LAB ROCKS
DOCUMENTATION

ZONGE LABRED Data Processing
Laboratory Rock Measurement and Processing Procedures
version 7.0x

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OVERVIEW

Data collected during measurements of rock samples in the laboratory are averaged by the CRAVG or RPAVG program, and LABRED provides data listings and plots of Real vs Imaginary and Magnitude and Phase vs Frequency.

INPUT FILES

Data files read by LABRED include an averaged data file (.S-file) and optionally a mode file (.MDE-file).

The data file is provided from 1) the CRAVG CR data averaging program, 2) the RPAVG RPIP data averaging program, or 3) the GDPHM decoupling program. The data file includes the averaged data curve for a set of frequencies, and the GDPHM program can include coupling parameters. GDPHM is not normally used for laboratory measurements.

An optional mode 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 wish to modify. Each line in a mode file includes the program name, mode name, and value. When running LABRED, help text and mode descriptions are also available at the MODE prompt. This manual also includes a description for each variable that may be modified in LABRED, and includes an appendix that describes modes in more detail.

OUTPUT FILES

The LABRED listing file (.LL-file) provides a page of data on each rock measurement, including raw data and a variety of parameters.

The data are available in pairs of plots, one of Real vs. Imaginary components and the other of Magnitude and Phase vs. Frequency.

ROCK LAB PROCEDURES

Materials Required:

1 GDP Geophysical Receiver
1 LDT-10 Laboratory Transmitter
1 2 channel oscilloscope
1 Decade resistance box
2 12 volt batteries
2 Electrodes, filled with copper sulfate, with felt pads
1 Plastic container with lid, for electrodes and sample
1 Very large rubber band
1 Fluke Voltmeter
1 Computer with data processing software

ROCK PREPARATION

Prepare a log for the rock samples to be measured. Each sample will need a separate numeric identifier, called a Z-number. It may be different from the Client's alphanumeric sample label, called a C-label. One original sample may be used to make several measurement samples, and the GDP-16 provides for numeric entries, not letters. Provide space or the shunt resistor and sample measurements for length and area. Column headings in the log should include:

Z-number	C-label	Length,cm	Area,cm^2	Shunt,KΩ	Date_measured

Cut two flat parallel surfaces on each rock sample. If the sample shows bedding or foliation, then two surfaces should be cut parallel to the foliation, and two surfaces cut perpendicular to the foliation. Wash each sample in running water to remove all traces of dust from the cutting operation.

Each sample must soak in distilled, de-ionized water for at least 72 hours before testing. Use disposable plastic cups with lids. Label each rock with the Z-number. Do not label the rock on the fresh cut surfaces. Label the lid of each cup with the Z-number, job number (if any), and C-label. Fill the cup with enough distilled, de-ionized water to completely cover the sample.

Some rocks will not withstand soaking and will crumble or dissolve in water. These samples must be put under vacuum and soaked immediately prior to testing.

EQUIPMENT SETUP

The LABROCKS MEASUREMENT SYSTEM diagram shows the wire configuration for the measurement system. The oscilloscope plugs into each channel that is being used, and is powered by one of the 12v batteries.

Set up the Lab Transmitter. The XMT-16 Transmitter Controller could be used to control the LDT-10, but the GDP provides more precise and accurate control. A special controller cable runs from the GDP Transmitter port to the INPUT port on the LDT-10. A battery cable runs from a 12v battery to the EXT.POWER port on the LDT-10.

Set the RANGE,mA to .01-.1 for most measurements. For some applications it may be necessary to increase or decrease the setting. The OFFSET is set to 5 in the window and 0 on the dial. The FINE adjust is normally set to 0 in the window and 1 on the dial. This results in a standard current of one microAmp. Some applications may require a higher or lower setting (1 in the window and 0 on the dial for 10 microAmps in the case of extremely low resistance samples). Set the TIME-FREQ switch to FREQ, and the ON-OFF-EXT switch to EXT. Refer to the LDT-10 manual for details as to the exact meaning of these settings.

Electrodes should be filled with a saturated solution of copper sulfate (CuSO4). The electrodes must soak long enough to become saturated with solution (the porous faces of the electrodes are leaking). After they have soaked long enough (about 15 minutes), cover the porous surfaces with round felt pads that are saturated with copper sulfate solution. Force the electrode surfaces together with a large rubber band, to minimize evaporation and hold rock samples in place during measurement.

The oscilloscope should be ON, and TRIGGER SOURCE set to EXT. Center both channels on GROUND, then switch to DC. VOLT/DIV should be set to 5, although in some samples it may be easier to read on 2 or 1. The SEC/DIV switch is usually set to 20m, but may be adjusted to whatever sweep rate is comfortable for the frequency being used. Check that all variable adjustments are turned off. This is at the end of the turn and has a distinct click or detent.

GDP SETUP

The GDP provides a laboratory measurement system as part of the CR (Spectral IP) program. The RPIP or TDIP program could be used, but CR is a more appropriate program. We have found in the field that Time Domain and Frequency Domain results are equivalent. The LABROX section of the CR program provides for input of sample length and area, and calculates Resistivity values as specified in the .S-file documentation (Appendix C). The system setup is equivalent to a Schlumberger array, with N=0.

Re-calibrate the GDP in CR mode, without the notch filters engaged, before acquiring LABROX data.

The channel 2 measurement is used for reference. The resistance box adjusts the reference channel load to be the same as the sample. The difference between the channel 1 and channel 2 measurements is the response from the sample.

Go to **LABROX MENU 1** on the GDP. Select **5) CR and HACSAMT**. The **Survey type** is **LABROX**, and **Array type** is **CORE SAMPLE**. **Shunt** is the value of the current measuring resistor in the decade resistance box (see the diagram at the end of this chapter), that is adjusted to be close to the resistance of the rock sample being measured. This can also be entered in **LABROX MENU 4** under **F5) L/A**.

LABROX MENU 1:

```
+-----------------------------------------+
|     CR 0520           15 Mar 91 08:53:40|
|                                         |
|Survey type: LABROX                      |
|Array type:  Core Sample                 |
|Shunt: 100.0 KΩ                          |
|                                         |
|Automatic Gain Mode: Noisy               |
|                                         |
|                                         |
| CONTINUE: Next menu, ESCAPE: Prev. menu |
|    Data                                 |
+-----------------------------------------+
     F1    F2    F3      F4     F5    F6
```

Press **CONTINUE** for **LABROX MENU 2**. This is the same as in normal CR operation. Enter your operator number, job number, and serial number of the Lab Transmitter. The other defaults to not need to be changed.

LABROX MENU 2:

```
+-----------------------------------------+
|     CR  0520          15 Mar 91 08:53:45|
|                                         |
|OPERATOR     1  TX ID    1  A-SP   100.0 |
|JOB 89001   LINE    1.0 N   SPREAD  1    |
|                                         |
|                                         |
|                                         |
|                                         |
|                                         |
| CONTINUE: Next menu, ESCAPE: Prev. menu |
|    Data                                 |
+-----------------------------------------+
     F1    F2    F3      F4     F5    F6
```

Press **CONTINUE** for **LABROX MENU 3**. Channels 1 and 2 are automatically set. Channel 1 is the rock sample, and channel 2 is the decade resistance box or shunt resistor.

LABROX MENU 3:

```
+----------------------------------------+
|0094 CR  0520          15 Mar 91 08:53:50|
|                                        |
|OPERATOR     1  TX ID    1  A-SP   100.0 |
|JOB 89001   LINE    1.0 N   SPREAD  1   |
|                                        |
|CH    N/Ant                             |
|1 Ex     1                              |
|2 Ref                                   |
|3 Off                                   |
|4 Off                                   |
|5 Off                                   |
|6 Off                                   |
|7 Off                                   |
|8 OFF                                   |
|Enter channel parameters                |
|   Data                      Ch Info    |
+----------------------------------------+
     F1    F2    F3      F4     F5    F6
```

Press **CONTINUE** for **LABROX MENU 4**. The main difference between this menu and the normal operating CR menu is the **F5** key which is now labeled **L/A**, and the TX Current which is now scaled in microAmperes. The current is automatically calculated by the REF channel and displayed in microAmperes. Press **F6** for the CRes option, to obtain an approximate value for the resistance of the sample, used for setting the Shunt resistor which is entered in either the **L/A SUBMENU** or **LABROX MENU 1**.

LABROX MENU 4:

```
+----------------------------------------+
|0094 CR  0520    12.3 15 Mar 91 08:57:59 |
|Survey LAB                              | <- We have selected the LABROX option.
|Tx     1 Rx     3 Notch OUT             |
|   1 Hz      /    1 Cycle  Tx Curr  1.0µ |
|                                        |   Note:
|CH    N/Ant                             |
|1 Ex     1                              |   Tx label is the Z-number
|2 Ref                                   |
|3 Off                                   |
|4 Off                                   |   Rx label is the XYZ orientation
|5 Off                                   |
|6 Off                                   |
|7 Off                                   |
|8 OFF                                   |
|CONT-Take data, ESC-Prev Menu, F2-Exit  |
|   Data  Exit   Cal    Gain   L/A  CRes |
+----------------------------------------+
     F1    F2    F3      F4     F5    F6
```

Press **F5** for the **L/A SUBMENU**. The Length and cross-section Area are used to calculate the sample resistivity. For **Length**, if the end faces are not parallel, measure the long and short sides and enter the average. For **Area**, measure the width times the height of each end and enter the average. If the sample is from a core drill, use ***pi*** times the square of half the diameter ($\pi*(d/2)^2$). All measurements are in centimeters. **Shunt** is the value of the current measuring resistor in the decade resistance box (see the diagram at the end of this chapter), that is adjusted to be close to the resistance of the rock sample being measured. This can also be entered in **LABROX MENU 1**.

L/A SUBMENU

```
+----------------------------------------+
|0094 CR  0520    12.3 15 Mar 91 08:57:59 |
|Survey LAB                              |
|Tx     1 Rx     3 Notch OUT             |
|    1 Hz      /   1 Cycle  Tx Curr  1.0µ |
|                                        |
|                                        |
|                                        |
|                                        |
|Length:  1.0  cm                        |
|Area:  1.0  cm squared                  |
|Shunt 100.0  KΩ                         |
|                                        |
|                                        |
|Enter Rock Dimensions and Shunt Value   |
|CONTINUE to save changes: Escape to exit |
|   Data                                 |
+----------------------------------------+
     F1    F2    F3      F4     F5    F6
```

ROCK SAMPLE MEASUREMENTS

Remove the sample from the water-filled cup and dry it with a paper towel. Make length and area measurements of the rock samples if they have not already been made.

Place the rock between the electrodes, and secure with the rubber band. Ensure that no wires are touching and the bottom of the electrode container is clean and dry. Sometimes the felt pads will drip, so ensure that the sample is not touching on the bottom, otherwise part of the rock length may be shorted by the solution along the bottom.

Measure the resistance of the sample, using a digital voltmeter. Duplicate this resistance in the resistance box, and enter it as the **Shunt** value. The **CRES** function from **LABROX MENU 4** may be of sufficient accuracy for setting **Shunt**. Ensure accuracy by making several measurements. The **Shunt** value is entered in KΩ, so some low resistance samples may be less than one. When settings are correct, press **CONTINUE** to return to **LABROX MENU 4**. Place the lid on the container.

Enter the Z-number as **RX**. Use **TX** to record the number of measurements of one sample (first, second, third, etc). Additional measurements may be made for different sample orientations or transmitted current or sample setups.

Run an auto gain and look at the oscilloscope. The signals should be the same amplitude. If not, check that the gain settings on the GDP are the same, and the oscilloscope settings are correct. If the signals are still different, the resistance box is not set properly. Try to match the signals by adjusting the resistance box. These must be an exact a match as possible. When finished, re-enter the **Shunt** value in the **L/A SUBMENU** and record the value in the log.

If the gains are set high and the signal is still weak, change the LDT-10 range to .1-1. If the signal is still too weak, change the dial to 1 in the window and 0 on the dial. This is usually needed only when the rock resistance is very low.

If the gains are set to zero, change the LDT-10 range to .001-.01. This is only needed if the rock resistance is extremely high. Be sure to note all changes in the log. The log is the only record of how the samples were set up.

Sometimes with highly mineralized or porous rocks the channel 1 signal will drift off the screen or begin to saturate. If any saturation is suspected, reject or skip the stack and do an auto gain. Pay attention to the signal at all times while taking measurements. Three sets of measurements are normally used:

8 Hz	1024 Cycles
1 Hz	128 Cycles
.125 Hz	32 Cycles

Start at the highest frequency. Acquire a minimum of 2 stacks for each frequency. When finished, rinse the rock, dry it, and return it to the cup in which it was soaked.

Sometimes, a rock is not stable and will require some time to settle in. The phase changing by a consistent amount from stack to stack is evidence of instability. Usually waiting ten minutes will solve the problem. Some rocks are noisy, with phase or magnitude having a wide scatter. Take as many stacks as needed for a good average. Skip any obviously bad stacks.

TIME DOMAIN MEASUREMENTS

The GDP TDIP program does not provide a LAB array type. The data processing programs do not provide for Time Domain LAB measurements. Time Domain measurements can be made, setting A-Space and Tx Current to 1.0, and using channel 2 as a reference channel to measure the transmitted signal in a manner similar to the CR Ref channel. The Tx Current and Sample resistivity will need to be manually calculated.

ROCK CALIBRATES

Separate calibrates for each rock are generally not needed. Some combinations of rocks and frequencies will require calibrates.

After measuring each rock, set another resistance box to the same setting as the first. Pull the electrode wires and put them into the second box. The two wires from each electrode should plug into the same side of the resistance box. Press F3 on the GDP and enter EXTERNAL SYSTEM CHECK mode. Take a stack at each frequency used, and skip any obviously bad stacks.

GDP DATA DUMP

The GDP INSTRUCTION MANUAL includes data dumping procedures in the OPERATING PROCEDURES section under DATA VIEWING AND TRANSFER. The KERMIT communications program is described, but most modem programs can capture a data stream and write it to a log file on the computer. The standard name for rock measurements is LAB<job#>.RAW.

DATA PROCESSING

Edit the data file to correct any mistakes made while entering the data. Common mistakes are incorrect sample numbers or forgetting to enter a new value. Some data blocks may need to be skipped.

Generate a .FLD-file by running SHRED. Phase values are recorded with the correct polarity (fourth quadrant), rather than by convention (first quadrant), so the polarity should be reversed. SHRED version 3.20 and later will automatically invert the phase values. Or, use SHRED <filename> /P

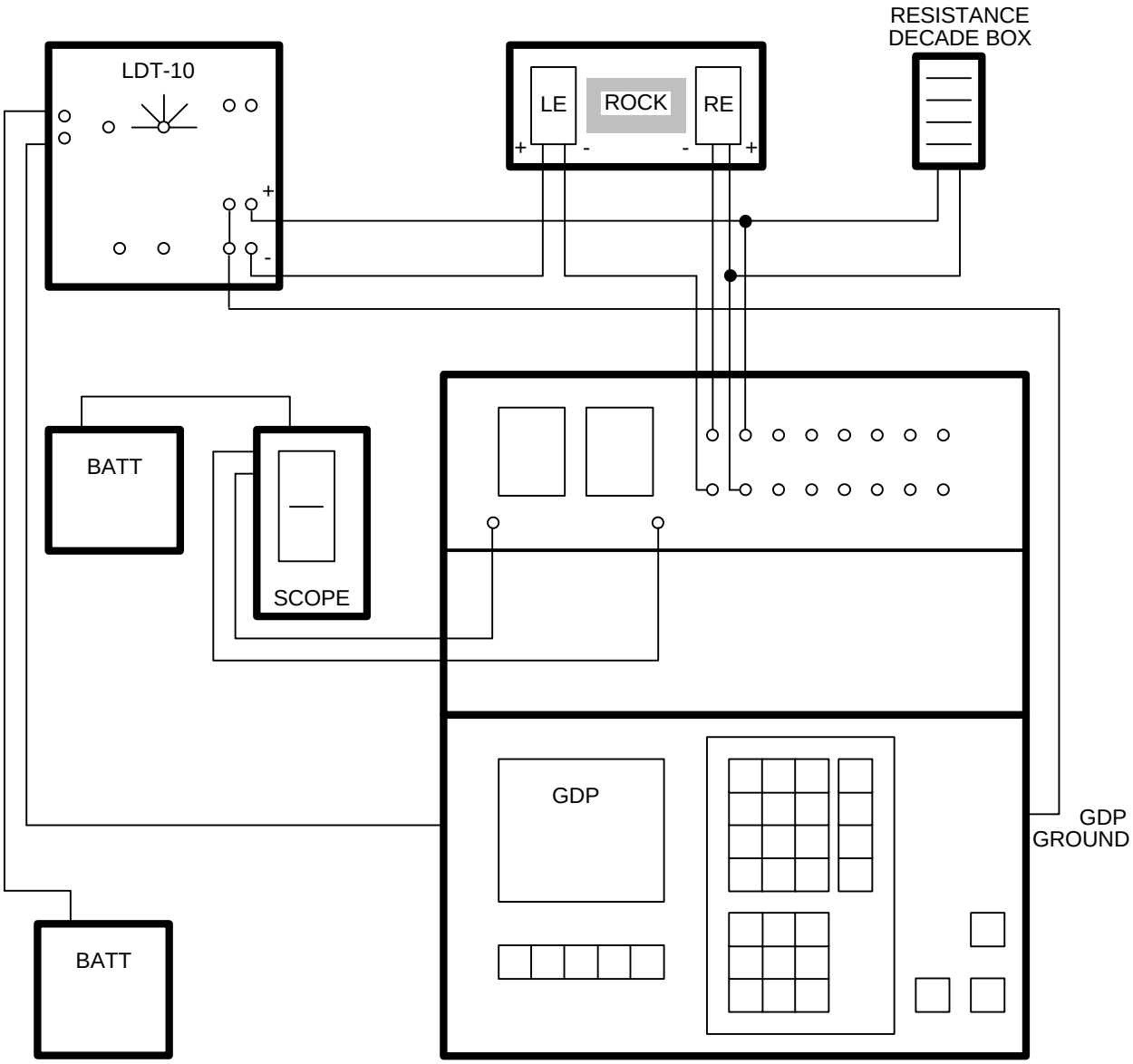
Average the data by using CRAVG. The automatic gain option may be useful, for both Real and Imaginary axes. The program will generate several files, and may display error messages. Always check the messages to minimize problems with further processing. Error messages are also included in the .LOG-file.

Finally, display the data with LABRED. The program will request C-labels and comments to be included on listings and plots. The program can be run automatically by editing the .S-file (averaged data) and adding mode lines before each rock, including modes CIDENT and COMMENT for each rock. This will also provide documentation in the data file itself.

The FPLOT utility is used to display or print .Xnn-files.

Check the data for smoothness and bracketing, and rerun the measurements as needed.

LAB ROCKS MEASUREMENT SYSTEM

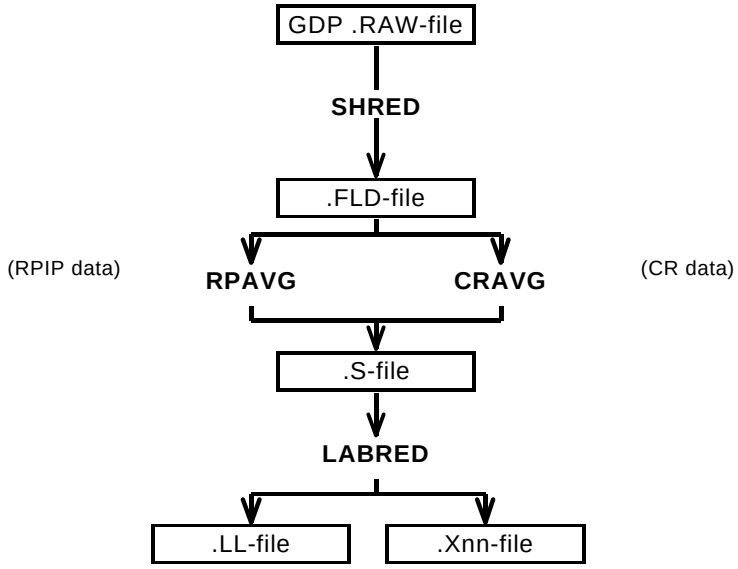


LAB ROCKS DATA PROCESSING FLOW

August, 1993

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

LABRED Usage

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

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

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

LABRED MODE DISPLAY

```
PROCESSING MODES USED:
+==============+=========+=========+=========+=========+=========+
|CONTROL MODES | AutoRun | RhoCalc | Screen  |         |         |
|   mode names | AUTO    | CALC    | VIEW    |         |         |
|  mode values |    YES  |   AUTO  |   NONE  |         |         |
+==============+=========+=========+=========+=========+=========+
```

LABRED ERROR MESSAGES

If errors or inconsistencies arise within the program, LABRED 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.

LABRED OUTPUT SELECTIONS

LABRED may write listing (.LL-files) and plot (.Xnn-files). A .LOG-file is automatically created by LABRED.

LABRED Sample Run

Input files: SAMLAB.S, SAMLAB.MDE
Output files: SAMLAB.LOG, SAMLAB.LL, SAMLAB.Xnn

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

C: > LABRED

ZONGE ENGINEERING: 3322 E. Fort Lowell, Tucson AZ 85716, USA
LABRED 7.02: LABORATORY DATA REDUCTION PROGRAM
   MS-DOS version implemented 20 February, 1993.

LABRED VERSION UPDATE INFORMATION
4.40 Replace XPLOT vector graphics files with HPGL commands.
7.00 Global Modes replace .I-file.  Implement prioritized Modes.
7.02 Include Mode CALC for resistivity adjust by 1/C * A/L

Data filename [quit]: SAMLAB                  *** Enter .S-file name  ***

MODE CLIENT  =ZONGE ENGINEERING
MODE PROJECT =Sample Rocks
MODE JOBNUMB =9200
MODE JOBDATE =Aug 1992
MODE JOBLINE =Rocks

(Type MENU for assistance with MODEs.)

MODE Change [name?, name= value] : LIST       *** List current modes  ***

PROCESSING MODES USED:
+==============+=========+=========+=========+=========+=========+
|CONTROL MODES | AutoRun | RhoCalc | Screen  |         |         |
|   mode names | AUTO    | CALC    | VIEW    |         |         |
|  mode values |    YES  |   AUTO  |   NONE  |         |         |
+==============+=========+=========+=========+=========+=========+

MODE Change [name?, name= value] : <RETURN>   *** Press RETURN        ***
Press any key to continue:
                                              *** READ FIRST DATA SET ***
ZERO I.D.: Z-120101
Enter ^Z to back up to previous prompt.

(enter <RETURN> to skip this sample)
                      ----+----1----+----2
Client Ident  [skip]: AB-123-A                *** Enter Client I.D.   ***

Enter: comment about this sample (up to 30 chars):
                  ----+----1----+----2----+----3
   Comment  [   ]: This is comment one.       *** Enter comments      ***
      Entered as: "This is comment one."
```

LABRED Sample Run (cont'd)

```
    Freq     Real   Imaginary       Magnitude   Phase
   0.125   1.0000    0.0084         1.0000    0.0084
   0.375   0.9939    0.0095         0.9940    0.0096
   0.625   0.9909    0.0101         0.9910    0.0102
   0.875   0.9892    0.0106         0.9892    0.0107
   1.125   0.9874    0.0113         0.9875    0.0114
   1.000   0.9883    0.0109         0.9884    0.0110
   3.000   0.9808    0.0136         0.9809    0.0139
   5.000   0.9765    0.0155         0.9766    0.0159
   7.000   0.9738    0.0171         0.9739    0.0175
   9.000   0.9711    0.0184         0.9713    0.0190
   8.000   0.9725    0.0177         0.9726    0.0182
  24.000   0.9603    0.0265         0.9607    0.0275
  40.000   0.9531    0.0330         0.9536    0.0347
  56.000   0.9471    0.0385         0.9479    0.0407
  72.000   0.9420    0.0432         0.9430    0.0459

 I.D.: B-123-A                Z-120101      Hanning filtered  0 times.
 RHOa=    3009.9 o-m   L=   10.4 cm   A=   15.9 sq cm   I=   0.92 ua

"C"hanges  "F"ilter  "S"kip_this_rock  "L"ist  "P"lot
   Choice  [List&Plot]: <RETURN>
Listing . . .
Plotting . . .

File: "SAMLAB.X01"      9119 bytes, ready for rasterizing.

***... READ AND PROCESS ADDITIONAL DATA SETS ...***

Files ready for rasterizing:
 SAMLAB.X01 thru SAMLAB.X05

Time used:   69.8 sec.  (  1.2 min.)   Start: 14:50:45, Stop: 14:51:55

Log file "SAMLAB.LOG" closed.
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.

LABRED MODE LIST

(v 7.0x)

PROCESSING MODE DEFAULT VALUES:

CONTROL MODES	AutoRun	RhoCalc	Screen			
mode names	AUTO	CALC	VIEW			
mode values	YES	AUTO	NONE			

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. One pass thru the program will occur, instead of requesting an additional input file after writing a plot file or listing file.

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

CALC
Laboratory measured Resistivity in ohm-meters:
Fourier_Mag = GDP measured magnitude, in volts.
Current = Square-wave current, in amps
Area = sample cross-sectional area, cm*cm.
Length = the length of the sample, in cm.
1m / 100cm = Conversion ohm-cm to ohm-meters.

$$RHO = \frac{FOURIER\_MAG}{4/pi} * \frac{1}{CURRENT} * \frac{AREA}{LENGTH} * \frac{1m}{100cm}$$

Laboratory Resistivity values are calculated and displayed by the GDP. The averaging program CRAVG recalculates the resistivity, and includes the value in output files. Earlier versions required the LABRED user to manually enter the current, sample length and area, then the resistivity was adjusted.

CALC= AUTO: If the input file includes the sample measurements, the Resistivity value is assumed to be accurate. Otherwise values are requested and the Resistivity is adjusted.
CALC= No : Do NOT adjust the input file resistivity value.
CALC= Yes : DO adjust the input file resistivity value.

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

VIEW
Screen plots of data as they are written may be selected by mode VIEW.

Values: VIEW= NONE (No), or SCREEN (Yes)
Default: VIEW= No

CIDENT
The Client Identification may be entered for each rock by inserting mode CIDENT in the input data file. This mode does not appear at the mode prompt. (20 chr max)

Values: CIDENT= Client Identification
Default: CIDENT= NONE

COMMENT
Comments about a specific rock sample may be entered for each rock by inserting mode COMMENT in the input data file. This mode does not appear at the mode prompt. (30 chr max)

Values: COMMENT= Comment about sample
Default: COMMENT= NONE

Appendix B ... SAMPLE FILES

Sample .LOG-file (program run summary)

```
LABRED 7.02, Processed: 18 Feb 93
GLOBAL MODE LIST:
+=========================================+==============+==============+
|  COMPANY                                |  JOBNUMB     | CSAMT XMTR   |
| ZONGE ENGINEERING                       | 9200         |              |
|  CLIENT                                 |  JOBDATE     |  TXLEN       |
| Zonge Engineering                       | 01 Nov 92    |              |
|  PROJECT                                |  JOBLINE     |  TXBRG       |
| Rock Samples                            |              |              |
+==============+==============+==========+==============+              |
|  BRGBACK     |  RXBRG       |  BRGLINE |  FRQLO       |  TXDIS       |
|              |              |          |   NONE       |              |
|  STNLO       |  STNDELT     |  STNHI   |  FRQHI       |  RX2TX       |
|   NONE       |      1.0     |   NONE   |   NONE       |              |
|  LBLFRST     |  LBLDELT     |  PLTREV  |  UNITS       |              |
|  STNLO       |      1.0     |    NO    |  METERS      |              |
+==============+==============+==========+==============+==============+

PROCESSING MODES USED:
+==============+=========+=========+=========+=========+=========+=========+
|CONTROL MODES | AutoRun | RhoCalc | Screen  |         |         |         |
|   mode names | AUTO    | CALC    | VIEW    |         |         |         |
|  mode values |    YES  |   AUTO  |   NONE  |         |         |         |
+==============+=========+=========+=========+=========+=========+=========+


 I.D.: SAMPLE-1              Z-300101      Hanning filtered  0 times.
 RHOa=       0.3 o-m   L=    4.9 cm   A=   31.2 sq cm   I= 103.63 ua

 I.D.: SAMPLE-2              Z-300201      Hanning filtered  0 times.
 RHOa=       0.3 o-m   L=    5.8 cm   A=   31.2 sq cm   I= 103.55 ua

 I.D.: SAMPLE-3              Z-300301      Hanning filtered  0 times.
 RHOa=    6946.8 o-m   L=    4.8 cm   A=   31.2 sq cm   I=   1.03 ua

 I.D.: SAMPLE-3              Z-300302      Hanning filtered  0 times.
 RHOa=    6976.9 o-m   L=    4.8 cm   A=   31.2 sq cm   I=   1.03 ua

 I.D.: SAMPLE-4              Z-300401      Hanning filtered  0 times.
 RHOa=   42373.3 o-m   L=    4.9 cm   A=   31.2 sq cm   I=   0.11 ua

 I.D.: SAMPLE-4              Z-300402      Hanning filtered  0 times.
 RHOa=   33579.7 o-m   L=    4.9 cm   A=   31.2 sq cm   I=   0.13 ua

 I.D.: SAMPLE-5              Z-300501      Hanning filtered  0 times.
 RHOa=       0.0 o-m   L=    5.5 cm   A=   19.5 sq cm   I= 103.46 ua

 I.D.: SAMPLE-6              Z-300601      Hanning filtered  0 times.
 RHOa=       0.0 o-m   L=    5.9 cm   A=   24.9 sq cm   I= 103.50 ua

 I.D.: SAMPLE-5              Z-300502      Hanning filtered  0 times.
 RHOa=       0.1 o-m   L=    4.7 cm   A=   28.0 sq cm   I= 103.17 ua

 I.D.: SAMPLE-6              Z-300602      Hanning filtered  0 times.
 RHOa=       0.1 o-m   L=    4.8 cm   A=   30.6 sq cm   I= 103.48 ua

 I.D.: SAMPLE-7              Z-300701      Hanning filtered  0 times.
 RHOa=       0.1 o-m   L=    5.1 cm   A=   31.2 sq cm   I= 103.20 ua

 I.D.: SAMPLE-8              Z-300801      Hanning filtered  0 times.
 RHOa=       0.2 o-m   L=    5.1 cm   A=   31.2 sq cm   I= 103.14 ua

Files ready for rasterizing:
 SAMROCKS.X01 thru SAMROCKS.X12

Log file "SAMROCKS.LOG" closed.
```

Sample .S-file CR / RPIP Averaged Data File

NOTE: The .S-file format for laboratory measurements includes the RESISTOR, LENGTH, AREA, and CURRENT values as shown in the .S-file documentation for data line 3. If not included (perhaps an old .S-file was used), the user will be prompted for values and the Resistivity value adjusted (See mode CALC).

```
 "SAMROCKS.S", from CRAVG 7.01
/* 01 Nov 92
$ CIDENT =SAMPLE-1
$ COMMENT=Massive Sample
 Rx: 3001. Tx:    1. NSP: 1.
 0 0 0 15 15     4.82   100.0  300.    4.9  31.2103.63
  SEM   2.0000E-05 2.9000E-04
  0.125 1.0000E+00 6.5574E-01
  0.375 7.4388E-01 3.4957E-01
  0.625 6.7351E-01 2.5906E-01
  0.875 6.3815E-01 2.1162E-01
  1.125 6.1581E-01 1.8316E-01
      1 6.2698E-01 1.9560E-01
      3 5.5725E-01 1.0255E-01
      5 5.3696E-01 7.6217E-02
      7 5.2722E-01 6.3358E-02
      9 5.1986E-01 5.5417E-02
      8 5.2354E-01 5.8883E-02
     24 5.0146E-01 3.3245E-02
     40 4.9445E-01 2.6280E-02
     56 4.9064E-01 2.2831E-02
     72 4.8804E-01 2.0656E-02
$ CIDENT =SAMPLE-2
$ COMMENT=Massive Sample
 Rx: 3002. Tx:    1. NSP: 1.
 0 0 0 15 15     5.013  100.0  200.    5.8  31.2103.55
  SEM   1.0000E-05 1.1000E-04
  0.125 1.0000E+00 5.8417E-01
  0.375 7.6256E-01 3.3016E-01
  0.625 6.8997E-01 2.5405E-01
  0.875 6.5114E-01 2.1354E-01
  1.125 6.2702E-01 1.8670E-01
      1 6.3908E-01 1.9986E-01
      3 5.5749E-01 1.1162E-01
      5 5.3345E-01 8.4884E-02
      7 5.2117E-01 7.0895E-02
      9 5.1319E-01 6.1985E-02
      8 5.1718E-01 6.6143E-02
     24 4.9099E-01 3.7831E-02
     40 4.8274E-01 2.9775E-02
     56 4.7824E-01 2.5754E-02
     72 4.7526E-01 2.3307E-02
$ CIDENT =SAMPLE-3
$ COMMENT=Banded Sample (run 1)
 Rx: 3003. Tx:    1. NSP: 1.
 0 0 0 15 15  1100.796  100.0  6000    4.8  31.2  1.03
  SEM   0.0000E+00 6.0000E-05
  0.125 1.0000E+00 3.1000E-03
  0.375 9.9779E-01 3.7916E-03
  0.625 9.9644E-01 4.1851E-03
  0.875 9.9540E-01 4.4793E-03
  1.125 9.9423E-01 3.7781E-03
      1 9.9314E-01 4.4691E-03
      3 9.8979E-01 5.3449E-03
      5 9.8807E-01 5.7309E-03
      7 9.8685E-01 5.9212E-03
      9 9.8590E-01 7.0986E-03
      8 9.8386E-01 6.4935E-03
     24 9.7919E-01 8.1275E-03
     40 9.7670E-01 9.2789E-03
     56 9.7498E-01 1.0140E-02
     72 9.7357E-01 1.0807E-02
$ CIDENT =SAMPLE-3
$ COMMENT=Banded Sample (run 2)
 Rx: 3003. Tx:    2. NSP: 1.
 0 0 0 15 15  1105.575  100.0  6000    4.8  31.2  1.03
  SEM   0.0000E+00 5.0000E-05
  0.125 1.0000E+00 3.2000E-03
  0.375 9.9775E-01 3.7915E-03
  0.625 9.9658E-01 3.9863E-03
  0.875 9.9500E-01 4.3780E-03
  1.125 9.9478E-01 4.6755E-03
      1 1.0129E+00 4.6594E-03
      3 1.0093E+00 5.5510E-03
      5 1.0076E+00 6.0460E-03
      7 1.0062E+00 6.0373E-03
      9 1.0058E+00 7.0410E-03
      8 1.0163E+00 6.8092E-03
     24 1.0115E+00 8.4965E-03
     40 1.0089E+00 9.6857E-03
     56 1.0070E+00 1.0675E-02
     72 1.0058E+00 1.1366E-02

continued next column ...
```

```
$ CIDENT =SAMPLE-4
$ COMMENT=Banded Sample ( 1 ua)
 Rx: 3004. Tx:    1. NSP: 1.
 0 0 0 15 15   732.026  100.0  8000    4.9  31.2  0.11
  SEM   3.6000E-04 1.0500E-03
  0.125 1.0000E+00 7.8002E-03
  0.375 9.9555E-01 2.3599E-02
  0.625 9.9154E-01 3.4123E-02
  0.875 9.8320E-01 4.5062E-02
  1.125 9.8216E-01 4.8361E-02
      1 9.8268E-01 4.1888E-02
      3 9.6140E-01 8.6954E-02
      5 9.5362E-01 1.2720E-01
      7 9.4532E-01 1.7231E-01
      9 9.2794E-01 2.0906E-01
      8 9.3663E-01 1.8091E-01
     24 8.1871E-01 4.8046E-01
     40 6.3253E-01 6.8927E-01
     56 4.0113E-01 8.5317E-01
     72 2.1274E-01 8.9371E-01
$ CIDENT =SAMPLE-4
$ COMMENT=Banded Sample (10 ua)
 Rx: 3004. Tx:    2. NSP: 1.
 0 0 0 15 15   685.586  100.0  8000    4.9  31.2  0.13
  SEM   2.9000E-04 4.8000E-04
  0.125 1.0000E+00 6.9001E-03
  0.375 9.9678E-01 1.7446E-02
  0.625 9.9334E-01 2.3944E-02
  0.875 9.8327E-01 3.2460E-02
  1.125 9.9260E-01 3.8532E-02
      1 9.8794E-01 3.1328E-02
      3 9.7216E-01 6.5623E-02
      5 9.6421E-01 9.8107E-02
      7 9.5680E-01 1.2606E-01
      9 9.4386E-01 1.6192E-01
      8 9.5033E-01 1.3073E-01
     24 8.6928E-01 3.4770E-01
     40 7.3688E-01 5.0478E-01
     56 6.0739E-01 6.3345E-01
     72 4.2858E-01 6.7518E-01
$ CIDENT =SAMPLE-5
$ COMMENT=Banded Sample (normal)
 Rx: 3005. Tx:    1. NSP: 1.
 0 0 0 15 15     0.671  100.0   80.    5.5  19.5103.46
  SEM   1.0000E-05 1.2000E-04
  0.125 1.0000E+00 7.8863E-02
  0.375 9.6612E-01 4.5248E-02
  0.625 9.5623E-01 3.4535E-02
  0.875 9.5056E-01 2.9001E-02
  1.125 9.4646E-01 2.5466E-02
      1 9.4851E-01 2.6755E-02
      3 9.3803E-01 1.3884E-02
      5 9.3542E-01 1.0009E-02
      7 9.3374E-01 8.3105E-03
      9 9.3371E-01 6.5361E-03
      8 9.3372E-01 7.5633E-03
     24 9.3132E-01 4.0047E-03
     40 9.3084E-01 3.2580E-03
     56 9.3056E-01 2.8847E-03
     72 9.3064E-01 2.9781E-03
$ CIDENT =SAMPLE-6
$ COMMENT=Banded Sample (normal)
 Rx: 3006. Tx:    1. NSP: 1.
 0 0 0 15 15     0.744  100.0   70.    5.9  24.9103.50
  SEM   0.0000E+00 1.5000E-04
  0.125 1.0000E+00 6.9411E-02
  0.375 9.6938E-01 4.1709E-02
  0.625 9.5928E-01 3.3204E-02
  0.875 9.5392E-01 2.8817E-02
  1.125 9.5105E-01 2.4828E-02
      1 9.5249E-01 2.6677E-02
      3 9.4070E-01 1.5523E-02
      5 9.3720E-01 1.1903E-02
      7 9.3536E-01 9.7281E-03
      9 9.3481E-01 9.0679E-03
      8 9.3509E-01 9.4447E-03
     24 9.3134E-01 5.7744E-03
     40 9.3022E-01 4.9302E-03
     56 9.2957E-01 4.6479E-03
     72 9.2935E-01 4.5539E-03

continued next page ...
```

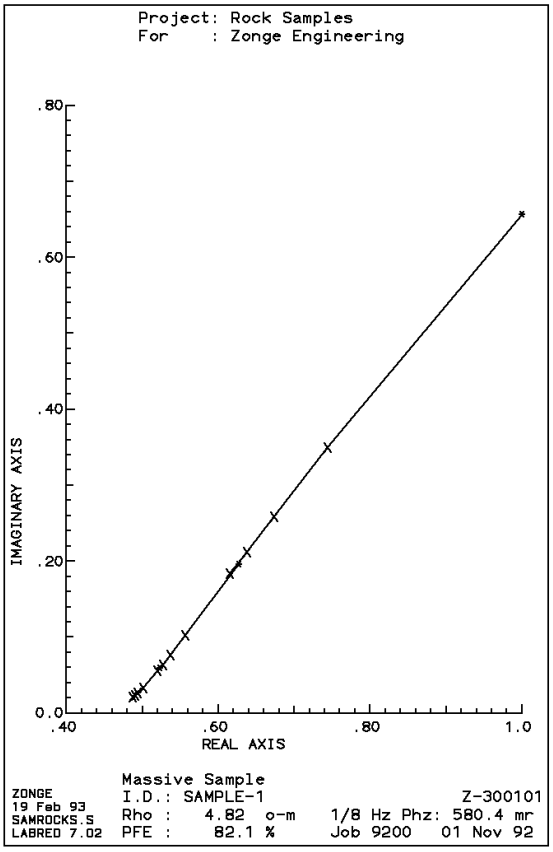
Sample .S-file (continued: page two)

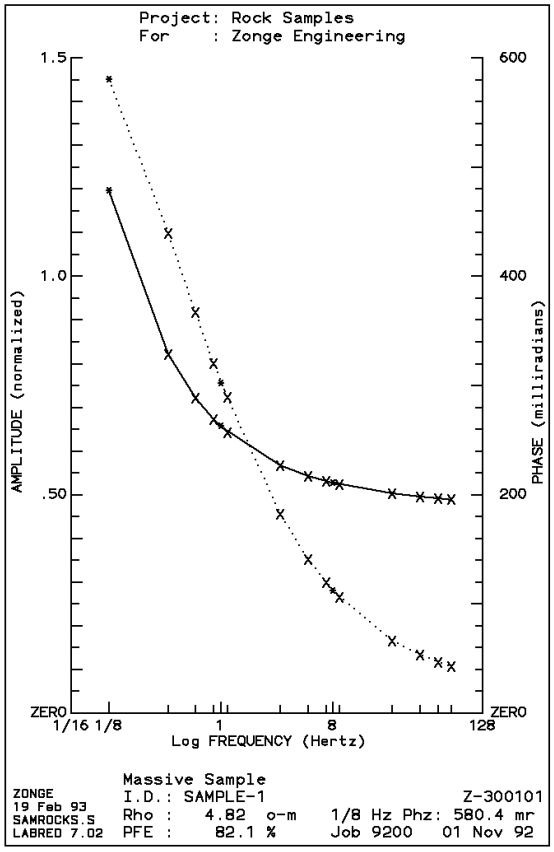
```
$ CIDENT =SAMPLE-5
$ COMMENT=Banded Sample (parallel)
 Rx: 3005. Tx:    2. NSP: 1.
 0 0 0 15 15     1.108  100.0   80.    4.7  28.0103.17
  SEM   0.0000E+00 1.1000E-04
  0.125 1.0000E+00 7.4035E-02
  0.375 9.6553E-01 4.4736E-02
  0.625 9.5483E-01 3.5632E-02
  0.875 9.4968E-01 3.0020E-02
  1.125 9.4448E-01 2.6169E-02
      1 9.4708E-01 2.7852E-02
      3 9.3510E-01 1.5244E-02
      5 9.3202E-01 1.1185E-02
      7 9.3101E-01 9.1242E-03
      9 9.2974E-01 7.9960E-03
      8 9.3038E-01 8.6528E-03
     24 9.2739E-01 4.7297E-03
     40 9.2661E-01 3.7991E-03
     56 9.2620E-01 3.4270E-03
     72 9.2628E-01 3.6125E-03

continued next column ...

$ CIDENT =SAMPLE-6
$ COMMENT=Banded Sample (parallel)
 Rx: 3006. Tx:    2. NSP: 1.
 0 0 0 15 15     1.107  100.0   70.    4.8  30.6103.48
  SEM   1.0000E-05 1.0000E-04
  0.125 1.0000E+00 6.7100E-02
  0.375 9.6932E-01 4.0541E-02
  0.625 9.5966E-01 3.2257E-02
  0.875 9.5407E-01 2.7103E-02
  1.125 9.5042E-01 2.3766E-02
      1 9.4980E-01 2.5556E-02
      3 9.3871E-01 1.4270E-02
      5 9.3564E-01 1.0760E-02
      7 9.3435E-01 8.5962E-03
      9 9.3330E-01 7.7466E-03
      8 9.3223E-01 8.3903E-03
     24 9.2918E-01 4.9247E-03
     40 9.2830E-01 4.0846E-03
     56 9.2778E-01 4.0822E-03
     72 9.2778E-01 3.9895E-03
$ CIDENT =SAMPLE-7
$ COMMENT=Banded Sample
 Rx: 3007. Tx:    1. NSP: 1.
 0 0 0 15 15     1.221  100.0   90.    5.1  31.2103.20
  SEM   2.0000E-05 1.8000E-04
  0.125 1.0000E+00 1.7908E-01
  0.375 9.2692E-01 9.9561E-02
  0.625 9.0533E-01 7.5133E-02
  0.875 8.9481E-01 6.2380E-02
  1.125 8.8711E-01 5.4003E-02
      1 8.9096E-01 5.6563E-02
      3 8.6954E-01 2.9750E-02
      5 8.6362E-01 2.1768E-02
      7 8.6083E-01 1.7477E-02
      9 8.5901E-01 1.5636E-02
      8 8.5992E-01 1.6082E-02
     24 8.5465E-01 8.0340E-03
     40 8.5345E-01 5.8889E-03
     56 8.5274E-01 4.9459E-03
     72 8.5262E-01 4.4337E-03
$ CIDENT =SAMPLE-8
$ COMMENT=Banded Sample
 Rx: 3008. Tx:    1. NSP: 1.
 0 0 0 15 15     3.426  100.0  100.    5.1  31.2103.14
  SEM   6.0000E-05 6.9000E-04
  0.125 1.0000E+00 3.6333E-01
  0.375 8.4791E-01 2.0615E-01
  0.625 8.0227E-01 1.5804E-01
  0.875 7.7804E-01 1.3275E-01
  1.125 7.6273E-01 1.1582E-01
      1 7.7038E-01 1.2061E-01
      3 7.2173E-01 6.6296E-02
      5 7.0773E-01 4.9765E-02
      7 7.0040E-01 4.0809E-02
      9 6.9634E-01 3.5474E-02
      8 6.9837E-01 3.7188E-02
     24 6.8498E-01 1.9253E-02
     40 6.8164E-01 1.4044E-02
     56 6.8036E-01 1.1295E-02
     72 6.7940E-01 9.3763E-03

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

Sample .LL-file (Data Listing File) (first page only)

```
LABORATORY ROCK MEASUREMENT SUMMARY  LABRED 7.02, Processed: 18 Feb 93


  Freq     Real    Imaginary   Magnitude    Phase
 0.125    1.0000     0.6557     1.1958     0.5804
 0.375    0.7439     0.3496     0.8219     0.4393
 0.625    0.6735     0.2591     0.7216     0.3672
 0.875    0.6381     0.2116     0.6723     0.3202
 1.125    0.6158     0.1832     0.6425     0.2891
 1.000    0.6270     0.1956     0.6568     0.3024
 3.000    0.5573     0.1025     0.5666     0.1820
 5.000    0.5370     0.0762     0.5423     0.1410
 7.000    0.5272     0.0634     0.5310     0.1196
 9.000    0.5199     0.0554     0.5228     0.1062
 8.000    0.5235     0.0589     0.5268     0.1120
24.000    0.5015     0.0332     0.5026     0.0662
40.000    0.4945     0.0263     0.4951     0.0531
56.000    0.4906     0.0228     0.4912     0.0465
72.000    0.4880     0.0207     0.4885     0.0423

Spectral Types: |    A    |    A    |    A    |  (slope: freq vs imag)
                |         |         |         |
Derivatives :       1.234     1.322     1.086    (slope: real vs imag)
                |         |         |         |
Frequency :  0.125         1         8

   Resistivity=       4.8 ohm-meters       Length:    4.9 cm
  Conductivity=     207.5 mmhos/meter        Area:   31.2 sq cm

 .125 Hz phase=     580.4 mr             Resistor:   300.
.125-1. Hz PFE=      82.1 %              Current: 103.63 microamps

      COMMENT: Massive Sample
```

Sample .Xnn-file SAMROCKS.X01





Appendix C ... FILE DOCUMENTATION

.S-file Format (v2.0) CR / RPIP Averaged Data File

```
 1:  "936L50S.S", from CRAVG 5.00
 2:  Rx:  2.0  Tx:  4.0  NSP: 1.0
 3:  1 0 4 18 18      82.7  588.0
 4:   SEM   0.0000E+00 0.0000E+00
 5:    1.4219  0.0693  171.
 6:    0.0747  0.2285  15.7
 7:    0.0426  0.4133  4.80
 8:   -0.0026  1.4776 0.375
 9:     2.955  -0.306   0.719
10:   0.125 1.0000E 00 5.7426E-03
      0.375 9.9734E-01 1.1810E-02
      0.625 9.9471E-01 1.7281E-02
      0.875 9.9243E-01 2.2393E-02
      1.125 9.8993E-01 2.6757E-02
      1.375 9.8754E-01 3.1019E-02
      1.000 9.9118E-01 2.4446E-02
      3.000 9.7520E-01 5.1194E-02
      5.000 9.6105E-01 7.4148E-02
      7.000 9.4681E-01 8.9063E-02
      9.000 9.3649E-01 1.0505E-01
     11.000 9.2290E-01 1.1720E-01
      8.000 9.4165E-01 9.7557E-02
     24.000 8.6712E-01 1.7926E-01
     40.000 8.0799E-01 2.3717E-01
     56.000 7.5174E-01 2.8224E-01
     72.000 6.9981E-01 3.1128E-01
     88.000 6.5208E-01 3.3569E-01
```

DESCRIPTION OF SAMPLE FILE VALUES, BY LINE NUMBER:

The .S-file is composed of a two line header, followed by blocks of data, each containing data for one pseudosection data point. Each block begins with a line indicating the specific point, several lines of parameters, followed by an array of data that includes frequency, real components, and imaginary components for a number of points that describe a curve. The data in this file are always raw, averaged, decalibrated field data normalized to the low frequency real component.

1. File header line generated by the averaging program.

   NOTE: Header line 1 occurs only at the beginning of the file.

2. Rx and Tx indicate the receiver and transmitter dipoles that were used for this block. Dipoles extend between two adjacent stations with the lowest numbered station entered for each dipole.

   The 2 in this file indicates that the receiver dipole was positioned between stations 2 and 3.
   The 4 in this file indicates that the transmitter dipole was positioned between stations 4 and 5.

   -3 would indicate that the dipole was positioned between stations -3 and -2.

   N-SP = N-Spacing = the number of A-Spacings between transmitter and receiver dipoles.

3.
1	Comm wire flag (0 = white wire #2, 1 = black wire (W21C)
0	Times to pass the data curve through a harmonic filter
4	Levels of coupling coefficients
18	Harmonics to use when decoupling
18	Harmonics in data block array
82.7	Apparent Resistivity, RHO (ohmmeters)
588.0	A-Spacing (meters).

   (Values included for LAB rock measurements are noted below)

RHO: dipole-dipole resistivity in ohmmeters =

$$\frac{MAG}{4/pi} * \frac{C}{FPGAIN} * \frac{ASPACING}{CRT} * pi * NSP * [NSP + 1] * [NSP + 2]$$

MAG = raw Fourier magnitude, in volts
4/pi corrects MAG from the Fourier magnitude to the Square-Wave magnitude
C = Communications-wire attenuation
This corrects for the voltage drop that occurs in the wire between the field preamp and the GDP
FPGAIN = field preamp gain
ASPACING = the A-Spacing, in meters
CRT = Current, in amps
NSP = N-Spacing

Comm-wire attenuation factors at 0.125 Hz (W21C wire)
The GDP is not concerned with these factors.

#Reels	Attenuation	#Reels	Attenuation
0	1.0000	5	1.2585
1	1.0505	6	1.3116
2	1.1025	7	1.3635
3	1.1542	8	1.4160
4	1.2070		

NOTE: RHO has been corrected to DC for decoupled data.

RHO: laboratory rock measurements in ohmmeters =

$$\frac{MAG}{4/pi} * \frac{1}{CRT} * \frac{AREA}{LENGTH} * \frac{1\ m}{100\ cm}$$

MAG = raw Fourier magnitude, in volts
4/pi corrects MAG from the Fourier magnitude to the Square-Wave magnitude
CRT = Current, in microAmps
LENGTH = Length of rock sample, in cm
AREA =Area of rock sample, in cm*cm

NOTE: for laboratory rock measurements, RESISTOR, LENGTH, AREA, and CRT are included on this data line, following the A-Spacing.

4. Minimum and maximum SEM values, respectively. SEM: Standard Error of the Mean for Channel 1 (receiver dipole), at the fundamental frequency, in radians (for frequencies of 1.0 Hz and below only)

5,6,7,8. Coupling coefficients, levels 1, 2, 3, 4, respectively. The number of levels varies according to the third value on line 4, as determined during manual decoupling. If the third number on line 4 is zero, the station has not been manually decoupled.

9. Hilbert response parameters: phase, slope 1, and slope 2.

10. The following lines are harmonic data with the 1st, 2nd and 3rd columns listing frequency, real and imaginary components, respectively. The number of lines varies according to the fourth value on line 4.