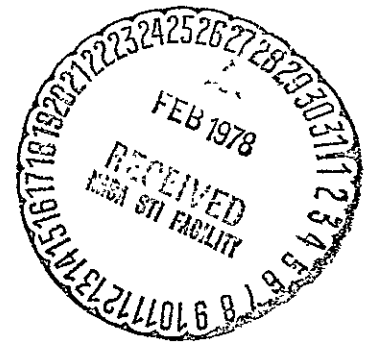
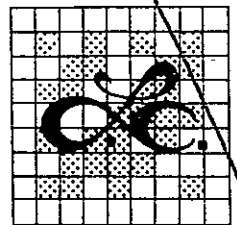


CR151614

(NASA-CR-151614) HARDWARE SIMULATION OF  
SHUTTLE Ku-BAND ANTENNA ACQUISITION, VOLUME  
5 (LinCom Corp., Pasadena, Calif.) 167 p  
HC A08/MF A01 CSCI 20N  
N78-17253  
Unclas  
G3/32 05338



*LinCom Corporation*  
P.O. Box 2793D, Pasadena, Calif 91105

HARDWARE SIMULATION OF SHUTTLE KU-BAND  
ANTENNA ACQUISITION  
VOLUME V

Prepared for

NASA JOHNSON SPACE CENTER  
HOUSTON, TX 77048

Technical Monitor: Jack Seyl

Contract Number NAS 9-14636

Prepared by

T. C. Huang  
W. C. Lindsey

LINCOM CORPORATION  
P.O. BOX 2793D  
PASADENA, CA 91105

OCTOBER 1977

TR No. 7810-0675

REPRODUCED BY  
NATIONAL TECHNICAL  
INFORMATION SERVICE  
U.S. DEPARTMENT OF COMMERCE  
SPRINGFIELD, VA. 22161

HARDWARE SIMULATION OF SHUTTLE KU-BAND  
ANTENNA ACQUISITION  
VOLUME V

- VOLUME IV: Ku-Band Antenna Acquisition and Tracking  
Performance Study
- VOLUME V: Hardware Simulation of Shuttle Ku-Band  
Antenna Acquisition

This two volume report documents the work accomplished during amended Phase II of Contract Number NAS 9-14636. The system tradeoff analysis and system performance study that led to three antenna pointing and acquisition algorithms for hardware simulation is provided in Volume IV. The construction of results obtained from the hardware simulation are described in Volume V. A high level software description and a detailed software documentation of the computer programs is to be found in Volume V. The first three volumes of this report documents the work accomplished during Phase I of this contract.

LINCOM CORPORATION  
P.O. BOX 2793D  
PASADENA, CA 91105

OCTOBER 1977

ACKNOWLEDGEMENT

The authors wish to thank Mr. Jack Seyl of the Johnson Space Center for providing us with certain technical data pertaining to the Shuttle Ku-Band pointing system and for participating in various stimulating discussions throughout the contract period.

## TABLE OF CONTENTS

	Page
SUMMARY	1
(1) Introduction	5
(2) Functional Diagram of Simulation Program	7
(3) Capabilities of Software Package	11
(4) Computer Program Utilization	12
(5) Functional Descriptions of Subroutines	16
APPENDIX I	23
HARDWARE SIMULATION COMPUTER FLOW CHART	48

## OBJECTIVES

LINCCMs overall objective under this contract was to develop a hardware simulation which could emulate the Shuttle's Ku-Band Antenna Pointing and Signal Acquisition System. The desire was to develop a simulation in which the antenna pattern, the TDRS search volume, the a priori probability distribution of TDRS satellite position relative to the Shuttle, and the antenna scan procedure could be selected for the purpose of predicting performance for various Shuttle/TDRS antenna pointing and acquisition scenarios.

The simulation was developed under the constraints of assuming a fixed network operation, the system must be real world implementable, it must be cost effective, the program execution time must not be excessive, the modulation technique is PN/B1- $\phi$ /BPSK, and optimum performance is desirable.

## SUMMARY

This document presents the results pertaining to the trade-off analysis and performance of the Ku-Band Shuttle antenna pointing and signal acquisition system. The study was performed assuming the existence of various antenna scanning trajectories and various signal acquisition algorithms. The square, hexagonal and spiral trajectories were investigated assuming the TDRS postulated uncertainty region and a flexible statistical model for the location of the TDRS within the uncertainty volume. The scanning trajectories, Shuttle/TDRS signal parameters and dynamics and three signal acquisition algorithms were integrated into a hardware simulation discussed herein and documented in detail in Volume IV. The hardware simulation is quite flexible in that it allows one to evaluate signal acquisition performance for an arbitrary (programmable) antenna pattern, a large range of  $C/N_0$ 's, various TDRS/Shuttle a priori uncertainty distributions and three distinct signal search algorithms.

Based upon the data made available during this contract period, certain Ku-Band forward link signal threshold characteristics were studied. The antenna pointing and acquisition threshold is found to be less than 60 dB-Hz with an acquisition time dependent on the antenna scan procedure and acquisition algorithm implemented. Various techniques are discussed in this report and a computer program is presented from which these can be evaluated. It appears that there will be no problem in meeting the system

ORIGINAL PAGE IS  
OF POOR QUALITY

spec even in light of the uncertainty associated with the possibilities of antenna sidelobe acquisition. The details are provided herein. Assuming a single channel monopulse system and a 30 MHz IF bandwidth, a monopulse tracking loop bandwidth of one Hz, the monopulse tracking jitter is 0.11 degrees at  $C/N_0 = 54$  dB-Hz. The Costas loop arm filter bandwidths can be chosen to be ten times the data rate such that no false-lock problem occurs during carrier acquisition. Assuming loop bandwidth of  $B_L = 3$  kHz, the loop jitter is 10 degrees at  $C/N_0 = 60.4$  dB-Hz. Acquisition can be accomplished in less than 10 seconds.

For the purpose of antenna scanning analysis, a reference coordinate system, whose z-axis is in line with the center axis of a specified uncertainty cone of the TDRS position, is chosen for the relative relation between the TDRS and the Shuttle antenna. The scan path of the Shuttle antenna can be projected onto the (x,y) plane of the coordinate system; while the uncertainty cone of the TDRS position can be described by a circle in the (x,y) plane. The uncertainty in the position of the TDRS is modeled by a truncated Gaussian probability density  $p(x,y)$  with uncertainty parameters  $\sigma_x^2 = \sigma_y^2 = \sigma^2$ . By changing the value of this variance parameter, the model is sufficiently general to include a uniform distribution of TDRS position uncertainty ( $\sigma_p = \infty$ ) to one which specifies the position with probability one ( $\sigma_p = 0$ ).

In the study of antenna scanning three types of trajectories are proposed and evaluated in terms of average scan time and the



structure of coverage over the uncertainty cone of the TDRS position. The analysis technique used for finding average scan time is discussed and an illustration of the technique for a specific type of scanning trajectories and motion of the Shuttle antenna is given. The results show that the spiral trajectories is in general better than the other two trajectories, especially for a constant velocity along a trajectory, since the path of a spiral trajectory (from the center of uncertainty cone to its edge) can be shorter than the other two.

From the Ku-band system specifications, it has been recognized that the variation of the received signal level at the Shuttle (due to TDRS EIRP path loss and antenna pointing loss variations) varies as much as 23 dB. If the antenna sidelobes are not sufficiently suppressed, a potential problem called sidelobe acquisition may cause the degradation in system performance. Therefore in this tradeoff analysis study, three different acquisition strategies are proposed and evaluated. The first acquisition strategy may be used for the case where the sidelobe acquisition does not impose a problem to the system. The other two strategies are primarily designed to avoid the sidelobe acquisition (especially the first sidelobe).

In this study, we assume that the first sidelobe of the Shuttle antenna is 17.5 dB suppression from the main lobe of the antenna so that we can study the effectiveness of the acquisition algorithm proposed. Surely, one should note that the sidelobe acquisition can be overcome by tapering down the sidelobes of the Shuttle antenna below 23 dB. However, it has been

found that with one particular acquisition algorithm studied, a strong sidelobe of the antenna can speed spatial acquisition significantly.

The scan schemes and acquisition algorithms are all integrated by a computer simulation program. This software package, discussed herein, provides a useful tool for predicting the performance of the Ku-band antenna pointing system. Various options are available for users to do tradeoff studies on system parameters in designing an acquisition system. The software package has been tested on UNIVAC 1100 Series computers and verified with analytical results.

ORIGINAL PAGE IS  
OF POOR QUALITY(1) Introduction

The Ku-band antenna pointing acquisition systems based on the noncoherent signal energy detection and scanning scheme discussed previously have been simulated by digital computer, for the tradeoff study in the design of the Shuttle antenna acquisition. Several acquisition algorithms implemented are given to provide flexibility in accommodating the different operating ranges of autotrack systems. The acquisition strategies are primarily oriented toward the avoidance of the first side lobe acquisition in the spatial search. In addition, the simulation also provides various options on the scan trajectories, scan rates and a wide range of CNR. It essentially integrates the effect of interaction of spatial search acquisition schemes and the noncoherent signal energy detection. So the simulation program is able to support the design of hardware development.

The simulation program was written in Fortran IV for the Univac 1100 series computer. Originally, it was developed for time-shared operation, which is available at LINCOM Corporation. However, the program can also be used for batch processing with some modification. The program consists of 19 internal subroutine references and two external subroutines MERFIC (from IMSLS package) and BSSL (from MATHPACK) which are normally available for computer systems.

The computing time to run the simulation program depends on the number of tests on the TDRS position and the number of

samples taken for channel noises. These two variables are also provided as options for a user. The higher the values of these two variables, the higher the accuracy in predicting the acquisition performance and the longer the CPU time. The CPU time for a typical case is well within 10 sec if the number of noise samples is one and the number of simulated TDRS position is less than 500.

The simulation program provides various options for users to test system performance for a wide range of system parameters. The following options included are:

- (1) The size of uncertainty cone of the TDRS position and its statistical distribution function over the cone.
- (2) The antenna pattern of the Shuttle receiver (3 dB beamwidth).
- (3) The types of antenna scan trajectories--square, hexagonal or spiral with different overlap.
- (4) The scan rates--constant angular velocity, constant speed along a trajectory or combination of both previous cases (also a switching angle  $\theta_s$ ).
- (5) The probability of false-alarm and the operating range of carrier-to-noise ratio (CNR).
- (6) The receiver parameters--dwell time of the signal energy detector, IF filter bandwidth, insertion loss and other circuit losses.
- (7) The number of TDRS positions used in the Monte Carlo simulation.
- (8) The number of samples taken for channel noises.
- (9) The types of acquisition algorithms.

- (10) The choices of a detailed printout or final results in the simulation.

The simulation program was structured as functional modules so that each subroutine can be easily replaced to adopt to any required function. For instance, the antenna pattern used in the simulation can be simply replaced by other types of antenna pattern. To do so, one should remove the subroutine ANTNNA and substitute an equivalent subroutine ANTNNA.

The simulation results are presented in two versions--one for a time-shared mode and the other for a batch process mode. For the time-shared mode, the computer asks for input data through interaction with users. A typical output generated by the simulation program consists of the following important parameters:

- (1) The threshold TH1 and TH2 used for the signal energy detector in a normal scan and in miniscans (such as adjacent and sidelobe scans), respectively.
- (2) Total number of cells to cover the whole uncertainty region.
- (3) Maximum scanning time (= time spent to reach the last cell through normal path only).
- (4) Average scanning time and corresponding standard deviation.
- (5) "Probabilities" of detection, miss and false alarm.

A sample printout is given in Fig. 1.

## (2) Functional Diagram of Simulation Program

To clarify the main functions performed in the simulation, a flow diagram of the simulation program is depicted in Fig. 2.

0  
10.,1.6,3  
30.  
1  
108.  
1.e-3,60.,80.  
60.,60.,1.  
5.,6.,1.5,0.  
500  
1  
1.,1.,1.  
0  
0.,0.,0.  
0  
2

ORIGINAL PAGE IS  
OF POOR QUALITY

RADIUS OF UNCERTAINTY REGION:	10.0000 DEGREES
BEAMWIDTH:	1.6000 DEGREES
SPIRAL TRAJECTORY:	OVERLAP = 30.0000 %
CONSTANT ROTATIONAL SPEED:	108.0000 DEGREES/S
PROBABILITY OF FALSE ALARM:	:1000-02
CNR EXPECTED RANGE:	60.0000 DB - 80.0000 DB
INTEGRATION TIME:	5.0000 MS
IF FILTER BANDWIDTH:	6.0000 MHZ
INSERTION LOSS:	1.5000 DB
OTHER LOSSES:	.0000 DB

THE PROBABILITY OF FALSE ALARM WAS RAISED TO 0.1 TO AVOID SIDELOB  
...E DETECTION  
WHEN CNR = 80.00 DB/HZ

THRESHOLDS: TH1 = 1.0568141 TH2 = 1.2276665

NUMBER OF CELLS: 302

MAXIMUM SCANNING TIME = .3217689+02 SECONDS

NUMBER OF SATELLITE POSITIONS GENERATED:	500
STANDARD DEVIATION:	.1000000+01
CARRIER-TO-NOISE RATIO:	.6000000+02 DB
ACQUISITION AVERAGE TIME:	.3023562+01 S
STANDARD DEVIATION:	.2362385+01 S
PROBABILITY OF DETECTION:	.1000000+01
PROBABILITY OF DETECTION (SL. VAR.):	.0000000
PROBABILITY OF MISS:	.0000000
PROBABILITY OF FALSE ALARM (IN THE SIMULATION):	.0000000

Figure 1a. A Sample of Input and Output Data.

Figure 2b. A SAMPLE OF INPUT DATA FOR BATCH PROCESSES.

```
fbk1 ac\ed  
BREAKPOINTED  
>ftpf,u.kuacq  
f>@*Del*  
>@xqt m.in  
>0  
>5.,1.6,2  
>3  
>108.,5.044,3  
>1e-4,60.,80.  
>60.,80.,20.  
>5.,6.,1.5;0.  
>5  
>1  
>2.5,2.5,1.  
>1  
>5  
>1.e-3,1.e-3,5.e-3  
>2  
>2  
>fbk2,u els  
13 PAGES SYMMED BY HUANG.  
>@fin  
RUNID: HUANG ACCT: 0544AA
```

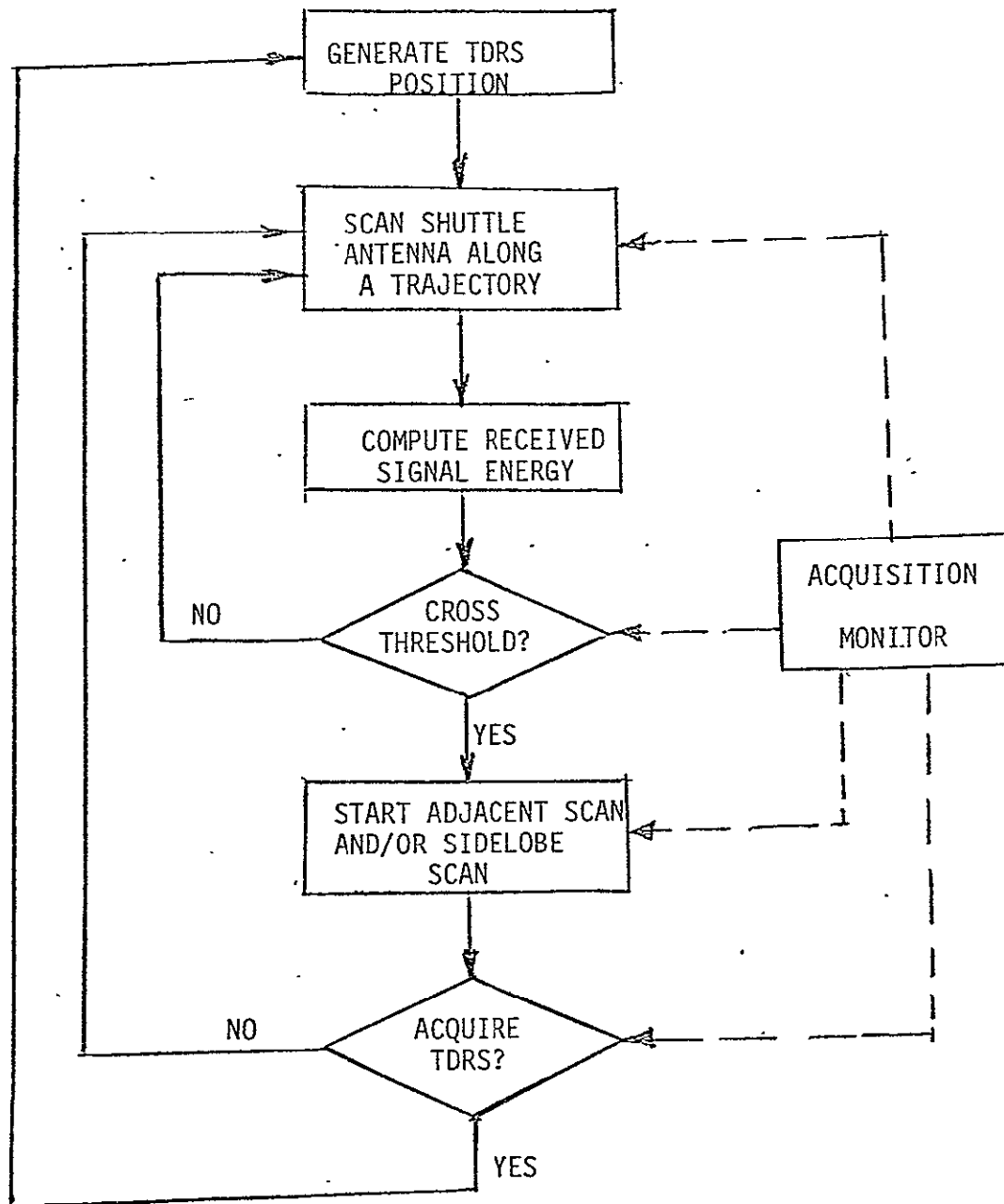


Figure 2 . Functional Flow Diagram of the Simulation Program.

ORIGINAL PAGE IS  
OF POOR QUALITY



The TDRS position is simulated by a random generator with a specified distribution function. To measure the spatial acquisition time of the TDRS position, a set of simulated TDRS positions is tested for a specified trajectory and scan rates (speed for constant angular velocity and/or constant velocity along a trajectory). The simulated data reported here are all obtained by 500 simulated TDRS positions.

In the simulation program, the acquisition monitor is not a separate unit, but imbedded in the subroutine ACQ. This is implemented just for the convenience in programming. The detailed structure of the program is referred to herein.

### (3) Capabilities of Software Package

The program developed for the Ku-band antenna pointing system provides various options in the size of uncertainty cone for the TDRS positions, the type of scanning and trajectories, and spatial acquisition algorithms. Here are the capabilities of the software package:

- (1) Conical angle of the TDRS position can be  $4^\circ$ ,  $8^\circ$  or  $10^\circ$ .
- (2) The variance  $\sigma_p^2$  of a priori probability distribution function of the TDRS position can vary from  $0.1^\circ$  to  $10^\circ$ .
- (3) Antenna pattern can have beamwidth  $\geq 10^\circ$ .
- (4) Three scan trajectories and wide range of scan rates (but limited by electrical dwell time) are available.
- (5) The noncoherent signal detector can be operated over a wide range of CNR and  $B_{IF}T$  product greater than 1000.
- (6) Spatial acquisition algorithms with/without avoidance of sidelobe acquisition are selectable.

- (7) Probability of false alarm can be from 0.5 down to  $10^{-7}$ .
- (8) The number of TDRS positions in Monte Carlo simulation can be selected by users. But it is limited by the CPU time in executing the simulation program.

In addition, the software package also provides a useful feature for system designers to interact with a computer if the time-shared facility is available. Upon user's choices, a detailed spatial acquisition procedure can be printed out for a closed examination on the behavior of acquisition systems. Finally one should also note that the application of the software package should not be limited to the Ku-band system parameters even though it is oriented toward the study of Ku antenna pointing systems.

#### (4) Computer Program Utilization

The simulation program was designed for two modes of usage-- batch process and time-shared modes. Since the computer program was originally developed through time-shared mode, it provides the mechanism of interactions between computers and users. However, this set of interactions should be suppressed for the batch processing. In order to run the program in batch, one should provide the same set of input data as one type in input data in the time-shared mode, except for the first input data. To illustrate the details of the input data required, several examples are given in Figs. 1 and 2 to show the options available in the simulation and the corresponding sets of input data for the batch process are also listed.

##### (1) Example 1

###### (a) Time Shared Mode

IF YOU ARE ON-LINE, PLEASE TYPE 1

>1  
 \*\*\* ON-LINE \*\*\*

INPUT DATA (FREE FORMAT)

(REAL) RADIUS OF UNCERTAINTY REGION (DEGREES)  
 (REAL) BEAMWIDTH (DEGREES)  
 (INTG) TYPE OF TRAJECTORY: 1(SQUARE) 2(HEXAGONAL) 3(SPIRAL)  
 >10.,1.6,1

(INTG) TYPE OF MOTION:  
 1 - CONSTANT ANGULAR VELOCITY  
 2 - CONSTANT VELOCITY ALONG TRAJECTORY  
 3 - COMBINATION OF "1" AND "2"  
 >2

(REAL) ANGULAR VELOCITY (DEGREES/S)  
 (REAL) VELOCITY ALONG TRAJECTORY (DEGREES/S)  
 >102.,5.044

(REAL) PROBABILITY OF FALSE ALARM  
 (REAL) EXPECTED MINIMUM CARRIER-TO-NOISE RATIO (DB)  
 (REAL) EXPECTED MAXIMUM CARRIER-TO-NOISE RATIO (DB)  
 >1.e-4,60.,80.

CNR VALUES TO BE USED IN THE SIMULATION  
 (REAL) (MINIMUM, MAXIMUM, INCREMENT.GE.O.)  
 >60.,80.,5.

RECEIVER PARAMETERS:  
 (REAL) INTEGRATION TIME (MS)  
 (REAL) IF FILTER BANDWIDTH (MHZ)  
 (REAL) INSERTION LOSS (DB)  
 (REAL) OTHER LOSSES (DB)  
 >5.,6.,1.5,0.

(INTG) NUMBER OF SATELLITE POSITIONS TO BE GENERATED DURING THE SIMULATION  
 >500

(INTG) 0 - SATELLITE POSITIONS ARE ENTERED AS INPUT DATA  
 1 - SATELLITE POSITIONS ARE INTERNALLY GENERATED  
 >1

(REAL) STANDARD DEVIATION VALUES: (MINIMUM, MAXIMUM, INCREMENT.GE.O.) IN DEGREES  
 >2.5,2.5,1.

(INTG) INTERMEDIATE RESULTS: NO(0) YES(1)  
 >0

TRANSITION MODES AND VERIFICATION TIMES:  
 (REAL) NORMAL TO SIDELobe SCANNING  
 (REAL) NORMAL TO SURROUNDING CELLS SCANNING  
 (REAL) VERIFICATION TIME  
 >1.e-3,1.e-3,5.e-3

SCANNING SCHEME:  
 (INTG) 0 - NORMAL PATH ONLY  
 1 - NORMAL PATH AND SIDELobe CELLS  
 2 - NORMAL PATH, NEARBY, AND THEN SIDELobe CELLS  
 >0

(INTG) NUMBER OF NOISE SAMPLES (EVEN 1<(.)<20 )  
 >

ORIGINAL PAGE IS  
 OF POOR QUALITY

Figure 3. A Sample Interaction Between a Computer and User.

IF YOU ARE ON-LINE, PLEASE TYPE 1

>1  
\*\*\* ON-LINE \*\*\*

*LinCom*

INPUT DATA (FREE FORMAT)

(REAL) RADIUS OF UNCERTAINTY REGION (DEGREES)  
(REAL) BEAMWIDTH (DEGREES)  
(INTG) TYPE OF TRAJECTORY: 1(SQUARE) 2(HEXAGONAL) 3(SPIRAL)  
>10.,1.6,3

(REAL) OVERLAP ( % )  
>30.

(INTG) TYPE OF MOTION:  
1 - CONSTANT ANGULAR VELOCITY  
2 - CONSTANT VELOCITY ALONG TRAJECTORY  
3 - COMBINATION OF "1" AND "2"

>3

(REAL) ANGULAR VELOCITY (DEGREES/S)  
(REAL) VELOCITY ALONG TRAJECTORY (DEGREES/S)  
(REAL) SWITCHING ANGLE (DEGREES)  
>108.,5.044,5.5

(REAL) PROBABILITY OF FALSE ALARM  
(REAL) EXPECTED MINIMUM CARRIER-TO-NOISE RATIO (DB)  
(REAL) EXPECTED MAXIMUM CARRIER-TO-NOISE RATIO (DB)  
>1.e-3,60.,80.

CNR VALUES TO BE USED IN THE SIMULATION  
(REAL) (MINIMUM, MAXIMUM, INCREMENT.GE.O.)  
>75.,75.,1.

RECEIVER PARAMETERS:  
(REAL) INTEGRATION TIME (MS)  
(REAL) IF FILTER BANDWIDTH (MHZ)  
(REAL) INSERTION LOSS (DB)  
(REAL) OTHER LOSSES (DB)  
>5.,6.,0.5,1.

(INTG) NUMBER OF SATELLITE POSITIONS TO BE GENERATED DURING THE SIMULATION  
>1000

(INTG) 0 - SATELLITE POSITIONS ARE ENTERED AS INPUT DATA  
1 - SATELLITE POSITIONS ARE INTERNALLY GENERATED

>1

(REAL) STANDARD DEVIATION VALUES: (MINIMUM, MAXIMUM, INCREMENT.GE.O.) IN DEGREES  
>1.0,5.5,1.5

(INTG) INTERMEDIATE RESULTS: NO(0) YES(1)  
>1

(INTG) HOW MANY RESULTS DO YOU WANT TO SEE IN DETAILS?  
>30

TRANSITION MODES AND VERIFICATION TIMES:  
(REAL) NORMAL TO SIDELobe SCANNING  
(REAL) NORMAL TO SURROUNDING CELLS SCANNING  
(REAL) VERIFICATION TIME  
>1.e-3,1.e-3,5.e-3

SCANNING SCHEME:  
(INTG) 0 - NORMAL PATH ONLY  
1 - NORMAL PATH AND SIDELobe CELLS  
2 - NORMAL PATH, NEARBY, AND THEN SIDELobe CELLS

>2

(INTG) NUMBER OF NOISE SAMPLES (EVEN 1<(.)<20 )

*LinCom*

Figure 3. (Cont'd) 14

IF YOU ARE ON-LINE, PLEASE TYPE 1

>1

\*\*\* ON-LINE \*\*\*

INPUT DATA (FREE FORMAT)

(REAL) RADIUS OF UNCERTAINTY REGION (DEGREES)  
(REAL) BEAMWIDTH (DEGREES)  
(INTG) TYPE OF TRAJECTORY: 1(SQUARE) 2(HEXAGONAL) 3(SPIRAL)  
>10.,1.6,2

(INTG) TYPE OF MOTION:  
1 - CONSTANT ANGULAR VELOCITY  
2 - CONSTANT VELOCITY ALONG TRAJECTORY  
3 - COMBINATION OF "1" AND "2"  
>1

(REAL) ANGULAR VELOCITY (DEGREES/S)  
>108.

(REAL) PROBABILITY OF FALSE ALARM  
(REAL) EXPECTED MINIMUM CARRIER-TO-NOISE RATIO (DB)  
(REAL) EXPECTED MAXIMUM CARRIER-TO-NOISE RATIO (DB)  
>1.e-4,60.,80.

CNR VALUES TO BE USED IN THE SIMULATION

(REAL) (MINIMUM, MAXIMUM, INCREMENT.GE.O.)  
>60.,80.,5.

RECEIVER PARAMETERS:

(REAL) INTEGRATION TIME (MS)  
(REAL) IF FILTER BANDWIDTH (MHZ)  
(REAL) INSERTION LOSS (DB)  
(REAL) OTHER LOSSES (DB)  
>5.,6.,1.5,0.

(INTG) NUMBER OF SATELLITE POSITIONS TO BE GENERATED DURING THE SIMULATION  
>10

(INTG) 0 - SATELLITE POSITIONS ARE ENTERED AS INPUT DATA  
1 - SATELLITE POSITIONS ARE INTERNALLY GENERATED  
>0

(INTG) INTERMEDIATE RESULTS: NO(0) YES(1)  
>0

TRANSITION MODES AND VERIFICATION TIMES:

(REAL) NORMAL TO SIDELobe SCANNING  
(REAL) NORMAL TO SURROUNDING CELLS SCANNING  
(REAL) VERIFICATION TIME  
>1.e-3,1.e-3,5.e-3

SCANNING SCHEME:

(INTG) 0 - NORMAL PATH ONLY  
1 - NORMAL PATH AND SIDELobe CELLS  
2 - NORMAL PATH, NEARBY, AND THEN SIDELobe CELLS  
>1

(INTG) NUMBER OF NOISE SAMPLES (EVEN 1<(.)<20 )  
>4

ORIGINAL PAGE IS  
OF POOR QUALITY

### (5) Functional Descriptions of Subroutines

The functions of each subroutine used in the computer program for UNIVAC 1100 series are briefly described one-by-one here. Their flow charts and detailed documentations are given in Volume II separately. The description of subroutines is given in alphabetical order to be consistent with the computer printouts from UNIVAC 1108 time-shared mode. The program is, in fact, started from MAIN then SIMULA. The subroutine SIMULA, the core of the simulation, cells and monitors the operations of the Monte Carlo simulation.

#### Subroutine ACQ

This simulates the acquisition algorithms discussed previously. The variable NULL, used to select the type of the acquisition algorithms for the simulation, is defined as follows:

NULL =	0	for normal scan
	1	for normal scan plus sidelobe scan
	2	for normal scan, adjacent scan and sidelobe scan

In the process of the spatial acquisition, the time spent in any scan, including the transition from one scan to another and verification time, is accumulated as one of the outputs of the subroutine. The other important output parameters of the subroutine are:

- (1) The status of the spatial search--success or failure (IPMISS and IPDET).
- (2) How to acquire--the detection was declared by a normal scan or plus sidelobe scans (IPDSL).

(3) The acquired location of the TDRS (KHIT (IHIT)).

Subroutine ANTNA

The antenna pattern of the simulated Shuttle receivers is assumed to have a first sidelobe of -175 dB from the peak of the main lobe. The antenna gain is computed from the offset angle between the simulated TDRS position and the boresight axis of the Shuttle. Hence, the offset angle (TH) is an input variable in addition to the parameters characterizing the antenna (THB, PATTC). A control variable K is used for computing the antenna parameters as shown here

K =    -2    for computing the angle of first null  
           -1    for computing the angle of the peak of  
                   of the second sidelobe  
           0    for computing the angle of the peak of the  
                   first sidelobe  
           +1    for -3 dB beamwidth  
           2    for normal usage in computing the gain  
                   of the antenna at offset TH.

Subroutine CELL

For a specified trajectory (KSCAN), the subroutine computes the locations of search cells (XCTR,YCTR) along the trajectory and the scan time to reach each search cell from the designated center of the uncertainty zone of the TDRS position. The scan time is computed by calling the subroutine TCENTR. Hence, it requires the following input variables

KSCAN =    1    for square trajectory  
               2    for hexagonal trajectory  
               3    for spiral trajectory

ORIGINAL PAGE IS  
OF POOR QUALITY.

MOTION = 1 for constant rotational speed  
          2 for constant speed along trajectory  
          3 for constant rotational speed first  
            then constant speed along trajectory

VANG = angular velocity for constant rotational  
        speed (in radian/sec)

VLIN = constant speed along trajectory (in radian/sec)

To ensure the electrical dwell time to be smaller than  $K_D$  times of the minimal mechanical dwell time, a warning is printed out if the antenna scan is too fast. In the subroutine  $K_D$  is set to be .10

#### Subroutine GAUSS

This is a Gauss random generator whose mean and standard deviation are specified by AVR and SIGMA, respectively. The Gaussian samples are obtained in pair by the following simple relations

$$y_1 = \sigma(-2. \ln x_1)^{1/2} \cos 2\pi x_2 + \mu$$

$$y_2 = \sigma(-2. \ln x_1)^{1/2} \sin 2\pi x_2 + \mu$$

where  $x_1$  and  $x_2$  are a pair of independent random variables uniformly distributed between 0 and 1, and  $\mu$  and  $\sigma^2$  are its mean and variance, respectively. The algorithm has been tested for its mean, variance and skew coefficient. The results show that the algorithm gives a high confidence in its statistical nature.

#### Subroutine HIT

The signal energy detector is simulated by this subroutine. The received signal energy (sum of signal power and noise power)



is compared with a preset threshold (TH). If the threshold is crossed, a hit is declared (HIT=.TRUE.); otherwise, no hit is given. The input variables are the position of the TDRS and the location of the boresight axis of the Shuttle antenna. The offset angle TETA is computed, then the antenna gain by calling subroutine ANTNNA, the signal power and noise power.

#### Subroutine HPOSTN

This subroutine computes the centers of hexagonal cells along the hexagonal trajectory. The computation is proceeded from  $K^{\text{th}}$  cell to  $(K+1)^{\text{th}}$  cell.

#### Subroutine ITR

This subroutine implements the iterative algorithm needed in solving for eqs. (20) and (21). The control variable K is used to indicate the application of the algorithm to eq. (20) or eq. (21).

#### MAIN

The function of the MAIN defines the dimension of variables used in the simulation. The program has been set to deal with the maximal number of search cells to be 500. If the number of the search cells goes beyond 500, one should expand dimensions of all variables in the first dimension statement.

#### MAIN/MAP

This is a set-up for executing the simulation program. Two system subroutine packages--MATHPACK and IMSL--are called to satisfy the external references.

#### Subroutine NOISE

The simulated channel noise power at the output of the integrator

is computed here. The number of samples for equivalent Gaussian noises is set by the variable KNOISE.

Subroutine QPOSTN

It computes the center of  $(K+1)^{th}$  search cell from the known center of the  $K^{th}$  search cell along the square trajectory.

Subroutine SIMULA

This is the core of the simulation program. It reads in the data, prints the outputs and also monitors the operation of the program. The detailed operation of the subroutine is referred to herein.

Subroutine SLCELL

The search cells along a sidelobe trajectory and adjacent cells to a hit cell are computed here. The adjacent cells are structured as those for hexagonal cells. Hence, the number of the adjacent cells to be scanned is fixed as six. However, the number of cells for the sidelobe trajectory varies depending upon the type of trajectory used for normal scan.

Subroutine SPOSTN

It computes the center of  $(K+1)^{st}$  cell along a spiral trajectory from the known center of the  $K^{th}$  cell.

Subroutine TCENTR

It computes the scan time required for the Shuttle antenna to sweep along a trajectory to reach a spatial point in the uncertainty zone of the TDRS position. It requires to input the type of motion, scan rate (constant rotation and/or constant speed along a trajectory) and the coordinates of the point.

ORIGINAL PAGE IS  
OF POOR QUALITY

Subroutine TDRS

The subroutine generates a simulated TDRS position according to a specified Gaussian distribution. If a Gaussian sample falls outside the uncertainty zone of the TDRS position, it is discarded and another sample is taken. Its input variables are SIGMA, THM2, and its output variables XTDRS and YTDRS.

Subroutine TH1TH2

The setup of threshold levels used for spatial acquisition is done in this subroutine. The threshold TH1 is first computed for the given probability of false-alarm under the channel noise condition. Then it checks the probability of detection  $P_{fas}$  due to the second sidelobe of the Shuttle antenna at the maximal value of CNR in the specified operating range. If  $P_{fas}$  is larger than the given probability of false alarm, the threshold is adjusted to yield at least 0.1 probability of false alarm due to second sidelobe at the strongest CNR. This implies that the probability of false-alarm at lowest CNR is much smaller than the specified one.

The threshold TH2 is computed based on the assurance of having the specified probability of false alarm due to the first sidelobe at strongest CNR.

Subroutine UNIFOR

This is a uniform random generator over (0,1). A pair of output samples are generated for each cell.

(4) Sample of Computer Run

APPENDIX I  
SUBROUTINE DESCRIPTIONS

1. MAIN Program

Purpose: Define the working areas needed throughout the simulation.

2. Subroutine SIMULA

Purpose: Read input data, determine the "a priori" set of data necessary for the "acquisition process," and compute desired time averages and probabilities.

Usage: Call SIMULA(NCELL ,XCTR,YCTR,TCTR,ELEV,AZIM,NSLDIM, XSLO,YSLO,XSL,YSL,NNEARD,XNEARO,YNEARO, XNEAR,YNEAR,KHIT,TH)

INPUT PARAMETERS

NCELLD - MAXIMUM NUMBER OF CELLS POSSIBLE TO BE USED TO SCAN THE UNCERTAINTY REGION  
 NSLDIM - MAXIMUM NUMBER OF CELLS POSSIBLE TO BE USED IN THE SIDELobe SCANNING  
 NNEARD - MAXIMUM NUMBER OF CELLS POSSIBLE TO BE USED IN THE "SURROUNDING CELLS" SCANNING

OUTPUT PARAMETERS

(XCTR,YCTR) - VECTORS WITH THE CENTERS OF THE VARIOUS CELLS (CARTESIAN COORDINATES)  
 (ELEV,AZIM) - VECTORS WITH THE CENTERS OF THE VARIOUS CELLS (POLAR COORDINATES)  
 (XSLO,YSLO) - VECTORS WITH THE CENTERS OF THE SIDELobe CELLS WHEN ANTENNA BORESIGHT IS POINTING TO THE ORIGIN  
 (XNEARO,YNEARO) VECTORS WITH THE CENTERS OF THE NEARBY CELLS WHEN ANTENNA BORESIGHT IS POINTING TO THE ORIGIN  
 KHIT - VECTOR WITH THE LAST HITS, STARTING WITH THE LAST CELL IN THE NORMAL PATH WHERE A HIT WAS OBSERVED  
 TH - VECTOR WITH THE THRESHOLDS USED TO SEARCH NEARBY CELLS

INTERNAL VARIABLES

THM - RADIUS OF THE UNCERTAINTY REGION (RADIAN)  
 THB - RADIUS OF -3DB ANTENNA MAIN LOBE.  
 OVLAP - OVERLAP  
 KSCAN - TYPE OF TRAJECTORY  
     1 - SQUARE  
     2 - HEXAGONAL  
     3 - SPIRAL  
 MOTION - DESIRED ANTENNA MOTION  
     1 - CONSTANT ROTATIONAL SPEED  
     2 - CONSTANT VELOCITY ALONG TRAJECTORY  
     3 - COMBINATION OF "1" AND "2"  
 VANG - ANGULAR VELOCITY (RADIAN/S)  
 VLIN - LINEAR VELOCITY ALONG TRAJECTORY (RADIAN/S)  
 SWTCH - SWITCHING ANGLE (IN RADIAN) TO GO FROM "MOTION=1"  
         TO "MOTION=2"  
 PFA - PROBABILITY OF FALSE ALARM  
 CNRMIN - CNRMAX - EXPECTED CARRIER-TO-NOISE RATIO DYNAMIC RANGE (DB)  
 CNR - ACTUAL CARRIER-TO-NOISE RATIO (IN DB) USED IN THE  
       SIMULATION  
 TD - ELECTRICAL DWELL TIME (MS)  
     BIF - IF FILTER BANDWIDTH (KHZ)  
 FLOSS - FILTER INSERTION LOSS (DB)  
 OTHERL - OTHER LOSSES (DB)  
 NDRSS - NUMBER OF SATELLITE POSITIONS GENERATED DURING THE  
       SIMULATION FOR EACH "SET OF CONDITIONS"  
 SIGMAP - STANDARD DEVIATION (IN RADIAN) OF THE TRUNCATED  
       GAUSSIAN DENSITY FUNCTION USED TO GENERATE THE SATELLITE  
       POSITION  
 TSL - TIME INTERVAL TO SWITCH FROM NORMAL SCANNING TO SIDELobe  
       SCANNING  
 TCLOSE - TIME INTERVAL TO SWITCH FROM NORMAL SCANNING TO NEARBY  
       SCANNING  
 TVERIF - VERIFICATION TIME  
 NULL - SELECT SCANNING SCHEME  
     0 - NORMAL PATH ONLY (AUTO-TRACK RANGE < ANGLE BETWEEN  
     1 - NORMAL PATH AND SIDELobe CELLS (AUTO-TRACK RANGE  
       < ANTENNA NULLS  
     2 - NORMAL PATH, SIDELobe, AND THEN NEARBY CELLS (AUTO-  
       TRACK RANGE < BEAMWIDTH)  
     3 - NORMAL PATH, NEARBY, AND THEN SIDELobe CELLS (AUTO-  
       TRACK RANGE < BEAMWIDTH)  
 TH1, TH2 - THRESHOLDS  
 PDET - PROBABILITY OF DETECTION  
 PDSL - PROBABILITY OF DETECTION BY SIDELobe ACQUISITION  
 PMISS - PROBABILITY OF MISS  
 PRFA - PROBABILITY OF FALSE ALARM (SIMULATED)  
 TAVR - AVERAGE TIME (IN SECONDS) TO DETECT THE SATELLITE  
 SIGMAT - CORRESPONDING STANDARD DEVIATION

ORIGINAL PAGE IS  
OF POOR QUALITY

Subroutines Required: HIT

Function Diagram (see Fig. A1)

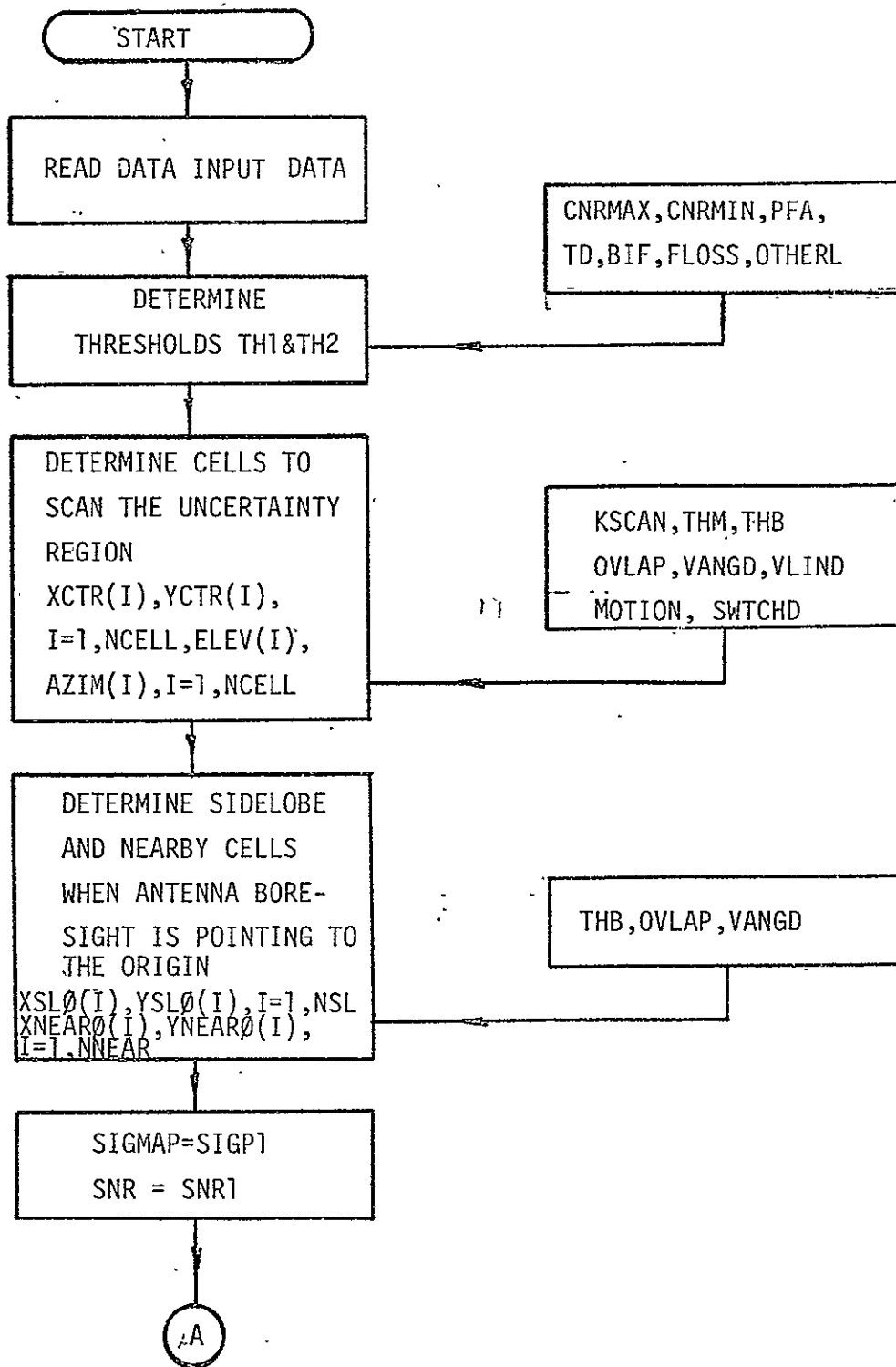
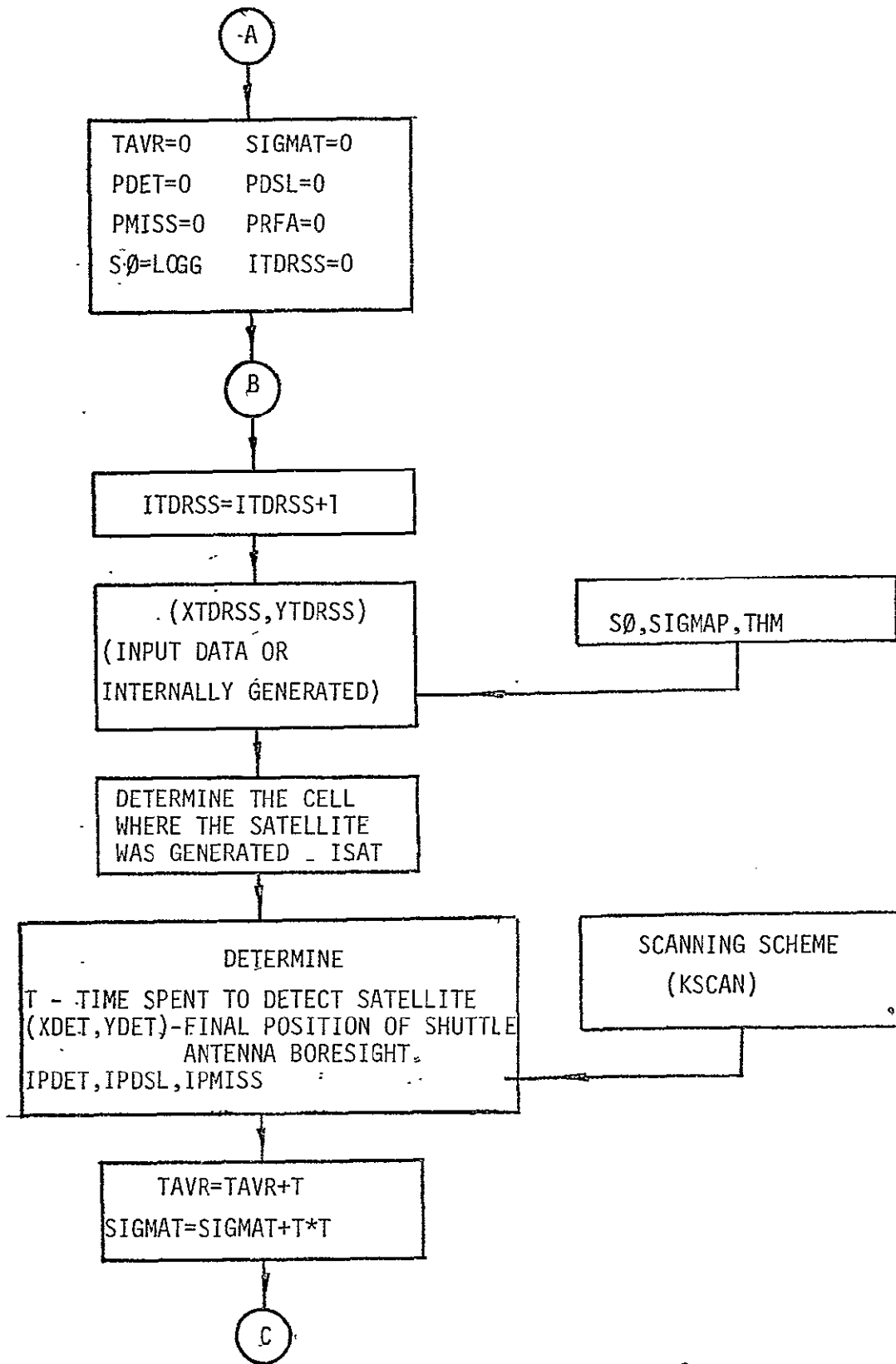


Figure A1. Flow Diagram for Subroutine SIMULA.





ORIGINAL PAGE IS  
OF POOR QUALITY

Fig. A1. Continued

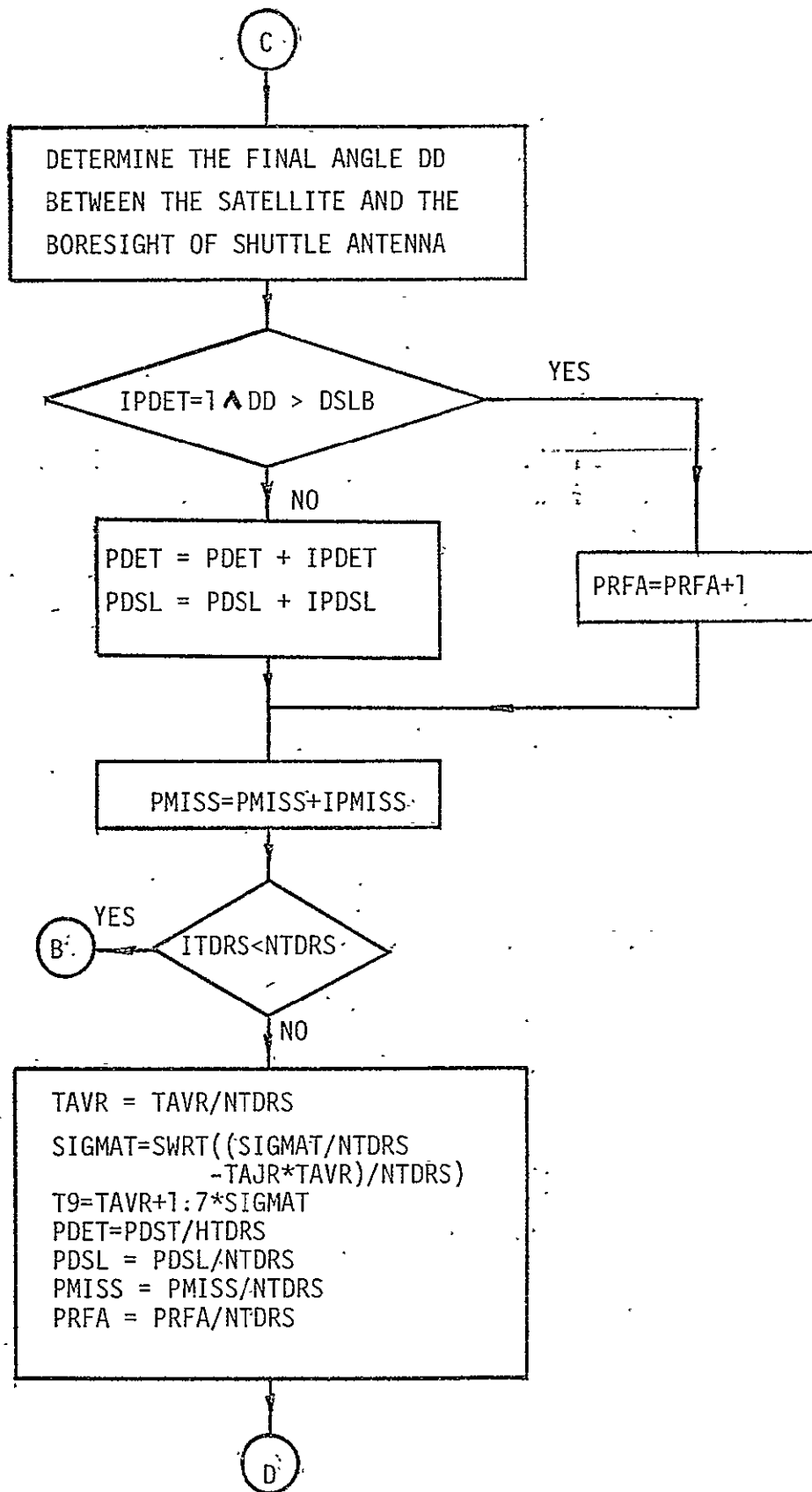


Fig. A1. Continued

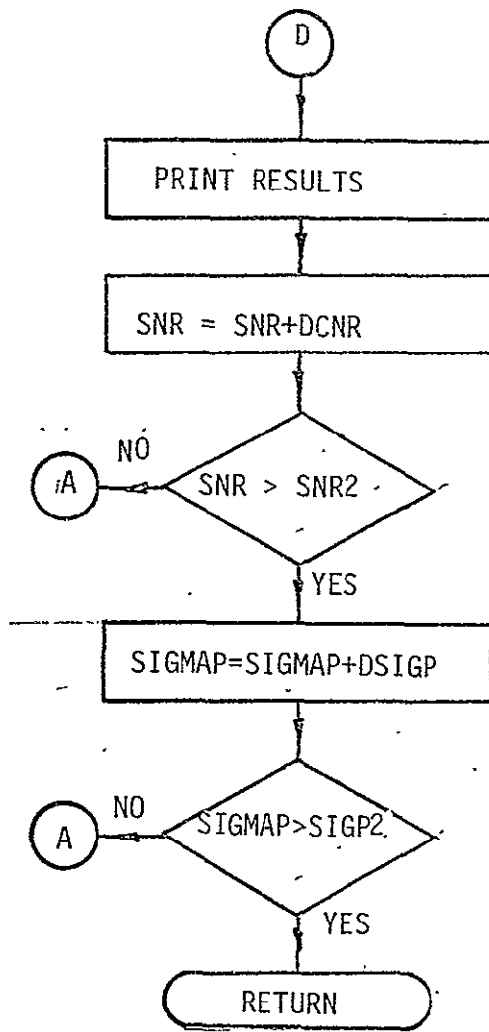


Fig. A1. Continued

16. Subroutine HIT

Purpose: Simulate the noisy output of the integrator and verify if this output is greater than a prescribed threshold (HIT=TRUE) OR NOT (HIT=FALSE).

Usage: Call HIT(X,Y,XTDRS,YTDRS,TH,RECSIG,HIT,SØ)

Input Parameters:

(X,Y) - ANTENNA BORESIGHT  
(XTDRS,YTDRS) - SATELLITE POSITION  
TH - THRESHOLD

Output Parameters:

RECSIG - RECEIVED SIGNAL POWER + NOISE  
HIT - LOGICAL VARIABLE  
TRUE - IF RECSIG > TH  
FALSE - IF RECSIG < TH  
SØ - VARIABLE USED IN THE NOISE GENERATION

Subroutines Required: NOISE

17. Subroutine NOISE

Purpose: Generate the equivalent noise power at the output of the integrator.

Usage: Call NOISE(SØ)

Input Parameter:

SØ - VARIABLE USED IN THE GAUSSIAN NOISE GENERATION  
SIGMAN - GAUSSIAN NOISE STANDARD DEVIATION (COMMON)  
POTXG - RECEIVED SIGNAL POWER (COMMON)  
NSAMPL - IF FILTER BANDWIDTH\*INTEGRATION TIME (COMMON)

Output Parameter:

EQN - EQUIVALENT NOISE AT THE OUTPUT OF THE INTEGRATOR (COMMON)

Subroutines Required: GAUSS

Model:

SIGN2 = SIGMAN\*SIGMAN  
AVR = SIGN2  
STD = SQRT((1.+2.\*POTXG/SIGN2)/NSAMPL)\*SIGN2  
EQN = N(AVR,STD)

ORIGINAL PAGE IS  
OF POOR QUALITY

14. Subroutine UNIFOR

Purpose: Generate two uniformly distributed random numbers  
in the interval  $(0,1)$ .

Usage: Call UNIFOR(S,X1,X2)

Input Variable:

S - INPUT RANDOM NUMBER (MODIFIED IN THE SUBROUTINE)

Output Variables:

X1,X2 - PAIR OF INDEPENDENT RANDOM VARIABLES UNIFORMLY  
DISTRIBUTED BETWEEN 0 AND 1

Method:

$$X = \text{MOD}(S*7**5,2**21-1)/2**31$$

15. Subroutine ACQ

Purpose: Simulate the Ku-Band acquisition system.

Usage:

Call

ACQ(NULL, THB, XKS, NCELL, XCTR, YCTR, TCTR, AZIM, NSL,  
XSLO, YSLO, DTSL, NNEAR, XNEARO, YNEARO, DTNEAR, VANG,  
TH1, TH2, TSL, TCLOSE, TVERIF, XTDRS, YTDRS, NNEARD, SO,  
PRT, T, IPMISS, IPDET, IPDSL, XDET, YDET, KHIT, IHIT, TH,  
XSL, YSL, XNEAR, YNEAR)

INPUT PARAMETERS:

- NULL - SELECTS SCANNING SCHEME
  - 0 - SEARCH CELLS IN THE NORMAL PATH ONLY WITH THRESHOLD TH1
  - 1 - SEARCH CELLS IN THE NORMAL PATH WITH THRESHOLD TH1 AND THEN SIDELobe CELLS WITH THRESHOLD TH2 (AUTO-TRACK RANGE < ANGLE BETWEEN NULLS)
  - 3 - SEARCH CELLS IN THE NORMAL PATH WITH THRESHOLD TH1, THEN NEARBY CELLS WITH THRESHOLD, AND THEN SIDELobe CELLS WITH SAME THRESHOLD TH2 (AUTO-TRACK RANGE < ANGLE BETWEEN NULLS)
- THB - RADIUS OF ANTENNA MAIN LOBE
- XKS - DISTANCE BETWEEN SUCESSIVE CENTERS
- NCELL - NUMBER OF CELLS TO SCAN THE WHOLE UNCERTAINTY REGION
- (XCTR, YCTR) - VECTORS WITH THE CENTERS OF THE CELLS
- TCTR - VECTOR WITH THE TIME INSTANTS EACH CENTER IS ACHIEVED
- AZIM - VECTOR WITH THE AZIMUTH OF EACH CENTER
- NSL - NUMBER OF SIDELobe CELLS
- (XSLO, YSLO) - VECTORS WITH THE CENTERS OF THE SIDELobe CELLS WHEN THE ANTENNA IS POINTING TO THE ORIGIN
- DTSL - TIME INTERVAL TO GO FROM ONE SIDELobe CELL TO THE NEXT ONE
- NNEAR - NUMBER OF NEARBY CELLS
- (XNEARO, YNEARO) - VECTORS WITH THE CENTERS OF THE NEARBY CELLS
- DTNEAR - TIME INTERVAL TO GO FROM ONE NEARBY CELL TO THE NEXT ONE
- VANG - CONSTANT ROTATIONAL SPEED
- TH1, TH2 - THRESHOLDS
- TSL - TIME INTERVAL TO GO FROM A NORMAL SCANNING SCHEME TO THE SIDELobe VARIATION
- TCLOSE - TIME INTERVAL TO GO FROM A NORMAL SCANNING SCHEME TO THE NEARBY VARIATION
- TVERIF - VERIFICATION TIME
- (XTDRS, YTDRS) - GENERATED SATELLITE POSITION
- NNEARD - DIMENSION OF VECTORS XNEARO, YNEARO, XNEAR, YNEAR, AND TH IN THE CALLING PROGRAM
- SO - VARIABLE USED FOR RANDOM NOISE GENERATION
- PRT - LOGICAL VARIABLE TRUE IF A PRINTOUT SAMPLE IS DESIRED

OUTPUT PARAMETERS:

- T - TIME SPENT TO DETECT THE SATELLITE
- IPMISS - (0) THE SATELLITE WAS DETECTED  
(1) THE SATELLITE WAS MISSED
- IPDET - (0) THE SATELLITE WAS MISSED  
(1) THE SATELLITE WAS DETECTED
- IPDSL - (0) THE SATELLITE WAS NOT DETCTED BY SIDELobe DETECTION  
(1) THE SATELLITE WAS DETECTED WHEN THE SYSTEM WAS SEARCHING SIDELobe CELLS
- KHIT - VECTOR WITH THE LAST HITS, STARTING WITH THE LAST CELL IN THE NORMAL PATH WHERE A HIT WAS OBSERVED
- IHIT - KHIT(IHIT) DEFINES THE CELL WHERE THE SATELLITE WAS DETECTED
- TH - VECTOR WITH THE THRESHOLDS USED TO SEARCH THE NEARBY CELLS CORRESPONDING TO THE LAST CELL SEARCHED IN THE NORMAL PATH

INTERNAL VARIABLES:

- (XSL, YSL) - VECTORS WITH THE CENTERS OF SJDELOBE CELLS CORRESPONDING TO A GENERIC POSITION IN THE NORMAL PATH
- (XNEAR, YNEAR) - VECTORS WITH THE CENTERS OF NEARBY CELLS CORRESPONDING TO A GENERIC POSITION IN THE NORMAL PATH

Subroutines Required:

ANTENNA, TH1TH2, SLCELL, UNIFOR, TDRSS, ACQ.

Function Diagram (see Fig. A2)

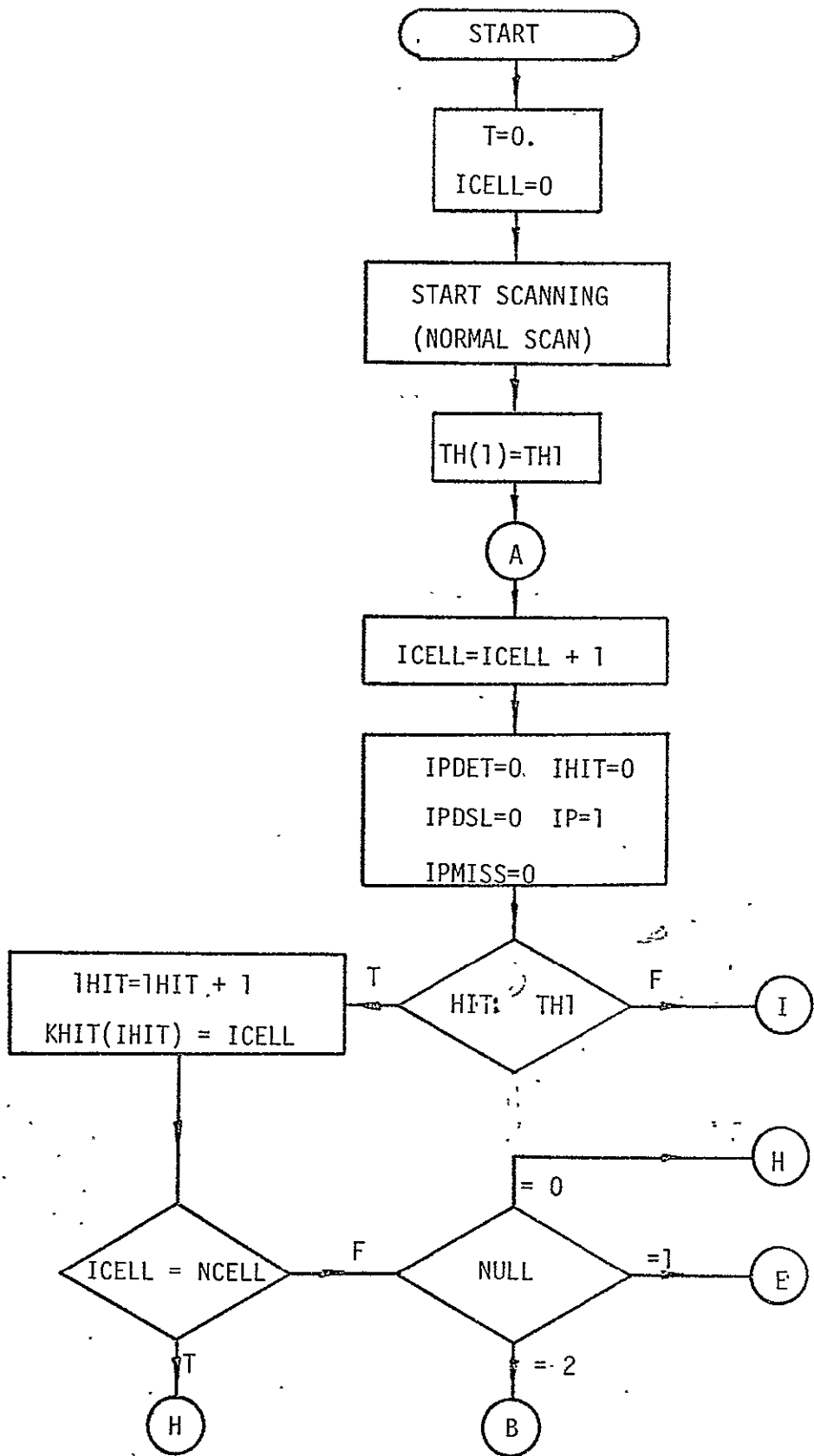
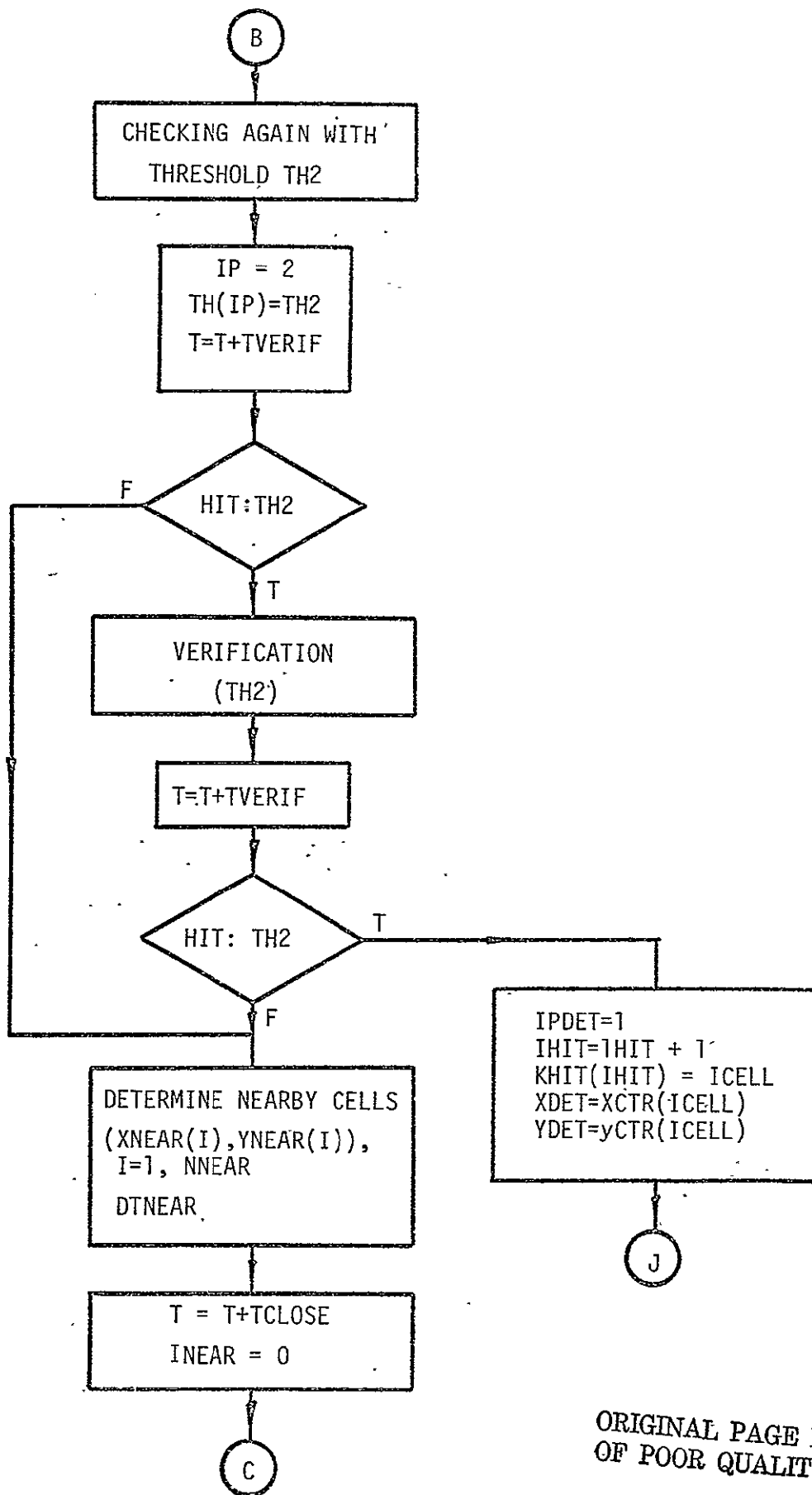


Figure A2. Flow Diagram for Subroutine ACQ.





ORIGINAL PAGE IS  
OF POOR QUALITY

Fig. A2. Continued

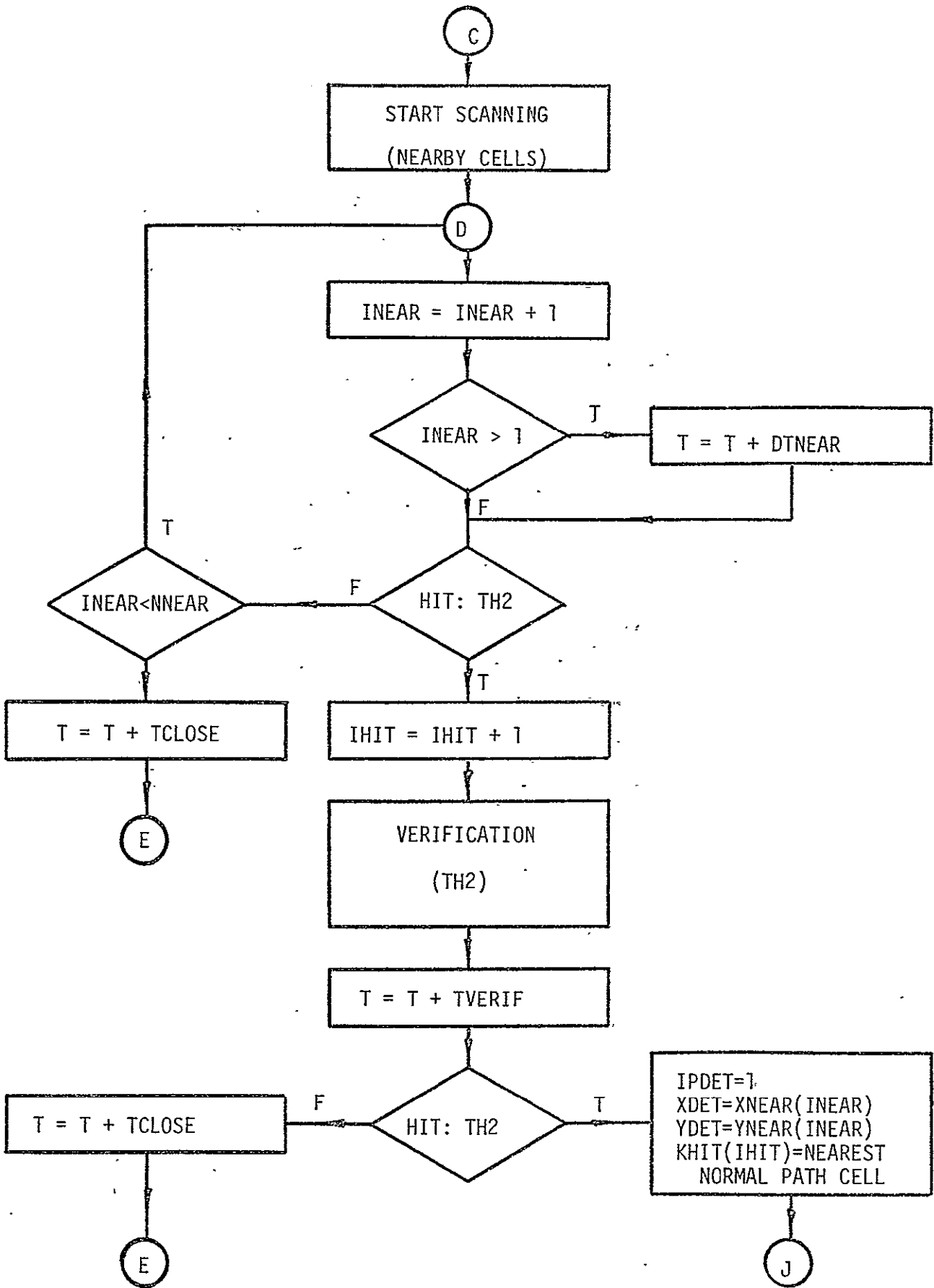
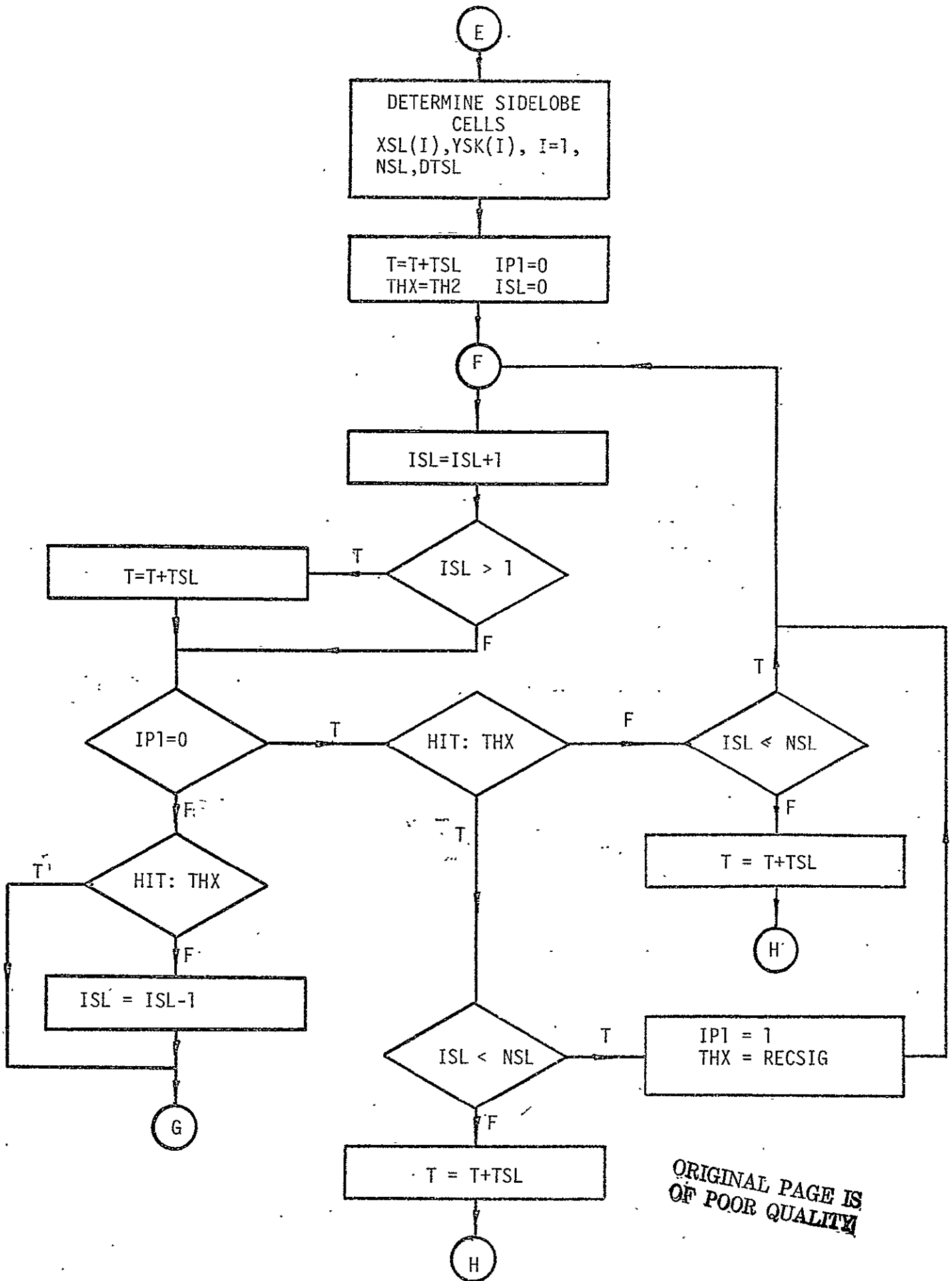


Figure A2. Continued



ORIGINAL PAGE IS  
OF POOR QUALITY

Figure A2. Continued.

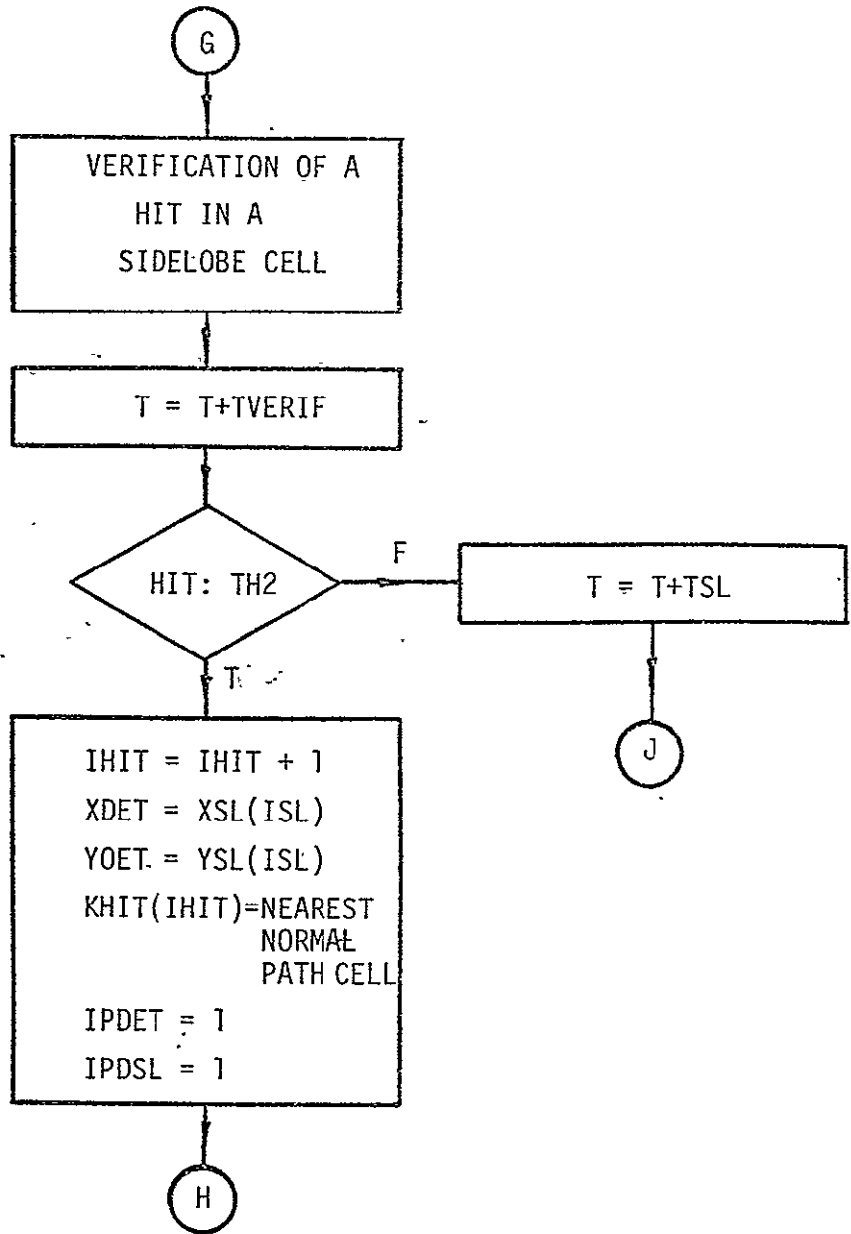
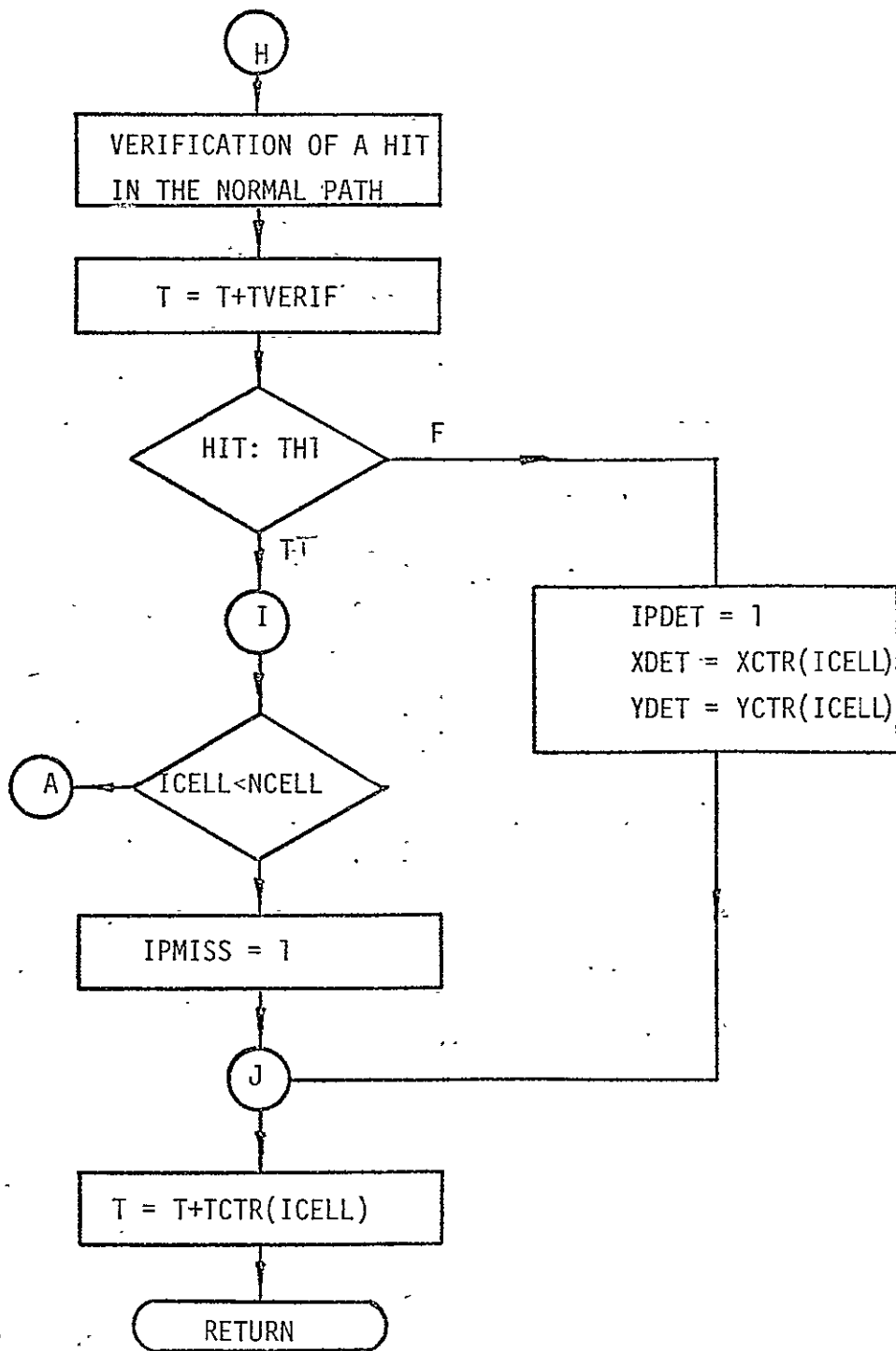


Figure A2. Continued



ORIGINAL PAGE IS  
OF POOR QUALITY

Figure A2. Continued.

3. Subroutine ANTNNNA

Purpose: Determine angle and gain corresponding to  
 (a) first null, (b) second sidelobe, (c) first  
 sidelobe, (d) -3 dB point in the mainlobe, and  
 (e) gain for any input angle.

Usage: Call ANTNNNA (K,TH,GAIN)

Input Parameters:

- K - CONTROL PARAMETER  
 -2 - THE SUBROUTINE DETERMINES ANGLE FOR FIRST ZERO  
 -1 - THE SUBROUTINE DETERMINES ANGLE FOR SECOND MAXIMUM  
 AND CORRESPONDING GAIN  
 0 - THE SUBROUTINE DETERMINES ANGLE FOR FIRST MAXIMUM  
 AND CORRESPONDING GAIN  
 1 - THE SUBROUTINE DETERMINES ANGLE CORRESPONDING  
 TO MAINLOBE -3dB POINT AND CORRESPONDING GAIN  
 2 - THE SUBROUTINE DETERMINES THE GAIN FOR THE  
 ANGLE = TH
- TH - INPUT ANGLE (K=2)

Output Parameters:

- TH - ANGLE OF FIRST NULL (K=-2), OR SECOND SIDELOBE  
 (K=-1), OR FIRST SIDELOBE (K=0), OR MAINLOBE  
 -3 dB POINT (K=1)
- GAIN - ANTENNA GAIN

Subroutines Required:

Bessel Function: BSSL (MATHPACK)

Model:

$$GAIN = J_1(x)/x; \quad x = \sin^{-1}(TH) + 1.61/TH$$

4. Subroutine TH1TH2

Purpose: Determine thresholds TH1 and TH2 for a given  
 probability of false alarm.

Usage: CALL TH1TH2 (CN21,CN22,PFA,BSF,FLOSS,OTHERL,  
 NSAMPL,TH1,TH2)

Input Parameters:

CNR1 - CNR2 - CARRIER-TO-NOISE DYNAMIC RANGE (DB)  
PFA -PROBABILITY OF FALSE ALARM  
BIF -IF FILTER BANDWIDTH  
FLOSS -FILTER INSERTION LOSS (DB)  
ORTHERL -OTHER LOSSES (DB)  
NSAMPL -NUMBER OF SAMPLES

Output Parameters:

TH1 -NORMAL PATH SCANNING THRESHOLD  
TH2 -SIDELOBE CELLS SCANNING THRESHOLD

Subroutines Required:

ANTNNA, MERFCI (IMSL)

Function Diagram (see Fig. A3)

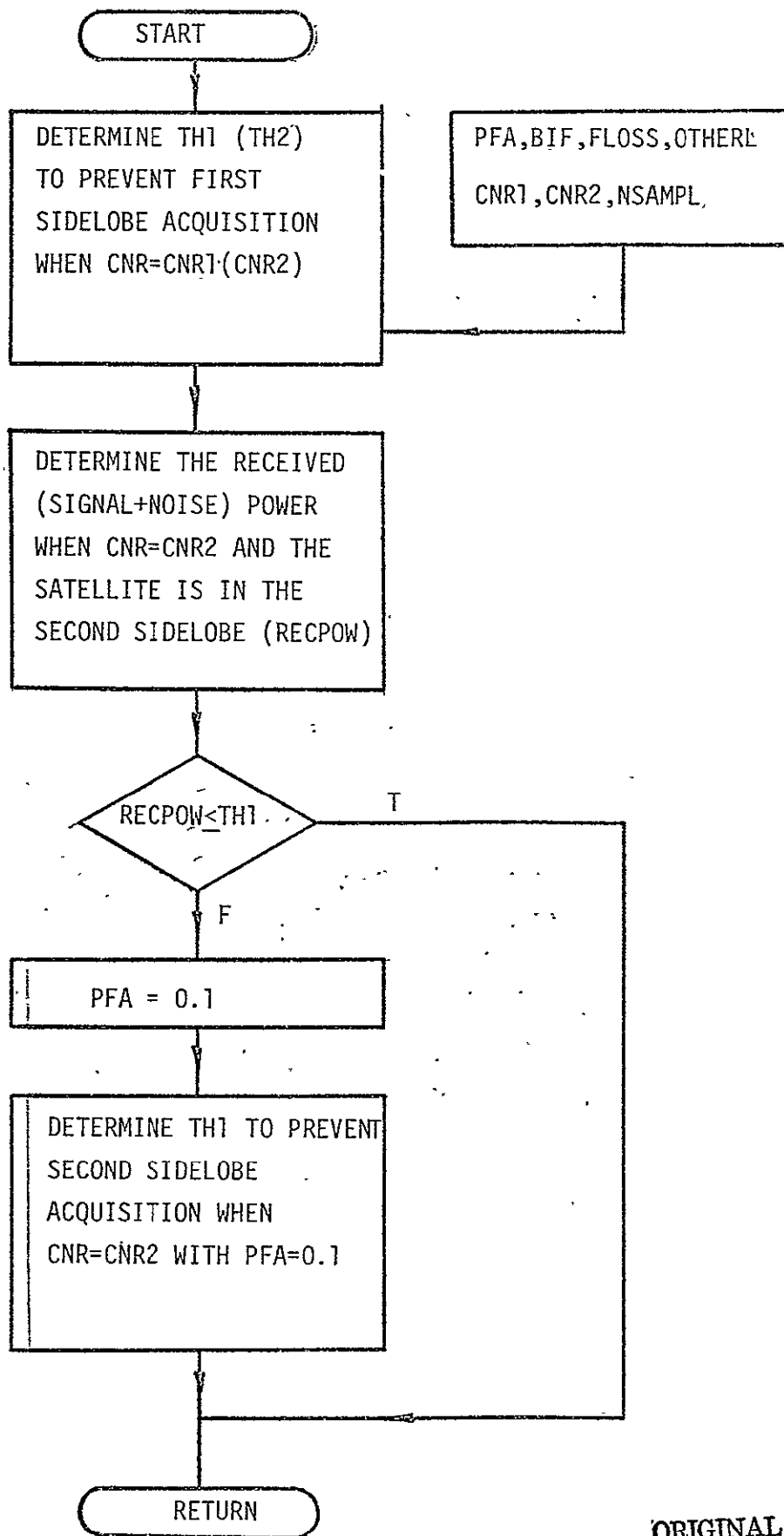


Figure A3. Flow Diagram for Subroutine TH1TH2.

ORIGINAL PAGE IS  
OF POOR QUALITY



5. Subroutine CELL

Purpose: Compute number of cells needed for complete scan of the uncertainty region, their centers and the time instants these centers are achieved.

Usage:

Call CELL (KSCAN,THM,OV,MOTION,VANG,VLIN,XKS,SWTCH,NCELL,XCTR,YCTR,TCTR,ELEV,AZIM,NCELLD)

Input Parameters:

KSCAN - TYPE OF TRAJECTORY  
 1 - SQUARE  
 2 - HEXAGONAL  
 3 - SPIRAL  
 THM - RADIUS OF THE UNCERTAINTY REGION (RADIAN)  
 OV - OVERLAP BETWEEN CELLS (%)  
 MOTION - DESIRED ANTENNA MOTION  
 1 - CONSTANT ROTATIONAL SPEED  
 2 - CONSTANT SPEED ALONG TRAJECTORY  
 3 - COMBINATION OF "1" AND "2"  
 VANG - ANGULAR VELOCITY (RADIAN/S)  
 VLIN - LINEAR VELOCITY ALONG TRAJECTORY (RADIAN/S)  
 XKS - DISTANCE BETWEEN SUCCESSIVE CENTERS (RADIAN)  
 SWTCH - SWITCHING ANGLE (IN RADIAN) TO GO FROM "MOTION=1" TO "MOTION=2"  
 NCELLD - DIMENSION OF VECTORS XCTR,YCTR,TCTR,AZIM, AND ELEV IN THE MAIN PROGRAM

Output Parameters:

(XCTR,YCTR) - VECTORS WITH THE CENTERS OF THE CELLS  
 TCTR - VECTOR WITH THE TIME INSTANTS THE CENTER OF EACH CELL IS ACHIEVED  
 ELEV - VECTOR WITH THE ELEVATION OF THE CELLS CENTERS  
 AZIM - VECTOR WITH THE AXIMUTE OF THE CELLS CENTERS

Subroutines Required:

QPOSTN,HPOSTN,SPOSTN

6. Subroutine QPOSTN

Purpose: Determine the  $(K+1)^{th}$  cell for the square type of trajectory.

Usage: Call QPOSTN(K)

input Parameters:

K - CELL NUMBER - 1  
ELI,AZI - ELEVATION AND AZIMUTH OF PREVIOUS CELL (COMMON)  
THB - RADIUS OF ANTENNA MAIN LOBE (COMMON)  
XI,YI - CARTESIAN COORDINATES OF PREVIOUS CELL (COMMON)

Output Parameters:

ELO,AZO - ELEVATION AND AZIMUTH OF FOLLOWING CELL (COMMON)  
XO,YO - CARTESIAN COORDINATES OF FOLLOWING CELL (COMMON)

Subroutines Required: None

7. Subroutine HPOSTN

Purpose: Determine the  $(K+1)^{th}$  cell for the hexagonal type  
of trajectory.

Usage: Call HPOSTN (K)

Input Parameters:

K - CELL NUMBER - 1  
ELI,AZI - ELEVATION AND AZIMUTH OF PREVIOUS CELL (COMMON)  
THB - RADIUS OF ANTENNA MAIN LOBE (COMMON)

Output Parameters:

ELO,AZO - ELEVATION AND AZIMUTH OF FOLLOWING CELL (COMMON)  
XO,YO - CARTESIAN COORDINATES OF FOLLOWING CELL (COMMON)

Subroutines Required: None

8. Subroutine SPOSTN

Purpose: Determine the  $(K+1)^{th}$  cell for the spiral type  
of trajectory.

Usage: Call SPOSTN (K)

ORIGINAL PAGE IS  
OF POOR QUALITY

Input Parameters:

K - CELL NUMBER - 1  
ELI,AZI - ELEVATION AND AZIMUTH OF PREVIOUS CELL (COMMON)  
THB - RADIUS OF ANTENNA MAIN LOBE (COMMON)  
XI,YI - CARTESIAN COORDINATES OF PREVIOUS CELL (COMMON)

Output Parameters:

ELO,AZO - ELEVATION AND AZIMUTH OF FOLLOWING CELL (COMMON)  
XO,YO - CARTESIAN COORDINATES OF FOLLOWING CELL (COMMON)

Subroutines Required: ITR

9. Subroutine ITR

Purpose: Determine iteratively the azimuth of the next center, given the position of the previous one, for the spiral trajectory.

Usage: Call ITR(A,B,AZO,GUSS,THB,D,PI,K)

Input Parameters:

A,B - ELEVATION AND AZIMUTH OF PREVIOUS CENTER  
GUSS - INITIAL AZIMUTH GUESS  
THB - RADIUS OF ANTENNA MAIN LOBE  
D - HALF DISTANCE BETWEEN SUCCESSIVE CENTERS  
PI - CONSTANT (3.141592653)  
K - CONTROL PARAMETER  
1 - INTERMEDIATE RESULT  
2 - FINAL RESULT

Output Parameter:

AZO - DESIRED AZIMUTH

Subroutines Required: None

10. Subroutine TCENTR

Purpose: Determine the time instant. The cell (ELO,AZO) is achieved following the normal path.

Usage: Call TCENTR (KSCAN,MOTION,VANG,VLIN,D2,SWTCH)

Input Parameters:

KSCAN - TYPE OF TRAJECTORY  
1 - SQUARE  
2 - HEXAGONAL  
3 - SPIRAL  
MOTION - TYPE OF ANTENNA MOTION  
1 - CONSTANT ANGULAR VELOCITY  
2 - CONSTANT VELOCITY ALONG TRAJECOTYR  
3 - COMBINATION OF "1" AND "2"  
VANG - ANGULAR VELOCITY (RADIAN/S)  
VLIN - LINEAR VELOCITY ALONG TRAJECTORY (RADIAN/S)  
D2 - DISTANCE BETWEEN SUCCESSIVE CENTERS  
SWTCH - SWITCHING ANGLE (IN RADIAN) FROM "MOTION=1" TO "MOTION=2"

Output Parameter:

TO . - INSTANT OF TIME A GIVEN CENTER IS ACHIEVED (COMMON)

Subroutine Required: None

11. Subroutine SLCELL

Purpose: Determine number and position of sidelobe or nearby cells when the antenna is pointing to the origin (ICELL=0).

Usage: Call SLCELL(KSL,THB,OVLAP,VANG,XSL,YSL,NSL,DTSL,NSLDIM)

Input Parameters:

KSL . - SELECTS SIDELOBE(=1) OR NEARBY(=0) CELLS  
 THB . - BEAMWIDTH RADIUS (RADIANS)  
 OVLAP . - OVERLAP (%)  
 VANG . - ANGULAR VELOCITY (RADIANS/S)  
 NSLDIM . - DIMENSION OF VECTORS XSL AND YSL IN THE CALLING PROGRAM

Output Parameters:

NSL . - NUMBER OF SIDELOBE CELLS  
 (XSL,YXL) . - VECTORS WITH THE CENTERS OF THESE SIDELOBE CELLS WHEN THE ANTENNA IS POINTING TO THE ORIGIN  
 DTSL . - TIME INTERVAL TO GO FROM ONE SIDELOBE CELL TO THE NEXT ONE

Subroutines Required: None

12. Subroutine TDRSS

Purpose: Generate a TDRSS position in the uncertainty region according to a truncated Gaussian probability density function

$$P(X,Y) = KP * EXP(-(X**2+Y**2)/(2*SIGMAP**2))/(2*(PI*SIGMAP**2)),$$

$$X**2+Y**2.LE.THM**2,$$

$$=0, ELSEWHERE,$$

WITH  
 $KP = (1 - EXP(-THM**2/(2*SIGMAP**2)))**(-1)$

Usage: Call TDRSS(S0,SIGMAP,THM2,XTDRSS,YTDRSS)

ORIGINAL PAGE IS  
OF POOR QUALITY

Input Parameters:

S0 - VARIABLE USED IN THE RANDOM GAUSSIAN  
VARIABLE GENERATION  
SIGMAP - DESIRED STANDARD DEVIATION  
THM2 - RADIUS OF UNCERTAINTY REGION SQUARED

Output Parameters:

(XTDRSS,YTDRSS)- GENERATED TDRSS POSITION

Subroutines Required: GAUSS

13. Subroutine GAUSS

Purpose: Generate "N" (even) normally distributed random numbers "X" with mean "AVR" and standard deviation "SIGMA".

Usage: Call GAUSS(S0,N,AVR,SIGMA,X)

Input Parameters:

S0 - INPUT RANDOM NUMBER  
N - NUMBER OF SAMPLES  
AVR - DESIRED MEAN  
SIGMA - DESIRED STANDARD DEVIATION

Output Parameters:

X - VECTOR OF LENGTH "N" WITH THE GENERATED NORMALLY DISTRIBUTED NUMBERS

Subroutines Required: UNIFOR

Method: Box and Muller

If

X1,X2 - INDEPENDENT RANDOM VARIABLES UNIFORMLY DISTRIBUTED BETWEEN 0 AND 1.

THEN

F1 = SIGMA\*SQRT(-2\*ALOG(X1))\*COS(2\*PI\*X2)+AVR,

F2 = SIGMA\*SQRT(-2\*ALOG(X1))\*SIN(2\*PI\*X2)+AVR

ARE NORMALLY DISTRIBUTED ACCORDING TO N(AVR,SIGMA)

HARDWARE SIMULATION COMPUTER  
FLOW CHART



\*TPF, (I KHACO  
READY

\*ISD\*UTL, FORFLO KU, ACC

PREPRM ERR-FILE NOT PREVIOUSLY ASSIGNED

ERROR FROM 'FORFLO' = .PREPRM

FORFLO	025416	025510	15102148	11/10/77	110R TIME-SHARING EXEC			
X PFG								
000000	004461025322	77777777760	77777777760	030056907600	777777040463	000000004514	000000000000	000000000004
000010	77777777760	030054721200	77777777760	777777025425	000307045026	400010000000	000000000001	000000000003
A PFG								
000014	000307045026	400010000000	000000000001	000000000003	000000000005	000000000001	000000000013	030054766700
000024	77777777760	77777777760	030056547100	000000000000	000000000005	000000000000	010000000000	000000012437
000034	77777777760	010000000000						
R PFG								
000100	000000000000	000000000000	252712252722	000000000141	77777777760	77777777760	010000000000	77777777760
000110	77777777760	010000000000	77777777760	77777777760	010000000000	77777777760	77777777760	000000000002

\*ISD\*UTL, FORFLO KHACO, ACC  
FLO-CHARTER BY FORFLO /X808/ ON 10 NOV 77 AT 15:03:33

ORIGINAL PAGE IS  
OF POOR QUALITY











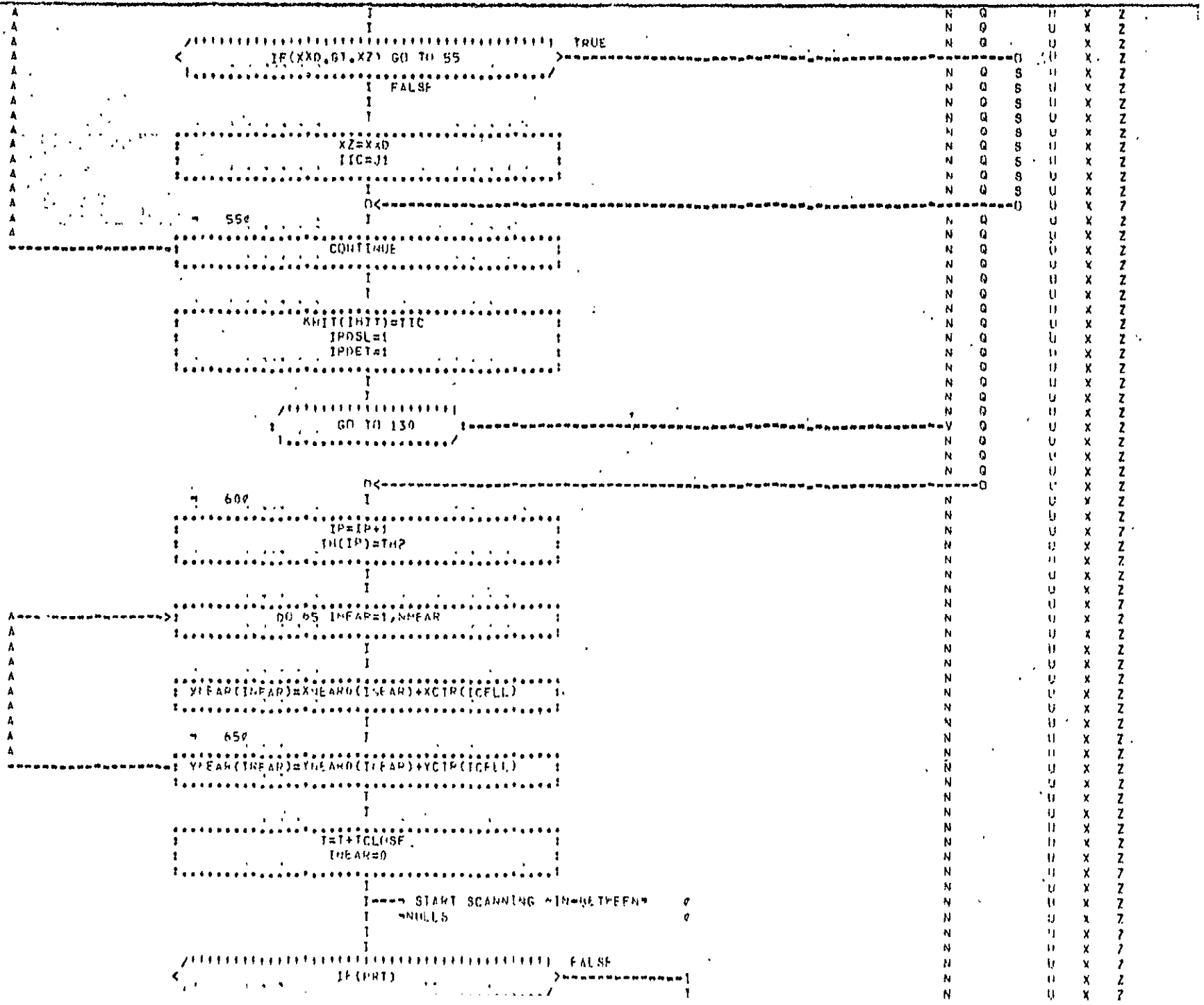












68









```
230 FORMAT(' ',//)' VERIFICATION  
OF A HIT WITH THRESHOLD TH2', * '  
IN THE CELL NO. I:13)  
240 FORMAT(' ',//)' VERIFICATION  
OF A HIT IN THE NORMAL PATH',//)  
250 FORMAT(' ',//)' START  
SCANNING SIDELobe CELLS',//)  
260 FORMAT(' ',//)' START  
SCANNING NEARBY CELLS',//)  
270 FORMAT(' ',//)' CONTINUE  
SCANNING CELLS IN THE NORMAL  
PATH',//)  
280 FORMAT(' ',//)' VERIFICATION  
OF A HIT IN THE NORMAL PATH', * '  
WITH THRESHOLD TH2',//)
```

```
1  
/...../  
RETURN  
/...../
```

ORIGINAL PAGE IS  
OF POOR QUALITY.

64

---

01SD+UTIL, FURFLO KUACD, ANTINA  
FLO+CHARTED BY FURFLO /X808/ ON 10 NOV 77 AT 15:05:25

65

.....  
SUBROUTINE ANTENNA(K,TH,GAIN)  
.....

```

I-----
I  * . . . . .
I  * PURPOSE
I  * DETERMINE ANGLE AND GAIN
I  * CORRESPONDING TO SECOND SIDELOBE
I  * MAXIMUM, OR FIRST SIDELOBE
I  * MAXIMUM, OR -3DB MAINLOBE POINT,
I  * OR GAIN FOR A GIVEN ANGLE=TH
I
I----- INPUT PARAMETERS
I  * K = CONTROL PARAMETER
I  * =2 = THE SUBROUTINE DETERMINES
I  * ANGLE FOR FIRST ZERO
I  * =1 = THE SUBROUTINE DETERMINES
I  * ANGLE FOR SECOND MAXIMUM
I
I----- 0 = THE SUBROUTINE DETERMINES
I  * ANGLE FOR FIRST MAXIMUM
I  * AND CORRESPONDING GAIN
I  * 1 = THE SUBROUTINE DETERMINES
I  * ANGLE CORRESPONDING TO
I  * LOBE -3DB POINT AND CORRESPONDING
I  * GAIN
I  * 2 = THE SUBROUTINE DETERMINES
I  * THE GAIN FOR THE ANGLE =
I  * TH = INPUT ANGLE (K=2)
I
I----- OUTPUT PARAMETERS
I  * TH = ANGLE FOR FIRST NULL (K=-2)
I  * OR ANGLE FOR SECOND
I  * SIDLOBE (K=-1), OR ANGLE FOR
I  * FIRST SIDLOBE (K=0),
I  * OR ANGLE FOR -3DB IN THE
I  * MAINLOBE (K=1)
I  * GAIN = ANTENNA GAIN
I  * . . . . .
I  * . . . . .
I
I
I

```

```

.....
COMMON/CPOS/ELI,AZI,EL0,AZ0,DELTAZ,TH0,
PI,PI,TO
      APATIC=1.61/(2.*TH0)
.....
I
I----- FALSE
IF(K,FO,-2)-----
I-----
I  TRUE
I
I-----
      TH=ABS(ASIN(.5*.8317060/(2.*APATIC)))
I-----
I
I
I

```

66  
ORIGINAL PAGE IS  
OF POOR QUALITY



69

```

      I
      /|.....| FALSE
      < IF(K, EQ, -1) >-----I
      |...../
      I TRUE I
      I I
      I I
      I TH=ABS(ASIN(0.417241/(P.*PATTC))) I
      I..... I
      I D<----- I
      I
      I
      /|.....| FALSE
      < IF(K, EQ, 0) >-----I
      |...../
      I TRUE I
      I I
      I I
      I TH=ABS(ASIN(5.1356273/(P.*PATTC))) I
      I..... I
      I I
      I D<----- I
      I
      I
      /|.....| FALSE
      < IF(K, EQ, 1) >-----I
      |...../
      I TRUE I
      I I
      I I
      I TH=ABS(ASIN(1.61/(2.*PATTC))) I
      I..... I
      I I
      I D<----- I
      I
      I
      ARG=2.*SIN(TH)*PATTC
      GATH=2.*ABS(BSSL(ARG, 3))/ARG
      I
      I
      /|.....|
      I RETURN I
      I...../

```

#190#UTIL.FORFLO KUACO.CELL  
FLO#CHARTED BY FORFLO /X808/ ON 10 NOV 77 AT 15:06:10

69:

CELL

FLOWCHARTED BY FORFLD /X808/ ON 10 NOV 77 AT 15:06:45

```

.....
SUBROUTINE CELL(KSCAN,THH,OV,MOTION,
: 1 VANG,VLIN,XMS,SWITCH,NCELL, XCTR,YCTR,
: 1 ICTR,ELEV,AZIM,ACELLO)
.....

```

```

I-----
I  * PURPOSE
I  * COMPUTE NUMBER OF CELLS NEEDED
I  * TO COMPLETELY
I  * SCAN THE UNCERTAINTY REGION,
I  * THEIR CENTERS, AND
I  * THE TIME INSTANTS THESE CENTER
I  * WERE ACHIEVED
I
I----- INPUT PARAMETERS
I  * KSCAN = TYPE OF TRAJECTORY
I
I----- THH = RADIUS OF THE UNCERTAINTY
I  * REGION (RADIANS)
I  * OV = OVERLAP BETWEEN CELLS ( % )
I  * MOTION = DESIRED ANTENNA MOTION
I  * 1 = CONSTANT ROTATIONAL SPEED
I  * 2 = CONSTANT SPEED ALONG
I  * TRAJECTORY
I  * 3 = COMBINATION OF *1* AND *2*
I  * VANG = ANGULAR VELOCITY (
I  * RADIANS/S)
I  * VLIN = LINEAR VELOCITY ALONG
I  * TRAJECTORY (RADIANS/S)
I  * XMS = DISTANCE BETWEEN
I  * SUCCESSIVE CENTERS (RADIANS)
I  * SWITCH = SWITCHING ANGLE (IN
I  * RADIANS) TO GO FROM
I  * MOTION=1* TO MOTION=2*
I  * NCELL = DIMENSION OF VECTORS
I  * XCTR,YCTR,ICTR,AZIM, AND EL
I  * IN THE SUBROUTINE SIMULA
I  * OUTPUT PARAMETERS
I  * (XCTR,YCTR) = VECTORS WITH THE
I  * CENTERS OF THE CELLS
I  * ICTR = VECTOR WITH THE TIME
I  * INSTANTS THE CENTER OF EACH
I
I----- ELEV = VECTOR WITH THE
I  * ELEVATION OF THE CELLS CENTERS
I  * AZIM = VECTOR WITH THE AZIMUTH
I  * OF THE CELLS CENTERS
I
I-----
I

```

```

.....
DIMENSION XCTR(1),YCTR(1),ICTR(1)
: DIMENSION ELEV(1),AZIM(1)
: COMMON/COMMON/ELI,AZI,EL0,AZ0,DELIAZ,THH,D,
: PI,II,TO
: COMMON/CARTS/XI,YI,X0,Y0
: COMMON/PAGE/ID2,PI2,PI3,P[4],PS,APRO,ENR
: COMMON/DATA1/VANG0,VLIN0,IO
.....

```

69

ORIGINAL PAGE IS  
OF POOR QUALITY

COMMON/DWELL/VANGD,VLIND,TD

I  
I PRINT 113  
I 113 FORMAT(' CELL')

PI=4.\*ATAN(1.)  
FACTOR=10.  
D=YKS/2.  
PI2=PI\*2.  
PI3=PI/3.  
PI4=PI/4.  
THEX=THM/SIN(PI3)  
EPS=.01  
TQSEC=FACTOR\*TD\*1.E-3

IF(KSCAN.EQ.1) FALSE

IF(KSCAN.EQ.1)

I TRUE

D=THM\*ACOS(PI/4.)

IF(KSCAN.EQ.2) FALSE

IF(KSCAN.EQ.2)

I TRUE

D=THM\*ACOS(PI/6.)

D2=.4D

ELI=0.

AZI=0.

XI=0.

YI=0.

TI=0.

ELFV(1)=0.

A71(1)=0.

XCTR(1)=0.

YCTR(1)=0.

TCIR(1)=0.

IANG=0

ILIN=0

I=1

100

I=I+1

IF(KSCAN.EQ.3) FALSE

0  
7  
7  
7  
7  
7  
7  
7







b6.

```
I-----60 FORMAT(* YOU EXCEEDED THE I
I *MAXIMUM NUMBER OF CELLS IN*, * )
I *SCAN THE UNCERTAINTY REGION* (I, I
I *I3,* )',/, * * **CHECK IF YOU I
I *ARE ENTERING THE RIGHT VALUES*, I
I * * OF THE TAN AND BEAMWIDTH***) I
I *70 FORMAT(' ',/,/, ' ***WARNING!*** I
I *',/, * * THE SCANNING IS TOO I
I *FAST!',/, * * THE SELECTED I
I *ANGULAR VELOCITY ('F9.0,' I
I *DEGREES/S)', * * IS NOT I
I *COMPATIBLE WITH SELECTED',/, * * I
I *ELECTRIC DWELL TIME ('F7.4,' MSI
I *',/)) I
I *80 FORMAT(' ',/,/, ' ***WARNING!*** I
I *',/, * * THE SCANNING IS TOO I
I *FAST!',/, * * THE SELECTED I
I *VELOCITY ALONG TRAJECTORY ('F9.0, I
I *0, * * DEGREES/S) IS NOT I
I *COMPATIBLE WITH SELECTED',/, * * I
I *ELECTRIC DWELL TIME ('F7.4,' MSI
I *',/)) I
I-----
O<-----
I
```

```
.....
RETURN
.....
```



---

\*150\*HTIL, FORFLO KHACC, GAUSS  
FLO-CHARTED BY FORFLO /X808/ ON 10 NOV 77 AT 15107114

96



---

\*ISD\*UTIL,FORELO KUACO,HIT  
FLOWCHARTED BY FORELO /XB08/ ON 10 NOV 77 AT 15108100

66.

HIT

PLONCHARTED BY FORFLD /X800/ DN 10 NOV 77 AT 15:09:28

```

.....
SUBROUTINE HIT(X,Y,XTORS,YTORS,TH,
RECSTG,HIT,SO)
.....

```

```

I-----
I  * PURPOSE
I  * DETERMINE IF THE NOISY OUTPUT
I  * OF THE INTEGRATOR IS GREATER
I  * THAN THE THRESHOLD TH (HIT=
I  * TRUE,) OR NOT (HIT=FALSE.)
I-----
I  * INPUT PARAMETERS
I  * (X,Y) = ANTENNA H/RESIGHT
I  * (XTORS,YTORS) = SATELLITE
I  * POSITION
I  * TH = THRESHOLD
I-----
I  * OUTPUT PARAMETERS
I  * RECSTG = RECEIVED SIGNAL POWER
I  * NOISE
I  * HIT = LOGICAL VARIABLE
I-----
I  * SO = VARIABLE USED IN THE NOISE
I  * GENERATION
I-----
I  *
I-----

```

```

.....
COMMON/SIGMA/SIGMAH,POT,SIGW2,POTXG,EVN
LOGICAL HIT
.....

```

```

I-----
I  * PRINT 113
I  * 113 FORMAT(' HIT')
I-----

```

```

.....
HIT=FALSE.
.....

```

```

I-----
I  * DETERMINING THE ANTENNA GAIN *G*
I-----

```

```

.....
G=1.
I  * TETA=SQRT((X-XTORS)*(X-XTORS)+(Y-YTORS)*(
I  * Y-YTORS))
.....

```

```

.....
IF(TETA,FO,0.) GO TO 10
.....
I  * FALSE
I-----

```

```

.....
CALL ANTENNA(2,TETA,G)
.....

```

0  
2  
2  
2  
2  
2  
2

ORIGINAL PAGE IS  
OF POOR QUALITY

18

```

I I CALL ANTENNA(2,THTA,G) I I 2
I ..... I I 2
I I COMPUTING THE EQUIVALENT NOISE @ I I 2
I I THAT THE OUTPUT OF THE INTEGRATOR @ I I 2
I I<----- I I 2
I I 10F I I 0
I ..... I
I PNTXG=PNTAGAB I
I ..... I
I CALL NOISE(SQ) I
I ..... I
I RECSIG=PNTXG+PDM I
I ..... I
I I I I FALSE I
I < IF (RECSIG.GT.TH) >----- I
I I TRUE I
I ..... I
I HIT=TRUE I
I ..... I
I I I
I I<----- I
I I I
I I I I
I I RETURN I
I ..... I

```

66

\*ISD#HTII, FORFLO KUICG, HP1STN  
FLG CHARTED BY FORFLO /XH08/ ON 10 NOV 77 AT 15:09:37

80

ORIGINAL PAGE IS  
OF POOR QUALITY









DISDAUTL.FURFLO KUACO,ITR  
FLO-CHARTED BY FURFLO /X808/ ON 10 NOV 77 AT 15:10:20

h8





.....  
RETURN  
.....

65.









•TPF,U KLIACO  
READY

ORIGINAL PAGE IS  
OF POOR QUALITY

C-2

\*ISD\*HTI, FORFLO KUACO, MAIN  
FLO-CHARTED BY FORFLO /X808/ ON 10 NOV 77 AT 15:11:57

92.

MAIN

FLOWCHARTED BY FORFLD /XAOB/ ON 10 NOV 77 AT 151128

```

/...../
|      BEGIN      |
|...../
|
|...../
| DIMENSION XCTR(1000), YCTR(1000), TCTR(
| 1000), ELEV(1000), AZIM(1000)
| DIMENSION XSL0(50), YSL0(50), XSL(50), YSL(
| 50)
| DIMENSION XHIT(50), TH(50)
| DIMENSION XNEAR0(50), YNEAR0(50), XNEAR(50)
| , YNEAR(50)
|
|          NCELL0=1000
|          NSLDIM=50
|          NNEAR0=50
|...../
|
|...../
| CALL SIMULA(NCELL0, XCTR, YCTR, TCTR,
| ELEV, AZIM, NSLDIM, XSL0, YSL0, XSL, YSL,
| XNEAR0, YNEAR0, XNEAR, YNEAR,
| XHIT, TH)
|...../
|
|...../
|      STOP      |
|...../

```

93

ORIGINAL PAGE IS  
OF POOR QUALITY

0180\*0111, F10FLO KUACO, NOISE  
FLO\*CHARTED BY FORFLO /X300/ ON 10 NOV 77 AT 15:12:30

hb

NOISE

PLDCHARTED BY FORFLO /XR08/ ON 10 NOV 77 AT 15:13:07

```

.....
SUBROUTINE NOISE(S0)
.....
I
I-----
I  * PURPOSE
I  * GENERATE THE EQUIVALENT NOISE
I  * AT THE OUTPUT OF THE INTEGRATOR
I
I----- INPUT PARAMETER
I  * S0 = VARIABLE USED IN THE
I  * GAUSSIAN NOISE GENERATION
I  * SIGMA = GAUSSIAN NOISE
I  * STANDARD DEVIATION ((COMMON))
I  * P0TXG = RECEIVED SIGNAL POWER ((
I  * COMMON))
I
I----- OUTPUT PARAMETER
I  * EQN = EQUIVALENT NOISE AT THE
I  * OUTPUT OF THE INTEGRATOR (COM
I
I
I
I

```

```

.....
DIMENSION X(10)
COMMON/SIGMA/SIGMA,DM,SIGM2,P0TXG,EQN
COMMON/SAMPLE/NSAMPL,KNOISE
FACTOR=1.
ND=P0TXG/SIGM2
AVR=SIGM2
STD=SQRT((1.+2.*ND)/NSAMPL)*SIGM2
EQN=0.
SSTD=0.
KK=0
N=10
.....

```

```

I
I
I----- FALSE
I
I-----
I  IF(KNOISE.LT.N)
I-----
I  TRUE
I
I
I-----
I  N=KNOISE
I
I
I-----
I
I
I-----
I  100
I
I-----
I  KK=KK+N
I
I
I-----
I
I----- TRUE
I
I-----
I  IF(KK.LT.KNOISE) GO TO 20
I-----
I  FALSE
I

```

7  
2  
2  
7  
2  
2  
7  
X 7  
X 2  
X 2

96

ORIGINAL PAGE IS  
OF POOR QUALITY



---

#13C#11L, FORFLO KUACO, QP13TH  
FLD-CHARTED BY FORFLO /X808/ ON 10 NOV 77 AT 15:13:16

99

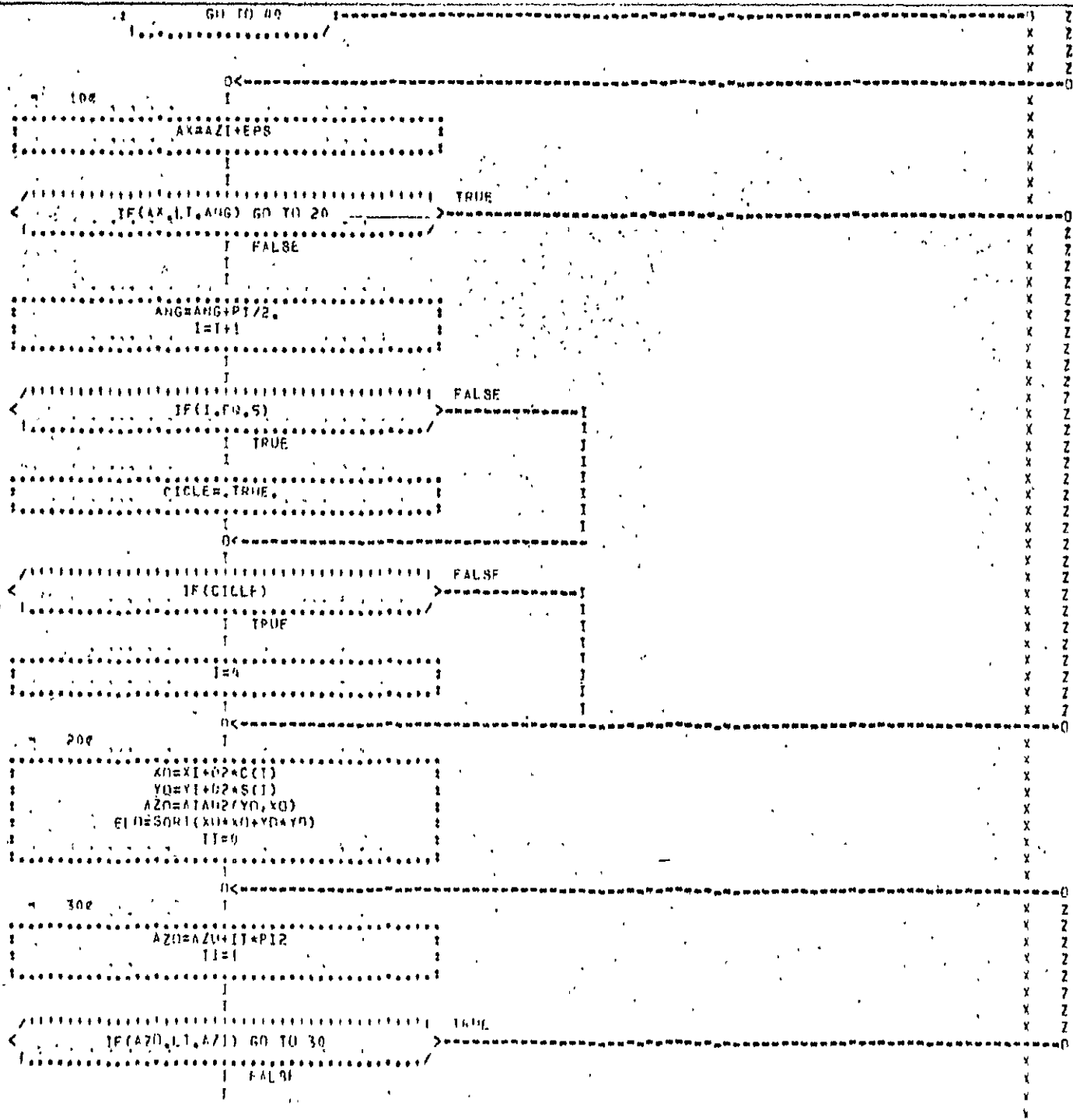
ORIGINAL PAGE IS  
OF POOR QUALITY



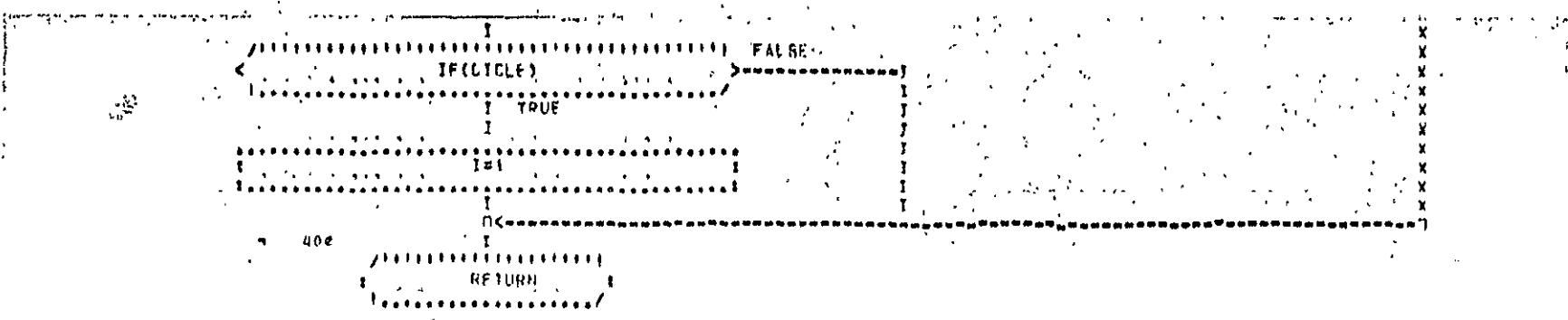


bb.

ORIGINAL PAGE IS  
OF POOR QUALITY.



001.



---

\*ISC\*UTIL, FORFLO KUACO, SIMULA  
FLOWCHARTED BY FORFLO /X808/ ON 10 NOV 77 AT 15113491

ORIGINAL PAGE IS  
OF POOR QUALITY

SIMULA

FLOWCHARTED BY FORFLO /X808/ ON 10 NOV 77 AT 15:14:57

```

.....
SUBROUTINE SIMULA(NCELLD,XCTR,YCTR,
  TCTR,FLFV,AZTH,NSLDIN,XSIO,YSIO,XSL,
  YSL,NNFARD,XNEAR,YNEAR,XNFAR,
  YNFAR,KHIT,TH)
.....
I-----
I-----
I-----
I * PURPOSE
I * READ INPUT DATA, DETERMINE THE
I * PARAMETERS NECESSARY FOR THE
I * "ACQUISITION PROCESS", AND
I * COMPUTE DESIRED "AVERAGES"
I-----
I----- INPUT PARAMETERS
I * NCELLD = MAXIMUM NUMBER OF
I * CELLS POSSIBLE TO BE USED TO S
I-----
I----- NSLDIN = MAXIMUM NUMBER OF
I * CELLS POSSIBLE TO BE USED IN T
I-----
I----- NNFARD = MAXIMUM NUMBER OF
I * CELLS POSSIBLE TO BE USED IN
I * "SURROUNDING CELLS" SCANNING
I-----
I----- OUTPUT PARAMETERS
I * (XCTR,YCTR) = VECTORS WITH THE
I * CENTERS OF THE VARIOUS CELLS
I-----
I----- (FLFV,AZTH) = VECTORS WITH THE
I * CENTERS OF THE VARIOUS CELLS
I-----
I----- (XSIO,YSIO) = VECTORS WITH THE
I * CENTERS OF THE SIDELOBE CELLS W
I * ANTENNA FORESIGHT IS POINTING
I * TO THE ORIGIN
I * (XNEAR,YNEAR) VECTORS WITH
I * THE CENTERS OF THE NEARBY CELLS
I * THE
I * ANTENNA FORESIGHT IS POINTING
I * TO THE ORIGIN
I * KHIT = VECTOR WITH THE LAST
I * HITS, STARTING WITH THE LAS
I * IN THE NORMAL PATH WHERE A HIT
I * WAS OBSERVED
I * TH = VECTOR WITH THE THRESHOLDS
I * USED TO SEARCH NEARBY
I-----
I----- INTERNAL VARIABLES
I * TH1 = RADIUS OF THE UNCERTAINTY
I * REGION (RADIANS)
I * TH2 = RADIUS OF -3DB ANTENNA
I * MAIN LOBE
I * OVERLAP = OVERLAP
I * HSCAN = TYPE OF TRAJECTORY
I-----
I----- METHOD = DESIRED ANTENNA MOTION
I * 1 = CONSTANT ROTATIONAL SPEED
I * 2 = CONSTANT VELOCITY ALONG

```

109

```

I 2 = CONSTANT VELOCITY ALONG 0
I TRAJECTORY 0
I 3 = COMBINATION OF 1 AND 2 0
I VANG = ANGULAR VELOCITY ( 0
I RADIANS/S) 0
I VLIN = LINEAR VELOCITY ALONG 0
I TRAJECTORY (RADIANS/S) 0
I SWITCH = SWITCHING ANGLE (IN 0
I RADIANS) TO GO FROM MOTION 0
I
I---- PFA = PROBABILITY OF FALSE 0
I ALARM 0
I
I---- CNRMAX = EXPECTED CARRIER-TO- 0
I NOISE RATIO DYNAMIC RANGE (D 0
I CNR = ACTUAL CARRIER-TO-NOISE 0
I RATIO (IN DB) USED IN TH 0
I
I---- TD = ELECTRICAL DWELL TIME (NS) 0
I BIF = IF FILTER BANDWIDTH (MHZ) 0
I FLOSS = FILTER INSERTION LOSS (C 0
I DB) 0
I OTHERL = OTHER LOSSES (DB) 0
I NTORSS = NUMBER OF SATELLITE 0
I POSITIONS GENERATED DURING T 0
I SIMULATION FOR EACH SET OF 0
I CONDITIONS 0
I SIGMA = STANDARD DEVIATION (IN 0
I RADIANS) OF THE TRUNCATED 0
I GAUSSIAN DENSITY FUNCTION USED 0
I TO GENERATE THE S 0
I
I---- TSI = TIME INTERVAL TO SWITCH 0
I FROM NORMAL SCANNING TO 0
I
I---- TCLOSE = TIME INTERVAL TO 0
I SWITCH FROM NORMAL SCANNING TO 0
I
I---- TVERTE = VERIFICATION TIME 0
I NULL = SELECT SCANNING SCHEME 0
I 0 = NORMAL PATH ONLY (AUTO 0
I TRACK RANGE < ANGLE R 0
I 1 = NORMAL PATH AND SIDELORE 0
I CELLS (AUTO-TRACK R 0
I
I---- 2 = NORMAL PATH, SIDELORE, AND 0
I NEARBY CELLS 0
I
I---- 3 = NORMAL PATH, NEARBY, AND 0
I SIDELORE CELLS 0
I
I---- TH1, TH2 = THRESHOLDS 0
I PDET = PROBABILITY OF DETECTION 0
I PMSL = PROBABILITY OF DETECTION 0
I BY SIDELORE ACQUISITION 0
I PMISS = PROBABILITY OF MISS 0
I PFA = PROBABILITY OF FALSE 0
I ALARM (ESTIMATED) 0
I TAVR = AVERAGE TIME (IN SECONDS) 0
I TO DETECT THE SATELLITE 0
I SIGMA = CORRESPONDING STANDARD 0
I DEVIATION 0
I ..... 0
I ..... 0
I ..... 0
I ..... 0

```

103

ORIGINAL PAGE IS  
OF POOR QUALITY

```

.....
LOGICAL PRT, TSHARE
DOUBLE PRECISION C1, C2, C3
DIMENSION XCTR(1), YCTR(1), TC1R(1), FLEV(1)
, AZIM(1)
DIMENSION XSLO(1), YSLO(1), XSL(1), YSL(1)
DIMENSION XNFAR0(1), YNFAR0(1), XNFAR(1),
YNFAR(1)
DIMENSION KHIT(1), TH(1)
COMMON/SIGNA/SIGNA4, PDT, SIGN2, DUM, FRN
COMMON/C1CPC3/C1, C2, C3
COMMON/CPNS/ELI, AZI, ELD, AZO, DELTA7, THB, D,
PJ, TI, TD
COMMON/SAMPLE/NSAMPL, KNDISE
COMMON/DELL/VANGD, VLIND, TD
C1=2.00**A31
C2=C1-.00
C3=7.00**A5
ITS=0
.....

```

INPUT DATA

```

.....
PRINT 580
.....

```

```

.....
READ(5,200) ITS
.....

```

```

.....
TSHARE=.FALSE.
.....

```

```

.....
IF(ITS.EQ.1)
.....
TRUE
.....

```

```

.....
TSHARE=.TRUE.
.....

```

```

.....
IF(TSHARE)
.....
TRUE.
.....

```

```

.....
PRINT 590
.....

```

```

.....
IF(.NOT.TSHARE)
.....
TRUE
.....

```

h01

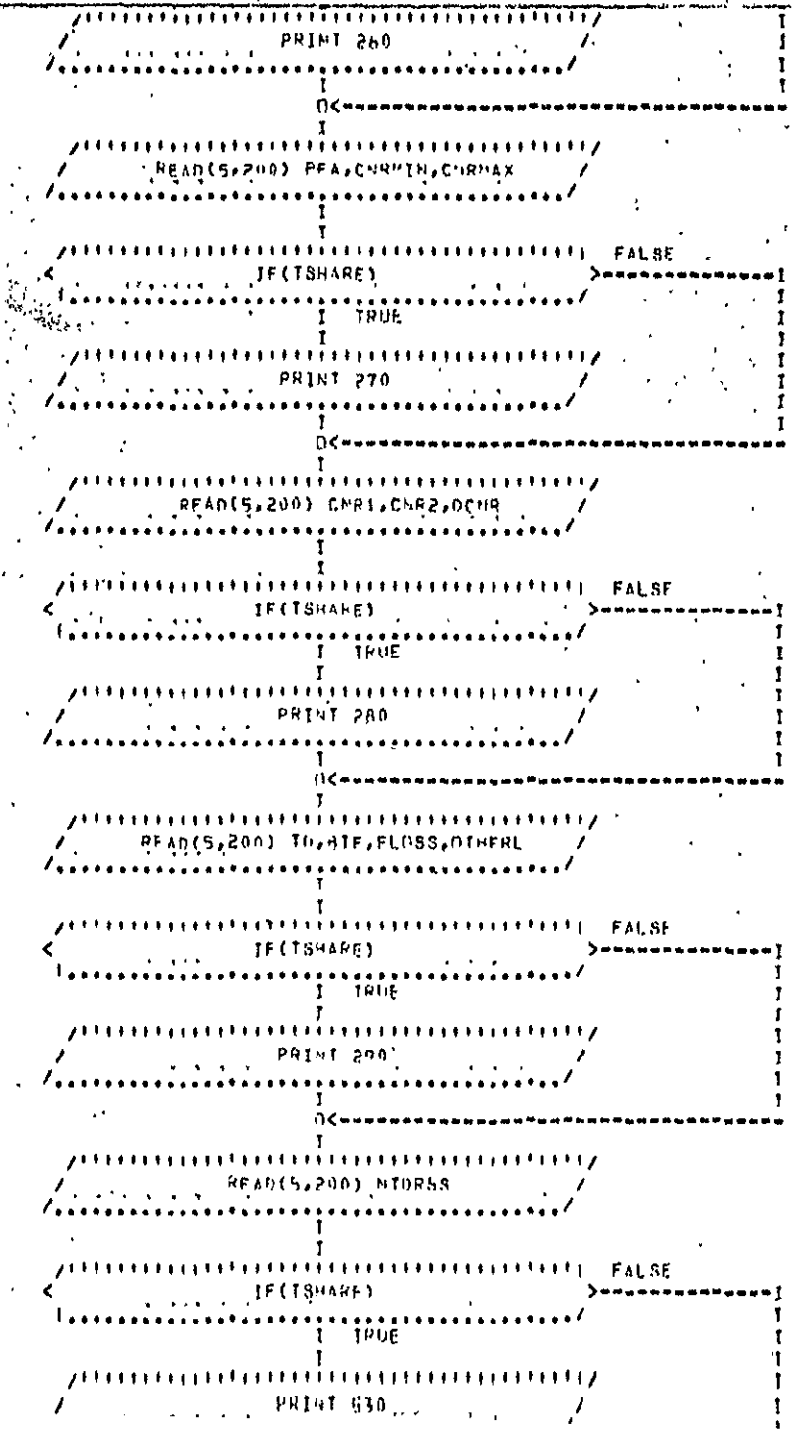






107

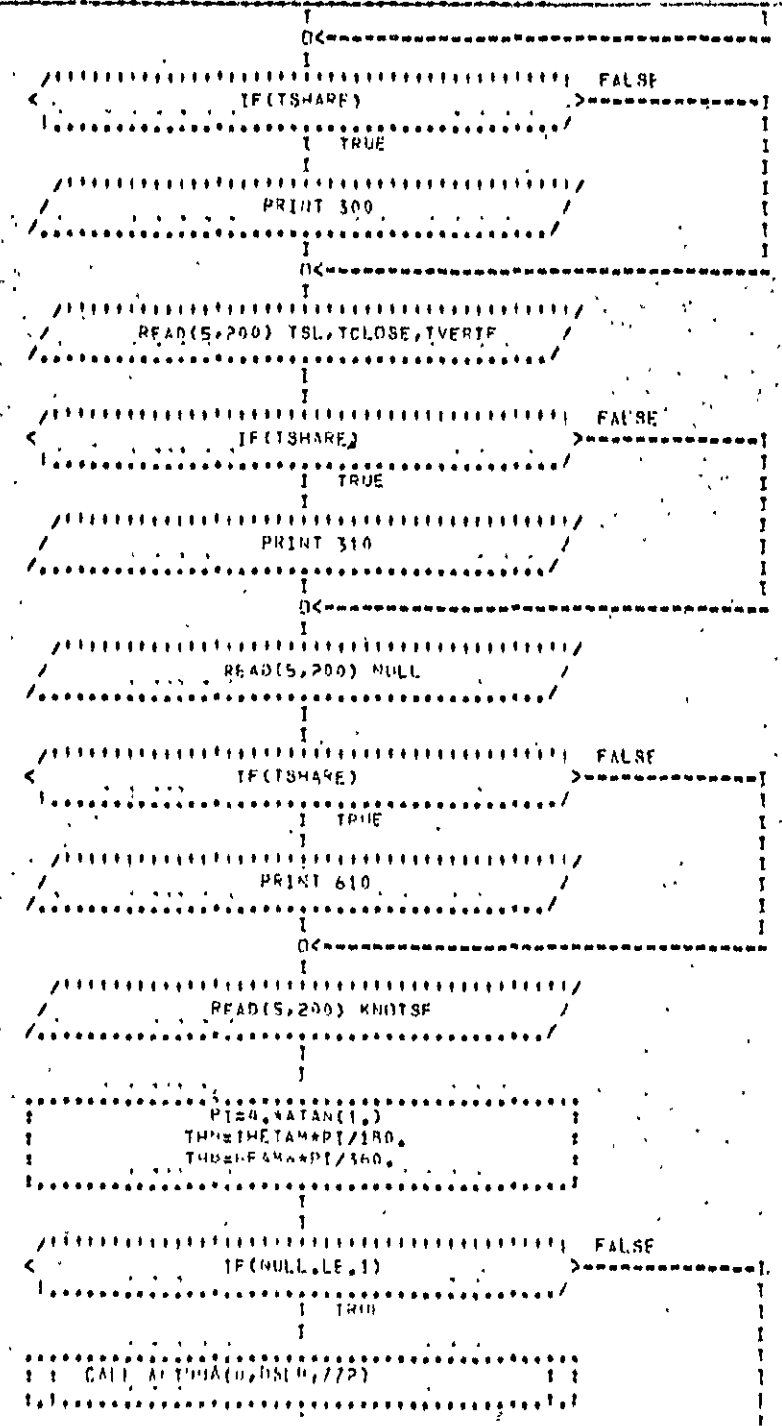
ORIGINAL PAGE IS  
OF POOR QUALITY





109

ORIGINAL PAGE IS  
OF POOR QUALITY





```

.....
OVLAP=OVERLP/130
YKS=P*THH*(1-OVLAP)
NSAMPL=INT(TID*RTF*1.E+3)
.....
|
|
|-----|
| PRINT 520,THETA,REANW |
|-----|
|
|
|-----|
| IF (KSCAN, EQ, 1) |
|-----|
| | TRUE |
| |-----|
| | PRINT 330,OVERLP |
| |-----|
| | O |
| |-----|
| |
| |-----| |
| | IF (KSCAN, EQ, 2) |
| |-----|
| | | TRUE |
| | |-----|
| | | PRINT 340,OVERLP |
| | |-----|
| | | O |
| | |-----|
| | |
| |-----|
| | IF (KSCAN, EQ, 3) |
| |-----|
| | | TRUE |
| | |-----|
| | | PRINT 350,OVERLP |
| | |-----|
| | | O |
| | |-----|
| | |
| |-----|
| | IF (NITION, EQ, 1) |
| |-----|
| | | TRUE |
| | |-----|
| | | PRINT 360,VANGD |
| | |-----|
| | | O |
| | |-----|
| | |
| |-----|
| | IF (NITION, EQ, 2) |
| |-----|
| | | TRUE |
| | |-----|
| | | PRINT 370,VANGD,VLIND |
| | |-----|
| | | O |
|-----|

```

ORIGINAL PAGE IS  
OF POOR QUALITY.

111

```

.....|
<.....| IF(MOTION.EQ,3) |.....| FALSE
.....| TRUE |.....|
| |.....| | |
| |.....| PRINT 380,VANGD,SWTCHD,VLIND,SWTCHD |.....|
| |.....|
| |.....|
| |.....| PRINT 390,PFA,CNRMIN,CNRMAX,TO,RIF, |.....|
| |.....| FLOSS,OTHERL |.....|
| |.....|
| |.....| DETERMINING THRESHOLDS TH1 AND 2 |.....|
| |.....| TH2 |.....|
| |.....|
| |.....| CALL TH1TH2(CNRMIN,CNRMAX,PFA,RIF, |.....|
| |.....| FLOSS,OTHERL,NSAMPL,TH1,TH2) |.....|
| |.....|
| |.....| PRINT 490,TH1,TH2 |.....|
| |.....|
| |.....| DETERMINING NUMBER OF CELLS TO 2 |.....|
| |.....| COMPLETELY SCAN THE |.....|
| |.....| UNCERTAINTY REGION, THEJR |.....|
| |.....| CENTERS, AND THE TIME INSTANTS 2 |.....|
| |.....| THESE CENTERS ARE ACHIEVED 2 |.....|
| |.....|
| |.....| CALL CELL(KSCAN,THM,OVIAP,MOTION, |.....|
| |.....| VANG,VLIN,XNS,SWTCH,NCPLL, XCTR,YCTR, |.....|
| |.....| TCTR,ELEV,AZIM,NCCELL,D) |.....|
| |.....|
| |.....| PRINT 500,NCCELL |.....|
| |.....|
| |.....| PRINT 620,TCTR(NCPLL) |.....|
| |.....|
| |.....|
| |.....| FALSE |.....|
| |.....| IF(INTRF 9.EQ,1) |.....|
| |.....| TRUE |.....|
| |.....|
| |.....| PRINT 605 |.....|
| |.....|
| |.....|
| |.....| FALSE |.....|
| |.....|
| |.....|
| |.....| FALSE |.....|

```

112



















ORIGINAL PAGE IS  
OF POOR QUALITY

181

```
I *TRAJECTORY',/, * 3 = COMBINATI  
I * OF *1* AND *2*')  
I *P30 FORMAT(' ',/, ' (REAL) 0  
I *ANGULAR VELOCITY (DEGREES/S)') 0  
I *P40 FORMAT(' ',/, ' (REAL) 0  
I *ANGULAR VELOCITY (DEGREES/S)')/,/, 0  
I * * 1 (REAL) VELOCITY ALONG 0  
I *TRAJECTORY (DEGREES/S)') 0  
I *P50 FORMAT(' ',/, ' (REAL) 0  
I *ANGULAR VELOCITY (DEGREES/S)')/,/, 0  
I * * 1 (REAL) VELOCITY ALONG 0  
I *TRAJECTORY (DEGREES/S)')/,/, * 1 (0  
I *REAL) SWITCHING ANGLE (DEGREES)')0  
I *P60 FORMAT(' ',/, ' (REAL) 0  
I *PROBABILITY OF FALSE ALARM',/, * 0  
I * 1 (REAL) EXPECTED MINIMUM 0  
I *CARRIER-TO-NOISE RATIO (DB)')/,/, 0  
I * * 1 (REAL) EXPECTED MAXIMUM 0  
I *CARRIER-TO-NOISE RATIO (DB)') 0  
I *P70 FORMAT(' ',/, ' CLR VALUES FOR  
I *BE USED IN THE SIMULATION',/, * 0  
I * * (REAL) (MINIMUM, MAXIMUM, 0  
I * INCREMENT, GF, 0, 0)') 0  
I *P80 FORMAT(' ',/, ' RECEPTOR 0  
I *PARAMETERS: ',/, * 1 (REAL) 0  
I *INTEGRATION TIME (MS)')/,/, * 1 ( 0  
I *REAL) IF FILTER BANDWIDTH (MHZ)')0  
I */, * 1 (REAL) INSERTION LOSS (DB) 0  
I *',/, * 1 (REAL) OTHER LOSSES (DB) 0  
I * 1) 0  
I *P90 FORMAT(' ',/, ' (INTG) NUMBER 0  
I *OF SATELLITE POSITIONS TO BE 1, 0  
I * GENERATED DURING THE SIMULATION  
I * 1) 0  
I *P95 FORMAT(' ',/, ' (INTG) 0  
I *INTERMEDIATE RESULTS; 0(0) YES(0  
I * 1)') 0  
I *P300 FORMAT(' ',/, ' TRANSITION 0  
I *MODES AND VERIFICATION TIMES: ',/, 0  
I * * 1 (REAL) NORMAL TO SIDELobe 0  
I *SCANNING',/, * 1 (REAL) NORMAL 0  
I *TO SURROUNDING CELLS SCANNING',/, 0  
I * * 1 (REAL) VERIFICATION TIME') 0  
I *P310 FORMAT(' ',/, ' SCANNING 0  
I *SCHEME',/, 0, 0, ' AUTO-TRACK RANGE', 0  
I * *, * 1 (INTG) 0 = NORMAL PATH 0  
I *ONLY',/, 0, 0, * 1 < ANGLE BETWEEN 0  
I *ANTENNA SIDELOBES',/, * 1 1 = 0  
I *NORMAL PATH AND SIDELobe CELLS') 0  
I *P26X, * 1 < ANGLE BETWEEN ANTENNA 0  
I *NULLS',/, * 1 2 = NORMAL PATH, 0  
I *FAIRLY, AND THE SIDELobe', * 1 0  
I *CELLS',/, 0, 0, * 1 < ANGLE BETWEEN 0  
I *ANTENNA NULLS') 0  
I *P320 FORMAT(' ',/, ' RADIUS OF 0  
I *UNCERTAINTY REGION: ',/, 0, 0, * 0  
I * 1 DEGREES',/, ' BEAMWIDTH',/, 0, 0, 0  
I * 0, 0, ' (DEGREES)') 0  
I *P330 FORMAT(' SQUARE TRAJECTORY: 0  
I *OVERLAP = ',/, 0, 0, ' 2)') 0  
I *P340 FORMAT(' HEXAGONAL TRAJECTORY: 0  
I * 1 OVERLAP = ',/, 0, 0, ' 2)') 0  
I *P350 FORMAT(' SPIRAL TRAJECTORY: 0  
I *OVERLAP = ',/, 0, 0, ' 2)') 0  
I *P360 FORMAT(' CONSTANT ROTATIONAL 0  
I *SPEED: ',/, 0, 0, * 1 DEGREES/SEC) 0  
I *P370 FORMAT(' CONSTANT ROTATIONAL 0
```

100

```

I 4370 FORMAT(' CONSTANT ROTATIONAL
I 4380 SPEED: ',F9.4, ' * DEG/SECS',/,/
I 4390 ' * CONSTANT VELOCITY ALONG
I 4400 TRAJECTORY: ',F9.4, ' * DEGREES/
I 4410 'S')
I 4420 FORMAT(' CONSTANT ROTATIONAL
I 4430 SPEED: ',F9.4, ' * DEGREES/S,
I 4440 ANGLE < ',F8.4, ' DEGREES',/, * '
I 4450 'CONSTANT VELOCITY ALONG
I 4460 TRAJECTORY: ',F9.4, ' * DEGREES/
I 4470 'S ANGLE > ',F8.4, ' DEGREES')
I 4480 FORMAT(' PROBABILITY OF
I 4490 FALSE ALARM: ',E13.4,/, * ' CNR
I 4500 EXPECTED RANGE: ',F8.4, ' DB', *
I 4510 'MHZ = ',F8.4, ' DB=H7',/, *
I 4520 'INTEGRATION TIME: ',F8.4, ' MS',/
I 4530 ' * IF FILTER BANDWIDTH: ',F8.4
I 4540 ' * MHZ',/, * ' INSERTION LOSS: ',
I 4550 'F8.4, ' DB',/, * ' OTHER LOSSES:
I 4560 'F8.4, ' DB')
I 4570 FORMAT(' ',/, ' NUMBER OF
I 4580 CELLS: ',I4,/)
I 4590 FORMAT(' ',I4X, 'CENTERS', 3BX
I 4600 'CENTERS', 2RX, 'TIME',/, ' ', 7X, *
I 4610 'CARTESIAN COORDINATES', 26X,
I 4620 'POLAR COORDINATES', * 21X,
I 4630 'INSTANTS',/, ' ', 13X, '(RADIAN)',
I 4640 '46X, '(RADIAN)', 25X, * '(SECONDS)
I 4650 ' ',/)
I 4660 FORMAT(' ',/, 2(' ',F15.7, 3X,
I 4670 'F15.7, 10X), E15.7)
I 4680 FORMAT(' ',/,/,/, ' (XTDRSS,
I 4690 'YIDRSS) = (',E13.7, ', ',E13.7, *
I 4700 ' ) IN THE ',I3, 'TH CELL')
I 4710 FORMAT(' ',/,/,/, ' (NORMAL
I 4720 'SCANNING) DETECTED IN THE ',I3,
I 4730 'TH CELL')
I 4740 FORMAT(' ',/,/,/, ' (SIDELOBE
I 4750 'VARIATION) DETECTED IN THE ',I3,
I 4760 'TH CELL')
I 4770 FORMAT(' ',/,/,/, ' THE
I 4780 'SATELLITE WAS MISSED: ',E17.7,
I 4790 'SECONDS')
I 4800 FORMAT(' ',/, ' CARRIER-TO-
I 4810 'NOISE RATIO: ',E15.7, * ' DB
I 4820 'MHZ')
I 4830 FORMAT(' ',/,/,/, ' NUMBER OF
I 4840 'SATELLITE POSITIONS GENERATED: ',
I 4850 'I12,/, * ' STANDARD DEVIATION:
I 4860 '29X, E13.7)
I 4870 FORMAT(' ACQUISITION AVERAGE
I 4880 'TIME: ',E20, E15.7, ' S',/, *
I 4890 'STANDARD DEVIATION: ',E10, E15.7,
I 4900 'S',/, * ' PROBABILITY OF
I 4910 'DETECTION: ',E10, E15.7,/, *
I 4920 'PROBABILITY OF DETECTION (SL.
I 4930 'VAR.): ',E10, E15.7,/, *
I 4940 'PROBABILITY OF MISS: ',E10, E15.7,
I 4950 '/, * ' PROBABILITY OF FALSE
I 4960 'ALARM (TO THE SIMULATION): ',E15.7
I 4970 '7)
I 4980 FORMAT(' ',/, ' THRESHOLDS:
I 4990 'TH1 = ',E10, 7, 5X, 'TH2 = ',E10, 7)
I 5000 FORMAT(' ',/, ' (1016) HOW
I 5010 'MANY RESULTS DO YOU WANT TO SEE
I 5020 'THAT ARE IDENTICALS')
I 5030 FORMAT(' ',/, ' NUMBER OF

```



123

ORIGINAL PAGE IS  
OF POOR QUALITY

```
I 7510 FORMAT(' ',//, 'NUMBER OF' 0
J 7515 'SIDELINE CELLS:',I4,/, ' * ' TIME 0
I 7520 'INTERVAL TO GO FROM A CELL TO' 0
J 7525 'THE NEXT ONE IN', * ' THE' 0
I 7530 'SIDELINE PATH:',E13,7, ' SECONDS' 0
I 7535 '///, ' ,I4, ' * 'CENTERS',//, ' ' ,7X 0
I 7540 ' * 'CARTESIAN COORDINATES',//, ' ' , 0
I 7545 ' -13X, * ' (RADIANS)',//) 0
I 7550 FORMAT(' ',E13,7, 'Y',F15,7)) 0
J 7555 '530 FORMAT(' ',//, ' (INTG) 0 -' 0
I 7560 'SATELLITE POSITIONS ARE ENTERED' 0
I 7565 ' * ' AS INPUT DATA',//, * ' 1 -' 0
I 7570 'SATELLITE POSITIONS ARE' 0
I 7575 'GENERATED', * ' INTERNALLY', * ' ' 0
I 7580 FORMAT(' ',//, ' (REAL)' 0
I 7585 'STANDARD DEVIATION VALUES:' ( 0
I 7590 'MINIMUM', * ' MAXIMUM,' 0
I 7595 'INCREMENT,GE,0.) IN DEGREES)' 0
I 7600 FORMAT(' ',//, ' ENTER' 0
I 7605 'SATELLITE POSITION (CARTESIAN', 0
I 7610 ' * ' COORDINATES)',//, * ' (REAL)' (0
I 7615 'XTORSS,YTORSS)') 0
I 7620 FORMAT(' ',//, ' ***ERROR***',// 0
I 7625 ' * ' THE POSITION GENERATED FOR' 0
I 7630 'THE SATELLITE IS', * ' OUTSIDE' 0
I 7635 'THE UNCERTAINTY REGION') 0
I 7640 FORMAT(' ',//, ' THE SATELLITE' 0
I 7645 'IS OUTSIDE THE UNCERTAINTY', * ' ' 0
I 7650 'REGION',//, ' *ENTER NEW SATELLITE' 0
I 7655 'POSITION') 0
I 7660 FORMAT(' ',///, ' IF YOU ARE' 0
J 7665 'ON-LINE, PLEASE TYPE 11)' 0
I 7670 FORMAT(' *** ON-LINE ***',// 0
I 7675 ') 0
I 7680 FORMAT(' *** MATCH ***',//) 0
I 7685 '7610 FORMAT(' ',//, ' (INTG) NUMBER' 0
I 7690 'OF MITSU SAMPLES (EVEN', * ' 1<(( 0
I 7695 ')<20)') 0
I 7700 FORMAT(' MAXIMUM SCANNING' 0
I 7705 'TIME =',E13,7, ' SECONDS',//) 0
I 7710 FORMAT(' ',//, ' THE SATELLITE' 0
I 7715 'WAS GENERATED IN THE ',I3, * ' THE' 0
I 7720 'CELL AND DETECTED IN THE ',I3, ' ' 0
I 7725 'TH', * ' IN',E15,7, ' SECONDS',//, 0
I 7730 ' * ' ***FALSE ALARM***',//) 0
I 7735 '7640 FORMAT(' ',//, * ' (REAL)' 0
I 7740 'OVERLAP ( X )') 0
I 7745 '7650 FORMAT(' DISTANCE (SATELLITE' 0
I 7750 'BORNSIGHT) = ',E13,7, 'X', * ' OF' 0
I 7755 'DISTANCE BETWEEN BORNESIGHT AND' 0
I 7760 'FIRST SIDELINE',//, ' ' , * 13X, ' ' 0
I 7765 'ACQUISITION TIME = ',F13,7, ' ' 0
I 7770 'SECONDS') 0
I 7775 '7660 FORMAT(' DISTANCE (SATELLITE' 0
I 7780 'BORNSIGHT) = ',E13,7, 'X', * ' OF' 0
I 7785 'DISTANCE BETWEEN BORNESIGHT AND' 0
I 7790 'FIRST DUL',//, ' ' , * 13X, * ' ' 0
I 7795 'ACQUISITION TIME = ',E13,7, ' ' 0
I 7800 'SECONDS') 0
I 7805 '7670 FORMAT(' ',//, ' NUMBER OF' 0
I 7810 'NEARBY CELLS',I4,/, ' * ' TIME' 0
I 7815 'INTERVAL TO GO FROM A CELL TO' 0
J 7820 'THE NEXT ONE IN', * ' THE NEARBY' 0
I 7825 'PATH:',F13,7, ' SECONDS',//, ' ' , 0
I 7830 ' -14X, * 'CENTERS',//, ' ' ,7X, ' ' 0
I 7835 ' * 'CARTESIAN (COORDINATES',//, ' ' ,13X 0
I 7840 ' * ' (RADIANS)',//) 0
```

I \* (RADIANS),/)

I

I

.....

RETURN

.....

124.

---

•ISD\*UTIL,F0RFL0 KIJACQ,SLCELL  
FLO:CHARTED BY F0RFL0 /XA008/ ON 10 NOV 77 AT 15:15:32

ORIGINAL PAGE IS  
OF POOR QUALITY

105









\*01S#0111.F0RFLO KUACQ.9P081N  
FLD%CHARTED BY FURFLO /X808/ ON 10 NOV 77 AT 15116:23



SPOSTN

FLOWCHARTED BY FQHFLD /XAOB/ ON 10 NOV 77 AT 15:17:22

ROUTINE SPOSTN(K)

```

I-----
I  .....
I  .....
I  .....
I  PURPOSE
I  DETERMINE THE (K+1)TH CELL
I  CENTER FOR THE SQUARE TYPE OF
I  TRAJECTORY
I
I----- INPUT PARAMETERS
I  K = CELL NUMBER = 1
I  ELI,AZI = ELEVATION AND AZIMUTH
I  OF PREVIOUS CELL (COMMON)
I  THR = RADIUS OF ANTENNA
I  THROBE (COMMON)
I  XI,YI = CARTESIAN COORDINATES
I  OF PREVIOUS CELL (COMMON)
I
I----- OUTPUT PARAMETERS
I  FLO,AZO = ELEVATION AND AZIMUTH
I  OF FOLLOWING CELL (COMMON)
I  XO,YO = CARTESIAN COORDINATES
I  OF FOLLOWING CELL (COMMON)
I  .....
I  .....
I

```

```

COMMON/COMMON/ELI,AZI,ELN,AZO,DELTA,THR,D,
PI,TI,TD

```

```

I----- PRINT 113
I  113 FORMAT(' SPOSTN')
I

```

```

FA=PI/D

```

```

IF(K.GT.1) GO TO P

```

```

FALSE

```

```

FLPI=THR

```

```

AZI=FA*(THR-D)

```

```

ELI=THR-D*90

```

```

IK

```

47

```

A=5 AELN1=1 D=1 AAZI1=AZM1

```

0  
2  
2  
2  
7  
7  
2  
2  
2  
2  
7  
0  
2  
X  
2  
X  
2

ORIGINAL PAGE IS  
OF POOR QUALITY

131



RETURN

ORIGINAL PAGE IS  
OF POOR QUALITY

#15D41111, FORFLO KUACQ, TCENTR  
FLO\*CHARTED BY FORFLO /XR009/ ON 10 NOV 77 AT 15117129

184

TCENTR

FLOWCHARTED BY FORFLD /XAOB/ ON 10 NOV 77 AT 15:18:00



135

ORIGINAL PAGE IS  
OF POOR QUALITY



DISUTIL, FURFLO KUACQ, YORS

PREPRM ERR=PF81 ERR RETURN

ERROR FROM FURFLO = PREPRM

FORFLO	025416	025510	15118118	11/10/77	110R TIME-SHARING EXEC			
X REG								
000000	004200025462	000000000000	000000000000	230026214111	400000000000	030026214103	230025375400	230025164700
000010	777777777760	030054721200	777777002472	001106025425	000305045105	000001025337	000000000001	000000000001
A REG								
000014	000305045105	000001025337	000000000001	000000000001	000000000007	000000000001	000000000030	00000002522
000024	264641000011	040067000050	532531162162	005530002122	000471000000	000000000000	000000000000	000003000000
000034	300022000604	030042002400						
R REG								
000100	000000000000	000000000000	252712252722	000001050630	000200000000	000020400001	000000000000	200100750061
000110	000000000000	000200000000	000023000000	000023000000	000023000000	000000000000	000100000024	000000000000

189

ORIGINAL PAGE IS  
OF POOR QUALITY

\*150\*UTTI, FURELO KUACO, THITH2  
FLO\*CHARTED BY FURELO /X800/ ON 10 NOV 77 AT 15:19:10

138









\*1SD\*UTIL,FDRFLO KUACC,UNIFDR  
FLOWCHARTED BY FDRFLO /XAOR/ ON 10 NOV 77 AT 15:20:34

141











TYPE, U KIIACD  
READY

EXIT MAIN

IF YOU ARE ON-LINE, PLEASE TYPE I  
\*\*\* BATCH \*\*\*

RADIUS OF UNCERTAINTY REGION: 5.0000 DEGREES  
BEAM WIDTH: 1.6000 DEGREES  
HEXAGONAL TRAJECTORY: OVERLAP = 13.3975 %  
CONSTANT ROTATIONAL SPEED: 108.0000 DEGREES/S, ANGLE < 3.0000 DEGREES  
CONSTANT VELOCITY ALONG TRAJECTORY: 5.0440 DEGREES/S, ANGLE > 3.0000 DEGREES  
PROBABILITY OF FALSE ALARM: .1000-03  
CNR EXPECTED RANGE: 60.0000 DB-MZ = 80.0000 DB-MZ  
INTEGRATION TIME: 5.0000 MS  
IF FILTER BANDWIDTH: 6.0000 MHz  
INSERTION LOSS: 1.5000 DB  
OTHER LOSSES: .0000 DB

THE PROBABILITY OF FALSE ALARM WAS RAISED TO 0.1 TO AVOID SECOND SIDELobe DETECTION.  
WHEN CNR = 80.00 DB/MZ

THRESHOLDS: TH1 = 1.0568141 TH2 = 1.2319816

NUMBER OF CELLS: 91

MAXIMUM SCANNING TIME = .2634002+02 SECONDS

CENTERS CARTESIAN COORDINATES (RADIANS)		CENTERS POLAR COORDINATES (RADIANS)		TIME INSTANTS (SECONDS)
.0000000	.0000000	.0000000	.0000000	.0000000
.1209200-01	.2094395-01	.2418399-01	.1047194+01	.6555556+00
-.1209200-01	.2094395-01	.2418399-01	.2094395+01	.1111111+01
-.2418399-01	.4727535-09	.2418399-01	.3141593+01	.1646667+01
-.1209199-01	.2094395-01	.2418399-01	.4184790+01	.2222222+01
.1209200-01	.2094395-01	.2418399-01	.5235088+01	.2777778+01
.2418399-01	.7597113-10	.2418399-01	.6283185+01	.3333333+01
.3627599-01	.2094395-01	.4184790-01	.6406784+01	.3611111+01
.2418399-01	.4184790-01	.4184790-01	.7330383+01	.3888889+01
.1209200-01	.4184790-01	.4184790-01	.7854982+01	.4166667+01
-.2418399-01	.4184790-01	.4184790-01	.8477580+01	.4444444+01
-.3627599-01	.2094395-01	.4184790-01	.8901179+01	.4722222+01
-.4727535-01	.4612307-08	.4184790-01	.9424778+01	.5000000+01
-.3627599-01	.2094395-01	.4184790-01	.9948377+01	.5277778+01

241839A-01	41AA790-01	4A36797-01	1047198+02	5545556+01
12A1585-07	41AA790-01	010A790-01	1099557+02	6A33334+01
2418400-01	41AA790-01	4A36799-01	1151917+02	A111111+01
3A27599-01	2094395-01	41A8791-01	1204777+02	43PAAA9+01
4A36797-01	3A3AA04-09	4A36799-01	1256637+02	A6A6A67+01
604599A-01	2094395-01	639A8A3-01	1289914+02	A8435A0+01
4A36799-01	41AA790-01	639A8A3-01	132A000+02	711A290+01
3627680-01	62A31A0-01	7255197-01	1361357+02	7303041+01
1209201-01	62A31A0-01	639A8A3-01	1394704+02	76A7711+01
1209197-01	62A31A0-01	639A8A1-01	1437229+02	7942022+01
3A27596-01	62A31A0-01	7255195-01	1466077+02	4217133+01
4A36795-01	41AA790-01	639A8A0-01	1499424+02	A001A43+01
604599A-01	2094394-01	639A8A0-01	1537409+02	A7A6A54+01
7255191-01	11530A6-07	7255193-01	1570796+02	0001264+01
604599A-01	2094394-01	639A8A1-01	1604144+02	0315975+01
4A36794-01	41AA790-01	639A8A7-01	1642169+02	0500AA5+01
3627595-01	62A31A3-01	7255194-01	1675516+02	08A5396+01
1209197-01	62A31A3-01	639A8A0-01	1706A63+02	1014011+02
1209201-01	62A31A3-01	639A8A0-01	1746A89+02	10410A2+02
3A27599-01	62A31A3-01	7255194-01	1740236+02	10A8953+02
4A36794-01	41AA790-01	639A8A2-01	1A135A3+02	1006470+02
604599A-01	2094393-01	639A8A2-01	1A516A0+02	1123A94+02
7255147-01	3060694-08	7255197-01	1A64956+02	1151366+02
6045997-01	2094394-01	8719652-01	1909212+02	117A837+02
725519A-01	41AA790-01	83775A0-01	1937315+02	120A308+02
6046000-01	62A31A1-01	87196A1-01	1965419+02	1233779+02
4A36802-01	6377575-01	9673590-01	1989A75+02	12A1250+02
2418405-01	6377575-01	871965A-01	2013032+02	12A8721+02
6220991-07	8377575-01	8377575-01	2042035+02	1316102+02
2418391-01	8377575-01	8719655-01	2070139+02	13436A3+02
4A36799-01	6377576-01	96735A8-01	2094395+02	1371134+02
604599A-01	62A31A3-01	8719652-01	2118651+02	130A605+02
7255185-01	41AA790-01	8377579-01	214A755+02	142A07A+02
6046340-01	2094394-01	8719610-01	2174A5A+02	1453547+02
96735A3-01	3305A07-07	96735A3-01	2199115+02	14A101A+02
8046340-01	2094390-01	871964A-01	2223371+02	15A8A9+02
7255185-01	41AA790-01	83775A0-01	2251475+02	15350A0+02
6045997-01	62A31A7-01	8719640-01	227957A+02	15A3A32+02
4A36789-01	8377571-01	96735A0-01	2303A35+02	1500903+02
2418492-01	8377571-01	87196A1-01	2320091+02	16A3370+02
6001A13-07	8377571-01	8377571-01	2356195+02	16A5A45+02
2418404-01	8377571-01	8719655-01	2384290+02	167331A+02
4A36A01-01	8377572-01	9673591-01	2400454+02	17007A7+02
6046000-01	62A31A7-01	871965A-01	2432A11+02	172A25A+02
725519A-01	41AA790-01	837757A-01	2460014+02	1755729+02
4A36797-01	2094392-01	87196A1-01	248061A+02	17A3200+02
967359A-01	15355A0-09	967359A-01	2513274+02	1810671+02
1AA-2000-00	2094393-01	110A250+00	25322A7+02	183A142+02
9673597-01	41AA790-01	165415A+00	2550130+02	1A5A113+02
8046000-01	62A3179-01	105415A+00	2577130+02	18730A4+02
7255202-01	8377572-01	110A200+00	259690A+02	1900655+02
6046045-01	1007197+00	1209192+00	2617404+02	19A002A+02
3A2760A-01	1007196+00	110A209+00	2647000+02	1975007+02
1209212-01	1007196+00	1054155+00	265A8A5+02	2002960+02
1209105-01	1007196+00	1054155+00	26A1A50+02	2030439+02
3627501-01	1697147+00	1100200+00	2703701+02	2047010+02
6045977-01	1007197+00	1209190+00	2722714+02	2005391+02

149

ORIGINAL PAGE IS  
OF POOR QUALITY

.7255173-01	.8377574-01	.1108248+00	.2741726+02	.2112852+02
.8464371-01	.6283182-01	.1054153+00	.2763577+02	.2140323+02
.9673509-01	.4188790-01	.1054153+00	.2786569+02	.2167794+02
.1088277+00	.2094398-01	.1108247+00	.2808421+02	.2195265+02
.1209197+00	.7783677-07	.1209197+00	.2827433+02	.2227736+02
.1088277+00	.2094388-01	.1108247+00	.2846406+02	.2250207+02
.9673570-01	.4188776-01	.1054153+00	.2868297+02	.2277678+02
.8464372-01	.6283169-01	.1054153+00	.2891209+02	.2315149+02
.7255174-01	.8377562-01	.1108247+00	.2913141+02	.2332620+02
.6045978-01	.1047196+00	.1209197+00	.2932153+02	.2360091+02
.3627561-01	.1047195+00	.1108247+00	.2951166+02	.2387562+02
.1209184-01	.1047195+00	.1054153+00	.2973017+02	.2415033+02
.1209212-01	.1087195+00	.1054154+00	.2996009+02	.2442504+02
.3627607-01	.1047196+00	.1108248+00	.3017860+02	.2469975+02
.6045905-01	.1047196+00	.1209198+00	.3036873+02	.2497446+02
.7255203-01	.8377563-01	.1108249+00	.3055886+02	.2524917+02
.8464401-01	.6283160-01	.1054155+00	.3077717+02	.2552388+02
.9673599-01	.4188778-01	.1054156+00	.3100729+02	.2579859+02
.1088280+00	.2098360-01	.1108250+00	.3122580+02	.2607331+02
.1209200+00	.7688204-07	.1209200+00	.3141593+02	.2634802+02

NUMBER OF SIDELobe CELLS: 11  
 TIME INTERVAL TO GO FROM A CELL TO THE NEXT ONE IN THE SIDELobe PATH: .2916289+00 SECONDS

CENTERS  
 CARTESIAN COORDINATES  
 (RADIAN'S)

.4455113-01	.0000000
.3784045-01	.2327624-01
.2923235-01	.3469425-01
.3484114-02	.0441654-01
.2617741-01	.3605170-01
.4115564-01	.1700439-01
.4800758-01	.6950857-02
.3389288-01	.2801807-01
.1374180-01	.4236470-01
.1037297-01	.4332878-01
.3144130-01	.3152624-01

NUMBER OF NEARBY CELLS: 6  
 TIME INTERVAL TO GO FROM A CELL TO THE NEXT ONE IN THE NEARBY PATH: .5555556+00 SECONDS

CENTERS  
 CARTESIAN COORDINATES  
 (RADIAN'S)

.2418309-01	.0000000
.2094395-01	.1209200-01
.2094395-01	.1209200-01
.2418309-01	.0000000
.2094395-01	.1209200-01
.2094395-01	.1209200-01

(XTRASS, YTRASS) = ( -.4499017-01, -.3700439-01 ) IN THE 30TH CELL

bhl

START SCANNING = NORMAL PATH

CELL NO.	1	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9994917+00	EQ. NOISE =	.9994043+00	HIT =	F
CELL NO.	2	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1005874+01	EQ. NOISE =	.1005285+01	HIT =	F
CELL NO.	3	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1006018+01	EQ. NOISE =	.1005760+01	HIT =	F
CELL NO.	4	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9968163+00	EQ. NOISE =	.9948761+00	HIT =	F
CELL NO.	5	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9951526+00	EQ. NOISE =	.9945000+00	HIT =	F
CELL NO.	6	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1005116+01	EQ. NOISE =	.1005084+01	HIT =	F
CELL NO.	7	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9979082+00	EQ. NOISE =	.9975731+00	HIT =	F
CELL NO.	8	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1002606+01	EQ. NOISE =	.1001260+01	HIT =	F
CELL NO.	9	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1005121+01	EQ. NOISE =	.1004086+01	HIT =	F
CELL NO.	10	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1005301+01	EQ. NOISE =	.1005281+01	HIT =	F
CELL NO.	11	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1005564+01	EQ. NOISE =	.1005181+01	HIT =	F
CELL NO.	12	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1005639+01	EQ. NOISE =	.1005704+01	HIT =	F
CELL NO.	13	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1004300+01	EQ. NOISE =	.1003484+01	HIT =	F
CELL NO.	14	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1029157+01	EQ. NOISE =	.9948032+00	HIT =	F
CELL NO.	15	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1025590+01	EQ. NOISE =	.1005704+01	HIT =	F
CELL NO.	16	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9999811+00	EQ. NOISE =	.9979984+00	HIT =	F
CELL NO.	17	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9986309+00	EQ. NOISE =	.9942089+00	HIT =	F
CELL NO.	18	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9998988+00	EQ. NOISE =	.9993782+00	HIT =	F
CELL NO.	19	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1005013+01	EQ. NOISE =	.1005725+01	HIT =	F
CELL NO.	20	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9945702+00	EQ. NOISE =	.9945224+00	HIT =	F
CELL NO.	21	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9982772+00	EQ. NOISE =	.9922288+00	HIT =	F
CELL NO.	22	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1004300+01	EQ. NOISE =	.1005278+01	HIT =	F
CELL NO.	23	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9948567+00	EQ. NOISE =	.9948452+00	HIT =	F
CELL NO.	24	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1003161+01	EQ. NOISE =	.1003111+01	HIT =	F
CELL NO.	25	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1003585+01	EQ. NOISE =	.1003197+01	HIT =	F
CELL NO.	26	THRESHOLD =	.1054814+01	RECEIVED POWER =	.9969551+00	EQ. NOISE =	.9966050+00	HIT =	F
CELL NO.	27	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1002412+01	EQ. NOISE =	.1002402+01	HIT =	F
CELL NO.	28	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1004177+01	EQ. NOISE =	.1002174+01	HIT =	F
CELL NO.	29	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1022170+01	EQ. NOISE =	.1005004+01	HIT =	F
CELL NO.	30	THRESHOLD =	.1054814+01	RECEIVED POWER =	.1110832+01	EQ. NOISE =	.1076012+01	HIT =	F
CELL NO.	30	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1094531+01	EQ. NOISE =	.9937102+00	HIT =	F

START SCANNING NEARBY CELLS

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1025719+01	EQ. NOISE =	.1005437+01	HIT =	F
CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1036280+01	EQ. NOISE =	.1005487+01	HIT =	F
CELL NO.	3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1003129+01	EQ. NOISE =	.9957135+00	HIT =	F
CELL NO.	4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1007516+01	EQ. NOISE =	.1004474+01	HIT =	F
CELL NO.	5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9973872+00	EQ. NOISE =	.9962050+00	HIT =	F
CELL NO.	6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1005077+01	EQ. NOISE =	.9959050+00	HIT =	F

START SCANNING SIDELINE CELLS

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1004001+01	EQ. NOISE =	.1002992+01	HIT =	F
CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1003590+01	EQ. NOISE =	.1002174+01	HIT =	F
CELL NO.	3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1004970+01	EQ. NOISE =	.1003237+01	HIT =	F
CELL NO.	4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1001559+01	EQ. NOISE =	.1000004+01	HIT =	F
CELL NO.	5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9965565+00	EQ. NOISE =	.9948271+00	HIT =	F
CELL NO.	6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9979082+00	EQ. NOISE =	.9949185+00	HIT =	F
CELL NO.	7	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1005577+01	EQ. NOISE =	.1003031+01	HIT =	F
CELL NO.	8	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1006219+01	EQ. NOISE =	.1005204+01	HIT =	F
CELL NO.	9	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9968157+00	EQ. NOISE =	.9956781+00	HIT =	F

149

ORIGINAL PAGE IS  
OF POOR QUALITY

CELL NO. 10	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1005656+01	EQ. NOISE =	.1003080+01	HIT =	F
CELL NO. 11	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1005727+01	EQ. NOISE =	.1003675+01	HIT =	F

VERIFICATION OF A HIT IN THE NORMAL PATH

CELL NO. 30	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1103800+01	EQ. NOISE =	.9989797+00	HIT =	T
-------------	-------------	-------------	------------------	-------------	-------------	-------------	-------	---

(NORMAL SCANNING) DETECTED IN THE 30TH CELL  
 DISTANCE (SATELLITE, PORESIGHT) = .1786547+02% OF DISTANCE BETWEEN PORESIGHT AND FIRST NULL  
 ACQUISITION TIME = .1529875+02 SECONDS

(XDRSS, YDRSS) = ( .6450336+02, .6569242+01 ) IN THE 25TH CELL

START SCANNING = NORMAL PATH

CELL NO. 1	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9944397+00	EQ. NOISE =	.9942294+00	HIT =	F
CELL NO. 2	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1007831+01	EQ. NOISE =	.1005770+01	HIT =	F
CELL NO. 3	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9967382+00	EQ. NOISE =	.9950313+00	HIT =	F
CELL NO. 4	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9952282+00	EQ. NOISE =	.9947394+00	HIT =	F
CELL NO. 5	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9957960+00	EQ. NOISE =	.9957064+00	HIT =	F
CELL NO. 6	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9990430+00	EQ. NOISE =	.9990330+00	HIT =	F
CELL NO. 7	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005600+01	EQ. NOISE =	.1005266+01	HIT =	F
CELL NO. 8	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003794+01	EQ. NOISE =	.1003324+01	HIT =	F
CELL NO. 9	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9967473+00	EQ. NOISE =	.9955034+00	HIT =	F
CELL NO. 10	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1012719+01	EQ. NOISE =	.1003110+01	HIT =	F
CELL NO. 11	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9954061+00	EQ. NOISE =	.9942271+00	HIT =	F
CELL NO. 12	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005160+01	EQ. NOISE =	.1005140+01	HIT =	F
CELL NO. 13	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9958450+00	EQ. NOISE =	.9958140+00	HIT =	F
CELL NO. 14	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9955752+00	EQ. NOISE =	.9944313+00	HIT =	F
CELL NO. 15	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9955591+00	EQ. NOISE =	.9945321+00	HIT =	F
CELL NO. 16	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9900149+00	EQ. NOISE =	.9949152+00	HIT =	F
CELL NO. 17	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005029+01	EQ. NOISE =	.1004044+01	HIT =	F
CELL NO. 18	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9952739+00	EQ. NOISE =	.9952391+00	HIT =	F
CELL NO. 19	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1006026+01	EQ. NOISE =	.1005266+01	HIT =	F
CELL NO. 20	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1002454+01	EQ. NOISE =	.1002410+01	HIT =	F
CELL NO. 21	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9979093+00	EQ. NOISE =	.9961144+00	HIT =	F
CELL NO. 22	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9954563+00	EQ. NOISE =	.9944373+00	HIT =	F
CELL NO. 23	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1009704+01	EQ. NOISE =	.9985214+00	HIT =	T
CELL NO. 25	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1103079+01	EQ. NOISE =	.9999267+00	HIT =	T

START SCANNING NEARBY CELLS

CELL NO. 1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1001340+01	EQ. NOISE =	.1000371+01	HIT =	F
CELL NO. 2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1000174+01	EQ. NOISE =	.9975221+00	HIT =	F
CELL NO. 3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1031794+01	EQ. NOISE =	.9958181+00	HIT =	F
CELL NO. 4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1035834+01	EQ. NOISE =	.1004104+01	HIT =	F
CELL NO. 5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1010875+01	EQ. NOISE =	.9950052+00	HIT =	F
CELL NO. 6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9950091+00	EQ. NOISE =	.9943590+00	HIT =	F

150

START SCANNING SIDELOBE CELLS

CELL NO.	1	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.9957183+00	EQ. NOISE =	.9940793+00	HIT =	F
CELL NO.	2	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1005474+01	EQ. NOISE =	.1003457+01	HIT =	F
CELL NO.	3	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.9964236+00	EQ. NOISE =	.9943641+00	HIT =	F
CELL NO.	4	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1004486+01	EQ. NOISE =	.1002732+01	HIT =	F
CELL NO.	5	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1001319+01	EQ. NOISE =	.9999606+00	HIT =	F
CELL NO.	6	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.999439A+00	EQ. NOISE =	.9941619+00	HIT =	F
CELL NO.	7	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.100655A+01	EQ. NOISE =	.1005102+01	HIT =	F
CELL NO.	8	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1003641+01	EQ. NOISE =	.1001771+01	HIT =	F
CELL NO.	9	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1006112+01	EQ. NOISE =	.1004055+01	HIT =	F
CELL NO.	10	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.99A3265+00	EQ. NOISE =	.9946A82+00	HIT =	F
CELL NO.	11	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.9994604+00	EQ. NOISE =	.9983380+00	HIT =	F

VERIFICATION OF A HIT IN THE NORMAL PATH

CELL NO.	23	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1101446+01	EQ. NOISE =	.9983030+00	HIT =	T
----------	----	-------------	-------------	------------------	-------------	-------------	-------------	-------	---

(NORMAL SCANNING) DETECTED IN THE 23TH CELL  
 DISTANCE (SATELLITE,BORESIGHT) = .1903175+02X OF DISTANCE BETWEEN BORESIGHT AND FIRST NULL  
 ACQUISITION TIME = .1337578+02 SECONDS

(ADDRESS, YPORES) = ( .1703049+01, -.7263459+02 ) IN THE 7TH CELL

START SCANNING - NORMAL PATH

CELL NO.	1	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1037985+01	EQ. NOISE =	.1005020+01	HIT =	F
CELL NO.	2	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005407+01	EQ. NOISE =	.1003312+01	HIT =	F
CELL NO.	3	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1007127+01	EQ. NOISE =	.1005610+01	HIT =	F
CELL NO.	4	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1007516+01	EQ. NOISE =	.1005457+01	HIT =	F
CELL NO.	5	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9959425+00	EQ. NOISE =	.9950083+00	HIT =	F
CELL NO.	6	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1051711+01	EQ. NOISE =	.9959096+00	HIT =	F
CELL NO.	7	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1076462+01	EQ. NOISE =	.9937000+00	HIT =	T
CELL NO.	7	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1076579+01	EQ. NOISE =	.9938067+00	HIT =	F

START SCANNING NEARBY CELLS

CELL NO.	1	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.9946669+00	EQ. NOISE =	.9945780+00	HIT =	F
CELL NO.	2	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1002990+01	EQ. NOISE =	.1002701+01	HIT =	F
CELL NO.	3	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1015596+01	EQ. NOISE =	.1004034+01	HIT =	F
CELL NO.	4	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1027074+01	EQ. NOISE =	.9941171+00	HIT =	F
CELL NO.	5	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1053057+01	EQ. NOISE =	.9977760+00	HIT =	F
CELL NO.	6	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1001117+01	EQ. NOISE =	.9988765+00	HIT =	F

START SCANNING SIDELOBE CELLS

CELL NO.	1	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1004391+01	EQ. NOISE =	.1003000+01	HIT =	F
CELL NO.	2	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.9944207+00	EQ. NOISE =	.9942021+00	HIT =	F
CELL NO.	3	THRESHOLD =	.12319A2+01	RECEIVED POWER =	.1001603+01	EQ. NOISE =	.1001027+01	HIT =	F

151

ORIGINAL PAGE IS  
OF POOR QUALITY

CELL NO.	4	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.9953587+00	EQ. NOISE	=	.9942220+00	HIT	=	F
CELL NO.	5	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.1006150+01	EQ. NOISE	=	.1004693+01	HIT	=	F
CELL NO.	6	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.1006725+01	EQ. NOISE	=	.1005167+01	HIT	=	F
CELL NO.	7	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.9961694+00	EQ. NOISE	=	.9953710+00	HIT	=	F
CELL NO.	8	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.9999860+00	EQ. NOISE	=	.9994795+00	HIT	=	F
CELL NO.	9	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.9958126+00	EQ. NOISE	=	.9951689+00	HIT	=	F
CELL NO.	10	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.1006954+01	EQ. NOISE	=	.1005673+01	HIT	=	F
CELL NO.	11	THRESHOLD	=	.12319A2+01	RECEIVED POWER	=	.1007702+01	EQ. NOISE	=	.1005768+01	HIT	=	F

VERIFICATION OF A HIT IN THE NORMAL PATH

CELL NO.	7	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1076690+01	EQ. NOISE	=	.9940804+00	HIT	=	T
----------	---	-----------	---	-------------	----------------	---	-------------	-----------	---	-------------	-----	---	---

(NORMAL SCANNING) DETECTED IN THE 7TH CELL  
 DISTANCE (SATELLITE, HORIZONT) = .3065623+02% OF DISTANCE BETWEEN HORIZONT AND FIRST NULL  
 ACQUISITION TIME = .9041400+01 SECONDS

(XTORSS, YTORSS) = ( -.785508E-01, -.3708831E-01 ) IN THE 51TH CELL

START SCANNING - NORMAL PATH

CELL NO.	1	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1004448+01	EQ. NOISE	=	.1004039+01	HIT	=	F
CELL NO.	2	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9972701+00	EQ. NOISE	=	.9971275+00	HIT	=	F
CELL NO.	3	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9962001+00	EQ. NOISE	=	.9962001+00	HIT	=	F
CELL NO.	4	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1000942+01	EQ. NOISE	=	.1000744+01	HIT	=	F
CELL NO.	5	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1001577+01	EQ. NOISE	=	.1001224+01	HIT	=	F
CELL NO.	6	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9997694+00	EQ. NOISE	=	.9997661+00	HIT	=	F
CELL NO.	7	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9983497+00	EQ. NOISE	=	.9982788+00	HIT	=	F
CELL NO.	8	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9948472+00	EQ. NOISE	=	.9947657+00	HIT	=	F
CELL NO.	9	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9971754+00	EQ. NOISE	=	.9970845+00	HIT	=	F
CELL NO.	10	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1002210+01	EQ. NOISE	=	.1002177+01	HIT	=	F
CELL NO.	11	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9953752+00	EQ. NOISE	=	.9952843+00	HIT	=	F
CELL NO.	12	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1004234+01	EQ. NOISE	=	.1003751+01	HIT	=	F
CELL NO.	13	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1004794+01	EQ. NOISE	=	.1002691+01	HIT	=	F
CELL NO.	14	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1005971+01	EQ. NOISE	=	.1003010+01	HIT	=	F
CELL NO.	15	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1000213+01	EQ. NOISE	=	.9996637+00	HIT	=	F
CELL NO.	16	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9969633+00	EQ. NOISE	=	.9966002+00	HIT	=	F
CELL NO.	17	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9966142+00	EQ. NOISE	=	.9964747+00	HIT	=	F
CELL NO.	18	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9965051+00	EQ. NOISE	=	.9964505+00	HIT	=	F
CELL NO.	19	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1000947+01	EQ. NOISE	=	.1000466+01	HIT	=	F
CELL NO.	20	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1001089+01	EQ. NOISE	=	.1001011+01	HIT	=	F
CELL NO.	21	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1002250+01	EQ. NOISE	=	.1002025+01	HIT	=	F
CELL NO.	22	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9951250+00	EQ. NOISE	=	.9950680+00	HIT	=	F
CELL NO.	23	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9932332+00	EQ. NOISE	=	.9932200+00	HIT	=	F
CELL NO.	24	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9975972+00	EQ. NOISE	=	.9975724+00	HIT	=	F
CELL NO.	25	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9971950+00	EQ. NOISE	=	.9971709+00	HIT	=	F
CELL NO.	26	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1000102+01	EQ. NOISE	=	.1000001+01	HIT	=	F
CELL NO.	27	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9997009+00	EQ. NOISE	=	.9997094+00	HIT	=	F
CELL NO.	28	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1005082+01	EQ. NOISE	=	.1004251+01	HIT	=	F
CELL NO.	29	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1006001+01	EQ. NOISE	=	.9966716+00	HIT	=	F
CELL NO.	30	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9956100+00	EQ. NOISE	=	.9949610+00	HIT	=	F

162

CELL NO.	31	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9959325+00	EQ. NOTSF	=	.994414+00	HIT	=	F
CELL NO.	32	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9947427+00	EQ. NOTSF	=	.9942732+00	HIT	=	F
CELL NO.	33	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9944986+00	EQ. NOTSF	=	.994469+00	HIT	=	F
CELL NO.	34	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1005084+01	EQ. NOTSF	=	.1005079+01	HIT	=	F
CELL NO.	35	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9944809+00	EQ. NOTSF	=	.9943022+00	HIT	=	F
CELL NO.	36	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1005757+01	EQ. NOTSF	=	.1005747+01	HIT	=	F
CELL NO.	37	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9943013+00	EQ. NOTSF	=	.9943107+00	HIT	=	F
CELL NO.	38	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1002031+01	EQ. NOTSF	=	.1002024+01	HIT	=	F
CELL NO.	39	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9943870+00	EQ. NOTSF	=	.9943669+00	HIT	=	F
CELL NO.	40	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9945302+00	EQ. NOTSF	=	.9945302+00	HIT	=	F
CELL NO.	41	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9957275+00	EQ. NOTSF	=	.9957194+00	HIT	=	F
CELL NO.	42	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9942664+00	EQ. NOTSF	=	.9942781+00	HIT	=	F
CELL NO.	43	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9942379+00	EQ. NOTSF	=	.9942774+00	HIT	=	F
CELL NO.	44	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1005654+01	EQ. NOTSF	=	.1005670+01	HIT	=	F
CELL NO.	45	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1004790+01	EQ. NOTSF	=	.1004724+01	HIT	=	F
CELL NO.	46	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9952736+00	EQ. NOTSF	=	.9950895+00	HIT	=	F
CELL NO.	47	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9949635+00	EQ. NOTSF	=	.9946645+00	HIT	=	F
CELL NO.	48	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9972072+00	EQ. NOTSF	=	.9971066+00	HIT	=	F
CELL NO.	49	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.9960525+00	EQ. NOTSF	=	.9942047+00	HIT	=	F
CELL NO.	50	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1033837+01	EQ. NOTSF	=	.9940020+00	HIT	=	F
CELL NO.	51	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1093154+01	EQ. NOTSF	=	.9945445+00	HIT	=	T
CELL NO.	51	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1102192+01	EQ. NOTSF	=	.1005441+01	HIT	=	F

START SCANNING NEARBY CELLS

CELL NO.	1	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.9970594+00	EQ. NOTSF	=	.9964017+00	HIT	=	F
CELL NO.	2	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1006163+01	EQ. NOTSF	=	.1003022+01	HIT	=	F
CELL NO.	3	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1049245+01	EQ. NOTSF	=	.1005056+01	HIT	=	F
CELL NO.	4	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1027131+01	EQ. NOTSF	=	.9956090+00	HIT	=	F
CELL NO.	5	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1015229+01	EQ. NOTSF	=	.9997444+00	HIT	=	F
CELL NO.	6	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.9948125+00	EQ. NOTSF	=	.9946604+00	HIT	=	F

START SCANNING SIDELobe CELLS

CELL NO.	1	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1006420+01	EQ. NOTSF	=	.1005735+01	HIT	=	F
CELL NO.	2	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.9975047+00	EQ. NOTSF	=	.9955417+00	HIT	=	F
CELL NO.	3	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1006370+01	EQ. NOTSF	=	.1004425+01	HIT	=	F
CELL NO.	4	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1006926+01	EQ. NOTSF	=	.1005020+01	HIT	=	F
CELL NO.	5	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1004066+01	EQ. NOTSF	=	.1003044+01	HIT	=	F
CELL NO.	6	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1004324+01	EQ. NOTSF	=	.1003404+01	HIT	=	F
CELL NO.	7	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.9973531+00	EQ. NOTSF	=	.9959026+00	HIT	=	F
CELL NO.	8	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1006911+01	EQ. NOTSF	=	.1004050+01	HIT	=	F
CELL NO.	9	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.9986492+00	EQ. NOTSF	=	.9967002+00	HIT	=	F
CELL NO.	10	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.9984122+00	EQ. NOTSF	=	.9972490+00	HIT	=	F
CELL NO.	11	THRESHOLD	=	.1231982+01	RECEIVED POWER	=	.1004926+01	EQ. NOTSF	=	.1004277+01	HIT	=	F

VERIFICATION OF A HIT IN THE NORMAL PATH

CELL NO.	51	THRESHOLD	=	.1056814+01	RECEIVED POWER	=	.1090105+01	EQ. NOTSF	=	.1002054+01	HIT	=	T
----------	----	-----------	---	-------------	----------------	---	-------------	-----------	---	-------------	-----	---	---

(NORMAL SCANNING) DETECTED IN THE 51TH CELL  
 DISTANCE (SATELLITE ELEVATION) = .2311531+02% OF DISTANCE BETWEEN BURESTIGHT AND FIRST NULL

163

ORIGINAL PAGE IS  
 OF POOR QUALITY



ACQUISITION TIME = .2106767+02 SECONDS

(XTORSS, YTORSS) = ( .2929696+01, .7793007+01 ) IN THE #2TH CELL

START SCANNING = NORMAL PATH

CELL NO.	1	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9980586+00	EQ. NOTSF =	.9979551+00	HIT =	F
CELL NO.	2	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003634+01	EQ. NOTSF =	.1003613+01	HIT =	F
CELL NO.	3	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9972903+00	EQ. NOTSF =	.9968840+00	HIT =	F
CELL NO.	4	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9944347+00	EQ. NOTSF =	.9943761+00	HIT =	F
CELL NO.	5	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003363+01	EQ. NOTSF =	.1003251+01	HIT =	F
CELL NO.	6	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003803+01	EQ. NOTSF =	.1003615+01	HIT =	F
CELL NO.	7	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9997013+00	EQ. NOTSF =	.9993091+00	HIT =	F
CELL NO.	8	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9990520+00	EQ. NOTSF =	.9978062+00	HIT =	F
CELL NO.	9	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1000960+01	EQ. NOTSF =	.1000651+01	HIT =	F
CELL NO.	10	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1006455+01	EQ. NOTSF =	.1004683+01	HIT =	F
CELL NO.	11	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9943449+00	EQ. NOTSF =	.9942263+00	HIT =	F
CELL NO.	12	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005386+01	EQ. NOTSF =	.1005170+01	HIT =	F
CELL NO.	13	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005799+01	EQ. NOTSF =	.1005743+01	HIT =	F
CELL NO.	14	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1002662+01	EQ. NOTSF =	.1002050+01	HIT =	F
CELL NO.	15	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1004505+01	EQ. NOTSF =	.1004270+01	HIT =	F
CELL NO.	16	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003519+01	EQ. NOTSF =	.1003654+01	HIT =	F
CELL NO.	17	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1002403+01	EQ. NOTSF =	.1002380+01	HIT =	F
CELL NO.	18	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9973647+00	EQ. NOTSF =	.9971841+00	HIT =	F
CELL NO.	19	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1004904+01	EQ. NOTSF =	.1004763+01	HIT =	F
CELL NO.	20	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005174+01	EQ. NOTSF =	.1005220+01	HIT =	F
CELL NO.	21	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003585+01	EQ. NOTSF =	.1001027+01	HIT =	F
CELL NO.	22	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1040073+01	EQ. NOTSF =	.9972084+00	HIT =	F
CELL NO.	23	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1014634+01	EQ. NOTSF =	.1000115+01	HIT =	F
CELL NO.	24	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1007045+01	EQ. NOTSF =	.1005627+01	HIT =	F
CELL NO.	25	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9953013+00	EQ. NOTSF =	.9950112+00	HIT =	F
CELL NO.	26	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003619+01	EQ. NOTSF =	.1003492+01	HIT =	F
CELL NO.	27	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9958723+00	EQ. NOTSF =	.9957130+00	HIT =	F
CELL NO.	28	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1003886+01	EQ. NOTSF =	.1003784+01	HIT =	F
CELL NO.	29	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9963890+00	EQ. NOTSF =	.9963271+00	HIT =	F
CELL NO.	30	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1000403+01	EQ. NOTSF =	.1000403+01	HIT =	F
CELL NO.	31	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9995576+00	EQ. NOTSF =	.9995062+00	HIT =	F
CELL NO.	32	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1001141+01	EQ. NOTSF =	.1001132+01	HIT =	F
CELL NO.	33	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005181+01	EQ. NOTSF =	.1005174+01	HIT =	F
CELL NO.	34	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9943625+00	EQ. NOTSF =	.9943577+00	HIT =	F
CELL NO.	35	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9942701+00	EQ. NOTSF =	.9942711+00	HIT =	F
CELL NO.	36	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9964160+00	EQ. NOTSF =	.9962140+00	HIT =	F
CELL NO.	37	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1005099+01	EQ. NOTSF =	.1005097+01	HIT =	F
CELL NO.	38	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1002160+01	EQ. NOTSF =	.1001077+01	HIT =	F
CELL NO.	39	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1004273+01	EQ. NOTSF =	.1004007+01	HIT =	F
CELL NO.	40	THRESHOLD =	.1056814+01	RECEIVED POWER =	.9948062+00	EQ. NOTSF =	.9946480+00	HIT =	F
CELL NO.	41	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1026159+01	EQ. NOTSF =	.1000151+01	HIT =	F
CELL NO.	42	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1092203+01	EQ. NOTSF =	.9959000+00	HIT =	T
CELL NO.	42	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1094516+01	EQ. NOTSF =	.1002290+01	HIT =	F

START SCANNING NEARBY CELLS

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1022422+01	EQ. NOTSF =	.9968137+00	HIT =	F
----------	---	-------------	-------------	------------------	-------------	-------------	-------------	-------	---

154

CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1006427+01	EQ. NOISE =	.9953141+00	HIT =	F
CELL NO.	3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9986449+00	EQ. NOISE =	.9944409+00	HIT =	F
CELL NO.	4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9977947+00	EQ. NOISE =	.9967657+00	HIT =	F
CELL NO.	5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1010375+01	EQ. NOISE =	.1005977+01	HIT =	F
CELL NO.	6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1045963+01	EQ. NOISE =	.1004891+01	HIT =	F

START SCANNING SIDELOBE CELLS

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9984669+00	EQ. NOISE =	.9970877+00	HIT =	F
CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1001497+01	EQ. NOISE =	.9995295+00	HIT =	F
CELL NO.	3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1003108+01	EQ. NOISE =	.1001188+01	HIT =	F
CELL NO.	4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1006753+01	EQ. NOISE =	.1005227+01	HIT =	F
CELL NO.	5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1001248+01	EQ. NOISE =	.1000227+01	HIT =	F
CELL NO.	6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1005567+01	EQ. NOISE =	.1004484+01	HIT =	F
CELL NO.	7	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1007194+01	EQ. NOISE =	.1005094+01	HIT =	F
CELL NO.	8	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9983380+00	EQ. NOISE =	.9942824+00	HIT =	F
CELL NO.	9	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1003218+01	EQ. NOISE =	.1001206+01	HIT =	F
CELL NO.	10	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9981606+00	EQ. NOISE =	.9970884+00	HIT =	F
CELL NO.	11	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1006622+01	EQ. NOISE =	.1005668+01	HIT =	F

VERIFICATION OF A HIT IN THE NORMAL PATH

CELL NO.	42	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1091178+01	EQ. NOISE =	.9949549+00	HIT =	T
----------	----	-------------	-------------	------------------	-------------	-------------	-------------	-------	---

(NORMAL SCANNING) DETECTED IN THE 42TH CELL  
 DISTANCE (SATELLITE, HORIZONT) = .2336659+02X OF DISTANCE BETWEEN ANRESIGHT AND FIRST NULL  
 ACQUISITION TIME = .1859528+02 SECONDS

NUMBER OF SATELLITE POSITIONS GENERATED: 5  
 STANDARD DEVIATION: .2500000+01  
 CARRIER-TO-NOISE RATIO: .4000000+02 DB-HZ  
 ACQUISITION AVERAGE TIME: .1507578+02 S  
 STANDARD DEVIATION: .1864793+01 S  
 PROBABILITY OF DETECTION: .1000000+01  
 PROBABILITY OF DETECTION (SL, VAR.): .0000000  
 PROBABILITY OF MISS: .0000000  
 PROBABILITY OF FALSE ALARM (IN THE SIMULATION): .0000000

(XTDRSS.YTDSS) = ( .2972895-01, -.2477371-01 ) IN THE 18TH CELL

START SCANNING - NORMAL PATH

CELL NO.	1	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1113836+01	EQ. NOISE =	.9986124+00	HIT =	T
CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1115467+01	EQ. NOISE =	.1000296+01	HIT =	F

START SCANNING NEARBY CELLS

ORIGINAL PAGE IS OF POOR QUALITY

165

CELL NO. 1 THRESHOLD = .1231982+01 RECEIVED POWER = .1728553+01 EQ. NOISE = .4913820+00 HIT = T

VERIFICATION OF A HIT WITH THRESHOLD TH2 IN THE CELL NO. 1  
CELL NO. 1 THRESHOLD = .1231982+01 RECEIVED POWER = .1728146+01 EQ. NOISE = .9909348+00 HIT = T

(NORMAL SCANNING) DETECTED IN THE 7TH CELL  
DISTANCE (SATELLITE, BUREFSIGHT) = .7638220+02% OF DISTANCE BETWEEN BUREFSIGHT AND FIRST NULL  
ACQUISITION TIME = .1100000+01 SECONDS

(XTDRSS, YTDPRS) = ( .5145452-01, -.4069500-01 ) IN THE 35TH CELL

START SCANNING = NORMAL PATH

CELL NO. 1 THRESHOLD = .1056814+01 RECEIVED POWER = .1022829+01 EQ. NOISE = .1004341+01 HIT = F  
CELL NO. 2 THRESHOLD = .1056814+01 RECEIVED POWER = .1043272+01 EQ. NOISE = .9942146+00 HIT = F  
CELL NO. 3 THRESHOLD = .1056814+01 RECEIVED POWER = .9982220+00 EQ. NOISE = .9962091+00 HIT = F  
CELL NO. 4 THRESHOLD = .1056814+01 RECEIVED POWER = .9982086+00 EQ. NOISE = .9958771+00 HIT = F  
CELL NO. 5 THRESHOLD = .1056814+01 RECEIVED POWER = .1027099+01 EQ. NOISE = .1002694+01 HIT = F  
CELL NO. 6 THRESHOLD = .1056814+01 RECEIVED POWER = .1207795+01 EQ. NOISE = .1002064+01 HIT = T  
CELL NO. 8 THRESHOLD = .1231982+01 RECEIVED POWER = .1211380+01 EQ. NOISE = .1005458+01 HIT = F

START SCANNING NEARBY CELLS

CELL NO. 1 THRESHOLD = .1231982+01 RECEIVED POWER = .1883327+01 EQ. NOISE = .9940682+00 HIT = T

VERIFICATION OF A HIT WITH THRESHOLD TH2 IN THE CELL NO. 1  
CELL NO. 1 THRESHOLD = .1231982+01 RECEIVED POWER = .1658381+01 EQ. NOISE = .1009112+01 HIT = T

(NORMAL SCANNING) DETECTED IN THE 18TH CELL  
DISTANCE (SATELLITE, BUREFSIGHT) = .7494704+02% OF DISTANCE BETWEEN BUREFSIGHT AND FIRST NULL  
ACQUISITION TIME = .2788778+01 SECONDS

(XTDRSS, YTDPRS) = ( -.4016849-01, .4022257+01 ) IN THE 26TH CELL

START SCANNING = NORMAL PATH

CELL NO. 1 THRESHOLD = .1056814+01 RECEIVED POWER = .1023704+01 EQ. NOISE = .1002497+01 HIT = F  
CELL NO. 2 THRESHOLD = .1056814+01 RECEIVED POWER = .1040832+01 EQ. NOISE = .1005250+01 HIT = F  
CELL NO. 3 THRESHOLD = .1056814+01 RECEIVED POWER = .1010090+01 EQ. NOISE = .1005760+01 HIT = F  
CELL NO. 4 THRESHOLD = .1056814+01 RECEIVED POWER = .1195212+01 EQ. NOISE = .9932751+00 HIT = T  
CELL NO. 4 THRESHOLD = .1231982+01 RECEIVED POWER = .1198984+01 EQ. NOISE = .9970778+00 HIT = F

START SCANNING NEARBY CELLS

156

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1026970+01	EQ. NOISE =	.1005460+01	HIT =	F
CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1193091+01	EQ. NOISE =	.9956054+00	HIT =	F
CELL NO.	3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1211714+01	EQ. NOISE =	.9944226+00	HIT =	F
CELL NO.	4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.117515+01	EQ. NOISE =	.1003438+01	HIT =	F
CELL NO.	5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1087056+01	EQ. NOISE =	.9965718+00	HIT =	F
CELL NO.	6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1015022+01	EQ. NOISE =	.1005440+01	HIT =	F

START SCANNING SIDELOBE CELLS

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1159191+01	EQ. NOISE =	.1004362+01	HIT =	F
CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1028802+01	EQ. NOISE =	.9963619+00	HIT =	F
CELL NO.	3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1023189+01	EQ. NOISE =	.9976041+00	HIT =	F
CELL NO.	4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.9960020+00	EQ. NOISE =	.9951295+00	HIT =	F
CELL NO.	5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1006314+01	EQ. NOISE =	.1005761+01	HIT =	F
CELL NO.	6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1017571+01	EQ. NOISE =	.9985122+00	HIT =	F
CELL NO.	7	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1031952+01	EQ. NOISE =	.9954300+00	HIT =	F
CELL NO.	8	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1116057+01	EQ. NOISE =	.9969024+00	HIT =	F
CELL NO.	9	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1107847+01	EQ. NOISE =	.1003892+01	HIT =	F
CELL NO.	10	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1130155+02	EQ. NOISE =	.1026797+01	HIT =	T
CELL NO.	11	THRESHOLD =	.1130155+02	RECEIVED POWER =	.0684644+01	EQ. NOISE =	.9923616+00	HIT =	F

VERIFICATION OF A HIT WITH THRESHOLD TH2 IN THE CELL NO. 10

CELL NO.	10	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1125699+02	EQ. NOISE =	.9822343+00	HIT =	T
----------	----	-------------	-------------	------------------	-------------	-------------	-------------	-------	---

(SIDELOBE VARIATION ) DETECTED IN THE 11TH CELL  
 DISTANCE (SATELLITE, HORIZON) = .1929775+02% OF DISTANCE BETWEEN HORIZON AND FIRST NULL  
 ACQUISITION TIME = .7373733+01 SECONDS

(XDRSS, YDRSS) = ( -.1691523+02, -.3991810+01 ) IN THE 16TH CELL

START SCANNING - NORMAL PATH

CELL NO.	1	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1038965+01	EQ. NOISE =	.9957800+00	HIT =	F
CELL NO.	2	THRESHOLD =	.1056814+01	RECEIVED POWER =	.1064412+01	EQ. NOISE =	.9943700+00	HIT =	T
CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1069331+01	EQ. NOISE =	.1000290+01	HIT =	F

START SCANNING NEARBY CELLS

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1014767+01	EQ. NOISE =	.1004116+01	HIT =	F
CELL NO.	2	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1054815+01	EQ. NOISE =	.1005804+01	HIT =	F
CELL NO.	3	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1005444+01	EQ. NOISE =	.9943750+00	HIT =	F
CELL NO.	4	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1086111+01	EQ. NOISE =	.1002450+01	HIT =	F
CELL NO.	5	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1157123+01	EQ. NOISE =	.9945370+00	HIT =	F
CELL NO.	6	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1081655+01	EQ. NOISE =	.9961021+00	HIT =	F

START SCANNING SIDELOBE CELLS

CELL NO.	1	THRESHOLD =	.1231982+01	RECEIVED POWER =	.1006109+01	EQ. NOISE =	.1005711+01	HIT =	F
----------	---	-------------	-------------	------------------	-------------	-------------	-------------	-------	---

159

ORIGINAL PAGE IS  
 OF POOR QUALITY

CELL NO. 2	THRESHOLD = .12319A2+01	RECEIVED POWER = .10A538A+01	EQ. NOISE = .1005A77+01	HIT = F
CELL NO. 3	THRESHOLD = .12319A2+01	RECEIVED POWER = .7032383+01	EQ. NOISE = .9791A45+00	HIT = T
CELL NO. 4	THRESHOLD = .7032383+01	RECEIVED POWER = .4160836+01	EQ. NOISE = .1009A90+01	HIT = F

VERIFICATION OF A HIT WITH THRESHOLD TH2 IN THE CELL NO. 3  
 CELL NO. 3 THRESHOLD = .12319A2+01 RECEIVED POWER = .7067150+01 EQ. NOISE = .1013A71+01 HIT = T

(SIDELORE VARIATION ) DETECTED IN THE 5TH CELL  
 DISTANCE (SATELLITE, HORSIGHT) = .4143377+02% OF DISTANCE BETWEEN HORSIGHT AND FIRST NULL  
 ACQUISITION TIME = .4221220+01 SECONDS

(XINDRSS, YINDRSS) = ( .2517179-01, .7252498-01 ) IN THE 42TH CELL

START SCANNING = NORMAL PATH

CELL NO. 1	THRESHOLD = .1056A14+01	RECEIVED POWER = .1035955+01	EQ. NOISE = .9948069+00	HIT = F
CELL NO. 2	THRESHOLD = .1056A14+01	RECEIVED POWER = .1082917+01	EQ. NOISE = .1005A29+01	HIT = T
CELL NO. 2	THRESHOLD = .12319A2+01	RECEIVED POWER = .1076380+01	EQ. NOISE = .9988031+00	HIT = F

START SCANNING NEARBY CELLS

CELL NO. 1	THRESHOLD = .12319A2+01	RECEIVED POWER = .1092502+01	EQ. NOISE = .1006251+01	HIT = F
CELL NO. 2	THRESHOLD = .12319A2+01	RECEIVED POWER = .1151801+01	EQ. NOISE = .9964A62+00	HIT = F
CELL NO. 3	THRESHOLD = .12319A2+01	RECEIVED POWER = .1100727+01	EQ. NOISE = .1001715+01	HIT = F
CELL NO. 4	THRESHOLD = .12319A2+01	RECEIVED POWER = .1006210+01	EQ. NOISE = .9988A17+00	HIT = F
CELL NO. 5	THRESHOLD = .12319A2+01	RECEIVED POWER = .1042544+01	EQ. NOISE = .99397A2+00	HIT = F
CELL NO. 6	THRESHOLD = .12319A2+01	RECEIVED POWER = .1015700+01	EQ. NOISE = .1005A8A+01	HIT = F

START SCANNING SIDELORE CELLS

CELL NO. 1	THRESHOLD = .12319A2+01	RECEIVED POWER = .1035924+01	EQ. NOISE = .9972A30+00	HIT = F
CELL NO. 2	THRESHOLD = .12319A2+01	RECEIVED POWER = .9977590+00	EQ. NOISE = .9960A10+00	HIT = F
CELL NO. 3	THRESHOLD = .12319A2+01	RECEIVED POWER = .101908A+01	EQ. NOISE = .10A3A5A+01	HIT = F
CELL NO. 4	THRESHOLD = .12319A2+01	RECEIVED POWER = .10165A3+01	EQ. NOISE = .1002037+01	HIT = F
CELL NO. 5	THRESHOLD = .12319A2+01	RECEIVED POWER = .9996817+00	EQ. NOISE = .9996561+00	HIT = F
CELL NO. 6	THRESHOLD = .12319A2+01	RECEIVED POWER = .104238A+01	EQ. NOISE = .9900A90+00	HIT = F
CELL NO. 7	THRESHOLD = .12319A2+01	RECEIVED POWER = .1054146+01	EQ. NOISE = .9960A2A+00	HIT = F
CELL NO. 8	THRESHOLD = .12319A2+01	RECEIVED POWER = .1057802+01	EQ. NOISE = .1006A4A+01	HIT = F
CELL NO. 9	THRESHOLD = .12319A2+01	RECEIVED POWER = .98180A7+01	EQ. NOISE = .99A7A2A+00	HIT = T
CELL NO. 10	THRESHOLD = .98180A7+01	RECEIVED POWER = .1851A26+01	EQ. NOISE = .990405A+00	HIT = F

VERIFICATION OF A HIT WITH THRESHOLD TH2 IN THE CELL NO. 9  
 CELL NO. 9 THRESHOLD = .12319A2+01 RECEIVED POWER = .9839320+01 EQ. NOISE = .1019091+01 HIT = T

(SIDELORE VARIATION ) DETECTED IN THE 22TH CELL  
 DISTANCE (SATELLITE, HORSIGHT) = .2781226+02% OF DISTANCE BETWEEN HORSIGHT AND FIRST NULL

158

ACQUISITION TIME = .5970993+01 SECONDS

NUMBER OF SATELLITE POSITIONS GENERATED:	5
STANDARD DEVIATION:	.2500000+01
CARRIER-TO-NOISE RATIO:	.8000000+02 DB-HZ
ACQUISITION AVERAGE TIME:	.4073145+01 S
STANDARD DEVIATION:	.1143123+01 S
PROBABILITY OF DETECTION:	.1000000+01
PROBABILITY OF DETECTION (SL. VAR.):	.6000000+00
PROBABILITY OF MISS:	.0000000
PROBABILITY OF FALSE ALARM (IN THE SIMULATION):	.0000000

PRK2,U FL5

159

ORIGINAL PAGE IS  
OF POOR QUALITY

16

\*\*\* INFORMATION SYSTEMS DESIGN, INC. \* 3205 CORONADO DR. \* SANTA CLARA, CA 95051 \* (408) 249-8100 \* \* \* 1100 100 \* \* \*

PRINTED BY: HUANG  
USER NAME: HUANG  
ACCOUNT: 0544AA  
ON SYSTEM: A  
EXEC LEVEL: 32924-036  
EXEC DATE: 10/14  
IFOP 1513P HUANG ACT PGS 16

CREATED BY: HUANG

FINISHED PRINTING: 11/10/77 15:32:53  
QUEUED: 11/10/77 15:30:42  
CREATED: 11/10/77 15:28:04  
PART NAME: "PK1"-"PK2"  
PART NO.: 05  
FILE NAME: 0544\*AD(1)

ACTUAL PAGES: 14  
INPUT DEVICE: T4N134  
QUEUED TO: E18  
PRINTED ON: E18

ORIGINAL PAGE IS  
OF POOR QUALITY

## SUMMARY

This document presents the results pertaining to the trade-off analysis and performance of the Ku-Band Shuttle antenna pointing and signal acquisition system. The study was performed assuming the existence of various antenna scanning trajectories and various signal acquisition algorithms. The square, hexagonal and spiral trajectories were investigated assuming the TDRS postulated uncertainty region and a flexible statistical model for the location of the TDRS within the uncertainty volume. The scanning trajectories, Shuttle/TDRS signal parameters and dynamics and three signal acquisition algorithms were integrated into a hardware simulation discussed herein and documented in detail in Volume IV. The hardware simulation is quite flexible in that it allows one to evaluate signal acquisition performance for an arbitrary (programmable) antenna pattern, a large range of  $C/N_0$ 's, various TDRS/Shuttle a priori uncertainty distributions and three distinct signal search algorithms.

Based upon the data made available during this contract period, certain Ku-Band forward link signal threshold characteristics were studied. The antenna pointing and acquisition threshold is found to be less than 60 dB-Hz with an acquisition time dependent on the antenna scan procedure and acquisition algorithm implemented. Various techniques are discussed in this report and a computer program is presented from which these can be evaluated. It appears that there will be no problem in meeting the system



spec even in light of the uncertainty associated with the possibilities of antenna sidelobe acquisition. The details are provided herein. Assuming a single channel monopulse system and a 30 MHz IF bandwidth, a monopulse tracking loop bandwidth of one Hz, the monopulse tracking jitter is 0.11 degrees at  $C/N_0 = 54$  dB-Hz. The Costas loop arm filter bandwidths can be chosen to be ten times the data rate such that no false-lock problem occurs during carrier acquisition. Assuming loop bandwidth of  $B_L = 3$  kHz, the loop jitter is 10 degrees at  $C/N_0 = 60.4$  dB-Hz. Acquisition can be accomplished in less than 10 seconds.

For the purpose of antenna scanning analysis, a reference coordinate system, whose z-axis is in line with the center axis of a specified uncertainty cone of the TDRS position, is chosen for the relative relation between the TDRS and the Shuttle antenna. The scan path of the Shuttle antenna can be projected onto the (x,y) plane of the coordinate system; while the uncertainty cone of the TDRS position can be described by a circle in the (x,y) plane. The uncertainty in the position of the TDRS is modeled by a truncated Gaussian probability density  $p(x,y)$  with uncertainty parameters  $\sigma_x^2 = \sigma_y^2 = \sigma^2$ . By changing the value of this variance parameter, the model is sufficiently general to include a uniform distribution of TDRS position uncertainty ( $\sigma_p = \infty$ ) to one which specifies the position with probability one ( $\sigma_p = 0$ ).

In the study of antenna scanning three types of trajectories are proposed and evaluated in terms of average scan time and the

structure of coverage over the uncertainty cone of the TDRS position. The analysis technique used for finding average scan time is discussed and an illustration of the technique for a specific type of scanning trajectories and motion of the Shuttle antenna is given. The results show that the spiral trajectory is in general better than the other two trajectories, especially for a constant velocity along a trajectory, since the path of a spiral trajectory (from the center of uncertainty cone to its edge) can be shorter than the other two.

From the Ku-band system specifications, it has been recognized that the variation of the received signal level at the Shuttle (due to TDRS EIRP path loss and antenna pointing loss variations) varies as much as 23 dB. If the antenna sidelobes are not sufficiently suppressed, a potential problem called sidelobe acquisition may cause the degradation in system performance. Therefore in this tradeoff analysis study, three different acquisition strategies are proposed and evaluated. The first acquisition strategy may be used for the case where the sidelobe acquisition does not impose a problem to the system. The other two strategies are primarily designed to avoid the sidelobe acquisition (especially the first sidelobe).

In this study, we assume that the first sidelobe of the Shuttle antenna is 17.5 dB suppression from the main lobe of the antenna so that we can study the effectiveness of the acquisition algorithm proposed. Surely, one should note that the sidelobe acquisition can be overcome by tapering down the sidelobes of the Shuttle antenna below 23 dB. However, it has been

found that with one particular acquisition algorithm studied, a strong sidelobe of the antenna can speed spatial acquisition significantly.

The scan schemes and acquisition algorithms are all integrated by a computer simulation program. This software package, discussed herein, provides a useful tool for predicting the performance of the Ku-band antenna pointing system. Various options are available for users to do tradeoff studies on system parameters in designing an acquisition system. The software package has been tested on UNIVAC 1100 Series computers and verified with analytical results.