Manufacturer: LINAK A/S

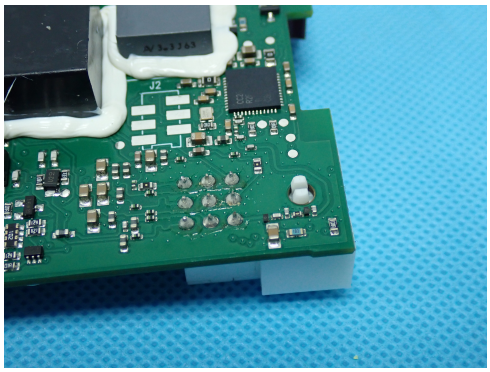
Antenna Type:Chip antenna

Model name:LA36IO

Conclusion:

The antenna is designed by manufacturer. One of the wires in the cable connected to the device is operating as an omnidirectional antenna.

Antenna diagram



Peak Gain:	0 dBi
Maximum power:	-2.10 dBm
Average power:	-7.64 dBm
Minimum power:	-20.94 dBm

Antenna gain

Frequency/MHz	2402	2440	2480
Peak Gain/dBi:	0	-2.97	-2.89

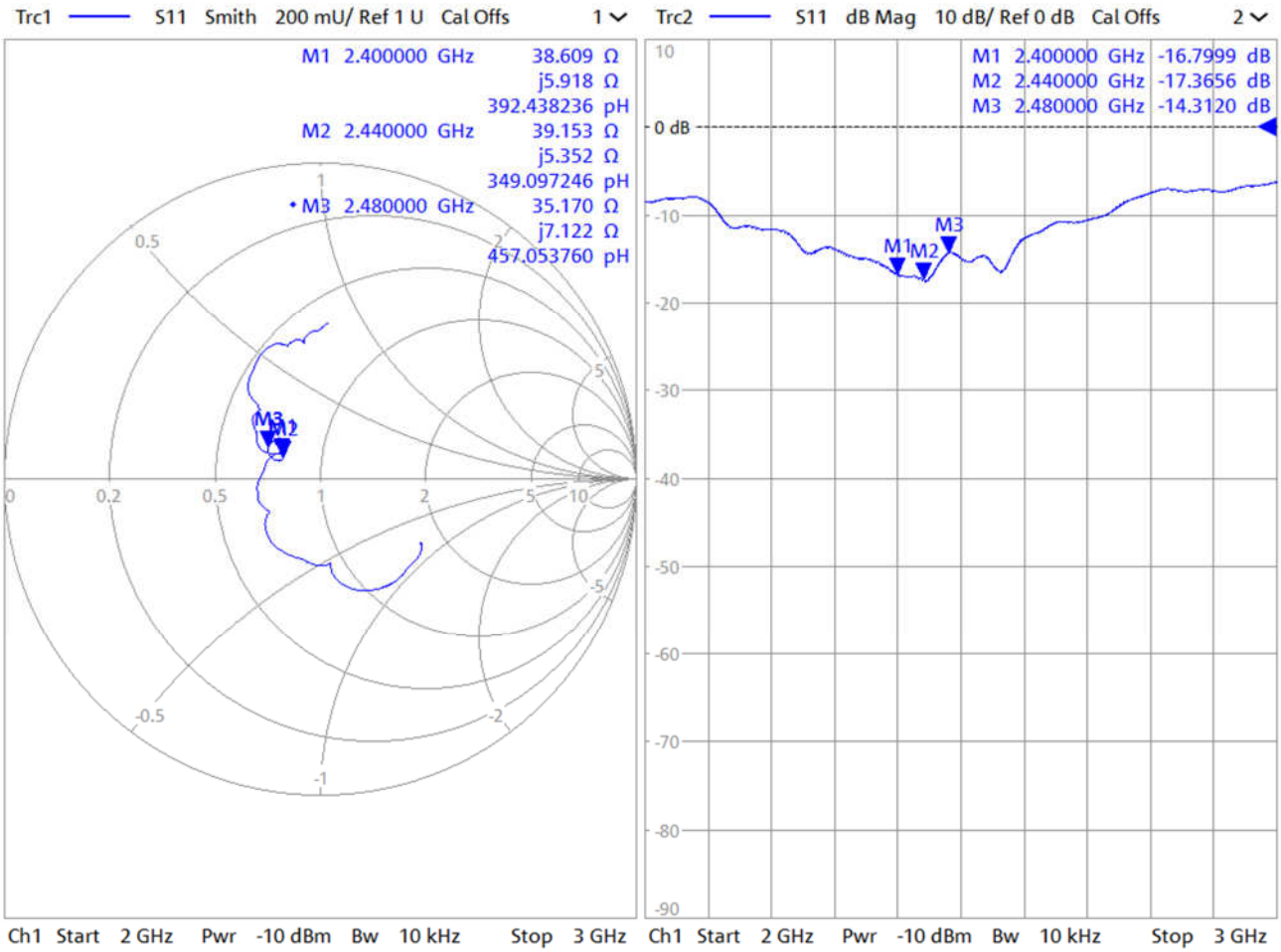
S11 is ~ -15 to 13dB for 2.4 – 2.48 GHz

There is no requirement to the radiated efficiency and 12% will as measured is sufficient.

Setup and measurements

The cable to the product is used as BLE antenna. The BLE interface itself is only used as service interface, and only a range about 3m is required. The cable is put position during test, where it is rolled up and taped directly to the housing of the actuator. This represents a normal use-case.

LA33IO antenna measurements:



Delta antenna test

OTA Test Results for Frequency 2480.000 MHz

OTA Evaluation Results:

Total Radiated Power	-9,08 dBm
Directivity	6,19 dBi
Total Efficiency	-9,08 dB
Total Efficiency	12,36 %
Peak Relaized Gain	-2,89 dBi
NHPRP 45°	-11,37 dBm
NHPRP 45° / TRP	-2,29 dB
NHPRP 45° / TRP	59,04 %
NHPRP 30°	-13,34 dBm
NHPRP 30° / TRP	-4,26 dB
NHPRP 30° / TRP	37,50 %
NHPRP 22.5°	-14,70 dBm
NHPRP 22.5° / TRP	-5,62 dB
NHPRP 22.5° / TRP	27,44 %
UHRP	-13,03 dBm
UHRP / TRP	-3,95 dB
UHRP / TRP	40,28 %
LHRP	-11,32 dBm
LHRP / TRP	-2,24 dB
LHRP / TRP	59,72 %
PGRP (0-120°)	-11,21 dBm
PGRP / TRP	-2,13 dB
PGRP / TRP	61,19 %
Front/Back Ratio	8,35
PhiBW	135,5 deg
PhiBW Up	83,1 deg
PhiBW Down	52,4 deg
ThetaBW	76,4 deg
ThetaBW Up	50,6 deg
ThetaBW Down	25,8 deg
Boresight Phi	120 deg
Boresight Theta	165 deg
Maximum Power	-2,89 dBm
Minimum Power	-20,94 dBm
Average Power	-7,58 dBm
Max/Min Ratio	18,05 dB
Max/Avg Ratio	4,69 dB
Min/Avg Ratio	-13,36 dB
Worst Single Value	-34,96 dBm
Worst Position	Azi = 195 deg; Elev = 90 deg; Pol = Ver
Best Single Value	-3,37 dBm
Best Position	Azi = 210 deg; Elev = 150 deg; Pol = Hor

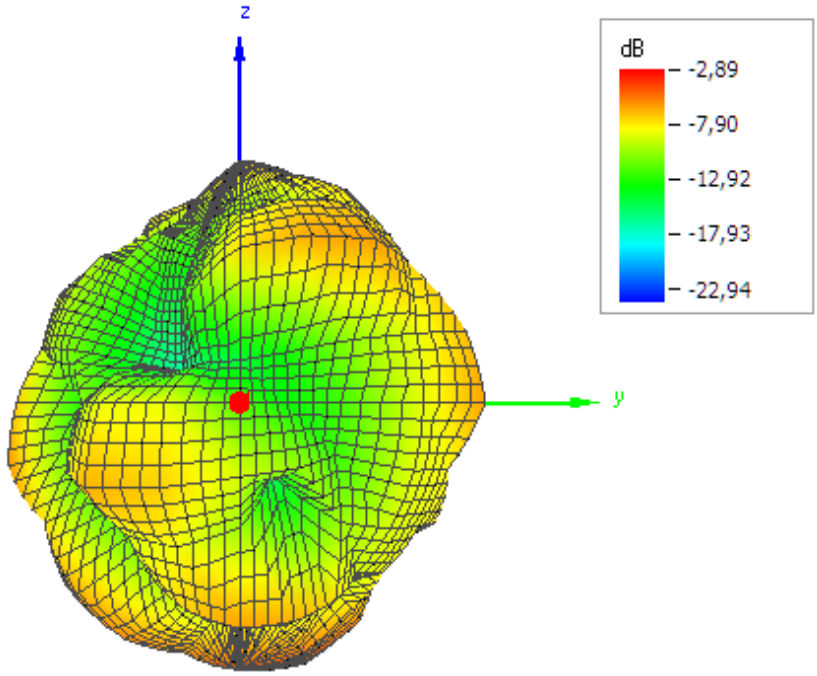
RP_2480.000_tot

Azimuth (deg)	Elevation 0 deg (dB)	Elevation 15 deg (dB)	Elevation 30 deg (dB)	Elevation 45 deg (dB)	Elevation 60 deg (dB)	Elevation 75 deg (dB)	Elevation 90 deg (dB)	Elevation 105 deg (dB)
0.00	-6.12	-9.29	-10.21	-8.46	-7.34	-14.11	-11.46	-8.67
15.00	-6.12	-8.68	-10.17	-7.39	-6.23	-12.59	-12.88	-9.99
30.00	-6.12	-8.15	-10.13	-7.08	-6.05	-10.01	-11.67	-11.90
45.00	-6.12	-7.68	-8.44	-7.38	-7.21	-8.29	-8.36	-8.45
60.00	-6.12	-7.25	-7.22	-8.74	-8.85	-6.69	-6.06	-7.86
75.00	-6.12	-7.04	-7.05	-8.32	-8.71	-10.04	-9.44	-8.92
90.00	-6.12	-6.85	-6.89	-7.82	-7.61	-10.99	-20.94	-12.81
105.00	-6.12	-6.66	-7.95	-8.06	-9.53	-10.58	-12.72	-10.28
120.00	-6.12	-6.48	-9.34	-10.21	-12.73	-13.46	-20.84	-8.37
135.00	-6.12	-6.22	-9.98	-10.68	-12.24	-12.55	-10.31	-9.21
150.00	-6.12	-5.97	-10.73	-9.22	-10.88	-10.73	-10.60	-11.75
165.00	-6.12	-5.74	-9.85	-9.32	-11.73	-11.53	-15.28	-13.97
180.00	-6.12	-5.53	-9.12	-9.57	-11.79	-13.30	-18.21	-15.38
195.00	-6.12	-6.04	-7.38	-9.56	-11.61	-13.29	-18.89	-14.86
210.00	-6.12	-6.62	-6.13	-8.83	-10.39	-11.10	-15.98	-10.67
225.00	-6.12	-7.29	-6.60	-9.01	-9.98	-10.22	-14.58	-9.10
240.00	-6.12	-8.08	-7.13	-9.60	-10.39	-10.92	-12.23	-9.60
255.00	-6.12	-8.68	-8.98	-10.52	-10.47	-9.25	-6.72	-6.96
270.00	-6.12	-9.38	-12.26	-9.21	-8.19	-8.47	-7.04	-5.82
285.00	-6.12	-10.21	-11.26	-9.45	-9.37	-9.52	-14.15	-11.82
300.00	-6.12	-11.24	-10.44	-10.74	-11.47	-10.83	-11.98	-10.83
315.00	-6.12	-10.66	-11.19	-13.35	-14.59	-14.26	-10.28	-8.60
330.00	-6.12	-10.15	-12.10	-13.57	-15.12	-16.32	-8.22	-6.36
345.00	-6.12	-9.70	-11.05	-11.25	-10.99	-14.62	-8.25	-6.98
360.00	-6.12	-9.29	-10.21	-8.46	-7.34	-14.11	-11.46	-8.67

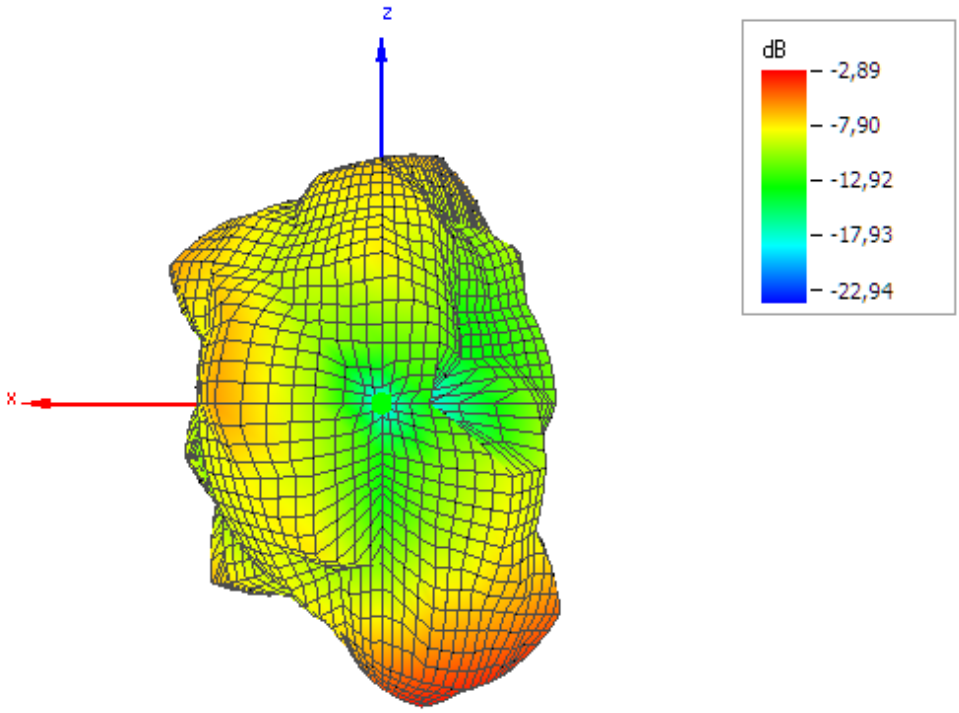
(continuation of the "RP_2480.000_tot" table from column 9 ...)

Azimuth (deg)	Elevation 120 deg (dB)	Elevation 135 deg (dB)	Elevation 150 deg (dB)	Elevation 165 deg (dB)	Elevation 180 deg (dB)
0.00	-9.79	-6.04	-10.72	-15.12	-4.26
15.00	-15.05	-6.33	-9.65	-11.03	-4.26
30.00	-9.84	-7.31	-8.79	-8.97	-4.26
45.00	-8.63	-8.74	-9.28	-7.57	-4.26
60.00	-8.16	-8.08	-9.84	-6.52	-4.26
75.00	-7.49	-9.79	-7.17	-5.29	-4.26
90.00	-13.09	-10.33	-5.53	-4.34	-4.26
105.00	-9.81	-7.19	-4.49	-3.55	-4.26
120.00	-7.62	-6.77	-3.65	-2.89	-4.26
135.00	-8.41	-5.77	-3.56	-3.36	-4.26
150.00	-11.71	-4.74	-3.47	-3.88	-4.26
165.00	-15.44	-5.83	-3.66	-4.47	-4.26
180.00	-15.14	-6.86	-3.86	-5.15	-4.26
195.00	-10.35	-7.16	-3.42	-5.61	-4.26
210.00	-5.94	-5.81	-3.02	-6.13	-4.26
225.00	-4.31	-5.23	-4.36	-6.72	-4.26
240.00	-5.11	-5.94	-6.31	-7.40	-4.26
255.00	-9.68	-8.73	-8.21	-6.92	-4.26
270.00	-8.86	-6.60	-11.67	-6.48	-4.26
285.00	-7.52	-5.96	-7.63	-6.09	-4.26
300.00	-11.08	-6.43	-5.57	-5.73	-4.26
315.00	-11.38	-10.46	-7.01	-6.82	-4.26
330.00	-8.63	-8.77	-9.20	-8.27	-4.26
345.00	-8.03	-6.99	-9.89	-10.46	-4.26
360.00	-9.79	-6.04	-10.72	-15.12	-4.26

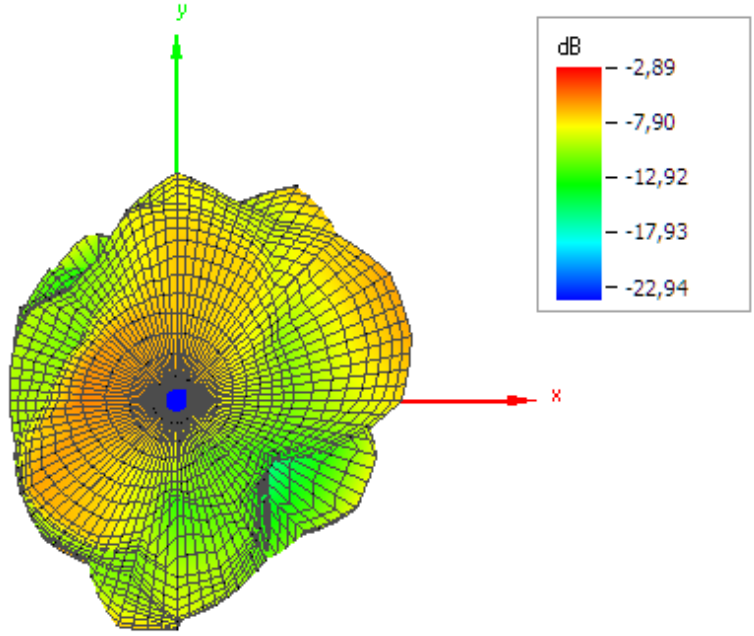
Theta = 90, Phi = 0



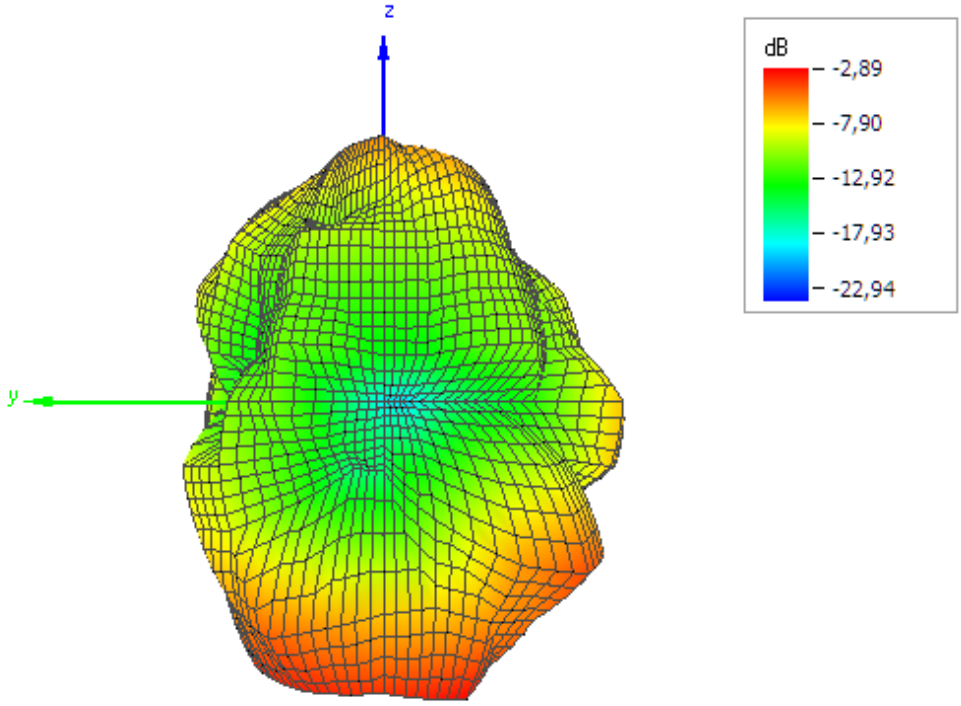
Theta = 90, Phi = 90



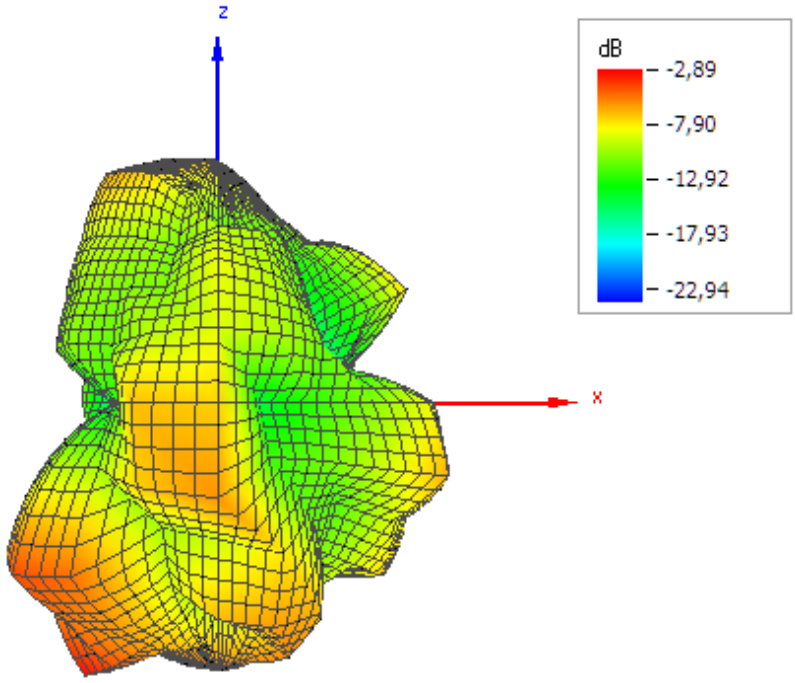
Theta = 0, Phi = 0



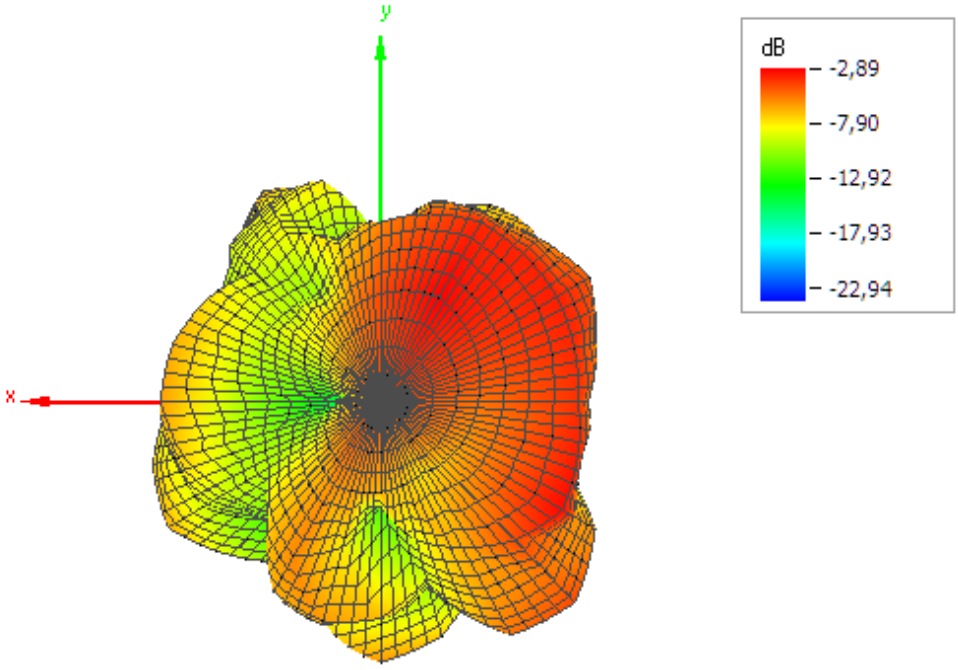
Theta = 90, Phi = 180



Theta = 90, Phi = 270



Theta = 180, Phi = 0



OTA Test Results for Frequency 2440.000 MHz

OTA Evaluation Results:

Total Radiated Power	-9,29 dBm
Directivity	6,32 dBi
Total Efficiency	-9,29 dB
Total Efficiency	11,77 %
Peak Relaized Gain	-2,97 dBi
NHPRP 45°	-11,83 dBm
NHPRP 45° / TRP	-2,54 dB
NHPRP 45° / TRP	55,75 %
NHPRP 30°	-13,89 dBm
NHPRP 30° / TRP	-4,59 dB
NHPRP 30° / TRP	34,72 %
NHPRP 22.5°	-15,24 dBm
NHPRP 22.5° / TRP	-5,95 dB
NHPRP 22.5° / TRP	25,41 %
UHRP	-13,13 dBm
UHRP / TRP	-3,84 dB
UHRP / TRP	41,33 %
LHRP	-11,61 dBm
LHRP / TRP	-2,32 dB
LHRP / TRP	58,67 %
PGRP (0-120°)	-11,48 dBm
PGRP / TRP	-2,18 dB
PGRP / TRP	60,47 %
Front/Back Ratio	8,62
PhiBW	133,1 deg
PhiBW Up	84,6 deg
PhiBW Down	48,5 deg
ThetaBW	45,7 deg
ThetaBW Up	29,0 deg
ThetaBW Down	16,7 deg
Boresight Phi	150 deg
Boresight Theta	150 deg
Maximum Power	-2,97 dBm
Minimum Power	-19,49 dBm
Average Power	-7,91 dBm
Max/Min Ratio	16,52 dB
Max/Avg Ratio	4,94 dB
Min/Avg Ratio	-11,58 dB
Worst Single Value	-31,67 dBm
Worst Position	Azi = 105 deg; Elev = 90 deg; Pol = Ver
Best Single Value	-3,52 dBm
Best Position	Azi = 210 deg; Elev = 150 deg; Pol = Hor

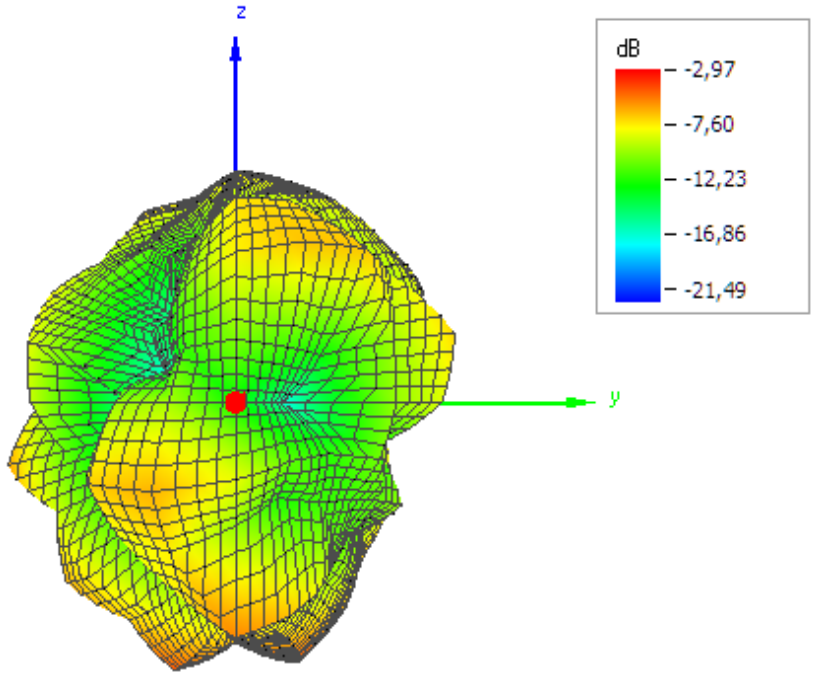
RP_2440.000_tot

Azimuth (deg)	Elevation 0 deg (dB)	Elevation 15 deg (dB)	Elevation 30 deg (dB)	Elevation 45 deg (dB)	Elevation 60 deg (dB)	Elevation 75 deg (dB)	Elevation 90 deg (dB)	Elevation 105 deg (dB)
0.00	-6.71	-9.57	-11.59	-7.12	-7.42	-9.95	-12.21	-7.96
15.00	-6.71	-8.95	-9.68	-7.14	-6.53	-11.07	-14.48	-10.57
30.00	-6.71	-8.40	-8.35	-8.05	-6.59	-12.28	-16.48	-11.54
45.00	-6.71	-7.91	-8.02	-9.56	-8.06	-9.26	-9.51	-10.19
60.00	-6.71	-7.48	-7.71	-8.54	-9.39	-6.89	-8.18	-12.14
75.00	-6.71	-7.25	-8.07	-7.96	-8.11	-11.59	-14.19	-14.76
90.00	-6.71	-7.04	-8.47	-8.09	-7.26	-10.28	-12.30	-16.03
105.00	-6.71	-6.83	-7.96	-9.57	-12.18	-11.50	-12.57	-11.93
120.00	-6.71	-6.64	-7.51	-9.82	-14.49	-13.32	-15.41	-7.76
135.00	-6.71	-6.34	-7.70	-9.52	-12.07	-11.90	-8.78	-6.98
150.00	-6.71	-6.07	-7.89	-8.98	-10.79	-11.86	-8.78	-8.72
165.00	-6.71	-5.81	-7.31	-9.12	-11.46	-13.43	-12.82	-13.06
180.00	-6.71	-5.56	-6.79	-9.95	-12.15	-14.40	-13.39	-16.43
195.00	-6.71	-6.03	-5.88	-10.45	-12.93	-15.18	-17.57	-12.51
210.00	-6.71	-6.54	-5.13	-9.15	-13.37	-14.85	-18.16	-10.28
225.00	-6.71	-7.13	-5.65	-7.93	-12.06	-13.12	-15.94	-10.69
240.00	-6.71	-7.80	-6.26	-7.91	-10.80	-14.30	-14.92	-11.18
255.00	-6.71	-8.51	-7.68	-9.16	-9.83	-12.67	-10.42	-7.48
270.00	-6.71	-9.35	-9.82	-9.04	-7.55	-7.78	-8.80	-5.90
285.00	-6.71	-10.39	-10.64	-10.41	-10.01	-8.02	-8.67	-10.40
300.00	-6.71	-11.77	-11.65	-13.38	-12.16	-10.34	-16.05	-15.72
315.00	-6.71	-11.11	-11.62	-15.23	-13.88	-16.27	-13.35	-10.87
330.00	-6.71	-10.53	-11.59	-12.92	-13.06	-15.02	-9.42	-6.78
345.00	-6.71	-10.03	-11.59	-9.79	-10.04	-11.22	-9.17	-6.24
360.00	-6.71	-9.57	-11.59	-7.12	-7.42	-9.95	-12.21	-7.96

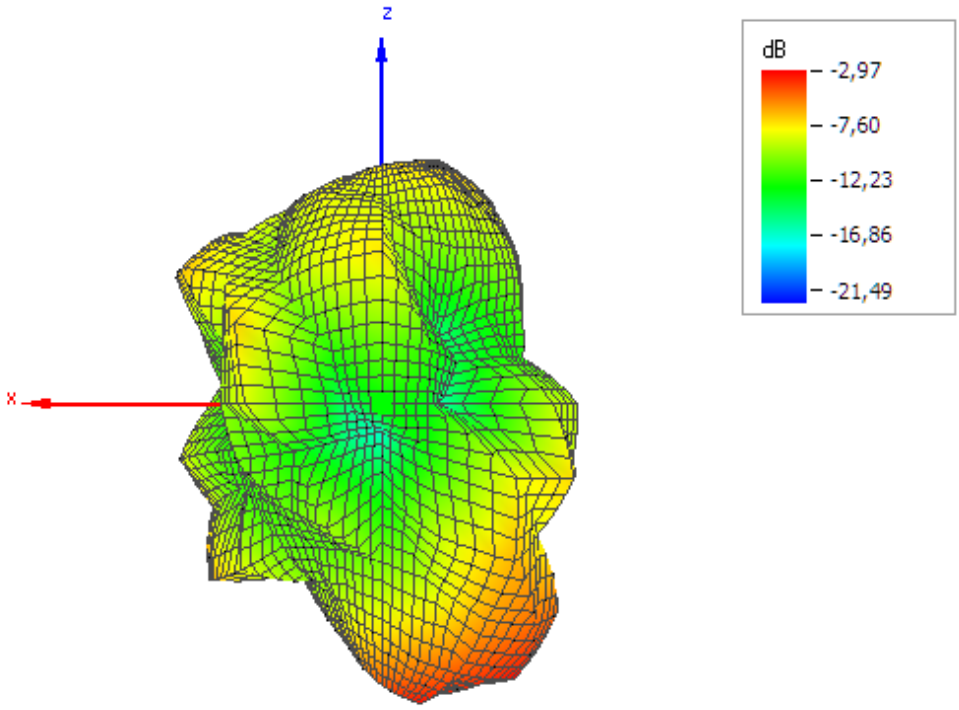
(continuation of the "RP_2440.000_tot" table from column 9 ...)

Azimuth (deg)	Elevation 120 deg (dB)	Elevation 135 deg (dB)	Elevation 150 deg (dB)	Elevation 165 deg (dB)	Elevation 180 deg (dB)
0.00	-9.52	-5.38	-10.49	-10.23	-6.14
15.00	-11.84	-6.46	-10.31	-8.95	-6.14
30.00	-11.22	-8.09	-10.13	-7.95	-6.14
45.00	-11.15	-10.39	-9.72	-7.15	-6.14
60.00	-10.51	-10.71	-9.35	-6.47	-6.14
75.00	-9.32	-10.63	-8.05	-5.37	-6.14
90.00	-12.75	-9.99	-7.05	-4.50	-6.14
105.00	-8.58	-8.82	-5.64	-3.77	-6.14
120.00	-6.26	-5.92	-4.57	-3.15	-6.14
135.00	-7.86	-4.90	-3.70	-3.38	-6.14
150.00	-14.55	-4.88	-2.97	-3.63	-6.14
165.00	-19.49	-5.85	-3.48	-3.89	-6.14
180.00	-13.68	-6.27	-4.06	-4.17	-6.14
195.00	-10.26	-6.35	-3.64	-4.33	-6.14
210.00	-7.72	-6.26	-3.26	-4.49	-6.14
225.00	-7.25	-6.74	-4.65	-4.66	-6.14
240.00	-8.55	-6.77	-6.72	-4.84	-6.14
255.00	-10.85	-6.24	-9.05	-4.73	-6.14
270.00	-8.20	-5.82	-14.48	-4.63	-6.14
285.00	-8.50	-6.17	-9.05	-4.53	-6.14
300.00	-12.24	-7.36	-6.71	-4.44	-6.14
315.00	-11.00	-11.08	-7.89	-5.32	-6.14
330.00	-8.01	-9.73	-9.53	-6.43	-6.14
345.00	-7.38	-7.36	-9.99	-7.93	-6.14
360.00	-9.52	-5.38	-10.49	-10.23	-6.14

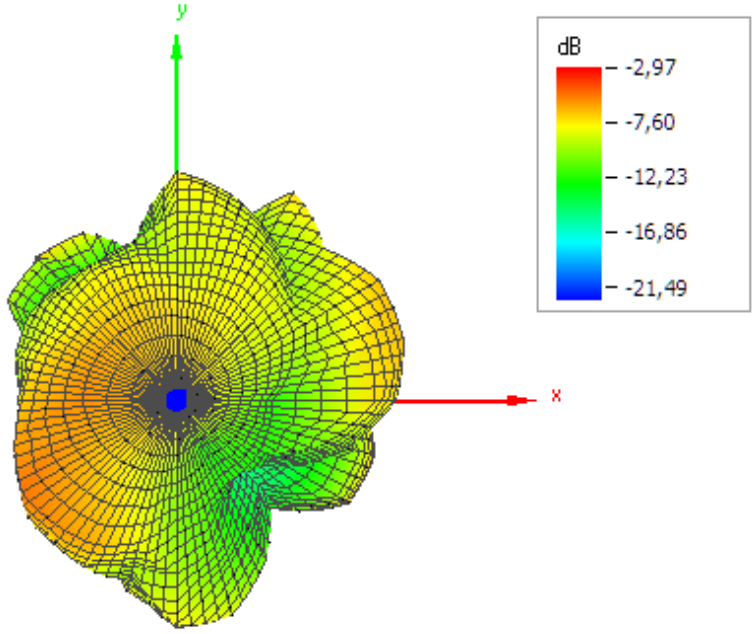
Theta = 90, Phi = 0



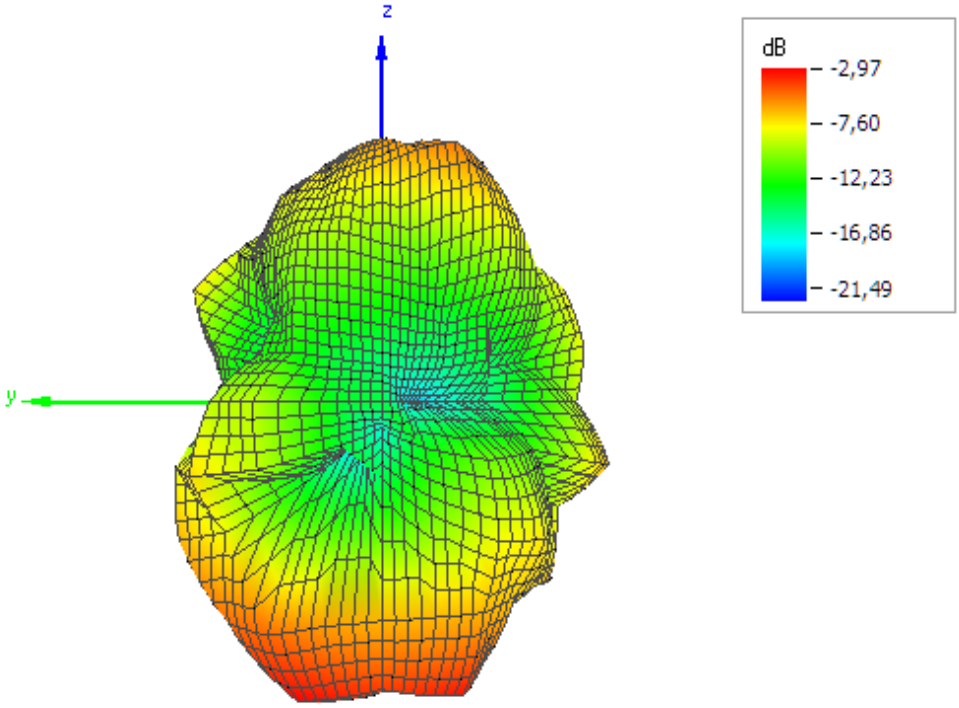
Theta = 90, Phi = 90



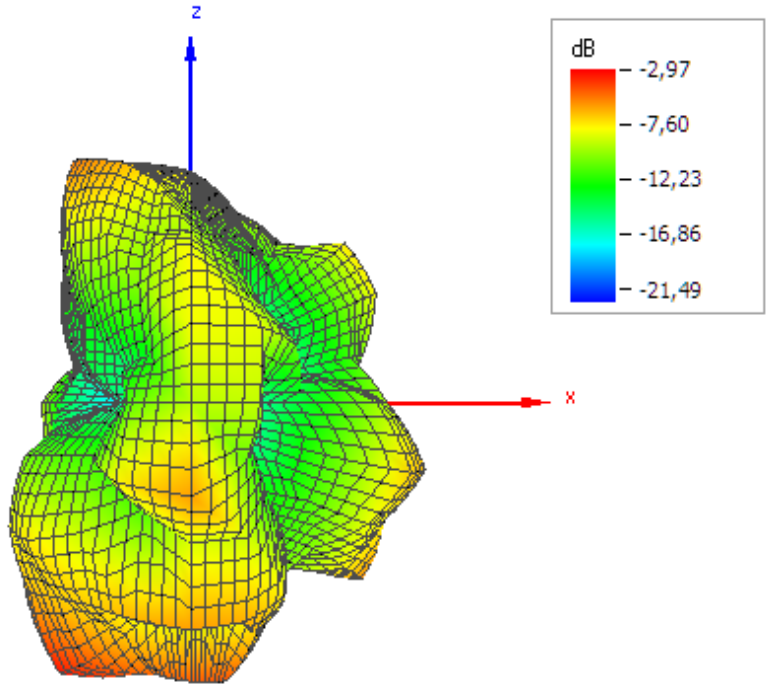
Theta = 0, Phi = 0



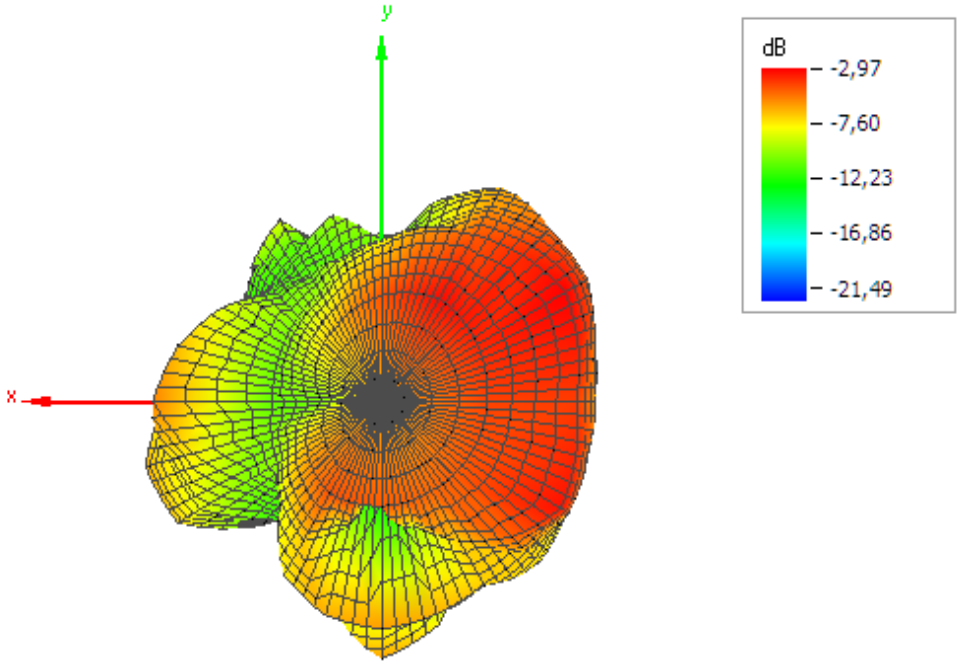
Theta = 90, Phi = 180



Theta = 90, Phi = 270



Theta = 180, Phi = 0



OTA Test Results for Frequency 2402.000 MHz

OTA Evaluation Results:

Total Radiated Power	-8,60 dBm
Directivity	6,51 dBi
Total Efficiency	-8,60 dB
Total Efficiency	13,79 %
Peak Relaized Gain	-2,10 dBi
NHPRP 45°	-10,84 dBm
NHPRP 45° / TRP	-2,23 dB
NHPRP 45° / TRP	59,81 %
NHPRP 30°	-12,82 dBm
NHPRP 30° / TRP	-4,22 dB
NHPRP 30° / TRP	37,85 %
NHPRP 22.5°	-14,17 dBm
NHPRP 22.5° / TRP	-5,57 dB
NHPRP 22.5° / TRP	27,73 %
UHRP	-12,77 dBm
UHRP / TRP	-4,17 dB
UHRP / TRP	38,30 %
LHRP	-10,70 dBm
LHRP / TRP	-2,10 dB
LHRP / TRP	61,70 %
PGRP (0-120°)	-10,84 dBm
PGRP / TRP	-2,24 dB
PGRP / TRP	59,69 %
Front/Back Ratio	10,49
PhiBW	113,9 deg
PhiBW Up	70,1 deg
PhiBW Down	43,8 deg
ThetaBW	106,5 deg
ThetaBW Up	53,2 deg
ThetaBW Down	53,2 deg
Boresight Phi	120 deg
Boresight Theta	165 deg
Maximum Power	-2,10 dBm
Minimum Power	-17,02 dBm
Average Power	-7,43 dBm
Max/Min Ratio	14,92 dB
Max/Avg Ratio	5,34 dB
Min/Avg Ratio	-9,59 dB
Worst Single Value	-30,36 dBm
Worst Position	Azi = 180 deg; Elev = 120 deg; Pol = Hor
Best Single Value	-2,39 dBm
Best Position	Azi = 120 deg; Elev = 165 deg; Pol = Hor

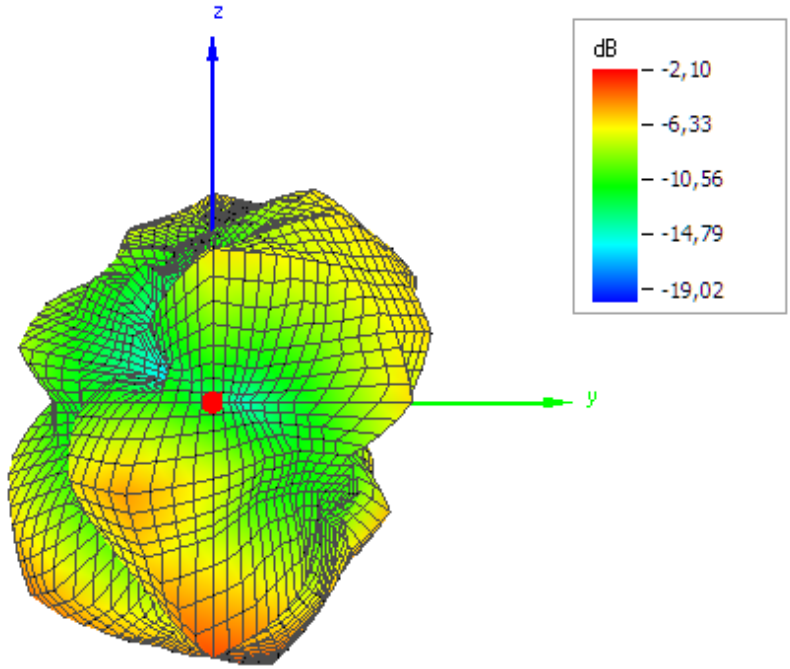
RP_2402.000_tot

Azimuth (deg)	Elevation 0 deg (dB)	Elevation 15 deg (dB)	Elevation 30 deg (dB)	Elevation 45 deg (dB)	Elevation 60 deg (dB)	Elevation 75 deg (dB)	Elevation 90 deg (dB)	Elevation 105 deg (dB)
0.00	-9.30	-10.02	-12.14	-9.13	-5.98	-9.25	-12.08	-6.73
15.00	-9.30	-9.35	-10.04	-7.90	-6.27	-10.17	-14.18	-9.48
30.00	-9.30	-8.77	-8.63	-6.77	-6.56	-8.60	-11.35	-10.49
45.00	-9.30	-8.25	-7.00	-5.94	-6.56	-6.35	-5.84	-9.25
60.00	-9.30	-7.80	-5.82	-6.01	-5.94	-5.72	-7.55	-11.20
75.00	-9.30	-7.49	-7.10	-7.53	-5.45	-7.77	-13.81	-13.62
90.00	-9.30	-7.20	-8.92	-9.90	-7.88	-7.39	-9.43	-14.40
105.00	-9.30	-6.94	-8.68	-11.80	-12.68	-10.26	-13.18	-10.41
120.00	-9.30	-6.68	-8.45	-11.50	-15.57	-13.18	-11.77	-5.89
135.00	-9.30	-6.28	-8.47	-11.70	-15.08	-12.27	-8.52	-5.51
150.00	-9.30	-5.91	-8.50	-12.44	-13.84	-13.08	-7.62	-7.36
165.00	-9.30	-5.57	-7.70	-12.10	-12.20	-14.19	-10.09	-10.80
180.00	-9.30	-5.25	-7.03	-11.24	-9.66	-13.92	-10.87	-12.42
195.00	-9.30	-6.00	-5.82	-10.17	-10.70	-15.52	-14.13	-9.83
210.00	-9.30	-6.90	-4.87	-8.97	-13.86	-16.33	-16.42	-8.02
225.00	-9.30	-8.04	-5.64	-7.66	-12.89	-12.58	-13.49	-8.39
240.00	-9.30	-9.59	-6.58	-8.17	-11.52	-12.11	-13.33	-11.08
255.00	-9.30	-10.17	-8.45	-11.61	-11.64	-13.20	-13.82	-8.88
270.00	-9.30	-10.83	-11.79	-9.24	-7.68	-8.63	-9.68	-6.63
285.00	-9.30	-11.62	-11.08	-9.37	-9.97	-7.52	-10.19	-9.98
300.00	-9.30	-12.58	-10.47	-10.96	-11.54	-10.82	-11.10	-12.35
315.00	-9.30	-11.79	-11.45	-14.40	-12.55	-12.95	-10.20	-11.46
330.00	-9.30	-11.12	-12.73	-13.83	-11.94	-16.39	-9.63	-5.95
345.00	-9.30	-10.53	-12.43	-11.46	-9.19	-11.57	-9.79	-4.73
360.00	-9.30	-10.02	-12.14	-9.13	-5.98	-9.25	-12.08	-6.73

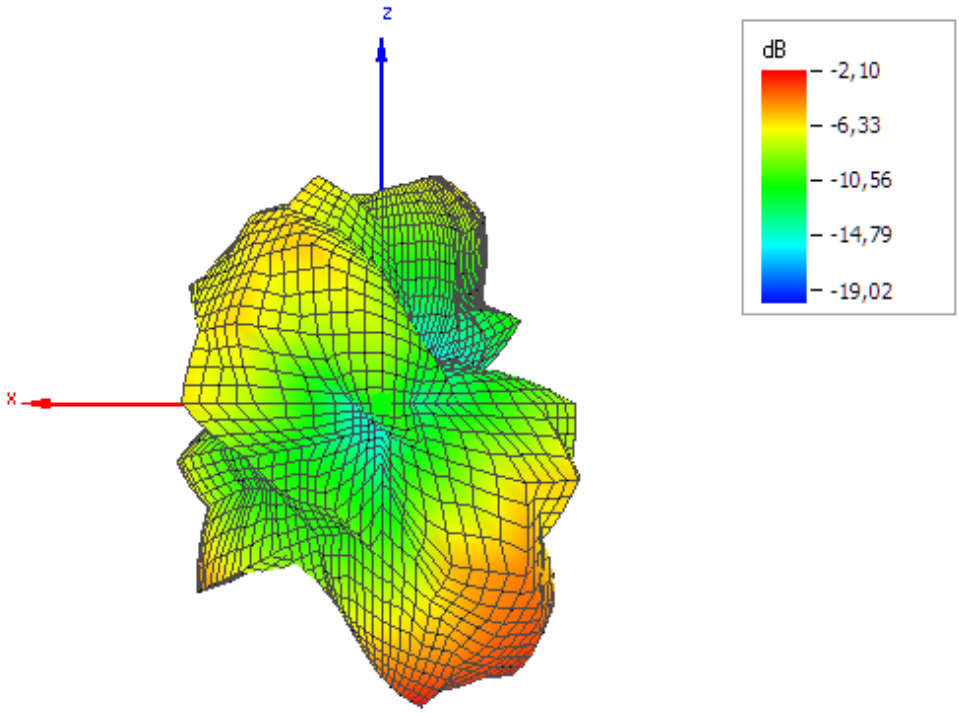
(continuation of the "RP_2402.000_tot" table from column 9 ...)

Azimuth (deg)	Elevation 120 deg (dB)	Elevation 135 deg (dB)	Elevation 150 deg (dB)	Elevation 165 deg (dB)	Elevation 180 deg (dB)
0.00	-7.28	-3.28	-10.93	-9.82	-4.10
15.00	-9.89	-4.80	-12.06	-8.95	-4.10
30.00	-10.44	-6.61	-13.60	-8.22	-4.10
45.00	-10.41	-8.72	-9.99	-7.60	-4.10
60.00	-9.83	-9.91	-8.04	-7.06	-4.10
75.00	-9.28	-10.23	-6.65	-5.20	-4.10
90.00	-13.52	-8.77	-5.59	-3.90	-4.10
105.00	-5.27	-6.22	-4.66	-2.91	-4.10
120.00	-4.13	-3.91	-3.90	-2.10	-4.10
135.00	-6.22	-3.47	-3.03	-2.65	-4.10
150.00	-12.74	-4.22	-2.31	-3.29	-4.10
165.00	-17.02	-4.99	-2.74	-4.03	-4.10
180.00	-13.50	-4.67	-3.23	-4.93	-4.10
195.00	-12.32	-4.23	-3.50	-5.18	-4.10
210.00	-8.67	-4.48	-3.79	-5.44	-4.10
225.00	-7.22	-7.45	-5.34	-5.72	-4.10
240.00	-8.02	-10.28	-7.75	-6.01	-4.10
255.00	-10.00	-8.45	-9.23	-5.72	-4.10
270.00	-5.38	-4.39	-11.49	-5.44	-4.10
285.00	-5.75	-4.00	-7.01	-5.17	-4.10
300.00	-8.73	-5.29	-4.86	-4.93	-4.10
315.00	-9.44	-11.11	-6.50	-5.73	-4.10
330.00	-7.02	-9.16	-9.18	-6.72	-4.10
345.00	-5.75	-5.78	-9.97	-8.00	-4.10
360.00	-7.28	-3.28	-10.93	-9.82	-4.10

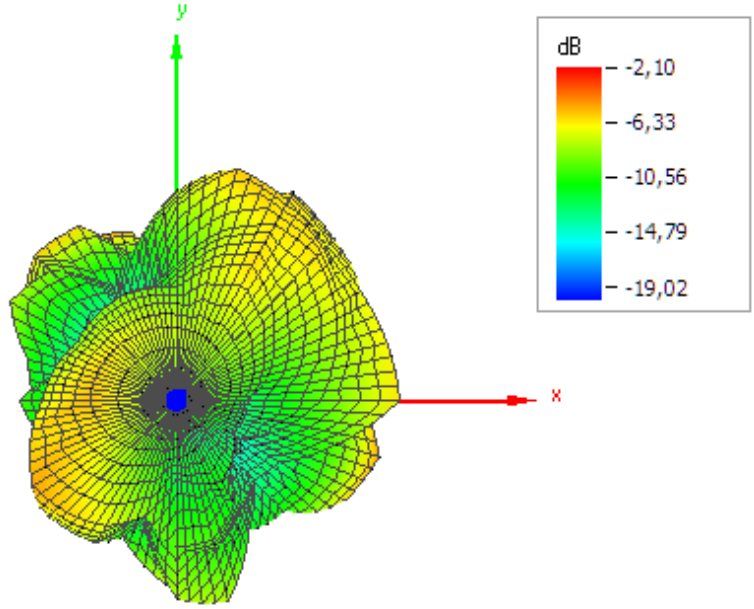
Theta = 90, Phi = 0



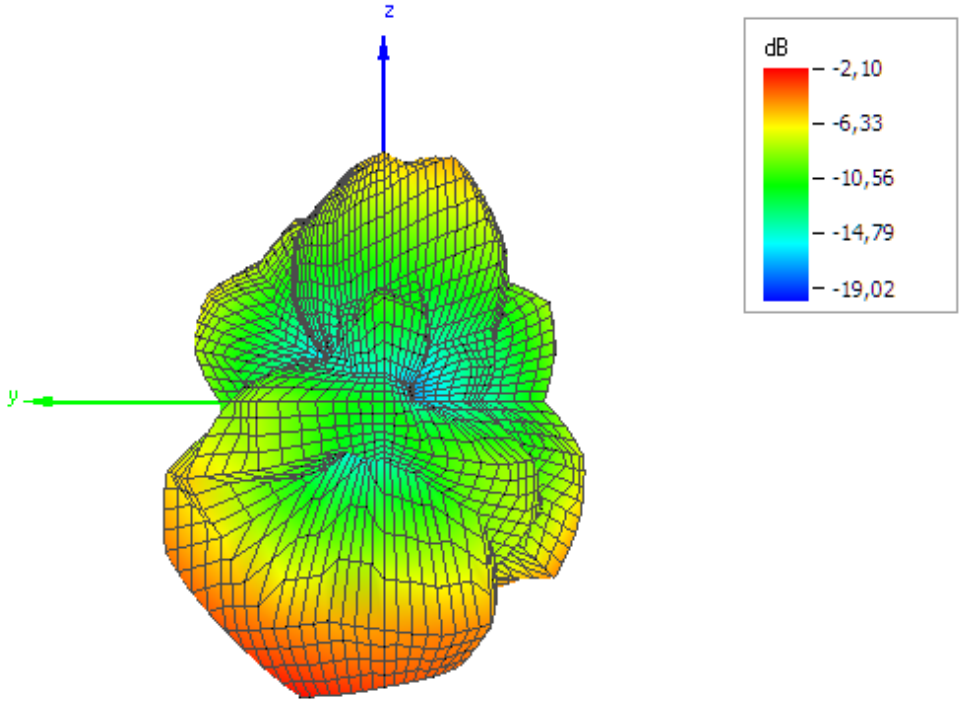
Theta = 90, Phi = 90



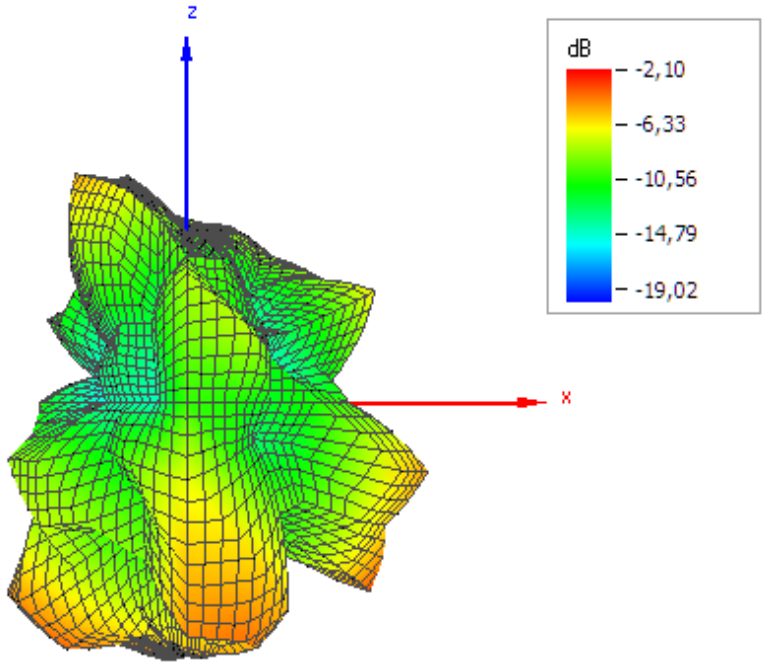
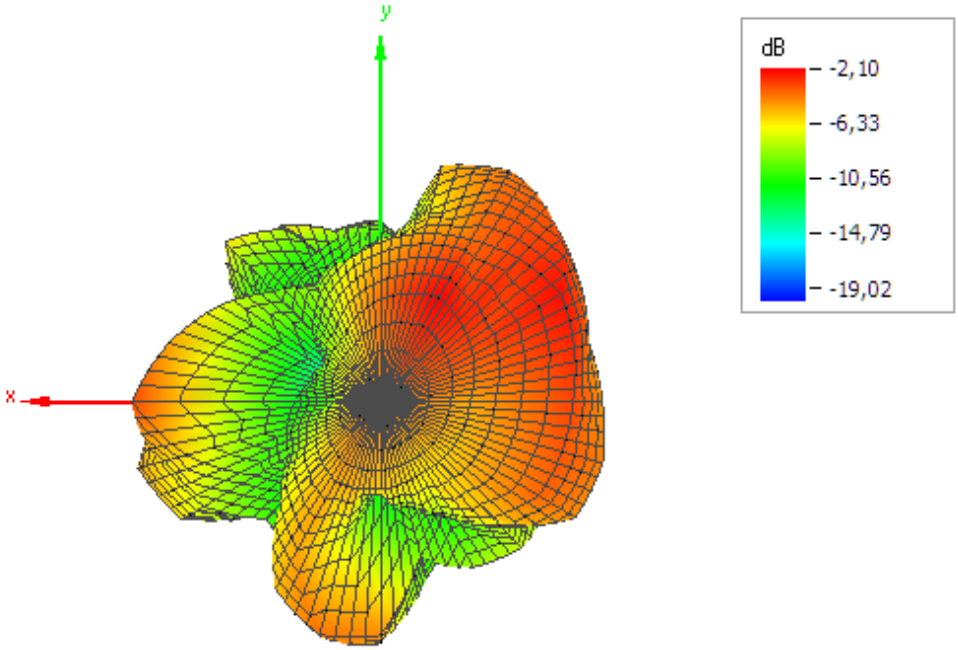
Theta = 0, Phi = 0



Theta = 90, Phi = 180



Theta = 90, Phi = 270



Theta = 180, Phi = 0