PROPAGATION OF ELECTROMAGNETIC WAVES IN THE EARTH CRUST WAVEGUIDE FROM ELF TO VLF

by

Kenneth P. Spies and James R. Wait
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Boulder, Colorado 80302

Order No. NA-ONR-15-71
Project No. NR 081-270

Technical Report No. 3
1 May 1972

Contract Monitor: John G. Heacock
Earth Physics Program
Earth Sciences Division

Prepared for
DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
ARLINGTON, VIRGINIA 22217

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
mode theory						
earth crust waveguide						
sub-sruface communication						
extremely low frequency						
very low frequency						

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II

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1. ORIGINATING ACTIVITY *(Corporate author)*
U. S. Department of Commerce, Office of Telecommunications
Institute for Telecommunication Sciences
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2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP

3. REPORT TITLE
PROPAGATION OF ELECTROMAGNETIC WAVES IN THE EARTH CRUST WAVE-GUIDE FROM ELF TO VLF

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Interim, Technical

5. AUTHOR(S) *(Last name, first name, initial)*
Kenneth P. Spies
James R. Wait

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
May 1, 1972	8	3

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
ONR Contract No. NA-ONR-15-71 b. PROJECT NO. NR 081-270 c. TASK d.	Technical Report No. 3 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

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13. ABSTRACT

Using an idealized model, the attenuation rate of the lowest order mode is calculated for a range of deep crustal conductivities. It is shown that attenuation rates may be as low as 1 dB/100 km at 1 Hz for a waveguide conductivity less than 10^{-8} mhos/m. Numerical values of the propagation parameters are appended.

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ABSTRACT

Using an idealized model, the attenuation rate of the lowest order mode is calculated for a range of deep crustal conductivities. It is shown that attenuation rates may be as low as 1 dB/100 km at 1 Hz for a waveguide conductivity less than 10^{-3} mhos/m. Numerical values of the propagation parameters are appended.

REFERENCES

Heacock, J. G. (Ed.) (1971), The Structure and Physical Properties of the Earth's Crust, American Geophysical Union, Geophysical Monograph Series, vol. 14, Washington, D. C.

Spies, Kenneth P. and James R. Wait (1971a; 1971b), "On calculations of the modal parameters of an idealized earth-crust waveguide," (ONR Technical Report No. 1, March 17, 1971), [AD 721 371], and "Attenuation calculations for a two-layer earth-crust waveguide for sub-surface electromagnetic propagation," (ONR Technical Report No. 2, June 17, 1971), [AD 726 754]. Available from the National Technical Information Service, Springfield, VA 22151.

Wait, J. R. and K. P. Spies (1971), "Note on calculations of propagation parameters for an idealized earth-crust waveguide," in The Structure and Physical Properties of the Earth's Crust (Ed. J. Heacock), Monograph 14, pp. 325-331, American Geophysical Union, Washington, D. C.

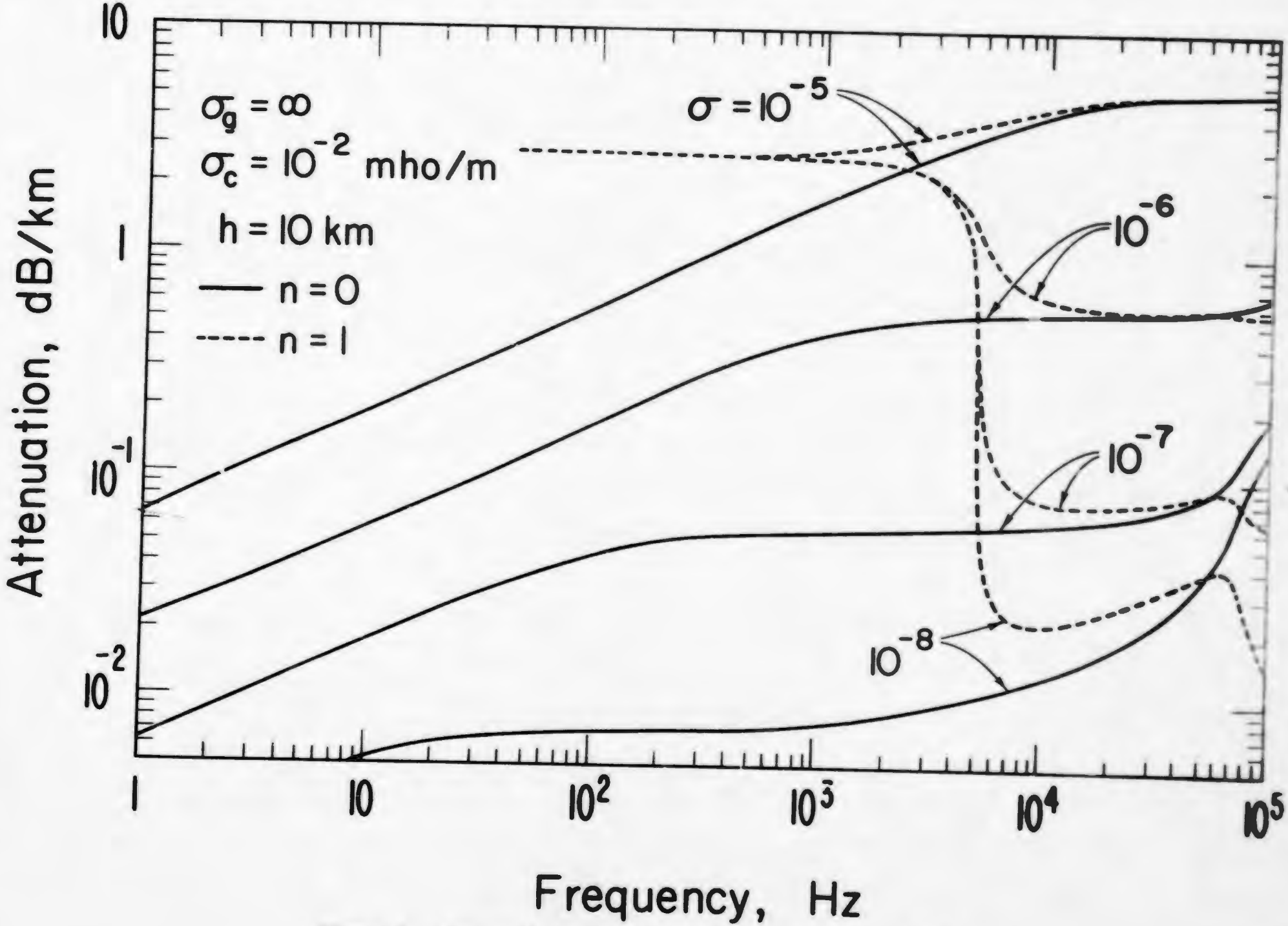

Figure 2. Attenuation rates for dominant waveguide modes for a lower wall conductivity $\sigma_c = 10^{-2}$ mhos/m.

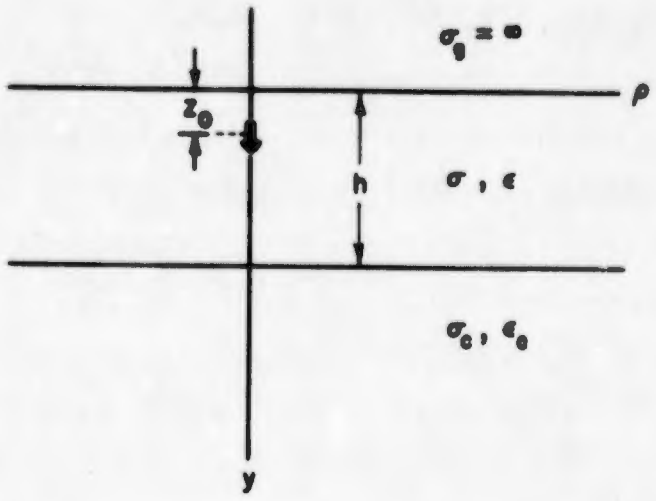

Figure 1. Geometry for deep crustal waveguide.

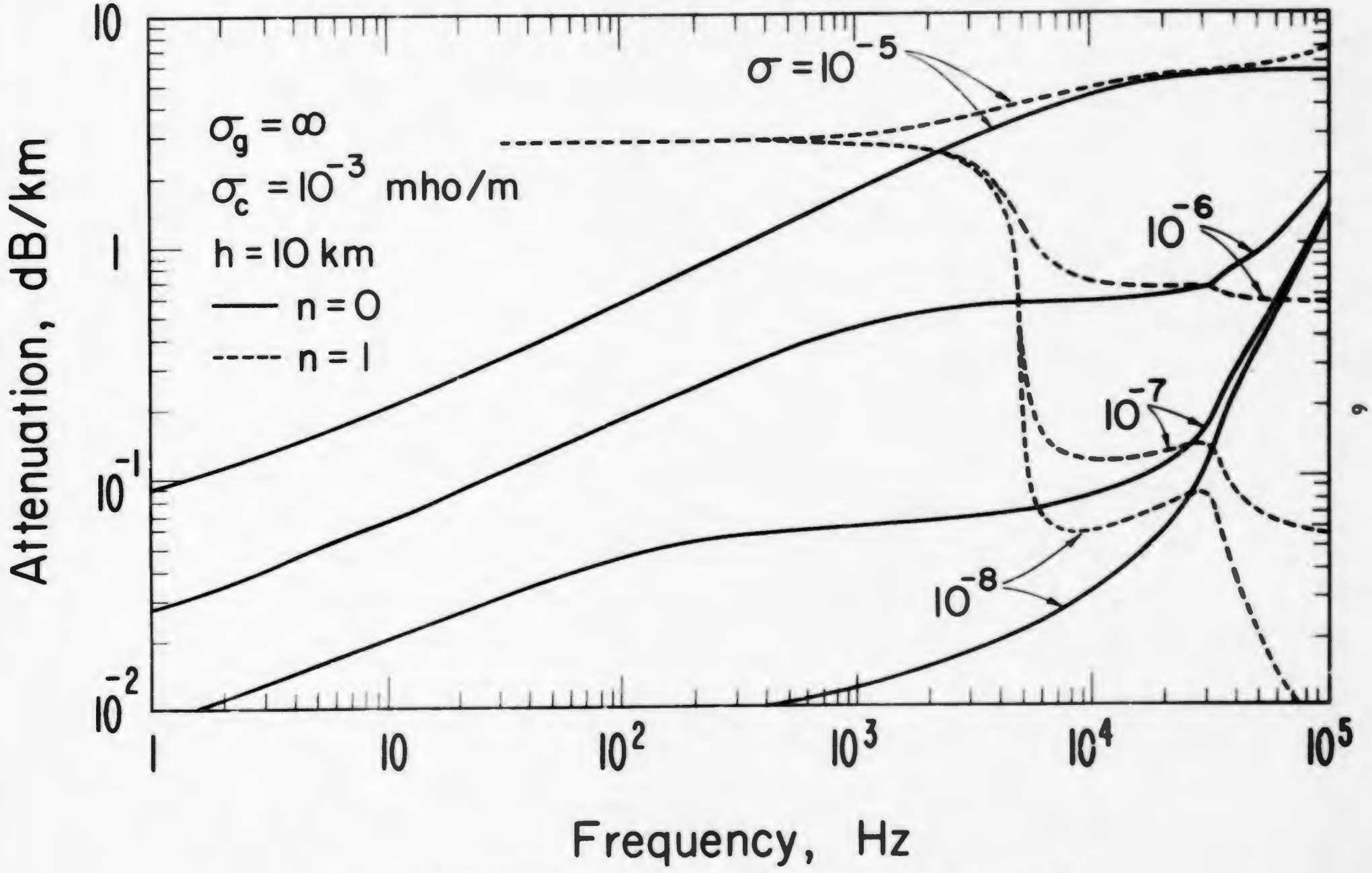

Figure 3. Attenuation rates for dominant waveguide modes for a lower wall conductivity $\sigma_c = 10^{-3}$ mhos/m.

APPENDIX

NUMERICAL VALUES OF MODAL PARAMETERS

On the following pages, reproduced directly from computer printout, numerical values of modal parameters for the dominant $n = 0$ mode are tabulated versus frequency for a fixed sequence of frequencies ranging from 1 kHz down to 1 Hz. In all cases, σ_g (SIGMA(G)) is infinite, ϵ/ϵ_o(K) is 9, and ϵ_1/ϵ_o(K(1)) is 15; the waveguide conductivity σ (SIGMA) takes on the values 10^{-5}, 10^{-6}, 10^{-7}, and 10^{-8} mhos/m, while the conductivity σ_c (SIGMA(1)) of the lower half-space is 10^{-2} or 10^{-3} mhos/m. The thickness h(H) of the waveguide assumes the values 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 km. Other parameters listed in the tables are as defined before (Spies and Wait, 1971a).

Numerical procedures for solving the mode equation are discussed in the earlier report. Here, it will suffice to add that solutions corresponding to $f = 1$ kHz are known from the prior calculations, while solutions for subsequent frequencies are obtained by means of Newton's method, using as a starting value the root for the preceding frequency.

NOTE:

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MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

P = 0 H = 0.10 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	4.05982-001	9.80020-001	7.8958-001	6.59868-001	0.49999	0.003
9.000-001	4.16811-001	1.00618+000	7.7262-001	6.39112-001	0.49998	0.003
8.000-001	4.29260-001	1.03625+000	7.5367-001	6.15150-001	0.49997	0.003
7.000-001	4.43826-001	1.07143+000	7.3159-001	5.87247-001	0.49997	0.003
6.000-001	4.61256-001	1.11353+000	7.0626-001	5.54418-001	0.49997	0.003
5.000-001	4.82756-001	1.16546+000	6.7640-001	5.15280-001	0.49997	0.003
4.000-001	5.10439-001	1.23232+000	6.4037-001	4.67798-001	0.49997	0.004
3.500-001	5.27759-001	1.27415+000	6.1924-001	4.39986-001	0.49997	0.004
3.000-001	5.48686-001	1.32422+000	5.9535-001	4.08716-001	0.49996	0.004
2.500-001	5.74055-001	1.38597+000	5.6792-001	3.73165-001	0.49996	0.005
2.000-001	6.06976-001	1.46549+000	5.3567-001	3.32124-001	0.49996	0.005
1.800-001	6.23169-001	1.50460+000	5.2099-001	3.13779-001	0.49995	0.005
1.600-001	6.41784-001	1.54956+000	5.0500-001	2.94091-001	0.49995	0.005
1.400-001	6.63560-001	1.60216+000	4.8742-001	2.72840-001	0.49995	0.006
1.200-001	6.89620-001	1.66511+000	4.6794-001	2.49732-001	0.49994	0.007
1.000-001	7.21765-001	1.74276+000	4.4567-001	2.24364-001	0.49994	0.007
9.000-002	7.41019-001	1.78927+000	4.3334-001	2.10658-001	0.49993	0.008
8.000-002	7.63152-001	1.84273+000	4.1996-001	1.96144-001	0.49993	0.008
7.000-002	7.89044-001	1.90528+000	4.0531-001	1.80695-001	0.49992	0.009
6.000-002	8.20027-001	1.98014+000	3.8905-001	1.64142-001	0.49992	0.009
5.000-002	8.58246-001	2.07247+000	3.7070-001	1.46250-001	0.49991	0.010
4.000-002	9.07450-001	2.19136+000	3.4986-001	1.26680-001	0.49990	0.011
3.500-002	9.38232-001	2.26574+000	3.3738-001	1.16111-001	0.49989	0.012
3.000-002	9.75066-001	2.35475+000	3.2397-001	1.04896-001	0.49989	0.013
2.500-002	1.02050+000	2.46455+000	3.0884-001	9.29028-002	0.49987	0.014
2.000-002	1.07899+000	2.60592+000	2.9134-001	7.99350-002	0.49986	0.016
1.800-002	1.10776+000	2.67547+000	2.8344-001	7.44119-002	0.49985	0.017
1.600-002	1.14083+000	2.75540+000	2.7488-001	6.86582-002	0.49984	0.018
1.400-002	1.17951+000	2.84892+000	2.6551-001	6.26385-002	0.49983	0.019
1.200-002	1.22580+000	2.96083+000	2.5511-001	5.63059-002	0.49982	0.021
1.000-002	1.28289+000	3.09888+000	2.4335-001	4.95957-002	0.49980	0.023
9.000-003	1.31704+000	3.18157+000	2.3682-001	4.60712-002	0.49979	0.024
8.000-003	1.35634+000	3.27663+000	2.2974-001	4.24135-002	0.49978	0.026
7.000-003	1.40235+000	3.38782+000	2.2198-001	3.86020-002	0.49976	0.027
6.000-003	1.45735+000	3.52089+000	2.1336-001	3.46096-002	0.49974	0.029
5.000-003	1.52519+000	3.68504+000	2.0361-001	3.03989-002	0.49972	0.032
4.000-003	1.61250+000	3.89638+000	1.9231-001	2.59148-002	0.49969	0.036
3.500-003	1.66712+000	4.02860+000	1.8586-001	2.35452-002	0.49966	0.038
3.000-003	1.73246+000	4.18681+000	1.7869-001	2.10706-002	0.49964	0.042
2.500-003	1.81304+000	4.38198+000	1.7058-001	1.84693-002	0.49960	0.046
2.000-003	1.91675+000	4.63325+000	1.6116-001	1.57092-002	0.49956	0.051
1.800-003	1.96774+000	4.75685+000	1.5690-001	1.45504-002	0.49953	0.054
1.600-003	2.02635+000	4.89892+000	1.5228-001	1.33538-002	0.49950	0.057
1.400-003	2.09489+000	5.06511+000	1.4720-001	1.21137-002	0.49947	0.061
1.200-003	2.17688+000	5.26399+000	1.4156-001	1.08222-002	0.49943	0.066
1.000-003	2.27797+000	5.50930+000	1.3517-001	9.46857-003	0.49937	0.072

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.10 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	4.06011-001	9.80065-001	2.3369-001	7.41284-001	0.49998	-0.000
9.000-001	4.16842-001	1.00622+000	2.2461-001	7.32961-001	0.49998	-0.000
8.000-001	4.29294-001	1.03430+000	2.1520-001	7.23555-001	0.49999	-0.000
7.000-001	4.43862-001	1.07148+000	2.0543-001	7.12756-001	0.49999	-0.000
6.000-001	4.61296-001	1.11358+000	1.9524-001	7.00088-001	0.49999	-0.000
5.000-001	4.82802-001	1.16551+000	1.8459-001	6.84752-001	0.49999	-0.000
4.000-001	5.10495-001	1.23238+000	1.7335-001	6.65244-001	0.49999	-0.000
3.500-001	5.27421-001	1.27422+000	1.6747-001	6.53018-001	0.49999	-0.000
3.000-001	5.48556-001	1.32428+000	1.6133-001	6.38203-001	0.49999	-0.000
2.500-001	5.74134-001	1.38604+000	1.5485-001	6.19429-001	0.49999	0.000
2.000-001	6.07069-001	1.46554+000	1.4779-001	5.94108-001	0.49999	0.000
1.800-001	6.23269-001	1.50468+000	1.4471-001	5.81108-001	0.49999	0.000
1.600-001	6.41893-001	1.54964+000	1.4140-001	5.65715-001	0.49999	0.000
1.400-001	6.63680-001	1.60225+000	1.3779-001	5.47147-001	0.49999	0.000
1.200-001	6.89754-001	1.66520+000	1.3374-001	5.24273-001	0.49999	0.000
1.000-001	7.21918-001	1.74286+000	1.2905-001	4.95417-001	0.49999	0.000
9.000-002	7.41184-001	1.78930+000	1.2637-001	4.77992-001	0.49999	0.000
8.000-002	7.63331-001	1.84285+000	1.2340-001	4.58003-001	0.49999	0.001
7.000-002	7.89241-001	1.90541+000	1.2005-001	4.34875-001	0.49999	0.001
6.000-002	8.20248-001	1.98027+000	1.1621-001	4.07840-001	0.49999	0.001
5.000-002	8.58497-001	2.07262+000	1.1171-001	3.75853-001	0.49999	0.001
4.000-002	9.07746-001	2.19153+000	1.0628-001	3.37416-001	0.49999	0.001
3.500-002	9.38557-001	2.26593+000	1.0309-001	3.15110-001	0.49999	0.001
3.000-002	9.75430-001	2.35495+000	9.9474-002	2.90235-001	0.49999	0.001
2.500-002	1.02091+000	2.46478+000	9.5292-002	2.62245-001	0.49999	0.001
2.000-002	1.07948+000	2.60618+000	9.0337-002	2.30369-001	0.49998	0.001
1.800-002	1.10929+000	2.67574+000	8.8064-002	2.16287-001	0.49996	0.002
1.600-002	1.14140+000	2.75570+000	8.5576-002	2.01299-001	0.49998	0.002
1.400-002	1.18015+000	2.84924+000	8.2824-002	1.85274-001	0.49998	0.002
1.200-002	1.22651+000	2.96119+000	7.9739-002	1.68044-001	0.49998	0.002
1.000-002	1.28370+000	3.09928+000	7.6220-002	1.49376-001	0.49998	0.002
9.000-003	1.31795+000	3.18200+000	7.4250-002	1.39405-001	0.49998	0.002
8.000-003	1.35733+000	3.27709+000	7.2102-002	1.28941-001	0.49998	0.002
7.000-003	1.40340+000	3.38833+000	6.9737-002	1.17911-001	0.49998	0.003
6.000-003	1.45853+000	3.52145+000	6.7097-002	1.06225-001	0.49997	0.003
5.000-003	1.52454+000	3.68567+000	6.4097-002	9.37561-002	0.49997	0.003
4.000-003	1.61410+000	3.89712+000	6.0601-002	8.03221-002	0.49997	0.004
3.500-003	1.66484+000	4.02940+000	5.8599-002	7.31601-002	0.49997	0.004
3.000-003	1.73443+000	4.18771+000	5.6368-002	6.56367-002	0.49996	0.004
2.500-003	1.81530+000	4.38300+000	5.3838-002	5.76806-002	0.49996	0.005
2.000-003	1.91941+000	4.63444+000	5.0894-002	4.91881-002	0.49996	0.005
1.800-003	1.97062+000	4.75813+000	4.9561-002	4.56073-002	0.49995	0.005
1.600-003	2.02949+000	4.90031+000	4.8111-002	4.19012-002	0.49995	0.006
1.400-003	2.09836+000	5.06665+000	4.6519-002	3.80507-002	0.49995	0.006
1.200-003	2.18078+000	5.26571+000	4.4747-002	3.40309-002	0.49994	0.007
1.000-003	2.28243+000	5.51126+000	4.2738-002	2.98073-002	0.49994	0.007

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

A = 0 H = 0.10 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	4.06014-001	9.80070-001	1.6598-001	7.30849-001	0.49998	-0.001
9.000-001	4.16846-001	1.00623+000	1.5599-001	7.21530-001	0.49999	-0.001
8.000-001	4.29297-001	1.03630+000	1.4552-001	7.10967-001	0.49999	-0.001
7.000-001	4.43866-001	1.07148+000	1.3449-001	6.98825-001	0.49999	-0.001
6.000-001	4.61300-001	1.11358+000	1.2281-001	6.84621-001	0.49999	-0.001
5.000-001	4.82807-001	1.16552+000	1.1032-001	6.67617-001	0.49999	-0.001
4.000-001	5.10501-001	1.23239+000	9.6829-002	6.46601-001	0.49999	-0.001
3.500-001	5.27828-001	1.27422+000	8.9610-002	6.33971-001	0.49999	-0.001
3.000-001	5.48563-001	1.32429+000	8.2006-002	6.19386-001	0.49999	-0.000
2.500-001	5.74142-001	1.38605+000	7.3939-002	6.02189-001	0.49999	-0.000
2.000-001	6.07078-001	1.46557+000	6.5305-002	5.81325-001	0.49999	-0.000
1.800-001	6.23279-001	1.50469+000	6.1659-002	5.71577-001	0.49999	-0.000
1.600-001	6.41904-001	1.54965+000	5.7886-002	5.60782-001	0.50000	-0.000
1.400-001	6.63693-001	1.60226+000	5.3968-002	5.48692-001	0.50000	-0.000
1.200-001	6.89767-001	1.66521+000	4.9888-002	5.34958-001	0.50000	-0.000
1.000-001	7.21933-001	1.74287+000	4.5622-002	5.19059-001	0.50000	-0.000
9.000-002	7.41200-001	1.78939+000	4.3410-002	5.10051-001	0.50000	-0.000
8.000-002	7.63349-001	1.84286+000	4.1141-002	5.00141-001	0.50000	-0.000
7.000-002	7.89261-001	1.90542+000	3.8810-002	4.89107-001	0.50000	-0.000
6.000-002	8.20270-001	1.98029+000	3.6413-002	4.76617-001	0.50000	-0.000
5.000-002	8.58522-001	2.07264+000	3.3944-002	4.62129-001	0.50000	-0.000
4.000-002	9.07775-001	2.19155+000	3.1398-002	4.44646-001	0.50000	-0.000
3.500-002	9.38590-001	2.26594+000	3.0091-002	4.34187-001	0.50000	-0.000
3.000-002	9.75466-001	2.35497+000	2.8756-002	4.21968-001	0.50000	-0.000
2.500-002	1.02096+000	2.46480+000	2.7381-002	4.07096-001	0.50000	-0.000
2.000-002	1.07953+000	2.60621+000	2.5938-002	3.87873-001	0.50000	0.000
1.800-002	1.10834+000	2.67577+000	2.5328-002	3.78279-001	0.50000	0.000
1.600-002	1.14146+000	2.75573+000	2.4688-002	3.67102-001	0.50000	0.000
1.400-002	1.18021+000	2.84928+000	2.4005-002	3.53822-001	0.50000	0.000
1.200-002	1.22658+000	2.96122+000	2.3258-002	3.37691-001	0.50000	0.000
1.000-002	1.28378+000	3.09932+000	2.2417-002	3.17604-001	0.50000	0.000
9.000-003	1.31804+000	3.18204+000	2.1946-002	3.05584-001	0.50000	0.000
8.000-003	1.35743+000	3.27713+000	2.1427-002	2.91880-001	0.50000	0.000
7.000-003	1.40351+000	3.38838+000	2.0849-002	2.76120-001	0.50000	0.000
6.000-003	1.45865+000	3.52151+000	2.0191-002	2.57820-001	0.50000	0.000
5.000-003	1.52667+000	3.68573+000	1.9429-002	2.36327-001	0.50000	0.000
4.000-003	1.61426+000	3.89719+000	1.8505-002	2.10727-001	0.50000	0.000
3.500-003	1.66905+000	4.02948+000	1.7966-002	1.95986-001	0.50000	0.000
3.000-003	1.73463+000	4.18780+000	1.7353-002	1.79652-001	0.50000	0.000
2.500-003	1.81552+000	4.38310+000	1.6644-002	1.61411-001	0.50000	0.000
2.000-003	1.91968+000	4.63456+000	1.5803-002	1.40825-001	0.50000	0.000
1.800-003	1.97091+000	4.75826+000	1.5416-002	1.31798-001	0.49999	0.000
1.600-003	2.02981+000	4.90045+000	1.4992-002	1.22239-001	0.49999	0.001
1.400-003	2.09871+000	5.06680+000	1.4522-002	1.12075-001	0.49999	0.001
1.200-003	2.18117+000	5.26588+000	1.3994-002	1.01213-001	0.49999	0.001
1.000-003	2.28288+000	5.51145+000	1.3390-002	8.95290-002	0.49999	0.001

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	2.87014-001	6.92602-001	2.3040+000	2.98085-001	0.50009	0.036
9.000-001	2.94661-001	7.11097-001	2.2185+000	2.82938-001	0.50008	0.035
8.000-001	3.03451-001	7.32357-001	2.1271+000	2.66768-001	0.50006	0.035
7.000-001	3.13734-001	7.57228-001	2.0287+000	2.49382-001	0.50005	0.034
6.000-001	3.26040-001	7.86991-001	1.9215+000	2.30516-001	0.50002	0.033
5.000-001	3.41219-001	8.23703-001	1.8033+000	2.09791-001	0.50000	0.033
4.000-001	3.60763-001	8.70972-001	1.6703+000	1.86628-001	0.49997	0.033
3.500-001	3.72989-001	9.00544-001	1.5963+000	1.73855-001	0.49995	0.033
3.000-001	3.87614-001	9.35932-001	1.5159+000	1.60060-001	0.49993	0.034
2.500-001	4.05663-001	9.79584-001	1.4272+000	1.44985-001	0.49990	0.035
2.000-001	4.28892-001	1.03579+000	1.3272+000	1.28232-001	0.49987	0.036
1.800-001	4.40318-001	1.06343+000	1.2831+000	1.20929-001	0.49985	0.037
1.600-001	4.53449-001	1.09521+000	1.2358+000	1.13199-001	0.49983	0.038
1.400-001	4.68810-001	1.13239+000	1.1849+000	1.04962-001	0.49981	0.039
1.200-001	4.87189-001	1.17687+000	1.1293+000	9.61112-002	0.49978	0.041
1.000-001	5.09856-001	1.23175+000	1.0678+000	8.64957-002	0.49975	0.044
9.000-002	5.23431-001	1.26462+000	1.0341+000	8.13345-002	0.49973	0.045
8.000-002	5.39032-001	1.30240+000	9.9798-001	7.58883-002	0.49971	0.047
7.000-002	5.57280-001	1.34660+000	9.5892-001	7.01061-002	0.49968	0.049
6.000-002	5.79112-001	1.39949+000	9.1615-001	6.39194-002	0.49964	0.052
5.000-002	6.06034-001	1.46473+000	8.6853-001	5.72321-002	0.49960	0.056
4.000-002	6.40683-001	1.54873+000	8.1429-001	4.99015-002	0.49954	0.062
3.500-002	6.62351-001	1.60128+000	7.8378-001	4.59285-002	0.49951	0.065
3.000-002	6.88272-001	1.66416+000	7.5025-001	4.16977-002	0.49946	0.070
2.500-002	7.20231-001	1.74172+000	7.1277-001	3.71501-002	0.49940	0.076
2.000-002	7.61354-001	1.84157+000	6.6985-001	3.21989-002	0.49933	0.084
1.800-002	7.81571-001	1.89069+000	6.5064-001	3.00772-002	0.49929	0.088
1.600-002	8.04801-001	1.94714+000	6.2991-001	2.78573-002	0.49924	0.093
1.400-002	8.31964-001	2.01318+000	6.0732-001	2.55231-002	0.49918	0.099
1.200-002	8.64450-001	2.09220+000	5.8239-001	2.30534-002	0.49911	0.107
1.000-002	9.04493-001	2.18967+000	5.5439-001	2.04184-002	0.49903	0.117
9.000-003	9.28461-001	2.24804+000	5.3890-001	1.90262-002	0.49897	0.123
8.000-003	9.55997-001	2.31514+000	5.2215-001	1.75748-002	0.49891	0.130
7.000-003	9.88198-001	2.39362+000	5.0386-001	1.60548-002	0.49883	0.139
6.000-003	1.02668+000	2.48753+000	4.8362-001	1.44536-002	0.49873	0.149
5.000-003	1.07410+000	2.60336+000	4.6083-001	1.27540-002	0.49861	0.163
4.000-003	1.13508+000	2.75245+000	4.3450-001	1.09305-002	0.49844	0.182
3.500-003	1.17317+000	2.84571+000	4.1953-001	9.96069-003	0.49833	0.195
3.000-003	1.21870+000	2.95729+000	4.0293-001	8.94301-003	0.49820	0.210
2.500-003	1.27477+000	3.09489+000	3.8420-001	7.86738-003	0.49802	0.230
2.000-003	1.34682+000	3.27200+000	3.6252-001	6.71904-003	0.49779	0.257
1.800-003	1.38220+000	3.35910+000	3.5273-001	6.23456-003	0.49767	0.271
1.600-003	1.42281+000	3.45919+000	3.4212-001	5.73278-003	0.49753	0.287
1.400-003	1.47024+000	3.57624+000	3.3048-001	5.21102-003	0.49735	0.307
1.200-003	1.52688+000	3.71631+000	3.1757-001	4.66570-003	0.49714	0.332
1.000-003	1.59658+000	3.88899+000	3.0296-001	4.09187-003	0.49687	0.364

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES
1.000+000	2.87090-001	6.92979-001	6.2781-001	7.20819-001	0.50000	0.004
9.000-001	2.94747-001	7.11476-001	6.1329-001	6.99200-001	0.50000	0.004
8.000-001	3.03550-001	7.32739-001	5.9676-001	6.74222-001	0.50000	0.004
7.000-001	3.13849-001	7.57615-001	5.7777-001	6.45127-001	0.50000	0.004
6.000-001	3.26175-001	7.87383-001	5.5568-001	6.10893-001	0.49999	0.003
5.000-001	3.41379-001	8.24105-001	5.2962-001	5.70085-001	0.49999	0.003
4.000-001	3.60957-001	8.71387-001	4.9825-001	5.20563-001	0.49999	0.003
3.500-001	3.73207-001	9.00969-001	4.7993-001	4.91531-001	0.49999	0.003
3.000-001	3.87865-001	9.36369-001	4.5931-001	4.58845-001	0.49999	0.003
2.500-001	4.05948-001	9.80038-001	4.3577-001	4.21594-001	0.49999	0.003
2.000-001	4.29231-001	1.03626+000	4.0836-001	3.78414-001	0.49998	0.003
1.800-001	4.40684-001	1.06392+000	3.9596-001	3.59029-001	0.49998	0.004
1.600-001	4.53850-001	1.09572+000	3.8254-001	3.38153-001	0.49998	0.004
1.400-001	4.69252-001	1.13291+000	3.6787-001	3.15522-001	0.49998	0.004
1.200-001	4.87684-001	1.17743+000	3.5165-001	2.90777-001	0.49998	0.004
1.000-001	5.10421-001	1.23233+000	3.3345-001	2.63415-001	0.49997	0.004
9.000-002	5.24041-001	1.26522+000	3.2340-001	2.48532-001	0.49997	0.004
8.000-002	5.39696-001	1.30303+000	3.1255-001	2.32685-001	0.49997	0.005
7.000-002	5.58011-001	1.34727+000	3.0074-001	2.15707-001	0.49997	0.005
6.000-002	5.79929-001	1.40020+000	2.8773-001	1.97374-001	0.49996	0.005
5.000-002	6.06965-001	1.46550+000	2.7316-001	1.77372-001	0.49996	0.006
4.000-002	6.41774-001	1.54957+000	2.5645-001	1.55237-001	0.49995	0.006
3.500-002	6.63552-001	1.60217+000	2.4701-001	1.43155-001	0.49995	0.006
3.000-002	6.89512-001	1.66511+000	2.3661-001	1.30225-001	0.49995	0.007
2.500-002	7.21758-001	1.74276+000	2.2495-001	1.16259-001	0.49994	0.008
2.000-002	7.63146-001	1.84274+000	2.1155-001	1.00977-001	0.49993	0.008
1.800-002	7.83504-001	1.89192+000	2.0554-001	9.44051-002	0.49993	0.009
1.600-002	8.06905-001	1.94845+000	1.9905-001	8.75149-002	0.49992	0.009
1.400-002	8.34280-001	2.01459+000	1.9198-001	8.02549-002	0.49992	0.010
1.200-002	8.67030-001	2.09374+000	1.8415-001	7.25570-002	0.49991	0.011
1.000-002	9.07446-001	2.19137+000	1.7536-001	6.43264-002	0.49990	0.012
9.000-003	9.31648-001	2.24985+000	1.7049-001	5.99706-002	0.49990	0.012
8.000-003	9.59468-001	2.31707+000	1.6522-001	5.54247-002	0.49989	0.013
7.000-003	9.92012-001	2.39572+000	1.5947-001	5.06587-002	0.49988	0.014
6.000-003	1.03095+000	2.48983+000	1.5310-001	4.56326-002	0.49987	0.015
5.000-003	1.07899+000	2.60593+000	1.4592-001	4.02911-002	0.49986	0.016
4.000-003	1.14083+000	2.75541+000	1.3763-001	3.45538-002	0.49984	0.018
3.500-003	1.17951+000	2.84893+000	1.3291-001	3.14997-002	0.49983	0.019
3.000-003	1.22579+000	2.96084+000	1.2768-001	2.82929-002	0.49982	0.021
2.500-003	1.28288+000	3.09889+000	1.2178-001	2.49013-002	0.49980	0.023
2.000-003	1.35637+000	3.27663+000	1.1495-001	2.12781-002	0.49978	0.026
1.800-003	1.39252+000	3.36406+000	1.1186-001	1.97487-002	0.49977	0.027
1.600-003	1.43406+000	3.46456+000	1.0852-001	1.81643-002	0.49975	0.029
1.400-003	1.48266+000	3.58213+000	1.0486-001	1.65163-002	0.49973	0.031
1.200-003	1.54080+000	3.72283+000	1.0079-001	1.47933-002	0.49971	0.033
1.000-003	1.61250+000	3.89638+000	9.6185-002	1.29796-002	0.49969	0.036

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	2.87098-001	6.93017-001	1.5625-001	8.45085-001	0.49999	0.001
9.000-001	2.94756-001	7.11514-001	1.5140-001	8.38835-001	0.49999	0.001
8.000-001	3.03560-001	7.32778-001	1.4635-001	8.31616-001	0.49999	0.001
7.000-001	3.13861-001	7.57654-001	1.4106-001	8.23110-001	0.49999	0.001
6.000-001	3.26188-001	7.87423-001	1.3551-001	8.12807-001	0.49999	0.000
5.000-001	3.41395-001	8.24145-001	1.2961-001	7.99823-001	0.49999	0.000
4.000-001	3.60977-001	8.71429-001	1.2328-001	7.82434-001	0.49999	0.000
3.500-001	3.73228-001	9.01011-001	1.1989-001	7.71027-001	0.49999	0.000
3.000-001	3.87890-001	9.36413-001	1.1628-001	7.56695-001	0.49999	0.000
2.500-001	4.05977-001	9.80083-001	1.1234-001	7.37810-001	0.50000	0.000
2.000-001	4.29265-001	1.03631+000	1.0787-001	7.11302-001	0.50000	0.000
1.800-001	4.40721-001	1.06397+000	1.0584-001	6.97336-001	0.50000	0.000
1.600-001	4.53890-001	1.09577+000	1.0361-001	6.80565-001	0.50000	0.000
1.400-001	4.69297-001	1.13297+000	1.0111-001	6.60069-001	0.50000	0.000
1.200-001	4.87734-001	1.17748+000	9.8234-002	6.34525-001	0.50000	0.000
1.000-001	5.10478-001	1.23239+000	9.4819-002	6.01970-001	0.50000	0.000
9.000-002	5.24102-001	1.26529+000	9.2835-002	5.82177-001	0.50000	0.000
8.000-002	5.39763-001	1.30310+000	9.0610-002	5.59372-001	0.50000	0.000
7.000-002	5.58084-001	1.34733+000	8.8082-002	5.32867-001	0.50000	0.000
6.000-002	5.80010-001	1.40027+000	8.5164-002	5.01740-001	0.49999	0.000
5.000-002	6.07058-001	1.46557+000	8.1731-002	4.64715-001	0.49999	0.000
4.000-002	6.41883-001	1.54965+000	7.7588-002	4.19929-001	0.49999	0.001
3.500-002	6.63672-001	1.60226+000	7.5153-002	3.93776-001	0.49999	0.001
3.000-002	6.89746-001	1.66521+000	7.2394-002	3.64456-001	0.49999	0.001
2.500-002	7.21911-001	1.74287+000	6.9216-002	3.31248-001	0.49999	0.001
2.000-002	7.63325-001	1.84286+000	6.5464-002	2.93111-001	0.49999	0.001
1.800-002	7.83697-001	1.89204+000	6.3748-002	2.76143-001	0.49999	0.001
1.600-002	8.07115-001	1.94858+000	6.1875-002	2.57996-001	0.49999	0.001
1.400-002	8.34512-001	2.01473+000	5.9809-002	2.38485-001	0.49999	0.001
1.200-002	8.67298-001	2.09389+000	5.7500-002	2.17371-001	0.49999	0.001
1.000-002	9.07741-001	2.19154+000	5.4876-002	1.94323-001	0.49999	0.001
9.000-003	9.31967-001	2.25003+000	5.3412-002	1.81934-001	0.49999	0.001
8.000-003	9.59816-001	2.31727+000	5.1819-002	1.68867-001	0.49999	0.001
7.000-003	9.92395-001	2.39593+000	5.0069-002	1.55020-001	0.49999	0.001
6.000-003	1.03138+000	2.49006+000	4.8122-002	1.40259-001	0.49999	0.001
5.000-003	1.07948+000	2.60619+000	4.5916-002	1.24400-001	0.49999	0.002
4.000-003	1.14140+000	2.75570+000	4.3354-002	1.07177-001	0.49998	0.002
3.500-003	1.18014+000	2.84925+000	4.1891-002	9.79320-002	0.49998	0.002
3.000-003	1.22650+000	2.96119+000	4.0264-002	8.81699-002	0.49998	0.002
2.500-003	1.28370+000	3.09928+000	3.8423-002	7.77865-002	0.49998	0.002
2.000-003	1.35733+000	3.27709+000	3.6288-002	6.66301-002	0.49998	0.003
1.800-003	1.39355+000	3.36455+000	3.5322-002	6.19020-002	0.49998	0.003
1.600-003	1.43519+000	3.46510+000	3.4274-002	5.69923-002	0.49997	0.003
1.400-003	1.48390+000	3.58272+000	3.3124-002	5.18736-002	0.49997	0.003
1.200-003	1.54219+000	3.72348+000	3.1846-002	4.65093-002	0.49997	0.003
1.000-003	1.61410+000	3.89712+000	3.0399-002	4.08494-002	0.49997	0.004

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	2.87098-001	6.93021-001	9.7522-002	8.38652-001	0.49998	0.001
9.000-001	2.94757-001	7.11518-001	9.2186-002	8.31820-001	0.49999	0.001
8.000-001	3.03561-001	7.32782-001	8.6570-002	8.23953-001	0.49999	0.000
7.000-001	3.13862-001	7.57658-001	8.0624-002	8.14748-001	0.49999	0.000
6.000-001	3.26189-001	7.87427-001	7.4282-002	8.03756-001	0.49999	0.000
5.000-001	3.41397-001	8.24149-001	6.7451-002	7.90271-001	0.49999	0.000
4.000-001	3.60979-001	8.71433-001	5.9995-002	7.73105-001	0.49999	-0.000
3.500-001	3.73231-001	9.01016-001	5.5970-002	7.62516-001	0.49999	-0.000
3.000-001	3.87892-001	9.36417-001	5.1697-002	7.50034-001	0.50000	-0.000
2.500-001	4.05979-001	9.80088-001	4.7125-002	7.34955-001	0.50000	-0.000
2.000-001	4.29269-001	1.03632+000	4.2177-002	7.16126-001	0.50000	-0.000
1.800-001	4.40725-001	1.06398+000	4.0069-002	7.07126-001	0.50000	-0.000
1.600-001	4.53894-001	1.09577+000	3.7874-002	6.97004-001	0.50000	-0.000
1.400-001	4.69301-001	1.13297+000	3.5580-002	6.85473-001	0.50000	-0.000
1.200-001	4.87739-001	1.17749+000	3.3173-002	6.72121-001	0.50000	-0.000
1.000-001	5.10483-001	1.23240+000	3.0633-002	6.56316-001	0.50000	-0.000
9.000-002	5.24108-001	1.26529+000	2.9306-002	6.47192-001	0.50000	-0.000
8.000-002	5.39769-001	1.30310+000	2.7937-002	6.37008-001	0.50000	-0.000
7.000-002	5.58092-001	1.34734+000	2.6521-002	6.25462-001	0.50000	-0.000
6.000-002	5.80018-001	1.40028+000	2.5054-002	6.12189-001	0.50000	-0.000
5.000-002	6.07067-001	1.46558+000	2.3531-002	5.96425-001	0.50000	-0.000
4.000-002	6.41894-001	1.54966+000	2.1941-002	5.76884-001	0.50000	-0.000
3.500-002	6.63684-001	1.60227+000	2.1116-002	5.64915-001	0.50000	-0.000
3.000-002	6.89759-001	1.66522+000	2.0265-002	5.50671-001	0.50000	-0.000
2.500-002	7.21926-001	1.74288+000	1.9377-002	5.32977-001	0.50000	-0.000
2.000-002	7.63343-001	1.84287+000	1.8429-002	5.09606-001	0.50000	0.000
1.800-002	7.83716-001	1.89206+000	1.8022-002	4.97772-001	0.50000	0.000
1.600-002	8.07136-001	1.94860+000	1.7590-002	4.83869-001	0.50000	0.000
1.400-002	8.34535-001	2.01475+000	1.7123-002	4.67220-001	0.50000	0.000
1.200-002	8.67324-001	2.09390+000	1.6607-002	4.48847-001	0.50000	0.000
1.000-002	9.07771-001	2.19155+000	1.6017-002	4.21305-001	0.50000	0.000
9.000-003	9.31999-001	2.25005+000	1.5683-002	4.09946-001	0.50000	0.000
8.000-003	9.59850-001	2.31729+000	1.5315-002	3.88378-001	0.50000	0.000
7.000-003	9.92433-001	2.39595+000	1.4901-002	3.66108-001	0.50000	0.000
6.000-003	1.03143+000	2.49009+000	1.4428-002	3.44487-001	0.50000	0.000
5.000-003	1.07953+000	2.60621+000	1.3876-002	3.16636-001	0.50000	0.000
4.000-003	1.14146+000	2.75573+000	1.3212-002	2.83309-001	0.50000	0.000
3.500-003	1.18021+000	2.84928+000	1.2822-002	2.64039-001	0.50000	0.000
3.000-003	1.22658+000	2.96123+000	1.2379-002	2.42616-001	0.50000	0.000
2.500-003	1.28378+000	3.09932+000	1.1867-002	2.18598-001	0.50000	0.000
2.000-003	1.35743+000	3.27714+000	1.1259-002	1.91368-001	0.50000	0.000
1.800-003	1.39366+000	3.36460+000	1.0980-002	1.79382-001	0.50000	0.000
1.600-003	1.43530+000	3.46515+000	1.0674-002	1.66657-001	0.50000	0.000
1.400-003	1.48403+000	3.58278+000	1.0336-002	1.53089-001	0.50000	0.000
1.200-003	1.54233+000	3.72355+000	9.9557-003	1.38545-001	0.50000	0.000
1.000-003	1.61426+000	3.89719+000	9.5217-003	1.22845-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.50 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.81650-001	4.37867-001	1.9465+000	3.05920-001	0.50046	0.067
9.000-001	1.86486-001	4.49570-001	1.8636+000	2.90842-001	0.50043	0.064
8.000-001	1.92045-001	4.63022-001	1.7752+000	2.74764-001	0.50040	0.061
7.000-001	1.98550-001	4.78760-001	1.6802+000	2.57495-001	0.50037	0.057
6.000-001	2.06335-001	4.97592-001	1.5773+000	2.38779-001	0.50034	0.053
5.000-001	2.15939-001	5.20821-001	1.4643+000	2.18241-001	0.50030	0.050
4.000-001	2.28306-001	5.50730-001	1.3381+000	1.95311-001	0.50026	0.046
3.500-001	2.36044-001	5.69441-001	1.2685+000	1.82673-001	0.50024	0.044
3.000-001	2.45304-001	5.91832-001	1.1932+000	1.69025-001	0.50021	0.041
2.500-001	2.56726-001	6.19451-001	1.1109+000	1.54103-001	0.50018	0.039
2.000-001	2.71434-001	6.55012-001	1.0191+000	1.37502-001	0.50014	0.037
1.800-001	2.78668-001	6.72504-001	9.7887-001	1.30253-001	0.50013	0.036
1.600-001	2.86984-001	6.92611-001	9.3620-001	1.22569-001	0.50011	0.035
1.400-001	2.96713-001	7.16134-001	8.9053-001	1.14364-001	0.50009	0.035
1.200-001	3.08355-001	7.44282-001	8.4116-001	1.05523-001	0.50006	0.034
1.000-001	3.22715-001	7.79004-001	7.8707-001	9.58780-002	0.50004	0.033
9.000-002	3.31316-001	7.99803-001	7.5778-001	9.06792-002	0.50002	0.033
8.000-002	3.41203-001	8.23710-001	7.2665-001	8.51729-002	0.50001	0.033
7.000-002	3.52768-001	8.51679-001	6.9327-001	7.92996-002	0.49999	0.033
6.000-002	3.66608-001	8.85148-001	6.5712-001	7.29779-002	0.49996	0.033
5.000-002	3.83678-001	9.26433-001	6.1739-001	6.60912-002	0.49994	0.034
4.000-002	4.05653-001	9.79589-001	5.7283-001	5.84620-002	0.49991	0.035
3.500-002	4.19400-001	1.01284+000	5.4812-001	5.42842-002	0.49988	0.036
3.000-002	4.35848-001	1.05264+000	5.2127-001	4.97951-002	0.49986	0.037
2.500-002	4.56134-001	1.10173+000	4.9163-001	4.49158-002	0.49983	0.038
2.000-002	4.82248-001	1.16493+000	4.5822-001	3.95270-002	0.49979	0.041
1.800-002	4.95090-001	1.19602+000	4.4344-001	3.71890-002	0.49977	0.042
1.600-002	5.09851-001	1.23175+000	4.2763-001	3.47219-002	0.49975	0.044
1.400-002	5.27116-001	1.27356+000	4.1056-001	3.21020-002	0.49973	0.046
1.200-002	5.47772-001	1.32358+000	3.9190-001	2.92979-002	0.49969	0.048
1.000-002	5.73246-001	1.38529+000	3.7117-001	2.62649-002	0.49965	0.052
9.000-003	5.88500-001	1.42225+000	3.5981-001	2.46431-002	0.49963	0.054
8.000-003	6.06031-001	1.46474+000	3.4761-001	2.29367-002	0.49960	0.056
7.000-003	6.26535-001	1.51444+000	3.3439-001	2.11309-002	0.49957	0.060
6.000-003	6.51064-001	1.57391+000	3.1988-001	1.92060-002	0.49953	0.064
5.000-003	6.81309-001	1.64727+000	3.0369-001	1.71344-002	0.49947	0.069
4.000-003	7.20229-001	1.74172+000	2.8518-001	1.48752-002	0.49940	0.076
3.500-003	7.44565-001	1.80081+000	2.7475-001	1.36563-002	0.49936	0.081
3.000-003	7.73673-001	1.87151+000	2.6325-001	1.23631-002	0.49930	0.087
2.500-003	8.09559-001	1.95871+000	2.5037-001	1.09788-002	0.49923	0.094
2.000-003	8.55726-001	2.07098+000	2.3558-001	9.47907-003	0.49913	0.105
1.800-003	8.78419-001	2.12620+000	2.2895-001	8.83892-003	0.49908	0.110
1.600-003	9.04492-001	2.18967+000	2.2178-001	8.17091-003	0.49903	0.117
1.400-003	9.34974-001	2.26391+000	2.1395-001	7.47054-003	0.49896	0.124
1.200-003	9.71424-001	2.35275+000	2.0530-001	6.73185-003	0.49887	0.134
1.000-003	1.01634+000	2.46231+000	1.9557-001	5.94660-003	0.49876	0.147

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.50 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	1.81592-001	4.38267-001	5.1407-001	7.60895-001	0.50002	0.009
9.000-001	1.86434-001	4.49965-001	5.0078-001	7.38531-001	0.50002	0.009
8.000-001	1.92001-001	4.63413-001	4.8554-001	7.12710-001	0.50002	0.008
7.000-001	1.98513-001	4.79146-001	4.6794-001	6.82678-001	0.50002	0.007
6.000-001	2.06308-001	4.97974-001	4.4741-001	6.47420-001	0.50002	0.006
5.000-001	2.15924-001	5.21199-001	4.2315-001	6.05520-001	0.50002	0.006
4.000-001	2.28306-001	5.51104-001	3.9400-001	5.54868-001	0.50002	0.005
3.500-001	2.36053-001	5.69814-001	3.7702-001	5.25269-001	0.50002	0.005
3.000-001	2.45324-001	5.92203-001	3.5800-001	4.92022-001	0.50002	0.004
2.500-001	2.56761-001	6.19823-001	3.3642-001	4.54216-001	0.50001	0.004
2.000-001	2.71488-001	6.55385-001	3.1149-001	4.10473-001	0.50001	0.004
1.800-001	2.78733-001	6.72879-001	3.0032-001	3.90851-001	0.50001	0.004
1.600-001	2.87060-001	6.92988-001	2.8828-001	3.69720-001	0.50001	0.004
1.400-001	2.96803-001	7.16513-001	2.7522-001	3.46803-001	0.50001	0.004
1.200-001	3.08462-001	7.44666-001	2.6090-001	3.21715-001	0.50000	0.003
1.000-001	3.22844-001	7.79395-001	2.4499-001	2.93910-001	0.50000	0.003
9.000-002	3.31459-001	8.00198-001	2.3629-001	2.78745-001	0.50000	0.003
8.000-002	3.41363-001	8.24112-001	2.2698-001	2.62555-001	0.50000	0.003
7.000-002	3.52949-001	8.52088-001	2.1693-001	2.45146-001	0.50000	0.003
6.000-002	3.66813-001	8.85567-001	2.0597-001	2.26257-001	0.50000	0.003
5.000-002	3.83917-001	9.26867-001	1.9384-001	2.05511-001	0.49999	0.003
4.000-002	4.05938-001	9.80043-001	1.8015-001	1.82339-001	0.49999	0.003
3.500-002	4.19716-001	1.01331+000	1.7252-001	1.69571-001	0.49999	0.004
3.000-002	4.36203-001	1.05313+000	1.6420-001	1.55793-001	0.49999	0.004
2.500-002	4.56542-001	1.10224+000	1.5499-001	1.40755-001	0.49998	0.004
2.000-002	4.82728-001	1.16547+000	1.4457-001	1.24074-001	0.49998	0.004
1.800-002	4.95609-001	1.19658+000	1.3996-001	1.16815-001	0.49998	0.004
1.600-002	5.10416-001	1.23234+000	1.3501-001	1.09141-001	0.49997	0.004
1.400-002	5.27739-001	1.27417+000	1.2966-001	1.00978-001	0.49997	0.005
1.200-002	5.48468-001	1.32423+000	1.2381-001	9.22246-002	0.49997	0.005
1.000-002	5.74039-001	1.38598+000	1.1730-001	8.27395-002	0.49997	0.005
9.000-003	5.89355-001	1.42298+000	1.1372-001	7.76607-002	0.49996	0.005
8.000-003	6.06962-001	1.46550+000	1.0989-001	7.23119-002	0.49996	0.006
7.000-003	6.27559-001	1.51524+000	1.0573-001	6.66462-002	0.49996	0.006
6.000-003	6.52207-001	1.57478+000	1.0116-001	6.06009-002	0.49995	0.006
5.000-003	6.82610-001	1.64821+000	9.6055-002	5.40883-002	0.49995	0.007
4.000-003	7.21756-001	1.74277+000	9.0220-002	4.69790-002	0.49994	0.008
3.500-003	7.46245-001	1.80192+000	8.6929-002	4.31407-002	0.49994	0.008
3.000-003	7.75551-001	1.87271+000	8.3303-002	3.90658-002	0.49993	0.009
2.500-003	8.11699-001	1.96004+000	7.9239-002	3.47018-002	0.49992	0.009
2.000-003	8.58239-001	2.07248+000	7.4571-002	2.99713-002	0.49991	0.010
1.800-003	8.91131-001	2.12779+000	7.2477-002	2.79513-002	0.49991	0.011
1.600-003	9.07445-001	2.19137+000	7.0214-002	2.58430-002	0.49990	0.012
1.400-003	9.38227-001	2.26575+000	6.7745-002	2.36319-002	0.49990	0.012
1.200-003	9.75061-001	2.35476+000	6.5014-002	2.12994-002	0.49989	0.013
1.000-003	1.02049+000	2.46456+000	6.1941-002	1.88191-002	0.49988	0.015

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0

H = 0.50 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.81587-001	4.38307-001	9.9043-002	9.28382-001	0.49998	0.003
9.000-001	1.86429-001	4.50005-001	9.7021-002	9.24707-001	0.49998	0.003
8.000-001	1.91996-001	4.63452-001	9.4900-002	9.20311-001	0.49998	0.003
7.000-001	1.98510-001	4.79185-001	9.2657-002	9.14903-001	0.49999	0.002
6.000-001	2.06305-001	4.98012-001	9.0262-002	9.07991-001	0.49999	0.002
5.000-001	2.15922-001	5.21237-001	8.7661-002	8.98675-001	0.49999	0.001
4.000-001	2.28306-001	5.51142-001	8.4747-002	8.85102-001	0.49999	0.001
3.500-001	2.36054-001	5.69851-001	8.3106-002	8.75536-001	0.50000	0.001
3.000-001	2.45326-001	5.92241-001	8.1270-002	8.62850-001	0.50000	0.001
2.500-001	2.56765-001	6.19860-001	7.9131-002	8.45181-001	0.50000	0.001
2.000-001	2.71494-001	6.55423-001	7.6481-002	8.19019-001	0.50000	0.001
1.800-001	2.78739-001	6.72916-001	7.5194-002	8.04783-001	0.50000	0.000
1.600-001	2.87068-001	6.93026-001	7.3717-002	7.87399-001	0.50000	0.000
1.400-001	2.96812-001	7.16551-001	7.1986-002	7.65845-001	0.50000	0.000
1.200-001	3.08472-001	7.44705-001	6.9913-002	7.38657-001	0.50000	0.000
1.000-001	3.22857-001	7.79435-001	6.7362-002	7.03685-001	0.50000	0.000
9.000-002	3.31474-001	8.00238-001	6.5848-002	6.82312-001	0.50000	0.000
8.000-002	3.41379-001	8.24152-001	6.4129-002	6.57618-001	0.50000	0.000
7.000-002	3.52967-001	8.52129-001	6.2157-002	6.28848-001	0.50000	0.000
6.000-002	3.66834-001	8.85609-001	5.9866-002	5.94986-001	0.50000	0.000
5.000-002	3.83941-001	9.26910-001	5.7164-002	5.54604-001	0.50000	0.000
4.000-002	4.05967-001	9.80088-001	5.3909-002	5.05576-001	0.50000	0.000
3.500-002	4.19748-001	1.01336+000	5.2004-002	4.76826-001	0.50000	0.000
3.000-002	4.36239-001	1.05317+000	4.9858-002	4.44459-001	0.50000	0.000
2.500-002	4.56582-001	1.10229+000	4.7403-002	4.07580-001	0.50000	0.000
2.000-002	4.82776-001	1.16553+000	4.4535-002	3.64864-001	0.50000	0.000
1.800-002	4.95661-001	1.19664+000	4.3235-002	3.45704-001	0.50000	0.000
1.600-002	5.10473-001	1.23240+000	4.1824-002	3.25089-001	0.50000	0.000
1.400-002	5.27801-001	1.27423+000	4.0279-002	3.02764-001	0.50000	0.000
1.200-002	5.48538-001	1.32430+000	3.8566-002	2.78390-001	0.50000	0.000
1.000-002	5.74118-001	1.38605+000	3.6638-002	2.51492-001	0.50000	0.000
9.000-003	5.89441-001	1.42305+000	3.5570-002	2.36890-001	0.50000	0.001
8.000-003	6.07055-001	1.46557+000	3.4416-002	2.21368-001	0.50000	0.001
7.000-003	6.27661-001	1.51532+000	3.3156-002	2.04771-001	0.50000	0.001
6.000-003	6.52321-001	1.57486+000	3.1764-002	1.86892-001	0.49999	0.001
5.000-003	6.82741-001	1.64830+000	3.0200-002	1.67444-001	0.49999	0.001
4.000-003	7.21909-001	1.74287+000	2.8402-002	1.46006-001	0.49999	0.001
3.500-003	7.46414-001	1.80203+000	2.7383-002	1.34345-001	0.49999	0.001
3.000-003	7.75739-001	1.87283+000	2.6257-002	1.21903-001	0.49999	0.001
2.500-003	8.11913-001	1.96017+000	2.4991-002	1.08510-001	0.49999	0.001
2.000-003	8.58491-001	2.07263+000	2.3533-002	9.39176-002	0.49999	0.001
1.800-003	8.81403-001	2.12795+000	2.2877-002	8.76635-002	0.49999	0.001
1.600-003	9.07740-001	2.19154+000	2.2168-002	8.11219-002	0.49999	0.001
1.400-003	9.38552-001	2.26593+000	2.1394-002	7.42471-002	0.49999	0.001
1.200-003	9.75425-001	2.35496+000	2.0536-002	6.69788-002	0.49999	0.001
1.000-003	1.02091+000	2.46478+000	1.9570-002	5.92335-002	0.49999	0.001

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.50 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.81586-001	4.38311-001	4.6166-002	9.27235-001	0.49997	0.003
9.000-001	1.86429-001	4.50009-001	4.3972-002	9.23698-001	0.49998	0.002
8.000-001	1.91996-001	4.63456-001	4.1657-002	9.19571-001	0.49998	0.002
7.000-001	1.98509-001	4.79189-001	3.9199-002	9.14663-001	0.49998	0.002
6.000-001	2.06305-001	4.98016-001	3.6566-002	9.08689-001	0.49999	0.001
5.000-001	2.15922-001	5.21241-001	3.3717-002	9.01184-001	0.49999	0.001
4.000-001	2.28306-001	5.51145-001	3.0585-002	8.91340-001	0.49999	0.001
3.500-001	2.36054-001	5.69855-001	2.8883-002	8.85096-001	0.49999	0.001
3.000-001	2.45326-001	5.92244-001	2.7067-002	8.77560-001	0.49999	0.000
2.500-001	2.56765-001	6.19864-001	2.5108-002	8.68191-001	0.50000	0.000
2.000-001	2.71494-001	6.55426-001	2.2969-002	8.56060-001	0.50000	0.000
1.800-001	2.78740-001	6.72920-001	2.2050-002	8.50083-001	0.50000	0.000
1.600-001	2.87069-001	6.93029-001	2.1087-002	8.43214-001	0.50000	0.000
1.400-001	2.96813-001	7.16555-001	2.0074-002	8.35191-001	0.50000	0.000
1.200-001	3.08474-001	7.44709-001	1.9001-002	8.25621-001	0.50000	0.000
1.000-001	3.22858-001	7.79439-001	1.7858-002	8.13872-001	0.50000	0.000
9.000-002	3.31475-001	8.00242-001	1.7255-002	8.06866-001	0.50000	0.000
8.000-002	3.41380-001	8.24156-001	1.6628-002	7.98837-001	0.50000	0.000
7.000-002	3.52968-001	8.52133-001	1.5973-002	7.89463-001	0.50000	0.000
6.000-002	3.66836-001	8.85614-001	1.5287-002	7.78240-001	0.50000	0.000
5.000-002	3.83943-001	9.26914-001	1.4563-002	7.64304-001	0.50000	0.000
4.000-002	4.05970-001	9.80093-001	1.3790-002	7.45992-001	0.50000	0.000
3.500-002	4.19751-001	1.01336+000	1.3380-002	7.34180-001	0.50000	0.000
3.000-002	4.36242-001	1.05318+000	1.2946-002	7.19533-001	0.50000	0.000
2.500-002	4.56586-001	1.10229+000	1.2479-002	7.00505-001	0.50000	0.000
2.000-002	4.82781-001	1.16553+000	1.1958-002	6.74175-001	0.50000	0.000
1.800-002	4.95666-001	1.19664+000	1.1725-002	6.60429-001	0.50000	0.000
1.600-002	5.10479-001	1.23240+000	1.1472-002	6.44003-001	0.50000	0.000
1.400-002	5.27807-001	1.27424+000	1.1190-002	6.24019-001	0.50000	0.000
1.200-002	5.48545-001	1.32430+000	1.0869-002	5.99210-001	0.50000	0.000
1.000-002	5.74126-001	1.38606+000	1.0491-002	5.67699-001	0.50000	0.000
9.000-003	5.89449-001	1.42306+000	1.0273-002	5.48582-001	0.50000	0.000
8.000-003	6.07064-001	1.46558+000	1.0029-002	5.26588-001	0.50000	0.000
7.000-003	6.27671-001	1.51533+000	9.7528-003	5.01061-001	0.50000	0.000
6.000-003	6.52332-001	1.57487+000	9.4346-003	4.71126-001	0.50000	0.000
5.000-003	6.82754-001	1.64831+000	9.0609-003	4.35578-001	0.50000	0.000
4.000-003	7.21924-001	1.74268+000	8.6098-003	3.92670-001	0.50000	0.000
3.500-003	7.46430-001	1.80204+000	8.3447-003	3.67665-001	0.50000	0.000
3.000-003	7.75757-001	1.87285+000	8.0441-003	3.39681-001	0.50000	0.000
2.500-003	8.11935-001	1.96019+000	7.6973-003	3.08058-001	0.50000	0.000
2.000-003	8.58516-001	2.07265+000	7.2872-003	2.71849-001	0.50000	0.000
1.800-003	8.81430-001	2.12796+000	7.0995-003	2.55779-001	0.50000	0.000
1.600-003	9.07770-001	2.19156+000	6.8942-003	2.38622-001	0.50000	0.000
1.400-003	9.38585-001	2.26595+000	6.6676-003	2.20214-001	0.50000	0.000
1.200-003	9.75462-001	2.35498+000	6.4140-003	2.00340-001	0.50000	0.000
1.000-003	1.02095+000	2.46480+000	6.1254-003	1.78706-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.28560-001	3.09398-001	1.8174+000	3.07656-001	0.50097	0.128
9.000-001	1.31977-001	3.17679-001	1.7349+000	2.92580-001	0.50093	0.121
8.000-001	1.35905-001	3.27198-001	1.6470+000	2.76512-001	0.50088	0.114
7.000-001	1.40501-001	3.38333-001	1.5526+000	2.59266-001	0.50082	0.106
6.000-001	1.46003-001	3.51657-001	1.4504+000	2.40584-001	0.50076	0.098
5.000-001	1.52791-001	3.68092-001	1.3384+000	2.20102-001	0.50069	0.090
4.000-001	1.61533-001	3.89252-001	1.2134+000	1.97256-001	0.50062	0.081
3.500-001	1.67003-001	4.02489-001	1.1446+000	1.84675-001	0.50057	0.076
3.000-001	1.73550-001	4.18329-001	1.0704+000	1.71100-001	0.50053	0.071
2.500-001	1.81626-001	4.37867-001	9.8924-001	1.56271-001	0.50048	0.065
2.000-001	1.92027-001	4.63023-001	8.9907-001	1.39790-001	0.50042	0.059
1.800-001	1.97143-001	4.75397-001	8.5972-001	1.32600-001	0.50039	0.057
1.600-001	2.03024-001	4.89620-001	8.1801-001	1.24982-001	0.50037	0.054
1.400-001	2.09905-001	5.06259-001	7.7349-001	1.16852-001	0.50034	0.051
1.200-001	2.18139-001	5.26170-001	7.2551-001	1.08098-001	0.50030	0.048
1.000-001	2.28297-001	5.50731-001	6.7316-001	9.85521-002	0.50027	0.045
9.000-002	2.34381-001	5.65443-001	6.4493-001	9.34089-002	0.50025	0.044
8.000-002	2.41375-001	5.82354-001	6.1501-001	8.79624-002	0.50022	0.042
7.000-002	2.49558-001	6.02137-001	5.8306-001	8.21534-002	0.50020	0.040
6.000-002	2.59350-001	6.25811-001	5.4862-001	7.59003-002	0.50017	0.039
5.000-002	2.71429-001	6.55013-001	5.1100-001	6.90854-002	0.50014	0.037
4.000-002	2.86980-001	6.92612-001	4.6916-001	6.15281-002	0.50011	0.035
3.500-002	2.96709-001	7.16135-001	4.4614-001	5.73837-002	0.50009	0.035
3.000-002	3.08351-001	7.44283-001	4.2127-001	5.29234-002	0.50007	0.034
2.500-002	3.22712-001	7.79005-001	3.9407-001	4.80639-002	0.50004	0.033
2.000-002	3.41200-001	8.23711-001	3.6371-001	4.26774-002	0.50001	0.033
1.800-002	3.50294-001	8.45701-001	3.5040-001	4.03318-002	0.49999	0.033
1.600-002	3.60747-001	8.70979-001	3.3625-001	3.78495-002	0.49997	0.033
1.400-002	3.72974-001	9.00551-001	3.2108-001	3.52042-002	0.49996	0.033
1.200-002	3.87605-001	9.35938-001	3.0464-001	3.23598-002	0.49993	0.034
1.000-002	4.05652-001	9.79590-001	2.8656-001	2.92647-002	0.49991	0.035
9.000-003	4.16460-001	1.00574+000	2.7673-001	2.76003-002	0.49989	0.035
8.000-003	4.28883-001	1.03579+000	2.6625-001	2.58407-002	0.49987	0.036
7.000-003	4.43415-001	1.07095+000	2.5498-001	2.39680-002	0.49985	0.037
6.000-003	4.60803-001	1.11303+000	2.4271-001	2.19579-002	0.49982	0.039
5.000-003	4.82247-001	1.16493+000	2.2916-001	1.97758-002	0.49979	0.041
4.000-003	5.09850-001	1.23175+000	2.1385-001	1.73698-002	0.49975	0.044
3.500-003	5.27116-001	1.27356+000	2.0531-001	1.60583-002	0.49973	0.046
3.000-003	5.47772-001	1.32358+000	1.9597-001	1.46547-002	0.49969	0.048
2.500-003	5.73245-001	1.38529+000	1.8560-001	1.31368-002	0.49965	0.052
2.000-003	6.06031-001	1.46474+000	1.7382-001	1.14715-002	0.49960	0.056
1.800-003	6.22153-001	1.50382+000	1.6858-001	1.07531-002	0.49958	0.059
1.600-003	6.40680-001	1.54873+000	1.6294-001	9.99815-003	0.49954	0.062
1.400-003	6.62349-001	1.60128+000	1.5683-001	9.20026-003	0.49951	0.066
1.200-003	6.88269-001	1.66416+000	1.5011-001	8.35101-003	0.49946	0.070
1.000-003	7.20228-001	1.74172+000	1.4260-001	7.43866-003	0.49940	0.076

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	1.28427-001	3.09884-001	4.7252-001	7.74014-001	0.50005	0.018
9.000-001	1.31849-001	3.18156-001	4.5955-001	7.51256-001	0.50005	0.017
8.000-001	1.35784-001	3.27665-001	4.4465-001	7.24993-001	0.50005	0.015
7.000-001	1.40387-001	3.38790-001	4.2738-001	6.94468-001	0.50005	0.014
6.000-001	1.45897-001	3.52104-001	4.0720-001	6.58672-001	0.50005	0.012
5.000-001	1.52695-001	3.68527-001	3.8333-001	6.16199-001	0.50005	0.011
4.000-001	1.61449-001	3.89674-001	3.5464-001	5.64965-001	0.50005	0.009
3.500-001	1.66927-001	4.02904-001	3.3794-001	5.35085-001	0.50005	0.009
3.000-001	1.73482-001	4.18736-001	3.1925-001	5.01578-001	0.50004	0.008
2.500-001	1.81569-001	4.38267-001	2.9807-001	4.63551-001	0.50004	0.007
2.000-001	1.91982-001	4.63414-001	2.7366-001	4.19653-001	0.50004	0.006
1.800-001	1.97104-001	4.75784-001	2.6274-001	3.99996-001	0.50004	0.006
1.600-001	2.02993-001	4.90004-001	2.5100-001	3.78853-001	0.50003	0.006
1.400-001	2.09882-001	5.06640-001	2.3830-001	3.55951-001	0.50003	0.005
1.200-001	2.18126-001	5.26548-001	2.2441-001	3.30913-001	0.50003	0.005
1.000-001	2.28296-001	5.51105-001	2.0904-001	3.03201-001	0.50002	0.005
9.000-002	2.34388-001	5.65816-001	2.0067-001	2.88103-001	0.50002	0.004
8.000-002	2.41391-001	5.82726-001	1.9174-001	2.71993-001	0.50002	0.004
7.000-002	2.49584-001	6.02509-001	1.8213-001	2.54682-001	0.50002	0.004
6.000-002	2.59388-001	6.26183-001	1.7170-001	2.35905-001	0.50002	0.004
5.000-002	2.71483-001	6.55387-001	1.6024-001	2.15287-001	0.50001	0.004
4.000-002	2.87056-001	6.92989-001	1.4739-001	1.92247-001	0.50001	0.004
3.500-002	2.96799-001	7.16515-001	1.4029-001	1.79540-001	0.50001	0.003
3.000-002	3.08458-001	7.44668-001	1.3259-001	1.65812-001	0.50001	0.003
2.500-002	3.22841-001	7.79397-001	1.2414-001	1.50796-001	0.50000	0.003
2.000-002	3.41360-001	8.24113-001	1.1468-001	1.34087-001	0.50000	0.003
1.800-002	3.50470-001	8.46109-001	1.1053-001	1.26791-001	0.50000	0.003
1.600-002	3.60942-001	8.71394-001	1.0610-001	1.19057-001	0.50000	0.003
1.400-002	3.73192-001	9.00976-001	1.0135-001	1.10802-001	0.50000	0.003
1.200-002	3.87853-001	9.36375-001	9.6194-002	1.01912-001	0.49999	0.003
1.000-002	4.05937-001	9.80044-001	9.0516-002	9.22217-002	0.49999	0.003
9.000-003	4.16770-001	1.00620+000	8.7427-002	8.70043-002	0.49999	0.004
8.000-003	4.29222-001	1.03627+000	8.4132-002	8.14840-002	0.49999	0.004
7.000-003	4.43790-001	1.07145+000	8.0584-002	7.56039-002	0.49998	0.004
6.000-003	4.61223-001	1.11354+000	7.6721-002	6.92870-002	0.49998	0.004
5.000-003	4.82727-001	1.16547+000	7.2450-002	6.24237-002	0.49998	0.004
4.000-003	5.10416-001	1.23234+000	6.7624-002	5.48494-002	0.49998	0.004
3.500-003	5.27738-001	1.27417+000	6.4928-002	5.07179-002	0.49997	0.005
3.000-003	5.48467-001	1.32423+000	6.1982-002	4.62945-002	0.49997	0.005
2.500-003	5.74038-001	1.38599+000	5.8709-002	4.15085-002	0.49997	0.005
2.000-003	6.06961-001	1.46550+000	5.4989-002	3.62552-002	0.49996	0.006
1.800-003	6.23156-001	1.50461+000	5.3333-002	3.39883-002	0.49996	0.006
1.600-003	6.41771-001	1.54957+000	5.1553-002	3.16055-002	0.49995	0.006
1.400-003	6.63549-001	1.60217+000	4.9622-002	2.90866-002	0.49995	0.007
1.200-003	6.89609-001	1.66512+000	4.7500-002	2.64051-002	0.49995	0.007
1.000-003	7.21756-001	1.74277+000	4.5128-002	2.35238-002	0.49994	0.008

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.28413-001	3.09932-001	7.7434-002	9.60574-001	0.49996	0.007
9.000-001	1.31836-001	3.18204-001	7.6389-002	9.58087-001	0.49996	0.006
8.000-001	1.35771-001	3.27712-001	7.5282-002	9.55011-001	0.49997	0.005
7.000-001	1.40376-001	3.38836-001	7.4096-002	9.51075-001	0.49998	0.004
6.000-001	1.45887-001	3.52149-001	7.2802-002	9.45804-001	0.49998	0.004
5.000-001	1.52686-001	3.68571-001	7.1349-002	9.38297-001	0.49999	0.003
4.000-001	1.61441-001	3.89716-001	6.9631-002	9.26646-001	0.49999	0.002
3.500-001	1.66919-001	4.02945-001	6.8603-002	9.18028-001	0.49999	0.002
3.000-001	1.73475-001	4.18777-001	6.7388-002	9.06203-001	0.50000	0.002
2.500-001	1.81563-001	4.38307-001	6.5873-002	8.89188-001	0.50000	0.001
2.000-001	1.91977-001	4.63453-001	6.3846-002	8.63253-001	0.50000	0.001
1.800-001	1.97100-001	4.75823-001	6.2807-002	8.48908-001	0.50000	0.001
1.600-001	2.02990-001	4.90043-001	6.1578-002	8.31253-001	0.50000	0.001
1.400-001	2.09879-001	5.06678-001	6.0098-002	8.09220-001	0.50000	0.001
1.200-001	2.18125-001	5.26585-001	5.8279-002	7.81300-001	0.50000	0.001
1.000-001	2.28296-001	5.51143-001	5.5996-002	7.45290-001	0.50000	0.001
9.000-002	2.34389-001	5.65853-001	5.4623-002	7.23267-001	0.50000	0.001
8.000-002	2.41393-001	5.82763-001	5.3054-002	6.97831-001	0.50000	0.001
7.000-002	2.49587-001	6.02546-001	5.1246-002	6.68224-001	0.50000	0.000
6.000-002	2.59392-001	6.26220-001	4.9139-002	6.33426-001	0.50000	0.000
5.000-002	2.71489-001	6.55424-001	4.6653-002	5.92008-001	0.50000	0.000
4.000-002	2.87064-001	6.93027-001	4.3663-002	5.41837-001	0.50000	0.000
3.500-002	2.96808-001	7.16553-001	4.1920-002	5.12467-001	0.50000	0.000
3.000-002	3.08469-001	7.44706-001	3.9964-002	4.79430-001	0.50000	0.000
2.500-002	3.22854-001	7.79436-001	3.7740-002	4.41808-001	0.50000	0.000
2.000-002	3.41376-001	8.24153-001	3.5161-002	3.98210-001	0.50000	0.000
1.800-002	3.50488-001	8.46150-001	3.4001-002	3.78632-001	0.50000	0.000
1.600-002	3.60961-001	8.71436-001	3.2749-002	3.57539-001	0.50000	0.000
1.400-002	3.73214-001	9.01018-001	3.1386-002	3.34652-001	0.50000	0.000
1.200-002	3.87877-001	9.36419-001	2.9887-002	3.09594-001	0.50000	0.000
1.000-002	4.05966-001	9.80089-001	2.8213-002	2.81824-001	0.50000	0.000
9.000-003	4.16801-001	1.00625+000	2.7294-002	2.66685-001	0.50000	0.000
8.000-003	4.29256-001	1.03632+000	2.6306-002	2.50532-001	0.50000	0.000
7.000-003	4.43827-001	1.07150+000	2.5236-002	2.33179-001	0.50000	0.000
6.000-003	4.61265-001	1.11360+000	2.4063-002	2.14376-001	0.50000	0.000
5.000-003	4.82775-001	1.16553+000	2.2758-002	1.93769-001	0.50000	0.000
4.000-003	5.10472-001	1.23240+000	2.1273-002	1.70827-001	0.50000	0.000
3.500-003	5.27800-001	1.27423+000	2.0440-002	1.58229-001	0.50000	0.000
3.000-003	5.48537-001	1.32430+000	1.9527-002	1.44681-001	0.50000	0.000
2.500-003	5.74117-001	1.38605+000	1.8508-002	1.29954-001	0.50000	0.001
2.000-003	6.07054-001	1.46557+000	1.7347-002	1.13715-001	0.50000	0.001
1.800-003	6.23256-001	1.50469+000	1.6830-002	1.06684-001	0.50000	0.001
1.600-003	6.41880-001	1.54966+000	1.6272-002	9.92799-002	0.50000	0.001
1.400-003	6.63669-001	1.60226+000	1.5667-002	9.14380-002	0.49999	0.001
1.200-003	6.89743-001	1.66521+000	1.5001-002	8.30734-002	0.49999	0.001
1.000-003	7.21908-001	1.74287+000	1.4255-002	7.40676-002	0.49999	0.001

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	1.28412-001	3.09937-001	2.6576-002	9.62095-001	0.49995	0.006
9.000-001	1.31835-001	3.18209-001	2.5474-002	9.60163-001	0.49996	0.005
8.000-001	1.35770-001	3.27717-001	2.4310-002	9.57897-001	0.49996	0.004
7.000-001	1.40375-001	3.38841-001	2.3073-002	9.55185-001	0.49997	0.004
6.000-001	1.45886-001	3.52153-001	2.1748-002	9.51857-001	0.49998	0.003
5.000-001	1.52685-001	3.68575-001	2.0312-002	9.47834-001	0.49998	0.002
4.000-001	1.61440-001	3.89720-001	1.8731-002	9.42019-001	0.49999	0.002
3.500-001	1.66918-001	4.02950-001	1.7871-002	9.38410-001	0.49999	0.001
3.000-001	1.73475-001	4.18781-001	1.6951-002	9.34002-001	0.49999	0.001
2.500-001	1.81562-001	4.38311-001	1.5957-002	9.28438-001	0.49999	0.001
2.000-001	1.91977-001	4.63457-001	1.4868-002	9.21083-001	0.50000	0.001
1.800-001	1.97100-001	4.75827-001	1.4399-002	9.17390-001	0.50000	0.000
1.600-001	2.02989-001	4.90046-001	1.3907-002	9.13085-001	0.50000	0.000
1.400-001	2.09879-001	5.06682-001	1.3387-002	9.07968-001	0.50000	0.000
1.200-001	2.18125-001	5.26589-001	1.2835-002	9.01728-001	0.50000	0.000
1.000-001	2.28296-001	5.51147-001	1.2244-002	8.93840-001	0.50000	0.000
9.000-002	2.34389-001	5.65857-001	1.1930-002	8.89003-001	0.50000	0.000
8.000-002	2.41393-001	5.82767-001	1.1602-002	8.83324-001	0.50000	0.000
7.000-002	2.49587-001	6.02550-001	1.1257-002	8.76497-001	0.50000	0.000
6.000-002	2.59393-001	6.26224-001	1.0892-002	8.68017-001	0.50000	0.000
5.000-002	2.71489-001	6.55428-001	1.0501-002	8.56985-001	0.50000	0.000
4.000-002	2.87064-001	6.93031-001	1.0074-002	8.41596-001	0.50000	0.000
3.500-002	2.96809-001	7.16556-001	9.8397-003	8.31136-001	0.50000	0.000
3.000-002	3.08470-001	7.44710-001	9.5852-003	8.17632-001	0.50000	0.000
2.500-002	3.22856-001	7.79440-001	9.2996-003	7.99323-001	0.50000	0.000
2.000-002	3.41378-001	8.24157-001	8.9621-003	7.72893-001	0.50000	0.000
1.800-002	3.50489-001	8.46154-001	8.8041-003	7.58725-001	0.50000	0.000
1.600-002	3.60963-001	8.71440-001	8.6268-003	7.41555-001	0.50000	0.000
1.400-002	3.73216-001	9.01022-001	8.4235-003	7.20402-001	0.50000	0.000
1.200-002	3.87880-001	9.36423-001	8.1847-003	6.93857-001	0.50000	0.000
1.000-002	4.05969-001	9.80094-001	7.8960-003	6.59837-001	0.50000	0.000
9.000-003	4.16804-001	1.00625+000	7.7264-003	6.39083-001	0.50000	0.000
8.000-003	4.29259-001	1.03632+000	7.5350-003	6.15124-001	0.50000	0.000
7.000-003	4.43831-001	1.07150+000	7.3162-003	5.87224-001	0.50000	0.000
6.000-003	4.61269-001	1.11360+000	7.0629-003	5.54398-001	0.50000	0.000
5.000-003	4.82780-001	1.16553+000	6.7643-003	5.15265-001	0.50000	0.000
4.000-003	5.10478-001	1.23240+000	6.4040-003	4.67787-001	0.50000	0.000
3.500-003	5.27807-001	1.27424+000	6.1927-003	4.39978-001	0.50000	0.000
3.000-003	5.48544-001	1.32430+000	5.9539-003	4.08711-001	0.50000	0.000
2.500-003	5.74125-001	1.38606+000	5.6796-003	3.73162-001	0.50000	0.000
2.000-003	6.07063-001	1.46558+000	5.3571-003	3.32125-001	0.50000	0.000
1.800-003	6.23266-001	1.50470+000	5.2103-003	3.13781-001	0.50000	0.000
1.600-003	6.41891-001	1.54966+000	5.0504-003	2.94094-001	0.50000	0.000
1.400-003	6.63681-001	1.60227+000	4.8746-003	2.72844-001	0.50000	0.000
1.200-003	6.89757-001	1.66522+000	4.6788-003	2.49738-001	0.50000	0.000
1.000-003	7.21924-001	1.74288+000	4.4571-003	2.24371-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	9.10578-002	2.18462-001	1.7509+000	3.08269-001	0.50198	0.251
9.000-001	9.34684-002	2.24325-001	1.6685+000	2.93184-001	0.50189	0.237
8.000-001	9.62407-002	2.31064-001	1.5807+000	2.77108-001	0.50179	0.223
7.000-001	9.94853-002	2.38947-001	1.4864+000	2.59857-001	0.50166	0.207
6.000-001	1.03370-001	2.48379-001	1.3844+000	2.41176-001	0.50156	0.191
5.000-001	1.08164-001	2.60013-001	1.2726+000	2.20702-001	0.50143	0.174
4.000-001	1.14334-001	2.74990-001	1.1480+000	1.97874-001	0.50128	0.156
3.500-001	1.18203-001	2.84358-001	1.0794+000	1.85310-001	0.50120	0.146
3.000-001	1.22828-001	2.95568-001	1.0054+000	1.71756-001	0.50111	0.135
2.500-001	1.28535-001	3.09395-001	9.2466-001	1.56958-001	0.50101	0.123
2.000-001	1.35885-001	3.27195-001	8.3494-001	1.40521-001	0.50091	0.110
1.800-001	1.39501-001	3.35951-001	7.9582-001	1.33354-001	0.50086	0.105
1.600-001	1.43658-001	3.46015-001	7.5439-001	1.25764-001	0.50081	0.099
1.400-001	1.48522-001	3.57787-001	7.1020-001	1.17667-001	0.50075	0.093
1.200-001	1.54342-001	3.71875-001	6.6263-001	1.08953-001	0.50069	0.087
1.000-001	1.61524-001	3.89251-001	6.1079-001	9.94578-002	0.50063	0.080
9.000-002	1.65825-001	3.99659-001	5.8287-001	9.43449-002	0.50059	0.076
8.000-002	1.70771-001	4.11623-001	5.5332-001	8.89331-002	0.50055	0.072
7.000-002	1.76556-001	4.25618-001	5.2182-001	8.31643-002	0.50051	0.068
6.000-002	1.83480-001	4.42365-001	4.8792-001	7.69584-002	0.50047	0.063
5.000-002	1.92022-001	4.63023-001	4.5099-001	7.02003-002	0.50042	0.059
4.000-002	2.03020-001	4.89620-001	4.1005-001	6.27124-002	0.50037	0.054
3.500-002	2.09901-001	5.06259-001	3.8760-001	5.86091-002	0.50034	0.051
3.000-002	2.18136-001	5.26171-001	3.6343-001	5.41954-002	0.50030	0.048
2.500-002	2.28294-001	5.50732-001	3.3710-001	4.93890-002	0.50027	0.045
2.000-002	2.41374-001	5.82354-001	3.0787-001	4.40633-002	0.50023	0.042
1.800-002	2.47807-001	5.97909-001	2.9513-001	4.17445-002	0.50021	0.041
1.600-002	2.55203-001	6.15789-001	2.8163-001	3.92904-002	0.50019	0.039
1.400-002	2.63855-001	6.36706-001	2.6722-001	3.66744-002	0.50016	0.038
1.200-002	2.74208-001	6.61736-001	2.5168-001	3.38600-002	0.50014	0.037
1.000-002	2.86979-001	6.92613-001	2.3471-001	3.07946-002	0.50011	0.035
9.000-003	2.94629-001	7.11107-001	2.2555-001	2.91441-002	0.50009	0.035
8.000-003	3.03422-001	7.32367-001	2.1583-001	2.73973-002	0.50008	0.034
7.000-003	3.13708-001	7.57237-001	2.0543-001	2.55351-002	0.50006	0.034
6.000-003	3.26017-001	7.86999-001	1.9420-001	2.35318-002	0.50003	0.033
5.000-003	3.41200-001	8.23711-001	1.8190-001	2.13501-002	0.50001	0.033
4.000-003	3.60746-001	8.70980-001	1.6816-001	1.89330-002	0.49998	0.033
3.500-003	3.72974-001	9.00551-001	1.6057-001	1.76089-002	0.49996	0.033
3.000-003	3.87605-001	9.35939-001	1.5234-001	1.61854-002	0.49993	0.034
2.500-003	4.05651-001	9.79590-001	1.4330-001	1.46366-002	0.49991	0.035
2.000-003	4.28883-001	1.03579+000	1.3314-001	1.29234-002	0.49987	0.036
1.800-003	4.40309-001	1.06364+000	1.2866-001	1.21789-002	0.49985	0.037
1.600-003	4.53441-001	1.09522+000	1.2389-001	1.13924-002	0.49983	0.038
1.400-003	4.68803-001	1.13239+000	1.1874-001	1.05559-002	0.49981	0.039
1.200-003	4.87183-001	1.17688+000	1.1314-001	9.65875-003	0.49979	0.041
1.000-003	5.09850-001	1.23175+000	1.0693-001	8.68599-003	0.49975	0.044

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	9.08414-002	2.19096-001	4.5098-001	7.80354-001	0.50010	0.036
9.000-001	9.32589-002	2.24945-001	4.3815-001	7.57348-001	0.50011	0.033
8.000-001	9.60388-002	2.31669-001	4.2338-001	7.30803-001	0.50011	0.030
7.000-001	9.92918-002	2.39536-001	4.0624-001	6.99961-001	0.50011	0.027
6.000-001	1.03186-001	2.48950-001	3.8620-001	6.63814-001	0.50011	0.024
5.000-001	1.07990-001	2.60564-001	3.6247-001	6.20957-001	0.50011	0.021
4.000-001	1.14178-001	2.75518-001	3.3392-001	5.69313-001	0.50010	0.018
3.500-001	1.18050-001	2.84873-001	3.1731-001	5.39225-001	0.50010	0.017
3.000-001	1.22685-001	2.96069-001	2.9872-001	5.05514-001	0.50010	0.015
2.500-001	1.28402-001	3.09880-001	2.7766-001	4.67294-001	0.50009	0.014
2.000-001	1.35764-001	3.27663-001	2.5340-001	4.23229-001	0.50008	0.012
1.800-001	1.39385-001	3.36411-001	2.4256-001	4.03518-001	0.50008	0.011
1.600-001	1.43549-001	3.46466-001	2.3091-001	3.82333-001	0.50007	0.011
1.400-001	1.48420-001	3.58230-001	2.1831-001	3.59403-001	0.50007	0.010
1.200-001	1.54249-001	3.72307-001	2.0455-001	3.34359-001	0.50007	0.009
1.000-001	1.61440-001	3.89673-001	1.8934-001	3.06672-001	0.50006	0.008
9.000-002	1.65747-001	4.00076-001	1.8107-001	2.91601-001	0.50006	0.008
8.000-002	1.70699-001	4.12033-001	1.7225-001	2.75534-001	0.50005	0.007
7.000-002	1.76492-001	4.26022-001	1.6278-001	2.58281-001	0.50005	0.007
6.000-002	1.83425-001	4.42763-001	1.5252-001	2.39587-001	0.50005	0.007
5.000-002	1.91977-001	4.63414-001	1.4127-001	2.19080-001	0.50004	0.006
4.000-002	2.02989-001	4.90004-001	1.2871-001	1.96194-001	0.50004	0.005
3.500-002	2.09478-001	5.06640-001	1.2178-001	1.83584-001	0.50003	0.005
3.000-002	2.16123-001	5.26548-001	1.1431-001	1.69971-001	0.50003	0.005
2.500-002	2.28294-001	5.51106-001	1.0613-001	1.55092-001	0.50003	0.005
2.000-002	2.41389-001	5.82726-001	9.7027-002	1.38545-001	0.50002	0.004
1.800-002	2.47831-001	5.98280-001	9.3048-002	1.31322-001	0.50002	0.004
1.600-002	2.55236-001	6.16160-001	8.8826-002	1.23666-001	0.50002	0.004
1.400-002	2.63899-001	6.37078-001	8.4313-002	1.15493-001	0.50002	0.004
1.200-002	2.74266-001	6.62110-001	7.9442-002	1.06807-001	0.50001	0.004
1.000-002	2.87055-001	6.92989-001	7.4114-002	9.70807-002	0.50001	0.004
9.000-003	2.94715-001	7.11486-001	7.1235-002	9.19028-002	0.50001	0.003
8.000-003	3.03521-001	7.32749-001	6.8177-002	8.64181-002	0.50001	0.003
7.000-003	3.13823-001	7.57624-001	6.4906-002	8.05471-002	0.50001	0.003
6.000-003	3.26152-001	7.87392-001	6.1369-002	7.42675-002	0.50000	0.003
5.000-003	3.41360-001	8.24113-001	5.7493-002	6.74017-002	0.50000	0.003
4.000-003	3.60941-001	8.71395-001	5.3160-002	5.97890-002	0.50000	0.003
3.500-003	3.73192-001	9.00976-001	5.0765-002	5.54167-002	0.50000	0.003
3.000-003	3.87852-001	9.36375-001	4.8169-002	5.11287-002	0.49999	0.003
2.500-003	4.05937-001	9.80044-001	4.5313-002	4.62439-002	0.49999	0.003
2.000-003	4.29222-001	1.03627+000	4.2106-002	4.08384-002	0.49999	0.004
1.800-003	4.40676-001	1.06393+000	4.0693-002	3.84888-002	0.49999	0.004
1.600-003	4.53842-001	1.09572+000	3.9184-002	3.60059-002	0.49998	0.004
1.400-003	4.69245-001	1.13292+000	3.7558-002	3.33649-002	0.49998	0.004
1.200-003	4.87678-001	1.17743+000	3.5787-002	3.05320-002	0.49995	0.004
1.000-003	5.10415-001	1.23234+000	3.3827-002	2.74597-002	0.49998	0.004

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	9.08196-002	2.19159-001	6.6060-002	9.77548-001	0.49992	0.014
9.000-001	9.32378-002	2.25007-001	6.5506-002	9.75721-001	0.49993	0.012
8.000-001	9.60184-002	2.31730-001	6.4909-002	9.73381-001	0.49994	0.011
7.000-001	9.92723-002	2.39595-001	6.4254-002	9.70267-001	0.49996	0.009
6.000-001	1.03167-001	2.49008-001	6.3515-002	9.65911-001	0.49997	0.007
5.000-001	1.07973-001	2.60619-001	6.2640-002	9.59409-001	0.49998	0.006
4.000-001	1.14162-001	2.75571-001	6.1522-002	9.48815-001	0.49999	0.005
3.500-001	1.18035-001	2.84925-001	6.0801-002	9.40701-001	0.49999	0.004
3.000-001	1.22670-001	2.96119-001	5.9894-002	9.29313-001	0.49999	0.003
2.500-001	1.28388-001	3.09929-001	5.8688-002	9.12581-001	0.50000	0.003
2.000-001	1.35752-001	3.27710-001	5.6964-002	8.86622-001	0.50000	0.002
1.800-001	1.39374-001	3.36457-001	5.6044-002	8.72126-001	0.50000	0.002
1.600-001	1.43538-001	3.46511-001	5.4932-002	8.56202-001	0.50000	0.002
1.400-001	1.48409-001	3.58274-001	5.3567-002	8.31755-001	0.50000	0.002
1.200-001	1.54239-001	3.72351-001	5.1861-002	8.03242-001	0.50000	0.001
1.000-001	1.61431-001	3.89716-001	4.9691-002	7.66425-001	0.50000	0.001
9.000-002	1.65740-001	4.00117-001	4.8376-002	7.43910-001	0.50000	0.001
8.000-002	1.70692-001	4.12074-001	4.6867-002	7.17922-001	0.50000	0.001
7.000-002	1.76486-001	4.26063-001	4.5122-002	6.87703-001	0.50000	0.001
6.000-002	1.83419-001	4.42803-001	4.3085-002	6.52243-001	0.50000	0.001
5.000-002	1.91973-001	4.63454-001	4.0678-002	6.10129-001	0.50000	0.001
4.000-002	2.02986-001	4.90043-001	3.7784-002	5.59263-001	0.50000	0.001
3.500-002	2.09876-001	5.06678-001	3.6100-002	5.29564-001	0.50000	0.001
3.000-002	2.18122-001	5.26586-001	3.4213-002	4.94225-001	0.50000	0.001
2.500-002	2.28294-001	5.51143-001	3.2074-002	4.58344-001	0.50000	0.000
2.000-002	2.41391-001	5.82763-001	2.9606-002	4.14552-001	0.50000	0.000
1.800-002	2.47833-001	5.98317-001	2.8501-002	3.94920-001	0.50000	0.000
1.600-002	2.55239-001	6.16197-001	2.7311-002	3.73789-001	0.50000	0.000
1.400-002	2.63904-001	6.37115-001	2.6022-002	3.50880-001	0.50000	0.000
1.200-002	2.74272-001	6.62148-001	2.4611-002	3.25812-001	0.50000	0.000
1.000-002	2.87063-001	6.93027-001	2.3045-002	2.98040-001	0.50000	0.000
9.000-003	2.94724-001	7.11524-001	2.2191-002	2.82897-001	0.50000	0.000
8.000-003	3.03531-001	7.32787-001	2.1277-002	2.66731-001	0.50000	0.000
7.000-003	3.13835-001	7.57663-001	2.0293-002	2.49350-001	0.50000	0.000
6.000-003	3.26165-001	7.87431-001	1.9221-002	2.30489-001	0.50000	0.000
5.000-003	3.41376-001	8.24153-001	1.8039-002	2.09769-001	0.50000	0.000
4.000-003	3.60961-001	8.71436-001	1.6708-002	1.86611-001	0.50000	0.000
3.500-003	3.73214-001	9.01018-001	1.5969-002	1.73842-001	0.50000	0.000
3.000-003	3.87877-001	9.36419-001	1.5165-002	1.60051-001	0.50000	0.000
2.500-003	4.05965-001	9.80089-001	1.4277-002	1.44979-001	0.50000	0.000
2.000-003	4.29256-001	1.03632+000	1.3278-002	1.28231-001	0.50000	0.000
1.800-003	4.40712-001	1.06398+000	1.2836-002	1.20930-001	0.50000	0.000
1.600-003	4.53882-001	1.09577+000	1.2364-002	1.13201-001	0.50000	0.000
1.400-003	4.69289-001	1.13297+000	1.1855-002	1.04966-001	0.50000	0.000
1.200-003	4.87727-001	1.17742+000	1.1299-002	9.61176-002	0.50000	0.000
1.000-003	5.10472-001	1.23240+000	1.0683-002	8.65043-002	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	9.08174-002	2.19165-001	1.6221-002	9.80641-001	0.49990	0.012
9.000-001	9.32357-002	2.25013-001	1.5668-002	9.79628-001	0.49991	0.010
8.000-001	9.60164-002	2.31736-001	1.5085-002	9.78436-001	0.49993	0.009
7.000-001	9.92703-002	2.39601-001	1.4465-002	9.77004-001	0.49994	0.007
6.000-001	1.03165-001	2.49013-001	1.3801-002	9.75237-001	0.49995	0.006
5.000-001	1.07971-001	2.60625-001	1.3081-002	9.72979-001	0.49996	0.004
4.000-001	1.14161-001	2.75576-001	1.2289-002	9.69945-001	0.49997	0.003
3.500-001	1.18034-001	2.84930-001	1.1857-002	9.67975-001	0.49998	0.003
3.000-001	1.22669-001	2.96124-001	1.1395-002	9.65545-001	0.49998	0.002
2.500-001	1.28387-001	3.09934-001	1.0895-002	9.62435-001	0.49999	0.002
2.000-001	1.35750-001	3.27715-001	1.0347-002	9.58241-001	0.49999	0.001
1.800-001	1.39373-001	3.36461-001	1.0111-002	9.56094-001	0.49999	0.001
1.600-001	1.43537-001	3.46516-001	9.8620-003	9.53553-001	0.49999	0.001
1.400-001	1.48408-001	3.58278-001	9.5989-003	9.50474-001	0.50000	0.001
1.200-001	1.54239-001	3.72355-001	9.3185-003	9.46620-001	0.50000	0.001
1.000-001	1.61431-001	3.89720-001	9.0163-003	9.41576-001	0.50000	0.000
9.000-002	1.65739-001	4.00121-001	8.8551-003	9.38377-001	0.50000	0.000
8.000-002	1.70691-001	4.12078-001	8.6853-003	9.34509-001	0.50000	0.000
7.000-002	1.76485-001	4.26067-001	8.5053-003	9.29689-001	0.50000	0.000
6.000-002	1.83419-001	4.42807-001	8.3118-003	9.23433-001	0.50000	0.000
5.000-002	1.91972-001	4.63457-001	8.0996-003	9.14838-001	0.50000	0.000
4.000-002	2.02985-001	4.90047-001	7.8582-003	9.02033-001	0.50000	0.000
3.500-002	2.09876-001	5.06682-001	7.7198-003	8.92848-001	0.50000	0.000
3.000-002	2.18122-001	5.26589-001	7.5622-003	8.80511-001	0.50000	0.000
2.500-002	2.28294-001	5.51147-001	7.3745-003	8.63114-001	0.50000	0.000
2.000-002	2.41391-001	5.82767-001	7.1357-003	8.37066-001	0.50000	0.000
1.800-002	2.47834-001	5.98321-001	7.0175-003	8.22800-001	0.50000	0.000
1.600-002	2.55240-001	6.16201-001	6.8803-003	8.05326-001	0.50000	0.000
1.400-002	2.63904-001	6.37119-001	6.7180-003	7.83602-001	0.50000	0.000
1.200-002	2.74273-001	6.62151-001	6.5216-003	7.56149-001	0.50000	0.000
1.000-002	2.87063-001	6.93031-001	6.2782-003	7.20793-001	0.50000	0.000
9.000-003	2.94725-001	7.11528-001	6.1330-003	6.99176-001	0.50000	0.000
8.000-003	3.03532-001	7.32791-001	5.9678-003	6.74199-001	0.50000	0.000
7.000-003	3.13836-001	7.57666-001	5.7778-003	6.45106-001	0.50000	0.000
6.000-003	3.26167-001	7.87435-001	5.5570-003	6.10874-001	0.50000	0.000
5.000-003	3.41377-001	8.24157-001	5.2964-003	5.70069-001	0.50000	0.000
4.000-003	3.60963-001	8.71440-001	4.9827-003	5.20551-001	0.50000	0.000
3.500-003	3.73216-001	9.01022-001	4.7994-003	4.91520-001	0.50000	0.000
3.000-003	3.87879-001	9.36424-001	4.5932-003	4.58836-001	0.50000	0.000
2.500-003	4.05968-001	9.80094-001	4.3579-003	4.21587-001	0.50000	0.000
2.000-003	4.29259-001	1.03632+000	4.0837-003	3.78409-001	0.50000	0.000
1.800-003	4.40716-001	1.06398+000	3.9598-003	3.59025-001	0.50000	0.000
1.600-003	4.53886-001	1.09578+000	3.8256-003	3.38150-001	0.50000	0.000
1.400-003	4.69294-001	1.13298+000	3.6789-003	3.15520-001	0.50000	0.000
1.200-003	4.87732-001	1.17749+000	3.5167-003	2.90776-001	0.50000	0.000
1.000-003	5.10478-001	1.23240+000	3.3347-003	2.63415-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.78695-002	1.37568-001	1.7103+000	3.08541-001	0.50500	0.616
9.000-001	5.93844-002	1.41290-001	1.6279+000	2.93444-001	0.50477	0.583
8.000-001	6.11275-002	1.45568-001	1.5401+000	2.77358-001	0.50452	0.547
7.000-001	6.31689-002	1.50571-001	1.4459+000	2.60097-001	0.50424	0.510
6.000-001	6.56142-002	1.56557-001	1.3440+000	2.41408-001	0.50395	0.471
5.000-001	6.86336-002	1.63937-001	1.2323+000	2.20928-001	0.50362	0.428
4.000-001	7.25252-002	1.73436-001	1.1077+000	1.98098-001	0.50325	0.382
3.500-001	7.49616-002	1.79376-001	1.0392+000	1.85535-001	0.50305	0.357
3.000-001	7.78788-002	1.86483-001	9.6530-001	1.71985-001	0.50283	0.330
2.500-001	8.14793-002	1.95248-001	8.8462-001	1.57193-001	0.50258	0.301
2.000-001	8.61176-002	2.06529-001	7.9504-001	1.40768-001	0.50231	0.269
1.800-001	8.84001-002	2.12077-001	7.5599-001	1.33608-001	0.50220	0.255
1.600-001	9.10244-002	2.18454-001	7.1464-001	1.26026-001	0.50207	0.241
1.400-001	9.40954-002	2.25912-001	6.7054-001	1.17941-001	0.50194	0.225
1.200-001	9.77712-002	2.34836-001	6.2309-001	1.09240-001	0.50179	0.209
1.000-001	1.02307-001	2.45842-001	5.7141-001	9.97632-002	0.50164	0.191
9.000-002	1.05024-001	2.52434-001	5.4359-001	9.46618-002	0.50155	0.181
8.000-002	1.08148-001	2.60010-001	5.1415-001	8.92637-002	0.50146	0.171
7.000-002	1.11804-001	2.68872-001	4.8278-001	8.35114-002	0.50137	0.160
6.000-002	1.16179-001	2.79477-001	4.4904-001	7.73259-002	0.50126	0.148
5.000-002	1.21577-001	2.92556-001	4.1233-001	7.05933-002	0.50115	0.136
4.000-002	1.28528-001	3.09394-001	3.7167-001	6.31391-002	0.50103	0.122
3.500-002	1.32878-001	3.19927-001	3.4941-001	5.90571-002	0.50096	0.114
3.000-002	1.38084-001	3.32531-001	3.2547-001	5.46690-002	0.50088	0.106
2.500-002	1.44506-001	3.48077-001	2.9943-001	4.98940-002	0.50080	0.097
2.000-002	1.52776-001	3.68091-001	2.7059-001	4.46083-002	0.50071	0.088
1.800-002	1.56844-001	3.77935-001	2.5805-001	4.23089-002	0.50067	0.084
1.600-002	1.61521-001	3.89251-001	2.4478-001	3.98767-002	0.50063	0.079
1.400-002	1.66993-001	4.02488-001	2.3064-001	3.72856-002	0.50059	0.075
1.200-002	1.73541-001	4.18329-001	2.1543-001	3.45007-002	0.50054	0.070
1.000-002	1.81619-001	4.37868-001	1.9889-001	3.14699-002	0.50048	0.064
9.000-003	1.86458-001	4.49571-001	1.8998-001	2.98393-002	0.50045	0.062
8.000-003	1.92021-001	4.63023-001	1.8056-001	2.81144-002	0.50042	0.059
7.000-003	1.98528-001	4.78761-001	1.7052-001	2.62767-002	0.50039	0.056
6.000-003	2.06316-001	4.97593-001	1.5971-001	2.43009-002	0.50035	0.052
5.000-003	2.15924-001	5.20823-001	1.4794-001	2.21502-002	0.50031	0.049
4.000-003	2.28294-001	5.50732-001	1.3490-001	1.97683-002	0.50027	0.045
3.500-003	2.36033-001	5.69443-001	1.2774-001	1.84633-002	0.50024	0.043
3.000-003	2.45294-001	5.91833-001	1.2003-001	1.70599-002	0.50021	0.041
2.500-003	2.56719-001	6.19453-001	1.1163-001	1.55317-002	0.50018	0.039
2.000-003	2.71427-001	6.55014-001	1.0230-001	1.38386-002	0.50015	0.037
1.800-003	2.78662-001	6.72506-001	9.8221-002	1.31014-002	0.50013	0.036
1.600-003	2.86979-001	6.92613-001	9.3900-002	1.23213-002	0.50011	0.035
1.400-003	2.96708-001	7.16135-001	8.9283-002	1.14897-002	0.50009	0.035
1.200-003	3.08350-001	7.44284-001	8.4300-002	1.05951-002	0.50007	0.034
1.000-003	3.22711-001	7.79006-001	7.8847-002	9.62080-003	0.50004	0.033

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.75095-002	1.38519-001	4.3780-001	7.84054-001	0.50026	0.090
9.000-001	5.90340-002	1.42219-001	4.2505-001	7.60878-001	0.50027	0.082
8.000-001	6.07877-002	1.46472-001	4.1035-001	7.34139-001	0.50028	0.075
7.000-001	6.28408-002	1.51448-001	3.9328-001	7.03077-001	0.50028	0.068
6.000-001	6.52992-002	1.57403-001	3.7329-001	6.66683-001	0.50028	0.060
5.000-001	6.83337-002	1.64749-001	3.4963-001	6.23551-001	0.50028	0.053
4.000-001	7.22430-002	1.74208-001	3.2114-001	5.71605-001	0.50026	0.046
3.500-001	7.46898-002	1.80126-001	3.0457-001	5.41357-001	0.50025	0.042
3.000-001	7.76185-002	1.87208-001	2.8601-001	5.07483-001	0.50024	0.038
2.500-001	8.12322-002	1.95944-001	2.6499-001	4.69098-001	0.50023	0.034
2.000-001	8.58861-002	2.07193-001	2.4078-001	4.24875-001	0.50021	0.030
1.800-001	8.81757-002	2.12726-001	2.2996-001	4.05104-001	0.50020	0.028
1.600-001	9.08080-002	2.19087-001	2.1834-001	3.83862-001	0.50019	0.026
1.400-001	9.38876-002	2.26528-001	2.0577-001	3.60881-001	0.50018	0.024
1.200-001	9.75733-002	2.35433-001	1.9205-001	3.35794-001	0.50017	0.022
1.000-001	1.02120-001	2.46417-001	1.7689-001	3.08077-001	0.50016	0.020
9.000-002	1.04844-001	2.52997-001	1.6865-001	2.92998-001	0.50015	0.019
8.000-002	1.07975-001	2.60561-001	1.5986-001	2.76928-001	0.50014	0.018
7.000-002	1.11639-001	2.69409-001	1.5044-001	2.59682-001	0.50013	0.017
6.000-002	1.16023-001	2.79998-001	1.4023-001	2.41006-001	0.50012	0.015
5.000-002	1.21431-001	2.93061-001	1.2904-001	2.20535-001	0.50011	0.014
4.000-002	1.28395-001	3.09879-001	1.1657-001	1.97708-001	0.50010	0.012
3.500-002	1.32752-001	3.20401-001	1.0971-001	1.85143-001	0.50009	0.012
3.000-002	1.37966-001	3.32993-001	1.0230-001	1.71588-001	0.50009	0.011
2.500-002	1.44398-001	3.48526-001	9.4218-002	1.56786-001	0.50008	0.010
2.000-002	1.52680-001	3.68526-001	8.5236-002	1.40342-001	0.50007	0.009
1.800-002	1.56754-001	3.78364-001	8.1319-002	1.33172-001	0.50007	0.008
1.600-002	1.61437-001	3.89673-001	7.7169-002	1.25576-001	0.50006	0.008
1.400-002	1.66916-001	4.02904-001	7.2742-002	1.17474-001	0.50006	0.008
1.200-002	1.73473-001	4.18736-001	6.7976-002	1.08751-001	0.50005	0.007
1.000-002	1.81561-001	4.38267-001	6.2781-002	9.92459-002	0.50005	0.006
9.000-003	1.86406-001	4.49966-001	5.9983-002	9.41265-002	0.50005	0.006
8.000-003	1.91976-001	4.63415-001	5.7019-002	8.87072-002	0.50004	0.006
7.000-003	1.98492-001	4.79148-001	5.3859-002	8.29294-002	0.50004	0.006
6.000-003	2.06289-001	4.97976-001	5.0457-002	7.67127-002	0.50004	0.005
5.000-003	2.15908-001	5.21201-001	4.6749-002	6.99410-002	0.50003	0.005
4.000-003	2.28293-001	5.51106-001	4.2635-002	6.24259-002	0.50003	0.005
3.500-003	2.36042-001	5.69816-001	4.0378-002	5.83220-002	0.50002	0.004
3.000-003	2.45314-001	5.92205-001	3.7946-002	5.38958-002	0.50002	0.004
2.500-003	2.56753-001	6.19825-001	3.5293-002	4.90746-002	0.50002	0.004
2.000-003	2.71481-001	6.55387-001	3.2345-002	4.37309-002	0.50001	0.004
1.800-003	2.78726-001	6.72880-001	3.1058-002	4.14038-002	0.50001	0.004
1.600-003	2.87055-001	6.92989-001	2.9693-002	3.89405-002	0.50001	0.004
1.400-003	2.96798-001	7.16515-001	2.8234-002	3.63144-002	0.50001	0.003
1.200-003	3.08457-001	7.44668-001	2.6659-002	3.34890-002	0.50001	0.003
1.000-003	3.22840-001	7.79397-001	2.4936-002	3.04115-002	0.50000	0.003

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.74727-002	1.38615-001	5.9039-002	9.88011-001	0.49979	0.036
9.000-001	5.89983-002	1.42312-001	5.8781-002	9.86601-001	0.49983	0.031
8.000-001	6.07531-002	1.46563-001	5.8490-002	9.84724-001	0.49986	0.027
7.000-001	6.28074-002	1.51536-001	5.8155-002	9.82127-001	0.49989	0.023
6.000-001	6.52672-002	1.57488-001	5.7748-002	9.78345-001	0.49992	0.019
5.000-001	6.83032-002	1.64830-001	5.7219-002	9.72471-001	0.49994	0.015
4.000-001	7.22144-002	1.74285-001	5.6460-002	9.62521-001	0.49997	0.011
3.500-001	7.46622-002	1.80201-001	5.5923-002	9.54705-001	0.49998	0.010
3.000-001	7.75921-002	1.87281-001	5.5200-002	9.43556-001	0.49999	0.008
2.500-001	8.12072-002	1.96014-001	5.4176-002	9.26941-001	0.49999	0.007
2.000-001	8.58627-002	2.07260-001	5.2630-002	9.00859-001	0.50000	0.005
1.800-001	8.81531-002	2.12791-001	5.1778-002	8.86201-001	0.50000	0.005
1.600-001	9.07861-002	2.19150-001	5.0732-002	8.68025-001	0.50000	0.004
1.400-001	9.38666-002	2.26590-001	4.9430-002	8.45210-001	0.50001	0.004
1.200-001	9.75533-002	2.35493-001	4.7786-002	8.16183-001	0.50001	0.003
1.000-001	1.02101-001	2.46475-001	4.5674-002	7.78676-001	0.50001	0.003
9.000-002	1.04826-001	2.53054-001	4.4388-002	7.55741-001	0.50001	0.003
8.000-002	1.07958-001	2.60616-001	4.2907-002	7.29276-001	0.50001	0.002
7.000-002	1.11622-001	2.69463-001	4.1190-002	6.98525-001	0.50001	0.002
6.000-002	1.16007-001	2.80051-001	3.9182-002	6.62479-001	0.50001	0.002
5.000-002	1.21416-001	2.93111-001	3.6806-002	6.19733-001	0.50001	0.002
4.000-002	1.28381-001	3.09928-001	3.3948-002	5.68210-001	0.50001	0.001
3.500-002	1.32739-001	3.20449-001	3.2286-002	5.38184-001	0.50001	0.001
3.000-002	1.37954-001	3.33040-001	3.0424-002	5.04535-001	0.50001	0.001
2.500-002	1.44387-001	3.48571-001	2.8315-002	4.66375-001	0.50001	0.001
2.000-002	1.52670-001	3.68570-001	2.5887-002	4.22366-001	0.50001	0.001
1.800-002	1.56745-001	3.78407-001	2.4801-002	4.02674-001	0.50001	0.001
1.600-002	1.61429-001	3.89716-001	2.3634-002	3.81506-001	0.50001	0.001
1.400-002	1.66909-001	4.02945-001	2.2371-002	3.58589-001	0.50001	0.001
1.200-002	1.73466-001	4.18777-001	2.0993-002	3.33553-001	0.50000	0.001
1.000-002	1.81556-001	4.38307-001	1.9469-002	3.05867-001	0.50000	0.001
9.000-003	1.86401-001	4.50006-001	1.8639-002	2.90792-001	0.50000	0.001
8.000-003	1.91971-001	4.63454-001	1.7755-002	2.74717-001	0.50000	0.001
7.000-003	1.98488-001	4.79186-001	1.6805-002	2.57453-001	0.50000	0.001
6.000-003	2.06286-001	4.98014-001	1.5776-002	2.38740-001	0.50000	0.001
5.000-003	2.15906-001	5.21239-001	1.4646-002	2.18207-001	0.50000	0.000
4.000-003	2.28293-001	5.51143-001	1.3384-002	1.95281-001	0.50000	0.000
3.500-003	2.36043-001	5.69853-001	1.2688-002	1.82645-001	0.50000	0.000
3.000-003	2.45316-001	5.92242-001	1.1935-002	1.69000-001	0.50000	0.000
2.500-003	2.56757-001	6.19862-001	1.1111-002	1.54081-001	0.50000	0.000
2.000-003	2.71487-001	6.55424-001	1.0193-002	1.37483-001	0.50000	0.000
1.800-003	2.78733-001	6.72918-001	9.7912-003	1.30236-001	0.50000	0.000
1.600-003	2.87062-001	6.93027-001	9.3644-003	1.22554-001	0.50000	0.000
1.400-003	2.96807-001	7.16553-001	8.9076-003	1.14351-001	0.50000	0.000
1.200-003	3.08468-001	7.44706-001	8.4139-003	1.05511-001	0.50000	0.000
1.000-003	3.22853-001	7.79436-001	7.8730-003	9.58684-002	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	5.74691-002	1.38625-001	9.8135-003	9.92134-001	0.49974	0.031
9.000-001	5.89947-002	1.42321-001	9.5919-003	9.91713-001	0.49978	0.026
8.000-001	6.07496-002	1.46572-001	9.3581-003	9.91214-001	0.49982	0.022
7.000-001	6.28040-002	1.51545-001	9.1096-003	9.90611-001	0.49985	0.018
6.000-001	6.52640-002	1.57496-001	8.8433-003	9.89861-001	0.49988	0.014
5.000-001	6.83002-002	1.64838-001	8.5547-003	9.88893-001	0.49991	0.011
4.000-001	7.22115-002	1.74293-001	8.2367-003	9.87571-001	0.49994	0.008
3.500-001	7.46594-002	1.80209-001	8.0634-003	9.86698-001	0.49995	0.007
3.000-001	7.75895-002	1.87288-001	7.8779-003	9.85600-001	0.49996	0.005
2.500-001	8.12047-002	1.96021-001	7.6771-003	9.84160-001	0.49997	0.004
2.000-001	8.58604-002	2.07266-001	7.4560-003	9.82144-001	0.49998	0.003
1.800-001	8.81508-002	2.12798-001	7.3603-003	9.81073-001	0.49998	0.003
1.600-001	9.07839-002	2.19157-001	7.2593-003	9.79770-001	0.49999	0.002
1.400-001	9.38645-002	2.26596-001	7.1520-003	9.78131-001	0.49999	0.002
1.200-001	9.75513-002	2.35499-001	7.0367-003	9.75981-001	0.49999	0.001
1.000-001	1.02100-001	2.46481-001	6.9107-003	9.72991-001	0.49999	0.001
9.000-002	1.04824-001	2.53059-001	6.8424-003	9.70985-001	0.49999	0.001
8.000-002	1.07956-001	2.60622-001	6.7693-003	9.68446-001	0.50000	0.001
7.000-002	1.11620-001	2.69469-001	6.6898-003	9.65106-001	0.50000	0.001
6.000-002	1.16005-001	2.80056-001	6.6012-003	9.60505-001	0.50000	0.001
5.000-002	1.21415-001	2.93116-001	6.4984-003	9.53732-001	0.50000	0.000
4.000-002	1.28380-001	3.09933-001	6.3708-003	9.42854-001	0.50000	0.000
3.500-002	1.32738-001	3.20454-001	6.2906-003	9.34607-001	0.50000	0.000
3.000-002	1.37953-001	3.33044-001	6.1918-003	9.23105-001	0.50000	0.000
2.500-002	1.44386-001	3.48576-001	6.0631-003	9.06307-001	0.50000	0.000
2.000-002	1.52669-001	3.68574-001	5.8827-003	8.80373-001	0.50000	0.000
1.800-002	1.56744-001	3.78411-001	5.7877-003	8.65928-001	0.50000	0.000
1.600-002	1.61428-001	3.89720-001	5.6734-003	8.48090-001	0.50000	0.000
1.400-002	1.66908-001	4.02949-001	5.5339-003	8.25773-001	0.50000	0.000
1.200-002	1.73465-001	4.18781-001	5.3605-003	7.97442-001	0.50000	0.000
1.000-002	1.81555-001	4.38311-001	5.1407-003	7.60874-001	0.50000	0.000
9.000-003	1.86401-001	4.50010-001	5.0078-003	7.38510-001	0.50000	0.000
8.000-003	1.91971-001	4.63458-001	4.8555-003	7.12691-001	0.50000	0.000
7.000-003	1.98488-001	4.79190-001	4.6795-003	6.82660-001	0.50000	0.000
6.000-003	2.06286-001	4.98018-001	4.4742-003	6.47403-001	0.50000	0.000
5.000-003	2.15906-001	5.21243-001	4.2316-003	6.05505-001	0.50000	0.000
4.000-003	2.28293-001	5.51147-001	3.9400-003	5.54855-001	0.50000	0.000
3.500-003	2.36043-001	5.69857-001	3.7703-003	5.25257-001	0.50000	0.000
3.000-003	2.45317-001	5.92246-001	3.5801-003	4.92011-001	0.50000	0.000
2.500-003	2.56757-001	6.19866-001	3.3643-003	4.54207-001	0.50000	0.000
2.000-003	2.71487-001	6.55428-001	3.1150-003	4.10466-001	0.50000	0.000
1.800-003	2.78733-001	6.72922-001	3.0032-003	3.90844-001	0.50000	0.000
1.600-003	2.87063-001	6.93031-001	2.8829-003	3.69714-001	0.50000	0.000
1.400-003	2.96808-001	7.16557-001	2.7522-003	3.46797-001	0.50000	0.000
1.200-003	3.08469-001	7.44710-001	2.6090-003	3.21710-001	0.50000	0.000
1.000-003	3.22855-001	7.79440-001	2.4500-003	2.93906-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	4.12386-002	9.65706-002	1.6966+000	3.08614-001	0.51008	1.205
9.000-001	4.22990-002	9.92196-002	1.6142+000	2.93512-001	0.50960	1.140
8.000-001	4.35202-002	1.02263-001	1.5265+000	2.77421-001	0.50909	1.072
7.000-001	4.49517-002	1.05821-001	1.4323+000	2.60155-001	0.50854	1.001
6.000-001	4.66679-002	1.10076-001	1.3304+000	2.41462-001	0.50794	0.924
5.000-001	4.87889-002	1.15322-001	1.2187+000	2.20978-001	0.50727	0.842
4.000-001	5.15250-002	1.22069-001	1.0941+000	1.98145-001	0.50653	0.752
3.500-001	5.32392-002	1.26288-001	1.0256+000	1.85580-001	0.50612	0.703
3.000-001	5.52925-002	1.31333-001	9.5172-001	1.72029-001	0.50568	0.651
2.500-001	5.78279-002	1.37554-001	8.7106-001	1.57237-001	0.50519	0.594
2.000-001	6.10957-002	1.45558-001	7.8149-001	1.40812-001	0.50465	0.531
1.800-001	6.27043-002	1.49493-001	7.4245-001	1.33653-001	0.50442	0.504
1.600-001	6.45542-002	1.54015-001	7.0111-001	1.26071-001	0.50417	0.475
1.400-001	6.67195-002	1.59304-001	6.5703-001	1.17987-001	0.50390	0.445
1.200-001	6.93118-002	1.65630-001	6.0960-001	1.09288-001	0.50361	0.412
1.000-001	7.25112-002	1.73431-001	5.5794-001	9.98139-002	0.50330	0.376
9.000-002	7.44284-002	1.78103-001	5.3013-001	9.47142-002	0.50313	0.357
8.000-002	7.66329-002	1.83472-001	5.0071-001	8.93182-002	0.50295	0.337
7.000-002	7.92127-002	1.89751-001	4.6936-001	8.35685-002	0.50276	0.315
6.000-002	8.23008-002	1.97263-001	4.3565-001	7.73863-002	0.50255	0.292
5.000-002	8.61114-002	2.06528-001	3.9896-001	7.06581-002	0.50233	0.267
4.000-002	9.10197-002	2.18452-001	3.5835-001	6.32099-002	0.50208	0.239
3.500-002	9.40913-002	2.25911-001	3.3612-001	5.91319-002	0.50195	0.224
3.000-002	9.77678-002	2.34835-001	3.1222-001	5.47486-002	0.50180	0.208
2.500-002	1.02304-001	2.45841-001	2.8622-001	4.99799-002	0.50164	0.190
2.000-002	1.08146-001	2.60010-001	2.5744-001	4.47026-002	0.50147	0.170
1.800-002	1.11020-001	2.66978-001	2.4492-001	4.24074-002	0.50139	0.162
1.600-002	1.14325-001	2.74987-001	2.3169-001	3.99801-002	0.50131	0.153
1.400-002	1.18191-001	2.84356-001	2.1759-001	3.73951-002	0.50122	0.143
1.200-002	1.22816-001	2.95567-001	2.0245-001	3.46170-002	0.50113	0.133
1.000-002	1.28527-001	3.09394-001	1.8597-001	3.15951-002	0.50103	0.122
9.000-003	1.31947-001	3.17675-001	1.7710-001	2.99698-002	0.50097	0.116
8.000-003	1.35879-001	3.27195-001	1.6773-001	2.82511-002	0.50091	0.109
7.000-003	1.40479-001	3.38330-001	1.5775-001	2.64207-002	0.50085	0.103
6.000-003	1.45984-001	3.51655-001	1.4702-001	2.44535-002	0.50079	0.096
5.000-003	1.52775-001	3.68091-001	1.3534-001	2.23134-002	0.50071	0.088
4.000-003	1.61521-001	3.89251-001	1.2242-001	1.99450-002	0.50063	0.079
3.500-003	1.66992-001	4.02488-001	1.1535-001	1.86484-002	0.50059	0.075
3.000-003	1.73541-001	4.18329-001	1.0774-001	1.72548-002	0.50054	0.070
2.500-003	1.81619-001	4.37866-001	9.9460-002	1.57383-002	0.50048	0.064
2.000-003	1.92020-001	4.63023-001	9.0291-002	1.40597-002	0.50042	0.059
1.800-003	1.97137-001	4.75397-001	8.6300-002	1.33293-002	0.50040	0.056
1.600-003	2.03019-001	4.89620-001	8.2076-002	1.25567-002	0.50037	0.054
1.400-003	2.09900-001	5.06260-001	7.7574-002	1.17336-002	0.50034	0.051
1.200-003	2.18135-001	5.26171-001	7.2730-002	1.08485-002	0.50031	0.048
1.000-003	2.28293-001	5.50732-001	6.7453-002	9.88504-003	0.50027	0.045

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	4.07316-002	9.78904-002	4.3337-001	7.85267-001	0.50053	0.180
9.000-001	4.18043-002	1.00506-001	4.2064-001	7.62030-001	0.50055	0.165
8.000-001	4.30392-002	1.03514-001	4.0595-001	7.35221-001	0.50056	0.150
7.000-001	4.44858-002	1.07033-001	3.8891-001	7.04081-001	0.50057	0.135
6.000-001	4.62190-002	1.11245-001	3.6894-001	6.67597-001	0.50057	0.121
5.000-001	4.83597-002	1.16440-001	3.4529-001	6.24364-001	0.50056	0.106
4.000-001	5.11189-002	1.23131-001	3.1682-001	5.72306-001	0.50053	0.091
3.500-001	5.28465-002	1.27317-001	3.0025-001	5.41999-001	0.50051	0.083
3.000-001	5.49149-002	1.32326-001	2.8170-001	5.08061-001	0.50049	0.075
2.500-001	5.74675-002	1.38505-001	2.6069-001	4.69612-001	0.50046	0.067
2.000-001	6.07556-002	1.46461-001	2.3649-001	4.25321-001	0.50042	0.059
1.800-001	6.23735-002	1.50375-001	2.2568-001	4.05524-001	0.50040	0.055
1.600-001	6.42337-002	1.54874-001	2.1406-001	3.84256-001	0.50039	0.052
1.400-001	6.64101-002	1.60137-001	2.0149-001	3.61249-001	0.50036	0.048
1.200-001	6.90151-002	1.66435-001	1.8778-001	3.36137-001	0.50034	0.044
1.000-001	7.22290-002	1.74204-001	1.7263-001	3.08397-001	0.50031	0.040
9.000-002	7.41543-002	1.78857-001	1.6439-001	2.93307-001	0.50030	0.038
8.000-002	7.63677-002	1.84207-001	1.5561-001	2.77228-001	0.50028	0.035
7.000-002	7.89573-002	1.90465-001	1.4619-001	2.59975-001	0.50027	0.033
6.000-002	8.20565-002	1.97953-001	1.3599-001	2.41293-001	0.50025	0.030
5.000-002	8.58799-002	2.07191-001	1.2482-001	2.20819-001	0.50023	0.028
4.000-002	9.08032-002	2.19086-001	1.1236-001	1.97996-001	0.50020	0.025
3.500-002	9.38835-002	2.26527-001	1.0550-001	1.85435-001	0.50019	0.023
3.000-002	9.75699-002	2.35432-001	9.8111-002	1.71887-001	0.50018	0.021
2.500-002	1.02117-001	2.46417-001	9.0039-002	1.57096-001	0.50016	0.019
2.000-002	1.07973-001	2.60560-001	8.1076-002	1.40671-001	0.50015	0.017
1.800-002	1.10854-001	2.67518-001	7.7168-002	1.33510-001	0.50014	0.016
1.600-002	1.14165-001	2.75515-001	7.3030-002	1.25927-001	0.50013	0.015
1.400-002	1.18039-001	2.84871-001	6.8617-002	1.17840-001	0.50012	0.014
1.200-002	1.22675-001	2.96068-001	6.3868-002	1.09136-001	0.50011	0.013
1.000-002	1.28394-001	3.09879-001	5.8694-002	9.96558-002	0.50010	0.012
9.000-003	1.31819-001	3.18152-001	5.5909-002	9.45517-002	0.50010	0.012
8.000-003	1.35758-001	3.27662-001	5.2961-002	8.91502-002	0.50009	0.011
7.000-003	1.40365-001	3.38788-001	4.9820-002	8.33937-002	0.50008	0.010
6.000-003	1.45878-001	3.52102-001	4.6441-002	7.72028-002	0.50008	0.010
5.000-003	1.52679-001	3.68526-001	4.2763-002	7.04631-002	0.50007	0.009
4.000-003	1.61437-001	3.89673-001	3.8688-002	6.29991-002	0.50006	0.008
3.500-003	1.66916-001	4.02904-001	3.6456-002	5.89108-002	0.50006	0.007
3.000-003	1.73473-001	4.18736-001	3.4056-002	5.45147-002	0.50005	0.007
2.500-003	1.81561-001	4.38267-001	3.1442-002	4.97298-002	0.50005	0.006
2.000-003	1.91976-001	4.63415-001	2.8547-002	4.44311-002	0.50004	0.006
1.800-003	1.97099-001	4.75785-001	2.7286-002	4.21251-002	0.50004	0.006
1.600-003	2.02988-001	4.90004-001	2.5952-002	3.96854-002	0.50004	0.005
1.400-003	2.09877-001	5.06640-001	2.4529-002	3.70858-002	0.50003	0.005
1.200-003	2.18122-001	5.26548-001	2.2999-002	3.42902-002	0.50003	0.005
1.000-003	2.28293-001	5.51106-001	2.1331-002	3.12466-002	0.50003	0.005

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	4.06787-002	9.80234-002	5.6666-002	9.91545-001	0.49958	0.072
9.000-001	4.17529-002	1.00636-001	5.6505-002	9.90276-001	0.49965	0.063
8.000-001	4.29893-002	1.03640-001	5.6317-002	9.88557-001	0.49972	0.054
7.000-001	4.44375-002	1.07155-001	5.6088-002	9.86136-001	0.49978	0.045
6.000-001	4.61727-002	1.11362-001	5.5791-002	9.82550-001	0.49984	0.037
5.000-001	4.83155-002	1.16553-001	5.5378-002	9.76887-001	0.49989	0.030
4.000-001	5.10772-002	1.23237-001	5.4739-002	9.67151-001	0.49993	0.023
3.500-001	5.28062-002	1.27420-001	5.4262-002	9.59431-001	0.49995	0.020
3.000-001	5.48762-002	1.32425-001	5.3601-002	9.48355-001	0.49997	0.016
2.500-001	5.74307-002	1.38600-001	5.2637-002	9.31765-001	0.49999	0.014
2.000-001	6.07210-002	1.46552-001	5.1149-002	9.05614-001	0.50000	0.011
1.800-001	6.23399-002	1.50463-001	5.0319-002	8.90886-001	0.50000	0.010
1.600-001	6.42011-002	1.54960-001	4.9295-002	8.72604-001	0.50001	0.009
1.400-001	6.63787-002	1.60220-001	4.8013-002	8.49638-001	0.50001	0.008
1.200-001	6.89850-002	1.66515-001	4.6388-002	8.20402-001	0.50001	0.007
1.000-001	7.22004-002	1.74281-001	4.4293-002	7.82615-001	0.50002	0.006
9.000-002	7.41266-002	1.78933-001	4.3015-002	7.59507-001	0.50002	0.005
8.000-002	7.63409-002	1.84280-001	4.1542-002	7.32846-001	0.50002	0.005
7.000-002	7.89315-002	1.90536-001	3.9833-002	7.01874-001	0.50002	0.004
6.000-002	8.20318-002	1.98023-001	3.7832-002	6.65580-001	0.50002	0.004
5.000-002	8.58565-002	2.07258-001	3.5463-002	6.22560-001	0.50002	0.003
4.000-002	9.07813-002	2.19149-001	3.2613-002	5.70738-001	0.50002	0.003
3.500-002	9.38625-002	2.26589-001	3.0954-002	5.40557-001	0.50002	0.003
3.000-002	9.75499-002	2.35492-001	2.9097-002	5.06751-001	0.50002	0.002
2.500-002	1.02099-001	2.46474-001	2.6994-002	4.68436-001	0.50001	0.002
2.000-002	1.07956-001	2.60616-001	2.4572-002	4.24282-001	0.50001	0.002
1.800-002	1.10837-001	2.67572-001	2.3489-002	4.04538-001	0.50001	0.002
1.600-002	1.14149-001	2.75568-001	2.2326-002	3.83322-001	0.50001	0.002
1.400-002	1.18023-001	2.84923-001	2.1068-002	3.60366-001	0.50001	0.002
1.200-002	1.22660-001	2.96118-001	1.9695-002	3.35301-001	0.50001	0.001
1.000-002	1.28380-001	3.09928-001	1.8178-002	3.07602-001	0.50001	0.001
9.000-003	1.31807-001	3.18200-001	1.7352-002	2.92530-001	0.50001	0.001
8.000-003	1.35745-001	3.27709-001	1.6473-002	2.76465-001	0.50001	0.001
7.000-003	1.40353-001	3.38834-001	1.5529-002	2.59221-001	0.50001	0.001
6.000-003	1.45867-001	3.52147-001	1.4507-002	2.40544-001	0.50001	0.001
5.000-003	1.52670-001	3.68570-001	1.3386-002	2.20065-001	0.50001	0.001
4.000-003	1.61428-001	3.89715-001	1.2136-002	1.97223-001	0.50001	0.001
3.500-003	1.66908-001	4.02945-001	1.1448-002	1.84645-001	0.50001	0.001
3.000-003	1.73466-001	4.18777-001	1.0706-002	1.71072-001	0.50001	0.001
2.500-003	1.81555-001	4.38307-001	9.8944-003	1.56246-001	0.50000	0.001
2.000-003	1.91971-001	4.63454-001	8.9925-003	1.39768-001	0.50000	0.001
1.800-003	1.97095-001	4.75823-001	8.5989-003	1.32579-001	0.50000	0.001
1.600-003	2.02985-001	4.90043-001	8.1818-003	1.24962-001	0.50000	0.001
1.400-003	2.09875-001	5.06678-001	7.7365-003	1.16835-001	0.50000	0.001
1.200-003	2.18121-001	5.26586-001	7.2567-003	1.08081-001	0.50000	0.000
1.000-003	2.28293-001	5.51143-001	6.7331-003	9.85377-002	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	4.06734-002	9.80367-002	7.6443-003	9.96027-001	0.49949	0.061
9.000-001	4.17477-002	1.00649-001	7.5330-003	9.95809-001	0.49956	0.053
8.000-001	4.29843-002	1.03653-001	7.4157-003	9.95549-001	0.49963	0.044
7.000-001	4.44327-002	1.07167-001	7.2910-003	9.95233-001	0.49970	0.036
6.000-001	4.61681-002	1.11374-001	7.1575-003	9.94837-001	0.49976	0.029
5.000-001	4.83111-002	1.16564-001	7.0127-003	9.94317-001	0.49982	0.022
4.000-001	5.10731-002	1.23248-001	6.8532-003	9.93593-001	0.49987	0.016
3.500-001	5.28022-002	1.27430-001	6.7662-003	9.93104-001	0.49990	0.013
3.000-001	5.48724-002	1.32435-001	6.6730-003	9.92476-001	0.49992	0.011
2.500-001	5.74270-002	1.38610-001	6.5718-003	9.91626-001	0.49994	0.008
2.000-001	6.07175-002	1.46561-001	6.4600-003	9.90383-001	0.49996	0.006
1.800-001	6.23365-002	1.50472-001	6.4114-003	9.89697-001	0.49996	0.005
1.600-001	6.41978-002	1.54968-001	6.3597-003	9.88836-001	0.49997	0.004
1.400-001	6.63755-002	1.60228-001	6.3044-003	9.87714-001	0.49998	0.004
1.200-001	6.89820-002	1.66523-001	6.2443-003	9.86179-001	0.49998	0.003
1.000-001	7.21975-002	1.74289-001	6.1773-003	9.83930-001	0.49999	0.002
9.000-002	7.41238-002	1.78940-001	6.1400-003	9.82356-001	0.49999	0.002
8.000-002	7.63382-002	1.84288-001	6.0992-003	9.80299-001	0.49999	0.002
7.000-002	7.89289-002	1.90543-001	6.0534-003	9.77499-001	0.49999	0.001
6.000-002	8.20294-002	1.98030-001	5.9998-003	9.73493-001	0.49999	0.001
5.000-002	8.58542-002	2.07265-001	5.9336-003	9.67374-001	0.50000	0.001
4.000-002	9.07791-002	2.19155-001	5.8439-003	9.57175-001	0.50000	0.001
3.500-002	9.38604-002	2.26595-001	5.7830-003	9.49245-001	0.50000	0.001
3.000-002	9.75479-002	2.35498-001	5.7037-003	9.38006-001	0.50000	0.001
2.500-002	1.02097-001	2.46480-001	5.5943-003	9.21353-001	0.50000	0.000
2.000-002	1.07954-001	2.60621-001	5.4328-003	8.95332-001	0.50000	0.000
1.800-002	1.10835-001	2.67577-001	5.3450-003	8.80745-001	0.50000	0.000
1.600-002	1.14147-001	2.75573-001	5.2379-003	8.62677-001	0.50000	0.000
1.400-002	1.18022-001	2.84928-001	5.1053-003	8.40019-001	0.50000	0.000
1.200-002	1.22659-001	2.96123-001	4.9386-003	8.11209-001	0.50000	0.000
1.000-002	1.28379-001	3.09933-001	4.7253-003	7.73995-001	0.50000	0.000
9.000-003	1.31805-001	3.18205-001	4.5956-003	7.51238-001	0.50000	0.000
8.000-003	1.35744-001	3.27714-001	4.4465-003	7.24975-001	0.50000	0.000
7.000-003	1.40352-001	3.38839-001	4.2738-003	6.94451-001	0.50000	0.000
6.000-003	1.45866-001	3.52151-001	4.0720-003	6.58657-001	0.50000	0.000
5.000-003	1.52669-001	3.68574-001	3.8334-003	6.16186-001	0.50000	0.000
4.000-003	1.61428-001	3.89720-001	3.5464-003	5.64952-001	0.50000	0.000
3.500-003	1.66907-001	4.02949-001	3.3795-003	5.35074-001	0.50000	0.000
3.000-003	1.73465-001	4.18781-001	3.1925-003	5.01568-001	0.50000	0.000
2.500-003	1.81555-001	4.38311-001	2.9807-003	4.63542-001	0.50000	0.000
2.000-003	1.91971-001	4.63458-001	2.7367-003	4.19645-001	0.50000	0.000
1.800-003	1.97094-001	4.75827-001	2.6275-003	3.99989-001	0.50000	0.000
1.600-003	2.02984-001	4.90047-001	2.5101-003	3.78846-001	0.50000	0.000
1.400-003	2.09875-001	5.06682-001	2.3830-003	3.55944-001	0.50000	0.000
1.200-003	2.18121-001	5.26590-001	2.2442-003	3.30907-001	0.50000	0.000
1.000-003	2.28293-001	5.51147-001	2.0905-003	3.03196-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	2.95853-002	6.72978-002	1.6898+000	3.08646-001	0.52041	2.305
9.000-001	3.03217-002	6.91941-002	1.6074+000	2.93541-001	0.51943	2.185
8.000-001	3.11712-002	7.13716-002	1.5196+000	2.77448-001	0.51838	2.060
7.000-001	3.21684-002	7.39160-002	1.4255+000	2.60180-001	0.51724	1.927
6.000-001	3.33659-002	7.69568-002	1.3235+000	2.41484-001	0.51602	1.785
5.000-001	3.48480-002	8.07023-002	1.2118+000	2.20997-001	0.51467	1.631
4.000-001	3.67628-002	8.55168-002	1.0873+000	1.98162-001	0.51316	1.461
3.500-001	3.79637-002	8.85247-002	1.0188+000	1.85597-001	0.51233	1.368
3.000-001	3.94034-002	9.21204-002	9.4489-001	1.72045-001	0.51143	1.269
2.500-001	4.11825-002	9.65509-002	8.6423-001	1.57252-001	0.51045	1.160
2.000-001	4.34775-002	1.02248-001	7.7468-001	1.40826-001	0.50935	1.040
1.800-001	4.46079-002	1.05048-001	7.3564-001	1.33667-001	0.50888	0.988
1.600-001	4.59083-002	1.08264-001	6.9430-001	1.26085-001	0.50837	0.933
1.400-001	4.74310-002	1.12024-001	6.5022-001	1.18001-001	0.50784	0.874
1.200-001	4.92548-002	1.16521-001	6.0279-001	1.09302-001	0.50726	0.810
1.000-001	5.15066-002	1.22063-001	5.5114-001	9.98284-002	0.50663	0.741
9.000-002	5.28564-002	1.25381-001	5.2334-001	9.47290-002	0.50629	0.704
8.000-002	5.44089-002	1.29193-001	4.9392-001	8.93334-002	0.50593	0.664
7.000-002	5.62261-002	1.33650-001	4.6257-001	8.35842-002	0.50555	0.622
6.000-002	5.84020-002	1.38982-001	4.2837-001	7.74028-002	0.50513	0.577
5.000-002	6.10877-002	1.45555-001	3.9219-001	7.06757-002	0.50469	0.527
4.000-002	6.45481-002	1.54013-001	3.5159-001	6.32290-002	0.50419	0.473
3.500-002	6.67143-002	1.59302-001	3.2936-001	5.91520-002	0.50392	0.442
3.000-002	6.93075-002	1.65629-001	3.0547-001	5.47700-002	0.50363	0.410
2.500-002	7.25077-002	1.73430-001	2.7948-001	5.00030-002	0.50331	0.375
2.000-002	7.66302-002	1.83471-001	2.5072-001	4.47281-002	0.50296	0.336
1.800-002	7.86588-002	1.88408-001	2.3821-001	4.24340-002	0.50281	0.319
1.600-002	8.09912-002	1.94082-001	2.2499-001	4.00082-002	0.50264	0.301
1.400-002	8.37205-002	2.00719-001	2.1090-001	3.74249-002	0.50247	0.282
1.200-002	8.69874-002	2.08660-001	1.9577-001	3.46489-002	0.50229	0.261
1.000-002	9.10185-002	2.18452-001	1.7931-001	3.16296-002	0.50209	0.239
9.000-003	9.34336-002	2.24317-001	1.7045-001	3.00060-002	0.50198	0.227
8.000-003	9.62103-002	2.31057-001	1.6109-001	2.82892-002	0.50186	0.214
7.000-003	9.94592-002	2.38941-001	1.5113-001	2.64611-002	0.50174	0.201
6.000-003	1.03348-001	2.48375-001	1.4042-001	2.44967-002	0.50161	0.186
5.000-003	1.08146-001	2.60009-001	1.2877-001	2.23601-002	0.50147	0.170
4.000-003	1.14324-001	2.74987-001	1.1588-001	1.99964-002	0.50131	0.153
3.500-003	1.18191-001	2.84356-001	1.0882-001	1.87028-002	0.50122	0.143
3.000-003	1.22818-001	2.95566-001	1.0124-001	1.73127-002	0.50113	0.133
2.500-003	1.28527-001	3.09394-001	9.2999-002	1.58007-002	0.50103	0.122
2.000-003	1.35879-001	3.27195-001	8.3876-002	1.41279-002	0.50091	0.109
1.800-003	1.39495-001	3.35950-001	7.9909-002	1.34004-002	0.50087	0.104
1.600-003	1.43653-001	3.46014-001	7.5713-002	1.26310-002	0.50081	0.098
1.400-003	1.48517-001	3.57787-001	7.1244-002	1.18117-002	0.50076	0.092
1.200-003	1.54339-001	3.71874-001	6.6441-002	1.09312-002	0.50070	0.086
1.000-003	1.61520-001	3.89251-001	6.1215-002	9.97335-003	0.50063	0.079

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	2.88949-002	6.91373-002	4.3114-001	7.85870-001	0.50107	0.358
9.000-001	2.96460-002	7.09872-002	4.1842-001	7.62601-001	0.50111	0.329
8.000-001	3.05119-002	7.31143-002	4.0375-001	7.35757-001	0.50114	0.299
7.000-001	3.15275-002	7.56034-002	3.8671-001	7.04576-001	0.50115	0.270
6.000-001	3.27460-002	7.85827-002	3.6676-001	6.68046-001	0.50114	0.241
5.000-001	3.42525-002	8.22584-002	3.4311-001	6.24761-001	0.50112	0.211
4.000-001	3.61964-002	8.69917-002	3.1465-001	5.72644-001	0.50106	0.181
3.500-001	3.74144-002	8.99532-002	2.9809-001	5.42305-001	0.50103	0.166
3.000-001	3.88733-002	9.34972-002	2.7954-001	5.08334-001	0.50098	0.151
2.500-001	4.06746-002	9.78691-002	2.5853-001	4.69850-001	0.50092	0.134
2.000-001	4.29959-002	1.03498-001	2.3433-001	4.25523-001	0.50084	0.118
1.800-001	4.41384-002	1.06267-001	2.2352-001	4.05711-001	0.50081	0.111
1.600-001	4.54520-002	1.09449-001	2.1190-001	3.84428-001	0.50077	0.103
1.400-001	4.69894-002	1.13173-001	1.9934-001	3.61406-001	0.50073	0.096
1.200-001	4.88296-002	1.17628-001	1.8562-001	3.36280-001	0.50068	0.088
1.000-001	5.11004-002	1.23124-001	1.7048-001	3.08525-001	0.50063	0.079
9.000-002	5.24608-002	1.26416-001	1.6224-001	2.93429-001	0.50060	0.075
8.000-002	5.40249-002	1.30200-001	1.5346-001	2.77343-001	0.50057	0.070
7.000-002	5.58550-002	1.34627-001	1.4405-001	2.60083-001	0.50053	0.064
6.000-002	5.80453-002	1.39924-001	1.3385-001	2.41396-001	0.50050	0.060
5.000-002	6.07476-002	1.46458-001	1.2268-001	2.20917-001	0.50046	0.055
4.000-002	6.42275-002	1.54872-001	1.1022-001	1.98090-001	0.50041	0.049
3.500-002	6.64049-002	1.60135-001	1.0337-001	1.85528-001	0.50038	0.046
3.000-002	6.90107-002	1.66433-001	9.5977-002	1.71980-001	0.50036	0.042
2.500-002	7.22255-002	1.74203-001	8.7909-002	1.57190-001	0.50033	0.038
2.000-002	7.63650-002	1.84206-001	7.8950-002	1.40768-001	0.50029	0.034
1.800-002	7.84014-002	1.89126-001	7.5045-002	1.33610-001	0.50028	0.033
1.600-002	8.07624-002	1.94782-001	7.0910-002	1.26029-001	0.50026	0.031
1.400-002	8.34811-002	2.01399-001	6.6500-002	1.17945-001	0.50025	0.029
1.200-002	8.67587-002	2.09319-001	6.1755-002	1.09247-001	0.50023	0.027
1.000-002	9.08020-002	2.19085-001	5.6587-002	9.97730-002	0.50021	0.024
9.000-003	9.32240-002	2.24936-001	5.3806-002	9.46732-002	0.50020	0.023
8.000-003	9.60082-002	2.31662-001	5.0862-002	8.92770-002	0.50019	0.022
7.000-003	9.92656-002	2.39530-001	4.7726-002	8.35269-002	0.50017	0.020
6.000-003	1.03164-001	2.48946-001	4.4353-002	7.73439-002	0.50016	0.019
5.000-003	1.07973-001	2.60560-001	4.0682-002	7.06146-002	0.50015	0.017
4.000-003	1.14164-001	2.75515-001	3.6618-002	6.31405-002	0.50013	0.015
3.500-003	1.18038-001	2.84871-001	3.4393-002	5.90850-002	0.50012	0.014
3.000-003	1.22674-001	2.96068-001	3.2001-002	5.46699-002	0.50011	0.013
2.500-003	1.28393-001	3.09879-001	2.9398-002	4.99287-002	0.50010	0.012
2.000-003	1.35757-001	3.27662-001	2.6517-002	4.46478-002	0.50009	0.011
1.800-003	1.39380-001	3.36410-001	2.5264-002	4.23507-002	0.50009	0.010
1.600-003	1.43544-001	3.46465-001	2.3939-002	3.99213-002	0.50008	0.010
1.400-003	1.48415-001	3.58229-001	2.2527-002	3.73336-002	0.50008	0.009
1.200-003	1.54245-001	3.72307-001	2.1009-002	3.45522-002	0.50007	0.009
1.000-003	1.61437-001	3.89673-001	1.9357-002	3.15260-002	0.50006	0.008

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	2.88200-002	6.93239-002	5.5472-002	9.93320-001	0.49916	0.145
9.000-001	2.95730-002	7.11690-002	5.5361-002	9.92123-001	0.49931	0.126
8.000-001	3.04410-002	7.32909-002	5.5224-002	9.90484-001	0.49944	0.108
7.000-001	3.14589-002	7.57742-002	5.5048-002	9.88151-001	0.49956	0.091
6.000-001	3.26799-002	7.87471-002	5.4807-002	9.84663-001	0.49968	0.075
5.000-001	3.41894-002	8.24156-002	5.4451-002	9.79105-001	0.49978	0.060
4.000-001	3.61368-002	8.71406-002	5.3872-002	9.69477-001	0.49987	0.046
3.500-001	3.73568-002	9.00973-002	5.3426-002	9.61804-001	0.49991	0.039
3.000-001	3.88179-002	9.36360-002	5.2795-002	9.50762-001	0.49994	0.033
2.500-001	4.06217-002	9.80019-002	5.1861-002	9.34182-001	0.49997	0.027
2.000-001	4.29459-002	1.03624-001	5.0401-002	9.07991-001	0.50000	0.021
1.800-001	4.40897-002	1.06389-001	4.9583-002	8.93224-001	0.50001	0.019
1.600-001	4.54049-002	1.09569-001	4.8569-002	8.74884-001	0.50002	0.017
1.400-001	4.69438-002	1.13289-001	4.7297-002	8.51835-001	0.50002	0.015
1.200-001	4.87859-002	1.17740-001	4.5681-002	8.22487-001	0.50003	0.013
1.000-001	5.10587-002	1.23231-001	4.3595-002	7.84548-001	0.50003	0.011
9.000-002	5.24203-002	1.26520-001	4.2321-002	7.61347-001	0.50003	0.010
8.000-002	5.39856-002	1.30301-001	4.0851-002	7.34580-001	0.50004	0.010
7.000-002	5.58170-002	1.34725-001	3.9145-002	7.03486-001	0.50004	0.009
6.000-002	5.80089-002	1.40019-001	3.7148-002	6.67056-001	0.50004	0.008
5.000-002	6.07130-002	1.46549-001	3.4782-002	6.23883-001	0.50003	0.007
4.000-002	6.41949-002	1.54958-001	3.1934-002	5.71892-001	0.50003	0.006
3.500-002	6.63735-002	1.60218-001	3.0277-002	5.41621-001	0.50003	0.005
3.000-002	6.89806-002	1.66514-001	2.8421-002	5.07721-001	0.50003	0.005
2.500-002	7.21969-002	1.74280-001	2.6320-002	4.69311-001	0.50003	0.004
2.000-002	7.63382-002	1.84279-001	2.3899-002	4.25061-001	0.50003	0.004
1.800-002	7.83754-002	1.89198-001	2.2817-002	4.05280-001	0.50003	0.004
1.600-002	8.07172-002	1.94852-001	2.1655-002	3.84028-001	0.50002	0.003
1.400-002	8.34569-002	2.01467-001	2.0398-002	3.61037-001	0.50002	0.003
1.200-002	8.67356-002	2.09384-001	1.9027-002	3.35941-001	0.50002	0.003
1.000-002	9.07801-002	2.19149-001	1.7512-002	3.08216-001	0.50002	0.003
9.000-003	9.32028-002	2.24998-001	1.6687-002	2.93133-001	0.50002	0.002
8.000-003	9.59879-002	2.31722-001	1.5809-002	2.77060-001	0.50002	0.002
7.000-003	9.92461-002	2.39589-001	1.4867-002	2.59812-001	0.50002	0.002
6.000-003	1.03145-001	2.49003-001	1.3847-002	2.41135-001	0.50002	0.002
5.000-003	1.07955-001	2.60615-001	1.2729-002	2.20664-001	0.50001	0.002
4.000-003	1.14148-001	2.75568-001	1.1482-002	1.97841-001	0.50001	0.002
3.500-003	1.18023-001	2.84923-001	1.0796-002	1.85279-001	0.50001	0.001
3.000-003	1.22660-001	2.96118-001	1.0056-002	1.71728-001	0.50001	0.001
2.500-003	1.28380-001	3.09928-001	9.2482-003	1.56932-001	0.50001	0.001
2.000-003	1.35745-001	3.27709-001	8.3509-003	1.40498-001	0.50001	0.001
1.800-003	1.39368-001	3.36456-001	7.9597-003	1.33333-001	0.50001	0.001
1.600-003	1.43533-001	3.46511-001	7.5453-003	1.25743-001	0.50001	0.001
1.400-003	1.48405-001	3.58274-001	7.1033-003	1.17648-001	0.50001	0.001
1.200-003	1.54236-001	3.72351-001	6.6275-003	1.08935-001	0.50001	0.001
1.000-003	1.61428-001	3.89715-001	6.1091-003	9.94419-002	0.50001	0.001

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

A = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	2.88124-002	6.93426-002	6.5533-003	9.97985-001	0.49897	0.123
9.000-001	2.95657-002	7.11872-002	6.4972-003	9.97869-001	0.49913	0.105
8.000-001	3.04338-002	7.33085-002	6.4381-003	9.97731-001	0.49927	0.088
7.000-001	3.14520-002	7.57913-002	6.3754-003	9.97560-001	0.49940	0.073
6.000-001	3.26733-002	7.87635-002	6.3082-003	9.97343-001	0.49953	0.058
5.000-001	3.41831-002	8.24313-002	6.2354-003	9.97052-001	0.49964	0.044
4.000-001	3.61308-002	8.71555-002	6.1551-003	9.96632-001	0.49975	0.032
3.500-001	3.73510-002	9.01117-002	6.1113-003	9.96339-001	0.49980	0.026
3.000-001	3.88123-002	9.36499-002	6.0642-003	9.95954-001	0.49984	0.021
2.500-001	4.06164-002	9.80151-002	6.0129-003	9.95402-001	0.49988	0.016
2.000-001	4.29409-002	1.03636-001	5.9557-003	9.94554-001	0.49992	0.012
1.800-001	4.40849-002	1.06402-001	5.9306-003	9.94065-001	0.49993	0.010
1.600-001	4.54002-002	1.09581-001	5.9037-003	9.93431-001	0.49994	0.009
1.400-001	4.69393-002	1.13300-001	5.8744-003	9.92574-001	0.49995	0.007
1.200-001	4.87815-002	1.17751-001	5.8419-003	9.91354-001	0.49996	0.006
1.000-001	5.10545-002	1.23241-001	5.8043-003	9.89486-001	0.49997	0.005
9.000-002	5.24162-002	1.26530-001	5.7826-003	9.88135-001	0.49998	0.004
8.000-002	5.39817-002	1.30311-001	5.7579-003	9.86324-001	0.49998	0.003
7.000-002	5.58132-002	1.34735-001	5.7289-003	9.83800-001	0.49999	0.003
6.000-002	5.80053-002	1.40028-001	5.6929-003	9.80100-001	0.49999	0.002
5.000-002	6.07095-002	1.46558-001	5.6449-003	9.74314-001	0.49999	0.002
4.000-002	6.41916-002	1.54966-001	5.5741-003	9.64455-001	0.50000	0.001
3.500-002	6.63703-002	1.60227-001	5.5229-003	9.56679-001	0.50000	0.001
3.000-002	6.89776-002	1.66522-001	5.4532-003	9.46561-001	0.50000	0.001
2.500-002	7.21940-002	1.74288-001	5.3534-003	9.28958-001	0.50000	0.001
2.000-002	7.63355-002	1.84287-001	5.2012-003	9.02849-001	0.50000	0.001
1.800-002	7.83727-002	1.89205-001	5.1169-003	8.88163-001	0.50000	0.001
1.600-002	8.07147-002	1.94860-001	5.0132-003	8.69944-001	0.50000	0.001
1.400-002	8.34545-002	2.01474-001	4.8839-003	8.47067-001	0.50000	0.000
1.200-002	8.67333-002	2.09390-001	4.7203-003	8.17956-001	0.50000	0.000
1.000-002	9.07779-002	2.19155-001	4.5099-003	7.80335-001	0.50000	0.000
9.000-003	9.32007-002	2.25004-001	4.3816-003	7.57330-001	0.50000	0.000
8.000-003	9.59858-002	2.31728-001	4.2338-003	7.30786-001	0.50000	0.000
7.000-003	9.92441-002	2.39595-001	4.0625-003	6.99945-001	0.50000	0.000
6.000-003	1.03143-001	2.49008-001	3.8620-003	6.63799-001	0.50000	0.000
5.000-003	1.07953-001	2.60621-001	3.6247-003	6.20944-001	0.50000	0.000
4.000-003	1.14147-001	2.75573-001	3.3393-003	5.69301-001	0.50000	0.000
3.500-003	1.18022-001	2.84928-001	3.1732-003	5.39215-001	0.50000	0.000
3.000-003	1.22659-001	2.96123-001	2.9872-003	5.05504-001	0.50000	0.000
2.500-003	1.28379-001	3.09933-001	2.7766-003	4.67285-001	0.50000	0.000
2.000-003	1.35744-001	3.27714-001	2.5341-003	4.23221-001	0.50000	0.000
1.800-003	1.39367-001	3.36461-001	2.4256-003	4.03511-001	0.50000	0.000
1.600-003	1.43532-001	3.46515-001	2.3091-003	3.82326-001	0.50000	0.000
1.400-003	1.48404-001	3.58278-001	2.1831-003	3.59397-001	0.50000	0.000
1.200-003	1.54235-001	3.72355-001	2.0455-003	3.34353-001	0.50000	0.000
1.000-003	1.61428-001	3.89720-001	1.8935-003	3.06667-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 50.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.93958-002	4.07341-002	1.6856+000	3.08660-001	0.55242	5.022
9.000-001	1.98455-002	4.19748-002	1.6033+000	2.93554-001	0.54981	4.794
8.000-001	2.03657-002	4.33974-002	1.5155+000	2.77459-001	0.54703	4.551
7.000-001	2.09778-002	4.50572-002	1.4214+000	2.60190-001	0.54406	4.291
6.000-001	2.17147-002	4.70374-002	1.3194+000	2.41494-001	0.54085	4.008
5.000-001	2.26290-002	4.94719-002	1.2077+000	2.21006-001	0.53734	3.696
4.000-001	2.38133-002	5.25946-002	1.0832+000	1.98169-001	0.53344	3.345
3.500-001	2.45575-002	5.45420-002	1.0147+000	1.85603-001	0.53129	3.150
3.000-001	2.54508-002	5.68668-002	9.4079-001	1.72051-001	0.52898	2.939
2.500-001	2.65563-002	5.97269-002	8.6013-001	1.57257-001	0.52646	2.705
2.000-001	2.79845-002	6.33983-002	7.7057-001	1.40832-001	0.52367	2.443
1.800-001	2.86887-002	6.52002-002	7.3153-001	1.33677-001	0.52245	2.328
1.600-001	2.94995-002	6.72684-002	6.9020-001	1.26090-001	0.52117	2.205
1.400-001	3.04495-002	6.96842-002	6.4612-001	1.18006-001	0.51980	2.073
.200-001	3.15883-002	7.25703-002	5.9869-001	1.09307-001	0.51832	1.929
1.000-001	3.29957-002	7.61237-002	5.4704-001	9.98330-002	0.51672	1.772
9.000-002	3.38399-002	7.82490-002	5.1924-001	9.47336-002	0.51586	1.686
8.000-002	3.48113-002	8.06894-002	4.8982-001	8.93381-002	0.51495	1.595
7.000-002	3.59490-002	8.35411-002	4.5847-001	8.35891-002	0.51398	1.498
6.000-002	3.73122-002	8.69493-002	4.2477-001	7.74078-002	0.51293	1.392
5.000-002	3.89958-002	9.11478-002	3.8810-001	7.06810-002	0.51180	1.277
4.000-002	4.11668-002	9.65454-002	3.4750-001	6.32347-002	0.51055	1.148
3.500-002	4.25266-002	9.99181-002	3.2527-001	5.91580-002	0.50986	1.077
3.000-002	4.41552-002	1.03950-001	3.0139-001	5.47764-002	0.50913	1.000
2.500-002	4.61661-002	1.08920-001	2.7540-001	5.00099-002	0.50833	0.916
2.000-002	4.87580-002	1.15311-001	2.4664-001	4.47355-002	0.50744	0.822
1.800-002	5.00340-002	1.18452-001	2.3414-001	4.24419-002	0.50706	0.781
1.600-002	5.15015-002	1.22061-001	2.2091-001	4.00164-002	0.50665	0.738
1.400-002	5.32192-002	1.26281-001	2.0683-001	3.74336-002	0.50622	0.691
1.200-002	5.52759-002	1.31328-001	1.9170-001	3.46583-002	0.50576	0.641
1.000-002	5.78145-002	1.37549-001	1.7524-001	3.16398-002	0.50525	0.587
9.000-003	5.93359-002	1.41274-001	1.6640-001	3.00167-002	0.50498	0.557
8.000-003	6.10855-002	1.45554-001	1.5704-001	2.83005-002	0.50470	0.526
7.000-003	6.31331-002	1.50560-001	1.4708-001	2.64731-002	0.50439	0.493
6.000-003	6.55844-002	1.56547-001	1.3637-001	2.45096-002	0.50406	0.457
5.000-003	6.86096-002	1.63930-001	1.2473-001	2.23742-002	0.50371	0.418
4.000-003	7.25068-002	1.73430-001	1.1185-001	2.00120-002	0.50331	0.375
3.500-003	7.49459-002	1.79372-001	1.0480-001	1.87193-002	0.50310	0.351
3.000-003	7.78658-002	1.86480-001	9.7230-002	1.73305-002	0.50287	0.325
2.500-003	8.14687-002	1.95245-001	8.8995-002	1.58200-002	0.50262	0.297
2.000-003	8.61095-002	2.06527-001	7.9885-002	1.41492-002	0.50234	0.266
1.800-003	8.83929-002	2.12075-001	7.5925-002	1.34227-002	0.50222	0.253
1.600-003	9.10181-002	2.18452-001	7.1737-002	1.26546-002	0.50209	0.239
1.400-003	9.40900-002	2.25911-001	6.7278-002	1.18367-002	0.50195	0.224
1.200-003	9.77667-002	2.34835-001	6.2486-002	1.09580-002	0.50180	0.207
1.000-003	1.02303-001	2.45841-001	5.7276-002	1.00023-002	0.50164	0.190

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 50.00 KM

SIGMA(G) = INFINITY.
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	1.84503-002	4.35704-002	4.2980-001	7.86230-001	0.50274	0.890
9.000-001	1.89114-002	4.47408-002	4.1709-001	7.62942-001	0.50283	0.816
8.000-001	1.94452-002	4.60871-002	4.0243-001	7.36076-001	0.50289	0.742
7.000-001	2.00740-002	4.76630-002	3.8539-001	7.04870-001	0.50291	0.669
6.000-001	2.08311-002	4.95496-002	3.6544-001	6.68312-001	0.50289	0.597
5.000-001	2.17705-002	5.18779-002	3.4180-001	6.24995-001	0.50281	0.524
4.000-001	2.29865-002	5.48764-002	3.1335-001	5.72843-001	0.50267	0.450
3.500-001	2.37501-002	5.67526-002	2.9678-001	5.42485-001	0.50258	0.412
3.000-001	2.46660-002	5.89978-002	2.7824-001	5.08493-001	0.50245	0.374
2.500-001	2.57983-002	6.17674-002	2.5723-001	4.69987-001	0.50230	0.334
2.000-001	2.72593-002	6.53332-002	2.3303-001	4.25638-001	0.50212	0.292
1.800-001	2.79789-002	6.70870-002	2.2222-001	4.05816-001	0.50203	0.275
1.600-001	2.88067-002	6.91030-002	2.1060-001	3.84524-001	0.50193	0.257
1.400-001	2.97759-002	7.14612-002	1.9804-001	3.61492-001	0.50183	0.238
1.200-001	3.09365-002	7.42830-002	1.8433-001	3.36356-001	0.50171	0.219
1.000-001	3.23692-002	7.77634-002	1.6918-001	3.08592-001	0.50156	0.198
9.000-002	3.32278-002	7.98480-002	1.6094-001	2.93490-001	0.50150	0.187
8.000-002	3.42151-002	8.22440-002	1.5217-001	2.77400-001	0.50142	0.175
7.000-002	3.53705-002	8.50469-002	1.4275-001	2.60135-001	0.50134	0.163
6.000-002	3.67537-002	8.84007-002	1.3255-001	2.41443-001	0.50125	0.151
5.000-002	3.84604-002	9.25374-002	1.2138-001	2.20960-001	0.50114	0.137
4.000-002	4.06587-002	9.78631-002	1.0893-001	1.98129-001	0.50103	0.122
3.500-002	4.20344-002	1.01195-001	1.0207-001	1.85566-001	0.50096	0.114
3.000-002	4.36809-002	1.05181-001	9.4685-002	1.72016-001	0.50089	0.105
2.500-002	4.57124-002	1.10098-001	8.6617-002	1.57225-001	0.50082	0.096
2.000-002	4.83285-002	1.16429-001	7.7660-002	1.40803-001	0.50073	0.086
1.800-002	4.96156-002	1.19543-001	7.3756-002	1.33644-001	0.50070	0.081
1.600-002	5.10952-002	1.23122-001	6.9621-002	1.26064-001	0.50066	0.076
1.400-002	5.28263-002	1.27309-001	6.5213-002	1.17980-001	0.50062	0.071
1.200-002	5.48981-002	1.32320-001	6.0469-002	1.09283-001	0.50057	0.066
1.000-002	5.74541-002	1.38500-001	5.5303-002	9.98105-002	0.50052	0.060
9.000-003	5.89852-002	1.42202-001	5.2522-002	9.47118-002	0.50049	0.057
8.000-003	6.07454-002	1.46458-001	4.9580-002	8.93169-002	0.50047	0.054
7.000-003	6.28047-002	1.51436-001	4.6444-002	8.35685-002	0.50044	0.050
6.000-003	6.52692-002	1.57393-001	4.3074-002	7.73879-002	0.50040	0.047
5.000-003	6.83096-002	1.64741-001	3.9405-002	7.06616-002	0.50037	0.043
4.000-003	7.22246-002	1.74202-001	3.5344-002	6.32157-002	0.50033	0.038
3.500-003	7.46740-002	1.80121-001	3.3121-002	5.91391-002	0.50031	0.036
3.000-003	7.76053-002	1.87204-001	3.0731-002	5.47575-002	0.50029	0.033
2.500-003	8.12216-002	1.95941-001	2.8132-002	4.99909-002	0.50026	0.030
2.000-003	8.58779-002	2.07191-001	2.5255-002	4.47162-002	0.50023	0.027
1.800-003	8.81685-002	2.12724-001	2.4004-002	4.24223-002	0.50022	0.026
1.600-003	9.08016-002	2.19085-001	2.2681-002	3.99965-002	0.50021	0.024
1.400-003	9.38822-002	2.26527-001	2.1272-002	3.74132-002	0.50019	0.023
1.200-003	9.75688-002	2.35432-001	1.9758-002	3.46372-002	0.50018	0.021
1.000-003	1.02117-001	2.46417-001	1.8111-002	3.16178-002	0.50016	0.019

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 50.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.83334-002	4.38647-002	5.4754-002	9.94388-001	0.49792	0.364
9.000-001	1.87973-002	4.50273-002	5.4672-002	9.93234-001	0.49827	0.316
8.000-001	1.93342-002	4.63651-002	5.4566-002	9.91643-001	0.49860	0.270
7.000-001	1.99663-002	4.79317-002	5.4422-002	9.89363-001	0.49891	0.227
6.000-001	2.07273-002	4.98081-002	5.4214-002	9.85934-001	0.49919	0.187
5.000-001	2.16711-002	5.21247-002	5.3893-002	9.80440-001	0.49945	0.149
4.000-001	2.28924-002	5.51098-002	5.3350-002	9.70876-001	0.49967	0.114
3.500-001	2.36590-002	5.69784-002	5.2921-002	9.63231-001	0.49977	0.098
3.000-001	2.45782-002	5.92152-002	5.2309-002	9.52209-001	0.49986	0.082
2.500-001	2.57144-002	6.19752-002	5.1393-002	9.35633-001	0.49993	0.068
2.000-001	2.71798-002	6.55298-002	4.9950-002	9.09416-001	0.50000	0.054
1.800-001	2.79015-002	6.72786-002	4.9138-002	8.94625-001	0.50002	0.048
1.600-001	2.87315-002	6.92891-002	4.8131-002	8.76248-001	0.50004	0.043
1.400-001	2.97032-002	7.16413-002	4.6865-002	8.53148-001	0.50006	0.038
1.200-001	3.08665-002	7.44564-002	4.5254-002	8.23729-001	0.50007	0.033
1.000-001	3.23023-002	7.79293-002	4.3173-002	7.85695-001	0.50008	0.028
9.000-002	3.31627-002	8.00096-002	4.1901-002	7.62435-001	0.50009	0.026
8.000-002	3.41519-002	8.24011-002	4.0434-002	7.35601-001	0.50009	0.024
7.000-002	3.53095-002	8.51989-002	3.8730-002	7.04432-001	0.50009	0.021
6.000-002	3.66949-002	8.85472-002	3.6734-002	6.67915-001	0.50009	0.019
5.000-002	3.84044-002	9.26775-002	3.4370-002	6.24645-001	0.50009	0.017
4.000-002	4.06058-002	9.79958-002	3.1523-002	5.72546-001	0.50008	0.014
3.500-002	4.19832-002	1.01323-001	2.9867-002	5.42216-001	0.50008	0.013
3.000-002	4.36318-002	1.05305-001	2.8012-002	5.08254-001	0.50008	0.012
2.500-002	4.56625-002	1.10217-001	2.5911-002	4.69780-001	0.50007	0.011
2.000-002	4.82843-002	1.16541-001	2.3491-002	4.25464-001	0.50007	0.009
1.800-002	4.95725-002	1.19653-001	2.2409-002	4.05656-001	0.50006	0.009
1.600-002	5.10535-002	1.23229-001	2.1248-002	3.84378-001	0.50006	0.008
1.400-002	5.27860-002	1.27413-001	1.9991-002	3.61361-001	0.50006	0.008
1.200-002	5.48595-002	1.32420-001	1.8620-002	3.36239-001	0.50005	0.007
1.000-002	5.74173-002	1.38596-001	1.7105-002	3.08489-001	0.50005	0.006
9.000-003	5.89494-002	1.42296-001	1.6281-002	2.93394-001	0.50005	0.006
8.000-003	6.07107-002	1.46548-001	1.5404-002	2.77311-001	0.50004	0.006
7.000-003	6.27713-002	1.51524-001	1.4462-002	2.60053-001	0.50004	0.005
6.000-003	6.52372-002	1.57478-001	1.3442-002	2.41368-001	0.50004	0.005
5.000-003	6.82791-002	1.64823-001	1.2325-002	2.20891-001	0.50004	0.004
4.000-003	7.21959-002	1.74280-001	1.1079-002	1.98065-001	0.50003	0.004
3.500-003	7.46464-002	1.80196-001	1.0394-002	1.85504-001	0.50003	0.004
3.000-003	7.75790-002	1.87277-001	9.6546-003	1.71956-001	0.50003	0.003
2.500-003	8.11966-002	1.96011-001	8.8477-003	1.57167-001	0.50003	0.003
2.000-003	8.58545-002	2.07257-001	7.9517-003	1.40745-001	0.50002	0.003
1.800-003	8.81458-002	2.12789-001	7.5612-003	1.33586-001	0.50002	0.003
1.600-003	9.07798-002	2.19149-001	7.1476-003	1.26005-001	0.50002	0.002
1.400-003	9.38612-002	2.26588-001	6.7066-003	1.17921-001	0.50002	0.002
1.200-003	9.75488-002	2.35492-001	6.2320-003	1.09222-001	0.50002	0.002
1.000-003	1.02098-001	2.46474-001	5.7151-003	9.97469-002	0.50002	0.002

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

A = 0 H = 50.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-002 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.83214-002	4.38943-002	5.8967-003	9.99163-001	0.49744	0.310
9.000-001	1.87856-002	4.50560-002	5.8737-003	9.99110-001	0.49782	0.265
8.000-001	1.93229-002	4.63930-002	5.8495-003	9.99045-001	0.49818	0.222
7.000-001	1.99554-002	4.79586-002	5.8239-003	9.98962-001	0.49851	0.182
6.000-001	2.07167-002	4.98340-002	5.7966-003	9.98853-001	0.49882	0.145
5.000-001	2.16610-002	5.21495-002	5.7670-003	9.98699-001	0.49911	0.111
4.000-001	2.28828-002	5.51332-002	5.7342-003	9.98464-001	0.49937	0.080
3.500-001	2.36497-002	5.70010-002	5.7163-003	9.98289-001	0.49949	0.066
3.000-001	2.45693-002	5.92369-002	5.6969-003	9.98045-001	0.49960	0.053
2.500-001	2.57059-002	6.19960-002	5.6755-003	9.97680-001	0.49970	0.041
2.000-001	2.71718-002	6.55495-002	5.6511-003	9.97073-001	0.49979	0.030
1.800-001	2.78937-002	6.72978-002	5.6401-003	9.96703-001	0.49982	0.026
1.600-001	2.87240-002	6.93077-002	5.6280-003	9.96207-001	0.49985	0.022
1.400-001	2.96958-002	7.16593-002	5.6143-003	9.95511-001	0.49988	0.018
1.200-001	3.08595-002	7.44738-002	5.5983-003	9.94483-001	0.49991	0.015
1.000-001	3.22956-002	7.79459-002	5.5785-003	9.92847-001	0.49993	0.011
9.000-002	3.31562-002	8.00258-002	5.5661-003	9.91631-001	0.49994	0.010
8.000-002	3.41456-002	8.24168-002	5.5511-003	9.89971-001	0.49996	0.008
7.000-002	3.53033-002	8.52141-002	5.5322-003	9.87614-001	0.49997	0.007
6.000-002	3.66890-002	8.85618-002	5.5067-003	9.84100-001	0.49997	0.006
5.000-002	3.83987-002	9.26916-002	5.4696-003	9.78515-001	0.49998	0.005
4.000-002	4.06005-002	9.80091-002	5.4102-003	9.68858-001	0.49999	0.004
3.500-002	4.19781-002	1.01336-001	5.3647-003	9.61173-001	0.49999	0.003
3.000-002	4.36268-002	1.05317-001	5.3008-003	9.50122-001	0.50000	0.003
2.500-002	4.56608-002	1.10229-001	5.2067-003	9.33539-001	0.50000	0.002
2.000-002	4.82798-002	1.16553-001	5.0600-003	9.07360-001	0.50000	0.002
1.800-002	4.95682-002	1.19664-001	4.9778-003	8.92603-001	0.50000	0.002
1.600-002	5.10493-002	1.23240-001	4.8761-003	8.74279-001	0.50000	0.001
1.400-002	5.27820-002	1.27423-001	4.7487-003	8.51253-001	0.50000	0.001
1.200-002	5.48556-002	1.32430-001	4.5869-003	8.21935-001	0.50000	0.001
1.000-002	5.74136-002	1.38605-001	4.3781-003	7.84037-001	0.50000	0.001
9.000-003	5.89458-002	1.42305-001	4.2505-003	7.60861-001	0.50000	0.001
8.000-003	6.07072-002	1.46557-001	4.1035-003	7.34123-001	0.50000	0.001
7.000-003	6.27679-002	1.51533-001	3.9328-003	7.03062-001	0.50000	0.001
6.000-003	6.52340-002	1.57486-001	3.7330-003	6.66669-001	0.50000	0.001
5.000-003	6.82761-002	1.64831-001	3.4963-003	6.23538-001	0.50000	0.001
4.000-003	7.21930-002	1.74287-001	3.2115-003	5.71593-001	0.50000	0.000
3.500-003	7.46437-002	1.80204-001	3.0457-003	5.41347-001	0.50000	0.000
3.000-003	7.75763-002	1.87284-001	2.8601-003	5.07473-001	0.50000	0.000
2.500-003	8.11941-002	1.96018-001	2.6499-003	4.69090-001	0.50000	0.000
2.000-003	8.58522-002	2.07264-001	2.4078-003	4.24867-001	0.50000	0.000
1.800-003	8.81436-002	2.12796-001	2.2996-003	4.05096-001	0.50000	0.000
1.600-003	9.07776-002	2.19155-001	2.1834-003	3.83855-001	0.50000	0.000
1.400-003	9.38591-002	2.26595-001	2.0577-003	3.60875-001	0.50000	0.000
1.200-003	9.75468-002	2.35498-001	1.9205-003	3.35788-001	0.50000	0.000
1.000-003	1.02096-001	2.46480-001	1.7689-003	3.08071-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.10 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	7.05918-001	1.73029+000	4.4128+000	2.23645-001	0.49372	0.738
9.000-001	7.23804-001	1.77622+000	4.2887+000	2.09872-001	0.49338	0.778
8.000-001	7.44290-001	1.82897+000	4.1540+000	1.95292-001	0.49299	0.825
7.000-001	7.68148-001	1.89063+000	4.0064+000	1.79777-001	0.49251	0.882
6.000-001	7.96539-001	1.96434+000	3.8425+000	1.63161-001	0.49191	0.953
5.000-001	8.31310-001	2.05514+000	3.6572+000	1.45210-001	0.49114	1.045
4.000-001	8.75647-001	2.17185+000	3.4427+000	1.25589-001	0.49011	1.170
3.500-001	9.03123-001	2.24475+000	3.3204+000	1.14998-001	0.48943	1.252
3.000-001	9.35728-001	2.33186+000	3.1847+000	1.03767-001	0.48859	1.355
2.500-001	9.75514-001	2.43911+000	3.0313+000	9.17625-002	0.48752	1.487
2.000-001	1.02600+000	2.57687+000	2.8535+000	7.87934-002	0.48606	1.667
1.800-001	1.05052+000	2.64448+000	2.7732+000	7.32735-002	0.48532	1.759
1.600-001	1.07843+000	2.72209+000	2.6861+000	6.75260-002	0.48444	1.869
1.400-001	1.11071+000	2.81270+000	2.5905+000	6.15164-002	0.48338	2.002
1.200-001	1.14878+000	2.92089+000	2.4842+000	5.51988-002	0.48207	2.168
1.000-001	1.19489+000	3.05395+000	2.3640+000	4.85105-002	0.48039	2.382
9.000-002	1.22204+000	3.13343+000	2.2970+000	4.50004-002	0.47935	2.516
8.000-002	1.25281+000	3.22460+000	2.2243+000	4.13600-002	0.47813	2.675
7.000-002	1.28817+000	3.33095+000	2.1444+000	3.75697-002	0.47665	2.868
6.000-002	1.32957+000	3.45780+000	2.0555+000	3.36034-002	0.47482	3.109
5.000-002	1.37923+000	3.61359+000	1.9547+000	2.94253-002	0.47248	3.421
4.000-002	1.44076+000	3.81303+000	1.8374+000	2.49834-002	0.46932	3.847
3.500-002	1.47782+000	3.93710+000	1.7702+000	2.26398-002	0.46727	4.129
3.000-002	1.52068+000	4.08484+000	1.6953+000	2.01959-002	0.46473	4.481
2.500-002	1.57123+000	4.26590+000	1.6102+000	1.76315-002	0.46147	4.939
2.000-002	1.63240+000	4.49702+000	1.5110+000	1.49171-002	0.45710	5.568
1.800-002	1.66083+000	4.60982+000	1.4659+000	1.37798-002	0.45487	5.894
1.600-002	1.69210+000	4.73875+000	1.4168+000	1.26075-002	0.45224	6.282
1.400-002	1.72675+000	4.88851+000	1.3627+000	1.13948-002	0.44908	6.755
1.200-002	1.76541+000	5.06616+000	1.3022+000	1.01348-002	0.44519	7.348
1.000-002	1.80878+000	5.28281+000	1.2334+000	8.81821-003	0.44020	8.122
9.000-003	1.83242+000	5.41120+000	1.1946+000	8.13467-003	0.43713	8.609
8.000-003	1.85739+000	5.55744+000	1.1528+000	7.43143-003	0.43351	9.191
7.000-003	1.88357+000	5.72663+000	1.1064+000	6.70560-003	0.42916	9.901
6.000-003	1.91053+000	5.92625+000	1.0545+000	5.95344-003	0.42379	10.795
5.000-003	1.93712+000	6.16799+000	9.9522-001	5.16984-003	0.41692	11.964
4.000-003	1.96038+000	6.47136+000	9.2567-001	4.34755-003	0.40769	13.584
3.500-003	1.96860+000	6.65632+000	8.8554-001	3.91865-003	0.40168	14.664
3.000-003	1.97201+000	6.87244+000	8.4053-001	3.47545-003	0.39426	16.026
2.500-003	1.96665+000	7.13068+000	7.8906-001	3.01533-003	0.38474	17.811
2.000-003	1.94446+000	7.44854+000	7.2852-001	2.53464-003	0.37188	20.285
1.800-003	1.92740+000	7.59843+000	7.0084-001	2.33547-003	0.36530	21.574
1.600-003	1.90297+000	7.76518+000	6.7057-001	2.13171-003	0.35752	23.115
1.400-003	1.86812+000	7.95237+000	6.3708-001	1.92280-003	0.34811	24.997
1.200-003	1.81805+000	8.16467+000	5.9950-001	1.70802-003	0.33643	27.357
1.000-003	1.74493+000	8.40811+000	5.5656-001	1.48647-003	0.32136	30.422

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.10 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	7.21170-001	1.74072+000	1.2891+000	4.95842-001	0.49907	0.042
9.000-001	7.40248-001	1.78722+000	1.2623+000	4.78365-001	0.49906	0.047
8.000-001	7.62177-001	1.84065+000	1.2325+000	4.58321-001	0.49903	0.053
7.000-001	7.87827-001	1.90316+000	1.1990+000	4.35129-001	0.49900	0.060
6.000-001	8.18516-001	1.97795+000	1.1605+000	4.08025-001	0.49896	0.069
5.000-001	8.56358-001	2.07019+000	1.1154+000	3.75960-001	0.49891	0.080
4.000-001	9.05052-001	2.18894+000	1.0611+000	3.37438-001	0.49882	0.094
3.500-001	9.35496-001	2.26321+000	1.0292+000	3.15086-001	0.49877	0.103
3.000-001	9.71906-001	2.35208+000	9.9291-001	2.90163-001	0.49869	0.115
2.500-001	1.01678+000	2.46169+000	9.5104-001	2.62125-001	0.49860	0.129
2.000-001	1.07450+000	2.60277+000	9.0141-001	2.30199-001	0.49847	0.147
1.800-001	1.10286+000	2.67216+000	8.7864-001	2.16097-001	0.49840	0.157
1.600-001	1.13543+000	2.75191+000	8.5371-001	2.01090-001	0.49831	0.168
1.400-001	1.17350+000	2.84519+000	8.2613-001	1.85046-001	0.49821	0.181
1.200-001	1.21901+000	2.95679+000	7.9522-001	1.67798-001	0.49809	0.198
1.000-001	1.27506+000	3.09442+000	7.5994-001	1.49114-001	0.49792	0.219
9.000-002	1.30859+000	3.17683+000	7.4019-001	1.39137-001	0.49782	0.232
8.000-002	1.34708+000	3.27156+000	7.1865-001	1.28666-001	0.49770	0.247
7.000-002	1.39205+000	3.38234+000	6.9493-001	1.17631-001	0.49755	0.265
6.000-002	1.44577+000	3.51488+000	6.6845-001	1.05941-001	0.49737	0.288
5.000-002	1.51190+000	3.67831+000	6.3835-001	9.34700-002	0.49713	0.317
4.000-002	1.59678+000	3.88863+000	6.0326-001	8.00367-002	0.49681	0.356
3.500-002	1.64973+000	4.02014+000	5.8315-001	7.28766-002	0.49659	0.382
3.000-002	1.71295+000	4.17746+000	5.6074-001	6.53563-002	0.49633	0.414
2.500-002	1.79067+000	4.37142+000	5.3531-001	5.74051-002	0.49599	0.455
2.000-002	1.89032+000	4.62097+000	5.0571-001	4.89201-002	0.49553	0.510
1.800-002	1.93915+000	4.74365+000	4.9230-001	4.53433-002	0.49529	0.538
1.600-002	1.99513+000	4.88460+000	4.7771-001	4.16417-002	0.49501	0.572
1.400-002	2.06040+000	5.04941+000	4.6168-001	3.77967-002	0.49467	0.612
1.200-002	2.13820+000	5.24650+000	4.4383-001	3.37835-002	0.49426	0.662
1.000-002	2.23366+000	5.48941+000	4.2357-001	2.95680-002	0.49372	0.727
9.000-003	2.29057+000	5.63480+000	4.1228-001	2.73697-002	0.49338	0.767
8.000-003	2.35573+000	5.80182+000	4.0001-001	2.51003-002	0.49299	0.815
7.000-003	2.43159+000	5.99706+000	3.8652-001	2.27489-002	0.49251	0.872
6.000-003	2.52184+000	6.23045+000	3.7149-001	2.03012-002	0.49192	0.944
5.000-003	2.63234+000	6.51803+000	3.5445-001	1.77373-002	0.49116	1.036
4.000-003	2.77319+000	6.88768+000	3.3461-001	1.50280-002	0.49013	1.161
3.500-003	2.86046+000	7.11858+000	3.2324-001	1.36055-002	0.48945	1.243
3.000-003	2.96400+000	7.39450+000	3.1058-001	1.21272-002	0.48862	1.345
2.500-003	3.09034+000	7.73427+000	2.9621-001	1.05816-002	0.48755	1.477
2.000-003	3.25065+000	8.17070+000	2.7948-001	8.95154-003	0.48610	1.656
1.800-003	3.32848+000	8.38493+000	2.7188-001	8.27037-003	0.48537	1.749
1.600-003	3.41710+000	8.63081+000	2.6362-001	7.56917-003	0.48449	1.858
1.400-003	3.51957+000	8.91793+000	2.5454-001	6.84481-003	0.48344	1.991
1.200-003	3.64046+000	9.26074+000	2.4441-001	6.09318-003	0.48214	2.156
1.000-003	3.78685+000	9.68238+000	2.3290-001	5.30855-003	0.48047	2.369

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0

H = 0.10 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	7.22698-001	1.74176+000	4.5650-001	5.19361-001	0.49961	-0.027
9.000-001	7.41896-001	1.78831+000	4.3432-001	5.10336-001	0.49962	-0.025
8.000-001	7.63970-001	1.84182+000	4.1157-001	5.00408-001	0.49964	-0.023
7.000-001	7.89801-001	1.90441+000	3.8821-001	4.89355-001	0.49965	-0.020
6.000-001	8.20721-001	1.97931+000	3.6419-001	4.76845-001	0.49967	-0.017
5.000-001	8.58872-001	2.07169+000	3.3947-001	4.62336-001	0.49968	-0.014
4.000-001	9.08005-001	2.19064+000	3.1397-001	4.44830-001	0.49970	-0.011
3.500-001	9.38749-001	2.26505+000	3.0088-001	4.34359-001	0.49971	-0.009
3.000-001	9.75544-001	2.35409+000	2.8752-001	4.22127-001	0.49971	-0.006
2.500-001	1.02093+000	2.46393+000	2.7376-001	4.07239-001	0.49972	-0.003
2.000-001	1.07938+000	2.60534+000	2.5932-001	3.87996-001	0.49972	0.000
1.800-001	1.10813+000	2.67490+000	2.5321-001	3.78394-001	0.49972	0.002
1.600-001	1.14118+000	2.75486+000	2.4681-001	3.67207-001	0.49972	0.004
1.400-001	1.17984+000	2.84840+000	2.3997-001	3.53915-001	0.49971	0.006
1.200-001	1.22610+000	2.96033+000	2.3251-001	3.37770-001	0.49971	0.009
1.000-001	1.28317+000	3.09841+000	2.2409-001	3.17667-001	0.49970	0.012
9.000-002	1.31735+000	3.18111+000	2.1937-001	3.05637-001	0.49970	0.013
8.000-002	1.35663+000	3.27618+000	2.1419-001	2.91922-001	0.49969	0.015
7.000-002	1.40259+000	3.38740+000	2.0840-001	2.76151-001	0.49968	0.018
6.000-002	1.45758+000	3.52048+000	2.0182-001	2.57838-001	0.49967	0.021
5.000-002	1.52540+000	3.68465+000	1.9416-001	2.36331-001	0.49965	0.024
4.000-002	1.61270+000	3.89601+000	1.8496-001	2.10716-001	0.49962	0.029
3.500-002	1.66730+000	4.02824+000	1.7956-001	1.95967-001	0.49961	0.032
3.000-002	1.73263+000	4.18648+000	1.7343-001	1.79624-001	0.49958	0.035
2.500-002	1.81320+000	4.38166+000	1.6634-001	1.61375-001	0.49955	0.040
2.000-002	1.91690+000	4.63295+000	1.5792-001	1.40781-001	0.49951	0.046
1.800-002	1.96789+000	4.75655+000	1.5405-001	1.31751-001	0.49949	0.049
1.600-002	2.02649+000	4.89863+000	1.4981-001	1.22189-001	0.49946	0.053
1.400-002	2.09502+000	5.06484+000	1.4510-001	1.12022-001	0.49943	0.057
1.200-002	2.17701+000	5.26373+000	1.3982-001	1.01158-001	0.49939	0.062
1.000-002	2.27809+000	5.50905+000	1.3378-001	8.94719-002	0.49934	0.069
9.000-003	2.33861+000	5.65599+000	1.3039-001	8.32677-002	0.49931	0.073
8.000-003	2.40816+000	5.82489+000	1.2669-001	7.67849-002	0.49927	0.078
7.000-003	2.48949+000	6.02247+000	1.2261-001	6.99856-002	0.49922	0.083
6.000-003	2.58676+000	6.25888+000	1.1804-001	6.28200-002	0.49916	0.090
5.000-003	2.70666+000	6.55049+000	1.1285-001	5.52202-002	0.49909	0.100
4.000-003	2.86091+000	6.92590+000	1.0677-001	4.70879-002	0.49899	0.112
3.500-003	2.95732+000	7.16073+000	1.0329-001	4.27770-002	0.49892	0.120
3.000-003	3.07261+000	7.44172+000	9.9395-002	3.82680-002	0.49884	0.130
2.500-003	3.21469+000	7.78828+000	9.4975-002	3.35221-002	0.49873	0.143
2.000-003	3.39738+000	8.23441+000	8.9822-002	2.84830-002	0.49858	0.160
1.800-003	3.48715+000	8.45381+000	8.7485-002	2.63671-002	0.49851	0.169
1.600-003	3.59024+000	8.70599+000	8.4941-002	2.41826-002	0.49842	0.179
1.400-003	3.71073+000	9.00097+000	8.2145-002	2.19193-002	0.49831	0.192
1.200-003	3.85474+000	9.35388+000	7.9028-002	1.95635-002	0.49818	0.208
1.000-003	4.03211+000	9.78912+000	7.5491-002	1.70965-002	0.49800	0.228

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.10 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	7.22651-001	1.74187+000	3.5828-001	5.06911-001	0.49966	-0.033
9.000-001	7.42061-001	1.78842+000	3.3399-001	4.96865-001	0.49968	-0.032
8.000-001	7.64149-001	1.84193+000	3.0880-001	4.85753-001	0.49970	-0.030
7.000-001	7.89998-001	1.90453+000	2.8258-001	4.73319-001	0.49972	-0.028
6.000-001	8.20941-001	1.97944+000	2.5514-001	4.59202-001	0.49974	-0.026
5.000-001	8.59124-001	2.07184+000	2.2625-001	4.42862-001	0.49976	-0.024
4.000-001	9.08301-001	2.19081+000	1.9556-001	4.23437-001	0.49979	-0.021
3.500-001	9.39075-001	2.26523+000	1.7938-001	4.12138-001	0.49980	-0.020
3.000-001	9.75908-001	2.35429+000	1.6253-001	3.99411-001	0.49981	-0.018
2.500-001	1.02135+000	2.46415+000	1.4488-001	3.84819-001	0.49983	-0.016
2.000-001	1.07987+000	2.60560+000	1.2627-001	3.67667-001	0.49984	-0.014
1.800-001	1.10866+000	2.67518+000	1.1851-001	3.59847-001	0.49985	-0.013
1.600-001	1.14175+000	2.75515+000	1.1053-001	3.51321-001	0.49986	-0.013
1.400-001	1.18048+000	2.84872+000	1.0232-001	3.41933-001	0.49986	-0.011
1.200-001	1.22681+000	2.96069+000	9.3835-002	3.31467-001	0.49987	-0.010
1.000-001	1.28398+000	3.09881+000	8.5054-002	3.19599-001	0.49988	-0.009
9.000-002	1.31823+000	3.18154+000	8.0539-002	3.12989-001	0.49988	-0.008
8.000-002	1.35759+000	3.27664+000	7.5934-002	3.05810-001	0.49989	-0.008
7.000-002	1.40365+000	3.38790+000	7.1235-002	2.97928-001	0.49989	-0.007
6.000-002	1.45876+000	3.52104+000	6.6437-002	2.89145-001	0.49990	-0.006
5.000-002	1.52675+000	3.68528+000	6.1536-002	2.79140-001	0.49990	-0.005
4.000-002	1.61429+000	3.89675+000	5.6531-002	2.67322-001	0.49991	-0.004
3.500-002	1.66906+000	4.02905+000	5.3986-002	2.60382-001	0.49991	-0.003
3.000-002	1.73461+000	4.18738+000	5.1405-002	2.52391-001	0.49991	-0.002
2.500-002	1.81546+000	4.38268+000	4.8774-002	2.42817-001	0.49991	-0.001
2.000-002	1.91956+000	4.63414+000	4.6047-002	2.30651-001	0.49991	0.000
1.800-002	1.97077+000	4.75784+000	4.4908-002	2.24650-001	0.49991	0.001
1.600-002	2.02963+000	4.90003+000	4.3723-002	2.17704-001	0.49991	0.001
1.400-002	2.09850+000	5.06638+000	4.2469-002	2.09504-001	0.49991	0.002
1.200-002	2.18090+000	5.26544+000	4.1113-002	1.99603-001	0.49991	0.003
1.000-002	2.28255+000	5.51101+000	3.9600-002	1.87345-001	0.49991	0.004
9.000-003	2.34344+000	5.65810+000	3.8757-002	1.80039-001	0.49990	0.004
8.000-003	2.41343+000	5.82718+000	3.7836-002	1.71733-001	0.49990	0.005
7.000-003	2.49531+000	6.02499+000	3.6812-002	1.62207-001	0.49990	0.006
6.000-003	2.59328+000	6.26171+000	3.5651-002	1.51180-001	0.49989	0.007
5.000-003	2.71414+000	6.55372+000	3.4305-002	1.38272-001	0.49989	0.008
4.000-003	2.86974+000	6.92969+000	3.2691-002	1.22957-001	0.49988	0.009
3.500-003	2.96708+000	7.16492+000	3.1744-002	1.14168-001	0.49987	0.010
3.000-003	3.08356+000	7.44640+000	3.0671-002	1.04456-001	0.49987	0.011
2.500-003	3.22723+000	7.79363+000	2.9428-002	9.36443-002	0.49986	0.013
2.000-003	3.41220+000	8.24071+000	2.7953-002	8.14879-002	0.49985	0.015
1.800-003	3.50318+000	8.46063+000	2.7274-002	7.61733-002	0.49984	0.015
1.600-003	3.60775+000	8.71343+000	2.6529-002	7.05560-002	0.49983	0.017
1.400-003	3.73007+000	9.00917+000	2.5704-002	6.45963-002	0.49982	0.018
1.200-003	3.87645+000	9.36307+000	2.4777-002	5.82429-002	0.49981	0.020
1.000-003	4.05698+000	9.79964+000	2.3715-002	5.14267-002	0.49979	0.022

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.04771-001	1.22550+000	3.3165+000	2.63371-001	0.49732	0.426
9.000-001	5.17859-001	1.25817+000	3.2158+000	2.48429-001	0.49713	0.442
8.000-001	5.32880-001	1.29571+000	3.1071+000	2.32520-001	0.49691	0.462
7.000-001	5.50418-001	1.33960+000	2.9887+000	2.15479-001	0.49664	0.487
6.000-001	5.71355-001	1.39210+000	2.8583+000	1.97080-001	0.49631	0.518
5.000-001	5.97097-001	1.45682+000	2.7120+000	1.77010-001	0.49590	0.559
4.000-001	6.30094-001	1.54007+000	2.5443+000	1.54806-001	0.49534	0.616
3.500-001	6.50648-001	1.59210+000	2.4496+000	1.42689-001	0.49498	0.654
3.000-001	6.75149-001	1.65433+000	2.3450+000	1.29725-001	0.49453	0.701
2.500-001	7.05220-001	1.73102+000	2.2277+000	1.15725-001	0.49397	0.763
2.000-001	7.43678-001	1.82964+000	2.0929+000	1.00411-001	0.49321	0.848
1.800-001	7.62483-001	1.87811+000	2.0324+000	9.38273-002	0.49282	0.891
1.600-001	7.84003-001	1.93377+000	1.9670+000	8.69260-002	0.49236	0.943
1.400-001	8.09045-001	1.99883+000	1.8956+000	7.96562-002	0.49181	1.006
1.200-001	8.38815-001	2.07659+000	1.8166+000	7.19501-002	0.49113	1.085
1.000-001	8.75231-001	2.17239+000	1.7278+000	6.37140-002	0.49026	1.187
9.000-002	8.96874-001	2.22969+000	1.6785+000	5.93568-002	0.48972	1.250
8.000-002	9.21591-001	2.29549+000	1.6252+000	5.48108-002	0.48909	1.326
7.000-002	9.50281-001	2.37237+000	1.5669+000	5.00464-002	0.48833	1.417
6.000-002	9.84283-001	2.46422+000	1.5023+000	4.50241-002	0.48738	1.531
5.000-002	1.02571+000	2.57729+000	1.4294+000	3.96897-002	0.48617	1.678
4.000-002	1.07817+000	2.72248+000	1.3450+000	3.39641-002	0.48454	1.880
3.500-002	1.11046+000	2.81308+000	1.2969+000	3.09184-002	0.48347	2.012
3.000-002	1.14855+000	2.92125+000	1.2435+000	2.77225-002	0.48216	2.177
2.500-002	1.19468+000	3.05429+000	1.1831+000	2.43451-002	0.48047	2.391
2.000-002	1.25261+000	3.22492+000	1.1130+000	2.07410-002	0.47820	2.683
1.800-002	1.28048+000	3.30855+000	1.0812+000	1.92211-002	0.47703	2.833
1.600-002	1.31199+000	3.40445+000	1.0468+000	1.76477-002	0.47566	3.012
1.400-002	1.34811+000	3.51629+000	1.0089+000	1.60125-002	0.47402	3.229
1.200-002	1.39027+000	3.64962+000	9.6683-001	1.43047-002	0.47198	3.501
1.000-002	1.44061+000	3.81329+000	9.1906-001	1.25095-002	0.46937	3.853
9.000-003	1.46985+000	3.91088+000	8.9242-001	1.15727-002	0.46776	4.073
8.000-003	1.50260+000	4.02263+000	8.6344-001	1.06052-002	0.46586	4.335
7.000-003	1.53971+000	4.15277+000	8.3157-001	9.60230-003	0.46357	4.654
6.000-003	1.58237+000	4.30762+000	7.9603-001	8.55788-003	0.46075	5.053
5.000-003	1.63229+000	4.49723+000	7.5564-001	7.46352-003	0.45713	5.572
4.000-003	1.69199+000	4.73894+000	7.0850-001	6.30702-003	0.45227	6.285
3.500-003	1.72664+000	4.88870+000	6.8143-001	5.69993-003	0.44911	6.758
3.000-003	1.76531+000	5.06634+000	6.5119-001	5.06930-003	0.44521	7.351
2.500-003	1.80868+000	5.28298+000	6.1675-001	4.41043-003	0.44023	8.125
2.000-003	1.85730+000	5.55760+000	5.7644-001	3.71657-003	0.43353	9.193
1.800-003	1.87816+000	5.69079+000	5.5808-001	3.42706-003	0.43012	9.749
1.600-003	1.89961+000	5.84227+000	5.3804-001	3.12943-003	0.42610	10.413
1.400-003	1.92123+000	6.01717+000	5.1593-001	2.82248-003	0.42128	11.224
1.200-003	1.94211+000	6.22303+000	4.9115-001	2.50469-003	0.41532	12.247
1.000-003	1.96030+000	6.47148+000	4.6285-001	2.17398-003	0.40771	13.586

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.10432-001	1.23133+000	9.4770-001	6.02324-001	0.49956	0.029
9.000-001	5.23965-001	1.26422+000	9.2784-001	5.82497-001	0.49955	0.031
8.000-001	5.39525-001	1.30202+000	9.0557-001	5.59654-001	0.49954	0.034
7.000-001	5.57731-001	1.34624+000	8.8025-001	5.33107-001	0.49953	0.037
6.000-001	5.79518-001	1.39915+000	8.5105-001	5.01933-001	0.49951	0.040
5.000-001	6.06395-001	1.46442+000	8.1669-001	4.64855-001	0.49948	0.045
4.000-001	6.40995-001	1.54844+000	7.7523-001	4.20010-001	0.49944	0.051
3.500-001	6.62638-001	1.60100+000	7.5086-001	3.93825-001	0.49941	0.056
3.000-001	6.88532-001	1.66390+000	7.2326-001	3.64470-001	0.49937	0.061
2.500-001	7.20464-001	1.74147+000	6.9145-001	3.31226-001	0.49932	0.067
2.000-001	7.61558-001	1.84134+000	6.5390-001	2.93052-001	0.49925	0.076
1.800-001	7.81763-001	1.89047+000	6.3674-001	2.76069-001	0.49922	0.081
1.600-001	8.04981-001	1.94693+000	6.1799-001	2.57906-001	0.49918	0.086
1.400-001	8.32131-001	2.01298+000	5.9731-001	2.38380-001	0.49912	0.093
1.200-001	8.64603-001	2.09201+000	5.7420-001	2.17250-001	0.49906	0.101
1.000-001	9.04632-001	2.18948+000	5.4793-001	1.94187-001	0.49898	0.111
9.000-002	9.28592-001	2.24787+000	5.3327-001	1.81791-001	0.49892	0.117
8.000-002	9.56121-001	2.31497+000	5.1732-001	1.68717-001	0.49886	0.125
7.000-002	9.88303-001	2.39346+000	4.9980-001	1.54864-001	0.49879	0.134
6.000-002	1.02678+000	2.48738+000	4.8030-001	1.40097-001	0.49869	0.145
5.000-002	1.07420+000	2.60321+000	4.5820-001	1.24233-001	0.49857	0.159
4.000-002	1.13516+000	2.75232+000	4.3254-001	1.07006-001	0.49841	0.179
3.500-002	1.17325+000	2.84558+000	4.1788-001	9.77598-002	0.49830	0.191
3.000-002	1.21878+000	2.95716+000	4.0158-001	8.79974-002	0.49817	0.207
2.500-002	1.27484+000	3.09477+000	3.8313-001	7.76146-002	0.49800	0.227
2.000-002	1.34689+000	3.27189+000	3.6171-001	6.64602-002	0.49777	0.255
1.800-002	1.38226+000	3.35899+000	3.5203-001	6.17335-002	0.49765	0.269
1.600-002	1.42286+000	3.45909+000	3.4151-001	5.68256-002	0.49751	0.285
1.400-002	1.47029+000	3.57616+000	3.2997-001	5.17092-002	0.49734	0.305
1.200-002	1.52694+000	3.71621+000	3.1715-001	4.63480-002	0.49713	0.330
1.000-002	1.59663+000	3.88890+000	3.0262-001	4.06919-002	0.49685	0.362
9.000-003	1.63828+000	3.99230+000	2.9454-001	3.77319-002	0.49668	0.382
8.000-003	1.68607+000	4.11113+000	2.8576-001	3.46681-002	0.49649	0.405
7.000-003	1.74185+000	4.25008+000	2.7613-001	3.14849-002	0.49624	0.433
6.000-003	1.80840+000	4.41629+000	2.6541-001	2.81611-002	0.49595	0.469
5.000-003	1.89020+000	4.62120+000	2.5327-001	2.46677-002	0.49556	0.514
4.000-003	1.99503+000	4.88482+000	2.3917-001	2.09625-002	0.49504	0.575
3.500-003	2.06030+000	5.04962+000	2.3111-001	1.90108-002	0.49470	0.615
3.000-003	2.13810+000	5.24670+000	2.2213-001	1.69780-002	0.49428	0.665
2.500-003	2.23357+000	5.48960+000	2.1196-001	1.48468-002	0.49374	0.730
2.000-003	2.35564+000	5.80200+000	2.0014-001	1.25928-002	0.49301	0.817
1.800-003	2.41533+000	5.95551+000	1.9478-001	1.16487-002	0.49263	0.862
1.600-003	2.48363+000	6.13184+000	1.8896-001	1.06754-002	0.49219	0.915
1.400-003	2.56310+000	6.33795+000	1.8256-001	9.66832-003	0.49165	0.980
1.200-003	2.65757+000	6.58433+000	1.7544-001	8.62153-003	0.49099	1.060
1.000-003	2.77312+000	6.88783+000	1.6736-001	7.52665-003	0.49014	1.163

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.10998-001	1.23192+000	3.0650-001	6.56529-001	0.49978	-0.010
9.000-001	5.24576-001	1.26482+000	2.9320-001	6.47393-001	0.49980	-0.009
8.000-001	5.40190-001	1.30265+000	2.7948-001	6.37197-001	0.49981	-0.009
7.000-001	5.58462-001	1.34690+000	2.6529-001	6.25658-001	0.49982	-0.008
6.000-001	5.80335-001	1.39986+000	2.5060-001	6.12351-001	0.49983	-0.007
5.000-001	6.07325-001	1.46518+000	2.3534-001	5.96573-001	0.49984	-0.006
4.000-001	6.42087-001	1.54928+000	2.1942-001	5.77017-001	0.49985	-0.004
3.500-001	6.63839-001	1.60189+000	2.1116-001	5.65039-001	0.49985	-0.003
3.000-001	6.89873-001	1.66485+000	2.0264-001	5.50786-001	0.49985	-0.002
2.500-001	7.21991-001	1.74252+000	1.9376-001	5.33082-001	0.49986	-0.001
2.000-001	7.63350-001	1.84251+000	1.8427-001	5.09698-001	0.49986	0.001
1.800-001	7.83696-001	1.89170+000	1.8019-001	4.97857-001	0.49986	0.001
1.600-001	8.07085-001	1.94824+000	1.7587-001	4.83947-001	0.49986	0.002
1.400-001	8.34447-001	2.01439+000	1.7121-001	4.67290-001	0.49986	0.003
1.200-001	8.67192-001	2.09354+000	1.6604-001	4.46907-001	0.49986	0.005
1.000-001	9.07585-001	2.19119+000	1.6014-001	4.21353-001	0.49985	0.006
9.000-002	9.31780-001	2.24967+000	1.5681-001	4.05988-001	0.49985	0.007
8.000-002	9.59592-001	2.31690+000	1.5312-001	3.88413-001	0.49985	0.008
7.000-002	9.92128-001	2.39556+000	1.4898-001	3.68135-001	0.49984	0.009
6.000-002	1.03106+000	2.48968+000	1.4425-001	3.44505-001	0.49983	0.011
5.000-002	1.07909+000	2.60578+000	1.3873-001	3.16645-001	0.49983	0.012
4.000-002	1.14091+000	2.75527+000	1.3209-001	2.83306-001	0.49981	0.015
3.500-002	1.17959+000	2.84880+000	1.2818-001	2.64031-001	0.49980	0.016
3.000-002	1.22587+000	2.96071+000	1.2375-001	2.42602-001	0.49979	0.018
2.500-002	1.28295+000	3.09877+000	1.1863-001	2.18578-001	0.49978	0.020
2.000-002	1.35644+000	3.27652+000	1.1255-001	1.91341-001	0.49976	0.023
1.800-002	1.39258+000	3.36395+000	1.0976-001	1.79353-001	0.49975	0.025
1.600-002	1.43412+000	3.46446+000	1.0670-001	1.66626-001	0.49973	0.026
1.400-002	1.48271+000	3.58203+000	1.0331-001	1.53056-001	0.49972	0.028
1.200-002	1.54085+000	3.72273+000	9.9515-002	1.38510-001	0.49970	0.031
1.000-002	1.61255+000	3.89629+000	9.5173-002	1.22808-001	0.49967	0.034
9.000-003	1.65549+000	4.00025+000	9.2740-002	1.14448-001	0.49965	0.036
8.000-003	1.70484+000	4.11975+000	9.0085-002	1.05692-001	0.49963	0.039
7.000-003	1.76256+000	4.25954+000	8.7158-002	9.64868-002	0.49961	0.042
6.000-003	1.83162+000	4.42683+000	8.3889-002	8.67604-002	0.49958	0.045
5.000-003	1.91678+000	4.63318+000	8.0169-002	7.64144-002	0.49954	0.050
4.000-003	2.02638+000	4.89885+000	7.5828-002	6.53068-002	0.49949	0.056
3.500-003	2.09492+000	5.06505+000	7.3339-002	5.94025-002	0.49946	0.060
3.000-003	2.17691+000	5.26393+000	7.0564-002	5.32140-002	0.49942	0.065
2.500-003	2.27800+000	5.50924+000	6.7413-002	4.66857-002	0.49936	0.071
2.000-003	2.40808+000	5.82507+000	6.3743-002	3.97366-002	0.49929	0.080
1.800-003	2.47203+000	5.98041+000	6.2079-002	3.68128-002	0.49925	0.084
1.600-003	2.54550+000	6.15896+000	6.0269-002	3.37907-002	0.49921	0.090
1.400-003	2.63142+000	6.36784+000	5.8281-002	3.06554-002	0.49915	0.096
1.200-003	2.73418+000	6.61777+000	5.6066-002	2.73874-002	0.49909	0.104
1.000-003	2.86084+000	6.92605+000	5.3554-002	2.39597-002	0.49900	0.114

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.20 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.11054-001	1.23198+000	2.2951-001	6.44418-001	0.49981	-0.014
9.000-001	5.24637-001	1.26489+000	2.1489-001	6.34184-001	0.49982	-0.013
8.000-001	5.40256-001	1.30271+000	1.9965-001	6.22710-001	0.49983	-0.013
7.000-001	5.58535-001	1.34697+000	1.8367-001	6.09681-001	0.49985	-0.012
6.000-001	5.80417-001	1.39993+000	1.6683-001	5.94645-001	0.49986	-0.012
5.000-001	6.07418-001	1.46525+000	1.4895-001	5.76922-001	0.49987	-0.011
4.000-001	6.42196-001	1.54936+000	1.2977-001	5.55414-001	0.49989	-0.010
3.500-001	6.63959-001	1.60198+000	1.1958-001	5.42685-001	0.49989	-0.009
3.000-001	6.90007-001	1.66495+000	1.0891-001	5.28162-001	0.49990	-0.009
2.500-001	7.22144-001	1.74262+000	9.7645-002	5.11267-001	0.49991	-0.008
2.000-001	7.63530-001	1.84263+000	8.5675-002	4.91084-001	0.49992	-0.007
1.800-001	7.83890-001	1.89182+000	8.0649-002	4.81767-001	0.49992	-0.006
1.600-001	8.07295-001	1.94837+000	7.5466-002	4.71529-001	0.49993	-0.006
1.400-001	8.34679-001	2.01453+000	7.0105-002	4.60160-001	0.49993	-0.006
1.200-001	8.67451-001	2.09370+000	6.4546-002	4.47367-001	0.49994	-0.005
1.000-001	9.07880-001	2.19136+000	5.8762-002	4.32710-001	0.49994	-0.004
9.000-002	9.32099-001	2.24985+000	5.5775-002	4.24478-001	0.49994	-0.004
8.000-002	9.59939-001	2.31710+000	5.2720-002	4.15481-001	0.49994	-0.004
7.000-002	9.92510-001	2.39577+000	4.9591-002	4.05536-001	0.49995	-0.003
6.000-002	1.03149+000	2.48991+000	4.6386-002	3.94369-001	0.49995	-0.003
5.000-002	1.07957+000	2.60604+000	4.3099-002	3.81538-001	0.49995	-0.002
4.000-002	1.14149+000	2.75557+000	3.9725-002	3.66226-001	0.49995	-0.002
3.500-002	1.18023+000	2.84912+000	3.8002-002	3.57154-001	0.49995	-0.001
3.000-002	1.22658+000	2.96107+000	3.6249-002	3.46637-001	0.49995	-0.001
2.500-002	1.28377+000	3.09917+000	3.4452-002	3.33941-001	0.49996	-0.001
2.000-002	1.35740+000	3.27698+000	3.2580-002	3.17676-001	0.49996	0.000
1.800-002	1.39361+000	3.36445+000	3.1793-002	3.09609-001	0.49996	0.000
1.600-002	1.43525+000	3.46499+000	3.0971-002	3.00242-001	0.49996	0.001
1.400-002	1.48396+000	3.58262+000	3.0098-002	2.89149-001	0.49995	0.001
1.200-002	1.54224+000	3.72338+000	2.9150-002	2.75717-001	0.49995	0.001
1.000-002	1.61415+000	3.89703+000	2.8086-002	2.59042-001	0.49995	0.002
9.000-003	1.65721+000	4.00104+000	2.7492-002	2.49084-001	0.49995	0.002
8.000-003	1.70672+000	4.12061+000	2.6840-002	2.37746-001	0.49995	0.002
7.000-003	1.76464+000	4.26049+000	2.6115-002	2.24727-001	0.49995	0.003
6.000-003	1.83395+000	4.42788+000	2.5292-002	2.09634-001	0.49995	0.003
5.000-003	1.91945+000	4.63437+000	2.4334-002	1.91937-001	0.49994	0.004
4.000-003	2.02953+000	4.90024+000	2.3187-002	1.70901-001	0.49994	0.005
3.500-003	2.09839+000	5.06658+000	2.2513-002	1.58810-001	0.49994	0.005
3.000-003	2.18081+000	5.26564+000	2.1749-002	1.45431-001	0.49993	0.006
2.500-003	2.28246+000	5.51120+000	2.0864-002	1.30514-001	0.49993	0.006
2.000-003	2.41334+000	5.82736+000	1.9814-002	1.13712-001	0.49992	0.007
1.800-003	2.47772+000	5.98288+000	1.9331-002	1.06356-001	0.49992	0.008
1.600-003	2.55173+000	6.16166+000	1.8802-002	9.85738-002	0.49992	0.008
1.400-003	2.63830+000	6.37081+000	1.8215-002	9.03089-002	0.49991	0.009
1.200-003	2.74189+000	6.62110+000	1.7555-002	8.14879-002	0.49990	0.010
1.000-003	2.86967+000	6.92984+000	1.6801-002	7.20124-002	0.49990	0.011

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.50 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	3.21782-001	7.74976-001	2.4429+000	2.94305-001	0.50025	0.335
9.000-001	3.30213-001	7.95733-001	2.3560+000	2.79097-001	0.50011	0.332
8.000-001	3.39903-001	8.19587-001	2.2629+000	2.62860-001	0.49995	0.331
7.000-001	3.51235-001	8.47485-001	2.1624+000	2.45403-001	0.49978	0.330
6.000-001	3.64788-001	8.80859-001	2.0528+000	2.26461-001	0.49957	0.332
5.000-001	3.81492-001	9.22012-001	1.9316+000	2.05658-001	0.49931	0.337
4.000-001	4.02972-001	9.74973-001	1.7947+000	1.82424-001	0.49899	0.347
3.500-001	4.16391-001	1.00809+000	1.7184+000	1.69622-001	0.49879	0.355
3.000-001	4.32429-001	1.04771+000	1.6352+000	1.55808-001	0.49856	0.366
2.500-001	4.52179-001	1.09656+000	1.5430+000	1.40730-001	0.49826	0.383
2.000-001	4.77547-001	1.15942+000	1.4387+000	1.24007-001	0.49789	0.408
1.800-001	4.89999-001	1.19033+000	1.3925+000	1.16730-001	0.49770	0.421
1.600-001	5.04289-001	1.22584+000	1.3429+000	1.09037-001	0.49748	0.438
1.400-001	5.20974-001	1.26738+000	1.2893+000	1.00854-001	0.49722	0.458
1.200-001	5.40893-001	1.31705+000	1.2307+000	9.20804-002	0.49691	0.485
1.000-001	5.65388-001	1.37829+000	1.1654+000	8.25737-002	0.49652	0.520
9.000-002	5.80018-001	1.41496+000	1.1296+000	7.74837-002	0.49628	0.542
8.000-002	5.96795-001	1.45708+000	1.0911+000	7.21235-002	0.49600	0.568
7.000-002	6.16365-001	1.50634+000	1.0493+000	6.64462-002	0.49567	0.601
6.000-002	6.39700-001	1.56524+000	1.0034+000	6.03892-002	0.49525	0.642
5.000-002	6.68355-001	1.63785+000	9.5218-001	5.38648-002	0.49473	0.696
4.000-002	7.05025-001	1.73123+000	8.9352-001	4.67442-002	0.49404	0.770
3.500-002	7.27832-001	1.78959+000	8.6041-001	4.29006-002	0.49359	0.819
3.000-002	7.54982-001	1.85937+000	8.2390-001	3.88209-002	0.49303	0.880
2.500-002	7.88252-001	1.94534+000	7.8294-001	3.44527-002	0.49232	0.960
2.000-002	8.30710-001	2.05588+000	7.3584-001	2.97193-002	0.49136	1.069
1.800-002	8.51432-001	2.11018+000	7.1470-001	2.76988-002	0.49088	1.125
1.600-002	8.75114-001	2.17253+000	6.9183-001	2.55902-002	0.49030	1.191
1.400-002	9.02627-001	2.24540+000	6.6685-001	2.33797-002	0.48962	1.272
1.200-002	9.35269-001	2.33248+000	6.3920-001	2.10484-002	0.48876	1.373
1.000-002	9.75095-001	2.43969+000	6.0805-001	1.85707-002	0.48767	1.504
9.000-003	9.98710-001	2.50381+000	5.9077-001	1.72659-002	0.48700	1.585
8.000-003	1.02563+000	2.57741+000	5.7205-001	1.59090-002	0.48620	1.682
7.000-003	1.05679+000	2.66337+000	5.5156-001	1.44918-002	0.48524	1.799
6.000-003	1.09362+000	2.76603+000	5.2882-001	1.30037-002	0.48406	1.945
5.000-003	1.13831+000	2.89233+000	5.0313-001	1.14297-002	0.48254	2.135
4.000-003	1.19462+000	3.05439+000	4.7335-001	9.74816-003	0.48049	2.393
3.500-003	1.22910+000	3.15543+000	4.5635-001	8.85715-003	0.47916	2.563
3.000-003	1.26959+000	3.27600+000	4.3746-001	7.92490-003	0.47751	2.776
2.500-003	1.31832+000	3.42415+000	4.1606-001	6.94287-003	0.47540	3.051
2.000-003	1.37902+000	3.61395+000	3.9118-001	5.89866-003	0.47255	3.428
1.800-003	1.40800+000	3.70688+000	3.7991-001	5.45956-003	0.47110	3.623
1.600-003	1.44057+000	3.81336+000	3.6766-001	5.00579-003	0.46938	3.854
1.400-003	1.47764+000	3.93742+000	3.5420-001	4.53512-003	0.46732	4.136
1.200-003	1.52051+000	4.08514+000	3.3919-001	4.04459-003	0.46478	4.487
1.000-003	1.57107+000	4.26619+000	3.2215-001	3.53016-003	0.46152	4.945

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.50 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	3.23090-001	7.78866-001	6.7349-001	7.03966-001	0.49989	0.036
9.000-001	3.31660-001	7.99670-001	6.9834-001	6.82574-001	0.49989	0.034
8.000-001	3.41515-001	8.23583-001	6.4113-001	6.57858-001	0.49989	0.033
7.000-001	3.53049-001	8.51558-001	6.2139-001	6.29064-001	0.49989	0.033
6.000-001	3.66856-001	8.85035-001	5.9848-001	5.95175-001	0.49988	0.032
5.000-001	3.83892-001	9.26328-001	5.7145-001	5.54762-001	0.49987	0.032
4.000-001	4.05834-001	9.79493-001	5.3888-001	5.05699-001	0.49984	0.033
3.500-001	4.19563-001	1.01275+000	5.1983-001	4.76930-001	0.49983	0.033
3.000-001	4.35993-001	1.05255+000	4.9837-001	4.44541-001	0.49981	0.034
2.500-001	4.56261-001	1.10165+000	4.7382-001	4.07640-001	0.49979	0.036
2.000-001	4.82356-001	1.16486+000	4.4513-001	3.64898-001	0.49976	0.038
1.800-001	4.95191-001	1.19595+000	4.3213-001	3.45728-001	0.49974	0.040
1.600-001	5.09943-001	1.23169+000	4.1801-001	3.25102-001	0.49972	0.041
1.400-001	5.27200-001	1.27349+000	4.0256-001	3.02765-001	0.49970	0.043
1.200-001	5.47848-001	1.32352+000	3.8543-001	2.78379-001	0.49967	0.046
1.000-001	5.73313-001	1.38523+000	3.6614-001	2.51469-001	0.49963	0.050
9.000-002	5.88562-001	1.42220+000	3.5545-001	2.36860-001	0.49961	0.052
8.000-002	6.06089-001	1.46469+000	3.4391-001	2.21332-001	0.49958	0.055
7.000-002	6.26588-001	1.51439+000	3.3131-001	2.04728-001	0.49955	0.058
6.000-002	6.51112-001	1.57387+000	3.1738-001	1.86842-001	0.49951	0.062
5.000-002	6.81352-001	1.64723+000	3.0174-001	1.67388-001	0.49946	0.067
4.000-002	7.20266-001	1.74168+000	2.8374-001	1.45942-001	0.49939	0.075
3.500-002	7.44599-001	1.80077+000	2.7354-001	1.34278-001	0.49935	0.079
3.000-002	7.73705-001	1.87147+000	2.6228-001	1.21833-001	0.49929	0.085
2.500-002	8.09587-001	1.95868+000	2.4961-001	1.08437-001	0.49922	0.093
2.000-002	8.55751-001	2.07095+000	2.3501-001	9.38418-002	0.49912	0.104
1.800-002	8.78443-001	2.12617+000	2.2845-001	8.75868-002	0.49908	0.109
1.600-002	9.04514-001	2.18964+000	2.2136-001	8.10444-002	0.49902	0.116
1.400-002	9.34995-001	2.26388+000	2.1360-001	7.41690-002	0.49895	0.124
1.200-002	9.71443-001	2.35272+000	2.0501-001	6.69003-002	0.49886	0.133
1.000-002	1.01636+000	2.46229+000	1.9534-001	5.91550-002	0.49875	0.146
9.000-003	1.04324+000	2.52791+000	1.8998-001	5.50678-002	0.49868	0.154
8.000-003	1.07412+000	2.60334+000	1.8417-001	5.08115-002	0.49860	0.163
7.000-003	1.11021+000	2.69156+000	1.7781-001	4.63595-002	0.49851	0.174
6.000-003	1.15335+000	2.79712+000	1.7077-001	4.16770-002	0.49839	0.188
5.000-003	1.20649+000	2.92730+000	1.6282-001	3.67156-002	0.49823	0.204
4.000-003	1.27478+000	3.09487+000	1.5361-001	3.14047-002	0.49802	0.230
3.500-003	1.31744+000	3.19968+000	1.4837-001	2.85858-002	0.49788	0.246
3.000-003	1.36839+000	3.32506+000	1.4255-001	2.56325-002	0.49771	0.265
2.500-003	1.43113+000	3.47969+000	1.3597-001	2.25168-002	0.49749	0.291
2.000-003	1.51169+000	3.67868+000	1.2835-001	1.91977-002	0.49720	0.325
1.800-003	1.55122+000	3.77653+000	1.2490-001	1.77998-002	0.49705	0.343
1.600-003	1.59659+000	3.88898+000	1.2116-001	1.63537-002	0.49687	0.363
1.400-003	1.64956+000	4.02048+000	1.1706-001	1.48518-002	0.49665	0.389
1.200-003	1.71278+000	4.17779+000	1.1250-001	1.32842-002	0.49638	0.420
1.000-003	1.79051+000	4.37173+000	1.0735-001	1.16371-002	0.49604	0.460

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 0.50 KM

SIGMA(0) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	3.23221-001	7.79257-001	1.7868-001	8.14002-001	0.49986	0.006
9.000-001	3.31804-001	8.00065-001	1.7263-001	8.06990-001	0.49987	0.005
8.000-001	3.41676-001	8.23985-001	1.6634-001	7.98954-001	0.49989	0.004
7.000-001	3.53230-001	8.51968-001	1.5978-001	7.89573-001	0.49990	0.003
6.000-001	3.67062-001	8.85454-001	1.5290-001	7.78343-001	0.49991	0.002
5.000-001	3.84132-001	9.26761-001	1.4565-001	7.64400-001	0.49992	0.002
4.000-001	4.06119-001	9.79946-001	1.3791-001	7.46079-001	0.49993	0.001
3.500-001	4.19879-001	1.01322+000	1.3380-001	7.34261-001	0.49993	0.001
3.000-001	4.36349-001	1.05304+000	1.2947-001	7.19609-001	0.49994	0.001
2.500-001	4.56669-001	1.10216+000	1.2480-001	7.00575-001	0.49994	0.001
2.000-001	4.82836-001	1.16540+000	1.1958-001	6.74238-001	0.49994	0.002
1.800-001	4.95710-001	1.19651+000	1.1725-001	6.60488-001	0.49994	0.002
1.600-001	5.10509-001	1.23227+000	1.1471-001	6.44058-001	0.49994	0.002
1.400-001	5.27823-001	1.27411+000	1.1189-001	6.24069-001	0.49994	0.002
1.200-001	5.48544-001	1.32417+000	1.0868-001	5.99254-001	0.49994	0.003
1.000-001	5.74105-001	1.38593+000	1.0490-001	5.67736-001	0.49994	0.003
9.000-002	5.89417-001	1.42292+000	1.0272-001	5.48616-001	0.49994	0.003
8.000-002	6.07019-001	1.46545+000	1.0028-001	5.26618-001	0.49994	0.003
7.000-002	6.27612-001	1.51520+000	9.7520-002	5.01085-001	0.49994	0.004
6.000-002	6.52255-001	1.57473+000	9.4338-002	4.71145-001	0.49994	0.004
5.000-002	6.82653-001	1.64817+000	9.0600-002	4.35591-001	0.49993	0.005
4.000-002	7.21793-001	1.74273+000	8.6089-002	3.92676-001	0.49993	0.006
3.500-002	7.46280-001	1.80188+000	8.3438-002	3.67667-001	0.49992	0.007
3.000-002	7.75582-001	1.87268+000	8.0431-002	3.39680-001	0.49992	0.007
2.500-002	8.11728-001	1.96001+000	7.6963-002	3.08053-001	0.49991	0.008
2.000-002	8.58265-001	2.07245+000	7.2862-002	2.71839-001	0.49990	0.009
1.800-002	8.81155-001	2.12776+000	7.0984-002	2.55768-001	0.49990	0.010
1.600-002	9.07467-001	2.19134+000	6.8932-002	2.38609-001	0.49989	0.011
1.400-002	9.38248-001	2.26572+000	6.6665-002	2.20200-001	0.49989	0.012
1.200-002	9.75080-001	2.35473+000	6.4129-002	2.00324-001	0.49988	0.013
1.000-002	1.02051+000	2.46453+000	6.1242-002	1.78689-001	0.49987	0.014
9.000-003	1.04772+000	2.53030+000	5.9629-002	1.67087-001	0.49986	0.015
8.000-003	1.07900+000	2.60591+000	5.7873-002	1.54874-001	0.49986	0.016
7.000-003	1.11559+000	2.69435+000	5.5941-002	1.41958-001	0.49985	0.017
6.000-003	1.15937+000	2.80020+000	5.3789-002	1.28221-001	0.49983	0.018
5.000-003	1.21338+000	2.93076+000	5.1348-002	1.13502-001	0.49982	0.020
4.000-003	1.28249+000	3.09887+000	4.8509-002	9.75669-002	0.49980	0.022
3.500-003	1.32638+000	3.20404+000	4.6885-002	8.90362-002	0.49978	0.024
3.000-003	1.37841+000	3.32989+000	4.5079-002	8.00467-002	0.49977	0.026
2.500-003	1.44259+000	3.48514+000	4.3032-002	7.05071-002	0.49975	0.029
2.000-003	1.52519+000	3.68503+000	4.0655-002	6.02841-002	0.49972	0.032
1.800-003	1.56582+000	3.78335+000	3.9580-002	5.59604-002	0.49970	0.034
1.600-003	1.61251+000	3.89637+000	3.8411-002	5.14766-002	0.49968	0.036
1.400-003	1.66712+000	4.02858+000	3.7129-002	4.68085-002	0.49966	0.038
1.200-003	1.73246+000	4.18680+000	3.5703-002	4.19241-002	0.49964	0.041
1.000-003	1.81304+000	4.38197+000	3.4087-002	3.67793-002	0.49960	0.045

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

A = 0 H = 0.50 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	3.23234-001	7.79296-001	1.1750-001	8.06072-001	0.49985	0.003
9.000-001	3.31819-001	8.00105-001	1.1083-001	7.98308-001	0.49987	0.002
8.000-001	3.41692-001	8.24025-001	1.0384-001	7.89413-001	0.49988	0.001
7.000-001	3.53248-001	8.52008-001	9.6440-002	7.79066-001	0.49990	-0.000
6.000-001	3.67082-001	8.85496-001	8.8569-002	7.66791-001	0.49991	-0.001
5.000-001	3.84156-001	9.26805-001	8.0113-002	7.51854-001	0.49993	-0.001
4.000-001	4.06148-001	9.79992-001	7.0913-002	7.33027-001	0.49994	-0.002
3.500-001	4.19911-001	1.01327+000	6.5961-002	7.21517-001	0.49994	-0.002
3.000-001	4.36384-001	1.05309+000	6.0719-002	7.08042-001	0.49995	-0.002
2.500-001	4.56710-001	1.10221+000	5.5124-002	6.91903-001	0.49996	-0.002
2.000-001	4.82884-001	1.16546+000	4.9093-002	6.71955-001	0.49996	-0.002
1.800-001	4.95762-001	1.19657+000	4.6531-002	6.62498-001	0.49996	-0.002
1.600-001	5.10565-001	1.23233+000	4.3870-002	6.51921-001	0.49997	-0.002
1.400-001	5.27885-001	1.27417+000	4.1094-002	6.39947-001	0.49997	-0.002
1.200-001	5.48613-001	1.32424+000	3.8189-002	6.26180-001	0.49997	-0.002
1.000-001	5.74185-001	1.38600+000	3.5134-002	6.10019-001	0.49997	-0.001
9.000-002	5.89503-001	1.42299+000	3.3542-002	6.00756-001	0.49998	-0.001
8.000-002	6.07112-001	1.46552+000	3.1903-002	5.90474-001	0.49998	-0.001
7.000-002	6.27714-001	1.51528+000	3.0213-002	5.78910-001	0.49998	-0.001
6.000-002	6.52369-001	1.57482+000	2.8466-002	5.65670-001	0.49998	-0.001
5.000-002	6.82784-001	1.64826+000	2.6657-002	5.50105-001	0.49998	-0.001
4.000-002	7.21946-001	1.74283+000	2.4779-002	5.31016-001	0.49998	-0.001
3.500-002	7.46448-001	1.80200+000	2.3808-002	5.19433-001	0.49998	-0.000
3.000-002	7.75770-001	1.87280+000	2.2811-002	5.05751-001	0.49998	-0.000
2.500-002	8.11942-001	1.96014+000	2.1776-002	4.88892-001	0.49998	-0.000
2.000-002	8.58516-001	2.07260+000	2.0678-002	4.66815-001	0.49998	0.000
1.800-002	8.81426-001	2.12792+000	2.0210-002	4.55700-001	0.49998	0.000
1.600-002	9.07763-001	2.19151+000	1.9715-002	4.42685-001	0.49998	0.000
1.400-002	9.38573-001	2.26590+000	1.9184-002	4.27148-001	0.49998	0.000
1.200-002	9.75444-001	2.35493+000	1.8599-002	4.08190-001	0.49998	0.001
1.000-002	1.02093+000	2.46476+000	1.7934-002	3.84486-001	0.49998	0.001
9.000-003	1.04817+000	2.53054+000	1.7559-002	3.70259-001	0.49998	0.001
8.000-003	1.07949+000	2.60616+000	1.7145-002	3.54006-001	0.49998	0.001
7.000-003	1.11613+000	2.69463+000	1.6682-002	3.35277-001	0.49998	0.001
6.000-003	1.15998+000	2.80051+000	1.6155-002	3.13483-001	0.49998	0.001
5.000-003	1.21406+000	2.93111+000	1.5539-002	2.87825-001	0.49998	0.002
4.000-003	1.28371+000	3.09927+000	1.4799-002	2.57176-001	0.49998	0.002
3.500-003	1.32728+000	3.20447+000	1.4364-002	2.39484-001	0.49998	0.002
3.000-003	1.37942+000	3.33038+000	1.3870-002	2.19841-001	0.49997	0.002
2.500-003	1.44373+000	3.48569+000	1.3300-002	1.97852-001	0.49997	0.003
2.000-003	1.52654+000	3.68566+000	1.2622-002	1.72968-001	0.49997	0.003
1.800-003	1.56728+000	3.78403+000	1.2311-002	1.62031-001	0.49997	0.003
1.600-003	1.61410+000	3.89711+000	1.1970-002	1.50432-001	0.49997	0.003
1.400-003	1.66888+000	4.02939+000	1.1592-002	1.38078-001	0.49996	0.004
1.200-003	1.73444+000	4.18770+000	1.1168-002	1.24853-001	0.49996	0.004
1.000-003	1.81530+000	4.38299+000	1.0683-002	1.10596-001	0.49996	0.004

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	2.28598-001	5.46967-001	2.0860+000	3.03701-001	0.50249	0.460
9.000-001	2.34580-001	5.61690-001	2.0024+000	2.88567-001	0.50231	0.442
8.000-001	2.41459-001	5.78610-001	1.9131+000	2.72421-001	0.50211	0.425
7.000-001	2.49511-001	5.98398-001	1.8172+000	2.55070-001	0.50189	0.407
6.000-001	2.59148-001	6.22071-001	1.7130+000	2.36252-001	0.50165	0.389
5.000-001	2.71039-001	6.51260-001	1.5985+000	2.15587-001	0.50137	0.371
4.000-001	2.86348-001	6.88826-001	1.4702+000	1.92496-001	0.50103	0.354
3.500-001	2.95924-001	7.12319-001	1.3992+000	1.79761-001	0.50084	0.346
3.000-001	3.07379-001	7.40424-001	1.3223+000	1.66002-001	0.50062	0.339
2.500-001	3.21501-001	7.75080-001	1.2379+000	1.50954-001	0.50036	0.333
2.000-001	3.39669-001	8.19682-001	1.1433+000	1.34207-001	0.50004	0.330
1.800-001	3.48598-001	8.41614-001	1.1018+000	1.26895-001	0.49989	0.330
1.600-001	3.58856-001	8.66818-001	1.0576+000	1.19144-001	0.49972	0.332
1.400-001	3.70846-001	8.96297-001	1.0101+000	1.10870-001	0.49953	0.334
1.200-001	3.85180-001	9.31561-001	9.5851-001	1.01959-001	0.49931	0.340
1.000-001	4.02837-001	9.75045-001	9.0173-001	9.22475-002	0.49904	0.348
9.000-002	4.13400-001	1.00108+000	8.7084-001	8.70182-002	0.49888	0.355
8.000-002	4.25528-001	1.03101+000	8.3788-001	8.14854-002	0.49869	0.363
7.000-002	4.39699-001	1.06600+000	8.0238-001	7.55920-002	0.49848	0.374
6.000-002	4.56628-001	1.10786+000	7.6373-001	6.92607-002	0.49823	0.389
5.000-002	4.77466-001	1.15948+000	7.2098-001	6.23820-002	0.49791	0.409
4.000-002	5.04220-001	1.22589+000	6.7265-001	5.47909-002	0.49750	0.439
3.500-002	5.20912-001	1.26742+000	6.4565-001	5.06504-002	0.49725	0.460
3.000-002	5.40837-001	1.31710+000	6.1612-001	4.62175-002	0.49693	0.486
2.500-002	5.65338-001	1.37833+000	5.8331-001	4.14215-002	0.49654	0.521
2.000-002	5.96752-001	1.45712+000	5.4600-001	3.61577-002	0.49601	0.570
1.800-002	6.12147-001	1.49585+000	5.2938-001	3.38865-002	0.49575	0.595
1.600-002	6.29795-001	1.54034+000	5.1151-001	3.14994-002	0.49544	0.626
1.400-002	6.50373-001	1.59237+000	4.9212-001	2.89762-002	0.49507	0.663
1.200-002	6.74899-001	1.65458+000	4.7079-001	2.62904-002	0.49462	0.710
1.000-002	7.04997-001	1.73126+000	4.4694-001	2.34049-002	0.49405	0.771
9.000-003	7.22939-001	1.77715+000	4.3379-001	2.18712-002	0.49369	0.809
8.000-003	7.43482-001	1.82986+000	4.1961-001	2.02650-002	0.49328	0.855
7.000-003	7.67400-001	1.89148+000	4.0417-001	1.85745-002	0.49278	0.910
6.000-003	7.95854-001	1.96514+000	3.8713-001	1.67837-002	0.49216	0.980
5.000-003	8.30691-001	2.05590+000	3.6799-001	1.48705-002	0.49137	1.069
4.000-003	8.75097-001	2.17256+000	3.4597-001	1.28026-002	0.49031	1.192
3.500-003	9.02611-001	2.24542+000	3.3347-001	1.16959-002	0.48962	1.273
3.000-003	9.35255-001	2.33249+000	3.1964-001	1.05289-002	0.48877	1.374
2.500-003	9.75082-001	2.43971+000	3.0405-001	9.28880-003	0.48768	1.504
2.000+003	1.02561+000	2.57743+000	2.8605-001	7.95684-003	0.48621	1.682
1.800-003	1.05015+000	2.64502+000	2.7793-001	7.39225-003	0.48545	1.774
1.600-003	1.07808+000	2.72261+000	2.6913-001	6.80578-003	0.48457	1.883
1.400-003	1.11038+000	2.81320+000	2.5949-001	6.19400-003	0.48350	2.015
1.200-003	1.14848+000	2.92137+000	2.4879-001	5.55241-003	0.48218	2.180
1.000-003	1.19461+000	3.05440+000	2.3668-001	4.87480-003	0.48050	2.393

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	2.28616-001	5.50684-001	5.5990-001	7.45528-001	0.50007	0.060
9.000-001	2.34671-001	5.65395-001	5.4616-001	7.23492-001	0.50008	0.056
8.000-001	2.41639-001	5.82307-001	5.3046-001	6.98042-001	0.50008	0.052
7.000-001	2.49788-001	6.02091-001	5.1237-001	6.68417-001	0.50008	0.048
6.000-001	2.59550-001	6.25766-001	4.9130-001	6.33600-001	0.50007	0.045
5.000-001	2.71599-001	6.54970-001	4.6643-001	5.92161-001	0.50006	0.041
4.000-001	2.87120-001	6.92572-001	4.3652-001	5.41966-001	0.50005	0.038
3.500-001	2.96834-001	7.16096-001	4.1909-001	5.12582-001	0.50004	0.036
3.000-001	3.08461-001	7.44246-001	3.9954-001	4.79531-001	0.50002	0.035
2.500-001	3.22806-001	7.78971-001	3.7729-001	4.41893-001	0.50000	0.034
2.000-001	3.41278-001	8.23679-001	3.5151-001	3.98277-001	0.49998	0.033
1.800-001	3.50366-001	8.45671-001	3.3991-001	3.78692-001	0.49997	0.033
1.600-001	3.60812-001	8.70950-001	3.2738-001	3.57591-001	0.49995	0.033
1.400-001	3.73033-001	9.00523-001	3.1375-001	3.34695-001	0.49994	0.033
1.200-001	3.87657-001	9.35912-001	2.9876-001	3.09627-001	0.49992	0.033
1.000-001	4.05697-001	9.79566-001	2.8202-001	2.81848-001	0.49989	0.034
9.000-002	4.16502-001	1.00571+000	2.7283-001	2.66704-001	0.49988	0.035
8.000-002	4.28921-001	1.03577+000	2.6296-001	2.50545-001	0.49986	0.036
7.000-002	4.43450-001	1.07093+000	2.5225-001	2.33186-001	0.49984	0.037
6.000-002	4.60833-001	1.11301+000	2.4052-001	2.14378-001	0.49981	0.038
5.000-002	4.82274-001	1.16491+000	2.2747-001	1.93764-001	0.49976	0.040
4.000-002	5.09873-001	1.23174+000	2.1262-001	1.70815-001	0.49974	0.043
3.500-002	5.27137-001	1.27354+000	2.0429-001	1.58214-001	0.49972	0.045
3.000-002	5.47791-001	1.32357+000	1.9515-001	1.44661-001	0.49969	0.048
2.500-002	5.73262-001	1.38528+000	1.8496-001	1.29931-001	0.49965	0.051
2.000-002	6.06045-001	1.46472+000	1.7335-001	1.13687-001	0.49960	0.056
1.800-002	6.22166-001	1.50380+000	1.6817-001	1.06655-001	0.49957	0.058
1.600-002	6.40693-001	1.54872+000	1.6260-001	9.92486-002	0.49954	0.061
1.400-002	6.62360-001	1.60127+000	1.5654-001	9.14049-002	0.49950	0.065
1.200-002	6.88280-001	1.66415+000	1.4987-001	8.30386-002	0.49946	0.070
1.000-002	7.20238-001	1.74171+000	1.4242-001	7.40310-002	0.49940	0.076
9.000-003	7.39372-001	1.78817+000	1.3830-001	6.92355-002	0.49937	0.079
8.000-003	7.61360-001	1.84157+000	1.3387-001	6.42078-002	0.49932	0.084
7.000-003	7.87071-001	1.90403+000	1.2904-001	5.89098-002	0.49927	0.089
6.000-003	8.17823-001	1.97878+000	1.2371-001	5.32905-002	0.49921	0.096
5.000-003	8.55732-001	2.07097+000	1.1772-001	4.72795-002	0.49913	0.105
4.000-003	9.04497-001	2.18966+000	1.1084-001	4.07735-002	0.49902	0.116
3.500-003	9.34979-001	2.26390+000	1.0693-001	3.72874-002	0.49895	0.124
3.000-003	9.71428-001	2.35274+000	1.0262-001	3.36083-002	0.49887	0.134
2.500-003	1.01635+000	2.46231+000	9.7757-002	2.96952-002	0.49876	0.146
2.000-003	1.07411+000	2.60335+000	9.2149-002	2.54874-002	0.49861	0.163
1.800-003	1.10248+000	2.67272+000	8.9624-002	2.37023-002	0.49853	0.172
1.600-003	1.13508+000	2.75245+000	8.6889-002	2.18468-002	0.49844	0.182
1.400-003	1.17317+000	2.84571+000	8.3896-002	1.99100-002	0.49833	0.195
1.200-003	1.21870+000	2.95728+000	8.0578-002	1.78772-002	0.49820	0.210
1.000-003	1.27478+000	3.09489+000	7.6833-002	1.57283-002	0.49802	0.230

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	2.28616-001	5.51058-001	1.2251-001	8.93926-001	0.49983	0.020
9.000-001	2.34678-001	5.65769-001	1.1936-001	8.89086-001	0.49985	0.017
8.000-001	2.41651-001	5.82679-001	1.1607-001	8.83404-001	0.49988	0.015
7.000-001	2.49814-001	6.02462-001	1.1261-001	8.76573-001	0.49990	0.012
6.000-001	2.59589-001	6.26138-001	1.0895-001	8.68089-001	0.49992	0.010
5.000-001	2.71654-001	6.55344-001	1.0503-001	8.57052-001	0.49993	0.008
4.000-001	2.87196-001	6.92949-001	1.0075-001	8.41658-001	0.49995	0.006
3.500-001	2.96924-001	7.16476-001	9.8405-002	8.31196-001	0.49996	0.005
3.000-001	3.08568-001	7.44631-001	9.5857-002	8.17688-001	0.49996	0.005
2.500-001	3.22935-001	7.79362-001	9.2998-002	7.99375-001	0.49997	0.004
2.000-001	3.41439-001	8.24081-001	8.9622-002	7.72941-001	0.49997	0.003
1.800-001	3.50542-001	8.46079-001	8.8041-002	7.58770-001	0.49997	0.003
1.600-001	3.61007-001	8.71365-001	8.6267-002	7.41598-001	0.49997	0.003
1.400-001	3.73251-001	9.00948-001	8.4233-002	7.20441-001	0.49998	0.003
1.200-001	3.87905-001	9.36349-001	8.1845-002	6.93893-001	0.49998	0.003
1.000-001	4.05982-001	9.80020-001	7.8958-002	6.59868-001	0.49998	0.003
9.000-002	4.16811-001	1.00618+000	7.7262-002	6.39112-001	0.49998	0.003
8.000-002	4.29260-001	1.03625+000	7.5347-002	6.15150-001	0.49997	0.003
7.000-002	4.43824-001	1.07143+000	7.3159-002	5.87247-001	0.49997	0.003
6.000-002	4.61254-001	1.11353+000	7.0626-002	5.54418-001	0.49997	0.003
5.000-002	4.82754-001	1.16546+000	6.7640-002	5.15280-001	0.49997	0.003
4.000-002	5.10439-001	1.23232+000	6.4037-002	4.67798-001	0.49997	0.004
3.500-002	5.27759-001	1.27415+000	6.1924-002	4.39986-001	0.49997	0.004
3.000-002	5.48486-001	1.32422+000	5.9535-002	4.08716-001	0.49996	0.004
2.500-002	5.74055-001	1.38597+000	5.6792-002	3.73165-001	0.49996	0.005
2.000-002	6.06976-001	1.46549+000	5.3567-002	3.32124-001	0.49996	0.005
1.800-002	6.23169-001	1.50460+000	5.2099-002	3.13779-001	0.49995	0.005
1.600-002	6.41784-001	1.54956+000	5.0500-002	2.94091-001	0.49995	0.006
1.400-002	6.63560-001	1.60216+000	4.8742-002	2.72840-001	0.49995	0.006
1.200-002	6.89620-001	1.66511+000	4.6784-002	2.49732-001	0.49994	0.007
1.000-002	7.21765-001	1.74276+000	4.4567-002	2.24364-001	0.49994	0.007
9.000-003	7.41019-001	1.78927+000	4.3334-002	2.10658-001	0.49993	0.008
8.000-003	7.63152-001	1.84273+000	4.1996-002	1.96144-001	0.49993	0.008
7.000-003	7.89044-001	1.90528+000	4.0531-002	1.80695-001	0.49992	0.009
6.000-003	8.20027-001	1.98014+000	3.8905-002	1.64142-001	0.49992	0.009
5.000-003	8.56246-001	2.07247+000	3.7070-002	1.46250-001	0.49991	0.010
4.000-003	9.07450-001	2.19136+000	3.4946-002	1.26680-001	0.49990	0.011
3.500-003	9.38232-001	2.26574+000	3.3738-002	1.16111-001	0.49989	0.012
3.000-003	9.75066-001	2.35475+000	3.2397-002	1.04896-001	0.49989	0.013
2.500-003	1.02050+000	2.46455+000	3.0884-002	9.29028-002	0.49987	0.014
2.000-003	1.07899+000	2.60592+000	2.9134-002	7.99350-002	0.49986	0.016
1.800-003	1.10776+000	2.67547+000	2.8344-002	7.44119-002	0.49985	0.017
1.600-003	1.14083+000	2.75540+000	2.7488-002	6.86582-002	0.49984	0.018
1.400-003	1.17951+000	2.84892+000	2.6551-002	6.26385-002	0.49983	0.019
1.200-003	1.22580+000	2.96083+000	2.5511-002	5.63059-002	0.49982	0.021
1.000-003	1.28289+000	3.09888+000	2.4335-002	4.95957-002	0.49980	0.023

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 1.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	2.28616-001	5.51096-001	6.7335-002	8.90302-001	0.49981	0.016
9.000-001	2.34679-001	5.65806-001	6.3883-002	8.85246-001	0.49983	0.013
8.000-001	2.41653-001	5.82716-001	6.0246-002	8.79379-001	0.49986	0.011
7.000-001	2.49817-001	6.02500-001	5.6389-002	8.72451-001	0.49988	0.009
6.000-001	2.59593-001	6.26175-001	5.2267-002	8.64085-001	0.49990	0.006
5.000-001	2.71659-001	6.55381-001	4.7815-002	8.53684-001	0.49992	0.005
4.000-001	2.87204-001	6.92986-001	4.2936-002	8.40218-001	0.49994	0.003
3.500-001	2.96933-001	7.16514-001	4.0292-002	8.31783-001	0.49995	0.002
3.000-001	3.08579-001	7.44669-001	3.7476-002	8.21708-001	0.49996	0.001
2.500-001	3.22948-001	7.79401-001	3.4449-002	8.09348-001	0.49996	0.001
2.000-001	3.41455-001	8.24121-001	3.1156-002	7.93614-001	0.49997	0.000
1.800-001	3.50559-001	8.46119-001	2.9746-002	7.85973-001	0.49997	0.000
1.600-001	3.61026-001	8.71407-001	2.8273-002	7.77284-001	0.49998	0.000
1.400-001	3.73273-001	9.00990-001	2.6728-002	7.67260-001	0.49998	-0.000
1.200-001	3.87929-001	9.36393-001	2.5098-002	7.55478-001	0.49998	-0.000
1.000-001	4.06011-001	9.80065-001	2.3369-002	7.41284-001	0.49998	-0.000
9.000-002	4.16842-001	1.00622+000	2.2461-002	7.32961-001	0.49998	-0.000
8.000-002	4.29294-001	1.03630+000	2.1520-002	7.23555-001	0.49999	-0.000
7.000-002	4.43862-001	1.07148+000	2.0543-002	7.12756-001	0.49999	-0.000
6.000-002	4.61296-001	1.11358+000	1.9524-002	7.00088-001	0.49999	-0.000
5.000-002	4.82802-001	1.16551+000	1.8459-002	6.84752-001	0.49999	-0.000
4.000-002	5.10495-001	1.23238+000	1.7335-002	6.65244-001	0.49999	-0.000
3.500-002	5.27821-001	1.27422+000	1.6747-002	6.53018-001	0.49999	-0.000
3.000-002	5.48556-001	1.32428+000	1.6133-002	6.38203-001	0.49999	-0.000
2.500-002	5.74134-001	1.38604+000	1.5485-002	6.19429-001	0.49999	0.000
2.000-002	6.07069-001	1.46556+000	1.4779-002	5.94108-001	0.49999	0.000
1.800-002	6.23269-001	1.50468+000	1.4471-002	5.81108-001	0.49999	0.000
1.600-002	6.41893-001	1.54964+000	1.4140-002	5.65715-001	0.49999	0.000
1.400-002	6.63681-001	1.60225+000	1.3779-002	5.47147-001	0.49999	0.000
1.200-002	6.89754-001	1.66520+000	1.3374-002	5.24273-001	0.49999	0.000
1.000-002	7.21918-001	1.74286+000	1.2905-002	4.95417-001	0.49999	0.000
9.000-003	7.41184-001	1.78938+000	1.2637-002	4.77992-001	0.49999	0.000
8.000-003	7.63331-001	1.84285+000	1.2340-002	4.58003-001	0.49999	0.001
7.000-003	7.89241-001	1.90541+000	1.2005-002	4.34875-001	0.49999	0.001
6.000-003	8.20248-001	1.98027+000	1.1621-002	4.07840-001	0.49999	0.001
5.000-003	8.58497-001	2.07262+000	1.1171-002	3.75853-001	0.49999	0.001
4.000-003	9.07746-001	2.19153+000	1.0628-002	3.37416-001	0.49999	0.001
3.500-003	9.38558-001	2.26593+000	1.0309-002	3.15110-001	0.49999	0.001
3.000-003	9.75430-001	2.35495+000	9.9474-003	2.90235-001	0.49999	0.001
2.500-003	1.02091+000	2.46478+000	9.5292-003	2.62245-001	0.49999	0.001
2.000-003	1.07948+000	2.60618+000	9.0337-003	2.30369-001	0.49998	0.001
1.800-003	1.10829+000	2.67574+000	8.8064-003	2.16287-001	0.49998	0.002
1.600-003	1.14140+000	2.75570+000	8.5576-003	2.01299-001	0.49998	0.002
1.400-003	1.18015+000	2.84924+000	8.2824-003	1.85274-001	0.49998	0.002
1.200-003	1.22651+000	2.96119+000	7.9739-003	1.68044-001	0.49998	0.002
1.000-003	1.28370+000	3.09928+000	7.6220-003	1.49376-001	0.49998	0.002

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.62624-001	3.85079-001	1.8900+000	3.07194-001	0.50599	0.805
9.000-001	1.66840-001	3.95537-001	1.8074+000	2.92093-001	0.50568	0.765
8.000-001	1.71692-001	4.07555-001	1.7193+000	2.75993-001	0.50534	0.724
7.000-001	1.77376-001	4.21607-001	1.6247+000	2.58707-001	0.50497	0.680
6.000-001	1.84185-001	4.38415-001	1.5223+000	2.39977-001	0.50457	0.635
5.000-001	1.92594-001	4.59137-001	1.4099+000	2.19431-001	0.50412	0.586
4.000-001	2.03432-001	4.85800-001	1.2845+000	1.96500-001	0.50360	0.535
3.500-001	2.10217-001	5.02472-001	1.2153+000	1.83867-001	0.50331	0.507
3.000-001	2.18339-001	5.22415-001	1.1407+000	1.70228-001	0.50299	0.478
2.500-001	2.28361-001	5.47004-001	1.0590+000	1.55321-001	0.50263	0.448
2.000-001	2.41266-001	5.78646-001	9.6809-001	1.38742-001	0.50222	0.417
1.800-001	2.47613-001	5.94205-001	9.2835-001	1.31505-001	0.50203	0.404
1.600-001	2.54910-001	6.12084-001	8.8618-001	1.23834-001	0.50183	0.391
1.400-001	2.63444-001	6.32995-001	8.4111-001	1.15645-001	0.50161	0.378
1.200-001	2.73654-001	6.58011-001	7.9245-001	1.06822-001	0.50136	0.365
1.000-001	2.86244-001	6.88857-001	7.3924-001	9.71968-002	0.50108	0.352
9.000-002	2.93782-001	7.07327-001	7.1047-001	9.20085-002	0.50092	0.346
8.000-002	3.02444-001	7.28555-001	6.7993-001	8.65129-002	0.50074	0.341
7.000-002	3.12571-001	7.53381-001	6.4724-001	8.06499-002	0.50055	0.336
6.000-002	3.24683-001	7.83082-001	6.1191-001	7.43375-002	0.50032	0.332
5.000-002	3.39611-001	8.19706-001	5.7317-001	6.74575-002	0.50006	0.330
4.000-002	3.58807-001	8.66840-001	5.2987-001	5.98291-002	0.49974	0.332
3.500-002	3.70802-001	8.96317-001	5.0593-001	5.56476-002	0.49955	0.335
3.000-002	3.85141-001	9.31580-001	4.7997-001	5.11500-002	0.49932	0.340
2.500-002	4.02803-001	9.75063-001	4.5141-001	4.62546-002	0.49905	0.349
2.000-002	4.25500-001	1.03102+000	4.1934-001	4.08374-002	0.49870	0.364
1.800-002	4.36645-001	1.05854+000	4.0520-001	3.84827-002	0.49854	0.372
1.600-002	4.49440-001	1.09016+000	3.9010-001	3.59943-002	0.49834	0.383
1.400-002	4.64386-001	1.12713+000	3.7383-001	3.33475-002	0.49812	0.397
1.200-002	4.82237-001	1.17137+000	3.5610-001	3.05085-002	0.49785	0.415
1.000-002	5.04203-001	1.22591+000	3.3647-001	2.74296-002	0.49751	0.440
9.000-003	5.17331-001	1.25856+000	3.2574-001	2.57793-002	0.49731	0.456
8.000-003	5.32393-001	1.29608+000	3.1425-001	2.40393-002	0.49707	0.475
7.000-003	5.49974-001	1.33996+000	3.0181-001	2.21938-002	0.49679	0.499
6.000-003	5.70954-001	1.39244+000	2.8820-001	2.02211-002	0.49645	0.530
5.000-003	5.96741-001	1.45713+000	2.7305-001	1.80909-002	0.49602	0.570
4.000-003	6.29786-001	1.54035+000	2.5580-001	1.57582-002	0.49545	0.626
3.500-003	6.50365-001	1.59238+000	2.4609-001	1.44950-002	0.49508	0.663
3.000-003	6.74891-001	1.65459+000	2.3542-001	1.31506-002	0.49463	0.710
2.500-003	7.04990-001	1.73126+000	2.2349-001	1.17065-002	0.49405	0.771
2.000-003	7.43476-001	1.82987+000	2.0982-001	1.01354-002	0.49328	0.855
1.800-003	7.62293-001	1.87832+000	2.0370-001	9.46246-003	0.49289	0.898
1.600-003	7.83825-001	1.93397+000	1.9709-001	8.75866-003	0.49242	0.950
1.400-003	8.08880-001	1.99902+000	1.8989-001	8.01892-003	0.49187	1.013
1.200-003	8.38664-001	2.07678+000	1.8193-001	7.23655-003	0.49119	1.091
1.000-003	8.75093-001	2.17256+000	1.7299-001	6.40225-003	0.49031	1.192

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.61836-001	3.89263-001	4.9688-001	7.66633-001	0.50029	0.115
9.000-001	1.66106-001	3.99666-001	4.8372-001	7.44109-001	0.50030	0.106
8.000-001	1.71019-001	4.11626-001	4.6863-001	7.18109-001	0.50031	0.097
7.000-001	1.76773-001	4.25617-001	4.5117-001	6.87877-001	0.50031	0.088
6.000-001	1.83666-001	4.42361-001	4.3079-001	6.52403-001	0.50031	0.080
5.000-001	1.92177-001	4.63016-001	4.0672-001	6.10273-001	0.50030	0.071
4.000-001	2.03145-001	4.89610-001	3.7777-001	5.59389-001	0.50028	0.062
3.500-001	2.10011-001	5.06249-001	3.6093-001	5.29678-001	0.50026	0.058
3.000-001	2.18231-001	5.26159-001	3.4207-001	4.96329-001	0.50024	0.053
2.500-001	2.28374-001	5.50720-001	3.2068-001	4.58435-001	0.50022	0.049
2.000-001	2.41438-001	5.82342-001	2.9600-001	4.14630-001	0.50019	0.045
1.800-001	2.47866-001	5.97897-001	2.8495-001	3.94993-001	0.50017	0.043
1.600-001	2.55256-001	6.15777-001	2.7305-001	3.73855-001	0.50016	0.041
1.400-001	2.63902-001	6.36695-001	2.6016-001	3.50939-001	0.50014	0.039
1.200-001	2.74249-001	6.61726-001	2.4605-001	3.25865-001	0.50012	0.038
1.000-001	2.87014-001	6.92602-001	2.3040-001	2.98085-001	0.50009	0.036
9.000-002	2.94661-001	7.11097-001	2.2185-001	2.82938-001	0.50008	0.035
8.000-002	3.03451-001	7.32357-001	2.1271-001	2.66768-001	0.50006	0.035
7.000-002	3.13734-001	7.57228-001	2.0287-001	2.49382-001	0.50005	0.034
6.000-002	3.26040-001	7.86991-001	1.9215-001	2.30516-001	0.50002	0.033
5.000-002	3.41219-001	8.23703-001	1.8033-001	2.09791-001	0.50000	0.033
4.000-002	3.60763-001	8.70972-001	1.6703-001	1.86628-001	0.49997	0.033
3.500-002	3.72989-001	9.00544-001	1.5963-001	1.73855-001	0.49995	0.033
3.000-002	3.87618-001	9.35932-001	1.5159-001	1.60060-001	0.49993	0.034
2.500-002	4.05663-001	9.79584-001	1.4272-001	1.44985-001	0.49990	0.035
2.000-002	4.28892-001	1.03579+000	1.3272-001	1.28232-001	0.49987	0.036
1.800-002	4.40318-001	1.06343+000	1.2831-001	1.20929-001	0.49985	0.037
1.600-002	4.53449-001	1.09521+000	1.2358-001	1.13199-001	0.49983	0.038
1.400-002	4.68810-001	1.13239+000	1.1849-001	1.04962-001	0.49981	0.039
1.200-002	4.87189-001	1.17687+000	1.1293-001	9.61112-002	0.49978	0.041
1.000-002	5.09856-001	1.23175+000	1.0678-001	8.64957-002	0.49975	0.044
9.000-003	5.23431-001	1.26462+000	1.0341-001	8.13345-002	0.49973	0.045
8.000-003	5.39032-001	1.30240+000	9.9798-002	7.58883-002	0.49971	0.047
7.000-003	5.57280-001	1.34660+000	9.5892-002	7.01061-002	0.49968	0.049
6.000-003	5.79112-001	1.39949+000	9.1615-002	6.39194-002	0.49964	0.052
5.000-003	6.06034-001	1.46473+000	8.6853-002	5.72321-002	0.49960	0.056
4.000-003	6.40683-001	1.54873+000	8.1429-002	4.99015-002	0.49954	0.062
3.500-003	6.62351-001	1.60128+000	7.8378-002	4.59285-002	0.49951	0.065
3.000-003	6.88272-001	1.66416+000	7.5025-002	4.16977-002	0.49946	0.070
2.500-003	7.20231-001	1.74172+000	7.1277-002	3.71501-002	0.49940	0.076
2.000-003	7.61354-001	1.84157+000	6.6985-002	3.21989-002	0.49933	0.084
1.800-003	7.81571-001	1.89069+000	6.5064-002	3.00772-002	0.49929	0.088
1.600-003	8.04801-001	1.94714+000	6.2991-002	2.78573-002	0.49924	0.093
1.400-003	8.31964-001	2.01318+000	6.0732-002	2.55231-002	0.49918	0.099
1.200-003	8.64450-001	2.09220+000	5.8239-002	2.30534-002	0.49911	0.107
1.000-003	9.04493-001	2.18967+000	5.5439-002	2.04184-002	0.49903	0.117

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	1.61753-001	3.89686-001	9.0224-002	9.41635-001	0.49972	0.044
9.000-001	1.66029-001	4.00083-001	8.8600-002	9.38434-001	0.49976	0.038
8.000-001	1.70948-001	4.12036-001	8.6893-002	9.34565-001	0.49980	0.033
7.000-001	1.76710-001	4.26022-001	8.5083-002	9.29743-001	0.49984	0.028
6.000-001	1.83611-001	4.42759-001	8.3140-002	9.23484-001	0.49988	0.023
5.000-001	1.92133-001	4.63407-001	8.1012-002	9.14887-001	0.49991	0.018
4.000-001	2.03114-001	4.89994-001	7.8592-002	9.02079-001	0.49994	0.014
3.500-001	2.09988-001	5.06629-001	7.7205-002	8.92892-001	0.49996	0.012
3.000-001	2.18218-001	5.26537-001	7.5627-002	8.80553-001	0.49997	0.010
2.500-001	2.28374-001	5.51094-001	7.3747-002	8.63154-001	0.49998	0.008
2.000-001	2.41454-001	5.82714-001	7.1358-002	8.37103-001	0.49999	0.007
1.800-001	2.47890-001	5.98269-001	7.0176-002	8.22836-001	0.49999	0.006
1.600-001	2.55289-001	6.16149-001	6.8804-002	8.05360-001	0.49999	0.006
1.400-001	2.63946-001	6.37067-001	6.7180-002	7.83634-001	0.49999	0.005
1.200-001	2.74307-001	6.62100-001	6.5216-002	7.56179-001	0.49999	0.005
1.000-001	2.87090-001	6.92979-001	6.2781-002	7.20819-001	0.50000	0.004
9.000-002	2.94747-001	7.11476-001	6.1329-002	6.99200-001	0.50000	0.004
8.000-002	3.03550-001	7.32739-001	5.9676-002	6.74222-001	0.50000	0.004
7.000-002	3.13849-001	7.57615-001	5.7777-002	6.45127-001	0.50000	0.004
6.000-002	3.26175-001	7.87383-001	5.5568-002	6.10893-001	0.49999	0.003
5.000-002	3.41379-001	8.24105-001	5.2962-002	5.70085-001	0.49999	0.003
4.000-002	3.60957-001	8.71387-001	4.9825-002	5.20563-001	0.49999	0.003
3.500-002	3.73207-001	9.00969-001	4.7993-002	4.91531-001	0.49999	0.003
3.000-002	3.87865-001	9.36369-001	4.5931-002	4.58845-001	0.49999	0.003
2.500-002	4.05948-001	9.80038-001	4.3577-002	4.21594-001	0.49999	0.003
2.000-002	4.29231-001	1.03626+000	4.0836-002	3.78414-001	0.49998	0.003
1.800-002	4.40684-001	1.06392+000	3.9596-002	3.59029-001	0.49998	0.004
1.600-002	4.53850-001	1.09572+000	3.8254-002	3.38153-001	0.49998	0.004
1.400-002	4.69252-001	1.13291+000	3.6787-002	3.15522-001	0.49998	0.004
1.200-002	4.87684-001	1.17743+000	3.5165-002	2.90777-001	0.49998	0.004
1.000-002	5.10421-001	1.23233+000	3.3345-002	2.63415-001	0.49997	0.004
9.000-003	5.24041-001	1.26522+000	3.2340-002	2.48532-001	0.49997	0.004
8.000-003	5.39696-001	1.30303+000	3.1255-002	2.32685-001	0.49997	0.005
7.000-003	5.58011-001	1.34727+000	3.0074-002	2.15707-001	0.49997	0.005
6.000-003	5.79929-001	1.40020+000	2.8773-002	1.97374-001	0.49996	0.005
5.000-003	6.06965-001	1.46550+000	2.7316-002	1.77372-001	0.49996	0.006
4.000-003	6.41774-001	1.54957+000	2.5645-002	1.55237-001	0.49995	0.006
3.500-003	6.63552-001	1.60217+000	2.4701-002	1.43155-001	0.49995	0.006
3.000-003	6.89612-001	1.66511+000	2.3661-002	1.30225-001	0.49995	0.007
2.500-003	7.21758-001	1.74276+000	2.2495-002	1.16259-001	0.49994	0.008
2.000-003	7.63146-001	1.84274+000	2.1155-002	1.00977-001	0.49993	0.008
1.800-003	7.83504-001	1.89192+000	2.0554-002	9.44051-002	0.49993	0.009
1.600-003	8.06905-001	1.94845+000	1.9905-002	8.75149-002	0.49992	0.009
1.400-003	8.34280-001	2.01459+000	1.9198-002	8.02549-002	0.49992	0.010
1.200-003	8.67039-001	2.09374+000	1.8415-002	7.25570-002	0.49991	0.011
1.000-003	9.07446-001	2.19137+000	1.7536-002	6.43264-002	0.49990	0.012

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 2.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.61745-001	3.89728-001	3.8193-002	9.41513-001	0.49966	0.037
9.000-001	1.66021-001	4.00125-001	3.6444-002	9.38611-001	0.49971	0.032
8.000-001	1.70941-001	4.12078-001	3.4600-002	9.35216-001	0.49975	0.026
7.000-001	1.76704-001	4.26062-001	3.2642-002	9.31170-001	0.49980	0.021
6.000-001	1.83606-001	4.42799-001	3.0547-002	9.26229-001	0.49984	0.017
5.000-001	1.92128-001	4.63446-001	2.8279-002	9.19998-001	0.49988	0.013
4.000-001	2.03111-001	4.90033-001	2.5786-002	9.11780-001	0.49991	0.009
3.500-001	2.09986-001	5.06667-001	2.4431-002	9.06543-001	0.49993	0.007
3.000-001	2.18217-001	5.26574-001	2.2984-002	9.00192-001	0.49994	0.006
2.500-001	2.28374-001	5.51132-001	2.1423-002	8.92252-001	0.49995	0.004
2.000-001	2.41456-001	5.82752-001	1.9716-002	8.81895-001	0.49997	0.003
1.800-001	2.47892-001	5.98306-001	1.8982-002	8.76757-001	0.49997	0.003
1.600-001	2.55292-001	6.16186-001	1.8213-002	8.70823-001	0.49997	0.002
1.400-001	2.63951-001	6.37104-001	1.7402-002	8.63851-001	0.49998	0.002
1.200-001	2.74313-001	6.62137-001	1.6543-002	8.55471-001	0.49998	0.001
1.000-001	2.87098-001	6.93017-001	1.5625-002	8.45085-001	0.49999	0.001
9.000-002	2.94756-001	7.11514-001	1.5140-002	8.38835-001	0.49999	0.001
8.000-002	3.03560-001	7.32778-001	1.4635-002	8.31616-001	0.49999	0.001
7.000-002	3.13861-001	7.57654-001	1.4106-002	8.23110-001	0.49999	0.001
6.000-002	3.26188-001	7.87423-001	1.3551-002	8.12807-001	0.49999	0.000
5.000-002	3.41395-001	8.24145-001	1.2961-002	7.99823-001	0.49999	0.000
4.000-002	3.60977-001	8.71429-001	1.2328-002	7.82434-001	0.49999	0.000
3.500-002	3.73228-001	9.01011-001	1.1989-002	7.71027-001	0.49999	0.000
3.000-002	3.87890-001	9.36413-001	1.1628-002	7.56695-001	0.49999	0.000
2.500-002	4.05977-001	9.80083-001	1.1234-002	7.37810-001	0.50000	0.000
2.000-002	4.29265-001	1.03631+000	1.0787-002	7.11302-001	0.50000	0.000
1.800-002	4.40721-001	1.06397+000	1.0584-002	6.97336-001	0.50000	0.000
1.600-002	4.53890-001	1.09577+000	1.0361-002	6.80565-001	0.50000	0.000
1.400-002	4.69297-001	1.13297+000	1.0111-002	6.60069-001	0.50000	0.000
1.200-002	4.87734-001	1.17748+000	9.8234-003	6.34525-001	0.50000	0.000
1.000-002	5.10478-001	1.23239+000	9.4819-003	6.01970-001	0.50000	0.000
9.000-003	5.24102-001	1.26529+000	9.2835-003	5.82177-001	0.50000	0.000
8.000-003	5.39763-001	1.30310+000	9.0610-003	5.59372-001	0.50000	0.000
7.000-003	5.58084-001	1.34733+000	8.8082-003	5.32867-001	0.50000	0.000
6.000-003	5.80010-001	1.40027+000	8.5164-003	5.01740-001	0.49999	0.000
5.000-003	6.07058-001	1.46557+000	8.1731-003	4.64715-001	0.49999	0.000
4.000-003	6.41883-001	1.54965+000	7.7588-003	4.19929-001	0.49999	0.001
3.500-003	6.63672-001	1.60226+000	7.5153-003	3.93776-001	0.49999	0.001
3.000-003	6.89746-001	1.66521+000	7.2394-003	3.64456-001	0.49999	0.001
2.500-003	7.21911-001	1.74287+000	6.9216-003	3.31248-001	0.49999	0.001
2.000-003	7.63325-001	1.84286+000	6.5464-003	2.93111-001	0.49999	0.001
1.800-003	7.83697-001	1.89204+000	6.3748-003	2.78143-001	0.49999	0.001
1.600-003	8.07115-001	1.94858+000	6.1875-003	2.57996-001	0.49999	0.001
1.400-003	8.34512-001	2.01473+000	5.9809-003	2.38485-001	0.49999	0.001
1.200-003	8.67298-001	2.09389+000	5.7500-003	2.17371-001	0.49999	0.001
1.000-003	9.07741-001	2.19154+000	5.4876-003	1.94323-001	0.49999	0.001

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.04384-001	2.40248-001	1.7660+000	3.08586-001	0.51587	1.862
9.000-001	1.07007-001	2.46944-001	1.6837+000	2.93480-001	0.51509	1.765
8.000-001	1.10032-001	2.54634-001	1.5959+000	2.77382-001	0.51427	1.664
7.000-001	1.13582-001	2.63621-001	1.5018+000	2.60107-001	0.51337	1.557
6.000-001	1.17842-001	2.74363-001	1.3999+000	2.41398-001	0.51240	1.443
5.000-001	1.23111-001	2.87599-001	1.2882+000	2.20892-001	0.51133	1.321
4.000-001	1.29915-001	3.04616-001	1.1637+000	1.98027-001	0.51013	1.186
3.500-001	1.34181-001	3.15250-001	1.0951+000	1.85441-001	0.50947	1.113
3.000-001	1.39292-001	3.27965-001	1.0212+000	1.71863-001	0.50874	1.035
2.500-001	1.45606-001	3.43634-001	9.4048-001	1.57036-001	0.50795	0.951
2.000-001	1.53747-001	3.63787-001	8.5079-001	1.40565-001	0.50707	0.858
1.800-001	1.57755-001	3.73692-001	8.1168-001	1.33382-001	0.50668	0.818
1.600-001	1.62365-001	3.85072-001	7.7025-001	1.25773-001	0.50627	0.775
1.400-001	1.67761-001	3.98378-001	7.2605-001	1.17657-001	0.50582	0.731
1.200-001	1.74221-001	4.14291-001	6.7846-001	1.08920-001	0.50534	0.683
1.000-001	1.82195-001	4.33907-001	6.2659-001	9.93986-002	0.50481	0.632
9.000-002	1.86972-001	4.45650-001	5.9865-001	9.42705-002	0.50453	0.605
8.000-002	1.92465-001	4.59145-001	5.6906-001	8.88419-002	0.50422	0.576
7.000-002	1.98893-001	4.74924-001	5.3750-001	8.30542-002	0.50389	0.546
6.000-002	2.06585-001	4.93799-001	5.0353-001	7.68266-002	0.50353	0.515
5.000-002	2.16075-001	5.17069-001	4.6651-001	7.00431-002	0.50313	0.481
4.000-002	2.28294-001	5.47014-001	4.2542-001	6.25246-002	0.50267	0.445
3.500-002	2.35938-001	5.65739-001	4.0288-001	5.84033-002	0.50241	0.426
3.000-002	2.45083-001	5.88138-001	3.7859-001	5.39692-002	0.50213	0.407
2.500-002	2.56362-001	6.15758-001	3.5210-001	4.91391-002	0.50181	0.387
2.000-002	2.70877-001	6.51302-001	3.2265-001	4.37855-002	0.50144	0.367
1.800-002	2.78014-001	6.68780-001	3.0980-001	4.14539-002	0.50127	0.359
1.600-002	2.86215-001	6.88965-001	2.9616-001	3.89859-002	0.50109	0.352
1.400-002	2.95805-001	7.12357-001	2.8159-001	3.63548-002	0.50089	0.344
1.200-002	3.07274-001	7.40459-001	2.6586-001	3.35239-002	0.50066	0.338
1.000-002	3.21412-001	7.75113-001	2.4864-001	3.04402-002	0.50039	0.333
9.000-003	3.29873-001	7.95864-001	2.3933-001	2.87800-002	0.50024	0.331
8.000-003	3.39594-001	8.19717-001	2.2944-001	2.70229-002	0.50007	0.330
7.000-003	3.50958-001	8.47604-001	2.1884-001	2.51501-002	0.49987	0.331
6.000-003	3.64543-001	8.80971-001	2.0736-001	2.31359-002	0.49965	0.333
5.000-003	3.81280-001	9.22116-001	1.9476-001	2.09435-002	0.49938	0.338
4.000-003	4.02794-001	9.75068-001	1.8063-001	1.85166-002	0.49905	0.349
3.500-003	4.16230-001	1.00818+000	1.7279-001	1.71883-002	0.49885	0.357
3.000-003	4.32286-001	1.04779+000	1.6428-001	1.57618-002	0.49860	0.369
2.500-003	4.52054-001	1.09664+000	1.5489-001	1.42118-002	0.49831	0.385
2.000-003	4.77440-001	1.15949+000	1.4430-001	1.25008-002	0.49792	0.410
1.800-003	4.89900-001	1.19040+000	1.3962-001	1.17587-002	0.49773	0.423
1.600-003	5.04198-001	1.22591+000	1.3461-001	1.09757-002	0.49751	0.440
1.400-003	5.20891-001	1.26744+000	1.2919-001	1.01444-002	0.49725	0.460
1.200-003	5.40819-001	1.31711+000	1.2328-001	9.25488-003	0.49694	0.487
1.000-003	5.65322-001	1.37835+000	1.1670-001	8.29296-003	0.49654	0.521

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	1.02674-001	2.45922-001	4.5672-001	7.78863-001	0.50082	0.284
9.000-001	1.05350-001	2.52502-001	4.4385-001	7.55919-001	0.50086	0.261
8.000-001	1.08434-001	2.60068-001	4.2904-001	7.29445-001	0.50088	0.238
7.000-001	1.12049-001	2.68919-001	4.1186-001	6.98683-001	0.50089	0.215
6.000-001	1.16386-001	2.79513-001	3.9178-001	6.62625-001	0.50088	0.192
5.000-001	1.21746-001	2.92583-001	3.6802-001	6.19866-001	0.50086	0.169
4.000-001	1.28661-001	3.09412-001	3.3944-001	5.68327-001	0.50082	0.145
3.500-001	1.32992-001	3.19941-001	3.2281-001	5.38293-001	0.50078	0.133
3.000-001	1.38180-001	3.32541-001	3.0419-001	5.04635-001	0.50075	0.121
2.500-001	1.44586-001	3.48084-001	2.8311-001	4.66465-001	0.50070	0.109
2.000-001	1.52839-001	3.68095-001	2.5882-001	4.22445-001	0.50064	0.096
1.800-001	1.56901-001	3.77938-001	2.4796-001	4.02749-001	0.50061	0.091
1.600-001	1.61571-001	3.89253-001	2.3630-001	3.81576-001	0.50058	0.085
1.400-001	1.67036-001	4.02490-001	2.2367-001	3.58654-001	0.50054	0.079
1.200-001	1.73578-001	4.18329-001	2.0989-001	3.33612-001	0.50050	0.073
1.000-001	1.81650-001	4.37867-001	1.9465-001	3.05920-001	0.50046	0.067
9.000-002	1.86486-001	4.49570-001	1.8636-001	2.90842-001	0.50043	0.064
8.000-002	1.92045-001	4.63022-001	1.7752-001	2.74764-001	0.50040	0.061
7.000-002	1.98550-001	4.78760-001	1.6802-001	2.57495-001	0.50037	0.057
6.000-002	2.06335-001	4.97592-001	1.5773-001	2.38779-001	0.50034	0.053
5.000-002	2.15939-001	5.20821-001	1.4643-001	2.18241-001	0.50030	0.050
4.000-002	2.28306-001	5.50730-001	1.3381-001	1.95311-001	0.50026	0.046
3.500-002	2.36044-001	5.69441-001	1.2685-001	1.82673-001	0.50024	0.044
3.000-002	2.45304-001	5.91832-001	1.1932-001	1.69025-001	0.50021	0.041
2.500-002	2.56726-001	6.19451-001	1.1109-001	1.54103-001	0.50018	0.039
2.000-002	2.71434-001	6.55012-001	1.0191-001	1.37502-001	0.50014	0.037
1.800-002	2.78668-001	6.72504-001	9.7887-002	1.30253-001	0.50013	0.036
1.600-002	2.86984-001	6.92611-001	9.3620-002	1.22569-001	0.50011	0.035
1.400-002	2.96713-001	7.16134-001	8.9053-002	1.14364-001	0.50009	0.035
1.200-002	3.08355-001	7.44282-001	8.4116-002	1.05523-001	0.50006	0.034
1.000-002	3.22715-001	7.79004-001	7.8707-002	9.58780-002	0.50004	0.033
9.000-003	3.31316-001	7.99803-001	7.5778-002	9.06792-002	0.50002	0.033
8.000-003	3.41203-001	8.23710-001	7.2665-002	8.51729-002	0.50001	0.033
7.000-003	3.52768-001	8.51679-001	6.9327-002	7.92996-002	0.49999	0.033
6.000-003	3.66608-001	8.85148-001	6.5712-002	7.29779-002	0.49996	0.033
5.000-003	3.83678-001	9.26433-001	6.1739-002	6.60912-002	0.49994	0.034
4.000-003	4.05653-001	9.79589-001	5.7283-002	5.84620-002	0.49991	0.035
3.500-003	4.19400-001	1.01284+000	5.4812-002	5.42842-002	0.49988	0.036
3.000-003	4.35848-001	1.05264+000	5.2127-002	4.97951-002	0.49986	0.037
2.500-003	4.56134-001	1.10173+000	4.9163-002	4.49156-002	0.49983	0.038
2.000-003	4.82248-001	1.16493+000	4.5822-002	3.95270-002	0.49979	0.041
1.800-003	4.95090-001	1.19602+000	4.4344-002	3.71890-002	0.49977	0.042
1.600-003	5.09851-001	1.23175+000	4.2763-002	3.47218-002	0.49975	0.044
1.400-003	5.27116-001	1.27356+000	4.1056-002	3.21020-002	0.49973	0.046
1.200-003	5.47772-001	1.32358+000	3.9190-002	2.92979-002	0.49969	0.048
1.000-003	5.73246-001	1.38529+000	3.7117-002	2.62649-002	0.49965	0.052

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.02489-001	2.46499-001	6.9158-002	9.73030-001	0.49933	0.114
9.000-001	1.05171-001	2.53067-001	6.8466-002	9.71024-001	0.49944	0.099
8.000-001	1.08262-001	2.60620-001	6.7726-002	9.68484-001	0.49955	0.085
7.000-001	1.11885-001	2.69457-001	6.6923-002	9.65145-001	0.49965	0.071
6.000-001	1.16230-001	2.80036-001	6.6030-002	9.60541-001	0.49974	0.059
5.000-001	1.21600-001	2.93088-001	6.4997-002	9.53766-001	0.49982	0.047
4.000-001	1.28527-001	3.09898-001	6.3716-002	9.42887-001	0.49989	0.036
3.500-001	1.32866-001	3.20416-001	6.2912-002	9.34639-001	0.49992	0.031
3.000-001	1.38063-001	3.33004-001	6.1922-002	9.23137-001	0.49995	0.026
2.500-001	1.44478-001	3.48534-001	6.0633-002	9.06337-001	0.49997	0.021
2.000-001	1.52743-001	3.68530-001	5.8829-002	8.80401-001	0.49999	0.017
1.800-001	1.56811-001	3.78367-001	5.7877-002	8.65955-001	0.50000	0.015
1.600-001	1.61487-001	3.89675-001	5.6735-002	8.48117-001	0.50001	0.014
1.400-001	1.66960-001	4.02905-001	5.5340-002	8.25798-001	0.50001	0.012
1.200-001	1.73510-001	4.18736-001	5.3605-002	7.97467-001	0.50002	0.011
1.000-001	1.81592-001	4.38267-001	5.1407-002	7.60895-001	0.50002	0.009
9.000-002	1.86434-001	4.49965-001	5.0078-002	7.38531-001	0.50002	0.009
8.000-002	1.92001-001	4.63413-001	4.8554-002	7.12710-001	0.50002	0.008
7.000-002	1.98513-001	4.79146-001	4.6794-002	6.82678-001	0.50002	0.007
6.000-002	2.06308-001	4.97974-001	4.4741-002	6.47420-001	0.50002	0.006
5.000-002	2.15924-001	5.21199-001	4.2315-002	6.05520-001	0.50002	0.006
4.000-002	2.28306-001	5.51104-001	3.9400-002	5.54868-001	0.50002	0.005
3.500-002	2.36053-001	5.69814-001	3.7702-002	5.25269-001	0.50002	0.005
3.000-002	2.45324-001	5.92203-001	3.5800-002	4.92022-001	0.50002	0.004
2.500-002	2.56761-001	6.19823-001	3.3642-002	4.54216-001	0.50001	0.004
2.000-002	2.71488-001	6.55385-001	3.1149-002	4.10473-001	0.50001	0.004
1.800-002	2.78733-001	6.72879-001	3.0032-002	3.90851-001	0.50001	0.004
1.600-002	2.87060-001	6.92988-001	2.8828-002	3.69720-001	0.50001	0.004
1.400-002	2.96803-001	7.16513-001	2.7522-002	3.46803-001	0.50001	0.004
1.200-002	3.08462-001	7.44666-001	2.6090-002	3.21715-001	0.50000	0.003
1.000-002	3.22844-001	7.79395-001	2.4499-002	2.93910-001	0.50000	0.003
9.000-003	3.31459-001	8.00198-001	2.3629-002	2.78745-001	0.50000	0.003
8.000-003	3.41363-001	8.24112-001	2.2698-002	2.62555-001	0.50000	0.003
7.000-003	3.52949-001	8.52088-001	2.1693-002	2.45146-001	0.50000	0.003
6.000-003	3.66813-001	8.85567-001	2.0597-002	2.26257-001	0.50000	0.003
5.000-003	3.83917-001	9.26867-001	1.9384-002	2.05511-001	0.49999	0.003
4.000-003	4.05938-001	9.80043-001	1.8015-002	1.82339-001	0.49999	0.003
3.500-003	4.19716-001	1.01331+000	1.7252-002	1.69571-001	0.49999	0.004
3.000-003	4.36203-001	1.05313+000	1.6420-002	1.55793-001	0.49999	0.004
2.500-003	4.56542-001	1.10224+000	1.5499-002	1.40755-001	0.49998	0.004
2.000-003	4.82728-001	1.16547+000	1.4457-002	1.24074-001	0.49998	0.004
1.800-003	4.95609-001	1.19658+000	1.3996-002	1.16815-001	0.49998	0.004
1.600-003	5.10416-001	1.23234+000	1.3501-002	1.09141-001	0.49997	0.004
1.400-003	5.27739-001	1.27417+000	1.2966-002	1.00978-001	0.49997	0.005
1.200-003	5.48468-001	1.32423+000	1.2381-002	9.22246-002	0.49997	0.005
1.000-003	5.74039-001	1.38598+000	1.1730-002	8.27395-002	0.49997	0.005

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

A = 0 H = 5.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	1.02470-001	2.46557-001	1.9051-002	9.75669-001	0.49918	0.097
9.000-001	1.05153-001	2.53124-001	1.8344-002	9.74404-001	0.49930	0.083
8.000-001	1.08244-001	2.60675-001	1.7598-002	9.72917-001	0.49942	0.069
7.000-001	1.11868-001	2.69511-001	1.6808-002	9.71133-001	0.49952	0.057
6.000-001	1.16214-001	2.80088-001	1.5962-002	9.68935-001	0.49962	0.045
5.000-001	1.21586-001	2.93139-001	1.5047-002	9.66133-001	0.49971	0.034
4.000-001	1.28514-001	3.09947-001	1.4040-002	9.62382-001	0.49980	0.025
3.500-001	1.32854-001	3.20464-001	1.3493-002	9.59955-001	0.49983	0.020
3.000-001	1.38051-001	3.33051-001	1.2907-002	9.56971-001	0.49987	0.016
2.500-001	1.44467-001	3.48579-001	1.2275-002	9.53171-001	0.49990	0.012
2.000-001	1.52734-001	3.68574-001	1.1582-002	9.48082-001	0.49993	0.009
1.800-001	1.56802-001	3.78410-001	1.1283-002	9.45496-001	0.49994	0.008
1.600-001	1.61479-001	3.89718-001	1.0969-002	9.42452-001	0.49995	0.007
1.400-001	1.66952-001	4.02946-001	1.0637-002	9.38790-001	0.49996	0.005
1.200-001	1.73503-001	4.18777-001	1.0284-002	9.34249-001	0.49997	0.004
1.000-001	1.81587-001	4.38307-001	9.9043-003	9.28382-001	0.49998	0.003
9.000-002	1.86429-001	4.50005-001	9.7021-003	9.24707-001	0.49998	0.003
8.000-002	1.91996-001	4.63452-001	9.4900-003	9.20311-001	0.49998	0.003
7.000-002	1.98510-001	4.79185-001	9.2657-003	9.14903-001	0.49999	0.002
6.000-002	2.06305-001	4.98012-001	9.0262-003	9.07991-001	0.49999	0.002
5.000-002	2.15922-001	5.21237-001	8.7661-003	8.98675-001	0.49999	0.001
4.000-002	2.28306-001	5.51142-001	8.4747-003	8.85102-001	0.49999	0.001
3.500-002	2.36054-001	5.69851-001	8.3106-003	8.75536-001	0.50000	0.001
3.000-002	2.45326-001	5.92241-001	8.1270-003	8.62850-001	0.50000	0.001
2.500-002	2.56765-001	6.19860-001	7.9131-003	8.45161-001	0.50000	0.001
2.000-002	2.71494-001	6.55423-001	7.6481-003	8.19019-001	0.50000	0.001
1.800-002	2.78739-001	6.72916-001	7.5194-003	8.04783-001	0.50000	0.000
1.600-002	2.87068-001	6.93026-001	7.3717-003	7.87399-001	0.50000	0.000
1.400-002	2.96812-001	7.16551-001	7.1986-003	7.65848-001	0.50000	0.000
1.200-002	3.08472-001	7.44705-001	6.9913-003	7.38657-001	0.50000	0.000
1.000-002	3.22857-001	7.79435-001	6.7362-003	7.03685-001	0.50000	0.000
9.000-003	3.31474-001	8.00238-001	6.5848-003	6.82312-001	0.50000	0.000
8.000-003	3.41379-001	8.24152-001	6.4129-003	6.57618-001	0.50000	0.000
7.000-003	3.52967-001	8.52129-001	6.2157-003	6.28848-001	0.50000	0.000
6.000-003	3.66834-001	8.85609-001	5.9866-003	5.94986-001	0.50000	0.000
5.000-003	3.83941-001	9.26910-001	5.7164-003	5.54604-001	0.50000	0.000
4.000-003	4.05967-001	9.80088-001	5.3909-003	5.05576-001	0.50000	0.000
3.500-003	4.19748-001	1.01336+000	5.2004-003	4.76826-001	0.50000	0.000
3.000-003	4.36239-001	1.05317+000	4.9858-003	4.44459-001	0.50000	0.000
2.500-003	4.56582-001	1.10229+000	4.7403-003	4.07580-001	0.50000	0.000
2.000-003	4.82776-001	1.16553+000	4.4535-003	3.64864-001	0.50000	0.000
1.800-003	4.95661-001	1.19664+000	4.3235-003	3.45704-001	0.50000	0.000
1.600-003	5.10473-001	1.23240+000	4.1824-003	3.25089-001	0.50000	0.000
1.400-003	5.27801-001	1.27423+000	4.0279-003	3.02764-001	0.50000	0.000
1.200-003	5.48538-001	1.32430+000	3.8566-003	2.78390-001	0.50000	0.000
1.000-003	5.74118-001	1.38605+000	3.6638-003	2.51492-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	7.53895-002	1.66024-001	1.7235+000	3.08879-001	0.53247	3.449
9.000-001	7.72023-002	1.70849-001	1.6412+000	2.93766-001	0.53087	3.279
8.000-001	7.92966-002	1.76386-001	1.5536+000	2.77662-001	0.52917	3.100
7.000-001	8.17587-002	1.82851-001	1.4595+000	2.60381-001	0.52734	2.910
6.000-001	8.47193-002	1.90571-001	1.3577+000	2.41671-001	0.52536	2.709
5.000-001	8.83890-002	2.00073-001	1.2461+000	2.21165-001	0.52319	2.492
4.000-001	9.31367-002	2.12275-001	1.1217+000	1.98306-001	0.52076	2.255
3.500-001	9.61175-002	2.19892-001	1.0533+000	1.85726-001	0.51943	2.099
3.000-001	9.96933-002	2.28993-001	9.7944-001	1.72157-001	0.51799	1.952
2.500-001	1.04115-001	2.40199-001	8.9885-001	1.57343-001	0.51641	1.792
2.000-001	1.09824-001	2.54598-001	8.0936-001	1.40893-001	0.51466	1.614
1.800-001	1.12637-001	2.61670-001	7.7035-001	1.33721-001	0.51390	1.537
1.600-001	1.15074-001	2.69791-001	7.2903-001	1.26125-001	0.51309	1.455
1.400-001	1.19665-001	2.79282-001	6.8497-001	1.18025-001	0.51222	1.367
1.200-001	1.24208-001	2.90627-001	6.3755-001	1.09308-001	0.51129	1.272
1.000-001	1.29818-001	3.04604-001	5.8590-001	9.98126-002	0.51028	1.169
9.000-002	1.33182-001	3.12968-001	5.5809-001	9.47004-002	0.50973	1.113
8.000-002	1.37051-001	3.22576-001	5.2866-001	8.92903-002	0.50915	1.055
7.000-002	1.41500-001	3.33807-001	4.9730-001	8.35246-002	0.50853	0.992
6.000-002	1.47005-001	3.47235-001	4.6356-001	7.73237-002	0.50786	0.925
5.000-002	1.53700-001	3.63785-001	4.2684-001	7.05731-002	0.50712	0.852
4.000-002	1.62328-001	3.85071-001	3.8616-001	6.30970-002	0.50631	0.771
3.500-002	1.67729-001	3.98377-001	3.6387-001	5.90019-002	0.50586	0.727
3.000-002	1.74194-001	4.14291-001	3.3990-001	5.45986-002	0.50537	0.680
2.500-002	1.82172-001	4.33907-001	3.1381-001	4.98057-002	0.50483	0.630
2.000-002	1.92447-001	4.59146-001	2.8490-001	4.44980-002	0.50423	0.575
1.800-002	1.97502-001	4.71553-001	2.7231-001	4.21882-002	0.50397	0.551
1.600-002	2.03313-001	4.85810-001	2.5899-001	3.97443-002	0.50369	0.527
1.400-002	2.10112-001	5.02483-001	2.4478-001	3.71402-002	0.50338	0.501
1.200-002	2.18249-001	5.22426-001	2.2950-001	3.43397-002	0.50305	0.473
1.000-002	2.28285-001	5.47015-001	2.1284-001	3.12908-002	0.50268	0.445
9.000-003	2.34295-001	5.61738-001	2.0387-001	2.96497-002	0.50247	0.430
8.000-003	2.41204-001	5.78658-001	1.9436-001	2.79131-002	0.50225	0.415
7.000-003	2.49284-001	5.98445-001	1.8422-001	2.60623-002	0.50201	0.399
6.000-003	2.58951-001	6.22116-001	1.7330-001	2.40714-002	0.50175	0.383
5.000-003	2.70872-001	6.51303-001	1.6137-001	2.19033-002	0.50145	0.367
4.000-003	2.86211-001	6.88866-001	1.4812-001	1.95006-002	0.50109	0.351
3.500-003	2.95401-001	7.12358-001	1.4082-001	1.81837-002	0.50089	0.344
3.000-003	3.07271-001	7.40460-001	1.3295-001	1.67670-002	0.50066	0.338
2.500-003	3.21409-001	7.75114-001	1.2434-001	1.52240-002	0.50039	0.333
2.000-003	3.39592-001	8.19713-001	1.1473-001	1.35143-002	0.50007	0.330
1.800-003	3.48528-001	8.41644-001	1.1052-001	1.27700-002	0.49992	0.330
1.600-003	3.58792-001	8.66847-001	1.0604-001	1.19824-002	0.49975	0.332
1.400-003	3.70788-001	8.96324-001	1.0124-001	1.11432-002	0.49955	0.335
1.200-003	3.85129-001	9.31587-001	9.6040-002	1.02409-002	0.49932	0.340
1.000-003	4.02792-001	9.75069-001	9.0318-002	9.25933-003	0.49905	0.349

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	7.29720-002	1.73569-001	4.4292-001	7.82793-001	0.50170	0.565
9.000-001	7.48350-002	1.78223-001	4.3013-001	7.59677-001	0.50176	0.518
8.000-001	7.69866-002	1.83574-001	4.1539-001	7.33008-001	0.50180	0.472
7.000-001	7.95149-002	1.89836-001	3.9829-001	7.02025-001	0.50182	0.426
6.000-001	8.25529-002	1.97333-001	3.7828-001	6.65720-001	0.50180	0.380
5.000-001	8.63152-002	2.06582-001	3.5459-001	6.22688-001	0.50176	0.333
4.000-001	9.11770-002	2.18492-001	3.2609-001	5.70852-001	0.50167	0.287
3.500-001	9.42261-002	2.25944-001	3.0950-001	5.40663-001	0.50161	0.263
3.000-001	9.78408-002	2.34861-001	2.9093-001	5.06848-001	0.50153	0.238
2.500-001	1.02396-001	2.45862-001	2.6990-001	4.68525-001	0.50144	0.213
2.000-001	1.08218-001	2.60024-001	2.4568-001	4.24360-001	0.50132	0.187
1.800-001	1.11084-001	2.66990-001	2.3485-001	4.04612-001	0.50126	0.176
1.600-001	1.14380-001	2.74997-001	2.2322-001	3.83392-001	0.50120	0.165
1.400-001	1.18239-001	2.84364-001	2.1064-001	3.60430-001	0.50114	0.153
1.200-001	1.22859-001	2.95573-001	1.9691-001	3.35360-001	0.50106	0.141
1.000-001	1.28560-001	3.09398-001	1.8174-001	3.07656-001	0.50097	0.128
9.000-002	1.31977-001	3.17679-001	1.7349-001	2.92580-001	0.50093	0.121
8.000-002	1.35905-001	3.27198-001	1.6470-001	2.76512-001	0.50088	0.114
7.000-002	1.40501-001	3.38333-001	1.5526-001	2.59266-001	0.50082	0.106
6.000-002	1.46003-001	3.51657-001	1.4504-001	2.40584-001	0.50076	0.098
5.000-002	1.52791-001	3.68092-001	1.3384-001	2.20102-001	0.50069	0.090
4.000-002	1.61533-001	3.89252-001	1.2134-001	1.97256-001	0.50062	0.081
3.500-002	1.67003-001	4.02489-001	1.1446-001	1.84675-001	0.50057	0.076
3.000-002	1.73550-001	4.18329-001	1.0704-001	1.71100-001	0.50053	0.071
2.500-002	1.81626-001	4.37867-001	9.8924-002	1.56271-001	0.50048	0.065
2.000-002	1.92027-001	4.63023-001	8.9907-002	1.39790-001	0.50042	0.059
1.800-002	1.97143-001	4.75397-001	8.5972-002	1.32600-001	0.50039	0.057
1.600-002	2.03024-001	4.89620-001	8.1801-002	1.24982-001	0.50037	0.054
1.400-002	2.09905-001	5.06259-001	7.7349-002	1.16852-001	0.50034	0.051
1.200-002	2.18139-001	5.26170-001	7.2551-002	1.08098-001	0.50030	0.048
1.000-002	2.28297-001	5.50731-001	6.7316-002	9.85521-002	0.50027	0.045
9.000-003	2.34381-001	5.65443-001	6.4493-002	9.34089-002	0.50025	0.044
8.000-003	2.41375-001	5.82354-001	6.1501-002	8.79624-002	0.50022	0.042
7.000-003	2.49558-001	6.02137-001	5.8306-002	8.21534-002	0.50020	0.040
6.000-003	2.59350-001	6.25811-001	5.4862-002	7.59003-002	0.50017	0.039
5.000-003	2.71429-001	6.55013-001	5.1100-002	6.90854-002	0.50014	0.037
4.000-003	2.86980-001	6.92612-001	4.6916-002	6.15281-002	0.50011	0.035
3.500-003	2.96709-001	7.16135-001	4.4614-002	5.73837-002	0.50009	0.035
3.000-003	3.08351-001	7.44283-001	4.2127-002	5.29234-002	0.50007	0.034
2.500-003	3.22712-001	7.79005-001	3.9407-002	4.80639-002	0.50004	0.033
2.000-003	3.41200-001	8.23711-001	3.6371-002	4.26774-002	0.50001	0.033
1.800-003	3.50294-001	8.45701-001	3.5040-002	4.03318-002	0.49999	0.033
1.600-003	3.60747-001	8.70979-001	3.3625-002	3.78495-002	0.49997	0.033
1.400-003	3.72974-001	9.00551-001	3.2108-002	3.52042-002	0.49996	0.033
1.200-003	3.87605-001	9.35938-001	3.0464-002	3.23598-002	0.49993	0.034
1.000-003	4.05652-001	9.79590-001	2.8656-002	2.92647-002	0.49991	0.035

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	7.26924-002	1.74345-001	6.1821-002	9.83962-001	0.49868	0.229
9.000-001	7.45632-002	1.78980-001	6.1439-002	9.82388-001	0.49890	0.199
8.000-001	7.67233-002	1.84312-001	6.1023-002	9.80330-001	0.49911	0.170
7.000-001	7.92611-002	1.90552-001	6.0557-002	9.77530-001	0.49931	0.143
6.000-001	8.23099-002	1.98025-001	6.0015-002	9.73524-001	0.49949	0.118
5.000-001	8.60846-002	2.07247-001	5.9348-002	9.67404-001	0.49965	0.094
4.000-001	9.09611-002	2.19126-001	5.8446-002	9.57203-001	0.49979	0.072
3.500-001	9.40189-002	2.26561-001	5.7836-002	9.49273-001	0.49985	0.062
3.000-001	9.76833-002	2.35459-001	5.7041-002	9.38033-001	0.49991	0.052
2.500-001	1.02210-001	2.46637-001	5.5945-002	9.21379-001	0.49996	0.043
2.000-001	1.08045-001	2.60575-001	5.4329-002	8.95357-001	0.50000	0.034
1.800-001	1.10917-001	2.67530-001	5.3451-002	8.80769-001	0.50001	0.031
1.600-001	1.14221-001	2.75526-001	5.2380-002	8.62700-001	0.50002	0.027
1.400-001	1.18087-001	2.84880-001	5.1053-002	8.40041-001	0.50003	0.024
1.200-001	1.22715-001	2.96074-001	4.9386-002	8.11231-001	0.50004	0.021
1.000-001	1.28427-001	3.09884-001	4.7252-002	7.74014-001	0.50005	0.018
9.000-002	1.31849-001	3.18156-001	4.5955-002	7.51256-001	0.50005	0.017
8.000-002	1.35784-001	3.27665-001	4.4465-002	7.24993-001	0.50005	0.015
7.000-002	1.40387-001	3.38790-001	4.2738-002	6.94468-001	0.50005	0.014
6.000-002	1.45897-001	3.52104-001	4.0720-002	6.58672-001	0.50005	0.012
5.000-002	1.52695-001	3.68527-001	3.8333-002	6.16199-001	0.50005	0.011
4.000-002	1.61449-001	3.89674-001	3.5464-002	5.64965-001	0.50005	0.009
3.500-002	1.66927-001	4.02904-001	3.3794-002	5.35085-001	0.50005	0.009
3.000-002	1.73482-001	4.18736-001	3.1925-002	5.01578-001	0.50004	0.008
2.500-002	1.81569-001	4.38267-001	2.9807-002	4.63551-001	0.50004	0.007
2.000-002	1.91982-001	4.63414-001	2.7366-002	4.19653-001	0.50004	0.006
1.800-002	1.97104-001	4.75784-001	2.6274-002	3.99996-001	0.50004	0.006
1.600-002	2.02993-001	4.90004-001	2.5100-002	3.78853-001	0.50003	0.006
1.400-002	2.09882-001	5.06640-001	2.3830-002	3.55951-001	0.50003	0.005
1.200-002	2.18126-001	5.26548-001	2.2441-002	3.30913-001	0.50003	0.005
1.000-002	2.28296-001	5.51105-001	2.0904-002	3.03201-001	0.50002	0.005
9.000-003	2.34388-001	5.65816-001	2.0067-002	2.88103-001	0.50002	0.004
8.000-003	2.41391-001	5.82726-001	1.9174-002	2.71993-001	0.50002	0.004
7.000-003	2.49584-001	6.02509-001	1.8213-002	2.54682-001	0.50002	0.004
6.000-003	2.59388-001	6.26183-001	1.7170-002	2.35905-001	0.50002	0.004
5.000-003	2.71483-001	6.55387-001	1.6024-002	2.15287-001	0.50001	0.004
4.000-003	2.87056-001	6.92989-001	1.4739-002	1.92247-001	0.50001	0.004
3.500-003	2.96799-001	7.16515-001	1.4029-002	1.79540-001	0.50001	0.003
3.000-003	3.08458-001	7.44668-001	1.3259-002	1.65812-001	0.50001	0.003
2.500-003	3.22841-001	7.79397-001	1.2414-002	1.50796-001	0.50000	0.003
2.000-003	3.41360-001	8.24113-001	1.1468-002	1.34087-001	0.50000	0.003
1.800-003	3.50470-001	8.46109-001	1.1053-002	1.26791-001	0.50000	0.003
1.600-003	3.60942-001	8.71394-001	1.0610-002	1.19057-001	0.50000	0.003
1.400-003	3.73192-001	9.00976-001	1.0135-002	1.10802-001	0.50000	0.003
1.200-003	3.87853-001	9.36375-001	9.6194-003	1.01912-001	0.49999	0.003
1.000-003	4.05937-001	9.80044-001	9.0516-003	9.22217-002	0.49999	0.003

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 10.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	7.26641-002	1.74423-001	1.2358-002	9.87658-001	0.49838	0.195
9.000-001	7.45356-002	1.79056-001	1.2000-002	9.87003-001	0.49862	0.167
8.000-001	7.66966-002	1.84386-001	1.1623-002	9.86231-001	0.49884	0.140
7.000-001	7.92354-002	1.90624-001	1.1224-002	9.85301-001	0.49906	0.115
6.000-001	8.22853-002	1.98094-001	1.0798-002	9.84149-001	0.49925	0.091
5.000-001	8.60613-002	2.07313-001	1.0337-002	9.82671-001	0.49944	0.070
4.000-001	9.09393-002	2.19190-001	9.8313-003	9.80671-001	0.49960	0.050
3.500-001	9.39980-002	2.26622-001	9.5560-003	9.79362-001	0.49967	0.041
3.000-001	9.76634-002	2.35519-001	9.2618-003	9.77734-001	0.49974	0.033
2.500-001	1.02191-001	2.46495-001	8.9439-003	9.75629-001	0.49981	0.026
2.000-001	1.08027-001	2.60630-001	8.5950-003	9.72743-001	0.49987	0.019
1.800-001	1.10900-001	2.67584-001	8.4443-003	9.71242-001	0.49989	0.016
1.600-001	1.14204-001	2.75578-001	8.2857-003	9.69442-001	0.49991	0.014
1.400-001	1.18071-001	2.84931-001	8.1176-003	9.67225-001	0.49992	0.011
1.200-001	1.22701-001	2.96124-001	7.9380-003	9.64391-001	0.49994	0.009
1.000-001	1.28413-001	3.09932-001	7.7434-003	9.60574-001	0.49996	0.007
9.000-002	1.31836-001	3.18204-001	7.6389-003	9.58087-001	0.49996	0.006
8.000-002	1.35771-001	3.27712-001	7.5282-003	9.55011-001	0.49997	0.005
7.000-002	1.40376-001	3.38836-001	7.4096-003	9.51075-001	0.49998	0.004
6.000-002	1.45887-001	3.52149-001	7.2802-003	9.45804-001	0.49998	0.004
5.000-002	1.52686-001	3.68571-001	7.1349-003	9.38297-001	0.49999	0.003
4.000-002	1.61441-001	3.89716-001	6.9631-003	9.26646-001	0.49999	0.002
3.500-002	1.66919-001	4.02945-001	6.8603-003	9.18028-001	0.49999	0.002
3.000-002	1.73475-001	4.18777-001	6.7388-003	9.06203-001	0.50000	0.002
2.500-002	1.81563-001	4.38307-001	6.5873-003	8.89188-001	0.50000	0.001
2.000-002	1.91977-001	4.63453-001	6.3846-003	8.63253-001	0.50000	0.001
1.800-002	1.97100-001	4.75823-001	6.2807-003	8.48908-001	0.50000	0.001
1.600-002	2.02990-001	4.90043-001	6.1578-003	8.31253-001	0.50000	0.001
1.400-002	2.09879-001	5.06678-001	6.0098-003	8.09220-001	0.50000	0.001
1.200-002	2.18125-001	5.26585-001	5.8279-003	7.81300-001	0.50000	0.001
1.000-002	2.28296-001	5.51143-001	5.5996-003	7.45290-001	0.50000	0.001
9.000-003	2.34389-001	5.65853-001	5.4623-003	7.23267-001	0.50000	0.001
8.000-003	2.41393-001	5.82763-001	5.3054-003	6.97831-001	0.50000	0.001
7.000-003	2.49587-001	6.02546-001	5.1246-003	6.68224-001	0.50000	0.000
6.000-003	2.59392-001	6.26220-001	4.9139-003	6.33426-001	0.50000	0.000
5.000-003	2.71489-001	6.55424-001	4.6653-003	5.92008-001	0.50000	0.000
4.000-003	2.87064-001	6.93027-001	4.3663-003	5.41837-001	0.50000	0.000
3.500-003	2.96808-001	7.16553-001	4.1920-003	5.12467-001	0.50000	0.000
3.000-003	3.08469-001	7.44706-001	3.9964-003	4.79430-001	0.50000	0.000
2.500-003	3.22854-001	7.79436-001	3.7740-003	4.41808-001	0.50000	0.000
2.000-003	3.41376-001	8.24153-001	3.5161-003	3.98210-001	0.50000	0.000
1.800-003	3.50488-001	8.46150-001	3.4001-003	3.78632-001	0.50000	0.000
1.600-003	3.60961-001	8.71436-001	3.2749-003	3.57539-001	0.50000	0.000
1.400-003	3.73214-001	9.01018-001	3.1386-003	3.34652-001	0.50000	0.000
1.200-003	3.87877-001	9.36419-001	2.9887-003	3.09594-001	0.50000	0.000
1.000-003	4.05966-001	9.80089-001	2.8213-003	2.81824-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.51145-002	1.12103-001	1.7021+000	3.08959-001	0.56649	5.950
9.000-001	5.63656-002	1.15631-001	1.6198+000	2.93843-001	0.56315	5.698
8.000-001	5.78130-002	1.19674-001	1.5322+000	2.77737-001	0.55962	5.428
7.000-001	5.95170-002	1.24388-001	1.4381+000	2.60455-001	0.55583	5.136
6.000-001	6.15688-002	1.30009-001	1.3363+000	2.41743-001	0.55174	4.816
5.000-001	6.41155-002	1.36914-001	1.2248+000	2.21237-001	0.54727	4.461
4.000-001	6.74149-002	1.45763-001	1.1004+000	1.98380-001	0.54230	4.057
3.500-001	6.94887-002	1.51278-001	1.0320+000	1.85801-001	0.53957	3.832
3.000-001	7.19785-002	1.57859-001	9.5818-001	1.72235-001	0.53663	3.585
2.500-001	7.50603-002	1.65949-001	8.7763-001	1.57425-001	0.53342	3.311
2.000-001	7.90427-002	1.76328-001	7.8818-001	1.40980-001	0.52987	3.001
1.800-001	8.10067-002	1.81419-001	7.4919-001	1.33811-001	0.52832	2.864
1.600-001	8.32681-002	1.87261-001	7.0791-001	1.26220-001	0.52669	2.718
1.400-001	8.59183-002	1.94082-001	6.6388-001	1.18125-001	0.52494	2.560
1.200-001	8.90955-002	2.02227-001	6.1651-001	1.09414-001	0.52307	2.389
1.000-001	9.30225-002	2.12251-001	5.6491-001	9.99263-002	0.52103	2.200
9.000-002	9.53784-002	2.18244-001	5.3714-001	9.48190-002	0.51993	2.097
8.000-002	9.80898-002	2.25124-001	5.0775-001	8.94148-002	0.51877	1.987
7.000-002	1.01265-001	2.33161-001	4.7644-001	8.36562-002	0.51754	1.870
6.000-002	1.05071-001	2.42764-001	4.4277-001	7.74640-002	0.51621	1.742
5.000-002	1.09771-001	2.54589-001	4.0612-001	7.07245-002	0.51476	1.602
4.000-002	1.15833-001	2.69785-001	3.6555-001	6.32630-002	0.51316	1.446
3.500-002	1.19630-001	2.79277-001	3.4333-001	5.91773-002	0.51228	1.359
3.000-002	1.24178-001	2.90623-001	3.1945-001	5.47854-002	0.51134	1.266
2.500-002	1.29794-001	3.04602-001	2.9346-001	5.00068-002	0.51031	1.165
2.000-002	1.37032-001	3.22574-001	2.6470-001	4.47176-002	0.50917	1.051
1.800-002	1.40595-001	3.31405-001	2.5218-001	4.24169-002	0.50868	1.002
1.600-002	1.44693-001	3.41550-001	2.3895-001	3.99836-002	0.50815	0.950
1.400-002	1.49489-001	3.53410-001	2.2485-001	3.73918-002	0.50759	0.896
1.200-002	1.55231-001	3.67592-001	2.0970-001	3.46059-002	0.50698	0.835
1.000-002	1.62319-001	3.85071-001	1.9321-001	3.15748-002	0.50632	0.770
9.000-003	1.66566-001	3.95534-001	1.8434-001	2.99443-002	0.50596	0.735
8.000-003	1.71449-001	4.07555-001	1.7495-001	2.82197-002	0.50558	0.699
7.000-003	1.77163-001	4.21611-001	1.6495-001	2.63827-002	0.50517	0.660
6.000-003	1.84003-001	4.38422-001	1.5420-001	2.44078-002	0.50472	0.619
5.000-003	1.92442-001	4.59146-001	1.4249-001	2.22587-002	0.50424	0.574
4.000-003	2.03310-001	4.85811-001	1.2953-001	1.98791-002	0.50369	0.526
3.500-003	2.10109-001	5.02483-001	1.2242-001	1.85759-002	0.50338	0.501
3.000-003	2.18246-001	5.22427-001	1.1477-001	1.71745-002	0.50305	0.473
2.500-003	2.28282-001	5.47016-001	1.0644-001	1.56469-002	0.50268	0.445
2.000-003	2.41202-001	5.78658-001	9.7194-002	1.39592-002	0.50225	0.415
1.800-003	2.47555-001	5.94216-001	9.3164-002	1.32236-002	0.50206	0.402
1.600-003	2.54858-001	6.12096-001	8.8895-002	1.24452-002	0.50186	0.389
1.400-003	2.63398-001	6.33006-001	8.4338-002	1.16156-002	0.50163	0.376
1.200-003	2.73614-001	6.58021-001	7.9426-002	1.07232-002	0.50138	0.364
1.000-003	2.86210-001	6.88867-001	7.4062-002	9.75128-003	0.50109	0.351

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	5.21162-002	1.22269-001	4.3593-001	7.84721-001	0.50351	1.121
9.000-001	5.33926-002	1.25561-001	4.2318-001	7.61512-001	0.50362	1.028
8.000-001	5.48735-002	1.29348-001	4.0848-001	7.34736-001	0.50368	0.935
7.000-001	5.66212-002	1.33782-001	3.9142-001	7.03634-001	0.50370	0.844
6.000-001	5.87299-002	1.39090-001	3.7144-001	6.67192-001	0.50367	0.752
5.000-001	6.13509-002	1.45640-001	3.4778-001	6.24008-001	0.50357	0.661
4.000-001	6.47495-002	1.54077-001	3.1930-001	5.72003-001	0.50339	0.568
3.500-001	6.68859-002	1.59356-001	3.0273-001	5.41725-001	0.50326	0.520
3.000-001	6.94503-002	1.65673-001	2.8417-001	5.07817-001	0.50310	0.472
2.500-001	7.26227-002	1.73465-001	2.6316-001	4.69398-001	0.50291	0.422
2.000-001	7.67186-002	1.83497-001	2.3895-001	4.25138-001	0.50267	0.370
1.800-001	7.87368-002	1.88430-001	2.2814-001	4.05353-001	0.50256	0.348
1.600-001	8.10591-002	1.94101-001	2.1652-001	3.84097-001	0.50244	0.325
1.400-001	8.37786-002	2.00735-001	2.0395-001	3.61101-001	0.50230	0.302
1.200-001	8.70360-002	2.08672-001	1.9024-001	3.36000-001	0.50215	0.277
1.000-001	9.10578-002	2.18462-001	1.7509-001	3.08269-001	0.50198	0.251
9.000-002	9.34684-002	2.24325-001	1.6685-001	2.93184-001	0.50189	0.237
8.000-002	9.62407-002	2.31064-001	1.5807-001	2.77108-001	0.50179	0.223
7.000-002	9.94853-002	2.38947-001	1.4864-001	2.59857-001	0.50168	0.207
6.000-002	1.03370-001	2.48379-001	1.3844-001	2.41176-001	0.50156	0.191
5.000-002	1.08164-001	2.60013-001	1.2726-001	2.20702-001	0.50143	0.174
4.000-002	1.14338-001	2.74990-001	1.1480-001	1.97874-001	0.50128	0.156
3.500-002	1.18203-001	2.84358-001	1.0794-001	1.85310-001	0.50120	0.146
3.000-002	1.22828-001	2.95568-001	1.0054-001	1.71756-001	0.50111	0.135
2.500-002	1.28535-001	3.09395-001	9.2466-002	1.56958-001	0.50101	0.123
2.000-002	1.35885-001	3.27195-001	8.3494-002	1.40521-001	0.50091	0.110
1.800-002	1.39501-001	3.35951-001	7.9582-002	1.33354-001	0.50086	0.105
1.600-002	1.43658-001	3.46015-001	7.5439-002	1.25764-001	0.50081	0.099
1.400-002	1.48522-001	3.57787-001	7.1020-002	1.17667-001	0.50075	0.093
1.200-002	1.54342-001	3.71875-001	6.6263-002	1.08953-001	0.50069	0.087
1.000-002	1.61524-001	3.89251-001	6.1079-002	9.94578-002	0.50063	0.080
9.000-003	1.65825-001	3.99659-001	5.8287-002	9.43449-002	0.50059	0.076
8.000-003	1.70771-001	4.11623-001	5.5332-002	8.89331-002	0.50055	0.072
7.000-003	1.76556-001	4.25618-001	5.2182-002	8.31643-002	0.50051	0.068
6.000-003	1.83480-001	4.42365-001	4.8792-002	7.69584-002	0.50047	0.063
5.000-003	1.92022-001	4.63023-001	4.5099-002	7.02003-002	0.50042	0.059
4.000-003	2.03020-001	4.89620-001	4.1005-002	6.27124-002	0.50037	0.054
3.500-003	2.09901-001	5.06259-001	3.8760-002	5.86091-002	0.50034	0.051
3.000-003	2.18136-001	5.26171-001	3.6343-002	5.41954-002	0.50030	0.048
2.500-003	2.28294-001	5.50732-001	3.3710-002	4.93890-002	0.50027	0.045
2.000-003	2.41374-001	5.82354-001	3.0787-002	4.40633-002	0.50023	0.042
1.800-003	2.47807-001	5.97909-001	2.9513-002	4.17445-002	0.50021	0.041
1.600-003	2.55203-001	6.15789-001	2.8163-002	3.92904-002	0.50019	0.039
1.400-003	2.63855-001	6.36706-001	2.6722-002	3.66744-002	0.50016	0.038
1.200-003	2.74208-001	6.61736-001	2.5168-002	3.38600-002	0.50014	0.037
1.000-003	2.86979-001	6.92613-001	2.3471-002	3.07946-002	0.50011	0.035

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	PHASE (DEGREES)
1.000+000	5.17159-002	1.23341-001	5.8089-002	9.89515-001	0.49737	0.461
9.000-001	5.30020-002	1.26605-001	5.7863-002	9.88163-001	0.49782	0.400
8.000-001	5.44937-002	1.30363-001	5.7609-002	9.86352-001	0.49824	0.342
7.000-001	5.62535-002	1.34764-001	5.7311-002	9.83828-001	0.49862	0.288
6.000-001	5.83758-002	1.40037-001	5.6945-002	9.80128-001	0.49898	0.236
5.000-001	6.10128-002	1.46547-001	5.6460-002	9.74341-001	0.49930	0.189
4.000-001	6.44302-002	1.54938-001	5.5748-002	9.64481-001	0.49958	0.144
3.500-001	6.65776-002	1.60190-001	5.5234-002	9.56705-001	0.49971	0.124
3.000-001	6.91544-002	1.66479-001	5.4536-002	9.45586-001	0.49982	0.104
2.500-001	7.23411-002	1.74238-001	5.3536-002	9.28982-001	0.49992	0.085
2.000-001	7.64538-002	1.84232-001	5.2013-002	9.02872-001	0.50000	0.068
1.800-001	7.84798-002	1.89149-001	5.1170-002	8.88185-001	0.50003	0.061
1.600-001	8.08106-002	1.94802-001	5.0133-002	8.69965-001	0.50005	0.055
1.400-001	8.35395-002	2.01416-001	4.8839-002	8.47088-001	0.50007	0.048
1.200-001	8.68074-002	2.09331-001	4.7203-002	8.17976-001	0.50009	0.042
1.000-001	9.08414-002	2.19096-001	4.5098-002	7.80354-001	0.50010	0.036
9.000-002	9.32589-002	2.24945-001	4.3815-002	7.57348-001	0.50011	0.033
8.000-002	9.60388-002	2.31669-001	4.2338-002	7.30803-001	0.50011	0.030
7.000-002	9.92918-002	2.39536-001	4.0624-002	6.99961-001	0.50011	0.027
6.000-002	1.03186-001	2.48950-001	3.8620-002	6.63814-001	0.50011	0.024
5.000-002	1.07990-001	2.60564-001	3.6247-002	6.20957-001	0.50011	0.021
4.000-002	1.14178-001	2.75518-001	3.3392-002	5.69313-001	0.50010	0.018
3.500-002	1.18050-001	2.84873-001	3.1731-002	5.39225-001	0.50010	0.017
3.000-002	1.22685-001	2.96069-001	2.9872-002	5.05514-001	0.50010	0.015
2.500-002	1.28402-001	3.09880-001	2.7766-002	4.67294-001	0.50009	0.014
2.000-002	1.35764-001	3.27663-001	2.5340-002	4.23229-001	0.50008	0.012
1.800-002	1.39385-001	3.36411-001	2.4256-002	4.03518-001	0.50008	0.011
1.600-002	1.43549-001	3.46466-001	2.3091-002	3.82333-001	0.50007	0.011
1.400-002	1.48420-001	3.58230-001	2.1831-002	3.59403-001	0.50007	0.010
1.200-002	1.54249-001	3.72307-001	2.0455-002	3.34359-001	0.50007	0.009
1.000-002	1.61440-001	3.89673-001	1.8934-002	3.06672-001	0.50006	0.008
9.000-003	1.65747-001	4.00076-001	1.8107-002	2.91601-001	0.50006	0.008
8.000-003	1.70699-001	4.12033-001	1.7225-002	2.75534-001	0.50005	0.007
7.000-003	1.76492-001	4.26022-001	1.6278-002	2.58281-001	0.50005	0.007
6.000-003	1.83425-001	4.42763-001	1.5252-002	2.39587-001	0.50005	0.007
5.000-003	1.91977-001	4.63414-001	1.4127-002	2.19080-001	0.50004	0.006
4.000-003	2.02989-001	4.90004-001	1.2871-002	1.96194-001	0.50004	0.005
3.500-003	2.09878-001	5.06640-001	1.2178-002	1.83584-001	0.50003	0.005
3.000-003	2.18123-001	5.26548-001	1.1431-002	1.69971-001	0.50003	0.005
2.500-003	2.28294-001	5.51106-001	1.0613-002	1.55092-001	0.50003	0.005
2.000-003	2.41389-001	5.82726-001	9.7027-003	1.38545-001	0.50002	0.004
1.800-003	2.47831-001	5.98280-001	9.3048-003	1.31322-001	0.50002	0.004
1.600-003	2.55236-001	6.16160-001	8.8926-003	1.23666-001	0.50002	0.004
1.400-003	2.63899-001	6.37078-001	8.4313-003	1.15493-001	0.50002	0.004
1.200-003	2.74266-001	6.62110-001	7.9442-003	1.06687-001	0.50001	0.004
1.000-003	2.87055-001	6.92989-001	7.4114-003	9.70807-002	0.50001	0.004

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 20.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	5.16748-002	1.23449-001	8.9500-003	9.93767-001	0.49676	0.393
9.000-001	5.29619-002	1.26710-001	8.7665-003	9.93430-001	0.49724	0.336
8.000-001	5.44548-002	1.30465-001	8.5742-003	9.93030-001	0.49769	0.282
7.000-001	5.62159-002	1.34863-001	8.3711-003	9.92547-001	0.49812	0.231
6.000-001	5.83397-002	1.40132-001	8.1549-003	9.91944-001	0.49851	0.184
5.000-001	6.09783-002	1.46638-001	7.9218-003	9.91163-001	0.49888	0.140
4.000-001	6.43978-002	1.55024-001	7.6663-003	9.90089-001	0.49920	0.101
3.500-001	6.65463-002	1.60274-001	7.5275-003	9.89375-001	0.49935	0.083
3.000-001	6.91244-002	1.66559-001	7.3792-003	9.88473-001	0.49949	0.067
2.500-001	7.23126-002	1.74316-001	7.2189-003	9.87278-001	0.49962	0.051
2.000-001	7.64270-002	1.84306-001	7.0427-003	9.85582-001	0.49973	0.037
1.800-001	7.84538-002	1.89221-001	6.9663-003	9.84671-001	0.49977	0.032
1.600-001	8.07855-002	1.94872-001	6.8857-003	9.83551-001	0.49981	0.027
1.400-001	8.35153-002	2.01484-001	6.7999-003	9.82126-001	0.49985	0.023
1.200-001	8.67844-002	2.09397-001	6.7074-003	9.80231-001	0.49988	0.018
1.000-001	9.08196-002	2.19159-001	6.6060-003	9.77548-001	0.49992	0.014
9.000-002	9.32378-002	2.25007-001	6.5506-003	9.75721-001	0.49993	0.012
8.000-002	9.60184-002	2.31730-001	6.4909-003	9.73381-001	0.49994	0.011
7.000-002	9.92723-002	2.39595-001	6.4254-003	9.70267-001	0.49996	0.009
6.000-002	1.03167-001	2.49008-001	6.3515-003	9.65911-001	0.49997	0.007
5.000-002	1.07973-001	2.60619-001	6.2640-003	9.59409-001	0.49998	0.006
4.000-002	1.14162-001	2.75571-001	6.1522-003	9.48815-001	0.49999	0.005
3.500-002	1.18035-001	2.84925-001	6.0801-003	9.40701-001	0.49999	0.004
3.000-002	1.22670-001	2.96119-001	5.9894-003	9.29313-001	0.49999	0.003
2.500-002	1.28388-001	3.09929-001	5.8688-003	9.12581-001	0.50000	0.003
2.000-002	1.35752-001	3.27710-001	5.6964-003	8.86622-001	0.50000	0.002
1.800-002	1.39374-001	3.36457-001	5.6044-003	8.72126-001	0.50000	0.002
1.600-002	1.43538-001	3.46511-001	5.4932-003	8.54202-001	0.50000	0.002
1.400-002	1.48409-001	3.58274-001	5.3567-003	8.31755-001	0.50000	0.002
1.200-002	1.54239-001	3.72351-001	5.1861-003	8.03242-001	0.50000	0.001
1.000-002	1.61431-001	3.89716-001	4.9691-003	7.66429-001	0.50000	0.001
9.000-003	1.65740-001	4.00117-001	4.8376-003	7.43910-001	0.50000	0.001
8.000-003	1.70692-001	4.12074-001	4.6867-003	7.17922-001	0.50000	0.001
7.000-003	1.76486-001	4.26063-001	4.5122-003	6.87703-001	0.50000	0.001
6.000-003	1.83419-001	4.42803-001	4.3085-003	6.52243-001	0.50000	0.001
5.000-003	1.91973-001	4.63454-001	4.0678-003	6.10129-001	0.50000	0.001
4.000-003	2.02986-001	4.90043-001	3.7784-003	5.59263-001	0.50000	0.001
3.500-003	2.09876-001	5.06678-001	3.6100-003	5.29564-001	0.50000	0.001
3.000-003	2.18122-001	5.26586-001	3.4213-003	4.96225-001	0.50000	0.001
2.500-003	2.28294-001	5.51143-001	3.2074-003	4.58344-001	0.50000	0.000
2.000-003	2.41391-001	5.82763-001	2.9606-003	4.14552-001	0.50000	0.000
1.800-003	2.47833-001	5.98317-001	2.8501-003	3.94920-001	0.50000	0.000
1.600-003	2.55239-001	6.16197-001	2.7311-003	3.73789-001	0.50000	0.000
1.400-003	2.63904-001	6.37115-001	2.6022-003	3.50880-001	0.50000	0.000
1.200-003	2.74272-001	6.62148-001	2.4611-003	3.25812-001	0.50000	0.000
1.000-003	2.87063-001	6.93027-001	2.3045-003	2.98040-001	0.50000	0.000

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 50.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-005 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	3.65428-002	6.18792-002	1.6893+000	3.08904-001	0.66469	9.432
9.000-001	3.73872-002	6.42531-002	1.6070+000	2.93794-001	0.65704	9.242
8.000-001	3.83559-002	6.69723-002	1.5193+000	2.77693-001	0.64881	9.021
7.000-001	3.94863-002	7.01407-002	1.4253+000	2.60417-001	0.63990	8.761
6.000-001	4.08351-002	7.39144-002	1.3235+000	2.41712-001	0.63015	8.451
5.000-001	4.24934-002	7.85437-002	1.2119+000	2.21214-001	0.61935	8.072
4.000-001	4.46208-002	8.44636-002	1.0876+000	1.98364-001	0.60718	7.597
3.500-001	4.59481-002	8.81452-002	1.0191+000	1.85790-001	0.60042	7.310
3.000-001	4.75337-002	9.25296-002	9.4533-001	1.72229-001	0.59311	6.977
2.500-001	4.94863-002	9.79081-002	8.6478-001	1.57424-001	0.58508	6.587
2.000-001	5.19971-002	1.04788-001	7.7535-001	1.40986-001	0.57613	6.116
1.800-001	5.32314-002	1.08155-001	7.3636-001	1.33820-001	0.57222	5.898
1.600-001	5.46500-002	1.12012-001	6.9508-001	1.26231-001	0.56807	5.658
1.400-001	5.63097-002	1.16507-001	6.5106-001	1.18139-001	0.56364	5.391
1.200-001	5.82963-002	1.21865-001	6.0370-001	1.09432-001	0.55888	5.092
1.000-001	6.07484-002	1.28443-001	5.5212-001	9.99491-002	0.55369	4.751
9.000-002	6.22182-002	1.32368-001	5.2435-001	9.48444-002	0.55090	4.561
8.000-002	6.39090-002	1.36867-001	4.9498-001	8.94431-002	0.54794	4.354
7.000-002	6.58886-002	1.42115-001	4.6368-001	8.36876-002	0.54480	4.128
6.000-002	6.82602-002	1.48374-001	4.3002-001	7.74993-002	0.54142	3.877
5.000-002	7.11897-002	1.56066-001	3.9340-001	7.07644-002	0.53775	3.595
4.000-002	7.49683-002	1.65928-001	3.5285-001	6.33088-002	0.53369	3.273
3.500-002	7.73361-002	1.72077-001	3.3065-001	5.92268-002	0.53147	3.091
3.000-002	8.01734-002	1.79417-001	3.0680-001	5.48393-002	0.52909	2.892
2.500-002	8.36787-002	1.88445-001	2.8084-001	5.00661-002	0.52651	2.670
2.000-002	8.82003-002	2.00032-001	2.5212-001	4.47840-002	0.52365	2.419
1.800-002	9.04277-002	2.05718-001	2.3963-001	4.24868-002	0.52241	2.309
1.600-002	9.29905-002	2.12244-001	2.2642-001	4.00576-002	0.52110	2.190
1.400-002	9.59919-002	2.19867-001	2.1236-001	3.74706-002	0.51971	2.062
1.200-002	9.95879-002	2.28972-001	1.9724-001	3.46905-002	0.51821	1.923
1.000-002	1.04029-001	2.40183-001	1.8080-001	3.16667-002	0.51659	1.770
9.000-003	1.06693-001	2.46888-001	1.7196-001	3.00406-002	0.51571	1.687
8.000-003	1.09757-001	2.54586-001	1.6261-001	2.83210-002	0.51479	1.599
7.000-003	1.13344-001	2.63582-001	1.5265-001	2.64899-002	0.51381	1.504
6.000-003	1.17641-001	2.74333-001	1.4195-001	2.45222-002	0.51275	1.401
5.000-003	1.22947-001	2.87576-001	1.3032-001	2.23820-002	0.51160	1.289
4.000-003	1.29787-001	3.04601-001	1.1744-001	2.00140-002	0.51032	1.163
3.500-003	1.34070-001	3.15238-001	1.1039-001	1.87179-002	0.50962	1.094
3.000-003	1.39198-001	3.27956-001	1.0282-001	1.73250-002	0.50887	1.020
2.500-003	1.45529-001	3.43628-001	9.4579-002	1.58099-002	0.50805	0.939
2.000-003	1.53686-001	3.63784-001	8.5460-002	1.41333-002	0.50714	0.850
1.800-003	1.57700-001	3.73690-001	8.1493-002	1.34041-002	0.50674	0.811
1.600-003	1.62316-001	3.85071-001	7.7298-002	1.26329-002	0.50632	0.770
1.400-003	1.67718-001	3.98377-001	7.2828-002	1.18115-002	0.50587	0.726
1.200-003	1.74185-001	4.14291-001	6.8024-002	1.09286-002	0.50538	0.680
1.000-003	1.82164-001	4.33909-001	6.2794-002	9.96796-003	0.50484	0.629

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 50.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-006 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	3.39154-002	7.64352-002	4.3171-001	7.85863-001	0.50952	2.738
9.000-001	3.46468-002	7.85243-002	4.1898-001	7.62596-001	0.50966	2.508
8.000-001	3.55087-002	8.09290-002	4.0431-001	7.35754-001	0.50971	2.281
7.000-001	3.65403-002	8.37454-002	3.8726-001	7.04575-001	0.50965	2.057
6.000-001	3.78010-002	8.71191-002	3.6730-001	6.68048-001	0.50947	1.834
5.000-001	3.93864-002	9.12840-002	3.4365-001	6.24766-001	0.50914	1.612
4.000-001	4.14638-002	9.66491-002	3.1519-001	5.72654-001	0.50863	1.387
3.500-001	4.27787-002	1.00006-001	2.9863-001	5.42317-001	0.50828	1.272
3.000-001	4.43640-002	1.04023-001	2.8008-001	5.08348-001	0.50786	1.155
2.500-001	4.63333-002	1.08978-001	2.5907-001	4.69865-001	0.50736	1.033
2.000-001	4.88854-002	1.15355-001	2.3487-001	4.25540-001	0.50675	0.906
1.800-001	5.01461-002	1.18491-001	2.2406-001	4.05728-001	0.50646	0.853
1.600-001	5.15986-002	1.22094-001	2.1244-001	3.84445-001	0.50615	0.798
1.400-001	5.33018-002	1.26309-001	1.9988-001	3.61423-001	0.50581	0.741
1.200-001	5.53444-002	1.31351-001	1.8617-001	3.36297-001	0.50543	0.680
1.000-001	5.78695-002	1.37568-001	1.7103-001	3.08541-001	0.50500	0.614
9.000-002	5.93844-002	1.41290-001	1.6279-001	2.93444-001	0.50477	0.583
8.000-002	6.11275-002	1.45568-001	1.5401-001	2.77358-001	0.50452	0.547
7.000-002	6.31689-002	1.50571-001	1.4459-001	2.60097-001	0.50424	0.510
6.000-002	6.56142-002	1.56557-001	1.3440-001	2.41408-001	0.50395	0.471
5.000-002	6.86336-002	1.63937-001	1.2323-001	2.20928-001	0.50362	0.428
4.000-002	7.25252-002	1.73436-001	1.1077-001	1.98098-001	0.50325	0.382
3.500-002	7.49616-002	1.79376-001	1.0392-001	1.85535-001	0.50305	0.357
3.000-002	7.78788-002	1.86483-001	9.6530-002	1.71985-001	0.50283	0.330
2.500-002	8.14793-002	1.95248-001	8.8462-002	1.57193-001	0.50258	0.301
2.000-002	8.61176-002	2.06529-001	7.9504-002	1.40768-001	0.50231	0.269
1.800-002	8.84001-002	2.12077-001	7.5599-002	1.33608-001	0.50220	0.255
1.600-002	9.10244-002	2.18454-001	7.1464-002	1.26026-001	0.50207	0.241
1.400-002	9.40954-002	2.25912-001	6.7054-002	1.17941-001	0.50194	0.225
1.200-002	9.77712-002	2.34836-001	6.2309-002	1.09240-001	0.50179	0.209
1.000-002	1.02307-001	2.45842-001	5.7141-002	9.97632-002	0.50164	0.191
9.000-003	1.05024-001	2.52434-001	5.4359-002	9.46618-002	0.50155	0.181
8.000-003	1.08148-001	2.60010-001	5.1415-002	8.92637-002	0.50146	0.171
7.000-003	1.11804-001	2.68872-001	4.8278-002	8.35114-002	0.50137	0.160
6.000-003	1.16179-001	2.79477-001	4.4904-002	7.73259-002	0.50126	0.148
5.000-003	1.21577-001	2.92556-001	4.1233-002	7.05933-002	0.50115	0.136
4.000-003	1.28528-001	3.09394-001	3.7167-002	6.31391-002	0.50103	0.122
3.500-003	1.32478-001	3.19927-001	3.4941-002	5.90571-002	0.50096	0.114
3.000-003	1.38094-001	3.32531-001	3.2547-002	5.46690-002	0.50088	0.106
2.500-003	1.44506-001	3.48077-001	2.9943-002	4.98940-002	0.50080	0.097
2.000-003	1.52776-001	3.68091-001	2.7059-002	4.46083-002	0.50071	0.088
1.800-003	1.56844-001	3.77935-001	2.5805-002	4.23089-002	0.50067	0.084
1.600-003	1.61521-001	3.89251-001	2.4478-002	3.98767-002	0.50063	0.079
1.400-003	1.66993-001	4.02489-001	2.3064-002	3.72858-002	0.50059	0.075
1.200-003	1.73541-001	4.18329-001	2.1543-002	3.45007-002	0.50054	0.070
1.000-003	1.81619-001	4.37868-001	1.9889-002	3.14699-002	0.50048	0.064

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 50.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-007 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	3.33096-002	7.81167-002	5.5830-002	9.92875-001	0.49354	1.174
9.000-001	3.40519-002	8.01581-002	5.5698-002	9.91658-001	0.49463	1.015
8.000-001	3.49265-002	8.25120-002	5.5540-002	9.89997-001	0.49565	0.866
7.000-001	3.59729-002	8.52738-002	5.5343-002	9.87640-001	0.49660	0.726
6.000-001	3.72511-002	8.85878-002	5.5082-002	9.84126-001	0.49748	0.595
5.000-001	3.88573-002	9.26862-002	5.4707-002	9.78540-001	0.49827	0.474
4.000-001	4.09600-002	9.79754-002	5.4108-002	9.68883-001	0.49897	0.362
3.500-001	4.22900-002	1.01289-001	5.3652-002	9.61197-001	0.49928	0.310
3.000-001	4.38924-002	1.05259-001	5.3012-002	9.50146-001	0.49956	0.261
2.500-001	4.58815-002	1.10160-001	5.2069-002	9.33563-001	0.49980	0.214
2.000-001	4.84572-002	1.16476-001	5.0601-002	9.07382-001	0.50000	0.170
1.800-001	4.97287-002	1.19584-001	4.9779-002	8.92625-001	0.50007	0.153
1.600-001	5.11932-002	1.23157-001	4.8762-002	8.74300-001	0.50013	0.137
1.400-001	5.29097-002	1.27339-001	4.7487-002	8.51272-001	0.50019	0.121
1.200-001	5.49672-002	1.32344-001	4.5869-002	8.21954-001	0.50023	0.105
1.000-001	5.75095-002	1.38519-001	4.3780-002	7.84054-001	0.50026	0.090
9.000-002	5.90340-002	1.42219-001	4.2505-002	7.60878-001	0.50027	0.082
8.000-002	6.07877-002	1.46472-001	4.1035-002	7.34139-001	0.50028	0.075
7.000-002	6.28408-002	1.51448-001	3.9328-002	7.03077-001	0.50028	0.068
6.000-002	6.52992-002	1.57403-001	3.7329-002	6.66683-001	0.50028	0.060
5.000-002	6.83337-002	1.64749-001	3.4963-002	6.23551-001	0.50028	0.053
4.000-002	7.22430-002	1.74208-001	3.2114-002	5.71605-001	0.50026	0.046
3.500-002	7.46898-002	1.80126-001	3.0457-002	5.41357-001	0.50025	0.042
3.000-002	7.76185-002	1.87208-001	2.8601-002	5.07483-001	0.50024	0.038
2.500-002	8.12322-002	1.95944-001	2.6499-002	4.69098-001	0.50023	0.034
2.000-002	8.58861-002	2.07193-001	2.4078-002	4.26875-001	0.50021	0.030
1.800-002	8.81757-002	2.12726-001	2.2996-002	4.05104-001	0.50020	0.028
1.600-002	9.08080-002	2.19087-001	2.1834-002	3.83862-001	0.50019	0.026
1.400-002	9.38876-002	2.26528-001	2.0577-002	3.60881-001	0.50018	0.024
1.200-002	9.75733-002	2.35433-001	1.9205-002	3.35794-001	0.50017	0.022
1.000-002	1.02120-001	2.46417-001	1.7689-002	3.08077-001	0.50016	0.020
9.000-003	1.04844-001	2.52997-001	1.6865-002	2.92998-001	0.50015	0.019
8.000-003	1.07975-001	2.60561-001	1.5986-002	2.76928-001	0.50014	0.018
7.000-003	1.11639-001	2.69409-001	1.5044-002	2.59682-001	0.50013	0.017
6.000-003	1.16023-001	2.79998-001	1.4023-002	2.41006-001	0.50012	0.015
5.000-003	1.21431-001	2.93061-001	1.2904-002	2.20535-001	0.50011	0.014
4.000-003	1.28395-001	3.09879-001	1.1657-002	1.97708-001	0.50010	0.012
3.500-003	1.32752-001	3.20401-001	1.0971-002	1.85143-001	0.50009	0.012
3.000-003	1.37966-001	3.32993-001	1.0230-002	1.71588-001	0.50009	0.011
2.500-003	1.44398-001	3.48526-001	9.4218-003	1.56786-001	0.50008	0.010
2.000-003	1.52680-001	3.68526-001	8.5236-003	1.40342-001	0.50007	0.009
1.800-003	1.56754-001	3.78364-001	8.1319-003	1.33172-001	0.50007	0.008
1.600-003	1.61437-001	3.89673-001	7.7169-003	1.25576-001	0.50006	0.008
1.400-003	1.66916-001	4.02904-001	7.2742-003	1.17474-001	0.50006	0.008
1.200-003	1.73473-001	4.18736-001	6.7976-003	1.08751-001	0.50005	0.007
1.000-003	1.81561-001	4.38267-001	6.2781-003	9.92459-002	0.50005	0.006

MODE CALCULATIONS FOR A PLANAR EARTH CRUST WAVEGUIDE
THREE LAYER MODEL

N = 0 H = 50.00 KM

SIGMA(G) = INFINITY
SIGMA = 1.00-008 MHO/M K = 9.0
SIGMA(1) = 1.00-003 MHO/M K(1) = 15.0

F (KHZ)	RE(C)	IM(C)	ATTENUATION (DB/KM)	V	EXCITATION FACTOR MAGNITUDE	EXCITATION FACTOR PHASE (DEGREES)
1.000+000	3.32448-002	7.82869-002	6.8850-003	9.97470-001	0.49196	1.005
9.000-001	3.39885-002	8.03233-002	6.8062-003	9.97327-001	0.49314	0.855
8.000-001	3.48647-002	8.26719-002	6.7245-003	9.97156-001	0.49428	0.715
7.000-001	3.59129-002	8.54281-002	6.6390-003	9.96947-001	0.49531	0.584
6.000-001	3.71932-002	8.87360-002	6.5488-003	9.96681-001	0.49630	0.464
5.000-001	3.88018-002	9.28276-002	6.4523-003	9.96329-001	0.49720	0.354
4.000-001	4.09075-002	9.81090-002	6.3472-003	9.95829-001	0.49801	0.255
3.500-001	4.22392-002	1.01419-001	6.2904-003	9.95483-001	0.49839	0.209
3.000-001	4.38435-002	1.05384-001	6.2297-003	9.95030-001	0.49873	0.167
2.500-001	4.58348-002	1.10279-001	6.1640-003	9.94402-001	0.49905	0.129
2.000-001	4.84131-002	1.16588-001	6.0914-003	9.93449-001	0.49933	0.094
1.800-001	4.96858-002	1.19693-001	6.0597-003	9.92907-001	0.49944	0.081
1.600-001	5.11516-002	1.23264-001	6.0260-003	9.92212-001	0.49954	0.069
1.400-001	5.28695-002	1.27442-001	5.9896-003	9.91285-001	0.49963	0.057
1.200-001	5.49287-002	1.32444-001	5.9495-003	9.89981-001	0.49971	0.046
1.000-001	5.74727-002	1.38615-001	5.9039-003	9.88011-001	0.49979	0.036
9.000-002	5.89983-002	1.42312-001	5.8781-003	9.86601-001	0.49983	0.031
8.000-002	6.07531-002	1.46563-001	5.8490-003	9.84724-001	0.49986	0.027
7.000-002	6.28074-002	1.51536-001	5.8155-003	9.82127-001	0.49989	0.023
6.000-002	6.52672-002	1.57488-001	5.7748-003	9.78345-001	0.49992	0.019
5.000-002	6.83032-002	1.64830-001	5.7219-003	9.72471-001	0.49994	0.015
4.000-002	7.22144-002	1.74285-001	5.6460-003	9.62521-001	0.49997	0.011
3.500-002	7.46622-002	1.80201-001	5.5923-003	9.54705-001	0.49998	0.010
3.000-002	7.75921-002	1.87281-001	5.5200-003	9.43556-001	0.49999	0.008
2.500-002	8.12072-002	1.96014-001	5.4176-003	9.26941-001	0.49999	0.007
2.000-002	8.58627-002	2.07260-001	5.2630-003	9.00859-001	0.50000	0.005
1.800-002	8.81531-002	2.12791-001	5.1778-003	8.86201-001	0.50000	0.005
1.600-002	9.07861-002	2.19150-001	5.0732-003	8.68025-001	0.50000	0.004
1.400-002	9.38666-002	2.26590-001	4.9430-003	8.45210-001	0.50001	0.004
1.200-002	9.75533-002	2.35493-001	4.7786-003	8.16183-001	0.50001	0.003
1.000-002	1.02101-001	2.46475-001	4.5674-003	7.78676-001	0.50001	0.003
9.000-003	1.04826-001	2.53054-001	4.4388-003	7.55741-001	0.50001	0.003
8.000-003	1.07958-001	2.60616-001	4.2907-003	7.29276-001	0.50001	0.002
7.000-003	1.11622-001	2.69463-001	4.1190-003	6.98525-001	0.50001	0.002
6.000-003	1.16007-001	2.80051-001	3.9182-003	6.62479-001	0.50001	0.002
5.000-003	1.21416-001	2.93111-001	3.6806-003	6.19733-001	0.50001	0.002
4.000-003	1.28381-001	3.09928-001	3.3948-003	5.68210-001	0.50001	0.001
3.500-003	1.32739-001	3.20449-001	3.2286-003	5.38184-001	0.50001	0.001
3.000-003	1.37954-001	3.33040-001	3.0424-003	5.04535-001	0.50001	0.001
2.500-003	1.44387-001	3.48571-001	2.8315-003	4.66375-001	0.50001	0.001
2.000-003	1.52670-001	3.68570-001	2.5887-003	4.22366-001	0.50001	0.001
1.800-003	1.56745-001	3.78407-001	2.4801-003	4.02674-001	0.50001	0.001
1.600-003	1.61429-001	3.89716-001	2.3634-003	3.81506-001	0.50001	0.001
1.400-003	1.66909-001	4.02945-001	2.2371-003	3.58589-001	0.50001	0.001
1.200-003	1.73466-001	4.18777-001	2.0993-003	3.33553-001	0.50000	0.001
1.000-003	1.81556-001	4.38307-001	1.9469-003	3.05867-001	0.50000	0.001

Missing pages: Order No. NA-ONR-15-71
Technical Report No. 3
1 May 1972
AD 748 331

PROPAGATION OF ELECTROMAGNETIC WAVES IN THE EARTH CRUST WAVEGUIDE FROM ELF TO VLF

by

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There has been considerable interest exhibited recently in the electromagnetic properties of the earth's crustal layers. Recent geophysical investigations in this area have been summarized in a monograph [Heacock, 1971]. The determination of the minimum conductivity of the sub-surface structure would seem to depend on a quantitative understanding of the waveguiding property of the layers.

From the analytical viewpoint, the problem is to calculate the attenuation rates, phase velocities, and excitation factors for the various waveguide modes. The numerical solution of the mode equation was obtained previously for a range of frequencies from 1 to 100 kHz using assumed crustal conductivities that are considered reasonable [Wait and Spies, 1971]. One dominant feature, for the idealized slab model, of the results was that the attenuation rate was reduced as the frequency was lowered. Also, of course, the crustal conductivity σ itself was a controlling factor. In fact, for frequencies above 1 kHz, the attenuation rate was never less than about 0.4 dB/km for $\sigma \geq 10^{-6}$ mhos/m.

Here, we wish to draw attention to the possible improvement if the frequency is reduced even farther. Adapting the same modal formulation as used before [Spies and Wait, 1971a; 1971b], we illustrate here what happens when the frequency is extended down to 1 Hz.

The waveguide model for the present discussion is illustrated in Figure 1. The "earth-crust waveguide" is assumed to be a homogeneous slab with conductivity σ and dielectric constant $K\varepsilon_o$. Its thickness is h,

the upper boundary is taken to be a perfect conductor (i.e., $\sigma_g = \infty$), and the lower boundary is a homogeneous half-space of conductivity σ_c and dielectric constant $K_c \epsilon_c$. The modes are excited by a vertical electric dipole located within the waveguide at depth h_1 from the top boundary.

In Figures 2 and 3, we show the attenuation rate, of the two lowest-order modes, in dB/km, computed for the present model using the theory described before [Wait and Spies, 1971]. In both cases, h, the waveguide thickness, is assigned the value 10 km. Also, we assume $K = 9$ and $K_c = 15$. The curves are parametric in the waveguide conductivity σ, and take the values 10^{-5}, 10^{-6}, 10^{-7}, and 10^{-8} mhos/m. In Figure 2, the lower wall conductivity $\sigma_c = 10^{-2}$ mhos/m, while in Figure 3, $\sigma_c = 10^{-3}$ mhos/m. Not surprisingly, the attenuation rates are higher in the latter case, but the difference is not striking. Additional numerical values are given in the appendix.

The character of the curves in the region above 1 kHz was discussed before [Wait and Spies, 1971]. For the range from 1 kHz down to 1 Hz, the attenuation rate of the dominant $n = 0$ mode becomes exceptionally small. Also, as expected, at sufficiently low frequencies, the attenuation rate is roughly proportional to $(\sigma \times \text{frequency})^{\frac{1}{2}}$. Of course, the $n = 1$ mode is well below cut-off, so it is out of contention.

While we have adopted an extremely idealized model, the order of magnitude of the attenuation rates should not be very different for more elaborate geometries for the same range of parameters. One simple extension that follows immediately is a homogeneous slab model, of thickness 2h and electrical parameters σ and K, bounded top and below by homogeneous half-spaces of parameters σ_c and K_c. The lowest order mode for this configuration has precisely the same attenuation rate as for the model depicted in Figure 1.

The difficulties of exciting waveguide modes in earth-crust waveguides have not been considered here. Therefore, we do not wish to suggest that ELF (i.e., frequencies below 1 kHz) should have advantages over VLF (i.e., frequencies above 1 kHz) for sub-surface communication. Nevertheless, in spite of the limited bandwidths available, the ELF band should be given some attention for such applications.