Data Set Catalog # 200

ORP and Model Programs
CORRORP 1 tape

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 This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system.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

File Name
P055.TXT

REQ.AGENT	RAND NO.	ACQ. AGENT
SAR	V0311	CYN

ERBS

MET, EPHEM, RAW ARCHIVAL TAPE (MERDAT)

84-108B-02A

(~~145~~ 198 TAPES)

This data set consists of 9-Track, 6250 BPI, 1 File, Binary Magnetic Tapes, created on a CDC6000 computer. D and C numbers along with the Time Spans are as follows.

D#	C#	TIME SPAN
D-75508	C-26921	11/01/84 - 11/15/84
D 75509	C-26922	11/16/84 - 11/30/84
D-75510	C-26923	12/01/84 - 12/17/84
D-75511	C-26924	12/18/84 - 12/31/84
D-75512	C-26925	01/01/85 - 01/15/85
D-75513	C-26926	01/16/85 - 01/31/85
D-75514	C-26931	02/01/85 - 02/15/85
D-75515	C-26932	02/16/85 - 02/28/85
D-75516	C-26933	03/01/85 - 03/15/85
D-75517	C-26934	03/16/85 - 03/31/85
D-75518	C-26935	04/01/85 - 04/15/85
D-75519	C-26936	04/16/85 - 04/30/85
D-75520	C-26937	05/01/85 - 05/15/85
D-75521	C-26938	05/16/85 - 05/31/85
D-75522	C-26939	06/01/85 - 06/18/85
D-75523	C-26940	06/19/85 - 06/30/85
D-75524	C-26941	07/01/85 - 07/15/85
D-75525	C-26942	07/16/85 - 07/31/85
D-75526	C-26943	08/01/85 - 08/15/85
D-75527	C-26944	08/16/85 - 08/31/85
D-75528	C-26945	09/01/85 - 09/15/85
D-75529	C-26946	09/16/85 - 09/30/85
D-75530	C-26947	10/01/85 - 10/15/85
D-75531	C-26948	10/16/85 - 10/31/85
D-75532	C-26949	11/01/85 - 11/15/85
D-75533	C-26950	11/16/85 - 11/30/85
D-75534	C-26951	12/01/85 - 12/17/85
D-75535	C-26952	12/18/85 - 12/31/85
D-75536	C-26953	01/01/86 - 01/15/86

D-75537	C-26954	01/16/86 - 01/31/86	
D-75538	C-26955	02/01/86 - 02/15/86	
D-75539	C-26956	02/16/86 - 02/28/86	
D-75540	C-26957	03/01/86 - 03/15/86	
D-75541	C-26958	03/16/86 - 03/31/86	
D-75542	C-26959	04/01/86 - 04/15/86	
D-75543	C-26960	04/16/86 - 04/30/86	
D-75544	C-26961	05/01/86 - 05/15/86	
D-75545	C-26962	05/16/86 - 05/31/86	
D-75546	C-26963	06/01/86 - 06/17/86	
D-75547	C-26964	06/18/86 - 06/30/86	
D-75548	C-26965	07/01/86 - 07/15/86	
D-75549	C-26966	07/16/86 - 07/31/86	
D-75550	C-26967	08/01/86 - 08/15/86	
D-75551	C-26968	08/16/86 - 08/31/86	
D-75552	C-26969	09/01/86 - 09/15/86	
D-75553	C-26970	09/16/86 - 09/30/86	
D-75554	C-26971	10/01/86 - 10/15/86	
D-75555	C-26974	~~10/16/86 - 10/31/86~~	06/01/87 - 06/16/87
D-75556	C-26975	~~11/01/86 - 11/15/86~~	6/17/87 - 6/30/87
D-75557	C-26976	~~11/16/86 - 11/30/86~~	7/1/87 - 7/15/87
D-78766	C-27767	12/01/86 - 12/15/86	
D-78767	C-27780	12/16/86 - 12/31/86	
D-78768	C-27768	01/01/87 - 01/15/87	
D-78769	C-27769	01/16/87 - 01/31/87	
D-78770	C-27770	02/01/87 - 02/24/87	
D-78771	C-27771	02/25/87 - 02/28/87	
D-78772	C-27772	03/01/87 - 03/15/87	
D-78773	C-27773	03/16/87 - 03/31/87	
D-78774	C-27774	04/01/87 - 04/15/87	
D-78775	C-27775	04/16/87 - 04/30/87	
D-78776	C-27776	05/01/87 - 05/15/87	
D-78777	C-27777	05/16/87 - 05/31/87	
D-78815	C-26989	06/01/87 - 06/16/87	
D-78816	C-26990	~~06/17/87 - 06/30/87~~	8/25/88 - 8/31/88
D-78817	C-26991	~~07/01/87 - 07/15/87~~	8/1/88 - 8/24/88
D-78818	C-26992	07/16/87 - 07/31/87	
D-78819	C-26993	08/01/87 - 08/15/87	
D-78820	C-26994	~~08/16/87 - 08/31/87~~	11/16/86 - 11/30/86
D-78821	C-26996	09/01/87 - 09/15/87	
D-78822	C-26997	09/16/87 - 09/30/87	
D-78823	C-26998	10/01/87 - 10/01/87	
D-78824	C-26999	10/16/87 - 10/31/87	
D-78825	C-27000	11/01/87 - 11/15/87	
D-78826	C-27001	11/16/87 - 11/30/87	
D-78827	C-27002	12/01/87 - 12/16/87	
D-78828	C-27003	12/17/87 - 12/31/87	
D-78829	C-27004	01/01/88 - 01/15/88	
D-78830	C-27005	01/16/88 - 01/31/88	
D-78831	C-27006	02/01/88 - 02/23/88	
D-78832	C-27007	02/24/88 - 02/29/88	
D-78833	C-27008	03/01/88 - 03/15/88	
D-78834	C-27009	03/16/88 - 03/31/88	
D-78835	C-27010	04/01/88 - 04/15/88	

D-78836	C-27011	04/16/88 - 04/30/88	
D-78837	C-27012	05/01/88 - 05/15/88	
D-78838	C-27013	05/16/88 - 05/31/88	
D-78839	C-27014	06/01/88 - 06/15/88	
D-78840	C-27015	06/16/88 - 06/30/88	
D-79034	C-26983	~~07/01/88 - 07/15/88~~	10/1/88 - 10/15/88
D-79035	C-26984	~~07/16/88 - 07/31/88~~	11/1/88 - 11/15/88
D-79036	C-26985	~~08/01/88 - 08/24/88~~	11/16/88 - 11/30/88
D-79037	C-26986	~~08/25/88 - 08/31/88~~	12/1/88 - 12/15/88
D-79038	C-26987	~~09/01/88 - 09/15/88~~	12/16/88 - 12/31/88
D-79039	C-26988	09/16/88 - 09/30/88	
D-79143	C-26977	~~10/01/88 - 10/15/88~~	07/16/87 - 7/31/87
D-79144	C-26978	~~10/16/88 - 10/31/88~~	08/01/87 - 8/15/87
D-79168	C-26979	~~11/01/88 - 11/15/88~~	08/16/87 - 08/31/87
D-79169	C-26980	~~11/16/88 - 11/30/88~~	10/16/86 - 10/31/86
D-79170	C-26981	~~12/01/88 - 12/15/88~~	11/1/86 - 11/15/86
D-79171	C-26982	~~12/16/88 - 12/31/88~~	10/16/88 - 10/31/88
D-79210	C-27016	01/01/89 - 01/15/89	
D-79211	C-27017	01/16/89 - 01/31/89	
D-79263	C-27062	02/01/89 - 02/15/89	
D-79264	C-27063	02/23/89 - 02/28/89	
D-79334	C-27116	03/01/89 - 03/15/89	
D-79335	C-27117	03/16/89 - 03/31/89	
D-79345	C-27167	04/01/89 - 04/15/89	
D-79346	C-27168	04/16/89 - 04/30/89	
D-79577	C-27183	05/01/89 - 05/15/89	
D-79578	C-27184	05/16/89 - 05/31/89	
D-79879	C-27376	06/01/89 - 06/15/89	
D-79880	C-27377	06/16/89 - 06/30/89	
D-79881	C-27378	07/01/89 - 07/15/89	
D-79882	C-27379	07/16/89 - 07/30/89	
D-80492	C-27745	08/01/89 - 08/23/89	
D-79883	C-27380	08/24/89 - 08/31/89	
D-80493	C-27746	09/01/89 - 09/15/89	
D-80494	C-27747	09/16/89 - 09/30/89	
D-80085	C-27510	10/01/89 - 10/15/89	
D-80086	C-27511	10/16/89 - 10/31/89	
D-80263	C-27566	11/01/89 - 11/15/89	
D-80264	C-27567	11/16/89 - 11/30/89	
D-80495	C-27748	12/01/89 - 12/15/89	
D-80496	C-27749	12/16/89 - 12/31/89	
D-80497	C-27750	01/01/90 - 01/15/90	
D-80498	C-27751	01/16/90 - 01/31/90	
D-80499	C-27752	02/01/90 - 02/20/90	
D-80500	C-27753	02/21/90 - 02/28/90	
D-80501	C-27754	03/01/90 - 03/16/90	
D-80502	C-27755	03/17/90 - 03/31/90	
D-80534	C-27778	04/01/90 - 04/15/90	
D-80535	C-27779	04/16/90 - 04/30/90	
D-80600	C-27787	05/01/90 - 05/16/90	
D-80601	C-27788	05/17/90 - 05/31/90	
D-80646	C-27859	06/13/90 - 06/15/90	
D-80647	C-27823	06/16/90 - 06/30/90	
D-80648	C-27860	07/01/90 - 07/15/90	
D-80649	C-27824	07/16/90 - 07/31/90	

D-82434	C-27855	08/01/90 - 08/15/90	
D-82435	C-27856	08/16/90 - 08/23/90	
D-82436	C-27857	09/01/90 - 09/15/90	
D-82437	C-27858	09/16/90 - 09/30/90	
D-80503	C-27756	10/01/90 - 10/16/90	
D-80504	C-27757	10/17/90 - 10/31/90	
D-82727	C-27902	11/01/90 - 11/15/90	
D-82728	C-27903	11/16/90 - 11/30/90	
D-82806	C-28007	~~12/12/90 - 12/15/90~~	12/16/90 - 12/31/90
D-82807	C-28008	~~12/16/90 - 12/31/90~~	12/12/90 - 12/15/90
D-82819	C-28009	01/01/91 - 01/15/91	
D-82820	C-28010	01/16/91 - 01/31/91	
D-82890	C-28027	02/01/91 - 02/15/91	
D-82891	C-28028	02/19/91 - 02/28/91	
D-83262	C-28071	03/01/91 - 03/16/91	
D-83263	C-28072	03/17/91 - 03/31/91	
D-83702	C-28168	04/01/91 - 04/15/91	
D-83703	C-28169	04/16/91 - 04/30/91	
D-86084	C-29154	05/01/91 - 05/15/91	
D-86085	C-29155	05/16/91 - 05/30/91	
D-84002	C-28208	06/11/91 - 06/15/91	
D-84003	C-28209	06/16/91 - 06/30/91	
D-84345	C-28689	07/01/91 - 07/15/91	
D-84346	C-28690	07/16/91 - 07/31/91	
D-84347	C-28691	08/01/91 - 08/15/91	
D-84348	C-28692	~~08/16/91 - 08/30/91~~	8/20/91 - 8/30/91
D-84420	C-28699	09/01/91 - 09/15/91	
D-84421	C-28700	09/16/91 - 09/30/91	
D-84422	C-28701	10/01/91 - 10/16/91	
D-84423	C-28702	10/17/91 - 10/31/91	
D-84805	C-28824	11/01/91 - 11/15/91	
D-84806	C-28825	11/15/91 - 11/30/91	
D-85473	C-28892	12/09/91 - 12/20/91	
D-85474	C-28893	12/21/91 - 12/30/91	
D-86016	C-29152	01/01/92 - 01/16/92	
D-86017	C-29153	01/17/92 - 01/30/92	
D-86015	C-29151	02/01/92 - 02/19/92	
D-86014	C-29150	02/20/92 - 02/28/92	
D-86204	C-29234	03/01/92 - 03/15/92	
D-86205	C-29235	03/16/92 - 03/31/92	
D-86225 86455	~~C-29245~~ C-29337	04/01/92 - 04/15/92	
D-86226 86456	~~C-29246~~ C-29338	04/16/92 - 04/30/92	
D-86268	C-29261	05/01/92 - 05/15/92	
D-86269	C-29262	05/16/92 - 05/30/92	
D-86455 → 86225	~~C-29337~~ C-29245	07/01/92 - 07/16/92	
D-86456 → 86226	~~C-29338~~ C-29246	07/17/92 - 07/31/92	
D-87894	C-29395	06/07/92 - 06/18/92	
D-87895	C-29396	06/19/92 - 06/30/92	
D-87896	C-29397	08/01/92 - 08/21/92	
D-87897	C-29398	08/22/92 - 08/31/92	
D-87898	C-29399	09/01/92 - 09/16/92	
D-87899	C-29400	09/17/92 - 09/30/92	
D-87919	C-29404	10/01/92 - 10/16/92	
D-87920	C-29405	10/17/92 - 10/30/92	
D-88209	C-29418	11/01/92 - 11/14/92	
D-88210	C-29419	11/15/92 - 11/30/92	
D-88211	C-29420	12/05/92 - 12/18/92	
D-88212	C-29421	12/19/92 - 12/30/92	
D-95308	C-29436	01/01/93 - 01/16/93	
D-95309	C-29437	01/17/93 - 01/30/93	

ERBS/SAGE II

METEOROLOGICAL, EPHEMERIS, RAW DATA ARCHIVAL TAPE (MERDAT) USER'S GUIDE

Final Report

March 31, 1987

(Revision 1. June 1988)

(Revision 2. December 1988)

RECORD OF REVISIONS

Revision Number	Date	Comments
1	6/88	Editorial corrections
2	12/88	Editorial corrections and addition of "Record of Revision" page.

ERBS/SAGE II

Meteorological, Ephemeris, Radiance Data Archival Tape (MERDAT)

USER'S GUIDE

INTRODUCTION

The Stratospheric Aerosol and Gas Experiment II (SAGE II) was launched from Shuttle flight 41-G October 5, 1984, aboard the Earth Radiation Budget Satellite (ERBS). The SAGE II instrument is a multi-channel, spectral radiometer measuring the attenuation of solar radiation through the Earth's atmosphere during spacecraft sunrises and sunsets. These data are inverted at LaRC to provide altitude profiles of aerosol extinction and ozone, nitrogen dioxide, and water vapor concentration profiles. The profiles are used to study the temporal and spatial variability of each species and its relationship on atmospheric processes and climate. Refer to References 1 and 4 for a more detailed description of the SAGE II instrument.

Both unprocessed solar radiance data from the SAGE II instrument and the resultant constitutent profiles are stored on magnetic tapes and made available to the science community through the National Space Science Data Center (NSSDC) at the NASA Goddard Space Flight Center, Code 633, Greenbelt, MD 20771. This User's Guide provides a description of the unprocessed data archival product (the Meteorological, Ephemeris, Radiance Data Archival Tape or MERDAT).

ERBS/SAGE II DATA COLLECTION AND PROCESSING

Data from the SAGE II instrument, along with spacecraft attitude and selected housekeeping data, are recorded onboard the satellite and are periodically transmitted to the NASA Goddard Space Flight Center (GSFC) via a GSTDN station or TDRSS (see Figure 1). GSFC extracts, formats, time correlates the relevant telemetered data, and screens these data for noise and statistical errors. GSFC then forwards these data on an experimenter tape (EXP) to NASA Langley Research Center (LaRC) for processing and scientific analysis. The spacecraft and solar ephemeris data are also sent to LaRC on a separate tape (EPH). The ephemeris data are used to locate the SAGE II observations on the Earth. The NOAA National Meteorological Center (NMC) provides LaRC with atmospheric temperture and pressure data coincident with the SAGE II observations on another separate tape (MET). The MET data are used during retrieval of the atmospheric constituent profiles.

MERDAT TAPE CHARACTERISTICS AND DATA ORGANIZATION

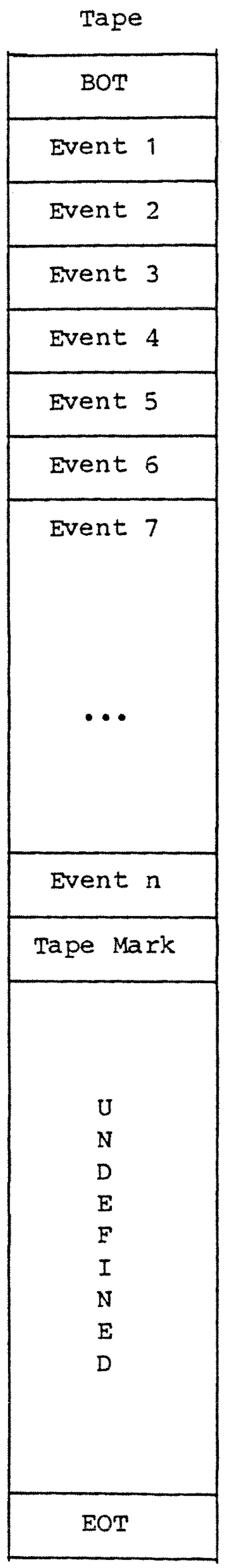
MERDAT tapes are recorded unlabeled, 9-track 6250 bpi. Record length for all records is 4635 bytes (618 60-bit Control Data Corp. (CDC) Cyber 170 words per record). The only tape mark is at the end of data for each tape. Approximately 60% of each 2400 ft tape contains SAGE II data. The remainder of the tape contains no meaningful data.

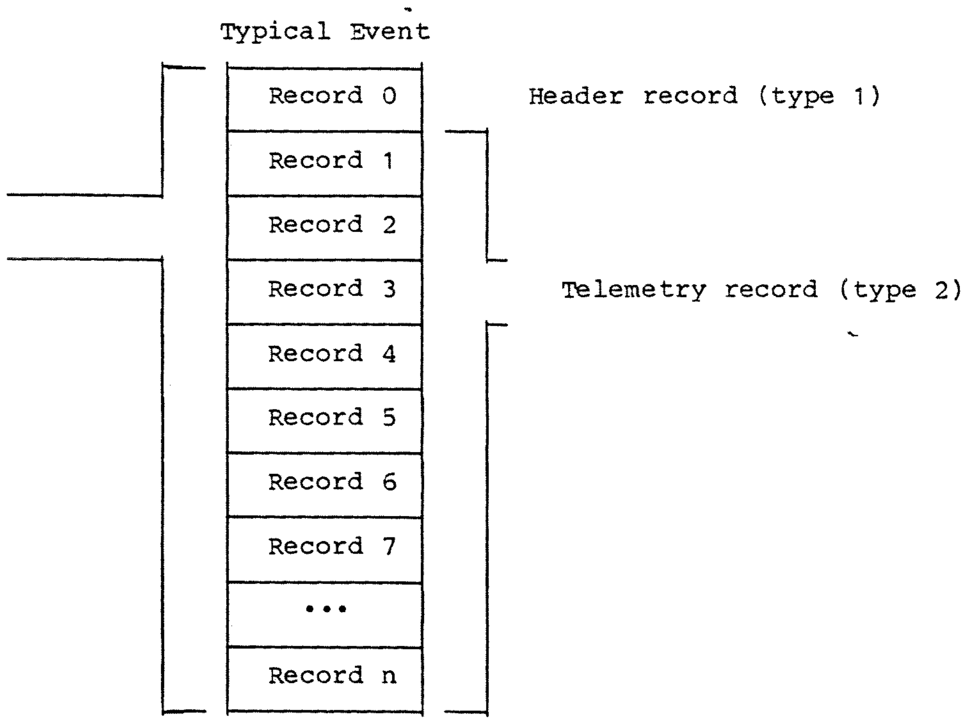
The MERDAT data are seperated into sunrise events and sunset events. Each event contains a header record as record number 0 (zero) followed by zero to 100 telemetry records as record number 1 to 101. A header record with no accompanying telemetry records implies that experiment data for that event is not available.

For each event, the SAGE II data contained on a MERDAT lies within a time interval obtained from the EPH tape. As the satellite passes into or out of Earth's shadow, the instrument experiences a sunset or a sunrise. The event falls within a ± 6 minute window from each shadow edge crossing time. Meteorological data is obtained by referencing the zero km sun-earth-satellite tangent point time (sunrise event) or the 100 km sun-earth-satellite tangent point time (sunset event). Event time, for the purpose of merging and tape placement, is the shawdow crossing time minus ≈ 6 minutes.

SAGE II events are placed onto monthly 2-tape volumes. Tape "A" contains the first 15 days' events, and tape "B" contains the events from day 16 to the end of that month. In no case does the data from a single event cross the tape boundary.

MERDAT TAPE FORMAT





- All records are 4635 bytes long
- Recorded unlabeled, 9-track 6250 bpi
- Tape mark at end of the days data

Tape Name Format:
"Myymmx" where: "M" Denotes MERDAT
yy = 2 digit year
mm = 2 digit month
x = "A" or "B"

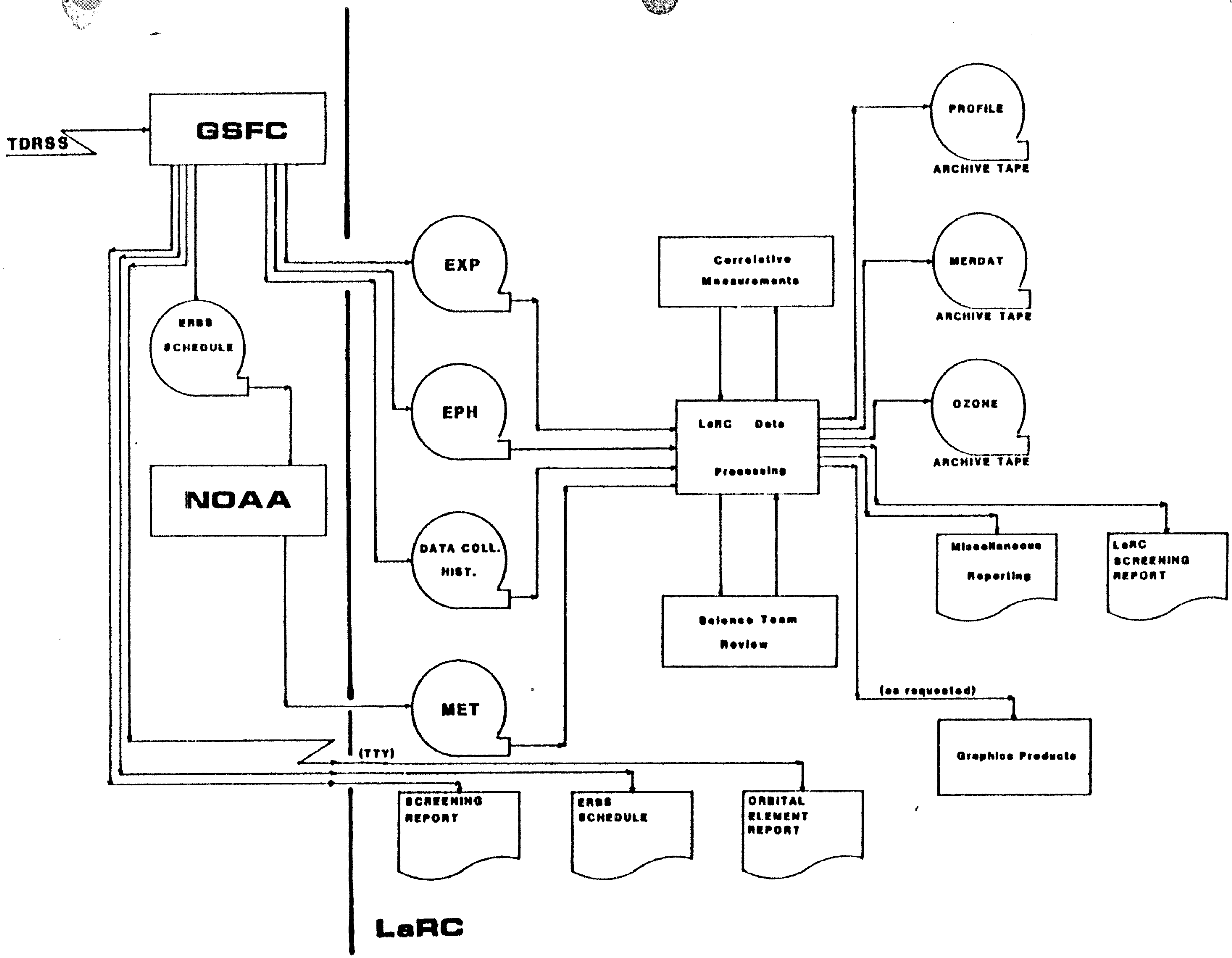


Figure 1. Flow of SAGE II data from the Earth Radiation Budget Satellite to Langley Research Center

MERDAT Tape Label
(example)

NASA LANGLEY RESEARCH CENTER
ARB MAILSTOP 475
HAMPTON, VIRGINIA 23665

SATELLITE ERBS

TAPE NT ~~1600~~ 6250 CPI DATE 11/14/86

SAGE II ARCHIVE PRODUCT MERDAT

DATA COVERAGE M8411B

REMARKS SAGE II

SAGE II ERBS NASA

Color: Red

In this example, the MERDAT would contain data for the last 15 days of November 1984. Note that all MERDAT tapes will be 6250 bpi density.

EVENT HEADER RECORD (Type 1)

Each event starts with a Type 1 record as record number zero. The Type 1 header record contains the following information:

1. 12 sets of ephemeris data in one minute increments.
2. Beta angle for the event.[1]
3. Event type (sunrise or sunset).
4. Predicited latitude and longitude of subtangent point at event start.
5. Meteorological data corresponding to 4 (above).
6. Miscellaneous data and pointers.

All data are formatted in 60-bit CDC Cyber floating-point notation. See Appendix C for decoding details and 60-bit word structure. Table 1 contains the format definition of the Type 1 event header record.

TELEMETRY RECORD (Type 2)

Each telemetrey record contains one 4 second major frame of packed data. The major frame is subdivided into 32 minor frames of 125 milliseconds' duration. Telemetry records are sequential (no time jumps) within each event. Refer to Appendix 'A' for format definition of the telemetry records. Table 2 contains general format information for the telemetry records.

[1]Beta angle is defined as the angle generated by the satellite orbit plane and the sun-earth vector.

TABLE 1. EVENT HEADER

Field Number (Note[1])	Discription of data (Ephemeris Section)	
1	Event record counter (zero)	
2	Tape record type (1.0)	
3	Ephemeris data start date (yymmdd.0)	
4	Ephemeris data start time (hhmmss.0)	
5	Ephemeris data start time (coded: yyddd. fraction of day) Example: 85235.5417 means day 235 of 1985 at 13:00	
6	Time increment between ephemeris data sets (60.0 seconds)	
7-21	Ephemeris data set 1	
22-36	Ephemeris data set 2	
37-51	Ephemeris data set 3	
52-66	Ephemeris data set 4	
67-81	Ephemeris data set 5	
82-96	Ephemeris data set 6	See Table 1a
97-111	Ephemeris data set 7	for Ephemeris data set
112-126	Ephemeris data set 8	details
127-141	Ephemeris data set 9	
142-156	Ephemeris data set 10	
157-171	Ephemeris data set 11	
172-186	Ephemeris data set 12	
187	Epoch data for ephemeris data (yymmdd.0)	
188	Epoch time for ephemeris data (hhmmss.0)	
189	Coordinate system reference data (yymmdd.0)	
190	Coordinate system reference data (hhmmss.0)	
191	Apparent sidereal time at "CSR" time (radians)	
192	Beta angle at data set 1 time (0.0 ± 61.0 degrees)	
193	Ephemeris data end time (coded: see field 5)	
194	Ephemeris data type -1.0: entering earth shadow +1.0: exiting earth shadow	
195-202	zero	

Note[1]: All fields are 60-bit CDC Cyber floating-point notation per Appendix C.

TABLE 1. EVENT HEADER (concluded)

Field Number	Discription of data (Meteorological Section) (Note[2])
203	Reference data of meteorological data (yymmdd.0)
204	Reference time of meteorological data (hhmmss.0)
205	Reference time of MET, data (coded: see field 5)
206	Sub-tangent latitude at reference time (0.0 ± 90.0 degrees)
207	Sub-tangent longitude at reference time (0.0 ± 180.0 degrees)
	MET DATA ARRAYS (see Note[3])
208-226	Pressure level array (mb)
227-245	Temperature corresponding to pressure levels (degrees K)
246-264	Corresponding temperature errors (degrees K)
265-283	Corresponding altitude (km)
284-302	Corresponding densities (gm/cm^3)
303-321	Corresponding density errors (temp/temp error)
322	Event type (-1.0 = sunset; +1.0 = sunrise)
323-326	Zero
327	Total number of events for current day
328	Index pointer to last valid index of the meteorological data arrays
329-618	Zero

Note[2]: If no met data is available, field 203-328 will be zero.
Note[3]: If data is not available the field will contain 9999.0E5.

TABLE 1a. EPHEMERIS DATA SET

Subfield Number	Discription of data
1	Data (yymmdd.0)
2	Time (hhmmss.0)
3	X } Spacecraft position vector (km)
4	Y } Spacecraft position vector (km)
5	Z } Spacecraft position vector (km)
6	X dot } Spacecraft velocity vector (km/sec)
7	Y dot } Spacecraft velocity vector (km/sec)
8	Z dot } Spacecraft velocity vector (km/sec)
9	latitude (deg) } Spacecraft position
10	longitude (deg) } Spacecraft position
11	height (km) } Spacecraft position
12	USX } Sun position vector (unitless)
13	USY } Sun position vector (unitless)
14	USZ } Sun position vector (unitless)
15	RS - Earth-sun vector magnitude (km)

Note: Data sets 1 through 12 (field number 7 through 186) of header record use this format.

TABLE 2. EXPERIMENT TELEMETRY RECORD

Field Number	Discription of data
1*	Events record count (1 through n)
2*	Tape record type (2.0)
3-617	Telemetry data (see Appendix A)
618	Zero

*Field 1 and 2 are 60-bit CDC Cyber floating point notation per Appendix C.

APPENDIX A

Telemetry Format Decoding Guide

1. Input and unpack the telemetry data from the telemetry record (Type 2). (The telemetry data is 4608 bytes in length packed into 615 CDC 60-bit words). The 4608 byte array may then be transferred or equivalenced to a (144 x 32) byte array designated as a "major frame". There are 32 144-byte minor frames within each major frame.

2. For each of the 32 144-byte minor frames, extract SAGE II science data by packing byte 29 thru 124 of each minor frame into consecutive 12-bit words. This will yield a 64 12-bit word array that may be transferred or equivalenced to an 8 x 8 array. The first dimension references the channel of data (1 = channel 0; 8 = channel 7). The second dimension references the channel set within the minor frame. Channel sets are captured at 15.62 millisecond intervals. All channels in one set of data are read within 1.0 millisecond of that set's start time. See Table A2a.

3. For each of the 32 144-byte minor frames, extract the clock time: Minor frame bytes 130, 131, 132, 133, 134 and bit 0 of minor frame word 2

TRUNCATED JULIAN DAY - 41 bits (8+8+8+8+8+1)

Bits 41-28 = Truncated Julian Day based on 83/06/15 = TJD 5500

Bits 27-11 = Seconds of Day

Bits 10-1 = Milliseconds

Appendix D describes the clock time format in detail.

Tables A2a thru A2e describe the contents of the telemetry science data for SAGE II.

TABLE A2. SAGE II SCIENCE DATA MEASUREMENT LIST

Measurement	Set #	Sample Rate	Parameter Range
Channel 0			
Frame Sync	1	8/sec	Hexadecimal "D60"
Elevation Position	2	8/sec	RVDT -4.2° to +4.2°
Edge Time - I	3	8/sec	See Table A2b
Edge Tine - II	4	8/sec	See Table A2b
Solar Intensity	5	8/sec	Zero to 112.5% full sun
Analog MUX #1	6	8/sec	See Table A2c
Analog MUX #2	7	8/sec	See Table A2d
Digital Submix	8	8/sec	See Table A2e
Channel 1 (1.02 μm)	1-8	64/sec	Zero to 4095 counts
Channel 2 (0.94 μm)	1-8	64/sec	Zero to 4095 counts
Channel 3 (0.6 μm)	1-8	64/sec	Zero to 4095 counts
Channel 4 (0.525 μm)	1-8	64/sec	Zero to 4095 counts
Channel 5 (0.453 μm)	1-8	64/sec	Zero to 4095 counts
Channel 6 (0.448 μm)	1-8	64/sec	Zero to 4095 counts
Channel 7 (0.385 μm)	1-8	64/sec	Zero to 4095 counts

Note: All Signals 12-bit digital

TABLE A2a. 12-BIT SCIENCE DATA FORMAT (each minor frame)
(See Appendix B for conversion constant)

→ Memory/Bit Increment

Set # Offset*	Channel Number							
	0	1	2	3	4	5	6	7
Set 1 T + 0.0	Frame Sync	1.02 μm Data	0.94 μm Data	0.6 μm Data	0.525 μm Data	0.453 μm Data	0.448 μm Data	0.385 μm Data
Set 2 T + 15.625	Elevation Position Table B2	↓	↓	↓	↓	↓	↓	↓
Set 3 T + 31.250	Edge Time (MSW) Table A2b	↓	↓	↓	↓	↓	↓	↓
Set 4 T + 48.875	Edge Time (LSW) Table A2b	↓	↓	↓	↓	↓	↓	↓
Set 5 T + 62.500	Solar Intensity Table B2	↓	↓	↓	↓	↓	↓	↓
Set 6 T + 78.125	Analog SUB-MUX 1 Table A2c	↓	↓	↓	↓	↓	↓	↓
Set 7 T + 93.750	Analog SUB-MUX 2 Table A2d	↓	↓	↓	↓	↓	↓	↓
Set 8 T + 109.375	Digital SUB-MUX Table A2e	↓	↓	↓	↓	↓	↓	↓

Note: All data are 12-bits long

*Offset is the millisecond offset from T.
T = (minor frame clock time minus 62.500 milliseconds)

TABLE A2b. EDGE TIME FORMAT

Measurement	Sci Bit	Magnitude	Sample Rate	Type Signal	Parameter Range
Scan down/up	11	--	8/sec	Bi-level	1 = Scanning Down
Time on bit 1	10	2^6			Zero to 127 counts equals zero
Time on bit 2	9	2^5			to 127 milliseconds. Zero time
Time on bit 3	8	2^4			is always trailing edge of
Time on bit 4	7	2^3	8/sec	Binary	base module minor frame pulse.
Time on bit 5	6	2^2		Counter	Counter is stopped by presence
Time on bit 6	5	2^1			of edge a LIMB crossing signal
Time on bit 7	4	2^0			
Time off bit 1	3	2^6			Zero to 127 counts equals zero
Time off bit 2	2	2^5			to 127 milliseconds. Zero time
Time off bit 3	1	2^4			is always trailing edge of bi-
Time off bit 4	0	2^3	8/sec	Binary	nary base module minor frame
*--------------	-----	---------		Counter	pulse. Counter is stopped by
Time off bit 5	11	2^2			absence of edge a LIMB cross-
Time off bit 6	10	2^1			ing signal.
Time off bit 7	9	2^0			
Spare bit 1	8	2^8			Spare
Spare bit 2	7	2^7			Spare
Spare bit 3	6	2^6			Spare
Spare bit 4	5	2^5			Spare
Spare bit 5	4	2^4			Spare
Spare bit 6	3	2^3			Spare
Spare bit 7	2	2^2			Spare
Spare bit 8	1	2^1			Spare
Spare bit 9	0	2^0			Spare

Above, <u>M</u>ost <u>S</u>ignificant <u>W</u>ord (MSW)

*---

Below, <u>L</u>east <u>S</u>ignificant <u>W</u>ord (LSW)

TABLE A2c. ANALOG SUB-MULTIPLEXER NO. 1
(See Appendix B for Conversion Constants)

Measurement	Minor Frame Location	Type Signal	Parameter Range
Azimuth Housing Temp.	0/16	Analog	-20 to +60°C
Detector Housing Temp.	1/17	Analog	-20 to +60°C
Aperture Plate Temp.	2/18	Analog	-20 to +60°C
Upper Bearing Temp.	3/19	Analog	-20 to +60°C
Azimuth Motor Temp.	4/20	Analog	-20 to +60°C
Lower Bearing Temp.	4/21	Analog	-20 to +60°C
Scan Head Temp.	6/22	Analog	-20 to +60°C
Elevation Motor Temp.	7/23	Analog	-20 to +60°C
RVDT Temp.	8/24	Analog	-20 to +60°C
Electronics Temp.	9/25	Analog	-20 to +60°C
+15 Volt Monitor	10/26	Analog	Zero to 25 V
-15 Volt Monitor	11/27	Analog	-91.25 to +35.2 Volts
+5 Volt Monitor	12/28	Analog	Zero to 8.33 V
+10 Volt Monitor	13/29	Analog	Zero to 16.6 V
+28 Volt Monitor	14/30	Analog	Zero to 50 V
+1 Volt Temp Ref. Monitor	15/31	Analog	Zero to +5 Volts full scale

All data sampled at 0.5 samples/second

TABLE A2d. ANALOG SUB-MULTIPLEXER NO. 2
(See Appendix B for Conversion Constants)

Measurement	Minor Frame Location	Type Signal	Parameter Range
+15 Volt Monitor	0/16	Analog	Zero to 0.66 amp
-15 Volt Monitor	1/17	Analog	Zero to -0.765 amp
+5 Volt Monitor	2/18	Analog	Zero to 187 ma
+10 Volt Monitor	3/19	Analog	Zero to 187 ma
+28 Volt Monitor	4/20	Analog	Zero to 1 amp
Azimuth Servo Error 1	4/21	Analog	+30 min (CW) to -30 min (CCW)
Elevation Servo Error	6/22	Analog	+72 sec (UP) to -72 sec (DN)
Azimuth Motor Current	7/23	Analog	Zero to 1.25 amp
Elevation Motor Current	8/24	Analog	Zero to 0.9 amp
ADC Calibration Low Ref.	9/25	Analog	Nominal zero Volts
ADC Calibration Mid Ref.	10/26	Analog	Nominal +2.33 Volts
ADC Calibratrion High Ref.	11/27	Analog	Nominal +4.66 Volts
Heater Current	12/28	Analog	Zero to 360 ma
Azimuth Servo Error 2	13/29	Analog	+30 min (CW) to -30 min (CCW)
Azimuth D/A Monitor	14/30	Analog	Zero to +10 Volts
Azimuth Position Pot	15/31	Analog	+197.5° (FULL CW) to -197.5° (FULL CCW)

All data sampled at 0.5 samples/sec

TABLE A2e. DIGITAL SUB-MULTIPLEXER FORMAT

Measurement (Magnitude)	Minor Frame Location	Sci Bit	Parameter Range
Spare	0/4/8/12/16	11	Always = 1
Azimuth Power	20/24/28	10	1 = Power On
Elevation Power		9	1 = Power On
Slew SR		8	1 = Slew Sunrise PTG Mode
Slew SS		7	1 = Slew Sunset PTG Mode
Gimbal SR		6	1 = Gimbal Sunrise PTG Mode
Gimbal SS		5	1 = Gimbal Sunset PTG Mode
Scan (Backup)		4	1 = Scan Backup PTG Mode
Scan Down/Up		3	1 = Scanning Down
Scan Norm/Fast		2	1 = Scanning Normal
Azimuth Wiper A/B		1	1 = Wiper A
Auto/CMD Update		0	1 = Auto Update Enabled
Azimuth Storage (2^8)	1/5/9/13	11	Monitors the data bus common to both SS and SR slew memories. Normally reads sunset memory but will read sunrise memory during Slew SR. This monitor will also read all update data during memory write, which, however, is present for only 40 msec. Will also read SR memory during gimbal SR mode.
Azimuth Storage (2^7)	17/21/25/29	10	
Azimuth Storage (2^6)		9	
Azimuth Storage (2^5)		8	
Azimuth Storage (2^4)		7	
Azimuth Storage (2^3)		6	
Azimuth Storage (2^2)		5	
Azimuth Storage (2^1)		4	
Azimuth Storage (2^0)		3	
Spare		2	Always = 0
Spare		1	Always = 0
Spare		0	Always = 0

All data sampled at 2 samples/sec

All signals Bi-level

TABLE A2e. DIGITAL SUB-MULTIPLEXER FORMAT (concluded)

Measurement (Magnitude)	Minor Frame Location	Sci Bit	Parameter Range
Azimuth Limit A	2/6/10/14/18	11	Logic 1 when Az > +187.5° (CW)
Azimuth Limit B	22/26/30	10	Logic 1 when Az < -187.5° (CW)
Azimuth Gain		9	Logic 1 = High gain mode
Spare		8	Always = 1
Spare		7	Always = 0
Sun TA Signal		6	Logic 1 = Illuminated
Spare		5	Always = 1
Sci Ch2/Selected		4	1 = Sci GHZ; 0 = Sci CH1 use Use for T/A
Spare		3	Always = 0
Select SRM		2	1 = Sunrise memory on
Select SRM		1	1 = Sunset memory on
Frame Count (2^{11})		0	12 bit frame counter counts (major frames from power on)
Frame Count (2^{10})	3/7/11/15/19	11	12 bit frame counter counts
Frame Count (2^{9})	23/27/31	10	(major frames from power on)
Frame Count (2^{8})		9	
Frame Count (2^{7})		8	
Frame Count (2^{6})		7	
Frame Count (2^{5})		6	
Frame Count (2^{4})		5	
Frame Count (2^{3})		4	
Frame Count (2^{2})		3	
Frame Count (2^{1})		2	
Frame Count (2^{0})		1	
MUX Sync		0	1/2 Hz signal. 1 = first 8 channels of analog MUX, 0 = last 8 channels

All data sampled at 2 samples/second

All signals Bi-level

APPENDIX B

Calibration Constants

Table B1 -- Reserved

Table B2 applies to the 12-bit data in the 64 12-bit word science data in each minor frame.

TABLE B - 1

(Reserved)

TABLE B2. SAGE SCIENCE DATA CALIBRATIONS (12-BIT)

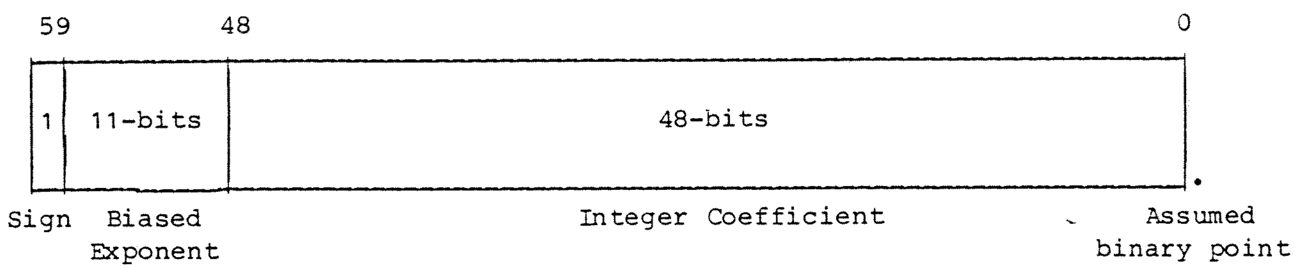
			$Y = AX^3 + BX^2 + CX + D$			
Discription	Range	Units	A	B	C	D
Elevation Position	-4.677 to 4.69236	Degrees (1)	0.0	0.0	2.288 E-3	-4.677
Solar Intensity	0 to 112.5	Percent	0.0	0.0	2.76 E-2	5 E-4
All Temperatures	-20 to +60	Degrees C	9.671 E-10	-5.4758 E-6	2.5849 E-2	20.27
+15 Volts Monitor	0 to 25.10	Volts	0.0	0.0	6.13 E-3	0.0
-15 Volts Monitor	0 to -25.51	Volts	0.0	0.0	-6.23 E-3	0.0
+5 Volts Monitor	0 to 8.47	Volts	0.0	0.0	2.07 E-3	0.0
+10 Volts Monitor	0 to 16.59	Volts	0.0	0.0	4.05 E-3	0.0
+28 Volts Monitor	0 to 49.96	Volts	0.0	0.0	1.22 E-2	0.0
1 Volt Temp. Ref.	0 to 4.99	Volts	0.0	0.0	1.22 E-3	0.0
+15 Volts I Monitor	0 to 596.36	Milliamps	0.0	0.0	1.486 E-1	-12.16
-15 Volts I Monitor	0 to 723.04	Milliamps	0.0	0.0	1.756 E-1	3.96
+5 Volts I Monitor	0 to 188.19	Milliamps	0.0	0.0	4.55 E-2	1.87
+10 Volts I Monitor	0 to 194.13	Milliamps	0.0	0.0	4.454 E-2	8.22
+28 Volts I Monitor	0 to 980.80	Milliamps	0.0	0.0	2.39 E-2	2.09
Az Servo Error 1	-29.30 to 29.67	Arc Minutes	0.0	0.0	1.44 E-2	-29.30
EL Servo Error	-45.73 to 46.00	Arc Seconds	0.0	0.0	2.24 E-2	-45.73
Az Motor I	0 to 995.41	Milliamps	0.0	0.0	2.431 E-1	-0.08
EL Motor I	0 to 660.61	Milliamps	0.0	0.0	1.615 E-1	-0.73
ADC Calibration	0 to 4.996	Volts	0.0	0.0	1.22 E-3	0.0
Heater I	0 to 548.11	Milliamps	0.0	0.0	1.338 E-1	0.20
Az Servo Error 2	-29.30 to 29.67	Arc Minutes	0.0	0.0	1.44 E-2	29.30
Az D/A Monitor	-196.88 to 197.00	Degrees	0.0	0.0	9.62 E-2	-196.88
Az Pot Position	-197.44 to 196.9	0.0	0.0	0.0	9.63 E-2	-197.44
Azimuth Storage	-196.96 to 196.97	Degrees	0.0	0.0	7.709 E-1	-196.96
Science Channels (1 thru 7)	0 to 4095	Counts	0.0	0.0	1.0	0.0

(1) + is rotation for Sunrise acquisition

APPENDIX C

Floating Point Notation: Cyber 60-bit word

Figure D-1



Bits 47 through 0 contain the coefficient of the number (equivalent to about 14 decimal digits). The binary point is considered to be at the right of bit 0. The exponent is biased by 2000 octal; that is, the exponent is represented by an 11-bit quantity (one's complement notation is used for negative numbers), 2000 octal is added to this quantity, and the low order 11 bits are used.

Additionally, real numbers are normalized. A normalized number is one in which bit 47 is the most significant bit; that is, bit 47 is different from bit 59. The special case of a word of all zero bits (positive zero) is also a normalized number. For every bit position that the coefficient is shifted to the left to achieve normalization, the exponent is reduced in value by one.

The sign of the number is represented by bit 59: the number is positive if bit 59 is 0 and negative if bit 59 is 1. Negative numbers are represented in one's complement form.

Minus zero (a word of all 1 bits) is considered to be equal to positive zero (a word of all zero bits).

Table D-1 summarizes the configuration of bits 58 and 59 and the exponent and coefficient signs resulting from each combination.

TABLE D-1. BITS 58 AND 59 COMBINATIONS

Bit 59	Coefficient Sign	Bit 58	Exponent Sign
0	Positive	1	Positive
0	Positive	0	Negative
1	Negative	0	Positive
1	Negative	1	Negative

Some examples of floating point numbers, as they would appear in octal format, are as follows:

Number	Octal Representation
+1	1720 4000 0000 0000 0000
+100	1726 6200 0000 0000 0000
-100	6051 1577 7777 7777 7777
1.E64	2245 6047 4037 2237 7733
-1.E-64	6404 2570 0025 6605 5317
0	0000 0000 0000 0000 0000

APPENDIX D

ERBS TIME CODE

The Time Code for ERBS is a variation of the parallel-grouped[1] binary (version 5) (PB5) time code consisting of three groups of time units: (1) Truncated Julian Data (TJD), (2) second, and (3) millisecond. PB5 is the standard time code for the real-time synchronization of the spacecraft clock[2] which is corrected, if necessary, from the ground at approximately weekly intervals[3]. For serial transmission from the ERBS, the bits are arranged as shown in Figure D-1. The time groups are defined as follows:

(1) Truncated Julian Data. The TJD count is derived from the Julian Day number. It is obtained by truncating all decimal digits after four,and ranges from 0 to 9999. The epoch of the TJD began on May 24, 1968, and will end on October 9, 1995. The epoch of the TJD was chosen for that time because the Julian day number was an integer multiple of 10,000 on that date. The TJD cycle has a period of approximately 27.379 years. The four-decimal digit TJD is stored in a 14-bit-binary-number representation.

(2) Seconds of a Day. The seconds-of-day count ranges from 0 to 86399 and is stored in a 17-bit-binary-number presentation.

(3) Milliseconds of a Second. The milliseconds-of-second count ranges from 0 to 999 and is stored in a 10-bit-binary-number representation.

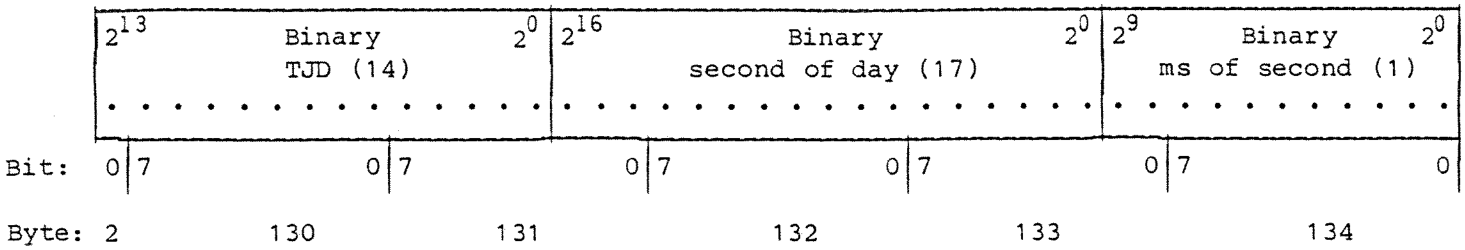
Notes:

[1] Each group is represented by a binary number which recycles at an appropriate decimal value less than 2^n-1 (e.g., the 17-bit seconds-of-a-day number increases from zero to the binary equivalent of 86,399, then advances the TJD by one, and recycles to zero instead of recycling at 131070).

[2] ERBS has two PB5 clocks which are completely independent of one another. Each clock has a stability of less than 3.86 parts per 100 million (10^8). Only one clock is read out in the TM, the other is a backup.

[3] The ERBS experiments require time to within an accuracy of ±20 ms. A stability of 3.86 parts per 100 million requires the clock to be ground connected once every six days.

Figure D1. Parallel-Grouped Binary Time Code for ERBE



Note:

1. Dots represent bit values (0 or 1).
2. The number in parentheses represent the bits in each group.
3. TJD, second of day and millisecond of day groups are all right-justified.

REFERENCES

1. "Telemetry and Command Handbook", Ball Document No. ERBS-306, Rev. G, 6 June 1984.
2. "Earth Radiation Budget Satellite -- SAGE II Interface Agreement Document", GSFC Title "IPD to SAGE II LaRC Data Transfer Interface", December 1, 1981 (with revs.).
3. "ERBS Interface Specification, Control and Compliance Document -- Stratospheric Aerosol and Gas Experiment II (SAGE II)", Ball Document 2319-009, 30 Jan 1981, Rev. D, May 1983.
4. "Stratospheric Aerosol and Gas Experiment II Instrument: A Functional Description" by L. E. Mauldin, III, N. H. Zaun, M. P. McCormick, J. H. Guy and W. P. Vaughan: Optical Engineering, 24, 2, 307-312, 1985.
5. "Fortran Extended Version 4 Reference Manual" Control Data Corporation Manual #60497800 (Rev. F).

REQ. AGENT
PAR

ACQ. AGENT
Mike Teague

ORP & MODEL PROGRAMS

CORRORP

This data set catalog contains documentation and listings of the ORP and MODEL programs. The tape containing these programs (D-10584) C-8007 is 556 BPI, BCD, 7-track, ~~2~~ 6 files. ~~The 1st file is ORP the 2nd file MODEL~~.

FILE	CONTENTS
1	ORP (029 punch) VERSION 2
2	MODEL (029)
3	BLOCK DATA (029)
4	ORP (026) VERSION 2
5	MODEL (026)
6	BLOCK DATA (026)

NSSDC 72-

The Use of the Inner Zone Electron Model AE-5 and Associated Computer Programs

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CONTENTS

ILLUSTRATIONS

1. INTRODUCTION

This report is intended as a guide to the users of the inner radiation zone electron model AE-5. Section 2 includes a description of the model, and the forms in which it is available, directions on how to use the model, and a discussion of its limitations. Computer programs MODEL and ORP are described in Sections 3 and 4, respectively. These are major programs needed to use the electron models AE-4 and AE-5 and the latest proton models.

This document is a companion to the paper previously published by Teague and Vette ("The Inner Zone Electron Model AE-5," NSSDC 72-10, 1972), and the reader is referred to this document for a complete description of the development of the model. Work is currently in progress to improve the part of model AE-5 concerning high-energy electrons. In addition, a new proton model is being developed. When completed both of these models will be compatible with the computer programs described in this document.

2. DESCRIPTION, USE, AND LIMITATIONS OF MODEL AE-5

A. Description of the Model

Model AE-5 describes the inner radiation zone electron environment and is based on data from five satellites spanning the period December 1964 to December 1967. The model provides omnidirectional integral flux for energy thresholds E_T in the range $4.0 > E_T/(\text{MeV}) > 0.04$ and for L values in the range $2.8 > L/(R_e) > 1.2$ for an epoch of October 1967. Confidence codes for certain regions of B-L space and certain energies are given based on data coverage and the assumptions made in the analysis.

Data from satellites OGO 1, OGO 3, 1963-38C, OV3-3, and Explorer 26 were used. The University of Minnesota electron spectrometers were carried on board OGO 1 and 3 and produced data used for model AE-5 (NSSDC data sets 64-054A-217 and 66-049A-227) ~~[illegible]~~. These measurements extended over the period September 1964 to December 1967. The 1963-38C satellite was launched in September 1963 and provided data through 1967. This spacecraft carried an integral electron spectrometer from the Applied Physics Laboratory (Bostrom, 1969). Data obtained from mid-1966 to late 1967 were used in developing model AE-5. Explorer 26 data from detectors designed ~~at the University of California at San Diego~~ were used for the time interval January to June 1965. OV3-3 data from the Aerospace Corporation differential nine-channel electron spectrometer, supplied by Vampola late in the development of the model, were also incorporated in model AE-5.

The model forms available to a user include graphical presentation and a variety of computer programs. This section describes the types of graphs and includes examples of each type. Computer programs are discussed in Sections 3 and 4.

In previous documentation on trapped particle models, the major source of data has been in the form of omnidirectional integral flux tables. Model AE-5, however, is presented in the form of two-dimensional carpet plots $J = J(B,L)$ for given energy thresholds. In addition, carpet plots are used for the graphical presentation of the solar cycle ratios. While the omnidirectional flux data have been presented tabularly in previous model documentation with greater resolution than can be obtained from carpet plots, the error associated with determining a number from the carpet plots is considered insignificant in comparison to the inherent error associated with ~~obtaining~~ the model.

Omnidirectional flux plots are presented in Figures 1 through 7 for threshold energies E_T = 40, 100, 250, and 500 keV and 1, 2, and 4 MeV. Fluxes at nongrid B, L, and E points may be obtained simply by interpolation as described in Appendix A of Teague and Vette (1972). B-L and R-λ flux maps are presented in Figures 8 through 13 for threshold energies E_T = 40 keV, 500 keV, and 1 MeV. In addition, a physical impression of the model at these energies may be obtained from the three-dimensional plots, Figures 14 through 16. While the basic epoch of model AE-5 is October 1967 corresponding approximately to solar maximum, AE-5 contains approximate values of the solar cycle parameter for time T

$$R_T\,(E_T,L,T) = \frac{J(E_T,L,T = \text{October 1967})}{J(E_T,L,T)}$$

Plots of $R_T(L,T)$ are presented in Figures 17 through 20 for energy thresholds E_T = 40, 100, 250, and 500 keV. In these plots, the time parameter T has units of months from solar minimum taken as September 1964. Values of R_T are not presented for higher energies because of magnetic storm effects (Teague and Vette, 1972). While the values of R_T presented in Figures 17 through 20 have been determined from data over the period 1964 to 1967, they may be used to obtain very approximate estimates of the solar cycle effects for epochs later than October 1967. Using as a basis the Zuhich Sunspot Number, it may be assumed that the flux is constant until T = 69 approximately (June 1970) and thereafter decreases approximately as described by Figures 17 through 20, reading a minimum at T = 100 approximately (January 1973). It should be appreciated that extrapolating the model solar cycle dependence in this manner is likely to provide very approximate flux estimates only (Section 2B).

B. Limitations of the Model

It should be remembered that model AE-5 is presented for an epoch of October 1967, and temporal variations may result in significant flux changes in certain regions of B-L-E space. These temporal variations include magnetic storm effects, solar cycle effects, and residual Starfish electrons. These effects are discussed in detail in the paper by Teague and Vette (1972). These temporal variations, however, generally cause the flux to decrease from that given by AE-5 at epoch October 1967, and thus the model is adequate to assess the influence of trapped inner zone electrons on orbital vehicles.

To enable the user to assess the reliability of model AE-5, a system of confidence codes is presented. In developing these codes a number of criteria were used: number of data sets used, data coverage, how much data agree, errors introduced by modeling technique, and uncertainties introduced by temporal variations. A scale of 1 to 10 is used, where 10 corresponds to the highest reliability with an expected error of 2 or less and 1 corresponds to the least reliability with an expected error in excess of a factor of 10. In general, however, efforts have been made to provide pessimistic flux estimates where low confidence codes are given which state that it is more probable that the flux is lower than the quoted value than higher. Two sets of codes are given --one for the omnidirectional flux at an epoch of October 1967 (Table 1) and one for the solar cycle parameters (Table 2). In each case, a brief explanation for the confidence code and a section reference to the paper by Teague and Vette (1972) are given.

For example, in Table 1, where the B range is $>B_0$, the L range is 1.2 to 1.4, and the E_T range is >3 MeV, the confidence code is 1. This code indicates that in these ranges the omnidirectional flux indicated by model AE-5 has low reliability, with an expected error of more than a factor of 10. The comment column indicates that this error results from extrapolation on both B dependence and spectrum and from a lack of data.

Three temporal variations have been noted in the inner radiation zone: the decay of Starfish electrons, solar cycle effect, and magnetic storm effects. AE-5 attempts to model all three of these, and the reader is referred to Teague and Vette (1972) for a complete description of the modeling techniques used. Model AE-5 contains a small Starfish residual flux in the energy range 500 keV $\leq E_T \leq 3$ MeV and the L range $1.2 < L/R_E < 1.5$. Because of the lack of Starfish-free data, natural flux levels could not be obtained in these intervals, and corresponding low confidence limits are quoted in Table 1. Estimates have been made of the times at which the Starfish flux component has decayed to the level of the natural flux component, and these are presented in Table 3. For the L and E_T region of AE-5 that is influenced by Starfish electrons, it is estimated that a maximum reduction of a factor of 5 will result from the decay of this component.

Some discussion of the solar cycle effect has been given in the previous section. The confidence limits presented in Table 1 are applicable to the model at epoch October 1967. At other epochs the confidence codes are smaller because of the solar cycle effect. If Figures 17 through 20 are used to estimate this solar cycle effect, however, only the higher confidence codes should be reduced. That is, where the model is already associated with a factor of 5 or 6 error, no further error is introduced, wheras errors of a factor of 2 will be increased to 3 or 4 dependent upon the value of R_T.

The third temporal variation included in model AE-5 is the effect of magnetic storms. This effect is most noticeable at L = 1.9 to 2.4, and E_T = 0.4 to 2 MeV. Three variables are considered in determining the magnetic storm effect: the frequency of the storm, the intensity in relation to the undisturbed (quiet day) background, and the duration. Assessment of the importance of magnetic storms can be performed in practice with consideration of the first two variables alone because these exhibit much greater variation with E and L than does the third variable.

The frequency of magnetic storms in the inner belt is too low for a statistical approach. However, although the storms are infrequent, their relative intensity is high. In these circumstances the flux varies considerably from quiet to storm conditions in such a way that the changes from one condition to another are unpredictable and cannot easily be modeled.

A crude method has been adopted in model AE-5 for including magnetic storm effects. Average fluxes including magnetically distrubed and quiet periods were determined for the period June 1966 to December 1967. Magnetic storm effects were found to influence this average in the region L ≥ 1.8 and 40 keV ≤ E_T ≤ 2 MeV. The maximum ratio of average to quiet period flux was found to be 100 approximately at E_T = 1 MeV at the ~~outer edge of the belt~~. At L = 1.9 this ratio had reduced to 3. It should be appreciated that the average storm flux included in AE-5 provides inaccurate estimates of the instantaneous fluxes and an inaccurate basis for orbit flux integrations because of the low frequence and high intensity of magnetic storm effects. These inaccuracies are incorporated in the confidence limits presented in Table 1. A model is currently being developed to describe the magnetic storm effects in the inner zone with greater accuracy than presently given by AE-5.

3. PROGRAM MODEL

Program MODEL is a Fortran program that enables the user to access any of the current trapped radiation models available through the National Space Science Data Center (NSSDC). These models include the Inner Zone Electron Model AE-5 for epoch October 1967 described in brief in Section 2 of this document and described in detail by Teague and Vette (1972), the Outer Zone Electron Model AE-4 for epoch 1967 given by Singley and Vette (1972), and a smoothed version of the proton models AP1, AP5, AP6, and AP7 originally presented by Vette et al. (1966-1970) and described by Kluge and Lenhart (1971). A matrix storage technique originally developed at ESRO (Kluge and Lenhart, 1971) is adopted for the containment of these models. A new interpolation scheme has been developed at NSSDC and is described in the following sections.

The matrix storage scheme and interpolation routines are completely general, and, as new models become available, these can be easily incorporated into Program MODEL. Work is currently in progress on developing new proton and high-energy electron inner zone models.

A. Program Logic and Restrictions

Flux versus $\frac{B}{B_0}$ curves are stored in Program MODEL at discrete energies and L values using the scheme indicated in Figure 21. Using the decadic logarithm of the omnidirectional integral flux, equal increments in the ordinate are chosen and the B/B_0 intervals $\delta(B/B_0)_i$ are determined. Each flux versus $\frac{B}{B_0}$ curve is represented in the stored matrix by the variable F_0, equal to the logarithm of the flux at the equator, and the B/B_0 intervals $\delta(B/B_0)_i$. Using equal increments in the ordinate as opposed to the abscissa has the advantage that a fixed accuracy is maintained for the flux versus $\frac{B}{B_0}$ curve even in the region of the atmospheric cutoff, where the slope of the curve becomes very large. Linear interpolation on the logarithm is used between the grid points defined by average to quiet period flux was found to be ~~100~~ approximately at $E_T = 1$ MeV at ~~the outer edge of the belt~~. At L = 1.9 this ratio had reduced to 3. It should be appreciated that the average storm flux included in AE-5 provides inaccurate estimates of the instantaneous fluxes and an inaccurate basis for orbit flux integrations because of the low frequence and high intensity of magnetic storm effects. These inaccuracies are incorporated in the confidence limits presented in Table 1. A model is currently being developed to describe the magnetic storm effects in the inner zone with greater accuracy than presently given by AE-5.

The present interpolation scheme has a number of advantages over the scheme described by Kluge and Lenhart (1971), which performs the interpolation at constant B. For $L_2 > L_1$ in Figure A, at the equator, $B_0(L_2) < B_0(L_1)$ and, at atmospheric cutoff, $B_c(L_2) > B_c(L_1)$. Thus there are two regions for $B < B_0(L_1)$ and $B > B_c(L_1)$ for which flux values can be determined for $L = L_2$ only. Interpolation at constant B/B_0 removes the region $B < B_0(L_1)$, but the problem remains at the cutoff. With the technique described in the previous paragraph, however, the interpolation is performed in a completely general fashion without restriction on B/B_0 or B. In addition, the Kluge and Lenhart scheme is inaccurate for low L values where the equatorial B value is quite different from one L grid point to the next.

In the following paragraphs, a brief description of the main program and subroutines of Program MODEL and their restrictions is given in the order in which they are called.

MAIN

MAIN performs the I/O function of Program MODEL and offers a variety of options to the user for inputting B, L, and E. These options are described fully in Section 3B. The variable retrieved by the interpolation subroutines is omnidirectional integral flux with units particles/cm^2-sec.

The radial profile and spectra for each model have been smoothed at grid points, and each model provides fluxes down to 1 particle/cm^2-sec. Smaller fluxes are defined as zero. MAIN is able to determine average differential flux in particles/cm^2-sec MeV for limited energy ranges. An infinite number of grid energies would be required to determine smooth point differential fluxes, and practical limits on the energy bandwidth

The Kluge and Lenhart (1971) scheme stores the flux using B as grid points and interpolates between grid L and E values at constant B. The present storage and interpolation scheme has a number of advantages over the Kluge and Lenhart method.

3. PROGRAM MODEL

Program MODEL is a Fortran program that enables the user to access any of the current trapped radiation models available through the National Space Science Data Center (NSSDC). These models include the Inner Zone Electron Model AE-5 for epoch October 1967 described in brief in Section 2 of this document and described in detail by Teague and Vette (1972), the Outer Zone Electron Model AE-4 for epoch 1967 given by Singley and Vette (1972), and a smoothed version of the proton models AP1, AP5, AP6, and AP7 originally presented by Vette et al. (1966-1970) and described by Kluge and Lenhart (1971). A matrix storage technique originally developed at ESRC (Kluge and Lenhart, 1971) is adopted for the containment of these models. A new interpolation scheme has been developed at NSSDC and is described in the following sections.

The matrix storage scheme and interpolation routines are completely general, and, as new models become available, these can be easily incorporated into Program MODEL. Work is currently in progress on developing new proton and high-energy electron inner zone models.

A. Program Logic and Restrictions

Flux versus $\frac{B}{B_0}$ curves are stored in Program MODEL at discrete energies and L values using the scheme indicated in Figure 21. Using the decadic logarithm of the omnidirectional integral flux, equal increments in the ordinate are chosen and the B/B_0 intervals $\delta(B/B_0)_i$ are determined. Each flux versus $\frac{B}{B_0}$ curve is represented in the stored matrix by the variable F_0, equal to the logarithm of the flux at the equator, and the B/B_0 intervals $\delta(B/B_0)_i$. Using equal increments in the ordinate as opposed to the abscissa has the advantage that a fixed accuracy is maintained for the flux versus $\frac{B}{B_0}$ curve even in the region of the atmospheric cutoff, where the slope of the curve becomes very large. Linear interpolation on the logarithm is used between the grid points defined by

$\delta(B/B_0)_i$, and the accuracy of the interpolated flux is essentially determined by the ordinate increment. Four points per decadic cycle are stored in the present matrix for the electron models and two per cycle for the proton model. Flux versus B curves are stored in this manner at a variety of energies and L values. Linear interpolation on the logarithm is performed to obtain fluxes at intermediate energies and L values. Sufficient energies and L values are stored such that an exponential assumption between grid points provides sufficient accuracy. This is determined by the radial profiles and spectra of the models and is therefore model dependent. The energy and L value grid points used for the three models are shown in Figure 22. Linear logarithmic interpolation between these grid points introduces less than 10% error in the flux, i.e., considerably less error than is presently associated with the models.

Program MODEL performs the interpolation between grid points in the following order: (1) B/B_0 interpolation, (2) L interpolation, and (3) energy interpolation. The interpolation scheme adopted for B/B_0 and L is presented in Figure 23. In this figure, the flux is required at some non-grid point $P(B/B_0, L)$ for which the nearest surrounding grid L values are L_1 and L_2. A number of rays are drawn from the origin O, taken as $B/B_0 = 1$, $\log_{10}(\text{flux}) = 0$, to the four grid points surrounding P, A_1, A_2 for $L = L_1$ and B_1, B_2 for $L = L_2$. The intermediate points B^{1} and A^{1} are determined by linear interpolation on the ~~logarithm~~ between points B_1 and B_2 and A_1 and A_2, respectively. Further linear interpolation ~~on the logarithm~~ is performed between C_1 and C_2 at the required L value. A final interpolation is performed to obtain the correct B/B_0 value at point P. In the event that the grid L flux-B/B_0 distributions cross (as occurs, for instance, in AE-5 at low L values and intermediate energies), a number of additional rays are drawn. For non-grid energies, the interpolation scheme described above and shown in Figure 23 is used at the two surrounding grid energies, and linear interpolation on ~~the logarithm~~ is performed to obtain the flux at the correct energy.

result from the finite number of grid energies stored (Figure 22). These practical limits are determined by imposing the restrictions that the resulting differential spectra and radial profiles must remain smooth. They are determined to be:

Protons:	$E < 1$ MeV	$\Delta E \geq 250$ keV
	$1 \leq E/(\text{MeV}) \leq 20$	$\Delta E \geq 1$ MeV
	$20 < E/(\text{MeV}) \leq 50$	$\Delta E \geq 5$ MeV
	$E > 50$ MeV	$\Delta E \geq 10$ MeV

Inner Zone Electrons:	$E < 100$ keV	$\Delta E \geq 50$ keV
	$100 \leq E/(\text{keV}) \leq 250$	$\Delta E \geq 100$ keV
	$E > 250$ keV	$\Delta E \geq 200$ keV

Outer Zone Electrons: same as inner zone electrons except

$E > 4$ MeV	$\Delta E \geq 100$ keV

An additional restriction is given for AE-5 as $L \geq 1.2$ R_E. MAIN tests that these conditions are satisfied and disallows smaller energy intervals than those shown above.

Program MAIN supplies the interpolation routines with the particle type, a single B and L value, and an array of energies. Multiple B and L values are obtained by looping within MAIN.

Subroutine TYPE

Subroutine TYPE is primarily a buffer routine between MAIN and the interpolation subroutines that facilitate the incorporation of Program MODEL into existing programs (Section 3B). In addition, TYPE determines the model to be accessed and converts from logarithm of the flux to flux.

Subroutine TRARA1

Subroutine TRARA1 determines the grid energies to be retrieved and performs the energy interpolation.

Subroutine TRARA2

Subroutine TRARA2 determines the grid L values to be retrieved and performs the B-L interpolation shown in Figure 23.

BLOCK DATA Statements

The BLOCK DATA statements contain the grid B, L, and E points stored for each model and shown in Figure 22. Three BLOCK DATA statements are included, one for each model (see Section 3B for removal of unneeded models). The format of the BLOCK DATA statements is shown in Figure 21 for an arbitrary grid energy E. The format is repeated for each grid energy. The variables E, L, F_0, and $\delta(B/B_0)$ are scaled such that they can be stored in the BLOCK DATA statements with an I6 format. The first number of each grid energy E_i is the number of points in the BLOCK DATA statement corresponding to that energy. A general flux versus B/B_0 curve J_j versus $(B/B_0)_j$ corresponding to $L = L_j$ is represented by the number of points at L_j, N_j, the L value L_j, the decadic logarithm of the equatorial flux, F_0, and n_j B/B_0 increments where $N_j = n_j + 3$. This format is repeated for each grid L value. The first two and the last L values stored are end points having $F_0 = 0$.

Subroutine DIFF

Subroutine DIFF accumulates the average differential flux for writing out by MAIN.

B. Use of Program MODEL

Versions of the Fortran Program MODEL that are suitable for operation on IBM 360 series or UNIVAC 1108 computers can be supplied to a user. Source deck setups for operation on these machines are shown in Figure 24. For operation with source decks, approximate CPU times are 6 minutes (IBM 360/75) and (UNIVAC 1108) for 2.5×10^4 points in B-L-E space. Reductions in CPU compile time are obtained if Program MODEL is executed with object block data statements. Because of variations in compiler speed, the actual savings are machine dependent. For the Fortran G compiler on the IBM 360/75 at the Goddard Space Flight Center, a reduction of a factor of 7 in CPU compile time is obtained for 2.5×10^4 B-L-E points. In general, however, a factor of 2 reduction may be more typical. Combined object and source deck setups are shown in Figure 24.

Program MODEL offers the user a number of options determined by the data cards described in the following paragraphs.

Card Number	Variable Name	Columns	Format	Function
a		1-18	6I3	
	NE	1-3	I3	Number of energies. Maximum NE = 9 for lineprinter output (IPUN = 0) and NE = 5 for card output (IPUN = 1). Program terminates for NE = 0.
	NL	4-6	I3	Number of L values. Maximum NL = 100 limited by DIMENSION statements only.
	MTYPE	7-9	I3	Particle type. MTYPE = 2 for electrons. MTYPE = 1 for protons.

Card Number	Variable Name	Columns	Format	Function
	IDIFF	9-12	I3	Determines type of tabular output. IDIFF = 0 for integral flux output, IDIFF = 1 for average differential flux, and IDIFF = 2 for both. For IDIFF = 1 or 2, NDELB (card e) is restricted to 50 by DIMENSION statements.
	IDEF	13-15	I3	Determines type of B/B_0 range used. For IDEF = 0, program defaults to 25 to 30 linear B/B_0 increments over the range B_0 to atmospheric cutoff. IDEF = 1 for user input (card e).
	IPUN	15-18	I3	Determines type of card output. IPUN = 0 for line printer; IPUN = 1 for card output (see also variable NE). For IPUN = 1, output variables are L, B, B/B_0, and integral flux for each input energy with format (F6.2, F8.4, F8.3, 5(IPE10.3).
b		1-63	9F7.3	
	E		F7.3	Energy (MeV) array of length NE (card a). Energies can be input in any order (see final paragraph, Section 3B). If average differential flux is required (IDIFF = 1 or 2, card a), this is determined in the interval E(I1) to E(I + 1) after the E array has been sorted into ascending order.

Card Number	Variable Name	Columns	Format	Function
c to d		1-77	11F7.3	Number of cards determined by NL (card a).
	XL	1-7 8-14 etc.	F7.3	L value array of length NL (card a). L values can be input in any order.
e to f		1-23	2E10.3,I3	These cards are not needed for IDEF = 0 (card a). For IDEF = 1, one card is required for each L value.
	B01	1-10	E10.3	Lower limit of B/B_0 required.
	B02	11-20	E10.3	Upper limit of B/B_0 required for NDELB ≠ 1. For NDELB = 1, B02 is the required B/B_0 increment and the upper limit of B/B_0 corresponds approximately to atmospheric cutoff.
	NDELB	21-23	I3	Number of B/B_0 intervals required between B01 and B02 for NDELB ≠ 1. For NDELB = 0, program defaults to NDELB = 20.
g		1-18	6I3	As card a. Program terminates for NE = 0.

A summary of the data setup is shown in Figure 25.

Sample integral and differential flux tables are shown in Figure 26 obtained with the variables NE = 9, NL = 1, MTYPE = 2, IDIFF = 2, IDEF = 0, E = 0.05, 0.1, 0.25, 0.5, 1.00, 1.25, 1.5, 1.75, 2.0, and XL = 1.7. In addition to the output shown, a number of messages may be printed in association with the model restrictions described in Section 3A. If at a given L value no flux is found greater than 1 particle/cm^2-sec or cm^2-sec-MeV, a message is written to that effect.

In addition, messages are given if the average differential flux cannot be accurately determined because the L value is less than 1.2 or because the energy interval input is too small.

If all BLOCK DATA statements are not required for regular usage of Program MODEL, the unneeded models can be removed by removal of (a) the appropriate BLOCK DATA statement in which the model is identified by the variable NAME, (b) the associated COMMON blocks from MAIN, and (c) the associated calls to subroutine TRARA1 made from subroutine TYPE and identified by comments cards. The operation of Program MODEL remains as described above.

Program MODEL is designed to be easily incorporated into existing programs. A single call to subroutine TYPE is required in the existing program:

```
CALL TYPE(MTYPE, B, FL, NE, E, FLUX)
```

where E, the energy array in MeV, and FLUX, the integral omnidirectional flux array returned by TYPE for these energies, must be dimensioned to NE in the existing program. In the calling argument for TYPE, MTYPE is the particle type as described in card a, and B and FL are, respectively, the required magnetic field strength in gauss and the L value in earth radii. The variable FLUX has units of particles/cm^2-sec and has been equated to zero for fluxes of less than 1 particle/cm^2-sec. A single additional restriction is imposed upon the user as a consequence of the interpolation algorithm used in subroutine TRARA. The energy E must be supplied to subroutine TYPE as an ascending array.

4. Program ORP

The Orbital Radiation Program (ORP) is a Fortran program designed to calculate the average geomagnetically trapped radiation accumulated by an orbiting vehicle. ORP is a replacement for Program TRECO, previously issued by NSSDC, and differs from that program in two respects. First, ORP requires B and L coordinates for the satellite orbit. Programs for the calculation of the B and L coordinates from latitude, longitude, and altitude can be supplied by NSSDC (King, 1971). Secondly, ORP uses Program MODEL, described in Section 3, for determining the particle omnidirectional integral flux along the orbit. As noted in Section 3, Program MODEL is general and will be able to contain new particle models as they become available with minor modification only.

ORP is able to generate the following tabular output.

Table 1 Intermediate Printout - a point by point printout of the omnidirectional integral flux at each point of the orbit for a given threshold energy.

Table 2 L-Band Summary - a summary of the omnidirectional particle flux (particles/cm^2-day) accumulated in arbitrary energy and L bands.

Table 3 Integrated Flux - a summary of the integrated flux accumulated in arbitrary energy bands.

Table 4 Intensity Summary - a summary of the omnidirectional particle flux accumulated in arbitrary energy and intensity bands.

Table 5 Peak Flux per Orbit - a table of peak omnidirectional integral flux encountered for each revolution for a given energy threshold.

Table 6 Standard Circular Orbits - a summary of omnidirectional fluxes (particles/cm^2-day) for standard circular orbits for four inclinations at a given altitude. This information may also be written on tape.

Any combination of the above tables may be obtained for a given program run with the restriction that the arbitrary energy bands are fixed for a given run. Examples of this Table are shown in Figure 27.

A. Program Logic

MAIN

ORP uses inputted logical controls to determine the types of tabular output to be presented. A search on the input tape (Section 4B) is initiated to locate the first of the orbits needed. ORP loops to determine the flux for each point along this orbit. The Intermediate Printout table is written out in this loop. At the end of each orbit, the summary tables described in Section 4 are written out and the program proceeds to the next orbit or terminates. Each new orbit data set must follow the previous set on the tape. For the special case of standard circular orbits at 0°, 30°, 60°, and 90° inclination, MAIN writes the Standard Circular Orbits table at the end of each fourth orbit. This last output table is primarily used for presenting exposures along standard orbits for inclusion in model documentation. Examples of this table are presented by Singley and Vette (1972) in the documentation for the outer zone electron environment AE-4.

Subroutines TYPE, TRARA1, TRARA2, and BLOCK DATA Statements

These subroutines are identical to the ones previously described in Section 3A and are the interpolation subroutines and model matrices providing omnidirectional integral flux at the B-L-E points supplied to TYPE by MAIN.

Subroutine STORE

Subroutine STORE accumulates integral fluxes in L bins for the L-Band Summary table. The L-bins are specified by the IF statements in Subroutine STORE.

Subroutine FLITAB

Subroutine FLITAB accumulates integral fluxes in intensity ranges for the Intensity Summary table. The intensity ranges are specified by DATA statement FLXBIN in subroutine FLITAB.

Subroutine DECACC

Subroutine DECACC determines the peak integral omnidirectional flux in each revolution for a given threshold energy. This energy is user input and is the same energy as used for the Intermediate Printout table. For nonequatorial orbits, the south-north crossing of the equatorial plane is used to denote the start of each orbit. For equatorial orbits, a local time of zero is used. Subroutine DECACC is not accessed if altitude is zero (see Section 4B).

Subroutine DEPRNT

Subroutine DEPRNT ~~compares~~ computes the ~~average~~ flux accumulated per day in the user input energy bands for the L-Band Summary, Integrated Flux, and Intensity Summary tables. DEPRNT writes these tables and the Peak Flux per Orbit table.

Subroutine STAND

Subroutine STAND accumulates the omnidirectional flux per day in energy bands for the Standard Circular Orbits table and writes this table on the lineprinter and on tape.

B. Use of Program ORP

Program ORP is run on an IBM 360/75 computer under MVT with the Fortran IV H, opt=2 compiler. The run time for four standard (0°, 30°, 60°, and 90° inclination) orbits of ~~1500~~ 1440 data points each was approximately 2 minutes CPU and 0.5 minutes I/O time using object BLOCK DATA statements. As noted in Section 3B, significant savings in CPU time are obtained by using object rather than source decks on a 360/75. The execution step used approximately 150K bytes of storage with the two electron models included; and this storage can be easily reduced by using overlays. A sample deck setup is shown in Figure 27 for combined object and source decks.

The orbit information is input to Program ORP using tape input with data set reference unit number 10 (see Figure 27). Each orbit is preceded by an alphanumeric header record of up to 76 characters in length that describes the orbit and is written out in Tables 1 through 5 (Section 4). The header record is followed by data records giving geocentric standard and B and L coordinates for each time. Each record contains the following data in E format: longitude, latitude, altitude, B, L, and time in hours since start of orbit. An altitude of -100 denotes the end of an orbit. The B and L coordinates are mandatory, but the latitude, longitude, and altitude information is optional unless the Peak Flux per Orbit table is required. These variables should be set to zero or left blank if actual values are not to be supplied. The input tape format is as follows:

Header Record (one per orbit)

Variable Name	Columns	Format	Function
HEAD	19A4	1-76	Alphanumeric Orbit Description

Data Record (one per point on orbit)

Variable Name	Columns	Format	Function
ORBVAL (1)	1-18	E18.8	Longitude (degrees)
ORBVAL (2)	19-36	E18.8	Latitude (degrees)
ORBVAL (3)	37-54	E18.8	Latitude (km)
ORBVAL (4)	55-72	E18.8	B (gauss)
ORBVAL (5)	73-90	E18.8	L (earth radii)
ORBVAL (6)	91-108	E18.8	Time (hours from start of orbit)

Trailer Record

Variable Name	Columns	Format	Function
ORBVAL (3)	37-54	E18.8	Set equal to -100 to signal end of orbit. Other ORBVAL variables are not important for this final record.

The various options of Program ORP may be obtained by use of the data deck setup described in the following paragraphs.

Card Number	Variable Name	Columns	Format	Function
a		1-70	10L1,10A4, I3,F6.2, 10X,I1	
	TABCON (1)	1	L1	TABCON(1) = T for Intermediate Printout table, F for no table.
	TABCON (2)	2	L1	TABCON(2) = T for L-Band Summary table, F for no table.
	TABCON (3)	3	L1	TABCON(3) = T for Integrated Flux Table, F for no table.
	TABCON (4)	4	L1	TABCON(4) = T for Intensity Summary table, F for no table.
	TABCON (5)	5	L1	TABCON(5) = T for Peak Flux per Orbit table, F for no table.
	TABCON (6)	6	L1	TABCON(6) = T for Standard Circular orbit table, F for no table.
	TABCON (7)	7	L1	TABCON(7) = T for tape output of Standard Circular Orbit table, F for no table.
	TITLE	11-50	10A4	Alphanumeric array for writing at top of first page.

Card Number	Variable Name	Columns	Format	Function
	NE	51-33	I3	The number of integral energy values input. Maximum NE = 30.
	ET	54-59	F6.2	The threshold energy (MeV) used for the Intermediate Printout and Peak Flux per orbit tables. ET may be omitted if these tables are not required.
	MODEL	70	I1	Particle Type. MODEL = 2 for electrons, 1 for protons. Appropriate BLOCK DATA statements must be included (Section 3).
b to c		1-62	10 (F6.2,2X)	Number of cards determined by NE. Ten values per card.
e		1-6	F6.2	Energy threshold array of length NE.
		9-14, etc.		Must be in ascending order. For tabular output Tables 2, 3, 4, and 6 (Section 4) the energy intervals E(I+1) to E(I) are subject to the restrictions given in Section 2.1 under MAIN. This function is not performed automatically by ORP.
d		1-4	2I2	
	IORB(1)	1-2		Index number for the first orbit required on the input tape. The first orbit is IORB(1) = 1.

Card Number	Variable Name	Columns	Format	Function
d (cont'd)	IORB(2)	3-4	I2	Index number for last orbit required on the input tape. If this tape contains a single orbit, IORB(2) may be left blank.

A summary of the data setup is given in Figure ~~28~~. 29

5. REFERENCES

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Vette, J. I., et al., Models of the Trapped Radiation Environment, Vols. I to VI, NASA SP-3024, 1966 to 1970.

Please add references t/o Bostrom and to Winckler (see Sept. 1971)

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Lucero A.B TRECO An Orbital Integration Computer Program for Trapped Radiation Data Users Note NSSDC 68-02

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Figure 2. Model Grid Points

Protons

Energies: 0.375, 0.78, 4.1, 8.0, 16.0, 50.0, 100.0 MeV

L values: 1.2 by 0.1 increments to 6.6

Inner Zone Electrons

Energies: 0.04, 0.1, 0.25 by 0.25 increments to 2.0, 2.0 by 0.5 increments to 4.5 MeV

L values: 1.2 by 0.05 increments to 1.5, 1.5 by 0.1 increments to 2.0, 2.0 by 0.2 increments to 2.8

Outer Zone Electrons

Energies: 0.04, 0.1, 0.3, 0.5, 1.0, 2.0, 2.5, 3.0, 3.5, 4.0, 4.1, 4.25, 4.35, 4.5, 4.65, 4.85 MeV

L values: 2.8 by 0.2 increments to 4.0, 4.0 by 0.5 increments to 6.0, 6.6, 7.0 by 1.0 increments to 11.0

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Figure 4. Model Deck Setup

IBM 360 Series

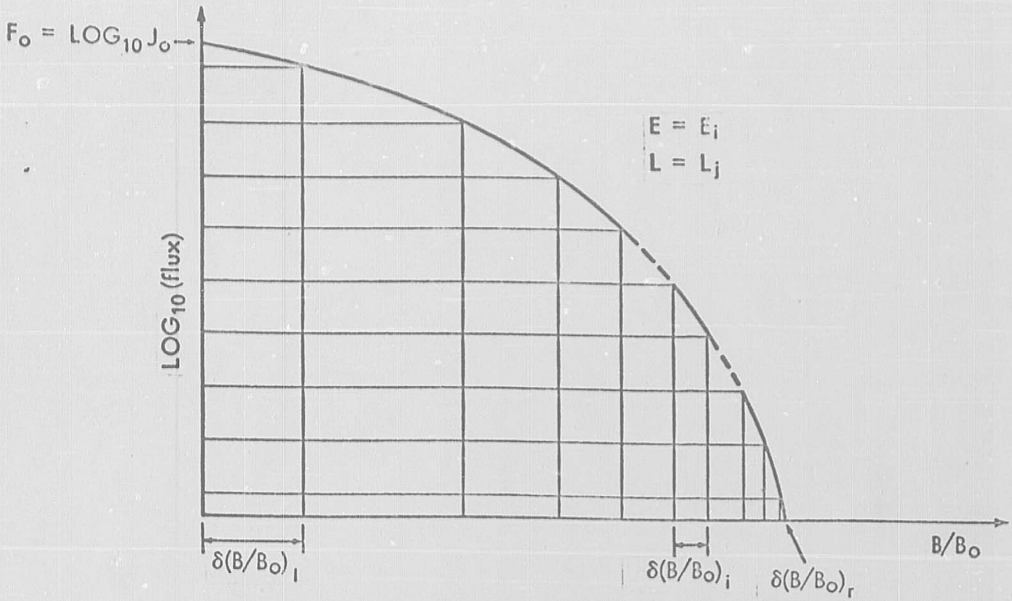
```
Job Card

// EXEC FORTRAN G, PARM = 'ID, MAP, XREF,'
   REGION = 200K

//SOURCE .SYSIN  DD  *

Source Deck

//STEPG EXEC LINKGO, REGION = 200K

//LINK. OBJECT  DD  *

Object Deck if used

//GO. SYSUDUMP.  DD  SYSOUT = A

//GO. GSFCDUMP  DD  SYSOUT = A (GSFC only)

//GO. DATA5  DD  *

Date Deck (Figure 25)

/ *

//
```

Univac 1108

```
Job Card

a For,S1A .MAIN,.MAIN/R
  Main Program

a FOR,S1A .SUB1,.SUB1/R
  Subroutine Type

a FOR,S1A .SUB2,.SUB2/R
  Subroutine DIFF

a FOR,S1A .SUB3,.SUB3/R
  Subroutine TRARA1

a FOR,S1A .SUB4,.SUB4/R
  Function TRARA2

a FOR,S1A .SUB8,.SUB8/R
  AE5 Block Data

a FOR,S1A .SUB9,.SUB9/R
  AE4 Block Data

a FOR,S1A .S010,.S010/R

a MAP,I .MAIN/R, .MJTP/A

a XQT .MJTP/A
  Data Deck

a FIN
```

Figure 6. ORP Deck Setup IBM 360 Series

```
Job Card
// EXEC FORTRANH, PARAM = 'ORP=2, ID, MAP, XREF'
//SOURCE .SYSIN  DD  *
Source Deck
//EXEC LINKGO, REGION .GO = 160k
//LINK. OBJECT  DD  *
  Object Deck
//GO. FT10F001  DD  (input tape information)
//GO. FT13F001  DD  (output tape information)
//GO. SYSUDUMP SYSOUT=A
//GO. GSFCDUMP SYSOUT=A (GSFC only)
//GO. DATAS  DD  *
  Data Deck (Figure 7)
/*                29
//
```



FORMAT OF BLOCK DATA STATEMENT:

N	E				
3	O	O			
3	L_1	O			
⋮					
N_j	L_j	$(F_o)_j$	$\delta(B/B_o)_{ij}$	$\delta(B/B_o)_{ij}$	$\delta(B/B_o)_{ij}$
⋮					
3	L_k	O			

Figure 1. Storage of Flux-B Curve.

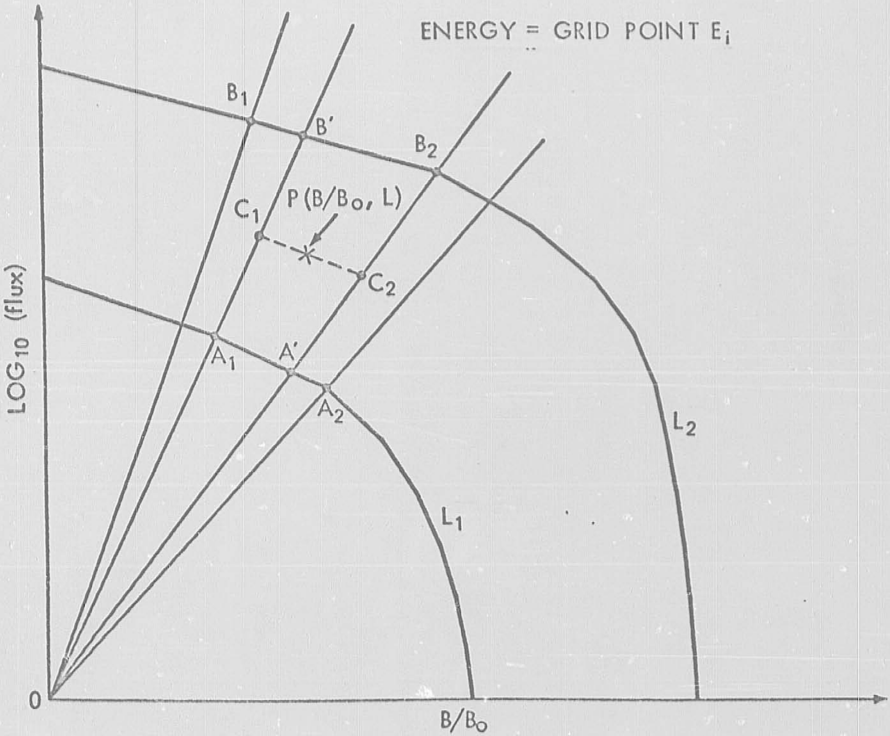


Figure 3. B/B_o and L Interpolation.

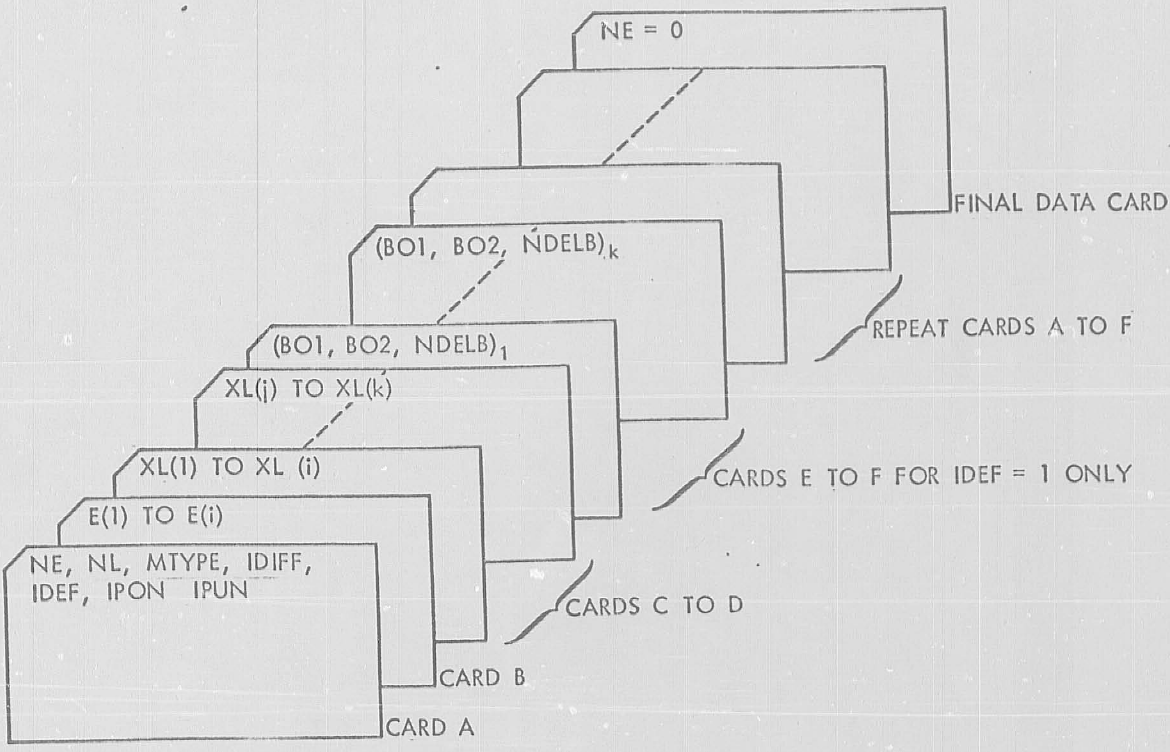


Figure 5. Model Data Deck Setup.

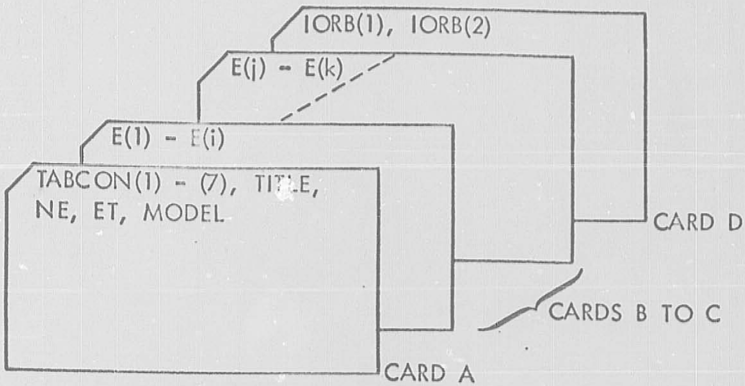


Figure 7. ORP Data Deck Setup.

D- 10584
C-8007
FILE 1 - ORP (029) VERSION #2

```
// EXEC FORTRANH,PARM  ID,LIST,MAP,XREF ,REGION 450K
//SOURCE.SYSIN DD *
C     *****ORP DECK THAT SHOULD WORK WITH EITHER PROTONS OR ELECTRONS
C***********************************************************************
      LOGICAL*1 TABCON 10 ,EQUIT,PEAKPR
      COMMON/MODE/ MODEL,NAME 2
      COMMON /ENERGY/ F1 30,45 ,FI1 30,8 ,E 30 ,NE
      COMMON /DELTA/ DELT
      COMMON /NEWORB/ PEAK1, ISN, ISN2, SNLON,TLOCAL,SFD1,SF01, NPER
      COMMON /SUMRY/ HEAD 19 ,MAP 2 ,TABCON,EQUIT
      COMMON /PEAK/ PKF 50 ,PKLON 50 ,PKLAT 50 ,PKALT 50 ,FKB 50
     1 ,PKL 50 ,PDF1 50 ,SN 50 ,PKT 50
      DIMENSION TITLE 10 ,WSUM 4,30 ,IORB 2 ,ORBVAL 6 ,F 30
     1 ,EXPOSE 30 ,SUMEXP 30 ,FLUXI 30 ,SUMENE 30 ,ORBCHK 6
      REAL*4 NELEC 2 ,DESCR 2 ,NAME
      DATA NELEC /4HAE4,, 4H AE5 /
      DATA DESCR/4HPROT,4HONS /
      DATA KORB/0/
C   STAE  IS A GODDARD SPACE FLIGHT CENTER DEBUGGING ROUTINE FOR USE ON
C     BASE S/360 S ONLY. IT DUMPS OUTPUT BUFFERS IF JOB IS ABENDED.
      CALL  STAE
C
C******INPUT TABLE PRINTOUT CONTROLS AND INTEGRATION ENERGIES.
      READ 5,11,END 1000  TABCON,TITLE,NE,ET,MODEL
      IF  MODEL .EQ. 1   NAME 1     DESCR 1
      IF  MODEL .EQ. 1   NAME 2     DESCR 2
      IF  MODEL .EQ. 2   NAME 1     NELEC 1
      IF  MODEL .EQ. 2   NAME 2     NELEC 2
      WRITE  6,12  TITLE
      WRITE 6,19
      M   0
      IF   .NOT. TABCON 1   GO TO 100
      WRITE 6,1
      M   M + 1
  100 IF   .NOT. TABCON 2   GO TO 101
      WRITE 6,2
      M   M + 1
  101 IF   .NOT. TABCON 3   GO TO 102
      WRITE 6,3
      M   M + 1
  102 IF   .NOT. TABCON 4   GO TO 103
      WRITE 6,4
      M   M + 1
  103 IF   .NOT. TABCON 5   GO TO 104
      WRITE 6,5
      M   M + 1
  104 IF   .NOT. TABCON 6   GO TO 105
      WRITE 6,6
      M   M + 1
  105 IF   .NOT. TABCON 7   GO TO 111
      WRITE 6,7
      M   M + 1
  111 IF  M   150,150,200
  150 WRITE 6,13
      GO TO  1000
  200 READ  5,14   E I ,I 1,NE
C******READ ENERGIES AND CHOOSE BEST THRESHOLD ENERGY.
      DO 225 I 1,NE
      II   NE - I + 1
      IF ET .GE. E II   GO TO 250
  225 CONTINUE
  250 IF  ET .LT. E 1   II 1
```

```
      ET    E II
      IORBIT   0
C
C                       *** START NEW SET OF ORBITS ***
C******INPUT ORBIT CONTROL PARAMETERS AND ORBIT TAPE HEADER RECORD.
C******OR END PROGRAM.
  300 READ   5,15,END 1000   IORB
      WRITE  6,20  IORB
      WRITE  6,25
  350 READ   10,16,END 950  HEAD
C******FIND FIRST ORBIT WANTED
      IORBIT   IORBIT + 1
      IF   IORBIT - IORB 1    375,400,400
  375 READ   10,18  ORBVAL
      IF   ORBVAL 3   + 100.   375,350,375
C******INITIALIZATION FOR START OF ORBIT.
  400 KORB    KORB + 1
      PEAKPR    .FALSE.
      IPAGE    0
      IPRNT    0
      TOLD    0.
      DO 450 J 1,30
      SUMEXP J     0.
      EXPOSE J     0.C
      FLUXI J     0.
      SUMENE J     0.
      DO 425 K 1,8
  425 FI1 J,K     0.
      DO 450 K 1,45
  450  F1 J,K     0.
C******INITIALIZATION FOR DECACC
      SFD1    0.
      SF01    0.
      NPER    1
      PEAK1    0.
      ISN    0
      ISN2    1
      SNLON   0.
      TLOCAL    0.
      EQUIT    .TRUE.
C******CHECK FOR EQUITORIAL ORBIT AND 0. ALTITUDE.
      DO 470 I 1,5
      READ   10,18  ORBVAL
      IF   I .EQ. 1    TOLD    ORBVAL 6
      IF   I .EQ. 1   SN 1     ORBVAL 2
      IF   ORBVAL 2   .NE. 0.   EQUIT    .FALSE.
      IF   ORBVAL 3   .NE. 0.   PEAKPR    .TRUE.
  470 CONTINUE
      DO 480 I 1,4
  480 BACKSPACE 10
C
C******READ B,L AND COMPUTE F FOR TABLES.
  500 READ   10,18  ORBCHK
      IF ORBCHK 3 .EQ.-100.  GO TO 800
      IF ORBCHK 3 .LT.105.  GO TO 800
      DO 525 I 1,6
  525 ORBVAL I     ORBCHK I
      DELT     ORBVAL 6   - TOLD   * 3600.
      TOLD    ORBVAL 6
C******IF B OR L VALUES ARE 0 SET F    0.
      IF   ORBVAL 4 .EQ. 0.   .OR.  ORBVAL 5 .EQ. 0.    GO TO 900
      IF ORBVAL 5 .GT.11.  GO TO 900
      CALL TYPE    MODEL, ORBVAL 4  , ORBVAL 5  , NE, E, F
  545  CONTINUE
```

```
      FLV ORBVAL 5
      DO 550 I 1.NE
      EXPOSE I     F I *DELT
  550 SUMEXP I     SUMEXP I   + EXPOSE I
C******PRINT INTERMEDIATE TABLE
  575 IF   .NOT. TABCON 1    GO TO 650
      IF   IPRNT .GT. 0  GO TO 600
      IPAGE   IPAGE + 1
      WRITE 6.24   IPAGE
      WRITE 6.21   HEAD.ET.NAME
      WRITE 6.23
  600 IPRNT    IPRNT + 1
      WRITE  6.22  ORBVAL. DELT.F II  .EXPOSE II  .SUMEXP II
      IF   IPRNT .GE. 52  IPRNT    0
  650 IF   TABCON 2   .AND.   ORBVAL 5   .NE.0.
     1  CALL STORE   EXPOSE.ORBVAL 5
      IF   TABCON 4    CALL FLITAB F.EXPOSE
      IF   TABCON 5   .AND. PEAKPR  CALL DECACC ORBVAL 1 .ORBVAL 2
     1 .ORBVAL 3 .ORBVAL 4 .ORBVAL 5 .ORBVAL 6 .EXPOSE II
      GO TO 500
C
C******END OF ORBIT - PRINT OUTPUT
  800 TF    ORBVAL 6 /24.
      DO 850 I 1.30
      FLUXI I     SUMEXP I /TF
  850 WSUM KORB.I     FLUXI I
C******PRINT SUMMATION TABLES AFTER ORBIT.
      IF   TABCON 2  .OR. TABCON 3  .OR. TABCCN 4   .OR.TABCCN 5
     1CALL  DEPRNT PEAKPR.FLUXI.TF.ORBVAL 3
C******PRINT SUBROUTINE STAND SUMMATION TABLES WHEN K 4
      IF    TABCON 6  .OR. TABCON 7     .AND.  KORB .EQ. 4
     1 CALL  STAND  ORBVAL 3 .ORBVAL 6 .WSUM
C******START NEXT SET OF ORBITS WHEN THIS SET IS FINISHED.
      IF   KORB.EQ.4  KORB  0
      IF   IORBIT - IORB 2    350.300.300
C
  900 DO 925 I 1.NE
      EXPOSE I     0.
  925 F I    0.
      GO TO 575
C
  950 WRITE 6.17
 1000 STOP 99
C
    1 FORMAT   0 POINT BY POINT  INTERMEDIATE  PRINTOUT  SOT
    2 FORMAT   0 L BAND SUMMARY.  SUB. STORE
    3 FORMAT   0 INTEGRATED FLUX TABLE.
    4 FORMAT   0 INTENSITY SUMMARY.  SUB. FLITAB
    5 FORMAT   0 PEAK FLUX PER ORBIT.  SUB. DECACC
    6 FORMAT   0 SUMMARY OF STANDARD CIRCULAR ORBIT FOR INCLINATIONS AT A
     1 GIVEN ALTITUDE.  SUBROUTINE STAND
    7 FORMAT   0 SUMMARY OF STANDARD CIRCULAR ORBIT FOR INCLINATIONS AT A
     1 GIVEN ALTITUDE WRITTEN ON TAPE.  SUB. STAND
   11 FORMAT 10L1.10A4.I3.F6.2.10X.I1
   12 FORMAT 1H1.30X.10A4
   13 FORMAT 1H0.///.30X. NO TABLES WANTED - PROGRAM ENDED.
   14 FORMAT 10 F6.2.2X
   15 FORMAT 2I2
   16 FORMAT 19A4
   17 FORMAT 1H1.20X. END OF TAPE - IORB VALUES WRONG.
   18 FORMAT 6E18.8
   19 FORMAT  0 .///.10X.  THE FOLLOWING TABLES WILL BE PRINTED
   20 FORMAT  1 .//.  FLUX IS CALCULATED FROM ORBITS .I3.  TO .I3
   21 FORMAT  0 .23X.19A4./
```

```
      DATA MAP025/                                                      LBP00285
     X 1203, 1849, 3560, 6700, 14134, 27231, 20511, 12168, 7160,        LBP00286
     X 4979, 13, 6144, 2346, 1170, 1895, 3953, 6758, 13071,             LBP00287
     X 30268, 24648, 17089, 11728, 7234, 12, 6348, 2219, 1529,          LBP00288
     X 2353, 4491, 7214, 16913, 33623, 28619, 18597, 11968, 12,         LBP00289
     X 6553, 2098, 1905, 2680, 4809, 9565, 19118, 37328, 36908,         LBP00290
     X 23690, 8961, 11, 6758, 1977, 1701, 3070, 6341, 11961,            LBP00291
     X 22972, 43219, 42413, 26791, 11, 6963, 1860, 1923, 3815,          LBP00292
     X 7724, 14817, 32361, 45728, 42339, 13840, 10, 7168, 1700,         LBP00293
     X 2717, 5090, 10731, 23577, 36440, 56474, 30937, 9, 7372,          LBP00294
     X 1517, 2114, 3087, 7109, 16275, 31540, 37676, 9, 7577,            LBP00295
     X 1311, 2397, 3676, 8551, 14746, 35301, 15295, 8, 7782,            LBP00296
     X 1156, 2399, 3719, 6624, 10166, 11465, 7, 7987, 1006,             LBP00297
     X 2593, 3616, 5044, 8850, 7, 8192, 852, 1540, 1566,                LBP00298
     X 3055, 6879, 5, 8396, 471, 2460, 2460, 5, 8601,                   LBP00299
     X 276, 4516, 4724, 4, 8806, 148, 8992, 4, 9011,                    LBP00300
     X 77, 18449, 3, 9216, 0, 3, 32767, 0, 336,                         LBP00301
     X 256, 3, 0, 0, 3, 2252, 0, 11, 2457,                              LBP00302
     X 1858, 380, 213, 147, 121, 93, 78, 82, 83,                        LBP00303
     Y 13/                                                              LBP00304
      DATA MAP026/                                                      LBP00306
     X 2662, 2413, 853, 576, 493, 361, 257, 223, 191,                   LBP00307
     X 131, 119, 270, 14, 2867, 2610, 1275, 1111, 827,                  LBP00308
     X 602, 428, 311, 233, 220, 153, 198, 249, 14,                      LBP00309
     X 3072, 2756, 1462, 1604, 1374, 1073, 670, 447, 334,               LBP00310
     X 282, 250, 157, 139, 15, 3276, 2939, 1317, 1684,                  LBP00311
     X 2059, 1763, 1269, 813, 527, 338, 305, 254, 259,                  LBP00312
     X 351, 15, 3481, 2985, 1373, 2190, 2787, 2373, 1816,               LBP00313
     X 1164, 668, 471, 420, 309, 183, 185, 15, 3686,                    LBP00314
     X 2979, 1625, 2518, 4130, 3038, 2123, 1571, 891, 500,              LBP00315
     X 376, 369, 302, 281, 15, 3891, 2927, 1868, 3083,                  LBP00316
     X 5532, 3975, 2745, 1766, 941, 633, 429, 371, 413,                 LBP00317
     X 759, 15, 4096, 2877, 2278, 3745, 6908, 4816, 3433,               LBP00318
     X 2233, 1027, 696, 501, 456, 565, 648, 15, 4300,                   LBP00319
     X 2824, 2146, 4188, 7421, 6953, 4704, 2669, 1355, 739,             LBP00320
     X 587, 520, 891, 1930, 14, 4505, 2793, 1789, 4401,                 LBP00321
     X 8927, 8513, 5874, 3539, 1810, 952, 619, 491, 935,                LBP00322
     X 14, 4710, 2671, 2186, 4830, 12187, 10924, 5894, 3322,            LBP00323
     X 1634, 1039, 810, 751, 893, 13, 4915, 2522, 2545,                 LBP00324
     Y 6248/                                                            LBP00325
      DATA MAP027/                                                      LBP00327
     X 15468, 12374, 5971, 3781, 1536, 798, 676, 660, 13,               LBP00328
     X 5120, 2389, 3121, 8059, 18651, 12290, 7282, 4155, 1316,          LBP00329
     X 815, 589, 595, 12, 5324, 2259, 3587, 9816, 21562,                LBP00330
     X 12930, 8794, 3706, 1444, 979, 817, 12, 5529, 2130,               LBP00331
     X 3978, 6243, 12430, 19919, 14387, 8492, 3244, 1744, 2123,         LBP00332
     X 11, 5734, 2006, 2333, 3310, 5026, 11241, 27394, 16030,           LBP00333
     X 8407, 3222, 11, 5939, 1862, 1203, 1849, 3599, 6817,              LBP00334
     X 15611, 27739, 18095, 7277, 10, 6144, 1726, 1170, 1895,           LBP00335
     X 3964, 6844, 14046, 32174, 16980, 10, 6348, 1582, 1529,           LBP00336
     X 2353, 4539, 7405, 19051, 33981, 8731, 9, 6553, 1449,             LBP00337
     X 1905, 2694, 4848, 9999, 21903, 31902, 9, 6758, 1313,             LBP00338
     X 1701, 3070, 6399, 12480, 24499, 11039, 8, 6963, 1186,            LBP00339
     X 1923, 3815, 7724, 15385, 19641, 7, 7168, 1020, 2717,             LBP00340
     X 5090, 10748, 18349, 7, 7372, 827, 2114, 3087, 7109,              LBP00341
     X 13058, 6, 7577, 614, 2397, 3676, 9770, 5, 7782,                  LBP00342
     X 451, 2399, 6271, 5, 7987, 297, 3354, 3402, 4,                    LBP00343
     X 8192, 138, 7778, 3, 8396, 0, 3, 32767, 0,                        LBP00344
     X 269, 512, 3, 0, 0, 3, 2252, 0, 10,                               LBP00345
     Y 2457/                                                            LBP00346
      DATA MAP028/                                                      LBP00348
     X 1761, 403, 212, 145, 121, 88, 83, 95, 12,                        LBP00349
     X 2662, 2257, 941, 633, 508, 343, 236, 217, 166,                   LBP00350
     X 101, 213, 13, 2867, 2402, 1488, 1209, 859, 536,                  LBP00351
```

```
     X  382,  257,  221,  176,  177,  267,   13, 3072, 2477,        LBP00352
     X 1735, 1963, 1424,  915,  528,  368,  296,  261,  171,        LBP00353
     X  149,   14, 3276, 2603, 1492, 2036, 2481, 1765, 1056,        LBP00354
     X  599,  358,  317,  256,  322,  458,   14, 3481, 2607,        LBP00355
     X 1455, 2578, 3388, 2472, 1599,  835,  510,  443,  315,        LBP00356
     X  236,  240,   14, 3686, 2568, 1723, 2855, 4929, 2738,        LBP00357
     X 2189, 1265,  585,  405,  379,  533,  718,   13, 3891,        LBP00358
     X 2474, 1961, 3590, 6288, 3837, 2610, 1287,  776,  487,        LBP00359
     X  413,  580,   13, 4096, 2437, 2320, 4088, 7897, 4569,        LBP00360
     X 3449, 1553,  870,  600,  513,  818,   13, 4300, 2402,        LBP00361
     X 2168, 4477, 8405, 6712, 4087, 2357, 1244,  716,  620,        LBP00362
     X  609,   13, 4505, 2417, 1810, 4465, 9114, 8256, 5379,        LBP00363
     X 3484, 1951, 1114,  653, 1904,   12, 4710, 2259, 2205,        LBP00364
     X 4971,13451,10158, 5098, 3108, 1795,  893, 1795,   11,        LBP00365
     X 4915, 2043, 2561, 6437,17802,11066, 4790, 3382, 1658,        LBP00366
     Y 1380/                                                        LBP00367
      DATA MAP029/                                                  LBP00369
     X   11, 5120, 1865, 3140, 8241,20267,11205, 6085, 4180,        LBP00370
     X 1786, 1899,   10, 5324, 1696, 3601,10238,23246,11676,        LBP00371
     X 7673, 3756, 1585,   10, 5529, 1544, 3978, 6298,12974,        LBP00372
     X21143,12643, 7466, 4506,    9, 5734, 1397, 2333, 3310,        LBP00373
     X 5062,11761,29234, 9921,    8, 5939, 1232, 1203, 1849,        LBP00374
     X 3629, 6964,10798,    8, 6144, 1084, 1170, 1895, 3964,        LBP00375
     X 6952, 8479,    7, 6348,  923, 1529, 2353, 4575, 5423,        LBP00376
     X    7, 6553,  775, 1905, 2720, 3876, 3942,    6, 6758,        LBP00377
     X  624, 1701, 3070, 5275,    5, 6963,  488, 1923, 3578,        LBP00378
     X    5, 7168,  314, 2287, 2339,    4, 7372,  112, 7015,        LBP00379
     X    3, 7577,    0,    3,32767,    0,  165, 1603,    3,        LBP00380
     X    0,    0,    3, 2252,    0,   10, 2457, 1700,  427,        LBP00381
     X  211,  121,  112,   96,   96,  113,   11, 2662, 2024,        LBP00382
     X 1340,  592,  288,  159,  110,   93,   96,  229,   12,        LBP00383
     X 2867, 2148, 2269, 1154,  535,  229,  165,  134,  135,        LBP00384
     X  168,  200,   12, 3072, 2152, 3404, 1679,  834,  487,        LBP00385
     X  272,  168,  160,  204,  273,   12, 3276, 2072, 4112,        LBP00386
     X 2765, 1280,  845,  506,  261,  195,  233,  236,   11,        LBP00387
     Y 3481/                                                        LBP00388
      DATA MAP031/                                                  LBP00390
     X 1968, 4814, 3809, 2113, 1260,  764,  360,  264,  244,        LBP00391
     X   11, 3686, 1843, 5240, 5123, 3073, 1903, 1101,  655,        LBP00392
     X  444,  409,   10, 3891, 1700, 6060, 6491, 4376, 2148,        LBP00393
     X 1301,  836,  655,   10, 4096, 1576, 6074, 8984, 5086,        LBP00394
     X 2699, 1383,  870,  895,    9, 4300, 1468, 6675, 9088,        LBP00395
     X 7674, 2988, 1585, 1611,    9, 4505, 1347, 6720,11364,        LBP00396
     X 7966, 3881, 1913, 1247,    8, 4710, 1218, 7274,12168,        LBP00397
     X10128, 4210, 2888,    8, 4915, 1072, 8976,13915,10877,        LBP00398
     X 3903, 2539,    7, 5120,  908, 9043,18049, 9990, 3522,        LBP00399
     X    6, 5324,  652,13614,15565, 5715,    5, 5529,  317,        LBP00400
     X11893, 4356,    3, 5734,    0,    3,32767,    0,  142,        LBP00401
     X 3200,    3,    0,    0,    3, 2252,    0,   10, 2457,        LBP00402
     X 1631,  392,  196,  105,   74,   87,  115,  142,   11,        LBP00403
     X 2662, 1931, 1330,  577,  262,  133,  100,   93,   89,        LBP00404
     X  290,   12, 2867, 2049, 2237, 1147,  468,  245,  172,        LBP00405
     X  144,  135,  139,  220,   11, 3072, 2044, 3357, 1681,        LBP00406
     X  693,  468,  334,  219,  173,  173,   11, 3276, 1953,        LBP00407
     X 4057, 2635, 1093,  806,  703,  378,  204,  548,   11,        LBP00408
     Y 3481/                                                        LBP00409
      DATA MAP032/                                                  LBP00411
     X 1839, 4634, 3632, 1843, 1231, 1079,  557,  418,  859,        LBP00412
     X   10, 3686, 1700, 4922, 4899, 2958, 1492, 1557,  994,        LBP00413
     X  648,   10, 3891, 1550, 5471, 5878, 3837, 2195, 1967,        LBP00414
     X 1323, 1073,    9, 4096, 1397, 5496, 7749, 4694, 2554,        LBP00415
     X 2538, 1367,    8, 4300, 1266, 5754, 7544, 6474, 3482,        LBP00416
     X 2417,    8, 4505, 1125, 5588, 9085, 6425, 4167, 3326,        LBP00417
     X    7, 4710,  926, 5669, 9221, 8401, 5001,    6, 4915,        LBP00418
```

```
      X    579,  7507, 10084,  5644,      4,  5120,    169,  6217,      3,     LBP00419
      X   5324,     0,     3, 32767,      0,                                   LBP00420
      Y      0/                                                               LBP00421
       END                                                                    LBP00422
//STEPG EXEC LINKGO,REGION=160K
//LINK.OBJECT DD *
//GO.SYSUDUMP DD SYSOUT=A
//GO.GSFCDUMP DD SYSOUT=A
//GO.DATA5  DD *
  9 39  2  2  0  0
   .04     .1     .25     .5     .75    1.     1.25    1.5    1.75
  1.1     1.15    1.2     1.25    1.3    1.35   1.4     1.45   1.5    1.55   1.6
  1.7     1.8     1.9     2.      2.1    2.2    2.3     2.4    2.5    2.6    2.7
  2.8     2.9     3.0     3.25    3.5    3.75   4.      4.5    5.0    5.5    6.0
  6.6     7.0     8.0     9.0    10.0   11.0
  6 39  2  2  0  0
  2.0     2.5     3.0     3.5     4.0    4.5
  1.1     1.15    1.2     1.25    1.3    1.35   1.4     1.45   1.5    1.55   1.6
  1.7     1.8     1.9     2.      2.1    2.2    2.3     2.4    2.5    2.6    2.7
  2.8     2.9     3.0     3.25    3.5    3.75   4.      4.5    5.0    5.5    6.0
  6.6     7.0     8.0     9.0    10.0   11.0
  9 39  1  2  0  0
   .4     1.      2.      5.     10.    15.    20.     25.    30.
  1.1     1.15    1.2     1.25    1.3    1.35   1.4     1.45   1.5    1.55   1.6
  1.7     1.8     1.9     2.      2.1    2.2    2.3     2.4    2.5    2.6    2.7
  2.8     2.9     3.0     3.25    3.5    3.75   4.      4.5    5.0    5.5    6.0
  6.6     7.0     8.0     9.0    10.0   11.0
  6 39  1  2  0  0
 35.     40.     50.     75.    100.   200.
  1.1     1.15    1.2     1.25    1.3    1.35   1.4     1.45   1.5    1.55   1.6
  1.7     1.8     1.9     2.      2.1    2.2    2.3     2.4    2.5    2.6    2.7
  2.8     2.9     3.0     3.25    3.5    3.75   4.      4.5    5.0    5.5    6.0
  6.6     7.0     8.0     9.0    10.0   11.0

/*
//
//
$STOP
```