Test Report Cover Sheet

TÜV Rheinland LGA Products GmbH

for SIGFOX [GPS Tracker]

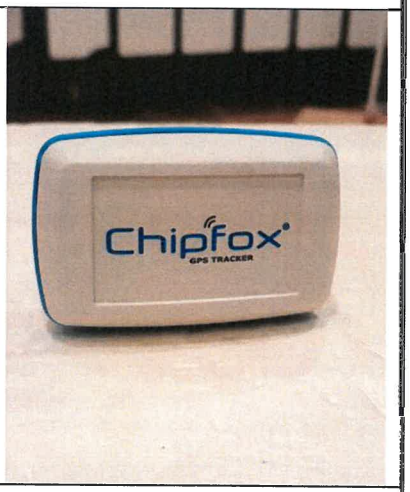
according to

SIGFOX READY certification for End Products
Test Specification for certification labs
Rev. 0.1 Date: 15th August 2017

This cover sheet is not part of the test report and does not carry a page number.

TÜVRheinland®

Prüfbericht-Nr.: *Test Report No.:*	21287637_002	**Auftrags-Nr.:** *Order No.:*	3244638_030	Seite 2 von 15 *Page 2 of 15*
Kunden Referenz-Nr.: Client Reference No.:		**Auftragsdatum:** *Order date:*	2018-01-31	
Auftraggeber: *Client:*	Carius TECH spol. s r.o. Na Folimance 2155/15 120 00 PRAHA 2 - VINOHRADY TSCHECHISCHE REPUBLIK			
Prüfgegenstand: *Test item:*	GPS Tracker			
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	GPS Tracker			
Auftrags-Inhalt: *Order content:*	SIGFOX Ready specification			
Prüfgrundlage: *Test specification:*	SIGFOX certification for End Products, Test Specification for certification labs, Rev. 1.1, Date: 26th August 2016			
Wareneingangsdatum: *Date of receipt:*	2018-01-24			
Prüfmuster-Nr.: *Test sample No.:*	A000187852			
Prüfzeitraum: *Testing period:*	2018-02-09 – 2018-02-13			
Ort der Prüfung: *Place of testing:*	Nürnberg / Nuremberg			
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland LGA Products GmbH Tillystrasse. 2, 90431 Nürnberg, Germany			
Prüfergebnis: *Test results:*	PASS			



Geprüft von *Tested by:*			**Kontrolliert von** *Reviewed by:*		
07.06.2018	Alaa El-Din Essam, SV		07.06.2018	T. Zahlmann, PM	
Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*

Sontiges / *Other:*

The test was performed as a reference test.
For details refer to page 4 of this report.

The test result "PASS" above refers indicates that test have been conducted according to the Sigfox specifications. No PASS / FAIL criteria have been given.
The conducted spurious emission test result complies also with the Japanese Radio Law.

Table of contents

1 EXECUTIVE SUMMARY

TÜV Rheinland is an international TIC (testing, inspection and certification) organization supporting the international community with necessary requirements for promoting safety, performance and quality in many industry verticals. TÜV Rheinland has been assigned and authorized by SIGFOX as a preferred test lab to undertake testing to their requirements as stated below. Please find in this report the details of the EUT and subsequent testing undertaken with final conclusions in terms of test results.

When building at first a RF Module or Reference Design, the device maker has to present its device as **SIGFOX Verified™ certification**. This certification handles all the Sigfox RF performance and protocol tests executed in conducted (modulated) mode:

Test	RF and Protocol Tests	Performed	Test-Setup	OP. Mode	Verdict Pass/Fail
A	**Test Cases – conducted**	unconditional	---	---	NA

Note: Please read https://resources.sigfox.com/document/be-prepared-for-sigfox-verified-certification

TÜV Rheinland® provides the following test cases summary in accordance with **SIGFOX Ready™** requirements:

Test	RF Test	Performed	Test-Setup	OP. Mode	Verdict Pass/Fail
A1	**Effective Radiated Power in 2 dimensions**	unconditional (fixed EUT)	---	CW	Pass
A2	**Radiation pattern in 2 dimensions**	unconditional (fixed EUT)	---	CW	Pass
B1	**Effective Radiated Power in 3 dimensions**	unconditional*)	---	CW	Pass
B2	**Radiation pattern in 3 dimensions**	unconditional*)	---	CW	Pass
C 1	**Spurious emissions – radiated**	N/A	---	---	NA
C2	**Spurious emissions - conducted**	N/A	---	---	NA
D	**Sensitivity radiated**	conditional	---	---	NA

Notes: - *) If EUT used not as fixed device and declared as portable/mobile shall tested as 3D, only.
- C1/C2 additionally performed for reference. This is not part of the requirements for Sigfox Ready.

2 PRODUCT INFORMATION

General information	
Description:	The product is a battery operated Sigfox radio transmitter with GPS receiver and integrated antennas. Built-in temperature sensor.
Manufacturer Serial Number	TD1205P
Hardware version:	1.0
Software version:	1.2
SIGFOX testing accordance	■ READY™ □ VERIFIED™ (s. page 4) □ BOTH Optional: □ A □ C1 □ C2
Regulatory tests	□ YES ■ NO General for which region(s)/country or RCx? RC1
Contact person:	Jan Schick (schick@chipfox.cz)
Phone number:	+420 602 800 430

SIGFOX EUT and AE Information	
Type of EUT A	Battery operated Sigfox transmitter with GPS receiver.
Intended use:	Tracking and securing of non-powered assets. People and pets geolocation.
Auxillary Equipment	-
Test-Setup 1	Chipfox device only
Device Class	-
Geographical area of operation	Czech Republic
Operating frequency	868.13 MHz
Output Power	15 dBm (radiated measurement, see chapter 6)
Number / Type of Antenna(s)	1, 1/4 wave
Antenna Gain	Permanent antenna
Modulation	DBPSK and GFSK
Testing modulation (Op. mode)	□ Modulated [CM] ■ Unmodulated [Continous Wave (CW)]
Duty Cycle	Normal operating mode: max 1% (100 % during the tests)
Power supply	□ DC ■Battery □ AC
Voltage	3 V

Submitted Documents

- No documents provided by the costumer

Remarks

- Recommended to have a radiated sample at least two or more (CW unmodulated mode).
- Optional: Conducted power at SMA connector port (CM mode).
  Depends on certification region and regulatory tests required beside SIGFOX requirements.
- EIRP Equivalent isotropic radiated power in vertical and horizontal polarization (CW mode)
- Radiation pattern in both polarizations (CW mode)
- Optional: Conducted spurious (CM mode). Depends on certification region
  and regulatory tests required beside SIGFOX requirements.
- Optional: Radiated spurious in both polarizations (CM mode) and depends on certification region,
  and regulatory tests required beside SIGFOX requirements.

- If your EUT has some restrictions please describe here below in the table:

Issue	Suggestion/ Remark	Comment by

3 TEST EQUIPMENT

Kind of Equipment	Manufacturer	Model Name	Equip. ID	Next Cal.
For Radiated Pattern				
Measurement Software	GNU Octave	octave-4.2.0-w64	Lxi_interface5\ amstest2.m	-
Software (Graph)	GNU Octave	octave-4.2.0-w64	Antgui2\ag4.m	-
Anechoic chamber	TDK	10 m / 3 m	NSA 30 MHz – 1 GHz SVSWR 1 – 40 GHz	15.02.2019 16.02.2020
Antenna, 0.8 – 18 GHz (2D + 3D pattern)	Rohde & Schwarz	HL025	05377	09-2019
Receiver	Rohde & Schwarz	ESU 26	05370	31.10.2018

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.

4 MEASUREMENT UNCERTAINTY

Measurement Type	Frequency	Uncertainty
Radiated Emission (TDK Semi-Anechoic Chamber with absorber on the floor: 3m)	30 MHz – 12.75 GHz	4.05 dB

5 TEST SET-UP AND OPERATION MODES

Test Methodology

Radio: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Operation Modes

The basic operation mode used for testing is:

A. EUT transmits an unmodulated signal at nominal frequency (868.125 MHz) with 100% duty cycle.

The EUT was operated on battery power and not connected to any external equipment during the test
It was taken care that the battery was sufficiently charged to not influence the test result.

6 TEST RESULTS

Radiation Pattern (2D + 3D) and EIRP

Date of testing:	2018-02-09
Ambient temperature:	23 °C
Relative humidity:	27 %
Atmospheric pressure:	1016 hPa
Reference standard:	EN 300 220-2 V2.4.1, clause 4.2.1.3 (*) and SIGFOX certification for End Products, Rev. 1.1
Test procedure:	EN 300 220-1 V2.4.1.clause 7.3 (*) and SIGFOX certification for End Products, Rev. 1.1
Measurement distance:	3 m
Kind of test site:	Full Anechoic Chamber
Supply voltage during testing:	DC 3 V (battery powered)
Test mode applied:	Mode A

(*) As the EIRP measurement the European EN standards were used as reference for this measurement. The pass/fail verdict is based on the EIRP measurement reported in the next section.

The EUT was placed on a styrene foam table in a full anechoic chamber and set to produce an unmodulated signal. The power emitted by the EUT was measured by a test antenna connected to a spectrum analyzer.

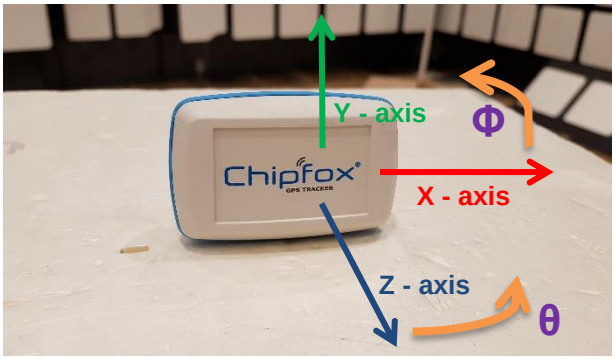
The measurement was performed for both horizontal and vertical polarizations of the test antenna. The table was rotated in order to find the maximum emission angle and the measured power was corrected by a substitution method factor.

This correction factor was obtained by replacing the EUT by a substitution antenna connected to a signal generator (SG). The factor was calculated based on the known SG output power, substitution antenna gain and reading of the spectrum analyzer.

Measurements were performed with a spectrum analyzer using the Sample detector with a resolution bandwidth 100 kHz and a video bandwidth of 300 kHz.

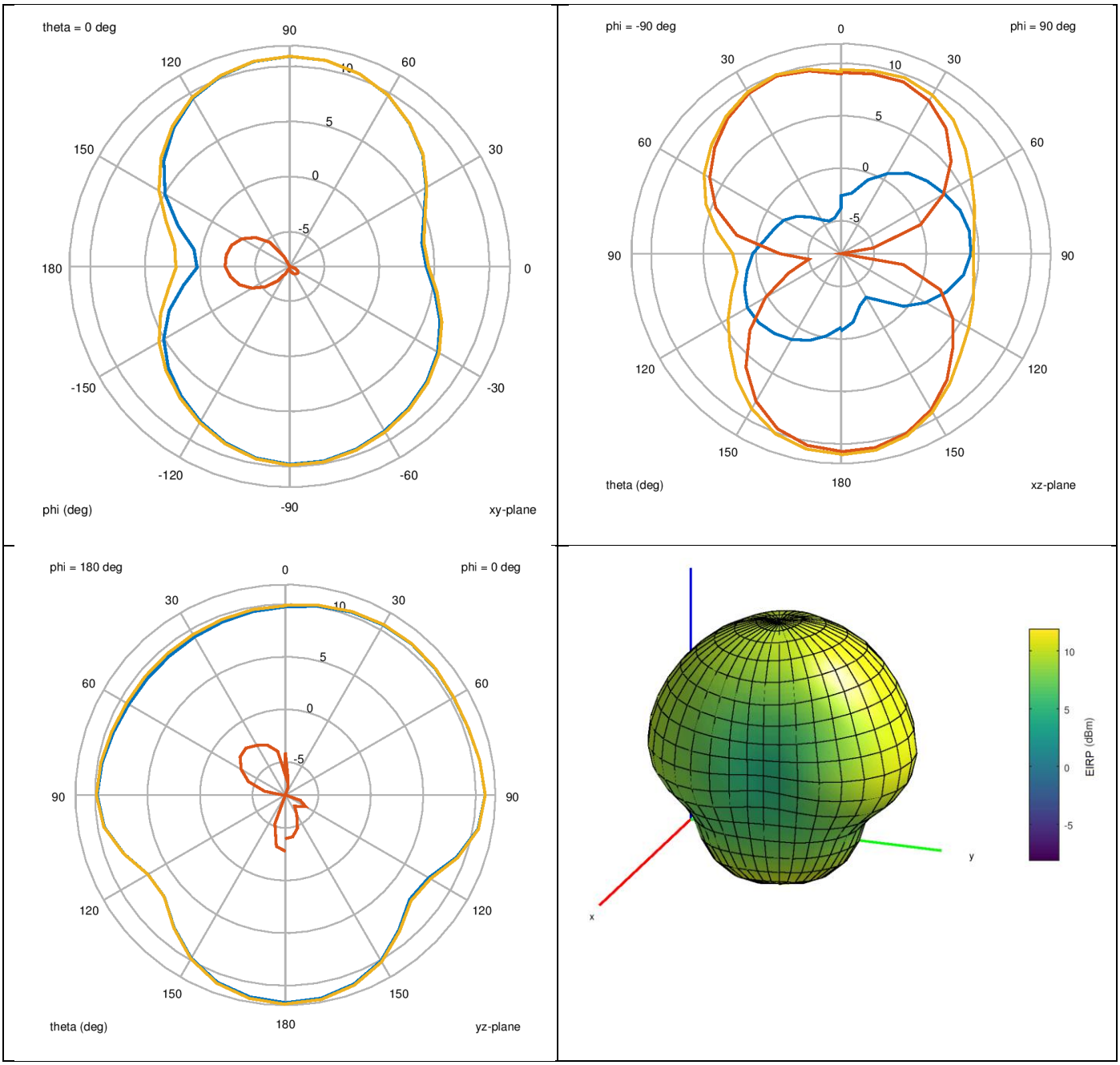
The measurements were taken during the full rotation and are recorded in 10 degree steps.
The highest value is indicated as maximum EIRP.

Antenna Axis:



Graph: Radiation Patterns

horizontal measurement
combined measurement
vertical measurement



Note: This are the reading values directly at the measurement receiver.
The maximum power output is 13.95 dBm (see next chapter).

Equivalent Isotropic Radiated Power (EIRP)

Date of testing:	2018-02-09
Ambient temperature:	23 °C
Relative humidity:	50 %
Atmospheric pressure:	1016 hPa
Reference standard:	EN 300 220-2 V2.4.1, clause 4.2.1.3 (*) and SIGFOX certification for End Products, Rev. 1.1
Test procedure:	EN 300 220-1 V2.4.1.clause 7.3 (*) and SIGFOX certification for End Products, Rev. 1.1
Measurement distance:	3 m
Kind of test site:	Semi Anechoic Chamber
Supply voltage during testing:	DC 3 V (battery powered)
Test mode applied:	Mode A

(*) As the EIRP measurement the European EN standard was used as reference for this measurement. The limit is indicated as reference based on this EN standard.

The maximum EIRP is derived from the EIRP radiation pattern in the previous section. The angle represents the center of the recorded maximum values.

Note: Equivalent Isotropic Radiated Power = Reading + Factor
Factor = SG output power – SG cable loss + Substitution antenna gain (in dBi) – Associated reading (on spectrum analyzer)

Equivalent Isotropic Radiated Power (EIRP) @ 3 m
800M - 1GHz @TDK (EIRP)

#1145
3244638_030
09.02.2018

Gehäuse / Enclosure

RMS (2)

Frequency (MHz)	Level (dBm)	Limit (dBm) RC1 Class 0u	Margin (dB)	Pol.
868.125	13.95	16.00	2.05	Horizontal
868.125	13.05	16.00	2.95	Vertical
868.125	14.05	16.00	1.95	Vertical + Horizontal (combined)

—

Bemerkung / *Remark*: Margin value = Measurement value – Limit value

7 PHOTO DOCUMENTATION

Photo 1: EUT front view

Photo 2: EUT front view mounted

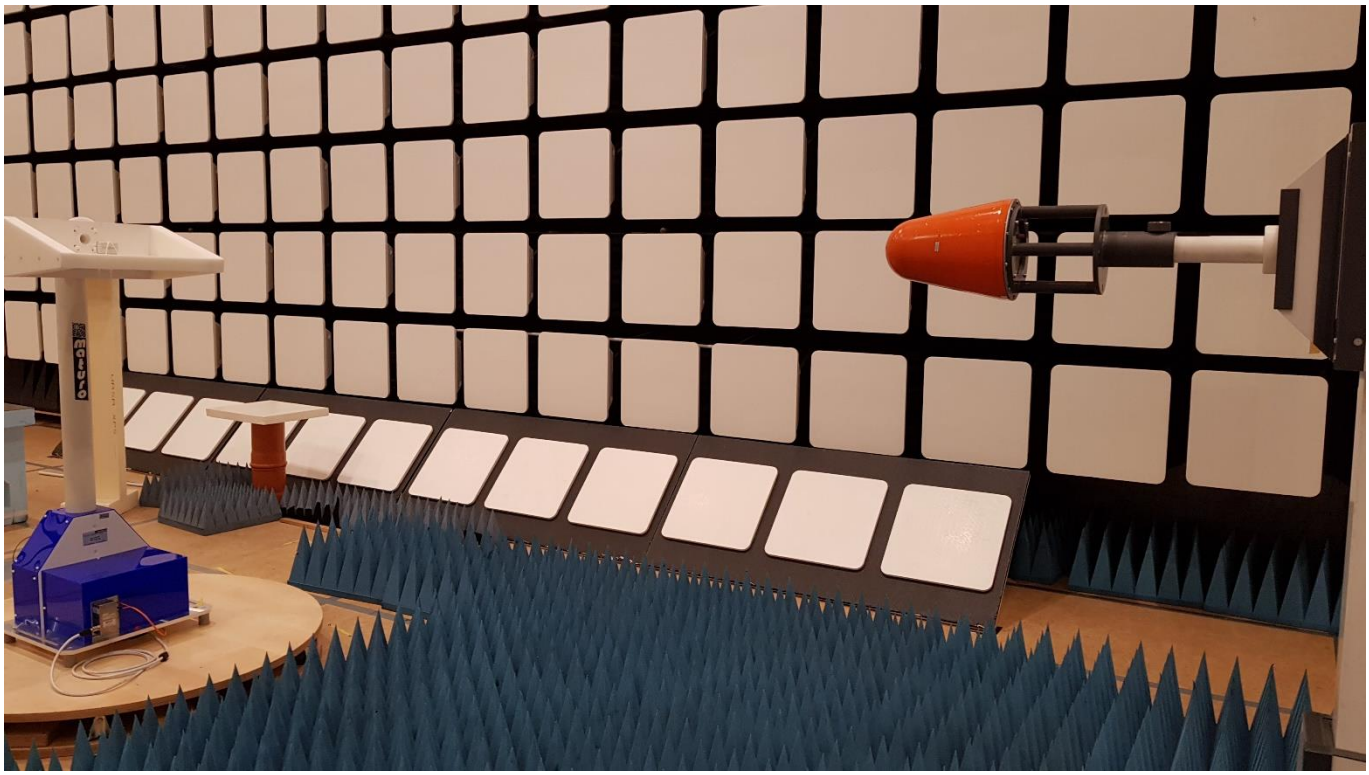


Photo 3: Test Setup Radiated Measurements (2D + 3D Pattern)

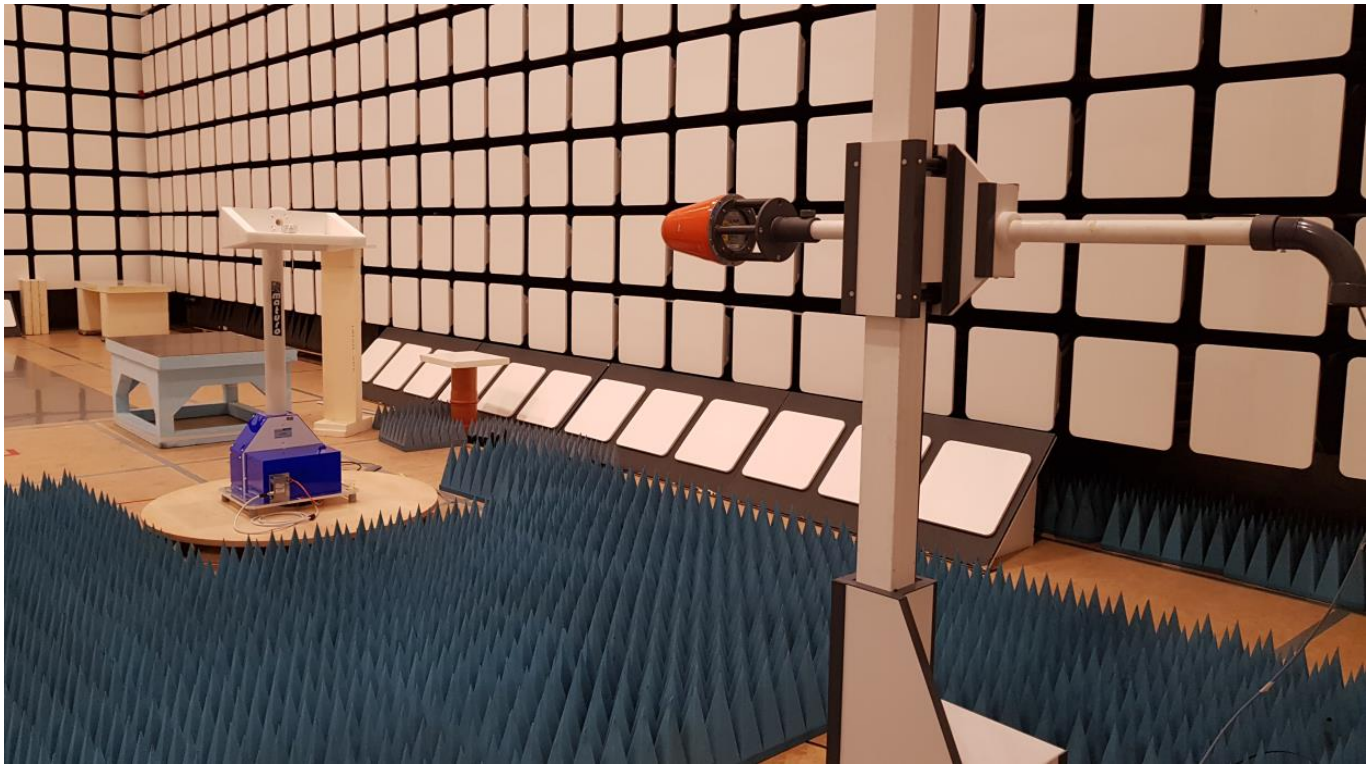


Photo 4: Test Setup Radiated Measurements (EIRP) @ 3 m

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Measurement data table:

Theta	Phi	Vertical	Horiz.	Comb.
0	-180	3.05	11.15	11.75
0	-170	1.85	11.35	11.85
0	-160	5.75	11.25	12.35
0	-150	5.35	10.85	11.95
0	-140	6.75	10.25	11.85
0	-130	7.85	9.25	11.65
0	-120	9.45	7.85	11.75
0	-110	10.65	5.85	11.95
0	-100	11.45	2.95	12.05
0	-90	11.85	-1.95	12.05
0	-80	12.05	-15.05	12.05
0	-70	11.95	-5.85	12.05
0	-60	11.65	1.25	12.05
0	-50	11.05	4.85	11.95
0	-40	10.05	7.15	11.85
0	-30	8.75	8.85	11.85
0	-20	6.95	9.95	11.75
0	-10	4.15	10.75	11.65
0	0	-0.45	11.25	11.55
0	10	-11.85	11.45	11.45
0	20	-5.45	11.35	11.45
0	30	1.75	11.05	11.55
0	40	5.55	10.35	11.55
0	50	7.85	9.25	11.65
0	60	9.45	7.65	11.65
0	70	10.65	5.35	11.75
0	80	11.45	1.95	11.95
0	90	11.85	-4.15	11.95
0	100	12.05	-17.95	12.05
0	110	11.85	-3.45	11.95
0	120	11.45	2.05	11.95
0	130	10.75	5.25	11.85
0	140	9.85	7.25	11.75
0	150	8.35	8.85	11.55
0	160	6.15	10.05	11.55
0	170	3.25	10.75	11.45
0	180	-1.65	11.15	11.35
10	-180	-1.45	11.65	11.85
10	-170	-10.15	11.85	11.85
10	-160	-2.35	11.65	11.75
10	-150	2.75	11.15	11.75

Theta	Phi	Vertical	Horiz.	Comb.
10	-140	5.85	10.45	11.75
10	-130	7.95	9.45	11.75
10	-120	9.35	7.95	11.75
10	-110	10.55	5.95	11.85
10	-100	11.25	3.15	11.85
10	-90	11.75	-1.75	11.95
10	-80	11.85	-13.85	11.95
10	-70	11.85	-6.95	11.85
10	-60	11.55	0.65	11.85
10	-50	10.95	4.65	11.85
10	-40	10.05	7.05	11.85
10	-30	8.75	8.75	11.75
10	-20	6.95	9.95	11.75
10	-10	4.35	10.85	11.65
10	0	-0.15	11.35	11.65
10	10	-8.65	11.65	11.75
10	20	-3.75	11.65	11.75
10	30	2.55	11.25	11.85
10	40	6.15	10.65	11.95
10	50	8.35	9.65	12.05
10	60	9.95	7.95	12.15
10	70	11.05	5.65	12.15
10	80	11.85	2.25	12.25
10	90	12.25	-4.45	12.35
10	100	12.25	-17.15	12.35
10	110	12.05	-1.75	12.25
10	120	11.55	3.35	12.15
10	130	10.75	6.35	12.05
10	140	9.65	8.25	12.05
10	150	8.15	9.65	11.95
10	160	5.75	10.65	11.95
10	170	2.65	11.35	11.85
10	180	-2.55	11.65	11.85
20	-180	-1.25	12.05	12.25
20	-170	-6.15	12.05	12.15
20	-160	-0.55	11.85	12.05
20	-150	3.45	11.35	12.05
20	-140	6.15	10.65	11.95
20	-130	8.05	9.55	11.85
20	-120	9.35	8.05	11.75
20	-110	10.35	6.15	11.75

Theta	Phi	Vertical	Horiz.	Comb.
20	-100	11.05	3.25	11.65
20	-90	11.55	-0.95	11.75
20	-80	11.75	-10.75	11.75
20	-70	11.65	-7.75	11.75
20	-60	11.45	0.25	11.75
20	-50	10.95	4.25	11.75
20	-40	10.15	6.85	11.85
20	-30	8.95	8.65	11.85
20	-20	7.35	9.85	11.85
20	-10	4.95	10.75	11.75
20	0	1.45	11.45	11.85
20	10	-2.55	11.75	11.85
20	20	-0.45	11.75	11.95
20	30	3.75	11.45	12.15
20	40	6.85	10.75	12.25
20	50	8.85	9.75	12.35
20	60	10.45	8.15	12.45
20	70	11.45	5.85	12.55
20	80	12.15	2.05	12.55
20	90	12.45	-5.25	12.55
20	100	12.55	-12.45	12.55
20	110	12.25	-0.85	12.45
20	120	11.65	4.35	12.45
20	130	10.75	7.05	12.35
20	140	9.65	8.85	12.35
20	150	7.95	10.15	12.25
20	160	5.55	11.15	12.25
20	170	2.35	11.75	12.25
20	180	-2.65	12.05	12.15
30	-180	-1.65	11.65	11.85
30	-170	-2.75	11.65	11.75
30	-160	1.25	11.35	11.75
30	-150	4.45	10.85	11.75
30	-140	6.65	10.15	11.75
30	-130	8.25	9.15	11.75
30	-120	9.45	7.75	11.65
30	-110	10.35	5.85	11.65
30	-100	10.95	3.65	11.65
30	-90	11.35	-0.55	11.65
30	-80	11.55	-7.75	11.65
30	-70	11.55	-9.55	11.55
30	-60	11.35	-1.05	11.55
30	-50	10.85	3.15	11.55
30	-40	10.15	5.95	11.55

Theta	Phi	Vertical	Horiz.	Comb.
30	-30	9.15	7.75	11.55
30	-20	7.55	9.15	11.45
30	-10	5.55	10.15	11.45
30	0	2.75	10.75	11.45
30	10	0.55	11.15	11.55
30	20	1.95	11.15	11.65
30	30	4.85	10.95	11.85
30	40	7.45	10.35	12.15
30	50	9.35	9.35	12.35
30	60	10.75	7.75	12.55
30	70	11.75	5.25	12.65
30	80	12.35	1.75	12.75
30	90	12.65	-6.25	12.75
30	100	12.65	-11.25	12.65
30	110	12.25	-0.35	12.55
30	120	11.65	4.35	12.35
30	130	10.75	6.95	12.25
30	140	9.45	8.75	12.05
30	150	7.75	10.05	12.05
30	160	5.15	10.85	11.95
30	170	1.85	11.35	11.85
30	180	-2.25	11.65	11.75
40	-180	-0.85	10.85	11.15
40	-170	-1.25	10.85	11.05
40	-160	2.15	10.55	11.15
40	-150	4.85	10.05	11.15
40	-140	6.85	9.25	11.25
40	-130	8.35	8.25	11.35
40	-120	9.35	6.95	11.35
40	-110	10.15	5.25	11.35
40	-100	10.85	3.25	11.55
40	-90	11.25	-0.15	11.55
40	-80	11.45	-5.35	11.55
40	-70	11.45	-10.25	11.55
40	-60	11.35	-3.75	11.45
40	-50	10.95	1.35	11.35
40	-40	10.25	4.25	11.25
40	-30	9.35	6.35	11.15
40	-20	7.95	7.85	10.95
40	-10	6.25	8.85	10.75
40	0	4.05	9.55	10.65
40	10	2.35	9.95	10.65
40	20	3.15	10.05	10.85
40	30	5.45	9.85	11.15

Theta	Phi	Vertical	Horiz.	Comb.
40	40	7.75	9.25	11.55
40	50	9.45	8.25	11.95
40	60	10.85	6.75	12.25
40	70	11.85	4.25	12.55
40	80	12.45	0.35	12.65
40	90	12.75	-7.95	12.75
40	100	12.65	-12.75	12.75
40	110	12.35	-0.95	12.55
40	120	11.75	3.65	12.35
40	130	10.75	6.35	12.05
40	140	9.35	7.95	11.75
40	150	7.65	9.25	11.55
40	160	5.15	10.15	11.35
40	170	2.05	10.65	11.15
40	180	-1.45	10.85	11.05
50	-180	-0.05	9.75	10.15
50	-170	0.05	9.65	10.15
50	-160	2.75	9.35	10.15
50	-150	5.05	8.75	10.35
50	-140	6.85	7.95	10.45
50	-130	8.25	7.05	10.65
50	-120	9.25	5.75	10.85
50	-110	10.15	4.25	11.15
50	-100	10.75	2.45	11.35
50	-90	11.15	-0.35	11.45
50	-80	11.45	-4.45	11.55
50	-70	11.45	-9.65	11.45
50	-60	11.25	-6.75	11.35
50	-50	10.85	-1.45	11.15
50	-40	10.25	1.85	10.85
50	-30	9.35	4.15	10.55
50	-20	8.15	5.85	10.15
50	-10	6.55	6.95	9.75
50	0	4.75	7.75	9.45
50	10	3.45	8.15	9.45
50	20	3.95	8.35	9.65
50	30	5.75	8.15	10.15
50	40	7.85	7.65	10.75
50	50	9.45	6.75	11.35
50	60	10.75	5.15	11.85
50	70	11.75	2.85	12.25
50	80	12.35	-0.85	12.55
50	90	12.65	-8.85	12.65
50	100	12.65	-14.05	12.65

Theta	Phi	Vertical	Horiz.	Comb.
50	110	12.25	-2.25	12.45
50	120	11.65	2.45	12.15
50	130	10.65	5.15	11.75
50	140	9.25	6.95	11.25
50	150	7.45	8.15	10.85
50	160	5.15	9.05	10.55
50	170	2.25	9.55	10.25
50	180	-0.45	9.75	10.15
60	-180	0.65	8.45	9.15
60	-170	0.75	8.35	9.05
60	-160	3.05	7.95	9.15
60	-150	5.05	7.25	9.35
60	-140	6.75	6.45	9.55
60	-130	8.05	5.35	9.95
60	-120	9.15	4.25	10.35
60	-110	10.05	2.85	10.85
60	-100	10.75	1.25	11.25
60	-90	11.25	-1.15	11.45
60	-80	11.45	-4.45	11.55
60	-70	11.45	-8.75	11.45
60	-60	11.15	-9.25	11.25
60	-50	10.85	-4.65	10.95
60	-40	10.25	-1.15	10.55
60	-30	9.45	1.35	10.15
60	-20	8.35	3.15	9.55
60	-10	6.95	4.35	8.85
60	0	5.45	5.25	8.35
60	10	4.35	5.85	8.15
60	20	4.55	6.05	8.35
60	30	5.95	5.95	8.95
60	40	7.75	5.45	9.75
60	50	9.35	4.75	10.65
60	60	10.55	3.15	11.35
60	70	11.55	0.95	11.95
60	80	12.25	-2.65	12.35
60	90	12.55	-10.25	12.55
60	100	12.45	-17.15	12.55
60	110	12.15	-4.15	12.25
60	120	11.55	0.75	11.95
60	130	10.65	3.75	11.45
60	140	9.35	5.75	10.85
60	150	7.65	7.05	10.35
60	160	5.35	7.85	9.75
60	170	2.55	8.35	9.35

Theta	Phi	Vertical	Horiz.	Comb.
60	180	0.35	8.45	9.05
70	-180	0.95	6.75	7.75
70	-170	1.35	6.55	7.65
70	-160	3.45	6.05	7.95
70	-150	5.35	5.25	8.35
70	-140	6.85	4.35	8.85
70	-130	8.15	3.35	9.35
70	-120	9.25	2.35	10.05
70	-110	10.25	1.15	10.75
70	-100	10.95	-0.35	11.25
70	-90	11.45	-2.25	11.65
70	-80	11.55	-4.75	11.65
70	-70	11.45	-7.75	11.55
70	-60	11.15	-9.65	11.25
70	-50	10.85	-7.85	10.85
70	-40	10.35	-4.75	10.45
70	-30	9.55	-2.25	9.85
70	-20	8.55	-0.35	9.15
70	-10	7.35	1.05	8.25
70	0	6.05	2.05	7.55
70	10	5.35	2.75	7.25
70	20	5.55	3.05	7.45
70	30	6.75	3.05	8.25
70	40	8.25	2.65	9.35
70	50	9.65	1.85	10.25
70	60	10.75	0.35	11.15
70	70	11.65	-1.95	11.85
70	80	12.25	-5.65	12.35
70	90	12.55	-13.65	12.55
70	100	12.55	-18.65	12.55
70	110	12.25	-5.85	12.25
70	120	11.55	-0.85	11.85
70	130	10.55	2.15	11.15
70	140	9.25	4.05	10.45
70	150	7.65	5.45	9.65
70	160	5.25	6.15	8.75
70	170	2.65	6.55	8.05
70	180	0.85	6.75	7.75
80	-180	1.55	4.15	6.05
80	-170	2.35	3.75	6.15
80	-160	4.45	3.15	6.85
80	-150	6.15	2.35	7.65
80	-140	7.55	1.35	8.45
80	-130	8.65	0.35	9.25

Theta	Phi	Vertical	Horiz.	Comb.
80	-120	9.65	-0.65	10.05
80	-110	10.55	-1.55	10.85
80	-100	11.25	-2.65	11.45
80	-90	11.75	-3.95	11.85
80	-80	11.85	-5.45	11.85
80	-70	11.55	-6.95	11.65
80	-60	11.25	-8.25	11.25
80	-50	10.85	-8.55	10.85
80	-40	10.35	-7.75	10.35
80	-30	9.65	-6.45	9.75
80	-20	8.65	-5.15	8.85
80	-10	7.55	-3.95	7.85
80	0	6.45	-2.85	6.95
80	10	5.95	-2.15	6.55
80	20	6.55	-1.65	7.15
80	30	7.65	-1.55	8.15
80	40	9.05	-1.85	9.35
80	50	10.25	-2.65	10.45
80	60	11.35	-4.35	11.45
80	70	12.15	-7.05	12.15
80	80	12.55	-11.55	12.65
80	90	12.85	-23.85	12.85
80	100	12.75	-14.25	12.75
80	110	12.35	-6.65	12.45
80	120	11.65	-2.85	11.85
80	130	10.65	0.15	11.05
80	140	9.25	1.85	10.05
80	150	7.45	3.05	8.75
80	160	5.35	3.75	7.55
80	170	2.85	4.05	6.55
80	180	1.45	4.15	5.95
90	-180	2.35	-0.15	4.25
90	-170	3.75	-0.55	5.15
90	-160	5.65	-1.15	6.45
90	-150	7.25	-2.05	7.75
90	-140	8.35	-3.15	8.65
90	-130	9.35	-4.25	9.55
90	-120	10.25	-5.25	10.35
90	-110	11.05	-5.75	11.15
90	-100	11.65	-5.85	11.75
90	-90	11.95	-5.65	12.05
90	-80	11.95	-5.55	11.95
90	-70	11.65	-5.35	11.75
90	-60	11.25	-5.25	11.35

Theta	Phi	Vertical	Horiz.	Comb.
90	-50	10.75	-5.05	10.85
90	-40	10.25	-5.05	10.35
90	-30	9.55	-5.15	9.65
90	-20	8.55	-5.45	8.75
90	-10	7.35	-5.95	7.55
90	0	6.35	-6.65	6.65
90	10	6.15	-7.45	6.35
90	20	6.95	-8.45	7.05
90	30	8.25	-9.35	8.35
90	40	9.75	-10.85	9.85
90	50	10.95	-12.65	10.95
90	60	11.85	-16.75	11.95
90	70	12.55	-22.55	12.55
90	80	12.95	-19.65	12.95
90	90	13.05	-13.95	13.05
90	100	12.85	-9.95	12.85
90	110	12.35	-7.15	12.35
90	120	11.65	-4.95	11.75
90	130	10.35	-3.15	10.55
90	140	8.95	-1.95	9.25
90	150	7.05	-0.95	7.75
90	160	4.75	-0.35	5.95
90	170	2.85	-0.15	4.65
90	180	2.45	-0.15	4.35
100	-180	2.95	-2.85	3.95
100	-170	4.35	-2.85	5.05
100	-160	5.85	-3.35	6.35
100	-150	7.25	-4.45	7.45
100	-140	8.25	-6.25	8.45
100	-130	9.15	-8.85	9.25
100	-120	9.95	-12.65	9.95
100	-110	10.65	-15.05	10.65
100	-100	11.25	-12.55	11.25
100	-90	11.55	-9.05	11.55
100	-80	11.45	-6.65	11.55
100	-70	11.25	-5.05	11.35
100	-60	10.85	-3.45	11.05
100	-50	10.45	-2.25	10.65
100	-40	9.95	-1.25	10.25
100	-30	9.25	-0.55	9.65
100	-20	8.25	-0.05	8.85
100	-10	6.95	0.05	7.75
100	0	5.85	0.05	6.85
100	10	5.55	-0.25	6.55

Theta	Phi	Vertical	Horiz.	Comb.
100	20	6.45	-0.75	7.15
100	30	7.95	-1.45	8.35
100	40	9.45	-2.45	9.75
100	50	10.65	-3.55	10.85
100	60	11.65	-4.65	11.75
100	70	12.25	-5.75	12.35
100	80	12.65	-6.65	12.65
100	90	12.65	-7.15	12.65
100	100	12.35	-7.45	12.45
100	110	11.85	-7.45	11.85
100	120	11.05	-7.35	11.15
100	130	9.75	-6.65	9.85
100	140	8.25	-5.85	8.35
100	150	6.45	-4.75	6.75
100	160	4.45	-3.75	5.05
100	170	3.05	-3.15	4.05
100	180	3.15	-2.85	4.05
110	-180	3.75	-0.75	5.05
110	-170	4.45	-0.55	5.65
110	-160	5.45	-0.95	6.35
110	-150	6.45	-1.85	7.05
110	-140	7.25	-3.45	7.65
110	-130	8.05	-5.95	8.25
110	-120	8.85	-9.85	8.95
110	-110	9.55	-16.75	9.55
110	-100	10.05	-27.95	10.05
110	-90	10.35	-13.45	10.35
110	-80	10.35	-7.95	10.45
110	-70	10.25	-4.75	10.35
110	-60	9.95	-2.25	10.15
110	-50	9.55	-0.25	9.95
110	-40	9.05	1.35	9.75
110	-30	8.35	2.45	9.35
110	-20	7.25	3.25	8.75
110	-10	5.95	3.75	8.05
110	0	4.65	4.05	7.45
110	10	4.25	4.15	7.15
110	20	5.15	3.85	7.55
110	30	6.75	3.45	8.35
110	40	8.35	2.65	9.45
110	50	9.55	1.65	10.25
110	60	10.55	0.35	10.95
110	70	11.15	-1.15	11.35
110	80	11.35	-2.75	11.55

Theta	Phi	Vertical	Horiz.	Comb.
110	90	11.35	-4.45	11.45
110	100	11.05	-6.45	11.15
110	110	10.55	-8.25	10.65
110	120	9.75	-8.85	9.85
110	130	8.65	-7.25	8.85
110	140	7.55	-5.25	7.75
110	150	6.05	-3.25	6.55
110	160	4.85	-1.95	5.65
110	170	3.95	-1.15	5.15
110	180	3.85	-0.75	5.15
120	-180	4.35	2.35	6.45
120	-170	4.15	2.55	6.45
120	-160	4.45	2.45	6.55
120	-150	5.05	1.75	6.75
120	-140	5.95	0.55	7.05
120	-130	6.85	-1.25	7.45
120	-120	7.55	-3.85	7.95
120	-110	8.25	-7.85	8.45
120	-100	8.85	-14.85	8.85
120	-90	9.15	-19.35	9.15
120	-80	9.15	-9.35	9.25
120	-70	9.05	-4.25	9.25
120	-60	8.75	-1.05	9.25
120	-50	8.35	1.45	9.15
120	-40	7.85	3.25	9.15
120	-30	7.05	4.45	8.95
120	-20	5.95	5.35	8.65
120	-10	4.55	5.95	8.35
120	0	3.35	6.35	8.05
120	10	3.05	6.35	8.05
120	20	3.95	6.25	8.25
120	30	5.55	5.75	8.65
120	40	7.15	5.05	9.25
120	50	8.25	4.05	9.65
120	60	9.05	2.55	9.95
120	70	9.65	0.85	10.15
120	80	9.85	-1.25	10.15
120	90	9.75	-3.75	9.95
120	100	9.55	-6.75	9.65
120	110	9.25	-9.05	9.25
120	120	8.65	-7.95	8.75
120	130	7.95	-5.15	8.15
120	140	7.25	-2.45	7.65
120	150	6.45	-0.35	7.25

Theta	Phi	Vertical	Horiz.	Comb.
120	160	5.65	0.95	6.95
120	170	4.95	1.85	6.65
120	180	4.35	2.35	6.45
130	-180	4.65	5.35	8.05
130	-170	3.05	5.75	7.65
130	-160	2.65	5.65	7.45
130	-150	3.55	5.15	7.45
130	-140	4.95	4.15	7.55
130	-130	6.25	2.65	7.85
130	-120	7.35	0.55	8.15
130	-110	8.15	-2.65	8.55
130	-100	8.75	-7.45	8.85
130	-90	9.05	-16.95	9.05
130	-80	9.15	-10.05	9.15
130	-70	8.95	-3.45	9.25
130	-60	8.65	0.35	9.25
130	-50	8.05	3.05	9.25
130	-40	7.15	4.85	9.15
130	-30	6.05	6.15	9.15
130	-20	4.55	7.05	9.05
130	-10	3.05	7.65	8.95
130	0	1.85	7.95	8.85
130	10	1.95	7.95	8.95
130	20	3.45	7.75	9.05
130	30	5.25	7.25	9.35
130	40	6.55	6.45	9.55
130	50	7.65	5.35	9.65
130	60	8.55	3.65	9.75
130	70	9.05	1.65	9.75
130	80	9.35	-0.95	9.75
130	90	9.45	-4.25	9.65
130	100	9.45	-8.25	9.55
130	110	9.35	-9.05	9.45
130	120	9.15	-5.15	9.35
130	130	8.85	-1.75	9.15
130	140	8.35	0.65	9.05
130	150	7.65	2.45	8.75
130	160	6.75	3.85	8.55
130	170	5.65	4.85	8.25
130	180	4.25	5.35	7.85
140	-180	4.55	8.15	9.75
140	-170	1.35	8.55	9.25
140	-160	0.45	8.45	9.05
140	-150	2.55	7.95	9.05

Theta	Phi	Vertical	Horiz.	Comb.
140	-140	5.15	7.15	9.25
140	-130	7.05	5.85	9.55
140	-120	8.45	4.05	9.85
140	-110	9.45	1.55	10.15
140	-100	10.15	-2.35	10.35
140	-90	10.45	-9.65	10.55
140	-80	10.55	-12.75	10.65
140	-70	10.45	-3.05	10.65
140	-60	10.05	1.65	10.65
140	-50	9.25	4.55	10.55
140	-40	8.25	6.55	10.45
140	-30	6.75	7.95	10.35
140	-20	4.65	8.85	10.25
140	-10	2.15	9.45	10.15
140	0	-0.15	9.75	10.15
140	10	0.15	9.75	10.15
140	20	2.65	9.45	10.25
140	30	5.05	8.95	10.45
140	40	6.95	8.05	10.55
140	50	8.15	6.85	10.65
140	60	9.25	5.15	10.65
140	70	9.95	2.95	10.75
140	80	10.45	-0.05	10.85
140	90	10.85	-4.65	10.95
140	100	11.05	-10.55	11.05
140	110	10.95	-7.15	11.05
140	120	10.85	-1.85	11.15
140	130	10.55	1.35	11.05
140	140	9.95	3.75	10.85
140	150	9.15	5.55	10.75
140	160	7.85	6.75	10.35
140	170	6.15	7.65	9.95
140	180	3.95	8.15	9.55
150	-180	4.35	10.25	11.25
150	-170	-0.85	10.55	10.85
150	-160	-1.65	10.45	10.75
150	-150	2.55	10.05	10.75
150	-140	5.85	9.25	10.85
150	-130	8.15	8.15	11.15
150	-120	9.75	6.45	11.35
150	-110	10.85	4.05	11.65
150	-100	11.45	0.55	11.85
150	-90	11.95	-5.95	12.05
150	-80	12.05	-17.35	12.05

Theta	Phi	Vertical	Horiz.	Comb.
150	-70	11.95	-2.95	12.05
150	-60	11.55	2.45	12.05
150	-50	10.85	5.65	11.95
150	-40	9.75	7.75	11.85
150	-30	8.25	9.15	11.75
150	-20	6.05	10.15	11.55
150	-10	2.95	10.85	11.45
150	0	-1.15	11.15	11.45
150	10	-2.75	11.25	11.45
150	20	1.15	11.05	11.45
150	30	4.75	10.55	11.55
150	40	7.25	9.75	11.65
150	50	8.95	8.55	11.75
150	60	10.25	6.85	11.85
150	70	11.15	4.55	11.95
150	80	11.85	1.35	12.15
150	90	12.25	-3.85	12.35
150	100	12.45	-12.05	12.45
150	110	12.45	-4.45	12.55
150	120	12.25	0.95	12.55
150	130	11.85	4.05	12.55
150	140	11.15	6.15	12.35
150	150	10.15	7.85	12.15
150	160	8.55	9.05	11.85
150	170	6.45	9.85	11.45
150	180	3.45	10.25	11.05
160	-180	4.05	11.75	12.45
160	-170	-3.45	11.95	12.15
160	-160	-3.25	11.85	11.95
160	-150	2.95	11.45	11.95
160	-140	6.65	10.65	12.15
160	-130	9.05	9.65	12.35
160	-120	10.65	8.05	12.55
160	-110	11.75	5.95	12.75
160	-100	12.55	2.65	12.95
160	-90	12.95	-3.05	13.05
160	-80	13.15	-50.65	13.15
160	-70	13.05	-3.15	13.15
160	-60	12.55	2.95	13.05
160	-50	11.95	6.35	12.95
160	-40	10.85	8.55	12.85
160	-30	9.45	10.05	12.75
160	-20	7.25	11.05	12.65
160	-10	4.25	11.75	12.55

Theta	Phi	Vertical	Horiz.	Comb.
160	0	-0.75	12.25	12.45
160	10	-7.05	12.35	12.45
160	20	-0.85	12.25	12.45
160	30	4.25	11.75	12.55
160	40	7.45	11.05	12.65
160	50	9.45	9.95	12.75
160	60	10.85	8.45	12.85
160	70	11.95	6.15	12.95
160	80	12.65	2.75	13.05
160	90	13.15	-2.65	13.25
160	100	13.35	-11.95	13.35
160	110	13.35	-2.85	13.45
160	120	13.15	2.75	13.55
160	130	12.65	5.75	13.45
160	140	11.85	7.95	13.35
160	150	10.75	9.55	13.15
160	160	8.95	10.65	12.95
160	170	6.55	11.35	12.65
160	180	2.85	11.75	12.25
170	-180	3.45	12.55	13.05
170	-170	-7.65	12.75	12.85
170	-160	-3.95	12.65	12.75
170	-150	3.35	12.25	12.75
170	-140	7.15	11.55	12.95
170	-130	9.55	10.55	13.15
170	-120	11.15	9.25	13.35
170	-110	12.25	7.15	13.45
170	-100	13.05	4.25	13.55
170	-90	13.55	-1.05	13.65
170	-80	13.65	-18.95	13.65
170	-70	13.55	-3.55	13.65
170	-60	13.25	3.05	13.65
170	-50	12.55	6.65	13.55
170	-40	11.55	8.95	13.45
170	-30	10.25	10.45	13.35
170	-20	8.25	11.55	13.25
170	-10	5.35	12.35	13.15
170	0	0.65	12.75	13.05
170	10	-10.25	12.95	12.95
170	20	-3.35	12.85	12.95
170	30	3.55	12.45	12.95
170	40	7.25	11.75	13.05
170	50	9.55	10.65	13.15
170	60	11.15	9.15	13.25

Theta	Phi	Vertical	Horiz.	Comb.
170	70	12.35	6.95	13.45
170	80	13.15	3.55	13.55
170	90	13.65	-1.95	13.75
170	100	13.85	-14.65	13.85
170	110	13.85	-2.65	13.95
170	120	13.55	3.45	13.95
170	130	12.95	6.65	13.85
170	140	12.15	8.75	13.85
170	150	10.85	10.35	13.65
170	160	9.05	11.45	13.45
170	170	6.35	12.15	13.15
170	180	1.95	12.55	12.95
180	-180	2.55	12.85	13.25
180	-170	-13.65	13.05	13.05
180	-160	-3.05	12.95	13.05
180	-150	4.05	12.55	13.15
180	-140	7.55	11.95	13.25
180	-130	9.85	10.95	13.45
180	-120	11.45	9.45	13.55
180	-110	12.55	7.45	13.75
180	-100	13.35	4.65	13.85
180	-90	13.75	-0.65	13.95
180	-80	13.95	-17.15	13.95
180	-70	13.85	-3.65	13.95
180	-60	13.45	3.15	13.85
180	-50	12.85	6.75	13.85
180	-40	11.95	9.05	13.75
180	-30	10.55	10.55	13.55
180	-20	8.65	11.65	13.45
180	-10	5.95	12.45	13.25
180	0	1.35	12.85	13.15
180	10	-10.05	13.05	13.05
180	20	-4.95	12.95	13.05
180	30	3.15	12.55	13.05
180	40	7.15	11.85	13.15
180	50	9.55	10.85	13.25
180	60	11.15	9.25	13.35
180	70	12.45	7.05	13.55
180	80	13.25	3.75	13.75
180	90	13.75	-1.85	13.85
180	100	13.95	-22.25	13.95
180	110	13.95	-2.85	13.95
180	120	13.65	3.55	14.05
180	130	12.95	6.85	13.95

Theta	Phi	Vertical	Horiz.	Comb.
180	140	12.05	9.05	13.75
180	150	10.75	10.55	13.65
180	160	8.75	11.75	13.45
180	170	5.85	12.45	13.35
180	180	1.05	12.85	13.15