STATIC-ELECTRICITY ANALYSIS PROGRAM

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    This volume, (Volume II) the Users Manual, describes the implementation of
    the computer program entitled PSTAT. PSTAT is based upon the theoretical and
    experimental work developed in the companion volume entitled "Static-Electricity
    Analysis Program (Volume I)".

    Volume I details the methodology used to model various aspects of p-static
    and streamering, while Volume II describes the specifics needed to run program
    PSTAT.
LIST OF FIGURES

Figure 1  PSTAT Flow Chart ........................................ 6
LIST OF VARIABLES USED IN P-STAT

NSECT: An integer variable specifying the program option to be used (corona noise or streamer noise).

LA: An integer variable specifying the antenna location.

LANT: An alphanumeric variable describing the antenna location.

NCOUP: An integer variable specifying the number of coupling coefficients to be read from data cards.

ESTO: A floating point array containing the NCOUP antenna-elevator coupling coefficients.

WSTO: A floating point array containing the NCOUP antenna-wing coupling coefficients.

RSTO: A floating point array containing the NCOUP antenna-rudder coupling coefficients.

NRUN: An integer variable specifying the number of program cycles to be made using the same coupling coefficients.

IOFF: An integer variable specifying the locations of the p-static discharges which are to be considered "quiet".

IT: An alphanumeric variable describing the type of aircraft under investigation.

XN: A floating point variable specifying the size of the aircraft relative to a KC-135.

SPD: A floating point variable specifying the aircraft speed.

ALT: A floating point variable specifying the aircraft altitude.

MODEF: An integer variable specifying the frequency select mode the user wishes to use (uniform or non-uniform frequency intervals).

FSTRT: (If MODEF equals 0) A floating point variable specifying the desired starting frequency (in MHz).

FSTP: (If MODEF equals 0) A floating point variable specifying the desired stopping frequency (in MHz).

FDEL: (If MODEF equals 0) A floating point variable specifying the frequency increment between FSTRT and FSTP (in MHz).
NFR: (If MODEF does not equal 0) An integer variable specifying the number of user-selected frequencies to be read in from cards.

FREQU: (If MODEF does not equal 0) A floating point variable specifying the user-selected frequency (in MHz). The maximum number of FREQU cards allowed is 90.

AANT: A floating point variable specifying the antenna induction area (in square meters).

BNDW: A floating point variable specifying the receiver bandwidth (in kHz).

ICLO: An integer variable specifying the type of cloud the aircraft is flying through.

IC: An alphanumeric variable describing the type of cloud the aircraft is flying through.

(Variables Used Only in Streamer-Noise Calculations)

IM: An integer variable specifying the type of dielectric material being charged.

IMAT: An alphanumeric variable describing the type of dielectric material being charged.

DAFT: A floating point variable specifying the distance (in meters) the receiving antenna is located behind the windshield canopy or the radome.

WX: A floating point variable specifying the minimum characteristic dimension (in meters) of the dielectric material being charged.

DIERAT: A floating point variable specifying the ratio of the frontal area of the dielectric material to the frontal area of the aircraft.
I INTRODUCTION

When an aircraft or other flight vehicle is operated in precipitation containing ice crystals or other particulate materials, frictional electrification associated with particle impact causes the impinging particles to acquire a net charge and to deposit an equal and opposite charge on the vehicle.\textsuperscript{1-5} The charging occurs on the frontal metallic and dielectric portions of the vehicle.\textsuperscript{6,7} Although the charge deposited by a single ice crystal changes the potential of the aircraft only slightly (of the order of 0.01 volt for the case of a KC-135 struck by a cirrus-cloud crystal),\textsuperscript{4} the particle impact rate in a typical cloud is sufficient to cause the vehicle potential to reach hundreds of kilovolts in less than a second.\textsuperscript{4}

The electrification of the vehicle is of relatively little concern in itself because the energies involved are small, and since the electrostatic fields do not penetrate to the interior. It is the consequences of the electrification that are of concern to the EMC engineer. When the vehicle potential reaches roughly 100 kV, the electric-field intensity at the aircraft extremities becomes sufficiently high that electrical breakdown of the air (corona discharge) occurs.\textsuperscript{8} At aircraft operating altitudes, the corona breakdown from the extremities occurs not as a continuous flow of charge, but as a series of pulses with roughly 10 ns rise times and 200 ns duration and therefore generates radio noise over a broad spectrum.\textsuperscript{4,5,8}

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\textsuperscript{*} References are listed at the end of this Users Manual.

1
A similar situation exists on the dielectric frontal surfaces. As charge continues to accumulate on the dielectric, the potential to the airframe rises until the electric-field intensity at the dielectric surface becomes sufficiently high that voltage breakdown (streamer discharge) across the plastic surface occurs. A surface streamer involves the rapid transfer of charge over a substantial distance, and also generates serious radio frequency interference.\(^6,7\)

The degree to which the radio frequency noise generated by corona and streamer discharges couples into electronic systems on the flight vehicle is determined by the relative locations of the noise source and the "antenna" via which the noise is coupled into the affected system. In addition, the coupling depends upon frequency, the size of the vehicle, and the size of the antenna.\(^4,5,7\)

On earlier efforts, various aspects of the problem of precipitation-static noise generation and coupling were studied analytically and experimentally both in the laboratory and in flight tests. Unfortunately, the results of these efforts are spread over a large number of reports, each of which treats only a limited part of the overall problem. Thus the EMC engineer is in the position of having to be familiar with all of the publications in considerable depth if he is to apply the results of the earlier work to his problems.

In order to overcome these problems, SRI developed a computer program, entitled PSTAT, which will accurately predict the effects of p-static noise in aircraft systems. The computer program has been demonstrated to allow the EMC engineer, or systems designer, to determine the effects of p-static charging on a wide variety of aircraft types and under a wide variety of flight regimes. Since the program is based on the results of earlier experimental and analytical work, the limitations of this earlier work are reflected in the computer program. The accuracy
of PSTAT depends on the modelling and on the faithfulness with which the experimental analytical data represent the true picture of p-static noise. It is felt that PSTAT is accurate to within a few percent for KC-135 type aircraft, decreasing to tens of percent for widely divergent aircraft types (delta wing fighters, for example). Although it has been possible to extend the applicability of the first-generation program described here somewhat beyond the strict confines of the earlier work, there are situations in which the program simply cannot be applied. For example, with the present program, it is not possible to consider helicopters or rockets because their geometries are radically different from aircraft.

This user manual is intended to guide the program user through the input and output requirements of the program. Sample input decks and output listings are included in this user manual to help the user understand the proper input-deck setup. Specific modeling techniques are not explained in this manual because they are fully explained in the accompanying Final Report under this contract.

The philosophy applied in creating the present program was one of simplicity. The authors felt that direct in-line coding was more appropriate to the needs of potential users than were more complicated coding techniques. In-line coding affords the non-programmer user the convenience of being able to look at the program and determine the sequence of events that have just taken place and those that are about to begin.

Extensive comments have been inserted throughout the program in order to clarify the various program steps.
II HARDWARE REQUIREMENTS AND LANGUAGE

A. Hardware Requirements

PSTAT was designed to run with a minimum computer configuration. The program uses a card reader for input and a line printer for output. No additional peripherals are required.

The program uses $5203_{10}$ words of core storage.

Execution time is dependent on the parameters selected during input, but typical execution times of, perhaps, 5 to 10 seconds could be expected for typical calculations, and this time would include the card read, CPU, and printer times.

It is estimated that the CPU time required for a typical run is on the order of 100 ms.

B. Language

PSTAT is written in standard ASA FORTRAN.
III COMPUTER PROGRAM

A. General

The experimental and analytical data regarding p-static noise is discussed fully in Section II of the Final Report (Vol. I) written under this contract and will not be repeated here.

The nature of the material presented in the final report was such that, in some cases, exact analytical expressions could be used in the computer program. In other cases, approximations to the desired parameters were used; and in still others, where the data did not lend themselves to approximation, the data were simply stored in tabular form.

B. Flowchart

Based on immediate needs, the requirements anticipated in the future, and information currently available, a flowchart was developed to be a guideline for the coding effort. This flowchart is shown in Figure 1.

It can be seen from this figure that the p-static program is broken into two sections, or modules. Module 1 deals with the calculation of noise generated in antennas by corona discharges from the aircraft extremities. Module 2 deals with the calculation of noise generated in antennas by surface streamer discharges across the plastic surfaces of the aircraft's radomes and canopies.

During program execution, either Module 1 or Module 2 is selected by the user by use of a data card read in as the first data card.

It can be observed from this figure that an input data error test is made only on the data input to Module 1. It was decided that the
FIGURE 1  PSTAT FLOWCHART
input requirements of Module 2 were sufficiently simple that an input error check could not be justified, whereas the input requirements of Module 1, while not complex, were sufficiently confusing to warrant the error check.

A brief description of the contents of each program module is given below. The input and output details of each module are not discussed here, but are left for a later section of this manual. The mathematical processes of the calculations performed in the modules are fully described in the Final Report, so they will not be repeated here.

C. Module 1--Corona Noise

After the data cards have been input, an error check is made on several of the important parameters of the program. PSTAT will produce the error message

***DATA INPUT ERROR***

print the input deck, repeat the error message, and then halt, if any of the following errors are detected:

- More than 100 coupling coefficients for each extremity are either read into the program or requested to be read into the program.
- More than 90 frequencies have been read into the program or requested to be read into the program (for MODEF .NE.0).
  (Note: For MODEF .EQ.0 any number of frequencies may be evaluated--see description of constants and variables below.)
- The requested frequency ranges and/or frequency interval are not consistent--e.g., if the last frequency were smaller than the first frequency, or if Δf were 0 or negative--note: (This check is made only if MODEF .EQ.0).
- The discharge quench code does not reflect any of the possible quenching modes.
- The aircraft's altitude is greater than 80,000 ft.
After the input deck has passed the error check, it is printed out, showing the user the parameters he has selected for evaluation.

The next step in the program is the calculation of the total charging current to the aircraft. The total charging current (and hence discharging current in the steady-state case under consideration) is determined from the aircraft speed, its size (relative to a KC-135), and the type of cloud it is penetrating. At the same time the charging current is calculated, the probability that this charging current will be exceeded is also calculated.

Since the noise coupled into the antenna is a function of the antenna induction area and aircraft size, the coupling coefficients are then scaled to reflect the antenna induction area and the aircraft size. The next step in the program distributes the total charging current among the extremities (rudder, elevator tips, wing-tips) and then calculates the discharge source spectrum normalizers, which are used to determine the intensity of the corona spectra.

After the pressure (altitude) and frequency parameters have been initialized, the equivalent noise-field calculations begin. The spectral function, PREL, in the program is calculated using the approximations detailed in the Final Report, and the coupling data are linearly interpolated from the table of coupling coefficients established during the input phase of the program.

After the short-circuit antenna current and equivalent noise fields have been calculated they are printed out for the frequency currently being investigated. A frequency-increment test directs the program either to a "continue processing" statement or to a "completion" statement.
D. Module 2—Streamer Noise

The technique used to calculate the equivalent noise caused by streamer discharge closely parallels the technique used to calculate corona noise. After the data cards have been read in, the input deck is printed showing the user the parameters he has selected for evaluation. This serves as an error check on the input data.

The next step in the program is the calculation of the total charging current to the aircraft. The total charging current is determined from the aircraft speed, size, and type of cloud it is penetrating. At this same time, the probability that this charging current will be exceeded is also calculated.

The next step in the program is the calculation of the streamering current. The streamering current is given by the ratio of the dielectric surface frontal area to the total aircraft frontal area multiplied by the calculated aircraft charging current.

After the frequency parameters have been initialized, the streamer spectrum is calculated at the particular frequency being examined. The short circuit antenna current is then calculated and the equivalent noise field is finally obtained and printed out. A frequency increment-test directs the program either to a "continue" processing, or a "completion" statement.

The inherent qualities of program PSTAT are that, in the brief module descriptions given above, many years of accumulated experimental data have been combined to form a unified program to solve many types of problems involving precipitation-static-induced noise in avionics systems. While the program, taken in its entirety involves considerable sophistication, the individual calculations are quite simple and easily followed in the program documentation. Accordingly, we have not provided
flow charts for the calculation of every parameter because it was felt that they would be simple but so numerous as to detract from the utility of this manual.
IV INPUT

PSTAT utilizes three input areas: (1) The initial one-card input to specify Module 1 (corona noise) or Module 2 (streamer noise), (2) the input area for the corona-noise calculation, and (3) the input area for the streamer-noise calculation.

At any one time the user will use only two of these areas: The module-select area and the corona-noise area, or the module-select area and the streamer-noise area.

The requirements and formats for each of these areas are given below. The order in which the material is presented is the order in which the input deck should be arranged.

A. Module Select Area

- Card 1—This will always be the first card of the data deck, and it contains either a 1 (Module 1), or a 2 (Module 2) and directs the program to the desired module. The card should be in an II format.

B. Corona-Noise Module

The description of each of the cards to be input into this module is given below, in the order of their location in the input deck.

- Card 2—LA, LANT; Format II, 1X, 7A2

LANT is a 14-character alphanumeric briefly describing the location of the antenna under test (i.e., BELLY, FUSELAGE, TAILCAP, etc.) and is used only for output annotation.

LA is a single-digit fixed-point variable describing the antenna location. Set LA = 0 if the antenna is not located at, or near, an extremity (e.g., a belly-mounted antenna).
If the antenna is located at, or near, the elevator extremity, set LA = 1. If the antenna is located at, or near, a wing-tip, set LA = 2. Set LA = 3 if the antenna is located at, or near, the rudder extremity. This parameter is used to scale the coupling coefficients to the scale size of the aircraft, for those discharge locations not located near the antenna. The coupling coefficient describing the coupling between noise sources and extremity-located antennas is not scaled to aircraft scale size if the antenna is located near those noise sources. The other coupling coefficients, however, are scaled, and the reasons for scaling are described in the final report.

- **Card 3--NCOPU; Format I3**
  This is a fixed-point number specifying the number of coupling coefficients to be read from cards (Maximum = 100).

- **Card 4--ESTO, WSTO, RSTO; Format 3(E9.2,1X)**
  These are the array names for the storage of the NCOPU coupling coefficients. The data on these cards are experimentally derived quantities and until the user gains familiarity with the program, or until more data become available, the SRI-supplied decks of coupling coefficients should be used. The user should note that SRI has supplied two decks of coupling coefficients: one for extremity-to-tail-cap antennas; and one for extremity-to-belly antennas. The user should select the deck appropriate to his needs--tail-cap or belly-mounted (fuselage-mounted) antennas.

- **Card 5--NRUN; Format I3**
  This card specifies the number of program cycles to be made using the same coupling data but various other parameters. It is suggested that until the user is familiar with the program, NRUN be limited to 1.

- **Card 6--IOFF; Format I1**
  This card specifies which (if any) of the corona discharges should be suppressed by 40 dB. (40 dB is typical of the quieting provided by p-static dischargers on aircraft.) The codes are as follows:
IOFF = 1  All discharges permitted
IOFF = 2  Rudder discharge quieted by 40 dB
IOFF = 3  Wing-tip discharges quieted by 40 dB
IOFF = 4  Elevator-tip discharges quieted by 40 dB
IOFF = 5  Rudder and wing-tip discharges quieted by 40 dB
IOFF = 6  Rudder and elevator-tip discharges quieted by 40 dB
IOFF = 7  Elevator and wing-tip discharges quieted by 40 dB.

- **Card 7—IT**; Format 6A2
  This is a 12-character alphanumeric describing the type of aircraft under investigation (i.e., TRANSPORT, FIGHTER, etc.), and is used only for output annotation.

- **Card 8—XN, SPD, ALT**; Format F5.2, 1X, F6.1, 1X, F4.1
  This card contains the information about the aircraft's size, XN (relative to a KC-135), and its speed (in mph) and its operating altitude (in kft).

- **Card 9—MODEF**; Format I1
  This card specifies the frequency-select mode the user wishes to use. If MODEF equals 0, it means that the user has decided to use uniformly spaced frequency intervals. If MODEF is not equal to 0, it means that the user has decided to use frequencies that will be read in from cards at a nonuniform Δf.

- **Card 10—(If MODEF .EQ.0) FSTRT, FSTP, FDEL**; Format 3(F5.2, 1X)
  This card contains the desired starting frequency (in MHz), ending frequency (in MHz), and frequency increment (in MHz) if MODEF is equal to zero.

- **Card 10—(If MODEF .NE.0) NFR**; Format I3
  This card specifies the number of user-selected frequencies to be read into the program. (The maximum number allowed is 90.)

- **Cards 10a, 10b, 10c, etc.—(If MODEF .NE.0) FREQU**; Format E9.2
  These cards are the user-selected frequencies (in MHz). There should be NFR of these cards.
• Card 11--AANT, BNDW; Format 2(F5.2, 2X)
  This card contains the information specifying the receiving
  antenna's induction area (in m²) and the receiver bandwidth
  (in kHz).

• Card 12--ICLO, IC; Format 11, 1X, 7A2
  This card contains the information about the type of particulate
  material the aircraft is flying in.
    ICLO = 1 implies a cirrus cloud or low charging material.
    ICLO = 2 implies a stratocumulus cloud or moderate
      charging material.
    ICLO = 4 implies a snow cloud or high-charging material.
  IC is a 14-character alphanumerical description of the cloud
  material. It is used only for output annotation.

C. Streamer-Noise Module

• Card 2--LANT; Format 4A2
  This alphanumerical is described in Section IV-B above.

• Card 3--IT; Format 6A2
  This alphanumerical is described in Section IV-B above.

• Card 4--XN, SPD, ALT; Format F5.2, 1X, F6.1, 1X, F4.1
  The data on this card are described in Section IV-B above.

• Card 5--MODEF; Format 11
  The data on this card are described in Section IV-B above.

• Card 6--(If MODEF .EQ.0) FSTRT, FSTP, FDEL; Format 3(F5.2, 1X)
  The data on this card are described in Section IV-B above.

• Card 6--(If MODEF .NE.0) NFR; Format 13
  The data on this card are described in Section IV-B above.

• Card 6a, 6b, 6c--(If MODEF .NE.0) FREQU; Format E9.2
  The data on these cards are described in Section IV-B above.
• **Card 7--AANT, BNDW; Format 2(F5.2, 2X)**
  
  The data on this card are described in Section IV-B above.

• **Card 8--ICLO, IC; Format 11, 1X, 7A2**
  
  The data on this card are described in Section IV-B above.

• **Card 9--IM, IMAT; Format 11, 1X, 7A2**
  
  This card contains the information about the type of dielectric material being charged.

  \[ IM = 1 \] implies that a windshield (canopy) is being charged.

  \[ IM = 2 \] implies that a radome is being charged.

  IMAT is a 14-character alphanumeric description of the dielectric material (i.e., WINDSHIELD, or RADOME). It is used only for output annotation.

• **Card 10--DAFT,WX; Format 2(F5.2, 2X)**
  
  This card describes the antenna location with respect to the charging material, and the minimum characteristic dimension of the dielectric material being charged.

  DAFT specifies the distance (in meters) the receiving antenna is located behind the windshield canopy or the radome. If the receiving antenna is located immediately beneath the dielectric material, DAFT should be read in as 0.00 m.

  WX specifies the minimum characteristic dimension (in meters) of the dielectric material being charged—i.e., the width of a rectangular section of dielectric. The floating-point variable, WX, may be thought of as roughly twice the length of the longest possible streamer discharge on the dielectric region under consideration.

• **Card 11--DIERAT; Format F5.2**
  
  DIERAT is the ratio of the frontal area of the dielectric to the frontal area of the aircraft.

  In the event that windshield canopy streamering is being considered, DIERAT should specify the ratio of the total frontal area of the dielectric to the total frontal area of the aircraft.
If radome streamering is being considered, DIERAT should specify the ratio of the radome's forward 3 feet of area to the total frontal area of the aircraft.

It can be seen from the input requirements described above that the use of alphanumerics has been limited to annotation only, while parameters which affect the processing has been limited to BCD (numbers). This technique could have been changed so that alphanumerics directed some of the processing, but it was felt that this would confuse the input requirements of PSTAT. The example INPUT/OUTPUT shown later in this volume will illustrate the use of the BCD/Alphanumeric input data described above.
V OUTPUT

During output, the user-supplied quantities that affect the computed results are printed out before the induced equivalent noise fields are printed out.

If an error is detected during the processing of the corona-noise input deck, an error message is produced. No error checks are made during the processing of the streamer-noise input deck, since the input requirements for this module are quite simple.

After the input quantities have been listed, the charging current is calculated and printed out. The probability that the charging current will exceed the calculated value (for the specified conditions of altitude, speed, aircraft size, and cloud type) is also calculated and printed out.

The short-circuit currents induced in the receiving antenna and the associated equivalent noise fields are then calculated and printed out for all of the user-desired frequencies. The dimensions of these output quantities are megahertz and hertz for the user-specified frequencies, amperes for the short-circuit current, and volts per meter for the equivalent noise fields.

It should be noted here that if the user elects to use the streamer-ing model for an antenna immediately beneath the canopy or radome, no equivalent noise field is calculated or printed. The reasons for this are fully described in the final report.

Examples of the output are given in a later section of this manual.
VI SAMPLE INPUT/OUTPUT

This section gives several examples of the use of program PSTAT, together with example input deck setup and output listing.

A. Example 1

Calculate the equivalent noise field induced in an antenna on the tail-cap of a KC-135 transport aircraft. Assume that the antenna has an induction area of $8.6 \text{ m}^2$, and that the receiver has a bandwidth of 1 kHz. Further assume that the aircraft is flying at a speed of 600 mph at an altitude of 20,000 feet through cirrus cloud. Allow all extremities of the aircraft to discharge and evaluate the equivalent noise fields at uniformly spaced frequencies of from 0.1 MHz to 4.0 MHz in steps of 0.1 MHz.
1. **Input Deck**

The input deck required to evaluate this problem is as follows:

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<td>+0.27E+02</td>
<td>+0.11E+02</td>
<td>+0.35E+01</td>
<td>5 mH TAILCAP</td>
<td></td>
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</tr>
<tr>
<td>+0.32E+02</td>
<td>+0.14E+02</td>
<td>+0.35E+01</td>
<td>6 mH TAILCAP</td>
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<tr>
<td>+0.43E+02</td>
<td>+0.17E+02</td>
<td>+0.35E+01</td>
<td>8 mH TAILCAP</td>
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<td>+0.40E+02</td>
<td>+0.35E+01</td>
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<td>+0.12E+02</td>
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<td>+0.35E+01</td>
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</table>

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| KC=135 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1.00 | 600.0 20.0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0.10 | 4.00 0.10 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 8.6 | 1.0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

1*CIRRUS CLOUD
2. Output Deck

The program output is as follows:

<table>
<thead>
<tr>
<th>SCALE SIZE</th>
<th>SPEED [MPH]</th>
<th>ALTITUDE [KFT]</th>
<th>CLOUD TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>600.0</td>
<td>20.0</td>
<td>CIRRUS CLOUD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>START FREQ [MHz]</th>
<th>STOP FREQ [MHz]</th>
<th>DELTA-F [MHz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4.00</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECEIVER NOISE [KHZ]</th>
<th>ANTENNA INDUCTION AREA [M**2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>8.60</td>
</tr>
</tbody>
</table>

ALL DISCHARGES PERMITTED
### SRI P-STATIC MODEL [CONT'D]

The calculated charging current is 1.00e03 amps.

The probability is 0.0020 that the charging current will be greater than 1.00e03 amps.

<table>
<thead>
<tr>
<th>FREQUENCY (MHz)</th>
<th>FREQUENCY [Hz]</th>
<th>SHORT-CIRCUIT CURRENT [Amps]</th>
<th>EQUIVALENT NOISE FIELD [Volts/m]</th>
<th>EQUIVALENT NOISE FIELD [DBV/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.20</td>
<td>1.000000e05</td>
<td>8.34e-07</td>
<td>1.76e-02</td>
<td>-3.50e01</td>
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<tr>
<td>1.30</td>
<td>1.100000e05</td>
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<td>1.76e-02</td>
<td>-3.11e01</td>
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<tr>
<td>1.40</td>
<td>1.200000e05</td>
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<td>1.50</td>
<td>1.300000e05</td>
<td>9.68e-07</td>
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<td>-3.39e01</td>
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<tr>
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<td>1.02e-06</td>
<td>1.76e-02</td>
<td>-3.50e01</td>
</tr>
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<td>1.70</td>
<td>1.500000e05</td>
<td>1.03e-06</td>
<td>1.76e-02</td>
<td>-3.57e01</td>
</tr>
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<td>1.600000e05</td>
<td>1.05e-06</td>
<td>1.76e-02</td>
<td>-3.64e01</td>
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<td>1.06e-06</td>
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<td>-3.70e01</td>
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<td>1.76e-02</td>
<td>-3.81e01</td>
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<td>1.76e-02</td>
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<tr>
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<tr>
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<td>1.16e-06</td>
<td>1.76e-02</td>
<td>-4.12e01</td>
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<td>3.000000e05</td>
<td>1.17e-06</td>
<td>1.76e-02</td>
<td>-4.14e01</td>
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<td>3.100000e05</td>
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<td>1.76e-02</td>
<td>-4.16e01</td>
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<tr>
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<td>3.200000e05</td>
<td>1.19e-06</td>
<td>1.76e-02</td>
<td>-4.17e01</td>
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<tr>
<td>3.50</td>
<td>3.300000e05</td>
<td>1.20e-06</td>
<td>1.76e-02</td>
<td>-4.18e01</td>
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<td>1.76e-02</td>
<td>-4.20e01</td>
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<tr>
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<td>3.600000e05</td>
<td>1.23e-06</td>
<td>1.76e-02</td>
<td>-4.21e01</td>
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<td>4.00</td>
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<td>1.25e-06</td>
<td>1.76e-02</td>
<td>-4.23e01</td>
</tr>
</tbody>
</table>
B. Example 2

Repeat the above example, but quiet the rudder discharge. (This might be done to investigate the effects of adding p-static dischargers to the rudder assembly of the aircraft.)

1. Input Deck

The input deck required to evaluate this problem is as follows:

```
1 TAILCAP
+0.41E+03 +0.23E+03 +0.35E+01 0 MHZ TAILCAP
+0.35E+03 +0.30E+03 +0.35E+01 1 MHZ TAILCAP
+0.40E+03 +0.36E+03 +0.35E+01 2 MHZ TAILCAP
+0.35E+03 +0.11E+03 +0.35E+01 3 MHZ TAILCAP
+0.50E+03 +0.21E+03 +0.35E+01 4 MHZ TAILCAP
+0.27E+03 +0.11E+03 +0.37E+01 5 MHZ TAILCAP
+0.27E+02 +0.75E+02 +0.40E+01 6 MHZ TAILCAP
+0.32E+03 +0.10E+03 +0.35E+01 7 MHZ TAILCAP
+0.43E+02 +0.17E+02 +0.38E+01 8 MHZ TAILCAP
+0.70E+02 +0.11E+03 +0.35E+01 9 MHZ TAILCAP
+0.10E+01 +0.40E+01 +0.35E+01 10 MHZ TAILCAP
+0.12E+01 +0.42E+01 +0.40E+01 11 MHZ TAILCAP
+0.13E+01 +0.74E+01 +0.41E+01 12 MHZ TAILCAP
+0.12E+01 +0.90E+01 +0.47E+01 13 MHZ TAILCAP
+0.10E+01 +0.10E+02 +0.65E+01 14 MHZ TAILCAP
```

1

K = 135
1.00 600.0 20.0
0.10 4.00 0.10
8.6 1.0
1 CIRRUS CLOUD
2. Output Deck

The program output is as follows:

<table>
<thead>
<tr>
<th>Scale Size</th>
<th>Speed [mph]</th>
<th>Altitude [kft]</th>
<th>Cloud Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>600.0</td>
<td>20.0</td>
<td>Cirrus Cloud</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Start Freq* [MHz]</th>
<th>Stop Freq* [MHz]</th>
<th>Delta F [MHz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>400</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Receiver Noise</th>
<th>Antenna Induction</th>
</tr>
</thead>
<tbody>
<tr>
<td>[kHz]</td>
<td>[<strong>2]</strong></td>
</tr>
<tr>
<td>1.00</td>
<td>2.60</td>
</tr>
</tbody>
</table>

Rudder discharge prohibited.
THE CALCULATED CHARGING CURRENT IS 1.000E-03 AMPS

THE PROBABILITY IS 1.000E-03 THAT THE CHARGING CURRENT WILL BE GREATER THAN 1.000E-03 AMPS

<table>
<thead>
<tr>
<th>FREQUENCY [MHz]</th>
<th>FREQUENCY [Hz]</th>
<th>SHORT-CIRCUIT CURRENT [Amps]</th>
<th>EQUIVALENT NOISE FIELD [Volts/m]</th>
<th>EQUIVALENT NOISE FIELD [DBV/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>1.000E +05</td>
<td>1.000E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
<td>2.00</td>
<td>2.000E +05</td>
<td>4.000E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
<td>1.50</td>
<td>1.500E +05</td>
<td>1.500E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
<td>1.10</td>
<td>1.100E +05</td>
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<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
<td>1.20</td>
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<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
<td>1.30</td>
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<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
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<td>1.400E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
<td>1.50</td>
<td>1.500E +05</td>
<td>1.500E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
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</tr>
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<td>-6.823E 01</td>
</tr>
<tr>
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<td>3.00E-08</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>2.000E +05</td>
<td>2.000E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
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<td>2.100E +05</td>
<td>2.100E-08</td>
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<tr>
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</tr>
<tr>
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</tr>
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<tr>
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<td>3.000E +05</td>
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<td>-6.823E 01</td>
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<tr>
<td>3.90</td>
<td>3.900E +05</td>
<td>3.900E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
<tr>
<td>4.00</td>
<td>4.000E +05</td>
<td>4.000E-08</td>
<td>3.00E-08</td>
<td>-6.823E 01</td>
</tr>
</tbody>
</table>
C. **Example 3**

Calculate the equivalent noise field induced in a belly-mounted antenna on an F-4 aircraft. Assume that the antenna has an induction area of 8.6 m², and that the receiver has a bandwidth of 1 kHz. Further assume that the aircraft is flying at a speed of 600 mph at 20 kft through stratocumulus cloud. Allow all extremities of the aircraft to discharge and evaluate the ENF at uniformly spaced frequencies of 0.1 to 4.0 MHz with a Δf of 0.1 MHz. (The F-4 is approximately 1/3 the size of a KC-135.)

1. **Input Deck**

The input deck required to evaluate this problem is as follows:

```
1
0 BELLY
15
+0.14E-03 +0.20E-03 +2.90E-05 0 MHz BELLY
+0.15E-03 +0.22E-03 +2.11E-03 1 MHz BELLY
+0.20E-03 +0.27E-03 +2.48E-03 2 MHz BELLY
+0.16E-03 +0.36E-03 +3.45E-03 3 MHz BELLY
+0.10E-02 +0.17E-02 +3.40E-03 4 MHz BELLY
+0.30E-03 +0.20E-03 +5.12E-03 5 MHz BELLY
+0.50E-03 +0.55E-03 +7.33E-03 6 MHz BELLY
+0.85E-03 +0.11E-02 +7.40E-03 7 MHz BELLY
+0.17E-02 +0.27E-02 +7.10E-02 8 MHz BELLY
+0.24E-02 +0.29E-02 +9.18E-02 9 MHz BELLY
+0.22E-02 +0.39E-02 +9.16E-02 10 MHz BELLY
+0.15E-02 +0.42E-02 +9.10E-02 11 MHz BELLY
+0.18E-02 +0.65E-02 +7.70E-02 12 MHz BELLY
+0.19E-02 +0.50E-02 +6.62E-02 13 MHz BELLY
+0.20E-02 +0.46E-02 +5.60E-02 14 MHz BELLY
1
1
F-4 FIGHTER
0.33 600 0.20 0.0
0.10 4.00 6.0
1 16
2 STRAT OC C
```
2. Output Deck

The program output is as follows:

<table>
<thead>
<tr>
<th>SCALE SIZE</th>
<th>SPEED [MPH]</th>
<th>ALTITUDE [KFT]</th>
<th>CLOUD TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>.33</td>
<td>600</td>
<td>200</td>
<td>STRATO CU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>START FREQ [MHz]</th>
<th>STOP FREQ [MHz]</th>
<th>DELTA-F [MHz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>.10</td>
<td>4.00</td>
<td>.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECEIVER NOISE [KHZ]</th>
<th>ANTENNA INDUCTION AREA [**2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>5.60</td>
</tr>
</tbody>
</table>

ALL DISCHARGES PERMITTED
The calculated charging current is $6 \times 600E-04$ Amps.
The probability is $6.061$ that the charging current will be greater than $6 \times 600E-04$ Amps.

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Frequency (Hz)</th>
<th>Short-Circuit Current (Amps)</th>
<th>Equivalent Noise Field (Volts/m)</th>
<th>Equivalent Noise Field (DBV/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>1.000E+05</td>
<td>1.171E-07</td>
<td>2.450E+03</td>
<td>5.221E 01</td>
</tr>
<tr>
<td>1.20</td>
<td>1.200E+05</td>
<td>1.166E-07</td>
<td>1.221E+03</td>
<td>5.826E 01</td>
</tr>
<tr>
<td>1.40</td>
<td>1.400E+05</td>
<td>1.157E-07</td>
<td>8.073E+04</td>
<td>5.185E 01</td>
</tr>
<tr>
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<td>1.600E+05</td>
<td>1.143E-07</td>
<td>5.983E+04</td>
<td>5.445E 01</td>
</tr>
<tr>
<td>1.80</td>
<td>1.800E+05</td>
<td>1.126E-07</td>
<td>4.712E+04</td>
<td>5.652E 01</td>
</tr>
<tr>
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<td>2.000E+05</td>
<td>1.104E-07</td>
<td>3.853E+04</td>
<td>5.827E 01</td>
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<td>2.760E+04</td>
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</tr>
<tr>
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<td>2.391E+04</td>
<td>7.242E 01</td>
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<tr>
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<td>1.000E-07</td>
<td>2.094E+04</td>
<td>7.357E 01</td>
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<td>1.850E+04</td>
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<td>9.144E-08</td>
<td>1.475E+04</td>
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</tr>
<tr>
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<td>3.600E+05</td>
<td>8.893E-08</td>
<td>1.303E+04</td>
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<tr>
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<td>3.800E+05</td>
<td>8.629E-08</td>
<td>1.204E+04</td>
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</tr>
<tr>
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<td>7.462E-08</td>
<td>7.798E+03</td>
<td>8.215E 01</td>
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<tr>
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<td>7.246E-08</td>
<td>7.222E+03</td>
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<td>6.707E+03</td>
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<tr>
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<td>6.833E-08</td>
<td>6.245E+03</td>
<td>8.407E 01</td>
</tr>
<tr>
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<td>5.600E+05</td>
<td>6.625E-08</td>
<td>5.830E+03</td>
<td>8.467E 01</td>
</tr>
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<td>5.800E+05</td>
<td>6.416E-08</td>
<td>5.456E+03</td>
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</tr>
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<td>6.219E-08</td>
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<td>3.483E+03</td>
<td>8.914E 01</td>
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<tr>
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<td>7.600E+05</td>
<td>4.856E-08</td>
<td>3.327E+03</td>
<td>8.954E 01</td>
</tr>
<tr>
<td>7.80</td>
<td>7.800E+05</td>
<td>4.721E-08</td>
<td>3.182E+03</td>
<td>8.993E 01</td>
</tr>
<tr>
<td>8.00</td>
<td>8.000E+05</td>
<td>4.591E-08</td>
<td>3.047E+03</td>
<td>9.031E 01</td>
</tr>
<tr>
<td>8.20</td>
<td>8.200E+05</td>
<td>4.470E-08</td>
<td>2.921E+03</td>
<td>9.067E 01</td>
</tr>
<tr>
<td>8.40</td>
<td>8.400E+05</td>
<td>4.355E-08</td>
<td>2.804E+03</td>
<td>9.103E 01</td>
</tr>
<tr>
<td>8.60</td>
<td>8.600E+05</td>
<td>4.251E-08</td>
<td>2.694E+03</td>
<td>9.137E 01</td>
</tr>
<tr>
<td>8.80</td>
<td>8.800E+05</td>
<td>4.151E-08</td>
<td>2.591E+03</td>
<td>9.171E 01</td>
</tr>
</tbody>
</table>

27
D. Example 4

Repeat Example 3, except assume that the aircraft is now flying through cirrus cloud.

1. Input Deck

The input deck required to evaluate this problem is as follows:

```
1
0 BELLY
 15
+0.14E-03 +0.20E-03 +0.90E-03
+0.15E-03 +0.22E-03 +0.11E-03
+0.20E-03 +0.27E-03 +0.18E-03
+0.16E-02 +0.55E-02 +0.13E-03
+0.10E-02 +0.17E-02 +0.40E-03
+0.30E-03 +0.80E-03 +0.12E-03
+0.50E-03 +0.55E-03 +0.23E-03
+0.85E-03 +0.11E-02 +0.40E-03
+0.17E-02 +0.27E-02 +0.10E-02
+0.24E-02 +0.29E-02 +0.15E-03
+0.22E-02 +0.29E-02 +0.16E-03
+0.15E-02 +0.42E-02 +0.18E-03
+0.18E-02 +0.65E-02 +0.30E-03
+0.19E-02 +0.50E-02 +0.62E-03
+0.20E-02 +0.46E-02 +0.60E-03

1
F=4 FIGHTER
 23 600 0 20 0
 0
+0.10 4 00 0.10

8 6 1 0
1=CIRRUS CLOUD
```
2. **Output Deck**

The program output is as follows:

---

**SRI STATIC ELECTRICITY MODEL**

---

- **P-STATIC MODEL EVALUATED FOR A F-4 FIGHTER AIRCRAFT WITH THE RECEIVING ANTENNA LOCATED AT THE BELLY**

<table>
<thead>
<tr>
<th>SCALE SIZE</th>
<th>SPEED [MPH]</th>
<th>ALTITUDE [KFT]</th>
<th>CLOUD TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.023</td>
<td>650.0</td>
<td>20.0</td>
<td>CIRRUS CLOUD</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>START FREQ [MHZ]</th>
<th>STOP FREQ [MHZ]</th>
<th>DELTA-F [MHZ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>4.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>RECEIVER NOISE [KHZ]</th>
<th>ANTENNA AREA [***2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>3.60</td>
</tr>
</tbody>
</table>

---

**ALL DISCHARGES PERMITTED**
SRI P-STATIC MODEL [CONT]

THE CALCULATED CHARGING CURRENT IS 3.300E-04 AMPS

THE PROBABILITY IS 0.061 THAT THE CHARGING CURRENT WILL BE GREATER THAN 3.300E-04 AMPS

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>FREQUENCY</th>
<th>SHORT-CIRCUIT CURRENT [AMPS]</th>
<th>EQUIVALENT NOISE FIELD [VOLS/M]</th>
<th>EQUIVALENT NOISE FIELD [DEV/M]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>1.000E-08</td>
<td>3.277E-08</td>
<td>1.732E-03</td>
<td>-5.522E-01</td>
</tr>
<tr>
<td>0.20</td>
<td>2.000E-08</td>
<td>6.547E-08</td>
<td>3.463E-03</td>
<td>+6.127E-01</td>
</tr>
<tr>
<td>0.30</td>
<td>3.000E-08</td>
<td>9.816E-08</td>
<td>5.193E-03</td>
<td>+6.486E-01</td>
</tr>
<tr>
<td>0.40</td>
<td>4.000E-08</td>
<td>1.246E-07</td>
<td>6.923E-03</td>
<td>+6.746E-01</td>
</tr>
<tr>
<td>0.50</td>
<td>5.000E-08</td>
<td>1.511E-06</td>
<td>8.653E-03</td>
<td>+6.953E-01</td>
</tr>
<tr>
<td>0.60</td>
<td>6.000E-08</td>
<td>1.776E-05</td>
<td>1.034E-02</td>
<td>+7.188E-01</td>
</tr>
<tr>
<td>0.70</td>
<td>7.000E-08</td>
<td>2.041E-04</td>
<td>1.204E-01</td>
<td>+7.381E-01</td>
</tr>
<tr>
<td>0.80</td>
<td>8.000E-08</td>
<td>2.306E-03</td>
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</tr>
<tr>
<td>0.90</td>
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<td>2.571E-02</td>
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<td>+7.765E-01</td>
</tr>
<tr>
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<td>1.000E-07</td>
<td>2.836E-01</td>
<td>1.714E-00</td>
<td>+7.968E-01</td>
</tr>
<tr>
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<td>1.100E-06</td>
<td>3.101E-00</td>
<td>1.884E-00</td>
<td>+8.161E-01</td>
</tr>
<tr>
<td>1.20</td>
<td>1.200E-06</td>
<td>3.366E-00</td>
<td>2.054E-00</td>
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</tr>
<tr>
<td>1.30</td>
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<td>2.224E-00</td>
<td>+8.547E-01</td>
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<td>1.500E-04</td>
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<td>2.564E-00</td>
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<td>9.198E-00</td>
<td>5.794E-00</td>
<td>+1.208E-00</td>
</tr>
<tr>
<td>3.50</td>
<td>3.500E-00</td>
<td>9.463E-00</td>
<td>5.964E-00</td>
<td>+1.223E-00</td>
</tr>
<tr>
<td>3.60</td>
<td>3.600E-00</td>
<td>9.728E-00</td>
<td>6.134E-00</td>
<td>+1.238E-00</td>
</tr>
<tr>
<td>3.70</td>
<td>3.700E-00</td>
<td>9.993E-00</td>
<td>6.304E-00</td>
<td>+1.253E-00</td>
</tr>
<tr>
<td>3.80</td>
<td>3.800E-00</td>
<td>1.025E-00</td>
<td>6.474E-00</td>
<td>+1.268E-00</td>
</tr>
<tr>
<td>3.90</td>
<td>3.900E-00</td>
<td>1.051E-00</td>
<td>6.644E-00</td>
<td>+1.283E-00</td>
</tr>
<tr>
<td>4.00</td>
<td>4.000E-00</td>
<td>1.077E-00</td>
<td>6.814E-00</td>
<td>+1.298E-00</td>
</tr>
</tbody>
</table>

30
E. Example 5

Using the streamering model, evaluate the ENF induced in an antenna mounted near the radome of a B-47 bomber due to cirrus-cloud-caused p-static charging. Assume that the antenna is 0.04 m aft of the front of the radome, and that the antenna has an induction area of 0.01 m$^2$. Assume that the minimum characteristic dimension of the radome is 0.24 m and that the ratio of the dielectric frontal area to the total aircraft frontal area is 0.01. Further assume that the size of the B-47 is 0.89 times the size of a KC-135, and that the B-47 is flying at 600 mph at 20,000 feet through cirrus cloud.

Evaluate the ENF at nonuniformly spaced frequencies of 1.13, 2.16, 4.35, 8.62, and 10.7 MHz for a receiver noise bandwidth of 1.0 kHz.

1. Input Deck

The input deck required to evaluate this problem is as follows:

```
2
NR RADOME
B-47 BOMBER
0.09 600.0 20.0
1
1.3E+00
2.16E+00
4.35E+00
8.62E+00
1.07E+01
C 10  1.00
1=CIRRUS
2=RADOME
0.04 0.24 0.30
C 0.01
```
2. Output Deck

The program output is as follows:

**SRI STATIC ELECTRICITY MODEL**

P-STATIC MODEL EVALUATED FOR A B-47 BOMBER AIRCRAFT WITH THE RECEIVING ANTENNA LOCATED AT THE NR RADOME

FOR STREAMING OCCURRING ON THE RADOME AND THE ANTENNA 0.04 METERS AFT OF THE FRONT OF THE RADOME AND A MINIMUM CHARACTERISTIC DIMENSION OF 0.24 METERS OF THE DIELECTRIC RADOME AND A FUSELAGE DIAMETER OF 0.30 METERS AND A DIELECTRIC AREA TO A/C FRONTAL AREA RATIO OF 0.01

<table>
<thead>
<tr>
<th>SCALE SIZE</th>
<th>SPEED</th>
<th>ALTITUDE</th>
<th>CLOUD TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>.89</td>
<td>600+0</td>
<td>20+0</td>
<td>CIRRUS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>START FREQ</th>
<th>STOP FREQ</th>
<th>DELTA-F</th>
</tr>
</thead>
<tbody>
<tr>
<td>[MHz]</td>
<td>[MHz]</td>
<td>[MHz]</td>
</tr>
<tr>
<td>1.13</td>
<td>10.70</td>
<td>NON-UNIFORM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECEIVER</th>
<th>ANTENNA</th>
<th>NOISE</th>
<th>BANDWIDTH</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>[kHz]</td>
<td>[kHz²]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>1.0</td>
</tr>
</tbody>
</table>
THE CALCULATED CHARGING CURRENT IS 8.900E-04 AMPS.

THE PROBABILITY IS 0.0022 THAT THE CHARGING CURRENT WILL BE GREATER THAN 8.900E-04 AMPS.

THE CALCULATED STREAMERING CURRENT IS 8.90E-06 AMPS.

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>[MHz]</td>
<td>[-2]</td>
</tr>
<tr>
<td>1.13</td>
<td>1.13E+06</td>
</tr>
<tr>
<td>2.16</td>
<td>2.16E+06</td>
</tr>
<tr>
<td>4.35</td>
<td>4.35E+06</td>
</tr>
<tr>
<td>8.62</td>
<td>8.62E+06</td>
</tr>
<tr>
<td>10.70</td>
<td>1.07E+07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SHORT-CIRCUIT CURRENT</th>
<th>EQUIVALENT NOISE FIELD</th>
<th>EQUIVALENT NOISE FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.299E-10</td>
<td>1.003E-04</td>
<td>-7.996E 01</td>
</tr>
<tr>
<td>2.928E-10</td>
<td>1.910E-05</td>
<td>-9.436E 01</td>
</tr>
<tr>
<td>6.883E-11</td>
<td>2.848E-06</td>
<td>-1.109E 02</td>
</tr>
<tr>
<td>1.913E-11</td>
<td>3.995E-07</td>
<td>-1.279E 02</td>
</tr>
<tr>
<td>1.260E-11</td>
<td>2.119E-07</td>
<td>-1.335E 02</td>
</tr>
</tbody>
</table>
Appendix

PSTAT PROGRAM LISTING
PSTAT COMPUTES THE EQUIVALENT NOISE FIELDS GENERATED IN AN AIRCRAFT ANTENNA DUE TO ELECTROSTATIC DISCHARGES OCCURRING FROM THE AIRPLANE EXTREMITIES. PSTAT COMPUTES THE EQUIVALENT NOISE FIELDS INDUCED IN AN AIRCRAFT ANTENNA DUE TO STREAMLINING DISCHARGES ON DIELECTRIC CANOPY OR RADIO SURFACES.

THE USER CAN SELECT EITHER MODE OF PROGRAM EXECUTION BY AN APPROPRIATE DATA CARD.


THE PROGRAM IS GENERALIZED, SO THAT AS ADDITIONAL COUPLING DATA BECOMES AVAILABLE, IT MAY BE INCORPORATED INTO THE PROGRAM. THE ADDITIONAL DATA MAY BE AN EXTENSION OF THE FREQUENCY RANGE OF THE EXISTING DATA (IN 1-MHZ INTERVALS, UP TO 100-MHZ), OR COUPLING DATA (AGAIN, IN 1-MHZ INTERVALS, UP TO 100-MHZ) FOR ANTENNAS LOCATED IN OTHER POSITIONS. THE COUPLING DATA USED IN PSTAT IS EXPERIMENTAL DATA OBTAINED FROM XC-135 SCALE MODEL AND FLIGHT TESTS, AND IS READ INTO THE PROGRAM FROM CARDS.

SRI HAS SUPPLIED 10 DECKS OF COUPLING DATA, EACH DECK CONSISTING OF 15-CARDS (0 TO 14-MHZ IN 1-MHZ INTERVALS). ONE DECK IS FOR EXTREMITY-TO-TAILCAP COUPLING, AND THE OTHER IS FOR EXTREMITY-TO-BELLY (FUSELAGE) COUPLING. THE USER SHOULD SELECT THE DECK APPROPRIATE TO HIS NEEDS.

SINCE THE SPECTRUM OF CORONA DISCHARGE NOISE FALLS OFF AS 1/F, A 100-MHZ FREQUENCY RANGE IS ADEQUATE TO HANDLE MOST CASES OF INTEREST, AND PSTAT PRESENTLY LIMITS THE CALCULATION TO FREQUENCIES AT OR BELOW 100-MHZ. SHOULD A HIGHER FREQUENCY RANGE BE DESIRED, A SIMPLER PROGRAM MODIFICATION MAY BE MADE TO DO SO, AFTER CONSULTING THE USERS GUIDE FOR DIRECTIONS.

DUE TO THE NATURE OF STREAMLINING, AND THE INPUT REQUIREMENTS FOR CALCULATING EQUIVALENT NOISE FIELDS, SEPARATE SECTIONS OF THIS PROGRAM ARE DEVOTED TO THE CALCULATION OF STREAMER NOISE OR CORONA NOISE. THE DESIRED SECTION IS SELECTED BY THE USER AS THE FIRST DATA CARD READ INTO THE PROGRAM. A 1 (ONE) ON INPUT IMPLIES SECTION ONE, THE CORONA SECTION. A 2 (TWO) ON INPUT IMPLIES SECTION 2, THE STREAMER SECTION.

****CONSTANTS DEFINITION****

LA=ANTENNA LOCATION ON EXTREMITY

IF LA=0, PGM ASSUMES THAT ANTENNA IS NOT LOCATED ON EXTREMITY
C IF LA=1, ANTENNA IS IN (OR NEAR) ELEVATOR TIP
   PSTA055
C IF LA=2, ANTENNA IS IN (OR NEAR) WING TIP
C IF LA=3, ANTENNA IS IN (OR NEAR) WING TIP
C LANT=14 CHARACTER ALPHANUMERIC DESCRIPTION OF ANTENNA LOCATION
C ERR= ERROR FLAG = SET=1 IF DATA INPUT ERROR OCCURS
C EPSIL= EPSILON = PERMITTIVITY OF FREE SPACE (FARADS/METER)
C NCQUP = NUMBER OF COUPLING COEFFICIENTS TO BE READ (NCQUP ALSO
C DEFINES THE MAXIMUM FREQUENCY + 1MHZ)
C ESTOP, WST, RST = STORAGE ARRAYS FOR NCQUP COUPLING COEFFICIENTS
C FROM ELEVATORS, WINGS, RUDDER TO SELECTED ANTENNA
C LOCATION
C NCQ= NCQUP + 1
C NRUN= NUMBER OF PROGRAM CYCLES TO BE MADE USING THE SAME COUPLING
C DATA BUT OTHERWISE VARIOUS OTHER PARAMETERS
C IBFF=CORONA DISCHARGE QUEEN CODE (AIRFOIL(S) P-STATIC PROTECTED)
C = 1-ALL DISCHARGES PERMITTED
C = 2-RUDDER DISCHARGE QUIETED BY 40 DB
C = 3-WING TIPS DISCHARGE QUIETED BY 40 DB
C = 4-ELEVATOR TIPS DISCHARGE QUIETED BY 40 DB
C = 5- RUDDER AND WING TIPS DISCHARGES QUIETED BY 40 DB
C = 6-RUDDER AND ELEVATOR TIPS DISCHARGES QUIETED BY 40 DB
C = 7-ELEVATOR AND WING TIPS DISCHARGES QUIETED BY 40 DB
C IT= 6 ALPHANUMERIC DESCRIPTION OF AIRCRAFT
C XM= AIRCRAFT SCALE SIZE (RELATIVE TO A KC-135)
C SR= AIRCRAFT SPEED (IN MILES/HOUR)
C ALT= AIRCRAFT ALTITUDE (IN KILOFEET)
C MODEF= FREQUENCY SELECT MODE (=EQ= 7 MEANS UNIFORM FREQUENCY
C INTERVALS; =NE= 0 MEANS USER SELECTED FREQUENCIES, UP TO
C 90)
C FSTRT= START FREQUENCY (IN MHZ) IF MODEF =EQ= 0
C FSTP=STOP FREQUENCY (IN MHZ) IF MODEF =EQ= 0
C DEL= DELTA FREQUENCY (IN MHZ) IF MODEF =EQ= 0
C NE= NUMBER OF FREQUENCIES TO BE EVALUATED IF MODEF =NE= 0
C FREQ= ARRAY TO CONTAIN USER SELECTED FREQUENCIES IF MODEF =NE= 0
C AANT= ANTENNA INDUCTION AREA (IN SQUARE METERS)
C BACK= RECEIVER NOISE BANDWIDTH (IN KHZ)
C ICL= ALPHANUMERIC DESCRIPTION OF CLOUD TYPE (SEE ICL9)
C ICL9= ICL= ALPHANUMERIC DESCRIPTION OF CLOUD TYPE (SEE ICL9)
C CLSU= FLOATING POINT ICL9
C SPF= SPEED FACTOR = CHARGING CURRENT IS RELATED TO AIRCRAFT
C SPEED THROUGH THIS FUNCTION
C CHG= CALCULATED CHARGING CURRENT (=DISCHARGING CURRENT) (IN AMPS)
C PROB= CALCULATED PROBABILITY OF CHARGING (=GT= CHG)
C ER= WORKING STORAGE ARRAYS FOR ELEVATOR, WING, AND RUDDER
C COUPLING COEFFICIENTS (MODIFIED TO ACCOUNT FOR ANTENNA
C INDUCTION AREA)
C RLUE=ELE=RUDDER DISTRIBUTION OF DISCHARGE CURRENT OVER VARIOUS
C AIRCRAFT EXTREMITIES
C O2R=O2E=O2W= DISCHARGE CURRENT SPECTRUM NORMALIZERS
C XCTU= MAXIMUM FREQUENCY OF COUPLING DATA
C F= FREQUENCY CURRENTLY BEING EVALUATED
C LF= COUNTER FOR FREQU
C EX= PRESSURE COEFFICIENT (PTRRR)=760*EX
C ALPHA= CORONA PULSE DECAY TIME CONSTANT
C
**CORONA PULSE AMPLITUDE**

**XX** = CORONA PULSE REPEITION RATE

**TEST** = FREQUENCY SCALLED TO AIRCRAFT SCALE SIZE

**XBX** = RADIAN FREQUENCY

**PREL** = RELATIVE PULSE SPECTRUM AMPLITUDE

**DB** = ASSUMED CORONA PULSE SPECTRUM AMPLITUDE SENSED

**IPL** = FIXED POINT LOW AND HI-FREQ BOUNDS FOR INTERPOLATION

**FLF** = FLOATING-POINT IPL

**PLF** = RADIX COUPLING COEFFICIENTS FOR INTERPOLATION BOUNDS

**PLF** = ELEVATE

**PLF** = WINS

**PI** = INTERPOLATION SCALER

**PEP** = COUPLING COEFFICIENT INTERPOLATED TO TEST FREQUENCY

**SEQP** = SEQUENCE NUMBER CURRENT SPECTRAL DENSITY

**B** = RADIUS RECEPTACLE

**SP** = SQRT(B

**SC** = COMPONENT SHORT-CIRCUIT NOISE CURRENT INDUCED IN ANTENNA

**SC** = TOTAL SHORT-CIRCUIT NOISE CURRENT (IN AMPS)

**S** = EQUIVALENT NOISE FIELD (VOLTS/METER)

**F** = FREQUENCY (IN Hz)

**EN** = EQUIVALENT NOISE FIELD (IN DB BEHIND 1 VOLT/METER)

**C** = CONSTANTS AND VARIABLES PARTICULAR TO STREAMER SECTION

**DF** = ANTENNA DISTANCE AFT OF STREAMER SOURCE (METERS)

**IG** = MATERIAL CODE - 1= CANDY, 2= PDRM

**CH** = CHARACTERISTIC DIMENSION OF DIELECTRIC SURFACE (METERS)

**ST** = STREAMER DISCHARGE CURRENT (AMPS)

**XI** = FLOATING-POINT MATERIAL CODE

**WX** = STREAMER SPECTRUM CONSTANT

**A** = STREAMER SPECTRUM CONSTANT

**B** = STREAMER SPECTRUM CONSTANT

**AL** = STREAMER SPECTRUM CONSTANT

**BE** = STREAMER SPECTRUM CONSTANT

**AR** = STREAMER SPECTRUM TERM

**FX** = STREAMER SPECTRUM TERM

**GL** = STREAMER SPECTRUM TERM

**C** = INPUT DATA FORMATS ARE DESCRIBED BELOW - THE NOTATION IS AS FOLLOWS

**N** = NUMBER

**D** = DECIMAL POINT (REQUIRED IN LOCATION WHEN SHOWN)

**A** = ALPHANUMERIC CHARACTER IF ALPHA WORD IS CALLED FOR

**S** = SPACE

**R** = AS APPROPRIATE

**X** = ALL FORMATS ILLUSTRATED BELOW ASSUME STARTING IN COLUMN 1,

**L** = RIGHT-JUSTIFIED

**NS** = ALPHANUMERIC

**NN** = NUMBER

**NC** = NUMBER (1, 2x)
C EST*,VST*,RST* (F9.+2.1X,E9.+2.1X,F9.+2.2X)
C  =**+X*XXE+NN symp+Y.XXE+NN+X*XXE+NNSS
C NRYW (1F3.2X)
C  =NNNS
C XFS (1F1.2X)
C  =**NS
C IT (6A2.2X)
C  =AAAAAABBBABB
C XNS=YS=ALT (F5.+2.1X,F6.+1.1X,F4.+1.2X)
C  =XX+YXSX+XX+XX+XX+XX
C YDEF (11.2X)
C  =**NS
C =FFS,FFS,FFS (3(F6.+2.1X)+1X), 9R*** DAFTW,JUSDI
C =XX+YXSX+XX+XX+XX
C NFR (1F3.2X)
C  =**NNNS
C FREQU (E9.+2.2X)
C  =**+X*XXE+NNSS
C AAYS,XNN (3(F5.+2.2X))  86*** DIERAT
C  =XX+YXSX+XX+XX
C ICBR,IC (11.1X,7A2), =**= IM,IMAT
C  =USAAAAAABBBABB
C DIVERSN= Z(10C),X(1C),R(1C),T(6),L(1),FREQU(90),LANT(7),IC(7)
C DIVERSN= EST(10C),VST(10C),RST(100),IMAT(7)
C
C ***FOMTAS**
C 39 FORMAT (6X,F9.+2.1X,4(1PE10.+3,7X))
C 79 FORMAT (4A2)
C 80 FORMAT (13.2X)
C 81 FORMAT (E9.+2.1X,9E8.2X,E9.+2.2X)
C 82 FORMAT (112.2X)
C 83 FORMAT (E9.2.2X)
C 84 FORMAT (F5.+2.1X,F6.11X,F4.12X)
C 85 FORMAT (3(F5.+2.1X),1X)
C 86 FORMAT (2(F5.+2.2X))
C 88 FORMAT (E9.2.2X)
C 89 FORMAT (11,1X,7A2)
C 200 FORMAT (1H1,25X,P8HSR1 STATIC ELECTRICITY MODEL,///)
C 203 FORMAT (4(10Y,24+++DATA INPUT ERROR+**1)///)
C 204 FORMAT (6X,31HP-STATIC MODEL EVALUATED FOR A,6A2,9H AIRCRAFT)
C 205 FORMAT (5X,10H SCALE SIZE,9X,5HSPEED,8X,8HALITUDE,8X,10H CLOUD TYPE)
C 206 FORMAT (2X,S9(MHZ),9X,SH(KFT))///
C 207 FORMAT (7X,F9.+2.11X,F6.+1,10X,F4.+1,10X,7A2,///)
C 208 FORMAT (5X,11HYSTART FREQ+4X,1CHSTOP FREQ+5X,MDELTA-F)
C 209 FORMAT (7X,SH(MHZ),12X,2(SH(MHZ),8X)///)
C 210 FORMAT (6X,F5.+2.10X,F6.28X,F5.+2///)
C 211 FORMAT (5X,8HRECEIVER,10X,7HANTENNA///5X,5HNOISE,13X,9HINDUCTION///
C A 5X,9H BAND WIDTH,10X,4HAREA///6X,SH(MHZ),13X,6H(M+2 ///)
212 \texttt{FORMAT(6X,E5.2,3X,FE.2//)}

214 \texttt{FORMAT(5X,34H THE CALCULATED CHARGING CURRENT IS, 1PE-10.3, 1X, 4H Amps, PSTA218 A/)}}

216 \texttt{FORMAT(1H1)}

217 \texttt{FORMAT(1H1,25X,26HSRI P-STATIC MODEL (CONTD)///)}

219 \texttt{FORMAT(5X,18H THE PROBABILITY IS, 1X, F6.4, 1X, 25H THAT THE CHARGING CURRENT IS, 3X, 1X, 4H Amps, PSTA222 A/)}}

220 \texttt{FORMAT(1X,20H WILL BE GREATER THAN, 1PE10.3, 1X, 4H Amps, PSTA223 ///)}

221 \texttt{FORMAT(5X,9HFREQUENCY, 5X, 13HSHERT-CIRCUIT 2, 5X, 10HEQUIVALENT)/// PSTA224}}

222 \texttt{FORMAT(36X,7HCURRENT, 3X, 2(11HNBISE FIELD, 5X///, 7X, 5H(MHZ), 9X, 4H(HZ), 11X, PSTA225}}

223 \texttt{FORMAT(6X,F6.2,10X, 6X, 7H(DBV/M))/// PSTA226}}

224 \texttt{FORMAT(5X,4H WITH THE RECEIVING ANTENNA LOCATED AT THE 41A2/// PSTA227}}

225 \texttt{FORMAT(5X, 5X,E6.2, 5X, 11HNB5E UNIFORM/// PSTA228}}

226 \texttt{FORMAT(5X, 5X, 24HALL DISCHARGES PERMITTED/// PSTA229}}

227 \texttt{FORMAT(5X, 5X, 32FBUBBER DISCHARGE PROHIBITED/// PSTA230}}

228 \texttt{FORMAT(5X, 5X, 30H TIPS DISCHARGE PROHIBITED/// PSTA231}}

229 \texttt{FORMAT(5X, 5X, 34HELEVAR TIPS DISCHARGE PROHIBITED/// PSTA232}}

230 \texttt{FORMAT(5X, 5X, 43FBUBBER AND WING TIPS DISCHARGE PROHIBITED/// PSTA233}}

231 \texttt{FORMAT(5X, 5X, 46FBUBBER AND ELEVATOR TIPS DISCHARGE PROHIBITED/// PSTA234}}

232 \texttt{FORMAT(5X, 5X, 44F ELEVATOR AND WING TIPS DISCHARGE PROHIBITED/// PSTA235}}

1001 \texttt{FORMAT(5X, 33H FPS STREAMING OCCURRING ON THE 7A2)}

1002 \texttt{FORMAT(5X, 16H AND THE ANTENNA, 28X, 22H METERS AFT OF THE FRONT OF THE 7A2)}

1003 \texttt{FORMAT(5X, 42H AND A MINIMUM CHARACTERISTIC DIMENSION OF 5X, 22H METERS OF THE DIELECTRIC 7A2)}

1004 \texttt{FORMAT(5X, 49H AND A DIELECTRIC AREA TO A/C FRONTAL AREA RATIO OF 22H/// PSTA239}}

1005 \texttt{FORMAT(5X, 47H AND 28H METERS)}

1027 \texttt{FORMAT(5X, 38H THE CALCULATED STREAMING CURRENT IS, 1PE8.2, 5H Amps PSTA244 A//// PSTA245}}

1028 \texttt{FORMAT(5X, 40H AND 28H METERS)}

C *DEFINE CONSTANTS

\texttt{PI=4*ATAN(1.0)}

\texttt{EERR=.0}

\texttt{EPSIL = (1.0/ (36.0+PI)) * 1.0E-09}

\texttt{C SELECT CORONA FP STREAMING PROGRAM OPTION}

\texttt{C 1=CORONA PROGRAM, 2=STREAMING PROGRAM}

\texttt{C READ 82\NSEC}

\texttt{C BRANCH TO APPROPRIATE PROGRAM SECTIONS}

\texttt{G8 TO (100,1000)\NSEC}

\texttt{C ***** CORONA DISCHARGE SECTION (PROGRAM OPTION 1) *****}

\texttt{100 CONTINUE}

\texttt{C *INPUT*}

\texttt{C READ ANTENNA LOCATION}

\texttt{READ 89\LX, (LANT(J),J=1,7)}

\texttt{C INPUT NUMBER OF COUPLING COEFFICIENTS TO BE READ}

\texttt{READ 80, NCoup}

\texttt{C READ IN THE -NCoup- COUPLING COEFFICIENTS}

39
C ZEROS BUT NON-USED PORTION OF ARRAYS

C READ NUMBER OF PROGRAM CYCLES

C READ NUR, NR

C READ AIRCRAFT TYPE

C READ A/C SCALE SIZE, SPEED, ALTITUDE

C READ FREQUENCY SELECT CODE

C READ IN FREQUENCY INTERVALS FROM FSTRT TO FSTP AT

C READ NUMBER OF FREQUENCIES TO BE EVALUATED

C READ IN FREQUENCY POINTS (IN MHZ)

C INPUT DATA ERROR CHECK

C ALLOW ROOM TO EXPAND ERROR CHECK

C PRINT INPUT DATA
C
PRINT 200
IF(IERR) 201,203,201
201 PRINT 203
202 PRINT 204, (IT(J), J=1,6)
PRINT 221, (LANT(J), J=1,4)
PRINT 205
PRINT 206
PRINT 207, XN, SPC, ALT, (IC(J), J=1,7)
PRINT 208
PRINT 209
IF(MDIF) 804, 305, 804
805 PRINT 210, FSTPR,FSTP,FDEL
GS T8 806
806 PRINT CONTINUE
PRINT 211
PRINT 212, RNDK, ALT
GS T8 (711,712,713,714,715,716,717), 18FF
711 PRINT 721
GS T8 718
712 PRINT 722
GS T8 718
713 PRINT 723
GS T8 718
714 PRINT 724
GS T8 718
715 PRINT 725
GS T8 718
716 PRINT 726
GS T8 718
717 PRINT 727
718 CONTINUE
C IF ERROR, THEN A REST RUN; ELSE CONTINUE
C IF(IERR) 27,26,27
27 PRINT 203
PRINT 216
GS T8 999
26 PRINT 217
C COMPUTE THE TOTAL CHARGING CURRENT TO THE AIRCRAFT
CLEV=FLAT(CLE)
SPDFA=((2.354E-09)*(SPD**3)) + (4.576E-06)*(SPD**2) + (6.65E-04)*SPD
APD
CHGC= 6.0757E-04*SPDFA*CL8U*XN
IF(CHGC<1.E-03) 700,700,701
700 PR8S*2.0/(CHGC+1.E+06)
GS T8 702
701 PR8S*2.0E+06/((CHGC+1.0E+06)**3)
702 IF(ALT<20.0) 704,704,705
704 PR8S*PR8S*CL8U*ALT/20.0
GS T8 706
705 PR8S*PR8S*CL8U*20.0/ALT
GS T8 706
706 CONTINUE
PRINT 214, CHGC
C *BEGIN CALCULATION*
C SCALE COUPLING COEFFICIENTS BY INDUCTION AREA
D9 J=1, NCUP
E(J)*EST(J)*AANT
W(J)*WST(J)*AANT
R(J)*RST(J)*AANT
32 CONTINUE
C SCALE COUPLING COEFFICIENTS BY SCALE SIZE UNLESS ANTENNA IS
C LOCATED AT OR NEAR A GIVEN EXTREMITY
SCAFAC=(1.0/nya)*(2.5)
IF(LA)(3110, 3110, 300?)
3005 G0 TO (3111, 3112, 3113, 3110), LA
3111 D9 J=1, NCUP
W(J)*W(J)*SCAFAC
R(J)*R(J)*SCAFAC
3120 CONTINUE
G0 TO 3114
3112 D9 J=1, NCUP
E(J)*E(J)*SCAFAC
R(J)*R(J)*SCAFAC
3121 CONTINUE
G0 TO 3114
3113 D9 J=1, NCUP
E(J)*E(J)*SCAFAC
W(J)*W(J)*SCAFAC
3122 CONTINUE
G0 TO 3114
3110 D9 J=1, NCUP
E(J)*E(J)*SCAFAC
W(J)*W(J)*SCAFAC
R(J)*R(J)*SCAFAC
3123 CONTINUE
3114 CONTINUE
C SCALE COMPONENT DISCHARGE CURRENTS
RUDI*0.182*CHGC
ELEI*0.364*CHGC
WINI*0.454*CHGC
C CALCULATE COMPONENT SPECTRUM NORMALIZERS
D2S=1.037E-06*SCAT(RUDI)
D2E=1.037E-06*SCAT(ELEI)
D2W=1.037E-06*SCAT(WINI)
C INITIALIZE FREQUENCY AND PRESSURE PARAMETERS
XGUP=FLOAT(NCUP)*1.0
IF(MODEF) 815, 816, 815
816 F=FSTRT
G0 TO 817
815 LF=1
F=FREQU(LF)
817 CONTINUE
EX=EXP(-((ALT + 0.002*(ALT**2))/25))
ALPHA = 2.111111E+07 + EX
A = 7.053457E+05 * (1760.0 + EX) * * (0.25)
XNU = 3.83767E+03 * (1760.0 + EX) * * (0.48)

C BEGIN FREQUENCY DEPENDENT CALCULATION
35 CONTINUE

TEST = XN
IF (TEST = XC8U) 36, 36, 38

36 CMEGA = 2.0 * PI * F * 1.0E+06
PREL = A * SORT(XNU/PI)/SORT( (CMEGA**2) + (ALPHA**2) )
DSMR = D2 * PREL
DSMR = D2 * PREL
DSMK = D2 * PREL

C CALCULATE SCALING COUPLING COEFFICIENTS
IFL = FIX(TEST)
IFH = IFL + 1
FL = FLPAT(IFL)
FH = FL + 1.0

PLR = (IFL+1)
PHR = (IFH+1)
PLE = (IFL+1)
PFH = (IFH+1)
PLW = (IFL+1)
PHW = (IFH+1)

RAT = (TEST - FL) / (FH - FL)
PR = PLR + (PHR - PLR) * RAT
PE = PLE + (PFH - PLE) * RAT
PW = PLW + (PHW - PLW) * RAT

C COMPUTE REST OF (CMEGA))
GSMR = PR + GSR
GSHR = PE + GSH
GSHR = PW + GSH

C COMPUTE SHORT-CIRCUIT NOISE CURRENT
SB = 2.0 * PI * 34 * 1000.0
SSB = SORT(3B)
SCB = GSH + SSB
SSHW = SSB

G9 T0 (308, 302, 353, 304, 305, 306, 307), 1FF

302 SCR = SCR / 100.0
G9 T0 308

303 SCW = SCW / 100.0
G9 T0 308

304 SCE = SCE / 100.0
G9 T0 308

305 SCR = SCR / 100.0
SCW = SCW / 100.0
G9 T0 308

306 SCR = SCR / 100.0
SCE = SCE / 100.0
G9 T0 308

307 SCE = SCE / 100.0
SCW = SCW / 100.0

PSTATA432
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PSTATA486
308 CONTINUE
C COMPUTE TOTAL SHORT-CIRCUIT NOISE CURRENT
SC=SQR((SCR**2) + (SCX**2) + (SCW**2))
C COMPUTE EQUIVALENT NOISE FIELD
ENF=SC/(6*MEGA*EPSILON*AANT)
PHI=180.0/CE+95
ENFDB=2.0*AL8G(ENF)/2.303
C OUTPUT RESULTS
PRINT 87, F,FH,SC,ENF,ENFDB
C INCREMENT F AND TEST FOR FREQUENCY RANGE COMPLETE
IF(MODEF) 820, 821, 820
821 F=F+FDEL
IF(F-ESTP) 35, 35, 40
820 LF=LF+1
F=FREQU(LF)
IF(LF-NFR) 35, 35, 40
40 G9 TO 999
C
C
C **** STEERING SECTION (PROGRAM OPTION 2) ****
1000 CONTINUE
C *** INPUT ***
C
C READ IN ANTENNA LOCATION
READ 79, (LANT(J),J=1,4)
C READ AIRCRAFT TYPE
READ 93, (IT(J),J=1,6)
C READ A/C SCALE SIZE, SPEED, ALTITUDE
READ 84, (XJ, J=1,4), ALT
C READ FREQUENCY SELECT MODE
C MODE *EC*0 = UNIFORM FREQUENCY INTERVALS FROM FSTRT TO FSTP AT
C INTERVALS OF FDEL
C MODE *NC*0 = USER SELECTED FREQUENCIES (UP TO 90)
READ LH, MODE
C TEST FOR MODE SELECT
IF(MODE) 1901, 19C2, 19C1
CC MODE *EC*0, READ FSTRT, FSTP, DELTA-F (IN MHZ)
1902 READ 85,FSTRT,FSTP,FDEL
39 TO 19C3
C MODE *NC*0, READ NUMBER OF FREQUENCIES TO BE EVALUATED
1903 READ 80,NFR
1801 READ 80,NFR
C READ IN NFR FREQUENCY POINTS (IN MHZ)
READ 88,(FREQ(J),J=1,NFR)
1803 CONTINUE
C READ ANTENNA INDUCTION AREA AND RECEIVER BANDWIDTH
READ 86, AANT, BNCH
C READ CLOUD TYPE (1=CIRRUS, 2=STRATO CUMULUS, 4=FRONTAL SNOW)
READ 89, ICOLB,(IC(J),J=1,7)
C READ IN CHARGING MATERIAL CODE AND MATERIAL
C MATERIAL CODE 1=WINDBLIND, 2=RADOME
C READ 89, IN,(IMAT(J),J=1,7)
C READ IN ANTENNA DISTANCE (METERS) AFT OF RADOME OR WINDBLIND
PSTAT487
PSTAT488
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PSTAT540
C AND MINIMUM CHARACTERISTIC DIMENSION OF DIELECTRIC SURFACE (METERS)
C AND FUSELAGE DIAMETER (METERS)
READ 85, PSTAT,XY,FUSDI
C READ IN RATIO OF DIELECTRIC AREA TO AIRCRAFT FRONTAL AREA
READ 92, DIEPAT
C ** PRINT INPUT DATA **
C
PRINT 200
PRINT 204,(IT(J),J=1,6)
PRINT 211,(LAT(J),J=1,4)
PRINT 121,(IMAT(J),J=1,7)
PRINT 1002,(CAF(J),IMAT(J),J=1,7)
PRINT 1009,(XX(IMAT(J),J=1,7)
PRINT 1006,FUSCI
PRINT 1004,DIEPAT
PRINT 205
PRINT 206
PRINT 237,XN,SPC,ALT,(IC(J),J=1,7)
PRINT 208
PRINT 209
IF(MODES) 1004,1005,1804
1805 PRINT 210,FSTAT,FPSTP,FDL
GS TO 1204
1804 PRINT 233,FPSTU(1),FRECUI,FR
1806 CONTINUE
C
PRINT 211
PRINT 212,END
PRINT 217
C COMPUTE THE TOTAL CHARGING CURRENT TO THE AIRCRAFT
CLBU=FLAT(ICL9)
C
SPDFA=((.-35.*4.66E-05)*(SP**31)*4.87E-05)*(SPD**2)*6.65E-04*SPD
CHGC= 6.0757*C4*SPDFA*CLBU*XN
IF(CHGC=1.E+03) 1700,1700,1701
1700 PR3=2.0/(CHGC*1.5*36)
GS TO 1002
1701 PR3=2.0E+06/(CHGC*1.06*06)**3)
1702 IF(ALT=20.0) 1704,1704,1705
1704 PR3=PR3*CLBU*ALT/20.0
GS TO 1706
1705 PR3=PR3*CLBU*ALT/20.0/ALT
1706 CONTINUE
PRINT 214,CHGC
PRINT 219,PR3,CHGC
C COMPUTE STREAMER CHARGING CURRENT
TEMP=DIEPAT*CHGC
GS TO (1710,1711.1)
1710 TEMP=TEM*0.5
1711 STRMI=TEMP
PRINT 1027, STRMI
PRINT 218
C ** BEGIN STREAMER NOISE CALCULATION **
C
C CONVERT DIELECTRIC PARAMETERS TO FEET FROM METERS
DAFT*DAFT/0.3076
FUSDI*FUSDI/0.3076
C COMPUTE COUPLING FUNCTION PS1
IF(DAFT) 1712, 1713, 1712
1713 PSI*300
Gb T= 1717
1712 GI T = (1715, 1715), IM
1715 PSI9NA=1.20E-32*(DAFT*FUSDI)
PSI*PSI*9NA*4AANT
Gb T= 1717
1716 PSI9NA=((DAFT)**(-4))*0.096+6.6E-05
PSI*PSI*9NA*4AANT
1717 CONTINUE
C INITIALIZE FREQUENCY PARAMETERS
IF(MODEF) 1815, 1816, 1815
1816 F=ESTRT
Gb T= 1817
1815 LF=1
F=FREQU(LF)
C CONTINUE
1817 CONTINUE
XIM=0.01
XXV=1.27E+05
XNU=STR'1/(1.5E-03)
A=0.597
B=0.403
ALP=1.7E+07
SET=3.47E+06
C BEGIN FREQUENCY DEPENDENT CALCULATION
1835 MEBA=2*0+1*E+06
C COMPUTE F(X/L)
ARG=WX8MEGA/(2*CXXV)
FXL=2.0*PSI*PSI*(1.0-(SIN(ARG)/ARG))
C COMPUTE LITTLE s8(MEGA)
T1=(MEGA+2)*(A+B)**2
T2=1.0*SET+3*ALP**2
B1=ALP=ALP*(3MEGA**2)
S2=SET*SET+(MEGA**2)
GLIT=(T1+T2)/(15MEGA**2)*B1+92
C COMPUTE BL 6 (MEGA)
R8M*XNU*XIM*XXV*XXV*GLIT*FXL/P1
C COMPUTE SHORT CIRCUIT CURRENT (SC)
SCM=2.0*PI*2.0/1000.0
S0M=SQRT(B8M)
RGM=SQRT(10M)
SC+R0M+RGM
C COMPUTE EQUIVALENT NOISE FIELD
IF(DAFT) 1903, 1904, 1903
1903 ENF*SC/(MEGA*EPSIL*AAANT)
1904 CONTINUE
C SETUP OUTPUT AND PRINT RESULTS
FH2=F*1.0E+06
IF (DAFT) 1900, 1901, 1900
1901 PRINT 39, F, FH2, SC
GO TO 1902

1900 ENFD=20.9*ALOG(ENF)/2.303
PRINT 39,F,FHZ,SC,ENF,ENFD

C INCREMENT F AND TEST FOR FREQUENCY RANGE COMPLETE

1902 CONTINUE

IF(MODEF) 1820,1821,1820

1821 F=F+FDEL
IF(F=FSTP) 1935,1935,999

1820 LF=LF+1
F=FREQU(LF)
IF(LF<=NFR) 1835,1835,999

999 CONTINUE
STOP

END

SUBROUTINE 4VER

PRINT 1

1 FORMAT( 45HCoupling DATA NON-EXISTENT BEYOND LAST LISTED! )
RETURN

END
REFERENCES


