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LEGO EMC Test Report

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Rev	
A	Initial version

Contents

1 Test Setup

1.1 Information

Hardware	R&S® TS8991 OTA (Over The Air) performance test system. Additional RSE (Radiated Spurious Emission) test capability with additional filter/LNA support for spurious emissions measurements.
Software	R&S® EMC32 measurement software for Automation for EMC compliance and pre-compliance.
Table of Calibrated Instruments	SA12 R&S® FSW Spectrum Analyser Calibration due: 28th August 2025
Test Site Information	TI Norway, Validation Lab, Hoffsveien 70C, 0377 Oslo
Completed Test Date(s)	
Test Personnel	Richard Wallace

1.2 Test Setup Photos

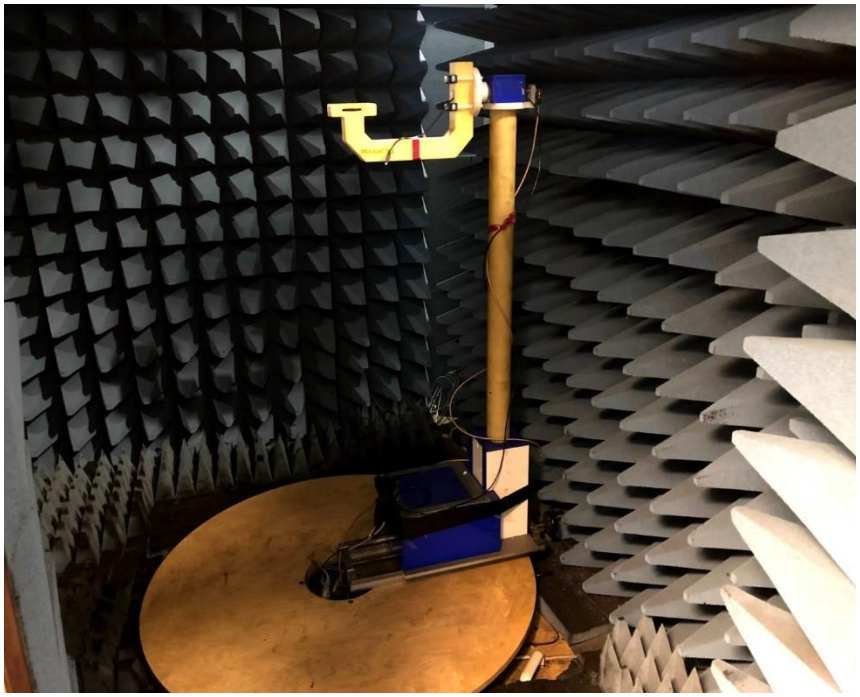


Figure 1: Turn arm in chamber

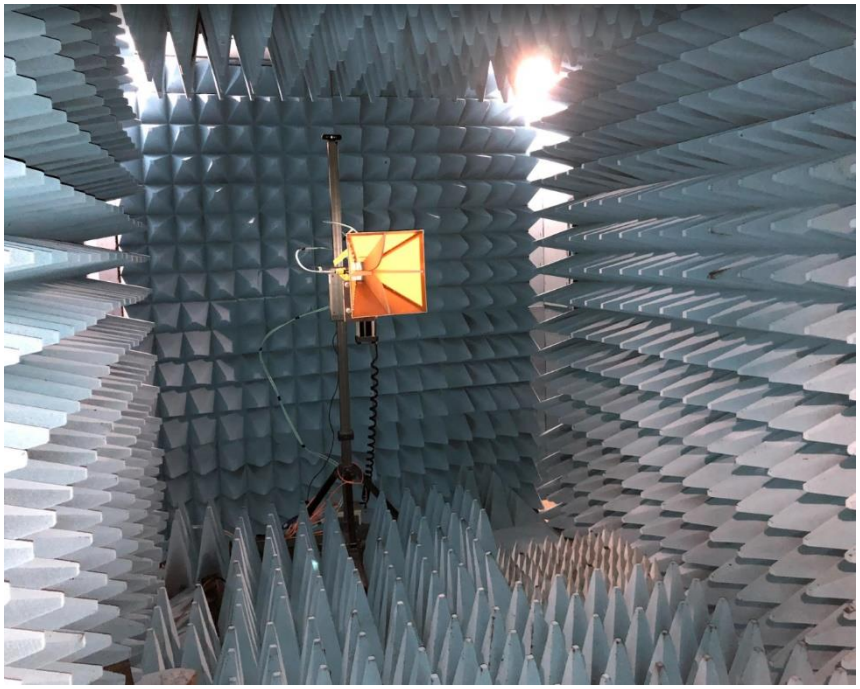


Figure 2: Receiving antenna in chamber

Figure 3: DUT 1 in chamber

Figure 4: DUT 1 showing product number

Figure 5: DUT 2 in chamber

Figure 6: DUT 3 in chamber

Figure 7: DUT 3 showing product number

Figure 8: DUT 4 in chamber

Figure 9: DUT 4 showing product number

2 HANDSET NO 3, +0 dBm, 2402 MHz

2.1 Setup

2402 MHz CW

2.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-9.33	dBm
Peak EIRP	-5.62	dBm
Antenna directivity	3.71	dBm
Antenna efficiency	-9.33	dB
Antenna gain	**-5.62**	**dBi**

2.3 Measured Data

2.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-6.097064907	-6.799816066	-9.504295284	-14.38537973	-24.26332849	-15.46749109	-9.834793026
30	-6.74810403	-6.596553737	-9.322238857	-12.39946359	-21.76933282	-15.58739465	-10.48313897
60	-10.33747857	-8.361072475	-9.954612667	-12.2354812	-15.18227761	-16.62796014	-13.84969323
90	-22.00101464	-12.5416488	-10.96966546	-10.22324746	-9.90882867	-15.46196359	-21.24860376
120	-14.76850122	-22.95558923	-13.23256677	-9.654506618	-8.323436672	-11.81933587	-17.32973474
150	-8.26637643	-19.92378228	-16.44666665	-10.48856347	-8.632377559	-11.02850717	-12.06884378
180	-6.273586208	-15.69420236	-18.28634256	-10.94049447	-8.343139583	-10.53270715	-10.28205484
210	-6.7029342	-16.23390954	-17.57774728	-11.48128122	-9.953128749	-10.37682718	-10.68904489
240	-9.832710201	-23.29097741	-15.83841317	-12.27478021	-12.22344201	-13.40452569	-13.58063501
270	-20.17812722	-19.4830932	-13.6337127	-13.55442041	-15.42143243	-19.64487451	-20.37670129
300	-15.92015451	-11.92505258	-11.64726632	-14.76266473	-19.85112375	-32.12567132	-17.15190118
330	-9.001731807	-8.386184627	-10.98865884	-14.82141107	-24.13428491	-17.49011987	-12.53203958

2.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-20.4552067	-19.54057581	-19.27288706	-20.56140787	-24.70102579	-28.40602762	-21.52474863
30	-16.40368158	-13.50734598	-17.26807672	-17.66415293	-21.6651066	-18.99262506	-17.02252848
60	-8.967940158	-9.165274447	-11.96180231	-13.46349604	-14.35312921	-11.58518106	-12.28315622
90	-6.425963229	-7.749453372	-9.851374453	-10.62991983	-10.28972513	-8.990874118	-10.67461283
120	-6.384634799	-8.54105646	-9.987669772	-11.03226358	-10.54844934	-9.911867922	-11.09984476
150	-9.034834689	-12.49846918	-13.21924478	-14.9371937	-13.98051721	-13.67128641	-13.71080667
180	-16.99223978	-25.19163401	-24.62262613	-27.18778879	-22.43938333	-22.33956797	-18.17460901
210	-17.82310373	-16.13485605	-17.10436136	-17.24274713	-18.38121302	-15.82318766	-16.27440531
240	-9.212946719	-10.33906824	-11.18585474	-12.50825388	-13.37995035	-12.80112726	-12.09570581
270	-6.579340762	-8.593130892	-9.269293612	-11.09419901	-12.02698023	-12.3555134	-10.26650507
300	-6.447729891	-9.080153292	-9.609625643	-12.07926065	-12.87522394	-12.89445002	-10.50951654
330	-8.790854281	-11.16255838	-11.91910059	-14.85666544	-15.70942957	-13.91717798	-13.31764109

2.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-5.940703841	-6.574701301	-9.06881434	-13.44692342	-21.46636543	-15.25215376	-9.550036851
30	-6.301712624	-5.791490012	-8.675868758	-11.26828881	-18.7066071	-13.95417637	-9.612957106
60	-6.588646496	-5.734285342	-7.832966636	-9.795928173	-11.73764597	-10.40210999	-9.985871505
90	-6.307295596	-6.505302229	-7.364324569	-7.411525341	-7.084802483	-8.108210973	-10.30984286
120	-5.796269142	-8.386677112	-8.303556707	-7.278677726	-6.284682637	-7.751410457	-10.17180354
150	-5.623330965	-11.77629181	-11.52950685	-9.156256554	-7.520197163	-9.141600179	-9.802384748
180	-5.920293576	-15.23210707	-17.37857007	-10.83864647	-8.177242527	-10.25527748	-9.628277266
210	-6.379708529	-13.17380045	-14.3243076	-10.45910256	-9.370340653	-9.286644069	-9.62933734
240	-6.50148239	-10.12437686	-9.906498548	-9.379648353	-9.75301276	-10.08205559	-9.764711789
270	-6.393734635	-8.252981566	-7.91458028	-9.142080088	-10.39038074	-11.6122305	-9.862481311
300	-5.983103946	-7.263404293	-7.499722742	-10.20662639	-12.08110839	-12.8429173	-9.657854876
330	-5.884713283	-6.545888363	-8.418709789	-11.82870252	-15.12623586	-12.33583379	-9.896800968

2.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.254641753	0.220054305	0.123913483	0.045217616	0.007134499	0.029839025	0.11091654
30	0.234330456	0.263542705	0.135647915	0.074674293	0.013469122	0.040232995	0.109321175
60	0.219348844	0.267037016	0.164703693	0.104811077	0.067024781	0.091156785	0.10032585
90	0.234029411	0.223598959	0.183471049	0.181487812	0.195667976	0.154589112	0.093114157
120	0.263252853	0.144988077	0.147789755	0.187125178	0.23525114	0.167825888	0.096121302
150	0.273947224	0.066431004	0.070315216	0.121443519	0.17700286	0.121854054	0.104655372
180	0.255841294	0.029977078	0.018287022	0.082439501	0.152151328	0.094291436	0.108936213
210	0.230159628	0.048152624	0.036946154	0.089968348	0.115602156	0.11785163	0.108909626
240	0.223795712	0.097176737	0.102176294	0.115354666	0.105851916	0.098128337	0.105567156
270	0.229417497	0.14952088	0.161637443	0.121840589	0.091403311	0.068988539	0.103217151
300	0.252167786	0.187784426	0.177839294	0.095353659	0.0619283	0.051964681	0.108196824
330	0.257945925	0.221519093	0.143922608	0.065634132	0.030716831	0.058400508	0.102404703

2.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

3 HANDSET NO 3, +0 dBm, 2442 MHz

3.1 Setup

2442 MHz CW

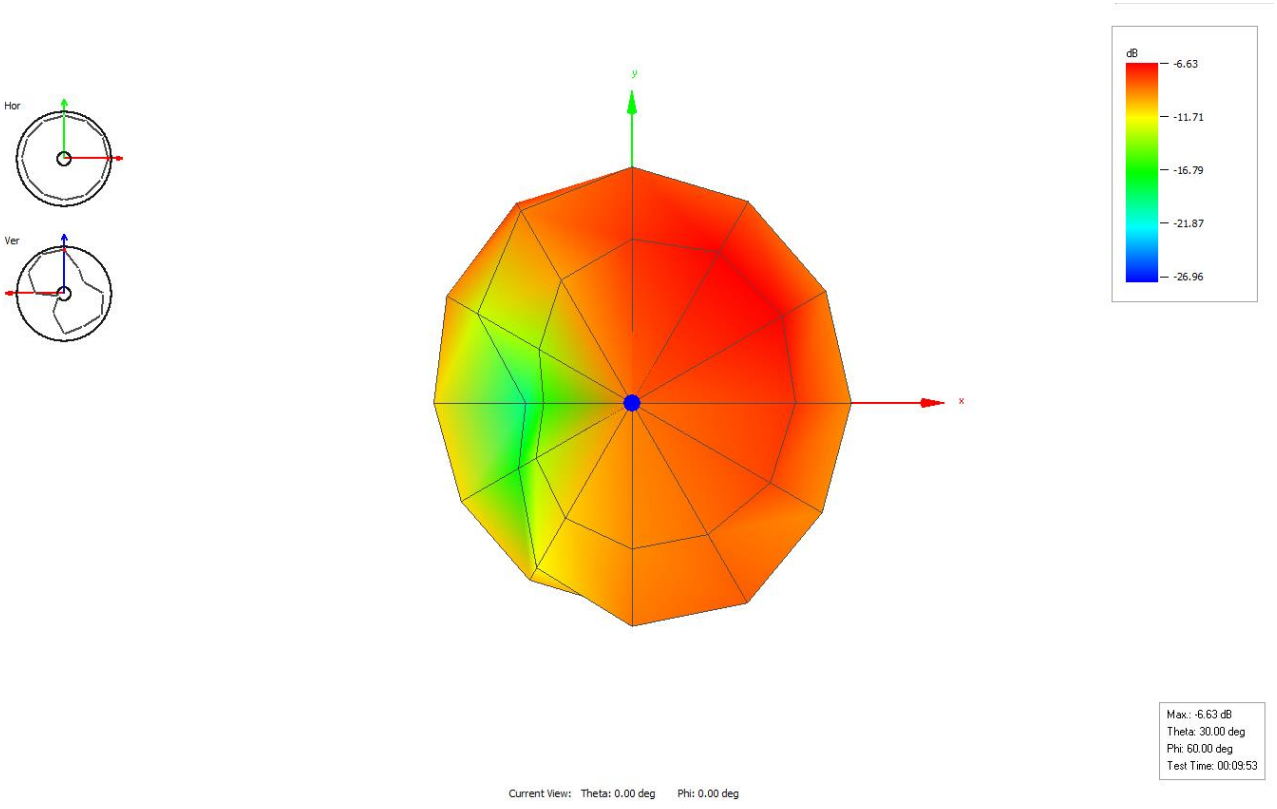
3.2 Summary

The calculations for this section are detailed in **Section 14**.

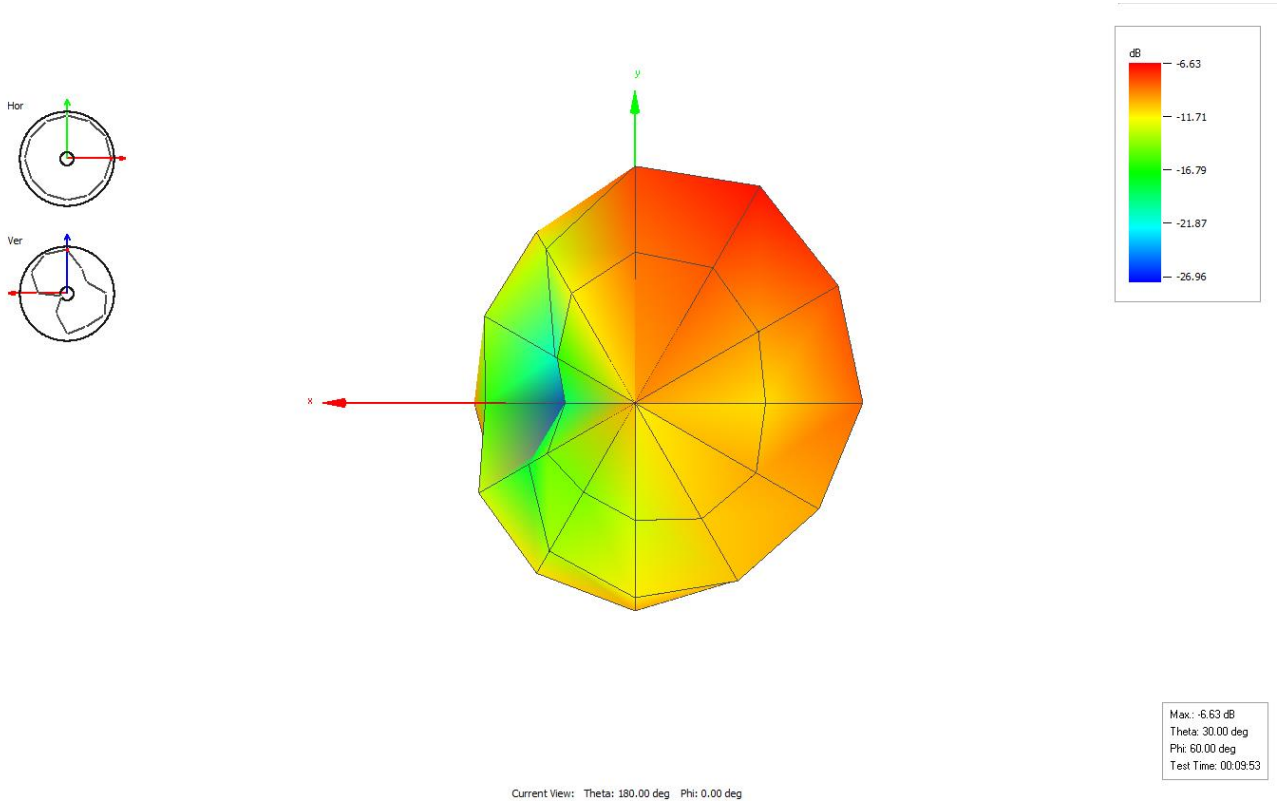
Total Radiated Power	-9.98	dBm
Peak EIRP	-6.63	dBm
Antenna directivity	3.36	dBm
Antenna efficiency	-9.98	dB
Antenna gain	**-6.63**	**dBi**

3.3 Radiation Pattern

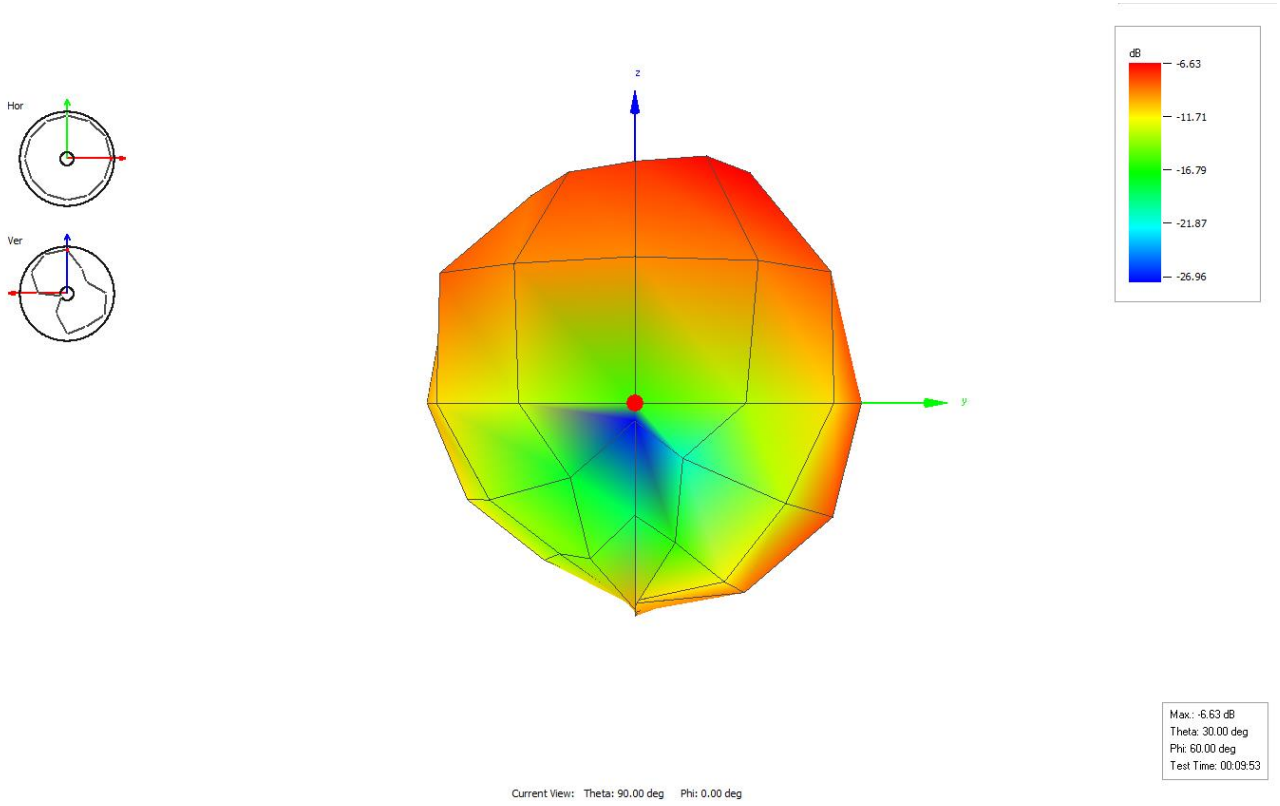
3.3.1 Theta = 0, Phi = 0



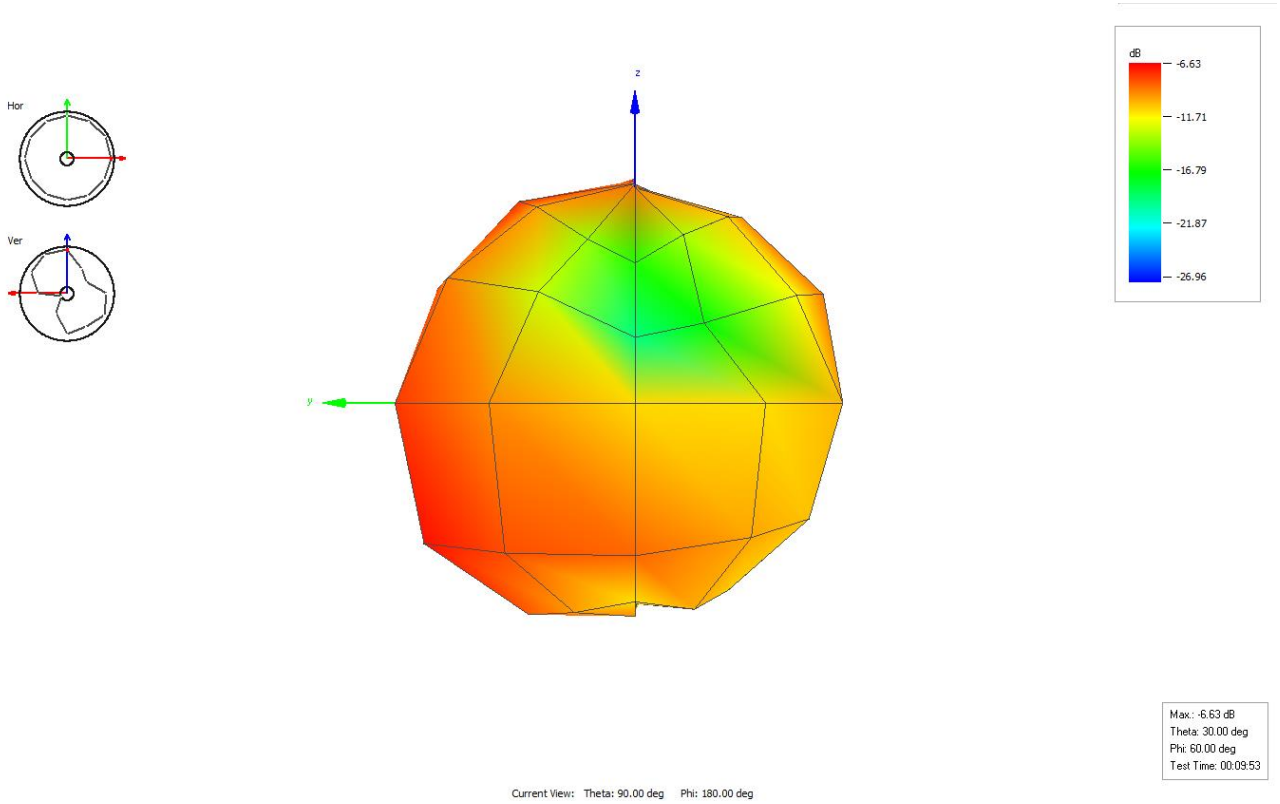
3.3.2 Theta = 180, Phi = 0



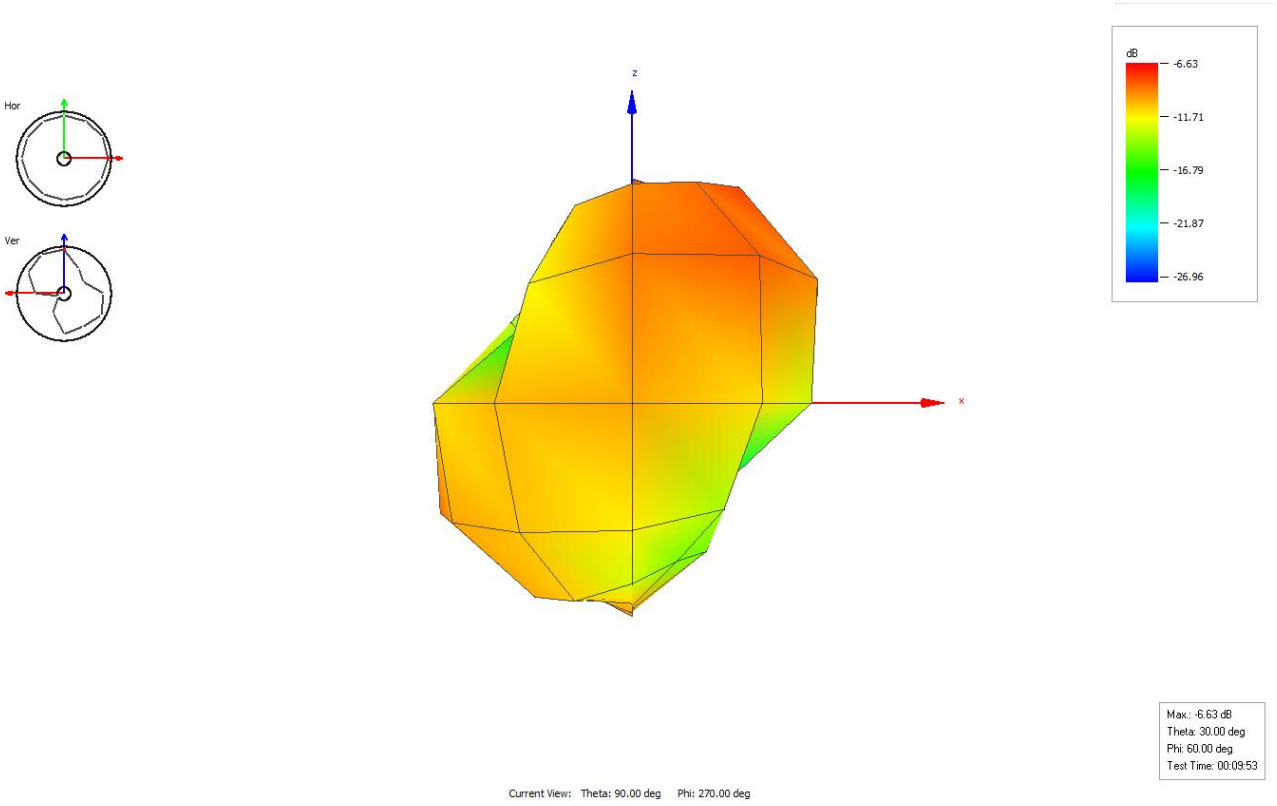
3.3.3 Theta = 90, Phi = 0



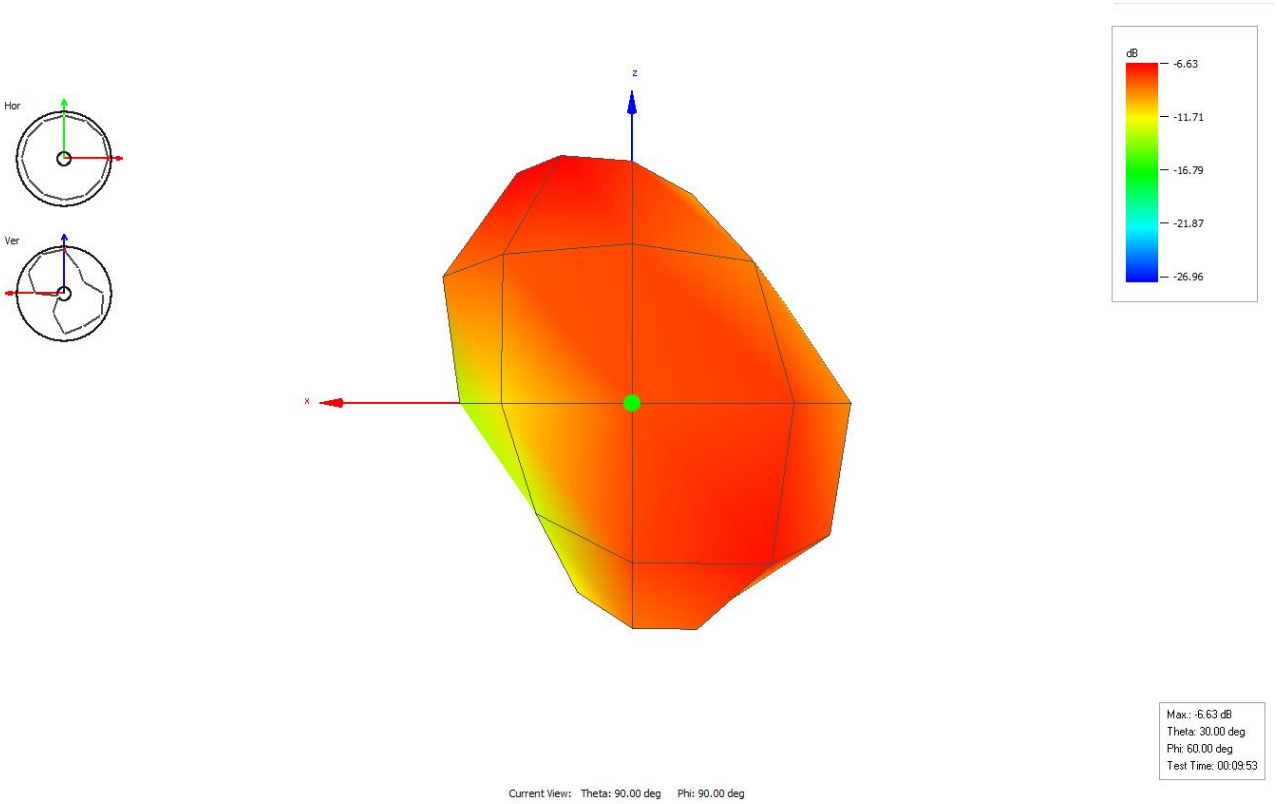
3.3.4 Theta = 90, Phi = 180



3.3.5 Theta = 90, Phi = 270



3.3.6 Theta = 90, Phi = 90



3.4 Measured Data

3.4.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-8.496672562	-7.608923843	-9.288702896	-15.32168095	-36.91503423	-17.90328496	-9.871390274
30	-8.743033341	-7.428950241	-9.340788773	-13.92536824	-28.51647466	-17.39363377	-10.90952199
60	-11.62847798	-9.164820603	-10.05907338	-13.09736531	-17.18226903	-18.36485951	-14.88793462
90	-20.00012486	-13.24800771	-11.1446256	-10.57761281	-11.2424268	-15.19727223	-22.08686345
120	-19.59331029	-24.10335057	-13.40279286	-9.684710434	-9.053427628	-11.64148229	-15.60980504
150	-11.71523564	-20.43196004	-16.72758	-10.15465825	-9.080466202	-10.96883672	-11.39594167
180	-9.167715958	-15.32355016	-19.32981007	-10.6399297	-8.610587051	-10.83590978	-10.04129308
210	-9.306155136	-15.63114064	-19.40595143	-11.56389134	-10.03546803	-10.64733022	-10.88573735
240	-12.00646108	-21.09683888	-17.21328252	-12.63423055	-12.3336591	-13.37106221	-14.41849416
270	-20.50717061	-25.43735783	-14.00974934	-13.36262029	-16.06685918	-19.67609685	-22.47252171
300	-19.27557271	-13.94353383	-11.73176854	-14.03032582	-21.62373631	-31.35170262	-16.64025777
330	-11.87814992	-9.736777237	-10.90717213	-14.61235707	-29.96915715	-18.6449384	-12.24318211

3.4.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-23.62411215	-24.32787039	-22.92997458	-24.18372824	-25.24242117	-28.04076865	-21.0318804
30	-17.53908255	-14.55365088	-18.06433585	-18.63533118	-19.79167273	-18.87227728	-17.52901556
60	-11.17615225	-10.16455176	-12.66717245	-14.20608618	-13.9088793	-11.9326525	-12.54995444
90	-8.950356506	-8.852582	-10.71278479	-11.52371313	-10.54096701	-9.785824798	-10.62012579
120	-9.044163726	-9.692887328	-10.84782507	-11.90517905	-11.01705267	-10.79731085	-10.75398352
150	-11.69998648	-13.96579459	-14.05367758	-15.99374106	-14.64754584	-14.77670767	-13.16314413
180	-19.37658026	-31.89882376	-23.95509817	-26.62799551	-24.27052023	-23.86143973	-18.61554816
210	-20.61882498	-15.80775549	-18.58495428	-17.68989661	-20.03632834	-16.82515433	-19.35579398
240	-12.04748633	-10.78517249	-12.52896216	-13.3173609	-14.12180807	-13.3024378	-13.55125525
270	-9.254780792	-9.232621215	-10.39243796	-12.07730963	-12.52869894	-12.8025141	-11.13378622
300	-9.082802795	-10.07003882	-10.88553336	-13.32276633	-13.34119131	-13.61775687	-11.11373236
330	-11.51576712	-12.40794089	-13.77974799	-15.65173056	-16.84871771	-15.43265631	-13.48247626

3.4.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-8.365314749	-7.517447705	-9.104865919	-14.79106685	-24.95656231	-17.50167832	-9.551044102
30	-8.204777589	-6.659348465	-8.794019197	-12.6605873	-19.24505158	-15.06002793	-10.05377523
60	-8.386128999	-6.625682675	-8.159913603	-10.60614045	-12.23390455	-11.04281199	-10.55317998
90	-8.62204326	-7.506155833	-7.913039933	-8.014650581	-7.8672501	-8.687866853	-10.32085717
120	-8.677387006	-9.538365797	-8.929770655	-7.64425342	-6.914893313	-8.188617812	-9.525594367
150	-8.697304411	-13.0822254	-12.17771285	-9.148642688	-8.016794011	-9.457852858	-9.179969028
180	-8.772367097	-15.22903044	-18.04347936	-10.53189463	-8.494185725	-10.62474081	-9.476592935
210	-8.996455753	-12.70825037	-15.9657814	-10.61566862	-9.621619384	-9.709222871	-10.30819783
240	-9.016625302	-10.3986726	-11.25768822	-9.952077832	-10.12604567	-10.32631451	-10.95296334
270	-8.940905555	-9.129782049	-8.824586926	-9.662288468	-10.93671014	-11.99113187	-10.82587587
300	-8.686051159	-8.578235427	-8.277772098	-10.65185244	-12.73985669	-13.54518702	-10.04121822
330	-8.682879928	-7.859851655	-9.099864531	-12.09072433	-16.6420066	-13.7380328	-9.808473087

3.4.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.14570301	0.177114954	0.122889113	0.033181294	0.003194065	0.017775923	0.110890819
30	0.151189712	0.215806814	0.13200734	0.05419276	0.011898572	0.031188695	0.098769414
60	0.145006376	0.217486214	0.152759645	0.086973301	0.059787383	0.078653636	0.088040399
90	0.137339567	0.17757606	0.161694783	0.157955569	0.16340863	0.135273683	0.092878306
120	0.135600503	0.111215014	0.127944887	0.172018303	0.203474818	0.151753326	0.111542549
150	0.134980042	0.049178747	0.060565975	0.121656616	0.15787763	0.113296036	0.120782245
180	0.132667117	0.029998322	0.015691052	0.088472956	0.14144299	0.086601601	0.11280821
210	0.125995323	0.053601256	0.025317561	0.086782696	0.109103344	0.106924619	0.093149433
240	0.125411531	0.091228963	0.074856786	0.101109559	0.097139404	0.092761668	0.080297804
270	0.127617268	0.122186098	0.131081471	0.108086425	0.080598876	0.063224705	0.082682274
300	0.13533025	0.138731939	0.148669811	0.086062658	0.053212582	0.044206008	0.099055405
330	0.135429105	0.163687243	0.123030715	0.061791333	0.021667028	0.042286011	0.104508759

3.4.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

4 HANDSET NO 3, +0 dBm, 2480 MHz

4.1 Setup

2480 MHz CW

4.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-13.33	dBm
Peak EIRP	-10.64	dBm
Antenna directivity	2.69	dBm
Antenna efficiency	-13.33	dB
Antenna gain	**-10.64**	**dBi**

4.3 Measured Data

4.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-12.70285288	-11.45465724	-12.74457423	-19.66934458	-28.27865473	-22.98594538	-12.60922495
30	-13.28384272	-11.57071177	-13.10576121	-19.3202273	-29.96877925	-20.58238093	-13.5183169
60	-16.2864329	-13.54929225	-14.15268961	-18.63289897	-24.56891505	-20.43775431	-16.7441775
90	-23.80687586	-17.84091822	-15.13091532	-15.00458399	-16.41853205	-19.55134074	-22.52560298
120	-22.3113238	-30.12188593	-17.04059855	-13.33025233	-13.399882	-16.63564173	-19.08936946
150	-16.18544261	-23.16396205	-19.63820902	-13.21831004	-13.13069026	-16.34050623	-15.11400858
180	-14.04020564	-18.88008372	-21.09995143	-13.15124384	-12.41902033	-16.31077067	-13.61077372
210	-14.36485545	-19.28064982	-20.47852961	-13.58544032	-13.48351161	-15.62176005	-14.41300837
240	-17.33279292	-24.88154475	-18.84895579	-14.46310679	-15.63613383	-18.08893076	-17.68437831
270	-25.63333003	-25.09419123	-16.50622431	-15.58582942	-19.42623393	-23.89004389	-23.22131983
300	-21.37869135	-17.00820414	-14.57026927	-17.21208064	-25.92929713	-33.87333552	-18.5435969
330	-15.5013682	-13.0091273	-13.88751475	-18.48989359	-35.96250025	-22.58529536	-15.01203791

4.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-26.02951341	-25.9030562	-23.53500658	-26.59035021	-34.30898577	-25.84498888	-22.71345049
30	-22.37036424	-19.64274507	-23.15232378	-21.523799	-23.7845183	-20.90280443	-18.76370531
60	-16.01567751	-13.82717424	-17.59645754	-17.42497164	-17.72152239	-15.08965975	-15.03357225
90	-13.36460787	-11.75773531	-14.90988451	-14.45009142	-14.18131548	-13.06513887	-13.63489061
120	-13.33446031	-12.16437059	-14.49773317	-14.86934954	-14.64533907	-14.21932512	-14.36553865
150	-15.5158301	-15.73730379	-17.37909609	-18.59883791	-18.31634813	-18.39935594	-17.22895342
180	-21.42529589	-26.89666277	-26.5972777	-25.86176592	-25.29994493	-24.82778459	-23.35853868
210	-25.96003252	-19.33314424	-21.62928301	-18.98454958	-20.74339586	-18.70287615	-20.98177629
240	-17.64259249	-14.0184775	-15.55380922	-15.11782747	-16.31962114	-16.26168733	-16.27668291
270	-14.56180101	-12.22642809	-13.40706545	-14.02061373	-15.07973772	-16.20632082	-14.13712984
300	-14.24203783	-12.47634035	-13.44884783	-15.31963259	-16.3781386	-17.21152407	-14.45600038
330	-16.19213014	-14.40499788	-15.7609778	-17.40986544	-20.42363649	-18.39325624	-16.99760347

4.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-12.50551343	-11.30145615	-12.39684699	-18.86600733	-27.31149908	-21.1740264	-12.20467047
30	-12.77846262	-10.94157582	-12.69604675	-17.27342805	-22.84766069	-17.72933828	-12.38270874
60	-13.1386456	-10.67571114	-12.5315138	-14.97677407	-16.90566584	-13.97746916	-12.79489184
90	-12.98907697	-10.80107984	-12.00869396	-11.70819428	-12.14712959	-12.18525123	-13.10756365
120	-12.81689774	-12.09541328	-12.57535403	-11.02167468	-10.96781666	-12.25125926	-13.1042573
150	-12.82744372	-15.01533246	-15.3530863	-12.11342592	-11.98126567	-14.23875251	-13.0336904
180	-13.31184202	-18.24342777	-20.021031	-12.92459659	-12.20087843	-15.73905069	-13.17330138
210	-14.07402237	-16.29651776	-18.00560283	-12.48472313	-12.73557864	-13.88432477	-13.54814598
240	-14.47463092	-13.67629626	-13.88578502	-11.76784104	-12.95414558	-14.06961073	-13.91344338
270	-14.23506849	-12.00764049	-11.67557094	-11.72278618	-13.72021433	-15.52274747	-13.63149355
300	-13.47437489	-11.16586782	-10.96316247	-13.15328219	-15.92143625	-17.11884936	-13.02535922
330	-12.82273013	-10.64092134	-11.71369803	-14.90609228	-20.30398948	-16.991675	-12.88202204

4.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.056162788	0.074106173	0.057585786	0.012983724	0.001857163	0.00763128	0.060191193
30	0.052741653	0.080508627	0.053752086	0.018735151	0.005190796	0.0168681	0.05777356
60	0.048543987	0.085591155	0.055827557	0.031792347	0.02039076	0.040017788	0.05254251
90	0.050244937	0.083155699	0.062969552	0.067480854	0.06099399	0.060460938	0.048892656
120	0.052276948	0.061724655	0.055266835	0.079037379	0.080023646	0.059548945	0.048929893
150	0.052150158	0.031511331	0.029153545	0.061469178	0.063368501	0.037681202	0.049731431
180	0.046646149	0.014985016	0.009951691	0.050996497	0.060243772	0.026674417	0.048158157
210	0.039137922	0.023461092	0.015828498	0.056432292	0.053265025	0.040885331	0.0441759
240	0.035689208	0.042891415	0.040871587	0.066560396	0.050650699	0.039177699	0.04061212
270	0.03771318	0.062984828	0.067989666	0.067254505	0.042459861	0.028036594	0.043336182
300	0.044932699	0.07645629	0.080109451	0.048380659	0.025577399	0.019414002	0.049826924
330	0.05220679	0.086279549	0.067395391	0.032314004	0.009323974	0.019990907	0.051498881

4.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

5 Motor NO 20, +0 dBm, 2402 MHz

5.1 Setup

2402 MHz CW

5.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-5.90	dBm
Peak EIRP	-2.65	dBm
Antenna directivity	3.25	dBm
Antenna efficiency	-5.90	dB
Antenna gain	**-2.65**	**dBi**

5.3 Measured Data

5.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-10.00519555	-17.33050149	-14.28359979	-13.65319055	-11.0641517	-18.14254754	-10.94385522
30	-13.98542016	-17.1785354	-11.49453729	-11.5694465	-10.72661966	-20.82007974	-17.56779092
60	-29.19075769	-10.58853906	-8.24696725	-7.801742488	-6.276039058	-14.04579156	-13.16537088
90	-15.47535318	-5.974891597	-5.137809688	-4.434116298	-3.918331081	-8.193145687	-9.041133815
120	-9.988937313	-3.623928005	-3.593326503	-3.660922939	-4.806617672	-7.036018306	-7.509826595
150	-8.305561	-2.689914638	-2.944377834	-4.157279903	-7.206260616	-9.267600948	-8.359577114
180	-8.990459377	-3.009906704	-3.083557064	-4.309284145	-7.420787746	-11.93674463	-11.8892669
210	-12.21317666	-4.620429927	-3.910411769	-4.951885158	-7.904830867	-12.54485696	-18.28982156
240	-22.33409875	-8.22725671	-5.633838588	-5.979816371	-7.887641841	-11.30070108	-12.80998605
270	-17.71236032	-15.30838006	-8.635188991	-7.746963436	-7.852222377	-9.736225063	-8.313060695
300	-11.28345483	-22.1696853	-12.05372232	-9.839862758	-9.130180294	-9.095634395	-6.55355447
330	-9.725185329	-16.82397454	-14.14524835	-12.02316659	-11.85359185	-10.13358682	-6.782371456

5.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-17.62167627	-10.0803364	-11.73270304	-13.55824167	-13.44909174	-10.23816568	-8.924471682
30	-12.29634745	-6.993635958	-9.324946231	-12.12899286	-12.33569986	-10.14341242	-7.309782809
60	-9.989985293	-6.623453921	-8.198675936	-12.21677668	-14.83623011	-9.477320498	-7.613272494
90	-10.12328989	-8.100603884	-8.51655466	-12.29029352	-20.61729319	-12.25114328	-10.42681772
120	-12.92431909	-12.86422617	-10.52862436	-13.47147638	-21.42909128	-23.79020578	-17.68197901
150	-21.89133341	-25.00778086	-14.42660791	-14.37196619	-15.42430765	-18.2665127	-15.6934231
180	-20.42949564	-13.64590341	-16.3341778	-13.03876764	-11.5141781	-10.57491953	-9.74040491
210	-12.52747995	-8.921870059	-13.34665186	-11.46258051	-10.35448343	-8.100458926	-7.5545376
240	-10.01338083	-7.547118014	-11.59334833	-11.54122049	-9.815527743	-9.359862155	-7.751791781
270	-10.09714014	-8.777628726	-12.61964685	-13.83785517	-12.14118463	-13.38367731	-10.45132715
300	-12.61780817	-13.70233423	-17.45041544	-21.76656992	-18.91054804	-23.31378824	-16.73414881
330	-19.90514643	-20.44111521	-21.49673349	-21.51636393	-19.2917927	-17.47582514	-14.86844522

5.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-9.311764249	-9.330864375	-9.813194721	-10.59515668	-9.084626386	-9.586039154	-6.807534174
30	-10.04898124	-6.596196608	-7.265345666	-8.829914433	-8.44676077	-9.786824836	-6.918688025
60	-9.938092167	-5.158078762	-5.212454515	-6.460534748	-5.709621673	-8.176353575	-6.546341492
90	-9.011995637	-3.898668405	-3.496272406	-3.775236521	-3.82643747	-6.754176991	-6.668643164
120	-8.202908125	-3.135176868	-2.792399556	-3.229428096	-4.713108736	-6.94527378	-7.111271007
150	-8.119409622	-2.664520856	-2.646139109	-3.762437314	-6.596532028	-8.752509831	-7.623261668
180	-8.689340654	-2.65009932	-2.882811346	-3.763216399	-5.991771888	-8.192370642	-7.672964538
210	-9.357185665	-3.248750324	-3.442100769	-4.076479202	-5.948882553	-6.767033531	-7.202541973
240	-9.766044999	-4.863586618	-4.652451484	-4.914910644	-5.73517533	-7.212453205	-6.57239165
270	-9.403522791	-7.905877154	-7.175353112	-6.791830948	-6.477159918	-8.177485508	-6.241604064
300	-8.889284979	-13.12445772	-10.95246409	-9.569754304	-8.695821515	-8.934245192	-6.155738463
330	-9.32731389	-15.25607178	-13.41167901	-11.56064372	-11.13338637	-9.398579085	-6.155126355

5.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.117171928	0.116657741	0.104395199	0.087193544	0.123463152	0.110000861	0.208567475
30	0.098878501	0.218967842	0.187700502	0.130920772	0.142996011	0.105031004	0.203297107
60	0.101435689	0.304924362	0.301130364	0.225915758	0.268557838	0.152182475	0.221495981
90	0.125545293	0.407505204	0.44706715	0.419253163	0.414339419	0.211145729	0.215345442
120	0.151254808	0.485827745	0.525726713	0.475397825	0.337822932	0.202056405	0.194479084
150	0.154191005	0.54143698	0.543733497	0.420490578	0.218950932	0.1332751	0.172851771
180	0.135227785	0.543237908	0.514895226	0.420415152	0.251664994	0.15162225	0.170884844
210	0.115952852	0.473287427	0.452678557	0.391157876	0.254162659	0.210521593	0.190434576
240	0.105534753	0.326318231	0.342574357	0.322484567	0.266982298	0.190000472	0.220171365
270	0.114722267	0.161961684	0.191630525	0.209322978	0.225052586	0.152142816	0.237596256
300	0.129143188	0.048702833	0.080307035	0.110414108	0.135026139	0.127813133	0.242340586
330	0.116753151	0.029812117	0.045586064	0.069812892	0.07703026	0.114852933	0.242374745

5.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

6 Motor NO 20, +0 dBm, 2442 MHz

6.1 Setup

2442 MHz CW

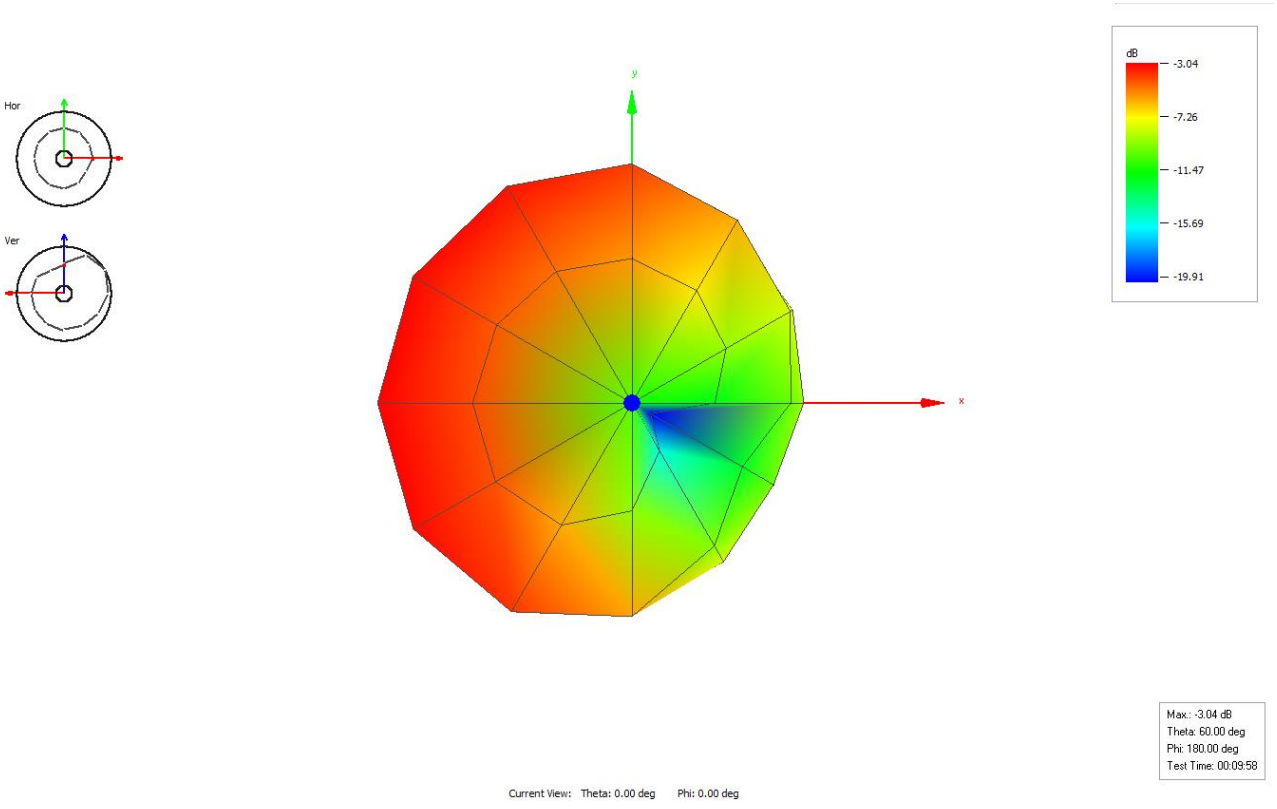
6.2 Summary

The calculations for this section are detailed in **Section 14**.

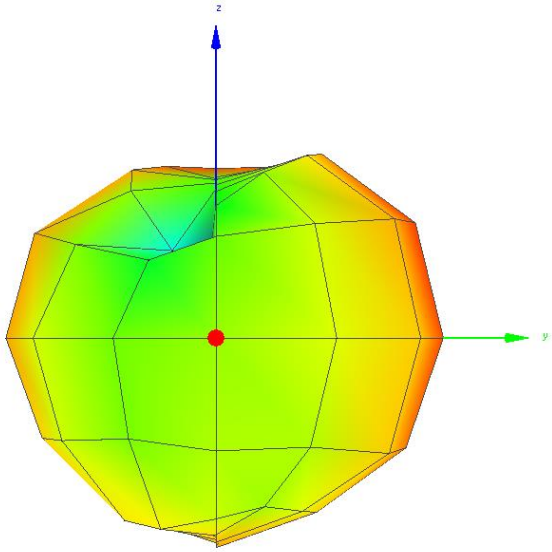
Total Radiated Power	-5.82	dBm
Peak EIRP	-3.04	dBm
Antenna directivity	2.78	dBm
Antenna efficiency	-5.82	dB
Antenna gain	**-3.04**	**dBi**

6.3 Radiation Pattern

6.3.1 Theta = 0, Phi = 0

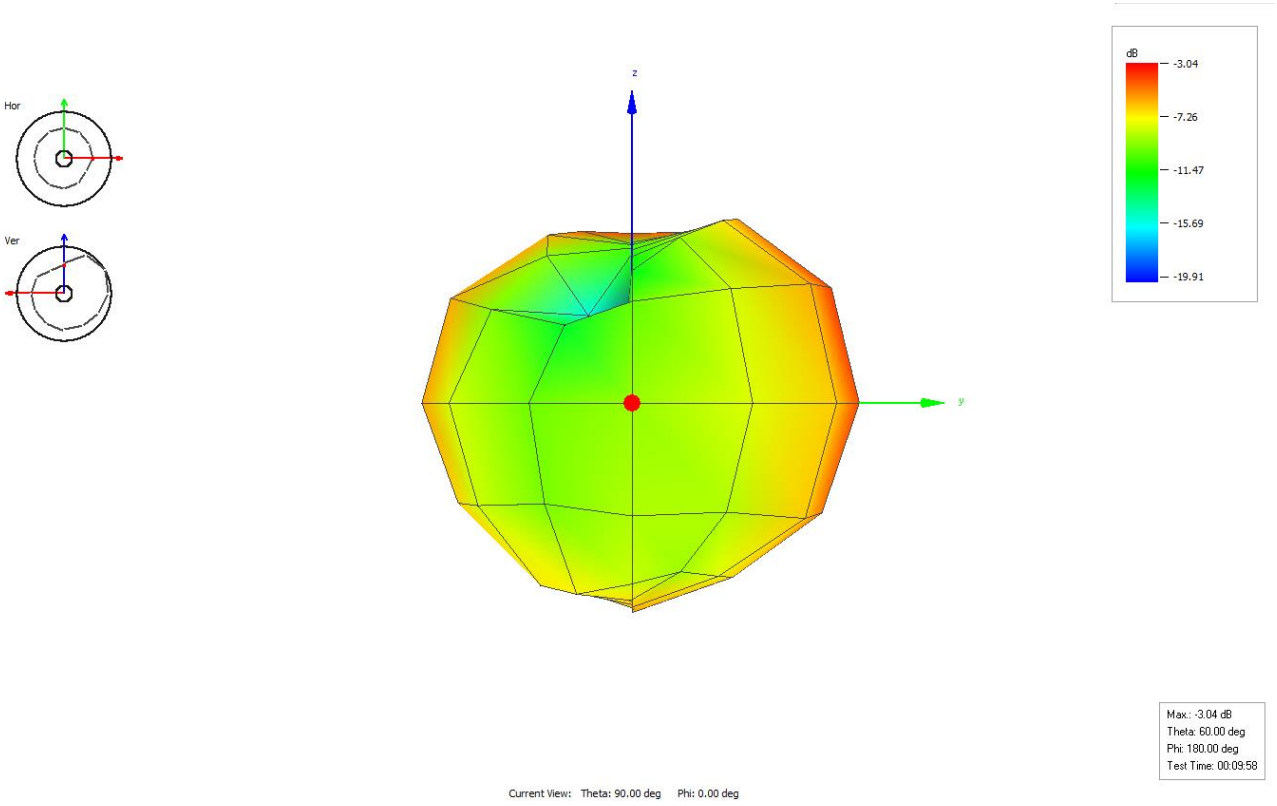


6.3.2 Theta = 180, Phi = 0

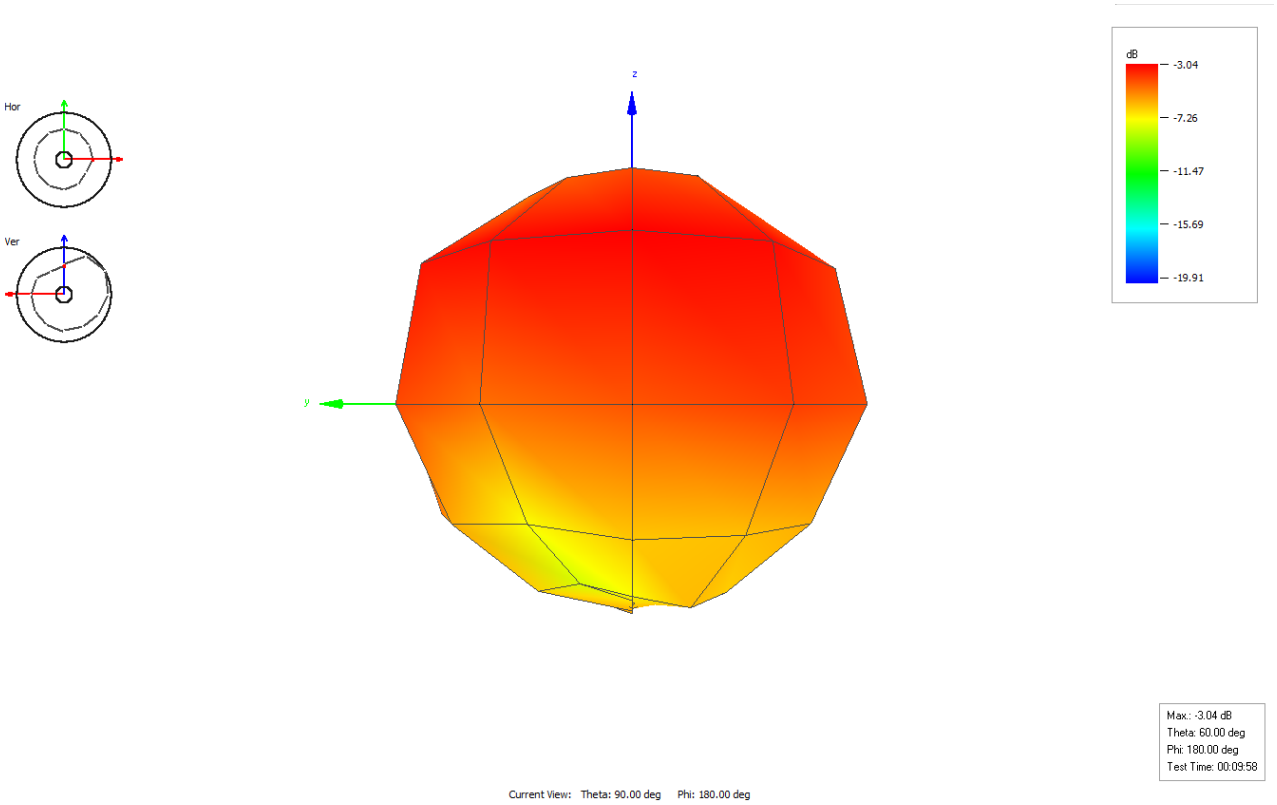


Theta: 90.00 deg

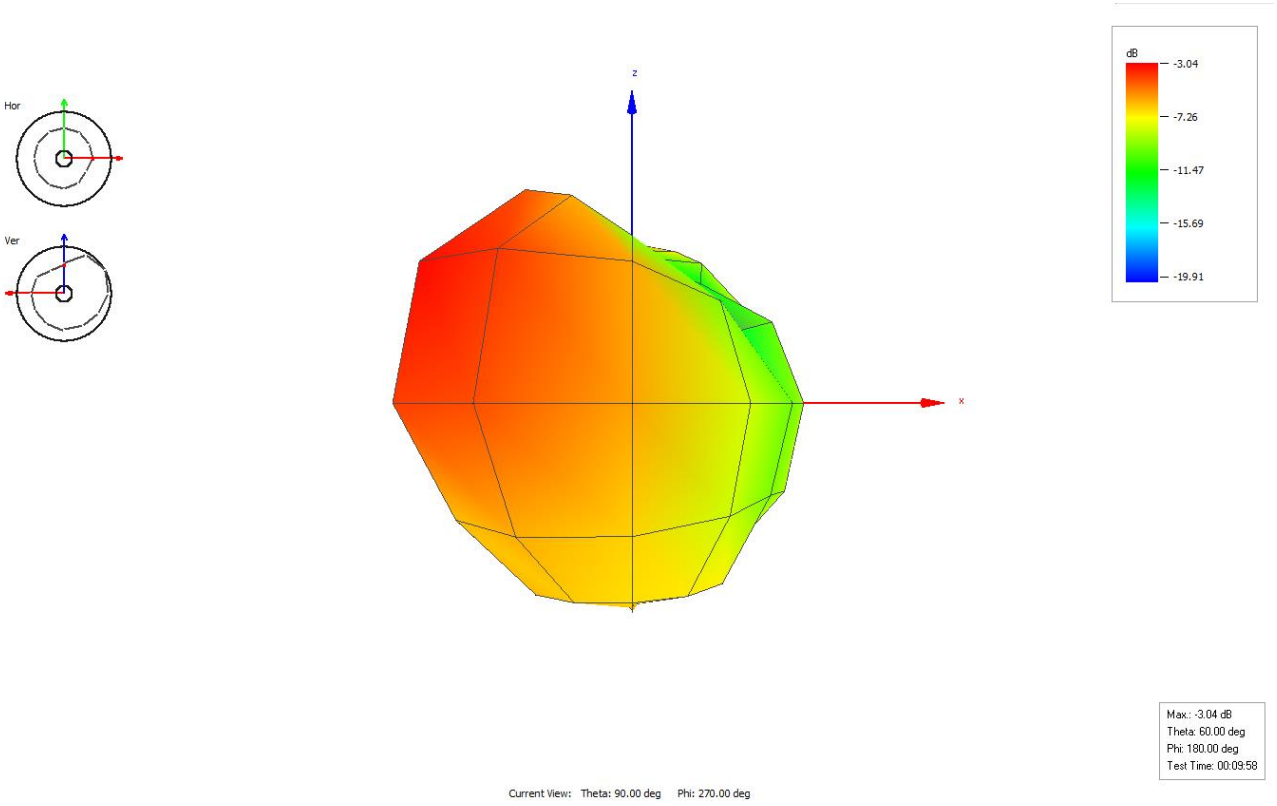
6.3.3 Theta = 90, Phi = 0



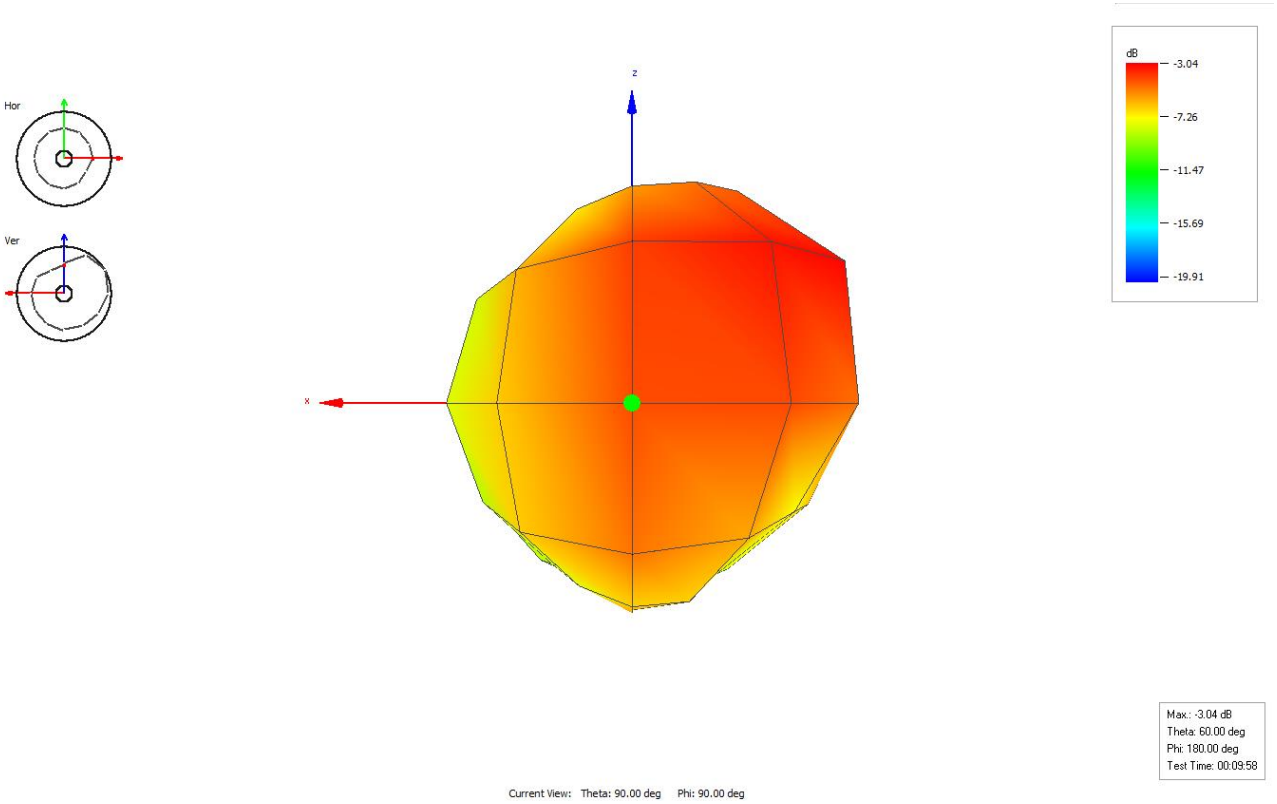
6.3.4 Theta = 90, Phi = 180



6.3.5 Theta = 90, Phi = 270



6.3.6 Theta = 90, Phi = 90



6.4 Measured Data

6.4.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-11.47636693	-18.13540166	-11.04366963	-10.02870458	-9.936160019	-11.44253438	-10.7435941
30	-15.26956838	-16.89725011	-9.932078293	-9.157587936	-10.62721913	-15.1249265	-17.29837315
60	-28.02384465	-11.63987248	-7.585593155	-7.19113057	-6.953024796	-14.08619588	-11.9952039
90	-16.55925267	-7.632857254	-5.198027542	-4.733496597	-4.910956314	-8.000216415	-7.542483261
120	-11.31627934	-5.399840286	-3.990778855	-4.490576676	-5.571200302	-6.318175247	-6.020136765
150	-9.552309921	-4.460616043	-3.429732254	-5.166586807	-7.925333908	-8.108054093	-6.87805455
180	-9.909098557	-4.477782181	-3.241545609	-5.098921707	-8.190436295	-10.76562398	-10.47600835
210	-12.52706807	-5.761176041	-3.673651627	-5.084757736	-8.692210129	-12.51934331	-19.05341618
240	-19.32218068	-8.861514023	-4.839972428	-5.308302811	-7.8560056	-10.54632085	-13.60338872
270	-19.88116353	-14.64814275	-6.710238388	-6.159857681	-7.16157811	-7.853465012	-8.110075882
300	-13.30558293	-21.06241505	-9.308508804	-7.545435837	-7.655413559	-6.611895493	-6.409792832
330	-12.04094212	-18.44843572	-11.13411992	-9.043684891	-9.130366257	-6.854842117	-6.695666245

6.4.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-16.16792014	-11.65482428	-13.1883898	-12.97580054	-12.21375372	-9.774987243	-8.344845794
30	-11.6980181	-8.947400115	-10.94535544	-11.69442465	-11.17926123	-9.067345641	-6.777768157
60	-9.703923248	-8.039879821	-10.04958441	-12.28571417	-13.19585135	-8.131546996	-7.051579498
90	-10.13742545	-9.039223693	-9.924969695	-13.12765982	-18.59003928	-10.53875067	-9.625222228
120	-13.02335074	-12.90372946	-11.56752112	-14.81575873	-23.60281088	-19.60289862	-16.55206015
150	-20.2115946	-20.40723517	-14.88123801	-14.26346686	-13.29476645	-15.36916449	-16.40289404
180	-18.20981314	-15.03063681	-16.46969702	-11.87862494	-9.902100585	-9.011265777	-9.779789947
210	-11.88404562	-9.545720123	-12.71647742	-10.22964194	-8.987759612	-6.815613769	-7.204628967
240	-9.710061096	-8.243592284	-10.631444	-10.50155356	-9.483460449	-7.936455749	-7.136864684
270	-9.903496764	-9.561905883	-11.54531577	-13.53293326	-12.86292364	-11.55298331	-9.672219299
300	-12.61228659	-14.63129141	-16.58916571	-22.3071337	-21.92038443	-21.19414999	-17.06386282
330	-18.8315325	-27.24213126	-30.71661856	-22.52605917	-18.93640616	-19.12799933	-17.44721701

6.4.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-10.20692733	-10.77390458	-8.974660018	-8.246621619	-7.91703086	-7.518912361	-6.370370057
30	-10.11624915	-8.301584618	-7.398932013	-7.233051593	-7.884174699	-8.105616551	-6.408672989
60	-9.640446529	-6.466773423	-5.634838726	-6.020356801	-6.027469595	-7.149176295	-5.844657668
90	-9.245660042	-5.269059953	-3.937530199	-4.146434197	-4.728679965	-6.076287687	-5.449879216
120	-9.076175204	-4.689608723	-3.291460283	-4.105226009	-5.503400434	-6.118964232	-5.651962671
150	-9.194349592	-4.351557905	-3.129447695	-4.662343407	-6.817955028	-7.36031509	-6.418717877
180	-9.31010906	-4.111305643	-3.03978241	-4.271397034	-5.952182412	-6.790155338	-7.103662739
210	-9.183366895	-4.243324749	-3.163449888	-3.925817553	-5.827171278	-5.781262986	-6.92978211
240	-9.259405524	-5.531272582	-3.824069335	-4.160642662	-5.583641881	-6.037921452	-6.253361513
270	-9.487534866	-8.389158329	-5.476729399	-5.429636795	-6.126721976	-6.310361119	-5.810985791
300	-9.934814968	-13.74125017	-8.563855558	-7.402724195	-7.495723365	-6.463265597	-6.051419698
330	-11.21530432	-17.90990554	-11.08656946	-8.853145367	-8.698444327	-6.60485967	-6.344934842

6.4.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.095347051	0.083677663	0.126629239	0.149740003	0.161546262	0.177055232	0.230655064
30	0.097358772	0.14785688	0.18201484	0.189101442	0.162773061	0.154681489	0.228629729
60	0.108631393	0.225591461	0.27322229	0.250013995	0.249604862	0.192789053	0.260336003
90	0.118969051	0.297230933	0.403875008	0.384907683	0.336613867	0.246814819	0.285109756
120	0.12370364	0.339655872	0.468655774	0.388577276	0.281617706	0.244401337	0.272147114
150	0.120382966	0.367150572	0.486469067	0.341794964	0.208067619	0.18364051	0.228101537
180	0.117216593	0.388033692	0.496617202	0.373990264	0.253969614	0.209403756	0.194820084
210	0.120687783	0.376415523	0.482675229	0.404965704	0.261386331	0.264164042	0.202778445
240	0.118593107	0.279816127	0.414565413	0.383650469	0.276462233	0.249004878	0.236953893
270	0.11252435	0.144905266	0.283352507	0.286441751	0.243965156	0.233864277	0.262362295
300	0.101512262	0.042254696	0.139192054	0.181855977	0.17800314	0.225773747	0.248232151
330	0.075590909	0.016181152	0.077865137	0.13022233	0.134944618	0.218531493	0.232009899

6.4.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

7 Motor NO 20, +0 dBm, 2480 MHz

7.1 Setup

2480 MHz CW

7.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-7.08	dBm
Peak EIRP	-4.01	dBm
Antenna directivity	3.07	dBm
Antenna efficiency	-7.08	dB
Antenna gain	**-4.01**	**dBi**

7.3 Measured Data

7.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-9.131979623	-25.19907252	-12.66943995	-11.63903681	-11.49622599	-10.79020945	-8.114691415
30	-14.11776225	-23.70175807	-11.47758357	-11.80414836	-14.03819911	-14.43973795	-14.94056956
60	-22.0769488	-14.50018946	-9.199846902	-9.769125619	-10.32198588	-19.55644099	-12.29463831
90	-12.98179881	-9.478575387	-7.070471444	-6.889750161	-7.391253152	-9.070357003	-6.732512155
120	-9.141127267	-6.969458261	-6.18348948	-6.63328425	-7.838938394	-6.583098092	-4.670870462
150	-8.040121713	-6.080759683	-6.033369699	-7.553000131	-10.19380824	-8.1446139	-4.955980935
180	-9.356413522	-6.23824183	-6.033091226	-7.601545968	-10.89592616	-10.62881342	-7.683634439
210	-13.76272074	-7.951231637	-6.104811349	-7.405462899	-11.834788	-12.9384791	-14.7228953
240	-20.17811457	-11.43743769	-6.846953073	-7.12704722	-10.29420725	-12.23258463	-13.65393702
270	-13.26092784	-18.1979243	-8.11752955	-7.035891214	-8.295565286	-8.572081247	-7.002901712
300	-8.809553781	-31.8133227	-10.41145197	-7.820440927	-7.814470926	-6.620566049	-4.699965158
330	-8.122683206	-20.21963374	-11.97412364	-9.365183511	-8.507872262	-6.473551431	-4.624323526

7.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-11.51122194	-13.85426622	-15.29804521	-13.87466341	-13.16582781	-10.17259127	-7.643496569
30	-7.799525316	-10.05181032	-11.7186194	-13.27341371	-12.42868715	-8.854292925	-5.565722521
60	-6.46593004	-8.626788195	-10.03764253	-13.88750749	-15.08352571	-7.840231951	-5.354277666
90	-7.509356554	-9.479838427	-9.577033098	-14.38658815	-22.48030382	-10.56565386	-7.331545885
120	-11.17370134	-12.96759706	-11.72429567	-15.31040865	-19.21022325	-19.01924425	-12.75189119
150	-18.24305254	-22.03310686	-16.62832552	-14.75033098	-12.69843965	-13.79809481	-14.88297563
180	-12.85689455	-19.08809954	-20.50917345	-12.42150408	-9.782385882	-8.307101305	-8.459116991
210	-8.379965838	-11.91105944	-14.95239931	-10.18643099	-8.418395098	-5.919619616	-5.601813372
240	-6.957091387	-9.949763353	-11.99792009	-9.66597658	-8.339880999	-6.618132647	-5.374213274
270	-7.757185991	-10.77379518	-12.13251024	-11.8112784	-10.96557146	-9.590964373	-7.467177446
300	-11.06835848	-14.92818361	-15.64221102	-18.71944719	-18.65050035	-16.65871721	-13.44619661
330	-18.43957811	-25.22754198	-27.60146623	-26.77826219	-20.56808	-20.42391878	-17.59513002

7.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-7.150367729	-13.54677111	-10.77753282	-9.604256225	-9.240983487	-7.460130563	-4.862406786
30	-6.888343079	-9.868332592	-8.586129539	-9.466641594	-10.14900459	-7.794603697	-5.091095819
60	-6.348227987	-7.627846499	-6.58827366	-8.347102585	-9.070178314	-7.557137221	-4.554202949
90	-6.424949992	-6.468906904	-5.135072868	-6.178454089	-7.258746685	-6.743666118	-4.011408954
120	-7.029273989	-5.995856606	-5.114096314	-6.08099713	-7.533248092	-6.342072757	-4.042945469
150	-7.644256247	-5.971843502	-5.67028494	-6.795110761	-8.257715473	-7.099565278	-4.535366293
180	-7.752826481	-6.018572819	-5.880846721	-6.364293795	-7.293264136	-6.30432377	-5.043789793
210	-7.275581868	-6.484350191	-5.572531835	-5.566753007	-6.78867251	-5.132653487	-5.100216396
240	-6.755004348	-7.619909298	-5.689436823	-5.203259892	-6.197728467	-5.564707428	-4.772513749
270	-6.679676022	-10.05143641	-6.66638537	-5.787547131	-6.418233503	-6.04141155	-4.21853849
300	-6.783429077	-14.84010729	-9.272473354	-7.480972259	-7.470235231	-6.210093669	-4.155872872
330	-7.736628283	-19.02822192	-11.85685725	-9.287098738	-8.245698688	-6.302097798	-4.410541728

7.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.192736171	0.044189887	0.083607785	0.109540414	0.119097227	0.179467967	0.326406893
30	0.204722555	0.10307818	0.138479997	0.113066993	0.096627232	0.16616503	0.309663785
60	0.231834039	0.172669388	0.219367676	0.1463153	0.123874572	0.1755037	0.350412593
90	0.227774447	0.225480666	0.306543925	0.241076341	0.187985924	0.211657367	0.397062712
120	0.198185831	0.251428404	0.308028122	0.246547321	0.176471749	0.232162849	0.394189864
150	0.172018191	0.252822458	0.271001382	0.209164956	0.149357987	0.195003979	0.351935738
180	0.167771177	0.250116716	0.258175679	0.230978002	0.186497746	0.23418961	0.313055271
210	0.187258618	0.224680293	0.27717038	0.277539435	0.209475265	0.306714743	0.309014146
240	0.211105508	0.172985249	0.269808929	0.301768574	0.240008793	0.27767019	0.333233477
270	0.214799071	0.098822619	0.215457424	0.263782079	0.228126979	0.248804852	0.378569962
300	0.209728327	0.032808719	0.118236799	0.178608768	0.179050887	0.239326414	0.384072058
330	0.168398094	0.01250771	0.065210011	0.117839292	0.149771828	0.234309674	0.362197816

7.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

8 Motor NO 21, +0 dBm, 2402 MHz

8.1 Setup

2402 MHz CW

8.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-12.02	dBm
Peak EIRP	-6.66	dBm
Antenna directivity	5.35	dBm
Antenna efficiency	-12.02	dB
Antenna gain	**-6.66**	**dBi**

8.3 Measured Data

8.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-20.78629296	-23.73637384	-16.73072427	-18.62342828	-14.27723306	-18.02244561	-17.23180383
30	-22.3905639	-27.34450525	-19.85692208	-21.14878839	-14.84856027	-13.74955362	-12.62234491
60	-20.95977014	-26.58707421	-16.75467675	-18.29454034	-11.00004571	-8.665996486	-11.26649469
90	-20.44075387	-20.03042596	-13.96566766	-14.32571023	-8.381324703	-6.858589107	-11.81703942
120	-20.10757821	-16.33500665	-13.94481271	-15.11051171	-10.46173852	-8.734519893	-14.93485254
150	-19.81029504	-13.73908609	-15.2494468	-20.19372934	-16.6615867	-15.11147683	-21.40911096
180	-20.23303979	-12.61016076	-15.83783334	-22.78314965	-18.88415139	-21.44804376	-17.41199868
210	-20.19612115	-12.25524514	-14.9083175	-20.96731561	-21.42463678	-20.3737716	-12.06355279
240	-19.06806558	-10.99391549	-12.41018289	-14.75671762	-17.79113	-21.56266778	-9.935005123
270	-17.62376016	-10.16795343	-10.47056955	-11.65968316	-14.07373803	-26.19905847	-10.43168634
300	-17.59121316	-11.2772445	-10.36799234	-10.91636651	-13.72008126	-33.69442743	-13.43180841
330	-18.85688775	-15.88917916	-11.75330346	-12.84304803	-14.90792077	-22.35926812	-19.93797677

8.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-19.21257288	-17.40056879	-26.64504129	-23.16183359	-16.79235346	-13.97549326	-11.60310633
30	-19.76285059	-20.2279957	-19.07509882	-15.31831247	-13.73594934	-15.39882166	-14.3249386
60	-20.06394083	-17.97332651	-14.42404444	-12.47963602	-12.98029215	-17.26148493	-21.53092081
90	-20.07083017	-16.43087656	-15.42746622	-14.68709833	-16.1285084	-20.25842173	-19.04848749
120	-20.90871698	-16.1350239	-19.10887796	-19.15960199	-17.78026087	-13.38859064	-13.07744104
150	-20.93143732	-15.90439493	-20.88419229	-17.17663843	-15.43731577	-13.54316599	-10.90379984
180	-20.82895166	-13.76039392	-15.60900385	-15.0556019	-17.18128855	-15.12555201	-10.92262537
210	-20.07890207	-12.81835443	-13.30262262	-15.6992367	-24.35483438	-17.00467569	-13.31155664
240	-19.7753895	-14.228957	-13.76681406	-17.28025324	-35.18979532	-25.0735615	-20.04978067
270	-20.07774622	-17.8257435	-18.21777994	-20.40561945	-24.43380625	-21.47418863	-21.79273874
300	-19.4036091	-15.61772806	-21.93678171	-25.35998423	-20.16171915	-16.33017618	-13.86299021
330	-19.27207071	-14.05464823	-20.08845407	-24.04750711	-20.54500849	-12.66364176	-11.43725473

8.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-16.91823745	-16.49270604	-16.30893783	-17.3146587	-12.34491015	-12.53340657	-10.55274541
30	-17.87062846	-19.45706269	-16.43814108	-14.31051585	-11.24642215	-11.48606331	-10.38043579
60	-17.47849826	-17.41342246	-12.4245603	-11.46860999	-8.867967097	-8.103879742	-10.87595223
90	-17.24155458	-14.85763546	-11.62505151	-11.4923464	-7.706936046	-6.664474084	-11.06459532
120	-17.47940061	-13.22356432	-12.79035745	-13.66902899	-9.723029801	-7.45554953	-10.89729619
150	-17.32448802	-11.67786788	-14.20038446	-15.41798831	-12.9961533	-11.24660985	-10.53345657
180	-17.51048286	-10.13700812	-12.71161168	-14.37838358	-14.93948796	-14.21517471	-10.04331918
210	-17.12681619	-9.517379574	-11.02138079	-14.56883893	-19.63685891	-15.36009901	-9.632579316
240	-16.39704347	-9.306632048	-10.02544014	-12.82741502	-17.71278798	-19.96229289	-9.531387969
270	-15.66938271	-9.480593636	-9.796184729	-11.11555612	-13.69133861	-20.21316914	-10.12529979
300	-15.39324583	-9.916104208	-10.07544516	-10.76299962	-12.83198643	-16.25121653	-10.6317504
330	-16.04921976	-11.86545849	-11.1587352	-12.52581373	-13.85936096	-12.22114606	-10.8635219

8.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.02033182	0.022424842	0.023394093	0.018558126	0.058278583	0.055803231	0.088049209
30	0.016328157	0.011331665	0.022708366	0.03706367	0.075051225	0.071022126	0.091612856
60	0.017871054	0.018140855	0.057219488	0.071308122	0.129778661	0.154743361	0.081734381
90	0.018873157	0.032676569	0.068785175	0.07091945	0.169553358	0.215552265	0.078260113
120	0.017867342	0.047604013	0.052597397	0.042963247	0.106585228	0.179657374	0.081333672
150	0.018516172	0.067953716	0.038015574	0.028721107	0.050163135	0.075047981	0.088441142
180	0.017739922	0.096894514	0.053559786	0.036488973	0.032066474	0.037886329	0.099007497
210	0.019378421	0.111753734	0.079042728	0.034923367	0.010872117	0.029106508	0.108828356
240	0.022924277	0.117310476	0.099415931	0.052150503	0.016932505	0.010087202	0.111393847
270	0.027105769	0.112704339	0.104804885	0.077347163	0.042743112	0.009521011	0.097156088
300	0.028885203	0.101950551	0.098277813	0.083888038	0.052095638	0.023707095	0.086461937
330	0.024835793	0.06508099	0.076581961	0.055900878	0.041121022	0.059963282	0.081968655

8.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

9 Motor NO 21, +0 dBm, 2442 MHz

9.1 Setup

2442 MHz CW

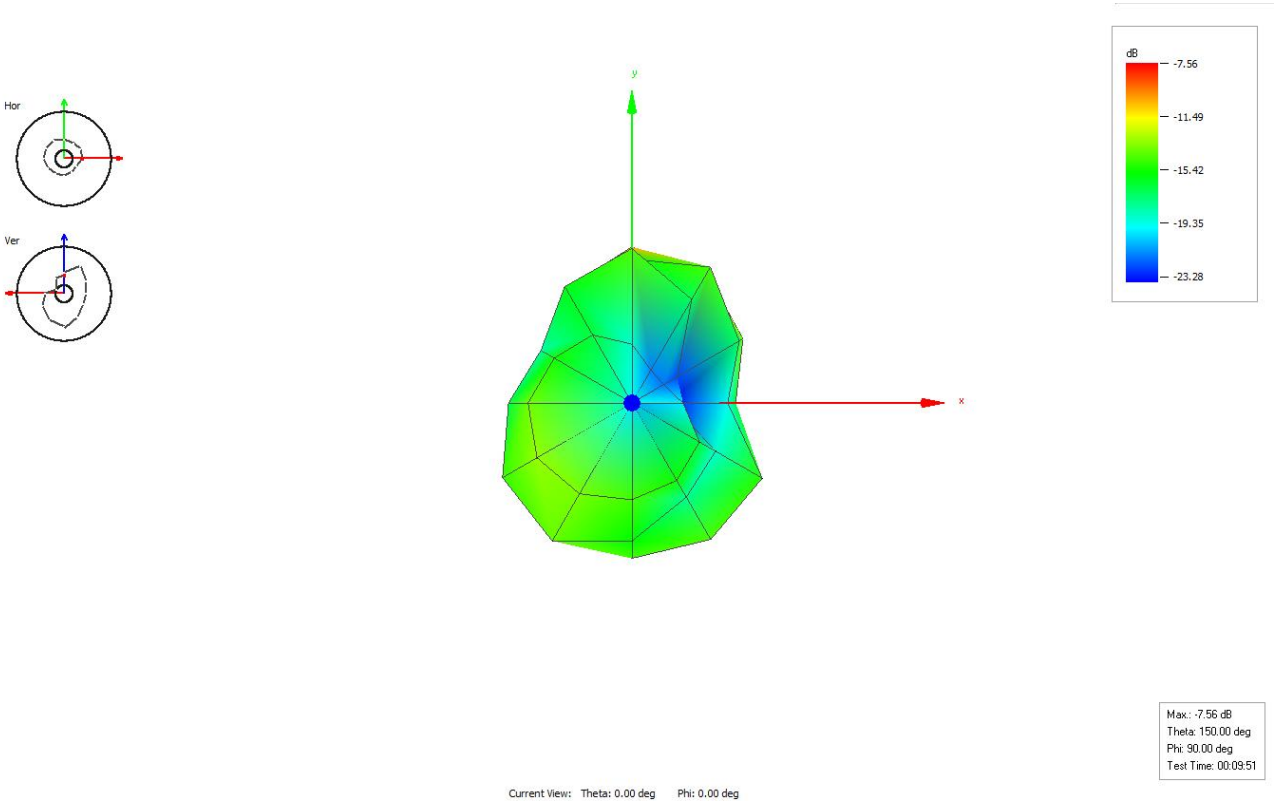
9.2 Summary

The calculations for this section are detailed in **Section 14**.

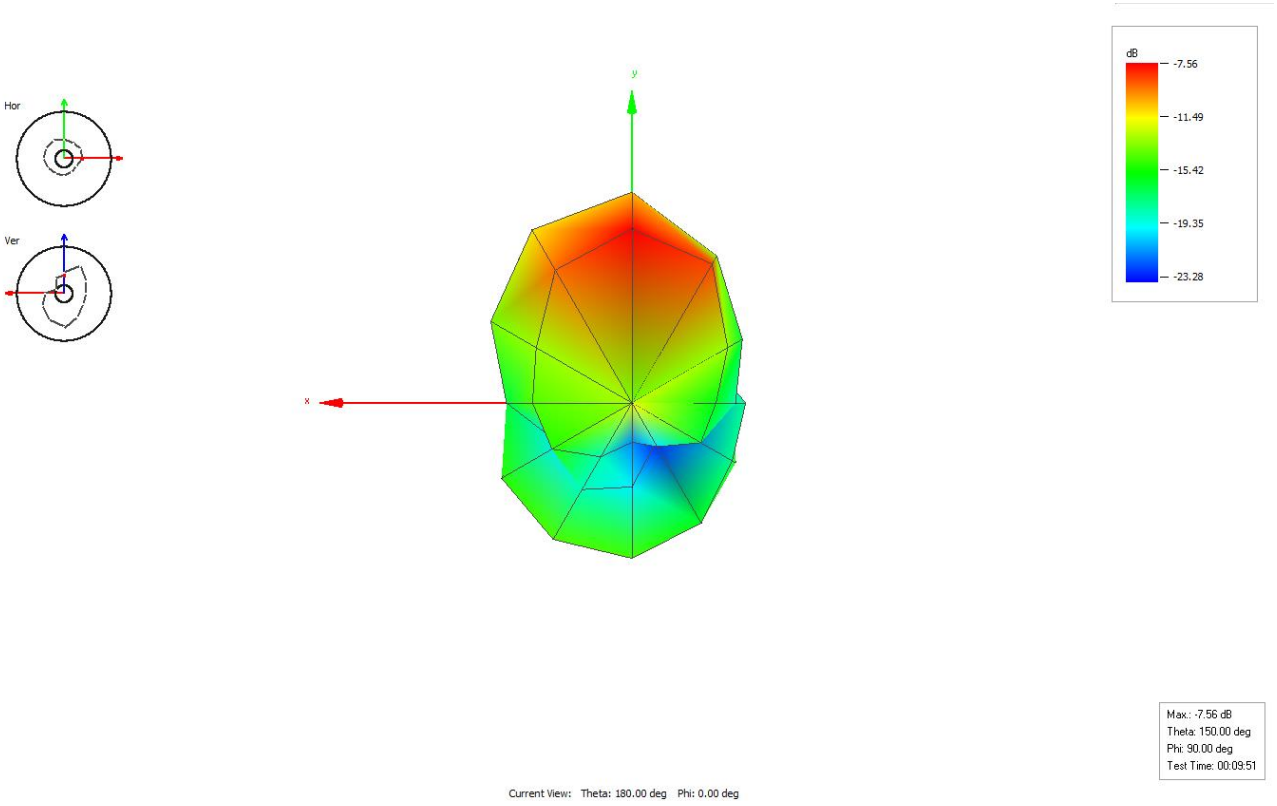
Total Radiated Power	-14.38	dBm
Peak EIRP	-7.56	dBm
Antenna directivity	6.82	dBm
Antenna efficiency	-14.38	dB
Antenna gain	**-7.56**	**dBi**

9.3 Radiation Pattern

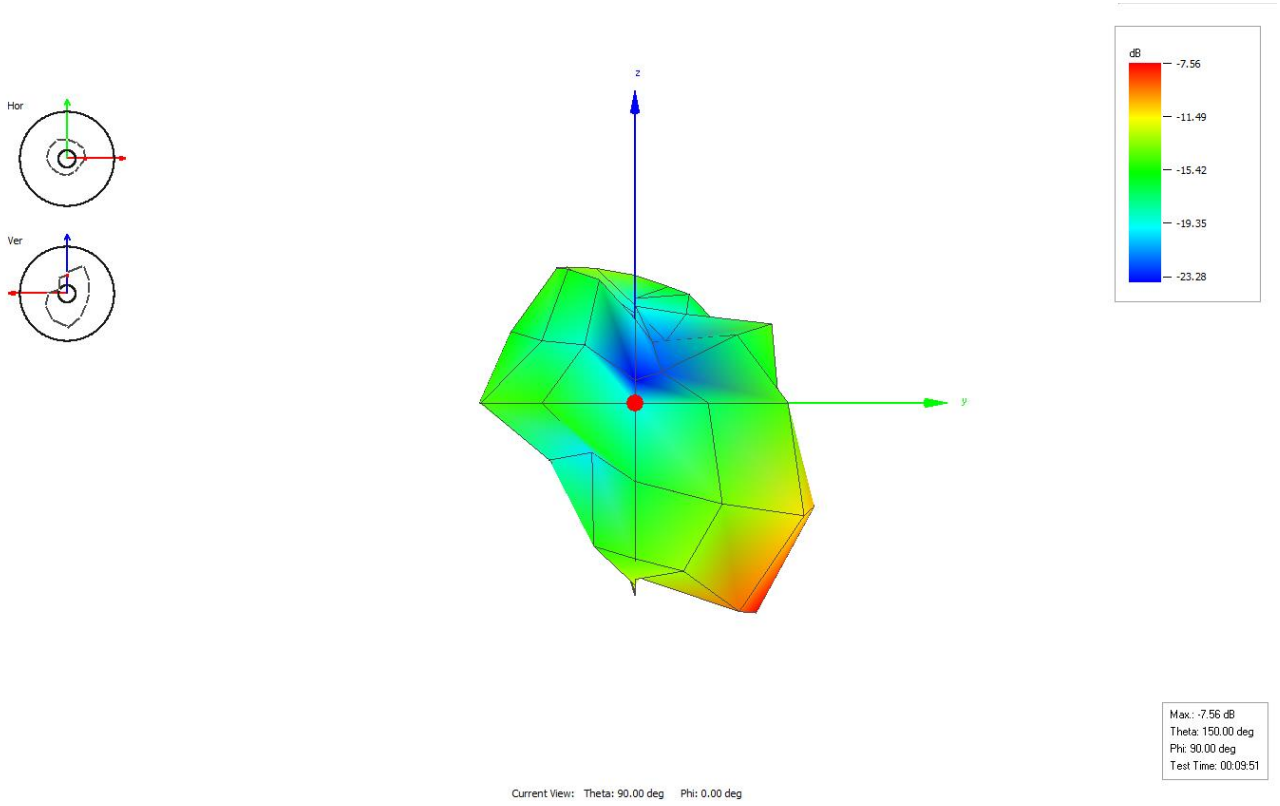
9.3.1 Theta = 0, Phi = 0



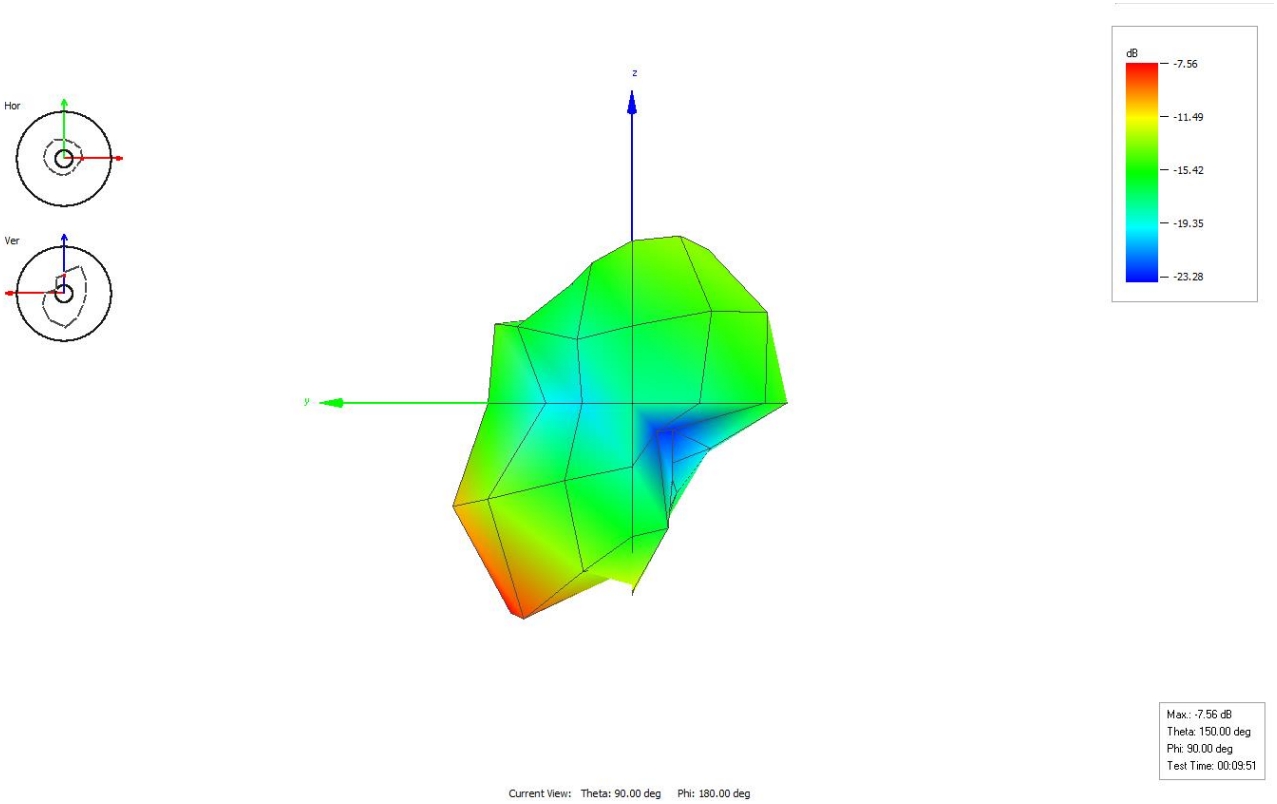
9.3.2 Theta = 180, Phi = 0



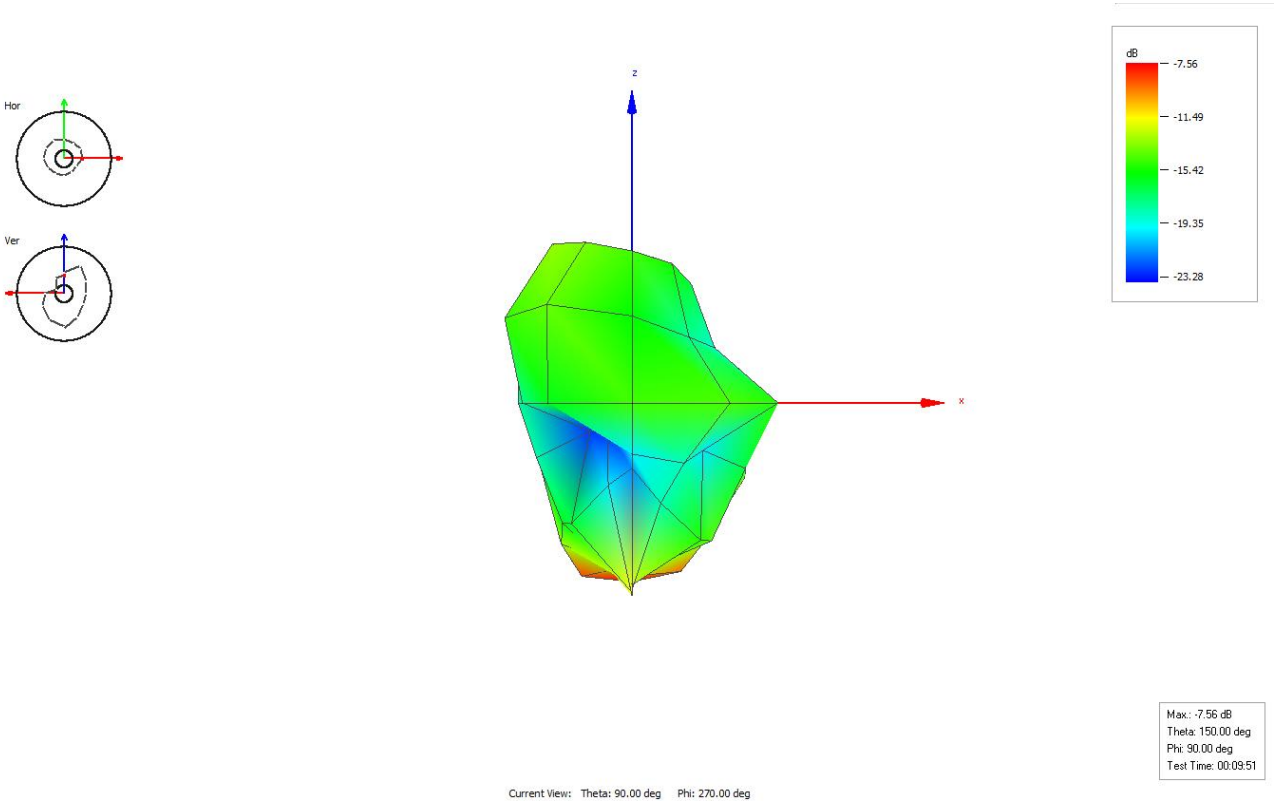
9.3.3 Theta = 90, Phi = 0



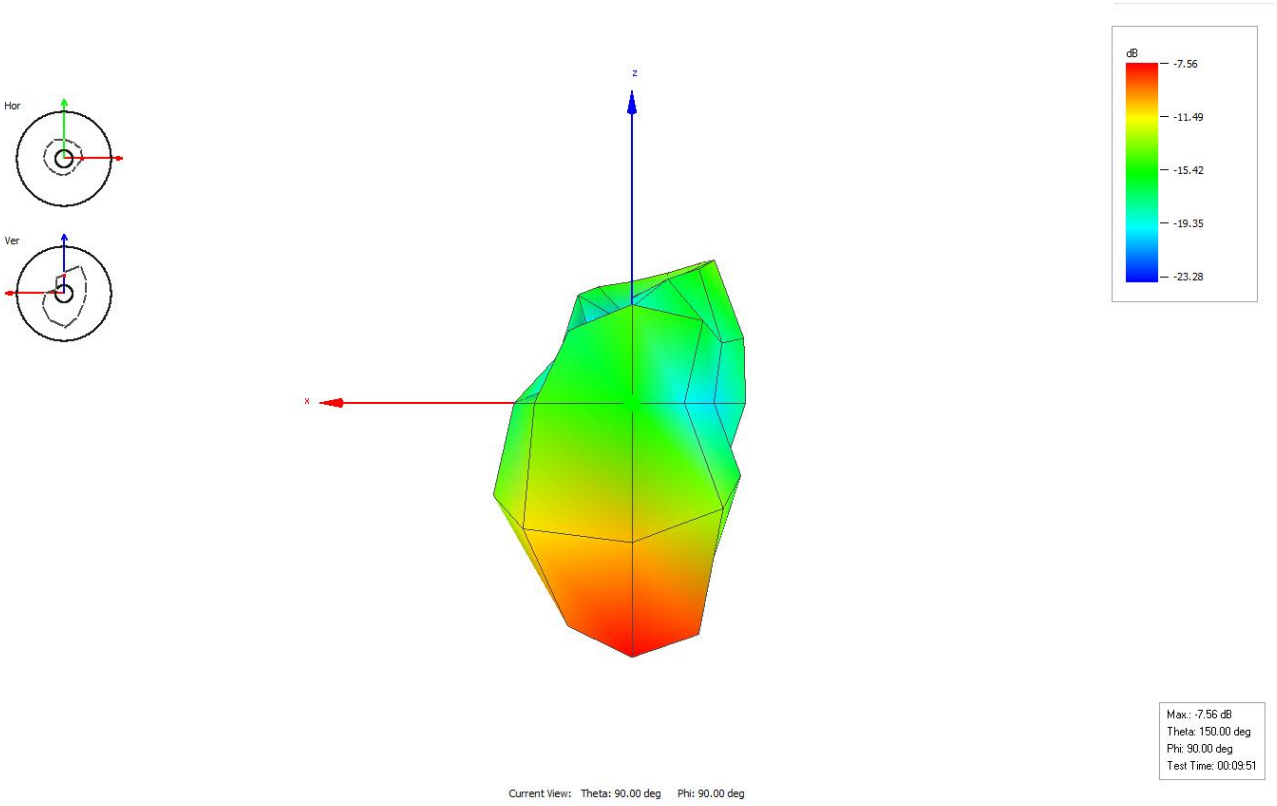
9.3.4 Theta = 90, Phi = 180



9.3.5 Theta = 90, Phi = 270



9.3.6 Theta = 90, Phi = 90



9.4 Measured Data

9.4.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-19.57368367	-29.13653081	-30.05525487	-23.63212102	-21.13070195	-23.40245335	-21.09949391
30	-19.19446462	-27.47053044	-27.60315221	-27.77846806	-19.45877736	-15.57068532	-14.73486607
60	-20.34514516	-33.72533696	-21.88354771	-26.27530187	-14.03895085	-9.765612534	-12.81943028
90	-22.02305119	-27.91983312	-16.16750996	-21.35294621	-11.15471547	-7.835196426	-13.15505498
120	-22.4541425	-19.03948872	-17.02876943	-22.25516026	-13.77678578	-9.661414078	-15.81326192
150	-20.89402669	-16.1371259	-18.36240666	-26.14512151	-21.02291005	-15.99140447	-22.39943211
180	-19.28042119	-15.26883595	-18.37037938	-26.34335606	-22.37604802	-21.71046727	-18.82939809
210	-19.42713063	-15.5775327	-18.72654622	-22.39747899	-23.82773106	-18.86731236	-13.99619954
240	-20.72272771	-15.19232457	-16.87829106	-16.62753194	-20.95833104	-18.91812413	-11.58238881
270	-22.67978185	-14.51066869	-16.12254613	-14.20566838	-18.22976201	-21.22547429	-11.30939763
300	-23.54970067	-15.83263677	-17.44784444	-13.79186147	-17.24887364	-23.95038121	-13.17301076
330	-22.69113438	-20.16974919	-20.56859868	-15.32727712	-19.74763387	-31.9967603	-17.73724645

9.4.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-22.31514456	-18.38999655	-21.89753439	-18.94259741	-16.5266886	-13.74189474	-13.02636816
30	-22.36542227	-20.43050482	-21.17586233	-16.0115824	-13.91829016	-15.12917426	-15.55796912
60	-21.4856539	-19.65365317	-16.79406836	-13.69751837	-13.2890444	-16.84408667	-22.00845053
90	-19.54125311	-17.6011286	-16.63608267	-15.32640173	-16.3202677	-19.63403036	-23.55168631
120	-18.56395056	-17.55539038	-18.42243674	-19.84465887	-18.1899729	-14.72995474	-16.36982062
150	-19.40364935	-18.5619364	-21.31935599	-18.91590598	-16.38480475	-14.76718237	-13.37038519
180	-20.86736014	-16.66811468	-18.38679221	-16.90286734	-18.05318549	-15.65900519	-12.68178656
210	-22.07285788	-15.26429465	-15.33734228	-17.50743582	-23.31808951	-17.50978567	-14.47334769
240	-21.50420859	-16.55441763	-15.41127875	-19.18902686	-32.92548087	-25.73598959	-19.95246603
270	-20.30412009	-20.48083594	-19.31729987	-22.16401389	-31.48488333	-23.88351157	-24.26237204
300	-20.50003912	-19.21206	-22.77908041	-24.17100241	-28.39883139	-17.78946402	-16.11307623
330	-21.5156832	-16.96933462	-19.80759909	-19.42252829	-23.12338736	-14.00202658	-12.97522833

9.4.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-17.72129645	-18.03887574	-21.27985606	-17.67264331	-15.2348941	-13.29598963	-12.39737952
30	-17.48644698	-19.64703956	-20.28511043	-15.73166824	-12.84882737	-12.33402165	-12.11664678
60	-17.86776777	-19.48683312	-15.62208791	-13.46402268	-10.63753173	-8.988470311	-12.32519237
90	-17.59693361	-17.21522757	-13.38517997	-14.35848987	-10.00060727	-7.557269599	-12.77572544
120	-17.07699463	-15.22405125	-14.65963723	-17.87447313	-12.43508722	-8.484472249	-13.07233186
150	-17.07491735	-14.17215317	-16.58363761	-18.16310665	-15.10175616	-12.32599891	-12.85865405
180	-16.99150575	-12.90206223	-15.36827808	-16.43499045	-16.68729717	-14.69605997	-11.73779333
210	-17.54126228	-12.40779026	-13.69909429	-16.28745268	-20.55513885	-15.1254213	-11.21792407
240	-18.08561414	-12.80988883	-13.07283408	-14.71180674	-20.69065064	-18.09719627	-10.99227364
270	-18.32119606	-13.53143506	-14.42225182	-13.56102577	-18.02921949	-19.34393806	-11.09475762
300	-18.75220746	-14.19131296	-16.33183929	-13.41106637	-16.92777769	-16.848067	-11.38856024
330	-19.05346152	-15.27087341	-17.16115178	-13.89878293	-18.10515478	-13.93365309	-11.72354053

9.4.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.016899364	0.015707694	0.007447567	0.017089748	0.029957846	0.046816726	0.057578726
30	0.017838376	0.01084666	0.009364594	0.026719798	0.051894014	0.058424881	0.061423608
60	0.016338915	0.011254253	0.027402564	0.045039933	0.086346915	0.126227206	0.05854378
90	0.017390283	0.018987913	0.045865064	0.036656501	0.099986018	0.175498351	0.052774904
120	0.019602007	0.030032734	0.034200801	0.016313708	0.057080961	0.141759697	0.049290907
150	0.019611385	0.038263499	0.021960197	0.015264737	0.030890461	0.058532909	0.051776727
180	0.019991686	0.051261791	0.029051743	0.022724846	0.021442246	0.03391517	0.067022507
210	0.01761464	0.057440865	0.042666849	0.023510114	0.00880007	0.030722593	0.075545325
240	0.015539555	0.052361384	0.049285208	0.033792422	0.008529723	0.015498168	0.079574265
270	0.014719071	0.044346208	0.036122252	0.044045082	0.015742658	0.011630709	0.077718469
300	0.013328438	0.038095064	0.023271055	0.045592495	0.020287206	0.020662996	0.072634671
330	0.012435231	0.029710685	0.019225818	0.040749446	0.015469794	0.040423572	0.067242824

9.4.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

10 Motor NO 21, +0 dBm, 2480 MHz

10.1 Setup

2480 MHz CW

10.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-15.99	dBm
Peak EIRP	-9.03	dBm
Antenna directivity	6.97	dBm
Antenna efficiency	-15.99	dB
Antenna gain	**-9.03**	**dBi**

10.3 Measured Data

10.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-18.1261851	-23.9576327	-28.9957873	-29.29009883	-26.00498835	-20.8848025	-16.50408427
30	-17.28872935	-24.81563441	-26.61922328	-31.5989062	-21.27094142	-16.05125681	-13.93415705
60	-18.54216258	-22.89537684	-20.98960749	-26.15571467	-16.44857661	-11.36555735	-12.45173136
90	-20.96855036	-26.43573634	-18.7432162	-29.70626704	-13.07213084	-9.550192514	-12.8509318
120	-23.13843409	-23.82872645	-20.09574763	-26.42652003	-14.93902842	-11.18238322	-15.69347254
150	-21.01597468	-20.02722422	-21.5026919	-29.50855128	-19.90330378	-16.98644511	-21.66815058
180	-18.5987765	-18.35033289	-19.94066111	-35.31595484	-23.29596583	-21.87018458	-17.97372309
210	-17.58030192	-17.28263728	-19.13102595	-26.50963465	-23.5539004	-18.37977091	-13.94444911
240	-18.60191599	-17.39697901	-18.45722071	-20.19919459	-20.74479548	-16.80915705	-12.22679774
270	-21.3197848	-17.84145609	-18.75743357	-16.35868327	-18.63915125	-20.2612826	-12.2118899
300	-23.85991541	-19.81624857	-21.7101504	-16.51687876	-17.79050318	-25.22186915	-14.59858195
330	-22.47473017	-23.10050837	-26.1874148	-18.97883479	-22.56302516	-32.1362292	-18.48604456

10.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-19.20527941	-25.2433806	-26.51679521	-19.84587389	-17.60805422	-14.69259172	-12.86881548
30	-22.3963347	-24.26929766	-23.40495592	-17.73823076	-15.9869948	-16.33970552	-15.58883959
60	-20.85735613	-20.47571474	-18.87014681	-15.50416094	-15.35656267	-17.58674532	-20.83831316
90	-18.0485602	-18.22912126	-17.61003404	-16.60908037	-17.59279924	-18.46198946	-20.34452349
120	-16.97451692	-18.17370516	-17.72730165	-21.03282457	-20.0221892	-14.3190642	-14.52552706
150	-16.89598757	-19.77999025	-20.21213823	-22.12565142	-19.58330065	-15.34874636	-12.93461138
180	-18.80590731	-20.19990068	-21.06568437	-18.84541612	-20.7738524	-16.45123583	-12.82786089
210	-20.43496233	-18.19234377	-18.27286821	-18.97400957	-25.25237566	-19.23125749	-14.95464617
240	-19.91766268	-19.05678087	-18.34248262	-22.29151445	-34.05150896	-27.73715502	-19.62067324
270	-18.3979941	-21.81840807	-22.07592302	-29.96004015	-27.37988573	-21.79468065	-20.42762667
300	-16.85019594	-23.20206743	-23.99211412	-23.49280077	-23.61700731	-17.13936907	-15.36263185
330	-16.53444582	-21.91117388	-22.0582686	-19.22616487	-20.86579424	-14.12590319	-13.01018053

10.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-15.62200275	-21.54279804	-24.57146282	-19.37837844	-17.02134207	-13.75727556	-11.30639822
30	-16.1210291	-21.52358068	-21.7109737	-17.56327051	-14.86022827	-13.18278689	-11.67286522
60	-16.53697564	-18.50886763	-16.79154682	-15.14558845	-12.85803697	-10.43584051	-11.86370965
90	-16.2573352	-17.61789354	-15.12947011	-16.40128566	-11.75873941	-9.025271179	-12.13914514
120	-16.03370438	-17.12898593	-15.74173124	-19.93089475	-13.76555272	-9.463190329	-12.06005573
150	-15.4744127	-16.89154821	-17.79935269	-21.39694952	-16.73005556	-13.08055306	-12.38902263
180	-15.69080721	-16.1670906	-17.45654507	-18.74861478	-18.84403963	-15.35495246	-11.66914975
210	-15.76688729	-14.70341472	-15.67048522	-18.26855101	-21.31033015	-15.77437956	-11.40994136
240	-16.19985115	-15.13776431	-15.38917281	-18.11025134	-20.54656799	-16.47186152	-11.49978943
270	-16.60737755	-16.37947614	-17.09684029	-16.17318465	-18.09441133	-17.95035418	-11.60185863
300	-16.06171365	-18.17693659	-19.69264557	-15.72276692	-16.78188372	-16.51164319	-11.95352625
330	-15.54916331	-19.4549547	-20.63924859	-16.09043943	-18.62172191	-14.05777282	-11.92652982

10.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.027403102	0.007010035	0.003490227	0.01153884	0.019854813	0.042099064	0.074021891
30	0.024428516	0.007041123	0.006743768	0.017525602	0.032657067	0.048053089	0.068032038
60	0.022197417	0.014096563	0.020933667	0.030580259	0.051784085	0.090451537	0.065107202
90	0.023673719	0.017306556	0.030693965	0.022901896	0.066700035	0.125162112	0.061106229
120	0.024924678	0.019368742	0.026657958	0.010160393	0.042018905	0.113156881	0.06222923
150	0.02835037	0.020457152	0.016598343	0.00724945	0.021232173	0.049197688	0.057689628
180	0.026972381	0.024170795	0.01796162	0.013339468	0.013049565	0.02914102	0.068090265
210	0.026503991	0.033857784	0.027098888	0.014898581	0.007395491	0.026458307	0.072277956
240	0.023989151	0.030635401	0.028912305	0.01545165	0.008817454	0.022532732	0.070798011
270	0.021840483	0.023017194	0.019512637	0.024136902	0.01550811	0.016031146	0.069153495
300	0.024764447	0.015216205	0.010733354	0.026774619	0.020980297	0.022327273	0.063774546
330	0.02786658	0.011337167	0.008631279	0.024601187	0.013734973	0.039284635	0.064172213

10.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

11 Sensor Colour NO 3, +0 dBm, 2402 MHz

11.1 Setup

2402 MHz CW

11.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-12.19	dBm
Peak EIRP	-7.49	dBm
Antenna directivity	4.70	dBm
Antenna efficiency	-12.19	dB
Antenna gain	**-7.49**	**dBi**

11.3 Measured Data

11.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-12.91314309	-13.60701364	-20.54019921	-23.23764032	-17.77594369	-13.27409356	-8.987354213
30	-14.16303247	-13.04976648	-20.07075113	-21.59954065	-18.28933328	-13.08056634	-9.660560543
60	-18.66689676	-15.76290887	-22.48867028	-23.04702752	-21.59778588	-13.8377723	-12.26749414
90	-35.9387893	-23.73300164	-31.45818322	-27.44831842	-26.851242	-17.17206186	-15.55363458
120	-18.920906	-21.11106866	-25.13690942	-23.82962793	-18.39180749	-15.40995401	-13.80321115
150	-14.22564309	-14.34376138	-19.03675454	-20.37427896	-15.86439126	-13.10977548	-10.41579431
180	-12.88321298	-12.07934945	-17.09490197	-18.04427713	-14.20604699	-12.89129632	-8.962360317
210	-13.91332238	-12.16590493	-17.67340081	-16.68928903	-14.22829049	-11.86920922	-9.314952785
240	-17.99422448	-14.67592996	-20.17280572	-16.81038659	-15.30433648	-12.88854593	-11.47100061
270	-33.0998916	-22.03576654	-24.42465966	-18.89450448	-17.63816446	-15.70859521	-15.22355264
300	-19.55855935	-25.83792108	-24.22638696	-23.78221124	-20.64056009	-16.6506347	-13.97602075
330	-14.66089242	-16.45444482	-22.78751367	-35.00111383	-20.25338357	-13.42954629	-10.98965066

11.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-31.85150797	-27.29271585	-28.34644205	-30.30242807	-24.71295053	-22.63057596	-16.36741144
30	-20.76029093	-15.68932611	-17.5143841	-17.22632868	-18.37850077	-17.96514399	-14.70751459
60	-15.6506489	-11.50540049	-12.92291147	-12.36480219	-12.18023188	-10.59992105	-11.02818949
90	-13.89036066	-10.2470463	-11.50757486	-10.30783731	-9.035029238	-7.979647464	-9.412382907
120	-14.5659054	-10.76854212	-11.69318659	-10.84465296	-9.296522921	-8.68168146	-9.74154169
150	-18.387595	-13.91281397	-14.0116337	-13.67607767	-12.29549295	-12.62807352	-12.0961445
180	-28.23045999	-20.91376383	-20.41017801	-18.99041635	-17.16829187	-17.85805017	-16.48782236
210	-21.46027262	-18.29897196	-22.47056467	-21.12762339	-21.52654154	-17.50331003	-15.22467691
240	-15.88508112	-13.34326059	-16.36826593	-16.8364361	-16.09681971	-13.78754312	-11.06962091
270	-14.23343546	-11.7158993	-14.27480585	-14.42124826	-13.19761164	-12.17011148	-9.143462008
300	-14.93321115	-12.39210779	-14.76902277	-14.82282526	-13.1656254	-12.00576288	-9.264006442
330	-18.3320492	-15.35246164	-18.96690256	-16.51084406	-15.83097345	-12.25353891	-11.48774988

11.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-12.85803826	-13.42500915	-19.87425561	-22.45825266	-16.97530451	-12.79756202	-8.258213103
30	-13.3033007	-11.16172464	-15.59682919	-15.87396983	-15.32338823	-11.85924403	-8.478484672
60	-13.89171804	-10.12177914	-12.4676643	-12.00865247	-11.71000705	-8.913541963	-8.593484968
90	-13.86334659	-10.05666043	-11.46386933	-10.22474233	-8.963810019	-7.485774514	-8.46714647
120	-13.20866619	-10.38466144	-11.50098087	-10.63155066	-8.792104597	-7.84519024	-8.303608273
150	-12.81574213	-11.11264458	-12.82434533	-12.83430303	-10.7129143	-9.851949407	-8.1649023
180	-12.75824571	-11.54554834	-15.43328736	-15.48133224	-12.42905689	-11.68997509	-8.255376484
210	-13.20955993	-11.21906643	-16.43048675	-15.35425973	-13.4864048	-10.82000853	-8.323449888
240	-13.80255395	-10.94837702	-14.85630297	-13.81309186	-12.67222701	-10.30452423	-8.255375459
270	-14.17741654	-11.33009711	-13.87429041	-13.09543358	-11.86316934	-10.57822196	-8.186195007
300	-13.64689585	-12.19999255	-14.30286641	-14.30329564	-12.45101324	-10.7244441	-7.999743694
330	-13.1092877	-12.85829435	-17.45965842	-16.44979188	-14.4917242	-9.79155792	-8.221263251

11.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.051784069	0.045446358	0.010293769	0.00567773	0.020066404	0.052510215	0.149340874
30	0.046737979	0.076529264	0.027562403	0.025858481	0.029353587	0.065174183	0.141955274
60	0.040815789	0.097234881	0.05665439	0.062970154	0.067452693	0.128423885	0.138245659
90	0.041083302	0.098703819	0.071386003	0.094956734	0.126945993	0.178411378	0.142326363
120	0.047767596	0.09152376	0.070778591	0.086465913	0.132065549	0.164240771	0.147788
150	0.05229086	0.077399034	0.052187377	0.052067856	0.084861083	0.103467763	0.152584272
180	0.052987744	0.070055972	0.028620108	0.028305236	0.057160275	0.067764539	0.149438449
210	0.047757766	0.075525456	0.022748425	0.029145669	0.044808409	0.082794054	0.147114341
240	0.041662431	0.080382646	0.032686597	0.041561462	0.05404771	0.09322826	0.149438484
270	0.038217154	0.073619064	0.040979906	0.049029407	0.065115303	0.087534207	0.151838009
300	0.043182762	0.060256062	0.037129009	0.03712534	0.056872023	0.08463609	0.158498673
330	0.048873251	0.051781016	0.017948748	0.022647528	0.035549016	0.1049166	0.15061689

11.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

12 Sensor Colour NO 3, +0 dBm, 2442 MHz

12.1 Setup

2442 MHz CW

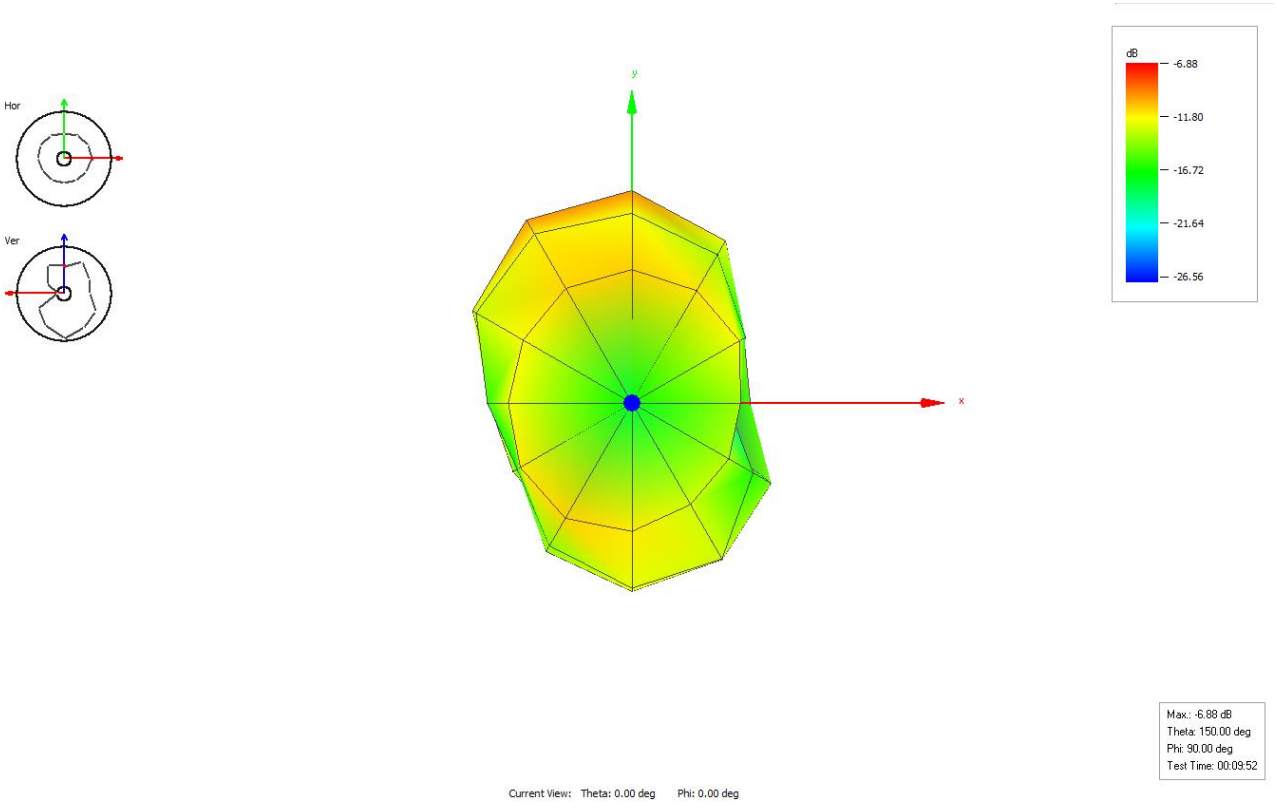
12.2 Summary

The calculations for this section are detailed in **Section 14**.

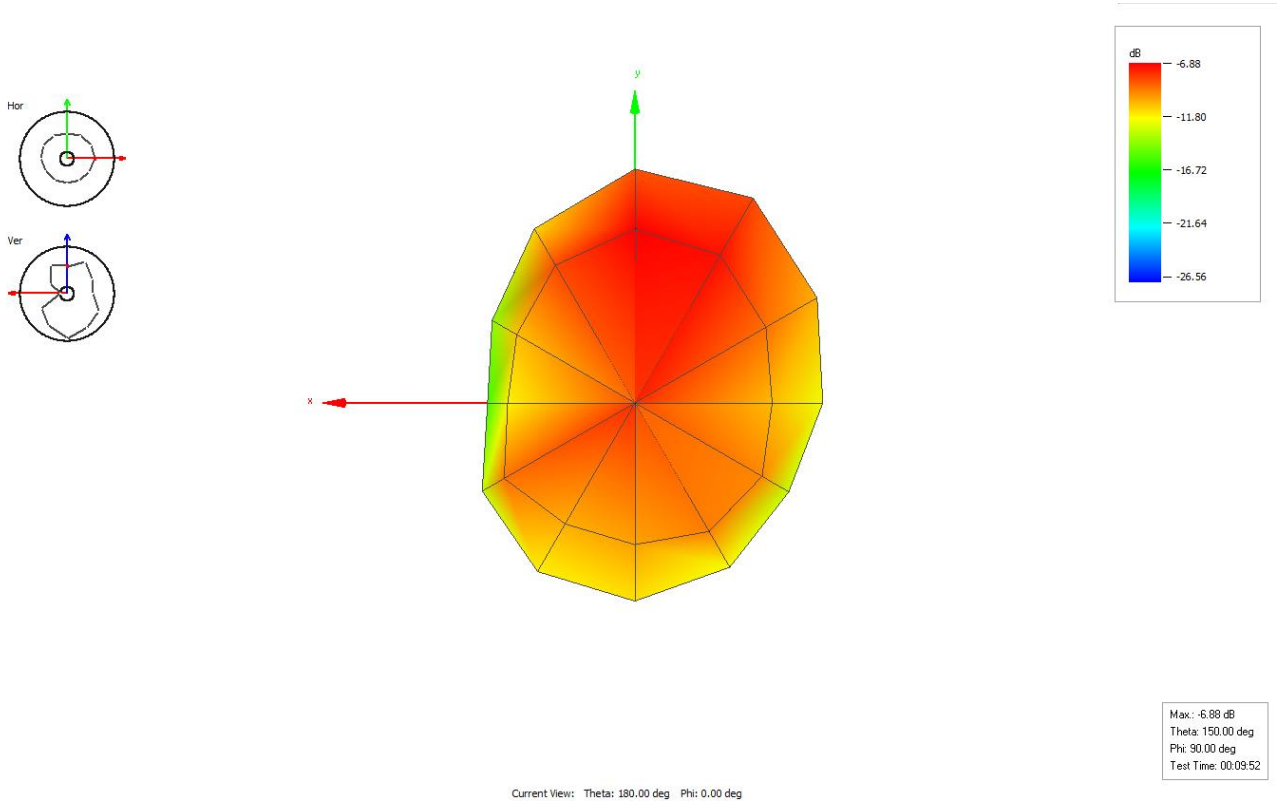
Total Radiated Power	-11.41	dBm
Peak EIRP	-6.88	dBm
Antenna directivity	4.53	dBm
Antenna efficiency	-11.41	dB
Antenna gain	**-6.88**	**dBi**

12.3 Radiation Pattern

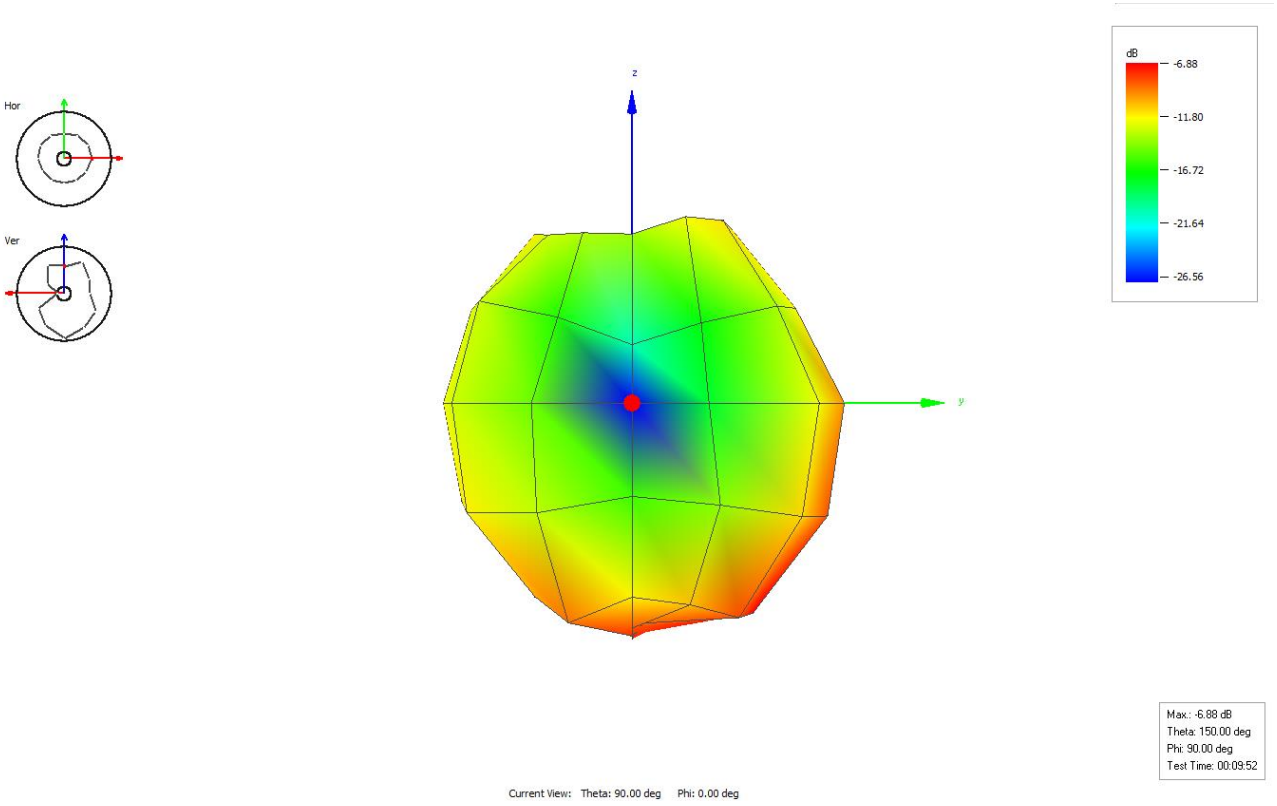
12.3.1 Theta = 0, Phi = 0



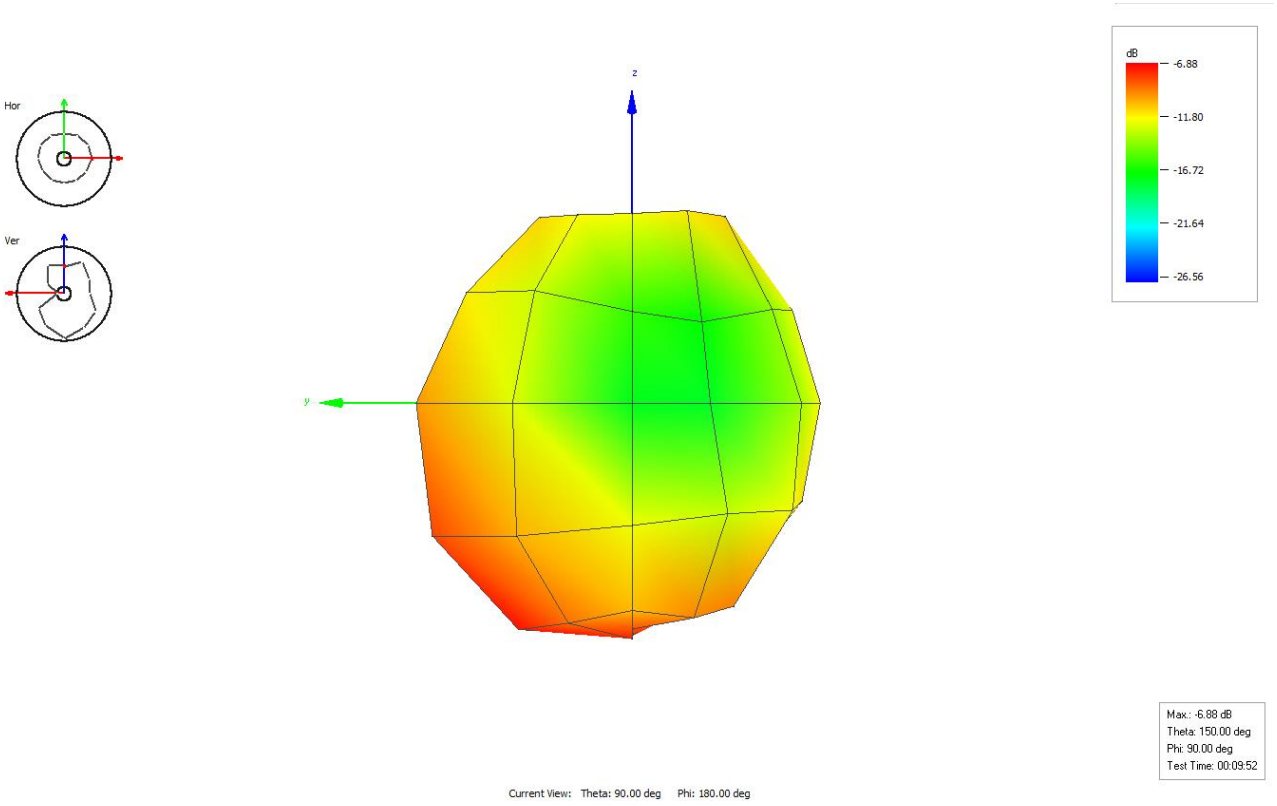
12.3.2 Theta = 180, Phi = 0



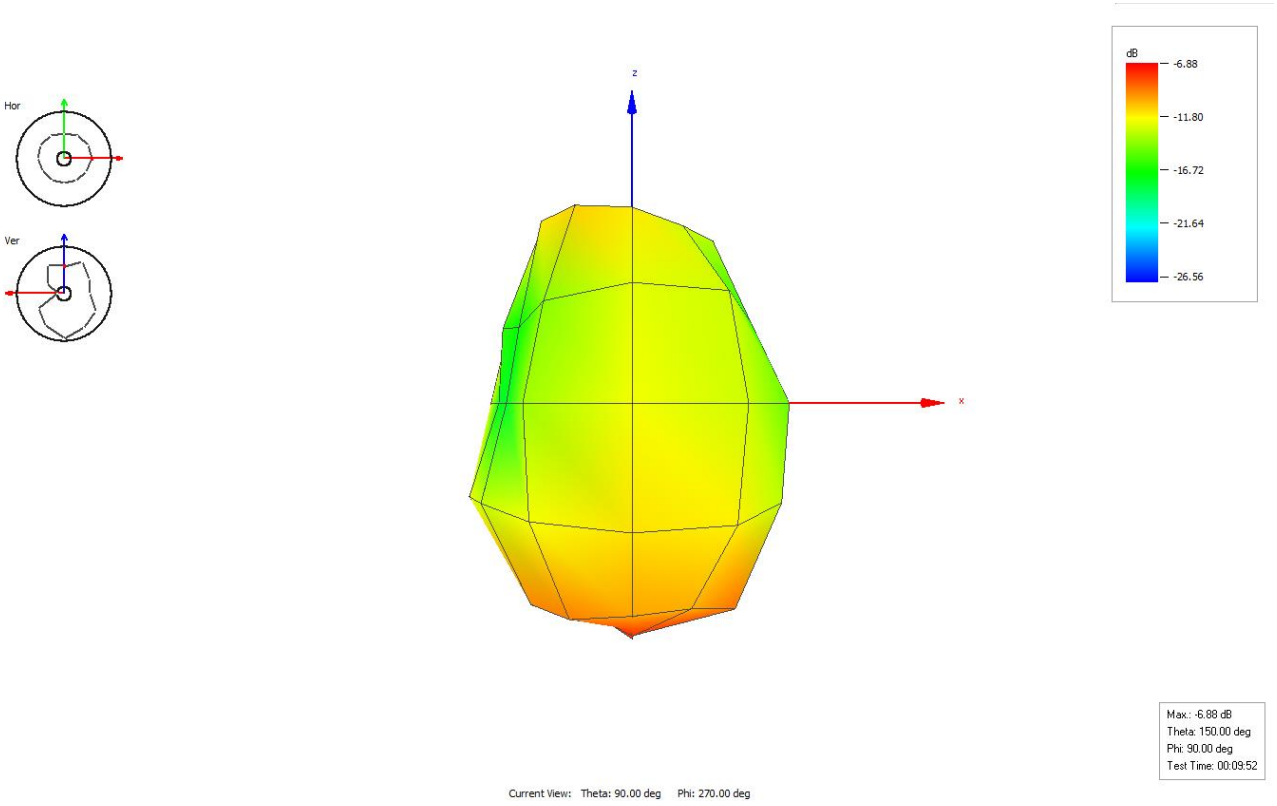
12.3.3 Theta = 90, Phi = 0



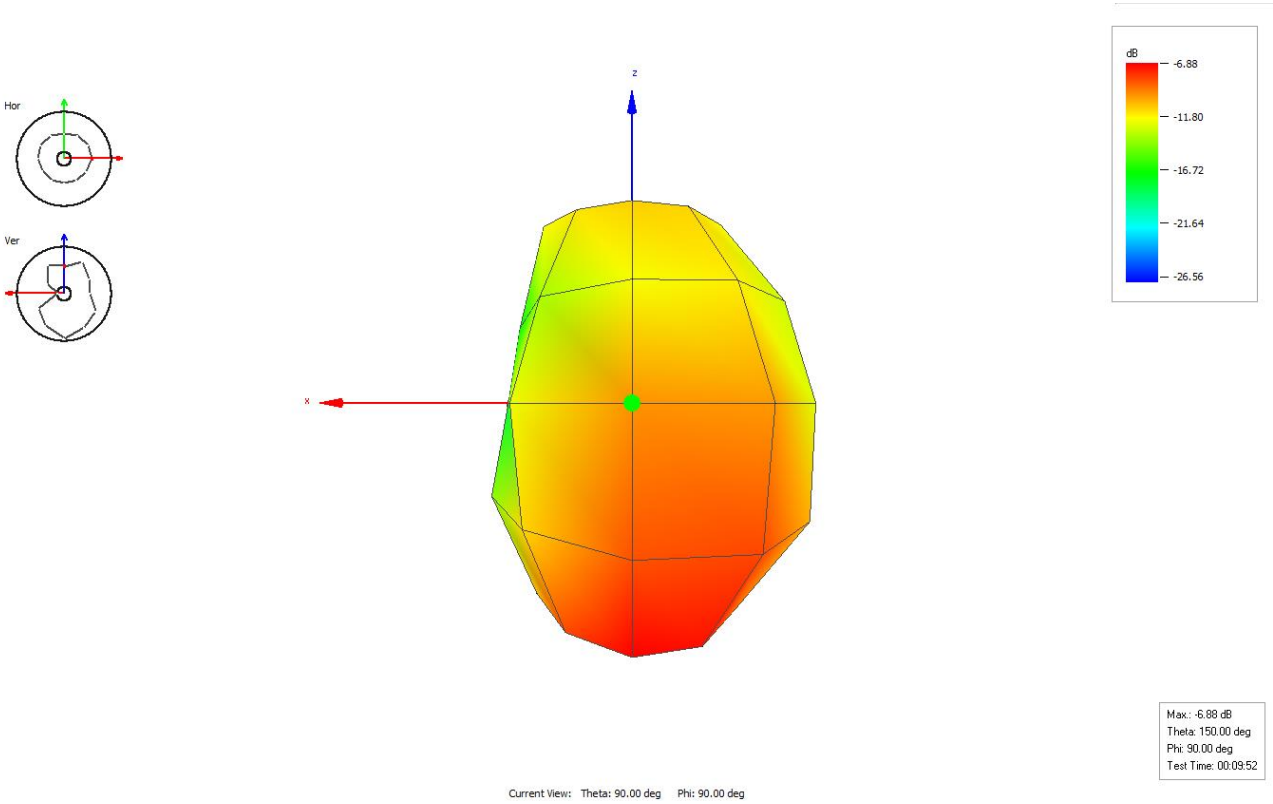
12.3.4 Theta = 90, Phi = 180



12.3.5 Theta = 90, Phi = 270



12.3.6 Theta = 90, Phi = 90



12.4 Measured Data

12.4.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-15.67044728	-13.10393422	-19.075015	-26.95921605	-15.19368642	-11.44576924	-8.269022873
30	-16.50741856	-13.22872441	-20.24941914	-29.38532536	-16.01089375	-11.18748372	-9.100241593
60	-20.42877095	-16.94147771	-24.87246983	-29.524661	-19.65103047	-12.83932011	-12.21481984
90	-33.83059209	-24.39515965	-26.99003117	-29.85484593	-30.75869267	-18.50567143	-16.73726933
120	-22.01961034	-19.60202306	-21.51097386	-21.69380467	-16.97595113	-15.51801579	-13.42744344
150	-17.48869984	-13.95527928	-17.64720052	-19.11936086	-14.0292043	-11.76578038	-9.652556351
180	-16.1597318	-11.69829457	-16.3655042	-18.82916921	-12.86640065	-10.89290135	-8.267077377
210	-17.06102269	-11.87127583	-16.97827046	-19.03718846	-13.47382253	-10.0063123	-8.829176834
240	-20.49817174	-14.79596608	-19.95249837	-19.32222646	-15.08494084	-11.70222752	-11.54672521
270	-31.02916234	-23.53903478	-25.92967503	-20.52537816	-18.20166295	-15.86578648	-16.06140797
300	-23.34032719	-22.28702062	-23.50669377	-23.53037541	-20.00503819	-17.26790517	-13.75558751
330	-18.25702565	-15.24016087	-20.95936101	-29.39222997	-16.99511998	-12.35107701	-10.31983846

12.4.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-28.1061373	-28.36423972	-32.2703295	-28.27826407	-23.75722983	-22.13661673	-18.83286764
30	-22.53293326	-15.98379614	-17.91639426	-16.76141455	-16.58604529	-17.11137869	-16.34409811
60	-18.09508231	-12.08670905	-13.09345343	-11.66355994	-11.16638281	-9.952099822	-11.29239371
90	-16.66599753	-10.6754389	-11.55362036	-9.477082275	-8.306927703	-7.187771819	-9.204865478
120	-17.54628088	-11.18266775	-11.43440344	-9.819397949	-8.700383209	-7.839894317	-9.185143493
150	-20.57978155	-14.57765677	-13.58559134	-12.75900366	-12.07260611	-11.927228	-11.42125418
180	-27.65748312	-23.83310416	-20.16841986	-19.67097952	-17.40153601	-18.02161887	-16.69559195
210	-24.32393362	-18.0268183	-22.06718924	-19.75270941	-18.59334662	-17.09732916	-17.43434241
240	-18.73752692	-12.54375555	-14.33324911	-14.05554297	-13.86892035	-12.55621054	-11.64786246
270	-16.76831915	-11.21599295	-11.92265036	-12.06250098	-11.68152716	-10.91580298	-8.990693115
300	-17.39716818	-12.52947714	-12.4624758	-12.46582892	-11.65110113	-10.77355292	-8.87160971
330	-20.67919638	-16.07988074	-16.5617037	-13.97829535	-14.27482321	-11.44002249	-11.11224463

12.4.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-15.42939732	-12.97647675	-18.87175577	-24.55855341	-14.6276788	-11.09029776	-7.903434647
30	-15.53930095	-11.38105843	-15.91779275	-16.53032126	-13.27865534	-10.19886957	-8.349769033
60	-16.0967256	-10.85806048	-12.81429547	-11.59306713	-10.5906575	-8.149771899	-8.718862706
90	-16.58335828	-10.49482538	-11.43115714	-9.437452196	-8.282302718	-6.878432187	-8.498923802
120	-16.22048546	-10.59878253	-11.02738202	-9.546117862	-8.09814579	-7.15550472	-7.797367591
150	-15.7545479	-11.24502866	-12.14764093	-11.85576181	-9.931338039	-8.835454054	-7.437181276
180	-15.86252145	-11.44045614	-14.85306368	-16.21940983	-11.55678005	-10.12395164	-7.684343315
210	-16.31356842	-10.92883087	-15.80615743	-16.36992993	-12.30892929	-9.231222687	-8.2682338
240	-16.51893231	-10.5151712	-13.2808567	-12.92482538	-11.42420837	-9.097962239	-8.586699474
270	-16.60847987	-10.96878574	-11.75337621	-11.48406682	-10.80784306	-9.710423205	-8.212278608
300	-16.41246901	-12.09294087	-12.13375819	-12.13858998	-11.058932	-9.895158881	-7.65014035
330	-16.29109204	-12.62945713	-15.21587231	-13.85520562	-12.41507551	-8.861403566	-7.687693967

12.4.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.028645755	0.050390924	0.01296655	0.003500617	0.034453403	0.077798321	0.162052799
30	0.027929934	0.072760246	0.025598866	0.022231454	0.047003962	0.09552412	0.146225494
60	0.024565604	0.082071799	0.052308282	0.069293626	0.087283921	0.153116788	0.134311664
90	0.02196161	0.08923135	0.071925731	0.113829487	0.148514798	0.205190279	0.141288762
120	0.023875444	0.087120778	0.07893358	0.111016674	0.154947802	0.192508331	0.166059315
150	0.026579402	0.07507531	0.060986808	0.065226461	0.101593564	0.130753883	0.180418834
180	0.025926737	0.071771891	0.032710986	0.023881358	0.069875028	0.097186252	0.170437701
210	0.023369163	0.080745237	0.026265414	0.023067844	0.058763421	0.1193652	0.14899669
240	0.022289831	0.088814297	0.046980143	0.05099381	0.072040905	0.123084616	0.138461825
270	0.021834941	0.080005792	0.066782455	0.071054783	0.083026302	0.106895071	0.150928807
300	0.022842998	0.061759805	0.061182072	0.061114041	0.078362233	0.10244343	0.171785287
330	0.023490421	0.054582609	0.030089347	0.041160386	0.05734459	0.129974945	0.170306257

12.4.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

13 Sensor Colour NO 3, +0 dBm, 2480 MHz

13.1 Setup

2480 MHz CW

13.2 Summary

The calculations for this section are detailed in **Section 14**.

Total Radiated Power	-12.06	dBm
Peak EIRP	-6.84	dBm
Antenna directivity	5.23	dBm
Antenna efficiency	-12.06	dB
Antenna gain	**-6.84**	**dBi**

13.3 Measured Data

13.3.1 Horizontal Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-14.78250758	-15.04272334	-22.6173617	-25.43269984	-15.80763117	-12.60957209	-7.422434488
30	-15.58553187	-16.58999888	-25.1822497	-22.41772334	-15.134154	-11.91660182	-7.893511453
60	-18.97417704	-20.8519427	-33.69563929	-21.604201	-17.33046595	-12.34686534	-10.63641993
90	-29.3871905	-34.22085444	-27.31422297	-27.73016993	-26.81117884	-16.6005427	-15.71995799
120	-24.37446467	-21.36011378	-21.21330134	-24.97973506	-21.05300776	-17.74035517	-14.31526438
150	-17.74602763	-16.35745875	-18.16377513	-19.81259791	-15.86398951	-13.51637904	-9.686373391
180	-15.4005572	-14.29633586	-17.23747508	-18.16068141	-13.64948908	-12.11555735	-7.587134042
210	-15.53578059	-14.50474803	-18.40716044	-18.02247492	-13.44885127	-10.38398997	-7.823786416
240	-18.37117259	-18.07726924	-21.88966242	-18.42394892	-14.76302592	-11.1359698	-10.32363001
270	-26.62728755	-29.93306605	-25.4545962	-19.79498927	-18.28555552	-14.75766245	-15.76412837
300	-25.33060328	-22.08416621	-22.91446559	-22.93424098	-23.86390559	-19.22520701	-14.81315486
330	-18.42850749	-16.42326991	-21.91083399	-28.91651026	-19.19602458	-14.59342066	-10.38314311

13.3.2 Vertical Power (dBm)

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-21.77720934	-35.89156633	-35.56372362	-28.86275011	-26.71900469	-21.39809709	-16.5136252
30	-29.00790697	-19.04311663	-20.06575304	-17.09994036	-17.45376116	-17.63411623	-15.9896689
60	-17.68550783	-14.08436495	-14.85336977	-12.51768022	-12.21753984	-10.42422777	-11.05148989
90	-14.0949164	-12.0182181	-12.79960161	-10.27161699	-9.385676439	-7.633688982	-8.694720324
120	-13.45183473	-12.46549898	-12.27623659	-10.54553514	-9.653002794	-8.166564043	-8.503615435
150	-15.10741335	-15.33836275	-14.06237322	-13.32154375	-12.91266542	-12.05545336	-10.40151506
180	-20.20051103	-23.11037737	-20.0503264	-20.15617662	-19.08216387	-18.06651598	-14.83190447
210	-27.64647203	-21.25174242	-24.88960558	-20.4527083	-20.10667711	-17.51034456	-16.03439241
240	-18.65080934	-14.82773882	-16.04166323	-13.74484545	-13.39590364	-12.57977587	-11.11663347
270	-14.86498934	-13.19792467	-13.71639925	-11.52067858	-11.0024901	-10.84741121	-8.456625994
300	-13.60060793	-14.04835802	-14.26305681	-12.20145708	-11.31609255	-10.65359407	-8.17428499
330	-14.43087679	-17.11781603	-17.962287	-14.26316744	-14.76072222	-11.07294756	-9.972796496

13.3.3 Total Power (dBm)

$$P_{dBm} = 10\log(10^{P_{hor}/10} + 10^{P_{ver}/10})$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	-13.99152834	-15.00715036	-22.4024026	-23.80724586	-15.46909116	-12.07043861	-6.917567061
30	-15.39239979	-14.63530676	-18.90014737	-15.98088299	-13.13059868	-10.88516881	-7.267621076
60	-15.27191893	-13.25473418	-14.79704002	-12.01230004	-11.05109343	-8.269709406	-7.828698132
90	-13.96838022	-11.99214358	-12.64867904	-10.19433837	-9.307812734	-7.115000698	-7.908810642
120	-13.11413784	-11.93861805	-11.75418456	-10.39184113	-9.349258528	-7.712115566	-7.491913111
150	-13.21903819	-12.80778706	-12.63560221	-12.44254559	-11.13200509	-9.714473511	-7.018940801
180	-14.15833734	-13.76017355	-15.40974387	-16.03451209	-12.55626408	-11.13243934	-6.836806503
210	-15.27654831	-13.67153097	-17.52658358	-16.05947498	-12.59993523	-9.614656742	-7.213082436
240	-15.49844071	-13.14511458	-15.03748982	-12.47224702	-11.01559067	-8.787848236	-7.691756988
270	-14.58478869	-13.10678546	-13.4346888	-10.91827834	-10.25821627	-9.36626144	-7.716191745
300	-13.3183819	-13.41431909	-13.70769084	-11.84926676	-11.08102292	-10.08857169	-7.321997233
330	-12.97479737	-13.74637336	-16.49216909	-14.11691044	-13.42489031	-9.47552306	-7.162825155

13.3.4 Total Power (mW)

$$P_{mW} = 10^{P_{dBm}/10}$$

θ (degrees) \ φ (degrees)	0	30	60	90	120	150	180
0	0.039888451	0.031570755	0.005751217	0.004161745	0.02838513	0.062080633	0.203349587
30	0.02889083	0.034392942	0.012882058	0.025229678	0.048634016	0.081561108	0.187602185
60	0.029703533	0.047263576	0.033135688	0.062917288	0.078503796	0.148946074	0.164865653
90	0.040101626	0.063209978	0.054341559	0.095623836	0.117278587	0.194312138	0.161852323
120	0.048818701	0.063993844	0.066770026	0.09137258	0.116164693	0.169351264	0.178159378
150	0.047653651	0.05238673	0.054505431	0.056983017	0.077054763	0.106795425	0.198657936
180	0.038385417	0.042070982	0.028775681	0.024920043	0.055510302	0.077047059	0.207166415
210	0.029671887	0.042938503	0.017674276	0.024777216	0.054954907	0.1092784	0.189972945
240	0.02819395	0.048471732	0.031350973	0.056594639	0.07914818	0.132195045	0.170147002
270	0.034795344	0.048901418	0.045345179	0.080941671	0.094227653	0.115710789	0.16919239
300	0.046575959	0.045558361	0.042582477	0.065324083	0.077964645	0.097981217	0.185267942
330	0.050410414	0.042204879	0.022427615	0.038753324	0.045447602	0.112836003	0.192184113

13.3.5 Measured Conducted Output Power (dBm)

$$P_{cond} = 0\ dBm$$

14 Calculation of Antenna Parameters

14.1.1 TRP (dBm)

Calculation of the Total Radiated Power was made according to:

Test Plan for Wireless Device Over-the-Air Performance, CTIA 01.90, Version 6.0.1

(https://ctiacertification.org/wp-content/uploads/2021/02/CTIA-01.90-Informative-Reference-Material-V6_0_1.pdf)

For a complete sphere, N and M define the number of measured angular intervals in theta, θ and phi, φ, respectively, both with even angular spacing:

$$N = 12$$

$$M = 7$$

Total Radiated Power (*TRP*):

$$TRP \cong \frac{1}{2}\sum_{i=0}^{N} w_i cut_i$$

where

$$cut_i \cong \frac{1}{M}\sum_{j=0}^{M-1}\left[EIRP_\theta(\theta_i,\varphi_j) + EIRP_\varphi(\theta_i,\varphi_j)\right]$$

is the average power for the phi cut at each theta angle (including the poles at index *0* and *N* if needed),

and

$$w_i = \frac{c_i}{N}\left[1 - \sum_{j=1}^{int\left(\frac{N}{2}\right)} \frac{b_j}{4j^2-1}\cos(2j\theta_i)\right]$$

is the Clenshaw-Curtis weighting factor, with

$$b_j = \begin{cases} 1, & 2j = N \\ 2, & otherwise \end{cases}$$

and

$$c_i = \begin{cases} 1, & i = 0 \; or \; N \\ 2, & otherwise \end{cases}$$

The final result is then converted to dBm:

$$TRP_{dBm} = \; 10\log_{10}(TRP_{mW})$$

14.1.2 Peak EIRP (dBm)

The peak EIRP, $EIRP_{PEAK}$ is the largest value of calculated Total Power (dBm).

14.1.3 Directivity (dBm)

$$D = EIRP_{PEAK} - TRP_{dBm}$$

14.1.4 Efficiency (dB)

The antenna efficiency, Eff_{dB} is calculated using:

$$Eff_{dB} = TRP_{dBm} - P_{cond}$$

Where P_{cond} is the measured conducted output power in dBm.

14.1.5 Gain (dBi)

The antenna gain, G is calculated using:

$$G = D + Eff_{dB}$$