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SIMPLIFIED VLF/LF MODE CONVERSION PROGRAM WITH ALLOWANCE FOR EL--ETC(U)
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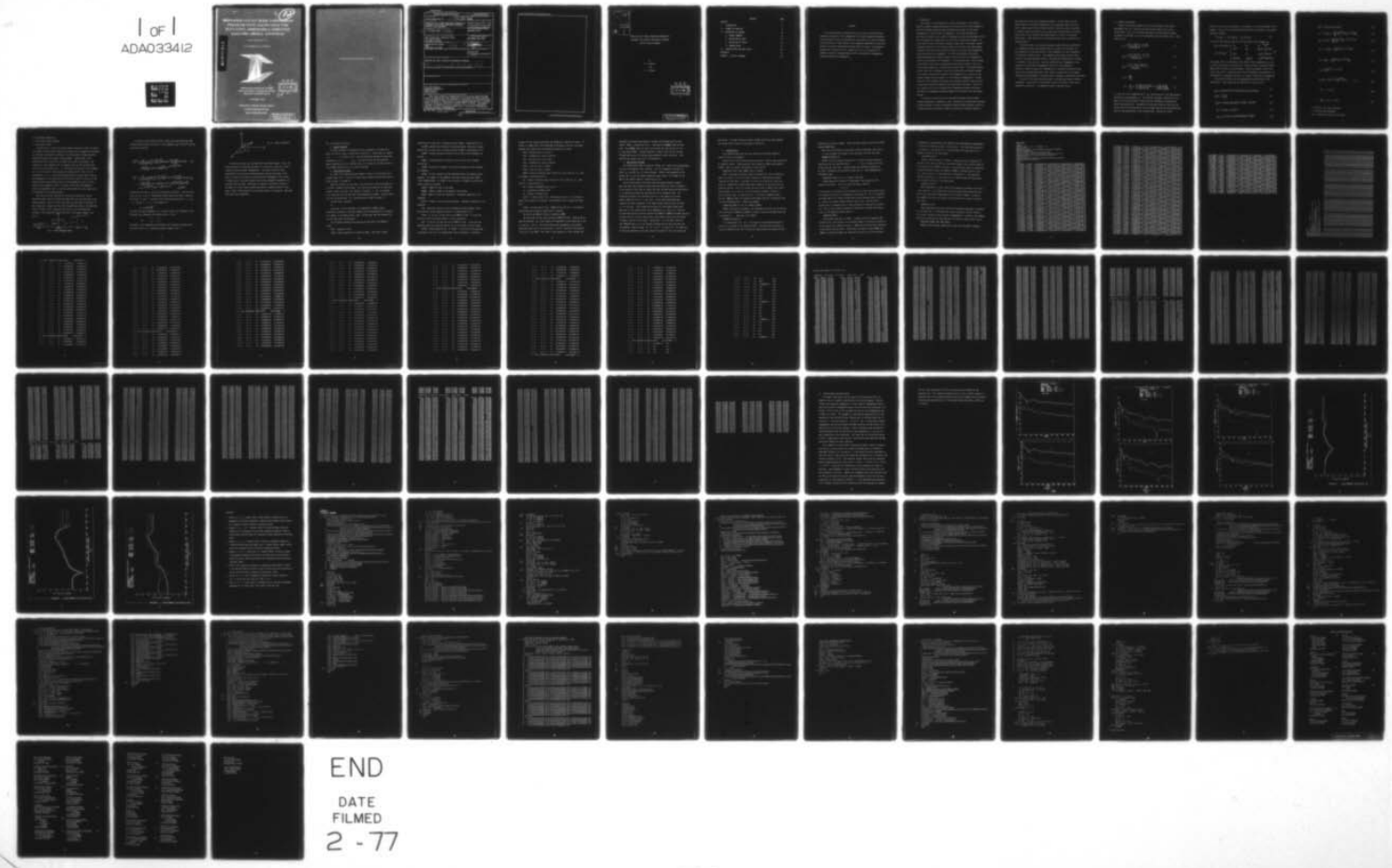

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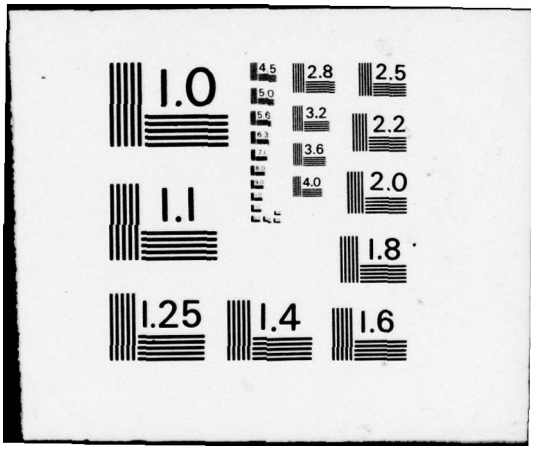
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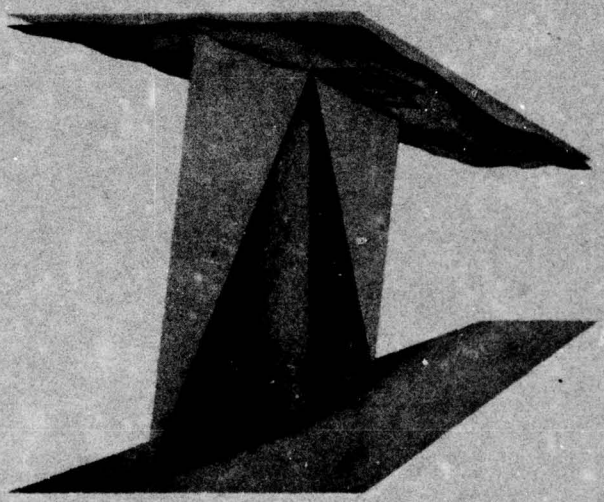
SIMPLIFIED VLF/LF MODE CONVERSION PROGRAM WITH ALLOWANCE FOR ELEVATED, ARBITRARILY ORIENTED ELECTRIC DIPOLE ANTENNAS

Interim Report No. 771

R. A. Pappert and L. R. Shockey



PROPAGATION TECHNOLOGY DIVISION
NAVAL ELECTRONICS LABORATORY CENTER
SAN DIEGO, CALIFORNIA 92152

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This report presents an updated version of an earlier simplified mode conversion program for VLF/LF propagation in the earth-ionosphere waveguide. The new program includes the provision for calculating at an arbitrary height within the guide all three electric field components generated by an electric dipole of arbitrary orientation and height within the guide. The program is designed for treating air to air, ground to air, or air to ground VLF/LF problems involving a waveguide channel which is horizontally inhomogeneous along the direction of propagation.

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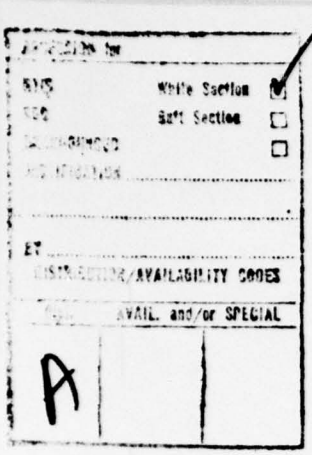


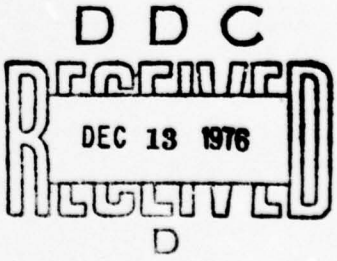
SIMPLIFIED VLF/LF MODE CONVERSION PROGRAM WITH ALLOWANCE FOR ELEVATED, ARBITRARILY ORIENTED ELECTRIC DIPOLE ANTENNAS

By

R. A. Pappert

and

L. R. Shockey



CONTENTS

ABSTRACT

This report presents an updated version of an earlier simplified mode conversion program for VLF/LF propagation in the earth-ionosphere waveguide. The new program includes the provision for calculating at an arbitrary height within the guide all three electric field components generated by an electric dipole of arbitrary orientation and height within the guide. The program is designed for treating air to air, ground to air or air to ground VLF/LF problems involving a waveguide channel which is horizontally inhomogeneous along the direction of propagation.

I. Introduction

This report is a continuation of a series (references 1, 2 and 3) which describes computer programs developed for calculating VLF/LF field strengths in the earth-ionosphere waveguide when allowance must be made for horizontal inhomogeneity in the direction of propagation. Thus these programs are particularly relevant to the problem of propagating across the terminator as well as to the problem of propagating in an artifically disturbed environment. As in the previous works, the present program is based upon a slab model, assumes waveguide invariance in the direction normal to the great circle path between transmitter and receiver and neglects reflections resulting from inhomogeneity along the direction of propagation. The field calculations, principally through waveguide modal constant inputs, do allow for vertical inhomogeneity as well as anisotropy of the ionosphere. In the previous works, field strength calculations or mode sums are generated for the vertical electric field, E_z, at the ground produced by a ground based vertical dipole. The present program differs from that of reference 3 only to the extent that the present program can be used to calculate all electric field components E_z, E_x and E_y for any receiver height within the guide (x-z is the plane of propagation). Furthermore, the field strength calculations can be made for electric dipole exciters of arbitrary orientation located at any height within the guide. Thus air to air, ground to air or air to ground VLF/LF propagation problems involving a horizontally inhomogeneous waveguide channel may be treated using the present program.

In addition to familiarity with the simplified mode conversion model concepts documented in references 2 and 3, familiarity is assumed with reference 4 which describes a Fortran IV program for obtaining mode constants as well as excitation factors for electric dipoles of arbitrary orientation located at

any height within the earth ionosphere waveguide. Crucial inputs from the latter program are the ground eigenangles, four independent quantities from which a tensor array of nine excitation factors relating to end-on, broadside or vertical dipole excitation of E_z, E_x and E_y may be determined, and a polarization factor which introduces the proper amount of TE wave into the modal height gains. These quantities for each mode and slab serve as input for the present program.

Principal outputs of the present program are mode conversion coefficients (in a generalized sense) and mode sum plots as a function of distance from the transmitter for the three electric field components for four orientations of the electric dipole exciter. The transmitter and receiver must be within the earth curvature dominated portion of the guide but otherwise their altitude is arbitrary. Since the mode conversion coefficients are independent of the location of the horizontal inhomogeneity relative to the transmitter, provision is made for moving the inhomogeneity in increments and plotting mode sums for the incremented distances (this option is useful only if the ground conductivity and geomagnetic orientation may be regarded as constant over the path).

In section II the mode conversion model is reviewed and relevant formulas summarized. A description of the program is given in section III and results presented in section IV. The appendix contains a program listing.

II. Summary of Equations

Inputs to the present program for each slab and mode are the ground eigenangles, the T_j's defined below and the polarization ratio f also defined below. The T_j's are readily obtainable from the waveguide program documented in reference 4 as are the eigenangles and polarization ratio. These quantities are

$$T_1 = \frac{S^{1/2}(1+{}_{\parallel}\bar{R}_{\parallel})^2(1-{}_{\perp}R_{\perp}{}_{\perp}\bar{R}_{\perp})}{F'(\theta_n)\,{}_{\parallel}R_{\parallel}\,D_{\parallel}} \tag{1}$$

$$T_2 = \frac{S^{1/2}(1+{}_{\perp}\bar{R}_{\perp})^2(1-{}_{\parallel}R_{\parallel}{}_{\parallel}\bar{R}_{\parallel})}{F'(\theta_n)\,{}_{\perp}\bar{R}_{\perp}\,D_{22}} \tag{2}$$

$$T_3 = \frac{S^{1/2}(1+{}_{\parallel}\bar{R}_{\parallel})(1+{}_{\perp}\bar{R}_{\perp})\,{}_{\parallel}R_{\perp}}{F'(\theta_n)\,D_{12}} \tag{3}$$

$$T_4 = \frac{{}_{\perp}R_{\parallel}}{{}_{\parallel}R_{\perp}} \tag{4}$$

$$f = \frac{e_y}{h_y} = \frac{(1+{}_{\perp}\bar{R}_{\perp})(1-{}_{\parallel}R_{\parallel}{}_{\parallel}\bar{R}_{\parallel})}{(1+{}_{\parallel}\bar{R}_{\parallel})\,{}_{\perp}R_{\parallel}\,{}_{\perp}\bar{R}_{\perp}} = \frac{(1+{}_{\perp}\bar{R}_{\perp})\,{}_{\parallel}R_{\perp}\,{}_{\parallel}\bar{R}_{\parallel}}{(1+{}_{\parallel}\bar{R}_{\parallel})(1-{}_{\perp}R_{\perp}{}_{\perp}\bar{R}_{\perp})} \tag{5}$$

S is the sine of the eigenangle and F' (θ_n) the derivative of the mode equation evaluated at the eigenangle, θ_n. The R and $\bar{R}$'s represent, respectively, elements of the reflection matrix looking into the ionosphere and towards the ground from ground level. Consistent with the usual notation, the first subscript refers to the polarization of the incident wave and the second subscript refers to the polarization of the reflected wave. Equation (5) gives

the ratio of e_y to h_y at the ground. The function f is also called F∅FR in this program. The D_{ij}'s are functions defined below which are negated in the present program by defining

$$\tau_1 = D_{11}T_1 \ , \quad \tau_2 = D_{22}T_2 \ , \quad \tau_3 = D_{12}T_3 \tag{6}$$

In terms of the preceding quantities the excitation tensor elements are

$$\lambda = (\!(\lambda_{ij})\!) = \begin{array}{c} \text{FIELD COMPONENT} \rightarrow \\ \\ \\ \\ \end{array} \begin{array}{c} E_z \\ \\ \\ \\ \end{array} \begin{array}{c} E_x \\ \\ \\ \\ \end{array} \begin{array}{c} E_y \\ \\ \\ \\ \end{array} \begin{array}{c} \text{EXCITER} \downarrow \\ \\ \\ \\ \end{array} \left| \begin{array}{ccc} \tau_1 S^2 & \tau_1 S & -\tau_3 S/f \\ -\tau_1 S & -\tau_1 & \tau_3/f \\ -\tau_3 T_4 S/f & -\tau_3 T_4/f & \tau_2/f^2 \end{array} \right| \begin{array}{l} \\ \text{VERTICAL} \\ \text{END-ON} \\ \text{BROADSIDE} \end{array} \tag{7}$$

The columns relate to excitation of the electric field components E_z, E_x and E_y and the rows apply to excitation by a vertical dipole, a horizontal dipole end-on and a horizontal dipole broadside. Recall the geometry of the situation is such that z is taken positive into the ionosphere, that positive x is the direction of propagation and that y is normal to the plane of propagation.

The excitation factors must be supplemented with definitions of the height gains. These along with the definitions of the D_{ij}'s are

$$f_1(z) = \exp(z/a)(F_1 h_1(q) + F_2 h_2(q))/(F_1 h_1(q_0) + F_2 h_2(q_0)) \tag{8}$$

$$f_2(z) = \frac{1}{ik}\frac{df_1}{dz} \tag{9}$$

$$f_3(z) = (F_3 h_1(q) + F_4 h_2(q))f/(F_3 h_1(q_0) + F_4 h_2(q_0)) \tag{10}$$

$$D_{11} = (F_1 h_1(q_0) + F_2 h_2(q_0))^2 \tag{11}$$

$$D_{12} = (F_1 h_1(q_0) + F_2 h_2(q_0))(F_3 h_1(q_0) + F_4 h_2(q_0)) \tag{12}$$

$$D_{22} = \left(F_3 h_1(q_0) + F_4 h_2(q_0)\right)^2 \tag{13}$$

$$F_1 = -H_2(q_0) + i\frac{n_0^2}{N_g^2}\left(\frac{ak}{2}\right)^{1/3}\left(N_g^2 - S^2\right)^{1/2} h_2(q_0) \tag{14}$$

$$F_2 = H_1(q_0) - i\frac{n_0^2}{N_g^2}\left(\frac{ak}{2}\right)^{1/3}\left(N_g^2 - S^2\right)^{1/2} h_1(q_0) \tag{15}$$

$$F_3 = -h_2'(q_0) + i\left(\frac{ak}{2}\right)^{1/3}\left(N_g^2 - S^2\right)^{1/2} h_2(q_0) \tag{16}$$

$$F_4 = h_1'(q_0) - i\left(\frac{ak}{2}\right)^{1/3}\left(N_g^2 - S^2\right)^{1/2} h_1(q_0) \tag{17}$$

$$q = \left(\frac{ak}{2}\right)^{2/3}\left(C^2 + 2z/a\right) \tag{18}$$

$$H_j(q) = h_j'(q) + \frac{1}{2}\left(\frac{2}{ak}\right)^{2/3} h_j(q) \quad ; \qquad j = 1, 2 \tag{19}$$

$$n^2 = 1 + 2z/a \tag{20}$$

$$N_g^2 = \varepsilon/\varepsilon_0 - i\sigma/\omega\varepsilon_0 \tag{21}$$

C = cosine of the ground eigenangle

k = the free space wavenumber

$\varepsilon/\varepsilon_0$ = dielectric constant of the ground

σ = the ground conductivity

ω = the circular radio frequency

a = the earth's radius

The functions h_1 and h_2 are modified Hankel functions of order 1/3 (which are linearly related to Airy functions) as defined by the Computation Laboratory at Cambridge, Massachusetts (reference 5) and the primes on these quantities denote derivatives with respect to the argument. Equation (20) is the modified refractive index which is chosen to be unity at the ground. The subscript, o, which appears on n^2 in equations (14) and 15) signifies that Eq (20) is to be evaluated for z = 0. Similarly the subscript o which appears on q in Eq (8) and Eqs. (10) through (17) signify that Eq. (18) is to be evaluated for z = 0. It should be pointed out that f_1 (apart from a sine of the eigenangle) is the height gain for the vertical electric field E_z, f_2 the height gain for the horizontal electric field component E_x, and f_3 for the electric field component E_y which is normal to the plane of propagation. Unlike the eigenangles, the T_j's and the polarization ratio, the height gains are generated in the present program.

The final quantities required for the mode sum evaluations are the generalized mode conversion coefficients A^p_{jk} which are also calculated in the present program. Details of their calculation are described in references 2 and 3 and we will remark here only that the quantities relate to the amplitude of the j^{th} mode in slab p generated by virtue of a unit amplitude wave incident in the transmitter region (slab NTR in the present program - see Fig. 1).

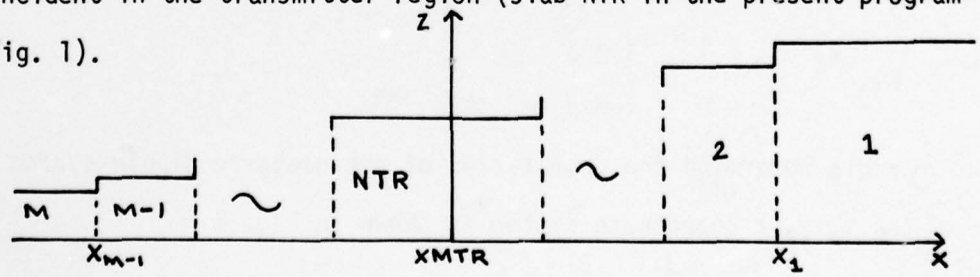


Fig. 1 MODE CONVERSION MODEL

In terms of the excitation factors, height gains and generalized mode conversion coefficients the electric field components E_ℓ^p in the p^{th} slab may be written as follows

$$E_\ell^{NTR} = \frac{Q}{[\sin(x/a)]^{1/2}} \sum_k \Big(\lambda_{1\ell k}^{NTR} f_{1k}^{NTR}(z_T) \cos\gamma + \lambda_{2\ell k}^{NTR} f_{2k}^{NTR}(z_T) \sin\gamma\cos\phi + \lambda_{3\ell k}^{NTR} f_{3k}^{NTR}(z_T) \sin\gamma\sin\phi \Big) f_{\ell k}^{NTR}(z_R)\, e^{-ik(s_k^{NTR}-1)x} \tag{22}$$

$$E_\ell^p = \frac{Q}{[\sin(x/a)]^{1/2}} \sum_j \sum_k \Big(\lambda_{1\ell k}^{NTR} f_{1k}^{NTR}(z_T) \cos\gamma + \lambda_{2\ell k}^{NTR} f_{2k}^{NTR}(z_T) \sin\gamma\cos\phi + \lambda_{3\ell k}^{NTR} f_{3k}^{NTR}(z_T) \sin\gamma\sin\phi \Big) \Big(\delta_{1\ell} + (1-\delta_{1\ell}) s_k^{NTR}/s_j^p \Big) f_{\ell j}^p(z_R) A_{jk}^p \times e^{-ik(s_k^{NTR} x_{NTR-1} + s_j^p (x - x_p) - x)} \quad ; \quad p \neq NTR \tag{23}$$

The receiver altitude is z_R and the transmitter altitude z_T. The final subscript on the λ's and f's denotes mode indices whereas the index ℓ takes on the values 1, 2 and 3. Consistent with the previous definition $\ell = 1 \rightarrow E_z$, $\ell = 2 \rightarrow E_x$ and $\ell = 3 \rightarrow E_y$. The constant Q is

$$Q = 0.03248k/\sqrt{F}$$

with the free space wavenumber, k, in inverse km and F the frequency in kHz. The symbol δ_{ij} represents the Kronecker delta. That is

$$\delta_{ij} \quad \begin{array}{ll} = 1 & i = j \\ = 0 & i \neq j \end{array}$$

The angles γ and ϕ determine the orientation of the electric dipole source relative to the x, y, z coordinate system as shown in Fig. 2

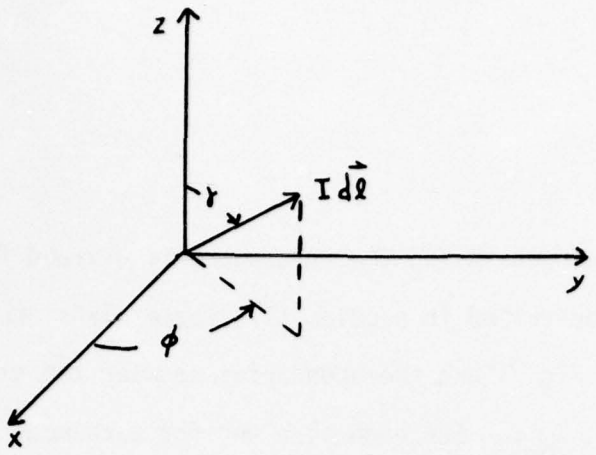


Fig. 2. Dipole Orientation

Two distinct options are available with the present program. One is for field calculations (amplitude and phase) as a function of range for a fixed location of the horizontal inhomogeneity. The second allows for field calculations at two distinct receiving points along the same great circle path as a function of position of the horizontal inhomogeneity (this option is useful only if the ground conductivity and the geomagnetic parameters are invariant over the path). Amplitude is expressed in dB above a microvolt per meter for a one kilowatt radiator and phase in degrees relative to free space. Both of these quantities are printed outputs of the program. Amplitude plots may also be requested.

III. Description of Program

A. General Comments

To handle horizontal inhomogeneities, the ionosphere is divided into a series of vertical slabs, as described in section II. These slabs are labeled 1, 2, · · · , M as shown in Fig. 1 and the boundaries between the slabs have coordinates X_1, X_2, · · · , X_{M-1}. For each slab and for each mode the ground eigenangle, the T_j's defined by Eqs. (1) through (4) and the function f (called FØFR) defined by Eq. (5) must be provided.

B. Description of Input

All input to the mode conversion program is given in a data deck on the standard input unit. A listing of sample input, showing the data deck setup is given on pages 17 through 19.

There are two parts to the input. The first part is read in by means of a Fortran IV NAMELIST input format. The first card of each set of input must contain a blank in column 1 and &DATUM in columns 2- 7. This is followed by at least one blank and then data items separated by commas. The data items have the following forms: (all cards must have a blank in column 1)

variable name = constant,

or

array name = set of constants, (all separated by commas), where successive occurrences of the same constant can be represented by k* constant; for example, in the sample input, sigma = 9*4.64 means that the conductivity for all nine slabs is 4.64 mhos/m.

The following variables and arrays may be specified in the NAMELIST input:

FREQ - frequency in kHz.

SIGMA - ground conductivity in mhos per metre. Note that a ground

conductivity for each slab is required and that SIGMA is dimensioned for 25.

EPSLØN - permittivity of ground in Farads per metre. Note that a ground permittivity for each slab is required and that EPSLØN is dimensioned for 25.

RHØMAX - maximum horizontal distance in km at which field strengths are desired.

RHØMIN - minimum horizontal distance in km at which field strengths are desired.

DELRHØ - horizontal increment in km for which successive field strengths are computed.

IDPLØT - literal constant up to 40 characters which is printed on plots produced. For example, in the NAMELIST input data, place the card IDPLØT = 'FIELD STRENGTH PLØT'. If IDPLØT is set to zero or if IDPLØT is omitted from input no plots are produced.

NRSLAB - Number of slabs in the model.

NRMØDE - Number of modes to be handled in the program.

NTMAX - Number of times the transmitter - terminator separation is incremented.

DELTAX - Distance in km by which transmitter - terminator separation is incremented.

XVAL - Horizontal position in km of boundaries between adjacent slabs. Note that XVAL can be negative and that it is dimensioned for 25.

IFIRST - Is set to 1 in the first set of NAMELIST input. If more than one set of input is used set IFIRST = 0 in the second set.

LAST - Is set to 1 in the last set of NAMELIST input. If the user has requested plots this causes the end of file to be written on the plot tape.

IPLTØP - Plotting option flag. If IPLTØP = 1 two plots (field amplitude in dB above a μv/m for 1 kw radiated power versus transmitter - terminator

distance for two receiver positions) are produced for each set of input. If IPLTØP = 2, NTMAX plots (field amplitude in dB above a μv/m for 1 kw versus distance from transmitter) are produced for each set of input.

XMIN - minimum value of X on plot.

XINC - increment of X scale in km/inch.

YMIN - minimum value of y on plot.

YINC - increment of y scale in dB/inch.

SIZEX - size of X axis in inches.

SIZEY - size of y axis in inches.

GAMMA - dipole orientation angle relative to z axis (see Fig. 2). Note that GAMMA is dimensioned for 4.

PHI - dipole orientation angle relative to X axis (see Fig. 2). Note that PHI is dimensioned for 4.

NRP - number of GAMMA-PHI pairs up to 4.

ZT - transmitter altitude in km.

ZR - receiver altitude in km.

INTFLG - Printing option flag. INTFLG must be set to 1 if printout of height gain integrals is required. See reference 2 for an output of height gain.

IPRNTA - Printing option flag. IPRNTA must be set for 1 if printout of generalized mode conversion coefficients is required.

The end of the NAMELIST input is signaled by &END.

The second part of the input follows the NAMELIST input. Three cards per mode are required. The first contains the eigenangle at the ground and T_1 and T_2 (see Eqs. 1 and 2). The second contains the eigenangles at the ground (duplicate input) and T_3 and T_4 (see Eqs. 3 and 4). The third card contains f (see Eq. 5) and TØPHT. The latter in this program is a real variable and

represents the height above ground in km above which height gains are discarded. TØPHT is dimensioned for 25. There must be 3*NRMØDE cards for each slab. The 3*NRMØDE cards for slab 2 follow those for slab one and so on up to slab number NRSLAB. Although ordering of modes is not critical, we have followed the practice of ordering them according to their real parts. (The mode with the largest real part is called mode 1).

C. Description of Output

The sample output shown on pages 20 through 42 begins with an abbreviated listing of the NAMELIST input variables. This is followed by a printout of THETA, T_j's and FØFR for all slabs and modes. THETA is the eigenangle at the ground, the T_j's are the complex quantities given by Eqs. (1) through (4) and FØFR is the complex quantity f defined by Eq. (5).

The principal output of the mode conversion program begins on page 21 where the total mode conversion coefficients defined by Eq. (24) of reference 2 are printed for each slab (we remark that they are mode conversion coefficients in the generalized sense that the modes are not an orthogonal set). The tabulation represents the conversion from k to j and appears as printout because IPRNTA was set to 1 in the input. On the other hand height gain integrals have been suppressed in the output because INTFLG was not set equal to 1 in the input. Since IPLTØP was set equal to 2 the sample output shows mode sums for the three electric field components E_z, E_x and E_y as a function of transmitter-receiver distance ranging from RHØMIN to RHØMAX at DELRHØ intervals. The mode sums are listed in dB/μv/m for a one kilowatt radiator and the phases in degrees relative to free space. Because NRP = 4 in the input, there are four GAMMA-PHI pairs (i.e. four antenna orientations) for which the mode sums are computed. Shown on pages 45, 46 and 47 in section IV are reductions of the plots generated by the mode conversion program for this case along with

WKB results. The mode conversion results and WKB results are shown together for program check purposes as discussed in section IV.

D. Program Layout

This subsection describes the basic features of the mode conversion program listed in the appendix.

Reading and printing of input quantities occurs in MAIN as does calculation of constant factors. These quantities are assigned to common areas MCINPT or MCSTØR. MAIN calls HTINTL and HTGAIN for each slab MM.

SUBROUTINE HTINTL (CAPI, NØRM, IFLG, M, INTFLG)

HTINTL calculates the height integrals defined by Eq. (4) in reference 3. NORM is an array of 25 by 5 by 5 which contains all combinations of modal integrals for the slab M. Also CAPI is an array of 25 by 5 by 5 which contains all combinations of modal height gain integrals for the slab M and the previous slab M+1. IFLG is a control flag set to zero in MAIN if the slab M equals NRSLAB. It is set to 1 if M is not equal to NRSLAB. INTFLG is a printing option flag. It must be set to 1 if printout of NØRM and CAPI is desired. NØRM and CAPI are assigned to the common area CAP in MAIN where they are called TNORM and CAPI. HTINTL calls MDHNKL

SUBROUTINE MDHNKL (Z, H1, H2, H1PRME, H2PRME)

MDHNKL calculates for argument Z two independent solutions (H1 and H2) and their derivatives (H1PRME and H2PRME) of Stokes' equation by methods described in reference 5. MAIN next calls HTGAIN.

SUBROUTINE HTGAIN (Z)

Z is dimensioned for 2. Z(1) is set equal to the transmitter height ZT and Z(2) is set equal to the receiver height. The height gain functions f_1, f_2 and f_3 defined by Eqs. (8), (9) and (10) respectively are computed for the

transmitter and receiver heights. These are made available to MCFLD and MCFLD2 through COMMON/HTGN/.

MAIN next calls MCSTEP for slabs equal to NTR (transmitter slab), NTR-1, . . ., 1 with allowance for changes in NTR consistent with the input data.

SUBROUTINE MCSTEP (M)

MCSTEP calls for CLINEQ and provides as its output the mode conversion coefficients for the slabs NTR, NTR-1, . . . , 1 for all values of NTR consistent with the input data. The mode conversion coefficients defined by Eq. (24) of reference 2 are printed out under the "A = TOTAL CONVERSION COEFFICIENTS" label.

SUBROUTINE CLINEQ (A, B, X, N, NDIM, IFLAG, ERR)

CLINEQ computes the solution of simultaneous linear equations with complex coefficients. That is it solves the matrix equation

$$A * X = B$$

for the vector X of length N, given the matrix A of size N by N and the vector B of length N by Crout's L-U decomposition (reference 6). The A is destroyed by CLINEQ, NDIM is an integer variable which must be greater than or equal to N. IFLAG is an integer variable normally set to zero. Setting IFLAG = 1 bypasses the L-U decomposition of A when solutions are required for different B's. ERR is a real variable computed by CLINEQ which indicates the relative errors in the computed solution vector X.

SUBROUTINE MCFLD

MCFLD called from MAIN if IPLTØP = 1 computes the field components E_{ℓ}^{M} defined by Eqs. (22) and (23) for transmitter height ZT and receiver height ZR for as many as four (GAMMA, PHI) pairs. GAMMA and PHI describe the orientation of the electric dipole source. Calculations are made for ranges RHØMIN and RHØMAX for distances between the transmitter and the start of the horizontal

inhomogeneity ranging between XVAL (NRSLAB-1) and NTMAX*DELTAX +XVAL(NRSLAB-1) at intervals of DELTAX using Eqs. (22) and (23). Field amplitude outputs are in dB above a μv per metre for 1 kw radiated power and phase angles are in degrees relative to free space phase.

SUBROUTINE MCFLD2

MCFLD2 called from MAIN if IPLTØP = 2 computes the field components E_{ℓ}^{M} defined by Eqs. (22) and (23) for transmitter height ZT and receiver height ZR for as many as four (GAMMA, PHI) pairs. Calculations are made for transmitter-receiver distances ranging from RHØMIN to RHØMAX at DELRHØ intervals using Eqs. (22) and (23) for a fixed horizontal inhomogeneity. Field amplitude outputs are dB above a μv per metre for 1 kw radiated power and phase angles are in degrees relative to free space phase.

SUBROUTINE MCPLTS

MCPLTS generates six plots (three field component amplitudes in dB above a μv per metre for 1 kw radiated power versus distance between transmitter and start of the horizontal inhomogeneity for two receiver ranges). As many as four (GAMMA, PHI) pairs are possible so that each plot can contain as many as four curves.

SUBROUTINE MCPLT2

MCPLT2 generates three plots (three field component amplitudes in dB above a μv per metre for 1 kw radiated power versus transmitter receiver distance for a single location of the horizontal inhomogeneity). As many as four (GAMMA, PHI) pairs are possible so that each plot can contain as many as four curves.

SUBROUTINE MAGANG (ARG, MAG, ANGLE)

MAGANG converts complex number ARG to polar form with ANGLE in degrees.

SAMPLE INPUT

```
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 NRSLAB=9,NRMODE=5,
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 XVAL=1025.,837.5,712.5,587.5,462.5,337.5,212.5,25.,0.,
 GAMMA=0.,90.,90.,45.,PHI=0.,0.,90.,45.,NRP=4,
 ZT=5.,ZR=10.,
 XMIN=0.,XINC=500.,YMIN=-80.,YINC=20.,SIZEX=10.,SIZEY=8.,
 IPRNTA=1,IPLTOP=2,IFIRST=1,
 LAST=1,
 &END
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2 89.43090 -3.45987  2.17578087D-08 1.89015164D-08 1.31038701D-01 7.29003334D-01
 89.43090 -3.45987   4.61230D-02  1.77108 -6.54711840D-07  1.16015319D-06  71.00
1 87.19352 -1.77741  4.82515778D-05-1.84202318D-05-6.04653512D-11-2.40773840D-11
2 87.19352 -1.77741 -4.26374528D-08-5.21264514D-08 1.36581734D-01 7.28501361D-01
 87.19352 -1.77741   1.09558D-04  2.77387 -4.11288203D-04 -1.23732211D-03  71.00
1 82.32644 -1.03410  1.51114665D-03-3.75244700D-02 2.82226677D-14-3.37278400D-13
2 82.32644 -1.03410  7.59683975D-08 1.06838941D-07 1.54794747D-01 7.23226265D-01
 82.32644 -1.03410   7.83811D-02  1.60618 -2.76117393D-06  2.13569802D-06  71.00
1 79.02547 -1.34370  1.17866851D-04-1.05381567D-05-3.26606199D-10-9.72733909D-11
2 79.02547 -1.34370 -1.25114015D-07-1.96725758D-07 1.74620182D-01 7.21086723D-01
 79.02547 -1.34370   2.42410D-04  3.04333 -9.05025258D-04 -1.74997603D-03  71.00
1 75.47092 -1.35774  1.58271624D-03-3.38606999D-02 2.46893660D-13-3.54150828D-12
2 75.47092 -1.35774  2.22513640D-07 3.34034385D-07 2.05880771D-01 7.18099615D-01
 75.47092 -1.35774   6.75171D-02  1.60522 -9.53695935D-06  7.01721882D-06  71.00
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2 89.42754 -3.44563  2.11904692D-08 1.86605947D-08 1.33034278D-01 7.38057194D-01
 89.42754 -3.44563   4.63765D-02  1.77055 -6.40077722D-07  1.12566747D-06  70.88
1 87.16147 -1.76119  4.69554395D-05-1.73259124D-05-6.10369677D-11-2.42565594D-11
2 87.16147 -1.76119 -4.16237489D-08-5.14515564D-08 1.38527718D-01 7.37660784D-01
 87.16147 -1.76119   1.06161D-04  2.78506 -4.24343247D-04 -1.25234512D-03  70.88
1 82.29943 -1.03634  1.50104026D-03-3.75923796D-02 3.11800874D-14-3.30051333D-13
2 82.29943 -1.03634  7.43304969D-08 1.05425947D-07 1.55145255D-01 7.33350767D-01
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1 78.99378 -1.34503  1.14919035D-04-9.22024502D-06-3.28887138D-10-9.76930460D-11
2 78.99378 -1.34503 -1.22219941D-07-1.94066081D-07 1.77326163D-01 7.30777892D-01
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1 75.43374 -1.36379  1.60318533D-03-3.39203565D-02 2.86670941D-13-3.46599972D-12
2 75.43374 -1.36379  2.16957625D-07 3.29943884D-07 2.07635648D-01 7.28359341D-01
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1 89.42413 -3.43135  4.35506496D-03-2.14365807D-02-1.25650075D-14-2.33991650D-14
2 89.42413 -3.43135  2.06383925D-08 1.84218647D-08 1.35160007D-01 7.47005957D-01
 89.42413 -3.43135   4.66300D-02  1.77003 -6.37459436D-07  1.09227167D-06  70.75
1 87.12937 -1.74541  4.56799934D-05-1.62909329D-05-6.16113691D-11-2.44374337D-11
2 87.12937 -1.74541 -4.06358199D-08-5.07857830D-08 1.40611195D-01 7.46709877D-01
 87.12937 -1.74541   1.02861D-04  2.79597 -4.37424060D-04 -1.26780403D-03  70.75
1 82.27200 -1.03930  1.51396429D-03-3.76378472D-02 3.38811915D-14-3.23028592D-13
2 82.27200 -1.03930  7.25983442D-08 1.04135660D-07 1.57128957D-01 7.42776620D-01
 82.27200 -1.03930   7.85979D-02  1.60608 -2.68484864D-06  2.03686222D-06  70.75
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1 75.39648 -1.36988  1.62360782D-03-3.39803005D-02 3.23724829D-13-3.39188129D-12
2 75.39648 -1.36988  2.11550838D-07 3.25950655D-07 2.09572770D-01 7.38486679D-01
 75.39648 -1.36988   6.77139D-02  1.60608 -9.27370098D-06  6.66879600D-06  70.75
1 89.42067 -3.41703  4.36780159D-03-2.15559704D-02-1.18448522D-14-2.27677493D-14
2 89.42067 -3.41703  2.01010536D-08 1.81857054D-08 1.37416971D-01 7.55849162D-01
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2 82.24464 -1.04249  7.08728697D-08 1.02928849D-07 1.59623994D-01 7.51297758D-01
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1 78.92935 -1.34675  1.09198429D-04-6.53890238D-06-3.33674041D-10-9.89079789D-11
2 78.92935 -1.34675 -1.16550339D-07-1.89099442D-07 1.81708653D-01 7.49879976D-01
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2 82.21716 -1.04550  6.92206598D-08 1.01684947D-07 1.61844433D-01 7.60461003D-01
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1 75.32087 -1.38223  1.66651159D-03-3.41082510D-02 3.83897798D-13-3.24508047D-12
2 75.32087 -1.38223  2.01614036D-07 3.18133718D-07 2.13229738D-01 7.57175903D-01
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1 89.41454 -3.39001  4.38789604D-03-2.17659106D-02-1.04687467D-14-2.14784492D-14
2 89.41454 -3.39001  1.90214090D-08 1.77299918D-08 1.43823279D-01 7.71326704D-01
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1 87.03294 -1.70078  4.20118682D-05-1.34765793D-05-6.33810198D-11-2.50068995D-11
2 87.03294 -1.70078 -3.78178704D-08-4.89490726D-08 1.48227417D-01 7.71575283D-01
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1 82.16221 -1.05178  1.56788845D-03-3.78283054D-02 4.30300220D-14-2.95602926D-13
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1 78.83179 -1.34989  1.01067223D-04-2.97529819D-06-3.40950328D-10-1.00954167D-10
2 78.83179 -1.34989 -1.08530594D-07-1.82127767D-07 1.88225678D-01 7.77398559D-01
 78.83179 -1.34989   2.06851D-04  3.10286 -1.01991231D-03 -1.83207187D-03  70.25
1 75.24741 -1.39414  1.69736890D-03-3.42131335D-02 4.49391510D-13-3.10056661D-12
2 75.24741 -1.39414  1.90933177D-07 3.10295906D-07 2.18818882D-01 7.78331729D-01
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1 89.40604 -3.35923  4.42044010D-03-2.20377663D-02-9.31176008D-15-2.03397772D-14
2 89.40604 -3.35923  1.81022843D-08 1.72816483D-08 1.47677538D-01 7.89068206D-01
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1 82.13465 -1.05486  1.580767360-03-3.787469400-02 4.490554560-14-2.890951120-13
2 82.13465 -1.05486  6.446578390-08 9.813217990-08 1.697020000-01 7.863812420-01
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1 86.93613 -1.65973  3.853131760-05-1.109060330-05-6.514991120-11-2.558452140-11
2 86.93613 -1.65973 -3.519411630-08-4.709895890-08 1.560215860-01 7.966881270-01
 86.93613 -1.65973   8.500310-05  2.85823 -5.185976360-04 -1.371629700-03  70.00
1 82.10705 -1.05796  1.594265930-03-3.792107190-02 4.662367560-14-2.826931210-13
2 82.10705 -1.05796  6.296461160-08 9.696915790-08 1.723808420-01 7.950220880-01
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1 78.76777 -1.35287  9.589639210-05-1.156973540-06-3.457724180-10-1.020825090-10
2 78.76777 -1.35287 -1.035283540-07-1.775312650-07 1.945133390-01 7.951944260-01
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1 75.17244 -1.40645  1.733162560-03-3.433070180-02 4.992436570-13-2.961785490-12
2 75.17244 -1.40645  1.813806980-07 3.028869260-07 2.243274580-01 7.974103650-01
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SAMPLE OUTPUT

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&DATUM
IDPLOT='HPRIME = 70  TO  HPRIME = 71              ',
FREQ=21.794,
RHOMIN=25.,RHOMAX=5000.,DELRHO=25.,DELTAX=0.,NTMAX=1,
NRSLAB=9,NRMODE=5,
SIGMA = 9*4.04, EPSLON = 9*.7172014E-09,
XVAL=1025.,837.5,712.5,587.5,462.5,337.5,212.5,25.,0.,
GAMMA=0.,90.,90.,45.,PHI=0.,0.,90.,45.,NRP=4,
ZT=5.,ZR=10.,
XMIN=0.,XINC=500.,YMIN=-80.,YINC=20.,SIZEX=10.,SIZEY=8.,
IPRNTA=1,IPLTOP=2,IFIRST=1,
LAST=1,
&END
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89.431 -3.460	0.433D-02-0.212D-01	-0.141D-13-0.247D-13	0.218D-07 0.189D-07	0.131D 00 0.729D 00	-0.655D-06 0.116D-05	71.0
87.194 -1.777	0.483D-04-0.184D-04	-0.605D-10-0.241D-10	-0.426D-07-0.521D-07	0.137D 00 0.729D 00	-0.411D-03-0.124D-02	71.0
82.326 -1.034	0.151D-02-0.575D-01	0.282D-13-0.337D-12	0.760D-07 0.107D-06	0.155D 00 0.723D 00	-0.276D-05 0.214D-05	71.0
79.325 -1.044	0.118D-03-0.135D-04	-0.327D-09-0.973D-10	-0.125D-06-0.197D-06	0.175D 00 0.721D 00	-0.905D-03-0.173D-02	71.0
75.471 -1.358	0.158D-02-0.339D-01	0.247D-12-0.354D-11	0.223D-06 0.334D-06	0.206D 00 0.716D 00	-0.954D-05 0.702D-05	71.0
89.428 -3.446	0.434D-02-0.213D-01	-0.133D-13-0.240D-13	0.212D-07 0.187D-07	0.133D 00 0.738D 00	-0.646D-06 0.113D-05	70.9
87.161 -1.761	0.470D-04-0.173D-04	-0.613D-10-0.243D-10	-0.416D-07-0.515D-07	0.139D 00 0.736D 00	-0.424D-03-0.125D-02	70.9
82.299 -1.036	0.150D-02-0.576D-01	0.312D-13-0.330D-12	0.743D-07 0.105D-06	0.155D 00 0.733D 00	-0.272D-05 0.209D-05	70.9
78.994 -1.345	0.115D-03-0.922D-05	-0.329D-09-0.977D-10	-0.122D-06-0.194D-06	0.177D 00 0.731D 00	-0.922D-03-0.176D-02	70.9
75.434 -1.364	0.160D-02-0.339D-01	0.287D-12-0.347D-11	0.217D-06 0.330D-06	0.208D 00 0.726D 00	-0.840D-05 0.684D-05	70.9
89.424 -3.451	0.436D-02-0.214D-01	-0.126D-13-0.234D-13	0.206D-07 0.184D-07	0.135D 00 0.747D 00	-0.637D-06 0.109D-05	70.8
87.129 -1.745	0.457D-04-0.163D-04	-0.616D-10-0.244D-10	-0.406D-07-0.503D-07	0.141D 00 0.747D 00	-0.437D-03-0.127D-02	70.8
82.272 -1.039	0.151D-02-0.576D-01	0.339D-13-0.323D-12	0.726D-07 0.104D-06	0.157D 00 0.743D 00	-0.268D-05 0.204D-05	70.8
78.961 -1.345	0.112D-03-0.769D-05	-0.331D-09-0.985D-10	-0.119D-06-0.192D-06	0.179D 00 0.740D 00	-0.943D-03-0.178D-02	70.8
75.396 -1.373	0.162D-02-0.340D-01	0.324D-12-0.339D-11	0.212D-06 0.326D-06	0.210D 00 0.738D 00	-0.927D-05 0.667D-05	70.8
89.421 -3.417	0.437D-02-0.216D-01	-0.116D-13-0.228D-13	0.201D-07 0.182D-07	0.137D 00 0.756D 00	-0.629D-06 0.106D-05	70.6
87.097 -1.730	0.444D-04-0.153D-04	-0.622D-10-0.246D-10	-0.397D-07-0.502D-07	0.143D 00 0.755D 00	-0.451D-03-0.126D-02	70.6
82.245 -1.042	0.153D-02-0.577D-01	0.365D-13-0.316D-12	0.734D-07 0.103D-06	0.160D 00 0.751D 00	-0.265D-05 0.199D-05	70.6
78.929 -1.347	0.109D-03-0.654D-05	-0.334D-09-0.989D-10	-0.117D-06-0.189D-06	0.182D 00 0.750D 00	-0.960D-03-0.179D-02	70.6
75.359 -1.376	0.164D-02-0.340D-01	0.354D-12-0.331D-11	0.206D-06 0.322D-06	0.211D 00 0.748D 00	-0.914D-05 0.650D-05	70.6
89.417 -3.403	0.438D-02-0.217D-01	-0.112D-13-0.221D-13	0.196D-07 0.180D-07	0.140D 00 0.765D 00	-0.620D-06 0.103D-05	70.5
87.065 -1.715	0.432D-04-0.144D-04	-0.628D-10-0.248D-10	-0.387D-07-0.495D-07	0.145D 00 0.764D 00	-0.464D-03-0.130D-02	70.5
82.217 -1.046	0.154D-02-0.577D-01	0.386D-13-0.309D-12	0.692D-07 0.102D-06	0.162D 00 0.760D 00	-0.262D-05 0.194D-05	70.5
78.897 -1.348	0.106D-03-0.552D-05	-0.336D-09-0.995D-10	-0.114D-06-0.187D-06	0.184D 00 0.759D 00	-0.980D-03-0.180D-02	70.5
75.321 -1.382	0.167D-02-0.341D-01	0.384D-12-0.325D-11	0.202D-06 0.318D-06	0.213D 00 0.757D 00	-0.902D-05 0.635D-05	70.5
89.415 -3.390	0.439D-02-0.218D-01	-0.105D-13-0.215D-13	0.190D-07 0.177D-07	0.144D 00 0.771D 00	-0.613D-06 0.998D-06	70.4
87.033 -1.701	0.420D-04-0.135D-04	-0.634D-10-0.250D-10	-0.378D-07-0.489D-07	0.148D 00 0.772D 00	-0.477D-03-0.132D-02	70.4
82.190 -1.049	0.155D-02-0.578D-01	0.410D-13-0.302D-12	0.676D-07 0.100D-06	0.164D 00 0.770D 00	-0.256D-05 0.190D-05	70.4
78.864 -1.349	0.104D-03-0.405D-05	-0.339D-09-0.100D-09	-0.111D-06-0.184D-06	0.186D 00 0.768D 00	-0.100D-02-0.182D-02	70.4
75.285 -1.388	0.168D-02-0.342D-01	0.421D-12-0.317D-11	0.196D-06 0.314D-06	0.216D 00 0.769D 00	-0.889D-05 0.617D-05	70.4
89.411 -3.376	0.440D-02-0.219D-01	-0.985D-14-0.209D-13	0.185D-07 0.175D-07	0.146D 00 0.780D 00	-0.605D-06 0.968D-06	70.3
87.001 -1.687	0.408D-04-0.126D-04	-0.640D-10-0.252D-10	-0.369D-07-0.483D-07	0.151D 00 0.780D 00	-0.491D-03-0.134D-02	70.3
82.162 -1.052	0.157D-02-0.578D-01	0.430D-13-0.296D-12	0.660D-07 0.993D-07	0.167D 00 0.778D 00	-0.255D-05 0.185D-05	70.3
78.832 -1.350	0.101D-03-0.296D-05	-0.341D-09-0.101D-09	-0.109D-06-0.182D-06	0.188D 00 0.777D 00	-0.102D-02-0.183D-02	70.3
75.247 -1.394	0.170D-02-0.342D-01	0.449D-12-0.310D-11	0.191D-06 0.310D-06	0.219D 00 0.778D 00	-0.877D-05 0.602D-05	70.3
89.406 -3.359	0.442D-02-0.220D-01	-0.931D-14-0.203D-13	0.181D-07 0.173D-07	0.148D 00 0.789D 00	-0.595D-06 0.941D-06	70.1
86.968 -1.673	0.397D-04-0.118D-04	-0.646D-10-0.254D-10	-0.360D-07-0.477D-07	0.153D 00 0.788D 00	-0.505D-03-0.135D-02	70.1
82.135 -1.055	0.158D-02-0.579D-01	0.449D-13-0.289D-12	0.645D-07 0.981D-07	0.170D 00 0.786D 00	-0.252D-05 0.181D-05	70.1
78.800 -1.351	0.984D-04-0.210D-05	-0.343D-09-0.101D-09	-0.106D-06-0.180D-06	0.192D 00 0.786D 00	-0.104D-02-0.185D-02	70.1
75.210 -1.403	0.171D-02-0.343D-01	0.475D-12-0.303D-11	0.186D-06 0.306D-06	0.221D 00 0.788D 00	-0.865D-05 0.586D-05	70.1
89.402 -3.345	0.443D-02-0.222D-01	-0.876D-14-0.198D-13	0.176D-07 0.171D-07	0.150D 00 0.797D 00	-0.587D-06 0.913D-06	70.0
86.936 -1.660	0.385D-04-0.111D-04	-0.651D-10-0.256D-10	-0.352D-07-0.471D-07	0.156D 00 0.797D 00	-0.519D-03-0.137D-02	70.0
82.107 -1.058	0.159D-02-0.579D-01	0.466D-13-0.283D-12	0.630D-07 0.970D-07	0.172D 00 0.795D 00	-0.248D-05 0.176D-05	70.0
78.768 -1.353	0.959D-04-0.116D-05	-0.346D-09-0.102D-09	-0.104D-06-0.178D-06	0.195D 00 0.795D 00	-0.106D-02-0.186D-02	70.0
75.172 -1.406	0.173D-02-0.343D-01	0.499D-12-0.296D-11	0.181D-06 0.303D-06	0.224D 00 0.797D 00	-0.853D-05 0.571D-05	70.0

A = TOTAL CONVERSION COEFFICIENTS SLAB NUMBER = 1

J = 1	K = 1	A=	0.32025D 00	0.66861D 00
J = 1	K = 2	A=	-0.12022D-01	-0.50513D-01
J = 1	K = 3	A=	0.19543D-02	-0.57036D-03
J = 1	K = 4	A=	-0.62145D-03	0.20240D-02
J = 1	K = 5	A=	0.45805D-03	0.18273D-03
J = 2	K = 1	A=	-0.10261D-03	0.11601D-03
J = 2	K = 2	A=	-0.34110D 00	0.41504D 00
J = 2	K = 3	A=	0.15638D-04	-0.25860D-04
J = 2	K = 4	A=	0.81234D-03	-0.41084D-03
J = 2	K = 5	A=	0.61937D-05	0.16765D-05
J = 3	K = 1	A=	-0.39335D-02	0.19757D-02
J = 3	K = 2	A=	0.58883D-02	-0.78321D-03
J = 3	K = 3	A=	0.31032D 00	-0.79064D-01
J = 3	K = 4	A=	-0.24997D-02	-0.85621D-02
J = 3	K = 5	A=	-0.62846D-03	-0.11447D-03
J = 4	K = 1	A=	0.24376D-05	-0.16548D-05
J = 4	K = 2	A=	-0.25079D-02	-0.55898D-03
J = 4	K = 3	A=	-0.91930D-05	0.13526D-04
J = 4	K = 4	A=	-0.87304D-01	-0.10069D 00
J = 4	K = 5	A=	0.61099D-05	0.90252D-06
J = 5	K = 1	A=	-0.81859D-03	-0.83606D-03
J = 5	K = 2	A=	0.20984D-02	0.14096D-02
J = 5	K = 3	A=	0.66462D-03	0.37303D-03
J = 5	K = 4	A=	0.12152D-02	0.46009D-03
J = 5	K = 5	A=	-0.34434D-01	-0.49622D-01

A = TOTAL CONVERSION COEFFICIENTS SLAB NUMBER = 2

J = 1	K = 1	A=	0.39210D 00	-0.67747D 00
J = 1	K = 2	A=	-0.31125D-01	0.38872D-01
J = 1	K = 3	A=	-0.21433D-02	-0.17677D-02

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J = 1      K = 4      A=    0.22119D-02   -0.11635D-02
J = 1      K = 5      A=   -0.10762D-03   -0.54839D-03
J = 2      K = 1      A=    0.14835D-03    0.35935D-05
J = 2      K = 2      A=    0.60193D 00   -0.73110D-01
J = 2      K = 3      A=   -0.34031D-04    0.16604D-04
J = 2      K = 4      A=   -0.84786D-03    0.25025D-04
J = 2      K = 5      A=   -0.51536D-05   -0.56192D-05
J = 3      K = 1      A=    0.69095D-02    0.15652D-02
J = 3      K = 2      A=   -0.78831D-02   -0.26392D-02
J = 3      K = 3      A=   -0.38760D 00    0.73188D-01
J = 3      K = 4      A=    0.35452D-02    0.12106D-01
J = 3      K = 5      A=    0.92573D-03    0.40657D-03
J = 4      K = 1      A=   -0.50274D-05   -0.29300D-05
J = 4      K = 2      A=    0.25393D-02    0.32505D-02
J = 4      K = 3      A=    0.10182D-04   -0.22528D-04
J = 4      K = 4      A=    0.19270D 00    0.25422D-01
J = 4      K = 5      A=   -0.77362D-05   -0.39013D-05
J = 5      K = 1      A=   -0.14762D-02    0.86429D-03
J = 5      K = 2      A=    0.15595D-02   -0.37714D-02
J = 5      K = 3      A=   -0.15121D-02   -0.13430D-02
J = 5      K = 4      A=   -0.29366D-02    0.10033D-02
J = 5      K = 5      A=    0.59296D-01   -0.81710D-01
A = TOTAL CONVERSION COEFFICIENTS      SLAB NUMBER =  3
J = 1      K = 1      A=    0.74853D 00   -0.31601D 00
J = 1      K = 2      A=   -0.43443D-01    0.13812D-01
J = 1      K = 3      A=   -0.13717D-02   -0.31117D-02
J = 1      K = 4      A=    0.18503D-02   -0.13321D-03
J = 1      K = 5      A=    0.17119D-03   -0.44336D-03
J = 2      K = 1      A=    0.10774D-03    0.77762D-04
J = 2      K = 2      A=    0.60694D 00    0.24723D 00
J = 2      K = 3      A=   -0.40345D-04    0.67443D-05
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J = 2	K = 4	A=	-0.31841D-03	-0.33003D-03
J = 2	K = 5	A=	-0.16289D-06	-0.61265D-05
J = 3	K = 1	A=	0.59591D-02	0.57812D-02
J = 3	K = 2	A=	-0.72836D-02	-0.56441D-02
J = 3	K = 3	A=	-0.44892D 00	0.66986D-01
J = 3	K = 4	A=	0.63419D-02	0.14125D-01
J = 3	K = 5	A=	0.12215D-02	0.11720D-03
J = 4	K = 1	A=	-0.30126D-05	-0.56140D-05
J = 4	K = 2	A=	0.28420D-04	0.41557D-02
J = 4	K = 3	A=	0.10471D-04	-0.27199D-04
J = 4	K = 4	A=	0.23399D 00	-0.86715D-01
J = 4	K = 5	A=	-0.23464D-04	0.18384D-05
J = 5	K = 1	A=	-0.17661D-02	0.83028D-04
J = 5	K = 2	A=	0.30037D-02	-0.27915D-02
J = 5	K = 3	A=	-0.16473D-02	-0.15670D-02
J = 5	K = 4	A=	-0.37526D-02	0.32486D-02
J = 5	K = 5	A=	-0.86601D-01	-0.11336D 00

A = TOTAL CONVERSION COEFFICIENTS SLAB NUMBER = 4

J = 1	K = 1	A=	0.81796D 00	0.20559D 00
J = 1	K = 2	A=	-0.39013D-01	-0.10833D-01
J = 1	K = 3	A=	0.60306D-06	-0.38568D-02
J = 1	K = 4	A=	0.63000D-03	0.73918D-03
J = 1	K = 5	A=	0.44747D-03	-0.12018D-03
J = 2	K = 1	A=	0.39390D-04	0.10845D-03
J = 2	K = 2	A=	0.44442D 00	0.55094D 00
J = 2	K = 3	A=	-0.41372D-04	-0.47395D-05
J = 2	K = 4	A=	0.44525D-03	-0.62648D-03
J = 2	K = 5	A=	0.57154D-05	-0.73086D-05
J = 3	K = 1	A=	0.28787D-02	0.87955D-02
J = 3	K = 2	A=	-0.47764D-02	-0.83304D-02

J = 3 K = 3 A= -0.51940D 00 0.59132D-01

J = 3 K = 4 A= 0.98714D-02 0.15311D-01

J = 3 K = 5 A= 0.93620D-03 -0.28309D-03

J = 4 K = 1 A= -0.44116D-08 -0.57608D-05

J = 4 K = 2 A= -0.29473D-02 0.42709D-02

J = 4 K = 3 A= 0.90101D-05 -0.31706D-04

J = 4 K = 4 A= 0.21195D 00 -0.24078D 00

J = 4 K = 5 A= -0.28193D-04 0.33283D-04

J = 5 K = 1 A= -0.12258D-02 -0.72304D-03

J = 5 K = 2 A= 0.40857D-02 -0.26841D-03

J = 5 K = 3 A= -0.18765D-02 -0.18059D-02

J = 5 K = 4 A= -0.17384D-02 0.72616D-02

J = 5 K = 5 A= -0.18829D 00 0.73263D-01

A = TOTAL CONVERSION COEFFICIENTS SLAB NUMBER = 5

J = 1 K = 1 A= 0.55033D 00 0.66100D 00

J = 1 K = 2 A= -0.22736D-01 -0.25973D-01

J = 1 K = 3 A= 0.14792D-02 -0.36815D-02

J = 1 K = 4 A= -0.12503D-02 0.13459D-02

J = 1 K = 5 A= 0.62556D-03 0.15082D-03

J = 2 K = 1 A= -0.23409D-04 0.93116D-04

J = 2 K = 2 A= 0.13363D 00 0.75336D 00

J = 2 K = 3 A= -0.37195D-04 -0.14878D-04

J = 2 K = 4 A= 0.12705D-02 -0.91845D-03

J = 2 K = 5 A= 0.78175D-05 -0.80754D-05

J = 3 K = 1 A= -0.13310D-02 0.93990D-02

J = 3 K = 2 A= -0.18786D-02 -0.94059D-02

J = 3 K = 3 A= -0.60069D 00 0.49427D-01

J = 3 K = 4 A= 0.13683D-01 0.14279D-01

J = 3 K = 5 A= 0.29220D-03 0.14267D-03

J = 4 K = 1 A= 0.25436D-05 -0.35708D-05

J = 4 K = 2 A= -0.57475D-02 0.31179D-02

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J = 4      K = 3      A=     0.53667D-05    -0.34550D-04
J = 4      K = 4      A=     0.91069D-01    -0.40251D 00
J = 4      K = 5      A=     0.97661D-05     0.64378D-04
J = 5      K = 1      A=     0.15483D-03    -0.17099D-02
J = 5      K = 2      A=     0.51266D-02     0.20225D-02
J = 5      K = 3      A=    -0.19122D-02    -0.21801D-02
J = 5      K = 4      A=     0.45141D-02     0.91488D-02
J = 5      K = 5      A=     0.28367D-01     0.26557D 00
A = TOTAL CONVERSION COEFFICIENTS      SLAB NUMBER =  6
J = 1      K = 1      A=     0.32346D-01     0.90607D 00
J = 1      K = 2      A=    -0.41123D-02    -0.27384D-01
J = 1      K = 3      A=     0.24615D-02    -0.27811D-02
J = 1      K = 4      A=    -0.31420D-02     0.15115D-02
J = 1      K = 5      A=     0.45834D-03     0.23819D-03
J = 2      K = 1      A=    -0.57262D-04     0.48745D-04
J = 2      K = 2      A=    -0.26414D 00     0.78363D 00
J = 2      K = 3      A=    -0.28566D-04    -0.21047D-04
J = 2      K = 4      A=     0.19570D-02    -0.11838D-02
J = 2      K = 5      A=     0.49045D-05    -0.34485D-05
J = 3      K = 1      A=    -0.45438D-02     0.76983D-02
J = 3      K = 2      A=     0.11689D-02    -0.84165D-02
J = 3      K = 3      A=    -0.69449D 00     0.37962D-01
J = 3      K = 4      A=     0.16446D-01     0.10860D-01
J = 3      K = 5      A=     0.61055D-03     0.13188D-02
J = 4      K = 1      A=     0.49300D-05     0.66709D-06
J = 4      K = 2      A=    -0.76319D-02     0.13697D-02
J = 4      K = 3      A=     0.52563D-06    -0.33505D-04
J = 4      K = 4      A=    -0.14827D 00    -0.51006D 00
J = 4      K = 5      A=     0.71846D-04     0.39197D-04
J = 5      K = 1      A=     0.58785D-03    -0.22668D-02
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J = 5 K = 2 A= 0.43634D-02 0.30987D-02

J = 5 K = 3 A= -0.22908D-02 -0.27356D-02

J = 5 K = 4 A= 0.11251D-01 0.48889D-02

J = 5 K = 5 A= 0.40306D 00 0.66700D-01

A = TOTAL CONVERSION COEFFICIENTS SLAB NUMBER = 7

J = 1 K = 1 A= -0.53858D 00 0.77454D 00

J = 1 K = 2 A= 0.80052D-02 -0.17977D-01

J = 1 K = 3 A= 0.25998D-02 -0.15262D-02

J = 1 K = 4 A= -0.41633D-02 0.14959D-02

J = 1 K = 5 A= -0.12169D-03 0.32831D-03

J = 2 K = 1 A= -0.51933D-04 0.50590D-05

J = 2 K = 2 A= -0.65604D 00 0.60739D 00

J = 2 K = 3 A= -0.17761D-04 -0.20988D-04

J = 2 K = 4 A= 0.21134D-02 -0.13454D-02

J = 2 K = 5 A= 0.38928D-05 0.74447D-05

J = 3 K = 1 A= -0.58830D-02 0.43230D-02

J = 3 K = 2 A= 0.30027D-02 -0.61111D-02

J = 3 K = 3 A= -0.80317D 00 0.24601D-01

J = 3 K = 4 A= 0.16254D-01 0.54558D-02

J = 3 K = 5 A= 0.23719D-02 0.14843D-02

J = 4 K = 1 A= 0.44381D-05 0.42002D-05

J = 4 K = 2 A= -0.74783D-02 -0.85094D-03

J = 4 K = 3 A= -0.32726D-05 -0.28677D-04

J = 4 K = 4 A= -0.48875D 00 -0.47946D 00

J = 4 K = 5 A= 0.78476D-04 -0.39266D-04

J = 5 K = 1 A= 0.73995D-03 -0.96209D-03

J = 5 K = 2 A= 0.10315D-02 0.36316D-02

J = 5 K = 3 A= -0.26318D-02 -0.32057D-02

J = 5 K = 4 A= 0.12206D-01 -0.40886D-02

J = 5 K = 5 A= 0.23669D 00 -0.53308D 00

A = TOTAL CONVERSION COEFFICIENTS SLAB NUMBER = 8

J = 1	K = 1	A=	0.99708D 00	0.20632D-03
J = 1	K = 2	A=	-0.10427D-01	0.31482D-02
J = 1	K = 3	A=	-0.19052D-02	0.19906D-04
J = 1	K = 4	A=	0.42738D-02	-0.14522D-03
J = 1	K = 5	A=	0.83337D-03	-0.38328D-03
J = 2	K = 1	A=	0.20913D-04	0.18854D-04
J = 2	K = 2	A=	0.10102D 01	-0.46824D-02
J = 2	K = 3	A=	0.49692D-05	0.16288D-04
J = 2	K = 4	A=	-0.19891D-02	0.99807D-03
J = 2	K = 5	A=	-0.63906D-05	-0.17656D-04
J = 3	K = 1	A=	0.44515D-02	-0.26536D-03
J = 3	K = 2	A=	-0.32103D-02	0.25626D-02
J = 3	K = 3	A=	0.99844D 00	-0.55677D-03
J = 3	K = 4	A=	-0.13008D-01	0.44765D-03
J = 3	K = 5	A=	-0.36172D-02	0.73323D-03
J = 4	K = 1	A=	-0.36087D-05	-0.41634D-05
J = 4	K = 2	A=	0.66698D-02	0.16070D-02
J = 4	K = 3	A=	0.89346D-05	0.18498D-04
J = 4	K = 4	A=	0.10068D 01	-0.60081D-02
J = 4	K = 5	A=	0.18990D-04	0.80002D-04
J = 5	K = 1	A=	-0.28552D-02	0.44727D-04
J = 5	K = 2	A=	-0.45427D-03	-0.80912D-02
J = 5	K = 3	A=	0.56547D-02	0.92237D-03
J = 5	K = 4	A=	0.12020D-02	0.12438D-01
J = 5	K = 5	A=	0.99736D 00	-0.17276D-02

A = TOTAL CONVERSION COEFFICIENTS SLAB NUMBER = 9

J = 1	K = 1	A=	0.10000D 01	0.0
J = 1	K = 2	A=	0.0	0.0
J = 1	K = 3	A=	0.0	0.0
J = 1	K = 4	A=	0.0	0.0

J = 1	K = 5	A=	0.0	0.0
J = 2	K = 1	A=	0.0	0.0
J = 2	K = 2	A=	0.10000D 01	0.0
J = 2	K = 3	A=	0.0	0.0
J = 2	K = 4	A=	0.0	0.0
J = 2	K = 5	A=	0.0	0.0
J = 3	K = 1	A=	0.0	0.0
J = 3	K = 2	A=	0.0	0.0
J = 3	K = 3	A=	0.10000D 01	0.0
J = 3	K = 4	A=	0.0	0.0
J = 3	K = 5	A=	0.0	0.0
J = 4	K = 1	A=	0.0	0.0
J = 4	K = 2	A=	0.0	0.0
J = 4	K = 3	A=	0.0	0.0
J = 4	K = 4	A=	0.10000D 01	0.0
J = 4	K = 5	A=	0.0	0.0
J = 5	K = 1	A=	0.0	0.0
J = 5	K = 2	A=	0.0	0.0
J = 5	K = 3	A=	0.0	0.0
J = 5	K = 4	A=	0.0	0.0
J = 5	K = 5	A=	0.10000D 01	0.0

ELECTRIC FIELD STRENGTH AS A FUNCTION OF RHO

GAMMA(DEG)= 0.0 PHI(DEG)= 0.0 ZT(KM)= 5.000 ZR(KM)= 10.000

Z			X			Y		
RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)
25.00	76.29234	263.2688	25.00	59.90491	152.2287	25.00	41.45424	238.2237
50.00	72.98376	257.5801	50.00	56.25769	135.7691	50.00	37.85649	212.8739
75.00	70.78876	252.3931	75.00	53.75735	119.4766	75.00	35.51668	187.0150
100.00	68.98273	247.8470	100.00	51.61769	103.3704	100.00	33.77069	161.0755
125.00	67.35411	244.0912	125.00	49.58498	87.3927	125.00	32.39372	135.1018
150.00	65.82755	241.2690	150.00	47.52316	71.4082	150.00	31.28989	109.1563
175.00	64.38651	239.4891	175.00	45.32722	55.4832	175.00	30.41103	83.3227
200.00	63.04761	238.7764	200.00	42.88458	39.2385	200.00	29.72945	57.7085
225.00	61.84721	239.0170	225.00	40.02911	23.0221	225.00	29.16455	33.4116
250.00	60.81107	239.8885	250.00	36.53989	4.6606	250.00	28.83185	8.5596
275.00	59.95270	240.9785	275.00	31.84071	341.5400	275.00	28.64261	344.3625
300.00	59.25110	241.8292	300.00	25.12791	297.7227	300.00	28.57390	320.9485
325.00	58.65680	242.0927	325.00	24.67183	209.2661	325.00	28.60027	298.4187
350.00	58.10954	241.5722	350.00	29.65506	166.0424	350.00	28.57823	276.8586
375.00	57.54008	240.3263	375.00	32.82829	144.7204	375.00	28.73222	256.3191
400.00	56.90408	238.4413	400.00	34.76332	127.9352	400.00	28.90077	236.7713
425.00	56.16014	236.0790	425.00	35.99524	112.9103	425.00	29.06299	218.1858
450.00	55.27319	233.4316	450.00	36.76811	98.8009	450.00	29.20108	200.5223
475.00	54.20961	230.6798	475.00	37.20258	84.8595	475.00	29.28441	183.4644
500.00	52.93156	228.1687	500.00	37.36682	71.8263	500.00	29.33116	167.5499
525.00	51.39867	226.2026	525.00	37.31810	59.1317	525.00	29.31720	152.4182
550.00	49.55347	225.3099	550.00	37.08209	46.7381	550.00	29.23508	138.0355
575.00	47.32220	226.4329	575.00	36.67429	34.6322	575.00	29.07872	124.3776
600.00	44.63403	231.4045	600.00	36.13287	22.7550	600.00	28.88341	111.2962
625.00	41.63359	244.3454	625.00	35.39701	11.2109	625.00	28.55882	99.0160
650.00	39.46725	269.7253	650.00	34.49896	0.0290	650.00	28.14732	87.4632
675.00	39.95416	298.2769	675.00	33.42958	349.2854	675.00	27.64709	76.6715
700.00	41.94011	315.4939	700.00	32.17734	339.1038	700.00	27.05814	66.6955
725.00	43.81900	323.6453	725.00	30.79295	330.0586	725.00	26.44009	57.7078
750.00	45.29208	327.3501	750.00	29.14931	321.5710	750.00	25.68810	49.5037
775.00	46.39511	329.0024	775.00	27.26694	314.6301	775.00	24.86755	42.4046
800.00	47.21843	329.7319	800.00	25.14587	310.1309	800.00	24.00182	36.5465
825.00	47.83922	330.0955	825.00	22.87070	309.5270	825.00	23.12830	32.0445
850.00	48.31659	330.4138	850.00	21.01863	315.1108	850.00	22.36522	29.1504
875.00	48.70630	330.7258	875.00	19.80577	323.9875	875.00	21.65184	27.1271
900.00	49.03757	331.0835	900.00	19.75130	332.7961	900.00	21.09418	26.0126
925.00	49.33565	331.4578	925.00	20.46809	336.9707	925.00	20.72151	25.3085
950.00	49.61635	331.7844	950.00	21.36862	336.0334	950.00	20.52293	24.4713
975.00	49.88675	331.9897	975.00	22.15694	331.3999	975.00	20.45189	23.0804
1000.00	50.14691	332.0081	1000.00	22.75043	324.3645	1000.00	20.44556	20.9269
1025.00	50.39211	331.7952	1025.00	23.14766	315.7686	1025.00	20.44417	17.9951
1050.00	50.61794	331.3523	1050.00	23.42491	306.0242	1050.00	20.44395	14.5671
1075.00	50.81192	330.6411	1075.00	23.48744	295.5928	1075.00	20.33031	10.3539
1100.00	50.96849	329.7109	1100.00	23.42499	284.6973	1100.00	20.11635	5.8188
1125.00	51.08234	328.6028	1125.00	23.25829	273.4995	1125.00	19.78918	1.1468
1150.00	51.15012	327.3650	1150.00	23.00464	262.1365	1150.00	19.34108	356.5193
1175.00	51.17041	326.0486	1175.00	22.67813	250.7361	1175.00	18.76810	352.1216
1200.00	51.14354	324.7034	1200.00	22.28987	239.4254	1200.00	18.07005	348.1531
1225.00	51.07132	323.3752	1225.00	21.84828	228.3357	1225.00	17.25197	344.8381
1250.00	50.95685	322.1050	1250.00	21.35965	217.6042	1250.00	16.32759	342.4343
1275.00	50.80411	320.9265	1275.00	20.82889	207.3739	1275.00	15.32566	341.2273
1300.00	50.61781	319.8655	1300.00	20.26102	197.7929	1300.00	14.29841	341.4915
1325.00	50.40297	318.9390	1325.00	19.66304	189.0123	1325.00	13.32873	343.3853
1350.00	50.16458	318.1558	1350.00	19.04646	181.1795	1350.00	12.52348	346.7732

1375.00	49.90724	317.5159	1375.00	18.43004	174.4257	1375.00	11.97878	351.0781
1400.00	49.63486	317.0127	1400.00	17.84206	168.8399	1400.00	11.72717	355.3843
1425.00	49.35028	316.6345	1425.00	17.32025	164.4294	1425.00	11.71518	358.8298
1450.00	49.05519	316.3669	1450.00	16.90714	161.0745	1450.00	11.83764	0.9493
1475.00	48.75000	316.1960	1475.00	16.63916	158.5040	1475.00	11.98946	1.7006
1500.00	48.43399	316.1116	1500.00	16.53325	156.3272	1500.00	12.09305	1.2926
1525.00	48.10559	316.1091	1525.00	16.57874	154.1279	1525.00	12.10005	0.0219
1550.00	47.76273	316.1919	1550.00	16.74065	151.5716	1550.00	11.98307	358.1875
1575.00	47.40327	316.3713	1575.00	16.97197	148.4663	1575.00	11.72742	356.0647
1600.00	47.02544	316.6677	1600.00	17.22643	144.7589	1600.00	11.32553	353.9082
1625.00	46.62828	317.1091	1625.00	17.46609	140.4926	1625.00	10.77408	351.9678
1650.00	46.21207	317.7302	1650.00	17.66344	135.7619	1650.00	10.07345	350.5076
1675.00	45.77864	318.5693	1675.00	17.80031	130.6794	1675.00	9.22959	349.8293
1700.00	45.33167	319.6663	1700.00	17.86580	125.3573	1700.00	8.25928	350.2927
1725.00	44.87686	321.0579	1725.00	17.85414	119.8995	1725.00	7.20053	352.3196
1750.00	44.42197	322.7742	1750.00	17.76328	114.3994	1750.00	6.12912	356.3398
1775.00	43.97664	324.8335	1775.00	17.59373	108.9400	1775.00	5.17413	2.6043
1800.00	43.55182	327.2371	1800.00	17.34813	103.5956	1800.00	4.50492	10.8328
1825.00	43.15898	329.9651	1825.00	17.03081	98.4320	1825.00	4.25525	19.9726
1850.00	42.80888	332.9751	1850.00	16.64783	93.5071	1850.00	4.42739	28.5775
1875.00	42.51033	336.2039	1875.00	16.20694	88.8699	1875.00	4.89522	35.6199
1900.00	42.26901	339.5735	1900.00	15.71765	84.5577	1900.00	5.50215	40.8360
1925.00	42.08691	342.9993	1925.00	15.19106	80.5925	1925.00	6.13425	44.4632
1950.00	41.96231	346.4006	1950.00	14.63950	76.9758	1950.00	6.73100	46.8907
1975.00	41.89052	349.7078	1975.00	14.07575	73.6839	1975.00	7.26907	48.4757
2000.00	41.86484	352.8669	2000.00	13.51171	70.6646	2000.00	7.74556	49.4885
2025.00	41.87776	355.8413	2025.00	12.95681	67.8374	2025.00	8.16704	50.1131
2050.00	41.92177	358.6086	2050.00	12.41643	65.0991	2050.00	8.54330	50.4632
2075.00	41.98990	1.1592	2075.00	11.89073	62.3342	2075.00	8.88384	50.6000
2100.00	42.07603	3.4903	2100.00	11.37442	59.4272	2100.00	9.19609	50.5491
2125.00	42.17485	5.6049	2125.00	10.85737	56.2744	2125.00	9.48461	50.3149
2150.00	42.28177	7.5088	2150.00	10.32607	52.7906	2150.00	9.75109	49.8925
2175.00	42.39275	9.2096	2175.00	9.76520	48.9110	2175.00	9.99476	49.2767
2200.00	42.50415	10.7162	2200.00	9.15905	44.5863	2200.00	10.21315	48.4675
2225.00	42.61272	12.0391	2225.00	8.49265	39.7748	2225.00	10.40284	47.4735
2250.00	42.71545	13.1898	2250.00	7.75243	34.4323	2250.00	10.56021	46.3120
2275.00	42.80971	14.1817	2275.00	6.92681	28.4996	2275.00	10.68198	45.0079
2300.00	42.89316	15.0291	2300.00	6.00704	21.8882	2300.00	10.76561	43.5922
2325.00	42.96381	15.7479	2325.00	4.98885	14.4642	2325.00	10.80947	42.0998
2350.00	43.02008	16.3544	2350.00	3.87602	6.0301	2350.00	10.81299	40.5675
2375.00	43.06079	16.8655	2375.00	2.68745	356.3123	2375.00	10.77662	39.0319
2400.00	43.08517	17.2981	2400.00	1.46979	344.9751	2400.00	10.70183	37.5284
2425.00	43.09276	17.6685	2425.00	0.31462	331.7158	2425.00	10.59095	36.0892
2450.00	43.08350	17.9922	2450.00	-0.63272	316.5171	2450.00	10.44716	34.7426
2475.00	43.05756	18.2836	2475.00	-1.20742	300.0037	2475.00	10.27423	33.5115
2500.00	43.01535	18.5556	2500.00	-1.31864	283.4971	2500.00	10.07642	32.4131
2525.00	42.95746	18.8200	2525.00	-1.01906	268.3994	2525.00	9.85818	31.4578
2550.00	42.88458	19.0869	2550.00	-0.45701	255.4790	2550.00	9.62397	30.6491
2575.00	42.79747	19.3650	2575.00	0.22197	244.7899	2575.00	9.37792	29.9841
2600.00	42.69690	19.6620	2600.00	0.92247	236.0135	2600.00	9.12360	29.4539
2625.00	42.58363	19.9846	2625.00	1.59561	228.7473	2625.00	8.86379	29.0456
2650.00	42.45836	20.3388	2650.00	2.22134	222.6308	2650.00	8.60033	28.7436
2675.00	42.32181	20.7302	2675.00	2.79415	217.3746	2675.00	8.33408	28.5320
2700.00	42.17461	21.1640	2700.00	3.31464	212.7543	2700.00	8.06500	28.3969
2725.00	42.01743	21.6455	2725.00	3.78530	208.5988	2725.00	7.79233	28.3277
2750.00	41.85091	22.1802	2750.00	4.20851	204.7787	2750.00	7.51482	28.3186
2775.00	41.67580	22.7736	2775.00	4.58593	201.1976	2775.00	7.23103	28.3695
2800.00	41.49289	23.4313	2800.00	4.91838	197.7858	2800.00	6.93965	28.4852
2825.00	41.30309	24.1590	2825.00	5.20608	194.4948	2825.00	6.63970	28.6751
2850.00	41.10747	24.9621	2850.00	5.44893	191.2934	2850.00	6.33079	28.9524
2875.00	40.90723	25.8456	2875.00	5.64677	188.1634	2875.00	6.01319	29.3320

2900.00	40.70374	26.6138	2900.00	5.79960	185.0970	2900.00	5.68795	29.8293
2925.00	40.49852	27.8700	2925.00	5.90771	182.0933	2925.00	5.35685	30.4591
2950.00	40.29324	29.0162	2950.00	5.97176	179.1567	2950.00	5.02233	31.2332
2975.00	40.08963	30.2526	2975.00	5.99279	176.2943	2975.00	4.68733	32.1600
3000.00	39.88948	31.5780	3000.00	5.97223	173.5148	3000.00	4.35516	33.2438
3025.00	39.69460	32.9891	3025.00	5.91181	170.8268	3025.00	4.02926	34.4837
3050.00	39.50665	34.4807	3050.00	5.81353	168.2382	3050.00	3.71298	35.8744
3075.00	39.32729	36.0459	3075.00	5.67950	165.7551	3075.00	3.40945	37.4064
3100.00	39.15790	37.6760	3100.00	5.51188	163.3814	3100.00	3.12143	39.0668
3125.00	38.99965	39.3611	3125.00	5.31270	161.1188	3125.00	2.85125	40.8406
3150.00	38.85349	41.0900	3150.00	5.08378	158.9663	3150.00	2.60083	42.7110
3175.00	38.72003	42.8511	3175.00	4.82655	156.9210	3175.00	2.37170	44.6606
3200.00	38.59964	44.6323	3200.00	4.54195	154.9783	3200.00	2.16511	46.6711
3225.00	38.49236	46.4214	3225.00	4.23035	153.1330	3225.00	1.98202	48.7237
3250.00	38.39798	48.2068	3250.00	3.89143	151.3801	3250.00	1.82314	50.7984
3275.00	38.31601	49.9774	3275.00	3.52421	149.7159	3275.00	1.68885	52.8740
3300.00	38.24576	51.7229	3300.00	3.12703	148.1391	3300.00	1.57913	54.9277
3325.00	38.18633	53.4342	3325.00	2.69756	146.6521	3325.00	1.49341	56.9361
3350.00	38.13667	55.1034	3350.00	2.23290	145.2624	3350.00	1.43047	58.8750
3375.00	38.09560	56.7238	3375.00	1.72963	143.9830	3375.00	1.38838	60.7217
3400.00	38.06183	58.2901	3400.00	1.18389	142.8343	3400.00	1.36452	62.4553
3425.00	38.03407	59.7984	3425.00	0.59149	141.8452	3425.00	1.35563	64.0590
3450.00	38.01096	61.2461	3450.00	-0.05201	141.0548	3450.00	1.35805	65.5201
3475.00	37.99115	62.6319	3475.00	-0.75115	140.5147	3475.00	1.36783	66.8315
3500.00	37.97336	63.9559	3500.00	-1.51041	140.2428	3500.00	1.38103	67.9913
3525.00	37.95636	65.2191	3525.00	-2.33375	140.4774	3525.00	1.39384	69.0025
3550.00	37.93900	66.4237	3550.00	-3.22392	141.1843	3550.00	1.40282	69.8723
3575.00	37.92023	67.5724	3575.00	-4.18100	142.5648	3575.00	1.40491	70.6114
3600.00	37.89912	68.6690	3600.00	-5.19974	144.8158	3600.00	1.39760	71.2328
3625.00	37.87485	69.7177	3625.00	-6.26458	148.1853	3625.00	1.37885	71.7512
3650.00	37.84671	70.7229	3650.00	-7.34159	152.9622	3650.00	1.34713	72.1819
3675.00	37.81412	71.6896	3675.00	-8.36735	159.4207	3675.00	1.30136	72.5401
3700.00	37.77664	72.6228	3700.00	-9.24117	167.6756	3700.00	1.24086	72.8407
3725.00	37.73387	73.5275	3725.00	-9.83776	177.4518	3725.00	1.16527	73.0975
3750.00	37.68559	74.4087	3750.00	-10.05761	187.9402	3750.00	1.07449	73.3237
3775.00	37.63161	75.2713	3775.00	-9.88961	198.0253	3775.00	0.96860	73.5307
3800.00	37.57182	76.1203	3800.00	-9.41850	206.8054	3800.00	0.84784	73.7294
3825.00	37.50623	76.9603	3825.00	-8.76787	213.9015	3825.00	0.71252	73.9293
3850.00	37.43486	77.7956	3850.00	-8.04357	219.3659	3850.00	0.56300	74.1390
3875.00	37.35782	78.6306	3875.00	-7.31455	223.4476	3875.00	0.39968	74.3667
3900.00	37.27530	79.4693	3900.00	-6.61859	226.4289	3900.00	0.22295	74.6199
3925.00	37.18745	80.3156	3925.00	-5.97347	228.5564	3925.00	0.03322	74.9058
3950.00	37.09459	81.1732	3950.00	-5.38582	230.0253	3950.00	-0.16907	75.2316
3975.00	36.99698	82.0454	3975.00	-4.85659	230.9846	3975.00	-0.38346	75.6044
4000.00	36.89497	82.9355	4000.00	-4.38403	231.5467	4000.00	-0.60943	76.0315
4025.00	36.78897	83.8463	4025.00	-3.96529	231.7970	4025.00	-0.84639	76.5201
4050.00	36.67938	84.7805	4050.00	-3.59719	231.8010	4050.00	-1.09367	77.0776
4075.00	36.56668	85.7404	4075.00	-3.27660	231.6102	4075.00	-1.35044	77.7114
4100.00	36.45135	86.7279	4100.00	-3.00057	231.2656	4100.00	-1.61578	78.4286
4125.00	36.33394	87.7447	4125.00	-2.76641	230.8006	4125.00	-1.88860	79.2362
4150.00	36.21500	88.7919	4150.00	-2.57164	230.2429	4150.00	-2.16765	80.1405
4175.00	36.09506	89.8703	4175.00	-2.41403	229.6157	4175.00	-2.45157	81.1474
4200.00	35.97473	90.9802	4200.00	-2.29151	228.9391	4200.00	-2.73881	82.2617
4225.00	35.85457	92.1216	4225.00	-2.20218	228.2301	4225.00	-3.02770	83.4873
4250.00	35.73515	93.2936	4250.00	-2.14431	227.5036	4250.00	-3.31646	84.8268
4275.00	35.61702	94.4955	4275.00	-2.11628	226.7727	4275.00	-3.60322	86.2815
4300.00	35.50069	95.7255	4300.00	-2.11662	226.0488	4300.00	-3.88601	87.8513
4325.00	35.38664	96.9819	4325.00	-2.14399	225.3421	4325.00	-4.16286	89.5342
4350.00	35.27534	98.2623	4350.00	-2.19715	224.6620	4350.00	-4.43174	91.3267
4375.00	35.16716	99.5642	4375.00	-2.27500	224.0169	4375.00	-4.69067	93.2233
4400.00	35.06244	100.8847	4400.00	-2.37655	223.4149	4400.00	-4.93775	95.2167

4425.00	34.96144	102.2206	4425.00	-2.50092	222.8635	4425.00	-5.17118	97.2974
4450.00	34.86435	103.5687	4450.00	-2.64732	222.3707	4450.00	-5.38934	99.4544
4475.00	34.77133	104.9256	4475.00	-2.81501	221.9443	4475.00	-5.59084	101.6745
4500.00	34.68243	106.2878	4500.00	-3.00334	221.5926	4500.00	-5.77458	103.9431
4525.00	34.59766	107.6520	4525.00	-3.21163	221.3245	4525.00	-5.93983	106.2442
4550.00	34.51692	109.0148	4550.00	-3.43921	221.1497	4550.00	-6.08622	108.5613
4575.00	34.44011	110.3732	4575.00	-3.68533	221.0787	4575.00	-6.21386	110.8772
4600.00	34.36702	111.7242	4600.00	-3.94911	221.1229	4600.00	-6.32326	113.1753
4625.00	34.29739	113.0650	4625.00	-4.22952	221.2946	4625.00	-6.41538	115.4398
4650.00	34.23094	114.3933	4650.00	-4.52529	221.6068	4650.00	-6.49154	117.6564
4675.00	34.16736	115.7069	4675.00	-4.83484	222.0733	4675.00	-6.55340	119.8128
4700.00	34.10628	117.0042	4700.00	-5.15623	222.7082	4700.00	-6.60286	121.8992
4725.00	34.04732	118.2838	4725.00	-5.48709	223.5254	4725.00	-6.64196	123.9081
4750.00	33.99007	119.5446	4750.00	-5.82455	224.5383	4750.00	-6.67286	125.8348
4775.00	33.93416	120.7859	4775.00	-6.16520	225.7589	4775.00	-6.69765	127.6768
4800.00	33.87918	122.0076	4800.00	-6.50506	227.1968	4800.00	-6.71840	129.4343
4825.00	33.82475	123.2096	4825.00	-6.83957	228.8579	4825.00	-6.73702	131.1090
4850.00	33.77051	124.3922	4850.00	-7.16370	230.7437	4850.00	-6.75527	132.7048
4875.00	33.71609	125.5560	4875.00	-7.47201	232.8490	4875.00	-6.77470	134.2265
4900.00	33.66118	126.7020	4900.00	-7.75894	235.1617	4900.00	-6.79666	135.6802
4925.00	33.60547	127.8311	4925.00	-8.01902	237.6612	4925.00	-6.82231	137.0728
4950.00	33.54869	128.9447	4950.00	-8.24731	240.3186	4950.00	-6.85258	138.4115
4975.00	33.49063	130.0441	4975.00	-8.43973	243.0973	4975.00	-6.88822	139.7039
5000.00	33.43106	131.1310	5000.00	-8.59344	245.9544	5000.00	-6.92982	140.9578

GAMMA(DEG)= 90.0 PHI(DEG)= 0.0 ZT(KM)= 5.000 ZR(KM)= 10.000

	Z			X			Y	
RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)
25.00	50.12587	339.2913	25.00	42.71786	228.9590	25.00	28.16039	316.5537
50.00	46.62431	323.8484	50.00	39.01591	209.3819	50.00	24.54335	292.3921
75.00	44.24646	308.7957	75.00	36.54716	189.7149	75.00	22.21384	267.8088
100.00	42.23627	294.1172	100.00	34.51863	169.9487	100.00	20.46371	243.2106
125.00	40.34470	279.8438	125.00	32.69846	149.9716	125.00	19.06551	218.6546
150.00	38.44202	266.0344	150.00	30.98608	129.6560	150.00	17.91919	194.2121
175.00	36.43317	252.7946	175.00	29.33362	108.8566	175.00	16.97090	169.9683
200.00	34.22368	240.3182	200.00	27.72240	87.4131	200.00	16.18588	146.0188
225.00	31.68236	229.0578	225.00	26.08528	65.4363	225.00	15.51073	122.9182
250.00	28.65649	219.7790	250.00	24.59290	42.3459	250.00	14.98362	99.8135
275.00	24.82620	214.9024	275.00	23.21300	18.2811	275.00	14.54688	77.2719
300.00	19.89055	222.6733	300.00	22.00006	353.3696	300.00	14.17793	55.3418
325.00	16.80251	261.1855	325.00	21.00266	327.9573	325.00	13.85535	34.0494
350.00	20.08025	289.5637	350.00	20.14536	302.6050	350.00	13.52044	13.5921
375.00	23.30537	292.2336	375.00	19.60426	277.8572	375.00	13.24250	353.5791
400.00	25.45798	286.6638	400.00	19.22394	254.3066	400.00	12.95739	334.1758
425.00	26.88760	278.2070	425.00	18.93776	231.4101	425.00	12.65184	315.3464
450.00	27.83131	268.5425	450.00	18.68539	209.8826	450.00	12.31454	297.0525
475.00	28.42650	258.3020	475.00	18.37082	189.2922	475.00	11.92619	279.3635
500.00	28.74255	247.8815	500.00	18.06393	169.7370	500.00	11.50248	262.0205
525.00	28.83633	237.4101	525.00	17.69263	150.8935	525.00	11.02089	245.0972
550.00	28.73862	226.9955	550.00	17.24289	132.6246	550.00	10.47436	228.5589
575.00	28.46931	216.7173	575.00	16.70468	114.8108	575.00	9.85599	212.3753
600.00	28.04149	206.6302	600.00	16.03992	97.4098	600.00	9.16008	196.5747
625.00	27.46289	196.8406	625.00	15.30481	80.2623	625.00	8.37870	181.0140
650.00	26.73857	187.4042	650.00	14.45802	63.2791	650.00	7.50127	165.7384
675.00	25.87073	178.4198	675.00	13.48899	46.3686	675.00	6.51679	150.7354
700.00	24.86089	170.0174	700.00	12.38424	29.4257	700.00	5.41149	135.9994
725.00	23.71315	162.3765	725.00	11.10239	12.6022	725.00	4.19222	121.5877
750.00	22.43643	155.7158	750.00	9.67964	355.2122	750.00	2.78945	107.3620
775.00	21.05009	150.3474	775.00	8.05382	337.1929	775.00	1.18947	93.4495
800.00	19.60046	146.6409	800.00	6.18925	318.0837	800.00	-0.65876	79.9252
825.00	18.17712	144.9353	825.00	4.05174	297.0745	825.00	-2.83560	66.9439

850.00	16.93253	145.3046	850.00	1.55823	273.4844	850.00	-5.41980	54.9953
875.00	16.01123	147.0887	875.00	-0.92556	243.5523	875.00	-8.76640	44.5380
900.00	15.51180	149.0718	900.00	-2.76862	208.0069	900.00	-13.40352	38.6397
925.00	15.38691	149.8441	925.00	-2.98147	165.6085	925.00	-20.44501	52.9764
950.00	15.48910	148.5864	950.00	-1.88040	131.2336	950.00	-21.06740	120.0637
975.00	15.66892	145.1890	975.00	-0.50272	104.3537	975.00	-15.38521	134.2345
1000.00	15.82633	139.9269	1000.00	0.67603	82.4164	1000.00	-12.10774	128.5356
1025.00	15.90991	133.1655	1025.00	1.56587	63.3818	1025.00	-10.12217	118.4413
1050.00	15.90829	125.1824	1050.00	2.14787	45.7867	1050.00	-8.84773	106.8211
1075.00	15.80011	116.3409	1075.00	2.52508	29.7507	1075.00	-8.06194	94.4345
1100.00	15.60522	106.7966	1100.00	2.69951	14.4776	1100.00	-7.61717	81.6596
1125.00	15.33576	96.7105	1125.00	2.69403	359.7627	1125.00	-7.43875	68.6442
1150.00	15.00594	86.2252	1150.00	2.52401	345.4807	1150.00	-7.48195	55.4601
1175.00	14.63044	75.4782	1175.00	2.20148	331.3535	1175.00	-7.71972	42.1405
1200.00	14.22325	64.6116	1200.00	1.72992	317.9348	1200.00	-8.13667	28.6946
1225.00	13.79670	53.7772	1225.00	1.11072	304.6018	1225.00	-8.72607	15.1133
1250.00	13.36078	43.1339	1250.00	0.34014	291.5515	1250.00	-9.48858	1.3680
1275.00	12.92306	32.8455	1275.00	-0.59066	278.8025	1275.00	-10.43219	347.4060
1300.00	12.48924	23.0716	1300.00	-1.69678	266.4001	1300.00	-11.57321	333.1370
1325.00	12.06435	13.9591	1325.00	-3.00184	254.4306	1325.00	-12.93859	318.4077
1350.00	11.65449	5.6319	1350.00	-4.54172	243.0204	1350.00	-14.56965	302.9470
1375.00	11.26843	358.1804	1375.00	-6.37100	232.5477	1375.00	-16.52730	286.2471
1400.00	10.91862	351.6499	1400.00	-8.57298	223.4955	1400.00	-18.89290	267.2744
1425.00	10.62090	346.0259	1425.00	-11.26961	217.1488	1425.00	-21.72650	243.7563
1450.00	10.39218	341.2251	1450.00	-14.57807	216.5953	1450.00	-24.75992	210.9310
1475.00	10.24653	337.0942	1475.00	-18.08344	229.1416	1475.00	-26.39537	165.5042
1500.00	10.19055	333.4260	1500.00	-19.08339	256.8428	1500.00	-25.18336	122.1428
1525.00	10.22027	329.9932	1525.00	-16.81729	274.0483	1525.00	-23.00887	91.8895
1550.00	10.32110	326.5874	1550.00	-14.34780	280.0989	1550.00	-21.14726	70.0159
1575.00	10.47087	323.0515	1575.00	-12.48160	281.1980	1575.00	-19.74744	52.2964
1600.00	10.64434	319.2908	1600.00	-11.13879	283.2432	1600.00	-18.73433	36.7877
1625.00	10.81732	315.2708	1625.00	-10.18744	283.7978	1625.00	-18.02769	22.5991
1650.00	10.96918	311.0012	1650.00	-9.53353	283.5677	1650.00	-17.56802	9.2901
1675.00	11.08393	306.5217	1675.00	-9.11454	282.9162	1675.00	-17.31342	356.6284
1700.00	11.15006	301.8662	1700.00	-8.88854	282.0544	1700.00	-17.23424	344.4880
1725.00	11.16008	297.1558	1725.00	-8.82681	281.1205	1725.00	-17.30902	332.8030
1750.00	11.10973	292.3918	1750.00	-8.90938	280.2160	1750.00	-17.52184	321.5447
1775.00	10.99737	287.6531	1775.00	-9.12225	279.4255	1775.00	-17.86020	310.7107
1800.00	10.82350	282.9944	1800.00	-9.45557	278.8276	1800.00	-18.31363	300.3203
1825.00	10.59039	278.4046	1825.00	-9.90237	278.5037	1825.00	-18.87234	290.4104
1850.00	10.30181	274.1064	1850.00	-10.45750	278.5437	1850.00	-19.52583	281.0359
1875.00	9.96290	269.9548	1875.00	-11.11654	279.0533	1875.00	-20.26129	272.2661
1900.00	9.57992	266.0356	1900.00	-11.87437	280.1608	1900.00	-21.06172	264.1812
1925.00	9.16092	262.3633	1925.00	-12.72306	282.0231	1925.00	-21.90376	256.8604
1950.00	8.71085	258.9380	1950.00	-13.64854	284.8304	1950.00	-22.75577	250.3632
1975.00	8.24001	255.7459	1975.00	-14.62548	288.7993	1975.00	-23.57738	244.6937
2000.00	7.75435	252.7557	2000.00	-15.61059	294.1436	2000.00	-24.32249	239.7608
2025.00	7.25911	249.9214	2025.00	-16.53687	300.9991	2025.00	-24.94719	235.3461
2050.00	6.75721	247.1845	2050.00	-17.31618	309.2937	2050.00	-25.42149	231.1133
2075.00	6.24862	244.4790	2075.00	-17.86099	318.8189	2075.00	-25.73880	226.6726
2100.00	5.73009	241.7368	2100.00	-18.12376	328.2468	2100.00	-25.91696	221.6782
2125.00	5.19532	238.8940	2125.00	-18.12469	337.3798	2125.00	-25.98973	215.9018
2150.00	4.63527	235.8947	2150.00	-17.93935	345.4592	2150.00	-25.99504	209.2526
2175.00	4.03888	232.6930	2175.00	-17.63921	352.2831	2175.00	-25.96616	201.7515
2200.00	3.39348	229.2525	2200.00	-17.36082	357.9191	2200.00	-25.92789	193.4902
2225.00	2.68531	225.5430	2225.00	-17.09607	92.5624	2225.00	-25.89676	184.5963
2250.00	1.89953	221.5351	2250.00	-16.89549	86.4370	2250.00	-25.88286	175.2102
2275.00	1.02007	217.1927	2275.00	-16.77505	79.7494	2275.00	-25.89204	165.4724
2300.00	0.02909	212.4614	2300.00	-16.74182	72.6749	2300.00	-25.92776	155.5177
2325.00	-1.09387	207.2525	2325.00	-16.79761	65.3586	2325.00	-25.99246	145.4720
2350.00	-2.37285	201.4150	2350.00	-16.94130	57.9212	2350.00	-26.08832	135.4512

2375.00	-3.83600	194.6868
2400.00	-5.51333	186.6044
2425.00	-7.42341	176.3318
2450.00	-9.52037	162.3968
2475.00	-11.52898	142.6946
2500.00	-12.70789	116.6863
2525.00	-12.37452	89.6875
2550.00	-10.99698	69.0060
2575.00	-9.39437	54.5491
2600.00	-7.92583	44.4035
2625.00	-6.66339	36.8870
2650.00	-5.59209	31.0016
2675.00	-4.68050	26.1693
2700.00	-3.89946	22.0416
2725.00	-3.22576	18.3968
2750.00	-2.64195	15.0877
2775.00	-2.13524	12.0136
2800.00	-1.69639	9.1048
2825.00	-1.31877	6.3136
2850.00	-0.99755	3.6083
2875.00	-0.72918	0.9694
2900.00	-0.51086	358.3860
2925.00	-0.34027	355.8547
2950.00	-0.21536	353.3762
2975.00	-0.13414	350.9541
3000.00	-0.09465	348.5945
3025.00	-0.09491	346.3037
3050.00	-0.13292	344.0884
3075.00	-0.20667	341.9546
3100.00	-0.31424	339.9067
3125.00	-0.45381	337.9482
3150.00	-0.62375	336.0818
3175.00	-0.82271	334.3079
3200.00	-1.04966	332.6270
3225.00	-1.30395	331.0386
3250.00	-1.58538	329.5432
3275.00	-1.89414	328.1414
3300.00	-2.23088	326.8364
3325.00	-2.59663	325.6335
3350.00	-2.99276	324.5417
3375.00	-3.42090	323.5740
3400.00	-3.88285	322.7483
3425.00	-4.38046	322.0884
3450.00	-4.91546	321.6252
3475.00	-5.48934	321.3972
3500.00	-6.10300	321.4524
3525.00	-6.75645	321.8491
3550.00	-7.44819	322.6577
3575.00	-8.17444	323.9624
3600.00	-8.92789	325.8591
3625.00	-9.69609	328.4539
3650.00	-10.45939	331.8521
3675.00	-11.18908	336.1372
3700.00	-11.84680	341.3372
3725.00	-12.38752	347.3792
3750.00	-12.76797	354.0532
3775.00	-12.95916	1.0189
3800.00	-12.95714	7.8709
3825.00	-12.78436	14.2438
3850.00	-12.48071	19.8909
3875.00	-12.09069	24.7048

2375.00	-17.16992	50.4653
2400.00	-17.47925	43.0806
2425.00	-17.86380	35.8484
2450.00	-18.31671	28.8436
2475.00	-18.82938	22.1364
2500.00	-19.39087	15.7900
2525.00	-19.98759	9.8576
2550.00	-20.60284	4.3751
2575.00	-21.21716	359.3513
2600.00	-21.80939	354.7581
2625.00	-22.35878	350.5208
2650.00	-22.84813	346.5183
2675.00	-23.26692	342.5945
2700.00	-23.61331	338.5801
2725.00	-23.89410	334.3203
2750.00	-24.12262	329.6958
2775.00	-24.31538	324.6348
2800.00	-24.48914	319.1116
2825.00	-24.65852	313.1379
2850.00	-24.83501	306.7524
2875.00	-25.02066	300.0105
2900.00	-25.23837	292.9758
2925.00	-25.47238	285.7170
2950.00	-25.72876	278.3035
2975.00	-26.00580	270.8040
3000.00	-26.30075	263.2849
3025.00	-26.60944	255.8100
3050.00	-26.92714	248.4386
3075.00	-27.24841	241.2239
3100.00	-27.56738	234.2111
3125.00	-27.87784	227.4352
3150.00	-28.17355	220.9188
3175.00	-28.44864	214.6702
3200.00	-28.69798	208.6826
3225.00	-28.91776	202.9348
3250.00	-29.10587	197.3932
3275.00	-29.26234	192.0159
3300.00	-29.38939	186.7575
3325.00	-29.49124	181.5739
3350.00	-29.57378	176.4267
3375.00	-29.64394	171.2866
3400.00	-29.70906	166.1341
3425.00	-29.77640	160.9601
3450.00	-29.85260	155.7639
3475.00	-29.94345	150.5523
3500.00	-30.05368	145.3371
3525.00	-30.18689	140.1334
3550.00	-30.34557	134.9577
3575.00	-30.53116	129.8266
3600.00	-30.74416	124.7552
3625.00	-30.98421	119.7564
3650.00	-31.25024	114.8398
3675.00	-31.54062	110.0109
3700.00	-31.85330	105.2704
3725.00	-32.18602	100.6136
3750.00	-32.53645	96.0305
3775.00	-32.90248	91.5056
3800.00	-33.28229	87.0183
3825.00	-33.67456	82.5436
3850.00	-34.07863	78.0531
3875.00	-34.49445	73.5161

2375.00	-26.21759	125.5613
2400.00	-26.38269	115.8983
2425.00	-26.58585	106.5494
2450.00	-26.82884	97.5943
2475.00	-27.11238	89.1065
2500.00	-27.43565	81.1545
2525.00	-27.79559	73.8021
2550.00	-28.18631	67.1069
2575.00	-28.59850	61.1162
2600.00	-29.01915	55.8607
2625.00	-29.43175	51.3437
2650.00	-29.81752	47.5305
2675.00	-30.15776	44.3390
2700.00	-30.43715	41.6395
2725.00	-30.64722	39.2663
2750.00	-30.78850	37.0417
2775.00	-30.87041	34.8048
2800.00	-30.90892	32.4342
2825.00	-30.92314	29.8585
2850.00	-30.93195	27.0543
2875.00	-30.95169	24.0358
2900.00	-30.99519	20.8422
2925.00	-31.07135	17.5268
2950.00	-31.18544	14.1480
2975.00	-31.33961	10.7628
3000.00	-31.53342	7.4229
3025.00	-31.76427	4.1714
3050.00	-32.02798	1.0403
3075.00	-32.31935	358.0486
3100.00	-32.63269	355.2012
3125.00	-32.96259	352.4875
3150.00	-33.30455	349.8840
3175.00	-33.65575	347.3545
3200.00	-34.01553	344.8555
3225.00	-34.38580	342.3406
3250.00	-34.77097	339.7651
3275.00	-35.17776	337.0913
3300.00	-35.61487	334.2903
3325.00	-36.09250	331.3447
3350.00	-36.62201	328.2476
3375.00	-37.21584	325.0020
3400.00	-37.88756	321.6179
3425.00	-38.65240	318.1121
3450.00	-39.52821	314.5042
3475.00	-40.53699	310.8149
3500.00	-41.70760	307.0657
3525.00	-43.08049	303.2742
3550.00	-44.71664	299.4514
3575.00	-46.71693	295.5942
3600.00	-49.26196	291.6633
3625.00	-52.75185	287.5029
3650.00	-58.35716	282.3506
3675.00	-75.03317	257.3833
3700.00	-61.59955	104.5586
3725.00	-55.10034	98.7084
3750.00	-51.62610	94.9171
3775.00	-49.30907	91.6770
3800.00	-47.60980	88.7205
3825.00	-46.29562	85.9566
3850.00	-45.24432	83.3401
3875.00	-44.38373	80.8414

3900.00	-11.65378	28.6882	3900.00	-34.92261	68.9007	3900.00	-43.66777	78.4373
3925.00	-11.20037	31.9091	3925.00	-35.36418	64.1747	3925.00	-43.06555	76.1081
3950.00	-10.75162	34.4635	3950.00	-35.82065	59.3066	3950.00	-42.55560	73.8373
3975.00	-10.32127	36.4516	3975.00	-36.29355	54.2659	3975.00	-42.12268	71.6113
4000.00	-9.91769	37.9662	4000.00	-36.78429	49.0227	4000.00	-41.75580	69.4194
4025.00	-9.54559	39.0885	4025.00	-37.29379	43.5483	4025.00	-41.44693	67.2546
4050.00	-9.20733	39.8873	4050.00	-37.82224	37.8141	4050.00	-41.19038	65.1129
4075.00	-8.90378	40.4201	4075.00	-38.36861	31.7917	4075.00	-40.98070	62.9934
4100.00	-8.63492	40.7351	4100.00	-38.93040	25.4527	4100.00	-40.81517	60.8979
4125.00	-8.40016	40.8725	4125.00	-39.50319	18.7696	4125.00	-40.69021	58.8302
4150.00	-8.19860	40.8663	4150.00	-40.08023	11.7183	4150.00	-40.60413	56.7955
4175.00	-8.02915	40.7451	4175.00	-40.65222	4.2794	4175.00	-40.55367	54.8001
4200.00	-7.89064	40.5335	4200.00	-41.20715	356.4458	4200.00	-40.53687	52.8500
4225.00	-7.78186	40.2527	4225.00	-41.73059	348.2283	4225.00	-40.55136	50.9512
4250.00	-7.70159	39.9210	4250.00	-42.20657	339.6628	4250.00	-40.59566	49.1085
4275.00	-7.64866	39.5544	4275.00	-42.61913	330.8164	4275.00	-40.66710	47.3256
4300.00	-7.62191	39.1671	4300.00	-42.95447	321.7881	4300.00	-40.76402	45.6045
4325.00	-7.62024	38.7716	4325.00	-43.20329	312.7021	4325.00	-40.88466	43.9458
4350.00	-7.64261	38.3790	4350.00	-43.36246	303.6960	4350.00	-41.02756	42.3483
4375.00	-7.68834	37.9997	4375.00	-43.43356	294.9011	4375.00	-41.19150	40.8098
4400.00	-7.75562	37.6430	4400.00	-43.43195	286.4268	4400.00	-41.37506	39.3271
4425.00	-7.84447	37.3178	4425.00	-43.36488	278.3501	4425.00	-41.57957	37.8966
4450.00	-7.95380	37.0326	4450.00	-43.24933	270.7129	4450.00	-41.80322	36.5150
4475.00	-8.08282	36.7958	4475.00	-43.10004	263.5261	4475.00	-42.04691	35.1799
4500.00	-8.23078	36.6155	4500.00	-42.93039	256.7778	4500.00	-42.31137	33.8901
4525.00	-8.39694	36.5004	4525.00	-42.75175	250.4398	4525.00	-42.59763	32.6467
4550.00	-8.58052	36.4591	4550.00	-42.57344	244.4764	4550.00	-42.90697	31.4529
4575.00	-8.78069	36.5006	4575.00	-42.40280	238.8489	4575.00	-43.24088	30.3150
4600.00	-8.99655	36.6343	4600.00	-42.24553	233.5193	4600.00	-43.60092	29.2423
4625.00	-9.22705	36.8698	4625.00	-42.10600	228.4528	4625.00	-43.98877	28.2474
4650.00	-9.47102	37.2173	4650.00	-41.98750	223.6181	4650.00	-44.40604	27.3466
4675.00	-9.72706	37.6868	4675.00	-41.89243	218.9884	4675.00	-44.85423	26.5601
4700.00	-9.99356	38.2886	4700.00	-41.82254	214.5410	4700.00	-45.33475	25.9119
4725.00	-10.26861	39.0324	4725.00	-41.77904	210.2568	4725.00	-45.84866	25.4310
4750.00	-10.55002	39.9274	4750.00	-41.76274	206.1199	4750.00	-46.39674	25.1512
4775.00	-10.83528	40.9818	4775.00	-41.77409	202.1171	4775.00	-46.97923	25.1122
4800.00	-11.12153	42.2020	4800.00	-41.81334	198.2373	4800.00	-47.59601	25.3606
4825.00	-11.40558	43.5921	4825.00	-41.88052	194.4707	4825.00	-48.24431	25.9501
4850.00	-11.68398	45.1535	4850.00	-41.97559	190.8090	4850.00	-48.92213	26.9431
4875.00	-11.95303	46.8837	4875.00	-42.09837	187.2443	4875.00	-49.62366	28.4096
4900.00	-12.20893	48.7760	4900.00	-42.24879	183.7693	4900.00	-50.34015	30.4260
4925.00	-12.44792	50.8191	4925.00	-42.42679	180.3770	4925.00	-51.05844	33.0699
4950.00	-12.66643	52.9965	4950.00	-42.63239	177.0603	4950.00	-51.75961	36.4094
4975.00	-12.86128	55.2869	4975.00	-42.86580	173.8123	4975.00	-52.41833	40.4853
5000.00	-13.02993	57.6648	5000.00	-43.12744	170.6261	5000.00	-53.00342	45.2854

GAMMA(DEG)= 90.0 PHI(DEG)= 90.0 ZT(KM)= 5.000 ZR(KM)= 10.000

Z			X			Y		
RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)
25.00	27.51953	179.5762	25.00	26.64450	82.8635	25.00	63.68800	244.1672
50.00	23.71263	152.9835	50.00	22.91521	38.9513	50.00	60.18823	234.2179
75.00	21.24971	125.9061	75.00	20.57001	14.5238	75.00	57.91200	224.2904
100.00	19.39833	98.5973	100.00	18.79927	350.0767	100.00	56.08687	214.3877
125.00	17.93675	71.1025	125.00	17.37453	325.6606	125.00	54.47812	204.4572
150.00	16.77313	43.4766	150.00	16.19535	301.3340	150.00	52.97903	194.4384
175.00	15.86622	15.7935	175.00	15.20720	277.1655	175.00	51.53078	184.2587
200.00	15.19932	348.1660	200.00	14.37761	253.2331	200.00	50.09673	173.8283
225.00	14.68836	320.7561	225.00	13.53481	229.8249	225.00	48.61855	163.2431
250.00	14.48950	293.9148	250.00	12.95894	206.7146	250.00	47.15327	151.9935
275.00	14.50465	267.8486	275.00	12.47722	184.0815	275.00	45.65547	140.0463
300.00	14.70259	242.6386	300.00	12.07032	161.9906	300.00	44.12877	127.1591

325.00	15.04035	219.0932	325.00	11.71879	140.4885	325.00	42.59467	113.0393
350.00	15.44227	196.3342	350.00	11.28092	119.2268	350.00	41.03471	97.6712
375.00	15.91372	175.4467	375.00	10.98483	99.0874	375.00	39.67424	80.3513
400.00	16.39468	155.8847	400.00	10.69120	79.5525	400.00	38.56801	61.4453
425.00	16.85536	137.5548	425.00	10.38532	60.6026	425.00	37.83057	41.6498
450.00	17.27397	120.3515	450.00	10.05420	42.2093	450.00	37.49753	22.0940
475.00	17.64844	103.9474	475.00	9.65236	23.8539	475.00	37.42128	3.6771
500.00	17.93361	88.7210	500.00	9.23174	6.5422	500.00	37.62994	347.2573
525.00	18.14555	74.3519	525.00	8.75738	349.6807	525.00	37.92076	332.6479
550.00	18.27980	60.7765	550.00	8.22102	333.2390	550.00	38.21210	319.6008
575.00	18.33372	47.9472	575.00	7.61479	317.1899	575.00	38.45778	307.8118
600.00	18.32005	35.7356	600.00	6.94424	301.3247	600.00	38.60204	296.8706
625.00	18.20772	24.3050	625.00	6.17437	285.9973	625.00	38.70047	286.8965
650.00	18.01485	13.5638	650.00	5.31045	271.0051	650.00	38.71852	277.5239
675.00	17.74373	3.5181	675.00	4.34158	256.3447	675.00	38.65631	268.6316
700.00	17.39825	354.1858	700.00	3.25451	242.0246	700.00	38.51506	260.1296
725.00	16.99300	345.5603	725.00	2.05814	228.2207	725.00	38.28123	251.9228
750.00	16.51900	337.7314	750.00	0.69364	214.6572	750.00	37.98572	244.0466
775.00	15.99590	330.7112	775.00	-0.82393	201.5730	775.00	37.61470	236.4043
800.00	15.43928	324.5293	800.00	-2.62532	189.1203	800.00	37.16756	228.9683
825.00	14.86887	319.1953	825.00	-4.67984	177.3653	825.00	36.64273	221.7180
850.00	14.31038	314.6685	850.00	-7.07410	167.8870	850.00	36.02940	214.7128
875.00	13.78281	310.8906	875.00	-9.95891	160.5397	875.00	35.34258	207.8142
900.00	13.30845	307.7170	900.00	-13.44832	158.9014	900.00	34.56577	201.0710
925.00	12.90063	304.9614	925.00	-17.14798	170.1273	925.00	33.69054	194.4840
950.00	12.56144	302.4126	950.00	-18.42049	196.5604	950.00	32.70526	188.0603
975.00	12.28085	299.8728	975.00	-16.40982	212.9942	975.00	31.59383	181.8153
1000.00	12.03916	297.1919	1000.00	-14.15699	214.1594	1000.00	30.33357	175.7779
1025.00	11.81143	294.2852	1025.00	-12.50782	208.1913	1025.00	28.89162	169.9984
1050.00	11.56709	291.1785	1050.00	-11.50663	199.4896	1050.00	27.23137	164.9296
1075.00	11.29702	287.8381	1075.00	-10.77415	188.8075	1075.00	25.27055	160.0508
1100.00	10.97444	284.3567	1100.00	-10.35609	177.1459	1100.00	22.87066	156.0451
1125.00	10.58460	280.8347	1125.00	-10.19076	164.8496	1125.00	19.80550	153.8077
1150.00	10.11718	277.3931	1150.00	-10.23762	152.0954	1150.00	15.53839	156.2572
1175.00	9.56624	274.1702	1175.00	-10.46999	138.9739	1175.00	9.20515	178.0092
1200.00	8.93063	271.3206	1200.00	-10.87060	125.5246	1200.00	8.45759	247.5210
1225.00	8.21519	269.0164	1225.00	-11.42896	111.7520	1225.00	14.11843	271.7388
1250.00	7.43295	267.4424	1250.00	-12.13978	97.6302	1250.00	17.71310	274.9158
1275.00	6.60830	266.7839	1275.00	-13.00195	83.1021	1275.00	20.06847	273.2195
1300.00	5.78028	267.1917	1300.00	-14.01779	68.0706	1300.00	21.72697	269.8064
1325.00	5.00335	268.7212	1325.00	-15.19204	52.3833	1325.00	22.94249	265.6294
1350.00	4.34077	271.2544	1350.00	-16.52971	35.8046	1350.00	23.84908	261.0696
1375.00	3.84725	274.4490	1375.00	-18.03075	17.9734	1375.00	24.52505	256.3098
1400.00	3.54630	277.7913	1400.00	-19.67679	358.3479	1400.00	25.01978	251.4503
1425.00	3.41837	280.7566	1425.00	-21.40083	338.1809	1425.00	25.36607	246.5521
1450.00	3.41034	282.9800	1450.00	-23.03203	318.7046	1450.00	25.58665	241.6563
1475.00	3.45772	284.3213	1475.00	-24.25844	281.9048	1475.00	25.69774	236.7936
1500.00	3.50321	284.8274	1500.00	-24.76881	251.6417	1500.00	25.71107	231.9890
1525.00	3.50453	284.6519	1525.00	-24.56595	222.9995	1525.00	25.63533	227.2651
1550.00	3.43423	283.9922	1550.00	-23.96211	197.8021	1550.00	25.47685	222.6440
1575.00	3.27662	283.0547	1575.00	-23.26505	176.0130	1575.00	25.24030	218.1490
1600.00	3.02454	282.0403	1600.00	-22.64091	156.8653	1600.00	24.92903	213.8057
1625.00	2.67735	281.1421	1625.00	-22.15285	139.6210	1625.00	24.54543	209.6435
1650.00	2.24008	280.5479	1650.00	-21.81560	123.7505	1650.00	24.09108	205.6970
1675.00	1.72384	280.4426	1675.00	-21.62531	108.9058	1675.00	23.56718	202.0082
1700.00	1.14713	281.0049	1700.00	-21.57225	94.8656	1700.00	22.97476	198.6279
1725.00	0.53789	282.3940	1725.00	-21.64574	81.4934	1725.00	22.31506	195.6192
1750.00	-0.06510	284.7227	1750.00	-21.83565	68.7097	1750.00	21.59032	193.0595
1775.00	-0.61325	288.0117	1775.00	-22.13268	56.4754	1775.00	20.80461	191.0443
1800.00	-1.05448	292.1438	1800.00	-22.52800	44.7827	1800.00	19.96550	189.6888
1825.00	-1.34563	296.8435	1825.00	-23.01260	33.6482	1825.00	19.08627	189.1263

1850.00	-1.46635	301.7234
1875.00	-1.42564	306.3882
1900.00	-1.25578	310.5422
1925.00	-0.99862	314.0366
1950.00	-0.69298	316.8506
1975.00	-0.36837	319.0422
2000.00	-0.04397	320.7031
2025.00	0.26933	321.9255
2050.00	0.56634	322.7883
2075.00	0.84509	323.3511
2100.00	1.10509	323.6560
2125.00	1.34615	323.7314
2150.00	1.56768	323.5964
2175.00	1.76849	323.2651
2200.00	1.94679	322.7515
2225.00	2.10041	322.0703
2250.00	2.22707	321.2397
2275.00	2.32459	320.2810
2300.00	2.39117	319.2185
2325.00	2.42555	318.0789
2350.00	2.42705	316.8901
2375.00	2.39570	315.6809
2400.00	2.33221	314.4790
2425.00	2.23794	313.3108
2450.00	2.11485	312.2002
2475.00	1.96543	311.1680
2500.00	1.79256	310.2314
2525.00	1.59940	309.4031
2550.00	1.38923	308.6912
2575.00	1.16529	308.0996
2600.00	0.93061	307.6272
2625.00	0.68786	307.2700
2650.00	0.43920	307.0210
2675.00	0.18627	306.8711
2700.00	-0.06991	306.8115
2725.00	-0.32882	306.8337
2750.00	-0.59036	306.9312
2775.00	-0.85474	307.0999
2800.00	-1.12229	307.3381
2825.00	-1.39330	307.6477
2850.00	-1.66787	308.0317
2875.00	-1.94584	308.4956
2900.00	-2.22669	309.0457
2925.00	-2.50953	309.6882
2950.00	-2.79311	310.4282
2975.00	-3.07592	311.2695
3000.00	-3.35619	312.2146
3025.00	-3.63209	313.2625
3050.00	-3.90176	314.4106
3075.00	-4.16339	315.6543
3100.00	-4.41534	316.9871
3125.00	-4.65612	318.4006
3150.00	-4.88444	319.8860
3175.00	-5.09915	321.4333
3200.00	-5.29928	323.0320
3225.00	-5.48398	324.6704
3250.00	-5.65257	326.3362
3275.00	-5.80453	328.0164
3300.00	-5.93959	329.6958
3325.00	-6.05776	331.3596
3350.00	-6.15946	332.9915

1850.00	-23.57629	23.1102
1875.00	-24.20651	13.2239
1900.00	-24.88675	4.0564
1925.00	-25.59488	355.6755
1950.00	-26.30173	348.1316
1975.00	-26.97098	341.4280
2000.00	-27.56192	335.4880
2025.00	-28.03612	330.1292
2050.00	-28.36693	325.0688
2075.00	-28.54767	319.9758
2100.00	-28.59315	314.5466
2125.00	-28.53366	308.5703
2150.00	-28.40532	301.9509
2175.00	-28.24210	294.6904
2200.00	-28.07161	286.8562
2225.00	-27.91437	278.5496
2250.00	-27.78474	269.8826
2275.00	-27.69246	260.9653
2300.00	-27.64400	251.9012
2325.00	-27.64377	242.7833
2350.00	-27.69470	233.6960
2375.00	-27.79886	224.7154
2400.00	-27.95750	215.9115
2425.00	-28.17125	207.3498
2450.00	-28.43994	199.0927
2475.00	-28.76247	191.2015
2500.00	-29.13644	183.7366
2525.00	-29.55779	176.7581
2550.00	-30.02029	170.3242
2575.00	-30.51503	164.4885
2600.00	-31.02998	159.2936
2625.00	-31.54996	154.7646
2650.00	-32.05708	150.8954
2675.00	-32.53239	147.6416
2700.00	-32.95837	144.9125
2725.00	-33.32220	142.5753
2750.00	-33.61861	140.4711
2775.00	-33.85107	138.4392
2800.00	-34.03098	136.3434
2825.00	-34.17480	134.0893
2850.00	-34.30089	131.6297
2875.00	-34.42653	128.9602
2900.00	-34.56619	126.1080
2925.00	-34.73065	123.1205
2950.00	-34.92694	120.0550
2975.00	-35.15858	116.9710
3000.00	-35.42607	113.9237
3025.00	-35.72742	110.9604
3050.00	-36.05867	108.1165
3075.00	-36.41458	105.4124
3100.00	-36.78940	102.8524
3125.00	-37.17761	100.4229
3150.00	-37.57503	98.0941
3175.00	-37.97948	95.8225
3200.00	-38.39166	93.5566
3225.00	-38.81538	91.2421
3250.00	-39.25708	88.8291
3275.00	-39.72838	86.2764
3300.00	-40.23988	83.5550
3325.00	-40.80659	80.6493
3350.00	-41.44495	77.5555

1850.00	18.18906	189.4990
1875.00	17.30827	190.9331
1900.00	16.49266	193.4891
1925.00	15.80212	197.0908
1950.00	15.29508	201.4622
1975.00	15.00812	206.1354
2000.00	14.93944	210.5670
2025.00	15.04984	214.3063
2050.00	15.28099	217.1014
2075.00	15.57442	218.8959
2100.00	15.88396	219.7625
2125.00	16.17769	219.8332
2150.00	16.43578	219.2533
2175.00	16.64693	218.1582
2200.00	16.80551	216.6653
2225.00	16.90932	214.8732
2250.00	16.95819	212.8641
2275.00	16.95317	210.7067
2300.00	16.89597	208.4591
2325.00	16.78864	206.1717
2350.00	16.63351	203.8892
2375.00	16.43312	201.6519
2400.00	16.19019	199.4977
2425.00	15.90779	197.4622
2450.00	15.58931	195.5798
2475.00	15.23875	193.8836
2500.00	14.86075	192.4053
2525.00	14.46080	191.1741
2550.00	14.04540	190.2155
2575.00	13.62209	189.5493
2600.00	13.19945	189.1867
2625.00	12.78689	189.1271
2650.00	12.39421	189.3553
2675.00	12.03093	189.8392
2700.00	11.70541	190.5296
2725.00	11.42388	191.3621
2750.00	11.18956	192.2624
2775.00	11.00279	193.1534
2800.00	10.86000	193.9630
2825.00	10.75539	194.6305
2850.00	10.68122	195.1113
2875.00	10.62887	195.3777
2900.00	10.58976	195.4187
2925.00	10.55591	195.2367
2950.00	10.52037	194.8447
2975.00	10.47737	194.2628
3000.00	10.42235	193.5158
3025.00	10.35188	192.6310
3050.00	10.26353	191.6364
3075.00	10.15575	190.5599
3100.00	10.02774	189.4284
3125.00	9.87936	188.2678
3150.00	9.71101	187.1022
3175.00	9.52360	185.9540
3200.00	9.31846	184.8437
3225.00	9.09734	183.7898
3250.00	8.86234	182.8085
3275.00	8.61590	181.9134
3300.00	8.36075	181.1152
3325.00	8.09985	180.4215
3350.00	7.83632	179.8362

3375.00	-6.24552	334.5750
3400.00	-6.31724	336.0950
3425.00	-6.37639	337.5374
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3475.00	-6.46584	340.1438
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3525.00	-6.53402	342.3362
3550.00	-6.56683	343.2729
3575.00	-6.60210	344.1077
3600.00	-6.64229	344.8462
3625.00	-6.68918	345.4971
3650.00	-6.74450	346.0698
3675.00	-6.80958	346.5750
3700.00	-6.88544	347.0232
3725.00	-6.97285	347.4260
3750.00	-7.07230	347.7937
3775.00	-7.18408	348.1367
3800.00	-7.30830	348.4648
3825.00	-7.44494	348.7874
3850.00	-7.59386	349.1130
3875.00	-7.75486	349.4495
3900.00	-7.92764	349.8044
3925.00	-8.11188	350.1855
3950.00	-8.30717	350.5991
3975.00	-8.51307	351.0525
4000.00	-8.72908	351.5518
4025.00	-8.95464	352.1035
4050.00	-9.18909	352.7139
4075.00	-9.43170	353.3889
4100.00	-9.68166	354.1345
4125.00	-9.93804	354.9561
4150.00	-10.19981	355.8584
4175.00	-10.46585	356.8459
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4275.00	-11.54701	1.7120
4300.00	-11.81450	3.1649
4325.00	-12.07787	4.7116
4350.00	-12.33562	6.3497
4375.00	-12.58624	8.0755
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4425.00	-13.06032	11.7689
4450.00	-13.28114	13.7226
4475.00	-13.48959	15.7363
4500.00	-13.68471	17.7998
4525.00	-13.86576	19.9022
4550.00	-14.03226	22.0317
4575.00	-14.18398	24.1761
4600.00	-14.32100	26.3230
4625.00	-14.44370	28.4603
4650.00	-14.55272	30.5763
4675.00	-14.64898	32.6606
4700.00	-14.73364	34.7038
4725.00	-14.80803	36.6981
4750.00	-14.87361	38.6376
4775.00	-14.93191	40.5179
4800.00	-14.98451	42.3364
4825.00	-15.03294	44.0924
4850.00	-15.07868	45.7864
4875.00	-15.12311	47.4204

3375.00	-42.17363	74.2807
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3425.00	-43.99463	67.2509
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3475.00	-46.52788	59.7199
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3525.00	-50.31540	51.8279
3550.00	-53.10341	47.7270
3575.00	-57.17126	43.3490
3600.00	-64.77711	37.5026
3625.00	-73.59723	227.1064
3650.00	-60.40248	215.8077
3675.00	-55.58057	211.3555
3700.00	-52.65762	207.5714
3725.00	-50.60878	204.0711
3750.00	-49.06798	200.7652
3775.00	-47.86082	197.6214
3800.00	-46.88991	194.6225
3825.00	-46.09486	191.7561
3850.00	-45.43564	189.0099
3875.00	-44.88431	186.3715
3900.00	-44.42078	183.8283
3925.00	-44.03029	181.3675
3950.00	-43.70189	178.9771
3975.00	-43.42743	176.6467
4000.00	-43.20082	174.3676
4025.00	-43.01750	172.1337
4050.00	-42.87405	169.9413
4075.00	-42.76782	167.7895
4100.00	-42.69664	165.6794
4125.00	-42.65869	163.6142
4150.00	-42.65231	161.5985
4175.00	-42.67589	159.6379
4200.00	-42.72778	157.7380
4225.00	-42.80635	155.9044
4250.00	-42.90990	154.1418
4275.00	-43.03670	152.4536
4300.00	-43.18510	150.8420
4325.00	-43.35359	149.3074
4350.00	-43.54079	147.8487
4375.00	-43.74561	146.4637
4400.00	-43.96724	145.1491
4425.00	-44.20529	143.9012
4450.00	-44.45972	142.7167
4475.00	-44.73083	141.5933
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4525.00	-45.32629	139.5281
4550.00	-45.65282	138.5918
4575.00	-46.00031	137.7283
4600.00	-46.37015	136.9484
4625.00	-46.76366	136.2665
4650.00	-47.18204	135.7009
4675.00	-47.62617	135.2741
4700.00	-48.09654	135.0126
4725.00	-48.59309	134.9473
4750.00	-49.11502	135.1133
4775.00	-49.66058	135.5499
4800.00	-50.22676	136.3005
4825.00	-50.80890	137.4111
4850.00	-51.40027	138.9286
4875.00	-51.99101	140.8975

3375.00	7.57335	179.3595
3400.00	7.31411	178.9872
3425.00	7.06157	178.7114
3450.00	6.81840	178.5199
3475.00	6.58681	178.3975
3500.00	6.36843	178.3259
3525.00	6.16426	178.2855
3550.00	5.97457	178.2558
3575.00	5.79894	178.2171
3600.00	5.63634	178.1514
3625.00	5.48518	178.0432
3650.00	5.34351	177.8803
3675.00	5.20911	177.6540
3700.00	5.07965	177.3591
3725.00	4.95281	176.9941
3750.00	4.82641	176.5605
3775.00	4.69847	176.0623
3800.00	4.56726	175.5058
3825.00	4.43136	174.8989
3850.00	4.28900	174.2507
3875.00	4.14137	173.5707
3900.00	3.98599	172.8692
3925.00	3.82334	172.1560
3950.00	3.65350	171.4407
3975.00	3.47680	170.7325
4000.00	3.29378	170.0394
4025.00	3.10520	169.3687
4050.00	2.91195	168.7263
4075.00	2.71506	168.1169
4100.00	2.51565	167.5437
4125.00	2.31436	167.0084
4150.00	2.11186	166.5112
4175.00	1.91378	166.0511
4200.00	1.71566	165.6253
4225.00	1.52041	165.2300
4250.00	1.32881	164.8604
4275.00	1.14145	164.5108
4300.00	0.95872	164.1750
4325.00	0.78081	163.8467
4350.00	0.60771	163.5195
4375.00	0.43920	163.1874
4400.00	0.27490	162.8450
4425.00	0.11431	162.4877
4450.00	-0.04321	162.1118
4475.00	-0.19837	161.7147
4500.00	-0.35190	161.2947
4525.00	-0.50454	160.8513
4550.00	-0.65701	160.3848
4575.00	-0.80998	159.8966
4600.00	-0.96404	159.3886
4625.00	-1.11968	158.8635
4650.00	-1.27729	158.3244
4675.00	-1.43718	157.7746
4700.00	-1.59952	157.2177
4725.00	-1.76437	156.6572
4750.00	-1.93171	156.0967
4775.00	-2.10141	155.5394
4800.00	-2.27325	154.9883
4825.00	-2.44696	154.4459
4850.00	-2.62219	153.9141
4875.00	-2.79857	153.3947

4900.00	-15.16748	48.9977	4900.00	-52.57071	143.3540	4900.00	-2.97568	152.8885
4925.00	-15.21292	50.5224	4925.00	-53.12230	146.3179	4925.00	-3.15311	152.3961
4950.00	-15.26039	51.9992	4950.00	-53.62843	149.7822	4950.00	-3.33046	151.9173
4975.00	-15.31072	53.4338	4975.00	-54.06989	153.7025	4975.00	-3.50734	151.4516
5000.00	-15.36457	54.8318	5000.00	-54.42841	157.9899	5000.00	-3.68340	150.9978

GAMMA(DEG)= 45.0 PHI(DEG)= 45.0 ZT(KM)= 5.000 ZR(KM)= 10.000

Z			X			Y		
RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)	RHO(KM)	AMP(DB)	ANG(DEG)
25.00	73.36125	265.0391	25.00	57.11514	156.6898	25.00	58.60384	244.4052
50.00	70.08977	259.2070	50.00	53.49205	140.1229	50.00	55.07178	232.9102
75.00	67.92786	253.8484	75.00	51.01920	123.7443	75.00	52.70839	221.4883
100.00	66.15047	249.0989	100.00	48.91153	107.5658	100.00	50.75159	210.2073
125.00	64.54466	245.1070	125.00	46.91699	91.5318	125.00	48.96678	199.0488
150.00	63.03299	242.0190	150.00	44.90222	75.5724	150.00	47.24698	187.9899
175.00	61.59627	239.9552	175.00	42.76662	59.5856	175.00	45.53255	176.9999
200.00	60.24879	238.9660	200.00	40.40565	43.3987	200.00	43.78535	166.0356
225.00	59.02640	238.9763	225.00	37.67102	27.3144	225.00	41.96317	155.2063
250.00	57.95911	239.7065	250.00	34.37202	9.4327	250.00	40.07841	144.0976
275.00	57.06750	240.7672	275.00	30.01935	347.9233	275.00	38.09776	132.7166
300.00	56.33910	241.6918	300.00	23.72365	312.0378	300.00	36.01187	120.8413
325.00	55.73026	242.0953	325.00	20.49284	226.4470	325.00	33.82320	108.1289
350.00	55.18227	241.7367	350.00	25.65434	172.5098	350.00	31.51431	94.4895
375.00	54.62460	240.6379	375.00	29.25513	149.1073	375.00	29.25627	78.5070
400.00	54.01028	238.8656	400.00	31.41409	131.6532	400.00	27.18816	59.9062
425.00	53.29570	236.5711	425.00	32.78314	116.3058	425.00	25.60826	38.8601
450.00	52.44432	233.9409	450.00	33.65111	101.9943	450.00	24.78053	17.1417
475.00	51.42180	231.1504	475.00	34.15388	87.8769	475.00	24.54012	357.2512
500.00	50.19116	228.5324	500.00	34.37671	74.7264	500.00	24.92218	340.8103
525.00	48.71306	226.3670	525.00	34.37863	61.9221	525.00	25.50070	327.4890
550.00	46.93167	225.1315	550.00	34.18842	49.4188	550.00	26.12001	316.4548
575.00	44.77299	225.6569	575.00	33.82356	37.1980	575.00	26.70790	306.9026
600.00	42.15192	229.5369	600.00	33.32080	25.1744	600.00	27.13791	298.1245
625.00	39.12422	240.4841	625.00	32.62607	13.4951	625.00	27.59230	290.0906
650.00	36.56781	263.8447	650.00	31.76903	2.1542	650.00	27.95822	282.2388
675.00	36.55359	293.9934	675.00	30.74326	351.2156	675.00	28.22745	274.4153
700.00	38.49928	313.6938	700.00	29.53743	340.7849	700.00	28.39357	266.5317
725.00	40.48842	323.0266	725.00	28.19783	331.3821	725.00	28.39462	258.5354
750.00	42.06168	327.1875	750.00	26.60345	322.4446	750.00	28.34650	250.5148
775.00	43.23714	328.9873	775.00	24.76787	314.8547	775.00	28.18394	242.3339
800.00	44.11003	329.7283	800.00	22.67577	309.3911	800.00	27.90222	233.9868
825.00	44.76305	330.0427	825.00	20.36671	307.3909	825.00	27.49591	225.4664
850.00	45.25908	330.2913	850.00	18.30606	311.5066	850.00	26.91833	216.7983
875.00	45.65749	330.5378	875.00	16.71956	319.9011	875.00	26.24445	207.9541
900.00	45.99010	330.8499	900.00	16.33151	330.1516	900.00	25.42175	198.8510
925.00	46.28499	331.2070	925.00	16.95714	336.4089	925.00	24.43529	189.4142
950.00	46.56055	331.5488	950.00	17.91704	336.9797	950.00	23.26511	179.5198
975.00	46.82620	331.7981	975.00	18.80157	333.2344	975.00	21.88472	168.9588
1000.00	47.08368	331.8826	1000.00	19.48572	326.7056	1000.00	20.26039	157.3678
1025.00	47.32916	331.7485	1025.00	19.95906	318.4048	1025.00	18.35500	144.0893
1050.00	47.55850	331.3896	1050.00	20.30281	308.8118	1050.00	16.12134	128.1226
1075.00	47.75908	330.7561	1075.00	20.41367	298.4812	1075.00	13.72663	106.9029
1100.00	47.92465	329.8936	1100.00	20.39037	287.6433	1100.00	11.69327	78.0407
1125.00	48.04921	328.8403	1125.00	20.25542	276.4707	1125.00	11.11564	43.9152
1150.00	48.12877	327.6431	1150.00	20.02751	265.1055	1150.00	12.13743	14.0309
1175.00	48.16132	326.3525	1175.00	19.72183	253.6769	1175.00	13.68418	352.2346
1200.00	48.14668	325.0198	1200.00	19.35040	242.3113	1200.00	15.10115	336.2466
1225.00	48.08629	323.6917	1225.00	18.92242	231.1390	1225.00	16.23962	323.7063
1250.00	47.98289	322.4111	1250.00	18.44467	220.2960	1250.00	17.11160	313.2551
1275.00	47.84032	321.2139	1275.00	17.92241	209.9243	1275.00	17.75919	304.1621
1300.00	47.66312	320.1277	1300.00	17.36058	200.1723	1300.00	18.22292	296.0198

1325.00	47.45625	319.1721
1350.00	47.22479	318.3572
1375.00	46.97346	317.6855
1400.00	46.70638	317.1514
1425.00	46.42665	316.7437
1450.00	46.13620	316.4482
1475.00	45.83569	316.2507
1500.00	45.52463	316.1396
1525.00	45.20154	316.1086
1550.00	44.86438	316.1592
1575.00	44.51093	316.3010
1600.00	44.13921	316.5522
1625.00	43.74802	316.9397
1650.00	43.33723	317.4968
1675.00	42.90826	318.2620
1700.00	42.46429	319.2747
1725.00	42.01051	320.5740
1750.00	41.55423	322.1924
1775.00	41.10404	324.1519
1800.00	40.67255	326.4590
1825.00	40.26942	329.0994
1850.00	39.90643	332.0366
1875.00	39.59306	335.2119
1900.00	39.33594	338.5498
1925.00	39.13805	341.9666
1950.00	38.99855	345.3787
1975.00	38.91338	348.7129
2000.00	38.87622	351.9104
2025.00	38.87961	354.9307
2050.00	38.91591	357.7480
2075.00	38.97797	0.3502
2100.00	39.05943	2.7330
2125.00	39.15480	4.8985
2150.00	39.25931	6.8519
2175.00	39.36880	8.6007
2200.00	39.47960	10.1535
2225.00	39.58835	11.5203
2250.00	39.69202	12.7124
2275.00	39.78787	13.7426
2300.00	39.87349	14.6251
2325.00	39.94684	15.3752
2350.00	40.00620	16.0091
2375.00	40.05031	16.5436
2400.00	40.07829	16.9956
2425.00	40.08961	17.3816
2450.00	40.08411	17.7173
2475.00	40.06192	18.0172
2500.00	40.02339	18.2948
2525.00	39.96910	18.5619
2550.00	39.89967	18.8290
2575.00	39.81590	19.1052
2600.00	39.71852	19.3984
2625.00	39.60829	19.7153
2650.00	39.48595	20.0621
2675.00	39.35217	20.4443
2700.00	39.20763	20.8673
2725.00	39.05293	21.3362
2750.00	38.88876	21.8564
2775.00	38.71577	22.4335
2800.00	38.53474	23.0730
2825.00	38.34654	23.7807

1325.00	16.76563	191.1921
1350.00	16.14803	183.1353
1375.00	15.52505	176.1412
1400.00	14.92334	170.3143
1425.00	14.37974	165.6858
1450.00	13.93764	162.1656
1475.00	13.63709	159.9098
1500.00	13.50081	157.3369
1525.00	13.52376	155.2159
1550.00	13.67415	152.7605
1575.00	13.90500	149.8052
1600.00	14.16795	146.2126
1625.00	14.42235	142.0338
1650.00	14.63827	137.3597
1675.00	14.79572	132.3040
1700.00	14.88251	126.9820
1725.00	14.89204	121.5011
1750.00	14.82165	115.9576
1775.00	14.67146	110.4375
1800.00	14.44368	105.0167
1825.00	14.14230	99.7631
1850.00	13.77298	94.7368
1875.00	13.34304	89.9894
1900.00	12.86156	85.5619
1925.00	12.33929	81.4811
1950.00	11.78838	77.7548
1975.00	11.22169	74.3668
2000.00	10.65162	71.2727
2025.00	10.08859	68.3990
2050.00	9.53934	65.6472
2075.00	9.00558	62.9926
2100.00	8.48346	60.3472
2125.00	7.96401	56.9721
2150.00	7.43434	53.5855
2175.00	6.87928	49.8163
2200.00	6.28295	45.6112
2225.00	5.62991	40.9267
2250.00	4.90599	35.7198
2275.00	4.09888	29.9356
2300.00	3.19884	23.4933
2325.00	2.20012	16.2705
2350.00	1.10400	8.0845
2375.00	-0.07509	358.6770
2400.00	-1.29818	347.7180
2425.00	-2.48475	336.8770
2450.00	-3.49926	326.0366
2475.00	-4.17250	313.6572
2500.00	-4.38640	298.9529
2525.00	-4.16261	281.4023
2550.00	-3.63940	261.9551
2575.00	-2.97130	240.7942
2600.00	-2.26623	217.6445
2625.00	-1.58173	193.1005
2650.00	-0.94242	167.7839
2675.00	-0.35578	141.8870
2700.00	0.17818	115.6708
2725.00	0.66191	89.4521
2750.00	1.09797	63.5923
2775.00	1.48821	38.9876
2800.00	1.83358	15.5625
2825.00	2.13435	353.2640

1325.00	18.53625	288.5864
1350.00	18.72600	281.7083
1375.00	18.81354	275.2795
1400.00	18.81696	269.2212
1425.00	18.74724	263.4680
1450.00	18.61778	257.9639
1475.00	18.43576	252.6578
1500.00	18.20676	247.5033
1525.00	17.93413	242.4584
1550.00	17.61919	237.4872
1575.00	17.26147	232.5607
1600.00	16.85910	227.6581
1625.00	16.40894	222.7678
1650.00	15.90699	217.8882
1675.00	15.34865	213.0284
1700.00	14.72885	208.2083
1725.00	14.04234	203.4602
1750.00	13.28375	198.8300
1775.00	12.44789	194.3798
1800.00	11.53007	190.1917
1825.00	10.52675	186.3739
1850.00	9.43676	183.0672
1875.00	8.26364	180.4544
1900.00	7.01978	178.7662
1925.00	5.73334	178.2746
1950.00	4.45803	179.2513
1975.00	3.28140	181.8535
2000.00	2.31853	185.9251
2025.00	1.67370	190.8284
2050.00	1.38150	195.5597
2075.00	1.36344	199.1903
2100.00	1.56847	201.2352
2125.00	1.83035	201.6584
2150.00	2.09379	200.6715
2175.00	2.31725	198.5569
2200.00	2.48024	195.5798
2225.00	2.57576	191.9600
2250.00	2.60386	187.8720
2275.00	2.56811	183.4524
2300.00	2.47361	178.8083
2325.00	2.32583	174.0255
2350.00	2.13006	169.1732
2375.00	1.89104	164.3088
2400.00	1.61272	159.4811
2425.00	1.29816	154.7326
2450.00	0.94944	150.1020
2475.00	0.56760	145.6262
2500.00	0.15265	141.3424
2525.00	-0.29633	137.2909
2550.00	-0.78110	133.5177
2575.00	-1.30395	130.0782
2600.00	-1.86726	127.0410
2625.00	-2.47270	124.4928
2650.00	-3.12026	122.5435
2675.00	-3.80572	121.3307
2700.00	-4.51809	121.0200
2725.00	-5.23481	121.7950
2750.00	-5.91649	123.8241
2775.00	-6.50337	127.1898
2800.00	-6.92022	131.7800
2825.00	-7.09649	137.1981

2850.00	38.15218	24.5621	2850.00	2.39039	192.0573	2850.00	-6.99779	142.8016
2875.00	37.95282	25.4225	2875.00	2.60146	188.9219	2875.00	-6.64539	147.9101
2900.00	37.74976	26.3665	2900.00	2.76745	185.8479	2900.00	-6.10488	152.0447
2925.00	37.54451	27.3976	2925.00	2.88852	182.8337	2925.00	-5.45520	155.0186
2950.00	37.33868	28.5183	2950.00	2.96521	179.8829	2950.00	-4.76389	156.8727
2975.00	37.13399	29.7296	2975.00	2.99845	177.0025	2975.00	-4.07814	157.7642
3000.00	36.93224	31.0306	3000.00	2.98957	174.2013	3000.00	-3.42671	157.8821
3025.00	36.73520	32.4186	3025.00	2.94024	171.4884	3025.00	-2.82505	157.4049
3050.00	36.54466	33.8891	3050.00	2.85240	168.8723	3050.00	-2.28007	156.4846
3075.00	36.36223	35.4356	3075.00	2.72816	166.3596	3075.00	-1.79359	155.2452
3100.00	36.18941	37.0499	3100.00	2.56968	163.9552	3100.00	-1.36446	153.7652
3125.00	36.02744	38.7224	3125.00	2.37906	161.6613	3125.00	-0.98992	152.1827
3150.00	35.87733	40.4422	3150.00	2.15819	159.4778	3150.00	-0.66634	150.4990
3175.00	35.73982	42.1979	3175.00	1.90864	157.4022	3175.00	-0.38968	148.7824
3200.00	35.61536	43.9772	3200.00	1.63148	155.4304	3200.00	-0.15577	147.0705
3225.00	35.50404	45.7681	3225.00	1.32724	153.5572	3225.00	0.03959	145.3927
3250.00	35.40576	47.5585	3250.00	0.99580	151.7775	3250.00	0.20046	143.7710
3275.00	35.32010	49.3373	3275.00	0.63634	150.0870	3275.00	0.33075	142.2221
3300.00	35.24641	51.0939	3300.00	0.24737	148.4840	3300.00	0.43416	140.7577
3325.00	35.18388	52.8186	3325.00	-0.17327	146.9696	3325.00	0.51416	139.3854
3350.00	35.13145	54.5033	3350.00	-0.62634	145.5504	3350.00	0.57396	138.1095
3375.00	35.08800	56.1408	3375.00	-1.12113	144.2376	3375.00	0.61647	136.9317
3400.00	35.05225	57.7253	3400.00	-1.65558	143.0497	3400.00	0.64434	135.8510
3425.00	35.02290	59.2527	3425.00	-2.23520	142.0134	3425.00	0.65992	134.8649
3450.00	34.99858	60.7198	3450.00	-2.86495	141.1651	3450.00	0.66528	133.9694
3475.00	34.97798	62.1251	3475.00	-3.54913	140.5532	3475.00	0.66223	133.1592
3500.00	34.95975	63.4683	3500.00	-4.29221	140.2409	3500.00	0.65229	132.4285
3525.00	34.94263	64.7501	3525.00	-5.09827	140.3108	3525.00	0.63675	131.7705
3550.00	34.92546	65.9724	3550.00	-5.97038	140.6707	3550.00	0.61666	131.1785
3575.00	34.90717	67.1379	3575.00	-6.90940	142.0618	3575.00	0.59283	130.6451
3600.00	34.88676	68.2501	3600.00	-7.91166	144.3673	3600.00	0.56586	130.1632
3625.00	34.86340	69.3131	3625.00	-8.96473	147.1208	3625.00	0.53613	129.7257
3650.00	34.83633	70.3313	3650.00	-10.04030	151.5008	3650.00	0.50381	129.3257
3675.00	34.80498	71.3096	3675.00	-11.08376	157.4908	3675.00	0.46889	128.9570
3700.00	34.76881	72.2530	3700.00	-12.00468	165.2618	3700.00	0.43115	128.6138
3725.00	34.72746	73.1664	3725.00	-12.68218	174.6602	3725.00	0.39024	128.2913
3750.00	34.68063	74.0551	3750.00	-13.00503	185.0171	3750.00	0.34564	127.9859
3775.00	34.62814	74.9240	3775.00	-12.93582	195.2635	3775.00	0.29676	127.6951
3800.00	34.56987	75.7779	3800.00	-12.53720	204.4069	3800.00	0.24291	127.4177
3825.00	34.50578	76.6215	3825.00	-11.92770	211.9312	3825.00	0.18341	127.1539
3850.00	34.43591	77.4594	3850.00	-11.22000	217.7954	3850.00	0.11760	126.9056
3875.00	34.36034	78.2958	3875.00	-10.49221	222.2127	3875.00	0.04469	126.6757
3900.00	34.27922	79.1350	3900.00	-9.78909	225.4627	3900.00	-0.03519	126.4684
3925.00	34.19275	79.9807	3925.00	-9.13274	227.8018	3925.00	-0.12296	126.2892
3950.00	34.10117	80.8368	3950.00	-8.53218	229.4371	3950.00	-0.21853	126.1440
3975.00	34.00476	81.7067	3975.00	-7.98961	230.5280	3975.00	-0.32182	126.0394
4000.00	33.90387	82.5936	4000.00	-7.50390	231.1949	4000.00	-0.43251	125.9823
4025.00	33.79887	83.5005	4025.00	-7.07246	231.5293	4025.00	-0.55006	125.9793
4050.00	33.69019	84.4301	4050.00	-6.69224	231.6012	4050.00	-0.67367	126.0365
4075.00	33.57826	85.3849	4075.00	-6.36012	231.4651	4075.00	-0.80235	126.1595
4100.00	33.46359	86.3668	4100.00	-6.07313	231.1647	4100.00	-0.93490	126.3525
4125.00	33.34668	87.3776	4125.00	-5.82850	230.7349	4125.00	-1.07000	126.6184
4150.00	33.22810	88.4186	4150.00	-5.62390	230.2050	4150.00	-1.20618	126.9586
4175.00	33.10840	89.4907	4175.00	-5.45687	229.5993	4175.00	-1.34194	127.3727
4200.00	32.98814	90.5943	4200.00	-5.32539	228.9385	4200.00	-1.47576	127.8584
4225.00	32.86792	91.7293	4225.00	-5.22752	228.2405	4225.00	-1.60620	128.4117
4250.00	32.74829	92.8953	4250.00	-5.16151	227.5207	4250.00	-1.73192	129.0267
4275.00	32.62981	94.0914	4275.00	-5.12572	226.7927	4275.00	-1.85176	129.6962
4300.00	32.51302	95.3163	4300.00	-5.11864	226.0684	4300.00	-1.96479	130.4117
4325.00	32.39841	96.5679	4325.00	-5.13890	225.3583	4325.00	-2.07031	131.1637
4350.00	32.28642	97.8443	4350.00	-5.18526	224.6719	4350.00	-2.16791	131.9424

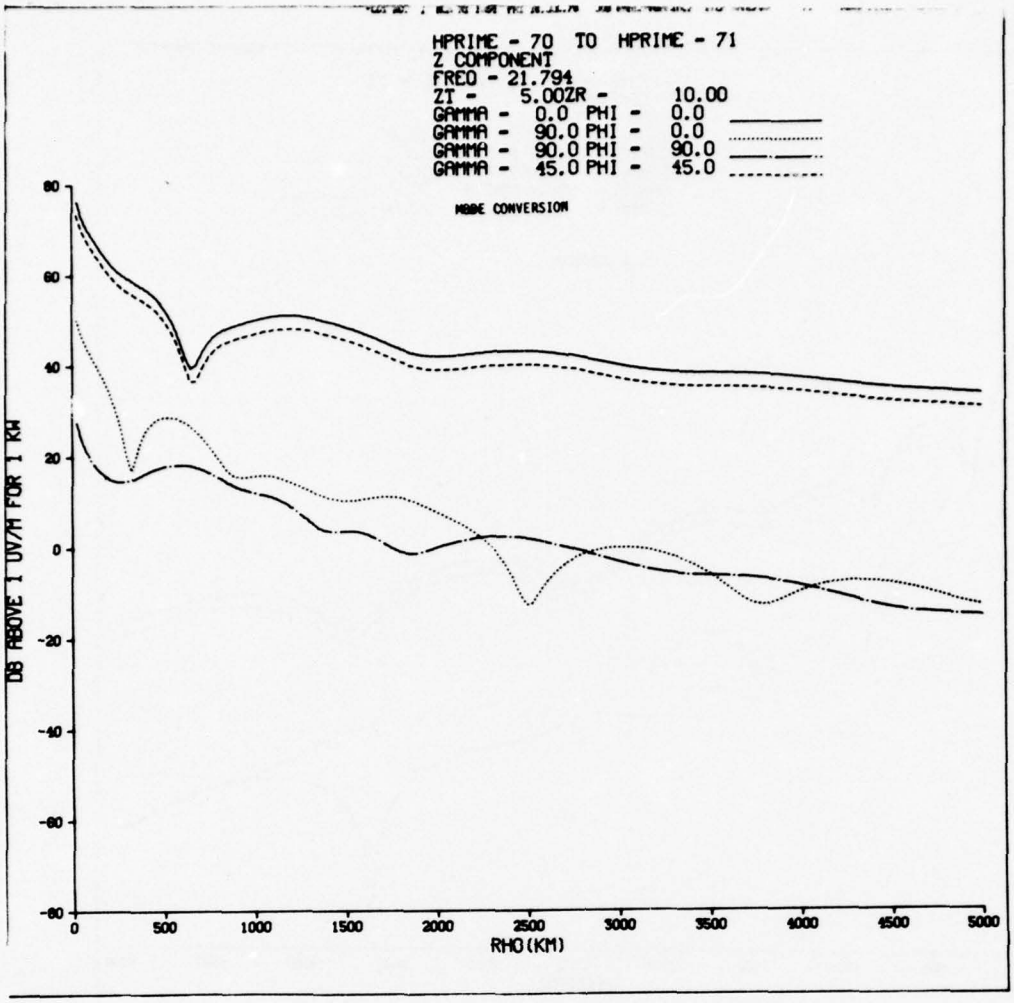
4375.00	32.17747	99.1429	4375.00	-5.25658	224.0178	4375.00	-2.25746	132.7377
4400.00	32.07191	100.4608	4400.00	-5.35184	223.4043	4400.00	-2.33907	133.5397
4425.00	31.97002	101.7950	4425.00	-5.47015	222.8391	4425.00	-2.41311	134.3393
4450.00	31.87202	103.1423	4450.00	-5.61070	222.3299	4450.00	-2.48018	135.1283
4475.00	31.77806	104.4992	4475.00	-5.77276	221.8845	4475.00	-2.54101	135.8992
4500.00	31.68823	105.8623	4500.00	-5.95564	221.5112	4500.00	-2.59651	136.6463
4525.00	31.60255	107.2283	4525.00	-6.15870	221.2188	4525.00	-2.64765	137.3646
4550.00	31.52095	108.5938	4550.00	-6.38128	221.0166	4550.00	-2.69544	138.0508
4575.00	31.44331	109.9555	4575.00	-6.62266	220.9152	4575.00	-2.74091	138.7028
4600.00	31.36946	111.3105	4600.00	-6.88200	220.9255	4600.00	-2.78508	139.3194
4625.00	31.29918	112.6559	4625.00	-7.15834	221.0598	4625.00	-2.82891	139.9006
4650.00	31.23216	113.9893	4650.00	-7.45047	221.3310	4650.00	-2.87328	140.4474
4675.00	31.16811	115.3086	4675.00	-7.75691	221.7527	4675.00	-2.91901	140.9613
4700.00	31.10664	116.6118	4700.00	-8.07582	222.3390	4700.00	-2.96681	141.4446
4725.00	31.04741	117.8975	4725.00	-8.40497	223.1041	4725.00	-3.01730	141.8999
4750.00	30.99002	119.1645	4750.00	-8.74161	224.0617	4750.00	-3.07099	142.3304
4775.00	30.93405	120.4122	4775.00	-9.08249	225.2244	4775.00	-3.12830	142.7392
4800.00	30.87914	121.6402	4800.00	-9.42377	226.6025	4800.00	-3.18956	143.1295
4825.00	30.82486	122.8483	4825.00	-9.76103	228.2032	4825.00	-3.25500	143.5047
4850.00	30.77087	124.0368	4850.00	-10.08935	230.0294	4850.00	-3.32479	143.8679
4875.00	30.71678	125.2063	4875.00	-10.40336	232.0780	4875.00	-3.39903	144.2221
4900.00	30.66229	126.3576	4900.00	-10.69747	234.3387	4900.00	-3.47774	144.5701
4925.00	30.60707	127.4917	4925.00	-10.96615	236.7935	4925.00	-3.56092	144.9146
4950.00	30.55086	128.6099	4950.00	-11.20425	239.4155	4950.00	-3.64855	145.2577
4975.00	30.49339	129.7134	4975.00	-11.40738	242.1700	4975.00	-3.74054	145.6017
5000.00	30.43448	130.8039	5000.00	-11.57233	245.0155	5000.00	-3.83684	145.9482

IV. Program Checks and Some Results

The sample input output case discussed in the previous section is an example of one of a number of checks made of the current program. That particular case represents propagation in a very slightly inhomogeneous guide in which the horizontal inhomogeneity begins just 25 km from the transmitter (i.e. XVAL(8) = 25.0 km since a nine slab model was used for the inhomogeneity) and is 1000 km in extent. The ionosphere is described by exponentials and in the convention of Wait and Spies[7] varies linearly over its 1000 km extent from H' = 70 km to H' = 71 km with constant $\beta = 0.3$ km^{-1}. This is a sufficiently modest inhomogeneity that one would expect the mode conversion and WKB results to be identical for all practical purposes. Figures 3 through 5 show the mode conversion and WKB results for the electric field components E_z, E_x and E_y for four orientations of the transmitter. The latter was at 5 km and the receiver at 10 km. Examination of the plots will show that the mode conversion and WKB results are indeed very nearly identical.

As an example of a more realistic terminator problem, Figures 6 through 8 show the E_z, E_x and E_y results for a Hawaii-San Diego path as a function of terminator location (i.e. the abscissa is the distance from the transmitter to XVAL (20) since 21 slabs were used to model the terminator) for a transmitter and receiver altitude of 15 km. The terminator extends 1000 km and the ionosphere (again assumed exponential) varies from H' = 86 km, $\beta = 0.5$ km^{-1} to H' = 70 km, $\beta = 0.3$ km^{-1}. Curves for four orientations of the transmitter are shown on each plot. Some jaggedness in some of the plots occurs as new slabs pass over the transmitter or receiver. However, the jaggedness would have been much worse for the E_y case except for the fact that the fundamental input from the waveguide runs (i.e. the program of reference 4) was generated using tolerances of 10^{-5} degrees for both real and imaginary parts of the eigenangle as compared

with our usual tolerances of 0.01^{o} for the real part and 0.005^{o} for the imaginary part. The increased tolerance results in only a slight increase in execution time of the waveguide program and we would recommend using the smaller tolerance when generating data for the present program and when E_y fields are of interest.


HPRIME - 70 TO HPRIME - 71
Z COMPONENT
FREQ - 21.794
ZI - 5.00ZR - 10.00
GAMMA - 0.0 PHI - 0.0
GAMMA - 90.0 PHI - 0.0
GAMMA - 90.0 PHI - 90.0
GAMMA - 45.0 PHI - 45.0
MODE CONVERSION
DB ABOVE 1 UV/M FOR 1 KW
RHO(KM)

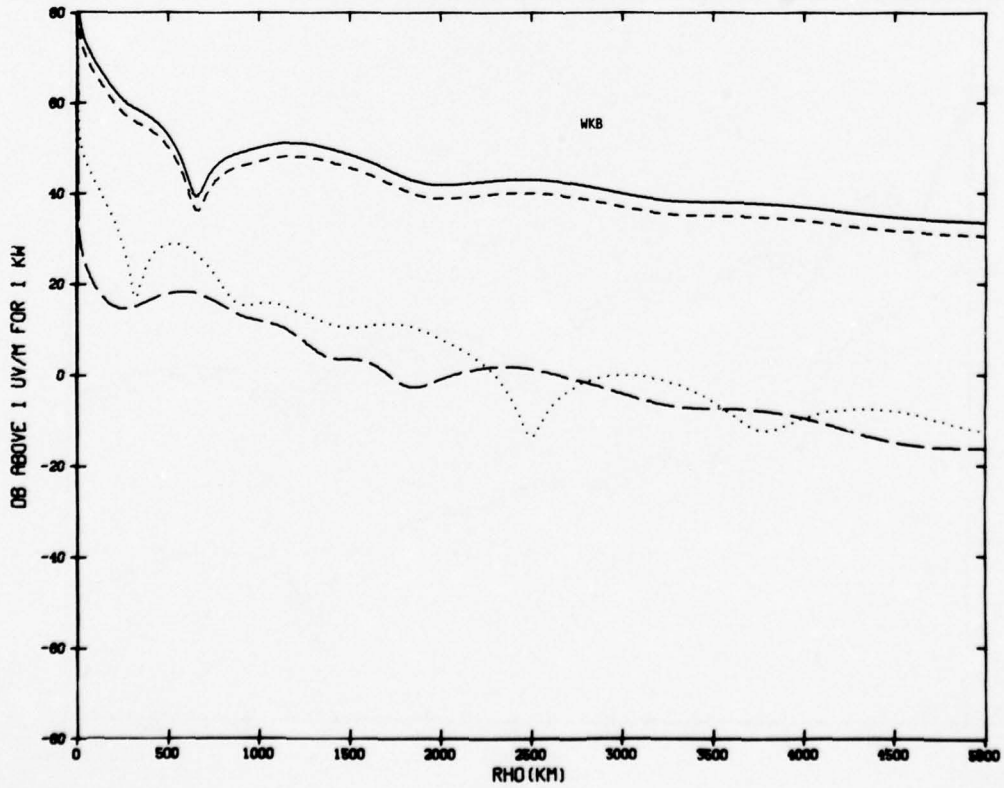

WKB
DB ABOVE 1 UV/M FOR 1 KW
RHO(KM)

FIGURE 3

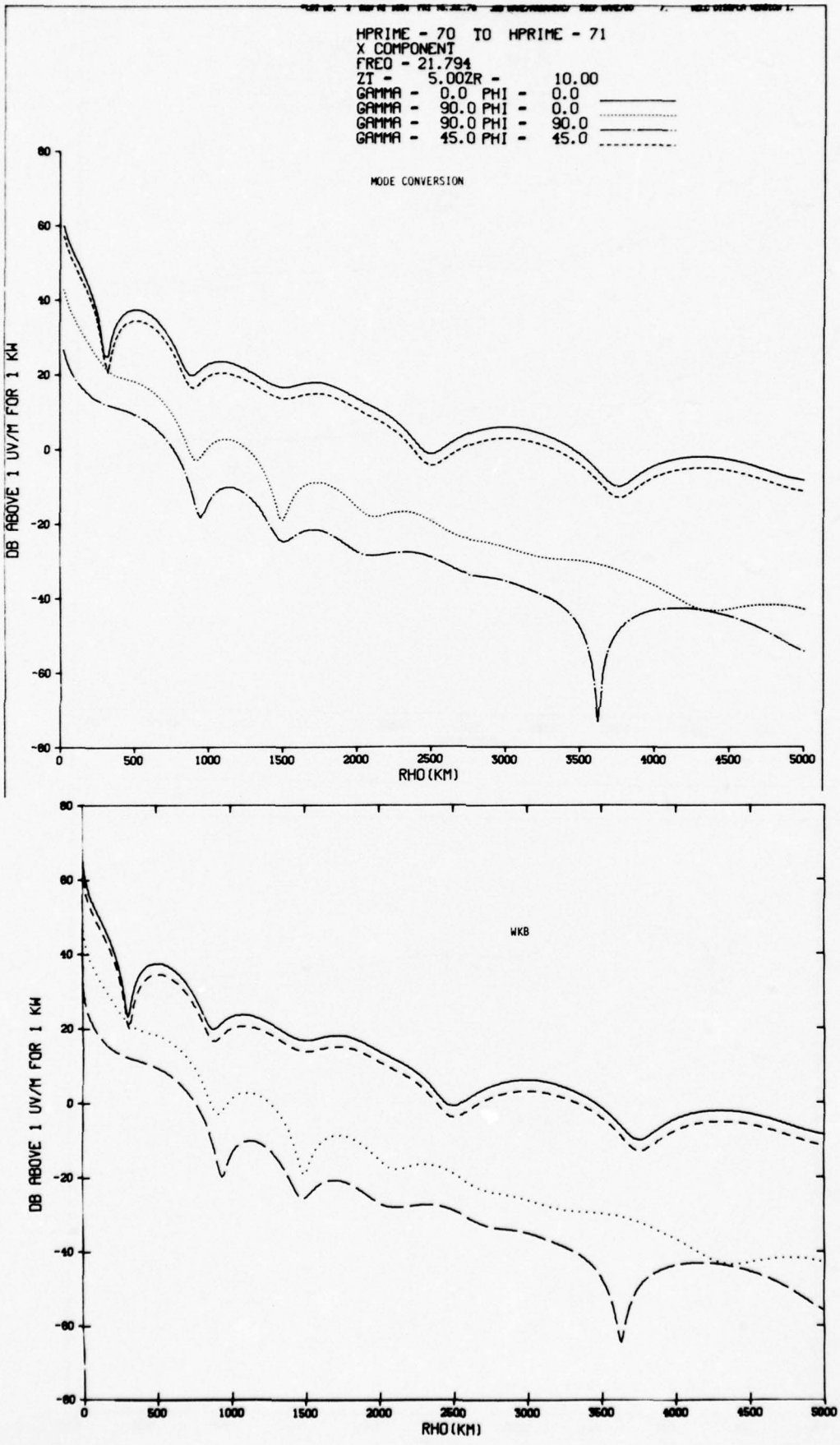
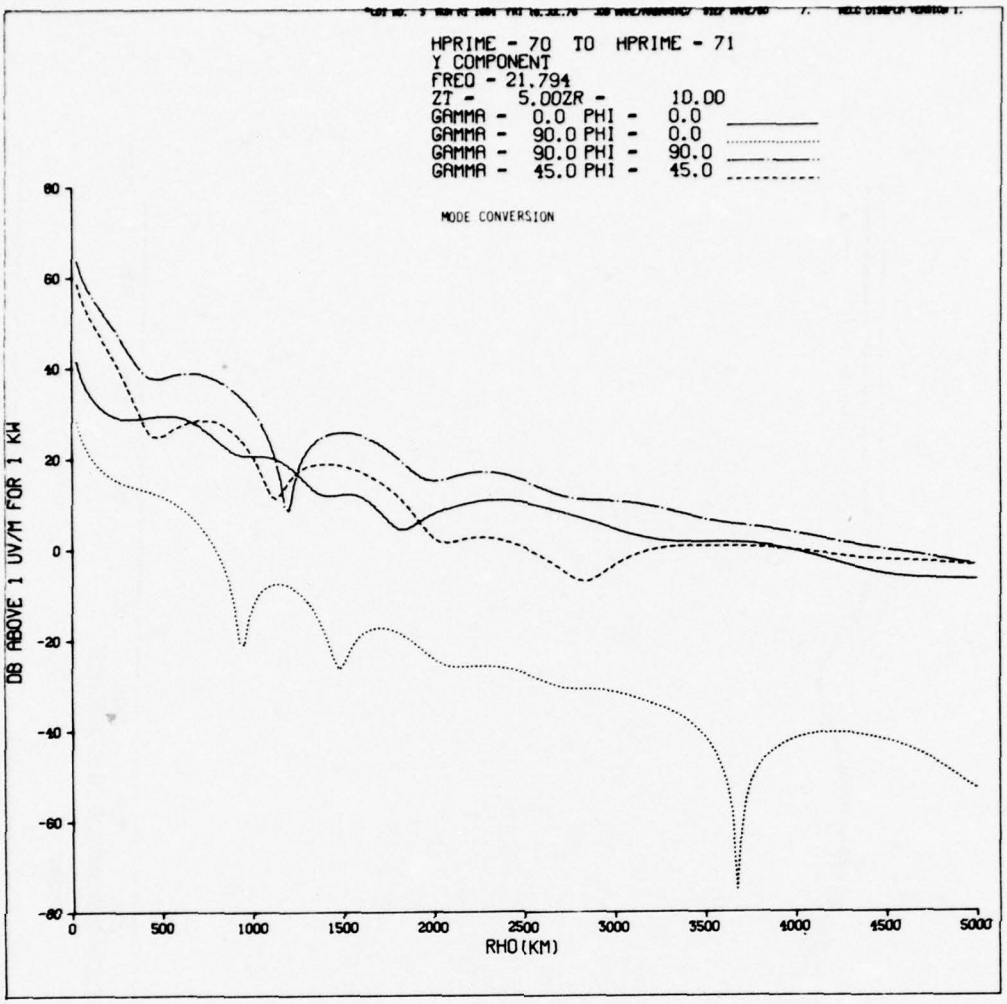

HPRIME - 70 TO HPRIME - 71
X COMPONENT
FREQ - 21.794
ZI - 5.00ZR - 10.00
GAMMA - 0.0 PHI - 0.0
GAMMA - 90.0 PHI - 0.0
GAMMA - 90.0 PHI - 90.0
GAMMA - 45.0 PHI - 45.0
MODE CONVERSION
DB ABOVE 1 UV/M FOR 1 KW
RHO(KM)
WKB
DB ABOVE 1 UV/M FOR 1 KW
RHO(KM)

FIGURE 4


HPRIME - 70 TO HPRIME - 71
Y COMPONENT
FREQ - 21.794
ZT - 5.00ZR - 10.00
GAMMA - 0.0 PHI - 0.0
GAMMA - 90.0 PHI - 0.0
GAMMA - 90.0 PHI - 90.0
GAMMA - 45.0 PHI - 45.0
MODE CONVERSION
DB ABOVE 1 UV/M FOR 1 KW
RHO(KM)

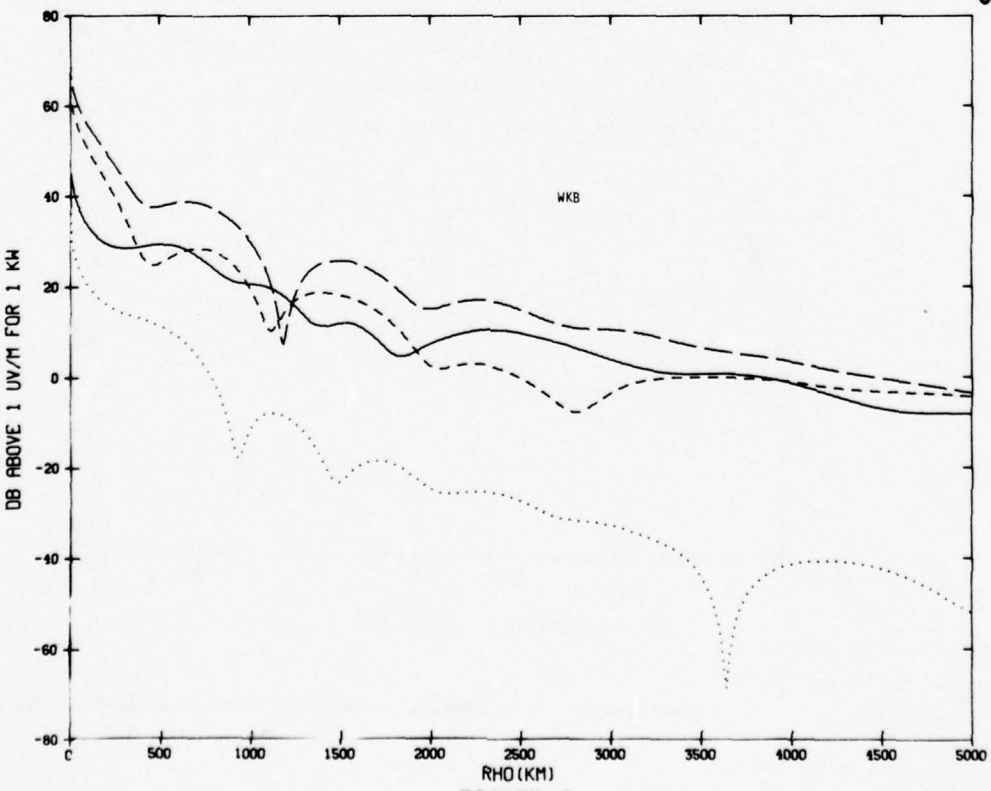

WKB
DB ABOVE 1 UV/M FOR 1 KW
RHO(KM)

FIGURE 5

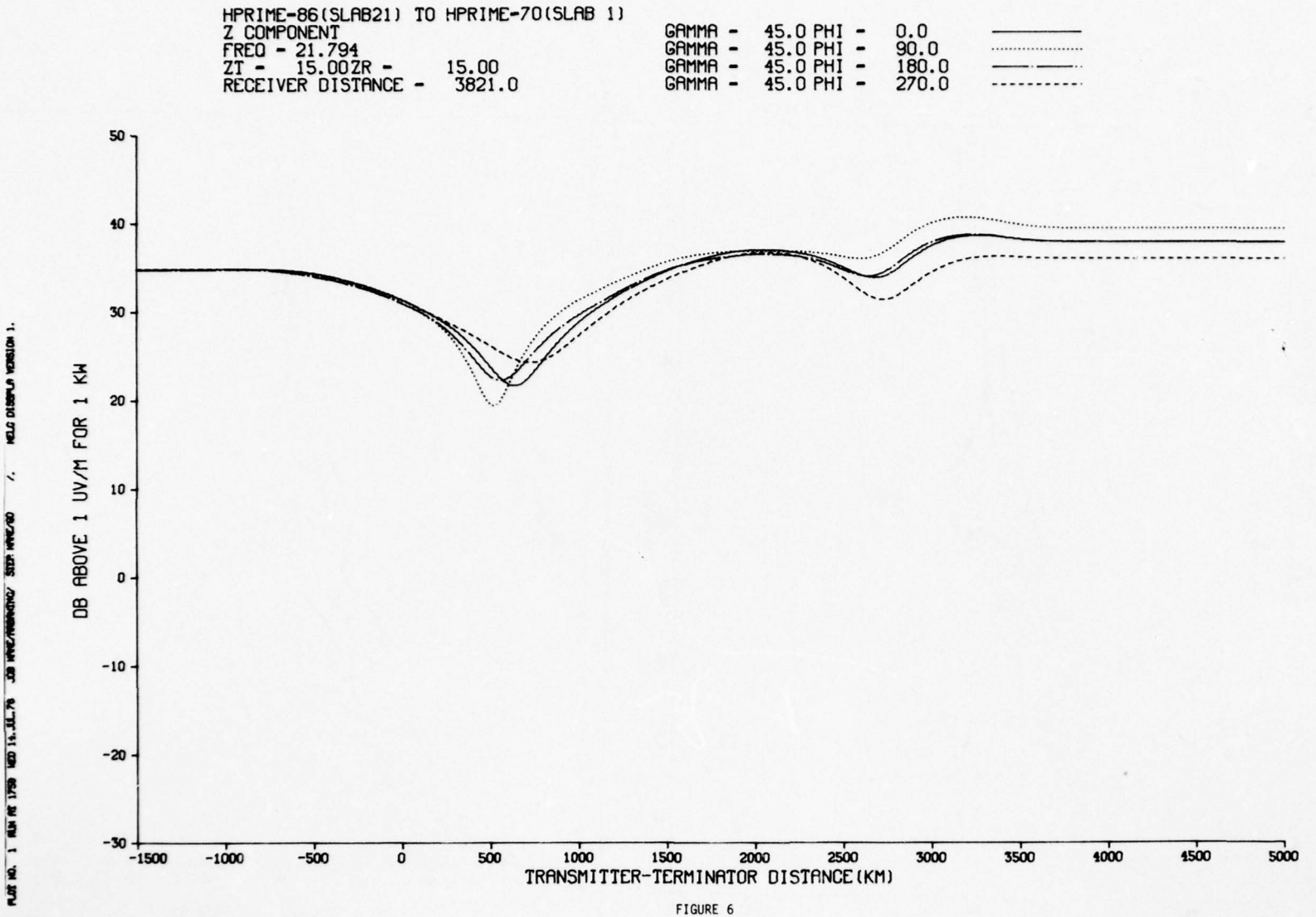

HPRIME-86(SLAB21) TO HPRIME-70(SLAB 1)
Z COMPONENT
FREQ - 21.794
ZT - 15.00ZR - 15.00
RECEIVER DISTANCE - 3821.0
GAMMA - 45.0 PHI - 0.0
GAMMA - 45.0 PHI - 90.0
GAMMA - 45.0 PHI - 180.0
GAMMA - 45.0 PHI - 270.0
DB ABOVE 1 UV/M FOR 1 KW
TRANSMITTER-TERMINATOR DISTANCE(KM)
50
40
30
20
10
0
-10
-20
-30
-1500
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

FIGURE 6

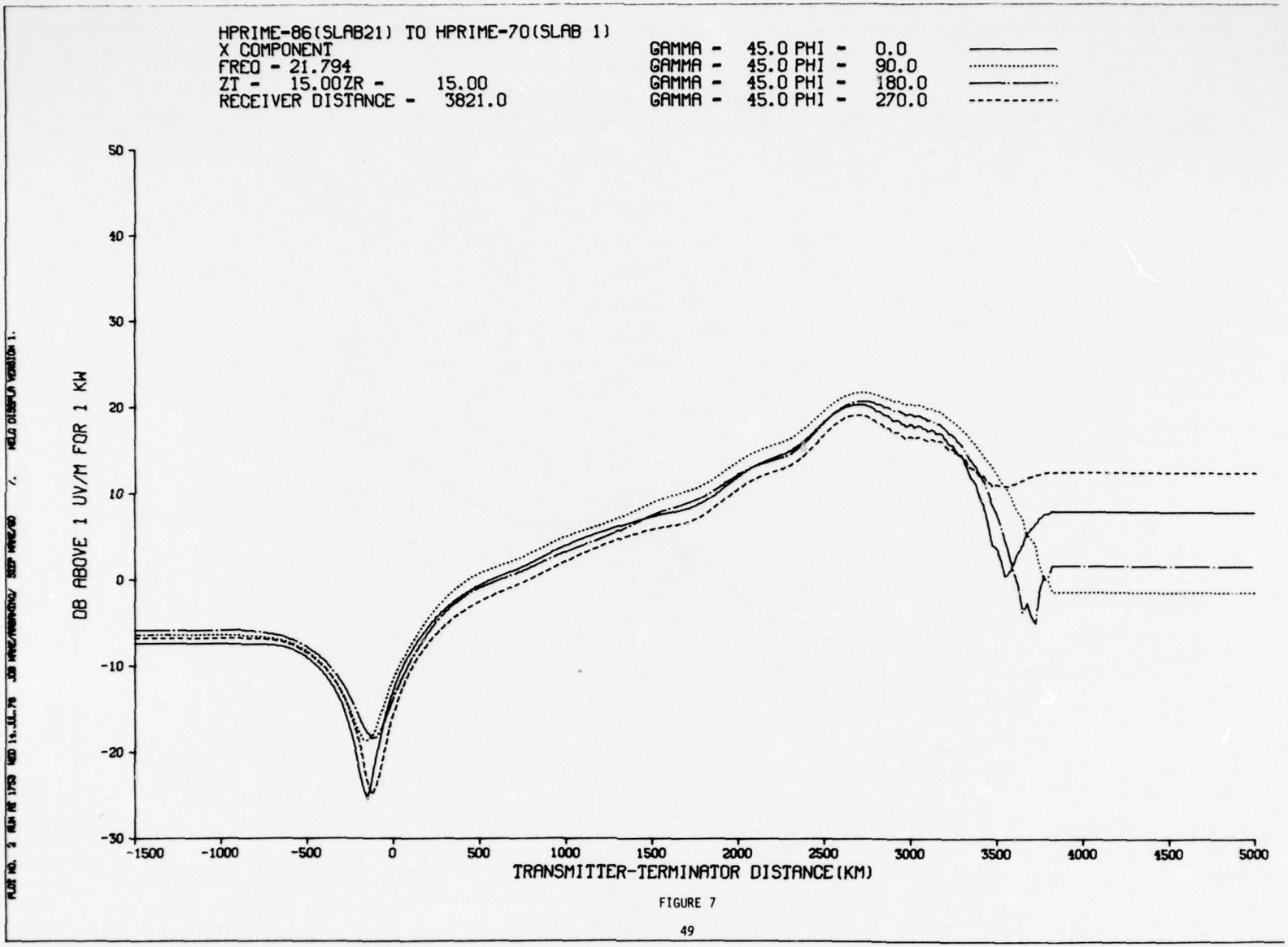

HPRIME-86(SLAB21) TO HPRIME-70(SLAB 1)
X COMPONENT
FREQ - 21.794
ZT - 15.00ZR - 15.00
RECEIVER DISTANCE - 3821.0
GAMMA - 45.0 PHI - 0.0
GAMMA - 45.0 PHI - 90.0
GAMMA - 45.0 PHI - 180.0
GAMMA - 45.0 PHI - 270.0
DB ABOVE 1 UV/M FOR 1 KW
50
40
30
20
10
0
-10
-20
-30
-1500
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
TRANSMITTER-TERMINATOR DISTANCE(KM)

FIGURE 7

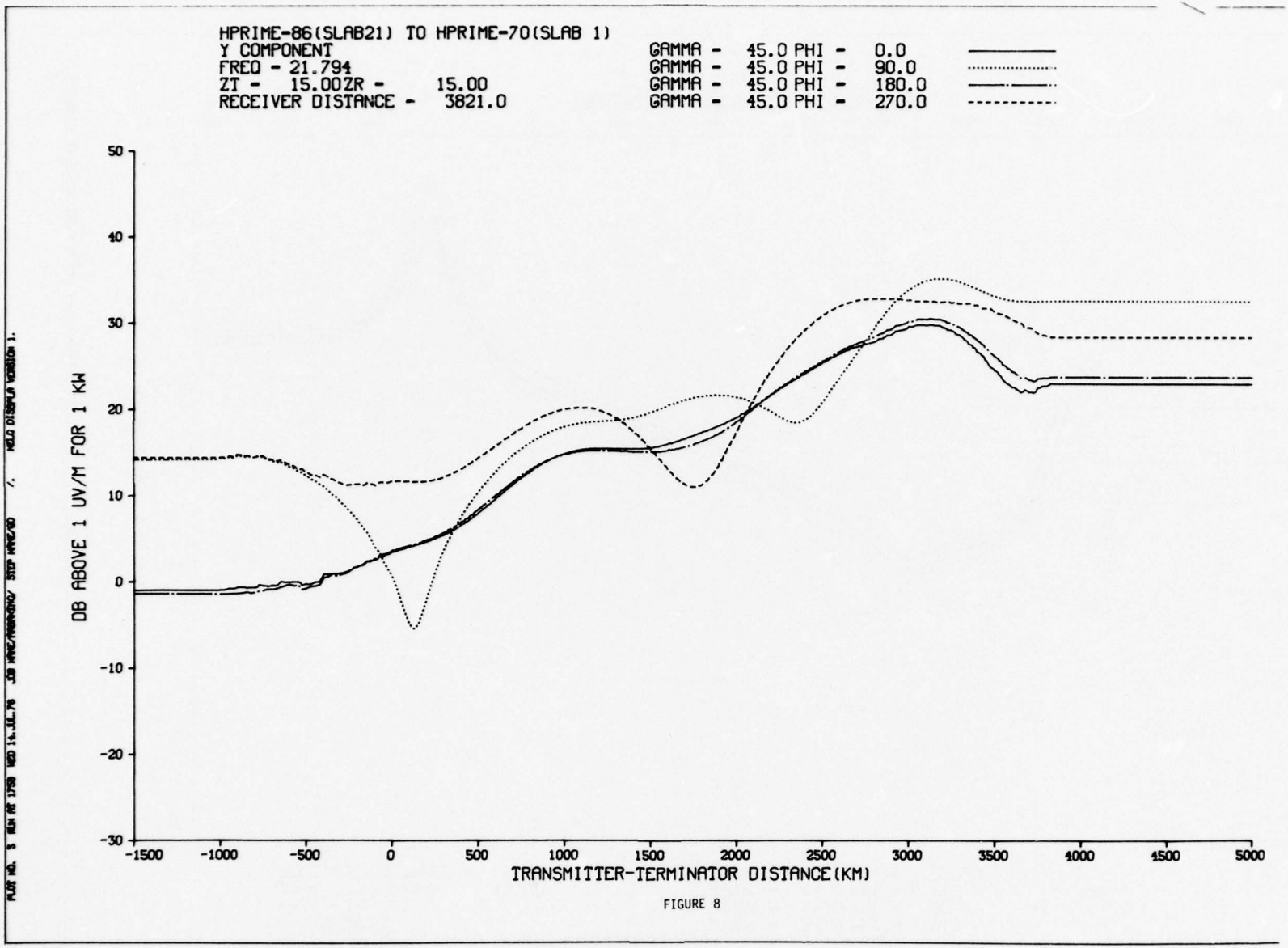

HPRIME-86(SLAB21) TO HPRIME-70(SLAB 1)
Y COMPONENT
FREQ - 21.794
ZT - 15.00ZR - 15.00
RECEIVER DISTANCE - 3821.0
GAMMA - 45.0 PHI - 0.0
GAMMA - 45.0 PHI - 90.0
GAMMA - 45.0 PHI - 180.0
GAMMA - 45.0 PHI - 270.0
DB ABOVE 1 UV/M FOR 1 KW
50
40
30
20
10
0
-10
-20
-30
-1500
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
TRANSMITTER-TERMINATOR DISTANCE(KM)

FIGURE 8

References

1. Pappert, R. A., L. Shockey (1972), "Mode Conversion Program for an Inhomogeneous Anisotropic Ionosphere," Defense Nuclear Agency Interim Report 722, prepared by Naval Electronics Laboratory Center.
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3. Pappert, R. A., L. R. Shockey (1975), "Effective Ionospheric Height for a Simplified Mode Conversion Model at VLF," Defense Nuclear Agency Interim Report 761, prepared by Naval Electronics Laboratory Center.
4. Pappert, R. A., W. F. Moler and L. R. Shockey (1970), "A Fortran Program for Waveguide Propagation which Allows for Both Vertical and Horizontal Dipole Excitation, DASA Interim Report 702, prepared by Naval Electronics Laboratory Center.
5. Staff of the Computation Laboratory at Cambridge, Massachusetts, "Tables of the Modified Hankel Functions of Order One Third and their Derivatives," Harvard University Press, Cambridge, Massachusetts, 1945.
6. Ralston, A., H. S. Wilf, "Mathematical Methods for Digital Computers," Vol. II, Wiley, New York, New York, 1967, p. 121.
7. Wait, J. R., K. P. Spies (1964), "Characteristics of the Earth-Ionosphere Waveguide for VLF Radio Waves," NBS Technical Note No. 300.

APPENDIX:
LISTING OF PROGRAM

```
C   SIMPLIFIED MODE CONVERSION MODEL MODIFIED TO CALCULATE FIELDS
C   FOR AN ANTENNA OF ARBITRARY HEIGHT AND ORIENTATION.
      IMPLICIT REAL *8(A-H,O-Z)
      COMMON/HGTEMP/FF1(25,5),FF3(25,5)
      COMMON/TERM/NT,NTR
      COMMON/CAP/CAPI(25,5,5),TNORM(25,5,5)
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(3,3,25,5),TOPHT(25),
     $              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     $              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMMON/MCSTOR/A(25,5,5),S(25,5),C(25,5),NTHSQ(25),KVRAOT,KVRATT,
     $              AVRKOT,AVRKTT,CONST,OMEGA,WAVENO
      COMMON/MCPLOT/R(400),DB(3,4,400),ANG(3,4,400),IOPLOT(10),ISUB,NRP
      COMMON/XPLOT/XMIN,XINC,YMIN,YINC,SIZEX,SIZEY
      COMMON/HGINPT/GAMMA(4),PHI(4),ZT,ZR
     $ ,SINGAM(4),COSGAM(4),SINPHI(4),COSPHI(4)
      DIMENSION BUFFER(2000)
      DIMENSION Z(2)
      REAL*4 BCD(20),OUT/' &EN'/
      REAL*4 R,DB,ANG,XMIN,XINC,YMIN,YINC,SIZEX,SIZEY
      COMPLEX*16 FF1,FF3
      COMPLEX*16 THETA,A,S,C,FOFR,IM/(0.0D0,1.0D0)/,CAPI,TNORM
      COMPLEX*16 XTRA,NTHSQ,T1,T2,T3,T4
      DATA TWOPI/6.28318SD0/,VELITE/2.997928D5/,ALPHA/3.14D-4/,
     $    DEGRAD/1.745329D-2/
      DATA LAST/0/,IPRNTA/0/
      REAL*8 KVRAOT,KVRATT
      NAMELIST/DATUM/       RHOMAX,
     &    RHOMIN,DELTAX,NRSLAB,NRMODE,NTMAX,XVAL,FREQ,IOPLOT,EPSLON,
     $    SIGMA,DELRHO,IFIRST,LAST,IPLTOP,
     $    XMIN,XINC,YMIN,YINC,SIZEX,SIZEY,
     $    GAMMA,PHI,ZT,ZR,NRP,IPRNTA
     $    ,INTFLG
C
      INTFLG=0
      IOPLOT(1) = 0
10    DO 250 K=1,200
      READ(5,201) BCD
      WRITE(6,202) BCD
      WRITE(1,201) BCD
      IF(BCD(1) .EQ. OUT) GO TO 260
250   CONTINUE
260   REWIND 1
      READ(1,DATUM)
      REWIND 1
      DO 200 N=1,NRP
      GAMMA(N) = GAMMA(N)*DEGRAD
      PHI(N) = PHI(N)*DEGRAD
      SINGAM(N) = DSIN(GAMMA(N))
      COSGAM(N) = DCOS(GAMMA(N))
      SINPHI(N) = DSIN(PHI(N))
      COSPHI(N) = DCOS(PHI(N))
200   CONTINUE
      PRINT 102
```

```
      DO 110 M=1,NRSLAB
      DO 110  K=1,NRMODE
      READ 100, THETA(M,K),T1,T2
      READ 100, THETA(M,K),T3,T4
      READ 101, FOFF(M,K),TOPHT(M)
      PRINT 103,THETA(M,K),T1,T2,T3,T4,FOFR(M,K),TOPHT(M)
102   FORMAT(5X,'THETA',15X,'T1',20X,'T2',20X,'T3',20X,'T4',20X,'FOFR',
     $ 10X,'TOPHT')
103   FORMAT(' ',2F7.3,2X, 5(2D10.3,2X),F4.1)
100   FORMAT(1X,2F9.5,1X,4D15.8)
101   FORMAT(41X,2D10.8,2X,F5.2)
      S(M,K) = DSIN(THETA(M,K)*DEGRAD)
      C(M,K) = DCOS(THETA(M,K)*DEGRAD)
      XTRA(1,1,M,K) = T1*S(M,K)**2
      XTRA(1,2,M,K) = T1*S(M,K)
      XTRA(1,3,M,K) = -T3*S(M,K)
      XTRA(2,1,M,K) = -T1*S(M,K)
      XTRA(2,2,M,K) = -T1
      XTRA(2,3,M,K) = T3
      XTRA(3,1,M,K) = -T3*T4*S(M,K)
      XTRA(3,2,M,K) = -T3*T4
      XTRA(3,3,M,K) = T2
110   CONTINUE
      IF(ILPLOT(1) .NE. 0 .AND. IFIRST .NE. 0)CALL PLOTS(BUFFER,2000,15)
      NT = 1
      WAVE NO = TWO PI*1000.0*FREQ/VELITE
      CONST = 0.03248*WAVE NO/DSQRT(FREQ)
      OMEGA = TWO PI*FREQ*1000.
      KVRAOT = DEXP(DLOG(WAVE NO/ALPHA)/3.)
      KVRATT = KVRAOT**2
      AVRKOT = 1./KVRAOT
      AVRKTT = AVRKOT**2*0.5
      DO 130 L=1,NRSLAB
130   NTHSQ(L) = 1.+ALPHA*TOPHT(L)
      IFLG = 0
      DO 135 M=1,NRSLAB
      MM = NRSLAB-M+1
      IF(MM .NE. NRSLAB) IFLG=1
135   CALL HTINTL(CAPI,TNORM,IFLG,MM,INTFLG)
      Z(1) = ZT
      Z(2) = ZR
      CALL FTGAIN(Z)
      DO 136 M=1,NRSLAB
      DO 136 K=1,NRMODE
      XTRA(1,1,M,K) = XTRA(1,1,M,K)*FF1(M,K)**2
      XTRA(1,2,M,K) = XTRA(1,2,M,K)*FF1(M,K)**2
      XTRA(1,3,M,K) = XTRA(1,3,M,K)*FF1(M,K)*FF3(M,K)/FOFR(M,K)
      XTRA(2,1,M,K) = XTRA(2,1,M,K)*FF1(M,K)**2
      XTRA(2,2,M,K) = XTRA(2,2,M,K)*FF1(M,K)**2
      XTRA(2,3,M,K) = XTRA(2,3,M,K)*FF1(M,K)*FF3(M,K)/FOFR(M,K)
      XTRA(3,1,M,K) = XTRA(3,1,M,K)*FF1(M,K)*FF3(M,K)/FOFR(M,K)
      XTRA(3,2,M,K) = XTRA(3,2,M,K)*FF1(M,K)*FF3(M,K)/FOFR(M,K)
      XTRA(3,3,M,K) = XTRA(3,3,M,K)*FF3(M,K)**2/(FOFR(M,K)**2)
```

```
136   CONTINUE
118   IF(XVAL(NRSLAB-1) .GE. 0.) GO TO 111
      DO 112 J=1,NRMODE
      DO 112 K=1,NRMODE
      DO 112 L=1,NRSLAB
112   A(L,K,J) = 0.0
      DO 113 L=2,NRSLAB
      IF(XVAL(NRSLAB+1-L) .GE. 0.) GO TO 114
113   CONTINUE
      NTR = 1
      GO TO 117
114   NTR = NRSLAB+2-L
117   CONTINUE
      DO 116 J=1,NRMODE
      DO 116 K=1,NRMODE
116   IF(K .EQ. J) A(NTR,K,J)=(1.0,0.0)
      NRMO = NRSLAB-1
      DO 401 MM=1,NTR
      M = NTR-MM+1
401   CALL MCSTEP(M)
      IF(IPRNTA .EQ. 0) GO TO 91
      PRINT 905
      DO 451 L=1,NTR
      PRINT 900,L
      DO 451 J=1,NRMODE
      DO 451 K=1,NRMODE
      PRINT 901,J,K,A(L,J,K)
451   CONTINUE
91    IF(IPLTOP .EQ. 1) CALL MCFLD
      IF(IPLTOP .EQ. 2) CALL MCFLD2
      NT = NT+1
      DO 106 ME=1,NRMO
106   XVAL(ME) = XVAL(ME)+DELTAX
      IF(XVAL(NTR) .GE. 0. .AND. NT .LE. NTMAX) GO TO 118
      IF(NT .LE. NTMAX) GO TO 91
      IF(LAST .EQ. 0) GO TO 10
      IF(IDPLOT(1) .NE. 0) CALL PLOT(0.,0.,999)
      RETURN
111   NTR = NRSLAB
      DO 150 J = 1, NRMODE
      DO 150 K = 1, NRMODE
      DO 120 L = 1,NRSLAB
      A(L,K,J) = 0.0
  120 CONTINUE
      IF(K .EQ. J) A(NRSLAB,K,J) = (1.0,0.0)
  150 CONTINUE
      NRMO = NRSLAB - 1
C     THE LOOP 400 DETERMINES(A)
C     IN SUCCESSIVE SLABS.
      DO 400 MM = 1,NRSLAB
      M = NRSLAB - MM + 1
      CALL MCSTEP(M)
      IF(NRSLAB .LE. 1) RETURN
```

```
  400 CONTINUE
      IF(IPRNTA .EQ. 0) GO TO 90
      PRINT 905
      DO 450 L=1,NRSLAB
      PRINT 900,L
      DO 450 J=1,NRMODE
      DO 450 K=1,NRMODE
      PRINT 901,J,K,A(L,J,K)
  450 CONTINUE
   90 IF(IPLTOP .EQ. 1) CALL MCFLD
      IF(IPLTOP .EQ. 2) CALL MCFLD2
      NT = NT + 1
      DO 105 ME = 1, NRMO
      XVAL(ME) = XVAL(ME) + DELTAX
  105 CONTINUE
      IF(NT .LE. NTMAX) GO TO 90
      IF(LAST .EQ. 0) GO TO 10
      IF(IDPLOT(1) .NE. 0) CALL PLOT(0.,0.,999)
      RETURN
  201 FORMAT(20A4)
  202 FORMAT(' ',20A4)
  900 FORMAT(1H ,14X,
     $ 'A = TOTAL CONVERSION COEFFICIENTS',6X,'SLAB NUMBER = ',I2,/)
  901 FORMAT(14X,' J =',I2,5X,' K =', I2,5X,' A=',(E15.5,E15.5),/)
  905 FORMAT(1H1)
      END
```

```
      SUBROUTINE HTINTL(CAPI,NORM,IFLG,M,INTFLG)
C  CALCULATE NORMALIZATION INTEGRALS AND INTEGRALS OF HEIGHT GAINS IN
C  ADJACENT SLABS.
      IMPLICIT REAL *8(A-H,O-Z)
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(5,3,25,5),TOPHT(25),
     $              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     $              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMMON/MCSTOR/A(25,5,5),S(25,5),C(25,5),NTHSQ(25),KVRAOT,KVRATT,
     $              AVRKOT,AVRKTT,CONST,OMEGA,WAVENO
      COMPLEX*16 NTHSQ
      COMPLEX*16 PTHA,H1TA,H2TA,H1PRTA,H2PRTA,HYTHA(5),EYTHA(5),
     $ HYTHPA(5),EYTHPA(5)
      COMPLEX*16 THETA,FOFR,   A,S,C,SSQ,CSQ,IM/(0.D0,1.D0)/,NGSQ,
     &   SQROOT,RTIORT,PO,PTH,H1O,H2O,H1PRMO,H2PRMO,CAPH1O,CAPH2O,
     &  A1ST,A2ND,A3RD,A4TH,DEN12,DEN34,DENMF,NORMF,
     &   H1T,H2T,H1PRMT,H2PRMT,HYTH(5),EYTH(5),HYTHPR(5),EYTHPR(5),
     &   HYOPR(5),EYOPR(5),EYO(5),MULT,FAC1,FAC2,NORM(25,5,5),PS(5),
     $   CAPI(25,5,5),PHYTH(5),PHYTHP(5),PEYTH(5),PEYTHP(5),PEYO(5),
     &   PEYOPR(5),PHYOPR(5),XTRA
      REAL*8 KVRAOT,KVRATT
      DATA EPSLNO/8.85434D-12/
C
C
      DO 100 K = 1, NRMODE
      SSQ = S(M,K)**2
      CSQ = C(M,K)**2
      NGSQ = (EPSLON(M) - IM*SIGMA(M)/OMEGA)/EPSLNO
      SQROOT = CDSQRT(NGSQ - SSQ)
      RSQR = SQROOT
      IF(RSQR .LT. 0.) SQROOT=-SQROOT
      RTIORT = 1./NGSQ*SQROOT
      PO = KVRATT*CSQ
      PTH = KVRATT*(NTHSQ(M)-SSQ)
      CALL MDHNKL(PO,H1O,H2O,H1PRMO,H2PRMO)
      CAPH1O = H1PRMO + AVRKTT*H1O
      CAPH2O = H2PRMO + AVRKTT*H2O
      A1ST = CAPH2O - IM*RTIORT*KVRAOT*H2O
      A2ND = CAPH1O - IM*RTIORT*KVRAOT*H1O
      A3RD = H2PRMO - IM*KVRAOT*SQROOT*H2O
      A4TH = H1PRMO - IM*KVRAOT*SQROOT*H1O
      DEN12 = H2O*A2ND - H1O*A1ST
      DEN34 = H2O*A4TH - H1O*A3RD
      CALL MDHNKL(PTH,H1T,H2T,H1PRMT,H2PRMT)
      HYTH(K) = (H2T*A2ND - H1T*A1ST)/DEN12
      EYTH(K) = (H2T*A4TH - H1T*A3RD)/DEN34*FOFR(M,K)
      HYTHPR(K) = (H2PRMT*A2ND - H1PRMT*A1ST)/DEN12
      EYTHPR(K) = (H2PRMT*A4TH - H1PRMT*A3RD)/DEN34*FOFR(M,K)
      HYOPR(K) = (H2PRMO*A2ND - H1PRMO*A1ST)/DEN12
      EYOPR(K) = (H2PRMO*A4TH - H1PRMO*A3RD)/DEN34*FOFR(M,K)
      IF(IFLG .EQ. 0) GO TO 100
      PTHA = KVRATT*(NTHSQ(M+1)-SSQ)
      CALL MDHNKL(PTHA,H1TA,H2TA,H1PRTA,H2PRTA)
      HYTHA(K) = (H2TA*A2ND-H1TA*A1ST)/DEN12
```

```
      EYTHA(K) = (H2TA*A4TH-H1TA*A3RD)/DEN34*FOFR(M,K)
      HYTHPA(K) = (H2PRTA*A2ND-H1PRTA *A1ST)/DEN12
      EYTHPA(K) = (H2PRTA*A4TH-H1PRTA*A3RD)/DEN34*FOFR(M,K)
  100 EYO(K) = FOFR(M,K)
      IF(INTFLG .EQ. 1) PRINT 906,M
      DO 240 J = 1,NRMODE
      DO 240 K = 1,NRMODE
      IF(J .EQ. K) GO TO 120
      MULT = AVRROT/((S(M,J) - S(M,K))*WAVENO)
      FAC1 = EYTH(K)*EYTHPR(J) - EYTH(J)*EYTHPR(K) + HYTH(K)*HYTHPR(J)
     $   -HYTH(J)*HYTHPR(K)
      FAC2 = -EYO(K)*EYOPR(J) + EYO(J)*EYOPR(K) - HYOPR(J) + HYOPR(K)
      NORM(M,J,K) = MULT*(FAC1+FAC2)
      IF(INTFLG .EQ. 1) PRINT 908,M,J,K,NORM(M,J,K)
      GO TO 240
  120 MULT = 2.0*S(M,J)*KVRAOT/WAVENO
      PTH = KVRATT*(NTHSQ(M)-S(M,J)**2)
       PO = KVRATT*C(M,J)**2
      FAC1 = EYTHPR(J)**2 + HYTHPR(J)**2 + PTH*(EYTH(J)**2 + HYTH(J)**2)
      FAC2 = -EYOPR(J)**2 - HYOPR(J)**2 - PO*(EYO(J)**2 + 1.0)
      NORM(M,J,K) = MULT*(FAC1+FAC2)
      IF(INTFLG .EQ. 1) PRINT 908,M,J,K,NORM(M,J,K)
  240 CONTINUE
      IF (IFLG  .EQ. 0) GO TO 500
      DO 400 K = 1, NRMODE
      DO 400 J = 1, NRMODE
      MULT = AVRROT/((PS(J) - S(M,K))*WAVENO)
      FAC1 = EYTHA(K)*PEYTHP(J)-PEYTH(J)*EYTHPA(K)
     $+HYTHA(K)*PHYTHP(J)-PHYTH(J)*HYTHPA(K)
      FAC2 = -EYO(K)*PEYOPR(J) + PEYO(J)*EYOPR(K) -PHYOPR(J) + HYOPR(K)
      CAPI(M,K,J) = MULT*(FAC1+FAC2)
      IF(INTFLG .EQ. 1) PRINT 910,M,K,J,CAPI(M,K,J)
  400 CONTINUE
  500 DO 600 J = 1, NRMODE
      PS(J) = S(M,J)
      PHYTH(J) = HYTH(J)
      PHYTHP(J) = HYTHPR(J)
      PEYTH(J) = EYTH(J)
      PEYTHP(J) = EYTHPR(J)
      PHYOPR(J) = HYOPR(J)
      PEYO(J) = EYO(J)
      PEYOPR(J) = EYOPR(J)
  600 CONTINUE
  720 CONTINUE
      RETURN
  906 FORMAT('0',20X,'INTEGRALS IN SLAB',I3,/)
  908 FORMAT(21X,'NORM(',I1,',',I1,',',I1,') =',2D13.6)
  910 FORMAT(21X,'CAPI(',I1,',',I1,',',I1,') =',2D13.6)
      END
```

```
      SUBROUTINE MCFLD
      IMPLICIT REAL *8(A-H,O-Z)
C     COMPUTE FIELDS FROM XVAL MIN TO XVAL MAX FOR TWO XMTR-RCVR DISTANCES
C     AT DELTAX INTERVALS
C
      COMMON/TERM/NT,NTR
      COMMON/SPLOT/SAVED(402),Y1(3,4,402),Y2(3,4,402)
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(3,3,25,5),TOPHT(25),
     $              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     $              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMMON/MCSTOR/A(25,5,5),S(25,5),C(25,5),NTHSQ(25),KVRAOT,KVRATT,
     $              AVRKOT,AVRKTT,CONST,OMEGA,WAVENO
      COMMON/MCPLOT/R(400),DB(3,4,400),ANG(3,4,400),IDPLOT(10),ISUB,NRP
      COMMON/HTGN/F(3,25,5,2)
      COMMON/HGINPT/GAMMA(4),PHI(4),ZT,ZR
     $ ,SINGAM(4),COSGAM(4),SINPHI(4),COSPHI(4)
      REAL*4 R,DB,ANG,SAVED,Y1,Y2,ANG1(3,4,402),ANG2(3,4,402)
      REAL*8 KVRAOT,KVRATT
      COMPLEX*16 SOLNA(5,5,4),THETA,A,S,C,XTRA,TB,TOBL,TA,FOFR,F,NTHSQ,
     $  IM/(0.0D0,1.0D0)/
      DATA ERAD/6.370D3/
C
C
      ISUB = 1
      MP=-10
      RHO = RHO MIN
600   CONTINUE
      DO 1 LL=2,NRSLAB
      IF(XVAL(NRSLAB+1-LL)-RHO .GE. 0.) GO TO 2
1     CONTINUE
      M=1
      GO TO 3
2     M = NRSLAB+2-LL
3     CONTINUE
      IF(M .EQ. MP) GO TO 720
      DO 710 N=1,NRP
      DO 710 L=1,5
      DO 710  J = 1,NRMODE
      SOLN A(J,L,N) = (0.0,0.0)
      DO 710  K = 1,NRMODE
      IF(M .NE. NTR) GO TO 35
      SOLN A(J,L,N) = SOLN A(J,L,N)
     $                      +A(M,J,K)*(XTRA(1,L,NTR,K)*F(1,NTR,K,1)*
     $COSGAM(N)      +XTRA(2,L,NTR,K)*F(2,NTR,K,1)*SINGAM(N)*
     $COSPHI(N)    +XTRA(3,L,NTR,K)*F(3,NTR,K,1)*SINGAM(N)*
     $SINPHI(N))
      IF(L .NE. 1) SOLN A(J,L,N) = SOLN A(J,L,N)*S(NTR,K)
      GO TO 710
35    SOLN A(J,L,N) = SOLN A(J,L,N)
     $                      +A(M,J,K)*(XTRA(1,L,NTR,K)*F(1,NTR,K,1)*
     $COSGAM(N)      +XTRA(2,L,NTR,K)*F(2,NTR,K,1)*SINGAM(N)*
     $COSPHI(N)    +XTRA(3,L,NTR,K)*F(3,NTR,K,1)*SINGAM(N)*
     $SINPHI(N))
```

```
     $ *CDEXP(-IM*WAVENO*S(NTR,K)*XVAL(NTR-1))
      IF(L .NE. 1) SOLN A(J,L,N) = SOLN A(J,L,N)*S(NTR,K)
  710 CONTINUE
C
  720 CONTINUE
      DO 900 N=1,NRP
      DO 900 L=1,3
      TA = (0.0,0.0)
      DO 730  J = 1,NRMODE
      IF(M   .NE. NTR) GO TO 45
      TB =CDEXP(-IM*WAVENO*S(M   ,J)*RHO)
      TA = TA+SOLN A(J,L,N)*TB*F(L,M   ,J,2)
      IF(L .NE. 1) TA = TA/S(M   ,J)
      GO TO 730
   45 TB =CDEXP(IM*WAVENO*S(M   ,J)*(XVAL(M   ) - RHO))
      TA = TA+SOLN A(J,L,N)*TB*F(L,M   ,J,2)
      IF(L .NE. 1) TA = TA/S(M   ,J)
  730 CONTINUE
      TA = TA*CONST/DSQRT(DSIN(RHO/ERAD))
      TDBL = TA *CDEXP (IM * WAVE NO * RHO)
      CALL MAGANG (TDBL, TDMAG, TDANG)
      TSMAG = TDMAG
      TSANG = TDANG
      TSDB = 8.685890 * DLOG (TSMAG * 1.0E6)
      R(ISUB) = RHO
      DB(L,N,ISUB) = TSDB
      ANG(L,N,ISUB) = TSANG
      SAVED(NT) = XVAL(NRSLAB-1)
      IF(MOD(ISUB,2) .EQ. 1) Y1(L,N,NT) = DB(L,N,ISUB)
      IF(MOD(ISUB,2) .EQ. 0) Y2(L,N,NT) = DB(L,N,ISUB)
      IF(MOD(ISUB,2) .EQ. 1) ANG1(L,N,NT) = ANG(L,N,ISUB)
      IF(MOD(ISUB,2) .EQ. 0) ANG2(L,N,NT) = ANG(L,N,ISUB)
  900 CONTINUE
      RHO = RHO + DEL RHO
      ISUB = ISUB+1
      MP = M
      IF (RHO.LE.RHO MAX)  GO TO 600
      ISUB = ISUB-1
      IF(NT .NE. NTMAX) RETURN
      DO 930 N=1,NRP
      PGAMMA = GAMMA(N)/1.745329D-2
      PPHI = PHI(N)/1.745329D-2
      PRINT 910
      PRINT 927,PGAMMA,PPHI,ZT,ZR
      PRINT 920
      PRINT 925
  927 FORMAT(' GAMMA(DEG)=',F6.1,' PHI(DEG)=',F6.1,' ZT(KM)=',F10.3,
     $' ZR(KM)=',F10.3)
      DO 930 JJ=1,NTMAX
      PRINT 908,SAVED(JJ),Y1(1,N,JJ),ANG1(1,N,JJ),Y1(3,N,JJ),
     $  ANG1(3,N,JJ),Y1(2,N,JJ),ANG1(2,N,JJ),Y2(1,N,JJ),ANG2(1,N,JJ),
     $    Y2(3,N,JJ),ANG2(3,N,JJ),Y2(2,N,JJ),ANG2(2,N,JJ)
  908 FORMAT(' ',F7.1,6(1X,F8.3,1X,F7.2))
```

```
930   CONTINUE
      IF (IDPLOT(1).EQ.0)  RETURN
      CALL MCPLTS
      RETURN
910   FORMAT('1',
     $ ' ELECTRIC FIELD STRENGTH AS A FUNCTION OF TRANSMITTER-TERMINATOR
     $ DISTANCE(D)',//)
920   FORMAT(' ',26X,'FIELD AT RHOMIN',34X,'FIELD AT RHOMAX')
925   FORMAT(' ',3X,'D',3X,2(2X,'EZ(DB)',2X,'EZ(ANG)',2X,'EY(DB)',2X,
     $  'EY(ANG)',2X,'EX(DB)',2X,'EX(ANG)'))
      END
```

```
      SUBROUTINE MCFLD2
      IMPLICIT REAL *8(A-H,O-Z)
C     COMPUTE FIELDS FROM RHO MIN TO RHO MAX
C     AT DEL RHO INTERVALS.
C
      COMMON/TERM/NT,NTR
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(3,3,25,5),TOPHT(25),
     $              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     $              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMMON/MCSTOR/A(25,5,5),S(25,5),C(25,5),NTHSQ(25),KVRAOT,KVRATT,
     $              AVRKOT,AVRKTT,CONST,OMEGA,WAVENO
      COMMON/MCPLOT/R(400),DB(3,4,400),ANG(3,4,400),IOPLOT(10),ISUB,NRP
      COMMON/HTGN/F(3,25,5,2)
      COMMON/HGINPT/GAMMA(4),PHI(4),ZT,ZR
     $ ,SINGAM(4),COSGAM(4),SINPHI(4),COSPHI(4)
      REAL*4 R,DB,ANG
      COMPLEX*16 SOLNA(5,3,4)
      COMPLEX*16 THETA,A,S,C,XTRA,          TB,TOBL,IM/(0.00,1.00)/,TA,
     $           FOFR,F,NTHSQ
      REAL*8 KVRAOT,KVRATT
      DATA ERAD/6.370D3/
C
C
      PRINT 910
      ISUB = 1
      DBMAX = -1000.0
      RHO = RHO MIN
      M = NTR
      X = RHO - 1.0
600   CONTINUE
  700 IF (RHO.LE.X)  GO TO 720
      DO 710 N=1,NRP
      DO 710 L=1,3
      DO 710  J = 1,NRMODE
      SOLN A(J,L,N) = (0.0,0.0)
      DO 710  K = 1,NRMODE
      IF(M .NE. NTR) GO TO 35
      SOLN A(J,L,N) = SOLN A(J,L,N)
     $                +A(M,J,K)*(XTRA(1,L,NTR,K)*F(1,NTR,K,1)*
     $COSGAM(N)      +XTRA(2,L,NTR,K)*F(2,NTR,K,1)*SINGAM(N)*
     $COSPHI(N)    +XTRA(3,L,NTR,K)*F(3,NTR,K,1)*SINGAM(N)*
     $SINPHI(N))
      IF(L .NE. 1) SOLN A(J,L,N) = SOLN A(J,L,N)*S(NTR,K)
      GO TO 710
35    SOLN A(J,L,N) = SOLN A(J,L,N)
     $                +A(M,J,K)*(XTRA(1,L,NTR,K)*F(1,NTR,K,1)*
     $COSGAM(N)      +XTRA(2,L,NTR,K)*F(2,NTR,K,1)*SINGAM(N)*
     $COSPHI(N)    +XTRA(3,L,NTR,K)*F(3,NTR,K,1)*SINGAM(N)*
     $SINPHI(N))
     $ *CDEXP(-IM*WAVENO*S(NTR,K)*XVAL(NTR-1))
      IF(L .NE. 1) SOLN A(J,L,N) = SOLN A(J,L,N)*S(NTR,K)
  710 CONTINUE
      M = M - 1
```

```
      X = 1.0E6
      IF (M.GT.0)  X = XVAL(M)
      GO TO 700
C
720   CONTINUE
      DO 900 N=1,NRP
      DO 900 L=1,3
      TA = (0.0,0.0)
      DO 730  J = 1,NRMODE
      IF(M+1 .NE. NTR) GO TO 45
      TB =CDEXP(-IM*WAVENO*S(M+1,J)*RHO)
      TA = TA+SOLN A(J,L,N)*TB*F(L,M+1,J,2)
      IF(L .NE. 1) TA = TA/S(M+1,J)
      GO TO 730
   45 TB =CDEXP(IM*WAVENO*S(M+1,J)*(XVAL(M+1) - RHO))
      TA = TA+SOLN A(J,L,N)*TB*F(L,M+1,J,2)
      IF(L .NE. 1) TA = TA/S(M+1,J)
  730 CONTINUE
      TA = TA*CONST/DSQRT(DSIN(RHO/ERAD))
      TDBL = TA *CDEXP (IM * WAVE NO * RHO)
      CALL MAGANG (TDBL, TDMAG, TDANG)
      TSMAG = TDMAG
      TSANG = TDANG
      TSDB = 8.685890 * DLOG (TSMAG * 1.0E6)
      R(ISUB) = RHO
      DB(L,N,ISUB) = TSDB
      ANG(L,N,ISUB) = TSANG
900   CONTINUE
      RHO = RHO + DEL RHO
      ISUB = ISUB+1
      IF (RHO .LE. RHOMAX) GO TO 600
      ISUB = ISUB-1
      DO 930 N=1,NRP
      PGAMMA = GAMMA(N)/1.745329D-2
      PPHI = PHI(N)/1.745329D-2
      PRINT 927,PGAMMA,PPHI,ZT,ZR
      PRINT 928
      PRINT 929
927   FORMAT('0',11X,'GAMMA(DEG)=',F6.1,' PHI(DEG)=',F6.1,' ZT(KM)=',
     $  F10.3,' ZR(KM)=',F10.3)
928   FORMAT(22X,'Z',37X,'X',37X,'Y')
929   FORMAT(2X,3(9X,'RHO(KM)',3X,'AMP(DB)',3X,'ANG(DEG)'))
      DO 930 J=1,ISUB
      PRINT 908,R(J),DB(1,N,J),ANG(1,N,J),R(J),DB(2,N,J),ANG(2,N,J),R(J)
     $,DB(3,N,J),ANG(3,N,J)
930   CONTINUE
      IF (IDPLOT(1).EQ.0)  RETURN
      CALL MCPLT2
      RETURN
908   FORMAT(2X,3(7X,F10.2,F10.5,F10.4))
910   FORMAT('1',10X,
     $  'ELECTRIC FIELD STRENGTH AS A FUNCTION OF RHO',//)
      END
```

```
      SUBROUTINE MCPLTS
C  MCPLTS GENERATES TWO PLOTS (FIELD AMPLITUDE IN DB ABOVE A
C  MICRO VOLT PER METER FOR 1 KW RADIATED POWER VERSUS TRANSMITTER-
C  TERMINATOR DISTANCE FOR TWO RECEIVER POSITIONS).
      COMMON/TERM/NT,NTR
      COMMON/SPLOT/SAVED(402),Y1(3,4,402),Y2(3,4,402)
      COMMON/MCPLOT/R(400),DB(3,4,400),ANG(3,4,400),IDPLOT(10),ISUB,NRP
      COMMON/XPLOT/XMIN,XINC,YMIN,YINC,SIZEX,SIZEY
      COMMON/HGINPT/GAMMA(4),PHI(4),ZT,ZR
     1 ,SINGAM(4),COSGAM(4),SINPHI(4),COSPHI(4)
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(3,3,25,5),TOPHT(25),
     1              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     2              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMPLEX*16 THETA,FOFR,XTRA
      REAL*8 XVAL,FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON,SIGMA,TOPHT
      REAL*8 SINGAM,COSGAM,SINPHI,COSPHI
      REAL*8 GAMMA,PHI,ZT,ZR
      REAL XCURVE(2)/0.,1./,YCURV1(2)/2*0./,YCURV2(2)/2*.2/,
     $  YCURV3(2)/2*.4/,YCURV4(2)/2*.6/
      DIMENSION Y(400)
      DIMENSION GAMMAD(4),PHID(4)
      COMPLEX*16 COMP(3)/'Z COMPONENT     ', 'X COMPONENT     ',
     $  'Y COMPONENT     '/
      DO 900 I=1,2
      DO 900 IBEGIN =1,3
      CALL DGNPL(IBEGIN)
      CALL YAXANG(0.)
      CALL INTAXS
      CALL PAGE(SIZEX+3.,SIZEY+3.)
      CALL PHYSOR(1.5,1.2)
      CALL TITLE(' ', 1,'TRANSMITTER-TERMINATOR DISTANCE(KM)',35,
     $  'DB ABOVE 1 UV/M FOR 1 KW',24,SIZEX,SIZEY)
      CALL GRAPH(XMIN,XINC,YMIN,YINC)
      DO 600 J=1,NRP
      GAMMAD(J) = GAMMA(J)/1.745329D-2
      PHID(J) = PHI(J)/1.745329D-2
      IF(J .EQ. 1) CALL RESET('DASH')
      IF(J .EQ. 2) CALL DOT
      IF(J .EQ. 3) CALL CHNDOT
      IF(J .EQ. 4) CALL DASH
      DO 500 K=1,NTMAX
      IF(I .EQ. 1) Y(K)=Y1(IBEGIN,J,K)
      IF(I .EQ. 2) Y(K)=Y2(IBEGIN,J,K)
500   CONTINUE
      CALL CURVE(SAVED,Y,NTMAX,0)
600   CONTINUE
      CALL MESSAG(IDPLOT,40,1.,9.3)
      CALL MESSAG(COMP(IBEGIN),16,1.,9.1)
      CALL MESSAG('FREQ = ',7,1.,8.9)
      CALL REALNO(FREQ,3,1.7,8.9)
      CALL MESSAG('ZT =         ZR = ',17,1.,8.7)
      CALL REALNO(ZT,2,1.70,8.7)
      CALL REALNO(ZR,2,3.40,8.7)
```

```
      CALL MESSAG('RECEIVER DISTANCE = ',20,1.0,8.5)
      IF(I .EQ. 1) CALL REALNO(RHOMIN,1,3.5,8.5)
      IF(I .EQ. 2) CALL REALNO(RHOMAX,1,3.5,8.5)
      CALL MESSAG('GAMMA =        PHI = ',20,6.0,9.1)
      CALL REALNO(GAMMAD(1),1,7.0,9.1)
      CALL REALNO(PHID(1),1,8.5,9.1)
      CALL MESSAG('GAMMA =        PHI = ',20,6.0,8.9)
      CALL REALNO(GAMMAD(2),1,7.0,8.9)
      CALL REALNO(PHID(2),1,8.5,8.9)
      CALL MESSAG('GAMMA =        PHI = ',20,6.0,8.7)
      CALL REALNO(GAMMAD(3),1,7.0,8.7)
      CALL REALNO(PHID(3),1,8.5,8.7)
      CALL MESSAG('GAMMA =        PHI = ',20,6.0,8.5)
      CALL REALNO(GAMMAD(4),1,7.0,8.5)
      CALL REALNO(PHID(4),1,8.5,8.5)
      CALL ENDGR(1)
      CALL OREL(9.7,8.56)
      CALL TITLE(' ',1,' ',0,' ',0,1.,1.)
      CALL GRAPH(0.,1.,0.,1.)
      CALL RESET('DASH')
      CALL CURVE(XCURVE,YCURV4,2,0)
      CALL DOT
      CALL CURVE(XCURVE,YCURV3,2,0)
      CALL CHNDOT
      CALL CURVE(XCURVE,YCURV2,2,0)
      CALL DASH
      CALL CURVE(XCURVE,YCURV1,2,0)
      CALL ENDPL(1BEGIN)
900   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE MCPLT2
C  MCPLT2 GENERATES ONE PLOT (FIELD AMPLITUDE IN DB ABOVE A MICRO VOLT
C  PER METER FOR 1 KW RADIATED POWER VERSUS DISTANCE FROM TRANSMITTER).
      COMMON/MCPLOT/R(400),DB(3,4,400),ANG(3,4,400),IDPLOT(10),ISUB,NRP
      COMMON/XPLOT/XMIN,XINC,YMIN,YINC,SIZEX,SIZEY
      COMMON/HGINPT/GAMMA(4),PHI(4),ZT,ZR
     $ ,SINGAM(4),COSGAM(4),SINPHI(4),COSPHI(4)
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(3,3,25,5),TOPHT(25),
     $              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     $              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMPLEX*16 THETA,FOFR,XTRA
      REAL*8 XVAL,FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON,SIGMA,TOPHT
      REAL*8 GAMMA,PHI,ZT,ZR
      REAL*8 SINGAM,COSGAM,SINPHI,COSPHI
      REAL XCURVE(2)/0.,1./,YCURV1(2)/2*0./,YCURV2(2)/2*.2/,
     $  YCURV3(2)/2*.4/,YCURV4(2)/2*.6/
      DIMENSION Y(400)
      DIMENSION GAMMAD(4),PHID(4)
      COMPLEX*16 COMP(3)/'Z COMPONENT      ', 'X COMPONENT      ',
     $  'Y COMPONENT      '/
      DO 900 IBEGIN =1,3
      CALL BGNPL(IBEGIN)
      CALL YAXANG(0.)
      CALL INTAXS
      CALL PAGE(11.,11.)
      CALL TITLE(' ',-1,'RHO(KM)',7,'DB ABOVE 1 UV/M FOR 1 KW',24,
     $ SIZEX,SIZEY)
      CALL GRAPH(XMIN,XINC,YMIN,YINC)
      DO 600 J=1,NRP
      GAMMAD(J) = GAMMA(J)/1.7453293D-2
      PHID(J) = PHI(J)/1.7453293D-2
      IF(J .EQ. 1) CALL RESET('DASH')
      IF(J .EQ. 2) CALL DOT
      IF(J .EQ. 3) CALL CHNDOT
      IF(J .EQ. 4) CALL DASH
      DO 500 K=1,ISUB
      Y(K) = DB(IBEGIN,J,K)
500   CONTINUE
      CALL CURVE(R,Y,ISUB,0)
600   CONTINUE
      CALL MESSAG(IDPLOT,40,4.,9.5)
      CALL MESSAG(COMP(IBEGIN),16,4.,9.3)
      CALL MESSAG('FREQ = ',7,4.,9.1)
      CALL REALNO(FREQ,3,4.7,9.1)
      CALL MESSAG('ZT =         ZR = ',17,4.,8.9)
      CALL REALNO(ZT,2,4.84,8.9)
      CALL REALNO(ZR,2,6.52,8.9)
      CALL MESSAG('GAMMA =       PHI = ',20,4.,8.7)
      CALL REALNO(GAMMAD(1),1,5.0,8.7)
      CALL REALNO(PHID(1),1,6.5,8.7)
      CALL MESSAG('GAMMA =       PHI = ',20,4.,8.5)
      CALL REALNO(GAMMAD(2),1,5.0,8.5)
      CALL REALNO(PHID(2),1,6.5,8.5)
```

```
      CALL MESSAG('GAMMA =        PHI = ',20,4.,8.3)
      CALL REALNO(GAMMAD(3),1,5.0,8.3)
      CALL REALNO(PHID(3),1,6.5,8.3)
      CALL MESSAG('GAMMA =        PHI = ',20,4.,8.1)
      CALL REALNO(GAMMAD(4),1,5.0,8.1)
      CALL REALNO(PHID(4),1,6.5,8.1)
      CALL ENDGR(1)
      CALL PHYSOR(8.,9.)
      CALL TITLE(' ',1,' ',0,' ',0,1.,1.)
      CALL GRAPH(0.,1.,0.,1.)
      CALL RESET('DASH')
      CALL CURVE(XCURVE,YCURV4,2,0)
      CALL DOT
      CALL CURVE(XCURVE,YCURV3,2,0)
      CALL CHNDOT
      CALL CURVE(XCURVE,YCURV2,2,0)
      CALL DASH
      CALL CURVE(XCURVE,YCURV1,2,0)
      CALL ENDPL(IBEGIN)
900   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE MCSTEP(M)
C  COMPUTE GENERALIZED MODE CONVERSION COEFFICIENTS.
      IMPLICIT REAL *8(A-H,O-Z)
      COMMON/TERM/NT,NTR
      COMMON/CAP/CAPI(25,5,5),TNORM(25,5,5)
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(3,3,25,5),TOPHT(25),
     $              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     $              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMMON/MCSTOR/A(25,5,5),S(25,5),C(25,5),NTHSQ(25),KVRAOT,KVRATT,
     $              AVRKOT,AVRKTT,CONST,OMEGA,WAVENO
      COMPLEX*16 CDEXP
      COMPLEX*16 NTHSQ
      COMPLEX*16 THETA,FOFR,A,S,C,TNORM,CAPI,
     $   IM/(0.D0,1.D0)/,B(5),ANS(5),TS(5,5),XTRA
      REAL*8 KVRAOT,KVRATT
      REAL*4 ERR
C
C
      MP = M+ 1
      IF(M .EQ. NTR) RETURN
      DO 17 N = 1,NRMODE
17    B(N) = (0.,0.)
      IF(MP .EQ. NTR) GO TO 21
      DO 29 K = 1,NRMODE
      DO 33 L = 1,NRMODE
      DO 33 J = 1,NRMODE
      TS(L,J) = TNORM(M,L,J)
33    B(L) = B(L) +A(MP,J,K)*CDEXP(-IM*WAVENO*S(MP,J) *(XVAL(M) -
     &   XVAL(MP)))*CAPI(M,L,J)
      CALL CLINEQ(TS,B,ANS,NRMODE,5,0,ERR)
      DO 27 I = 1,NRMODE
27    A(M,I,K) = ANS(I)*S(M,I)/S(NTR,K)
      DO 18 N=1,NRMODE
18    B(N) = (0.,0.)
29    CONTINUE
      GO TO 24
21    DO 23 K = 1,NRMODE
      DO 25 LL=1,NRMODE
      DO 25 L = 1,NRMODE
      TS(LL,L) = TNORM(M,LL,L)
25    B(L) = CAPI(M,L,K)
      CALL CLINEQ(TS,B,ANS,NRMODE,5,0,ERR)
      DO 35 J = 1,NRMODE
35    A(M,J,K) = ANS(J)*S(M,J)/S(NTR,K)
23    CONTINUE
24    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE MDHNKL (Z,H1,H2,H1PRME,H2PRME)
C  COMPUTE MODIFIED HANKEL FUNCTIONS OF ORDER ONE THIRD
      IMPLICIT REAL *8 (A-H,O-Z)
      COMPLEX*16 CDSQRT,CDEXP
      REAL*8 CDABS
      COMPLEX*16 Z,I,H1,H2,H1PRME,H2PRME,ZPOWER,TERM1,TERM2,
     $           TERM3,ZTERM,TERM,SUM1,SUM2,SUM3,SUM4,SQRTZ3,
     $           EXP1,EXP2,EXP3,EXP4,EXP5,GM2F,GPMFP,MPOWER,BETA,RTZ,
     $           CONST1,CONST2,CONST3,CONST4
      DIMENSION A(23), B(23), C(23), D(23), CAP(14)
      DATA A/
     $   9.3043671693000OD-01,3.1014557230970OOD 01,2.0670371487316OOD 02,
     $   5.7434305242345OOD 02,8.7021705515OO8OD 02,8.2877871922560400D 02,
     $   5.4168543740434OD 02,2.5794544638302OD 02,9.3458495Oo631OOD 01,
     $   2.66263518707400D 01,6.1210004300560OOD 00,1.1592803044800OOD 00,
     $   1.84012759441000D-01,2.4833030964000OD-02,2.8842080100000OD-03,
     $   2.91334142000000D-04,2.5827495000000OD-05,2.0256860000000OD-06,
     $   1.41557000000000D-07,8.8700000000000OD-09,5.0100000000000OD-10,
     $   2.6300000000000OD-11,1.0000000000000OD-12/
      DATA B/
     $   6.7829872514000OD-01,1.1304976752400OD 01,5.9833232159310OD 01,
     $   1.1962940478735OD 02,1.5337103177865OD 02,1.2780919514888OD 02,
     $   7.4742218215720OD 01,3.2355938621520OD 01,1.0785312873840OD 01,
     $   2.853257374030OOD 00,6.1360375635100OD-01,1.0937678009800OD-01,
     $   1.0422939955000OD-02,2.1055051220000OD-03,2.3316778300000OD-04,
     $   2.2528289000000D-05,1.9156710C000000D-06,1.4447000000000OD-07,
     $   9.7290000000000OD-09,5.8900000000000OD-10,3.2000000000000OD-11,
     $   2.0000000000000OD-12,0.0000000000000OD 00/
      DATA C/
     $   4.6521835846000OD-01,6.2029114461900OD 00,2.5845464359150OD 01,
     $   5.2213059311400OD 01,6.2158403942150OD 01,4.8751o893663900D 01,
     $   2.7084271870220OD 01,1.1215019407960OD 01,3.5945575025500OD 00,
     $   9.1815006451000OD-01,1.9128126343900OD-01,3.3122296o9900OOD-02,
     $   4.8424410380000CD-03,6.0506308200000D-04,6.5550182000000OD-05,
     $   6.1985990000000OD-06,5.1655000000000OD-07,3.8220000000000OD-08,
     $   2.5280000000000OD-09,1.5000000000000OD-10,8.0000000000000OD-12,
     $   0.0000000000000OD 00,0.0000000000000OD 00/
      DATA D/
     $   6.7829872514000OD-01,4.5219915009620OD 01,3.7683262500150OD 02,
     $   1.1962940478735OD 03,1.9938234131225OD 03,2.0449470903820OD 03,
     $   1.4201021460986OD 03,7.1183064967351OD 02,2.6963282184603OD 02,
     $   7.9891206472900OD 01,1.9021715826880OD 01,3.7188105233390CD 00,
     $   6.0764877832300OD-01,8.4220204896000OD-02,1.0026214869000OD-02,
     $   1.0363012780000OD-03,9.3867869000000OD-05,7.5124350000000OD-06,
     $   5.3507400000000OD-07,3.4135000000000OD-08,1.9620000000000OD-09,
     $   1.0200000000000OD-10,5.0000000000000OD-12/
      DATA CAP/
     $   1.0416666666667D-01,8.3550347222222D-02,1.2822657455632TD-01,
     $   2.9164902646414OD-01,8.8162726744375OD-01,3.3214082818627TD 00,
     $   1.4995762986862OD 01,7.8923013011587OD 01,4.7445153o868000D 02,
     $   3.2074900910000CD 03,2.4086549600000OOD 04,1.9892312o000000D 05,
     $   1.7919020000000OD 06,1.7484377000000OD 07/
C
```

```
      DATA I/(0.D0,1.D0)/
      DATA ROOT3/1.732050807568880 00/
      DATA ALPHA/8.53607210638951D-01/
      DATA CONST1/( 2.588190451025220-01,-9.659258262890670-01)/
      DATA CONST2/( 2.588190451025220-01, 9.659258262890670-01)/
      DATA CONST3/(-9.659258262890670-01, 2.588190451025220-01)/
      DATA CONST4/(-9.659258262890670-01,-2.588190451025220-01)/
C
      ZPOWER=1.0
      SUM3=0.0
      SUM4=0.0
      ZMAG=CDABS(Z)
      IF(ZMAG .GT. 4.2) GO TO 70
      IF(ZMAG .GE. 3.2) GO TO 10
      N=12
      GO TO 30
10    IF(ZMAG .GE. 4.1) GO TO 20
      N=15
      GO TO 30
20    N=23
30    SUM1=0.
      SUM2=0.
      ZTERM=-Z**3/200.0
      DO 50 M=1,N
      SUM1=SUM1+A(M)*ZPOWER
      SUM2=SUM2+B(M)*ZPOWER
      SUM3=SUM3+C(M)*ZPOWER
      SUM4=SUM4+D(M)*ZPOWER
      ZPOWER=ZPOWER*ZTERM
      IF(CDABS(ZPOWER) .LE. 1.00-30) GO TO 60
50    CONTINUE
60    GM2F=I*(Z*SUM2-2.*SUM1)/ROOT3
      GPMFP=I*(SUM4+2.*Z*Z*SUM3)/ROOT3
      H1=Z*SUM2+GM2F
      H2=H1-2.0*GM2F
      H1PRME=SUM4+GPMFP
      H2PRME=H1PRME-2.0*GPMFP
      RETURN
C
70    SUM1=1.0
      SUM2=1.0
      RTZ=CDSQRT(Z)
      SQRTZB=RTZ*Z
      ZTERM=1/SQRTZB
      MPOWER=1.0
      TERM=-1.5/Z
      DO 80 M=1,14
      ZPOWER=ZPOWER*ZTERM
      MPOWER=MPOWER*(-ZTERM)
      TERM1=CAP(M)*ZPOWER
      TERM2=CAP(M)*MPOWER
      SUM1=SUM1+TERM1
      SUM2=SUM2+TERM2
```

```
      SUM3=SUM3+M*TERM1
      SUM4=SUM4+M*TERM2
80    CONTINUE
      SUM3=SUM3*TERM
      SUM4=SUM4*TERM
      EXP1=CDEXP(2.*I*SQRTZB/3.)
      EXP2=EXP1*CONST1
      EXP3=CONST2/EXP1
      EXP4=CONST3*EXP1
      EXP5=CONST4/EXP1
      BETA=ALPHA/CDSQRT(RTZ)
      ZREAL=Z
      ZIMAG=-1*Z
      IF (ZREAL.GE.0.0.OR.ZIMAG.GE.0.0)GO TO 90
      H1=BETA*(EXP2*SUM2+EXP5*SUM1)
      H1PRME=BETA*(EXP2*(SUM2*(-0.25/Z+I*RTZ)+SUM4)+EXP5*(SUM1*(-0.25/Z
     $        -I*RTZ)+SUM3))
      GO TO 110
90    H1=BETA*EXP2*SUM2
      H1PRME=BETA*EXP2*(SUM2*(-0.25/Z+I*RTZ)+SUM4)
110   IF (ZREAL.GE.0.0.OR.ZIMAG.LT.0.0)GO TO 120
      H2=BETA*(EXP3*SUM1+EXP4*SUM2)
      H2PRME=BETA*(EXP3*(SUM1*(-0.25/Z-I*RTZ)+SUM3)+EXP4*(SUM2*(-0.25/Z
     $        +I*RTZ)+SUM4))
      RETURN
120   H2=BETA*EXP3*SUM1
      H2PRME=BETA*EXP3*(SUM1*(-0.25/Z-I*RTZ)+SUM3)
      RETURN
      END
```

```
      SUBROUTINE MAGANG(ARG,MAG,ANGLE)
      IMPLICIT REAL *8(A-H,O-Z)
      REAL*8 DSQRT,DARCOS
      COMPLEX*16 ARG,IM/(0.D0,1.D0)/
      REAL*8 MAG
      DATA RDTDEG/57.29577951/
      ENTRY DGNGLE(ARG,MAG,ANGLE)
      ARGRAL = ARG
      ARGMAG = IM*ARG
      MAG = DSQRT(ARGRAL*ARGRAL + ARGMAG*ARGMAG)
      IF(MAG .EQ. 0.0) GO TO 10
      COSQ = ARGRAL/MAG
      IF (COSQ .LT. -1.0.AND. COSQ .GT. -1.01) COSQ = -1.0
      IF(COSQ .GT. 1.0.AND. COSQ .LT. 1.01) COSQ = 1.0
    5 ANGLE = DARCOS(COSQ)*RDTDEG
      IF(ARGMAG .LT. 0.0) ANGLE = 360.0 - ANGLE
      RETURN
   10 COSQ = 0.0
      GO TO 5
      END
```

```
      SUBROUTINE HTGAIN(Z)
C  COMPUTE EZ,EX,EY HEIGHT GAINS FOR TRANSMITTER AND RECEIVER.
      IMPLICIT COMPLEX*16(A-H,O-Z)
      COMMON/HGTEMP/FF1(25,5),FF3(25,5)
      COMMON/HTGN/F(3,25,5,2)
      COMMON/MCINPT/THETA(25,5),FOFR(25,5),XTRA(3,3,25,5),TOPHT(25),
     $              XVAL(25),FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON(25),
     $              SIGMA(25),NRSLAB,NRMODE,NTMAX
      COMMON/MCSTOR/A(25,5,5),S(25,5),C(25,5),NTHSQ(25),KVRAOT,KVRATT,
     $              AVRKOT,AVRKTT,CONST,OMEGA,WAVENO
      COMPLEX*16 CDSQRT
      REAL*8 DEXP
      COMPLEX*16 NGSQ,IM/(0.D0,1.D0)/,NTHSQ
      REAL*8 XVAL,FREQ,RHOMAX,RHOMIN,DELRHO,DELTAX,EPSLON,SIGMA
      REAL*8 KVRAOT,KVRATT,AVRKOT,AVRKTT,CONST,OMEGA,WAVENO
      REAL*8 Z(2),EPSLNO/8.85434D-12/,ALPHA/3.14D-4/,FAC1
      REAL*8 RSQR
      REAL*8 TOPHT
      DO 100 M=1,NRSLAB
      NGSQ = (EPSLON(M)-IM*SIGMA(M)/OMEGA)/EPSLNO
      DO 100 K=1,NRMODE
      SSQ = S(M,K)**2
      SQROOT = CDSQRT(NGSQ-SSQ)
      CSQ = C(M,K)**2
      RSQR = SQROOT
      IF(RSQR .LT. 0.) SQROOT=-SQROOT
      DO 100 IZ=1,2
      Q = KVRATT*(CSQ+ALPHA*Z(IZ))
      Q0 = KVRATT*CSQ
      CALL MDHNKL(Q0,H10,H20,H1PRM0,H2PRM0)
      CALL MDHNKL(Q,H1,H2,H1PRM,H2PRM)
      CAPH10 = H1PRM0+AVRKTT*H10
      CAPH20 = H2PRM0+AVRKTT*H20
      FAC2 = IM*KVRAOT*SQROOT
      FAC3 = FAC2/NGSQ
      F1 = -(CAPH20-FAC3*H20)
      F2 =   CAPH10-FAC3*H10
      F3 = -(H2PRM0-FAC2*H20)
      F4 =   H1PRM0-FAC2*H10
      FAC1 = DEXP(ALPHA/2.*Z(IZ))
      F(1,M,K,IZ) = FAC1*(F1*H1+F2*H2)
      F(2,M,K,IZ) = ALPHA/(IM*2.*WAVENO)*F(1,M,K,IZ)+1./IM*AVRKOT*FAC1*
     $ (F1*H1PRM+F2*H2PRM)
      F(3,M,K,IZ) = F3*H1+F4*H2
      FF1(M,K) = F1*H10+F2*H20
      FF3(M,K) = F3*H10+F4*H20
      F(1,M,K,IZ) = F(1,M,K,IZ)/FF1(M,K)
      F(2,M,K,IZ) = F(2,M,K,IZ)/FF1(M,K)
      F(3,M,K,IZ) = F(3,M,K,IZ)*FOFR(M,K)/FF3(M,K)
100   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE CLIN EQ (A, B, X, N,
     $   N DIM, IFLAG, ERR)
C
C   CLIN EQ USES L-U DECOMPOSITION TO
C   FIND THE TRIANGULAR MATRICES L, U
C   SUCH THAT  L * U = A.  L AND U ARE
C   STORED IN A.  THIS FORM IS USED WITH
C   BACK-SUBSTITUTION TO FIND THE SOLN
C   X OF    A * X = L * U * X = B.
C   N IS THE NUMBER OF EQUATIONS AND
C   N DIM IS THE DIMENSION OF ALL ARRAYS
C   IN THE PARAMETER LIST.
C
C   IF IFLAG = 0, L, U, AND X ARE
C   COMPUTED.
C   IF IFLAG IS NON-ZERO, IT IS ASSUMED
C   THAT L AND U HAVE BEEN COMPUTED IN
C   A PREVIOUS CALL AND ARE STILL STORED
C   IN A.  THUS ONLY X IS COMPUTED.
C   ERR  IS THE ESTIMATED RELATIVE
C   ERROR OF THE SOLUTION VECTOR.
C
      COMPLEX*16  A, B, X, T
      INTEGER*2  IROW
      DIMENSION  A(N DIM, N DIM),
     $  B(N DIM), X(N DIM)
      DIMENSION  IROW(50), Q(50)
      DATA  EPS /1.0E-15/
C
C
      IF (N.GT.50)  GO TO 900
      IF (IFLAG.NE.0)  GO TO 600
      DO 050  I = 1,N
      Q(I) = 0.0
      DO 040  J = 1,N
      QQ = CDABS (A(I,J))
  040 IF (Q(I).LT.QQ)  Q(I) = QQ
      IF (Q(I).EQ.0.0)  GO TO 901
  050 CONTINUE
      ERR = EPS
      PPIV = 0.0
      DO 100  I = 1,N
  100 IROW(I) = I
C
      DO 500  L = 1,N
      PIVOT = 0.0
      K = L - 1
      DO 240  I = L,N
      IF (K.LT.1)  GO TO 230
      DO 220  J = 1,K
  220 A(I,L) = A(I,L) - A(J,L) * A(I,J)
  230 F = CDABS (A(I,L)) / Q(I)
      IF (PIVOT.GT.F)  GO TO 240
```

```
      PIVOT = F
      NPIVOT = I
  240 CONTINUE
      IF (PIVOT.EQ.0.0)  GO TO 901
      IF (PPIV.LE.PIVOT)  GO TO 250
      ERR = ERR * PPIV / PIVOT
      IF (ERR.GE.1.0)  GO TO 901
  250 PPIV = PIVOT
      IF (NPIVOT.EQ.L)  GO TO 280
      Q(NPIVOT) = Q(L)
      J = IROW(L)
      IROW(L) = IROW(NPIVOT)
      IROW(NPIVOT) = J
      DO 260  I = 1,N
      T = A(L,I)
      A(L,I) = A(NPIVOT,I)
      A(NPIVOT,I) = T
  260 CONTINUE
  280 IF (L.EQ.N)  GO TO 500
      T = (1.0D0,0.0D0) / A(L,L)
      K = L + 1
      M = L - 1
      DO 450  I = K,N
      IF (M.LT.1)  GO TO 400
      DO 350  J = 1,M
  350 A(L,I) = A(L,I) - A(L,J) * A(J,I)
  400 A(L,I) = T * A(L,I)
  450 CONTINUE
  500 CONTINUE
      IF (ERR.GT.1.0E-5)   PRINT 998, ERR
C
C
  600 DO 620  I = 2,N
  620 X(I) = (0.0D0,0.0D0)
      J = IROW(1)
      X(1) = B(J) / A(1,1)
      DO 700  I = 2,N
      J = IROW(I)
      K = I - 1
      DO 650  L = 1,K
  650 X(I) = X(I) + A(I,L) * X(L)
      X(I) = (B(J) - X(I)) / A(I,I)
  700 CONTINUE
      K = N - 1
      DO 800  I = 1,K
      J = N - I
      M = J + 1
      DO 800  L = M,N
      X(J) = X(J) - X(L) * A(J,L)
  800 CONTINUE
      RETURN
C
  900 PRINT 999
```

```
      ERR = 1.0
      RETURN
  901 PRINT 997
      ERR = 1.0
      RETURN
  997 FORMAT ('1ERROR IN CLIN EQ, MATRIX IS SINGULAR')
  998 FORMAT (' CAUTION-',
     $ ' CLIN EQ HAS DECOMPOSED AN ILL-CONDITIONED MATRIX.',/,
     $ ' RESULTS WILL HAVE RELATIVE ERROR =',E11.2)
  999 FORMAT ('1ERROR IN CLIN EQ, MATRIX SIZE GREATER THAN 50')
      END
```

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