CALCULATION OF THE ATTENUATION AND PHASE DISPLACEMENT PER UNIT OF LENGTH DUE TO RAIN COMPOSED OF ELLIPSOIDAL DROPS

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1. Introduction

A knowledge of the "scatter" (or diffusion) of individual hydrometeors (rain, snow, hail) is indispensable in the study of the effects caused by a population of hydrometeors on the propagation of radiowaves at frequencies above 10 GHz.

As a matter of fact all of the phenomena which influence propagation at such frequencies (attenuation, depolarization, scintillation, etc.) can be intensified by parameters directly derived from a solution of individual scatter, naturally in addition to the meteorological elements which characterize the physical medium.

This paper will go into detail on the diffusion caused by rainy precipitation; the physical models which will be taken into consideration are rain composed of spherical drops, rain composed of drops in an ellipsoidal form with axes of rotational symmetry arranged along the vertical line of a generic reference point.

Since the most general type of electromagnetic wave polarization, including circular polarization and rectangular polarization as special cases, is elliptical polarization, there is a certain amount of interest in a detailed study, as complete as possible, of the effects of diffusion on tropospheric propagation of electromagnetic waves in the presence of rain alone with generic polarization, specified for the cases of interest to us within the "range" of frequency from 10 to 100 GHz.

The case of earth-space propagation will not be treated in detail in the present work, although for the sake of completeness there will be a report of attenuation and phase displacement results obtained for some possible links with axes of propagation inclined with respect to the vertical line in the case of rectilinear polarization alone.

2. Rain Composed of Spherical Drops: G. Mie's Algorithm

The diffusion due to drops of a spherical shape will be treated briefly in this paragraph for the sole purpose of greater clarity and completeness of the results reported in this paper.

G. Mie has developed an algorithm [B.1] to evaluate the individual scatter of spheres of any material whatsoever at any frequency whatsoever.

For our specific interests the theory has been developed for spherical drops of rain at the F.U.B. [Fondazione Ugo Bordoni] [B.2]; the scatter functions in the "forward" direction have been evaluated from:

$$S(0) = \sum_{n=1}^{\infty} \frac{1}{2}(2n+1)(a_n+b_n) \qquad (1)$$

and the corresponding sections of extinction and phase displacement [B.2]:

$$C_{ext}(D) = \frac{\lambda^2}{\pi} \, Re \sum_{n=1}^{\infty} 1/2(2n+1)(a_n+b_n)$$
$$C_f(D) = \frac{\lambda^2}{\pi} \, Im \sum_{n=1}^{\infty} 1/2(2n+1)(a_n+b_n) \qquad (2)$$

In (2) D is the diameter (in mm) of the drops of rain taken into consideration, λ is the wavelength (in cm), and a_n and b_n are the so-called coefficients of Mie.

The specific attenuation and phase displacement have been determined by using the extinction and phase section [B.2]:

$$A_s\,(dB/Km) = 4.34 \cdot 10^{-3} \sum_i C_{ext}(D_i) \cdot N(D_i)$$
$$F_s\,(gradi/Km) = \frac{90}{\pi} \cdot 10^{-3} \sum_i C_f(D_i) \cdot N(D_i) \qquad (3)$$

Every term in the preceding summations is the product of the extinction (or phase) section relative to drops of diameter D_i by the number of drops $M(D_i)$ contained in 1 m^3 with diameters in the field of $D_i \pm \frac{\Delta D}{2}$ with $\Delta D = 0.5$ mm.

The number of spherical drops $N(D_i)$ is found by means of the equation:

$$N(D_i) = \frac{10^4}{6\pi} \cdot \frac{R \cdot M(D_i)}{V(D_i) \cdot D_i^3} \tag{4}$$

in which R(mm/h) is the intensity of precipitation, $M(D_i)$ [B.3] is the fraction of the total volume of rain due to drops with diameters in the field of $D_i \pm \frac{\Delta D}{2}$, and relative to the predetermined value of R, V(Di) in m/sec is the terminal falling velocity of the drops with diameter Di [B.4]. The $N(D_i)$ presented in Table 2 were calculated from the values reported in Table 1. Assuming Ray's water refraction index [B.5] at a drop temperature of 20°C, the values obtained from A_s (dB/Km) and F_s (°/Km) for 19 frequencies between 10 and 100 GHz are presented in Tables 3-11 and 12-20 as a function of R.

3. Rain Composed of Ellipsoidal Drops: T. Oguchi's Algorithm

In the case of simultaneous transmission of two electromagnetic waves at the same frequency with one polarized rectilinear lead in the vertical direction and the other in the horizontal direction, experimental findings have demonstrated the existence of a difference in attenuation and in phase displacement between the two polarization directions [B.6].

The phenomenon cannot be explained with the simple physical model of spherical drops.

For this reason it has been assumed that the real form of the raindrops, rather than being spherical, can be assimilated to an ellipsoid of rotational symmetry with axes arranged along the vertical line.

This then entails the need of going into deeper study of the scatter of an individual ellipsoid. Such a study has been carried out by T. Oguchi [B.7] by way of three different algorithms. The one defined as the "Point Matching Technique" has been implemented at F.U.B., since it offers the advantage, over the other two, of being applicable to electromagnetic diffusors of any form whatsoever provided that they have rotational symmetry.

This method determines the coefficients of a series development of spherical harmonics analogous in principle to those of Mie, with the difference that, since in this case the diffusor is not spherical, the variable spherical harmonics are not decoupled: i.e., a definite spherical harmonic present in the incident wave is not limited to stimulating only the corresponding spherical harmonic in the diffuse wave, but stimulates a whole set of them coupled with it, in addition to stimulating spherical harmonics in the diffuse wave without any corresponding ones existing in the incident wave.

Actually, the generic component of the electromagnetic field can be expressed as a function of the spherical harmonics which satisfy Maxwell's equation [B.8]; all of the harmonics can be regrouped into two families, a and b, each with two degrees of freedom, m and n.

The "point matching technique" is based on the finding that the special rotational symmetry of the problem guarantees that all of the harmonics of a different index m are decoupled from one another. This means that the harmonics can be regrouped into families characterized by the same index m, including harmonics coupled to one another by the various values of n.

All of this considerably simplifies the problem, and in fact if N is the number of harmonics to be given consideration, it turns out that the two indices, m and n, vary from one another:

$$0 \le m \le N \qquad ([illegible] \neq 0)$$
$$m \le n \le N$$

Each m family therefore has N-m+1 unknown harmonic amplitudes, and therefore requires N-m+1 independent equations [B.8].

Since there are four successive equations for the contour of the drop (two tangential components of E and two of H) for N = 14, in the worst case 4x14=56 independent equations are necessary, requiring N-m+1 points for the contour of each for applying the four successive conditions of the fields. In practice the symmetrical diffusor is divided into N-m+1 touches (Figure 1).

The solution of the systems of equations referred to allows the "forward scattering function" to be found (or advance diffusion) $S_{II.I}(o)$ along the two directions I and II shown in Figure 1. As already seen for the spherical drops, these functions are indispensable for the calculation of attenuation.

The values for $S_{II.I}$,(o) calculated at F.U.B. at the frequencies presented in Table 3 and successive ones are presented in Tables 21-39 as a function of the various diameters of the spherical drops equivalent to the ellipsoidal ones with semiaxes a and b and eccentricity ϵ .

4. Specific Phase Displacement and Attenuation Along the Principal Planes

The transition from individual scatter functions to attenuation and phase displacement, due to a medium composed of a discrete number of diffusors, is not immediate. As a matter of fact, the bonds between the fields and material defined by the equation $\vec{D} = \epsilon \vec{E}$, $B = \mu H$, $\vec{J} = \sigma \vec{E}$ are immediate in the case of "continuous" media and not granular as in the present case.

The difficulty has been overcome with the criterion of the equivalent of V. De Hulst [B.9], in which the equivalent is postulated between a dielectric layer and a layer of the same thickness of spherical diffusors.

Such a layer is presumed to be indefinite and transverse to the direction of propagation of a uniform plane wave [B.10]. The problem consists of determining the equivalent dielectric constant to be attributed to the dielectric, so that the mean radiation toward an observation point outside of the layer (Figure 2) proves to be equal to that which would exist at the same point with a real medium. The solution of the equivalence is given by [B.12]:

$$\tilde{m} = 1 - j\, S(o)\, 2\pi\, N\, K_o^{-3}$$

where $\tilde{m}$ is the complex refraction index of the medium (almost equal to 1). S(o) is the "forward scattering function" (presented in Tables 21-39 for the two directions of interest to us), K_o is the propagation constant in free space. From this there is a direct transition to the propagation constant of a medium composed of a set of spherical diffusors given by:

$$\gamma = \frac{2\pi}{K_o^2} \cdot \sum_i S_i(o)\, N(D_i) \qquad (5)$$

in the real case of ellipsoidal drops, assuming all of the drops to have rotational axes in the transverse plane, defining the plane yz as the first principal plane (I) and the plane xy as the second principal plane (II) (Figure 1). Thus we can apply (S) along the two principal planes: (the index of the wave transmitted normally on the transverse plane, θ = 90°)

$$\gamma_{[illegible]} = \frac{[illegible]}{[illegible]} \sum_{[illegible]} [illegible] \qquad (6)$$

The application of (6) is based on an equivalence between the volumes of the ellipsoidal and spherical drops represented by means of [B.7]:

$\frac{4}{3} \pi a b^2 = \frac{4}{3} \pi$ [illegible]

$\frac{1}{5}$ [illegible]

The values calculated for $A_{II,I} = Re(\gamma_{II,I})$ and $[illegible]_{II,I} = Im(\gamma_{II,I})$ by means of $S_{II.I}$ presented in Tables 21-39 and the $N(D_i)$ of Table 2 are presented in Tables 3-20. Ray's refraction index at the temperature of 20°C is also used in this case.

5. Propagation of Radiowaves in Generic Polarization

The hypothesis of equioriented drops inclined with respect to the verticals, suggested by depolarization measurements, introduces a need to consider an inclination angle parameter "Φ" in the model propagating the electromagnetic waves [B.10]:

Since the state of polarization of an electromagnetic wave can be completely described by means of two special parameters "α" and "ψ" [B.11], the need arises to represent the propagating channel in a complete way, either from the physical viewpoint by means of the parameter Φ and the propagation constants $\gamma_{II.I}$, or from the electromagnetic viewpoint by means of the parameters "α" and "ψ".

The complete representation as a function of the parameters referred to is given by the matrix expression [B.11]:

$$\begin{vmatrix} E_{1,out} \\ E_{2,out} \end{vmatrix} = e^{-\frac{\gamma_{II}+\gamma_{I}}{2} \cdot \ell} \cdot \left\{ Ch\left(\frac{\gamma_{II}-\gamma_{I}}{2} \cdot \ell\right) \|u\| + Sh \frac{\gamma_{II}-\gamma_{I}}{2} \|a\| \right\} \begin{vmatrix} E_{1,inc} \\ E_{2,inc} \end{vmatrix} \quad (7) \qquad (7)$$

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in which $\gamma_{II.I}$ are the propagation constants described above, ℓ is the connection length in Km, $||u||$ is the unit matrix, $||a||$ is a matrix taking into account the state of polarization of the wave and of the angle of inclination of the ellipsoids, the terms of which are expressed by [B.11]:

a_{11} = [illegible] φ [illegible] φ cos ψ

a_{12} = [illegible] φ [illegible] φ sin [illegible] φ sin ψ

$a_{22} = - a_{11}$

$a_{21} = a_{12}$

Table 40 represents the values to be attributed to α and ψ to obtain some special types of polarization of the electromagnetic waves which are of interest in practice.

For the case of rectilinear polarizations, the values calculated by (7), with the hypothesis that $\Phi = \sigma$, coincide with the values given in Tables 3-11 for attenuation and Tables 12-20 for the phases. However, we can affirm that if the angle Φ is limited to a few degrees, the values found for $A_{II.I}$ and $B_{II.I}$ can now be considered valid.

Considering circular polarization, the values of α and ψ in Table 40 introduced in (7) tend to affirm that the attenuation and phase displacements in left circular polarization are equal to those in right circular polarization, and that both polarizations are independent of the angle of inclination of the drops.

It is known from (7) that the value of the attenuation and of the phase displacement in circular polarization can be conveniently expressed as the sum of a mean contribution (equal to the arithmetic mean of attenuation and phase displacements for $\Phi = \sigma$), and a variation given by the model and argument of:

The values of the mean $A_M = \frac{A_{II} \cdot A_I}{2}$ of attenuation A_c and phase displacement F_c are presented in Tables 3-20 at the frequencies previously given consideration.

6. Propagation with Inclined Axes

The case of earth-space propagation of electromagnetic waves in rectilinear or circular polarization can be treated in analogy with what has been said in the previous paragraphs.

In the case of terrestrial radioelectrical connections, the direction of incidence of the transmitted wave is normal to the transverse plane (Figure 1; $\theta = 90°$) and, if we wish to consider inclined connections, it is sufficient to vary the angle of incidence θ to obtain the values of the propagation constants $\gamma_{II.I}(\theta)$, through the calculation program available in F.U.B. As an indication Table 41 presents the values of $(\gamma_{II} - \gamma_I)$ for three possible angles of inclination relative to waves transmitted in rectilinear polarization along the two principal planes of rain precipitation.

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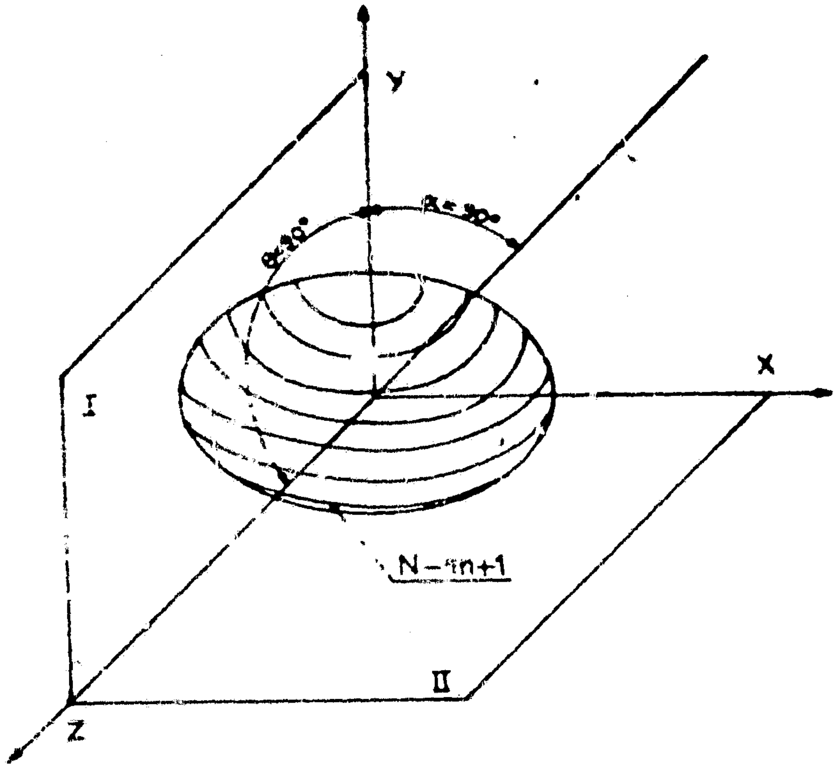

FIG. 1

Figure 1

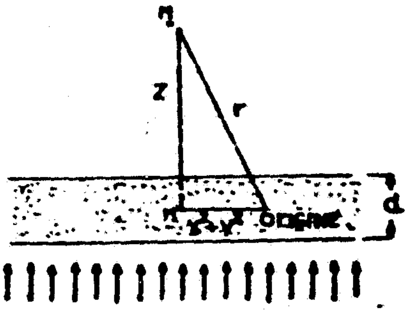

Figure 2

Key: 1-Origin.

			j	1	2	3	4	5	6	7	8	9
			R_j mm/h	0.[illegible]	1.25	2.5	[illegible]	12.5	25	50	100	150
i	D_i (cm)	$V(D_i)$ [m/sec]		m_{Di_1}%	m_{Di_2}%	m_{Di_3}%	m_{Di_4}%	m_{Di_5}%	m_{Di_6}%	m_{Di_7}%	m_{Di_8}%	m_{Di_9}%
1	0.05	2.1		28.0	[illegible]	7.3	4.7	2.?	1.?	1.?	1.0	1.0
2	0.10	3.9		50.?	37.1	27.8	20.3	1?	[illegible]	?.4	4.1	4.1
3	0.15	?.3		18.?	31.3	?.8	31.0	24.5	11.4	12.5	8.8	7.6
4	0.20	6.4		[illegible]	13.5	19.0	[illegible]	?.4	21.9	19.9	13.9	11.7
5	0.25	7.3		0.?	4.9	7.8	11.4	17.?	19.9	20.9	17.1	13.9
6	0.30	7.9			1.5	3.3	6.?	16.1	12.8	15.6	18.4	17.7
7	0.35	8.35			0.6	1.1	2.5	4.3	8.2	10.9	15.0	16.1
8	0.40	8.70			0.2	0.6	1.0	2.3	3.5	6.7	9.?	11.9
9	0.45	9.0				0.2	0.5	1.2	?.1	3.3	5.8	7.7
10	0.50	9.2					0.3	0.6	1.1	1.8	3.0	3.6
11	0.55	9.35						0.2	0.5	1.1	1.7	2.7
12	0.60	9.5							0.3	0.5	1.0	1.2
13	0.65	9.6								0.?	0.7	1.0

Table 1. Distribution of the Diameters of Drops as a Percentage of the Total Volume of Water (Laws - Parsons)

D(MM)	R(MM/H)								
	0.25	.25	2.50	5.00	[illegible]	[illegible]	[illegible]	100.00	150.00
0.5	141.467	275.355	368.824	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.0	17.032	[illegible]	94.538	130.066	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.5	1.349	11.604	24.319	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2.0	0.078	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2.5	0.008	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.0	0.0	0.045	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.5	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4.5	0.0	0.0	0.003	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.420
5.0	0.0	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5.5	0.0	0.0	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6.0	0.0	0.0	0.0	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]
6.5	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]	[illegible]	[illegible]

Table 2. Number of Drops Contained in One m^3 of Precipitation as a Function of Their Diameter

F(GHZ)	AII	AI	AMFU	AC	AS
10.0	.20339-02	.18671-02	.19505-02	.19506-02	.19560-02
15.0	.64677-02	.58934-02	.61505-02	.61508-02	.61562-02
20.0	.13842-01	.12775-01	.13308-01	.13309-01	.13315-01
25.0	.23932-01	.22105-01	.23018-01	.23019-01	.23054-01
30.0	.36489-01	.33644-01	.[illegible]066-01	.35067-01	.35182-01
35.0	.51777-01	.47577-01	.49678-01	.49679-01	.49933-01
40.0	.70037-01	.64140-01	.67092-01	.67094-01	.67557-01
45.0	.91153-01	.83331-01	.87242-01	.87243-01	.87985-01
50.0	.11461+00	.10470+00	.10969+00	.10970+00	.11077+00
55.0	.13978+00	.12797+00	.13383+00	.13383+00	.13527+00
60.0	.16596+00	.15244+00	.15920+00	.15920+00	.16099+00
65.0	.19314+00	.17790+00	.18552+00	.18552+00	.18767+00
70.0	.22083+00	.20397+00	.21240+00	.21240+00	.21498+00
75.0	.24887+00	.22989+00	.23898+00	.23898+00	.24178+00
80.0	.27396+00	.25459+00	.26407+00	.26407+00	.26712+00
85.0	.29621+00	.27709+00	.28665+00	.28664+00	.28984+00
90.0	.31561+00	.29687+00	.30624+00	.30624+00	.30949+00
95.0	.33286+00	.31402+00	.32384+00	.32384+00	.32678+00
100.0	.34636+00	.32911+00	.33774+00	.33893+00	.34093+00

Table 3. Values of Attenuation (dB/Km) at Precipitation Intensity R= .25(mm/h)

F(GHZ)	AII	AI	AMIE	AC	AS
10.0	.13266-01	.11716-01	.12491-01	.12494-01	.12463-01
15.0	.44535-01	.39946-01	.42240-01	.42247-01	.42189-01
20.0	.91167-01	.82134-01	.86651-01	.86662-01	.86647-01
25.0	.14976+00	.13440+00	.14208+00	.14210+00	.14263+00
30.0	.22025+00	.19664+00	.20844+00	.20846+00	.21087+00
35.0	.30380+00	.26968+00	.28630+00	.28631+00	.28945+00
40.0	.39692+00	.35306+00	.37499+00	.37499+00	.37997+00
45.0	.49804+00	.44473+00	.47168+00	.47167+00	.47863+00
50.0	.60310+00	.54058+00	.57184+00	.57180+00	.58072+00
55.0	.70480+00	.63605+00	.67042+00	.67037+00	.68181+00
60.0	.80678+00	.72803+00	.76440+00	.76434+00	.77635+00
65.0	.89158+00	.81598+00	.85377+00	.85369+00	.86678+00
70.0	.97843+00	.90832+00	.93937+00	.93929+00	.95323+00
75.0	.10603+01	.98034+00	.10203+01	.10202+01	.10340+01
80.0	.11340+01	.10536+01	.10938+01	.10937+01	.11088+01
85.0	.11962+01	.11174+01	.11568+01	.11567+01	.11718+01
90.0	.12456+01	.11790+01	.12078+01	.12077+01	.12226+01
95.0	.12832+01	.12120+01	.12476+01	.12475+01	.12620+01
100.0	.13119+01	.12453+01	.12786+01	.12785+01	.12925+01

Table 4. Values of Attenuation (dB/Km) at Precipitation Intensity R= 1.25(mm/h)

F(GHZ)	AII	AI	A45	AC	AS
10.0	.31767-01	.27613-01	.29694-01	.29703-01	.29572-01
15.0	.10428+00	.92582-01	.98431-01	.98459-01	.98021-01
20.0	.20457+00	.18179+00	.19328+00	.19332+00	.19345+00
25.0	.32660+00	.28855+00	.30757+00	.30763+00	.30948+00
30.0	.47153+00	.41404+00	.44278+00	.44283+00	.44764+00
35.0	.63730+00	.55840+00	.59788+00	.59789+00	.60857+00
40.0	.81795+00	.71855+00	.76825+00	.76819+00	.78114+00
45.0	.10045+01	.88762+00	.94606+00	.94593+00	.96301+00
50.0	.11871+01	.10570+01	.11220+01	.11218+01	.11426+01
55.0	.13563+01	.12182+01	.12871+01	.12863+01	.13104+01
60.0	.15068+01	.13660+01	.14364+01	.14361+01	.14617+01
65.0	.16423+01	.15009+01	.15716+01	.15713+01	.15981+01
70.0	.17674+01	.16258+01	.16966+01	.16963+01	.17238+01
75.0	.18833+01	.17417+01	.18126+01	.18123+01	.18403+01
80.0	.19868+01	.18471+01	.19170+01	.19167+01	.19447+01
85.0	.20733+01	.19379+01	.20056+01	.20054+01	.20331+01
90.0	.21412+01	.20122+01	.20767+01	.20765+01	.21036+01
95.0	.21922+01	.20710+01	.21316+01	.21314+01	.21574+01
100.0	.22301+01	.21169+01	.21735+01	.21734+01	.21983+01

Table 5. Values of Attenuation (dB/Km) at Precipitation Intensity R= 2.50(mm/h)

F(GHZ)	AII	AI	AMLD	AC	AS
10.0	.79243-01	.6782[illegible]-01	.73535-01	.73594-01	.72891-01
15.0	.24181+00	.21210+00	.22699+00	.22711+00	.22679+00
20.0	.45176+00	.39511+00	.42343+00	.42361+00	.42473+00
25.0	.70314+00	.60942+00	.65618+00	.65635+00	.66268+00
30.0	.99471+00	.85803+00	.92638+00	.92643+00	.94033+00
35.0	.13142+01	.11257+01	.12250+01	.12248+01	.12476+01
40.0	.16453+01	.14309+01	.15381+01	.15377+01	.15694+01
45.0	.19713+01	.17297+01	.18505+01	.18498+01	.18891+01
50.0	.22769+01	.20173+01	.21469+01	.21460+01	.21954+01
55.0	.25468+01	.22813+01	.24135+01	.24125+01	.24672+01
60.0	.27763+01	.25170+01	.26437+01	.26429+01	.26949+01
65.0	.29726+01	.27137+01	.28431+01	.28422+01	.28950+01
70.0	.31473+01	.28944+01	.30209+01	.30199+01	.30728+01
75.0	.33061+01	.30555+01	.31623+01	.31815+01	.32339+01
80.0	.34461+01	.32054+01	.33257+01	.33250+01	.33767+01
85.0	.35617+01	.33311+01	.34465+01	.34458+01	.34963+01
90.0	.36514+01	.34355+01	.35472+01	.35417+01	.35984+01
95.0	.37171+01	.35125+01	.36148+01	.36144+01	.36689+01
100.0	.37643+01	.35738+01	.36689+01	.36686+01	.37131+01

Table 6. Values of Attenuation (dB/Km) at Precipitation Intensity R= 5.00(mm/h)

F(GHZ)	AII	AI	AMEU	AC	AS
10.0	.25992+00	.21948+00	.23970+00	.24011+00	.23684+00
15.0	.72032+00	.62294+00	.67163+00	.67240+00	.66933+00
20.0	.12640+01	.10791+01	.11715+01	.11725+01	.11794+01
25.0	.19930+01	.16041+01	.17535+01	.17540+01	.17885+01
30.0	.26183+01	.22039+01	.24111+01	.24101+01	.24621+01
35.0	.33475+01	.28395+01	.30935+01	.30908+01	.31687+01
40.0	.40365+01	.34660+01	.37511+01	.37470+01	.38465+01
45.0	.46531+01	.40585+01	.43518+01	.43467+01	.44612+01
50.0	.51848+01	.45772+01	.48785+01	.48731+01	.49967+01
55.0	.56230+01	.50194+01	.53212+01	.53160+01	.54434+01
60.0	.59688+01	.53895+01	.56791+01	.56745+01	.58016+01
65.0	.62436+01	.56943+01	.59689+01	.59649+01	.60891+01
70.0	.64754+01	.59540+01	.62147+01	.62112+01	.63313+01
75.0	.66806+01	.61834+01	.64320+01	.64290+01	.65448+01
80.0	.68681+01	.63863+01	.66232+01	.66207+01	.67322+01
85.0	.70068+01	.65591+01	.67829+01	.67810+01	.68882+01
90.0	.71178+01	.66983+01	.69081+01	.69065+01	.70092+01
95.0	.71973+01	.68065+01	.70019+01	.70008+01	.70987+01
100.0	.72528+01	.68695+01	.70712+01	.70704+01	.71639+01

Table 7. Values of Attenuation (dB/Km) at Precipitation Intensity R= 12.50(mm/h)

F(GHZ)	AII	AI	AMID	AC	AS
10.0	.63013+00	.52657+00	.57935+00	.58104+00	.57155+00
15.0	.15708+01	.13356+01	.14532+01	.14562+01	.14508+01
20.0	.26570+01	.22127+01	.24349+01	.24376+01	.24621+01
25.0	.39058+01	.32167+01	.35622+01	.35610+01	.36364+01
30.0	.52270+01	.43297+01	.47783+01	.47707+01	.49048+01
35.0	.64873+01	.54464+01	.59660+01	.59532+01	.61373+01
40.0	.76007+01	.64847+01	.70427+01	.70254+01	.72460+01
45.0	.85362+01	.74021+01	.79692+01	.79507+01	.81909+01
50.0	.92987+01	.81825+01	.87406+01	.87228+01	.89706+01
55.0	.98993+01	.88257+01	.93625+01	.93465+01	.95933+01
60.0	.10355+02	.93427+01	.98489+01	.98354+01	.10075+02
65.0	.10766+02	.97583+01	.10232+02	.10221+02	.10450+02
70.0	.10995+02	.10187+02	.10551+02	.10542+02	.10759+02
75.0	.11248+02	.10411+02	.10829+02	.10872+02	.11029+02
80.0	.11467+02	.10679+02	.11073+02	.11067+02	.11265+02
85.0	.11643+02	.10985+02	.11274+02	.11270+02	.11459+02
90.0	.11773+02	.11085+02	.11429+02	.11426+02	.11607+02
95.0	.11861+02	.11274+02	.11542+02	.11541+02	.11713+02
100.0	.11918+02	.11328+02	.11623+02	.11672+02	.11787+02

Table 8. Values of Attenuation (dB/Km) at Precipitation Intensity R= 25.00(mm/h)

F(GHZ)	AII	AI	AMED	AC	AS
10.0	.15283+01	.12775+01	.14029+01	.14101+01	.13826+01
15.0	.34447+01	.28652+01	.31549+01	.31664+01	.31581+01
20.0	.56289+01	.45490+01	.53892+01	.50933+01	.51758+01
25.0	.80551+01	.64796+01	.72673+01	.72484+01	.74665+01
30.0	.10427+02	.85033+01	.94651+01	.94286+01	.97689+01
35.0	.12500+02	.10399+02	.11449+02	.11389+02	.11829+02
40.0	.14184+02	.12041+02	.13112+02	.13047+02	.13537+02
45.0	.15502+02	.13408+02	.14455+02	.14373+02	.14895+02
50.0	.16524+02	.14523+02	.15523+02	.15469+02	.15963+02
55.0	.17313+02	.15426+02	.16369+02	.16323+02	.16798+02
60.0	.17915+02	.16154+02	.17034+02	.16997+02	.17445+02
65.0	.18385+02	.16748+02	.17566+02	.17537+02	.17958+02
70.0	.18775+02	.17250+02	.18013+02	.17990+02	.18387+02
75.0	.19116+02	.17693+02	.18405+02	.18388+02	.18763+02
80.0	.19410+02	.18079+02	.18744+02	.18732+02	.19089+02
85.0	.19641+02	.18403+02	.19022+02	.19014+02	.19354+02
90.0	.19802+02	.18656+02	.19229+02	.19225+02	.19558+02
95.0	.19903+02	.18846+02	.19375+02	.19374+02	.19684+02
100.0	.19958+02	.18984+02	.19471+02	.19473+02	.19772+02

Table 9. Values of Attenuation (dB/Km) at Precipitation Intensity R= 50.00(mm/h)

F(GHZ)	AII	AI	AMED	AC	AS
10.0	.36113+01	.29991+01	.33052+01	.33343+01	.32560+01
15.0	.72829+01	.58695+01	.65763+01	.66157+01	.66129+01
20.0	.11654+02	.90911+01	.10373+02	.10349+02	.10626+02
25.0	.16198+02	.12725+02	.14461+02	.14329+02	.14966+02
30.0	.20105+02	.16207+02	.181[illegible]+02	.17951+02	.18847+02
35.0	.23156+02	.19170+02	.21167+02	.20942+02	.21957+02
40.0	.25512+02	.21615+02	.23565+02	.23348+02	.24390+02
45.0	.27371+02	.23636+02	.25504+02	.25313+02	.26327+02
50.0	.28867+02	.25340+02	.27[illegible]+02	.26941+02	.27982+02
55.0	.30063+02	.26761+02	.28412+02	.28281+02	.29182+02
60.0	.31081+02	.27950+02	.29469+02	.29367+02	.30207+02
65.0	.31758+02	.28921+02	.30339+02	.30262+02	.31045+02
70.0	.32487+02	.29761+02	.31084+02	.31025+02	.31765+02
75.0	.32983+02	.30578+02	.31755+02	.31715+02	.32485+02
80.0	.33480+02	.31180+02	.32333+02	.32306+02	.32963+02
85.0	.33866+02	.31739+02	.32802+02	.32789+02	.33414+02
90.0	.34130+02	.32169+02	.33149+02	.33147+02	.33744+02
95.0	.34286+02	.32484+02	.33385+02	.33392+02	.33963+02
100.0	.34361+02	.32706+02	.335[illegible]3+02	.33547+02	.34099+02

Table 10. Values of Attenuation (dB/Km) at Precipitation Intensity R= 100.00(mm/h)

F(GHZ)	AII	AI	AMED	AC	AS
10.0	.57609+01	.47861+01	.52735+01	.53398+01	.51940+01
15.0	.11136+02	.97851+01	.99605+01	.10036+02	.10043+02
20.0	.17723+02	.15598+02	.15640+02	.15528+02	.16094+02
25.0	.24079+02	.18734+02	.21400+02	.21059+02	.27241+02
30.0	.29127+02	.23397+02	.26202+02	.25808+02	.27337+02
35.0	.32039+02	.27230+02	.30[illegible]+02	.29628+02	.31262+02
40.0	.35910+02	.30387+02	.33251+02	.32776+02	.34350+02
45.0	.38314+02	.33040+02	.35601+02	.35310+02	.36860+02
50.0	.40267+02	.35320+02	.37794+02	.37480+02	.38931+02
55.0	.41841 02	.37227+02	.39534+02	.39288+02	.40627+02
60.0	.43074+02	.38809+02	.40941+02	.40754+02	.41990+02
65.0	.44069+02	.40233+02	.4[illegible]+02	.41963+02	.43105+02
70.0	.44928+02	.41250+02	.43092+02	.429[illegible]9+02	.44063+02
75.0	.457[illegible]1+02	.42319+02	.44015+02	.43937+02	.44933+02
80.0	.46374+02	.43207+02	.447[illegible]+02	.44748+02	.45693+02
85.0	.46902+02	.43970+02	.454[illegible]+02	.45420+02	.46315+02
90.0	.47266+02	.44560+02	.45917+02	.45922+02	.46775+02
95.0	.47490+02	.45012+02	.46251+02	.46273+02	.47088+02
100.0	.47606+02	.45333+02	.46470+02	.46504+02	.47291+02

Table 11. Values of Attenuation (dB/Km) at Precipitation Intensity R= 150.00(mm/h)

F(GHZ)	FII	FI	FMED	FC	FS
10.0	.37985+00	.36172+00	.11974+01	.37838+00	.37292+00
15.0	.57827+00	.55169+00	.12924+01	.56498+00	.56584+00
20.0	.77620+00	.74052+00	.13860+01	.75839+00	.76380+00
25.0	.96942+00	.92404+00	.14769+01	.91703+00	.95421+00
30.0	.11577+01	.11040+01	.15686+01	.11309+01	.11480+01
35.0	.13404+01	.12785+01	.16558+01	.13045+01	.13286+01
40.0	.15138+01	.14454+01	.17393+01	.14790+01	.14926+01
45.0	.16729+01	.16005+01	.18168+01	.16367+01	.16514+01
50.0	.18133+01	.17401+01	.18866+01	.17767+01	.17926+01
55.0	.19333+01	.18619+01	.19475+01	.18976+01	.19143+01
60.0	.20331+01	.19653+01	.19992+01	.19992+01	.20181+01
65.0	.21118+01	.20493+01	.20412+01	.20805+01	.20972+01
70.0	.21663+01	.21117+01	.20724+01	.21390+01	.21551+01
75.0	.21944+01	.21584+01	.20917+01	.21724+01	.21874+01
80.0	.21970+01	.21862+01	.20996+01	.21919+01	.21953+01
85.0	.21824 1	.21636+01	.20983+01	.21730+01	.21847+01
90.0	.21586+01	.21501+01	.20916+01	.21540+01	.21840+01
95.0	.21332+01	.21334+01	.20832+01	.21533+01	.21419+01
100.0	.21140+00	.21193+01	.20762+01	.11653+01	.21242+01

Table 12. Values of Phase Displacement (°/Km) at the Precipitation Intensity R= .25(mm/h)

F(GHZ)	FII	FI	FMED	FC	FS
10.0	.15280+01	.14318+01	.39045+01	.14799+01	.14933+01
15.0	.23225+01	.21773+01	.42773+01	.22499+01	.22712+01
20.0	.30684+01	.28751+01	.46267+01	.29722+01	.30038+01
25.0	.37670+01	.35311+01	.49542+01	.36490+01	.36918+01
30.0	.44152+01	.41447+01	.52610+01	.42799+01	.43336+01
35.0	.49992+01	.47080+01	.55429+01	.48549+01	.49164+01
40.0	.54950+01	.52028+01	.57900+01	.53489+01	.54175+01
45.0	.58811+01	.56062+01	.59910+01	.57438+01	.58191+01
50.0	.61478+01	.59065+01	.61419+01	.60271+01	.60977+01
55.0	.63040+01	.61067+01	.62420+01	.62053+01	.62722+01
60.0	.63773+01	.62244+01	.63000+01	.63008+01	.63622+01
65.0	.63896+01	.62773+01	.63273+01	.63334+01	.63880+01
70.0	.63427+01	.62708+01	.63241+01	.63067+01	.63556+01
75.0	.62282+01	.62034+01	.62893+01	.62148+01	.62566+01
80.0	.60467+01	.60693+01	.62233+01	.60580+01	.60921+01
85.0	.58162+01	.58871+01	.61322+01	.58516+01	.58780+01
90.0	.55662+01	.56785+01	.60279+01	.56223+01	.56416+01
95.0	.53254+01	.54689+01	.59231+01	.53971+01	.54109+01
100.0	.51134+01	.52775+01	.58274+01	.51954+01	.52854+01

Table 13. Values of Phase Displacement (°/Km) at the Precipitation Intensity R= 1.25(mm/h)

F(GHZ)	FLL	FL	FMID	FC	FS
10.0	.20178+01	.26151+01	.62911+01	.27164+01	.27430+01
15.0	.42462+01	.39438+01	.69554+01	.40950+01	.41407+01
20.0	.55379+01	.51422+01	.75547+01	.53400+01	.54088+01
25.0	.67200+01	.62438+01	.81054+01	.64819+01	.65747+01
30.0	.77743+01	.72470+01	.86075+01	.75110+01	.76247+01
35.0	.86618+01	.81252+01	.90461+01	.83931+01	.85210+01
40.0	.91398+01	.88372+01	.94672+01	.90885+01	.92225+01
45.0	.97000+01	.93557+01	.96614+01	.95711+01	.97054+01
50.0	.10016+02	.96740+01	.98209+01	.98453+01	.99694+01
55.0	.10053+02	.98150+01	.98914+01	.99343+01	.10045+02
60.0	.99671+01	.98200+01	.98965+01	.98905+01	.99921+01
65.0	.98138+01	.97520+01	.98595+01	.97829+01	.98638+01
70.0	.96050+01	.96127+01	.97899+01	.96089+01	.96762+01
75.0	.93259+01	.94044+01	.96858+01	.93651+01	.94196+01
80.0	.89695+01	.91220+01	.95450+01	.90461+01	.90881+01
85.0	.85559+01	.87812+01	.93742+01	.86686+01	.86984+01
90.0	.81740+01	.84114+01	.91880+01	.82672+01	.82865+01
95.0	.77127+01	.80450+01	.90060+01	.78788+01	.78901+01
100.0	.73474+01	.77107+01	.88389+01	.75290+01	.75353+01

Table 14. Values of Phase Displacement (° /Km) at the Precipitation Intensity R= 2.50(mm/h)

F(GHZ)	FII	FI	FMED	FC	FS
10.0	.52319+01	.40033+01	.10052+02	.50174+01	.50743+01
15.0	.77571+01	.71281+01	.11214+02	.74426+01	.75425+01
20.0	.99705+01	.91591+01	.12230+02	.95648+01	.97160+01
25.0	.11929+02	.10987+02	.13143+02	.11458+02	.11657+02
30.0	.13500+02	.12570+02	.13939+02	.13069+02	.13304+02
35.0	.14798+02	.13860+02	.14503+02	.14332+02	.14583+02
40.0	.15608+02	.14805+02	.15052+02	.15206+02	.15456+02
45.0	.16003+02	.15377+02	.15338+02	.15690+02	.15923+02
50.0	.16020+02	.15602+02	.15451+02	.15811+02	.16010+02
55.0	.15743+02	.15538+02	.15419+02	.15640+02	.150[illegible]5+02
60.0	.15300+02	.15282+02	.15291+02	.15291+02	.15432+[illegible]
65.0	.14799+02	.14925+02	.15113+02	.14862+02	.14974+02
70.0	.14279+02	.14513+02	.14900+02	.14391+02	.14477+02
75.0	.13686+02	.14038+02	.14669+02	.13862+02	.13926+02
80.0	.13020+02	.13487+02	.14393+02	.13257+02	.13301+02
85.0	.12300+02	.12873+02	.14086+02	.12590+02	.12617+02
90.0	.11581+02	.12233+02	.13760+02	.11907+02	.11919+02
95.0	.10895+02	.11613+02	.13450+02	.11254+02	.11255+02
100.0	.10283+02	.11044+02	.13172+02	.10663+02	.10658+02

Table 15. Values of Phase Displacement (° /Km) at the Precipitation Intensity R= 5.00(mm/h)

F(GHZ)	FII	FI	FMED	FC	FS
10.0	.11884+02	.10730+02	.17924+02	.11310+02	.11462+02
15.0	.17061+02	.15430+02	.20271+02	.16255+02	.16539+02
20.0	.21471+02	.19340+02	.22230+02	.20372+02	.20811+02
25.0	.25012+02	.22752+02	.23932+02	.23862+02	.24422+02
30.0	.27553+02	.25427+02	.25270+02	.26466+02	.27085+02
35.0	.28940+02	.27199+02	.26155+02	.28045+02	.28657+02
40.0	.29307+02	.28081+02	.26597+02	.28674+02	.29225+02
45.0	.28895+02	.28209+02	.26661+02	.28542+02	.29000+02
50.0	.27920+02	.27753+02	.26433+02	.27836+02	.28194+02
55.0	.26581+02	.26885+02	.25999+02	.26713+02	.27000+02
60.0	.25113+02	.25601+02	.25457+02	.25467+02	.25645+02
65.0	.23708+02	.24674+02	.24893+02	.24205+02	.24315+02
70.0	.22412+02	.23577+02	.24345+02	.23012+02	.23070+02
75.0	.21163+02	.22495+02	.23804+02	.21846+02	.21869+02
80.0	.19894+02	.21385+02	.23249+02	.20659+02	.20652+02
85.0	.18603+02	.20239+02	.22676+02	.19441+02	.19411+02
90.0	.17345+02	.19094+02	.22103+02	.18239+02	.18193+02
95.0	.16179+02	.18008+02	.21560+02	.17113+02	.17056+02
100.0	.15136+02	.17015+02	.21004+02	.16093+02	.16036+02

Table 16. Values of Phase Displacement (°/Km) at the Precipitation Intensity R= 12.50(mm/h)

F(GHZ)	FII	FI	FMEJ	FC	FS
10.0	.21943+02	.19580+02	.27984+02	.20764+02	.21089+02
15.0	.30701+02	.27325+02	.31853+02	.28990+02	.29634+02
20.0	.37770+02	.33703+02	.35042+02	.35684+02	.36647+02
25.0	.43050+02	.38955+02	.37668+02	.40922+02	.42096+02
30.0	.46054+02	.42593+02	.39487+02	.44234+02	.45450+02
35.0	.46909+02	.44457+02	.40419+02	.45609+02	.46716+02
40.0	.46120+02	.44794+02	.40580+02	.45418+02	.46328+02
45.0	.44291+02	.44010+02	.40195+02	.44150+02	.44827+02
50.0	.41847+02	.42480+02	.39431+02	.42183+02	.42658+02
55.0	.39167+02	.40508+02	.38444+02	.39851+02	.40141+02
60.0	.36361+02	.38374+02	.37378+02	.37435+02	.37578+02
65.0	.33893+02	.36304+02	.36342+02	.35164+02	.35200+02
70.0	.31675+02	.34370+02	.35378+02	.33094+02	.33058+02
75.0	.29613+02	.32542+02	.34461+02	.31147+02	.31065+02
80.0	.2759[illegible]+02	.30726+02	.33553+02	.29229+02	.29116+02
85.0	.25584+02	.28904+02	.32642+02	.27314+02	.27180+02
90.0	.23662+02	.27115+02	.31748+02	.25456+02	.25310+02
95.0	.21896+02	.25433+02	.30907+02	.23729+02	.23580+02
100.0	.20321+02	.23901+02	.30141+02	.22171+02	.22031+02

Table 17. Values of Phase Displacement (°/Km) at the Precipitation Intensity R= 25.00(mm/h)

F(GHZ)	[illegible]	[illegible]	[illegible]	FC	FS
10.0	.41173+02	.36237+02	.4[illegible]2+02	.38672+02	.39422+02
15.0	.55688+02	.488[illegible]5+02	.51[illegible]7+02	.522[illegible]0+02	.53774+02
20.0	.67229+02	.592[illegible]2+02	.564[illegible]+02	.6[illegible]+02	.65225+02
25.0	.7423[illegible]+02	.57107+02	.68[illegible]7+02	.7[illegible]319+02	.72868+02
30.0	.76553+02	.7142[illegible]+02	[illegible]	.73[illegible]67+02	.74062+02
35.0	.7524[illegible]	[illegible]	[illegible]	.7[illegible]709+02	.75606+02
40.0	.71775+02	.712[illegible]0+02	[illegible]	.71464+02	.72837+02
45.0	.67327+02	.68[illegible]1+02	.611[illegible]4+02	.68074+02	.68923+02
50.0	.62685+02	.65392+02	.59476+02	.641[illegible]0+02	.64509+02
55.0	.57937+02	.61854+02	.5[illegible]701+02	.60107+02	.60233+02
60.0	.53548+02	.58311+02	.559[illegible]9+02	.56170+02	.56080+02
65.0	.49607+02	.54967+02	.5425[illegible]+02	.52538+02	.52310+02
70.0	.46081+02	.51850+02	.52699+02	.49218+02	.48911+02
75.0	.42803+02	.48683+02	.51215+02	.46092+02	.45739+02
80.0	.39598+02	.45940+02	.49747+02	.43015+02	.42646+02
85.0	.36437+02	.43019+02	.49283+02	.399[illegible]+02	.39586+02
90.0	.33423+02	.40152+02	.46650+02	.37309+02	.36641+02
95.0	.30662+02	.37466+02	.45507+02	.34271+02	.33[illegible]24+02
100.0	.28290+02	.35021+02	.44284+02	.31805+02	.31495+02

Table 18. Values of Phase Displacement (°/Km) at the Precipitation Intensity R= 50.00(mm/h)

F(GHZ)	FII	FI	FMP	FC	FS
10.0	.76855+02	.66630+02	.75997+02	.71566+02	.73340+02
15.0	.10147+03	.87099+02	.86227+02	.93698+02	.97350+02
20.0	.11635+03	.10455+03	.94953+02	.11066+03	.11606+03
25.0	.12000+03	.11545+03	.10040+03	.11992+03	.12521+03
30.0	.12538+03	.11934+03	.10235+03	.12169+03	.12589+03
35.0	.12001+03	.11853+03	.10194+03	.11910+03	.12109+03
40.0	.11322+03	.11530+03	.10033+03	.11449+03	.11607+03
45.0	.10611+03	.11097+03	.98165+02	.10905+03	.10971+03
50.0	.98093+02	.10663+03	.95695+02	.10322+03	.10321+03
55.0	.91973+02	.10075+03	.93053+02	.97189+02	.96706+02
60.0	.85350+02	.95347+02	.90351+02	.91225+02	.90465+02
65.0	.79356+02	.90104+02	.87770+02	.85649+02	.84730+02
70.0	.73889+02	.85252+02	.85304+02	.80432+02	.79461+02
75.0	.68662+02	.80539+02	.82931+02	.75421+02	.74417+02
80.0	.63455+02	.75650+02	.80507+02	.70361+02	.69379+02
85.0	.58236+02	.70780+02	.78005+02	.65275+02	.64316+02
90.0	.53271+02	.65943+02	.75649+02	.56300+02	.59484+02
95.0	.48612+02	.61400+02	.73381+02	.55673+02	.54850+02
100.0	.44522+02	.57253+02	.71304+02	.51495+02	.50781+02

Table 19. Values of Phase Displacement (° /Km) at the Precipitation Intensity R= 100.00(mm/h)

F(GHZ)	FII	FI	FMEN	FC	FS
10.0	.11318+03	.94633+02	.10468+03	.10197+03	.10494+03
15.0	.14409+03	.12292+03	.11882+03	.13232+03	.13862+03
20.0	.16721+03	.14648+03	.13063+03	.15438+03	.16308+03
25.0	.17280+03	.15907+03	.13689+03	.16388+03	.17190+03
30.0	.16817+03	.16219+03	.13845+03	.16423+03	.16986+03
35.0	.16062+03	.16019+03	.13745+03	.16013+03	.16339+03
40.0	.15102+03	.15562+03	.13527+03	.15416+03	.15562+03
45.0	.14181+03	.15027+03	.13249+03	.14729+03	.14742+03
50.0	.13255+03	.14390+03	.12931+03	.13980+03	.13902+03
55.0	.12338+03	.13700+03	.12586+03	.13197+03	.13055+03
60.0	.11472+03	.12989+03	.12230+03	.12414+03	.12240+03
65.0	.10691+03	.12311+03	.11891+03	.11683+03	.11493+03
70.0	.99840+02	.11662+03	.11567+03	.10999+03	.10839+03
75.0	.93110+02	.11047+03	.11260+03	.10347+03	.10156+03
80.0	.86333+02	.10411+03	.10941+03	.96837+02	.95023+02
85.0	.79531+02	.97726+02	.10672+03	.90162+02	.88423+02
90.0	.72993+02	.91353+02	.10304+03	.83599+02	.81999+02
95.0	.66995+02	.85396+02	.10006+03	.77510+02	.76051+02
100.0	.61694+02	.79931+02	.97325+02	.72089+02	.70753+02

Table 20. Values of Phase Displacement ($^\circ$ /Km) at the Precipitation Intensity R= 150.00(mm/h)

1 DIAMETRO / 2	SKKII		SKKI	
0.25	0.339399321E-05	J 0.140445467E-03	0.323101722E-05	J 0.136756731E-03
0.50	0.412966183E-04	J 0.116060092E-02	0.379392150E-04	J 0.109955901E-02
0.75	0.244910829E-03	J 0.411709026E-02	0.218482339E-03	J 0.379090034E-02
1.00	0.110889180E-02	J 0.104424097E-01	0.955660595E-03	J 0.933215767E-02
1.25	0.440577418E-02	J 0.219819173E-01	0.362505694E-02	J 0.190828703E-01
1.50	0.151915154E-01	J 0.384999365E-01	0.120885111E-01	J 0.330430605E-01
1.75	0.340193659E-01	J 0.499180816E-01	0.290198082E-01	J 0.435243137E-01
2.00	0.451665856E-01	J 0.603063256E-01	0.414643511E-01	J 0.473479293E-01
2.25	0.576436259E-01	J 0.849649310E-01	0.489891069E-01	J 0.570930578E-01
2.50	0.814852119E-01	J 0.117840588E+00	0.596768036E-01	J 0.767533183E-01
2.75	0.115566790E+00	J 0.155800521E+00	0.811892152E-01	J 0.980874896E-01
3.00	0.165476680E+00	J 0.199884236E+00	0.959444256E-01	J 0.138249338E+00
3.25	0.230372787E+00	J 0.243303657E+00	0.109081566E+00	J 0.139803112E+00

Table 21. Values of Forward Scattering Function at Frequency of 10 GHz.

Key: 1-Diameter

[1]DIAMETRO 2	SKKII		SKKI	
0.25	0.189240673E-04	J 0.476351638E-03	0.180589559E-04	J 0.463836594E-03
0.50	0.287175644E-03	J 0.400875509E-02	0.265529146E-03	J 0.379579351E-02
0.75	0.214368268E-02	J 0.145207718E-01	0.192288356E-02	J 0.133619122E-01
1.00	0.111352764E-01	J 0.356044509E-01	0.970586389E-02	J 0.319712199E-01
1.25	0.332292856E-01	J 0.604876056E-01	0.294484794E-01	J 0.532044172E-01
1.50	0.372534017E-01	J 0.906019211E-01	0.302037741E-01	J 0.735709667E-01
1.75	0.948195457E-01	J 0.139337659E+00	0.749425888E-01	J 0.105254829E+00
2.00	0.159412279E+00	J 0.198918104E+00	0.115498768E+00	J 0.139582515E+00
2.25	0.254790187E+00	J 0.261795640E+00	0.161695779E+00	J 0.193732619E+00
2.50	0.388734698E+00	J 0.311703742E+00	0.206790566E+00	J 0.264882863E+00
2.75	0.549714029E+00	J 0.328017890E+00	0.316599190E+00	J 0.268255532E+00
3.00	0.711949110E+00	J 0.305404723E+00	0.412915094E+00	J 0.278526495E+00
3.25	0.956897652E+00	J 0.260682344E+00	0.507764519E+00	J 0.406129837E+00

Table 22. Values of Forward Scattering Function at Frequency of 15 GHz.

Key: 1-Diameter

1 DIAMETRO	SKKII		SKKI	
0.25	0.643523542E-04	J 0.113419862E-02	0.616792335E-04	J 0.110439374E-02
0.50	0.114316889E-02	J 0.967654958E-02	0.105979246E-02	J 0.916157663E-02
0.75	0.921853632E-02	J 0.343174487E-01	0.831172615E-02	J 0.316028558E-01
1.00	0.363858074E-01	J 0.733102560E-01	[illegible]	J 0.656039715E-01
1.25	0.793339610E-01	J 0.120885593E+00	[illegible]	J 0.106408179E+00
1.50	0.158411066E+00	J 0.204034567E+00	[illegible]	J 0.163379060E+00
1.75	0.292100132E+00	J 0.261372486E+00	[illegible]	J 0.227122178E+00
2.00	0.480209172E+00	J 0.332531095E+00	[illegible]	J [illegible]
2.25	0.691280365E+00	J 0.325902641E+00	[illegible]	J 0.313747585E+00
2.50	0.892100403E+00	J 0.277389252E+00	0.590905229E+00	J 0.325500346E+00
2.75	0.104333496E+01	J 0.228043497E+00	[illegible]	J 0.334339797E+00
3.00	0.119967842E+01	J 0.200034559E+00	0.809255719E+00	J 0.337915361E+00
3.25	0.137415218E+01	J 0.202389717E+00	0.976307177E+00	J 0.326870203E+00

Table 23. Values of Forward Scattering Function at Frequency of 20 GHz.

Key: 1-Diameter

[1]DIAMETRO	SKKII		SKKI	
0.25	0.366904909E-03	J 0.222384138E-02	0.159585479E-03	J 0.216539041E-02
0.50	0.327117415E-02	J 0.190955624E-01	0.303541965E-02	J 0.180733912E-01
0.75	0.246979409E-01	J 0.638720393E-01	0.224097259E-01	J 0.587849021E-01
1.00	0.797094235E-01	J 0.132266700E+00	0.691875815E-01	J 0.116056621E+00
1.25	0.187955439E+00	J 0.230552197E+00	0.150243342E+00	J 0.194215715E+00
1.50	0.391925269E+00	J 0.317069352E+00	0.293155978E+00	J 0.273734927E+00
1.75	0.633428872E+00	J 0.339440942E+00	0.458356380E+00	J 0.325711429E+00
2.00	0.875924468E+00	J 0.293673992E+00	0.642314732E+00	J 0.337399244E+00
2.25	0.107859993E+01	J 0.238939404E+00	0.892354717E+00	J 0.336365534E+00
2.50	0.127478981E+01	J 0.221369386E+00	0.945581198E+00	J 0.347320199E+00
2.75	0.151263046E+01	J 0.236906230E+00	0.107242630E+01	J 0.395917416E+00
3.00	0.181864262E+01	J 0.249618649E+00	0.127214437E+01	J 0.460935320E+00
3.25	0.217529297E+01	J 0.213243067E+00	0.146717453E+01	J 0.535333037E+00

Table 24. Values of Forward Scattering Function at Frequency of 25 GHz.

Key: 1-Diameter

DIAMETRO[1]	SKKII	SKKI
0.25	0.361726852E-03 J 0.395604962E-02	0.346053159E-03 J 0.375460926E-02
0.50	0.755892321E-02 J 0.330804661E-01	0.701477379E-02 J 0.312997065E-01
0.75	0.508306399E-01 J 0.104620576E+00	0.460241102E-01 J 0.958473682E-01
1.00	0.160510778E+00 J 0.215396225E+00	0.145459960E+00 J 0.188646197E+00
1.25	0.386344790E+00 J 0.321464121E+00	0.302262664E+00 J 0.287070572E+00
1.50	0.684965253E+00 J 0.338005066E+00	0.527399182E+00 J 0.340373158E+00
1.75	0.959850789E+00 J 0.279524922E+00	0.752403915E+00 J 0.343067110E+00
2.00	0.119433308E+01 J 0.236183405E+00	0.947548568E+00 J 0.342677355E+00
2.25	0.145666981E+01 J 0.247912884E+00	0.113755703E+01 J 0.384711742E+00
2.50	0.180578232E+01 J 0.273189247E+00	0.136157799E+01 J 0.466176953E+00
2.75	0.222437382E+01 J 0.242730677E+00	0.164695072E+01 J 0.538264632E+00
3.00	0.264269447E+01 J 0.149687350E+00	0.197198009E+01 J 0.640377700E+00
3.25	0.305297279E+01 J 0.463137813E-01	0.225930309E+01 J 0.688936830E+00

Table 25. Values of Forward Scattering Function at Frequency of 30 GHz.

Key: 1-Diameter

1 DIAMETRO 2	SKKII		SKKI	
0.25	0.694801332E-03	J 0.614237040E-02	0.664853270E-03	J 0.598066300E-02
0.50	0.151010528E-01	J 0.523184761E-01	0.240066147E-01	J 0.494843200E-01
0.75	0.931299661E-01	J 0.158917904E+00	0. 342617755E-01	J 0.144929290E+00
1.00	0.302060064E+00	J 0.299726678E+00	0.249249697E+00	J 0.268648922E+00
1.25	0.639111161E+00	J 0.344038963E+00	0.513110697E+00	J 0.342174947E+00
1.50	0.961076558E+00	J 0.285012792E+00	0.785762131E+00	J 0.344273686E+00
1.75	0.123692131E+01	J 0.243443131E+00	0.102218819E+01	J 0.345610092E+00
2.00	0.156339120E+01	J 0.269439757E+00	0.126694293E+01	J 0.404207528E+00
2.25	0.200559902E+01	J 0.285655399E+00	0.157312691E+01	J 0.501512902E+00
2.50	0.250000286E+01	J 0.215345025E+00	0.195830441E+01	J 0.579099894E+00
2.75	0.296543747E+01	J 0.112561822E+00	0.230632919E+01	J 0.626253247E+00
3.00	0.345662890E+01	J 0.480745323E-01	0.297056440E+01	J 0.888181269E+00
3.25	0.403268242E+01	J-0.238907486E-01	0.309172916E+01	J 0.704825461E+00

Table 26. Values of Forward Scattering Function at Frequency of 35 GHz.

Key: 1-Diameter

DIAMETRO[1]	SKKII		SKKI	
0.25	0.122300815E-02	J 0.919519737E-02	0.117036398E-02	J 0.895301253E-02
0.50	0.272350758E-01	J 0.773653984E-01	0.252263919E-01	J 0.731441379E-01
0.75	0.162092149E+00	J 0.224525869E+00	0.142518878E+00	J 0.205074966E+00
1.00	0.494554758E+00	J 0.345542371E+00	0.410326779E+00	J 0.329070151E+00
1.25	0.879037857E+00	J 0.306811750E+00	0.737073183E+00	J 0.347459257E+00
1.50	0.120064926E+01	J 0.250547945E+00	0.102287006E+01	J 0.340141296E+00
1.75	0.156715870E+01	J 0.276618421E+00	0.131390190E+01	J 0.400487781E+00
2.00	0.207611179E+01	J 0.293171763E+00	0.169650745E+01	J 0.506960154E+00
2.25	0.263607979E+01	J 0.207633317E+00	0.215753746E+01	J 0.575913131E+00
3.50	0.317268085E+01	J 0.107979238E+00	0.261570072E+01	J 0.604339719E+00
2.75	0.376511574E+01	J 0.543118604E-01	0.307796001E+01	J 0.661386430E+00
3.00	0.446344662E+01	J-0.361431390E-01	0.357394695E+01	J 0.774493158E+00
3.25	0.519155502E+01	J-0.214619935E+00	0.423013973E+01	J 0.829336464E+00

Table 27. Values of Forward Scattering Function at Frequency of 40 GHz.

Key: 1-Diameter

DIAMETER[1]	SKKII		SKKI	
0.25	0.201558974E-02	J 0.131272376E-01	0.192976114E-02	J 0.127913704E-01
0.50	0.486352681E-01	J 0.108580013E+00	0.421772419E-01	J 0.107625906E+00
0.75	0.265972240E+00	J 0.290449262E+00	0.232169093E+00	J 0.248643260E+00
1.00	0.700436711E+00	J 0.341115117E+00	0.[illegible]957450818E+00	J 0.351924999E+00
1.25	0.109640395E+01	J 0.265766190E+00	0.[illegible]445206[illegible]E+00	J 0.344483392E+00
1.50	0.146916349E+01	J 0.269431124E+00	0.[illegible]2[illegible]957[illegible]E+01	J 0.373975873E+00
1.75	0.201028156E+01	J 0.303683996E+00	0.169[illegible]776[illegible]E+01	J 0.484462559E+00
2.00	0.264018250E+01	J 0.221769224E+00	0.222981[illegible]49E+01	J 0.554474250E+00
2.25	0.324569091E+01	J 0.219[illegible]7[illegible]928E+00	0.2764969[illegible]9E+01	J 0.583404899E+00
2.50	0.393099785E+01	J 0.663[illegible]515[illegible]0E-01	0.[illegible]315[illegible]0925E+01	J 0.667481244E+00
2.75	0.473396765E+01	J-0.445959829E-01	0.[illegible]92747[illegible]E+01	J 0.744694531E+00
3.00	0.555048752E+01	J-0.222[illegible]94503[illegible]E+00	0.462203217E+01	J 0.9376504[illegible]E+00
3.25	0.641467190E+01	J-0.397485921E+00	0.5324[illegible]921[illegible]E+01	J 0.682415[illegible]3E+00

Table 28. Values of Forward Scattering Function at Frequency of 45 GHz.

Key: 1-Diameter

1 DIAMETRO/2	SKKII		SKKI	
0.25	0.315601681E-02	J 0.180508569E-01	0.301971692E-02	J 0.175753124E-01
0.50	0.724200010E-01	J 0.145959914E+00	0.667117238E-01	J 0.137959349E+00
0.75	0.403720915E+00	J 0.339073598E+00	0.350842416E+00	J 0.3[illegible]2041690E+00
1.00	0.988158917E+00	J 0.305907130E+00	0.277961959E+00	J 0.3-38035.
1.25	0.129019165E+01	J 0.256460190E+00	0.14417171[illegible]E+01	J 0.339350522E+00
1.50	0.181560135E+01	J 0.305158138E+00	0.157543429E+01	J 0.439657986E+00
1.75	0.250726319E+01	J 0.256[illegible]07612E+00	0.216279076E+01	J 0.527972817E+00
2.00	0.318384361E+01	J 0.1[illegible]1307056E+00	0.279064346E+01	J 0.548599064E+00
2.25	0.393656921E+01	J 0.962756174E-01	0.34095[illegible]95E+01	J 0.620742559E+00
2.50	0.482839290E+01	J-0.288021341E-01	0.415104395E+01	J 0.741446137E+00
2.75	0.573863506E+01	J-0.209309639E+00	0.4925[illegible]4978E+01	J 0.808692469E+00
3.00	0.678004032E+01	J-0.365958810E+00	0.578645374E+01	J 0.928954959E+00
3.25	0.781069516E+01	J-0.581457496E+00	0.6629[illegible]005[illegible]E+01	J 0.103679848E+01

Table 29. Values of Forward Scattering Function at Frequency of 50 GHz.

Key: 1-Diameter

Diameter	SKKII		SKKI	
0.25	0.474332273E-02	J 0.240765549E-01	0.453753209E-02	J 0.234427489E-01
0.50	0.110150516E+00	J 0.188721478E+00	0.101097405E+00	J 0.178566515E+00
0.75	0.561056077E+00	J 0.356840253E+00	0.491495716E+00	J 0.352671742E+00
1.00	0.105439569E+01	J 0.271088779E+00	0.945913970E+00	J 0.327325165E+00
1.25	0.152969311E+01	J 0.290337512E+00	0.136578560E+01	J 0.374360740E+00
1.50	0.223094368E+01	J 0.298222542E+00	0.195608997E+01	J 0.491715491E+00
1.75	0.298800005E+01	J 0.177395880E+00	0.265159476E+01	J 0.518037856E+00
2.00	0.378004932E+01	J 0.1[illegible]85242[illegible]3E+00	0.334873396E+01	J 0.567742646E+00
2.25	0.474281502E+01	J 0.945978774E-02	0.415345001E+01	J 0.674898326E+00
2.50	0.574734592E+01	J-0.174103200E+00	0.50[illegible]9174E+01	J 0.750096795E+00
2.75	0.682896614E+01	J-0.335668504E+00	0.589508152E+01	J 0.966747046E+00
3.00	0.802605439E+01	J-0.563196957E+00	0.701769543E+01	J 0.100171089E+01
3.25	0.928829335E+01	J-0.044767213E+00	0.868055344E+01	J 0.113277092E+01

Table 30. Values of Forward Scattering Function at Frequency of 55 GHz.

Key: 1-Diameter

[1] DIAMETRO / 2	SKKII		SKKI	
0.25	0.689445436E-02	J 0.313114263E-01	0.659439713E-02	J 0.304884240E-01
0.50	0.161545277E+00	J 0.234886050E+00	0.147765934E+00	J 0.222878098E+00
0.75	0.717770159E+00	J 0.344359040E+00	0.640466034E+00	J 0.357300401E+00
1.00	0.121500206E+01	J 0.256138563E+00	0.110658550E+01	J 0.322193146E+00
1.25	0.182725716E+01	J 0.307883561E+00	0.163553905E+01	J 0.425043106E+00
1.50	0.265710449E+01	J 0.239959657E+00	0.237757874E+01	J 0.497830153E+00
1.75	0.349178673E+01	J 0.131907940E+00	0.314149094E+01	J 0.511076570E+00
2.00	0.447673035E+01	J 0.622034655E-01	0.399414253E+01	J 0.609065592E+00
2.25	0.557388306E+01	J-0.120123982E+00	0.499457645E+01	J 0.690179288E+00
2.50	0.673215389E+01	J-0.286543250E+00	0.603512192E+01	J 0.748093426E+00
2.75	0.804301834E+01	J-0.507925749E+00	0.718439339E+01	J 0.873258770E+00
3.00	0.942497993E+01	J-0.799668252E+00	0.837599659E+01	J 0.996834934E+00
3.25	0.108976612E+02	J-0.111278725E+01	0.969943714E+01	J 0.993586302E+00

Table 31. Values of Forward Scattering Function at Frequency of 60 GHz.

Key: 1--Diameter

1 DIAMETRO/2	SKKII		SKKI	
0.25	0.974557549E-02	J 0.398567617E-01	0.731932405E-02	J 0.388113327E-01
0.50	0.228761791E+00	J 0.280893028E+00	0.203790[illegible]41E+00	J 0.267994881E+00
0.75	0.960908508E+00	J 0.314552665E+00	0.79[illegible]17953E+00	J 0.343461812E+00
1.00	0.139073277E+01	J 0.264722824E+00	0.127548[illegible]44E+01	J 0.336965561E+00
1.25	0.217170715E+01	J 0.304396312E+00	0.195749474E+01	J 0.462029815E+00
1.50	0.306991768E+01	J 0.175407549E+00	0.24[illegible]59032E+01	J 0.475906134E+00
1.75	0.404394722E+01	J 0.107739021E+00	0.36[illegible]921616E+01	J 0.533103526E+00
2.00	0.521811295E+01	J-0.410734303E-01	0.472997656E+01	J 0.6[illegible]7458420E+00
2.25	0.643982229E+01	J-0.276313989E+00	0.586460096E+01	J 0.660839306E+00
2.50	0.783162880E+01	J-0.425850570E+00	0.71[illegible]74[illegible]6E+01	J 0.754276872E+00
2.75	0.931008434E+01	J-0.717592190E+00	0.84[illegible]780613E+01	J 0.890229592E+00
3.00	0.108960266E+02	J-0.104297733E+01	0.[illegible]1[illegible]98077E+01	J 0.959250053E+00
3.25	0.125534136E+02	J-0.145565891E+01	0.113872634E+02	J 0.895040035E+00

Table 32. Values of Forward Scattering Function at Frequency of 65 GHz.

Key: 1-Diameter

DIAMETRO (1) / 2	SKKII		SKKI	
0.25	0.134539381E-01	J 0.498046997E-01	0.125622099E-01	J 0.495041514E-01
0.50	0.312308729E+00	J 0.321787715E+00	0.285013974E+00	J 0.309747756E+00
0.75	0.989054372E+00	J 0.282901820E+00	0.912001843E+00	J 0.313387146E+00
1.00	0.159820747E+01	J 0.287162423E+00	0.146790395E+01	J 0.308258159E+00
1.25	0.252934837E+01	J 0.263777971E+00	0.231020546E+01	J 0.465740800E+00
1.50	0.349736500E+01	J 0.137797475E+00	0.322526150E+01	J 0.462691472E+00
1.75	0.467519951E+01	J 0.527709424E-01	0.427209298E+01	J 0.538429182E+00
2.00	0.596774292E+01	J-0.151121901E+00	0.549264240E+01	J 0.594117045E+00
2.25	0.739886284E+01	J-0.331020534E+00	0.678204346E+01	J 0.661505938E+00
2.50	0.997837734E+01	J-0.608680844E+00	0.825131239E+01	J 0.762014329E+00
2.75	0.106616020E+02	J-0.910574853E+00	0.980394415E+01	J 0.906892717E+00
3.00	0.124664875E+02	J-0.130197620E+01	0.118006077E+02	J 0.117957916E+01
3.25	0.143428211E+02	J-0.179171181E+01	0.978840160E+01	J-0.16133[illegible]E+01

Table 33. Values of Forward Scattering Function at Frequency of 70 GHz.

Key: 1-Diameter

1 DIAMETRO	SKKII		SKKI	
0.25	0.181990676E-01	J 0.612346579E-01	0.17[illegible]944272E-01	J 0.596446693E-01
0.50	0.410069406E+00	J 0.352253973E+00	0.37[illegible]159[illegible]21E+00	J 0.343411744E+00
0.75	0.110859013E+01	J 0.260035217E+00	0.103386307E+01	J 0.307750583E+00
1.00	0.184302330E+01	J 0.305655479E+00	0.169830227E+01	J 0.403334439E+00
1.25	0.287842560E+01	J 0.206757963E+00	0.266593102E+01	J 0.443060398E+00
1.50	0.397529984E+01	J 0.116645873E+00	0.358044755E+01	J 0.472095947E+00
1.75	0.532835579E+01	J-0.421462432E-01	0.492723846E+01	J 0.546867669E+00
2.00	0.676813793E+01	J-0.237188339E+00	0.628[illegible]16014[illegible]E+01	J 0.573141873E+00
2.25	0.842245293E+01	J-0.478931248E+00	[illegible]	J 0.659221351E+00
2.50	0.101801844E+02	J-0.779170215E+00	[illegible]	J 0.713562224E+00
2.75	0.121144276E+02	J-0.114657307E+01	0.114[illegible]E+02	J 0.732676923E+00
3.00	0.141351614E+02	J-0.160022736E+01	0.132651701E+02	J 0.517222297E+00
3.25	0.162596576E+02	J-0.227998791E+01	0.155643932E+02	J 0.780960500E+00

Table 34. Values of Forward Scattering Function at Frequency of 75 GHz.

Key: 1-Diameter

1 DIAMETRO/2	SKKII		SKKI	
0.25	0.241838805E-01	J 0.742075443E-01	0.231089400E-01	J 0.722960830E-01
0.50	0.517208040E+00	J 0.368358195E+00	0.475550592E+00	J 0.365074694E+00
0.75	0.122890936E+01	J 0.251162529E+00	0.115433693E+01	J 0.302849174E+00
1.00	0.211662579E+01	J 0.303917229E+00	0.195920658E+01	J 0.426206172E+00
1.25	0.322514057E+01	J 0.160346866E+00	0.301969719E+01	J 0.416928389E+00
1.50	0.450749969E+01	J 0.777361393E-01	0.419158745E+01	J 0.485791550E+00
1.75	0.598872662E+01	J-0.137376547E+00	0.560517447E+01	J 0.507980168E+00
2.00	0.764337730E+01	J-0.336421132E+00	0.713244438E+01	J 0.556930840E+00
2.25	0.947654529E+01	J-0.638205707E+00	0.887967959E+01	J 0.600816429E+00
2.50	0.114787388E+02	J-0.962735057E+00	0.107543440E+02	J 0.606370509E+00
2.75	0.136242161E+02	J-0.139863873E+01	0.126656866E+02	J 0.666410327E+00
3.00	0.159100685E+02	J-0.191146183E+01	0.148976803E+02	J 0.673215806E+00
3.25	0.182089844E+02	J-0.255811596E+01	0.174994659E+02	J 0.664816082E+00

Table 35. Values of Forward Scattering Function at Frequency of 80 GHz.

Key: 1-Diameter

DIAMETRO (1)	SKKII		SKKI	
0.25	0.316342451E-01	J 0.887627602E-01	0.302209370E-01	J 0.865010023E-01
0.50	0.627375841E+00	J 0.369056404E+00	0.580861747E+00	J 0.373014809E+00
0.75	0.135888958E+01	J 0.255905926E+00	0.128149414E+01	J 0.310403526E+00
1.00	0.240182781E+01	J 0.277235210E+00	0.224039841E+01	J 0.427240849E+00
1.25	0.359148312E+01	J 0.133193076E+00	0.338121510E+01	J 0.405099988E+00
1.50	0.506637669E+01	J 0.623677671E-02	0.474714375E+01	J 0.475408018E+00
1.75	0.668638706E+01	J-0.214239405E+00	0.630125237E+01	J 0.469116271E+00
2.00	0.856313705E+01	J-0.470204473E+00	0.[illegible]0[illegible]027103E+01	J 0.530552506E+00
2.25	0.105912571E+02	J-0.787987232E+00	0.100042324E+02	J 0.525875449E+00
2.50	0.129359222E+02	J-0.118176651E+01	0.120375950E+02	J 0.629817486E+00
2.75	0.152390232E+02	J-0.165521717E+01	0.143935[illegible]6[illegible]E+02	J 0.648150802E+00
3.00	0.177505493E+02	J-0.228282928E+01	0.169542084E+02	J 0.680137694E+00
3.25	0.202196655E+02	J-0.286739635E+01	0.135646210E+02	J 0.119210720E+01

Table 36. Values of Forward Scattering Function at Frequency of 85 GHz.

Key: 1-Diameter

DIAMETRO	SKKII		SKKI	
0.25	0.407976806E-01	J 0.164908285E+00	0.399673822E-01	J 0.102273107E+00
0.50	0.734674633E+00	J 0.356537998E+00	0.685647428E+00	J 0.368309975E+00
0.75	0.150609016E+01	J 0.269940419E+00	0.142258072E+01	J 0.328114510E+00
1.00	0.269481350E+01	J 0.234390259E+00	0.252709103E+01	J 0.408289552E+00
1.25	0.399479009E+01	J 0.113376677E+00	0.377023315E 01	J 0.406773865E+00
1.50	0.562994957E+01	J-0.796446204E-01	0.532414C55E+01	J 0.437623441E+00
1.75	0.744257736E+01	J-0.294688582E+00	0.703660965E+01	J 0.446529329E+00
2.00	0.950507069E+01	J-0.610113263E+00	0.901392281E+01	J 0.466841161E+00
2.25	0.117825747E+02	J-0.955615699E+00	0.111676245E+02	J 0.480787575E+00
2.50	0.142589798E+02	J-0.139935875E+01	0.133658264E+02	J 0.518267393E+00
2.75	0.169238892E+02	J-0.195080376E+01	0.161594570E+02	J 0.519094408E+00
3.00	0.196363525E+02	J-0.257453728E+01	0.158423462E+02	J 0.8 3296149E+00
3.25	0.223159943E+02	J-0.311209393E+01	0.220712433E+02	J 0.432319105E+00

Table 37. Values of Forward Scattering Function at Frequency of 90 GHz.

Key: 1-Diameter

1 DIAMETRO/2	SKKII		SKKI	
0.25	0.519407503E-01	J 0.122616410E+00	0.496031679E-01	J 0.119592547E+00
0.50	0.835271418E+00	J 0.335242629E+0[illegible]	0.7[illegible]009E+00	J 0.354297101E+00
0.75	0.167415714E+01	J 0.285704434E+00	0.158252911E+01	J 0.350542724E+00
1.00	0.296258259E+01	J 0.189577997E+00	0.291119393E+01	J 0.360270560E+00
1.25	0.443544483E+01	J 0.817244053E-01	0.4197[illegible]195E+01	J 0.408673644E+00
1.50	0.620599651E+01	J-0.156345546E+00	0.591[illegible]76088E+01	J 0.391252519E+00
1.75	0.824092865E+01	J-0.401965499E+00	0.[illegible]83182812E+01	J 0.416[illegible]37633E+00
2.00	0.104959707E+02	J-0.741912186E+00	0.10[illegible]124102E+02	J 0.394702673E+00
2.25	0.130195370E+02	J-0.114894390E+01	0.1243[illegible]9425E+02	J 0.431563020E+00
2.50	0.157508659E+02	J-0.162663841E+01	0.150455294E+02	J 0.398890674E+00
2.75	0.186624451E+02	J-0.225298023E+01	0.1797[illegible]8770E+02	J 0.317969859E+00
3.00	0.216236725E+02	J-0.286176900E+01	0.21314360[illegible]E+02	J 0.2[illegible]65422E+00
3.25	0.247220306E+02	J-0.349890327E+01	0.2324[illegible]9014E+02	J 0.193165302E+01

Table 38. Values of Forward Scattering Function at Frequency of 95 GHz.

Key: 1-Diameter

1 DIAMETRO/2	SKKII		SKKI	
0.25	0.553443933E-01	J 0.241813517E+00	0.629828844E-01	J 0.133397992E+00
0.50	0.927929865E+00	J 0.310261754E+00	0.679537480E+00	J 0.335357429E+00
0.75	0.188232376E+01	J 0.295465026E+00	0.176255894E+01	J 0.370523572E+00
1.00	0.324212837E+01	J 0.355623700E+00	0.357429073E+01	J 0.354704554E+00
1.25	0.489798927E+01	J 0.277683176E-01	0.465617770E+01	J 0.394525111E+00
1.50	0.681515026E+01	J-0.222495437E+00	0.651271725E+01	J 0.354660869E+00
1.75	0.905884266E+01	J-0.525216281E+00	0.854221714E+01	J 0.361275911E+00
2.00	0.215464315E+02	J-0.883087218E+00	0.110510998E+02	J 0.337830186E+00
2.25	0.143010473E+02	J-0.133882141E+01	0.137451191E+02	J 0.340129137E+00
2.50	0.175283081E+02	J-0.188562775E+01	0.166553497E+02	J 0.251493990E+00
2.75	0.204802814E+02	J-0.257758904E+01	0.198596497E+02	J 0.253106534E+00
3.00	0.236419983E+02	J-0.314304256E+01	0.229228058E+02	J 0.224739134E+00
3.25	0.269911652E+02	J-0.396090984E+01	0.268662872E+02	J-0.498324531E-01

Table 39. Values of Forward Scattering Function at Frequency of 100 GHz.

Key: 1-Diameter

α \ ψ	[illegible]°	[illegible]°	[illegible]°	[illegible]°
0°	1 [illegible]	1 [illegible]	1	1 [illegible]
45°	2 [illegible] III quadrant	3 [illegible]	4 [illegible]	5 [illegible]
90°	6. [illegible] vertica [illegible]	6 [illegible]	6 [illegible]	6 [illegible]

Table 40. Values of the Parameters ψ and α for Various Types of Polarization

Key: 1-Linear horizontal, 2-Linear, bisector I and III quadrant, 3-Circular left, 4-Linear, bisector II and IV quadrant, 5-Circular right, 6-Linear vertical.

R	$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$		$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$		$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$		$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$	
0.25	.1367	E-3	.1731	E-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.25	.1551	E-2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2.5	.4155	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5.	.1142	E-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12.25	.4044	E-1	.1148	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25.	.1316	E+0	.2557	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50.	.2508	E+0	.4930	E+1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
100.	.6122	E+0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
150	.9748	E+0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

R	$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$		$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$		$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$		$Re(\gamma_{II}-\gamma_I)$		$Im(\gamma_{II}-\gamma_I)$	
0.25	.2846	E-2	.5370	E-1	[illegible]	E-2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	E-1	[illegible]	E-2	.4874	E-1
1.25	.2361	E-1	.2706	E 0	[illegible]	E-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	E-1	.2027	E 0
2.5	.5749	E-1	.5265	E 0	[illegible]	E-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	E-1	.1944	E 0
5.	.1367	E 0	.9829	E 0	.1326	E 0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	E 0	.2356	E 0
12.5	.4143	E 0	.2127	E+1	.4020	E	.2061	[illegible]	[illegible]	[illegible]	[illegible]	E+1	[illegible]	E 0	.3588	E+1
25.	.8973	E 0	.3461	E+1	.8755	E	.3352	E+1	.2334	[illegible]	[illegible]	E+1	.6761	E 0	[illegible]	E+1
50.	.1924	E+1	.5127	E+1	.1867	E+[illegible]	.3954	E+1	[illegible]	E+1	.4480	E+1	.1450	E+1	.3768	E+1
100.	.3888	E+1	.6035	E+1	.3782	E+1	[illegible]	E+1	.3444	E+1	.3200	E+1	.2937	E+1	.4303	E+1
150.	.5730	E+1	.5974	E+1	.5559	E+1	.5731	E+1	.5666	E+1	.5054	E+1	.4 13	E+1	.4080	E+1

Table 41

Key: 1-Frequency