Data SET CATALOG # 37

Alouette 1

Sweep Frequency Ionosonde
62-049A-01G 6 tapes

Sweep Frequency Ionosonde 'I'
62-049A-01I 1 tapes

Frequency vs Th-Reduced Ionograms
62-049A-01M 1 tape

Electron density profiles
62-049A-01N 3 tapes

Frequency vs Th-Reduced Ionograms
Duplicate data Removed

037

037

ALOUETTE 1

CRC N(H) DATA, SCALED POINTS
CRC N(H) DATA, N + HGT COEF

62-049A-01T
62-049A-01U

Table of Contents

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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP’s).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM:

http://nssdc.gsfc.nasa.gov/nmc/

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

a. Associated Documents — To find associated documents you will need to know the document ID number and then click here. http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/

b. Core Catalog Materials

ALOUETTE 1

SP10 00028

ARC N(H) & H SUMMARIES TAPE

62-049A-01I

This data set has been restored. There was originally 1 Binary 7-Track, 556 BPI tape. There is one restored tape. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The tape was created on an IBM 7094 computer. The DR and DS number along with the corresponding D number and the time span is as follows:

DR#	DS#	D#	FILES	TIME SPAN
DR03059	DS03059	D05516	1	10/31/62 - 1/27/64

ALOUETTE-1

CRC N(H) DATA, SCALED POINTS, TAPE

62-049A-01T

This data set has been restored. There were originally 2 9-track, 1600 BPI tapes written in EBCDIC. There is one restored tape written in EBCDIC. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The tapes were created on a Modcomp computer. The DR and DS numbers along with the corresponding D numbers and the time spans are as follows:

DR#	DS#	DD#	FILES	TIME SPAN
DR03634	DS03634	D61708	1	09/29/62 - 12/31/63
		D61709	2	01/01/64 - 03/30/66

ALOUETTE-1

CRC N(H) DATA, N + HGT COEF, TAPE

62-049A-01U

This data set has been restored. There was originally 1 9-track, 1600 BPI tape written in EBCDIC. There is one restored tape written in EBCDIC. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The tape was created on a Modcomp computer. The DR and DS numbers along with the corresponding D number and the time span is as follows:

DR#	DS#	DD#	FILES	TIME SPAN
DR03635	DS03635	D61710	1	11/19/62 - 12/16/71

ALOUETTE 1

SWEEP FREQUENCY IONOSONDE

62-049A-01G

556 BPI, BCD, 7 track, 1 file, IBM 7094.

D-NUMBER	C-NUMBER	TIME SPAN
D-00335	C-02136	9/29/62 - 10/05/63
D-00336	C-02137	10/01/62 - 6/24/64
D-00337	C-02138	1/4/63 - 12/31/64
D-00338	C-02139	9/30/62 - 3/30/66
D-001488	C-00971	01/04/63 - 12/31/64
D-001485	C-00970	10/20/62 - 03/30/66

SWEEP FREQUENCY IONOSONDE 'J'

62-049A-01I

556 BPI, BCD, 7 track, 1 file, IBM 7094.

D-NUMBER	C-NUMBER	TIME SPAN
D-05516	C-04027	10/31/62 - 1/27/64

FREQUENCY VS TH-REDUCED IONOGRAMS

62-049A-01M

556 BPI, BCD, 7 track, 1 file, IBM 7094.

D-NUMBER	C-NUMBER	TIME SPAN
D-05105	C-00049	1/22/63 - 7/28/68

ELECTRON DENSITY PROFILES

62-049A-01N

D-NUMBER	C-NUMBER	TIME SPAN
D-05527		9/29/62 - 9/7/63
D-05528		9/7/63 - 5/29/65
D-05529		5/29/65 - 3/30/66

USERS' GUIDE FOR N(h) ANALYSIS OF
CONVENTIONAL SF IONOGRAMS (PI-11D)

1. Introduction

Program PI-11D, stored in the NSSDC library, is an N(h) reduction program for converting ground based ionosonde data into vertical electron distributions. It uses the parabolic in log (N) lamination method of analysis (Doupnik and Schmerling, 1965; Jackson, 1971).

This document describes how to (a) prepare the computer input data from h'(f) data scaled from ionograms and (b) run the program. Full details on the interpretation and the scaling of the ionograms can be obtained from the "URSI Handbook of Ionogram Interpretation and Reduction" (Piggott and Rawer, 1961), and an extensive treatment of N(h) reduction techniques is given in the special issue of Radio Science, Vol 2, published in September 1967.

2. Brief description of the program

Essentially the program uses the O-trace to calculate a number (specified by the user) of trial N(h) profiles corresponding to different combinations of starting frequency and E-vally depth. A theoretical X-trace is computed for each trial N(h) profile and the standard deviation and average virtual height difference between the observed X-trace and each computed trace are calculated. The N(h) profile which leads to the minimum error is thus the most likely solution.

It should be appreciated, however, that the accuracy of the derived electron distributions depends critically on the quality of the ionograms. It is doubtful, therefore, whether it is worth taking account of the effects of the E-valley if the E-valley cusp is poorly defined or if the ionograms can not be scaled to an accuracy of better than 0.1 MHz in frequency and 5 km in virtual height (those recorded on photographic paper, for example).

3. Data Input

The program uses data cards containing the following parameters:

CARD	PARAMETERS	FORMAT	COMMENTS
1	KZN, HTN,GN,GIN	I10.3F10.4	Remain in deck at all times; rarely changed
2	KZD,GD,GID,DELF	I10,3F10.4	
3	TITLE	20A4	Heading for printer Output
4	TITLE	20A4	
5	N,IYR,MO,MD,ITI, IDY,NV,LVA	8I10	The remaining cards are supplied for each ionogram
6	HT,DIP,FHS,DLAT, DLONG,XDATA,RUN,VAL START	6F10.4,F4.1 2F8.4	
7...k	HP(I),N(I),I=1,N	8F10.4	O-trace data in pairs 4 pairs/card
k +1...k + 3	HPXD (I),FXD (I), I = 1, 10	8F10.4	X-trace data in pairs, 4 pairs/card

3.1 Definition of the parameters

Night-time parameters:

KZN Number of trial starting frequencies - usually 8.

HTN Starting height - usually 150 km.

GN First trial starting frequency-usually 0.1 MHZ.

Day-time para-meters	GIN	Increment by which starting frequency is increased-usually 0.1 MHz.
	KZD	Number of trial starting frequencies - usually 3.
	GD	First trial starting frequency-usually 0.16 MHz.
	GID	Increment by which starting frequency is incresed-usually 0.1 MHz.
	DELF	Increment by which E-valley depth is increased below foE-usually 0.2 MHz.
	TITLE	Two cards are used for providing a heading to the computed results.
	N	Number of data points scaled from the O-trace.
	IYR	Year; for example, 1970 is given as 70.
	MO	Month.
	MD	Day.
	ITI	Local standard time(Hrs. Mins. Secs) eg 1724 30.
	IDY	Day of the year.
	NV	1 + number of data points scaled between f_{min} and foE inclusive.
	LVA	Number of trial valley depths, i.e., 1 + LVA profiles are computed for each starting frequency with depths of 0, DELF, 2 DELF......LVA x DELF MHz.
	HT	Starting height. If less than 120 km, 'Daytime parameters' assumed for calculating trial N(h) profiles.
	DIP	Estimated magnetic dip at starting height; recalculated in program.
	FHS	Estimated gyrofrequency at starting height; recalculated in program.
	DLAT	Geographic latitude (north positive)

DLONG Geographic longitude (east positive).

XDATA $XDATA = 0.0$ if X-trace data are available. Otherwise, set $XDATA = -1.0$ and set all X-trace to zero on the data cards.

RUN $RUN = 1.0$ for special run, in which case VAL and START must be assigned values. Otherwise, RUN, VAL, $START = 0.0$.

VAL $\left[\dfrac{\text{Minimum electron concentration in the E-valley}}{\text{Electron concentration corresponding to foE.}}\right]$

START $\left[\dfrac{\text{Starting frequency}}{\text{foE}}\right]$

F(1), HP(1) $F(1) = 0.0$ always. HP(1) = starting height (HT).

F(2), HP(2) $F(2) = f_{min}$ HP(2) = virtual height of f_{min}.

F(3), HP(3) ... F(N), HP(N) O-trace frequencies and corresponding virtual heights scaled at any frequency interval. It is unnecessary to scale more than about 25 points.

FXD(1), HPXD(1) ... FXD(10), HPXD(10) X-trace frequencies and corresponding virtual heights. Ten points should be scaled, five of which should be close to the E-layer cusp on the X-trace.

4. Printer output

Three pages of output are provided for each ionogram. The first two show inout data and details of the calculations. The third is a summary of the results. This output includes:

O-trace input data
The magnetic dip and gyrofrequency at the starting height.
The electron concentration and gyrofrequency at, and the height of, the refection point of the coded O-trace frequencies.
Extrapolated values of hmF2 and NmF2.
Extrapolated values of electron concentration at 10 km intervals between $h_{f(N)}$ and hmF2.
The computed X-trace.
A detailed comparison of the observed and computed X-traces.
Standard deviation and average difference between the observed and computed X-traces.
Interpolated electron concentration at fixed densities

Interpolated electron concentration at 10 km intervals above the E-valley.

Each record consists of ID, then pairs of values (N_e and ht). If at the end one of these pairs, an octal 77 (a vertical bar, |, on this printout) occurs, the data following the bar is invalid until begining of the next physical record (ID). See example on record 63 attached.

L. Dubach

D. Little

TADG
DB0335

62-049A-01G
" " 01N

ALOUETTE I IONOSPHERIC DATA N(h)

FORMAT

Column 1	4	The data are N(h) profiles
Column 2	X or 0	X appears when an Extraordinary wave was used 0 appears when an Ordinary wave was used
Column 3	T or B	Topside or Bottomside sounder
Colum 4 - 6	DIP	Angle of dip of the earth's magnetic field at the satellite
Column 7 - 8	Q	Quality of the ionogram, according to a code in which 4 refers to best and 9 refers to minimal information. (Use 7 to 9 with caution.) 0 refers to tabulations made before code was established.
Column 9	Blank	
Column 10 - 11	Year	
Column 12	Blank	
Column 13 - 15	Day	Day of the year
Column 16	Blank	
Column 17 - 20	GMT	Universal time at which the ionogram was recorded in hours, minutes, and seconds. (The time given is for 3.0 $\pm$ 1 sec before the occurrence of the 0.5 Mc/s freguency marker.)
Column 21	Slash/	
Column 22 - 23	Seconds	
Column 24	X	For internal use by observers
Column 25 - 31	FOF2*	The Ordinary wave frequency (in Mc/s) corresponding to the highest number density computed for the ionogram. This is always less than, or equal to, the Ordinary wave penetration frequency of the F layer.
Column 32 - 38	HMAX	

ALOUETTE I IONOSPHERIC DATA N(h)

FORMAT

Column 39 - 49	TOTALN	Integral of N, the number of electrons in a column 1 cm^2 in horizontal cross section extending from the satellite to the height corresponding to FOF2*. This number is expressed in units of 10^{11} electrons per square centimeter column.
Column 50 - 52	P	Number of frequencies used for computing the N(h) profile.
Column 53 - 57	FH	Gyrofrequency at the satellite in Mc/s
Column 58 - 64	LONG	Longitude
Column 65 - 71	LAT	Latitude
Column 72 - 74	CHI	Solar zenith angle, χ

62-049A-01I

Alouette I
(Ionograms)
Tape Format

FIELD	COL.(S)	BYTES	FORMAT	DESCRIPTION
1	1-5	5	I	Pass number
2	6-12	6	A	Station name
3	13-17	5	I	Local time (HHMM)
4	18-22	5	F	Electron density at 1000 KM
5	23-27	5	F	Electron density at 900 KM
6	28-32	5	F	Electron density at 800 KM
7	33-37	5	F	Electron density at 700 KM
8	38-42	5	F	Electron density at 600 KM
9	43-47	5	F	Electron density at 500 KM
10	48-52	5	F	Electron density at 400 KM
11	53-57	5	I	Longitude in degrees
12	58-61	5	I	Latitude in degrees
13	62-65	4	I	DIP Latitude in degrees
14	66-70	5	I	Scale heights at 900 KM
15	71-75	5	I	Scale heights at 700 KM
16	76-80	5	I	Scale heights at 500 KM
17	81-74	4	I	Universal Time (HHMM)
18	85	1	I	Sequence/Universal Time
19	86-90	5	I	Date (YYDDD)

TO ACQUISITION FILE

FROM: COMPUTER SERVICES

ALOUETTE 1

DRTF FREQ/TH

Experiment 62-049-01G

Tape Number D-00336

Volume 2

Book 1 and 2

Physical Record 5328

Character #159 is blank

Sample 39 =

Should be 391

See listing from Interim Data Set.

DATA USERS' NOTE

NSSDC 67-29

ALOUETTE 1 (1962 BETA ALPHA 1)

TOPSIDE SOUNDER

JULY 1967

NATIONAL SPACE SCIENCE DATA CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.

DATA USERS' NOTE
NSSDC 67-29

ALOUETTE 1 (1962 BETA ALPHA 1)
TOPSIDE SOUNDER

INVESTIGATORS
G. L. B. Nelms
E. Warren
E. L. Hagg
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J. W. King
R. Fitzenreiter
J. E. Jackson

JULY 1967

FOREWORD

This Data Users' Note is specifically designed to help potential data users decide if they can make use of the data obtained in the Alouette 1 (1962 Beta Alpha 1) topside sounder experiment. Once a data user decides that he requires the data, it will serve as the unifying element – the key – in the actual use of the data available at the National Space Science Data Center (NSSDC). To achieve these goals, the Note briefly describes the experiment, including the instrumentation and measurements, the telemetry, and the operational experience. All available details are then provided on the actual reduction techniques and format of recorded data. For those desiring more details, names and addresses of the investigators are provided to facilitate direct contact. As a further aid, detailed references (and bibliography) are also included. When available, NASA accession numbers* are given. The primary purpose of these references is to identify the sources containing complete information concerning the subject under discussion. Most of these references are physically available at NSSDC – those that are not are readily obtainable.

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*For example, N64-2243 is an accession number for an article reported in the *Scientific and Technical Aerospace Reports* (STAR), and A63-5921 refers to an entry in the *International Aerospace Abstracts* (IAA).

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ALOUETTE 1 (1962 BETA ALPHA 1)
TOPSIDE SOUNDER

BACKGROUND

The Alouette 1 topside sounder satellite was launched on September 29, 1962, from the Pacific Missile Range. The Canadian Defence Research Telecommunications Establishment (DRTE) of Ottawa, Canada, proposed and constructed the satellite in cooperation with NASA. The orbital period of Alouette 1 was 105.5 min and the inclination was 80.5 deg to the equatorial plane. The spacecraft achieved a nearly circular orbit having an apogee of approximately 1030 km and a perigee of 998 km.[1,2]

The topside sounder instrumentation was one of the four experiments on Alouette 1, as shown in Figure 1. The primary data collected from the topside sounder underwent several different methods of reduction by DRTE scientists, as well as by scientists at Ames Research Center (ARC), Goddard Space Flight Center (GSFC), the Institute for Telecommunication Sciences and Aeronomy (ITSA), and the Radio and Space Research Station (RSRS). These data are grouped according to the arrangement shown in Figure 1.

INVESTIGATORS

G. L. B. Nelms – Defence Radio Telecommunications Establishment*
E. Warren – Defence Radio Telecommunications Establishment*
R. Fitzenreiter – Goddard Space Flight Center**
J. E. Jackson – Goddard Space Flight Center**

See the "Data" section for the names and current addresses of other investigators.

EXPERIMENT

Instrumentation and Measurements

The topside sounding technique used in Alouette 1 was an extension of the sounding method used for routine ionospheric sounding observations from the ground. In general, this equipment consists of a low frequency radar system

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*Address: Defence Radio Telecommunications Establishment, Shirley Bay, Ottawa 4, Ontario, Canada.

**Address: Goddard Space Flight Center, Code 615, Greenbelt, Maryland 20771.

FIGURE 1

ALOUETTE 1 EXPERIMENTS

No.	Experiment	Investigator(s)	Affiliation
01	Topside Sounder	G. L. B. Nelms E. Warren R. Fitzenreiter J. Jackson	DRTE[a] DRTE[a] GSFC[b] GSFC[b]
	A – Ionograms (Primary Data)	G. L. B. Nelms	DRTE[a]
	B – Alosyn	E. L. Hagg	DRTE[a]
	C – Synoptic Data	W. Calvert	ITSA[c]
	D – Electron (Number) Density Profiles	G. L. B. Nelms G. E. K. Lockwood	DRTE[a] DRTE[a]
	E – Electron Density Profiles	W. Calvert T. E. Van Zandt J. W. King	ITSA[c] ITSA[c] RSRS[d]
	F – Electron Density Profiles and Scale Height Profiles	J. O. Thomas M. J. Rycroft L. Colin K-L. Chan	ARC[e] ARC[e] ARC[e] ARC[e]
02	Energetic Particle Counters	D. C. Rose I. B. McDiarmid	NRC[f] NRC[f]
03	VLF Receiver	J. S. Belrose R. Barrington	DRTE[a] DRTE[a]
04	Cosmic Noise	T. R. Hartz	DRTE[a]

a – Defence Research Telecommunications Establishment (Canada)
b – Goddard Space Flight Center
c – Institute for Telecommunication Sciences and Aeronomy (formerly known as Central Radio Propagation Laboratories, CRPL)
d – Radio and Space Research Station (formerly known as Radio Research Station, Great Britain)
e – Ames Research Center
f – National Research Council (Canada)

NOTE: Some of the affiliations have changed since the time of the Alouette 1 experiments. Current addresses are provided in the descriptions of the individual data sets.

in which the carrier frequency is swept from 1 Mc/s to about 20 Mc/s. The transmitted Ordinary wave signals propagate downward in the ionosphere and are subsequently reflected when they reach a region of electron density, N, which is given by[3]

$$N = 1.2388 \times 10^4 f^2$$

where

N = electron density per cm^3, and

f = frequency in Mc/s of the Ordinary ray†

The topside sounding instrument in Alouette 1 is basically a pulsed transmitter and receiver tuned to the transmitter wave frequency in order to obtain echo returns from the ionosphere. The wave frequency is continuously varied from 0.5 to 11.5 Mc/s at a rate of 1 Mc/s^2. The time required for one complete sweep is approximately 12 sec, during which time the satellite traveled a distance of about 80 km. The time interval between ionograms is about 18 sec, which corresponds to a distance of about 125 km.[3]

Telemetry

The output of the receiver was telemetered to the ground via a two-watt transmitter which operated in the 136-Mc/s band. The system operated on command from the ground, obtaining and telemetering data for a 10-min period after which it turned off automatically.

The telemetry signals were recorded on magnetic tape and were subsequently transcribed onto 35-mm film. In this manner, a photographic record was provided showing the variation of the virtual depth of reflection beneath the satellite, P', as a function of the frequency, f, of the transmitted radio waves.[1]

Operational Experience

The Alouette tracking stations, as shown in Figure 2, are situated in locations which provided for successive monitoring from 80°N to 80°S.[4] Since the satellite orbit rotated only 0.99° per day, three months were required to sample all local times at the equator.[5] Ionograms are still being recorded at the time of publication of this Note.

†By agreement, all investigators use 1.24×10^4 as the multiplicative constant.

FIGURE 2

LOCATION AND COVERAGE OF ALOUETTE 1 TELEMETRY STATIONS

DATA

Introductory Remarks

As stated earlier in this Note, the variable depths of reflection below the satellite, P', of radio pulses vertically incident on the topside ionosphere were measured as a function of frequency, f. The frames of 35-mm film showed traces of the P'(f) data. From these traces, or ionograms, various methods of data reduction were used to obtain the data sets listed in Figure 1.

The virtual depth of reflection below the satellite, P', is defined by $P' = 1/2\, ct$, where c is the speed of light and t is the travel time. Since the radio pulse did not travel in a vacuum, but in a plasma, the actual distance traveled differed from the virtual depth. If h is the real depth of reflection below the satellite, then for the Extraordinary trace:

$$P'(f) = \int_{fos}^{f_{Nr}} M' \frac{dh}{df_N}\, df_N$$

where

f = the measured Extraordinary wave frequency on the ionogram trace

$f_{Nr} = (f^2 - ff_H)^{1/2}$ = plasma frequency at the reflection point

f_H = the gyrofrequency for an electron in the earth's magnetic field for the position corresponding to h

$fos = (f_{xs}^2 - f_{xs}\, f_{Hs})^{1/2}$ where the s denotes the frequencies at the position of the satellite. fos is the plasma frequency at the satellite.

f_{xs} = the frequency at which the Extraordinary trace had zero range

M' = the group refractive index of the Extraordinary ray, which may be calculated from the Appleton-Hartree Magneto-ionic equation, and,

f_N = the plasma frequency (considered as a variable dependent upon the altitude).[1]

The following pages include a brief description of the primary data set (ionograms) and the derived data sets, as well as a summary of the reduction techniques involved for each set. These descriptions are arranged in the order in which they appear in Figure 1.

A – Ionograms

Investigator

G. L. B. Nelms – Defence Radio Telecommunications Establishment

The Alouette ionograms exhibit plasma resonances, echoes from Ordinary, Extraordinary and Z plasma modes, and echoes from below the F2 maximum atmospheric layer reflections. The ionograms, on 35-mm film, were directly recorded from the analog record. The analog record contained time, frequency versus virtual depth signals, and frequency markers. These markers occurred at 0.5, 1.5, 2.0, 2.5, 3.5, and 7.0 Mc/s and were generated on board the satellite. The vertical lines, showing frequency (see sample in Figure 3), were constructed from the frequency markers at the time of filming.

The frequency lines began at any point and moved downward to the bottom of the ionogram, and once again moved from top to bottom. The beginning point, or the left extreme of the frequency lines, gives the exact frequency values as shown in Figure 3.

Several methods of time coding appear on the filmed ionograms. These are shown in Figures 4-7.* In each of these figures, an actual photograph of an ionogram containing a certain type of code is shown along with a schematic representation of the coded ionogram. Figure 4 shows a Horizontal Binary Dot Coding. The time code is represented along the lower edge of the ionogram in binary code. The code is formed by representing each character by a vertical grouping of dots representing various powers of 2 with decreasing magnitude found in the forward direction. The code beds are located as follows:

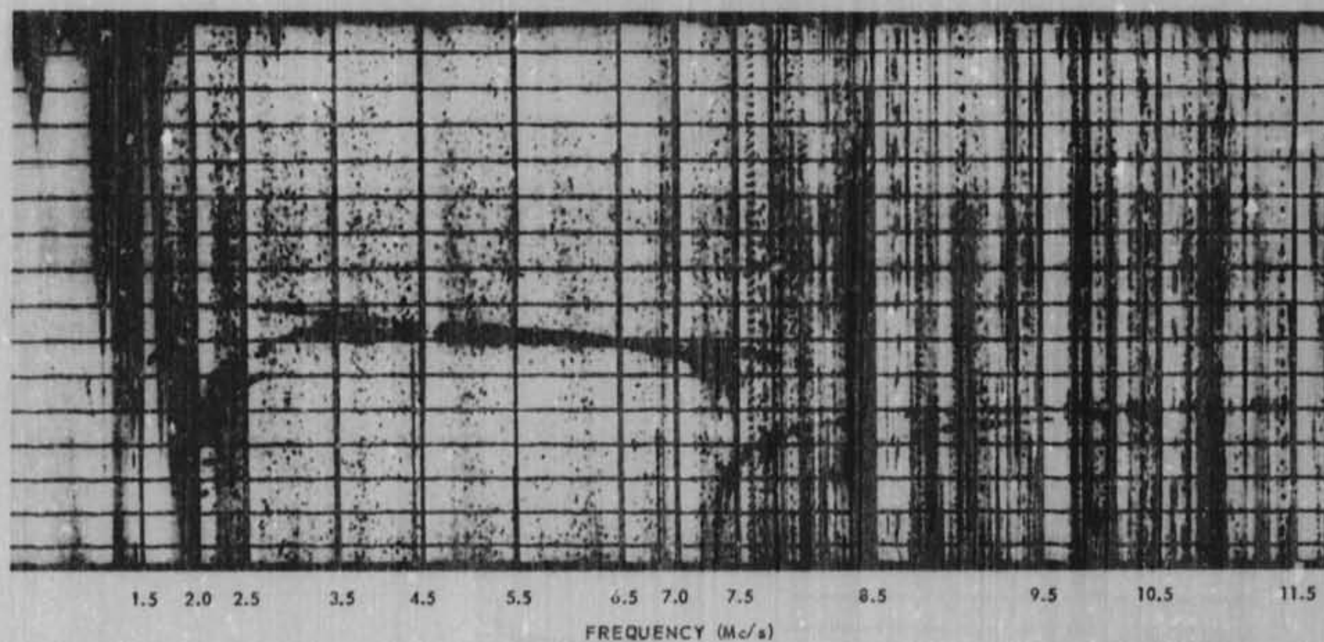
the first three vertical dot groupings representing the day,
the fourth and fifth groupings representing the hour,
the sixth and seventh representing the minutes,
the eighth and ninth representing the seconds, and
the tenth and last vertical group of dots representing the station number.

Figure 5 illustrates a display of Vertical Binary Dot Coding. This system of coding is identical to the horizontal coding except that the code groupings run vertically upward from the bottom left of the ionogram. This code is most easily read with the ionograms in the vertical position with the frequency markers

*At times, the identification is not complete. For example, Figures 4 and 5 do not indicate the year–complete identification can be obtained from the film log sheets.

FIGURE 3

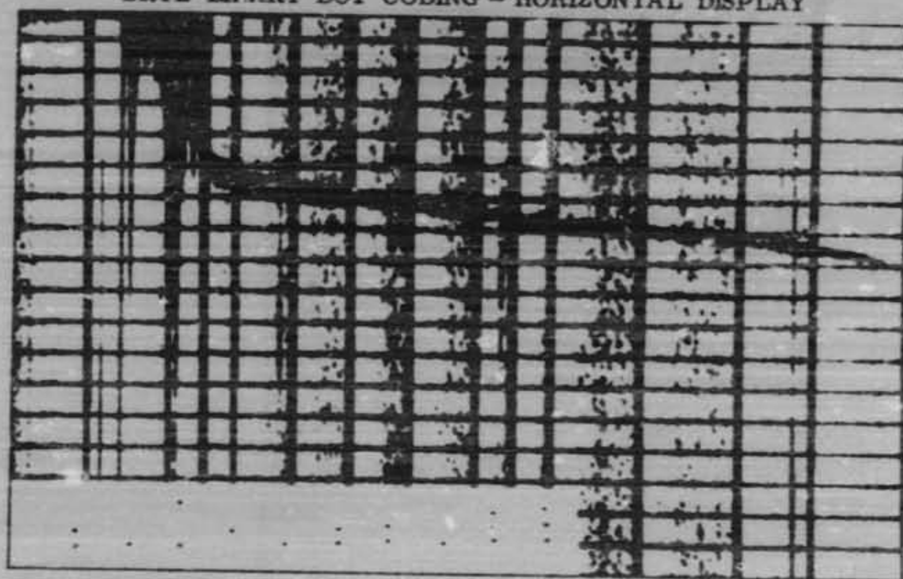
SAMPLE OF TYPICAL IONOGRAM



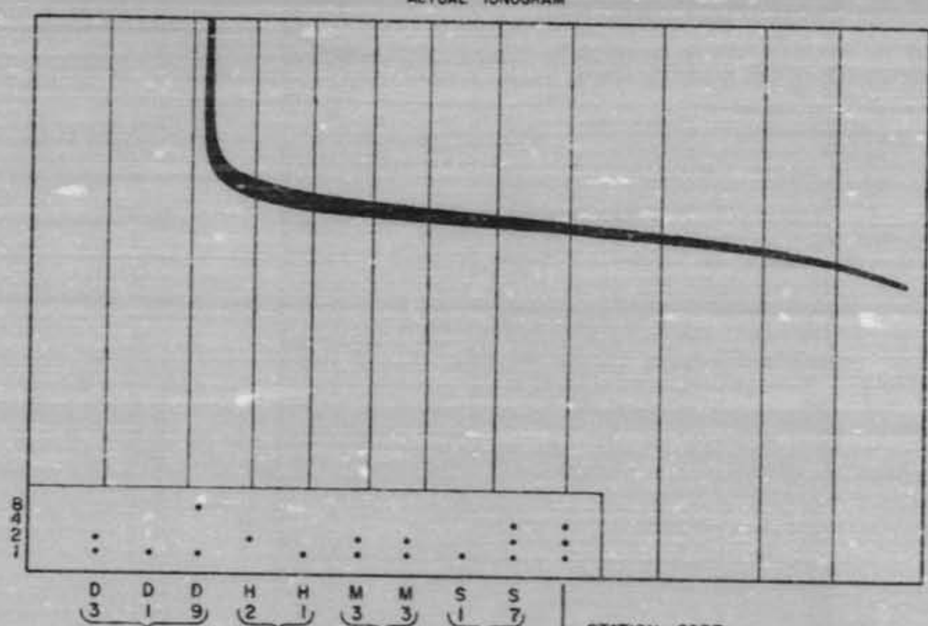
NOTE: The frequency lines and lines of virtual depth are not labelled on the 35-mm frames. The lines have essentially the same values on all frames.

FIGURE 4

DRTE BINARY DOT CODING - HORIZONTAL DISPLAY



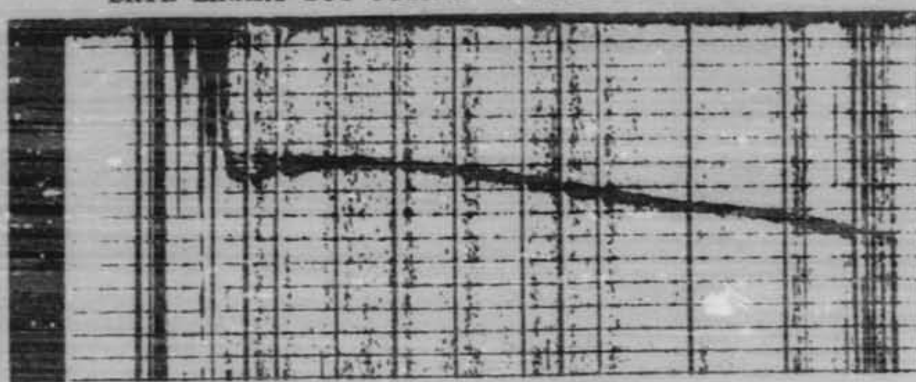
ACTUAL IONOGRAM



IONOGRAM SCHEMATIC

FIGURE 5

DRTE BINARY DOT CODING – VERTICAL DISPLAY

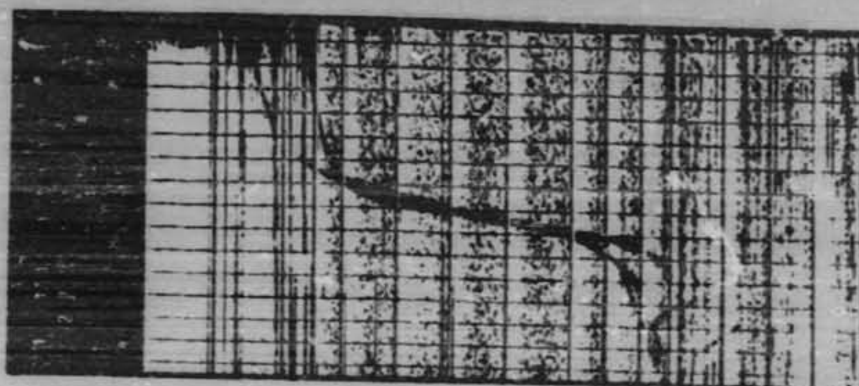


ACTUAL IONOGRAM

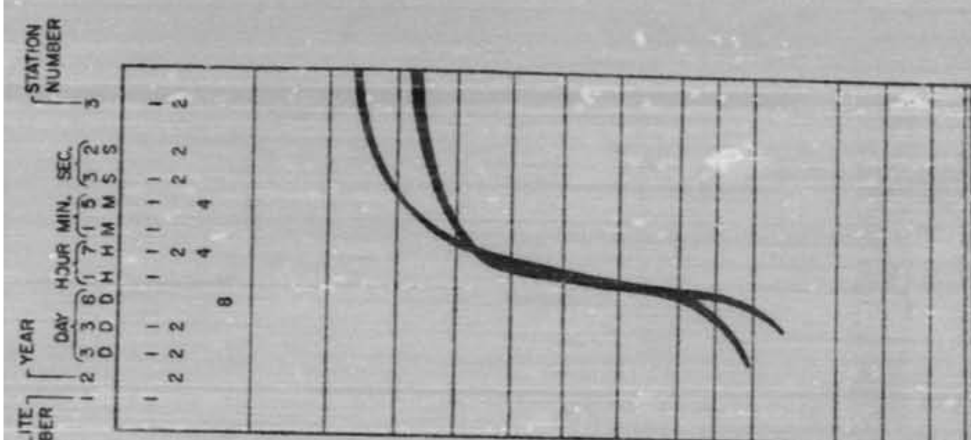
IONOGRAM SCHEMATIC

FIGURE 6

DRTE BINARY DIGITAL CODING



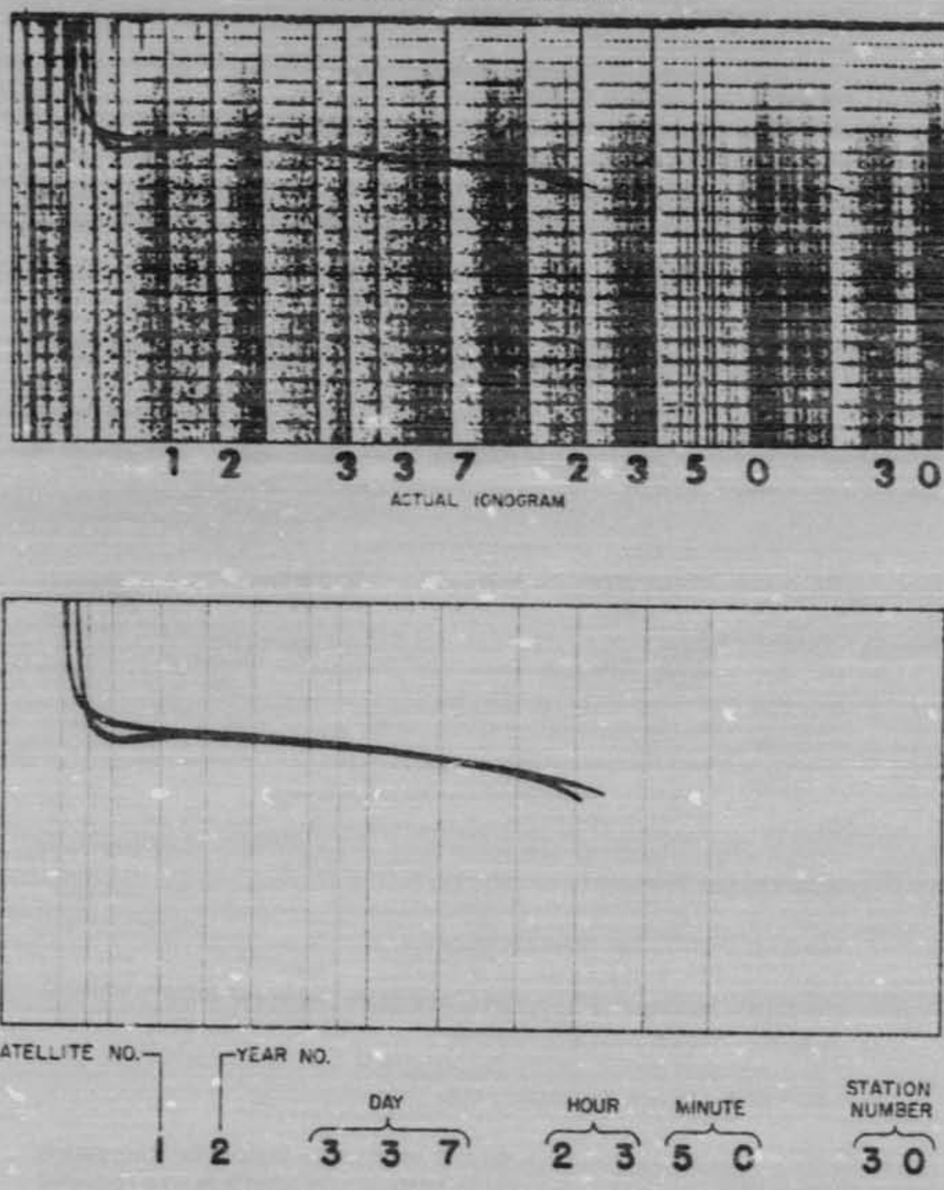
ACTUAL IONOGRAM



IONOGRAM SCHEMATIC

FIGURE 7

NUMERICAL TIME CODING



increasing in the downward direction. The code is then read with the significance of binary code beds from left to right as follows:

the first three vertical groupings representing the day,
the fourth and fifth groupings representing the hour,
the sixth and seventh representing the minutes,
the eighth and ninth representing the seconds, and
the tenth representing the station code.

When the ionogram is held in the vertical position, the higher powers of two are at the top.

A third method of time coding, shown in Figure 6, is the Binary Digital Coding. This is a vertical display in which arabic numerals are used instead of dots and two extra code groupings are added to give the satellite number and last digit of the year. The coding is located on the left edge of the ionogram and is best read with the numerals in the upright position. The sum of the digits in each vertical code grouping gives the number to be represented. The significance of the code groupings running from left to right is as follows:

the first group gives the satellite number,
the second group gives the last digit of the year,
the third, fourth, and fifth groups give the days since the start of
the year,
the sixth and seventh groupings give the hours,
the eighth and ninth groupings give the minutes,
the tenth and eleventh groupings give the seconds, and
the twelfth and thirteenth groupings give the station number.

An additional Numerical Time Coding is given in Figure 7. This code is printed in arabic numerals at the bottom of the ionogram. The significance of the numerals from left to right is as follows:

the first digit is the satellite number,
the second is the last digit of the year,
the third, fourth, and fifth digits are the days of the year,
the sixth and seventh are the hours,
the eighth and ninth are the minutes, and
the last digits are the station code.

The Alouette telemetry station code list is given in Figure 8. The station number, three-letter code, and geographic latitude and longitude are included for each station.

FIGURE 8

CODE LIST FOR ALOUETTE TELEMETRY STATIONS

STATION NAME	STATION NUMBER	3-LETTER CODE	GEOGRAPHIC LAT.	GEOGRAPHIC LONG.
Antofagasta, Chile	8*	ANT	23.6S	70.3W
Blossom Point, Maryland	14*, 1	BPT	38.4N	77.1W
Boulder, Colorado	46	BLR	40.1N	105.1W
College, Fairbanks, Alaska	5*, 13	COL	64.9N	147.8W
Darwin, Australia	65	DAR	12.5S	130.8E
East Grand Forks, Minnesota	13*, 14	GRK	48.0N	97.1W
Fort Myers, Florida	6*, 3	FTM	26.6N	81.9W
Gilmore Creek, Fairbanks, Alaska	49	GIL	65.0N	147.5W
Johannesburg, South Africa	16	JOB	25.9S	27.7E
Kano, Nigeria	53	KNO	12.0N	8.5E
Kauai, Hawaii	37	HAW	22.1N	159.7W
Lima, Peru	6	LIM	11.8S	77.2W
Mojave, California	17	MOJ	35.3N	116.9W
Orroral Valley, Australia	21	RAL	35.6S	149.0E
Ottawa, Canada	3*, 50	OTT	45.4N	75.7W
Prince Albert, Canada	2*, 44	PRI	53.2N	105.9W
Quito, Ecuador	7*, 5	QUI	0.6S	78.6W
Resolute Bay, No. W. Territories	1*, 43	RES	74.7N	95.0W
Rosman, No. Carolina	20	ROS	35.2N	82.9W
St. John's, Newfoundland	4*, 12	NEW	47.6N	52.4W
Santiago, Chile	8*, 8	SNT	33.2S	70.1W
Singapore, Malaysia	11*, 48	SNP	1.3N	103.8E
South Atlantic, Falkland Islands	9*, 38	SOL	51.8S	57.9W
South Point, Hawaiian Islands	15*, 55	SPT	18.9N	155.7W
Stanford, California		STN	34.4N	122.2W
Tananarive, Madagascar	63	MAD	19.0S	47.3E
Tromso, Norway	25	TRO	69.7N	18.9E
University of Alaska, Fairbanks, Alaska	19	ULA	65.0N	147.5W
Winkfield, England	10*, 18*, 15	WNK	51.4N	0.4W
Woomera, Australia	12*, 18	WOO	31.1S	136.8E

*Indicates station number used prior to July 1965.

Additional information available for the interpretation and use of the ionograms includes log sheets for the rolls of filmed ionograms and refined world maps (Brouwer).

Each film log sheet includes the film number, the date the film was processed, the station name, the pass time, tape number, and qualitative remarks. A list of abbreviations used in the remarks appears in Figure 9.

FIGURE 9

TERMS USED IN REMARKS ON FILM LOG SHEET

VLF ONLY	– very low freq. transmission only
VLF on	– very low freq. transmission on video
VLF INT.	– very low freq. transmission interference
INT.	– interference
L.L.S.	– loss of line synchronization
L.F.S.	– loss of frame synchronization
L.S.D.	– line synchronization distortion
T.C.R.	– time code rolling
N.T.C.	– no time code
STN.	– station
C.T.O.	– camera turned off
T.S.E.	– tape speed erratic
T.F.	– TELEMETRY FAILURE
d/os	– drop outs
TOBAS	– turned on by another station

The satellite maps are generated from a computer program that computes subsatellite points at specified time intervals of the satellite's orbit. The subsatellite point consists of longitude in degrees ±180 deg, geodetic latitude in degrees ±90, and height above sea level in kilometers. The program also computes ascending node crossing for each pass. The Alouette satellite maps include Brouwer elements. The maps are available on rolls of 16-mm microfilm and usually cover periods of about 10 weeks.

The ionograms that are available at NSSDC at the time of publication of this <u>Data Users' Note</u> are given in Figure 10 according to stations and times. A total of 3140 rolls of 35-mm microfilm ionograms are currently available.

FIGURE 10

IONOGRAM TIMES AND STATIONS

STATION	PASS NUMBER*	PERIOD*					
		START			END		
		MO	DA	YR	MO	DA	YR
Antofagasta, Chile	18 - 4130	09	30	62	07	28	63
College, Alaska, U.S.A.	1 - 17549	09	29	62	04	07	66
East Grand Forks, Minn., U.S.A.	1940 - 16239	02	18	63	01	01	66
Fort Myers, Florida, U.S.A.	12 - 15980	09	30	62	12	13	65
Kano, Nigeria	9625 - 11735	09	03	64	02	05	65
Kauai, Hawaii, U.S.A.	14274 - 16600	08	10	65	01	27	66
Orroral Valley, Australia	15713 - 16180	11	23	65	01	18	66
Ottawa, Ont., Canada	6 - 18009	09	29	62	05	10	66
Port Stanley, Falkland Islands	12 - 16888	09	30	62	02	17	66
Prince Albert, Sask., Canada	13 - 4473	09	30	62	08	23	63
Quito, Ecuador	20 - 16074	09	30	62	12	20	65
Resolute Bay, N.W.T., Canada	7 - 17787	09	29	62	04	24	66
St. John's, Nfld., Canada	11 - 15545	09	30	62	11	11	65
Santiago, Chile	4246 - 16074	08	06	63	12	20	65
Singapore, Malaysia	12 - 16210	09	30	62	12	30	65
South Point, Hawaii, U.S.A.	531 - 13451	11	07	62	06	10	65
University of Alaska, Alaska, U.S.A.	15793 - 15974	11	29	65	12	12	65
Winkfield, England	9 - 15680	09	29	62	11	21	65
Woomera, Australia	18 - 15395	10	01	62	10	31	65

*Pass numbers and dates are not necessarily inclusive.

B – Alosyn

Investigator

E. L. Hagg – Defence Radio Telecommunications Establishment*

Tabulations of selected ionospheric parameters were compiled from representative ionograms recorded from September 29, 1962, to January 31, 1964. One horizontal row of tabulation was derived from each selected ionogram. These ionograms were recorded at the following tracking stations:

Resolute Bay, N.W.T., Canada
College, Alaska, U.S.A.
Prince Albert, Sask., Canada
East Grand Forks, Minn., U.S.A.
Ottawa, Ont., Canada
St. John's, Nfld., Canada
Winkfield, England
South Point, Hawaii, U.S.A.
Fort Myers, Fla., U.S.A.
Quito, Ecuador
Antofagasta, Chile
Port Stanley, Falkland Islands
Santiago, Chile
Woomera, Australia

Figure 11 is a sample of the Alosyn data. The symbols used in the tabulations are the following:

YR	Year
MO	Month
DY	Day of the month
GMT	GMT at which the record was taken, in hours, minutes, and seconds, with the minutes and seconds separated by a solidus. The time given is for 3.0 ± 1 sec before the occurrence of the 0.5 Mc/s frequency marker.
LMT	Local mean time in hours and minutes
LONG	Longitude (deg); (+) denotes East
LAT	Latitude (deg); (+) denotes North
HGT	Height of satellite in km
CHI	Solar zenith angle, χ
DIP	Angle of dip of earth's magnetic field at the satellite; (+) denotes North

*Address: Defence Radio Telecommunications Establishment, Shirley Bay, Ottawa 4, Ontario, Canada.

FIGURE 11

ALOSYN DATA (DRIFT)

FH Gyrofrequency at the satellite, in Mc/s. The dip and gyrofrequency are calculated by using the set of 48 spherical harmonic coefficients determined by Jensen and Cain (epoch 1960).

JFOS Ordinary wave frequency at the satellite, calculated from the observed Extraordinary wave frequency. That is, JFOS is the plasma frequency at the satellite in Mc/s.

FXS Observed Extraordinary wave frequency at the satellite in Mc/s

FXS A Accuracy of observation, according to the following code:

1. Estimated error less than .025 Mc/s
2. Estimated error less than .05 Mc/s
3. Estimated error less than .1 Mc/s
4. Magnitude of FXS less than tabulated value
5. Magnitude of FXS greater than tabulated value

FXS Q Quality of the reflection trace near the satellite, according to the following quality table:

	No Spread	Slightly Spread	Moderately Spread	Extremely Spread
Unambiguous records	A	D	G	J
Oblique traces present	B	E	H	K
Cusps and/or forking of the records	C	F	I	L

The classifications of Spread F in this quality table refer to the degree of Spread F at the particular apparent height and frequency at which the parameter was obtained. It is not a classification of Spread F for the ionogram as a whole.

FOF2 Observed Ordinary wave penetration frequency of the F2 layer in Mc/s

FOF2 A Accuracy of observation according to the following code:

1. Estimated error less than .05 Mc/s
2. Estimated error less than .1 Mc/s
3. Estimated error less than .2 Mc/s
4. Magnitude of FOF2 less than tabulated value
5. Magnitude of FOF2 greater than tabulated value

FOF2 Q Quality of the reflection trace at the Ordinary wave penetration frequency according to the quality table

JFOF2	Ordinary wave penetration of the F2 layer, calculated from the observed fxF2. The gyrofrequency appropriate to a height of 300 km is used for this calculation.
FXF2	Observed Extraordinary wave penetration of the F2 layer
FXF2 A	Accuracy of observation, according to the FOF2 accuracy code
FXF2 Q	Quality of the reflection trace at the Extraordinary wave penetration frequency, according to the quality table
FES	Maximum frequency of observation of sporadic E
FES Q	Quality of sporadic E, according to the first row of the quality table
G	Strength of signal returned from the earth, according to the following code: 1. Strong, well-defined echoes 2. Weak and intermittent echoes 3. Echoes not observed
KP	3 hourly Magnetic K_p index

The symbol "-O-" occurring in a column of the tabulations indicates that the parameter was not observed on the ionogram.

It should be noted that one percent of the data recorded at telemetry stations have timing errors greater than 400 sec, and one-fifth percent have timing errors greater than 10 000 sec. Such timing errors can probably be considered systematic over about 30 consecutive ionograms.

C – Synoptic Data

Investigator

W. Calvert – ITSA*

Another tabulation has been compiled by ITSA* for September 29, 1962, to May 30, 1964 (passes 1 - 8318). This listing also includes a partial listing of the ground stations which may have bottomside sounding data to complement the topside data from Alouette 1. The columns in these tabulations are given in Figure 12.

*Address: Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

FIGURE 12

DESCRIPTION OF TOPSIDE SOUNDER CATALOG LISTING (ITSA)

TITLE AND IDENTIFICATION
- S - 27 - Satellite code
- DATE - YYMMDD of the first ionogram
- DAY OF THE YEAR
- UNIVERSAL TIME - HHMM/SS of the first ionogram
- PASS NUMBER - Pass number of the first ionogram
- TELEMETRY STATION CODE

SATELLITE DATA

Frame Number of Ionogram

Correspondence between film and catalog should exist.

The number of frames is approximated from the command schedule (based on a 10-minute readout) and may not correspond with the time and number of frames on the film.

An * alone denotes data computed at a given special time interval. No one-to-one correspondence will exist between catalog and film.

UT	Universal time (HHMM) at the satellite
LMT	Local mean time (HHMM) at the satellite
LT	Latitude (deg); (+) denotes North
LN	Longitude (deg); (+) denotes East
HT	Height above the geoid (km)
FH	Gyrofrequency at satellite (Mc/s)
I	Dip of magnetic field at satellite (deg); (+) denotes North
X	Zenith angle of the sun at the satellite (deg)
GLT	Geomagnetic latitude (deg); (+) denotes North

BOTTOMSIDE GROUND STATION DATA

Station Code

GND	Ground distance from subsatellite point to station (km)
ISO	Distance from subsatellite point to isocline passing through station (km); (+) denotes subsatellite point north of isocline
AZ	Azimuth of satellite as seen from station (deg)
LMT	Local mean time (HHMM) at the station
CHI	Zenith angle of the sun at the station (deg)

GAP

Denotes re-timing and often corresponds to obvious gaps in the film

The pertinent telemetry stations and their code descriptions are given in Figure 13.

FIGURE 13

TELEMETRY STATION CODE AND LOCATION (ITSA)

STATION	CODE	STATION LOCATION
BOULDR	Q-19	Boulder, Colorado
BPOINT	P-14	Blossom Point, Maryland
COLEGE	E-05	College, Alaska
FTMYRS	F-06	Fort Myers, Florida
GFORKS	N-13	East Grand Forks, Minnesota
HAWAII	R-15	Naalehu, Hawaii
NEWFLD	D-04	St. John's, Newfoundland
OTTAWA	C-03	Ottawa, Canada
PRINCE	B-02	Prince Albert, Canada
QUITOE	G-07	Quito, Ecuador
RESLUT	A-01	Resolute Bay, Canada
SNPORE	L-11	Singapore, Malaysia
SNTAGO	H-08	Santiago, Chile
SOLANT	J-09	South Atlantic (Falkland Islands)
WNKFLD	K-10	Winkfield, England
WOMERA	M-12	Woomera, Australia

D – Electron Density vs Real Height

Investigators

G. L. B. Nelms – Defence Research Telecommunications Establishment*
G. E. K. Lockwood – Defence Research Telecommunications Establishment*

These data consist of tabulations of electron (number) density profiles derived from ionograms selected from the period of September 29, 1962, to December 31, 1964. The ionograms were reduced under the assumption that the echoes are received from the area vertically beneath the satellite. When more than one set of reflections was present on the ionogram, the number density was computed from the reflection trace at the shortest apparent range. An exception occurred

*Address: Defence Research Telecommunications Establishment, Shirley Bay, Ottawa 4, Ontario, Canada.

when the reflections from the earth were found to be associated with the longer range echoes. The ionograms were reduced by the method of laminations[7] using a matrix:

$$\Delta h_i = \frac{p'_i - \sum_{j=2}^{i-1} B_{ij}\,\Delta h_j}{B_{ii}}$$

where p'_i is the virtual range at the wave frequency f_i

$\Delta h_j = |h_j - h_{j-1}|$ and the point (f_{xs}, h_{sat}) is considered point 1

B_{ij} = the average group refractive index, at the wave frequency f_i, for the lamination from h_{j-1} to h_j.

About 20 laminations were used for each trace, with a linear change of plasma frequency with real height assumed within each lamination. The magnetic dip angle and gyrofrequency, which were based upon the 48-term spherical harmonic representation of the earth's magnetic field (Jensen and Cain-epoch 1960), were used to derive the matrix elements B_{ij}.[8]

For the calculation of the matrix elements for points below the satellite, the gyrofrequency was obtained by means of an inverse cube extrapolation from the value at the satellite. When the Extraordinary trace was used, each wave frequency was converted to an electron density, N(h), by using the gyrofrequency determined from the spherical harmonic coefficients evaluated at the height involved.[8]

Figure 14 is a sample of the data held at NSSDC, and the following are the symbols used in the tabulations:

4	The data are N(h) profiles
X or O	X appears when an Extraordinary wave was used O appears when an Ordinary wave was used
T or B	Topside or Bottomside sounder
YR	Year
DAY	Day of the year
GMT	Universal time at which the ionogram was recorded in hours, minutes, and seconds. (The time given is for 3.0 ± 1 sec before the occurrence of the 0.5 Mc/s frequency marker.)
LONG	Longitude (calculated from the orbital elements)
LAT	Latitude (calculated from the orbital elements)
CHI	Solar zenith angle, χ (calculated from the orbital elements)
DIP	Angle of dip of the earth's magnetic field at the satellite

FIGURE 14

ALOUETTE 1 REAL HEIGHT PROFILES (DRTE)

```
     YR DAY   GMT      LONG    LAT    CHI  DIP   FH   Q   FOF2*      TOTALN   P

4XT 63 123 2305/ 5   -68.9 -30.29   105  -28  0.51  9   5.36     46.119E11  21
     1.17 1022.       1.26  984.     1.50  873.    1.76  792.      2.06  732.    2.36  684.    2.72  646.
     3.10  615.       3.50  589.     4.34  556.    5.31  520.      6.39  498.    7.57  479.    8.84  463.
    12.46  427.      16.70  397.    21.46  371.   26.93  345.     33.02  319.   34.31  314.   35.49  310.

4XT 63 123 2305/23   -68.7 -31.30   105  -30  0.51  9   6.26     69.245E11  22
     1.05 1023.       1.24  924.     1.47  822.    1.73  749.      2.03  694.    2.36  651.    2.68  619.
     3.06  586.       3.46  962.     4.34  525.    5.31  498.      6.39  477.    7.57  459.    8.77  443.
    12.38  410.      16.61  378.    21.46  350.   26.93  321.     32.. [illegible]   34.56  265.   46.90  238.
    48.44  232.

4XT 63 123 2305/41   -68.6 -32.30   105  -31  0.52  9   5.31     49.835E11  21
     1.05 1023.       1.24  923.     1.47  916.    1.73  740.      2.03  684.    2.33  640.    2.68  607.
     3.66  560.       3.46  557.     4.34  522.    5.26  496.      6.33  475.    7.50  458.    6.77  443.
    12.38  409.      16.61  377.    21.46  346.   26.81  316.     32.89  292.   34.18  276.   34.83  273.

4XT 63 123 2305/59   -68.4 -33.31   106  -32  0.52  9   5.31     50.466E11  20
     1.00 1024.       1.22  879.     1.45  780.    1.70  710.      2.00  657.    2.33  617.    2.64  580.
     3.42  543.       4.29  512.     5.26  486.    8.33  467.      7.50  450.    8.77  434.   12.28  396.
    16.52  361.      21.36  329.    26.81  294.   32.89  264.     34.05  258.   34.83  255.

4XT 63 123 2306/17   -68.3 -34.32   106  -33  0.53  9   4.95     47.384E11  24
     1.03 1025.       1.22  887.     1.45  781.    1.70  709.      2.00  656.    2.29  616.    2.64  585.
     3.02  560.       3.42  536.     4.29  507.    5.26  484.      6.33  463.    7.50  446.    8.71  430.
    10.07  414.      11.54  399.    13.10  384.   14.76  369.     16.52  354.   21.36  318.   26.70  280.
    27.86  273.      29.05  265.    30.26  256.

4XT 63 123 2306/34   -68.1 -35.27   107  -35  0.53  9   4.15     30.794E11  23
     0.98 1026.       0.98 1009.     1.19  859.    1.42  759.      1.67  689.    1.97  637.    2.29  597.
     2.61  568.       2.98  544.     3.38  524.    4.24  491.      5.21  469.    6.28  451.    7.44  434.
     8.71  417.      10.07  401.    11.54  385.   13.10  371.     14.76  357.   16.52  342.   18.28  327.
    20.24  312.      21.25  305.

4XT 63 123 2306/52   -67.9 -36.27   107  -36  0.54  9   3.98     30.080E11  22
     1.22 1027.       1.22  988.     1.45  837.    1.70  750.      1.97  691.    2.29  645.    2.64  610.
     3.02  582.       3.38  559.     4.24  525.    5.21  497.      6.28  473.    7.44  454.    8.71  436.
    10.07  420.      11.54  403.    13.10  387.   14.67  371.     16.43  356.   18.28  338.   19.29  329.
    19.54  326.

4XT 63 123 2307/10   -67.7 -37.27   107  -37  0.54  9   3.76     24.119E11  23
     0.94 1027.       0.96  976.     1.17  831.    1.39  732.      1.64  663.    1.94  677.    2.26  581.
     2.57  553.       2.94  531.     3.34  512.    4.20  483.      5.16  460.    6.22  442.    7.38  425.
     8.64  405.      10.00  394.    11.46  381.   13.02  367.     14.67  354.   15.54  347.   16.43  339.
    17.34  330.      17.44  324.

4XT 63 123 2307/28   -67.5 -38.28   108  -38  0.55  9   4.02     44.061E11  23
     0.94 1028.       0.96  989.     1.14  820.    1.37  717.      1.64  656.    1.91  611.    2.23  574.
     2.57  546.       2.94  524.     3.34  506.    4.20  477.      5.16  454.    6.22  435.    7.38  418.
     8.64  402.      10.00  387.    11.46  373.   12.94  358.     14.59  342.   16.34  325.   18.19  304.
    19.19  292.      19.94  239.

4XT 63 123 2307/46   -67.3 -39.28   108  -39  0.55  9   3.91     41.918E11  23
     0.94 1029.       0.96 1001.     1.14  834.    1.37  722.      1.61  654.    1.91  607.    2.23  570.
     2.54  545.       2.90  524.     3.29  506.    4.15  478.      5.11  454.    6.17  434.    7.32  417.
     8.58  400.       9.93  383.    11.38  360.   12.94  353.     14.59  337.   16.34  320.   17.25  310.
    18.09  298.      18.96  244.

4XT 63 123 2308/ 3   -67.1 -40.22   108  -40  0.56  9   3.93     38.705E11  24
     0.94 1030.       0.94 1012.     1.14  837.    1.34  722.      1.61  649.    1.88  603.    2.19  566.
     2.54  538.       2.90  517.     3.29  499.    4.15  471.      5.11  447.    6.17  426.    7.32  407.
     8.58  391.       9.93  376.    11.31  361.   12.86  347.     14.50  333.   16.25  318.   17.16  308.
    19.09  297.      19.05  281.    19.15  266.

4XT 63 123 2308/21   -66.9 -41.22   108  -41  0.57  9   3.98     42.772E11  23
     0.98 1031.       1.14  886.     1.34  760.    1.61  677.      1.88  623.    2.19  581.    2.54  551.
     2.90  525.       3.25  510.     4.11  480.    5.06  456.      6.11  435.    7.26  417.    8.51  400.
     9.86  383.      11.31  367.    12.86  351.   14.50  336.     16.25  319.   17.16  310.   18.09  301.
    18.96  288.      19.64  243.

4XT 63 123 2308/39   -66.7 -42.22   109  -4.  0.57  9   3.88     74.544E11  22
     0.98 1031.       1.12  875.     1.29  772.    1.47  709.      1.70  664.    1.94  626.    2.19  598.
     2.43  573.       2.72  553.     3.50  512.    4.38  479.      5.36  452.    6.65  429.    7.63  409.
     8.91  390.      10.29  373.    11.69  356.   13.26  340.     14.93  324.   15.80  316.   16.70  307.
    17.53  246.
```

FH	Gyrofrequency at the satellite in Mc/s
Q	Quality of the ionogram, according to a code in which 4 refers to best and 9 refers to minimal information. (Use 7 to 9 with caution.) 0 refers to tabulations made before code was established.
FOF2*	The Ordinary wave frequency (in Mc/s) corresponding to the highest number density computed for the ionogram. This is always less than, or equal to, the Ordinary wave penetration frequency of the F layer.
TOTALN	Integral of N, the number of electrons in a column 1 cm^2 in horizontal cross section extending from the satellite to the height corresponding to FOF2*. This number is expressed in units of 10^{11} electrons per square centimeter column.
P	Number of frequencies used for computing the N(h) profile

In Figure 14, the line which is introduced by symbols such as 4 XT contains the values identified by the symbols, as listed in the previous paragraph. The horizontal lines directly following consist of pairs of numbers representing the electron density and the real height at which the number density occurs, computed for a single ionogram. The first number in each pair is the electron density, expressed in 10^4 electrons per cm^3. The second number in the pair is the real height expressed in km above the surface of the oblate spheroid which best approximates the surface of the earth. The number density and the height at the satellite are given by the first pair of points for each ionogram. The electron densities listed correspond to the frequencies used for the real height calculation.

The reading errors are such that, for the best quality ionograms, the real heights are reproducible to an accuracy of about one percent. The systematic error introduced by the assumptions on which lamination methods of computation are based has not yet been adequately investigated. Such systematic error in the computed real height is probably less than five percent.[6]

One percent of data recorded at telemetry stations have timing errors greater than 400 sec; one-fifth percent have time errors greater than 10 000 sec. Such timing errors will probably be systematic over 30 consecutive ionograms.[8]

E – Electron Density Profiles

Investigators

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The Institute for Telecommunication Sciences and Aeronomy (ITSA) in the United States and the Radio and Space Research Station (RSRS) of the Science Research Council in England used selected ionograms to make electron density profiles of the ionosphere. The Radio and Space Research Station selected ionograms from the passes indicated by an asterisk at the Port Stanley and Singapore tracking stations, while ITSA selected ionograms from all the other tracking stations shown in Figure 15.

The ionograms were converted to curves showing the electron density as a function of height. This was accomplished by the reduction of the Extraordinary trace with the method of laminations described in Section D.[9]

Figure 16 is a sample of the RSRS data. The universal time is given in hours, minutes, and seconds for the time when the sounder frequency was 2.0 Mc/s. The electron densities, listed at 10-km intervals of real height, are multiplied by 10^{-5} and given in electrons per cm^3. The plot in Figure 16 shows the variation of electron density with geopotential height, H', where $1/H' = 1/h + 1/R$ and R represents the mean radius of the earth.

The electron density profiles produced by CRPL are in the form of computer plots and listings. The real height is plotted against the electron density (i.e., plasma frequency) on semilogarithmic paper. The computer listing for each reduced ionogram includes the following:

1. Indication of the type of trace – Extraordinary or Ordinary
2. Magnetic dip angle and gyrofrequency at the satellite
3. Latitude, longitude, and height of the satellite
4. Date and universal time
5. Date and place of reduction

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FIGURE 15

STATIONS AND TIMES FOR SELECTED IONOGRAMS (ITSA, RSRS)

Station/Pass No.	Date Mo	Da	Yr	Begin Time (UT)
Antofagasta, Chile				
26	10	01	62	0408
100	10	06	62	1450
1823	02	[illegible]	63	2114
1864	02	12	63	2126
1877	02	13	63	2010
1891	02	14	63	2049
1918	02	16	63	2017
1932	02	17	63	2053
1959	02	19	63	2025
2081	02	28	63	1859
2597	04	07	63	1428
3527	06	14	63	1732
3568	06	17	63	1741
Blossom Point, Maryland, U.S.A.				
501	11	04	62	2307
989	12	10	62	1728
1933	02	17	63	2112
2096	03	01	63	1957
2191	03	08	63	1902
2286	03	15	63	1808
2571	04	05	63	1522
2787	04	19	63	1245
2957	05	03	63	2240
College, Alaska, U.S.A.				
26	10	01	62	0335
472	11	02	62	1952
503	11	05	62	0238
542	11	07	62	2304
553	11	08	62	1815
579	11	10	62	1557
850	11	30	62	1237
1465	01	14	63	1425
Fort Myers, Florida, U.S.A.				
26	10	01	62	0348
Ottawa, Ont., Canada				
26	10	01	62	0337
1464	01	14	63	1255
1817	02	09	63	0944
2218	03	10	63	1833
Ottawa (Cont'd)				
2577	04	06	63	0228
2598	04	07	63	1448
2672	04	13	63	01[illegible]2
2903	04	27	63	2340
2911	04	28	63	1320
2916	04	28	63	2236
2924	04	29	63	1212
2938	04	30	63	1254
3066	05	09	63	2228
3907	07	10	63	1331
Port Stanley, Falkland Islands				
370	10	26	62	0930
588	11	11	62	0856
609	11	12	62	2140
* 1626	01	26	63	1012
* 1660	01	28	63	2221
* 1667	01	29	63	1017
1817	02	09	63	1006
* 1836	02	10	63	1953
Quito, Ecuador				
26	10	01	62	0355
623	11	13	62	2153
637	11	14	62	2231
650	11	15	62	2122
677	11	17	62	2048
691	11	18	62	2129
1342	01	05	63	1434
1932	02	17	63	2103
2041	02	25	63	2041
2597	04	07	63	1438
3527	06	14	63	1722
3568	06	17	63	1728
4375	08	15	63	2139
4565	08	29	63	1950
4592	08	31	63	1919
4613	09	02	63	0729
6133	12	22	63	1640
7441	03	27	64	1545
7463	03	29	64	0355
7510	04	01	64	1521
7530	04	03	64	0330
7536	04	03	64	1449

FIGURE 15 (CONT'D)

STATIONS AND TIMES FOR SELECTED IONOGRAMS (ITSA, RSRS)

Station/Pass No.	Date Mo	Da	Yr	Begin Time (UT)
Quito (Cont'd)				
7604	04	08	64	1425
7632	04	10	64	1355
7653	04	12	64	0203
8196	05	21	64	2104
8223	05	23	64	2026
8277	05	27	64	1932
8291	05	28	64	2002
8481	06	11	64	1818
8549	06	16	64	1754
8644	06	23	64	1659
8671	06	25	64	1628
8739	06	30	64	1603
8766	07	02	64	1532
8834	07	07	64	1506
8861	07	09	64	1436
8956	07	16	64	1334
9044	07	23	64	0114
9641	09	04	64	1910
9654	09	05	64	1810
10191	10	15	64	0142
10204	10	16	64	0035
10211	10	16	64	1339
10666	11	18	64	2100
10679	11	19	64	1958
10951	12	09	64	1821
10964	12	10	64	1711
10978	12	11	64	1743
11704	02	02	65	2324
12651	04	15	65	1340
12702	04	17	65	0143
12708	04	17	65	1310
13557	06	18	65	1724
13563	06	19	65	0455
Resolute Bay, N.W.T., Canada				
26	10	01	62	0332
2598	04	07	63	1458
Santiago, Chile				
4375	08	15	63	2133
7510	04	01	64	1519
7632	04	10	64	1352
8196	05	21	64	2106
8223	05	23	64	2036

Station/Pass No.	Date Mo	Da	Yr	Begin Time (UT)
Santiago (Cont'd)				
8291	05	28	64	2011
8549	06	16	64	1757
8576	06	18	64	1725
8644	06	23	64	1702
8671	06	25	64	1630
8766	07	02	64	1535
8834	07	07	64	1511
9641	09	04	64	1905
10191	10	15	64	0144
10211	10	16	64	1334
10666	11	18	64	2111
10761	11	25	64	2012
10951	12	09	64	1822
11114	12	21	64	1701
11141	12	23	64	1631
11703	02	02	65	2138
11704	02	02	65	2318
12681	04	15	65	1338
12702	04	17	65	0155
12708	04	17	65	1304
13557	06	18	65	1734
Singapore, Malaysia				
643	11	15	62	0902
657	11	16	62	0941
670	11	17	62	0832
684	11	18	62	0909
* 792	11	26	62	0707
* 1952	02	19	63	0811
* 2292	03	16	63	0609
* 2346	03	20	63	0508
* 2414	03	25	63	0443
* 2706	04	15	63	1323
* 2801	04	22	63	1228
* 4164	07	31	63	1034
South Point, Hawaii, U.S.A.				
612	11	13	62	0226
626	11	14	62	0304
639	11	15	62	0155
653	11	16	62	0233
666	11	17	62	0131
680	11	18	62	0203

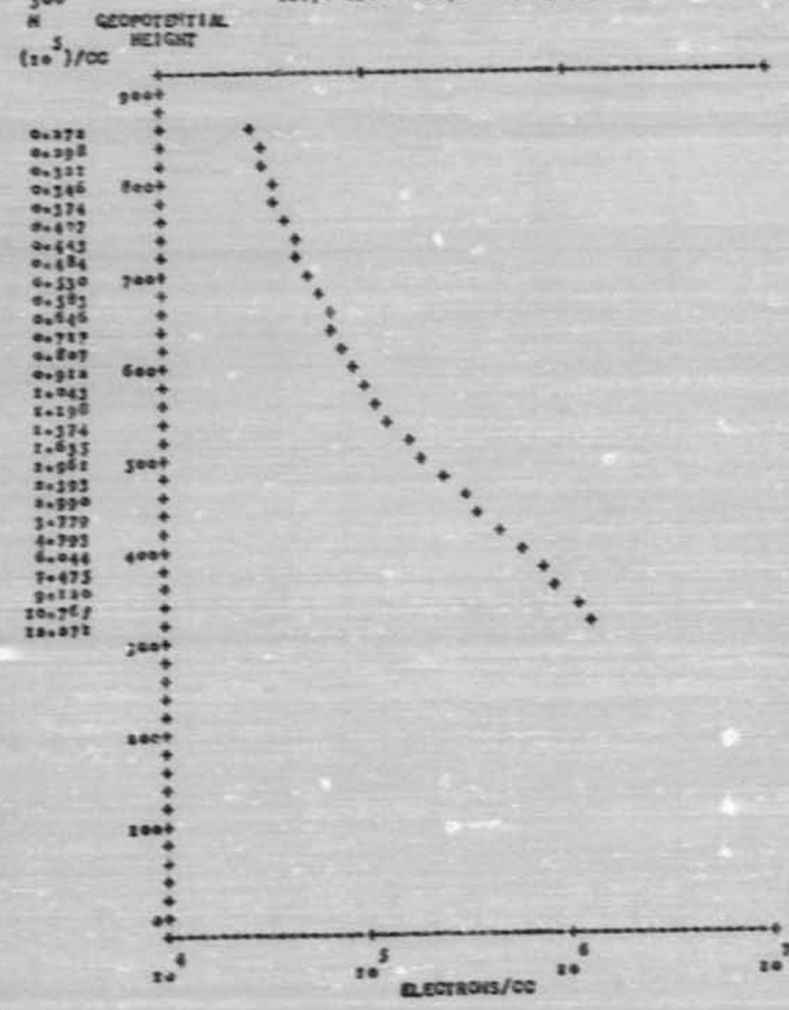
FIGURE 16

SAMPLE OF RSRS DATA

SINGAPORE 26 NOV 1962 REV 792 FRAME 29

0715.40 UT +117.5 LONG -13.8 LAT

HT	0	10	20	30	40	50	60	70	80	90
1000	0.265									
900	0.362	0.351	0.341	0.331	0.322	0.313	0.304	0.296	0.287	0.277
800	0.504	0.487	0.469	0.453	0.438	0.424	0.410	0.397	0.385	0.373
700	0.757	0.721	0.692	0.664	0.636	0.609	0.586	0.563	0.543	0.523
600	1.294	1.225	1.159	1.094	1.031	0.970	0.923	0.877	0.833	0.793
500	2.850	2.608	2.371	2.173	2.006	1.841	1.707	1.591	1.481	1.376
400	7.762	7.082	6.444	5.858	5.339	4.774	4.298	3.880	3.501	3.171
300				12.70	12.08	11.42	10.71	9.975	9.238	8.487



6. Receiving station, pass number, and frame number
7. Digitization of the measured frequency vs virtual height
8. Tabulation of electron density and the corresponding altitude
9. FOF2 – the Ordinary wave frequency corresponding to the highest density computed for the ionogram
10. TOTALN – the number of electrons in a column 1 cm^2 in horizontal cross section extending from the satellite to the height of reflection corresponding to the FOF2
11. The scale height
12. Tabulation of interpolated values of electron density at fixed heights
13. Tabulation of interpolated values of height at fixed electron densities

F – Electron Density and Scale Height vs Real Height

Investigators

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L. Colin – Ames Research Center ***
K-L. Chan – Ames Research Center***

Six volumes of data are available; they consist of tabulations and/or graphs of electron density vs real height and scale height vs real height. Scale height, H, is defined by

$$H = \frac{-N}{\frac{dN}{dh}}$$

where N is the electron density and h is the real height.

The data included in one volume were computed from Alouette 1 ionograms recorded at Stanford University. These ionograms were recorded during the periods of May 1 to July 23, 1963, and November 1, 1963, to January 28, 1964. Plots of average electron density versus dip latitude, and average scale height versus dip latitude, are included.

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Another volume contains data computed from all Alouette 1 ionograms recorded at South Point, Hawaii. These ionograms were recorded during the months of November and December 1962, and May, June, October, and November 1963. Graphs of average electron density and average scale height versus local time and dip latitude are also included.

A series of four volumes contains data chosen primarily for nearly complete latitudinal coverage over the American continents during an epoch of solar minimum. The ionograms were recorded at the following tracking stations, which are listed with their codes:

Antofagasta, Chile	AGASTA
College, Alaska, U.S.A.	COLEGE
Fort Myers, Fla., U.S.A.	FTMYRS
East Grand Forks, Minn., U.S.A.	GFORKS
Ottawa, Ont., Canada	OTTAWA
Prince Albert, Sask., Canada	PRINCE
Quito, Ecuador	QUITOE
Resolute Bay, N.W.T., Canada	RESLUT
South Atlantic Station (U.K.)	SOLANT
St. John's, Nfld., Canada	STJOHN

The first of these four volumes covers the period from November 1, 1962, to January 29, 1963; the second covers the periods from March 1 to March 31 and from May 3 to May 31, 1963; and the third covers the periods June 1 to July 31, from September 1 to September 30, and the day of October 31, 1963. The fourth volume of the series contains the summary graphs of electron density and scale height for the data presented in the first three volumes. The graphs are grouped into three main categories:

1. Variations along the individual satellite orbits
2. Latitudinal variations of the seasonal average at fixed altitudes vs local time
3. Diurnal variations of the seasonal average at fixed altitudes vs dip latitude

The data in all six volumes were reduced by the method of overlapping polynomials. Details of this method of reduction are given in references 1 and 7. The computations were based upon digitizations of the leading edge of the ionograms. The number of points used varied from 8 for smooth traces to 20 or more for curves with severe cusps.[1]

The reduction method assumed that, over small ranges of plasma frequency, the real height profile can be approximated by a polynomial,

$$\Delta h = \sum_{j=1}^{n} a_j (f_N - f_{N_s})^j$$

where f_{N_s} is the plasma frequency at the satellite and n is the number of points to which the polynomial was fit. Since several polynomials were used over a series of small frequency ranges, a polynomial representing the exact shape near the designated frequency only was required when the real depth was calculated. The polynomial was chosen to give the correct virtual depth at frequencies just above and below, as well as at the frequency under consideration. The polynomial was also joined to an already determined part of the curve, so that a smooth continuation of the real depth curve with the correct gradient is assured. The coefficients, a_j, were evaluated by using the known real depths and the integral relation between virtual and real height.[1,7]

Since this procedure required known values, the previously described technique of laminations was used for the section of the trace near the satellite. Both f_{xs} and f_N at the satellite were needed because the method of laminations started with the plasma frequency for that position. The required positional data were obtained by linear interpolation of the orbital information listed at 1-min intervals in the Alouette 1 World Maps of the Goddard Space Flight Center. The 48-term spherical harmonic expansion of the earth's magnetic field (Jensen and Cain, epoch 1960) was then used to calculate the gyrofrequency at the satellite. Since the gyrofrequency was a function of height, an inverse cube approximation was applied to obtain the gyrofrequency for a given real height. This value was used to get the plasma frequency and, hence, the electron density.[1]

Possible sources of error were the digitization of the ionograms, the location of the zero range frequency, and the use of linear interpolations in evaluating positions. For a good ionogram, the height at which a given electron density was found is probably correct to ±10 kilometers. The accuracy increases with an increase in height. Scale heights are probably correct to ±10 percent at heights below 800 km, and the accuracy decreases with increasing height.[10]

Data users are further cautioned that, in the reduction from ionograms to electron density profiles, the radio signals were always assumed to be propagated vertically beneath the satellite. Any error introduced by this assumption is a function of how far the signal deviated from the vertical path. This error, if any, cannot be readily estimated unless a complicated computer program of ray tracing is used. The scale height data were computed from the vertical electron density profiles. If the scale height of interest is along a magnetic field line, the value of the scale height in the volumes has to be modified. The method for accomplishing this is illustrated in references 4 and 11 and is especially needed for the low latitudinal region.

A sample of the data appears in Figure 17. The symbols and units appearing in the tabulations are as follows:

N	Electron density, 10^5 per cm^3
h	Real height above the ground, km
Pass	Pass number of Alouette I
UT	Universal time for the occurrence of the frequency at which the Extraordinary trace had zero range for the particular ionogram
Date	Given as $\underset{\text{year, month, day}}{\text{XX XX XX}}$; all zeros are suppressed
Time	Given as $\underset{\text{hour, minute, second}}{\text{XX XX XX}}$; all zero digits on extreme left are suppressed
LONG	Geographic longitude, deg; positive longitude is east of Greenwich, and negative is west of Greenwich
LAT	Geographic latitude, deg; positive indicates northern latitude, and negative indicates southern latitude
QUAL	Quality factor for the ionogram, coded in two-digit numbers (11, 21, 31, 12, 22, 32, 13, 23, and 33) and defined as follows:

First Digit

1. Excellent quality ionogram. Extraordinary trace is narrow, of high contrast, easily identifiable, possesses only small gaps, and cannot be confused with Ordinary trace, spreading or resonances anywhere along its extent. No spurious responses.

2. Good quality ionogram. Extraordinary trace is not too spread, of good contrast, fairly easily identifiable along most of its extent; any large gaps are easily interpolated, and no major confusion exists with the Ordinary trace, spreading or resonances, or spurious responses.

3. Poor quality ionogram, but readable. Considerable spreading, lack of contrast, overlapping traces and resonances, spurious traces, etc., which cause somewhat questionable scaling accuracies.

FIGURE 17

SAMPLE OF ELECTRON DENSITY AND SCALE HEIGHT DATA VS REAL HEIGHT (ARC)

PASS 2194 AT OTTAWA, 63 3 6

ELECTRON DENSITY IN ELECTRONS PER CC (X10-5)

HEIGHT	TIME (UT)							
	193201	193236	193311	193346	193421	193456	193531	193606
1000	0.160	0.162	0.150	0.149	0.153	0.146	0.134	0.130
950	0.181	0.186	0.168	0.170	0.17[illegible]	0.166	0.152	0.150
900	0.206	0.212	0.194	0.194	0.198	0.191	0.176	0.174
850	0.236	0.241	0.222	0.223	0.226	0.220	0.203	0.201
800	0.271	0.279	0.257	0.257	0.260	0.253	0.234	0.232
750	0.320	0.328	0.306	0.304	0.308	0.300	0.279	0.275
700	0.386	0.389	0.366	0.362	0.367	0.358	0.332	0.328
650	0.469	0.471	0.441	0.438	0.437	0.427	0.395	0.399
600	0.583	0.588	0.546	0.537	0.544	0.529	0.492	0.495
550	0.748	0.759	0.703	0.701	0.688	0.676	0.617	0.642
500	0.998	1.013	0.938	0.920	0.921	0.903	0.826	0.851
450	1.363	1.411	1.292	1.260	1.279	1.240	1.129	1.163
400	1.964	2.014	1.841	1.769	1.826	1.757	1.593	1.651
350	2.84[illegible]	2.954	2.735	2.583	2.661	2.577	2.344	2.438
300	4.2[illegible]9	4.325	4.140	3.925	3.993	3.803	3.531	3.708
HEIGHT	SCALE HEIGHT, KM							
950	384.1	372.4	394.7	361.3	387.2	374.2	370.5	335.1
900	366.2	371.2	358.0	359.9	366.4	351.2	346.9	334.4
850	346.5	348.0	334.5	342.0	344.0	335.2	330.6	326.3
800	326.8	326.0	313.8	323.8	322.8	319.[illegible]	314.4	317.7
750	301.9	305.3	298.0	304.0	305.4	303.0	298.9	296.1
700	274.[illegible]	284.6	282.1	284.1	288.0	286.8	283.3	274.5
650	246.9	256.5	260.7	252.6	270.5	268.7	267.5	246.6
600	219.6	214.8	221.0	213.1	230.9	225.4	232.9	214.7
550	192.1	189.8	192.5	197.0	195.0	194.1	199.8	194.0
500	166.2	165.5	172.0	181.0	170.1	175.0	176.4	177.7
450	153.5	149.2	153.2	159.7	150.1	154.6	156.5	157.7
400	138.7	135.9	132.9	138.6	135.2	135.5	137.6	134.1
350	128.8	129.6	123.1	125.8	128.3	129.6	124.9	124.7
300	138.7	145.8	125.3	125.3	127.9	129.9	130.4	125.2
LONG	-79.72	-79.33	-78.93	-78.50	-78.03	-77.53	-76.95	-76.35
LAT	36.41	38.35	40.30	42.24	44.18	46.11	48.03	49.96
QUAL	13	13	13	13	13	13	13	13

Second Digit

1. f_xF_2 clearly visible and read.
2. f_xF_2 not quite visible, but highest visible frequency close to f_xF_2 or presence of ground reflections would allow an estimate of f_xF_2.
3. f_xF_2 not visible.

The volume of data from Hawaii has the following additional parameters:

SPOINT	Tracking station at South Point, Hawaii
SAT	Electron density at the altitude of the satellite
NT	Integrated electron density in units of 10^{13} per cm^2
HS	Satellite altitude in km
DIPL	Magnetic dip latitude, deg; positive sign indicates northern magnetic latitude, and negative sign indicates southern magnetic latitude
INVL	Magnetic invariant latitude in deg
L	Magnetic L shell number
DIP	Magnetic dip angle in deg; positive sign indicates northern magnetic latitude, and negative sign indicates southern magnetic latitude
FHS	Electron gyrofrequency at the satellite in Mc/s
KP	Planetary magnetic activity index
SNL	Sunlight indicator; 1 = satellite solar illuminated 0 = satellite not solar illuminated

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4XT 72 5 62 272 1941/03X 03.88 294.0 043.122E11 18 1.01 -125.9 651.57 54 01.03
01.160935.01.250877.01.340824.01.430777.01.530736.01.620699.01.710606.01.810636.02.29
03.260382.03.460356.03.650331.03.750318.03.840303.03.870298.0000

4XT 73 8 62 272 1941/22X 03.83 270.0 046.995E11 17 1.02 -125.5 652.61 55 01.02
01.160939.01.250880.01.340827.01.430783.01.520743.01.620707.01.710674.01.800645.02.29
03.250377.03.450360.03.640322.03.740307.03.830281.

4XT 74 6 62 272 1941/59X 03.65 295.0 041.118E11 17 1.03 -124.7 654.63 57 01.01
01.150933.01.240874.01.330822.01.420780.01.510740.01.600704.01.700670.01.790639.02.27
03.240373.03.440345.03.530330.03.630310.03.640303.

4XT 75 6 62 272 1942/18X 03.71 252.0 047.789E11 17 1.03 -124.2 655.66 58 01.01
01.140933.01.230874.01.320823.01.410780.01.510740.01.600704.01.690670.01.790640.02.27
03.240367.03.430337.03.520321.03.620301.03.710266.

4XT 76 6 62 272 1942/37X 03.70 249.0 048.447E11 17 1.04 -123.7 656.69 59 01.00
01.140933.01.230876.01.320824.01.410779.01.600739.01.600702.01.690669.01.780640.02.27
03.230371.03.430343.03.520327.03.620310.03.700267.

4XT 77 5 62 272 1942/55X 03.55 266.0 045.007E11 17 1.04 -123.3 657.66 60 01.00
01.130935.01.220876.01.310824.01.410781.01.500740.01.590704.01.690672.01.780642.02.26
03.230370.03.330354.03.420336.03.510311.03.550284.

4XT 83 6 62 272 1945/44X 03.44 240.0 042.740E11 20 1.07 -116.6 666.60 69 01.04
01.210892.01.300833.01.390784.01.480739.01.570698.01.660661.01.760628.01.950570.02.14
02.520437.02.710401.02.910369.03.100335.03.190316.03.290296.03.380273.03.430252.00

4XT 83 8 62 272 1946/02X 04.28 208.0 064.272E11 20 1.07 -115.5 667.53 70 01.18
01.330939.01.430892.01.510841.01.600792.01.690747.01.790706.01.880669.01.970636.02.06
02.250555.02.740462.03.220384.03.700314.03.900287.04.090257.04.180240.04.270218.00

4XT 89 6 62 272 1949/32X 03.86 245.0 051.941E11 18 1.06 -092.8 677.22 81 01.0
01.130961.01.220899.01.310846.01.400799.01.500755.01.590716.01.690682.01.780651.02.2
03.240382.03.430357.03.630326.03.720309.03.820285.03.860261.0000

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01.110900.01.200822.01.290786.01.390742.01.480703.01.580668.01.670636.01.770607.02.2
03.230357.03.330343.03.430325.03.520298.03.550276.

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01.240935.01.330879.01.420829.01.510784.01.610744.01.700707.01.790675.01.890646.01.9
02.180571.02.270551.02.760466.03.250396.03.450370.03.640342.03.740324.03.820279.00

4XT 87 6 62 272 1950/46X 03.96 341.0 051.981E11 20 1.05 -075.7 679.54 85 01.2
01.360964.01.450920.01.550878.01.640837.01.730799.01.830764.01.920733.02.020703.02.1
02.310627.02.790536.03.280465.03.480440.03.670417.03.770404.03.870388.03.960355.00

4XT 87 6 62 272 1951/05X 03.74 280.0 047.338E11 19 1.04 -070.2 679.95 86 01.0
01.140940.01.230888.01.320841.01.420799.01.510760.01.610725.01.700692.01.800661.01.9
02.380527.02.870450.03.360383.03.460369.03.550353.03.650333.03.740296. 0000

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01.120893.01.220840.01.310792.01.400752.01.500715.01.600682.01.690651.01.790624.02.2
02.970419.03.160393.03.360367.03.550340.03.650326.03.750310.03.830271. 0000

4XT 86 6 62 272 1951/42X 04.25 264.0 061.596E11 20 1.04 -058.4 680.43 88 01.1
01.350914.01.440867.01.540822.01.630781.01.730744.01.820709.01.920679.02.010652.02.1
02.300582.02.790501.03.280431.03.770371.03.960347.04.060334.04.160317.04.250280.00

4XT 85 5 62 272 1952/01X 03.95 261.0 049.789E11 18 1.03 -052.1 680.52 89 00.9
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1 AND 2                    0000                      REC    1. LENGTH   84
25.9 651.57 54            01.031023.01.070994.       REC    2. LENGTH  264
01.710666.01.810636.02.290529.02.780450.
0000
25.5 652.61 55            01.021024.01.070998.       REC    3. LENGTH  [illegible]2
01.710674.01.800645.02.290534.02.270450.

24.7 654.63 57            01.011025.01.060991.       REC    4. LENGTH  252
01.700670.01.790639.02.270529.02.760445.

24.2 655.66 58            01.011026.01.050992.       REC    5. LENGTH  252
01.690670.01.790640.02.270529.02.750443.

23.7 656.69 59            01.001026.01.050993.       REC    6. LENGTH  252
01.690669.01.780640.02-270529.02.750444.

23.3 657.66 60            01.001027.01.040993.       REC    7. LENGTH  252
01.690672.01.780642.02.260531.02.750445.

16.6 666.60 69            01.041032.01.120959.       REC    8. LENGTH  282
01.760628.01.950570.02.140519.02.330475.
03.380273.03.430252.00
15.5 667.53 70            01.181032.01.240996.       REC    9. LENGTH  282
01.880669.01.970636.02.060606.[illegible].160580.
04.180240.04.270218.00
92.8 677.22 81            01.011037.01.041022.       REC   10. LENGTH  264
01.690682.01.780651.02.260536.02.750452.
0000
89.3 677.88 82            00.991038.01.030986.       REC   11. LENGTH  252
01.670636.01.770607.02.260503.02.740425.

85.1 678.51 83            01.051038.01.150990.       REC   12. LENGTH  282
01.790675.01.890646.01.950619.02.080594.
03.740324.03.820279.00
75.7 679.54 85            01.241039.01.271021.       REC   13. LENGTH  282
01.920733.02.020703.02.110676.02.210650.
03.870388.03.960355.00
70.2 679.95 86            01.001039.01.041000.       REC   14. LENGTH  276
01.700692.01.800661.01.990609.02.150565.
03.740296.  0000
64.3 680.25 87            00.951039.01.030557.       REC   15. LENGTH  276
01.690651.01.790624.02.280521.02.770447.
03.830271.  0000
58.4 680.43 88            01.171039.01.260972.       REC   16. LENGTH  282
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52.1 680.52 89            00.951040.01.040964.       REC   17. LENGTH  264
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C-02136
1st 16 RECS
62-049A-01G

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4XT 78 5 63 278 15 4/39T   4.90  203.0  56.305E11 14 1.03  -64.6  55.81 62        0.791
 1.01 860. 1.19 755. 1.29 709. 1.77 558. 2.26 463. 2.75 396. 3.24 348. 3.74 311. 4.23
 4.82 226. 4.90 211.00

4XT 78 5 63 278 15 4/56T   4.98  223.9  52.358E11 15 1.03  -64.1  56.74 63        0.781
 1.01 857. 1.19 753. 1.29 708. 1.77 564. 2.26 466. 2.75 404. 3.24 356. 3.74 317. 4.24
 4.83 244. 4.92 235. 4.97 228.  00

4XT 79 5 63 278 15 5/14T   4.73  238.5  45.081E11 12 1.04  -63.6  57.72 63        0.771
 1.01 855. 1.19 749. 1.28 705. 1.77 555. 2.25 460. 2.75 396. 3.24 345. 3.74 306. 4.23
0000

4XT 80 5 63 278 15 6/ 3T   4.97  229.0  54.590E11 15 1.04  -62.1  60.36 66        0.77
 1.01 862. 1.19 762. 1.29 719. 1.77 572. 2.26 482. 2.76 418. 3.25 370. 3.75 331. 4.24
 4.83 254. 4.93 242. 4.96 236.  00

4XT 80 5 63 278 15 6/21T   5.04  234.7  56.129E11 13 1.04  -61.4  61.33 67        0.83
 1.20 780. 1.30 735. 1.78 587. 2.27 495. 2.76 428. 3.26 378. 3.75 339. 4.25 304. 4.74
 5.03 241.  0000
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4.6  55.81 62          0.791009. 0.83 984.  REC     1. LENGTH   222
 3.24 348. 3.74 311. 4.23 280. 4.72 238.
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C-02136

LAST 5 RECS

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4.1  56.74 63          0.781010. 0.82 976.  REC     2. LENGTH   234
 3.24 356. 3.74 317. 4.24 286. 4.73 252.

63.6  57.72 63         0.771010. 0.82 978.  REC     3. LENGTH   204
 3.24 345. 3.74 306. 4.23 272. 4.73 243.

62.1  60.36 66         0.771010. 0.82 981.  REC     4. LENGTH   234
 3.25 370. 3.75 331. 4.24 298. 4.74 263.

61.4  61.33 67         0.831010. 1.02 883.  REC     5. LENGTH   216
 3.75 339. 4.25 304. 4.74 271. 4.94 255.
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51017. 1.43 894. 1.61 802. 1.80 727. 2.28 593. 2.76 498. 3.24 421. 3.73 352. 4.19 21

0018604XT 87 5 65 142 1938/28G   4.19  211.1  71.417E11 10 1.07   -88.9  71.60 53
51014. 1.43 398. 1.61 805. 1.80 730. 2.28 600. 2.76 506. 3.25 432. 3.73 361. 4.19 2

0019804XT 87 5 65 142 1938/45G   4.19  211.0  76.422E11 11 1.07   -87.4  70.78 53
  893. 1.82 795. 2.01 719. 2.19 657. 2.38 605. 2.57 560. 2.77 521. 3.25 440. 3.73 37

0019804XT 86 5 65 142 1939/ 2G   4.39  199.3  72.520E11 11 1.07   -86.1  69.94 53
4 987. 1.42 879. 1.61 789. 1.79 714. 2.27 583. 2.75 490. 3.24 413. 3.72 348. 4.20 2
2 277. 4.31 259. 4.37

0022204XT 86 5 65 142 1939/20G   4.35  240.1  66.603E11 13 1.07   -84.8  69.04 52
61013. 1.53 883. 1.71 781. 1.90 706. 2.08 643. 2.27 591. 2.75 494. 3.24 420. 3.73 3
1 275. 4.35 254.  0000

0022204XT 85 6 65 142 1939/37G   4.52  273.3  66.398E11 13 1.07   -83.7  68.18 52
4 920. 1.62 815. 1.80 735. 1.99 670. 2.18 615. 2.37 570. 2.56 531. 2.76 496. 3.24 4

0018604XT 85 5 65 142 1939/54G   4.60  224.5  73.043E11 10 1.06   -82.6  67.32 51
4 912. 1.61 808. 1.80 731. 2.27 594. 2.76 500. 3.24 429. 3.73 371. 4.22 316. 4.59 2
2 314. 4.51 281.  0000

0022204XT 85 5 65 142 1940/12G   4.50  275.2  70.705E11 13 1.06   -81.6  66.39 51
5 915. 1.83 821. 2.01 744. 2.20 680. 2.39 627. 2.58 581. 2.77 543. 3.26 464. 3.74 4

0019804XT 84 5 65 142 1940/29G   4.70  216.5  88.410E11 11 1.06   -80.7  65.52 51
6 970. 1.74 861. 1.92 778. 2.11 710. 2.29 654. 2.78 553. 3.26 476. 3.75 415. 4.23 3
2 309. 4.49 287.  0000

0022204XT 84 5 65 142 1940/47G   4.62  274.0  73.880E11 13 1.06   -79.9  64.58 50
 1002. 1.64 895. 1.83 814. 2.01 747. 2.20 689. 2.39 638. 2.58 594. 2.78 555. 3.26 4
3 356. 4.6

0021004XT 83 5 65 142 1941/ 4G   4.62  281.0  72.405E11 12 1.06   -79.1  63.69 50
5 910. 1.83 819. 2.02 747. 2.20 688. 2.39 638. 2.58 594. 2.78 557. 3.26 478. 3.75
1 293.00001 287.  0000240.00.87 221. 5.92 212. 4.66 281. 5.16 258.00007 275. 4.97
8 309. 5.27 305.  .68 260. 8.78 256. 8.88 252. 8.98 248. 9.08 244.

0036604XT-13 5 65 142 20 6/26G   8.00  390.9 118.157E11 28 0.47   -62.1 -20.76 72
4 962. 1.53 898. 1.63 850. 1.72 813. 1.82 785. 1.92 761. 2.02 742. 2.12 725. 2.22
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5 72.46 54          1.241032. 1.2  REC     1, LENGTH  186  71-05529
73 352. 4.19 218.                                           1st 12 RECS.

9  71.60 53         1.231032. 1.2  REC     2. LENGTH  198
73 361. 4.19 233. 4.18 205.

4  70.78 53         1.471032. 1.6  REC     3. LENGTH  193  62-049A-01N
25 440. 3.73 372. 4.19 234.

1  69.94 53         1.151032. 1.2  REC     4. LENGTH   222
72 348. 4.20 268. 4.38 214.  .2

8  69.04 52         1.351033. 1.3  REC     5. LENGTH   222
.24 420. 3.73 359. 4.21 292. 4.3

.7  68.18 52        1.261033. 1.4  REC     6. LENGTH   [illegible]
.76 496. 3.24 427.

.6  67.32 51        1.261033. 1.4  REC     7. LENGTH   222
.22 316. 4.59 239. 3.73 370. 4.2

.6  66.39 51        1.471033. 1.6  REC     8. LENGTH   198
.26 464. 3.74 402. 4.23 339. 4

.7  65.52 51        1.471033. 1.5  REC     9. LENGTH   222
.75 415. 4.23 351. 4.69 236.  .4

.9  64.58 50        1.421033. 1.4  REC    10. LENGTH   210
.78 555. 3.26 477. 3.75 416. 4.2

.1  63.69 50        1.481034. 1.6  REC    11. LENGTH   365
.26 478. 3.75 414. 4.23 355. 4.6
007 275. 4.97 272. 5.07 268.  00

.1 -20.76 72        1.341038. 1.4  REC    12. LENGTH   258
.12 725. 2.22 711. 2.32 699. 2.4
```

```
0025804XT 82 7 66  89 1625/14G   4.28  326.0  49.920E11 17 1.01   53.4  76.05
91017. 1.38 962. 1.47 908. 1.56 859. 1.66 815. 1.75 774. 1.84 735. 1.93 700.
2 612. 2.32 587. 2.80 451. 3.29 422. 3.78 370. 4.28 332.  .97 330.00008 272.

0028804XT 81 7 66  89 1625/47G   4.27  284.2  61.687E11 20 1.01   58.0  74.65
91020. 1.48 957. 1.57 907. 1.67 860. 1.76 815. 1.85 774. 1.94 736. 2.04 701.
 614. 2.80 512. 3.29 433. 3.78 364. 3.8

0024004XT 80 7 66  89 1626/39G   2.99  454.5  27 931E11 15 1.02   63.8  72.26
8 998. 1.37 944. 1.46 893. 1.55 846. 1.65 801. 1.74 761. 1.83 724. 1.93 692.
1 608. 2.31 584. 2.79 493. 2.99 463.  007 351. 3.97 337. 4.07 323. 4.16 308.

0028804XT 80 7 66  89 1626/56G   4.16  304.9  53.679E11 20 1.02   65.3  71.45
81002. 1.37 945. 1.46 892. 1.55 847. 1.65 805. 1.74 768. 1.83 733. 1.93 701.
1 617. 2.31 594. 2.79 500. 3.28 428. 3.7

0024004XT 80 7 66  89 1627/13G   4.06  301.5  49.915E11 15 1.02   66.8  70.62
7 983. 1.36 919. 1.45 863. 1.54 814. 1.63 771. 1.73 730. 1.82 696. 2.30 571.
6 346. 3.86 333. 3.95 321. 4.05 307.  00
```

```
76.05 93           1.241052. 1.2  REC      1. LENGTH   288   D-05524
700. 2.03 669. 2.12 640. 2.2
272.  0000272. 5                                              LAST 5 RECS

74.65 95           1.351052. 1.3  REC      2. LENGTH   240
701. 2.13 670. 2.23 641. 2.3

72.26 97           1.191052. 1.2  REC      3. LENGTH   288
692. 2.02 662. 2.12 634. 2.2
308. 4.26 291.00

71.45 98           1.191052. 1.2  REC      4. LENGTH   240
701. 2.02 670. 2.12 643. 2.2

70.62 99           1.191052. 1.2  REC      5. LENGTH   240
571. 2.78 481. 3.27 410. 3.7
```

REQ. AGENT	RAND NO.	ACQ. AGENT
DAD	V0241	JEJ

ALOUETTE 1

CRC N(H) DATA, SCALED POINTS

CRC N(H) DATA, N + HGT COEF

62-049A-01T

62-049A-01U

This data set catalog contains 3 magnetic tapes. The tapes description, and D and C numbers are on the following pages:

ALOUETTE 1

CRC N(H) DATA, SCALED POINTS

62-049A-01T

This data set, prepared from tapes created by the Communications Research Centre (CRC) in Ottawa, Canada, consists of electron density profiles for the ionosphere above the F2 maximum (topside ionosphere). This data set consists of 2 9-track, 1600 bpi, odd-parity, EBCDIC tapes , and are written on a MODCOMP IV computer. Records contain 1 logical record per physical record and are variable length with a maximum blocksize of 620 bytes. These tapes were created by merging tapes that contain similar data from data set 62-049A-01G, sorting the data by time and then regenerating the data back on tape. The data set includes about 4.3E4 profiles obtained primarily during the period 1962 to 1965. During the merging of this data, occurences of duplicate times were detected, each occurence was included in the merged data set as it represents a different profile. Profiles were not obtained for the complete time period, please check the documentation page entitled TIME SPANS FOR 62-049A-01T for desired time period.

The profiles were computed from digital values of frequency and virtual height that were scaled from the ionogram. Profile data consist of electron density and real height values for each point scaled from the ionogram. Telemetry stations are not identified, but satellite location, time of observation (Greenwich and local mean time), solar zenith angle at the satellite, magnetic dip and gyrofrequency at the satellite, total electron content down to the lowest topside reflection altitude, and other relevant information are listed for each profile. These profiles correspond to about 2% of the 2.E6 Alouette 1 ionograms observed. Data for most latitudes are included, but those data from longitudes near 80 deg W are more numerous than those from other longitudes.

D#	C#	TIME SPAN
D-61708	C-23845	09/29/62 - 12/31/63
D-61709	C-23846	01/01/64 - 03/30/66

DATA FORMAT FOR 62-049A-01T

CHARACTER POSTION	FORMAT	DESCRIPTION
1	Literal 4	Represents description for TOPSIDE
2	Literal X	profile calculated from the
3	Literal T	X-wave.
4- 6	I3	Dip angle
7- 8	I2	Quality code
9-11	I3	Year
12-15	I4	Day of year
.16	1X	Blank
17-20	2I2	Hours and minutes
21	Literal /	Slash
22-23	I2	Seconds
24	A1	Observer Code
25-31	F7.2	Ordinary wave frequency (in Mc/s) corresponding to highest number density computed for the ionogram.
32-38	F8.2	HMAX
39-49	E11.3	Total electron content (e/cm2)
50	1X	Blank
51-52	I2	N=number of pairs of data in profile
53	1X	Blank
54-57	F4.2	Gyrofrequency (MHz)
58-64	F7.1	Longitude
65-71	F7.2	Latitude
72-74	I3	Solar zenith angle
75-80	6X	Blanks

Character positions 81 - end of the record consists of N (bytes 51-52) pairs of electron density profiles with a format of F5.2, F5.0. For a description of these profiles read enclosed documentation.

TIME SPANS FOR 62-049A-01T   D# = D-61708   C# = D-23845

START YY	START DDD	START HH	START MM	START SS	-	STOP YY	STOP DDD	STOP HH	STOP MM	STOP SS	START RECORD	NUMBER RECORDS
62	272	19	41	22	-	62	277	2	26	42	1	453
62	278	13	33	17	-	62	279	2	0	56	454	103
62	280	13	44	22	-	62	282	1	32	59	557	237
62	285	13	34	51	-	62	286	14	4	25	794	68
62	287	23	55	38	-	62	288	14	3	14	862	197
62	290	1	34	23	-	62	294	0	44	27	1059	425
62	297	11	49	40	-	62	303	23	39	44	1484	589
62	305	11	48	18	-	62	307	0	17	12	2073	237
62	308	8	7	6	-	62	308	8	14	37	2310	26
62	309	10	38	14	-	62	309	22	38	33	2336	262
62	310	22	48	40	-	62	311	18	25	3	2598	130
62	312	22	7	36	-	62	314	4	16	51	2728	122
62	315	20	12	30	-	62	315	20	19	44	2850	25
62	316	20	53	42	-	62	317	21	49	36	2875	178
62	319	7	31	10	-	62	320	9	50	37	3053	249
62	322	19	0	0	-	62	325	8	55	28	3302	466
62	326	14	37	29	-	62	327	21	13	19	3768	250
62	330	7	53	46	-	62	330	19	52	41	4018	215
62	333	19	18	23	-	62	333	19	52	41	4233	96
62	335	7	31	12	-	62	335	8	5	43	4329	62
62	336	19	27	32	-	62	337	18	59	1	4391	331
62	339	6	27	15	-	62	339	7	6	58	4722	83
62	340	18	39	3	-	62	340	18	56	30	4805	55
62	342	4	39	25	-	62	342	4	48	37	4860	31
62	343	18	22	44	-	62	344	6	42	46	4891	254
62	346	9	37	19	-	62	346	9	43	49	5145	20
62	347	17	29	25	-	62	359	10	42	26	5165	1555
62	361	10	2	14	-	62	362	3	51	22	6720	125
62	363	14	59	33	-	62	363	15	49	3	6845	139
63	1	15	29	35	-	63	1	15	48	29	6984	58
63	4	2	9	8	-	63	4	16	3	53	7042	235
63	9	13	6	9	-	63	9	13	51	37	7277	132
63	12	2	0	15	-	63	12	2	39	20	7409	77
63	14	23	43	15	-	63	14	23	52	24	7486	32
63	17	1	37	12	-	63	18	14	13	23	7518	273
63	21	0	33	38	-	63	21	22	57	25	7791	60
63	23	22	17	27	-	63	24	1	20	8	7851	159
63	25	12	28	21	-	63	25	21	56	46	8010	189
63	27	21	16	41	-	63	27	21	25	30	8199	30
63	28	21	53	30	-	63	30	11	6	47	8229	170
63	32	2	40	16	-	63	32	21	39	12	8399	77
63	33	21	57	13	-	63	36	14	12	5	8476	230
63	38	21	32	3	-	63	39	11	28	46	8706	231
63	42	22	49	51	-	63	43	19	5	44	8937	36
63	46	9	43	33	-	63	48	18	41	41	8973	274
63	50	18	1	33	-	63	50	18	10	40	9247	25
63	53	20	30	16	-	63	55	17	43	53	9272	339
63	56	18	13	33	-	63	57	19	36	20	9611	201
63	59	18	22	8	-	63	59	18	30	3	9812	28
63	61	17	49	50	-	63	64	16	19	25	9840	249
63	65	16	47	15	-	63	66	7	11	9	10089	57

TIME SPANS FOR 62-049A-01T D# = D-61708 C# = D-23845

START YY	DDD	HH	MM	SS	-	STOP YY	DDD	HH	MM	SS	START RECORD	NUMBER RECORDS
63	69	8	14	21	-	63	70	19	9	2	10146	333
63	76	5	35	4	-	63	76	6	22	4	10479	137
63	80	16	11	1	-	63	80	16	52	11	10616	133
63	85	15	47	32	-	63	85	15	56	23	10749	31
63	88	4	13	12	-	63	88	4	54	19	10780	113
63	91	3	13	26	-	63	91	3	24	16	10893	33
63	93	2	26	32	-	63	93	2	35	4	10926	29
63	95	1	30	18	-	63	95	4	8	4	10955	181
63	97	14	28	14	-	63	98	13	21	18	11136	187
63	100	0	29	17	-	63	100	1	58	39	11323	174
63	103	1	17	13	-	63	103	1	24	53	11497	27
63	104	13	33	33	-	63	107	19	40	11	11524	524
63	109	21	54	17	-	63	110	12	29	48	12048	238
63	112	22	0	53	-	63	113	21	1	10	12286	50
63	115	22	7	21	-	63	115	22	16	30	12336	31
63	117	10	57	8	-	63	118	0	52	54	12367	262
63	119	10	38	14	-	63	125	19	42	45	12629	1076
63	126	20	10	16	-	63	128	19	48	45	13705	236
63	130	10	26	27	-	63	132	18	47	24	13941	240
63	134	20	46	26	-	63	135	7	47	26	14181	132
63	139	8	58	19	-	63	139	9	37	20	14313	114
63	140	18	20	16	-	63	141	19	8	24	14427	231
63	143	7	48	11	-	63	143	8	36	33	14658	134
63	144	17	19	16	-	63	144	17	28	6	14792	30
63	145	20	24	32	-	63	145	21	12	38	14822	140
63	147	17	25	51	-	63	150	7	41	27	14962	229
63	152	19	29	13	-	63	152	20	16	12	15191	137
63	155	17	48	41	-	63	157	6	45	56	15328	309
63	158	14	14	21	-	63	162	17	33	46	15637	508
63	164	11	10	25	-	63	165	6	28	51	16145	147
63	168	14	40	17	-	63	168	17	56	37	16292	183
63	170	11	7	12	-	63	171	4	56	42	16475	211
63	173	16	44	14	-	63	173	17	32	7	16686	124
63	175	10	42	28	-	63	175	14	43	34	16810	80
63	176	15	16	29	-	63	176	15	22	55	16890	15
63	178	3	13	46	-	63	178	4	1	37	16905	109
63	180	15	49	10	-	63	180	21	16	18	17014	175
63	182	15	15	8	-	63	182	16	5	59	17189	143
63	185	2	19	8	-	63	185	3	5	59	17332	132
63	186	14	16	52	-	63	186	14	25	38	17464	31
63	187	14	53	8	-	63	187	15	41	19	17495	152
63	190	13	26	15	-	63	193	14	9	40	17647	358
63	195	23	52	14	-	63	196	11	9	20	18005	63
63	198	7	26	13	-	63	199	1	16	6	18068	210
63	200	6	55	15	-	63	200	13	14	15	18278	195
63	201	22	24	8	-	63	205	9	44	9	18473	164
63	207	9	3	17	-	63	210	21	4	27	18637	296
63	212	5	36	17	-	63	212	23	26	10	18933	182
63	214	10	36	5	-	63	214	11	5	25	19115	95
63	217	10	39	10	-	63	218	20	46	29	19210	195
63	219	21	15	46	-	63	219	21	24	56	19405	32

TIME SPANS FOR 62-049A-01T   D# = D-61708   C# = D-23845

START						STOP					START	NUMBER
YY	DDD	HH	MM	SS	-	YY	DDD	HH	MM	SS	RECORD	RECORDS
63	220	22	26	12	-	63	225	19	51	43	19437	544
63	226	20	47	11	-	63	227	10	41	38	19981	279
63	228	19	48	35	-	63	228	19	57	27	20260	30
63	230	19	19	6	-	63	231	18	19	30	20290	51
63	232	21	29	13	-	63	234	21	17	21	20341	316
63	237	9	12	13	-	63	237	9	23	22	20657	35
63	239	17	51	17	-	63	241	20	21	32	20692	363
63	245	16	20	15	-	63	245	16	29	23	21055	30
63	246	16	56	15	-	63	246	19	47	21	21085	58
63	248	18	46	52	-	63	250	7	24	38	21143	295
63	251	16	32	17	-	63	252	15	34	21	21438	63
63	255	0	54	11	-	63	278	15	15	7	21501	5120
63	285	13	39	18	-	63	285	14	19	52	26621	124
63	288	0	25	43	-	63	288	1	4	17	26745	100
63	292	11	22	18	-	63	292	13	26	23	26845	189
63	294	0	34	14	-	63	294	1	25	49	27034	121
63	295	12	58	45	-	63	306	11	25	18	27155	2116
63	307	11	55	30	-	63	309	11	31	19	29271	239
63	311	10	49	5	-	63	313	10	33	28	29510	158
63	314	11	0	30	-	63	316	10	40	5	29668	337
63	317	11	12	55	-	63	320	9	29	21	30005	92
63	321	10	5	36	-	63	325	9	13	11	30097	322
63	326	9	38	10	-	63	327	8	42	5	30419	45
63	328	9	10	28	-	63	332	8	15	13	30464	380
63	333	8	43	3	-	63	334	7	47	34	30844	55
63	335	8	14	25	-	63	337	7	54	33	30899	123
63	338	8	26	29	-	63	339	7	29	57	31022	241
63	340	7	48	10	-	63	341	6	52	19	31263	49
63	342	7	21	32	-	63	347	7	5	41	31312	421
63	350	5	14	6	-	63	352	5	3	24	31733	158
63	353	5	20	40	-	63	355	4	51	43	31891	172
63	356	5	29	44	-	63	360	4	33	39	32063	325
63	361	5	6	6	-	63	362	4	5	48	32388	11
63	363	4	34	40	-	63	364	3	27	5	32399	14
63	365	5	10	9	-	63	365	5	18	35	32413	14

TIME SPANS FOR 62-049A-01T   D# = D-61709   C# = C-23846

START						STOP					START	NUMBER
YY	DDD	HH	MM	SS	-	YY	DDD	HH	MM	SS	RECORD	RECORDS
64	1	2	25	29	-	64	6	14	2	17	1	624
64	8	1	30	40	-	64	8	15	23	19	625	249
64	15	0	33	29	-	64	15	14	27	59	874	301
64	20	11	30	56	-	64	20	12	18	43	1175	120
64	24	12	16	25	-	64	24	13	3	19	1295	139
64	53	9	24	56	-	64	53	9	29	19	1434	15
64	90	1	40	50	-	64	90	1	49	1	1449	29
64	94	16	49	32	-	64	94	17	1	48	1478	42
64	100	17	5	37	-	64	100	17	22	16	1520	56
64	107	16	9	14	-	64	107	16	26	59	1576	59
64	116	1	1	13	-	64	116	1	12	22	1635	37
64	123	0	6	12	-	64	123	0	17	22	1672	37
64	124	20	3	46	-	64	124	20	15	47	1709	39
64	129	12	14	18	-	64	129	23	22	25	1748	92
64	134	11	48	14	-	64	134	11	57	20	1840	32
64	141	10	53	14	-	64	141	11	5	48	1872	40
64	162	6	22	4	-	64	162	19	6	57	1912	89
64	169	5	26	10	-	64	169	18	11	15	2001	86
64	176	15	32	22	-	64	176	15	39	39	2087	26
64	191	23	28	15	-	64	191	23	37	17	2113	32
64	193	0	4	15	-	64	193	0	13	16	2145	32
64	198	22	33	14	-	64	198	22	42	19	2177	32
64	200	23	48	32	-	64	200	23	57	19	2209	29
64	202	23	16	15	-	64	202	23	25	24	2238	32
64	204	22	45	15	-	64	204	22	54	22	2270	27
64	205	23	23	6	-	64	205	23	32	25	2297	30
64	207	22	51	15	-	64	207	23	0	22	2327	32
64	210	23	1	8	-	64	211	21	59	22	2359	60
64	213	21	20	43	-	64	213	21	28	1	2419	23
64	214	21	56	28	-	64	214	22	4	59	2442	22
64	216	21	25	23	-	64	216	21	34	21	2464	28
64	218	20	54	42	-	64	218	21	2	47	2492	24
64	220	20	24	51	-	64	220	20	30	8	2516	19
64	221	21	1	15	-	64	221	21	10	22	2535	26
64	223	20	30	15	-	64	223	20	39	21	2561	27
64	225	19	59	32	-	64	225	20	6	0	2588	23
64	226	20	37	15	-	64	226	20	42	15	2611	16
64	260	19	51	14	-	64	260	20	0	14	2627	32
64	272	18	30	31	-	64	272	18	43	38	2659	42
64	274	18	0	48	-	64	274	18	12	58	2701	41
64	279	17	36	11	-	64	279	17	45	12	2742	32
64	281	17	5	46	-	64	282	15	57	40	2774	51
64	300	23	59	28	-	64	301	12	6	30	2825	80
64	302	23	28	12	-	64	303	11	35	36	2905	73
64	306	11	26	26	-	64	306	11	38	18	2978	33
64	307	23	4	14	-	64	308	11	11	47	3011	66
64	309	11	39	27	-	64	310	10	40	13	3077	30
64	311	11	2	28	-	64	311	23	59	18	3107	71
64	313	10	35	4	-	64	315	10	16	56	3178	117
64	316	10	43	27	-	64	318	10	22	45	3295	109
64	319	10	58	54	-	64	335	19	37	14	3404	1322

TIME SPANS FOR 62-049A-01T   D# = D-61709   C# = C-23846

START						STOP					START	NUMBER
YY	DDD	HH	MM	SS	-	YY	DDD	HH	MM	SS	RECORD	RECORDS
64	337	15	22	20	-	64	337	15	32	12	4726	29
64	338	15	55	42	-	64	343	6	30	56	4755	288
64	344	7	3	23	-	64	348	6	1	50	5043	309
64	349	6	34	11	-	64	353	5	45	48	5352	377
64	354	6	10	12	-	64	359	6	0	2	5729	453
64	361	5	15	11	-	65	1	3	45	5	6182	418
65	2	4	19	12	-	65	3	3	23	42	6600	80
65	4	11	18	9	-	65	26	11	6	25	6680	1231
65	27	11	29	1	-	65	28	23	58	38	7911	40
65	30	0	44	42	-	65	30	23	40	16	7951	53
65	32	0	10	47	-	65	35	0	28	5	8004	153
65	36	21	55	41	-	65	37	22	48	4	8157	72
65	38	23	14	12	-	65	40	9	13	19	8229	139
65	41	23	25	12	-	65	41	23	32	33	8368	23
65	43	20	59	50	-	65	44	21	50	52	8391	70
65	45	22	19	48	-	65	46	21	15	56	8461	62
65	72	17	34	14	-	65	72	17	43	14	8523	32
65	76	22	18	33	-	65	77	2	2	15	8555	120
65	78	16	5	53	-	65	78	16	14	11	8675	26
65	81	16	30	11	-	65	81	16	38	54	8701	31
65	83	17	47	7	-	65	89	18	11	24	8732	241
65	91	15	20	31	-	65	92	0	47	22	8973	120
65	93	3	12	11	-	65	96	1	50	0	9093	214
65	97	2	10	12	-	65	98	1	17	35	9307	98
65	99	1	49	17	-	65	102	15	45	12	9405	514
65	106	12	51	48	-	65	106	12	53	51	9919	8
65	108	0	50	16	-	65	108	0	52	18	9927	8
65	113	0	25	1	-	65	113	0	30	28	9935	16
65	114	23	49	9	-	65	116	13	50	27	9951	180
65	118	13	11	40	-	65	118	22	31	57	10131	59
65	119	23	3	32	-	65	120	11	3	34	10190	76
65	121	22	27	34	-	65	123	16	39	17	10266	239
65	125	12	23	12	-	65	125	12	32	18	10505	32
65	128	21	22	25	-	65	129	11	30	16	10537	64
65	135	20	27	33	-	65	135	21	6	10	10601	49
65	137	9	17	9	-	65	137	9	26	18	10650	32
65	141	8	15	14	-	65	141	8	16	7	10682	4
65	142	19	32	5	-	65	143	20	51	14	10686	168
65	147	7	56	16	-	65	147	19	20	53	10854	108
65	149	18	36	26	-	65	149	19	18	14	10962	64
65	165	18	10	55	-	65	165	18	21	11	11026	33
65	344	16	55	55	-	65	344	16	55	55	11059	1
65	347	17	1	5	-	65	347	17	2	49	11060	4
65	350	17	3	36	-	65	351	16	0	17	11064	7
65	354	16	2	20	-	65	356	15	32	3	11071	7
65	357	16	9	36	-	65	357	16	9	53	11078	2
66	75	18	4	14	-	66	75	18	17	40	11080	43
66	77	17	32	16	-	66	77	17	47	9	11123	47
66	84	16	37	18	-	66	84	16	51	13	11170	44
66	89	16	13	50	-	66	89	16	27	13	11214	44

0-61708
9/29/62 - 12/31/63

```
$NOP
$NOP
$NOP ***** LIST OF DOUT1 ********
$EXE TPLIST BS

INPUT PARAMETERS ARE:  ED FL=1=1

 TAPE NO.   1                  FILE NO.   1
 RECORD    1                   LENGTH    260
4XT 72 0 62 272 1941/03X  03.88   294.0 043.122E11 18 1.01 -125.9 +51.57 54        01.031023.01.070994
.01.160935.01.250877.01.340824.01.430777.01.530736.01.620699.01.710666.01.810636.02.290529.02.78045
0.03.260382.03.460356.03.650331.03.750318.03.840303.03.870298.

 TAPE NO.   1                  FILE NO.   1
 RECORD    32429               LENGTH    272
4XT-71 8 63 365 518/35K   2.70   233.9   10.794E11 19 1.00 -123.7 -65.04 85        0.411031. 0.45 956
. 0.46 856. 0.49 783. 0.52 720. 0.56 666. 0.65 582. 0.74 519. 0.84 475. 0.95 444. 1.05 418. 1.16 39
7. 1.26 380. 1.37 366. 1.47 354. 1.57 342. 1.68 331. 2.19 285. 2.69 241.

***** JOB DONE.
$WEOL PS

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D-61709
1/1/64 - 3/30/66

```
$NOP
$NOP ********* DOUT=2 *********
$EXEC TPLIST BS

INPUT PARAMETERS ARE:  ED FL=1=1 1

 TAPE NO.    1  year 1964  Day 1    FILE NO.    1
 RECORD    1                        LENGTH   260
4XT-62 6 64  1  225/11K    7.11   282.1 105.801E11 18 0.84  -81.2 -64.07 86        1.121032. 1.20 983
. 1.29 926. 1.38 879. 1.48 839. 1.96 698. 2.45 606. 2.94 542. 3.43 495. 3.93 462. 4.43 433. 4.92 40
7. 5.42 385. 5.92 362. 6.41 339. 6.91 309. 7.00 301. 7.10 288.

 TAPE NO. year 1964  1              FILE NO.    1
 RECORD    11252 - Day 89           LENGTH   232
4XT 80 7 66  89 1627/13G    4.06   301.5   49.915E11 15 1.02    66.8  70.62 99        1.191052. 1.27 983
. 1.36 919. 1.45 863. 1.54 814. 1.63 771. 1.73 730. 1.82 696. 2.30 571. 2.78 481. 3.27 410. 3.76 34
6. 3.86 333. 3.95 321. 4.05 307.

***** JOB DONE.
$WEO LPS

$$
```

ALOUETTE 1

CRC N(H) DATA, N + HGT COEF

62-049A-01U

This data set, prepared from tapes created by the Communications Research Centre (CRC) in Ottawa, Canada, consists of electron density profiles for the ionosphere above the F2 maximum (topside ionosphere). This data set consists of 1 9-track, 1600 bpi, odd-parity, EBCDIC tape, and is written on a MODCOMP IV computer. Records contain 1 logical record per physical record and are variable length with a maximum blocksize of 900 bytes. The tape was created by merging tapes which contain similar data from data set 62-049A-01G with data set 62-049A-01M, sorting the data by time, and regenerating the data back on tape. The data set includes about 2.7E4 profiles obtained primarily during the period 1963 to 1967. During the merging of this data, occurences of duplicate times were detected, each occurence was included in the merged data set as it represents a different profile. Profiles were not obtained for the complete time period, please check the documentation page entitled TIME SPANS FOR 62-049A-01U for desired time period.

The electron density profiles were computed from digital values of frequency and virtual height, which had in turn been scaled from the ionograms. Profiles were selected because of their scientific interest. Telemetry stations are not identified, but satellite location, time of observation, solar zenith angle at the satellite, magnetic dip at the satellite, total content down to the lowest altitude of topside ionospheric reflection, and other relevant information are listed for each profile. The format gives sequences of numbers for each point scaled from the ionogram. These sequences include electron density at the successive points, and the coefficient a2, b3, b4, b5, etc. from which geometric heights can be calculated, using formulas 40 and 41 in J. E. Jackson, Proceedings of the IEEE., p. 960, June 1969. These formulas can also be used to calculate interpolated density-height values. A CRC interpolation program (available at NSSDC) can be used with this data set. These data make up a a very small portion of the recorded Alouette 1 ionograms. Latitudinal coverage is widespread, but data at longitudes near 80 deg W are more numerous than others.

D#	C#	TIME SPAN
D-61710	C-23847	11/19/62 - 12/16/71

DATA FORMAT FOR 62-049A-01U

CHARACTER POSTION	FORMAT	DESCRIPTION
1	Literal 4	Represents description for TOPSIDE
2	Literal X	profile calculated from the
3	Literal T	X-wave.
4- 6	I3	Dip angle
7- 8	I2	Quality code
9-11	I3	Year
12-15	I4	Day of year
16	1X	Blank
17-20	2I2	Hours and minutes
21	Literal /	Slash
22-23	I2	Seconds
24-38	15X	Blanks
32-38	F8.2	HMAX
39-49	E11.3	Total electron content (e/cm2)
50	1X	Blank
51-52	I2	N=number of pairs of data in profile
53	1X	Blank
54-57	F4.2	Gyrofrequency (MHz)
58-64	F7.1	Longitude
65-71	F7.2	Latitude
72-74	I3	Solar zenith angle
75-80	6X	Blanks

Character positions 81 - end of the record consists of N (bytes 51-52) pairs of electron density profiles with a format of F10.2, F10.2. For a description of these profiles read enclosed documentation.

TIME SPANS FOR 62-049A-01U   D# = D-61710 C# = C-23847

START YY	DDD	HH	MM	SS	-	STOP YY	DDD	HH	MM	SS	START RECORD	NUMBER RECORDS
62	333	20	7	32	-	62	323	20	17	38	1	32
62	337	18	18	17	-	62	337	18	27	30	34	31
63	2	8	40	32	-	63	2	8	47	55	65	20
63	4	8	9	26	-	63	4	8	17	8	85	26
63	5	8	46	6	-	63	5	8	52	53	111	24
63	9	7	45	12	-	63	9	8	4	22	135	34
63	10	8	22	14	-	63	10	8	41	41	169	50
63	12	7	51	14	-	63	13	7	2	23	219	64
63	22	12	57	4	-	63	23	12	0	0	283	84
63	25	8	50	16	-	63	25	13	18	51	367	143
63	27	8	20	21	-	63	27	8	46	17	510	73
63	28	11	30	46	-	63	28	13	25	48	583	63
63	46	21	48	26	-	63	46	21	54	2	646	20
63	51	21	20	11	-	63	51	21	27	22	666	24
63	53	20	53	30	-	63	53	20	59	22	690	21
63	58	20	25	18	-	63	58	20	34	57	711	33
63	65	19	31	57	-	63	65	19	40	9	744	29
63	72	18	34	16	-	63	72	18	45	23	773	38
63	81	17	8	9	-	63	81	17	19	33	811	39
63	95	15	19	5	-	63	95	15	29	5	850	34
63	107	14	1	58	-	63	107	14	11	7	884	32
63	114	13	4	4	-	63	114	13	15	44	916	40
63	122	7	33	17	-	63	122	7	42	28	956	25
63	183	14	19	16	-	63	183	14	24	31	981	19
63	257	0	13	13	-	63	257	23	33	19	1000	693
63	266	23	24	15	-	63	268	23	11	30	1693	1239
63	270	15	9	40	-	63	270	17	10	52	2932	47
63	272	14	44	20	-	63	273	15	30	8	2979	83
63	291	0	33	39	-	63	291	0	47	37	3062	37
63	295	1	12	15	-	63	297	23	48	42	3099	2382
63	300	23	38	59	-	63	300	23	50	43	5481	34
63	303	4	41	17	-	63	303	23	56	47	5515	245
63	309	11	19	54	-	63	309	11	31	19	5760	38
63	325	19	57	39	-	63	325	20	12	46	5798	51
63	353	16	17	2	-	63	353	16	32	8	5849	51
64	9	23	11	9	-	64	10	1	10	27	5900	67
64	12	22	53	19	-	64	12	22	53	19	5967	1
64	14	21	0	10	-	64	15	21	49	59	5968	142
64	16	22	16	11	-	64	17	0	12	15	6110	35
64	20	21	15	2	-	64	20	23	9	37	6145	58
64	48	21	14	16	-	64	48	21	45	31	6203	96
64	87	15	43	0	-	64	87	15	53	15	6299	34
64	88	16	37	36	-	64	88	16	46	21	6333	31
64	91	1	7	8	-	64	93	23	39	18	6364	1650
64	137	9	8	56	-	64	137	9	16	12	8014	19
64	149	20	2	8	-	64	149	20	10	14	8033	24
64	153	7	43	47	-	64	154	6	39	58	8057	40
64	155	7	12	5	-	64	155	7	28	37	8097	24
64	158	7	20	25	-	64	158	7	33	50	8121	25
64	160	6	48	40	-	64	160	7	0	55	8146	28
64	247	23	55	15	-	64	248	0	3	59	8174	30

TIME SPANS FOR 62-049A-01U   D# = D-61710   C# = C-23847

START						STOP					START	NUMBER
YY	DDD	HH	MM	SS	-	YY	DDD	HH	MM	SS	RECORD	RECORDS
64	284	19	8	42	-	64	284	19	18	25	8204	31
64	296	23	34	19	-	64	296	23	41	23	8235	22
64	327	16	1	20	-	64	329	22	49	37	8257	962
65	7	1	13	27	-	65	7	12	28	41	9219	53
65	11	11	19	5	-	65	11	11	27	30	9272	28
65	17	23	16	3	-	65	17	23	24	30	9300	29
65	19	9	14	16	-	65	19	22	54	16	9329	57
65	20	23	22	48	-	65	21	10	38	17	9386	48
65	23	23	31	42	-	65	24	8	59	50	9434	57
65	32	9	49	31	-	65	35	21	0	21	9491	438
65	37	9	24	13	-	65	40	20	39	38	9929	364
65	52	16	6	24	-	65	54	17	31	58	10293	116
65	60	0	3	30	-	65	60	8	4	49	10409	73
65	80	15	35	16	-	65	80	15	42	31	10482	26
65	92	2	45	55	-	65	93	15	24	35	10508	116
65	95	2	45	43	-	65	95	14	49	7	10624	62
65	100	19	38	16	-	65	100	23	31	59	10686	123
65	102	1	45	22	-	65	102	15	45	12	10809	107
65	104	15	1	23	-	65	105	0	21	29	10916	60
65	106	0	44	4	-	65	106	23	50	4	10976	698
65	108	0	9	24	-	65	110	0	0	30	11674	1541
65	113	11	51	26	-	65	113	11	58	10	13215	24
65	114	23	13	17	-	65	115	4	44	59	13239	94
65	116	12	3	33	-	65	116	13	54	16	13333	47
65	119	22	53	42	-	65	119	23	3	6	13380	33
65	121	8	8	34	-	65	150	19	34	53	13413	3551
65	164	1	19	24	-	65	164	19	29	14	16964	758
65	166	2	3	15	-	65	168	20	5	45	17722	1901
65	307	21	53	3	-	65	307	22	22	12	19623	94
65	308	22	32	15	-	65	309	21	55	25	19717	202
65	310	21	58	17	-	65	310	22	35	20	19919	121
65	334	19	21	16	-	65	336	17	21	2	20040	256
66	91	15	46	57	-	66	91	15	48	58	20296	8
66	96	15	23	1	-	66	96	15	23	53	20304	4
66	99	17	14	12	-	66	100	14	23	1	20308	20
66	121	15	8	29	-	66	126	12	56	49	20328	720
66	128	21	37	20	-	66	128	21	38	47	21048	6
66	130	21	6	28	-	66	130	21	7	57	21054	5
66	134	21	45	16	-	66	135	22	34	0	21059	102
66	138	20	41	9	-	66	138	20	55	45	21161	19
66	139	21	27	28	-	66	140	20	21	1	21180	104
66	141	20	52	17	-	66	143	9	28	53	21284	127
66	144	9	56	16	-	66	147	19	24	27	21411	894
66	148	19	53	46	-	66	148	20	5	29	22305	36
66	149	20	39	28	-	66	149	20	43	11	22341	14
66	152	13	21	5	-	66	152	13	34	11	22355	42
66	165	7	10	17	-	66	165	16	32	18	22397	75
66	167	1	33	6	-	66	167	1	34	15	22472	5
66	186	4	23	35	-	66	192	13	49	12	22477	1053
66	201	6	47	29	-	66	201	6	55	19	23530	28
66	215	18	57	4	-	66	215	19	4	20	23558	24

TIME SPANS FOR 62-049A-01U   D# = D-61710   C# = C-23847

START						STOP					START	NUMBER
YY	DDD	HH	MM	SS	-	YY	DDD	HH	MM	SS	RECORD	RECORDS
66	218	11	9	4	-	66	218	11	14	1	23582	14
66	219	17	53	40	-	66	219	18	2	25	23596	14
66	222	10	5	10	-	66	222	10	8	22	23610	5
66	223	16	51	57	-	66	223	17	1	17	23615	23
66	224	22	43	5	-	66	224	22	47	27	23638	16
66	226	22	12	19	-	66	226	22	21	21	23654	31
66	231	21	47	16	-	66	231	22	0	13	23685	38
66	233	21	22	31	-	66	233	21	26	18	23723	13
66	246	1	18	19	-	66	247	19	33	31	23736	320
66	256	0	29	19	-	66	256	21	48	18	24056	379
66	277	3	12	8	-	66	277	3	25	22	24435	39
66	278	10	43	10	-	66	278	10	49	11	24474	21
66	281	2	10	6	-	66	281	2	16	8	24495	21
66	290	9	23	9	-	66	290	9	28	11	24516	17
66	294	8	21	13	-	66	294	8	27	1	24533	21
66	296	22	15	7	-	66	296	23	53	58	24554	27
66	331	19	18	47	-	66	331	19	27	25	24581	28
66	338	18	22	31	-	66	338	18	31	25	24609	32
66	344	20	15	12	-	66	345	17	35	26	24641	46
66	352	16	30	50	-	66	352	16	41	11	24687	34
67	4	3	43	15	-	67	4	23	24	58	24721	281
67	7	2	5	16	-	67	8	22	13	28	25002	694
67	12	1	26	19	-	67	15	21	18	32	25696	1050
67	34	3	19	18	-	67	34	19	0	22	26746	203
67	38	0	14	16	-	67	38	0	23	19	26949	31
67	42	6	22	18	-	67	43	7	9	22	26980	125
67	45	6	29	25	-	67	45	6	38	26	27105	32
67	48	9	6	19	-	67	50	6	21	12	27137	126
67	54	10	27	19	-	67	54	10	36	15	27263	32
67	101	18	20	22	-	67	101	18	29	15	27295	32
67	103	17	41	36	-	67	104	3	5	14	27327	49
67	193	0	1	6	-	67	193	0	7	2	27376	12
67	313	16	26	38	-	67	313	16	33	17	27388	24
67	321	16	6	37	-	67	321	16	10	57	27412	16
68	37	9	59	30	-	68	37	10	4	26	27428	18
68	87	15	50	36	-	68	87	15	53	11	27446	10
68	138	2	22	35	-	68	138	2	30	58	27456	27
68	193	21	46	29	-	68	193	21	55	24	27483	29
68	209	19	22	31	-	68	209	19	31	32	27512	32
71	350	22	14	29	-	71	350	22	21	28	27544	32

D-61710
11/19/62 –
12/16/71

```
$NOP
$NOP
$NOP ********** DOUT3
$EXEC TPLIST BS

INPUT PARAMETERS ARE:  ED FL=1=1 1

 TAPE NO.    1              FILE NO.   1
 RECORD      1              LENGTH   240
4XT 83 8 62 323 20 7/14                          49.457E11  8 1.07  -81.8  59.83 87          20222.69   1019.2
6  30204.35    -336.82  41725.66        3.05  66398.24       81.74  96627.70       42.13 147749.06        45.
85 194819.14      50.21 247471.70       22.53

 TAPE NO.    1              FILE NO.   1
 RECORD      27557          LENGTH   160
4XT 84 8 71 350 2221/28                           9.582E11  41.283 -131.5  73.01 98          25203.76      563.6
3  36820.18    -205.16  50844.94    -211.92  55352.89   -4588.30

***** JOB DONE.
$WEO LPS

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year 1962 day 323
year 1971 day 350