NPN 7 GHz wideband transistor

BFR134

DESCRIPTION

NPN transistor in a plastic SOT37 envelope.

It is primarily intended for use in MATV and microwave amplifiers, such as aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers etc.

Emitter-ballasting resistors and application of gold sandwich metallization ensure an optimum temperature profile and excellent reliability properties.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

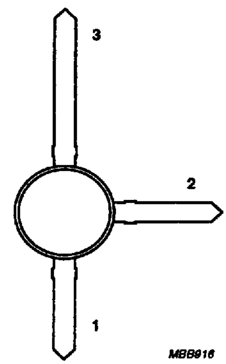


Fig.1 SOT37.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	–	15	V
I_C	DC collector current		–	–	150	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 10 V; T_j = 25 °C	80	130	–	
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	–	7	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = 100 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	11.5	–	dB
V_O	output voltage	I_C = 90 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C; d_{im} = −60 dB; $f_{(p+q-r)}$ = 793.25 MHz	–	850	–	mV

Note

1. T_s is the temperature at the soldering point of the collector lead.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	150	mA
P_{tot}	total power dissipation	up to T_s = 145 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 145 °C (note 1)	30 K/W

Note

1. T_s is the temperature at the soldering point of the collector lead.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10$ V	–	–	50	μA
h_{FE}	DC current gain	$I_C = 100$ mA; $V_{CE} = 10$ V	80	130	–	
f_T	transition frequency	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 1 GHz; $T_{amb} = 25$ °C	–	7	–	GHz
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	2.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	6	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10$ V; f = 1 MHz	–	1.2	–	pF
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 100$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	–	16	–	dB
		$I_C = 100$ mA; $V_{CE} = 10$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	11.5	–	dB
V_O	output voltage	note 2	–	900	–	mV
		note 3	–	850	–	mV
d_2	second order intermodulation distortion	note 4	–	–60	–	dB
		note 5	–	–56	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $d_{im} = -60$ dB (DIN45004B); $I_C = 90$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_O$ at $d_{im} = -60$ dB; $f_p = 445.25$ MHz;
   $V_q = V_O$ –6 dB; $f_q = 453.25$ MHz;
   $V_r = V_O$ –6 dB; $f_r = 455.25$ MHz;
   measured at $f_{(p+q-r)} = 443.25$ MHz.
3. $d_{im} = -60$ dB (DIN45004B); $I_C = 90$ mA; $V_{CE} = 10$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_O$ at $d_{im} = -60$ dB; $f_p = 795.25$ MHz;
   $V_q = V_O$ –6 dB; $f_q = 803.25$ MHz;
   $V_r = V_O$ –6 dB; $f_r = 805.25$ MHz;
   measured at $f_{(p+q-r)} = 793.25$ MHz.
4. $I_C = 80$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; $V_O = 50$ dBmV; $f_{(p+q)} = 450$ MHz.
5. $I_C = 80$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; $V_O = 50$ dBmV; $f_{(p+q)} = 810$ MHz.

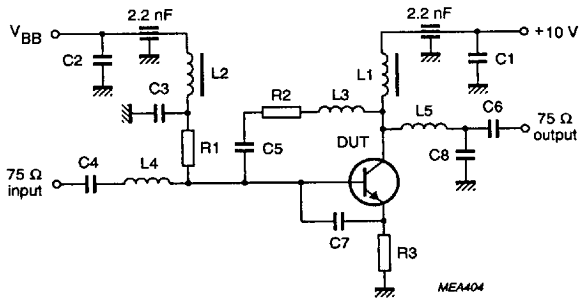


Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

List of components (see test circuit)

DESIGNATION	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C2	miniature ceramic capacitor	10 nF		2222 629 08103
C3, C4, C5, C6	multilayer ceramic capacitor	10 nF		2222 851 06627
C7	multilayer ceramic capacitor	1.2 pF		2222 851 12128
C8	multilayer ceramic capacitor	1.0 pF		2222 851 12108
L1, L2	Ferroxcube choke	5 μH		3122 108 20153
L3	4 turns 0.4 mm copper wire		int. dia. 3 mm; winding pitch 1 mm	
L4, L5	1.5 turns 0.4 mm copper wire		int. dia. 3 mm	
R1	chip resistor	10 kΩ		2322 712 30103
R2	chip resistor	220 Ω		2322 712 30221
R3, R4	chip resistor	15 Ω		2322 712 30159

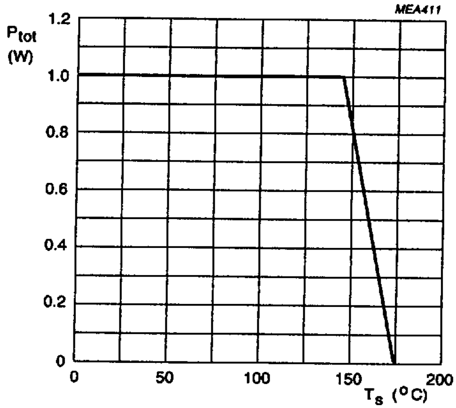
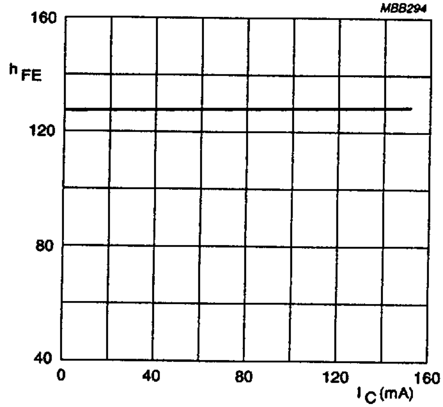
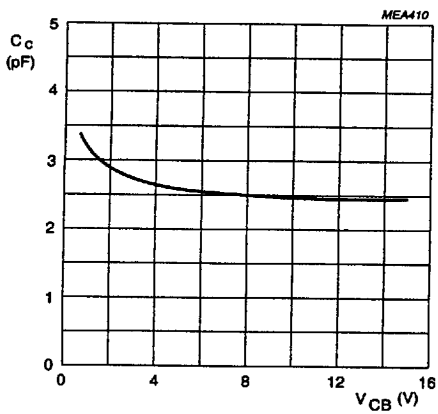


Fig.3 Power derating curve.



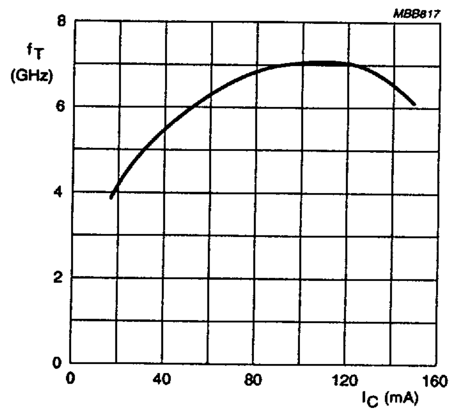
V_{CE} = 10 V; T_j = 25 °C.

Fig.4 DC current gain as a function of collector current.



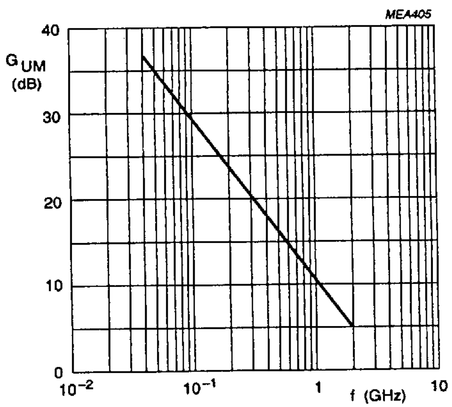
I_E = 0; f = 1 MHz; T_j = 25 °C.

Fig.5 Collector capacitance as a function of collector-base voltage.



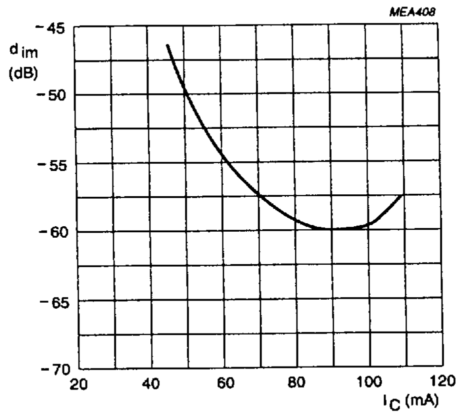
V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C.

Fig.6 Transition frequency as a function of collector current.



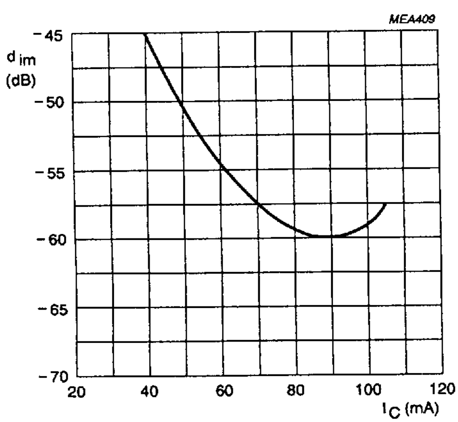
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.7 Maximum unilateral power gain as a function of frequency.



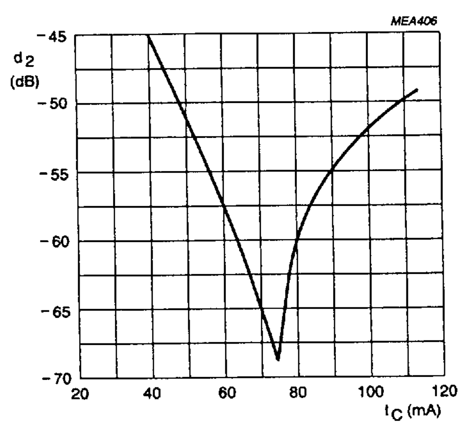
V_{CE} = 10 V; V_O = 900 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 443.25 MHz.

Fig.8 Intermodulation distortion as a function of collector current.



V_{CE} = 10 V; V_O = 850 mV; T_{amb} = 25 °C;
$f_{(p+q-r)}$ = 793.25 MHz.

Fig.9 Intermodulation distortion as a function of collector current.



V_{CE} = 10 V; V_O = 50 dBmV; T_{amb} = 25 °C;
f_p = 50 MHz; f_q = 400 MHz; $f_{(p+q)}$ = 450 MHz.

Fig.10 Second order intermodulation distortion as a function of collector current.

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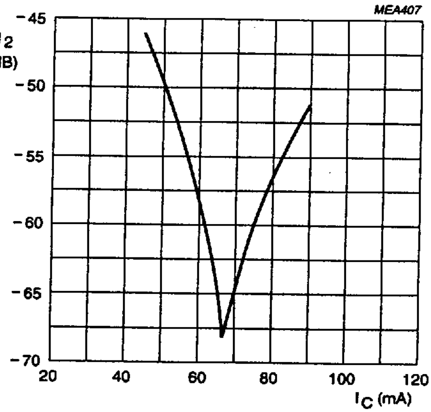
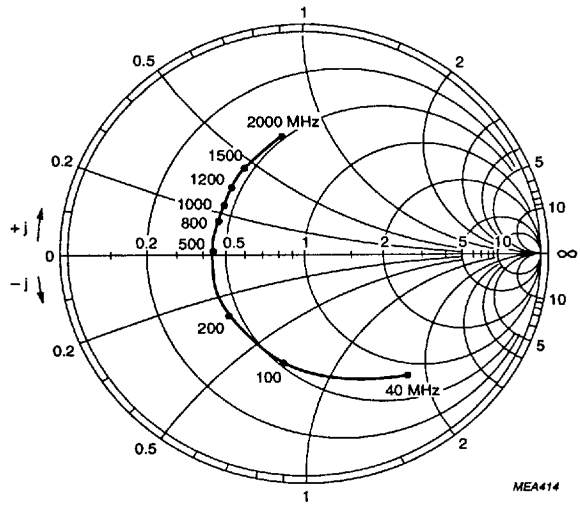


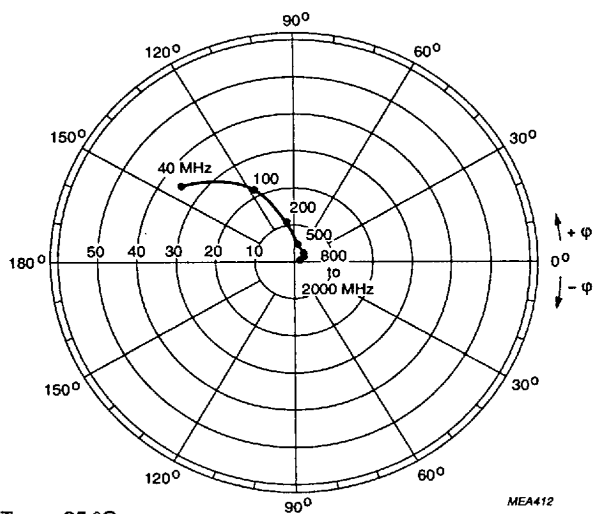
V_{CE} = 10 V; V_O = 50 dBmV; T_{amb} = 25 °C;
f_p = 250 MHz; f_q = 560 MHz; $f_{(p+q)}$ = 810 MHz.

Fig.11 Second order intermodulation distortion as a function of collector current.



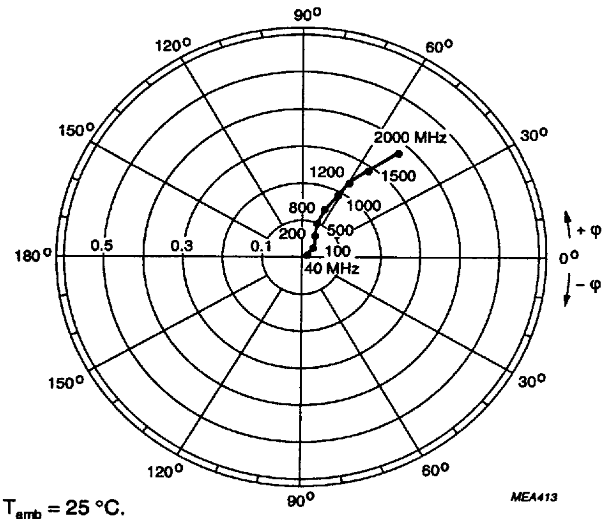
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.12 Common emitter input reflection coefficient (S_{11}).



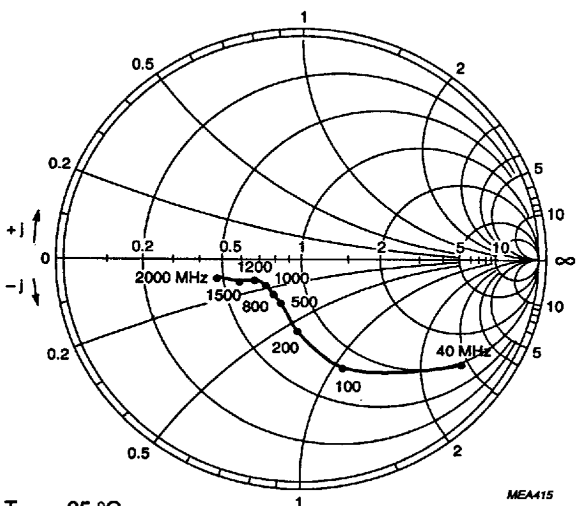
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.13 Common emitter forward transmission coefficient (S_{21}).



I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.14 Common emitter reverse transmission coefficient (S_{12}).



I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

Fig.15 Common emitter output reflection coefficient (S_{22}).

Table 1 Common emitter scattering parameters, I_C = 50 mA; V_{CE} = 10 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.635	−53.3	35.903	144.0	0.022	66.4	0.796	−36.8	37.7
100	0.475	−101.0	22.081	116.5	0.037	56.1	0.503	−66.0	29.3
200	0.394	−139.8	12.325	98.5	0.054	57.9	0.310	−87.6	23.0
300	0.377	−159.9	8.454	89.0	0.071	60.1	0.245	−100.3	19.5
400	0.378	−171.5	6.454	81.9	0.089	61.7	0.222	−109.5	17.1
500	0.377	179.9	5.220	75.8	0.107	61.7	0.217	−116.0	15.2
600	0.380	172.4	4.406	70.6	0.125	61.1	0.218	−120.3	13.8
700	0.376	165.4	3.816	65.5	0.143	60.2	0.223	−123.9	12.5
800	0.376	158.9	3.376	60.9	0.161	59.2	0.226	−126.8	11.5
900	0.378	153.2	3.036	56.4	0.180	57.8	0.229	−130.1	10.5
1000	0.386	147.0	2.748	52.2	0.198	56.4	0.234	−133.8	9.7
1200	0.403	136.0	2.356	43.8	0.233	52.9	0.251	−143.4	8.5
1400	0.432	127.1	2.061	36.0	0.266	49.0	0.281	−152.8	7.5
1600	0.443	119.2	1.837	28.2	0.299	44.9	0.313	−158.2	6.7
1800	0.445	110.2	1.701	20.4	0.333	40.1	0.341	−163.4	6.1
2000	0.467	101.8	1.550	13.5	0.365	35.4	0.361	−170.1	5.5
2200	0.506	93.3	1.436	7.0	0.395	31.8	0.381	−177.9	5.1
2400	0.528	87.5	1.351	1.6	0.422	28.0	0.415	174.9	4.9
2600	0.546	82.4	1.266	−5.1	0.448	23.8	0.456	169.1	4.6
2800	0.554	75.7	1.194	−10.9	0.469	18.8	0.483	163.5	4.3
3000	0.560	68.0	1.132	−16.4	0.495	13.9	0.508	158.1	4.0

Table 2 Common emitter scattering parameters, I_C = 75 mA; V_{CE} = 10 V

f (MHz)	S_{11} MAG. (RAT)	S_{11} ANG. (DEG)	S_{21} MAG. (RAT)	S_{21} ANG. (DEG)	S_{12} MAG. (RAT)	S_{12} ANG. (DEG)	S_{22} MAG. (RAT)	S_{22} ANG. (DEG)	G_{UM} (dB)
40	0.622	−55.3	37.152	143.3	0.022	66.8	0.777	−38.6	37.6
100	0.462	−104.0	22.432	116.3	0.036	56.9	0.486	−68.3	29.2
200	0.391	−142.5	12.452	99.1	0.052	60.1	0.299	−90.3	23.0
300	0.375	−161.0	8.532	90.9	0.070	63.2	0.239	−103.4	19.5
400	0.372	−173.1	6.496	84.8	0.087	65.3	0.218	−112.4	17.1
500	0.377	178.8	5.262	79.6	0.105	66.1	0.212	−119.0	15.3
600	0.372	171.4	4.417	75.2	0.123	66.2	0.213	−123.2	13.7
700	0.373	165.4	3.830	71.0	0.142	65.9	0.217	−126.4	12.5
800	0.372	158.6	3.374	67.0	0.158	65.6	0.220	−129.8	11.4
900	0.374	152.6	3.023	63.4	0.177	65.0	0.224	−132.9	10.5
1000	0.379	145.9	2.759	60.1	0.195	64.0	0.230	−137.0	9.7
1200	0.401	135.7	2.344	53.8	0.229	62.1	0.246	−145.8	8.4
1400	0.419	127.4	2.043	47.1	0.260	59.5	0.276	−153.1	7.4
1600	0.427	119.6	1.814	41.5	0.294	57.9	0.305	−158.6	6.5
1800	0.431	112.0	1.666	35.8	0.328	53.7	0.332	−163.6	5.8
2000	0.456	102.9	1.535	31.1	0.358	51.4	0.347	−169.4	5.3
2200	0.485	95.0	1.435	25.4	0.388	48.3	0.368	−177.3	4.9
2400	0.511	89.6	1.307	21.9	0.414	46.9	0.400	174.9	4.4
2600	0.525	84.5	1.260	18.1	0.444	43.0	0.435	169.1	4.3
2800	0.523	79.0	1.153	12.4	0.455	39.5	0.467	164.3	3.7
3000	0.529	71.4	1.096	9.4	0.479	37.5	0.483	158.9	3.4

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Table 3 Common emitter scattering parameters, I_C = 100 mA; V_{CE} = 10 V

f (MHz)	S_{11} MAG. (RAT)	S_{11} ANG. (DEG)	S_{21} MAG. (RAT)	S_{21} ANG. (DEG)	S_{12} MAG. (RAT)	S_{12} ANG. (DEG)	S_{22} MAG. (RAT)	S_{22} ANG. (DEG)	G_{UM} (dB)
40	0.605	−57.2	38.147	141.8	0.021	64.4	0.766	−40.0	37.4
100	0.452	−106.4	22.641	114.5	0.036	56.5	0.470	−70.4	29.2
200	0.381	−143.9	12.470	97.3	0.054	59.1	0.290	−93.3	23.0
300	0.373	−162.8	8.520	88.3	0.071	61.7	0.233	−107.2	19.5
400	0.372	−173.7	6.494	81.5	0.090	62.6	0.216	−116.7	17.1
500	0.375	177.5	5.256	75.6	0.109	62.7	0.213	−122.9	15.3
600	0.376	170.9	4.447	70.3	0.127	61.8	0.215	−127.2	13.8
700	0.372	163.7	3.831	65.5	0.146	60.6	0.220	−130.3	12.5
800	0.374	157.1	3.392	61.0	0.165	59.3	0.224	−133.2	11.5
900	0.374	151.4	3.055	56.4	0.184	57.7	0.226	−136.5	10.6
1000	0.382	145.5	2.763	52.6	0.202	56.3	0.231	−139.9	9.8
1200	0.400	135.1	2.372	44.1	0.238	52.5	0.249	−149.0	8.5
1400	0.428	125.6	2.073	36.3	0.271	48.3	0.278	−157.5	7.6
1600	0.439	117.7	1.853	28.7	0.305	44.3	0.308	−162.7	6.7
1800	0.438	109.3	1.709	20.9	0.338	39.4	0.336	−167.4	6.1
2000	0.461	100.7	1.562	14.0	0.369	34.4	0.358	−173.9	5.5
2200	0.496	92.5	1.449	7.9	0.400	30.8	0.376	178.7	5.1
2400	0.523	86.5	1.358	2.2	0.427	27.2	0.407	171.9	4.8
2600	0.536	81.7	1.274	−4.2	0.450	22.6	0.446	166.3	4.5
2800	0.542	75.3	1.212	−10.2	0.469	17.7	0.476	161.1	4.3
3000	0.546	67.3	1.149	−15.5	0.494	12.9	0.497	156.3	4.0