AMTRED
DOCUMENTATION

ZONGE Data Processing
AMT Data Processing Program
version 7.1x

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AMTRED Program Documentation

OVERVIEW

AMTRED handles averaged CSAMT, CSHAMT, and NSAMT data files, containing data for a number of frequencies at a sequence of stations. The data may be displayed on screen, and written to data files in several formats. Various options are provided for filtering, conversion, and basic analysis.

INPUT FILES

AMTRED expects to read a Data file and optionally a Station file and Mode file.

The Data file (.AVG-file) is usually written by the AMTAVG or NSAVG averaging program, and contains transmit and receive dipole locations, component labels, component data and block-average variation statistics. Magnitude and phase data for electric and magnetic fields at each measured frequency for each station are used by AMTRED.

An optional Station file (.STN-file) includes a list of station labels and dipole midpoint coordinates. The coordinate data is used by the MacRho algorithm.

An optional Mode file (.MDE-file) includes entries that modify mode values defined by Zonge DATPRO programs. A mode name is specified for several program variables that a user may modify. Each line in a mode file includes the program name, mode name, and value. While running AMTRED, help text and mode descriptions are available at the MODE prompt. An appendix to this manual summarizes the use of mode variables and includes a description of each mode defined by AMTRED.

OUTPUT FILES

The log file (.LOG-file) includes a brief summary of the options selected while running AMTRED. It is useful when reviewing the operation of the program.

The listing file (.L-file) presents data in pseudosection format when selected by the operator. The tabular format presents data in columns for each station, with high frequency data at the top of each column. The file is designed for printing on paper.

The plot file (.Z-file) written by AMTRED uses a format expected by Zonge DATPRO plot programs. It contains header information and columns of data, each line including X,Y location and Z value for one parameter, optionally followed by sections for additional parameters. AMTRED writes data sets when selected by the operator.

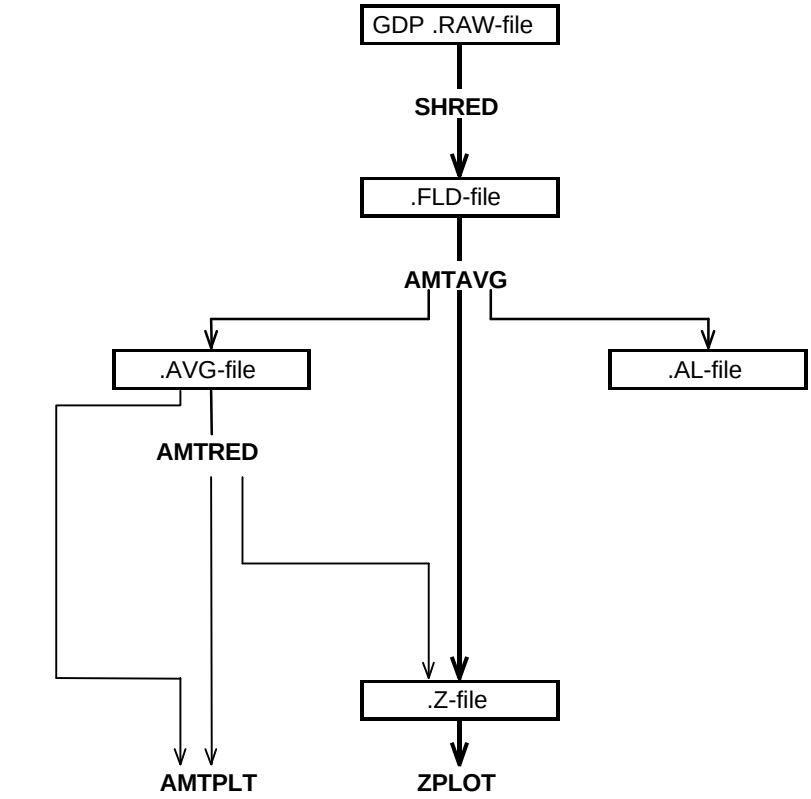
Plot files may be written when plots of magnitude or phase are displayed on screen. They may be printed on paper by using the FPLOT utility program to rasterize the plot files (.Xnn-files).

CSAMT DATA PROCESSING FLOW

March, 1993

Program names are **CAPITALIZED**
File names are Boxed

Bold lines ━━ show standard GDP data processing flow.



Other files read or written:

.MDE-file | .STN-file | .LOG-file | .Xnn-files

AMTRED Usage

The GENERAL DATA PROCESSING DOCUMENTATION includes many details that are common to data processing programs.

Start the processing program by typing "AMTRED" <RETURN>. Respond to the prompt with the name of the .AVG-file. Command line execution also allows the user to type "AMTRED" followed by the .AVG-filename <RETURN> to automatically load the data file.

Several variable parameters called "MODES" influence the operation of AMTRED. A brief explanation of each mode, as well as its current value, can be listed within the program. An appendix to this manual summarizes the use of mode variables and includes a description of each mode defined by AMTRED.

AMTRED MODE DISPLAY

PROCESSING MODES USED:

CONTROL MODES	AutoRun	Station	Method	PhaseRef	MacRHO	NormAmps
mode names	AUTO	SORT	CALCULATE	PDREF	MACSEL	AMPNORM
mode values	NO	YES	LINE	NONE	CagR	1.00
FILE OPTIONS	**InputFile**	**Yvalues**	**MinDelY**	**.L-file**	**LowFreq**	**HighFreq**
mode names	COMPONENT	YVALUE	DELY	WIDTH	FLO	FHI
mode values	ExHy	FNUM	0.35	15	NONE	NONE
OTHER OPTIONS	**FileWith**	**Freq.Sort**	**Contour**	**PlotLimit**	**HarmLimit**	**ScreenPlt**
mode names	TRACE	FREQ	SPEC	PLIMIT	HARM	XFILE
mode values	YES	Freq.	YES	AUTO	NONE	NO
OPTION MODES	**DepthLim**	**MagCalc**	**StaticFrq**	**StaticRho**	**StaticPhz**	**SaveArray**
mode names	DEPTH	BOSTICK	FSTATIC	RSTATIC	PSTATIC	ESAVE
mode values	1127.	MAG	8192 Hz	100.0	785.	YES

AMTRED ERROR MESSAGES

If errors or inconsistencies arise within the program, AMTRED may type a "NOTE" or an "ERROR" message. A "NOTE" message usually indicates some irregularity in the data file that is not fatal to program operation. Depending on the severity of the problem, an "ERROR" message may allow the program to continue to run or cause it to interrupt and wait for a response to a prompt to continue, restart the program, or to end. These messages are also included in a .LOG-file, which provides documentation of the program operation, which is especially useful when running several programs automatically from a batch file.

AMTRED MENUS

AMTRED operates interactively. The data file is read, and operations are performed at the request of the operator. Output files and displays are generated only when requested.

The MAIN MENU provides a choice of a variety of operations. A selection may be made by entering either a number or a two-letter combination for each option. A short description for each option is available by entering the number or letters and a question mark. These descriptions are also included in the next section of this manual.

```
+=====================================================================+
| MAIN MENU:            (Type HELP or MENU for HIDDEN MENU options.)  |
|  0: Q  EXIT program             + #?: HELP file for option no."#"   |
|                                 |                                   |
|  4: W= SAVE array options  M/P + 14: BD Bostick Depth          MAG |
|  5: NS Normalize by Stn. V M/P + 15: BM Bostick Magnitude      MAG |
|  6: NF Normalize by Freq.H M/P + 16: RI Re/Im data from Mag/Phz M/P |
|  7: OF Offset              M/P + 17: PR Phz integration to Mag  PHZ |
|  8: FL Filter Selections   M/P + 18: SC Static Correction       MAG |
|  9: SL Slope of data curve M/P + 19: RE Real RHO from Cag RHO   MAG |
| 10: OV Overlay data curves M/P + 20: SI Flip RHO to SIGMA       MAG |
+=================================+===================================+
```

A prompt that begins with an asterix "*" symbol will also recognize requests from the "HIDDEN MENU". These options are displayed only when requested, by using the "MENU" option. Descriptions for several of the HIDDEN MENU options are included in the next section of this manual.

```
     * OPTION [nn]: MENU
```

```
+=====================================================================+
| HIDDEN MENU:  A "*" marks prompts where these options are valid.    |
|  "HELP": General information.   +    "MENU": List this menu.        |
|  "SAVE": Save current array.    +    "MODE": Display/change modes.  |
|  "XSAVE": Cross-save current working array.                         |
|                                                                     |
|  "E": Copy E-field storage arrays to working arrays.                |
|  "H": Copy H-field storage arrays to working arrays.                |
|  "A": Copy AMT storage arrays to working arrays.                    |
|                                                                     |
|  "M": Point to the magnitude ( RHO for AMT ) working array.         |
|  "P": Point to the phase ( PHZ DIFF for AMT ) working array.        |
|                                                                     |
|  "D": Display section.          +    "L": Write section to .L-file. |
|  "T": Plot data vs log-freq.    +    "Z": Write section to .Z-file. |
|  "D?", "L?", "T?", and "Z?" will show an option description.        |
|                                                                     |
|  "W": Identify the current working arrays.                          |
|  "R": Display the menu for the original prompt (if any).            |
+=====================================================================+
```

A prompt for mode changes is provided when AMTRED begins, after the filename is entered. The mode change prompt is available at other times by entering "MODE", when the HIDDEN MENU is available.

AMTRED OUTPUT SELECTIONS

The HIDDEN MENU is available at prompts marked with an "*", and provides several output selections. Selections are usually made at the main option prompt "* OPTION [nn]: ". The data array currently SELECTED in the MAIN array pair will be displayed or written.

The "Display" option will display the array on the screen, in pseudosection format: one column of data for each station, high frequency data at the top.

The "Listing" option will write the array to a listing file (.L-file) in pseudosection format: one column of data for each station, high frequency data at the top.

The "Plot data" option will plot one curve per station on the screen, using a log-frequency X-axis and log-magnitude Y-axis (or linear-phase Y-axis). A selection of curves may be made. The plot will be written to an .Xnn-file when mode XFILE=YES.

The "Plot file" option will write data in .Z-file format, usually for use by the Zonge AMTPLT or ZPLOT programs. A variety of options are available for Y-coordinates, such as frequency as power of two, frequency as pseudo-depth, or depth in meters as provided by a Bostic conversion. These selections are made by mode YVAL. Contour and display parameters may also be modified from default values before the data is written.

AMTRED Sample Run

This sample run illustrates writing a simple .Z-file containing RHO and PHASE data.

Input files:	SAMCSAM.AVG	SAMCSAM.STN	SAMCSAM.MDE	
Output files:	SAMCSAM.LOG	SAMCSAM.L		log and listing files
	SAMCSAM.Z	SAMCSAM.Xnn		XYZ and plot files

***** Bold text: user input and comments *****

```
C:> AMTRED SAMCSAM                          *** Start program, specify data file  ***

ZONGE ENGINEERING: 3322 E. Fort Lowell, Tucson AZ 85716, USA
AMTRED 7.10: CSAMT Data Reduction Program
   MS-DOS version implemented 01 January, 1993.

MODE CLIENT  =ZONGE ENGINEERING             *** entries from .MDE-file           ***
MODE PROJECT =Sample Data
 :
 :
MODE RX2TX   =North
MODE RXBRG   =N 90 E
Data:   9 Stations,    94 Lines,    90 Points
Frequency limits from    16 Hz to  8192 Hz

(Type MENU for assistance with MODEs.)
MODE Change [name?, name= value] : PDREF= 1000
                                    *** Provide comparable phase difference values ***

MODE Change [name?, name= value] : <RETURN>    *** Continue                         ***
```

```
CAUTION: This program is very flexible.  Titles reflect the
   last option performed, not the overall flow of options.
   Document your options when the program does not do so.

Trace: <RHO-C
+=====================================================================+
| MAIN MENU:          (Type HELP or MENU for HIDDEN MENU options.)    |
|  0: Q  EXIT program           + #?: HELP file for option no. "#".   |
|                               |                                     |
|  4: W= SAVE array options  M/P + 14: BD Bostick Depth          MAG  |
|  5: NS Normalize by Stn. V M/P + 15: BM Bostick Magnitude      MAG  |
|  6: NF Normalize by Freq.H M/P + 16: RI Re/Im data from Mag/Phz M/P |
|  7: OF Offset              M/P + 17: PR Phz integration to Mag  PHZ |
|  8: FL Filter Selections   M/P + 18: SC Static Correction       MAG |
|  9: SL Slope of data curve M/P + 19: RE Real RHO from Cag RHO   MAG |
| 10: OV Overlay data curves M/P + 20: SI Flip RHO to SIGMA       MAG |
+=================================+===================================+

* OPTION  [nn]: Z                          *** Write Rho data to .Z-file         ***

Trace: <RHO-C
Contour plot file # 1

CURRENT CONTOUR & DISPLAY SPECS:     (Use "MENU", "HELP", and "LIST" for aid.)
LOGARITHMIC contours (CTYP= 1), (CNUM=  5) contours per 10**(CEXP= 0) units,
(NSIG= 3) significant digits, (NDIG= 1) digits after decimal for small values.
SPEC Change [name?, name= value] : <RETURN>   *** No changes to specs     ***

Data points written:   90

Contour file done: Cagniard Resistivity
Trace: <RHO-C>Zfile
* OPTION  [nn]: P                          *** Point to Phase data array        ***
Trace: <PDIFF
* OPTION  [nn]: Z                          *** Write Phase data to .Z-file      ***

Trace: <PDIFF
Contour plot file # 2

CURRENT CONTOUR & DISPLAY SPECS:     (Use "MENU", "HELP", and "LIST" for aid.)
ARITHMETIC  contours (CTYP= 0), (CNUM= 10) contours per 10**(CEXP= 3) units,
(NSIG= 3) significant digits, (NDIG= 0) digits after decimal for small values.
SPEC Change [name?, name= value] : <RETURN>   *** No changes to specs            ***

Data points written:   90

Contour file done: Impedance Phase
Trace: <PDIFF>Zfile
* OPTION  [nn]: Q                           *** Quit                             ***

Data filename [quit]: <RETURN>              *** No more files                    ***
Thank You !!
```

AMTRED MAIN MENU OPTIONS

(v 7.1x)

MAIN MENU

```
+=====================================================================+
| MAIN MENU:           (Type HELP or MENU for HIDDEN MENU options.)   |
|  0: Q  EXIT program            + #?: HELP file for option no. "#".  |
|                                |                                    |
|  4: W= SAVE array options  M/P + 14: BD Bostick Depth          MAG |
|  5: NS Normalize by Stn. V M/P + 15: BM Bostick Magnitude      MAG |
|  6: NF Normalize by Freq.H M/P + 16: RI Re/Im data from Mag/Phz M/P |
|  7: OF Offset              M/P + 17: PR Phz integration to Mag  PHZ |
|  8: FL Filter Selections   M/P + 18: SC Static Correction      MAG |
|  9: SL Slope of data curve M/P + 19: RE Real RHO from Cag RHO  MAG |
| 10: OV Overlay data curves M/P + 20: SI Flip RHO to SIGMA      MAG |
+================================+====================================+
```

4: "W=" SAVE ARRAY OPTIONS

OPTIONS USING WORKING AND SAVE ARRAYS

The array to which the program is currently set (either the MAG or PHZ WORKING array) may be combined with the corresponding MAG or PHZ SAVE array. The arrays may be added, multiplied, one may be subtracted from or divided by the other. The WORKING array may be set to a constant value. The results replace the current WORKING array.

NOTE: titles will not be modified by this subroutine at this time. The titles associated with the WORKING arrays remain the same. It is up to the operator to keep track of work performed by this subroutine. If the SAVE array is merely copied to the WORKING array, titles will not be correct if output is requested before further processing.

```
+=====================================================================+
| SAVE AND WORKING ARRAY OPERATIONS                                   |
| Construct a statement of the form:                                  |
|    W =  [S or W]  [+, -, * or /]  [S or W]                          |
|      OR                                                             |
|    W =  [S or W]  [L or A]                                          |
|      OR                                                             |
|    W =  [X or VALUE]                                                |
+---------------------------------------------------------------------+
| ? will display this summary.                                        |
| S represents the current SAVE array.                                |
| W represents the current WORKING array.                             |
| L represents LOG base 10, A represents anti-LOG.                    |
| X represents EXCHANGING the current WORKING and SAVE arrays.        |
| VALUE represents a floating point constant of up to 9 characters.   |
+---------------------------------------------------------------------+
| Examples: W = W + W,  W = S / W,  W = W - S,  W = S * S, W = S      |
|           W = W L, W = S A                                          |
|           W = 1.0, W = 1.2345678, W = -12345.67, W = X              |
+---------------------------------------------------------------------+
| To return to the MAIN MENU, type Q or just <RETURN>.                |
+=====================================================================+
```

5: "NS" NORMALIZE BY STATION

RATIO- or DELTA-OF-MEAN NORMALIZING by STATION (VERTICAL)
FOR MAG DATA, divide (default) the data values at a station by the geometric mean of the values at that station.

FOR PHZ DATA, subtract (default) the arithmetic mean of the data values at a station from the values at that station.

AUTO AVERAGE will compute the averages for you, using only the frequencies you indicate. Otherwise you may enter any values. The average is saved for use on other data files while you remain in the program and do not average any other data by this subroutine.

6: "NF" NORMALIZE BY FREQUENCY

RATIO- or DELTA-OF-MEAN NORMALIZING by FREQUENCY (HORIZONTAL)
FOR MAG DATA, divide (default) the data values at a freq by the geometric mean of the values at that frequency.

FOR PHZ DATA, subtract (default) the arithmetic mean of the data values at a freq from the values at that frequency.

AUTO AVERAGE will compute the averages for you, using only the stations you indicate. Otherwise you may enter any values. The average is saved for use on other data files while you remain in the program and do not average any other data by this subroutine.

7: "OF" OFFSET

NORMALIZE BY AN OFFSET VALUE
For MAG data, multiply the entire set of data by the value selected for the offset. The results replace the original MAG data. For PHZ data, add the offset value to the elements of the data set.

The default offset value is the high frequency average.
(just <RETURN> at the prompt).

8: "FL" FILTER SELECTIONS

PSEUDOSECTION FILTERING
FIRST DIFFERENCE FILTER: replace the first value with the difference between the first and second values, the second value is replaced with the difference between the second and third values. The last value is undefined.

SECOND DIFFERENCE FILTER: replace each value with one/half the prior, plus one/half the next, minus the value. The end points are undefined.

THREE POINT FILTER: replace each value with half the value plus one/quarter the prior value and plus one/quarter the next value. End values are replaced with half the value plus half the next value.

Filtering may be done station-by-station or frequency-by-frequency. Also, either the magnitude or the phase data may be filtered.

9: "SL" SLOPE OF DATA CURVE

SLOPE OF CURVES, STATION BY STATION
Slope calculations are available for MAG or PHZ data.

Slopes of MAG data are calculated on a linear(mag)-vs-log(freq) plot or a log(mag)-vs-log(freq) plot depending upon mode CALCULATE.

Slopes of PHZ data are calculated on a linear(phz)-vs-log(freq) plot.

Two methods are available: First, the simple slope is measured for the line segment between two magnitude values. The result is saved as the value at the higher frequency, but applies to the midpoint to the segment. An undefined value between high and low frequencies results in at least two undefined slopes.

The second method recovers the slope of a spline curve. Values are obtained for all frequencies between high and low values.

MAG data 1st derivatives by either method may be converted to
PHZ data by: PHZ = ATAN(MAG) * 1000. + PI/4.

10: "OV" OVERLAY DATA CURVES

SHIFT CURVES TO OVERLAY AT SPECIFIED POINT
Specify a frequency and a value (or a station whose value at the frequency will be used), shift all curves for the line to match at that point. The shape and orientation of the curves remain as they were, the curves are shifted up or down as necessary to match at the specified point.

The intent of this subroutine is to compare curves whose surface layer is causing the curve to shift. Also, H-field magnitude curves may be compared with less shift due to geometry of the receive and transmit dipoles.

14: "BD" BOSTIC DEPTH

BOSTICK DEPTH DATA (MAG data only)
Compute depth data according to Bosticks "First Guess". The results are returned in the SAVE array. The unmodified magnitude data remains in the WORKING array. Depth data may be trimmed by value specified by mode DEPTH when data is written to a .Z-file.

15: "BM" BOSTIC MAGNITUDE

BOSTICK MAGNITUDE DATA (MAG data only)
Compute magnitude data according to Bosticks "First Guess". Mag values use derivatives of splined log(MAG)/log(FREQ). The results are returned in the WORKING array, replacing the original values. One of several modified calculations is specified by mode BOSTICK, including phase ratio and squared phase ratio.

16: "RI" REAL/IMAG DATA FROM MAG/PHZ

REAL vs IMAGINARY
Translate the MAGNITUDE / PHASE data to REAL / IMAGINARY data, replacing the original data.

17: "PR" PHASE INTEGRATION TO MAG

CALCULATE MAG FROM INTEGRATION OF PHZ DATA

For each station, integrate the "log2(FREQ) vs PHZ" curve, provide the results in the MAG array. Results from phase-difference data are proportional to far-field resistivity. The user selects a reference station number. Mode RSTAT provides the normalizing resistivity value.

Replace phase values > pi/2 with pi/2, convert to radians, and subtract homogeneous half-space phase (785 mr). The trapezoidal rule sums from the high frequency to the freq for which a value is needed. The high freq value is approximated by using f(hi+1) phase = f(hi) phase, and f(hi+2) phase = 0. (=785. before normalizing). Convert by exp(-4/pi * data), divide by the high frequency value for the reference station, and multiply the results by the normalizing resistivity.

The normalizing resistivity will match the high freq value only for the reference station. The integrated phase data are normalized by the high frequency value for the reference station, THEN multiplied by the normalizing resistivity (mode RSTAT).

18: "SC" STATIC CORRECTION

RESISTIVITY SURFACE STRIPPING, USING PHASE DATA

The Static Correction method uses the REDRHO Resistivity Surface Stripping procedure. Modes FSTATIC, RSTATIC, and PSTATIC define user-specified values for frequency, resistivity and phase.

For each station, multiply each resistivity by two ratios:

1. The ratio of the specified normalizing resistivity, divided by the resistivity at the specified freq.
2. The inverse log ratio of the specified normalizing phase and the phase at the specified frequency.

$$RR = \frac{RHOn}{RHOfn} \qquad PR = 10.^{**}\left[\frac{4}{pi} * \frac{PHZn - PHZfn}{1000.}\right]$$

At each station, get the resistivity and phase at the specified frequency. The resistivity ratio is the normalizing resistivity divided by the station resistivity. Subtract the station phase from the normalizing phase, then: EXP(4/PI * DIFF) = the phase ratio. Multiply each resistivity by both ratios.

19: "RE" REAL RHO FROM CAGNIARD RHO

REAL COMPONENT OF CAGNIARD RESISTIVITY.

$$CRHO = \frac{1}{5f} * \frac{E^2}{H^2} \qquad RRHO = CRHO * 2 * COS(PD)$$

RRHO is identical to recovering the real component of E/H, and calculating CRHO with the results. Normalize cos(PD) to pi/4 (45 degrees) by noting that 2. * cos(45) * cos(45) = 1.0 This normalizes the homogeneous half space real component of apparent resistivity to the homogeneous half space Cagniard Resistivity. The 2*cos(PD)*cos(PD) factor is 2. at PD=0, 1. at PD=.25*pi, 0. at PD=.50*pi, 1. at PD=.75*pi, and 2. at PD=pi. If RRHO is less than 0.1 ohm-meters, then RRHO is set to 0.1.

20: "SI" CONVERT RHO TO SIGMA

RESISTIVE TO CONDUCTIVE MAGNITUDE

Convert resistive to conductive magnitude by `1/R * 1000`.

AMTRED HIDDEN MENU OPTIONS

(v 7.1x)

```
"MENU" HIDDEN MENU
+=====================================================================+
| HIDDEN MENU:  A "*" marks prompts where these options are valid.    |
|  "HELP": General information.   +    "MENU": List this menu.        |
|  "SAVE": Save current array.    +    "MODE": Display/change modes.  |
|  "XSAVE": Cross-save current working array.                         |
|                                                                     |
|  "E": Copy E-field storage arrays to working arrays.                |
|  "H": Copy H-field storage arrays to working arrays.                |
|  "A": Copy AMT storage arrays to working arrays.                    |
|                                                                     |
|  "M": Point to the magnitude ( RHO for AMT ) working array.         |
|  "P": Point to the phase ( PHZ DIFF for AMT ) working array.        |
|                                                                     |
|  "D": Display section.          +    "L": Write section to .L-file. |
|  "T": Plot data vs log-freq.    +    "Z": Write section to .Z-file. |
|  "D?", "L?", "T?", and "Z?" will show an option description.        |
|                                                                     |
|  "W": Identify the current working arrays.                          |
|  "R": Display the menu for the original prompt (if any).            |
+=====================================================================+
```

"HELP" GENERAL INFORMATION

Program arrays contain data in station vs frequency format. Arrays are paired, mag data in one, phase data in the other. Three pairs of STORAGE arrays contain E-field, H-field, and AMT data from the data file: these arrays remain unchanged. A pair of WORKING arrays may be loaded with a STORAGE pair, and is modified by processing options. One of the WORKING arrays is selected for work by the operator, a few options will modify both WORKING arrays. The current WORKING array may be copied to the matching SAVE array using "SAVE", or to the opposite SAVE array using "XSAVE" (if MAG is the current working array, XSAVE copies it to the PHZ SAVE array).

A response to a prompt beginning with a "*" will be checked for a selection from the HIDDEN MENU. A valid choice will be performed, the action noted, then return to the original prompt. A response not applicable to the HIDDEN MENU is applied to the original prompt.

TYPE "MENU" for display of the HIDDEN MENU.

"D" DISPLAY PSEUDOSECTION

DISPLAY PSEUDOSECTION:
A condensed, brief format pseudosection will be shown so that you may review a set of data at your terminal. When prompted to <press RETURN>, abort the display by entering any character, then RETURN.

Limit the range of frequencies by modes FLO and FHI.
Limit the maximum harmonic by mode HARMONIC.

"T" DISPLAY CURVE PLOTS

LOG-FREQUENCY PLOTS

Magnitude data are normally plotted using log-MAG and log-FREQ axes. If magnitude data is processed such that any values become negative, then the data are plotted using linear-MAG and log-FREQ axes. The aspect ratio is 1:1, so the length of one base-10 decade is the same on both axes.

Phase data are plotted using linear-MAG and log-FREQ axes.

Data may be plotted using axes set for the limits of ALL stations (mode PLIMIT= AUTO), or plotted using axes set for the limits of ONLY the curves being plotted (mode PLIMIT= SET).

Curve plot data may be written to both the screen and an .X-file which can be printed (mode XFILE=Yes).

Limit the range of frequencies by modes FLO and FHI.
Limit the maximum harmonic by mode HARMONIC.

"L" WRITE PSEUDOSECTION FILE

WRITE PSEUDOSECTION FILE:
Data may be written to a listing file suitable for printing in pseudosection format. (.L-file)

Limit the range of frequencies by modes FLO and FHI.
Limit the maximum harmonic by mode HARMONIC.

The number of lines per frequency is dependent upon the total number of frequencies to be included.
3 lines: 22 frequencies per page at 8 lines per vertical inch.
2 lines: 33 frequencies per page at 8 lines per vertical inch.
1 line : 66 frequencies per page at 8 lines per vertical inch.

"Z" WRITE .Z-FILE

WRITE DATA TO PLOT FILE:
Data may be written to a file suitable for use by ZPLOT or AMTPLT. (.Z-file)

Limit the range of frequencies by modes FLO and FHI.
Limit the maximum harmonic by mode HARMONIC.

Appendix A ... MODE VARIABLES

Control of various aspects of many data processing programs is provided by names called "Modes". Each name refers to a specific program function. For example, the Mode name "AUTO" refers to the automatic mode of program operation, which the user may enable.

Mode changes are recognized when prompted by a program, when read from a Mode file, or when included in an input data file.

MODE PROMPTS, Manual entry

The first prompt after a data filename is requested is commonly a mode prompt. In the following example, user requests are in BOLD type, and the results are typical responses.

```
(Type MENU for assistance with MODEs.)

MODE Change [name?, name= value] : MENU

PROCESSING MODE MENU:   Review and changing of mode values.
Change value: type "NAME= value", where NAME is the variable
              name, followed by "= ", then the value to be
              assigned to the variable called NAME.
Description : type "NAME?" for description of value.
This menu   : type "MENU", or "M", to list this menu.
List globals: type "GLOBL" or "G", to list global mode values.
List values : type "LOCAL" or "L", to list local mode values.
Version info: type "VRSN", or "V", for program version info.
Back up     : type <CRTL><Z> to back up in program.
All done    : type <RETURN>.

MODE Change [name?, name= value] : LIST

   PROCESSING MODE LIST:   (Type MENU for assistance)
```

CONTROL MODES	AutoRun	LowFreq	InitGain	GridOrgX	GridOrgY
mode names	AUTO	FMIN	(not yet)	GORX	GORY
mode values	YES	1/16 Hz	NONE	NONE	NONE

```
MODE Change [name?, name= value] : AUTO?

AUTO mode will automatically delete existing output files (if
any), not prompt for MODE changes (if AUTO= YES is included in the
.MDE-file, and exit when completed.  Plots will be done as
specified by entries in the .MDE-file (MODE PLOT and VIEW).
Enter: AUTO= No, or Yes.

MODE Change [name?, name= value] : AUTO= yes

MODE Change [name?, name= value] : <RETURN>

(the program continues ...)
```

Display a definition of any Mode by typing the variable name and a question mark (as shown for Mode AUTO). Each program manual includes an appendix of mode definitions defined by that program.

Change the value of a Mode by typing the variable name, an equals sign, and a valid value. Press <RETURN> to indicate that the program should continue.

MODE CHANGE PRIORITIES

Mode changes may be manually entered, added to mode files or to input data files. Mode statements in files include the program name (optional), the Mode name, and the Mode value. Include a dollar sign ($) in the first column, a colon (:) after the program name (if any), and an equal sign after the Mode name such as:

```
$ ZPLOT: AUTO= yes
```

Modes will NOT be changed unless they are from a source with the same or higher priority as the entry to be replaced:

1: default mode values
2: Mode lines in input data files
3: Mode lines in Mode files (global or local)
4: Mode changes made at a MODE prompt

LOCAL MODE FILES

The program will read a Mode file (if it exists) with the same name as the data file and an extension of ".MDE" (like LINE10.MDE). Specify a different Mode file from the DOS prompt, by entering the program name, data file name, then Mode file name. Include the filename extension if not the same as the default. For example:

Start ZPLOT by:			ZPLOT looks for files named:	
C:> ZPLOT	LINE10		LINE10.Z	LINE10.MDE
C:> ZPLOT	LINE10	PROJECT	LINE10.Z	PROJECT.MDE
C:> ZPLOT	LINE10.ZZ	PROJECT.MOD	LINE10.ZZ	PROJECT.MOD

GLOBAL MODE FILES

Frequently used Mode statements may be included in a file named "DATPRO.MDE" and located in any subdirectory included on your PATH. Or, the environment variable DATMDE may specify any Mode file located anywhere on your computer. One of these files will be used automatically by the program, in addition to any local mode file. Your MS-DOS manuals describe environment variables and PATH.

DATA FILE MODE STATEMENTS

Mode statements may be included in an input data file (near the top of the file). Some programs will include Mode statements in output data files, for use by subsequent programs.

AMTRED MODE LIST

(v 7.1x)

PROCESSING MODE DEFAULT VALUES:

CONTROL MODES	AutoRun	Station	Method	PhaseRef	MacRHO	NormAmps
mode names	AUTO	SORT	CALCULATE	PDREF	MACSEL	AMPNORM
mode values	NO	YES	LINE	NONE	CagR	1.00
FILE OPTIONS	InputFile	Yvalues	MinDelY	.L-file	LowFreq	HighFreq
mode names	COMPONENT	YVALUE	DELY	WIDTH	FLO	FHI
mode values	ExHy	FNUM	0.35	15	NONE	NONE
OTHER OPTIONS	FileWith	Freq.Sort	Contour	PlotLimit	HarmLimit	ScreenPlt
mode names	TRACE	FREQ	SPEC	PLIMIT	HARM	XFILE
mode values	YES	Freq.	YES	AUTO	NONE	NO
OPTION MODES	DepthLim	MagCalc	StaticFrq	StaticRho	StaticPhz	SaveArray
mode names	DEPTH	BOSTICK	FSTATIC	RSTATIC	PSTATIC	ESAVE
mode values	1127.	MAG	8192 Hz	100.0	785.	YES

COMPANY
Company name (40 chr max)

Values: COMPANY= Name of survey company
Default: COMPANY= (blank)

CLIENT
Client name (40 chr max)

Values: CLIENT= Company requesting the survey
Default: CLIENT= (blank)

PROJECT
Project name (40 chr max)

Values: PROJECT= Name of the survey project.
Default: PROJECT= (blank)

JOBNUMBER
Company job number (10 chr max)

Values: JOBNUMBER= Survey Job Number.
Default: JOBNUMBER= (blank)

JOBDATE
Survey date (10 chr max)

Values: JOBDATE= Date of Survey.
Default: JOBDATE= (blank)

JOBLINE
Survey line number (10 chr max)

Values: JOBLINE= Survey Line Number.
Default: JOBLINE= (blank)

BRGLINE
Line forward bearing (10 chr max)

Values: BRGLINE= Line Bearing, to high stn.
Default: BRGLINE= (blank)

BRGBACK
Line back bearing (10 chr max)

Values: BRGBACK= Back Bearing, to low stn.
Default: BRGBACK= (blank)

STNLOW
Low station number, plot limit

Values: STNLOW= X-axis low station limit.
Default: STNLOW= NONE

STNHIGH
High station number, plot limit

Values: STNHIGH= X-axis high station limit.
Default: STNHIGH= NONE

STNDELT
Station number increment, plot scale

Values: STNDELT= X-axis station increment.
Default: STNDELT= 1.0

LBLFRST
Low station number, axis label

Values: LBLFRST= X-axis low station label.
Default: LBLFRST= mode STNLOW value.

LBLDELT
Station number increment, axis label

Values: LBLDELT= X-axis station label increment.
Default: LBLDELT= 1.0

FRQLO
Low frequency, plot limit

Values: FRQLO= None, or low frequency limit, Hz.
Default: FRQLO= NONE

FRQHI
High frequency, plot limit

Values: FRQHI= None, or high frequency limit, Hz.
Default: FRQHI= NONE

TXLEN
CSAMT Transmitter length (10 chr max)

Values: TXLEN= CSAMT Transmitter Length
Default: TXLEN= (blank)

TXBRG
CSAMT Transmitter bearing (10 chr max)

Values: TXBRG= CSAMT Transmitter Bearing
Default: TXBRG= (blank)

TXDIS
CSAMT Transmitter distance from survey line (10 chr max)

Values: TXDIS= Distance from Rx Line to Tx
Default: TXDIS= (blank)

TXCX
CSAMT Transmitter center, X-coordinate
If units in feet or meters are not included, mode UNITS will be used.

Values: TXCX=
X-coordinate of center of Tx dipole. (10 chr max)
Default: TXCX= (blank)

TXCY
CSAMT Transmitter center, Y-coordinate
If units in feet or meters are not included, mode UNITS will be used.

Values: TXCY=
Y-coordinate of center of Tx dipole. (10 chr max)
Default: TXCY= (blank)

RX2TX
CSAMT Receiver to Transmitter direction

Values: RX2TX=
Direction from Rx Line to Tx (10 chr max)
Default: RX2TX= (blank)

RXBRG
Receive dipole bearing, usually same as survey line orientation

Values: RXBRG=
Receiver Dipole Bearing (10 chr max)
Default: RXBRG= (blank)

COMWIRE
Communications wire type, used for decalibration of GDP-12 data

Values: COMWIRE= NONE,
1WHITE, 2WHITE, or BLACK.
Default: COMWIRE= NONE

PLTREV
Plot X-axis reverse selection

Values: PLTREV= No, or Yes.
Default: PLTREV= NO

UNITS
Units for listed values, such as A-Spacing. Feet or meters.

Values: UNITS= Feet or Meters.
Default: UNITS= Meters

AUTO
AUTO mode will automatically delete existing output files (if any), not prompt for MODE changes (if AUTO= YES is included in the .MDE-file) and exit when completed.

Values: AUTO= No, or Yes.
Default: AUTO= No

SORT
Stations are read in .AVG-file order. When SORT is enabled, if all station labels are numeric then a numeric sort will be done, otherwise a character sort will be done.

Values: SORT= No, or Yes.
Default: SORT= YES

CALCULATE
CALCULATE selects arithmetic or geometric calculations for magnitude values in some subroutines. Normally, geometric (arithmetic calculations using the log of magnitude values) is used for averaging, plotting, filtering, and so on. CALCULATE offers a selection in some cases. Unless specifically stated, no choice is offered.

Values: CALCULATE= "LIN"ear,
or "LOG"arithmic
Default: CALCULATE= LINEAR

PDREF
Impedance Phase values (Ephz – Hphz) are examined station-by-station, from low to high frequency. The "Phase Reference" filter adjusts the value at one frequency to be within 2pi of the previous value (next lower frequency that has a value). By default, the starting reference value at each station is the value at the lowest available frequency (PDREF = NONE).

PDREF=
- NONE : Set the starting reference value to the value at the lowest available frequency for each station.
- Value : Set the starting reference value.
- 1PI : Reduce each phase value to satisfy -1pi < phz < +1pi
- 2PI : Reduce each phase value to satisfy -2pi < phz < +2pi
- REAL : Convert mag/phz to real/imag, then back to mag/phz.
- OFF : Do not use the Phase Reference filter

PDREF is used ONLY when reading the .AVG-file.

Values: PDREF= NONE, OFF, REAL, 1PI, 2PI, OFF, PDREF= millirad
Default: PDREF= NONE

MACSELECT
The WORKING array is initialized with RESISTIVITY values by using the E- and H-field magnitudes from the input data file. RESISTIVITY values may be calculated as CAGNIARD RESISTIVITY, or as CSAMT APPARENT RESISTIVITY by using the "MacRHO" algorithm.

Station Coordinates are expected to be provided in a Station file (.STN-file). Transmitter Coordinates are defined by modes TXCX and TXCY. The MacRHO algorithm uses Tx and Rx coordinates to determine the separation for use in a half-space model.

MACSEL= C : Cagniard Resistivity Phase will be PD from field values.
MACSEL= M : MacRHO Resistivity Phase will be computed with MacRHO.

The MacRHO algorithm finds a half-space model which has an impedance magnitude equal to an observed impedance magnitude for a particular frequency and transmitter-receiver separation. The resistivity and phase of the half-space model are the MacRHO apparent resistivity and phase values.

Values: MACSELECT= Cagniard Rho, or MacRHO.
Default: MACSELECT= Cagniard Rho

AMPNORM
AMPNORM is the current used to normalize the data during averaging. If a constant value was not used to normalize the data, then AMPNORM is not defined.

Values: AMPNORM= normalizing current, in amps.
Default: AMPNORM= 1.00

COMPONENT
Mode COMPONENT provides for reading either ExHy or EyHx data from input .AVG-files and ignoring other component pairs.

Values: COMPONENT= ExHy or EyHx.
Default: COMPONENT= ExHy

XVALUE
.Z-files may be written with a choice of X-values: Station number, X-coordinate or Y-coordinate, as given by .STN-file values.

Values: XVALUE= Station; Xc, East, West; Yr, North, South.
Default: XVALUE= Station

YVALUE
.Z-files may be written with a choice of Y-values: log2(FREQ), Linear Depth (similar to 1/sqrt(FREQ)), or the SAVE array values (mag or phz, according to the WORKING array to which you are POINTED).

When Y-values are related to frequency YVALUE=
FNUM Y-values are log2(FREQ) [DEFAULT]
LINE Y-values are linear depth (like1/sqrt(FREQ))

Three selections are available when using the SAVE array, each subject to the depth limit entered for calculating depth data:
STRAW: the data should be used unmodified.
STRIM : provides a magnitude at the depth limit for each station whose data extend below the limit. STRIM uses all values for one station to interpolate a value at the cutoff depth.
STERP : replaces all values with interpolated magnitudes at equally spaced depth values, to the depth limit. Useful for planmaps at specific depths.

Example: Use the Bostick Depth option, resulting in DEPTH data in the SAVE array and original magnitude data in the WORKING array. Then use the Bostick Magnitude option, resulting in MAGNITUDE data in the WORKING array. Set YALUE to STRIM, and write the data to a .Z-file.

Values: YVALUE= FNUM, LINE, STRAW, STRIM, or STERP.
Default: YVALUE= FNUM

WIDTH
The number of stations per page of .L-file pseudosections is specified by WIDTH. The printer may offer various print styles, or fonts, which define the number of characters that may be printed across the page. The user should select the value for WIDTH, and then set the printer print style. Values from 4 to 33 stations per page may be used.

This table is a guide for EPSON printers. Combinations of fonts offer variations, like 272 characters per line for the EPSON 185 using the compressed elite combination.

print style (font):	draft/NLQ	Elite	Comp/Elite Compressed	
stations per 8.5" page:	8	10	15	15
stations per 14." page:	15	18	27	30
characters per inch:	10	12	17	19
characters per 8.5" page:	80	96	137	165
characters per 14." page:	136	163	233	272

Values: WIDTH= number from 4 to 33.
Default: WIDTH= 15

DELY
Values in .Z-file plots using Linear Depth (YVALUE= line) Y-axes will overwrite each other at higher frequencies. DELY= 0.00 will allow the values to overwrite. Larger values of DELY (up to about 1.00) increase the separation between values, but distort the curves and positions of values at higher frequencies.

Values: DELY= value, about 0.00 to 1.00.
Default: DELY= 0.35

FLO
Data output to screen, .L-file, or .Z-file is dependent upon the .AVG-file frequency limits, which may be reset by changing mode FLO and/or FHI. The .AVG-file is NOT changed. A note will be displayed if data will not be shown due to frequency limits.

Values: FLO= minimum freqency, Hz.
Default: FLO= NONE

FHI
Data output to screen, .L-file, or .Z-file is dependent upon the .AVG-file frequency limits, which may be reset by changing mode FLO and/or FHI. The .AVG-file is NOT changed. A note will be displayed if data will not be shown due to frequency limits.

Values: FHI= maximum frequency, Hz.
Default: FHI= NONE

TRACE
TRACE shows processing done on the WORKING array to which you are POINTED. A TRACE is provided for the mag WORKING array and the phz WORKING array, and may be included in sections written to the terminal, .L-file, or .Z-file.

Values: TRACE= No, or Yes.
Default: TRACE= YES

FREQUENCY
Mode FREQUENCY specifies the order in which data will be plotted and displayed. Descending frequencies is used by default. Or, use descending fundamental (log2) values with all harmonic frequencies grouped with the fundamental.

Values: FREQUENCY= Harmonic or Frequency (No or Yes)
Default: FREQUENCY= Frequency

SPEC
Contour and display SPECs are normally displayed for review and change by the operator. If SPEC= No, then the default specifications will be used.
By default SPEC= Yes, but if AUTO=Yes then default SPEC= No.

Values: SPEC= No, or Yes.
Default: SPEC= YES (if AUTO=Yes, SPEC=No.)

PLIMIT
Screen plots may be made by using the HIDDEN MODE option "T".
Mag data plots use log(MAG) vs log(FREQ).
Phz data plots use PHASE vs log(FREQ).

Set mode PLIMIT= AUTO to specify plot limits that will accommodate all data in the current WORKING array to which you are POINTED.
Set mode PLIMIT= SET to specify plot limits that will accommodate just the data for the stations marked within the screen plot procedure.

Values: PLIMIT= AUTO or SET.
Default: PLIMIT= AUTO

HARMONIC
Limit the maximum harmonic to be displayed by setting mode HARMONIC. Any value other than 1, 3, 5, or 7 will be set to 9 (displayed in the mode list as NONE).

Values: HARMONIC= NONE, 1, 3, 5, 7, or 9.
Default: HARMONIC= NONE

XFILE
Screen plots of magnitude and phase may be written to an .X-file when mode XFILE is ON. Previous plot files will NOT be overwritten.

Values: XFILE= No, or Yes.
Default: XFILE= NO

DEPTH
DEPTH DATA LIMIT: The values calculated for depth may be limited to values that are less than one-fifth of the RxTx distance, or less than a value specified by the user, or not limited at all.

The calculation is based upon frequency-sounding far-field effects, and not the effects of near-field geometric sounding. The default limit is based upon empirical observations.

The default value 1/5 of the mode RX2TX distance.
The value will be converted to the units specified for the A-Spacing.
Enter a value of zero if no limit is to be used.

Values: DEPTH= Depth calculation limit, m or ft.
Default: DEPTH= NONE

BOSTIC
Bosticks "First Guess" calculations use derivatives of splined log(MAG)/log(FREQ). In addition, phase ratio or squared phase ratio may be included in the calculations.

BOSTICK=
MAG : uses Bostick Iinversion (splined dM/df)
PHZ1 : uses ABS[RHO*{ ((pi/2)-phz)/phz }
PHZ2 : uses ABS[RHO*{ ((pi/2)-phz)/phz) }**2

Values: BOSTICK= MAG, PHZ1, or PHZ2.
Default: BOSTICK= MAG

FSTAT
The Static Correction method uses the REDRHO Resistivity Surface Stripping procedure. Modes FSTATIC, RSTATIC, and PSTATIC define user-specified values for frequency, resistivity and phase.

Values: FSTAT= Static Correction normalizing frequency, Hz
Default: FSTAT= NONE

RSTAT
The Static Correction method uses the REDRHO Resistivity Surface Stripping procedure. Modes FSTATIC, RSTATIC, and PSTATIC define user-specified values for frequency, resistivity and phase.

The Phase Integration method uses mode RSTATIC to define the normalizing resistivity.

Values: RSTAT= Static Correction normalizing resistivity.
Default: RSTAT= 100.0

PSTAT
The Static Correction method uses the REDRHO Resistivity Surface Stripping procedure. Modes FSTATIC, RSTATIC, and PSTATIC define user-specified values for frequency, resistivity and phase.

Values: PSTATIC= Static Correction normalizing phase, mr.
Default: PSTATIC= 785.

ESAVE
The SAVE arrays are normally set to blanks when reading an .AVG-file. Disable ESAVE to keep the contents of the arrays when reading a new .AVG-file. This allows comparing two sets of data when using SAVE array options. It is assumed that each set of data contains the same range of frequencies and stations, otherwise the results may not be comparable as intended.

Values: ESAVE= No, or Yes.
Default: ESAVE= YES

Appendix B ... SAMPLE FILES

Sample .LOG-file

```
AMTRED   7.10, Processed: 01 January, 1993

GLOBAL MODE LIST:
+=============================================+==============+==============+
|  COMPANY                                    |  JOBNUMB     | CSAMT XMTR   |
| Zonge Engineering                           | 91000        |              |
|  CLIENT                                     |  JOBDATE     |  TXLEN       |
| ZONGE ENGINEERING                           | Jan 91       | 5000 ft      |
|  PROJECT                                    |  JOBLINE     |  TXBRG       |
| Sample Data                                 | 1            | N 90 E       |
+==============+==============+==============+==============+              |
|  BRGBACK     |  RXBRG       |  BRGLINE     |  FRQLO       |  TXDIS       |
| S 90 W       | N 90 E       | N 90 E       |    1/8 Hz    | 3.5 mi       |
|  STNLO       |  STNDELT     |  STNHI       |  FRQHI       |  RX2TX       |
|     0.0      |      6.0     |     48.0     |   8192 Hz    | North        |
|  LBLFRST     |  LBLDELT     |  PLTREV      |  UNITS       |              |
|  STNLO       |      6.0     |    NO        |  METERS      |              |
+==============+==============+==============+==============+==============+

PROCESSING MODES USED:
+==============+=========+=========+=========+=========+=========+=========+
|CONTROL MODES |AutoRun  |Station  |Method   |PhaseRef |MacRHO   |NormAmps |
|   mode names |  AUTO   |  SORT   |CALCULATE|  PDREF  |  MACSEL |  AMPNORM|
|  mode values |    NO   |    YES  |   LINE  |  1000.  |   CagR  |   1.00  |
|==============+=========+=========+=========+=========+=========+=========+
|FILE OPTIONS  |InputFile|Yvalues  |MinDelY  |.L-file  |LowFreq  |HighFreq |
|   mode names |COMPONENT| YVALUE  |  DELY   | WIDTH   |  FLO    |  FHI    |
|  mode values |   ExHy  |   FNUM  |   0.35  |   15    |   NONE  |   NONE  |
|==============+=========+=========+=========+=========+=========+=========+
|OTHER OPTIONS |FileWith |Freq.Sort|Contour  |PlotLimit|HarmLimit|ScreenPlt|
|   mode names |  TRACE  |  FREQ   |  SPEC   |  PLIMIT |  HARM   |  XFILE  |
|  mode values |    YES  |   Freq. |    YES  |   AUTO  |   NONE  |    NO   |
|==============+=========+=========+=========+=========+=========+=========+
|OPTION MODES  |DepthLim |MagCalc  |StaticFrq|StaticRho|StaticPhz|SaveArray|
|   mode names |  DEPTH  |  BOSTICK|  FSTATIC|  RSTATIC|  PSTATIC|  ESAVE  |
|  mode values |   1127. |   MAG   | 8192 Hz |   100.0 |   785.  |    YES  |
+==============+=========+=========+=========+=========+=========+=========+

Reading "SAMCSAM.AVG" . . .
Transmitter azimuth, degrees:    90.0
Transmitter length , meters :  1524.4
Transmitter coords , meters :     0.0  5634.1
Receiver    azimuth, degrees:    90.0

Reading station file "SAMCSAM.STN" . . .
Load .STN-file coords for stations:   9
   1 "       0.0"      0.00    304.88
   2 "       6.0"    182.93    304.88
   3 "      12.0"    365.85    304.88
   4 "      18.0"    548.78    304.88
   5 "      24.0"    731.71    304.88
   6 "      30.0"    914.63    304.88
   7 "      36.0"   1097.56    304.88
   8 "      42.0"   1280.49    304.88
   9 "      48.0"   1463.41    304.88

>Load original CSAMT data.

>Data written to data file.

>Select Phase data.

>Data written to data file.

Log file "SAMCSAM.LOG" closed.
```

Sample .AVG-file (CSAMT Averaged Data File)

```
Reference ruler line                                                                                                1
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8----+----9----+----0----+----1----+----2----+--

\ AMTAVG 7.01: "SAMCSAM.FLD", Dated 91-01-01, Processed 16 Nov 92
skp Station Freq  Comp Amps     Emag     Ephz      Hmag     Hphz  Resistivity   Phase  %Emag  sEphz  %Hmag  sHphz   %Rho   sPhz
\=][======][====][===][====][=========][======][=========][======][=========][======][=====][=====][=====][=====][=====][=====]
 2      0.0  8192 ExHy  4.5   1.1731e+3  1491.0  3.5150e-1   722.7  2.7195e+2   768.3    0.4    3.1    1.4   14.7    1.7   16.6
 2      0.0  4096 ExHy  8.    8.5835e+2  2087.0  3.9003e-1  1244.7  2.3648e+2   842.4    0.4    3.1    0.9    7.1    1.4   12.9
 2      0.0  2048 ExHy 15.    6.7279e+2  2450.4  4.4613e-1  1557.8  2.2209e+2   892.6    1.1   11.3    1.2    1.6    0.1    1.1
 2      0.0  1024 ExHy 22.    5.4680e+2  2809.1  5.4905e-1  1884.1  1.9372e+2   925.0    1.0    6.0    1.2    7.5    0.4    3.5
 2      0.0   512 ExHy 27.    4.3143e+2  3087.0  6.6498e-1  2170.8  1.6442e+2   916.3    0.0    1.4    0.1    0.6    0.2    1.8
 2      0.0   256 ExHy 29.    3.6102e+2 -3065.5  8.6567e-1  2361.3  1.3588e+2   856.3    0.0    0.3    0.2    2.1    0.2    1.9
 2      0.0   128 ExHy 30.    3.1513e+2 -3056.5  1.1202e+0  2473.8  1.2365e+2   752.8    0.1    0.6    0.3    3.3    0.3    2.8
 2      0.0    64 ExHy 30.    2.9184e+2 -3073.0  1.3978e+0  2519.9  1.3621e+2   690.3    0.2    4.8    0.5    4.2    0.2    2.0
 2      0.0    32 ExHy 30.    2.3443e+2  3015.3  1.8517e+0  2488.9  1.0018e+2   526.4    0.5    2.1    0.5    4.3    0.2    1.4
 2      0.0    16 ExHy 30.    3.4135e+2  2697.3  2.7474e+0  2616.3  1.9295e+2    81.0    0.5    4.3    0.5    4.9    0.1    1.2
 2      6.0  8192 ExHy  4.5   1.2513e+3 -2111.5  3.6216e-1 -3036.5  2.9142e+2   925.0    1.0   12.0    1.3   12.8    2.4   19.8
 2      6.0  4096 ExHy  8.    8.5772e+2 -1267.2  3.8044e-1 -2183.9  2.4819e+2   916.7    0.2    3.0    0.7    8.3    1.2   12.0
 2      6.0  2048 ExHy 15.    6.4934e+2  -785.8  4.2923e-1 -1762.4  2.2349e+2   976.6    0.1    1.1    0.4    4.3    0.5    3.2
 2      6.0  1024 ExHy 22.    5.0469e+2  -373.3  5.2905e-1 -1355.6  1.7775e+2   982.3    0.1    0.4    0.1    1.7    0.2    2.0
 2      6.0   512 ExHy 27.    3.9387e+2   -73.8  6.4048e-1 -1031.4  1.4772e+2   957.5    0.0    1.5    0.1    0.9    0.2    2.7
 2      6.0   256 ExHy 29.    3.2680e+2    68.6  8.3859e-1  -819.4  1.1865e+2   887.9    0.1    0.4    0.1    0.9    0.3    2.8
 2      6.0   128 ExHy 30.    2.8114e+2    92.6  1.0776e+0  -709.6  1.0635e+2   802.3    0.0    0.3    0.0    0.3    0.1    0.5
 2      6.0    64 ExHy 30.    2.6778e+2    87.0  1.4003e+0  -635.9  1.1428e+2   722.9    0.1    1.1    0.3    2.5    0.2    2.2
 2      6.0    32 ExHy 30.    2.0597e+2    -8.5  1.8163e+0  -679.5  8.0377e+1   671.0    0.1    1.4    0.2    1.7    0.2    1.9
 2      6.0    16 ExHy 30.    2.6405e+2  -442.2  2.6760e+0  -546.5  1.2170e+2   104.2    0.3    4.6    0.2    2.2    0.5    1.2
 2     12.0  8192 ExHy  4.5   1.5175e+3 -3128.3  3.5544e-1  2424.6  4.4503e+2   730.3    0.6   13.9    2.4   25.7    3.7   36.7
 2     12.0  4096 ExHy  8.    1.0776e+3 -1818.9  3.5323e-1 -2617.0  4.5444e+2   798.1    0.2    3.8    0.5    5.3    1.0    9.6
 2     12.0  2048 ExHy 15.    8.4220e+2 -1080.0  4.0646e-1 -2001.8  4.1928e+2   921.8    0.1    1.0    0.2    1.4    0.3    2.5
 2     12.0  1024 ExHy 22.    6.6369e+2  -532.1  4.9443e-1 -1481.4  3.5192e+2   949.3    0.0    0.3    0.0    1.8    0.2    1.7
 2     12.0   512 ExHy 27.    5.2781e+2  -170.1  6.0843e-1 -1104.1  2.9397e+2   933.9    0.1    2.0    0.3    1.8    0.3    2.4
 2     12.0   256 ExHy 29.    4.4406e+2    -7.6  8.0176e-1  -861.5  2.3966e+2   854.0    0.1    0.2    0.1    0.9    0.1    0.9
 2     12.0   128 ExHy 29.    3.9475e+2    18.2  1.0473e+0  -721.9  2.2197e+2   740.1    0.1    1.4    0.3    2.5    0.4    3.7
 2     12.0    64 ExHy 30.    3.8188e+2    24.0  1.3362e+0  -646.9  2.5524e+2   670.8    0.1    1.2    0.3    2.5    0.5    5.0
 2     12.0    32 ExHy 30.    3.0221e+2  -146.5  1.7584e+0  -676.9  1.8461e+2   530.4    0.3    5.0    0.2    2.3    0.2    3.4
 2     12.0    16 ExHy 30.    4.4644e+2  -491.6  2.6151e+0  -548.9  3.6431e+2    57.3    0.1    1.3    0.2    2.1    0.4    1.9
 2     18.0  8192 ExHy  4.5   1.6965e+3  2432.0  3.1821e-1  1483.5  6.9396e+2   948.4    1.8   18.0    2.8   24.0    4.8   46.8
 2     18.0  4096 ExHy  8.    1.1682e+3 -2162.8  3.4951e-1 -3086.2  5.4546e+2   923.4    1.6   17.2    0.3   20.6    0.5    5.7
 2     18.0  2048 ExHy 15.    8.8357e+2 -1238.2  4.0162e-1 -2206.4  4.7266e+2   968.2    0.0    1.0    0.6    6.4    0.4    5.4
 2     18.0  1024 ExHy 22.    6.8430e+2  -614.6  4.8870e-1 -1614.7  3.8294e+2  1000.1    0.0    0.4    0.4    0.8    0.7    6.2
 2     18.0   512 ExHy 26.    5.3223e+2  -192.5  5.9619e-1 -1180.4  3.1131e+2   987.9    0.2    0.7    0.1    1.5    0.2    2.6
 2     18.0   256 ExHy 28.    4.3459e+2    -1.5  7.7973e-1  -904.0  2.4270e+2   902.4    0.0    0.6    0.1    1.3    0.1    1.4
 2     18.0   128 ExHy 28.    3.8217e+2    43.6  1.0276e+0  -747.1  2.1611e+2   790.8    0.5    2.6    0.7    6.5    0.3    3.0
 2     18.0    64 ExHy 30.    3.6596e+2    60.4  1.2974e+0  -649.7  2.4861e+2   710.1    0.7   10.4    0.9   10.4    0.6    5.7
 2     18.0    32 ExHy 30.    2.7788e+2   -38.6  1.7036e+0  -690.5  1.6629e+2   651.9    0.2    5.4    0.4    4.2    0.2    2.0
 2     18.0    16 ExHy 30.    3.7603e+2  -491.6  2.5579e+0  -558.1  2.7013e+2    66.5    0.3    1.8    0.3    2.2    0.0    0.4
 2     24.0  8192 ExHy  4.    2.0018e+3  1453.4  2.8862e-1   672.6  1.1744e+3   780.8    0.5    6.7    3.1   31.1    3.7   36.6
 2     24.0  4096 ExHy  8.    1.4450e+3 -2661.4  3.3326e-1  2765.7  9.1792e+2   856.0    0.5    4.2    1.2   13.7    2.2   22.2
 2     24.0  2048 ExHy 15.    1.1192e+3 -1485.7  3.7744e-1 -2406.8  8.5868e+2   921.1    0.2    1.1    0.4    4.3    0.6    6.3
 2     24.0  1024 ExHy 22.    8.6714e+2  -712.8  4.4784e-1 -1683.9  7.3225e+2   971.2    0.0    0.2    0.1    3.4    0.3    3.8
 2     24.0   512 ExHy 26.    6.6926e+2  -240.2  5.4469e-1 -1212.4  5.8973e+2   972.2    0.0    0.1    0.2    1.9    0.3    3.4
 2     24.0   256 ExHy 28.    5.1201e+2   -28.6  6.6927e-1  -921.4  4.5725e+2   892.8    0.0    0.2    0.2    2.4    0.5    4.7
 2     24.0   128 ExHy 28.    4.9467e+2    26.6  9.7175e-1  -771.2  4.0490e+2   797.8    0.0    0.8    0.2    1.6    0.3    3.0
 2     24.0    64 ExHy 28.    5.0064e+2    42.6  1.3067e+0  -657.9  4.5872e+2   700.5    0.5    2.5    0.3    2.8    1.0    9.8
 2     24.0    32 ExHy 28.    3.7409e+2   -33.2  1.6845e+0  -676.6  3.0825e+2   643.4    0.3    4.1    0.4    4.5    0.2    2.0
 2     24.0    16 ExHy 28.    5.1261e+2  -515.1  2.5315e+0  -562.5  5.1254e+2    47.4    0.2    2.1    0.2    2.1    0.1    1.4
 2     30.0  8192 ExHy  4.5   1.0969e+3 -1667.4  2.9457e-1 -2325.8  3.3851e+2   658.4    1.9   15.6    6.9   69.6   11.6  108.7
 2     30.0  4096 ExHy  8.    7.8682e+2 -1051.9  2.9363e-1 -1843.0  3.5059e+2   791.1    0.1    0.8    0.7    8.2    1.2   11.6
 2     30.0  2048 ExHy 15.    6.1638e+2  -662.2  3.2983e-1 -1574.8  3.4105e+2   912.7    0.1    0.8    0.7   10.1    1.8   16.8
 2     30.0  1024 ExHy 22.    4.7630e+2  -287.8  3.9858e-1 -1263.9  2.7891e+2   976.0    0.1    0.5    0.2    5.8    0.5    5.5
 2     30.0   512 ExHy 28.    3.6720e+2   -16.6  4.7574e-1 -1008.9  2.3272e+2   992.4    0.2    1.4    0.3    4.1    0.3    3.7
 2     30.0   256 ExHy 30.    3.0297e+2    93.6  6.4638e-1  -821.1  1.7164e+2   914.7    0.1    0.9    0.1    1.5    0.3    2.9
 2     30.0   128 ExHy 30.    2.6245e+2    97.7  8.5108e-1  -715.2  1.4859e+2   812.9    0.2    0.8    0.3    2.6    0.3    2.8
 2     30.0    64 ExHy 30.    2.5341e+2    83.7  1.0888e+0  -632.8  1.6928e+2   716.5    0.1    1.7    0.7    6.1    0.6    5.9
 2     30.0    32 ExHy 30.    1.8666e+2    38.9  1.3951e+0  -653.1  1.1188e+2   691.9    0.3    1.1    0.7    6.5    0.7    7.9
 2     30.0    16 ExHy 30.    2.4393e+2  -518.6  2.0950e+0  -565.6  1.6947e+2    47.0    0.4    3.7    0.6    5.0    0.5    2.5

continued ...
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Sample .AVG-file (CSAMT second page)

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Reference ruler line                                                                                                1
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8----+----9----+----0----+----1----+----2----+--

 2     36.0  8192 ExHy  4.5   1.3909e+3 -1630.5  2.9845e-1 -2231.7  5.3027e+2   601.2    0.8   11.3    5.5   55.1    9.0   82.0
 2     36.0  4096 ExHy  8.    9.9495e+2 -1050.9  2.8522e-1 -1824.2  5.9415e+2   773.2    0.1    0.7    0.9    7.3    1.5   15.3
 2     36.0  2048 ExHy 15.    7.8571e+2  -666.0  3.2131e-1 -1533.9  5.8395e+2   867.9    0.0    0.4    0.6    5.8    1.1   11.6
 2     36.0  1024 ExHy 22.    6.0881e+2  -289.9  3.8106e-1 -1231.6  4.9855e+2   941.8    0.0    0.6    0.5    5.2    0.6    7.2
 2     36.0   512 ExHy 27.    4.6744e+2   -17.8  4.5015e-1  -990.5  4.2120e+2   972.7    0.1    0.6    0.2    2.6    0.5    4.0
 2     36.0   256 ExHy 29.    3.8347e+2    91.5  6.0522e-1  -811.7  3.1365e+2   903.2    0.1    0.3    0.3    2.7    0.5    4.6
 2     36.0   128 ExHy 30.    3.3563e+2    98.6  8.1093e-1  -701.4  2.6766e+2   800.0    0.1    2.1    0.3    2.3    0.5    5.1
 2     36.0    64 ExHy 30.    3.2922e+2    81.2  1.0407e+0  -624.5  3.1273e+2   705.6    0.8    4.6    0.9    9.4    1.6   15.7
 2     36.0    32 ExHy 30.    2.4422e+2    51.8  1.3326e+0  -636.9  2.0992e+2   688.7    0.7    3.2    0.5    4.4    0.4    4.5
 2     36.0    16 ExHy 30.    3.0535e+2  -528.8  1.9452e+0  -564.6  3.0804e+2    35.8    0.3    1.7    0.4    2.4    0.2    1.1
 2     42.0  8192 ExHy  4.5   1.2131e+3  -471.6  2.7422e-1 -1113.9  4.7775e+2   642.3    1.1   13.6    5.0   56.3    7.8   81.0
 2     42.0  4096 ExHy  8.    9.0781e+2  -488.6  2.8341e-1 -1179.7  5.0099e+2   691.1    0.1    0.8    1.7   27.3    2.6   27.9
 2     42.0  2048 ExHy 15.    7.2021e+2  -405.1  3.0157e-1 -1169.1  5.5699e+2   764.0    0.0    0.5    0.4    5.5    0.7    7.0
 2     42.0  1024 ExHy 22.    5.7228e+2  -168.0  3.5195e-1 -1043.0  5.1641e+2   875.0    0.1    0.5    0.3    4.9    0.7    6.2
 2     42.0   512 ExHy 26.    4.3890e+2 -3105.9  4.3269e-1  2257.2  4.0192e+2   920.1    0.1    1.3    0.2    1.6    0.5    5.4
 2     42.0   256 ExHy 28.    3.6474e+2  1683.6  5.6368e-1   818.6  3.2712e+2   865.0    0.0    0.0    0.2    1.5    0.2    1.5
 2     42.0   128 ExHy 30.    3.1866e+2   894.9  7.3635e-1    95.9  2.9263e+2   799.0    0.3    3.3    0.4    3.6    0.4    4.1
 2     42.0    64 ExHy 30.    3.1227e+2   487.3  9.6601e-1  -190.5  3.2655e+2   677.8    0.2    2.7    0.8    5.9    1.5   13.4
 2     42.0    32 ExHy 30.    2.3070e+2 -2818.6  1.1810e+0  2707.2  2.3848e+2   757.4    0.6    4.9    0.7    5.2    0.3    3.2
 2     42.0    16 ExHy 30.    2.6395e+2  1149.3  1.7723e+0  1094.5  2.7727e+2    54.8    0.3    2.8    0.4    4.9    0.7    5.5
 2     48.0  8192 ExHy  4.5   8.1509e+2  -470.8  2.9521e-1  -974.0  1.8612e+2   503.2    0.7    5.7    2.8   24.9    5.0   41.1
 2     48.0  4096 ExHy  8.    6.2295e+2  -489.1  2.7569e-1 -1151.4  2.4931e+2   662.3    0.1    1.2    1.8   13.5    3.7   36.4
 2     48.0  2048 ExHy 15.    4.9481e+2  -406.5  3.0274e-1 -1180.2  2.6087e+2   773.7    0.0    0.3    0.3    1.8    0.6    5.8
 2     48.0  1024 ExHy 22.    3.9242e+2  -164.2  3.5530e-1 -1044.9  2.3827e+2   880.7    0.0    0.5    0.4    4.5    0.4    4.1
 2     48.0   512 ExHy 26.    3.0773e+2 -3095.5  4.3108e-1  2245.6  1.9907e+2   942.1    0.2    4.0    0.2    1.8    0.2    2.1
 2     48.0   256 ExHy 28.    2.4759e+2  1695.9  5.5445e-1   806.7  1.5579e+2   889.2    0.0    1.3    0.1    0.8    0.1    1.3
 2     48.0   128 ExHy 30.    2.1577e+2   911.0  7.3018e-1    91.2  1.3645e+2   819.8    0.4    4.6    0.2    6.8    0.5    5.0
 2     48.0    64 ExHy 30.    2.1024e+2   508.5  9.5573e-1  -205.0  1.5121e+2   713.5    0.4    3.2    0.2    0.6    0.5    4.7
 2     48.0    32 ExHy 30.    1.5808e+2 -2717.0  1.1366e+0  2711.9  1.2090e+2   854.3    0.1    1.7    0.1    1.4    0.3    3.0
 2     48.0    16 ExHy 30.    1.4876e+2  1194.8  1.6987e+0  1068.3  9.5852e+1   126.5    0.3    2.8    0.3    3.2    0.0    0.7

*** end-of-file ***
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Sample .AVG-file (NSAMT Averaged Data File)

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Reference ruler line                                                                                                1    >
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8----+----9----+----0---->

\ NSAVG 1.02: "SAMAMT.FLD", Dated 92-06-16, Processed 22 Dec 92
skp Station Freq  Comp    Emag       Hmag1      Hmag2       RHO1       RHO2       RHOA   Phase1  Phase2
\=][======][====][===][=========][=========][=========][=========][=========][=========][======][======]
 2      9.0   896 ExHy  1.0834e+3  2.7027e+0  0.0000e+0  3.0869e+1  3.6073e+1  3.3471e+1      *    807.2
 2      9.0   640 ExHy  9.6063e+2  2.7076e+0  0.0000e+0  3.4442e+1  3.9255e+1  3.6849e+1      *    849.5
 2      9.0   448 ExHy  6.0642e+2  2.2041e+0  0.0000e+0  3.2607e+1  3.4077e+1  3.3342e+1      *    873.6
 2      9.0   320 ExHy  6.4349e+2  2.7309e+0  0.0000e+0  3.2627e+1  3.5632e+1  3.4130e+1      *    877.4
 2      9.0   224 ExHy  6.0800e+2  3.0315e+0  0.0000e+0  3.5401e+1  3.6749e+1  3.6075e+1      *    906.0
 2      9.0   160 ExHy  3.4158e+2  2.2177e+0  0.0000e+0  2.8638e+1  3.0312e+1  2.9475e+1      *    931.8
 2      9.0   112 ExHy  5.5977e+2  4.4097e+0  0.0000e+0  2.8687e+1  2.9364e+1  2.9026e+1      *    952.2
 2      9.0    80 ExHy  3.6818e+2  3.5942e+0  0.0000e+0  2.6002e+1  2.6844e+1  2.6423e+1      *    950.7
 2      9.0    56 ExHy  3.4890e+2  4.1809e+0  0.0000e+0  2.2244e+1  2.7281e+1  2.4762e+1      *    915.7
 2      9.0    40 ExHy  1.9262e+2  2.8893e+0  0.0000e+0  2.1371e+1  2.2640e+1  2.2005e+1      *    942.6
 2      9.0    28 ExHy  2.0028e+2  3.7781e+0  0.0000e+0  1.9430e+1  2.0049e+1  1.9739e+1      *    906.3
 2      9.0    20 ExHy  1.2696e+2  2.9728e+0  0.0000e+0  1.7678e+1  1.8454e+1  1.8066e+1      *    873.3
 2      9.0    14 ExHy  1.1006e+2  3.0145e+0  0.0000e+0  1.7313e+1  2.1489e+1  1.9401e+1      *    726.0
 2      9.0    10 ExHy  7.1923e+1  2.4038e+0  0.0000e+0  1.6968e+1  2.0819e+1  1.8893e+1      *    665.7
 2      9.0     7 ExHy  7.1707e+1  2.9014e+0  0.0000e+0  1.5782e+1  2.0114e+1  1.7948e+1      *    660.6
 2      9.0     5 ExHy  4.4583e+1  2.1473e+0  0.0000e+0  1.5667e+1  1.9395e+1  1.7531e+1      *    677.3
 2      9.0   3.5 ExHy  5.9773e+1  2.9068e+0  0.0000e+0  2.1501e+1  2.6782e+1  2.4141e+1      *    698.0
 2      9.0   2.5 ExHy  4.6220e+1  2.4572e+0  0.0000e+0  2.4228e+1  3.3463e+1  2.8846e+1      *    722.4
 2      9.0  1.75 ExHy  6.0993e+1  3.3649e+0  0.0000e+0  2.6137e+1  5.8983e+1  4.2560e+1      *    752.8
 2      9.0  1.25 ExHy  4.7471e+1  3.1784e+0  0.0000e+0  2.8031e+1  4.7740e+1  3.7885e+1      *    947.6
 2      9.0  .875 ExHy  4.6194e+1  3.8484e+0  0.0000e+0  1.8227e+1  6.6190e+1  4.2208e+1      *    849.9
 2      9.0   896 EyHx  7.2488e+2  1.7745e+0  0.0000e+0  2.9111e+1  4.1078e+1  3.5095e+1      *    797.2
 2      9.0   640 EyHx  1.0810e+3  2.9565e+0  0.0000e+0  4.0120e+1  4.3202e+1  4.1661e+1      *    825.4
 2      9.0   448 EyHx  1.7999e+3  5.8964e+0  0.0000e+0  4.1157e+1  4.1827e+1  4.1492e+1      *    838.5
 2      9.0   320 EyHx  1.9322e+3  7.4448e+0  0.0000e+0  4.1424e+1  4.2358e+1  4.1891e+1      *    874.3
 2      9.0   224 EyHx  1.4780e+3  6.9748e+0  0.0000e+0  4.0014e+1  4.0368e+1  4.0191e+1      *    911.4
 2      9.0   160 EyHx  1.0503e+3  6.2890e+0  0.0000e+0  3.4548e+1  3.5195e+1  3.4871e+1      *    937.4
 2      9.0   112 EyHx  1.5332e+3  1.1146e+1  0.0000e+0  3.3899e+1  3.4378e+1  3.4139e+1      *    935.8
 2      9.0    80 EyHx  9.4014e+2  8.3650e+0  0.0000e+0  2.9149e+1  3.3325e+1  3.1237e+1      *    943.7
 2      9.0    56 EyHx  1.2254e+3  1.4346e+1  0.0000e+0  1.7037e+1  4.3973e+1  3.0505e+1      *    852.2
 2      9.0    40 EyHx  4.4640e+2  6.2551e+0  0.0000e+0  2.4146e+1  2.5809e+1  2.4977e+1      *    930.3
 2      9.0    28 EyHx  3.2596e+2  5.8985e+0  0.0000e+0  2.1027e+1  2.2543e+1  2.1785e+1      *    934.0
 2      9.0    20 EyHx  1.8256e+2  4.2161e+0  0.0000e+0  1.8372e+1  1.9830e+1  1.9101e+1      *    874.3
 2      9.0    14 EyHx  2.2278e+2  6.4082e+0  0.0000e+0  1.6695e+1  1.7758e+1  1.7227e+1      *    801.2
 2      9.0    10 EyHx  1.2354e+2  4.3730e+0  0.0000e+0  1.5206e+1  1.7426e+1  1.6316e+1      *    691.7
 2      9.0     7 EyHx  1.7231e+2  6.7166e+0  0.0000e+0  1.7137e+1  2.1098e+1  1.9118e+1      *    577.1
 2      9.0     5 EyHx  1.2714e+2  5.7996e+0  0.0000e+0  1.7084e+1  2.1662e+1  1.9373e+1      *    385.5
 2      9.0   3.5 EyHx  1.5217e+2  6.9028e+0  0.0000e+0  2.3223e+1  3.5004e+1  2.9114e+1      *    264.6
 2      9.0   2.5 EyHx  1.4037e+2  6.1503e+0  0.0000e+0  3.6801e+1  5.0572e+1  4.3687e+1      *    275.2
 2      9.0  1.75 EyHx  2.0270e+2  8.8640e+0  0.0000e+0  4.2950e+1  9.5927e+1  6.9438e+1      *    257.1
 2      9.0  1.25 EyHx  1.9541e+2  8.7846e+0  0.0000e+0  6.3619e+1  1.0063e+2  8.2122e+1      *    241.7
 2      9.0  .875 EyHx  2.2724e+2  1.1726e+1  0.0000e+0  6.7449e+1  1.1606e+2  9.1753e+1      *    268.2
 2      9.0  .625 EyHx  1.8580e+2  1.0657e+1  0.0000e+0  7.2140e+1  1.4633e+2  1.0923e+2      *    298.9

continued ...
```

Sample .AVG-file (NSAMT second section)

```
<     1         1         1         1         1         1
<+----1----+----2----+----3----+----4----+----5----+----6

  %Emag %Hmag1 %Hmag2  %RHO1  %RHO2  %RHOA  sPHZ1  sPHZ2
 [=====][=====][=====][=====][=====][=====][=====][=====]
   133.1  130.1    0.0   22.9   13.2   16.4    0.1   81.8
   147.5  145.9    0.0   22.1   15.8   17.9    0.1   63.3
    33.8   30.7    0.0   13.1   11.3   12.1    0.0   44.2
    39.3   36.0    0.0   13.8    9.8   11.5    0.0   60.3
    44.3   44.1    0.0    6.9    8.4    7.5    0.0   24.8
    23.1   21.0    0.0    7.5    7.1    7.2    0.0   39.4
    58.5   59.5    0.0    8.9    8.8    8.9    0.0   19.4
    53.6   54.0    0.0    7.0    7.4    7.1    0.0   22.6
    29.7   21.5    0.0   23.6   20.8   21.0    0.1   86.5
    33.1   28.0    0.0   12.4   14.1   13.1    0.0   61.6
    39.1   36.1    0.0   10.6   14.0   12.3    0.0   66.0
    28.0   24.7    0.0    6.4   12.6    9.5    0.0   60.1
    23.1   18.8    0.0   16.1   38.2   27.1    0.1   99.2
    21.2   21.5    0.0   31.7   46.7   39.7    0.1   78.1
    21.6   21.9    0.0   16.7   20.2   16.0    0.1   68.8
    23.2   20.7    0.0   20.8   16.2   17.5    0.1   48.3
    37.2   31.0    0.0   18.2   23.0   20.2    0.1   84.7
    29.1   25.6    0.0   17.2   21.2   19.1    0.0   66.0
    17.6   15.6    0.0   39.9   23.4   23.4    0.1  227.9
    18.0   14.3    0.0   26.3   28.9   27.5    0.0  176.5
    14.7   15.9    0.0   42.4   33.8   35.6    0.0   38.9
    86.1   79.2    0.0   34.7   16.7   19.5    0.2  115.5
    71.9   71.4    0.0    9.9    8.7    8.6    0.0   59.5
    43.0   42.9    0.0    5.2    4.7    4.9    0.0   18.9
    38.5   37.4    0.0    5.4    4.9    5.1    0.0   30.3
    24.6   25.1    0.0    3.0    3.1    3.1    0.0   13.1
    35.6   35.5    0.0    5.4    5.4    5.4    0.0   21.4
    39.3   40.0    0.0    6.6    7.0    6.8    0.0   19.7
    45.1   43.0    0.0   13.2   11.3   10.7    0.1   49.5
     7.5   12.1    0.0   31.8   42.7   39.6    0.0  167.8
    53.9   52.1    0.0   16.5   18.6   17.5    0.0   87.6
    29.2   28.3    0.0    7.2    6.5    6.2    0.0   42.3
    31.3   32.5    0.0    9.8    9.8    9.6    0.0   44.0
    19.2   17.6    0.0    8.2    8.2    6.7    0.0   64.5
    23.3   23.7    0.0   19.4   21.6   20.0    0.0   56.9
    30.3   32.1    0.0   14.7   11.9   12.2    0.1   59.9
    24.5   22.9    0.0   14.8   15.9   14.7    0.0   87.6
    27.7   24.2    0.0   28.0   27.2   24.4    0.1   82.5
    25.2   24.9    0.0   26.1   31.0   28.7    0.0  169.2
    24.9   23.7    0.0   33.5   52.3   44.0    0.1  141.7
    23.8   21.3    0.0   23.8   18.8   19.3    0.1  116.8
    25.5   23.0    0.0   29.0   28.5   25.0    0.1  146.3
    24.3   21.6    0.0   31.4   36.5   30.8    0.1  173.5

 *** end-of-file ***
```

Sample .STN-file (Station Coordinates)

```
\ MANUAL ENTRY
  Station    Grid_E    Grid_N  Elevation
\========][========][========][========]
     0.0    000000.   001000.      500.
     6.0    000600.   001000.      525.
    12.0    001200.   001000.      575.
    18.0    001800.   001000.      600.
    24.0    002400.   001000.      610.
    30.0    003000.   001000.      580.
    36.0    003600.   001000.      550.
    42.0    004200.   001000.      560.
    48.0    004800.   001000.      565.
```

Sample .L-file (Pseudosection listing)

```
CSAMT SURVEY DATA                                              Zonge AMTRED 7.10

Client  : Zonge Engineering
Location: Sample Data                          Tx Length  : 5000 ft
Job     : 91000          Line    : 1              Distance: 3.5 mi
Date    : Jan 91         Orient. : East           Orient. : East
                         Asp     :  183.m         Rx to Tx: North

CAGNIARD RESISTIVITY
  values in ohm-meters


<RHO-C>Zfile

          0.0     6.0    12.0    18.0    24.0    30.0    36.0    42.0    48.0
  Hz    West  -----+-------+-------+-------+-------+-------+-------+----East  --


         272.    291.    445.    694.    1174    339.    530.    478.    186.
 8192      +       +       +       +       +       +       +       +       +

         236.    248.    454.    545.    918.    351.    594.    501.    249.
 4096      +       +       +       +       +       +       +       +       +

         222.    223.    419.    473.    859.    341.    584.    557.    261.
 2048      +       +       +       +       +       +       +       +       +

         194.    178.    352.    383.    732.    279.    499.    516.    238.
 1024      +       +       +       +       +       +       +       +       +

         164.    148.    294.    311.    590.    233.    421.    402.    199.
  512      +       +       +       +       +       +       +       +       +

         136.    119.    240.    243.    457.    172.    314.    327.    156.
  256      +       +       +       +       +       +       +       +       +

         124.    106.    222.    216.    405.    149.    268.    293.    136.
  128      +       +       +       +       +       +       +       +       +

         136.    114.    255.    249.    459.    169.    313.    327.    151.
   64      +       +       +       +       +       +       +       +       +

         100.    80.4    185.    166.    308.    112.    210.    238.    121.
   32      +       +       +       +       +       +       +       +       +

         193.    122.    364.    270.    513.    169.    308.    277.    95.9
   16      +       +       +       +       +       +       +       +       +

continued ...
```

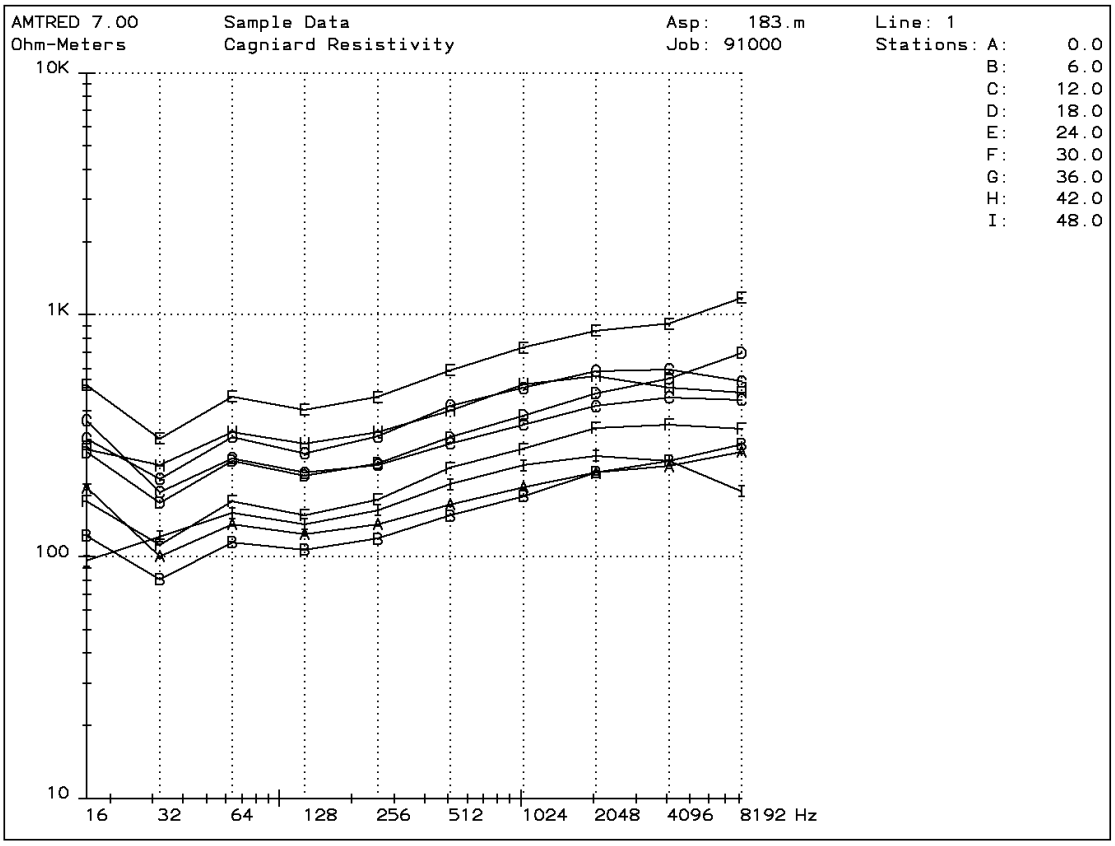
Sample .L-file (page 2)

```
CSAMT SURVEY DATA                                          Zonge AMTRED 7.10

Client  : Zonge Engineering
Location: Sample Data                          Tx Length  : 5000 ft
Job     : 91000          Line    : 1              Distance: 3.5 mi
Date    : Jan 91         Orient. : East           Orient. : East
                         Asp     :  183.m         Rx to Tx: North

IMPEDANCE PHASE
  values in milliradians


<PDIFF>Zfile

          0.0     6.0    12.0    18.0    24.0    30.0    36.0    42.0    48.0
  Hz    West  -----+-------+-------+-------+-------+-------+-------+----East  --


         768.    925.    731.    948.    781.    658.    601.    642.    503.
 8192      +       +       +       +       +       +       +       +       +

         842.    917.    798.    923.    857.    791.    773.    691.    662.
 4096      +       +       +       +       +       +       +       +       +

         893.    977.    922.    968.    921.    913.    868.    764.    774.
 2048      +       +       +       +       +       +       +       +       +

         925.    982.    949.    1000    971.    976.    942.    875.    881.
 1024      +       +       +       +       +       +       +       +       +

         916.    958.    934.    988.    972.    992.    973.    921.    943.
  512      +       +       +       +       +       +       +       +       +

         857.    888.    854.    902.    893.    915.    903.    865.    889.
  256      +       +       +       +       +       +       +       +       +

         754.    802.    740.    791.    798.    813.    800.    799.    820.
  128      +       +       +       +       +       +       +       +       +

         691.    723.    671.    710.    701.    716.    706.    678.    714.
   64      +       +       +       +       +       +       +       +       +

         526.    671.    530.    652.    643.    692.    689.    758.    855.
   32      +       +       +       +       +       +       +       +       +

          81.    104.     57.     67.     47.     47.     36.     55.    127.
   16      +       +       +       +       +       +       +       +       +

*** end-of-file ***
```

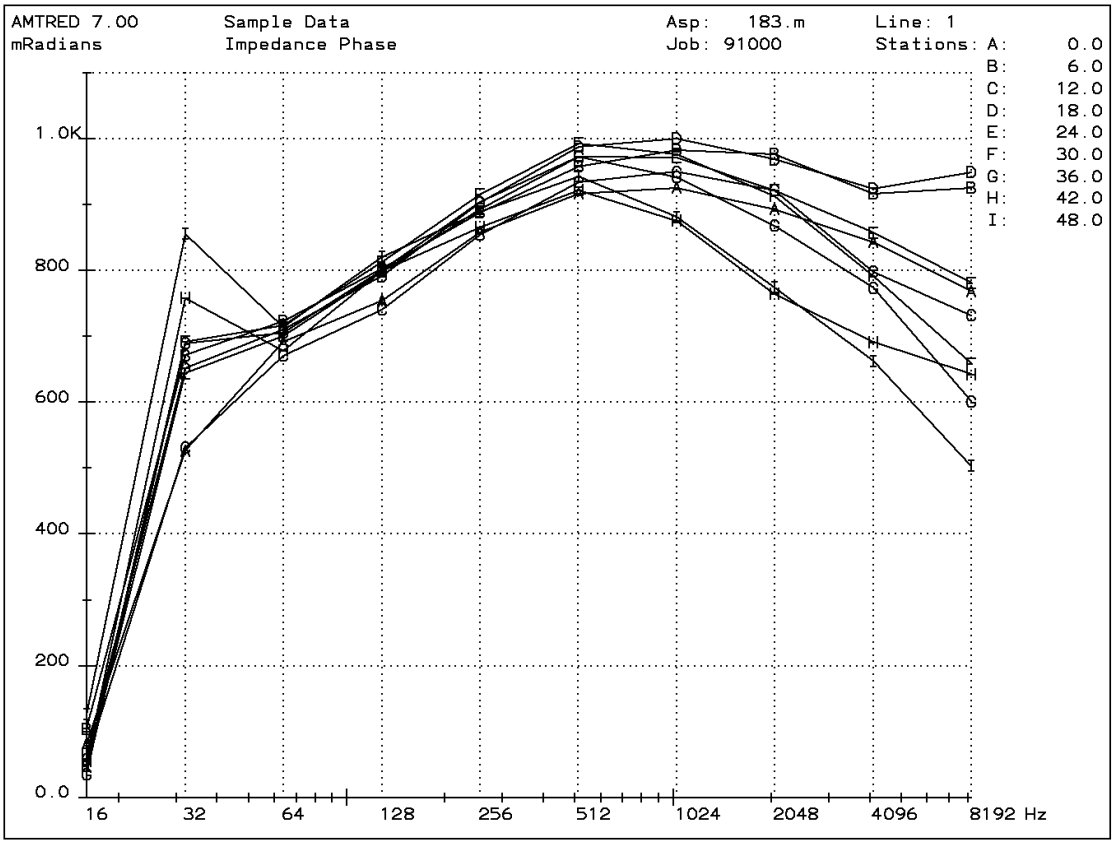
Sample .Z-file (Plot data file)

```
 AMTRED 7.10 Contour file.
/* 01 Jan 93
$ ZPLOT: DATA= FLOG
 Cl Cn Ce Ns Nd Yl   Plot file  1
  1  5  0  3  1  1
 CSAMT SURVEY DATA
 CAGNIARD RESISTIVITY
   values in ohm-meters
 <RHO-C
IIxxxxxxxxYYYYYYYYzzzzzzzzzzzz  AAA
 2     0.0   22.00   2.719E+02
 2     0.0   21.00   2.365E+02
 2     0.0   20.00   2.221E+02
 2     0.0   19.00   1.937E+02
 2     0.0   18.00   1.644E+02
 2     0.0   17.00   1.359E+02
 2     0.0   16.00   1.237E+02
 2     0.0   15.00   1.362E+02
 2     0.0   14.00   1.002E+02
 2     0.0   13.00   1.930E+02
 2     6.0   22.00   2.914E+02
 2     6.0   21.00   2.482E+02
 2     6.0   20.00   2.235E+02
 2     6.0   19.00   1.777E+02
 2     6.0   18.00   1.477E+02
 2     6.0   17.00   1.187E+02
 2     6.0   16.00   1.063E+02
 2     6.0   15.00   1.143E+02
 2     6.0   14.00   8.038E+01
 2     6.0   13.00   1.217E+02
 2    12.0   22.00   4.450E+02
 2    12.0   21.00   4.544E+02
 2    12.0   20.00   4.193E+02
 2    12.0   19.00   3.519E+02
 2    12.0   18.00   2.940E+02
 2    12.0   17.00   2.397E+02
 2    12.0   16.00   2.220E+02
 2    12.0   15.00   2.552E+02
 2    12.0   14.00   1.846E+02
 2    12.0   13.00   3.643E+02
 2    18.0   22.00   6.940E+02
 2    18.0   21.00   5.455E+02
 2    18.0   20.00   4.727E+02
 2    18.0   19.00   3.829E+02
 2    18.0   18.00   3.113E+02
 2    18.0   17.00   2.427E+02
 2    18.0   16.00   2.161E+02
 2    18.0   15.00   2.486E+02
 2    18.0   14.00   1.663E+02
 2    18.0   13.00   2.701E+02
 2    24.0   22.00   1.174E+03
 2    24.0   21.00   9.179E+02
 2    24.0   20.00   8.587E+02
 2    24.0   19.00   7.323E+02
 2    24.0   18.00   5.897E+02
 2    24.0   17.00   4.572E+02
 2    24.0   16.00   4.049E+02
 2    24.0   15.00   4.587E+02
 2    24.0   14.00   3.082E+02
 2    24.0   13.00   5.125E+02
 2    30.0   22.00   3.385E+02
 2    30.0   21.00   3.506E+02
 2    30.0   20.00   3.411E+02
 2    30.0   19.00   2.789E+02
 2    30.0   18.00   2.327E+02
 2    30.0   17.00   1.716E+02
 2    30.0   16.00   1.486E+02
 2    30.0   15.00   1.693E+02
 2    30.0   14.00   1.119E+02
 2    30.0   13.00   1.695E+02
 2    36.0   22.00   5.303E+02
 2    36.0   21.00   5.941E+02
 2    36.0   20.00   5.839E+02
 2    36.0   19.00   4.985E+02
 2    36.0   18.00   4.212E+02
 2    36.0   17.00   3.136E+02
 2    36.0   16.00   2.677E+02
 2    36.0   15.00   3.127E+02
 2    36.0   14.00   2.099E+02
 2    36.0   13.00   3.080E+02
 2    42.0   22.00   4.778E+02
 2    42.0   21.00   5.010E+02
 2    42.0   20.00   5.570E+02
 2    42.0   19.00   5.164E+02
 2    42.0   18.00   4.019E+02
 2    42.0   17.00   3.271E+02
 2    42.0   16.00   2.926E+02
 2    42.0   15.00   3.265E+02
 2    42.0   14.00   2.385E+02
 2    42.0   13.00   2.773E+02
 2    48.0   22.00   1.861E+02
 2    48.0   21.00   2.493E+02
 2    48.0   20.00   2.609E+02
 2    48.0   19.00   2.383E+02
 2    48.0   18.00   1.991E+02
 2    48.0   17.00   1.558E+02
 2    48.0   16.00   1.364E+02
 2    48.0   15.00   1.512E+02
 2    48.0   14.00   1.209E+02
 2    48.0   13.00   9.585E+01
9999.00
 Cl Cn Ce Ns Nd Yl   Plot file  2
  0 10  3  3  0  1
 CSAMT SURVEY DATA
 IMPEDANCE PHASE
   values in milliradians
IIxxxxxxxxYYYYYYYYzzzzzzzzzzzz  AAA
 2     0.0   22.00   7.683E+02
 2     0.0   21.00   8.424E+02
 2     0.0   20.00   8.926E+02
 2     0.0   19.00   9.250E+02
 2     0.0   18.00   9.163E+02
 2     0.0   17.00   8.563E+02
 2     0.0   16.00   7.528E+02
 2     0.0   15.00   6.903E+02
 2     0.0   14.00   5.264E+02
 2     0.0   13.00   8.100E+01
 2     6.0   22.00   9.250E+02
 2     6.0   21.00   9.167E+02
 2     6.0   20.00   9.766E+02
 2     6.0   19.00   9.823E+02
 2     6.0   18.00   9.575E+02
 2     6.0   17.00   8.879E+02
 2     6.0   16.00   8.023E+02
 2     6.0   15.00   7.229E+02
 2     6.0   14.00   6.710E+02
 2     6.0   13.00   1.042E+02
 2    12.0   22.00   7.303E+02
 2    12.0   21.00   7.981E+02
 2    12.0   20.00   9.218E+02
 2    12.0   19.00   9.493E+02
 2    12.0   18.00   9.339E+02
 2    12.0   17.00   8.540E+02
 2    12.0   16.00   7.401E+02
 2    12.0   15.00   6.708E+02
 2    12.0   14.00   5.304E+02
 2    12.0   13.00   5.733E+01
 2    36.0   22.00   6.012E+02
 2    36.0   21.00   7.732E+02
 2    36.0   20.00   8.679E+02
 2    36.0   19.00   9.418E+02
 2    36.0   18.00   9.727E+02
 2    36.0   17.00   9.032E+02
 2    36.0   16.00   8.000E+02
 2    36.0   15.00   7.056E+02
 2    36.0   14.00   6.887E+02
 2    36.0   13.00   3.576E+01
 2    42.0   22.00   6.423E+02
 2    42.0   21.00   6.911E+02
 2    42.0   20.00   7.640E+02
 2    42.0   19.00   8.750E+02
 2    42.0   18.00   9.201E+02
 2    42.0   17.00   8.650E+02
 2    42.0   16.00   7.990E+02
 2    42.0   15.00   6.778E+02
 2    42.0   14.00   7.574E+02
 2    42.0   13.00   5.477E+01
 2    48.0   22.00   5.032E+02
 2    48.0   21.00   6.623E+02
 2    48.0   20.00   7.737E+02
 2    48.0   19.00   8.807E+02
 2    48.0   18.00   9.421E+02
 2    48.0   17.00   8.892E+02
 2    48.0   16.00   8.198E+02
 2    48.0   15.00   7.135E+02
 2    48.0   14.00   8.543E+02
 2    48.0   13.00   1.265E+02
9999.00

*** end of file ***
```

Sample .Xnn-file SAMCSAM.X01



Sample .Xnn-file SAMCSAM.X02



Appendix C ... FILE DOCUMENTATION

.AVG-file Format (v1.0) CSAMT Averaged Data File

The .AVG-file is defined by the order of data on each line. The first line is a list of column titles, with at least one space between each title. Lines of data values follow, one value for each title provided, in the same order, with at least one space between values. If no value is available, then an asterix (*) is used. Data may be aligned in columns. Comment lines may occur anywhere in the file, with the characters (/*) or (\) in the first column.

```
\ AMTAVG 7.01: "SAMCSAM.FLD", Dated 91-01-01, Processed 16 Nov 92
skp Station Freq  Comp Amps     Emag     Ephz      Hmag     Hphz  Resistivity   Phase  %Emag  sEphz  %Hmag  sHphz   %Rho   sPhz
\=][======][====][===][====][=========][======][=========][======][=========][======][=====][=====][=====][=====][=====][=====]
 2      0.0  8192 ExHy  4.5   1.1731e+3  1491.0  3.5150e-1   722.7  2.7195e+2   768.3    0.4    3.1    1.4   14.7    1.7   16.6
 2      0.0  4096 ExHy  8.    8.5835e+2  2087.0  3.9003e-1  1244.7  2.3648e+2   842.4    0.4    3.1    0.9    7.1    1.4   12.9
 2      0.0  2048 ExHy 15.    6.7279e+2  2450.4  4.4613e-1  1557.8  2.2209e+2   892.6    1.1   11.3    1.2    1.6    0.1    1.1
 2      0.0  1024 ExHy 22.    5.4680e+2  2809.1  5.4905e-1  1884.1  1.9372e+2   925.0    1.0    6.0    1.2    7.5    0.4    3.5
 2      0.0   512 ExHy 27.    4.3143e+2  3087.0  6.6498e-1  2170.8  1.6442e+2   916.3    0.0    1.4    0.1    0.6    0.2    1.8
 2      0.0   256 ExHy 29.    3.6102e+2 -3065.5  8.6567e-1  2361.3  1.3588e+2   856.3    0.0    0.3    0.2    2.1    0.2    1.9
 2      0.0   128 ExHy 30.    3.1513e+2 -3056.5  1.1202e+0  2473.8  1.2365e+2   752.8    0.1    0.6    0.3    3.3    0.3    2.8
 2      0.0    64 ExHy 30.    2.9184e+2 -3073.0  1.3978e+0  2519.9  1.3621e+2   690.3    0.2    4.8    0.5    4.2    0.2    2.0
 2      0.0    32 ExHy 30.    2.3443e+2  3015.3  1.8517e+0  2488.9  1.0018e+2   526.4    0.5    2.1    0.5    4.3    0.2    1.4
 2      0.0    16 ExHy 30.    3.4135e+2  2697.3  2.7474e+0  2616.3  1.9295e+2    81.0    0.5    4.3    0.5    4.9    0.1    1.2
```

skp
skip flag

Station
Receiver Station location

Freq
Frequency at which data was measured (hertz)

Comp
Components measured

Amps
Square-wave current (amps)

Emag
E-field magnitude (nanoVolts/(Meter*Amp))

Ephz
E-field phase (milliRadians)

Hmag
H-field magnitude (picoTesla/amp)
(milliGammas/amp)

Hphz
H-field phase (milliRadians)

Resistivity
Cagniard Resistivity (Ohm-Meters)

Phase
Impedance phase = (E-phase - H-phase)
(milliRadians)

%Emag
Statistical variation of averaged data block magnitude values.
100 * Standard Deviation / Average Emag (percent)

sEphz
Statistical variation of data blocks averaged for this data point.
Standard Deviation of Ephz values (milliradians)

%Hmag
Statistical variation of averaged data block magnitude values.
100 * Standard Deviation / Average Hmag (percent)

sHphz
Statistical variation of data blocks averaged for this data point.
Standard Deviation of Hphz values (milliradians)

%Rho
Statistical variation of averaged data block resistivity values.
100 * Standard Deviation / Average Rho (percent)

sPhz
Statistical variation of data blocks averaged for this data point.
Standard Deviation of Phase values (milliradians)

.AVG-file Format (v1.0) NSAMT Averaged Data File

The .AVG-file is defined by the order of data on each line. The first line is a list of column titles, with at least one space between each title. Lines of data values follow, one value for each title provided, in the same order, with at least one space between values. If no value is available, then an asterix (*) is used. Data may be aligned in columns. Comment lines may occur anywhere in the file, with the characters (/*) or (\) in the first column.

```
\ NSAVG 1.02: "SAMAMT.FLD", Dated 92-06-16, Processed 22 Dec 92
skp Station Freq  Comp    Emag       Hmag1      Hmag2       RHO1       RHO2       RHOA   Phase1  Phase2
\=][======][====][===][=========][=========][=========][=========][=========][=========][======][======]
 2      9.0   896 ExHy  1.0834e+3  2.7027e+0  0.0000e+0  3.0869e+1  3.6073e+1  3.3471e+1      *    807.2
 2      9.0   640 ExHy  9.6063e+2  2.7076e+0  0.0000e+0  3.4442e+1  3.9255e+1  3.6849e+1      *    849.5
 2      9.0   448 ExHy  6.0642e+2  2.2041e+0  0.0000e+0  3.2607e+1  3.4077e+1  3.3342e+1      *    873.6
 2      9.0   320 ExHy  6.4349e+2  2.7309e+0  0.0000e+0  3.2627e+1  3.5632e+1  3.4130e+1      *    877.4

 %Emag %Hmag1 %Hmag2  %RHO1  %RHO2  %RHOA  sPHZ1  sPHZ2
Æ=====][=====][=====][=====][=====][=====][=====][=====]
  133.1  130.1    0.0   22.9   13.2   16.4    0.1   81.8
  147.5  145.9    0.0   22.1   15.8   17.9    0.1   63.3
   33.8   30.7    0.0   13.1   11.3   12.1    0.0   44.2
   39.3   36.0    0.0   13.8    9.8   11.5    0.0   60.3
```

skp
skip flag

Station
Receiver Station location

Freq
Frequency at which data was measured (Hertz)

Comp
Components measured

Emag
E-field magnitude (nanoVolts/Meter)

Hmag1
H-field-1 magnitude (picoTesla)

Hmag2
H-field-2 magnitude (picoTesla)

RHO1
Cagniard Resistivity 1 (Ohm-Meters)

RHO2
Cagniard Resistivity 2 (Ohm-Meters)

RHOA
Cagniard Resistivity average (Ohm-Meters)

Phase1
Impedance phase 1 = (E-phase - H-phase) (milliRadians)

Phase2
Impedance phase 2 = (E-phase - H-phase) (milliRadians)

%Emag
Statistical variation of from averaged data block magnitude values.
100 * Standard Deviation / Average Emag (percent)

%Hmag1
Statistical variation of from averaged data block magnitude values.
100 * Standard Deviation / Average Hmag1 (percent)

%Hmag2
Statistical variation of from averaged data block magnitude values.
100 * Standard Deviation / Average Hmag2 (percent)

%RHO1
Statistical variation of from averaged data block resistivity values.
100 * Standard Deviation / Average RHO1 (percent)

%RHO2
Statistical variation of from averaged data block resistivity values.
100 * Standard Deviation / Average RHO2 (percent)

%RHOA
Statistical variation of from averaged data block resistivity values.
100 * Standard Deviation / Average RHOA (percent)

sPHZ1
Statistical variation of data blocks averaged for this data point.
Standard Deviation of Phase1 values (milliRadians)

sPHZ2
Statistical variation of data blocks averaged for this data point.
Standard Deviation of Phase2 values (milliRadians)

.STN-file Format (v2.0) Station Coordinate File

The .STN-file provides a list of station labels and their coordinates. Each data line includes a station label, X- and Y-coordinates, and elevation. The labels are normally numeric. AMTRED will accept alphanumeric labels that do not contain spaces. The coordinates are expected to be based on a single grid system, with positive values increasing to the left for GRID_EAST values, and increasing up for GRID_NORTH values. Values are normally in meters. AMTRED will accept values in feet if specified by mode UNITS.

AMTRED requires a line for each station in the input .AVG-file. Some programs may provide interpolation for stations whose coordinates are not included, but AMTRED does not. Interpolation assumes that station numbers represent distance along line. These files should contain entries for at least two stations.

A Header line is optional (but some programs may require it to be removed). Comment lines begin with a backslash. The line of column titles must contain at least "Station", "Grid-E", "Grid-N" and "Elevation". If the header line is removed, data for these columns must be the first four columns, optionally followed by other columns. If the header line is included, these four columns and any other optional columns may be in any order.

Old .AD-files provide for coordinate data. The AD-AD utility program will convert these files to .AVG-file format. It will also include coordinate data in a .STN-file if coordinates for at least two stations are included in the .AD-file. The program will also use elevation data included in a topographic .TC-file.

Sample file created by the .AD-file conversion program AD-AD.

```
\ AD-AD 7.10: from "250T20.AD", Converted 11 Mar 93
  Station    Grid_E    Grid_N  Elevation
\========][========][========][========]
 -05.0       7727.    18739.      990.00
 -04.0       7550.    18915.     1050.00
 -03.0       7373.    19092.     1040.00
```

```
Sample file created manually.

\ MANUAL ENTRY
  Station    Grid_E    Grid_N  Elevation
\========][========][========][========]
     0.0    000000.   001000.      500.
     6.0    000600.   001000.      525.
    12.0    001200.   001000.      575.
    18.0    001800.   001000.      600.
```

.Z-file Format (v2.0) Plot File For All Data

```
 1: $ ZPLOT: DATA= FLOG
 2: /* 29 Jul 93
 3:  AMTAVG 7.20 Contour file.
 4:  Cl Cn Ce Ns Nd Yl   Plot file  1
 5:   1  5  0  3  1  1
 6:  CSAMT SURVEY DATA
 7:  CAGNIARD RESISTIVITY
 8:   values in ohm-meters
 9: IIxxxxxxxxYYYYYYYYzzzzzzzzzzz  AAA
     2     0.0   22.00   2.719E+02
     2     0.0   21.00   2.365E+02
     2     0.0   20.00   2.221E+02
     2     0.0   19.00   1.937E+02
     2     0.0   18.00   1.644E+02
     :      :      :         :
99: 9999.00
```

DESCRIPTION OF VALUES IN SAMPLE FILE BY LINE NUMBER:

Line # Explanation:

2: **$ ZPLOT: DATA= FLOG** Mode line, Y-value data type (log Freq)

3: **AMTAVG 7.20** Program name and version that generated this file.

4: **Cl** Label for contour type: 0 = linear
1 = logarithmic
2 = pseudo-log
Pseudo-log contours: positive and negative values contoured separately, using $\log_{10}$(abs(value)), plus a zero contour.

Cn Label for number of contours per interval.

Ce Label for exponent of the contour interval.
The "interval" is an integer power of ten: 10^{Ce}

Ns Label for number of significant digits when posting values.
Values: -1, 3, 4, 5. (-1 = free format for small values)

Nd Label for the number of digits after the decimal.

Yl Label for vertical axis: 0 = none
1 = linear frequency (log spacing)
2 = log frequency (linear spacing)
3 = linear depth

5: **1** Value of Cl: logarithmic contours
5 Value of Cn: 5 contours per "interval"
0 Value of Ce: interval = $10^0 = 1$
3 Value of Ns: use 3 significant digits for contouring
1 Value of Nd: plot 1 digit after the decimal
1 Value of Yl: linear frequency axis (log spacing of freqs)

6-8: Data description for this Plot File. Two to six lines are available, NOT including the first column. Plot programs may plot these lines as title information.

9: Header line for the data that follows:

II - Command flag:

0 = Skip this line of data.
1 = Omit for contouring, but post the bracketed value.
2 = Use for contouring and post the value (most common).
3 = Label a point or station by plotting a symbol under the X-axis at the X-coordinate.
4 = Use for contouring, post the symbol and not the value.
Used for depth plots where values are interpolated for the bottom of the plot to improve the gridding.
5 = Use to set plot limits, do not contour or post.
Used for depth plots to set zero depth. Used to provide a margin around the data, as for plan maps.

xxxxxxxx - X-coordinate, usually station coordinate.

YYYYYYYY - Y-coordinate, not used for Flag = 3

zzzzzzzz - Value to be plotted at X-Y for Flags 1, 2, 4.

AAA - For Flag 1 or 2, ZPLOT posts any characters in the AAA column instead of the value in the **zzzzzzzz** column.

For Flag 3, ZPLOT plots a symbol below the X-axis at the x-value, according to an integer in column AAA. A zero or positive integer refers to symbols in TABLE 1 of the PLOT Manual. A negative integer refers to topographic symbols in the CTOPO Manual.

99: **9999.0** - End-Of-Plot indicator.

Transient ElectroMagnetic data append profile plot data. Points at a single time (Y) for one frequency (f) and window (w) are connected from station to station by a profile line.

YYYYYYYY - Time in milliseconds for a particular window.
ffffffff - Frequency at which data was acquired.
wwww - Window number.

```
IIxxxxxxxxYYYYYYYYzzzzzzzzzzzz  AAA   ffffffffwwww
 2  100.00   0.121-9.10488E+02          *32* Hz W 1
 2  100.00   0.243-1.34988E+03          *32* Hz W 2
 2  100.00   0.364-3.91872E+02          *32* Hz W 3
```