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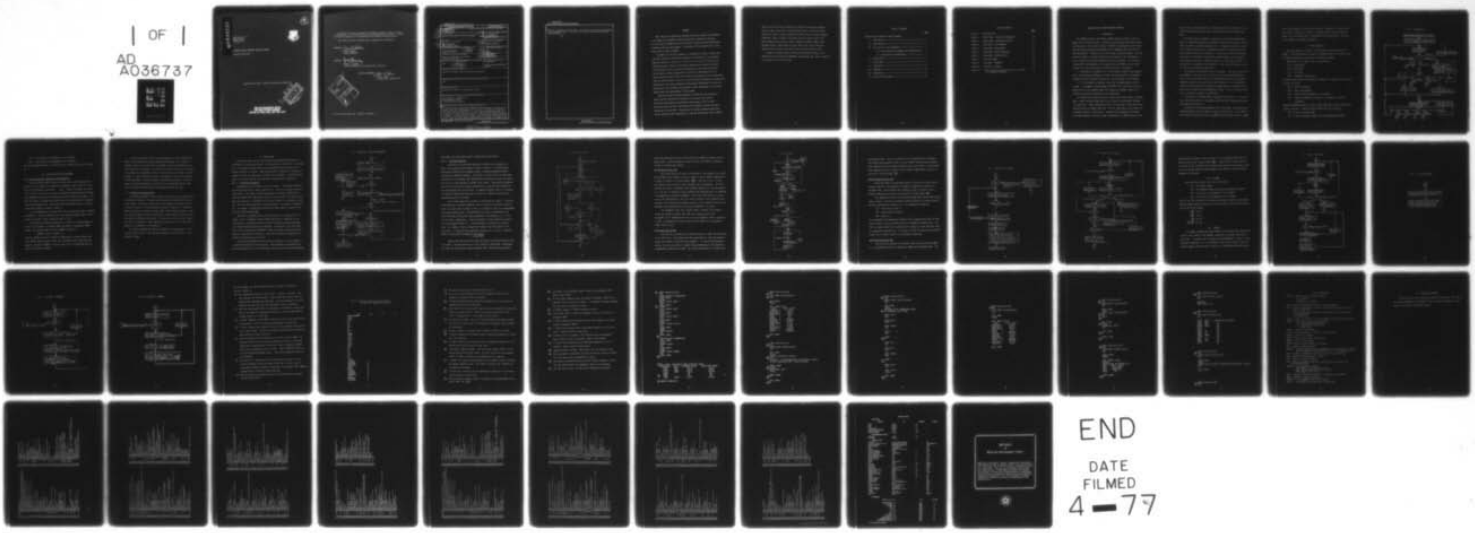

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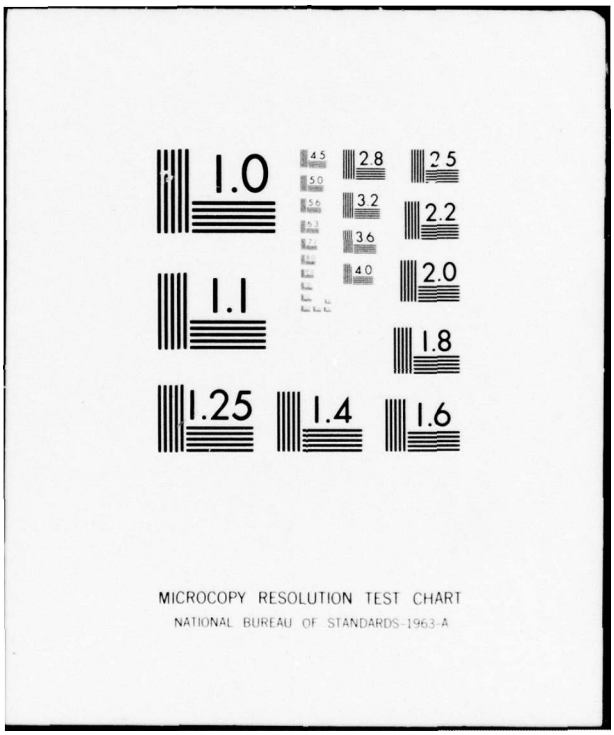
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RADC-TR-77-32
Phase Report
January 1977

ANTENNA SELECT COMPUTER PROGRAM (ANTSEL)

Syracuse University

ROME AIR DEVELOPMENT CENTER
AIR FORCE SYSTEMS COMMAND
GRIFFISS AIR FORCE BASE, NEW YORK 13441

This report has been reviewed by the RADC Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be releasable to the general public including foreign nations.

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APPROVED: Jacob Scherer

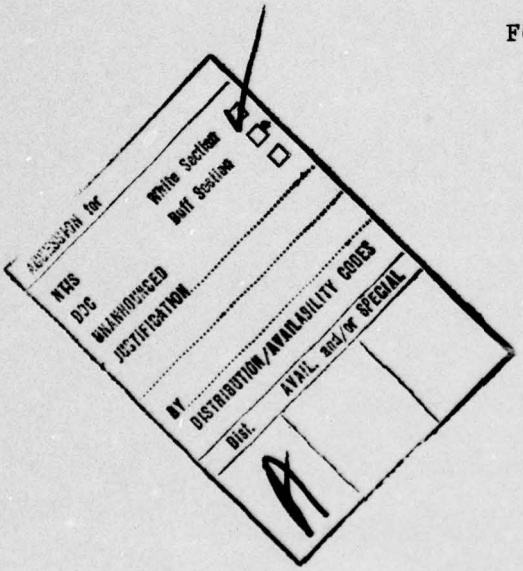
JACOB SCHERER
Project Engineer

APPROVED: Joseph J. Naresky

JOSEPH J. NARESKY
Chief, Reliability and Compatibility Division

FOR THE COMMANDER: John P. Huss

JOHN P. HUSS
Acting Chief, Plans Office



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The Antenna Select Computer code (ANTSEL) is described here. The code is designed to aid the ship designer in the selection of appropriate antennas at the concept stage of ship design. It is an initial version upon which the feasibility of such codes can be assessed. There are essentially three modes of operation -- Learn, Search, and List. Under Learn Mode, stored antenna data is updated. Under Search Mode, antennas that meet desired specifications are found. Under List Mode, selected antenna data is presented. Listings of two -

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versions of ANTSEL are included here. One version is suited for the Honeywell GCOS timesharing system. The other for the Control Data Corporation time-sharing system.

PREFACE

This effort was conducted by Syracuse University under the sponsorship of the Rome Air Development Center Post-Doctoral Program for the Navy. Mr. Tony Testa of NAVSEC was the task project engineer and provided overall technical direction and guidance. The authors of this report are Dr. Jose Perini and Dr. Harvey Schuman.

The RADC Post-Doctoral Program is a cooperative venture between RADC and some sixty-five universities eligible to participate in the program. Syracuse University (Department of Electrical and Computer Engineering), Purdue University (School of Electrical Engineering), Georgia Institute of Technology (School of Electrical Engineering), and State University of New York at Buffalo (Department of Electrical Engineering) act as prime contractor schools with other schools participating via sub-contracts with the prime schools. The U.S. Air Force Academy (Department of Electrical Engineering), Air Force Institute of Technology (Department of Electrical Engineering), and the Naval Post Graduate School (Department of Electrical Engineering) also participate in the program.

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ANTENNA SELECT COMPUTER PROGRAM (ANTSEL)

I. INTRODUCTION

The FORTRAN computer code ANTSEL (ANTenna SELect) provides a ship designer with an efficient means to determine those antennas that meet desired specifications. This initial version of ANTSEL was developed with the belief that many modifications and extensions will be suggested after the code becomes operational. Therefore, the code was kept relatively simple. Only the essential aspects of antenna selection were included in its development so that a program could become operational as soon as possible. In this way it is hoped that ship designers, the intended users of ANTSEL, can, by exercising it, do two things before an extensive effort is initiated.

1. Determine the feasibility of a user-oriented computer code augmenting or even replacing handbooks and other conventional means for selecting antennas and their shipboard locations in the early phase of ship design.

2. If the concept is feasible, then offer recommendations on how to proceed. For example, one improvement of ANTSEL that is certain to be suggested is that the allowable length of antenna and parameter names be increased (the present limitation is four characters).

The ANTSEL code allows the user to perform three major tasks: (1) Search Mode - search through antenna data file to locate an "acceptable" antenna, (2) Learn Mode - update antenna data file, (3) List Mode - print selected information from the antenna data file. Each of these modes is the subject of a separate section in this report. Detailed block diagrams are included. (For easy reference, each block label corresponds to a FORTRAN label in the

source code listings (Section IX). Another section (VII) describes a user-computer communication which serves to demonstrate operation under these modes.

The ANTSEL code is designed to operate in a time-sharing environment. There is considerable interaction between the user and the computer, and an effort was made to minimize response time. For example, during the search for acceptable antennas there is immediate printing of antennas that meet specification as they are encountered. In this way the user can terminate the search if satisfactory antennas are already brought to his attention. Also, whenever possible, a computer request for a user input includes a printing of all acceptable user responses. Thus, a quick reference to control options is immediately available.

Two versions of the ANTSEL code are available. One version operates on the Honeywell GCOS system and the other on the CDC time-sharing system. From a user's standpoint there is no appreciable difference except when attempting to supply a line with only a blank character. On the Honeywell system, these situations are effected by simply entering a carriage return <CR> since a blank is then automatically entered. On the CDC system, however, a blank must precede the <CR> entry.

A dictionary of variable names is provided in Section VIII. This section should prove useful to the reader especially when reviewing the source code listings (Section IX).

A discussion concerning peripheral and core storage, in particular the antenna-parameter data file ASDAT, is given in Section III. It is expected that ASDAT will eventually contain parameter data for many antennas. (ASDAT

can be easily updated via Learn Mode control.) Therefore, to prevent loss of the data in ASDAT in the event of a machine "crash" during an input to ASDAT, it is recommended that a backup data file be maintained. This file can be updated at reasonable intervals.

II. MODE SELECTION

The block diagram in Figure 1 portrays the mode selection aspect of ANTSEL. (The block numbers correspond to FORTRAN labels in the source code.) All options available to the user are 2-character strings.

When control is at "mode" level, the choices are

"SE" -- Search Mode

"LE" -- Learn Mode

"LI" -- List Mode

"EX" -- Terminate Program (exit)

The Search Mode control is discussed in Section IV. Under Learn Mode control the user can select

"NA" -- Add a new antenna

"NP" -- Add a new parameter

"MA" -- Modify certain parameters of an antenna

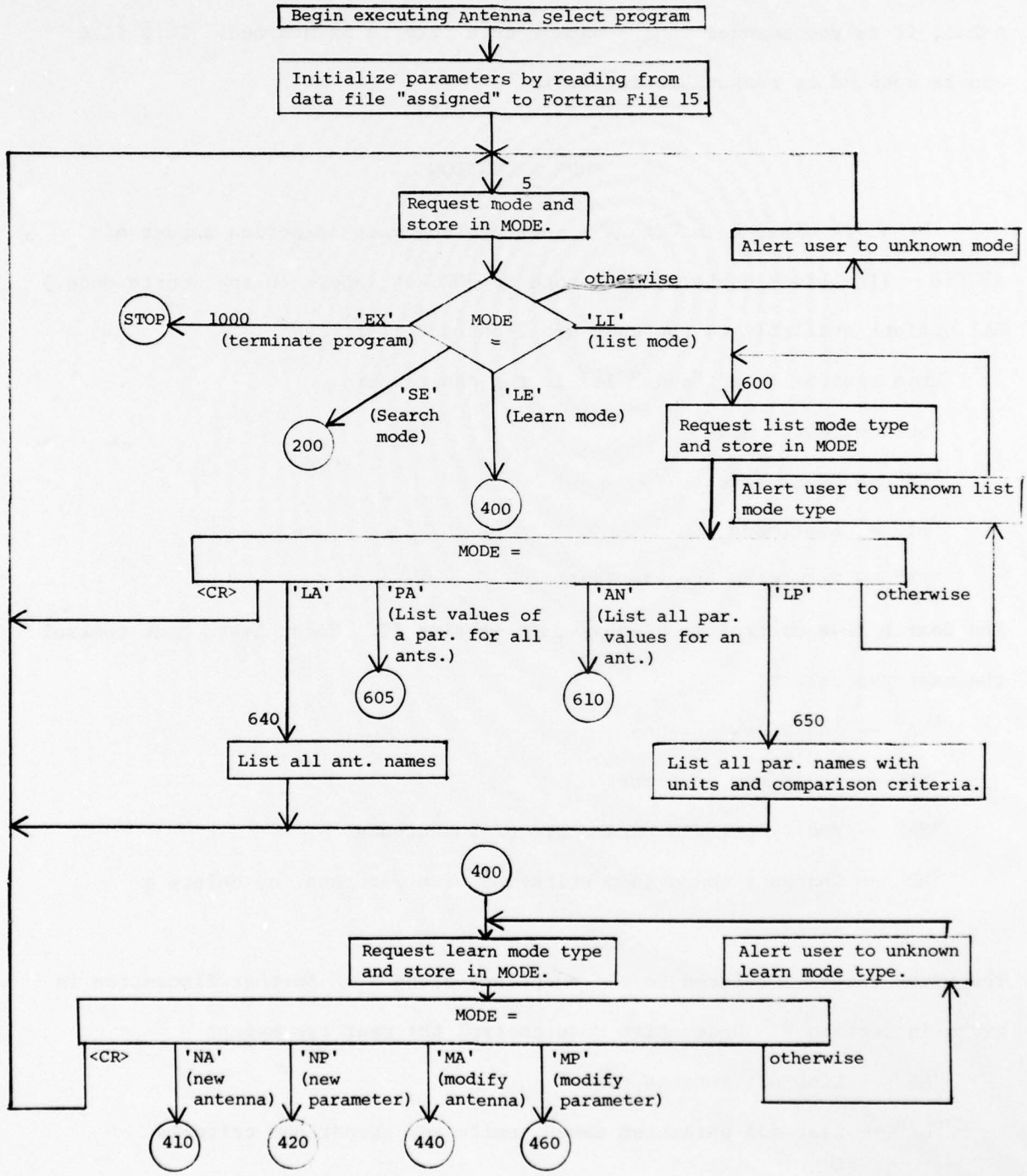
"MP" -- Change a comparison criterion of a parameter or delete a parameter.

The block diagrams related to these options along with further discussion is given in Section V. Under List Mode control the user can select

"LA" -- List all antenna names

"LP" -- List all parameter names, units and comparison criteria

Fig. 1 MODE SELECTION



"PA" -- List values of a parameter for all antennas

"AN" -- List values of all parameters for an antenna.

The block diagrams related to the "PA" and "AN" options are given in Section VI.

III. DATA AND CORE SIZE MANAGEMENT

3.1. Data Storage and Program Core Considerations

All data (antenna names; parameter values, units, and comparison criteria; etc.) are stored in a system file assigned to Fortran file 15. This file is called ASDAT in the report. Also, ASDAT is assigned to Fortran file 15 in the control lines of both the Honeywell compatible and CDC compatible (ANTSELCD) versions of the ANTSEL code (note Section IX listings). The data file ASDAT is automatically updated after each modification or addition to antenna parameter data. This occurs under Learn Mode control. The pertinent block diagram is shown in Figure 8.

It is recommended that a backup data file be maintained which is updated periodically. This will prevent loss of the antenna-parameter data in the event of a machine "crash" during an input to ASDAT.

The peripheral storage requirement for the data file ASDAT depends, of course, on the number of antennas (NANT) and number of parameters (NPAR) stored. The minimum number of words (NWORDS) required is

$$NWORDS = (NANT + 4)(NPAR + 1)$$

Also, the ANTSEL code must be properly dimensioned to contain these words since ANTSEL reads the entire ASDAT file immediately after initiating the program. Therefore, NWORDS is also the main factor in estimating the run-time core storage for ANTSEL.

If, under Learn Mode control, the user attempts to add an antenna when NANT = JDIM, where JDIM = array dimensioning pertaining to the number of antennas, then he is notified that the ANTSEL source code dimension statements must first be changed. The particular variables affected by the dimension changes are automatically listed to aid the user in carrying out these changes. A similar situation occurs if an attempt to enter a new parameter is made when NPAR = IDIM (the parameter dimensioning variable.) For these checks on array dimensioning to be effective, the variables JDIM and IDIM must be adjusted in ASDAT whenever dimensioning changes are made.

3.2. Input/Output Considerations

All antenna, parameter and units names are limited to one computer word of 4-character length. Of course, future versions of ANTSEL will allow for larger names. This severe restriction in name length was imposed in order to permit operation of this preliminary version of ANTSEL on the Honeywell system with only one computer word per name. When typing an antenna, parameter, or units name, the user is permitted to append the four characters with any number of additional characters. Of course, only the first four characters will be recognized. Each comparison criterion, e.g. "LE" (less than or equal to), is limited to two characters.

All numeric parameter data must be supplied in floating point. On input the format is G16.8. The character parameter data is limited to a two character string.

IV. SEARCH MODE

Under Search Mode control those antennas satisfying user-specified requirements are located and printed. This operation is carried out in two steps. First, the design parameter values are specified and then the data file of "known" antennas is searched. Upon encountering a "satisfactory" antenna its parameter values are immediately printed before continuing. A satisfactory antenna is one satisfying all user-specified "high priority" parameters.

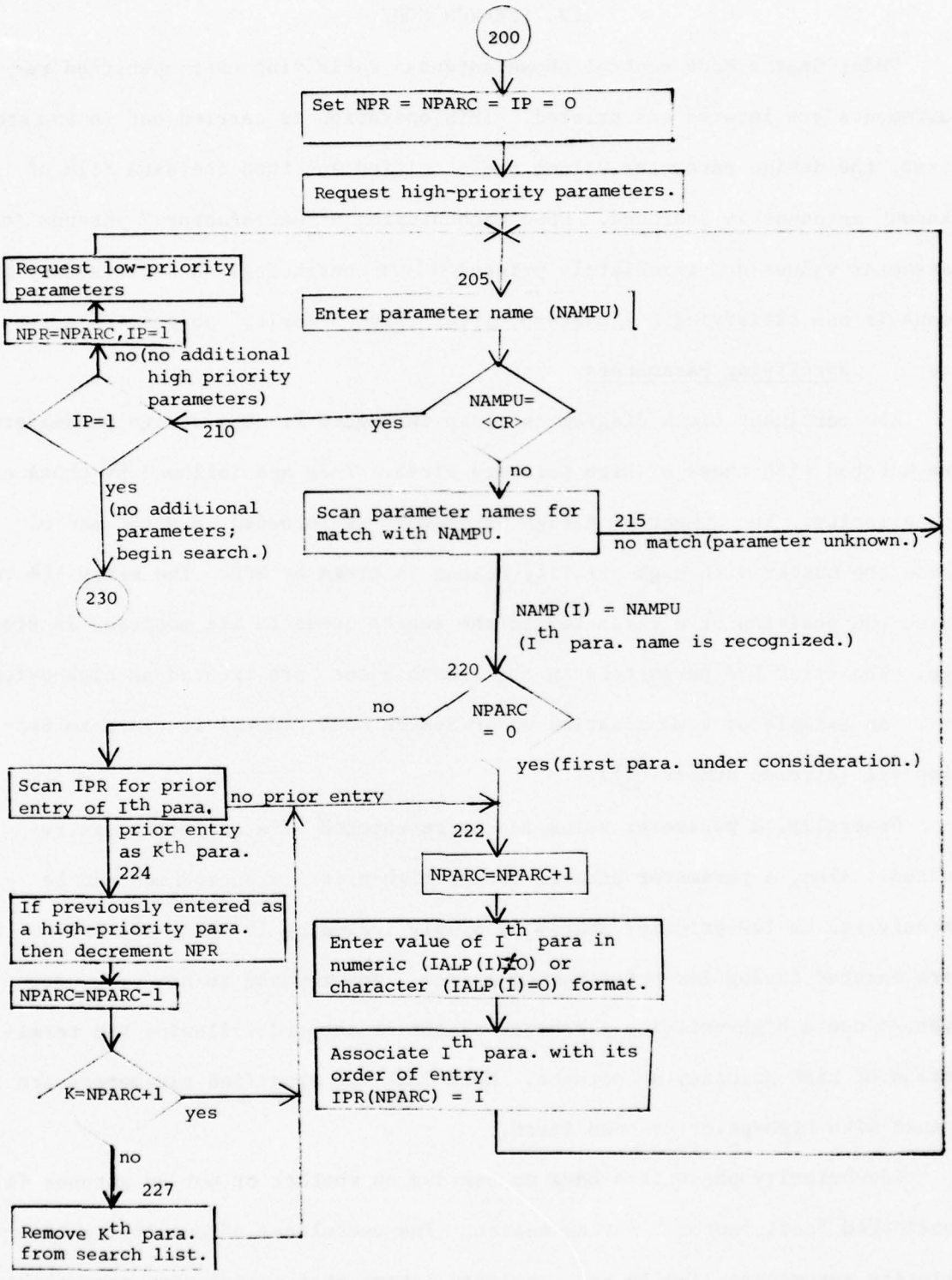
Step 1. Specifying Parameters

The pertinent block diagram is given in Figure 2. The design parameters are entered with those of high priority first. They are followed by those of low priority. The number of design parameters is recorded in NPARC and of these the number with high-priority status is given by NPR. The array IPR relates the position of a parameter in the search queue to its position in storage. The first NPR parameters in the search queue are treated as high-priority. An example of communication under Search Mode control is given in Section VII (circled number (1)).

Generally, a parameter value can be re-entered if a correction is required. Also, a parameter entered during high-priority acceptance can be transferred to low-priority status by simply including it among the parameters entered during low-priority acceptance. The reverse is not true, however, since a high-priority parameter cannot be entered following the termination of high-priority acceptance. Note that the specified parameters are queued with high-priority ones first.

Low-priority parameters have no bearing on whether or not an antenna is considered "satisfactory" during search. The usefulness of specifying low-priority parameters lies in the tabulated output that occurs upon encountering

Fig. 2 SEARCH MODE - SPECIFYING PARAMETERS



an antenna that meets high-priority specifications (see below).

Step 2. Searching Antennas

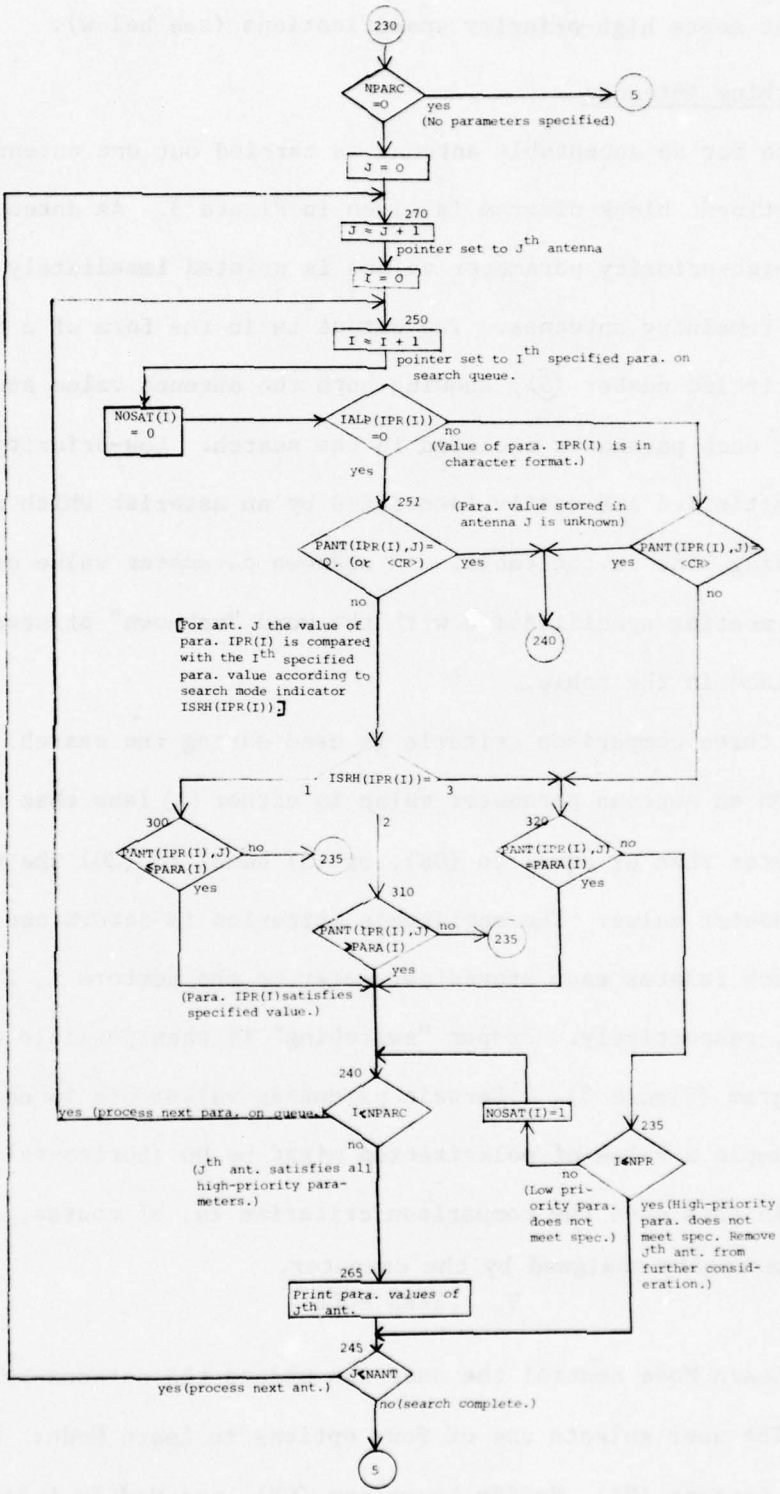
A search for an acceptable antenna is carried out one antenna at a time. The pertinent block diagram is given in Figure 3. An antenna with satisfactory high-priority parameter values is printed immediately before searching the remaining antennas. The output is in the form of a table (See Section VII, circled number ⑤) showing both the antenna value and the specified value for each parameter included in the search. Low-priority parameters that are not satisfied are easily identified by an asterisk which appears in the corresponding line in the table. An unknown parameter value of an antenna is treated as meeting specification with the word "unknown" printed in the appropriate place in the table.

One of three comparison criteria is used during the search. To satisfy a specification an antenna parameter value is either (1) less than or equal to (LE), (2) greater than or equal to (GE), or (3) equal to (EQ) the corresponding specified parameter value. The applicable criterion is determined by the array ISRH which relates each stored parameter to the numbers 1, 2 or 3 for LE, GE and EQ, respectively. Proper "switching" is then possible as shown in the block diagram (Figure 3). Certain parameter values are in character form. For example a value of polarization might be HO (horizontal) or VE (vertical). In this case the comparison criterion is, of course, 3 (equals) which is automatically assigned by the computer.

V. LEARN MODE

Under Learn Mode control the user can update the antenna-parameter data file ASDAT. The user selects one of four options to Learn Mode: New Parameter (NP), New Antenna (NA), Modify Parameter (MP), and Modify Antenna (MA).

Fig. 3 SEARCH MODE - SEARCHING ANTENNAS



During the operation of any of these options the changes are made to data in core storage. Upon concluding an option the data file ASDAT in peripheral storage is automatically updated.

New Parameter Option (NP)

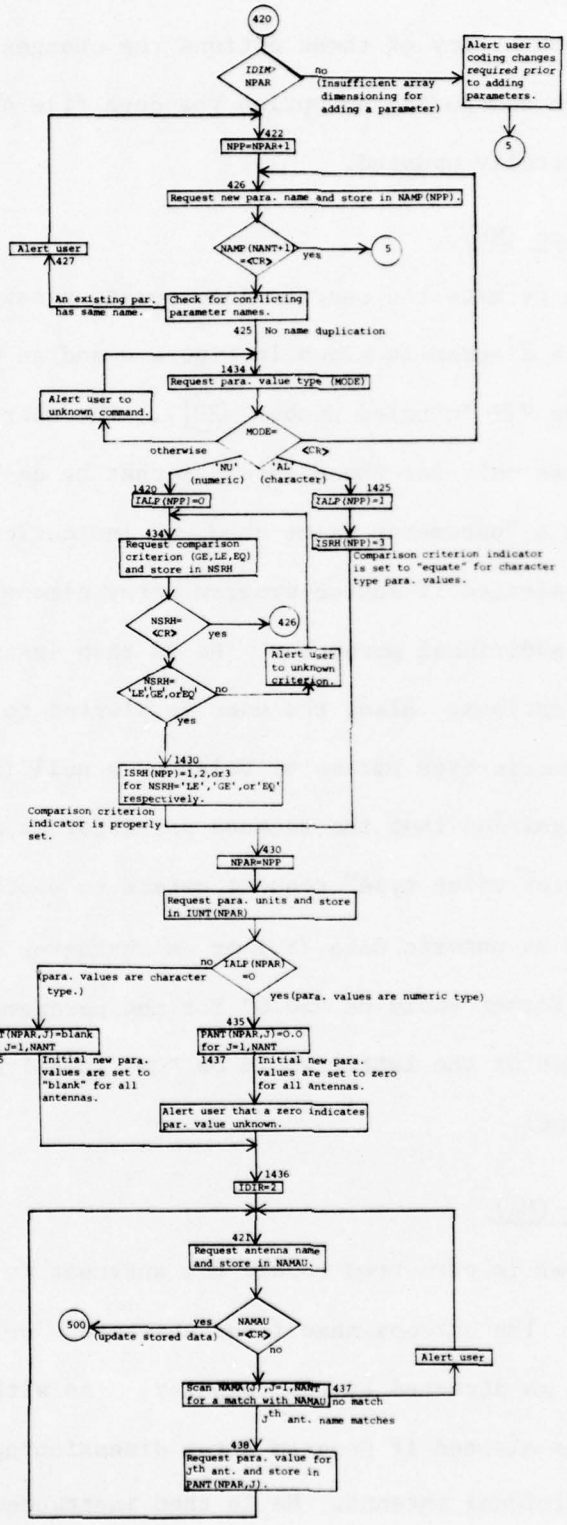
This option permits the user to incorporate a new parameter into ASDAT. The pertinent block diagram is given in Figure 4 and an example communication is given in Section VII (circled number (20)). The user is asked to enter new parameter values only for those antennas that he designates. All other antennas are given a "parameter value unknown" indication for the new parameter. The user is alerted if source program array dimensioning is not adequate to accommodate an additional parameter. He is then instructed as to proper source code modifications. Also, the user is alerted to the convention that an exactly zero numeric-type parameter value or a null (blank) character-type parameter value signifies that the antenna parameter is not known.

The "parameter value type" request refers to whether the parameter values are treated as numeric data (NU) or as character data (AL). An example of the former would be "50.0" for the parameter "IMPE" (impedance) in ohms. An example of the latter would be "OM" (omni) for the parameter "BEAM" (pattern type).

New Antenna Option (NA)

Here the user is permitted to add new antennas to ASDAT upon availability of their data. The antenna name (four characters or less) and parameter values are entered as directed by the computer. As with the New Parameter option, the user is alerted if program array dimensioning is not adequate to accommodate an additional antenna. He is then instructed as to proper source

Fig. 4 LEARN MODE - NEW PARAMETER



code modifications. Also, he is alerted to the convention that an exactly zero numeric-type parameter value or a null (blank) character-type parameter value signifies that the antenna parameter value is not known. The pertinent block diagram is given in Figure 5 and an example communication is given in Section VII (circled number (16)).

Modify Parameter Option (MP)

Under this aspect of Learn Mode control, the user can either delete a parameter (DE) (for all antennas) or change the comparison criterion of a parameter (MO). The pertinent block diagram is given in Figure 6 and an example communication is given in Section VII (circled number (30)).

The comparison criteria are the means through which Search Mode control either accepts or rejects an antenna during the search for antennas satisfying user specifications (Section IV). The comparison criteria are

"LE" - less than or equal to,

"GE" - greater than or equal to

"EQ" - equal to.

For a parameter with comparison criterion "LE" an antenna value that is less than or equal to a user specified value is considered as meeting spec. For "GE" an antenna value that is greater than or equal to a user specified value is considered as meeting spec. Of course, for "EQ" the antenna and specified values must be exactly equal for the antenna to meet spec.

Modify Antenna Option (MA)

Here an entire antenna can be deleted (DE) from the data file ASDAT, or the parameter values of an antenna in ASDAT can be modified (MO). The

Fig. 5 LEARN MODE - NEW ANTENNA

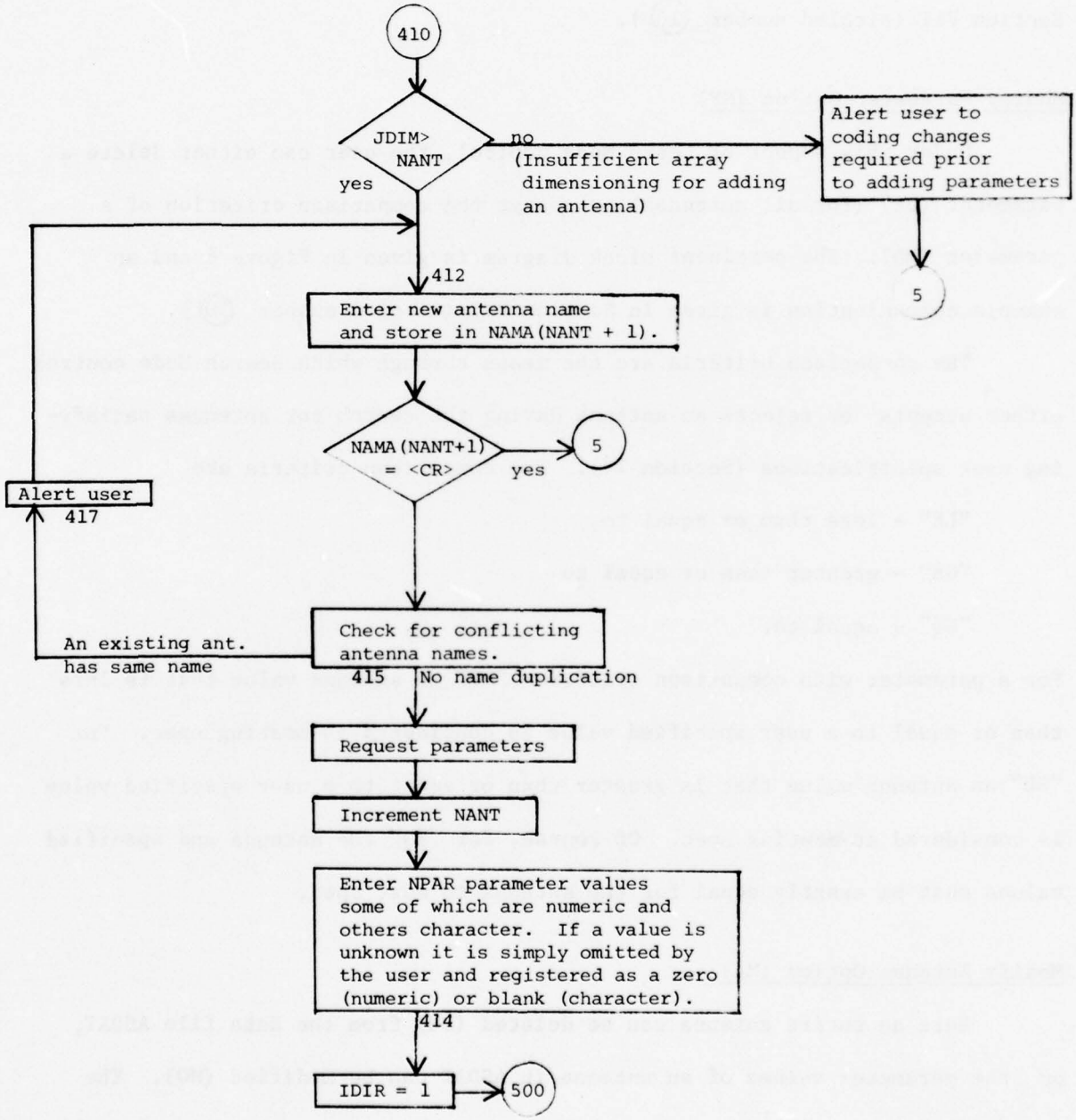
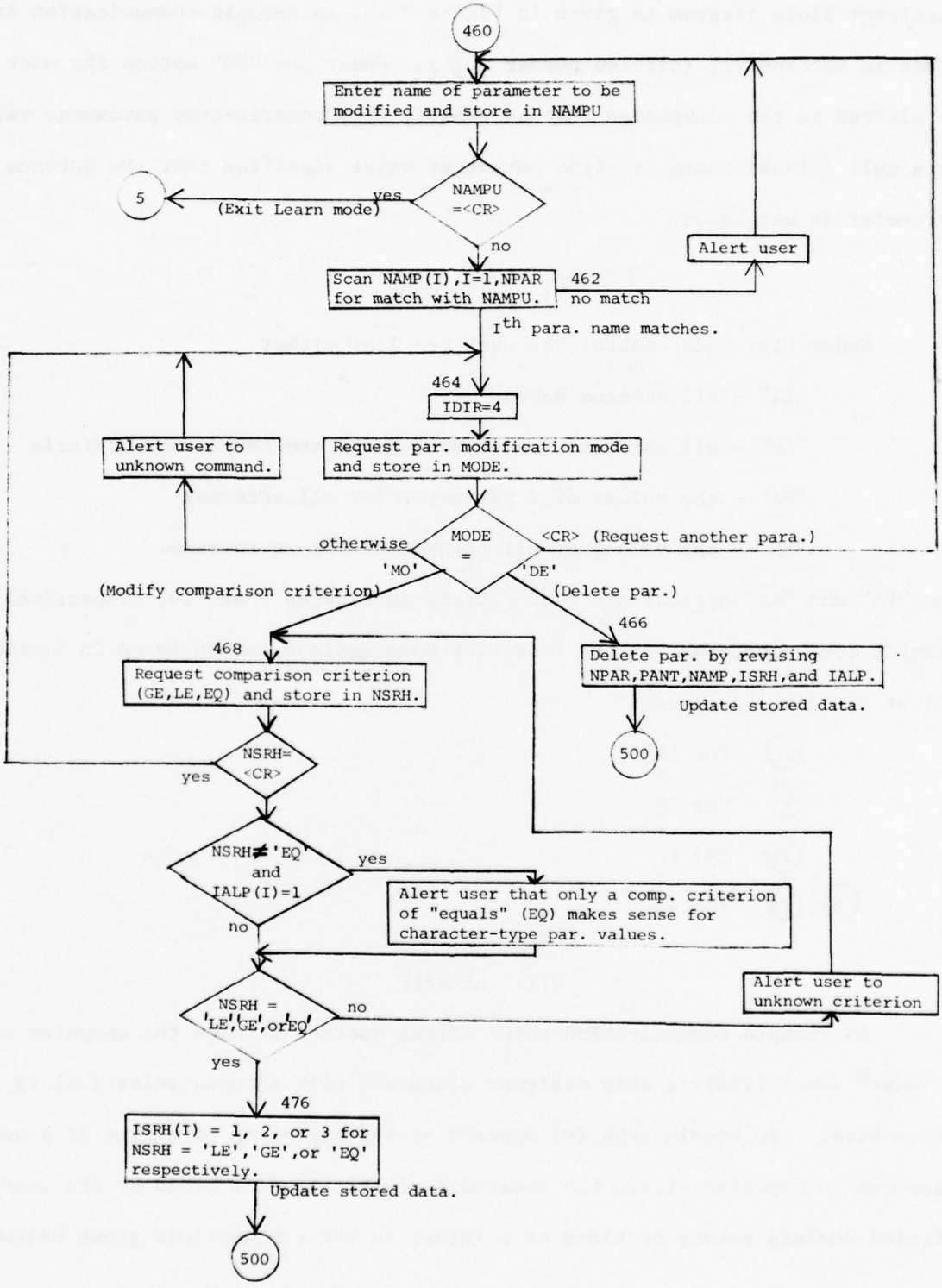


Fig. 6 LEARN MODE - MODIFY PARAMETER



pertinent block diagram is given in Figure 7 and an example communication is given in Section VII (circled number (11)). Under the "MO" option the user is alerted to the convention that an exactly zero numeric-type parameter value or a null (blank) character-type parameter value signifies that the antenna parameter is not known.

VI. LIST MODE

Under List Mode control the user can list either

"LA" - all antenna names

"LP" - all parameter names with units and comparison criteria

"PA" - the values of a parameter for all antennas

"AN" - the values of all parameters for an antenna.

The "PA" and "AN" options are flow-charted in Figures 9 and 10, respectively. Example communications for the four List Mode options can be found in Section VII at the circled numbers

(28) for LA

(29) for LP

(26) for PA

(9), (19) for AN

VII. EXAMPLE

An example communication under ANTSEL control between the computer and a "user" (most likely a ship designer concerned with antenna selection) is given here. An equals sign (=) appears at the beginning of a line if a user response is expected, i.e., the remainder of that line is typed by the user. Circled numbers relate sections of printout to the explanations given below.

Fig. 7 LEARN MODE - MODIFY ANTENNA

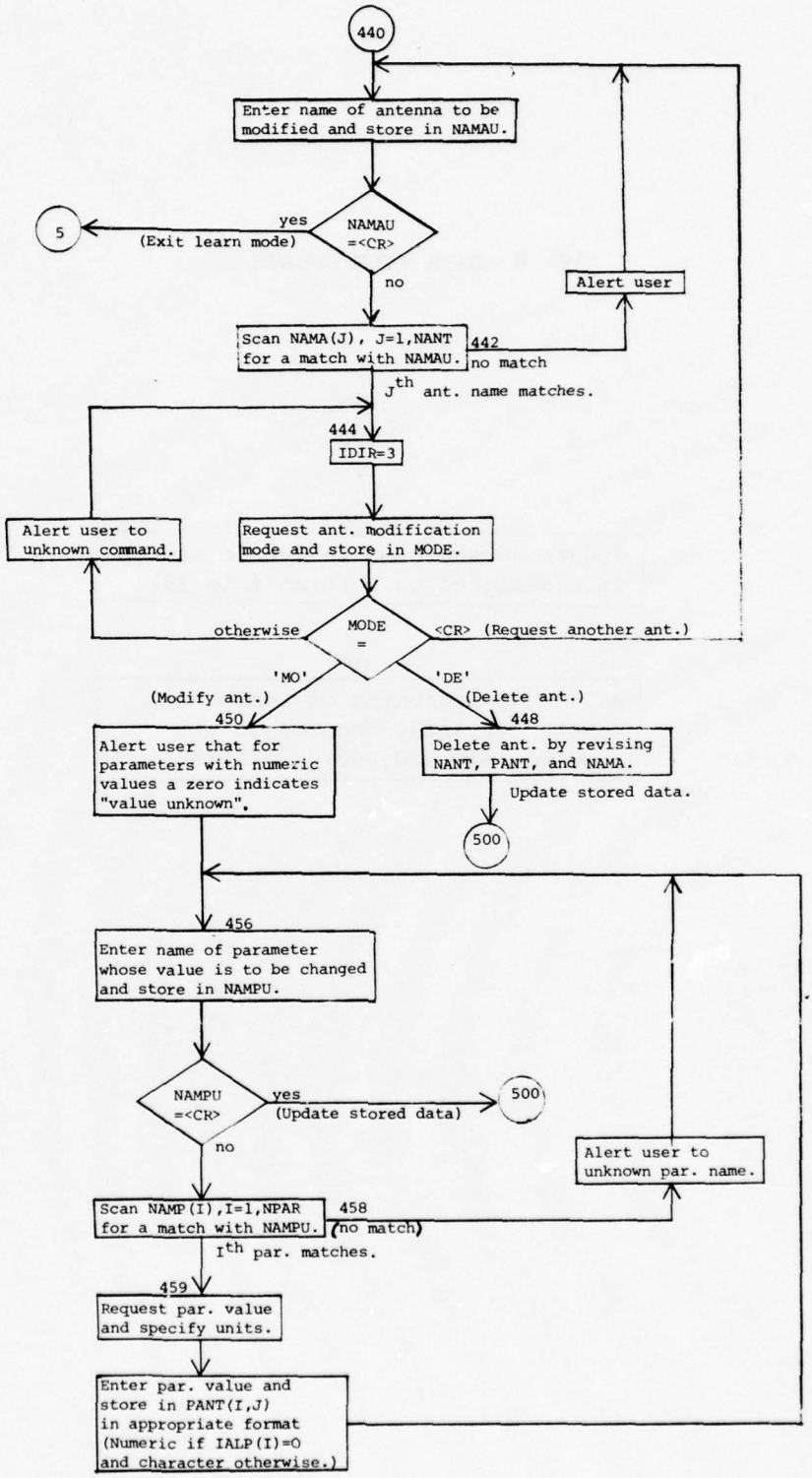


Fig. 8 DATA FILE UPDATE

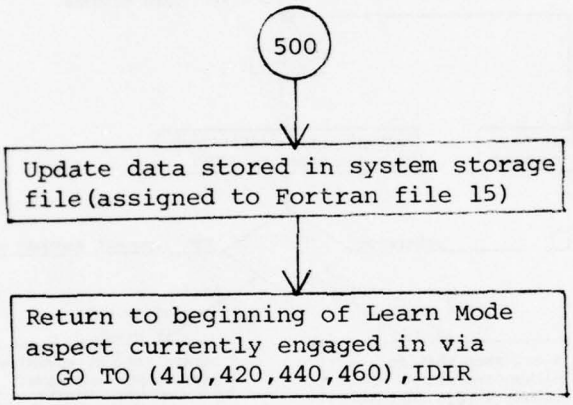


Fig. 9 LIST MODE - PARAMETER

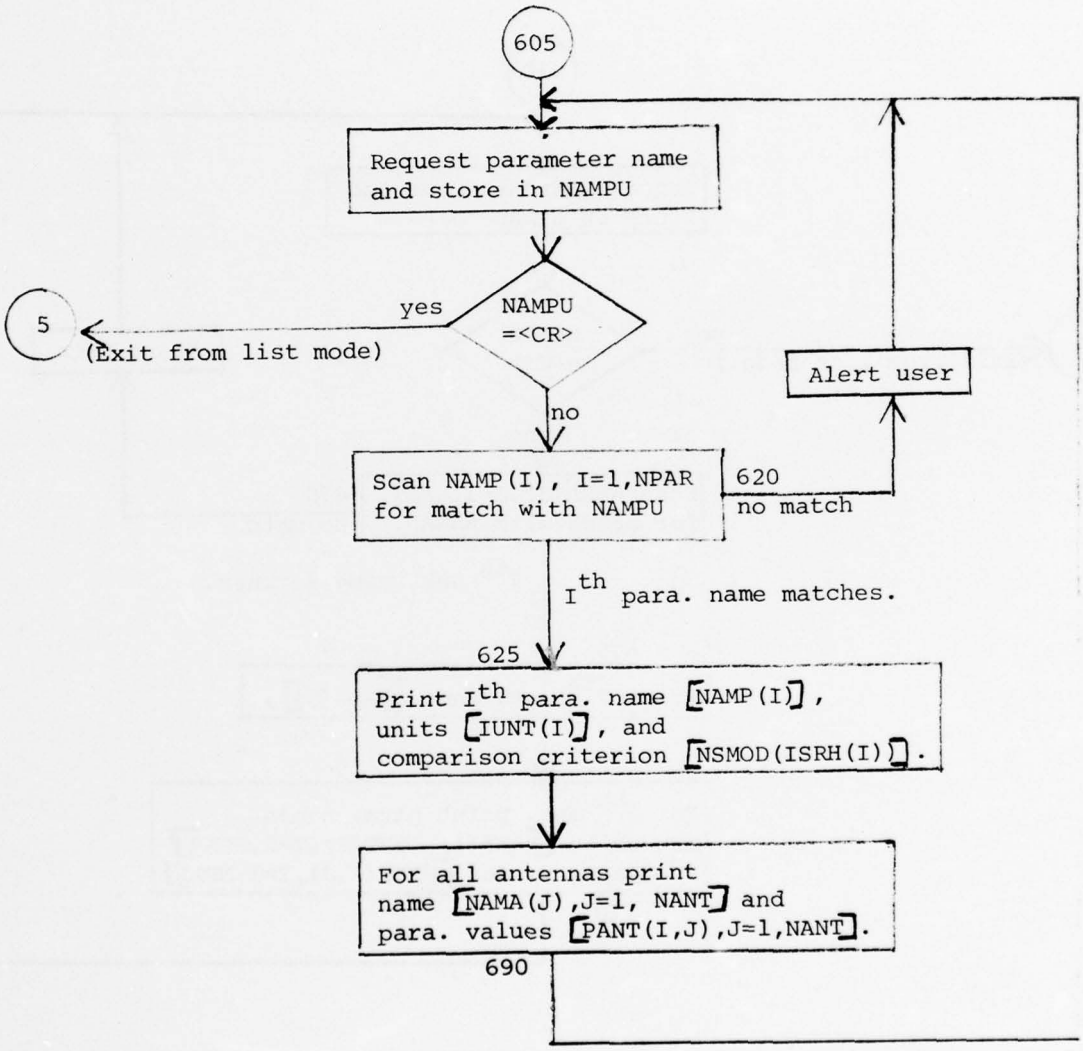
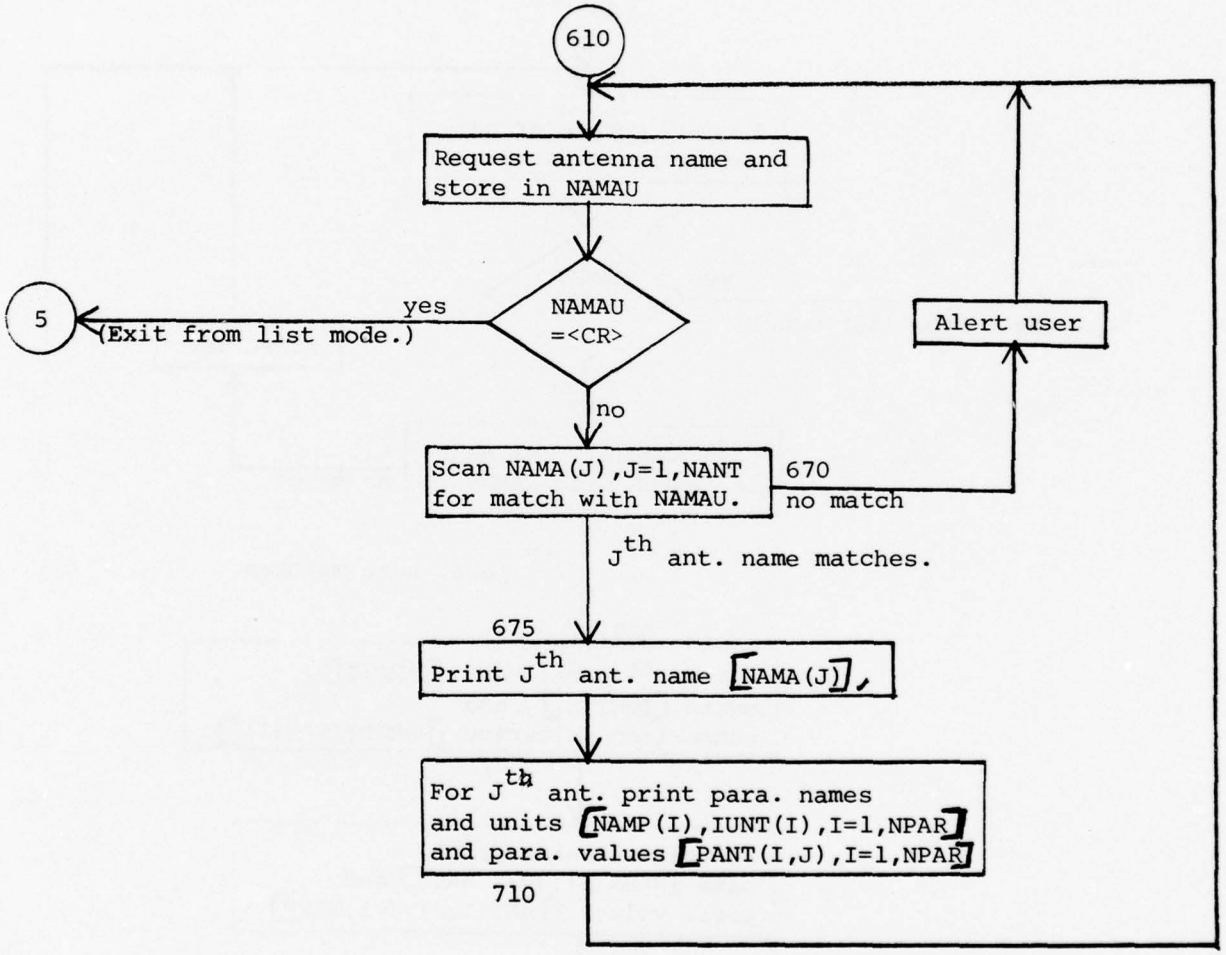


Fig. 10 LIST MODE - ANTENNA



For this example, the data initially stored in the data file ASDAT is listed in Figure 11.

① The communication begins at "Mode" level. A mode is requested. The user supplies "SE" (Search Mode). Under Search Mode control first the high-priority parameters are specified. The user responds first with a parameter name and then with that parameter's value as indicated.

② Note that the parameter LFRE (low frequency) is specified a second time. This is the means for changing specification -- in the example LFRE is changed from 150.0 to 120.0 MHz.

③ A "blank" response to "PARA.NAME" indicates the end of the high-priority specifications. Next the low-priority parameters are specified.

④ A "blank" response here indicates the end of the parameter specification part of Search Mode. A search for antennas satisfying the high-priority specifications is then carried out.

⑤ Upon encountering such an antenna, such as "DIPO" in the example, the parameter values of the antenna are immediately printed in the format shown before continuing with the search. Under the heading "ANTENNA VALUE" are the parameter values of "DIPO". Under "SPECIFIED VALUE" are the user-specified parameter values. Only those parameters specified are tabulated.

⑥ An asterisk (*) following the last column alerts the user to a low-priority parameter value that does not meet spec. In this case the polarization parameter ("POLA") is specified as horizontal ("HO") whereas antenna DIPO is vertically ("VE") polarized.

⑦ When the search is complete the user is so notified, and the control returns to Mode level.

Fig. 11 Listing of data initially stored in File ASDAT for example of Section 7.

```
          25          10          11          2
00011000000
WHIP
.014
32.
0.
VE
OM
0.
5.15
0.
2000.
123.
14.4
DIPO
115.
162.
100.
VE
OM
0.
2.
50.
2.
7.5
.535
LFREMHZ          1
HFREMHZ          2
PMAXWATT         2
POLA             3
BEAM             3
SLOBDB           1
GAINDB           2
IMPEOHMS         3
VSWR             1
WEIGLBS          1
VOLUFT3          1
```

⑧ The user now chooses the List Mode option ("LI").

⑨ He is at List Mode command level and now requests ("AN") that the parameters of antenna "DIPO" be printed.

⑩ A "blank" indicates that no additional antennas are to be printed and command then returns to Mode level.

⑪ Learn Mode ("LE") is now chosen since the user is interested in modifying ("MA") the antenna "DIPO". Under this option he may delete ("DE") "DIPO" or change some of its parameter values ("MO").

⑫ He chooses the latter. The user is then cautioned that numeric parameter values of exactly zero are interpreted as "parameter value unknown" by the program.

⑬ The user changes the sidelobe level ("SLOB") of "DIPO" to .001 dB.

⑭ A "blank" response here indicates that no additional parameters of "DIPO" are to be modified.

⑮ A "blank" response here indicates that no additional antennas are to be modified and control returns to Mode level.

⑯ Learn Mode is again selected. This time a new antenna ("NA") is to be entered and given the name "CROS". The user then enters the parameter values of "CROS" according to the prompting of the computer.

⑰ A "blank" (or simply an omitted entry on the Honeywell system) indicates an unknown parameter value. For "CROS" the pattern type ("BEAM") and the VSWR are not known.

⑱ A "blank" here indicates that no additional antennas are to be entered. Control returns to Mode level.

⑲ Here a listing of antenna "CROS" is requested in the same manner as for "DIPO" above (ref. ⑧).

⑳ Learn Mode is now invoked in order to enter a new parameter ("NP" option) named "FEED".

㉑ The "AL" option signifies that the values of parameter "FEED" are of character type in contrast to numeric. For example "AC" might indicate that the feed of an antenna is active.

㉒ A "blank" response to "UNITS" indicates no units.

㉓ Here antenna "CROS" is given the parameter value "AC" (active) for parameter "FEED".

㉔ A "blank" response here indicates that no other antennas have known values of parameter "FEED".

㉕ A "blank" here indicates that no additional parameters are to be entered. Control returns to Mode level.

㉖ List Mode ("LI") is invoked. This time with the print-parameter option ("PA") so that the parameter "FEED" can be printed.

㉗ A "blank" here indicates that no additional parameters are to be printed. Control returns to Mode level.

㉘ Again List Mode is chosen. This time to list all antennas ("LA").

㉙ This invocation of List Mode, with the "LP" option, lists all parameters with their units and comparison criteria.

㉚ Learn Mode is selected here with the "MP" (Modify Parameter) option. The user deleted ("DE") the parameter "VOLU" for all antennas.

㉛ The "EX" (exit) option, at Mode level, terminates the program.

```
(1) MODE (SE,LE,LI,EX)
    =SE
    HIGH-PRIORITY PARAMETERS
    PARA. NAME
    =LFRE
    PARA. VALUE (MHZ )
    =150.
    PARA. NAME
(2) =LFRE
    PARA. VALUE (MHZ )
    =120.
    PARA. NAME
    =HFRE
    PARA. VALUE (MHZ )
    =150.
    PARA. NAME
    =PMAX
    PARA. VALUE (W ATT)
    =80.
    PARA. NAME
    =BEAM
    PARA. VALUE (    )
    =OM
    PARA. NAME
(3) =
    LOW-PRIORITY PARAMETERS
    PARA. NAME
    =POLA
    PARA. VALUE (    )
    =HO
    PARA. NAME
    =IMPE
    PARA. VALUE (OHMS)
    =50.
    PARA. NAME
(4) =


(5) ANT. DIPO  SATISFIES HIGH PRIORITY PARS.
    PARAMETER   UNITS   ANTENNA VALUE    SPECIFIED VALUE
       LFRE      MHZ        115.0             120.0
       HFRE      MHZ        162.0             150.0
       PMAX      WATT       100.0             80.00
       BEAM                  OM                OM
(6)    POLA                  VE                HO          *
       IMPE      OHMS       50.00             50.00

(7) SEARCH COMPLETE
```

```
MODE (SE,LE,LI,EX)
(8) =LI
LIST MODE (PA,AN,LA,LP)
(9) =AN

ANT. NAME
=DIPO

ANT. NAME= DIPO
  PAR.          PAR. VALUE
LFRE(MHZ )         115.0
HFRE(MHZ )         162.0
PMAX(WATT)         100.0
POLA(    )          VE
BEAM(    )          OM
SLOB(DB  )       UNKNOWN
GAIN(DB  )         2.000
IMPE(OHMS)         50.00
VSWR(    )         2.000
WEIG(LBS )         7.500
VOLU(FT3 )        0.5350
FEED(    )       UNKNOWN

ANT. NAME
(10) =


MODE (SE,LE,LI,EX)
(11) =LE
LEARN MODE (NA,NP,MA,MP)
=MA

ANT. NAME
=DIPO
DELETE OR MODIFY (DE,MO)
(12) =MO
CAUTION - FOR PARAMETERS WITH NUMERIC VALUES
A ZERO INDICATES PAR. VALUE UNKNOWN

PARA. NAME
(13) =SLOB
NEW VALUE (DB  )
=.001

PARA. NAME
(14) =

ANT. NAME
(15) =
```

```
MODE (SE,LE,LI,EX )
(16) =LE
LEARN MODE (NA,N P,MA,MP)
=NA

ANT. NAME
=CROS
RESPOND WITH PARAMETER VALUE.
(17) IF UNKNOWN OMIT ENTRY.

LFRE (MHZ )
=30.

HFRE (MHZ )
=250.

PMAX (WATT)
=50.

POLA (    )
=HO

BEAM (    )
(17) =

SLOB (DB  )
=2.

GAIN (DB  )
=1.8

IMPE (OHMS)
=50.

VSWR (    )
(17) =

WEIG (LBS )
=70.

VOLU (FT3 )
=123.

ANT. NAME
(18) =
```

```
MODE (SE,LE,LI,EX)
(19)=LI
LIST MODE (PA,AN,LA,LP)
=AN

ANT. NAME
=CROS

ANT. NAME= CRO S
  PAR.          PAR. VALUE
LFRE(MHZ )        30.00
HFRE(MHZ )        250.0
PMAX(WATT)        50.00
POLA(    )         HO
BEAM(    )       UNKNOWN
SLOB(DB  )        2.000
GAIN(DB  )        1.800
IMPE(OHMS)        50.00
VSWR(    )       UNKNOWN
WEIG(LBS )        70.00
VOLU(FT3 )        123.0

ANT. NAME
=
```

```
MODE (SE,LE,LI,EX)
(20) =LE
LEARN MODE (NA,NP,MA,MP)
=NP

PARA. NAME
=FEED
PARA. VALUE TYPE (AL,NU)
(21) =AL
UNITS
(22) =

ANT. NAME
(23) =CROS
PARAMETER VALUE
=AC

ANT. NAME
(24) =

PARA. NAME
(25) =


MODE (SE,LE,LI,E X)
(26) =LI
LIST MODE (PA,AN ,LA,LP)
=PA

PARA. NAME
=FEED

PAR. NAME= F EED
UNITS=
COMPARISON CRITERION= EQ
ANT.     PAR. V ALUE
WHIP      UNKN OWN
DIPO      UNKN OWN
CROS        AC

PARA. NAME
(27) =
```

```
MODE (SE,LE,LI,EX)
(28) =LI
LIST MODE (PA,AN ,LA,LP)
=LA

ANTENNAS
WHIP DIPO CRO S


MODE (SE,LE,LI,EX)
(29) =LI
LIST MODE (PA,AN,LA,LP)
=LP

PARA   UNITS   COMPARISON CRITERIA
LFRE   MHZ        LE
HFRE   MHZ        GE
PMAX   WATT       GE
POLA              EQ
BEAM              EQ
SLOB   DB         LE
GAIN   DB         GE
IMPE   OHMS       EQ
VSWR              LE
WEIG   LBS        LE
VOLU   FT3        LE
FEED              EQ


MODE (SE,LE,LI,EX)
(30) =LE
LEARN MODE (NA,NP,MA,MP)
=MP

PARA. NAME
=VOLU
DELETE PAR OR MODIFY COMPARISON CRITERION (DE,MO)
=DE

PARA. NAME
=


MODE (SE,LE,LI,EX)
(31) =EX
```

VIII. DEFINITIONS

IALP(I) - data type of Ith parameter values.

$$= \begin{cases} 0 \text{ - numeric} \\ \text{otherwise - character} \end{cases}$$

IDIM - array dimensioning for number of stored parameters.

IDIR - pointer to keep track of return location after revising ASDAT (data file) in Learn Mode.

IP - priority indicator of parameters being specified for Search Mode.

$$= \begin{cases} 0 \text{ high-priority} \\ 1 \text{ low-priority} \end{cases}$$

IPR(I) - order, in storage, of the Ith parameter entered during Search Mode.

ISRH(I) - comparison criterion of Ith parameter.

$$= \begin{cases} 1 \text{ - less than or equal (LE)} \\ 2 \text{ - greater than or equal (GE)} \\ 3 \text{ - equal (EQ)} \end{cases}$$

IUNT(I) - units of Ith parameter.

JDIM - array dimensioning for number of stored antennas.

NAMA(J) - name of Jth antenna.

NAMAU - name of antenna under consideration.

NAMP(I) - name of Ith parameter.

NAMPU - name of parameter under consideration.

NANT - number of stored antennas.

NOSAT(I) - indicates whether the Ith parameter has been satisfied for antenna under consideration during Search Mode. If satisfied, then = 0.

NPARC - number of parameters considered by user during Search Mode.

NPM - temporary storage variable. = NPAR-1.

NPAR - number of stored parameters.

NPR - number of parameters specified as high-priority (entered first) during Search Mode.

NSMOD(K) - Kth comparison criterion.

$$= \begin{cases} \text{"LE" (less than or equal to) for K=1.} \\ \text{"GE" (greater than or equal to) for K=2.} \\ \text{"EQ" (equal to) for K=3} \end{cases}$$

NSRH - comparison criterion entered for a parameter in Learn Mode.

NUMSH - number of comparison criteria.

PANT(I,J) - Ith parameter value of Jth antenna.

PARA(I) - Ith parameter value specified in Search Mode.

IX. SOURCE CODE LISTINGS

Two Fortran source code listings of ANTSEL are given here. The first is the version compatible with Honeywell GCOS. The second (ANTSELCD) is compatible with the CDC time-sharing system.

```
10*#RUN= # ASDAT "15"
20C  ANTENNA SELECT PROGRAM
30       DIMENSION PANT(25,10),ISRH(25),IPR(25),PARA(25),NOSAT(25)
40       DIMENSION NAMP(25),IUNT(25),NAMA(10),NSMOD(3),IFMT(2),IALP(25)
50       DATA NSEAR,LEARN,LIST,NEXIT/'SE','LE','LI','EX'/
60       DATA NSMOD,NUMSH/'LE','GE','EQ',3/
70       DATA NEWA,NEWP,MODA,MODP/'NA','NP','MA','MP'/
80       DATA ICR,IASK1/' ','*'/
90       DATA IPA,IAN,ILA,ILP/'PA','AN','LA','LP'/
100       DATA IDE,IMO/'DE','MO'/
110       DATA IFMIN,IFMTA,IFMT(2)/'(G16.','(A2)',.8) '/
120       DATA ACR/' '/
130       DATA INU,IAL/'NU','AL'/
140       REWIND 15
150       READ(15,1) IDIM,JDIM,NPAR,NANT
160     1 FORMAT(4I11)
170       READ(15,2)(IALP(I),I=1,NPAR)
180     2 FORMAT(80I1)
190       DO 20 J=1,NANT
200       READ(15,26) NAMA(J)
210       DO 20 I=1,NPAR
220       IF(IALP(I).EQ.0) GO TO 23
230       READ(15,15) PANT(I,J)
240       GO TO 20
250    23 READ(15,22) PANT(I,J)
260    20 CONTINUE
270    22 FORMAT(G20.9)
280       DO 25 I=1,NPAR
290    25 READ(15,26) NAMP(I),IUNT(I),ISRH(I)
300    26 FORMAT(2A4,I11)
310     5 PRINT 10
320    10 FORMAT(///1X,'MODE (SE,LE,LI,EX)')
330       READ 15,MODE
340    15 FORMAT(A2)
350       IF(MODE.EQ.NSEAR) GO TO 200
360       IF(MODE.EQ.LEARN) GO TO 400
370       IF(MODE.EQ.LIST) GO TO 600
380       IF(MODE.EQ.NEXIT) GO TO 1000
390       PRINT 16,MODE
400    16 FORMAT('MODE ',A2,' UNKNOWN')
410       GO TO 5
420   200 NPR=0
430       NPARC=0
440       IP=0
450       PRINT,'HIGH-PRIORITY PARAMETERS'
460   205 PRINT,'PARA. NAME'
470       READ 206,NAMPU
480   206 FORMAT(A4)
490       IF(NAMPU.EQ.ICR) GO TO 210
500       DO 215 I=1,NPAR
510       IF(NAMPU.EQ.NAMP(I)) GO TO 220
520   215 CONTINUE
530       PRINT,'PARA. NAME UNKNOWN'
540       GO TO 205
550   220 IF(NPARC.EQ.0) GO TO 222
560       DO 223 K=1,NPARC
570       IF(IPR(K).EQ.I) GO TO 224
580   223 CONTINUE
590       GO TO 222
600   224 IF(K.LE.NPR) NPR=NPR-1
610       NPARC=NPARC-1
620       IF(K.EQ.NPARC+1) GO TO 222
630       DO 227 KK=K,NPARC
640       PARA(KK)=PARA(KK+1)
650   227 IPR(KK)=IPR(KK+1)
660   222 PRINT 221,IUNT(I)
670   221 FORMAT('PARA. VALUE (',A4,')')
680       NPARC=NPARC+1
690       IFMT(1)=IFMIN
700       IF(IALP(I).NE.0) IFMT(1)=IFMTA
710       READ IFMT,PARA(NPARC)
720       IPR(NPARC)=I
730       GO TO 205
740   210 IF(IP.EQ.1) GO TO 230
750       IP=1
760       NPR=NPARC
770       PRINT,'LOW-PRIORITY PARAMETERS'
780       GO TO 205
790   230 IF(NPARC.EQ.0) GO TO 5
800       J=0
810   270 J=J+1
820       I=0
830   250 I=I+1
840       NOSAT(I)=0
850       IF(IALP(IPR(I)).EQ.0) GO TO 251
860       IF(PANT(IPR(I),J).EQ.ACR) GO TO 240
870       GO TO 320
880   251 IF(PANT(IPR(I),J).EQ.0.) GO TO 240
890       GO TO (300,310,320), ISRH(IPR(I))
900   300 IF(PANT(IPR(I),J)-PARA(I)) 240,240,235
910   310 IF(PANT(IPR(I),J)-PARA(I)) 235,240,240
920   320 IF(PANT(IPR(I),J)-PARA(I)) 235,240,235
930   235 IF(I.LE.NPR) GO TO 245
940       NOSAT(I)=1
950   240 IF(I.LT.NPARC) GO TO 250
960   265 PRINT 266,NAMA(J)
970   266 FORMAT(///'ANT.',1X,A4,'  SATISFIES HIGH PRIORITY PARS.')
980       PRINT,'PARAMETER   UNITS   ANTENNA VALUE    SPECIFIED VALUE'
990       DO 255 I=1,NPARC
1000       IASK=ICR
1010       IF(NOSAT(I).NE.0) IASK=IASK1
1020       IF(IALP(IPR(I)).EQ.0) GO TO 267
1030       IF(PANT(IPR(I),J).NE.ACR) GO TO 268
1040       PRINT 269,NAMP(IPR(I)),IUNT(IPR(I)),PARA(I)
```

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```
1050  269 FORMAT(4X,A4,6X,A4,6X,'UNKNOWN',14X,A2)
1060      GO TO 255
1070  268 PRINT 271,NAMP(IPR(I)),IUNT(IPR(I)),PANT(IPR(I),J),
1080     &PARA(I),IASK
1090  271 FORMAT(4X,A4,6X,A4,8X,A2,18X,A2,11X,A1)
1100      GO TO 255
1110  267 IF (PANT(IPR(I),J).NE.0.) GO TO 262
1120      PRINT 261,NAMP(IPR(I)),IUNT(IPR(I)),PARA(I)
1130  261 FORMAT(4X,A4,6X,A4,6X,'UNKNOWN',10X,G13.4)
1140      GO TO 255
1150  262 PRINT 260,NAMP(IPR(I)),IUNT(IPR(I)),PANT(IPR(I),J),PARA(I),IASK
1160  260 FORMAT(4X,A4,6X,A4,3X,G13.4,7X,G13.4,5X,A1)
1170  255 CONTINUE
1180  245 IF(J.LT.NANT) GO TO 270
1190      PRINT 246
1200  246 FORMAT(/1X,'SEARCH COMPLETE')
1210      GO TO 5
1220  400 PRINT,'LEARN MODE (NA,NP,MA,MP)'
1230      READ 15,MODE
1240      IF(MODE.EQ.ICR) GO TO 5
1250      IF(MODE.EQ.NEWA) GO TO 410
1260      IF(MODE.EQ.NEWP) GO TO 420
1270      IF(MODE.EQ.MODA) GO TO 440
1280      IF(MODE.EQ.MODP) GO TO 460
1290      PRINT 401,MODE
1300  401 FORMAT('LEARN MODE ',A2,' UNKNOWN')
1310      GO TO 400
1320  410 IF(JDIM.GT.NANT) GO TO 412
1330      PRINT 405,JDIM
1340  405 FORMAT(/'NUMBER OF STORED ANTENNAS EQUALS'
1350     &/'CORRESPONDING DIMENSIONING OF ARRAYS,'
1360     &/'NANT=JDIM=',I11
1370     &/'TO ADD MORE ANTS,'
1380     &/'INCREASE DIMENSION OF PANT (SECOND SUBSCRIPT)'
1390     &/'AND NAMA, ALSO RESET JDIM APPROPRIATELY.')
1400      GO TO 5
1410  417 PRINT 418,NAMA(J)
1420  418 FORMAT(1X,'NAME ',A4,' CONFLICTS WITH EXISTING ANT. NAME')
1430  412 PRINT 413
1440  413 FORMAT(/1X,'ANT. NAME')
1450      NPP=NANT+1
1460      READ 206,NAMA(NPP)
1470      IF(NAMA(NPP).EQ.ICR) GO TO 5
1480      DO 415 J=1,NANT
1490      IF(NAMA(NPP).EQ.NAMA(J)) GO TO 417
1500  415 CONTINUE
1510      PRINT,'RESPOND WITH PARAMETER VALUE.'
1520      PRINT,'IF UNKNOWN OMIT ENTRY.'
1530      NANT=NPP
1540      DO 414 I=1,NPAR
1550      PRINT 416,NAMP(I),IUNT(I)
1560  416 FORMAT(/1X,A4,1X,'(',A4,')')
1570      IFMT(1)=IFMTN
1580      IF(IALP(I).NE.0) IFMT(1)=IFMTA
1590  414 READ IFMT,PANT(I,NANT)
1600      IDIR=1
1610  500 REWIND 15
1620      WRITE(15,1) IDIM,JDIM,NPAR,NANT
1630      WRITE(15,2) (IALP(I),I=1,NPAR)
1640      DO 510 J=1,NANT
1650      WRITE(15,25) NAMA(J)
1660      DO 510 I=1,NPAR
1670      IF(IALP(I).EQ.0) GO TO 511
1680      WRITE(15,15) PANT(I,J)
1690      GO TO 510
1700  511 WRITE(15,22) PANT(I,J)
1710  510 CONTINUE
1720      DO 520 I=1,NPAR
1730  520 WRITE(15,26) NAMP(I),IUNT(I),ISRH(I)
1740      GO TO (410,420,440,460),IDIR
1750  420 IF(IDIM.GT.NPAR) GO TO 422
1760      PRINT 424,IDIM
1770  424 FORMAT(/'NUMBER OF STORED PARAMETERS EQUALS'
1780     &/'CORRESPONDING DIMENSIONING OF ARRAYS,'
1790     &/'NPAR=IDIM=',I11
1800     &/'TO ADD MORE PARAMETERS'
1810     &/'INCREASE DIMENSION OF PANT (FIRST SUBSCRIPT),'
1820     &/'ISRH,IPR,NOSAT,IALP,NAMP,PARA,IUNT,'
1830     &/'ALSO RESET IDIM APPROPRIATELY.')
1840      GO TO 5
1850  427 PRINT 428,NAMP(I)
1860  428 FORMAT('NAME ',A4,' CONFLICTS WITH EXISTING PARA.')
1870  422 NPP=NPAR+1
1880  426 PRINT 429
1890  429 FORMAT(/1X,'PARA. NAME')
1900      READ 206,NAMP(NPP)
1910      IF(NAMP(NPP).EQ.ICR) GO TO 5
1920      DO 425 I=1,NPAR
1930      IF(NAMP(I).EQ.NAMP(NPP)) GO TO 427
1940  425 CONTINUE
1950 1434 PRINT,'PARA. VALUE TYPE (AL,NU)'
1960      READ 15,MODE
1970      IF(MODE.EQ.ICR) GO TO 426
1980      IF(MODE.EQ.INU) GO TO 1420
1990      IF(MODE.EQ.IAL) GO TO 1425
2000      PRINT 446,MODE
2010      GO TO 1434
2020 1420 IALP(NPP)=0
2030      GO TO 434
2040 1425 IALP(NPP)=1
2050      ISRH(NPP)=3
2060      GO TO 430
2070  434 PRINT 436
2080  436 FORMAT(/1X,'COMPARISON CRITERION (GE,LE,EQ)')
```

```
      READ15,NSRH
      IF(NSRH.EQ.ICR) GO TO 426
      DO 431 K=1,NUMSH
      IF(NSRH.EQ.NSMOD(K)) GO TO 1430
  431 CONTINUE
      PRINT 433,NSRH
  433 FORMAT('CRITERION ',A2,' NOT RECOGNIZED')
      GO TO 434
 1430 ISRH(NPP)=K
  430 NPAR=NPP
      PRINT,'UNITS'
      READ 206,IUNT(NPAR)
      IF(IALP(NPAR).EQ.0) GO TO 435
      DO 1435 J=1,NANT
 1435 PANT(NPAR,J)=ACR
      GO TO 1436
  435 DO 1437 J=1,NANT
 1437 PANT(NPAR,J)=0.
      PRINT,'CAUTION - A ZERO INDICATES PAR. VALUE UNKNOWN'
 1436 IDIR=2
  421 PRINT 413
      READ 206,NAMAU
      IF(NAMAU.EQ.ICR) GO TO 500
      DO 437 J=1,NANT
      IF(NAMA(J).EQ.NAMAU) GO TO 438
  437 CONTINUE
      PRINT 439,NAMAU
  439 FORMAT('ANT. ',A4,' UNKNOWN')
      GO TO 421
  438 PRINT,'PARAMETER VALUE'
      IFMT(1)=IFMTN
      IF(IALP(NPAR).NE.0) IFMT(1)=IFMTA
      READ IFMT,PANT(NPAR,J)
      GO TO 421
  440 PRINT 413
      READ 206,NAMAU
      IF(NAMAU.EQ.ICR) GO TO 5
      DO 442 J=1,NANT
      IF(NAMA(J).EQ.NAMAU) GO TO 444
  442 CONTINUE
      PRINT 439,NAMAU
      GO TO 440
  444 IDIR=3
      PRINT,'DELETE OR MODIFY (DE,MO)'
      READ 15,MODE
      IF(MODE.EQ.IDE) GO TO 448
      IF(MODE.EQ.IMO) GO TO 450
      IF(MODE.EQ.ICR) GO TO 440
      PRINT 445,MODE
  446 FORMAT('COMMAND ',A2,' UNKNOWN')
      GO TO 444
  448 NANT=NANT-1
      IF(J.EQ.NANT+1) GO TO 500
      DO 452 JN=J,NANT
      DO 454 I=1,NPAR
  454 PANT(I,JN)=PANT(I,JN+1)
  452 NAMA(JN)=NAMA(JN+1)
      GO TO 500
  450 PRINT,'CAUTION - FOR PARAMETERS WITH NUMERIC VALUES'
      PRINT,'A ZERO INDICATES PAR. VALUE UNKNOWN'
  456 PRINT 429
      READ 206,NAMPU
      IF(NAMPU.EQ.ICR) GO TO 500
      DO 458 I=1,NPAR
      IF(NAMPU.EQ.NAMP(I)) GO TO 459
  458 CONTINUE
      PRINT 630,NAMPU
      GO TO 456
  459 PRINT 1450,IUNT(I)
 1450 FORMAT(1X,'NEW VALUE (',A4,')')
      IFMT(1)=IFMTN
      IF(IALP(I).NE.0) IFMT(1)=IFMTA
      READ IFMT,PANT(I,J)
      GO TO 456
  460 PRINT 429
      READ 206, NAMPU
      IF(NAMPU.EQ.ICR) GO TO 5
      DO 462 I=1,NPAR
      IF(NAMP(I).EQ.NAMPU) GO TO 464
  462 CONTINUE
      PRINT 630,NAMPU
      GO TO 460
  464 IDIR=4
      PRINT,'DELETE PAR OR MODIFY COMPARISON CRITERION (DE,MO)'
      READ 15,MODE
      IF(MODE.EQ.IDE) GO TO 466
      IF(MODE.EQ.IMO) GO TO 468
      IF(MODE.EQ.ICR) GO TO 460
      PRINT 445,MODE
      GO TO 464
  466 NPAR=NPAR-1
      IF(I.EQ.NPAR+1) GO TO 500
      DO 470 IN=I,NPAR
      DO 472 J=1,NANT
  472 PANT(IN,J)=PANT(IN+1,J)
      IUNT(IN)=IUNT(IN+1)
      NAMP(IN)=NAMP(IN+1)
      IALP(IN)=IALP(IN+1)
  470 ISRH(IN)=ISRH(IN+1)
      GO TO 500
  468 PRINT 435
      READ 15,NSRH
      IF(NSRH.EQ.ICR) GO TO 464
      IF(NSRH.NE.NSMOD(3).AND.IALP(I).EQ.1) PRINT 469
```

```
  469 FORMAT(/'CAUTION - ONLY COMPARISON CRITERION OF EQUALS (EQ)'
     &/'MAKES SENSE FOR CHARACTER PAR. VALUES')
      DO 474 K=1,NUMSH
      IF(NSRH.EQ.NSMOD(K)) GO TO 476
  474 CONTINUE
      PRINT 433,NSRH
      GO TO 468
  476 ISRH(I)=K
      GO TO 500
C LIST MODE
  600 PRINT,'LIST MODE (PA,AN,LA,LP)'
      READ 15,MODE
      IF(MODE.EQ.IPA) GO TO 605
      IF(MODE.EQ.IAN) GO TO 610
      IF(MODE.EQ.ILA) GO TO 640
      IF(MODE.EQ.ILP) GO TO 650
      IF(MODE.EQ.ICR) GO TO 5
      PRINT 615, MODE
  615 FORMAT('LIST MODE ',A2,' UNKNOWN')
      GO TO 600
  640 PRINT 641,(NAMA(J),J=1,NANT)
  641 FORMAT(/1X,'ANTENNAS'/10(1X,A4))
      GO TO 5
  650 PRINT 651,(NAMP(I),IUNT(I),NSMOD(ISRH(I)),I=1,NPAR)
  651 FORMAT(/1X,'PARA',3X,'UNITS',3X,'COMPARISON CRITERIA'
     &/(1X,A4,3X,A4,7X,A2))
      GO TO 5
  605 PRINT 429
      READ 206,NAMPU
      IF(NAMPU.EQ.ICR) GO TO 5
      DO 620 I=1,NPAR
      IF(NAMPU.EQ.NAMP(I)) GO TO 625
  620 CONTINUE
      PRINT 630,NAMPU
  630 FORMAT('PARAMETER ',A4,' UNKNOWN')
      GO TO 605
  625 PRINT 635,NAMP(I),IUNT(I)
  635 FORMAT(/'PAR. NAME= ',A4/'UNITS= ',A4)
      PRINT 660,NSMOD(ISRH(I))
  660 FORMAT('COMPARISON CRITERION= ',A2/'ANT.',4X,'PAR. VALUE')
      DO 690 J=1,NANT
      IF(IALP(I).EQ.0) GO TO 691
      IF(PANT(I,J).NE.ACR) GO TO 692
      PRINT 700,NAMA(J)
      GO TO 690
  692 PRINT 693,NAMA(J),PANT(I,J)
  693 FORMAT(A4,7X,A2)
      GO TO 690
  691 IF(PANT(I,J).NE.0.) GO TO 695
      PRINT 700,NAMA(J)
  700 FORMAT(A4,5X,'UNKNOWN')
      GO TO 690
  695 PRINT 705,NAMA(J),PANT(I,J)
  705 FORMAT(A4,2X,G13.4)
  690 CONTINUE
      GO TO 605
  610 PRINT 413
      READ 206,NAMAU
      IF(NAMAU.EQ.ICR) GO TO 5
      DO 670 J=1,NANT
      IF(NAMAU.EQ.NAMA(J)) GO TO 675
  670 CONTINUE
      PRINT 439,NAMAU
      GO TO 610
  675 PRINT 685,NAMA(J)
  685 FORMAT(/'ANT. NAME= ',A4/
     &3X,'PAR.',7X,'PAR. VALUE')
      DO 710 I=1,NPAR
      IF(IALP(I).EQ.0) GO TO 711
      IF(PANT(I,J).NE.ACR) GO TO 712
      PRINT 720,NAMP(I),IUNT(I)
      GO TO 710
  712 PRINT 713,NAMP(I),IUNT(I),PANT(I,J)
  713 FORMAT(A4,'(',A4,')',7X,A2)
      GO TO 710
  711 IF(PANT(I,J).NE.0.) GO TO 715
      PRINT 720,NAMP(I),IUNT(I)
  720 FORMAT(A4,'(',A4,')',5X,'UNKNOWN')
      GO TO 710
  715 PRINT 725,NAMP(I),IUNT(I),PANT(I,J)
  725 FORMAT(A4,'(',A4,')',2X,G13.4)
  710 CONTINUE
      GO TO 610
 1000 STOP
      END
```

```
0010PROGRAM(INPUT,OUTPUT,ASDAT,TAPE15=ASDAT)
0020C  ANTENNA SELECT PROGRAM - MODIFIED FOR CDC SYSTEM (ANTSELCD)
0030       DIMENSION PANT(25,10),ISRH(25),IPR(25),PARA(25),NOSAT(25)
0040       DIMENSION NAMP(25),IUNT(25),NAMA(10),NSMOD(3),IFMT(2),IALP(25)
0050       DATA NSEAR,LEARN,LIST,NEXIT/"SE","LE","LI","EX"/
0060       DATA NSMOD,NUMSH/"LE","GE","EQ",3/
0070       DATA NEWA,NEWP,MODA,MODP/"NA","NP","MA","MP"/
0080       DATA ICR,IASK1/" ","*"/
0090       DATA IPA,IAN,ILA,ILP/"PA","AN","LA","LP"/
0100       DATA IDE,IMO/"DE","MO"/
0110       DATA IFMTN,IFMTA,IFMT(2)/"(G16","(A2)",",8) "/
0120       DATA ACR/" "/
0130       DATA INU,IAL/"NU","AL"/
0140       REWIND 15
0150       READ(15,1) IDIM,JDIM,NPAR,NANT
0160     1 FORMAT(4I11)
0170       READ(15,2)(IALP(I),I=1,NPAR)
0180     2 FORMAT(60I1)
0190       DO 20 J=1,NANT
0200       READ(15,26) NAMA(J)
0210       DO 20 I=1,NPAR
0220       IF(IALP(I).EQ.0) GO TO 23
0230       READ(15,15) PANT(I,J)
0240       GO TO 20
0250    23 READ(15,22) PANT(I,J)
0260    20 CONTINUE
0270    22 FORMAT(G20.9)
0280       DO 25 I=1,NPAR
0290    25 READ(15,26) NAMP(I),IUNT(I),ISRH(I)
0300    26 FORMAT(2A4,I11)
0310     5 PRINT 10
0320    10 FORMAT(///1X,"MODE (SE,LE,LI,EX)"/" =")
0330       READ 15,MODE
0340    15 FORMAT(A2)
0350       IF(MODE.EQ.NSEAR) GO TO 200
0360       IF(MODE.EQ.LEARN) GO TO 400
0370       IF(MODE.EQ.LIST) GO TO 600
0380       IF(MODE.EQ.NEXIT) GO TO 1000
0390       PRINT 16,MODE
0400    16 FORMAT(" MODE ",A2," UNKNOWN")
0410       GO TO 5
0420   200 NPR=0
0430       NPARC=0
0440       IP=0
0470       PRINT*,"HIGH-PRIORITY PARAMETERS"
0480   205 PRINT*,"PARA. NAME"
0490       PRINT*,"="
0500       READ 206,NAMPU
0510   206 FORMAT(A4)
0520       IF(NAMPU.EQ.ICR) GO TO 210
0530       DO 215 I=1,NPAR
0540       IF(NAMPU.EQ.NAMP(I)) GO TO 220
0550   215 CONTINUE
0560       PRINT*,"PARA. NAME UNKNOWN"
0570       GO TO 205
0580   220 IF(NPARC.EQ.0) GO TO 222
0590       DO 223 K=1,NPARC
0600       IF(IPR(K).EQ.I) GO TO 224
0610   223 CONTINUE
0620       GO TO 222
0630   224 IF(K.LE.NPR) NPR=NPR-1
0640       NPARC=NPARC-1
0650       IF(K.EQ.NPARC+1) GO TO 222
0660       DO 227 KK=K,NPARC
0670       PARA(KK)=PARA(KK+1)
0680   227 IPR(KK)=IPR(KK+1)
0690   222 PRINT 221,IUNT(I)
0700   221 FORMAT(" PARA. VALUE (",A4,")"/" =")
0710       NPARC=NPARC+1
0720       IFMT(1)=IFMTN
0730       IF(IALP(I).NE.0) IFMT(1)=IFMTA
0740       READ IFMT,PARA(NPARC)
0750       IPR(NPARC)=I
0760       GO TO 205
0770   210 IF(IP.EQ.1) GO TO 230
0780       IP=1
0790       NPR=NPARC
0800       PRINT*,"LOW-PRIORITY PARAMETERS"
0810       GO TO 205
0820   230 IF(NPARC.EQ.0) GO TO 5
0830       J=0
0840   270 J=J+1
0850       I=0
0860   250 I=I+1
0865       NOSAT(I)=0
0870       IF(IALP(IPR(I)).EQ.0) GO TO 251
0880       IF(PANT(IPR(I),J).EQ.ACR) GO TO 240
0890       GO TO 320
0900   251 IF(PANT(IPR(I),J).EQ.0.) GO TO 240
0910       GO TO (300,310,320), ISRH(IPR(I))
0920   300 IF(PANT(IPR(I),J)-PARA(I)) 240,240,235
0930   310 IF(PANT(IPR(I),J)-PARA(I)) 235,240,240
0940   320 IF(PANT(IPR(I),J)-PARA(I)) 235,240,235
0950   235 IF(I.LE.NPR) GO TO 245
0960       NOSAT(I)=1
0970   240 IF(I.LT.NPARC) GO TO 250
0980   265 PRINT 266,NAMA(J)
0990   266 FORMAT(///" ANT.",1X,A4,"  SATISFIES HIGH PRIORITY PARS.")
1000       PRINT*,"PARAMETER   UNITS   ANTENNA VALUE    SPECIFIED VALUE"
1010       DO 255 I=1,NPARC
1020       IASK=ICR
1030       IF(NOSAT(I).NE.0) IASK=IASK1
1040       IF(IALP(IPR(I)).EQ.0) GO TO 267
1050       IF(PANT(IPR(I),J).NE.ACR) GO TO 268
```

```
      PRINT 263,NAMP(IPR(I)),IUNT(IPR(I)),PARA(I)
  269 FORMAT(4X,A4,6X,A4,6X,"UNKNOWN",14X,A2)
      GO TO 255
  268 PRINT 271,NAMP(IPR(I)),IUNT(IPR(I)),PANT(IPR(I),J),
     &PARA(I),IASK
  271 FORMAT(4X,A4,6X,A4,8X,A2,18X,A2,11X,A1)
      GO TO 255
  267 IF (PANT(IPR(I),J).NE.0.) GO TO 262
      PRINT 261,NAMP(IPR(I)),IUNT(IPR(I)),PARA(I)
  261 FORMAT(4X,A4,6X,A4,6X,"UNKNOWN",10X,G13.4)
      GO TO 255
  262 PRINT 260,NAMP(IPR(I)),IUNT(IPR(I)),PANT(IPR(I),J),PARA(I),IASK
  260 FORMAT(4X,A4,6X,A4,3X,G13.4,7X,G13.4,5X,A1)
  255 CONTINUE
  245 IF(J.LT.NANT) GO TO 270
      PRINT 246
  246 FORMAT(/1X,"SEARCH COMPLETE")
      GO TO 5
  400 PRINT*,"LEARN MODE (NA,NP,MA,MP)"
      PRINT*,"="
      READ 15,MODE
      IF(MODE.EQ.ICR) GO TO 5
      IF(MODE.EQ.NEWA) GO TO 410
      IF(MODE.EQ.NEWP) GO TO 420
      IF(MODE.EQ.MODA) GO TO 440
      IF(MODE.EQ.MODP) GO TO 460
      PRINT 401,MODE
  401 FORMAT(" LEARN MODE ",A2," UNKNOWN")
      GO TO 400
  410 IF(JDIM.GT.NANT) GO TO 412
      PRINT 405,JDIM
  405 FORMAT(/" NUMBER OF STORED ANTENNAS EQUALS"
     &/" CORRESPONDING DIMENSIONING OF ARRAYS."
     &/" NANT=JDIM=",I11
     &/" TO ADD MORE ANTS."
     &/" INCREASE DIMENSION OF PANT (SECOND SUBSCRIPT)"
     &/" AND NAMA. ALSO RESET JDIM APPROPRIATELY.")
      GO TO 5
  417 PRINT 418,NAMA(J)
  418 FORMAT(1X,"NAME ",A4," CONFLICTS WITH EXISTING ANT. NAME")
  412 PRINT 413
  413 FORMAT(/1X,"ANT. NAME"/" =")
      NPP=NANT+1
      READ 206,NAMA(NPP)
      IF(NAMA(NPP).EQ.ICR) GO TO 5
      DO 415 J=1,NANT
      IF(NAMA(NPP).EQ.NAMA(J)) GO TO 417
  415 CONTINUE
      PRINT*,"RESPOND WITH PARAMETER VALUE."
      PRINT*,"IF UNKNOWN OMIT ENTRY."
      NANT=NPP
      DO 414 I=1,NPAR
      PRINT 416,NAMP(I),IUNT(I)
  416 FORMAT(/1X,A4,1X,"(",A4,")"/" =")
      IFMT(1)=IFMTN
      IF(IALP(I).NE.0) IFMT(1)=IFMTA
  414 READ IFMT,PANT(I,NANT)
      IDIR=1
  500 REWIND 15
      WRITE(15,1) IDIM,JDIM,NPAR,NANT
      WRITE(15,2) (IALP(I),I=1,NPAR)
      DO 510 J=1,NANT
      WRITE(15,26) NAMA(J)
      DO 510 I=1,NPAR
      IF(IALP(I).EQ.0) GO TO 511
      WRITE(15,15) PANT(I,J)
      GO TO 510
  511 WRITE(15,22) PANT(I,J)
  510 CONTINUE
      DO 520 I=1,NPAR
  520 WRITE(15,26) NAMP(I),IUNT(I),ISRH(I)
      GO TO (410,420,440,460),IDIR
  420 IF(IDIM.GT.NPAR) GO TO 422
      PRINT 424,IDIM
  424 FORMAT(/" NUMBER OF STORED PARAMETERS EQUALS"
     &/" CORRESPONDING DIMENSIONING OF ARRAYS."
     &/" NPAR=IDIM=",I11
     &/" TO ADD MORE PARAMETERS"
     &/" INCREASE DIMENSION OF PANT (FIRST SUBSCRIPT),"
     &/" ISRH,IPR,NOSAT,IALP,NAMP,PARA,IUNT."
     &/" ALSO RESET IDIM APPROPRIATELY.")
      GO TO 5
  427 PRINT 428,NAMP(I)
  428 FORMAT(" NAME ",A4," CONFLICTS WITH EXISTING PARA.")
  422 NPP=NPAR+1
  426 PRINT 429
  429 FORMAT(/1X,"PARA. NAME"/" =")
      READ 206,NAMP(NPP)
      IF(NAMP(NPP).EQ.ICR) GO TO 5
      DO 425 I=1,NPAR
      IF(NAMP(I).EQ.NAMP(NPP)) GO TO 427
  425 CONTINUE
 1434 PRINT*,"PARA. VALUE TYPE (AL,NU)"
      PRINT*,"="
      READ 15,MODE
      IF(MODE.EQ.ICR) GO TO 426
      IF(MODE.EQ.INU) GO TO 1420
      IF(MODE.EQ.IAL) GO TO 1425
      PRINT 446,MODE
      GO TO 1434
 1420 IALP(NPP)=0
      GO TO 434
 1425 IALP(NPP)=1
      ISRH(NPP)=3
```

```
      GO TO 430
  434 PRINT 436
  436 FORMAT(/1X,"COMPARISON CRITERION (GE,LE,EQ)"/" =")
      READ15,NSRH
      IF(NSRH.EQ.ICR) GO TO 426
      DO 431 K=1,NUMSH
      IF(NSRH.EQ.NSMOD(K)) GO TO 1430
  431 CONTINUE
      PRINT 433,NSRH
  433 FORMAT(" CRITERION ",A2," NOT RECOGNIZED")
      GO TO 434
 1430 ISRH(NPP)=K
  430 NPAR=NPP
      PRINT*,"UNITS"
      PRINT*,"="
      READ 206,IUNT(NPAR)
      IF(IALP(NPAR).EQ.0) GO TO 435
      DO 1435 J=1,NANT
 1435 PANT(NPAR,J)=ACR
      GO TO 1436
  435 DO 1437 J=1,NANT
 1437 PANT(NPAR,J)=0.
      PRINT*,"CAUTION - A ZERO INDICATES PAR. VALUE UNKNOWN"
 1436 IDIR=2
  421 PRINT 413
      READ 206,NAMAU
      IF(NAMAU.EQ.ICR) GO TO 500
      DO 437 J=1,NANT
      IF(NAMA(J).EQ.NAMAU) GO TO 438
  437 CONTINUE
      PRINT 439,NAMAU
  439 FORMAT(" ANT. ",A4," UNKNOWN")
      GO TO 421
  438 PRINT*,"PARAMETER VALUE"
      PRINT*,"="
      IFMT(1)=IFMTN
      IF(IALP(NPAR).NE.0) IFMT(1)=IFMTA
      READ IFMT,PANT(NPAR,J)
      GO TO 421
  440 PRINT 413
      READ 206,NAMAU
      IF(NAMAU.EQ.ICR) GO TO 5
      DO 442 J=1,NANT
      IF(NAMA(J).EQ.NAMAU) GO TO 444
  442 CONTINUE
      PRINT 439,NAMAU
      GO TO 440
  444 IDIR=3
      PRINT*,"DELETE OR MODIFY (DE,MO)"
      PRINT*,"="
      READ 15,MODE
      IF(MODE.EQ.IDE) GO TO 448
      IF(MODE.EQ.IMO) GO TO 450
      IF(MODE.EQ.ICR) GO TO 440
      PRINT 446,MODE
  446 FORMAT(" COMMAND ",A2," UNKNOWN")
      GO TO 444
  448 NANT=NANT-1
      IF(J.EQ.NANT+1) GO TO 500
      DO 452 JN=J,NANT
      DO 454 I=1,NPAR
  454 PANT(I,JN)=PANT(I,JN+1)
  452 NAMA(JN)=NAMA(JN+1)
      GO TO 500
  450 PRINT*,"CAUTION - FOR PARAMETERS WITH NUMERIC VALUES"
      PRINT*,"A ZERO INDICATES PAR. VALUE UNKNOWN"
  456 PRINT 429
      READ 206,NAMPU
      IF(NAMPU.EQ.ICR) GO TO 500
      DO 458 I=1,NPAR
      IF(NAMPU.EQ.NAMP(I)) GO TO 459
  458 CONTINUE
      PRINT 630,NAMPU
      GO TO 456
  459 PRINT 1450,IUNT(I)
 1450 FORMAT(1X,"NEW VALUE (",A4,")"/" =")
      IFMT(1)=IFMTN
      IF(IALP(I).NE.0) IFMT(1)=IFMTA
      READ IFMT,PANT(I,J)
      GO TO 456
  460 PRINT 429
      READ 206, NAMPU
      IF(NAMPU.EQ.ICR) GO TO 5
      DO 462 I=1,NPAR
      IF(NAMP(I).EQ.NAMPU) GO TO 464
  462 CONTINUE
      PRINT 630,NAMPU
      GO TO 460
  464 IDIR=4
      PRINT*,"DELETE PAR OR MODIFY COMPARISON CRITERION (DE,MO)"
      PRINT*,"="
      READ 15,MODE
      IF(MODE.EQ.IDE) GO TO 466
      IF(MODE.EQ.IMO) GO TO 468
      IF(MODE.EQ.ICR) GO TO 460
      PRINT 446,MODE
      GO TO 464
  466 NPAR=NPAR-1
      IF(I.EQ.NPAR+1) GO TO 500
      DO 470 IN=I,NPAR
      DO 472 J=1,NANT
  472 PANT(IN,J)=PANT(IN+1,J)
      IUNT(IN)=IUNT(IN+1)
      NAMP(IN)=NAMP(IN+1)
```

```
      IALP(IM)=IALP(IN+1)
  470 ISRH(IM)=ISRH(IN+1)
      GO TO 500
  468 PRINT 435
      READ 15,NSRH
      IF(NSRH.EQ.ICR) GO TO 464
      IF(NSRH.NE.NSMOD(3).AND.IALP(I).EQ.1) PRINT 469
  469 FORMAT(/" CAUTION - ONLY COMPARISON CRITERION OF EQUALS (EQ)"
     &/" MAKES SENSE FOR CHARACTER PAR. VALUES")
      DO 474 K=1,NUMSH
      IF(NSRH.EQ.NSMOD(K)) GO TO 476
  474 CONTINUE
      PRINT 433,NSRH
      GO TO 468
  476 ISRH(I)=K
      GO TO 500
3300C  LIST MODE
  600 PRINT*,"LIST MODE (PA,AN,LA,LP)"
      PRINT*,"="
      READ 15,MODE
      IF(MODE.EQ.IPA) GO TO 605
      IF(MODE.EQ.IAN) GO TO 610
      IF(MODE.EQ.ILA) GO TO 640
      IF(MODE.EQ.ILP) GO TO 650
      IF(MODE.EQ.ICR) GO TO 5
      PRINT 615, MODE
  615 FORMAT(" LIST MODE ",A2," UNKNOWN")
      GO TO 600
  640 PRINT 641,(NAMA(J),J=1,NANT)
  641 FORMAT(/1X,"ANTENNAS"/10(1X,A4))
      GO TO 5
  650 PRINT 651,(NAMP(I),IUNT(I),NSMOD(ISRH(I)),I=1,NPAR)
  651 FORMAT(/1X,"PARA",3X,"UNITS",3X,"COMPARISON CRITERIA"
     &/(1X,A4,3X,A4,7X,A2))
      GO TO 5
  605 PRINT 429
      READ 206,NAMPU
      IF(NAMPU.EQ.ICR) GO TO 5
      DO 620 I=1,NPAR
      IF(NAMPU.EQ.NAMP(I)) GO TO 625
  620 CONTINUE
      PRINT 630,NAMPU
  630 FORMAT(" PARAMETER ",A4," UNKNOWN")
      GO TO 605
  625 PRINT 635,NAMP(I),IUNT(I)
  635 FORMAT(/" PAR. NAME= ",A4/" UNITS= ",A4)
      PRINT 960,NSMOD(ISRH(I))
  660 FORMAT(" COMPARISON CRITERION= ",A2/" ANT.",4X,"PAR. VALUE")
      DO 690 J=1,NANT
      IF(IALP(I).EQ.0) GO TO 691
      IF(PANT(I,J).NE.ACR) GO TO 692
      PRINT 700,NAMA(J)
  700 FORMAT(1X,A4,5X,"UNKNOWN")
      GO TO 690
  692 PRINT 693,NAMA(J),PANT(I,J)
  693 FORMAT(1X,A4,7X,A2)
      GO TO 690
  691 IF(PANT(I,J).NE.0.) GO TO 695
      PRINT 700,NAMA(J)
      GO TO 690
  695 PRINT 705,NAMA(J),PANT(I,J)
  705 FORMAT(1X,A4,2X,G13.4)
  690 CONTINUE
      GO TO 605
  610 PRINT 413
      READ 206,NAMAU
      IF(NAMAU.EQ.ICR) GO TO 5
      DO 670 J=1,NANT
      IF(NAMAU.EQ.NAMA(J)) GO TO 675
  670 CONTINUE
      PRINT 439,NAMAU
      GO TO 610
  675 PRINT 685,NAMA(J)
  685 FORMAT(/" ANT. NAME= ",A4/
     &4X,"PAR.",7X,"PAR. VALUE")
      DO 710 I=1,NPAR
      IF(IALP(I).EQ.0) GO TO 711
      IF(PANT(I,J).NE.ACR) GO TO 712
      PRINT 720,NAMP(I),IUNT(I)
      GO TO 710
  712 PRINT 713,NAMP(I),IUNT(I),PANT(I,J)
  713 FORMAT(1X,A4,"(",A4,")",7X,A2)
      GO TO 710
  711 IF(PANT(I,J).NE.0.) GO TO 715
      PRINT 720,NAMP(I),IUNT(I)
  720 FORMAT(1X,A4,"(",A4,")",5X,"UNKNOWN")
      GO TO 710
  715 PRINT 725,NAMP(I),IUNT(I),PANT(I,J)
  725 FORMAT(1X,A4,"(",A4,")",2X,G13.4)
  710 CONTINUE
      GO TO 610
 1000 STOP
      END
```


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METRIC SYSTEM

BASE UNITS:

Quantity	Unit	SI Symbol	Formula
length	metre	m	...
mass	kilogram	kg	...
time	second	s	...
electric current	ampere	A	...
thermodynamic temperature	kelvin	K	...
amount of substance	mole	mol	...
luminous intensity	candela	cd	...

SUPPLEMENTARY UNITS:

plane angle	radian	rad	...
solid angle	steradian	sr	...

DERIVED UNITS:

Acceleration	metre per second squared	...	m/s
activity (of a radioactive source)	disintegration per second	...	(disintegration)/s
angular acceleration	radian per second squared	...	rad/s
angular velocity	radian per second	...	rad/s
area	square metre	...	m
density	kilogram per cubic metre	...	kg/m
electric capacitance	farad	F	A·s/V
electrical conductance	siemens	S	A/V
electric field strength	volt per metre	...	V/m
electric inductance	henry	H	V·s/A
electric potential difference	volt	V	W/A
electric resistance	ohm		V/A
electromotive force	volt	V	W/A
energy	joule	J	N·m
entropy	joule per kelvin	...	J/K
force	newton	N	kg·m/s
frequency	hertz	Hz	(cycle)/s
illuminance	lux	lx	lm/m
luminance	candela per square metre	...	cd/m
luminous flux	lumen	lm	cd·sr
magnetic field strength	ampere per metre	...	A/m
magnetic flux	weber	Wb	V·s
magnetic flux density	tesla	T	Wb/m
magnetomotive force	ampere	A	...
power	watt	W	J/s
pressure	pascal	Pa	N/m
quantity of electricity	coulomb	C	A·s
quantity of heat	joule	J	N·m
radiant intensity	watt per steradian	...	W/sr
specific heat	joule per kilogram-kelvin	...	J/kg·K
stress	pascal	Pa	N/m
thermal conductivity	watt per metre-kelvin	...	W/m·K
velocity	metre per second	...	m/s
viscosity, dynamic	pascal-second	...	Pa·s
viscosity, kinematic	square metre per second	...	m/s
voltage	volt	V	W/A
volume	cubic metre	...	m
wavenumber	reciprocal metre	...	(wave)/m
work	joule	J	N·m

SI PREFIXES:

Multiplication Factors	Prefix	SI Symbol
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
1 000 000 = 10^{6}	mega	M
1 000 = 10^{3}	kilo	k
100 = 10^{2}	hecto*	h
10 = 10^{1}	deka*	da
0.1 = 10^{-1}	deci*	d
0.01 = 10^{-2}	centi*	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

* To be avoided where possible.

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