HEMAVG
DOCUMENTATION

ZONGE Data Processing
Multi-Component CR Averaging Program
version 7.4x

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HEMAVG Program Documentation

OVERVIEW

HEMAVG averages GDP CR raw data that includes measurements for one or more components. Several output files are created, including a log file (.LOG-file), plot file (.Z-file), average file (.AVG-file), and a combined average file (.DAT-file). Plots of individual data points are available for reviewing data quality, which are written to vector plot files (.Xnn-files).

The Zonge DATPRO program CRAVG provides a similar function. CRAVG is better suited for X-component E-field data. HEMAVG handles all components measured at any binary fundamental GDP frequency.

INPUT FILES

Data files read by HEMAVG include a data file (.FLD-file) and optionally a mode file (.MDE-file).

The data file is usually the result of using the SHRED program to read a GDP data dump file (.RAW-file), which writes a data file (.FLD-file). These data files include records, each containing data for one measurement. For CR data, one record contains data measured by one channel. The SHRED program uses the GDP data block entries for Tx, Rx, and N-Spacing, and includes updated values in each data record.

The records are sorted, so that the records that need to be averaged are grouped together. Refer to the SHRED program documentation for details of this procedure and for the formats of the input and output files. Note that the /P- switch will normally be appropriate for data processed by HEMAVG.

An optional mode file includes entries that modify mode values defined by Zonge Data Processing (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. When running HEMAVG, help text and mode descriptions are also 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 HEMAVG.

OUTPUT FILES

The log file (.LOG-file) includes a summary of the data processed. Notes are also included, concerning the progress of the HEMAVG program. It is useful when reviewing the operation of the program.

The plot file (.Z-file) written by HEMAVG 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. HEMAVG includes Resistivity, Raw Phase and 3-Pt Phase for one component and frequency (specified by mode values). The .Z-file will optionally include magnitude ratio and phase difference data for two components and one frequency.

The average file (.AVG-file) includes a variety of location and parameter data in columnar format, for all components and frequencies. The file is composed of sections, each of which has constant values for location and component. Vector and Tensor IP data may be further processed using the TIP program.

The combined data file (.DAT-file) uses a format similar to the average file, and combines data at the various components. The sections of this file have constant values for location.

Undefined values in .AVG- and .DAT-files are indicated by a "*". This format is expected of newer utility routines and some ZONGE modeling programs. The format is also suitable for use by spreadsheet, database, and plot programs.

Plots are written to vector files (.Xnn-files) using the HPGL plotter commands, and are suitable for rasterizing and printing on a dot-matrix printer. A program such as FPLOT, PrintGL, or PRINTaPLOT is suitable for printing the vector plot files.

SURVEY LOCATION CONVENTIONS

Zonge DATPRO programs assume that the GDP operator enters survey locations in a specific manner for measurements across one or more dipoles. First, the N-Spacing for each channel is entered for each channel. Then, the Tx and Rx entries indicate the dipoles for the channel with the **SMALLEST** N-Spacing. Also, Dipoles extend between two adjacent stations with the **LOWEST** numbered station entered for each dipole.

Station numbers are assumed to increase towards the north or east, and decrease towards the south or west (negative values when the station is south or west of the zero coordinate). Therefore, the Tx and Rx entries reflect the south or west end of each dipole.

DATA AVERAGING NOTES

GDP data blocks record magnitude and phase values for each channel. HEMAVG provides averaged values and error estimates, according to selections made by the user. Mode CALC selects Mag/Phz or Real/Imaginary averaging, and mode DC3PT selects the coefficients for 3-point DC calculations designed to minimize the effects of electromagnetic coupling. Additional notes about the modes are included in Appendix A.

Data whose magnitude and phase values are averaged, are then converted to real and imaginary (in-phase and out-of-phase) values.

For real and imaginary averages, the recorded magnitude and phase values are converted, then averaged. The averages are converted back to magnitude and phase values.

The .AVG-file includes values for each measured frequency, with both magnitude/phase and real/imaginary values recorded. DC-corrected values are calculated for all four components: magnitude, phase, real, and imaginary. These values are recorded in an .AVG-file record for zero hertz.

Error estimates are provided for each frequency, as coefficient of variation (percent) for magnitude values, and standard deviation (milliradians) for phase values. When using real/imaginary averaging, error estimates are calculated for real and imaginary components, then converted to magnitude and phase values. The estimates for each frequency are also used to provide error estimates for the DC-corrected values.

Phase values may vary around *PI*. Phase averaging and DC corrections require values that measure in a consistent direction. HEMAVG notes the first value, then adjusts the next value by $\pm 2*PI$ so that the next value is within $\pm PI$ of the first. The third value is adjusted according to the second, and so on for any additional values. Note that changing values by *PI* is not automatically allowed. For instance, the GDP operator may note that connections to one or more channels were reversed. A symbol included in the .RAW-file is recognized by averaging programs, resulting in phase values being flipped by *PI* (for frequency-domain measurements, or the sign of the magnitude is flipped for time-domain measurements).

Magnitude, Phase averaging:
Calculate average Magnitude and average Phase values
Calculate DC magnitude and DC phase
Calculate magnitude variation and phase variation
Calculate magnitude error (percent) and phase error (milliradians)

Convert averages to Real, Imaginary values
Calculate DC Real and DC Imaginary values

Real, Imaginary averaging:
Convert raw values to Real, Imaginary values
Calculate average Real and average Imaginary values
Calculate DC Real and DC Imaginary values
Calculate Real variation and Imaginary variations

Convert averages to Magnitude, Phase values
Calculate DC Magnitude and DC Phase values
Calculate Magnitude error (percent) and Phase error (milliradians) from Real, Imaginary variances and Magnitude, Phase averages.

Definitions:
DC corrections, given values at three frequencies:

$$ValueDC = c1 * ValueF1 + c2 * ValueF2 + c3 * ValueF3$$

The coefficients c1,c2,c3 depend upon the frequency relationship and selected calculation, according to mode DC3PT. Several calculations for binary harmonic frequencies are available (like .125,.375,.625 Hz), and one is available for binary fundamental frequencies (like .125,.250,.500 Hz).

Error estimates:

$$Variance = \frac{\sum_{i=1}^{n} (x - \bar{x})^2}{N}$$ Variance, based upon the entire population.

$$SEM = \sqrt{Variance}$$ Standard Error of the Mean

$$CVar = \left| 100 * \frac{SEM}{avg} \right|$$ Coefficient of Variation, magnitude data, %

$$SPhz = 1000 * SEM$$ SEM, phase data, milliradians

Variance for DC-corrected values, given variance for each factor:

$$VarDC = \sqrt{(c1 * VarF1)^2 + (c2 * VarF2)^2 + (c3 * VarF3)^2}$$

Error estimates for Magnitude and Phase, from Real and Imaginary variances:

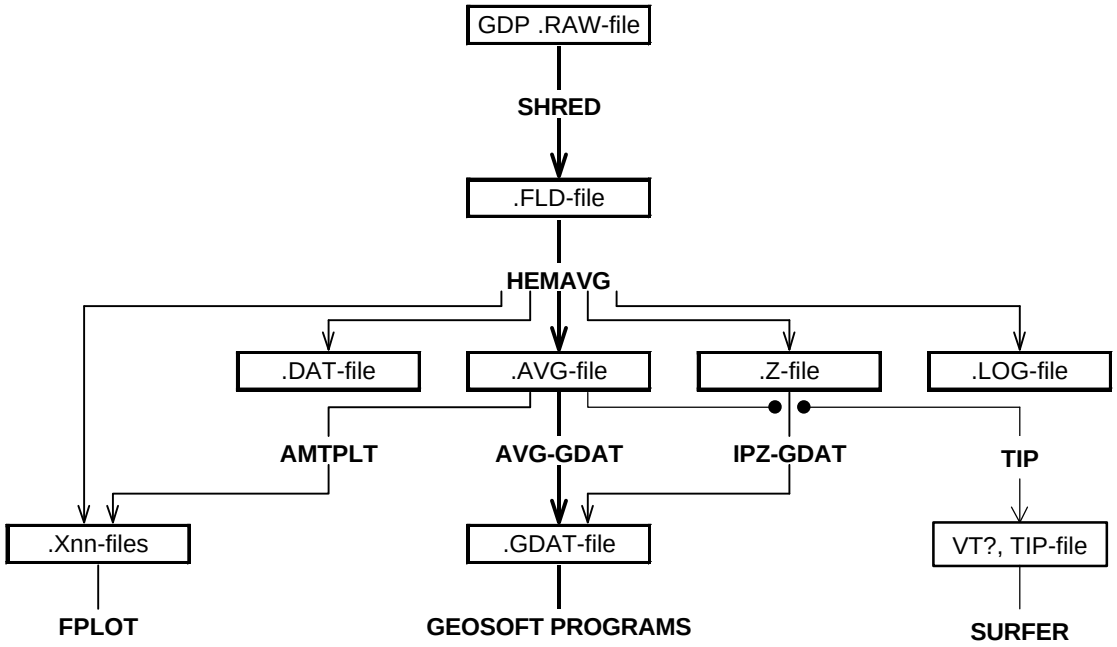
$$ErrorMag = 100 * \frac{\sqrt{(Var\,\mathrm{Re} * \cos(AvgPhz))^2 + (Var\,\mathrm{Im} * \sin(AvgPhz))^2}}{AvgMag}$$

$$ErrorPhz = 1000 * \frac{\sqrt{(Var\,\mathrm{Re} * \sin(AvgPhz))^2 + (Var\,\mathrm{Im} * \cos(AvgPhz))^2}}{AvgMag}$$

HARMONIC DATA PROCESSING FLOW

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

Bold lines ━━ show standard GDP data processing flow.



Other files read or written:

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

HEMAVG Usage

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

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

Several variable parameters called "MODES" influence the operation of HEMAVG. 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 HEMAVG.

HEMAVG MODE DISPLAY

PROCESSING MODES USED:

CONTROL MODES	AutoRun	LowFreq	Calculate	Polarity	GridOrgX	GridOrgY
mode names	AUTO	FMIN	CALC	SIGN	GORX	GORY
mode values	YES	1st Data	Real/Imag	NO	NONE	NONE
OUTPUT MODES	DataFile	PlotFile	.Z-ratio	Xvalues	Zvalues	
mode names	DFILE	ZFILE	ZTWO	XVALUE	ZVALUE	
mode values	YES	Ex	NONE	Pp	Raw	
PLOT MODES	DataPlot	NumPlots	Screen			
mode names	PLOT	NUMCURVES	VIEW			
mode values	None	4	NONE			

HEMAVG ERROR MESSAGES

If errors or inconsistencies arise within the program, HEMAVG 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 included in a .LOG-file, which provides documentation of the program operation, especially useful when running several programs automatically from a batch file.

Note: a station whose data is split into different .FLD-files is processed as two separate stations.

HEMAVG OUTPUT SELECTIONS

HEMAVG will write average data (.AVG- and .DAT-files), and plot data (.Z-file). A .LOG-file is automatically created by HEMAVG. Vector plot files will be written according to mode PLOT.

HEMAVG Sample Run

Input files: HARMONIC.FLD, HARMONIC.MDE
Output files: HARMONIC.LOG, HARMONIC.AVG, HARMONIC.DAT, HARMONIC.Z , HARMONIC.Xnn

***** NOTE: responses to prompts are in *italic* type; comments regarding program operation are enclosed in stars *****

```
C: > HEMAVG

ZONGE ENGINEERING: 3322 E. Fort Lowell, Tucson AZ 85716, USA
HEMAVG 7.40: AVERAGING PROGRAM FOR HARMONIC DATA.
   MS-DOS version implemented 14 March, 1997.

Reading global file   "D:\DATPRO\DATPRO.MDE"
End of global file
Reading mode file  1: "HARMONIC.MDE"
End of mode file   1

Data filename [quit]: harmonic                      *** Enter .FLD-file   ***

MODE CLIENT  =ZONGE ENGINEERING
MODE PROJECT =Sample Data
MODE JOBNUMB =91000
MODE JOBDATE =Jan 91
MODE JOBLINE =HARMONIC

(Type MENU for assistance with MODEs.)

MODE Change [name?, name= value] : ZFILE= Hx        *** Select Hx ***

MODE Change [name?, name= value] : ZTWO = Hz        *** and select Hz  ***

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

Files used: "HARMONIC.FLD", and "HARMONIC.MDE"

    Tx        Rx    N-Sp Cmp  Line  Avg  Dat
  4400.     3600.    3.   Ex    14    1    1
  4400.     3600.    3.   Hx    26    2    1
  4400.     3600.    3.   Hz    38    3    1
    Tx        Rx    N-Sp Cmp  Line  Avg  Dat
  4200.     3600.    2.   Ex    47    4    2
  4200.     3600.    2.   Hx    56    5    2
  4200.     3600.    2.   Hz    65    6    2
    Tx        Rx    N-Sp Cmp  Line  Avg  Dat
  4000.     3600.    1.   Ex    74    7    3
  4000.     3600.    1.   Hx    83    8    3
  4000.     3600.    1.   Hz    92    9    3
     |
    Tx        Rx    N-Sp Cmp  Line  Avg  Dat
  4000.     3200.    3.   Ex   263   28   10
  4000.     3200.    3.   Hx   272   29   10
  4000.     3200.    3.   Hz   281   30   10
    Tx        Rx    N-Sp Cmp  Line  Avg  Dat
  3800.     3200.    2.   Ex   290   31   11
  3800.     3200.    2.   Hx   299   32   11
  3800.     3200.    2.   Hz   308   33   11
    Tx        Rx    N-Sp Cmp  Line  Avg  Dat
  3600.     3200.    1.   Ex   317   34   12
  3600.     3200.    1.   Hx   326   35   12
  3600.     3200.    1.   Hz   334   36   12

Completing and closing files . . .
File "HARMONIC.AVG" contains averaged data for  36 stations.
File "HARMONIC.DAT" contains combined data for  12 stations.
Log file "HARMONIC.LOG" closed.

Data filename [quit]: <CR>          *** Press RETURN      ***
Thank You !!
```

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.

HEMAVG MODE LIST

PROCESSING MODE DEFAULT VALUES:

CONTROL MODES	AutoRun	LowFreq	Calculate	DC Extrap	GridOrgX	GridOrgY
mode names	AUTO	FMIN	CALC	DC3PT	GORX	GORY
mode values	YES	1st Data	Re/Im	3LOW	NONE	NONE
OUTPUT MODES	DataFile	PlotFile	.Z-ratio	Xvalues	Yvalues	Zvalues
mode names	DFILE	ZFILE	ZTWO	XVALUE	YVALUE	ZVALUE
mode values	YES	Ex	NONE	Pp	None	Raw
PLOT MODES	DataPlot	NumPlots	Screen			Polarity
mode names	PLOT	NUMCURVES	VIEW			SIGN
mode values	None	4	NONE			NO

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, in Hz.
Default: FRQLO= NONE

FRQHI

High frequency, plot limit

Values: FRQHI=
NONE, or high frequency limit, in 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 (10 chr max)

Values: RX2TX= Direction from Rx Line to Tx
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. Output files will be according to default values or as specified by .MDE-file entries.

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

FMIN

Mode FMIN specifies a reference frequency. (normally a fundamental)

If FMIN= ALL, data for all frequencies will be included, and the Y-value will be set to 9+log2(FREQ). [valid only for ratio or difference data, when mode ZTWO has been set to a second component] Also see mode ZFILE.

The default frequency is specified by mode FRQLO. A fundamental or harmonic frequency may be entered, in Hertz. Specify the entry as an expression or as a numeric value:

(1) "0.375" or "3/8"
(2) "24" or "3*8"
(3) "3072" or "3*1024"

Mode FMIN specifies the frequency for which 3-Pt DC Magnitude, Raw Phase and 3-Pt DC Phase data are included in the .Z-file. 3-Pt DC data are calculated using the 1st, 3rd, and 5th harmonics of the fundamental of the specified frequency. Also see mode CALC.

Values: FMIN=
frequency (Hz) (fraction or numeric)
Default: FMIN= 1st Data

GAIN

THIS MODE IS NOT ENABLED.

If gains change during data acquisition, real components of curve segments are adjusted automatically to fit the curve for the next lower fundamental frequency. The operator may wish to require curve adjustment for all data, whether or not gains were changed during acquisition. Mode GAIN specifies the default value, normally no curve adjust when no gain change. Set mode GAIN = REAL, and real components will be adjusted for all curves. Set mode GAIN= BOTH, and both real and imaginary components will be adjusted for all curves.

Values: GAIN= NONE, REAL, or BOTH.
Default: GAIN= NONE

CALC

Data may be averaged using Magnitude/Phase or Real/Imaginary values. When Mag/Phz averaging is used, and component phase values are near pi (±3142.mr), the phase average is unpredictable, with a large variation (error) between values. Use of Re/Im averaging will provide useable results, except when data are very noisy.

Reference frequency parameters are DC-corrected by 3-Pt calculations. Measured magnitude values are normalized by current before averaging. In the .AVG-file, these are included in the records for which Freq=0. In the .Z-file, these are included in the sections for "3-PT DC MAGNITUDE" and "3-PT DC PHASE"

Parm	Method	Calculated from:
REAL	either	averaged Real values
IMAG	either	averaged Imag values
MAG	Mag/Phz	averaged Mag values
PHZ	Mag/Phz	averaged Phz values
MAG	Real/Imag	converted from REAL
PHZ	Real/Imag	converted from IMAG

Values: CALC=
Real/Imaginary or Magnitude/Phase
Default: CALC= Real/Imaginary

DC3PT

Magnitude, Phase, Real, and Imaginary components are extrapolated to minimize inductive coupling effects. Values are included in the .AVG-file, in records labeled with 0.Hz.

$ DC3PT= 3LOW 3-Pt LOW (DEFAULT)
$ DC3PT= 315 3-Pt 1.5
$ DC3PT= 325 3-Pt 2.5

The 3-Pt 1.5 and 2.5 methods are from Coggon, 1984, New three-point formulas for inductive coupling removal in induced polarization, Geophysics, v49, p307-309.

3-Pt LOW= 1.8750*h1-1.2500*h3+0.3750*h5
3-Pt 1.5 = 2.1141*h1-1.7282*h3+0.6141*h5
3-Pt 2.5 = 2.4683*h1-2.4918*h3+1.0235*h5

SIGN

CR Dipole-Dipole data are normally adjusted when the sign of the low-frequency magnitude is negative. This usually indicates that the polarity of the receive dipole is reversed. Both magnitude and phase values are multiplied by the sign of the low-frequency magnitude.

This adjustment is not expected for vector measurements, and by default will not be performed by HEMAVG.

Values: SIGN= No, or Yes
Default: SIGN= No

GORX

Grid coordinates used for Gradient and Schlumberger Arrays are expected to be specified in meters. Values may be larger than can be included in reports and data files.

Mode GridORiginX (GORX) specifies the X-Coordinate of an alternate origin. Grid Coordinates will be specified relative to the alternate origin. The smaller coordinate values may be better suited for files.

Values: GORX= Alternate GridOrigin,
X-direction, meters.
Default: GORX= NONE

GORY

Grid coordinates used for Gradient and Schlumberger Arrays are expected to be specified in meters. Values may be larger than can be included in reports and data files.

Mode GridORiginY (GORY) specifies the Y-Coordinate of an alternate origin. Grid Coordinates will be specified relative to the alternate origin. The smaller coordinate values may be better suited for files.

Values: GORY= Alternate GridOrigin,
Y-direction, meters.
Default: GORY= NONE

DFILE

Averaged data for all components and frequencies may be written to an .AVG-file and a .DAT-file, which are tabular files more suitable for use by non-Zonge programs.

The .AVG-file will include a record at Freq 0., with 3-Pt DC values for Magnitude, Phase, Real and Imag. See mode CALC.

Real and Imaginary data at other frequencies are normalized by the reference frequency Real component. See mode FMIN.

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

ZFILE

The averaged data for one component and one frequency may be written to a .Z-file for direct use by plot programs. Mode ZFILE specifies which component (if any) to write. See mode FMIN.

Mode ZTWO specifies a second component. The .Z-file data will include the ratio of the mode ZFILE magnitude to the mode ZTWO magnitudes at the mode FMIN frequency. Also included will be the mode ZFILE phase minus the mode ZTWO phase.

Values: ZFILE= None, Yes, or
component (Ex, Ey, Hx, Hy, Hz)
Default: ZFILE= Ex

ZTWO

Mode ZTWO specifies a second component, when mode ZFILE specifies the first component. The data written to the .Z-file will include the ratio of the mode ZFILE magnitude to the mode ZTWO magnitudes at the mode FMIN frequency. Also included will be the mode ZFILE phase minus the mode ZTWO phase. A file of 3-Pt Phase values is not included when mode ZTWO is specified.

Values: ZTWO= None, Yes, or
component (Ex, Ey, Hx, Hy, Hz)
Default: ZTWO= NONE

XVALUE

Plots and .Z-files may be written with a choice of X-values: Transmitter value, Receiver value, or Plot Point. Tx and Rx values are as provided by the input data file.

Plot Point is calculated dependent upon the Survey Array:

PseudoSections:
D-D Midpoint: Rx, Tx dipole centers N-Sp
P-D Midpoint: Tx pole, Rx dipole center N-Sp
P-P Midpoint: Tx, Rx poles N-Sp
Soundings:
Sch Tx value Station ID
PlanMaps:
Grd Rx dipole lowest numbered end Ry value
Rock Samples:
Lab RockSample ID

Mode XVALUE is effective for plots, and .Z-files when mode ZTWO is defined.

Values: XVALUE= Tx, Rx, or, Pp.
Default: XVALUE= Pp

YVALUE

Plots may be labeled with a Y-value (usually N-Spacing), when mode YVAL=NSp. By default, no Y-label is provided.

Values: YVALUE= Tx, Rx, or, Pp.
Default: YVALUE= Pp

ZVALUE

.Z-files may be written with a choice of Z-values: Raw data or Parameters calculated from raw values. Parameters include Apparent Resistivity, Raw Phase, 3-Point Decoupled Phase, and Tilt Angle.

Mode ZVALUE is used only when mode ZTWO is defined, and the ratio of magnitudes is interpreted as the Trigonometric Tangent of the Tilt Angle, expressed in degrees.

Values: ZVALUE= Raw or Parm.
Default: ZVALUE= Raw

PLOT

Data for each station will be plotted to a raster file, when mode PLOT is set. Plots are made using either:

1. combined log-Magnitude and Phase versus log-Frequency axes.
2. Real versus Imaginary axes. Error bars are not available.

Related modes:
VIEW = enables plot preview on screen.
NUMCURVES = the number of plots per page.
XVAL = the station label that will be used.
YVAL = exclude or include a Y-coordinate.

Values: PLOT= None, Mag/Phz, or Real/Imag.
Default: PLOT= None

NUMC

Data plots may include multiple components per page, according to mode NUMCURVES.

1: One component per page, full page format.
2: One or two components per page, half page format.
3: One to three components per page, quarter page format.
4: One to four components per page, quarter page format.

When NUMCURVES is positive, each page will include plots from ONE station.

When NUMCURVES is negative, each page will include plots from MULTIPLE stations.

Related modes:
PLOT = the type of plot.
VIEW = enables plot preview on screen.
XVAL = the station label that will be used.
YVAL = exclude or include a Y-coordinate.

Values: NUMCURVES=
1 to 4 (one stn) or -1 to -4 (mix stns)
Default: NUMCURVES= 4

VIEW

A screen plot of station curves as they are created may be selected by mode VIEW. The plot will be scaled to fit on one screen. Note that plot limits are set automatically: manual limits are not yet available.

Related modes:
PLOT= the type of plot.
NUMCURVES = the number of plots per page.
XVAL = the station label that will be used.
YVAL = exclude or include a Y-coordinate.

Values: VIEW= None, or Screen.
Default: VIEW= None

Appendix B ... SAMPLE FILES

Sample .LOG-file (partial)

```
HEMAVG 7.40, Processed: 28 Apr 97
ZONGE ENGINEERING                        Sample Data

GLOBAL MODE LIST:
```

COMPANY Zonge Engineering CLIENT ZONGE ENGINEERING PROJECT Sample Data			JOBNUMB 91000 JOBDATE Jan 91 JOBLINE HARMONIC	TXLEN TXBRG TXDIS
BRGBACK S 90 W STNLO 2600.0 LBLFRST STNLO	RXBRG East STNDELT 200.0 LBLDELT 200.0	BRGLINE N 90 E STNHI 7000.0 PLTREV NO	FRQLO 1/8 Hz FRQHI 32. Hz UNITS METERS	RX2TX TXCX TXCY

PROCESSING MODES USED:

CONTROL MODES mode names mode values	AutoRun AUTO YES	LowFreq FMIN 0.125 Hz	Calculate CALC Re/Im	DC Extrap DC3PT 3LOW	GridOrgX GORX NONE	GridOrgY GORY NONE
OUTPUT MODES mode names mode values	DataFile DFILE YES	PlotFile ZFILE Hx	.Z-ratio ZTWO Hz	Xvalues XVALUE Pp	Yvalues YVALUE None	Zvalues ZVALUE Raw
PLOT MODES mode names mode values	DataPlot PLOT None	NumPlots NUMCURVES 4	Screen VIEW NONE			Polarity SIGN NO

```
Files used: "HARMONIC.FLD", and "HARMONIC.MDE"

 Job 91000       Date 90-12-27  Line HARMONIC    A-Sp   61.0 meters
 blk: line  freq____Tx_____Rx____NSp  curr   G_mix   Sem  stks arr cmp pi avg
  36:    3  1024  4400.   3600.   3.    1.6    5 0    0.  16384 D-D  Ex  0  1
  37:    4  1024  4400.   3600.   3.    1.6    5 0    0.  16384 D-D  Ex  0  1
  38:    5  1024  4400.   3600.   3.    1.6    5 0    1.5 16384 D-D  Ex  0  0
  34:    6   128  4400.   3600.   3.    1.4    5 1    0.  16384 D-D  Ex  0  1
  35:    7   128  4400.   3600.   3.    1.4    5 1    0.  16384 D-D  Ex  0  1
  32:    8    16  4400.   3600.   3.    1.4    5 1    0.   8192 D-D  Ex  0  1
  33:    9    16  4400.   3600.   3.    1.4    5 1    0.   8192 D-D  Ex  0  1
  30:   10     1  4400.   3600.   3.    1.4    5 1    0.    512 D-D  Ex  0  1
  31:   11     1  4400.   3600.   3.    1.4    5 1    0.    512 D-D  Ex  0  1
  28:   12  .125  4400.   3600.   3.    1.3    5 1    0.     64 D-D  Ex  0  1
  29:   13  .125  4400.   3600.   3.    1.3    5 1    0.     64 D-D  Ex  0  1
...

 Job 91000       Date 90-12-28  Line HARMONIC    A-Sp   61.0 meters
 blk: line  freq____Tx_____Rx____NSp  curr   G_mix   Sem  stks arr cmp pi avg
 130:  327  1024  3600.   3200.   1.    3.8    4 0    0.  16384 D-D  Hz  0  1
 131:  328  1024  3600.   3200.   1.    3.8    4 0    0.  16384 D-D  Hz  0  1
 128:  329   128  3600.   3200.   1.    3.8    7 1    0.1  8192 D-D  Hz  0  1
 129:  330   128  3600.   3200.   1.    3.8    7 1    0.1  4096 D-D  Hz  0  1
 126:  331    16  3600.   3200.   1.    3.8    9 1    0.7  1024 D-D  Hz  0  1
 127:  332    16  3600.   3200.   1.    3.8    9 1    0.8  1024 D-D  Hz  0  1
 124:  333  .125  3600.   3200.   1.    3.6   12 1  331.2     8 D-D  Hz  0  1
 125:  334  .125  3600.   3200.   1.    3.6   12 1  265.      8 D-D  Hz  0  1

File "HARMONIC.AVG" contains averaged data for  36 stations.
File "HARMONIC.DAT" contains combined data for  12 stations.
Log file "HARMONIC.LOG" closed.
```

Sample .FLD-file (partial: only data for Tx=4400, Rx=3600, N-Sp=3.0)
(columns 1-129 followed by remaining columns)

```
Reference ruler line                                                                                       1         1         1
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8----+----9----+----0----+----1----+----2----+---
/* SHRED v3.42: "HARMONIC.FLD"
H 1 0027   1 3 CR  0516 90-12-27  9:53:36 12.2 D-D        1    1   61.0     1   2500.0 E   1      0
D 1 0036   1 3 90-12-27 12:02:10 12.1  1024 16384  1.60        4400      3600     Ex 0        3  24.970e-3   996.7       140.9
D 1 0037   1 3 90-12-27 12:04:34 12.1  1024 16384  1.60        4400      3600     Ex 0        3  24.970e-3   996.6       140.9
D 0 0038   1 3 90-12-27 12:11:35 12.1  1024 16384  1.60        4400      3600     Ex 0        3  25.364e-3  2511.7       143.2
D 1 0034   1 3 90-12-27 11:49:23 12.1   128 16384  1.40        4400      3600     Ex 0        3  25.737e-3  2351.0       166.0
D 1 0035   1 3 90-12-27 11:57:24 12.1   128 16384  1.40        4400      3600     Ex 0        3  25.727e-3  2351.5       166.0
D 1 0032   1 3 90-12-27 11:31:00 12.1    16  8192  1.40        4400      3600     Ex 0        3  26.177e-3    -9.4       168.9
D 1 0033   1 3 90-12-27 11:39:52 12.1    16  8192  1.40        4400      3600     Ex 0        3  26.155e-3    -9.5       168.7
D 1 0030   1 3 90-12-27 11:12:33 12.2     1   512  1.40        4400      3600     Ex 0        3  26.434e-3     4.5       170.5
D 1 0031   1 3 90-12-27 11:21:20 12.2     1   512  1.40        4400      3600     Ex 0        3  26.422e-3     4.9       170.4
D 1 0028   1 3 90-12-27 10:53:25 12.2  .125    64  1.30        4400      3600     Ex 0        3  25.881e-3     2.2       179.8
D 1 0029   1 3 90-12-27 11:02:41 12.2  .125    64  1.30        4400      3600     Ex 0        3  25.867e-3     2.3       179.7
H 1 0027   2 4 CR  0516 90-12-27  9:53:36 12.2 D-D        1    1   61.0     1   2500.0 E   1      0
D 1 0036   2 4 90-12-27 12:02:10 12.1  1024 16384  1.60        4400      3600     Hx 0        3  3.8060e-3 -1145.9       8.593
D 1 0037   2 4 90-12-27 12:04:34 12.1  1024 16384  1.60        4400      3600     Hx 0        3  3.8068e-3 -1146.2       8.595
D 0 0038   2 4 90-12-27 12:11:35 12.1  1024 16384  1.60        4400      3600     Hx 0        3  3.8087e-3 -1144.6       8.599
D 1 0034   2 4 90-12-27 11:49:23 12.1   128 16384  1.40        4400      3600     Hx 0        3  279.10e-6  -856.9       720.1e-3
D 1 0035   2 4 90-12-27 11:57:24 12.1   128 16384  1.40        4400      3600     Hx 0        3  280.39e-6  -863.6       723.5e-3
D 1 0032   2 4 90-12-27 11:31:00 12.1    16  8192  1.40        4400      3600     Hx 0        3  30.391e-6 -1579.2       78.41e-3
D 1 0033   2 4 90-12-27 11:39:52 12.1    16  8192  1.40        4400      3600     Hx 0        3  31.196e-6 -1554.7       80.49e-3
D 1 0030   2 4 90-12-27 11:12:33 12.2     1   512  1.40        4400      3600     Hx 0        3  0.8375e-6  -826.9       2.161e-3
D 1 0031   2 4 90-12-27 11:21:20 12.2     1   512  1.40        4400      3600     Hx 0        3  7.4283e-6 -1121.5       19.17e-3
D 1 0028   2 4 90-12-27 10:53:25 12.2  .125    64  1.30        4400      3600     Hx 0        3  3.8418e-6  1419.4       10.68e-3
D 1 0029   2 4 90-12-27 11:02:41 12.2  .125    64  1.30        4400      3600     Hx 0        3  3.4685e-6  1869.3       9.638e-3
H 1 0027   3 5 CR  0516 90-12-27  9:53:36 12.2 D-D        1    1   61.0     1   2500.0 E   1      0
D 1 0036   3 5 90-12-27 12:02:10 12.1  1024 16384  1.60        4400      3600     Hz 0        3  5.1101e-3  -814.0       28.84
D 1 0037   3 5 90-12-27 12:04:34 12.1  1024 16384  1.60        4400      3600     Hz 0        3  5.1109e-3  -814.0       28.85
D 0 0038   3 5 90-12-27 12:11:35 12.1  1024 16384  1.60        4400      3600     Hz 0        3  5.1269e-3  -817.2       28.94
D 1 0034   3 5 90-12-27 11:49:23 12.1   128 16384  1.40        4400      3600     Hz 0        3  560.01e-6  -814.5       3.612
D 1 0035   3 5 90-12-27 11:57:24 12.1   128 16384  1.40        4400      3600     Hz 0        3  561.61e-6  -816.4       3.623
D 1 0032   3 5 90-12-27 11:31:00 12.1    16  8192  1.40        4400      3600     Hz 0        3  67.113e-6 -1602.1       432.9e-3
D 1 0033   3 5 90-12-27 11:39:52 12.1    16  8192  1.40        4400      3600     Hz 0        3  67.769e-6 -1597.2       437.1e-3
D 1 0030   3 5 90-12-27 11:12:33 12.2     1   512  1.40        4400      3600     Hz 0        3  4.5909e-6 -1527.7       29.61e-3
D 1 0031   3 5 90-12-27 11:21:20 12.2     1   512  1.40        4400      3600     Hz 0        3  4.5887e-6 -1662.0       29.60e-3
D 1 0028   3 5 90-12-27 10:53:25 12.2  .125    64  1.30        4400      3600     Hz 0        3  1.0207e-6   963.8       7.090e-3
D 1 0029   3 5 90-12-27 11:02:41 12.2  .125    64  1.30        4400      3600     Hz 0        3  2.0317e-6 -2545.5       14.11e-3
...
```

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

0050    0.00       -0.96   2.69e+3     1  24.970e-3   947.0  20.319e-3 -3056.7  23.403e-3  -826.8  27.363e-3  1452.5  143.96e-3 -2808.9
0050    0.00       -0.96   2.69e+3     1  24.970e-3   947.0  20.285e-3 -3055.3  23.336e-3  -821.8  27.379e-3  1459.5  143.27e-3 -2805.0
0050    1.54       -0.96   2.69e+3     1  25.364e-3   939.8  20.987e-3  3122.3  22.794e-3  -989.3  24.244e-3  1294.3  142.34e-3 -2864.3
0050    0.01       -0.41   2.69e+3     1  25.737e-3   893.0  25.118e-3  2681.5  24.338e-3 -1796.1  23.443e-3    23.1  22.654e-3  1851.3
0050    0.01       -0.41   2.69e+3     1  25.727e-3   892.9  25.106e-3  2681.5  24.307e-3 -1796.7  23.423e-3    23.6  22.634e-3  1850.6
0050    0.01        0.55   2.69e+3     1  26.177e-3    89.4  26.349e-3   249.9  26.402e-3   411.3  26.361e-3   573.4  26.298e-3   736.6
0050    0.01        0.55   2.69e+3     1  26.155e-3    89.3  26.321e-3   249.4  26.373e-3   410.2  26.337e-3   572.0  26.270e-3   734.8
0050    0.01        1.38   2.69e+3     1  26.434e-3     0.5  26.528e-3     6.5  26.634e-3     7.1  26.696e-3     6.7  26.746e-3     5.7
0050    0.01        1.38   2.69e+3     1  26.422e-3     0.4  26.516e-3     6.8  26.627e-3     7.8  26.704e-3     7.2  26.746e-3     6.2
0050    0.03        2.48   2.69e+3     1  25.881e-3    -2.2  25.820e-3    -1.7  25.789e-3    -0.4  25.768e-3     1.0  25.760e-3     2.5
0050    0.03        2.48   2.69e+3     1  25.867e-3    -2.2  25.804e-3    -1.7  25.771e-3    -0.5  25.757e-3     1.0  25.748e-3     2.4

0060    0.11        1.24   90.3        1  3.8060e-3  2631.6  12.701e-3 -2213.7  22.271e-3  -726.1  24.231e-3   949.5  153.75e-3 -3033.0
0060    0.10        1.24   90.3        1  3.8068e-3  2632.0  12.701e-3 -2213.1  22.245e-3  -725.2  24.212e-3   949.0  153.99e-3 -3032.4
0060    0.13        1.24   90.3        1  3.8087e-3  2631.9  12.703e-3 -2212.2  22.209e-3  -726.0  24.255e-3   950.4  154.05e-3 -3032.3
0460    0.68        1.38   90.3        1  279.10e-6  2628.2  1.0325e-3 -1772.4  1.9585e-3    -8.7  2.9777e-3  1738.3  4.0494e-3 -2804.9
0460    0.86        1.38   90.3        1  280.39e-6  2629.7  1.0320e-3 -1775.5  1.9640e-3    -8.8  2.9772e-3  1738.4  4.0489e-3 -2801.9
0260    2.44        1.51   90.3        1  30.391e-6  1684.5  103.24e-6  1891.0  174.05e-6  2092.2  253.42e-6  2300.9  330.12e-6  2494.2
0260    2.14        1.51   90.3        1  31.196e-6  1672.2  103.08e-6  1894.3  174.02e-6  2099.5  250.57e-6  2299.4  330.38e-6  2494.9
0660   34.72        1.65   90.3        1  0.8375e-6  1019.5  5.4206e-6  1336.3  13.016e-6  1562.2  17.631e-6  1440.8  6.2930e-6  1260.6
0660   35.64        1.65   90.3        1  7.4283e-6  1446.6  11.822e-6  1908.0  12.436e-6  2117.7  18.836e-6  2340.0  23.392e-6  1192.9
0260  106.33        1.79   90.3        1  3.8418e-6   132.5  16.644e-6  1265.9  9.8887e-6  -227.9  43.802e-6  -223.5  8.5977e-6  -449.9
0260  100.44        1.79   90.3        1  3.4685e-6 -1216.3  7.5404e-6  -393.6  15.309e-6  -215.3  20.140e-6   -37.6  25.185e-6   426.7

0060    0.07       20.22    101        1  5.1101e-3  2289.7  11.834e-3 -2524.1  15.052e-3  -936.4  13.027e-3   872.4  81.804e-3  3101.1
0060    0.07       20.22    101        1  5.1109e-3  2289.9  11.833e-3 -2523.5  15.041e-3  -935.6  12.999e-3   874.8  81.668e-3  3100.0
0060    0.53       20.22    101        1  5.1269e-3  2289.1  12.029e-3 -2535.2  15.654e-3  -961.5  13.675e-3   806.1  87.414e-3  3065.5
0360    0.21       20.35    101        1  560.01e-6  2485.5  1.7671e-3 -2046.9  2.9983e-3  -323.2  4.1628e-3  1407.1  5.2731e-3  3139.8
0360    0.20       20.35    101        1  561.61e-6  2486.3  1.7667e-3 -2047.0  2.9978e-3  -322.8  4.1644e-3  1407.0  5.2732e-3  3139.8
0560    1.08       20.49    101        1  67.113e-6  1678.5  206.84e-6  1833.6  354.99e-6  1992.0  498.66e-6  2168.8  649.87e-6  2330.9
0560    0.98       20.49    101        1  67.769e-6  1672.1  209.18e-6  1830.6  355.17e-6  2000.6  498.32e-6  2167.5  648.85e-6  2330.6
0660   36.40       20.35    101        1  4.5909e-6  1555.3  12.164e-6  1587.4  22.209e-6  1588.7  29.189e-6  1574.6  42.607e-6  1588.9
0660   36.68       20.35    101        1  4.5887e-6  1585.3  13.225e-6  1514.5  21.302e-6  1554.0  30.731e-6  1596.9  40.424e-6  1580.5
0560   95.94       20.49    101        1  1.0207e-6  -135.8  3.2362e-6   976.7  2.5016e-6  1364.4  4.1030e-6  1866.7  8.4259e-6  2099.4
0560  111.50       20.49    101        1  2.0317e-6  1933.4  4.1602e-6  1308.6  3.4669e-6  1483.3  5.8513e-6  1381.7  4.5858e-6  1308.3
...
```

Sample .AVG-file (partial: only data for Tx=4400, Rx=3600, N-Sp=3.0)

```
\ HEMAVG 7.40: "HARMONIC.FLD", Dated 90-12-27, Processed 28 Apr 97
$ ASPACE=  61.0m
\ 0.Hz Mag= 3-Pt Mag @  .1250  Hz , Phz= 3-Pt Phz (harmonics 1,3,5 @  .1250  Hz ) 3LOW
skp     Tx       Rx     PltPt    NSp  Freq Cmp Amps  Magnitude   Phase     Real       Imag      %Mag   sPhz
\=++=======++=======++=======++====++=====++=++=====++==========++======++==========+=========++======++======+
 2   4400.    3600.    4100.     3. 0.     Ex  0.    1.9936e-2    -2.2  1.9936e-2 -4.3254e-5    0.1    0.2
 2   4400.    3600.    4100.     3. 0.125  Ex  1.3   1.9903e-2    -2.2  1.0000e+0 -2.2000e-3    0.     0.
 2   4400.    3600.    4100.     3. 0.375  Ex  1.3   1.9855e-2    -1.7  9.9760e-1 -1.6959e-3    0.     0.
 2   4400.    3600.    4100.     3. 0.625  Ex  1.3   1.9831e-2    -0.4  9.9637e-1 -4.4835e-4    0.     0.
 2   4400.    3600.    4100.     3. 0.875  Ex  1.3   1.9817e-2     1.   9.9569e-1  9.9569e-4    0.     0.
 2   4400.    3600.    4100.     3. 1.125  Ex  1.3   1.9811e-2     2.5  9.9536e-1  2.4387e-3    0.     0.1
 2   4400.    3600.    4100.     3. 1.     Ex  1.3   1.8877e-2     0.4  9.4846e-1  4.2682e-4    0.     0.1
 2   4400.    3600.    4100.     3. 3.     Ex  1.3   1.8944e-2     6.7  9.5181e-1  6.3296e-3    0.     0.1
 2   4400.    3600.    4100.     3. 5.     Ex  1.3   1.9022e-2     7.4  9.5570e-1  7.1200e-3    0.     0.3
 2   4400.    3600.    4100.     3. 7.     Ex  1.3   1.9071e-2     6.9  9.5819e-1  6.6596e-3    0.     0.3
 2   4400.    3600.    4100.     3. 9.     Ex  1.3   1.9104e-2     6.   9.5985e-1  5.7112e-3    0.     0.2
 2   4400.    3600.    4100.     3. 16.    Ex  1.3   1.8690e-2    89.4  9.3531e-1  8.3793e-2    0.     0.1
 2   4400.    3600.    4100.     3. 48.    Ex  1.3   1.8811e-2   249.7  9.1582e-1  2.3351e-1    0.     0.4
 2   4400.    3600.    4100.     3. 80.    Ex  1.3   1.8848e-2   410.8  8.6823e-1  3.7814e-1    0.     0.7
 2   4400.    3600.    4100.     3. 112.   Ex  1.3   1.8821e-2   572.7  7.9474e-1  5.1243e-1    0.     0.7
 2   4400.    3600.    4100.     3. 144.   Ex  1.3   1.8774e-2   735.7  6.9932e-1  6.3305e-1    0.1    0.8
 2   4400.    3600.    4100.     3. 128.   Ex  1.3   1.8380e-2   893.   5.7913e-1  7.1932e-1    0.     0.1
 2   4400.    3600.    4100.     3. 384.   Ex  1.3   1.7937e-2  2681.5 -8.0751e-1  4.0017e-1    0.     0.1
 2   4400.    3600.    4100.     3. 640.   Ex  1.3   1.7373e-2 -1796.4 -1.9526e-1 -8.5077e-1    0.1    0.2
 2   4400.    3600.    4100.     3. 896.   Ex  1.3   1.6738e-2    23.4  8.4074e-1  1.9635e-2    0.     0.2
 2   4400.    3600.    4100.     3. 1152.  Ex  1.3   1.6174e-2  1851.  -2.2470e-1  7.8097e-1    0.     0.4
 2   4400.    3600.    4100.     3. 1024.  Ex  1.3   1.5606e-2   947.   4.5802e-1  6.3644e-1    0.     0.
 2   4400.    3600.    4100.     3. 3072.  Ex  1.3   1.2689e-2 -3056.  -6.3519e-1 -5.4501e-2    0.1    0.6
 2   4400.    3600.    4100.     3. 5120.  Ex  1.3   1.4606e-2  -824.3  4.9834e-1 -5.3870e-1    0.2    2.
 2   4400.    3600.    4100.     3. 7168.  Ex  1.3   1.7107e-2  1456.   9.8451e-2  8.5385e-1    0.1    3.4
 2   4400.    3600.    4100.     3. 9216.  Ex  1.3   8.9759e-2 -2807.  -4.2597e+0 -1.4811e+0    0.3    1.4
 2   4400.    3600.    4100.     3. 0.     Hx  0.   -7.3185e-7 -2055.2  1.4108e-6 -9.0163e-6 -960.7    0.
 2   4400.    3600.    4100.     3. 0.125  Hx  1.3   2.1980e-6  -501.1  1.0000e+0 -5.4773e-1   51.   617.2
 2   4400.    3600.    4100.     3. 0.375  Hx  1.3   6.7898e-6   826.4  2.3863e+0  2.5906e+0   78.6  724.9
 2   4400.    3600.    4100.     3. 0.625  Hx  1.3   9.6912e-6  -220.2  4.9058e+0 -1.0983e+0   20.6   61.2
 2   4400.    3600.    4100.     3. 0.875  Hx  1.3   2.4501e-5  -165.   1.2537e+1 -2.0881e+0   35.1  150.3
 2   4400.    3600.    4100.     3. 1.125  Hx  1.3   1.2073e-5   214.6  6.1190e+0  1.3336e+0   48.2  452.7
 2   4400.    3600.    4100.     3. 1.     Hx  1.3   2.9278e-6  1404.3  2.5175e-1  1.4978e+0   80.1  146.5
 2   4400.    3600.    4100.     3. 3.     Hx  1.3   5.9433e-6  1730.8 -4.9129e-1  3.0436e+0   35.3  311.9
 2   4400.    3600.    4100.     3. 5.     Hx  1.3   8.7418e-6  1833.5 -1.1774e+0  4.3792e+0   11.7  260.8
 2   4400.    3600.    4100.     3. 7.     Hx  1.3   1.1731e-5  1906.3 -2.0039e+0  5.7461e+0   19.2  444.1
 2   4400.    3600.    4100.     3. 9.     Hx  1.3   1.0598e-5  1207.2  1.9549e+0  5.1382e+0   50.3  283.3
 2   4400.    3600.    4100.     3. 16.    Hx  1.3   2.1995e-5  1678.3 -1.2239e+0  1.1344e+1    1.4    4.9
 2   4400.    3600.    4100.     3. 48.    Hx  1.3   7.3686e-5  1892.6 -1.2091e+1  3.6261e+1    0.1    1.3
 2   4400.    3600.    4100.     3. 80.    Hx  1.3   1.2431e-4  2095.8 -3.2324e+1  5.5799e+1    0.2    2.9
 2   4400.    3600.    4100.     3. 112.   Hx  1.3   1.8000e-4  2300.2 -6.2222e+1  6.9618e+1    0.4    4.1
 2   4400.    3600.    4100.     3. 144.   Hx  1.3   2.3589e-4  2494.6 -9.7634e+1  7.3767e+1    0.     0.3
 2   4400.    3600.    4100.     3. 128.   Hx  1.3   1.9982e-4  2629.  -9.0330e+1  5.0840e+1    0.2    1.2
 2   4400.    3600.    4100.     3. 384.   Hx  1.3   7.3732e-4 -1773.9 -7.7169e+1 -3.7462e+2    0.1    1.4
 2   4400.    3600.    4100.     3. 640.   Hx  1.3   1.4009e-3    -8.8  7.2668e+2 -6.3586e+0    0.1    0.1
 2   4400.    3600.    4100.     3. 896.   Hx  1.3   2.1268e-3  1738.3 -1.8399e+2  1.0878e+3    0.     0.
 2   4400.    3600.    4100.     3. 1152.  Hx  1.3   2.8922e-3 -2803.4 -1.4154e+3 -4.9779e+2    0.1    1.3
 2   4400.    3600.    4100.     3. 1024.  Hx  1.3   2.3790e-3  2631.8 -1.0772e+3  6.0223e+2    0.     0.1
 2   4400.    3600.    4100.     3. 3072.  Hx  1.3   7.9381e-3 -2213.4 -2.4678e+3 -3.2965e+3    0.     0.2
 2   4400.    3600.    4100.     3. 5120.  Hx  1.3   1.3911e-2  -725.7  5.3983e+3 -4.7889e+3    0.     0.5
 2   4400.    3600.    4100.     3. 7168.  Hx  1.3   1.5138e-2   949.3  4.5727e+3  6.3843e+3    0.     0.3
 2   4400.    3600.    4100.     3. 9216.  Hx  1.3   9.6169e-2 -3032.7 -4.9592e+4 -5.4216e+3    0.1    0.4
 2   4400.    3600.    4100.     3. 0.     Hz  0.   -1.3611e-6  1721.7 -1.0621e-6 -1.0995e-6 -116.9    0.
 2   4400.    3600.    4100.     3. 0.125  Hz  1.3   6.8662e-7  1407.3  1.0000e+0  6.0605e+0  113.7  975.1
 2   4400.    3600.    4100.     3. 0.375  Hz  1.3   2.8063e-6  1163.6  9.9430e+0  2.3052e+1   17.3  117.4
 2   4400.    3600.    4100.     3. 0.625  Hz  1.3   2.2916e-6  1433.5  2.8063e+0  2.0308e+1   16.7   41.8
 2   4400.    3600.    4100.     3. 0.875  Hz  1.3   3.7201e-6  1580.8 -3.3229e-1  3.3277e+1   18.8  237.4
 2   4400.    3600.    4100.     3. 1.125  Hz  1.3   4.6530e-6  1826.5 -1.0527e+1  4.0272e+1   25.5  439.1
 2   4400.    3600.    4100.     3. 1.     Hz  1.3   3.2781e-6  1570.3  1.4657e-2  2.9325e+1    0.    15.
 2   4400.    3600.    4100.     3. 3.     Hz  1.3   9.0615e-6  1549.4  1.7322e+0  8.1044e+1    4.1   37.3
 2   4400.    3600.    4100.     3. 5.     Hz  1.3   1.5537e-5  1571.8 -1.2724e-1  1.3899e+2    2.1   17.4
 2   4400.    3600.    4100.     3. 7.     Hz  1.3   2.1399e-5  1586.  -2.9174e+0  1.9141e+2    2.6   11.5
 2   4400.    3600.    4100.     3. 9.     Hz  1.3   2.9654e-5  1584.8 -3.7175e+0  2.6525e+2    2.6    4.6
 2   4400.    3600.    4100.     3. 16.    Hz  1.3   4.8172e-5  1675.3 -4.4946e+1  4.2859e+2    0.5    2.7
 2   4400.    3600.    4100.     3. 48.    Hz  1.3   1.4858e-4  1832.1 -3.4336e+2  1.2840e+3    0.6    1.5
 2   4400.    3600.    4100.     3. 80.    Hz  1.3   2.5363e-4  1996.3 -9.3656e+2  2.0666e+3    0.2    3.7
 2   4400.    3600.    4100.     3. 112.   Hz  1.3   3.5606e-4  2168.2 -1.7916e+3  2.6337e+3    0.     0.6
 2   4400.    3600.    4100.     3. 144.   Hz  1.3   4.6383e-4  2330.8 -2.8584e+3  3.0077e+3    0.1    0.6
 2   4400.    3600.    4100.     3. 128.   Hz  1.3   4.0058e-4  2485.9 -2.8404e+3  2.1849e+3    0.1    0.9
 2   4400.    3600.    4100.     3. 384.   Hz  1.3   1.2621e-3 -2047.  -5.1751e+3 -1.0034e+4    0.     0.1
 2   4400.    3600.    4100.     3. 640.   Hz  1.3   2.1415e-3  -323.   1.8166e+4 -6.0807e+3    0.     0.2
 2   4400.    3600.    4100.     3. 896.   Hz  1.3   2.9740e-3  1407.1  4.3370e+3  2.6249e+4    0.     0.1
 2   4400.    3600.    4100.     3. 1152.  Hz  1.3   3.7665e-3  3139.8 -3.3695e+4  6.0393e+1    0.     0.
 2   4400.    3600.    4100.     3. 1024.  Hz  1.3   3.1941e-3  2289.8 -1.8820e+4  2.1500e+4    0.     0.1
 2   4400.    3600.    4100.     3. 3072.  Hz  1.3   7.3959e-3 -2523.8 -5.3933e+4 -3.8324e+4    0.     0.2
 2   4400.    3600.    4100.     3. 5120.  Hz  1.3   9.4041e-3  -936.   4.9888e+4 -6.7738e+4    0.     0.3
 2   4400.    3600.    4100.     3. 7168.  Hz  1.3   8.1331e-3   873.6  4.6715e+4  5.5779e+4    0.1    1.2
 2   4400.    3600.    4100.     3. 9216.  Hz  1.3   5.1085e-2  3100.6 -4.5661e+5  1.8751e+4    0.1    0.5
...
```

Sample .DAT-file (partial: only data for Tx=4400, Rx=3600, N-Sp=3.0)
(columns 1-105 followed by remaining columns)

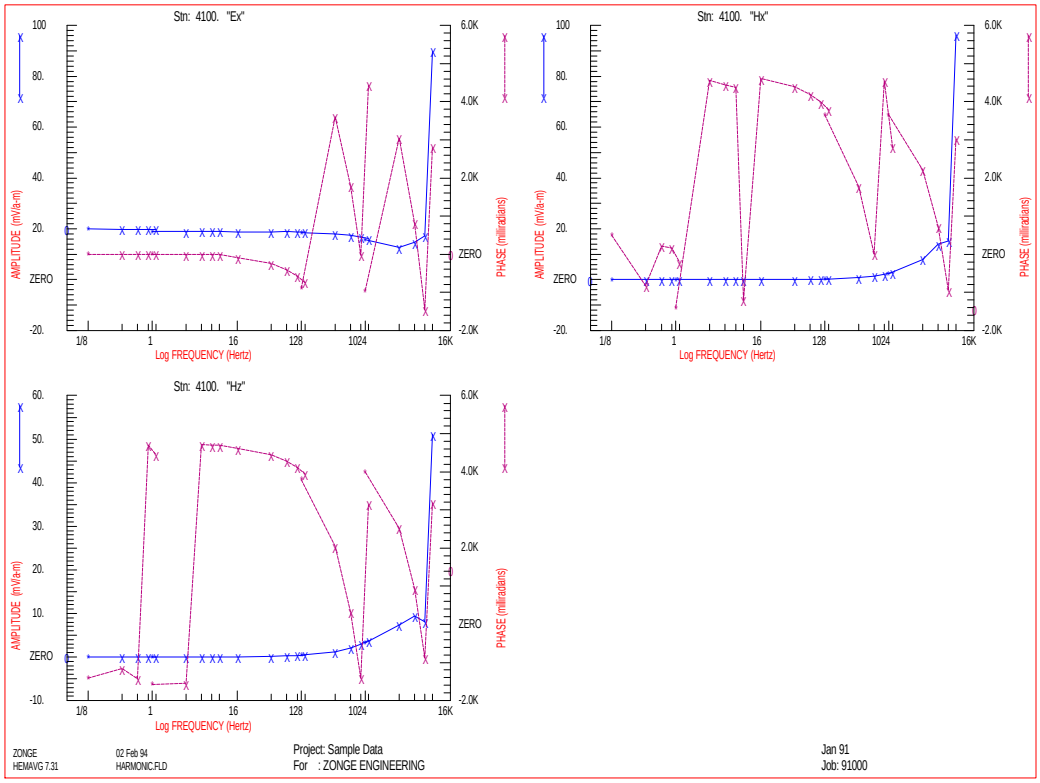
```
Reference ruler line
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8----+-
\ HEMAVG 7.40: "HARMONIC.FLD", Dated 90-12-28, Processed 28 Apr 97
skp     Tx       Rx     PltPt    NSp  Freq  Amps    Ex Mag    Ex Phz    Ey Mag   Ey Phz
\=++=======++=======++=======++====++====++====++=========++======++=========++======+
 2   4400.    3600.    4100.     3. 0.125   1.3   1.9903e-2    -2.2         *        *
 2   4400.    3600.    4100.     3. 0.375   1.3   1.9855e-2    -1.7         *        *
 2   4400.    3600.    4100.     3. 0.625   1.3   1.9831e-2    -0.4         *        *
 2   4400.    3600.    4100.     3. 0.875   1.3   1.9817e-2     1.0         *        *
 2   4400.    3600.    4100.     3. 1.125   1.3   1.9811e-2     2.5         *        *
 2   4400.    3600.    4100.     3. 1.      1.3   1.8877e-2     0.4         *        *
 2   4400.    3600.    4100.     3. 3.      1.3   1.8944e-2     6.7         *        *
 2   4400.    3600.    4100.     3. 5.      1.3   1.9022e-2     7.4         *        *
 2   4400.    3600.    4100.     3. 7.      1.3   1.9071e-2     6.9         *        *
 2   4400.    3600.    4100.     3. 9.      1.3   1.9104e-2     6.0         *        *
 2   4400.    3600.    4100.     3. 16.     1.3   1.8690e-2    89.4         *        *
 2   4400.    3600.    4100.     3. 48.     1.3   1.8811e-2   249.7         *        *
 2   4400.    3600.    4100.     3. 80.     1.3   1.8848e-2   410.8         *        *
 2   4400.    3600.    4100.     3. 112.    1.3   1.8821e-2   572.7         *        *
 2   4400.    3600.    4100.     3. 144.    1.3   1.8774e-2   735.7         *        *
 2   4400.    3600.    4100.     3. 128.    1.3   1.8380e-2   893.0         *        *
 2   4400.    3600.    4100.     3. 384.    1.3   1.7937e-2  2681.5         *        *
 2   4400.    3600.    4100.     3. 640.    1.3   1.7373e-2 -1796.4         *        *
 2   4400.    3600.    4100.     3. 896.    1.3   1.6738e-2    23.4         *        *
 2   4400.    3600.    4100.     3. 1152.   1.3   1.6174e-2  1851.0         *        *
 2   4400.    3600.    4100.     3. 1024.   1.3   1.5606e-2   947.0         *        *
 2   4400.    3600.    4100.     3. 3072.   1.3   1.2689e-2 -3056.0         *        *
 2   4400.    3600.    4100.     3. 5120.   1.3   1.4606e-2  -824.3         *        *
 2   4400.    3600.    4100.     3. 7168.   1.3   1.7107e-2  1456.0         *        *
 2   4400.    3600.    4100.     3. 9216.   1.3   8.9759e-2 -2807.0         *        *
...

             1         1         1         1         1         1         1
---9----+----0----+----1----+----2----+----3----+----4----+----5----+----6--
   Ez Mag   Ez Phz    Hx Mag   Hx Phz    Hy Mag   Hy Phz    Hz Mag   Hz Phz
+=========++======++=========++======++=========++======++=========++======+
         *       *   2.1980e-6  -501.1         *       *   6.8662e-7  1407.3
         *       *   6.7898e-6   826.4         *       *   2.8063e-6  1163.6
         *       *   9.6912e-6  -220.2         *       *   2.2916e-6  1433.5
         *       *   2.4501e-5  -165.0         *       *   3.7201e-6  1580.8
         *       *   1.2073e-5   214.6         *       *   4.6530e-6  1826.5
         *       *   2.9278e-6  1404.3         *       *   3.2781e-6  1570.3
         *       *   5.9433e-6  1730.8         *       *   9.0615e-6  1549.4
         *       *   8.7418e-6  1833.5         *       *   1.5537e-5  1571.8
         *       *   1.1731e-5  1906.3         *       *   2.1399e-5  1586.0
         *       *   1.0598e-5  1207.2         *       *   2.9654e-5  1584.8
         *       *   2.1995e-5  1678.3         *       *   4.8172e-5  1675.3
         *       *   7.3686e-5  1892.6         *       *   1.4858e-4  1832.1
         *       *   1.2431e-4  2095.8         *       *   2.5363e-4  1996.3
         *       *   1.8000e-4  2300.2         *       *   3.5606e-4  2168.2
         *       *   2.3589e-4  2494.6         *       *   4.6383e-4  2330.8
         *       *   1.9982e-4  2629.0         *       *   4.0058e-4  2485.9
         *       *   7.3732e-4 -1773.9         *       *   1.2621e-3 -2047.0
         *       *   1.4009e-3    -8.8         *       *   2.1415e-3  -323.0
         *       *   2.1268e-3  1738.3         *       *   2.9740e-3  1407.1
         *       *   2.8922e-3 -2803.4         *       *   3.7665e-3  3139.8
         *       *   2.3790e-3  2631.8         *       *   3.1941e-3  2289.8
         *       *   7.9381e-3 -2213.4         *       *   7.3959e-3 -2523.8
         *       *   1.3911e-2  -725.7         *       *   9.4041e-3  -936.0
         *       *   1.5138e-2   949.3         *       *   8.1331e-3   873.6
         *       *   9.6169e-2 -3032.7         *       *   5.1085e-2  3100.6
...
```

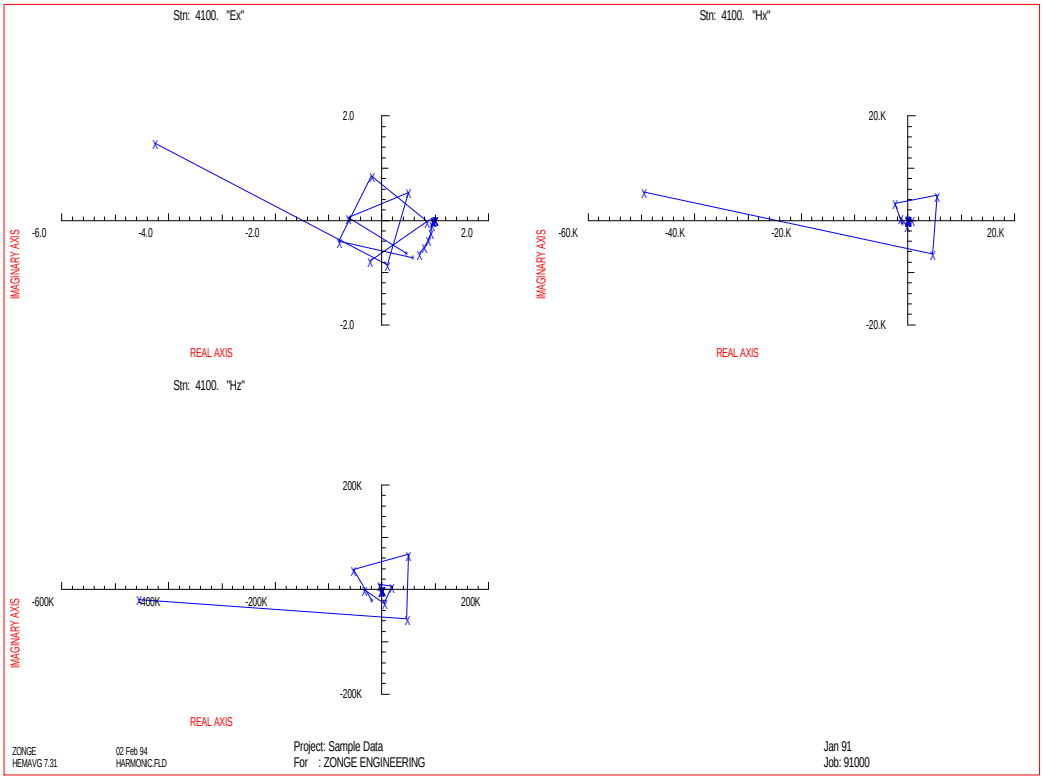
Sample .Z-file

```
$ DATE= 90-12-27
$ ASPACE=  61.0m
$ ZPLOT: DATA= N-SP
/* 28 Apr 97
 HEMAVG 7.40 Contour file.
 Cl Cn Ce Ns Nd Yl   Plot file  1
  1 10  0  3  2  1
 HARMONIC SURVEY DATA
 MAGNITUDE RATIO
    unitless
    Hx / Hz at  0.125 Hz
IIxxxxxxxxYYYYYYYYzzzzzzzzzzz  AAA
 2 4000.      3.     3.201E+00
 2 3900.      2.     8.799E-01
 2 4150.      1.     7.470E-01
 2 3900.      1.     8.944E-01
 2 3800.      3.     1.818E+00
 2 3700.      2.     1.008E+00
 2 3900.      1.     3.878E+00
 2 3800.      5.     1.389E+00
 2 3700.      4.     2.880E+00
 2 3600.      3.     1.013E+00
 2 3500.      2.     5.233E+00
 2 3500.      1.     1.312E+00
 9999.0
 Cl Cn Ce Ns Nd Yl   Plot file  2
  0 20  2  3  1  0
 HARMONIC SURVEY DATA
 PHASE DIFFERENCE
    values in milliRadians
    Hx - Hz at  0.125 Hz
IIxxxxxxxxYYYYYYYYzzzzzzzzzzz  AAA
 2 4000.      3.    -1.908E+03
 2 3900.      2.    -2.222E+03
 2 4150.      1.    -2.309E+02
 2 3900.      1.     7.623E+01
 2 3800.      3.     2.135E+03
 2 3700.      2.    -4.396E+02
 2 3900.      1.    -5.400E+02
 2 3800.      5.    -3.391E+03
 2 3700.      4.    -4.798E+03
 2 3600.      3.     3.507E+03
 2 3500.      2.     1.806E+03
 2 3500.      1.    -3.329E+02
 9999.0
```

Sample Magnitude/Phase Plot..... SAMCSAM.X01



Sample Real/Imaginary Plot SAMCSAM.X01



Appendix C ... FILE DOCUMENTATION

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

```
\ HEMAVG 7.40: "HARMONIC.FLD", Dated 90-12-27, Processed 28 Apr 97
$ ASPACE=  61.0m
\ 0.Hz Mag= 3-Pt Mag @  .1250  Hz , Phz= 3-Pt Phz (harmonics 1,3,5 @  .1250  Hz ) 3LOW
skp     Tx       Rx    PltPt    NSp  Freq Cmp Amps  Magnitude   Phase    Real       Imag      %Mag   sPhz
\=++=======++=======++=======++====++====++=++=====++==========++======++==========++=========++=====++=====+
 2   4400.    3600.    4100.     3. 0.     Ex  0.    1.9936e-2    -2.2  1.9936e-2 -4.3254e-5    0.1    0.2
 2   4400.    3600.    4100.     3. 0.125  Ex  1.3   1.9903e-2    -2.2  1.0000e+0 -2.2000e-3    0.     0.
 2   4400.    3600.    4100.     3. 0.375  Ex  1.3   1.9855e-2    -1.7  9.9760e-1 -1.6959e-3    0.     0.
 2   4400.    3600.    4100.     3. 0.625  Ex  1.3   1.9831e-2    -0.4  9.9637e-1 -4.4835e-4    0.     0.
 2   4400.    3600.    4100.     3. 0.875  Ex  1.3   1.9817e-2     1.   9.9569e-1  9.9569e-4    0.     0.
 2   4400.    3600.    4100.     3. 1.125  Ex  1.3   1.9811e-2     2.5  9.9536e-1  2.4387e-3    0.     0.1
...
```

skp
skip flag

Tx
Transmitter Dipole, station number of lowest numbered end.

Rx
Receiver Dipole, station number of lowest numbered end.

PltPt
Plot Point, station number at the midpoint between Tx and Rx.

NSp
N-Spacing, relationship between Tx and Rx, plotted as Y-Coordinate.

Freq
Frequency at which data was measured. If Frequency is zero, values are coupling corrected when possible.

Cmp
Component measured: Ex, Ey, Ez, Hx, Hy, Hz

Amps
Average SquareWave transmitter Current in amps, as entered into the GDP. For Reference CR, the reference channel magnitudes are measured Fourier Current values. The calculated SquareWave Current is saved.

Magnitude
Average Fourier magnitude, divided by the SquareWave current |v/a|. The GDP displays the Fourier magnitude values and SquareWave Current. The .AVG-file values are the same. When the Frequency is zero, the 3-point Decoupled Magnitude and Phase values are included in the Magnitude and Phase columns. The Frequency for which these values are calculated is noted in the header.

Phase
Average Phase angle, in milliradians. When the frequency is zero, the 3-point Decoupled Magnitude and Phase values are included in the Magnitude and Phase columns. The Frequency for which these values are calculated is noted in the header.

Real
Component of Rectangular coordinates, converted from Polar X-Mag/Phase, and normalized to 1.0 at the Reference Frequency.

Imag
Component of Rectangular coordinates, converted from Polar Y-Mag/Phase, and normalized by the Real component normalization factor.

%Mag
Statistical variation of the data averaged for this data point. Standard Deviation / Average Normalized Magnitude * 100, percent.

sPhz
Statistical variation of the data averaged for this data point. Standard Deviation of Phase values, milliradians.

.DAT-file Format (v1.0) Averaged Data File, combined format

```
\ HEMAVG 7.40: "HARMONIC.FLD", Dated 90-12-28, Processed 28 Apr 97
skp     Tx       Rx    PltPt    NSp  Freq  Amps    Ex Mag   Ex Phz    Ey Mag   Ey Phz
\=++=======++=======++=======++====++====++====++=========++======++=========++======+
 2   4400.    3600.    4100.     3. 0.125   1.3   1.9903e-2    -2.2         *       *
 2   4400.    3600.    4100.     3. 0.375   1.3   1.9855e-2    -1.7         *       *
 2   4400.    3600.    4100.     3. 0.625   1.3   1.9831e-2    -0.4         *       *
 2   4400.    3600.    4100.     3. 0.875   1.3   1.9817e-2     1.0         *       *
 2   4400.    3600.    4100.     3. 1.125   1.3   1.9811e-2     2.5         *       *
...

   Ez Mag   Ez Phz    Hx Mag   Hx Phz    Hy Mag   Hy Phz    Hz Mag   Hz Phz
+=========++======++=========++======++=========++======++=========++======+
         *       *   2.1980e-6  -501.1         *       *   6.8662e-7  1407.3
         *       *   6.7898e-6   826.4         *       *   2.8063e-6  1163.6
         *       *   9.6912e-6  -220.2         *       *   2.2916e-6  1433.5
         *       *   2.4501e-5  -165.0         *       *   3.7201e-6  1580.8
         *       *   1.2073e-5   214.6         *       *   4.6530e-6  1826.5
...
```

skp
skip flag

Tx
Transmitter Dipole, station number of lowest numbered end.

Rx
Receiver Dipole, station number of lowest numbered end.

PltPt
Plot Point, station number at the midpoint between Tx and Rx.

NSp
N-Spacing, relationship between Tx and Rx, plotted as Y-Coordinate.

Freq
Frequency at which data was measured. If Frequency is zero, values are coupling corrected when possible.

Amps
Average SquareWave transmitter Current in amps, as entered into the GDP. For Reference CR, the reference channel magnitudes are measured Fourier Current values. The calculated SquareWave Current is saved.

Note:
For the following magnitude and phase components, all values are indicated by a "*" symbol, except for those values that were measured.

Ex Mag (same for Ey Ez Hx Hy Hz Mags)
Average Fourier magnitude for Ex component, divided by the square-wave current v/a. The GDP displays the Fourier magnitude values and square-wave current. The .DAT-file values are the same.

Ex Phz (same for Ey Ez Hx Hy Hz Phzs)
Average Phase angle for Ex component, in milliradians.

.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 Electro-Magnetic 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
```