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April 1st, 2010 Renesas Electronics Corporation

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Silicon Transistor

μ PA834TF

NPN SILICON EPITAXIAL TRANSISTOR (WITH 2 DIFFERENT ELEMENTS) IN A 6-PIN THIN-TYPE SMALL MINI MOLD PACKAGE

DESCRIPTION

The μ PA834TF has two different built-in transistors (Q1 and Q2) for low noise amplification in the VHF band to UHF band.

FEATURES

· Low noise

Q1 : NF = 1.4 dB TYP., Q2 : NF = 1.2 dB TYP. @f = 1 GHz, Vce = 3 V, Ic = 7 mA

· High gain

Q1 : $|S21e|^2 = 12.0 \text{ dB TYP.}$ Q2 : $|S21e|^2 = 9.0 \text{ dB TYP.}$ @f = 1 GHz, VcE = 3 V, Ic = 7 mA

- 6-pin thin-type small mini mold package
- 2 different transistors on-chip (2SC4227, 2SC4226)

ON-CHIP TRANSISTORS

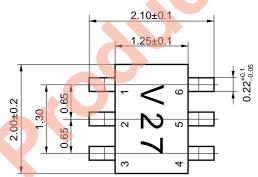
	Q1	Q2
3-pin small mini mold part No.	2SC4227	2SC4226

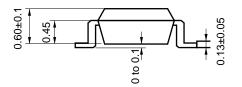
The μ PA831TF features the Q1 and Q2 in inverted positions.

ORDERING INFORMATION

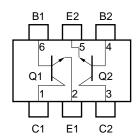
PART NUMBER	QUANTITY	PACKING STYLE
μPA834TF	Loose products (50 pcs)	8-mm wide embossed tape. Pin 6 (Q1 Base), pin 5 (Q2
μPA83 <mark>4TF-T</mark> 1	Taping products (3 kpcs/reel)	Emitter), and pin 4 (Q2 Base) face perforated side of tape.

PACKAGE DRAWINGS (Unit:mm)





PIN CONFIGURATION (Top View)



PIN CONNECTIONS

1. Collector (Q1)
2. Emitter (Q1)

4. Base (Q2)

3. Collector (Q2)

5. Emitter (Q2)
 6. Base (Q1)

Caution is required concerning excess input, such as from static electricity, because the high-frequency process is used for this device.

The information in this document is subject to change without notice.



ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

PARAMETER	SYMBOL	RAT	TING	UNIT			
PARAMETER	STIVIBOL	Q1	Q2	UNII			
Collector to base voltage	Vсво	20	20	V			
Collector to emitter voltage	Vceo	10	12	V			
Emitter to base voltage	VEBO	1.5	3	V			
Collector current	lc	65	100	mA			
Total power dissipation	PT	150 in 1 element	150 in 1 element	mW			
		200 in 2 elements ^{Note}					
Junction temperature	Tj	150	150	°C			
Storage temperature	T _{stg}	-65 to	-65 to +150				

Note 110 mW must not be exceeded for 1 element.

(1) Q1

ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Collector cutoff current	Ісво	Vcb = 10 V, IE = 0			0.8	μΑ
Emitter cutoff current	ІЕВО	V _{EB} = 1 V, I _C = 0			0.8	μΑ
DC current gain	hfe	Vce = 3 V, Ic = 7 mA ^{Note 1}	70		150	
Gain bandwidth product	f⊤	Vce = 3 V, lc = 7 mA, f = 1 GHz	4.5	7.0		GHz
Feedback capacitance	Cre	$V_{CB} = 3 \text{ V}, \text{ IE} = 0, \text{ f} = 1 \text{ MHz}^{\text{Note 2}}$		0.45	0.9	pF
Insertion power gain	S _{21e} ²	VcE = 3 V, lc = 7 mA, f = 1 GHz	10	12		dB
Noise figure	NF	VcE = 3 V, Ic = 7 mA, f = 1 GHz		1.4	2.7	dB

Notes 1. Pulse measurement: PW \leq 350 μ s, Duty cycle \leq 2%

2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitance meter.



(2) Q2

ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Collector cutoff current	Ісво	Vcb = 10 V, IE = 0			1	μΑ
Emitter cutoff current	Ієво	V _{EB} = 1 V, I _C = 0			1	μΑ
DC current gain	hfe	Vce = 3 V, Ic = 7 mA ^{Note 1}	100		145	
Gain bandwidth product	f⊤	Vce = 3 V, Ic = 7 mA, f = 1 GHz	3.0	4.5		GHz
Feedback capacitance	Cre	Vcb = 3 V, IE = 0, f = 1 MHz ^{Note 2}		0.7	1.5	pF
Insertion power gain	S _{21e} ²	VcE = 3 V, Ic = 7 mA, f = 1 GHz	7	9		dB
Noise figure	NF	VcE = 3 V, Ic = 7 mA, f = 1 GHz		1.2	2.5	dB

Notes 1. Pulse measurement: PW \leq 350 μ s, Duty cycle \leq 2%

2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitance meter.

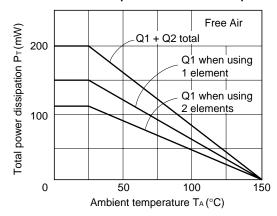
hfe CLASSIFICATION

Rank	FB
Marking	V27
h _{FE} value of Q1	70 to 150
hre value of Q2	100 to 145

TYPICAL CHARACTERISTICS (TA = 25°C)

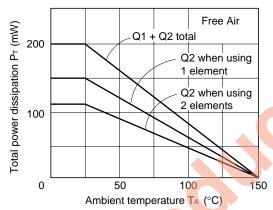
Q1

Total Power Dissipation vs. Ambient Temperature

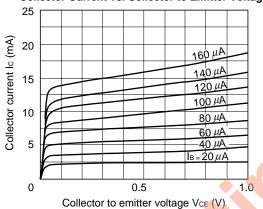


Q2

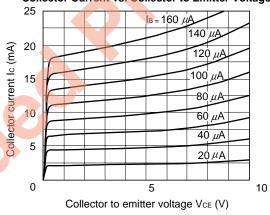
Total Power Dissipation vs. Ambient Temperature



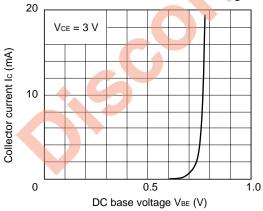
Collector Current vs. Collector to Emitter Voltage



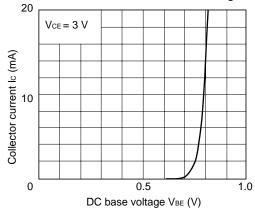
Collector Current vs. Collector to Emitter Voltage



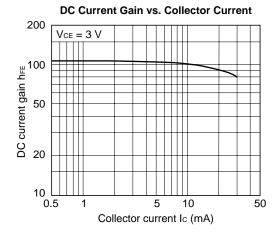
Collector Current vs. DC Base Voltage



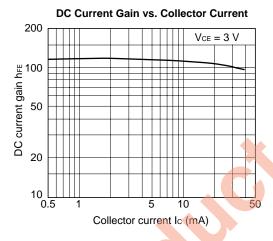
Collector Current vs. DC Base Voltage



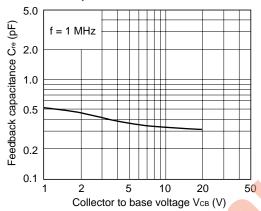
Q1



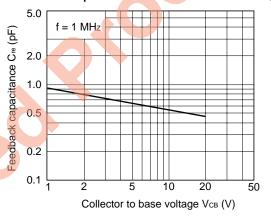
Q2



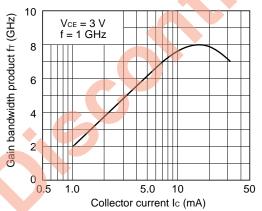
Feedback Capacitance vs. Collector to Base Voltage



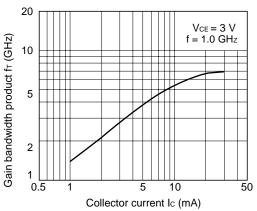
Feedback Capacitance vs. Collector to Base Voltage



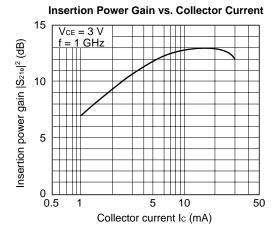
Gain Bandwidth Product vs. Collector Current



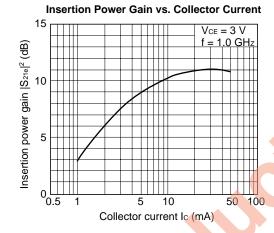
Gain Bandwidth Product vs. Collector Current



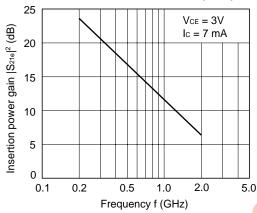
Q1



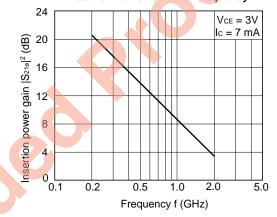
Q2



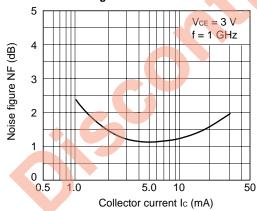
Insertion Power Gain vs. Frequency



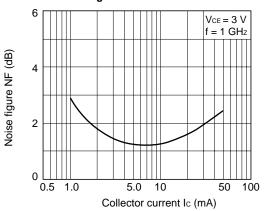
Insertion Power Gain vs. Frequency



Noise Figure vs. Collector Current



Noise Figure vs. Collector Current



S22



S-PARAMETERS Q1

FREQUENCY

$V_{CE} = 3 \text{ V}, \text{ Ic} = 1 \text{ mA}, Z_0 = 5$	50Ω	
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S11

FREQUENCT		311	•	321		312	•	022
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.98	-10.78	2.41	169.01	.03	82.67	.99	-5.20
.20	.96	-21.46	2.38	159.18	.05	75.20	.98	-10.20
.30	.93	-32.33	2.38	150.24	.07	68.08	.95	-14.68
.40	.90	-43.06	2.31	141.69	.09	61.29	.92	-19.11
.50	.86	-53.99	2.29	133.94	.11	55.59	.89	-22.74
.60	.83	-65.11	2.25	126.69	.12	49.63	.85	-26.47
.70	.79	-75.84	2.20	119.35	.14	44.96	.82	-29.32
.80	.75	-86.87	2.15	112.56	.14	40.36	.78	-32.30
.90	.71	-98.16	2.12	105.57	.15	36.37	.75	-34.43
1.00	.67	-108.55	2.03	99.27	.15	33.12	.72	-36.33
1.10	.64	-119.41	1.98	93.31	.16	30.12	.70	-38.40
1.20	.61	-129.95	1.91	87.38	.16	27.62	.67	-39.93
1.30	.59	-140.03	1.83	82.09	.16	25.60	.65	-41.61
1.40	.57	-149.74	1.77	76.93	.16	23.97	.64	-43.18
1.50	.56	-159.25	1.70	71.93	.16	22.71	.62	-44.84
1.60	.55	-167.88	1.63	67.38	.15	21.92	.60	-46.37
1.70	.55	-176.04	1.56	63.04	.15	21.49	.59	-47.97
1.80	.55	176.32	1.50	58.92	.15	21.38	.58	-49.69
1.90	.56	169.01	1.44	54.98	.15	21.63	.57	-51.43
2.00	.56	162.45	1.38	51.49	.14	22.61	.56	-53.25
2.10	.57	156.21	1.33	47.84	.14	23.68	.56	-55.13
2.20	.57	150.38	1.28	44.42	.14	25.20	.55	-57.17
2.30	.58	145.04	1.23	41.01	.14	26.84	.54	-59.39
2.40	.59	140.15	1.19	38.01	.14	29.10	.54	-61.77
2.50	.60	135.44	1.15	35.10	.14	31.12	.53	-64.21
2.60	.61	131.19	1.11	32.40	14	33.13	.53	-66.96
2.70	.62	127.22	1.06	29.58	.15	35.36	.52	-69.82
2.80	.63	123.39	1.03	26.90	.15	37.21	.52	-72.84
2.90	.64	119.95	1.00	24.53	.16	39.10	.52	-72.84 -75.84
3.00	.65	116.76	.96	22.15	.16	40.55	.52	-73.64 -79.12
3.00	.05	110.76	.90	22.10	.10	40.55	.51	-79.12
\/a= 2\/ la 2	· · · · Λ · · · · · · · · · · · · · · ·	F0 0						
Vce = 3 V, Ic = 3	3 mA, Z ₀ =	= 50 Ω						
	s mA, Z ₀ =	= 50 Ω S11		S21		S12	5	S22
FREQUENCY		S11		S21		S12		S22
FREQUENCY GHz	MAG	S11 ANG	MAG	ANG	MAG	ANG	MAG	ANG
FREQUENCY GHz .10	MAG .92	S11 ANG -16.30	MAG 6.78	ANG 163.07	MAG .02	ANG 78.39	MAG .97	ANG -10.08
FREQUENCY GHz .10 .20	MAG .92 .87	S11 ANG -16.30 -31.98	MAG 6.78 6.40	ANG 163.07 150.08	MAG .02 .05	ANG 78.39 68.80	MAG .97 .91	ANG -10.08 -18.72
FREQUENCY GHz .10 .20 .30	MAG .92 .87	S11 ANG -16.30 -31.98 -47.80	MAG 6.78 6.40 6.19	ANG 163.07 150.08 138.86	MAG .02 .05 .06	ANG 78.39 68.80 61.19	MAG .97 .91 .83	ANG -10.08 -18.72 -25.37
FREQUENCY GHz .10 .20 .30 .40	MAG .92 .87 .80 .73	ANG -16.30 -31.98 -47.80 -63.07	MAG 6.78 6.40 6.19 5.85	ANG 163.07 150.08 138.86 128.99	MAG .02 .05 .06 .08	ANG 78.39 68.80 61.19 55.07	MAG .97 .91 .83 .76	ANG -10.08 -18.72 -25.37 -30.73
FREQUENCY GHz .10 .20 .30 .40 .50	MAG .92 .87 .80 .73 .66	ANG -16.30 -31.98 -47.80 -63.07 -78.19	MAG 6.78 6.40 6.19 5.85 5.54	ANG 163.07 150.08 138.86 128.99 119.82	MAG .02 .05 .06 .08 .09	ANG 78.39 68.80 61.19 55.07 51.31	MAG .97 .91 .83	ANG -10.08 -18.72 -25.37 -30.73 -34.06
FREQUENCY GHz .10 .20 .30 .40 .50	MAG .92 .87 .80 .73 .66	ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43	MAG 6.78 6.40 6.19 5.85 5.54 5.14	ANG 163.07 150.08 138.86 128.99 119.82 111.99	MAG .02 .05 .06 .08 .09	ANG 78.39 68.80 61.19 55.07 51.31 47.96	MAG .97 .91 .83 .76 .69	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91
FREQUENCY GHz .10 .20 .30 .40 .50	MAG .92 .87 .80 .73 .66	ANG -16.30 -31.98 -47.80 -63.07 -78.19	MAG 6.78 6.40 6.19 5.85 5.54	ANG 163.07 150.08 138.86 128.99 119.82	MAG .02 .05 .06 .08 .09	ANG 78.39 68.80 61.19 55.07 51.31	MAG .97 .91 .83 .76 .69	ANG -10.08 -18.72 -25.37 -30.73 -34.06
FREQUENCY GHz .10 .20 .30 .40 .50	MAG .92 .87 .80 .73 .66	ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43	MAG 6.78 6.40 6.19 5.85 5.54 5.14	ANG 163.07 150.08 138.86 128.99 119.82 111.99	MAG .02 .05 .06 .08 .09	ANG 78.39 68.80 61.19 55.07 51.31 47.96	MAG .97 .91 .83 .76 .69	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91
FREQUENCY GHz .10 .20 .30 .40 .50 .60	MAG .92 .87 .80 .73 .66 .59	ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35	MAG .02 .05 .06 .08 .09 .09	78.39 68.80 61.19 55.07 51.31 47.96 45.84	MAG .97 .91 .83 .76 .69 .64	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80	MAG .92 .87 .80 .73 .66 .59 .53	ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95	MAG .02 .05 .06 .08 .09 .09 .10	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63	MAG .97 .91 .83 .76 .69 .64 .59	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90	MAG .92 .87 .80 .73 .66 .59 .53 .48	ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12	MAG .02 .05 .06 .08 .09 .09 .10 .10	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53	MAG .97 .91 .83 .76 .69 .64 .59 .55	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .11	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80	MAG .97 .91 .83 .76 .69 .64 .59 .55 .52	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45	ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84	MAG .02 .05 .06 .08 .09 .09 .10 .10 .11	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97	MAG .97 .91 .83 .76 .69 .64 .59 .55 .52 .50 .48	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39	ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .12 .13	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 43.07 43.15	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .12 .13 .13 .14	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.90 -45.97 -47.30 -48.61 -49.93
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .39 .40 .41	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1,50 1.60 1.70 1.80	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .39 .40 .41 .42	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .39 .40 .41 .42 .43	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .15	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .15	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51	MAG .02 .05 .06 .08 .09 .09 .10 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .15 .16 .16	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .15 .16 .16	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46 .48	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80 41.99	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .15 .16 .16 .17 .17	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46 .48 .49	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54 127.05	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83 1.76	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80 41.99 39.59	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .16 .16 .16 .17 .18	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96 44.03	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92 -65.35
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46 .48 .49	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54 127.05 123.60	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83 1.76 1.70	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80 41.99 39.59 37.06	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .15 .15 .16 .16 .17 .17 .18 .19	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96 44.03 43.96 44.03 43.96	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92 -65.35 -68.06
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46 .48 .49 .50 .51	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54 127.05 123.60 120.58	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83 1.76 1.70 1.64	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80 41.99 39.59 37.06 34.59	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .15 .16 .16 .17 .17 .18 .19	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96 44.03 43.96 44.03 43.82 43.64	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92 -65.35 -68.06 -70.86
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46 .48 .49 .50 .51	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54 127.05 123.60 120.58 117.57	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83 1.76 1.70 1.64 1.57	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80 41.99 39.59 37.06 34.59 32.06	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .15 .16 .16 .17 .17 .18 .19 .20	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.90 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96 44.03 43.82 43.64 43.46	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92 -65.35 -68.06 -70.86 -73.84
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46 .48 .49 .50 .51 .53 .54	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54 127.05 123.60 120.58 117.57 114.76	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83 1.76 1.70 1.64 1.57 1.52	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80 41.99 39.59 37.06 34.59 32.06 29.74	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .16 .16 .17 .17 .18 .19 .19 .20 .21	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96 44.03 43.82 43.64 43.46 43.46	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92 -65.35 -68.06 -70.86 -73.84 -77.22
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80 2.90	MAG	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54 127.05 123.60 120.58 117.57 114.76 112.21	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83 1.76 1.70 1.64 1.57 1.52 1.48	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 47.51 44.80 41.99 39.59 37.06 34.59 32.06 29.74 27.37	MAG .02 .05 .06 .08 .09 .09 .10 .10 .11 .11 .12 .12 .13 .13 .14 .15 .15 .16 .16 .17 .17 .18 .19 .19 .20 .21 .21	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96 44.03 43.82 43.64 43.46 43.11 42.63	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92 -65.35 -68.06 -70.86 -73.84 -77.22 -80.66
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80	MAG .92 .87 .80 .73 .66 .59 .53 .48 .45 .42 .40 .39 .39 .39 .40 .41 .42 .43 .44 .45 .46 .48 .49 .50 .51 .53 .54	S11 ANG -16.30 -31.98 -47.80 -63.07 -78.19 -92.43 -106.02 -118.85 -130.67 -141.99 -152.49 -162.31 -171.32 -179.82 172.48 165.52 159.29 153.32 148.09 143.19 138.60 134.31 130.54 127.05 123.60 120.58 117.57 114.76	MAG 6.78 6.40 6.19 5.85 5.54 5.14 4.78 4.43 4.09 3.79 3.52 3.28 3.07 2.88 2.71 2.56 2.42 2.30 2.19 2.09 2.00 1.91 1.83 1.76 1.70 1.64 1.57 1.52	ANG 163.07 150.08 138.86 128.99 119.82 111.99 104.35 97.95 92.12 86.84 82.25 77.80 73.85 69.91 66.35 62.96 59.69 56.50 53.49 50.44 47.51 44.80 41.99 39.59 37.06 34.59 32.06 29.74	MAG .02 .05 .06 .08 .09 .09 .10 .11 .11 .12 .12 .13 .13 .14 .14 .15 .16 .16 .17 .17 .18 .19 .19 .20 .21	ANG 78.39 68.80 61.19 55.07 51.31 47.96 45.84 44.63 43.53 42.97 42.80 42.90 42.99 43.07 43.15 43.24 43.43 43.66 43.80 44.03 43.95 44.09 43.96 44.03 43.82 43.64 43.46 43.46	MAG	ANG -10.08 -18.72 -25.37 -30.73 -34.06 -36.91 -38.80 -40.46 -41.67 -42.81 -44.00 -44.90 -45.97 -47.30 -48.61 -49.93 -51.48 -53.05 -54.77 -56.48 -58.43 -60.58 -62.92 -65.35 -68.06 -70.86 -73.84 -77.22

S21

S12



S-PARAMETERS Q1

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Vce = 3 V, Ic = 5	mA, Z ₀ =	= 50 Ω						
FREQUENCY		S11		S21	S	12	5	S22
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.87	-21.09	10.58	158.69	.02	76.37	.94	-14.02
.20	.79	-40.93	9.70	143.52	.04	65.52	.84	-24.75
.30	.69	-60.74	9.05	130.65	.05	58.91	.73	-31.35
.40	.59	-79.32	8.25	119.70	.06	54.93	.64	-35.74
.50	.51	-96.36	7.41	110.29	.07	52.81	.58	-38.18
.60	.45	-111.30	6.58	102.97	.08	51.55	.52	-39.98
.70	.40	-125.02	5.89	96.43	.09	51.22	.49	-40.96
.80	.37	-137.56	5.31	91.07	.09	50.87	.46	-41.93
.90	.35	-149.03	4.81	86.20	.10	50.93	.43	-42.70
1.00	.34	-159.60	4.40	81.84	.10	51.15	.41	-43.47
1.10	.33	-169.27	4.04	77.94	.11	51.32	.39	-44.47
1.20	.33	-178.09	3.74	74.24	.12	51.48	.38	-45.31
1.30	.34	173.96	3.48	70.81	.12	51.28	.37	-46.39
1.40	.34	166.63	3.25	67.44	.13	51.26	.35	-47.72
1.50	.35	160.09	3.04	64.24	.13	50.97	.34	-49.34 50.64
1.60	.36	154.15	2.86	61.19	.14	50.81	.33	-50.61
1.70 1.80	.37 .38	148.92 144.05	2.71 2.57	58.30 55.55	.15	50.56 50.22	.32	-52.38 -54.20
1.90	.40	139.59	2.37	52.81	.15 .16	49.88	.30	-54.20 -56.12
2.00	.40	135.38	2.32	49.98	.10	49.47	.29	-58.03
2.10	.42	131.62	2.22	47.31	.17	49.04	.29	-60.33
2.20	.43	127.88	2.12	44.92	.18	48.43	.28	-62.85
2.30	.45	124.89	2.03	42.30	.19	47.89	.27	-65.31
2.40	.46	121.79	1.96	39.95	.20	47.20	.26	-68.20
2.50	.47	118.87	1.88	37.68	.20	46.59	.25	-71.18
2.60	.49	116.22	1.81	35.13	.21	45.84	.25	-74.54
2.70	.50	113.70	1.75	32.81	.22	45.14	.24	-77.91
2.80	.51	111.27	1.69	30.83	.22	44.42	.23	-81.95
2.90	.53	109.07	1.63	28.42	.23	43.48	.23	-85.74
3.00	.54	107.01	1.58	26.31	.24	42.59	.22	-89.88
Vce = 3 V, Ic = 7	mA 70 =	= 50 O						
FREQUENCY		S11		S21	9	12		S22
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.82	-25.55 -49.26	13.98	155.09	.02	74.20	.91	-17.27
.20 .30	.71 .59	-49.26 -72.38	12.46 11.17	138.19 124.11	.04 .05	63.64 58.57	.77 .65	-28.79 -34.68
.40	.49	-72.36 -92.62	9.74	112.93	.06	56.34	.63 .57	-34.00 -38.01
.50	.49	-109.93	8.41	104.27	.07	55.60	.51	-39.47
.60	.37	-109.95 -124.76	7.29	97.81	.07	55.26	.46	-40.56
.70	.33	-138.09	6.42	92.16	.08	55.61	.43	-41.10
.80	.32	-150.18	5.72	87.44	.09	55.90	.40	-41.73
.90	.31	-161.02	5.15	83.20	.09	56.11	.38	-42.38
1.00	.30	-170.86	4.68	79.33	.10	56.24	.36	-43.03
1.10	.30	-179.78	4.28	75.75	.11	56.22	.35	-43.93
1.20	.31	172.28	3.95	72.27	.12	55.78	.34	-44.92
1.30	.32	165.19	3.67	69.16	.12	55.77	.33	-46.11
1.40	.32	158.69	3.42	66.03	.13	55.48	.31	-47.50
1.50	.33	152.94	3.20	63.14	.14	54.94	.31	-49.12
1.60	.35	147.77	3.01	60.34	.14	54.21	.29	-50.81
1.70	.36	143.12	2.85	57.57	.15	53.87	.29	-52.68
1.80	37	138 67	2 69	54.83	16	53 35	28	_54 58

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2.60

2.70

2.80

2.90

3.00

138.67

134.81

131.11

127.67

124.46

121.60

119.00 116.26

113.87

111.60

109.39

107.25 105.43

2.69

2.56

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1.66

54.83

52.19

49.63

47.15

44.92

42.23

39.97

37.83

35.53

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31.17

28.93

26.77

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51.21

50.46

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48.78 47.73

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44.95

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-54.58

-56.92

-58.94

-61.40

-64.15

-67.06

-70.23 -73.73

-77.51

-81.23

-85.62

-90.14 -94.79

S-PARAMETERS Q1

NEC

Vce = 3 V, Ic = 10 mA, Z_0 = 50 Ω

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FREQUENCY		S11	9	S21	S	12		S22
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.75	-31.91	18.36	150.69	.02	72.56	.87	-20.90
.20	.61	-60.80	15.66	131.59	.04	63.19	.70	-32.54
.30	.48	-86.66	13.17	116.85	.04	59.71	.57	-36.87
.40	.39	-107.49	10.90	106.51	.05	59.23	.49	-38.88
.50	.33	-124.54	9.12	99.07	.06	59.61	.44	-39.52
.60	.31	-138.94	7.79	93.48	.07	59.77	.40	-39.85
.70	.29	-151.59	6.79	88.62	.08	60.28	.38	-40.07
.80	.28	-162.92	6.01	84.41	.08	60.52	.36	-40.48
.90	.28	-172.78	5.38	80.67	.09	60.56	.34	-41.09
1.00	.28	178.41	4.88	77.11	.10	60.42	.33	-41.78
1.10	.29	170.63	4.45	73.88	.11	60.16	.32	-42.77
1.20	.30	163.65	4.11	70.70	.12	59.73	.30	-43.79
1.30	.30	157.49	3.80	67.78	.12	59.25	.29	-45.08
1.40	.31	151.77	3.54	64.89	.13	58.69	.28	-46.76
1.50	.33	146.82	3.32	62.07	.14	57.93	.28	-48.56
1.60	.34	142.17	3.12	59.45	.15	57.17	.27	-50.29
1.70	.35	138.10	2.95	56.81	.15	56.34	.26	-52.45
1.80	.36	134.29	2.79	54.39	.16	55.58	.25	-54.60
1.90	.38	130.79	2.65	51.88	.17	54.62	.24	-57.08
2.00	.39	127.57	2.52	49.37	.18	53.90	.23	-59.39
2.10	.40	124.44	2.41	46.97	.19	52.90	.23	-62.24
2.20	.41	121.52	2.30	44.61	.19	51.89	.22	-65.29
2.30	.43	119.00	2.20	42.27	.20	50.81	.21	-68.41
2.40	.44	116.60	2.12	40.22	.21	49.84	.20	-72.04
2.50	.46	114.12	2.04	37.82	.22	48.85	.19	-75.87
2.60	.47	111.93	1.96	35.73	.22	47.63	.19	-79.99
2.70	.48	109.71	1.89	33.52	.23	46.80	.18	-84.55
2.80	.49	107.65	1.83	31.28	.24	45.54	.17	-89.50
2.90	.51	105.77	1.78	29.36	.24	44.38	.17	-97.37
3.00	.52	103.96	1.71	27.21	.25	43.16	.16	-99.87



S-PARAMETERS Q2

Vce = 3 V, Ic = 1	mA, Zo =	: 50 Ω						
FREQUENCY		S11		S21	S	312	;	S22
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.97	-20.79	2.52	162.21	.04	76.22	.98	-8.81
.20	.93	-40.50	2.43	147.42	.08	63.75	.93	-16.39
.30	.89	-59.73	2.35	134.45	.11	53.38	.87	-22.34
.40	.84	-76.87	2.20	123.37	.13	44.64	.81	-27.24
.50	.80	-93.28	2.11	113.14	.14	38.01	.76	-30.90
.60	.76	-107.72	1.99	104.15	.15	32.06	.71	-34.29
.70	.74	-120.25	1.85	96.02	.16	27.52	.68	-36.96
.80	.71	-131.32	1.74	88.78	.15	24.29	.65	-39.46
.90	.69	-141.35	1.64	82.34	.15	21.95	.62	-41.97
1.00	.68	-150.05	1.53	76.48	.15	20.46	.60	-44.52
1.10	.68	-157.96	1.44	71.18	.15	19.32	.58	-47.14
1.20	.67	-165.04	1.36	66.07	.14	19.44	.57	-50.06
1.30	.67	-171.63	1.29	61.58	.14	20.32	.56	-52.97
1.40	.67	-177.36	1.23	57.26	.13	22.04	.54	-56.38
1.50	.67	176.90	1.17	52.95	.13	24.64	.53	-59.83
1.60	.67	171.98	1.11	49.02	.13	27.93	.52	-63.99
1.70	.68	166.97	1.06	45.23	.13	32.01	.51	-68.26
1.80	.68	162.82	1.02	41.90	.13	35.88	.50	-72.94
1.90	.69	158.53	.98	38.32	.13	39.86	.49	-77.61
2.00	.69	154.69	.94	35.40	.14	44.56	.48	-82.95
2.10	.70	150.93	.91	32.13	.15	48.10	.47	-88.66
2.20	.70	147.32	.88	29.30	.16	51.51	.46	-94.50
2.30	.71	144.13	.84	26.66	.17	53.73	.46	-100.96
2.40	.72	140.81	.81	24.15	.19	54.94	.45	-107.69
2.50	.72	137.73	.79	21.71	.21	55.71	.45	-114.70
2.60	.73	134.85	.76	19.47	.23	55.82	.45	-122.04
2.70	.73	132.23	.74	17.56	.24	55.39	.45	-129.51
2.80	.74	129.37	.72	15.32	.26	54.32	.45	-137.20
2.90	.75	126.78	.69	13.76	.28	53.05	.45	-144.79
3.00	.75	124.46	.68	11.96	.30	51.65	.46	-152.23
	. 7	50 0						
Vce = 3 V, Ic = 3	$mA, \angle 0 =$: 50 13						
FREQUENCY		S11	S21		S12		S22	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.90	-29.30	6.71	155.29	.04	71.05	.93	-16.80
00	00	FC 44	0.00	407.70	07	FC 00	0.4	00.70

FREQUENCY		S11	;	S21	S	12	;	S22
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.90	-29.30	6.71	155.29	.04	71.05	.93	-16.80
.20	.82	-56.11	6.09	137.78	.07	56.98	.81	-28.76
.30	.73	-80.82	5.56	123.40	.09	48.29	.68	-35.65
.40	.67	-101.56	4.95	111.97	.10	42.87	.59	-40.13
.50	.62	-118.49	4.38	102.51	.11	39.94	.52	-42.64
.60	.59	-131.80	3.86	94.93	.11	38.27	.47	-44.51
.70	.57	-142.87	3.44	88.40	.11	37.56	.43	-45.87
.80	.56	-152.14	3.11	82.68	.12	37.77	.40	-47.30
.90	.55	-159.99	2.82	77.69	.12	38.47	.38	-48.65
1.00	.54	-166.88	2.59	73.06	.13	39.41	.36	-50.22
1.10	.54	-173.10	2.39	68.79	.13	40.39	.34	-51.85
1.20	.55	- 178.59	2.21	64.68	.13	41.56	.32	-54.00
1.30	.55	176.42	2.07	61.03	.14	42.83	.31	-56.35
1.40	.55	171.90	1.95	57.31	.15	44.25	.29	-59.16
1.50	.56	167.41	1.84	53.63	.15	45.41	.28	-62.05
1.60	.57	163.59	1.74	50.19	.16	46.21	.26	-66.12
1.70	.57	159.71	1.66	46.97	.17	47.04	.25	-70.04
1.80	.58	156.43	1.58	43.76	.18	47.53	.24	-74.96
1.90	.59	153.08	1.51	40.55	.19	47.85	.23	-79.98
2.00	.60	149.93	1.45	37.59	.19	48.39	.22	-85.71
2.10	.60	146.93	1.40	34.56	.21	48.56	.21	-92.39
2.20	.61	144.08	1.34	31.82	.22	48.55	.20	-99.18
2.30	.62	141.48	1.29	28.94	.23	48.56	.19	-107.58
2.40	.63	138.74	1.25	26.22	.24	48.08	.19	-116.23
2.50	.64	136.23	1.20	23.63	.25	47.57	.19	-125.28
2.60	.65	133.79	1.16	20.97	.26	46.88	.19	-134.70
2.70	.66	131.63	1.13	18.63	.28	46.03	.20	-144.38
2.80	.67	129.33	1.09	16.09	.29	45.03	.20	-153.65
2.90	.68	127.06	1.06	14.06	.30	43.72	.22	-162.12
3.00	.68	125.06	1.02	11.49	.31	42.77	.23	-169.77

S22



S-PARAMETERS Q2

FREQUENCY

$Vce = 3 V, Ic = 5 mA, Z_0 = 50$	Ω	
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S11

		011	•	<i>7</i> 2 i		012		0
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.83	-36.95	10.41	149.93	.04	67.41	.87	-23.15
.20	.72	-69.61	9.00	130.38	.06	54.36	.70	-36.92
.30	.62	-97.36	7.70	115.33	.07	48.48	.56	-43.33
.40	.56	-117.96	6.47	104.59	.08	46.08	.46	-46.73
.50	.53	-133.20	5.47	96.45	.09	45.55	.40	-48.28
.60	.51	-145.02	4.72	89.97	.10	45.75	.35	-49.37
.70	.50	-154.27	4.13	84.56	.10	46.29	.32	-50.23
.80	.49	-162.17	3.68	79.59	.11	47.21	.29	-50.94
.90	.49	-168.79	3.31	75.30	.12	48.13	.27	-51.90
1.00	.49	-174.60	3.02	71.24	.13	48.87	.25	-53.05
1.10	.49	-179.99	2.77	67.35	.13	49.47	.23	-54.36
1.20	.50	175.37	2.56	63.72	.14	49.97	.22	-56.22
1.30	.50	170.99	2.38	60.38	.15	50.55	.20	-58.24
1.40	.51	167.14	2.25	57.00	.16	50.91	.19	-61.34
1.50	.52	163.26	2.11	53.63	.17	50.87	.18	-64.21
1.60	.52	159.95	1.99	50.49	.18	50.85	.16	-68.73
1.70	.53	156.57	1.90	47.43	.19	50.65	.15	-73.44
1.80	.54	153.53	1.80	44.40	.20	50.10	.14	-79.56
1.90	.55	150.58	1.72	41.65	.21	49.55	.12	-86.25
2.00	.56	147.71	1.65	38.70	.22	49.28	.11	-94.06
2.10	.57	144.98	1.59	35.74	.23	48.70	.11	-104.12
2.20	.58	142.44	1.53	32.92	.24	47.88	.10	-114.99
2.30	.59	140.07	1.47	30.23	.25	47.17	.10	-127.57
2.40	.60	137.58	1.41	27.68	.26	46.25	.10	-141.02
2.50	.61	135.31	1.36	25.02	.27	45.44	.11	-153.25
2.60	.62	133.07	1.31	22.56	.28	44.32	.12	-164.94
2.70	.63	131.02	1.28	20.38	.29	43.24	.13	-174.58
2.80	.64	128.83	1.23	17.84	.30	41.94	.14	176.60
2.90	.65	126.81	1.20	15.67	.31	40.75	.16	170.26
3.00	.66	124.98	1.16	13.38	.32	39.42	.18	163.89
.,								
Vce = 3 V, Ic = 7	$mA, Z_0 =$: 50 <u>Ω</u>						
	mA, Z ₀ =			321		S12		S22
FREQUENCY		S11		S21 ANG		S12		S22 ANG
FREQUENCY GHz	MAG	S11 ANG	MAG	ANG	MAG	ANG	MAG	ANG
FREQUENCY GHz .10	MAG .78	S11 ANG -43.98	MAG 13.56	ANG 145.65	MAG .04	ANG 65.30	MAG .83	ANG -28.08
FREQUENCY GHz .10 .20	MAG .78 .64	ANG -43.98 -81.06	MAG 13.56 11.15	ANG 145.65 124.63	MAG .04 .05	ANG 65.30 53.73	MAG .83 .62	ANG -28.08 -42.31
FREQUENCY GHz .10 .20 .30	MAG .78 .64	ANG -43.98 -81.06 -109.37	MAG 13.56 11.15 9.00	ANG 145.65 124.63 109.90	MAG .04 .05 .07	ANG 65.30 53.73 50.12	MAG .83 .62 .47	ANG -28.08 -42.31 -48.09
FREQUENCY GHz .10 .20 .30 .40	MAG .78 .64 .55	ANG -43.98 -81.06 -109.37 -128.61	MAG 13.56 11.15 9.00 7.29	ANG 145.65 124.63 109.90 100.27	MAG .04 .05 .07	ANG 65.30 53.73 50.12 49.49	MAG .83 .62 .47 .39	ANG -28.08 -42.31 -48.09 -50.66
FREQUENCY GHz .10 .20 .30 .40 .50	MAG .78 .64 .55 .50	ANG -43.98 -81.06 -109.37 -128.61 -142.36	MAG 13.56 11.15 9.00 7.29 6.05	ANG 145.65 124.63 109.90 100.27 93.07	MAG .04 .05 .07 .07	ANG 65.30 53.73 50.12 49.49 50.25	MAG .83 .62 .47 .39 .33	ANG -28.08 -42.31 -48.09 -50.66 -51.72
FREQUENCY GHz .10 .20 .30 .40 .50 .60	MAG .78 .64 .55 .50 .48	ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78	MAG 13.56 11.15 9.00 7.29 6.05 5.16	ANG 145.65 124.63 109.90 100.27 93.07 87.38	MAG .04 .05 .07 .07 .08 .09	ANG 65.30 53.73 50.12 49.49 50.25 50.94	MAG .83 .62 .47 .39 .33	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25
FREQUENCY GHz .10 .20 .30 .40 .50 .60	MAG .78 .64 .55 .50 .48 .47	ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41	MAG .04 .05 .07 .07 .08 .09	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76	MAG .83 .62 .47 .39 .33 .29 .26	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80	MAG .78 .64 .55 .50 .48 .47 .46	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92	MAG .04 .05 .07 .07 .08 .09 .10	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62	MAG .83 .62 .47 .39 .33 .29 .26	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90	MAG .78 .64 .55 .50 .48 .47 .46 .46	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02	MAG .04 .05 .07 .07 .08 .09 .10 .11	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24	MAG .83 .62 .47 .39 .33 .29 .26 .23	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .46	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72	MAG .04 .05 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60	MAG	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67 -72.24
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1,50 1.60 1.70	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .50 .51	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67 -72.24 -78.75
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .50 .51	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .51 .52 .53	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .50 .51 .52 .53 .54	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .50 .51 .52 .53 .54	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .07	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .51 .52 .53 .54 .55 .56	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89 141.54	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68 1.62	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30 33.80	MAG .04 .05 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74 47.70	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .06 .06	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63 -144.64
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30	MAG	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89 141.54 139.30	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68 1.62 1.55	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30 33.80 31.21	MAG .04 .05 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74 47.70 46.78	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .07 .06 .06 .07	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63 -144.64 -160.83
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40	MAG	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89 141.54 139.30 136.93	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68 1.62 1.55 1.50 1.44 1.39	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30 33.80 31.21 28.56 26.11 23.72	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74 47.70 46.78 45.56 44.37 43.25	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .07 .06 .06 .07 .08 .09 .11	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63 -144.64 -160.83 -175.36 174.41 166.38
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .50 .51 .52 .53 .54 .55 .56 .57 .58 .59 .60 .61	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89 141.54 139.30 136.93 134.74	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68 1.62 1.55 1.50 1.44	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30 33.80 31.21 28.56 26.11 23.72 21.44	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28 .29 .30	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74 47.70 46.78 45.56 44.37	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .07 .06 .06 .07 .08 .09	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -58.07 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63 -144.64 -160.83 -175.36 174.41 166.38 159.99
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .51 .52 .53 .54 .55 .56 .57 .58 .59 .60 .61	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89 141.54 139.30 136.93 134.74 132.62 130.60 128.48	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68 1.62 1.55 1.50 1.44 1.39 1.35 1.31	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30 33.80 31.21 28.56 26.11 23.72 21.44 18.83	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28 .29 .30 .31	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74 47.70 46.78 45.56 44.37 43.25 41.87 40.71	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .06 .06 .07 .08 .09 .11 .13 .14	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63 -144.64 -160.83 -175.36 174.41 166.38 159.99 154.42
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80 2.90	MAG	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89 141.54 139.30 136.93 134.74 132.62 130.60 128.48 126.53	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68 1.62 1.55 1.50 1.44 1.39 1.35 1.31 1.27	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30 33.80 31.21 28.56 26.11 23.72 21.44 18.83 16.82	MAG .04 .05 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28 .29 .30 .31 .32	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74 47.70 46.78 45.56 44.37 43.25 41.87 40.71 39.19	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .07 .06 .06 .07 .08 .09 .11 .13	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63 -144.64 -160.83 -175.36 174.41 166.38 159.99 154.42 150.20
FREQUENCY GHz .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80	MAG .78 .64 .55 .50 .48 .47 .46 .46 .46 .47 .47 .48 .49 .50 .51 .52 .53 .54 .55 .56 .57 .58 .59 .60 .61	S11 ANG -43.98 -81.06 -109.37 -128.61 -142.36 -152.78 -161.04 -168.03 -173.82 -179.09 176.20 171.98 168.07 164.50 160.99 157.91 154.69 151.94 149.12 146.49 143.89 141.54 139.30 136.93 134.74 132.62 130.60 128.48	MAG 13.56 11.15 9.00 7.29 6.05 5.16 4.49 3.98 3.57 3.24 2.97 2.75 2.55 2.40 2.25 2.13 2.02 1.92 1.83 1.75 1.68 1.62 1.55 1.50 1.44 1.39 1.35 1.31	ANG 145.65 124.63 109.90 100.27 93.07 87.38 82.41 77.92 74.02 70.24 66.63 63.22 60.08 56.83 53.72 50.70 47.63 44.73 41.86 39.20 36.30 33.80 31.21 28.56 26.11 23.72 21.44 18.83	MAG .04 .05 .07 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28 .29 .30 .31	ANG 65.30 53.73 50.12 49.49 50.25 50.94 51.76 52.62 53.24 53.84 53.96 53.97 53.98 53.80 53.24 52.57 52.05 51.25 50.40 49.60 48.74 47.70 46.78 45.56 44.37 43.25 41.87 40.71	MAG .83 .62 .47 .39 .33 .29 .26 .23 .21 .19 .18 .16 .15 .14 .12 .11 .09 .08 .07 .06 .06 .07 .08 .09 .11 .13 .14	ANG -28.08 -42.31 -48.09 -50.66 -51.72 -52.25 -52.80 -53.35 -54.00 -55.03 -56.17 -60.12 -63.36 -66.67 -72.24 -78.75 -87.51 -97.71 -110.79 -127.63 -144.64 -160.83 -175.36 174.41 166.38 159.99 154.42

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