The SEG Standard for Magnetotelluric Data

presented at the
Society of Exploration Geophysicists Annual Meeting
November, 1988

by
David E. Wight

Summary

In December, 1987, the Society of Exploration Geophysicists (SEG) adopted a standard format for the interchange of magnetotelluric (MT) and electromagnetic array profiling (EMAP) data. The standard format was developed over a period of two years and incorporated input from a variety of audiences who deal with MT and EMAP data including oil company representatives, contractors, and consultants. The complete, published description of the format is available from SEG.

This presentation briefly summarizes some of the important aspects of the standard. It includes brief discussions of the history, purpose, and scope of the standard, the format of an interchange file, and the representation of spatial relations. Finally, it makes recommendations regarding the application of the format.

Background

In early 1986, representatives from some of the major users of magnetotelluric (MT) and electromagnetic array profiling (EMAP) data formed an ad hoc committee to investigate a standard for the interchange of MT and EMAP data. By June, 1986, the committee produced a first draft describing an industry-wide standard for the interchange of MT and EMAP data. Over the course of the next 16 months, the standard was circulated to a variety of audiences for review and revision. A draft was presented to the SEG Standards Committee in November, 1986. In August, 1987, a meeting of the ad hoc committee was held which approved a final draft and forwarded it to the SEG Standards Committee. The standard was adopted by the SEG Executive Committee on December 14, 1987. Copies of the standard may be obtained from SEG.

A data file which conforms to the standard for the interchange of MT, EMAP, or similar electrical geophysical data is referred to here as an Electrical Data Interchange (EDI) file.

Purpose and Scope of the Standard

The standard is intended to provide a complete, orthogonal, unambiguous description of a data set. The standard has been designed such that the data in an EDI file can be interpreted without referencing a base map or other field documents. Within an EDI file, concepts specific to a particular acquisition system do not drive the organization of the data.

Although the format is rigorously specified, it has been designed to be flexible and extensible. The inclusion of complete spatial information is inherent in the standard. The format described by the standard was designed for the interchange and archival of data. It is not intended for use as a working format.

The standard defines the physical format and media on which EDI files may reside. Although the only media currently specified by the standard is magnetic tape, the use of non-standard media is discussed within the standard.

The standard provides a consistent set of definitions for geophysical quantities and units. These include units, phase conventions, and similar concepts. It supports a variety of processing alternatives and includes escape mechanisms to handle experimental and non-standard data.

The standard specifies the syntax and semantics for an EDI file with the same precision that a computer language is specified by its reference manual. In fact, the format for an EDI file is analogous to a source code file for a computer program. A program which reads EDI files and converts the data into a usable form is analogous to a compiler.

General Characteristics of Electrical Data Interchange (EDI) Files

EDI files are ASCII text files. Although such a file is made up of a series of data records, the file is considered to be a character stream. For handling special cases with large amounts of data, the standard makes provisions for parallel binary data files which are referenced by the EDI file. However, these are the exception rather than the rule and will not be discussed here.

Comments may be embedded within EDI files, allowing special annotations to be included. Additionally, there is a special provision for a section of free-form text to be included with each file. This section serves a special purpose, embedding a description of the system dependent parameters related to the acquisition and processing of a particular data set.

Building Blocks for EDI Files

EDI files are constructed from Data Blocks (or sometimes simply, Blocks). A data block consists of a keyword, optionally followed by one or more options, optionally followed by a data set.

All data blocks begin with a keyword. A keyword always begins with the character >. Examples of keywords are >HEAD, >SPECTRA, >FREQ, and >ZXXR. Over one hundred keywords are defined for EDI files. An option has two parts: an option name, and an option argument, separated by an equal sign (=). Examples of options are:

```
DATAID=SITE1,
ACQDATE=01/31/88,
ROTATE=NORTH,
REFLAT=+30:50:40.3,   and
GAIN=1.25
```

Normally, a data set consists of two slash characters //, followed by a number which gives the number of data values, followed by the actual data values. Alternatively, a data set may be represented by special characters which indicate that the actual data is to be read from a parallel binary data file.

Syntactically, an EDI file is a sequence of data blocks. Every data block exactly fits the description above. The one exception to this rule is the free-form text which immediately follows the >INFO block.

Organizing the Data Blocks

Within an EDI file, sequences of data blocks may be grouped into sections. Each section begins with a special data block whose keyword begins with the two characters >=. These special data blocks are analogous to the FORTRAN statements SUBROUTINE and FUNCTION which separate a FORTRAN program into contexts.

Just as there are rules for the order of statements in a FORTRAN program,

there are rules for the ordering of blocks within an EDI file. All files begin with a >HEAD block, an >INFO block and a >=DEFINEMEAS section. Following this are one or more data sections. Types of data sections include >=MTSECT sections, >=EMAPSECT sections, and >=SPECTRASECT sections. Following all of the data sections is an >END block.

Measurements and Spatial Relations

Each EDI file defines a set of measurements. All of the data within the file is referenced back to that set of measurements. Each measurement corresponds to a particular channel (E-field dipole or H-field sensor) and to a particular run. A measurement is defined in terms of sensor locations and other parameters.

All sensor locations within an EDI file are expressed as relative offsets from a single reference point.

Programs to Read and Write EDI Files

It has been pointed out repeatedly that EDI files are analogous to source code files. That analogy may be extended to programs for reading them. The same techniques used for writing compilers can be applied to developing programs for reading EDI files. Formal specification mechanisms such as Backus-Naur form for syntactic specification can be used to precisely specify the syntax for an EDI file.

Techniques are available which can take such formal specifications and generate tables which succinctly describe the data format. Through the use of unambiguous specifications, a program can verify an EDI file as syntactically and semantically correct, just as a compiler verifies the correctness of a source code file. Additionally, the same tables can be used to write data which is guaranteed to be in the standard format.

A FORTRAN 77 program for reading and writing data EDI files was developed in parallel with the formulation of the standard. Not only did this assure that the published standard was implementable, it pointed out a number of inconsistencies which were addressed prior to the final version.

Comments and Recommendations

The EDI format allows a great deal of flexibility in the organization and presentation of data, just as within a programming language there are many ways to do the same task. The following recommendations may provide some guidance:

Expressing all spatial locations for measurements relative to a common reference location allows the interpreter to relate a number of sites or surveys to one another. Within the limits of projection accuracy, surveys should attempt to use a common reference location.

Channel identifiers should be chosen so as to be meaningful, such as (10*SiteNumber)+C, where C=1 for Hx, 2 for Hy, 3 for Hz, 4 for Ex, and 5 for Ey. Run identifiers should be assigned sequentially.

For all but very large MT surveys, it is recommended that data for all sites be put into a single EDI file. This guarantees a common reference location. Within the file, an >=MTSECT section should be included for each site. Within each section are data blocks for all of the computed quantities.

If spectra for an MT survey are to be delivered, it is recommended that these reside in an EDI file which is separate than that used for the computed parameters. However, the reference location and measurement definition section should be identical. A separate >SPECTRASECT section should be used for each site.

The set of measurements for the section should include all of those for the site plus any others which may be used as remote reference pairs. Seven or nine measurements would be typical. It is recommended that all spectra be rotated to true North.

For EMAP surveys, it is recommended that data for a survey be included within a single EDI file. An >=EMAPSECT section will be used for each line. Within each section, it is recommended that only the impedances (Z's) be included for each dipole. The large data volume of the apparent resistivities, phases, and 1-D inversions usually outweigh the time to re-compute them. Because the volume of EMAP data can become quite large, it may be necessary to break the lines within a survey into separate files for practical reasons. In such cases, the same reference should be used for all files within the limits of projection accuracy. If both raw and spatially filtered data are to be delivered, it is recommended that they be written in separate EDI files.

Spectra for EMAP surveys should be delivered in an EDI file which is separate than that used for the impedances. The reference location and measurement definition section would, however, be identical. A >=SPECTRASET will be included for each set of simultaneously acquired dipoles and H-field measurements.

Specifications for delivery of time series data have been included within the standard, but it is recommended that time series data not be included with data deliveries unless there are specific reasons for doing so. Parallel binary files have been defined within the standard for handling very large data sets. They are not recommended for normal use.

Conclusions

In the past, each contractor has supported its own format for data interchange. These formats were also subject to change from time to time. As a result, many programs were required for reading and writing data. Additionally, the content of the data formats was insufficient to reconstruct the data without outside information.

The introduction of a standard format will allow both contractors and clients to support programs for reading and writing data in a single format. Data written in the standard format is guaranteed to be completely and unambiguously specified. Because the standard has been thoroughly documented and officially adopted by the SEG, data archived in the standard format will always be usable in the future.

Additionally, the standard offers new opportunities for processing and interpretation. New interpretation workstations are becoming available which can take advantage of the spatial relations within a data set.

Most of the MT and EMAP contractors are now able to produce data in the standard format. Efforts are also underway to re-format old data to conform to the new standard. The success of any standard hinges upon its widespread acceptance. A great deal of effort has been put into producing a standard which matches the current needs of the industry while retaining the flexibility to meet future needs. This standard will, hopefully, be a major benefit to MT and EMAP exploration.

References

Aho, A. V., and Ullman, J. D., 1978, Principles of Compiler Design: Addison Wesley.

Wight, D. E., 1988, SEG MT/EMAP Data Interchange Standard: Society of Exploration Geophysicists.

Example EDI File

The following is a simple example of an Electrical Data Interchange (EDI) file:

```
>HEAD

DATAID=DEMO
ACQBY="GEOTOOLS CORP"
FILEBY="GEOTOOLS CORP"
ACQDATE=01/01/88
FILEDATE=10/01/88
PROSPECT=BLEAK
LOC=NEAR AUSTIN
LAT=30:46:00
LONG=-98:54:38
ELEV=170
STDVERS=SEG 1.0
PROGVERS=WSE_1.2
PROGDATE=08/07/89
MAXSECT=64
EMPTY=1.0E+32

>INFO MAXINFO=500

THIS IS WHERE FREE-FORM TEXT GOES. IT SHOULD CONTAIN ANY AND ALL RELEVANT
INFORMATION WHICH IS NOT PROVIDED ELSEWHERE IN THE FILE. EXAMPLES OF ITEMS
TO BE INCLUDED HERE WOULD BE:

-    A DESCRIPTION OF THE ACQUISITION SYSTEM USED
-    A DESCRIPTION OF HOW THE DATA WAS PROCESSED
-    OPERATOR LOGS FROM THE ACQUISITION
-    ANY NON-STANDARD ASPECTS OF ACQUISITION
-    ANY SPECIAL PROCESSING USED
     ETC...

THE FOLLOWING IS A VERY SIMPLE EXAMPLE OF MT DATA IN THE SEG STANDARD FORMAT
FOR MT DATA. COPIES OF THE SEG MT/EMAP DATA INTERCHANGE STANDARD DESCRIBING
THE STANDARD ARE AVAILABLE FROM:

   THE SOCIETY OF EXPLORATION GEOPHYSICISTS
   P.O. BOX 702740
   TULSA, OKLAHOMA 74170 USA

THIS EXAMPLE FILE CONTAINS SPECTRA FOR FOUR REMOTE REFERENCED MT SITES WHICH
WERE ACQUIRED TWO AT A TIME USING A 10 CHANNEL SYSTEM. RUN 1 INCLUDED SITES
1 AND 2. RUN 2 INCLUDED SITES 3 AND 4.

>=DEFINEMEAS
MAXCHAN=16
MAXRUN=999
MAXMEAS=320
UNITS=M
REFTYPE=CART
REFLOC=NEAR AUSTIN
REFLAT=30:46:00
REFLONG=-98:54:38
REFELEV=170

>! ---- MEASUREMENTS FOR SITE DEMO-001 ---- !
>HMEAS ID=11.001 CHTYPE=HX X=6932 Y=2697 Z=0 AZM=+0
      ACQCHAN=CH1 SENSOR=COIL426
>HMEAS ID=12.001 CHTYPE=HY X=6932 Y=2697 Z=0 AZM=+90
```

```
     |  ACQCHAN=CH2 SENSOR=COIL429
>HMEAS ID=13.001 CHTYPE=HZ X=6932 Y=2697 Z=0 AZM=0
     |  ACQCHAN=CH3 SENSOR=LOOP419
>EMEAS ID=14.001 CHTYPE=EX X=6853 Y=2697 Z=0 X2=7011 Y2=2697 Z2=0
     |  ACQCHAN=CH4
>EMEAS ID=15.001 CHTYPE=EY X=6932 Y=2620 Z=0 X2=6932 Y2=2775 Z2=0
     |  ACQCHAN=CH5

>! ---- MEASUREMENTS FOR SITE DEMO-002 ---- !
>HMEAS ID=21.001 CHTYPE=HX X=6070 Y=2456 Z=0 AZM=+45
     |  ACQCHAN=CH6 SENSOR=COIL210
>HMEAS ID=22.001 CHTYPE=HY X=6070 Y=2456 Z=0 AZM=+135
     |  ACQCHAN=CH7 SENSOR=COIL433
>HMEAS D=23.001 CHTYPE=HZ X=6070 Y=2456 Z=0 AZM=0
     |  ACQCHAN=CH8 SENSOR=LOOP420
>EMEAS ID=24.001 CHTYPE=EX X=6014 Y=2400 Z=0 X2=6126 Y2=2512 Z2=0
     |  ACQCHAN=CH9
>EMEAS ID=25.001 CHTYPE=EY X=6127 Y=2399 Z=0 X2=6013 Y2=2513 Z2=0
     |  ACQCHAN=CH10

>! ---- MEASUREMENTS FOR SITE DEMO-003 ---- !
>HMEAS D=31.002 CHTYPE=HX X=4068 Y=1729 Z=0 AZM=+0
     |  ACQCHAN=CH6 SENSOR=COIL210
>HMEAS ID=32.002 CHTYPE=HY X=4068 Y=1729 Z=0 AZM=+90
     |  ACQCHAN=CH7 SENSOR=COIL433
>HMEAS ID=33.002 CHTYPE=HZ X=4068 Y=1729 Z=0 AZM=0
     |  ACQCHAN=CH8 SENSOR=LOOP420
>EMEAS ID=34.002 CHTYPE=EX X=3988 Y=1729 Z=0 X2=4148 Y2=1729 Z2=0
     |  ACQCHAN=CH9
>EMEAS ID=35.002 CHTYPE=EY X=4068 Y=1654 Z=0 X2=4068 Y2=1804 Z2=0
     |  ACQCHAN=CH10

>! ---- MEASUREMENTS FOR SITE DEMO-004 ---- !
>HMEAS   ID=41.002 CHTYPE=HX X=3543 Y=1332 Z=0 AZM=+0
     |  |ACQCHAN=CH1 SENSOR=COIL426
>HMEAS   ID=42.002 CHTYPE=HY X=3543 Y=1332 Z=0 AZM=+90
     |  |ACQCHAN=CH2 SENSOR=COIL429
>HMEAS   ID=43.002 CHTYPE=HZ X=3543 Y=1332 Z=0 AZM=0
     |  |ACQCHAN=CH3 SENSOR=LOOP419
>EMEAS   ID=44.002 CHTYPE=EX X=3468 Y=1332 Z=0 X2=3618 Y2=1332 Z2=0
     |  |ACQCHAN=CH4
>EMEAS   ID=45.002 CHTYPE=EY X=3543 Y=1257 Z=0 X2=3543 Y2=1407 Z2=0
     |  |ACQCHAN=CH5

>=SPECTRASECT
SECTID=DEMO-001 NCHAN=7 NFREQ=2 MAXBLKS=40 // 7
  11.001
  12.001
  13.001
  14.001
  15.001
  21.001
  22.001

>SPECTRA FREQ=3.840E+02 ROTSPEC=0 BW=9.600E+01 AVGT=128 // 49
  8.93219188E-09  3.71313841E-09 -1.99191788E-10 -9.43570484E-08 -2.54417358E-07
  6.56718013E-09  1.75055614E-10 -8.61504687E-11  9.85530768E-09 -2.53706234E-09
  1.63427922E-06  4.33353976E-08  2.34660158E-09  6.69126132E-09  1.13502585E-09
 -8.05332334E-09  1.11871438E-07  1.17737466E-06  3.85129027E-07 -3.16019499E-09
 -1.26499855E-09 -5.67650205E-10 -1.43017530E-06  1.78105165E-06  2.78377570E-04
  5.92902070E-05  8.31623552E-08  1.13337330E-06  3.81438383E-06  4.76444831E-07
 -2.58341146E-07 -6.22527441E-05  1.01763383E-03  5.63803605E-07  9.25995527E-07
  8.64011918E-10  4.57928584E-10 -1.40479095E-09  7.71970939E-07 -2.30292790E-06
  6.16830498E-09  1.41650280E-09  2.73843559E-10  1.74602843E-10  6.35243058E-09
```

```
  1.25763188E-06 -5.62930573E-08  1.31729710E-10  1.69909675E-09

>SPECTRA FREQ=2.880E+02 ROTSPEC=0 BW=9.600E+01 AVGT=256 // 49
  3.15044417E-07  1.06661282E-07  3.64470010E-09  3.87696252E-06 -1.80462666E-05
  2.72093047E-07  3.34956098E-08 -7.56839569E-09  1.25672912E-07  1.69090590E-08
  5.12637325E-06 -7.93242543E-06  8.65761720E-08  4.60385825E-08  1.52567363E-08
  7.02055480E-09  2.08181916E-07  7.89371768E-07  1.14016069E-07  4.31243663E-09
  1.09012408E-08  5.77810113E-07 -2.74804620E-06 -1.02846582E-06  3.50923481E-04
 -3.33768548E-04  9.04688490E-06  3.67553912E-06  1.28061911E-05  4.04646153E-06
  1.93325127E-06  2.96053035E-04  1.67080865E-03 -1.56074220E-05 -3.67275243E-06
  1.12941212E-09  6.12248605E-09 -1.46238799E-08 -9.46047010E-07 -1.12315583E-05
  2.47161296E-07  5.20412648E-08 -1.60585287E-08 -7.86881671E-09  2.23404428E-09
  2.32770299E-06 -1.83344355E-07 -1.08858877E-08  7.89583936E-08

>=SPECTRASECT
SECTID=DEMO-002 NCHAN=7 NFREQ=2 MAXBLKS=40 // 7
  21.001
  22.001
  23.001
  24.001
  25.001
  11.001
  12.001

>SPECTRA FREQ=3.840E+02 ROTSPEC=0 BW=9.600E+01 AVGT=128 // 49
  2.52592258E-07  4.65419134E-08  3.08377679E-09 -8.94308414E-06 -2.11387942E-05
  2.88274492E-07  1.18568487E-07 -9.83677317E-09  7.07770056E-08  5.30707145E-10
  5.83948986E-06 -5.11656572E-06  6.47362981E-08  9.01098929E-08 -3.86029209E-09
 -1.66674993E-10  6.05896355E-09 -6.12111251E-08 -6.36822620E-07  3.55957752E-09
  1.31788647E-09 -8.59396368E-06 -1.18576436E-05 -3.21819726E-07  3.17180669E-03
 -2.05396049E-04 -9.69346820E-06  3.45619628E-06  2.43835020E-05  4.19823346E-06
 -3.44752742E-08 -1.59833569E-03  4.23136307E-03 -2.33113933E-05 -1.03467892E-05
  9.93493376E-09  1.64090661E-08  4.45259385E-09  1.17983709E-05 -2.88556057E-05
  3.36828322E-07  1.49064846E-07 -9.23587873E-10  6.79298884E-09  1.34812683E-09
  1.55594862E-05 -1.20594650E-05 -9.31386346E-09  1.34248651E-07

>SPECTRA FREQ=2.880E+02 ROTSPEC=0 BW=9.600E+01 AVGT=256 // 49
  4.26219188E-09  3.71313841E-09 -1.99191788E-10 -9.43570484E-08 -2.54417358E-07
  6.56718013E-09  1.75055614E-10 -8.61504687E-11  9.85530768E-09 -2.53706234E-09
  1.63427922E-06  4.33353976E-08  2.34660158E-09  6.69126132E-09  1.13502585E-09
 -8.05332334E-09  1.11871438E-07  1.17737466E-06  3.85129027E-07 -3.16019499E-09
 -1.26499855E-09 -5.67650205E-10 -1.43017530E-06  1.78105165E-06  2.78377570E-04
  5.92902070E-05  8.31623552E-08  1.13337330E-06  3.81438383E-06  4.76444831E-07
 -2.58341146E-07 -6.22527441E-05  1.01763383E-03  5.63803605E-07  9.25995527E-07
  8.64011918E-10  4.57928584E-10 -1.40479095E-09  7.71970939E-07 -2.30292790E-06
  6.16830498E-09  1.41650280E-09  2.73843559E-10  1.74602843E-10  6.35243058E-09
  1.25763188E-06 -5.62930573E-08  1.31729710E-10  1.69909675E-09

>=SPECTRASECT
SECTID=DEMO-003 NCHAN=7 NFREQ=2 MAXBLKS=40 // 7
  31.002
  32.002
  33.002
  34.002
  35.002
  41.002
  42.002

>SPECTRA FREQ=3.840E+02 ROTSPEC=0 BW=9.600E+01 AVGT=448 // 49
  1.85453537E-08 -2.35638553E-09  5.83249760E-09 -1.66184475E-06 -2.69476141E-06
  2.08384048E-08  1.30347078E-09 -5.30692268E-10  2.72998335E-09 -3.55058960E-09
  5.72594956E-07  2.03653656E-07 -2.52966537E-09  1.80482251E-09 -2.89235358E-10
  5.16686416E-10  2.18115758E-07 -1.13343378E-06 -8.79012646E-07  7.39186001E-09
 -2.49609133E-09  8.55428311E-07 -7.50339609E-07  9.73336569E-07  4.84545744E-04
```

```
  4.08155844E-04 -1.94715790E-06  3.24843143E-07  3.75374361E-06 -5.15723684E-07
  1.01657486E-06 -2.39149202E-04  1.24885608E-03 -3.13672035E-06 -2.62098297E-07
 -2.61620337E-10  8.02747369E-10 -3.69188180E-10 -8.65357549E-07 -4.37259632E-06
  2.49390926E-08  1.72167713E-09 -1.49038247E-11 -8.62808366E-11  4.03163170E-10
  5.79959476E-07 -3.34648405E-07 -8.26554242E-11 3.05876013E-09

>SPECTRA FREQ=2.880E+02 ROTSPEC=0 BW=9.600E+01 AVGT=448 // 49
  2.63053010E-07 -1.86626856E-08  3.47274698E-09 -1.86342259E-05 -3.25878136E-05
  2.92078738E-07  2.40497382E-08 -4.81067319E-09  2.11735447E-08  1.30200730E-08
  3.86379634E-06  1.31988884E-06 -1.87654976E-08  1.52600848E-08 -4.05656273E-08
  5.04376185E-09  3.89669310E-07 -4.38075006E-07 -6.91867081E-06  3.46689455E-09
  9.79225145E-09  8.37796324E-06 -5.64516859E-06 -6.22880680E-06  3.41640925E-03
  3.75395408E-03 -2.11596525E-05  9.93123649E-07  4.29204811E-05 -3.68187966E-06
 -3.57394492E-06 -2.11867993E-03  1.14109479E-02 -3.72892173E-05 -2.33954370E-06
 -3.77258891E-09  7.83583953E-09  4.04610319E-08 -8.13271345E-06 -4.76403948E-05
  3.32276358E-07  2.87468112E-08  4.88581353E-09  5.42131451E-10  1.27342048E-09
  3.54476401E-06 -4.47584534E-06  4.27400115E-09  2.29760690E-08

>=SPECTRASECT
SECTID=DEMO-004 NCHAN=7 NFREQ=2 MAXBLKS=40 // 7
  41.002
  42.002
  43.002
  44.002
  45.002
  31.002
  32.002

>SPECTRA FREQ=3.840E+02 ROTSPEC=0 BW=9.600E+01 AVGT=827 // 49
  2.25159500E-08  2.66077760E-09  2.54485544E-10 -8.00217776E-07 -5.59272053E-07
  1.86462330E-08 -1.33919453E-09 -1.79324611E-10  4.66960470E-09 -1.73868042E-09
 -7.22674329E-08 -2.78178121E-08  1.99099448E-09  2.98927705E-09  4.01740374E-09
 -4.76813207E-11  1.97632815E-07 -6.90266830E-08  2.37283317E-07  1.00231057E-09
 -2.33578179E-09  3.32538974E-08 -2.82358343E-07  3.19204190E-07  6.10780407E-05
  1.16585970E-05 -6.58140436E-07  5.72356065E-08  2.09420409E-06  3.35528938E-07
  7.60314833E-08 -7.69914986E-05  2.31511891E-04 -4.96301709E-07  3.15968727E-08
  1.53057428E-10 -2.01594002E-11 -2.39216114E-09 -4.12738821E-08 -1.79923654E-06
  1.66293415E-08 -1.38102607E-09 -7.94963373E-10  7.36340641E-11  3.53096080E-10
  2.77789042E-07  7.81626781E-08 -4.50162296E-10  3.57415941E-09

>SPECTRA FREQ=2.880E+02 ROTSPEC=0 BW=9.600E+01 AVGT=379 // 49
  4.83657274E-08  3.59201096E-08 -7.29046690E-09  1.23940788E-06 -2.80609743E-06
  3.59514836E-08  2.47264538E-08 -4.64733008E-09  4.46614282E-08 -9.54583346E-09
  1.98810972E-06 -2.77659933E-06  2.63789683E-08  6.62920298E-08  3.33196248E-09
 -5.41198686E-09  4.32842199E-07  4.41772954E-07  2.39921434E-07 -6.00080652E-09
 -2.86685253E-09 -6.89438053E-08 -8.52197672E-07  6.32025081E-07  2.19856272E-04
 -1.84273755E-04  1.01042895E-06  1.81962480E-06  4.22828180E-06  1.52178586E-06
 -6.59768830E-07  9.50032315E-05  3.72802082E-04 -2.30165188E-06 -2.29079183E-06
 -7.39286687E-10  8.89206272E-10 -4.99152053E-10 -1.21379600E-07 -1.73064541E-06
  3.42624986E-08  7.76607617E-08 -5.21406784E-09  4.74383699E-10  7.02073644E-09
  8.31757916E-07 -9.01606199E-07 -2.57352295E-09  4.15102761E-08
>END
```