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CEDAR DATABASE FORMAT

Contents

I. OVERVIEW

I.a. Summary

The CEDAR Database at NCAR employs an integer format for which there are two versions, binary and character. The binary version is compact and is more efficient to compute with but requires more complicated programming than the character version. Both versions provide blocking to facilitate efficient use of storage media.

The binary format employs a variable record length pack under checksum control, where the basic field length is 16 bits. Each field may contain either one 16-bit binary integer or two 8-bit ASCII characters. Fields are grouped into variable length logical records of three kinds: Catalogue, Header, and Data. Any or all of these logical record types may be combined to form a dataset. The first 12 fields of each logical record identify the record length, record kind, instrument, and period of time covered by the record. For the binary format, logical records are grouped into longer blocks. Each binary block contains one or more complete logical record, plus two extra fields containing the length of the physical record and a checksum. Binary blocks are grouped into files, separated by end-of-file marks, such that a dataset may contain more than one file. File marks may be used arbitrarily; they often separate experiments, or contiguous data periods.

The character version of the format is a translation of the binary format. Each 16-bit integer field is converted to six characters. Fields have the same order as the binary version, retaining similar definitions. Fields are combined into lines not exceeding 120 bytes. Each Catalogue, Header or Data record is composed of multiple lines. When blocking is required for compact storage, lines are blank filled to 120 bytes length, so that they may be combined to produce fixed length blocks. When unblocked, each "line" is terminated by newline (and carriage return on some systems). When lines are combined to form a block, intervening line terminators are eliminated. These character blocks are fixed length and they do not have the binary version's length prefix or checksum suffix.

I.b. Word Definition and Character Type

The basic binary word length is 16 bits, composed of two 8-bit bytes.

All binary words are 16 bit, 2's complement integers. Positive numbers run from 0 to 32767 (00000000 00000000 to 01111111 11111111 binary). Negative numbers run from -32768 to -1 (10000000 00000000 to 11111111 11111111 binary). The high order byte occurs first in each word. (This is the common convention for most computers, except for DEC equipment and PC's.)

In the binary version, all text is stored two characters per word. Characters are contained in sequential 8-bit bytes, one character per byte. The characters are 7-bit ASCII (also known as CCITT V.3, International Alphabet No. 5; and ISO 646, the 7-bit Character Set for Information Processing Interchange), and the high-order bit of each 8-bit byte is zero. Two characters (including blanks) are counted as one 16-bit word when logical record lengths are calculated.

The character version is exclusively composed of 8-bit characters. The character set may be either ASCII or EBCDIC. Numeric fields are integers composed of six characters; e.g., written as a Fortran "I6" format. The range of integers is restricted to run from -32768 to +32767, reflecting the limits of 16 bit binary integer representation. Fields containing text are identical in the binary and character versions of the format (except for the optional ASCII to EBCDIC conversion).

I.c. Logical Records

The three kinds of logical records are: Catalogue, Header, and Data. The catalogue record describes the experiment. The header record explains the data or parameters that accompany it and describes the way the parameters were derived. The data records contain the actual parameter values. These three kinds of logical records have variable lengths and content as described in detail in the following sections. To facilitate recognition, the prologue, or first fields are defined similarly for each type of logical record. Prologues contain the record length, record kind, instrument, experiment or analysis procedure, and period of time covered by the record.

In the binary version, Catalogue and Header records are organized by groups of 40 16-bit words, that is, 80 8-bit bytes, having the structure of 80 character “card images”. The first 40 words of a Catalogue or Header record are binary integers; all remaining words contain ASCII characters. Data records are composed entirely of binary integers.

It is possible that a binary logical record contains a few extra dummy words at the end, with no information content. (These were created on computers with word lengths other than 16-bits.) These dummy words are included in the word count represented by the first word of the logical record.

The character version follows the binary version order, but blocking is optional and two fields in the prologue are altered. The first line of every logical record is the prologue, composed of six character integers. The first field in the prologue is a count of the number of lines in the logical record including the first line. This count is restricted so that if the record were converted to the binary version, it would not exceed the allowed maximum (16000 bytes or 8000 integer fields); for Catalog and Header records this corresponds to 199 lines; for Data records it is 7998 values. Lines subsequent to the prologue in Catalogue and Header records each contain up to 80 characters of text. Lines subsequent to the prologue in Data records contain integer parameter codes and values formatted as “20I6”.

I.d. Physical Records (Blocks)

Efficient use of some storage media may require blocking records. For instance, a 9-track tape end-of-record is 0.6 inches when data are stored at 1600 bytes per inch, so 8000 bytes in one record consumes 5.6 inches but 8000 bytes in 80 byte records consumes 65 inches. For this reason, the binary version defines a larger block composed of an integral number of logical records, plus two extra fields: a length prefix and checksum suffix. The block may be a variable length but should not exceed 16,000 8-bit bytes (8000 16-bit words). The layout of a binary block is as follows, described in 16-bit words:

Word 1 ↓	logical rec ↓				last word ↓
/////// ///////					/////// ///////

where:

- Word 1: The length of the physical record, representing a count of all 16-bit words in the physical record including this word and the last one (the checksum).
- Logical record: A Catalogue, Header, or Data Record. (The first 16-bit word of each logical record contains the number of words within that logical record.)
- Last word: A checksum of the physical record. It is a 16-bit checksum, an “exclusive or” of all the other fields in the record.

This checksum is calculated by performing a boolean exclusive or (XOR) masking on each 16-bit word in the physical record; for example:

0	00101	01111	01000	←	n^{th} word of physical record
0	01010	00011	00111	←	previous checksum total
0	01111	01100	01111	←	new checksum total

The checksum is accumulated over all other words in the physical record as is illustrated in the following Fortran example:

```
      CKSUM = 0B
      DO 100 I = 1,NWORDS
  100 CKSUM = PREC(I).XOR.CKSUM
```

The checksum can be used to assure integrity of each physical record by computing and comparing it with that found on tape each time it is read.

Character version datasets may be blocked for efficient off-line storage. In contrast to the mandatory variable length binary blocks, the character version blocking is optional and is fixed length (except for the last block). The block size is not prescribed, except that it must be a 120 byte multiple. The block size is not stored in the block, nor is there a checksum suffix. Blocks are created by first padding lines with blanks to a consistent 120 bytes length, then combining the lines into fixed size blocks without regard for logical record lengths. In other words, logical records may span blocks and the last block may be shorter.

When combining multiple logical records in the character format, it is acceptable to separate them by one or more blank lines. (This facilitates viewing the records interactively.)

If the data volume is small enough or a medium other than tape is used, the character version data may remain unblocked and the lines may be variable length; i.e., they do not need to be padded and blocked. In fact, most character version datasets on disk are not blocked.

I.e. File Organization

A dataset may contain one or more files separated by end-of-file marks. Each file contains one or more Catalogue, Header or Data records. The ordering of files is not prescribed. The order of logical records within a file is prescribed only to the extent that sequential data records of the same type should be chronological. Table 1 gives an example of how a dataset could be arranged.

Catalogue and Header records may or may not be present, and they may appear either preceding or following the Data records to which they relate. They may or may not be followed by an end-of-file mark.

Depending on how the data were obtained or analyzed, there may be several types of data records with different parameters for a given time period. For example, there may be data records that contain electrodynamic parameters, and others that contain neutral atmosphere parameters. These different records may be interleaved or they may be grouped, each group with its own header.

The use of end-of-file marks to separate sets of data records is flexible. For example, when a radar is operated in a series of elevation scans, data from each scan may be separated by a file mark. Another possible use is to separate experiments. It is also customary to terminate a tape with two consecutive end-of-file marks (often interpreted as end-of-data).

II. CATALOGUE RECORDS

A catalogue record describes an experiment. Its purpose is to:

(1) Identify what instrument was operating and when it was operating.

(2) Describe the experiment mode and its purpose.

(3) Comment on correlative experiments, special or unusual scientific occurrences, performance of the equipment, and the conditions occurring during each experiment (if relevant).

The format of Catalogue records is based around keywords and their modifiers, presented as card images of text. These card images are preceeded by a prologue which serves as a consistant introduction for all record types. The first twelve fields of the prologue are meaningful for Catalogue records.

In the character version, the prologue consists of a line where the first twelve six-character integer fields are defined, with an optional blank fill to 120 bytes length. With the exception of the first two fields, the values are the same as the binary version of the format as shown in Table 2. The first field of the prologue is a count of the number of lines in the logical record including the first line. This count must not exceed 199 lines due to a length restriction imposed on the maximum block size in the binary version. The second field in the character version has the value of 2101 to be distinct from the binary version. Lines subsequent to the prologue contain up to 80 bytes text optionally followed by blanks (to 120 bytes) when filling for blocking. The content of these text "card images" is the same as the binary version; see Table 2 for examples.

In the binary version of the format, each Catalogue record looks like a two-dimensional array, 80 characters (or 40 integer words) wide, with as many rows as needed. Each card image is not a record but rather a row in the array that comprises the Catalogue record. The very first card image is binary. This is so that the programs may consistently parse the prologue regardless of record type. The format of this first "card" is similar to a truncated prologue of a data record. All other card images in the binary version have ASCII characters. Table 2 serves the dual purpose of presenting an example of the Catalogue record layout and providing definitions of the keywords.

The character and binary version text portion of Catalogue records have the same card image layout. There are two types of card images. The first have keywords beginning with the letter "C" in column 1. They are special comment cards. For them, the characters between columns 9 and 80 can be used for free format comments. The second are more stringently specified. They have 2 fields of 8 characters each followed by a 64-character comment field. The first field contains the keyword, left-justified. The second field contains a numerical value, which is right-justified if it is an integer.

One code in the Catalogue records, MODEXP, defines the experimental mode. This code value in combination with the instrument code should uniquely identify the procedure and should be used to consistently identify all similar periods of data taking. A significant change in procedure should be reflected by a different MODEXP value. The MODEXP value is defined by card images beginning with the CMODEXP keyword.

III. HEADER RECORDS

The Header record precedes or follows the data records that it describes. Its purpose is to:

(1) Provide an overview of the associated data records.

(2) Document the procedure used to calculate the parameters.

(3) Document the types of physical parameters included in the data records.

(4) Provide any information helpful or necessary for data interpretation.

The Header format has a similar structure to the Catalogue record: Header records are composed of a prologue followed by card images containing text composed of keywords and modifiers. The first 15 fields of the prologue are meaningful for Header records.

In the character version, the prologue consists of a line where the first 15 six-character integer fields are defined, optionally followed by blanks to 120 bytes length. As with the character version of the catalogue record, the first field is a count of the number of lines comprising the Header record; it must not not exceed 199. The second field in the character version has the value of 3101 to be distinct from the binary version. The third through fifteenth fields in the prologue have the same definition as the binary version which are shown in Table 5. Lines subsequent to the prologue contain up to 80 bytes text optionally followed by blank fill (to 120 bytes length). The content of the text is the same as the binary version; see Table 5 for examples.

In the binary version, the Header records are in the form of 80-character card images, preceded by forty 16-bit binary integers. Table 5 serves the dual purpose of presenting examples of the card images and of providing definitions of the keywords.

There are two types of card images. The first have keywords beginning with the letter "C" in column 1. They are special comment cards. For them, the characters between columns 9 and 80 can be used for free format comments. The second are more stringently specified. They have three fields of 8 characters each followed either by a 56-character comment field or else by a 40-character field and two 8-character fields. The first field contains the keyword. The second field contains an integer, if appropriate, denoting the position within the data records of the quantity denoted by the keyword. The third field contains a numerical value. This value may be either a code (as for KRECH, KINST, KINDAT, KODS(*), and KODM (*)), or else a calculable number (IBYRT through NROW). The fourth field describes the meaning of the code or of the calculable number in the third field. A fifth and sixth field are given for KODS(*) and KODM(*) lines to list the physical units employed for the parameter defined by the code specified in field three. The fifth field gives a numerical factor in exponential format (designed to be machine-readable in FORTRAN E format), while the sixth field gives a character designation, normally based on the Systeme International. The units and associated scale factor for a given parameter are fixed, and are listed in Table 8.

In these fields, the keywords are left justified and all integers (numbers without a decimal point) are right justified. Otherwise, the entries in a field do not need to be justified but may appear anywhere within the field.

The special code KINDAT in Header records replaces MODEXP in catalogue records. The purpose of KINDAT is to uniquely identify the data processing algorithm used to compute the parameters in the associated Data records. KINDAT is defined in card images that begin with the keyword CKINDAT. As with MODEXP, it is actually the combination of two codes, KINDAT and KINST, that guarantee reference to a unique data processing algorithm. KINDAT may or may not be identical to MODEXP in an associated catalogue record. Ranges of KINDAT values are allocated to various database contributors as indicated in Table 6. Four-digit numbers are used to identify programs that compute basic parameters; i.e., parameters most directly obtained from the measurement. Five-digit numbers are for derived parameters. Once a value has been established it should be changed to reflect any significant difference in the data processing algorithm. It is up to the contributing organizations to judiciously use the range of values to distinguish minor revisions, major changes and fundamentally different algorithms.

IV. DATA RECORDS

A Data record consists of a Prologue, a one-dimensional (1-D) array of single-valued parameters, and a two-dimensional (2-D) array of multiple-valued parameters. The prologue contains at least 16 meaningful values and introduces the combination of parameter codes and values in the 1-D and 2-D arrays. Data records should contain no more than 7998 values (“I6” fields in the character version or 16-bit integers in the binary version).

The character version of the Data record uses multiple lines for a single Data record. A single format, “20I6”, may be used in all instances. Normally the prologue occupies only the first line of a Data record; however, if the prologue contains more than 20 fields, it will occupy more than one line. There is no restriction to the number of 1-D or 2-D parameters. The 1-D array consists of a list of parameter codes on one or more lines followed by the same number of lines of parameter values. The 2-D array is constructed similarly, except there are multiple rows (lines) of values for each parameter code.

In the binary version of the format, the 1-D and 2-D arrays are appended to the prologue to form a continuous array as follows:

Length
(16-bit words)

LPROL		Prologue
JPAR	→	1-D parameter codes
JPAR	→	1-D parameter values
MPAR	→	2-D parameter codes
MPAR	→	2-D parameter values (row = 1)
MPAR	→	2-D parameter values (row = 2)
	. . .	
MPAR	→	2-D parameter values (row = NROW)

All words are 16-bit binary integers. Table 7 shows an example of the binary version of a Data record.

IV.a. Prologue

The number of words or fields in the prologue is given by LPROL (word or field number 13), and is at least 16. If more than 16 are used, those beyond 16 ought to be defined in a Header record. The variable length prologue provides format flexibility at the expense of complicating interpretation.

The KINDAT (word or field number 4) code has an important function, to identify the analysis algorithm used to produce the data. The meaning of a particular KINDAT code is documented in the accompanying Header Record (which is uniquely identifiable by matching the KINDAT and KINST codes for a given experiment).

When data records are interleaved as in the example of Table 1, each type of record has a unique set of KINST, KINDAT values. That is, KINST, KINDAT or both must change between different types of interleaved records such that it is easy to identify the different types of Data records.

The first field of the prologue in the character version of the Data record is defined consistantly with Catalogue and Header records: The record length is specified as a count of the number of lines comprising the Data record. The second field, KREC, in the character version has a value of 1101. The third through sixteenth fields in the prologue have the same definition as the binary version as is shown in Table 7.

IV.b. 1-D Data Array

Following the prologue of the Data record is a one-dimensional (1-D) data array. This array contains parameters that have a single value for this data record. A Data record contains data for a time interval specified in the prologue; hence, 1-D array parameters are constant for this interval. Consider the example of a steerable radar, which samples at multiple distances for a fixed pointing direction (or for a limited range of azimuth and elevation). In this case the pointing information could be given in the 1-D array, along with other range- or height-independent information, such as maximum electron density. The array consists of a string of parameter codes (listed in Table 8 and discussed below), followed by a string of equal length containing the corresponding parameter values in the same order. Any given parameter code may appear only once within a single data record (including the 1-D and 2-D arrays).

The character version of the 1-D array may use zero lines (no 1-D codes), 2 lines (one to 20 codes), or a multiple of 2 lines (more than 20 codes). If there are no 1-D parameters as indicated by JPAR in the prologue, then there is no 1-D array. If there are one to 20 parameters then all codes are on one line and all values are on the following line in the same order. For 21 to 40 parameters, there are two lines of codes followed by two lines of values. In general, each additional increment of up to 20 codes requires two additional lines, one for codes and one for values. All lines with parameter codes precede lines with values.

IV.c. 2-D Data Array

The two-dimensional (2-D) data array follows the 1-D array. The first row of MPAR values contains the parameter code numbers (listed in Table 8 and discussed below) that uniquely identify each of the parameters. The first code can be, for example, that for range, altitude, or time, followed by codes for measured quantities and their uncertainties. The remaining NROW rows contain the corresponding parameter values. NROW may vary. Any given parameter code may appear only once within a single data record (including the 1-D and 2-D arrays). The array elements are stored row by row.

The character version of the 2-D array is constructed in the same way as the 1-D array except there are now NROW values for each parameter code, each of which is on a separate line.

V. PARAMETER CODES AND VALUES

V.a. Parameter Code List

The parameter codes are listed in Table 8. These codes have been organized by general categories which are described in the table. Each parameter code has an associated scale of physical units. New parameter codes will be added as they are needed.

V.b. Error Codes

The code for the error of a parameter is the negative of the parameter code itself. For example code 560 is for Te, and -560 for the error in Te. The units for errors are the same as the units for the corresponding parameters. Error values for logarithmic parameters (i.e., those scaled by $\log_{10}$ such as code 520) are calculated as the logarithm of the error as opposed to error of the logarithm.

V.c. Missing Data (value -32767)

A missing datum is indicated by the value -32767.

V.d. Assumed Parameters (error value -32766)

Sometimes parameters are assumed rather than derived in the process of producing data records. For example, ion composition, electron/ion temperature ratio, and ion-neutral collision frequency are often taken from models in certain height ranges because of the difficulty in extracting them independently from the radar measurements. When this is the case, the corresponding error values are set to -32766 to signify that the associated parameter is assumed or taken from a model.

V.e. Known Bad Data (error value +32767)

Sometimes data are known to be unrepresentative of the parameter in question, but for some reason have not been removed from the data set (perhaps because they have value in representing something else, like coherent echos). In this case, the corresponding error value is set to positive full-scale, or +32767.

V.f. Special Meaning Codes (451-480, 3100-3799, 4001-4599, 30000-32767)

Codes 451-480, giving information about data quality, are defined individually for each incoherent scatter radar and are described in the header record. Corresponding codes 4001-4599 are for other instruments or outputs. Codes 3100-3799 are used internally by the incoherent scatter radar organizations and do not normally appear in exchanged datasets. Codes 30000-32767 are available to each organization to define in whatever way they want to. They are not a part of the official parameter code list at any other organization, and should be described in the header record for outside users.

V.g. Uncorrected Electron Density (codes 500, 505)

An approximate measure of electron density is obtained simply by multiplying the radar received power by $(\text{range})^2$ and an appropriate scaling constant. This quantity can be obtained without the temperature information that is needed to produce true densities, and therefore it is sometimes available when true densities are not. The formula for correcting the electron density is:

$$N = \frac{(1 + \alpha^2 + T_e/T_i)\,(1 + \alpha^2)}{2}\, N_{uncorrected}$$

$$\alpha^2 = 7.654 \text{ x } 10^5\, \frac{T_e}{\lambda^2\, N}$$

where

N = true electron density (m^{-3})
T_e = electron temperature (K)
T_i = ion temperature (K)
λ = radar wavelength (m)

The uncorrected density approximates the true density well if $\alpha^2 \ll 1$ and $T_e/T_i \approx 1$, provided the received power has been well normalized. Codes 500 and 505 are for uncorrected densities. Codes 510-535 are for true densities.

V.h. Relative Intensity Codes (2505, 2506, 2507)

Often Fabry-Perot data are recorded as relative intensities, using codes 2505-2507, rather than absolute intensities (codes 2500-2502) because of a lack of calibration. The relative intensity is useful for comparison of intensities over a single night of observations, and possibly also for a longer period of time. The relative intensity is often relatively close (within a factor of 5) to the true intensity. Calibration is often done with photometer measurements. The lack of knowledge of the true intensity does not effect either the neutral wind or the neutral temperature measurement.

V.i. Double-Precision Data

A few parameters sometimes require higher precision than permitted with 16 bits and a fixed scaling factor. For these parameters a parameter code for an "additional increment" is also provided, usually with units 10^{-4} of those for the parameter itself. In this way, two words can be used to provide double precision for that parameter. Examples are the pair of codes (110, 111) for height and the pair (510, 511) for electron density. When such pairs of codes are used, they will be adjacent within either the 1-D or 2-D array. It is not required to use such codes in pairs. If single precision is adequate, either code may be used depending on the units needed.

V.j. Specifying Vector Components

Vector information can be represented in many different ways. Most of the more common ways can be represented as one or more of three systems defined below. Each system has three vector components. The first system (components 1, 2, 3) is orthogonal and geodetically based, with component 3 vertically upward, and components 1 and 2 horizontal, in more-or-less eastward and northward directions, respectively. The actual orientation of components 1 and 2 is defined under code 1010. The second system (components 4, 5, 6) is also orthogonal, but is magnetic-field-oriented, with component 6 antiparallel to the magnetic field, component 4 more-or-less eastward, and component 5 perpendicular to the magnetic field in a magnetic meridian, with a positive upward component (and a positive northward component in the northern hemisphere and positive southward component in the southern hemisphere). The actual orientation of components 4 and 5 is defined under code 1020. Finally, a third system (component 7, 8, 9) is defined to have arbitrary (not necessarily orthogonal) directions, defined under codes 1030-1080. More specific information follows.

(A) Components 1, 2, 3 are orthogonal, with 1 and 2 being horizontal and 3 being vertically upward (geodetic). Direction 1 is rotated horizontally from the east towards the south by the angle given under parameter code 1010, while direction 2 is rotated from the north towards the east by this same angle. Special values (between -32767 and -32701) entered for parameter 1010 do not denote this angular rotation, however, but rather denote one of several specific coordinate systems as follows:

0	No rotation (i.e., directions 1 and 2 are geographic east and north, respectively).
-32701	Direction 1 is geomagnetic (centered dipole) east and direction 2 is geomagnetic north.
-32702	Direction 1 is local magnetic east and direction 2 is local magnetic north (i.e., rotation angle equals magnetic declination in volume of measurement.
-32703	Direction 1 is tangent to the intersection of an L-shell with the horizontal (positive towards magnetic east) and direction 2 is 90^o from this (positive towards magnetic north).
-32704	Direction 1 is tangent to the intersection of a constant-apex-latitude surface with the horizontal (positive towards magnetic east) and direction 2 is 90^o from this (positive towards magnetic north).

(B) Components 4, 5, 6 are orthogonal, with direction 6 anti-parallel to the magnetic field (positive towards magnetic south), and with directions 4, 5 perpendicular to the magnetic field. Direction 4 is generally eastward, while direction 5 is generally upward/northward in the northern hemisphere. The reference direction, from which direction 4 is rotated, is local magnetic east, i.e., 90^o from the horizontal component of the local magnetic field. (This reference direction is both horizontal and perpendicular to $\vec{B}$.) Direction 4 is rotated clockwise, looking in the direction of $\vec{B}$, from this reference direction by the angle given under parameter code 1020. Direction 5 is 90^o from direction 4, such that 4, 5, 6 make a right-handed set. Special values (between -32767 and -32701) entered under 1020 do not denote this angular rotation, however, but rather denote one of several specific coordinate systems as follows:

0	No rotation. Direction 4 is local magnetic east in the volume of measurement; the azimuth and elevation angles of direction 5 are (magnetic declination) and (90^o minus the magnetic downward inclination), respectively.
-32703	Direction 5 is in the direction of grad(L); direction 4 is 90^o from this towards magnetic east.
-32704	Direction 5 is in the direction of grad$\lvert$apex latitude$\rvert$; direction 4 is 90^o from this towards magnetic east.

(C) Components 7, 8, 9 are in arbitrary directions. For each, the geodetic azimuth and elevation, in the volume of measurement, are specified under a pair of codes: (1030, 1040), (1050, 1060), (1070, 1080), respectively.

The special parameter code 1455 has been established to allow convenient specification of the neutral wind component which is the horizontal projection of the component in direction 5 (perpendicular north). It is possible to describe this component separately (by using code 1420 and indicating the rotation with code 1010 values assigned the magnetic declination). However, without the use of code 1455, it is not possible to combine this component with other horizontal geographic components in the same data record (because 1010 would have to be used for two purposes).

APPENDIX A. Reading The CEDAR Database Format

Access software is dependent on the storage medium. 9-track tapes and off-line storage were predominant when the format was developed. This influenced the database format design (record blocking was incorporated) and the access program was built to read directly from tape. Now, however, disk is inexpensive and 9-track tapes are now uncommon, so discussion of tape access is relegated to the final section of this appendix and the first two sections focus on disk access.

With the advent of relatively inexpensive disk and internet file transfer, files are commonly accessed from disk. To accommodate this change, a layer was added the format which retains tape concepts recognized by the format (end-of-record and end-of-file); thus, solving the problem of reading variable length records from disk. Known as COS (Cray Operating System) blocking, this uses fixed length records to hold variable length blocks of the CEDAR Database format. COS blocking retains the notion of multi-file volumes and its fixed length record buffering naturally lends itself to faster access than stream I/O (an otherwise viable alternative). Section A.1 describes the implementation and use of COS blocking by the portable Fortran-77 access routine (CBFOPN). Section A.2 continues the access description, summarizing the function of the portable read program.

Section A.1. CBFOPN

CBFOPN is a Fortran-77 subroutine which supports sequential reading and writing COS blocked files. CBFOPN ports to common operating systems with a few changes outlined here. CBFOPN is part of the binary data access program (READTP) whose source is distributed with CEDAR data.

A.1.a. COS blocks

The complete COS blocked format definition is given in any Cray Operating System Reference manual. The implementation in CBFOPN is incomplete, omitting elements for blank character compression and interactive tape processing. Also, CBFOPN is currently set up only for forward sequential processing, although hooks have been retained for record and file backspacing. Each 4096 byte record begins with an (8 byte) block control word (BCW) which contains fields:

Name	First bit	Last bit	Description
M	0	3	Type of control word = 0 for a block control word.
BDF	11	11	Bad data flag; indicates that the following data, up to the next control word are bad.
BN	31	54	Block number; number of the current data block, starting with 0.
FWI	55	63	Forward word index; number of 8-byte words to the next RCW or BCW, starting with 0.

Field position bits are numbered starting zero at the leftmost, or most significant bit. A record control word (RCW) follows each record, file or dataset. It contains fields:

Name	First bit	Last bit	Description
M	0	3	Type of control word = 8 for an end-of-record (EOR) = 14 for an end-of-file (EOF) = 15 for an end-of-data (EOD)
UBC	4	9	Unused bit count; Number of unused bits in the last (8-byte) word of the data record. This must be zero for EOF and EOD RCWs.
BDF	11	11	Bad data flag; indicates that the following data, up to the next control word are bad.
PFI	20	39	Previous file index; the number of COS records (modulo 2**20) back to the beginning of the current file, starting with 0.
PRI	40	54	Previous record index; the number of COS records (modulo 2**15) back to the beginning of the current data record, starting with 0.
FWI	55	63	Forward word index; number of 8-byte words to the next RCW or BCW.

An EOR RCW immediately follows the data for the record it terminates. If the record is null (contains no data), it may follow another EOR or EOF RCW. An EOF RCW may follow an EOR RCW, another EOF RCW (signifying an empty file), or be the first word of the dataset (an empty first file). An EOD RCW immediately follows the final EOF RCW of the dataset or it may be the first word of the dataset (a null dataset).

A.1.b. Installation

CBFOPN has been installed on most common operating systems, including Sun, Cray, SGI, HP, IBM, DEC, and PC. Installation may require a few changes depending on the operating system; default is Sun, which also runs on HP and IBM (AIX) without change.

The source is distributed with the binary read program when it is obtained via the interactive interface (cmenu). It is available on the web at URL http://www.scd.ucar.edu/dss/softlib/io/html; also click on GBYTES and pick up a suitable version (DEC and PC users should also get swap.for). These files are also available via anonymous ftp:

```
ftp ncardata.ucar.edu    or  ftp 128.117.108.222
cd libraries/io
get cbfopn.f
```

The fortran source (cbfopn.f) consists of subroutines CBFOPN and RDCRBK; CBFOPN has alternate entries (CBFRD, CBFWR, CBFREW, CBFCLS, and CBFEOF). Before quitting the ftp session, refer to the information file which identifies the suitable version of gbytes/sbytes and maybe swap4 (required for byte reversed systems such as DEC and PC). Change directory and display the contents of file README,

```
cd ../gbytes
get README |more      or   get README - or   show README
```

then then pick up the appropriate gbytes source file(s).

Operating system dependent changes are described in embedded comments in the source file. The first item is a CBFOPN call argument: LMWD defines word size and work array dimension; the other two require changing which lines are commented. Search for the indicated string (e.g., "Cbyte") and swap commented code segments:

Cbyte PC and DEC computers interpret bytes in each word in the reverse order of many other computers. It is probably best to turn on byte reversal on input and output, so the order in the files is consistent with other machines. However, if files are only written and read back locally, one can leave everything byte reversed (and gain a slight speedup). This requires subroutine SWAP4, also available in the gbytes directory.

Crecl The 'RECL' argument units may be bytes (Sun, Cray, HP-UX, IBM-AIX and PC's) or words (DEC and SGI). Activate the line matching the operating system.

A generic fortran version of gbytes and sbytes is provided with the binary read routine obtained via cmenu. The generic version may require changes when installing on non default systems. Generally, (1) LMWD must indicate the native word size; (2) the MASKS array may need additional elements activated; and (3) statement functions OR, AND and NOT may need to be activated. The compiler will probably recognize and complain about all of these except LMWD. Embedded comments identify operating systems specifics.

A.1.c. Use

These routines provide the following functionality. Call arguments are defined for each entry in comments the source:

CBFOPN Prepare for reading or writing a dataset.

CBFRD Read the next sequential record.

CBFWR Write the next sequential record.

CBFREW Rewind the unit (read only).

CBFCLS Close the unit, if open for write, first flush the buffer and add an EOF.

CBFEOF Write an EOF (write only).

GBYTE Singular of GBYTES.

GBYTES Get bytes, i.e., unpack bits: Extract arbitrary size values from a packed bit string, right justifying each value in the unpacked array. The maximum size may not exceed the number of bits in a native computer word.

SBYTE Singular of SBYTES.

SBYTES Store bytes, i.e., pack bits: Put arbitrary size values into a packed bit string, taking the low order bits from each value in the unpacked array.

Section A.2. Reading the Database format

A portable Fortran program (READTP) is available for reading character and binary versions of the Database format. The name was historically correct, but is misleading now that READTP reads disk files. READTP prints logical records from the data file, selected by time interval or selected by position in the file. READTP is distributed via the interactive access utility (cmenu) and READTP is described in the CEDAR Database User Guide.

READTP may be customized to suit the current analysis. Perhaps the simplest change would be to modify print statements to produce output matching analysis program inputs. Another option which avoids generating intermediate files would be to incorporate the READTP input routines into the analysis program; viz., RDBLK6 (plus CBFOPN and GBYTES) for binary version data or RDCHR for character version data.

The binary version of READTP relies on subroutine CBFOPN to remove the COS blocking and deliver CEDAR blocks into subroutine RDBLK6 which then extracts logical records from the CEDAR blocks, producing one at a time for possible printing.

The character version of READTP expects any blocking to have been removed, such that it reads lines of maximum length 120 bytes. Such unblocked character formatted files are produced by cmenu or may be generated by tape read utilities; see the next section. The character READTP program has a subroutine (RDCHR) which assembles these lines into logical records and returns them one logical record at a time for possible printing.

The character version needs no changes to run on an operating system supporting a Fortran-77 compiler. The binary version, however, requires proper specification of LMWD in the main routine plus possible changes to routines: CBFOPN, GBYTES, and SBYTES.

Section A.3. Using Tapes

A number of options are available for reading from a tape. It is probably easiest to transfer the file to disk, then read the disk copy. On Unix systems, devices such as CDROM, Exabyte, or DAT are now usually connected via SCSI (Standard Computer System Interface) and they are accessed via operating systems commands or through Fortran or C library routines. Older systems with 1/2 inch tape drives may have different hardware configuration using special hardware and access drivers. Some combinations of medium, operating system and access code are not feasible: A version of the 9-track tape access code is available for VMS systems, but this author is not aware of high level 9-Track tape access software for PC's.

If the tape is already COS blocked, then **mt** and **dd** are suitable for copying the data to disk. In this case, the input block size must match that used when writing the tape (which may be a multiple of 4096 bytes) and the output block size should be 4096 bytes. If the tape is not COS blocked, and contains the binary version of the format, then COS blocking should be added when copying to disk. A program (tape2cosb.f) is available to do this which uses Unix Fortran access functions (TOPEN, TCLOSE, TREAD, TSKIPF) and CBFOPN to write the COS blocks. It is available from the Data Support Section at NCAR, via the web (http://www.scd.ucar.edu/dss/softlib/io.html) or anonymous ftp (to ncardata.ucar.edu or 128.117.108.222, then cd libraries/io_devices).

If reading fixed length blocked character tape, it is assumed that an unblocking utility is available to break up larger blocks. **dd** on Unix systems will split the larger blocks into the 120 byte maximum records, adding a new-line and trimming trailing blanks. If **dd** is not available, it is possible to unblock the file after copying onto disk using either the Unix command **fold** or a fortran subroutine (lrecio.f, also available via web (http://www.scd.ucar.edu/dss/softlib/io.html) or anonymous ftp (to ncardata.ucar.edu or 128.117.108.222, then cd libraries/io_devices). lrecio.f could be put unto a separate program or incorporated into READTP by making subroutine RDCHR use lrecio.f.

Table 1

EXAMPLE OF TAPE LAYOUT

Type of Record	Remarks
Catalogue record	Describes the whole experiment
Header record, type A	Describes the data that follow, which consists of basic parameters such as Ne, Te, Ti, Vlos
Data record, type A	Consists of prologue + 1-D and 2-D data matrices
Data record, type A . . . EOF	
Data record, type A	
Data record, type A . . . EOF	
Header record, type B	Describes a different data set that consists of derived parameters such as Vx, Vy, Vz
Header record, type C	For derived parameters such as Umerid, exospheric temperature
Data record, type B	
Data record, type C	
Data record, type B	
Data record, type C . . . EOF EOF	

Table 2

FORMAT OF CATALOGUE RECORDS

Binary version first “card image” (40 16-bit binary words) or character version first 120 byte line (20I6).

Binary Word or Character Field	Name	Definition	Comments
1	LTOT	Length of this record.	Binary version: Length is specified as the number of 16-bit words including this one. LTOT = 40* (1 + number of succeeding card images). Character version: Length is specified as the number of 120 byte lines including this one. LTOT = (1 + number of succeeding card images).
2	KRECC	Kind of record.	Binary version: Value is 2001 Character version: Value is 2101
3	KINSTE	Instrument code for this experiment.	See Table 3
4	MODEXP	Code to indicate experimental mode employed	Each instrument will have its own code list. Each code indicates a particular data taking scheme; for radars this would refer to antenna motion and pulse patterns.
5	IBYRE	Beginning year	Gives begin and end UT of the
6	IBDTE	" date	measurements covered by this record
7	IBHME	" hour & min	See format in Table 4.
8	IBCSE	" centisecond	
9	IEYRE	Ending year	
10	IEDTE	" date	
11	IEHME	" hour & min	
12	IECSE	" centisecond	
13-n		Zeros	Binary version: n=40 Character version: n=20

Table 2 (Continued)

Sucessive “card images”. Binary version is 80 ASCII characters each, each therefore adding 40 words to the word count. Character version each is formatted as “A80,40X”.

Keyword	Value	Description	Explanation
COLS:1-8	9-16	17-80	
CKEYWORD	VALUE	DESCRIPTION	
KRECC	2001	Catalogue Record, Version 1	
KINSTE	70	EISCAT (Tromso, Kiruna, and Sodnakyla)	
MODEXP	302	Common Progamme 3, Version 2	
CMODEXP	(Start description in column 9)		Further elaboration of
CMODEXP			meaning of MODEXP; e.g.
CMODEXP			antenna patterns and
.			pulse sequences.
.			
.			
TIMCY	30.	Minutes for one full measurement cycle	
ALT1	80.	Kilometers, Lowest altitude measured	
ALT2	800.	Kilometers, Highest altitude measured	
C	Data above 500 km are poor quality		Appropriate comments
GGLAT1	64.2	Degrees, lowest geographic latitude measured	
GGLAT2	73.6	Degrees, highest geographic latitude measured	
GMLAT1	61.	Degrees, lowest invariant latitude measured	Define magnetic coord-
GMLAT2	71.	Degrees, highest invariant latitude measured	inate system used.
IBYRE	1983	Beginning year	For this experiment.
IBDTE	308	Beginning month and day	Values should match
IBHME	1000	Beginning UT hour and minute	those in prologue.
IBCSE	0	Beginnning centisecond	
IEYRE	1983	Ending year	For this experiment.
IEDTE	309	Ending month and day	Values should match
IEHME	2325	Ending UT hour and minute	those in prologue.
IECSE	3000	Ending centisecond	
CPURP	World day-thermospheric dynamics experiment		Brief description of
CPURP			the experiment PURPose
CCOREXP	Other incoherent-scatter radars		CORrelative EXPeriments,
CCOREXP	Fabry-Perot Interferometer from 2030 on 830308		one experiment per
CCOREXP	Low-Light Level TV from 2100 to 0400 on 830308		card image.
CCOREXP	TRIAD passes at 0130 and 0305 UT		
CCOREXP	IMP-8		
CSREM	Large TID between 0330 and 0430 on 830309		Scientific REMarks
CSREM	Sudden commencement at 2010 UT on 830308		
CSREM	Very intense type A red aurora 2215 to 2350 on 830308		
CIREM	1st experiment with new paramp. Much lower system temp		Instrument REMarks
CIREM	Still have the added noise problem		
CIREM	Only one short transmitter failure		
CPI	M. Baron		Names of responsible Principal Investigator(s) or others knowledgeable about the experiment.
CPREPDAT	1984 June 26		PREParation DATe

Table 3

INSTRUMENT CODES (KINSTE or KINST)

Ordered by ascending KINST CODE:

INSTRUMENT	KINST CODE	DATA VOLUME PREFIX
Jicamarca Peru I.S. Radar	10	JRO
Arecibo P.R. I.S. Radar	20	ARO
MU I.S. Radar, Shigaraki Japan	25	MUI
Millstone Hill I.S. Radar	30	MLH
Millstone Hill (steerable uhf antenna)	31	MLH
Millstone Hill (zenith uhf antenna)	32	MLH
Millstone Hill (steerable L-band ant.)	33	MLH
Saint Santin I.S. Radar	40	STS
Saint Santin (Nancay receiver)	41	STS
Saint Santin (Mende receiver)	42	STS
Saint Santin (Montpazier receiver)	43	STS
Chatanika AK I.S. Radar	50	CHT
EISCAT I.S. Radar	70	EIS
Kiruna (EISCAT) I.S. Radar	71	EIS
Tromso (EISCAT) I.S. Radar	72	EIS
Sodankyla (EISCAT) I.S. Radar	73	EIS
Tromso (EISCAT) VHF Radar	74	EIS
Sondrestrom I.S. Radar	80	SON
Interplanetary Mag Fld and Solar Wind	120	IMF
Estimated Hemispheric Power	175	EHP
Midnight Equatorward Boundary	180	EQB
Geophysical indices from NGDC: Lenhart	210	GPI
Geophysical indices from NGDC: AE	211	AEI
Geophysical indices from NGDC: Dst	212	DST
NCAR TGCM/TIGCM Model Output	310	GCM
AMIE Model Output	311	ARE
Forbes/Vial Model Semidiurnal Tides	320	SDT
Vial/Forbes Model Lunar Tides	321	SDL
GSWM solar diurnal & semidiurnal tides	322	GSW
Halley Antarctica HF Radar	820	HHF
Syowa Antarctica HF Radar	830	SYF
Kapuskasing HF Radar	845	KHF
Saskatoon HF Radar	861	SHF
Goose Bay HF Radar	870	GBF
Hankasalmi Finland HF Radar	900	FHF
Stokkseyri (Iceland West) HF Radar	910	WHF
Pykkvibaer (Iceland East) HF Radar	911	EHF
Arecibo P.R. MST Radar	1040	ARM
Poker Flat Alaska MST Radar	1140	PKR
Scott Base Antarctica MF Radar	1210	SBF
Mawson Antarctica MF Radar	1220	MAF
Christchurch New Zealand MF Radar	1230	CCF
Adelaide Australia MF Radar	1240	ADF
Collm LF Radar	1320	COF
Saskatoon Canada MF Radar	1340	SAF
Tromso Norway MF Radar	1390	TRF
Atlanta Georgia Meteor Wind Radar	1560	ATM
Durham N Hampshire Meteor Wind Radar	1620	DUM
Christmas Island ST (MEDAC) Radar	2090	CIA

Platteville Colorado ST (MEDAC) Radar	2200	PLA
Qaanaaq Greenland Digisonde	2930	QAD
Halley Antarctica Fabry-Perot	5020	HFP
Arequipa, Peru Fabry-Perot	5140	AQF
Arecibo P.R. Fabry-Perot	5160	AFP
Peach Mountain Fabry-Perot	5300	PFP
Millstone Hill Fabry-Perot	5340	MFP
Watson Lake, Canada Fabry-Perot	5430	WFP
College Fabry-Perot	5460	CFP
Sondre Stromfjord Fabry-Perot	5480	SFP
Thule Greenland Fabry-Perot	5540	TFP
Stockholm Sweden IR Michelson Interfer.	5860	STM
U of Illinois LIDAR	6300	UIL
Colorado State Sodium Lidar	6320	CSL
Millstone Hill Imager	7240	

Ordered by DATA VOLUME PREFIX:

Millstone Hill Imager	7240	
Adelaide Australia MF Radar	1240	ADF
Geophysical indices from NGDC: AE	211	AEI
Arecibo P.R. Fabry-Perot	5160	AFP
Arequipa, Peru Fabry-Perot	5140	AQF
AMIE Model Output	311	ARE
Arecibo P.R. MST Radar	1040	ARM
Arecibo P.R. I.S. Radar	20	ARO
Atlanta Georgia Meteor Wind Radar	1560	ATM
Christchurch New Zealand MF Radar	1230	CCF
College Fabry-Perot	5460	CFP
Chatanika AK I.S. Radar	50	CHT
Christmas Island ST (MEDAC) Radar	2090	CIA
Collm LF Radar	1320	COF
Colorado State Sodium Lidar	6320	CSL
Geophysical indices from NGDC: Dst	212	DST
Durham N Hampshire Meteor Wind Radar	1620	DUM
Pykkvibaer (Iceland East) HF Radar	911	EHF
Estimated Hemispheric Power	175	EHP
EISCAT I.S. Radar	70	EIS
Kiruna (EISCAT) I.S. Radar	71	EIS
Tromso (EISCAT) I.S. Radar	72	EIS
Sodankyla (EISCAT) I.S. Radar	73	EIS
Tromso (EISCAT) VHF Radar	74	EIS
Midnight Equatorward Boundary	180	EQB
Hankasalmi Finland HF Radar	900	FHF
Goose Bay HF Radar	870	GBF
NCAR TGCM/TIGCM Model Output	310	GCM
Geophysical indices from NGDC: Lenhart	210	GPI
GSWM solar diurnal & semidiurnal tides	322	GSW
Halley Antarctica Fabry-Perot	5020	HFP
Halley Antarctica HF Radar	820	HHF
Interplanetary Mag Fld and Solar Wind	120	IMF
Jicamarca Peru I.S. Radar	10	JRO
Kapuskasing HF Radar	845	KHF
Mawson Antarctica MF Radar	1220	MAF
Millstone Hill Fabry-Perot	5340	MFP
Millstone Hill I.S. Radar	30	MLH
Millstone Hill (steerable uhf antenna)	31	MLH
Millstone Hill (zenith uhf antenna)	32	MLH
Millstone Hill (steerable L-band ant.)	33	MLH

MU I.S. Radar, Shigaraki Japan	25	MUI
Peach Mountain Fabry-Perot	5300	PFP
Poker Flat Alaska MST Radar	1140	PKR
Platteville Colorado ST (MEDAC) Radar	2200	PLA
Qaanaaq Greenland Digisonde	2930	QAD
Saskatoon Canada MF Radar	1340	SAF
Scott Base Antarctica MF Radar	1210	SBF
Vial/Forbes Model Lunar Tides	321	SDL
Forbes/Vial Model Semidiurnal Tides	320	SDT
Sondre Stromfjord Fabry-Perot	5480	SFP
Saskatoon HF Radar	861	SHF
Sondrestrom I.S. Radar	80	SON
Stockholm Sweden IR Michelson Interfer.	5860	STM
Saint Santin I.S. Radar	40	STS
Saint Santin (Nancay receiver)	41	STS
Saint Santin (Mende receiver)	42	STS
Saint Santin (Montpazier receiver)	43	STS
Syowa Antarctica HF Radar	830	SYF
Thule Greenland Fabry-Perot	5540	TFP
Tromso Norway MF Radar	1390	TRF
U of Illinois LIDAR	6300	UIL
Watson Lake, Canada Fabry-Perot	5430	WFP
Stokkseyri (Iceland West) HF Radar	910	WHF

Table 4

DATE AND TIME FIELDS

Description	Example
Year	1981
Month and day (MMDD)	0825
Hours and Minutes (HHMM)	1053
CentiSeconds	3700

Example is for 25 August 1981 at 1053 37.00 UT

Table 5
FORMAT OF HEADER RECORDS

Binary version first "card image" (40 16-bit binary words) or character version first line (20I6):

Binary Word or Character Field	Name	Definition	Comments
1	LTOT	Length of this record.	Binary version: Length is specified as the number of 16-bit words including this one. LTOT = 40* (1 + number of succeeding card images). Character version: Length is specified as the number of 120 byte lines including this one. LTOT = (1 + number of succeeding card images).
2	KRECH	Kind of record.	Binary version: Value is 3002 Character version: Value is 3101
3	KINST	Instrument code for these data (same value as for associated data records)	See Table 3.
4	KINDAT	Kind-of-data code (Same value as for associated data records)	Each code indicates a particular data analysis algorithm. KINDAT must differ for each different type of interleaved records for the same instrument.
5	IBYRT	Beginning year	For the data covered by this
6	IBDTT	" date	record. Format in Table 4.
7	IBHMT	" hour & min	Beginning time should be
8	IBCST	" centisecond	≤ that in first data record;
9	IEYRT	Ending year	ending time should be
10	IEDTT	" date	≥ that in last data record.
11	IEHMT	" hour & min	Universal Time is used
12	IECST	" centisecond	
13	LPROL	Length of prologue in accompanying data records	
14	JPAR	Number of single-valued parameters in accompanying data records	These numbers help in identifying to which data
15	MPAR	Number of multiple-valued parameters in accompanying data records	records this header record belongs.
16-n		Zeros	Binary version: n=40 Character version: n=20

Table 5 (Continued)

Successive “card images”. Binary version is 80 ASCII characters each, each therefore adding 40 words to the word count; in the character version each is formatted as “A80,40X”. The ordering of keywords, except those beginning with “C”, is similar to the ordering of parameters in accompanying data records. For those keywords that have an identical meaning to corresponding words in the data records, the position of the word in the data record is given under “data record word number (DRWDNO).”

Keyword	Value		Description			Explanation
COLS:1-8	9-16	17-24	25-64	65-72	73-80	
CKEYWORD	DRWDNO	VALUE	DESCRIPTION	UNITS		
C	DRWDNO is data record word number					
KRECH		x	Header Record, Version 2			Binary version: x=3002
						Character version: x=3101
KINST	3	72	Tromso			
KINDAT	4	6123	(Name of algorithm), Version 3			Define KINDAT
CKINDAT	(Start description in column 9.)					Further elaboration of
CKINDAT						meaning of KINDAT.
.						
.						
CHIST	Input to this algorithm was output of algorithm 6041					List the processing
						history of these data
C	Eleven-position part of experiment was used for these data					Comments inserted
C						as appropriate
C	NASA TIMED mission keywords					
PRODTYP		Analysis Level 3				Data Product Classification
VERNO		2				Version number
REVNO		0				Revision number
IBYRT		1983	Beginning year for these data			
IBDTT		508	Beginning month and day			Applicable to data in the
IBHMT		1422	Beginning UT hour and minute			accompanying records.
IBCST		200	Beginnning centisecond			
IEYRT		1983	Ending year for these data			
IEDTT		509	Ending month and day			Values should match
IEHMT		2325	Ending UT hour and minute			those in prologue.
IECST		3000	Ending centisecond			
LPROL	13	16	Length of prologue in data records			
JPAR	14	6	Number of single-valued parameters			
MPAR	15	3	Number of multiple-valued parameters			
NROW	16		Number of entries for each multiple valued parameter			
C	NROW is variable					
KODS(1)	17	132	Beginning azimuth	1.E-2	Degree	Define single valued
KODS(2)	18	133	Ending azimuth	1.E-2	Degree	parameter codes in 1-D
KODS(3)	19	142	Beginning elevation	1.E-2	Degree	array; see Table 8
KODS(4)	20	143	Ending elevation	1.E-2	Degree	
KODS(5)	21	530	Max electron density	1.E9	m-3	
KODS(6)	22	540	Height of max electron density	1.	km	
KODM(1)	29	110	Altitude	1.	km	Define multiple valued
KODM(2)	30	520	LOG10(electron density in m-3)	1.E-3		parameter codes in
KODM(3)	31	-520	Error in LOG10(electron density in m-3)	1.E-3		2-D array
C	Missing parameter values are -32767					
C	Assumed parameters have an error value of -32766					
CMGFLD	IGRF 1980, Epoch 1983.5 is used.					
CCOMP	Ion composition is asumed to be ...					
CNATM	Neutral atmosphere model is assumed to be MSIS 1983					
CCOLL	Ion-neutral collision frequencies are taken from...					
CANALYST	(names of persons knowledgeable about the analysis)					
CANDATE	1984 June 26					ANalysis DATE

Table 6

ALLOCATIONS OF KINDAT CODES

Code range	Instrument or Institution
Algorithms that primarily produce basic parameters	
1001-2000	Jicamarca I.S. Radar
2001-3000	Arecibo I.S. Radar
3001-4000	Millstone Hill I.S. Radar
4001-5000	St. Santin I.S. Radar
5001-6000	Chatanika or Sondrestromfjord I.S. Radar
6001-7000	EISCAT I.S. Radar
7001-9999	Other instruments or institutions
Algorithms that primarily produce derived parameters	
11001-12000	Jicamarca I.S. Radar
12001-13000	Arecibo I.S. Radar
13001-14000	Millstone Hill I.S. Radar
14001-15000	St. Santin I.S. Radar
15001-16000	Chatanika or Sondrestromfjord I.S. Radar
16001-17000	EISCAT I.S. Radar
17001-20000	Other instruments or institutions
30001-32767	Used by the database

Table 7

FORMAT OF DATA RECORDS

Binary Word or Character Field	Name	Definition	Comments
Prologue			
1	LTOT	Length of this record.	Binary version: Length is the number of 16-bit words including this one, or LTOT = LPROL + 2*JPAR + MPAR*(NROW+1) Character version: Length is the number of 120 byte lines including this one, or LTOT = 1 + ((JPAR+19)/20)*2 + ((MPAR+19)/20)*(NROW+1)
2	KREC	Kind of record.	Binary version: Value is 1002 Character version: Value is 1101
3	KINST	Instrument code for these data	See Table 3.
4	KINDAT	Kind-of-data code (Same value as for associated data records)	Each code indicates a particular data analysis algorithm. KINDAT must differ for each different type of interleaved records for the same instrument.
5	IBYR	Beginning year	
6	IBDT	" date	
7	IBHM	" hour & min	
8	IBCS	" centisecond	For data covered by this record.
9	IEYR	Ending year	Format in Table 4.
10	IEDT	" date	Universal Time is used.
11	IEHM	" hour & min	
12	IECS	" centisecond	
13	LPROL	Length of this prologue	Number of words or fields. Must be at least 16.
14	JPAR	Number of single-valued parameters	2*JPAR is length of 1-D data array. Zero is permissible.
15	MPAR	Number of multiple-valued parameters	Number of columns in 2-D data array. Zero is permissible.
16	NROW	Number of entries for each multiple-valued parameter	(NROW+1)*MPAR is length of 2-D data array.

Table 7 (Continued)

Binary Word Number	Name	Definition	Comments
1-D data array:			
LPROL+1	KODS(1)	Code for first single-valued parameter	Codes from Table 8 Character version starts the 1-D array on a new line using a 20I6 format, or up to 20 codes per line
.	.		
.	.		
.	.		
LPROL+JPAR	KODS(JPAR)	Code for last single-valued parameter	
LPROL+JPAR+1	IPARS(1)	Value of first single-valued parameter	Missing values are entered as -32767. Character version starts 1-D array values on a new line using 20I6 format, or up to 20 values per line
.	.		
.	.	.	
.	.	.	
LPROL+2*JPAR	IPARS(JPAR)	Value of last single-valued parameter	
2-D data array:			
LPROL+2*JPAR+1	KODM(1)	Code for first multiple-valued parameter	Codes from Table 8 Character version starts the 2-D array on a new line using a 20I6 format, or up to 20 codes per line.
.	.		
.	.	.	
.	.	.	
LPROL+2*JPAR +MPAR	KODM(MPAR)	Code for last multiple-valued parameter	
LPROL+2*JPAR +MPAR+1	IPARM(1,1)	First value of first multiple-valued parameter	Character version starts each row of array values on a new line using 20I6 format, or up to 20 values per line.
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.	.	.	
.	.	.	
LPROL+2*JPAR +2*MPAR	IPARM(1,MPAR)	First value of last multiple-valued parameter	Data are stored row by row, rather than column by column
.	.		
.	.	.	
.	.	.	
LPROL+2*JPAR +NROW*MPAR+1	IPARM(NROW,1)	Last value of first multiple-valued parameter	
.	.		
.	.	.	
.	.	.	
LPROL+2*JPAR +(NROW+1)*MPAR	IPARM(NROW,MPAR)	Last value of last multiple-valued parameter	

Table 8
PARAMETER CODES

VALUE	DESCRIPTION	UNITS		MNEMONIC
((Time Related Codes:)				
9	Beginning year (universal time)	1.	yr	byear
10	Year (universal time)	1.	yr	year
19	Beginning month/day (universal time)	1.	mmdd	bmd
20	Month/day (universal time)	1.	mmdd	md
21	Day number of year (universal time)	1.	day	dayno
28	Beginning hour/min (universal time)	1.	hhmm	bhm
29	Beginning additional increment to hhmm	1.E-02	s	bhmi
30	Hour/min (universal time)	1.	hhmm	hm
31	Additional increment to hour/min UT	1.E-02	s	hmi
34	Time past 0000 UT	1.E-03	hour	uth
36	Time past 0000 UT	1.E+01	s	uts
37	Additional increment to time past 0 UT	1.E-03	s	utsi
42	Local solar time diff (=SLT-UT) +E lon	1.	hhmm	sltmut
44	Local solar time	1.E-03	hour	slt
47	Local solar time at conjugate point	1.E-03	hour	sltc
54	Magnetic local time	1.E-03	hour	Tmlt
60	Integration time for these data	1.	s	inttms
61	Integration time for these data	1.	min	inttmm
62	Integration time for these data	1.	day	datntd
66	Time increment between rows	1.	s	dtrow
70	Sampling interval (time between sampls)	1.	s	smpint
95	Cycle sequence number (e.g., 5th cycle)	1.		cycn
96	Position number within cycle	1.		posn
(Geographic Coordinate Codes:)				
106	Minimum altitude	1.	km	altb
107	Additional increment to min alt	1.E-01	m	alti
108	Maximum altitude	1.	km	alte
109	Additional increment to max alt	1.E-01	m	altei
110	Altitude (height)	1.	km	gdalt
111	Additional increment to altitude	1.E-01	m	gdalti
112	Normalizing altitude	1.	km	rhaltn
113	Additional increment to normalizing alt	1.E-01	m	rhalti
115	Altitude averaging interval	1.	km	altav
116	Additional increment to ht avgng intrvl	1.E-01	m	altavi
117	Virtual height	1.E-01	km	altv
120	Range	1.	km	range
121	Additional increment to range	1.E-01	m	rangei
125	Width of range gate	1.	km	rgate
126	Additional increment to rnge gate width	1.E-01	m	rgatei
127	Range gate number	1.		rgatn
130	Mean azimuth angle (0=geog N,90=east)	1.E-02	deg	azm
132	Beginning azimuth (0=geog N,90=east)	1.E-02	deg	az1
133	Ending azimuth (0=geog N,90=east)	1.E-02	deg	az2
135	Variation in azimuth (end Az - beg Az)	1.E-02	deg	daz
140	Elevation angle (0=horizontal,90=vert)	1.E-02	deg	elm
142	Beginning elevation angle	1.E-02	deg	el1
143	Ending elevation angle	1.E-02	deg	el2
145	Variation in elevation (end El-beg El)	1.E-02	deg	del

150	Horiz great crcl dist from ref lat/lon	1.	km	gcdist
153	Reference geod latitude (N hemi=pos)	1.E-02	deg	gdlatr
156	Reference geodetic longitude	1.E-02	deg	gdlonr
160	Geodetic latitude of measurement	1.E-02	deg	gdlat
170	Geodetic longitude of measurement	1.E-02	deg	glon
180	Solar zenith angle in measurement vol	1.E-02	deg	szen
183	Conjugate solar zenith angle	1.E-02	deg	szenc
186	Shadow height	1.	km	sdwht
190	Half scattering angle (bistatic system)	1.E-02	deg	hsa

(Magnetic Coordinate Codes:)

204	Northward component of geomagnetic fld	1.E-08	T	bn
206	Eastward component of geomagnetic field	1.E-08	T	be
208	Downward component of geomagnetic field	1.E-08	T	bd
210	Geomagnetic field strength	1.E-08	T	bmag
213	Geomagnetic field east declination	1.E-02	deg	bdec
216	Geomagnetic field downward inclination	1.E-02	deg	binc
218	L value in measurement volume	1.E-02		lshell
220	Dip latitude in measurement volume	1.E-02	deg	diplat
222	Invariant latitude in measurement vol	1.E-02	deg	invlat
224	Geomagnetic (centered dipole) latitude	1.E-02	deg	gdilat
225	PACE magnetic latitude of meas volume	1.E-02	deg	paclat
226	Apex latitude in measurement volume	1.E-02	deg	aplat
230	PACE magnetic azimuth	1.E-02	deg	pacaz
244	Geomagnetic (cntrd dipol) east longitud	1.E-02	deg	gdilon
245	PACE magnetic longitude of meas volume	1.E-02	deg	paclon
246	Apex longitude in measurement volume	1.E-02	deg	aplon
277	Begin X Geocentric Solar Magnetospheric	1.E-02	Re	xgsmb
278	End X Geocentric Solar Magnetospheric	1.E-02	Re	xgsme
279	Begin Y Geocentric Solar Magnetospheric	1.E-02	Re	ygsmb
280	End Y Geocentric Solar Magnetospheric	1.E-02	Re	ygsme
281	Begin Z Geocentric Solar Magnetospheric	1.E-02	Re	zgsmb
282	End Z Geocentric Solar Magnetospheric	1.E-02	Re	zgsme
283	Begin X Geocentric Solar Ecliptic	1.E-02	Re	xgseb
284	End X Geocentric Solar Ecliptic	1.E-02	Re	xgsee
285	Begin Y Geocentric Solar Ecliptic	1.E-02	Re	ygseb
286	End Y Geocentric Solar Ecliptic	1.E-02	Re	ygsee
287	Begin Z Geocentric Solar Ecliptic	1.E-02	Re	zgseb
288	End Z Geocentric Solar Ecliptic	1.E-02	Re	zgsee
292	X Coord Geocentric Solar Magnetospheric	1.E-02	Re	xgsm
293	Y Coord Geocentric Solar Magnetospheric	1.E-02	Re	ygsm
294	Z Coord Geocentric Solar Magnetospheric	1.E-02	Re	zgsm
295	X Coordinate Geocentric Solar Ecliptic	1.E-02	Re	xgse
296	Y Coordinate Geocentric Solar Ecliptic	1.E-02	Re	ygse
297	Z Coordinate Geocentric Solar Ecliptic	1.E-02	Re	zgse

(Geophysical Indices:)

310	Kp Index	1.E-01		kp
320	Ae Index (1 or 2.5 min sample)	1.	nT	ae
321	Al Index (1 or 2.5 min sample)	1.	nT	al
322	Au Index (1 or 2.5 min sample)	1.	nT	au
323	Ao Index (1 or 2.5 min sample)	1.	nT	ao
324	Ae Index (hourly mean)	1.	nT	aem
325	Al Index (hourly mean)	1.	nT	alm
326	Au Index (hourly mean)	1.	nT	aum
327	Ao Index (hourly mean)	1.	nT	aom
330	Dst index	1.	nT	dst

335	ap index (3-hourly)	1.		ap3
340	AP index (daily)	1.		ap
341	aa index	1.		aa
350	F10.7 solar flux (Sa)	1.E-23	W/m2/Hz	f107a
351	F10.7 solar flux qualifier	1.		f107qa
352	F10.7 Multiday average	1.E-23	W/m2/Hz	fbara
353	352’s avg code: 1=>81day ; 2=13mon	1.		fbarta
354	F10.7 solar flux observed (Ottawa)	1.E-23	W/m2/Hz	f10.7
355	F10.7 solar flux qualifier observed	1.		f10.7q
356	F10.7 Multiday average observed	1.E-23	W/m2/Hz	fbar
357	356’s avg code: 1=>81day ; 2=13mon	1.		fbart
360	Sunspot number	1.		sspotn
365	Estimated Hemispheric Power Input	1.E+08	W	epow
366	Estimated Hemispheric Power Index	1.		epowi
367	Estimated Hemispheric Power Qualifier	1.		epowq
370	Est mag lat 0MLT equatorwd aurora bndry	1.E-02	deg	eqb0

(Parameters Relevent to Data Quality:)

401	Lag to the first range gate	1.E-06	sec	lag1
402	Pulse length	1.E-06	sec	pl
404	Density sampling time	1.E-06	sec	denst
406	Spectral sampling time	1.E-06	sec	spcst
407	Interpulse Period	1.E-06	sec	ipp
410	Signal to noise ratio	1.E-02		sn
411	Signal to noise ratio	1.E-03		snp3
412	log10 (signal to noise ratio)	1.E-03	lg	snl
413	No samples available in time average	1.		nsmpta
414	No samples used in time average	1.E+04		nsmptu
415	No smpls in time avg; or 414 incremnt	1.		nsmpti
417	No samples used in Fourier transform	1.		nsmfft
418	No ACF lags calculated	1.		nlags
419	No samples used	1.		nsmpu
420	Reduced-chi square of fit	1.E-03		chisq
421	Reduced-chi square of fit	1.E-01		chip1
430	Goodness of fit	1.		gfit
431	Code baud length	1.		cbadl
432	No. bauds in code	1.		cbadn
433	Code type (0=non,1=cmplmntry)	1.		codt
434	No incoherent integrations	1.		iin
440	Cloud cover (0-8=clr-ovcst;9=obscured)	1.	okta	cloudc
451	Jicamarca data quality code 1	1.		jidqc1
452	Jicamarca data quality code 2	1.		jidqc2
453	Jicamarca data quality code 3	1.		jidqc3
454	Jicamarca data quality code 4	1.		jidqc4
455	Jicamarca data quality code 5	1.		jidqc5
456	Arecibo data quality code 1 (IFIT)	1.		aodqc1
457	Arecibo data quality code 2	1.		aodqc2
458	Arecibo data quality code 3	1.		aodqc3
459	Arecibo data quality code 4	1.		aodqc4
460	Arecibo data quality code 5	1.		aodqc5
461	Millstone Hill data quality code 1	1.		mhdqc1
462	Millstone Hill data quality code 2	1.		mhdqc2
463	Millstone Hill data quality code 3	1.		mhdqc3
464	Millstone Hill data quality code 4	1.		mhdqc4
465	Millstone Hill data quality code 5	1.		mhdqc5
466	St. Santin data quality code 1	1.		ssdqc1
467	St. Santin data quality code 2	1.		ssdqc2
468	St. Santin data quality code 3	1.		ssdqc3

469	St. Santin data quality code 4	1.		ssdqc4
470	St. Santin data quality code 5	1.		ssdqc5
471	Chatanika/Sondrestrom data qual code 1	1.		chdqc1
472	Chatanika/Sondrestrom data qual code 2	1.		chdqc2
473	Chatanika/Sondrestrom data qual code 3	1.		chdqc3
474	Chatanika/sondrestrom data qual code 4	1.		chdqc4
475	Chatinika/Sondrestrom data qual code 5	1.		chdqc5
476	EISCAT data quality code 1	1.		eidqc1
477	EISCAT data quality code 2	1.		eidqc2
478	EISCAT data quality code 3	1.		eidqc3
479	EISCAT data quality code 4	1.		eidqc4
480	EISCAT data quality code 5	1.		eidqc5
482	System temperature	1.	K	systmp
483	Additional increment to system temp	1.E-04	K	systmi
484	Calibration temperature	1.	K	caltmp
486	Peak power	1.	kW	power
490	Transmitted frequency	1.E+05	Hz	tfreq
492	Received doppler frequency offset	1.	Hz	rcdfo
494	Receiver bandwidth	1.	kHz	rcbw
496	Receiver delay time	1.E-06	sec	rcdt

(I.S. Radar Basic Parameters:)

500	Uncorrected electron density (Te/Ti=1)	1.E+09	m-3	neuc
505	log10 (uncorrected electron density)	1.E-03	lg(m-3)	neucl
510	Electron density	1.E+09	m-3	ne
511	Additional increment to code 510 (Ne)	1.E+05	m-3	nei
512	Electron density	1.E+08	m-3	ne8
520	log10 (Ne in m-3)	1.E-03	lg(m-3)	nel
530	Maximum electron density	1.E+09	m-3	nemax
531	Maximum uncorrected electron density	1.E+09	m-3	neucmx
535	log10 (max Ne in m-3)	1.E-03	lg(m-3)	nemaxl
536	log10 (max uncorrected Ne in m-3)	1.E-03	lg(m-3)	neucml
540	Height of maximum electron density	1.	km	hmax
550	Ion temperature	1.	K	ti
552	Ion temperature	1.E-01	K	tip1
560	Electron temperature	1.	K	te
570	Temperature ratio (Te/Ti)	1.E-03		tr
580	Line of sight ion velocity (pos = away)	1.	m/s	vo
581	Additional increment to code 580	1.E-04	m/s	voi
585	Ion Velocity spread (spectral width)	1.	m/s	vos
590	Bisector ion vel (bistatic sys,pos=up)	1.	m/s	vobi
600	Velocity direction - local azimuth	1.E-02	deg	voaz
610	Velocity direction - local elevation	1.E-02	deg	voel
620	Ion Composition - [O+]/Ne	1.E-03		pop
630	Ion Composition - [NO+]/Ne	1.E-03		pnop
640	Ion Composition - [O2+]/Ne	1.E-03		po2p
650	Ion Composition - [HE+]/Ne	1.E-03		phep
660	Ion Composition - [H+]/Ne	1.E-03		php
690	Ion Composition - [mol wt 28 to 32]/Ne	1.E-03		pmp
691	Mean mol wt for ions from 28 to 32	1.E-02	AMU	mmwt30
710	Ion-neutral collision frequency	1.	s-1	co
720	log10 (ion-neutral collision frequency)	1.E-03	lg(s-1)	col

(Neutral Atmosphere Parameters:)

800	Line of sight neutral vel (pos = away)	1.	m/s	vnlu
801	Additional increment to Neutral Vlos	1.E-04	m/s	vnlui
802	Line of sight neutral vel (pos = away)	1.E-02	m/s	vnlu2

803	Line of sight neutral vel (pos = away)	1.E-03	m/s	vnlu3
805	Neutral velocity spread	1.E-02	m/s	vnus
806	Neutral velocity spread	1.E-03	m/s	vnus3
810	Neutral temperature	1.	K	tn
811	Model Neutral temperature	1.		tnm
812	Neutral temperature	1.E-01	K	tn1
820	Exospheric temperature	1.	K	tinf
821	Model Exospheric temperature	1.	K	tinfm
830	log10 (neutral mass density)	1.E-03	lg(Kg/m3	mol
840	log10 (neutral number density)	1.E-03	lg(m-3)	ntotl
842	log10 (relative neutral number density)	1.E-03	lg	nrtotl
850	log10 (N2 number density)	1.E-03	lg(m-3)	nn2l
860	log10 (O2 number density)	1.E-03	lg(m-3)	no2l
870	log10 (O number density)	1.E-03	lg(m-3)	nol
880	log10 (AR number density)	1.E-03	lg(m-3)	narl
890	log10 (HE number density)	1.E-03	lg(m-3)	nhel
900	log10 (H number density)	1.E-03	lg(m-3)	nhl
901	log10 (NO number density)	1.E-03	lg(m-3)	nnol
902	log10 (N(4S) number density)	1.E-03	lg(m-3)	nn4sl
903	log10 (N(2D) number density)	1.E-03	lg(m-3)	nn2dl
904	log10 (Na number density)	1.E-03	lg(m-3)	nnal
905	log10 (Fe number density)	1.E-03	lg(m-3)	nfel
910	log10 (Neutral pressure)	1.E-03	lg(Pa)	npresl
920	Pressure scale height	1.E+01	m	psh

(Harmonic Analysis:)

921	Number of coefficients in analysis	1.		nc
922	Number of directions in analysis	1.		nd
923	Groves coefficient number	1.		gcn
924	Groves coefficient	1.E-02	m/s	gc
925	Number of hours filled in harm anal	1.	hr	nhf
935	Mean eastward neutral wind	1.E-02	m/s	vnea
936	Mean northward neutral wind	1.E-02	m/s	vnna
937	Mean neutral temperature	1.E-01	K	tna
939	Mean ion temperature	1.E-01	K	tia
940	24-h eastward neutral wind amplitude	1.E-02	m/s	vne24a
941	24-h northwrd neutral wind amplitude	1.E-02	m/s	vnn24a
942	24-h neutral temperature amplitude	1.E-02	K	tn24a
943	24-h eastward neutral wind amplitude	1.E-01	m/s	vne2a1
944	24-h ion temperature amplitude	1.E-02	K	ti24a
945	24-h max eastward neutral wind phase	1.E-03	hr	vne24p
946	24-h max northwrd neutral wind phase	1.E-03	hr	vnn24p
947	24-h max neutral temperature phase	1.E-03	hr	tn24p
948	24-h northward neutral wind amplitude	1.E-01	m/s	vnn2p1
949	24-h max ion temperature phase	1.E-03	hr	ti24p
950	12-h eastward neutral wind amplitude	1.E-02	m/s	vne12a
951	12-h northward neutrl wind amplitude	1.E-02	m/s	vnn12a
952	12-h neutral temperature amplitude	1.E-02	K	tn12a
953	log10 (12-h geopotential amplitude)	1.E-03	lg(m2/s2	pt12al
954	12-h ion temperature amplitude	1.E-02	K	ti12a
955	12-h max eastward neutral wind phase	1.E-03	hr	vne12p
956	12-h max northward neutrl wind phase	1.E-03	hr	vnn12p
957	12-h max neutral temperature phase	1.E-03	hr	tn12p
958	12-h max geopotential phase	1.E-03	hr	pt12p
959	12-h max ion temperature phase	1.E-03	hr	ti12p
960	8-h eastward neutral wind amplitude	1.E-02	m/s	vne08a
961	8-h northward neutral wind amplitude	1.E-02	m/s	vnn08a
962	8-h neutral temperature amp	1.E-02	K	tn08a

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 965 8-h max eastward neutral wind phase       1.E-03 hr       vne08p
 966 8-h max northward neutral wind phase      1.E-03 hr       vnn08p
 967 8-h max neutral temperature phase         1.E-03 hr       tn08p
 970 2-dy eastward neutral wind amplitude      1.E-02 m/s      vne2da
 971 2-dy northward neutrl wind amplitude      1.E-02 m/s      vnn2da
 975 2-dy max eastward neutral wind phase      1.E-02 hr       vne2dp
 976 2-dy max northward neutrl wind phase      1.E-02 hr       vnn2dp
 980 2-day component period                    1.E-02 hr       p2d
 981 UT day no rel to 2-dy comp phase          1.     day      dn2dp
 982 UT at start of 2-day comp calc            1.     hhmm     ut2dp
 986 24-h upward neutral wind amplitude        1.E-04 m/s      vnu24a
 987 24-h max upward neutral wind phase        1.E-03 hr       vnu24p
 988 12-h upward neutral wind amplitude        1.E-04 m/s      vnu12a
 989 12-h max upward neutral wind phase        1.E-03 hr       vnu12p
 990 6-h eastward neutral wind amplitude       1.E-02 m/s      vne06a
 991 6-h northward neutral wind amplitude      1.E-02 m/s      vnn06a
 992 6-h neutral temperature amplitude         1.E-02 K        tn06a
 995 6-h max eastward neutral wind phase       1.E-03 hr       vne06p
 996 6-h max northward neutral wind phase      1.E-03 hr       vnn06p
 997 6-h max neutral temperature phase         1.E-03 hr       tn06p
```

(Unit Vector Definitions:)

```
1010 Geographic unit vector rotation angle     1.E-02 deg      gdra
1020 Magnetic unit vector rotation angle       1.E-02 deg      gmra
1030 Direction 7 Azimuth angle                 1.E-02 deg      az7
1040 Direction 7 Elevation angle               1.E-02 deg      el7
1050 Direction 8 Azimuth angle                 1.E-02 deg      az8
1060 Direction 8 Elevation angle               1.E-02 deg      el8
1070 Direction 9 Azimuth angle                 1.E-02 deg      az9
1080 Direction 9 Elevation angle               1.E-02 deg      el9
1085 Direction 10 Azimuth angle                1.E-02 deg      az10
1090 Direction 10 Elevation angle              1.E-02 deg      el10
```

(Vector Quantities:)

```
1210 Direction 1 Ion velocity (eastward)       1.     m/s      vie
1211 Direction 1 F-region ion velocity         1.     m/s      vief
1220 Direction 2 Ion velocity (northward)      1.     m/s      vin
1221 Direction 2 F-region ion velocity         1.     m/s      vinf
1230 Direction 3 Ion velocity (up)             1.     m/s      viu
1240 Direction 4 Ion velocity (perp east)      1.     m/s      vipe
1241 Direction 4 Ion velocity (perp east)      1.E-01 m/s      vipe1
1242 Direction 4 Ion velocity (perp east)      1.E-02 m/s      vipe2
1250 Direction 5 Ion velocity (perp north)     1.     m/s      vipn
1252 Direction 5 Ion velocity (perp north)     1.E-02 m/s      vipn2
1260 Direction 6 Ion velocity (antiparallel)   1.     m/s      viap
1270 Direction 7 Ion velocity                  1.     m/s      vi7
1272 Direction 7 Ion velocity                  1.E-02 m/s      vi72
1280 Direction 8 Ion velocity                  1.     m/s      vi8
1282 Direction 8 Ion velocity                  1.E-02 m/s      vi82
1290 Direction 9 Ion velocity                  1.     m/s      vi9
1300 Direction 10 Ion velocity                 1.     m/s      vi10
1410 Direction 1 Neutral wind (eastward)       1.     m/s      vne
1411 Direction 1 Neutral wind (eastward)       1.E-01 m/s      vnep1
1412 Direction 1 Neutral wind (eastward)       1.E-02 m/s      vnep2
1420 Direction 2 Neutral wind (northward)      1.     m/s      vnn
1421 Direction 2 Neutral wind (northward)      1.E-01 m/s      vnnp1
1422 Direction 2 Neutral wind (northward)      1.E-02 m/s      vnnp2
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```
1430 Direction 3 Neutral wind (up)             1.E-02 m/s      vnu
1431 Direction 3 Neutral wind (up)             1.E-01 m/s      vnup1
1440 Direction 4 Neutral wind (perp east)      1.     m/s      vnpe
1450 Direction 5 Neutral wind (perp north)     1.     m/s      vnpn
1455 Direction 5 Neutral wind horizontl comp   1.     m/s      vnpnh
1456 Direction 5 Neutral wind horizontl comp   1.E-01 m/s      vnpnh1
1460 Direction 6 Neutral wind                  1.     m/s      vnap
1470 Direction 7 Neutral wind                  1.     m/s      vn7
1480 Direction 8 Neutral wind                  1.     m/s      vn8
1490 Direction 9 Neutral wind                  1.     m/s      vn9
1610 Direction 1 electric field (eastward)     1.E-05 V/m      ee
1620 Direction 2 electric field (northward)    1.E-05 V/m      en
1630 Direction 3 electric field (up)           1.E-05 V/m      eu
1640 Direction 4 electric field (perp east)    1.E-05 V/m      epe
1650 Direction 5 electric field (perp north)   1.E-05 V/m      epn
1660 Direction 6 electric field (antipara)     1.E-05 V/m      eap
1670 Direction 7 electric field                1.E-05 V/m      e7
1680 Direction 8 electric field                1.E-05 V/m      e8
1690 Direction 9 electric field                1.E-05 V/m      e9
1810 Direction 1 electric current density      1.E-08 A/m2     je
1820 Direction 2 electric current density      1.E-08 A/m2     jn
1830 Direction 3 electric current density      1.E-08 A/m2     ju
1840 Direction 4 electric current density      1.E-08 A/m2     jpe
1850 Direction 5 electric current density      1.E-08 A/m2     jpn
1860 Direction 6 electric current density      1.E-08 A/m2     jap
1870 Direction 7 electric current density      1.E-08 A/m2     j7
1880 Direction 8 electric current density      1.E-08 A/m2     j8
1890 Direction 9 electric current density      1.E-08 A/m2     j9
1910 Ht integral: dir 1 current density        1.E-03 A/m      jehi
1920 Ht integral: dir 2 current density        1.E-03 A/m      jnhi
1940 Line int (1 hemi): dir 4 current den      1.E-03 A/m      jpeli
1950 Line int (1 hemi): dir 5 current den      1.E-03 A/m      jpnli
```

(Conductivities:)

```
2010 Pedersen conductivity                     1.E-06 mho/m    cp
2011 log10 (Pedersen Conductivity)             1.E-03 lg(mho/m cpl
2020 Hall conductivity                         1.E-06 mho/m    ch
2021 log10 (Hall Conductivity)                 1.E-03 lg(mho/m chl
2040 Height integral pedersen conductivity     1.E-02 mho      cphi
2050 Height integral hall conductivity         1.E-02 mho      chhi
2070 Field line integral(1 hemi) Ped Cond      1.E-02 mho      cpli
2080 Field line integral(1 hemi) Hall Cond     1.E-02 mho      chli
```

(Energy Parameters:)

```
2110 Particle energy deposition rate           1.E-08 W/m3     ped
2120 Joule energy deposition rate              1.E-08 W/m3     jed
2121 log10 (Joule energy dep rate)             1.E-03 lg(W/m3) jedl
2140 Ht integral particle energy dep rate      1.E-04 W/m2     pedhi
2141 log10 (Ht int part energy dep rate)       1.E-03 lg(W/m2) pedhil
2142 Hemispheric ht integ: part energy dep     1.E+08 W        pedhhi
2150 Height integral: Joule energy dep rate    1.E-04 W/m2     jedhi
2151 log10 (ht int Joule energy dep rate)      1.E-03 lg(W/m2) jedhil
2152 Hemispheric ht integ: Joule energy dep    1.E+08 W        jedhhi
2155 Average electron energy                   1.     eV       eem
2170 Fld-ln int(1 hemi) part energy dep rate   1.E-04 W/m2     pedli
2180 Fld-ln int(1 hemi) Joule energy dep rat   1.E-04 W/m2     jedli
```

(Interplanetary Magnetic Field:)

2204	Interplanetary Mag Field Bx GSM	1.E-11	T	bxgsm
2206	Interplanetary Mag Field By GSM	1.E-11	T	bygsm
2208	Interplanetary Mag Field Bz GSM	1.E-11	T	bzgsm
2210	Interplanetary Mag Field strength	1.E-11	T	bimf
2214	Interplanetary Mag Field Bx GSE	1.E-11	T	bxgse
2216	Interplanetary Mag Field By GSE	1.E-11	T	bygse
2218	Interplanetary Mag Field Bz GSE	1.E-11	T	bzgse
2232	Solar Wind Plasma Density	1.E+05	m-3	swden
2234	Solar Wind Plasma Speed	1.E+02	m/s	swspd
2236	IMF/Solar Wind Qualifier	1.		swq

(Miscellaneous Scalar Quantities:)

2301	Polar cap potential difference	1.E+01	V	pcp
2302	Potential minimum	1.E+01	V	pcmn
2303	Potential maximum	1.E+01	V	pcmx
2310	Electric Potential	1.E+01	V	ep

(Spectral Parameters:)

2400	Wavelength	1.E-01	nm	wavlen
2401	Beginning wavelength	1.E-01	nm	bwavl
2402	Ending wavelength	1.E-01	nm	ewavl
2411	Beginning wavenumber	1.	cm-1	bwavn
2412	Ending wavenumber	1.	cm-1	ewavn
2455	Refernce rel 1/2-width (arb press unit)	1.E-02		wid2
2456	Relative 1/2-width deviation from 2455	1.E-02		wid2r
2491	log10 (Counts)	1.E-03	lg	countl
2495	log10 (Rayleigh counts)	1.E-03	lg	rcontl
2500	Line emission rate	1.	R	le
2501	log10 (Line emission rate)	1.E-03	lg(R)	lel
2502	Line emission rate	1.E-01	R	lep1
2505	Relative line emission rate	1.		rle
2506	log10 (Relative line emission rate)	1.E-03	lg	rlel
2507	Relative line emission rate	1.E-01		rlep1
2555	Relative background radiance	1.		rbr
2560	Log10 (background noise, residual)	1.E-03	lg(R)	bnl
2561	log10 (background counts)	1.E-03	lg	bcl

(I.S. Radar Operation Parameters:)

3100	JRO normalizing factor (JRO661111A)	1.E-04		jronf1
3101	JRO parameter 2	1.		jrop02
3102	JRO parameter 3	1.		jrop03
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3199	JRO parameter 100	1.		jro100
3200	ARO parameter 1	1.		arop01
3201	ARO parameter 2	1.		arop02
3202	ARO parameter 3	1.		arop03
.				
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3299	ARO parameter 100	1.		aro100
3300	MLH Mode Letter (65-80 = A-P)	1.		mlhm
3301	MLH Power Normalization constant	1.E-03		pnorm

3302	MLH Number signal samples in profile	1.		nrp
3303	MLH Number noise samples in profile	1.		nnsamp
3304	MLH Number calibration samples in prof	1.		ncsamp
3305	MLH parameter 6	1.		mlhp06
3306	MLH Number profile Noise level samples	1.		npnswp
3307	MLH parameter 8	1.		mlhp08
3308	MLH Number radar sweeps for record	1.		nrswp
3309	MLH Number noise gates in radar sweep	1.		nnrswp
3310	MLH Mean power prof Normalizatn Const	1.		pnrmmp
3311	MLH H+ Line of site velocity	1.	m/s	vh
3312	MLH H Number Density	1.		nh
3313	MLH ACF Normalization Factor	1.E-03		fa
3314	MLH parameter 15	1.		mlhp15
3315	MLH Signal Temperature	1.	K	stp
3316	MLH Profile Power Normalized to 1.0	1.		popn
3317	MLH Reflected Power	1.		po
3318	MLH parameter 19	1.		mlhp19
3319	MLH parameter 20	1.		mlhp20
3320	MLH parameter 21	1.		mlhp21
3321	MLH parameter 22	1.		mlhp22
3322	MLH parameter 23	1.		mlhp23
3323	MLH parameter 24	1.		mlhp24
3324	MLH parameter 25	1.		mlhp25
3325	MLH parameter 26	1.		mlhp26
3326	MLH Universal Time (Hours MOD 24)	1.E-03	hour	ut
3327	MLH Local Time (Hours MOD 24)	1.E-03	hour	lt
3328	MLH parameter 29	1.		mlhp29
3329	MLH parameter 30	1.		mlhp30
3330	MLH Apex Local Time (Hours MOD 24)	1.	hour	aplt
3331	MLH Bperp. Dir Cosine (South [Apex])	1.	m/s	cxr
3332	MLH Bperp. Dir Cosine (East [Apex])	1.	m/s	cyr
3333	MLH Dir Cosine (Up field line [Apex])	1.	m/s	czr
3334	MLH Experiment Cycle Time	1.	hour	tcycle
3335	MLH Julian Day Number	1.	day	jdayno
3336	MLH Exper beg UT (0 = midnight, day 1)	1.	s	ut1
3337	MLH Exper end UT (0 = midnight, day 1)	1.	s	ut2
3338	MLH Variation in UT (UT2 - UT1)	1.	s	dut21
3339	MLH Instrument Code	1.		kinst
3340	MLH Logical Record Number	1.		recno
3341	MLH Start Range	1.	km	range1
3342	MLH End Range	1.	km	range2
3343	MLH Variation in Range (R2 - R1)	1.	km	drng21
3344	MLH parameter 45	1.		mlhp45
3345	MLH parameter 46	1.		mlhp46
3346	MLH parameter 47	1.		mlhp47
3347	MLH parameter 48	1.		mlhp48
3348	MLH parameter 49	1.		mlhp49
3349	MLH parameter 50	1.		mlhp50
3350	MLH parameter 51	1.		mlhp51
3351	MLH parameter 52	1.		mlhp52
3352	MLH parameter 53	1.		mlhp53
3353	MLH parameter 54	1.		mlhp54
3354	MLH parameter 55	1.		mlhp55
3355	MLH parameter 56	1.		mlhp56
3356	MLH parameter 57	1.		mlhp57
3357	MLH parameter 58	1.		mlhp58
3358	MLH parameter 59	1.		mlhp59
3359	MLH parameter 60	1.		mlhp60
3360	MLH parameter 61	1.		mlhp61

3361	MLH parameter 62	1.		mlhp62
3362	MLH parameter 63	1.		mlhp63
3363	MLH Ephemeris Time	1.	hour	ephem
3364	MLH parameter 64	1.		mlhp64
3365	MLH parameter 66	1.		mlhp65
3366	MLH parameter 67	1.		mlhp66
3367	MLH parameter 68	1.		mlhp67
3368	MLH parameter 69	1.		mlhp68
3369	MLH FoF2 level	1.E-02	MHz	fof2
3370	MLH parameter 71	1.		mlhp71
3371	MLH parameter 72	1.		mlhp72
3372	MLH Lat Angle of Average Field Vector	1.	deg	mflat
3373	MLH Lon Angle of Average Field Vector	1.	deg	mflon
3374	MLH Plasma Temperature	1.	K	ptemp
3375	MLH parameter 76	1.		mlhp76
3376	MLH parameter 77	1.		mlhp77
3377	MLH Epsilon	1.		eps
3378	MLH parameter 79	1.		mlhp79
3379	MLH parameter 80	1.		mlhp80
3380	MLH parameter 81	1.		mlhp81
3381	MLH parameter 82	1.		mlhp82
3382	MLH parameter 83	1.		mlhp83
3383	MLH parameter 84	1.		mlhp84
3384	MLH parameter 85	1.		mlhp85
3385	MLH Model Ion velocity in direction 4	1.	m/s	modvpe
3386	MLH Model Ion velocity in direction 5	1.	m/s	modvpn
3387	MLH parameter 88	1.		mlhp88
3388	MLH parameter 89	1.		mlhp89
3389	MLH parameter 90	1.		mlhp90
3390	MLH parameter 91	1.		mlhp91
3391	MLH parameter 92	1.		mlhp92
3392	MLH parameter 93	1.		mlhp93
3393	MLH parameter 94	1.		mlhp94
3394	MLH parameter 95	1.		mlhp95
3395	MLH parameter 96	1.		mlhp96
3396	MLH parameter 97	1.		mlhp97
3397	MLH parameter 98	1.		mlhp98
3398	MLH parameter 99	1.		mlhp99
3399	MLH parameter 100	1.		mlh100
3400	STS parameter 1	1.		stsp01
3401	STS parameter 2	1.		stsp02
3402	STS parameter 3	1.		stsp03
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3499	STS parameter100	1.		sts100
3500	SON FIT Code	1.		fit
3501	SON EPEC E-Region source code	1.		srce
3502	SON EPEC F-Region source code	1.		srcf
3503	SON Source of temperature	1.		srct
3504	SON Source of velocity	1.		srcv
3505	SON Source of density profile	1.		srcden
3506	SON parameter 7	1.		sonp07
3507	SON parameter 8	1.		sonp08
3508	SON parameter 9	1.		sonp09
3509	SON parameter 10	1.		sonp10
3510	SON Derivative of Ti with altitude	1.E-02	K/km	dtidh
3511	SON Derivative of Te with altitude	1.E-02	K/km	dtedh
3512	SON Portion of Umerid due to Vpar	1.	m/s	upar

3513	SON	Umerid from ambipolar diffusn	1.	m/s	uambi
3514	SON	Uambi from DNe/DH fit to ne	1.	m/s	uden1
3515	SON	Uambi from DNe/DH fit to ln(ne)	1.	m/s	uden2
3516	SON	portion of Uambi from dTp/dH	1.	m/s	utemp
3517	SON	portion of Uambi from gravity	1.	m/s	ugrav
3518	SON	Mean azimuth position 1	1.E-02	deg	azm1
3519	SON	Mean elevation position 1	1.E-02	deg	elm1
3520	SON	Mean azimuth position 2	1.E-02	deg	azm2
3521	SON	Mean elevation position 2	1.E-02	deg	elm2
3522	SON	Mean azimuth position 3	1.E-02	deg	azm3
3523	SON	Mean elevation position 3	1.E-02	deg	elm3
3524	SON	Mean azimuth position 4	1.E-02	deg	azm4
3525	SON	Mean elevation position 4	1.E-02	deg	elm4
3526	SON	Mean azimuth position 5	1.E-02	deg	azm5
3527	SON	Mean elevation position 5	1.E-02	deg	elm5
3528	SON	Mean azimuth position 6	1.E-02	deg	azm6
3529	SON	Mean elevation position 6	1.E-02	deg	elm6
3530	SON	Mean azimuth position 7	1.E-02	deg	azm7
3531	SON	Mean elevation position 7	1.E-02	deg	elm7
3532	SON	Mean azimuth position 8	1.E-02	deg	azm8
3533	SON	Mean elevation position 8	1.E-02	deg	elm8
3534	SON	Begin year of composite (UT)	1.	UT	yrcb
3535	SON	Begin month/day of composite (UT)	1.	UT	mdb
3536	SON	Begin hour/minute of composite (UT)	1.	UT	hmb
3537	SON	Begin centisecond of composite (UT)	1.E-02	sec	csb
3538	SON	End year of composite (UT)	1.	UT	yrce
3539	SON	End month/day of composite (UT)	1.	UT	mde
3540	SON	End hour/minute of composite (UT)	1.	UT	hme
3541	SON	End centisecond of composite (UT)	1.E-02	sec	cse
3542	SON	Type of density correction	1.		dcor
3543	SON	log10 (ionization rate el/m**3-s)	1.E-03	lg(e/m3s	inzrl
3544	SON	log10 (alpha effective in m**3/s)	1.E-03	lg(m3/s)	alphrl
3545	SON	log10 (part flux el/cm**2-s-kev)	1.E-03	lg(****)	pfluxl
3546	SON	log10 (energy in kev)	1.E-03	lg(kev)	el
3547	SON	Parallel current density	1.E-09	A/m2	jpar
3548	SON	Energy flux	1.E-04	W/m2	eflx
3549	SON	Mean energy	1.E-03	kev	em
3550	SON	I(4278)	1.	R	i4278
3551	SON	log10 (molecular ion density)	1.E-03	lg(m-3)	midl
3552	SON	Covariance xx	1.		covxx
3553	SON	Covariance xy	1.		covxy
3554	SON	Covariance xz	1.		covxz
3555	SON	Covariance yx	1.		covyx
3556	SON	Covariance yy	1.		covyy
3557	SON	Covariance yz	1.		covyz
3558	SON	Covariance zx	1.		covzx
3559	SON	Covariance zy	1.		covzy
3560	SON	Covariance zz	1.		covzz
3561	SON	Observed uncertainty on Ti	1.		odti
3562	SON	Reduced chi square of Ti	1.E-01		chiti
3563	SON	Observed uncertainty on Te	1.		odte
3564	SON	Reduced chi square of Te	1.E-01		chite
3565	SON	log10 (obs uncertainty Ne)	1.E-03	lg(m-3)	odnel
3566	SON	Reduced chi square of Ne	1.E-01		chine
3567	SON	Amount subtracted from Vlos	1.	m/s	vbias
3568	SON	log10 (ne-parabolic fit to ln(ne))	1.E-03	lg(m-3)	fitnel
3569	SON	Velocity in xy plane perp to b	1.	m/s	vperph
3570	SON	Azimuth angle of vel in x-y plane	1.E-02	deg	azvpbh
3571	SON	Correlation coefficient vxy	1.E-04		ccfvxy

3572	SON	Correlation coefficient vxz	1.E-04		ccfvxz
3573	SON	Correlation coefficient vyz	1.E-04		ccfvyz
3574	SON	Neutral atmosphere model code	1.		natmc
3575	SON	Correlation coefficient Exy	1.E-04		ccfexy
3576	SON	Cross correlation coefficient Uxy	1.E-04		xcfuxy
3577	SON	Cross correlation coefficient Une	1.E-04		xcfuen
3578	SON	Cross correlatn on Uxy from signeut	1.E-04		xcfxyn
3579	SON	Total cross correlation for Uxy	1.E-04		xcfxyt
3580	SON	Cross correlatn on Une from signeut	1.E-04		xcfenn
3581	SON	Total cross correlatn for Ue and Un	1.E-04		xcfent
3582	SON	Horizontal magn neutral wind	1.		umerid
3583	SON	Alternate error on Uzum (code 1460)	1.		duzneu
3584	SON	Total error on Uzum (code 1460)	1.		duztot
3585	SON	Correction term = Ux-Vx	1.		uxcor
3586	SON	Correction term = Uy-Vy	1.		uycor
3587	SON	Error on Ux from signeut	1.		duxneu
3588	SON	Error on Uy from signeut	1.		duyneu
3589	SON	Total error on Ux	1.		duxt
3590	SON	Total error on Uy	1.		duyt
3591	SON	Error on Ue from signeut	1.		dueneu
3592	SON	Error on Un from signeut	1.		dunneu
3593	SON	Total error on Ue	1.		duet
3594	SON	Total error on Un	1.		dunt
3595	SON	Relative error in neutral atmos	1.		rdna
3596	SON	Ion gyro frequency	1.	hz	fig
3597	SON	Azimuth of axis of symmetry	1.E-02	deg	axsym
3598	SON	Ion-neutral collision freq. coeff.	1.E-12	cm-3/s	niuc
3599	SON	Direction 4 F Region ion velocity	1.	m/s	vipef
3600	SON	Direction 5 F Region ion velocity	1.	m/s	vipnf
3601	SON	O+O ion-neut coll freq. factor	1.E+02		fopoco
3602	SON	log10 (measured ion-neut col freq)	1.E-03	lg(s-1)	fmcol
3603	SON	Fit 2 log10 (ne in m-3)	1.E-03	lg(m-3)	nef2l
3604	SON	Fit 2 electron temperature, te	1.	k	tef2
3605	SON	Fit 2 ion temperature, ti	1.	k	tif2
3606	SON	Fit 2 temperature ratio, te/ti	1.E-03		trf2
3607	SON	Fit 2 ion velocity (pos = away)	1.	m/s	vof2
3608	SON	Fit 2 composition - [o+]/ne	1.E-03		popf2
3609	SON	Fit 2 log10(ion-neutral coll. freq)	1.E-03	lg(s-1)	colf2l
3610	SON	Reduced-chi square of fit 2	1.E-03		chisq2
3611	SON	Goodness of fit 2	1.		gfit2
3612	SON	Usability code fit 2	1.		ucf2
3613	SON	Fit 3 log10 (ne in m-3)	1.E-03	lg(m-3)	nef3l
3614	SON	Fit 3 electron temperature, te	1.	k	tef3
3615	SON	Fit 3 ion temperature, ti	1.	k	tif3
3616	SON	Fit 3 temperature ratio, te/ti	1.E-03		trf3
3617	SON	Fit 3 ion velocity (pos = away)	1.	m/s	vof3
3618	SON	Fit 3 composition - [o+]/ne	1.E-03		popf3
3619	SON	Fit 3 log10(ion-neutral coll. freq)	1.E-03	lg(s-1)	colf3l
3620	SON	Reduced-chi square of fit 3	1.E-03		chisq3
3621	SON	Goodness of fit 3	1.		gfit3
3622	SON	Usability code fit 3	1.		ucf3
3623	SON	Zone number for fitted data	1.		zonn
3624	SON	Fit code of fit 2	1.		fitcf2
3625	SON	Fit code of fit 3	1.		fitcf3
3626	SON	parameter 127	1.		son127
3627	SON	parameter 128	1.		son128
3628	SON	parameter 129	1.		son129
3629	SON	parameter 130	1.		son130
3630	SON	parameter 131	1.		son131

3631	SON parameter 132	1.		son132
3632	SON parameter 133	1.		son133
3633	SON parameter 134	1.		son134
3634	SON parameter 135	1.		son135
3635	SON parameter 136	1.		son136
3636	SON parameter 137	1.		son137
3637	SON parameter 138	1.		son138
3638	SON parameter 139	1.		son139
3639	SON parameter 140	1.		son140
3640	SON parameter 141	1.		son141
3641	SON parameter 142	1.		son142
3642	SON parameter 143	1.		son143
3643	SON parameter 144	1.		son144
3644	SON parameter 145	1.		son145
3645	SON parameter 146	1.		son146
3646	SON parameter 147	1.		son147
3647	SON parameter 148	1.		son148
3648	SON parameter 149	1.		son149
3649	SON parameter 150	1.		son150
3650	SON Thermal red line emission	1.E-02	ph/cm3-s	e630t
3651	SON Dissoc-Recomb red line emission	1.E-02	ph/cm3-s	e630
3652	SON Volume emission of 5200 Angstrom	1.E-02	ph/cm3-s	e520
3653	SON parameter 154	1.		son154
3654	SON parameter 155	1.		son155
3655	SON Electron to ion energy loss rate	1.	ev/cm3-s	lei
3656	SON Elec. to neutral energy loss rate	1.	ev/cm3-s	len
3657	SON Energy loss rate (Le = Lei + Len)	1.	ev/cm3-s	lein
3658	SON Heat conduction	1.	ev/cm3-s	hc
3659	SON Energy input (=Le-Hc)	1.	ev/cm3-s	qe
3660	SON Ion to neut energy loss rate (Lin)	1.E+01	ev/cm3-s	lin
3661	SON Joule heating (=Lin-Lei)	1.E+01	ev/cm3-s	qj
3662	SON Heat flux	1.E+07	ev/cm2-s	hflx
3663	SON parameter 164	1.		son164
3664	SON parameter 165	1.		son165
3665	SON parameter 166	1.		son166
3666	SON parameter 167	1.		son167
3667	SON parameter 168	1.		son168
3668	SON parameter 169	1.		son169
3669	SON parameter 170	1.		son170
3670	SON 6300 A thermal intensity	1.	R	ith630
3671	SON 6300 A dissoc-recomb. intensity	1.	R	idr630
3672	SON 6300 A thermal+diss intensity	1.	R	itd630
3673	SON 5200 A dissoc-recomb intensity	1.	R	idr520
3674	SON parameter 175	1.		son175
3675	SON parameter 176	1.		son176
3676	SON parameter 177	1.		son177
3677	SON parameter 178	1.		son178
3678	SON parameter 179	1.		son179
3679	SON parameter 180	1.		son180
3680	SON parameter 181	1.		son181
3681	SON parameter 182	1.		son182
3682	SON parameter 183	1.		son183
3683	SON parameter 184	1.		son184
3684	SON parameter 185	1.		son185
3685	SON parameter 186	1.		son186
3686	SON parameter 187	1.		son187
3687	SON parameter 188	1.		son188
3688	SON parameter 189	1.		son189
3689	SON parameter 190	1.		son190

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3690 SON parameter 191                  1.              son191
3691 SON parameter 192                  1.              son192
3692 SON parameter 193                  1.              son193
3693 SON parameter 194                  1.              son194
3694 SON parameter 195                  1.              son195
3695 SON parameter 196                  1.              son196
3696 SON parameter 197                  1.              son197
3697 SON parameter 198                  1.              son198
3698 SON parameter 199                  1.              son199
3699 SON parameter 200                  1.              son200
3700 EIS parameter 1                    1.              eisp01
3701 EIS parameter 2                    1.              eisp02
3702 EIS parameter 3                    1.              eisp03
  .
  .
  .
3799 EIS parameter100                   1.              eis100
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(Autocorrelation Function:)

```
3800 Scaled real ACF at zero lag        1.              acfrs0
3801 Normalized real ACF at lag 1       1.E-04          acfr1
3802 Normalized real ACF at lag 2       1.E-04          acfr2
3803 Normalized real ACF at lag 3       1.E-04          acfr3
  .
  .
  .
3834 Normalized real ACF at lag 34      1.E-04          acfr34
3900 Scale factor for ACF at zero lag   1.              acfsf0
3901 Normalized imaginary ACF at lag 1  1.E-04          acfi1
3902 Normalized imaginary ACF at lag 2  1.E-04          acfi2
3903 Normalized imaginary ACF at lag 3  1.E-04          acfi3
  .
  .
  .
3934 Normalized imaginary ACF at lag 34 1.E-04          acfi34
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(Non-I.S. Radar Instrument Operation Parameters:)

```
4001 PKR QC 0=Okay                      1.              pfqc
4002 PKR QC No records in noise avg     1.              pfnnr
4003 PKR QC Avg of Galactic Noise       1.              pfgn
4004 PKR QC log10 (noise pwr in spectrm) 1.E-03 lg      pfpnl
4005 PKR QC log10 (signl pwr in spectrm) 1.E-03 lg      pfpsl
4015 UIL QC log10 (sodium counts)       1.E-03 lg       uinacl
4016 UIL QC log10 (F factor)            1.E-03 lg       uiffl
4017 UIL QC log10 (Na returns/bkgnd noise) 1.E-03 lg    uinfl
4018 UIL QC log10 (av Rayleigh) = NrmlzFctr 1.E-03 lg   uiarl
4025 CFP QC No coefficients             1.              cfpnc
4031 GBF QC Skynoise (A/D convertor units) 1.           gbskn
4032 GBF QC XCF flag (0=Off, 1=On)      1.              gbxcf
4035 GBF QC Groundscatter flag (0:n, 1:y) 1.            gbgsct
4050 AFP QC Zenith ref flag (1=use ; 0=no) 1.           afpzf
4051 AFP QC Free spectral range(arb p unit) 1.E-01      afpsr
4052 AFP QC Etalon Thickness            1.E-04 m        afpet
4053 AFP QC Intensity Calibration Factor 1.E-02 cnt/s-R afpif
4055 AFP QC No Harmonics in Fourier Anal 1.             afpnh
4056 AFP QC D(Vne)/Dx per 1000 km (x +Ewrd) 1.E-04 m/s-km afdvne
4057 AFP QC D(Vnn)/Dy per 1000 km (y +Nwrd) 1.E-04 m/s-km afdvnn
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4058	AFP	QC Error in 4056/4057 per 1000 km	1.E-04	m/s-km	afddvn
4060	AQF	QC Standard deviation in 1411	1.E-01	m/s	sd1411
4061	AQF	QC # Samples in time avg of 1411	1.		nv1411
4062	AQF	QC Standard deviation in 1421	1.E-01	m/s	sd1421
4063	AQF	QC # Samples in time avg of 1421	1.		nv1421
4070	COF	QC Mean sampling density for winds	1.E-01	mn-1	coftsw
4071	COF	QC Mean sampling density for hts	1.E-01	mn-1	coftsh
4080	STM	QC Solar scaling factor	1.E-04		solsf
4090	MUI	QC Ion velocity (up from NS dirs)	1.	m/s	viuns
4091	MUI	QC Ion velocity (up from EW dirs)	1.	m/s	viuew
4092	MUI	QC (0-3 <=> ok-bad)	1.		muqc1
4093	MUI	Ne calibration factor	1.		munec