Directorate Of Operations Research

TACTICAL TARGET ACQUISITION MODEL (TATAC)

VOLUME II

USERS' MANUAL

DECEMBER 1977

PREPARED FOR ASD BY
LULEJIAN AND ASSOCIATES, INC.

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S. A. TREMAINE
Deputy for Development Planning
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TACTICAL TARGET ACQUISITION MODEL (TATAC) Users' Manual

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Target Acquisition Target Sensors
Tactical Air Power Radar
Air-to-Ground Attack Infrared
Atmospheric Effects TV Systems
Tactical Scenarios

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
A computer model for determining target acquisition capability of airborne sensors against ground targets is presented. The theory and general structure of the model plus details for the user are discussed. The model can be used to evaluate various types of electrooptical and radar sensors.

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PREFACE

This is one of two volumes of a report describing a target acquisition model developed under contract to Lulejian and Associates by the Deputy for Development Planning (XRO), of the Aeronautical Systems Division. The model was developed to support in-house studies of tactical air-to-ground attack.
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TACTICAL TARGET ACQUISITION MODEL (TATAC)

I. INTRODUCTION

This volume documents the operating procedures, input requirements, and output formats for the Tactical Target Acquisition (TATAC) computer model. After defining the problem this guide can be used to assist the user in setting up the necessary steps to make a computer run.

The computer program is comprised of the following sensor system models:

- Visual Observer (VISOB)
- Forward-Looking Infrared (FLIR)
- Television (TV)
  - Active (Illuminated)
  - Passive (Daylight)
- Forward-Looking Radar (FLR)
  - Moving Target Indicator (MTI) Mode
  - Non-MTI Mode
- Synthetic Aperture Radar

Section II of this guide describes the operation and structure of the program in terms of:

- Execution List (Input)
- Output
- Library Data
- Fixed Data

Section III describes the logical structure of the programs. Section IV contains a listing of the fixed data. Section V contains a listing of the library data. Section VI contains sample problems including the execution list and output from the computer run for each problem to demonstrate the method of using the model. Section VII contains a listing of all programs in the model.
II. PROGRAM OPERATION

This section describes the procedures necessary to run the TATAC computer model. Detailed in this section are:

- Description and form of the execution list;
- Form of output generated by a computer run;
- Library data description; and
- Fixed data description.

Figure 1 is a diagram of the program deck. Figure 2 summarizes the information flow in the program.
Figure 2. TATA C Program Information Flow
A. EXECUTION LIST

The execution list follows the program deck as shown in Figure 1. It begins with an EXECUTE card and ends with an ENDRUN card. This list is the only portion of the data which must be formulated by the user before each computer run. As a reference to the following description, a sample execution list is shown in Figure 3.

The execution list performs the following functions in the model:

- Determines the type of run to be executed; and
- Denotes all data of the library to be modified.

These functions are described in the following paragraphs.
1. Determining the Run

The first card in the execution list is the EXECUTE card (Figure 3, card 1). Besides indicating to the computer model that this is the beginning of the execution list, this card conveys the type of run to be executed. The following sensor runs may be executed:

Visual Observer (1);
Forward-Looking Infrared (2);
Active (illuminated) Television (3);
Passive (daylight) Television (4);
Forward-Looking Radar, MTI Mode (5);
Forward-Looking Radar, non-MTI Mode (6); and
Synthetic Aperture Radar (7).

To indicate the sensor run being set up, the user places one of the single-integer codes, shown in parenthesis in the above list, into column 11 of the EXECUTE card.

2. Data Entry

Besides the EXECUTE and ENDRUN cards the only other types of cards that may be needed are "data name" and "data modification" cards. A "data modification" card(s) is used in conjunction with a "data name" card. That is, a "data name" card need never be used unless a "data modification" card(s) immediately follows it.

a. Data Name Cards

The "data name" card (Figure 3, Card 2) has the legal name of the data being modified in columns 1-15 (left justified). Legal names for data used in the program are given in Table 1. The user then places an integer in columns 20-30 (right justified). This integer tells the input program how many modifications are to be made to that particular library entry. Then for each modification a "data modification" card follows. Recall that a "data name" card is only used if one or more modifications are made to that particular library "data name."

<table>
<thead>
<tr>
<th>TABLE 1. LEGAL DATA NAMES *</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATIONAL VAR</td>
</tr>
<tr>
<td>TARGET</td>
</tr>
<tr>
<td>BACKGROUND</td>
</tr>
<tr>
<td>ENVIRONMENTAL **</td>
</tr>
<tr>
<td>TERRAIN **</td>
</tr>
<tr>
<td>SEARCH</td>
</tr>
<tr>
<td>SENSOR</td>
</tr>
</tbody>
</table>

* Only the first four characters are checked by the program. Thus, all data names in the list may be shortened.

** Environmental and terrain data are combined into one array - either name may be used as a legal data name for this array.
b. Data Modification Cards

Each of these cards (Figure 3, cards 3 - 4) contains the number of the variable to be modified in columns 9 - 10 (right justified) and the new value assigned to it in columns 11 - 20 in E10.4 format (right justified). The variable number and its type are found in the library data tables in Subsection C of this Section. The number of "data modification" cards which follow a "data name" card must agree with the integer placed in columns 29 - 30 of the "data name" card.

3. Setting Up an Execution List

This subsection lists the steps which the user should follow when setting up an execution list to run the TATAC computer model.

Defining the problem:

(1) Define the problem to be run including the sensor system, operational variables, target, background, environmental/terrain, and search variables.

(2) Determine if the data needed is in the library. If not, "data name" and "data modification" cards for new entries will be required.

Filling out the execution list:

(3) List the EXECUTE card including the sensor number in column 11 for the run to be made.

(4) Insert all "data name" cards along with the proper number of "data modification" cards for each.

(5) List the ENDRUN card.

B. OUTPUT

There are basically three categories of output from the computer model:

List of data modifications;
Error messages; and
Standard model output.

Types of each output applicable to a specific run will be automatically generated by the program. A discussion of the categories
of output will be given in the next three subsections. Following these discussions will be a discussion on variations of standard model output among the sensor models. Reference will be made at that point to sample problems which illustrate the distinctions in output generated by computer runs.

1. **List of Data Modifications**

Preceding all standard output, a listing of data modifications made through the use of "data modification" cards in the execution list will be given. If no data modifications have been made, no output of this category will be generated. The list will include the legal data name for which modifications were made, the number of the variable modified, IVAR (found in the library data table for the applicable data name), and the value assigned to that variable. Space for output is reserved for as many as ten modifications per data name used. If more than ten "data modification" cards follow a "data name" card, a message is printed alerting the user to this occurrence. This in no way affects the program run. It simply means that all changes made after the tenth one, will not be listed on the output. There are two ways to avoid this situation. One is to repunch the entire portion of the library data array applicable to the library data name in question. The other is to distribute the "data modification" cards behind multiple "data name" cards containing the same data name. For example: if 15 data modifications are to be made to a library entry, set up a "data name" card with a "10" in columns 29 - 30, followed by ten "data modification" cards for the first 10 modifications and place the remaining five behind another "data name" card with a "5" in columns 29 - 30.

2. **Error Messages**

At a number of points in the program, checks are made on various input data to determine if it is in the correct form. If there is an error the program will print out a message. Generally, the program will attempt to assign a default value so as to continue with the run. These messages may appear anywhere in the output and usually give an indication of where the problem occurred. These messages are listed below, followed by an explanation of the cause.

**EXECUTE CARD MISSING OR OUT OF ORDER**

The first card of the execution list must be the EXECUTE card which includes the sensor number. If the first card read is not the EXECUTE card then the above message is printed and the sensor number defaults to the value "1".

**INVALID SENSOR NUMBER - (value)**

Valid sensor numbers range from "1" to "7". Any sensor number input outside this range will result in the above message. The invalid sensor number read is printed. The sensor number defaults to "1".

II-7
INVALID DATA NAME - (name)

The name read does not match one of the legal data names given in Table 1. The invalid name read is printed.

VARIABLE NUMBER OUTSIDE RANGE OF DATA NAME ARRAY - (value)

The variable number in columns 9-10 of a "data modification" card is outside the range of the array reserved for the data name appearing on the previous "data name" card. The read value is printed.

MORE MODIFICATIONS THAN LISTED

This refers only to the data modification "listing." It does not imply an error in the run. Space is reserved to print out a maximum of 10 data modifications per "data name" card. If more than 10 "data modification" cards are required for one "data name" card, the user should place the remaining "data modification" cards after another "data name" card containing the same data name as for the first 10 modifications. For many modifications it may be more efficient to repunch that section of the library.

DEPRESSION ANGLE TOO STEEP, PHID RESET = (value)

This message is applicable to all non-radar, fixed sensor depression angle runs. If the input depression angle, PHID, is too large, the computed dive profile point may be reached before the target enters the sensor footprint. The program will then set the angle back to where the target just enters the footprint when the dive profile point is reached. The new angle, in degrees, is printed.

OFFSET (Y) GREATER THAN YMAX. SET Y = (value)

This message is applicable to all models using a fixed sensor depression angle with the exception of the Synthetic Aperture Radar model. For a given depression angle, horizontal beamwidth, and vertical beamwidth, a ground sensor footprint is calculated. The cross-track distance of the footprint at the leading edge is calculated as YMAX. If the input offset (Y) is greater than YMAX, the target never passes into the ground footprint. If such a condition is encountered, Y defaults to the value printed.
ONLY POSITIVE OFFSETS CONSIDERED, USED ABS. VALUE

Offsets are considered to be symmetric with respect to flight path. Therefore, if a negative offset is input the program will convert it to its absolute value.

TUBE SATURATION, NEW FNUM = (value)

Illumination level great enough to saturate tube. Lens is stopped down and another trial is made to see if the illumination is within tube operating limits.

THRESHOLD SPEED IS GREATER THAN 1/2 BLIND SPEED

The MTI filter threshold velocity exceeds one-half the calculated value of blind speed. This means that the filter has no passband and that detection is impossible.

AN MF VALUE WAS NOT INPUT SO MF IS SET - 12

For Forward-Looking Radar (MTI mode) a filter rolloff value, MF, was not input (or input as zero). The program defaults to a value of 12.

Y TOO SMALL, INCREASED TO BE 1.5 SWATH WIDTHS

The offset, Y, is measured to the far edge of the swath width. No information is obtained from the area below or close to the aircraft. For offsets less than 1 - 1/2 swath width, Y is reset to 1.5 times the input swath width. Typical offset values for SAR are on the order of 10 - 30 nautical miles.

3. Standard Model Output

There are basically three types of standard model output generated by a computer run. All three may not be applicable to all sensor models. The discussion below and reference to Figure 4 should familiarize the user with this output. Standard model output follows the list of data modifications (if any).

a. Variable Description

The first lines in this output section (Figure 4, lines 12 - 27) for any run consist of a brief description of the variables which head a given column. Further description may be found in Volume I of this report.
Figure 4. Sample Computer Output

II-10
b. Flight Profile Points

The first two rows of numbers following the variable description (Figure 4, lines 29 - 30) display profile points along the flight path for all computer runs except the Synthetic Aperture Radar*. The first of these rows represents the along-track ground range, in feet, from target to aircraft position for the various profile points listed. The second row represents ground range, in feet, from target to aircraft position for the same profile points. In case of zero offset these two rows are equivalent.

c. Ranges, Time, and Probabilities

Beneath the rows indicating flight profile (or immediately beneath the variable description for the Synthetic Aperture run) is a row of variables (Figure 4, line 31) which head 10 columns of numerical data. These columns of numerical data represent a combination of ranges, time, and probabilities which correspond to the variable description of whichever variable heads a given column. All the data in one particular row is related in-so-far-as it was all generated by one iteration of the program. Each can be thought of as being a function of the range given in the first column.

4. Variations in Standard Model Output

A few special points can be made regarding the output described in the above sections.

a. Non-Radar Cases

For all non-radar cases the following notes apply:

The first row of numerical output from the "ranges, time, and probabilities" output section was computed at a range which corresponded to one "glimpse" before launch point;

The second of these rows of output was computed at a range which corresponds to the first "glimpse" after the dive profile point; and

The third of these rows of output was computed at a range which corresponds to the first "glimpse" before the dive profile point.

* Output generated by a Synthetic Aperture Radar run will be given special consideration in a following subsection.
b. Forward-Looking Radar

As discussed in Volume I to this report, all radar submodels are essentially taken from MARSAM with technology updates. Users familiar with MARSAM will recall that it utilized a fixed depression angle for radar sensors. Thus, for given horizontal and vertical beamwidths a sensor footprint on the ground was clearly defined. Results at one range between the leading and trailing edges of this footprint were output. In the TATAC version a footprint is clearly defined, however, output will be generated for intermittent ranges from the trailing edge up to the leading edge. The flight profile is straight and level throughout and no dive is assumed. Profile points normally printed thus appear as blanks in the dive phase. Refer to Problem B, Section VI for an example of output from the Forward-Looking Radar models.

c. Synthetic Aperture Radar

The Synthetic Aperture Radar is also a version of a MARSAM submodel. Again, there is no dive profile. Furthermore, the Synthetic Aperture Radar processes the doppler phase history of the illuminated ground area over the entire illumination period to generate the display. All returns from the target are integrated into this display. Thus, only one line of output is necessary to present the results. For an example, see Problem C, Section VI.

C. PROGRAM LIBRARY DATA

The program library consists of a group of DATA declaration statements found in subroutine INPUT1. It contains information needed by the program to describe sensors, target, background, etc. The library may contain more information than is needed by the program for a particular run. A complete list of the library data supplied with the program is given in Section V. Tables 2 through 13 following this discussion define the sets of entries allowed in the library. These sets of library data are:

- Operational variables;
- Target data;
- Background data;
- Environmental/terrain data;
- Search data;
- Visual Observer sensor data;
- Forward-Looking Infrared sensor data;
- Television sensor data (active);

Television sensor data (passive);
Forward-Looking Radar (MTI) sensor data;
Forward-Looking Radar (non-MTI) sensor data; and
Synthetic Aperture Radar sensor data.

Each of these tables lists the name of the type data which it describes, the number of integers in the data (NI), and the number of floating-point numbers (NF). For each integer and floating-point number used to define the entry, the table lists the type of data, the variable number, the FORTRAN symbol which is to represent the variable, the units in which the data is expressed, and a description of the entry.

**TABLE 2. OPERATIONAL VARIABLES**

**NAME: OPERATIONAL VAR: NI = 1; NF = 14**

<table>
<thead>
<tr>
<th>VARIABLE NUMBER</th>
<th>VARIABLE TYPE</th>
<th>FORTRAN SYMBOL</th>
<th>UNITS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ID</td>
<td></td>
<td></td>
<td>UNUSED</td>
</tr>
<tr>
<td>2</td>
<td>FD</td>
<td>Y</td>
<td>FEET</td>
<td>FLIGHT PATH OFFSET</td>
</tr>
<tr>
<td>3</td>
<td>FD</td>
<td>EL</td>
<td>FEET</td>
<td>SEARCH ALTITUDE</td>
</tr>
<tr>
<td>4</td>
<td>FD</td>
<td>HP</td>
<td>FEET</td>
<td>PENETRATION ALTITUDE</td>
</tr>
<tr>
<td>5</td>
<td>FD</td>
<td>SPD</td>
<td>KNOTS</td>
<td>SPEED IN DIVE'</td>
</tr>
<tr>
<td>6</td>
<td>FD</td>
<td>SPL</td>
<td>KNOTS</td>
<td>SPEED IN LEVEL FLIGHT</td>
</tr>
<tr>
<td>7</td>
<td>FD</td>
<td>SPC</td>
<td>KNOTS</td>
<td>SPEED IN CLimb</td>
</tr>
<tr>
<td>8</td>
<td>FD</td>
<td>SPP</td>
<td>KNOTS</td>
<td>SPEED IN PENETRATION</td>
</tr>
<tr>
<td>9</td>
<td>FD</td>
<td>SRL</td>
<td>FEET</td>
<td>SLANT RANGE, MINIMUM LAUNCH</td>
</tr>
<tr>
<td>10</td>
<td>FD</td>
<td>SRL2</td>
<td>FEET</td>
<td>SLANT RANGE, POP-UP ATTAINED</td>
</tr>
<tr>
<td>11</td>
<td>FD</td>
<td>ANGLD</td>
<td>DEG</td>
<td>DIVE ANGLE</td>
</tr>
<tr>
<td>12</td>
<td>FD</td>
<td>ANGLC</td>
<td>DEG</td>
<td>CLIMB ANGLE</td>
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<td>13</td>
<td>FD</td>
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<tr>
<td>15</td>
<td>FD</td>
<td></td>
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### TABLE 3. TARGET DATA

**NAME:** TARGET; **NI:** 3; **NF:** 17

<table>
<thead>
<tr>
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<th>VARIABLE TYPE</th>
<th>FORTRAN SYMBOL</th>
<th>UNITS</th>
<th>DESCRIPTION</th>
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<td>DTX</td>
<td>FEET</td>
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</tr>
<tr>
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<td>DTY</td>
<td>FEET</td>
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<td>DTZ</td>
<td>FEET</td>
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<td>RT</td>
<td>-</td>
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</tr>
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<td>8</td>
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<td>DELTT</td>
<td>°K</td>
<td>TARGET TEMPERATURE</td>
</tr>
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<td>9</td>
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<td>EM1T</td>
<td>-</td>
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<tr>
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<td>FD</td>
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<td>m²</td>
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<td>FD</td>
<td>TSPACE</td>
<td>FEET</td>
<td>SPACING BETWEEN TARGETS</td>
</tr>
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<td>14</td>
<td>FD</td>
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<td>DEG</td>
<td>ANGULAR DIRECTION OF TARGET RELATIVE TO FLIGHT PATH</td>
</tr>
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<td>15</td>
<td>FD</td>
<td>VTT</td>
<td>KNOTS</td>
<td>TARGET VELOCITY</td>
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<tr>
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<td>FD</td>
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<td>-</td>
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### TABLE 4. BACKGROUND DATA

**NAME:** BACKGROUND; **NI:** 1; **NF:** 6

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<th>UNITS</th>
<th>DESCRIPTION</th>
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<td>RB</td>
<td>-</td>
<td>REFLECTANCE OF BACKGROUND</td>
</tr>
<tr>
<td>3</td>
<td>FD</td>
<td>DELTB</td>
<td>°K</td>
<td>TEMPERATURE OF BACKGROUND</td>
</tr>
<tr>
<td>4</td>
<td>FD</td>
<td>EM1B</td>
<td>-</td>
<td>EMISSIVITY OF BACKGROUND</td>
</tr>
<tr>
<td>5</td>
<td>FD</td>
<td>-</td>
<td>-</td>
<td>UNUSED</td>
</tr>
<tr>
<td>6</td>
<td>FD</td>
<td>WP</td>
<td>METERS</td>
<td>EXTENT OF PRIMARY BACKGROUND AROUND TARGET</td>
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**TABLE 5. ENVIRONMENTAL/TERRAIN DATA**

NAME: ENVIRONMENTAL OR TERRAIN; NI - 5; NF - 8

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<th>DESCRIPTION</th>
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<tbody>
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<td>1</td>
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<td>ICLOUD</td>
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<td>CLOUD COVERAGE (1 = CLEAR, 2 = PARTIAL OVERCAST, 3 = SOLID OVERCAST)</td>
</tr>
<tr>
<td>2</td>
<td>ID</td>
<td>ISUNW</td>
<td></td>
<td>SUN ANGLE ABOVE HORIZON (1 = 90°, 2 = 30°, 3 = 11.5°)</td>
</tr>
<tr>
<td>3</td>
<td>ID</td>
<td>ICFLS</td>
<td></td>
<td>SWITCH FOR CLOUD FREE LOS (0 = DO NOT CONSIDER, 1 = use tables)</td>
</tr>
<tr>
<td>4</td>
<td>ID</td>
<td>ITAT</td>
<td></td>
<td>SWITCH FOR ATMOSPHERIC TRANSMITTANCE (0 = USE ANALYTIC APPROXIMATION, 1 = USE EMPIRICAL DATA)</td>
</tr>
<tr>
<td>5</td>
<td>ID</td>
<td>IAZIM</td>
<td></td>
<td>SUN AZIMUTH, USED IF ITAT = 1 (1 = 90°, 2 = 0°)</td>
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<td>FD</td>
<td>XTE</td>
<td></td>
<td>REFLECTANCE OF TERRAIN</td>
</tr>
<tr>
<td>7</td>
<td>FD</td>
<td>ANGIM DEC.</td>
<td></td>
<td>AVERAGE MASKING ANGLE</td>
</tr>
<tr>
<td>8</td>
<td>FD</td>
<td>RATIO</td>
<td></td>
<td>CULTURAL MASKING RATIO</td>
</tr>
<tr>
<td>9</td>
<td>FD</td>
<td>VGC</td>
<td>NM</td>
<td>METEOROLOGICAL VISIBILITY</td>
</tr>
<tr>
<td>10</td>
<td>FD</td>
<td>RH</td>
<td></td>
<td>RELATIVE HUMIDITY</td>
</tr>
<tr>
<td>11</td>
<td>FD</td>
<td>G</td>
<td></td>
<td>MEASURE OF SCENE COMPLEXITY</td>
</tr>
<tr>
<td>12</td>
<td>FD</td>
<td>VW</td>
<td>K/SEC</td>
<td>APPARENT RMS VELOCITY DUE TO WIND</td>
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<td>13</td>
<td>FD</td>
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<td></td>
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**TABLE 6. SEARCH DATA**

NAME: SEARCH; NI - 1; NF - 9

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<tr>
<td>2</td>
<td>FD</td>
<td></td>
<td></td>
<td>UNUSED</td>
</tr>
<tr>
<td>3</td>
<td>FD</td>
<td>DSX</td>
<td>FEET</td>
<td>SEARCH LENGTH*</td>
</tr>
<tr>
<td>4</td>
<td>FD</td>
<td>DSY</td>
<td>FEET</td>
<td>SEARCH WIDTH*</td>
</tr>
<tr>
<td>5</td>
<td>FD</td>
<td>VLOC</td>
<td>FEET</td>
<td>LOC WIDTH</td>
</tr>
<tr>
<td>6</td>
<td>FD</td>
<td>SIGX</td>
<td></td>
<td>STANDARD DEVIATION OF ALONG-TRACK ERROR</td>
</tr>
<tr>
<td>7</td>
<td>FD</td>
<td>SIGY</td>
<td></td>
<td>STANDARD DEVIATION OF CROSS-TRACK ERROR</td>
</tr>
<tr>
<td>8</td>
<td>FD</td>
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<td></td>
<td>UNUSED</td>
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<tr>
<td>9</td>
<td>FD</td>
<td></td>
<td></td>
<td>UNUSED</td>
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<tr>
<td>10</td>
<td>FD</td>
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* ENTER -1 for these variables if FOV is to be searched. The visual case uses a unique geometry in search along a LOC as described in App A.

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### TABLE 7. VISUAL SENSOR DATA

**NAME:** VISOB; **NI:** 2; **NF:** 5

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<td>SWITCH FOR COCKPIT MASKING (0 = NO, 1 = YES)</td>
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<td>ID</td>
<td>-</td>
<td>-</td>
<td>UNUSED</td>
</tr>
<tr>
<td>3</td>
<td>FD</td>
<td>VISMAX</td>
<td>FEET</td>
<td>MAXIMUM VISUAL SEARCH RANGE</td>
</tr>
<tr>
<td>4</td>
<td>FD</td>
<td>-</td>
<td>-</td>
<td>UNUSED</td>
</tr>
<tr>
<td>5</td>
<td>FD</td>
<td>-</td>
<td>-</td>
<td>UNUSED</td>
</tr>
<tr>
<td>6</td>
<td>FD</td>
<td>XLAMDA</td>
<td>μm</td>
<td>RESPONSIVE WAVE LENGTH</td>
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<tr>
<td>7</td>
<td>FD</td>
<td>-</td>
<td>-</td>
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### TABLE 8. FORWARD-LOOKING INFRARED

**NAME:** FLIR; **NI:** 2; **NF:** 10

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<tbody>
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<td>SWITCH FOR DEPRESSION ANGLE (1 = VARIABLE, 2 = FIXED)</td>
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<td>ID</td>
<td>-</td>
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<td>UNUSED</td>
</tr>
<tr>
<td>3</td>
<td>FD</td>
<td>ASPECT</td>
<td>-</td>
<td>RATIO OF THE VERTICAL FOV TO HORIZONTAL FOV</td>
</tr>
<tr>
<td>4</td>
<td>FD</td>
<td>THETAV</td>
<td>DEG</td>
<td>VERTICAL FOV (NARROW)</td>
</tr>
<tr>
<td>5</td>
<td>FD</td>
<td>THETAV</td>
<td>DEG</td>
<td>VERTICAL FOV (WIDE)</td>
</tr>
<tr>
<td>6</td>
<td>FD</td>
<td>PHID</td>
<td>DEG</td>
<td>SENSOR DEPRESSION ANGLE</td>
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<td>ZK2</td>
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<td>EXPONENTIAL CONSTANT TO HRT CURVE</td>
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<td>FD</td>
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<tr>
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<td>FD</td>
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### Table 9. Active TV Sensor Data

**Name:** TELEVISION; NI - 2; NF - 24

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<tr>
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<td>ID</td>
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<tr>
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<td>FD</td>
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<td>RATIO OF THE VERTICAL FOV TO HORIZONTAL FOV</td>
</tr>
<tr>
<td>4</td>
<td>FD</td>
<td>THETAV</td>
<td>DEG</td>
<td>VERTICAL FOV (NARROW)</td>
</tr>
<tr>
<td>5</td>
<td>FD</td>
<td>THETAV</td>
<td>DEG</td>
<td>VERTICAL FOV (WIDE)</td>
</tr>
<tr>
<td>6</td>
<td>FD</td>
<td>PHID</td>
<td>DEG</td>
<td>SENSOR DEPRESSION ANGLE</td>
</tr>
<tr>
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<td>FD</td>
<td>BAND</td>
<td>Hz</td>
<td>BANDWIDTH</td>
</tr>
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<td>8</td>
<td>FD</td>
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<td>mm</td>
<td>DIAGONAL OF EFFECTIVE PHOTOSURFACE AREA</td>
</tr>
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<td>F - NUMBER (NARROW FOV)</td>
</tr>
<tr>
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<td>FD</td>
<td>FNUM</td>
<td></td>
<td>F - NUMBER (WIDE FOV)</td>
</tr>
<tr>
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<td>FD</td>
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<td>FC</td>
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<td>XI</td>
<td>AMPS</td>
<td>SIGNAL AT H4</td>
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<td>AMPS</td>
<td>MAXIMUM SIGNAL CAPABILITY</td>
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<td>XPAR</td>
<td>AMPS</td>
<td>PRE-AMP NOISE</td>
</tr>
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<td>FD</td>
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<td>μm</td>
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<td>WATTS</td>
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<tr>
<td>22</td>
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<td>GT</td>
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### TABLE 10. PASSIVE TV

**NAME:** TELEVISION; **NI = 2; NF = 24**

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<tbody>
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<td>1</td>
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<td>ISTYPE</td>
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<td>SWITCH FOR DEPRESSION ANGLE (1=VARIABLE, 2=FIXED)</td>
</tr>
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<td>2</td>
<td>ID</td>
<td>-</td>
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<td>UNUSED</td>
</tr>
<tr>
<td>3</td>
<td>FD</td>
<td>ASPECT</td>
<td>-</td>
<td>RATIO OF THE VERTICAL FOV TO HORIZONTAL FOV</td>
</tr>
<tr>
<td>4</td>
<td>FD</td>
<td>THETAV DEG</td>
<td>-</td>
<td>VERTICAL FOV (NARROW)</td>
</tr>
<tr>
<td>5</td>
<td>FD</td>
<td>THETAV DEG</td>
<td>-</td>
<td>VERTICAL FOV (WIDE)</td>
</tr>
<tr>
<td>6</td>
<td>FD</td>
<td>PHID DEG</td>
<td>-</td>
<td>SENSOR DEPRESSION ANGLE</td>
</tr>
<tr>
<td>7</td>
<td>FD</td>
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<td>F - NUMBER (NARROW FOV)</td>
</tr>
<tr>
<td>10</td>
<td>FD</td>
<td>FNUM</td>
<td>-</td>
<td>F - NUMBER (WIDE FOV)</td>
</tr>
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<td>11</td>
<td>FD</td>
<td>GAMMA DEG</td>
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<td>FD</td>
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<td>-</td>
<td>LENS SYSTEM TRANSMITTANCE</td>
</tr>
<tr>
<td>13</td>
<td>FD</td>
<td>XFC FC</td>
<td>-</td>
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</tr>
<tr>
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<td>SIGNAL AT H4</td>
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<tr>
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<td>MAXIMUM SIGNAL CAPABILITY</td>
</tr>
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<td>PRE-AMP NOISE</td>
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<td>KASTER COUNT</td>
</tr>
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<td>FD</td>
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<td>EFFECTIVE POWER OF THE ILLUMINATOR</td>
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<td>21</td>
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<td>GAIN</td>
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<td>BACKSCATTER GAIN RELATIVE TO ISOTROPIC ILLUMINATOR WAVELENGTH</td>
</tr>
<tr>
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<td>FD</td>
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<td>M/SEC</td>
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# TABLE 12. FORWARD-LOOKING RADAR, NON-MTI

**NAME:** FLR; NI = 2; NF = 23

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<td>NM</td>
<td>GROUND SWATH WHICH CAN BE PROCESSED IN REAL TIME</td>
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</table>
D. FIXED DATA

The fixed data consists of a group of DATA declaration statements found in subroutine INPUT. It contains data which is constant for all sensor models in the program. It should not be modified by the user unless the program itself is modified or the user wishes to change some of the contained data which is discussed below. The only method of modifying the fixed data is to repunch the cards containing the data. As a reference for the discussion of this subsection, see the Fixed Data List in Section IV.

The first portion of the fixed data contains 50 integers which are described in Table 14. This portion of the fixed data is addressed as array IC in the program.

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</table>

* ID - INTEGER; FD - FLOATING-POINT
The second portion of the fixed data contains 50 additional integers which are described in Table 15. This portion of the fixed data is addressed as array ICT in the program.

### Table 15. Integers in Fixed Data Array ICT

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<td>29</td>
<td>NUMBER OF FIRST INDEPENDENT VARIABLES IN TABLE 10</td>
</tr>
<tr>
<td>30</td>
<td>NUMBER OF SECOND INDEPENDENT VARIABLES IN TABLE 10</td>
</tr>
</tbody>
</table>
The third portion of the fixed data contains all the tables used in the program. The original 14 tables are described in Table 16. This portion of the fixed data is addressed by the array FDTAB.

The floating-point, third portion of the fixed data contains all the tables used in the program. The original 14 tables are described in Table 16. This portion of the fixed data is addressed by the array FDTAB.
<table>
<thead>
<tr>
<th>TABLE NUMBER</th>
<th>TABLE SIZE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>88</td>
<td>Tabular values for $E_2$ (2) where $E_2(2) = \int_1^\infty e^{-x^2/2} , dx$</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Probability of cloud-free LOS versus zenith angle (deg.) for altitudes less than or equal to 5000 ft.</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Probability of cloud-free LOS versus zenith angle (deg.) for altitudes greater than 5000 ft.</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>Background RCS ($m^2$) versus depression angle (deg.) and radar band.</td>
</tr>
<tr>
<td>5</td>
<td>31</td>
<td>Attenuation rate versus rain rate (mm/hr) and radar band.</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>Altitude of cloud layer (ceiling or floor) versus season.</td>
</tr>
<tr>
<td>7</td>
<td>49</td>
<td>Liquid water content ($g/m^3$) versus season and octals of cloud cover.</td>
</tr>
<tr>
<td>8</td>
<td>49</td>
<td>Percentage frequency of cloud cover versus season and octals of cloud cover.</td>
</tr>
<tr>
<td>9</td>
<td>39</td>
<td>Frequency of rainfall rate versus season and rainfall rate (mm/hr) slant range from bottom of cloud cover to ground greater than or equal to 10 km.</td>
</tr>
<tr>
<td>10</td>
<td>39</td>
<td>Frequency of rainfall rate versus season and rainfall rate (mm/hr) slant range from bottom of cloud cover to ground less than 10 km.</td>
</tr>
<tr>
<td>11</td>
<td>181</td>
<td>Directional path reflectance versus altitude (ft.) and slant range (ft.) for 50° azimuth.</td>
</tr>
<tr>
<td>12</td>
<td>181</td>
<td>Directional path reflectance versus altitude (ft.) and slant range (ft.) for 0° azimuth.</td>
</tr>
<tr>
<td>13</td>
<td>8</td>
<td>Reflectance factor versus zenith angle (deg.) for 90° azimuth.</td>
</tr>
<tr>
<td>14</td>
<td>8</td>
<td>Reflectance factor versus zenith angle (deg.) for 0° azimuth.</td>
</tr>
</tbody>
</table>
III. LOGICAL STRUCTURE

This program is arranged modularly with respect to the sensor models. The control section is independent, allowing sensor models to be added or changed without changing the whole program.

Four main data arrays form the basic structure of the TATAC model. They are the IC, ICT, FDTAB, and FD arrays. The first three array names stored the fixed data as discussed in the previous section. These three arrays (IC, ICT, and FDTAB) are contained in the labeled common blocks ARRSET, TABSET, and TABLES, respectively. The information is available to all programs in which the common block appears.

The array FD contains the input library data used by the program to execute the model for a particular run. This array is contained in the common block ARRAYS. The information is passed through the program using the subroutine call statements. Integer values in this array are addressed by the array ID which shares storage with the FD array through the use of an EQUIVALENCE statement. In the main program, the data in the FD array is identified by pointers to the section reserved for each data type. These pointers are listed in Table 17.

TABLE 17. DATA IDENTIFICATION POINTERS

<table>
<thead>
<tr>
<th>FORTRAN SYMBOL</th>
<th>TYPE OF DATA</th>
<th>TYPE OF DATA IDENTIFIED</th>
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</thead>
<tbody>
<tr>
<td>I1D</td>
<td>ID</td>
<td>OPERATIONAL VARIABLES</td>
</tr>
<tr>
<td>IFO</td>
<td>FD</td>
<td>OPERATIONAL VARIABLES</td>
</tr>
<tr>
<td>IIT</td>
<td>ID</td>
<td>TARGET</td>
</tr>
<tr>
<td>IFT</td>
<td>FD</td>
<td>TARGET</td>
</tr>
<tr>
<td>IIR</td>
<td>ID</td>
<td>BACKGROUND</td>
</tr>
<tr>
<td>IFR</td>
<td>FD</td>
<td>BACKGROUND</td>
</tr>
<tr>
<td>IIEVT</td>
<td>ID</td>
<td>ENVIRONMENTAL/TERRAIN</td>
</tr>
<tr>
<td>IFEVT</td>
<td>FD</td>
<td>ENVIRONMENTAL/TERRAIN</td>
</tr>
<tr>
<td>IITS</td>
<td>ID</td>
<td>SEARCH</td>
</tr>
<tr>
<td>IFTS</td>
<td>FD</td>
<td>SEARCH</td>
</tr>
<tr>
<td>ISETID</td>
<td>ID</td>
<td>SENSORS</td>
</tr>
<tr>
<td>ISETFD</td>
<td>FD</td>
<td>SENSORS</td>
</tr>
</tbody>
</table>

III-1
The data is passed through the call handler using the following procedure:

```
CALL TEST (....ID(IO),FD(IO),FD(IFT),....)
```

and is received in the subroutine as follows:

```
SUBROUTINE TEST (....IDO, FDO,FDT,.....)
DIMENSION IDO(1),FDO(1),FDT(1)
```

Table 18 lists the internal representatives for all the sections of the data used in the subroutines.

**TABLE 18. INTERNAL ARRAY NAMES**

<table>
<thead>
<tr>
<th>ARRAY NAME</th>
<th>TYPE OF DATA</th>
<th>LIBRARY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDO</td>
<td>ID</td>
<td>OPERATIONAL VARIABLES</td>
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<td>FDO</td>
<td>FD</td>
<td>OPERATIONAL VARIABLES</td>
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<td>ID</td>
<td>TARGET</td>
</tr>
<tr>
<td>FDT</td>
<td>FD</td>
<td>TARGET</td>
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<tr>
<td>IDB</td>
<td>ID</td>
<td>BACKGROUND</td>
</tr>
<tr>
<td>FDB</td>
<td>FD</td>
<td>BACKGROUND</td>
</tr>
<tr>
<td>IDENVT</td>
<td>ID</td>
<td>ENVIRONMENTAL/TERRAIN</td>
</tr>
<tr>
<td>FDEVNT</td>
<td>FD</td>
<td>ENVIRONMENTAL/TERRAIN</td>
</tr>
<tr>
<td>IDTS</td>
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<td>FD</td>
<td>SEARCH</td>
</tr>
<tr>
<td>IDS</td>
<td>ID</td>
<td>SENSORS</td>
</tr>
<tr>
<td>FDS</td>
<td>FD</td>
<td>SENSORS</td>
</tr>
</tbody>
</table>

* ID - INTEGER; FD - FLOATING-POINT NUMBER.
IV. FIXED DATA LISTING

The following is a listing of the TATAC fixed data. For an explanation of listing content, see Section II-D of this Volume.

IC ARRAY

<table>
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<tbody>
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</tr>
</tbody>
</table>

IV-1
V. LIBRARY DATA LISTING

The following is a listing of the TATAC library data. For an explanation of listing content, see Section II-C of this Volume.

FD ARRAY

| 0  | 0.0 | 4000E+00 | 5000E+03 | 4000E+03 | 4000E+03 |
| 10  | 0  | 0.0 | 1000E+02 | 3330E+00 | 0.0 |
| 0  | 0.0 | P050E+02 | 1070E+02 | 2800E+01 | 1600E+00 | 6000E+03 |
| 0  | 0.0 | 9000E+00 | 1170E+02 | 1170E+02 | 9000E+02 |
| 0  | 0.0 | 0.0 | 0.0 |

| 0  | 0.0 | 8000E-01 | 3000E+03 | 9100E+00 | 0.0 | 6000E+01 |
| 0  | 0.0 | 0.0 |

| 0  | 0.0 | 1000E+00 | 5000E+01 | 0.0 | 6000E+01 | 4000E+00 |
| 0  | 0.0 | 4000E+01 | 2500E+00 | 0.0 |

| 0  | 0.0 | 3600E+05 | 1000E+03 | 2000E+02 | 2550E+03 |
| 0  | 0.0 | 2550E+03 | 0.0 | 0.0 |

| 0  | 0.0 | 3600E+05 | 0.0 | 0.0 | 5500E+00 | 0.0 |

| 0  | 0.0 | 1330E+01 | 1860E+01 | 7440E+01 | 3000E+02 | 3600E-01 |
| 0  | 0.0 | 1030E+01 | 0.0 | 0.0 | 0.0 |

| 0  | 0.0 | 1000E+01 | 1000E+01 | 1000E+01 | 3000E+02 | 4500E+07 |
| 0  | 0.0 | 2500E+02 | 5600E+01 | 5600E+01 | 1000E+01 | 6000E+00 |
| 0  | 0.0 | 4500E+02 | 3000E+04 | 2000E+01 | 2000E-08 | 8400E+00 |
| 0  | 0.0 | 4000E+03 | 5100E+03 | 5000E+02 | 2400E+00 | 1000E+01 |
| 0  | 0.0 | 0.0 | 0.0 | 0.0 |
| 0  | 0.0 | 0.0 | 0.0 |

| 0  | 0.0 | 1000E+01 | 1000F+01 | 4000E+01 | 3000E+02 | 9250F+07 |
| 0  | 0.0 | 1570E+02 | 5600E+01 | 5600E+01 | 1000E+01 | 8000F+00 |
| 0  | 0.0 | 4500E+02 | 3000E+08 | 3000E-08 | 7000E-08 | 5500F+00 |
| 0  | 0.0 | 6000F+03 | 5110F+03 | 0.0 | 0.0 | 1000F+01 |
| 0  | 0.0 | 0.0 | 0.0 |

V-1
FD ARRAY (Continued)

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VI. SAMPLE PROBLEMS

This section, containing sample problems, is provided to assist the user in setting up problems for interpreting the outputs of the computer model. It does not present a comprehensive list of all possible representative uses of the model. Each sample briefly describes the problem, presents the execution list and computer printout, and discusses the results.

A. VISUAL OBSERVER (VISOB) - SAMPLE PROBLEM A

This sample problem exemplifies the use of the Visual Observer model. The aircraft search altitude is 6,000 feet with a meteorological visibility of 4 nautical miles.

The specific variables which were entered into the program are shown in the execution list of Figure 5. Two "data name" cards were required with one "data modification" card following each. All other stored library values remain unchanged.

The results of the computer run can be seen from the computer output of Figure 6. The cumulative probability of detection (PAD) was .196 up to the dive point and 1.0 at the minimum launch point.
Figure 6. Computer Output - Sample Problem A
B. FORWARD-LOOKING RADAR (FLR) - SAMPLE PROBLEM B

This sample problem exemplifies the use of the Forward-Looking Radar model with MTI mode. The radar is operated against a target which has a median RCS of 50 m$^2$.

The specific variables entered into the program are shown in the execution list of Figure 7. Only one "data name" card and one "data modification" card were required. All other stored library values remain unchanged.

The results of the computer run can be seen from the computer output of Figure 8. As can be seen by the flight profile printout (lines 28-29), the aircraft achieved search altitude at a ground range of 22,689 feet and the target passed out of the sensor field of view at a ground range of 4768 feet. The cumulative probability of detection (PAD) reached a maximum of .994 which was achieved on the first "glimpse" at 22,528 feet. Closing to the target did not improve the PAD and at a ground range below 8365 feet the MTI could not discriminate the target for detection. This situation occurred due to the following reasons:

1. The area of the resolution cell increases as the range decreases, and

2. The unit background RCS increases with increasing depression angle to target.
### SFMSAR Number = 5

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### Field Definitions

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<td>Dive Beginning</td>
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<td>III</td>
<td>Country Position</td>
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<td>IV</td>
<td>Target Passes Out of FOV (Fixed Depression Angle)</td>
</tr>
<tr>
<td>V</td>
<td>Search Altitude Achieved</td>
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<td>VI</td>
<td>Climbs to Altitude Begins</td>
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### Variables

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### Definitions

- **PLOS**: Probability Target Is Within LOS
- **PFUV**: Probability Target Is Within FOV
- **SP**: Search Term Probability
- **PDD**: Discriminability (Detection)
- **PSR**: Discriminability (Recognition)
- **PAD**: Cumulative Probability of Detection
- **PAR**: Cumulative Probability of Recognition

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**Figure 8.** Computer Output - Sample Problem B

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C. SYNTHETIC APERTURE RADAR (SAR) - SAMPLE PROBLEM C

This sample problem exemplifies the use of the Synthetic Aperture Radar model. The search aircraft is flying at an altitude of 10,000 feet and looking at an offset of 150,000 feet.

The specific variables which were entered into the program are shown in the execution list of Figure 9. One "data name" card and two "data modification" cards were required. All other library values remain unchanged.

The results of the computer run can be seen in the computer output of Figure 10. The Synthetic Aperture Radar processes the doppler phase history of the illuminated ground area over the entire illumination period to generate the display. All returns from the target are integrated into this display. Thus, only one line of output is necessary to present the results. The radar beam was directed 26,509 feet ahead of the flight path and 152,323 feet from the aircraft. The cumulative probability of detection (PAD) achieved was .178.
**Sensor Number = 7**

1 = Visual OSEF/UPF
2 = Forward-Looking Infrared
3 = Active (Illuminated) TV
4 = Passive (Daylight) TV
5 = Forward-Looking Radar, MTI
6 = Forward-Looking Radar, Non-MTI
7 = Synthetic Aperture Radar

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<th>PFov</th>
<th>P2</th>
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Figure 10. Computer Output - Sample Problem C
VII. TATAC PROGRAM LISTINGS

This section contains the listings of the TATAC computer programs written in FORTRAN IV. The following listing includes all routines needed to run the TATAC model.

PROGRAM TATAC(INPUT,OUTPUT)
COMMON/ARRAYS/FD(250)
COMMON/ARRSET/IC(50)
COMMON/TABLES/FTAB(725)
COMMON/TABSET/ICT(50)
COMMON/FL/TAFAN,THETA,T,PHID
COMMON/FL/XX,XY,XX,SR,SP,ANGLD,ANGLT,DTLAT
COMMON/FL/XX,XX,XY,XX,XY,XY,XY,XY
DIMENSION ID(250)
EQUIVALENCE (FD, ID)
ISNUM=1
CRT=.01745
CALL INPUT1
IIO=IC(1)
IFB=IC(2)
IIT=IC(3)
IFC=IC(4)
IH=IC(5)
IFD=IC(6)
IEVT=IC(7)
IFFUT=IC(8)
IIDS=IC(9)
IFTS=IC(10)
CALL INPUT2(ISNUM)
C0 T0(10,20,30,40,50,60,70),ISNUM
10 ISFTID=IC(11)
ISSETFD=IC(12)
ISFNS=1
ISYPF=1
C0 T0 200
20 ISFTID=IC(13)
ISSETFD=IC(14)
ISFNS=2
C0 T0 75
30 ISFTID=IC(15)
ISSETFD=IC(16)
ISFNS=3
C0 T0 75
40 ISFTID=IC(17)
ISSETFD=IC(18)
ISFNS=4
C0 T0 75
50 ISFTID=IC(19)
ISSETFD=IC(20)
ISFNS=5
ISYPF=2
C0 T0 70
60 ISFTID=IC(21)
ISSETFD=IC(22)
ISFNS=6
ISTYPF=9
GO TO 70
70 ISFTFD=IC(93)
ISFTFD=IC(24)
ISFN5=7
ISTYPF=9
GO TO 100
75 ISTYPF=10(ISFTFD)
ASPFCT=FD(ISFTFD)
TMFTAU=FD(ISFTFD+2)+CR
TMFTAU=ASPFCT+TMFTAU
PMID=FD(ISFTFD+3)+CR
GO TO 200
80 TMFTAU=FD(ISFTFD+11)+CR
TMFTAV=FD(ISFTFD+1)+CR
PMID=FD(ISFTFD+7)+CR+TMFTAV/9.
CALL FLIGHT(ISFVS, ISTYPF, FD(IFNA), ID(ISFTFD), FD(ISFTFD))
PRINT 209
PRINT 203
PRINT 204
PRINT 85, X, X
PRINT 95, XY, XY
95 FORWAT(1X, 34X, P(F7, O, 1X))
PRINT 206
TFMT=F0.
IPRINT=1
IPRINT=1
PAD=0.
PAR=0.
90 CALL FFRAME(ISFVS, ISTYPF, FD(IFN), ISTOP)
IF (ISTOP=FD-1) GO TO 600
TFMT=TIF+1
FLMTAT
PFAV=1.0
CALL L95(ISFVS, ISTYPF, ID(I1FT), FD(I1FT), PLS)
PL=PLS+FPAV
call SFFLR(ISFVS, ID(I1FT), FD(I1FT), FPAV, PLS)
F1D(ftf), ID(ISFTFD), FD(ISFTFD), P2, P3D, PAR)
IF (P2=P3D+1) GO TO 900
IF (((IPRINT+3)×S3)+VR, IPRINT+1) GO TO 90
PRINT 405, XY, TMFT, PFAV, PP, P3D, PPAR, PAD, PAR
GO TO 90
100 CONTINUE
PFAV=1.0
CALL SAR(FD(IFN), ID(I1FT), FD(IFN), FD(IFN), FD(IFN),
FD(ISFTFD), IFD(ISFTFD), PP, P3D, P3R)
CALL L05(ISFVS, ISTYPF, FD(IFFT), FD(IFFT), PLS)
PL=PLS+FPAV
PAD=PAD+PP, P3D
PAR=PAR+PP, P3R
PRINT 203
PRINT 204
PRINT 205, X, XY, PLAS, PF0V, PP, P30, P3R, PAD, PAR
105 FORMAT(I,2(F7.0,1X),6X,7C,6X)
GO TO 600

C
200 CALL FLIGHT(1SFNS,ISTYPF,FDF(IFO),ID(ISFTID),FD(ISFTFD))
PRINT 202
202 FORMAT(I,1X,1X*I = MINIMUM LAUNCH POINT*,
$/1X*II = DIVE PECINS*,
$/1X*III = (DUMMY POSITION*)*,
$/1X*IV = TARGET PASSES OUT OF FIXED DEPRESSION*,
$/1X*V = ANGLE*,
$/1X*VI = SEARCH ALTITUDE ACHIEVED*,
$/1X*VII = CLIPED T ALTITUDE PECINS*)
PRINT 203
PRINT 204
PRINT 205, X1, X2, X3, X4, X5, X6
PRINT P05, XY1, XY2, XY3, XY4, XY5, XY6
203 FORMAT(I,1X,1X*X = ALmissive-TRACK GROUND DISTANCE TO *,
$/1X*FT. = GROUND RANGE TO TARGET,FT.*,
$/1X*TIMF = TIMF BEFORE LAUNCH, SFC.*, *
$/1X*PLAS = PECAPABILITY TARGET IS WITHIN LOS*,
$/1X*PF0V = PECAPABILITY TARGET IS WITHIN FOV*,
$/1X*PP = SEARCH TPHM PECAPABILITY*,
$/1X*P30 = DISCRIMINATIPN(PECTION)*,
$/1X*P3R = DISCRIMINATIPN(PECTION)*,
$/1X*PAD = CUMULATIVE PECAPABILITY OF PECTION*,
$/1X*PAP = CUMULATIVE PECAPABILITY OF PECTION*,
204 FORMAT(I,1X,1X*,A,4X*I,*,AX,*,11,*,AX,*,11,*,5X,*,IV*,*,6X,*,6V*,*,7X,*,V1*)
205 FORMAT(I,1X,1X,6I(1X,F7.0))
PRINT 206
206 FORMAT(I,1X,4X*,X*,6X*,XY*,5X*,TIMF*,*,P*,*,PLAS*,*,P*,*,PF0V*,
5X*,P2*,*,AX*,*,P30*,*,P3R*,*,3X*,*,3X*,*,PAR*)
IPHASF=0
TIME=0.
IPRINT=1
X0=0.
XY0=0.
TIMF=0.
PLS0=0.
PF0V=0.
P0=0.
P30=0.
P3R=0.
PAD=PAR
PAR=PAR
CALL CFM(1SFNS,ISTYPF,FDF(IFO),ISTOP)
IF (ISTOP .NE. 0) GO TO 600
TIME=TIME+DFLAT

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300  IPhASF=IPHASF+1
IF(IPHASF.GT.2) GO TO 600
IF(IPHASF.EQ.0) PRINT 92,S,X,XY,TIMF,PL80,PF0V,
$ P20,P30,P39,PADD,PAPR
IPRNTP=-1
IF(ISFSNS.EQ.1) GO TO 305
IPFV=IPHASF
ASPCT=FD(ISETFD)
THF1AU=FD(ISFTFD*IFAV)*CR
THETA=ASPCT*THF1AU
ISTYPE=ID(ISETID)
305 CONTINUE
CALL SFARCH(ISFSNS,ISTYPE,1D(IIT),FD(IIT)),
$ FDIFFVT),FD(IIF),F2)
CALL FDV(ISFSNS,ISTYPD,FD(IFTS),PFAV)
CALL L0S(ISFSNS,ISTYPF,1D(IIFVT),FD(IFEV1,PL80)
P1=PL80*PFAV
GO TO(310,320,330,340,350) ISNUMB
310 CALL VISOR(FD(IIF),FD(IFR),1D(1IFVT),FD(IFEV1)
$ ID(ISETID),FD(ISFTFD),P3D,P3R)
GO TO 360
320 CALL FLIR(FD(IIF),FD(IFR),FD(IFEV1)
$ ID(ISETID),FD(ISFTFD),P3D,P3R)
GO TO 340
330 CALL TUS(ISFSNS,FD(IIF),FD(IFR),1D(IIFVT),FD(IFEV1)
$ ID(ISETID),FD(ISFTFD),IF0V,P3D,P3R)
GO TO 330
340 CALL SNSFLR(ISFSNS,1D(IIT),FD(IF),FD(IFR),FD(IFV)
$ FD(IFTS),ID(ISETID),FD(ISETFD),P2,P3D,P3R)
GO TO 350
350 CONTINUE
GO TO 100
360 OR=P1+PF2
PAD=P3D*OR
PAR=P3R*OR
400 IF(ISFSNS.EQ.1) GO TO 410
IF((X-LF,X2) .AND. ((PRVT+1.0-0)) GO TO 450
IF((X-LF,X2) .AND. (P3D.LT.0.05)) GO TO 600
GO TO 420
410 IF((P1,PR.PP.OR,P3D.LT.0.05)) GO TO 600
420 IPRNT=IPRNT+1
IF((IPRNT/3)*3),NF.,IPRNT) GO TO 450
PRINT 450,X,X,TIMF,PL80,PF0V,PP,P3D,P3R,PAR
425 FORMAT(1X,2(X7.0,1X),F5.2,7(1X,F5.3))
IPRNT=0
450 CONTINUE
$OR=OR
PADN=PAD
PARN=PAR
CALL CFAM(ISFSNS,ISTYPF,FD(IFR),ISTOP)

VII-4
IF(ISTP.FO.1) GO TO 600
TIME=TIME+DFLAT
IF(ISFNS.EQ.4) GO TO 440
IF(XC+XT.XP).AND.(1PHASF.EQ.1)) GO TO 300
CALL SFARCH(ISFNS,ISTYPF,IC(I1T),FD(I1T), $ FD(I1FT),PFDCIFTS),PLO5)
CALL FAVF(ISFNS,ISTYPF,FDC(IFTS),PFDC)
460 CALL LOS(ISFNS,ISTYPF,IC(I1FVT),FD(I1FVT),PFDCIPTS),PLO5)
P1=PLO5+PFDV
C0 TO (510,520,530,540,550) ISNUMB
510 CALL VISOFB(FD(IFT),FD(IFR),IC(I1FVT),FD(IFEVT), $ IC(ISFTID),FD(IFSFTID),P3D,P3R)
C0 TO 590
520 CALL FLIR(FD(IFT),FD(IFR),FD(IFEVT), $ IC(ISFTID),FD(ISFTID),P3D,P3R)
GO TO 590
530 CALL TVC(ISFNS,FD(IFT),FD(IFR),IC(I1FVT),FD(IFEVT), $ IC(ISFTID),FD(ISFTID),PFDCIFTS),P3D,P3R)
GO TO 590
540 CALL SVNFLP(ISFNS,IC(I1T),FD(IFT),FD(IFR),FD(IFEVT), $ FD(IFTS),IC(ISFTID),FD(ISFTID),P2,P3D,P3R)
GO TO 590
550 CONTINUE
GO TO 100
580 CR=P1*P2+(1.-PP)QRV
        X=X
        XY=XY
        TIME=TIME
        PLO5=PLO5
        PFDC=PFDC
        P1=P1
        P3D=P3D
        P3R=P3R
        DELTOR=CR-CRV
        IF(DFLTOR.LE.0.) DELTOR=0.
        PAD=PAD1+DFLTOR*P3D
        PAR=PARN1+DFLTOR*P3R
        PAD=PAD
        PAR=PAR
        GO TO 100
600 CONTINUE
END
SUBROUTINE INPUT
COMMON/ARRAYS/FD(250)
COMMON/ARRSFT/IC(50)
COMMON/TAPSLS/FDTAP(750)
COMMON/TRANSFT/ICT(57)
DIMENSION IC(N)
EQUIVALENCE (FD,IC)
DATA(IC1),I=1,24)/1,2,16,19,36,37,43,48,56,57,
DATA FDOTAP(1), I=61, 702, 25, 99, R, 1, 0, A, 5, 4, R,
$ 7, 5, 25, 30, 65, 100, 5, 3, 100, 6, 100, 1, 1, 2, 1, 3, 5, 60, 120, 1, 120,
$ 7, 9, 14, 29, 9, 64, 1, 2, 7, 3, 1, 8, 5, 7, 3, 65,
$ 7, 5, 25, 1, 703, 710, 95, 1, 120, 1, 150, 1, 120,
$ 1, 95, 1, 1, 65, 1,/
$ DATA FDOTAP(1), I=71, 710, 95, 1, 120, 1, 150, 1, 120,
$ 2, 7, 1, 7, 1, 1, 1,/
$ DATA FDOTAP(1), I=71, 710, 95, 1, 120, 1, 150, 1, 120,
$ RETURN
$ END
$ SUBROUTINE INPUT(ISNUM)
$ COMMON ARRAYS FD(250)
$ COMMON ARR SET IC(50)
$ DIMENSION ID(250), XTEMP(10), ITMP1(10), ITMP3(10, 10)
$ EQUIVALENCE (FD, IC)
$ DATA XFXFCX0RPPPRXTAPCG/4XEC*HNR4ePF.4HTARC/
$ DATA XHCPFVPSA.SN/PA~AF4l4SApHES
$ DATA XPLANKoXTERR/lI s4HTFRR/
$ ISNUM = 1
$ NTEMP = 0
$ DO 1 J = 1, 10
  1 XTEMP(J) = XRLANK
  READ 5, AAA, KSNUM
  5 FORMAT (A6, 11)
  IF (AAA.EQ. 'XEXFC') GO TO 15
  PRINT 10
  10 FORMAT (* EXECUTE CARD MISSING OR OUT OF ORDER*)
  GO TO 30
  15 IF (KSNUM.GT. 0) AND (KSNUM.LT. 8) GO TO 25
  PRINT 20, KSNUM
  20 FORMAT (* INVALID SENSOR NUMBER -- */12)
  GO TO 30
  25 KSNUM = KSNUM
  30 ISFT = 5, ISNUM
  35 READ 40, XNAMF, IN
  40 FORMAT (A, 2, 12)
  II = 0
  IF (XNAMF .EQ. 'XFR') GO TO 50
  IF (XNAMF .EQ. 'XPER') II = 1
  IF (XNAMF .EQ. 'XTARG') II = 2
  IF (XNAMF .EQ. 'XFRACK') II = 3
  IF (XNAMF .EQ. 'XFRN') II = 4
  IF (XNAMF .EQ. 'XFS') II = 5
  II = 0

VII-8
IF(XNAME,FO,XSFS) I=ISFT
IF(I=NF.0) GO TO 50
PRINT 45,XNAME
45 FORMAT(* INVALID DATA NAME--*A4)
GO TO 35
50 LOOP=0
NTEMP1=NTEMP1+1
XTEMP(NTEMP1)=XNAME
ITFMP1(NTEMP1)=IN
NTEMP2=0
I2=I1+1
I3=I1+1
I1=IC(I1)-1
I2=IC(I2)-1
I3=IC(I3)
60 LOOP=LOOP+1
IF(LOOP,CT,IN) GO TO 35
READ 70,IVAR,VALUE
70 FORMAT(RX,IP,FLG.A)
IF(IVAR,CT,0) GO TO 80
PRINT 75,IVAR
75 FORMAT(* VARIABLE NUMBER OUTSIDE RANGE OF DATA NAME*,
* ARRAY--*A4)
GO TO 60
80 IF(IVAR,0,<I3-I11)) GO TO 100
PRINT 90,IVAR
90 FORMAT(* VARIABLE NUMBER OUTSIDE RANGE OF DATA NAME*,
* ARRAY--*A4)
GO TO 60
100 JJ=I11+IVAR
NTEMP2=NTEMP2+1
ITEMP2(NTEMP1,NTEMP2)=IVAR
TFMP3(NTEMP1,NTEMP2)=VALUE
IF(IVAR,CT,<I3-I11)) GO TO 110
IDC(JJ)=IFX(VALUE)
GO TO 60
110 FD(JJ)=VALUE
GO TO 60
200 PRINT 205,ISNUMR
205 FORMAT(I/X,10X,SNSOR NUMBER = *X11,
8/IX=1 = VISUAL OBSERVATION*,
8/IX=2 = FORWARD-LOOKING INFRARED*,
8/IX=3 = ACTIVF (ILLUMINATED) TV*,
8/IX=4 = PASSIVE (DAYLIGHT) TV*,
8/IX=5 = FORWARD-LOOKING RADAR,MTI*,
8/IX=6 = FORWARD-LOOKING RADAR,NON-MTI*,
8/IX=7 = SYNTHETIC APERTURE RADAR*)
LOOP=0
210 LOOP=LOOP+1
IF (LOOP.GT.10) GO TO 240.
IF (XTEMP.LT.LOOP).NE.XFLANK) GO TO 215
RETURN
215 IF (LOOP.EQ.1) PRINT 220
220 FORMAT (1X,'** NAME IVAR VALUE**')
NN=ITMP1(LOOP)
DO 230 J=1,NN
PRINT 225,XTEMP(LOOP),ITEMP(LOOP,J),TFMP3(LOOP,J)
225 FORMAT (1X,'A','A',X,10.4)
230 CONTINUE
GO TO 210
240 PRINT 245
245 FORMAT(* MORE MODIFICATIONS THAN LISTED*)
RETURN
END
SUBROUTINE FLYTH(ISFS,ISTYPE,FD0,IDS,DFS)
COMMON BLOCK1/THETAH,THETAH,PHID
COMMON BLOCK2/HL,HP,SPD,SLP,SPC,SPP
COMMON BLOCK3/X,Y,XY,X,Y,X5,X6,XY1,XY2,XY3,XY4,XY5,XY6
DIMENSION FDO(20),IDS(20),FPS(20)
CR=.01745
Y=FDO(1)
HL=FDO(2)
SPD=FDO(3)*1.68777
IF(ISFS.EQ.4) GO TO 500
ANCLD=FDO(4)+CR
SPC=FDO(5)*1.68777*COS(ANCLD)
SR=FDO(6)
DELTAT=FDO(7)
XP=HL/TAN(ANCLD)
XY2=SORT(X2)*XY2-YY)
TFMP1=ATAN/(YY/XP)
XY1=SR*COS(ANCLD)
XI=XY1*COS(TFMP1)
IF(ISFS.EQ.1) GO TO 300
IF(ISTYPE.EQ.2) GO TO 200
100 PHID=ANCLD
HP=FDO(8)
SPP=FDO(9)*1.68777
ANCLF=FDO(10)+CR
SPC=FDO(11)*1.68777*COS(ANCLF)
SR=FDO(12)
XY3=XY2
X3=XY2
XY4=XY2
X4=XY2
XY5=SORT(SRP*SPP-HP*HL)
X5=SORT(X5*XY5-YY)
X6=X5+(HL-HP)/TAN(ANCLF)
XYA=SORT(XA+YA+Y*Y)
CALL COVF(1SFNS, IDS, FDS, Y, HL, XMAX, XMIN)
IF(XMAX.EQ.XP) G0 TO 210
PHID=(ATAN(XL/XP)+THETA/V+Y)CR
PRINT 205, PHID
205 FORMAT(* DEPRESSION ANCLF TOO STFFP. PHID RESET= *)
$ F5. P,+ DFRGERS *)
PHID=PHID+CR
CALL COVF(1SFNS, IDS, FDS, Y, HL, XMAX, XMIN)
210 X5=XMAX
XY5=SORT(X5*XY5+Y*Y)
SRP=SORT(HL+HL+Y*Y+XY5*XY5)
X6=X5
XY6=XY5
X3=XP
XY3=XY2
X4=MAX(1, X2, XMIN)
XY4=SORT(X4*XY4+Y*Y)
HP=HL
SPP=SPL
SPL=SPL
ANCLC=0.
G0 TO 400
300 CALL COVF(1SFNS, IDS, FDS, Y, HL, XMAX, XMIN)
C0 TO 210
400 X=X1
XY=XY1
SR=SR1
ANCL0=ACOS(X2/XY2)
ANCLT=ANCLD
H=XY*TAN(ANCLT)
SP=SPD
RETURN
500 IF(ISFNS.EQ.7) G0 TO 600
CALL COVF(1SFNS, IDS, FDS, Y, HL, XMAX, XMIN)
X4=XM1N
XY4=SORT(X4*XY4+Y*Y)
X5=XMAX
XY5=SORT(X5*XY5+Y*Y)
F0 TO 700
600 CONTINUE
700 PX=X4
XY=XY4
H=HL
ANCL0=ATAN(Y/X4)
ANCLT=ATAN(H/XY)
SR=SORT(XY4*XY4+H*H)
SP=SPL
DELTAT=FDA(1P)

VII-11
RETURN
END
SUBROUTINE COVER(ISFNS, IDS, FDS, Y, H, XMAX, XMIN)
EXTERNAL FUN1
COMMON/BLACK1/THTAN, THFTA, PHID
COMMON/BLACKS/XMAX, XMIN, VISMAX
DIMENSION IDS(20), FDS(20)
C= 0.01745
IF(ISFNS .EQ. 1) GO TO 200
XMAX= H/TAN(PHID-THFTA/P.)*
XMIN= H/TAN(PHID-THFTA/P.)*
TEMPI= TAN(THFTA/P.)*
YMIN=XMIN+TEMPI
IFCY, CT, YMIN) GO TO 120
RETURN
120 YMAX=XMAX+TEMPI
IFCY, CT, YMAX) GO TO 150
XMIN=XMAX-(YMAX-Y)/TEMPI
RETURN
150 Y= 0.
PRINT 155, Y
155 FORMAT(* OFFSETS(Y) GREATER THAN YMAX. SFT Y= *, F10.4)
RETURN
200 VISMAX=FDS(1)
RMAX= VISMAX
ICMASK= IDS(1)
IFCY, 210, 220, 230
210 Y= ABS(Y)
PRINT 215
215 FORMAT(* ONLY POSITIVE OFFSETS CONSIDERED. USED ABS. VALUF*)
GO TO 230
220 XMAX=RMAX
TEMPI= FUN1(C0.)*CT
XMIN= H/TAN(TEMPI)
IF(CIMASK .EQ. 0.) XMIN= 0.
GO TO 300
230 IF(Y.LT. RMAX) GO TO 250
XMAX= 0.
XMIN= 0.
GO TO 300
250 XMAX= SORT (RMAX+RMAX-Y-Y)
XMIN= 0.
IF(CIMASK .EQ. 0.) GO TO 300
CUFSS= ASIN(Y/RMAX)/CR
TFMPI= H/TAN(FUN1(CUFSS)*C8)
TEMP2= Y/SIN(CUFSS*CR)
IF(TFMP1 .LE. TFMP2) GO TO 260
XMAX= 0.
XMIN= 0.
GO TO 300
VII-12
260 CFSS=CFSS+5.
   IF(CFSS.GT.90.) CFSS=90.
   TMP1=H/TAN(FUN1(CFSS)+CR)
   TMP2=Y/SIN(CFSS+CR)
   IF(TMP1.GT.TMP2) GO TO 270
   IF(CFSS.LT.90.) GO TO 260
   XMIN=0.
   GO TO 300
270 CALL APPROX(GUESS,THETA0,IFAIL)
   TFMP1=FUN1(THETA0)+CR
   TFMP1=H/TAN(TFMP1)
   XMIN=SORT(TFMP1+TFMP1-Y)*Y)
300 XMAX=XMAX
   XMIN=XMIN
   RETURN
END
SUBROUTINE APPROX(GUESS,ANS,IFAIL)
   FXTFRNAL FUNV,FUNDF
   IFAIL=0
   ANS=GUESS
   DO 100 I=1,50
   TFMP1=ANS
   ANS=ANS-(FUNF(ANS)/FUNDF(ANS))
   TFMP2=ANS(ANS-TFMP1)
   IF(TFMP2.LE.1.E-4) RETURN
100 CONTINUE
   IFAIL=1
   RETURN
END
FUNCTION FUNF(THETA0)
   FXTFRNAL FUNV
   C0MP0N/PLOCK2/HL,HP,SPD,SPL,SPC,SPP
   C0MP0N/PLOCK3/X,Y,XY,H,SR,SP,ANGLE,ANCLT,DELTAT
   CR=.01745
   THETAR=THETA0+CR
   TFMP1=FUN1(THETA0)+CR
   FUNV=HL/TAN(TFMP1)-Y/SIN(THETAR)
   END
FUNCTION FUNDF(THETA0)
   FXTFRNAL FUN1,FUNP
   C0MP0N/PLOCK2/HL,HP,SPD,SPH,SPC,SPP
   C0MP0N/PLOCK3/X,Y,XY,H,SR,SP,ANGLE,ANCLT,DELTAT
   CR=.01745
   THETAR=THETA0+CR
   TFMP1=FUN1(THETA0)+CR
   FUNDF=HL*FUNP2(THETA0)+CR/SIN(THETAR)**2
   $ +HL*COS(THETAR)/SIN(THETAR)**2
   END
FUNCTION FUN1(COSTVF)
   FUN1=-.00314P*DFCREF*DFGREF**2P309*DFGREF+129176
FUNCTION FND (DFRARFF)
FTNP = 0.042424 * DEGRFF + 42309
END

SUBROUTINE CM( SFSVS, ISTYPE, FDP, ISTAP)
COMMON / PLACK, HL, HP, SPD, SPL, SPC, SPP
COMMON / PLACKX3, X, Y, XY, H, SR, SP, ANGL0, ANGL1, DFLTAT
COMMON / PLACKX3, X, Y, XY, H, SR, SP, ANGL0, ANGL1, DFLTAT
COMMON / PLACKX3, X, Y, XY, H, SR, SP, ANGL0, ANGL1, DFLTAT
COMMON / PLACKX3, X, Y, XY, H, SR, SP, ANGL0, ANGL1, DFLTAT
COMMON / PLACKX3, X, Y, XY, H, SR, SP, ANGL0, ANGL1, DFLTAT
DIMENSION FD(20)
ISTOP=0
CR=.01745
IF(ISFVS (CT. 4)) GO TO 200
ANGL0=FDO (10)+CR
IF(XY. CT. XY) GO TO 130
XY=XY+SPD*DFLTAT
TFMP1=ATAN(Y/X)
XY=XY+CTF1
H=XY*TFMP1
IF(XY. LF. XY) GO TO 120
TGO=(XY-XY)/SPD
X*XY*SPC*TFMP1
SP=SPC
H=HL
110
XY=SQRT(X*X+Y*Y)
ANGL0=ATAN(Y/X)
ANGL1=ATAN(H/X)
SR=SQRT(XY+XY+XY)
RETURN
130
IF(ISFVS (FO. 1).AR. (ISTYPE.EQ.
ANGLC=FDC (6)+CR
IF(XY. CT. X5) GO TO 140
XY*SPC*DFLTAT
TFMP1=ATAN(Y/X)
XY=XY+SPC*TFMP1
SP=SPC
H=HL-SPC*TFMP1
ANGLC=ATAN(Y/X)
TFMP1=ATAN(Y/X)
XY=XY+SPC*TFMP1
SP=SPC
H=HL
GO TO 110
140
IF(XY. CT. X6) GO TO 150
X*X+SPC*DFLTAT
SP=SPC
H=HL-SPC*DFLTAT
ANGLC=ATAN(Y/X)
TFMP1=ATAN(Y/X)
XY=XY+SPC*TFMP1
X*X+SPC*TFMP1
RETURN

VII-14
SP=SPP
H=HP
GO TO 110
150 X=X*SPP*DFLTAT
GO TO 110
200 X=X*SPL*DFLTAT
IF(X>LF,X5) GO TO 110
ISTRP=1
GO TO 110
FND
SUPROUTZF SSEARCHISENSI,ISTYPF,IDENTFDT,
$DEVTF,FDTS,PP)
COMMON/LACK1/THFTAH,THFTAU,PHID
COMMON/LACK3/X,Y,XY,M,SR,F,P,ANFLA,ANFLT,DFLTAT
COMMON/LACK4/X1,XP,X2,X4,X5,X6,XY1,XY3,XY4,XY5,XY6
COMMON/LACK5/XPMAX,XMIN,VSMAX
COMMON/LACK6/ALPHAM,ALPHAL,ALPHA
DIMENSION IDT(20),FDT(20),FDEV(20),FDTS(20)
F(D1,D2)=2.*ATAN((-D1-1.*SORT(D1+1.*R+D1*D2*D2))/(D1*D2))
CPI=3.14159
DX=FDT(1)
DY=FDT(2)
DTZ=FDT(3)
NT=IDT(1)
TSPACE=FDT(10)
DSX=FDTS(2)
DSY=FDTS(3)
ANSTC=CPI/2.*ANCLT
TANSTC=TAN(ANSTC)
IF(ANCLT=LF.ATAN(DTY/DTX)) GO TO 10
TEMP1=SIN(ANCLT)
DTX=DTY/TEMP1
GO TO 20
10 TEMP1=COS(ANCLT)
DTXX=DTX/TEMP1
20 TEMPC=TAN*TANSTC
TEMP2=(DTXX-DTZ/TAN(ANCLT))/H
ALPHAV=F(TEMP1,FYPE)
ALPHAV=2.*ATAN((DX*SIN(ANCLT)+DTY*COS(ANCLT))+(2.*SR))
ALPHAV=2.*ATAN((DX*COS(ANCLT)+SIN(ANCLT))
S=DTY*SIN(ANCLT)+SIN(ANCLT)+DTZ*COS(ANCLT)/(2.*SR))
IF(X<LT,XA) GO TO 250
AT=DTX*DTY*SIN(ANCLT)+
S=(DTX*DTZ+SIN(ANCLT)+DTY*DTZ*COS(ANCLT)+COS(ANCLT))
AT=AT*(NT-(NT-1)*TSPACE/DTX)
IF(ISFNS.F0.1) GO TO 100
IF(ISFNS.F0.1) PHID=ANCLT
PHID=CP1/P.+PHID
TPHIC=TAN(PHIC)
IF(DX=XF.LF.0.) GO TO 30

VII-15
TEMP1=TPHIC*TPHIC
TPPP=DSX/H
BETAV=F(TEMP1,TEMP3)
10 IF(BETAV.LT.THTAV) G0 TO 40
30 RETAV=THETAV
40 IF(DSY.LF.0.) G0 TO 50
BETAN=-RATAN(DSY/9.+SR))
10 IF(BETAN.LT.THTAH) G0 TO 60
50 RETAH=THTAH
60 OMEGA=PFTAH*(SIN(PHID+PFTAV/2.)-SIN(PHID-RETAV/2.)
SRPHID=H/SIN(PHID)
AS=OPEPA+SPHID+SRPHID
G0 TO P0D
100 VLOC=FDTS(4)
TEMP1=XP*AX*SORT(XP*MAX+XP*AX+Y*Y+H)
TEMP2=XIMIN*SORT(XIMIN*XIMIN+Y*Y+H)
AS=VLOC+ALOC(TEMP1/TEMP2)
200 ARAT10=AT/AS
G=FDEV INT(6)
TEMP1=(T00.0E6)*ARAT10*DELTAT
1IF(T00.1E6) CC TO 270
250 P2=1.0
RETURN
270 P2=1.0-EXP(-TEMP1)
RETURN
END
SUBROUTINE LAS(ISENS,ISTYPF,IDEV1,FDEV1,PL0S)
COMMON/TARLFST,FDATA(T925)
COMMON/TARGET,ICT(50)
COMMON/PLCCK/X,Y,XY,H,SP,SR,ANGL,ANGLT,DFDTAT
COMMON/VLOCK/X1,X2,X3,X4,X5,Y1,Y2,Y3,Y4,Y5
DIMENSION IDFVT(PO),FDFVT(PO)
IF(X.LT.X) GO TO 35
CB=.01745
ICFLAS=IDFVT(3)
ANGLM=FDFVT(2)*CR
RAT10=FDFVT(3)
PNMASK=1.0
IF(ASINH(SR).GT.ATAN(RAT10)) G0 TO 10
PL0S=0.
RETURN
10 IF(ANGLL.LF.0.) GO TO 20
PNMask=PMASK*1-EXP(-ANGLT/ANGLM))
20 PCFLAS=1.0
IF(ISENS.GT.4) GO TO 30
IF(ICFLO5.F0.0) GO TO 30
ZENITH=ANGLT/CR+90.
JJ=ICT(4)
NX=ICT(5)
IX=JJ
VII-16
IF(H.LT.5000.) GO TO 25
JJ=ICT(7)
NX=ICT(8)
IX=JJ
IY=IX+NX
25 CALL INTFR1(FDTAR(X),FDTAR(Y),NX,ZFITH,PCFL8S)
30 PL8S=PNSASK*PCFL8S
RETURN
35 PL8S=1.0
RETURN
END
SUBROUTINE INTFR1(X,X,YY,NN,X,Y)
DIMENSION YY(X),XX(K)
Y=YY(1)
IF(NN.EQ.1) RETURN
DO 1 K=1,NN
IF(X.LE.XX(K)) GO TO 2
1 CONTINUE
Y=YY(NN)
RETURN
2 IF(K.EQ.1) RETURN
Y=(X-XX(K-1))/((XX(K)-XX(K-1))*(YY(K)-YY(K-1)))+YY(K-1)
RETURN
END
SUBROUTINE F0V(ISFNS,ISTYP,FDTS,PFOV)
COMMON/BLOCK1/THTAH,THTAV,PHID
COMMON/BLOCK2/X,Y,X,Y,H,SR,SP,ANF,M,TTH10,DFLTAT
COMMON/BLOCK3/X1,X2,X3,X4,X5,X6,X1,X2,X3,X4,X5,X6,X1,X2,X3,X4,X5,X6
DIMENSION FDTS(20)
CPI=3.14159
SIX=F0TS(5)
SICY=F0TS(6)
IF(ISFNS.EQ.1) GO TO 100
IF(ISTYP.EQ.2) GO TO 100
IF(X.LT.X2) GO TO 100
ANGTC=CPI/P.*-A.XLT
IF(SIRX.T.GT.0.) GO TO 40
PFOVX=1.0
GO TO 50
40 XY=P.*SR*TAN(TH4TAV/P.)/C2.R2A2*SICX)
PFOVX=FRRF0N(XY)
50 IF45G'Y.GT.0.) GO TO 60
PFOVV=1.0
GO TO 90
60 IF(XANCTC+TH4TAU/P.)*LT.(CPI/2.) GO TO 70
PYL=5
GO TO 80
70 XLI=K*(TAN(XANCTC+TH4TAU/P.)*TAN(XANCTC)/(2.828454*CY))
PYL=5*ERRF0N(XLI)
VII-17
80 XLP=HE*(TAN(ANCTC)-TAY(ANCTC-THFTAV/P.))/((P.*P4A2R*S1G))
   PYP=5.*FPFRUV(XLP)
   FPFRUV=PY1+PY2
90 FPFRUV=FPFRUV*FPFRUV
RETURN
100 FPFRUV=1.0
RETURN
END
FUNCTION ERRFUV(X)
C=1.*,PV3791679551
ERRFUV=1.*F50
IF(X) 61,1
1 X2=X*X
IF(X-2.75.LT.150) GO TO 10
DENS=0.
GO TO 11
10 DENS=C*FPX(-X2)
11 IF(X-2.25) 4,4,2

C COMPUTE ERRFUV USING A CONTINUED FRACTION EXPANSION
2 N=76./X-4.
   A1=X*XP*(X-5.*X2)+P.
   AP=X*(X+(X-7.5)+R.25)
   B1=X*(X+(X-5.5)+3.75)
   B2=X*(X+(X-7.5)+11.25)+1.875
   T3=3.
   D0 3.1=3*N
   A3=X*AP+T*A1
   A1=A2
   A2=A3
   B3=X*B2+T*B1
   B1=B2
   B2=B3
   T=T+.5
   CERRF=DENS*A3/(P.*P3)
   ERRFUV=1.-CERRF
   RETURN
C COMPUTE ERRFUV FROM THE MCLAURIN POWER SERIES
4 N=11.5*X+5.
   T5=5.
   ERRFUV=X*C.1.-X2*(3.333333333333333365-1.*X2*
   S (1.-X2*(P.*P4A03406520528902-2.*X2.*4.62969262962963F-31)))
   Y=X*XP*X2*X*/P16.
   D0 5.1=2.Y
   Y=-X2*(P.*X-1.)*Y/(T*(P.*T+1.))
   ERRFUV=FRRFUN+Y
5 T=T+1
   FRRFUN=C+FRRFUN
   CERRF=1.-FRRFUN
6 RTURN
FND

VII-18
SUBROUTINE ATMS(DFDT,FDFA,FDFVT,FDVT,IDS,FDS,ISFNS,
STAT,CA,CM)
COMMON/TARLF5,FDTAR(25),
CMON/TA5SET/ICT(50)
COMMON/LOCK1,THFTAK,THTAU,PHID
COMMON/LOCKX,XY,XYH,SP,SP,ANGL,ANLT,DFLAT
DI S I M N V F D T(20),FD (20),ID F V T(20),FDFVT(20),
FDOS(20),FDS(20)
VG=FDFVT(4)
IF(ISFNS.F0.2) C0 T0 200
RT=FDT(4)
RB=FDF(4)
CI=ABS(RT-RP)/AMAX(RT,RB)
TEMP1=001*N
TEMP1=001*(1.2)*.56*EXP(-.08*TEMP1)*.073
VS=VG/TEMP1
IF(ISFNS.F0.1) XLAMDA=FDS(4)
IF(ISFN5,F0.3) XLAMDA=FDS(15)
IF(ISFNS.F0.4) XLAMDA=FDS(15)
SIGMA=(3.912/(VS*6075.))*X(XLAMDA+.55)
IF(ISFNS.F0.1) C0 T0 5
GAMMAT=FDS(9)
IF(ISFNS.F0.3) C0 T0 100
5 TAT=EXP(-SIGMA*SR)
ITAT=FDFVT(4)
IF(ITAT.F0.1) C0 T0 300
10 ICLOUD=FDFVT(1)
TEMP1=2
IF(ICLOUD.F0.2) TEMP1=6
IF(ICLOUD.F0.3) TEMP1=1.
ZK=TEMP1/RT
TEMP1=1.2*ZK*(1.-TAT)/TAT
50 C=1/TEMP1
55 IF(ISFNS.F0.1) TRETURN
60 CM=CA/(2.*CI)
CM=1.-(1.-CM)**(CAMAT
RETURN
100 GAIN=FDS(19)
ISTYPE=IDS(1)
IF(ISTYPF.F0.1) PHID=ANLT
TEMP1=PHID*THFT/IT2.
TFM2=PHI*THFT/IT2.
SRMIN=H/SIN(TEMP1)
SRMAX=H/SIN(TEMP1)
ZMIN=2.*SIGMA+SRMIN
ZMAX=2.*SIGMA+SRMAX
TAT=EXP(-ZMAX)
J=ICT(1)
NX=ICT(2)
CALL INTFR1(FDTAP(I),FDTAP(I),NX,ZWIN,F2WIN)
CALL INTFR1(FDTAP(I),FDTAP(I),NX,ZMAX,F2MAX)
XNA=6(IN+SIGMA*SPMAX*.25)*
SRMAX/SRMIN*F2ZMIN-F2ZMAX)
XNT=XNA+RT*TAT
XNB=XNA+RP*TAT
CA=AR*(XNT/XVP-1.)
GO TO 60

200 RH=DFDVT(5)
DFLTP=FDPC2)
TEMP1=100.13*H
TEMP1=(1./FMTPI)*(1.-EXP(-TEMP1))
TEMP2=1002/H
TEMP2=(1./FMTPI)*(1.-EXP(-TEMPI))
XW0=1.43*RH*EXP(-FMTPI)-0.35*(DFLT=0.73.)
TEMP2=(.27*FMTPI)/(VC*F.0760.017*XW0*TEMPI
TAT=EXP(-FMTPI)*SP+.001)
RETURN

300 IAZIM=IDFVT(5)
WH=H
SR1000=0.0115D0
BMAX=AMAX1(FT,PP)
ZENITH=ANCLT/.017/5+90.
IF (IAZIM.F0.2) GO TO 350
JJ=ICTC31)
NX=ICT(32)
NY=ICT(33)
IX=JJ
IY=IX+NX
IZ=IY+N
CALL INTFR2(WH,SR1000,FDTAP(I),FDTAP(I),FDTAP(I)),
SNX,SNY,NNP,XX,NN)
JL=ICTC37)
NX=ICT(38)
IX=JJ
IY=IX+N
CALL INTFR1(FDTAP(I),FDTAP(I),NX,ZENITH,R)
GO TO 360

350 JJ=ICTC34)
NX=ICT(35)
IX=JJ
IY=IX+N
IZ=IY+N
CALL INTFR2(WH,SR1000,FDTAP(I),FDTAP(I),FDTAP(I)),
SNX,SNY,NNP,XX,NN)
JL=ICTC40)
NX=ICT(41)
IX=JJ

VII-20
IY=IX\*NX
CALL INTFR1(FDTAP(IX),FDTAP(IY),NX,ZF\*WTH,RF)
360 CA=CI/(1.*DFR/(RMAX*RF))
  GO TO 35
END
SUFFIXED VISOR(FDT,FDN,IDEVT,FDFT)
SIDS(FDS,P3D,P3F)
COMMON/BLOCK4/X1,X2,X3,X4,X5,X6,Y1,Y2,Y3,Y4,Y5,Y6
COMMON/BLOCK4/ALPHAH,ALPHAV
DIMENSION FDT(20),FDN(20),IDEVT(20),FDFT(20),SIDS(20)
SIDS(20),FDS(20)
ISENS=1
THETA=0
CR=.01745
RR=0.0265
XX2=.04
XX4=1.6
CT=XX1*THETA**XX2*(XX3+XX4+XX5)/
S ((AMIN(ALPHAH,ALPHAV)+60./CR)**2).
CALL ATMS(FDT,FDN,IDEVT,FDFT,XXX,FDS,ISENS,
XXX,XX,XX)
TEMP1=CA/CT
IF(TEMP1.LT.0.5) GO TO 90
IF(TEMP1.LT.1.) GO TO 40
AK=.43
GO TO 50
40 AK=-.57
50 TEMP1=4.2*((TEMP1-1.)*2)
  P3D=.57+AK*SORT(1.*EXP(-TEMP1))
A=3.
B=2.9F-6
IF(XF.FE.XP) GO TO 55
VALPHA=0.
GO TO 60
55 VALPHA=(SP*SROT(H+H+Y+Y)/(SR+SR))/CRA
60 TVA=(A+B*(VALPHA**3))/P,
  TEMP1=(AMIN(ALPHAH,ALPHAV)+60./CR)/TVA)**2
IF(TEMP1.LE.3.P) GO TO 100
IF(TEMP1.LE.1.0P) GO TO 70
P3R=1.0
RETURN
70 P3R=1.-EXP(-TEMP1)
RETURN
90 P3D=0.
100 P3R=0.
RETURN
FND

VII-21
SURROUTINE FLIR(FDT, FDR, FDFVT, IDS, FDS, P30, P3R)
COMMON/BLCK1/THETAH, THETAU, PHI0
COMMON/BLCK2/X, Y, XY, H, SN, SP, ANCO, ANFLT, DFLTAT
COMMON/BLCK6/ALPHAH, ALPHAL, ALPHAV
DIMENSION FDT(20), FDR(20), FDFVT(20)
$IDS(20), FDS(20)
ISENS=2
DELTB=FDR(2)
EMMT=FDR(3)
DELTT=FDT(5)
EMMT=FDT(6)
G=FDFVT(6)
ZK=FDS(5)
ZK2=FDS(6)
CALL ATNS(XXX, FDR, XXX, FDFVT, XXX, XXX, ISENS,
STAT, XXX, XXX)
XNVT=AMN1(ALPHAH, ALPHAL)/AMAXI(ALPHAH, ALPHAL)
IX=1
100 TEMP1=0.
XN=2.*THETAU/AMN1(ALPHAH, ALPHAV)
IF(XN.GT.500.) GO TO 320
IF(XN.NE.1) GO TO 110
XN=X+XN
IF(XN.GT.500.) GO TO 320
GO TO 130
110 IF(XN.GT.300.) GO TO 190
SNRT=6.1R.EXP(-.00252*XN)
GO TO 150
120 SNRT=9.*0116-.00P*(XN-300.)
GO TO 150
130 IF(XN.GT.300.) GO TO 190
SNRT=9.*R.EXP(-.00248*XN)
GO TO 150
140 SNRT=R.9661-.002*(XN-300.)
150 SNRT=SNRT*(1.+.00F*XN)
IF(XN.LT.100.) GO TO 160
SNVRT=3.+.002*XN
GO TO 170
160 SNVRT=5.+.002*XN
170 XMRT=2*XN.EXP2(XN)
TDIFF=APS(DFLTT+EMMT)EMMT*EMMT
SNRD=(SNRTTDIFF/XMRT)*(DELTA*EMMB/30.0)**3)*$SORT(1./(7.*XMRT))
SNRD=SNRD-SNRT
IF(SNRT.LT.5.) GO TO 310
TEMP1=1.0
GO TO 320
310 TEMP1=1.0
SNR=1.41AP1A
TFK=5.*TEMP1
IF(SNR.GT.0.) TEMP1=1.0-TEMP1

VII-22
320 IF (IX.F0>2) GO TO 390
330 P3D=TFMPI
   IF (TPP1.LF.0.) GO TO 390
   Ix=2
   GO TO 100
390 P3D=TFMPI
   RETURN
   FND
   SUBROUTINE TV (ISFNS,FDT,FDA,IDFVT,FDEV,
   $IDS,FDS,IF0W,P30,P3R)
   COMMON/BLACK1/THFTAH,THFTAV,PHD
   COMMON/BLACK2/Y,Y,X,Y,XY,SP,SPAN,ANG1,ANGL,DELTAT
   COMMON/BLACK6/ALPHAH,ALPHAV
   DIMENSION FDT(20),FDR(20),IDEVT(20),FDEV(20),
   $IDS(20),FDS(20)
   ASPECT=FDS(1)
   BAND=FDS(5)
   DIAG=FDS(6)
   FNUM=FDS(A+IF0W)
   GAMMAT=FDS(9)
   XFC=FDS(11)
   XI=FDS(12)
   XIMAX=FDS(13)
   XIF=FDS(14)
   XMAXA=FDS(15)
   XNL=FDS(16)
   XNR=FDS(17)
   GT=FDS(20)
   RTE=FDEV(1)
   G=FDEV(4)
   CALL ATMOS(FDT,FDA,IDFVT,FDEV,IDS,FDS,ISFNS,
   $STAT,XXX,CK)
   EAREA=ASPFCT*DIAG+DIAG/(1.*ASPFCT*ASPFCT)
   RESPONS=10.**((ALOE10(XI)-ALOE10(FARFA))/FAMAT
   $)
   IFLAG=0
   IF (ISFNS.FO.3) GO TO 10
   ICLUD=1.*VT(1)
   ISUNAN=1.*VT(2)
   TRANSM=FDS(10)
   CFAC=1.
   IF (ICLOUD.FO.2) CFAC=3.1635
   IF (ICLOUD.FO.3) CFAC=10.
   HS=595.
   IF (ISUNAN.FO.2) HS=465.
   IF (ISUNAN.FO.3) HS=345.
   XICON=RESP:N+HS+RTF*TRANSM+TRANSM/(4.*CFAC)
   GO TO 20
10 POUT=FDS(18)
   ASTR=THFTAV+THFTAH

VII-23
20 IF(ISFNS.FR.3) GO TO 30
   XIAVF=FRAREA/(XICON/(FNUM*FNUM))**GAMMAT
   GO TO 40
30 XICOV2=FRSPDN*PTF*PMT*TAT*TRANS/(4.*ASTR*SR*SR)
   XIAVF=EANFA/(XICON/(FNUM*FNUM))**GAMMAT
40 IF(XIAVF.LT.(.85*XIMAX)) GO TO 50
   FNUM=1.414214*FNUM
   IFLAG=1
   GO TO 20
50 IF(IFLAG.EQ.0) GO TO 60
   PRINT 55,FNUM
55 FORMAT(* TUPF SATURATION, NEW FNUM= **FS.P)
60 XNISF=XIP*XIP/(2.*RND)
   XF=SORT(XN,XNR/(1.414214*ASPECT))
   XNB=1.24*XF
   XNET=31*XF
   XNEL=545.*DIAG/(2*AMDA*FNUM*SORT(1.*ASPECT*ASPECT))
   XNOL=3.6A*XVF
   XNV=AMNI/(ALPHA+ALPHA)/AMAX1(ALPHA,ALPHA)
   IX=1
100 TEMP=0.
   XN=2.*TFSTAV/AMIN/(ALPHA,ALPHA)
   IF(XN.GT.700.) GO TO 320
   IF(XN.LE.2) GO TO 110
   XN=4.*XN
   IF(XN.GT.700.) GO TO 320
   GO TO 130
110 IF(XN.GT.300.) GO TO 190
   SNRT=6.18*EXP(-.00258*XN)
   GO TO 150
120 SNRT=90176.-002*(XN-300.)
   GO TO 150
130 IF(XN.GT.300.) GO TO 140
   SNRT=8.2*EXP(-.00248*XN)
   GO TO 150
140 SNRT=3.96711.-002*(XN-300.)
150 SNRT=SNRT*(1.++*G=G)
   ZNFT=(XN/(XNU*XNET))**2
   ZNFL=(XN/(XNU*XNFL))**2
   PSIY=SORT(1.*ZNET+ZNFL)
   GAMMA=PSIY/SORT(1.+ZNFL+ZNET)
   IF(XN.GT.(XNU/(3.*))) GO TO 210
   BETA=(.3*XN/XN)*ERRFUN(3.*XN/XF)
   GO TO 220
210 BETA=(XF/XN)*(.384+.233+ERRFUN(2.45*XN/XF))
220 IF(XN.LT.10.) GO TO 240
   IF(XN.GT.XM) GO TO 250
   I=1
   RSOF=0.
240 I=I+2
IF(I+CT.50) GO TO 260
XIN=I*XN
IF(XIN+CT.XN0F) GO TO 260
PHIX=XIN/XVAL
RLN=E37*(ACRS(PHIX)-PHIX*SORT(1.-PHIX*PHIX))
IF(XIN+CT.XN0E/3.) GO TO 230
RSOF=RSOF+(A11+RLN*EXP(-4.4*XIN*XIN/(XE*XE)))/(I+I)
GO TO 225
225 RSOF=RSOF+(-637*RLN*EXP(-3.*XIN*XIN/(XE*XE)))/(I+I)
GO TO 225
220 RSOF=1.0
GO TO 260
250 RSOF=0.
GO TO 320
260 SNRD=(P.*RSOF+C*CT*XIAVE/XN)*SORT(.1*XN/V/(ASPECT*PSIY*C*CT+BFTAT*GAMAYXIAVF+1.6E-19*XN0ISF))
SNR=SNRD-SNRT
IF(SNR+LT.5.) GO TO 310
TEMP1=1.0
GO TO 320
310 TEMP1=1.0-FRPFUN(ABS(SNR)/1.414214)
TEMP1=5.*TEMP1
IF(SNR+CT.0.) TEMP1=1.0-TEMP1
320 IF(X+CT.2) GO TO 350
IF(RSOF+CT.0.) GO TO 330
P3D=0.
P3R=0.
RETURN
330 P3D=TEMP1
IX=2
GO TO 100
350 IF(RSOF+CT.0.) GO TO 390
P3R=0.
RETURN
390 P3R=TEMP1
RETURN
END
SUBEROUTINE SENLR(15ENS,IDT,FDT,FDB,FDEVTS,FDT$15S,FOS$15P,3D$15R)
COMMON/TAPLE$/FDTAR(75)
COMMON/TAR$1T/ICT(50)
COMMON/PLACK1/THFTA1,THFAT,PHIN
COMMON/PLACK2/X,Y,H,SR,SP,SPNL0,ANFT,DELTAT
DIMENSION IDT(20),FDT(20),FDR(20),FDEVTS(20)
$ FDT$15S,FOS$15P,3D$15R
C CPI=3.14159285
C$ =-2.048
C 3=1.689

VII-25
CR= .01745
SNB=0.
VC=0.
NT-IDT(1)
PN=0.
VRT=0.
VB=0.

C

C= FDFVT(6)
VTI=FDT(12)
C= 3. F R
H=H*C2
VG=SP/1.6R7778
CO=FDS(2)
PRF=FDS(4)
PX=FDS(5)
FLAMDA=FDS(6)
WS=FDS(7)
PHIM=PHID-THFTAV/P.
VW=FDFVT(7)
TAUP=FDS(12)
TAUP1=FDS(13)
TAUP2=FDS(14)
VF=FDS(15)
VPRF=FDS(16)
CAS=FDS(18)
ISEAS=IDS(1)
DTX=FDT(1)*C2
DTY=FDT(2)*C2
PSI=FDT(11)*C8
XXXX=0.
WP=FDE(5)
GG = C.
PNR=FDS(3)

C SELECT BAND
IRAND=1
IF(FLAMDA-LT (.025)) IRAND=2
IF(FLAMDA-LT (.0125)) IBAND=3
BAND=IRAND

C COVERAGE C
Y=+C2

C

C P3DPO.
X=+C2

C GEN=FTRY
SR=SP+C2
PHI=AYuLH
DCY=SH*THFTAH
DGX=C*TAU+V/(2.*COS(PHI))

VII.26
TSPACF=FDT(I0)*C?
RNJC=NT
DNMIN=AMIN1(DCX,DCY)
RNJCI=DNMIN/(VT*{TSPACF+DTX})
RATSIG=AMIN1(RNJG,RNJCI)
SIEFAC=AMAX1(1.,RATSIG)
XTE=AMIN1(CTX,DCX)
YTE=AMIN1(CTY,DCY)
AG=DCX+DCY
ATE=XTF+YTF
ABE=AMAX1(({AG-ATF),0.})
TFMP1=COS(PHI)**2
TFMP1=SORT(SW*SR*TFMP1-Y*Y)
ALPHA=ATAN2(Y,TFMP1)
VRT=VTT+COS(PHI)*COS(PSI-ALPHA)
TFMP1=SIN(PHI)**2
TFMP2=SIN(PHIM)**2
TFMP3=SORT(COS(PHI))
TFMP4=SORT(COS(PHIM))
CAF=FO+TFMP2*TFMP3/(TFMP1*TFMP4)
C RFSOLUTION GEOMETRY
AC1=AC
ABE1=0.
C
C
   IF(ABE1.EQ.-0.)GO TO 200
   100 DX=AMAX1(DCX,DCY)
   DN=AMIN1(DCX,DCY)
   IF(DX.LE.VP) GO TO 200
   IF(DN.LE.VP) GO TO 110
   AP=VP*(DX+DN)/2.
   GO TO 120
   110 AP=DX+DN)/2.
   120 AL=AMAX1(({AG-AP),0.})
   F1=1-0
   TFMP1=F1
   F1=F1/TMP1
   A1=AP+F1+AL
   IF(ATE+CT.AP) GO TO 130
   ABE1=A1-ATF
   GO TO 140
   130 ATEL=ATE-AP
   ABE1=A1-F1+ATEL-AP
   140 AC1=F1+AC
C RADAR CROSS SECTION
   200 TFMP1=SIN(PHI)
   AT=DTX+RTY
   I=1+IRAND
   SIGTF=FDT((1.)*(3/FLAMDA)**3
   SIGTF=10.**(ALOG10(SIGTF)+PHI/(CR+5.))
VII-27
TFMP5=PSI
IF(PSI.GT.7.5) TFMP5=CP1/PSI
SIGTF=SIGTF-5/45.*PSI/CR
SIGTF=10.*SIGTF/10.
SIGTF=SIGTF*SIGTF
210 TEMPP=AC/AT
IF(TFMP2.GT.1.) GO TO 220
SIGTF=SIGTF*TEMPP

C
PHI=PHI/CR
JJP=ICT(J)
NXX=ICT(11)
NY=ICT(12)
IX=JJ
IY=IX+NX
IZ=IY+NY
CALL INTERP(PHI,PAND,FDTAR(IX),FDTAR(IY),FDTAR(IZ),
 & NX,NY,SIG1,XXX,NX)
SIGR1=10.*SIG1/10.

222 PHI=PHI*CR
SIGBF=TEMPI*(APF1*SIGR1)
SIGG=TEMPI*(AG1*SIGBF)

C
CALL ATTFCF(RAND,CAS,H,ISEAS,PHI,TAUAR)
TAUAR=1./10.*(TAUAR/10.)
310 PNB=0.

C
RECEIVER POWER
C
TEMP3=4*CP1*CP1*SR*SR
PDAR=TAUP1*PX*CAF*TAUAR*CP1/TEMP3
PRTT=SIGTF*PDAR
PRT1=SIGTF*PDAR
PARR=SIGG*PDAR
TFMP1=TAUP2*CAF*TAUAR*FLAMDA*/(4.*TFMP3)
PATT=TFMP1*PRTT
PRT=TFMP1*PRRT
PARR=TFMP1*PARR
TFMP1=SORT(TFMP1)
PRT=TFMP1*FATT
PARR=TFMP1*PARR
SNRAT=(PRT+PARR)/(PARR+PNR)
IF(ISENS.FC.6) GO TO 361

C
CLUTTER FREQUENCY
C
VR=0.
330 TFMP1=SIN(PHI)

VII-28
TFMPP = COS(PHI)
TFMP3 = SIN(ALPHA)
TFMP4 = COS(ALPHA)
VVY = C3 + VC + TANPI * TFMP4 * TFMP4 * 3 / (TFMPP * FLAMDA + H)
VVX = C2 + C3 + VC + TANPI * TFMP3 / FLAMDC
VV = 2 * VV / FLAMDA
VS = FDS(7) * C5 / (SORT(2 * CP1) + TANPI)
VC = SORT (VVY + P * VVX + P * VV + 2 + VS * 2 + VS * 2)

C CLUTTER ATTENUATION
C
VT = SORT (VC * P + VF * P + VPRF * 2)
VTH = FDS(3)
VB = FLAMDA * PRF / (2 * C3 * C2)
IF ((2 * VTH) LT. VR) G0 TO 333
PRINT 339, X, Y
332 FPMAT(1, 157) THRESHOLD SPFFD IS OR FATFR THAN 1/P,
$12H ALIND SPEED, sX, 2HX = E12.5, sX, 2HY = E12.5
P3D = 0.
G0 TO 370
333 FN1 = (VRT - VTH)/VB
N1 = FN1 + 00001
IF (FN1 - LT. 0) N1 = N1 - 1
N1 = N1 + 1
FN1 = N1
TFMP1 = (VRT - VTH)/VB
IF (FN1 LT. TFMP1 G0 TO 334
P3D = 0.
G0 TO 370
334 FTH = 2 * C2 + C3 * VTH / FLAMDA
FMF = FDS(1)
IF (FMF) 9, 7, 9
7 FMF = 12.
PRINT 8
IF FPMAT(5X, 142) MAN MF VALUE WAS NOT INPUT SO MF IS SET 12.
9 FII = FMF/6.
FKK = 1 / (1.414 * FTH * FII)
FRT = 2 * C2 + C3 * VRT / FLAMDA
FBK = FTH / 1.414 * (1 / FII)
GC = FKK * FRT * (P. * FII)
IF (FRT GT. F BK) GC = 1
PIT1 = PTT * GC
TFMP1 = 0.
CALL GAIN (TFMP1, F BK, TFMP3, VT, 0, XXXX)
TEMP2 = 5 - (TFMP2 / (VT SORT(2 * CP1))
IF (TFMP2 LT. 0) TEMP2 = 0.
P N = 2 * TEMP2
TFMP1 = 0.
CALL GAIN (TFMP1, F BK, TFMP3, VT, 1, FII)
P N = P N + P + FKK * II / (SORT(2 * CP1) + VT) * TEMP2

VII-29
PRC = PNN/(PNN+PRP)
PTC = PNN/(PTN+PRP)
SNRAT = (PNN+PTC)/(PRP+PRC)
361 SNDP = 1D.*ALTD10(SNRAT)
365 TSN = FDS(21)
P30 = 0.
P31 = 0.
IF(SNDP+CT5+TSN)P30 = 1.
IF(P30.LE.0.) GO TO 400
370 CONTINUE
XNR = AMIN1(DTX,DTY)/D6X
TFEP = DXP-3.*P1/1I.
IF(TFEP.LT.10.) GO TO 390
P3R = 1.
400 GO TO 400
390 P3R = 1.-EXP(-TEMP)
400 ATE = DEX*DEY
AT = AT*(NT+TSPACE/D6X)
DSX = FDTS(2)
DSY = FDTS(3)
XMAX = H*TAN(PHID+THETAV/2.)
XMIN = H*TAN(PHID+THETAV/2.)
YMAX = 2.*XMAX*TAN(THETAV/P.)
YMIN = 2.*XMIN*TAN(THETAV/P.)
IF((DSX+CT,0.) GT.(DSY+CT,0.)) GO TO 450
AS = 2.*YMAX-2.*YMIN
60 TO 500
450 DDSX = XMAX-XMIN
IF(DSX.GT.0.) DDSX = AMIN1(DSX,DDX)
DDY = (YMAX+YMIN)/4.-Y
IF(DSY.GT.0.) DSY = AMIN1(DSY/2.,DDY)
IF((DDY-Y).GT.(YMIN/2.)) GO TO 470
AS = P.*DDY+ODY
60 TO 500
470 AA = (DDY-Y)-(YMIN/2.)/TAN(THETAH/C.)
BB = AA*TAN(THETAH/P.)
AS = ODY*DDX-5.*AA+DD
DDY = (YMAX+YMIN)/2.*Y
IF(DSY.GT.0.) DSY = AMIN1(DSY/2.,DDY)
IF((DDY-Y).GT.(YMIN/2.)) GO TO 490
AS = AS+DSY*DSX
60 TO 500
490 AA = (DDY-Y)-(YMIN/2.)/TAN(THETAH/P.)
BB = AA*TAN(THETAH/P.)
AS = AS+ODY*DDX-5.*AA+RB
500 ARAT0 = AT/AS
TEMP = (700./C.)*ARAT0*DFLAT
IF(TEMP.LT.180.) GO TO 510
P3P = 1.
60 TO 520
C PERFORMS BIVARIATE INTERPOLATION
C
DIMENSION TAB(NX,1),X(1,1),Y(1,1)
IFLAG=0
1 IF(TAREX-X(1,1))<0.33
2 IFLAG=-1
3 ARGX=TAREX
4 IF(TAREY-Y(1,1))<5.66
5 IFLAG=-1
ARGY=Y(1,1)
6 ARGY=TAREY
7 DO 6 II=2,NX
8 CONTINUE
6 I=II
7 DO 8 JJ=2,NY
9 CONTINUE
8 II=NX
9 I=II
10 CONTINUE
11 J=JJ
12 CY1=(ARGY-Y(J,J))/DY
13 CY2=(ARGY-Y(J,J))/DY
14 DX=X(1,1)-X(I-1)
15 CX1=(ARGX-X(1,1))/DX
16 CX2=(ARGX-X(I-1))/DX
17 ANS=CY1*(CX1+TARI(I-1,J-1))*CX2+TARI(I,J)
18 CYP=CY1*(CX1+TARI(I-1,J))*CX2+TARI(I,J)
19 RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END
SUBROUTINE INTFP(TAREX,TAREY,X,Y,TAB,NX,NY,ANS,IFLAG,N)
C
510 PP=1.-FEXP(-TEMP1)
520 X=X/C2
Y=Y/C2
H=H/C2
SR=SR/C2
RETURN
END

X=X1
DO 40 I=1,101
IF(CITYPF) 5,5,4
5 TEMP=-X*X-.5/(VT*VT)
   IF(CITYPF.LT.0) TEMP=TEMP*X**P.*FI
   GO TO 7.
6 TEMP=SQRT(COS(X))/(SIN(X)+X)
7 IF(I.EQ.1) GO TO 30
   IF(I.EQ.101) GO TO 30
   IF(I/I+0.75-1) 10,20,30
10 TEMP=2.*TEMP
   GO TO 30
20 TEMP=4.*TEMP
30 Y=Y+TFMP
40 X=X+DX
       Y=DX*Y/3.
RETURN
END
SUBROUTINE SAR(FDO, IDT, FDT, FDP, FDEVT, 
& IDS, FDS, P30, P32)
COMMON/TAFES/FDTAR(725) 
COMMON/TAES/ICT(50)
COMMON/PLA2/32, Y, X, H, SR, SP, ANGLO, ANGLT, NFATAT
DIMENSION FDO(20), IDT(20), FDT(20), FDP(20), 
& FDEVT(20), IDS(20), FDS(25)
CAS=FDS(19)
ISEAS=IDS(1)
IBAND=1
FTK=1.
CP1=P*ASIN(1.)
CP2=30#4R
C3=1.649
CR=.01745
C=.35#R
DX=FDS(1)
TAUVP=FDS(13)
FLAMDA=FDS(9)
IF(FLAMDA.LT.0P5) IBAND =2
IF(FLAMDA.LT.0125) IBAND =3
XXXX=0.
DTX=FDT(1)*C2
DTY=FDT(2)*C2
C2FR=FDS(2)
THFTAV=FDS(12)*CR
SL1=FDS(20)
SL2=FDS(21)
SL3=FDS(22)
PX=FDS(5)
TAUPI=FDS(14)
TAUP = FDS(15)
TSN = FDS(7)
PNR = FDS(3)
PRF = FDS(4)
PSI = FDT(1) * CR
RC = FDS(A)
Z = 6367450
AH = FDS(17) * CR
VCI = FDS(5)
H = FDS(2) * C2
NT = IDT(1)
RNJC = VT
TSPACE = FDT(10) * C2
Y = FDS(1) * C2
VS = FDS(3) * 6076 * C2
G = FDEVT(A)
IF(Y.LT.(1.5 * VS)) GO TO 20
GO TO 30
20 Y = 1.5 * VS
PRINT 25
25 FORMAT(* Y TOO SMALL, INCREASE TO BE 1.5 SWATH WIDTHS *)
30 GAMMA = Y/2
222 SR = SORT((P * Z * (Z + H) * (1 - COS(COS(GAMMA)))) + H * H)
GRA = SR + TAN(AH)
SR = SORT(CSR + (SR * GRA))
HORIZ = SORT((Z + H) ** P - Z * Z)
PHI = ASIN(HORIZ/(Z + H))
PH1 = PHI - CPI/2.
FLP = CTAUP * 5/RC
DCY = FLP/(COS(PHI) * COS(AH))
DCX = N/COS(AH)
DCM = AMAX1(DCX, DCY)
RNJC = AMIN1(RNJC, RNJC+C)
SIGFAC = AMAX1(1., PATSIG)
XTE = AMIN1(DCX, DTX)
XTY = AMIN1(DCY, DTY)
ATF = XTF * XTY
AG = DCX * DCY
AB = AMAX1(1. + ATF, 0.)
PHI = PHI - THTAU
IF(PHI - LE. PHIH) PHIH = PHIH
COMP = CPI/2. - PHIM
IF(PHI - LE. PHIH) GO TO 51
COMP = CPI - AMC*(CPI/2. - PHIM) * (Z + H)/Z
51 GAMMA = CPI/2. + PHIM - COMP
YMAX = Z * PHIH
GAMAX = AMAX1((SR * P - (Z + H) ** P - Z * Z)/(P * Z * (Z + H)))
XY = Z * GAMAX/CP

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PHI1=PHI-(Y+Z)/Z  
CAMAAX=AC55((-R+2*Z)/(-2*Z))  
X=Z*CAMAAX/C  
CAF=ZFR*(SIN(PHI1))/SIN(PHI1)**1.5  
VP=FD(5)  
AC=AC  
ABF1=0.  
105 IF(AF.F0.0.) GO TO 200  
110 IF(DX+VP) GO TO 200  
115 IF(DX+VP) GO TO 110  
120 AL=MAX(10*AC-AP),0.  
130 ATFL=ATF-AP  
140 AC=ATFL+AC  
200 AT=DTX+DTY  
PHI=PHI/C  
210 TFM=AT+AT  
220 SIGTE=SIGFAC*SIGTE  
SICR0=0.  
JX=ICT(10)  
NY=ICT(12)  
IY=IX+NY  
IZ=IY+NX  
CALL INTR2(PHI,FAND,FDTAC(IX),FDTAC(IY),FDTAC(IZ),  
NX,NY,SICR0,XXX,NX)  
SICR0=SICR0+10.,**5.56*(SICR0/10.)
PHI*PHI*CR
SIGR=SIGF*SIGF+SIGP*SIGP
CALL ATTFM(FP9,CF9,FS,PHI,TAUAR)
TAUAR=1./(10.**(TAUAP/10.))
Q=0.

TEMP3=0.
IF(SL1) 270,290,270
270 IFMP3=1./(10.**(SL1/10.))
290 IF(SLP) 90,300,90
290 IFMP3=1./(10.**(SLP/10.))
300 IF(SL2) 310,320,310
310 IFMP3=IFMP3+1./(10.**(SL3/10.))
320 IF(TFMP3) 0=1
PDD=TAUAP*SIGF/CPI*SR*SR*TAUAR
PRTT=TAUAR*SIGF*PDD
PRT=TAUAR*SIGF*PDD
PRTT=TAUAR*SIGF*PDD
PRT=TAUAR*SIGF*PDD
TFMP4=TAUAP*TAUAR*GAF*FLAMDA**2/(4*CPI*SR)**2:
PATT=PRTT+TFMP4
PAAT=PRTT+TFMP4
PAP=PRTT+TFMP4
FL=AA*FL*MA*SR/DFX
FN=FL*PF*(C2*C3*VC1)
PR=FV*PAAT
PTT=FN*PATT
PRB=FN*PARR
PSL=0*PBR
SNRAT=(PIT+PRT)/PARR+PSL+PNR
SNRAT=10.*ALG10(SNRAT)
Y=Y/C2
ANGL0=ATAN(Y/X)
SR=SR/CP
H=H/CP
SP=VC1*C3
ANGLT=PHI
P30=0.
P3R=0.
IF(SNRAT,CF,TSN) P30=1.0
IF(P30,LE,0.) 60 TO 400
XNR=AMN1(DFX,DCY)/SCRT(DFX*DCY)
TEMP1=XNR-3.2.*TSP+11.
IF(TEMP1,LT,1.0.) 60 TO 390
P3R=1.0
60 TO 400
390 P3R=1.-EXP(-TFMP3)
400 AT=DFX*DCY
AT=AT*(VT*(VT-1)*TSP*CF/DFX)
ASPFC=FS(17)

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500 ARAT!ON=AT/AS
TVIFV=ASPECT=.5//SP*CR
TEMP=(700./C)*ARAT!ON+TVIFV
IF(TEMP.LT.(80.) GO TO 510
PP=1.0
RETURN
510 PP=1.-EXP(-TEPV)
RETURN
END
SUBROUTINE ATTFN(IAND,CAS,H,ISFAS,PH1,ATT)
COMMON/TERLS/FDTAP(225)
COMMON/TERST/FICT(50)
JJI=ICT(13)
JJS=ICT(14)
JJ3=ICT(19)
JJ4=ICT(22)
JJ5=ICT(25)
JJ6=ICT(28)
NXI=ICT(14)
NY1=ICT(15)
NX2=ICT(17)
NY2=ICT(18)
NX3=ICT(20)
NY3=ICT(21)
NX4=ICT(23)
NY4=ICT(24)
NX5=ICT(26)
NY5=ICT(27)
NX6=ICT(29)
NY6=ICT(30)
I2=J2+NY3+NY4
I1=17-17+1SFA
I2=17+ISFAS
CP*P=.5*ASIN(1.)
IF(H.LT.FDTAP(11)) GO TO 50
IF(H.LT.FDTAP(12)) GO TO 70
DFLS=S1(FDTAP(11),H,PH1)-S1(FDTAP(12),H,PH1)
GO TO 100
50 DFLS=0.
GO TO 100
70 DFLS=S1(FDTAP(11),H,PH1)
100 SUM=0.
I2=J2+NY4+NYA
DO 200 1=1,NYA
N=1Z+NYA+(ISF*5-1.)*I
SUM=SUM+FDTAP(V)
IF(SUM.EQ.CAS) GO TO 250
200 CONTINUE
950 C*,0A
IF(IAND,FO.P) C*,P
IF(IAND,FO.3) C*,A
11*JJ3*NY3*VX3*NY3*(1*IFSAS-1)+1
ATT=C*IFDAP(I1)*.0D1*IFLS*(1-1)/R
IF(M.O.FDAP(I1)+1) GO TO 280
IFLS=S1(F0,H,PHI)-S1(FDAP(I1),H,PHI)
GO TO 280
260 DFLS=S1CO.H,PHI)
280 SUM=O.
MC=0
IF(CDFLS.LT.10000.) MC=1
IZ=JJS+NXS+NY5
IF(MC.EQ.1) IZ=JJK+VX6+NY6
IF(MC.EQ.1) NY5=NY6
IF(MC.EQ.1) NX5=NX6
DO 300 I=1,NYS
N=IZ+NY5*(1*IFSAS-1)+1
SUM=SUM+FDTAP(N)
IF(SUM.CF.CAS) GO TO 350
300 CONTINUE
350 IZ=JJK+NX1*NY1
ILOC=IZ+NY1*(IAND-1)+1
ATR=FDTAP(ILOC)+DFLS
ATT=ATT*ATR
RETURN
END
FUNCTION S1(H1,H,PHI)
CP1=2.*ASIN(1.)
Z=6367+50.
S1=-(Z+H)*COS(CP1/2.-PHI)*SRT(((Z+H)*COS(CP1/2.-PHI))+/+2)
*(Z+H)**2-(Z+H)**2)
RETURN
END

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