A BANDLIMITED MAGNETOTELLURIC STUDY OF AN AREA IN HARVARD, MASSACHUSETTS

by

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ABSTRACT

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Submitted to the Department of Earth
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A narrow-band magnetotelluric survey was performed over a small area in Harvard, Massachusetts. The area of interest is centered at Harvard University's observatory which sets on a ridge formed by the conductive mica schist facies of the Worcester formation. Magnetotelluric signals in the 50 to 150 second period band were recorded at a matrix of sites and analyzed for tensor resistivities. The resulting tensors were rotated to indicate the principal axes of a two-dimensional horizontally anisotropic model. The magnitudes and directions of the anisotropic resistivities, when plotted on a map, indicate a strong regional enhancement of telluric currents which is related to the coastline indentation and estuary of the Boston basin and bay area.

This distant current source tends to dominate over the local effect of the conductive mica schist which diverts only a portion of the excess surface current along its strike. Measurements made at the contact between the Ayer granite and the mica schist indicate that the depth extent of the schist is relatively shallow. Telluric measurements, in fact, show that the schist thins along strike to the southwest in the vicinity of Whitney Road.

Thesis Advisor: Theodore R. Madden
Professor, Geophysics

ACKNOWLEDGEMENTS

Coming to M.I.T. from a modest background was both a frightening and awesome experience. I would like to express my appreciation to Prof. William Brace and the Admissions Committee for giving me that opportunity, and also thank those who offered their recommendations in my behalf. Unfortunately, as I complete this work I feel that I am leaving when an entirely new perspective is beginning to come together.

I would especially like to thank my advisor, Prof. Ted Madden, for whom I have a great amount of respect, for his guidance and assistance when it was needed. Professor Madden also provided the equipment necessary to make the magnetotelluric measurements.

I owe many hours of sweat, bug spray and poison ivy lotion to Jerry LaTorraca, Dale Morgan and Dave Smith for their greatly appreciated assistance in speeding up the fieldwork. I also enjoyed many interesting discussions with Jerry, Dale, Earle Williams, Adolfo Vina and Steve Park.

I also wish to thank the Student Financial Aid Office, to whom I am greatly indebted, for their financial assistance throughout the time I have been at M.I.T. I understand I set some sort of record there.

Finally, I want to express my appreciation to my wife, Diane, for her endless work and assistance.

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CHAPTER 1

INTRODUCTION

The rock units of principal interest in this study include a northeast-southwest-trending narrow band of conductive schist of the Worcester formation and the more electrically resistive rocks which abound it. The scope of this thesis will be to gain an insight into the local and regional distribution of earth currents as they relate to this geologic structure, and to obtain a relative measure of the electrical properties of the rocks themselves.

1.1 Geological History*

The earliest events recorded in this area occurred, presumably, during the deposition of the Marlboro formation, for it is generally regarded as pre-Cambrian. Its interstratified relationship with the Gospel Hill gneiss, which is a granitized facies of the Carboniferous Nashoba formation, indicates either un-interupted deposition or obliteration by granitization of a once existing unconformity.

The Marlboro formation was deposited as a thick series of sediments of several types. A large portion of the rocks are hornblendic and therefore may be of volcanic origin. There are also derivatives of calcareous sedimentary rocks and arenaceous deposits are represented now by quartzite beds.

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*Hansen, 1956

Shaly deposits have been converted to mica schist.

Before an igneous invasion, thought to be of Devonian age, the Marlboro formation had attained essentially its present degree of deformation and grade of metamorphism. Gabbro-diorite intrusion was followed by the intrusion of less basic quartz diorite, and cooling of this magma was accompanied by shrinkage and fracturing. Aplite was injected into many of the fractures. Finally, widespread epidotization extended along the joints and fractures beyond the quartz diorite mass.

The Carboniferous rocks lying northwest of the belt of the Marlboro formation can be traced into fossiliferous rocks in the Worcester formation in the Harvard area. Thus, the Worcester formation at this locality was laid down in a continuous depositional sequence (see sketch in Figure 1.1). The earliest episode recorded by these rocks is the deposition of the Harvard conglomerate lentil under littoral conditions. A gradual change toward deeper water conditions followed, accompanied first by the accumulation of sand that later became the Vaughn Hills member, and then by the accumulation of finer grained sediments that are now represented by the phyllite and mica schist facies of the Worcester formation. Toward the top of the mica schist facies are amphibolite beds which could represent either a change to limy sedimentation

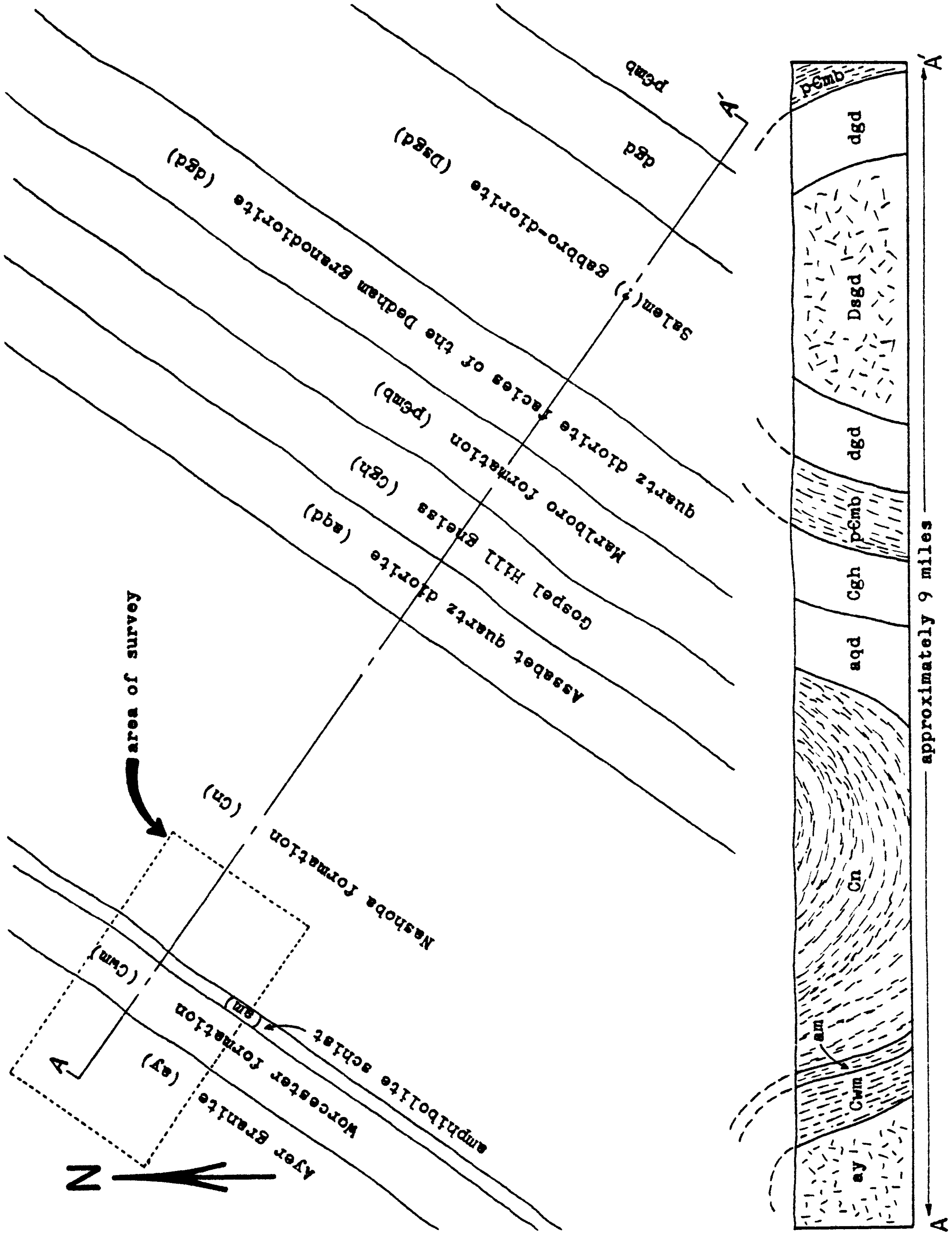


Figure 1.1 Bedrock Geology

or the intercalation of volcanic material. The contact of the mica schist with the Nashoba formation is marked by a fairly thick and very continuous zone of amphibolitic material. Some of these amphibolite beds are undoubtedly derivatives from limestones and are distributed throughout the Nashoba formation.

The Nashoba formation itself represents a very thick accumulation of mostly arenaceous sediments deposited for the most part in shallow water. There are places where it tends to be more schistose, and at infrequent intervals limestone beds were deposited.

The end of deposition of the Nashoba sediments marked, apparently, the close of sedimentation in this area for a long period of time and the beginning of mountain-forming movements that folded and otherwise deformed the rocks to such an extent that, with accompanying metamorphism, many of the original features were completely obliterated. The stresses that were responsible for the bulk of the folding, as it is now displayed, appear to have come from a northwesterly direction. Nearly all the minor folds are asymmetrical with axial planes that dip steeply to the northwest.

Feldspathization of the Nashoba formation closely followed the deformation, as shown by bending, fracturing and microfaulting of some of the feldspar grains which probably occurred before deformation ceased. If a second period of deformation followed, or if in continuing the deformation entered a second phase of redirected stresses, this possibly would postdate the general feldspathization. Cross-folding in the rocks that flank the Nashoba may be caused by such a disturbance.

Igneous intrusion began after folding and migmatization had nearly ceased, since there is no evidence in this area that the igneous rocks were folded along with the metasediments. Inclusions of country rock in many of the igneous bodies indicate that the country rock was essentially in its present state when it was invaded. Little is known of the order of intrusion of the several igneous bodies because all of them crop out in separate areas. Roadcuts along Route 2 display Ayer granite, conspicuous and easily recognized, in close proximity to the Worcester schist, suggesting a buried contact below the alluvium cover which separates the two outcrops.

Jounting in the area may have been almost fully developed by Triassic time. High-angle faulting which produced displacements in Bolton and Harvard, and probably much of the small-scale faulting observed elsewhere, may have also occurred in Triassic.

These are the latest expressions of general structural deformation in the area.

The subsequent geologic history prior to the Pleistocene glaciation is pieced together largely by inference. Uplift of the region by folding of the rocks exposed the area to a long period of erosion. By Late Jurassic or Early Cretaceous time the land surface had been reduced to a peneplane. Submergence of at least part of this erosion surface followed in eastern Massachusetts where it is covered by Miocene strata exposed at the present surface (Cretaceous strata being exposed on Martha's Vineyard). It is not known, however, whether or not Cretaceous rocks ever covered the Harvard area. Renewed uplift ultimately followed peneplanation. The first streams to flow off the re-elevated surface largely ignored the structure of the underlying bedrock, but as they cut into the peneplane the tributary streams in general adjusted themselves to the bedrock structure and developed a trellis drainage pattern in the areas of folded rocks.

Continental glaciers occupied the area probably several times during the Pleistocene period. Although the direction of ice movement may have varied during the existence of the ice sheet, the ice flowed with little regard for the underlying topography. At the time of its greatest magnitude, the ice sheet over this area must have been hundreds, possibly thousands of feet thick. Not only was the ice, with rock fragments firmly frozen in its bed, capable of scouring rock surfaces, but it also was able to pluck large masses of rock directly from the outcrops and transport them southward. Bare Hill Pond in Harvard is due in part to glacial plucking in the bed of preglacial Bowers Brook. Several smaller but still relatively large bedrock basins attributed to glacial plucking lie on the rocky hill between Murrays Lane in Harvard and Codman Hill Road in Boxborough. The largest of these is about 800 feet long. Horse Meadows (see Figure 4.1), about a mile north, is of similar origin.

1.2 Brief Description of Rock Types in which Magnetotelluric Measurements Were Made

The area of interest is centered at Harvard University's Agassiz Observatory which sets high on a ridge formed by the mica schist facies of the Worcester formation in Harvard, Massachusetts. The Worcester formation includes those rocks of Carboniferous age formerly mapped in this area as Worcester phyllite and Brimfield schist, and also a previously unmapped quartzite unit called the Vaughn Hills member. The Worcester phyllite and Brimfield schist are regarded as stratigraphically equivalent metamorphic facies and are now referred to as the phyllite facies and mica schist facies of the Worcester formation.

The mica schist facies is a moderately coarse grained muscovite schist that commonly contains abundant quartz and pyrite with frequent local amounts of biotite, andalusite and sillimanite. It weathers rapidly on exposed surfaces, displaying its characteristic stain of oxidation products of the pyrite. Freshly exposed rock is commonly light gray with a pearly luster owed to the predominance of muscovite. The metamorphic grade increases across the strike from east to west. The grain size of the rock, due to recrystallization, is progressively coarser toward the east. The average thickness in the area where the magnetotelluric measurements were made is in the order of 5,000 feet (1.5 km).

Between the mica schist facies and the Nashoba formation to the southeast is a wide continuous transition zone of amphibolitic beds. The rocks of this zone are prodominantly quartz-hornblende schist. The amphibolite zone grades into the mica schist facies of the Worcester formation at its base and into the Nashoba formation at its top, and contains interbedded mica schists of the Worcester formation type as well as biotite gneiss of the Nashoba type.

The Nashoba formation represents the great mass of metamorphic rocks of Carboniferous age that extends northeastward across east-central Massachusetts. Locally, in the vicinity of the survey, the Nashoba formation consists chiefly of biotite gneiss, but also contains biotite schist and interbedded layers of amphibolite schist. These beds are predominantly hard medium-grained paragneiss composed principally of quartz, biotite and sodic plagioclase. Increased proportions of biotite make the rock more schistose.

The Ayer granite, conspicuous because of its abundant orthoclase phenocrysts, is presumed by the author to be in contact with the mica schist facies of the Worcester formation along the northwest base of Oak Hill beneath alluvial cover. It consists mostly of orthoclase, quartz and albite with accessory biotite, muscovite, chlorite and apatite. The orthoclase phenocrysts are as large as 3 inches in length, slightly perthitic and commonly twinned. This porphyritic facies of the rock has a rude planar structure caused by a subparallel orientation of its phenocrysts, due probably to viscous flow of the magma before complete solidification.

CHAPTER 2

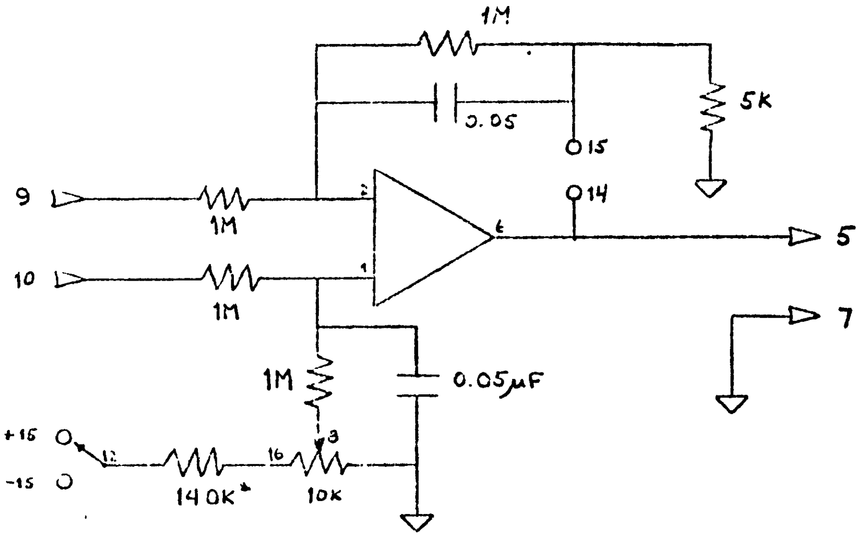
MAGNETOTELLURIC MEASUREMENTS

2.1 Measuring Equipment

Horizontal components of the earth's time-varying electric field were measured using 1-kilometer dipoles of no. 22 copper magnet wire with silver/silver chloride porous pot electrodes. By electrolysis, silver chloride was plated onto a pencil-size rod of silver mesh about 4 inches in length. The coated electrode was inserted through a hole in a rubber stopper which then was placed in a 3/4"-diameter porous porcelain pot filled with a supersaturated solution of silver chloride and potassium chloride. Electrode noise was virtually eliminated in comparison to other types of electrodes tested before the survey began.

The horizontal components of the time-varying magnetic field orthogonal to each dipole were measured with two coils (described in Cantwell, 1960), each having 90,000 turns of no. 26 copper magnet wire around a Permaloy core. The Permaloy rods for each coil were of different lengths, resulting in different sensitivities for each coil. Both coils were calibrated by first aligning them in the magnetic N-S direction, then rotating them 180° while integrating the voltage output. A schematic of the integrating circuit is shown in Figure 2.1. The total horizontal magnetic field at the time of calibration was obtained from the Weston Observatory (18,363 gammas). The

Figure 2.1 Schematic of Circuit Used to Integrate Coil Voltage During Calibration



* 150K || 2.10M

Pos	Gain
1	201
2	101
3	41
4	21
5	11
6	5
7	3
8	2
9	1.4
10	1.2

79 Differential Input DC-3cps
±1 volt offset

july 1977

integrated voltages

long coil:	S-N	-1.689
	N-S	+1.650
	S-N	-1.671
	N-S	+1.649
short coil:	S-N	-1.100
	N-S	+1.076

were obtained, resulting in coil factors of

long coil factor = $3.51 \frac{\text{gammas}}{\text{mv}}$ cps

short coil factor = $5.37 \frac{\text{gammas}}{\text{mv}}$ cps.

2.2 Instrumentation

The electronic instrumentation was designed by Professor Madden and built by Dave Smith and Jim Wang. The output voltage from each coil was sent to a preamplifier (Figure 2.2) having a 2 cps cutoff frequency and with the gain set at 1001. Then each component of the measured E-field and H-field signals was fed to a separate two-stage amplifier, each of which was cascaded stages of the amplifier shown in Figure 2.3. Each stage had a single-pole bandpass filter with -3 db cutoffs at 50 and 150 seconds of period. Outputs of the four amplifiers were recorded on two two-channel Rustrack recorders.

In an attempt to reduce the amount of chart speed drift, the DC chart drive motors were replaced by AC motors. The recorders were then run off a 300-watt 12vdc/120vac inverter powered by the car battery. Only moderate success, if any, was achieved since one recorder continued to vary in speed.

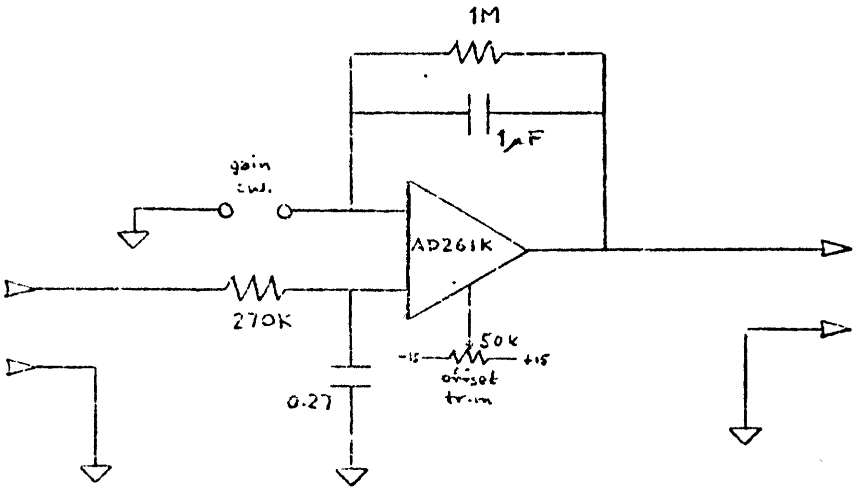


Figure 2.2 Magnetotelluric Preamp

Pos.	Gain
1	2
2	3
3	6
4	11
5	21
6	51
7	101
8	201
9	501
10	1001

80 Magnetotelluric Preamp
2cps Lowpass

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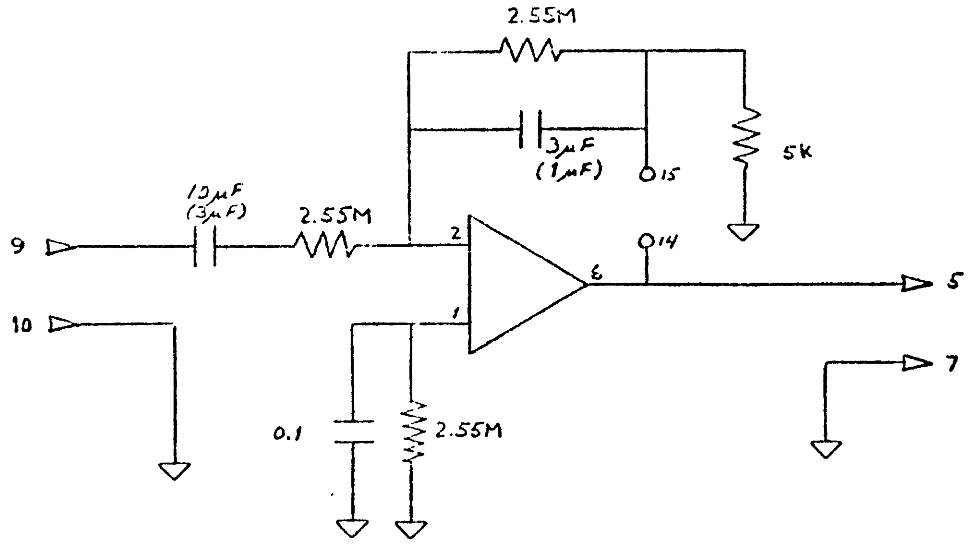


Figure 2.3 Magnetotelluric Bandpass Amplifier
(single stage)

Pos.	Gain 77	 78
1		201
2		101
3		41
4		21
5		11
6		5
7		3
8		2
9		1.4
10		1.2

77: 150-50 second bandpass
component values in ( ) for
78: 50-15 second bandpass

july 1977

The use of timing marks made on each chart at ten minute intervals by means of a stop watch made it possible to correct the records for variations in chart speed.

2.3 Fieldwork

The fieldwork, at best, was arduous, and at worst it was frustrating. All the peculiarities and extremes of New England inhabitants manifested during this work. Many residents and passers-by showed genuine interest in the measurements being made. Some offered the use of their land and even assisted. A few showed extreme indignation, and others ripped up long lengths of dipole wire when they discovered it passing in front of their driveway. Usual setup time for the author working alone to lay out two dipoles and set the magnetometers in place was about 2½ hours. Normally, 1½ hours of magnetotelluric recording and an hour to pickup resulted in about five hours for each MT station. The work went considerably faster with the assistance of Jerry LaTorraca, Dale Morgan and Dave Smith.

Magnetotelluric stations were selected to provide minimum interference from power lines and road traffic. On a lightly traveled road the magnetometers set 200 feet from the road were insensitive to passing vehicles. Dipoles were laid out in directions generally parallel and perpendicular to the strike of the geologic structure.

CHAPTER 3

DATA ANALYSIS

> . . . for thou shalt learn
> The wisdom early to discern
> True beauty in utility.
> Longfellow

3.1 Digitization, Rotation, Mean Correction and Tapering of Data

Selected sections of the analog data were digitized using a third-order polynomial regression technique applied to short segments of the waveforms. By observing identical timing marks on each Rustrack recording, a correction was made to give all channels a uniform chart speed (equal time-length syncronized data sections).

In order to identify the components of all the digitized data sections a three-part title is associated with each channel

```
MT1.E64.12      CHANNEL 1
 |  | |  └─Data Section 1 of 2
 |  | └────Original Dipole Azimuth
 |  └──────Electric Dipole
 └─────────Magnetotelluric Station 1

MT1.H334.12     CHANNEL 2
 |  |  |  └─Data Section 1 of 2
 |  |  └────Original Coil Azimuth
 |  └───────Magnetic Coil
 └──────────Magnetotelluric Station 1
```

etc. The horizontal components of the real vectors E and H

($\dot{H} = \frac{dH}{dt}$) were then rotated to a set of structurally-oriented orthogonal axes (Figure 3.1), such that

$$E1 = 42.5^{\circ} = x$$
$$\dot{H}2 = 132.5^{\circ} = y$$
$$E3 = 132.5^{\circ} = y$$
$$\dot{H}4 = 42.5^{\circ} = x$$

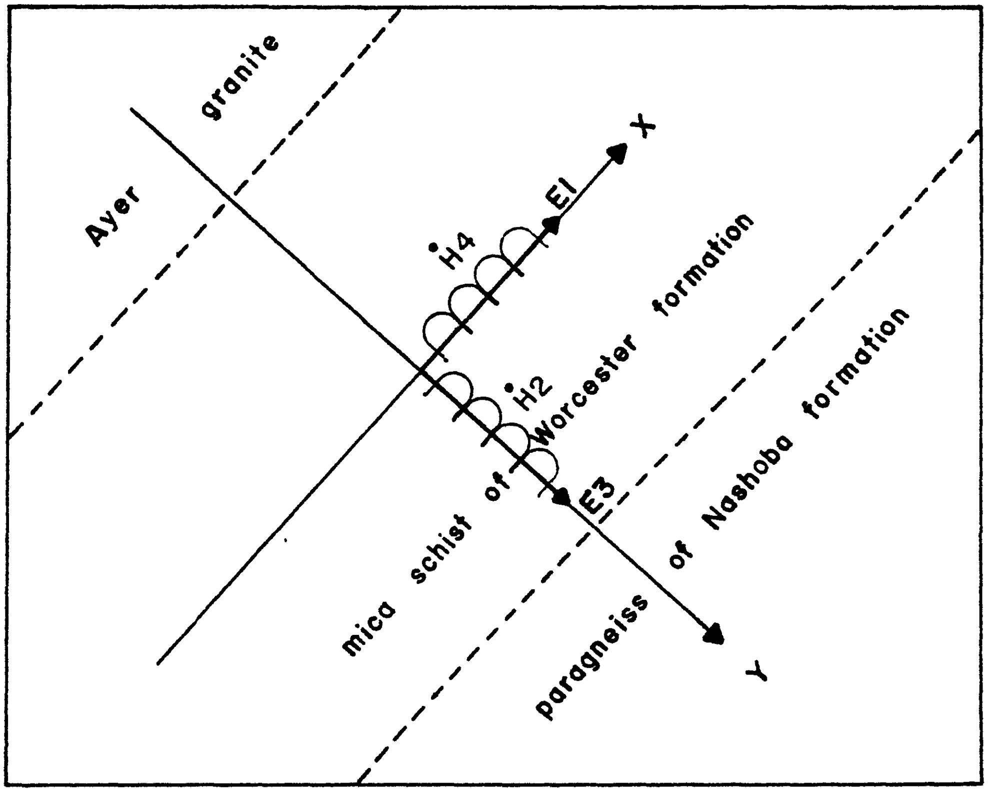


Figure 3.1 Structurally-oriented Reference Axes

A cosine taper of one-tenth the data length was applied to each end of the digitized data sections. The power and crosspower estimates were then adjusted by a factor $\frac{1}{0.875}$ which is the ratio of the area of a boxcar data window to that of the cosine tapered data window.

3.2 Power and Crosspower Spectral Estimates By The Smoothed Periodogram Method

The most efficient and straightforward method of computing power and crosspower spectral estimates is to fast-Fourier-transform[+] the digitized data series and then take the complex-vector products EE^*, $\dot{H}\dot{H}^*$ and $E\dot{H}^*$ (* indicates complex conjugate).

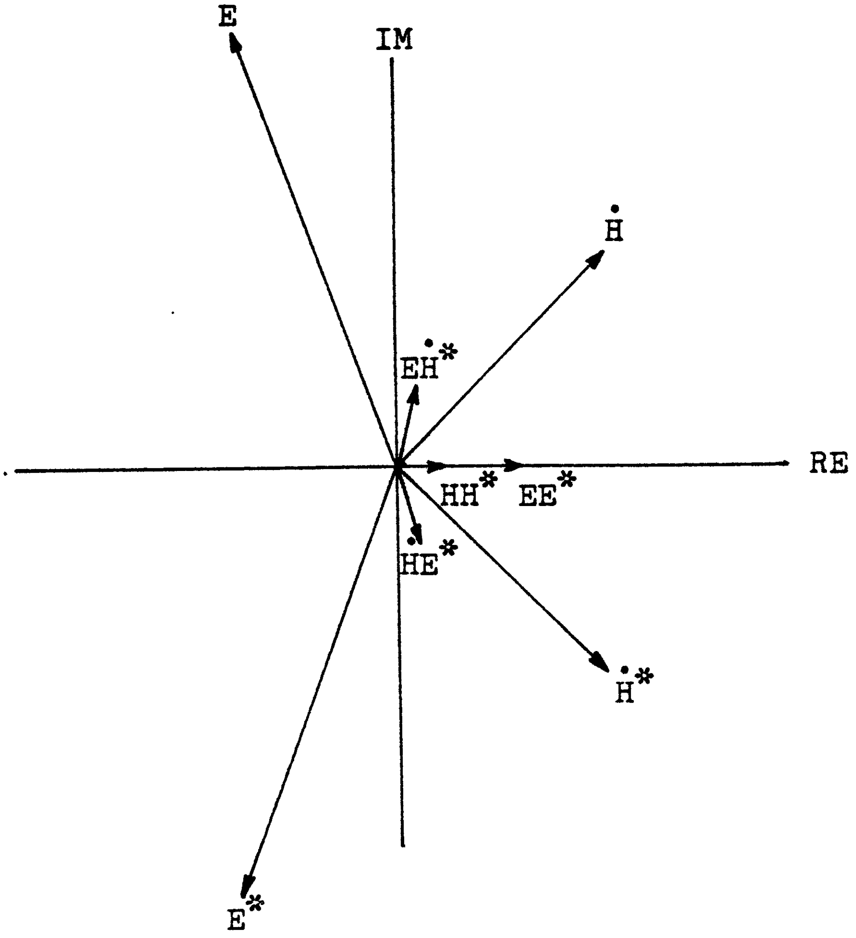


Figure 3.2 Graphic Example of Autopower and Crosspower in the Complex Plane ($|E|<1$ and $|H|<1$)

[+] An explanation of the fast Fourier transform can be found in nearly every digital signal processing or time series spectral analysis text written since about 1962.

The quantities EE^* and $\dot{H}\dot{H}^*$ so obtained are called periodograms ($E\dot{H}^*$ being a cross-periodogram). As an estimate of the power spectrum $F_E(f)$ a critical disadvantage of the periodogram is that its variance is approximately $F_E(f)^2$, even when based on a lengthy section of data. A method of improving the distribution properties of the periodogram as an estimator of power spectrum is by simple averaging the ordinates of EE^* at several frequencies in the neighborhood of f. If the number of values that are averaged is not too large compared to the total number of data points $<EE^*>$ can be expected to be near $F_E(f)$, assuming $F_E(f)$ is continuous and reasonably smooth.

Smoothing by frequency averaging, however, directly reduces the number of frequencies that will be represented in the smoothed estimate. Delta f of the periogram is given by

$$\Delta f_{raw} = \frac{1}{N\Delta T} \qquad (\Delta T \text{ is the sampling interval})$$

Averaging values of EE^*, $\dot{H}\dot{H}^*$ and $E\dot{H}^*$ in groups of eight frequencies produces the smoothed spectral quantities $<EE^*>$, $<\dot{H}\dot{H}^*>$ and $<E\dot{H}^*>$ having a delta f of

$$\Delta f_{smoothed} = \frac{8}{N\Delta T}$$

or eight times that of the periodogram. The autopower and crosspower of each component of E and $\dot{H}$ were computed in this manner giving the ten spectral quantities

$$\langle E_1E_1^*\rangle \quad \langle E_3E_3^*\rangle \quad \langle \dot{H}_2\dot{H}_2^*\rangle \quad \langle \dot{H}_4\dot{H}_4^*\rangle$$

$$\langle E_1\dot{H}_2^*\rangle \quad \langle E_1E_3^*\rangle \quad \langle E_1\dot{H}_4^*\rangle \quad \langle \dot{H}_2E_3^*\rangle \quad \langle \dot{H}_2\dot{H}_4^*\rangle \quad \langle E_3\dot{H}_4^*\rangle$$

From these quantities the coherences of each crosspower were computed using the expression

$$\text{Coh } AB^* = \frac{\langle AB^*\rangle}{(\langle AA^*\rangle\langle BB^*\rangle)^{\frac{1}{2}}}$$

3.3 The Impedance Tensor

Apparent resistivities computed from the individual ratios of measured orthogonal electric and magnetic field components (Cagniard, 1953)

$$\rho_{a_{1,2}} = \frac{i}{2\pi f\mu}\left[\frac{\langle E_1E_1^*\rangle}{\langle H_2H_2^*\rangle}\right]$$

$$\rho_{a_{3,4}} = \frac{i}{2\pi f\mu}\left[\frac{\langle E_3E_3^*\rangle}{\langle H_4H_4^*\rangle}\right]$$

are strongly dependent on the direction of a polarized H-field in the presence of horizontal anisotropies or inhomogeneities (Madden and Nelson, 1964). To take account of the anisotropy of a structure the horizontal field components are related by

$$\begin{bmatrix} E_1 \\ E_3 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{13} \\ Z_{31} & Z_{33} \end{bmatrix} \begin{bmatrix} H_4 \\ H_2 \end{bmatrix}$$

or

$$E_1 = Z_{11}H_4 + Z_{13}H_2$$

$$E_3 = Z_{31}H_4 + Z_{33}H_2$$

where the Z_{ij}'s are the elements of a surface impedance tensor. Generally for an anisotropic earth both components of H can contribute to a single component of E. Rotation of the measurement axes to the axes of anisotropy of course would eliminate the diagonal elements Z_{11} and Z_{33}. This will be discussed in a later section. Although E could be written as the source field operated on by an admittance tensor to produce H (Bostick and Smith, 1962), commonly greater linear independence between components of H makes an H-field source preferable.

If we multiply this set of equations by the complex conjugate of each component of the source field H_2^* and H_4^*, then after frequency averaging we obtain the set of equations

$$\langle E_1H_2^*\rangle = Z_{11}\langle H_2H_2^*\rangle + Z_{13}\langle H_4H_2^*\rangle$$

$$\langle E_1H_4^*\rangle = Z_{11}\langle H_2H_4^*\rangle + Z_{13}\langle H_4H_4^*\rangle$$

$$\langle E_3H_2^*\rangle = Z_{31}\langle H_2H_2^*\rangle + Z_{33}\langle H_4H_2^*\rangle$$

$$\langle E_3H_4^*\rangle = Z_{31}\langle H_2H_4^*\rangle + Z_{33}\langle H_4H_4^*\rangle$$

which, when solved for the impedance elements Z_{ij}, give

$$Z_{11} = \frac{\langle E_1H_4^*\rangle\langle H_2H_2^*\rangle - \langle E_1H_2^*\rangle\langle H_2H_4^*\rangle}{\langle H_2H_2^*\rangle\langle H_4H_4^*\rangle - \langle H_2H_4^*\rangle\langle H_4H_2^*\rangle}$$

$$= \frac{|E_1|}{|H_4|}\;\frac{\mathrm{Coh}\langle E_1H_4^*\rangle - \mathrm{Coh}\langle E_1H_2^*\rangle\mathrm{Coh}\langle H_2H_4^*\rangle}{1 - \left|\mathrm{Coh}\langle H_4H_2^*\rangle\right|^2}$$

$$Z_{13} = \frac{\langle E_1H_2^*\rangle\langle H_4H_4^*\rangle - \langle E_1H_4^*\rangle\langle H_4H_2^*\rangle}{\langle H_2H_2^*\rangle\langle H_4H_4^*\rangle - \langle H_2H_4^*\rangle\langle H_4H_2^*\rangle}$$

$$= \frac{|E_1|}{|H_2|}\;\frac{\mathrm{Coh}\langle E_1H_2^*\rangle - \mathrm{Coh}\langle E_1H_4^*\rangle\mathrm{Coh}\langle H_4H_2^*\rangle}{1 - \left|\mathrm{Coh}\langle H_4H_2^*\rangle\right|^2}$$

$$Z_{31} = \frac{\langle E_3H_4^*\rangle\langle H_2H_2^*\rangle - \langle E_3H_2^*\rangle\langle H_2H_4^*\rangle}{\langle H_2H_2^*\rangle\langle H_4H_4^*\rangle - \langle H_2H_4^*\rangle\langle H_4H_2^*\rangle}$$

$$= \frac{|E_3|}{|H_4|}\;\frac{\mathrm{Coh}\langle E_3H_4^*\rangle - \mathrm{Coh}\langle E_3H_2^*\rangle\mathrm{Coh}\langle H_2H_4^*\rangle}{1 - \left|\mathrm{Coh}\langle H_4H_2^*\rangle\right|^2}$$

$$Z_{33} = \frac{\langle E_3H_2^*\rangle\langle H_4H_4^*\rangle - \langle E_3H_4^*\rangle\langle H_4H_2^*\rangle}{\langle H_2H_2^*\rangle\langle H_4H_4^*\rangle - \langle H_2H_4^*\rangle\langle H_4H_2^*\rangle}$$

$$= \frac{|E_3|}{|H_2|}\;\frac{\mathrm{Coh}\langle E_3H_2^*\rangle - \mathrm{Coh}\langle E_3H_4^*\rangle\mathrm{Coh}\langle H_4H_2^*\rangle}{1 - \left|\mathrm{Coh}\langle H_4H_2^*\rangle\right|^2}$$

where $$\frac{|E_i|}{|H_j|} = \frac{(<E_i E_i^*>)^{\frac{1}{2}}}{(<H_j H_j^*>)^{\frac{1}{2}}}$$

Clearly, if the $<H_4 H_2^*>$ coherence is very nearly equal to 1 the impedances become unstable.

During all the spectral computations the measured quantity $\frac{\partial H}{\partial t}$ was used. Transformation to H is made by dividing $\dot{H}$ by frequency in hertz. A quick look at the expressions that define the impedances will show that transformation of the impedance elements is performed by multiplying by frequency. No correction was made for phase since we are interested in squared magnitudes at this point.

Although the impedances were stored as complex numbers, they were output in units of apparent resistivity (ohm-meters), where

$$\rho_{a_{i,j}} = \frac{i}{2\pi f\mu}\left(Z_{ij}Z_{ij}^*\right)$$

3.4 Skewness

Skewness, S, defined as

$$S = \frac{|Z_{11} + Z_{33}|}{|Z_{13} - Z_{31}|}$$

is an invariant quantity used to determine how closely the measured impedance tensor approximates an ideal tensor for a two-dimensional structure. For a two-dimensional conductivity structure the impedance elements Z_{11} and Z_{33} vanish when the axes of the tensor are aligned with the structural axes, and $Z_{11} = -Z_{33}$ for all other orientations. In the ideal case, therefore, the sum $Z_{11} + Z_{33}$ is always zero so that $S = 0$.

3.5 Coherence of $E^{predicted}E^{observed}$

The equations

$$E_1 = Z_{11}H_4 + Z_{13}H_2$$

$$E_3 = Z_{31}H_4 + Z_{33}H_2$$

suggest that the orthogonal components of E can be computed (predicted) from H_2 and H_4 if the impedance elements are known. Having computed the impedances from the observed data, a measure of the quality of the data is the coherence between the observed E and a predicted E, such that

$$\mathrm{Coh}\langle E_i^p E_i^{o*}\rangle = \frac{\langle E_i^p E_i^{o*}\rangle}{(\langle E_i^p E_i^{p*}\rangle\langle E_i^o E_i^{o*}\rangle)^{\frac{1}{2}}}$$

$$= \frac{Z_{i1}\langle H_4 E_i^*\rangle + Z_{i3}\langle H_2 E_i^*\rangle}{\left[|Z_{i1}|^2\langle H_4 H_4^*\rangle + |Z_{i3}|^2\langle H_2 H_2^*\rangle + 2\mathrm{Re}\,(Z_{i1}Z_{i3}^*\langle H_4 H_2^*\rangle)\right]^{\frac{1}{2}}\left[\langle E_i E_i^*\rangle\right]^{\frac{1}{2}}}$$

Expanding the numerator of this expression would show that the coherence of $\langle E_i^p E_i^{o*}\rangle$ is always a real quantity, that is, E_i^p is in phase with E_i^o as expected.

3.6 Principal Axes of the Impedance Tensor

For a homogeneous isotropic halfspace, or an isotropic horizontally layered model, the relationship between electric and magnetic field components reduces to a scalar impedance

$$E_x = ZH_y$$

$$E_y = -ZH_x$$

where Z is independent of horizontal direction because all field components are mutually orthogonal and J is parallel to E.

Within a horizontal two-dimensional conductivity structure, however, the E-field is biased by the gross strike of the structure and the contrast of neighboring conductivity inhomogeneities. The effect is approximated by a horizontal anisotropy in which H and J are orthogonal and the relationship between E and H is represented by a second-order tensor.

If electric and magnetic measurements were to be made along the axes, x' and y', of such an anisotropic model, the diagonal elements $Z_{x'x'}$ and $Z_{y'y'}$ of the impedance tensor would vanish. $Z_{x'y'}$ and $Z_{y'x'}$ would then be the principal impedances of the structure. As the tensor is rotated from the principal axes of anisotropy an angle $\emptyset$, the rotated tensor is related to the principal tensor by

$$\underbrace{\begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix}}_{Z(\phi)} = \underbrace{\begin{bmatrix} \cos\phi & \sin\phi \\ -\sin\phi & \cos\phi \end{bmatrix}}_{B} \underbrace{\begin{bmatrix} 0 & Z_{x'y'} \\ Z_{y'x'} & 0 \end{bmatrix}}_{Z(x',y')} \underbrace{\begin{bmatrix} \cos\phi & -\sin\phi \\ \sin\phi & \cos\phi \end{bmatrix}}_{B^T}$$

where the diagonal elements Z_{xx} and Z_{yy} resulting from the rotation would have the relationship $Z_{xx} = -Z_{yy}$.

In actual practice, performing the inverse rotational transformation on a measured impedance tensor does not yield a set of orthogonal axes where $Z_{x'x'} = Z_{y'y'} = 0$. It has been concluded that such principal axes would be skew (Swift, 1967), and is equivalent to seeking the directions where a linearly polarized H produces an E in only an orthogonal direction.

The most common method used to analyze measured impedance tensors for two-dimensional characteristics orients the axes in the direction in which one of the elements $|Z_{xy}|$ or $|Z_{yx}|$ is maximized. Either element will give the same orientation since $Z_{x'y'}(\phi) = Z_{y'x'}(\phi+90)$. In closed form, the same axes are obtained by maximizing the sum of the squared magnitudes $|Z_{xy}|^2 + |Z_{yx}|^2$, which gives

$$\tan 4\phi = \frac{(Z_{xx} - Z_{yy})(Z_{xy} + Z_{yx})^* + (Z_{xx} - Z_{yy})^*(Z_{xy} + Z_{yx})}{|Z_{xx} - Z_{yy}|^2 - |Z_{xy} + Z_{yx}|^2}$$

which reduces to

$$\tan 4\phi = \frac{2\mathrm{Re}\left[(Z_{xx} - Z_{yy})(Z_{xy} + Z_{yx})^*\right]}{\left|Z_{xx} - Z_{yy}\right|^2 - \left|Z_{xy} + Z_{yx}\right|^2}$$

This equation has two solutions for each ϕ, a maximum and a minimum 45° apart.

As the tensor is rotated through 360° the sum $|Z_{xy}|^2 + |Z_{yx}|^2$ passes through a maximum or a minimum at 45°-intervals, and $|Z_{xy}|^2$ or $|Z_{yx}|^2$ will be a maximum at 90°-intervals (where the sum is maximized). Also, when $|Z_{xy}|^2$ or $|Z_{yx}|^2$ is a maximum it will be greater than any other $|Z_{ij}|^2$. The principal axes were determined by these criteria and the rotated tensor elements computed from the expressions

$$Z'_{11} = Z_{11}\cos^2\phi + \tfrac{1}{2}(Z_{13} + Z_{31})\sin 2\phi + Z_{33}\sin^2\phi$$

$$Z'_{13} = Z_{13}\cos^2\phi + \tfrac{1}{2}(Z_{33} - Z_{11})\sin 2\phi - Z_{31}\sin^2\phi$$

$$Z'_{31} = Z_{31}\cos^2\phi + \tfrac{1}{2}(Z_{33} - Z_{11})\sin 2\phi - Z_{13}\sin^2\phi$$

$$Z'_{33} = Z_{33}\cos^2\phi - \tfrac{1}{2}(Z_{13} + Z_{31})\sin 2\phi + Z_{11}\sin^2\phi$$

3.7 Summary of Data Analysis

All calculations were performed on a Hewlett Packard 9825A minicomputer, with a HP 9872A plotter used to digitize the analog data. Results of the data analyses are summarized in Table 3.1. The computer output is contained in Appendix C.

Consistency in the orientation of the principal axes of the impedance tensor and of the principal impedances was highly dependent on the coherence of the signals within each frequency band. Frequencies having low coherent crosspower display erratic results, although consistent directions are obtained even at low coherencies when the station is highly anisotropic.

There are three problem data stations. Stations 1 and 14 are badly corrupted by noise, consequently representative values at these sites were difficult to select objectively. Also, the N-S dipole of station 19 crosses the contact from the Worcester schist into the Ayer granite, thereby precluding a tensor interpretation of this data.

In addition to noise, station 14 has a local bias which may be attributed to a marsh and small pond at Horse Meadows. A look at the gains of the telluric measurements of station 15 (which uses the N-S dipole of sta. 14 and another N-S dipole to the south) shows that the E-field of the south dipole is ten times greater in magnitude than that of the common dipole.

Multiplying the y-component of the E-field of sta. 14 by ten would rotate the principal axes toward a direction more perpendicular to strike, as it is expected to be. Actual calculations using this factor, however, produce only about half the rotation desired.

Table 3.1a
SUMMARY OF M-T DATA ANALYSIS

						ROTATED IMPEDANCE TENSOR			
STA	DATA FILE	FREQ	COH $E_1^pE_1^{o*}$	COH $E_3^pE_3^{o*}$	OPTIM ANGLE ROTAT	$\|Z_{11}\|^2$ (OHM-M)	$\|Z_{13}\|^2$ (OHM-M)	$\|Z_{31}\|^2$ (OHM-M)	$\|Z_{33}\|^2$ (OHM-M)
1	2	.014	.58	.67	76	10561	120500	29	1342
		.032	.60	.78	68	10693	163710	1872	11325
		.050	.48	.45	78	12555	333120	10593	6912
	2^+	.014	.50	.56	75	1441	44745	66	1210
		.032	.82	.83	74	18891	166060	2525	10229
		.050	.47	.66	-89	22940	187620	1303	15878
	3	.014	.70	.76	-86	3443	26796	125	918
		.032	.58	.54	-74	3824	9333	3088	2252
		.050	.92	.87	-81	3552	26039	1212	1219
	3^+	.014	.63	.66	46	3877	6126	2413	4014
		.032	.84	.67	68	13729	22043	2025	3994
		.050	.89	.85	-64	5593	8376	1496	4229
2	4	.009	.75	.92	89	598	13975	10	486
		.018	.95	.99	-88	133	17757	79	143
		.027	.89	.97	84	1263	18747	25	959
		.036	.96	.97	88	851	18096	25	433
		.045	.46	.92	85	368	23869	20	499
	5	.010	.69	.61	89	67	9786	199	312
		.019	.86	.90	-83	83	11801	425	72
		.028	.93	.94	-87	94	18336	330	526
		.038	.84	.92	87	612	13917	409	201
		.047	.94	.84	-81	134	35868	372	933
	6	.010	.82	.88	88	14	26166	13	208
		.019	.90	.79	84	54	11463	187	51
		.028	.96	.99	86	1215	25059	329	286
		.037	.94	.91	82	1600	17006	324	80
		.046	.94	.89	-90	1256	32291	267	568
6	7	.010	.96	.93	78	1	90	29	5
		.019	.81	.64	-89	6	50	27	9
		.029	.86	.67	13	5	54	9	7
		.038	.89	.84	70	14	81	4	9
		.048	.87	.54	9	54	176	28	59
	8	.010	.94	.91	41	23	99	2	8
		.019	.93	.91	52	6	101	1	2
		.029	.90	.44	-29	1	66	6	0
		.038	.90	.74	42	4	72	28	2
		.048	.80	.80	-78	78	363	81	65

$^+$indicates shifted portion of data section

Table 3.1b

SUMMARY OF M-T DATA ANALYSIS

						ROTATED IMPEDANCE TENSOR			
STA	DATA FILE	FREQ	COH $E_1^pE_1^{o*}$	COH $E_3^pE_3^{o*}$	OPTIM ANGLE ROTAT	$\|Z_{11}\|^2$ (OHM-M)	$\|Z_{13}\|^2$ (OHM-M)	$\|Z_{31}\|^2$ (OHM-M)	$\|Z_{33}\|^2$ (OHM-M)
9	9	.016	.45	.50	69	15	51	2	9
		.035	.79	.72	22	4	20	15	19
	10	.016	.90	.92	52	6	34	9	4
		.035	.94	.80	66	3	66	17	3
	11	.016	.96	.85	38	7	46	36	10
		.035	.97	.73	-52	8	25	16	7
14	12	.010	.76	.69	7	489	5416	123	71
		.019	.85	.55	-3	655	11398	28	160
		.029	.29	.51	24	1468	1471	532	111
		.038	.65	.36	-17	7420	36323	1091	4481
		.048	.50	.70	-8	4865	17167	617	2612
	12$^+$	.010	.78	.58	13	819	4105	72	287
		.019	.79	.78	-1	1344	15327	6	467
		.029	.68	.45	19	2424	23554	85	1229
		.038	.34	.42	-3	364	15305	110	495
		.048	.61	.62	-14	1665	20092	2566	
	12$^@$	.010	.83	.73	-27	3969	34197	2718	1778
		.019	.90	.67	-32	3161	58804	921	705
		.029	.44	.65	-40	13619	59421	2571	5415
		.038	.77	.55	-29	129	200920	2396	1607
		.048	.43	.57	-28	14285	11662	11159	11349
	13	.010	.38	.36	38	1718	3066	871	1551
		.019	.86	.91	15	509	11194	228	257
		.029	.45	.26	27	1384	5082	527	973
		.038	.52	.48	-11	8293	18569	112	1326
		.048	.53	.67	3	81	19507	468	889
	13$^@$	.010	.35	.35	-7	10004	18126	608	2068
		.019	.84	.87	-36	708	63049	2778	1949
		.029	.45	.34	-54	5743	15442	6987	5654
		.038	.63	.56	-69	78371	92222	74267	97738
		.048	.78	.74	2	105720	223460	42874	78933

$^+$indicates shifted portion of data section

$^@$indicates E3 signal multiplied by 10 to adjust for a local effect

Table 3.1c

SUMMARY OF M-T DATA ANALYSIS

						ROTATED IMPEDANCE TENSOR			
STA	DATA FILE	FREQ	COH $E_1^pE_1^{o*}$	COH $E_3^pE_3^{o*}$	OPTIM ANGLE ROTAT	$\|Z_{11}\|^2$ (OHM-M)	$\|Z_{13}\|^2$ (OHM-M)	$\|Z_{31}\|^2$ (OHM-M)	$\|Z_{33}\|^2$ (OHM-M)
18	14	.009	.75	.81	83	526	17602	7	69
		.018	.85	.97	73	1580	18915	74	235
		.027	.34	.85	79	813	20709	70	95
		.036	.67	.80	78	1223	25881	141	31
		.045	.24	.53	81	164	3538	206	109
	15	.009	.60	.64	75	1049	1869	20	35
		.018	.79	.81	70	1834	10972	49	930
		.027	.59	.60	68	2981	14580	405	3056
		.036	.84	.74	80	22	5617	62	944
		.045	.68	.84	69	384	8410	133	676
19	16	.009	.92	.97	68	1147	2886	417	1107
		.018	.92	.94	73	901	4165	238	998
		.027	.94	.97	81	1071	8533	41	1186
		.036	.71	.86	75	942	8772	335	1153
		.045	.40	.73	62	1424	3721	419	1469
	17	.009	.71	.79	87	372	5164	11	403
		.018	.54	.59	76	1184	3362	376	730
		.027	.37	.64	66	402	975	166	403
		.036	.65	.48	62	451	873	524	471
		.045	.85	.88	82	936	2602	139	237

CHAPTER 4

INTERPRETATION

4.1 A Review of the Results

The E-field bias observed at station 14, as discussed in section 3.7, is undoubtedly caused by current being drawn locally into the glacial basin at Horse Meadows which is described in section 1.1. This must be a considerably deep feature in comparison to the broad marshland at station 1, which had little, if any effect on the tensor orientation.

The apparent tensor resistivities and their associated directions are tabulated in Table 4.1 and plotted on the map in Figure 4.1. With the exception of sta. 19, all of the results can be interpreted from a horizontal anisotropic model, probably with a regional bias caused by the proximity of the ocean. In this model, local conductivity inhomogeneities due to geologic structures tend to have a local anisotropic effect on the telluric current distribution (preferred current direction) in the crust of the earth. At the same time, larger scale regional features may have a similar influence, but over a broader area. The measured result would then be one superimposed over the other.

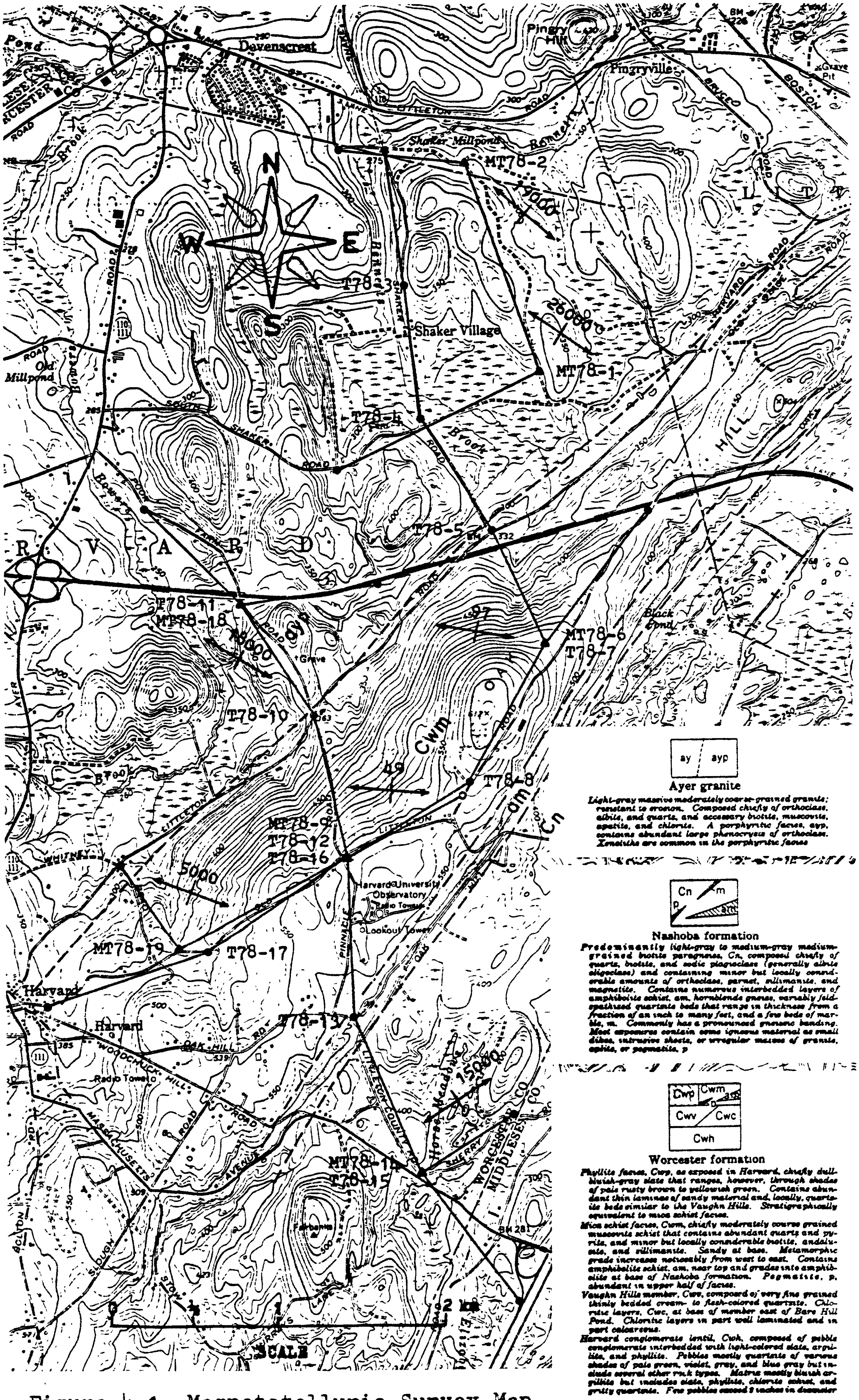
At the contact between the Ayer granite and the schist facies of the Worcester formation the telluric measurements at station 10, made perpendicular to strike, show a drop in the electric field by a factor of 23 as it passes from the granite into the schist. If the schist was much deeper in extent than its width, continuity in the normal component of J would require that the contrast in the normal components of the E-field be proportional to the contrast in resistivity across the contact. Shallow electrical measurements made in granites in this region have produced typical resistivities in the order of 20,000 ohm-meters, whereas that of the schist is in the order of 100 ohm-meters. The resistivity ratio would therefore be in the order of 200:1, indicating that the schist is considerably shallow in depth extent in this area. Indeed, a line of dipole measurements made along strike in the schist at stations 8, 16, and 17 show a progressively increasing electric field toward the southwest, which confirms that the schist disappears in the vicinity of Whitney Road. It does, however, reappear further to the southwest beyond Harvard center.

Tensor resistivities measured at stations 1, 2, and 18 in the Ayer granite are highly anisotropic. At all three stations the direction of greatest impedance points generally in the direction of the Boston basin and bay area, which probably acts as a current source, since the magnetic measurement $\frac{\partial B}{\partial t}$, and thus the computed impedance, is proportional to the total current flowing in the ground. Theoretical apparent resistivities for a crustal model in the frequency

Table 4.1

ORIENTATION AND MAGNITUDE OF PRINCIPAL RESISTIVITIES

STA	GEOLOGIC FORMATION	AZIMUTH OF LARGEST PRINCIPAL RESISTIVITY	ρ_{13}	ρ_{31}
1	ayp	82°	26,000	125
2	ayp	88°	19,000	330
6	Cwm	57°	97	11
9	Cwm	52°	49	21
14	Cn	15°	15,000	120
18	ayp	78°	19,000	150
19	Cwm & ayp?	77°	5,000	180



Ayer granite

Light-gray massive moderately coarse-grained granite; resistant to erosion. Composed chiefly of orthoclase, albite, and quartz, and accessory biotite, muscovite, apatite, and chlorite. A porphyritic facies, ayp, contains abundant large phenocrysts of orthoclase. Xenoliths are common in the porphyritic facies

Nashoba formation

Predominantly light-gray to medium-gray medium-grained biotite paragneiss, Cn, composed chiefly of quartz, biotite, and sodic plagioclase (generally albite oligoclase) and containing minor but locally considerable amounts of orthoclase, garnet, sillimanite, and magnetite. Contains numerous interbedded layers of amphibolite schist, am, hornblende gneiss, variably feldspathized quartzite beds that range in thickness from a fraction of an inch to many feet, and a few beds of marble, m. Commonly has a pronounced gneissic banding. Most exposures contain some igneous material as small dikes, intrusive sheets, or irregular masses of granite, aplite, or pegmatite, p

Worcester formation

Phyllite facies, Cwp, as exposed in Harvard, chiefly dull-bluish-gray slate that ranges, however, through shades of pale rusty brown to yellowish green. Contains abundant thin laminae of sandy material and, locally, quartzite beds similar to the Vaughn Hills. Stratigraphically equivalent to mica schist facies.

Mica schist facies, Cwm, chiefly moderately course grained muscovite schist that contains abundant quartz and pyrite, and minor but locally considerable biotite, andalusite, and sillimanite. Sandy at base. Metamorphic grade increases noticeably from west to east. Contains amphibolite schist, am, near top and grades into amphibolite at base of Nashoba formation. Pegmatite, p, abundant in upper half of facies.

Vaughn Hills member, Cwv, composed of very fine grained thinly bedded cream- to flesh-colored quartzite. Chloritic layers, Cwc, at base of member east of Bare Hill Pond. Chloritic layers in part well laminated and in part calcareous.

Harvard conglomerate lentil, Cwh, composed of pebble conglomerate interbedded with light-colored slate, argillite, and phyllite. Pebbles mostly quartzite of various shades of pale green, violet, gray, and blue gray but include several other rock types. Matrix mostly bluish argillite but includes slate, phyllite, chlorite schist, and gritty quartzite. Few pebbles exceed 2 inches in diameter

Figure 4.1 Magnetotelluric Survey Map

range of 10^{-3} to 10^{-2} hz, with no sedimentary cover, are in the order of 140 to 600 ohm-meters (Cantwell-McDonald model*). The smaller anisotropic resistivity values at these stations generally fall into this range, suggesting that the smaller values are closer to what one would expect to obtain from a crustal measurement in this frequency band. The resistivities in the direction of the apparent current source are therefore enhanced by a factor to 50 to 200, J being 7 to 14 times higher in this direction.

At stations 6 and 9 in the mica schist, currents entering the conductive zone are deflected only slightly by the local structure. Their magnitude of anisotropy is an order of magnitude lower than that of the granite since a portion of the excess current is diverted along the strike of the conductor.

4.2 The Thin Sheet Model

Ranganayaki, 1978, and Ranganayaki and Madden, 1979, have used a thin conductive sheet approximation of the earth's crust to analyze the resistive coupling effects between the surface of the earth and the mantle. They demonstrated that at an ocean-continent discontinuity there is a large adjustment distance (in the order of 1000 km) required for the excess surface current to leak back into the mantle.

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*T. Cantwell and T. Madden, "Preliminary Report on Crustal Magnetotelluric Measurements," J. Geophys. Res., Vol. 65, 1960, pp. 4202-4205.

4.3 Conclusion

The horizontally anisotropic model represented by the impedance tensor is a simplification used to approximate the effects of lateral inhomogeneities in the conductivity of the earth's crust and upper mantle. Strong anisotropies in the tensor resistivities obtained in the Ayer granite are attributed to a current source in the Boston basin and bay area. Surface currents apparently channelled by the coastline indentation and estuary raise the current density in this direction a factor of 7 to 14 times greater than that of the orthogonal direction.

Measurements made in the conductive mica schist facies of the Worcester formation tend to be less anisotropic than the more resistive rocks, diverting a portion of the excess surface current along its strike. Telluric measurements indicate that the schist is considerably shallow in depth extent, and in fact thins along strike to the southwest in the vicinity of Whitney Road.

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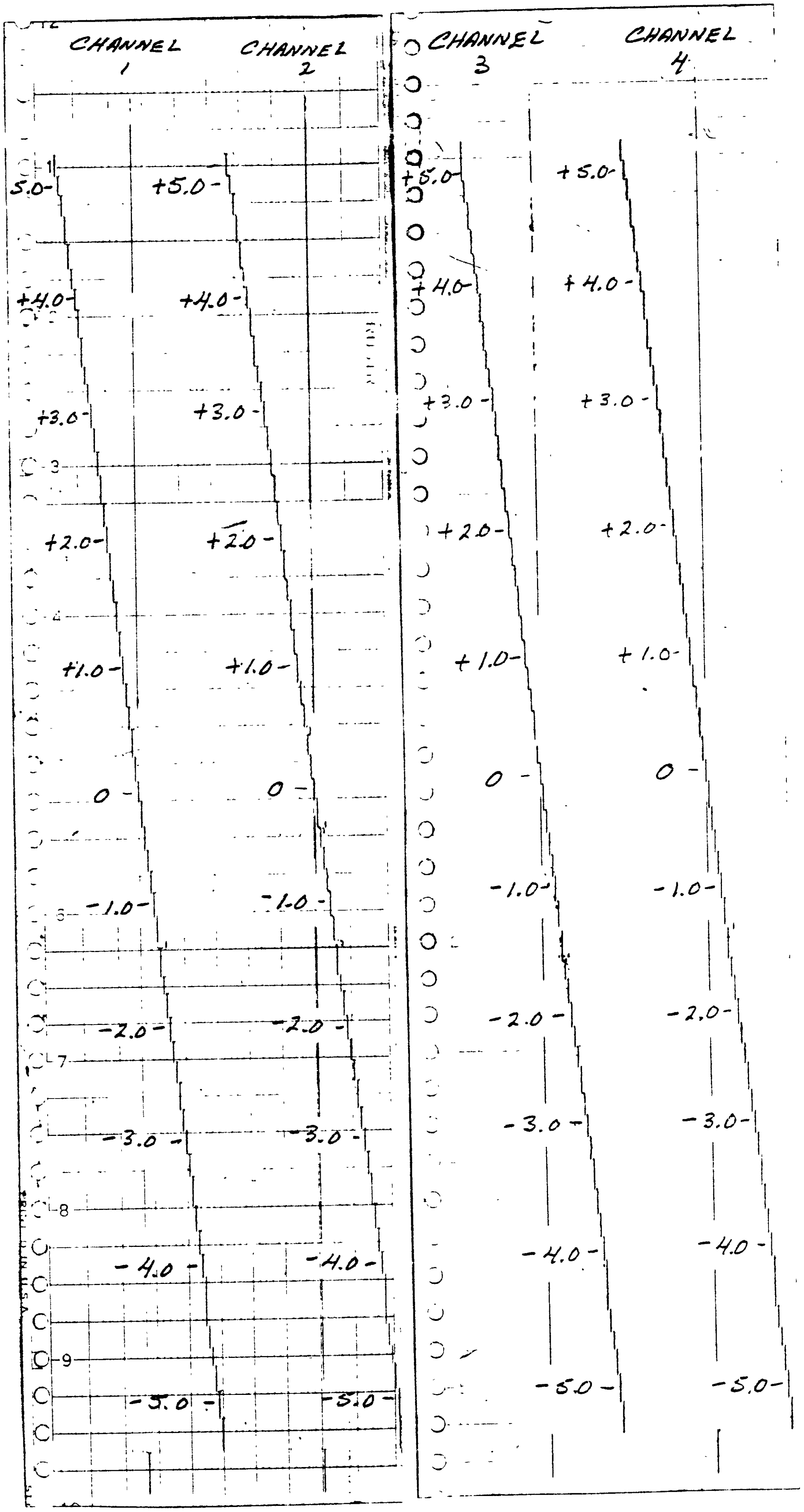
BIOGRAPHICAL NOTE

The author was born in Cambridge, Massachusetts. He received the Geophysical Engineer degree from the Colorado School of Mines in 1970. Upon graduation he was employed by Kennecott Exploration, Inc. during which time he performed induced polarization surveys in a porphyry copper exploration program. Subsequently, he operated a land development and surveying business in Montana. In the fall of 1975 he returned to the Colorado School of Mines as a masters candidate and in February of 1977 he was pleased to be accepted into the Department of Earth and Planetary Sciences at M.I.T.

APPENDIX A

Analog Rustrack Data



PULSTRAN CALIBRATION

6/7/78

MAGNETOTELLURIC DATA SHEET

PAGE 1 OF 2

STATION: MT78-1 DATE: 6-16-78 LOCATION: (off Shaker Road) Harvard, Massachusetts

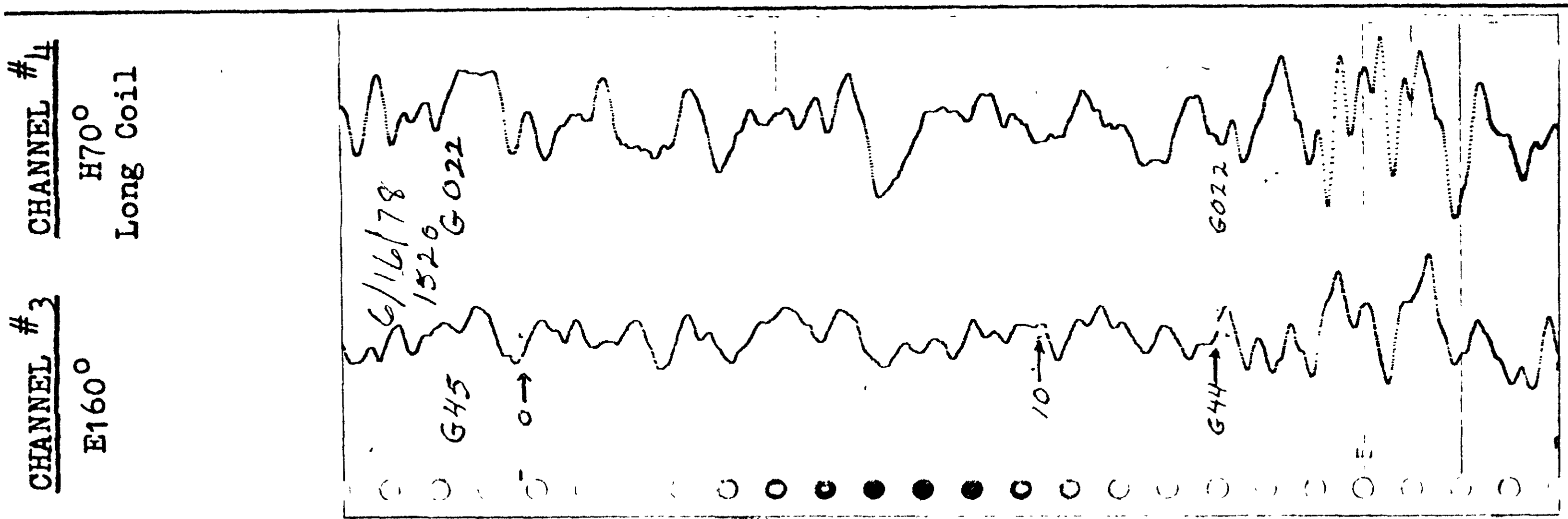
CHANNEL #1 E ⊥ S.C. AZ: 64° LENGTH: 1.30 km CHANNEL #3 E ⊥ L.C. AZ: 160° LENGTH: 1.28 km

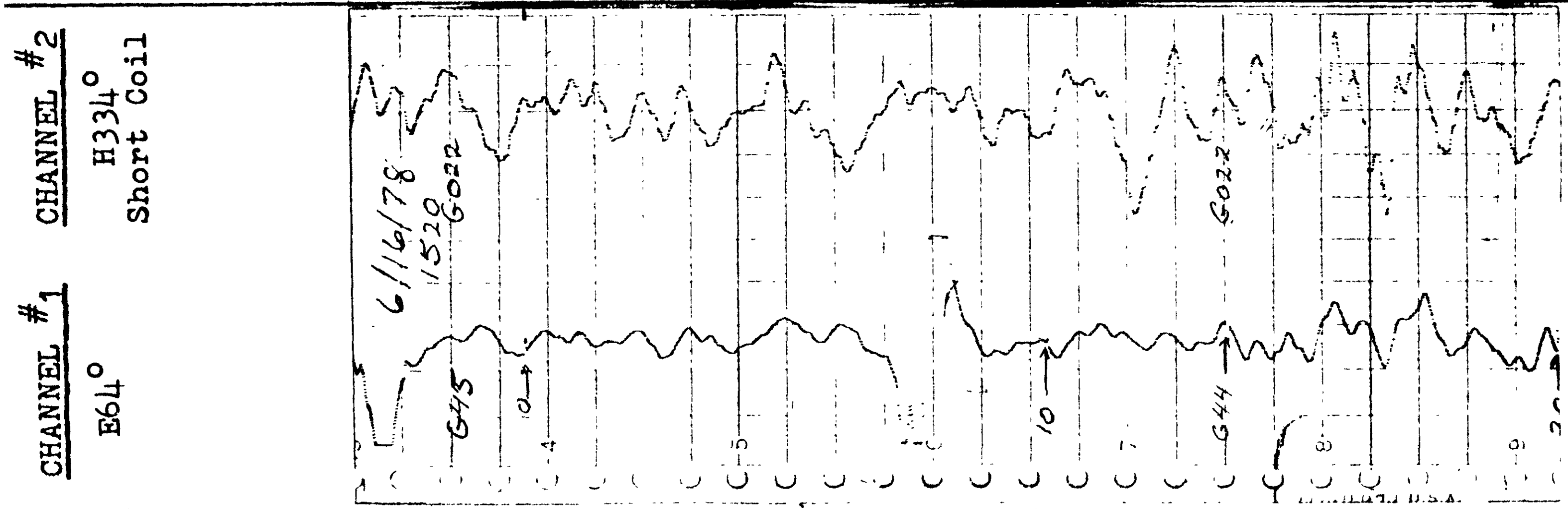
CHANNEL #2 SHORT COIL AZ: 334° CHANNEL #4 LONG COIL AZ: 70°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.06 div/min (0.265 inches/min)





PAGE 2 OF 2

MAGNETOTELLURIC DATA SHEET

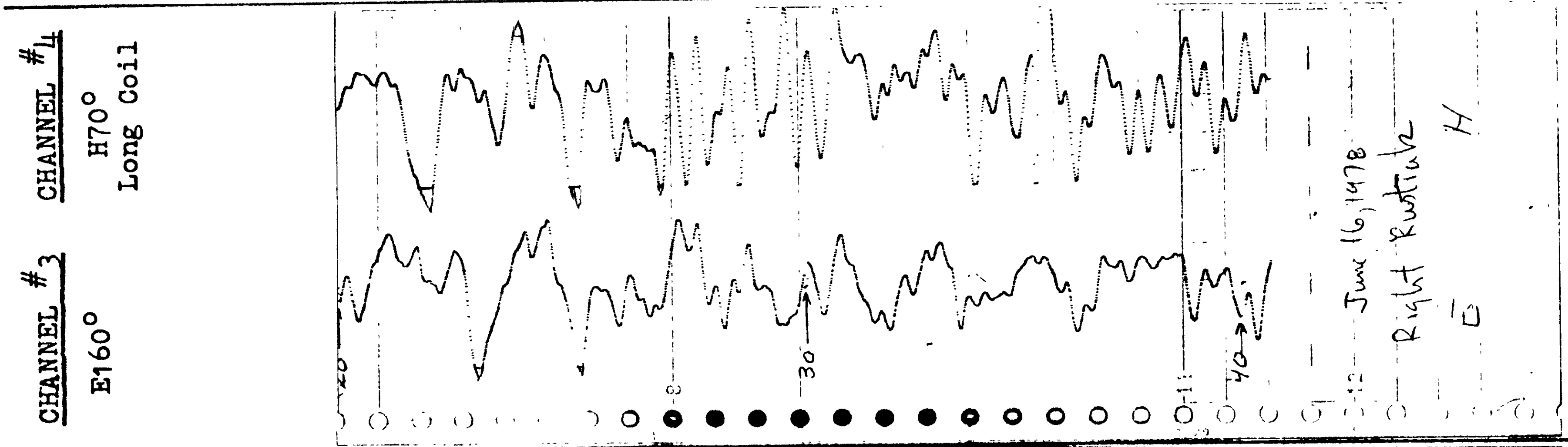
STATION: MT78-1 DATE: 6-16-78 LOCATION: (off Shaker Road) Harvard, Massachusetts

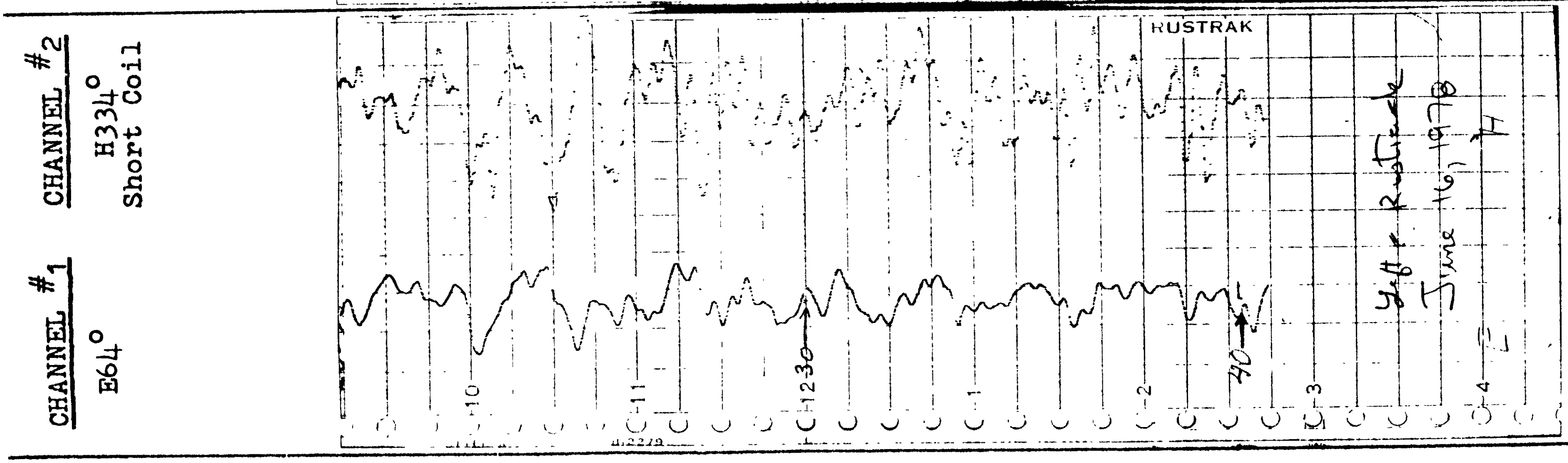
CHANNEL #1 E ⊥ S.C. AZ: 64° LENGTH: 1.30 km CHANNEL #3 E ⊥ L.C. AZ: 160° LENGTH: 1.28 km

CHANNEL #2 SHORT COIL AZ: 334° CHANNEL #4 LONG COIL AZ: 70°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.07 div/min (0.266 inches/min)





MAGNETOTELLURIC DATA SHEET

PAGE 1 OF 3

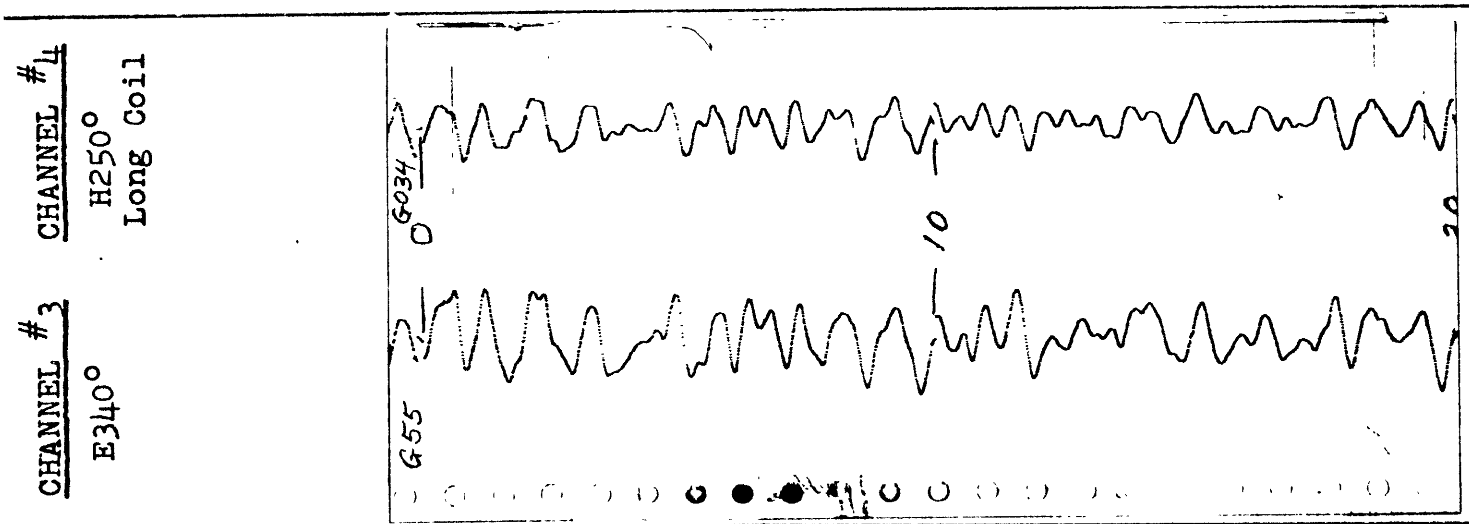
STATION: MT78-2 DATE: 6-22-78 LOCATION: (off Shaker Road) Harvard/Ayer, Massachusetts

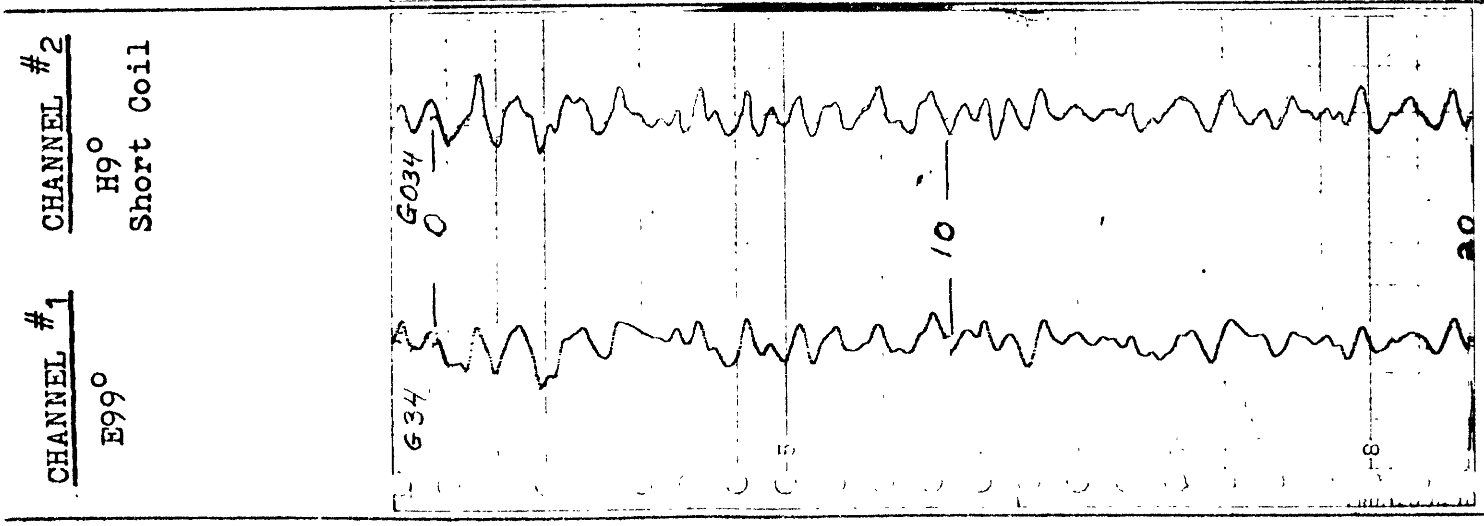
CHANNEL #1 E ⊥ S.C. AZ: 99° LENGTH: 0.74 km CHANNEL #3 E ⊥ L.C. AZ: 340° LENGTH: 1.28 km

CHANNEL #2 SHORT COIL AZ: 9° CHANNEL #4 LONG COIL AZ: 250°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.07 div/min (0.266 inches/min) Channels 1, 2, 3 & 4





MAGNETOTELLURIC DATA SHEET

PAGE 2 OF 3

STATION: MT78-2 DATE: 6-22-78 LOCATION: (off Shaker Road) Harvard/Ayer, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 99° LENGTH: 0.74 km CHANNEL #3 E ⊥ L.C. AZ: 340° LENGTH: 1.28 km

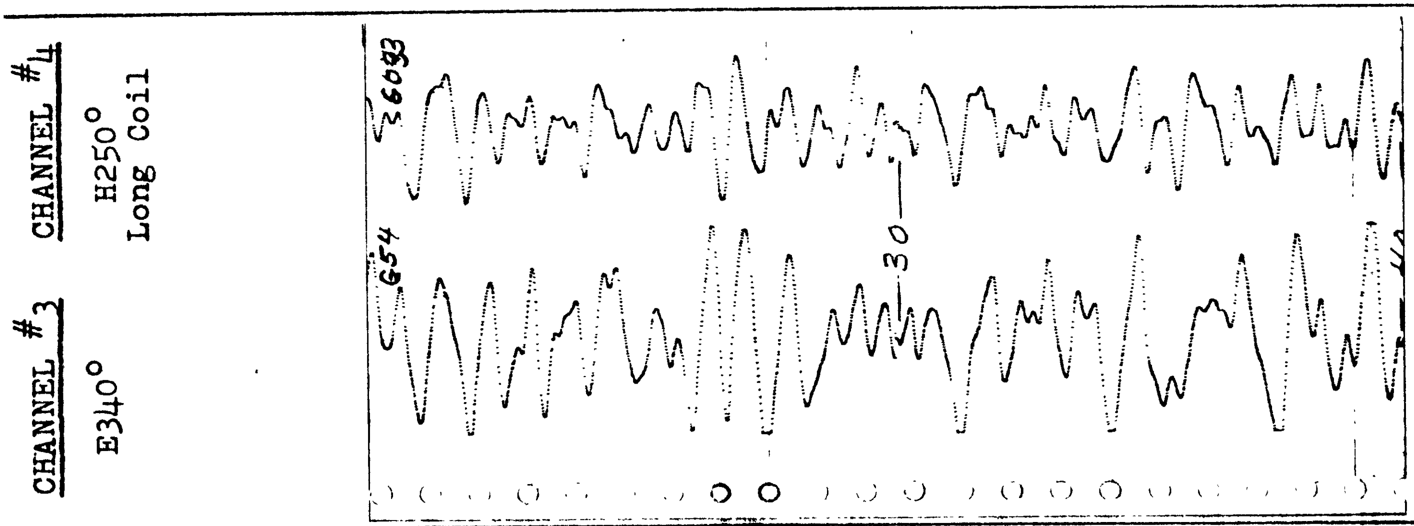
CHANNEL #2 SHORT COIL AZ: 9° CHANNEL #4 LONG COIL AZ: 250°

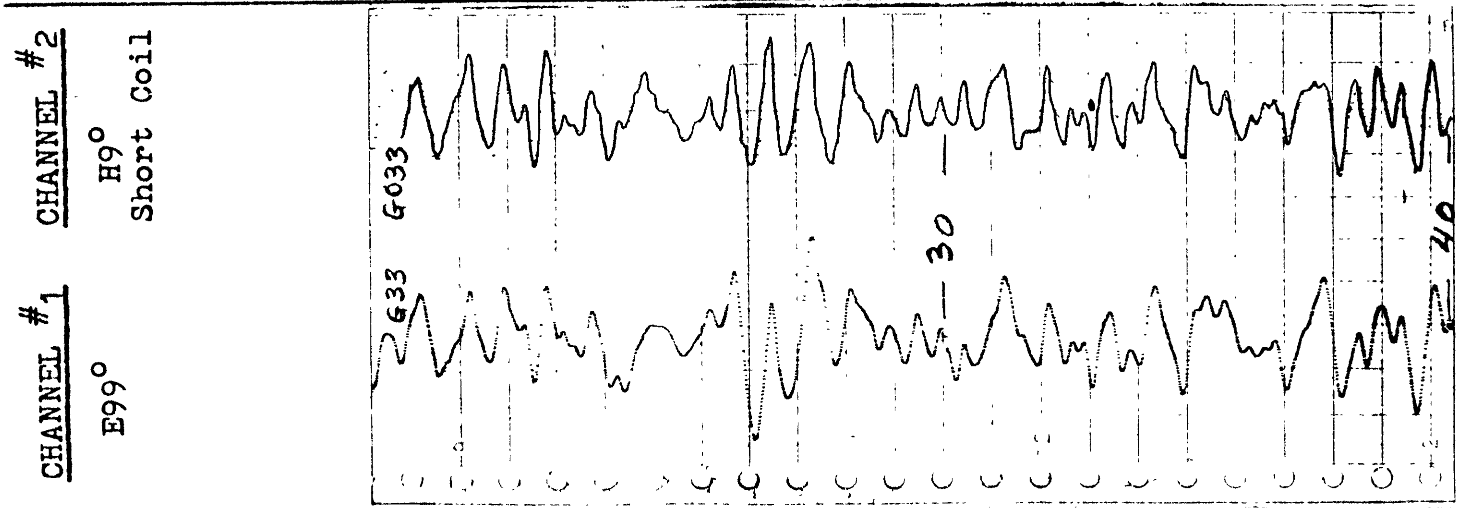
AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.11 div/min (0.277 inches/min) Channels 1 & 2

1.06 div/min (0.266 inches/min) Channels 3 & 4





MAGNETOTELLURIC DATA SHEET

PAGE 3 OF 3

STATION: MT78-2 DATE: 6-22-78 LOCATION: (off Shaker Road) Harvard/Ayer, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 99° LENGTH: 0.74 km CHANNEL #3 E ⊥ L.C. AZ: 340° LENGTH: 1.28 km

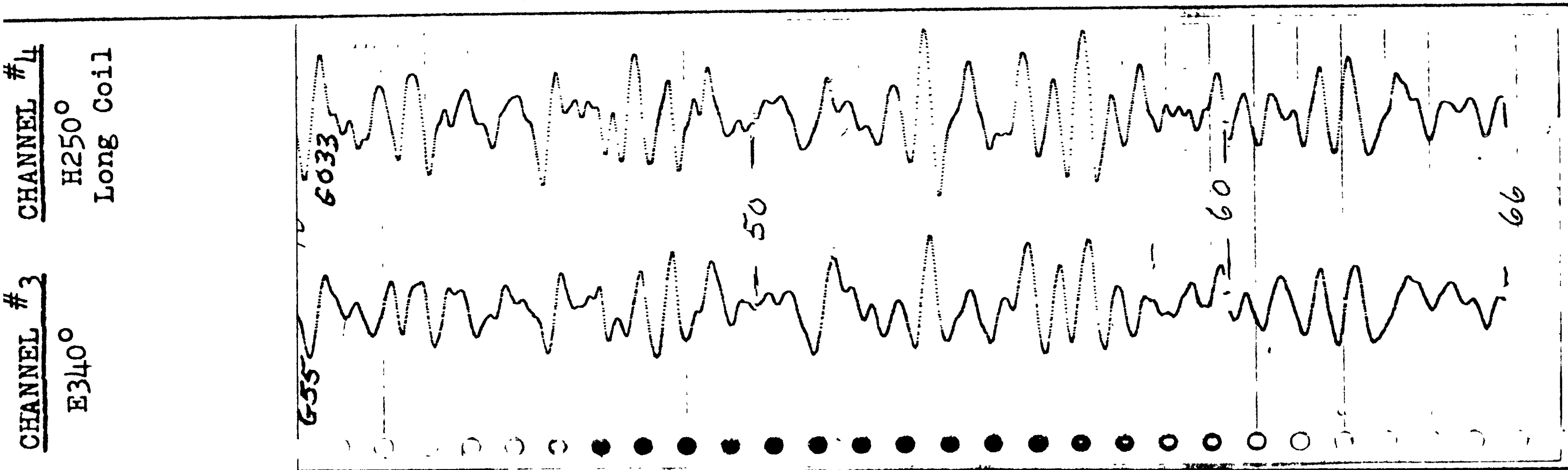
CHANNEL #2 SHORT COIL AZ: 9° CHANNEL #4 LONG COIL AZ: 250°

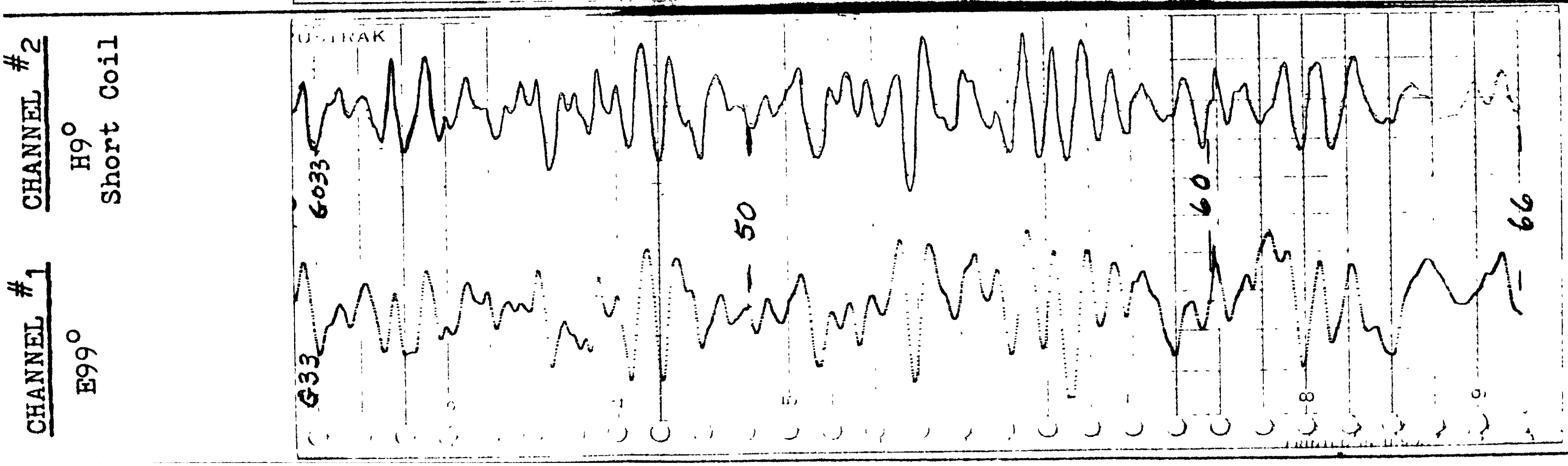
AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.10 div/min (0.274 inches/min) Channels 1 & 2

1.06 div/min (0.265 inches/min) Channels 3 & 4





TELLURIC DATA SHEET

STATION: T78-3 DATE: 6-23-78 LOCATION: Shaker Road, Harvard, Massachusetts

CHANNEL #1

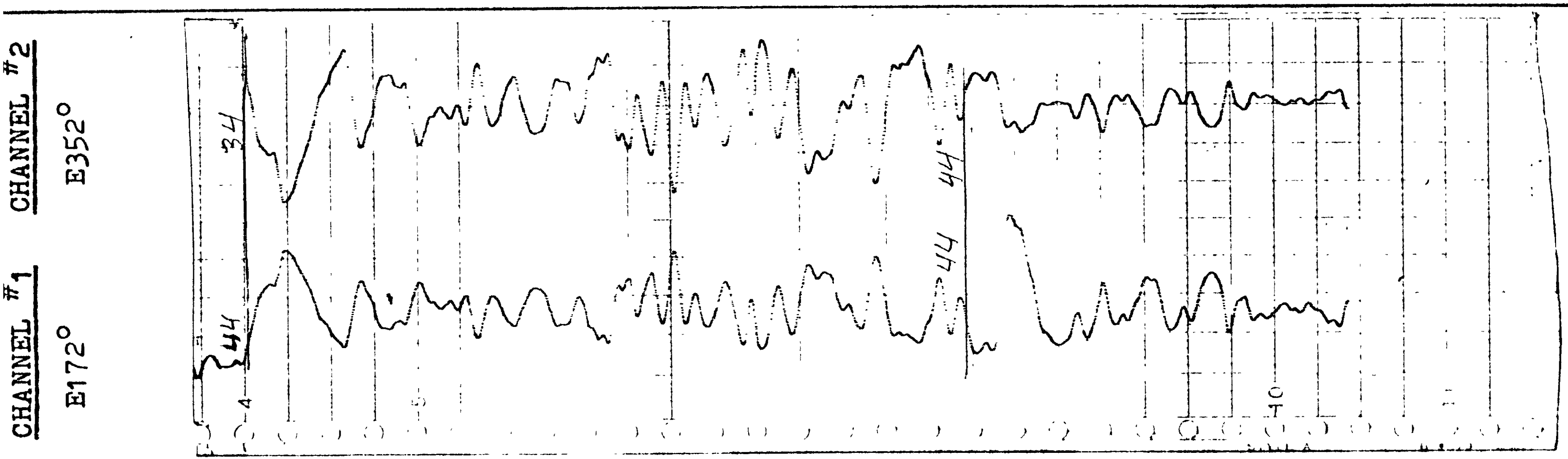
AZIMUTH: 172° LENGTH OF DIPOLE: 0.8 km

CHANNEL #2

AZIMUTH: 352° LENGTH OF DIPOLE: 0.8 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS:



TELLURIC DATA SHEET

PAGE 2 OF 2

STATION: T78-3 DATE: 6-26-78 LOCATION: Shaker Road, Harvard, Massachusetts

CHANNEL #1

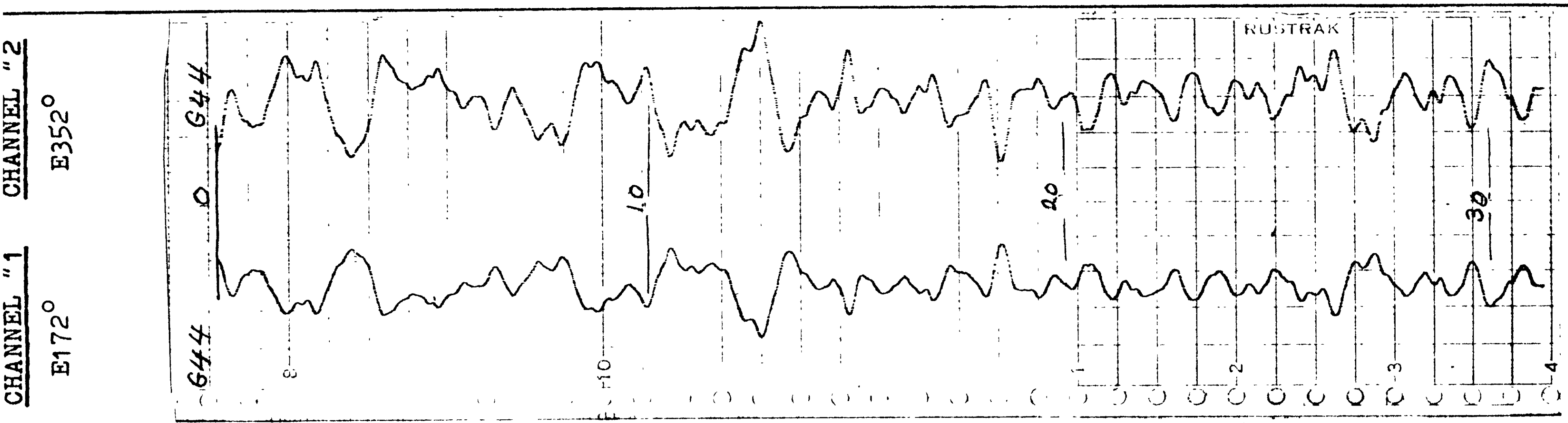
AZIMUTH: 172° LENGTH OF DIPOLE: 0.8 km

CHANNEL #2

AZIMUTH: 352° LENGTH OF DIPOLE: 0.8 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.07 div/min (0.268 inches/min)



TELLURIC DATA SHEET

STATION: T78-4 DATE: 6-26-78 LOCATION: Shaker Road, Harvard, Massachusetts

CHANNEL #1

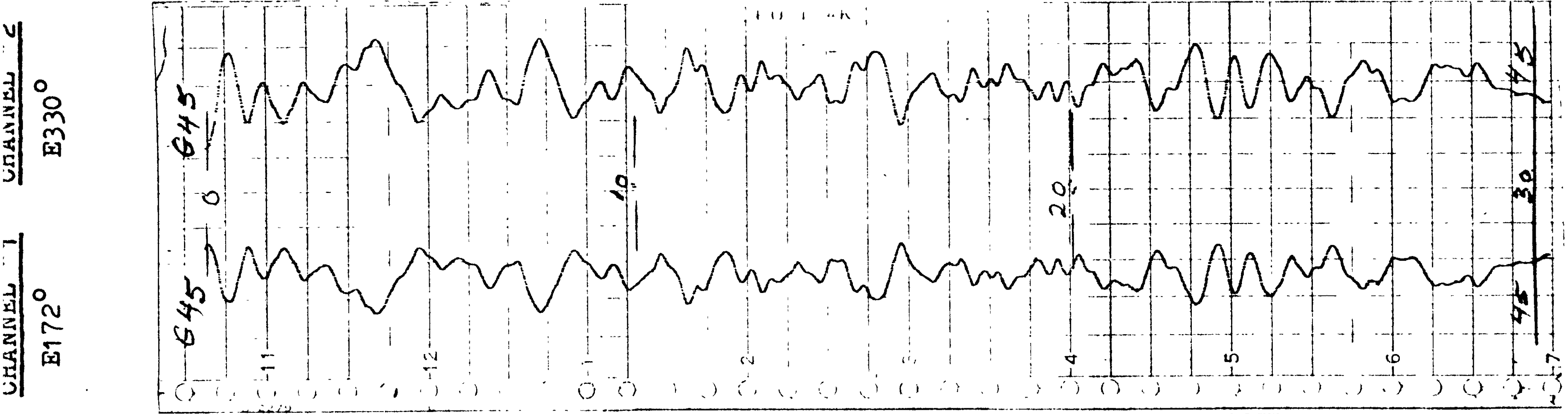
AZIMUTH: 172° LENGTH OF DIPOLE: 0.8 km

CHANNEL #2

AZIMUTH: 330° LENGTH OF DIPOLE: 0.8 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.10 div/min (0.275 inches/min)



TELLURIC DATA SHEET

PAGE 1 OF 2

STATION: T78-5 DATE: 6-29-78 LOCATION: Intersection Shaker & Littleton Roads, Harvard, Mass.

CHANNEL #1**

AZIMUTH: 150° LENGTH OF DIPOLE: 0.8 km

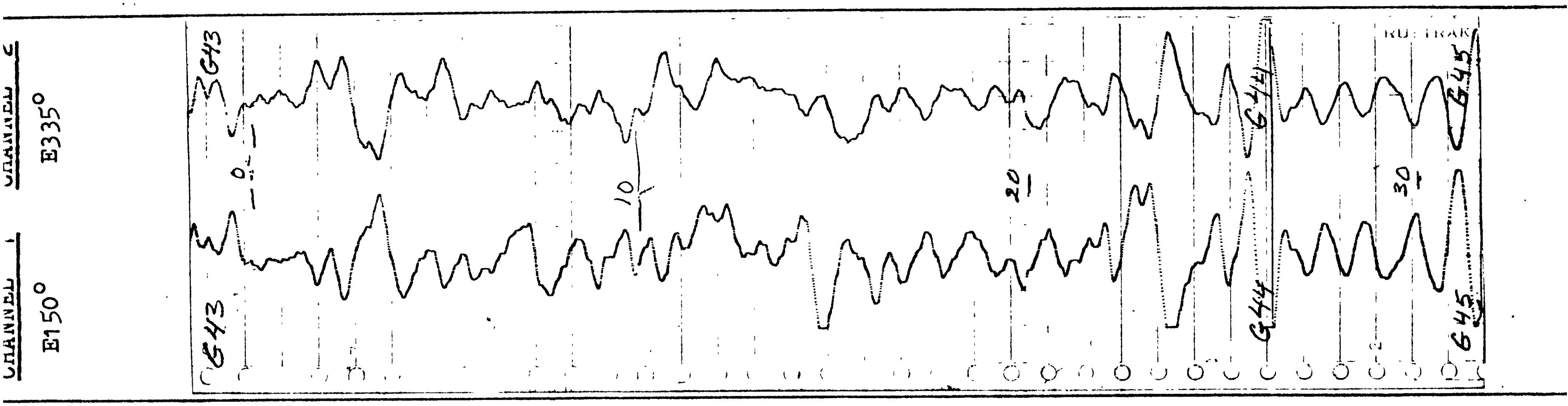
CHANNEL #2**

AZIMUTH: 335° LENGTH OF DIPOLE: 0.72 km

NOTE:** Recorded on Channels 3 & 4 of recorder with Channels 1 & 2 amplifiers.

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.065 div/min (0.266 inches/min)



TELLURIC DATA SHEET

PAGE 2 OF 2

STATION: T78-5 DATE: 6-29-78 LOCATION: Intersection Shaker & Littleton Roads, Harvard, Mass.

CHANNEL #1

AZIMUTH: 150° LENGTH OF DIPOLE: 0.8 km

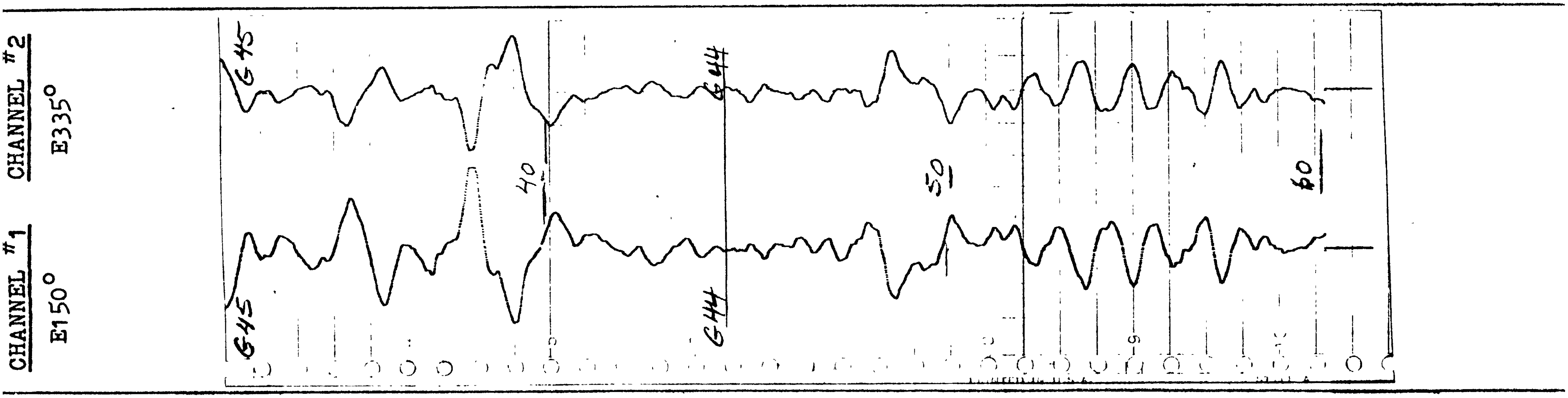
CHANNEL #2

AZIMUTH: 335° LENGTH OF DIPOLE: 0.72 km

NOTE:** Recorded on Channels 3 & 4 of recorder with Channels 1 & 2 amplifiers.

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.065 div/min (0.266 inches/min)



MAGNETOTELLURIC DATA SHEET

PAGE 1 OF 3

STATION: MT78-6 DATE: 6-29-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 220° LENGTH: 1.02 km CHANNEL #3 E ⊥ L.C. AZ: 155° LENGTH: 0.72 km

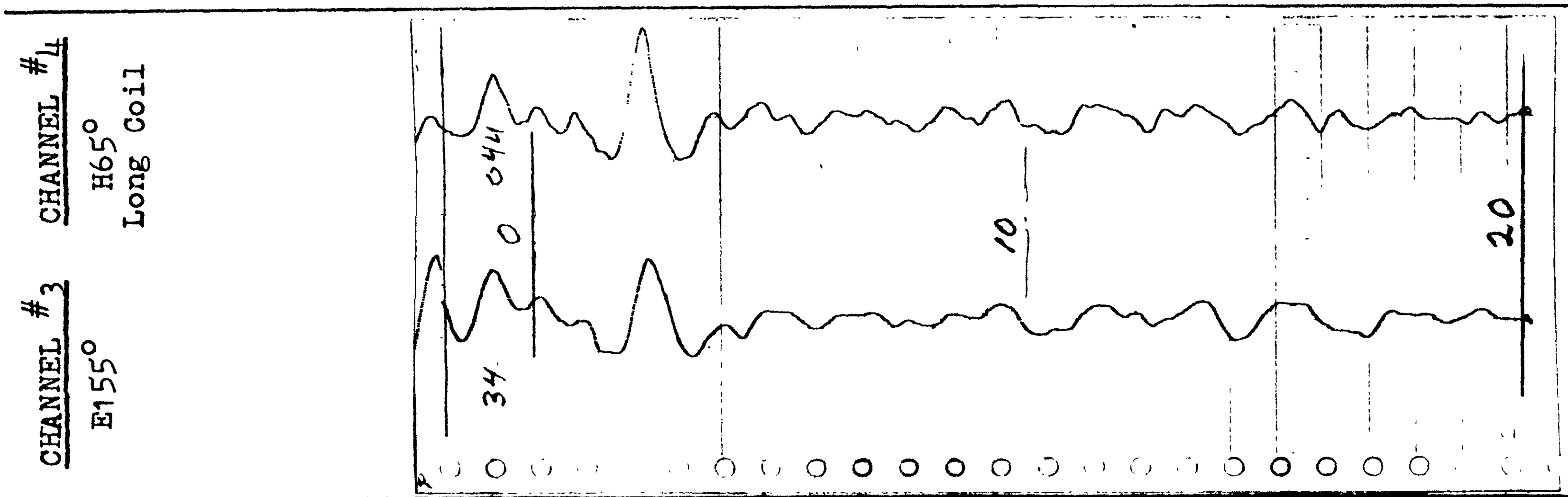
CHANNEL #2 SHORT COIL AZ: 130° CHANNEL #4 LONG COIL AZ: 65°

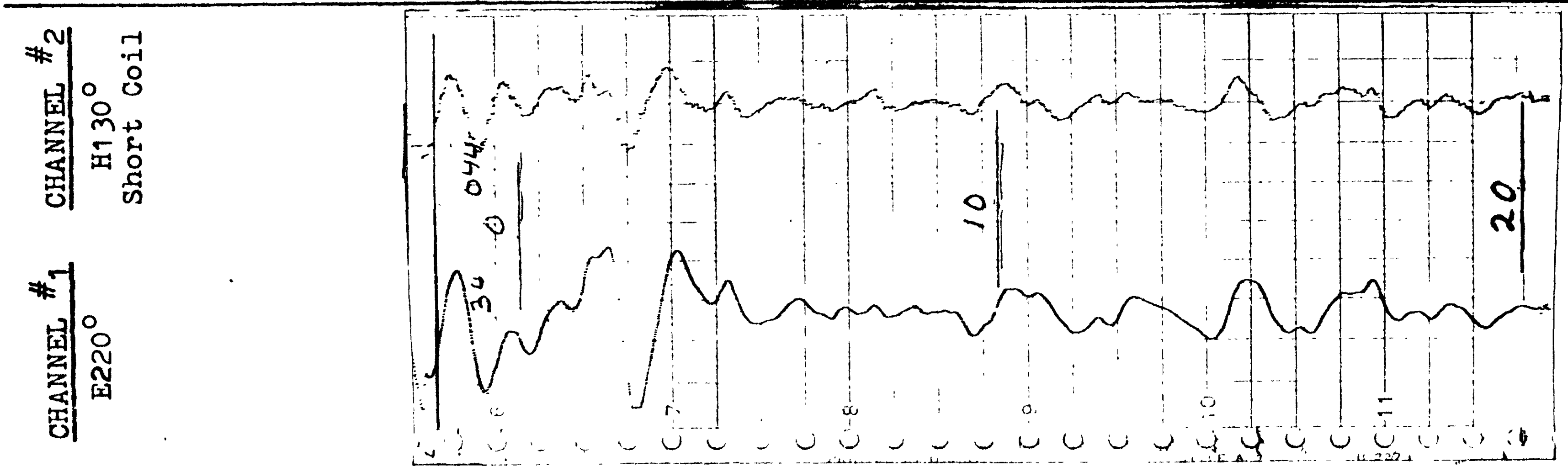
AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.13 div/min (0.282 inches/min) Channels 1 & 2

1.07 div/min (0.268 inches/min) Channels 3 & 4





MAGNETOTELLURIC DATA SHEET

PAGE 2 OF 3

STATION: MT78-6 DATE: 6-29-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 220° LENGTH: 1.02 km CHANNEL #3 E ⊥ L.C. AZ: 155° LENGTH: 0.72 km

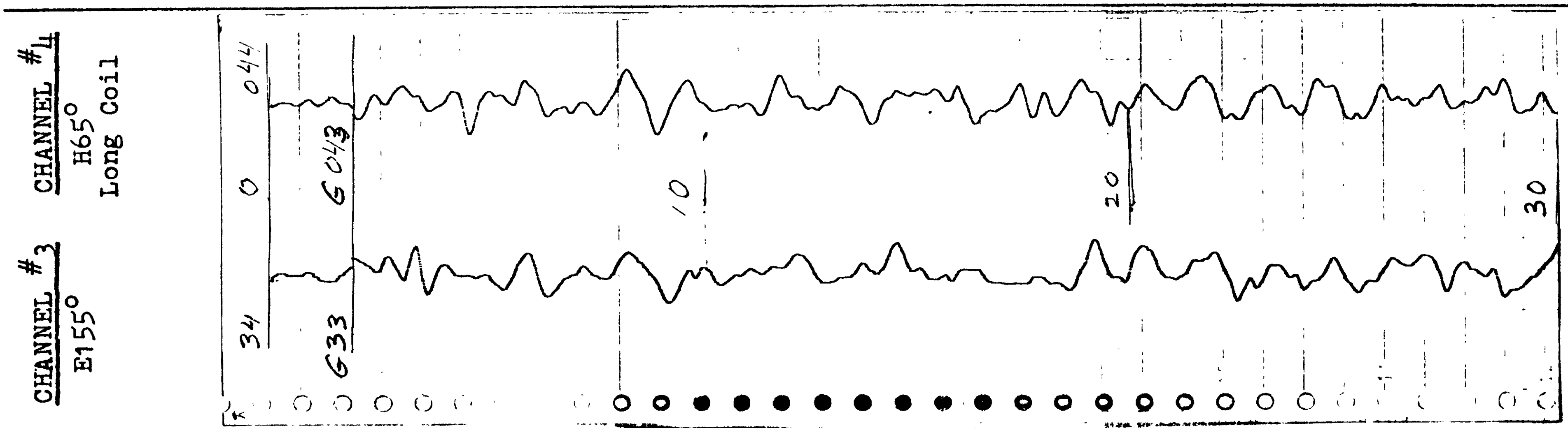
CHANNEL #2 SHORT COIL AZ: 130° CHANNEL #4 LONG COIL AZ: 65°

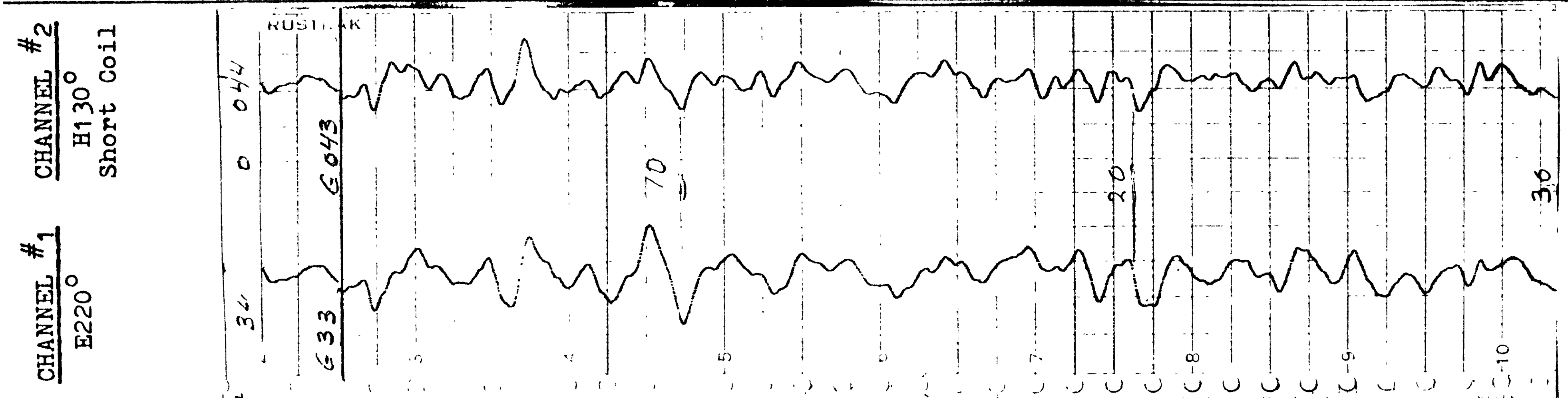
AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.13 div/min (0.282 inches/min) Channels 1 & 2

1.07 div/min (0.268 inches/min) Channels 3 & 4





MAGNETOTELLURIC DATA SHEET

PAGE 3 OF 3

STATION: MT78-6 DATE: 6-29-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 220° LENGTH: 1.02 km CHANNEL #3 E ⊥ L.C. AZ: 155° LENGTH: 0.72 km

CHANNEL #2 SHORT COIL AZ: 130° CHANNEL #4 LONG COIL AZ: 65°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

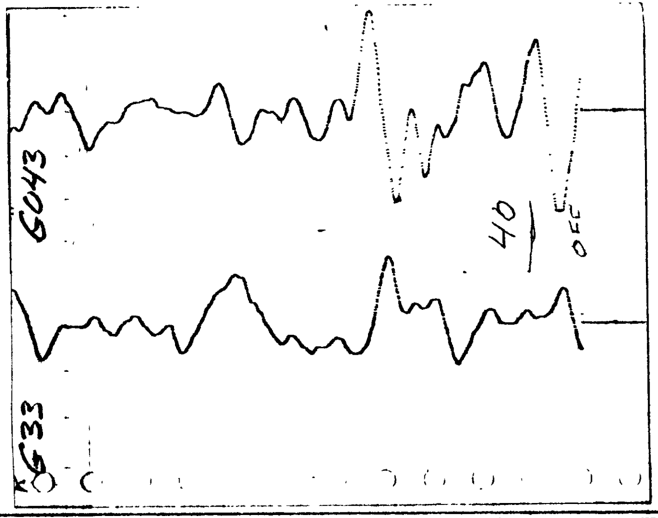
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.13 div/min (0.282 inches/min) Channels 1 & 2

1.07 div/min (0.268 inches/min) Channels 3 & 4

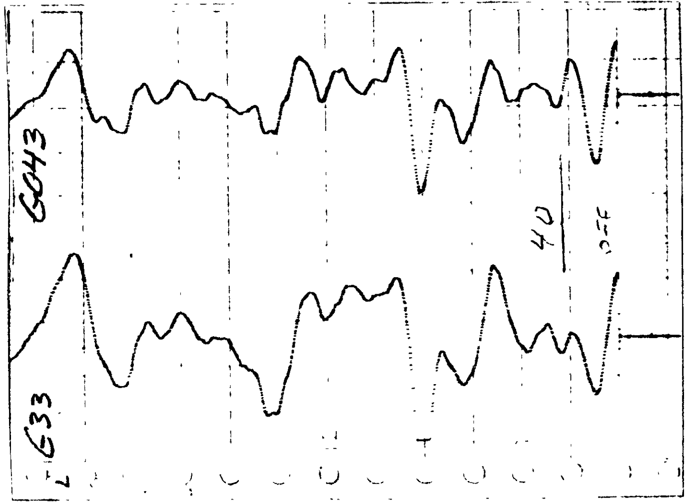
CHANNEL #4
H65°
Long Coil

CHANNEL #3
E155°



CHANNEL #2
H130°
Short Coil

CHANNEL #1
E220°



TELLURIC DATA SHEET

PAGE 1 OF 1

STATION: T78-7 DATE: 6-30-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1

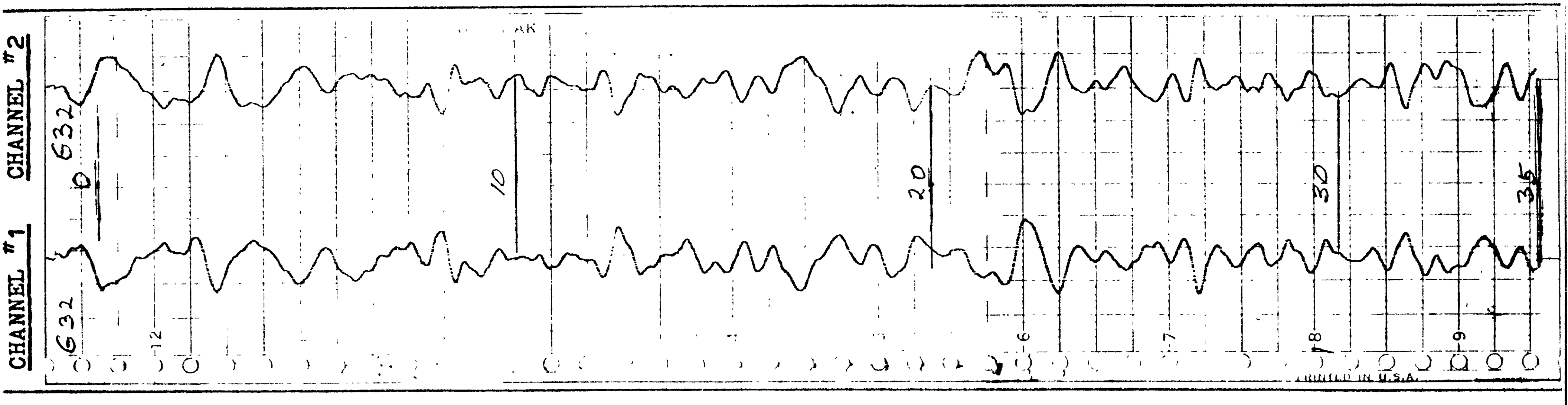
AZIMUTH: 220° LENGTH OF DIPOLE: 1.02 km

CHANNEL #2

AZIMUTH: 28° LENGTH OF DIPOLE: 0.94 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.14 div/min (0.283 inches/min)



TELLURIC DATA SHEET

PAGE 1 OF 3

STATION: T78-8 DATE: 7-5-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1

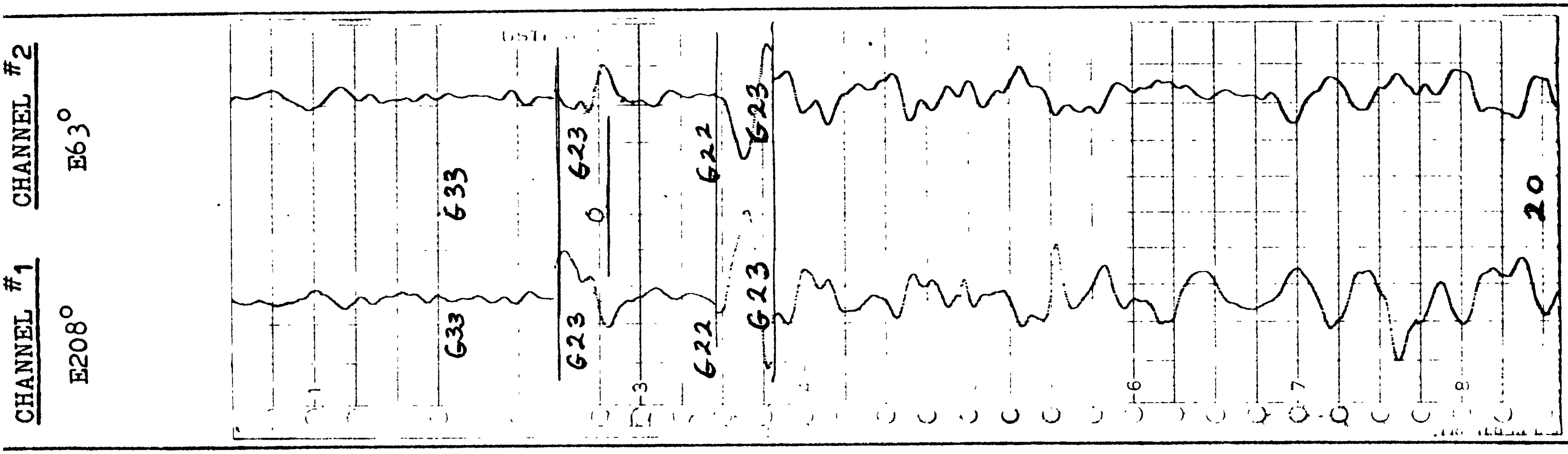
AZIMUTH: 208° LENGTH OF DIPOLE: 0.94 km

CHANNEL #2

AZIMUTH: 63° LENGTH OF DIPOLE: 0.87 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.17 div/min (0.292 inches/min)



TELLURIC DATA SHEET

STATION: T78-8 DATE: 7-5-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1

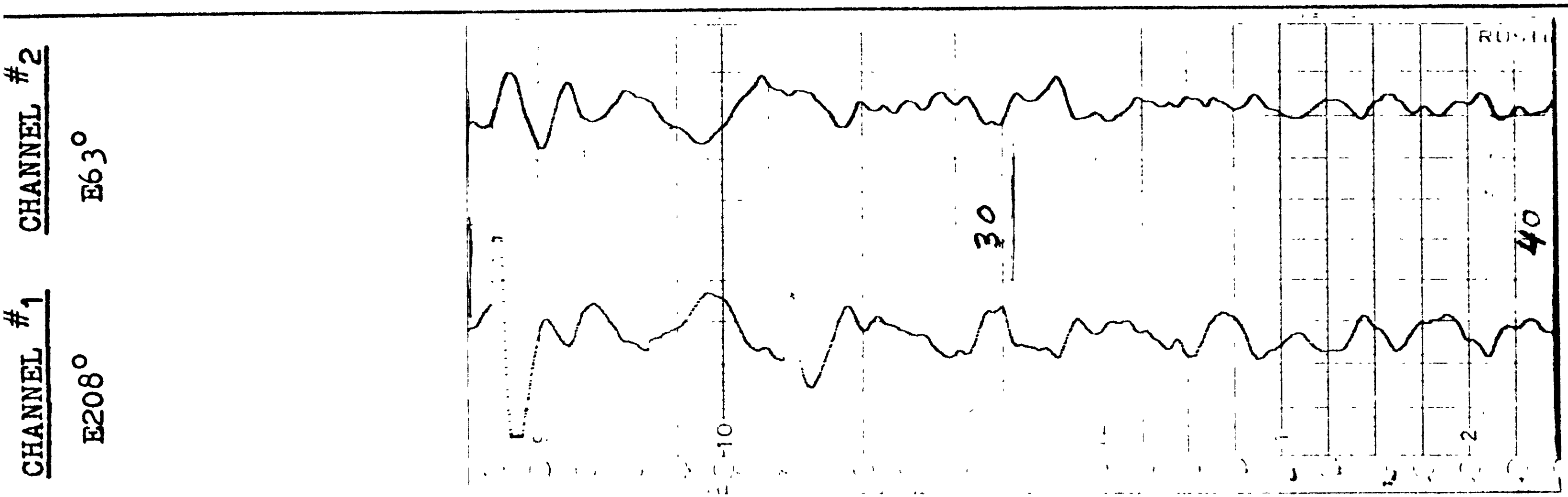
AZIMUTH: 208° LENGTH OF DIPOLE: 0.94 km

CHANNEL #2

AZIMUTH: 63° LENGTH OF DIPOLE: 0.87 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.17 div/min (0.292 inches/min)



TELLURIC DATA SHEET

PAGE 3 OF 3

STATION: T78-8 DATE: 7-5-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1

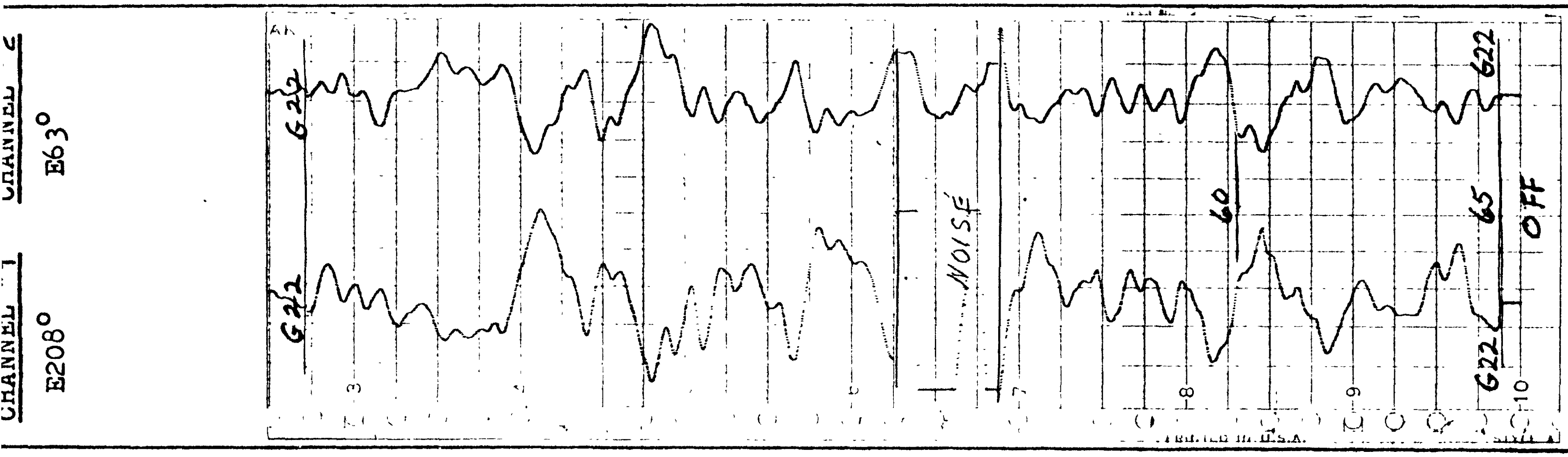
AZIMUTH: 208° LENGTH OF DIPOLE: 0.94 km

CHANNEL #2

AZIMUTH: 63° LENGTH OF DIPOLE: 0.87 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.17 div/min (0.292 inches/min)



MAGNETOTELLURIC DATA SHEET

PAGE 1 OF 4

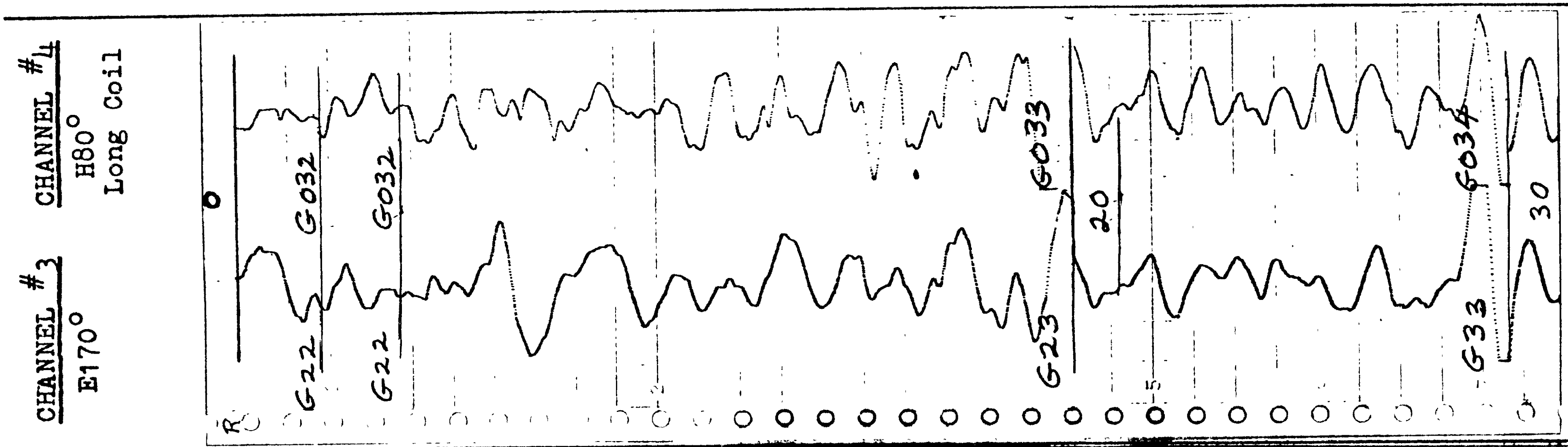
STATION: MT78-9 DATE: 7-6-78 LOCATION: Intersection Old Littleton & Pinnacle Roads, Harvard, Massachusetts

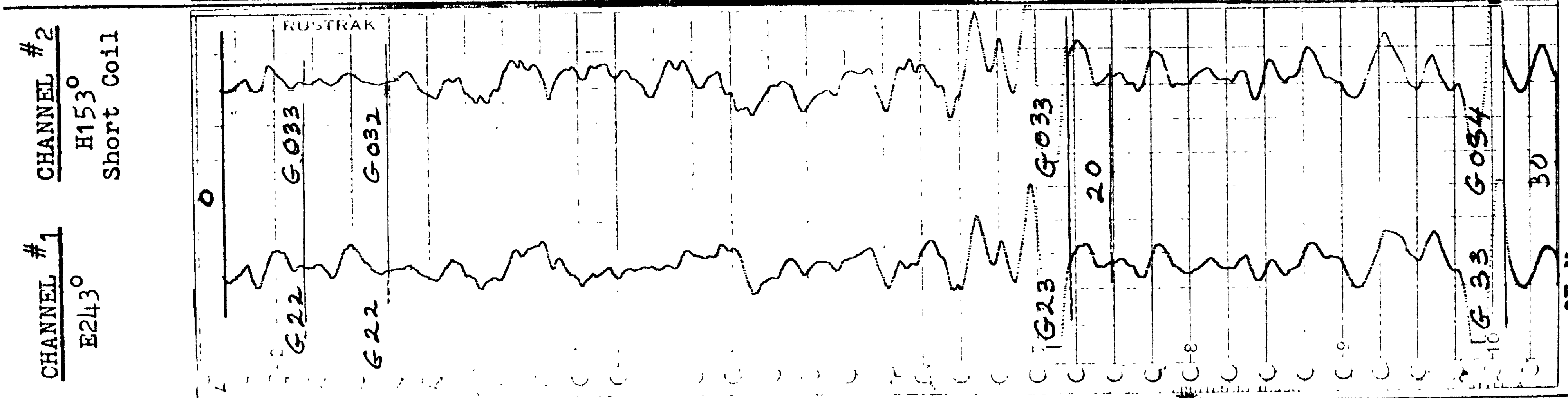
CHANNEL #1 E ⊥ S.C. AZ: 243° LENGTH: 0.87 km CHANNEL #3 E ⊥ L.C. AZ: 170° LENGTH: 0.82 km

CHANNEL #2 SHORT COIL AZ: 153° CHANNEL #4 LONG COIL AZ: 80°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min) Channels 1 & 2
1.07 div/min (0.268 inches/min) Channels 3 & 4





MAGNETOTELLURIC DATA SHEET

PAGE 2 OF 4

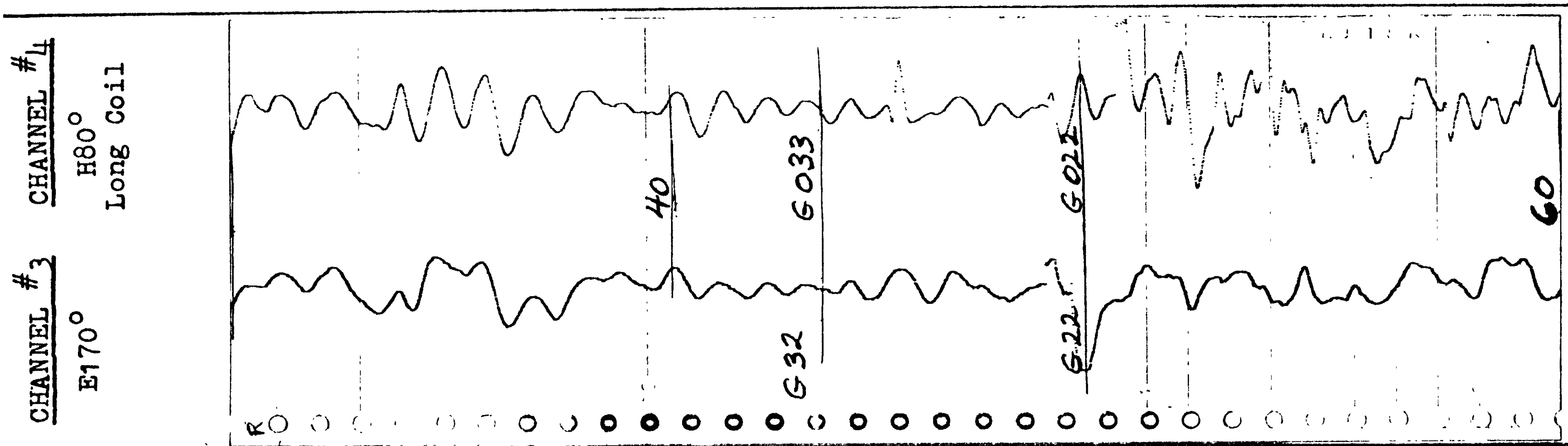
STATION: MT78-9 DATE: 7-6-78 LOCATION: Intersection Old Littleton & Pinnacle Roads, Harvard, Massachusetts

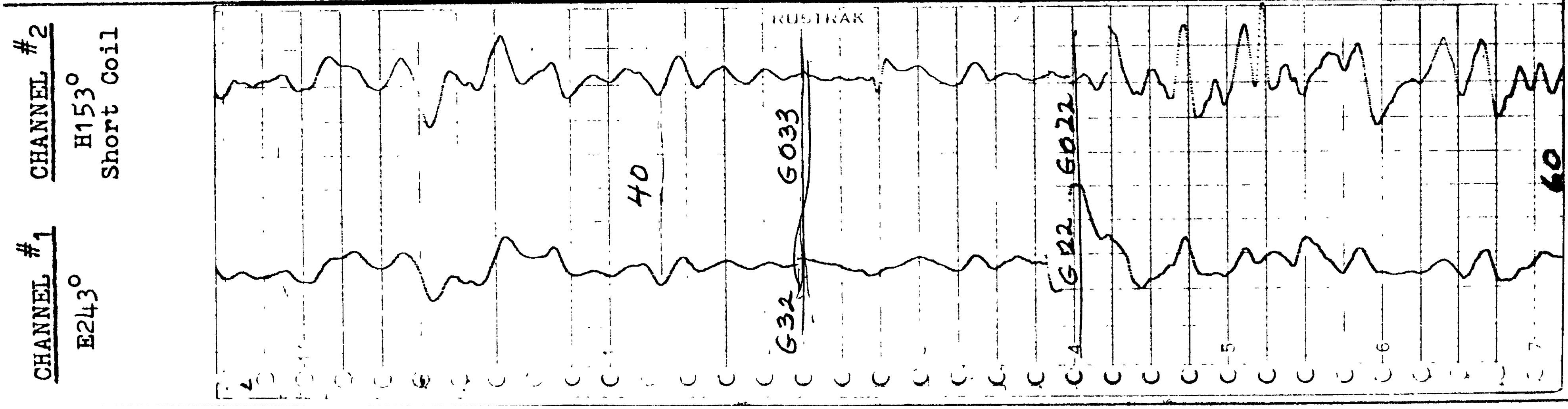
CHANNEL #1 E ⊥ S.C. AZ: 243° LENGTH: 0.87 km CHANNEL #3 E ⊥ L.C. AZ: 170° LENGTH: 0.82 km

CHANNEL #2 SHORT COIL AZ: 153° CHANNEL #4 LONG COIL AZ: 80°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min) Channels 1 & 2
1.07 div/min (0.268 inches/min) Channels 3 & 4





MAGNETOTELLURIC DATA SHEET

PAGE 3 OF 4

STATION: MT78-9 DATE: 7-6-78 LOCATION: Intersection Old Littleton & Pinnacle Roads, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 243° LENGTH: 0.87 km CHANNEL #3 E ⊥ L.C. AZ: 170° LENGTH: 0.82 km

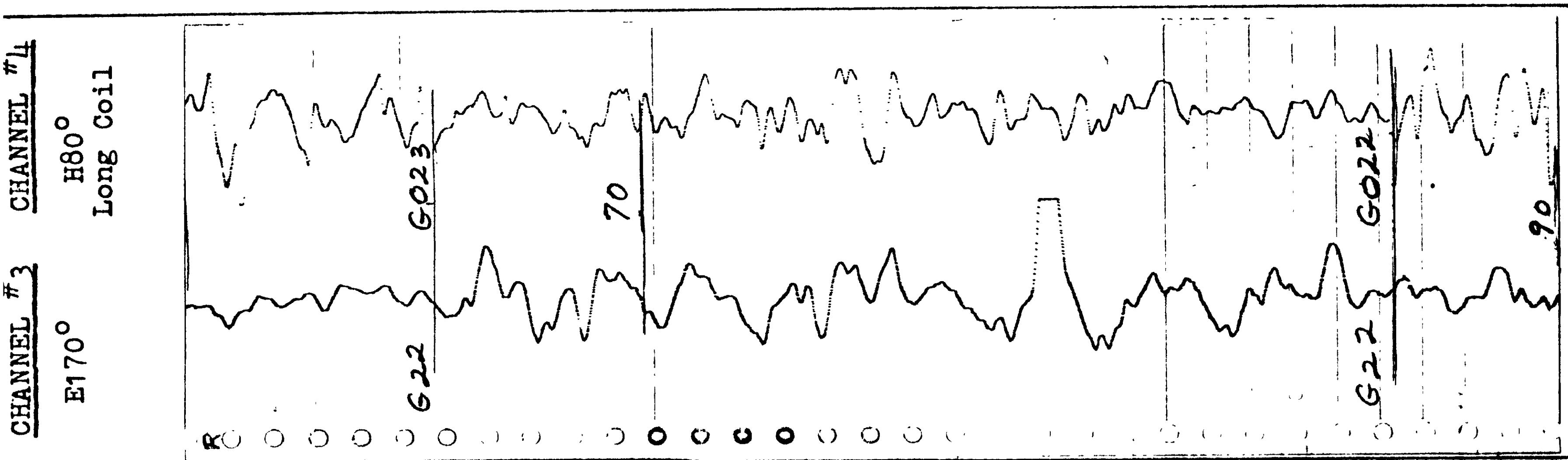
CHANNEL #2 SHORT COIL AZ: 153° CHANNEL #4 LONG COIL AZ: 80°

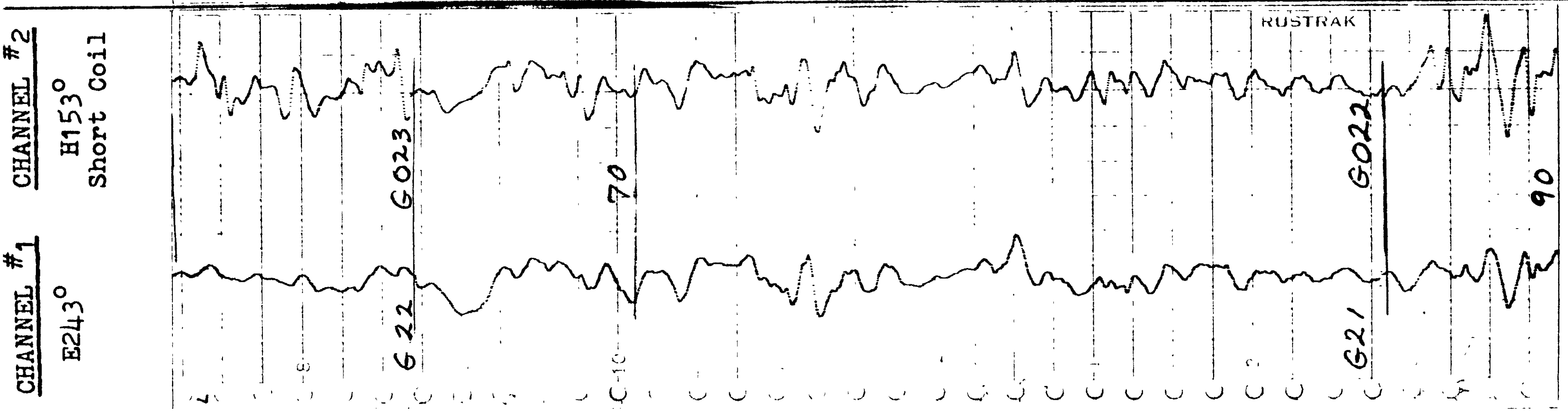
AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min) Channels 1 & 2

1.07 div/min (0.268 inches/min) Channels 3 & 4





MAGNETOTELLURIC DATA SHEET

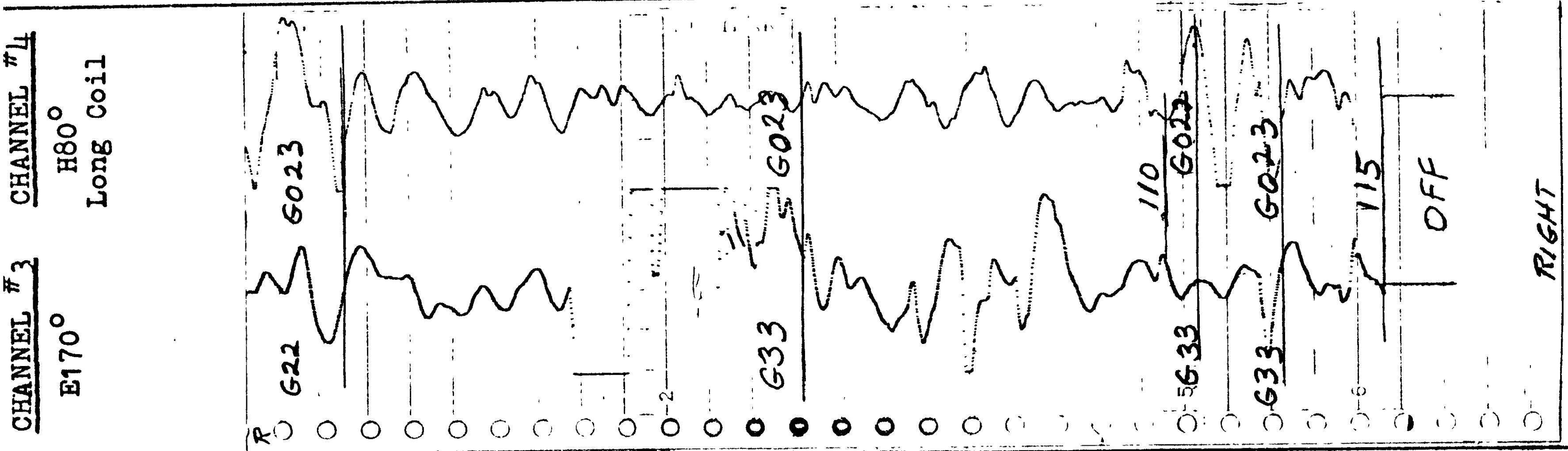
STATION: MT78-9 DATE: 7-6-78 LOCATION: Intersection Old Littleton & Pinnacle Roads, Harvard, Massachusetts

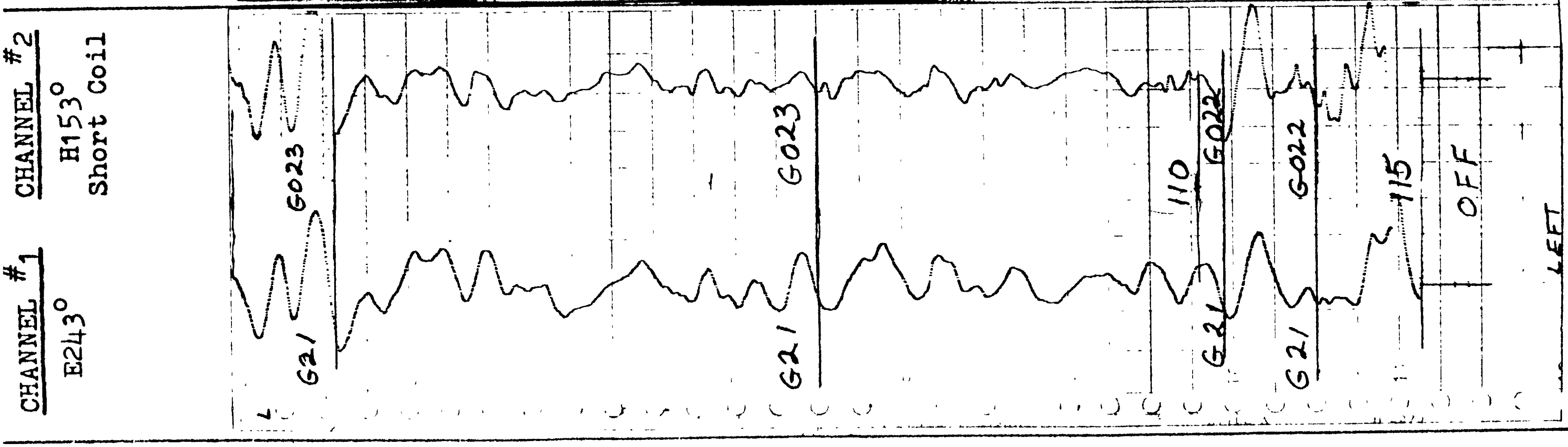
CHANNEL #1 E ⊥ S.C. AZ: 243° LENGTH: 0.87 km CHANNEL #3 E ⊥ L.C. AZ: 170° LENGTH: 0.82 km

CHANNEL #2 SHORT COIL AZ: 153° CHANNEL #4 LONG COIL AZ: 80°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min) Channels 1 & 2
1.07 div/min (0.268 inches/min) Channels 3 & 4





TELLURIC DATA SHEET

PAGE 1 OF 3

STATION: T78-10 DATE: 7-7-78 LOCATION: Poor Farm & Pinnacle Roads, Harvard, Massachusetts

CHANNEL #1

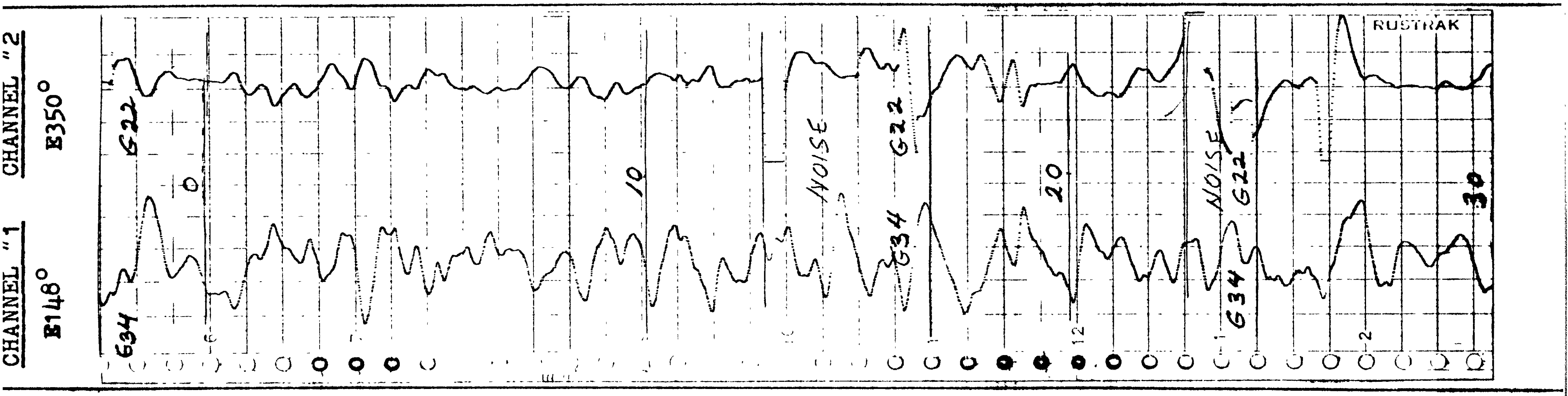
AZIMUTH: 148° LENGTH OF DIPOLE: 0.80 km

CHANNEL #2

AZIMUTH: 350° LENGTH OF DIPOLE: 0.82 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min)



TELLURIC DATA SHEET

PAGE 2 OF 3

STATION: T78-10 DATE: 7-7-78 LOCATION: Poor Farm & Pinnacle Roads, Harvard, Massachusetts

CHANNEL #1

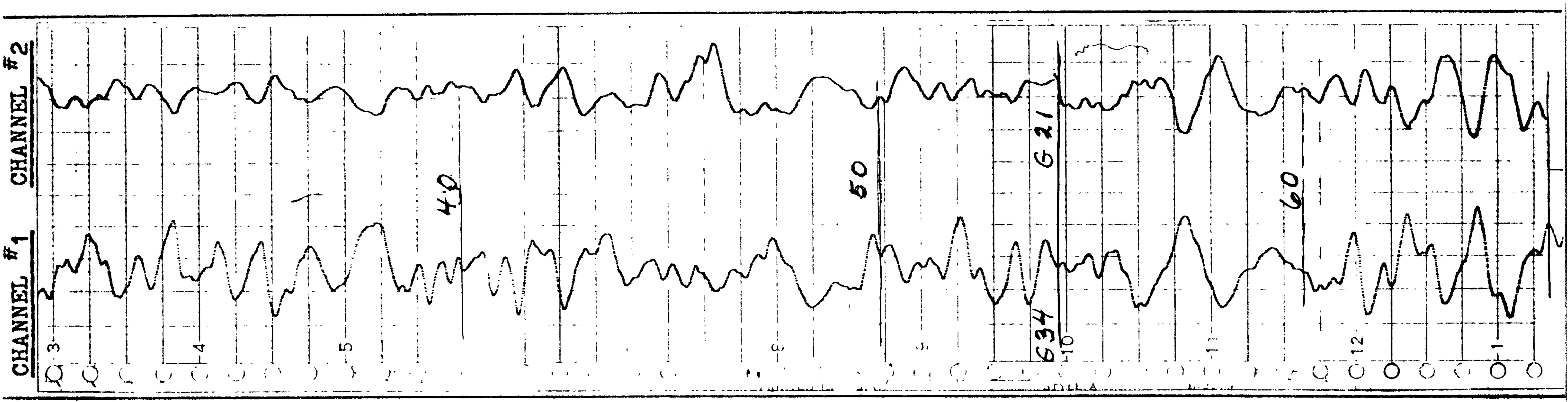
AZIMUTH: 148° LENGTH OF DIPOLE: 0.80 km

CHANNEL #2

AZIMUTH: 350° LENGTH OF DIPOLE: 0.82 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min)



TELLURIC DATA SHEET

PAGE 3 OF 3

STATION: T78-10 DATE: 7-7-78 LOCATION: Poor Farm & Pinnacle Roads, Harvard, Massachusetts

CHANNEL #1

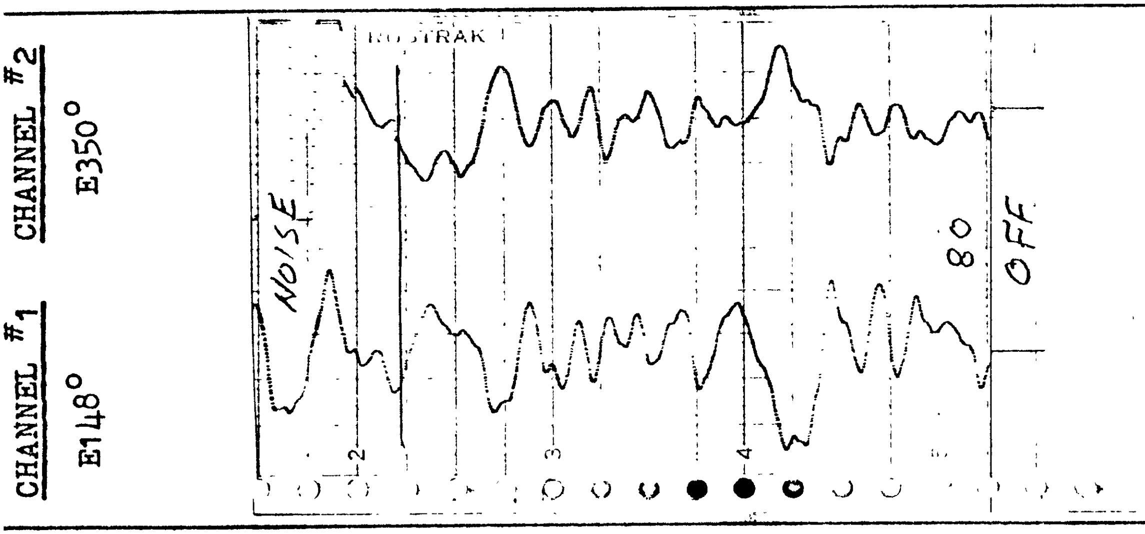
AZIMUTH: 148° LENGTH OF DIPOLE: 0.80 km

CHANNEL #2

AZIMUTH: 350° LENGTH OF DIPOLE: 0.82 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min)



TELLURIC DATA SHEET

PAGE 1 OF 1

STATION: T78-11 DATE: 7-7-78 LOCATION: Poor Farm Road, Harvard, Massachusetts

CHANNEL #1

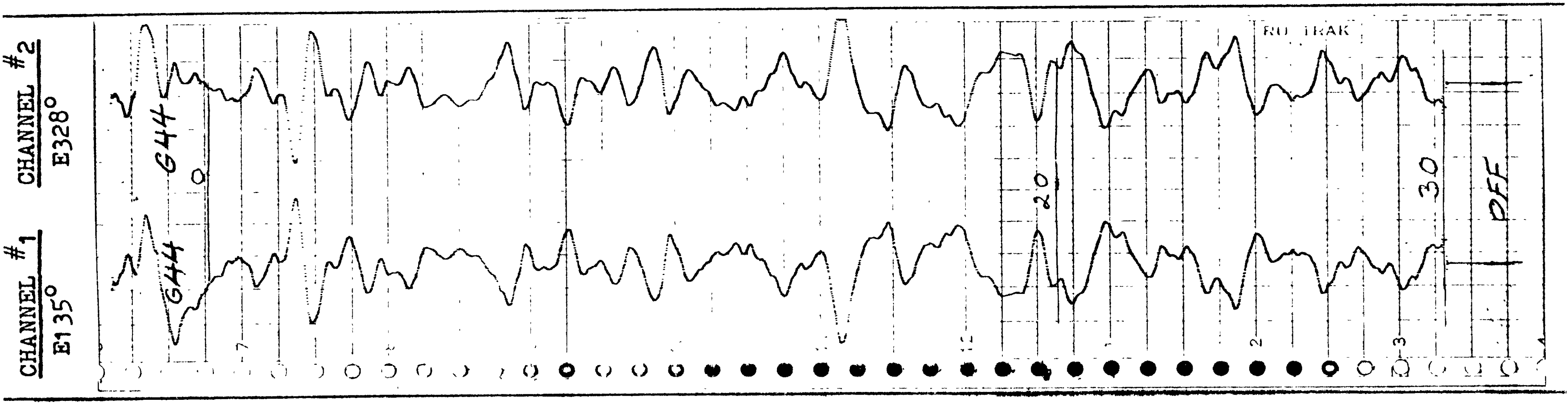
AZIMUTH: 135° LENGTH OF DIPOLE: 0.80 km

CHANNEL #2

AZIMUTH: 328° LENGTH OF DIPOLE: 0.80 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.14 div/min (0.283 inches/min) - decreasing chart speed



TELLURIC DATA SHEET

PAGE 1 OF 1

STATION: T78-12 DATE: 7-11-78 LOCATION: Intersection Old Littleton & Pinnacle Roads,
Harvard, Massachusetts

CHANNEL #1

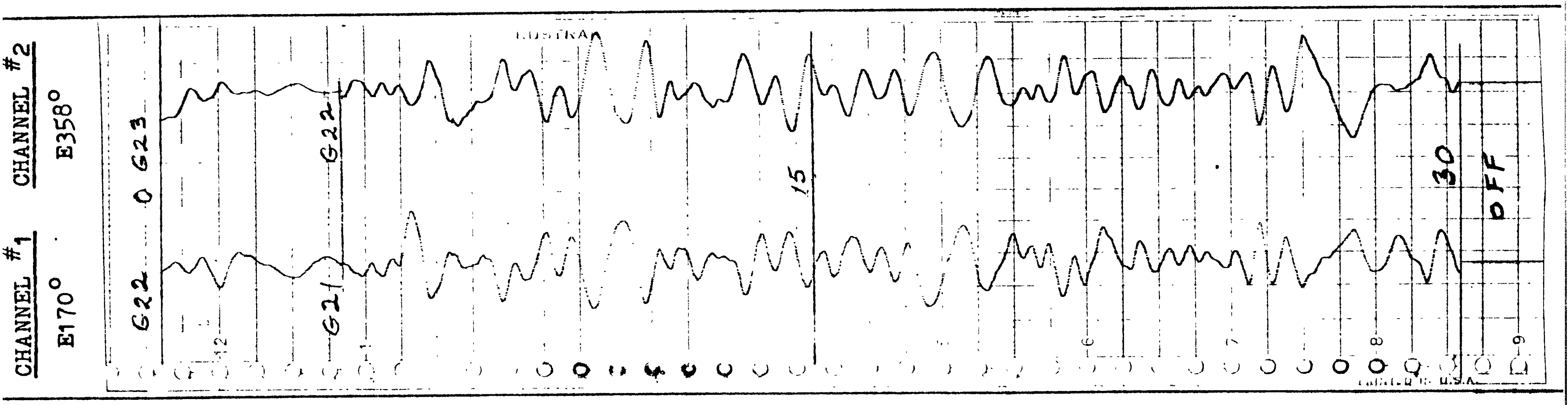
AZIMUTH: 170° LENGTH OF DIPOLE: 0.82 km

CHANNEL #2

AZIMUTH: 358° LENGTH OF DIPOLE: 0.98 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.20 div/min (0.299 inches/min)



TELLURIC DATA SHEET

PAGE 1 OF 1

STATION: T78-13 DATE: 7-11-78 LOCATION: Intersection Oak Hill & Cleaves Hill Roads, Harvard, Massachusetts

CHANNEL #1

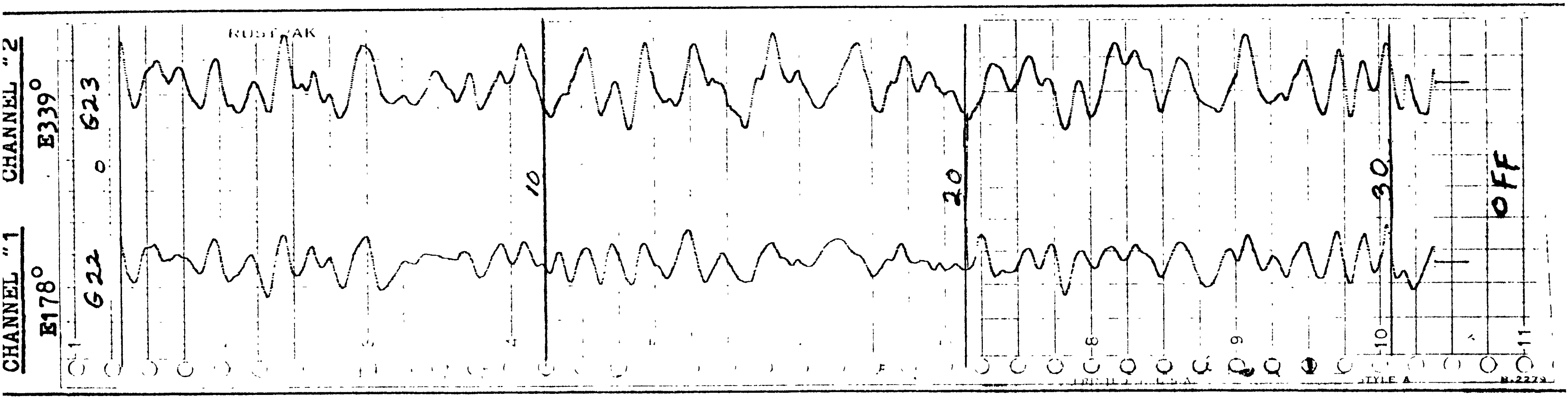
AZIMUTH: 178° LENGTH OF DIPOLE: 0.98 km

CHANNEL #2

AZIMUTH: 339° LENGTH OF DIPOLE: 1.00 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.17 div/min (0.291 inches/min)



MAGNETOTELLURIC DATA SHEET

PAGE 1 OF 2

STATION: MT78-14 DATE: 7-11-78 LOCATION: Intersection Littleton County & Sherry Roads, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 238° LENGTH: 0.64 km CHANNEL #3 E ⊥ L.C. AZ: 159° LENGTH: 1.0 km

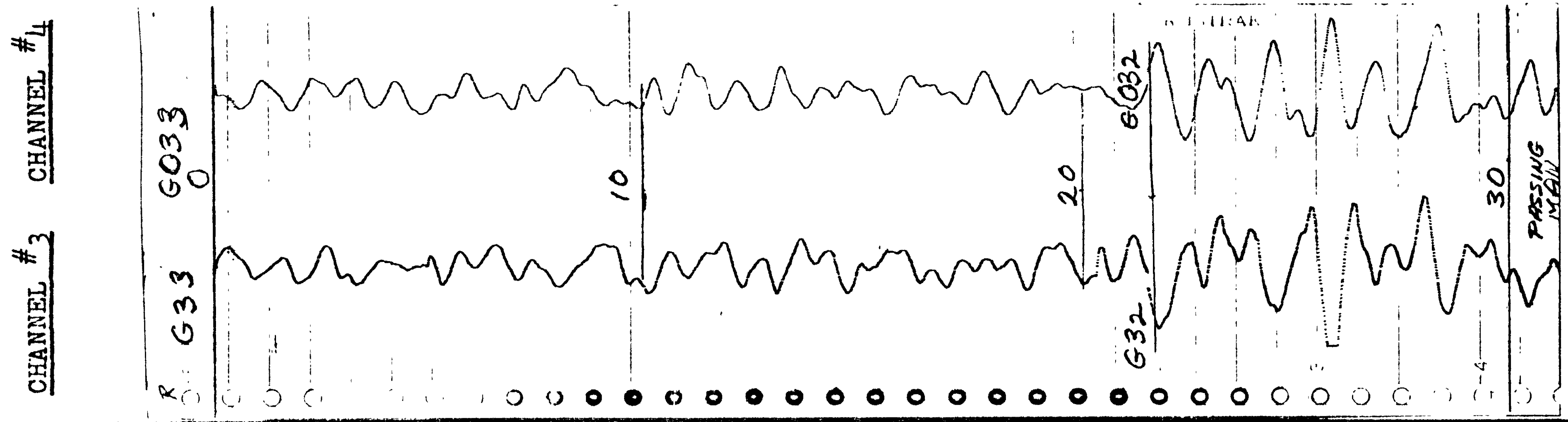
CHANNEL #2 SHORT COIL AZ: 148° CHANNEL #4 LONG COIL AZ: 69°

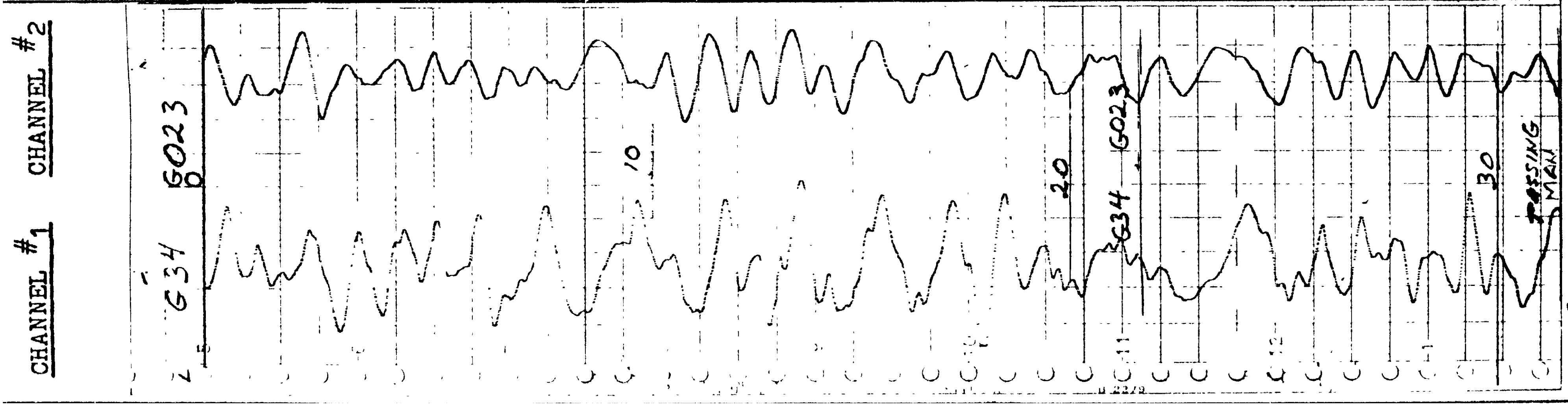
AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.13 div/min (0.282 inches/min) Channels 1 & 2

1.07 div/min (0.267 inches/min) Channels 3 & 4





A-30

MAGNETOTELLURIC DATA SHEET

PAGE 2 OF 2

STATION: MT78-14 DATE: 7-11-78 LOCATION: Intersection Littleton County & Sherry Roads, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 238° LENGTH: 0.64 km CHANNEL #3 E ⊥ L.C. AZ: 159° LENGTH: 1.0 km

CHANNEL #2 SHORT COIL AZ: 148° CHANNEL #4 LONG COIL AZ: 69°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE

(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 1.13 div/min (0.282 inches/min) Channels 1 & 2

1.07 div/min (0.267 inches/min) Channels 3 & 4

TELLURIC DATA SHEET

PAGE 1 OF 2

STATION: T78-15 DATE: 7-12-78 LOCATION: Intersection Littleton County & Sherry Roads, Harvard, Massachusetts

CHANNEL #1

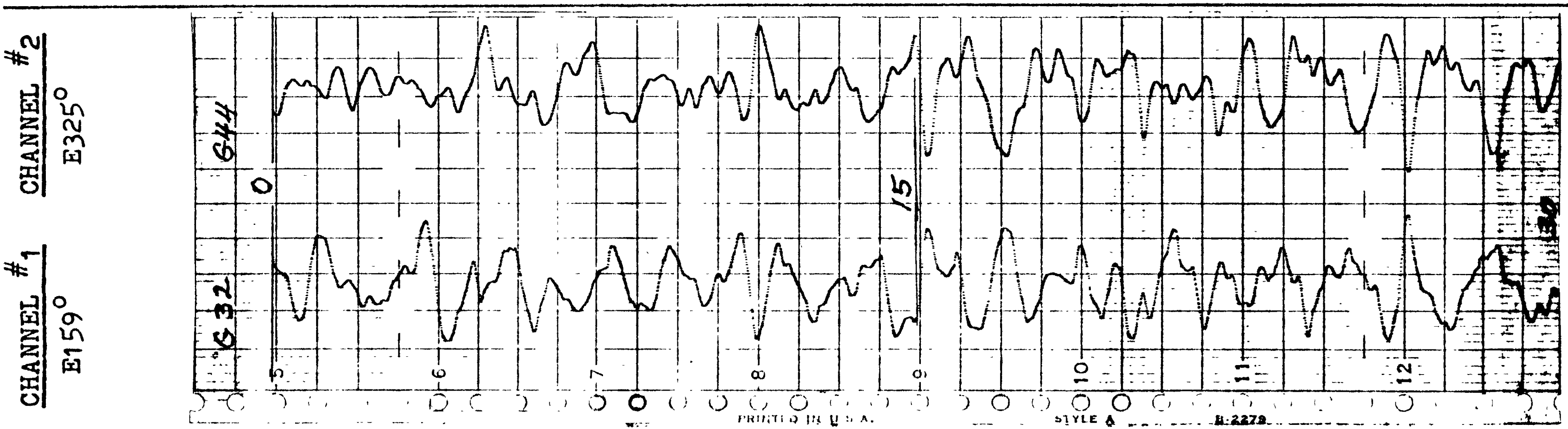
AZIMUTH: 159° LENGTH OF DIPOLE: 1.0 km

CHANNEL #2

AZIMUTH: 325° LENGTH OF DIPOLE: 1.0 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.07 div/min (0.267 inches/min)



TELLURIC DATA SHEET

PAGE 2 OF 2

STATION: T78-15 DATE: 7-12-78 LOCATION: Intersection Littleton County & Sherry Roads, Harvard, Massachusetts

CHANNEL #1

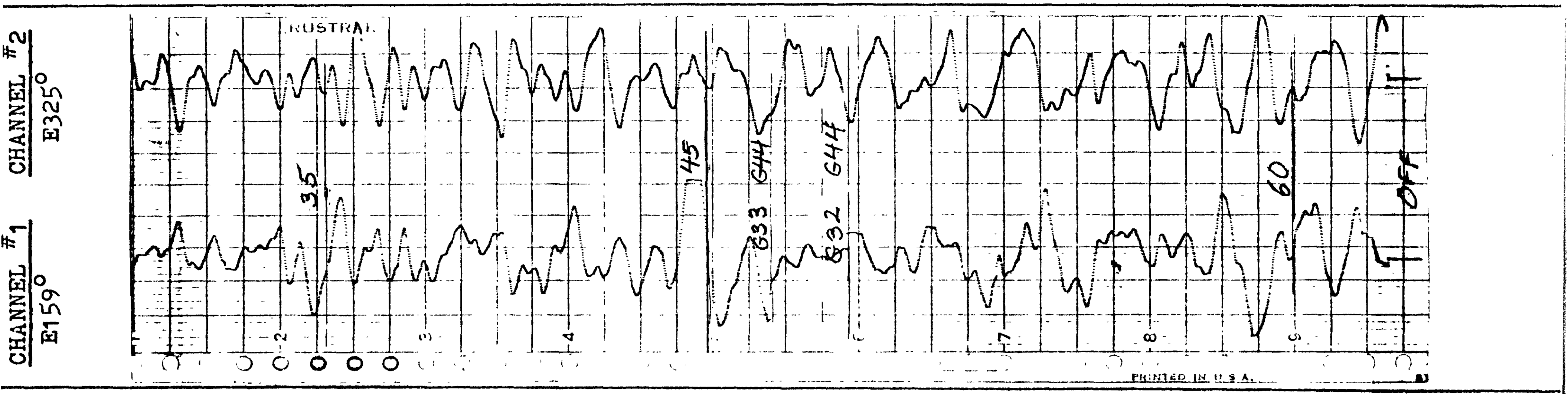
AZIMUTH: 159° LENGTH OF DIPOLE: 1.0 km

CHANNEL #2

AZIMUTH: 325° LENGTH OF DIPOLE: 1.0 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.07 div/min (0.267 inches/min)



TELLURIC DATA SHEET

PAGE 1 OF 1

STATION: T78-16 DATE: 7-13-78 LOCATION: Intersection Old Littleton & Pinnacle Roads,
Harvard, Massachusetts

CHANNEL #1

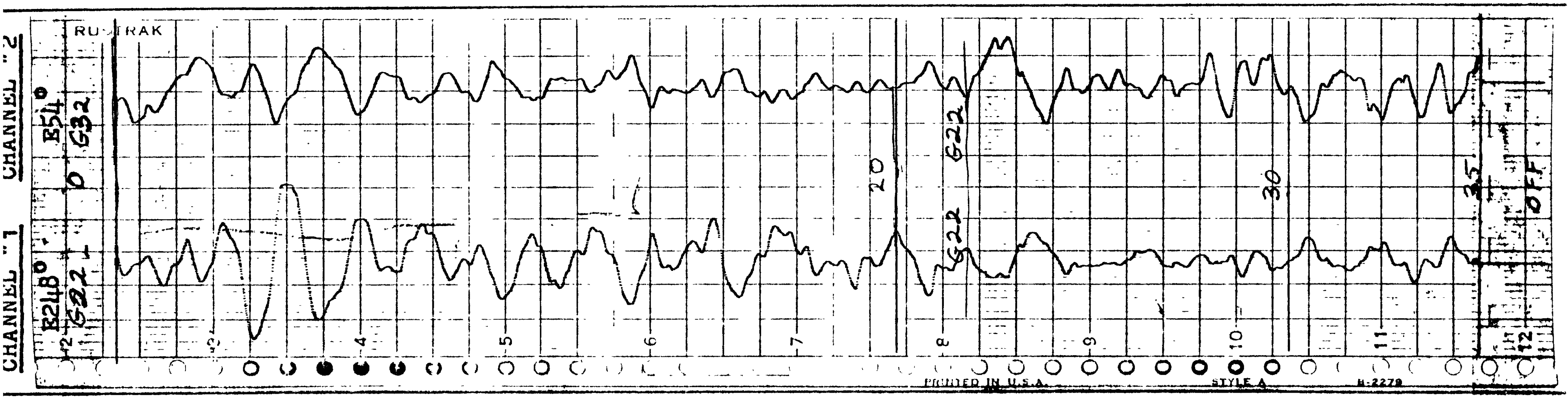
AZIMUTH: 248° LENGTH OF DIPOLE: 0.77 km

CHANNEL #2

AZIMUTH: 54° LENGTH OF DIPOLE: 0.99 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.07 div/min (0.268 inches/min)



TELLURIC DATA SHEET

PAGE 1 OF 2

STATION: T78-17 DATE: 7-18-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1

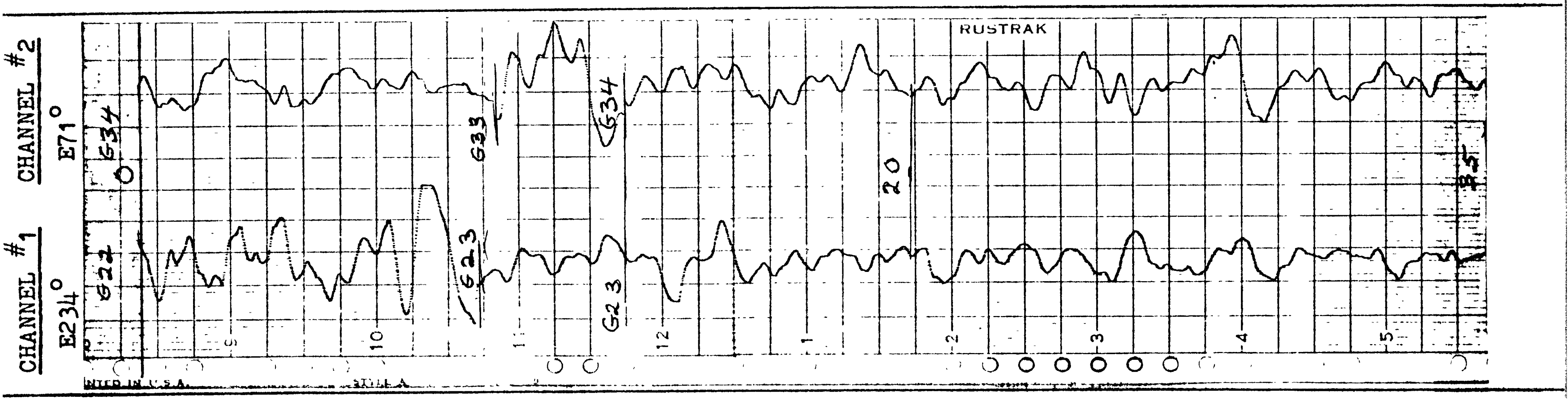
AZIMUTH: 234° LENGTH OF DIPOLE: 0.99 km

CHANNEL #2

AZIMUTH: 71° LENGTH OF DIPOLE: 1.01 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.07 div/min (0.266 inches/min)



TELLURIC DATA SHEET

PAGE 2 OF 2

STATION: T78-17 DATE: 7-18-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1

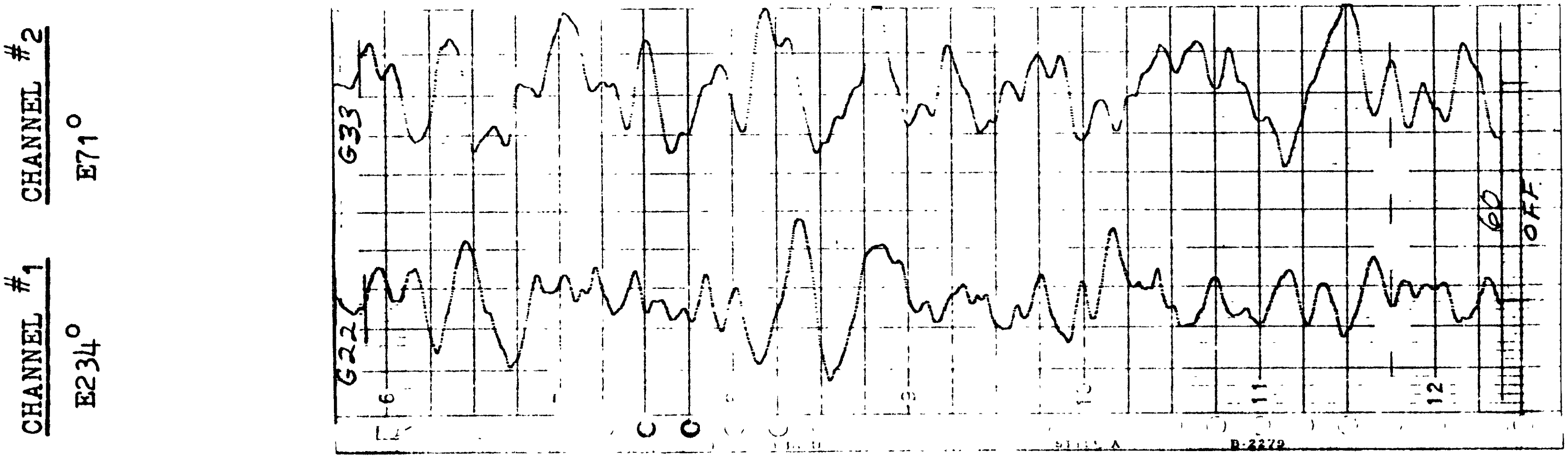
AZIMUTH: 234° LENGTH OF DIPOLE: 0.99 km

CHANNEL #2

AZIMUTH: 71° LENGTH OF DIPOLE: 1.01 km

AZIMUTH CONVENTION: DIPOLE POINTS TOWARD CENTER ELECTRODE

COMMENTS: Average Chart Speed: 1.07 div/min (0.266 inches/min)



MAGNETOTELLURIC DATA SHEET

PAGE 1 OF 4

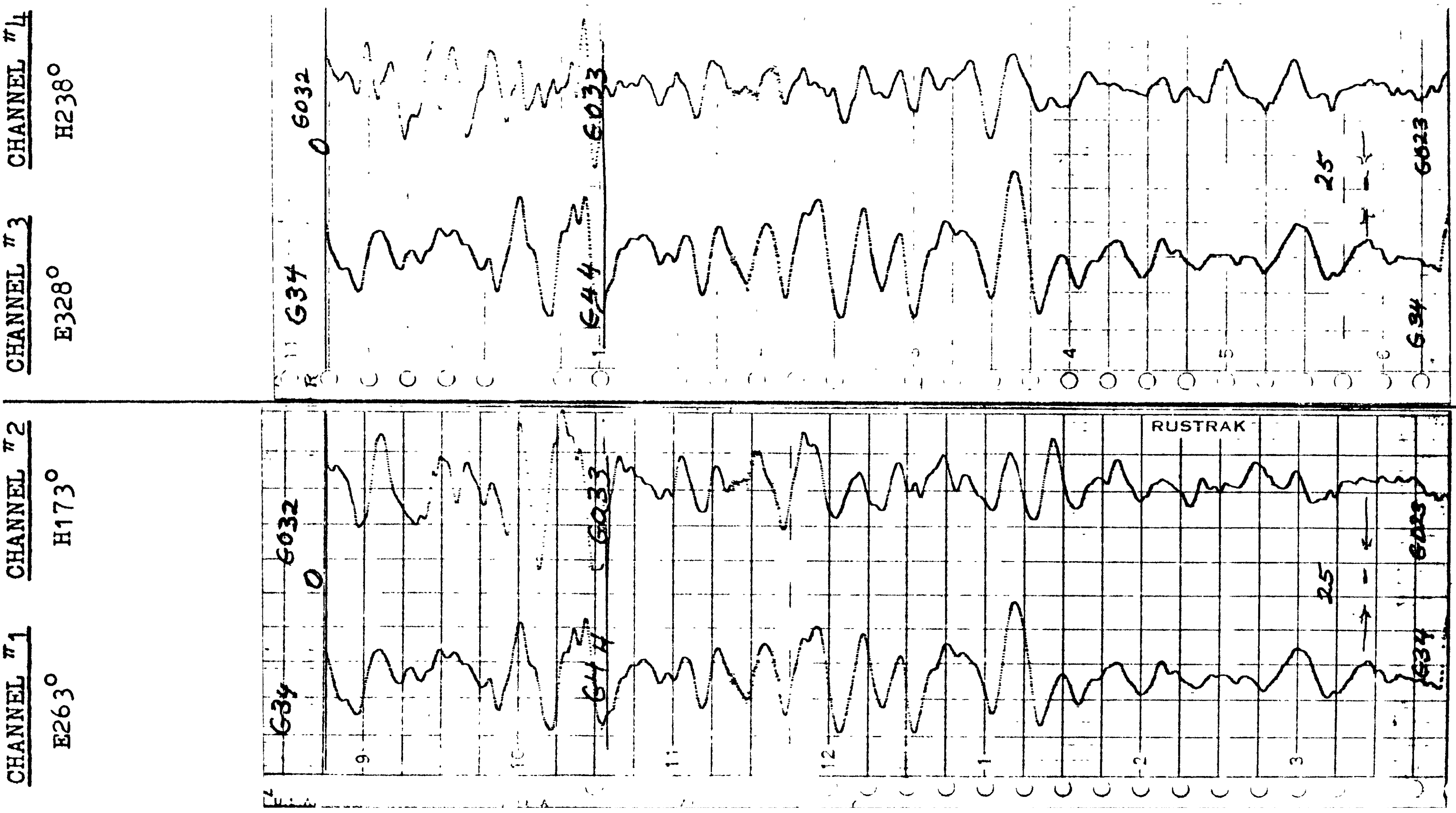
STATION: MT78-18 DATE: 8-17-78 LOCATION: Poor Farm Road, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 263° LENGTH: 0.8 km CHANNEL #3 E ⊥ L.C. AZ: 328° LENGTH: 0.8 km

CHANNEL #2 SHORT COIL AZ: 173° CHANNEL #4 LONG COIL AZ: 238°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 0.266 inches/min Channels 1,2,3 and 4



MAGNETOTELLURIC DATA SHEET

PAGE 2 OF 4

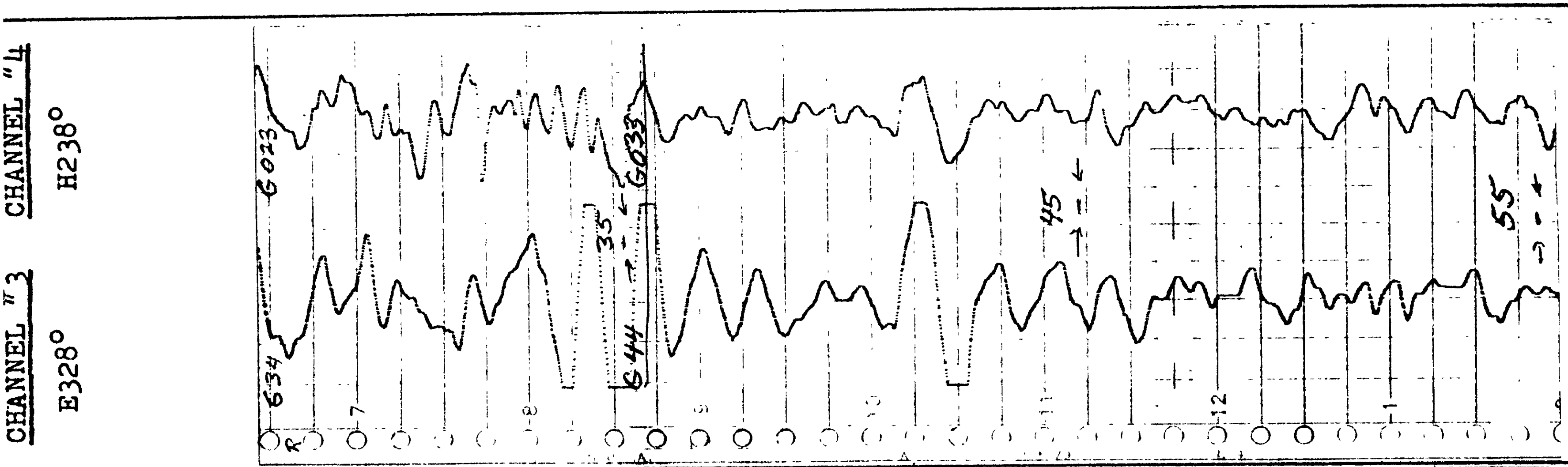
STATION: MT78-18 DATE: 8-17-78 LOCATION: Poor Farm Road, Harvard, Massachusetts

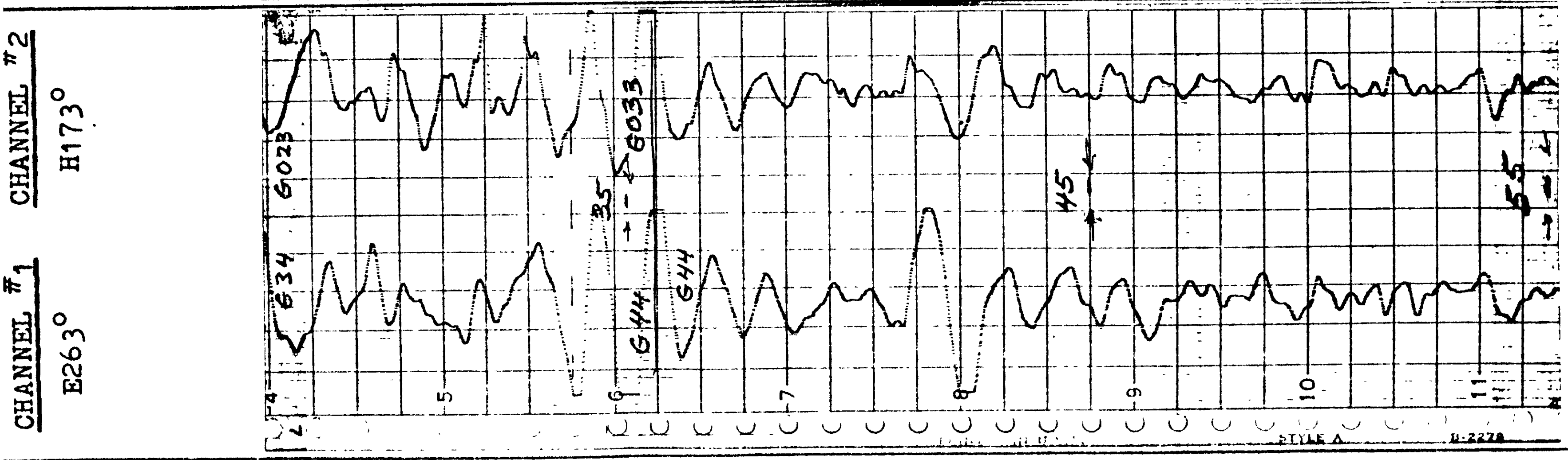
CHANNEL #1 E ⊥ S.C. AZ: 263° LENGTH: 0.8 km CHANNEL #3 E ⊥ L.C. AZ: 328° LENGTH: 0.8 km

CHANNEL #2 SHORT COIL AZ: 173° CHANNEL #4 LONG COIL AZ: 238°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 0.266 inches/min Channels 1,2,3 and 4





MAGNETOTELLURIC DATA SHEET

PAGE 3 OF 4

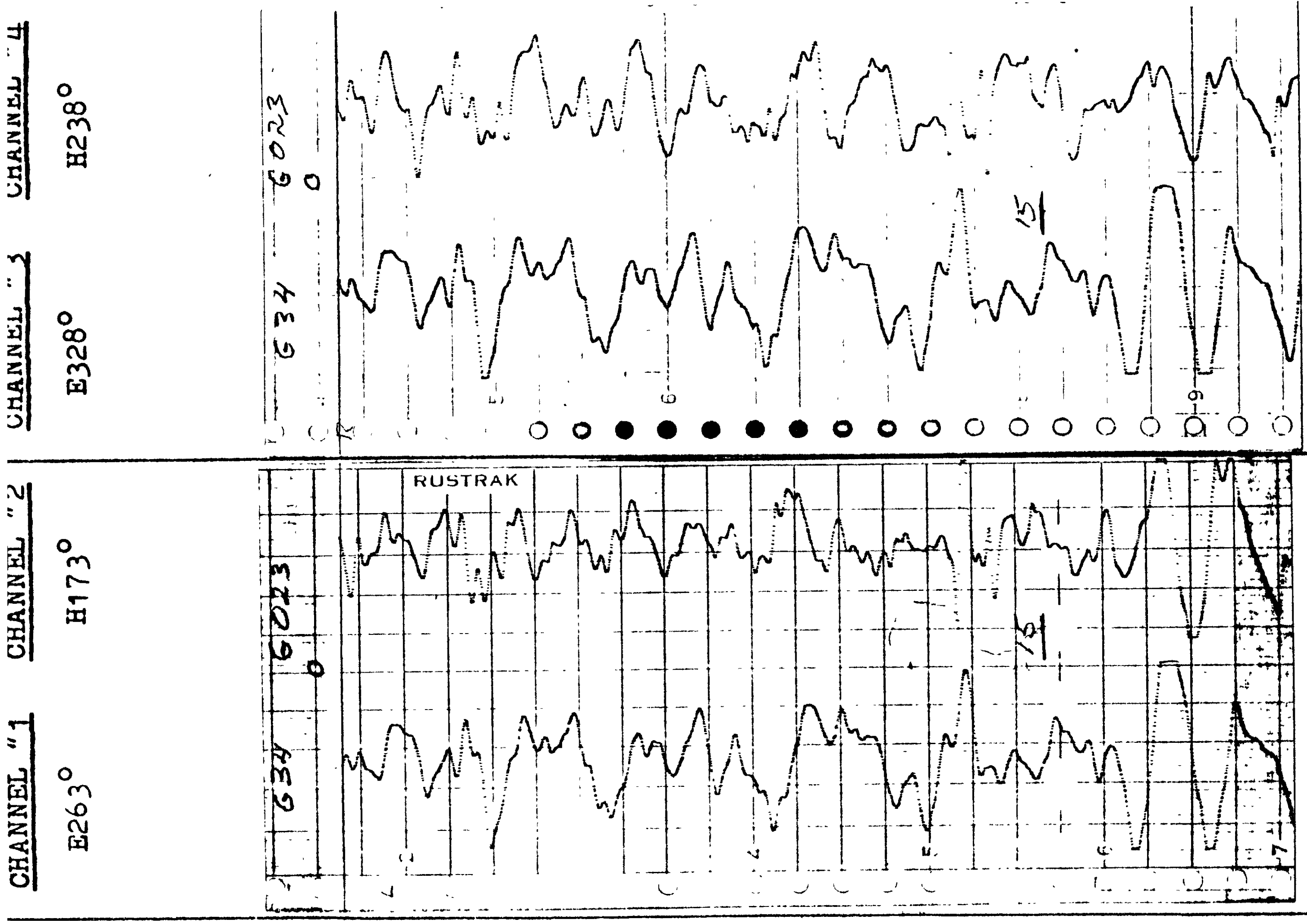
STATION: MT78-18 DATE: 8-17-78 LOCATION: Poor Farm Road, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 263° LENGTH: 0.8 km CHANNEL #3 E ⊥ L.C. AZ: 328° LENGTH: 0.8 km

CHANNEL #2 SHORT COIL AZ: 173° CHANNEL #4 LONG COIL AZ: 238°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 0.266 inches/min Channels 1,2,3 and 4



MAGNETOTELLURIC DATA SHEET

PAGE 4 OF 4

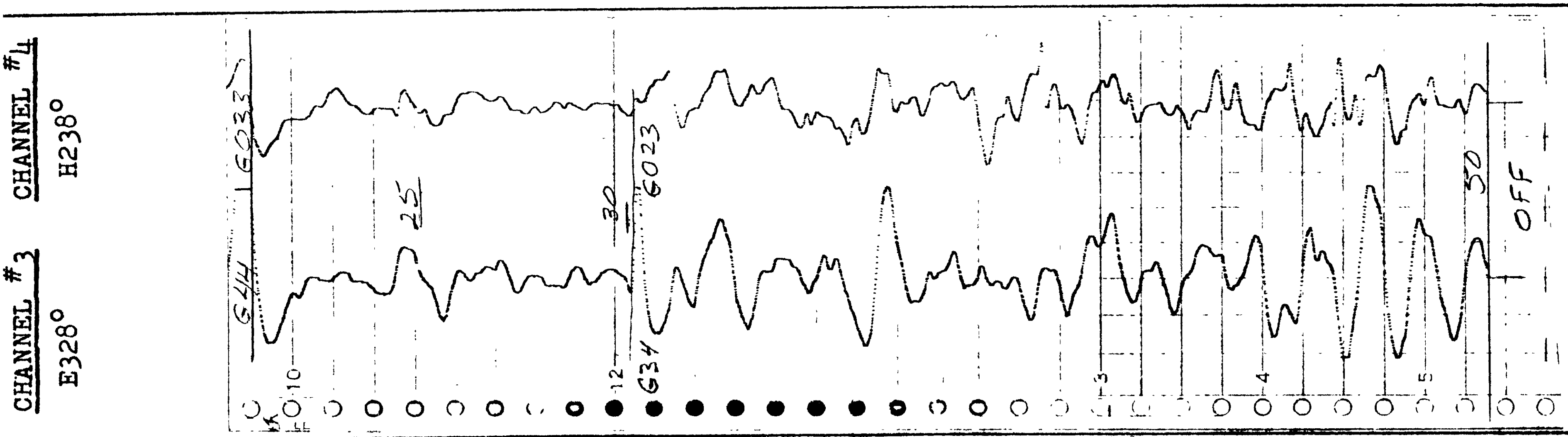
STATION: MT78-18 DATE: 8-17-78 LOCATION: Poor Farm Road, Harvard, Massachusetts

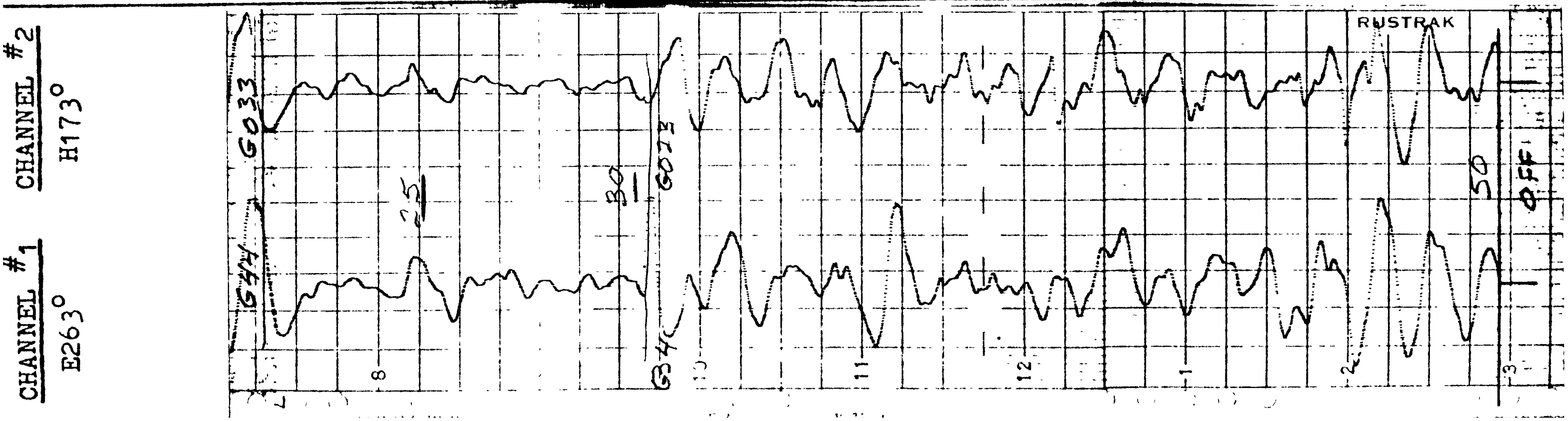
CHANNEL #1 E ⊥ S.C. AZ: 263° LENGTH: 0.8 km CHANNEL #3 E ⊥ L.C. AZ: 328° LENGTH: 0.8 km

CHANNEL #2 SHORT COIL AZ: 173° CHANNEL #4 LONG COIL AZ: 238°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 0.266 inches/min Channels 1,2,3 and 4





MAGNETOTELLURIC DATA SHEET

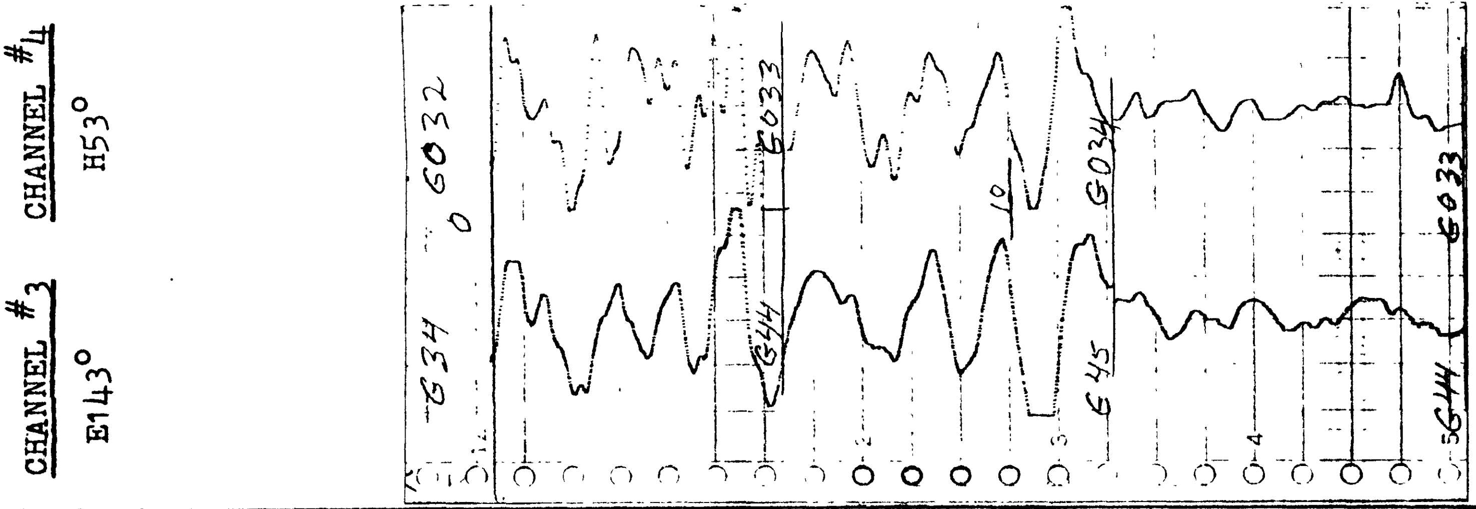
STATION: MT78-19 DATE: 8-17-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

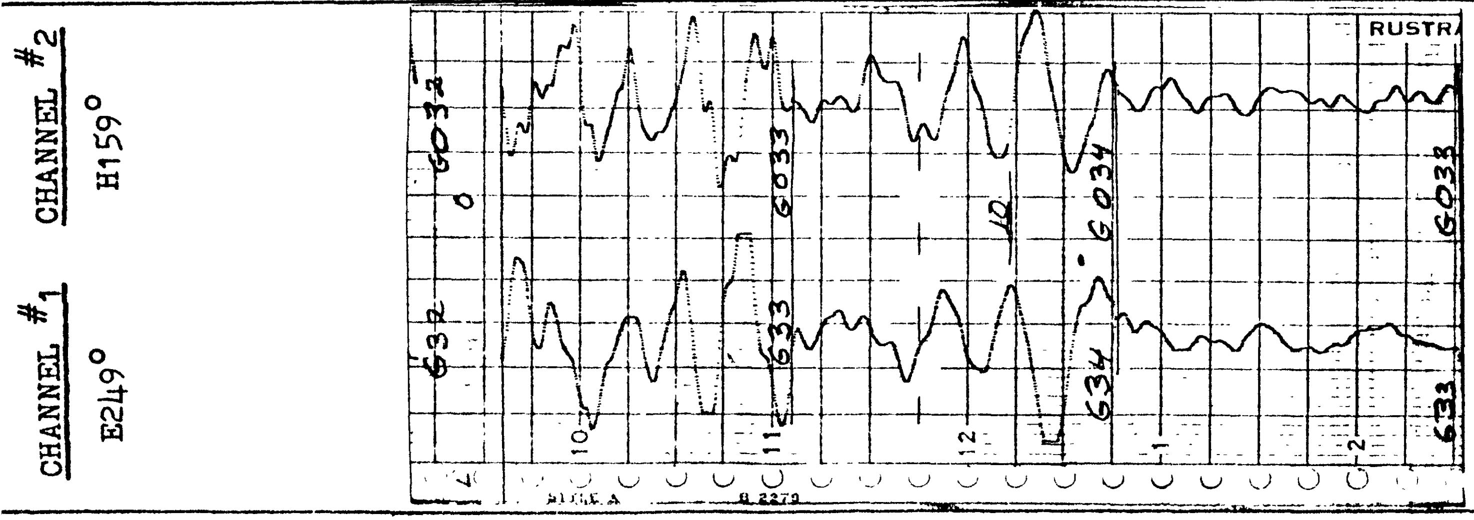
CHANNEL #1 E ⊥ S.C. AZ: 249° LENGTH: 1.08 km CHANNEL #3 E ⊥ L.C. AZ: 143° LENGTH: 0.62 km

CHANNEL #2 SHORT COIL AZ: 159° CHANNEL #4 LONG COIL AZ: 53°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 0.265 inches/min Channels 1,2,3 and 4





MAGNETOTELLURIC DATA SHEET

PAGE 2 OF 3

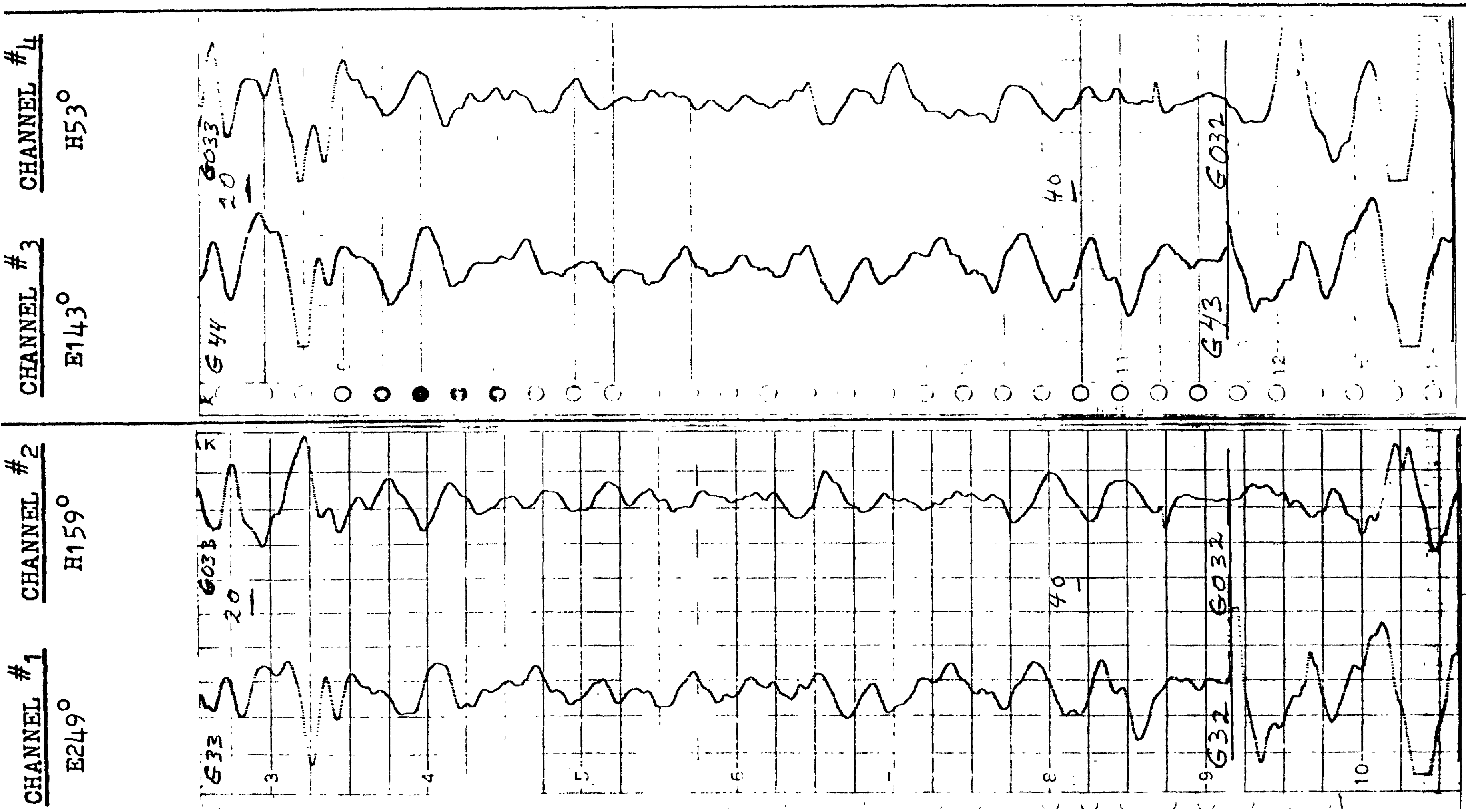
STATION: MT78-19 DATE: 8-17-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

CHANNEL #1 E ⊥ S.C. AZ: 249° LENGTH: 1.08 km CHANNEL #3 E ⊥ L.C. AZ: 143° LENGTH: 0.62 km

CHANNEL #2 SHORT COIL AZ: 159° CHANNEL #4 LONG COIL AZ: 53°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 0.265 inches/min Channels 1,2,3 and 4



MAGNETOTELLURIC DATA SHEET

PAGE 3 OF 3

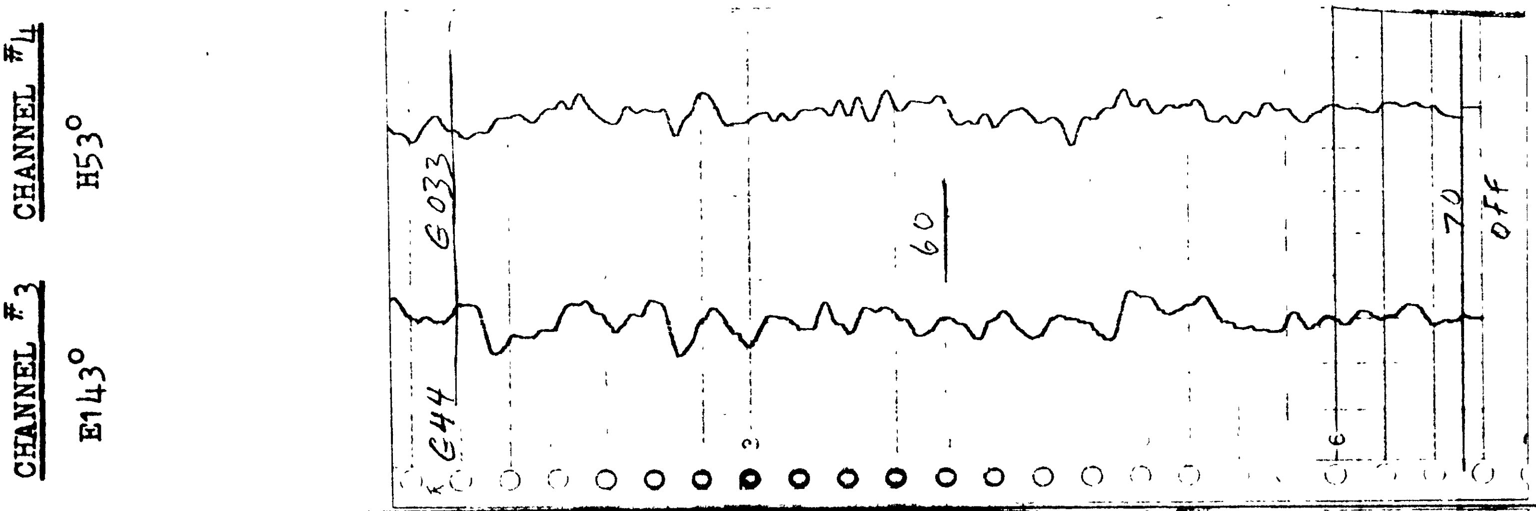
STATION: MT78-19 DATE: 8-17-78 LOCATION: Old Littleton Road, Harvard, Massachusetts

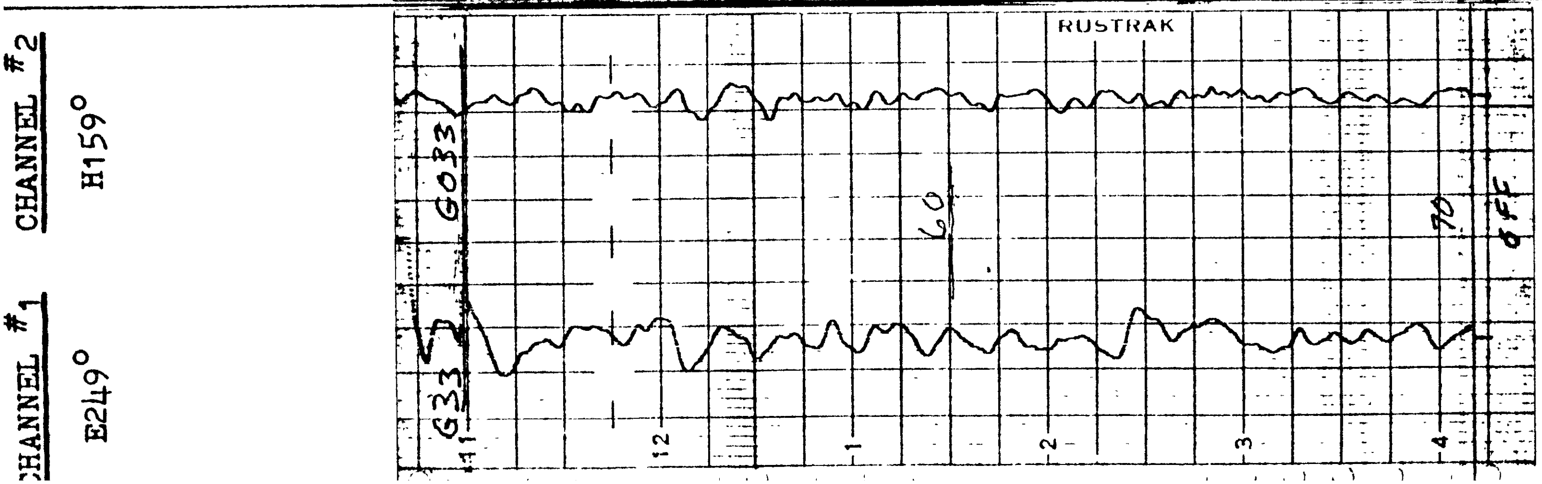
CHANNEL #1 E ⊥ S.C. AZ: 249° LENGTH: 1.08 km CHANNEL #3 E ⊥ L.C. AZ: 143° LENGTH: 0.62 km

CHANNEL #2 SHORT COIL AZ: 159° CHANNEL #4 LONG COIL AZ: 53°

AZIMUTH CONVENTION: (1) DIPOLE POINTS TOWARD CENTER ELECTRODE
(2) COIL ⊥ - E IS ROTATED 90° CCW FROM THE DIPOLE AZIMUTH

COMMENTS: Average Chart Speed: 0.265 inches/min Channels 1,2,3 and 4



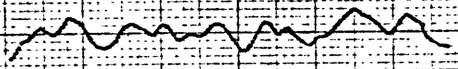


APPENDIX B

Digitized Data

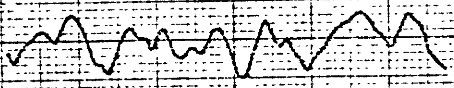
MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

CHANNEL 1 MT1.E64.12
DIPOLE LENGTH = 1.30 KM
GAIN = 2.3100e 02
ELECTRIC FACTOR = 2.9414e-03 (VOLTS/M)/CM

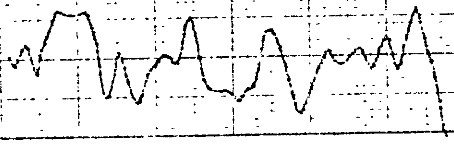


CHANNEL 2 MT1.H324.12
SHORT COIL
GAIN = 1.0211e 07
MAGNETIC FACTOR = 1.6052e 01 (AMPS/M)/CM/HZ

CHANNEL 3 MT1.E160.12
DIPOLE LENGTH = 1.28 KM
GAIN = 2.3100e 02
ELECTRIC FACTOR = 3.1978e-03 (VOLTS/M)/CM



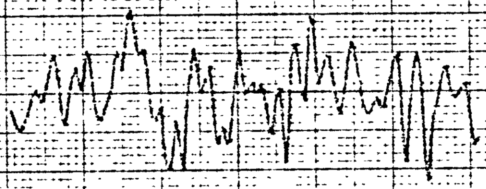
CHANNEL 4 MT1.H70.12
LONG COIL
GAIN = 1.0211e 07
MAGNETIC FACTOR = 1.1362e 01 (AMPS/M)/CM/HZ



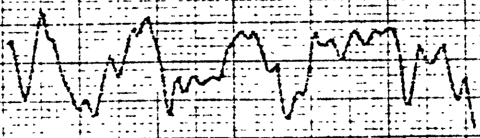
MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

CHANNEL 1 MT1.E64.22
DIPOLE LENGTH = 1.30 KM
GAIN = 4.4100e 02
ELECTRIC FACTOR = 2.9987e-03 (VOLTS/M)/CM

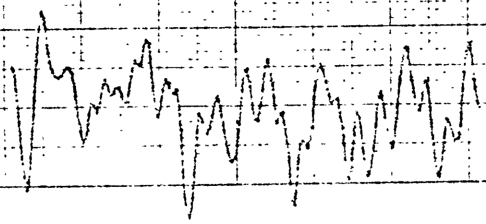
CHANNEL 2 MT1.H334.22
SHORT COIL
GAIN = 1.0211e 07
MAGNETIC FACTOR = 1.6228e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT1.E160.22
DIPOLE LENGTH = 1.28 KM
GAIN = 4.4100e 02
ELECTRIC FACTOR = 3.2464e-03 (VOLTS/M)/CM

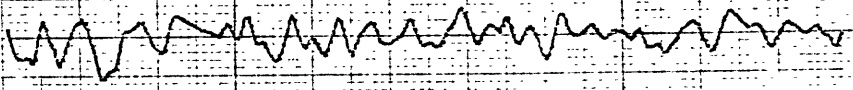


CHANNEL 4 MT1.H70.22
LONG COIL
GAIN = 1.0211e 07
MAGNETIC FACTOR = 1.1494e 01 (AMPS/M)/CM/HZ

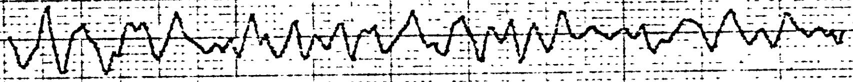


MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

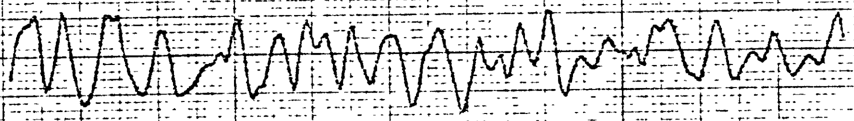
CHANNEL 1 MT2.E99.13
DIPOLE LENGTH = 0.74 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 5.2413e-03 (VOLTS/M)/CM



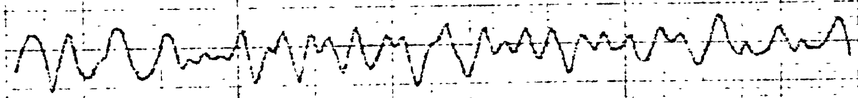
CHANNEL 2 MT2.H9.13
SHORT COIL
GAIN = 8.6186e 05
MAGNETIC FACTOR = 1.6255e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT2.E340.13
DIPOLE LENGTH = 1.28 KM
GAIN = 1.2100e 02
ELECTRIC FACTOR = 3.2382e-03 (VOLTS/M)/CM



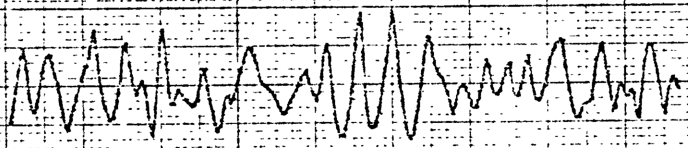
CHANNEL 4 MT2.H250.13
LONG COIL
GAIN = 8.6186e 05
MAGNETIC FACTOR = 1.1485e 01 (AMPS/M)/CM/HZ



MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

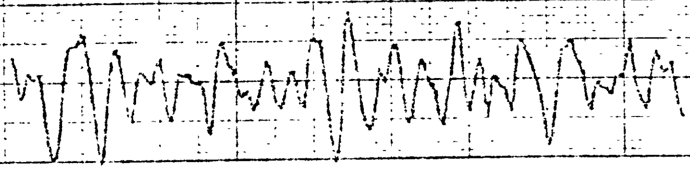
CHANNEL 1 MT2.E99.23
DIPOLE LENGTH = 0.74 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 5.2635e-03 (VOLTS/M)/CM

CHANNEL 2 MT2.H9.23
SHORT COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.6241e 01 (AMPS/M)/CM/HZ



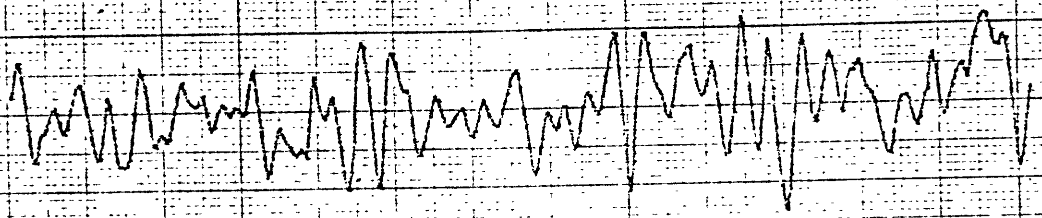
CHANNEL 3 MT2.E340.33
DIPOLE LENGTH = 1.28 KM
GAIN = 2.3100e 02
ELECTRIC FACTOR = 3.2328e-03 (VOLTS/M)/CM

CHANNEL 4 MT2.H250.23
LONG COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.1446e 01 (AMPS/M)/CM/HZ

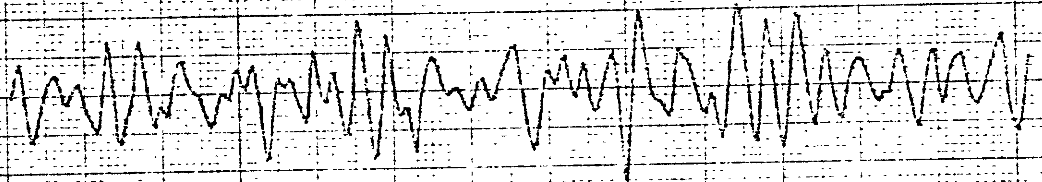


MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

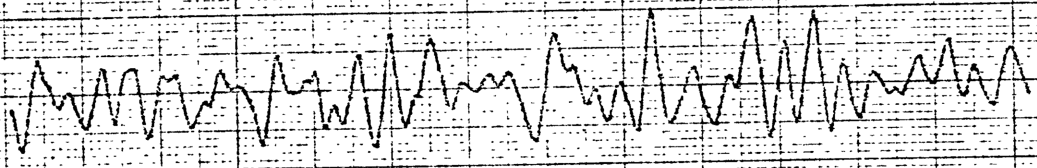
CHANNEL 1 MT2.E99.33
DIPOLE LENGTH = 0.74 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 5.2724e-03 (VOLTS/M)/CM



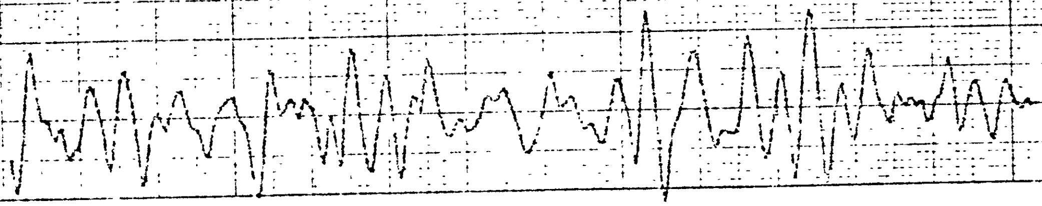
CHANNEL 2 MT2.H9.33
SHORT COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.6269e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT2.E340.33
DIPOLE LENGTH = 1.28 KM
GAIN = 1.2102e 02
ELECTRIC FACTOR = 3.2355e-03 (VOLTS/M)/CM

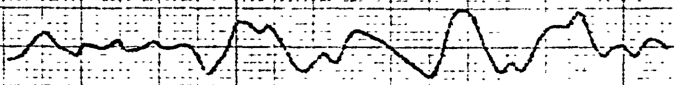


CHANNEL 4 MT2.H250.33
LONG COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.1475e 01 (AMPS/M)/CM/HZ

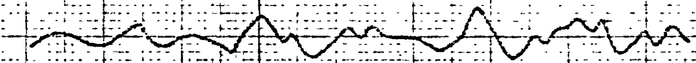


MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

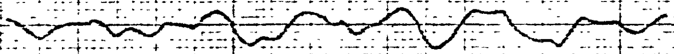
CHANNEL 1 MT6.E220.12
DIPOLE LENGTH = 1.02 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 3.8025e-03 (VOLTS/M)/CM



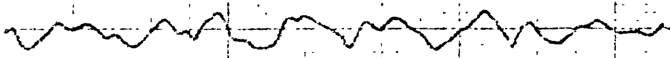
CHANNEL 2 MT6.H130.12
SHORT COIL
GAIN = 4.4144e 05
MAGNETIC FACTOR = 1.6173e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT6.E155.12
DIPOLE LENGTH = 0.72 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 5.7183e-03 (VOLTS/M)/CM

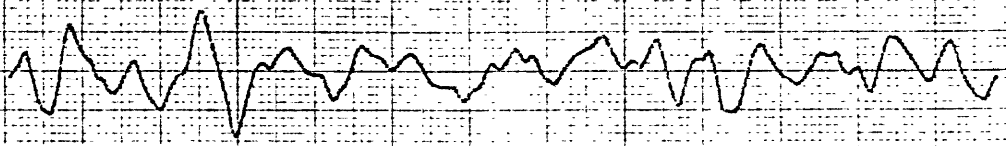


CHANNEL 4 MT6.H65.12
LONG COIL
GAIN = 4.4144e 05
MAGNETIC FACTOR = 1.1485e 01 (AMPS/M)/CM/HZ

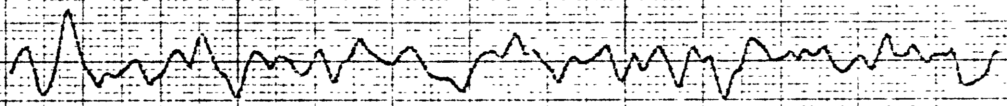


MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

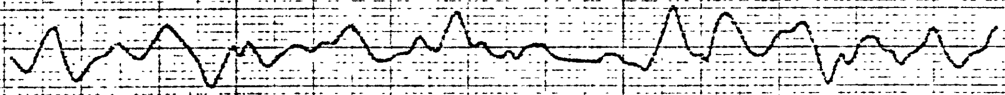
CHANNEL 1 MT6.E220.22
DIPOLE LENGTH = 1.02 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 3.7834e-03 (VOLTS/M)/CM



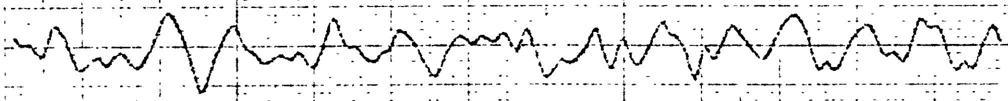
CHANNEL 2 MT6.H130.22
SHORT COIL
GAIN = 8.6186e 05
MAGNETIC FACTOR = 1.6214e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT6.E155.22
DIPOLE LENGTH = 0.72 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 5.7231e-03 (VOLTS/M)/CM



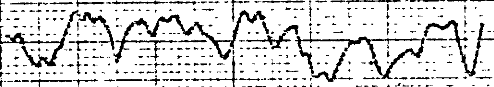
CHANNEL 4 MT6.H65.22
LONG COIL
GAIN = 8.6186e 05
MAGNETIC FACTOR = 1.1465e 01 (AMPS/M)/CM/HZ



MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

CHANNEL 1 MT9.E243.13
DIPOLE LENGTH = 0.87 KM
GAIN = 1.0201e 04
ELECTRIC FACTOR = 4.4506e-03 (VOLTS/M)/CM

CHANNEL 2 MT9.H153.13
SHORT COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.6269e 01 (AMPS/M)/CM/HZ



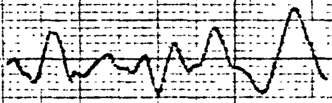
CHANNEL 3 MT9.E170.13
DIPOLE LENGTH = 0.82 KM
GAIN = 1.0201e 04
ELECTRIC FACTOR = 5.0293e-03 (VOLTS/M)/CM

CHANNEL 4 MT9.H80.13
LONG COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.1407e 01 (AMPS/M)/CM/HZ

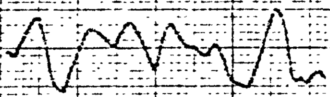
MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

CHANNEL 1 MT9.E243.23
DIPOLE LENGTH = 0.87 KM
GAIN = 4.1410e 03
ELECTRIC FACTOR = 4.4320e-03 (VOLTS/M)/CM

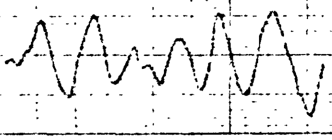
CHANNEL 2 MT9.H153.23
SHORT COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.6255e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT9.E170.23
DIPOLE LENGTH = 0.82 KM
GAIN = 4.1410e 03
ELECTRIC FACTOR = 5.0548e-03 (VOLTS/M)/CM



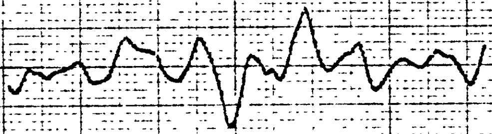
CHANNEL 4 MT9.H80.23
LONG COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.1398e 01 (AMPS/M)/CM/HZ



MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

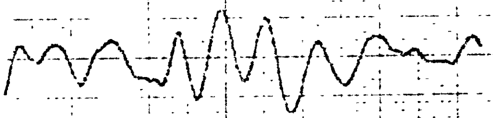
CHANNEL 1 MT9.E243.33
DIPOLE LENGTH = 0.87 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 4.4732e-03 (VOLTS/M)/CM

CHANNEL 2 MT9.H143.33
SHORT COIL
GAIN = 8.6186e 05
MAGNETIC FACTOR = 1.6366e 01 (AMPS/M)/CM/HZ



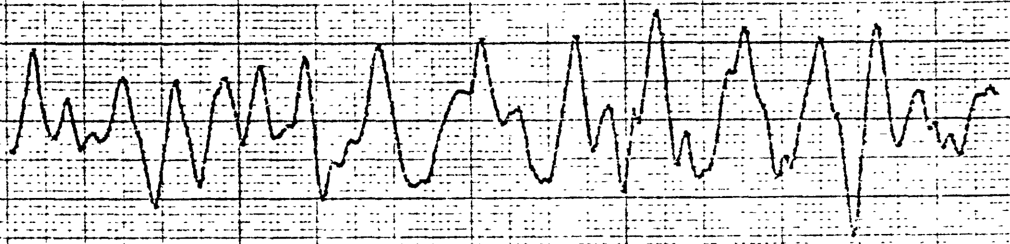
CHANNEL 3 MT9.E170.33
DIPOLE LENGTH = 0.82 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 5.0633e-03 (VOLTS/M)/CM

CHANNEL 4 MT9.H80.33
LONG COIL
GAIN = 8.6186e 05
MAGNETIC FACTOR = 1.1475e 01 (AMPS/M)/CM/HZ

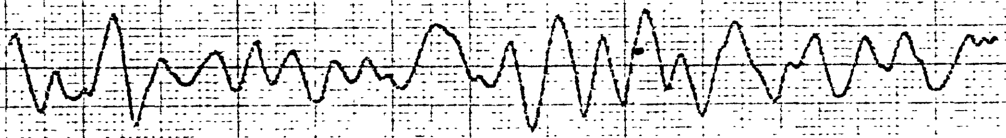


MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

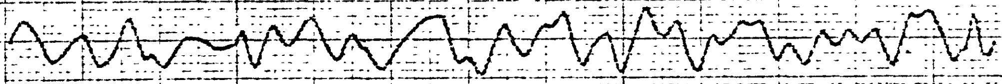
CHANNEL 1 MT14.E238.12
DIPOLE LENGTH = 0.64 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 6.0399e-03 (VOLTS/M)/CM



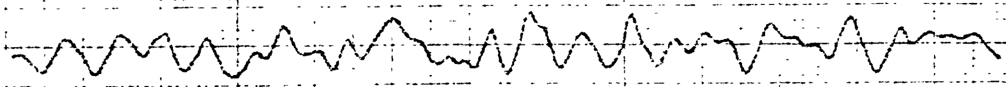
CHANNEL 2 MT14.H148.12
SHORT COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.6214e 01 (AMPS/M)/CM/HZ

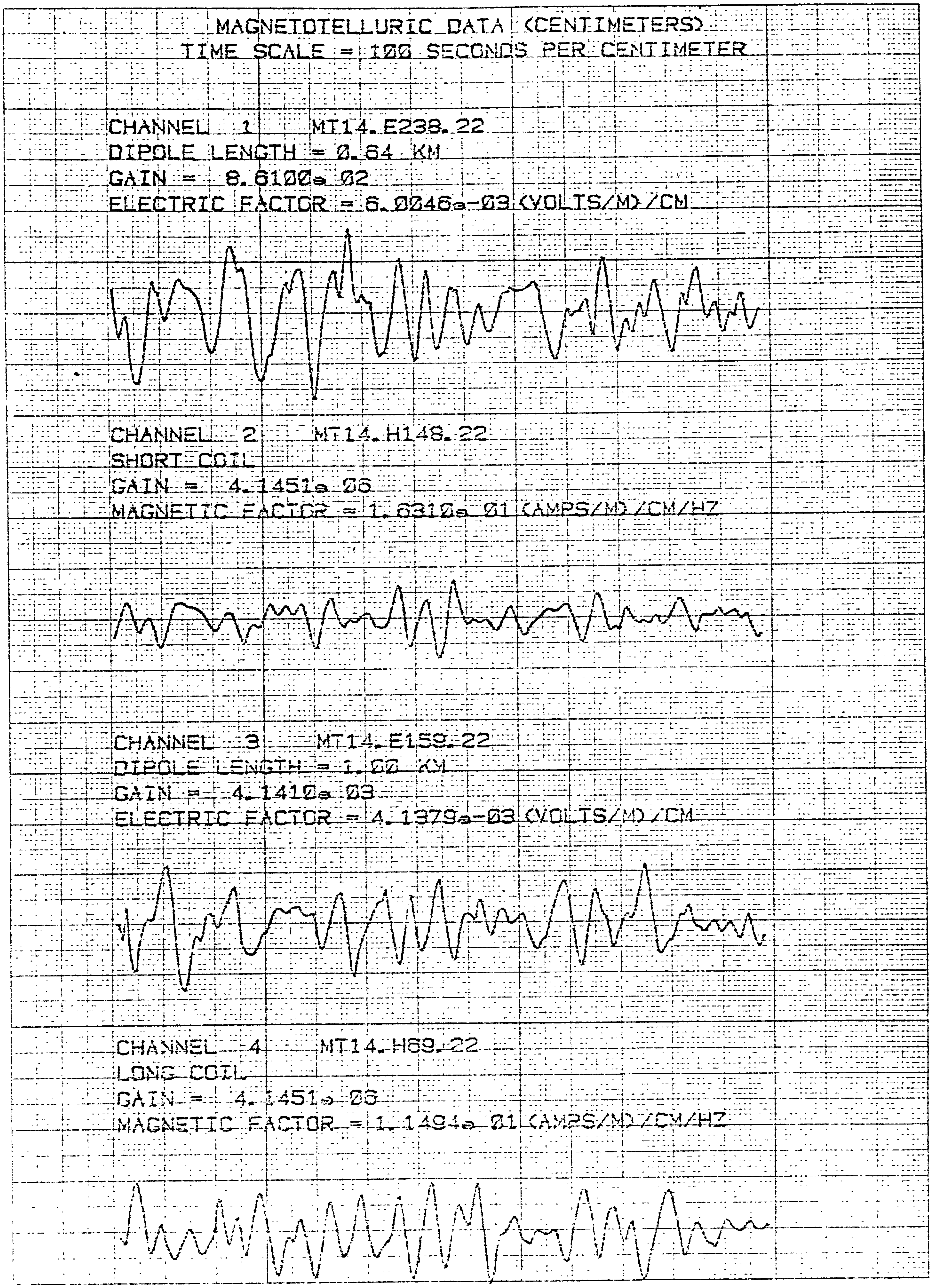


CHANNEL 3 MT14.E159.12
DIPOLE LENGTH = 1.00 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 4.1660e-03 (VOLTS/M)/CM



CHANNEL 4 MT14.H69.12
LONG COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.1308e 01 (AMPS/M)/CM/HZ





MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

CHANNEL 1 MT14.E238.22
DIPOLE LENGTH = 0.64 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 6.0046e-03 (VOLTS/M)/CM

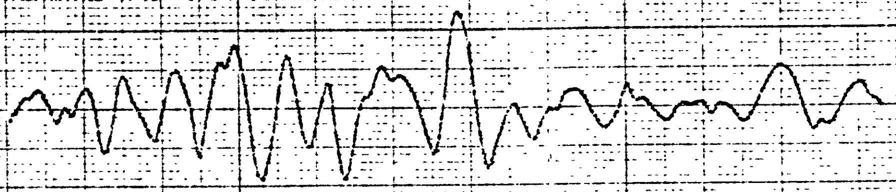
CHANNEL 2 MT14.H148.22
SHORT COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.6310e 01 (AMPS/M)/CM/HZ

CHANNEL 3 MT14.E159.22
DIPOLE LENGTH = 1.00 KM
GAIN = 4.1410e 03
ELECTRIC FACTOR = 4.1379e-03 (VOLTS/M)/CM

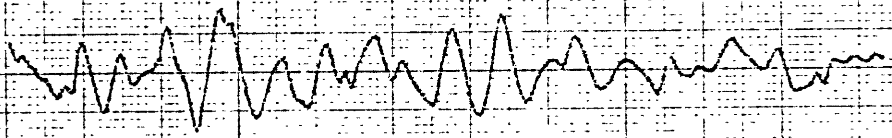
CHANNEL 4 MT14.H69.22
LONG COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.1494e 01 (AMPS/M)/CM/HZ

MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

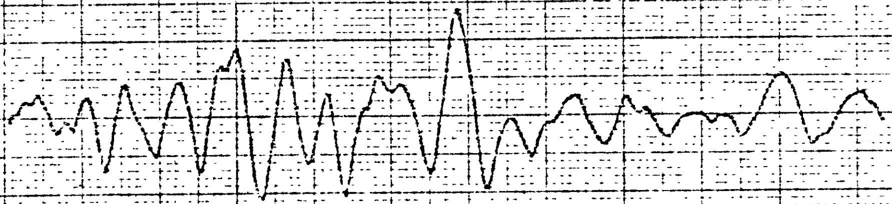
CHANNEL 1 MT18.E263.12
DIPOLE LENGTH = 0.80 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 4.7877e-03 (VOLTS/M)/CM



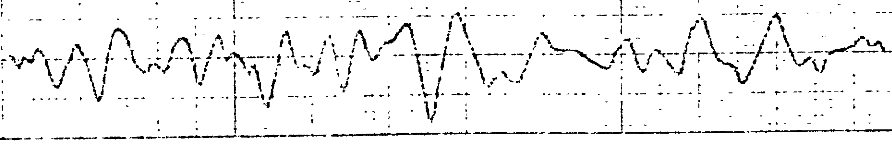
CHANNEL 2 MT18.H173.12
SHORT COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.6038e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT18.E328.12
DIPOLE LENGTH = 0.80 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 5.1122e-03 (VOLTS/M)/CM

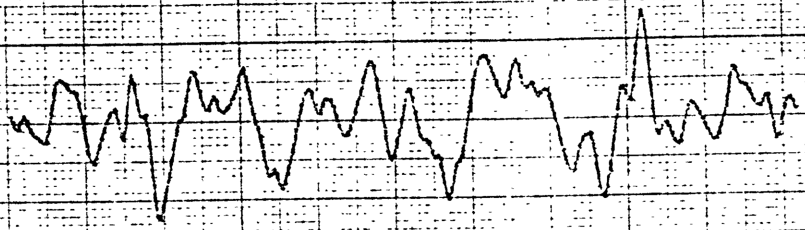


CHANNEL 4 MT18.H238.12
LONG COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.1265e 01 (AMPS/M)/CM/HZ

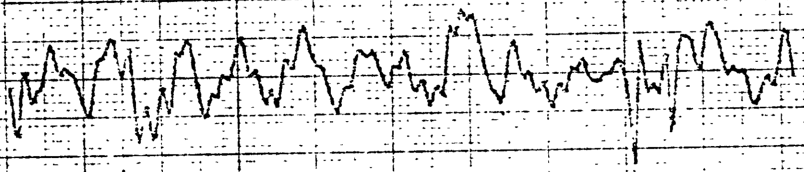


MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

CHANNEL 1 MT18.E263.22
DIPOLE LENGTH = 0.80 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 4.7877e-03 (VOLTS/M)/CM

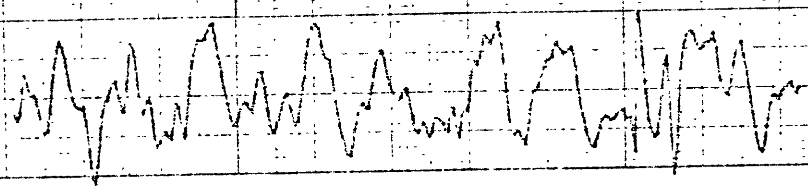


CHANNEL 2 MT18.H173.22
SHORT COIL
GAIN = 4.1451e 06
MAGNETIC FACTOR = 1.6052e 01 (AMPS/M)/CM/HZ



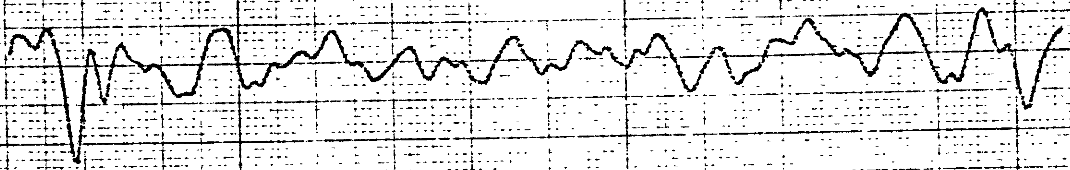
CHANNEL 3 MT18.E328.22
DIPOLE LENGTH = 0.80 KM
GAIN = 8.6100e 02
ELECTRIC FACTOR = 5.1080e-03 (VOLTS/M)/CM

CHANNEL 4 MT18.H238.22
LONG COIL
GAIN = 4.1451e 05
MAGNETIC FACTOR = 1.1331e 01 (AMPS/M)/CM/HZ

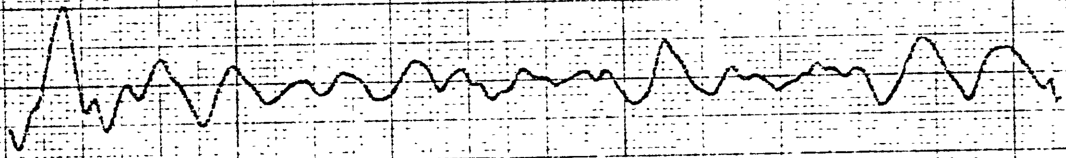


MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

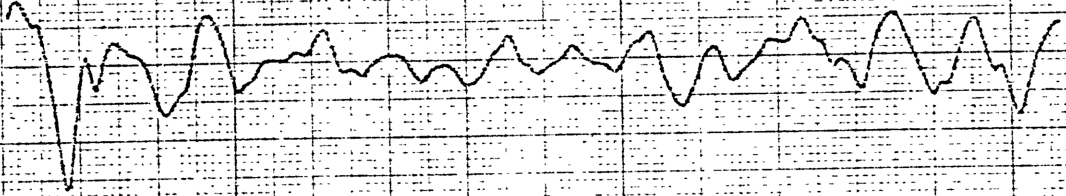
CHANNEL 1 MT19.E249.12
DIPOLE LENGTH = 1.08 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 3.5553e-03 (VOLTS/M)/CM



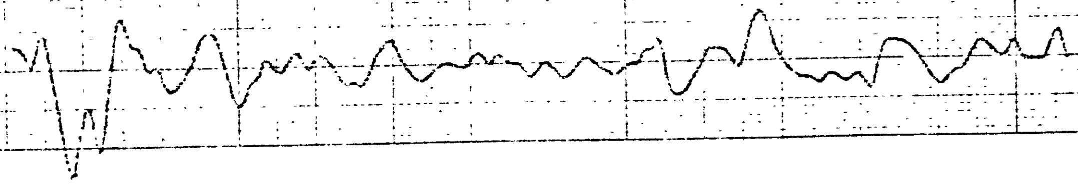
CHANNEL 2 MT19.H159.12
SHORT COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.5908e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT19.E143.12
DIPOLE LENGTH = 2.62 KM
GAIN = 4.4100e 02
ELECTRIC FACTOR = 6.6074e-03 (VOLTS/M)/CM



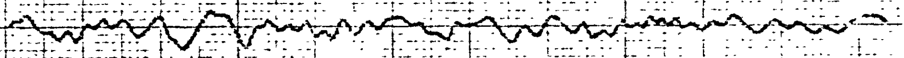
CHANNEL 4 MT19.H53.12
LONG COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.1275e 01 (AMPS/M)/CM/HZ



MAGNETOTELLURIC DATA (CENTIMETERS)
TIME SCALE = 100 SECONDS PER CENTIMETER

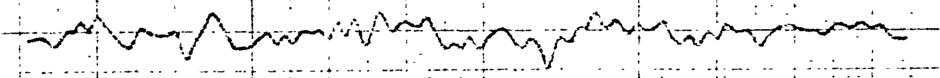
CHANNEL 1 MT19.E249.22
DIPOLE LENGTH = 1.08 KM
GAIN = 1.6810e 03
ELECTRIC FACTOR = 3.5405e-03 (VOLTS/M)/CM

CHANNEL 2 MT19.H159.22
SHORT COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.6012e 01 (AMPS/M)/CM/HZ



CHANNEL 3 MT19.E143.22
DIPOLE LENGTH = 0.62 KM
GAIN = 4.4100e 02
ELECTRIC FACTOR = 6.6129e-03 (VOLTS/M)/CM

CHANNEL 4 MT19.H53.22
LONG COIL
GAIN = 1.6827e 06
MAGNETIC FACTOR = 1.1312e 01 (AMPS/M)/CM/HZ



APPENDIX C

Output of Data Analysis Programs

DATA ANALYSIS STA. MT70-1

DATA FILE 2 SPECTRAL FILE 18 PAGE 1 OF 3

```
ENTER INPUT FILE
 NUMBER
2
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
64
H2 AZ          334
E3 DIPOLE AZ
160
H4 AZ           70

DIPOLE ROTATION
ALPHA         21.5
BETA          27.5
COIL ROTATION
ALPHA         27.5
BETA         201.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
               128
NYQUIST
FREQ =
      1.4133e-01
RAW DELTA f =
      2.2083e-03
SMOOTHED FOURIER
FREQ'S =        16
SMOOTHED DELTA f
F =    1.7667e-02
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =       0.014354
```

```
AUTOSPECTRUM OF
MT1.E64.12
CHANNEL NO.     1
0.014 2.5340E-12
0.032 9.4090E-13
0.050 2.3357E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.2733e-08
****************
AUTOSPECTRUM OF
MT1.H334.12
CHANNEL NO.     2
0.014 2.1805E-12
0.032 1.9168E-13
0.050 2.0286E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.5720e-09
****************
AUTOSPECTRUM OF
MT1.E160.12
CHANNEL NO.     3
0.014 8.8632E-11
0.032 9.3438E-12
0.050 9.0754E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.3843e-08
****************
AUTOSPECTRUM OF
MT1.H70.12
CHANNEL NO.     4
0.014 9.3629E-13
0.032 1.5726E-13
0.050 2.7345E-15
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.1125e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.014 2.1126E 03
0.032 1.9907E 04
0.050 7.2458E 04

CHANNELS 3 & 4
0.014 1.7210E 05
0.032 2.4097E 05
0.050 2.0886E 06
```

DATA ANALYSIS STA. MT78-1

DATA FILE 2 SPECTRAL FILE 18 PAGE 2 OF 3

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.12
CHANNEL NO.     1
WITH
MT1.H334.12
CHANNEL NO.     2
0.014 8.2126E-13
0.032 2.1683E-13
0.050 3.3135E-14
PHASE
0.014   162.3326
0.032   158.8660
0.050   109.2900
MAGNITUDE OF
COHERENCE
0.014     0.3494
0.032     0.5106
0.050     0.4814
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.E64.12
CHANNEL NO.     1
WITH
MT1.E160.12
CHANNEL NO.     3
0.014 1.1624E-11
0.032 2.2969E-12
0.050 2.7037E-13
PHASE
0.014    27.9723
0.032    56.6435
0.050    49.6671
MAGNITUDE OF
COHERENCE
0.014     0.7756
0.032     0.7746
0.050     0.5872
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.12
CHANNEL NO.     1
WITH
MT1.H70.12
CHANNEL NO.     4
0.014 4.9878E-13
0.032 6.5908E-14
0.050 6.4250E-15
PHASE
0.014    15.5488
0.032   348.2264
0.050   154.6426
MAGNITUDE OF
COHERENCE
0.014     0.3238
0.032     0.1713
0.050     0.2542
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.H334.12
CHANNEL NO.     2
WITH
MT1.E160.12
CHANNEL NO.     3
0.014 5.4806E-12
0.032 5.2391E-13
0.050 4.2257E-14
PHASE
0.014   251.4554
0.032   263.1350
0.050   248.4506
MAGNITUDE OF
COHERENCE
0.014     0.3942
0.032     0.3915
0.050     0.3114
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.H334.12
CHANNEL NO.     2
WITH
MT1.H70.12
CHANNEL NO.     4
0.014 1.0374E-12
0.032 5.2810E-14
0.050 3.8308E-15
PHASE
0.014   273.9387
0.032   321.8792
0.050    40.6495
MAGNITUDE OF
COHERENCE
0.014     0.7261
0.032     0.3042
0.050     0.5143
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E160.12
CHANNEL NO.     3
WITH
MT1.H70.12
CHANNEL NO.     4
0.014 5.0159E-12
0.032 7.0324E-13
0.050 1.6008E-14
PHASE
0.014   348.9981
0.032   303.9796
0.050   213.5429
MAGNITUDE OF
COHERENCE
0.014     0.5506
0.032     0.5801
0.050     0.3213
```

DATA ANALYSIS STA. MT70-1

DATA FILE 2 SPECTRAL FILE 18 PAGE 3 OF 3

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 2.2374E 03
0.032 2.6355E 03
0.050 4.6503E 02
PHASE
0.014   329.0596
0.032   325.7228
0.050   224.4360

Z[1,3,f]
0.014 1.0376E 03
0.032 7.2368E 03
0.050 1.6524E 04
PHASE
0.014   202.6339
0.032   162.8919
0.050   107.5408

Z[3,1,f]
0.014 1.0652E 05
0.032 1.1957E 05
0.050 3.0719E 05
PHASE
0.014   320.3867
0.032   294.2413
0.050   243.4348

Z[3,3,f]
0.014 2.2643E 04
0.032 5.8160E 04
0.050 3.9007E 04
PHASE
0.014   180.4500
0.032   115.8637
0.050    79.5566
```

```
SKEWNESS

0.014 3.2935E-01
0.032 4.8718E-01
0.050 2.7622E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0144    0.5806
0.0320    0.5994
0.0497    0.4820
PHASE
0.0144  360.0000
0.0320  360.0000
0.0497    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0144    0.6694
0.0320    0.7769
0.0497    0.4529
PHASE
0.0144  360.0000
0.0320    0.0000
0.0497    0.0000
****************
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.014         76
0.032         68
0.050         78
****************
ROTATED AZIMUTH

E1 (x')
0.014      118.5
0.032      110.5
0.050      120.5

H2 (y')
0.014      208.5
0.032      200.5
0.050      210.5

E3 (y')
0.014      208.5
0.032      200.5
0.050      210.5

H4 (x')
0.014      118.5
0.032      110.5
0.050      120.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 1.0561E 04
0.032 1.0693E 04
0.050 1.2555E 04
PHASE
0.014   211.8919
0.032   127.8262
0.050   103.7351

Z[f,1,3]
0.014 1.2050E 05
0.032 1.6371E 05
0.050 3.3312E 05
PHASE
0.014   144.6949
0.032   117.1660
0.050    64.7843

Z[f,3,1]
0.014 2.8813E 01
0.032 1.8720E 03
0.050 1.0593E 04
PHASE
0.014   113.4852
0.032    27.0194
0.050   290.9292

Z[f,3,3]
0.014 1.3419E 03
0.032 1.1325E 04
0.050 6.9119E 03
PHASE
0.014   128.1917
0.032    89.6590
0.050    57.1457
```

```
ENTER INPUT FILE
 NUMBER
2
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
64
H2 AZ        334
E3 DIPOLE AZ
160
H4 AZ         70

DIPOLE ROTATION
ALPHA       21.5
BETA        27.5
COIL ROTATION
ALPHA       27.5
BETA       201.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
.5
****************
N (ADJUSTED) =
             128
NYQUIST
FREQ =
      1.4133e-01
RAW DELTA f =
      2.2083e-03
SMOOTHED FOURIER
FREQ'S =      16
SMOOTHED DELTA f
F =   1.7667e-02
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.014354
```

```
AUTOSPECTRUM OF
MT1.E64.12
CHANNEL NO.    1
0.014 2.6650E-12
0.032 5.8806E-13
0.050 1.1234E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.2733e-08
****************
AUTOSPECTRUM OF
MT1.H334.12
CHANNEL NO.    2
0.014 1.9803E-12
0.032 3.0622E-13
0.050 2.7659E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.5720e-09
****************
AUTOSPECTRUM OF
MT1.E160.12
CHANNEL NO.    3
0.014 9.1605E-11
0.032 1.1072E-11
0.050 1.5058E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.3843e-08
****************
AUTOSPECTRUM OF
MT1.H70.12
CHANNEL NO.    4
0.014 8.1347E-13
0.032 1.4991E-13
0.050 1.2414E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.1125e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.014 2.4465E 03
0.032 7.7882E 03
0.050 2.5559E 04

CHANNELS 3 & 4
0.014 2.0472E 05
0.032 2.9954E 05
0.050 7.6333E 05
```

DATA FILE 2 SPECTRAL FILE 34 PAGE 2 OF 3

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.12
CHANNEL NO.     1
WITH
MT1.H334.12
CHANNEL NO.     2
0.014 1.0704E-12
0.032 3.0927E-13
0.050 8.4492E-15
PHASE
0.014   128.6583
0.032   134.2491
0.050   119.0546
MAGNITUDE OF
COHERENCE
0.014     0.4659
0.032     0.7288
0.050     0.1516
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.E64.12
CHANNEL NO.     1
WITH
MT1.E160.12
CHANNEL NO.     3
0.014 1.3473E-11
0.032 2.0536E-12
0.050 2.3181E-13
PHASE
0.014    39.4156
0.032    72.9386
0.050    88.6929
MAGNITUDE OF
COHERENCE
0.014     0.8623
0.032     0.8048
0.050     0.5636
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.12
CHANNEL NO.     1
WITH
MT1.H70.12
CHANNEL NO.     4
0.014 4.4191E-13
0.032 1.6350E-13
0.050 1.5763E-14
PHASE
0.014   357.9543
0.032    59.7893
0.050   134.3856
MAGNITUDE OF
COHERENCE
0.014     0.3001
0.032     0.5507
0.050     0.4221
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.H334.12
CHANNEL NO.     2
WITH
MT1.E160.12
CHANNEL NO.     3
0.014 5.3663E-12
0.032 1.0698E-12
0.050 1.0192E-13
PHASE
0.014   249.7981
0.032   299.4983
0.050   231.5671
MAGNITUDE OF
COHERENCE
0.014     0.3984
0.032     0.5810
0.050     0.4994
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.H334.12
CHANNEL NO.     2
WITH
MT1.H70.12
CHANNEL NO.     4
0.014 5.6849E-13
0.032 1.0811E-13
0.050 9.6623E-15
PHASE
0.014   261.8186
0.032   320.8231
0.050   326.3966
MAGNITUDE OF
COHERENCE
0.014     0.4479
0.032     0.5046
0.050     0.5214
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E160.12
CHANNEL NO.     3
WITH
MT1.H70.12
CHANNEL NO.     4
0.014 4.2002E-12
0.032 8.7111E-13
0.050 8.4053E-14
PHASE
0.014   339.9140
0.032   335.5097
0.050    84.9967
MAGNITUDE OF
COHERENCE
0.014     0.4866
0.032     0.6761
0.050     0.6148
```

DATA ANALYSIS STA. MT70-1

DATA FILE 2 SPECTRAL FILE 34 PAGE 3 OF 3

```
S NATURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 2.6103E 02
0.032 3.0885E 03
0.050 1.5103E 04
PHASE
0.014   315.8502
0.032    19.4923
0.050   143.5306

Z[1,3,f]
0.014 4.9600E 02
0.032 3.8931E 03
0.050 1.3301E 03
PHASE
0.014   140.2421
0.032   151.9803
0.050    31.4644

Z[3,1,f]
0.014 3.8923E 04
0.032 1.4384E 05
0.050 1.8760E 05
PHASE
0.014   324.1235
0.032   311.4944
0.050    77.9196

Z[3,3,f]
0.014 7.7826E 03
0.032 4.6882E 04
0.050 2.3705E 04
PHASE
0.014   138.6471
0.032    95.9861
0.050   145.0422
```

```
SKEWNESS

0.014 3.2839E-01
0.032 5.3799E-01
0.050 6.7709E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0144     0.5021
0.0320     0.8221
0.0497     0.4648
PHASE
0.0144   360.0000
0.0320   360.0000
0.0497   360.0000

COHERENCE OF
E3-pred & E3-obs
0.0144     0.5574
0.0320     0.8340
0.0497     0.6545
PHASE
0.0144   360.0000
0.0320     0.0000
0.0497   360.0000
****************
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.014          75
0.032          74
0.050         -89
****************
ROTATED AZIMUTH

E1 (x')
0.014       117.5
0.032       116.5
0.050       313.5

H2 (y')
0.014       207.5
0.032       206.5
0.050        43.5

E3 (y')
0.014       207.5
0.032       206.5
0.050        43.5

H4 (x')
0.014       117.5
0.032       116.5
0.050       313.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 1.4413E 03
0.032 1.8891E 04
0.050 2.2940E 04
PHASE
0.014   131.8408
0.032    75.2042
0.050   147.8979

Z[f,1,3]
0.014 4.4745E 04
0.032 1.6636E 05
0.050 1.8762E 05
PHASE
0.014   143.3686
0.032   128.9614
0.050   257.9897

Z[f,3,1]
0.014 6.5577E 01
0.032 2.5245E 03
0.050 1.3033E 03
PHASE
0.014   333.2140
0.032     3.9673
0.050   212.0665

Z[f,3,3]
0.014 1.2103E 03
0.032 1.0229E 04
0.050 1.5878E 04
PHASE
0.014   147.3896
0.032    92.9992
0.050   140.1310
```

DATA ANALYSIS STA. MT78-1

DATA FILE 3 SPECTRAL FILE 19 PAGE 1 OF 3

```
ENTER INPUT FILE
 NUMBER
3
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
64
H2 AZ         334
E3 DIPOLE AZ
160
H4 AZ          70

DIPOLE ROTATION
ALPHA        21.5
BETA         27.5
COIL ROTATION
ALPHA        27.5
BETA        201.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              128
NYQUIST
FREQ =
     1.4187e-01
RAW DELTA f =
     2.2167e-03
SMOOTHED FOURIER
FREQ'S =      16
SMOOTHED DELTA f
F =   1.7733e-02
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.014408
```

```
AUTOSPECTRUM OF
MT1.E64.22
CHANNEL NO.    1
0.014 1.5923E-12
0.032 3.9293E-13
0.050 2.6927E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      6.7998e-09
****************
AUTOSPECTRUM OF
MT1.H334.22
CHANNEL NO.    2
0.014 2.4501E-12
0.032 6.9636E-13
0.050 7.1681E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.5892e-09
****************
AUTOSPECTRUM OF
MT1.E160.22
CHANNEL NO.    3
0.014 8.4868E-11
0.032 7.4183E-12
0.050 2.8967E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      7.3615e-09
****************
AUTOSPECTRUM OF
MT1.H70.22
CHANNEL NO.    4
0.014 2.3978E-12
0.032 8.7701E-13
0.050 3.2554E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.1257e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.014 1.1859E 03
0.032 2.2970E 03
0.050 2.3729E 03

CHANNELS 3 & 4
0.014 6.4568E 04
0.032 3.4433E 04
0.050 5.6207E 04
```

DATA ANALYSIS STA. MT78-1

DATA FILE 3 SPECTRAL FILE 19 PAGE 2 OF 3

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.22
CHANNEL NO.     1
WITH
MT1.H334.22
CHANNEL NO.     2
0.014 9.5084E-13
0.032 7.0320E-14
0.050 3.9299E-13
PHASE
0.014   134.9111
0.032   292.6801
0.050   188.6999
MAGNITUDE OF
COHEPENCE
0.014     0.4814
0.032     0.1344
0.050     0.8945
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.E64.22
CHANNEL NO.     1
WITH
MT1.E160.22
CHANNEL NO.     3
0.014 1.0974E-11
0.032 1.4017E-12
0.050 7.9361E-13
PHASE
0.014    37.8594
0.032    60.1182
0.050    76.7429
MAGNITUDE OF
COHERENCE
0.014     0.9440
0.032     0.8210
0.050     0.8986
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.22
CHANNEL NO.     1
WITH
MT1.H70.22
CHANNEL NO.     4
0.014 1.3056E-12
0.032 1.9725E-13
0.050 2.3838E-13
PHASE
0.014    38.4424
0.032    11.9680
0.050    60.2483
MAGNITUDE OF
COHERENCE
0.014     0.6682
0.032     0.3360
0.050     0.8051
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.H334.22
CHANNEL NO.     2
WITH
MT1.E160.22
CHANNEL NO.     3
0.014 7.4291E-12
0.032 8.5045E-13
0.050 1.1052E-12
PHASE
0.014   265.9383
0.032    57.1826
0.050   247.1248
MAGNITUDE OF
COHERENCE
0.014     0.5152
0.032     0.3742
0.050     0.7670
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.H334.22
CHANNEL NO.     2
WITH
MT1.H70.22
CHANNEL NO.     4
0.014 1.2071E-12
0.032 5.5982E-13
0.050 3.8383E-13
PHASE
0.014   247.9366
0.032   319.4594
0.050   226.1143
MAGNITUDE OF
COHERENCE
0.014     0.4980
0.032     0.7164
0.050     0.7946
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E160.22
CHANNEL NO.     3
WITH
MT1.H70.22
CHANNEL NO.     4
0.014 1.0344E-11
0.032 1.2055E-12
0.050 8.0258E-13
PHASE
0.014   357.5051
0.032   290.5872
0.050   348.7438
MAGNITUDE OF
COHERENCE
0.014     0.7251
0.032     0.4726
0.050     0.8265
```

DATA ANALYSIS STA. MT78-1

DATA FILE 3 SPECTRAL FILE 19 PAGE 3 OF 3

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 4.1864E 02
0.032 1.1879E 03
0.050 5.4005E 02
PHASE
0.014     46.8275
0.032     24.2449
0.050     94.8520

Z[1,3,f]
0.014 7.1063E 01
0.032 1.0487E 03
0.050 1.2233E 03
PHASE
0.014    105.8332
0.032    253.2740
0.050    175.4692

Z[3,1,f]
0.014 2.6626E 04
0.032 1.0483E 04
0.050 2.5511E 04
PHASE
0.014      5.6734
0.032    318.8322
0.050     13.3072

Z[3,3,f]
0.014 4.1669E 03
0.032 5.7772E 03
0.050 5.0185E 03
PHASE
0.014     64.0559
0.032    238.1790
0.050     69.9814
```

```
SKEWNESS

0.014 5.1139E-01
0.032 5.4582E-01
0.050 4.7821E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0144    0.7011
0.0321    0.5789
0.0499    0.9156
PHASE
0.0144  360.0000
0.0321    0.0000
0.0499    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0144    0.7586
0.0321    0.5369
0.0499    0.8692
PHASE
0.0144  360.0000
0.0321    0.0000
0.0499  360.0000
****************
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.014          -86
0.032          -74
0.050          -81
****************
ROTATED AZIMUTH

E1 (x')
0.014        316.5
0.032        328.5
0.050        321.5

H2 (y')
0.014         46.5
0.032         58.5
0.050         51.5

E3 (y')
0.014         46.5
0.032         58.5
0.050         51.5

H4 (x')
0.014        316.5
0.032        328.5
0.050        321.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 3.4429E 03
0.032 3.8244E 03
0.050 3.5522E 03
PHASE
0.014     73.1251
0.032    211.7335
0.050     85.2061

Z[f,1,3]
0.014 2.6796E 04
0.032 9.3331E 03
0.050 2.6309E 04
PHASE
0.014    186.6702
0.032    123.2592
0.050    195.1910

Z[f,3,1]
0.014 1.2520E 02
0.032 3.0876E 03
0.050 1.2124E 03
PHASE
0.014    280.7539
0.032     53.0359
0.050    345.8669

Z[f,3,3]
0.014 9.1828E 02
0.032 2.2518E 03
0.050 1.2190E 03
PHASE
0.014     33.7115
0.032    337.8338
0.050     60.2896
```

DATA ANALYSIS STA. MT78-1

DATA FILE 3 SPECTRAL FILE 35 PAGE 1 OF 3

```
ENTER INPUT FILE
 NUMBER
3
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
64
H2 AZ         334
E3 DIPOLE AZ
160
H4 AZ          70

DIPOLE ROTATION
ALPHA        21.5
BETA         27.5
COIL ROTATION
ALPHA        27.5
BETA        201.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
.5
****************
N (ADJUSTED) =
              128
NYQUIST
FREQ =
      1.4187e-01
RAW DELTA f =
      2.2167e-03
SMOOTHED FOURIER
FREQ'S =       16
SMOOTHED DELTA f
F =   1.7733e-02
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.014408
```

```
AUTOSPECTRUM OF
MT1.E64.22
CHANNEL NO.    1
0.014 1.0846E-12
0.032 5.8717E-13
0.050 2.2346E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      6.7998e-09
****************
AUTOSPECTRUM OF
MT1.H334.22
CHANNEL NO.    2
0.014 2.4283E-12
0.032 1.1156E-12
0.050 7.5363E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.5892e-09
****************
AUTOSPECTRUM OF
MT1.E160.22
CHANNEL NO.    3
0.014 6.8598E-11
0.032 1.0210E-11
0.050 2.8773E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      7.3615e-09
****************
AUTOSPECTRUM OF
MT1.H70.22
CHANNEL NO.    4
0.014 2.2995E-12
0.032 8.9202E-13
0.050 3.0610E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.1257e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.014 8.1509E 02
0.032 2.1426E 03
0.050 1.8730E 03

CHANNELS 3 & 4
0.014 5.4437E 04
0.032 4.6592E 04
0.050 5.9377E 04
```

DATA ANALYSIS STA. MT78-1

DATA FILE 3 SPECTRAL FILE 35 PAGE 2 OF 3

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.22
CHANNEL NO.     1
WITH
MT1.H334.22
CHANNEL NO.     2
0.014 1.0073E-12
0.032 5.1121E-13
0.050 3.4475E-13
PHASE
0.014     152.4366
0.032     198.3142
0.050     180.9344
MAGNITUDE OF
COHERENCE
0.014       0.6207
0.032       0.6316
0.050       0.8401
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.E64.22
CHANNEL NO.     1
WITH
MT1.E160.22
CHANNEL NO.     3
0.014 8.1647E-12
0.032 2.2173E-12
0.050 6.7715E-13
PHASE
0.014      42.3615
0.032      68.5254
0.050      84.3775
MAGNITUDE OF
COHERENCE
0.014       0.9465
0.032       0.9056
0.050       0.8445
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E64.22
CHANNEL NO.     1
WITH
MT1.H70.22
CHANNEL NO.     4
0.014 6.2489E-13
0.032 1.6722E-13
0.050 2.0758E-13
PHASE
0.014      49.1636
0.032       7.2849
0.050      69.0201
MAGNITUDE OF
COHERENCE
0.014       0.3957
0.032       0.2311
0.050       0.7937
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.H334.22
CHANNEL NO.     2
WITH
MT1.E160.22
CHANNEL NO.     3
0.014 8.1933E-12
0.032 1.3310E-12
0.050 1.2066E-12
PHASE
0.014     251.9854
0.032     238.3203
0.050     264.3389
MAGNITUDE OF
COHERENCE
0.014       0.6348
0.032       0.3944
0.050       0.8194
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT1.H334.22
CHANNEL NO.     2
WITH
MT1.H70.22
CHANNEL NO.     4
0.014 1.3514E-12
0.032 5.4505E-13
0.050 3.3955E-13
PHASE
0.014     246.8215
0.032     276.2026
0.050     240.9816
MAGNITUDE OF
COHERENCE
0.014       0.5719
0.032       0.5464
0.050       0.7070
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT1.E160.22
CHANNEL NO.     3
WITH
MT1.H70.22
CHANNEL NO.     4
0.014 6.2584E-12
0.032 8.6015E-13
0.050 6.5502E-13
PHASE
0.014     354.8421
0.032     269.9071
0.050     347.2418
MAGNITUDE OF
COHERENCE
0.014       0.4983
0.032       0.2850
0.050       0.6979
```

DATA ANALYSIS STA. MT78-1

DATA FILE 3 SPECTRAL FILE 35 PAGE 3 OF 3

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 1.1110E 01
0.032 1.1966E 03
0.050 8.6890E 02
PHASE
0.014   102.1664
0.032   322.6022
0.050    88.7926

Z[1,3,f]
0.014 2.8751E 02
0.032 2.0123E 03
0.050 6.3686E 02
PHASE
0.014   146.8474
0.032   208.5308
0.050   167.1709

Z[3,1,f]
0.014 2.1987E 03
0.032 1.9247E 04
0.050 6.6169E 03
PHASE
0.014   354.8580
0.032   247.7732
0.050    26.8910

Z[3,3,f]
0.014 1.3933E 04
0.032 1.9336E 04
0.050 1.1570E 04
PHASE
0.014   108.0097
0.032   135.7385
0.050    80.4748
```

```
SKEWNESS

0.014 1.9457E 00
0.032 9.7216E-01
0.050 1.3407E 00
****************
COHERENCE OF
E1-pred & E1-obs
0.0144    0.6276
0.0321    0.8439
0.0499    0.8944
PHASE
0.0144    0.0000
0.0321  360.0000
0.0499    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0144    0.6559
0.0321    0.6673
0.0499    0.8527
PHASE
0.0144    0.0000
0.0321  360.0000
0.0499    0.0000
****************
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.014          46
0.032          68
0.050         -64
****************
ROTATED AZIMUTH

E1 (x')
0.014        88.5
0.032       110.5
0.050       338.5

H2 (y')
0.014       178.5
0.032       200.5
0.050        68.5

E3 (y')
0.014       178.5
0.032       200.5
0.050        68.5

H4 (x')
0.014        88.5
0.032       110.5
0.050       338.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.014 3.8768E 03
0.032 1.3729E 04
0.050 5.5928E 03
PHASE
0.014    92.7436
0.032   165.9550
0.050    93.3658

Z[f,1,3]
0.014 6.1264E 03
0.032 2.2043E 04
0.050 9.3756E 03
PHASE
0.014   128.6654
0.032    91.7562
0.050   220.0028

Z[f,3,1]
0.014 2.4134E 03
0.032 2.0246E 03
0.050 1.4958E 03
PHASE
0.014    75.8660
0.032   113.0503
0.050   314.3804

Z[f,3,3]
0.014 4.0140E 03
0.032 3.9940E 03
0.050 4.2288E 03
PHASE
0.014   122.6890
0.032    48.8745
0.050    69.4641
```

DATA FILE 4 SPECTRAL FILE 20 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
4
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
99
H2 AZ           9
E3 DIPOLE AZ
340
H4 AZ         250

DIPOLE ROTATION
ALPHA        56.5
BETA        207.5
COIL ROTATION
ALPHA       207.5
BETA       -123.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
      1.4187e-01
RAW DELTA f =
      1.1083e-03
SMOOTHED FOURIER
FREQ'S =       32
SMOOTHED DELTA f
F =   8.8667e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009421
```

```
AUTOSPECTRUM OF
MT2.E99.13
CHANNEL NO.     1
0.009 8.8305E-12
0.018 9.4756E-12
0.027 2.1393E-12
0.036 8.4233E-13
0.045 1.8284E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      6.0875e-09
****************
AUTOSPECTRUM OF
MT2.H9.13
CHANNEL NO.     2
0.009 1.6949E-11
0.018 1.2361E-11
0.027 1.3817E-11
0.036 1.1469E-11
0.045 9.0639E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.8861e-08
****************
AUTOSPECTRUM OF
MT2.E340.13
CHANNEL NO.     3
0.009 2.2268E-10
0.018 5.5222E-10
0.027 1.2968E-10
0.036 8.3161E-11
0.045 1.4277E-11
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.6762e-08
****************
AUTOSPECTRUM OF
MT2.H250.13
CHANNEL NO.     4
0.009 1.4143E-11
0.018 7.1969E-11
0.027 1.9924E-11
0.036 1.7453E-11
0.045 1.9163E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.3325e-08
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.009 6.2164E 02
0.018 1.7754E 03
0.027 5.3246E 02
0.036 3.3506E 02
0.045 1.1468E 02

CHANNELS 3 & 4
0.009 1.8787E 04
0.018 1.7772E 04
0.027 2.2385E 04
0.036 2.1738E 04
0.045 4.2354E 04
```

```
ORTHOGONAL            COLINEAR              SINGLE-CHANNEL
E(t) and H(t)         E(t) and H(t)         CROSS-SPECTRUM
CROSS-SPECTRUM        CROSS-SPECTRUM        OF
OF                    OF                    MT2.H9.13
MT2.E99.13            MT2.E99.13            CHANNEL NO.      2
CHANNEL NO.      1    CHANNEL NO.      1    WITH
WITH                  WITH                  MT2.H250.13
MT2.H9.13             MT2.H250.13           CHANNEL NO.      4
CHANNEL NO.      2    CHANNEL NO.      4    0.009 6.0452E-12
0.009 3.9577E-12      0.009 8.2499E-12      0.018 1.0229E-11
0.018 4.1175E-12      0.018 2.4316E-11      0.027 6.2119E-12
0.027 2.0334E-12      0.027 5.7544E-12      0.036 8.5513E-12
0.036 1.3232E-12      0.036 3.5608E-12      0.045 3.1258E-12
0.045 3.1955E-13      0.045 2.1069E-13      PHASE
PHASE                 PHASE                 0.009    270.8650
0.009    245.5408     0.009    137.7565     0.018    311.8419
0.018    173.9717     0.018    155.9997     0.027     75.3714
0.027     56.8830     0.027    144.6884     0.036     76.6182
0.036     84.3931     0.036    176.0426     0.045    131.0795
0.045     96.2629     0.045    183.8302     MAGNITUDE OF
MAGNITUDE OF          MAGNITUDE OF          COHERENCE
COHERENCE             COHERENCE             0.009      0.3905
0.009      0.3235     0.009      0.7382     0.018      0.3429
0.018      0.3804     0.018      0.9311     0.027      0.3744
0.027      0.3740     0.027      0.8814     0.036      0.6044
0.036      0.4257     0.036      0.9287     0.045      0.7500
0.045      0.2482     0.045      0.3559     ****************
****************      ****************      ORTHOGONAL
SINGLE-CHANNEL        COLINEAR              E(t) and H(t)
CROSS-SPECTRUM        E(t) and H(t)         CROSS-SPECTRUM
OF                    CROSS-SPECTRUM        OF
MT2.E99.13            OF                    MT2.E340.13
CHANNEL NO.      1    MT2.H9.13             CHANNEL NO.      3
WITH                  CHANNEL NO.      2    WITH
MT2.E340.13           WITH                  MT2.H250.13
CHANNEL NO.      3    MT2.E340.13           CHANNEL NO.      4
0.009 3.1284E-11      CHANNEL NO.      3    0.009 5.0151E-11
0.018 6.5393E-11      0.009 2.7911E-11      0.018 1.9764E-10
0.027 1.4731E-11      0.018 2.6628E-11      0.027 4.7555E-11
0.036 7.8882E-12      0.027 2.0277E-11      0.036 3.6711E-11
0.045 6.2889E-13      0.036 2.0061E-11      0.045 4.6913E-12
PHASE                 0.045 8.8912E-12      PHASE
0.009    168.6134     PHASE                 0.009    329.1991
0.018    164.5046     0.009    280.7594     0.018    351.2042
0.027    166.8185     0.018    319.1158     0.027    336.0210
0.036    176.6524     0.027    126.1857     0.036    356.9787
0.045    171.9531     0.036     88.2309     0.045     25.4185
MAGNITUDE OF          0.045    113.4987     MAGNITUDE OF
COHERENCE             MAGNITUDE OF          COHERENCE
0.009      0.7055     COHERENCE             0.009      0.8937
0.018      0.9040     0.009      0.4543     0.018      0.9914
0.027      0.8844     0.018      0.3223     0.027      0.9355
0.036      0.9425     0.027      0.4790     0.036      0.9636
0.045      0.3893     0.036      0.6496     0.045      0.8969
                      0.045      0.7816
```

DATA ANALYSIS STA. MT78-2

DATA FILE 4 SPECTRAL FILE 20 PAGE 3 OF 4

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 3.9848E 02
0.018 2.6398E 02
0.027 2.7742E 02
0.036 2.5533E 02
0.045 1.8490E 02
PHASE
0.009   134.0203
0.018   160.5830
0.027   147.0068
0.036   181.6460
0.045   153.7058

Z[1,3,f]
0.009 9.5500E 00
0.018 8.3649E 01
0.027 5.5650E 00
0.036 2.8899E 01
0.045 2.2033E 01
PHASE
0.009   306.8725
0.018   117.0100
0.027     2.9540
0.036   315.7481
0.045   169.7122

Z[3,1,f]
0.009 1.3963E 04
0.018 1.7712E 04
0.027 1.8409E 04
0.036 1.8053E 04
0.045 2.3535E 04
PHASE
0.009   324.2293
0.018   351.0133
0.027   341.9804
0.036     2.7990
0.045    39.6088

Z[3,3,f]
0.009 6.9785E 02
0.018 5.1883E 01
0.027 2.3013E 03
0.036 1.0675E 03
0.045 1.0147E 03
PHASE
0.009   123.3703
0.018   193.6926
0.027   190.2885
0.036   222.0284
0.045   207.9702
```

```
SKEWNESS

0.009 4.0082E-01
0.018 1.6318E-01
0.027 4.5830E-01
0.036 3.5198E-01
0.045 2.6393E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0094    0.7470
0.0183    0.9532
0.0272    0.8865
0.0360    0.9577
0.0449    0.4591
PHASE
0.0094  360.0000
0.0183  360.0000
0.0272    0.0000
0.0360  360.0000
0.0449    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0094    0.9145
0.0183    0.9916
0.0272    0.9678
0.0360    0.9742
0.0449    0.9241
PHASE
0.0094    0.0000
0.0183  360.0000
0.0272  360.0000
0.0360  360.0000
0.0449    0.0000
```

DATA ANALYSIS STA. MT78-2

DATA FILE 4 SPECTRAL FILE 20 PAGE 4 OF 4

```
OPTIMUM AXES          ROTATED
(CW ANGLE OF          IMPEDANCE TENSOR
ROTATION)             (RESISTIVITIES)

0.009           89    Z[1,1,f]
0.018          -88    0.009 5.9757E 02
0.027           84    0.018 1.3264E 02
0.036           88    0.027 1.2629E 03
0.045           85    0.036 8.5119E 02
****************      0.045 3.6811E 02
ROTATED AZIMUTH       PHASE
                      0.009   121.6441
E1 (x')               0.018   186.2585
0.009        131.5    0.027   200.9837
0.018        314.5    0.036   228.2034
0.027        126.5    0.045   198.9039
0.036        130.5
0.045        127.5    Z[f,1,3]
                      0.009 1.3975E 04
H2 (y')               0.018 1.7757E 04
0.009        221.5    0.027 1.8747E 04
0.018         44.5    0.036 1.8096E 04
0.027        216.5    0.045 2.3869E 04
0.036        220.5    PHASE
0.045        217.5    0.009   144.1799
                      0.018   170.9237
E3 (y')               0.027   163.1535
0.009        221.5    0.036   183.1128
0.018         44.5    0.045   219.7914
0.027        216.5
0.036        220.5    Z[f,3,1]
0.045        217.5    0.009 1.0052E 01
                      0.018 7.8809E 01
H4 (x')               0.027 2.4960E 01
0.009        131.5    0.036 2.4823E 01
0.018        314.5    0.045 2.0430E 01
0.027        126.5    PHASE
0.036        130.5    0.009   125.3861
0.045        127.5    0.018   296.9133
                      0.027   208.8727
                      0.036   142.8640
                      0.045   335.0154

                      Z[f,3,3]
                      0.009 4.8619E 02
                      0.018 1.4275E 02
                      0.027 9.5845E 02
                      0.036 4.3288E 02
                      0.045 4.9891E 02
                      PHASE
                      0.009   134.9487
                      0.018   155.5151
                      0.027   154.7059
                      0.036   181.6059
                      0.045   186.9440
```

DATA FILE 5 SPECTRAL FILE 21 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
5
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
99
H2 AZ           9
E3 DIPOLE AZ
340
H4 AZ         250

DIPOLE ROTATION
ALPHA        56.5
BETA        207.5
COIL ROTATION
ALPHA       207.5
BETA       -123.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
       1.4773e-01
RAW DELTA f =
       1.1542e-03
SMOOTHED FOURIER
FREQ'S =       32
SMOOTHED DELTA f
F =    9.2333e-03
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009810
```

```
AUTOSPECTRUM OF
MT2.E99.23
CHANNEL NO.    1
0.010 1.5991E-11
0.019 4.5161E-11
0.028 2.0614E-11
0.038 4.1358E-12
0.047 2.5497E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
       3.1312e-09
****************
AUTOSPECTRUM OF
MT2.H9.23
CHANNEL NO.    2
0.010 3.7204E-11
0.019 1.4998E-10
0.028 9.1381E-11
0.038 2.3814E-11
0.047 2.1552E-11
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
       9.6521e-09
****************
AUTOSPECTRUM OF
MT2.E340.33
CHANNEL NO.    3
0.010 1.6408E-10
0.019 3.8325E-10
0.028 1.4488E-10
0.038 5.6846E-11
0.047 1.7125E-11
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
       1.3995e-08
****************
AUTOSPECTRUM OF
MT2.H250.23
CHANNEL NO.    4
0.010 7.7413E-12
0.019 5.1038E-11
0.028 2.2505E-11
0.038 1.1780E-11
0.047 1.9946E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
       6.8022e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 5.3405E 02
0.019 7.2624E 02
0.028 8.0790E 02
0.038 8.2506E 02
0.047 7.0038E 02

CHANNELS 3 & 4
0.010 2.6335E 04
0.019 1.8111E 04
0.028 2.3055E 04
0.038 2.2935E 04
0.047 5.0829E 04
```

DATA ANALYSIS STA. MT78-2

DATA FILE 5 SPECTRAL FILE 21 PAGE 2 OF 4

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.E99.23
CHANNEL NO.     1
WITH
MT2.H9.23
CHANNEL NO.     2
0.010 1.4620E-11
0.019 7.0350E-11
0.028 3.6868E-11
0.038 7.9087E-12
0.047 5.8878E-12
PHASE
0.010   125.0228
0.019   157.5055
0.028   172.0071
0.038   209.1695
0.047   208.8515
MAGNITUDE OF
COHERENCE
0.010     0.5994
0.019     0.8548
0.028     0.8494
0.038     0.7969
0.047     0.7943
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT2.E99.23
CHANNEL NO.     1
WITH
MT2.E340.33
CHANNEL NO.     3
0.010 3.6747E-11
0.019 9.0795E-11
0.028 4.3445E-11
0.038 1.0621E-11
0.047 4.5527E-12
PHASE
0.010   265.8769
0.019   156.9778
0.028   121.9618
0.038   125.4952
0.047   154.7766
MAGNITUDE OF
COHERENCE
0.010     0.7174
0.019     0.6901
0.028     0.7950
0.038     0.6927
0.047     0.6890
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.E99.23
CHANNEL NO.     1
WITH
MT2.H250.23
CHANNEL NO.     4
0.010 3.4803E-12
0.019 1.8768E-11
0.028 1.6176E-11
0.038 3.9454E-12
0.047 1.5064E-12
PHASE
0.010   223.9075
0.019   114.8427
0.028    84.1652
0.038    96.8722
0.047   101.7003
MAGNITUDE OF
COHERENCE
0.010     0.3128
0.019     0.3909
0.028     0.7510
0.038     0.5652
0.047     0.6680
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.H9.23
CHANNEL NO.     2
WITH
MT2.E340.33
CHANNEL NO.     3
0.010 6.8200E-12
0.019 1.2163E-10
0.028 6.1636E-11
0.038 2.1799E-11
0.047 5.1707E-12
PHASE
0.010   175.4341
0.019   355.4241
0.028   304.1300
0.038   271.2894
0.047   324.3432
MAGNITUDE OF
COHERENCE
0.010     0.0873
0.019     0.5073
0.028     0.5357
0.038     0.5925
0.047     0.2691
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT2.H9.23
CHANNEL NO.     2
WITH
MT2.H250.23
CHANNEL NO.     4
0.010 1.1090E-12
0.019 3.1014E-11
0.028 2.2460E-11
0.038 7.3604E-12
0.047 1.6599E-12
PHASE
0.010   327.2592
0.019   318.8836
0.028   273.6686
0.038   258.9864
0.047   228.8364
MAGNITUDE OF
COHERENCE
0.010     0.0653
0.019     0.3545
0.028     0.4953
0.038     0.4394
0.047     0.2532
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.E340.33
CHANNEL NO.     3
WITH
MT2.H250.23
CHANNEL NO.     4
0.010 2.1416E-11
0.019 1.2170E-10
0.028 5.3523E-11
0.038 2.2982E-11
0.047 4.6377E-12
PHASE
0.010   326.8003
0.019   336.6352
0.028   329.2719
0.038   345.2677
0.047   332.8814
MAGNITUDE OF
COHERENCE
0.010     0.6009
0.019     0.8702
0.028     0.9374
0.038     0.8881
0.047     0.7935
```

DATA ANALYSIS STA. MT78-2

DATA FILE 5 SPECTRAL FILE 21 PAGE 3 OF 4

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 2.9939E 02
0.019 2.1821E 01
0.028 6.2973E 02
0.038 1.3807E 02
0.047 2.0843E 03
PHASE
0.010   228.8462
0.019   109.5361
0.028    82.2434
0.038    79.7053
0.047   111.2908

Z[1,3,f]
0.010 2.0250E 02
0.019 4.8740E 02
0.028 3.2369E 02
0.038 3.9097E 02
0.047 3.3108E 02
PHASE
0.010   123.5949
0.019   157.8046
0.028   173.1831
0.038   214.1893
0.047   202.7121

Z[3,1,f]
0.010 9.7734E 03
0.019 1.1486E 04
0.028 1.8282E 04
0.038 1.3890E 04
0.047 3.4499E 04
PHASE
0.010   326.8475
0.019   340.0102
0.028   329.1666
0.038   344.2608
0.047   337.5943

Z[3,3,f]
0.010 8.8373E 01
0.019 3.8527E 02
0.028 5.0938E 01
0.038 7.1939E 02
0.047 3.9188E 02
PHASE
0.010   183.0074
0.019   345.8147
0.028    57.6022
0.038    93.3796
0.047   351.9123
```

```
SKEWNESS

0.010 2.2117E-01
0.019 1.3520E-01
0.028 2.0894E-01
0.038 2.9165E-01
0.047 2.0034E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0098    0.6895
0.0190    0.8600
0.0283    0.9308
0.0375    0.8378
0.0467    0.9427
PHASE
0.0098  360.0000
0.0190    0.0000
0.0283  360.0000
0.0375    0.0000
0.0467  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0098    0.6141
0.0190    0.9011
0.0283    0.9410
0.0375    0.9165
0.0467    0.8412
PHASE
0.0098    0.0000
0.0190  360.0000
0.0283  360.0000
0.0375  360.0000
0.0467    0.0000
```

DATA ANALYSIS STA. MT78-2

DATA FILE 5 SPECTRAL FILE 21 PAGE 4 OF 4

```
OPTIMUM AXES                ROTATED
(CW ANGLE OF                IMPEDANCE TENSOR
ROTATION)                   (RESISTIVITIES)

0.010           89          Z[1,1,f]
0.019          -83          0.010 6.6832E 01
0.028          -87          0.019 8.2810E 01
0.038           87          0.028 9.3652E 01
0.047          -81          0.038 6.1161E 02
****************            0.047 1.3438E 02
ROTATED AZIMUTH             PHASE
                            0.010   188.6788
E1 (x')                     0.019   352.1026
0.010        131.5          0.028    97.7879
0.019        319.5          0.038    81.8575
0.028        315.5          0.047   116.7881
0.038        129.5
0.047        321.5          Z[f,1,3]
                            0.010 9.7861E 03
H2 (y')                     0.019 1.1801E 04
0.010        221.5          0.028 1.8336E 04
0.019         49.5          0.038 1.3917E 04
0.028         45.5          0.047 3.5868E 04
0.038        219.5          PHASE
0.047         51.5          0.010   146.7294
                            0.019   159.9003
E3 (y')                     0.028   148.8223
0.010        221.5          0.038   163.9346
0.019         49.5          0.047   156.3756
0.028         45.5
0.038        219.5          Z[f,3,1]
0.047         51.5          0.010 1.9857E 02
                            0.019 4.2490E 02
H4 (x')                     0.028 3.2976E 02
0.010        131.5          0.038 4.0889E 02
0.019        319.5          0.047 3.7158E 02
0.028        315.5          PHASE
0.038        129.5          0.010   304.2534
0.047        321.5          0.019   338.2274
                            0.028   355.7844
                            0.038    35.6595
                            0.047    38.9717

                            Z[f,3,3]
                            0.010 3.1210E 02
                            0.019 7.2180E 01
                            0.028 5.2644E 02
                            0.038 2.0085E 02
                            0.047 9.3264E 02
                            PHASE
                            0.010   224.0707
                            0.019     5.6916
                            0.028    68.1960
                            0.038   102.1550
                            0.047    74.3335
```

DATA ANALYSIS STA. MT78-2

DATA FILE 6 SPECTRAL FILE 22 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
6
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
99
H2 AZ          9
E3 DIPOLE AZ
340
H4 AZ        250

DIPOLE ROTATION
ALPHA       56.5
BETA       207.5
COIL ROTATION
ALPHA      207.5
BETA      -123.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
             256
NYQUIST
FREQ =
      1.4613e-01
RAW DELTA f =
      1.1417e-03
SMOOTHED FOURIER
FREQ'S =      32
SMOOTHED DELTA f
F =   9.1333e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.009704
```

```
AUTOSPECTRUM OF
MT2.E99.33
CHANNEL NO.    1
0.010 5.7098E-12
0.019 2.8608E-11
0.028 1.7690E-11
0.037 3.2008E-12
0.046 1.2466E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      3.1365e-09
****************
AUTOSPECTRUM OF
MT2.H9.33
CHANNEL NO.    2
0.010 1.0318E-10
0.019 2.3160E-10
0.028 1.5377E-10
0.037 3.9813E-11
0.046 1.2182E-11
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      9.6685e-09
****************
AUTOSPECTRUM OF
MT2.E340.33
CHANNEL NO.    3
0.010 3.8954E-10
0.019 2.4712E-10
0.028 3.1144E-10
0.037 6.4346E-11
0.046 1.8511E-11
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.6740e-08
****************
AUTOSPECTRUM OF
MT2.H250.33
CHANNEL NO.    4
0.010 1.5234E-11
0.019 2.3803E-11
0.028 3.4903E-11
0.037 1.0024E-11
0.046 2.8643E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.8194e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 6.8012E 01
0.019 2.9470E 02
0.028 4.0755E 02
0.037 3.7780E 02
0.046 5.9926E 02

CHANNELS 3 & 4
0.019 3.1427E 04
0.019 2.4769E 04
0.029 3.1610E 04
0.037 3.0165E 04
0.046 3.7847E 04
```

DATA ANALYSIS STA. MT78-2

DATA FILE 6 SPECTRAL FILE 22 PAGE 2 OF 4

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.E99.33
CHANNEL NO.     1
WITH
MT2.H9.33
CHANNEL NO.     2
0.010 1.7252E-11
0.019 7.2314E-11
0.028 4.4717E-11
0.037 9.8432E-12
0.046 3.2632E-12
PHASE
0.010    136.4281
0.019    149.1524
0.028    139.1359
0.037    144.7883
0.046    167.2800
MAGNITUDE OF
COHERENCE
0.010      0.7108
0.019      0.8884
0.028      0.8574
0.037      0.8719
0.046      0.8374
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT2.E99.33
CHANNEL NO.     1
WITH
MT2.E340.33
CHANNEL NO.     3
0.010 3.2225E-11
0.019 4.3031E-11
0.028 1.0498E-11
0.037 5.7220E-12
0.046 2.0128E-12
PHASE
0.010    103.4068
0.019     68.5913
0.028    325.5567
0.037    329.2096
0.046     47.9464
MAGNITUDE OF
COHERENCE
0.010      0.6833
0.019      0.5118
0.028      0.1414
0.037      0.3987
0.046      0.4190
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.E99.33
CHANNEL NO.     1
WITH
MT2.H250.33
CHANNEL NO.     4
0.010 7.0915E-12
0.019 1.3502E-11
0.028 7.5817E-12
0.037 2.1568E-12
0.046 1.3616E-12
PHASE
0.010     70.3224
0.019     52.6434
0.028     51.3056
0.037      6.9391
0.046     36.0436
MAGNITUDE OF
COHERENCE
0.010      0.7604
0.019      0.5174
0.028      0.3051
0.037      0.3808
0.046      0.7206
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.H9.33
CHANNEL NO.     2
WITH
MT2.E340.33
CHANNEL NO.     3
0.010 1.3271E-10
0.019 1.2935E-10
0.028 1.0532E-10
0.037 2.6608E-11
0.046 4.7685E-12
PHASE
0.010    340.4069
0.019    275.7967
0.028    124.5339
0.037    139.6546
0.046    181.9353
MAGNITUDE OF
COHERENCE
0.010      0.6619
0.019      0.5407
0.028      0.4813
0.037      0.5257
0.046      0.3175
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT2.H9.33
CHANNEL NO.     2
WITH
MT2.H250.33
CHANNEL NO.     4
0.010 3.0594E-11
0.019 3.7971E-11
0.028 1.7855E-11
0.037 9.7967E-13
0.046 2.5163E-12
PHASE
0.010    306.8132
0.019    271.2841
0.028     17.0127
0.037    167.9952
0.046    214.0429
MAGNITUDE OF
COHERENCE
0.010      0.7717
0.019      0.5114
0.028      0.2437
0.037      0.0490
0.046      0.4260
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT2.E340.33
CHANNEL NO.     3
WITH
MT2.H250.33
CHANNEL NO.     4
0.010 6.7483E-11
0.019 5.7435E-11
0.028 9.2961E-11
0.037 1.9179E-11
0.046 6.0208E-12
PHASE
0.010    322.0164
0.019    335.5060
0.028    309.6616
0.037    335.4163
0.046    337.7413
MAGNITUDE OF
COHERENCE
0.010      0.8760
0.019      0.7489
0.028      0.8916
0.037      0.7552
0.046      0.8269
```

DATA ANALYSIS STA. MT78-2

DATA FILE 6 SPECTRAL FILE 22 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.010            88
0.019            84
0.028            86
0.037            82
0.046           -90
****************
ROTATED AZIMUTH

E1 (x')
0.010        130.5
0.019        126.5
0.028        128.5
0.037        124.5
0.046        312.5

H2 (y')
0.010        220.5
0.019        216.5
0.028        218.5
0.037        214.5
0.046         42.5

E3 (y')
0.010        220.5
0.019        216.5
0.028        218.5
0.037        214.5
0.046         42.5

H4 (x')
0.010        130.5
0.019        126.5
0.028        128.5
0.037        124.5
0.046        312.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 1.3837E 01
0.019 5.4231E 01
0.028 1.2145E 03
0.037 1.5999E 03
0.046 1.2561E 03
PHASE
0.010   104.0416
0.019    88.8047
0.028   224.2208
0.037   245.0100
0.046   246.6396

Z[f,1,3]
0.010 2.6166E 04
0.019 1.1463E 04
0.028 2.5059E 04
0.037 1.7006E 04
0.046 3.2291E 04
PHASE
0.010   136.0748
0.019   144.4938
0.028   137.7585
0.037   156.8296
0.046   149.3802

Z[f,3,1]
0.010 1.2350E 01
0.019 1.8744E 02
0.028 3.2845E 02
0.037 3.2383E 02
0.046 2.6676E 02
PHASE
0.010   356.6500
0.019   333.5532
0.028   312.6785
0.037   300.9596
0.046   339.0687

Z[f,3,3]
0.010 2.0794E 02
0.019 5.0578E 01
0.028 2.8599E 02
0.037 7.9794E 01
0.046 5.6776E 02
PHASE
0.010    64.4176
0.019   100.4598
0.028    53.4423
0.037    99.0030
0.046    49.6134
```

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 1.8580E 02
0.019 4.3755E 01
0.028 3.4384E 02
0.037 1.9260E 02
0.046 5.6776E 02
PHASE
0.010    41.8152
0.019    10.1629
0.028    21.9182
0.037    12.5045
0.046    49.6134

Z[1,3,f]
0.010 1.5167E 01
0.019 2.1263E 02
0.028 3.5620E 02
0.037 2.8152E 02
0.046 2.6676E 02
PHASE
0.010   179.7939
0.019   152.4316
0.028   143.8247
0.037   143.7812
0.046   159.0687

Z[3,1,f]
0.010 2.6119E 04
0.019 1.1267E 04
0.028 2.4846E 04
0.037 1.6595E 04
0.046 3.2291E 04
PHASE
0.010   315.9310
0.019   324.5704
0.028   316.4501
0.037   333.8233
0.046   329.3802

Z[3,3,f]
0.010 8.0030E 01
0.019 2.3245E 02
0.028 1.3419E 03
0.037 1.9404E 03
0.046 1.2561E 03
PHASE
0.010   122.7156
0.019   120.1100
0.028   208.7899
0.037   223.7046
0.046   246.6396
```

```
SKEWNESS

0.010 1.0610E-01
0.019 1.1941E-01
0.028 1.0409E-01
0.037 2.2682E-01
0.046 7.3814E-02
****************
COHERENCE OF
E1-pred & E1-obs
0.0097    0.8175
0.0188    0.8947
0.0280    0.9567
0.0371    0.9425
0.0462    0.9400
PHASE
0.0097  360.0000
0.0188  360.0000
0.0280  360.0000
0.0371    0.0000
0.0462  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0097    0.8800
0.0188    0.7926
0.0280    0.9854
0.0371    0.9084
0.0462    0.8940
PHASE
0.0097  360.0000
0.0188    0.0000
0.0280  360.0000
0.0371    0.0000
0.0462    0.0000
```

```
ENTER INPUT FILE
 NUMBER
7
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
220
H2 AZ         130
E3 DIPOLE AZ
155
H4 AZ          65

DIPOLE ROTATION
ALPHA       177.5
BETA         22.5
COIL ROTATION
ALPHA        22.5
BETA         -2.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
      1.5040e-01
RAW DELTA f =
      1.1750e-03
SMOOTHED FOURIER
FREQ'S =       32
SMOOTHED DELTA f
F =   9.4000e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.009988
```

```
AUTOSPECTRUM OF
MT6.E220.12
CHANNEL NO.     1
0.010 1.4073E-11
0.019 1.3866E-12
0.029 3.0446E-13
0.038 5.5211E-14
0.048 2.0148E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
    : 4.4164e-09
****************
AUTOSPECTRUM OF
MT6.H130.12
CHANNEL NO.     2
0.010 3.7240E-10
0.019 5.8898E-11
0.029 1.5581E-11
0.038 6.8839E-12
0.048 7.9363E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.6637e-08
****************
AUTOSPECTRUM OF
MT6.E155.12
CHANNEL NO.     3
0.010 2.7743E-11
0.019 1.6459E-12
0.029 2.3322E-13
0.038 7.2184E-14
0.048 3.5772E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      6.6414e-09
****************
AUTOSPECTRUM OF
MT6.H65.12
CHANNEL NO.     4
0.010 2.6875E-10
0.019 5.4164E-11
0.029 8.3563E-12
0.038 2.7285E-12
0.048 9.2414E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      2.6016e-08
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 4.7802E 01
0.019 5.7809E 01
0.029 7.1245E 01
0.038 3.8790E 01
0.048 1.5301E 02

CHANNELS 3 & 4
0.010 1.3059E 02
0.019 7.4614E 01
0.029 1.0176E 02
0.038 1.2795E 02
0.048 2.3330E 02
```

DATA ANALYSIS STA. MT78-6

DATA FILE 7 SPECTRAL FILE 23 PAGE 2 OF 4

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.E220.12
CHANNEL NO.     1
WITH
MT6.H130.12
CHANNEL NO.     2.
0.010 6.8179E-11
0.019 6.9685E-12
0.029 1.8355E-12
0.038 4.6048E-13
0.048 9.8071E-14
PHASE
0.010   137.2124
0.019   159.4749
0.029   202.2597
0.038   199.3032
0.048   229.1898
MAGNITUDE OF
COHERENCE
0.010      0.9418
0.019      0.7711
0.029      0.8428
0.038      0.7469
0.048      0.7756
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT6.E220.12
CHANNEL NO.     1
WITH
MT6.E155.12
CHANNEL NO.     3
0.010 1.6557E-11
0.019 8.3443E-13
0.029 2.0329E-13
0.038 5.4040E-14
0.048 1.6392E-14
PHASE
0.010   334.1520
0.019    24.3677
0.029    19.0803
0.038    25.0124
0.048    17.8311
MAGNITUDE OF
COHERENCE
0.010      0.8380
0.019      0.5523
0.029      0.7629
0.038      0.8560
0.048      0.6106
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.E220.12
CHANNEL NO.     1
WITH
MT6.H65.12
CHANNEL NO.     4
0.010 4.6751E-11
0.019 5.7457E-12
0.029 7.5524E-13
0.038 2.9788E-13
0.048 2.3886E-14
PHASE
0.010   315.9037
0.019   351.4918
0.029     8.9470
0.038    60.1667
0.048   359.3110
MAGNITUDE OF
COHERENCE
0.010      0.7602
0.019      0.6630
0.029      0.4735
0.038      0.7675
0.048      0.1750
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.H130.12
CHANNEL NO.     2
WITH
MT6.E155.12
CHANNEL NO.     3
0.010 7.4773E-11
0.019 2.9355E-12
0.029 1.1010E-12
0.038 3.9482E-13
0.048 8.0441E-14
PHASE
0.010   200.6532
0.019   247.1092
0.029   192.6545
0.038   193.4121
0.048   147.6800
MAGNITUDE OF
COHERENCE
0.010      0.7356
0.019      0.2981
0.029      0.5776
0.038      0.5601
0.048      0.4774
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT6.H130.12
CHANNEL NO.     2
WITH
MT6.H65.12
CHANNEL NO.     4
0.010 2.2678E-10
0.019 4.0866E-11
0.029 5.0713E-12
0.038 2.0091E-12
0.048 5.1664E-13
PHASE
0.010   185.7107
0.019   204.9561
0.029   177.9979
0.038   215.0709
0.048   148.6963
MAGNITUDE OF
COHERENCE
0.010      0.7168
0.019      0.7235
0.029      0.4444
0.038      0.4636
0.048      0.6033
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.E155.12
CHANNEL NO.     3
WITH
MT6.H65.12
CHANNEL NO.     4
0.010 7.9298E-11
0.019 5.7141E-12
0.029 7.5502E-13
0.038 3.5132E-13
0.048 5.3329E-14
PHASE
0.010   344.8803
0.019   314.1211
0.029   327.3537
0.038    41.9225
0.048    42.6530
MAGNITUDE OF
COHERENCE
0.010      0.9184
0.019      0.6052
0.029      0.5408
0.038      0.7916
0.048      0.2933
```

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DATA FILE 7 SPECTRAL FILE 23 PAGE 3 OF 4

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 4.1841E 00
0.019 8.2577E 00
0.029 3.4403E 00
0.038 2.8603E 01
0.048 3.0621E 01
PHASE
0.010   273.4322
0.019   305.1612
0.029   334.2768
0.038    64.8896
0.048   208.3494

Z[1,3,f]
0.010 3.3414E 01
0.019 2.6401E 01
0.029 4.4997E 01
0.038 9.7987E 00
0.048 1.7298E 02
PHASE
0.010   146.6423
0.019   178.9594
0.029   205.9705
0.038   194.0819
0.048   232.0409

Z[3,1,f]
0.010 8.4476E 01
0.019 5.0029E 01
0.029 1.4903E 01
0.038 6.4030E 01
0.048 2.4628E 01
PHASE
0.010   344.6413
0.019   312.0623
0.029   312.3927
0.038    51.2408
0.048   110.4617

Z[3,3,f]
0.010 2.3866E 00
0.019 6.0668E 00
0.029 1.0787E 01
0.038 5.1621E 00
0.048 8.9282E 01
PHASE
0.010   160.8549
0.019   281.3061
0.029   179.3561
0.038   136.0949
0.048   193.5116
```

```
SKEWNESS

0.010 1.3758E-01
0.019 4.6505E-01
0.029 2.0694E-01
0.038 6.0470E-01
0.048 9.1153E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0100    0.9580
0.0194    0.8107
0.0288    0.8550
0.0382    0.8873
0.0476    0.8659
PHASE
0.0100  360.0000
0.0194    0.0000
0.0288  360.0000
0.0382  360.0000
0.0476  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0100    0.9250
0.0194    0.6391
0.0288    0.6716
0.0382    0.8406
0.0476    0.5432
PHASE
0.0100  360.0000
0.0194    0.0000
0.0288    0.0000
0.0382  360.0000
0.0476    0.0000
```

DATA ANALYSIS STA. MT78-6

DATA FILE 7 SPECTRAL FILE 23 PAGE 4 OF 4

```
OPTIMUM AXES            ROTATED
(CW ANGLE OF            IMPEDANCE TENSOR
ROTATION)               (RESISTIVITIES)

0.010          78       Z[1,1,f]
0.019         -89       0.010 6.2559E-01
0.029          13       0.019 5.6472E 00
0.038          70       0.029 4.5732E 00
0.048           9       0.038 1.4124E 01
****************        0.048 5.4425E 01
ROTATED AZIMUTH         PHASE
                        0.010   136.1622
E1 (x')                 0.019   281.9046
0.010       120.5       0.029   288.2278
0.019       313.5       0.038    98.3501
0.029        55.5       0.048   208.3322
0.038       112.5
0.048        51.5       Z[f,1,3]
                        0.010 9.0092E 01
H2 (y')                 0.019 4.9832E 01
0.010       210.5       0.029 5.4260E 01
0.019        43.5       0.038 8.0621E 01
0.029       145.5       0.048 1.7586E 02
0.038       202.5       PHASE
0.048       141.5       0.010   161.6714
                        0.019   131.9421
E3 (y')                 0.029   199.5094
0.010       210.5       0.038   227.7747
0.019        43.5       0.048   230.0426
0.029       145.5
0.038       202.5       Z[f,3,1]
0.048       141.5       0.010 2.8817E 01
                        0.019 2.6611E 01
H4 (x')                 0.029 8.4905E 00
0.010       120.5       0.038 4.1704E 00
0.019       313.5       0.048 2.8238E 01
0.029        55.5       PHASE
0.038       112.5       0.010   330.6884
0.048        51.5       0.019   358.9589
                        0.029   305.4521
                        0.038     9.9368
                        0.048   114.0018

                        Z[f,3,3]
                        0.010 4.9264E 00
                        0.019 8.6647E 00
                        0.029 6.8031E 00
                        0.038 8.6782E 00
                        0.048 5.8990E 01
                        PHASE
                        0.010   249.7989
                        0.019   304.0356
                        0.029   151.0363
                        0.038    66.4212
                        0.048   190.0031
```

DATA ANALYSIS STA. MT78-6

DATA FILE 8 SPECTRAL FILE 24 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
8
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
220
H2 AZ         130
E3 DIPOLE AZ
155
H4 AZ          65

DIPOLE ROTATION
ALPHA       177.5
BETA         22.5
COIL ROTATION
ALPHA        22.5
BETA         -2.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
       1.5040e-01
RAW DELTA f =
       1.1750e-03
SMOOTHED FOURIER
FREQ'S =       32
SMOOTHED DELTA f
F =    9.4000e-03
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009988
```

```
AUTOSPECTRUM OF
MT6.E220.22
CHANNEL NO.    1
0.010 5.9737E-12
0.019 1.1733E-12
0.029 2.4680E-13
0.038 7.1293E-14
0.048 1.4008E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.2507e-09
****************
AUTOSPECTRUM OF
MT6.H130.22
CHANNEL NO.    2
0.010 1.6037E-10
0.019 6.9820E-11
0.029 2.2613E-11
0.038 6.7355E-12
0.048 9.5307E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.8813e-08
****************
AUTOSPECTRUM OF
MT6.E155.22
CHANNEL NO.    3
0.010 1.1492E-11
0.019 2.8554E-12
0.029 2.3656E-13
0.038 1.0150E-13
0.048 3.9517E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      3.4046e-09
****************
AUTOSPECTRUM OF
MT6.H65.22
CHANNEL NO.    4
0.010 1.2987E-10
0.019 3.5601E-11
0.029 2.2968E-11
0.038 4.1935E-12
0.048 4.3332E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.3303e-08
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 4.7119E 01
0.019 4.1262E 01
0.029 3.9793E 01
0.038 5.1193E 01
0.048 8.8581E 01

CHANNELS 3 & 4
0.010 1.1193E 02
0.019 1.9694E 02
0.029 3.7553E 01
0.038 1.1797E 02
0.048 5.4963E 02
```

DATA ANALYSIS STA. MT78-6

DATA FILE 8 SPECTRAL FILE 24 PAGE 2 OF 4

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.E220.22
CHANNEL NO.     1
WITH
MT6.H130.22
CHANNEL NO.     2
0.010 2.7344E-11
0.019 7.9506E-12
0.029 2.0079E-12
0.038 6.0455E-13
0.048 9.1091E-14
PHASE
0.010   156.1652
0.019   161.7269
0.029   194.6848
0.038   188.8770
0.048   209.0879
MAGNITUDE OF
COHERENCE
0.010     0.8834
0.019     0.8784
0.029     0.8500
0.038     0.8724
0.048     0.7884
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT6.E220.22
CHANNEL NO.     1
WITH
MT6.E155.22
CHANNEL NO.     3
0.010 7.4712E-12
0.019 1.4928E-12
0.029 9.0742E-15
0.038 6.6102E-14
0.048 1.6092E-14
PHASE
0.010    15.2702
0.019     4.5793
0.029    62.6398
0.038   352.7712
0.048   343.0535
MAGNITUDE OF
COHERENCE
0.010     0.9017
0.019     0.8156
0.029     0.0376
0.038     0.7770
0.048     0.6840
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.E220.22
CHANNEL NO.     1
WITH
MT6.H65.22
CHANNEL NO.     4
0.010 1.9542E-11
0.019 4.7241E-12
0.029 1.2650E-12
0.038 3.5826E-13
0.048 3.2366E-14
PHASE
0.010     2.1798
0.019   351.4680
0.029    42.2230
0.038   330.7565
0.048   342.0029
MAGNITUDE OF
COHERENCE
0.010     0.7016
0.019     0.7309
0.029     0.5313
0.038     0.6552
0.048     0.4154
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.H130.22
CHANNEL NO.     2
WITH
MT6.E155.22
CHANNEL NO.     3
0.010 3.5050E-11
0.019 1.1527E-11
0.029 6.3010E-13
0.038 5.2675E-13
0.048 1.0016E-13
PHASE
0.010   221.7310
0.019   205.7211
0.029    56.0313
0.038   154.2641
0.048   134.0543
MAGNITUDE OF
COHERENCE
0.010     0.8165
0.019     0.8164
0.029     0.2724
0.038     0.6371
0.048     0.5161
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT6.H130.22
CHANNEL NO.     2
WITH
MT6.H65.22
CHANNEL NO.     4
0.010 9.7060E-11
0.019 2.6510E-11
0.029 1.6606E-11
0.038 4.1316E-12
0.048 3.8451E-13
PHASE
0.010   224.0342
0.019   184.8322
0.029   196.2457
0.038   129.3727
0.048   145.4941
MAGNITUDE OF
COHERENCE
0.010     0.6726
0.019     0.5317
0.029     0.7287
0.038     0.7774
0.048     0.5983
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT6.E155.22
CHANNEL NO.     3
WITH
MT6.H65.22
CHANNEL NO.     4
0.010 2.7544E-11
0.019 7.7838E-12
0.029 5.5109E-13
0.038 4.7003E-13
0.048 4.5359E-14
PHASE
0.010   338.7124
0.019   345.6164
0.029    68.1893
0.038   340.6567
0.048   275.5868
MAGNITUDE OF
COHERENCE
0.010     0.7130
0.019     0.7720
0.029     0.2364
0.038     0.7204
0.048     0.3466
```

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 1.0174E 01
0.019 1.1345E 01
0.029 6.6774E 00
0.038 1.1356E 01
0.048 5.9442E 00
PHASE
0.010   308.8000
0.019     0.0267
0.029   150.2808
0.038    63.4443
0.048   228.3697

Z[1,3,f]
0.010 3.3033E 01
0.019 1.9440E 01
0.029 4.4121E 01
0.038 4.9999E 01
0.048 6.4647E 01
PHASE
0.010   174.7276
0.019   157.8535
0.029   181.2103
0.038   172.4903
0.048   214.7526

Z[3,1,f]
0.010 3.4442E 01
0.019 4.5363E 01
0.029 9.7576E 00
0.038 4.0421E 01
0.048 3.1651E 02
PHASE
0.010   292.3784
0.019   353.8300
0.029    18.8426
0.038   352.5426
0.048   236.4951

Z[3,3,f]
0.010 5.4085E 01
0.019 3.3000E 01
0.029 1.1401E 01
0.038 4.3168E 00
0.048 2.0082E 02
PHASE
0.010   165.2462
0.019   147.7845
0.029   341.8378
0.038   171.5157
0.048   246.9533
```

```
SKEWNESS

0.010 5.1813E-01
0.019 3.0867E-01
0.029 1.0251E-01
0.038 2.5065E-01
0.048 1.5358E 00
****************
COHERENCE OF
E1-pred & E1-obs
0.0100    0.9361
0.0194    0.9339
0.0288    0.8957
0.0382    0.9032
0.0476    0.8067
PHASE
0.0100  360.0000
0.0194  360.0000
0.0288  360.0000
0.0382  360.0000
0.0476  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0100    0.9138
0.0194    0.9120
0.0288    0.4429
0.0382    0.7365
0.0476    0.7975
PHASE
0.0100    0.0000
0.0194  360.0000
0.0288    0.0000
0.0382  360.0000
0.0476    0.0000
```

DATA ANALYSIS STA. MT78-6

DATA FILE 8 SPECTRAL FILE 24 PAGE 4 OF 4

```
OPTIMUM AXES           ROTATED
(CW ANGLE OF           IMPEDANCE TENSOR
ROTATION)              (RESISTIVITIES)

0.010           41     Z[1,1,f]
0.019           52     0.010 2.2535E 01
0.029          -29     0.019 5.7821E 00
0.038           42     0.029 4.9236E-01
0.048          -78     0.038 3.6199E 00
****************       0.048 7.8216E 01
ROTATED AZIMUTH        PHASE
                       0.010   219.7462
E1 (x')                0.019   101.3655
0.010         83.5     0.029    31.2756
0.019         94.5     0.038   103.3499
0.029         13.5     0.048   256.6822
0.038         84.5
0.048        324.5     Z[f,1,3]
                       0.010 9.9244E 01
H2 (y')                0.019 1.0063E 02
0.010        173.5     0.029 6.5813E 01
0.019        184.5     0.038 7.1876E 01
0.029        103.5     0.048 3.6312E 02
0.038        174.5     PHASE
0.048         54.5     0.010   151.2300
                       0.019   165.1880
E3 (y')                0.029   175.4396
0.010        173.5     0.038   183.1554
0.019        184.5     0.048    58.6663
0.029        103.5
0.038        174.5     Z[f,3,1]
0.048         54.5     0.010 1.9465E 00
                       0.019 1.2025E 00
H4 (x')                0.029 5.5004E 00
0.010         83.5     0.038 2.8426E 01
0.019         94.5     0.048 8.1125E 01
0.029         13.5     PHASE
0.038         84.5     0.010   236.2616
0.048        324.5     0.019     9.3678
                       0.029    49.9086
                       0.038   335.4409
                       0.048    41.9864

                       Z[f,3,3]
                       0.010 8.0084E 05
                       0.019 1.5358E 00
                       0.029 1.5118E-01
                       0.038 2.1720E 00
                       0.048 6.5459E 01
                       PHASE
                       0.010   121.1324
                       0.019   145.2376
                       0.029   339.5723
                       0.038    94.2450
                       0.048   230.6480
```

DATA ANALYSIS STA. MT78-9

DATA FILE 9 SPECTRAL FILE 25 PAGE 1 OF 3

```
ENTER INPUT FILE
 NUMBER
9
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
243
H2 AZ         153
E3 DIPOLE AZ
170
H4 AZ          80

DIPOLE ROTATION
ALPHA       200.5
BETA         37.5
COIL ROTATION
ALPHA        37.5
BETA         20.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              128
NYQUIST
FREQ =
      1.5520e-01
RAW DELTA f =
      2.4250e-03
SMOOTHED FOURIER
FREQ'S =       16
SMOOTHED DELTA f
F =   1.9400e-02
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.015763
```

```
AUTOSPECTRUM OF
MT9.E243.13
CHANNEL NO.    1
0.016 3.6427E-14
0.035 4.9916E-15
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      4.3629e-10
****************
AUTOSPECTRUM OF
MT9.H153.13
CHANNEL NO.    2
0.016 5.1351E-12
0.035 4.7933E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.9248e-09
****************
AUTOSPECTRUM OF
MT9.E170.13
CHANNEL NO.    3
0.016 7.0241E-13
0.035 1.2381E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      4.9302e-10
****************
AUTOSPECTRUM OF
MT9.H80.13
CHANNEL NO.    4
0.016 6.1462E-12
0.035 8.5996E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      2.7520e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.016 1.4162E 01
0.035 4.6376E 01

CHANNELS 3 & 4
0.016 2.2815E 02
0.035 6.4117E 01
```

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E243.13
CHANNEL NO.     1
WITH
MT9.H153.13
CHANNEL NO.     2
0.016 1.9114E-13
0.035 2.3433E-14
PHASE
0.016    80.8339
0.035    94.3470
MAGNITUDE OF
COHERENCE
0.016     0.4420
0.035     0.4791
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT9.E243.13
CHANNEL NO.     1
WITH
MT9.E170.13
CHANNEL NO.     3
0.016 1.0005E-13
0.035 2.2001E-15
PHASE
0.016   226.4726
0.035   252.0469
MAGNITUDE OF
COHERENCE
0.016     0.6255
0.035     0.2799
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E243.13
CHANNEL NO.     1
WITH
MT9.H80.13
CHANNEL NO.     4
0.016 5.7297E-14
0.035 4.7012E-14
PHASE
0.016    74.2809
0.035   339.5553
MAGNITUDE OF
COHERENCE
0.016     0.1211
0.035     0.7175
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.H153.13
CHANNEL NO.     2
WITH
MT9.E170.13
CHANNEL NO.     3
0.016 6.1479E-13
0.035 4.3331E-14
PHASE
0.016   225.0294
0.035   172.2554
MAGNITUDE OF
COHERENCE
0.016     0.3237
0.035     0.5625
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT9.H153.13
CHANNEL NO.     2
WITH
MT9.H80.13
CHANNEL NO.     4
0.016 1.6420E-12
0.035 3.9840E-13
PHASE
0.016   325.1040
0.035   277.7914
MAGNITUDE OF
COHERENCE
0.016     0.2923
0.035     0.6205
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E170.13
CHANNEL NO.     3
WITH
MT9.H80.13
CHANNEL NO.     4
0.016 7.1824E-13
0.035 7.0001E-14
PHASE
0.016     7.5469
0.035    90.4453
MAGNITUDE OF
COHERENCE
0.016     0.3457
0.035     0.6784
```

DATA ANALYSIS STA. MT78-9

DATA FILE 9 SPECTRAL FILE 25 PAGE 3 OF 3

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.016 5.3971E-02
0.035 1.6663E 01
PHASE
0.016   157.3949
0.035   320.6362

Z[1,3,f]
0.016 2.8620E 00
0.035 8.3741E 00
PHASE
0.016    76.4917
0.035   160.9220

Z[3,1,f]
0.016 3.5821E 01
0.035 2.1162E 01
PHASE
0.016   352.4279
0.035    75.5410

Z[3,3,f]
0.016 3.8485E 01
0.035 1.1059E 01
PHASE
0.016   152.0668
0.035   222.8288
```

```
SKEWNESS

0.016 1.0537E 00
0.035 9.3670E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0158     0.4466
0.0352     0.7911
PHASE
0.0158   360.0000
0.0352     0.0000

COHERENCE OF
E3-pred & E3-obs
0.0158     0.4984
0.0352     0.7207
PHASE
0.0158   360.0000
0.0352   360.0000
****************
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.016          69
0.035          22
****************
ROTATED AZIMUTH

E1 (x')
0.016       111.5
0.035        64.5

H2 (y')
0.016       201.5
0.035       154.5

E3 (y')
0.016       201.5
0.035       154.5

H4 (x')
0.016       111.5
0.035        64.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.016 1.5363E 01
0.035 3.7573E 00
PHASE
0.016   133.6727
0.035   339.6652

Z[f,1,3]
0.016 5.0862E 01
0.035 1.9943E 01
PHASE
0.016   165.0263
0.035   176.1217

Z[f,3:1]
0.016 2.0394E 00
0.035 1.4849E 01
PHASE
0.016   205.0092
0.035    98.5373

Z[f,3,3]
0.016 8.9579E 00
0.035 1.8709E 01
PHASE
0.016   176.9301
0.035   255.2289
```

DATA ANALYSIS STA. MT78-9

DATA FILE 10 SPECTRAL FILE 26 PAGE 1 OF 3

```
ENTER INPUT FILE
 NUMBER
10
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
243
H2 AZ         153
E3 DIPOLE AZ
170
H4 AZ          80

DIPOLE ROTATION
ALPHA       200.5
BETA         37.5
COIL ROTATION
ALPHA        37.5
BETA         20.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              128
NYQUIST
FREQ =
      1.5520e-01
RAW DELTA f =
      2.4250e-03
SMOOTHED FOURIER
FREQ'S =       16
SMOOTHED DELTA f
F =   1.9400e-02
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.015763
```

```
AUTOSPECTRUM OF
MT9.E243.23
CHANNEL NO.     1
0.016 2.3076E-13
0.035 2.4333E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.0703e-09
****************
AUTOSPECTRUM OF
MT9.H153.23
CHANNEL NO.     2
0.016 4.7530E-11
0.035 2.5635E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      9.6603e-09
****************
AUTOSPECTRUM OF
MT9.E170.23
CHANNEL NO.     3
0.016 1.7844E-12
0.035 6.1628E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.2207e-09
****************
AUTOSPECTRUM OF
MT9.H80.23
CHANNEL NO.     4
0.016 5.5378E-11
0.035 2.5384E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.7736e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.016 9.6924E 00
0.035 4.2272E 01

CHANNELS 3 & 4
0.016 6.4326E 01
0.035 1.0812E 02
```

DATA ANALYSIS STA. MT70-9

DATA FILE 10 SPECTRAL FILE 26 PAGE 2 OF 3

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E243.23
CHANNEL NO.      1
WITH
MT9.H153.23
CHANNEL NO.      2
0.016 2.7174E-12
0.035 2.2078E-13
PHASE
0.016     158.6254
0.035     161.4668
MAGNITUDE OF
COHERENCE
0.016       0.8265
0.035       0.8846
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT9.E243.23
CHANNEL NO.      1
WITH
MT9.E170.23
CHANNEL NO.      3
0.016 4.6829E-13
0.035 2.4246E-14
PHASE
0.016      69.8417
0.035      41.6608
MAGNITUDE OF
COHERENCE
0.016       0.7298
0.035       0.6261
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E243.23
CHANNEL NO.      1
WITH
MT9.H80.23
CHANNEL NO.      4
0.016 1.7803E-12
0.035 1.6898E-13
PHASE
0.016      45.6928
0.035     350.4210
MAGNITUDE OF
COHERENCE
0.016       0.4980
0.035       0.6799
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.H153.23
CHANNEL NO.      2
WITH
MT9.E170.23
CHANNEL NO.      3
0.016 7.5606E-12
0.035 1.9694E-13
PHASE
0.016     272.8157
0.035     237.3439
MAGNITUDE OF
COHERENCE
0.016       0.8210
0.035       0.4955
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT9.H153.23
CHANNEL NO.      2
WITH
MT9.H80.23
CHANNEL NO.      4
0.016 2.9232E-11
0.035 1.1916E-12
PHASE
0.016     293.7880
0.035     182.4469
MAGNITUDE OF
COHERENCE
0.016       0.5698
0.035       0.4671
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E170.23
CHANNEL NO.      3
WITH
MT9.H80.23
CHANNEL NO.      4
0.016 7.8619E-12
0.035 3.0584E-13
PHASE
0.016     358.5861
0.035     320.9006
MAGNITUDE OF
COHERENCE
0.016       0.7909
0.035       0.7733
```

DATA ANALYSIS STA. MT78-9

DATA FILE 10 SPECTRAL FILE 26 PAGE 3 OF 3

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.016 1.7024E 00
0.035 5.2315E 00
PHASE
0.016    339.4886
0.035      0.2675

Z[1,3,f]
0.016 8.0864E 00
0.035 2.2437E 01
PHASE
0.016    174.5902
0.035    157.8433

Z[3,1,f]
0.016 1.7153E 01
0.035 5.4321E 01
PHASE
0.016    341.8646
0.035    327.4306

Z[3,3,f]
0.016 2.5368E 01
0.035 5.5267E 00
PHASE
0.016    101.4264
0.035     89.0382
```

```
SKEWNESS

0.016 6.4594E-01
0.035 2.7488E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0158    0.9008
0.0352    0.9366
PHASE
0.0158  360.0000
0.0352  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0158    0.9242
0.0352    0.7989
PHASE
0.0158  360.0000
0.0352  360.0000
****************
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.016         52
0.035         66
****************
ROTATED AZIMUTH

E1 (x')
0.016       94.5
0.035      108.5

H2 (y')
0.016      184.5
0.035      198.5

E3 (y')
0.016      184.5
0.035      198.5

H4 (x')
0.016       94.5
0.035      108.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.016 5.8893E 00
0.035 2.5157E 00
PHASE
0.016     81.0003
0.035     46.6315

Z[f,1,3]
0.016 3.3488E 01
0.035 6.5527E 01
PHASE
0.016    142.5481
0.035    146.4292

Z[f,3,1]
0.016 8.5697E 00
0.035 1.6483E 01
PHASE
0.016     42.0776
0.035    341.6547

Z[f,3,3]
0.016 4.3618E 00
0.035 2.9913E 00
PHASE
0.016     94.2670
0.035     44.3138
```

DATA FILE 11 SPECTRAL FILE 27 PAGE 1 OF 3

```
ENTER INPUT FILE
 NUMBER
11
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
243
H2 AZ         153
E3 DIPOLE AZ
170
H4 AZ          80

DIPOLE ROTATION
ALPHA       200.5
BETA         37.5
COIL ROTATION
ALPHA        37.5
BETA         20.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              128
NYQUIST
FREQ =
      1.5520e-01
RAW DELTA f =
      2.4250e-03
SMOOTHED FOURIER
FREQ'S =       16
SMOOTHED DELTA f
F =   1.9400e-02
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.015763
```

```
AUTOSPECTRUM OF
MT9.E243.33
CHANNEL NO.    1
0.016 1.3931E-12
0.035 5.8404E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.6611e-09
****************
AUTOSPECTRUM OF
MT9.H143.33
CHANNEL NO.    2
0.016 1.0864E-10
0.035 9.0138E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.8989e-08
****************
AUTOSPECTRUM OF
MT9.E170.33
CHANNEL NO.    3
0.016 1.2943E-11
0.035 1.2374E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      3.0121e-09
****************
AUTOSPECTRUM OF
MT9.H80.33
CHANNEL NO.    4
0.016 2.9636E-10
0.035 6.6742E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      1.3314e-08
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.016 2.5598E 01
0.035 2.8855E 01

CHANNELS 3 & 4
0.016 8.7183E 01
0.035 8.2566E 01
```

DATA FILE 11 SPECTRAL FILE 27 PAGE 2 OF 3

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E243.33
CHANNEL NO.    1
WITH
MT9.H143.33
CHANNEL NO.    2
0.016 1.1115E-11
0.035 6.8487E-13
PHASE
0.016   157.6523
0.035   216.2004
MAGNITUDE OF
COHERENCE
0.016     0.9035
0.035     0.9439
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT9.E243.33
CHANNEL NO.    1
WITH
MT9.E170.33
CHANNEL NO.    3
0.016 2.4974E-12
0.035 5.7019E-14
PHASE
0.016   321.7037
0.035   109.7417
MAGNITUDE OF
COHERENCE
0.016     0.5882
0.035     0.6707
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E243.33
CHANNEL NO.    1
WITH
MT9.H80.33
CHANNEL NO.    4
0.016 1.4795E-11
0.035 2.2432E-13
PHASE
0.016   311.0422
0.035   235.8842
MAGNITUDE OF
COHERENCE
0.016     0.7281
0.035     0.3593
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.H143.33
CHANNEL NO.    2
WITH
MT9.E170.33
CHANNEL NO.    3
0.016 1.9519E-11
0.035 7.4092E-13
PHASE
0.016   195.4010
0.035   244.3313
MAGNITUDE OF
COHERENCE
0.016     0.5205
0.035     0.7016
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT9.H143.33
CHANNEL NO.    2
WITH
MT9.H80.33
CHANNEL NO.    4
0.016 9.6029E-11
0.035 2.1862E-12
PHASE
0.016   165.8863
0.035   348.2911
MAGNITUDE OF
COHERENCE
0.016     0.5352
0.035     0.2919
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT9.E170.33
CHANNEL NO.    3
WITH
MT9.H80.33
CHANNEL NO.    4
0.016 4.9770E-11
0.035 3.5139E-13
PHASE
0.016   357.8860
0.035    94.6256
MAGNITUDE OF
COHERENCE
0.016     0.8036
0.035     0.3867
```

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.016 1.4101E 00
0.035 1.6868E 00
PHASE
0.016    288.8185
0.035    282.2392

Z[i,3,f]
0.016 1.4110E 01
0.035 2.5131E 01
PHASE
0.016    166.8100
0.035    212.6799

Z[3,1,f]
0.016 5.5798E 01
0.035 3.6747E 00
PHASE
0.016     10.8635
0.035     85.1198

Z[3,3,f]
0.016 2.7281E 01
0.035 2.5478E 01
PHASE
0.016    109.6214
0.035    117.3732
```

```
SKEWNESS

0.016 3.6666E-01
0.035 5.9837E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0158    0.9610
0.0352    0.9648
PHASE
0.0158    0.0000
0.0352  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0158    0.8530
0.0352    0.7302
PHASE
0.0158    0.0000
0.0352  360.0000
****************
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.016         38
0.035        -52
****************
ROTATED AZIMUTH

E1 (x')
0.016       80.5
0.035      350.5

H2 (y')
0.016      170.5
0.035       80.5

E3 (y')
0.016      170.5
0.035       80.5

H4 (x')
0.016       80.5
0.035      350.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[i,1,f]
0.016 6.9769E 00
0.035 7.6284E 00
PHASE
0.016     59.0666
0.035     76.7896

Z[f,1,3]
0.016 4.5657E 01
0.035 2.5219E 01
PHASE
0.016    154.2952
0.035    264.9608

Z[f,3,1]
0.016 3.6178E 01
0.035 1.5684E 01
PHASE
0.016     35.3674
0.035    354.4118

Z[f,3,3]
0.016 9.7871E 00
0.035 7.4394E 00
PHASE
0.016    150.7178
0.035    168.9170
```

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```
ENTER INPUT FILE
 NUMBER
12
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
238
H2 AZ        148
E3 DIPOLE AZ
159
H4 AZ         69

DIPOLE ROTATION
ALPHA      195.5
BETA        26.5
COIL ROTATION
ALPHA       26.5
BETA        15.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
             256
NYQUIST
FREQ =
      1.5040e-01
RAW DELTA f =
      1.1750e-03
SMOOTHED FOURIER
FREQ'S =      32
SMOOTHED DELTA f
F =   9.4000e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.009988
```

```
AUTOSPECTRUM OF
MT14.E238.12
CHANNEL NO.    1
0.010 1.1517E-10
0.019 7.2244E-11
0.029 1.3070E-11
0.038 3.8451E-12
0.048 7.1237E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      7.0150e-09
****************
AUTOSPECTRUM OF
MT14.H148.12
CHANNEL NO.    2
0.010 8.8281E-12
0.019 1.3478E-11
0.029 1.1915E-12
0.038 1.9281E-13
0.048 4.7164E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.9116e-09
****************
AUTOSPECTRUM OF
MT14.E159.12
CHANNEL NO.    3
0.010 7.9640E-12
0.019 3.3717E-12
0.029 8.1745E-13
0.038 1.5039E-13
0.048 2.5106E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.4783e-09
****************
AUTOSPECTRUM OF
MT14.H69.12
CHANNEL NO.    4
0.010 2.3803E-11
0.019 3.1459E-11
0.029 1.0686E-12
0.038 4.4640E-13
0.048 1.7416E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.7736e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 1.6501E 04
0.019 1.3161E 04
0.029 3.9996E 04
0.038 9.6451E 04
0.048 9.1033E 04

CHANNELS 3 & 4
0.010 4.2322E 02
0.019 2.6317E 02
0.029 2.7892E 03
0.038 1.6294E 03
0.048 8.6882E 02
```

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.H148.12
CHANNEL NO.     2
0.010 2.2797E-11
0.019 2.4907E-11
0.029 1.0122E-12
0.038 2.9376E-13
0.048 3.4499E-14
PHASE
0.010    118.5173
0.019     95.1425
0.029    149.8216
0.038    111.8545
0.048    186.2156
MAGNITUDE OF
COHERENCE
0.010       0.7150
0.019       0.7982
0.029       0.2565
0.038       0.3412
0.048       0.1882
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.E159.12
CHANNEL NO.     3
0.010 2.3706E-11
0.019 1.0128E-11
0.029 2.6864E-12
0.038 5.7057E-13
0.048 8.6203E-14
PHASE
0.010      7.5149
0.019      5.9797
0.029     10.9256
0.038    354.3829
0.048     34.4440
MAGNITUDE OF
COHERENCE
0.010       0.7827
0.019       0.6490
0.029       0.8219
0.038       0.7503
0.048       0.6446
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 3.2592E-11
0.019 2.2268E-11
0.029 8.9035E-13
0.038 5.3790E-13
0.048 1.1331E-13
PHASE
0.010    291.4433
0.019    299.9873
0.029    250.9976
0.038     57.0283
0.048    117.9554
MAGNITUDE OF
COHERENCE
0.010       0.6225
0.019       0.4671
0.029       0.2382
0.038       0.4106
0.048       0.3217
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.     2
WITH
MT14.E159.12
CHANNEL NO.     3
0.010 3.8035E-12
0.019 3.1633E-12
0.029 5.0066E-13
0.038 4.3505E-14
0.048 1.8602E-14
PHASE
0.010    282.2010
0.019    270.0567
0.029    234.6875
0.038    175.6903
0.048    146.3161
MAGNITUDE OF
COHERENCE
0.010       0.4536
0.019       0.4693
0.029       0.5073
0.038       0.2555
0.048       0.5406
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.     2
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 9.2255E-12
0.019 1.3282E-11
0.029 6.4058E-13
0.038 1.2547E-13
0.048 4.3270E-14
PHASE
0.010    184.0894
0.019    179.4039
0.029    119.3317
0.038    182.9777
0.048    135.4838
MAGNITUDE OF
COHERENCE
0.010       0.6364
0.019       0.6450
0.029       0.5677
0.038       0.4277
0.048       0.4774
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E159.12
CHANNEL NO.     3
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 9.4448E-12
0.019 5.1084E-12
0.029 2.0463E-13
0.038 7.8974E-14
0.048 3.0919E-14
PHASE
0.010    264.2427
0.019    252.3558
0.029    240.4085
0.038     45.0129
0.048     46.4244
MAGNITUDE OF
COHERENCE
0.010       0.6860
0.019       0.4960
0.029       0.2190
0.038       0.3048
0.048       0.4676
```

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```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 6.7029E 02
0.019 8.0888E 02
0.029 1.1686E 03
0.038 1.5830E 04
0.048 6.8025E 03
PHASE
0.010   264.8669
0.019    29.4187
0.029   226.5648
0.038    71.2183
0.048   123.0738

Z[1,3,f]
0.010 5.2369E 03
0.019 1.1329E 04
0.029 1.5809E 03
0.038 3.0491E 04
0.048 1.7094E 04
PHASE
0.010   131.7458
0.019    81.3219
0.029   168.0508
0.038    92.9840
0.048   175.5637

Z[3,1,f]
0.010 1.8911E 02
0.019 3.8963E 01
0.029 3.1058E 01
0.038 1.2729E 02
0.048 2.2549E 02
PHASE
0.010   265.9513
0.019   229.1747
0.029    77.7142
0.038    62.0344
0.048    79.9230

Z[3,3,f]
0.010 2.0141E 00
0.019 6.3769E 01
0.029 8.0087E 02
0.038 1.6714E 02
0.048 1.1385E 03
PHASE
0.010    31.9558
0.019   119.7376
0.029   126.6845
0.038   156.6802
0.048   189.5877
```

```
SKEWNESS

0.010 3.0359E-01
0.019 2.6391E-01
0.029 1.0071E 00
0.038 7.7249E-01
0.048 7.5747E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0100    0.7592
0.0194    0.8490
0.0288    0.2890
0.0382    0.6534
0.0476    0.4985
PHASE
0.0100  360.0000
0.0194    0.0000
0.0288    0.0000
0.0382    0.0000
0.0476    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0100    0.6867
0.0194    0.5538
0.0288    0.5147
0.0382    0.3593
0.0476    0.7019
PHASE
0.0100  360.0000
0.0194    0.0000
0.0288    0.0000
0.0382  360.0000
0.0476    0.0000
```

DATA ANALYSIS STA. MT78-14

DATA FILE 12 SPECTRAL FILE 28 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.010              7
0.019             -3
0.029             24
0.038            -17
0.048             -8
****************
ROTATED AZIMUTH

E1  (x')
0.010           49.5
0.019           39.5
0.029           66.5
0.038           25.5
0.048           34.5

H2  (y')
0.010          139.5
0.019          129.5
0.029          156.5
0.036          115.5
0.048          124.5

E3  (y')
0.010          139.5
0.019          129.5
0.029          156.5
0.038          115.5
0.048          124.5

H4  (x')
0.010           49.5
0.019           39.5
0.029           66.5
0.038           25.5
0.048           34.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 4.8848E 02
0.019 6.5496E 02
0.029 1.4679E 03
0.038 4.7203E 03
0.048 4.8648E 03
PHASE
0.010   248.1943
0.019    19.8693
0.029   198.0637
0.038    57.3234
0.048   112.9342

Z[f,1,3]
0.010 5.4157E 03
0.019 1.1398E 04
0.029 1.4707E 03
0.038 3.6323E 04
0.048 1.7167E 04
PHASE
0.010   129.7200
0.019    80.5501
0.029   141.9716
0.038    88.2320
0.048   171.2504

Z[f,3,1]
0.010 1.2337E 02
0.019 2.8267E 01
0.029 5.3180E 02
0.038 1.0907E 03
0.048 6.1740E 02
PHASE
0.010   270.9541
0.019   240.5775
0.029    64.6428
0.038    52.1581
0.048    81.9409

Z[f,3,3]
0.010 7.0759E 01
0.019 1.5958E 02
0.029 1.1097E 02
0.038 4.4811E 03
0.048 2.6118E 03
PHASE
0.010   327.5394
0.019   104.9379
0.029   112.2266
0.038    97.2577
0.048   180.8307
```

DATA ANALYSIS STA. MT78-14

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```
ENTER INPUT FILE
 NUMBER
12
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
238
H2 AZ         148
E3 DIPOLE AZ
159
H4 AZ          69

DIPOLE ROTATION
ALPHA       195.5
BETA         26.5
COIL ROTATION
ALPHA        26.5
BETA         15.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
1
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
      1.5040e-01
RAW DELTA f =
      1.1750e-03
SMOOTHED FOURIER
FREQ'S =       32
SMOOTHED DELTA f
F =    9.4000e-03
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009988
```

```
AUTOSPECTRUM OF
MT14.E238.12
CHANNEL NO.     1
0.010 1.9598E-10
0.019 4.2683E-11
0.029 1.3693E-11
0.038 4.9194E-12
0.048 1.5774E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      7.0150e-09
****************
AUTOSPECTRUM OF
MT14.H148.12
CHANNEL NO.     2
0.010 1.0579E-11
0.019 8.5360E-12
0.029 8.1966E-13
0.038 1.2519E-13
0.048 3.2332E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.9116e-09
****************
AUTOSPECTRUM OF
MT14.E159.12
CHANNEL NO.     3
0.010 8.7065E-12
0.019 3.2485E-12
0.029 8.7378E-13
0.038 1.3469E-13
0.048 6.2409E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.4783e-09
****************
AUTOSPECTRUM OF
MT14.H69.12
CHANNEL NO.     4
0.010 3.2406E-11
0.019 3.2216E-11
0.029 1.3140E-12
0.038 4.3367E-13
0.048 1.3200E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.7736e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 2.3432E 04
0.019 1.2278E 04
0.029 6.0893E 04
0.038 1.9006E 05
0.048 2.9405E 05

CHANNELS 3 & 4
0.010 3.3985E 02
0.019 2.4760E 02
0.029 2.4245E 03
0.038 1.5022E 03
0.048 2.8495E 03
```

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.H148.12
CHANNEL NO.     2
0.010 3.4506E-11
0.019 1.6573E-11
0.029 2.0610E-12
0.038 3.1570E-13
0.048 8.8974E-14
PHASE
0.010   130.9875
0.019   111.9673
0.029   182.8981
0.038    76.6707
0.048   110.5840
MAGNITUDE OF
COHERENCE
0.010     0.7578
0.019     0.8682
0.029     0.6151
0.038     0.4023
0.048     0.3940
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.E159.12
CHANNEL NO.     3
0.010 3.1741E-11
0.019 8.1001E-12
0.029 2.6578E-12
0.038 6.6502E-13
0.048 2.7051E-13
PHASE
0.010     1.9544
0.019     6.8303
0.029    18.3974
0.038   348.1643
0.048     7.7203
MAGNITUDE OF
COHERENCE
0.010     0.7684
0.019     0.6879
0.029     0.7684
0.038     0.8170
0.048     0.8621
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 5.1146E-11
0.019 2.3596E-11
0.029 1.9516E-12
0.038 2.2710E-13
0.048 2.7436E-13
PHASE
0.010   322.8108
0.019   296.1200
0.029   332.4949
0.038    87.0586
0.048    69.1101
MAGNITUDE OF
COHERENCE
0.010     0.6418
0.019     0.6363
0.029     0.4601
0.038     0.1555
0.048     0.6013
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.     2
WITH
MT14.E159.12
CHANNEL NO.     3
0.010 4.6495E-12
0.019 3.4420E-12
0.029 4.2848E-13
0.038 4.3896E-14
0.048 1.1060E-14
PHASE
0.010   262.4987
0.019   274.5229
0.029   198.0568
0.038   246.5530
0.048   276.2584
MAGNITUDE OF
COHERENCE
0.010     0.4845
0.019     0.6536
0.029     0.5062
0.038     0.3380
0.048     0.2462
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.     2
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 1.3795E-11
0.019 1.3330E-11
0.029 2.7953E-13
0.038 5.7175E-14
0.048 7.7622E-15
PHASE
0.010   192.3415
0.019   185.5393
0.029   128.2623
0.038   115.7798
0.048   293.4586
MAGNITUDE OF
COHERENCE
0.010     0.7451
0.019     0.8038
0.029     0.2693
0.038     0.2454
0.048     0.1188
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E159.12
CHANNEL NO.     3
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 8.8699E-12
0.019 5.4581E-12
0.029 4.1918E-13
0.038 2.7211E-14
0.048 5.8223E-14
PHASE
0.010   281.8190
0.019   249.9800
0.029   302.5828
0.038   332.1406
0.048    65.4966
MAGNITUDE OF
COHERENCE
0.010     0.5281
0.019     0.5335
0.029     0.3912
0.038     0.1126
0.048     0.6415
```

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```
STRUCTURALLY-       SKEWNESS
ORIENTED
IMPEDANCE TENSOR    0.010 7.4792E-02
(RESISTIVITIES)     0.019 3.3107E-01
                    0.029 2.6943E-01
Z[1,1,f]            0.038 3.7319E-01
0.010 2.3142E 02    0.048 1.1139E 00
0.019 1.0538E 02    ****************
0.029 4.2905E 03    COHERENCE OF
0.038 2.6131E 03    E1-pred & E1-obs
0.048 2.3173E 04    0.0100    0.7666
PHASE               0.0194    0.8748
0.010   319.0274    0.0288    0.6951
0.019   131.4990    0.0382    0.4545
0.029   343.6455    0.0476    0.6873
0.038    59.4106    PHASE
0.048    71.1426    0.0100  360.0000
                    0.0194  360.0000
Z[1,3,f]            0.0288    0.0000
0.010 9.2608E 03    0.0382  360.0000
0.019 1.2506E 04    0.0476    0.0000
0.029 1.7821E 04
0.038 3.6893E 04    COHERENCE OF
0.048 3.3077E 04    E3-pred & E3-obs
PHASE               0.0100    0.5530
0.010   131.8734    0.0194    0.7301
0.019   113.9537    0.0288    0.5736
0.029   177.7431    0.0382    0.3735
0.038    81.7675    0.0476    0.6735
0.048   105.3317    PHASE
                    0.0100  360.0000
Z[3,1,f]            0.0194    0.0000
0.010 5.4361E 01    0.0288    0.0000
0.019 7.4031E 01    0.0382  360.0000
0.029 1.9007E 02    0.0476    0.0000
0.038 4.0363E 01
0.048 1.1357E 03
PHASE
0.010   265.3708
0.019   172.8589
0.029   309.0446
0.038     3.7980
0.048    67.5077

Z[3,3,f]
0.010 6.3198E 01
0.019 6.5598E 02
0.029 7.3716E 02
0.038 7.0237E 02
0.048 4.9628E 02
PHASE
0.010   127.5661
0.019   116.7628
0.029   158.7384
0.038   108.9737
0.048    67.5136
```

DATA ANALYSIS STA. MT78-14

DATA FILE 12 SPECTRAL FILE 37 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.010              7
0.019              4
0.029             18
0.038             -4
0.048            -15
****************
ROTATED AZIMUTH

E1 (x')
0.010           49.5
0.019           46.5
0.029           60.5
0.038           38.5
0.048           27.5

H2 (y')
0.010          139.5
0.019          136.5
0.029          150.5
0.038          128.5
0.048          117.5

E3 (y')
0.010          139.5
0.019          136.5
0.029          150.5
0.038          128.5
0.048          117.5

H4 (x')
0.010           49.5
0.019           46.5
0.029           60.5
0.038           38.5
0.048           27.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 1.5389E 01
0.019 3.3536E 02
0.029 6.1706E 02
0.038 1.4915E 03
0.048 1.0137E 04
PHASE
0.010   330.1201
0.019   125.2857
0.029   315.7152
0.038    52.5386
0.048    56.7006

Z[f,1,3]
0.010 9.5382E 03
0.019 1.2625E 04
0.029 2.1923E 04
0.038 3.7170E 04
0.048 3.8294E 04
PHASE
0.010   131.9189
0.019   113.8701
0.029   174.5387
0.038    81.1237
0.048   100.4697

Z[f,3,1]
0.010 4.2721E 01
0.019 7.6666E 01
0.029 3.1755E 01
0.038 7.4351E 01
0.048 2.9664E 03
PHASE
0.010   255.7598
0.019   169.3150
0.029   199.4114
0.038     5.4031
0.048    62.1781

Z[f,3,3]
0.010 1.3438E 01
0.019 3.0379E 02
0.029 4.6718E 02
0.038 1.5126E 03
0.048 6.4843E 03
PHASE
0.010   332.0318
0.019   116.4248
0.029    23.8684
0.038    99.0138
0.048    88.2590
```

DATA ANALYSIS STA. MT78-14

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```
ENTER INPUT FILE
 NUMBER
12
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
238
H2 AZ        148
E3 DIPOLE AZ
159
H4 AZ         69

DIPOLE ROTATION
ALPHA      195.5
BETA        26.5
COIL ROTATION
ALPHA       26.5
BETA        15.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
2
****************
N (ADJUSTED) =
             256
NYQUIST
FREQ =
      1.5040e-01
RAW DELTA f =
      1.1750e-03
SMOOTHED FOURIER
FREQ'S =      32
SMOOTHED DELTA f
F =   9.4000e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.009988
```

```
AUTOSPECTRUM OF
MT14.E238.12
CHANNEL NO.    1
0.010 1.9710E-10
0.019 6.8875E-11
0.029 1.4779E-11
0.038 5.0223E-12
0.048 5.8878E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      7.0150e-09
****************
AUTOSPECTRUM OF
MT14.H148.12
CHANNEL NO.    2
0.010 1.2419E-11
0.019 7.5700E-12
0.029 6.8548E-13
0.038 1.7252E-13
0.048 5.7094E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.9116e-09
****************
AUTOSPECTRUM OF
MT14.E159.12
CHANNEL NO.    3
0.010 9.8772E-12
0.019 2.6349E-12
0.029 7.8227E-13
0.038 1.7379E-13
0.048 8.5258E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.4783e-09
****************
AUTOSPECTRUM OF
MT14.H69.12
CHANNEL NO.    4
0.010 3.8739E-11
0.019 3.3266E-11
0.029 1.1627E-12
0.038 3.6012E-13
0.048 1.3493E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.7736e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 2.0075E 04
0.019 2.2341E 04
0.029 7.8610E 04
0.038 1.4080E 05
0.048 6.2153E 04

CHANNELS 3 & 4
0.010 3.2252E 02
0.019 1.9450E 02
0.029 2.4530E 03
0.038 2.3340E 03
0.048 3.8062E 03
```

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```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.    1
WITH
MT14.H148.12
CHANNEL NO.    2
0.010 3.6973E-11
0.019 1.6615E-11
0.029 1.7255E-12
0.038 3.0450E-13
0.048 7.5538E-14
PHASE
0.010   133.0373
0.019   100.7003
0.029   169.9018
0.038    88.0647
0.048   122.3154
MAGNITUDE OF
COHERENCE
0.010     0.7473
0.019     0.7276
0.029     0.5421
0.038     0.3271
0.048     0.4120
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.    1
WITH
MT14.E159.12
CHANNEL NO.    3
0.010 3.4255E-11
0.019 9.5765E-12
0.029 2.1453E-12
0.038 7.0796E-13
0.048 1.1222E-13
PHASE
0.010     3.0291
0.019    28.7719
0.029    20.9183
0.038   341.7045
0.048   348.5932
MAGNITUDE OF
COHERENCE
0.010     0.7764
0.019     0.7109
0.029     0.6309
0.038     0.7578
0.048     0.5009
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.    1
WITH
MT14.H69.12
CHANNEL NO.    4
0.010 6.5648E-11
0.019 3.0444E-11
0.029 1.9838E-12
0.038 2.1278E-13
0.048 8.8656E-14
PHASE
0.010   320.4505
0.019   304.4565
0.029   318.9671
0.038   198.6347
0.048   124.3310
MAGNITUDE OF
COHERENCE
0.010     0.7513
0.019     0.6360
0.029     0.4786
0.038     0.1582
0.048     0.3145
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.    2
WITH
MT14.E159.12
CHANNEL NO.    3
0.010 4.8591E-12
0.019 3.4596E-12
0.029 2.0726E-13
0.038 6.4300E-14
0.048 2.9445E-14
PHASE
0.010   256.7810
0.019   295.4475
0.029   192.3045
0.038   197.4631
0.048   154.1267
MAGNITUDE OF
COHERENCE
0.010     0.4387
0.019     0.7746
0.029     0.2830
0.038     0.3714
0.048     0.4220
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.    2
WITH
MT14.H69.12
CHANNEL NO.    4
0.010 1.8774E-11
0.019 1.3183E-11
0.029 1.2753E-13
0.038 1.0639E-13
0.048 2.7063E-14
PHASE
0.010   191.4671
0.019   188.7775
0.029   128.8320
0.038   137.8719
0.048   142.9436
MAGNITUDE OF
COHERENCE
0.010     0.8559
0.019     0.8308
0.029     0.1429
0.038     0.4268
0.048     0.3083
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E159.12
CHANNEL NO.    3
WITH
MT14.H69.12
CHANNEL NO.    4
0.010 1.1236E-11
0.019 6.4519E-12
0.029 3.7077E-13
0.038 8.3402E-14
0.048 5.7983E-14
PHASE
0.010   295.1244
0.019   249.6908
0.029   283.2311
0.038   287.2237
0.048    16.0548
MAGNITUDE OF
COHERENCE
0.010     0.5744
0.019     0.6891
0.029     0.3888
0.038     0.3334
0.048     0.5406
```

DATA ANALYSIS STA. MT78-14

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```
STRUCTURALLY-       SKEWNESS
ORIENTED
IMPEDANCE TENSOR    0.010 5.9605E-01
(RESISTIVITIES)     0.019 4.0364E-01
                    0.029 5.2618E-01
Z[1,1,f]            0.038 3.0752E-01
0.010 1.3386E 03    0.048 5.9744E-01
0.019 1.4362E 03    ***************
0.029 7.9919E 03    COHERENCE OF
0.038 5.3122E 02    E1-pred & E1-obs
0.048 5.6880E 03    0.0100    0.7836
PHASE               0.0194    0.7855
0.010   298.6883    0.0288    0.6803
0.019    16.0261    0.0382    0.3368
0.029   322.7421    0.0476    0.6045
0.038   136.6995    PHASE
0.048   113.3634    0.0100    0.0000
                    0.0194    0.0000
Z[1,3,f]            0.0288  360.0000
0.010 3.7267E 03    0.0382    0.0000
0.019 1.5320E 04    0.0476  360.0000
0.029 1.8760E 04
0.038 1.5224E 04    COHERENCE OF
0.048 1.8306E 04    E3-pred & E3-obs
PHASE               0.0100    0.5835
0.010   156.2740    0.0194    0.7826
0.019    68.5427    0.0288    0.4526
0.029   167.0699    0.0382    0.4227
0.038    94.6791    0.0476    0.6177
0.048   129.4654    PHASE
                    0.0100  360.0000
Z[3,1,f]            0.0194    0.0000
0.010 1.7845E 02    0.0288  360.0000
0.019 7.8374E 00    0.0382    0.0000
0.029 3.1234E 02    0.0476  360.0000
0.038 1.1645E 02
0.048 8.5608E 02
PHASE
0.010   295.9516
0.019   208.6395
0.029   281.7067
0.038   275.8087
0.048    24.0338

Z[3,3,f]
0.010 3.9551E 01
0.019 3.7963E 02
0.029 2.2805E 02
0.038 4.0249E 02
0.048 8.8810E 02
PHASE
0.010   287.2852
0.019    74.6880
0.029   170.8882
0.038   170.4736
0.048   190.3058
```

DATA ANALYSIS STA. MT78-14

DATA FILE 12 SPECTRAL FILE 38 PAGE 4 OF 4

```
OPTIMUM AXES                ROTATED
(CW ANGLE OF                IMPEDANCE TENSOR
ROTATION)                   (RESISTIVITIES)

0.010             13        Z[1,1,f]
0.019             -1        0.010 8.1899E 02
0.029             19        0.019 1.3441E 03
0.038             -3        0.029 2.4239E 03
0.048            -14        0.038 3.6426E 02
***************             0.048 1.6651E 03
ROTATED AZIMUTH             PHASE
                            0.010   281.6944
E1 (x')                     0.019    13.3713
0.010           55.5        0.029   296.5953
0.019           41.5        0.038   148.7298
0.029           61.5        0.048   113.0238
0.038           39.5
0.048           28.5        Z[f,1,3]
                            0.010 4.1046E 03
H2 (y')                     0.019 1.5327E 04
0.010          145.5        0.029 2.3554E 04
0.019          131.5        0.038 1.5305E 04
0.029          151.5        0.048 2.0092E 04
0.038          129.5        PHASE
0.048          118.5        0.010   152.4358
                            0.019    68.2828
E3 (y')                     0.029   162.3120
0.010          145.5        0.038    94.5820
0.019          131.5        0.048   125.6759
0.029          151.5
0.038          129.5        Z[f,3,1]
0.048          118.5        0.010 7.2379E 01
                            0.019 6.0188E 00
H4 (x')                     0.029 8.5249E 01
0.010           55.5        0.038 1.0959E 02
0.019           41.5        0.048 1.4144E 03
0.029           61.5        PHASE
0.038           39.5        0.010   305.4803
0.048           28.5        0.019   218.3396
                            0.029   188.2395
                            0.038   276.9909
                            0.048    36.9541

                            Z[f,3,3]
                            0.010 2.8734E 02
                            0.019 4.6651E 02
                            0.029 1.2291E 03
                            0.038 4.9493E 02
                            0.048 2.5664E 03
                            PHASE
                            0.010   323.5278
                            0.019    74.1418
                            0.029   347.3027
                            0.038   155.5146
                            0.048   148.6607
```

DATA ANALYSIS STA. MT78-14

DATA FILE 12 SPECTRAL FILE 40 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
12
TEST CASE
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
238
H2 AZ         148
E3 DIPOLE AZ
159
H4 AZ          69

DIPOLE ROTATION
ALPHA       195.5
BETA         26.5
COIL ROTATION
ALPHA        26.5
BETA         15.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
      1.5040e-01
RAW DELTA f =
      1.1750e-03
SMOOTHED FOURIER
FREQ'S =       32
SMOOTHED DELTA f
F =   9.4000e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009988
```

```
AUTOSPECTRUM OF
MT14.E238.12
CHANNEL NO.    1
0.010 2.0075E-10
0.019 1.8495E-10
0.029 2.0228E-11
0.038 7.8684E-12
0.048 2.2374E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      7.0150e-09
****************
AUTOSPECTRUM OF
MT14.H148.12
CHANNEL NO.    2
0.010 8.8281E-12
0.019 1.3478E-11
0.029 1.1915E-12
0.038 1.9281E-13
0.048 4.7164E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.9116e-09
****************
AUTOSPECTRUM OF
MT14.E159.12
CHANNEL NO.    3
0.010 2.7199E-10
0.019 1.5794E-10
0.029 2.4760E-11
0.038 5.2887E-12
0.048 1.6106E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.4783e-09
****************
AUTOSPECTRUM OF
MT14.H69.12
CHANNEL NO.    4
0.010 2.3803E-11
0.019 3.1459E-11
0.029 1.0686E-12
0.038 4.4640E-13
0.048 1.7416E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.7736e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 2.8764E 04
0.019 3.3693E 04
0.029 6.1900E 04
0.038 1.9737E 05
0.048 2.8591E 05

CHANNELS 3 & 4
0.010 1.4454E 04
0.019 1.2327E 04
0.029 8.4484E 04
0.038 5.7300E 04
0.048 5.5735E 04
```

DATA ANALYSIS STA. MT78-14

DATA FILE 12 SPECTRAL FILE 40 PAGE 2 OF 4

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.H148.12
CHANNEL NO.     2
0.010 3.3565E-11
0.019 3.2642E-11
0.029 1.4707E-12
0.038 5.9091E-13
0.048 6.1286E-14
PHASE
0.010   145.8104
0.019    98.2455
0.029   268.5710
0.038    86.0355
0.048    66.5900
MAGNITUDE OF
COHERENCE
0.010     0.7973
0.019     0.6538
0.029     0.2996
0.038     0.4797
0.048     0.1887
***************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.E159.12
CHANNEL NO.     3
0.010 1.3814E-10
0.019 1.2284E-10
0.029 1.2412E-11
0.038 4.0534E-12
0.048 1.5974E-12
PHASE
0.010   167.0503
0.019   175.0844
0.029   155.7897
0.038   187.9129
0.048   162.3371
MAGNITUDE OF
COHERENCE
0.010     0.5912
0.019     0.7188
0.029     0.5546
0.038     0.6284
0.048     0.8415
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.12
CHANNEL NO.     1
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 3.1250E-11
0.019 3.4450E-11
0.029 6.5954E-13
0.038 6.5452E-13
0.048 2.5108E-13
PHASE
0.010   350.4554
0.019   342.8568
0.029   271.5358
0.038    66.0608
0.048   163.8321
MAGNITUDE OF
COHERENCE
0.010     0.4521
0.019     0.4516
0.029     0.1419
0.038     0.3492
0.048     0.4022
***************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.     2
WITH
MT14.E159.12
CHANNEL NO.     3
0.010 2.2912E-11
0.019 7.1110E-12
0.029 3.2296E-12
0.038 4.7084E-13
0.048 1.2550E-13
PHASE
0.010   346.8577
0.019    63.8917
0.029   245.1386
0.038   119.9819
0.048   135.9319
MAGNITUDE OF
COHERENCE
0.010     0.4676
0.019     0.1541
0.029     0.5946
0.038     0.4663
0.048     0.4553
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.H148.12
CHANNEL NO.     2
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 9.2255E-12
0.019 1.3282E-11
0.029 6.4058E-13
0.038 1.2547E-13
0.048 4.3270E-14
PHASE
0.010   134.0594
0.019   179.4035
0.029   119.3317
0.038   182.9777
0.048   135.4838
MAGNITUDE OF
COHERENCE
0.010     0.6364
0.019     0.6450
0.029     0.5677
0.038     0.4277
0.048     0.4774
***************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E159.12
CHANNEL NO.     3
WITH
MT14.H69.12
CHANNEL NO.     4
0.010 4.8411E-11
0.019 3.3633E-11
0.029 6.4011E-13
0.038 1.6022E-13
0.048 2.6944E-13
PHASE
0.010   238.8630
0.019   209.3805
0.029   219.7688
0.038   304.3184
0.048    13.3322
MAGNITUDE OF
COHERENCE
0.010     0.6017
0.019     0.4772
0.029     0.1244
0.038     0.1043
0.048     0.5087
```

DATA ANALYSIS STA. MT78-14

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```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 9.7258E 02
0.019 9.4010E 03
0.029 1.0593E 04
0.038 3.7798E 04
0.048 1.4677E 04
PHASE
0.010    87.8238
0.019    37.1851
0.029   236.5070
0.038    74.5172
0.048   154.2847

Z[1,3,f]
0.010 2.3476E 04
0.019 3.4835E 04
0.029 1.5859E 04
0.038 1.1364E 05
0.048 7.4639E 03
PHASE
0.010   134.9779
0.019    71.7975
0.029   280.7147
0.038    80.6452
0.048   138.9335

Z[3,1,f]
0.010 7.4684E 03
0.019 8.8190E 03
0.029 8.8437E 03
0.038 6.0585E 03
0.048 8.5322E 03
PHASE
0.010   266.3938
0.019   220.9649
0.029    62.3209
0.038   263.1365
0.048    23.2029

Z[3,3,f]
0.010 1.0745E 04
0.019 1.0536E 04
0.029 4.5731E 04
0.038 4.7557E 04
0.048 1.7783E 04
PHASE
0.010   318.6313
0.019   235.7716
0.029   116.7770
0.038   244.6051
0.048   209.2982
```

```
SKEWNESS

0.010 3.9685E-01
0.019 1.2048E-01
0.029 8.9288E-01
0.038 1.0298E-01
0.048 1.4913E 00
****************
COHERENCE OF
E1-pred & E1-obs
0.0100     0.8306
0.0194     0.8987
0.0288     0.4402
0.0382     0.7697
0.0476     0.4265
PHASE
0.0100  360.0000
0.0194  360.0000
0.0288  360.0000
0.0382    0.0000
0.0476  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0100     0.7253
0.0194     0.6645
0.0288     0.6515
0.0382     0.5512
0.0476     0.5706
PHASE
0.0100  360.0000
0.0194    0.0000
0.0288  360.0000
0.0382    0.0000
0.0476  360.0000
```

DATA ANALYSIS STA. MT78-14

DATA FILE 12 SPECTRAL FILE 40 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.010           -27
0.019           -32
0.029           -40
0.038           -29
0.048           -28
****************
ROTATED AZIMUTH

E1 (x')
0.010          15.5
0.019          10.5
0.029           2.5
0.038          13.5
0.048          14.5

H2 (y')
0.010         105.5
0.019         100.5
0.029          92.5
0.038         103.5
0.048         104.5

E3 (y')
0.010         105.5
0.019         100.5
0.029          92.5
0.038         103.5
0.048         104.5

H4 (x')
0.010          15.5
0.019          10.5
0.029           2.5
0.038          13.5
0.048          14.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 3.9694E 03
0.019 3.1612E 03
0.029 1.3619E 04
0.038 1.2909E 02
0.048 1.4285E 04
PHASE
0.010     1.5162
0.019   323.1767
0.029   155.4776
0.038   262.0502
0.048   185.7690

Z[f,1,3]
0.010 3.4197E 04
0.019 5.8804E 04
0.029 5.9421E 04
0.038 2.0092E 05
0.048 1.1662E 04
PHASE
0.010   128.7894
0.019    59.6565
0.029   273.5565
0.038    76.3520
0.048   128.0295

Z[f,3,1]
0.010 2.7180E 03
0.019 9.2074E 02
0.029 2.5715E 03
0.038 2.3959E 03
0.048 1.1159E 04
PHASE
0.010   255.5797
0.019   257.2241
0.029   314.3281
0.038    31.6508
0.048    37.7698

Z[f,3,3]
0.010 1.7778E 03
0.019 7.0543E 02
0.029 5.4147E 03
0.038 1.6068E 03
0.048 1.1349E 04
PHASE
0.010   292.2964
0.019   163.7515
0.029   129.6595
0.038   177.6979
0.048   180.3639
```

DATA ANALYSIS STA. MT78-14

DATA FILE 13 SPECTRAL FILE 29 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
13
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
238
H2 AZ          148
E3 DIPOLE AZ
159
H4 AZ           69

DIPOLE ROTATION
ALPHA        195.5
BETA          26.5
COIL ROTATION
ALPHA         26.5
BETA          15.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
               256
NYQUIST
FREQ =
      1.5040e-01
RAW DELTA f =
      1.1750e-03
SMOOTHED FOURIER
FREQ'S =        32
SMOOTHED DELTA f
F =    9.4000e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009988
```

```
AUTOSPECTRUM OF
MT14.E238.22
CHANNEL NO.     1
0.010 2.2378E-10
0.019 9.7523E-11
0.029 1.2936E-11
0.038 4.1017E-12
0.048 6.5164E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      6.9740e-09
****************
AUTOSPECTRUM OF
MT14.H148.22
CHANNEL NO.     2
0.010 8.3349E-12
0.019 1.6653E-11
0.029 1.4851E-12
0.038 1.3797E-13
0.048 5.6297E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.9348e-09
****************
AUTOSPECTRUM OF
MT14.E159.22
CHANNEL NO.     3
0.010 3.5009E-12
0.019 1.9484E-12
0.029 2.8991E-13
0.038 9.5236E-14
0.048 2.8403E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      9.9926e-10
****************
AUTOSPECTRUM OF
MT14.H69.22
CHANNEL NO.     4
0.010 7.3218E-12
0.019 1.6074E-11
0.029 2.1247E-12
0.038 2.3649E-13
0.048 3.6701E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      2.7730e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 3.3962E 04
0.019 1.4379E 04
0.029 3.1760E 04
0.038 1.4378E 05
0.048 6.9763E 04

CHANNELS 3 & 4
0.010 6.0483E 02
0.019 2.5762E 02
0.029 4.9750E 02
0.038 1.9477E 03
0.048 4.6643E 03
```

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.22
CHANNEL NO.     1
WITH
MT14.H148.22
CHANNEL NO.     2
0.010 1.2049E-12
0.019 3.2588E-11
0.029 4.7860E-13
0.038 3.2193E-13
0.048 1.0099E-13
PHASE
0.010     84.0364
0.019    126.0212
0.029    201.4675
0.038    165.6630
0.048     16.2004
MAGNITUDE OF
COHERENCE
0.010      0.0279
0.019      0.8086
0.029      0.1092
0.038      0.4279
0.048      0.5273
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.E238.22
CHANNEL NO.     1
WITH
MT14.E159.22
CHANNEL NO.     3
0.010 1.8250E-11
0.019 8.5093E-12
0.029 8.3773E-13
0.038 2.7796E-13
0.048 9.9876E-14
PHASE
0.010     42.2899
0.019    287.3718
0.029     32.2696
0.038    341.5919
0.048     52.7876
MAGNITUDE OF
COHERENCE
0.010      0.6520
0.019      0.6173
0.029      0.4326
0.038      0.4447
0.048      0.7341
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.22
CHANNEL NO.     1
WITH
MT14.H69.22
CHANNEL NO.     4
0.010 1.4078E-11
0.019 2.2669E-11
0.029 1.8877E-12
0.038 4.2330E-13
0.048 2.2369E-14
PHASE
0.010    289.0705
0.019     54.4260
0.029    332.5318
0.038    155.3850
0.048    174.6985
MAGNITUDE OF
COHERENCE
0.010      0.3478
0.019      0.5726
0.029      0.3601
0.038      0.4298
0.048      0.1446
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.H148.22
CHANNEL NO.     2
WITH
MT14.E159.22
CHANNEL NO.     3
0.010 1.5575E-12
0.019 4.7489E-12
0.029 1.4676E-13
0.038 3.0703E-14
0.048 2.3976E-14
PHASE
0.010    164.0526
0.019    161.5311
0.029    212.3266
0.038    167.7083
0.048     64.2339
MAGNITUDE OF
COHERENCE
0.010      0.2883
0.019      0.8337
0.029      0.2237
0.038      0.2678
0.048      0.5996
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.H148.22
CHANNEL NO.     2
WITH
MT14.H69.22
CHANNEL NO.     4
0.010 2.6303E-12
0.019 1.0266E-11
0.029 7.3111E-13
0.038 9.2654E-14
0.048 1.2364E-14
PHASE
0.010     47.8553
0.019    311.7309
0.029    343.6696
0.038     18.0597
0.048    148.1474
MAGNITUDE OF
COHERENCE
0.010      0.3367
0.019      0.6275
0.029      0.4116
0.038      0.5129
0.048      0.2720
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E159.22
CHANNEL NO.     3
WITH
MT14.H69.22
CHANNEL NO.     4
0.010 1.2990E-12
0.019 2.7847E-12
0.029 1.4916E-13
0.038 6.5864E-14
0.048 1.2572E-14
PHASE
0.010    291.5980
0.019    181.5623
0.029    101.7533
0.038    248.6610
0.048     41.7166
MAGNITUDE OF
COHERENCE
0.010      0.2566
0.019      0.4976
0.029      0.1901
0.038      0.4389
0.048      0.3894
```

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 6.2492E 03
0.019 2.0968E 03
0.029 5.1139E 03
0.038 1.0325E 04
0.048 8.4445E 01
PHASE
0.010   289.6561
0.019   352.3820
0.029   336.0144
0.038   131.6178
0.048   256.8223

Z[1,3,f]
0.010 8.8623E 02
0.019 9.7574E 03
0.029 2.8149E 03
0.038 1.7385E 04
0.048 1.9422E 04
PHASE
0.010    65.5482
0.019   142.5707
0.029   182.6271
0.038   189.7669
0.048    15.3715

Z[3,1,f]
0.010 3.2154E 01
0.019 6.2119E 01
0.029 1.0217E 01
0.038 4.1918E 02
0.048 4.5761E 02
PHASE
0.010   312.1928
0.019   260.9747
0.029    79.3024
0.038   263.0870
0.048    19.5269

Z[3,3,f]
0.010 3.8610E 01
0.019 2.7199E 02
0.029 2.6530E 01
0.038 1.7086E 02
0.048 9.8096E 02
PHASE
0.010   180.4174
0.019   182.4796
0.029   161.6112
0.038   135.4564
0.048   303.5397
```

```
SKEWNESS

0.010 2.3808E 00
0.019 2.8897E-01
0.029 1.2321E 00
0.038 8.9932E-01
0.048 3.2371E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0100     0.3796
0.0194     0.8598
0.0288     0.4508
0.0382     0.5233
0.0476     0.5279
PHASE
0.0100     0.0000
0.0194     0.0000
0.0288     0.0000
0.0382     0.0000
0.0476     0.0000

COHERENCE OF
E3-pred & E3-obs
0.0100     0.3609
0.0194     0.9064
0.0288     0.2590
0.0382     0.4799
0.0476     0.6711
PHASE
0.0100     0.0000
0.0194   360.0000
0.0288     0.0000
0.0382   360.0000
0.0476   360.0000
```

DATA ANALYSIS STA. MT78-14

DATA FILE 13 SPECTRAL FILE 29 PAGE 4 OF 4

```
OPTIMUM AXES                ROTATED
(CW ANGLE OF                IMPEDANCE TENSOR
ROTATION)                   (RESISTIVITIES)

0.010          38           Z[1,1,f]
0.019          15           0.010 1.7178E 03
0.029          27           0.019 5.0872E 02
0.038         -11           0.029 1.3842E 03
0.048           3           0.038 8.2926E 03
****************            0.048 8.1178E 01
ROTATED AZIMUTH             PHASE
                            0.010   302.9322
E1 (x')                     0.019    19.0228
0.010         80.5          0.029   322.8726
0.019         57.5          0.038   116.4549
0.029         69.5          0.048   312.0542
0.038         31.5
0.048         45.5          Z[f,1,3]
                            0.010 3.0661E 03
H2 (y')                     0.019 1.1194E 04
0.010        170.5          0.029 5.0818E 03
0.019        147.5          0.038 1.8569E 04
0.029        159.5          0.048 1.9507E 04
0.038        121.5          PHASE
0.048        135.5          0.010   100.0961
                            0.019   146.8376
E3 (y')                     0.029   172.0673
0.010        170.5          0.038   183.4928
0.019        147.5          0.048    14.9047
0.029        159.5
0.038        121.5          Z[f,3,1]
0.048        135.5          0.010 8.7092E 02
                            0.019 2.2806E 02
H4 (x')                     0.029 5.2689E 02
0.010         80.5          0.038 1.1210E 02
0.019         57.5          0.048 4.6826E 02
0.029         69.5          PHASE
0.038         31.5          0.010   128.1280
0.048         45.5          0.019   221.1883
                            0.029   137.8260
                            0.038   216.2446
                            0.048    16.4635

                            Z[f,3,3]
                            0.010 1.5514E 03
                            0.019 2.5737E 02
                            0.029 9.7260E 02
                            0.038 1.3259E 03
                            0.048 8.8864E 02
                            PHASE
                            0.010   267.6644
                            0.019   298.2235
                            0.029   350.7959
                            0.038   174.3191
                            0.048   287.9253
```

DATA ANALYSIS STA. MT78-14
DATA FILE 13 SPECTRAL FILE 41 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
13
TEST CASE
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
238
H2 AZ          148
E3 DIPOLE AZ
159
H4 AZ           69

DIPOLE ROTATION
ALPHA        195.5
BETA          26.5
COIL ROTATION
ALPHA         26.5
BETA          15.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
               256
NYQUIST
FREQ =
      1.5040e-01
RAW DELTA f =
      1.1750e-03
SMOOTHED FOURIER
FREQ'S =        32
SMOOTHED DELTA f
F =   9.4000e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009988
```

```
AUTOSPECTRUM OF
MT14.E238.22
CHANNEL NO.     1
0.010 9.3543E-10
0.019 7.2085E-10
0.029 7.9205E-11
0.038 2.3385E-11
0.048 5.6191E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      6.9740e-09
****************
AUTOSPECTRUM OF
MT14.H148.22
CHANNEL NO.     2
0.010 8.3349E-12
0.019 1.6653E-11
0.029 1.4651E-12
0.038 1.3797E-13
0.048 5.6297E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.9348e-09
****************
AUTOSPECTRUM OF
MT14.E159.22
CHANNEL NO.     3
0.010 2.1324E-10
0.019 1.6012E-10
0.029 2.0009E-11
0.038 6.2128E-12
0.048 1.8485E-12
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      9.9926e-10
****************
AUTOSPECTRUM OF
MT14.H69.22
CHANNEL NO.     4
0.010 7.3218E-12
0.019 1.6074E-11
0.029 2.1247E-12
0.038 2.3649E-13
0.048 3.6701E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      2.7730e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.010 1.4196E 05
0.019 1.0629E 05
0.029 1.9445E 05
0.038 8.1972E 05
0.048 6.0157E 05

CHANNELS 3 & 4
0.010 3.6840E 04
0.019 2.4459E 04
0.029 3.4336E 04
0.038 1.2706E 05
0.048 3.0356E 05
```

DATA ANALYSIS STA. MT78-14

DATA FILE 13 SPECTRAL FILE 41 PAGE 2 OF 4

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.22
CHANNEL NO.    1
WITH
MT14.H148.22
CHANNEL NO.    2
0.010 2.4891E-11
0.019 8.3335E-11
0.029 1.8397E-12
0.038 3.3171E-13
0.048 3.9191E-13
PHASE
0.010    21.3742
0.019    69.7719
0.029   301.6332
0.038   125.8416
0.048    83.5479
MAGNITUDE OF
COHERENCE
0.010     0.2819
0.019     0.7606
0.029     0.1696
0.038     0.1847
0.048     0.6968
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.E238.22
CHANNEL NO.    1
WITH
MT14.E159.22
CHANNEL NO.    3
0.010 3.9296E-10
0.019 3.2196E-10
0.029 3.5779E-11
0.038 1.0675E-11
0.048 3.0880E-12
PHASE
0.010   161.7979
0.019   194.6069
0.029   172.7971
0.038   184.7497
0.048   165.0765
MAGNITUDE OF
COHERENCE
0.010     0.8799
0.019     0.9477
0.029     0.8988
0.038     0.8856
0.048     0.9581
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E238.22
CHANNEL NO.    1
WITH
MT14.H69.22
CHANNEL NO.    4
0.010 9.6395E-12
0.019 8.0686E-11
0.029 5.6806E-12
0.038 1.3811E-12
0.048 2.2724E-13
PHASE
0.010   283.8143
0.019    29.5145
0.029   314.3770
0.038   108.5527
0.048   212.9818
MAGNITUDE OF
COHERENCE
0.010     0.1165
0.019     0.7496
0.029     0.4379
0.038     0.5873
0.048     0.5004
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.H148.22
CHANNEL NO.    2
WITH
MT14.E159.22
CHANNEL NO.    3
0.010 1.4139E-11
0.019 4.0723E-11
0.029 1.1667E-12
0.038 1.3795E-13
0.048 2.1144E-13
PHASE
0.010   161.4757
0.019   135.9993
0.029   223.1294
0.038   130.9656
0.048    79.6815
MAGNITUDE OF
COHERENCE
0.010     0.3354
0.019     0.7886
0.029     0.2140
0.038     0.1490
0.048     0.6554
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT14.H148.22
CHANNEL NO.    2
WITH
MT14.H69.22
CHANNEL NO.    4
0.010 2.6303E-12
0.019 1.0266E-11
0.029 7.3111E-13
0.038 9.2654E-14
0.048 1.2364E-14
PHASE
0.010    47.8552
0.019   311.7369
0.029   343.6696
0.038    18.0597
0.048   148.1474
MAGNITUDE OF
COHERENCE
0.010     0.3367
0.019     0.6275
0.029     0.4116
0.038     0.5129
0.048     0.2720
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT14.E159.22
CHANNEL NO.    3
WITH
MT14.H69.22
CHANNEL NO.    4
0.010 3.6444E-12
0.019 3.4103E-11
0.029 2.1682E-12
0.038 6.4670E-13
0.048 1.2102E-13
PHASE
0.010   297.1479
0.019   198.9729
0.029   124.1791
0.038   270.3981
0.048    37.2753
MAGNITUDE OF
COHERENCE
0.010     0.0922
0.019     0.6722
0.029     0.3325
0.038     0.5335
0.048     0.4646
```

DATA ANALYSIS STA. MT78-14

DATA FILE 13 SPECTRAL FILE 41 PAGE 3 OF 4

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 8.3832E 03
0.019 2.4305E 04
0.029 2.8210E 04
0.038 2.3177E 05
0.048 1.1478E 05
PHASE
0.010   268.3409
0.019    43.0196
0.029   319.5209
0.038   102.4201
0.048   202.2515

Z[1,3,f]
0.010 1.7916E 04
0.019 2.6383E 04
0.029 2.2033E 03
0.038 5.1482E 04
0.048 2.2758E 05
PHASE
0.010    25.4270
0.019    57.2376
0.029   219.5050
0.038   235.1455
0.048    87.9451

Z[3,1,f]
0.010 3.7885E 02
0.019 5.6855E 03
0.029 2.9799E 03
0.038 5.0447E 04
0.048 3.7501E 04
PHASE
0.010    13.7643
0.019   240.8888
0.029   125.4884
0.038   274.1316
0.048    20.7960

Z[3,3,f]
0.010 4.1279E 03
0.019 1.2111E 04
0.029 4.3229E 02
0.038 8.9016E 03
0.048 7.0123E 04
PHASE
0.010   194.1678
0.019   201.4625
0.029   130.4696
0.038    95.6446
0.048   287.1374
```

```
SKEWNESS

0.010 1.0916E 00
0.019 2.8226E-01
0.029 1.9808E 00
0.038 3.8176E 00
0.048 1.0194E 00
****************
COHERENCE OF
E1-pred & E1-obs
0.0100    0.3542
0.0194    0.8440
0.0288    0.4485
0.0382    0.6255
0.0476    0.7751
PHASE
0.0100    0.0000
0.0194  360.0000
0.0288  360.0000
0.0382  360.0000
0.0476  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0100    0.3487
0.0194    0.8734
0.0288    0.3434
0.0382    0.5610
0.0476    0.7376
PHASE
0.0100    0.0000
0.0194  360.0000
0.0288  360.0000
0.0382  360.0000
0.0476  360.0000
```

DATA ANALYSIS STA. MT78-14

DATA FILE 13 SPECTRAL FILE 41 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.010           -7
0.019          -36
0.029          -54
0.038          -69
0.048            2
****************
ROTATED AZIMUTH

E1 (x')
0.010         35.5
0.019          6.5
0.029        348.5
0.038        333.5
0.048         44.5

H2 (y')
0.010        125.5
0.019         96.5
0.029         78.5
0.038         63.5
0.048        134.5

E3 (y')
0.010        125.5
0.019         96.5
0.029         78.5
0.038         63.5
0.048        134.5

H4 (x')
0.010         35.5
0.019          6.5
0.029        348.5
0.038        333.5
0.048         44.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.010 1.0004E 04
0.019 7.0839E 02
0.029 5.7429E 03
0.038 7.8371E 04
0.048 1.0572E 05
PHASE
0.010   253.2046
0.019    56.0515
0.029   333.1272
0.038    86.6040
0.048   199.6653

Z[f,1,3]
0.010 1.8126E 04
0.019 6.3049E 04
0.029 1.5442E 04
0.038 9.2222E 04
0.048 2;2346E 05
PHASE
0.010    20.6041
0.019    46.4161
0.029   307.3547
0.038   101.8372
0.048    86.2979

Z[f,3,1]
0.010 6.0790E 02
0.019 2.7784E 03
0.029 6.9866E 03
0.038 7.4267E 04
0.048 4.1874E 04
PHASE
0.010   347.2067
0.019   337.0179
0.029   342.9775
0.038    72.1450
0.048    18.1484

Z[f,3,3]
0.010 2.0675E 03
0.019 1.9485E 03
0.029 5.6539E 03
0.038 9.7738E 04
0.048 7.8933E 04
PHASE
0.010   191.8533
0.019    94.2873
0.029   308.3585
0.038   114.4518
0.048   284.5626
```

DATA ANALYSIS STA. MT78-18

DATA FILE 14 SPECTRAL FILE 30 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
14
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
263
H2 AZ         173
E3 DIPOLE AZ
328
H4 AZ         238

DIPOLE ROTATION
ALPHA       220.5
BETA        195.5
COIL ROTATION
ALPHA       195.5
BETA         40.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
      1.4187e-01
RAW DELTA f =
      1.1083e-03
SMOOTHED FOURIER
FREQ'S =       32
SMOOTHED DELTA f
F =   8.8667e-03
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.009421
```

```
AUTOSPECTRUM OF
MT18.E263.12
CHANNEL NO.     1
0.009 2.4932E-12
0.018 3.9632E-12
0.027 6.7021E-13
0.036 2.1321E-13
0.045 1.0781E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      5.5606e-09
****************
AUTOSPECTRUM OF
MT18.H173.12
CHANNEL NO.     2
0.009 1.0755E-11
0.018 1.3171E-11
0.027 1.6716E-12
0.036 5.6923E-13
0.045 2.3467E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      3.8692e-09
****************
AUTOSPECTRUM OF
MT18.E328.12
CHANNEL NO.     3
0.009 5.9947E-11
0.018 9.3945E-11
0.027 5.2062E-12
0.036 1.8260E-12
0.045 1.3228E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      5.9375e-09
****************
AUTOSPECTRUM OF
MT18.H238.12
CHANNEL NO.     4
0.009 2.6468E-12
0.018 5.6968E-12
0.027 7.2289E-13
0.036 2.2946E-13
0.045 5.2881E-14
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      2.7177e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.009 2.7660E 02
0.018 6.9696E 02
0.027 1.3789E 03
0.036 1.7088E 03
0.045 2.6118E 03

CHANNELS 3 & 4
0.009 2.7023E 04
0.018 3.8195E 04
0.027 2.4769E 04
0.036 3.6385E 04
0.045 1.4221E 04
```

DATA ANALYSIS STA. MT78-18

DATA FILE 14 SPECTRAL FILE 30 PAGE 2 OF 4

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.E263.12
CHANNEL NO.     1
WITH
MT18.H173.12
CHANNEL NO.     2
0.009 1.1262E-12
0.018 4.7101E-12
0.027 1.3545E-13
0.036 1.5485E-13
0.045 3.3541E-14
PHASE
0.009     73.1427
0.018    127.0198
0.027    309.9595
0.036    158.9993
0.045    139.7580
MAGNITUDE OF
COHERENCE
0.009      0.2175
0.018      0.6519
0.027      0.1280
0.036      0.4445
0.045      0.2109
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT18.E263.12
CHANNEL NO.     1
WITH
MT18.E328.12
CHANNEL NO.     3
0.009 1.1185E-11
0.018 1.6968E-11
0.027 1.0460E-12
0.036 3.3334E-13
0.045 2.3877E-14
PHASE
0.009    350.7520
0.018    359.9623
0.027     25.8868
0.036     13.6209
0.045     51.5830
MAGNITUDE OF
COHERENCE
0.009      0.9149
0.018      0.8794
0.027      0.5600
0.036      0.5342
0.045      0.1999
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.E263.12
CHANNEL NO.     1
WITH
MT18.H238.12
CHANNEL NO.     4
0.009 1.7880E-12
0.018 3.6927E-12
0.027 2.3712E-13
0.036 1.0317E-13
0.045 9.3874E-15
PHASE
0.009    346.7290
0.018    332.5223
0.027    346.3260
0.036    348.8145
0.045     95.3228
MAGNITUDE OF
COHERENCE
0.009      0.6960
0.018      0.7771
0.027      0.3407
0.036      0.4665
0.045      0.1243
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.H173.12
CHANNEL NO.     2
WITH
MT18.E328.12
CHANNEL NO.     3
0.009 4.8276E-12
0.018 2.7144E-11
0.027 5.7124E-13
0.036 1.9527E-13
0.045 4.0189E-14
PHASE
0.009    263.4142
0.018    236.5277
0.027    266.7749
0.036    204.3198
0.045     90.9908
MAGNITUDE OF
COHERENCE
0.009      0.1901
0.018      0.7717
0.027      0.1936
0.036      0.1915
0.045      0.2281
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT18.H173.12
CHANNEL NO.     2
WITH
MT18.H238.12
CHANNEL NO.     4
0.009 5.9248E-13
0.018 3.8574E-12
0.027 3.7770E-13
0.036 1.0954E-13
0.045 2.6502E-14
PHASE
0.009     59.0738
0.018    210.3643
0.027     17.9252
0.036    273.4164
0.045    262.0576
MAGNITUDE OF
COHERENCE
0.009      0.1110
0.018      0.4453
0.027      0.3436
0.036      0.3031
0.045      0.2379
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.E328.12
CHANNEL NO.     3
WITH
MT18.H238.12
CHANNEL NO.     4
0.009 9.6352E-12
0.018 1.9994E-11
0.027 1.4240E-12
0.036 4.7002E-13
0.045 3.6664E-14
PHASE
0.009    351.3299
0.018    338.2171
0.027    345.0040
0.036    329.7589
0.045     54.0783
MAGNITUDE OF
COHERENCE
0.009      0.7649
0.018      0.8643
0.027      0.7340
0.036      0.7261
0.045      0.4384
```

DATA ANALYSIS STA. MT78-18

DATA FILE 14 SPECTRAL FILE 30 PAGE 3 OF 4

```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 5.9072E 02
0.018 5.9824E 02
0.027 3.6716E 02
0.036 1.1397E 03
0.045 1.3746E 02
PHASE
0.009   345.6341
0.018   329.6350
0.027   348.9898
0.036   332.2966
0.045   118.4362

Z[1,3,f]
0.009 2.2959E 01
0.018 1.0321E 02
0.027 2.9385E 00
0.036 4.2175E 02
0.045 1.1128E 02
PHASE
0.009    81.9951
0.018   132.4755
0.027   244.5315
0.036   177.1433
0.045   132.7444

Z[3,1,f]
0.009 1.7082E 04
0.018 1.6212E 04
0.027 1.9132E 04
0.036 2.3961E 04
0.045 3.4627E 03
PHASE
0.009   350.9138
0.018   341.0977
0.027   341.0295
0.036   325.3060
0.045    48.1159

Z[3,3,f]
0.009 5.0764E 02
0.018 3.8904E 03
0.027 2.1856E 03
0.036 1.7532E 03
0.045 3.0424E 02
PHASE
0.009   101.4087
0.018   119.1386
0.027   123.9691
0.036   199.3811
0.045   287.6541
```

```
SKEWNESS

0.009 1.9058E-01
0.018 3.1631E-01
0.027 2.5892E-01
0.036 1.8026E-01
0.045 1.0745E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0094    0.7526
0.0183    0.8501
0.0272    0.3434
0.0360    0.6646
0.0449    0.2359
PHASE
0.0094  360.0000
0.0183  360.0000
0.0272    0.0000
0.0360    0.0000
0.0449    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0094    0.8127
0.0183    0.9674
0.0272    0.8478
0.0360    0.7975
0.0449    0.5308
PHASE
0.0094    0.0000
0.0183  360.0000
0.0272    0.0000
0.0360  360.0000
0.0449  360.0000
```

DATA ANALYSIS STA. MT78-18

DATA FILE 14 SPECTRAL FILE 30 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.009           83
0.018           73
0.027           79
0.036           78
0.045           81
****************
ROTATED AZIMUTH

E1 (x')
0.009        125.5
0.018        115.5
0.027        121.5
0.036        120.5
0.045        123.5

H2 (y')
0.009        215.5
0.018        205.5
0.027        211.5
0.036        210.5
0.045        213.5

E3 (y')
0.009        215.5
0.018        205.5
0.027        211.5
0.036        210.5
0.045        213.5

H4 (x')
0.009        125.5
0.018        115.5
0.027        121.5
0.036        120.5
0.045        123.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 5.2563E 02
0.018 1.5802E 03
0.027 8.1312E 02
0.036 1.2225E 03
0.045 1.6369E 02
PHASE
0.009    59.4568
0.018    81.6229
0.027    90.2482
0.036   244.9812
0.045   321.3191

Z[f,1,3]
0.009 1.7602E 04
0.018 1.8915E 04
0.027 2.0709E 04
0.036 2.5881E 04
0.045 3.5375E 03
PHASE
0.009   169.6637
0.018   155.4918
0.027   159.1507
0.036   148.2274
0.045   231.7518

Z[f,3,1]
0.009 7.0232E 00
0.018 7.3816E 01
0.027 6.9528E 01
0.036 1.4088E 02
0.045 2.0601E 02
PHASE
0.009   216.5981
0.018    75.3102
0.027   110.6670
0.036   338.1269
0.045   312.1185

Z[f,3,3]
0.009 6.8924E 01
0.018 2.3453E 02
0.027 9.5209E 01
0.036 3.1195E 01
0.045 1.0853E 02
PHASE
0.009   333.6104
0.018   169.5124
0.027   137.4592
0.036    22.0135
0.045   170.6934
```

DATA ANALYSIS STA. MT78-18

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```
ENTER INPUT FILE
 NUMBER
15
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
263
H2 AZ          173
E3 DIPOLE AZ
328
H4 AZ          238

DIPOLE ROTATION
ALPHA        220.5
BETA         195.5
COIL ROTATION
ALPHA        195.5
BETA          40.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
               256
NYQUIST
FREQ =
      1.4187e-01
RAW DELTA f =
      1.1083e-03
SMOOTHED FOURIER
FREQ'S =        32
SMOOTHED DELTA f
F =    8.8667e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =       0.009421
```

```
AUTOSPECTRUM OF
MT18.E263.22
CHANNEL NO.     1
0.009 6.4843E-12
0.018 4.5837E-12
0.027 2.5859E-12
0.036 8.2897E-13
0.045 6.7018E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
       5.5606e-09
****************
AUTOSPECTRUM OF
MT18.H173.22
CHANNEL NO.     2
0.009 2.1243E-11
0.018 1.9704E-11
0.027 4.3024E-12
0.036 5.2555E-12
0.045 1.4124E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
       3.8724e-09
****************
AUTOSPECTRUM OF
MT18.E328.22
CHANNEL NO.     3
0.009 1.4697E-10
0.018 5.9078E-11
0.027 1.4986E-11
0.036 4.5010E-12
0.045 8.5133E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
       5.9326e-09
****************
AUTOSPECTRUM OF
MT18.H238.22
CHANNEL NO.     4
0.009 1.6306E-11
0.018 3.0169E-12
0.027 1.0568E-12
0.036 2.9350E-12
0.045 4.9794E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
       2.7336e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.009 3.6421E 02
0.018 5.3879E 02
0.027 2.0670E 03
0.036 7.1960E 02
0.045 2.6975E 03

CHANNELS 3 & 4
0.009 1.0754E 04
0.018 4.5355E 04
0.027 4.8769E 04
0.036 6.9964E 03
0.045 9.7198E 03
```

```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.E263.22
CHANNEL NO.     1
WITH
MT18.H173.22
CHANNEL NO.     2
0.009 6.5438E-12
0.018 6.4117E-12
0.027 1.1985E-12
0.036 1.1256E-12
0.045 3.7522E-13
PHASE
0.009       6.9527
0.018      93.7345
0.027     122.1364
0.036     223.7792
0.045     193.6108
MAGNITUDE OF
COHERENCE
0.009       0.5576
0.018       0.6747
0.027       0.3593
0.036       0.5393
0.045       0.3857
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT18.E263.22
CHANNEL NO.     1
WITH
MT18.E328.22
CHANNEL NO.     3
0.009 3.0097E-11
0.018 1.5803E-11
0.027 5.6864E-12
0.036 1.3739E-12
0.045 4.8818E-13
PHASE
0.009     336.7131
0.018     321.4813
0.027     295.8227
0.036     303.9542
0.045     305.2775
MAGNITUDE OF
COHERENCE
0.009       0.9750
0.018       0.9603
0.027       0.9134
0.036       0.7113
0.045       0.6463
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.E263.22
CHANNEL NO.     1
WITH
MT18.H238.22
CHANNEL NO.     4
0.009 5.5252E-12
0.018 1.4798E-12
0.027 2.9159E-13
0.036 1.3038E-12
0.045 3.5433E-13
PHASE
0.009     314.1166
0.018       6.5921
0.027     249.9404
0.036     258.5650
0.045     320.8112
MAGNITUDE OF
COHERENCE
0.009       0.5373
0.018       0.3979
0.027       0.1764
0.036       0.8359
0.045       0.6134
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.H173.22
CHANNEL NO.     2
WITH
MT18.E328.22
CHANNEL NO.     3
0.009 3.1864E-11
0.018 2.4514E-11
0.027 3.6682E-12
0.036 1.8621E-12
0.045 2.5398E-13
PHASE
0.009     324.7575
0.018     236.9906
0.027     159.7779
0.036      88.3726
0.045     143.9958
MAGNITUDE OF
COHERENCE
0.009       0.5703
0.018       0.7185
0.027       0.4568
0.036       0.3829
0.045       0.2316
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT18.H173.22
CHANNEL NO.     2
WITH
MT18.H238.22
CHANNEL NO.     4
0.009 1.3149E-11
0.018 3.9772E-12
0.027 1.2420E-12
0.036 2.7285E-12
0.045 1.9710E-13
PHASE
0.009     314.9576
0.018     327.7329
0.027     326.2302
0.036      42.0020
0.045      94.8080
MAGNITUDE OF
COHERENCE
0.009       0.7065
0.018       0.5158
0.027       0.5824
0.036       0.6947
0.045       0.2350
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT18.E328.22
CHANNEL NO.     3
WITH
MT18.H238.22
CHANNEL NO.     4
0.009 2.8274E-11
0.018 7.1314E-12
0.027 4.9815E-13
0.036 2.5907E-12
0.045 5.3878E-13
PHASE
0.009     338.7530
0.018      53.4008
0.027     267.0574
0.036     322.3051
0.045     354.6180
MAGNITUDE OF
COHERENCE
0.009       0.5776
0.018       0.5342
0.027       0.1252
0.036       0.7128
0.045       0.8275
```

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```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 4.6296E 01
0.018 7.8470E 02
0.027 2.7938E 03
0.036 1.0479E 03
0.045 2.4907E 03
PHASE
0.009   294.1528
0.018   311.3733
0.027   259.9462
0.036   252.7755
0.045   325.9796

Z[1,3,f]
0.009 5.1646E 01
0.018 3.3805E 02
0.027 9.9283E 02
0.036 1.7948E 01
0.045 2.2855E 02
PHASE
0.009    22.7921
0.018   110.5208
0.027   118.0701
0.036   340.5559
0.045   177.3014

Z[3,1,f]
0.009 1.7044E 03
0.018 9.0864E 03
0.027 1.1027E 04
0.036 5.3320E 03
0.045 6.7813E 03
PHASE
0.009   315.1116
0.018    10.2157
0.027   323.3992
0.036   327.4016
0.045   357.3548

Z[3,3,f]
0.009 1.1708E 03
0.018 3.5757E 03
0.027 6.2079E 03
0.036 2.4757E 02
0.045 1.0155E 02
PHASE
0.009    60.6668
0.018   141.5134
0.027   191.5573
0.036   126.6282
0.045   160.1338
```

```
SKEWNESS

0.009 7.8365E-01
0.018 3.2514E-01
0.027 8.1883E-01
0.036 3.8250E-01
0.045 4.1256E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0094    0.5999
0.0183    0.7867
0.0272    0.5903
0.0360    0.8436
0.0449    0.5755
PHASE
0.0094    0.0000
0.0183  360.0000
0.0272    0.0000
0.0360  360.0000
0.0449    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0094    0.6361
0.0183    0.8144
0.0272    0.5984
0.0360    0.7354
0.0449    0.8443
PHASE
0.0094  360.0000
0.0183    0.0000
0.0272  360.0000
0.0360  360.0000
0.0449    0.0000
```

DATA ANALYSIS STA. MT78-18

DATA FILE 15 SPECTRAL FILE 31 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.009          75
0.018          70
0.027          68
0.036          80
0.045          69
***************
ROTATED AZIMUTH

E1 (x')
0.009       117.5
0.018       112.5
0.027       110.5
0.036       122.5
0.045       111.5

H2 (y')
0.009       207.5
0.018       202.5
0.027       200.5
0.036       212.5
0.045       201.5

E3 (y')
0.009       207.5
0.018       202.5
0.027       200.5
0.036       212.5
0.045       201.5

H4 (x')
0.009       117.5
0.018       112.5
0.027       110.5
0.036       122.5
0.045       111.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[i,1,f]
0.009 1.0486E 03
0.018 1.8343E 03
0.027 2.9809E 03
0.036 2.2158E 01
0.045 3.8377E 02
PHASE
0.009    40.0304
0.018   105.0019
0.027   217.1389
0.036    67.3870
0.045   355.2134

Z[f,1,3]
0.009 1.8688E 03
0.018 1.0972E 04
0.027 1.4580E 04
0.036 5.6168E 03
0.045 8.4096E 03
PHASE
0.009   122.6957
0.018   176.8245
0.027   144.3827
0.036   142.5632
0.045   171.2873

Z[f,3,1]
0.009 2.0424E 01
0.018 4.8865E 01
0.027 4.0468E 02
0.036 6.2136E 01
0.045 1.3308E 02
PHASE
0.009    99.2646
0.018   128.2622
0.027   272.7637
0.036   104.5892
0.045    54.3937

Z[f,3,3]
0.009 3.5349E 01
0.018 9.2987E 02
0.027 3.0558E 03
0.036 9.4442E 02
0.045 6.7563E 02
PHASE
0.009   151.9741
0.018   235.6526
0.027   219.1052
0.036   227.4462
0.045   298.4070
```

DATA ANALYSIS STA. MT78-19

DATA FILE 16 SPECTRAL FILE 32 PAGE 1 OF 4

```
ENTER INPUT FILE
 NUMBER
16
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
249
H2 AZ          159
E3 DIPOLE AZ
143
H4 AZ           53

DIPOLE ROTATION
ALPHA        206.5
BETA          10.5
COIL ROTATION
ALPHA         10.5
BETA          26.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
               256
NYQUIST
FREQ =
       1.4133e-01
RAW DELTA f =
       1.1042e-03
SMOOTHED FOURIER
FREQ'S =        32
SMOOTHED DELTA f
F =    8.8333e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =       0.009385
```

```
AUTOSPECTRUM OF
MT19.E249.12
CHANNEL NO.     1
0.009 1.0819E-11
0.018 2.0526E-12
0.027 1.3112E-12
0.036 2.0356E-13
0.045 1.5885E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
       2.1150e-09
****************
AUTOSPECTRUM OF
MT19.H159.12
CHANNEL NO.     2
0.009 5.0749E-11
0.018 1.9936E-11
0.027 2.9814E-12
0.036 9.6778E-13
0.045 2.4638E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
       9.5076e-09
****************
AUTOSPECTRUM OF
MT19.E143.12
CHANNEL NO.     3
0.009 3.2454E-10
0.018 4.5567E-11
0.027 2.3216E-11
0.036 5.0192E-12
0.045 7.4346E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
       1.4983e-08
****************
AUTOSPECTRUM OF
MT19.H53.12
CHANNEL NO.     4
0.009 6.7810E-11
0.018 1.1462E-11
0.027 6.6627E-12
0.036 1.1136E-12
0.045 4.6872E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
       6.7005e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.009 2.5341E 02
0.018 2.3757E 02
0.027 1.5068E 03
0.036 9.5598E 02
0.045 3.6517E 02

CHANNELS 3 & 4
0.009 5.6990E 03
0.018 9.1729E 03
0.027 1.1938E 04
0.036 2.0484E 04
0.045 8.9834E 03
```

DATA ANALYSIS STA. MT78-19

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```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E249.12
CHANNEL NO.    1
WITH
MT19.H159.12
CHANNEL NO.    2
0.009 1.9262E-11
0.018 2.7951E-12
0.027 8.1703E-13
0.036 2.7873E-13
0.045 1.0966E-14
PHASE
0.009   285.5163
0.018   313.4901
0.027   303.6712
0.036   349.7639
0.045   321.4961
MAGNITUDE OF
COHERENCE
0.009     0.8220
0.018     0.4369
0.027     0.4132
0.036     0.6280
0.045     0.1753
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT19.E249.12
CHANNEL NO.    1
WITH
MT19.E143.12
CHANNEL NO.    3
0.009 5.8243E-11
0.018 8.8390E-12
0.027 5.2291E-12
0.036 8.6645E-13
0.045 3.6590E-14
PHASE
0.009   156.7384
0.018   129.9458
0.027   125.9686
0.036   123.0675
0.045   157.7079
MAGNITUDE OF
COHERENCE
0.009     0.9829
0.018     0.9139
0.027     0.9478
0.036     0.8572
0.045     0.3367
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E249.12
CHANNEL NO.    1
WITH
MT19.H53.12
CHANNEL NO.    4
0.009 2.2402E-11
0.018 3.9186E-12
0.027 2.7765E-12
0.036 3.1131E-13
0.045 2.8725E-14
PHASE
0.009   147.2495
0.018    90.4408
0.027    98.2057
0.036   128.5309
0.045   207.1118
MAGNITUDE OF
COHERENCE
0.009     0.8271
0.018     0.8078
0.027     0.9394
0.036     0.6538
0.045     0.3329
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.H159.12
CHANNEL NO.    2
WITH
MT19.E143.12
CHANNEL NO.    3
0.009 1.1378E-10
0.018 2.0961E-11
0.027 5.0456E-12
0.036 1.6188E-12
0.045 2.4347E-13
PHASE
0.009   230.9256
0.018   185.1734
0.027   182.1598
0.036   156.8530
0.045   171.0337
MAGNITUDE OF
COHERENCE
0.009     0.8866
0.018     0.6954
0.027     0.6065
0.036     0.7345
0.045     0.5689
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT19.H159.12
CHANNEL NO.    2
WITH
MT19.H53.12
CHANNEL NO.    4
0.009 4.4866E-11
0.018 2.0983E-12
0.027 1.7614E-12
0.036 6.9375E-13
0.045 4.7630E-14
PHASE
0.009   235.2732
0.018   215.4829
0.027   154.5074
0.036   146.0967
0.045   100.4514
MAGNITUDE OF
COHERENCE
0.009     0.7648
0.018     0.1388
0.027     0.3952
0.036     0.6683
0.045     0.1402
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E143.12
CHANNEL NO.    3
WITH
MT19.H53.12
CHANNEL NO.    4
0.009 1.2811E-10
0.018 1.5269E-11
0.027 1.1663E-11
0.036 1.9243E-12
0.045 2.8892E-13
PHASE
0.009   352.2872
0.018   333.5707
0.027   331.5476
0.036   357.3057
0.045   346.6374
MAGNITUDE OF
COHERENCE
0.009     0.8636
0.018     0.6681
0.027     0.9377
0.036     0.8139
0.045     0.4894
```

DATA ANALYSIS STA. MT78-19

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```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 7.5140E 01
0.018 2.7357E 02
0.027 5.7034E 02
0.036 1.6091E 02
0.045 2.4934E 01
PHASE
0.009   112.9588
0.018    86.1693
0.027    98.2114
0.036   115.8326
0.045   209.3879

Z[1,3,f]
0.009 9.5326E 01
0.018 4.5450E 01
0.027 3.7321E 00
0.036 1.2793E 02
0.045 1.7601E 01
PHASE
0.009   321.0890
0.018   328.3337
0.027   303.4313
0.036     5.7458
0.045   314.3830

Z[3,1,f]
0.009 1.9900E 03
0.018 3.6710E 03
0.027 8.1708E 03
0.036 7.5088E 03
0.045 1.9034E 03
PHASE
0.009   317.0394
0.018   326.0954
0.027   331.2730
0.036     9.1608
0.045   355.1799

Z[3,3,f]
0.009 3.3963E 03
0.018 2.3112E 03
0.027 2.0866E 03
0.036 3.4034E 03
0.045 5.0866E 03
PHASE
0.009   158.9026
0.018   181.6862
0.027   179.0965
0.036   181.8794
0.045   182.7760
```

```
SKEWNESS

0.009 1.8524E 00
0.018 9.1571E-01
0.027 6.1784E-01
0.036 8.5633E-01
0.045 1.8700E 00
****************
COHERENCE OF
E1-pred & E1-obs
0.0094     0.9166
0.0182     0.9166
0.0271     0.9405
0.0359     0.7082
0.0447     0.3976
PHASE
0.0094  360.0000
0.0182    0.0000
0.0271  360.0000
0.0359    0.0000
0.0447    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0094     0.9650
0.0182     0.9360
0.0271     0.9723
0.0359     0.8616
0.0447     0.7289
PHASE
0.0094  360.0000
0.0182    0.0000
0.0271    0.0000
0.0359  360.0000
0.0447  360.0000
```

DATA ANALYSIS STA. MT78-19

DATA FILE 16 SPECTRAL FILE 32 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.009            68
0.018            73
0.027            81
0.036            75
0.045            62
****************
ROTATED AZIMUTH

E1 (x')
0.009         110.5
0.018         115.5
0.027         123.5
0.036         117.5
0.045         104.5

H2 (y')
0.009         200.5
0.018         205.5
0.027         213.5
0.036         207.5
0.045         194.5

E3 (y')
0.009         200.5
0.018         205.5
0.027         213.5
0.036         207.5
0.045         194.5

H4 (x')
0.009         110.5
0.018         115.5
0.027         123.5
0.036         117.5
0.045         104.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 1.1465E 03
0.018 9.0109E 02
0.027 1.0709E 03
0.036 9.4194E 02
0.045 1.4241E 03
PHASE
0.009   168.9942
0.018   200.1124
0.027   189.9971
0.036   174.9309
0.045   189.1414

Z[f,1,3]
0.009 2.8863E 03
0.018 4.1648E 03
0.027 8.5332E 03
0.036 8.7717E 03
0.045 3.7206E 03
PHASE
0.009   146.3258
0.018   156.6331
0.027   155.1622
0.036   189.9161
0.045   178.3268

Z[f,3,1]
0.009 4.1699E 02
0.018 2.3764E 02
0.027 4.0867E 01
0.036 3.3472E 02
0.045 4.1868E 02
PHASE
0.009   164.3180
0.018   197.6037
0.027   208.3056
0.036   190.9173
0.045   176.8807

Z[f,3,3]
0.009 1.1070E 03
0.018 9.9769E 02
0.027 1.1864E 03
0.036 1.1526E 03
0.045 1.4692E 03
PHASE
0.009   137.4603
0.018   126.4398
0.027   119.3007
0.036   168.4590
0.045   179.8642
```

DATA ANALYSIS STA. MT78-19

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```
ENTER INPUT FILE
 NUMBER
17
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
249
H2 AZ        159
E3 DIPOLE AZ
143
H4 AZ         53

DIPOLE ROTATION
ALPHA      206.5
BETA        10.5
COIL ROTATION
ALPHA       10.5
BETA        26.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
0
****************
N (ADJUSTED) =
             256
NYQUIST
FREQ =
      1.4133e-01
RAW DELTA f =
      1.1042e-03
SMOOTHED FOURIER
FREQ'S =      32
SMOOTHED DELTA f
F =   8.8333e-03
***************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =     0.009385
```

```
AUTOSPECTRUM OF
MT19.E249.22
CHANNEL NO.    1
0.009 2.1808E-12
0.018 1.5038E-12
0.027 2.0367E-13
0.036 5.8703E-14
0.045 3.3813E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.1062e-09
****************
AUTOSPECTRUM OF
MT19.H159.22
CHANNEL NO.    2
0.009 1.2412E-11
0.018 2.5346E-12
0.027 2.9727E-12
0.036 7.8426E-13
0.045 1.0591E-12
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      9.5155e-09
****************
AUTOSPECTRUM OF
MT19.E143.22
CHANNEL NO.    3
0.009 3.3902E-11
0.018 2.4784E-11
0.027 2.8682E-12
0.036 7.5338E-13
0.045 9.4013E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.4995e-08
****************
AUTOSPECTRUM OF
MT19.H53.22
CHANNEL NO.    4
0.009 5.3027E-12
0.018 2.2735E-12
0.027 1.3159E-12
0.036 7.4998E-13
0.045 5.0518E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.7228e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.009 2.0885E 02
0.018 1.3690E 03
0.027 2.3474E 02
0.036 3.4020E 02
0.045 1.8082E 02

CHANNELS 3 & 4
0.009 7.5995E 03
0.018 2.5154E 04
0.027 7.4677E 03
0.036 4.5655E 03
0.045 1.0540E 04
```

DATA ANALYSIS STA. MT78-19

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```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E249.22
CHANNEL NO.     1
WITH
MT19.H159.22
CHANNEL NO.     2
0.009 1.1605E-12
0.018 9.2114E-13
0.027 2.7719E-13
0.036 1.4022E-13
0.045 1.5631E-13
PHASE
0.009    187.5460
0.018    249.4134
0.027    244.7006
0.036    214.3482
0.045    232.9273
MAGNITUDE OF
COHERENCE
0.009      0.2231
0.018      0.4718
0.027      0.3562
0.036      0.6535
0.045      0.8260
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT19.E249.22
CHANNEL NO.     1
WITH
MT19.E143.22
CHANNEL NO.     3
0.009 8.1198E-12
0.018 5.8979E-12
0.027 6.4768E-13
0.036 1.4287E-13
0.045 1.6802E-13
PHASE
0.009    186.4529
0.018    198.5520
0.027    216.2317
0.036    223.6307
0.045    193.1713
MAGNITUDE OF
COHERENCE
0.009      0.9443
0.018      0.9661
0.027      0.8474
0.036      0.6794
0.045      0.9424
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E249.22
CHANNEL NO.     1
WITH
MT19.H53.22
CHANNEL NO.     4
0.009 2.3201E-12
0.018 8.9586E-13
0.027 1.5458E-13
0.036 1.1351E-13
0.045 1.0211E-13
PHASE
0.009    111.0720
0.018    146.4257
0.027    167.2215
0.036    155.5674
0.045    153.1547
MAGNITUDE OF
COHERENCE
0.009      0.6823
0.018      0.4845
0.027      0.2986
0.036      0.5410
0.045      0.7813
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.H159.22
CHANNEL NO.     2
WITH
MT19.E143.22
CHANNEL NO.     3
0.009 3.9426E-12
0.018 4.0037E-12
0.027 1.8217E-12
0.036 3.4745E-13
0.045 8.3870E-13
PHASE
0.009    297.1727
0.018    295.9007
0.027    309.4558
0.036      3.0397
0.045    317.5054
MAGNITUDE OF
COHERENCE
0.009      0.1922
0.018      0.5051
0.027      0.6239
0.036      0.4520
0.045      0.8405
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT19.H159.22
CHANNEL NO.     2
WITH
MT19.H53.22
CHANNEL NO.     4
0.009 3.0772E-12
0.018 1.3802E-12
0.027 1.6179E-12
0.036 6.3953E-13
0.045 6.0793E-13
PHASE
0.009    328.5801
0.018    254.4684
0.027    292.7814
0.036    302.2687
0.045    285.7121
MAGNITUDE OF
COHERENCE
0.009      0.3793
0.018      0.5750
0.027      0.8180
0.036      0.8339
0.045      0.8311
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E143.22
CHANNEL NO.     3
WITH
MT19.H53.22
CHANNEL NO.     4
0.009 9.2357E-12
0.018 3.9648E-12
0.027 1.0342E-12
0.036 2.4362E-13
0.045 5.7961E-13
PHASE
0.009    292.2147
0.018    312.8068
0.027    333.4325
0.036    287.6693
0.045    324.0599
MAGNITUDE OF
COHERENCE
0.009      0.6888
0.018      0.5282
0.027      0.5324
0.036      0.3241
0.045      0.8410
```

DATA ANALYSIS STA. MT78-19

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```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 2.6084E 02
0.018 1.5573E 02
0.027 1.3728E 01
0.036 4.3958E-01
0.045 5.5074E 01
PHASE
0.009   105.5770
0.018   149.6538
0.027    90.0763
0.036    44.3163
0.045   119.3256

Z[1,3,f]
0.009 1.0021E 01
0.018 1.1487E 02
0.027 3.2860E 01
0.036 1.5052E 02
0.045 6.8308E 01
PHASE
0.009   265.1538
0.018   245.7574
0.027   265.2744
0.036   216.6849
0.045   251.9871

Z[3,1,f]
0.009 5.1411E 03
0.018 3.2597E 03
0.027 5.8421E 02
0.036 3.8109E 02
0.045 2.5764E 03
PHASE
0.009   286.3487
0.018   305.8578
0.027   262.1047
0.036   166.7814
0.045   304.7664

Z[3,3,f]
0.009 5.3711E 02
0.018 2.1214E 03
0.027 1.3156E 03
0.036 1.7873E 03
0.045 1.2145E 03
PHASE
0.009   110.6184
0.018    72.6401
0.027    71.5473
0.036    13.0924
0.045    61.9195
```

```
SKEWNESS

0.009 5.7140E-01
0.018 9.5769E-01
0.027 2.1573E 00
0.036 2.8685E 00
0.045 8.5113E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0094    0.7117
0.0182    0.5394
0.0271    0.3681
0.0359    0.6538
0.0447    0.8528
PHASE
0.0094  360.0000
0.0182  360.0000
0.0271  360.0000
0.0359  360.0000
0.0447    0.0000

COHERENCE OF
E3-pred & E3-obs
0.0094    0.7849
0.0182    0.5847
0.0271    0.6443
0.0359    0.4793
0.0447    0.8843
PHASE
0.0094  360.0000
0.0182  360.0000
0.0271    0.0000
0.0359    0.0000
0.0447    0.0000
```

DATA ANALYSIS STA. MT78-19

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```
OPTIMUM AXES        ROTATED
(CW ANGLE OF        IMPEDANCE TENSOR
ROTATION)           (RESISTIVITIES)

0.009           87  Z[1,1,f]
0.018           76  0.009 3.7145E 02
0.027           66  0.018 1.1838E 03
0.036           62  0.027 4.0199E 02
0.045           82  0.036 4.5078E 02
****************    0.045 9.3601E 02
ROTATED AZIMUTH     PHASE
                    0.009   111.6478
E1 (x')             0.018    56.2293
0.009        129.5  0.027    65.9482
0.018        118.5  0.036    17.4875
0.027        108.5  0.045    50.0314
0.036        104.5
0.045        124.5  Z[f,1,3]
                    0.009 5.1640E 03
H2 (y')             0.018 3.3621E 03
0.009        219.5  0.027 9.7525E 02
0.018        208.5  0.036 8.7313E 02
0.027        198.5  0.045 2.6023E 03
0.036        194.5  PHASE
0.045        214.5  0.009   106.4322
                    0.018   116.6308
E3 (y')             0.027    77.1214
0.009        219.5  0.036   357.4437
0.018        208.5  0.045   120.2138
0.027        198.5
0.036        194.5  Z[f,3,1]
0.045        214.5  0.009 1.0759E 01
                    0.018 3.7560E 02
H4 (x')             0.027 1.6612E 02
0.009        129.5  0.036 5.2402E 02
0.018        118.5  0.045 1.3895E 02
0.027        108.5  PHASE
0.036        104.5  0.009    87.8664
0.045        124.5  0.018    52.2891
                    0.027    71.3921
                    0.036    27.2338
                    0.045    60.3654

                    Z[f,3,3]
                    0.009 4.0287E 02
                    0.018 7.3026E 02
                    0.027 4.0308E 02
                    0.036 4.7142E 02
                    0.045 2.3700E 02
                    PHASE
                    0.009   105.5722
                    0.018   126.7069
                    0.027    80.5269
                    0.036     9.7037
                    0.045   116.5591
```

DATA ANALYSIS STA. MT78-19

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```
ENTER INPUT FILE
 NUMBER
17
****************
FIELD AZIMUTHS

E1 DIPOLE AZ
249
H2 AZ          159
E3 DIPOLE AZ
143
H4 AZ           53

DIPOLE ROTATION
ALPHA        206.5
BETA          10.5
COIL ROTATION
ALPHA         10.5
BETA          26.5
****************
IF DATA IS TO BE
 SHIFTED ENTER N
UMBER OF INCHES
1
****************
N (ADJUSTED) =
              256
NYQUIST
FREQ =
      1.4133e-01
RAW DELTA f =
      1.1042e-03
SMOOTHED FOURIER
FREQ'S =        32
SMOOTHED DELTA f
F =    8.8333e-03
****************
FIRST SMOOTHED
FOURIER
FREQUENCY
U =      0.009385
```

```
AUTOSPECTRUM OF
MT19.E249.22
CHANNEL NO.     1
0.009 1.1145E-12
0.018 1.3003E-12
0.027 2.2314E-13
0.036 6.6454E-14
0.045 1.4365E-14
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      2.1062e-09
****************
AUTOSPECTRUM OF
MT19.H159.22
CHANNEL NO.     2
0.009 1.0320E-11
0.018 2.0940E-12
0.027 2.2039E-12
0.036 9.1378E-13
0.045 8.9948E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      9.5155e-09
****************
AUTOSPECTRUM OF
MT19.E143.22
CHANNEL NO.     3
0.009 1.6884E-11
0.018 1.8739E-11
0.027 3.7380E-12
0.036 6.6448E-13
0.045 5.7822E-13
ELECTRIC AMPLITU
DE FACTOR
[(VOLTS/METER)/M
ILLI-CM]
      1.4995e-08
****************
AUTOSPECTRUM OF
MT19.H53.22
CHANNEL NO.     4
0.009 3.7104E-12
0.018 1.8187E-12
0.027 1.0761E-12
0.036 8.3831E-13
0.045 4.2620E-13
MAGNETIC AMPLITU
DE FACTOR
[(AMPS/METER)/MI
LLI-CM]*HZ
      6.7228e-09
```

```
SCALAR
RESISTIVITIES

CHANNELS 1 & 2
0.009 1.2836E 02
0.018 1.4328E 03
0.027 3.4689E 02
0.036 3.3053E 02
0.045 9.0448E 01

CHANNELS 3 & 4
0.009 5.4089E 03
0.018 2.3774E 04
0.027 1.1901E 04
0.036 3.6025E 03
0.045 7.6839E 03
```

DATA ANALYSIS STA. MT78-19

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```
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E249.22
CHANNEL NO.    1
WITH
MT19.H159.22
CHANNEL NO.    2
0.009 2.4064E-13
0.018 2.6212E-13
0.027 2.6356E-13
0.036 1.2908E-13
0.045 9.4737E-14
PHASE
0.009    23.1132
0.018   195.0899
0.027   221.6083
0.036   199.3563
0.045   235.2278
MAGNITUDE OF
COHERENCE
0.009     0.0710
0.018     0.1589
0.027     0.3758
0.036     0.5238
0.045     0.8334
****************
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT19.E249.22
CHANNEL NO.    1
WITH
MT19.E143.22
CHANNEL NO.    3
0.009 4.0997E-12
0.018 4.5908E-12
0.027 7.9516E-13
0.036 1.2884E-13
0.045 8.0831E-14
PHASE
0.009   187.8637
0.018   200.5899
0.027   212.3748
0.036   217.5869
0.045   194.9994
MAGNITUDE OF
COHERENCE
0.009     0.9451
0.018     0.9300
0.027     0.8707
0.036     0.6131
0.045     0.8869
```

```
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E249.22
CHANNEL NO.    1
WITH
MT19.H53.22
CHANNEL NO.    4
0.009 1.2751E-12
0.018 3.9935E-13
0.027 2.5242E-13
0.036 6.7256E-14
0.045 6.4240E-14
PHASE
0.009    97.9548
0.018   106.5301
0.027   126.8263
0.036   147.1899
0.045   157.9799
MAGNITUDE OF
COHERENCE
0.009     0.6271
0.018     0.2597
0.027     0.5151
0.036     0.2850
0.045     0.8210
****************
COLINEAR
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.H159.22
CHANNEL NO.    2
WITH
MT19.E143.22
CHANNEL NO.    3
0.009 3.3280E-12
0.018 1.1938E-12
0.027 1.7608E-12
0.036 3.0800E-13
0.045 5.3397E-13
PHASE
0.009   218.0898
0.018   281.9779
0.027   324.7686
0.036    29.1597
0.045   314.4736
MAGNITUDE OF
COHERENCE
0.009     0.2521
0.018     0.1906
0.027     0.6135
0.036     0.3953
0.045     0.7404
```

```
SINGLE-CHANNEL
CROSS-SPECTRUM
OF
MT19.H159.22
CHANNEL NO.    2
WITH
MT19.H53.22
CHANNEL NO.    4
0.009.2.7000E-12
0.018 1.2437E-12
0.027 1.2965E-12
0.036 7.6123E-13
0.045 5.1730E-13
PHASE
0.009   356.6306
0.018   236.4438
0.027   268.0256
0.036   305.5436
0.045   280.7638
MAGNITUDE OF
COHERENCE
0.009     0.4363
0.018     0.6373
0.027     0.8419
0.036     0.8697
0.045     0.8355
****************
ORTHOGONAL
E(t) and H(t)
CROSS-SPECTRUM
OF
MT19.E143.22
CHANNEL NO.    3
WITH
MT19.H53.22
CHANNEL NO.    4
0.009 4.6707E-12
0.018 1.8075E-12
0.027 1.2968E-12
0.036 1.5089E-13
0.045 3.6021E-13
PHASE
0.009   270.9513
0.018   284.6664
0.027   292.8975
0.036   296.5437
0.045   320.3582
MAGNITUDE OF
COHERENCE
0.009     0.5901
0.018     0.3096
0.027     0.6466
0.036     0.2022
0.045     0.7256
```

DATA ANALYSIS STA. MT78-19

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```
STRUCTURALLY-
ORIENTED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1,1,f]
0.009 2.1037E 02
0.018 1.6192E 02
0.027 3.3394E 02
0.036 1.7814E 02
0.045 3.3988E 01
PHASE
0.009   100.7499
0.018   124.7145
0.027   122.3754
0.036   321.0879
0.045   168.9101

Z[1,3,f]
0.009 1.4092E 01
0.018 3.8805E 01
0.027 1.5269E 01
0.036 4.2563E 02
0.045 2.2262E 01
PHASE
0.009   296.3305
0.018   118.8690
0.027    21.2683
0.036   197.3029
0.045   226.0868

Z[3,1,f]
0.009 3.6960E 03
0.018 3.0572E 03
0.027 3.9030E 03
0.036 1.7351E 03
0.045 1.3700E 03
PHASE
0.009   277.9218
0.018   268.2008
0.027   259.0672
0.036    72.0397
0.045   290.2630

Z[3,3,f]
0.009 6.4503E 02
0.018 5.8494E 02
0.027 1.0729E 03
0.036 3.1573E 03
0.045 9.1085E 02
PHASE
0.009   117.8492
0.018   156.8582
0.027    86.6813
0.036   316.0922
0.045    70.0361
```

```
SKEWNESS

0.009 6.8986E-01
0.018 5.8632E-01
0.027 7.5458E-01
0.036 1.2376E 00
0.045 8.4743E-01
****************
COHERENCE OF
E1-pred & E1-obs
0.0094     0.6943
0.0182     0.2890
0.0271     0.5274
0.0359     0.6283
0.0447     0.8651
PHASE
0.0094  360.0000
0.0182  360.0000
0.0271    0.0000
0.0359  360.0000
0.0447  360.0000

COHERENCE OF
E3-pred & E3-obs
0.0094     0.7854
0.0182     0.3357
0.0271     0.6869
0.0359     0.5230
0.0447     0.7759
PHASE
0.0094  360.0000
0.0182    0.0000
0.0271  360.0000
0.0359  360.0000
0.0447  360.0000
```

DATA ANALYSIS STA. MT78-19

DATA FILE 17 SPECTRAL FILE 39 PAGE 4 OF 4

```
OPTIMUM AXES
(CW ANGLE OF
ROTATION)

0.009          86
0.018         -89
0.027          81
0.036          64
0.045          72
****************
ROTATED AZIMUTH

E1 (x')
0.009       128.5
0.018       313.5
0.027       123.5
0.036       106.5
0.045       114.5

H2 (y')
0.009       218.5
0.018        43.5
0.027       213.5
0.036       196.5
0.045       204.5

E3 (y')
0.009       218.5
0.018        43.5
0.027       213.5
0.036       196.5
0.045       204.5

H4 (x')
0.009       128.5
0.018       313.5
0.027       123.5
0.036       106.5
0.045       114.5
```

```
ROTATED
IMPEDANCE TENSOR
(RESISTIVITIES)

Z[1;1;f]
0.009 4.4738E 02
0.018 5.9835E 02
0.027 5.3002E 02
0.036 1.4198E 03
0.045 3.4612E 02
PHASE
0.009   121.7206
0.018   154.9048
0.027    89.1481
0.036   328.1283
0.045    51.5070

Z[f;1;3]
0.009 3.7378E 03
0.018 3.0583E 03
0.027 4.0924E 03
0.036 2.0519E 03
0.045 1.5798E 03
PHASE
0.009    98.4342
0.018    87.9314
0.027    77.8607
0.036   267.0858
0.045   100.4328

Z[f;3;1]
0.009 1.8227E 01
0.018 4.0421E 01
0.027 4.1976E 00
0.036 9.1465E 02
0.045 1.3941E 02
PHASE
0.009   121.8596
0.018   300.9292
0.027   186.0480
0.036     0.9876
0.045    41.1269

Z[f;3;3]
0.009 3.6210E 02
0.018 1.4576E 02
0.027 6.9849E 02
0.036 1.1099E 03
0.045 2.7176E 02
PHASE
0.009   100.4421
0.018   127.4060
0.027   108.1462
0.036   304.4989
0.045   115.1130
```

APPENDIX D

Computer Programs

```
0: "FILE 2":
1: prt "DIGITIZI
 NG PROGRAM FOR
 RUSTRACK DATA
 WITH SPEED CORR
 ECTION"
2: dim T$[16],
 V$[2*400],L,M,
 K,W
3: dim S
4: enp "ENTER
 TITLE IN T$",T$
5: 1→S
6: enp "ENTER
 CHANNEL #",r0;
 if r0<3;gto
 "skip speed"
7: enp "ENTER
 REFERENCE SPEED
  AND VARIABLE
 SPEED",W,r0;W/
 r0→S
8: "skip speed":
9: scl ;prt "DIG
 ITIZE START
 AND END OF TIME
  REFERENCE AXIS
 "
10: dig r3,r4;
 beep;r3→r0;r4→r
 1;dig r5,r6;
 beep
11: cll 'atan'(r
 5-r3,r6-r4,r7)
12: enp "LENGTH
 OF REFERENCE
 AXIS",r8;r8→r21
13: √((r6-r4)↑2+
 (r5-r3)↑2)/r8→r
 8
14: cll 'rotate'
 (r3,r4,r7);r4→r
 12
```

```
15: prt "DIG
 MIN AND MAX
 VOLTAGE";dig
 r3,r4;beep;cll
 'rotate'(r3,r4,
 r7)
16: dig r5,r6;
 beep;cll 'rotat
 e'(r5,r6,r7)
17: enp "MAX-
 MIN",r9
18: abs(r6-r4)/
 r9→r9;1/r9→K
19: r0→r10;r21*
 r8+r0→r11
20: prt "DIGITIZ
 E STARTING BEFO
 RE START AND
 GOING BEYOND
 END"
21: dig r5,r6;
 (r5-r0)*S→r5;
 r5+r0→r5;cll
 'rotate'(r5,r6,
 r7);beep
22: if r5-r10<0;
 jmp 2
23: prt "NOT
 LEFT OF START";
 jmp -2
24: for P=1 to
 199
25: "start":
26: r5→r3;r6→r4
27: "nextdig":
28: dig r5,r6;
 (r5-r0)*S→r5;
 r5+r0→r5
29: if r5-r10<0;
 prt "NEXT POINT
  MUST BE RIGHT
 OF START";gto
 "nextdig"
30: cll 'rotate'
 (r5,r6,r7)
```

```
31: if r5<=r3;
 prt "YOU WENT
 BACKWARDS";gto
 "nextdig"
32: beep
33: if r5<r10;
 gto "start"
34: fti (1000(r4
 -r12))→V$[4P-3,
 4P-2]
35: fti (1000(r3
 -r10))→V$[4P-1,
 4P]
36: if r3>r11;
 gto "lastP"
37: next P
38: 199→P
39: "lastP":
40: fti (1000(r6
 -r12))→V$[4P+1,
 4P+2];fti (1000
 (r5-r10))→V$[4P
 +3,4P+4]
41: P+1→V
42: trk 0;ldf 3
43: end
44: "rotate":
45: p1→p7;p2→p8;
 cll 'atan'(p7,
 p8,p9)
46: √(p7p7+p8p8)
 →p10;p9-p3→p9;
 p10sin(p9)→p2;
 p10cos(p9)→p1
47: ret
48: "atan":
49: deg;if p1=0;
 gto +5
50: atn(p2/p1)→p
 3
51: if p2<0 and
 p1<0;p3-180→p3
52: if p2>0 and
 p1<0;p3+180→p3
53: gto +2
54: 90*sgn(p2)→p
 3
55: ret
```

```
0: "FILE 3":
1: prt "OUTPUT
 LIMITED TO 400
 POINTS"
2: enp "NUMBER
 OF POINTS PER
 INCH",r18
3: dim Y[3],S[3]
 ,W[4,4],Q[4,1],
 R[4,1],S$[800]
4: dim X[4]
5: for L=1 to 2;
 itf(V$[4L-1,
 4L])/1000r8→X[L
 +1]
6: itf(V$[4L-3,
 4L-2])/1000→Y[L
 +1];next L;0→S[
 2];0→r35
7: 0→r25
8: 1→r26
9: for I=3 to
 400
10: X[2]→X[1];
 X[3]→X[2];Y[2]→
 Y[1];Y[3]→Y[2];
 S[2]→S[1]
11: if r25=0;
 X[1]→r27
12: if I>V;gto
 "finish"
13: 0→S[2];itf(V
 $[4I-1])/1000r8
 →X[3];itf(V$[4I
 -3])/1000→Y[3]
14: if (Y[2]-
 Y[1])(Y[3]-Y[2]
 )>0;(Y[3]-Y[1])
 /(X[3]-X[1])→S[
 2]
15: if X[2]<0;
 gto "skipI"
16: 1→r25
17: cll 'polyfit
 '(X[1],Y[1],
 S[1],X[2],Y[2],
 S[2],r30,r31,
 r32,r33)
18: for M=int(r2
 7r18)+r26 to
 int(X[2]r18)
19: r26+1→r26
20: if M<=0;gto
 "skipM"
21: M/r18→r21;
 if r21>(r11-
 r10)/r8;gto
 "finish"
22: M→L
23: r30+r31r21+
 r32r21↑2+r33r21
 ↑3→r34;r34+r35→
 r35
24: fti (1000r34
 )→S$[2M-1,2M]
25: if L=400;
 gto "finish"
26: "skipM":
27: next M
28: "skipI":
29: next I
30: "finish":
31: r35/L→r35
32: for J=1 to
 L;fti (itf(S$[2
 J-1,2J])-1000*
 r35)→V$[2J-1,
 2J];next J
33: r18→M
34: enp "TRACK
 AND FILE FOR
 OUTPUT",r0,r1
35: trk r0;rcf
 r1,T$,V$,L,M,K,
 W
36: dsp "FINISHE
 D"
37: trk 0;idf 2
38: end
39: "polyfit":
40: 1→W[1,1]→W[3
 ,1];p1→W[1,2];
 p1p1→W[1,3];
 p1p1p1→W[1,4];
 0→W[2,1]→W[4,1]
41: 1→W[2,2]→W[4
 ,2];2p1→W[2,3];
 3p1p1→W[2,4];
 p4→W[3,2];p4p4→
 W[3,3]
42: p4p4p4→W[3,
 4];2p4→W[4,3];
 3p4p4→W[4,4];
 p2→Q[1,1];p3→Q[
 2,1];p5→Q[3,1]
43: p6→Q[4,1]
44: p5→R[1,1];
 0→R[2,1]→R[3,
 1]→R[4,1]
45: if abs((p1-
 p4)/(p1+p4))<.0
 001;gto +4
46: inv W→W
47: mat W*Q→R
48: R[1,1]→p7;
 R[2,1]→p8;R[3,
 1]→p9;R[4,1]→p1
 0
49: ret
```

```
0: "FILE 4":
1: "CATENATE 4
 RECORDS AND
 COMPUTE GAINS
 ":
2: dim T$[16],
 V$[2*400],L,M,
 K,W
3: dim D$[4,16],
 A$[4,2*400],
 K[4],G[4],D[4],
 C[4],S[2],N,P,
 V,T
4: enp "ENTER
 INPUT TRACK",r1
5: trk r1;400→N
6: for I=1 to 4
7: enp "ENTER
 INPUT FILE",r2
8: ldf r2,T$,V$,
 L,M,K,W
9: if int(I/2)=I
 /2;gto "pass
 dipole"
10: enp "ENTER
 DIPOLE LENGTH
 (KM)",D[I]
11: if I=1;enp
 "ENTER ALPHA
 (CCW ROTATION)"
 ,S[1]
12: if I=2;enp
 "ENTER BETA
 (CCW ROTATION)"
 ,S[2]
13: "pass dipole
 ":
14: if I=3;W→V
15: T$→D$[I]
16: if I=1;L→N
17: if L<N;L→N
18: K→K[I]
19: if I=1;M→P
20: if M#P;prt
 "inconsistant
 no/inch";stp
21: for J=1 to
 L;V$[2J-1,2J]→A
 $[I,2J-1,2J];
 next J
22: next I
23: prt "N =",N
24: 60/(P*V)→T;
 prt "DELTA t
 (SEC)";fxd 4;
 prt T
```

```
25: for I=1 to 4
26: fxd 0
27: prt "*******
 ********"
28: prt "GAIN
 PARAMETERS FOR"
 ;prt D$[I]
29: prt "CHANNEL
 ",I;prt "******
 **********"
30: if I=2;gto
 "mag gains"
31: if I=4;gto
 "mag gains"
32: prt "ENTER
 2 GAIN INDICES
 FOR CHANNEL",I;
 enp r7,r8;gto
 "factor"
33: "mag gains":
34: prt "ENTER
 3 GAIN INDICES
 FOR CHANNEL",I;
 enp r6,r7,r8
35: "factor":
36: jmp r7
37: 201→r7;gto
 "nxt fact"
38: 101→r7;gto
 "nxt fact"
39: 41→r7;gto
 "nxt fact"
40: 21→r7;gto
 "nxt fact"
41: 11→r7;gto
 "nxt fact"
42: 5→r7;gto
 "nxt fact"
43: "nxt fact":
44: jmp r8
45: 201→r8;gto
 "product"
46: 101→r8;gto
 "product"
47: 41→r8;gto
 "product"
48: 21→r8;gto
 "product"
49: 11→r8;gto
 "product"
50: 5→r8;gto
 "product"
```

continued on next page

```
51: "product":
52: r8*r7→G[I]
53: if I=1;gto
 "no preamp"
54: if I=3;gto
 "no preamp"
55: 1001*G[I]→G[
 I]
56: "no preamp":
57: flt 4;prt
 "GAIN";prt "G[I
 ]=",G[I]
58: prt "CALIBRA
 TION";prt "(VOL
 TS/DIV)"
59: if I=1;prt
 "2.3";2.3→C[I]
60: if I=2;prt
 "2.25";2.25→C[I
 ]
61: if I=3;prt
 "2.46";2.46→C[I
 ]
62: if I=4;prt
 "2.43";2.43→C[I
 ]
63: prt "CHART
 SCALE";prt "(DI
 V/CM)"
64: fxd 4;prt
 "K[I]=",K[I];
 K[I]*C[I]→C[I]
65: if int(I/
 2)<I/2;gto "ele
 ctric"
66: prt "COIL
 FACTOR";prt
 "(GAMMAS/MV/
 HZ)"
67: if I=2;prt
 "SHORT COIL=5.3
 7";5.37*C[I]→C[
 I]
68: if I=4;prt
 "LONG COIL=3.51
 ";3.51*C[I]→C[I
 ]
69: prt "MAGNETI
 C FACTOR=K[I]*
 CALIB*COIL FACT
 OR/400π"
70: prt "[(AMP/
 M)/MILLI-CM/
 HZ)]"
71: flt 4;400*
 π→r1;C[I]/r1→C[
 I];prt C[I];
 gto "magnetic"
72: "electric":
73: prt "LENGTH
 OF DIPOLE";prt
 "(KM)";fxd 2
74: prt "D[I]=",
 D[I];C[I]/D[I]→
 C[I]
75: prt "ELECTRI
 C FACTOR=K[I]*
 CALIB/D[I]/10↑6
 "
76: prt "[(VOLTS
 /M)/MILLI-CM]"
77: flt 4;C[I]*
 .000001→C[I];
 prt C[I]
78: "magnetic":
79: next I
80: enp "ENTER
 OUTPUT FILE
 NUMBER",r0
81: trk 1;rcf
 r0,D$,A$,K[*],
 G[*],D[*],C[*],
 S[*],N,P,V,T
82: trk 0;ldf 5
83: end
```

```
0: "FILE 5":
1: "PROGRAM TO
 PLOT DATA":
2: dim Z$[12,
 50],B[2]
3: "MAGNETOTELLU
 RIC DATA (CENTI
 METERS)"→Z$[1]
4: "CHANNEL"→Z$[
 2]
5: "DIPOLE LENGT
 H =      KM"→Z$
 [3]
6: "SHORT COIL"→
 Z$[4]
7: "LONG COIL"→Z
 $[5]
8: "GAIN ="→Z$[6
 ]
9: "ELECTRIC
 FACTOR =
      (VOLTS/M)/
 CM"→Z$[7]
10: "MAGNETIC
 FACTOR =
      (AMPS/M)/
 CM/HZ"→Z$[8]
11: "TIME SCALE
 = 100 SECONDS
 PER CENTIMETER"
 →Z$[9]
12: for I=1 to 4
13: cll 'plot
 data'(I)
14: next I
15: end
16: "plot data":
17: scl ;pen# 1;
 csiz 1
18: if p1>1;B[1]
 →r20;B[2]-6→r21
 ;r21→B[2];gto
 "next plot"
19: dsp "LOCATE
 START AND DIGIT
 IZE";beep;dig
 r20,r21
20: r20→B[1];
 r21→B[2]
21: plt r20+2.13
 ,r21+5.5,1;lbl
 Z$[1]
22: plt r20+1.43
 ,r21+5,1;lbl
 Z$[9]
```

```
23: "next plot":
24: plt r20,r21+
 3.5,1;lbl Z$[2]
25: fxd 0;plt
 r20+2.3,r21+
 3.5,1;lbl p1
26: plt r20+4,
 r21+3.5,1;lbl
 D$[p1]
27: if int(p1/
 2)<p1/2;plt
 r20,r21+3,1;
 lbl Z$[3]
28: if int(p1/
 2)<p1/2;fxd 2;
 plt r20+4.2,
 r21+3,1;lbl
 D[p1]
29: if p1=2;plt
 r20,r21+3;lbl
 Z$[4]
30: if p1=4;plt
 r20,r21+3,1;
 lbl Z$[5]
31: plt r20,r21+
 2.5,1;lbl Z$[6]
32: flt 4;plt
 r20+2,r21+2.5,
 1;lbl G[p1]
33: if int(p1/
 2)<p1/2;plt
 r20,r21+2,1;
 lbl Z$[7]
34: if int(p1/
 2)=p1/2;plt
 r20,r21+2,1;
 lbl Z$[8]
35: C[p1]*1000→r
 22;flt 4;plt
 r20+4.76,r21+2,
 1;lbl r22
36: for J=1 to N
37: itf(A$[p1,
 2J-1,2J])→r23;
 r23/1000→r23
38: 2.540005/
 P→r22;(J-1)*T/
 100→r22
39: r20+r22→X;
 r21+r23→Y;plt
 X,Y
40: next J;pen
41: ret
```

```
0: "FILE 6":
1: "BEGINNING
 OF SPECTRAL
 ANALYSIS":
2: spc 3
3: dim D$[4,16],
 A$[4,2*400],
 K[4],G[4],D[4],
 C[4],S[2],N,P,
 V,T
4: dim T$[4,16],
 Q,Z,W,D,R,B[4],
 E[4],X$[4,2*
 128],Y$[4,2*
 128],Z[4]
5: dim R[256],
 I[256]
6: enp "ENTER
 INPUT FILE NUMB
 ER",r0
7: trk 1;ldf r0,
 D$,A$,K[*],G[*
 ],D[*],C[*],S[*
 ],N,P,V,T
8: for A=1 to 4;
 C[A]/G[A]→E[A];
 D$[A]→T$[A];
 next A
9: deg;fxd 0
10: prt "*******
 *********"
11: prt "FIELD
 AZIMUTHS";spc 1
12: for A=1 to
 3 by 2;A+1→B
13: if A=1;enp
 "E1 DIPOLE AZ",
 B[1]
14: if A=3;enp
 "E3 DIPOLE AZ",
 B[3]
15: B[A]-90→B[B]
16: if B[B]<0;
 B[B]+360→B[B]
17: if B[B]>360;
 B[B]-360→B[B]
18: if A=1;prt
 "H2 AZ",B[2]
19: if A=3;prt
 "H4 AZ",B[4]
20: next A
21: spc 1;fxd 1
22: for A=1 to 2
23: if A=1;B[1]-
 42.5→S[1];B[3]-
 132.5→S[2];1→B;
 3→C;prt "DIPOLE
  ROTATION"
24: if A=2;B[4]-
 42.5→S[1];B[2]-
 132.5→S[2];4→B;
 2→C;prt "COIL
 ROTATION"
25: prt "ALPHA",
 S[1];prt "BETA"
 ,S[2]
26: cos(S[2])→r0
 ;sin(S[1])→r1;
 cos(S[1]-S[2])→
 r2
27: sin(S[2])→r3
 ;cos(S[1])→r4
28: for J=1 to N
29: itf(A$[B,2J-
 1,2J])*r0-itf(A
 $[C,2J-1,2J])*
 r1→r5
30: itf(A$[B,2J-
 1,2J])*r3+itf(A
 $[C,2J-1,2J])*
 r4→r6
31: fti (r5/r2)→
 A$[B,2J-1,2J]
32: fti (r6/r2)→
 A$[C,2J-1,2J]
33: next J
34: next A
35: fmt 1,1f3.0,
 1e12.4;fmt 2,
 1f3.0,1f12.4
36: 0→R
37: prt "*******
 *********"
38: enp "IF DATA
  IS TO BE SHIFT
 ED ENTER NUMBER
  OF INCHES",R
39: if R#0;int(6
 4*R)-2→R;N-R→N
40: if N=128;
 128→Q;jmp 4
41: if N=256;
 256→Q;jmp 3
42: log(N)/log(2
 )→r0;int(r0)→r0
43: 2↑r0→Q;int(Q
 +.5)→Q
44: Q/8→Z;int(Z+
 .5)→Z
45: fxd 0;prt "*
 ***************
 ";prt "N (ADJUS
 TED) =",Q
46: .5/T→r0;flt
 4;prt "NYQUIST"
 ;prt "FREQ =",
 r0
47: 1/(Q*T)→E;
 flt 4;prt "RAW
 DELTA f =";prt
 E
48: fxd 0;prt
 "SMOOTHED FOURI
 ER";prt "FREQ'S
  =",Z
49: E*8→W;flt 4;
 prt "SMOOTHED
 DELTA f";prt
 "F =",W
50: T→D
51: trk 0;ldf 7
52: end
```

```
0: "FILE 7":
1: "FFT SPECTRA"
 :
2: fmt 1,1f3.0,
 1e12.4;fmt 2,
 1f3.0,1f12.4
3: for A=1 to 4
4: rad;0→r0
5: for J=1 to Q;
 J+R→I
6: 1→K;if J<E+1;
 sin(π*(J-1)/2/
 E)→K
7: if J>Q-E;cos(
 π*(J+E-Q)/2/
 E)→K
8: itf(A$[A,2I-
 1,2I])*K→R[J];
 R[J]+r0→r0;0→I[
 J]
9: next J
10: r0/Q→r0
11: for J=1 to
 Q;R[J]-r0→R[J];
 next J
12: cll 'fft'(-
 1,Q)
13: for B=1 to
 Q/2
14: fti (R[B]/
 .875)→X$[A,2B-
 1,2B];fti (I[B]
 /.875)→Y$[A,2B-
 1,2B]
15: next B
16: next A
17: trk 0;rcf
 14,T$,Q,Z,W,D,
 R,B[*],E[*],X$,
 Y$
18: trk 0;ldp 8
19: end
20: "FAST FOURIE
 R TRANSFORM":
21: "fft":
22: 1→J
23: √(1/p2)→r0
24: for I=1 to
 p2
25: if I>J;jmp 4
26: r0*R[J]→r1;
 r0*I[J]→r2
27: r0*R[I]→R[J]
 ;r0*I[I]→I[J]
28: r1→R[I];r2→I
 [I]
29: p2/2→r2
30: if J<=r2;
 jmp 4
31: J-r2→J
32: r2/2→r2
33: if r2>=1;
 jmp -3
34: J+r2→J;next
 I
35: 1→L
36: 2*L→r1
37: for K=1 to L
38: p1*π*(K-1)/
 L→r2
39: cll 'complex
 '(1,0,r2,0,0)
40: r98→r2;r99→r
 3
41: for I=K to
 p2 by r1
42: cll 'complex
 '(2,r2,r3,R[I+
 L],I[I+L])
43: r98→r4;r99→r
 5
44: cll 'complex
 '(3,R[I],I[I],-
 r4,-r5)
45: r98→R[I+L];
 r99→I[I+L]
46: cll 'complex
 '(3,R[I],I[I],
 r4,r5)
47: r98→R[I];
 r99→I[I]
48: next I
49: next K
50: r1→L
51: if L<p2;jmp
 -15
52: ret
53: "complex":
54: rad
55: if p1=1;exp(
 p2)*cos(p3)→r98
 ;exp(p2)*sin(p3
 )→r99
56: if p1=2;p2*
 p4-p3*p5→r98;
 p2*p5+p4*p3→r99
57: if p1=3;p2+
 p4→r98;p3+p5→r9
 9
58: if p1=4;atn(
 p3/p2)→r98
59: if p2=5;p2↑2
 +p3↑2→r98;√r98→
 r98
60: ret
```

```
0: "FILE 8":
1: "AUTO- AND
 CROSS-SPECTRA
 FROM FFT SPECTR
 A":
2: fmt 1,1f5.3,
 1e11.4;fmt 2,
 1f5.3,1f11.4
3: dim T$[4,16],
 Q,Z,W,D,R,B[4],
 E[4],X$[4,2*
 128],Y$[4,2*
 128]
4: dim D$[4,16],
 R$[4,2*128],
 I$[4,2*128],N,
 M,T,F,S,R[4],
 N[4],M[4,6],
 A[6,6]
5: dim C[6,6],
 F[6,6],S[2],U
6: trk 0;ldf 14,
 T$,Q,Z,W,D,R,
 B[*],E[*],X$,Y$
7: Q→N;D→T;W→F;
 Z→M;R→S
8: int(.005*8/
 F)→X
9: M/2→V
10: if X>0;M/2-
 1→V
11: prt "*******
 ********"
12: X*F/8+F/8/2+
 4*F/8→U;prt
 "FIRST SMOOTHED
 ";prt "FOURIER"
 ;prt "FREQUENCY
 "
13: fxd 6;prt
 "U =",U
```

```
14: for I=1 to 4
15: T$[I]→D$[I];
 E[I]→N[I];B[I]→
 R[I]
16: for J=1 to
 N/2;X$[I,2J-1,
 2J]→R$[I,2J-1,
 2J];Y$[I,2J-1,
 2J]→I$[I,2J-1,
 2J]
17: next J
18: prt "*******
 *********";prt
 "AUTOSPECTRUM
 OF";prt D$[I]
19: fxd 0;prt
 "CHANNEL NO.",I
20: for B=1 to
 V;(B-1)*8→r0;
 0→r1
21: (B-1)*F+U→r1
 0;if r10>.05;
 gto "S1"
22: for J=1 to
 8;J+r0+X→K
23: (K-1)*F/8→r5
24: itf(R$[I,2K-
 1,2K])*N[I]→r3;
 itf(I$[I,2K-1,
 2K])*N[I]→r4
25: r3↑2+r4↑2+
 r1→r1
26: next J
27: r1/8→M[I,B];
 wrt 16.1,r10,
 M[I,B]
28: next B
29: "S1":
30: if int(I/
 2)<I/2;prt "ELE
 CTRIC AMPLITUDE
  FACTOR"
31: if int(I/
 2)<I/2;prt "[(V
 OLTS/METER)/
 MILLI-CM]";jmp
 2
32: prt "MAGNETI
 C AMPLITUDE
 FACTOR";prt
 "[(AMPS/METER)/
 MILLI-CM]*HZ"
33: flt 4;prt
 N[I]
34: next I
```

continued on next page

```
35: 0→r0
36: for H=1 to 3
37: for I=H+1
 to 4
38: r0+1→r0
39: fxd 0;prt "*
 **************
 "
40: if H=3;gto
 "orth"
41: if H=2;jmp 4
42: if I=2;gto
 "orth"
43: if I=3;gto
 "single"
44: if I=4;gto
 "colin"
45: if I=3;gto
 "colin"
46: if I=4;gto
 "single"
47: "orth":prt
 "ORTHOGONAL";
 prt "E(t) and
 H(t)";jmp 3
48: "single":prt
  "SINGLE-CHANNE
 L";jmp 2
49: "colin":prt
 "COLINEAR";prt
 "E(t) and H(t)"
50: prt "CROSS-
 SPECTRUM";prt
 "OF";prt D$[H]
51: prt "CHANNEL
  NO.",H;prt
 "WITH";prt D$[I
 ];prt "CHANNEL
 NO.",I
52: for B=1 to
 V;(B-1)*8→r1;
 0→r2;0→r3;0→r11
53: (B-1)*F+U→r1
 0;if r10>.05;
 gto "S2"
54: for J=1 to
 8;J+r1+X→A
55: (A-1)*F/8→r8
56: itf(R$[H,2A-
 1,2A])*N[H]→r4;
 itf(R$[I,2A-1,
 2A])*N[I]→r5
57: itf(I$[H,2A-
 1,2A])*N[H]→r6;
 itf(I$[I,2A-1,
 2A])*N[I]→r7
58: r4*r5+r6*r7+
 r2→r2
59: -r4*r7+r6*
 r5+r3→r3
60: next J
61: r2/8→r2;r3/
 8→r3
62: √(r2↑2+r3↑2)
 →A[r0,B];wrt
 16.1,r10,A[r0,
 B]
63: deg
64: cll 'quadran
 t'(atn(r3/r2),
 r2,r3)
65: next B
66: "S2":
67: prt "PHASE"
68: for B=1 to
 V;(B-1)*F+U→r10
 ;if r10>.05;
 gto "S3"
69: wrt 16.2,
 r10,P[r0,B];
 next B
70: "S3":
71: prt "MAGNITU
 DE OF";prt "COH
 ERENCE"
72: for B=1 to
 V;(B-1)*F+U→r10
 ;if r10>.05;
 gto "S4"
73: A[r0,B]/√(M[
 H,B]*M[I,B])→C[
 r0,B]
74: wrt 16.2,
 r10,C[r0,B];
 next B
75: "S4":
76: next I;next
 H
77: trk 0;ldf 9
78: end
79: "quadrant":
80: if p2<0;gto
 "neg RE"
81: if p3>0;p1→P
 [r0,B];gto "ret
 urn"
82: p1+360→P[r0,
 B];gto "return"
83: "neg RE":p1+
 180→P[r0,B]
84: "return":
85: ret
```

```
0: "FILE 9":
1: "COMPUTES
 SCALAR RESISTIV
 ITIES":
2: fmt 1,1f5.3,
 1e11.4;fmt 2,
 1f5.3,1f11.4
3: M/2→C
4: deg
5: prt "********
 ********"
6: prt "SCALAR";
 prt "RESISTIVIT
 IES"
7: 8*π↑2/10↑7→G
8: for I=1 to 2;
 spc 1
9: if I=1;1→X;
 2→Y;prt "CHANNE
 LS 1 & 2"
10: if I=2;3→X;
 4→Y;prt "CHANNE
 LS 3 & 4"
11: for J=1 to C
12: (J-1)*F+U→r0
 ;if r0>.05;gto
 "S1"
13: M[X,J]→r1;
 M[Y,J]/r0↑2→r2;
 r1/r2→r3
14: r3/(r0*G)→r2
 2
15: wrt 16.1,r0,
 r22
16: next J
17: "S1":
18: next I
19: spc 2
20: enp "OUTPUT
 TRACK & FILE",
 r0,r1
21: trk r0;rcf
 r1,D$,R$,I$,N,
 M,T,F,S,R[*],
 N[*],M[*],A[*],
 C[*],P[*],S[*],
 U
22: spc 2
23: trk 0;ldp 10
24: end
```

```
0: "FILE 10":
1: "COMPUTES
 STRUCTURALLY-
 ORIENTED IMPEDA
 NCE TENSOR":
2: fmt 1,1f5.3,
 1e11.4;fmt 2,
 1f5.3,1f11.4
3: dim D$[4,16],
 R$[4,2*128],
 I$[4,2*128],N,
 M,T,F,S,R[4],
 N[4],M[4,6],
 A[6,6]
4: dim C[6,6],
 P[6,6],S[2],U
5: dim Z[6,2,2,
 2],Q[6],C
6: enp "INPUT
 TRACK & FILE",
 r0,K
7: trk r0;ldf K,
 D$,R$,I$,N,M,T,
 F,S,R[*],N[*],
 M[*],A[*],C[*],
 P[*],S[*],U
8: M/2→C
9: deg
10: spc 2;prt "*
 ***************
 "
11: prt "STRUCTU
 RALLY-";prt
 "ORIENTED";prt
 "IMPEDANCE TENS
 OR"
12: prt "(RESIST
 IVITIES)"
13: 8*π↑2/10↑7→G
14: for I=1 to
 4;spc 1
15: if I=1;prt
 "Z[1,1,f]";1→X;
 1→Y
16: if I=2;prt
 "Z[1,3,f]";1→X;
 2→Y
17: if I=3;prt
 "Z[3,1,f]";2→X;
 1→Y
18: if I=4;prt
 "Z[3,3,f]";2→X;
 2→Y
19: for J=1 to C
20: (J-1)*F+U→r0
 ;if r0>.05;gto
 "S1"
21: M[2,J]→r1;
 M[4,J]→r2;A[5,
 J]↑2→r3
22: r1*r2-r3→D
23: if I=1;3→r1;
 M[2,J]→r2;1→r3;
 5→r4
24: if I=2;1→r1;
 M[4,J]→r2;3→r3;
 5→r4
25: if I=3;6→r1;
 M[2,J]→r2;4→r3;
 5→r4
26: if I=4;4→r1;
 M[4,J]→r2;6→r3;
 5→r4
27: cll 'xspectr
 a'(r1,r3,r4)
28: r2*r6→r12;
 r2*r7→r13
29: r8*r10-r9*
 r11→r14;r8*r11+
 r9*r10→r15
30: (r12-r14)/D*
 r0→Z[J,1,X,Y]→r
 20
31: (r13-r15)/D*
 r0→Z[J,2,X,Y]→r
 21
32: (r20↑2+r21↑2
 )/(r0*G)→r22
33: wrt 16.1,r0,
 r22
34: next J
35: "S1":
36: prt "PHASE"
37: for J=1 to
 C;(J-1)*F+U→r10
38: if r10>.05;
 gto "S2"
39: atn(Z[J,2,X,
 Y]/Z[J,1,X,Y])→
 r1
40: cll 'quadran
 t'(r1,Z[J,1,X,
 Y],Z[J,2,X,Y])
41: wrt 16.2,
 r10,P;next J
42: "S2":
43: next I
44: prt "*******
 *********";prt
 "SKEWNESS";spc
 1
45: for J=1 to
 C;(J-1)*F+U→r0;
 if r0>.05;gto
 "S3"
46: (Z[J,1,1,1]+
 Z[J,1,2,2])↑2→r
 1;(Z[J,2,1,1]+
 Z[J,2,2,2])↑2→r
 2
47: (Z[J,1,1,2]-
 Z[J,1,2,1])↑2→r
 3;(Z[J,2,1,2]-
 Z[J,2,2,1])↑2→r
 4
48: √((r1+r2)/
 (r3+r4))→S
49: wrt 16.1,r0,
 S
50: next J
51: "S3":
52: trk 0;ldf 11
53: end
54: "xspectra":
55: A[p1,J]*cos(
 P[p1,J])→r6
56: A[p1,J]*sin(
 P[p1,J])→r7
57: if I=4;-r7→r
 7
58: A[p2,J]*cos(
 P[p2,J])→r8
59: A[p2,J]*sin(
 P[p2,J])→r9
60: if I=3;-r9→r
 9
61: A[p3,J]*cos(
 P[p3,J])→r10
62: A[p3,J]*sin(
 P[p3,J])→r11
63: if I=2 or
 I=4;-r11→r11
64: ret
65: "quadrant":
66: if p2<0;gto
 "neg RE"
67: if p3>0;p1→P
 ;gto "return"
68: p1+360→P;
 gto "return"
69: "neg RE":p1+
 180→P
70: "return":
71: ret
```

```
0: "FILE 11":
1: "COHERENCE
 OF E-pred & E-
 obs":
2: dim F[6]
3: fmt 1,1f6.4,
 1f10.4
4: deg
5: prt "********
 ********"
6: for A=1 to 3
 by 2;1→B;if
 A=3;2→B
7: if A=3;spc 1
8: prt "COHERENC
 E OF"
9: if A=1;prt
 "E1-pred & E1-
 obs";3→K;1→L
10: if A=3;prt
 "E3-pred & E3-
 obs";6→K;4→L
11: 0→r35
12: for I=1 to C
13: (I-1)*F+U→r3
 0;if r30>.05;
 gto "S1"
14: r35+1→r35
15: Z[I,1,B,1]→r
 1;Z[I,2,B,1]→r2
16: Z[I,1,B,2]→r
 3;Z[I,2,B,2]→r4
17: A[K,I]*cos(-
 P[K,I])→r5;A[K,
 I]*sin(-P[K,
 I])→r6
18: A[L,I]*cos(P
 [L,I])→r7;A[L,
 I]*sin(P[L,I])→
 r8
19: if A=1;-r8→r
 8
20: r1*r5-r2*
 r6→r9;r1*r6+r2*
 r5→r10
21: r3*r7-r4*
 r8→r11;r3*r8+
 r4*r7→r12
22: r9+r11→X;
 r10+r12→Y
23: (r1↑2+r2↑2)*
 M[4,I]→r15;(r3↑
 2+r4↑2)*M[2,
 I]→r16
24: r1*r3+r2*
 r4→r17;-r1*r4+
 r2*r3→r18
25: A[5,I]*cos(-
 P[5,I])→r19;
 A[5,I]*sin(-
 P[5,I])→r20
26: r17*r19-r18*
 r20→r21
27: (r15+r16+2*
 r21)*M[A,I]→r22
 ;√r22→D
28: X/D→r23;Y/
 D→r24;√(r23↑2+
 r24↑2)→r25
29: wrt 16.1,
 r30,r25
30: cll 'quadran
 t'(atn(Y/X),X,
 Y)
31: next I
32: "S1":
33: prt "PHASE"
34: for L=1 to
 r35;(L-1)*F+
 U→r30;wrt 16.1,
 r30,F[L];next L
35: next A
36: trk 0;ldf 12
37: end
38: "quadrant":
39: if p2<0;gto
 "neg RE"
40: if p3>0;p1→F
 [I];gto "return
 "
41: p1+360→F[I];
 gto "return"
42: "neg RE":p1+
 180→F[I]
43: "return":
44: ret
```

```
0: "FILE 12":
1: "COMPUTES
 OPTIMUM AXES":
2: "(CW ANGLE
 OF ROTATION)":
3: "SEARCH METHO
 D":
4: fmt 1,1f5.3,
 1e11.4;fmt 2,
 1f5.3,1f11.0
5: deg
6: prt "********
 ********";prt
 "OPTIMUM AXES";
 prt "(CW ANGLE
 OF"
7: prt "ROTATION
 )";spc 1
8: for J=1 to C;
 (J-1)*F+U→r0;
 if r0>.05;gto
 "S2"
9: Z[J,1,1,1]→r1
 ;Z[J,2,1,1]→r2
10: Z[J,1,1,2]→r
 3;Z[J,2,1,2]→r4
11: Z[J,1,2,1]→r
 5;Z[J,2,2,1]→r6
12: Z[J,1,2,2]→r
 7;Z[J,2,2,2]→r8
13: r7-r1→r10;
 r8-r2→r11
14: r3+r5→r12;
 r4+r6→r13
15: for K=1 to
 181;K-91→A
16: cos(A)↑2→r20
 ;sin(2*A)/2→r21
 ;sin(A)↑2→r22
17: r1*r20+r12*
 r21+r7*r22→r24;
 r2*r20+r13*r21+
 r8*r22→r25
18: r3*r20+r10*
 r21-r5*r22→r26;
 r4*r20+r11*r21-
 r6*r22→r27
19: r5*r20+r10*
 r21-r3*r22→r28;
 r6*r20+r11*r21-
 r4*r22→r29
20: r7*r20-r12*
 r21+r1*r22→r30;
 r8*r20-r13*r21+
 r2*r22→r31
21: r24↑2+r25↑2→
 r32;r26↑2+r27↑2
 →r33;r28↑2+r29↑
 2→r34;r30↑2+
 r31↑2→r35
22: r26↑2+r27↑2+
 r28↑2+r29↑2→r36
23: if K=1;r36→Z
 ;A→B;gto "K1"
24: if r36>Z
 and r33>r32
 and r33>r34
 and r33>r35;
 r36→Z;A→B
25: "K1":
26: next K
27: B→Q[J];wrt
 16.2,r0,Q[J]
28: next J
29: "S2":
30: trk 0;ldf 13
31: end
```

```
0: "FILE 13":
1: "ROTATES IMPE
 DANCE TENSOR
 TO OPTIMUM AXES
 ":
2: "(CW ANGLE
 OF ROTATION)":
3: dim X[2,6]
4: fmt 1,1f5.3,
 1e11.4;fmt 2,
 1f5.3,1f11.4;
 fmt 3,1f5.3,
 1f11.1
5: deg
6: prt "********
 ********"
7: prt "ROTATED
 AZIMUTH"
8: for I=1 to 4;
 spc 1
9: if I=1;prt
 "E1 (x')";42.5→
 A
10: if I=2;prt
 "H2 (y')";132.5
 →A
11: if I=3;prt
 "E3 (y')";132.5
 →A
12: if I=4;prt
 "H4 (x')";42.5→
 A
13: for J=1 to
 C;(J-1)*F+U→r0;
 if r0>.05;gto
 "S3"
14: A+Q[J]→r1;
 if r1<0;r1+360→
 r1
15: if r1>360;
 r1-360→r1
16: wrt 16.3,r0,
 r1;next J
17: "S3":
18: next I
19: prt "*******
 *********"
20: prt "ROTATED
 ";prt "IMPEDANC
 E TENSOR"
21: prt "(RESIST
 IVITIES)"
22: for I=1 to 4
23: spc 1
24: if I=1;prt
 "Z[1,1,f]";1→X;
 1→Y
25: if I=2;prt
 "Z[f,1,3]";1→X;
 2→Y
26: if I=3;prt
 "Z[f,3,1]";2→X;
 1→Y
27: if I=4;prt
 "Z[f,3,3]";2→X;
 2→Y
28: 8*π↑2/10↑7→r
 11
29: for K=1 to 2
30: for J=1 to C
31: (J-1)*F+U→r1
 0;if r10>.05;
 gto "S1"
32: if I=1;Z[J,
 K,1,1]→r1;Z[J,
 K,1,2]+Z[J,K,2,
 1]→r2;Z[J,K,2,
 2]→r3
33: if I=2;Z[J,
 K,1,2]→r1;Z[J,
 K,2,2]-Z[J,K,1,
 1]→r2;-Z[J,K,2,
 1]→r3
34: if I=3;Z[J,
 K,2,1]→r1;Z[J,
 K,2,2]-Z[J,K,1,
 1]→r2;-Z[J,K,1,
 2]→r3
35: if I=4;Z[J,
 K,2,2]→r1;-(Z[J
 ,K,1,2]+Z[J,K,
 2,1])→r2;Z[J,K,
 1,1]→r3
36: r1*cos(Q[J])
 ↑2+r2*sin(Q[J])
 *cos(Q[J])+r3*
 sin(Q[J])↑2→X[K
 ,J]
37: if K<2;gto
 "1"
38: (X[1,J]↑2+
 X[2,J]↑2)/(r10*
 r11)→r4
39: wrt 16.1,
 r10,r4
40: "1":
41: next J
42: "S1":
43: next K
44: prt "PHASE"
45: for J=1 to
 C;(J-1)*F+U→r10
46: if r10>.05;
 gto "S1B"
47: atn(X[2,J]/
 X[1,J])→r1
48: cll 'quadran
 t'(r1,X[1,J],
 X[2,J])
49: wrt 16.2,
 r10,P;next J
50: "S1B":
51: next I
52: spc 3
53: spc 4
54: trk 0;ldp 6
55: end
56: "quadrant":
57: if p2<0;gto
 "neg RE"
58: if p3>0;p1→P
 ;gto "return"
59: p1+360→P;
 gto "return"
60: "neg RE":p1+
 180→P
61: "return":
62: ret
```