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FCC and IC Test report for parts
15.209, 15.249
RSS-Gen, RSS-210

Product name	: VP4002
Applicant	: NEDAP N.V.
FCC ID	: CGDVP4002
IC ID	: 1444A-VP4002

Test report No. : 201200787 005 Ver 2.0

Laboratory information

Accreditation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Telefication is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Designation number is: NL0001.

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Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Telefication Netherlands.

Testing Location

Test Site	Kiwa Telefication BV
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001
CABID	NL0001

Revision History

Version	Date	Remarks	By
v0.50	03-09-2021	First draft	PvW
V1.0	13-09-2021	Initial release	PvW
V1.5	18-10-2021	Updated emission designator Added 20 dB and 99% bandwidth measurements	PvW
V2.0	22-10-2021	Version 2 release	PvW

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.249(d) 15.209 (a)	RSS-Gen 8.9	Radiated spurious emissions	3.1	Pass
15.205 (a)	RSS Gen 8.10 RSS-210 7.1	Spurious emissions in the restricted bands	3.1	Pass
15.249 (a)	RSS-Gen	RF output power	3.2	Pass
15.215 (c)	RSS-Gen 6.7	20 dB bandwidth	3.3	Pass
--	RSS-Gen 6.7	99% occupied bandwidth	3.4	Pass

1 General Description

1.1 Applicant

Client name:	NEDAP N.V.
Address:	Parallelweg 2, 7141 DC GROENLO, the Netherlands
Telephone:	+31(0)544 471 111
E-mail:	annepieter.haytema@nedap.com
Contact name:	Anne Pieter Haytema

1.2 Manufacturer

Manufacturer name:	NEDAP N.V.
Address:	Parallelweg 2, 7141 DC GROENLO, the Netherlands
Telephone:	+31(0)544 471 111
E-mail:	annepieter.haytema@nedap.com
Contact name:	Anne Pieter Haytema

1.3 Tested Equipment Under Test (EUT)

Product name:	VP4002 (tested in conjunction with the Nedap Smartflow Milk measuring system)
Brand name:	NEDAP
FCC ID:	CGDVP4002
IC ID:	1444A-VP4002
Product type:	Milk Flow Measurement Float
Model(s):	VP4002
Batch and/or serial No.	-
Software version:	-
Hardware version:	-
Date of receipt	11-05-2021
Tests started:	05-07-2021
Testing ended:	12-10-2021

1.4 Product specifications of Equipment under test

Tx Frequency:	Data transmission: 921.8 MHz – 924.2MHz Milk flow speed detection: 170 kHz
Rx frequency:	Data transmission: 921.8 MHz – 924.2MHz Milk flow speed detection: 170 kHz
Antenna type:	Data transmission: Integrated trace on PCB Milk flow speed detection: Integrated trace on PCB
Antenna gain:	Data transmission: -10.8 dBi
Type of modulation:	FSK
Emission designator	Data transmission signal: 346KF1D

Disclaimer: The antenna gain and operating frequency bands are declared by the applicant

1.5 Environmental conditions

Test date	05-07-2021	20-08-2021
Ambient temperature	22.5°C	20.1°C
Humidity	55 %	59.3%

1.6 Measurement standards

- ANSI C63.4:2014
- ANSI C63.10:2013

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.209
- FCC Part 15 Subpart C §15.249
- RSS-Gen, Issue 5 + Amendment 1&2

1.8 Observation and remarks

The VP4002 is tested in conjunction with the Nedap Smartflow Milk measuring system.

1.9 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards".*

All conducted tests are performed by:

Name : Raoul Tolud, MSc under supervision of P. van Wanrooij, BASc

Review of test methods and report by:

Name : ing. R. van Barneveld

The above conclusions have been verified by the following signatory:

Date : 22-10-2021

Name : ing. R. van Barneveld

Function : Test Engineer

Signature :

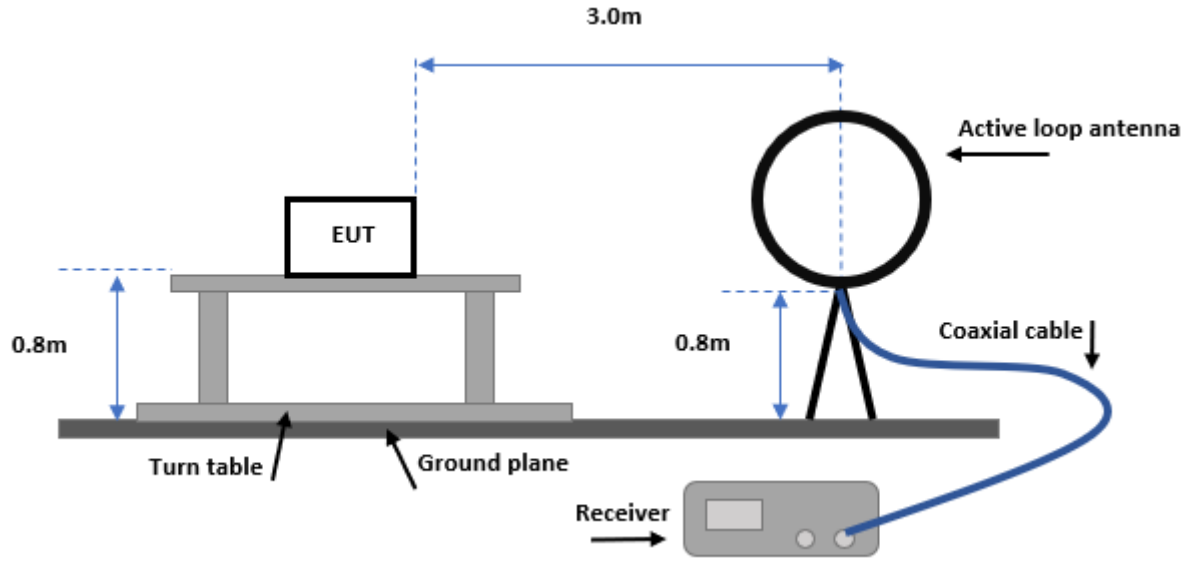
2 Test configuration of the Equipment Under Test

2.1 Test mode

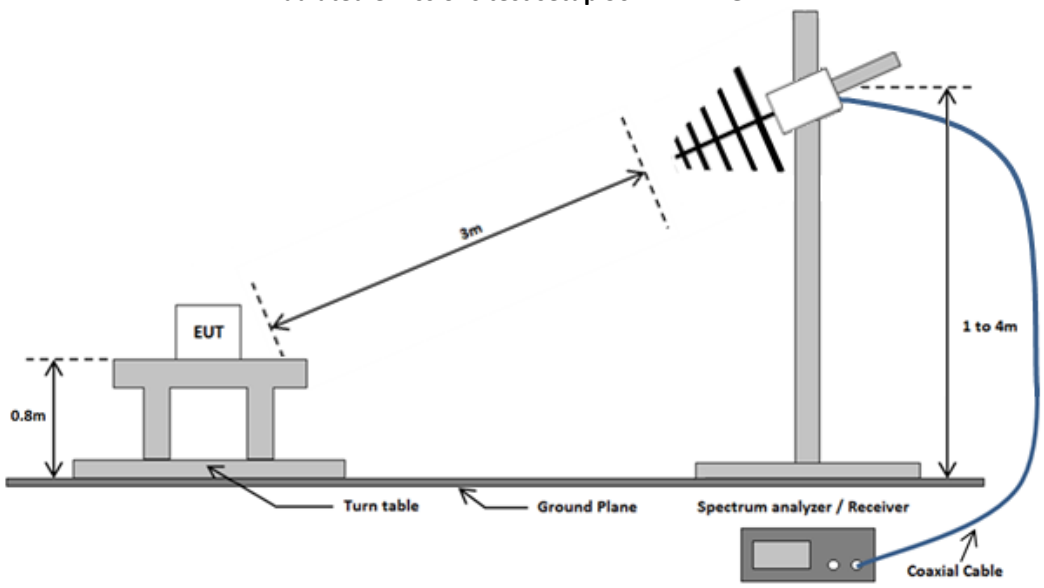
The manufacturer provided samples which could be configured to transmit continuously. When the sample is in continuous Tx mode for the 921.8-924.2 MHz transmission, the 170 kHz signal is not active due to test mode limitations. The 170 kHz signal is tested separately.

2.2 Test setups

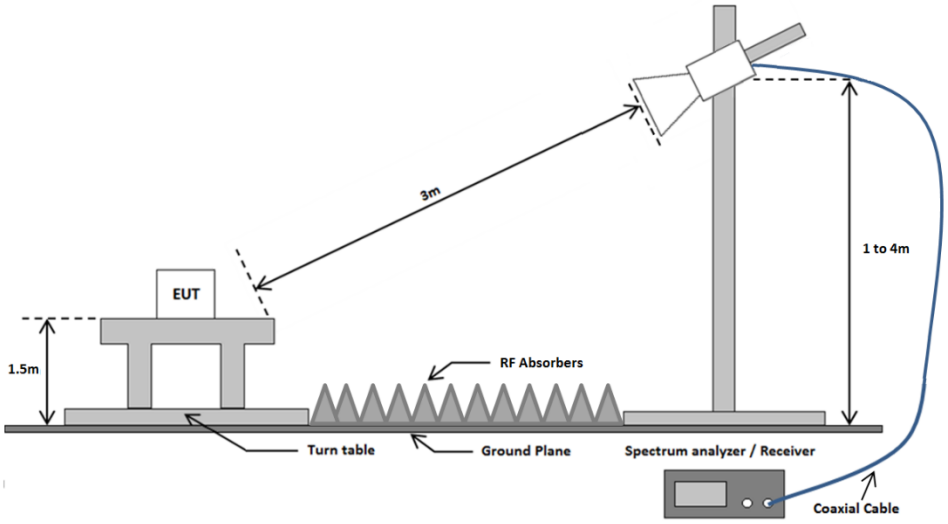
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
EMI Receiver	Rohde & Schwarz	ESR7	TE01220	3.1; 3.2
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	3.1
1.1 GHz HPF	Wainwright	WHK1.1/15G-10EF	TE01139	3.1
Active loop antenna	EMCO	6502	TE11171	3.1
Biconilog antenna	Chase	CBL6112A	TE00967	3.1; 3.2
Horn antenna	EMCO	3115	TE00531	3.1
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	TE11175	3.1
Radimation Test software	DARE	Version 2020.2.8	--	3.1;

All measurement equipment which needs to be calibrated is kept calibrated according to ISO 17025 requirements. Calibration state, and calibration history is tracked in the Telefication and Kiwa database.

2.4 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test results

3.1 Radiated spurious emissions

3.1.1 Limit

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
0.009 – 0.490	2400/F(kHz)	20*{log[2400]-log[F(kHz)]}	300*
0.490 – 1.705	24000/F(kHz)	20*{log[24000]-log[F(kHz)]}	30*
1.705 – 13.11 14.01 – 30.0	30	29.5	30*
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

*Note: Limit lines in the plots corrected to 3m measurement distance according to the method described in ANSI C63.10-2013, clause 6.4

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.1.4 Test procedure

9 kHz – 30 MHz: According to ANSI C63.4-2014, section 5.4.2 and 8.2.3
30 MHz to 26.5 GHz: According to ANSI C63.4-2014, section 8.3

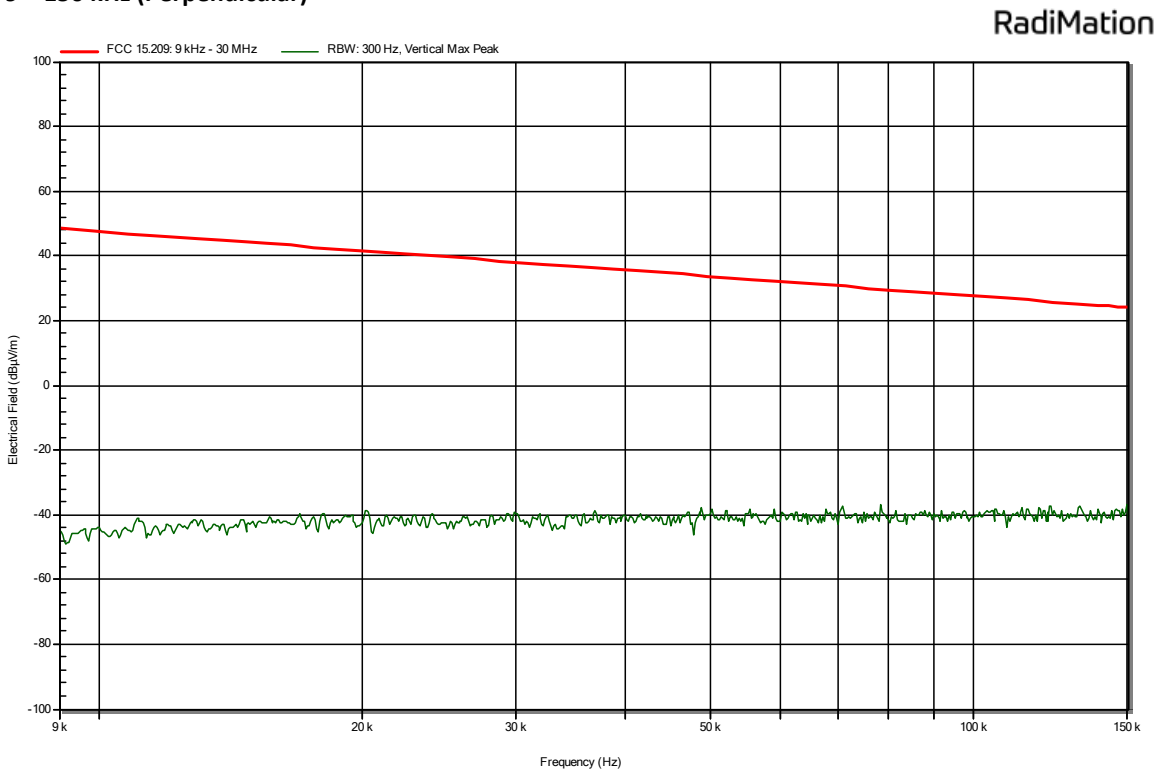
9 kHz to 30 MHz: IRN 026 – Method 10
30 MHz to 1 GHz: IRN 026 – Method 1
1 GHz to 10 GHz: IRN 026 – Method 2

3.1.5 Measurement Uncertainty

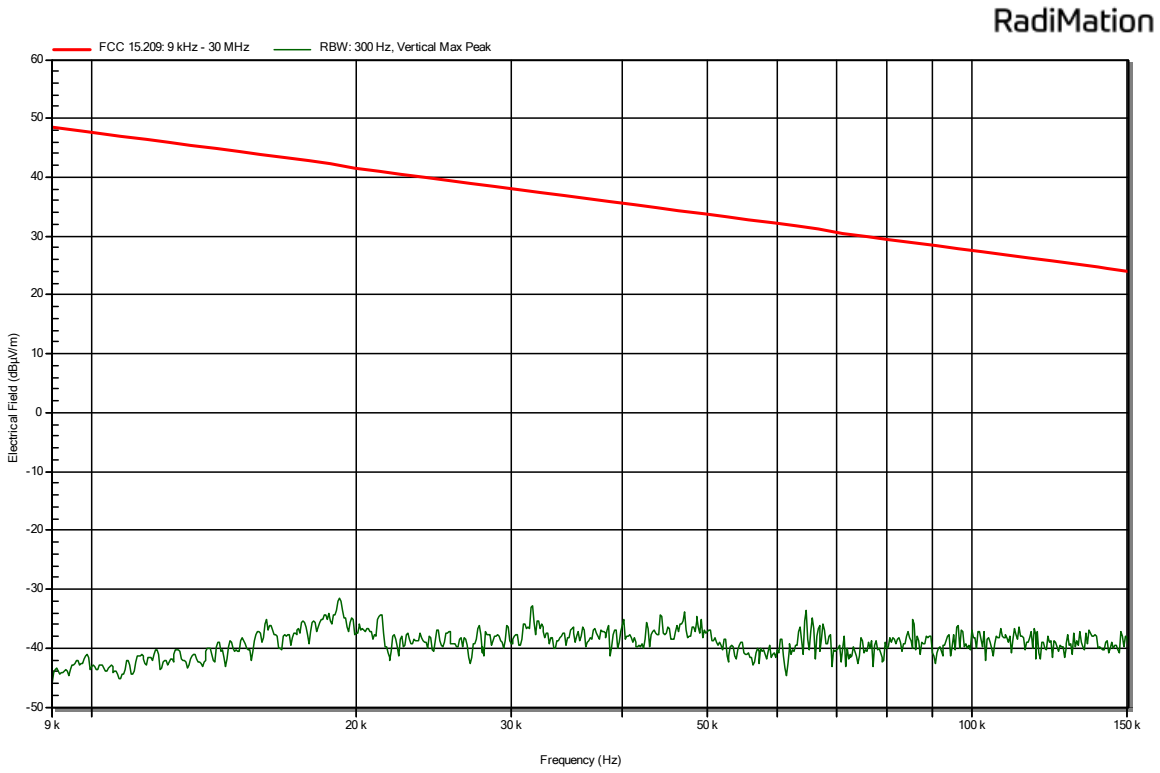
Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 10 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB

3.1.6 Plots of the Radiated Spurious Emissions Measurement

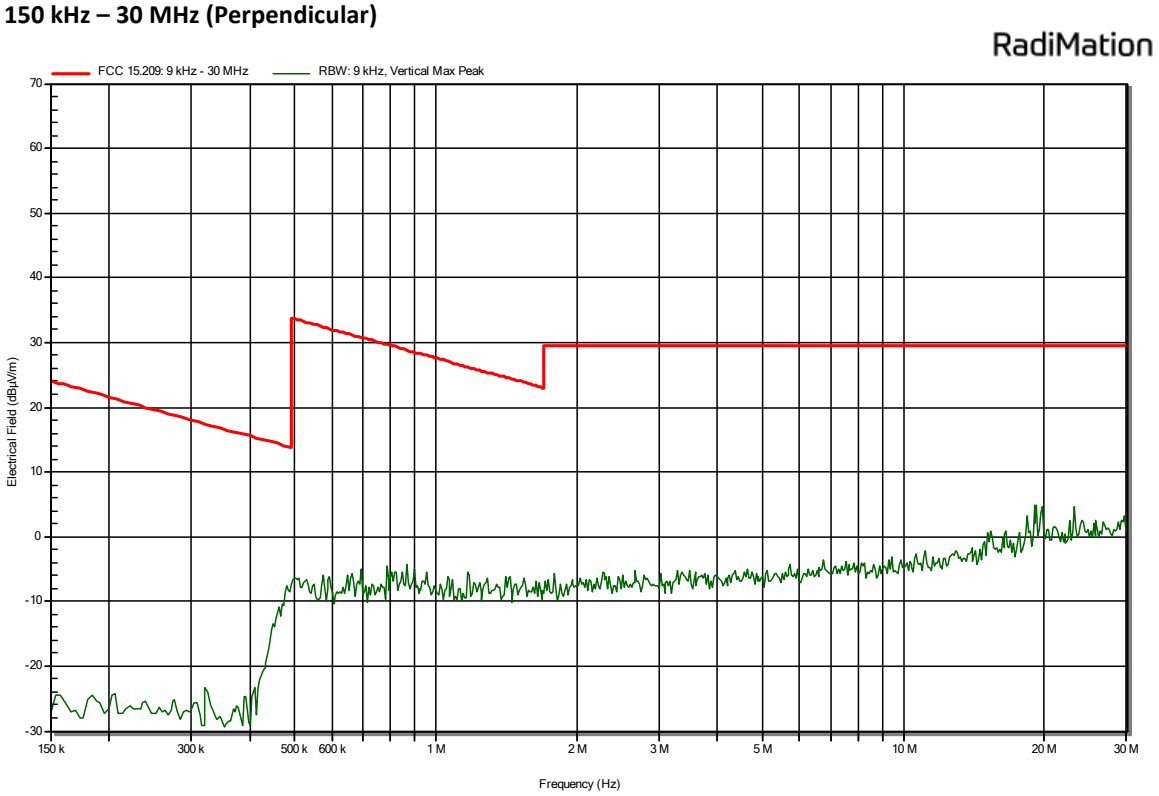
9 – 150 kHz (Perpendicular)



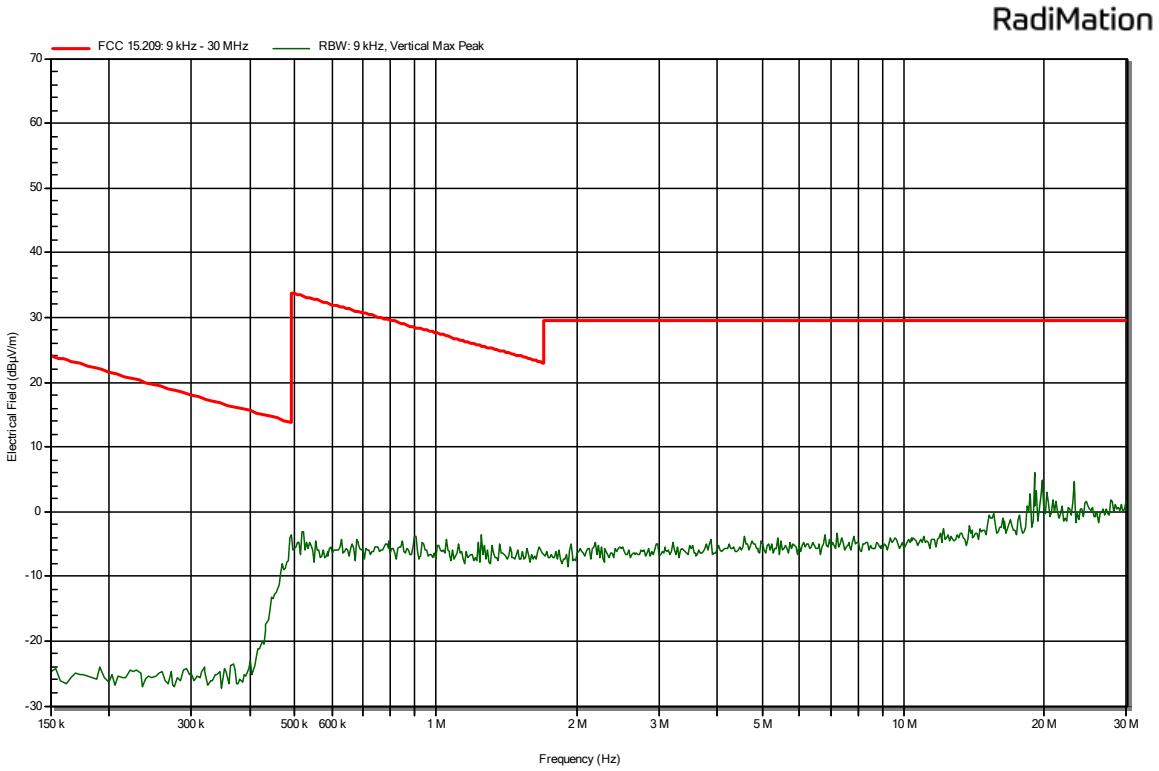
9 – 150 kHz (Orthogonal)



150 kHz – 30 MHz (Perpendicular)

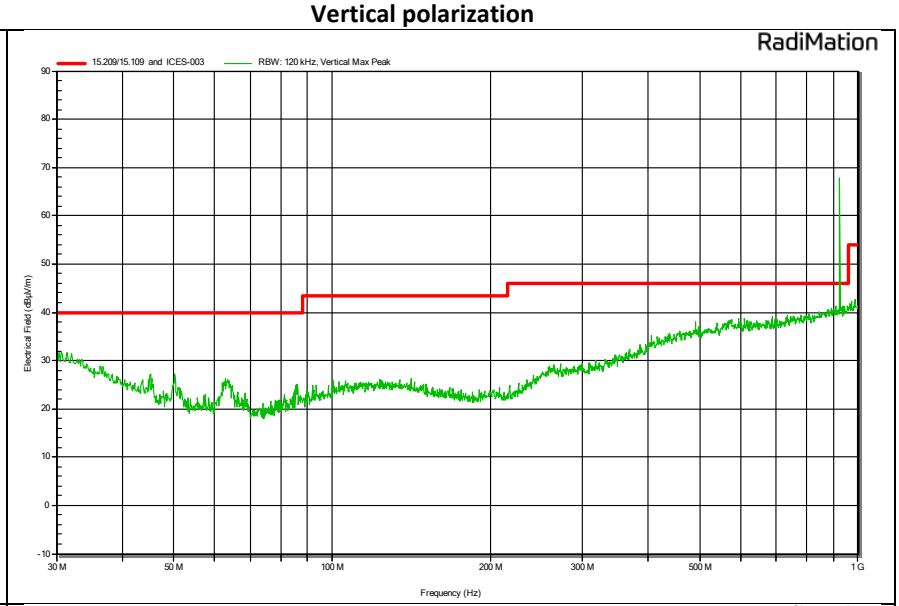
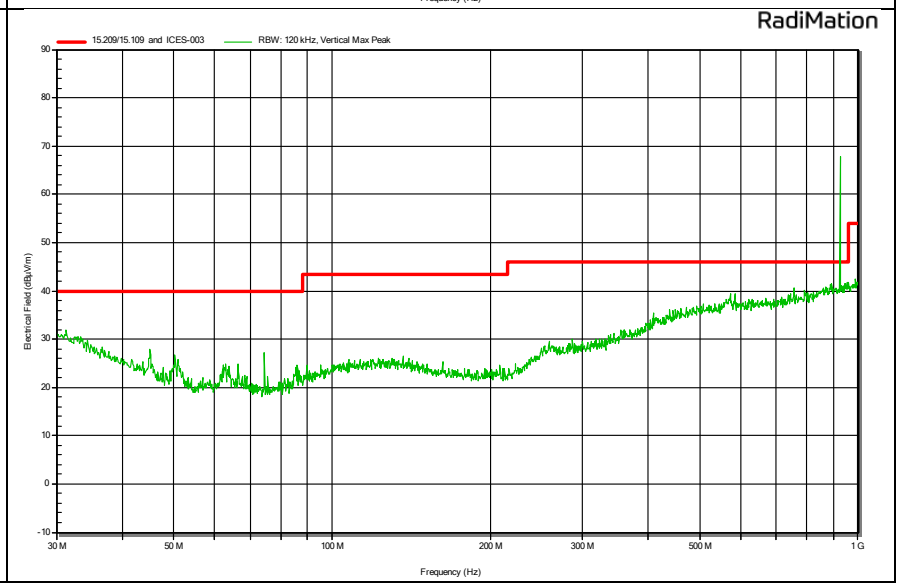


150 kHz – 30 MHz (Orthogonal)



30 MHz to 1 GHz

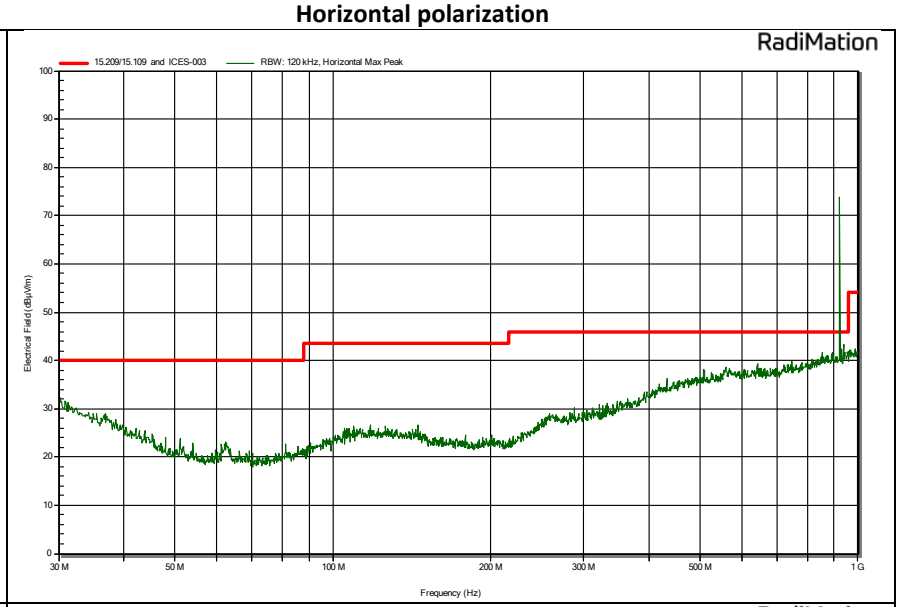
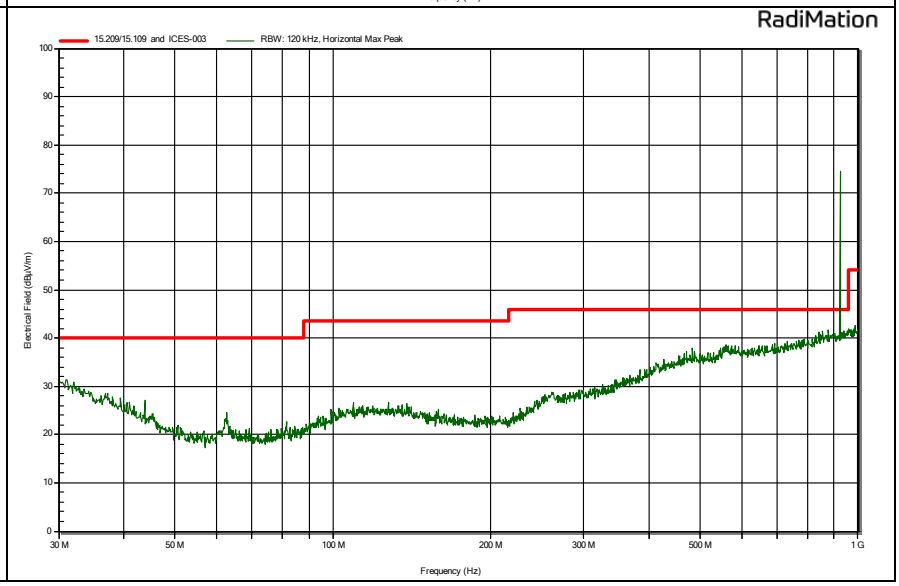
Vertical polarization

Low ch	
High ch	

Note: The peaks at 921.4 and 924.8 MHz are the transmission frequencies and are not subject to the spurious emissions limit.

30 MHz to 1 GHz

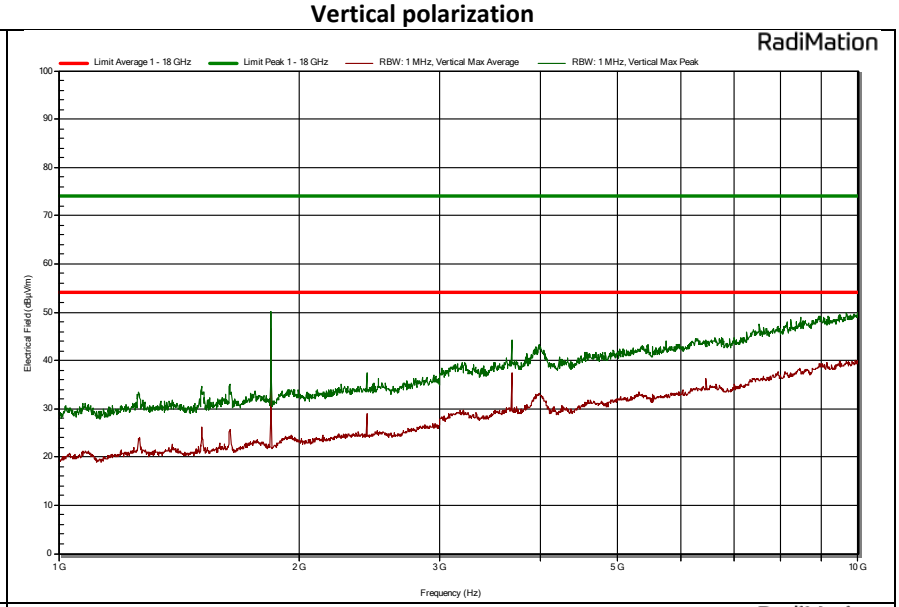
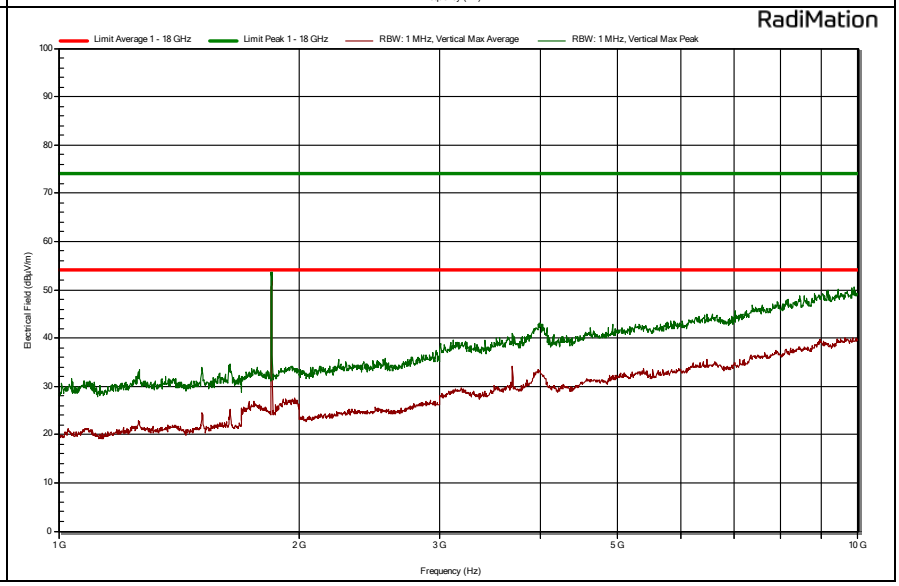
Horizontal polarization

Low ch	
High ch	

Note: The peaks at 921.4 and 924.8 MHz are the transmission frequencies and are not subject to the spurious emissions limit.

1 GHz to 10 GHz

Vertical polarization

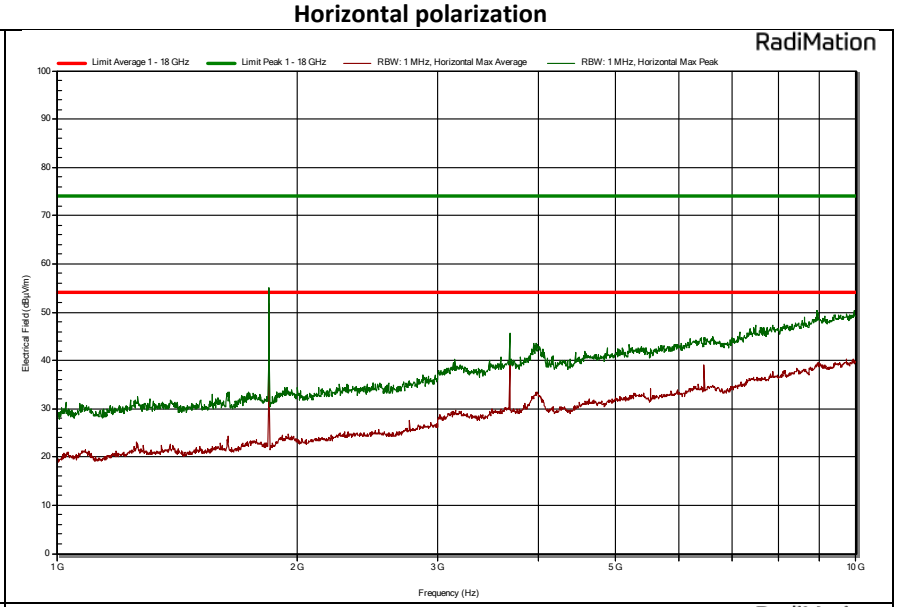
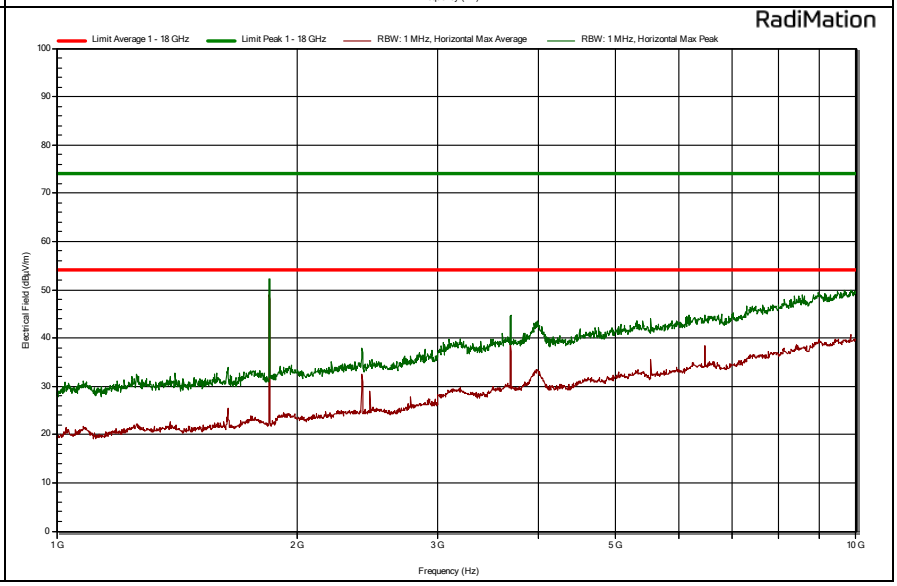
Low ch	
High ch	

Measured peaks Vertical 1 – 18 GHz High channel

Frequency (MHz)	Polarization	Average (dBµV/m)	Average Limit (dBµV/m)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Result
1846.536	Vertical	52.0	54.0	52.9	74.0	Pass
1846.857	Vertical	52.7	54.0	53.5	74.0	Pass

1 GHz to 10 GHz

Horizontal polarization

Low ch	
High ch	

3.2 Output Power Measurement

3.2.1 Limit

According to FCC part 15.249:

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Output power of fundamental (dBm) EIRP
902 – 928	50	-1.23
2400 – 2483.5	50	-1.23
5725 – 5875	50	-1.23
24000 – 24250	250	10.6

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.2.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05.
IRN 014 - RF power (W) - Method 1 – AVGSA (DTS) according to ANSI C63.10.

3.2.5 Test results of Output Power Measurement

Peak method

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power EIRP (dBm)
Proprietary	1	921.8	300 kb/s	-15.12
	4	924.2	300 kb/s	-13.98
Uncertainty	±0.71 dB			

Note: Output power is measured conducted, with the antenna gain added using the equation below
P(EIRP) = P(cond) + G (dBi)

Zoom in on 170 kHz transmission signal

The 170 kHz signal has a very low transmission level. In order to measure the level of the transmission, a deviation from the normal measurement method was made. The normal measurement distance of emissions in the 150 kHz – 30 MHz range is 3m. At this distance the level of the transmission signal was less than the noise floor of the measurement setup.

The measurement distance was reduced to 1.6m in order to be able to measure a peak signal level.

The measured level is then corrected to the limit distance 300m using equation (2) in ANSI C63.10-2013:

$$FS_{limit} = FS_{max} - 40\log\left(\frac{d_{nearfield}}{d_{measure}}\right) - 20\log\left(\frac{d_{limit}}{d_{nearfield}}\right)$$

Where

FS_{limit} is the field strength at the limit distance

FS_{max} is the measured field strength at measurement distance

$D_{nearfield}$ is the $\lambda/2\pi$ distance

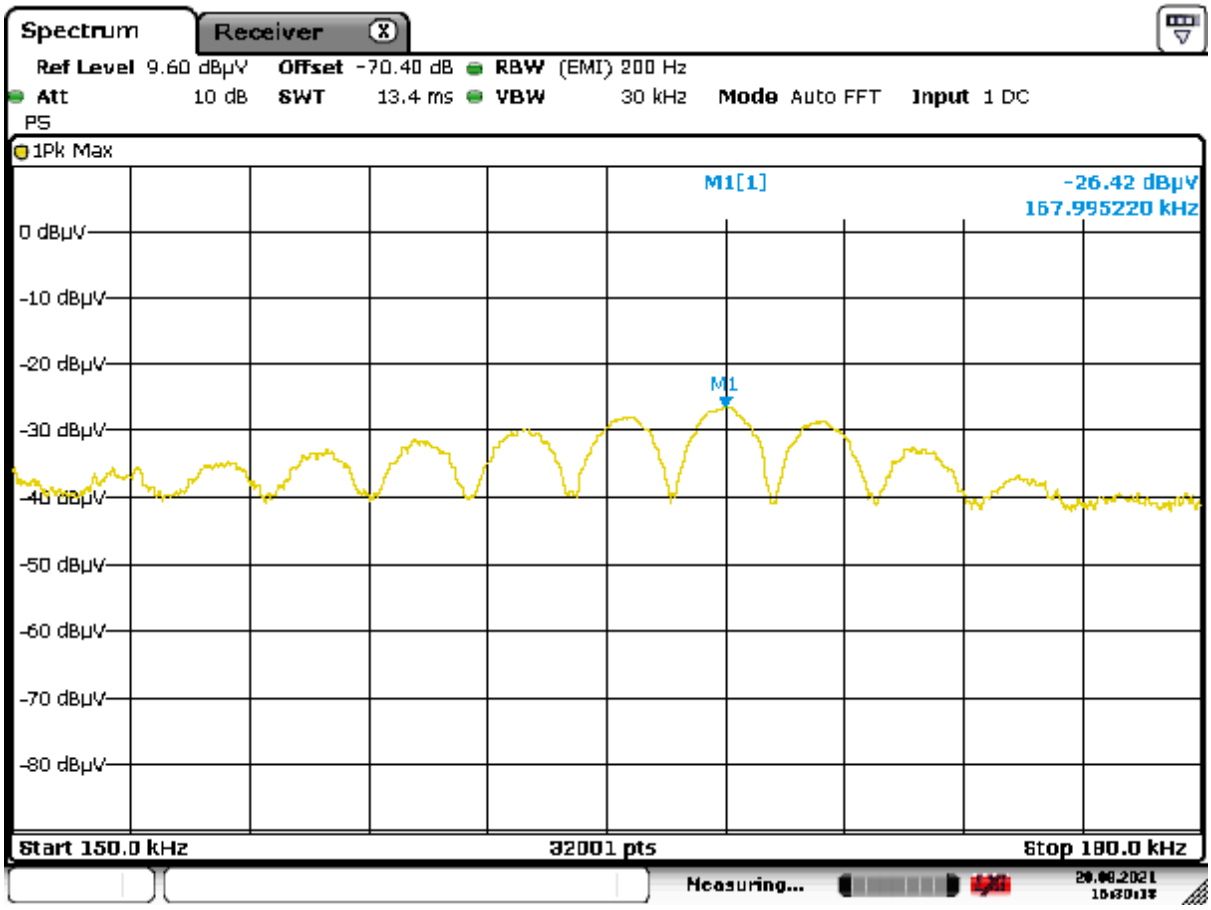
$D_{measure}$ is the measurement distance

D_{limit} is the limit distance

The result of this measurement and calculation can be found below:

Frequency	Peak level	Spurious emissions limit	Status	Measurement distance
170.264 kHz	-26.42 dBµV/m@300m	23.0 dBµV/m@300m	Pass	1.6 m

Plot of the transmission signal measured at 1.6m, corrected to 300m



3.3 20 dB bandwidth Measurement

3.3.1 Limit

According to FCC part 15.215 (c): The intentional radiator must ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.3.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.3.4 Test procedure

Tests according to ANSI C63.10

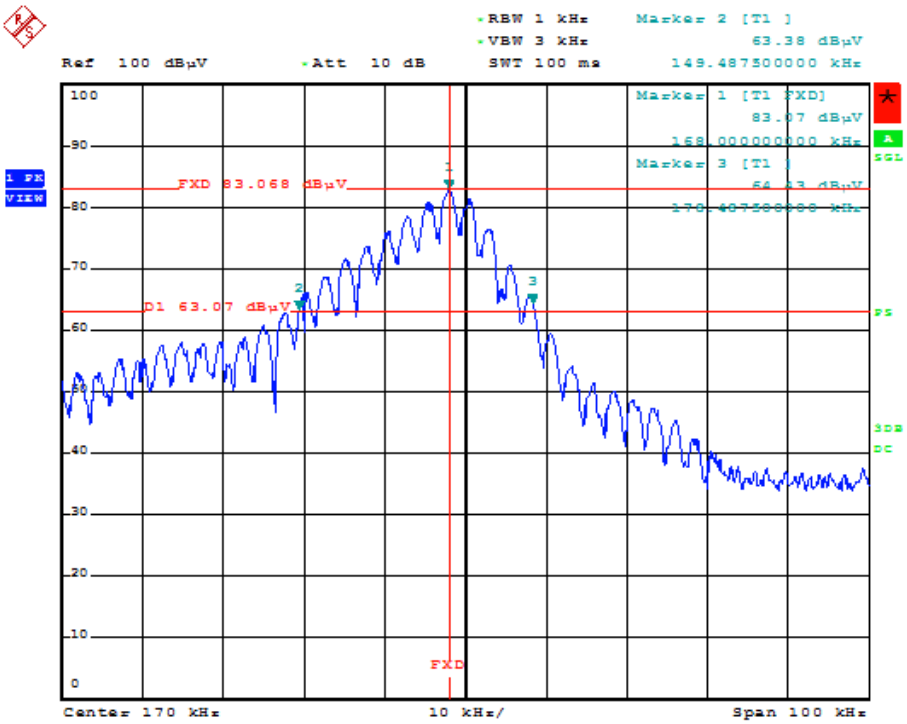
IRN 017 - Occupied bandwidth (Hz) Method 2

3.3.5 Test Result of the 20 dB bandwidth Measurement

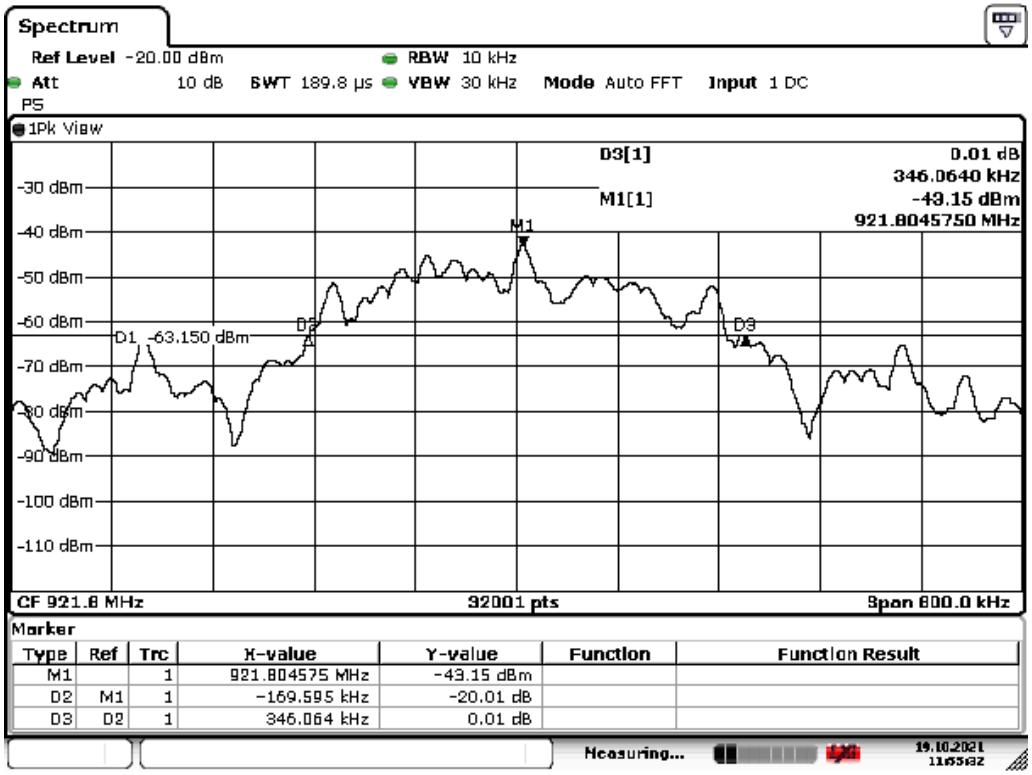
Technology Std.	Channel	Frequency (MHz)	20 dB bandwidth (kHz)	Uncertainty (kHz)
170 kHz	1	0.170	20.92	1.4
Data transmission	1	921.8	346.1	5.8
	4	924.2	320.5	

3.3.6 Plots of the 20 dB bandwidth measurement

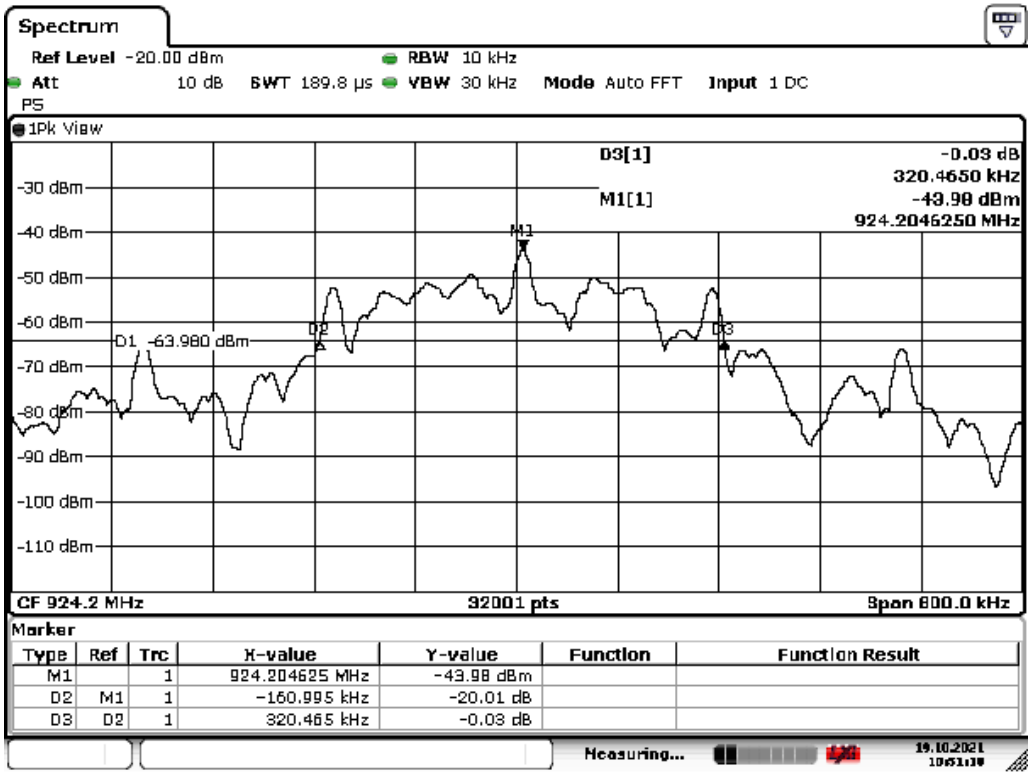
170 kHz



Data transmission channel 1



Data transmission channel 4



3.4 99% Occupied Bandwidth

3.4.1 Limit

According to RSS-Gen 6.7

3.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.4.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.4.4 Test procedure

IRN 017 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

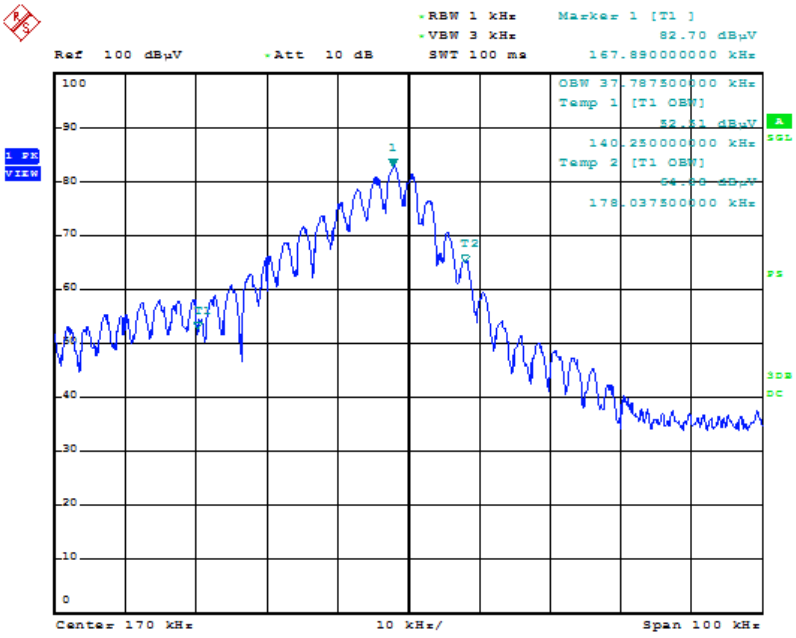
1. Set the centre frequency to the nominal EUT channel centre frequency
2. Set span = 1.5 times to 0.5 times the Occupied Bandwidth
3. Set VBW ≥ 3x RBW
4. Video averaging is not permitted. Where practical, detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

3.4.5 Test results of the 99% occupied bandwidth measurement

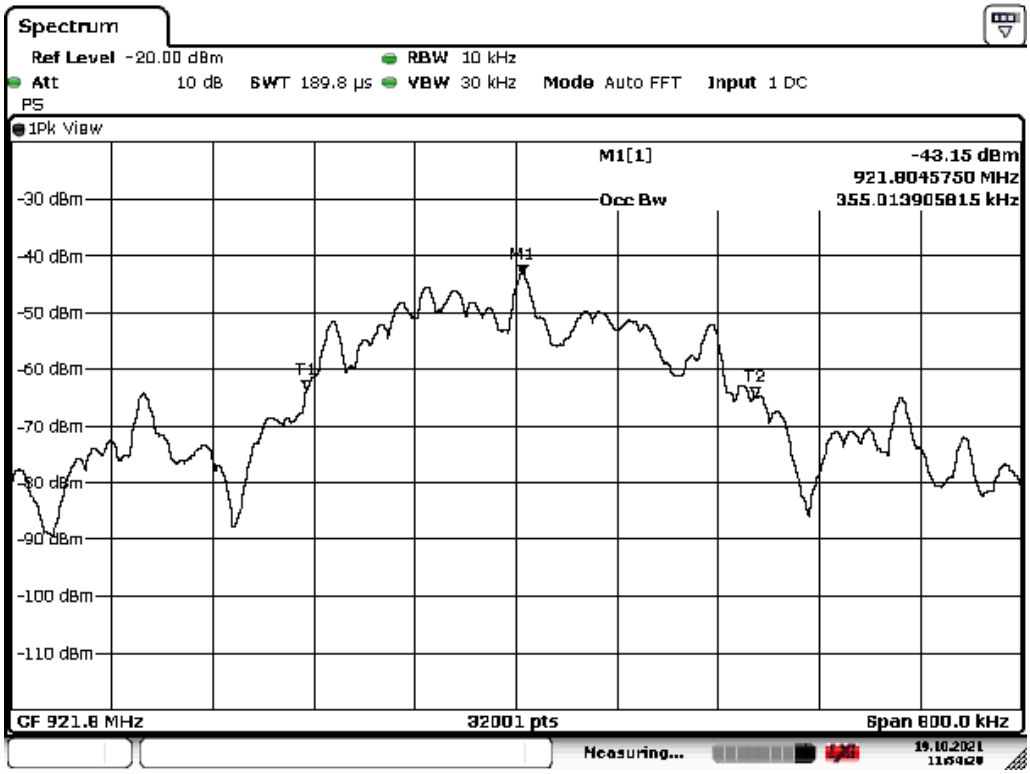
Technology Std.	Channel	Frequency (kHz)	99% bandwidth (kHz)	Uncertainty (kHz)
170 kHz	1	170	37.79	1.4
Data transmission	1	921.8	355.0	5.8
	4	924.2	362.5	

3.4.6 Plots of the 99% occupied bandwidth measurement

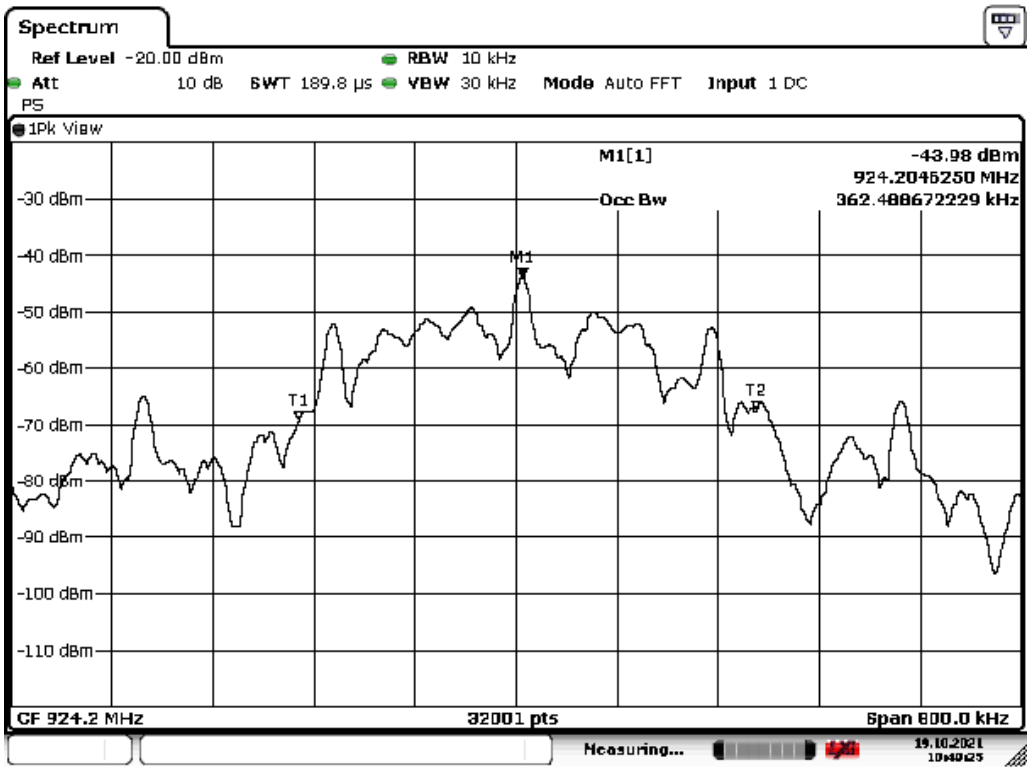
170 kHz



Data transmission channel 1



Data transmission channel 4



4 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Conducted emission Measurement:

U_{lisn} (dBµV) = U (dBµV) + Corr. (dB)

Where:
U = Measuring receiver voltage
LISN insertion loss = Voltage division factor of LISN
Corr. = sum of single correction factors of used LISN, cables and pulse limiter.
Linear interpolation will be used for frequencies in between the values in the table.

Frequency (Mhz)	**Voltage division LISN (db)**	**Insertion Loss Pulse limiter (dB)**	**Cable loss (dB)**	**Corr. (dB)**
	TE 00208 SN: 892785/004 Rohde & Schwarz ESH3-Z5	**TE 00756 SN: 5SM03153 Rohde & Schwarz ESH3-Z2**	**TE 11134**	
0.15	0.09	9.87	0.02	9.98
0.2	0.1	9.87	0.03	10
0.3	0.1	9.87	0.03	10
0.5	0.1	9.87	0.08	10.05
0.7	0.12	9.87	0.25	10.24
0.8	0.12	9.87	0.25	10.24
1	0.13	9.87	0.11	10.11
2	0.16	9.87	0.15	10.18
3	0.19	9.87	0.21	10.27
5	0.26	9.88	0.21	10.35
7	0.36	9.89	0.25	10.5
8	0.39	9.89	0.25	10.53
10	0.46	9.91	0.29	10.66
15	0.77	9.93	0.34	11.04
20	0.95	9.96	0.37	11.28
25	1.12	9.99	0.43	11.54
30	1.1	10.04	0.45	11.59

Field Strength Measurement:

E (dBµV/m) = U(dBµV) + AF (dB/m) + Corr. (dB)

Where:
E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).
Linear interpolation will be used for frequencies in between the values in the table.
Tables shows an extract of the values.

Frequency (Mhz)	**AF (dB/m)** **TE 00967** **Chase CBL6112A** **SN: 2308**	**Cable loss (dB)** **Id: SAR cable**	**Corr. (dB)**
30	18.6	0.68	19.28
100	10.7	1.15	11.85
150	10.6	1.41	12.01
200	9.3	1.63	10.93
250	12.6	1.93	14.53
300	13.3	2.12	15.42
350	14.6	2.2	16.8
400	15.5	2.29	17.79
450	16.9	2.53	19.43
500	17.5	2.67	20.17
550	18.4	2.9	21.3
600	18.8	3.02	21.82
650	19.2	3.09	22.29
700	19	3.22	22.22
750	19.8	3.56	23.36
800	19.7	3.69	23.39
900	20.4	3.81	24.21
950	20.8	3.91	24.71
1000	21.2	4.3	25.5

Frequency (Mhz)	AF (dB/m) TE 00531 Emco 3115 SN: 9412-4377	Gain (dB) TE 11132 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) TE 01315	Corr. (dB)
1000	23.6	40.4	2.0	66
1500	25.1	40.5	2.4	68
2000	27.1	40.5	2.7	70.3
2500	28.6	40.7	3.2	72.5
3000	30.5	40.7	3.2	74.4
3500	31.2	40.7	3.4	75.3
4000	32.7	40.9	4.9	78.5
4500	32.4	40.9	4.4	77.7
5000	33.2	40.7	4.6	78.5
5500	34.0	40.5	4.5	79
6000	34.6	40.0	5.2	79.8
6500	34.3	39.4	5.9	79.6
7000	35.2	38.6	5.7	79.5
7500	36.4	39.2	5.9	81.5
8000	37.0	38.9	6.3	82.2
8500	37.5	38.4	6.4	82.3
9000	38.1	37.4	6.5	82
9500	37.8	37.0	7.1	81.9
10000	38.2	36.5	7.3	82
10500	38.1	36.7	7.6	82.4
11000	38.3	36.9	8.3	83.5
11500	38.5	37.6	8.1	84.2
12000	39.1	38.3	8.4	85.8
12500	38.7	38.5	8.3	85.5
13000	39.2	38.9	9.2	87.3
13500	40.5	40.2	8.3	89
14000	41.1	40.0	8.2	89.3
14500	41.4	40.1	8.2	89.7
15000	40.2	41.4	8.3	89.9
15500	37.9	41.4	8.6	87.9
16000	37.5	42.8	9.2	89.5
16500	38.6	42.3	8.8	89.7
17000	41.1	43.1	9.4	93.6
17500	42.7	43.2	9.4	95.3
18000	44.0	44.2	9.8	98

Frequency (Mhz)	AF (dB/m) TE 00531 Emco 3115 SN: 9412-4377	Gain (dB) TE 11132 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) TE 01315	Corr. (dB)
18000	31.3	26.2	9.8	67.3
19000	31.5	26.1	9.6	67.2
20000	31.7	25.9	11	68.6
21000	31.9	24.3	10.7	66.9
22000	32.1	18.3	10.5	60.9
23000	32.2	18.9	10.8	61.9
24000	32.3	23.6	11.4	67.3
25000	32.4	24.5	11.6	68.5
26000	32.5	25.3	11.7	69.5