLE	VADD
IC	EXTRACTS THE CONTENTS OF IC , MAX VALUE OR SCALE FACTOR CELLS FROM SYMBOL TABLE	VOC1
IC	ATTRIBUTES IC POT FOR RECTANGULAR RATE RESOLVERS	YRPIC
IMPOSE	IMPOSE FOR AMPLIFIERS	AIMP
IMPOSE	IMPOSE FOR COMPARATORS	CIMP
IMPOSE	IMPOSE FOR DFG	FIMP
IMPOSE	PROCESSES THE IMPOSE STATEMENTS WHICH DEFINE A TYPE OF MULTIPLIER	MPLIMP
IMPOSE	IMPOSE FOR HIGH ACCURACY MULTIPLIERS	QIMP
IMPOSE	IMPOSE FOR QUARTER SQUARE MULTIPLIERS	QS1
IMPOSE	IMPOSE FOR QUARTER SQUARE MULTIPLIERS	QS2
IMPOSE	IMPOSE FOR RESOLVERS	RES1
IMPOSE	IMPOSE FOR RESOLVERS	RES2
IMPOSE	SYMBOL TABLE LOOKUP FOR VARIABLES AFFECTED BY IMPOSE OF A TYPE OF MULTIPLIER	SMVAR
IMPOSE	IMPOSE FOR SERVO MULTIPLIERS	SM1R
IMPOSE	IMPOSE FOR SERVO MULTIPLIERS	SM2R
IMPOSE	STORES IN SYMBOL TABLE VARIABLES AFFECTED BY A TYPE OF MULTIPLIER IMPOSE	STMV
IMPOSE	IMPOSE FOR ELECTRONIC MULTIPLIERS	TIMP
IMPOSE	FOR ZERO FUNCTIONS REDUCES TO 1 GAINS WITH IMPOSE GAIN1	ZCDIV
INTEGRATOR	IDENTIFIES WHETHER AMPLIFIER IS SUMMER OR INTEGRATOR	NUAMP
INTEGRATORS	ATTRIBUTES THE INTEGRATORS BY PARTITION	RIPINT
INVERTOR	FINDS AND OCCUPIES INVERTOR OF DFG 10 SEGMENTS	AMRIC
INVERTOR	MAKES CONNECTION BETWEEN MAIN ELEMENT AND ITS INVERTOR	COLLIN
INVERTOR	SUPPLIES CONNECTION BETWEEN MAIN ELEMENT AND ITS INVERTOR FOR PANEL CONNECTIONS LIST	COLLIX
INVERTOR	FOR MAIN ELEMENT INCREASES TOTAL OF OUTPUTS REQUIRED BY ONE IF ENTERS AN INVERTOR	COMCON
INVERTOR	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR MULTIPLIERS NOT SERVO MULTIPLIERS	CONMOL

INVERTOR	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR SERVO MULTIPLIERS	CONSM
INVERTOR	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS	CONTAM
INVERTOR	COUNTS THE NUMBER OF TRUNKS NECESSARY FOR A MAIN ELEMENT AND ITS INVERTOR . STORES THE TOTAL IN SYMBOL TABLE	FPG
INVERTOR	SUPPLIES SATANAS COORDINATES FOR INVERTOR OUTPUTS	INVUSC
INVERTOR	CALCULATES TOTAL OF OUTPUTS REQUIRED FROM A MAIN ELEMENT OR ITS INVERTOR ON ANY CONSOLE	PRIGO
INVERTOR	FINDS WHETHER ENTRY TO ELEMENT COMES FROM MAIN ELEMENT OR ITS INVERTOR AND INCREASES TOTAL OF OUTPUTS FOR MAIN ELEMENT OR INVERTOR	RICALW
INVERTOR	DETERMINES THE SIGNS OF ALL VARIABLES APPEARING IN LINEAR EQUATIONS AND DECIDES WHICH NEED AN INVERTOR	SIGN
INVERTOR	SUPPLIES SATANAS COORDINATES FOR CONNECTION BETWEEN MAIN ELEMENT AND/OR ITS INVERTOR AND INPUT TRUNK	TRUKIN
INVERTOR	SUPPLIES CONNECTIONS FOR INPUT TO TRUNK FROM MAIN ELEMENT OR INVERTOR FOR PANEL CONNECTIONS LIST	TRUKIX
INVERTOR	DETERMINES IF THE VARIABLE ENTERING A COMPARATOR COIL NEEDS AN INVERTOR	VCOM
INVERTOR	FINDS THE INVERTOR ASSIGNED TO A GIVEN VARIABLE	VEREB
INVERTOR	DETERMINES THE AVAILABLE INVERTOR NEAREST TO A GIVEN ELEMENT	VERNA
INVERTOR	WRITES INVERTOR EQUATIONS	WRQIN
INVERTOR	GENERATES INVERTOR EQUATIONS	ZQINV
INVERTORS	ASSIGNS INVERTORS WHEN REQUESTED	ATTINV
INVERTORS	COUNTS INVERTORS	ICOUNT
INVERTORS	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONTAM	RICALT
INVERTORS	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONMOL AND CONSM	SIMIN
INVERTORS	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONMOL AND CONSM	SIPLUS
INVERTORS	COUNTS COMPARATOR AND ASSOCIATED POTS AND INVERTORS	ZCOMP
INVERTORS	COUNTS SERVO MULTIPLIERS AND ASSOCIATED INVERTORS	ZC3
INVERTORS	COUNTS SIGN INVERTORS FOR OUTPUTS OF MULTIPLIERS	ZC5
INVERTORS	COUNTS ELECTRONIC MULTIPLIERS AND ASSOCIATED INVERTORS	ZEM3
INVERTORS	COUNTS DFG AND ASSOCIATED INVERTORS	ZZDFG
INVERTORS	COUNTS QUARTER SQUARE MULTIPLIERS WITH ASSOCIATED AMPLIFIER AND INVERTORS AND CONSTRUCTS TABLE TSM FOR QUARTER SQUARES	ZQS3

INVERTORS	COUNTS INVERTORS ASSOCIATED WITH SWITCHES	ZSW5
INVERTORS	COUNTS RESOLVERS AND ASSOCIATED INVERTORS AND POTS	ZZRES
KTYPE-CODE	EXTRACTS KTYPE-CODE	IDEQ
KTYPE-CODE	GIVES KTYPE-CODE TO DFG , SWITCHES , COMPARATORS , RESOLVERS	ISPEQ
LEVEL ZERO	PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS	LZP
LEVEL ZERO	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS	LZP2
LINEAR	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS	CONTAM
LINEAR	SUPPLIES INPUT SATANAS COORDINATES FOR TERMS ON RIGHT HAND SIDE OF LINEAR EQUATION	SECMEA
LINEAR	SUPPLIES INPUT CONNECTIONS FOR TERMS ON RHS OF LINEAR EQUATIONS FOR PANEL CONNECTIONS LIST	SECMEX
LINEAR	DETERMINES THE SIGNS OF ALL VARIABLES APPEARING IN LINEAR EQUATIONS AND DECIDES WHICH NEED AN INVERTOR	SIGN
LIST	INSERTS IN A LIST A VECTOR OR ANOTHER LIST	AFTER
LIST	OBTAINS THE ADDRESS OF THE NEXT ELEMENT IN A TWO DIMENSIONAL LIST	ANR
LIST	FINDS THE PRECEDING OR SUCCEEDING ELEMENT IN A LIST . USED WITH TABLE VETT	APCW1
LIST	OBTAINS THE ADDRESS OF THE PRECEDING ELEMENT IN A TWO DIMENSIONAL LIST	APR
LIST	TRANSFORMS A SEQUENTIAL VECTOR INTO A LIST FORM VECTOR WHEN SUBLISTS ARE NOT PRESENT . USED FOR TABLE VETT	BLD1
LIST	TRANSFORMS A SEQUENTIAL VECTOR INTO A LIST FORM VECTOR	BUILD
LIST	DEFINES A PART OF A LIST AS A NEW LIST	DEFINE
LIST	CONSTRUCTS LIST HEADERS FOR CONSTRUCTION OF TABLE VETT	ELIST
LIST	EXTRACTS THE N-TH ELEMENT PRECEDING THE CURRENT ONE IN A LIST	DLAST
LIST	EXTRACTS THE N-TH ELEMENT FOLLOWING THE CURRENT ONE IN A LIST	DNEXT
LIST	END OF LIST TEST	END
LIST	ERASES A LIST	ERASEL
LIST	ERASES A PART OF A LIST	ERASES
LIST	LIST COMPARE	LCMP

LIST	DUPLICATES A LIST	LCPY
LIST	TRANSFORMS A TWO DIMENSIONAL ARRAY INTO A TWO DIMENSIONAL LIST FORM ARRAY	LELLA2
LIST	COUNTS THE NUMBER OF VARIABLES WHICH APPEAR IN A BRANCH OF A LIST FORM EQUATION	LSCAN
LIST	PLACES NEW INFORMATION IN AN ELEMENT OF A LIST	PLACE
LIST	CONNECTS THE CELLS OF THE LIST PROCESSING STORAGE	RESET
LIST	FINDS LIST HEADER FOR TABLE VETT	RNLST
LIST	OBTAINS THE ADDRESS OF THE ROW OR COLUMN HEAD IN A TWO DIMENSIONAL LIST	RRH
LIST	CONNECTS CELLS OF LIST PROCESSING STORAGE WHEN SUBLISTS ARE NOT PRESENT . USED FOR TABLE VETT	RST1
LIST	DEFINES A LIST AS A SUBLIST OF AN ELEMENT WHICH IS ALREADY A SUBLIST HEAD	SLIST
LIST	DEFINES A LIST AS A SUBLIST OF AN ELEMENT WHICH IS NOT A SUBLIST HEAD	SLIST1
LIST	SUB LIST HEAD TEST	SLTRA
LIST	SEE DNEXT AND DLAST . LIST PROCESSING	SNEXT
LIST	TRANSFORMS A LIST INTO A SEQUENTIAL VECTOR	STRING
LIST	LIST PROCESSING ERROR ROUTINE	WLPD
LISTS	USED BY ROUTINE AFTER TO JOIN TWO ELEMENTS OF TWO DIFFERENT LISTS	JOIN
LISTS	EXTRACTS VECTOR FROM LISTS FOR TABLE VETT	VFL
LOGICAL TREE	TRANSFORMS EQUATIONS INTO LOGICAL TREE FORM	TREE
M-CODE	EXTRACTS M-CODE	MULTCD
MAIN ELEMENT	MAKES CONNECTION BETWEEN MAIN ELEMENT AND ITS INVERTOR	COLLIN
MAIN ELEMENT	SUPPLIES CONNECTION BETWEEN MAIN ELEMENT AND ITS INVERTOR FOR PANEL CONNECTIONS LIST	COLLIX
MAIN ELEMENT	FOR MAIN ELEMENT INCREASES TOTAL OF OUTPUTS REQUIRED BY ONE IF ENTERS AN INVERTOR	COMCON
MAIN ELEMENT	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR MULTIPLIERS NOT SERVO MULTIPLIERS	CONMOL
MAIN ELEMENT	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR SERVO MULTIPLIERS	CONSM
MAIN ELEMENT	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS	CONTAM
MAIN ELEMENT	COUNTS THE NUMBER OF TRUNKS NECESSARY FOR A MAIN ELEMENT AND ITS INVERTOR . STORES THE TOTAL IN SYMBOL TABLE	FPG
MAIN ELEMENT	CALCULATES TOTAL OF OUTPUTS REQUIRED FROM A MAIN ELEMENT OR ITS INVERTOR ON ANY CONSOLE	PRIGO

MAIN ELEMENT	FINDS WHETHER ENTRY TO ELEMENT COMES FROM MAIN ELEMENT OR ITS INVERTOR AND INCREASES TOTAL OF OUTPUTS FOR MAIN ELEMENT OR INVERTO`	RICALW
MAIN ELEMENT	SUPPLIES SATANAS COORDINATES FOR CONNECTION BETWEEN MAIN ELEMENT AND/OR ITS INVERTOR AND INPUT TRUNK	TRUKIN
MAIN ELEMENT	SUPPLIES CONNECTIONS FOR INPUT TO TRUNK FROM MAIN ELEMENT OR INVERTOR FOR PANEL CONNECTIONS LIST	TRUKIX
MAIN ELEMENT	ATTACHES TO EACH VARIABLE THE SIGN WITH WHICH IT OUTPUTS FROM ITS MAIN ELEMENT	VLIN
MAX VALUE	REPLACES IC , MAX VALUE OR SCALE FACTOR CELL IN SYMBOL TABLE WITH NEW VALUE	LINO1
MAX VALUE	EXTRACTS THE CONTENTS OF IC , MAX VALUE OR SCALE FACTOR CELLS FROM SYMBOL TABLE	VOC1
MEAN VALUE	CALCULATES MEAN VALUE	AVER
MEAN VALUE	CONSTRUCTS THE NAME OF THE MEAN VALUE OF A PERTURBED VARIABLE	BUPPA
NETWORK	GENERATES POT SETTING , READ OUT , NETWORK CARDS	CSEL
NETWORK	WRITES ON TAPE POT SETTING , READ OUT , NETWORK CARDS	PUNCH
NL-CODE	GIVES NL-CODE FOR NON-LINEAR AUXILIARY VARIABLES	TYPE
NON-LINEAR	GENERATES NON-LINEAR AUXILIARY EQUATIONS	AGENT
NON-LINEAR	SUPPLIES EQM-RECORD FOR NON-LINEAR AUXILIARY EQUATIONS	AUXREC
NON-LINEAR	GIVES GP-CODE FOR NON-LINEAR AUXILIARY VARIABLES	FLAG
NON-LINEAR	GIVES NL-CODE FOR NON-LINEAR AUXILIARY VARIABLES	TYPE
OMIT	ERROR ROUTINE FOR OMIT	EONERR
OMIT	ERROR ROUTINE FOR OMIT	ERRNUS
OMIT	OMIT FOR AMPLIFIERS	OMITA
OMIT	GENERAL OMIT ROUTINE	OMITG
OMIT	OMIT FOR TIEPOINTS	OMITN
ON-LINE	LOADS INPUT ONTO INPUT TAPE IF ON-LINE	CTS
ON-LINE	PRINTS ON-LINE END OF EDITOR MESSAGES	ENDMS
ON-LINE	PRINTS ON-LINE END OF EDITOR MESSAGES	ENDMS3
ON-LINE	PRINTS ON-LINE ERROR MESSAGES AND RESTART PROCEDURES FOR EDITOR	PREMG
ON-LINB	ON-LINE PRINTING ROUTINE	PRINT
ON-LINE	PRINTS ON-LINE IO-MESSAGES AND RESTART PROCEDURES FOR EDITOR	PRIOEM

OPERATOR	IDENTIFIES AND GIVES E-CODE TO EACH OPERAND AND OPERATOR OF EQUATIONS . RECOGNISES AND COMPUTES VALUES OF PARAMETRIC EXPRESSIONS . BUILDS W-RECORDS	IDNTFY
OPERATOR	TESTS IF AN OPERATOR IS PLUS OR MINUS	TST
OPTION	STORES SIGNALS FOR OPTION CARDS	CNTRCD
OUTPUT LIST	EXTRACTS FROM SYMBOL TABLE ALL INFORMATION RELATIVE TO PARAMETERS AND VARIABLES NECESSARY FOR OUTPUT LIST	TIDEN
OUTPUT LIST	GENERATES INFORMATION FOR CROSS-REFERENCES FOR OUTPUT LIST	VVV
PANEL CONNECTIONS	SUPPLIES OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ARRIX
PANEL CONNECTIONS	SUPPLIES OUTPUT AND INPUT CONNECTIONS OF POTS FOR PANEL CONNECTIONS LIST	ARRPOX
PANEL CONNECTIONS	SUPPLIES CONNECTION BETWEEN MAIN ELEMENT AND ITS INVERTOR FOR PANEL CONNECTIONS LIST	COLLIX
PANEL CONNECTIONS	SUPPLIES COMPARATOR OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	COMUX
PANEL CONNECTIONS	SUPPLIES CONNECTIONS RELATIVE TO IC CIRCUIT FOR PANEL CONNECTIONS LIST	CONDIX
PANEL CONNECTIONS	SUPPLIES DFG OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	DFGUX
PANEL CONNECTIONS	SUPPLIES DFG FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTDFX
PANEL CONNECTIONS	SUPPLIES HIGH ACCURACY MULTIPLIER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTHAX
PANEL CONNECTIONS	SUPPLIES QUARTER SQUARE MULTIPLIERS FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTQSX
PANEL CONNECTIONS	SUPPLIES SERVO MULTIPLIER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTSEX
PANEL CONNECTIONS	SUPPLIES SWITCH INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTSX
PANEL CONNECTIONS	SUPPLIES AND WRITES REFERENCE AND GROUND IN PANEL CONNECTIONS LIST	RESTA
PANEL CONNECTIONS	SUPPLIES FIXED CONNECTIONS AND CAPACITIES FOR AMPLIFIERS IN PANEL CONNECTIONS LIST	SATAX
PANEL CONNECTIONS	SUPPLIES INPUT CONNECTIONS FOR TERMS ON RHS OF LINEAR EQUATIONS FOR PANEL CONNECTIONS LIST	SECMEX
PANEL CONNECTIONS	WRITES A LINE IN PANEL CONNECTIONS LIST	STAM
PANEL CONNECTIONS	PREPARES NAME OF VARIABLE FOR PANEL CONNECTIONS LIST	STAVA
PANEL CONNECTIONS	SUPPLIES CONNECTIONS FOR AUXILIARY NETWORKS AND RESISTANCES FOR PANEL CONNECTIONS LIST	SUMJOX
PANEL CONNECTIONS	SUPPLIES SWITCH OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	SWUX
PANEL CONNECTIONS	SUPPLIES ELECTRONIC MULTIPLIERS OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	TDVUX
PANEL CONNECTIONS	PREPARES MESSAGE FOR WRITING OF PANEL CONNECTIONS LIST	TEX
PANEL CONNECTIONS	SUPPLIES TIEPOINT INPUT AND OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	TIEUX

PANEL CONNECTIONS	SUPPLIES CONNECTIONS FOR INPUT TO TRUNK FROM MAIN ELEMENT OR INVERTOR FOR PANEL CONNECTIONS LIST	TRUKIX
PANEL CONNECTIONS	SUPPLIES OUTPUT CONNECTIONS FOR ELEMENTS NOT TIEPOINTS FOR PANEL CONNECTIONS LIST	USCIX
PANEL CONNECTIONS	SUPPLIES COMPARATOR COIL AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	XCRIX
PANEL CONNECTIONS	SUPPLIES RESOLVER OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	XOCEX
PANEL CONNECTIONS	SUPPLIES RECORDER AND VARIPLOTTER INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	XSRIX
PANEL CONNECTIONS	SUPPLIES RESOLVER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ZSCX
PARAMETRIC EXPRESSIONS	IDENTIFIES AND GIVES E-CODE TO EACH OPERAND AND OPERATOR OF EQUATIONS . RECOGNISES AND COMPUTES VALUES OF PARAMETRIC EXPRESSIONS . BUILDS W-RECORDS	IDNTFY
PARAMETRIC EXPRESSIONS	STORES IN SYMBOL TABLE THE VALUE OF PARAMETRIC EXPRESSIONS	VPX
PARTITION	ATTRIBUTES THE INTEGRATORS BY PARTITION	RIPINT
PATCH PANEL	ERROR IN COD1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRAD1
PATCH PANEL	ERROR IN COD2 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRAD2
PATCH PANEL	ERROR IN COD3 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRCD1
PATCH PANEL	ERROR IN ADR1 ON PATCH PANEL DESCRIPTION CARDS FOR LINK 7	ERRCD2
PATCH PANEL	SUPPLIES TOTAL OF OUTPUTS AVAILABLE ON PATCH PANEL FOR EACH ELEMENT	NUMUSC
PATCH PANEL	FINDS ON PATCH PANEL UNUSED ANALOG ELEMENT NEAREST TO A GIVEN ELEMENT	PYTAG
PATCH PANELS	CONSTRUCTED BY LINK 7 CONTAINS DATA OF ALL PATCH PANELS OF INSTALLATION IN MACHINE CODE	PANEL
PERTURBED VARIABLE	CONSTRUCTS THE NAME OF THE MEAN VALUE OF A PERTURBED VARIABLE	BUPPA
PERTURBED VARIABLE	RECOGNISES IF A VARIABLE IS A PERTURBED VARIABLE	PERT
PI	SUBSTITUTES THE CURRENT VALUE FOR A SIGMA OR PI RECURRENCE PARAMETER	SBST
PI	DEVELOPS SIGMA AND PI EXPRESSIONS	SIGMAP
POT SETTING	GENERATES POT SETTING , READ OUT , NETWORK CARDS	CSEL
POT SETTING	WRITES ON TAPE POT SETTING , READ OUT , NETWORK CARDS	PUNCH
POTS	COUNTS AMPLIFIERS WITH ASSOCIATED POTS AND AUXILIARY NETWORKS	ACOUNT
POTS	SUPPLIES OUTPUT AND INPUT CONNECTIONS OF POTS FOR PANEL CONNECTIONS LIST	ARRPOX
POTS	SUPPLIES OUTPUT AND INPUT SATANAS COORDINATES FOR POTS	ARRPOT
POTS	REDUCES ENTRIES OF AMPLIFIERS TO COMPONENT POTS AND GAINS . ASSIGNS AUXILIARY NETWORKS , ENTRY RESISTANCES	XENTRY

POTS	ATTRIBUTES POTS AND NETWORKS FOR RIGHT HAND SIDE VARIABLES	YPR
POTS	COUNTS COMPARATOR AND ASSOCIATED POTS AND INVERTORS	ZCOMP
POTS	COUNTS SWITCH AND ASSOCIATED POTS	ZSW
POTS	COUNTS RESOLVERS AND ASSOCIATED INVERTORS AND POTS	ZZRES
PRINT	PROCESSES PRINT STATEMENTS FOR SIMULATOR	INPSC
PRINT	FOR SIMULATOR WRITES LABELS CORRESPONDING TO AN OUTPUT LINE AS SPECIFIED IN PRINT STATEMENT	PHEAD
PRINT	SIMULATOR PRINT STATEMENT PRE-PROCESSOR . IDENTIFIES ITEMS OF THE STATEMENT AND GIVES DIAGNOSTICS	PREPR
PRINTING	ON-LINE PRINTING ROUTINE	PRINT
PRINTS	PRINTS ON-LINE END OF EDITOR MESSAGES	ENDMS3
PRINTS	PRINTS ON-LINE END OF EDITOR MESSAGES	ENDMS
PRINTS	PRINTS ON-LINE ERROR MESSAGES AND RESTART PROCEDURES FOR EDITOR	PREMG
PRINTS	PRINTS ON-LINE IO-MESSAGES AND RESTART PROCEDURES FOR EDITOR	PRIOEM
QUARTER SQUARE	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO QUARTER SQUARE HIGH ACCURACY OR ELECTRONIC MULTIPLIERS OR RESOLVERS	CONMOP
QUARTER SQUARE	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR QUARTER SQUARE MULTIPLIERS	ENTQSQ
QUARTER SQUARE	SUPPLIES QUARTER SQUARE MULTIPLIERS FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTQSX
QUARTER SQUARE	CONTROLS TOTAL OF QUARTER SQUARE MULTIPLIERS REQUIRED	QSFAB
QUARTER SQUARE	IMPOSE FOR QUARTER SQUARE MULTIPLIERS	QS1
QUARTER SQUARE	IMPOSE FOR QUARTER SQUARE MULTIPLIERS	QS2
QUARTER SQUARE	DETERMINE THE SIGN OF INPUT AND OUTPUT VARIABLES OF QUARTER SQUARE MULTIPLIERS	VQSQ
QUARTER SQUARE	ATTRIBUTES QUARTER SQUARE MULTIPLIERS	YQS2
QUARTER SQUARE	COUNTS QUARTER SQUARE MULTIPLIERS WITH ASSOCIATED AMPLIFIER AND INVERTORS AND CONSTRUCTS TABLE TSM FOR QUARTER SQUARES	ZQS3
READING	TAPE READING ROUTINE FOR EDITOR	EREAD
READING	READING ROUTINE FOR INTERMEDIATE TAPES . USED BY LINKS 36 361 3613 362	RUTLET
READING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 341	YRW
READING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 342	YRW2
READING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343	YRW3

READING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343	YRW4
READS	READS AND COPIES THE CHAIN TABLE IN EDITOR PHASE	COPYCT
READS	READS BCD CARDS FROM INPUT TAPE	READ
RECORD	CONVERTS VALUE OF BETA READ FROM RECORD INTO FLOATING POINT	BFIND
RECORD	RECORD PACKING ROUTINE	BLANK
RECORD	CONVERTS CARDS IMAGES TO A BCD RECORD	CNVRT
RECORD	RECORD SPLITTING ROUTINE	SPLIT
RECORDER	PROCESSES RECORDER STATEMENTS	RCRDER
RECORDER	SUPPLIES RECORDER AND VARIPLOTTER INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	XSRIX
RECORDER	COUNTS RECORDER CHANNELS	ZZRECO
RECORDERS	SUPPLIES SATANAS COORDINATES FOR INPUTS TO RECORDERS AND VARIPLOTTERS	XSRIC
RECORDERS	ATTRIBUTES RECORDERS	YRCD
REFERENCE	LOADS REFERENCE AND GROUND INFORMATION FOR TABLE VETT	KST
REFERENCE	SUPPLIES SATANAS COORDINATES FOR REFERENCE AND GROUND	REFSER
REFERENCE	SUPPLIES AND WRITES REFERENCE AND GROUND IN PANEL CONNECTIONS LIST	RESTA
RESISTANCE	LOADS RESISTANCE AND CAPACITY INFORMATION FOR TABLE VETT	GHST
RESISTANCES	COUNTS CAPACITIES AND RESISTANCES	RESCAP
RESISTANCES	SUPPLIES SATANAS COORDINATES FOR AUXILIARY NETWORKS AND RESISTANCES	SUMJON
RESISTANCES	SUPPLIES CONNECTIONS FOR AUXILIARY NETWORKS AND RESISTANCES FOR PANEL CONNECTIONS LIST	SUMJOX
RESISTANCES	REDUCES ENTRIES OF AMPLIFIERS TO COMPONENT POTS AND GAINS . ASSIGNS AUXILIARY NETWORKS , ENTRY RESISTANCES	XENTRY
RESOLVER	PROCESSES RESOLVER STATEMENTS	RES
RESOLVER	SUPPLIES SATANAS COORDINATES FOR RESOLVER OUTPUTS	XOCEL
RESOLVER	SUPPLIES RESOLVER OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	XOCEX
RESOLVER	SUPPLIES RESOLVER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ZSCX
RESOLVERS	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO QUARTER SQUARE HIGH ACCURACY OR ELECTRONIC MULTIPLIERS OR RESOLVERS	CONMOP
RESOLVERS	GIVES KTYPE-CODE TO DFG , SWITCHES , COMPARATORS , RESOLVERS	ISPEQ

RESOLVERS	COMPUTES IC OF VARIABLES OUTPUT FROM RESOLVERS	RESCP
RESOLVERS	CONTROLS TOTAL OF RESOLVERS REQUIRED	RESFAB
RESOLVERS	IMPOSE FOR RESOLVERS	RES1
RESOLVERS	IMPOSE FOR RESOLVERS	RES2
RESOLVERS	ATTRIBUTES IC POT FOR RECTANGULAR RATE RESOLVERS	YRPIC
RESOLVERS	ATTRIBUTES RESOLVERS	YRES
RESOLVERS	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF RESOLVERS	ZRES
RESOLVERS	CONTROLS ALL COUNT ROUTINES FOR MULTIPLIERS AND RESOLVERS	ZC2
RESOLVERS	COUNTS RESOLVERS AND ASSOCIATED INVERTORS AND POTS	ZZRES
RESOLVERS	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR RESOLVERS	ZSC
RIF-TABLE	OBTAINS THE RIF-TABLE CELL CORRESPONDING TO A GIVEN VARIABLE	RISY
SATANAS	SUPPLIES INTER-AMPLIFIER CODE FOR USE IN SATANAS	IUS
SATANAS	PREPARES SATANAS CARDS	PUNCHC
SATANAS	PUNCHES SATANAS CARDS	ZZZLST
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR AMPLIFIER OUTPUTS	AMPUSC
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES OF OUTPUTS	ARRIV
SATANAS COORDINATES	SUPPLIES OUTPUT AND INPUT SATANAS COORDINATES FOR POTS	ARRPOT
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR COMPARATOR OUTPUTS	COMUSC
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR DFG OUTPUTS	DFGUSC
SATANAS COORDINATES	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR DFG	ENTDFG
SATANAS COORDINATES	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR HIGH ACCURACY MULTIPLIERS	ENTHAM
SATANAS COORDINATES	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR QUARTER SQUARE MULTIPLIERS	ENTQSQ
SATANAS COORDINATES	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR SERVO MULTIPLIERS	ENTSER
SATANAS COORDINATES	SUPPLIES INPUT SATANAS COORDINATES FOR SWITCH	ENTSW
SATANAS COORDINATES	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR ELECTRONIC MULTIPLIERS	ENTTDV
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR INVERTOR OUTPUTS	INVUSC
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR REFERENCE AND GROUND	REFSER

SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES OF FIXED CONNECTIONS FOR AMPLIFIERS INCLUDING CAPACITIES	SATAM
SATANAS COORDINATES	SUPPLIES INPUT SATANAS COORDINATES FOR TERMS ON RIGHT HAND SIDE OF LINEAR EQUATION	SECMEA
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR AUXILIARY NETWORKS AND RESISTANCES	SUMJON
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR SWITCH OUTPUTS	SWUSC
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR ELECTRONIC MULTIPLIER OUTPUTS	TDVUSC
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES OF OUTPUT AND INPUT FOR TIEPOINTS	TIEUSC
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR CONNECTION BETWEEN MAIN ELEMENT AND/OR ITS INVERTOR AND INPUT TRUNK	TRUKIN
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES OF OUTPUT FOR ELEMENTS NOT TIEPOINTS	USCITE
SATANAS COORDINATES	SUPPLIES COIL AND INPUT SATANAS COORDINATES FOR COMPARATORS	XCRIC
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR RESOLVER OUTPUTS	XOCEL
SATANAS COORDINATES	SUPPLIES SATANAS COORDINATES FOR INPUTS TO RECORDERS AND VARIPLOTTERS	XSRIC
SATANAS COORDINATES	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR RESOLVERS	ZSC
SCALE FACTOR	REPLACES IC , MAX VALUE OR SCALE FACTOR CELL IN SYMBOL TABLE WITH NEW VALUE	LINO1
SCALE FACTOR	EXTRACTS FROM SYMBOL TABLE THE IC AND SCALE FACTOR OF A VARIABLE	VAR
SCALE FACTOR	EXTRACTS THE CONTENTS OF IC , MAX VALUE OR SCALE FACTOR CELLS FROM SYMBOL TABLE	VOC1
SCALING FACTOR	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS	LZP2
SCALING FACTOR	PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS	LZP
SCALING FACTORS	MAKES HIGHEST GAIN TO COIL = 1 AND COMPENSATES FOR ANY DIFFERENCE IN THE SCALING FACTORS OF THE ENTRIES TO COMPARATORS	CMCOIL
SERVICE ROUTINE	MODIFIES ADDRESSES . SERVICE ROUTINE	ACTW
SERVICE ROUTINE	ADDS AND SUBTRACTS INTEGERS . SERVICE ROUTINE	ADDA
SERVICE ROUTINE	FINDS ADDRESS OF A FORTRAN SYMBOL . SERVICE ROUTINE	ADR
SERVICE ROUTINE	BOOLEAN COMPARE . SERVICE ROUTINE	CNFR
SERVICE ROUTINE	STORES SIGNAL IN WORD . SERVICE ROUTINE . (NOT USED)	FFG2
SERVICE ROUTINE	STORES SIGNAL IN WORD . SERVICE ROUTINE . (NOT USED)	FFG1
SERVICE ROUTINE	SHIFTS MEMORY AREA HIGH TO LOW . SERVICE ROUTINE	HTOL

SERVICE ROUTINE	CALCULATES THE NUMBER OF WORDS BETWEEN TWO ADDRESSES . SERVICE ROUTINE	INDEX
SERVICE ROUTINE	LOGICAL SHIFT SERVICE ROUTINE	LSHR
SERVICE ROUTINE	PERFORMS INDIRECT STORE . SERVICE ROUTINE	LINO
SERVICE ROUTINE	SHIFTS MEMORY AREA LOW TO HIGH . SERVICE ROUTINE	LTOH
SERVICE ROUTINE	INDIRECT CLEAR AND ADD . SERVICE ROUTINE	PAL
SERVICE ROUTINE	SUBTRACT ROUTINE FOR ADDRESSES . SERVICE ROUTINE	PINCO
SERVICE ROUTINE	ADDING ROUTINE . SERVICE ROUTINE	RICHEL
SERVICE ROUTINE	ADDING ROUTINE . SERVICE ROUTINE	RICHIN
SERVICE ROUTINE	SHIFT SERVICE ROUTINE	RSH
SERVICE ROUTINE	SHIFT SERVICE ROUTINE	SHL
SERVICE ROUTINE	BOOLEAN COMPARE . SERVICE ROUTINE	TEST
SERVICE ROUTINE	EQUATES TWO SYMBOLS . SERVICE ROUTINE	TRB
SERVICE ROUTINE	OBTAINS INFORMATION ABOUT A GIVEN VARIABLE . SERVICE ROUTINE	XYZR
SERVICE ROUTINE	LOGICAL OR OF A MASK TO A GIVEN ADDRESS . SERVICE ROUTINE	YYY
SERVO	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR SERVO MULTIPLIERS	CONSM
SERVO	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO SERVO MULTIPLIERS	CONSP
SERVO	SUPPLIES FIXED AND INPUT SATANAS COORDINATES FOR SERVO MULTIPLIERS	ENTSER
SERVO	SUPPLIES SERVO MULTIPLIER FIXED AND INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTSEX
SERVO	LOADS SERVO MULTIPLIER INFORMATION FOR TABLE VETT	MST
SERVO	PRELIMINARY STAGE OF CONSTRUCTION OF TABLE TSM FOR SERVO MULTIPLIERS	SMFAB
SERVO	TRANSFERS INFORMATION IN TABLE TSM FOR SERVO MULTIPLIERS	SMOUT
SERVO	COMPLETION OF CONSTRUCTION OF TABLE TSM FOR SERVO MULTIPLIERS	SMPVOC
SERVO	IMPOSE FOR SERVO MULTIPLIERS	SM2R
SERVO	ATTRIBUTES SERVO MULTIPLIERS	SM3R
SERVO	IMPOSE FOR SERVO MULTIPLIERS	SM1R
SERVO	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF PLUS OR MINUS SERVO MULTIPLIERS	VSMS
SERVO	COORDINATES THE ROUTINES VSMN AND VSMS . DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF SERVO MULTIPLIERS USED IN DIVISION	VSM

SERVO	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF NORMAL SERVO MULTIPLIERS	VSMN
SERVO	ATTRIBUTES SERVO MULTIPLIERS	YSM2
SERVO	COUNTS SERVO MULTIPLIERS AND ASSOCIATED INVERTORS	ZC3
SIGMA	SUBSTITUTES THE CURRENT VALUE FOR A SIGMA OR PI RECURRENCE PARAMETER	SBST
SIGMA	DEVELOPS SIGMA AND PI EXPRESSIONS	SIGMAP
SIGN	ATTACHES TO EACH VARIABLE THE SIGN WITH WHICH IT OUTPUTS FROM ITS MAIN ELEMENT	VLIN
SIGN	DETERMINE THE SIGN OF INPUT AND OUTPUT VARIABLES OF QUARTER SQUARE MULTIPLIERS	VQSQ
SIGN	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF NORMAL SERVO MULTIPLIERS	VSMN
SIGN	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF PLUS OR MINUS SERVO MULTIPLIERS	VSMS
SIGN	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF ELECTRONIC MULTIPLIERS	VTDV
SIGN	DETERMINES THE SIGN OF INPUT AND OUTPUT VARIABLES OF RESOLVERS	ZRES
SIGN	COUNTS SIGN INVERTORS FOR OUTPUTS OF MULTIPLIERS	ZC5
SIGNS	DETERMINES THE SIGNS OF ALL VARIABLES APPEARING IN LINEAR EQUATIONS AND DECIDES WHICH NEED AN INVERTOR	SIGN
SIGNS	DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF HIGH ACCURACY MULTIPLIERS USED FOR MULTIPLICATION	VHAMM
SIGNS	DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF HIGH ACCURACY MULTIPLIERS USED FOR DIVISION	VHAMD
SIGNS	COORDINATES THE ROUTINES VSMN AND VSMS . DETERMINES THE SIGNS OF INPUT AND OUTPUT VARIABLES OF SERVO MULTIPLIERS USED IN DIVISION	VSM
SIGNS MATRIX	CONSTRUCTS THE COLUMN HEADER WORDS OF SIGNS MATRIX	CLCT1
SIGNS MATRIX	CONSTRUCTS THE COLUMN AND ROW HEADERS OF THE SIGNS MATRIX	TT1
SIGNS MATRIX	USED BY ROUTINE WWF IN CONSTRUCTION OF SIGNS MATRIX	WFORM
SIGNS MATRIX	PUTS COMPARATOR EQUATIONS INTO SIGNS MATRIX	XCMAT
SIGNS MATRIX	CONSTRUCTS AN ELEMENT OF THE SIGNS MATRIX	WWF
SIGNS MATRIX	PUTS SWITCH EQUATIONS INTO SIGNS MATRIX	XSMAT
SIMULATOR	WRITES ONTO AN INTERMEDIATE TAPE THE COMPILED EQUATIONS . USED WITH THE SIMULATOR	ATRIN
SIMULATOR	DUMMY ROUTINE USED IN SIMULATOR	DAUX
SIMULATOR	PROCESSES PRINT STATEMENTS FOR SIMULATOR	INPSC

SIMULATOR	INTEGRATION ROUTINE USED IN SIMULATOR	INT
SIMULATOR	LOADS COMPILED EQUATIONS AND BUILDS SUBROUTINE DAUX FOR SIMULATOR	LOADER
SIMULATOR	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS	LZP2
SIMULATOR	FOR SIMULATOR WRITES LABELS CORRESPONDING TO AN OUTPUT LINE AS SPECIFIED IN PRINT STATEMENT	PHEAD
SIMULATOR	SIMULATOR PRINT STATEMENT PRE-PROCESSOR . IDENTIFIES ITEMS OF THE STATEMENT AND GIVES DIAGNOSTICS	PREPR
SIMULATOR	DUMMY SUBROUTINE FOR SIMULATOR	PRINTT
SORT	SORT ROUTINE	CORD
SORT	COMPARE ROUTINE FOR ROUTINE SORT	CRIT1
SORT	SYMBOL TABLE SORT	SORT
SPECIAL CHARACTERS	USED BY SUBROUTINE SYMBOL TO DETECT SPECIAL CHARACTERS	SPCH
STANDARD FORM	TRANSFORMS EQUATIONS TO THE STANDARD FORM	POTA
STANDARD FORM	GROUPS COMMON FACTORS IN EQUATIONS REDUCED TO THE STANDARD FORM	RFC
STATEMENT NUMBERS	EXTRACTS STATEMENT NUMBERS	STATN
STATEMENT NUMBERS	CONSTRUCTS STATEMENT NUMBERS	XNSA
STATEMENTS	DETECTS WRITING ERRORS IN PROGRAM STATEMENTS	DIAGN
STATEMENTS	PROCESSES PRINT STATEMENTS FOR SIMULATOR	INPSC
STATEMENTS	PROCESSES THE IMPOSE STATEMENTS WHICH DEFINE A TYPE OF MULTIPLIER	MPLIMP
STATEMENTS	PROCESSES RECORDER STATEMENTS	RCRDER
STATEMENTS	PROCESSES RESOLVER STATEMENTS	RES
STATEMENTS	PROCESSES VARIPLOTTER STATEMENTS	VRPLOT
STRATEGIES	SETS ADDRESSING STRATEGIES	STRSET
SUMMER	IDENTIFIES WHETHER AMPLIFIER IS SUMMER OR INTEGRATOR	NUAMP
SWITCH	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS	CONTAM
SWITCH	SUPPLIES SWITCH INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	ENTSX
SWITCH	SUPPLIES INPUT SATANAS COORDINATES FOR SWITCH	ENTSW

SWITCH	LOADS SWITCH AND COMPARATOR INFORMATION FOR TABLE VETT	SCST
SWITCH	CONTROLS GAINS TO SWITCH CONTACTS . ENTRY TO COUNT ROUTINE FOR SWITCHES	SWGAIN
SWITCH	SUPPLIES SATANAS COORDINATES FOR SWITCH OUTPUTS	SWUSC
SWITCH	SUPPLIES SWITCH OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	SWUX
SWITCH	PUTS SWITCH EQUATIONS INTO SIGNS MATRIX	XSMAT
SWITCH	SEARCHES IN SWITCH TABLE	YSRIC
SWITCH	COUNTS SWITCH AND ASSOCIATED POTS	ZSW
SWITCHES	SPLITS EQUATIONS OF COMPARATORS OR SWITCHES INTO SEVERAL EQUATIONS CORRESPONDING EACH TO A CONTACT	CMSW
SWITCHES	GIVES KTYPE-CODE TO DFG , SWITCHES , COMPARATORS , RESOLVERS	ISPEQ
SWITCHES	CONTROLS GAINS TO SWITCH CONTACTS . ENTRY TO COUNT ROUTINE FOR SWITCHES	SWGAIN
SWITCHES	CONSTRUCTS TABLE FOR SWITCHES	TSW
SWITCHES	ATTRIBUTES SWITCHES	YSW
SWITCHES	COUNTS INVERTORS ASSOCIATED WITH SWITCHES	ZSW5
SYMBOL TABLE	INSERTS GP-CODE IN SYMBOL TABLE	AFSIS
SYMBOL TABLE	ZEROS WORD IN SYMBOL TABLE	AZZS
SYMBOL TABLE	SUPPLIES ADDRESS IN SYMBOL TABLE OF VARIABLE IF ALREADY STORED . IF NOT STORES NEW VARIABLE IN SYMBOL TABLE	BRECHT
SYMBOL TABLE	SEARCHES A VARIABLE IN SYMBOL TABLE	CLETS2
SYMBOL TABLE	COUNTS THE NUMBER OF TRUNKS NECESSARY FOR A MAIN ELEMENT AND ITS INVERTOR . STORES THE TOTAL IN SYMBOL TABLE	FPG
SYMBOL TABLE	EXTRACTS GP-CODE FROM SYMBOL TABLE	LGP
SYMBOL TABLE	SYMBOL TABLE LOOK-UP ROUTINE	LOOK
SYMBOL TABLE	REPLACES IC , MAX VALUE OR SCALE FACTOR CELL IN SYMBOL TABLE WITH NEW VALUE	LIN01
SYMBOL TABLE	EXTRACTS THE NAME OF A PARAMETER OR VARIABLE FROM THE SYMBOL TABLE . CONVERTS ALL FLOATING POINT BINARY NUMBERS WHICH APPEAR INTO BCD NUMBERS	NAME
SYMBOL TABLE	EXTRACTS THE NAME OF A PARAMETER OR VARIABLE FROM THE SYMBOL TABLE	NAME1
SYMBOL TABLE	SEARCHES PARAMETERS IN SYMBOL TABLE	PARSE
SYMBOL TABLE	SEARCHES INFORMATION RELATIVE TO A GIVEN VARIABLE IN SYMBOL TABLE	RSYMB

SYMBOL TABLE	PLACES THE COMPUTED IC IN SYMBOL TABLE	SETIC
SYMBOL TABLE	SYMBOL TABLE LOOKUP FOR VARIABLES AFFECTED BY IMPOSE OF A TYPE OF MULTIPLIER	SMVAR
SYMBOL TABLE	SYMBOL TABLE SORT	SORT
SYMBOL TABLE	FINDS GP-CODE IN SYMBOL TABLE FOR VARIABLES IN MULTIPLIER TABLES	STABLE
SYMBOL TABLE	STORES IN SYMBOL TABLE VARIABLES AFFECTED BY A TYPE OF MULTIPLIER IMPOSE	STMV
SYMBOL TABLE	STORES PARAMETERS AND VARIABLES IN SYMBOL TABLE	STORE
SYMBOL TABLE	SEARCHES A VARIABLE IN SYMBOL TABLE	SYRES
SYMBOL TABLE	CONTROLS TOTAL OF OUTPUTS FOR EACH ELEMENT AND ATTRIBUTES TIEPOINT WHEN NECESSARY TAKING ACCOUNT OF TRUNKS . PUTS ADDRESSING INFORMATION FOR TIEPOINTS IN SYMBOL TABLE	TIEPO
SYMBOL TABLE	EXTRACTS FROM SYMBOL TABLE ALL INFORMATION RELATIVE TO PARAMETERS AND VARIABLES NECESSARY FOR OUTPUT LIST	TIDEN
SYMBOL TABLE	SEARCHES A VARIABLE IN SYMBOL TABLE	TNEWT2
SYMBOL TABLE	STORES TRUNKS FLAG IN SYMBOL TABLE	TRUTI
SYMBOL TABLE	ASSOCIATES A NUMBER WITH EACH VARIABLE IN THE SYMBOL TABLE	VARN
SYMBOL TABLE	EXTRACTS FROM SYMBOL TABLE THE IC AND SCALE FACTOR OF A VARIABLE	VAR
SYMBOL TABLE	EXTRACTS THE CONTENTS OF IC , MAX VALUE OR SCALE FACTOR CELLS FROM SYMBOL TABLE	VOC1
SYMBOL TABLE	STORES IN SYMBOL TABLE THE VALUE OF PARAMETRIC EXPRESSIONS	VPX
SYMBOL TABLE	STORES ADDRESSING INFORMATION IN SYMBOL TABLE	YSYW
SYSTEM	APACHE SYSTEM CHAIN ROUTINE	CHAIN
SYSTEM	APACHE SYSTEM EXIT ROUTINE	EXITA
SYSTEM	APACHE SYSTEM DUMP ROUTINE	FDUMP
SYSTEM	SYSTEM ERROR DIAGNOSTIC, ROUTINE	PINTA
SYSTEM	APACHE SYSTEM TEST	PSYMB
SYSTEM	APACHE SYSTEM TEST	WRNV
SYSTEM	APACHE SYSTEM TEST	WRTST
SYSTEM	APACHE SYSTEM TEST	ZREC
SYSTEM	SYSTEM ERROR DIAGNOSTIC ROUTINE FOR LINKS 36 AND 361	ZZPN
SYSTEM	SYSTEM ERROR DIAGNOSTIC ROUTINE FOR LINK 3613	ZZZPX

TAPE	WRITES ONTO AN INTERMEDIATE TAPE THE COMPILED EQUATIONS . USED WITH THE SIMULATOR	ATRIN
TAPE	TAPE COPYING ROUTINE USED IN EDITOR	COPY
TAPE	LOADS INPUT ONTO INPUT TAPE IF ON-LINE	CTS
TAPE	TAPE READING ROUTINE FOR EDITOR	EREAD
TAPE	WRITES ON TAPE POT SETTING , READ OUT , NETWORK CARDS	PUNCH
TAPE	WRITES FAP ROUTINE PANEL ON TAPE	PUNP
TAPE	READS BCD CARDS FROM INPUT TAPE	READ
TAPE	TAPE SKIPPING ROUTINE FOR EDITOR	SKIP
TAPE	TAPE WRITING ROUTINE FOR EDITOR	WRITE
TAPES	READING ROUTINE FOR INTERMEDIATE TAPES . USED BY LINKS 36 361 3613 362	RUTLET
TAPES	WRITING ROUTINE FOR INTERMEDIATE TAPES . USED BY LINKS 36 361 3613 362	RUTWR
TAPES	ALLOCATES TAPES	SETTAP
TAPES	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 341	YRW
TAPES	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 342	YRW2
TAPES	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343	YRW3
TAPES	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343	YRW4
TIEPOINT	LOADS TIEPOINT INFORMATION FOR TABLE VETT	NST
TIEPOINT	CONTROLS TOTAL OF OUTPUTS FOR EACH ELEMENT AND ATTRIBUTES TIEPOINT WHEN NECESSARY TAKING ACCOUNT OF TRUNKS . PUTS ADDRESSING INFORMATION FOR TIEPOINTS IN SYMBOL TABLE	TIEPO
TIEPOINT	SUPPLIES TIEPOINT INPUT AND OUTPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	TIEUX
TIEPOINTS	OMIT FOR TIEPOINTS	OMITN
TIEPOINTS	SUPPLIES SATANAS COORDINATES OF OUTPUT AND INPUT FOR TIEPOINTS	TIEUSC
TOTAL OF OUTPUTS	FOR MAIN ELEMENT INCREASES TOTAL OF OUTPUTS REQUIRED BY ONE IF ENTERS AN INVERTOR	COMCON
TOTAL OF OUTPUTS	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO QUARTER SQUARE HIGH ACCURACY OR ELECTRONIC MULTIPLIERS OR RESOLVERS	CONMOP
TOTAL OF OUTPUTS	COUNTS TOTAL OF OUTPUTS OF A VARIABLE WHICH ARE ENTRIES TO SERVO MULTIPLIERS	CONSP
TOTAL OF OUTPUTS	SUPPLIES TOTAL OF OUTPUTS AVAILABLE ON PATCH PANEL FOR EACH ELEMENT	NUMUSC
TOTAL OF OUTPUTS	CALCULATES TOTAL OF OUTPUTS REQUIRED FROM A MAIN ELEMENT OR ITS INVERTOR ON ANY CONSOLE	PRIGO

TOTAL OF OUTPUTS	FINDS WHETHER ENTRY TO ELEMENT COMES FROM MAIN ELEMENT OR ITS INVERTOR AND INCREASES TOTAL OF OUTPUTS FOR MAIN ELEMENT OR INVERTOR	RICALW
TOTAL OF OUTPUTS	CONTROLS TOTAL OF OUTPUTS FOR EACH ELEMENT AND ATTRIBUTES TIEPOINT WHEN NECESSARY TAKING ACCOUNT OF TRUNKS . PUTS ADDRESSING INFORMATION FOR TIEPOINTS IN SYMBOL TABLE	TIEPO
TPOM	CONTROLS IN TABLE TPOM IF GIVEN ELEMENT AVAILABLE	CTPOM
TPOM	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM	TDEC1
TPOM	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM	TDEC2
TPOM	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM	TDEC3
TPOM	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM	TDEC4
TPOM	ADD AND SUBTRACT ROUTINE FOR USE WITH TABLE TPOM	TDEC5
TPOM	COUNTS AVAILABLE ANALOG ELEMENTS AND CONSTRUCTS TABLE TPOM	ZCTP
TRUNK	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR MULTIPLIERS NOT SERVO MULTIPLIERS	CONMOL
TRUNK	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR SERVO MULTIPLIERS	CONSM
TRUNK	SUBSTITUTES AN INVERTOR OR TRUNK FOR MAIN ELEMENT IN EB-RECORD . USED FOR LINEAR COMPARATOR SWITCH EQUATIONS	CONTAM
TRUNK	LOADS INPUT AND OUTPUT TRUNK INFORMATION FOR TABLE VETT	IOST
TRUNK	SUPPLIES SATANAS COORDINATES FOR CONNECTION BETWEEN MAIN ELEMENT AND/OR ITS INVERTOR AND INPUT TRUNK	TRUKIN
TRUNK	SUPPLIES CONNECTIONS FOR INPUT TO TRUNK FROM MAIN ELEMENT OR INVERTOR FOR PANEL CONNECTIONS LIST	TRUKIX
TRUNK	ON REQUEST OF AN OUTPUT TRUNK BLOCKS THE CORRESPONDING INPUT TRUNK	YITKR
TRUNKS	COUNTS THE NUMBER OF TRUNKS NECESSARY FOR A MAIN ELEMENT AND ITS INVERTOR . STORES THE TOTAL IN SYMBOL TABLE	FPG
TRUNKS	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONTAM	RICALT
TRUNKS	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONMOL AND CONSM	SIPLUS
TRUNKS	PLACES INVERTORS AND TRUNKS IN THE EB-RECORDS AS DECIDED BY CONMOL AND CONSM	SIMIN
TRUNKS	CONTROLS TOTAL OF OUTPUTS FOR EACH ELEMENT AND ATTRIBUTES TIEPOINT WHEN NECESSARY TAKING ACCOUNT OF TRUNKS . PUTS ADDRESSING INFORMATION FOR TIEPOINTS IN SYMBOL TABLE	TIEPO
TRUNKS	STORES TRUNKS FLAG IN SYMBOL TABLE	TRUTI
TRUNKS	FINDS INPUT OR OUTPUT TRUNKS OF A GIVEN VARIABLE	YITKCR
TRUNKS	ASSIGNS TRUNKS	YTK2

VALUE OF COEFFICIENTS	FOR SIMULATOR PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS . GENERATES PROGRAM CORRESPONDING TO THE EQUATIONS	LZP2
VALUE OF COEFFICIENTS	PROCESSES LEVEL ZERO OF AN EQUATION . SEPARATES PARAMETERS FROM VARIABLES . COMPUTES THE VALUE OF COEFFICIENTS . COMPUTES IC AND SCALING FACTOR FOR AUXILIARY VARIABLES . COMPUTES IC FOR ALGEBRAIC EQUATIONS	LZP
VALUE OF COEFFICIENTS	CONTROLS VALUE OF COEFFICIENTS	SCARTO
VARIPLOTTER	PROCESSES VARIPLOTTER STATEMENTS	VRPLOT
VARIPLOTTER	SUPPLIES RECORDER AND VARIPLOTTER INPUT CONNECTIONS FOR PANEL CONNECTIONS LIST	XSRIX
VARIPLOTTERS	SUPPLIES SATANAS COORDINATES FOR INPUTS TO RECORDERS AND VARIPLOTTERS	XSRIC
VARIPLOTTERS	ATTRIBUTES VARIPLOTTERS	YVP
VARIPLOTTERS	COUNTS VARIPLOTTERS	ZZVP
VETT	FINDS THE PRECEDING OR SUCCEEDING ELEMENT IN A LIST . USED WITH TABLE VETT	APCW1
VETT	LOADS AMPLIFIER INFORMATION FOR TABLE VETT	AST
VETT	TRANSFORMS A SEQUENTIAL VECTOR INTO A LIST FORM VECTOR WHEN SUBLISTS ARE NOT PRESENT . USED FOR TABLE VETT	BLD1
VETT	LOADS INFORMATION COMMON TO ALL ANALOG ELEMENTS FOR TABLE VETT	COMMN
VETT	ORDERS ANALOG ELEMENT TABLE VETT	CORD1
VETT	ORDERS VECTORS OF ANALOG ELEMENTS FOR TABLE VETT	CORVE
VETT	CONSTRUCTS LIST HEADERS FOR CONSTRUCTION OF TABLE VETT	ELIST
VETT	FINDS ANALOG ELEMENT IN ANALOG ELEMENT TABLE VETT	EONA
VETT	LOADS ELECTRONIC MULTIPLIER INFORMATION FOR TABLE VETT	EST
VETT	SELECTS FOR EACH TYPE OF ELEMENT ROUTINE TO CONSTRUCT TABLE VETT	EWB
VETT	LOADS DFG INFORMATION FOR TABLE VETT	FST
VETT	LOADS RESISTANCE AND CAPACITY INFORMATION FOR TABLE VETT	GHST
VETT	LOADS INPUT AND OUTPUT TRUNK INFORMATION FOR TABLE VETT	IOST
VETT	LOADS REFERENCE AND GROUND INFORMATION FOR TABLE VETT	KST
VETT	LOADS LIMITERS INFORMATION FOR TABLE VETT (NOT USED)	LST
VETT	LOADS SERVO MULTIPLIER INFORMATION FOR TABLE VETT	MST
VETT	LOADS TIEPOINT INFORMATION FOR TABLE VETT	NST

VETT	ORDERS VECTORS OF ANALOG ELEMENTS FOR TABLE VETT	ORV
VETT	LOADS POTENTIOMETER INFORMATION FOR TABLE VETT	PST
VETT	LOADS HIGH ACCURACY MULTIPLIER INFORMATION FOR TABLE VETT	QST
VETT	ORDERS ANALOG ELEMENT TABLE VETT	RLA
VETT	FINDS LIST HEADER FOR TABLE VETT	RNLST
VETT	FINDS TYPE OF ANALOG ELEMENT IN TABLE VETT	RNEL
VETT	CONNECTS CELLS OF LIST PROCESSING STORAGE WHEN SUBLISTS ARE NOT PRESENT . USED FOR TABLE VETT	RST1
VETT	LOADS SWITCH AND COMPARATOR INFORMATION FOR TABLE VETT	SCST
VETT	CONSTRUCTS SYMBOL AND SUBROUTINE CALL FOR TYPES OF ANALOG ELEMENTS TO BE USED FOR TABLE VETT	TAB
VETT	CONSTRUCTS PSEUDO INSTRUCTIONS IN FAP FROM TABLE VETT	TRAN
VETT	PREPARES VECTORS FOR EACH TYPE OF ANALOG ELEMENT FOR TABLE VETT	VECT
VETT	EXTRACTS VECTOR FROM LISTS FOR TABLE VETT	VFL
VETT	SEARCHES UNUSED ANALOG ELEMENT OF A GIVEN TYPE IN ANALOG ELEMENT TABLE VETT	YRV
W-RECORDS	IDENTIFIES AND GIVES E-CODE TO EACH OPERAND AND OPERATOR OF EQUATIONS . RECOGNISES AND COMPUTES VALUES OF PARAMETRIC EXPRESSIONS . BUILDS W-RECORDS	IDNTFY
WRITES	WRITES ONTO AN INTERMEDIATE TAPE THE COMPILED EQUATIONS . USED WITH THE SIMULATOR	ATRIN
WRITES	FOR SIMULATOR WRITES LABELS CORRESPONDING TO AN OUTPUT LINE AS SPECIFIED IN PRINT STATEMENT	PHEAD
WRITES	WRITES ON TAPE POT SETTING , READ OUT , NETWORK CARDS	PUNCH
WRITES	WRITES FAP ROUTINE PANEL ON TAPE	PUNP
WRITES	SUPPLIES AND WRITES REFERENCE AND GROUND IN PANEL CONNECTIONS LIST	RESTA
WRITES	WRITES A LINE IN PANEL CONNECTIONS LIST	STAM
WRITES	WRITES INVERTOR EQUATIONS	WRQIN
WRITING	DETECTS WRITING ERRORS IN PROGRAM STATEMENTS	DIAGN
WRITING	WRITING ROUTINE FOR INTERMEDIATE TAPES . USED BY LINKS 36 361 3613 362	RUTWR
WRITING	PREPARES MESSAGE FOR WRITING OF PANEL CONNECTIONS LIST	TEX
WRITING	TAPE WRITING ROUTINE FOR EDITOR	WRITE
WRITING	MESSAGE WRITING ROUTINE	WMNS

WRITING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 341	YRW
WRITING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 342	YRW2
WRITING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343	YRW3
WRITING	READING WRITING ROUTINE FOR INTERMEDIATE TAPES USED BY LINK 343	YRW4

4. LOGIC OF MAIN SECTIONS

4.1 THE APACHE LIST PROCESSING

4.1.1 General

One way of storing information in the core storage is that of putting it sequentially in adjacent cells.

With this method, to insert or delete an element we must change the physical position of a part of the information, and this operation could imply a long processing time which depends on the volume of information. This method of storage is successful if the relationship between the different elements is sequential, that is, if their relative position is able to show the existing relationship. It would be rather difficult to show by a sequential storage the concept of subordination, although it is possible.

Another way of storing information is that of making the concept of relationship between two elements independent of the physical position in which they are stored. In this case, together with the element of information itself, the locations of the preceding as well as of the succeeding element are also stored. This technique permits easy locating of the different elements of information and fast addition of information.

The method is referred to as list processing. In the APACHE System list processing is used whenever it is necessary to process large amount of information of variable length which need to be often modified, as:

a. while constructing the SYMBOL TABLE. (LINK 1)

b. while transforming equations to standard form. (LINK 21)

c. while construncting the cross-references table. (LINK 4)

4.1.2 List and Sublist

In the Apache List Processing System one element of information is stored in two neighbouring locations: one contains the element itself, the other contains the addresses of its preceding and succeeding elements.

A number of elements stored in this way is called a LIST. An element of the list may have a subordinate list which, in general, is a specifier of the element. A subordinate list is called a SUB-LIST. Elements of a sub-list may also have sub-lists.

4.1.3 Structure of a list

As explained above an element of a list is made of two words of storage:

1. Control word (location A)

Bits	Contents	
S	1	Last element of the list
	0	Other elements
1	1	This element has a sublist
	0	This element has no sublist
2	1	First element of the list
	0	Other elements
3-17	a.	The element is the first of a sublist: Address of the element succeeding the element to which the sublist is attached
	b.	The element is the first of a main list: zero
	c.	The element is not a. nor b. address of the preceding element.
18-20	not used	

Bits		Contents
21-35	a.	The element is the ast of a list: zero
	b.	The element is not the last: address of the succeeding element

2. Information word (location A-1)

Bits	Contents
S-35	Information

Example:

1. List with no sublist.

A_1-1	Information		
A_1	1	0	A_2

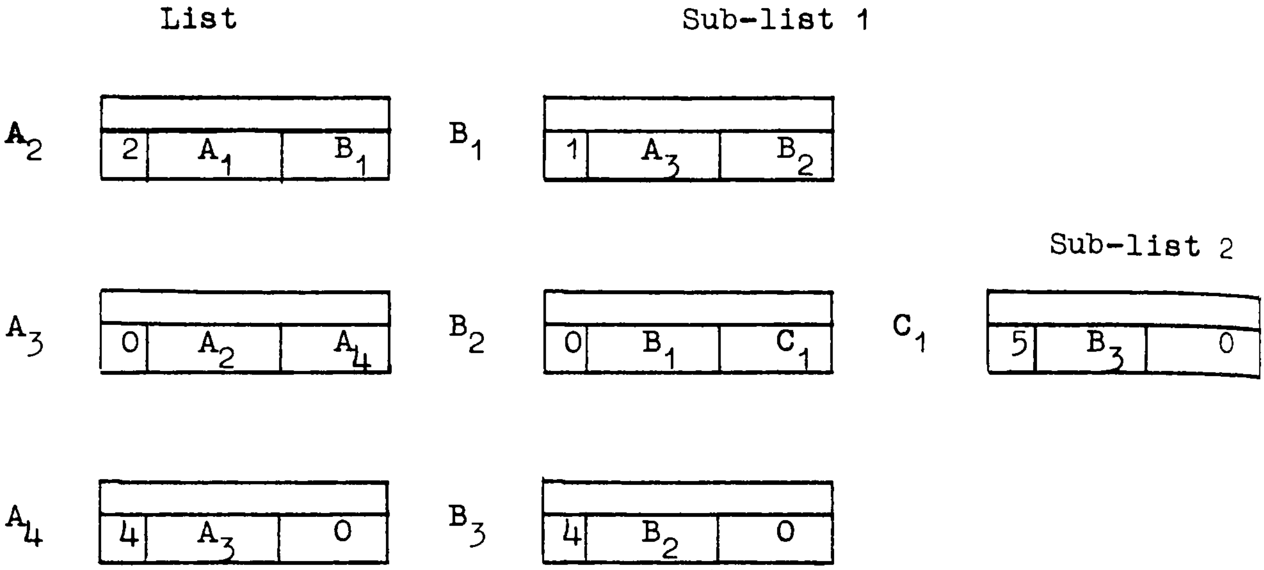
A_2-1	Information		
A_2	0	A_1	A_3

A_3-1	Information		
A_3	4	A_2	0

2. List with sublists

List

A_1	1	0	A_2



4.1.4 Storage Allocation

In the Apache System a fixed portion of the core storage is reserved for list storage and processing. This is located in the COMMON and called BLIST. In addition the address of the control word of the first element of each main list which is defined is stored in a sequential table ALIST. In this way it is possible to refer to a given list by knowing the relative location of ALIST which contains the address of its first element.

4.1.5 The list processing subroutines

A description of the principle routines used in the list processing.

4.1.5.1 Construction of a list

SUBROUTINE RESET

This subroutine is used before any list operation is started. It constructs an empty list which occupies the whole storage assigned (BLIST).

SUBROUTINE BUILD (A(1), A(N), K)

This subroutine constructs a list whose first address is found in ALIST(K). The information is taken from the vector A and each word is considered one information word of the list.

Example

N = 3 , K = 5

CALL BUILD (Z(1), Z(3), 5)

Result:

L_1-1	Z(1)		
L_1	1	0	L_2

ALIST (5)

0	0	0	L_1

L_2-1	Z(2)		
L_2	0	L_1	L_3

L_3-1	Z(3)		
L_3	4	L_2	0

Note: the subroutine BUILD may also be used as a function. In this case the value of the function will be the address of the last element of the generated List.

Example:

A = BUILD (Z(1), Z(3), 5)
after execution A = L_3

SUBROUTINE DEFINE (A1, A2, K)

Given a list M two elements of which are E1 and E2 with addresses A1 and A2 respectively, and E2 comes logically after E1, this subroutine constructs the list K with all the elements of the list M from E1 to E2. These are deleted from the list M.

Example

Address E1 = L2
Address E2 = L4
First address list K in ALIST (7)
First address list M in ALIST (3)
CALL DEFINE (L2, L4, 7)

List M (before execution)

L_1	1	0	L_2
L_2	0	L_1	L_3
L_3	0	L_2	L_4
L_4	0	L_3	L_5
L_5	0	L_4	L_6
L_6	4	L_5	0

List K (after execution)

L_2	1	0	L_3
L_3	0	L_2	L_4
L_4	4	L_3	0

List M (after execution)

L_1	1	0	L_5
L_5	0	L_1	L_6
L_6	4	L_5	0

ALIST (3)		L_1
ALIST (7)		L_2

SUBROUTINE AFTER (E, A(1), A(N))
SUBROUTINE FORE (E, A(1), A(N))

If E is an element of a given List, the subroutine AFTER inserts between E and its succeeding element the N new elements whose information word is found in the vector A. The subroutine FORE performs the same operation between E and its preceding element.

Example:

Original List (list number 10)

L_1		1	0	L_2
L_2		0	L_1	L_3
L_3		4	L_2	0

ALIST (10)		L_1

CALL AFTER (L_2, A(1), A(2))

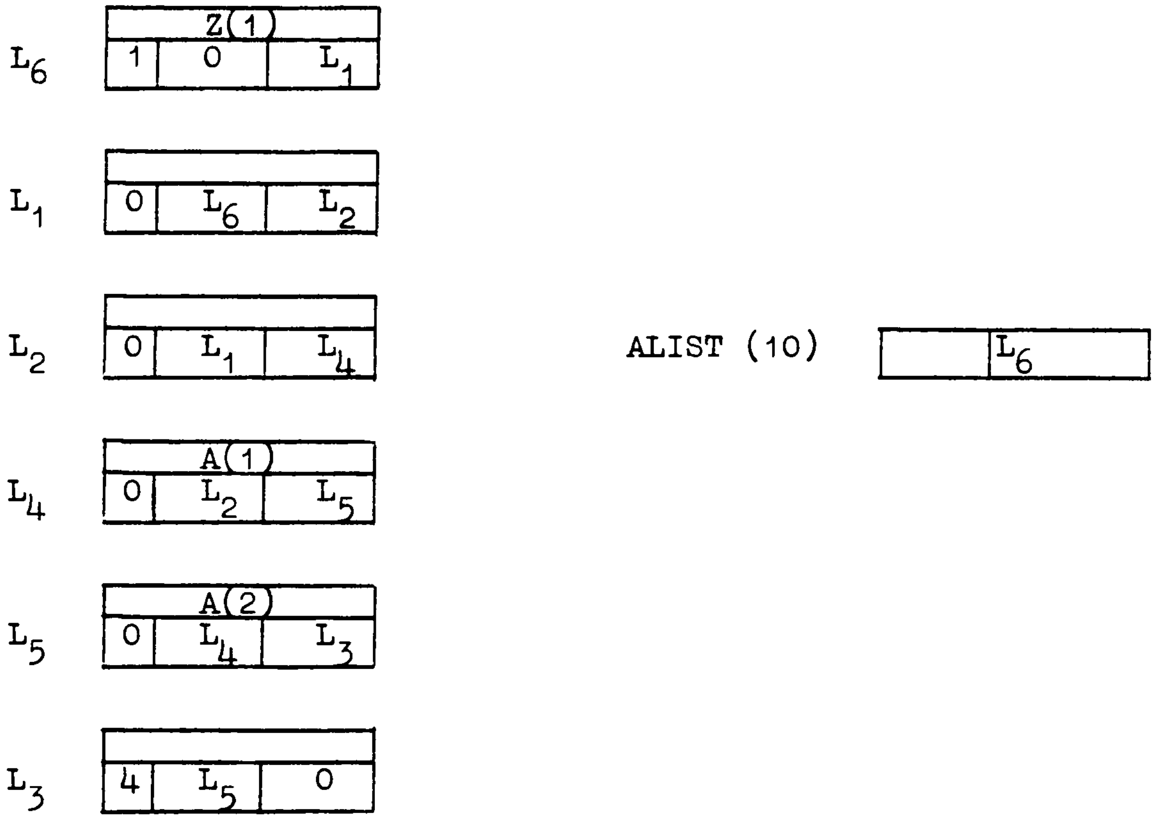
Resulting list

L_1		1	0	L_2
L_2		0	L_1	L_4
L_4	A(1)	0	L_2	L_5
L_5	A(2)	0	L_4	L_3
L_3		4	L_5	0

ALIST (10)		L_1

CALL FORE (L_1, Z(1), Z(1))

Resulting List



SUBROUTINE INSLA (E, L1, L2)

SUBROUTINE INSLF (E, L1, L2)

If E is an element of a given list, and L1 and L2 are two elements of another list, L2 coming logically after L1, the subroutine INSLA inserts between E and its succeeding element the elements L1 to L2 of the second list. The subroutine INSLF performs the same operation between E and its preceding element. In both cases elements L1 through L2 are deleted from the second list.

Example:

Before execution

L_1		L_2	S_1		S_2
L_2	L_1	L_3	S_2	S_1	S_3
L_3	L_2	L_4	S_3	S_2	S_4
L_4	L_3	L_5	S_4	S_3	S_5
L_5	L_4		S_5	S_4	

CALL INSLA (L2, S2, S4)

After execution

L_1		L_2	S_1		S_5
L_2	L_1	S_2	S_5	S_1	
S_2	L_2	S_3			
S_3	S_2	S_4			
S_4	S_3	L_3			
L_3	S_4	L_4			
L_4	L_3	L_5			
L_5	L_4				

4.1.5.2 List processing

FUNCTION DNEXT (I,E)
FUNCTION DLAST (I,E)

If E is an element of a given List the value of the function DNEXT is the information word of the I-th element succeeding E, the value of DLAST is the information word of the I-th element preceding E.

Each time DNEXT is called, after the execution the cell CNEXT in the COMMON storage contains the address of the control word of the resulting element. After the execution of DLAST the cell CLAST in the common storage contains the address of the control word of the resulting element.

Example:

List

L_1

C(1)		
1	0	L_2

L_2

C(2)		
0	L_1	L_3

L_3

C(3)		
0	L_2	L_4

L_4

C(4)		
4	L_3	0

A = DNEXT (2, L_2)

Result:
A = C(4)
CNEXT = L_4

B = DLAST (1, CNEXT)

Result:
B = C(3)
CLAST = L_3

FUNCTION SLTRA (E)

If E is an element of a list and it has no sublist then the value of the function is zero. If it has a sublist, the value of the function is the address of the control word of the first element of the sublist.

Example:

L_1	0	0	L_2
L_2	2	L_1	S_1
L_3	4	L_2	0

S_1	1	L_3	S_2

$A = \text{SLTRA}\ (L_1) = 0$
$A = \text{SLTRA}\ (L_2) = S_1$

FUNCTION END (E)

If E is not the last element of a list the value of the function is $\neq 0$. If E is the last element the value of the function is zero.

4.1.5.3 Erasure of lists

SUBROUTINE ERASEL (I)

The list I is erased. This means that it cannot be referred to any more. The storage occupied by the List I is made available for a new list.

4.2 TRANSFORMATION OF EQUATIONS TO STANDARD FORM

4.2.1 The STANDARD FORM

The standard form of an equation is defined as follows:

$$\left\{\begin{array}{l}\text{VARIABLE}\\ \text{DER (VARIABLE)}\\ \text{ZERO (VARIABLE)}\end{array}\right\} = \sum_{i=1}^{n} \text{PARAMETRIC EXPRESSION}_i * \text{VARIABLE}_i$$

The first operation performed in order to obtain the standard form of an equation is that of reorganising the physical structure of the equation itself in order to permit a quick and powerful processing using list-processing. This operation is done by assigned a hierarchical value to each arithmetic operator or parenthesis which appears in the equation. This value is called LEVEL-VALUE.

The level-value is determined as follows:

a) The equals sign (=) has by definition a level-value equal to zero.

b) The equation is scanned from left to right and each consecutive pair of operators is taken into consideration in turn. ("operators" for this purpose includes, besides the arithmetic operators, parenthesis open and close, beginning of equation, and end of equation).
To each pair corresponds an increment or decrement of the level-value as shown in Fig. 1.

Present operator \ Next operator	Beginning or end of statement	(	)	±	*/	=
Beginning or end of statement		+3		+1	+2	0
(		+2	0	0	+1	
)	-3		-2	-2	-1	-3
±	-1	+2	0	0	+1	-1
*/	-2	+1	-1	-1	0	-2
=	0	+3		+1	+2	

FIG. 1

E.g. for the equation:

X = (A+B) * (Y+Z) - (C/(W+T)+D) * S

the consecutive pairs of operators would be:

Present operator	Next operator	Increment in level-value	Level-value
Beginning of equation	=	+0	0
=	(	+3	3
(	+	+0	3
+	)	+0	3
)	*	-1	2
*	(	+1	3
(	+	+0	3

and so on.

Using this method of organisation of the equation we represent it diagrammatically as shown below:

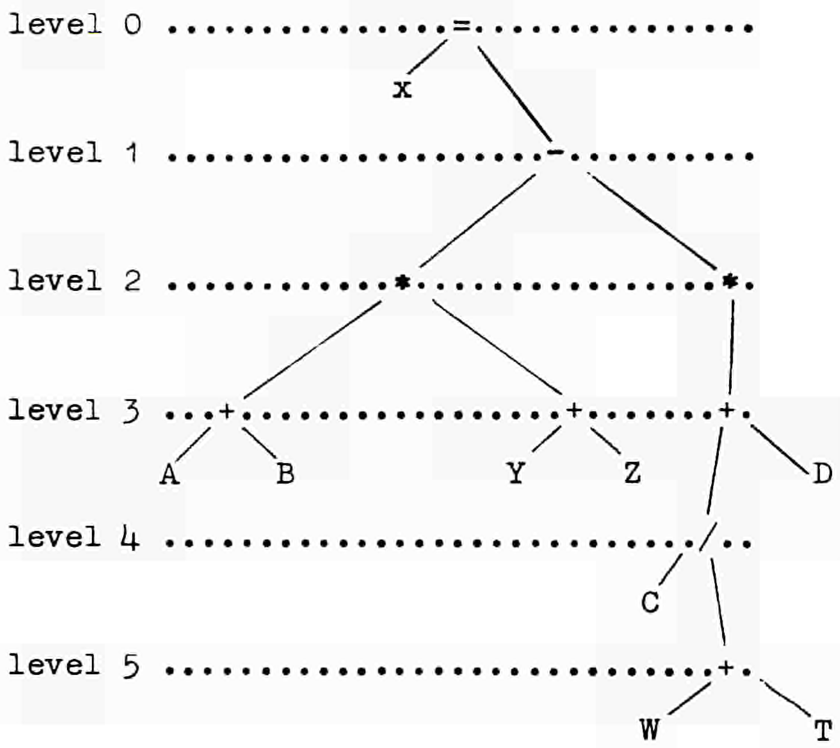


FIG. 2a

We note that add and subtract operations always fall on odd level-values, multiply and divide operations always fall on even level-values.

In order to show up more clearly that this method of organising the equation reduces it to a form suitable for the use of list-processing we redraw Fig. 2a in another form.

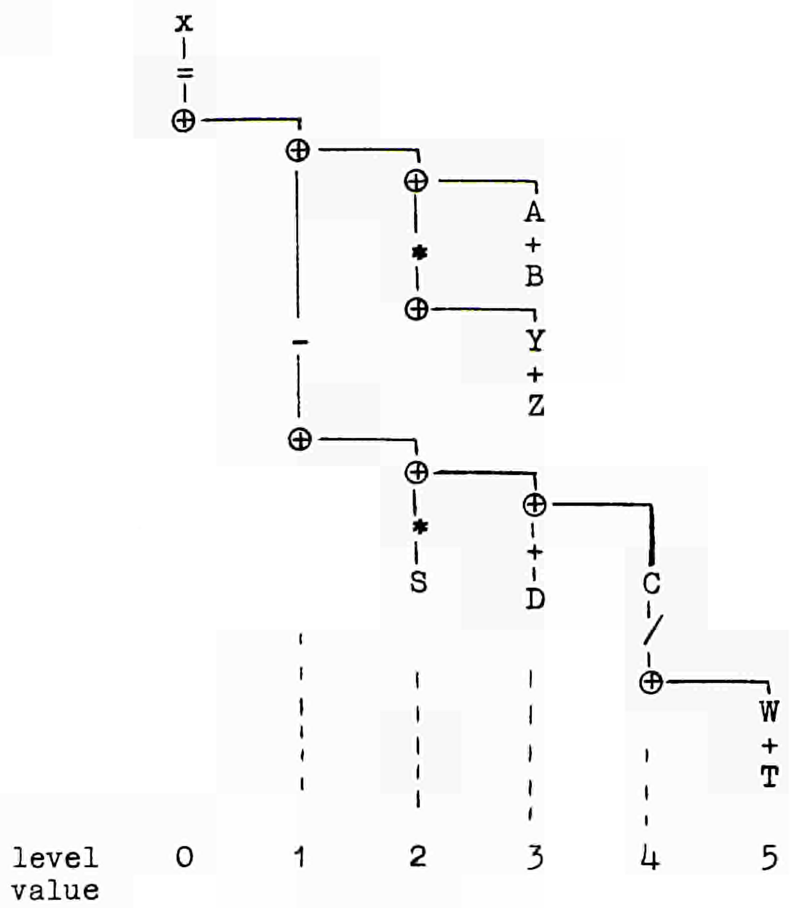


FIG. 2b

The elements ⊕ are "dummy elements" and correspond to the point of attachment of a list to the list of which it is a sub-list.

Note that if the LHS of an equation is an arithmetic expression the same rules apply.

If, after the transformation, the maximum level-value reached is L, then the equation is said to be of level L.

An EXPRESSION of level K is said to be a STANDARD EXPRESSION of level L(L=K) if either it does not contain any expression of level higher than L or, if it does, this is not further reducible.

In the example above the equation is of level 5, W+T is a standard expression of level 5; A+B and Y+Z are standard expressions of level 3 and C/(W+T) is a standard expression of level 4 because, even containing W+T which is of level 5, no further operation is possible.

Note that if A is a standard expression of level L, (A) is one of level L+2 and it is not a standard expression.

A given level is said to be satisfied if it contains only standard expressions. The standard form of an equation is obtained by the application of the following rules:

a. The LHS is transformed into one of the following forms

1. VARIABLE
2. DER (VARIABLE)
3. ZERO (VARIABLE)

b. The RHS is reduced to a standard expression of the minimum possible level.

c. Each term of the standard expression is transformed into the following form

$\pm$ PARAMETRIC EXPRESSION * VARIABLE

(In this connection note that an arithmetic expression which contains at least one variable is considered a variable. For example (A+X)/Y is a single variable).

d. If no parametric expression results, one is supplied whose value is 1.

e. If no variable is present the variable REF is supplied. This is also supplied in cases in which the resulting term is of the form

$\pm$ PARAMETRIC EXPRESSION/VARIABLE

which is transformed to

$\pm$ PARAMETRIC EXPRESSION * REF/VARIABLE

f. Terms containing NULL parameters are deleted. If all terms are NULL the entire equation is deleted.

g. Terms which have the same variable are grouped together.

4.2.2 The TREE

The diagrams shown in Fig. 2 are called trees. For our purpose the type of tree in Fig. 2b has been chosen because it was more suitable for processing by means of the Apache list processing. The construction of the tree is performed in the following way:

a) An empty main list is constructed

b) The equation is scanned from left to right and the level-values determined as explained in 4.2.2 a) and b)

c) Every time the level-value is increased by one unit a "dummy element" is placed in the next available position of the list in process and an empty sublist is attached to this "dummy element".

Example

X = (Y+Z) * C

Scanning from left to right:

Present operator	Next operator	Increment in level-value	Level-value
Beginning of equations	=	+0	0
=	(	+3	3
(	+	+0	3
+	)	+0	3
)	*	-1	2
*	end of equation	-2	0

we begin, with in the main list:

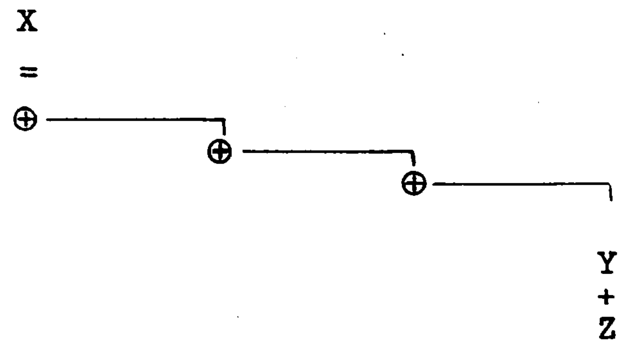
MAIN LIST (level 0)

X

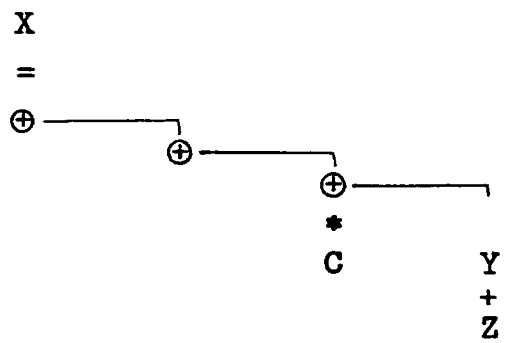
=

at this point there is an increment in level-value of 3 so we put a "dummy element" in the next available position of the main list and attach a sublist (level 1), fill in a "**dummy** element" and attach a sublist (level 2), fill in a "dummy element" and attach a sublist (level 3). We continue to fill in elements in sublist (level 3) until there is another change of level-value. At this point we have:

Main list (level 0) Sublist (level 1) Sublist (level 2) Sublist (level 3)



At the matching of) with * there is a decrease in level-value of 1. To represent this we must move back one level to the sublist of level 2. The organisation of the equation is thus:



Note that parentheses are never placed in the tree.

The general rules for the placing of dummy elements in the tree are:

1) If the level-value increment is positive, "dummy elements" are put in the next available position of the list in process <u>before</u> the level-value is increased.

2) If the level-value increment is negative, "dummy elements" are put in the next available position of the list which is arrived at <u>after</u> the level-value has been decreased.

We illustrate a more complicated example

$$A * X = B * (Y+Z) - C * T$$

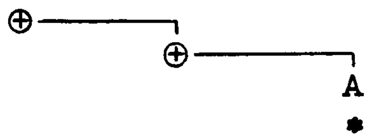
Scanning from left to right:

	Present operator	Next operator	Increment in level-value	Level-value
a)	Beginning of equation	*	+2	2
b)	*	=	-2	0
c)	=	*	+2	2
d)	*	(	+1	3
e)	(	+	0	3
f)	+	)	0	3
g)	)	-	-2	1
h)	-	*	+1	2
i)	*	end of equation	-2	0

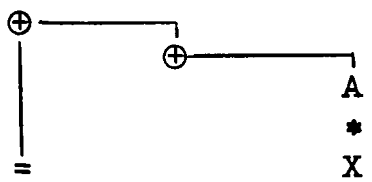
which gives us, stage by stage:

<u>Main list</u> (level 0)   <u>Sublist</u> (level 1)   <u>Sublist</u> (level 2)   <u>Sublist</u> (level 3)

a)



b)

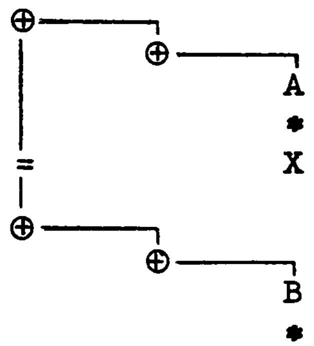


These two stages illustrate the general rules for the placing of the variables in the tree, equivalent to the rules for the placing of the "dummy elements" stated in 1) and 2) above.

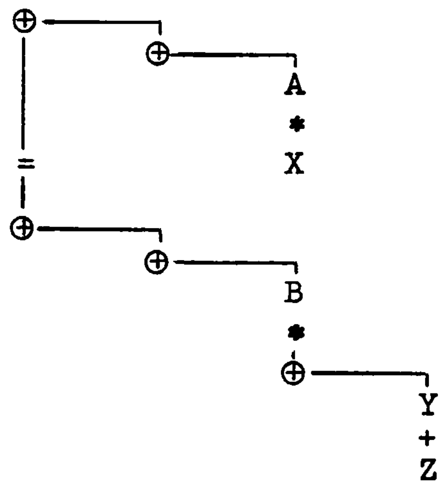
3) When the level-value is increased, any variable coming between the pair of operators which have caused the increase is written in the sublist arrived at <u>after</u> the level value has been increased.

4) When the level-value is decreased, any variable coming between the pair of operators which have caused the decrease is written in the sublist in process <u>before</u> the level-value is decreased.

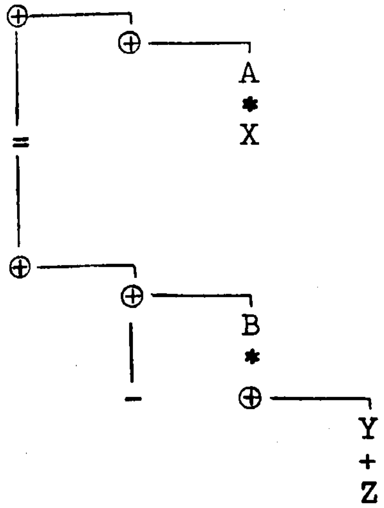
c)



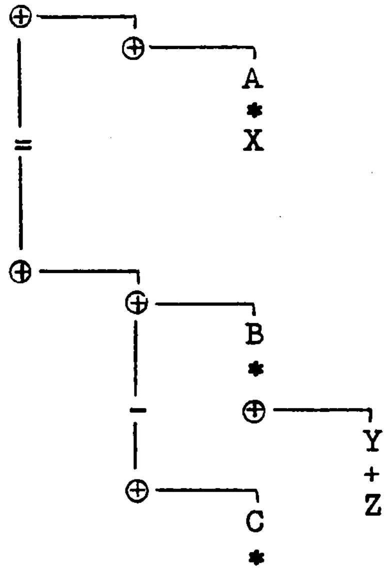
d)
e)
f)



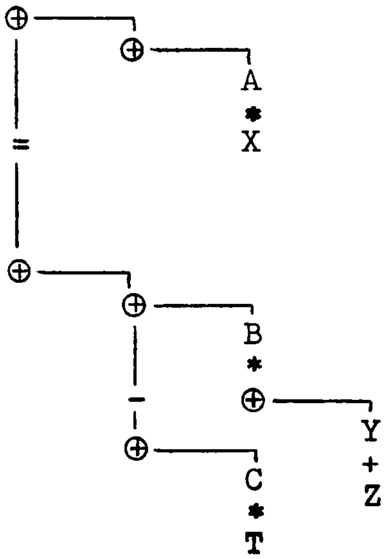
g)



h)



i)



The construction of the tree, in the Apache System, is performed by the subroutine TREE.

4.2.3 Processing of the tree

By definition, if an equation is of level L the expressions of level L which it contains are all standard expressions; and since the level-value is increased each time a higher hierarchy operation is encountered, the processing starts at the highest level-value reached minus one. The transformation is then performed in the following way

a. All expressions of the same level are processed in one pass.

b. Even levels are processed as follows:

1. Each multiply operator produces the algebraic development of the product.
2. The first divide operator is not processed. Each subsequent division, if any, is performed by multuplying the dividend by the divisor of the first fraction.
3. When all the operations have been performed the result is a standard expression.
4. The level is satisfied when it contains only standard expressions.

Examples:

.... + A*B/X*(Y+Z)/W + ...

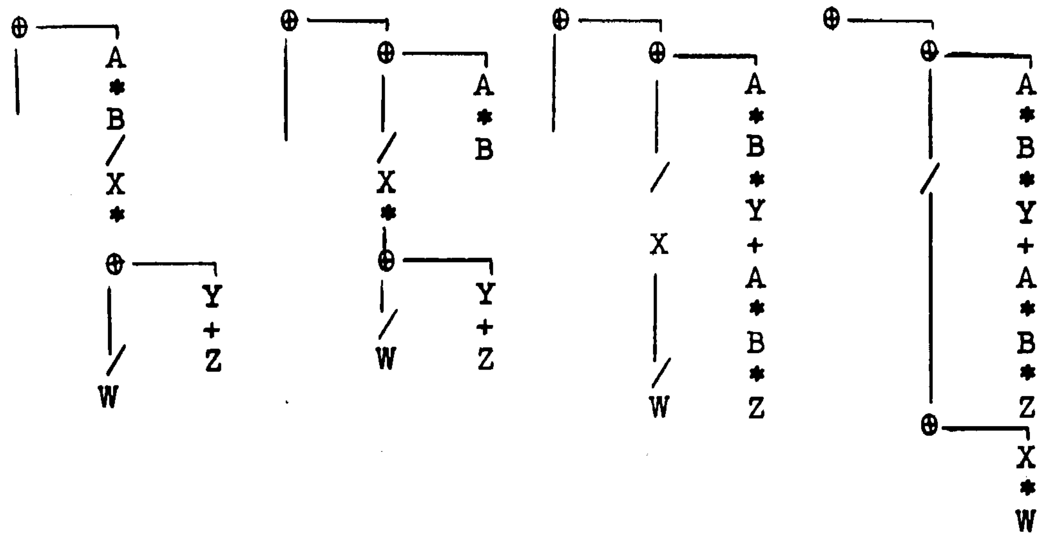


FIG. 5

.... + A * X * (Y+Z) + ...

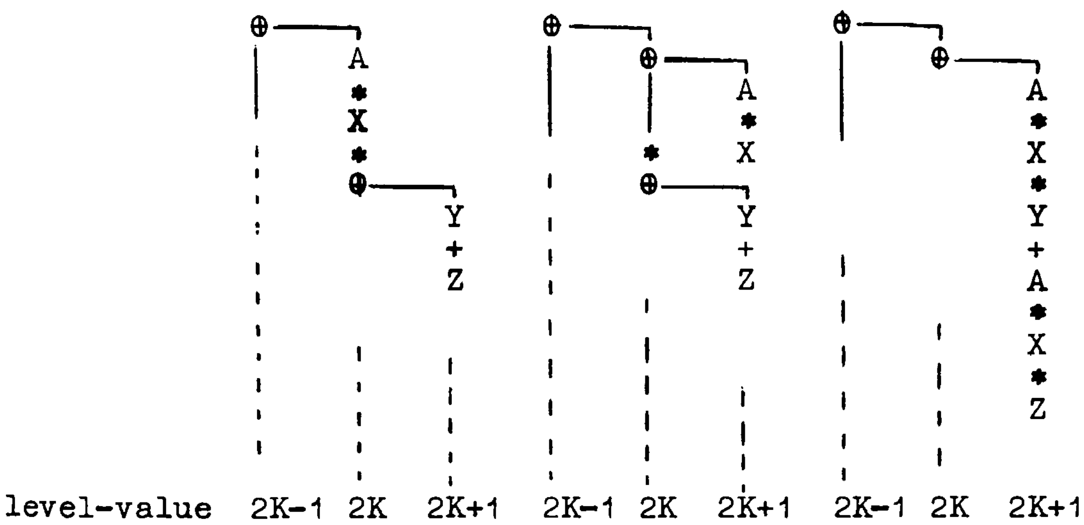


FIG.6

c. Processing of odd levels does not imply any algebraic development but consists merely in the elimination of the higher even level which becomes redundant after having been processed.

Examples :

... + A B/X (Y+Z)/W + ...

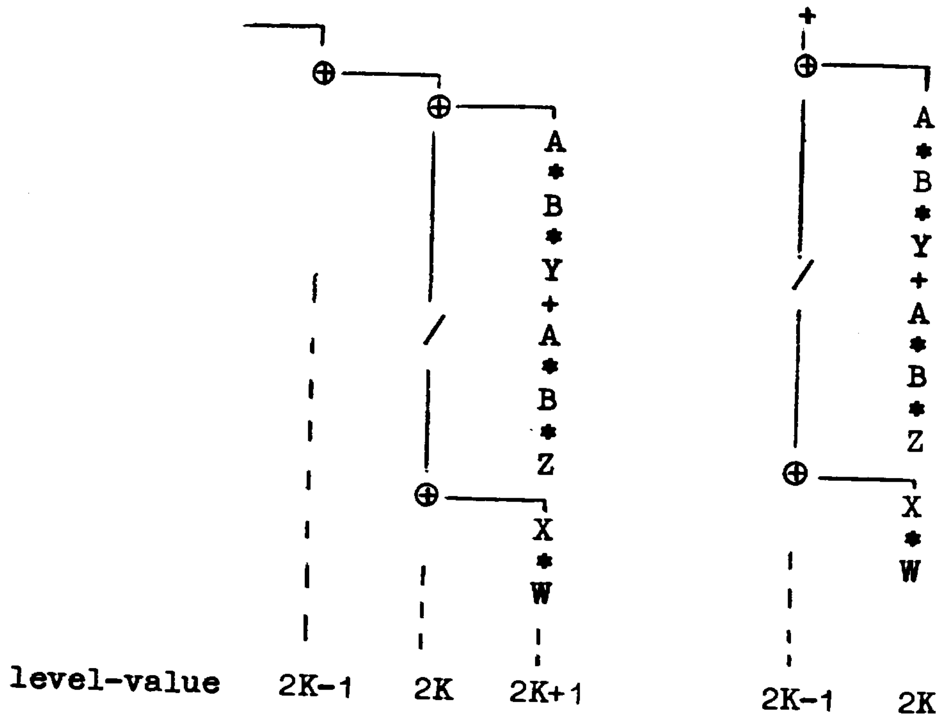


FIG. 7

... + A * X * (Y+Z) + ...

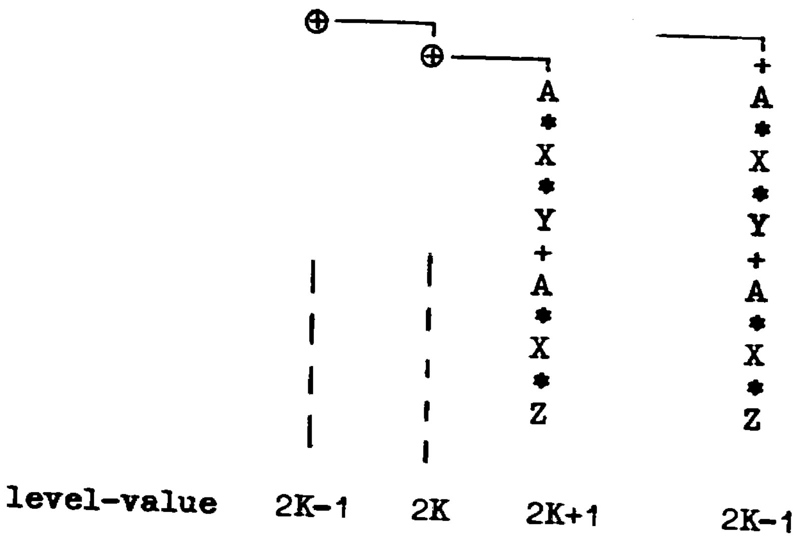


FIG. 8

d. Steps b. and c. are repeated alternately until level 1 is satisfied.

e. The equation at this point is not in the standard form because:

   1. Parameters and variables are not separated.
   2. Terms which have the same variables have not yet been grouped.
   3. If the LHS was an expression the LHS variable has not yet been isolated.
   4. REF has not been added where needed.

Two subroutines are used to process the tree. The subroutine POTA reduces the RHS of the equation to a standard expression of level 1 and transforms the LHS to a standard LHS. The subroutine LZP (Level Zero Processor) obtains the standard form of the equation as explained in 4.2.1.

4.2.4 Parametric Expressions

During the generation of W-RECORDS in LINK 2 (see 8.2) PARAMETRIC EXPRESSIONS are recognized and coded as a single item. The value of the expression is recorded in the SYMBOL TABLE (see also IDNTFY and 7.3). Parametric expressions are only recognized as such when they are enclosed in parentheses.

This feature has the following advantages:

1. Avoids development and regrouping of the same expression

   Example:

   (A+B)*X would otherwise give A*X+B*X which would then be rewritten as (A+B) X after the tree had been processed.

2. Avoids undesired variables being generated as the result of a division

Example :

(A+B/C)*X/Y would otherwise give A*X/Y + B*X/(C*Y)

3. Permits the analog programmer to influence the standard form of the equations.

4.3 Minimisation of invertors

4.3.1 General

The aim of LINK 31 is to arrange the signs of the equations which will make up the analog circuit in such a way that the number of invertors is as near as possible to an absolute minimum.

4.3.2 Invertors necessary for technical reasons

For technical reasons associated with the analog computer certain variables will have to be given invertors and these are assigned before attempting to arrange the signs of the equations. These cases are as follows:

1) Linear equation with feedback of same sign as output of element, invertor given to output variable.
2) Normal servo-multiplier, variable entering cup has both signs.
3) Quarter square multipliers; multiplication - invertor needed for both factors; division - invertor needed for quotient and denominator.
4) High accuracy multipliers, as for 3) above.
5) Comparators and switches, if same variable enters on two contacts it will have positive and negative sign.
6) Resolvers; rectangular, the radius requires an invertor, polar, the x and y entries need both signs.

4.3.3 Programmed invertors

The analog programmer can impose the sign with which a variable is output from its main element, by using PLUS and MINUS, and can impose an invertor on a variable, by using INV. (See Programmers Manual page 19). These imposed signs are taken into consideration in the signs matrix.

4.3.4 Signs Matrix

4.3.4.1 General

Using the list-processing method described in 4.1 a two-dimensional matrix is constructed containing all the linear equations of the problem.

These equations are entered with their signs appearing as they would on the analog computer, that is a linear, differential, or ZERO equation has the L.H.S. variable changed in sign as it would be changed by the amplifier, a comparator or switch keeps the algebraic signs as there is no sign-changing in the element.

For the construction of the matrix the signs of the RHS are entered as written, the sign of the LHS is put negative for variables output from amplifiers. The matrix is arranged in rows by equation and columns by variables, with any column containing only terms of the same variable.

4.3.4.2 Construction of matrix

Each element of the matrix is as follows:

S	3	18	21
S	C	P	R
G	PR		SR
G	PC		SC

PR   address of preceding element of the same row.
SR   address of succeeding element of the same row.
PC   address of preceding element of the same column.
SC   address of succeeding element of the same column.
G = 2 if this is the first element of a line or column (in this case PR or PC give the address of the header word for this line or column)
G = 4 if this is the last element of a row or column (in this case PR or PC is zero)
G = 6 if the two conditions occur together.

Header word for row

S 1	2	3	18	21
S	S1		U	FR

S = 0 positive sign
   = 1 negative sign
FR   address of first element of the row
S1 = 0 if the row has not been treated
S1 = 2 if the row has been treated (i.e. has been assigned a sign)

Header word for column

S 1	2	3	18	21
S	S1	NC	U	FC

S, S1   as above
NC   number of column
FC   address of first element of the column
U = 0   if the column has not been treated
U = 4   if it has been treated and has been assigned an invertor (i.e. both signs of the variable are available)
U = 6   if it has been treated and has not been given an invertor
U = 5   when there is a programmed impose of sign PLUS or MINUS for this variable.

Control word for column header

	NE		CO

CO address of the corresponding column header word
NE number of variables which make up the column

4.3.5 Processing of signs matrix

The routine SIGN uses an algorithm to arrange the signs of the rows and columns of the matrix so that the number of invertors required is as near as possible to a minimum.

4.3.6 Attribution of invertors to non-linear equations

These are left until last so that the signs can be given taking account of the distribution of signs already fixed.

1) DFG : the input and output signs are to follow the same relation as given in the original equation
2) Servo-multipliers, positive and negative : an invertor is given to the second factor if the input and output signs are not consistent
3) High accuracy multipliers, division : to the numerator if it is negative and has not already an invertor.
4) Electronic multipliers : multiplication, to the second factor if the signs are not consistent; division, to the denominator if it is negative, to the numerator if the signs are not consistent.
5) Variplotters : all entries must have the sign as programmed.

4.3.7 Signals in SYMBOL TABLE

In the SYMBOL TABLE is put information about the sign of the IC of variables, the output sign of a variable, and a signal if an invertor is required. Special signals for ZERO functions, corresponding to feedback and GAIN 1 are also inserted.

4.4 Control of Gains and Reduction of Amplifier Entries to Patchable Components

4.4.1 General

This work is carried out in LINK 331. This LINK receives the equations reduced to their standard form and with all physical values of the coefficients and the scaling factor attached to each variable codified in the EQM-record (8.3). The first task is to calculate the scaled coefficients, taking account of BETA for differential equations, these values are then stored in EQM. Using these scaled coefficients, if the scaled equations were decodified from EQM they would be algebraically correct but would not necessarily be in a form which corresponds to the representation of the equation on the patch panel. To obtain this each entry must be broken down into components which correspond to the patching possibilities, that is for amplifiers gains of 1 or 10 combined, or not, with a pot, and gains of 1 for comparators and switches.

This breaking down into components can be performed in many ways, the system which was chosen for the standard APACHE is explained below.

4.4.2 Control of gains

Before attempting to reduce the gains into components their value must be controlled and if too large reduced where technically possible.

Control Criteria (see also 5.6.1)

AMAX	= 30	(maximum value of gain allowed for algebraic equations)
AMHG	= 10	(maximum value of gain allowed for implicit equations)
AMIN	= .0005	(minimum value of gain below which a diagnostic will be given)
MCAP	= 3	(value of smallest external capacitor to be used for integrators is $1/10^{\mathrm{MCAP}}$)

MPOWER = 10 (maximum value of gain allowed for differential equations is AMAX * 10^{MPOWER})

The methods of reduction used are explained in the Programmers Manual Appendix F.

For differential, algebraic, and zero equations this work is carried out in XGAINS. The gains to the coil of comparators are scaled and controlled in CMCOIL. The gains to the contracts of switches and comparators are controlled with COMPOT. All zero equations are processed before XGAINS by ZCDIV. Any entries coming from a servo-multiplier are given a gain 1 to eliminate the need for a buffer amplifier. All entries with an IMPOSE GAIN 1 are reduced to gain 1 if possible, otherwise a diagnostic is given.

4.4.3 Reduction of entries to components

In XENTRY each term of an equation which requires more than one of the components (entry resistance 1, entry resistance .1, resistance 1+pot, resistance .1+pot) to make up its gain is split into two or more terms according to the table below.

COEFFICIENT = C	COMPONENTS
C < AMIN	POT x GAIN 1 (with warning diagnostic)
C < 1	POT x GAIN 1
C < 2	POT x GAIN 10
C = 2	GAIN 1 + GAIN 1
2 < C < 10	POT x GAIN 10
C = 10	GAIN 10
10 < C < 11	POT x GAIN 1 + GAIN 10
C = 11	GAIN 1 + GAIN 10
11 < C < 20	POT x GAIN 10 + GAIN 10
C = 20	GAIN 10 + GAIN 10
20 < C < 21	POT x GAIN 1 + GAIN 10 + GAIN 10
C = 21	GAIN 1 + GAIN 10 + GAIN 10
21 < C < 30	POT x GAIN 10 + GAIN 10 + GAIN 10
C = 30	GAIN 10 + GAIN 10 + GAIN 10

The record EQM for each equation is modified accordingly.

EXAMPLE

EQM

J = 1	J = 2	J = 3	
Physical coeff.		Scaled coeff.	EQM (N,J)
variable X	IC of X	scaling of X	EQM (N+1,J)

Suppose that the scaled coefficient is 20.32. The entry in EQM becomes:

P.C x $\frac{.32}{20.32}$		.32	EQM (N,J)
X	I.C X	Scaling of X	EQM (N+1,J)
P.C x $\frac{10}{20.32}$		10	EQM (N+2,J)
X	I.C X	Scaling of X	EQM (N+3,J)
P.C x $\frac{10}{20.32}$		10	EQM (N+4,J)
X	I.C X	Scaling of X	EQM (N+5,J)

For each equation a total is made of the number of pots, manual pots, entry resistances of 1, entry resistances of .1.

The standard PACE amplifier has three entry resistances of .1, three entry resistances of 1. The total of resistances for an equation is controlled against this standard. If one more resistance of .1 or one more resistance of 1 is needed, a signal is put in EQM (99,2) (7.10) indicating that an external resistance is to be used as input. If more than one extra resistance is needed the number of auxiliary amplifier networks is calculated and put in EQM (99,2). For use in the section of Link 331 which counts the elements, the number of manual pots, normal pots, and auxiliary networks are stored in the EQM record for each equation.

4.5 Accounting of elements and distribution between consoles

4.5.1 General

The allocation of a console number to each variable is carried out in LINK 331 and involves a count of the elements required to patch the problem and a comparison with the totals of elements available, stored in table TPOM (6.9), taking into consideration either the consoles selected by the analog programmer, or if no console select has been made, the consoles available. If no AVAILABLE CONSOLES has been provided, any console for which panel information exists is considered available.

In any case in which the number of elements available is not sufficient, a diagnostic is given (see Programmers Manual Appendix G) and the addressing skipped, the output link, LINK 4, being called.

4.5.2 Precedence of impose

If there has been an IMPOSE of a specific element a preliminary pass of the equations is made in which only the IMPOSE elements are counted into TPOM. This is necessary because, counting IMPOSE elements together in one pass with non-IMPOSE elements, a console may be filled before all the IMPOSE elements on that console are counted. All the subroutines for the count are common to IMPOSE and non-IMPOSE passes, they distinguish the passes with the switch ITRO.

4.5.3 Distribution between consoles

The count of the elements into TPOM is carried out with the following criteria.

If CONSOLE SELECT is given, all elements of the relative equations are counted on the selected console except for multipliers. If no CONSOLE SELECT, or CONSOLE SELECT 0, is present the count begins on the first available console in the order in which they are given in the AVAILABLE CONSOLES card (7.9). The number of the working console is always saved in ICON.

Multipliers and resolvers are considered a special case in that they have multiple inputs which may come from various consoles. Multipliers and resolvers are counted when their "arm" variable appears on the left hand side of an equation and are placed on the same console as the "arm" variable when possible, if not, on the first available console which has a free element. Every multiplier in a concatenation of multipliers is counted when the "arm" variable of the first multiplier in the chain is found on the left hand side of an equation.

External variables (i.e. variables which never appear on the left hand side of an equation) are not counted. Multipliers which have an external variable as "arm" variable are counted after all the equations have been passed.

For each linear equation the left hand side element together with any entry pots, invertor, auxiliary networks and resistances and capacitors is considered as an indivisible block which must be placed on the same console. Switches and capacitors are also considered as a block with their entry pots.

4.5.4 General organisation of LINK 331

The chain is organised in general plan in two sections the first treating the control of the gains (4.4) and the second accounting of the elements (4.5).

The first section uses KTYPE to process the equations according to their type. All linear, switch and comparator equations are controlled for gains. CONSOLE SELECT and BETA are also processed. After the first section all non-auxiliary equations pass to the second section which at entry tests if there has been a diagnostic "console full" (IFULL = 1). If so, section 2 is skipped. IFULL is also put on when option NOADDR is requested as section 1 is necessary for the output listing while section 2 is not.

The switch ITRO is put equal to 1 for the impose pass and 2 for the non-impose pass. LSEN is put equal to 1 for the first pass of the equation (can be non-IMPOSE pass if no IMPOSE present) and 2 for the second pass (always non-IMPOSE). If ITRO = 1 the equations are repassed, with ITRO = 2. Putting LSEN = 2, section 1 is skipped.

4.6 ADDRESSING

4.6.1 General

The addressing aims at an efficient distribution on the panel of the analog elements which are needed to make up the circuits to simulate the given equations. To each variable and coefficient of the equations must be attributed from some position on the panel one or more analog elements. This attribution is carried out with the following criteria:

1. Any IMPOSE of a named element always takes precedence
2. The different types of elements are assigned in an order of precedence which is fixed in the routine STRSET (5.5)
3. There are "strategies" for the distribution and association of variables which are fixed in STRSET.

4.6.2 Impose

For the IMPOSE, LINK 321 carries out the processing of the IMPOSE commands. For each variable which has a valid IMPOSE the name of the imposed element is put in the SYMBOL TABLE entry for that variable, and the imposed element blocked in the table VETT (6.5). In the addressing links any variable with an IMPOSE is skipped as already treated.

The addressing proper using criteria 2 and 3 is carried out in LINKS 341, 342 and 343.

4.6.3 Partition of integrators

Link 341 calls the routine STRSET. Depending on the choice set in STRSET (see 5.5 for description of how to change the codes in STRSET) the integrators may be attributed by partition in this link taking precedence over all other elements, or they may be left to be attributed in LINK 342 with the other elements.

A pass is made of all the equations and the records lengthened by adding the addressing records EBB, EB1, MEB1, and EB2, (section 8.4). The records will eventually be filled with the information relative to the addressing which will be printed on the output listing.

4.6.4 Use of strategies

The "strategy" of attribution used in the standard APACHE is that of proximity of entries, that is each element of the RHS is taken as near as possible to the element on the LHS.

This means no RHS variable can be assigned an element until the LHS variable has been assigned an element. In the standard APACHE elements are assigned in the first place by the partition of the integrators (4.6.3), and afterwards automatically to variables appearing on the RHS of an equation where the LHS variable has already been given its element. If partition of the integrators is not used some LHS variable is forcibly assigned an element to provide a starting point for the addressing.

Successive passes of the equations are made, using tapes in flip-flop. It is obvious that the execution time of the addressing will vary very much depending on the order in which the equations are written.

For each pass of the addressing the elements indicated in STRSET for that and all preceding passes are assigned where possible. Each successive pass is called when it is not possible to assign any more of the types of elements indicated, this can occur before all indicated elements are assigned because of the inter-connected nature of the equations.

When all passes of the addressing have been finished and there remain some variable not yet assigned an element, a "strategy" of forced attribution is used. The first LHS variable with no assigned element is assigned the first available element of the type required in the elements vector VETT (5.3 and 6.5). Any variable never appearing on the LHS of an equation is called an EXTERNAL variable, and is never assigned an element.

LINK 343 completes the work oi 342 for RECORDERS, VARIPLOTTERS and I.C. pots of RATE RESOLVERS. If an error has occurred LINK 4 is called.

4.6.5 Completion of addressing

The first part of LINK 36 attributes all the invertors for sign-changing as well as those used as buffers for multiplier outputs. The invertors of the high-accuracy multipliers have already been attributed in the previous phases. The number and type of the invertors attached to any variable is signalled in the SYMBOL TABLE.

The second part of the link reviews and completes the analog records. It requires one pass of the equation tape.

1) Depending on the sign called for in the equation the name of an analog element may be substituted by the name of its invertor
2) If an input of an equation comes from another console, the name of the trunk relative to the input variable is substituted for the analog element name of the variable.
3) In the EQM record the sign of the I.C. is made to correspond with the sign given to the LHS of the equation.

4) The EB record for multipliers and resolvers is modified to allow for the double entries of the two polarities.

4.7 SATANAS

4.7.1 SATAC option

If the options SATAC or SATAL are not used LINK 36 ends with a control that any variable with GAIN 1 is used only once as an input.

Link 361 is called by the option SATAC, and requires two passes of the equation tape for every available console.

4.7.2 Tiepoints

In the first pass is counted the number of times each variable and its inversion are requested as input on the console being examined. For each variable the totals (RE and RI) of requests are compared with the number of outputs of the relative analog elements and, if necessary, tiepoints are attributed, and their order number stored in the SYMBOL TABLE.

4.7.3 SATANAS cards

At the second pass the SATANAS cards are written on tape. Equation by equation, for each connection is written a pair of coordinates in the order : abscissa, ordinate of input; abscissa, ordinate of output. The connection may represent a patch cord or a plug. For plugs a code is added which distinguishes between integrator and summer plugs (grey and orange). Codes are also added for external tiepoints and capacities, (see section 9.2).

The order in which the connections for each equation are developed is:

1. Fixed connections for invertor (e.g. bottle plug for 20 seg mode of DFG).
2. Connection main element - invertor
   invertor - input trunks
   main element - input trunks
3. Fixed connections for main element (e.g. bottle plugs, I.C., auxiliary networks)
4. Connections to elements of RHS of the equation

The development of the connections is carried out using coordinates as follows:

a) Basic coordinates

   Prefixed for each element in the coded information used to form the subroutine PANEL (5.3) and stored in the vector VETT (6.5)

b) Relative coordinates

   Represent the relative distance of the output or input under consideration from the basic coordinate of the element. Each output or input hole of an element has a prefixed order number.

c) Absolute coordinates

   The algebraic sum of the basic and relative coordinates. This is punched on the SATANAS cards.

The routines of LINK 361 which process the connections can be divided into two categories; those which treat inputs and those which treat outputs.

The first searches the coordinates of the input holes of the element corresponding to the LHS of the equation. The second searches the coordinates of the outputs corresponding to the RHS of the equation. Each pair of absolute coordinates is punched.

4.7.4 Panel connections output list

The option SATAL calls LINK 3613 which follows the same logic as LINK 36 (see preceding paragraphs). Its final output is a list of panel connections giving in printed form the same information as would be punched on the SATANAS cards, except that the exact input and output holes to be used for each element are not specified.

4.7.5 Completion of records for output listing

LINK 362 which follows the SATANAS section can be considered as the final phase of the addressing, after which all information necessary for the output listing is complete.

The equation tape is passed once and for each equation the analog records referring to both LHS and RHS are completed, and equations are constructed for trunks fed from the LHS element or its invertor.

For resolvers and servo-multipliers the equations for buffer invertors are also constructed. For resolvers and multipliers the records are returned to the standard form.

At the same time all signs in the EQM record are reviewed, completing the work begun in LINK 36.

4.8 STATIC CHECK

4.8.1 Production of POTSETTING, NETWORK and READ-OUT cards

The preliminary stage of the STATIC CHECK is a pass of the APACHE program for the problem which is to be set up on the analog computer, using the option CARDS. This option, after the output list has been written by LINK 4, calls LINK 5.

LINK 5 passes the equation records once for each console, picking out the equations relevant to the current console and writing on separate tapes the **POTSETTING,** READ-OUT and NETWORK cards. After all consoles have been processed, all cards are copied onto the binary card output tape (see SETTAP, 5.2). Thus the packs for each type of card are subdivided into packs for each console. The format of the cards is explained in 9.1.

4.8.2 STATIC CHECK procedure on analog computer

To make use of the APACHE STATIC CHECK an installation must have a converted ADIOS system as describea in section 1.2.2.

The panel is wired with the help of the SATANAS cards (4.7 and 9.2). The pots are set using the POT SETTING cards. The analog computer is put in I.C. mode and the pack of READ-OUT cards passed through the modified 026-ADIOS. The card punched with the element names interrogates the elements, and each element name and its read-out value is punched on the following blank card.

The pack of READ-OUT cards and the corresponding NETWORK cards are made up into a problem deck as explained in the Programmers Manual (page 77) using the options CHECK or CHECKE Note that the complete pack of read-out cards is included, though only the cards with the read-out values are processed by LINK 6.

4.8.3 General principle of APACHE STATIC CHECK

The option CHECK or CHECKE calls LINK 6 which processes the network cards and the readout cards with the read-out values of the elements.

The APACHE STATIC CHECK considers each element as a separate entity and checks the element by taking the values of the entries as read out and from these calculating an expected value of output for the element. This expected value is then compared with the read output of the element. As, in the APACHE, to each element (except pots) corresponds an equation, checking element by element corresponds to checking equation by equation.

4.8.4 Processing of STATIC CHECK

The network cards are all transfered into a storage vector T3, with table T4 as control, containing information on the limits of each console in T3. The read-out cards are stored in storage vector T1 with a pair of words for each element, the first containing the element name and console number, the second its read-out value. Table T8 contains information on the limits of each console in T1. After all cards have been read and stored processing begins.

Each element name (except pots) is taken in turn from T1 and the network of the equation in which it appears on the left hand side found in T3. The relevant network is copied into the working area T5. From the network each right hand side element is identified, found in T1, and its read-out value copied into the working area T6.

Where the inputs from the input elements pass through pots the expected output value of the pot is calculated as the read output value of the input element multiplied by the pot setting. This value is compared with the actual read-out value.

To check the left hand side element its expected output value is calculated from the read input values (the form of the calculation depending on the type of element) and compared with the output actually read.

Warning diagnostics are given whenever the difference between the calculated output and the read-out output is beyond a pre-set tolerance (see section 5.6.2 for tolerances). The value of read-out outputs is also checked against given upper and lower limits for saturation and significance, and warning diagnostics given where necessary.

If the option CHECK has been used the output listing contains complete information for each equation, if CHECKE is used only equations which have had diagnostics are printed out.

4.9 SIMULATOR

4.9.1 Integration Routine as part of APACHE

When simulation is requested by means of the options SIMULA or SIMULC the normal procedure of APACHE is followed up to the end of LINK 2. LINK 22 is then called instead of LINK 21. LINK 22 carries out the same work as LINK 21 with some informations for the simulator, then calls LINK 24 which contains the integration routine. At the end of LINK 24 if SIMULA was requested control is returned to the APACHE MONITOR (LINK 11) or if SIMULC was requested control is returned to LINK 21 with the output tape of LINK 2 which was saved by LINK 22. Then LINK 21 carries on as from LINK 2 in the normal procedure.

4.9.2 Routine of integration

The integration routine used in the APACHE SIMULATOR is the FORTRAN version of the subroutine RDWDE2F [1]. This requires the following information:

a) a subroutine DAUX for the calculation of the derivatives.

b) an indicator for the method of integration to be used, to be chosen from:

   Runge-Kutta fixed step
   Predictor-Corrector fixed step
   Predictor-Corrector variable step

c) the following parameters if the variable step method is used:

   $\bar{E}$ upper limit of the error
   $\underline{E}$ lower limit of the error
   A value above which a relative error is considered and below which an absolute error.

----

[1] Share distribution 602

h_{max} maximum integration step
h_{min} minimum integration step
β factor for increasing or decreasing the integration step

d) initial value of the integration step.

4.9.3 Supply of Information to integration routine

The method by which APACHE passes to the integration routine the necessary information listed under 4.9.2 paragraphs b) to d) is explained in the Programmers Manual section 3.20.

4.9.3.1 Routine DAUX

In LINK 22, with a method analogous to that of LINK 21, the equations are reduced to the standard form (4.2) and the SYMBOL TABLE constructed (6.1). In the normal APACHE procedure though a program statement corresponding to each equation is generated it is destroyed once it has been used. In LINK 22 instead, these statements are saved and put together to form the subroutine DAUX. An important point to note is that, while in the normal APACHE the order of the equations has no effect on the calculated results, the routine DAUX must be written with the algebraic equations in a precise order. That is, no variable must appear on the right hand side of an algebraic equation unless it has already been calculated on the left hand side of a preceding equation. To construct the routine DAUX use is made of the fact that in calculating the initial conditions APACHE implicitly orders the equations, since no I.C. of an algebraic equation can be calculated until all the I.C.'s of the right hand side have been calculated. This means that a programmer using APACHE with simulation may write his equations in any order, as they will be ordered automatically by APACHE in constructing DAUX, while if using the integration routine with DAUX written directly in FORTRAN he must himself order the equations in DAUX. Also the equations have been reduced to their simplest form saving integration time.

4.9.3.2 Print Routine

All the statements PRINT (see Programmers Manual section 3.20.4) are compiled and united into a subroutine which is called at every integration step.

4.10 EDITOR

1) Purpose

This program was written to eliminate as much as possible the incovenience of handling punched cards when dealing with large FORTRAN CHAIN JOBS. All program links are written on a magnetic tape once, and all further modifications are performed by updating this tape rather than rewriting the entire deck.

2) The EDITOR

The EDITOR program accepts as input a magnetic tape (referred to as MASTER TAPE) on which are stacked all the routines composing the program and a table of the routines (Chain Table).

It takes the information from this MASTER TAPE and uses it to built a new tape which is called the FORTRAN INPUT TAPE. This tape has all the links together with their subroutines in the form accepted as input by the FORTRAN SYSTEM. This FORTRAN INPUT DATE is then processed by the FORTRAN SYSTEM and the final tape, referred to as the APACHE SYSTEM TAPE, is produced.

3) The MASTER TAPE

The MASTER tape is composed of three files as described below.

The CHAIN TABLE file

The CHAIN TABLE is a set of cards (*) describing the chain

(*) Since each record of the tape corresponds to a card, for practical reason we refer to card format rather than to records.

job. (see 12.1) For each link, the link number, the tape assignment and a list of all subroutines requested by this link are given. The order in which the link specifications are given is the same as that in which they will be loaded on the input tape. The first card of the CHAIN TABLE must be a CHAIN TABLE card. The format is shown below:

1	7	13	19	61	67	73	80
*	CHAIN	TABLE					
l_1	t_1	$SB1_1$	$SB1_2$	$SB1_9$	$SB1_{10}$		
		$SB1_{11}$	$SB1_{12}$....$SB1_{n1}$				
l_2	t_2	$SB2_1$	$SB2_2$	$SB2_9$			
		$SB2_{10}$	$SB2_{11}$....$SB2_{n2}$				
.							
.							
.							
l_n	t_n	SBn_1	SBn_2 ....SBn_{nn}				

where:

- l_i : link number
- t_i : tape assignment
- SBI_j : name of the j-th subroutine requested by link I.

All items must be left adjusted in relation to columns 1+K*6 (K=0,1...11). The routine names are written on each card starting from column 13; each card may contain from 1 to 10 routine names, where if less than 10 names are put on any card the blanks can only appear on the right hand side of the card. Continuation cards must not be punched in columns 1-12. The subroutine names must be in alphabetical (BCD) order.

The MAIN PROGRAMS file

This file contains the main programs of the different links. Their order must correspond to the one stated in the chain table. The programs can be either symbolic (FORTRAN or FAP) or binary, and each program must be preceded by a CHAIN card with the following format:

1	7	13	73	80
*	CHAIN	(l_i, t_i)		

The LIBRARY file

This file contains all the subroutines called by the program in alphabetical (BCD) order. Each subroutine appears only once regardless of the number of links which use it.
The subroutine can be either symbolic (FORTRAN or FAP) or binary. In the case of symbolic programs the first card of the deck must be one of the following

1) * FAP (Monitor Control Card)
2) SUBROUTINE ..... (FORTRAN statement)
3) FUNCTION .... (" ")

Diagram A shows an example of the MASTER DECK.

The UPDATE file

If after the MASTER TAPE has been generated, it is desired to modify any subroutine or main program, this modification can be performed by the EDITOR PROGRAM.
These modifications comprise what is referred to as the UPDATE FILE. This file is of the same form as the deck of cards used to produce the MASTER TAPE, except that only one end-of-file is needed.
The UPDATE file is given as input to the EDITOR PROGRAM. It is possible to modify any file of the master tape provided that the following rules are observed:

a) If the CHAIN TABLE has to be modified the entire CHAIN TABLE must be supplied.
b) Modifications to each file must appear in the order in which the files appear on the MASTER TAPE.
c) If the MAIN PROGRAMS file has to be modified, the updating requests must appear in the order stated in the CHAIN TABLE.
d) Modifications to the LIBRARY file must appear in alphabetical order.
e) The first EOF encountered on the UPDATE file ends the updating phase.

Updating can be carried out by two methods:

a) Using the UPDATE file, as described, as data after the EDITOR pack as shown in diagram A.
b) More simply, as the constructed APACHE SYSTEM TAPE already contains the EDITOR in the form of a chain link by taking the UPDATE file as a normal APACHE program and using the selector EDIT.

In this case the UPDATE deck is made up as follows:

1) Identification card
2) Selector EDIT
3) UPDATE file
4) E.O.F.

Operating Remarks

The EDITOR is a FAP program working under the standard FORTRAN Monitor. The editor program produces

a) A new MASTER TAPE on A5 if updating is requested.
b) A FORTRAN INPUT TAPE on A4 if one is requested.

Tape definitions

A4 New FORTRAN INPUT TAPE if requested
A5 New MASTER TAPE if requested
B5 Old MASTER TAPE

B3 APACHE SYSTEM TAPE if the selector EDIT is used. On this tape the FORTRAN MONITOR will build the new APACHE SYSTEM TAPE after the editing phase.

B1 Scratch

B2 Scratch

B6 Scratch

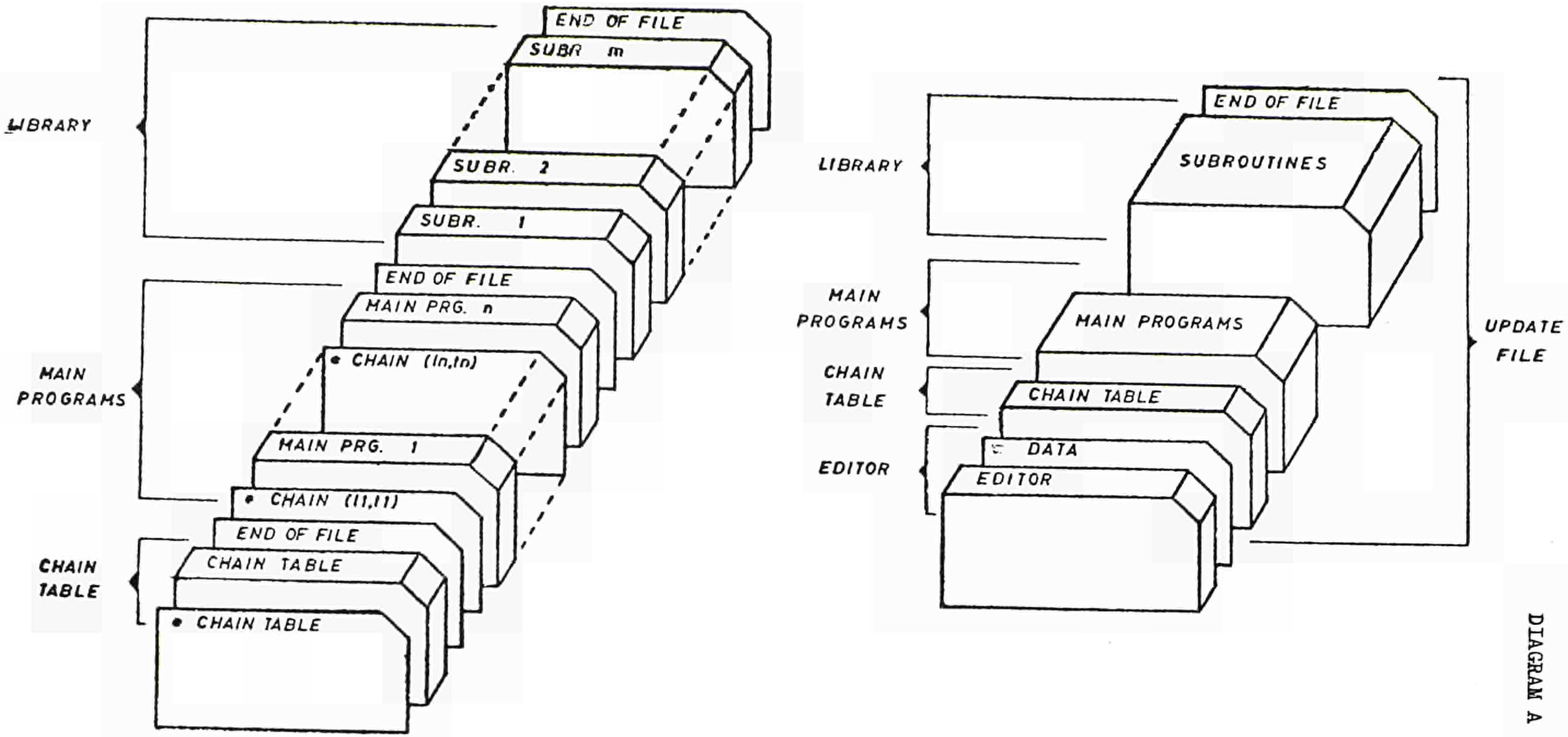
A1 FORTRAN MONITOR

A2 EDITOR + UPDATE FILE (or UPDATE FILE when the selector EDIT is used).

An on-line message is given when the NEW FORTRAN INPUT TAPE (A4) must be redefined as A2 to produce a system tape. After this is done the EDITOR gives control to FORTRAN which compiles the program on the new FORTRAN INPUT TAPE. Before beginning compilation an on-line message is given to mount B3. The new SYSTEM TAPE will be produced on this unit.

Sense Switches

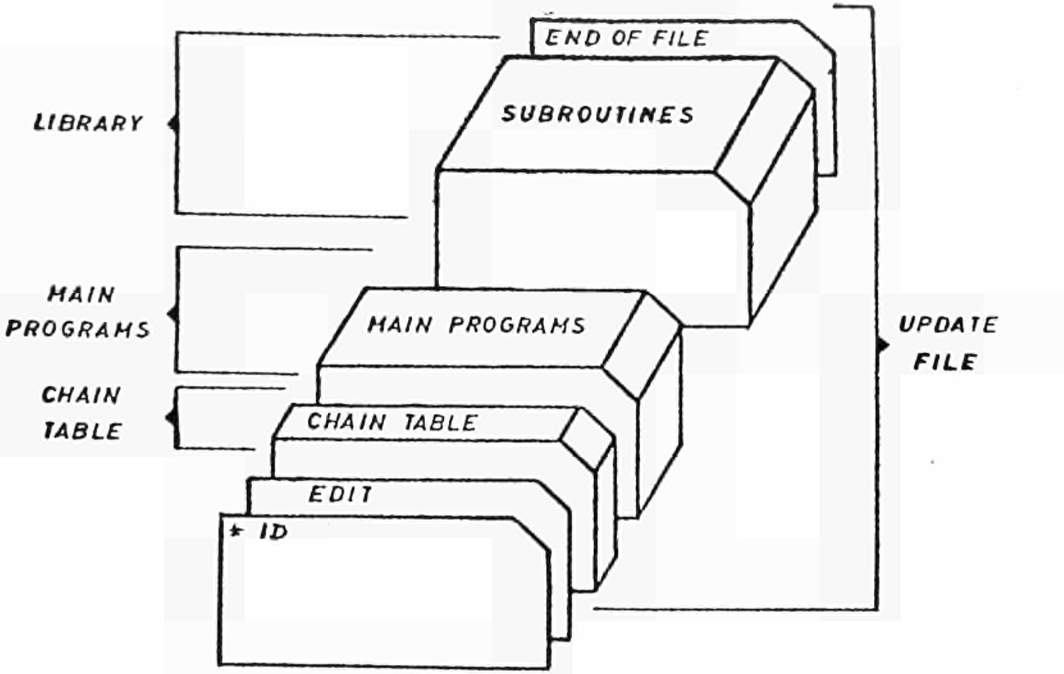
SSW 1	SSW 2	OPERATION PERFORMED
UP	UP	PRODUCE A NEW MASTER TAPE ON A5 AND PRODUCE A FORTRAN INPUT TAPE ON A4
UP	DOWN	PRODUCE A NEW MASTER TAPE ON A5
DOWN	UP	PRODUCE A FORTRAN INPUT TAPE ON A4



MASTER DECK

UPDATE DECK

DIAGRAM A



UPDATE DECK (using Selector EDIT)

DIAGRAM B

5. SYSTEM PARAMETERS

5.1 General

The immediate changes that an installation would want to make would be the adaption of the standard APACHE to its digital and analog computers.

The parts of the APACHE system which directly depend on the configuration of the hardware have been designed to be easily modifiable. How to carry out the modifications is described in this section.

5.2 TAPES

SETTAP

In the table of tape numbers, each installation must put the numerical definition of the tape which corresponds to the comment, always keeping the table in the same order.

OUTPUT TAPE (BINARY)	Tape on which binary cards are written
INTERMEDIATE TAPE	Any scratch tape
INTERMEDIATE TAPE	Any scratch tape
INTERMEDIATE TAPE	Any scratch tape
OUTPUT TAPE	Tape on which output listings are written
INPUT TAPE	Tape on which inputs are made.

The table of symbolic tape names in common must not be altered in any way.

CHAIN

As explained in the Programmers Manual, the APACHE SYSTEM TAPE is to be loaded on tape unit B3. Installations which prefer to use another unit can change the unit name in the routine CHAIN. The name of the tape in the pseudo instruction

S TAPENO B3B.

must be changed.

SET INPUT OUTPUT TAPES.

```
BINARY CARD NO. SETAP000
                     00000              ENTRY    SETTAP

BINARY CARD NO. SETAP001
     00000  0634 00 4 00005  SETTAP SXA      *+5,4
     00001  0774 00 4 00007         AXT      7,4
     00002  0500 00 4 00017         CLA      TAPES+1,4
     00003  0601 00 4 77462         STO      INTAPE+1,4
     00004  2 00001 4 00002         TIX      *-2,4,1
     00005  0774 00 4 00000         AXT      **,4
     00006  0600 00 0 77451         STZ      OPTION
     00007  0020 00 4 00001         TRA      1,4

     00010 +000007000000            OCT      07000000       B4-OUTPUT TAPE (BIN)
     00011 +000011000000            OCT      11000000           A5-INTERMEDIATE (BIN)
     00012 +000004000000            OCT      04000000           A4-INTERMEDIATE (BIN)
     00013 +000012000000            OCT      12000000           B5-INTERMEDIATE (BIN)
     00014 +000010000000            OCT      10000000           B1-INTERMEDIATE (BIN)
     00015 +000006000000            OCT      06000000           A3-OUTPUT TAPE (BCD)
     00016 +000005000000      TAPES OCT      05000000           A2-INPUT TAPE (BCD)
                     77461   INTAPE COMMON   1
                     77460   NUTAPE COMMON   1
                     77457   NRTAPE COMMON   1
                     77456   NWTAPE COMMON   1
                     77455   NS1TPE COMMON   1
                     77454   NS2TPE COMMON   1
                     77453   NS3TPE COMMON   1
                     77452   DUMMY  COMMON   1
                     77451   OPTION COMMON   1
                                    END
```

SET INPUT OUTPUT TAPES.
POST PROCESSOR ASSEMBLY DATA

```
   77450 IS THE LAST LOCATION NOT USED BY THIS PROGRAM
      17 IS THE FIRST LOCATION NOT USED BY THIS PROGRAM

REFERENCES TO DEFINED SYMBOLS
    77452  DUMMY      17
       16  TAPES       2
    77461 INTAPE       3,    17
    77457 NRTAPE      17
    77455 NS1TPE      17
    77454 NS2TPE      17
    77453 NS3TPE      17
    77460 NUTAPE      17
    77456 NWTAPE      17
    77451 OPTION       6,    17
        0 SETTAP       0

NO ERROR IN ABOVE ASSEMBLY.
```

```
BINARY CARD NO. CHAIN000
                00001         ENTRY  CHAIN                                   64   40
                00003         ENTRY  CHAINB                                  64   50
                00075         ENTRY  REWSYS                                  64   60

     TRANSFER VECTOR

BINARY CARD NO. CHAIN001
   00000  746325623460    (TES)

                02223    S    TAPENO B3B            SYSTEM TAPE              64   70


   00001  0600 00 0 00077 CHAIN  STZ    CF                                   64   90
   00002  0020 00 0 00004        TRA    CHAINB+1                             64  100
   00003 -0625 00 0 00077 CHAINB STL    CF                                   64  110
   00004 -0760 00 0 00007        LTM                                         64  120
   00005  0634 00 4 00007        SXA    *+2,4                                64  130
   00006  0522 60 0 00000        XEC*   $(TES)          CHECK LAST WRITE     64  140
   00007  0774 00 4 00000        AXT    **,4                                 64  150
   00010  0500 60 4 00001        CLA*   1,4             STORE                64  160
   00011  0622 00 0 00100        STD    CHWRD           LINK NUMBER          64  170
   00012  0760 00 0 02000        BTTS                                        64  180
   00013  0020 00 0 00014        TRA    *+1                                  64  190
   00014 -0520 00 0 00077        NZT    CF                                   64  200
   00015  0020 00 0 00020        TRA    RDC                                  64  210
   00016  0764 00 0 02223        BSR    S                                    64  220
   00017  0020 00 0 00041        TRA    NF                                   64  230


                                        READ CONTROL RECORD                  64  250
                                                                             64  260
   00020  0762 00 0 02223  RDC   RDS    S                                    64  270
   00021 -0540 00 0 00065        RCHS   CNC                                  64  280
   00022  0061 00 0 00022        TCOS   *                                    64  290
   00023 -0022 00 0 00025        TRCS   *+2                                  64  300
BINARY CARD NO. CHAIN002
   00024  0020 00 0 00027        TRA    *+3                                  64  310
   00025  0764 00 0 02223        BSR    S                                    64  320
   00026  0020 00 0 00020        TRA    RDC                                  64  330
   00027 -0030 00 0 00057        TEFS   EFIL                                 64  340
   00030 -0500 00 0 77471        CAL    LINK                                 64  350
   00031 -0320 00 0 00101        ANA    =077777000000                        64  360
   00032 -0340 00 0 00100        LAS    CHWRD                                64  370
   00033  0020 00 0 00035        TRA    *+2                                  64  380
   00034  0020 00 0 00052        TRA    LOAD                                 64  390
   00035  0520 00 0 00077        ZET    CF                                   64  400
   00036  0020 00 0 00041        TRA    NF                                   64  410
   00037  0762 00 0 02223        RDS    S                                    64  420
   00040  0020 00 0 00020        TRA    RDC                                  64  430
   00041  0764 00 0 02223  NF    BSR    S                                    64  440
```

```
                    APACHE *CHAIN* ROUTINE                                          PAGE 2
   00042  0764 00 0 02223          BSR     S                                        64  450
   00043  0764 00 0 02223          BSR     S                                        64  460
   00044  0760 00 0 02000          BTTS                                             64  470
   00045  0020 00 0 00020          TRA     RDC                                      64  480
   00046  0020 00 0 00047          TRA     BOT                                      64  490
   00047  0600 00 0 00077    BOT   STZ     CF                                       64  500

BINARY CARD NO. CHAIN003
   00050  0600 00 0 00001          STZ     CHAIN                                    64  510
   00051  0020 00 0 00020          TRA     RDC                                      64  520
   00052  0774 00 1 00007    LOAD  AXT     LDR3-LDR+1,1                             64  530
   00053  0500 00 1 00075          CLA     LDR3+1,1                                 64  540
   00054  0601 00 1 77471          STO     LDR3.+1,1                                64  550
   00055  2 00001 1 00053          TIX     *-2,1,1                                  64  560
   00056  0020 00 0 77462          TRA     LDR.                                     64  570
                                           END OF FILE                              64  580
                                                                                    64  590
                                                                                    64  600
   00057 -0520 00 0 00001    EFIL  NZT     CHAIN                                    64  610
   00060  0020 00 0 00064          TRA     ERR                                      64  620
   00061  0600 00 0 00001          STZ     CHAIN                                    64  630
   00062  0772 00 0 02223          REW     S                                        64  640
   00063  0020 00 0 00020          TRA     RDC                                      64  650
   00064  0420 00 7 00007    ERR   HPR     7,7                                      64  660
   00065  0 00003 0 77471    CNC   IOCD    LINK,,3                                  64  670
   00066  0762 00 0 02223    LDR   RDS     S                                        64  680
   00067 -0540 00 0 77472          RCHS    CMD                                      64  690
   00070  0061 00 0 77464    LDR1  TCOS    LDR1.                                    64  700
   00071 -0022 00 0 77467          TRCS    LDR2.                                    64  710
   00072  0020 60 0 77473          TRA*    TRA                                      64  720
   00073  0764 00 0 02223    LDR2  BSR     S                                        64  730

BINARY CARD NO. CHAIN004
   00074  0020 00 0 77462    LDR3  TRA     LDR.                                     64  740
   00075  0772 00 0 02223  REWSYS  REW     S                                        64  750
   00076  0020 00 4 00001          TRA     1,4                                      64  760
   00077  0 00000 0 00000    CF    ...                                              64  770
   00100  0 00000 0 00000   CHWRD  ...                                              64  780
                    77473          COMMON  -LDR3+LDR-4                              64  790
                    77473    TRA   COMMON  1                                        64  800
                    77472    CMD   COMMON  1                                        64  810
                    77471    LINK  COMMON  1                                        64  820
                    77470    LDR3. COMMON  1                                        64  830
                    77467    LDR2. COMMON  1                                        64  840
                    77465          COMMON  1                                        64  850
                    77464          COMMON  1                                        64  860
                    77464    LDR1. COMMON  1                                        64  870
                    77462          COMMON  1                                        64  880
                    77462    LDR.  COMMON  1                                        64  890
                                   END                                              64  900

     LITERALS
   00101  077777000000
```

```
                  APACHE *CHAIN* ROUTINE
                     POST PROCESSOR ASSEMBLY DATA

      77461 IS THE LAST LOCATION NOT USED BY THIS PROGRAM
        102 IS THE FIRST LOCATION NOT USED BY THIS PROGRAM

REFERENCES TO DEFINED SYMBOLS
     2223        S      1,    12,    16,    20,    21,    22,    23,    25,    27,    37,    41,    42,    43,    44,    62,    66,    67
                       70,    71,    73,    75
       77       CF      1,     3,    14,    35,    47
       41       NF     17,    36
       47      BOT     46
    77472      CMD     67,   101
       65      CNC     21
       64      ERR     60
       66      LDR     52,   101
       20      RDC     15,    26,    40,    45,    51,    63
    77473      TRA     72,   101
       57     EFIL     27
       70     LDR1
       73     LDR2
       74     LDR3     52,    53,   101
    77462     LDR.     56,    74,   101
    77471     LINK     30,    65,   101
       52     LOAD     34
        1    CHAIN      0,    50,    57,    61
      100    CHWRD     11,    32
    77464    LDR1.     70,   101
    77467    LDR2.     71,   101
    77470    LDR3.     54,   101
        0    (TES)      6
        3   CHAINB      0,     2
       75   REWSYS      0

 NO ERROR IN ABOVE ASSEMBLY.
```

<u>TSH</u>

The library version for FORTRAN 2 VERSION 2 has been slightly modified as can be seen from the list.

```
BINARY CARD NO. (TSH)000
                         00005         ENTRY    (TSH)                   442
                         00005         ENTRY    (TSHM)                  442

     TRANSFER VECTOR

BINARY CARD NO. (TSH)001
    00000   743146303460        (IOH)
    00001   745124623460        (RDS)
    00002   745124233460        (RDC)
    00003   745123303460        (RCH)
    00004   745125513460        (RER)

                         00026  BUFSIZ EQU      22                      442
                                *                                       442
    00005   0560 00 0    00007   (TSH) LDQ      *+2                     442
    00006   0020 60 0    00000         TRA*     $(IOH)                  442
    00007   0761 00 0    00010         NOP      TSH                     442
                         00005  (TSHM) EQU      (TSH)                   442
                                *               REENTRY FROM (IOH)      442
    00010   0634 00 4    00016   TSH   SXA      TSHX,4                  442
    00011   0522 60 0    00001         XEC*     $(RDS)                  442
    00012  -0774 00 4    00020         AXC      TSHC,4                  442
    00013   0754 00 4    00000         PXA      ,4                      442
    00014   0621 60 0    00002         STA*     $(RDC)                  442
    00015   0522 60 0    00003         XEC*     $(RCH)                  442
    00016   0774 00 4    00000   TSHX  AXT      ..,4                    442
    00017   0020 60 0    00004   TSHSW TRA*     $(RER)                  442
    00020   3 00026 0    77751  TSHC   IORT     REC,,BUFSIZ             442
                         77751         COMMON   -206+BUFSIZ             442
                         77751  REC    COMMON   1                       442
                         00000  ..     EQU      0                       442
                                       END                              442


                    POST PROCESSOR ASSEMBLY DATA

      77750 IS THE LAST LOCATION NOT USED BY THIS PROGRAM
         21 IS THE FIRST LOCATION NOT USED BY THIS PROGRAM


REFERENCES TO DEFINED SYMBOLS
          0      ..      16,    21
      77751     REC      20,    21
         10     TSH       7
         20    TSHC      12
         16    TSHX      10
         17   TSHSW
          0   (IOH)       6
          3   (RCH)      15
          2   (RDC)      14
          1   (RDS)      11
          4   (RER)      17
          5   (TSH)       0,    10
         26  BUFSIZ       5,    20,    21
          5  (TSHM)       0,    10

NO ERROR IN ABOVE ASSEMBLY.
```

5.3 PATPAN, PATCH PANEL CODING

CONSTRUCTION OF PANEL

Installations wishing to change the panel description as at present **used** by APACHE must prepare a pack of input cards giving the coded description of their panels. An explanation of how to prepare this pack is given after.

This pack is given as input to the APACHE system as if it were a normal problem. The selector PATPAN calls LINK 7 which develops the coded description of each element into a two-word information. These double words are ordered in the table VETT which has, as guide, table TV. The input cards are controlled for compatibility and correct coding, any error found will be signalled by an off-line diagnostic.

If no errors are found, on the tape with symbolic name NS2TPE (see subroutine SETTAP for actual tape number) will be written a subroutine PANEL (FAP) which contains as pseudo-instructions the tables VETT and TV. This subroutine must be punched and assembled, and by using the EDITOR the binary cards substituted for the present PANEL on the APACHE SYSTEM tape. PANEL is called by LINK 32.

CODED DESCRIPTION OF ANALOG ELEMENTS

Each installation must prepare cards as explained below for the description of their panels.

The cards are of two types:

type 1 each card corresponds to an element shown on the panel
type 4 each card gives the number of "boxes" available for a certain type of element.

For example, a card of type 1 would correspond to each servo-multipliers position of the panel which is wired, a card of type 4 would give the number of servo-multipliers "boxes" available, a second card of type 4 would give the number of quarter-square "boxes" available. As the "boxes" are movable and interchangeable, both types of information are necessary for a complete description of available elements.

Type 1 cards

General description

Column	Type of perforation	Information given
1	1	Type of card
2 - 6	Alphanumeric	APACHE name of the element (left justified)
7	Numeric	Console number
8 -10	Numeric	Abscissa (right justified)
11 -13	Numeric	Ordinate (right justified)
14	Numeric	COD1
15	Numeric	COD2
16 -18	Numeric	COD3 (right justified)
19 -23	Alphanumeric or numeric	ADR1 (left justified)

Abscissa and ordinate fix the position of the element on the panel, they are calculated by counting the holes from the top left hand corner of the panel, starting from 0,0.

	0	1	2	3	4	5	6
0	o	o	o	o	o	o	o
1	o	o	o	o	o	o	o
2	o	o	o	$\boxed{o}$	o	o	o
3	o	o	o	o	o	o	o
4	o	o	o	o	o	o	o

The abscissa and ordinate of the hole marked would be 3,2.

If the SATANAS cards are required, the co-ordinates of the elements must follow the convention used by APACHE. The co-ordinate values are those on the complete panel description as used by the standard APACHE, file 8 of the tape which you have been sent.

If SATANAS cards are not required any panel hols incorporated in the element can be used as the basic point for the co-ordinates.

Description of codes, element by element

AMPLIFIER

COD1	0		Integrator
	1		Summer
	2		Invertor (taken from DFG etc.)
		When	COD1 = 0,1
COD2	0		Element whose network can be used
	1		Element whose network cannot be used
		When	COD1 = 2
	0		taken from DFG
	1		taken from RESOLVER
	2		taken from HAM
	3		taken from DFG and RESOLVER
COD3	N		N = number of outputs
ADR1	00000		when COD1 = 0,1
	NAME		NAME = APACHE name of element from which the invertor is taken (DFG etc.)

CAPACITOR (measured in μ F,eg 1 * 10^{-2})

COD1	Value of capacitor
COD2	Sign of the exponent of 10 (0 = +, 1 = -)
COD3	Value of the exponent, base 10
ADR1	00000

COMPARATOR

COD1	0
COD2	Number of relays (N=1 or 2 for APACHE)
COD3	000
ADR1	00000

DFG

Every couple of DFG 10 segments is described by two cards. The first DFG is to be considered the "leading" element.

COD1	0	Not sharing ampli. with RESOLVER
	1	Sharing ampli. with RESOLVER
COD2	0	
COD3	000	DFG 10 segments not associated with another DFG 10 segments
	1	Leading element of a pair of DFG 10 segments
	2	Second element of a pair of DFG 10 segments
ADR1	NAME1	APACHE name of the second DFG of the pair (COD3=1)
	NAME2	when COD3 = 0,2 APACHE name of the amplifier associated with the leading DFG.

HAM

COD1	0	If not possible to perform square or square root.
	1	If possible to perform square and square root.
COD2	N1	no. of amps which are not independent
COD3	N2	no. of amps which can be independent
ADR1	NAME	APACHE name of the ampli. which can be used when HAM is not occupied.

POTENTIOMETER

COD1, COD2, COD3, ADR1 all punched zero.

MANUAL POTENTIOMETER

COD1, COD2, COD3, ADR1 all punched zero.

RECORDERS (panel position)

COD1	N	N = number of channels (N = 8 for APACHE)

COD2, COD3, ADR1 all zero

REFERENCE (and EARTH)

COD1	0	Normal reference
	1	Adjacent to servo-multiplier
	2	Special (value 90 or 25)
	3	Static test reference
COD2	0	Negative reference
	1	Earth
	2	Positive reference
COD3	000	when COD1 = 0,1
	N	N = 25,90 (voltage) when COD1 = 2
ADR1	NAME	when COD1 = 1, name of adjacent servo-multiplier
	00000	if COD1 = 0, 2, 3.

RESISTANCE (measured in M)

COD1		Value of resistance
COD2		Sign of the exponent of 10 (0 = +, 1 = -)
COD3		Value of the exponent, base 10.
ADR1		00000

SERVOMULTIPLIER (panel position)

COD1	0	Position cannot be used by RESOLVER
COD1	1	Position can be used by RESOLVER
COD2	N	N = number of products (3 or 5)
COD3	000	
ADR1	00000	COD1 = 0
	NAME	COD1 = 1, name of ampli associated with the resolver.

MANUAL SWITCHES

COD1	0	
COD2	N	N = number of contacts (N = 3 for APACHE)
COD3	000	
ADR1	00000	

TIME DIVISION

COD1	N1	Number of divisions possible (N1 = 1 for APACHE)
COD2	N2	Number of multiplications possible (N2 = 2 for APACHE)
COD3	000	Only multiplication possible
	1	Division possible
ADR1	00000	

TIEPOINTS

COD1	0	Grouped tiepoint (type ROJ)
	1	Distributed tiepoint (type TP05)
COD2	N1	N1 = total number of holes in group (COD1 = (
	N2	N2 = 0, 1, 5, 6. For distributed tiepoint gives number of series. i.e. TP0, TP1, TP5, or TP6. (COD1 = 1)
COD3	0	COD1 = 0
	N	N = number of holes available (COD1 = 1)
ADR1	00000	COD1 = 0
	NAME	APACHE name of the next tiepoint in the series (COD1 = 1). The last in the series carries the name of the first.

TRUNKS

COD1	0	
COD2	0	
COD3	N	N = number of console linked
ADR1	NAME	APACHE name of the trunk linked on the console indicated in COD3.

VARIPLOTTER

COD1, COD2, COD3, ADR1 all zero.

Type 4 cards

These cards give the total of "boxes" available for each type of element which can be inserted in the analog computer.

General description

Column	Type of perforation	Information given
1	4	Type of card
8 - 10	Numeric	Code of type of element
11 - 13	Numeric	Number of boxes of this type of element available
(31	Alphabetic	Can be used for name of type of element. Not significant)

Code of type of element

001	Servo-multiplier with 5 outputs
002	Servo-multiplier with 3 outputs
005	Quarter-square
006	TDM (Time division)
007	HAM
008	DFG (10 segments, 20 segments counted as two elements)
009	Resolver
010	Variplotter
011	Recorder

CONSTRUCTION OF THE INPUT PACK

Control cards

Cards of type 1 and type 4 should be present.
Each pack of cards of one type has as first and last card:

col. 1 1 or 4 depending on type
col. 2 - 40 punched with zero

The pack of type 1 is divided into sub-packs for each console by cards:

col. 1 1
col. 2 - 3 MC
col. 7 Number of console

The last card of the completed pack (before the EOF) must be :

col. 1 - 2 punched with 9

The selector PATPAN must be placed at the beginning of the pack, preceded by an identification card with * in col. 1.

INPUT PACK

```
Col.1 Col.7                              Col.40
   *     PANEL FOR OUR INSTALLATION
         PATPAN
   10000000................................0
   1MC    1

      Cards with coded description of elements of console 1
      (type 1), in any order.
   1MC    2

      Cards with coded description of elements of console 2
      (type 1)
   ..........
   1MC    N

      Cards with coded description of elements of console N
      (N less than or equal to 6) (type 1)
   1000....................................0
   400000..................................0

      Cards with total of "boxes" available (type 4)
```

```
40000....................................0
99
EOF
* END APACHE
EOF
```

This pack is given as input to the APACHE SYSTEM as though it were a normal problem.

5.4 OPTIONS

The use and effect of the OPTIONS is explained in section 5.1 of the Analog Programmers Manual. The option cards are processed by the routine CNTRCD called by LINK 11. Indicating bits for each OPTION requested are stored in the cell **PRMAIN** (in COMMON) as follows:

BIT	VALUE	OPTION REQUESTED
35	1	NOADDR
34	1	SATAL
33	1	SATAC
32	1	SIMULA
31	1	CARDS
30	1	CHECKE
29	1	FPC
28	1	VPC
27	1	SIMULC

```
      SUBROUTINE CNTRCD(ENDAP)
*     LABEL
CCNTRCD
C
C     APACHE MONITOR-CONTROL CARDS PROCESSOR.
C
C**********************************************************************
      COMMON INTAPE,NUTAPE,NRTAPE,NWTAPE,NS1TPE,NS2TPE,NS3TPE,CHAIN ,
     1       PRMAIN,RUTINE,KBK777,LE7777,IE    ,NW    ,NW1   ,N     ,
     2       NUMB  ,AUX   ,IRE   ,RESULT,SUITE ,NLIST ,BLA   ,CNEXT ,
     3       CLAST ,NCARD ,CW    ,ASY   ,NSY   ,REF   ,BETA  ,D77771,
     4       REC   ,W     ,W1    ,NW2   ,W3    ,BLIST ,ALIST ,FTRN  ,
     5       ATR   ,CARD  ,VALUES,D77772,RIF   ,SYMB
      DIMENSION D77771(  19),REC   ( 500),W     ( 500),W1    ( 500),
     1          NW2   ( 500),W3    ( 500),BLIST (3000),ALIST (2150),
     2          FTRN  ( 200),ATR   ( 251),CARD  (  11),VALUES(  10),
     3          D77772( 278),RIF   (1000),SYMB  (0002)
C**********************************************************************
      DIMENSION OPTION(10),BPT(10)
      OPTION(1)=6HNOADDR
      OPTION(2)=5HSATAL
      OPTION(3)=5HSATAC
      OPTION(4)=6HSIMULA
      OPTION(5)=5HCARDS
      OPTION(6)=6HCHECKE
      OPTION(7)=3HFPC
      OPTION(8)=3HVPC
      OPTION(9)=6HSIMULC
      OPTION(10)=4HCALC
      NOPTIN=10
B     BPT(1)=1
B     BPT(2)=2
B     BPT(3)=4
B     BPT(4)=10
B     BPT(5)=20
B     BPT(6)=40
B     BPT(7)=100
B     BPT(8)=200
B     BPT(9)=400
B     BPT(10)=1000
      PRMAIN=0.
      WRITE OUTPUT TAPE NUTAPE,9001
      READ INPUT TAPE INTAPE,9002,C1,(REC(I),I=1,12)
      IF(TEST(C1,6H*     ))12,1,12
   12 IF(TEST(C1,6H$     ))6,1,6
    1 WRITE OUTPUT TAPE NUTAPE,9003,(REC(I),I=1,12)
      WRITE OUTPUT TAPE NS3TPE,9002,C1,(REC(I),I=1,12)
      ENDFILE NS3TPE
      PRINT 9003,(REC(I),I=1,12)
      CALL BLANK(REC,12)
      IF(TEST(REC(1),6HENDAPA))10,9,10
    9 IF(TEST(REC(2),6HCHE   ))10,8,10
   10 CALL ACCUNT(REC)
   13 CONTINUE
      READ INPUT TAPE INTAPE,9002,C1,(REC(I),I=1,12)
      IF(TEST(C1,6H*     ))7,2,7
    2 WRITE OUTPUT TAPE NUTAPE,9003,(REC(I),I=1,12)
```

```
      SUBROUTINE CNTRCD(ENDAP)
      PRINT 9003,(REC(I),I=1,12)
      CALL BLANK(REC,12)
      CALL SPLIT
      NW=NW
      IF (TEST(REC(1),6HPAUSE ))15,14,15
   14 PAUSE 77777
      GO TO 13
   15 CONTINUE
      DO 11 K=1,NW,2
      DO 4 J=1,NOPTIN
      IF(TEST(W(K),OPTION(J)))4,3,4
    4 CONTINUE
      GO TO 13
B   3 PRMAIN=PRMAIN+BPT(J)
   11 CONTINUE
      GO TO 13
C
C     IDENTIFICATION CARD MISSING.
C
    6 PRINT 9004
C
C     OPTIONS CARD MISSING
C
    7 BACKSPACE INTAPE
    5 ENDAP=0.
      RETURN
C
C     *END APACHE CARD
C
    8 ENDAP=1.
      RETURN
 9001 FORMAT (1H1)
 9002 FORMAT (1A1,11A6,1A5)
 9003 FORMAT (1H0,1H*,11A6,1A5)
 9004 FORMAT (1H0,27HIDENTIFICATION CARD MISSING/1H ,17HCONDITION IGNORE
     1D)
      END(1,0,0,0,0,0,1,0,0,0,0,0,0,0,0)
```

```
SUBROUTINE CNTRCD(ENDAP)

                                        STORAGE NOT USED BY PROGRAM

      DEC   OCT              DEC   OCT
      379 00573            23109 55105

                          STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
ALIST 27011 64603        ASY 32534 77426        ATR 24661 60125        AUX 32544 77440       BETA 32531 77423
  BLA 32539 77433      BLIST 30011 72473       CARD 24410 57532      CHAIN 32554 77452      CLAST 32537 77431
CNEXT 32538 77432         CW 32535 77427     D77771 32530 77422     D77772 24389 57505       FTRN 24861 60435
   IE 32549 77445     INTAPE 32561 77461        IRE 32543 77437     KBK777 32551 77447     LE7777 32550 77446
NCARD 32536 77430      NLIST 32540 77434     NRTAPE 32559 77457          N 32546 77442     NS1TPE 32557 77455
NS2TPE 32556 77454    NS3TPE 32555 77453        NSY 32533 77425       NUMB 32545 77441     NUTAPE 32560 77460
  NW1 32547 77443        NW2 31011 74443         NW 32548 77444     NWTAPE 32558 77456     PRMAIN 32553 77451
  REC 32511 77377        REF 32532 77424     RESULT 32542 77436        RIF 24111 57057     RUTINE 32552 77450
SUITE 32541 77435       SYMB 23111 55107     VALUES 24399 57517         W1 31511 75427         W3 30511 73457
    W 32011 76413

              STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
  BPT   368 00560     OPTION   378 00572

            STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENT

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
   C1   358 00546          J   357 00545          K   356 00544     NOPTIN   355 00543

                        SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

        EFN   LOC                EFN   LOC                EFN   LOC                EFN   LOC                EFN   LOC
8)8P9  9001 00540      8)8PA    9002 00537     8)8PB    9003 00534     8)8PC    9004 00530

                         LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
   2)   281 00431         3)   316 00474         6)   328 00510         B)   284 00434       C)G2   353 00541
 C)G3   354 00542      D)40D   163 00243      D)50D   162 00242        E)R   249 00371        E)T   258 00402

                               LOCATIONS OF NAMES IN TRANSFER VECTOR

        DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT                DEC   OCT
ACCUNT    8 00010      BLANK     7 00007      SPLIT     9 00011       TEST     4 00004      (BST)    10 00012
 (EFT)    5 00005      (FIL)     1 00001      (RTN)     3 00003      (SPH)     6 00006      (STH)     0 00000
 (TSH)    2 00002

                        ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

ACCUNT      BLANK      SPLIT      TEST      (BST)      (EFT)      (FIL)      (RTN)      (SPH)      (STH)
(TSH)

           EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

 EFN   IFN   LOC         EFN   IFN   LOC         EFN   IFN   LOC         EFN   IFN   LOC         EFN   IFN   LOC
  12    41 00134           1    43 00144           9    64 00227          10    66 00235          13    68 00244
   2    77 00271          14    93 00336          15    95 00340           4   100 00367           3   102 00375
  11   103 00400           6   105 00404           7   106 00411           5   107 00415           8   110 00423
```

5.5 STRATEGIES

How to change codes in STRSET

STRSET is called by Chain 341. It sets the codes for the strategies of the addressing (4.6).

Programmed switch NRIP

NRIP = 1, integrators assigned by partition.

NRIP = 0, integrators assigned by proximity of entries, or forced attribution if necessary.

For the standard APACHE NRIP = 1

Matrices PE and PU

The matrices PE(I,J) and PU(I,J), (I = 1, 10 : J = 1,2) are in the common of chains 341, 342 and are given values in STRSET.

The index I indicates the number of the pass of addressing. J = 1 and J = 2 are to be considered as a continuous 72 bit word, where each bit refers to a type of element as listed in the table below:

	BIT	ELEMENT
	S	Ampli used as integrator
	1	Ampli used as summer
	2	Ampli used as high gain
	3	
	4	Servo-multiplier normal
	5	Servo-multiplier plus
J	6	Servo-multiplier minus
=	7	
1	8	
	9	

BIT	ELEMENT
10	Quarter square used for multiplication
11	TDM used for multiplication
12	TDM used for division
13	DFG 10 segments
14	DFG 20 segments
15	Resolver polar position
16	Resolver rectangular position
17	
18	Resolver rectangular rate
19	Potentiometer
20	Manual potentiometer
21	Switch, 3 output, 1 input
22	Switch, 1 output, 3 input
23	Comparator, 2 outputs, 1 input
24	Comparator, 1 output, 2 input
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	HAM used for multiplication
35	HAM used for division

	S
J	1
=	2
2	3
	4

For each pass I a bit indicates which types of elements are to be taken into consideration for that pass; once an element has been indicated by a bit it will be considered for attribution in that and all succeeding passes. The bit is placed in PE or PU according as the element is to be attributed by proximity of entry or output.

STRSET in the standard version of APACHE has the following indicators set:

PE

700030074000,000000000000 (1,1),(1,2)
037747400003,700000000000 (2,1),(2,2)

PU

000000200000,000000000000 (1,1),(1,2)

which correspond to:

PASS	STRATEGY	ELEMENT
1	Proximity of entry	Integrators Ampli used as high gain Summer DFG (10 and 20 segments) Switch Comparator
2	Proximity of output	Potentiometers
2	Proximity of entry	Servo-multiplier Quarter square TDM Resolvers HAM
3	Forced attribution	All

SUBROUTINE STRSET(NRIP)

```
      SUBROUTINE STRSET(NRIP)
*     LABEL
CSTRSET
C***********************************************************************
      DIMENSION NCONS (    6),D77771(   14),SYMB  (7000),RIF    (1000)
     1          ETW   (   40),AFUN  (   10),NBOX  (   30),
     2          GRETA (   30),TSM1  (   90),TSM2  (   90),THAM1 ( 300),
     3          THAM2 (  300),TTD1  (   60),TTD2  (   60),TCP1  (  60),
     4          TCP2  (   60),CUBB1 (   60),CUBB2 (  120),CUBB3 ( 120),
     5          RUBB  (  500),TUBB1 (  100),TUBB2 (  100),HUBB1 ( 500),
     6          HUBB2 (  500),QUBB  (  100),SUBB1 (  120),SUBB2 ( 120)
      DIMENSION VETT  (1400,    6),TV    (  60,    6),TPOM  (  30,    8)
      DIMENSION EQM(100,3),EB1(30),MEB1(30),EB2(2,100)
      DIMENSION KRIP(6)
      DIMENSION REC (500)
      DIMENSION PE(10,2),PU(10,2),TNET(15)
      DIMENSION COMEL 72)
      COMMON INTAPE,NUTAPE,NRTAPE,NWTAPE,NS1TPE,NS2TPE,NS3TPE,CHLK77,
     1       PRMAIN,RUTINE,KBK777,LE7777,IE    ,NW    ,NCONS ,KCP   ,
     2       KTSM  ,KTTD  ,KHAM  ,KKKKKK,COMIM ,CW    ,ASY   ,NSY   ,
     3       REF   ,BETA  ,BETAC ,IKCP  ,IKTSM ,IKTTD ,IKHAM ,D77771,
     4       VETT  ,RIF   ,SYMB  ,TV    ,ETW   ,AFUN  ,NBOX  ,TPOM  ,
     5       GRETA ,TSM1  ,TSM2  ,TTD1  ,TTD2  ,THAM1 ,THAM2 ,TCP1  ,
     6       TCP2  ,CUBB1 ,CUBB2 ,CUBB3 ,RUBB  ,TUBB1 ,TUBB2 ,HUBB1 ,
     7       HUBB2 ,QUBB  ,SUBB1 ,SUBB2 ,IDC   ,IDX   ,JDX   ,IDH   ,
     8       IDQ   ,IDS
      COMMON EQM,EB1,MEB1,EB2
      COMMON ALFCD,MAC,NORD,ALF1,MAC1,NORD1,ATBEL,NEL,TLEL,EBB,NCOD1,NCO
     1D2
      COMMON KRIP,MON,IM,KFIRST,NA,REC
      COMMON PE,PU,TNET
      COMMON COMEL
      COMMON NUMB,KTYPE,VALMA
C***********************************************************************
C
C     RIPARTIZIONE PER INTEGRATORI - NRIP=1 -
C     NESSUNA RIPARTIZIONE - NRIP=0 -
C
      NRIP=1
C
C     STRATEGIE DI ATTRIBUZIONE
C
      DO 1020 I=1,10
      DO 1020 J=1,2
      PE(I,J)=0.
      PU(I,J)=0.
 1020 CONTINUE
B     PU(1,1)=200000
B     PE(1,1)=700030074000
B     PE(2,1)=37747400003
B     PE(2,2)=700000000000
      RETURN
      END(1,0,0,0,0,0,1,0,0,0,0,0,0,0,0)
```

SUBROUTINE STRSET(NRIP)

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
47	00057	10823	25107

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AFUN	15711	36537	ALF1	11472	26320	ALFCD	11475	26323	ASY	32534	77426	ATBEL	11469	26315
BETAC	32530	77422	BETA	32531	77423	CHLK77	32554	77452	COMEL	10898	25222	COMIM	32536	77430
CUBB1	14381	34055	CUBB2	14321	33761	CUBB3	14201	33571	CW	32535	77427	D77771	32525	77415
EB1	11735	26727	EB2	11675	26633	EBB	11466	26312	EQM	12035	27403	ETW	15751	36607
GRETA	15431	36107	HUBB1	13381	32105	HUBB2	12881	31121	IDC	12041	27411	IDH	12038	27406
IDQ	12037	27405	IDS	12036	27404	IDX	12040	27410	IE	32549	77445	IKCP	32529	77421
IKHAM	32526	77416	IKTSM	32528	77420	IKTTD	32527	77417	IM	11456	26300	INTAPE	32561	77461
JDX	12039	27407	KBK777	32551	77447	KCP	32541	77435	KFIRST	11455	26277	KHAM	32538	77432
KKKKKK	32537	77431	KRIP	11463	26307	KTSM	32540	77434	KTTD	32539	77433	KTYPE	10825	25111
LE7777	32550	77446	MAC1	11471	26317	MAC	11474	26322	MEB1	11705	26671	MON	11457	26301
NA	11454	26276	NBOX	15701	36525	NCOD1	11465	26311	NCOD2	11464	26310	NCONS	32547	77443
NEL	11468	26314	NORD1	11470	26316	NORD	11473	26321	NRTAPE	32559	77457	NS1TPE	32557	77455
NS2TPE	32556	77454	NS3TPE	32555	77453	NSY	32533	77425	NUMB	10826	25112	NUTAPE	32560	77460
NW	32548	77444	NWTAPE	32558	77456	PE	10953	25311	PRMAIN	32553	77451	PU	10933	25265
QUBB	12381	30135	REC	11453	26275	REF	32532	77424	RIF	24111	57057	RUBB	14081	33401
RUTINE	32552	77450	SUBB1	12281	27771	SUBB2	12161	27601	SYMB	23111	55107	TCP1	14501	34245
TCP2	14441	34151	THAM1	15101	35375	THAM2	14801	34721	TLEL	11467	26313	TNET	10913	25241
TPOM	15671	36467	TSM1	15401	36051	TSM2	15311	35717	TTD1	15221	35565	TTD2	15161	35471
TUBB1	13581	32415	TUBB2	13481	32251	TV	16111	37357	VALMA	10824	25110	VETT	32511	77377

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
2)	35	00043	3)	36	00044	6)	41	00051						

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
1020	22	00022												

5.6 TOLERANCES

5.6.1 GAINS

The values used for the control of gains to the amplifiers in the standard APACHE are given and explained in section 4.4.

Any installation wishing to change these parameters may do so by changing the values set at the beginning of Link 331.

The following restrictions must be observed:

$0 < AMAX \leq 30$

$0 < AMHG \leq 30$

$0 < MCAP$

$0 < MPOWER$

LNK331

```
C           *** APACHE 7090/4 ***    CHAIN LINK 331
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      DIMENSION NCONS (     6),D77771(    14),SYMB   (7000),RIF    (1000),
     1          ETW    (    40),AFUN   (    10),NBOX   (   30),
     2          GRETA  (    30),TSM1   (    90),TSM2   (   90),THAM1  (  300),
     3          THAM2  (   300),TTD1   (    60),TTD2   (   60),TCP1   (   60),
     4          TCP2   (    60),CUBB1  (    60),CUBB2  (  120),CUBB3  (  120),
     5          RUBB   (   500),TUBB1  (   100),TUBB2  (  100),HUBB1  (  500),
     6          HUBB2  (   500),QUBB   (   100),SUBB1  (  120),SUBB2  (  120)
      DIMENSION EMPTY(3437),REC(500),EQM(100,3)
      DIMENSION                       TV     (  60,    6),TPOM   (  30,    8)
      DIMENSION RESUBB(60)
      COMMON INTAPE,NUTAPE,NRTAPE,NWTAPE,NS1TPE,NS2TPE,NS3TPE,CHLK77,
     1       PRMAIN,RUTINE,KBK777,LE7777,IE    ,NW    ,NCONS ,KCP   ,
     2       KTSM  ,KTTD  ,KTHAM ,KKKKKK,COMIM ,CW    ,ASY   ,NSY   ,
     3       REF   ,BETA  ,BETAC ,IKCP  ,IKTSM ,IKTTD ,IKTHAM,D77771,
     4              REC   ,EQM   ,TV    ,ETW   ,AFUN  ,NBOX  ,TPOM  ,
     5       GRETA ,TSM1  ,TSM2  ,TTD1  ,TTD2  ,THAM1 ,THAM2 ,TCP1  ,
     6       TCP2  ,CUBB1 ,CUBB2 ,CUBB3 ,RUBB  ,TUBB1 ,TUBB2 ,HUBB1 ,
     7       HUBB2 ,QUBB  ,SUBB1 ,SUBB2 ,IDC   ,IDX   ,JDX   ,IDH   ,
     8        IDQ  ,IDS   ,IQUAD ,KQUAD ,IROOT ,KROOT ,IQS   ,IOLDQS,
     9IKCUBB,KCUBB,ITRO,IFULL,MERR,KTYPE,ICOSEL,NUMB,ICON
      COMMON RESUBB,IDR
      COMMON LPOT,LMPOT,JPOT,JMPOT,ISWPOT,ISWPOM,AMAX,AMIN,MPOWER,MCAP
      COMMON AMHG
      COMMON EMPTY,RIF,SYMB
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C     READ EQUATION TAPE
C
C
      EQUIVALENCE (ID,BID)
      EQUIVALENCE(ICOP,CON)
      EQUIVALENCE (NVARC,VARC)
      EQUIVALENCE(A,KA)
C
C     TOLERANCES FOR GAIN VALUES
C     MINIMUM FINAL GAIN VALUE=AMIN
C     MAXIMUM FINAL GAIN VALUE=AMAX(LESS THAN OR EQUAL TO 30)
C     MAXIMUM POWER OF 10 BY WHICH ENTRY TO INTEGRATOR CAN BE REDUCED=
C     MPOWER.COMPENSATED FOR BY CAPACITOR OR CHANGE TO HIGH GAIN
C     MAXIMUM POWER OF 10 WHICH CAN BE COMPENSATED FOR BY CHANGING
C     CAPACITOR=MCAP
C
      AMIN=.0005
      AMAX=30.
      AMHG=10.
      MPOWER=10
      MCAP=3
C
      CHLK77=331.
      IF(SENSE SWITCH 3)31,32
   31 PAUSE 331
   32 CONTINUE
B     SEV=777777777777
      IKDF=KDF-1
```

```
      KDF=IKDF
      KSEN=1
      LSEN=1
      ICOSEL=0
B     EMPTY(1111)=0
C
C     VALUE FOR ICON IF NO INITIAL CONS. SELECT
C
      CW2=CW
      IF(CW2)63,60,63
B  63 AVCON=CW2*770000000000
      IF(AVCON)61,64,61
   64 CALL LSHL(CW2,6,CW2)
      GO TO 63
   61 CALL LSHR(AVCON,12,ICON)
B     CW=CW2
      GO TO 65
   60 ICON=1
   65 ICON1=ICON
   62 CONTINUE
B     IF(CNFR(COMIM,2,0))399,499,399
  399 ITRO=1
      GO TO 200
  499 ITRO=2
C
  200 CONTINUE
      IF(LSEN-1)202,201,202
  201 KOP=NRTAPE
      KOW=NWTAPE
      GO TO 100
  202 KOP=NWTAPE
      KOW=NRTAPE
C
C     READ TAPE,ALL STATEMENTS,REC
C
  100 READ TAPE KOP,ID,NUMB,NA,(REC(I),I=1,NA)
      GO TO (101,101,101,102,101,104,101,120,101,85,86,101,101,101,101
     1,101,101,101,130,101,101,101),ID
C
C     WRITE TAPE,STATEMENTS WITH NO EQM
  101 CONTINUE
      WRITE TAPE KOW,ID,NUMB,NA,(REC(I),I=1,NA)
      IF(KSEN-1)999,100,999
C
C     READ TAPE,STATEMENTS WITH EQM
C
  102 CONTINUE
      KTYPE=IDEQ(ID)
  151 CONTINUE
      IF(LSEN-1)231,230,231
  230 CONTINUE
      READ TAPE KOP,MON,((EQM(I,J),I=1,MON),J=1,3)
B     EQM(93,2)=0
B     EQM(95,2)=0
B     EQM(97,2)=0
B     EQM(99,2)=0
```

LNK331

```
   17 GO TO (18,2,18,18,18,18,9,4,2,1,2,2,2,2),KTYPE
   18 IF(LSEN-1)899,3,899
  231 CONTINUE
      READ TAPE KOP,MON,((EQM(I,J),I=1,MON),J=1,3), EQM(99,2)  , EQM(95,2
     1),EQM(97,2),EQM(93,2)
      GO TO 17
C
C     I.C. POT FOR RECTANGULAR RATE RESOLVER
C
    1 CONTINUE
B     GP=(PALF(EQM(1,1)*77777))*770000
      CALL LSHL (GP,6,IGP)
      IF(IGP-19)2,21,2
B  21 GARM=EQM(4,1)*77777
B     IF(PALF(GARM)*4000)2,24,2
   24 CONTINUE
B     IF(EQM(1,2)*377000000000)7000,7001,7000
 7001 THETIO=3.14159/2.0
      GO TO 7003
 7000 CONTINUE
      THETIO=ATANF((EQM(2,2)*EQM(2,3))/(EQM(1,2)*EQM(2,3)))
 7003 CONTINUE
      THETIO=(THETIO*180./3.14159)/2.
      THETIC=ABSF(THETIO)/100.
      IF(THETIC-1.00004)29,77,103
  103 CALL STATN(NUMB,N1,N2,N3)
      WRITE OUTPUT TAPE NUTAPE,9000,N1,N2,N3
      WRITE OUTPUT TAPE NUTAPE,9001
      GO TO 2
   29 IF(THETIC-.99995)13,77,77
B  13 IF(THETIC*377000000000)2,77,2
B  77 EQM(99,2)=EQM(99,2)+1000000
      IF (SENSE SWITCH 5) 108,109
  108 WRITE OUTPUT TAPE NUTAPE,9002,EQM(2,2),EQM(2,3),EQM(1,2),EQM(1,3),
     1THETIC,EQM(99,2)
 9002 FORMAT(1H0,4O15,E12.6,1O15)
  109 CONTINUE
C
C     ALL EQM OF NORMAL TYPE
C
    2 CONTINUE
      WRITE TAPE KOW,ID,NUMB,NA,(REC(I),I=1,NA)
      WRITE TAPE KOW,MON,((EQM(I,J),I=1,MON),J=1,3),EQM(99,2),EQM(95,2),
     1EQM(97,2),EQM(93,2)
      GO TO 100
C
C     VARIPLOTTER
C
   85 CONTINUE
      IF(LSEN-1)101,27,101
   27 CONTINUE
      CALL ZZVP(NA)
      GO TO 101
C
C     RECORDER
C
```

```
   86 CONTINUE
      IF(LSEN-1)101,28,101
   28 CONTINUE
      CALL ZZRECO(NA)
      GO TO 101
C
C     BETA RECORD
C
  104 CONTINUE
      CALL BFIND(NA,BETA)
      GO TO 101
C
C     CONSOLE SELECT RECORD
C
  120 CONTINUE
      IF(MERR-12)30,101,30
   30 QCON=REC(1)
B     IF(QCON*77777000000)1102,1103,1102
C
C     CONSOLE ZERO
 1103 CONTINUE
      ICOSEL=0
      ICON=ICON1
      GO TO 101
C
C     CONSOLE NON-ZERO
 1102 CONTINUE
      CON=REC(1)
      ICON=ICOP
      ICOSEL=1
      IF(SENSE SWITCH 5)300,301
  300 CONTINUE
      WRITE OUTPUT TAPE NUTAPE,9137,(ICON)
 9137 FORMAT (1H0,21H CONSOLE SELECT CON= ,1015)
  301 CONTINUE
      IF(NCONS(ICON))101,1101,101
 1101 WRITE OUTPUT TAPE NUTAPE,9131
 9131 FORMAT (1H0,41H CONSOLE SELECT FOR NON-AVAILABLE CONSOLE)
      MERR=12
      IFULL=1
      GO TO 101
C
C     END RECORD
C
  130 KSEN=2
C
C****
      IF(SENSE SWITCH 5)312,313
  312 CONTINUE
      DO 19 IZ=1,NSY
      CALL RSYMB(RIF(IZ),C2,AWO,IZ1)
      IF(IZ1-1)20,19,20
B  20 C1=RIF(IZ)*77777
      C3=PALF(ACTW(AWO,-1))
      WRITE OUTPUT TAPE NUTAPE,15,C1,C2,C3
   19 CONTINUE
```

```
      WRITE OUTPUT TAPE NUTAPE,9119,(TSM1(I),TSM2(I),I=1,KTSM)
      WRITE OUTPUT TAPE NUTAPE,16,(RUBB(I),I=1,IDX)
      WRITE OUTPUT TAPE NUTAPE,16,(QUBB(I),I=1,IDQ)
      WRITE OUTPUT TAPE NUTAPE,16,(RESUBB(I),I=1,IDR)
      WRITE OUTPUT TAPE NUTAPE,9119,(TTD1(I),TTD2(I),I=1,KTTD)
      WRITE OUTPUT TAPE NUTAPE,9119,(TUBB1(I),TUBB2(I),I=1,JDX)
      WRITE OUTPUT TAPE NUTAPE,9119,(THAM1(I),THAM2(I),I=1,KTHAM)
      WRITE OUTPUT TAPE NUTAPE,9119,(HUBB1(I),HUBB2(I),I=1,IDH)
      WRITE OUTPUT TAPE NUTAPE,16,(TCP2(I),I=1,KDF)
      WRITE OUTPUT TAPE NUTAPE,9110,((TPOM(I,J),J=1,8),I=1,30)
  313 CONTINUE
C****
C
      GO TO 101
C
C     REWIND TAPES AND EXIT
C
  999 CONTINUE
      REWIND NRTAPE
      REWIND NWTAPE
      IF(IFULL)2999,1999,2999
 1999 CONTINUE
C
C     CONSOLE NUMBER FOR MULTIPLIERS WITH EXTERNAL VARIABLE ON ARM
      CALL ZEXTR(ICON1)
      IF(IFULL)42,33,42
   42 GO TO (51,50),ITRO
B  50 PASS=606045464540
      GO TO 52
B  51 PASS=606060606060
B  52 BASS=314447466225
      WRITE OUTPUT TAPE NUTAPE,9132,PASS,BASS
      WRITE OUTPUT TAPE NUTAPE,9133
      WRITE OUTPUT TAPE NUTAPE,9110,((TPOM(I,J),J=1,8),I=1,30)
      WRITE OUTPUT TAPE NUTAPE,9134
      GO TO 2999
   33 GO TO (372,2999),ITRO
  372 CONTINUE
      LSEN=2
      KSEN=1
      ITRO=2
      GO TO 200
 2999 CONTINUE
C
C****
      IF(SENSE SWITCH 5)22,23
   22 CONTINUE
      WRITE OUTPUT TAPE NUTAPE,16,(RUBB(I),I=1,IDX)
      WRITE OUTPUT TAPE NUTAPE,16,(QUBB(I),I=1,IDQ)
      WRITE OUTPUT TAPE NUTAPE,16,(RESUBB(I),I=1,IDR)
      WRITE OUTPUT TAPE NUTAPE,9119,(TUBB1(I),TUBB2(I),I=1,JDX)
      WRITE OUTPUT TAPE NUTAPE,9119,(HUBB1(I),HUBB2(I),I=1,IDH)
B     ZERO=0
      DO 11 I=1,KCUBB
      J=(2*I)-1
      WRITE OUTPUT TAPE NUTAPE,9136,CUBB1(I),CUBB2(J),CUBB3(J),ZERO,CUBB
```

```
     12(J+1),CUBB3(J+1)
   11 CONTINUE
      WRITE OUTPUT TAPE NUTAPE,9119,(SUBB1(I),SUBB2(I),I=1,IDS)
      WRITE OUTPUT TAPE NUTAPE,9110,((TPOM(I,J),J=1,8),I=1,30)
      CALL PDUMP(SYMB,SYMB(7000),0)
   23 CONTINUE
C****
C
      GO TO (70,71),LSEN
   70 CONTINUE
      NTT=NRTAPE
      NRTAPE=NWTAPE
      NWTAPE=NTT
   71 CONTINUE
C
C     IF CONSOLE FULL,SKIP ADDRESSING
C
      IF(IFULL)9140,9141,9140
 9140 CONTINUE
      LE7777=2
      NSB=INDEX(ADRF(SYMB(1)),ASY)-1
      READ TAPE NS2TPE,(SYMB(I),I=1,NSB),(RIF(I),I=1,NSY)
      REWIND NS2TPE
      CALL CHAINB(4,B3)
 9141 CONTINUE
      CALL CHAIN(341, 3)
C
C
C     COUNT OF ENTRIES AND POTS FOR R.H.S OF EQUATIONS
C     ------------------------------------------------
C
C
C
C     COMPARATOR EQUATION
C
    4 CONTINUE
B     IF(BID*700000)5,6,5
    5 KEQCM=KEQCM+1
      GO TO (110,899),LSEN
    6 KEQCM=0
      LPOT=0
      LMPOT=0
C     MEMORISE COIL
B     SAVE1=EQM(3,1)*77777
      CALL LSHL(SAVE1,18,SAVE1)
B     SAVE2=EQM(4,1)*400000000000
      CALL LSHR(SAVE2,18,SAVE2)
B     D77771(1)=EQM(2,1)*400000000000+SAVE1+EQM(5,1)*77777+SAVE2
      CALL CMCOIL(LSEN)
C
C****
      IF(SENSE SWITCH 5)2000,2001
 2000 CONTINUE
      WRITE OUTPUT TAPE NUTAPE,9136,((EQM(I,J),J=1,3),I=1,MON)
 2001 CONTINUE
C****
C
```

```
      GO TO 2
C
C     SWITCH EQUATION
C
    9 CONTINUE
B     IF(BID*700000)10,12,10
   12 ISWPOT=0
      ISWPOM=0
      KEQSW=0
      GO TO 2
   10 KEQSW=KEQSW+1
      GO TO (110,899),LSEN
C
C     CALCULATE VALUES OF ENTRIES WITH SCALE FACTORS INCLUDED
C
    3 CONTINUE
  110 CONTINUE
      NON=MON-1
      DO 8805 I=2,NON,2
      J=I+1
      EQM(I,2)=EQM(I,1)*EQM(1,3)/EQM(J,3)
 8805 CONTINUE
C
C     CALCULATE VALUES OF ENTRIES WITH BETA FOR INTEGRATORS
C                                 WITHOUT BETA FOR SUMMERS,HIGH GAINS
C
B     VARC=EQM(1,1)*77000000
      IF(NVARC-9)8801,8802,8801
 8802 CONTINUE
      DO 8800 I=2,NON,2
      EQM(I,3)=EQM(I,2)/BETA
 8800 CONTINUE
      GO TO 34
 8801 CONTINUE
      DO 8803 I=2,NON,2
      EQM(I,3)=EQM(I,2)
 8803 CONTINUE
   34 CONTINUE
      GO TO (26,26,80,26,400,400,899,899,26,26,26,26,26,26),KTYPE
C
C     DFG
C
  400 CONTINUE
      CALL STATN(NUMB,N1,N2,N3)
      WRITE OUTPUT TAPE NUTAPE,9153,N1,N2,N3,EQM(2,3)
      GO TO 899
C
C     ZERO EQUATION
C
   80 CONTINUE
      CALL ZCDIV(MON,NUMB,ID)
      GO TO 26
C
C     CONTROL POTS ALGEBRAIC EQUATION
C
   26 CONTINUE
```

```
      CALL XGAINS(MON,ID,NA)
C
      CALL XENTRY(MON)
C
  899 CONTINUE
C
C****
      IF(SENSE SWITCH 5)302,303
  302 CONTINUE
      WRITE OUTPUT TAPE NUTAPE,9136,(EQM(1,1))
  303 CONTINUE
C****
C
      IF(IFULL)2,1603,2
C
C     COUNT OF ELEMENTS
C     -----------------
C
 1603 CONTINUE
      LCON=ICON
B     VARC=EQM(1,1)*77777
      GO TO (7,7,7,7,8,8,14,25,7,7,7,7,7,7),KTYPE
C
C     COUNT ALGEBRAIC EQUATION
C     LEFT HAND SIDE VARIABLE
C
    7 CONTINUE
      CALL ZC1 (LCON,VARC,ID)
      IF(IFULL)1694,1607,1694
C
C     COUNT DFG
C
    8 CONTINUE
      CALL ZZDFG(LCON,VARC)
      IF(IFULL)1694,1607,1694
C
C     COUNT COMPARATOR
C
   25 CONTINUE
      CALL ZCOMP(LCON,VARC,KEQCM,KOP)
      IF(IFULL)1694,2002,1694
 2002 CONTINUE
      GO TO(1607,2004),KEQCM
 2004 CONTINUE
B     IF(CUBB2(KKKKKK)*77777000000)1607,2,1607
C
C     COUNT SWITCH
C
   14 CONTINUE
      CALL SWGAIN(LCON,KEQSW,VARC)
      IF(IFULL)1694,2003,1694
 2003 CONTINUE
      GO TO(1607,210,210),KEQSW
  210 CONTINUE
B     IF(SUBB1(KKKKKK)*400000000000)1607,   2,1607
C
```

LNK331

```
C       COUNT OF MULTIPLIERS CALLED BY VARIABLE
C       ON LEFT HAND SIDE
C
 1607   CONTINUE
        LCON=LCON
B       VARC=EQM(1,1)*77777
        CALL ZC2(VARC,LCON)
        IF(IFULL)1694,2,1694
C
C       ERRORS
C
 1694   CALL STATN(NUMB,N1,N2,N3)
        WRITE OUTPUT TAPE NUTAPE,9135,N1,N2,N3,MERR
        WRITE OUTPUT TAPE NUTAPE,9133
        WRITE OUTPUT TAPE NUTAPE,9110,((TPOM(I,J),J=1,8),I=1,30)
        WRITE OUTPUT TAPE NUTAPE,9134
        GO TO 2
   15   FORMAT (1H ,30I5)
   16   FORMAT (1H0/(0I5))
 9000   FORMAT (1H0,1H ,I4,1H.,I3,1H.,I2,16H CHECK FOR GAINS)
 9001   FORMAT (1H0,12X,37X,60H I.C. POT SETTING GREATER THAN 1 ,POT COUNT
       1ED FOR ADDRESSING)
 9110   FORMAT (1H0/(80I5))
 9119   FORMAT (1H0/(20I5))
 9132   FORMAT (1H1,45H CONSOLE FULL FOR MULTIPLIER OR RESOLVER WITH,2A6,2
       17H EXTERNAL VARIABLE AS ENTRY)
 9133   FORMAT (1H0,14H PRINT OF TPOM)
 9134   FORMAT (1H1)
 9135   FORMAT (1H1,26H CONSOLE FULL AT EQUATION ,I4,1H.,I3,1H.,I2,20H, DI
       1AGNOSTIC NUMBER ,I4,2H .)
 9136   FORMAT (1H0/(30I5))
 9153   FORMAT (1H0,1H ,I4,1H.,I3,1H.,I2,25H DFG WITH INTERNAL SCALE ,E12.
       16)
        END(1,0,0,0,0,0,1,0,0,0,0,0,0,0,0)
```

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
1525	02765	16111	37357

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AFUN	31311	75117	AMAX	27553	65641	AMHG	27549	65635	AMIN	27552	65640	ASY	32534	77426
BETAC	32530	77422	BETA	32531	77423	CHLK77	32554	77452	COMIM	32536	77430	CUBB1	29981	72435
CUBB2	29921	72341	CUBB3	29801	72151	CW	32535	77427	D77771	32525	77415	EMPTY	27548	65634
EQM	32011	76413	ETW	31351	75167	GRETA	31031	74467	HUBB1	28981	70465	HUBB2	28481	67501
ICON	27621	65745	ICOSEL	27623	65747	IDC	27641	65771	IDH	27638	65766	IDQ	27637	65765
IDR	27560	65650	IDS	27636	65764	IDX	27640	65770	IE	32549	77445	IFULL	27626	65752
IKCP	32529	77421	IKCUBB	27629	65755	IKTHAM	32526	77416	IKTSM	32528	77420	IKTTD	32527	77417
INTAPE	32561	77461	IOLDQS	27630	65756	IQS	27631	65757	IQUAD	27635	65763	IROOT	27633	65761
ISWPOM	27554	65642	ISWPOT	27555	65643	ITRO	27627	65753	JDX	27639	65767	JMPOT	27556	65644
JPOT	27557	65645	KBK777	32551	77447	KCP	32541	77435	KCUBB	27628	65754	KKKKKK	32537	77431
KQUAD	27634	65762	KROOT	27632	65760	KTHAM	32538	77432	KTSM	32540	77434	KTTD	32539	77433
KTYPE	27624	65750	LE7777	32550	77446	LMPOT	27558	65646	LPOT	27559	65647	MCAP	27550	65636
MERR	27625	65751	MPOWER	27551	65637	NBOX	31301	75105	NCONS	32547	77443	NRTAPE	32559	77457
NS1TPE	32557	77455	NS2TPE	32556	77454	NS3TPE	32555	77453	NSY	32533	77425	NUMB	27622	65746
NUTAPE	32560	77460	NW	32548	77444	NWTAPE	32558	77456	PRMAIN	32553	77451	QUBB	27981	66515
REC	32511	77377	REF	32532	77424	RESUBB	27620	65744	RIF	24111	57057	RUBB	29681	71761
RUTINE	32552	77450	SUBB1	27881	66351	SUBB2	27761	66161	SYMB	23111	55107	TCP1	30101	72625
TCP2	30041	72531	THAM1	30701	73755	THAM2	30401	73301	TPOM	31271	75047	TSM1	31001	74431
TSM2	30911	74277	TTD1	30821	74145	TTD2	30761	74051	TUBB1	29181	70775	TUBB2	29081	70631
TV	31711	75737												

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
A	1521	02761	BID	1524	02764	CON	1523	02763	ICOP	1523	02763	ID	1524	02764
KA	1521	02761	NVARC	1522	02762	VARC	1522	02762						

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENT

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AVCON	1520	02760	AWO	1519	02757	B3	1518	02756	BASS	1517	02755	C1	1516	02754
C2	1515	02753	C3	1514	02752	CW2	1513	02751	GARM	1512	02750	GP	1511	02747
ICON1	1510	02746	IGP	1509	02745	IKDF	1508	02744	I	1507	02743	IZ1	1506	02742
J	1505	02741	KDF	1504	02740	KEQCM	1503	02737	KEQSW	1502	02736	KOP	1501	02735
KOW	1500	02734	KSEN	1499	02733	LCON	1498	02732	LSEN	1497	02731	MON	1496	02730
N1	1495	02727	N2	1494	02726	N3	1493	02725	NA	1492	02724	NON	1491	02723
NSB	1490	02722	NTT	1489	02721	PASS	1488	02720	QCON	1487	02717	SAVE1	1486	02716
SAVE2	1485	02715	SEV	1484	02714	THETIC	1483	02713	THETIO	1482	02712	ZERO	1481	02711

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

	EFN	LOC		EFN	LOC		EFN	LOC		EFN	LOC		EFN	LOC
8)F	15	02647	8)G	16	02645	8)8P8	9000	02643	8)8P9	9001	02633	8)8PA	9002	02672
8)8SM	9110	02616	8)8SV	9119	02613	8)8TB	9131	02660	8)8TC	9132	02610	8)8TD	9133	02571
8)8TE	9134	02565	8)8TF	9135	02564	8)8TG	9136	02545	8)8TH	9137	02666	8)8U1	9153	02542

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
1)	1467	02673	2)	1323	02453	3)	1336	02470	4)	32767	77777	6)	1362	02522
C)G2	1470	02676	C)G3	1471	02677	C)G4	1472	02700	C)G6	1473	02701	C)G7	1474	02702
C)G8	1475	02703	C)G9	1476	02704	C)GA	1477	02705	C)GB	1478	02706	C)103	1479	02707
C)104	1480	02710	D)11C	436	00664	D)13S	929	01641	D)145	977	01721	D)14I	1071	02057
D)20A	130	00202	D)30A	129	00201	D)42U	745	01351	D)436	785	01421	D)44V	1178	02232
D)45B	1272	02370	D)54V	1177	02231	E)1J	486	00746	E)1L	495	00757	E)10	508	00774
E)1V	561	01061	E)2S	732	01334	E)BOG	184	00270						

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
ACTW	18	00022	ADR	23	00027	ATAN	10	00012	BFIND	16	00020	CHAINB	24	00030
CHAIN	25	00031	CMCOIL	26	00032	CNFR	3	00003	IDEQ	8	00010	INDEX	22	00026
LSHL	1	00001	LSHR	2	00002	PAL	9	00011	PDUMP	21	00025	RSYMB	17	00021
STATN	11	00013	SWGAIN	33	00041	XENTRY	29	00035	XGAINS	28	00034	ZC1	30	00036
ZC2	34	00042	ZCDIV	27	00033	ZCOMP	32	00040	ZEXTR	20	00024	ZZDFG	31	00037
ZZRECO	15	00017	ZZVP	14	00016	(FIL)	13	00015	(FPT)	0	00000	(RLR)	5	00005
(RWT)	19	00023	(STB)	6	00006	(STH)	12	00014	(TSB)	4	00004	(WLR)	7	00007

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

ACTW	ADR	ATAN	BFIND	CHAINB	CHAIN	CMCOIL	CNFR	IDEQ	INDEX
LSHL	LSHR	PAL	PDUMP	RSYMB	STATN	SWGAIN	XENTRY	XGAINS	ZC1
ZC2	ZCDIV	ZCOMP	ZEXTR	ZZDFG	ZZRECO	ZZVP	(FIL)	(FPT)	(RLR)
(RWT)	(STB)	(STH)	(TSB)	(WLR)					

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
31	37	00076	32	38	00077	63	48	00124	64	50	00133	61	53	00142
60	57	00153	65	58	00157	62	59	00161	399	62	00170	499	64	00175
200	65	00203	201	67	00210	202	70	00215	100	72	00221	101	79	00271
102	87	00316	151	90	00325	230	92	00332	17	106	00376	18	107	00414
231	108	00421	1	119	00466	21	124	00510	24	126	00523	7001	128	00530
7000	130	00534	7003	132	00550	103	136	00566	29	142	00622	13	143	00626
77	144	00633	108	146	00640	109	148	00664	2	149	00665	85	166	00747
27	168	00754	86	172	00760	28	174	00765	104	178	00770	120	182	00775
30	184	01000	1103	186	01007	1102	190	01016	300	195	01030	301	201	01042
1101	203	01046	130	207	01062	312	209	01066	20	214	01106	19	219	01140
313	273	01333	999	275	01335	1999	279	01345	42	283	01352	50	284	01355
51	286	01360	52	287	01362	33	301	01422	372	302	01424	2999	307	01437
22	309	01441	11	340	01600	23	356	01642	70	358	01645	71	362	01653
9140	364	01655	9141	379	01715	4	382	01722	5	384	01725	6	386	01736
2000	399	02011	2001	408	02027	9	410	02030	12	412	02035	10	416	02046
3	418	02057	110	419	02060	8805	424	02104	8802	427	02117	8800	430	02125
8801	432	02130	8803	435	02135	34	436	02137	400	438	02157	80	444	02207
26	448	02216	899	453	02233	302	455	02235	303	459	02247	1603	461	02253
7	465	02277	8	469	02311	25	473	02322	2002	477	02335	2004	479	02340
14	481	02346	2003	485	02360	210	487	02364	1607	489	02371	1694	495	02405

5.6.2 ANALOG ELEMENTS

In the STATIC CHECK (LINK 6) for each element a comparison is made between the output calculated from the read input values, and the output actually read. The difference is controlled against a given tolerance for that type of element, and if it exceeds it a diagnostic is given.

The output of each element is also controlled against an upper limit (saturation level) and a lower limit (significance level). The tolerance values are pre-fixed in LINK 6 in the table TOLERT, the values are the actual tolerance values of the elements multiplied by 10^4.

```
          *** APAPCHE 7090/4 ***   CHAIN LINK 6
```

```
                                     *      STATIC  CHECK ROUTINE                                          22    40
                                     *      INITIALIZE                                                     22    50
BINARY CARD NO. LNK06000
          PROGRAM CARD

     TRANSFER VECTOR

BINARY CARD NO. LNK06001
     00000  512566627062     REWSYS
     00001  674647254560     XOPEN
     00002  675125212460     XREAD
     00003  233021314560     CHAIN

     00004 -0760 00 0 00004          LFTM                                                              22    70
     00005  0564 00 0 13016          ENB       =0           FORTRAN I VERSION 3                        22    80
     00006  0074 00 4 00000          CALL      REWSYS                                                  22    90
     00007  0441 00 0 77451          LDI       PRMAIN                                                  22   100
     00010  0056 00  000040          RNT       40                                                      22   110
     00011  0020 00 0 00013          TRA       *+2                                                     22   120
     00012 -0625 00 0 11524          STL       OPTION                                                  22   130
     00013 -0774 00 1 00241          AXC       T3,1                                                    22   140
     00014  0634 00 1 00237          SXA       POINTA,1                                                22   150
     00015 -0774 00 1 04253          AXC       T1,1                                                    22   160
     00016  0634 00 1 04252          SXA       POINTB,1                                                22   170
     00017  0074 00 4 00001          TSX       $XOPEN,4                                                22   180
     00020  0074 00 0 77461          TSX       SYSIN1,0                                                22   190
     00021  0074 00 0 00120          TSX       BUFFA+23,0                                              22   200
     00022  0074 00 0 13037          TSX       =030000000,0                                            22   210

     00023  0074 00 4 00002  GET     TSX       $XREAD,4                                                22   230

BINARY CARD NO. LNK06002
     00024  0074 00 0 00121          TSX       FLAG,0                                                  22   240
     00025  0074 00 0 77461          TSX       SYSIN1,0                                                22   250
     00026  0074 00 0 00120          TSX       BUFFA+23,0                                              22   260
     00027  0074 00 0 13037          TSX       =030000000,0                                            22   270
     00030  0074 00 0 00070          TSX       CARD+23,0                                               22   280
     00031  0074 00 0 13037          TSX       =030000000,0                                            22   290
     00032  0500 00 0 00121          CLA       FLAG                                                    22   300
     00033  0402 00 0 13035          SUB       =01000000                                               22   310
     00034  0100 00 0 00040          TZE       REDUN                                                   22   320
     00035  0120 00 0 00155          TPL       EOF                                                     22   330
     00036  0074 00 4 00122          TSX       CKSEQ,4                                                 22   340
     00037  0020 00 0 00136          TRA       SELTY                                                   22   350
     00040  0020 00 0 00023  REDUN   TRA       GET                                                     22   360
     00041                   CARD    BSS       24                                                      22   370
     00071                   BUFFA   BSS       24                                                      22   380

BINARY CARD NO. LNK06003
     00121  0 00000 0 00000  FLAG                                                                      22   390
```

```
        *** APAPCHE 7090/4 ***   CHAIN LINK 6
```

```
                                   *      CHECK CARD SEQUENCE NUMBER
00122 -0534 00 2 00070    CKSEQ    LXD       CARD+23,2
00123  3 00000 2 00125             TXH       NTNEW,2,0
00124  0020 00 0 00132             TRA       RITE
00125 -0634 00 2 00127    NTNEW    SXD       *+2,2
00126  0535 00 1 00134             LAC       CCOUNT,1
00127  1 00000 1 00130             TXI       *+1,1,*-*
00130 -3 00001 1 00132             TXL       RITE,1,1
00131  0634 00 2 00135             SXA       ORDERF,2
00132  0634 00 2 00134    RITE     SXA       CCOUNT,2
00133  0020 00 4 00001             TRA       1,4
00134  0 00000 0 00000    CCOUNT
00135  0 00000 0 00000    ORDERF
```

```
        *** APACHE 7090/4 ***   CHAIN LINK 6
```

```
                          *        SELECT TYPE OF CARD
                          *        SET UP CONSOLE NUMBER
                          *        IF CURRENT CONSOLE IS NON-ZERO STORE IT IN CONSOL
00136 -0500 00 0 00070    SELTY    CAL       CARD+23
00137 -0320 00 0 13033             ANA       =0700000
00140 -0763 00 0 00003             LGL       3
00141  0100 00 0 00143             TZE       *+2
00142  0622 00 0 00163             STD       CONSOL
00143  0534 00 2 00070             LXA       CARD+23,2
00144  3 00004 2 00023             TXH       GET,2,4

BINARY CARD NO. LNK06004
00145  0020 00 2 00152             TRA       *+5,2
00146  0020 00 0 00157             TRA       NWCON
00147  0020 00 0 00153             TRA       NWGP
00150  0020 00 0 00164             TRA       NETW
00151  0020 00 0 04161             TRA       RESP
00152  0020 00 0 00023             TRA       GET
```

```
        *** APACHE 7090/4 ***   CHAIN LINK 6
```

```
                          *        NEW TYPE OF CARD DEFINED
00153 -0625 00 0 00161    NWGP     STL       LASTCF
00154  0020 00 0 00166             TRA       LNWC
00155 -0625 00 0 00161    EOF      STL       LASTCF
00156  0020 00 0 04163             TRA       NWRES
                          *        NEW CONSOLE DEFINED ON FOLLOWING CARDS
00157 -0625 00 0 00162    NWCON    STL       NWCONF
00160  0020 00 0 00023             TRA       GET
00161  0 00000 0 00000    LASTCF
00162  0 00000 0 00000    NWCONF
00163  0 00000 0 00000    CONSOL
```

```
                 *** APACHE 7090/4 ***   CHAIN LINK 6

                                 *       PROCESS NETWORK CARDS                                         22  840
                                 *       BUILD T3 AND T4 FROM NETWORK CARDS                             22  850
                                 *       T4 CONTAINS CONSOLE COUNT AND LAST ADDRESS POINTER             22  860
      00164 -0520 00 0 00162     NETW    NZT     NWCONF                                                 22  870
      00165  0020 00 0 00200             TRA     SMCON                                                  22  880
      00166  0535 00 1 00237     LNWC    LAC     POINTA,1                                               22  890
      00167  0074 00 4 10225             TSX     POINT,4                                                22  900
      00170  0 00000 2 00236             PZE     T4+6,2                                                 22  910

 BINARY CARD NO. LNK06005
      00171 -0520 00 0 00161             NZT     LASTCF                                                 22  920
      00172  0020 00 0 00200             TRA     SMCON                                                  22  930
      00173  0774 00 2 04253             AXT     T1,2                                                   22  940
      00174  0634 00 2 10242             SXA     FSTAB,2                                                22  950
      00175  0600 00 0 00236             STZ     CURCON                                                 22  960
      00176  0600 00 0 00161             STZ     LASTCF                                                 22  970
      00177  0020 00 0 00023             TRA     GET                                                    22  980
      00200  0534 00 1 00237     SMCON   LXA     POINTA,1                                               22  990
      00201  0634 00 1 00223             SXA     TEOU,1              *                                  22 1000
      00202  0600 00 0 00240             STZ     SUMMER                                                 22 1010
      00203  0774 00 2 00025             AXT     21,2                                                   22 1020
      00204 -0500 00 2 00070     NWORD   CAL     CARD+23,2                                              22 1030
      00205  0100 00 0 00214             TZE     LSTWD                                                  22 1040
      00206  0361 00 0 00240             ACL     SUMMER                                                 22 1050
      00207  0602 00 0 00240             SLW     SUMMER                                                 22 1060
      00210 -0500 00 2 00070             CAL     CARD+23,2                                              22 1070
      00211  0602 00 1 00000             SLW     ,1                                                     22 1080
      00212  1 77777 1 00213             TXI     *+1,1,-1                                               22 1090
      00213  2 00001 2 00204             TIX     NWORD,2,1                                              22 1100
      00214  0634 00 1 00237     LSTWD   SXA     POINTA,1                                               22 1110

 BINARY CARD NO. LNK06006
      00215 -0500 00 0 00240             CAL     SUMMER                                                 22 1120
      00216  0361 00 0 00041             ACL     CARD                                                   22 1130
      00217  0322 00 0 00042             ERA     CARD+1                                                 22 1140
      00220  0100 00 0 00223             TZE     TEOU                                                   22 1150
      00221  0074 00 4 12627             TSX     WRMESS,4                                               22 1160
      00222  0 00006 0 12130             PZE     ERRB,,6                                                22 1170
      00223 -0774 00 1 00000     TEOU    AXC     *-*,1                                                  22 1180
      00224  0634 00 1 00226             SXA     *+2,1               *                                  22 1190
      00225  0074 00 4 12420             TSX     WRITE,4                                                22 1200
      00226  1 00025 0 00000             PON     *-*,,21                                                22 1210
      00227  0020 00 0 00023             TRA     GET                                                    22 1220
      00230                      T4      BSS     6                                                      22 1230

 BINARY CARD NO. LNK06007
      00236  0 00000 0 00000     CURCON                                                                 22 1240
      00237  0 00000 0 00000     POINTA  PZE     *-*                                                    22 1250
      00240  0 00000 0 00000     SUMMER                                                                 22 1260
      00241                      T3      BSS     2000                                                   22 1270
```

```
                        *      PROCESS RESPONSE CARDS                          22 1290
                        *      WITH ELEMENTS AND VALUES                        22 1300
                        *      WHEN    ZCOUNT IS ZERO A NEW CONSOLE IS DEFINED 22 1310
                 00764  LNTOT  EQU     500                                     22 1320

BINARY CARD NO. LNK06008
   04161 -0520 00 0 00162  RESP   NZT     NWCONF                               22 1330
   04162  0020 00 0 04170         TRA     SAMEC                                22 1340
   04163  0535 00 1 04252  NWRES  LAC     POINTB,1                             22 1350
   04164  0074 00 4 10225         TSX     POINT,4                              22 1360
   04165  0 00000 2 10201         PZE     T8+6,2                               22 1370
   04166  0520 00 0 00161         ZET     LASTCF                               22 1380
   04167  0020 00 0 10243         TRA     RUN                                  22 1390
   04170  0774 00 2 00006  SAMEC  AXT     LNCOLT,2                             22 1400
   04171  0534 00 1 04252         LXA     POINTB,1                             22 1410
   04172 -0500 00 2 11064  STLP   CAL     COLTAB+LNCOLT,2                      22 1420
   04173  0600 00 0 10201         STZ     TENDIV                               22 1430
   04174  0074 00 4 10726         TSX     CVERT,4                              22 1440
   04175 -0320 00 0 13064         ANA     =0777777000000                       22 1450
   04176  0100 00 0 04250         TZE     NMEHR                                22 1460
   04177 -0765 00 0 00036         LGR     30                                   22 1470
   04200 -0340 00 0 13020         LAS     =3                                   22 1480
   04201  0020 00 0 04206         TRA     STLPA                                22 1490
   04202  0020 00 0 04204         TRA     *+2                                  22 1500
   04203  0020 00 0 04206         TRA     STLPA                                22 1510
   04204 -0625 00 0 10201         STL     TENDIV                               22 1520

BINARY CARD NO. LNK06009
   04205 -0501 00 0 13022         ORA     =H00000C                             22 1530
   04206 -0763 00 0 00036  STLPA  LGL     30                                   22 1540
   04207  0602 00 1 00000         SLW     ,1                                   22 1550
   04210  0500 00 0 00163         CLA     CONSOL                               22 1560
   04211  0771 00 0 00022         ARS     18                                   22 1570
   04212  0621 00 1 00000         STA     ,1                                   22 1580
   04213 -0500 00 2 11065         CAL     COLTAB+LNCOLT+1,2                    22 1590
   04214  0074 00 4 10726         TSX     CVERT,4                              22 1600
   04215  0044 00 0 00000         PAI                                          22 1610
   04216  0056 00  000077         RNT     77                                   22 1620
   04217  0020 00 0 04221         TRA     *+2                                  22 1630
   04220  0771 00 0 00006         ARS     6                                    22 1640
   04221  0140 00 0 04222         TOV     *+1                                  22 1650
   04222 -0520 00 0 10201         NZT     TENDIV                               22 1660
   04223  0020 00 0 04227         TRA     STLPB                                22 1670
   04224 -0765 00 0 00006         LGR     6                                    22 1680
   04225  0767 00 0 00006         ALS     6                                    22 1690
   04226 -0763 00 0 00006         LGL     6                                    22 1700
   04227  0602 00 1 00001  STLPB  SLW     1,1                                  22 1710
   04230 -0520 00 0 10201         NZT     TENDIV                               22 1720

BINARY CARD NO. LNK06010
   04231  0020 00 0 04246         TRA     STLPD                                22 1730
   04232 -0140 00 0 04241         TNO     STLPC                                22 1740
   04233 -0500 00 1 00000         CAL     0,1                                  22 1750
   04234 -0501 00 0 13031         ORA     =H000 -0                             22 1760
   04235  0602 00 0 10204         SLW     ERRE+2                               22 1770
   04236  0074 00 4 12627         TSX     WRMESS,4                             22 1780
```

```
04237   0 00013 0 10202          PZE    ERRE,,11
04240   0020 00 0 04246          TRA    STLPD
04241  -0500 00 1 00000   STLPC  CAL    0,1
04242  -0501 00 0 13031          ORA    =H000 -0
04243   0602 00 0 10217          SLW    ERRF+2
04244   0074 00 4 12627          TSX    WRMESS,4
04245   0 00010 0 10215          PZE    ERRF,,8
04246   1 77776 1 04247   STLPD  TXI    *+1,1,-2
04247   2 00002 2 04172          TIX    STLP,2,2
04250   0634 00 1 04252   NMEHR  SXA    POINTB,1
04251   0020 00 0 00023   TEOUT  TRA    GET
04252   0 00000 0 00000   POINTB PZE    *-*
04253                     T1     BSS    2000
                  03720   LNT1   EQU    *-T1
10173                     T8     BSS    6
BINARY CARD NO. LNK06011
10201   0 00000 0 00000   TENDIV
10202   006060606060       ERRE  BCI    9,0       ***       OUTPUT GREATER THAN 999.99. FIRST D
10203   545454606060
10204   606060606060
10205   604664634764
10206   636027512521
10207   632551606330
10210   214560111111
10211   331111336026
10212   315162636024
10213   312731636043             BCI    2,IGIT LOST
10214   466263606060
10215   006060606060       ERRF  BCI    8,0       ***       OUTPUT BETWEEN 100 AND 999.99
10216   545454606060
10217   606060606060
10220   604664634764
10221   636022256366
10222   252545600100
10223   006021452460
10224   111111331111
```



```
                          *      MAKE ENTRY IN APPROPRIATE POINTER TABLE
                          *      TXI CONTAINS NEXT AVAILABLE TABLE POSITION
                          *      POINTA CONTAINS THE COMPLEMENT OF NEXT AVAILABLE TI ADDRESS
BINARY CARD NO. LNK06012
10225  -0534 00 2 00236   POINT  LXD    CURCON,2
10226  -2 00000 2 10235          TNX    NTHNG,2,0
10227   0754 00 1 00000          PXA    ,1
10230   0621 60 4 00001          STA*   1,4
10231   0402 00 0 10242          SUB    FSTAB
10232   0767 00 0 00022          ALS    18
10233   0622 60 4 00001          STD*   1,4
10234   0634 00 1 10242          SXA    FSTAB,1
10235  -0534 00 2 00163   NTHNG  LXD    CONSOL,2
10236  -0634 00 2 00236          SXD    CURCON,2
10237   0600 00 0 00162          STZ    NWCONF
10240   0020 00 4 00002          TRA    2,4
10241   0 00000 0 00000   TYPEF
10242   0 00000 0 00241   FSTAB  PZE    T3
```

```
                                 *       RUNDOWN T1 ONE ELEMENT AT A TIME                  22 2170
                                 *       FIND CORRESPONDING EQUATION IN T3                 22 2180
                                 *       MOVE EQUATION TO T5                               22 2190
                        00024    LNT5    EQU     20                                        22 2200
      10243  0774 00 2 00000     RUN     AXT     0,2                                       22 2210
      10244 -0500 00 2 04253             CAL     T1,2                                      22 2220
      10245  0100 00 0 11131             TZE     FINITO                                    22 2230
      10246 -0320 00 0 13062             ANA     =0770000000000                            22 2240
      10247  0322 00 0 13053             ERA     =HP00000                                  22 2250
      10250  0100 00 0 10254             TZE     SKPOT                                     22 2260

BINARY CARD NO. LNK06013
      10251  0322 00 0 13053             ERA     =HP00000                                  22 2270
      10252  0322 00 0 13054             ERA     =HQ00000                                  22 2280
      10253 -0100 00 0 10255             TNZ     *+2                                       22 2290
      10254  1 77776 2 10244     SKPOT   TXI     RUN+1,2,-2                                22 2300
      10255 -0500 00 2 04253             CAL     T1,2                                      22 2310
      10256  0621 00 0 00236             STA     CURCON                                    22 2320
      10257  0734 00 1 00000             PAX     ,1                                        22 2330
      10260 -0320 00 0 13064             ANA     =0777777000000                            22 2340
      10261 -0501 00 0 13032             ORA     =H000                                     22 2350
      10262  0602 00 0 10301             SLW     ELEM                                      22 2360
      10263  0074 00 4 10702             TSX     NMTNET,4                                  22 2370
      10264  1 77776 2 10244             TXI     RUN+1,2,-2                                22 2380
      10265  0774 00 4 00000             AXT     0,4                                       22 2390
      10266  0500 60 0 10711     NENT    CLA*    GTNET                                     22 2400
      10267  0100 00 0 10275             TZE     NOMO                                      22 2410
      10270 -2 00000 4 10272             TNX     *+2,4,0                                   22 2420
      10271 -0120 00 0 10275             TMI     NOMO                                      22 2430
      10272  0601 00 4 10302             STO     T5,4                                      22 2440
      10273  1 77777 4 10274             TXI     *+1,4,-1                                  22 2450
      10274  1 77777 1 10266             TXI     NENT,1,-1                                 22 2460

BINARY CARD NO. LNK06014
      10275  0600 00 4 10302     NOMO    STZ     T5,4                                      22 2470
      10276  1 77776 2 10277             TXI     *+1,2,-2                                  22 2480
      10277  0634 00 2 10243             SXA     RUN,2                                     22 2490
      10300  0020 00 0 10327             TRA     PACK                                      22 2500
      10301  0 00000 0 00000     ELEM                                                      22 2510
      10302                      T5      BSS     LNT5                                      22 2520

BINARY CARD NO. LNK06015
      10326  0 00000 0 00000     ACTVAL                                                    22 2530
```

```
                                  *        SCAN T5 AND BUILD OUTPUT VECTORS
                                  *        BUILD T6 WITH ACTUAL INPUTS IN FL. POINT
 10327  0500 00 0 10302   PACK    CLA      T5
 10330 -0765 00 0 00014           LGR      12
 10331 -0320 00 0 13036           ANA      =07777777
 10332 -0734 00 4 00000           PDX      ,4
 10333  0634 00 4 10501           SXA      TRUCON,4
 10334 -0320 00 0 13034           ANA      =0777777
 10335 -0763 00 0 00014           LGL      12
 10336  0622 00 0 10472           STD      TYPE
 10337  0074 00 4 11525           TSX      STATN,4
 10340 -0634 00 0 00236           SXD      CURCON,0
 10341 -0500 00 0 10303           CAL      T5+1
 10342  0771 00 0 00003           ARS      3
 10343 -0320 00 0 13040           ANA      =0007777770000
 10344 -0501 00 0 00236           ORA      CURCON
 10345 -0501 00 0 13056           ORA      =H 000-0
 10346  0602 00 0 11622           SLW      MELEM
 10347  0767 00 0 00006           ALS      6
 10350  0074 00 4 10616           TSX      NMTVAL,4
 10351  0604 00 0 11725           STI      OUTACT

BINARY CARD NO. LNK06016
 10352  0601 00 0 10473           STO      BOUTAC
 10353  0774 00 1 00000           AXT      0,1
 10354  0774 00 2 00022           AXT      LNT5-2,2
 10355 -0500 00 2 10326   LOOKUP  CAL      T5+LNT5,2
 10356  0100 00 0 10467           TZE      ENDT5
 10357  0044 00 0 00000           PAI
 10360 -0054 00   200000          LFT      200000
 10361  0020 00 0 10504           TRA      GOTPOT
                                  *        CHECK FOR LITERAL ENTRY
 10362 -0054 00   077777  CKLIT   LFT      077777
 10363  0020 00 0 10413           TRA      VALNAM
 10364  0621 00 0 10570           STA      TEMPS
 10365  0500 00 0 10570           CLA      TEMPS
 10366  0074 00 4 11070           TSX      CVTBCD,4
 10367  0767 00 0 00014           ALS      12
 10370  0054 00   400000          RFT      400000
 10371  0020 00 0 10374           TRA      SNEG
 10372 -0501 00 0 13043           ORA      =020000000000
 10373  0020 00 0 10375           TRA      *+2
 10374 -0501 00 0 13052   SNEG    ORA      =040000000000
 10375  0602 00 1 12204           SLW      OUTELE,1

BINARY CARD NO. LNK06017
 10376 -0520 00 0 10567           NZT      POTF
 10377  0602 00 1 12324           SLW      INPACT,1
 10400 -0500 00 0 13055           CAL      =HREF.
 10401  0602 00 1 12160           SLW      INPELE,1
 10402  0500 00 0 10570   FLTLIT  CLA      TEMPS
 10403 -0501 00 0 13050           ORA      =0233000000000
 10404  0300 00 0 13050           FAD      =0233000000000
 10405  0054 00   400000          RFT      400000
 10406 -0760 00 0 00003           SSM
 10407  0131 00 0 00000           XCA
```

```
      10410  0260 00 0 13046          FMP     =100.
      10411  0601 00 0 10474          STO     BOUTEL
      10412  0020 00 0 10443          TRA     TPOT
                               *      CONVERT ELEMENT NAME TO ITS OUTPUT VALUE
      10413  0767 00 0 00003   VALNAM ALS     3
      10414  0602 00 1 12160          SLW     INPELE,1
      10415  0600 00 0 10503          STZ     TRUNKE
      10416 -0534 00 4 10472          LXD     TYPE,4
      10417  3 00013 4 10426          TXH     *+7,4,11
      10420 -3 00012 4 10426          TXL     *+6,4,10
      10421  0560 00 0 00236          LDQ     CURCON

BINARY CARD NO. LNK06018
      10422 -0600 00 0 10502          STQ     SAVCON
      10423  0560 00 0 10501          LDQ     TRUCON
      10424 -0600 00 0 00236          STQ     CURCON
      10425 -0625 00 0 10503          STL     TRUNKE
      10426  0074 00 4 10616          TSX     NMTVAL,4
      10427 -0520 00 0 10503          NZT     TRUNKE
      10430  0020 00 0 10433          TRA     *+3
      10431  0560 00 0 10502          LDQ     SAVCON
      10432 -0600 00 0 00236          STQ     CURCON
      10433  0604 00 1 12204          STI     OUTELE,1
      10434  0601 00 0 10474          STO     BOUTEL
      10435  0560 00 1 12160          LDQ     INPELE,1
      10436  0074 00 4 11275          TSX     STSGAC,4
      10437  0 00000 0 10474          PZE     BOUTEL,,0
      10440 -0520 00 0 10567          NZT     POTF
      10441  0604 00 1 12324          STI     INPACT,1
      10442  0500 00 0 10474          CLA     BOUTEL
      10443  0520 00 0 10567   TPOT   ZET     POTF
      10444  0500 00 0 10476          CLA     BINPAC
      10445  0560 00 0 13057   PUTVAL LDQ     =H

BINARY CARD NO. LNK06019
      10446 -0534 00 4 10472          LXD     TYPE,4
      10447  3 00002 4 10457          TXH     SVAL-1,4,2
      10450  0441 00 2 10326          LDI     T5+LNT5,2
      10451  0560 00 0 13042          LDQ     =H1
      10452 -0054 00   100000         LFT     100000
      10453  0020 00 0 10457          TRA     SVAL-1
      10454  0131 00 0 00000          XCA
      10455  0260 00 0 13045          FMP     =10.
      10456  0560 00 0 13041          LDQ     =H10
      10457 -0600 00 1 12374          STQ     GAIN,1
      10460  0601 00 1 10571   SVAL   STO     T6,1
      10461  0520 00 0 10567          ZET     POTF
      10462  0020 00 0 10530          TRA     FINPOT
      10463  1 77777 1 10464   MODO   TXI     *+1,1,-1
      10464  2 00001 2 10355   GOLK   TIX     LOOKUP,2,1
      10465  0074 00 4 12627          TSX     WRMESS,4
      10466  0 00011 0 12146          PZE     ERRD,,9
      10467  0634 00 1 11514   ENDT5  SXA     VARCT,1
      10470  0600 00 1 10571          STZ     T6,1
      10471  0020 00 0 11141          TRA     SIMULA
```

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                *** APACHE 7090/4 ***   CHAIN LINK 6
BINARY CARD NO. LNK06020
     10472  0 00000 0 00000   TYPE                                              22 3580
     10473  0 00000 0 00000   BOUTAC                                            22 3590
     10474  0 00000 0 00000   BOUTEL                                            22 3600
     10475  0 00000 0 00000   BINACT                                            22 3610
     10476  0 00000 0 00000   BINPAC                                            22 3620
     10477  0 00000 0 00000   BSETTI                                            22 3630
     10500  0 00000 0 00000   BINPCO                                            22 3640
     10501  0 00000 0 00000   TRUCON PZE                                        22 3650
     10502  0 00000 0 00000   SAVCON PZE                                        22 3660
                *** APACHE 7090/4 ***   CHAIN LINK 6                            22 3670

                              *      GENERATE POT INFORMATION                   22 3690
     10504  0621 00 0 10570   GOTPOT STA      TEMPS                             22 3700
     10505  0767 00 0 00003          ALS      3                                 22 3710
     10506 -0320 00 0 13064          ANA      =0777777000000                    22 3720
     10507 -0501 00 0 13032          ORA      =H000                             22 3730
     10510  0602 00 1 12230          SLW      POTS,1                            22 3740
     10511  0074 00 4 10616          TSX      NMTVAL,4                          22 3750
     10512  0604 00 1 12324          STI      INPACT,1                          22 3760
     10513  0601 00 0 10476          STO      BINPAC                            22 3770
     10514  0500 00 0 10570          CLA      TEMPS                             22 3780
     10515  0074 00 4 11070          TSX      CVTBCD,4                          22 3790

BINARY CARD NO. LNK06021
     10516  0767 00 0 00014          ALS      12                                22 3800
     10517 -0501 00 0 13024          ORA      =H0000                            22 3810
     10520  0602 00 1 12254          SLW      SETTIN,1                          22 3820
     10521  0500 00 0 10570          CLA      TEMPS                             22 3830
     10522 -0501 00 0 13050          ORA      =0233000000000                    22 3840
     10523  0300 00 0 13050          FAD      =0233000000000                    22 3850
     10524  0241 00 0 13047          FDP      =10000.                           22 3860
     10525 -0600 00 0 10477          STQ      BSETTI                            22 3870
     10526 -0625 00 0 10567          STL      POTF                              22 3880
     10527  0020 00 0 10464          TRA      GOLK                              22 3890
     10530  0560 00 0 10477   FINPOT LDQ      BSETTI                            22 3900
     10531  0260 00 0 10474          FMP      BOUTEL                            22 3910
     10532  0601 00 0 10500          STO      BINPCO                            22 3920
     10533  0760 00 0 00003          SSP                                        22 3930
     10534  0300 00 0 13044          FAD      =.5              ROUND            22 3940
     10535 -0300 00 0 13050          UFA      =0233000000000                    22 3950
     10536 -0320 00 0 13034          ANA      =0777777                          22 3960
     10537  0074 00 4 11070          TSX      CVTBCD,4                          22 3970
     10540  0441 00 0 10500          LDI      BINPCO                            22 3980
     10541 -0054 00   400000         LFT      400000                            22 3990

BINARY CARD NO. LNK06022
     10542  0020 00 0 10545          TRA      SNEG2                             22 4000
     10543  0322 00 0 13052          ERA      =0400000000000                    22 4010
     10544  0020 00 0 10546          TRA      *+2                               22 4020
     10545  0322 00 0 13043   SNEG2  ERA      =0200000000000                    22 4030
     10546  0602 00 1 12300          SLW      INPCOM,1                          22 4040
     10547  0500 00 0 10500          CLA      BINPCO                            22 4050
     10550  0302 00 0 10476          FSB      BINPAC                            22 4060
     10551  0602 00 0 10615          SLW      BDIFF                             22 4070
     10552  0760 00 0 00003          SSP                                        22 4080
     10553  0300 00 0 13044          FAD      =.5              ROUND            22 4090
     10554 -0300 00 0 13050          UFA      =0233000000000                    22 4100
     10555 -0320 00 0 13034          ANA      =0777777                          22 4110
```

```
 10556  0074 00 4 11070              TSX     CVTBCD,4                                              22 4120
 10557  0767 00 0 00006              ALS     6                                                     22 4130
 10560 -0501 00 0 13023              ORA     =H00000                                               22 4140
 10561  0602 00 1 12350              SLW     DIFF,1                                                22 4150
 10562  0560 00 1 12230              LDQ     POTS,1                                                22 4160
 10563  0074 00 4 11275              TSX     STSGAC,4                                              22 4170
 10564 -0 10615 0 10476              MZE     BINPAC,,BDIFF                                         22 4180
 10565  0600 00 0 10567              STZ     POTF                                                  22 4190

              *** APACHE 7090/4 ***   CHAIN LINK 6

BINARY CARD NO. LNK06023
 10566  0020 00 0 10463              TRA     MODO                                                  22 4200
 10567  0 00000 0 00000     POTF                                                                   22 4210
 10570  0 00000 0 00000     TEMPS                                                                  22 4220
 10571                      T6       BSS     LNT5                                                  22 4230

BINARY CARD NO. LNK06024
 10615  0 00000 0 00000     BDIFF                                                                  22 4240


              *** APACHE 7090/4 ***   CHAIN LINK 6

                            *        LOOKUP ELEMENT NAME AND SEND ITS OUTPUT VALUE                 22 4260
                            *        IN BOTH BCD AND BINARY                                        22 4270
 10616  0634 00 2 10653     NMTVAL   SXA     IX2A,2                                                22 4280
 10617  0634 00 1 10654              SXA     IX1B,1                                                22 4290
 10620  0634 00 4 10655              SXA     IX4B,4                                                22 4300
 10621  0602 00 0 10301     REVIEW   SLW     ELEM                                                  22 4310
 10622 -0320 00 0 13064              ANA     =0777777000000                                        22 4320
 10623  0602 00 0 10657              SLW     FELEM                                                 22 4330
 10624  0534 00 1 00236              LXA     CURCON,1                                              22 4340
 10625  0500 00 1 10201              CLA     T8+6,1                                                22 4350
 10626 -0734 00 1 00000              PDX     ,1                                                    22 4360
 10627  0621 00 0 10630              STA     *+1                                                   22 4370
 10630 -0500 00 1 00000     SEARCH   CAL     *-*,1                                                 22 4380
 10631 -0320 00 0 13064              ANA     =0777777000000                                        22 4390
 10632  0322 00 0 10657              ERA     FELEM                                                 22 4400
 10633  0100 00 0 10636              TZE     THISON                                                22 4410
 10634  2 00002 1 10630              TIX     SEARCH,1,2                                            22 4420
 10635  0020 00 0 10660              TRA     UNREAD                                                22 4430
 10636  1 77777 1 10637     THISON   TXI     *+1,1,-1                                              22 4440
 10637  0560 60 0 10630              LDQ*    SEARCH                                                22 4450
 10640 -0773 00 0 00036              RQL     30                                                    22 4460

BINARY CARD NO. LNK06025
 10641 -0130 00 0 00000              XCL                                                           22 4470
 10642  0044 00 0 00000              PAI                                                           22 4480
 10643 -0765 00 0 00036              LGR     30                                                    22 4490
 10644 -0754 00 0 00000              ZAC                                                           22 4500
 10645  0774 00 1 00005              AXT     5,1                                                   22 4510
 10646  0074 00 4 11106              TSX     CVTB,4                                                22 4520
 10647 -0501 00 0 13050              ORA     =0233000000000                                        22 4530
 10650  0300 00 0 13050              FAD     =0233000000000                                        22 4540
 10651 -0054 00   400000             LFT     400000                                                22 4550
 10652 -0760 00 0 00003              SSM                                                           22 4560
 10653  0774 00 2 00000     IX2A     AXT     *-*,2                                                 22 4570
 10654  0774 00 1 00000     IX1B     AXT     *-*,1                                                 22 4580
 10655  0774 00 4 00000     IX4B     AXT     *-*,4                                                 22 4590
 10656  0020 00 4 00001              TRA     1,4                                                   22 4600
 10657  0 00000 0 00000     FELEM                                                                  22 4610
```

```
                                  *       AN UNREAD ELEMENT ENCOUNTERED, IF SWITCH SEARCH FOR INPUT
                                  *       OTHERWISE SET OUTPUT TO ZERO
      10660 -0500 00 0 10301     UNREAD  CAL      ELEM
      10661 -0320 00 0 13063             ANA      =0777700000000
      10662  0322 00 0 13061             ERA      =HSW0000
      10663 -0100 00 0 10673             TNZ      NTSWIT
      10664  0534 00 1 00236             LXA      CURCON,1

BINARY CARD NO. LNK06026
      10665  0074 00 4 10702             TSX      NMTNET,4
      10666  0020 00 0 10677             TRA      USEZER
      10667  1 77776 1 10670             TXI      *+1,1,-2
      10670 -0500 60 0 10711             CAL*     GTNET
      10671  0767 00 0 00003             ALS      3
      10672  0020 00 0 10621             TRA      REVIEW
      10673 -0500 00 0 10301     NTSWIT  CAL      ELEM
      10674  0602 00 0 11340             SLW      NAME
      10675  0074 00 4 11341             TSX      ENTERR,4
      10676  0 11360 1 12070             PZE      ERATAB,1,ERACTR
      10677  0441 00 0 13060     USEZER  LDI      =H XXXXX
      10700 -0754 00 0 00000             ZAC
      10701  0020 00 0 10653             TRA      IX2A
```



```
                                  *       LOCATE NETWORK IN T3 CORRESPONDING TO -ELEM
      10702  0634 00 4 10724     NMTNET  SXA      IX4F,4
      10703  0500 00 1 00236             CLA      T4+6,1
      10704  0734 00 1 00000             PAX      ,1
      10705  0634 00 1 10711             SXA      GTNET,1
      10706  1 00001 1 10707             TXI      *+1,1,1
      10707  0634 00 1 10713             SXA      GTNAM,1
      10710 -0734 00 1 00000             PDX      ,1

BINARY CARD NO. LNK06027
      10711  0500 00 1 00000     GTNET   CLA      *-*,1
      10712  0120 00 0 10717             TPL      NOGOOD
      10713 -0500 00 1 00000     GTNAM   CAL      *-*,1
      10714  0767 00 0 00003             ALS      3
      10715  0322 00 0 10301             ERA      ELEM
      10716  0100 00 4 00002             TZE      2,4
      10717  2 00001 1 10711     NOGOOD  TIX      GTNET,1,1
      10720 -0500 00 0 10301             CAL      ELEM
      10721  0602 00 0 12140             SLW      ERRC+2
      10722  0074 00 4 12627             TSX      WRMESS,4
      10723  0 00010 0 12136             PZE      ERRC,,8
      10724  0774 00 4 00000     IX4F    AXT      *-*,4
      10725  0020 00 4 00001             TRA      1,4
```

```
                                 *       PREFIX INDICATES THE NUMBER OF FIRST WORD CHARACTERS TO SKIP
                                 *       (0T02)
                                 *       ADDRESS IS THE LOCATION OF THE FIRST WORD
                                 *       DECREMENT IS THE NUMBER OF CHARACTERS
                                 *       TO BE CONVERTED (1T06)
                                 *       RESULT IS LEFT ADJUSTED IN LOGICAL AC
                                 *       UP TO SIX CHARACTERS MAY BE CONVERTED
                                 *       ONE WORD OF BCD
    10726  0634 00 1 11023       CVERT   SXA     IX1A,1
    10727  0634 00 2 11024               SXA     IX2B,2
    10730  0634 00 4 11025               SXA     IX4A,4
    10731  0602 00 0 11027               SLW     ARGO
    10732 -0500 00 0 13017               CAL     =1
    10733  0602 00 0 11066               SLW     BCDWD
    10734  0600 00 0 11067               STZ     FULLF

BINARY CARD NO. LNK06028
    10735 -0500 00 0 11027               CAL     ARGO
    10736 -0734 00 2 00000               PDX     ,2
    10737  0634 00 2 11065               SXA     TEMP3,2
    10740  0771 00 0 00041               ARS     33
    10741  0621 00 0 11064               STA     TEMP2
    10742  0402 00 0 13020               SUB     =3
    10743  0621 00 0 10752               STA     NUMCHA
    10744  0400 00 0 11065               ADD     TEMP3
    10745  0621 00 0 11005               STA     NUMCHB
    10746  0560 00 0 11064               LDQ     TEMP2
    10747  0200 00 0 13021               MPY     =12
    10750  0131 00 0 00000               XCA
    10751  0621 00 0 10754               STA     FSTSHF
    10752  0774 00 4 00000       NUMCHA  AXT     *-*,4
    10753  0560 60 0 11027       LOOP    LDQ*    ARGO
    10754 -0763 00 0 00000       FSTSHF  LGL     *-*
    10755  0634 00 0 10754               SXA     *-1,0
    10756 -0754 00 0 00000       SECLP   ZAC
    10757 -0763 00 0 00014               LGL     12
    10760  0621 00 0 11065               STA     TEMP3

BINARY CARD NO. LNK06029
    10761  0774 00 2 00026               AXT     TLN,2
    10762 -0500 00 2 11056       NENTRY  CAL     TABLE+TLN,2
    10763 -0320 00 0 13026               ANA     =077777
    10764  0340 00 0 11065               CAS     TEMP3
    10765  0020 00 0 10770               TRA     USBLNK
    10766  0020 00 0 10772               TRA     FOUND
    10767  2 00001 2 10762               TIX     NENTRY,2,1
    10770 -0754 00 0 00000       USBLNK  ZAC
    10771  0020 00 0 10774               TRA     *+3
    10772 -0500 00 2 11056       FOUND   CAL     TABLE+TLN,2
    10773  0771 00 0 00017               ARS     15
    10774  0621 00 0 11065               STA     TEMP3
    10775  0140 00 0 10776               TOV     *+1
    10776 -0500 00 0 11066               CAL     BCDWD
    10777  0767 00 0 00006               ALS     6
    11000 -0140 00 0 11002               TNO     *+2
    11001 -0625 00 0 11067               STL     FULLF
```

```
                    *** APACHE 7090/4 ***   CHAIN LINK 6
      11002 -0501 00 0 11065           ORA      TEMP3                                                       22 5580
      11003  0602 00 0 11066           SLW      BCDWD                                                       22 5590
      11004  2 00001 4 10756           TIX      SECLP,4,1                                                   22 5600

 BINARY CARD NO. LNK06030
      11005  0774 00 4 00000    NUMCHB AXT      *-*,4                                                       22 5610
      11006 -2 00003 4 11012           TNX      *+4,4,3                                                     22 5620
      11007  0634 00 4 11005           SXA      *-2,4                                                       22 5630
      11010  0774 00 4 00003           AXT      3,4                                                         22 5640
      11011  0020 00 0 11014           TRA      NXTHE                                                       22 5650
      11012 -2 00000 4 11020           TNX      LFTJUS,4,0                                                  22 5660
      11013  0634 00 0 11005           SXA      NUMCHB,0                                                    22 5670
      11014  0534 00 1 11027    NXTHE  LXA      ARGO,1                                                      22 5680
      11015  1 00001 1 11016           TXI      *+1,1,1                                                     22 5690
      11016  0634 00 1 11027           SXA      ARGO,1                                                      22 5700
      11017  0020 00 0 10753           TRA      LOOP                                                        22 5710
      11020 -0500 00 0 11066    LFTJUS CAL      BCDWD                                                       22 5720
      11021 -0520 00 0 11067           NZT      FULLF                                                       22 5730
      11022  0767 00 0 00022           ALS      18                                                          22 5740
      11023  0774 00 1 00000    IX1A   AXT      *-*,1                                                       22 5750
      11024  0774 00 2 00000    IX2B   AXT      *-*,2                                                       22 5760
      11025  0774 00 4 00000    IX4A   AXT      *-*,4                                                       22 5770
      11026  0020 00 4 00001           TRA      1,4                                                         22 5780
      11027  0 00000 0 00000    ARGO                                                                        22 5790
      11030 +000000000004       TABLE  OCT      0000004       0                                             22 5800

 BINARY CARD NO. LNK06031
      11031 +000005100024              OCT      5100024       R                                             22 5810
      11032 +000001000044              OCT      1000044       8                                             22 5820
      11033 +000000400104              OCT      0400104       4                                             22 5830
      11034 +000002100124              OCT      2100124       A                                             22 5840
      11035 +000007700164              OCT      7700164       TAB                                           22 5850
      11036 +000000200204              OCT      0200204       2                                             22 5860
      11037 +000002600224              OCT      2600224       F                                             22 5870
      11040 +000002000264              OCT      2000264       +                                             22 5880
      11041 +000000600304              OCT      0600304       6                                             22 5890
      11042 +000004700324              OCT      4700324       P                                             22 5900
      11043 +000000100400              OCT      0100400       U*         HIGH ORDER ONE                     22 5910
      11044 +000000100404              OCT      0100404       1                                             22 5920
      11045 +000004400424              OCT      4400424       M                                             22 5930
      11046 +000001100444              OCT      1100444       9                                             22 5940
      11047 +000000500504              OCT      0500504       5                                             22 5950
      11050 +000006300524              OCT      6300524       T                                             22 5960
      11051 +000000300604              OCT      0300604       3                                             22 5970
      11052 +000002300624              OCT      2300624       C                                             22 5980
      11053 +000004000664              OCT      4000664       -                                             22 5990
      11054 +000000700704              OCT      0700704       7                                             22 6000

 BINARY CARD NO. LNK06032
      11055 +000005000724              OCT      5000724       Q                                             22 6010
                       00026    TLN    EQU      *-TABLE                                                     22 6020
      11056                     COLTAB BSS      0                                                           22 6030
      11056  1 00003 0 00043           PON      CARD+2,,3                                                   22 6040
      11057  2 00006 0 00044           PTW      CARD+3,,6                                                   22 6050
      11060  1 00003 0 00051           PON      CARD+8,,3                                                   22 6060
      11061  2 00006 0 00052           PTW      CARD+9,,6                                                   22 6070
```

```
         *** APAPACHE 7090/4 ***   CHAIN LINK 6
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```
                                  *       SELECT CORRECT SIMULATION FOR MAIN ELEMENT                          22 6460
                                  *       ARGUMENTS STORED IN T6                                              22 6470
      11141 -0535 00 1 10472   SIMULA LDC     TYPE,1                                                          22 6480
      11142  0774 00 2 00000          AXT     0,2                                                             22 6490
      11143  0020 00 1 11143          TRA     *,1                                                             22 6500
      11144  0020 00 0 11164          TRA     SINTEG        1                                                 22 6510
      11145  0020 00 0 11164          TRA     SSUMMR        2                                                 22 6520
      11146  0020 00 0 11207          TRA     SSERVO        3                                                 22 6530
      11147  0020 00 0 11175          TRA     STMDM         4                                                 22 6540
      11150  0020 00 0 11214          TRA     STMDD         5                                                 22 6550

 BINARY CARD NO. LNK06035
      11151  0020 00 0 11175          TRA     SHAMM         6                                                 22 6560
      11152  0020 00 0 11214          TRA     SHAMD         7                                                 22 6570
      11153  0020 00 0 11175          TRA     SQSQ          8                                                 22 6580
      11154  0020 00 0 11223          TRA     SCOMP         9                                                 22 6590
      11155  0020 00 0 11223          TRA     SSWTCH        10                                                22 6600
      11156  0020 00 0 11223          TRA     STRUNK        11                                                22 6610
      11157  0020 00 0 11225          TRA     SRESOP        12                                                22 6620
      11160  0020 00 0 11227          TRA     SRESOR        13                                                22 6630
      11161  0020 00 0 11231          TRA     SDFG          14                                                22 6640
      11162  0020 00 0 11214          TRA     SQSQD         15                                                22 6650
      11163  0020 00 0 11203          TRA     SSERVS        16                                                22 6660
      11164                    SINTEG BSS     0                                                               22 6670
      11164  0535 00 2 11514   SSUMMR LAC     VARCT,2                                                         22 6680
      11165  1 10571 2 11166          TXI     *+1,2,T6                                                        22 6690
      11166  0634 00 2 11171          SXA     *+3,2                                                           22 6700
      11167  0535 00 2 11514          LAC     VARCT,2                                                         22 6710
      11170 -0754 00 0 00000          ZAC                                                                     22 6720
      11171  0300 00 2 00000          FAD     *-*,2                                                           22 6730
      11172  2 00001 2 11171          TIX     *-1,2,1                                                         22 6740
      11173  0760 00 0 00002   ENDLST CHS                                                                     22 6750
      11174  0020 00 0 11232          TRA     SET                                                             22 6760
      11175                    SQSQ   BSS     0                                                               22 6770
      11175                    SHAMM  BSS     0                                                               22 6780

 BINARY CARD NO. LNK06036
      11175  0560 00 0 10571   STMDM  LDQ     T6                                                              22 6790
      11176  0260 00 0 10572          FMP     T6+1                                                            22 6800
      11177  0241 00 0 11272          FDP     REF                                                             22 6810
      11200  0131 00 0 00000          XCA                                                                     22 6820
      11201  0760 00 0 00002          CHS                                                                     22 6830
      11202  0020 00 0 11232          TRA     SET                                                             22 6840
      11203  0500 00 0 10571   SSERVS CLA     T6                                                              22 6850
      11204  0760 00 0 00003          SSP                                                                     22 6860
      11205  0131 00 0 00000          XCA                                                                     22 6870
      11206  0020 00 0 11210          TRA     SSERVO+1                                                        22 6880
      11207  0560 00 0 10571   SSERVO LDQ     T6                                                              22 6890
      11210  0260 00 0 10572          FMP     T6+1                                                            22 6900
      11211  0241 00 0 11272          FDP     REF                                                             22 6910
      11212  0131 00 0 00000          XCA                                                                     22 6920
      11213  0020 00 0 11232          TRA     SET                                                             22 6930
      11214                    SHAMD  BSS     0                                                               22 6940
      11214                    SQSQD  BSS     0                                                               22 6950
      11214  0500 00 0 10571   STMDD  CLA     T6                                                              22 6960
      11215  0241 00 0 10572          FDP     T6+1                                                            22 6970
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      11216   0260 00 0 11272          FMP     REF                                22 6980
      11217   0560 00 0 10571          LDQ     T6                                 22 6990
      11220   0763 00 0 00000          LLS     0                                  22 7000

BINARY CARD NO. LNK06037
      11221   0760 00 0 00002          CHS                                        22 7010
      11222   0020 00 0 11232          TRA     SET                                22 7020
      11223                     STRUNK BSS     0                                  22 7030
      11223                     SSWTCH BSS     0                                  22 7040
      11223   0500 00 0 10571   SCOMP  CLA     T6                                 22 7050
      11224   0020 00 0 11232          TRA     SET                                22 7060
      11225  -0754 00 0 00000   SRESOP ZAC                                        22 7070
      11226   0020 00 0 11232          TRA     SET                                22 7080
      11227  -0754 00 0 00000   SRESOR ZAC                                        22 7090
      11230   0020 00 0 11232          TRA     SET                                22 7100
      11231  -0754 00 0 00000   SDFG   ZAC                                        22 7110
      11232   0601 00 0 11273   SET    STO     TEMP4                              22 7120
      11233   0441 00 0 11273          LDI     TEMP4                              22 7130
      11234   0760 00 0 00003          SSP                                        22 7140
      11235   0300 00 0 13044          FAD     =.5              ROUND             22 7150
      11236  -0300 00 0 13050          UFA     =0233000000000                     22 7160
      11237  -0320 00 0 13034          ANA     =0777777                           22 7170
      11240   0074 00 4 11070          TSX     CVTBCD,4                           22 7180
      11241  -0054 00  400000          LFT     400000                             22 7190
      11242   0020 00 0 11245          TRA     SNEG3                              22 7200
      11243   0322 00 0 13052          ERA     =0400000000000                     22 7210
      11244   0020 00 0 11246          TRA     *+2                                22 7220

BINARY CARD NO. LNK06038
      11245   0322 00 0 13043   SNEG3  ERA     =0200000000000                     22 7230
      11246   0602 00 0 11723          SLW     OUTCOM                             22 7240
      11247   0500 00 0 11273          CLA     TEMP4                              22 7250
      11250   0302 00 0 10473          FSB     BOUTAC                             22 7260
      11251   0602 00 0 11274          SLW     BDIFFM                             22 7270
      11252   0760 00 0 00003          SSP                                        22 7280
      11253   0300 00 0 13044          FAD     =.5              ROUND             22 7290
      11254  -0300 00 0 13050          UFA     =0233000000000                     22 7300
      11255  -0320 00 0 13034          ANA     =0777777                           22 7310
      11256   0074 00 4 11070          TSX     CVTBCD,4                           22 7320
      11257   0767 00 0 00006          ALS     6                                  22 7330
      11260  -0501 00 0 13023          ORA     =H00000                            22 7340
      11261   0602 00 0 11727          SLW     DIFFM                              22 7350
      11262  -0500 00 0 11622          CAL     MELEM                              22 7360
      11263   0767 00 0 00006          ALS     6                                  22 7370
      11264  -0320 00 0 13064          ANA     =0777777000000                     22 7380
      11265  -0501 00 0 13032          ORA     =H000                              22 7390
      11266  -0130 00 0 00000          XCL                                        22 7400
      11267   0074 00 4 11275          TSX     STSGAC,4                           22 7410
      11270   0 11274 0 10473          PZE     BOUTAC,,BDIFFM                     22 7420

BINARY CARD NO. LNK06039
      11271   0020 00 0 11403          TRA     OUTPUT                             22 7430
      11272  +216470400000      REF    DEC     10000.                             22 7440
      11273   0 00000 0 00000   TEMP4                                             22 7450
      11274   0 00000 0 00000   BDIFFM                                            22 7460
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                 *** APACHE 7090/4 ***   CHAIN LINK 6

                                  *      CHECK    FOR SATURATION,SIGNIFICANCE AND ACCURACY          22 7480
                         00024    MAXER  EQU      20                                                 22 7490
  11275   0634 00 4 11333         STSGAC SXA      IX4C,4                                             22 7500
  11276   0634 00 1 11332                SXA      IX1C,1                                             22 7510
  11277  -0600 00 0 11340                STQ      NAME                                               22 7520
  11300   0500 00 4 00001                CLA      1,4                                                22 7530
  11301   0601 00 0 11337                STO      AMENT                                              22 7540
  11302   0500 60 4 00001                CLA*     1,4                                                22 7550
  11303   0760 00 0 00003                SSP                                                         22 7560
  11304   0302 00 0 11335                FSB      LOWLIM                                             22 7570
  11305   0120 00 0 11311                TPL      CKULIM                                             22 7580
  11306   0074 00 4 11341                TSX      ENTERR,4                                           22 7590
  11307   0 11356 1 11770                PZE      SIGTAB,1,SIGCTR                                    22 7600
  11310   0020 00 0 11315                TRA      CKACCY                                             22 7610
  11311   0302 00 0 11336         CKULIM FSB      UPLIM                                              22 7620
  11312  -0120 00 0 11315                TMI      CKACCY                                             22 7630
  11313   0074 00 4 11341                TSX      ENTERR,4                                           22 7640
  11314   0 11355 1 11730                PZE      SATTAB,1,SATCTR                                    22 7650

BINARY CARD NO. LNK06040
  11315   0500 00 0 11337         CKACCY CLA      AMENT                                              22 7660
  11316  -0734 00 1 00000                PDX      ,1                                                 22 7670
  11317  -2 00000 1 11332                TNX      HOME,1,0                                           22 7680
  11320   0634 00 1 11326                SXA      GDIF,1                                             22 7690
  11321   0120 00 0 11324                TPL      LKUTYP                                             22 7700
  11322   0500 00 0 11362                CLA      POTTOL                                             22 7710
  11323   0020 00 0 11326                TRA      GDIF                                               22 7720
  11324  -0535 00 1 10472         LKUTYP LDC      TYPE,1                                             22 7730
  11325   0500 00 1 11362                CLA      TOLERT-1,1                                         22 7740
  11326   0302 00 0 00000         GDIF   FSB      *-*                                                22 7750
  11327   0120 00 0 11332                TPL      HOME                                               22 7760
  11330   0074 00 4 11341                TSX      ENTERR,4                                           22 7770
  11331   0 11357 1 12030                PZE      ACCTAB,1,ACCCTR                                    22 7780
  11332                           HOME   BSS      0                                                  22 7790
  11332   0774 00 1 00000         IX1C   AXT      *-*,1                                              22 7800
  11333   0774 00 4 00000         IX4C   AXT      *-*,4                                              22 7810
  11334   0020 00 4 00002                TRA      2,4                                                22 7820
  11335  +207620000000            LOWLIM DEC      100.                                               22 7830
  11336  +216465320000            UPLIM  DEC      9901.                                              22 7840
  11337   0 00000 0 00000         AMENT                                                              22 7850
  11340   0 00000 0 00000         NAME                                                               22 7860
                 *** APACHE 7090/4 ***   CHAIN LINK 6

                                  *      MAKE AN ENTRY IN APPROPRIATE DIAGNOSTIC TABLE               22 7880

BINARY CARD NO. LNK06041
  11341   0500 00 4 00001         ENTERR CLA      1,4                                                22 7890
  11342  -0734 00 1 00000                PDX      ,1                                                 22 7900
  11343   0634 00 1 11352                SXA      CGED,1                                             22 7910
  11344   0634 00 1 11345                SXA      *+1,1                                              22 7920
  11345   0534 00 1 00000                LXA      *-*,1                                              22 7930
  11346  -3 77754 1 11354                TXL      FULL,1,-MAXER                                      22 7940
  11347  -0500 00 0 11340                CAL      NAME                                               22 7950
  11350   0602 60 4 00001                SLW*     1,4                                                22 7960
  11351   1 77777 1 11352                TXI      *+1,1,-1                                           22 7970
  11352   0634 00 1 00000         CGED   SXA      *-*,1                                              22 7980
  11353  -0625 00 0 11361                STL      ERFDF                                              22 7990
  11354   0020 00 4 00002         FULL   TRA      2,4                                                22 8000
  11355  +000000077776            SATCTR OCT      77776                                              22 8010
  11356  +000000077776            SIGCTR OCT      77776                                              22 8020
  11357  +000000077776            ACCCTR OCT      77776                                              22 8030
  11360  +000000077776            ERACTR OCT      77776                                              22 8040
  11361   0 00000 0 00000         ERFDF                                                              22 8050
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                                 *                                                    22 8070
                                 *                                                    22 8080
                                 *                                                    22 8090
                                 *      TABLE OF ALLOWABLE TOLERANCES                 22 8100
                                 *      POTENTIOMETER                                 22 8110
      11362 +202600000000      POTTOL DEC      3.                                     22 8120
      11363                    TOLERT BSS      0                                      22 8130
                                 *      INTEGRATORS                                   22 8140
      11363 +202600000000             DEC      3.                                     22 8150
                                 *      SUMMERS                                       22 8160
      11364 +202600000000             DEC      3.                                     22 8170
                                 *      OUARTER SQUARE                                22 8180

BINARY CARD NO. LNK06042
      11365 +205500000000             DEC      20.                                    22 8190
                                 *      HIGH ACCURACY MULTIPLIER                      22 8200
      11366 +203500000000             DEC      5.                                     22 8210
                                 *      TIME DIVISION                                 22 8220
      11367 +203400000000             DEC      4.                                     22 8230
                                 *      SERVOMULTIPLIERS                              22 8240
      11370 +205740000000             DEC      30.                                    22 8250
                                 *      TIME DIVISION                                 22 8260
      11371 +203400000000             DEC      4.                                     22 8270
                                 *      HIGH ACCURACY MULTIPLIERS                     22 8280
      11372 +203500000000             DEC      5.                                     22 8290
                                 *      TRUNKS                                        22 8300
      11373 +202600000000             DEC      3.                                     22 8310
                                 *      SWITCH                                        22 8320
      11374 +202600000000             DEC      3.                                     22 8330
                                 *      COMARATOR                                     22 8340
      11375 +202600000000             DEC      3.                                     22 8350
                                 *      RESOLVER POLAR                                22 8360
      11376 +206620000000             DEC      50.                                    22 8370
                                 *      RESOLVER RECTANGULAR                          22 8380
      11377 +206620000000             DEC      50.                                    22 8390
                                 *      FUNCTION GENERATOR                            22 8400
      11400 +206620000000             DEC      50.                                    22 8410
                                 *      QUARTER SQUARE (DIVISION)                     22 8420
      11401 +205500000000             DEC      20.                                    22 8430
                                 *      SIGNED SERVOMULTIPLIERS                       22 8440
      11402 +205740000000             DEC      30.                                    22 8450
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                                  *      OPTION DETERMINES NORMAL OR DIAGNOSTIC OUTPUT          22 8470
   11403                          OUTPUT BSS    0                                               22 8480
   11403 -0520 00 0 11524                NZT    OPTION                                          22 8490
   11404  0020 00 0 11407                TRA    *+3                                             22 8500
   11405 -0520 00 0 11361                NZT    ERFDF                                           22 8510
   11406  0020 00 0 11506                TRA    INIZE                                           22 8520
   11407  0600 00 0 11361                STZ    ERFDF                                           22 8530
   11410  0535 00 1 11514                LAC    VARCT,1                                         22 8540

BINARY CARD NO. LNK06043
   11411  1 00005 1 11412                TXI    *+1,1,5                                         22 8550
   11412 -0634 00 1 11414                SXD    *+2,1                                           22 8560
   11413  0534 00 2 11521                LXA    CURLN,2                                         22 8570
   11414  1 00000 2 11415                TXI    *+1,2,*-*                                       22 8580
   11415  0634 00 2 11521                SXA    CURLN,2                                         22 8590
   11416  0754 00 2 00000                PXA    ,2                                              22 8600
   11417  0402 00 0 11522                SUB    MAXLN                                           22 8610
   11420 -0120 00 0 11425                TMI    NORM                                            22 8620
   11421  0634 00 0 11521                SXA    CURLN,0                                         22 8630
   11422  0074 00 4 12627                TSX    WRMESS,4                                        22 8640
   11423  0 00016 0 11576                PZE    TITLE,,14                                       22 8650
   11424 -0625 00 0 11523                STL    NPAGEF                                          22 8660
   11425  0074 00 4 12627         NORM   TSX    WRMESS,4                                        22 8670
   11426  0 00003 0 11614                PZE    FSTLNA,,3                                       22 8680
   11427  0074 00 4 12627                TSX    WRMESS,4                                        22 8690
   11430  0 00003 0 11617                PZE    FSTLNB,,3                                       22 8700
   11431  0074 00 4 12627                TSX    WRMESS,4                                        22 8710
   11432  0 00004 0 11622                PZE    FSTLNC,,4                                       22 8720
   11433 -0520 00 0 11523                NZT    NPAGEF                                          22 8730
   11434  0020 00 0 11442                TRA    OLDPG                                           22 8740

BINARY CARD NO. LNK06044
   11435  0600 00 0 11523                STZ    NPAGEF                                          22 8750
   11436  0074 00 4 12627                TSX    WRMESS,4                                        22 8760
   11437  0 00026 0 11626                PZE    SCDLNA,,22                                      22 8770
   11440  0074 00 4 12627                TSX    WRMESS,4                                        22 8780
   11441  0 00026 0 11654                PZE    SCDLNB,,22                                      22 8790
   11442  0774 00 1 00026         OLDPG  AXT    22,1                                            22 8800
   11443 -0634 00 1 11465                SXD    WNTH,1                                          22 8810
   11444  0535 00 4 11514         NOPASS LAC    VARCT,4                                         22 8820
   11445  0774 00 2 00020                AXT    16,2                                            22 8830
   11446  0774 00 1 00240         SKIPRD AXT    LNT5*8,1                                        22 8840
   11447 -0500 00 1 12420                CAL    INPELE+LNT5*8,1                                 22 8850
   11450  0322 00 0 13057                ERA    =H                                              22 8860
   11451 -0100 00 0 11454                TNZ    STOIT                                           22 8870
   11452 -0500 00 0 13051                CAL    =H. . .                                         22 8880
   11453  0020 00 0 11455                TRA    *+2                                             22 8890
   11454  0322 00 0 13057         STOIT  ERA    =H                                              22 8900
   11455  0602 00 2 11723                SLW    INPELX+16,2                                     22 8910
   11456  1 77754 1 11457                TXI    *+1,1,-LNT5                                     22 8920
   11457  2 00002 2 11447                TIX    SKIPRD+1,2,2                                    22 8930
   11460  0534 00 1 11446                LXA    SKIPRD,1                                        22 8940

BINARY CARD NO. LNK06045
   11461  1 77777 1 11462                TXI    *+1,1,-1                                        22 8950
   11462  0634 00 1 11446                SXA    SKIPRD,1                                        22 8960
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11463  0634 00 4 11470           SXA     SIMF,4                                22 8970
11464  0074 00 4 12627           TSX     WRMESS,4                              22 8980
11465  0 00000 0 11702  WNTH     PZE     NTHLN,,*-*                            22 8990
11466  0774 00 1 00020           AXT     16,1                                  22 9000
11467 -0634 00 1 11465           SXD     *-2,1                                 22 9010
11470  0774 00 4 00000  SIMF     AXT     *-*,4                                 22 9020
11471  2 00001 4 11445           TIX     NOPASS+1,4,1                          22 9030
11472  0074 00 4 11546           TSX     STDIAG,4                              22 9040
11473 -0500 00 0 13057           CAL     =H                                    22 9050
11474  0774 00 2 00004           AXT     4,2                                   22 9060
11475  0774 00 1 00022           AXT     MAXER-2,1                             22 9070
11476  0602 60 2 11521           SLW*    RESTAB+4,2                            22 9080
11477  2 00001 1 11476           TIX     *-1,1,1                               22 9090
11500  2 00001 2 11475           TIX     *-3,2,1                               22 9100
11501  0774 00 1 77776           AXT     -2,1                                  22 9110
11502  0634 00 1 11355           SXA     SATCTR,1                              22 9120
11503  0634 00 1 11356           SXA     SIGCTR,1                              22 9130
11504  0634 00 1 11357           SXA     ACCCTR,1                              22 9140

BINARY CARD NO. LNK06046
11505  0634 00 1 11360           SXA     ERACTR,1                              22 9150
11506 -0500 00 0 13057  INIZE    CAL     =H                                    22 9160
11507  0774 00 1 00240           AXT     LNT5*8,1                              22 9170
11510  0634 00 1 11446           SXA     SKIPRD,1                              22 9180
11511  0602 00 1 12420           SLW     INPELE+LNT5*8,1                       22 9190
11512  2 00001 1 11511           TIX     *-1,1,1                               22 9200
11513  0020 00 0 10243           TRA     RUN                                   22 9210
11514  0 00000 0 00000  VARCT                                                  22 9220
11515  0 00000 1 12014  RESTAB   PZE     SIGTAB+MAXER,1                        22 9230
11516  0 00000 1 11754           PZE     SATTAB+MAXER,1                        22 9240
11517  0 00000 1 12054           PZE     ACCTAB+MAXER,1                        22 9250
11520  0 00000 1 12114           PZE     ERATAB+MAXER,1                        22 9260
11521 +000000000062     CURLN    DEC     50                                    22 9270
11522 +000000000062     MAXLN    DEC     50                                    22 9280
11523  0 00000 0 00000  NPAGEF                                                 22 9290
11524  0 00000 0 00000  OPTION                                                 22 9300
```



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                        *        CONVERT CODE TO STATEMENT NUMBER              22 9320
11525  0634 00 4 11543  STATN    SXA     IX4E,4                                22 9330
11526 -0320 00 0 13034           ANA     =0777777                              22 9340
11527 -0765 00 0 00007           LGR     7                                     22 9350
11530 -0600 00 0 11545           STQ     TNUM                                  22 9360

BINARY CARD NO. LNK06047
11531  0074 00 4 11070           TSX     CVTBCD,4                              22 9370
11532  0767 00 0 00022           ALS     18                                    22 9380
11533  0602 00 0 11624           SLW     EQUA                                  22 9390
11534  0560 00 0 11545           LDQ     TNUM                                  22 9400
11535 -0754 00 0 00000           ZAC                                           22 9410
11536 -0763 00 0 00007           LGL     7                                     22 9420
11537  0074 00 4 11070           TSX     CVTBCD,4                              22 9430
11540 -0320 00 0 13025           ANA     =07777                                22 9440
11541 -0501 00 0 13030           ORA     =H000.00                              22 9450
11542 -0602 00 0 11624           ORS     EQUA                                  22 9460
11543  0774 00 4 00000  IX4E     AXT     *-*,4                                 22 9470
11544  0020 00 4 00001           TRA     1,4                                   22 9480
11545  0 00000 0 00000  TNUM                                                   22 9490
```

*** APACHE 7090/4 ***   CHAIN LINK 6

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                                 *       SET-UP DIAGNOSTIC OUTPUT                           22 9510
      11546  0634 00 4 11570   STDIAG SXA      IX4D,4                                      22 9520
      11547  0774 00 1 00022          AXT      MAXER-2,1                                   22 9530
      11550  0774 00 2 00004          AXT      4,2                                         22 9540
      11551 -0500 00 0 13057   NXTSEL CAL      =H                                          22 9550
      11552  0322 60 2 11521          ERA*     RESTAB+4,2                                  22 9560
      11553  0100 00 0 11567          TZE      SELECT                                      22 9570
      11554  0534 00 4 11521          LXA      CURLN,4                                     22 9580

BINARY CARD NO. LNK06048
      11555  1 00003 4 11556          TXI      *+1,4,3                                     22 9590
      11556  0634 00 4 11521          SXA      CURLN,4                                     22 9600
      11557  0500 00 2 11576          CLA      MESSTB+4,2                                  22 9610
      11560  0621 00 0 11564          STA      FSTPT                                       22 9620
      11561  0771 00 0 00022          ARS      18                                          22 9630
      11562  0621 00 0 11566          STA      SCDPT                                       22 9640
      11563  0074 00 4 12627          TSX      WRMESS,4                                    22 9650
      11564  0 00026 0 00000   FSTPT  PZE      *-*,,22                                     22 9660
      11565  0074 00 4 12627          TSX      WRMESS,4                                    22 9670
      11566  0 00012 0 00000   SCDPT  PZE      *-*,,10                                     22 9680
      11567  2 00001 2 11551   SELECT TIX      NXTSEL,2,1                                  22 9690
      11570  0774 00 4 00000   IX4D   AXT      *-*,4                                       22 9700
      11571  0020 00 4 00001          TRA      1,4                                         22 9710
      11572  0 12016 0 11770   MESSTB PZE      SIGTAB,,EMESSS                              22 9720
      11573  0 11756 0 11730          PZE      SATTAB,,EMESPS                              22 9730
      11574  0 12056 0 12030          PZE      ACCTAB,,EMESTS                              22 9740
      11575  0 12116 0 12070          PZE      ERATAB,,ERRA                                22 9750
```

```
                                  *     OUTPUT BUFFERS BEGIN **                                   22 9770
      11576  016060606060        TITLE  BCI      7,1                                              22 9780
      11577  606060606060
      11600  606060606060

BINARY CARD NO. LNK06049
      11601  606060606060
      11602  606060606060
      11603  606060606060
      11604  606060606060
      11605  214721233025               BCI      7,APACHE           STATIC          CHECK         22 9790
      11606  606060606060
      11607  606060606060
      11610  626321633123
      11611  606060606060
      11612  606060606060
      11613  233025234260
      11614  002543254433        FSTLNA BCI      1,OELEM.                                         22 9800
      11615  606060606060               BCI      1,                                               22 9810
      11616  255064216333               BCI      1,EQUAT.                                         22 9820
      11617  604040404040        FSTLNB BCI      1, -----                                         22 9830
      11620  606060606060               BCI      1,                                               22 9840
      11621  404040404040               BCI      1,------                                         22 9850
      11622                      FSTLNC BSS      0                                                22 9860
      11622  0 00000 0 00000     MELEM                                                            22 9870
      11623  606060606060               BCI      1,                                               22 9880
      11624  0 00000 0 00000     EQUA                                                             22 9890

BINARY CARD NO. LNK06050
      11625  606060606060               BCI      1,                                               22 9900
      11626  606060606060        SCDLNA BCI      1,                                               22 9910
      11627  314547254325               BCI      1,INPELE                                         22 9920
      11630  606060606060               BCI      1,                                               22 9930
      11631  466463476463               BCI      1,OUTPUT                                         22 9940
      11632  606060606060               BCI      1,                                               22 9950
      11633  474663606060               BCI      1,POT                                            22 9960
      11634  606060606060               BCI      1,                                               22 9970
      11635  622563633127               BCI      1,SETTIG                                         22 9980
      11636  606060606060               BCI      1,                                               22 9990
      11637  234644314547               BCI      1,COMINP                                         2210000
      11640  606060606060               BCI      1,                                               2210010
      11641  212363314547               BCI      1,ACTINP                                         2210020
      11642  606060606060               BCI      1,                                               2210030
      11643  243126263360               BCI      1,DIFF.                                          2210040
      11644  606060606060               BCI      1,                                               2210050
      11645  272131456060               BCI      1,GAIN                                           2210060
      11646  606060606060               BCI      1,                                               2210070
      11647  234644466463               BCI      1,COMOUT                                         2210080
      11650  606060606060               BCI      1,                                               2210090

BINARY CARD NO. LNK06051
      11651  212363466463               BCI      1,ACTOUT                                         2210100
      11652  606060606060               BCI      1,                                               2210110
      11653  243126263360               BCI      1,DIFF.                                          2210120
      11654  606060606060        SCDLNB BCI      1,                                               2210130
      11655  404040404040               BCI      1,------                                         2210140
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      11656  606060606060                 BCI       1,                            2210150
      11657  404040404040                 BCI       1,------                      2210160
      11660  606060606060                 BCI       1,                            2210170
      11661  404040606060                 BCI       1,---                         2210180
      11662  606060606060                 BCI       1,                            2210190
      11663  404040404040                 BCI       1,------                      2210200
      11664  606060606060                 BCI       1,                            2210210
      11665  404040404040                 BCI       1,------                      2210220
      11666  606060606060                 BCI       1,                            2210230
      11667  404040404040                 BCI       1,------                      2210240
      11670  606060606060                 BCI       1,                            2210250
      11671  404040404060                 BCI       1,-----                       2210260
      11672  606060606060                 BCI       1,                            2210270
      11673  404040406060                 BCI       1,----                        2210280
      11674  606060606060                 BCI       1,                            2210290

BINARY CARD NO. LNK06052
      11675  404040404040                 BCI       1,------                      2210300
      11676  606060606060                 BCI       1,                            2210310
      11677  404040404040                 BCI       1,------                      2210320
      11700  606060606060                 BCI       1,                            2210330
      11701  404040404060                 BCI       1,-----                       2210340
      11702  606060606060          NTHLN  BCI       1,                            2210350
      11703  0 00000 0 00000       INPELX                                         2210360
      11704  606060606060                 BCI       1,                            2210370
      11705  0 00000 0 00000       OUTPUX                                         2210380
      11706  606060606060                 BCI       1,                            2210390
      11707  0 00000 0 00000       POTX                                           2210400
      11710  606060606060                 BCI       1,                            2210410
      11711  0 00000 0 00000       SETTIX                                         2210420
      11712  606060606060                 BCI       1,                            2210430
      11713  0 00000 0 00000       COMINX                                         2210440
      11714  606060606060                 BCI       1,                            2210450
      11715  0 00000 0 00000       ACTINX                                         2210460
      11716  606060606060                 BCI       1,                            2210470
      11717  0 00000 0 00000       DIFFX                                          2210480
      11720  606060606060                 BCI       1,                            2210490

BINARY CARD NO. LNK06053
      11721  0 00000 0 00000       GAINX                                          2210500
      11722  606060606060                 BCI       1,                            2210510
      11723  0 00000 0 00000       OUTCOM                                         2210520
      11724  606060606060                 BCI       1,                            2210530
      11725  0 00000 0 00000       OUTACT                                         2210540
      11726  606060606060                 BCI       1,                            2210550
      11727  0 00000 0 00000       DIFFM                                          2210560
      11730  006060606060          SATTAB BCI ,0          ***                     2210570
      11731  545454606060
      11732  606060606060
      11733  606060606060
      11734  606060606060
      11735  606060606060
      11736  606060606060
      11737  606060606060
      11740  606060606060
      11741  606060606060
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     11742  606060606060           BCI ,                                                                     2210580
     11743  606060606060
     11744  606060606060

BINARY CARD NO. LNK06054
     11745  606060606060
     11746  606060606060
     11747  606060606060
     11750  606060606060
     11751  606060606060
     11752  606060606060
     11753  606060606060
     11754  606060606060           BCI     2,                                                                2210590
     11755  606060606060
     11756  606060606060    EMESPS BCI ,       *** ABOVE ELEMENTS APPEAR TO BE SATURATED                     2210600
     11757  545454602122
     11760  466525602543
     11761  254425456362
     11762  602147472521
     11763  516063466022
     11764  256062216364
     11765  512163252460
     11766  606060606060
     11767  606060606060
     11770  006060606060    SIGTAB BCI ,0      ***                                                           2210610

BINARY CARD NO. LNK06055
     11771  545454606060
     11772  606060606060
     11773  606060606060
     11774  606060606060
     11775  606060606060
     11776  606060606060
     11777  606060606060
     12000  606060606060
     12001  606060606060
     12002  606060606060           BCI ,                                                                     2210620
     12003  606060606060
     12004  606060606060
     12005  606060606060
     12006  606060606060
     12007  606060606060
     12010  606060606060
     12011  606060606060
     12012  606060606060
     12013  606060606060
     12014  606060606060           BCI     2,                                                                2210630

BINARY CARD NO. LNK06056
     12015  606060606060
     12016  606060606060    EMESSS BCI ,       *** ABOVE ELEMENTS ARE OPERATING BELOW SIGNIFICANCE           2210640
     12017  545454602122
     12020  466525602543
     12021  254425456362
     12022  602151256046
     12023  472551216331
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                   *** APACHE 7090/4 ***   CHAIN LINK 6
      12024   452760222543
      12025   466660623127
      12026   453126312321
      12027   452325606060
      12030   006060606060     ACCTAB BCI ,0     ***                                                2210650
      12031   545454606060
      12032   606060606060
      12033   606060606060
      12034   606060606060
      12035   606060606060
      12036   606060606060
      12037   606060606060
      12040   606060606060

BINARY CARD NO. LNK06057
      12041   606060606060
      12042   606060606060            BCI ,                                                         2210660
      12043   606060606060
      12044   606060606060
      12045   606060606060
      12046   606060606060
      12047   606060606060
      12050   606060606060
      12051   606060606060
      12052   606060606060
      12053   606060606060
      12054   606060606060            BCI      2,                                                   2210670
      12055   606060606060
      12056   606060606060     EMESTS BCI ,      ***ABOVE ELEMENTS ARE OPERATING OUT-OF-TOLERANCE     2210680
      12057   545454212246
      12060   652560254325
      12061   442545636260
      12062   215125604647
      12063   255121633145
      12064   276046646340

BINARY CARD NO. LNK06058
      12065   462640634643
      12066   255121452325
      12067   606060606060
      12070   006060606060     ERATAB BCI ,0     ***                                                2210690
      12071   545454606060
      12072   606060606060
      12073   606060606060
      12074   606060606060
      12075   606060606060
      12076   606060606060
      12077   606060606060
      12100   606060606060
      12101   606060606060
      12102   606060606060            BCI ,                                                         2210700
      12103   606060606060
      12104   606060606060
      12105   606060606060
      12106   606060606060
      12107   606060606060
```

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    12110  606060606060

BINARY CARD NO. LNK06059
    12111  606060606060
    12112  606060606060
    12113  606060606060
    12114  606060606060        BCI     2,                                                   2210710
    12115  606060606060
    12116  606060606060   ERRA BCI ,       *** ABOVE ELEMENTS NOT READ BY ADIOS             2210720
    12117  545454602122
    12120  466525602543
    12121  254425456362
    12122  604546636051
    12123  252124602270
    12124  602124314662
    12125  606060606060
    12126  606060606060
    12127  606060606060
    12130  006060606060   ERRB BCI     6,0     *** CHECKSUM ERROR IGNORED                   2210730
    12131  545454602330
    12132  252342626444
    12133  602551514651
    12134  603127454651

BINARY CARD NO. LNK06060
    12135  252460606060
    12136  006060606060   ERRC BCI     8,0     ***         NOT DEFINED ON NETWORK CARDS     2210740
    12137  545454606060
    12140  606060606060
    12141  454663602425
    12142  263145252460
    12143  464560452563
    12144  664651426023
    12145  215124626060
    12146  006060606060   ERRD BCI ,0      *** TABLE ASSEMBLY PARAMETER -LNT5- EXCEEDED     2210750
    12147  545454606321
    12150  224325602162
    12151  622544224370
    12152  604721512144
    12153  256325516040
    12154  434563054060
    12155  256723252524
    12156  252460606060
    12157  606060606060
    12160                 INPELE BSS   LNT5           *                                     2210760
    12204                 OUTELE BSS   LNT5           *                                     2210770
    12230                 POTS   BSS   LNT5           *                                     2210780
    12254                 SETTIN BSS   LNT5           *                                     2210790
    12300                 INPCOM BSS   LNT5           *                                     2210800
    12324                 INPACT BSS   LNT5           *                                     2210810
    12350                 DIFF   BSS   LNT5           *                                     2210820
    12374                 GAIN   BSS   LNT5           *                                     2210830
                          *      OUTPUT BUFFERS END  **                                     2210840
                          *                                                                 2210850
                          *      MZE   ON-LINE                                              2210860
                          *      PON   OFF-LINE                                             2210870
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                                *       MON     ON-LINE AND OFF-LINE                                    2210880
                                *               CONVERT BINARY TO OCTAL BCD                             2210890

BINARY CARD NO. LNK06061
      12420   0020 00 4 00002    WRITE TRA      2,4                                                     2210900
                                       HEAD     X                                                       2210910
      12421   0634 00 4 12566   WRITE  SXA      IX4B,4                                                  2210920
      12422   0634 00 2 12567          SXA      IX2B,2                                                  2210930
      12423   0634 00 1 12570          SXA      IX1B,1                                                  2210940
                        001203  Y      BOOL     1203                                                    2210950
      12424   0604 00 0 12574          STI      INDIC                                                   2210960
      12425   0441 00 0 12612          LDI      BCDBUF-1                                                2210970
      12426  -0057 00   770000         RIL      770000                                                  2210980
      12427   0604 00 0 12612          STI      BCDBUF-1                                                2210990
      12430  -0500 00 4 00001   FZE    CAL      1,4                                                     2211000
      12431  -0734 00 1 00000          PDX      ,1                                                      2211010
      12432  -2 00000 1 12562          TNX      BACK,1,0                                                2211020
      12433  -0734 00 2 00000          PDX      ,2                                                      2211030
      12434   0044 00 0 00000          PAI                                                              2211040
      12435   0767 00 0 00022          ALS      18                                                      2211050
      12436   0622 00 0 12437          STD      *+1                                                     2211060
      12437   1 00000 2 12440          TXI      *+1,2,*-*                                               2211070
      12440   0634 00 2 12473          SXA      LOADQ,2                                                 2211080
                                *      PRINT    THE FIRST AND LAST LINE OF EACH REQUEST                 2211090
                                *      PRINT    ONLY THE FIRST LINE OF A SERIES OF ALIKE LINES          2211100
      12441  -0500 60 0 12473   CHKER  CAL*     LOADQ                                                   2211110
      12442   0602 00 0 12601          SLW      WORD                                                    2211120
      12443   0534 00 4 12600   PICKER LXA      WOC,4                                                   2211130

BINARY CARD NO. LNK06062
      12444  -3 00004 1 12471   LINECT TXL      NOTOL,1,4                                               2211140
      12445   0774 00 2 00004          AXT      4,2                                                     2211150
      12446   0634 00 1 12470          SXA      SVON,1                                                  2211160
      12447  -0500 00 0 12601   GETTER CAL      WORD                                                    2211170
      12450   0322 60 0 12473          ERA*     LOADQ                                                   2211180
      12451   0100 00 0 12457          TZE      ALIKE                                                   2211190
      12452  -0520 00 0 12602          NZT      SMMESF                                                  2211200
      12453   0020 00 0 12470          TRA      SVON                                                    2211210
      12454   0600 00 0 12602          STZ      SMMESF                                                  2211220
      12455   0522 00 0 12470          XEC      SVON                                                    2211230
      12456   0020 00 0 12441          TRA      CHKER                                                   2211240
      12457   1 77777 1 12460   ALIKE  TXI      *+1,1,-1                                                2211250
      12460   2 00001 2 12447          TIX      GETTER,2,1                                              2211260
      12461  -0520 00 0 12602          NZT      SMMESF                                                  2211270
      12462   0020 00 0 12467          TRA      FLINE                                                   2211280
      12463   1 00004 4 12464          TXI      *+1,4,4                                                 2211290
      12464   0634 00 4 12600          SXA      WOC,4                                                   2211300
      12465  -0625 00 0 12603          STL      ASABVF                                                  2211310
      12466   0020 00 0 12444          TRA      LINECT                                                  2211320
      12467  -0625 00 0 12602   FLINE  STL      SMMESF                                                  2211330

BINARY CARD NO. LNK06063
      12470   0774 00 1 00000   SVON   AXT      *-*,1                                                   2211340
      12471   0774 00 4 00000   NOTOL  AXT      0,4                                                     2211350
      12472   0774 00 2 00002   LDTH   AXT      2,2                                                     2211360
      12473   0560 00 1 00000   LOADQ  LDQ      *-*,1                                                   2211370
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 12474 -0500 00 0 12577   SETUP  CAL      UN00                 2211380
 12475  0140 00 0 12476          TOV      *+1                  2211390
 12476  0767 00 0 00003   SHIFT  ALS      3                    2211400
 12477 -0763 00 0 00003          LGL      3                    2211410
 12500 -0140 00 0 12476          TNO      *-2                  2211420
 12501  0602 00 4 12613          SLW      BCDBUF,4             2211430
 12502  0520 00 0 12573          ZET      WCNT                 2211440
 12503  0020 00 0 12527          TRA      SENDFT               2211450
 12504  1 77777 4 12505          TXI      *+1,4,-1             2211460
 12505  2 00001 2 12474          TIX      SETUP,2,1            2211470
 12506  1 77777 4 12507          TXI      *+1,4,-1             2211480
 12507 -3 77764 4 12511          TXL      GETCT,4,-12          2211490
 12510  2 00001 1 12472   WDLOOP TIX      LDTH,1,1             2211500
 12511  0754 00 4 00000   GETCT  PXA      ,4                   2211510
 12512  0737 00 4 00000          PAC      ,4                   2211520
 12513  0754 00 4 00000          PXA      ,4                   2211530

BINARY CARD NO. LNK06064
 12514  0131 00 0 00000          XCA                           2211540
 12515 -0754 00 0 00000          ZAC                           2211550
 12516  0221 00 0 12576          DVP      TRE                  2211560
 12517  0131 00 0 00000          XCA                           2211570
 12520  0400 00 0 12600          ADD      WOC                  2211580
 12521  0621 00 0 12600          STA      WOC                  2211590
 12522 -0765 00 0 00017          LGR      15                   2211600
 12523 -0625 00 0 12573          STL      WCNT                 2211610
 12524  0774 00 4 77765          AXT      -11,4                2211620
 12525 -0500 00 0 12575          CAL      BLANK                2211630
 12526  0020 00 0 12475          TRA      SETUP+1              2211640
 12527 -0056 00    400000 SENDFT LNT      400000               2211650
 12530  0020 00 0 12537          TRA      *+7                  2211660
 12531 -0520 00 0 12603          NZT      ASABVF               2211670
 12532  0020 00 0 12535          TRA      *+3                  2211680
 12533  0074 00 4 12646          TSX      PRMESS,4             2211690
 12534  0 00006 0 12604          PZE      ASABM,,6             2211700
 12535  0074 00 4 12646          TSX      PRMESS,4             2211710
 12536  0 00014 0 12613          PZE      BCDBUF,,12           2211720
 12537 -0056 00    100000        LNT      100000               2211730

BINARY CARD NO. LNK06065
 12540  0020 00 0 12547          TRA      *+7                  2211740
 12541 -0520 00 0 12603          NZT      ASABVF               2211750
 12542  0020 00 0 12545          TRA      *+3                  2211760
 12543  0074 00 4 12627          TSX      WRMESS,4             2211770
 12544  0 00006 0 12604          PZE      ASABM,,6             2211780
 12545  0074 00 4 12627          TSX      WRMESS,4             2211790
 12546  0 00015 0 12612          PZE      BCDBUF-1,,13         2211800
 12547  0600 00 0 12573   NXLP   STZ      WCNT                 2211810
 12550 -0500 00 0 11105          CAL      BLANKS               2211820
 12551  0774 00 4 00014          AXT      12,4                 2211830
 12552  0602 00 4 12626          SLW      BCDBUF+11,4          2211840
 12553  2 00001 4 12552          TIX      *-1,4,1              2211850
 12554  0600 00 0 12603          STZ      ASABVF               2211860
 12555  2 00001 1 12557          TIX      *+2,1,1              2211870
 12556  0020 00 0 12562          TRA      BACK                 2211880
 12557  0520 00 0 12602          ZET      SMMESF               2211890
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                  *** APACHE 7090/4 ***   CHAIN LINK 6

      12560   0020 00 0 12443            TRA     PICKER                                     2211900
      12561   0020 00 0 12441            TRA     CHKER                                      2211910
      12562   0600 00 0 12626   BACK     STZ     WORDC                                      2211920
      12563   0600 00 0 12602            STZ     SMMESF                                     2211930

BINARY CARD NO. LNK06066
      12564   0600 00 0 12600            STZ     WOC                                        2211940
      12565   0441 00 0 12574            LDI     INDIC                                      2211950
      12566   0774 00 4 00000   IX4B     AXT     *-*,4                                      2211960
      12567   0774 00 2 00000   IX2B     AXT     *-*,2                                      2211970
      12570   0774 00 1 00000   IX1B     AXT     *-*,1                                      2211980
      12571   0020 00 4 00002            TRA     2,4                                        2211990
      12572   0 00014 0 12613   BCDIO    IOCD    BCDBUF,,12                                 2212000
      12573   0 00000 0 00000   WCNT                                                        2212010
      12574   0 00000 0 00000   INDIC                                                       2212020
      12575   000000000060      BLANK    BCI     1,00000                                    2212030
      12576  +000000000003      TRE      DEC     3                                          2212040
      12577  +000000000001      UN00     DEC     1                                          2212050
      12600   0 00000 0 00000   WOC                                                         2212060
      12601   0 00000 0 00000   WORD                                                        2212070
      12602   0 00000 0 00000   SMMESF                                                      2212080
      12603   0 00000 0 00000   ASABVF                                                      2212090
      12604   606767676767      ASABM    BCI     6, XXXXX INTERMEDIATE WORDS AS ABOVE       2212100
      12605   603145632551
      12606   442524312163
      12607   256066465124

BINARY CARD NO. LNK06067
      12610   626021626021
      12611   224665256060
                                *****    BEGIN BCD BUFFER                                   2212110
      12612   606060606060               BCI     1,                                         2212120
                     12613               DUP     1,11                                       2212130
      12613   606060606060      BCDBUF   BCI     1,                                         2212140
      12614   606060606060
      12615   606060606060
      12616   606060606060
      12617   606060606060
      12620   606060606060
      12621   606060606060
      12622   606060606060
      12623   606060606060
      12624   606060606060
      12625   606060606060
      12626   606060606060      WORDC    BCI     1,                                         2212150
                                *****    END OF BCD BUFFER                                  2212160
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                                                     SUBROUTINE TO WRITE MESSAGES       2212180
     12627   0500 00 4 00001  WRMESS CLA      1,4                                       2212190
     12630   0601 00 0 12644         STO      IOF                                       2212200
     12631   0766 00 0 01203  TRMESS WTDY                                               2212210
     12632   0540 00 0 12644         RCHY     IOF                                       2212220
     12633   0060 00 0 12633         TCOY     *                                         2212230

BINARY CARD NO. LNK06068
     12634   0022 00 0 12637         TRCY     SKIP                                      2212240
     12635   0600 00 0 12645         STZ      OFFTOO                                    2212250
     12636   0020 00 4 00002         TRA      2,4                                       2212260
     12637   0764 00 0 01203  SKIP   BSRY                                               2212270
     12640   0766 00 0 01203         WTDY                                               2212280
     12641   0060 00 0 12641         TCOY     *                                         2212290
     12642   0022 00 0 12643         TRCY     *+1                                       2212300
     12643   0020 00 0 12631         TRA      TRMESS                                    2212310
     12644   0 00000 0 00000  IOF                                                       2212320
     12645   0 00000 0 00000  OFFTOO                                                    2212330
                              *                                                         2212340
                                                     SUBROUTINE TO PRINT MESSAGES       2212350
                                                                                        2212360
     12646   0634 00 1 12735  PRMESS SXA      PRX1,1                                    2212370
     12647   0634 00 2 12734         SXA      PRX2,2                                    2212380
     12650   0634 00 4 12733         SXA      PRX4,4                                    2212390
     12651   0060 00 0 12651         TCOA     *                                         2212400
     12652   0774 00 1 00032         AXT      26,1                                      2212410
     12653   0600 00 1 13014         STZ      BUFPRT+26,1                               2212420
     12654   2 00001 1 12653         TIX      *-1,1,1                                   2212430
     12655   0600 00 0 12756         STZ      FLGPRT                                    2212440
     12656   0500 00 4 00001         CLA      1,4                                       2212450
     12657   0120 00 0 12661         TPL      *+2                                       2212460

BINARY CARD NO. LNK06069
     12660  -0625 00 0 12645         STL      OFFTOO                                    2212470
     12661   0737 00 4 00000         PAC      0,4                                       2212480
     12662   0634 00 4 12673         SXA      ADDINT,4                                  2212490
     12663   0774 00 1 13014         AXT      BUFPRT+26,1                               2212500
     12664   0774 00 2 13004         AXT      BUFPRT+18,2                               2212510
     12665  -0734 00 4 00000         PDX      0,4                                       2212520
     12666   0500 00 0 12761  CONT3  CLA      UNO                                       2212530
     12667   0601 00 0 12755         STO      DEP                                       2212540
     12670   0634 00 1 12715         SXA      STO012,1                                  2212550
     12671   0634 00 2 12722         SXA      STO19,2                                   2212560
     12672   0634 00 4 12727  CONT1  SXA      NWORD,4                                   2212570
     12673   0774 00 4 00000  ADDINT AXT      **,4                                      2212580
     12674   0560 00 4 00000         LDQ      0,4                                       2212590
     12675   1 77777 4 12676         TXI      *+1,4,-1                                  2212600
     12676   0634 00 4 12673         SXA      ADDINT,4                                  2212610
     12677   0774 00 4 00006         AXT      6,4                                       2212620
     12700  -0754 00 0 00000  CONT   ZAC                                                2212630
     12701  -0763 00 0 00002         LGL      2                                         2212640
     12702   0767 00 0 00001         ALS      1                                         2212650
     12703   0734 00 1 00000         PAX      0,1                                       2212660
```

```
                    ### APACHE 7090/4 ###   CHAIN LINK 6
BINARY CARD NO. LNK06070
    12704 =0754 00 0 00000            ZAC                                                          2212670
    12705 =0763 00 0 00004            LGL    4                                                     2212680
    12706  0734 00 2 00000            PAX    0,2                                                   2212690
    12707 =0634 00 2 12710            SXD    **1,2                                                 2212700
    12710  1 00000 2 12711            TXI    **1,2,**                                              2212710
    12711  3 00000 2 12714            TXH    ST0012=1,2,0                                          2212720
    12712  3 00000 1 12751            TXH    BLANKZ,1,0                                            2212730
    12713  0774 00 1 00006            AXT    6,1                                                   2212740
    12714 =0500 00 0 12755            CAL    DEP                                                   2212750
    12715 =0602 00 1 00000     ST0012 ORS    **,1                                                  2212760
    12716 =3 00022 2 12722            TXL    ST019,2,18                                            2212770
    12717  1 77760 2 12720            TXI    **1,2,=16                                             2212780
    12720  0522 00 0 12722            XEC    ST019                                                 2212790
    12721  0774 00 2 00020            AXT    16,2                                                  2212800
    12722 =0602 00 2 00000     ST019  ORS    **,2                                                  2212810
    12723  0771 00 0 00001            ARS    1                                                     2212820
    12724  0602 00 0 12755            SLW    DEP                                                   2212830
    12725  2 00001 4 12700            TIX    CONT,4,1                                              2212840
    12726  0100 00 0 12741            TZE    CONT2                                                 2212850
    12727  0774 00 4 00000     NWORD  AXT    **,4                                                  2212860

BINARY CARD NO. LNK06071
    12730  2 00001 4 12672            TIX    CONT1,4,1                                             2212870
    12731  0766 00 0 01361     PRINTF WPDA                                                         2212880
    12732  0540 00 0 12757            RCHA   PRINT                                                 2212890
    12733  0774 00 4 00000     PRX4   AXT    **,4                                                  2212900
    12734  0774 00 2 00000     PRX2   AXT    **,2                                                  2212910
    12735  0774 00 1 00000     PRX1   AXT    **,1                                                  2212920
    12736  0520 00 0 12645            ZET    OFFT00                                                2212930
    12737  0020 00 0 12627            TRA    WRMESS                                                2212940
    12740  0020 00 4 00002            TRA    2,4                                                   2212950
    12741  0520 00 0 12756     CONT2  ZET    FLGPRT                                                2212960
    12742  0020 00 0 12731            TRA    PRINTF                                                2212970
    12743 =0625 00 0 12756            STL    FLGPRT                                                2212980
    12744  0774 00 1 13015            AXT    BUFPRT+27,1                                           2212990
    12745  0774 00 2 13005            AXT    BUFPRT+19,2                                           2213000
    12746  0534 00 4 12727            LXA    NWORD,4                                               2213010
    12747  2 00001 4 12666            TIX    CONT3,4,1                                             2213020
    12750  0020 00 0 12731            TRA    PRINTF                                                2213030
    12751  3 00006 1 12714     BLANKZ TXH    ST0012=1,1,6                                          2213040
    12752 =3 00005 1 12714            TXL    ST0012=1,1,5                                          2213050
    12753  0774 00 1 00000            AXT    0,1                                                   2213060

BINARY CARD NO. LNK06072
    12754  0020 00 0 12714            TRA    ST0012=1                                              2213070
                                                                                                   2213080
                                             COSTANTI  SUBROUTINE  PRINT  MESSAGES                 2213090
                                                                                                   2213100
    12755  0 00000 0 00000     DEP    PZE    0,0                                                   2213110
    12756  0 00000 0 00000     FLGPRT PZE    0,0                                                   2213120
    12757 =0 00022 0 12762     PRINT  IOCP   BUFPRT,,18                                            2213130
    12760  0 00006 0 13006            IOCD   BUFPRT+20,,6                                          2213140
    12761 =000000000000        UNO    OCT    400000000000                                          2213150
    12762                      BUFPRT BSS    28                                                    2213160
                      77461    INTAPE COMMON 1                                                     2213170
```

```
*** APACHE 7090/4 ***   CHAIN LINK 6
        77453         COMMON  5                                   2213180
        77453  NS3TPE COMMON  1                                   2213190
        77451         COMMON  1                                   2213200
        77451  PRMAIN COMMON  1                                   2213210
        77446         COMMON  2                                   2213220
        77446  LE7777 COMMON  1                                   2213230
        77461  SYSIN1 EQU     INTAPE                              2213240
                      END                                         2213250

     LITERALS

BINARY CARD NO. LNK06073
      13016  000000000000
      13017  000000000001
      13020  000000000003
      13021  000000000014
      13022  000000000023
      13023  000000000060
      13024  000000006060
      13025  000000007777
      13026  000000077777
      13027  000000300002
      13030  000000330000
      13031  000000604000
      13032  000000606060
      13033  000000700000
      13034  000000777777
      13035  000001000000
      13036  000007777777
      13037  000030000000
      13040  007777770000
      13041  010060606060

BINARY CARD NO. LNK06074
      13042  016060606060
      13043  200000000000
      13044  200400000000
      13045  204500000000
      13046  207620000000
      13047  216470400000
      13050  233000000000
      13051  336033603360
      13052  400000000000
      13053  470000000000
      13054  500000000000
      13055  512526336060
      13056  600000004000
      13057  606060606060
      13060  606767676767
      13061  626600000000
      13062  770000000000
      13063  777700000000
      13064  777777000000
```

```
                  *** APACHE 7090/4 ***    CHAIN LINK 6
                       POST PROCESSOR ASSEMBLY DATA

       77445 IS THE LAST LOCATION NOT USED BY THIS PROGRAM
       13065 IS THE FIRST LOCATION NOT USED BY THIS PROGRAM


REFERENCES TO DEFINED SYMBOLS
    11140      B3 11136
     4253      T1    15,   173,10173,10244,10255
      241      T3    13,10242
      230      T4   170,10703
    10302      T5 10272,10275,10327,10341,10355,10450
    10571      T6 10460,10470,11165,11175,11176,11203,11207,11210,11214,11215,11217,11223
    10173      T8  4165,10625
    11137     C11 11135
      155     EOF    35
       23     GET    40,   144,   152,   160,   177,   227,  4251
    11272     REF 11177,11211,11216
    10243     RUN  4167,10254,10264,10277,11513
    11232     SET 11174,11202,11213,11222,11224,11226,11230
       26     TLN 10761,10762,10772,11056
    11027    ARGO 10731,10735,10753,11014,11016
       41    CARD    30,   122,   136,   143,   204,   210,   216,   217,11056,11057,11060,11061,11062,11063
    11352    CGED 11343
    11106    CVTB 10646,11114
    12350    DIFF 10561
    10301    ELEM 10262,10621,10660,10673,10715,10720
    11624    EQUA 11533,11542
    12116    ERRA 11575
    12130    ERRB   222
    12136    ERRC 10721,10723
    12146    ERRD 10466
    10202    ERRE  4235, 4237
    10215    ERRF  4243, 4245
      121    FLAG    24,    32
    11354    FULL 11346
    12374    GAIN 10457
    11326    GDIF 11320,11323
    10464    GOLK 10527
    11332    HOME 11317,11327
    11023    IX1A 10726
    10654    IX1B 10617
    11332    IX1C 11276
    10653    IX2A 10616,10701
    11024    IX2B 10727
    11025    IX4A 10730
    10655    IX4B 10620
    11333    IX4C 11275
    11570    IX4D 11546
    11543    IX4E 11525
    10724    IX4F 10702
     3720    LNT1 10173
       24    LNT5 10243,10302,10354,10355,10450,10571,11446,11447,11456,11507,11511,12160,12204,12230,12254,12300,12324
                  12350,12374
      166    LNWC   154
    10753    LOOP 11017
    10463    MODO 10566
```

```
11340    NAME  10674,11277,11347
10266    NENT  10274
  164    NETW    150
10275    NOMO  10267,10271
11425    NORM  11420
  153    NWGP    147
11115    OUTC  11107
10327    PACK  10300
10567    POTF  10376,10440,10443,10461,10526,10565
12230    POTS  10510,10562
11707    POTX
 4161    RESP    151
  132    RITE    124,   130
11231    SDFG  11161
11470    SIMF  11463
10374    SNEG  10371
11175    SQSQ  11153
 4172    STLP   4247
10460    SVAL  10447,10453
11130    TEMP  11111,11113
  223    TEOU    201,   220
11545    TNUM  11530,11534
10443    TPOT  10412
10472    TYPE  10336,10416,10446,11141,11324
11465    WNTH  11443
11337   AMENT  11301,11315
11066   BCDWD  10733,10776,11003,11020
11100   BCVDT  11071,11072,11073,11074,11075
10615   BDIFF  10551,10564
   71   BUFFA     21,    26
    3   CHAIN  11134
10362   CKLIT
  122   CKSEQ     36
11521   CURLN  11413,11415,11421,11554,11556
10726   CVERT   4174, 4214
11727   DIFFM  11261
11717   DIFFX
10467   ENDT5  10356
11361   ERFDF  11353,11405,11407
10657   FELEM  10623,10632
10772   FOUND  10766
10242   FSTAB    174,10231,10234
11564   FSTPT  11560
11067   FULLF  10734,11001,11021
11721   GAINX
10713   GTNAM  10707
10711   GTNET  10266,10670,10705,10717
11506   INIZE  11406
  764   LNTOT   4161
  214   LSTWD    205
   24   MAXER  11275,11346,11475,11515,11516,11517,11520,11547
11522   MAXLN  11417
11622   MELEM  10346,11262
 4250   NMEHR   4176
11702   NTHLN  11465
```

```
*** APACHE 7090/4 ***    CHAIN LINK 6
         POST PROCESSOR ASSEMBLY DATA

10235   NTHNG  10226
  125   NTNEW    123
  157   NWCON    146
  204   NWORD    213
 4163   NWRES    156
11014   NXTHE  11011
11442   OLDPG  11434
10225   POINT    167,  4164
   40   REDUN     34
 4170   SAMEC   4162
11566   SCDPT  11562
11223   SCOMP  11154
10756   SECLP  11004
  136   SELTY     37
11214   SHAMD  11152
11175   SHAMM  11151
10254   SKPOT  10250
  200   SMCON    165,   172
10545   SNEG2  10542
11245   SNEG3  11242
11214   SQSQD  11162
11525   STATN  10337
 4206   STLPA   4201,  4203
 4227   STLPB   4223
 4241   STLPC   4232
 4246   STLPD   4231,  4240
11214   STMDD  11150
11175   STMDM  11147
11454   STOIT  11451
11030   TABLE  10762,10772,11056
11064   TEMP2  10741,10746
11065   TEMP3  10737,10744,10760,10764,10774,11002
11273   TEMP4  11232,11233,11247
10570   TEMPS  10364,10365,10402,10504,10514,10521
 4251   TEOUT
11576   TITLE  11423
10241   TYPEF
11336   UPLIM  11311
11514   VARCT  10467,11164,11167,11410,11444
12420   WRITE    225
    1   XOPEN     17
    2   XREAD     23
11357  ACCCTR  11331,11504
12030  ACCTAB  11331,11517,11574
11715  ACTINX
10326  ACTVAL
12673  ADDINT  12662,12676
12603  ASABVF  12465,12531,12541,12554
12613  BCDBUF  12425,12427,12501,12536,12546,12552,12572
11274  BDIFFM  11251,11270
10475  BINACT
10476  BINPAC  10444,10513,10550,10564
10500  BINPCO  10532,10540,10547
11105  BLANKS  11070,12550
12751  BLANKZ  12712
```

```
*** APACHE 7090/4 ***   CHAIN LINK 6
   POST PROCESSOR ASSEMBLY DATA

10473 BOUTAC 10352,11250,11270
10474 BOUTEL 10411,10434,10437,10442,10531
10477 BSETTI 10525,10530
12762 BUFPRT 12653,12663,12664,12744,12745,12757,12760
  134 CCOUNT   126,  132
11315 CKACCY 11310,11312
11311 CKULIM 11305
11056 COLTAB  4172, 4213,11064
11713 COMINX
  163 CONSOL   142, 4210,10235
  236 CURCON   175,10225,10236,10256,10340,10344,10421,10424,10432,10624,10664
11070 CVTBCD 10366,10515,10537,10556,11240,11256,11531,11537
11756 EMESPS 11573
12016 EMESSS 11572
12056 EMESTS 11574
11173 ENDLST
11341 ENTERR 10675,11306,11313,11330
11360 ERACTR 10676,11505
12070 ERATAB 10676,11520,11575
11131 FINITO 10245
10530 FINPOT 10462
12756 FLGPRT 12655,12741,12743
10402 FLTLIT
11614 FSTLNA 11426
11617 FSTLNB 11430
11622 FSTLNC 11432
10754 FSTSHF 10751
12447 GETTER 12460
10504 GOTPOT 10361
12324 INPACT 10377,10441,10512
12300 INPCOM 10546
12160 INPELE 10401,10414,10435,11447,11511
11703 INPELX 11455
77461 INTAPE 13016
  161 LASTCF   153,  155,  171,  176, 4166
77446 LE7777 11132,13016
11020 LFTJUS 11012
12444 LINECT 12466
11324 LKUTYP 11321
    6 LNCOLT  4170, 4172, 4213,11064
10355 LOOKUP 10464
11335 LOWLIM 11304
11572 MESSTB 11557
10762 NENTRY 10767
10702 NMTNET 10263,10665
10616 NMTVAL 10350,10426,10511
10717 NOGOOD 10712
11444 NOPASS 11471
11523 NPAGEF 11424,11433,11435
77453 NS3TPE 13016
10673 NTSWIT 10663
10752 NUMCHA 10743
11005 NUMCHB 10745,11013
  162 NWCONF   157,  164, 4161,10237
11551 NXTSEL 11567
```

*** APACHE 7090/4 ***   CHAIN LINK 6
POST PROCESSOR ASSEMBLY DATA

```
12645 OFFTOO 12635,12660,12736
11524 OPTION    12,11403
  135 ORDERF   131
11725 OUTACT 10351
11723 OUTCOM 11246
12204 OUTELE 10375,10433
11403 OUTPUT 11271
11705 OUTPUX
12443 PICKER 12560
  237 POINTA    14,  166,  200,  214
 4252 POINTB    16, 4163, 4171, 4250
11362 POTTOL 11322
12731 PRINTF 12742,12750
77451 PRMAIN     7,13016
12646 PRMESS 12533,12535
10445 PUTVAL
11515 RESTAB 11476,11552
10621 REVIEW 10672
    0 REWSYS     6
11355 SATCTR 11314,11502
11730 SATTAB 11314,11516,11573
10502 SAVCON 10422,10431
11626 SCDLNA 11437
11654 SCDLNB 11441
10630 SEARCH 10634,10637
11567 SELECT 11553
12527 SENDFT 12503
12254 SETTIN 10520
11711 SETTIX
11356 SIGCTR 11307,11503
11770 SIGTAB 11307,11515,11572
11141 SIMULA 10471
11164 SINTEC 11144
11446 SKIPRD 11457,11460,11462,11510
12602 SMMESF 12452,12454,12461,12467,12557,12563
11225 SRESOP 11157
11227 SRESOR 11160
11207 SSERVO 11146,11206
11203 SSERVS 11163
11164 SSUMMR 11145
11223 SSWTCH 11155
11546 STDIAG 11472
12715 STO012 12670,12711,12751,12752,12754
11223 STRUNK 11156
11275 STSGAC 10436,10563,11267
  240 SUMMER   202,  206,  207,  215
77461 SYSIN1    20,   25,13016
11116 TABLEC 11106
10201 TENDIV  4173, 4204, 4222, 4230
10636 THISON 10633
11363 TOLERT 11325
12631 TRMESS 12643
10501 TRUCON 10333,10423
10503 TRUNKE 10415,10425,10427
10660 UNREAD 10635
```

```
10770 USBLNK 10765
10677 USEZER 10666
10413 VALNAM 10363
12510 WDLOOP
12627 WRMESS   221, 4236, 4244,10465,10722,11422,11425,11427,11431,11436,11440,11464,11563,11565,12543,12545,12737
 1203 X     Y 12424,12631,12632,12633,12634,12637,12640,12641,12642
12755 X   DEP 12667,12714,12724
12430 X   FZE
12644 X   IOF 12630,12632
12576 X   TRE 12516
12761 X   UNO 12666
12600 X   WOC 12443,12464,12520,12521,12564
12562 X BACK  12432,12556
12700 X CONT  12725
12570 X IX1B  12423
12567 X IX2B  12422
12566 X IX4B  12421
12472 X LDTH  12510
12547 X NXLP
12735 X PRX1  12646
12734 X PRX2  12647
12733 X PRX4  12650
12637 X SKIP  12634
12470 X SVON  12446,12453,12455
12577 X UNOO  12474
12573 X WCNT  12502,12523,12547
12601 X WORD  12442,12447
12457 XALIKE 12451
12604 XASABM 12534,12544
12572 XBCDIO
12575 XBLANK 12525
12441 XCHKER 12456,12561
12672 XCONT1 12730
12741 XCONT2 12726
12666 XCONT3 12747
12467 XFLINE 12462
12511 XGETCT 12507
12574 XINDIC 12424,12565
12473 XLOADQ 12440,12441,12450
12471 XNOTOL 12444
12727 XNWORD 12672,12746
12757 XPRINT 12732
12474 XSETUP 12505,12526
12476 XSHIFT
12722 XSTO19 12671,12716,12720
12626 XWORDC 12562
12421 XWRITE
```

NO ERROR IN ABOVE ASSEMBLY.

6. SYSTEM TABLES

6.1 SYMBOL TABLE

The SYMBOL TABLE (SYMB) contains all information relevant to the variables and parameters. It is constructed in LINK 1 and information is added during the whole course of the elaboration of a problem.

SYMBOL TABLE as constructed in LINK 1

<table>
<tr><td></td><td>Number of words in name = N</td><td>CODE GP</td><td>see A below</td><td>Control word</td></tr>
<tr><td>N words</td><td colspan="3">Alphabetic name of variable, split. (see B below)</td><td rowspan="5">for each variable</td></tr>
<tr><td>for each parameter</td><td colspan="3">Value of parameter, IC of variable</td></tr>
<tr><td></td><td colspan="3">Maximum value of variable</td></tr>
<tr><td></td><td colspan="3">Scale factor of variable (REF = 1)</td></tr>
<tr><td></td><td colspan="3">Minimum value of variable</td></tr>
</table>

A. Each bit 24-35 when = 1 indicates that the following conditions are present:

24 NULL
25 MANUAL
26 Composite variable
27 EXACT
28 TEST
29 not significant
30 not significant
31 Minimum value given
32 Maximum value given
33 Variable: IC given
Parameter: value given
34 Variable
35 Parameter

B Names of variables and parameters are written in the following way:

BC3 will have N = 1
222303606060

A(5) will have N = 4
216060606060
746060606060
203500000001
346060606060

Note that numbers are written in floating point and are distinguished by having 1 in bit 35. (Names of variables and parameters have a maximum of 5 characters).

When a bit is present in bit 26 of the control word, (i.e. composite variable), after the name will be one word containing a symbolic name for the composite variable which will be of the form:

$00...0M blank

where M is a number, different for each composite variable. The area occupied by the split name + the symbolic name will be (N+1) words.

The SYMBOL TABLE is also used to store information regarding variables which are object of an IMPOSE of a type of multiplier, and variables which have an IMPOSE GAIN 1. These are stored in the following way:

Control word

Bits

3-17	Length of the name = N
18-23	GP-code of the imposed type of multiplier, or zero if impose of GAIN 1.
24	= 0 if 18-23 not equal to 0
	= 1 if GAIN 1

Alphabetic name of variable split (as above)

Following word is zero if this is the last variable with an impose of the types mentioned above, if not the last it will contain the SYMBOL TABLE address of the next variable with an impose.

These entries in the SYMBOL TABLE do not have a corresponding reference in the RIF table (6.2).

SYMBOL TABLE as used to contain addressing information

This description applies to variables only, parameter entries are not changed.

In the addressing phase the information, IC value, maximum value and scale value, is no longer required, and these three words are used to store information relative to the addressing.

IC word

Bits	
S-5	NCOD2 (see 7.11)
6-8	NCOD1 (see 7.11)
9-11	number of console on which the variable has its main element.
12-20	analog name of the element
21	sign of the variable (1 = -, 0 = +)
22	signal for inversion of polarity
23	for multiplier entries
24	= 1 if main element has invertor
25	= 1 the variable enters in a high-accuracy multiplier and is automatically inverted.
26-35	Numeration of variable corresponding to columns of sign-matrix.

Maximum value word

S	Sign of IC
1 - 3	Signals from which output of servo, quarter square or comparator the variable exits.
4	= 1 if main element has output going to trunk
5	= 1 if invertor of main element has output going to trunk
6 - 8	Code indicating type of invertor named in bits 9-17
9 - 17	Analog name of buffer invertor
18 - 20	Number of trunks associated with sign invertor
21 - 23	Number of trunks associated with main element
24 - 26	Code indicating type of invertor named in bits 27-35
27 - 35	Analog name of sign invertor

Minimum value word

SATANAS information

S-8	Number of outputs of inverted variable which come directly from invertor
9-17	Number of outputs of variable which come directly from main element
18	= 1, tiepoint needed for invertor
19-26	Analog name of tiepoint associated with invertor
27	= 1, tiepoint needed for main element
28-35	Analog name of tiepoint associated with main element.

6.2 Reference to SYMBOL TABLE (RIF)

To facilitate research in the SYMBOL TABLE a reference table RIF is constructed by LINK 1. This contains the addresses of each control word in the SYMBOL TABLE, and in the decrement the length of the corresponding entry. This table is sorted in the order:

1. Length of name
2. Names of same length in alphabetical order

i.e. A(3), Z, B, A(4) becomes
B, Z, A(3), A(4)

In LINK 31 the sign of the variable is placed in bit S. Bits 1, 2 indicate type of invertor:

= 0 no invertor
= 1 if buffer invertor
= 2 INV
= 3 assigned by minimisation

6.3 Multiplication terms tables

These tables are constructed in LINK 31 and after being used in the minimisation of the invertors are written on tape. They are reloaded into the COMMON by LINK 321 and used by LINKS 321, 33, 331, 342.

The tables list all variables produced by multiplication, division, or polar or rectangular resolution. They are used as a guide to control the IMPOSE and to construct the multiplier tables. The variables are represented by their address in the SYMBOL TABLE.

(In the following descriptions multiplication is to mean multiplication or division unless a difference is specified).

Servo multipliers

LINK 31

Constructed in areas FTRN(i), REC(i)

FTRN(i)

±	x * y	x

REC(i)

		y

Length IDX

<u>LINKS 321, 33, 331</u>

Only the first half of the table is loaded.

RUBB (i)

	x * y		x

console number (331)

= 4 if sign invertor is required (31)
= 2 when x has been considered as an entry variable to multipliers (331)
= 1 when x * y has been considered as an entry variable to multipliers (331)

<u>Quarter square multipliers</u>

<u>LINK 31</u>

BLIST (i)

	x * y	x

BLIST (i+100)

	y

= 0 multiplication
= 1 division

Length IDQ

<u>LINKS 321, 33, 331</u>

Only first half of table is loaded

QUBB (i)

	x * y		x

console number (331)

= 2 when x has been considered as entry variable to multipliers (331)
= 1 when x * y has been considered as an entry variable to multipliers (331)

<u>Electronic multipliers</u>

<u>LINK 31</u>

BLIST (i+200)

x*y	x
x/y	x

BLIST (i+300)

		y	mult.
	4	y	div.

Length JDX

division

<u>LINK 321, 33, 331</u>

TUBB1 (i)

	x*y		x
	x/y		x

TUBB2 (i)

		y	mult.
	4	y	div.

number console (331)

Division (31)

as above

<u>High accuracy multipliers</u>

<u>LINK 31</u>

BLIST (i+400)

x*y	x
x/y	x

BLIST (i+900)

	4	y	mult.
	2	y	div.

Length IDH

<u>LINKS 321, 33, 331</u>

HUBB1 (i)

	x*y		x
	x/y		x

HUBB2 (i)

	4	y	mult.
	2	y	div.

number console (331)

as above

(In LINK 331 this table is sorted in the order multiplication and division, second power witn fourth power used, square roots, second power with fourth power not used. Only multiplication and division are accepted by the APACHE in its present form).

Resolvers

(The resolvers are included with the multipliers as they occupy servo positions on the panel)

LINK 31

BLIST (i+1700)

0	R	X
4	THETA	Y

Polar

R, THETA = X, Y

Each resolver needs two words in the table to specify it.

	X	R
	Y	THETA

Rectangular

X, Y = R, THETA

4,0 for rate, 0,0 for position

Length IDR

LINKS 321, 33, 331

RESUBB (i)

console number

signals as above +
2 when arm variable has been considered as input variable to other multipliers
1 when output variable has been considered as input variable to other multipliers

6.4 Multiplier Tables

The area for the tables is initialised in LINK 321, which enters in the tables all multipliers assigned to a specific element with an IMPOSE.

In LINK 33 the tables for servo-multipliers and electronic multipliers are completed. In LINK 331 the quarter squares and resolvers are added to the servo-multiplier tables and the high-accuracy multiplier tables are completed.

In all the tables each pair of voices corresponds to one analog element, each element having at least one entry. Specific elements given with an IMPOSE are entered as stated, all other multiplier terms taken from the multiplier terms tables (6.2) are filled into the framework of the tables in the most efficient way, that is, using the least number of analog elements taking account of the "arm" variables of the multiplication terms. The console number is taken into account only for the "arm" variable, as explained in 4.5.

Servo multipliers, Resolvers, Quarter squares

(As these elements use the same panel areas, they are grouped in one table)

Tables TSM1 (i) and TSM2 (i)

General form of TSM1 (i)

Bits:	
S-4	name of analog element
5-7	Console number
8	= 0 servo with 5 entries
	= 1 servo with 3 entries
9-10	= 00 normal servo
	= 01 + servo
	= 10 - servo
11	= 0 polar resolver
	= 1 rectangular resolver

12-14	000 initialisation 001 servo-multiplier 010 quarter-square 110 resolver position 111 resolver rate
15	output F for servo position
16	output A
17	output B
18	output C
19	output D
20	output E
21-35	SYMBOL TABLE address of variable entering "arm" of servo-multiplier Blank for quarter squares SYMBOL TABLE address of factor equivalent to THETA for rectangular resolvers Blank for polar resolvers

Length of table + 1 = KTSM
Length of area filled in by IMPOSE + 1 = IKTSM

In LINK 321 for each IMPOSE the complete information is filled in and controls for compatibility made.

In LINK 33 the table is completed for servo multipliers but without console number and analog element name.

In LINK 331 the console number is filled in, and quarter squares and resolvers added to the table.

In LINK 342 an analog element name is assigned to the non-IMPOSE entries.

TSM2 (i) is used as a working area.

Electronic multipliers

Tables TTD1 (i), TTD2 (i)

General form:

TTD1 (i)

Bits	
S-4	name of analog element
5-7	console number
8-14	not significant
15	= 0 multiplication mode
	= 1 division mode
16	output G
17	output H
18-35	SYMBOL TABLE address of variable entering "arm"

TTD2 (i)

18-35	For division mode, address in SYMBOL TABLE of denominator

Length of table + 1 = KTTD

Length of area filled by IMPOSE + 1 = IKTTD

In LINK 321 for each IMPOSE the complete information is filled in and controls for compatibility made.

In LINK 33 the table is completed but without console number and analog element name.

In LINK 331 the console number is added.

In LINK 342 an analog name is assigned to each electronic multiplier.

High-accuracy multipliers

Table THAM1 (i) THAM2 (i)

General form:

THAM1 (i)

Bits

S-4	name of analog element
5-7	console number
8-9	not significant
10	output B
11	output A
12	used for multiplication
13	used for division
14	used for 2nd power
15	used for root
16	used for 4th power

(14, 15, 16 are not used in the present version of APACHE)

17	not significant
18-35	SYMBOL TABLE address of variable on "arm"

THAM2 (i)

18-35	SYMBOL TABLE address of output variable from B.

6.5 Comparator Tables

These tables are constructed in LINK 31 and used in LINKS 321 33, 331, 342.

LINK 31

```
e.g.    COMPARE (-A+B), Z1 = -Y1
        COMPARE (-C+D), Z4 = Y3, Y4
        COMPARE (-A+B), Z2, Z3 = Y2
```

would produce the following entries in the tables:

COIL (i)
(= CUBB1)

-	A	+	B

-	C	+	D

TAC (i)
(= CUBB2)

			Z1
	Z2		Z3

			Z4

TAC2 (i)
(= CUBB3)

		-	Y1
		+	Y2

+	Y3	+	Y4

Note that the coil table is half the length of the contacts tables. The length of the coil table is IDC.

LINK 321

A fourth table is added in TCP1, containing the order and the console number of the comparator assigned with an IMPOSE and whose description is in a parallel position in the tables CUBB2 (TAC1) and CUBB3 (TAC2).

LINK 33

The tables are cleared of all except entries corresponding to IMPOSE. The entries are pushed-up to eliminate blank entries.

LINK 331

The comparator table for non-IMPOSE entries is reconstructed, taking account of console number. Where possible contacts having the same coil are put together. The console number is put in the tag of CUBB2.

LINK 342

Addressing information is filled in in TCP1 parallel with the CUBB tables.

6.6 Switch Tables

These tables are contructed in LINK 31 and used in LINKS 321, 331.

LINK 31

E.g. SWITCH, X1 = Y1
SWITCH, X2 = Y2, Y3
SWITCH, X3 = Y4, Y5, Y6
SWITCH, X4, X5 = Y7
SWITCH, X6, X7, X8 = Y8

TAS1 (i) (= SUBB1)

	X1	±	Y1
	X2	±	Y2
	X3	±	Y4
-	X4		X5
-	X6		X7

TAS2 (i) (= SUBB2)

±	Y3		
±	Y5	±	Y6
		±	Y7
	X8		Y8

Note the sign bit = 1 in TAS1 indicates multiple outputs, single input

LINK 321

For switches with IMPOSE the console number is put in the tag of SUBB1 (= TAS1), other information is put in the SYMBOL TABLE.

LINK 331

The table is used as a control for the count. The console number for non-IMPOSE variables is put in the tag of SUBB1.

6.7 DFG Tables

Tables for the DFG are constructed in LINK 31

LINK 31

BLIST (i + 1500)

			X

BLIST (i + 1600)

	±	Y

e.g. DFG, X = Y

LINK 321

A new table is constructed and all DFG with IMPOSE filled in. The table is in TCP2 with length index KCP.

Bits	
S	= 1 occupied as 20 segments or twice as 10 segments
1	= 1 1st entry blocked
2	= 1 2nd entry blocked
3-5	console number
6-13	analog element name
14-17	not significant
18	= 1 cannot be used as 20 segment, both 10 segment available
19	= 1 cannot be used as 20 segment, only 1x10 segment available
20	= 1 can be used only for 20 segments.

LINK 331

Length of IMPOSE part of table = IKDF
Length of non-IMPOSE part of table = KDF

During the count, entries are made in the table for non-IMPOSE DFG's with the console number and appropriate signals. DFG's entered with IMPOSE are filled up if they have entries free and the console number agrees.

6.8 Analog element tables

All information relative to the analog elements and the patch panels is stored in two tables, NBOX and VETT, with TV as a guide table for VETT.

The method of entering the information is explained in 5.3. The information is developed into the table form by LINK 7.

NBOX

Each word in the table corresponds to a type of element which is mobile, that is, it can be inserted in different positions to correspond with different panel positions.

In the decrement is the total available of that type of element

NBOX (1)	Servo multipliers (5 entry)
(2)	Servo multipliers (3 entry)
(3)	Not used
(4)	Not used
(5)	Quarter-square multipliers
(6)	Electronic multipliers
(7)	High accuracy multipliers
(8)	DFG
(9)	Resolvers
(10)	Variplotters
(11)	Recorders

TV

The matrix TV is dimensioned (60,6) where the columns refer to the console of the same number.

In each column, each pair of words refers to a type of element and acts as a guide to the table VETT.

TV (i,j)

Bits

S-5	Hollerith alphabetic character referring to type of element (see list below)
6-11	Hollerith blank (= 60)
12-14	Console number (= j)
15-20	Not significant
21-35	Address in VETT of first abscissa word of i^{th} type of element

TV (i+1, j)

S-3	not significant
4-17	number of elements of this type in VETT
18-20	not significant
21-35	address in VETT of first ordinate word of i^{th} type of element

Hollerith character		Type of element
TV (1, j)	A	Amplifiers
TV (3, j)	M	Servo multipliers Quarter squares Resolvers
TV (5, j)	not used	
TV (7, j)	T	Electronic multipliers
TV (9, j)	F	DFG
TV (11,j)	not used	
TV (13,j)	P	Potentiometers
TV (15,j)	J	Manual potentiometers
TV (17,j)	S	Switches
TV (19,j)	C	Comparators
TV (21,j)	X	Variplotters
TV (23,j)	N	Tiepoints
TV (25,j)	K	References

TV (27,j)	H	Resistances
TV (29,j)	G	Capacities
TV (31,j)	I	Input trunks
TV (33,j)	O	Output trunks
TV (35,j)	E	Recorders
TV (37,j)	not used	
TV (39,j)	Q	High accuracy multipliers
TV (41,j) etc.	not used	

<u>VETT</u> (1400, 6)

The information contained on the panel description cards is translated into a pair of words for each element, one called the abscissa word and containing the value of the abscissa of the basic panel coordinate, the other called the ordinate word and containing the value of the ordinate of the basic panel coordinate of the element.

<u>N. B.</u> As each element occupies a pair of words in VETT, no more than 700 elements can be included for each console.

Each column of the matrix corresponds to a console and each column is sorted by type of element. Each type of element is then sorted into abscissa words and ordinate words and the abscissa words ordered by increasing order number of the element.

Connection between the abscissa and ordinate words of a pair is maintained by a relative address in the address part of each abscissa (or ordinate) word numbering the position of its corresponding ordinate (or abscissa) word in the section of VETT which refers to that type of element.

<u>Abscissa word - general form</u>

Bits

S	put = 1 in addressing phase when element is occupied, put = 1 with OMIT
1-2	information varying with type of element

3-5	console number
6-13	order number of the element
14-20	information
21-27	value of abscissa coordinate
28-35	relative address of the associated ordinate word

Ordinate word - general form

S-20	information
21-27	value of the ordinate
28-35	relative address of the associated word

Amplifiers

Abscissa word

1	= 0 network free
	= 1 network occupied
2	= 0 integrator
	= 1 summer
15	= 1 used as summer
16	= 1 used as high gain
17	= 1 used as invertor
18	= 1 invertor associated with DFG
19	= 1 invertor associated with resolver
20	= 1 invertor associated with high accuracy multiplier

Ordinate word

S-8	not used
9	= 0 network can be used as auxiliary network
10-17	order number of the invertor if bit in 18, 19, or 20 of abscissa word

<u>Comparator</u>
<u>Ordinate word</u>

S	= 1 if J contact occupied
1	= 1 if K contact occupied

<u>Switch</u>
<u>Ordinate word</u>

S	= 1 if left contact occupied
1	= 1 if centre contact occupied
2	= 1 if right contact occupied

<u>DFG</u>
<u>Abscissa word</u>

S	= 1 occupied as 20 segment or twice as 10 segment
1	= 1 1st entry 10 segment occupied
2	= 1 2nd entry 10 segment occupied
18	= 1 used by IMPOSE
19	= 1 cannot be used as 20 segments, only one 10 segment available (OMIT = 86 or 24)
20	= 1 cannot be used as 10 segments (OMIT = 22)

<u>Ordinate word</u>

18	= 1 cannot be used as 20 segments but can be used as 2*10 segments (OMIT = 66)
19,20	as 19,20 of abscissa

Capacity, Resistance

Ordinate word

S-4	value of capacity of resistance (e.g. 1)
5	sign of exponent (e.g. -)
6-11	exponent base 10 (e.g. 1)

Trunks

Abscissa word

15-20	put together with 12-20 of ordinate word gives SYMBOL TABLE address of input variable (added in LINK 36)

Ordinate word

S-7	number of corresponding input/output trunk
8	= 1 if trunk is attached to invertor of variable (added in LINK 36)
9-11	console number of corresponding input/output trunk
12-20	see 15-20 above

Reference

Abscissa word

15	= 1 -100 volts
16	= 1 ground
17	= 1 +100 volts
20	= 1 test reference

Ordinate word

S-7	number of associated servo multiplier
8	sign of special value (1 = -)
9-17	special value (25 or 90)

Tiepoints

Abscissa word

1	= 1 if tiepoint with distributed outputs (e.g. TPO)
2	= 1 if this is first of distributed series
15	= 1 if TPO
16	= 1 if TP1
17	= 1 if TP5
18	= 1 if TP6

Ordinate word

S-7	for distributed series gives number of successive output (See Appendix D, Programmers Manual for numbering of distributed tiepoints)
8-11	represents outputs of four output type tiepoints
8-13	represents outputs of six output type tiepoint
12 or 14-17	are filled with 1's for 4 or 6 output tiepoints, respectively

Potentiometers, Manual Potentiometers

Abscissa word

1	= 1 if earthed pot
2	= 1 if isolated pot

Ordinate word

S-7	order number of amplifier to which it is nearest.

High Accuracy multipliers

Abscissa word

1	= 1 output B blocked
2	= 1 output A blocked
15	= 1 used as multiplier
16	= 1 used as divider

<u>Ordinate word</u>

S-7	order number of associated invertor
15-17	number of associated invertors which can be used independently
18-20	number of associated invertors which cannot be used independently

<u>Servo multipliers</u> (Panel positions)
<u>Abscissa word</u>

1	= 0	5 outputs
	= 1	3 outputs
2	= 1	can be used as resolver position
	Bits 15-19 are used for partial OMIT	
15	= 1	resolver cannot be used in position mode
16	= 1	resolver cannot be used in rate mode
17	= 1	resolver cannot be used in polar mode
18	= 1	1st output not available
19	= 1	2nd output not available

<u>Ordinate word</u>

S-7	order number of associated amplifier
15-20	represent the outputs F A B C D E

For resolvers:

8	= 1	I.C. pot has been attributed
9	= 0	I.C. pot is normal pot
	= 1	I.C. pot is manual pot
10-17	order number of IC pot for rectangular rate mode (added in LINK 343)	

<u>Electronic multipliers</u>
<u>Abscissa word</u>

1	= 1	if used for division
20	= 1	if cannot be used for division (OMIT = 72)

Ordinate word

19	= 1 output G blocked (OMIT = 76)
20	= 1 output H blocked (OMIT = 74)

6.9 Analog elements, available and used, matrix (TPOM (30, 8))

This matrix is used for the accounting of the elements (4.5). It consists of 8 columns each of 30 words. The first 6 columns refer to the 6 possible consoles, the eighth is a working area. (The seventh is not used). The significance of each word in a column is shown below:

I	TPOM (I,J)	
	DECREMENT	ADDRESS
1	Total integrators used as integrators	Total integrators available
2	Total integrators used as summers	Total integrators used
3	Total integrators used as invertors	
4	Total summers used as networks for integrators	Total summers available
5	Total summers used as networks for summers	Total summers used
6	Total summers used as summers	
7	Total summers used as invertors	
8	Total invertors used	Total invertors available
9	Total networks used from unusable amplis	Total networks from unusable amplis available

	DECREMENT = TOTAL REQUIRED	ADDRESS = TOTAL AVAILABLE
11		DFG
12		DFG (1*10 segment only)
13		DFG (2*10 segment only)
14		DFG (1*20 segment only)
15		Potentiometers
16		Manual potentiometers
17		Switches
18		Comparators
19		Variplotters
20		Resistance (1 MΩ)
21		Resistance (. 1 MΩ)
22		Capacity (1 μF)
23		Capacity (. 1 μF)
24		Recorder channels
25		
26		Servo multipliers (5 outputs)
27		Servo multipliers (3 outputs)
28		Electronic multipliers
29		
30		High accuracy multipliers

The totals available are filled in in LINK 321, counting from the panel description and taking account of the OMIT. In LINK 331 the totals required are counted and filled in. The addressing phase uses the required totals as a control.

If in LINK 331 the elements available are found not sufficient, the matrix TPOM is printed out, together with a diagnostic number. (See Programmers Manual, Appendix G)

7. INTERNAL CODING AND INFORMATION WORDS

7.1 ID-code

ID is the first word of the ID-record (8.1). It contains two codes, the ID-code which defines types of statements, and the KTYPE-code (7.2) which defines types of equations.

The ID-code is in the decrement of ID.

ID-Code	Type of Statement
1	COMMENTS
4.	EQUATIONS
5	IMPOSE
6	BETA
7	REF
8	CONSOLE SELECT
9	MULTIPLIER
10	VARIPLOTTER
11	RECORDER
12	AVAILABLE CONSOLES
13	OMIT
19	END
20	PRINT
22	DO

The following ID-codes are used for internal identification and have no corresponding ID-record

ID-Code	Type of Statement
2	PARAMETERS
3	VARIABLES
14	PATPAN
15	EDIT
21	CHECK

These statements are selectors and are never written onto intermediate tape.

The ID word is also used to carry other signals:

Zero equations

Bit 29 = 1 Zero equation generated for division

For Comparator

Tag = 0 coil equation
$\neq$ 0 contact equation

For switch

Tag = 0 general equation
$\neq$ 0 contact equation

7.2 KTYPE-code

KTYPE is contained in the address part of ID, bits 31 - 34. The subroutine extracts and converts it to an integer.

KTYPE	Type of equation
1	Algebraic
2	Multiplier
3	Implicit (ZERO)
4	Differential
5	DFG (10 segments)
6	DFG (20 segments)
7	Switch
8	Compare
9	Resolver (polar)
10	Resolver (rectangular)
11	Invertor
12	Trunk

7.3 E-Code

The E-code is used by LINK 2 and LINK 21 to identify the operands and operators which appear in an equation.

E-code	Description
1	Variable
2	Parameter
3	(
4	)
5	+
6	-
7	*
8	/
9	Derivative (DER)
10	ZERO function
11	=
12	Auxiliary variable
13	Mean value of a perturbed variable
14	Parametric expression
15	Constant
16	SIGMA
17	PI

7.4 M-code

Identifies the type of multiplier defined by a MULTIPLIER statement or by an IMPOSE statement.

M-code	Type of multiplier
1	SMN
2	SMP
3	SMM
4	TDM (multiplication
5	TDM (division)
6	HAM (multiplication)
7	HAM (division)
8	QSQ (multiplication)
9	QSQ (division)

7.5 NL-Code

Determines which type of non-linear auxiliary equation is to be generated depending on the corresponding M-code.

NL-code	Type of equation
1	Multiplier
2	Division by means of TDM, QSQ or HAM
3	Division by means of a High gain amplifier.

7.6 GP-Code

The GP code is placed in bits 18-23 of the first word, (control word), applying to each variable in the SYMBOL TABLE (6.1), and defines the type of element from which the variable is output. It is inserted by LINK 1. Shifted left six positions it gives an integer code as follows:

GP-code (decimal)	Type of element
1	Integrator
2	Summer
3	High gain
4	Invertor
5	Servo multiplier normal
6	Servo multiplier plus
7	Servo multiplier neg.
11	Quarter square (multiplication)
12	Electronic multiplier (multiplication)
13	Electronic multiplier (division)
14	DFG (10 segments)
15	DFG (20 segments)
16	Resolver polar position
17	Resolver rectangular position
18	Resolver polar rate

GP-code	Type of element
20	Potentiometer
21	Manual potentiometer
22	Switch (1 entry, 3 outputs)
23	Switch (3 entries, 1 output)
24	Comparator (1 entry, 2 outputs)
25	Comparator (2 entries, 1 output
26	Variplotter
27	Tiepoints
28	Reference
29	Resistance
30	Capacity
31	Trunk (input)
32	Trunk (output)
33	Recorders
35	High accuracy multipliers (mult.)
36	High accuracy multipliers (div.)
41	Quarter Square (division)

7.7 CHLK777

The number of each link is stored in CHLK777 in COMMON at entry to each link.

7.8 LE7777

Signals of error levels are stored in LE7777 in COMMON.

The error levels describe the path of execution as shown in the system flow chart (2.1) and inform LINK 4, the output link, now much information has been prepared for the output list.

LE7777 = 2   no addressing performed
LE7777 = 3   exit to LINK 4 before

LINK 331 and therefore scaled coefficients in EQM must be calculated by LINK 4.

7.9 CW

CW contains the list of available consoles as written on the AVAILABLE CONSOLES card, or is zero if no AVAILABLE CONSOLES card is included in the problem.

Example

AVAILABLE CONSOLES 1,3,2

CW =	1	3	2	0	0	0
	S					35

7.10 EQM (99,2), VALMA

The information obtained in LINK 331 on the auxiliary elements needed by amplifiers is passed on to the addressing phase in the word EQM (99,2) for each equation. (Referred to as VALMA).

The information contained in the word is shown below:

Bit	
2	= 1, auxiliary networks required
3	= 1, external capacity required
4	= 1, panel capacity to be used
5-7	= I, where the value of the capacity required $1^{-I}\mu F$
8	= 1, 1MΩ resistance on panel required for input resistance
9	= 1, .1MΩ resistance on panel required for input resistance
10-16	not significant
17	= 1, integrator which does not require I.C. i.e. ZERO used for division
18-21	not significant
22-26	= N, number of auxiliary networks required
27-35	not significant

7.11 NCOD1, NCOD2

The codes NCOD1, NCOD2 are used throughout the addressing to distinguish the different types of analog element, NCOD2 indicates the general type of element (e.g. amplifier), NCOD1 indicates the special case of the general type (e.g. summer). The codes are formed using the GP-code (7.6) as base

GP-code (decimal)	NCOD1	NCOD2	
1	0	01	Integrator
2	1	01	Summer
3	2	01	High gain
4	3	01	Invertor
5	0	02	Servo multiplier normal
6	1	02	Servo multiplier plus
7	2	02	Servo multiplier minus
11	0	03	Quarter square (mult.)
12	0	04	Electronic multiplier (mult.)
13	1	04	Electronic multiplier (div.)
14	0	05	DFG (10 segments)
15	1	05	DFG (20 segments)
16	0	06	Resolver polar position
17	1	06	Resolver rectangular position
18	2	06	Resolver polar rate
20	0	07	Potentiometer
21	0	08	Manual potentiometer
22	0	09	Switch (1 entry 3 outputs)
23	1	09	Switch (3 entries, 1 output)
24	0	10	Comparator (1 entry, 2 outputs)
25	1	10	Comparator (2 entries, 1 output)
26	0	11	Variplotter
27	0	12	Tiepoint
28	0	13	Reference
29	0	14	Resistance
30	0	15	Capacity

GP-code (decimal)	NCOD1	NCOD2	
31	0	16	Trunk (input)
32	0	17	Trunk (output)
33	0	18	Recorders
35	0	20	High accuracy mult. (mult.)
36	1	20	High accuracy mult. (div.)
41	0	21	Quarter square (division)

8. TAPE RECORD FORMAT

TAPE RECORD FORMAT

The transmission of information between the different links of the system is obtained by mean of the COMMON storage and intermediate magnetic tapes.

The format of tape records is explained below.

8.1 ID-RECORD

All the statements of an Apache program are composed of at least one record (*) which identifies and describes them. This is the ID-Record. It is generated by LINK 1.

Format:

ID, NUMB, N, (REC(I), I = 1,N) (**)

where

ID : contains the following information:

Bits 3 - 17 : ID-code (see 7.1)

26 : if 1 the corresponding equation was generated by LINK 1

29 : if 1 indicates that the equation is implicit and there is some feedback through a multiplier or that the equation is a multiplier which is feedback in an implicit (ZERO) equation.

31 : 34 : KTYPE-code (7.2)

35 : if 1 the equation has already been reduced to standard form.

Tag : Contains signal for SWITCH and COMPARATOR (see 7.1)

(*) By the word -record- is always meant a logical record.

(**) The record format is described with the FORTRAN notations.

NUMB : contains the statement numbers.

N : is the length of the array REC

REC : contains the description of the statement.
Initially in REC is found the statement as written by the programmer.
The contents of REC are then modified for the following statements:

EQUATIONS - Standard form as found in the output list.

OMIT - REC(1) : Analog Element
REC(2) : Console number
REC(3) : OMIT code

IMPOSE - REC(1) : Analog Element
REC(2) : Console number
REC(3).....REC(N) : Name of the variable

CONSOLE SELECT - REC(1) : Console number

RECORDER - Original record is of the form:
REC(1).....REC(N) : Address in SYMBOL TABLE of variables
- in LINK 343 the record is tripled in length by adding:
REC(N+1).....REC(2N) : Analog name of recorder used
REC(2N+1).....REC(3N): Analog name of element from which variable is output.
In Link 331 the console number of the recorder is placed in the tag of REC(1).....REC(N)

VARIPLOTTER - Original record is of the form:
REC(1) : x_1 ,
REC(2) : x_2
....
REC(N-1) : x_n
REC(N) : y_n
- in Link 343 the record is tripled in length by adding:

REC(N+1) : Analog name of variplotter for x_1 y_1
REC(N+2) : Zero, not significant
....
REC(2N-1) : Analog name of variplotter for x_n y_n
REC(2N) : Zero

REC(2N+1) : Analog name of element from which x_1 is output
REC(2N+2) : Analog name of element from which y_1 is output
....
REC(3N-1) : Analog name of element from which x_n is output
REC(3N) : Analog name of element from which y_n is output

8.2 W-RECORD

This Record appears after the ID-Record of all EQUATIONS elaborated by LINK 2, except for RESOLVER equations which are immediately attributed an EQM-Record.

Format:

NW, (W(I),I=1,NW),NW1,(W1(I),I=1,NW1),(NW2(I),I=1,NW1),(W3(I),I=1,NW1)

NW - length of W

NW1 - length of W1, NW2 and W3

W - contains the split form of the contents of REC of the corresponding ID-Record

W1 - contains, for each operand or operator of W, its corresponding E-code (7.3) and, for variables and parameters, its address in the SYMBOL TABLE

NW2 - for each cell of W1 contains the number of cells occupied by the corresponding item in W

W3 - as W1 except that it contains also the address of the corresponding W1

8.3 EQM-Record

This Record is substituted for the W-Record created by LINK 2. It is generated by LINK 21.

Format:

MON, ((EQM(I,J), I=1, MON), J=1,3)

where:

MON - Actual row-dimension of EQM

EQM - describes the standard form of the equation as follows:

for I = 1,3,5,...,MON

EQM(I,1) : address of the variable in the SYMBOL TABLE
EQM(I,2) : IC of the variable
EQM(I,3) : Scale Factor of the variable

for I = 2,4,6,...,MON-1

EQM(I,1) : physical value of coefficient
EQM(I,2) : scaled coefficient
EQM(I,3) : pot setting

The values EQM(I,2), EQM(I,3) for I even valued are generated in LINK 331, or in LINK 4 if 331 is not executed.

I = 1 refers to the LHS of the equation
I > 1 refers to the RHS of the equation

8.4 ADDRESSING RECORDS

These records are added for each equation in LINK 341 and information **is** filled in in the successive links.

EBB

Decrement Address in SYMBOL TABLE of the variable on the left hand side of the equation

Bit 33 = 1 if all variables in this equation have been attributed an analog element.

Bit 34 = 1 if the auxiliary elements of the left hand side element are attributed.

Bit 35 = 1 if the L.H. variable has been attributed an element.

EB1(I), I=1,30

EB1(1) the analog name of the element attributed to the L.H.S. variable
EB1(2) analog name of invertor (if any) associated with LHS variable
EB1(3) analog name of I.C. pot (if any)
EB1(4) analog name of panel resistance or EXTRN if external resistance (if any) needed for input resistance
EB1(5) analog name of panel capacitor or EXTRN if external **capacity** (if any) needed for integrator
EB1(6) analog name of buffer invertor neeeded for output of servo-multiplier or quarter-square.

EB1(I), I=15,30

Analog name of amplifiers (if any) ceding network to be used as inputs for analog element in EB1(1).

<u>MEB1(I), I=1,30</u>

In parallel with EB1 contains console number relative to analog elements.

<u>((EB2(I,J), J=1, IM), I=1,2)</u>

IM number of terms on R.H.S.

<u>EB2(1,J)</u> analog name of element attributed to J^{th} term of R.H.S.

<u>EB2(2,J)</u>

<u>Bits S-29</u> analog name of potentiometer, if necessary, attributed to coefficient of J^{th} term of R.H.S.

<u>Bit 30</u> significant when L.H.S. element is an amplifier
= 0 for gain 1
= 1 for gain 10

<u>Bits 31-35</u> significant when L.H.S. element is an amplifier using auxiliary networks, indicates the entry to be used by the J^{th} term of the R.H.S.

= 1 when entry of main element attributed to L.H.S. is to be used

= n when entry of auxiliary network is to be used, where n(= 2, 17) refers to the auxiliary networks listed in EB1(I), I=15,30

9. CARDS FORMAT

9.1 Cards prepared by LINK 5

9.1.1 COLUMNS 71 - 72 - 73

The pot setting, network and read out cards punched by LINK 5 have in the address part of the binary word punched in columns 70 - 71 - 72 a type of card code which is used by LINK 6.

CODE	SIGNIFICANCE
0	card non-significant for LINK 6
1	response card of read-out cards
2	network card
3	end of network cards, first card of read-out card
4	the following card is the first of a different console (for all types of cards)

In the decrement part of the word is a progressive count which starts from 1 for each type of card and for each console. In the tag is the number of the relevant console.

9.1.2 Pot setting cards

The cards are punched in a code analogous to the ADIOS punched tape code. They contain the ADIOS name of each pot used and its setting.

ADIOS code as punched on cards

SYMBOL	ROW								
	1	2	3	4	5	6	7	8	9
0							X		
1	X						X		
2		X					X		
3	X	X					X		
4			X				X		
5	X		X				X		
6		X	X				X		
7	X	X	X				X		
8				X			X		
9	X			X			X		
A			X		X		X		
B				X	X		X		
C	X	X			X		X		
D				X		X	X		
E	X			X		X	X		
F		X			X		X		
G			X			X	X		
H		X	X	X		X	X		
I			X	X		X	X		
J	X		X	X		X	X		
K	X	X		X		X	X		
L	X		X			X	X		
M	X				X		X		
N		X	X			X	X		
O	X	X	X	X		X	X		
P		X	X		X		X		
Q	X	X	X		X		X		
R					X		X		
S	X	X				X	X		
T	X		X		X		X		
U	X	X	X			X	X		
V	X			X	X		X		
W						X	X		

SYMBOL	ROW								
	1	2	3	4	5	6	7	8	9
X	X					X	X		
Y		X				X	X		
Z		X		X		X	X		
CS		X	X			X	X		
RT	X		X	X		X	X		
PS		X		X		X	X		
ST	X	X		X		X	X		
IC			X	X		X	X		
HLD		X	X	X		X	X		
OP	X	X	X	X		X	X		
CR	X		X	X	X		X		
RCY		X	X	X	X		X		
TAB			X	X	X		X		
SET						X	X		
CHK	X					X	X		
RD		X				X	X		
PC	X	X	X		X	X	X		
+		X		X	X		X		
-	X	X		X	X		X		

A single punch in row 12 is an automatic signal for the modified 026, the card is released and the next read.

The cards are used in conjunction with the ADIOS-CRESSIDA system (1.2.2) to set potentiometer values. The pack of pot setting cards begins with a visual recognition card "POT SETTING". The cards are divided by console and mode select cards into blocks corresponding to each console.

9.1.3 Network Cards

The cards are to be read column binary. The pack of network cards begins with the visual recognition card "NETWORK", which is repeated at each change of console.

Each card

Cols.	
1 - 3	12 - 7 - 9 punch
4 - 6	Checksum
7 - 69	Network description
70 - 72	see 9.1.1
73 - 80	Label

Network description

The beginning of each equation is signalled by a code word of tne following form.

S						18
4	X	0	0	Y	Z	NUMB

where NUMB is the statement number as in the ID-record

X is present only for trunks and gives the console of origin.
YZ is a type of circuit code.

YZ	Type of circuit
01	I.C. circuit for integrator used for DER or ZERO (not division)
02	Algebraic, inversion, ZERO used for division, or check circuit for integrator corresponding to I.C. circuit above
03	Servo multiplication (normal)
04	Electronic multiplication
05	Electronic division
06	High accuracy multiplication
07	High accuracy division
10	Quarter square multiplication
11	Compare
12	Switch
13	Trunk
16	DFG
17	Quarter square division
20	Servo multiplication (minus, plus)

The code word is followed by the circuit description in the order; output element, (pot), input element, (pot), input element etc.

Examples

I.C. circuit: A10 with I.C. pot P10

1. Code word 400001 (NUMB)
2. A10 021010060606

(note the element name is always filled up with blanks and shifted 3 right)

3. 2 P10 SETTING 247010001750

(note that 2 indicates a pot, and the pot name occupies only 6 positions, the address contains the setting)

4. 100000400144

```
        100000400144
        ↑      ↑   ↖
   Gain 1   Sign    value
            REF(-ve) REF
```

If the I.C. were connected directly to the REF only 1/. 2/. and 4/. would be punched

Algebraic Circuit: A13 entries A24*P10*1, A32*10, setting P10=.3456

1/. 400002 NUMB
2/. 021010360606
3/. 247010003456
4/. 121020460606 note gain 1 = 1 in bit 2
5/. 021030260606 note gain 10 = 0 in bit 2

9.1.4 Read-out Cards

The cards are punched in the code analogous to the ADIOS paper tape code as listed in 9.1.2.

The pack of read-out cards begins with a visual recognition card "READ OUT". The cards are divided by console and mode select cards into blocks corresponding to each console.

The read-out cards are in pairs: an element name card, punched by LINK 5, and a response card, blank except for identifications when produced by LINK 5, on which the converted ADIOS-CRESSIDA system (see section 1.2.2) punches the element name together with its read out value.

The format of these cards is shown below:

Console select card

Col.	1	7/9 punch
Cols.	2-9	console select in ADIOS code
Col.	10	Release
Col.	70-71	See 9.1.1
Col.	74-80	Label

Read-out card

Col.	1	7/9 punch
Col.	3-8	Element name with Adios control codes
Col.	21-26	Same
Col.	39-44	Same
Col.	56	Release
Cols.	70-71	See 9.1.1
Col.	73-80	Label

Response Card

As punched by LINK 5 :

Col.	1	12/7/9 punch
Col.	2	Release
Cols.	70-71	See 9.1.1
Col.	73-80	Label

Added by ADIOS-CRESSIDA

Col.	8-	Element name, read out value with sign, and Adios control codes
Col.	26-	Same
Col.	44-	Same

9.2 SATANAS Cards

The Satanas cards are prepared by LINK 361. The cards are punched in group of four columns corresponding to X, Y and X', Y' of the two holes to be joined.

Rows 5 and 9 are always perforated, giving signals for the synchronisation of the Satanas apparatus with the modified 026.

The coordinates on the panel range from 00 to 74 and are represented by the codes listed below, using rows 12, 11, 0, 1, 2, 3 and 4. The X coordinate has no extra punch, the Y coordinate has row 6 punched, the X' coordinate 7, and the Y' coordinate 6 and 7. Where the four coordinates define a bottle plug an additional punch 8 in X, Y, X' or Y' defines the colour and illuminates a signal lamp.

X + punch 8 = green bottle plug
Y + punch 8 = orange bottle plug
X' + punch 8 = grey bottle plug
Y' + punch 8 = red bottle plug

The pack begins and ends with a visual recognition card punched horizontally.

Satanas coordinates codes

00	+	-	0	1	2	3	4
01		-	0	1	2	3	4
02	+		0	1	2	3	4
03			0	1	2	3	4
04	+	-		1	2	3	4
05		-		1	2	3	4
06	+			1	2	3	4
07				1	2	3	4
08	+	-	0		2	3	4
09		-	0		2	3	4
10	+		0		2	3	4
11			0		2	3	4
12	+	-			2	3	4
13		-			2	3	4
14	+				2	3	4
15					2	3	4
16	+	-	0	1		3	4
17		-	0	1		3	4
18	+		0	1		3	4
19			0	1		3	4
20	+	-		1		3	4
21		-		1		3	4
22	+			1		3	4
23				1		3	4
24	+	-	0			3	4
25		-	0			3	4
26	+		0			3	4
27			0			3	4
28	+	-				3	4
29		-				3	4
30	+					3	4
31						3	4
32	+	-	0	1	2		4
33		-	0	1	2		4
34	+		0	1	2		4
35			0	1	2		4
36	+	-		1	2		4
37		-		1	2		4
38	+			1	2		4
39				1	2		4
40	+	-	0		2		4
41		-	0		2		4
42	+		0		2		4
43			0		2		4
44	+	-			2		4
45		-			2		4
46	+				2		4
47					2		4
48	+	-	0	1			4
49		-	0	1			4
50	+		0	1			4
51			0	1			4
52	+	-		1			4
53		-		1			4
54	+			1			4
55				1			4
56	+	-	0				4
57		-	0				4
58	+		0				4
59			0				4
60	+	-					4
61		-					4
62	+						4
63							4
64	+	-	0	1	2	3	
65		-	0	1	2	3	
66	+		0	1	2	3	
67			0	1	2	3	
68	+	-		1	2	3	
69		-		1	2	3	
70	+			1	2	3	
71				1	2	3	
72	+	-	0		2	3	
73		-	0		2	3	
74	+		0		2	3	

10. DIAGNOSTICS AND OFF LINE WITH RELEVANT ROUTINE

ROUTINE OR LINK	TEXT OF DIAGNOSTIC
LK. 321	ANALOG CODE WRONGLY WRITTEN
LK. 321	ANALOG ELEMENT ALREADY OCCUPIED
LK. 01	APACHE DIAGNOSTIC SUPERVISOR. PROGRAM CANNOT BE CONTINUED BECAUSE OF ERRORS DETECTED WHEN PERFORMING SECTION 1. END OF JOB.
LK. 2	APACHE DIAGNOSTIC SUPERVISOR. PROGRAM CANNOT BE CONTINUED BECAUSE OF ERRORS DETECTED WHILE PERFORMING SECTION 2. END OF JOB.
WLPD	APACHE LIST PROCESSING ERROR WHILE PERFORMING SECTION N. LIST TABLES OVERFLOW. IT CAN BE DUE TO - TOO MANY INTERDIPENDENT SYMBOLS - THE DEVELOPEMENT OF AN EQUATION BECAME TOO LARGE - INSUFFICIENT STORAGE FOR CROSS REFERENCES TABLE - SYSTEM FAILURE
ATRIN	ATRAN3 ERROR
PREMG	BAD MAIN PROGRAMS FILE ON MASTER TAPE
ZBETA	CALCULATED BETA = X
TIEPO	CANAP IN TIEPO. VAR. X
ZZCW	CANAP2 IN ZZCW. VAR. X
LK. 321	CARD AVAILABLE CONSOLE MISSING
PREMG	CHAIN LINK NR. N MISSING
PREMG	CHAIN LINK TO UPDATE NOT LISTED IN CHAIN TABLE
ZC2	CLOSED LOOP IN MULTIPLIERS OR RESOLVERS, NO ADDRESSING.
LK. 331	CONSOLE FULL AT EQUATION N DIAGNOSTIC NUMBER (MERR)

MERR	ROUTINE GIVING ERROR SIGNAL	SIGNIFICANCE
1	ZC1	
2	ZC3	ERROR IN TABLE TSM
3	ZC3	
4	ZC3	
5	ZC3	
6	ZC3	
7	ZC1	
30	ZEM3	ERROR IN TABLE TTD
31	ZEM3	
32	ZEM3	
33	ZEM3	
34	ZEM3	
40	ZQS3	ERROR IN TABLE TSM FOR IMPOSE
41	ZQS3	
42	ZQS3	
43	ZQS3	
44	ZQS3	ERROR IN TSM FOR NON-IMPOSE
46	ZQS3	
50	ZZDFG	
52	ZZDFG	
53	ZZDFG	
54	ZZDFG	ERROR IN TABLE TCP2
55	ZZDFG	
63	ZHMD	
67	ZHMD	ERROR IN TABLE THAM
68	ZHAM3	
69	ZHAM3	
70	ZZRES	ERROR IN TABLE TSM FOR IMPOSE
71	ZZRES	
72	ZZRES	
73	ZZRES	
74	ZZRES	
75	ZZRES	
76	ZZRES	
80	ZCOMP	
81	ZCOMP	
82	ZCOMP	
83	ZCOMP	ERROR IN TABLE CUBB FOR IMPOSE
84	ZCOMP	
87	ZCOMP	

90	ZSW	
91	ZSW	
92	ZSW	
93	ZSW	
94	SWGAIN	ERROR IN TABLE SUBB
95	ZSW	
96	ZSW	

FOR THE SIGNIFICANCE OF THE ERROR SIGNALS NOT EXPLAINED SEE THE PROGRAMMERS MANUAL APPENDIX G.

LK. 331 CONSOLE FULL FOR MULTIPLIER OR RESOLVER WITH (IMPOSE/NON-IMPOSE) EXTERNAL VARIABLE ON ARM.

ZZZZZE CONSOLE FULL *** ADDRESSING DELETED

LK. 321 CONSOLE NOT ALLOWED

LK. 321 CONSOLE NUMBER GREATER THAN 6

LK. 321 CONSOLE NUMBER NOT GIVEN (=0)

LK. 331 CONSOLE SELECT FOR NON-AVAILABLE CONSOLE

TIEPO CVRT IN TIEPO. VAR. X

PRIOEM DEPRESS START KEY TO RETRY.

LK. 331 DFG WITH INTERNAL SCALE X

LK. 33 DIAGNOSTIC NUMBER (MERR) FOR MULTIPLIERS OR RESOLVERS

MERR	ROUTINE GIVING ERROR SIGNAL	ASSOCIATED DIAGNOSTIC
101	SMFAB	BEYOND TABLE DIMENSIONS
102	EMFAB	BEYOND TABLE DIMENSIONS
103	HMFAB2	ERROR IN SIGNALS IN TABLE
104	SMPVOC	BEYOND TABLE DIMENSIONS
105	SMPVOC	NO MORE SM BOXES AVAILABLE
106	EMFAB	NO MORE EM BOXES
107	QSFAB	NO MORE QS BOXES
108	LINK 33	NO MORE HAM BOXES
109	RESFAB	NO MORE RESOLVER BOXES
110	SMFAB	ERROR IN SIGNALS IN TABLE

PARAD DO STATEMENT CONTAINS EITHER UNDEFINED OR NOT PRÈVIOUSLY DEFINED CHARACTERS

PARAD1 DO STATEMENT CONTAINS EITHER UNDEFINED OR NOT PREVIOUSLY DEFINED PARAMETERS

LK. 321 DOUBLE OR INCOMPATIBLE IMPOSE

TIEPO EONA IN TIEPO. VAR. X

LZP EQUATION N CONTAINS A NON-LINEAR VARIABLE WHICH IS FEEDBACK WITH GAIN 1 IN A HIGH GAIN AMPLIFIER. CONDITION CANNOT BE IGNORED.

LZP2 EQUATION N CONTAINS A NON-LINEAR VARIABLE WHICH IS FEEDBACK WITH GAIN 1 IN A HIGH GAIN AMPLIFIER. CONDITION CANNOT BE IGNORED.

LZP2 EQUATION N DEFINES AN IC FOR A VARIABLE WHICH WAS ALREADY GIVEN ONE. THIS MAY RESULT IN UNCORRECT SIMULATION. CONDITION IGNORED.

LZP EQUATION N DELETED BECAUSE OF NULL CONDITION

LZP2 EQUATION N DELETED BECAUSE OF NULL CONDITION

POTA EQUATION N DELETED BECAUSE OF NULL CONDITION

CSEL EQUATION N ILLEGAL SETTING FOR POT X = N. SETTING ASSUMED = .9999

CSEL EQUATION N ILLEGAL MULTIPLIER CODE

LK.31 EQUATIONS WITHOUT VARIABLES * ADDRESSING AND INVERTERS OMITTED

PINTA ERR. IN ATTRIB. TRUNKS
CON START SI ESCE
PER PROSEGUIRE SW4 ON
(ERROR IN ATTRIBUTION OF TRUNKS)
(WITH START PROGRAM EXIT)
(TO CARRY ON SWITCH 4 ON)

```
PINTA     ERR. IN RICERCA INVERS. VAR. X
               PER PROSEGUIRE SW4 ON
               CON START SI ESCE
          (ERROR IN SEARCH FOR INVERTOR VARIABLE X)
             (TO CARRY ON SWITCH 4 ON)
             (WITH START PROGRAM EXIT)

LK. 321   ERROR IN CARD OMIT

BFIND     ERROR IN DBCV FOR BETA, BETA PUT =1.

IDNTFY    ERROR NOT DETECTED BY VALIDITY CHECK IN STATEMENT N

AGENT     ERROR WHILE GENERATING AUXILIARY EQUATIONS (ST.NR. N).IT CAN BE DUE TO
               -  A SYSTEM FAILURE
               -  A  MACHINE ERROR

ZZPN      ERRORE N. N  VAR. X  PRIMO M. X
          (ERROR NO. N, VARIABLE X, LHS VARIABLE OF EQUATION IS X)
                       N       VARIABLE X   SIGNIFICANCE

                       1       VARIABLE     ERROR IN CANAP IN LK. 361
                       2       VARIABLE     ERROR IN CANAP FOR ARRIV
                       3       VARIABLE     ERROR IN EONA FOR ARRIV
                       4       VARIABLE     TIEPOINT NOT ATTRIBUTED
                       5       VARIABLE     ERROR IN CANAP FOR BASCO
                       6       VARIABLE     ERROR IN EONA FOR BASCO
                       7       VARIABLE     ERROR IN EONA FOR COLLIN
                       9   LHS VARIABLE     ERROR IN CANAP FOR PRIGI
                      10       VARIABLE     ERROR IN CANAP2 FOR PRIGI
                      12       EB2(POT)     RESISTANCE
                      13       TIEPOINT     ERROR IN EONA FOR TIEUSC
                      14       TIEPOINT     TIEPOINT NOT SPECIFIED
                      15       TIEPOINT     TIEPOINT SPECIFIED
                      16       VARIABLE     ERROR IN CANAP2 FOR TRUKIN
                      17       VARIABLE     ERROR IN EONA FOR USCITE

LK.31     ERRORS IN STATEMENTS OF PROBLEM CAUSE ONE OR MORE VARIABLES TO APPEAR
               TWICE AS LEFT HAND SIDE OF EQUATION
               ADDRESSING AND INVERTERS OMITTED

LK. 11    EXECUTION ERROR. HPR X,Y. UNIT Z

PREMG     EXPECTED CHAIN LINK NOT ON MASTER TAPE

ATRIN     FTRN OVERFLOW

CMCOIL    GAINS COIL *X, TO MAKE HIGHEST GAIN =1.

CMCOIL    GAINS COIL *X/Y, XX/YY TO COMPENSATE SCALING.

COMPOT    GAINS OF ENTRY TO COMPARATOR OR SWITCH TOO HIGH.

XENTRY    GAINS REDUCED BY FACTOR X. INTEGRATOR CHANGED TO HIGH GAIN.

XENTRY    GAINS REDUCED BY FACTOR X. COMPENSATED BY CHANGE IN CAPACITOR.

XENTRY    GAINS REDUCED BY FACTOR X. HIGH GAIN EQUATION.

CNTRCD    IDENTIFICATION CARD MISSING. CONDITION IGNORED.

LK. 331   I.C. POT SETTING GREATER THAN 1, POT COUNTED FOR ADDRESSING. (RESOLVERS)

XENTRY    I.C. POT SETTING GREATER THAN 1, POT COUNTED FOR ADDRESSING.

PRIOEM    ILLEGAL CARD IN BINARY DECK. TAPE N

PREMG     ILLEGAL CHAIN TABLE OR MAIN UPDATING REQUEST

LK. 11    ILLEGAL CHARACTER IN DATA OR BAD FORMAT

LK. 11    ILLEGAL CHARACTER IN FORMAT STATEMENT

CTS       ILLEGAL CHARACTER ON CARD. CORRECT AND PUSH START.

LK. 2     ILLEGAL DO-S NESTING

LK. 2     ILLEGAL DO STATEMENT (NO. N)

POTA      ILLEGAL END OF EVEN PROCESSING
```

PREMG ILLEGAL FAP PROGRAM ON MASTER

MPLIMP ILLEGAL IMPOSE CARD FOR MULTIPLIERS (ST. NO. N)

POTA ILLEGAL LEFT HAND SIDE

IDNTFY ILLEGAL MATCHING IN CHECK VALIDITY, STATEMENT N

IDNTFY ILLEGAL MATCHING IN END VALIDITY CHECK, STATEMENT N

LK. 2 ILLEGAL MULTIPLIER STATEMENT (ST.NO. N)

LK. 2 ILLEGAL PRINT ORDER (ST.NO. N)

LK. 2 ILLEGAL *AVAILABLE CONSOLES* CARD (ST.NO. N)

LK. 2 ILLEGAL *CONSOLE SELECT* CARD (ST.NO. N)

LK. 2 ILLEGAL *IMPOSE* CARD (ST.NO. N)

LK. 2 ILLEGAL *OMIT* CARD (ST.NO. N)

RCRDER ILLEGAL *RECORDER* STATEMENT, NO. N

IDNTFY ILLEGAL *SIGMA* OR *PI* REFERENCE IN STATEMENT N

VRPLOT ILLEGAL *VARIPLOTTER* STATEMENT NO. N

RES ILLEGAL USE OF PUNCTUATION IN STATEMENT NO. N

CMSW ILLEGAL USE OF PUNCTUATION OR UNDEFINED SYMBOL IN STATEMENT NO. N

LK. 321 IMPOSE ON NOT ALLOWED ELEMENT

LK.31 IMPOSE SIGN ON RESOLVERS IGNORED

LK. 01 INCORRECT DO-S NESTING

LK.31 INPUT VARIABLE EQUAL OUTPUT VARIABLE IN ONE OR MORE COMPARE STATEMENTS * ADDRESSING OMITTED

LK.31 INPUT VARIABLE EQUAL OUTPUT VARIABLE IN ONE OR MORE DFG STATEMENTS * ADDRESSING OMITTED

LK.31 INPUT VARIABLE EQUAL OUTPUT VARIABLE IN ONE OR MORE SWITCH STATEMENTS * ADDRESSING OMITTED

XENTRY INTEGRATOR EQUATION WITH GAINS BEYOND TOLERANCE.

LK. 11 I/O CHECK LIGHT TURNED ON BY LAST READ INSTRUCTION ON TAPE N

LK. 11 I/O CHECK LIGHT TURNED ON BY LAST WRITE INSTRUCTION. TAPE N.

IDNTFY -X- WAS NOT DEFINED AS A SYMBOL (STATEMENT N)

LK. 11 LIST EXCEEDS LOGICAL RECORD LENGTH. TAPE N.

XENTRY MANUAL POT VALUE GREATER THAN 10, COUNTED AS GAIN 10 FOR ADDRESSING.

XENTRY MANUAL POT VALUE LESS THAN TOLERANCE VALUE OF .0005, COUNTED AS GAIN 1 FOR ADDRESSING.

IDNTFY MAX LENGTH OVERFLOWED IN STATEMENT N

ENDMS3 NEW *APACHE MASTER TAPE IS ON UNIT N. SAVE IT WITH FILE PROTECT. DEPRESS START KEY TO GIVE CONTROL TO FORTRAN.

ENDMS NEW *APACHE MASTER TAPE IS ON UNIT N. SAVE IT WITH FILE PROTECT. RESET AND SAVE TAPE ON A2 FOR SUBSEQUENT MONITOR RUNS. NOW APACHE IS GIVING CONTROL TO FORTRAN MONITOR TO FORM A NEW *APACHE SYSTEM TAPE. INPUT TAPE ON THIS RUN ON UNIT N. HENCE CHANGE A4 TO A2. DEPRESS START KEY TO BEGIN RUN.

LK. 8 NO CONTROL CARD FOR THIS PROBLEM

PREMG NO CONTROL CARD FOR SOME UPDATING REQUEST

LK. 2 NO ENDING STATEMENT SUPPLIED FOR A DO LOOP

LK. 8 NO ENTRY PSEUDO-OPERATION FOR A FAP PROGRAM

YTK2 NO MORE AVAILABLE OUTPUT TRUNKS ON CONSOLE N

```
PRIGI    NO MORE AVAILABLE POTS ON CONSOLE N
PRIGI    NO MORE AVAILABLE REFERENCES ON CONSOLE N
REFSER   NO MORE AVAILABLE REFERENCES ON CONSOLE N
LK. 321  NO MORE PLACE FOR HAMS
LK. 321  NO MORE PLACE FOR SERVOS
LK. 321  NO MORE PLACE FOR TIME-DIVISION
LK. 321  NO MORE SM-BOXES AVAILABLE - CONSOLE FULL
LK. 321  NON EXISTANT ANALOG ELEMENT
LK. 321  NON EXISTANT VARIABLE
LK. 321  NORMAL IMPOSE ON PARAMETER
ZZRECO   NOT ENOUGH RECORDERS.
ZZVP     NOT ENOUGH VARIPLOTTERS.
LK. 11   PHYSICAL RECORD SIZE EXCEEDS BUFFER SIZE. TAPE N.
XENTRY   POT VALUE GREATER THAN TOLERANCE VALUE OF 30, COUNTED AS GAIN 10 FOR
             ADDRESSING.
XENTRY   POT VALUE LESS THAN TOLERANCE VALUE OF .0005, COUNTED AS GAIN 1 FOR
             ADDRESSING.
LK. 331  PRINT OF TPOM
PREMG    PROBABLE MACHINE ERROR
LK.31    PROBLEM WITHOUT EQUATIONS * ADDRESSING AND INVERTERS OMITTED
LK. 321  PROGRAM ERROR - IMPOSE IGNORED
LK. 11   PUSH START TO GIVE CONTROL TO FORTRAN MONITOR
POTA     *ERASABLE TERM NOT FOUND. SUB POTA ST. 15(+)1
POTA     *ERASABEL TERM NOT FOUND. SUB POTA ST. 47(+)1
POTA     *EXPECTED SIGN NOT FOUND. SUB POTA ST. 37 OR 54
LK. 8    *ID APACHE SYSTEM TAPE SETTING
             *      XEQ
             *      AT PAUSE LOAD APACHE SYSTEM TAPE
             *      ON UNIT B3 WITHOUT FILE PROTECT.
             *      AFTER END TAPE STOP UNLOAD TAPE
             *      ON UNIT B3, SET FILE PROTECT AND SAVE REEL
POTA     *ILLEGAL OPERATOR WHILE PROCESSING EVEN LEVEL.SUB POTA ST. 6(+)1
POTA     *NO BEGINNING OF LIST PROVIDED.SUB POTA ST. 2(+)1
XREWIN   ** E.O.F  READNG UNIT N
XREWIN   ** END-OF-TAPE,UNIT N
XREWIN   ** INCORRECT CALLING SEQUENCE FOR SR. X
XREWIN   ** REDUN. READNG UNIT N
XREWIN   **EOF OR REDUNDANCY TABLE OVERFLOW
XREWIN   **NON-EXISTANT UNIT REQUESTED FOR
LK. 6    *** ABOVE ELEMENTS APPEAR TO BE SATURATED
LK. 6    *** ABOVE ELEMENTS ARE OPERATING BELOW SIGNIFICANCE
LK. 6    *** ABOVE ELEMENTS ARE OPERATING OUT-OF-TOLERANCE
LK. 6    *** ABOVE ELEMENTS NOT READ BY ADIOS
LK. 6    *** CHECKSUM ERROR IGNORED
LK. 6    *** CXX OUTPUT BETWEEN 100 AND 999.99
```

LK. 6 *** CXX OUTPUT GREATER THAN 999.99. FIRST DIGIT LOST

LK. 6 *** NOT DEFINED ON NETWORK CARDS

LK. 6 *** TABLE ASSEMBLY PARAMETER -LNT5- EXCEEDED

YKERR **** ADDRESSING-PROGRAM ERROR ****
(FOLLOWED BY PRINT OF EQUATION, EQM, EBB, EB1, MEB1, EB2)
ERROR NUMBER (KERR) VARIABLE INDEX (J)

KERR	ROUTINE GIVING ERROR SIGNAL	SIGNIFICANCE
1	LK. 341	ERROR IN CVRT
2	LK. 341	ERROR IN CANAP2
6	ATERM1	ERROR FORCED ATTRIBUTION AMPLIFIERS
7	ATERM1	ERROR GP CODE FOR INVERTORS
8	ATERM1	ERROR CONTROL TPOM FOR INTEGRATORS
9	ATERM1	ERROR CONVERSION AMPLIFIER NAME
10	ATERM1	ERROR CONTROL TPOM FOR SUMMERS
11	LK. 342	PROXIMITY OF OUTPUTS FOR RHS VARIABLE
12	LK. 342	ERROR CVRT
13	LK. 342	ERROR YOCEL FOR SEARCH POTENTIOMETERS
14	LK. 342	ERROR YOCEL FOR SEARCH REFERENCES
15	LK. 342	ERROR YPR
16	LK. 342	FORCED ATTRIBUTION LHS NON-ALLOWED ELEMENT
17	LK. 342	AUXILIARY ELEMENT FOR NON-ALLOWED ELEMENT
18	LK. 342	ERROR CANAP2 FOR RHS VARIABLE
19	LK. 342	CONSOLE = 0 FOR LHS VARIABLE
31	YHAM	FAILED SEARCH IN THAM1
32	YHAM	HAM NOT MULTIPLICATION OR DIVISION
33	YHAM	ERROR YOCEL
34	YHAM	FAILED SEARCH FOR LINKED AMPLIFIEF FOR HAM
35	YHAM	FAILED SEARCH IN HUBB1
40	YCOMP	FAILED SEARCH WITH YCRIC
41	YCOMP	ERRORE CIMP
42	YCOMP	INCOMPATIBLE IMPOSE SIGNALS
43	YCOMP	ERROR YOCEL OR CANAP2
44	YSW	FAILED SEARCH WITH YSRIC
45	YSW	ERROR YOCEL FOR ATTRIBUTION SWITCH
46	YSW	ERROR CANAP2
50	ZYF1	NO DFG DISPONIBLE (YRV)
51	ZYF1	ERROR FIMP
52	ZYF2	NO DFG DISPONIBLE (YOCEL)
53	ZYF2	ERROR FIMP
201	YAMP2	ERROR GP CODE FOR INVERTOR
202	YAMP2	ERROR CONTROL TPOM FOR AMPLIFIERS
203	YAMP2	ERROR IN YOCEL AMPLIFIER ATTRIBUTION
205	YSM2	FAILED SEARCH IN RUBB
206	YSM2	ERROR IN TSM1
208	YSM2	ERROR CANAP2
209	YSM2	ERROR YOCEL ATTRIBUTION NEW SM
210	ACOMPL	ERROR GP CODE FOR INVERTOR
211	ACOMPL	ERROR ATTRIBUTION IC POT
212	ACOMPL	ERROR ATTRIBUTION RESISTANCE
213	ACOMPL	ERROR ATTRIBUTION CAPACITY
214	ACOMPL	ERROR NETWORK INFORMATION IN VALMA
215	ACOMPL	ERROR PYTAG FOR SEARCH NETWORKS
216	ACOMPL	ERROR CONTROL TPOM FOR NETWORKS
217	ACOMPL	MORE THAN 15 NETWORKS FOR ONE AMPLIFIER
218	YQS2	FAILED SEARCH IN TSM1
219	YQS2	ERROR SEARCH QSQ PARTIALLY OCCUPIED
207	YSM2	ERROR SEARCH SM PARTIALLY OCCUPIED
220	YQS2	ERROR CANAP2
221	YQS2	ERROR YOCEL FOR SEARCH NEW QSQ
222	YTDM	FAILED SEARCH IN TUBB1
223	YTDM	FAILED SEARCH IN TTD1
224	YTDM	ERROR CANAP2
225	YTDM	ERROR YOCEL FOR SEARCH NEW EM
227	YTDM	ERROR SEARCH EM PARTIALLY OCCUPIED
300	YRES	FAILED SEARCH IN RESUBB
301	YRES	FAILED SEARCH IN TSM1
302	YRES	FAILED ATTRIBUTION
303	YRES	ERROR SEARCH RES PARTIALLY OCCUPIED
305	YRES	ERROR CANAP2
306	YRES	ERROR ATTRIBUTION IN RES1
307	YRES	ERROR SEARCH AMP. LINKED TO RESOLVER
500	YRCD	ERROR SEARCH RECORDER
600	YVP	ERROR SEARCH VARIPLOTTER
610	LK. 343	ERROR IN VARIABLE FOR RECORDER OR V/P
650	YRPIC	ERROR CANAP
651	YRPIC	ERROR SEARCH LHS VARIABLE FOR RESOLVER
652	YRPIC	ERROR CANAP2

PINTA	**** ERRORE N. N, RIF DELLA VARIABILE INCRIMINATA = X, RIF DELLA VARIABILE PRIMO MEMBRO = X (ERROR NO. N, RIF WORD FOR RELEVANT VARIABLE= X, RIF WORD FOR THE LHS VARIABLE OF EQUATION= X)

N	ROUTINE GIVING ERROR SIGNAL	SIGNIFICANCE
114	VERNA	DIFFICULTY ATTRIBUTION INVERTOR
118	YITKR	ERROR IN ATTRIBUTION TRUNKS
119	YITKCR	ERROR IN ATTRIBUTION TRUNKS

POTA	*UNEXPECTED END OF LIST. SUB POTA ST. 62
LK. 11	REDUNDANCY ENCOUNTERED IN READING TAPE N
LK. 11	REDUNDANCY WRITING TAPE N.
VSM	SIGN OF SERVO MADE EQUAL TO I.C. SIGN FOR VARIABLE X
LK. 2	SIMULATION OMITTED BECAUSE OF ABOVE ERRORS
LK. 22	SOME I.C. CANNOT BE COMPUTED. SIMULATION OMITTED.
PREPR	SOME PRINT STATEMENT IS INCORRECTLY WRITTEN. SIMULATION OMITTED.
LZP	STATEMENT N CONTAINS AN ALGEBRAIC EXPRESSION WHICH CANNOT BE COMPUTED BECAUSE OF INSUFFICIENT STORAGE
LZP2	STATEMENT N CONTAINS AN ALGEBRAIC EXPRESSION WHICH CANNOT BE COMPUTED BECAUSE OF INSUFFICIENT STORAGE
LZP	STATEMENT N PRODUCES A TABLE OVERFLOW. CONDITION IGNORED. EQUATION COMPILED CORRECTLY. ERRORS MAY OCCUR WHILE GENERATING AUXILIARY EQUATIONS.
LZP2	STATEMENT N PRODUCES A TABLE OVERFLOW. CONDITION IGNORED. EQUATION COMPILED CORRECTLY. ERRORS MAY OCCUR WHILE GENERATING AUXILIARY EQUATIONS.
POTA	STATEMENT N CONTAINS A SYNTAX ERROR
LZP	STATEMENT N,WHEN DEVELOPED,CONTAINS TOO MUCH TERMS (MORE THAN 200)
LZP2	STATEMENT N,WHEN DEVELOPED,CONTAINS TOO MUCH TERMS (MORE THAN 200)
PREMG	SUBROUTINE X MISSING
XENTRY	SUMMER WITH GAINS BEYOND TOLERANCE.
RES	SYMBOL APPEARING IN THE RESOLVER STATEMENT NO. N EITHER IS NOT A VARIABLE OR IS NOT DEFINED
LZP	SYNTAX ERROR DETECTED WHILE COMPUTING STATIC-CHECK VALUES FOR STATEMENT
LZP2	SYNTAX ERROR DETECTED WHILE COMPUTING STATIC-CHECK VALUES FOR STATEMENT
STRING	SYSTEM FAILURE OR MACHINE ERROR WHILE COMPILING STATEMENT N
SETIC	THE FOLLOWING VARIABLE WAS GIVEN AN I.C. (N1).APACHE COMPUTED A NEW ONE (N2). (DELTA= N3).
LK. 01	THE FOLLOWING STATEMENT IS INCORRECTLY WRITTEN
LK. 01	THE FOLLOWING SYMBOL DEFINITIONS FORM A SET OF SIMULTANEOUS EQUATIONS OR SOME UNDEFINED SYMBOL APPEARS IN THEIR RIGHT HAND SIDE
LK. 21	THE I.C. OF THE FOLLOWING VARIABLES WAS NEVER COMPUTED. APACHE ASSUMES I.C. = 0.0000
LK. 24	TIME OR STEP UNDEFINED. SIMULATION CANNOT PROCEED.
LK. 11	TO GO TO NEXT PROGRAM DEPRESS SIGN KEY AND PUSH START
LK. 01	TO MUCH NESTED DO-S
LK. 11	TO RETRY THIS PROGRAM PUSH START
IDNTFY	TOO MANY LEFT PAR. IN STATEMENT N
IDNTFY	TOO MANY RIGHT PAR. IN STATEMENT N

LK.31 TOO MANY VARIABLES IN COMPARE OR SWITCH STATEMENT * ADDRESSING AND INVERTERS OMITTED

LK. 01 TOO MUCH CARDS FOR THE FOLLOWING STATEMENT

PREMG UNCORRECT MASTER POSITIONING (SUBR. SEARCH)

IDNTFY UNDEFINED LOW ORDER DERIVATIVE OR ILLEGAL REFERENCE TO IT IN STATEMENT N

LK. 11 UNIT ADDRESS NOT FOUND IN IOU

PINTA VARIABILE RICHIESTA CON SEGNO DIVERSO DA QUELLO DI USCITA E NON DOTATA DI INVERSORE.
RIPASSARE CON SWITCHES ON.
CON START SI ESCE. PER PROSEGUIRE SW4 ON
(VARIABLE REQUIRED WITH SIGN DIFFERENT FROM THAT OF OUTPUT AND NO INVERTOR EXISTS)
(REPASS WITH SWITCHES ON)
(WITH START PROGRAM EXITS. TO CARRY ON SWITCH 4 ON)

LK.36 VARIABLE OUTPUT FROM MULTIPLIER CUP AND WITH GAIN1 USED MORE THAN ONCE

LK.361 VARIABLE OUTPUT FROM MULTIPLIER CUP AND WITH GAIN1 USED MORE THAN ONCE - SATANAS OMITTED

LK.3613 VARIABLE OUTPUT FROM MULTIPLIER CUP AND WITH GAIN1 USED MORE THAN ONCE - SATANAS OMITTED

LK. 321 VARIABLE WRONGLY WRITTEN

TIEPO YITKCR IN TIEPO. VAR. X

ATRIN ZERO EQUATION CANNOT YET BE SIMULATED. SIMULATION OMITTED.

XENTRY ZERO EQUATION WITH ENTRIES GAIN 1 FROM MULTIPLIERS, HAS OTHER GAINS TOO HIGH.

ZCDIV ZERO EQUATION WITH UNEQUAL GAINS FOR IMPOSED GAINS OF ONE.

PRIOEM 20 CONSECUTIVE REDUNDANCIES IN READING TAPE N

PRIOEM 5 CONSECUTIVE REDUNDANCIES IN WRITING TAPE N

PREMG 5 CONSECUTIVE REDUNDANCIES IN WRITING TAPE A4.

ZZZPX NUMBERS PRINTED IN RHS MARGIN OF SATANAS CONNECTIONS LIST IN LK. 3613

N	SIGNIFICANCE
1	ERROR OF CANAP2 IN COLLIX
2	ERROR OF EONA IN COLLIX
3	ERROR OF CANAP2 IN TRUKIX
4	INPUT TRUNK NOT FOUND IN TRUKIX
5	ERROR OF CANAP IN ARRIX
6	ERROR OF EONA IN RESTA
7	TIEPOINT NOT FOUND IN ARRIX
8	ERROR OF CANAP2 IN USCIX
9	EXTERNAL RESISTANCE NOT FOUND. SECMEX
10	ERROR OF EONA IN ENTHAX
11	ERROR OF CANAP IN LK. 3613
12	ERROR OF EONA IN SATAX

11. EXTRA INFORMATION ON OUTPUT LISTING

11.1 Use of console switches to obtain extra information on output listing

There exist in the standard APACHE many WRITE OUTPUT TAPE instructions which are executed only when Switches 1 and 5 on the console are ON. These are used during testing to give a write out of tables and useful information at different points of the execution. There follows a sample APACHE problem passed with switches 1 and 5 ON with annotations describing the extra output.

At the beginning of LINKS 31, 321, 33, 331, 342, 343, 36, 361, 362 there is a pause activated by switch 3 on the console. This can be useful if a dump of the memory is required, or if the extra information obtained with switch 1 and 5 is only needed in certain links.

11.2 Sample APACHE problem passed with console switches 1 and 5 on

```
*       GUIDE TO APACHE LISTING
*       SATAL,SATAC
```

```
              IMPOSE
0.    1       TDM,(T)*(T)
0.    2       A00,1,X
              PARAMETERS
0.    3       AB=0.00001
              VARIABLES
0.    4       X=0.5,1
0.    5       Y=,1
0.    6       Z(2)=0.3,1
0.    7       T=0.5,1
              EQUATIONS
0.    8       CONSOLESELECT,1
0.    9       X=T*T
0.   10       COMPARE(X+0.5),Y=Z(2),0
0.   11       DER(T)=X*Y+AB*Z(2)
0.   12       RECORDER,X,T
0.   13       END
THE FOLLOWING VARIABLE WAS GIVEN AN I.C.(  5.0000E-01).APACHE COMPUTED A NEW ONE(  2.5000E-01).(DELTA= -2.5000E-01).
(X)
```

LINK 1

SETIC (LINK 21 OR 22)

```
000000055102   000001000005   072441000000   000000000000   AB
000001055107   000001000016   000000000001   000000000000   REF
500002455055   000001010016   000000044002   000000000000   T
700003455077   000001020016   000000044003   000000000000   X
100004455072   000001310012   000000004004   000000000000   Y
000005455043   000003140016   000000020005   000000000000   T*T
000006455034   000003050016   000000000006   000000000000   X*Y
000007455065   000004000016   000000000007   000000000000   Z(2)
```

LINK 31 (SW. 5)

EXTRACT FROM SYMBOL TABLE

CONTROL WORD + 1st. 2nd. 3rd. WORDS AFTER NAME

```
IDX =   1
                         055034055077   000000055072

JDX =   1
                         055043055055   000000055055
```

LINK 31 (SW. 5)

MULTIPLIER TERMS TABLES, COMPARATOR, SWITCH TABLES

```
IDC =   1
              055077055107   000000055072   000000055065
                             000000000000   000000000000
```

** SIGNS OF THE VARIABLES **

```
(+)   REF
(-) * T
(-) * X
(+) * Y
(+)   T*T
(+)   X*Y
(+)   Z(2)
```

LINK 31

VARIABLES REQUIRING INVERTORS

```
REQ   T
MIN   X
REQ   Y
```

LINK 31

VARIABLES WHICH HAVE INVERTERS TO SATISFY REQUIREMENTS OF PACE, NO. 2

SERVO MULTIPLIERS. CUP CONNECTIONS

(E) VARIABLE FEEDING POSITIVE POLE OF NORMAL OR + SM CUP (OR NEGATIVE POLE OF - SM) IS OUTPUT OF MAIN ELEMENT

(I) VARIABLE FEEDING POSITIVE POLE OF NORMAL OR + SM CUP (OR NEGATIVE POLE OF - SM) IS OUTPUT OF INVERTER

```
(E)   Y                         SMN   X*Y
```

MULTIPLIERS OTHER THAN SERVOS

FOR THE FOLLOWING VARIABLES THE OUTPUT OF INVERTER FEEDS POSITIVE POLE OF MULTIPLIER

```
      T                         TDM   T*T
```

LINK 31

```
    000005000000      000000000400      000003000000
A00    +-0001X

    000010000000      000000002000      000001000000
001000

    000004000003      000000002200      000002000000
X=+(+1)*T*T
      3
         000001055077         177400000003         201400000000
         201400000001         000000000000         000000000000
         000000055043         177400000002         201400000000

    000004000026      000000000000      000002000000
(X)=(X)
      3
         000001055077
         2014000

(X*Y)=(X)*(Y)
      3
         000002055034         1754631463z
         000001055077         177400000003
         000001055072         177463146316         201400

    000023000000      000000000000      000001000000
END

CARD AVAILABLE CONSOLES MISSING
```

<u>LINK 31 (SW. 5)</u>

ID, NUMB, NA, REC FOR EVERY STATEMENT
+ MON, EQM FOR EQUATION STATEMENTS

AC	MQ	SI	KEYS	XR1	XR2	XR4
000000000001	254524606060	000004000001	-000000000001	00023	00001	73305
.00000000-38	.11708489+14			-77755	-77777	-04473

TRAP	OCT	IOT	OFL	SENSE LIGHT	1	2	3	4	SENSE SWITCH	1	2	3	4	5	6
OFF	OFF	OFF	ON		OFF	OFF	OFF	OFF		ON	OFF	OFF	OFF	ON	OFF

36610	000000000000	000060000000	000000000000	000060000000	000000000000	000060000000	000000000000	000060000000
36620	000000000000	000060000000	000000000000	000060000000	000000000000	000060000000	000000000000	000060000000
36630	000000000000	000060000000	000000000000	000060000000	000000000000	-106060000000	000000000000	-036060000000
36640	000000000000	256060000000	000000000000	-066060000000	000000000000	316060000000	000000000000	276060000000
36650	000000000000	306060000000	000000000000	-026060000000	000000000000	-056060000000	000000000000	-276060000000
36660	000000000000	236060000000	000000000000	-226060000000	000000000000	-016060000000	000000000000	-076060000000
36670	000000000000	000060000000	000000000000	[illegible]	000000000000	-236060000000	000000000000	000060000000
36700	000000000000	-046060000000	[illegible]			[illegible]50000000	000000000000	000050000000
36710	[illegible]						[illegible]	000050000000

LINK 321 (SW. 1)

DUMP OF TABLES TV AND VETT

TV 37357-36610, VETT 77377-57057

77260	[illegible]						[illegible]	012200021510
77270	012160020507	012140017506	[illegible]		[illegible]	012040415102	012020415101	012000014100
77300	011760013077	011740012076	011720011075	011700010074	011660205473	011640606472	011620605471	011600405470
77310	011560405467	011540004466	011520003465	011500002464	011460001463	011440000462	111420042461	111400041460
77320	111360040457	011340037456	011320036455	111300042454	111260041453	111240040452	011220037451	011200036450
77330	111160033047	111140032046	111120031045	011100030044	011060027043	111040033042	111020032041	111000031040
77340	010760030037	010740027036	110720023435	110700022434	110660021433	010640020432	010620017431	110600023430
77350	110560022427	110540021426	010520020425	010500017424	110460014023	110440013022	110420012021	010400011020
77360	010360010017	110340014016	110320013015	110300012014	010260011013	010240010012	110220004411	110200003410
77370	110160002407	010140001406	010120000405	110100004404	110060003403	110040002402	010020001401	-210004000400

```
 000000000000

000000000000   000000000000   TSM

000000000000   000000000000       TTD

000000000000   000000000000  THAM

055077055107   000000055072   000000055065  CUBB
000000000000   000000000000   000000000000

000000000000   000000000000   SUBB

000000000000   000000000000   000000000000
000000000000   000000000000   000000000000
 000000055107   000000000001   000000000000                 LINK 33 (SW. 5)
 000000055055   000000044002   000000000000
 000000055077   011100044003   000000000000
 000000055072   000000004004   000000000000
 000000055043   000000020005   000000000000
 000000055034   000000000006   000000000000
 000000055065   000000000007   000000000000  EXTRACT FROM SYMB

000012055077   000001000000    TSM
000000000000   000000000000

055034055077  RUBB

100000072471  QUBB

067231067225  RESUBB

000000255055   000000000000   TTD
000000000000   000000000000

055043055055   000000055055   TUBB

000000000000   000000000000   THAM

071655071651   070671070665   HUBB

201400000001   175631463150                        ZBETA

175631463146   000001000000   400001000000   000000000000
CALCULATED BETA =0.100000E-00
```

```
CONSOLE SELECT CON=     000001000000

TOTAL ENTRIES        000000000000   000000000000   000000000000   000001000000   000000000000
    XENTRY, TOTALS: POTS, MANUAL POTS, AUXILIARY NETWORKS, ENTRIES 1, ENTRIES 10 FOR EQUATION X = T * T
 000001055077   EQM (1,1) FOR X = T * T

 000001055107   201400000001   201400000000
 201400000001   201400000001   201400000001
 000000055077   177400000003   201400000000      EQM FOR COMPARATOR STATEMENT
 200400000001   200400000001   200400000001
 000000055107   201400000001   201400000000

 000001055072     EQM(1,1) FOR Y = Z(2)
   0. 11. 0 CHECK FOR GAINS
              POT VALUE LESS THAN TOLERANCE VALUE OF .0005, COUNTED AS GAIN 1 FOR ADDRESSING
TOTAL ENTRIES        000001000000   000000000000   000000000000   000001000000   000001000000

 000011055055    EQM(1.1) FOR DER(T) = X * Y + AB * Z(2)
  000000055107    000000000001   000000000000
  000000055055    000000044002   000000000000
  000000055077    011100044003   000000000000      EXTRACT FROM SYMB
  000000055072    000000004004   000000000000
  000000055043    000000020005   000000000000
  000000055034    000000000006   000000000000
  000000055065    000000000007   000000000000

 000012055077   000001000000    TSM
 000000000000   000000000000

 155034055077   RUBB                                              LINK 331 (SW. 5)

 100000072471   QUBB

 067231067225   RESUBB

 000000255055   000000000000    TTD
 000000000000   000000000000

 155043055055   000000055055    TUBB

 000000000000   000000000000    THAM

 071655071651   070671070665    HUBB
                                                       TPOM (END OF IMPOSE COUNT PASS)
 000000000000    TCP2

 000001000055   000000000055   000000000055   000000000000   000000000000   000000000000   000000000000   000001000055
 000000000001   000000000000   000000000000   [illegible]    [illegible]    000000000000   000000000000   000000000001
 000000000000   [illegible]                                                 [illegible]    000000000000   000000000000
 [illegible]                                                                               [illegible]    000000000036
                                                                                                          [illegible]
```

```
000000000000   000000000000   000000000000   000000000000   000000000000   000000000000   000000000000   000000000000

000012055077   000001000000
000000000000   000000000000
CONSOLE SELECT CON=     000001000000

000001055077

000001055107   201400000001   201400000000
201400000001   201400000001   201400000001
000000055077   177400000003   201400000000
200400000001   200400000001   200400000001
000000055107   201400000001   201400000000

000001055072

000011055055
 000000055107   000000000001   000000000000
 000000055055   000100044002   000000000000
 000000055077   011100044003   000000000000
 000000055072   000100004004   000000000000
 000000055043   000100020005   000000000000
 000000055034   000100000006   000000000000
 000000055065   000000000007   000000000000
```

LINK 331 (SW. 5)

```
002012055077   000000000001
000000000000   000000000000

155034155077

100000072471

067231067225

002000255055   000000600000
000000000000   000000000000

155043155055   000000055055

000000000000   000000000000

071655071651   070671070665

000000000000
```

TPOM (END OF NON-IMPOSE COUNT PASS)

```
000002000055   000000000055   000000000055   000000000000   000000000000   000000000000   000000000000   000002000055
000000000002   000000000000   000000000000   000000000000   000000000000   000000000000   000000000000   0000
000000000000   000000000000   000000000000   000000000000   000000000000   000000000000   000000000000
       036     000000000036   000000000036   000000000000   000000000000   000000000000
                              000000000000   000000000000   000000000000   000000000000
                                             000000000000   000000000000
                                                            000000000000
```

```
000000000000 000000000000
000000000000 000000000000 000000000060 000000000000 000000000000 000000000000 000000000000 000000001000005
                                                                                          000000000000 000000000000
                                                                                                       000000000000

002012055077 000000000001 TSM
000000000000 000000000000

155034155077 RUBB                                          LINK 331 (SW.5)

100000072471 QUBB

067231067225 RESUBB

155043155055 000000055055 TUBB

071655071651 070671070665 HUBB

055077055107 000000155072 000000055065 CUBB
000000000000 000000000000 000000000000

000000000000 000000000000 SUBB                 TPOM (EXIT LINK 331)

000002000055 000000000055 000000000055 000000000000 000000000000 000000000000 000000000000 000002000055
000000000002 000000000000 000000000000 000000000000 000000000000 000000000000 000000000000 000000000002
000000000000 000000000000 000000000000                                        000000000000 000000000000
```

AC	MQ	SI	KEYS	XR1	XR2	XR4
000000000000	076100000000	000004000001	-000000000001	00037	00001	75617
.00000000+00	.16940659-20			-77741	-77777	-02161

TRAP	DCT	IOT	OFL	SENSE LIGHT 1	2	3	4	SENSE SWITCH 1	2	3	4	5	6
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF

```
37360  050200077733  060100077732  002000037365  050000037036  002000037200  077400440233  063400437422  077400477725
37370  063400440227  077400400001 -063400440236 -063400440242  002000037203  002000037400  060000077732  002000037363
37400  300025437403  077400440122  002000037404  077400440016  063400437422  077400477721  063400440227  077400400005
37410  002000037372  002100037412  063400140334  063400240335  063400440336  053400400000  063400440337 -060000077750
37420  077400037146  050000077750  002000037756  053400440271  060000077737  056000077734  077400100000  077400200000
37430  002060037422  05000004036[illegible]                                   [illegible]77731  060100077742  050000077732  060100077743
37440 -0140000[illegible]                                                                           [illegible]00277751 -075400000000
```

DUMP OF SYMB (55107-37360)

```
55070  000100004004 -306060606060  000001310012  000000000000  000000000000  011100044003 -276060606060  000001020016
55100  160517426543  212260606060  000001000005  000000000000  000000000000  000000000001 -112526606060  000001000016
```

```
055077000003
A00           1      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0

000000       000000000000

              EBB
055077000007
A00           1      000000     0     000000     0     000000     0     000000     0
000000 EB1    0 MEB1 000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0

A00  EB2     000000000000

055055000003
A01           1      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
P01           0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0

000000       000000000040
EXTRN        470000606000

055055000007
A01           1      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0                       000000     0
000000        0      000000     0     000000                                       0
000000        0      000000     0     000000
000000        0      000000     0     0000

A01          000000000000                         LINK 342 (SW. 5)
                                                  ADDRESSING PASSES
       END


055072000007
M0            1
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000     0     000000     0     000000     0     000000     0
000000        0      000000                                       0     000000     0
                                                                        000000     0

M0           000000000000

       END
```

```
000001055077   000001055055   512301606021   512301606022   210000606060   210001606060
```

RECORDER RECORD

```
    000005000000     000000000400     000003000000
A00    +-0001X
```

LINK 36 (SW. 5)

```
    000010000000     000000002000     000001000000
001000
```

REC, MON, EQM, VALMA, ADDRESSING RECORDS

```
    000004000003     000000002200     000002000000
X=+(+1)*T*T

     3
      000001055077          177400000003          201400000000
      201400000001          201400000001          201400000001
      000000055043          177400000002          201400000000          VALMA 000000000000

055077000007
A00          1     000000     0     000000     0     000000     0     000000     0
000000       0     000000     0     000000     0     000000     0     000000     0
000000       0     000000     0     000000     0     000000     0     000000     0
000000       0     000000     0     000000           000000     0     000000     0
000000       0     000000     0                                       000000     0
000000       0     000000                                                        0

EMO         0000
```

RIF

EXTRACT FROM SYMB

*2 FOR EACH CONSOLE

```
000001055107   000001000016   000100000001   000000000000   000000000000
500002555055   000001010016   010100144002   000000002002   000000000000
700003555077   000001020016   011100044003   000000002003   000000000000
100004555072   000001310012   121100004004   040000003070   000000000000
000005455043   000003140016   040100020005   040000000000   000000000000
000006455034   000003050016   020100000006   041012000000   000000000000
000007455065   000004000016   000077700007   000000000000   000000000000
```

*** COLLEGAMENTI SATANAS ***

*** CONSOLE 1 ***

LINK 361 (SW. 5)

ENTRATE		USCITE		
6	6	7	6	ORANGE
6	11	1	7	
0	4	1	4	GRAY
0	11	11	8	
10	13			
10				

***** PATCH PANEL CONNECTIONS *****
****

***** CONSOLE 1 ***** LINK 3613

VARIABLE	ELEM.	INPUT	ELEM.	OUTPUT	NOTES
+(X)	A03	....	....	....	ORANGE BOTTLE PLUG (INV)
	A03	(1)	A00		
-(X)	A00				GRAY BOTTLE PLUG (SUM)

RIF EXTRACT SYMB

LINK 3613 (SW. 5)

000001055107	000001000016	000100000001	000000000000	000001000000
500002555055	000001010016	010100144002	000000002002	000000000000
700003555077	000001020016	011100044003	000000002003	000000000000
100004555072	000001310012	121100004004	040000003070	000000000063
000005455043	000003140016	040100020005	040000000000	000000000000
000006455034	000003050016	020100000006	041012000000	000000000000
000007455065	000004000016	000077700007	000000000000	000002000000

LINK 362 (SW. 5)

REC, MON, EQM, ADDRESSING RECORDS

```
    000005000000     000000000400     000003000000
A00   +-0001X

    000010000000     000000002000     000001000000
001000

    000004000003     000000002200     000002000000
X=+(+1)*T*T

     3
      000001455077        177400000003        201400000000
      201400000001        201400000001        201400000001
      000000055043        17740[illegible]    [illegible]

055077000007
A00             1       [illegible]
```

VALMA 000000000000

PARAMETERS

LINK 4

NAME	VALUE
AB	1.0000E-05

**** VARIABLES CROSS REFERENCES ****

VARIABLE NAME	OUTPUT BY	CONSOLE	DEFINED BY	PAGE	REFERRED TO BY		PAGE
(REF)	MO	1	LIST	2	EQUATION	10	3
(T)	A01	1	LIST	5	EQUATION	13	5
						13	5
						0	5
(X)	A00	1	LIST	3	EQUATION	14	5
						10	3
						0	3
(Y)	MOJ	1	LIST	4	EQUATION	14	5
						0	4
(T*T)	EMOG	1	EQUATION 13	5	EQUATION	9	3
(X*Y)	SMOA	1	LIST	6	EQUATION	0	6
						11	4
(Z(2))		0	LIST	2	EQUATION	11	4
						10	4

END OF JOB

12. INTER-RELATION OF ROUTINES

12.1 Chain table

```
*       CHAIN  TABLE                                                                  CHTBL000
10      B3     CHAIN  CNVRT  CTS    EXITA  PRINT  SETTAP(EXEM)(IOS)  (IOU)  (TES)    CHTBL001
343     B3     ADDA   ADR    CANAP2CANAP                                              CHTBL002
               CHAIN  CNFR   CVRT   EONA   ERRIT  EXITA  IDEQ   INDEX                 CHTBL003
               LINO   LSHR   PAL    PYTAG  RNEL   RNLST  RSYMB  TAB2   YKERR  YOCEL  CHTBL004
               YRCD   YRPIC  YRV    YRW3   YRW4   YVP    YYY                          CHTBL005
               (EXEM)(FPT)  (IOB)  (IOH)  (IOS)  (IOU)  (RER)  (RWT)  (STB)          CHTBL006
               (STH)  (TES)  (TSB)  (WER)                                             CHTBL007
36      B3     ADDA   ADR    ATTINVAZZS   CANAP2CANAP  CHAIN                          CHTBL008
               CNFR   COMCONCONMOLCONMOPCONSM  CONSP  CONTAMCVRT   EONA   ERRIT       CHTBL009
               EXITA  FPG    IDEQ   INDEX  LINO1  LINO   LSHR   MELEM  PAL            CHTBL010
               PINTA  PRIGI  PRIGO  PSYMB  PYTAG  RICALTRICALWRISY   RNEL   RNLST     CHTBL011
               RUTLETRUTWR  SIMIN  SIPLUSTAB2   TRUTI  VADD   VEREB  VERNA  VOC1      CHTBL012
               XOCEL  YITKCRYITKR  YTK2   ZREC   ZZPN   ZZZZZE                        CHTBL013
               (BST)  (EXEM)(FPT)  (IOB)  (IOH)  (IOS)  (IOU)  (RER)  (RWT)  (SPH)   CHTBL014
               (STB)  (STH)  (TES)  (TSB)  (WER)                                      CHTBL015
361     B3     ADDA   ADR    AMPUSCARRIV  ARRPOTATAN                                  CHTBL016
               AZZS   BASCO  CANAP2CANAP                                              CHTBL017
               CHAIN  CNFR   COLLINCOMCONCOMUSCCONDINCONMOP                           CHTBL018
               CONSP  COOR   CVRT   DFGUSCENTDFGENTHAMENTQSQ                          CHTBL019
               ENTSERENTSW  ENTTDVEONA   ERRIT  EXITA  IDEQ   INDEX  INVUSCIUS       CHTBL020
               LINO1  LINO   LSHR   MELEM  NUAMP  NUMUSCPAL    PINTA  PRIGO  PSYMB   CHTBL021
               PUNCHCPYTAG  REFSERRICALWRISY   RNEL   RNLST  RUTLETRUTWR  SATAM       CHTBL022
               SECMEASUMJONSWUSC  TAB2   TDVUSCTIEPO  TIEUSCTRUKINTRUTI  USCITECHTBL023
               VADD   VOC1   XCRIC  XOCEL  XSRIC  YITKCRZSC    ZZPN   ZZZLSTZZZZZECHTBL024
               (BST)  (EXEM)(FPT)  (IOB)  (IOH)  (IOS)  (IOU)  (RER)  (RWT)  (SPH)   CHTBL025
               (STB)  (STH)  (TES)  (TSB)  (WER)                                      CHTBL026
3613    B3     ADDA   ADR    ARRIX  ARRPOXATAN                                        CHTBL027
               AZZS   BDC    BLANK  CANAP2CANAP                                       CHTBL028
               CHAIN  CNFR   COLLIXCOMCONCOMUX  CONDIXCONMOP                          CHTBL029
               CONSP  CVRT   DFGUX  ENTDFXENTHAXENTQSXENTSEX                          CHTBL030
               ENTSX  ENTTDXEONA   ERRIT  EXITA  FTDC   FTDIC  IDEQ   LGP             CHTBL031
               LINO1  LINO   LSHR   MELEM  NAME   NUAMP  NUMUSCPAL    PRIGO  PSYMB   CHTBL032
               PYTAG  RESTA  RICALWRISY   RNEL   RNLST  RUTLETRUTWR  SATAX  SECMEXCHTBL033
               STAM   STAVA  SUMJOXSWUX   TAB2   TDVUX  TEX    TIEPO  TIEUX  TRUKIXCHTBL034
               USCIX  VADD   VOC1   XCRIX  XOCEX  XSRIX  YITKCRZSCX   ZZZPX           CHTBL035
               (BST)  (EXEM)(FPT)  (IOB)  (IOH)  (IOS)  (IOU)  (RER)  (RWT)  (STB)   CHTBL036
               (STH)  (TES)  (TSB)  (WER)                                             CHTBL037
362     B3     ADDA   ADR    BDC    BLANK  CANAP2CHAIN  CNFR   CVRT   ERRIT  EXITA   CHTBL038
               FTDC   FTDIC  IDEQ   INDEX  LINO1  LSHR   NAME   PAL    RNEL   RNLST   CHTBL039
               RSYMB  RUTLETRUTWR  TAB2   VADD   VOC1   YITKCRZREC   ZZCW   ZZZZ      CHTBL040
               (BST)  (EXEM)(FPT)  (IOB)  (IOH)  (IOS)  (IOU)  (RER)  (RWT)  (STB)   CHTBL041
               (STH)  (TES)  (TSB)  (WER)                                             CHTBL042
4       B3     ADR                                                                    CHTBL043
               AFTER  ATAN   BDC    BLANK  BUILD  CHAIN  DBCV   DLAST  DNEXT  END     CHTBL044
               EXITA  FLAG   FTDC   FTDIC  IDEQ   JOIN   MULTCDNAME   PAL    RESET   CHTBL045
               RETURNSETIC  SHL    SNEXT  SPLIT  STATN  TEST   TIDEN  TRB    VAR      CHTBL046
               VVV    WLPD                                                            CHTBL047
               (BST)  (EFT)  (EXEM)(FPT)  (IOB)  (IOH)  (IOS)  (IOU)  (RER)  (RWT)   CHTBL048
               (SLO)  (SPH)  (STH)  (TES)  (TSB)  (TSH)  (WER)                        CHTBL049
5       B3     CHAIN  CSEL   DBCV   EXITA  FTDC   IDEQ   PUNCH  SPLIT  STATN  TEST    CHTBL050
               (BST)  (EXEM)(FPT)  (IOB)  (IOH)  (IOS)  (IOU)  (RER)  (RWT)  (STH)   CHTBL051
               (TES)  (TSB)  (TSH)  (WER)                                             CHTBL052
11      B3     ACCUNTBLANK  CHAIN  CNTRCDDBCV   EXIT   PRINT  SPLIT  TEST            CHTBL053
               (BST)  (EFT)  (EXEM)(IOH)  (IOS)  (IOU)  (RER)  (SPH)  (STH)  (TES)   CHTBL054
               (TSH)  (WER)                                                           CHTBL055
1       B3     ADR    ATRAN  AUXT   BDC    BLANK  BUILD  CHAIN  COMPDOCRIT1  DAN     CHTBL056
               DBCV   DIAGN  DNEXT  END    ERASELEXITA  FTDC   FTDIC  LOOK   NAME1   CHTBL057
               NAME                                                                   CHTBL058
               PARAD1PARSE  READ   RESET  RETURNSEARCHSNEXT  SORT   SPCH              CHTBL059
```

```
            SPLIT STORE SYMBOLTEST  TRB   VAR   VLV   WLPD  XNSA  (BST) CHTBL060
            (CSH) (EXE) (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) CHTBL061
            (STB) (STH) (TES) (TSH) (WER)                               CHTBL062
2     B3    ADR   ATRAN AVC   BLANK BUPPA CHAIN CMSW  COMPDODAN   DBCV  CHTBL063
            DFG   EXITA FLAG  IDNTFYISPEQ LOOK  MPLIMPPAL   PARAD PERT  CHTBL064
            RCRDERRES   RETURNRSH   SBST  SEARCHSHL   SIGMAPSPLIT STATN CHTBL065
            STMV  TEST  TRB   UXDIF VAR   VLV   VPX   VRPLOT            CHTBL066
            (BST) (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB) CHTBL067
            (STH) (TES) (TSB) (WER)                                     CHTBL068
21    B3    ADR   AFSIS AFTER AGENT ATAN  ATRAN AUXRECBDC   BLANK BRECHTCHTBL069
            BUILD CHAIN COS   CRIT1 DEFINEDLAST DNEXT END   ERASELERASESCHTBL070
            EXITA FLAG  FMPY  FTDC  FTDIC IDEQ  INDEX JOIN  LCMP  LCPY  CHTBL071
            LOOK  LSCAN LZP   NAME1 NAME  PAL   PLACE POTA  RESCP RESET CHTBL072
            RETURNRFC   SETIC SLIST1SLIST SLTRA SMVAR SNEXT SORT        CHTBL073
            SQRT  STATN                                                 CHTBL074
            STRINGTEST  TREE  TST   TYPE  VAR   WLPD  (EXE) (EXEM)(FPT) CHTBL075
            (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB) (STH) (TES) (TSB) CHTBL076
            (WER)                                                       CHTBL077
31    B3    ACTW  ADDA  ADR   ANR   APR   BDC   BLANK CHAIN CLCT1 CNFR  CHTBL078
            CORD  DBCV  EXITA FTDC  FTDIC IDEQ  INDEX LELLA2LINO1 LINO  CHTBL079
            LSHR  NAME  PAL   RRH   SHL   SIGN  TCM1  TCM2  TSW   TT1   CHTBL080
            VADD  VARN  VCOM  VHAMD VHAMM VHAM  VLIN  VOC1              CHTBL081
            VQSQ  VSMN  VSM                                             CHTBL082
            VSMS  VTDV  WFORM WMNS  WRNV  WRQIN WRTST WWF   XCMAT XSMAT CHTBL083
            XYZR  ZQINV ZRES                                            CHTBL084
            (BST) (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB) CHTBL085
            (STH) (TES) (TSB) (WER)                                     CHTBL086
32    B3    CHAIN EXITA PANEL (EXEM)(FPT) (IOS) (IOU) (TES)             CHTBL087
321   B3    ACTW  ADDA  ADR   AIMP  AMRIC BLANK CANAP CHAIN CIMP  CLETS2CHTBL088
            CNFR  CVRT  DUMP  EONA  EONERRERRIT ERRNUS                  CHTBL089
            EXITA FDUMP FFG1  FFG2  FIMP                                CHTBL090
            IDEQ  LINO  LSHR  OMITA OMITG OMITN PAL   PYTAG QIMP  QS1   CHTBL091
            QS2   RES1  RES2  RNEL  RNLST RSYMB SHL   SM1R  SM2R  SYRES CHTBL092
            TAB2  TIMP  TNEWT2YCRIC YSRIC YYY   ZCTP                    CHTBL093
            (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STH) (TES) CHTBL094
            (TSB) (WER)                                                 CHTBL095
33    B3    ACTW  ADDA  ADR   CHAIN CMGAINCNFR  EMFAB                   CHTBL096
            EXITA EXP(2                                                 CHTBL097
            HMFAB2HMOUT HUBSORIDEQ  LSHR  LTOH  PAL   QSFAB RESFAB      CHTBL098
            RSYMB SMFAB SMOUT SMPVOCSTABLEZBETA                         CHTBL099
            (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB) (STH) CHTBL100
            (TES) (TSB) (WER)                                           CHTBL101
331   B3    ACOUNTACTW  ADDA  ADR   ATAN                                CHTBL102
            BFIND CHAIN CMCOILCNFR  COMPOTDBCV                          CHTBL103
            DUMP  EXITA EXP(2 EXP(3                                     CHTBL104
            ICOUNTIDEQ  INDEX LINO  LSHR  PAL   PINCO RESCAP            CHTBL105
            RSYMB SHL   STATN SWGAINTDEC1 TDEC2 TDEC3 TDEC4 TDEC5       CHTBL106
            XENTRYXGAINSZC1   ZC2   ZC3   ZC5   ZC7   ZCDIV ZCOMP       CHTBL107
            ZEM3  ZEXTR ZHAM3 ZHMD  ZHQD  ZHRT  ZQS3  ZSW5  ZSW         CHTBL108
            ZZDFG ZZRECOZZRES ZZVP                                      CHTBL109
            (BST) (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB) CHTBL110
            (STH) (TES) (TSB) (WER)                                     CHTBL111
341   B3    ADDA  ADR   CANAP2                                          CHTBL112
            CHAIN CNFR  CORD1 CVRT  EXITA HTOL  IDEQ  INDEX LINO        CHTBL113
            LSHR  PAL   RIPINTRLA   RSYMB STRSETTAB2  YKERR YRW         CHTBL114
            (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB) (STH) CHTBL115
            (TES) (TSB) (WER)                                           CHTBL116
342   B3    ACOMPLADDA  ADR   AMRIC ATERM1CANAP2                        CHTBL117
            CHAIN CIMP  CNFR  CTPOM CVRT  EONA  ERRIT EXITA FIMP  IDEQ  CHTBL118
            INDEX LINO  LSHR  PAL   PYTAG QS1                           CHTBL119
            QS2   RES1  RES2  RET1  RNEL  RNLST RSYMB SCARTOSHL   SM3R  CHTBL120
            TAB2  YAMP2 YCOMP YCRIC YHAM  YKERR YOCEL YPASS YPR   YQS2  CHTBL121
            YRES  YRV   YRW2  YSM2  YSRIC YSW   YSYW  YTDM  YYY   ZYF1  CHTBL122
            ZYF2                                                        CHTBL123
            (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB)       CHTBL124
```

```
                    (STH) (TES) (TSB) (WER)                                     CHTBL125
6         B3        CHAIN EXITA XREWIN(EXEM)(IOS) (IOU) (TES)                   CHTBL126
22        B3        ADR   AFSIS AFTER ATRAN ATRIN BDC   BLANK BRECHTBUILD       CHTBL127
                    CHAIN CRIT1                                                 CHTBL128
                    DEFINEDLAST DNEXT END   ERASELERASESEXITA FMPY  FTDC  FTDIC CHTBL129
                    IDEQ  INDEX JOIN  LCMP  LCPY  LOOK  LSCAN LZP2  NAME1 NAME  CHTBL130
                    PAL   PLACE POTA  RESET RETURNRFC   RSYMB SETIC SLIST1SLIST CHTBL131
                    SLTRA SNEXT SORT  STATN STRINGTEST  TREE  TST   VAR   WLPD  CHTBL132
                    (BST) (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STB) CHTBL133
                    (STH) (TES) (TSB) (WER)                                     CHTBL134
24        B3        BDC   BLANK CHAIN DAUX  EXITA FTDC  FTDIC INPSC INT   LOADERCHTBL135
                    LOOK  NAME  PAL   PHEAD PREPR PRINTTRETURN                  CHTBL136
                    RSYMB SEARCHTEST  TIDEN VAR                                 CHTBL137
                    (BST) (EXEM)(FPT) (IOB) (IOH) (IOS) (IOU) (RER) (RWT) (STH) CHTBL138
                    (TES) (TSB) (WER)                                           CHTBL139
7         B3        ACTW  ADDA  ADR   APCW1 AST   BLD1  CANAP2CANAP             CHTBL140
                    CHAIN CNFR  COMMN CORVE ELIST ERR2  ERRAD1ERRAD2            CHTBL141
                    ERRCD1ERRCD2ERRIT ERR   EST   EWB   EXITA FST               CHTBL142
                    GHST  IOST  KST   LINO  LSHR  LST   MST   NEBB              CHTBL143
                    NST   ORV   PAL   PST   PUNP  QST   RNEL  RNLST RST1  SCST  CHTBL144
                    SHL   TAB   TRAN  VECT  VFL   (BST)                         CHTBL145
                    (EFT) (EXEM)(FPT) (IOH) (IOS) (IOU) (RER) (RWT) (SLO) (SPH) CHTBL146
                    (STH) (TES) (TSH) (WER)                                     CHTBL147
8         B3        CHAIN COPYCTCOPY  ENDMS3ENDMS EREAD ESR   EXIT  PREMG PRIOEMCHTBL148
                    SKIP  WRITE                                                 CHTBL149
                    (EXEM)(IOH) (IOS) (IOU) (SPH) (TES)                         CHTBL150
```

12.2 Calls

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
10	23	55105	SETTAP	CTS	(IOU)	CHAIN						
343	542	25107	(FPT)	(RWT)	ADR	TAB2	YRW3	YVP	RSYMB	PAL	LSHL	CVRT
			CANAP2	(STH)	(FIL)	YRCD	YRW4	INDEX	(TSB)	(RLR)	CHAIN	YKERR
36	357	34500	(FPT)	(RWT)	TAB2	ADR	ATTINV	PRIGI	ZREC	PSYMB	ZZZZZE	CHAIN
			AZZS	PRIGO	MELEM	PAL	CNFR	VOC3	(STH)	(FIL)		
361	1027	34500	(FPT)	TAB2	ADR	AZZS	PRIGO	MELEM	PAL	CNFR	VOC3	PSYMB
			TIEPO	RUTLET	CANAP	ZZPN	BASCO	LSHL	COLLIN	TRUKIN	CONDIN	SATAM
			SUMJON	SECMEA	XCRIC	ENTSER	ENTQSQ	ENTTDV	ENTDFG	ENTSW	ENTHAM	XSRIC
			ZSC	RUTWR	ZZZLST	(STH)	(FIL)	ZZZZZE	CHAIN			
3613	1034	34416	(FPT)	TAB2	ADR	PAL	LINO	SUBA	AZZS	PRIGO	MELEM	CNFR
			VOC3	TIEPO	PSYMB	RUTLET	CANAP	ZZZPX	LSHL	COLLIX	TRUKIX	CONDIX
			SATAX	SUMJOX	SECMEX	XCRIX	ENTSEX	ENTQSX	ENTTDX	ENTDFX	ENTSX	ENTHAX
			XSRIX	ZSCX	RUTWR	(STH)	(FIL)	CHAIN				
362	1776	34500	(FPT)	TAB2	ADR	RUTLET	CNFR	LSHL	ZZCW	LSHR	VOC2	CANAP2
			PAL	RUTWR	NAME	BLANK	YITKCR	VOC1	ZREC	INDEX	(RWT)	(TSB)
			(RLR)	CHAIN								
4	14573	55105	(FPT)	(RWT)	RESET	(STH)	(FIL)	(TSB)	(RLR)	SPLIT	PAL	SHL
			TIDEN	XTRB	BLANK	SETR	SETEL	STATN	IDEQ	TEST	MULTCD	ADR
			NAME	FTDC	(SLQ)	SRI	ATT	BUILD	FORE	ATAN	FLAG2	VAR
			PUCR	SPL	SPL1	CNEXT	END	(SPH)	CHAIN	(EFT)		
5	1643	55105	(FPT)	(RWT)	(TSB)	(RLR)	CSEL	IDEQ	TEST	PCH	SPLIT	CPCH
			CHAIN									
11	406	55105	PRINT	(IOS)	(RDS)	(TCO)	(TEF)	(BSR)	(REW)	CNTRCD	CHAIN	EXIT
			(WRS)	(RCH)	(TRC)							
1	4605	55105	(FPT)	CRIT1	CRIT2	(STH)	(FIL)	ADR	(RWT)	RESET	BUILD	SYMBOL
			(TSH)	(RTN)	READ	VLV	TEST	BLANK	DIAGN	SPLIT	DAN	PARADT
			INITDO	COMPDO	ERASEL	TRB	XNSA	(STB)	(WLR)	DNEXT	BDC	END
			(BST)	SORT	AUXT	NAME	CHAIN					
2	3567	55105	(FPT)	(RWT)	(TSB)	(RLR)	STATN	XTRB	(STB)	(WLR)	UXDIF	DFG
			CMSW	RES	ISPEQ	SPLIT	IDNTFY	VLV	PARAD	TRB	INITDO	COMPDO
			TEST	(STH)	(FIL)	CAN	BLANK	AVC	FLAG	MPLIMP	VRPLOT	RCRDER
			CHAINB	CHAIN								
21	3107	55105	(FPT)	(RWT)	(STB)	(WLR)	(TSB)	(RLR)	IDEQ	VAR	TEST	RESET
			TREE	LZP	AGENT	ADR	SETIC	RESCP	NAME	BLANK	(STH)	(FIL)
			CHAIN									
31	10400	55105	(FPT)	(RWT)	INDEX	ADR	(STB)	(WLR)	VADD	PAL	LINO2	LINO3
			VARN	(TSB)	(RLR)	IDEQ	CNFR	LSHL	VOC1	LINO1	LINO	WWF
			CORD	LELLA2	TCM1	TCM2	TSW	VOC3	(STH)	(FIL)	XCMAT	XSMAT
			TT1	CLCT1	ACTW	ANC	RRH	SIGN	VLIN	VQSQ	VTDV	VSM
			VHAM	VCOM	ZRES	WRTST	WRNV	NAME	BLANK	LSHR	WMNS	ZQINV
			CHAINB	CHAIN								
32	40	77451	(FPT)	PANEL	CHAIN							
321	7451	27267	(FPT)	(RWT)	(TSB)	(RLR)	(STH)	(FIL)	SHR	SHL	ADR	TAB2
			IDEQ	CANAP	CNFR	OMITA	ACTW	OMITN	OMITG	ZCTP	EONA	SYRES
			RSYMB	PAL	LSHL	CVRT	AIMP	FIMP	QIMP	LSHR	YYY	SUBA
			LINO	YCRIC	CIMP	YSRIC	SMIR	QS1	FFG1	RES1	RES2	SM2R
			QS2	FFG2	TIMP	PDUMP	CHAIN	BLANK				
33	1772	37357	(FPT)	(RWT)	(STB)	(WLR)	LTOH	CHAIN	(STH)	(FIL)	STABLE	SMFAB
			LSHR	HUBSOR	HMFAB2	EMFAB	QSFAB	RESFAB	SMPVOC	SMOUT	HMOUT	CMGAIN
			RSYMB	ACTW	PAL	ZBETA						

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
331	3217	37357	(FPT)	LSHL	LSHR	CNFR	(TSB)	(RLR)	(STB)	(WLR)	IDEQ	PAL
			ATAN	STATN	(STH)	(FIL)	ZZVP	ZZRECO	BFIND	RSYMB	ACTW	(RWT)
			ZEXTR	PDUMP	INDEX	ADR	CHAINB	CHAIN	CMCOIL	ZCDIV	XGAINS	XENTRY
			ZC1	ZZDFG	ZCOMP	SWGAIN	ZC2					
341	433	25106	(FPT)	ADR	TAB2	(RWT)	STRSET	HTOL	PAL	(TSB)	(RLR)	RIPINT
			RSYMB	LSHL	CVRT	CANAP2	LSHR	YRW	CHAIN	YKERR		
342	2566	25106	(FPT)	REWSYS	ADR	(RWT)	TAB2	YPASS	YRW2	PAL	SUBA	CNFR
			RSYMB	LSHL	LSHR	CVRT	RNLST	ATERM1	YSW	YCOMP	ZYF1	YRES
			ACOMPL	CANAP2	YPR	LINO	YAMP2	ZYF2	YSM2	YQS2	YTDM	YHAM
			YOCEL	CHAIN	YKERR							
6	13065	77445	REWSYS	XOPEN	XREAD	CHAIN						
22	1012	41327	(FPT)	(RWT)	INDEX	ADR	(STB)	(WLR)	(BST)	PAL	SETIC	LOOK
			(TSB)	(RLR)	VAR	TEST	RESET	TREE	LZP2	CHAIN	(STH)	(FIL)
			CHAINB									
24	1020	41327	(FPT)	REWSYS	(RWT)	INPSC	(TSB)	(RLR)	PREPR	CLPSC	LOOK	VAR3
			TIDEN	PAL	TEST	LOADER	INT	(STH)	(FIL)	BLANK	RSYMB	INTM
			PRINTT	(BST)	CHAIN							
7	4663	36467	(FPT)	(RWT)	REWSYS	ADR	(TSH)	(RTN)	(STH)	(FIL)	TAB	ELIST
			VECT	ORV	PAL	CNFR	LINO	SUBA	LSHR	CANAP2	RST1	CANAP
			ERRAD2	LSHL	RNLST	EWB	BLD1	ACTW	PUNP	SHR	SHL	(SPH)
			(BST)	CHAIN								
8	1775	53446	READ	ESR	COPYCT	COPY	WRITE	SKIP	READCT	(SPH)	(FIL)	DCOPY
			ENDMS	EXIT	ENDMS3	PREMG						
ACCUNT	1	0										
ACOMPL	764	25107	PAL	YOCEL	LSHR	LSHL	CTPOM	PYTAG	CANAP2	LINO	SUBA	
ACOUNT	1220	37357	TDEC3	RSYMB	TDEC4	TDEC5	TDEC1	LSHL	TDEC2	LSHR		
ACTW	5	0										
ADDA SUBA	6	0										
ADR	45	0										
AFSIS	10	0										
AFTER FORE INSLA INSLF INSL	166	55105	BUILD	DNEXT	DLAST	NLH	JOIN					
AGENT	3244	55105	DNEXT	END	DLAST	STRING	ADR	LCPY	INDEX	TEST	(STB)	(WLR)
			DEFINE	ERASES	PAL	VAR	BRECHT	SMVAR	FLAG1	TYPE	AFSIS	GAIN1
			AUXREC	NAME1	STATN	(STH)	(FIL)	RETURN				
AIMP	50	0										
AMPUSC	132	34501	IUS									
AMRIC	75	0	EONA									
ANR ANC	16	0										
APCW1 AFCW1	14	0										

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
APR	21	0										
APC												
ARRIV	625	34501	CNFR	PUNCHC	CANAP	ZZPN	EONA	COOR	PAL	LSHL	VOC3	USCITE
			TIEUSC	LINO	LSHR							
ARRIX	454	34416	CNFR	CANAP	ZZZPX	RESTA	PAL	LSHL	VOC3	USCIX	TEX	TIEUX
			STAM	LINO	LSHR							
ARRPOT	113	34501	BASCO	PUNCHC								
ARRPOX	73	34416	STAM									
AST	156	0	ERRCD1	ERRCD2	ERRAC1							
ATAN	115	77774										
ATERM1	414	25107	CTPOM	YRV	YYY	SUBA	LINO	PAL	LSHR	YSYW	CANAP2	
ATRAN	3715	55105										
ATRAN1												
ATRAN2												
ATRAN3												
XEQ												
ATRIN	523	41327	(STH)	(FIL)	RETURN	ADR	TEST	STRING	ATRAN3	XEQ	VAR	RSYMB
			(STB)	(WLR)								
ATTINV	505	34501	LINO3	PAL	LSHL	VOC1	LSHR	VOC2	LINO2	LINO1	VERNA	
AUXREC	241	55105	NAME	BLANK								
AUXT	12	0										
AVC	15	55105										
AZZS	67	34501	VADD	VOC2	LINO2	LINO3						
BASCO	103	34501	CANAP	EONA	COOR	ZZPN						
BDC	136	77461	FTDIC	FTDC								
BFIND	166	37357	LSHL	LSHR	DBCV	(STH)	(FIL)					
BLANK	113	55105										
BLD1	202	0	ERR2									
BRECHT	107	55105	LOOK	SORT	CRIT1	CRIT2						
INITBR												
BUILD	103	55105	WLPD									
NLH												
BUPPA	43	0										
CANAP2	476	0										
CANAP	1274	0										
CHAIN	102	77461	(TES)									
CHAINB												
REWSYS												
CIMP	40	77430										

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR
CLCT1	54	0	
CLETS2	41	0	
CMCOIL	441	37357	STATN (STH) (FIL)
CMGAIN	341	37357	
CMSW	2300	55105	TEST SEARCH IDNTFY (STB) (WLR) STATN (STH) (FIL) (BST) VLV
CNFR	4	0	
CNTRCD	564	55105	(STH) (FIL) (TSH) (RTN) TEST (EFT) (SPH) BLANK ACCUNT SPLIT (BST)
CNVRT	333	0	
COLLIN	650	34501	VOC2 LSHR VOC1 LSHL EONA ZZPN COOR PUNCHC PAL LINO ARRIV
COLLIX	651	34416	VOC2 LSHR VOC1 STAVA LSHL CANAP2 ZZZPX STAM EONA PAL LINO ARRIX
COMCON	66	34501	VOC1 VOC3 LINO3
COMMN	25	0	
COMPDO INITDO	331	55105	
COMPOT	134	37357	STATN (STH) (FIL)
COMUSC	133	34501	VOC2
COMUX	107	34416	VOC2
CONDIN	561	34501	RISY PUNCHC ATAN CNFR BASCO VOC2 PAL REFSER PYTAG LSHL LINO
CONDIX	233	34416	RISY ATAN CNFR STAM VOC2 PAL RESTA
CONMOL	454	34501	MELEM RISY VOC1 SIPLUS SIMIN VEREB YTK2
CONMOP	261	34501	COMCON VOC1 VOC2 VOC3 LINO3
CONSM	302	34501	MELEM RISY YTK2 VOC1 SIPLUS SIMIN VEREB
CONSP	220	34501	COMCON LSHR VOC2 VOC3 LINO3 VOC1
CONTAM	305	34501	MELEM CNFR (TSB) (RLR) (BST) VOC2 VOC1 RICALT YTK2
COOR	55	34501	PAL LSHL
COPYCT READCT	136	53446	READ WRITE
COPY DCOPY	201	53446	READ WRITE
CORD1	53	0	
CORD	53	0	
CORVE	105	0	
COS SIN	151	77773	

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
CRIT1	51	0										
CRIT2												
CSEL	2637	55105	(IOS)	(REW)	(WRS)	(BSR)	(WEF)	(RCH)	(TCO)	(TRC)	(STH)	(FIL)
PCH			(RDS)	(TEF)	STATN	PUNCH	FTDC					
EPCH												
CPCH												
APAD												
PSC												
EPSC												
ROC												
EROC												
CTPOM	66	77461	ADR									
CTS	307	77460	(IOS)	(WRS)	(REW)	CNVRT	(RCH)	(TCO)	(TRC)	(BSR)	(WEF)	PRINT
CVRT	111	0										
DAN	450	55105	TRB	TEST								
DAUX	1	0										
DBCV	333	0										
DEFINE	143	55105	NLH									
DFG	152	55105	IDNTFY	(STB)	(WLR)							
DFGUSC	161	34501	VOC2									
DFGUX	60	34416	VOC2									
DIAGN	433	55105										
DLAST	36	55105	WLPC	LAST								
DNEXT	36	55105	WLPC	SNEXT								
DUMP	267	0	(TES)	EXIT								
PDUMP												
ELIST	51	0										
EMFAB	315	37357	CNFR	(STH)	(FIL)							
ENDMS3	64	77461	(SPH)	(FIL)								
ENDMS	127	77461	(SPH)	(FIL)								
END	7	0										
ENTDFG	210	34501	VOC2	PUNCHC	ARRPOT	ARRIV	ADR					
ENTDFX	137	34416	VOC2	STAM	ARRPOX	ARRIX	ADR					
ENTHAM	422	34501	PUNCHC	ARRIV	ADR	VOC1	LSHR	VOC2	LSHL	EONA	ZZPN	PAL
ENTHAX	376	34416	STAM	ARRIX	ADR	VOC1	LSHR	VOC2	LSHL	EONA	ZZZPX	PAL
ENTQSQ	354	34501	COLLIN	VOC2	LSHR	CNFR	PUNCHC	ARRIV	ADR			
ENTQSX	377	34416	COLLIX	VOC2	LSHR	LSHL	STAM	ARRIX	ADR			
ENTSER	476	34501	LSHR	VOC2	PUNCHC	REFSER	ARRIV	ADR	PAL	COLLIN		

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
ENTSEX	521	34416	LSHR	VOC2	RESTA	STAM	ARRIX	ADR	LSHL	PAL	COLLIX	
ENTSW	170	34501	LSHL	PUNCHC	ARRPOT	ARRIV	ADR					
ENTSX	165	34416	LSHL	ARRPOX	ARRIX	ADR						
ENTTDV	170	345C1	VOC2	PUNCHC	ARRIV	ADR						
ENTTDX	156	34416	VOC2	ARRIX	ADR	STAM						
ECNA	117	0	RNLST									
EONERR	56	77457	(STH)	(FIL)								
ERASEL	134	551C5										
ERASES	55	551C5	CEFINE	ERASEL								
EREAC READ	611	53446	PRICEM									
ERR2	51	77457	(STH)	(FIL)	(SPH)	EXIT						
ERRAC1	63	77457	(STH)	(FIL)								
ERRAC2	63	77457	(STH)	(FIL)								
ERRCD1	63	77457	(STH)	(FIL)								
ERRCD2	63	77457	(STH)	(FIL)								
ERRIT	56	77451	(STH)	(FIL)								
ERRNUS	61	77457	(STH)	(FIL)								
ERR	51	77457	(STH)	(FIL)	(SPH)	EXIT						
ESR	134	53446	READ									
EST	5	0										
EWB	142	0	COMMN	RNEL								
EXITA EXIT	6	0	CHAIN									
EXIT	23	0	(TES)									
EXP(2	46	77775										
EXP(3	136	77773										
FDUMP	16	0	PDUMP									
FFG1	14	0										
FFG2	52	0										
FIMP	137	77430	AMRIC									
FLAG FLAG1 FLAG2	77	0										
FMPY FDIV	553	551C5	DNEXT ERASES	SLTRA	END	PLACE	BUILD	AFTER	LCPY	INSLA	JOIN	SLIST

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
FPG	227	34501	VADD	VOC3	LSHR	VOC2	LINO2	LINO3				
FST	110	0	ERRCD1	ERRCD2								
FTDC	406	0										
FTDIC	51	0	FTDC									
GHST	22	0										
HMFAB2	435	37357	LSHR	CNFR	RSYMB							
HMOUT	67	37357	LSHR									
HTOL	36	0										
HUBSOR	505	37357	LSHL	LSHR	CNFR							
ICOUNT	201	37357	TDEC3	TDEC1	ACTW	TDEC2						
IDEQ	5	0										
IDNTFY	2677	55105	STATN PAL	SEARCH ATRAN1	VAR VPX	TEST (STH)	PERT (FIL)	XLSH	RSH	SIGMAP	BUPPA	ADR
INDEX	14	0										
INPSC PTRAN1 PTRAN2 CLPSC	332	41327	PRINTT	RSYMB	PHEAD	(STH)	(FIL)					
INT INTM	1273	0	DAUX									
INVUSC	256	34501										
IOST	37	0	ERRAD2									
ISPEQ	143	55105	BLANK									
IUS	130	34501	PAL	LSHL	BASCO							
JOIN	45	0										
KST	140	0	ERRCD1	ERRCD2	ERRAD1							
LCMP	540	55105	DNEXT	TEST	PAL	INDEX	ADR	END	SLTRA			
LCPY FLCPY	1416	55105	DNEXT	SLTRA	END	BUILD	SLIST	AFTER				
LELLA2	144	0										
LGP	7	0										
LINO1 LINO2 LINO3	30	0	VADD									
LINO	5	0										
LOADER	162	41327	DAUX	(TSB)	(RLR)							
LOCK	103	55105										

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
LSCAN	264	55105	DNEXT	SLTRA	END							
LSHR LSHL	21	0										
LST	22	0										
LTOH	31	0										
LZP2	3037	55105	STATN SLTRA BUILD	BRECHT TST ERASEL	ADR END STRING	DNEXT AFTER ATRAN1	PAL LSCAN ATRAN2	AFSIS DLAST RFC	VAR DEFINE IDEQ	TEST INSLA ATRIN	(STH) ERASES RETURN	(FIL) FORE
LZP	3245	55105	STATN LSCAN ATRAN1	BRECHT DLAST ATRAN2	ADR DEFINE RFC	DNEXT INSLA BDC	PAL ERASES BLANK	VAR FORE SETIC	SLTRA BUILD (STH)	TST TEST (FIL)	END ERASEL AFSIS	AFTER STRING RETURN
MELEM MSER MINV	41	0	VOC1	VOC2								
MPLIMP	624	55105	TEST	FLAG1	SEARCH	STMV	STATN	(STH)	(FIL)			
MST	107	0	ERRCD1	ERRCD2								
MULTCC	27	0										
NAME1	30	0										
NAME	57	0	BDC									
NEBB	1	0										
NST	162	0	ERRCD1	ERRCD2	ERRAD1							
NUAMP	125	34501	VOC1	LSHL	EONA	(STH)	(FIL)	PAL				
NUMUSC	323	34501	PAL	LSHL	NUAMP	VOC2	LSHR	VOC1				
OMITA	326	0	EONA	PYTAG								
OMITG	251	0	EONA	ERRNUS	EONERR							
OMITN	145	0	EONA	EONERR	ERRNUS							
ORV	45	0	CORVE									
PAL	3	0										
PANEL	21223	36467										
PARAD1	302	55105	TEST	PARSE	VAR	(STH)	(FIL)	RETURN				
PARAD	312	55105	TEST	SEARCH	VAR	(STH)	(FIL)	RETURN				
PARSE	77	55105										
PERT	6	0										
PHEAD	273	60435	(STH)	(FIL)	NAME	BLANK						
PINCO	5	0										
PINTA	241	34501	(SPH)	(FIL)	(STH)	EXIT						
PLACE	7	0										

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
POTA	4453	55105	SLTRA	DNEXT	LSCAN	END	PAL	STATN	(STH)	(FIL)	RETURN	FMPY
			PLACE	TEST	FDIV	ERASES	SLIST1	FLCPY	FORE	ADR	INSLA	TST
			DLAST	DEFINE	INSL	SLIST	BUILD	JOIN				
PREMG	475	77461	(SPH)	(FIL)								
PREPR	354	75427	TEST	SEARCH	PTRAN1	PTRAN2	(STH)	(FIL)	RETURN			
PRIGI	2436	34501	RUTLET	CNFR	LSHR	CANAP	ZZPN	PYTAG	(STH)	(FIL)	PAL	LINO
			CANAP2	LSHL	CVRT	VOC1	VOC2	LINO2	CONTAM	CONSM	CONMOL	RISY
			SIPLUS	SIMIN	YTK2	VEREB	RUTWR	FPG				
PRIGO	476	34501	RUTLET	CNFR	RICALW	VOC3	LINO3	MELEM	COMCON	VOC1	PAL	LSHL
			CONSP	CONMOP								
PRINT	162	0										
PRINTT	1	0										
PRIOEM	152	77461	(SPH)	(FIL)								
PST	67	0	ERRCD1	ERRCD2								
PSYMB	123	34501	(STH)	(FIL)	PAL	VOC1	VOC2	VOC3				
PUNCHC	363	34501	(STH)	(FIL)	ZZZSTP							
PUNCH	141	0	(IOS)	(WRS)	(BSR)	(RCH)	(TCO)	(TRC)				
PUNP	302	36467	(STH)	(FIL)	TRAN	(EFT)	(RWT)					
PYTAG	275	0	EONA	RNLST								
QIMP	376	0	EONA									
QS1	17	77430										
QS2	35	77430										
QSFAB	311	37357	CNFR	(STH)	(FIL)							
QST	30	0										
RCRDER	243	55105	BLANK	SPLIT	TEST	SEARCH	STATN	(STH)	(FIL)			
READ	162	55105	TEST	(TSH)	(RTN)							
REFSER	364	34501	PYTAG	(STH)	(FIL)	LSHL	PAL	LINO	PUNCHC			
RES1	112	77430										
RES2	47	77430										
RESCAP	252	37357	CNFR	TDEC5	TDEC1	LSHR						
RESCP	211	55105	COS	SIN	SETIC	ATAN	SQRT					
RESET	27	55105										
RESFAB	341	37357	CNFR									
RES	450	55105	SEARCH	VAR	TEST	(STB)	(WLR)	STATN	(STH)	(FIL)		
RESTA	222	34416	EONA	ZZZPX	PAL	TEX						
RETI	46	0										

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
RETURN	1	77446										
RFC	264	55105	LCMP	ERASEL	JOIN							
RICALT	136	34501	VOC3	RISY	CNFR	VEREB	LINO3					
RICALW	72	34501	VOC3	RISY	CNFR	LINO3						
RICHEL	NOT LISTED IN CHAIN TABLE											
RICHIN	NOT LISTED IN CHAIN TABLE											
RIPINT	542	25311	CORD1 LSHR	RLA (STH)	(TSB) (FIL)	(RLR) (RWT)	IDEQ	PAL	CNFR	RSYMB	SUBA	LINO
RISY	67	34501	CNFR									
RLA	36	0										
RNEL	50	0	ERRIT									
RNLST	57	0	RNEL									
RRH RCH	20	0										
RSH XLSH	7	0										
RST1	77	0	ERR									
RSYMB	53	0										
RUTLET	674	34501	(TSB) (BST)	(RLR) LSHR	IDEC (RWT)	CNFR	VOC1	LINO1	PAL	LSHL	VOC2	LINO2
RUTWR	232	34501	(STB)	(WLR)	(RWT)							
SATAM	342	34501	NUAMP	IUS	PUNCHC	CNFR	BASCO	ARRIV				
SATAX	443	34416	CNFR	NUAMP	LGP	EONA	ZZZPX	PAL	STAM	TEX	ARRIX	
SBST	31	55105										
SCARTO	57	77461										
SCST	44	0	ERRCD1									
SEARCH	452	55107	LOOK									
SECMEA	470	34501	LSHL	CNFR	PUNCHC	BASCO	ZZPN	ARRPOT	ARRIV	ADR		
SECMEX	416	34416	LSHL	CNFR	ZZZPX	ARRPOX	ARRIX	ADR				
SETIC	131	55105	NAME	BLANK	(STH)	(FIL)						
SETTAP	17	77450										
SHL SHR	14	0										
SIGMAP	1736	55105	TEST	SEARCH	VAR	SBST						
SIGN	343	0										
SIMIN	144	34501	VEREB	YTK2								
SIPLUS	64	34501	VEREB	YTK2								
SKIP	56	53446	READ									

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
SLIST1	31	0										
SLIST	47	55105	DNEXT									
SLTRA	16	0										
SM1R	51	77430										
SM2R	221	77430										
SM3R	130	77430										
SMFAB	503	37357	CNFR	LSHR	LSHL							
SMOUT	137	37357	CNFR	LSHL								
SMPVOC	1355	37357	CNFR	LSHR	LSHL	(STH)	(FIL)					
SMVAR GAIN1	103	55105										
SNEXT LAST	71	55105	WLPD									
SORT	460	55105										
SPCH	106	0										
SPLIT	546	55105	DBCV									
SQRT	54	77773										
STABLE	103	37357	LSHR	RSYMB	PAL	LSHL						
STAM	404	34416	(STH)	(FIL)								
STATN	12	0										
STAVA	142	34416	VOC1	NAME	BLANK							
STMV	41	55105										
STORE	477	55105	DNEXT									
STRING	722	55105	DNEXT	SLTRA	INDEX	ADR	PAL	END	STATN	(STH)	(FIL)	RETURN
STRSET	57	25107										
SUMJON	441	34501	LSHL	CNFR	BASCO	PUNCHC						
SUMJOX	376	34416	LSHL	CNFR	STAM	TEX						
SWGAIN	246	37357	RSYMB	LSHL	CNFR	COMPOT	ZSW					
SWUSC	105	34501	VOC2	LSHR								
SWUX	104	34416	VOC2	LSHR								
SYMBOL	1147	55105	ADR	DNEXT	TEST	SPCH	END	PARSE	VAR	ATRAN	STORE	
SYRES	101	37357	ADR	TNEWT2	CLETS2							
TAB2	51	0										
TAB	126	0	AST IOST	MST LST	NEBB QST	FST	PST	SCST	EST	NST	KST	GHST

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
TCM1	224	55105	LSHL	LSHR	CNFR							
TCM2	247	55105	LSHR	CNFR	LSHL							
TDEC1	15	0										
TDEC2	22	0										
TDEC3	32	0										
TDEC4	34	0										
TDEC5	17	0										
TDVUSC	113	34501	VOC2									
TDVUX	55	34416	VOC2									
TEST	3	0										
TEX	42	34416										
TIDEN	111	0	BDC									
TIEPO	1476	34501	ADR	VADD	CNFR	VOC2	VOC1	LSHR	LSHL	VOC3	LINO3	NUMUSC
			YITKCR	(STH)	(FIL)	CANAP	PAL	CVRT	PYTAG	LINO	EONA	
TIEUSC	412	34501	EONA	ZZPN	PAL	LSHR	LINO	COOR	CNFR			
TIEUX	70	34416										
TIMP	226	77430										
TNEWT2	32	0										
TRAN	323	77453	(STH)	(SLO)	(FIL)							
TRB	2	0										
XTRB												
TREE	722	55105	BUILD	DNEXT	PLACE	AFTER	SLIST	POTA				
TRUKIN	306	34501	VOC2	LSHL	CANAP2	ZZPN	ADR	YITKCR	BASCO	PUNCHC	ARRIV	
TRUKIX	277	34416	VOC2	LSHL	CANAP2	ZZZPX	ADR	STAVA	YITKCR	ARRIX		
TRUTI	107	34501	LSHL	VOC3	LINO3							
TST	63	77461										
TSW	312	55105	LSHR	LSHL	CNFR							
TT1	124	0										
TYPE	63	0										
USCITE	643	34501	AMPUSC	PAL	VOC2	LSHR	EONA	ZZPN	COOR	INVUSC	TDVUSC	DFGUSC
			SWUSC	COMUSC	VOC1	XOCEL	CNFR	BASCO	LSHL	VOC3	LINO3	
USCIX	526	34416	PAL	VOC2	CANAP2	ZZZPX	TDVUX	DFGUX	SWUX	COMUX	VOC1	XOCEX
			LSHR	CNFR	LSHL	VOC3	LINO3					
UXDIF	513	55105	TEST	SHL	SHR	IDNTFY	(STB)	(WLR)				
VADD	26	0										

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
VARN	46	0	VADD									
VAR	32	0										
VAR3												
VCOM	224	55105	LSHR	LSHL	XYZR	CNFR	VOC1	LINO1				
VECT	101	0	VFL									
VEREB	151	34501	CNFR	VOC1	LSHL	VOC2	CANAP2	ZZPN				
VERNA	271	34501	VOC1	LSHR	CVRT	LSHL	PYTAG	PAL	LINO	(STH)	(FIL)	RISY
			PINTA									
VFL	54	0	AFCW1									
VHAMD	311	55105	VOC2	VOC1	LINO1							
VHAMM	262	55105	CNFR	VOC1	LINO1							
VHAM	242	55105	LSHR	XYZR	VHAMM	VOC1	VHAMD	LINO1				
VLIN	407	55105	VOC1	ACTW	PAL	RRH	ANC	LINO1				
VLV	34	55105										
VOC1	27	0	VADD									
VOC2												
VOC3												
VPX	10	55105										
VQSQ	276	55105	LSHR	XYZR	VHAMD	CNFR	VOC1	LINO1				
VRPLOT	355	55105	BLANK	SPLIT	TEST	SEARCH	STATN	(STH)	(FIL)			
VSMN	251	55105	VOC1	LINO1								
VSM	676	55105	LSHR	XYZR	PAL	LSHL	VOC2	WRNV	(STH)	(FIL)	LINO	VSMN
			VSMS	VOC1	LINO1							
VSMS	367	55105	PAL	LINO	VOC1	LINO1						
VTDV	473	55105	LSHR	XYZR	VHAMD	CNFR	VOC1	LINO1				
VVV	127	55105										
SETR												
SRI												
ATT												
SPL												
SETEL												
SPL1												
PUCR												
WFORM	6	0										
WLPD	127	55105	(STH)	(FIL)	RETURN							
WMNS	251	55105	LSHR	VOC1	WRNV	(STH)	(FIL)					
WRITE	106	53446	PRIOEM									
WRNV	73	55105	NAME	BLANK								
WRQIN	206	55105	NAME	BLANK	(STB)	(WLR)						

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
WRTST	714	55105	PAL	(STH)	(FIL)	VOC1	VOC2	NAME	BLANK	LINO		
WWF	63	55105	VADD	PAL	LSHL	WFORM						
XCMAT	536	55105	PAL	LINO	WWF	LSHR	LSHL	CNFR	CORD	ADR		
XCRIC	305	34501	CNFR	PUNCHC	ARRPOT	ARRIV	ADR	VOC2				
XCRIX	342	34416	CNFR	LSHR	ARRPOX	ARRIX	ADR	VOC2				
XENTRY	2045	37357	SHR	STATN	(STH)	(FIL)						
XGAINS	713	37357	PAL	EXP(2	EXP(3	SHL	PINCO	ADR	LSHL			
XNSA	7	0										
XOCEL	31	34501										
XOCEX	50	34416	LSHL									
XREWIN	1205	0	(IOU)	EXIT								
XREAD												
XWRITE												
XCLOSE												
XOPEN												
XWAIT												
XLEAVE												
CLOSEW												
SKIPF												
EOFILE												
EOFREW												
BACKR												
BACKF												
XSMAT	732	55105	LSHR	PAL	LINO	WWF	LSHL	CNFR	CORD	ADR		
XSRIC	262	34501	CNFR	LSHL	BASCO	PUNCHC	ARRIV	ADR				
XSRIX	212	34416	CNFR	LSHL	ARRIX	ADR						
XYZR	123	55105	CNFR	ACTW	PAL							
YAMP2	347	25107	SUBA	PAL	CTPOM	YOCEL	YSYW	LINO	YKERR			
YCOMP	561	25107	YCRIC	YOCEL	CIMP	LSHR	YYY	RSYMB	YSYW	LSHL	SUBA	PAL
			LINO	YRV	CANAP2	YKERR						
YCRIC	240	27403	LSHL	CNFR	LSHR							
YHAM	522	25107	LSHL	CNFR	YOCEL	YSYW	PAL	LSHR	EONA	YYY	SUBA	LINO
			RSYMB	YKERR								
YITKCR	435	34501	RNLST	LSHL	PAL	CNFR	LSHR	SUBA	CANAP2	(STH)	(FIL)	
YITKR	167	34501	LSHR	EONA	LSHL	PAL	LINO					
YKERR	267	25107	(STH)	(FIL)	CHAINB	CHAIN						
YOCEL	130	25311	PYTAG	PAL	LINO	LSHR	CANAP2					
YPASS	207	25112	LSHL									
YPR	257	25112	SCARTO	RETI	LSHR							
YQS2	330	25107	LSHL	CNFR	LSHR	EONA	PAL	QS2	CANAP2	LINO	YSYW	YOCEL
			QS1	YYY	YKERR							

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
YRCD	272	25107	YRV	PAL	LSHR	CANAP2	YYY	LSHL	LINO	YKERR		
YRES	1017	25106	LSHL	CNFR	LSHR	EONA	ADR	PAL	RES2	LINO	YYY	YSYW
			CANAP2	RSYMB	YRV	YOCEL	RES1	YKERR				
YRPIC	270	25107	PAL	LSHL	CANAP	EONA	CANAP2	YOCEL	LINO	YKERR		
YRV	222	25107	PAL	CNFR	SUBA							
YRW2	612	25107	(TSB)	(RLR)	(STB)	(WLR)	IDEQ	CNFR	(STH)	(FIL)	(RWT)	
YRW3	555	25107	(TSB)	(RLR)	IDEC	(STB)	(WLR)	YRPIC	(RWT)			
YRW4	403	25107	(TSB)	(RLR)	(STB)	(WLR)	IDEQ	(RWT)				
YRW	725	25107	(TSB)	(RLR)	(STB)	(WLR)	IDEQ	CNFR	LSHL	RSYMB	(RWT)	
YSM2	476	25311	LSHL	CNFR	LSHR	EONA	ADR	PAL	SM3R	LINO	YYY	YSYW
			CANAP2	YOCEL	YKERR							
YSRIC	230	27403	LSHR	CNFR	LSHL							
YSW	332	25107	YSRIC	YOCEL	RSYMB	YSYW	YRV	PAL	LSHR	CANAP2	YYY	YKERR
YSYW	124	25311	LSHL	LSHR	LINO	SUBA	PAL					
YTDM	476	25107	LSHL	CNFR	YOCEL	PAL	YYY	LINO	YSYW	LSHR	EONA	CANAP2
			YKERR									
YTK2	443	34501	MELEM	ADR	CNFR	VOC1	LSHR	TRUTI	PYTAG	PAL	LINO	CANAP2
			YITKR	YITKCR	(STH)	(FIL)	RISY	PINTA				
YVP	122	25107	YRV	PAL	LSHR	CANAP2	YYY	YKERR				
YYY	44	77461	PAL	LINO								
ZBETA	444	37357	(TSB)	(RLR)	(RWT)	IDEQ	(STH)	(FIL)	EXP(2			
ZC1	462	37357	RSYMB	LSHR	PAL	LSHL	ACTW	LINO	CNFR	RESCAP	ICOUNT	ACOUNT
			ZC7									
ZC2	642	37357	ZC3	ZEM3	ZHAM3	ZQS3	ZZRES	LSHR	LSHL	(STH)	(FIL)	
ZC3	771	37357	CNFR	LSHR	RSYMB	LSHL	PAL	TDEC5	ZC7	LINO	ICOUNT	ZC5
ZC5	72	37357	LSHR	RSYMB	ICOUNT							
ZC7	152	37357	LSHL	LSHR								
ZCDIV	430	37357	PAL	LSHL	STATN	(STH)	(FIL)					
ZCOMP	1273	37357	RSYMB	COMPOT	(TSB)	(RLR)	IDEQ	(BST)	CNFR	LSHL	LSHR	TDEC5
			ICOUNT	ZC7	LINO							
ZCTP	1523	27403	PAL	SUBA	ADDA	CNFR						
ZEM3	755	37357	CNFR	LSHR	RSYMB	LSHL	LINO	TDEC5	ZC7	ZC5		
ZEXTR	554	37357	CNFR	RSYMB	ZC3	ZEM3	ZHAM3	ZQS3	ZZRES	(STH)	(FIL)	
ZHAM3	1041	37357	CNFR	LSHR	RSYMB	LSHL	TDEC5	ICOUNT	ZC5	ZHMD	ZHQD	ZHRT
ZHMD	323	37357	TDEC5	ZC7	ICOUNT	ZC5	LSHL	LSHR	RSYMB	LINO		
ZHQD	505	37357	LSHR	CNFR	ZHRT	TDEC5	ICOUNT	LSHL	RSYMB	LINO		

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
ZHRT	612	37357	CNFR	LSHR	RSYMB	LSHL	LINO	ZC5	TDEC5			
ZQINV	564	55105	ADR VOC3	(RWT) WRQIN	(STB)	(WLR)	(BST)	(TSB)	(RLR)	CNFR	VOC1	LINO1
ZQS3	1070	37357	CNFR	LSHR	RSYMB	LSHL	TDEC5	ZC7	LINO	ACOUNT	ZC5	
ZREC	510	34500	(RWT)	(STH)	(FIL)	(TSB)	(RLR)	CNFR	IDEQ			
ZRES	244	55105	LSHR	XYZR	VOC1	LINO1						
ZSC	616	34501	VOC2	PUNCHC	REFSER	COLLIN	ARRIV	ADR	CONDIN			
ZSCX	611	34416	LSHL	VOC2	RESTA	STAM	TEX	COLLIX	ARRIX	ADR	CONDIX	
ZSW5	212	37357	LSHL	LSHR	RSYMB	LINO	ICOUNT					
ZSW	376	37357	LSHL	TDEC5	ZC7	LSHR	ZSW5					
ZYF1	352	25311	YRV	FIMP	PAL	LSHR	CANAP2	YSYW	YKERR			
ZYF2	312	25311	YOCEL	FIMP	YSYW	YKERR						
ZZCW	546	77461	CNFR	PAL	LSHL	VOC2	CANAP2	(STH)	(FIL)	LSHR	ZZZZ	
ZZDFG	1147	37357	RSYMB	LSHL	CNFR	LSHR	TDEC5	ZC7	ICOUNT	LINO		
ZZPN	54	34501	(STH)	(FIL)								
ZZRECO	364	37357	LSHL	(STH)	(FIL)	ZC7						
ZZRES	1417	37357	CNFR	LSHR	RSYMB	LSHL	TDEC5	PAL	ZC7	LINO	ICOUNT	ZC5
ZZVP	271	37357	TDEC5	ZC7	(STH)	(FIL)						
ZZZLST ZZZSTP	172	0										
ZZZPX	115	34416	LSHR	STAM	(STH)	(FIL)						
ZZZZ	231	77461	CNFR	LSHR								
ZZZZZE	307	34501	(STH)	(FIL)	(RWT)	(TSB)	(RLR)	(STB)	(WLR)	CNFR	INDEX	ADR
(BST)	34	77776	(IOS)	(BSR)	(RDS)	(RCH)	(TCO)	(TRC)	(TEF)			
(CSH)	175	77634	(IOH)	(TCO)	(TEF)	(RCS)	(RCH)	(EXE)				
(EFT)	7	0	(IOS)	(WEF)								
(EXE)	11	0										
(EXEM)	117	77445	(RDS)	REWSYS	CHAIN							
(FPT)	36	77461										
(IOB) (EXB) (BUF) (SET)	1072	77774	(IOS)									
(IOH) (FIL) (RTN)	1711	77521	(IOS)	(EXE)								
(IOS) (RDS) (WRS) (BSR) (WEF) (REW) (ETT) (RCH) (TEF) (TCO) (TRC) (STC)	141	0	(TES)	(IOU)	(EXE)							

PROGRAM	LENGTH	COMMON	TRANSFER VECTOR									
(IOU)	24	0										
(RER) (RDC)	62	0	(TCO)	(TEF)	(TRC)	(STC)	(BSR)	(RDS)	(RCH)	(EXE)		
(RWT)	7	0	(IOS)	(REW)								
(SLO)	15	0										
(SPH)	267	77613	(IOH)	(WRS)	(TCO)	(RCH)						
(STB) (WLR)	70	77776	(IOB)	(WER)	(WRS)	(WTC)	(RCH)	(TES)	(EXB)			
(STH) (STHM) (STHD)	123	77750	(IOH)	(WER)	(TES)	(WRS)	(WTC)	(RCH)				
(TES)	1	0										
(TSB) (RLR)	102	0	(IOB)	(RER)	(BUF)	(RDS)	(RDC)	(RCH)	(EXE)	(SET)	(EXB)	
(TSH) (TSHM)	21	77750	(IOH)	(RDS)	(RDC)	(RCH)	(RER)					
(WER) (WTC)	71	0	(TCO)	(ETT)	(TRC)	(TES)	(BSR)	(WRS)	(RCH)	(EXE)	(WEF)	(REW)

12.3 Called by

PROGRAM	CALLED BY									
ACCUNT	CNTRCD									
ACOMPL	342									
ACOUNT	ZC1	ZQS3								
ACTW	31	321	33	331	7	ICOUNT	VLIN	XYZR	ZC1	
ADDA	ZCTP									
ADR	1	21	22	31	321	331	341	342	343	36
	361	3613	362	4	7	AGENT	ATRIN	CTPOM	ENTDFG	ENTDFX
	ENTHAM	ENTHAX	ENTQSQ	ENTQSX	ENTSER	ENTSEX	ENTSW	ENTSX	ENTTDV	ENTTDX
	ICNTFY	LCMP	LZP	LZP2	POTA	SECMEA	SECMEX	STRING	SYMBOL	SYRES
	TIEPC	TRUKIN	TRUKIX	XCMAT	XCRIC	XCRIX	XGAINS	XSMAT	XSRIC	XSRIX
	YRES	YSM2	YTK2	ZSC	ZSCX	ZZZZZE				
AFCW1	VFL									
AFSIS	AGENT	LZP	LZP2							
AFTER	FMPY	LCPY	LZP	LZP2	TREE					
AGENT	21									
AIMP	321									
AMPUSC	USCITE									
AMRIC	FIMP									
ANC	31	VLIN								
ARRIV	COLLIN	ENTDFG	ENTHAM	ENTQSQ	ENTSER	ENTSW	ENTTDV	SATAM	SECMEA	TRUKIN
	XCRIC	XSRIC	ZSC							
ARRIX	COLLIX	ENTDFX	ENTHAX	ENTQSX	ENTSEX	ENTSX	ENTTDX	SATAX	SECMEX	TRUKIX
	XCRIX	XSRIX	ZSCX							
ARRPOT	ENTDFG	ENTSW	SECMEA	XCRIC						
ARRPOX	ENTDFX	ENTSX	SECMEX	XCRIX						
AST	TAB									
ATAN	331	4	CONDIN	CONDIX	RESCP					

PROGRAM	CALLED BY									
ATERM1	342									
ATRAN	SYMBCL									
ATRAN1	IDNTFY	LZP	LZP2							
ATRAN2	LZP	LZP2								
ATRAN3	ATRIN									
ATRIN	LZP2									
ATT	4									
ATTINV	36									
AUXREC	AGENT									
AUXT	1									
AVC	2									
AZZS	36	361	3613							
BASCO	361	ARRPOT	CONDIN	IUS	SATAM	SECMEA	SUMJON	TRUKIN	USCITE	XSRIC
BDC	1	LZP	NAME	TIDEN						
BFIND	331									
BLANK	1	2	21	24	31	321	362	4	AUXREC	CNTRCD
	ISPEQ	LZP	PHEAD	RCRDER	SETIC	STAVA	VRPLOT	WRNV	WRQIN	WRTST
BLD1	7									
BRECHT	AGENT	LZP	LZP2							
BUILD	1	4	AFTER	FMPY	LCPY	LZP	LZP2	POTA	TREE	
BUPPA	IDNTFY									
CANAP	321	361	3613	7	ARRIV	ARRIX	BASCO	PRIGI	TIEPO	YRPIC
CANAP2	341	342	343	362	7	ACOMPL	ATERM1	COLLIX	PRIGI	TRUKIN
	TRUKIX	USCIX	VEREB	YCOMP	YITKCR	YOCEL	YQS2	YRCD	YRES	YRPIC
	YSM2	YSW	YTDM	YTK2	YVP	ZYF1	ZZCW			
CHAIN	1	11	10	2	21	22	24	31	32	321
	33	331	341	342	343	36	361	3613	362	4
	5	6	7	EXITA	(EXEM)	YKERR				

PROGRAM	CALLED BY									
CHAINB	2	22	31	331	YKERR					
CIMP	321	YCOMP								
CLCT1	31									
CLETS2	SYRES									
CLPSC	24									
CMCOIL	331									
CMGAIN	33									
CMSW	2									
CNFR	31	321	331	342	36	361	3613	362	7	ARRIV
	ARRIX	CONDIN	CONDIX	CONTAM	EMFAB	ENTQSQ	HMFAB2	HUBSOR	PRIGI	PRIGO
	QSFAB	RESCAP	RESFAB	RICALT	RICALW	RIPINT	RISY	RUTLET	SATAM	SATAX
	SECMEA	SECMEX	SMFAB	SMOUT	SMPVOC	SUMJCN	SUMJOX	SWGAIN	TCM1	TCM2
	TIEPO	TIEUSC	TSW	USCITE	USCIX	VCOM	VEREB	VHAMM	VQSQ	VTDV
	XCMAT	XCRIC	XCRIX	XSMAT	XSRIC	XSRIX	XYZR	YCRIC	YHAM	YITKCR
	YQS2	YRES	YRV	YRW	YRW2	YSM2	YSRIC	YTDM	YTK2	ZC1
	ZC3	ZCOMP	ZCTP	ZEM3	ZEXTR	ZHAM3	ZHQD	ZHRT	ZQINV	ZQS3
	ZREC	ZZCW	ZZDFG	ZZRES	ZZZZ	ZZZZZE				
CNTRCD	11									
CNVRT	CTS									
COLLIN	361	ENTQSQ	ENTSER	ZSC						
COLLIX	3613	ENTQSX	ENTSEX	ZSCX						
COMCON	CONMOP	CONSP	PRIGO							
COMMN	EWB									
COMPDO	1	2								
COMPOT	SWGAIN	ZCOMP								
COMUSC	USCITE									
COMUX	USCIX									

PROGRAM	CALLEC BY						
CONDIN	361	ZSC					
CONDIX	3613	ZSCX					
CONMOL	PRIGI						
CCNMOP	PRIGC						
CONSM	PRIGI						
CONSP	PRIGO						
CONTAM	PRIGI						
COOR	ARRIV	BASCO	COLLIN	TIEUSC	USCITE		
COPY	8						
COPYCT	8						
CORD	31	XCMAT	XSMAT				
CORD1	RIPINT						
CORVE	ORV						
COS	RESCP						
CPCH	5						
CRIT1	1	BRECHT					
CRIT2	1	BRECHT					
CSEL	5						
CTPOM	ACOMPL	ATERM1	YAMP2				
CTS	10						
CVRT	321	341	342	343	PRIGI	TIEPO	VERNA
DAN	1	2					
DAUX	INT	LOADER					
DBCV	BFINC	SPLIT					
DCOPY	8						
DEFINE	AGENT	ERASES	LZP	LZP2	POTA		
DFG	2						

PROGRAM	CALLED BY									
DFGUSC	USCITE									
DFGUX	USCIX									
DIAGN	1									
DLAST	AFTER	AGENT	LZP	LZP2	POTA					
DNEXT	1	4	AFTER	AGENT	FMPY	LCMP	LCPY	LSCAN	LZP	LZP2
	POTA	SLIST	STORE	STRING	SYMBOL	TREE				
ELIST	7									
EMFAB	33									
END	1	4	AGENT	FMPY	LCMP	LCPY	LSCAN	LZP	LZP2	POTA
	STRING	SYMBOL								
ENDMS	8									
ENDMS3	8									
ENTDFG	361									
ENTDFX	3613									
ENTHAM	361									
ENTHAX	3613									
ENTQSQ	361									
ENTQSX	3613									
ENTSER	361									
ENTSEX	3613									
ENTSW	361									
ENTSX	3613									
ENTTDV	361									
ENTTDX	3613									
EONA	321	AMRIC	ARRIV	BASCO	COLLIN	COLLIX	ENTHAM	ENTHAX	NUAMP	OMITA
	OMITG	OMITN	PYTAG	QIMP	RESTA	SATAX	TIEPO	TIEUSC	USCITE	YHAM
	YITKR	YQS2	YRES	YRPIC	YSM2	YTDM				

PROGRAM	CALLED BY					
EONERR	OMITC	CMITN				
ERASEL	1	ERASES	LZP	LZP2	RFC	
ERASES	AGENT	FMPY	LZP	LZP2	POTA	
ERR	RST1					
ERR2	BLD1					
ERRAD1	AST	KST	NST			
ERRAD2	7	IOST				
ERRCD1	AST	FST	KST	MST	NST	PST	SCST
ERRCD2	AST	FST	KST	MST	NST	PST	
ERRIT	RNEL					
ERRNUS	OMITC	CMITN				
ESR	8					
EST	TAB					
EWB	7					
EXIT	11	8	DUMP	ERR	ERR2	PINTA	XREWIN
EXP(2	XGAINS	ZBETA				
EXP(3	XGAINS					
FDIV	POTA					
FFG1	321					
FFG2	321					
FIMP	321	ZYF1	ZYF2			
FLAG	2					
FLAG1	AGENT	MPLIMP				
FLAG2	4					
FLCPY	POTA					
FMPY	POTA					
FORE	4	LZP	LZP2	POTA		

PROGRAM	CALLED BY									
FPG	PRIGI									
FST	TAB									
FTDC	4	BDC	CSEL	FTDIC						
FTDIC	BCC									
GAIN1	AGENT									
GHST	TAB									
HMFAB2	33									
HMOUT	33									
HTOL	341									
HUBSOR	33									
ICOUNT	ZC1	ZC3	ZC5	ZCOMP	ZHAM3	ZHMD	ZHQD	ZSW5	ZZDFG	ZZRES
IDEQ	21	31	321	331	4	5	LZP2	RIPINT	RUTLET	YRW
	YRW2	YRW3	YRW4	ZBETA	ZCOMP	ZREC				
IDNTFY	2	CMSW	DFG	UXDIF						
INDEX	22	31	331	343	362	AGENT	LCMP	STRING	ZZZZZE	
INITDO	1	2								
INPSC	24									
INSL	POTA									
INSLA	FMPY	LZP	LZP2	POTA						
INT	24									
INTM	24									
INVUSC	USCITE									
IOST	TAB									
ISPEQ	2									
IUS	AMPUSC	SATAM								
JOIN	AFTER	FMPY	POTA	RFC						
KST	TAB									

PROGRAM	CALLED BY									
LAST	DLAST									
LCMP	RFC									
LCPY	AGENT	FMPY								
LELLA2	31									
LGP	SATAX									
LINO	31	321	342	3613	7	ACOMPL	ARRIV	ARRIX	ATERM1	COLLIN
	COLLIX	CONDIN	PRIGI	REFSER	RIPINT	TIEPO	TIEUSC	VERNA	VSM	VSMS
	WRTST	XCMAT	XSMAT	YAMP2	YCOMP	YHAM	YITKR	YOCEL	YQS2	YRCD
	YRES	YRPIC	YSM2	YSYW	YTDM	YTK2	YYY	ZC1	ZC3	ZCOMP
	ZEM3	ZHMD	ZHQD	ZHRT	ZQS3	ZSW5	ZZDFG	ZZRES		
LINO1	31	ATTINV	RUTLET	VCOM	VHAM	VHAMD	VHAMM	VLIN	VQSQ	VSM
	VSMN	VSMS	VTDV	ZRES						
LINO2	31	ATTINV	AZZS	FPG	PRIGI	RUTLET				
LINO3	31	ATTINV	AZZS	COMCON	CONMOP	CONSP	FPG	PRIGO	RICALT	RICALW
	TIEPO	TRUTI	USCITE	USCIX						
LOADER	24									
LOOK	22	24	BRECHT	SEARCH						
LSCAN	LZP	LZP2	POTA							
LSHL	31	321	331	341	342	343	361	3613	362	7
	ACOMPL	ACOUNT	ARRIV	ARRIX	ATTINV	BFINC	COLLIN	COLLIX	CONDIN	COOR
	ENTHAM	ENTHAX	ENTQSX	ENTSEX	ENTSW	ENTSX	HUBSOR	IUS	NUAMP	NUMUSC
	PRIGI	PRIGO	REFSER	RUTLET	SECMEA	SECMEX	SMFAB	SMOUT	SMPVOC	STABLE
	SUMJON	SUMJOX	SWGAIN	TCM1	TCM2	TIEPC	TRUKIN	TRUKIX	TRUTI	TSW
	USCITE	USCIX	VCOM	VEREB	VERNA	VSM	WWF	XCMAT	XGAINS	XOCEX
	XSMAT	XSRIC	XSRIX	YCOMP	YCRIC	YHAM	YITKCR	YITKR	YPASS	YQS2
	YRCD	YRES	YRPIC	YRW	YSM2	YSRIC	YSYW	YTDM	ZC1	ZC2
	ZC3	ZC7	ZCDIV	ZCOMP	ZEM3	ZHAM3	ZHMD	ZHQD	ZHRT	ZQS3
	ZSCX	ZSW	ZSW5	ZZCW	ZZDFG	ZZRECO	ZZRES			

PROGRAM	CALLED BY									
LSHR	31	321	33	331	341	342	362	7	ACOMPL	ACOUNT
	ARRIV	ARRIX	ATERM1	ATTINV	BFIND	COLLIN	COLLIX	CONSP	ENTHAM	ENTHAX
	ENTQSQ	ENTQSX	ENTSER	ENTSEX	FPG	HMFAB2	HMOUT	HUBSOR	NUMUSC	PRIGI
	RESCAP	RIPINT	RUTLET	SMFAB	SMPVOC	STABLE	SWUSC	SWUX	TCM1	TCM2
	TIEPC	TIEUSC	TSW	USCITE	USCIX	VCOM	VERNA	VHAM	VQSQ	VSM
	VTDV	WMNS	XCMAT	XCRIX	XSMAT	YCOMP	YCRIC	YHAM	YITKCR	YITKR
	YOCEL	YPR	YQS2	YRCD	YRES	YSM2	YSRIC	YSW	YSYW	YTDM
	YTK2	YVP	ZC1	ZC2	ZC3	ZC5	ZC7	ZCOMP	ZEM3	ZHAM3
	ZHMD	ZHQD	ZHRT	ZQS3	ZRES	ZSW	Z9W5	ZYF1	ZZCW	ZZDFG
	ZZRES	ZZZPX	ZZZZ							
LST	TAB									
LTOH	33									
LZP	21									
LZP2	22									
MELEM	36	361	3613	CONMOL	CONSM	CONTAM	PRIGO	YTK2		
MPLIMP	2									
MST	TAB									
MULTCD	4									
NAME	1	21	31	362	4	AUXREC	PHEAD	SETIC	STAVA	WRNV
	WRQIN	WRTST								
NAME1	AGENT									
NEBB	TAB									
NLH	AFTER	CEFINE								
NST	TAB									
NUAMP	NUMUSC	SATAM	SATAX							
NUMUSC	TIEPO									
OMITA	321									

PROGRAM	CALLED BY									
OMITG	321									
OMITN	321									
ORV	7									
PAL	22	24	31	321	33	331	341	342	343	36
	361	3613	362	4	7	ACOMPL	AGENT	ARRIV	ARRIX	ATERM1
	ATTINV	COLLIN	COLLIX	CONDIN	CONDIX	COOR	ENTHAM	ENTHAX	ENTSER	ENTSEX
	IDNTFY	IUS	LCMP	LZP	LZP2	NUAMP	NUMUSC	POTA	PRIGI	PRIGO
	PSYMB	REFSER	RESTA	RIPINT	RUTLET	SATAX	STABLE	STRING	TIEPO	TIEUSC
	USCITE	USCIX	VEREB	VERNA	VLIN	VSM	VSMS	WRTST	WWF	XCMAT
	XGAINS	XSMAT	XYZR	YAMP2	YCOMP	YHAM	YITKCR	YITKR	YOCEL	YQS2
	YRCD	YRES	YRPIC	YRV	YSM2	YSYW	YTDM	YTK2	YVP	YYY
	ZC1	ZC3	ZCDIV	ZCTP	ZYF1	ZZCW	ZZRES			
PANEL	32									
PARAD	2									
PARAD1	1									
PARSE	PARAD1	SYMBOL								
PCH	5									
PDUMP	321	331	FDUMP							
PERT	IDNTFY									
PHEAD	INPSC									
RINCO	XGAINS									
PINTA	VERNA	YTK2								
PLACE	FMPY	POTA	TREE							
POTA	TREE									
PREMG	8									
RREPR	24									
RRIGI	36									

PROGRAM	CALLED BY									
PRIGO	36	361	3613							
PRINT	11	CTS								
PRINTT	24	INPSC								
PRIOEP	EREAC	WRITE								
PST	TAB									
PSYMB	36	361	3613							
PTRAN1	PREPR									
PTRAN2	PREPR									
PUCR	4									
PUNCH	CSEL									
PUNCHC	ARRIV	ARRPOT	CCLLIN	CONDIN	ENTDFG	ENTHAM	ENTQSQ	ENTSER	ENTSW	ENTTDV
	REFSER	SATAM	SECMEA	SUMJON	TRUKIN	XCRIC	XSRIC	ZSC		
PUNP	7									
PYTAG	ACOMPL	CONDIN	OMITA	PRIGI	REFSER	TIEPO	VERNA	YOCEL	YTK2	
QIMP	321									
QS1	321	YQS2								
QS2	321	YQS2								
QSFAB	33									
QST	TAB									
RCRDER	2									
READ	1	8	COPY	COPYCT	ESR	SKIP				
READCT	8									
REFSER	CONDIN	ENTSER	ZSC							
RES	2									
RES1	321	YRES								
RES2	321	YRES								
RESCAP	ZC1									

PROGRAM	CALLED BY									
RESCP	21									
RESET	1	21	22	4						
RESFAB	33									
RESTA	ARRIX	CONDIX	ENTSEX	ZSCX						
RETI	YPR									
RETURN	AGENT	ATRIN	LZP	LZP2	PARAD	PARAD1	POTA	PREPR	STRING	WLPD
REWSYS	24	342	6	7	(EXEM)					
RFC	LZP	LZP2								
RICALT	CONTAM									
RICALW	PRIGC									
RIPINT	341									
RISY	CONDIN	CONDIX	CONMOL	CONSM	PRIGI	RICALT	RICALW	VERNA	YTK2	
RLA	RIPINT									
RNEL	EWB	RNLST								
RNLST	342	7	EONA	PYTAG	YITKCR					
RRH	31	VLIN								
RSH	IDNTFY									
RST1	7									
RSYMB	24	321	33	331	341	342	343	ATRIN	HMFAB2	INPSC
	RIPINT	STABLE	SWGAIN	YCOMP	YHAM	YRES	YRW	YSW	ZC1	ZC3
	ZC5	ZCOMP	ZEM3	ZEXTR	ZHAM3	ZHMD	ZHQD	ZHRT	ZQS3	ZSW5
	ZZDFG	ZZRES								
RUTLET	361	3613	362	PRIGI	PRIGO					
RUTWR	361	3613	362	PRIGI						
SATAM	361									
SATAX	3613									
SBST	SIGMAP									

PROGRAM	CALLED BY								
SCARTO	YPR								
SCST	TAB								
SEARCH	CMSW	IDNTFY	MPLIMP	PARAD	PREPR	RCRDER	RES	SIGMAP	VRPLOT
SECMEA	361								
SECMEX	3613								
SETEL	4								
SETIC	21	22	LZP	RESCP					
SETR	4								
SHL	321	4	7	UXDIF	XGAINS				
SHR	321	7	UXDIF	XENTRY					
SIGMAP	IDNTFY								
SIGN	31								
SIMIN	CONMOL	CONSM	PRIGI						
SIN	RESCP								
SIPLUS	CONMOL	CONSM	PRIGI						
SKIP	8								
SLIST	FMPY	LCPY	POTA	TREE					
SLIST1	POTA								
SLTRA	FMPY	LCMP	LCPY	LSCAN	LZP	LZP2	POTA	STRING	
SM1R	321								
SM2R	321								
SM3R	YSM2								
SMFAB	33								
SMOUT	33								
SMPVOC	33								
SMVAR	AGENT								
SNEXT	DNEXT								

PROGRAM	CALLED BY									
SORT	1	BRECHT								
SPCH	SYMBCL									
SPL	4									
SPL1	4									
SPLIT	1	2	4	5	CNTRCD	RCRDER	VRPLOT			
SQRT	RESCP									
SRI	4									
STABLE	33									
STAM	ARRIX	ARRPOX	COLLIX	CONDIX	ENTDFX	ENTHAX	ENTQSX	ENTSEX	ENTTDX	SATAX
	SUMJCX	ZSCX	ZZZPX							
STATN	2	331	4	AGENT	CMCOIL	CMSW	COMPOT	CSEL	IDNTFY	LZP
	LZP2	MPLIMP	POTA	RCRDER	RES	STRING	VRPLOT	XENTRY	ZCDIV	
STAVA	COLLIX	TRUKIX								
STMV	MPLIMP									
STORE	SYMBCL									
STRING	AGENT	ATRIN	LZP	LZP2						
STRSET	341									
SUBA	321	342	3613	7	ACOMPL	ATERM1	RIPINT	YAMP2	YCOMP	YHAM
	YITKCR	YRV	YSYW	ZCTP						
SUMJON	361									
SUMJOX	3613									
SWGAIN	331									
SWUSC	USCITE									
SWUX	USCIX									
SYMBOL	1									
SYRES	321									
TAB	7									

PROGRAM	CALLED BY									
TAB2	321	341	342	343	36	361	3613	362		
TCM1	31									
TCM2	31									
TDEC1	ACOUNT	ICOUNT	RESCAP							
TDEC2	ACOUNT	ICOUNT								
TDEC3	ACOUNT	ICOUNT								
TDEC4	ACOUNT									
TDEC5	ACOUNT	RESCAP	ZC3	ZCOMP	ZEM3	ZHAM3	ZHMD	ZHQD	ZHRT	ZQS3
	ZSW	ZZDFG	ZZRES	ZZVP						
TDVUSC	USCITE									
TDVUX	USCIX									
TEST	1	2	21	22	24	4	5	AGENT	ATRIN	CMSW
	CNTRCD	DAN	IDNTFY	LCMP	LZP	LZP2	MPLIMP	PARAD	PARAD1	POTA
	PREPR	RCRDER	READ	RES	SIGMAP	SYMBOL	UXDIF	VRPLOT		
TEX	ARRIX	RESTA	SATAX	SUMJOX	ZSCX					
TIDEN	24	4								
TIEPO	361	3613								
TIEUSC	ARRIV									
TIEUX	ARRIX									
TIMP	321									
TNEWT2	SYRES									
TRAN	PUNP									
TRB	1	2	DAN							
TREE	21	22								
TRUKIN	361									
TRUKIX	3613									
TRUTI	YTK2									

PROGRAM	CALLED BY									
TST	LZP	LZP2	POTA							
TSW	31									
TT1	31									
TYPE	AGENT									
USCITE	ARRIV									
USCIX	ARRIX									
UXDIF	2									
VADD	31	AZZS	FPG	LINO1	TIEPO	VARN	VOC1	WWF		
VAR	21	22	4	AGENT	ATRIN	IDNTFY	LZP	LZP2	PARAD	PARAD1
	RES	SIGMAP	SYMBOL							
VAR3	24									
VARN	31									
VCOM	31									
VECT	7									
VEREB	CONMCL	CONSM	PRIGI	RICALT	SIMIN	SIPLUS				
VERNA	ATTINV									
VFL	VECT									
VHAM	31									
VHAMD	VHAM	VQSQ	VTDV							
VHAMM	VHAM									
VLIN	31									
VLV	1	2	CMSW							
VOC1	31	362	ATTINV	COLLIN	COLLIX	COMCCN	CONMOL	CONMOP	CONSM	CONSP
	CONTAM	ENTHAM	ENTHAX	MELEM	NUAMP	NUMUSC	PRIGI	PRIGO	PSYMB	RUTLET
	STAVA	TIEPO	USCITE	USCIX	VCOM	VEREB	VERNA	VHAM	VHAMD	VHAMM
	VLIN	VQSQ	VSM	VSMN	VSMS	VTDV	WMNS	WRTST	YTK2	ZQINV
	ZRES									

PROGRAM	CALLED BY									
VOC2	362	ATTINV	AZZS	COLLIN	COLLIX	COMUSC	COMUX	CONDIN	CONDIX	CONMOP
	CONSP	CONTAM	DFGUSC	DFGUX	ENTDFG	ENTDFX	ENTHAM	ENTHAX	ENTQSQ	ENTQSX
	ENTSER	ENTSEX	ENTTDV	ENTTDX	FPG	MELEM	NUMUSC	PRIGI	PSYMB	RUTLET
	SWUSC	SWUX	TDVUSC	TDVUX	TIEPO	TRUKIN	TRUKIX	USCITE	USCIX	VEREB
	VHAMD	VSM	WRTST	XCRIC	XCRIX	ZSC	ZSCX	ZZCW		
VOC3	31	36	361	3613	ARRIV	ARRIX	COMCON	CONMOP	CONSP	FPG
	PRIGO	PSYMB	RICALT	RICALW	TIEPO	TRUTI	USCITE	USCIX	ZQINV	
VPX	IDNTFY									
VQSQ	31									
VRPLOT	2									
VSM	31									
VSMN	VSM									
VSMS	VSM									
VTDV	31									
WFORM	WWF									
WLPD	BUILC	DLAST	DNEXT	SNEXT						
WMNS	31									
WRITE	8	COPY	COPYCT							
WRNV	31	VSM	WMNS							
WRQIN	ZQINV									
WRTST	31									
WWF	31	XCMAT	XSMAT							
XCMAT	31									
XCRIC	361									
XCRIX	3613									
XENTRY	331									
XEQ	ATRIN									

PROGRAM	CALLED BY									
XGAINS	331									
XLSH	IDNTFY									
XNSA	1									
XOCEL	USCITE									
XOCEX	USCIX									
XOPEN	6									
XREAD	6									
XSMAT	31									
XSRIC	361									
XSRIX	3613									
XTRB	2	4								
XYZR	VCOM	VHAM	VQSQ	VSM	VTDV	ZRES				
YAMP2	342									
YCOMP	342									
YCRIC	321	YCOMP								
YHAM	342									
YITKCR	362	TIEPO	TRUKIN	TRUKIX	YTK2					
YITKR	YTK2									
YKERR	341	342	343	YAMP2	YCOMP	YHAM	YQS2	YRCD	YRES	YRPIC
	YSM2	YSW	YTDM	YVP	ZYF1	ZYF2				
YOCEL	342	ACOMPL	YAMP2	YCOMP	YHAM	YQS2	YRES	YRPIC	YSM2	YSW
	YTDM	ZYF2								
YPASS	342									
YPR	342									
YQS2	342									
YRCD	343									
YRES	342									

PROGRAM	CALLED BY									
YRPIC	YRW3									
YRV	ATERM1	YCOMP	YRCD	YRES	YSW	YVP	ZYF1			
YRW	341									
YRW2	342									
YRW3	343									
YRW4	343									
YSM2	342									
YSRIC	321	YSW								
YSW	342									
YSYW	ATERM1	YAMP2	YCOMP	YHAM	YQS2	YRES	YSM2	YSW	YTDM	ZYF1
	ZYF2									
YTDM	342									
YTK2	CONMCL	CONSM	CONTAM	PRIGI	SIMIN	SIPLUS				
YVP	343									
YYY	321	ATERM1	YCOMP	YHAM	YQS2	YRCD	YRES	YSM2	YSW	YTDM
	YVP									
ZBETA	33									
ZC1	331									
ZC2	331									
ZC3	ZC2	ZEXTR								
ZC5	ZC3	ZEM3	ZHAM3	ZHMD	ZHRT	ZQS3	ZZRES			
ZC7	ZC1	ZC3	ZCOMP	ZEM3	ZHMD	ZQS3	ZSW	ZZDFG	ZZRECO	ZZRES
	ZZVP									
ZCDIV	331									
ZCOMP	331									
ZCTP	321									
ZEM3	ZC2	ZEXTR								

PROGRAM	CALLED BY									
ZEXTR	331									
ZHAM3	ZC2	ZEXTR								
ZHMD	ZHAM3									
ZHQD	ZHAM3									
ZHRT	ZHAM3	ZHQD								
ZQINV	31									
ZQS3	ZC2	ZEXTR								
ZREC	36	362								
ZRES	31									
ZSC	361									
ZSCX	3613									
ZSW	SWGAIN									
ZSW5	ZSW									
ZYF1	342									
ZYF2	342									
ZZCW	362									
ZZDFG	331									
ZZPN	361	ARRIV	BASCO	COLLIN	ENTHAM	PRIGI	SECMEA	TIEUSC	TRUKIN	USCITE
	VEREB									
ZZRECO	331									
ZZRES	ZC2	ZEXTR								
ZZVP	331									
ZZZZZE	361									
ZZZLST	361									
ZZZPX	3613	ARRIX	COLLIX	ENTHAX	RESTA	SATAX	SECMEX	TRUKIX	USCIX	
ZZZSTP	PUNCHC									
ZZZZ	ZZCW									

PROGRAM	CALLED BY									
ZZZZZE	36									
(BSR)	11	CSEL	CTS	PUNCH	(BST)	(RER)	(WER)			
(BST)	1	22	24	7	CMSW	CNTRCD	CONTAM	RUTLET	ZCOMP	ZQINV
(BUF)	(TSB)									
(EFT)	4	CNTRCD	PUNP							
(ETT)	(WER)									
(EXB)	(STB)	(TSB)								
(EXE)	(CSH)	(IOH)	(IOS)	(RER)	(TSB)	(WER)				
(FIL)	1	2	21	22	24	31	321	33	331	343
	36	361	3613	4	7	8	AGENT	ATRIN	BFIND	CMCOIL
	CMSW	CNTRCD	COMPOT	CSEL	EMFAB	ENDMS	ENDMS3	EONERR	ERR	ERR2
	ERRAD1	ERRAD2	ERRCD1	ERRCD2	ERRIT	ERRNUS	IDNTFY	INPSC	LZP	LZP2
	MPLIMP	NUAMP	PARAD	PARAD1	PHEAD	PINTA	POTA	PREMG	PREPR	PRIGI
	PRIOEM	PSYMB	PUNCHC	PUNP	QSFAB	RCRDER	REFSER	RES	RIPINT	SETIC
	SMPVOC	STAM	STRING	TIEPO	TRAN	VERNA	VRPLOT	VSM	WLPD	WMNS
	WRTST	XENTRY	YITKCR	YKERR	YRW2	YTK2	ZBETA	ZC2	ZCDIV	ZEXTR
	ZREC	ZZCW	ZZPN	ZZRECO	ZZVP	ZZZPX	ZZZZZE			
(FPT)	1	2	21	22	24	31	32	321	33	331
	341	342	343	36	361	3613	362	4	5	7
(IOB)	(STB)	(TSB)								
(IOH)	(CSH)	(SPH)	(STH)	(TSH)						
(IOS)	11	CSEL	CTS	PUNCH	(BST)	(EFT)	(IOB)	(IOH)	(RWT)	
(IOU)	10	XREWIN	(IOS)							
(RCH)	11	CSEL	CTS	PUNCH	(BST)	(CSH)	(RER)	(SPH)	(STB)	(STH)
	(TSB)	(TSH)	(WER)							
(RDC)	(TSB)	(TSH)								
(RDS)	11	CSEL	(BST)	(CSH)	(EXEM)	(RER)	(TSB)	(TSH)		

PROGRAM	CALLED BY								
(RER)	(TSB)	(TSH)							
(REW)	11	CSEL	CTS	(RWT)	(WER)				
(RLR)	2	21	22	24	31	321	331	341	343	362
	4	5	CONTAM	LOADER	RIPINT	RUTLET	YRW	YRW2	YRW3	YRW4
	ZBETA	ZCOMP	ZQINV	ZREC	ZZZZZE					
(RTN)	1	7	CNTRCD	READ						
(RWT)	1	2	21	22	24	31	321	33	331	341
	342	343	36	362	4	5	7	PUNP	RIPINT	RUTLET
	RUTWR	YRW	YRW2	YRW3	YRW4	ZBETA	ZQINV	ZREC	ZZZZZE	
(SET)	(TSB)									
(SLO)	4	TRAN								
(SPH)	4	7	8	CNTRCD	ENDMS	ENDMS3	ERR	ERR2	PINTA	PREMG
	PRIOEM									
(STB)	1	2	21	22	31	33	331	AGENT	ATRIN	CMSW
	DFG	RES	RUTWR	UXDIF	WRQIN	YRW	YRW2	YRW3	YRW4	ZQINV
	ZZZZZE									
(STC)	(RER)									
(STH)	1	2	21	22	24	31	321	33	331	343
	36	361	3613	4	7	AGENT	ATRIN	BFIND	CMCOIL	CMSW
	CNTRCD	COMPOT	CSEL	EMFAB	EONERR	ERR	ERR2	ERRAD1	ERRAD2	ERRCD1
	ERRCD2	ERRIT	ERRNUS	IDNTFY	INPSC	LZP	LZP2	MPLIMP	NUAMP	PARAD
	PARAD1	PHEAD	PINTA	POTA	PREPR	PRIGI	PSYMB	PUNCHC	PUNP	QSFAB
	RCRDER	REFSER	RES	RIPINT	SETIC	SMPVOC	STAM	STRING	TIEPO	TRAN
	VERNA	VRPLOT	VSM	WLPD	WMNS	WRTST	XENTRY	YITKCR	YKERR	YRW2
	YTK2	ZBETA	ZC2	ZCDIV	ZEXTR	ZREC	ZZCW	ZZPN	ZZRECO	ZZVP
	ZZZPX	ZZZZZE								
(TCO)	11	CSEL	CTS	PUNCH	(BST)	(CSH)	(RER)	(SPH)	(WER)	

PROGRAM	CALLED BY								
(TEF)	11	CSEL	(BST)	(CSH)	(RER)				
(TES)	CHAIN	DUMP	EXIT	(IOS)	(STB)	(STH)	(WER)		
(TRC)	11	CSEL	CTS	PUNCH	(BST)	(RER)	(WER)		
(TSB)	2	21	22	24	31	321	331	341	343	362
	4	5	CONTAM	LOADER	RIPINT	RUTLET	YRW	YRW2	YRW3	YRW4
	ZBETA	ZCOMP	ZQINV	ZREC	ZZZZZE					
(TSH)	1	7	CNTRCD	READ						
(WEF)	CSEL	CTS	(EFT)	(WER)						
(WER)	(STB)	(STH)								
(WLR)	1	2	21	22	31	33	331	AGENT	ATRIN	CMSW
	DFG	RES	RUTWR	UXDIF	WRQIN	YRW	YRW2	YRW3	YRW4	ZQINV
	ZZZZZE									
(WRS)	11	CSEL	CTS	PUNCH	(SPH)	(STB)	(STH)	(WER)		
(WTC)	(STB)	(STH)								

12.4 Subsidiary entries to routines referred to the main entry

UBSIDIARY NTRY	MAIN ENTRY
AFCW1	APCW1
ANC	ANR
APAD	CSEL
APC	APR
ATRAN1	ATRAN
ATRAN2	ATRAN
ATRAN3	ATRAN
ATT	VVV
BACKF	XREWIN
BACKR	XREWIN
CHAINB	CHAIN
CLOSEW	XREWIN
CLPSC	INPSC
CPCH	CSEL
CRIT2	CRIT1
DCOPY	COPY
EOFILE	XREWIN
EOFREW	XREWIN
EPCH	CSEL
EPSC	CSEL
EROC	CSEL
EXIT	EXITA
FDIV	FMPY
FLAG1	FLAG
FLAG2	FLAG
FLCPY	LCPY
FORE	AFTER
INITBR	BRECHT
INITDO	COMPDO
INSLA	AFTER
INSLF	AFTER
INSL	AFTER
INTM	INT
LAST	SNEXT
LINO2	LINO1
LINO3	LINO1
LSHL	LSHR
MINV	MELEM
MSER	MELEM
NLH	BUILD
PCH	CSEL
PDUMP	DUMP
PSC	CSEL
PTRAN1	INPSC
PTRAN2	INPSC
PUCR	VVV
RCH	RRH
READCT	COPYCT
READ	EREAD
REWSYS	CHAIN
ROC	CSEL
SETEL	VVV
SETR	VVV
SHR	SHL
SIN	COS
SKIPF	XREWIN
SPL1	VVV
SPL	VVV
SRI	VVV
SUBA	ADDA
VAR3	VAR
VOC2	VOC1
VOC3	VOC1
XCLOSE	XREWIN
XEQ	ATRAN
XLEAVE	XREWIN
XLSH	RSH
XOPEN	XREWIN
XREAD	XREWIN
XTRB	TRB
XWAIT	XREWIN
XWRITE	XREWIN
ZZZSTP	ZZZLST

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Alfred Nobel

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