RADIO TEST REPORT

No. 1711946STO-001, Ed. 2

RF Performance

EQUIPMENT UNDER TEST

Equipment:	RFID reader
Type/Model:	XT-5
Additional type/model*:	XT-5 ETC
Manufacturer:	TagMaster AB
Tested by request of:	TagMaster AB

*See opinions and interpretations clause 2.5

SUMMARY

Referring to the emission limits, and the operating mode during the tests specified in this report, the equipment comply with the requirements according to the following standards:

47 CFR Part 15 (2016): Subpart C: Intentional radiators. Section 15.247

47 CFR Part 15 (2016): Subpart B: Unintentional radiators

RSS-GEN Issue 5 (2018): General requirements of compliance of radio apparatus (2014)

RSS-247 Issue 2 (2017): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

For details, see clause 2 – 4.

Date of issue: 2018-08-15

Tested by: Robert Hietala

Approved by: Matti Virkki

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Revision History

Edition	Date	Description	Changes
1	2017-12-13	First release	
2	2018-08-15	Second release	Moved capacitor C1946 closer to the AMS chip (Q1911) to improve radiated spurious emission which has been re measured. XT ETC changed name to XT-5 ETC but with no change of performance.

CONTENTS

Page

1 Client Information 5

2 EQUIPMENT UNDER TEST (EUT) 5
2.1 Identification of the EUT 5
2.2 Additional information about the EUT 6
2.3 Peripheral equipment 6
2.4 Test signals and operation modes 6
2.5 Opinions and interpretations 6
2.6 Modifications made during the tests 6

3 TEST SPECIFICATIONS 7
3.1 Standards 7
3.2 Additions, deviations and exclusions from standards and accreditation 7
3.3 Test site 7

4 TEST SUMMARY 8

5 CONDUCTED CONTINUOUS DISTURBANCES IN THE FREQUENCY-RANGE 0.15 TO 30 MHZ 10
5.1 Test set-up and test procedure 10
5.2 Requirement 10
5.3 Test results 11

6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHZ TO 13 GHZ 12
6.1 Test set-up and test procedure. 12
6.2 Test conditions 12
6.3 Requirements 13
6.4 Test results 30 MHz – 1000 MHz, TX 13
6.5 Test results 30 MHz – 1000 MHz, RX 16
6.6 Test results 1 GHz - 13 GHz, TX 17
6.7 Test results 1 GHz – 13 GHz, RX 20

7 CONDUCTED BAND EDGE MEASUREMENT 21
7.1 Test set-up and test procedure. 21
7.2 Test conditions 21
7.3 Requirement 21
7.4 Test results 22

8 PEAK CONDUCTED OUTPUT POWER 25
8.1 Test set-up and test procedure. 25
8.2 Test conditions 25
8.3 Requirements 25
8.4 Test results 26

9 OCCUPIED 20 DB BANDWIDTH 28
9.1 Test set-up and test procedure. 28
9.2 Test conditions 28
9.3 Requirements 28
9.4 Test results 29

10 99 % BANDWIDTH 31
10.1 Test set-up and test procedure. 31
10.2 Test conditions 31
10.3 Test results 31

11 NUMBER OF HOPPING FREQUENCIES 33
11.1 Test set-up and test procedure. 33
11.2 Test conditions 33
11.3 Requirements 33
11.4 Test results 34

12 CARRIER FREQUENCY SEPARATION 35
12.1 Test set-up and test procedure. 35
12.2 Test conditions 35
12.3 Requirements 35
12.4 Test results 36
13 TRANSMITTER TIME OF OCCUPANCY 37
13.1 Test set-up and test procedure. 37
13.2 Test conditions 37
13.3 Requirement 37
13.4 Test results 38
14 TEST EQUIPMENT 39
15 MEASUREMENT UNCERTAINTY 41
16 TEST SET UP AND EUT PHOTOS 41

1 CLIENT INFORMATION

The EUT has been tested by request of

Company	TagMaster AB Kronborgsgränd 11 164 46 Kista SWEDEN
Name of contact	Mattias Gyllenros

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT

Equipment:	RFID reader	
Type/Model:	XT-5	
Additional model:	XT-5 ETC	
Brand name:	TagMaster	
Serial number:	173900004	
Manufacturer:	TagMaster AB	
Transmitter frequency range:	902.75 – 927.25 MHz	
Receiver frequency range:	902.75 – 927.25 MHz	
Frequency agile or hopping:	☒ Yes	☐ No
Antenna:	☒ Internal antenna	☐ External antenna
Antenna connector:	☐ None, internal antenna	☒ Yes, TNC Reverse polarity
Antenna gain:	+5.5 dBi	
Rating RF output power:	+36 dBm	
Type of modulation:	ASK	
Temperature range:	☐ Category I (General): -20°C to +55°C ☐ Category II (Portable equipment): -10°C to +55°C ☐ Category III (Equipment for normal indoor use): +5°C to +35°C ☒ Other: <-40°C to +60°C	
Transmitter standby mode supported:	☒ Yes	☐ No

2.2 Additional information about the EUT

The EUT consists of the following units:

Unit	Type	Serial number
RFID reader	XT-5	173900004

During the tests the EUT supported following software:

Version	Revision	Comment
1.4.3-pre3	7485P	--

The EUT was tested with the following cables:

Port:	Type:	Length: [m]	Specifications:
Power	DC Power	5,0	Two-core
Ethernet	Telecom	3,0	Shielded

2.3 Peripheral equipment

Peripheral equipment is equipment needed for correct operation of the EUT, but not included as part of the testing and evaluation of the EUT.

Equipment	Type / Model	Manufacturer	Serial no.
RFID tag	ISO Card	TagMaster	30249305
Laptop	EliteBook 2570p	HP	CNU25198RR

2.4 Test signals and operation modes

Continuous modulated signal.

2.5 Opinions and interpretations

The following is a declaration from the manufacturer regarding the similarities and differences of the additional model:

XT-5 has been chosen for testing as only this was available at time of testing.

XT-5 and XT-5 ETC have the same metal base and controller board. XT-5 has one internal antenna and one external antenna connector. XT-5 ETC has four external antenna connectors and a lid without antenna. The internal and external antennas are exactly the same.

2.6 Modifications made during the tests

Client has moved capacitor C1946 closer to the AMS chip (Q1911) to improve radiated spurious emission. According to client this change will not affect other performance.

No other modifications have been made during the test.

3 TEST SPECIFICATIONS

3.1 Standards

Requirements:

47 CFR Part 15 (2016): Subpart C: Intentional radiators. Section 15.247

47 CFR Part 15 (2016): Subpart B: Unintentional radiators

RSS-GEN Issue 5 (2018): General requirements of compliance of radio apparatus (2014).

RSS-247 Issue 2 (2017): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test methods:
ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3.2 Additions, deviations and exclusions from standards and accreditation

No additions, deviations or exclusions have been made from standards and accreditation.

3.3 Test site

Measurements were performed at:

Intertek Semko AB
Torshamnsgatan 43
Box 1103
SE-164 22 Kista

Intertek Semko AB is a FCC listed test site with site registration number 90913
Intertek Semko AB is a FCC accredited conformity assessment body with designation number SE0002
Intertek Semko AB is an Industry Canada listed test facility with IC assigned code 2042G

Measurement chambers

Measurement Chamber	Type of chamber	IC Site filing #
STORA HALLEN	Semi-anechoic 10 m and 3 m	2042G-2
Radio chamber 3mFAC	FAR	2042G-4
BJÖRKHALLEN / 3mSAC	Semi-anechoic 3 m	2042G-1

4 TEST SUMMARY

The results in this report apply only to sample tested:

Requirement	Description	Result
FCC §15.203 **RSS-GEN 8.3**	**Antenna requirement** The manufacturer declares that the EUT is only used in a professional installation as per 15.203.	**PASS**
FCC §15.207, 15.107 **RSS-GEN 8.8 table 3**	**Conducted continuous emission in the frequency range 150 kHz to 30 MHz, DC Power input port** The EUT complies with the limits. The margin to the limit was at least 3.8 dB at 0.690 MHz. See clause 5.3.	**PASS**
FCC §15.247 (b)(4) **RSS-247 5.4(4), 5.4(5)**	**Field strength of fundamental and antenna gain** The EUT complies with the limits. The margin to the limit was at least 24.4 dB. See clause 6.4. Antenna gain is less than 6 dBi.	**PASS**
FCC §15.247 (d), 15.209(a), 15.109 **RSS-GEN 8.9** **RSS-247 5.5**	**Radiated emission of electromagnetic fields in the frequency range 30 – 1000 MHz** The EUT **does not comply** with the limits. The margin to the limit was at least 5.0 dB at 37.518 MHz. See clause 6.4 – 6.5.	**PASS**
FCC §15.247(d), 15.209(a), 15.109 **RSS-GEN 8.9** **RSS-247 5.5**	**Radiated emission of electromagnetic fields in the frequency range above 1 GHz** The EUT **does not comply** with the limits. The margin to the limit was at least 3.3 dB at 1805.4 MHz. See clause 6.6 – 6.7.	**PASS**
FCC §15.247(a)(1) **RSS-GEN 6.6** **RSS-247 5.1**	**Occupied bandwidth** The EUT complies with the limits. The margin to the limit is at least 448.7 kHz See clause 10.4.	**PASS**
FCC §15.247(b) **RSS-247 5.4**	**Conducted output power** The EUT complies with the limits. The margin to the limit was at least 6.9 dB at 915.25 MHz. See clause 9.4.	**PASS**
FCC §15.247(a)(1) **RSS-247 5.1(2)**	**Carrier frequency separation** The EUT complies with the limits. The margin to the limit was at least 448.0 kHz. See clause 13.4.	**PASS**
FCC §15.247(a)(1) **RSS-247 5.1**	**Number of hopping frequencies** The EUT complies with the limits. See clause 12.4.	**PASS**
FCC §15.247(a)(1) **RSS-247 5.1**	**Time of occupancy** The EUT complies with the limits. The margin to the limit was at least 8.0 ms. See clause 14.4.	**PASS**

FCC §15.247(d) **RSS-247 5.5**	**Band edge** The EUT complies with the limits. The margin to the limit was at least 39.0 dB at 902.0 MHz. See clause 6.4.	**PASS**

5 CONDUCTED CONTINUOUS DISTURBANCES IN THE FREQUENCY-RANGE 0.15 TO 30 MHZ

Date of test:	2017-11-02	**Test location:**	Bur 1
EUT Serial:	173900004	**Ambient temp:**	22 °C
Tested by:	DNI	**Relative humidity:**	37 %
Test result:	Pass	**Margin:**	3.8 dB

5.1 Test set-up and test procedure

The test method is in accordance with ANSI C63.10-2013 section 6.2.

The EUT was connected to the power via Artificial Mains Networks AMN.

The EUT was placed on an insulating support 0.8 m above the floor, 0.4 m from the vertical reference ground plane (RGP) and 0.8 m from the AMN/ISN.

Overview sweeps were performed for each lead.

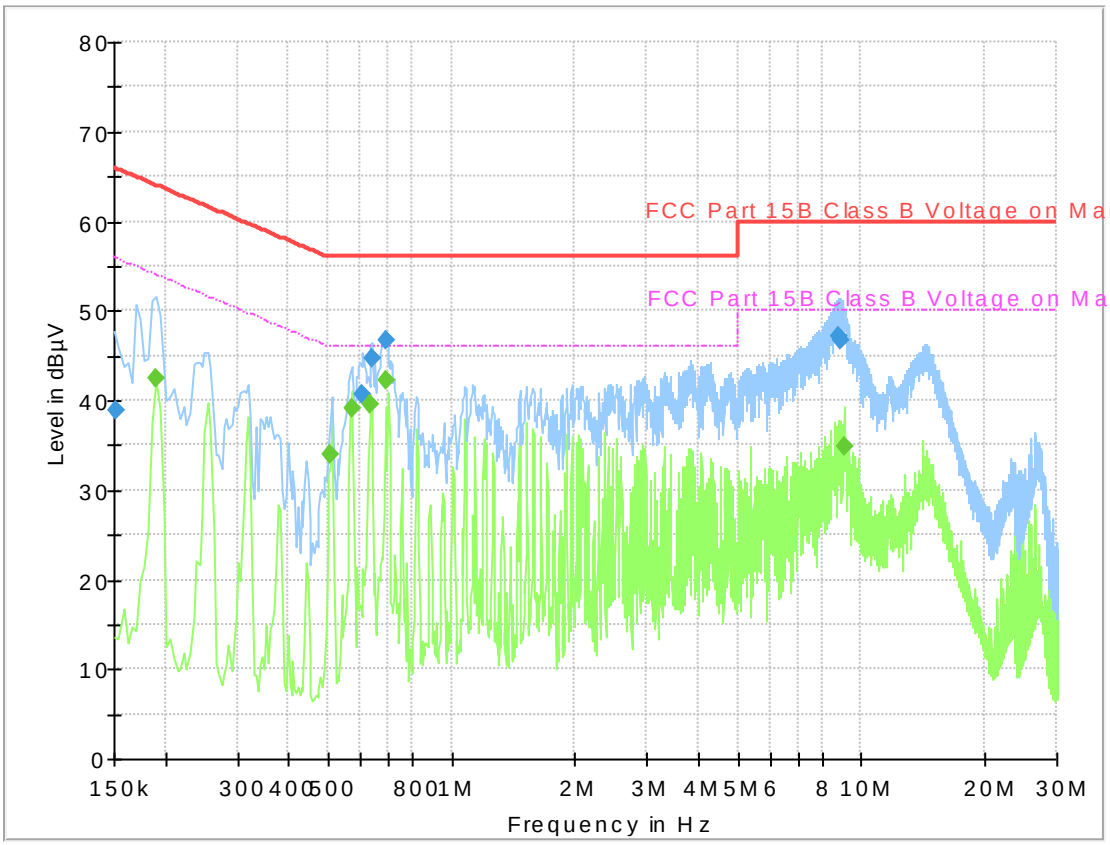
During the tests the EUT was operated according to the mode of operation mentioned in clause 2.4.

5.2 Requirement

Limits for conducted emission from AC mains
The EUT shall meet the limits for the standards.
Reference: 47 CFR §15.207, 1§15.107
RSS-GEN, section 8.8 table 3

Frequency range [MHz]	Limits [dBµV]	
	Quasi-Peak	Average
0.15 – 0.50	66 – 56	56 – 46
0.50 – 5.00	56	46
5.00 – 30.0	60	50

5.3 Test results



Diagram, Peak and Average overview sweep

Measurement results, Quasi-peak

Frequency [MHz]	Level [dBµV]	Limit [dBµV]	Line L/N	Margin [dB]
0.151	38.9	66.0	N	27.1
0.603	40.7	56.0	N	15.3
0.639	44.7	56.0	N	11.3
0.689	46.6	56.0	N	9.4
8.814	47.2	60.0	N	12.8
8.899	46.7	60.0	L	13.3

Measurement results, Average

Frequency [MHz]	Level [dBµV]	Limit [dBµV]	Line L/N	Margin [dB]
0.189	42.4	54.1	N	11.7
0.507	34.0	46.0	L	12.0
0.572	39.2	46.0	N	6.8
0.635	39.6	46.0	N	6.4
0.690	42.2	46.0	N	3.8
9.055	34.8	50.0	L	15.2

Result [dBµV] = Analyser reading [dBµV] + cable loss [dB] + LISN insertion loss [dB]

6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHZ TO 13 GHZ

Date of test:	2018-04-26, 2018-05-25	**Test location:**	Radio hallen / 5mSAC
EUT Serial:	173900004	**Ambient temp:**	21 °C
Tested by:	PLA / RHI	**Relative humidity:**	37 %
Test result:	Pass	**Margin:**	5 dB

6.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013.

The EUT was set up in order to emit maximum disturbances.

EUT was placed on turntable which is part of the reference ground plane.

Overview sweeps were performed with the measurement receiver in max-hold mode and the peak detector activated in the frequency-range 30 – 1000 MHz. Above 1 GHz additionally the average detector was activated.

6.2 Test conditions

Test set-up:	**30 MHz to 1000 MHz**	
Test receiver set-up:		
Preview test:	Peak,	RBW 120 kHz. VBW 1 MHz
Final test:	Quasi-Peak,	RBW 120 kHz. VBW 1 MHz
EUT height above ground plane:	0.8 m	
Measuring distance:	3 m	
Measuring angle:	0 – 359°	
Antenna		
Height above ground plane:	1 – 4 m	
Polarisation:	Vertical and Horizontal	
Type:	Bilog	

Test set-up:	**1 GHz – 26.5 GHz**	
Test receiver set-up:		
Preview test:	Peak,	RBW 1 MHz. VBW 3 MHz
	Average,	RBW 1 MHz. VBW 3 MHz
Final test:	Peak,	RBW 1 MHz. VBW 3 MHz
	Average	RBW 1 MHz. VBW 3 MHz
EUT height above ground plane:	1.5 m	
Measuring distance:	3 m	
Measuring angle:	0 – 359°	
Antenna		
Height above ground plane:	1 – 4 m	
Polarisation:	Vertical and Horizontal	
Type:	Horn	
Antenna tilt:	Activated	

6.3 Requirements

Within restricted bands and receive mode:
Reference: CFR 47 §15.209, §15.109, RSS-Gen section 8.9

Field strength of emissions must comply with limits shown in table below

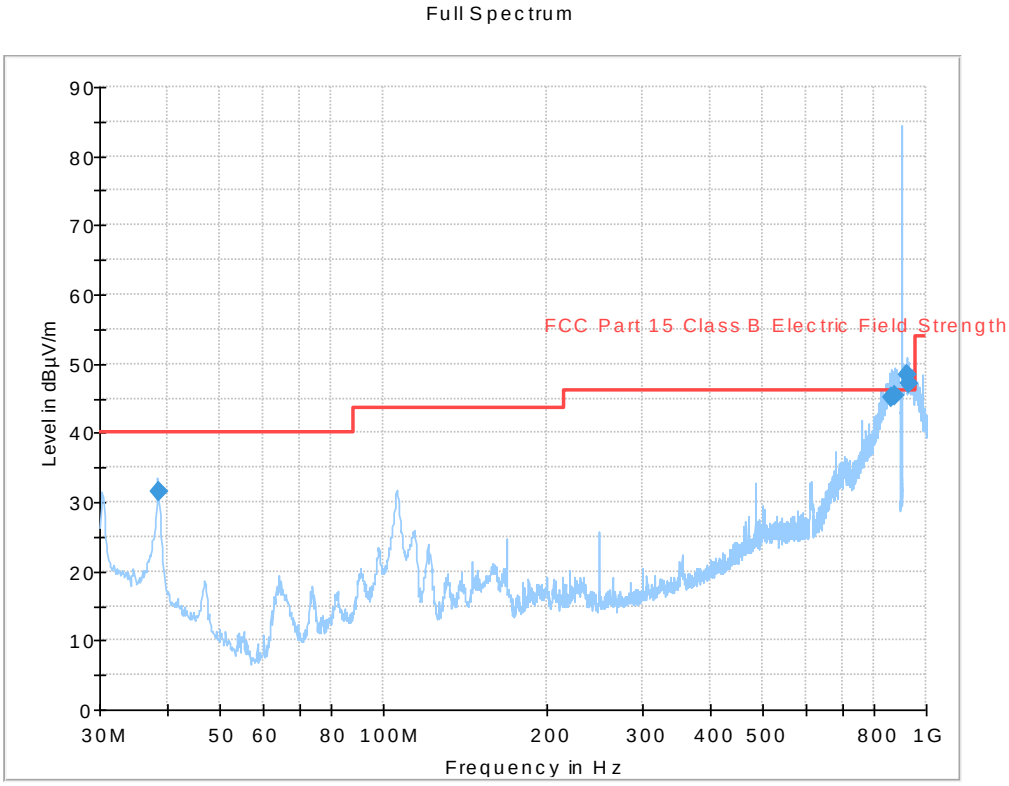
Frequency range [MHz]	Field strength at 3 m (dBµV/m)	Field strength at 10 m (dBµV/m)	Detector (dBµV/m)
30 – 88	40.0	29.5	Quasi Peak
88 – 216	43.5	33.0	Quasi Peak
216 – 960	46.0	35.5	Quasi Peak
960 – 1000	54.0	43.5	Quasi Peak
Above 1000	54.0 / 74.0	43.5 / 63.5	Average / Peak

The values for 10 m measuring distance are calculated by subtracting 10.5 dB from the 3 m limit.
(i.e. an extrapolation factor of 20 dB/decade according to CFR 47 §15.31(f)(1))

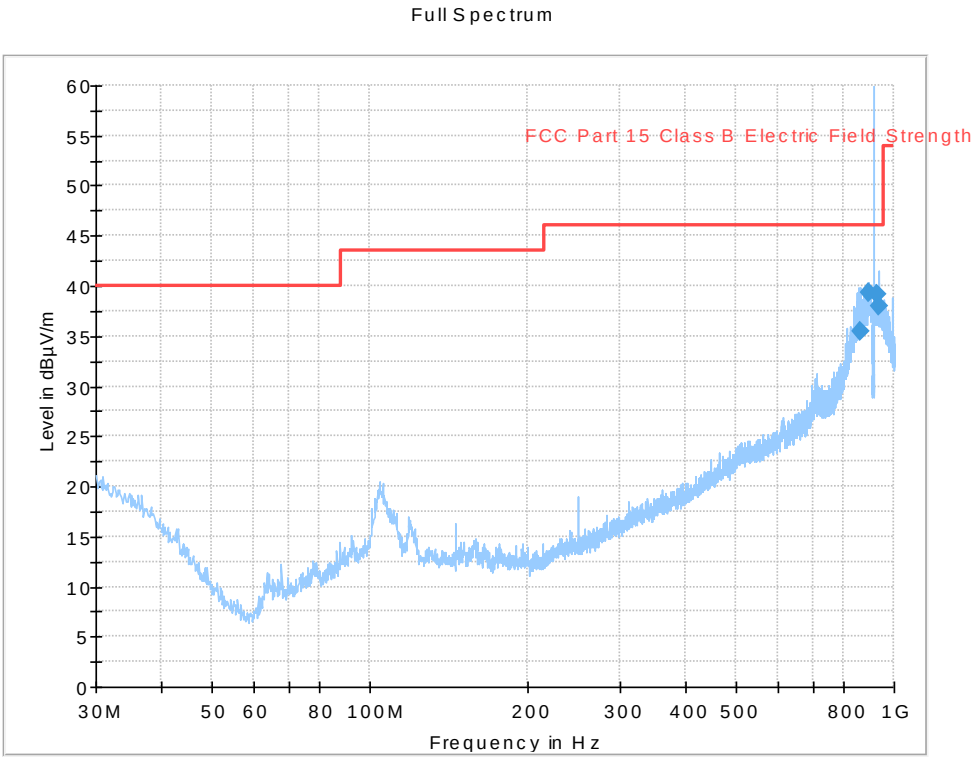
Outside the restricted bands:
Reference: CFR 47 §15.247(d), RSS-247 5.5,

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

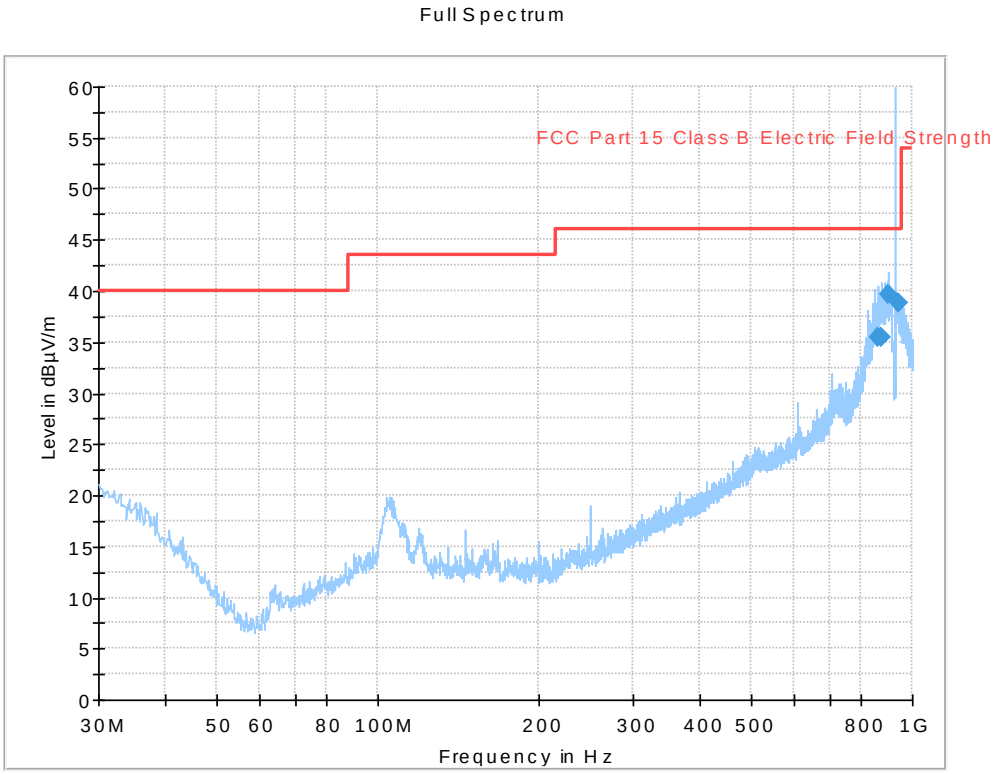
6.4 Test results 30 MHz – 1000 MHz, TX



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX low channel. Carrier attenuated with notch filter.



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX mid channel. Carrier attenuated with notch filter. Additionally 10 dB attenuator used.



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX high channel. Carrier attenuated with notch filter. Additionally 10 dB attenuator used.

Measurement results, Quasi Peak

Low channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
38.517	31.5	40.0	V	8.5
863.568	45.1	46.0	H	0.9
874.351	45.4	46.0	H	0.6
902.750	132.9	46.0	V	*
920.160	48.3	46.0	V	-2.3**
928.616	47.1	46.0	V	-1.1**

NOTE: *****Carrier frequency

NOTE: **Signal originates from transmitter, re-measured manually. Fulfils requirement of 20 dB lower than highest emission within band with 100 kHz measuring bandwidth and is not within a restricted band.

Middle channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
862.243	45.5	46.0	H	0.5
894.271	49.3	46.0	V	-3.3**
915.250	132.3	46.0	V	*
932.206	49.1	46.0	V	-3.1**
936.393	48.0	46.0	V	-2.0**

NOTE: *****Carrier frequency

NOTE: **Signal originates from transmitter, re-measured manually. Fulfils requirement of 20 dB lower than highest emission within band with 100 kHz measuring bandwidth and is not within a restricted band.

High channel

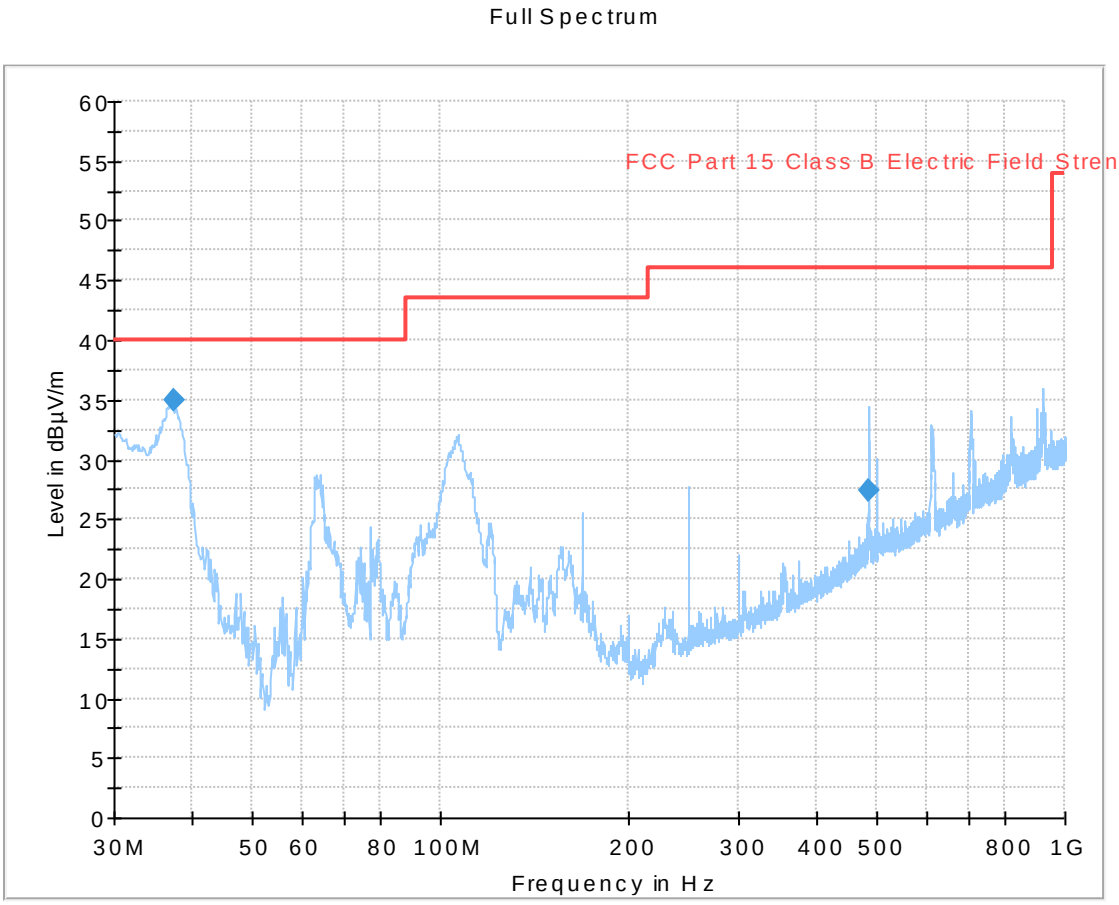
Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
865.711	45.5	46.0	H	0.5
878.237	45.5	46.0	H	0.5
899.920	49.7	46.0	V	-3.7**
927.250	131.6	46.0	V	*
393.617	48.8	46.0	V	-2.8**

NOTE: *****Carrier frequency

NOTE: **Signal originates from transmitter, re-measured manually. Fulfils requirement of 20 dB lower than highest emission within band with 100 kHz measuring bandwidth and is not within a restricted band.

Result [dBµV/m] = Analyser reading [dBµV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB] + Notch filter loss [dB]

6.5 Test results 30 MHz – 1000 MHz, RX



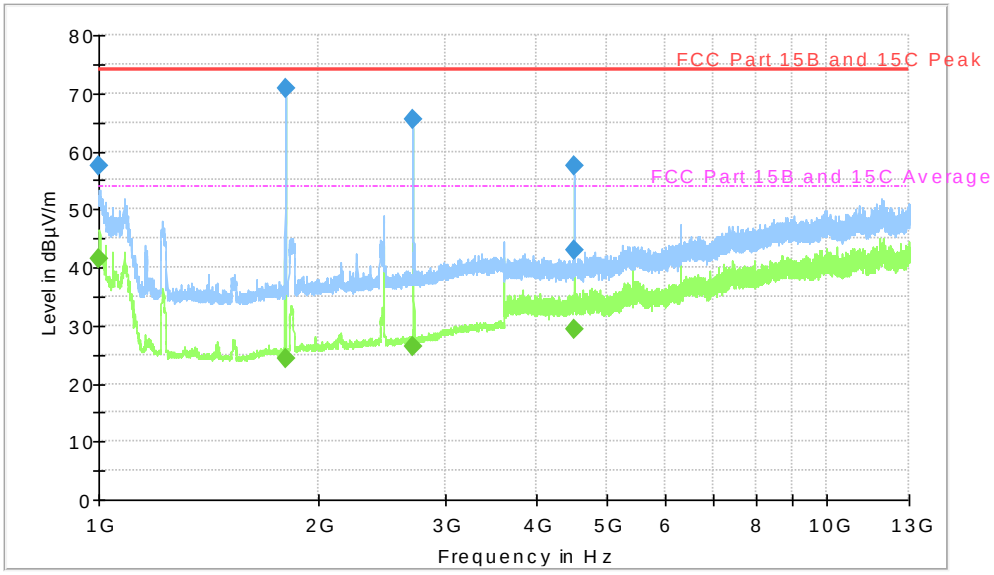
Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance, RX.

Measurement results, Quasi Peak

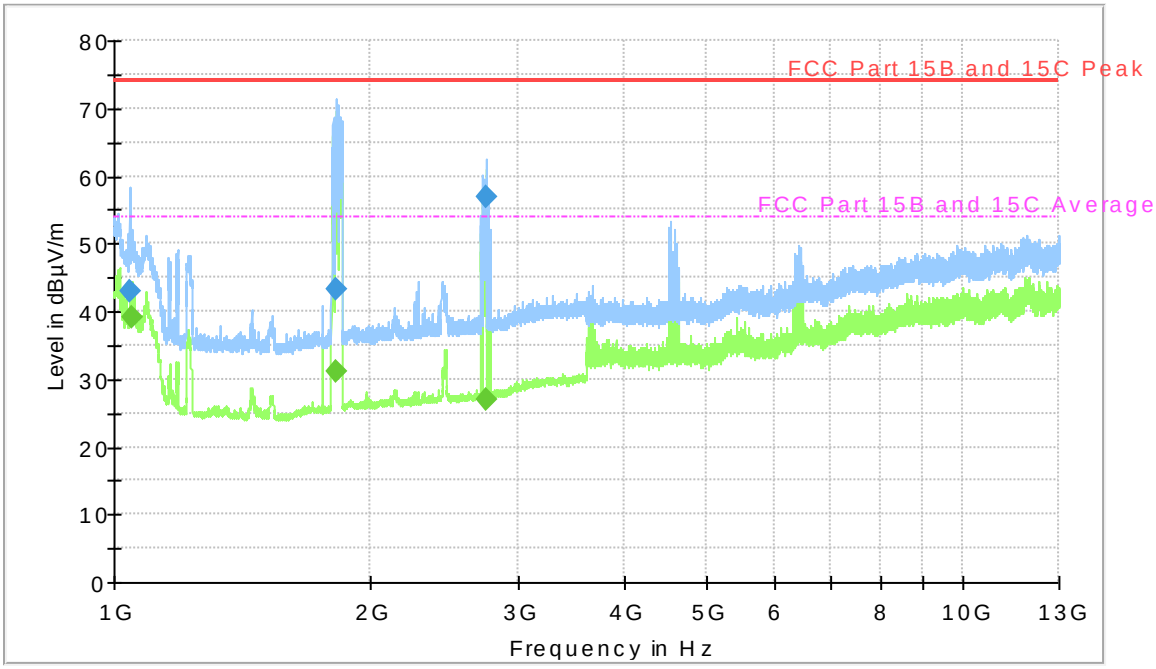
Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
37.518	35.0	40.0	V	5.0
484.0	27.4	40.0	V	18.7

Result [dBµV/m] = Analyser reading [dBµV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

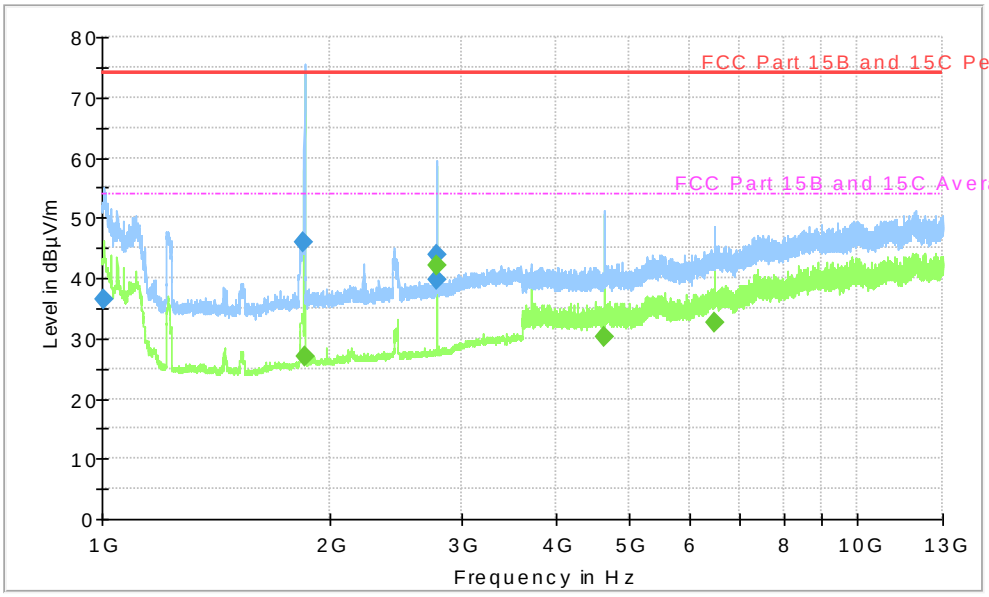
6.6 Test results 1 GHz - 13 GHz, TX



Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. TX low channel, emissions below 1 GHz are attenuated by high pass filter.



Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. TX mid channel, emissions below 1 GHz are attenuated by high pass filter.



Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. TX high channel, emissions below 1 GHz are attenuated by high pass filter.

Measurement results, Peak, TX low channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
1002.3	57.5	74.0	H	16.5
1805.4	70.7	74.0	V	3.3
2708.2	65.5	74.0	V	8.5
4512.2	42.9	74.0	V	31.1

Measurement results, Average, TX low channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
1002.4	41.4	54.0	H	12.6

Measurement results, Peak, TX middle channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
2741.7	57.0	74.0	V	17.0

Measurement results, Average, TX middle channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
1051.2	39.2	54.0	H	14.8

Measurement results, Peak, TX high channel

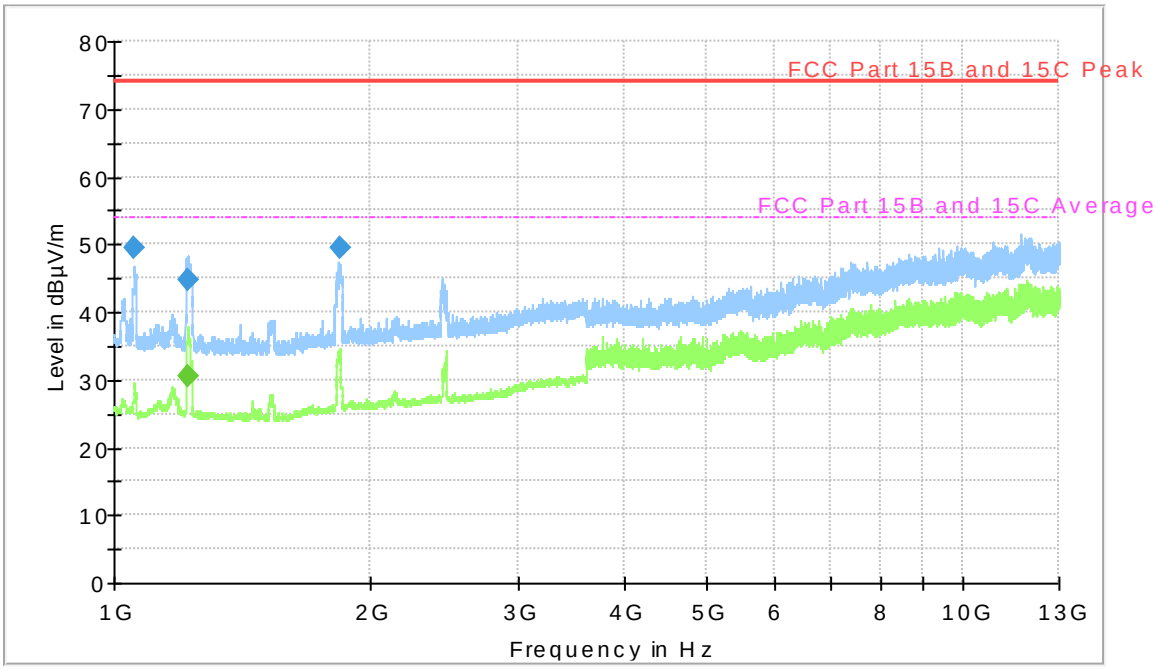
All disturbances have a margin to the limit of more than 20 dB.

Measurement results, Average, TX high channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
2781.6	42.1	11.9	V	11.9

Result [dBµV/m] = Analyser reading [dBµV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB] + High pass filter loss [dB] + Attenuator loss [dB]

6.7 Test results 1 GHz – 13 GHz, RX



Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX.

Measurement results, RX

All disturbances have a margin to the limit of more than 20 dB.

Result [dBµV/m] = Analyser reading [dBµV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

7 CONDUCTED BAND EDGE MEASUREMENT

Date of test:	2017-11-01, 2017-11-17	**Test location:**	Wireless Lab
EUT Serial:	173900004	**Ambient temp:**	21-22 °C
Tested by:	DNI	**Relative humidity:**	35-40 %
Test result:	Pass	**Margin:**	39.0 dB

7.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 6.10.4.

The EUT was connected to spectrum analyser via rf-cable and attenuator

The EUT was set up in order to emit maximum disturbances. Measurements are made with EUT on single channel and with EUT in hopping mode.

7.2 Test conditions

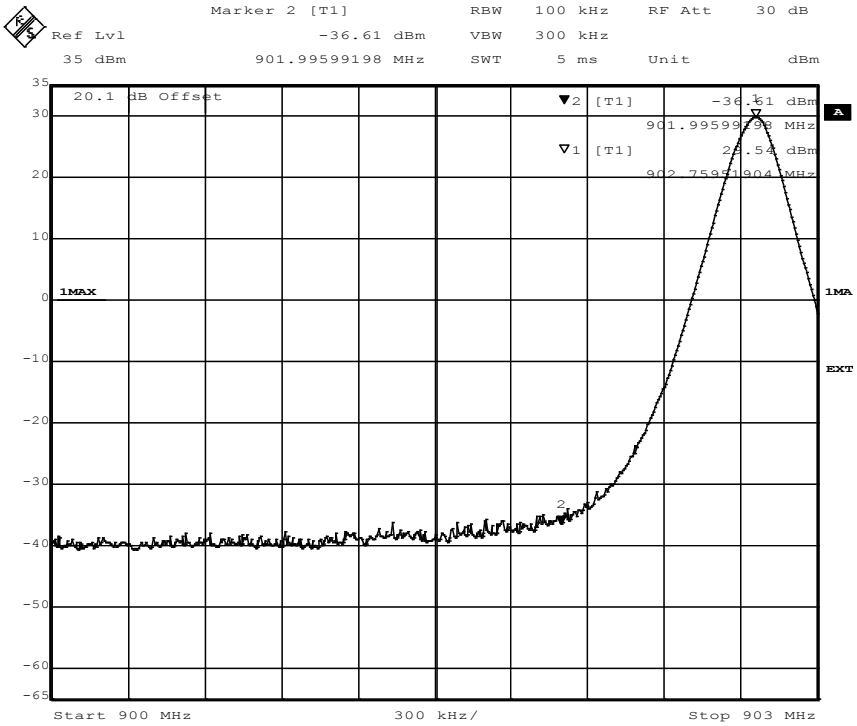
Detector: Peak,
RBW: 100 kHz
VBW: 300 kHz

7.3 Requirement

Reference: CFR 47 §15.247(d), RSS-247 5.5

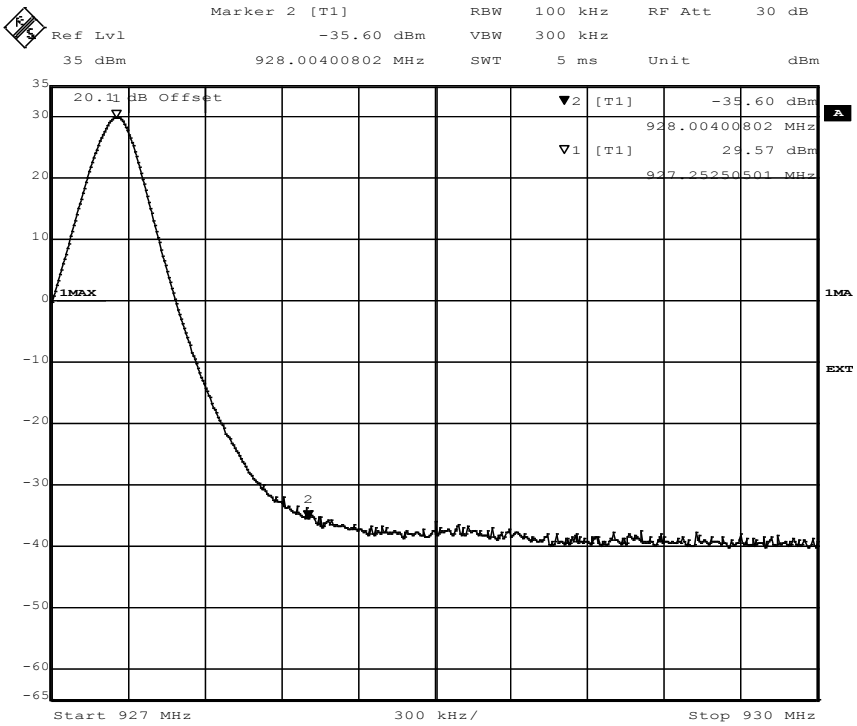
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

7.4 Test results



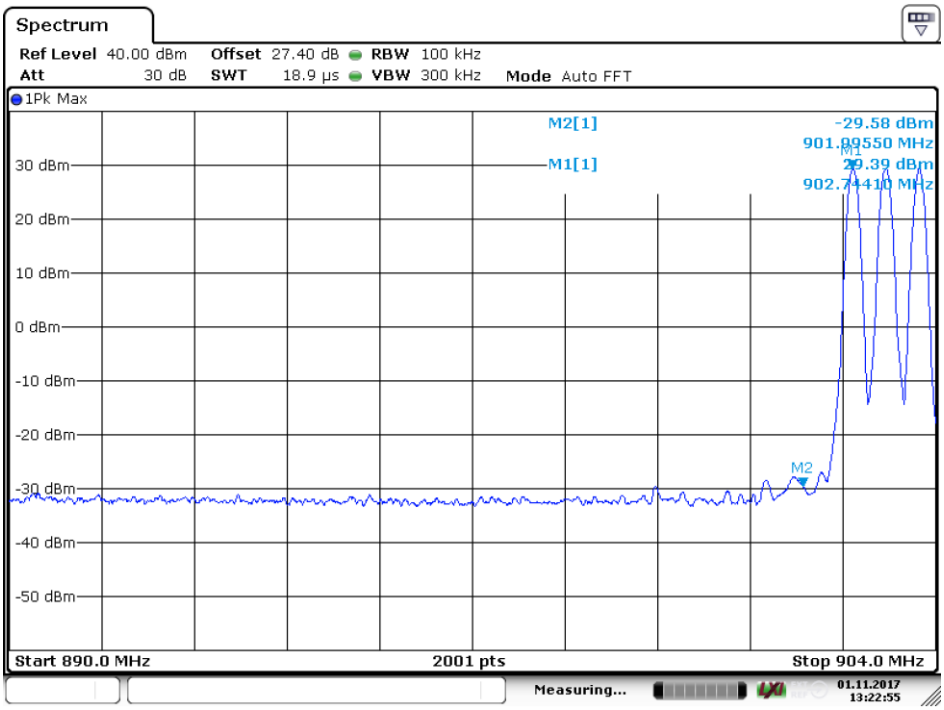
Date: 17.NOV.2017 09:25:50

Screenshot: Lower band edge sweep, single channel



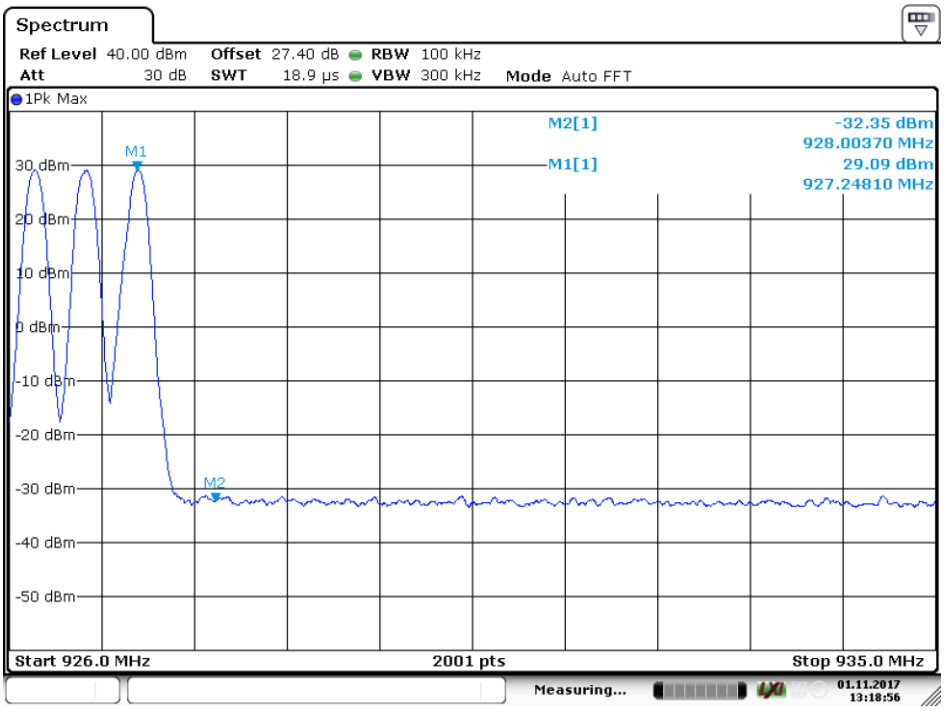
Date: 17.NOV.2017 09:23:21

Screenshot: Upper band edge sweep, single channel



Date: 1.NOV.2017 13:22:56

Screenshot: Lower band edge sweep, hopping mode



Date: 1.NOV.2017 13:18:57

Screenshot: Upper band edge sweep, hopping mode

Measurement results

Band edge	EUT mode of operation	Delta [dBc]	Limit [dBc]	Margin [dB]
Lower	Single channel	66.2	20.0	46.2
Upper	Single channel	65.2	20.0	45.2
Lower	Hopping	59.0	20.0	39.0
Upper	Hopping	61.5	20.0	41.5

8 PEAK CONDUCTED OUTPUT POWER

Date of test:	2017-11-17	**Test location:**	Wireless Center
EUT Serial:	173900004	**Ambient temp:**	22 °C
Tested by:	DNI	**Relative humidity:**	35 %
Test result:	Pass	**Margin:**	6.4 dB

8.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 7.8.5.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

8.2 Test conditions

Detector: Peak,
RBW: >20 dB BW
VBW: 3 x RBW
Span: 5 x 20 dB BW

The EUT was set up in order to emit maximum disturbances.

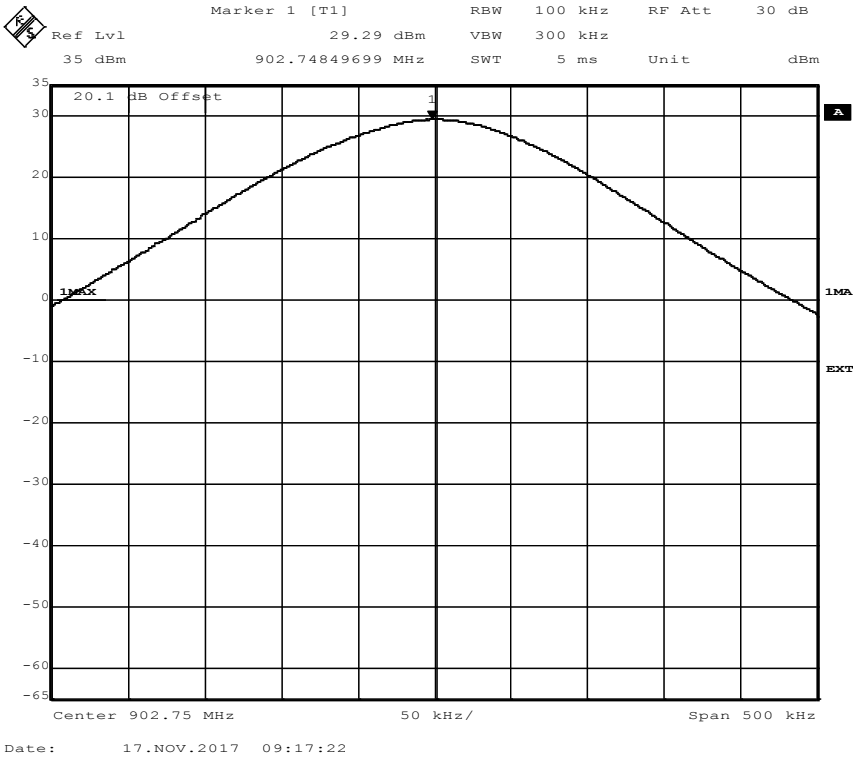
8.3 Requirements

Reference: CFR 47 §15.247(b)(1), RSS-247 5.4
The maximum peak conducted output power of the intentional radiator shall not exceed the following:

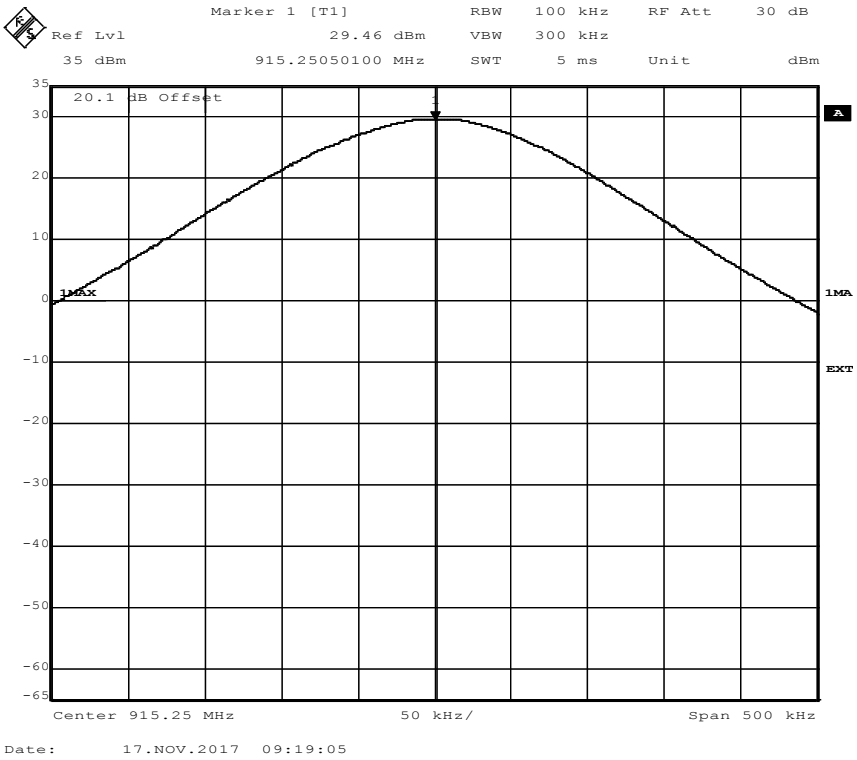
For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

The e.i.r.p. shall not exceed 4 W.

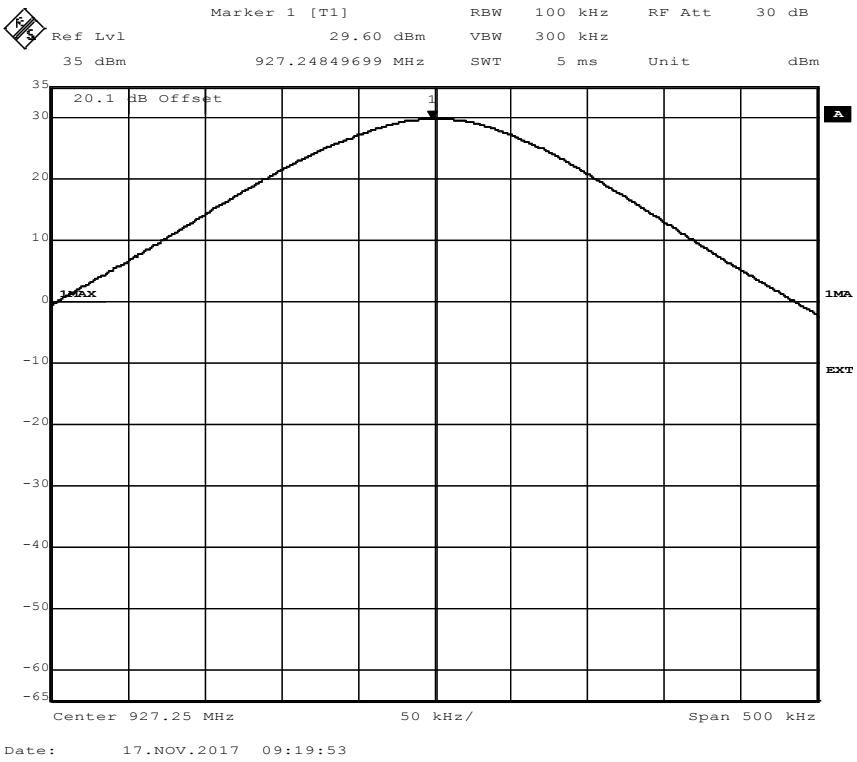
8.4 Test results



Screenshot: Output power, low channel



Screenshot: Output power, middle channel



Screenshot: Output power, high channel

Measurement results

Channel [MHz]	Output power [dBm]	Limit [dBm]	Margin [dB]
902.75	29.3	36.0	6.7
915.25	29.5	36.0	6.5
927.25	29.6	36.0	6.4

9 OCCUPIED 20 DB BANDWIDTH

Date of test:	2017-11-01	**Test location:**	Wireless Center
EUT Serial:	173900004	**Ambient temp:**	21 °C
Tested by:	DNI	**Relative humidity:**	40 %
Test result:	Pass	**Margin:**	448.7 kHz

9.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 6.9.2.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

9.2 Test conditions

Detector: Peak,
RBW: 1 – 5 % of span
VBW: 3 x RBW
Span: >1,5 x OBW

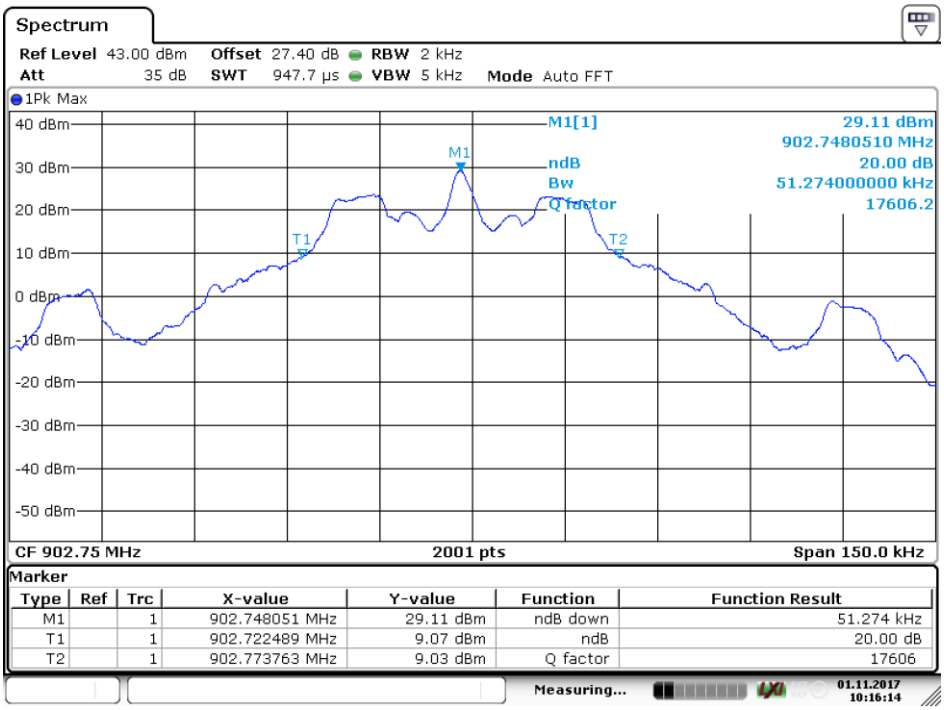
The EUT was set up in order to emit maximum disturbances.

9.3 Requirements

Reference: CFR 47 §15.247(a)(1), RSS-247 5.1

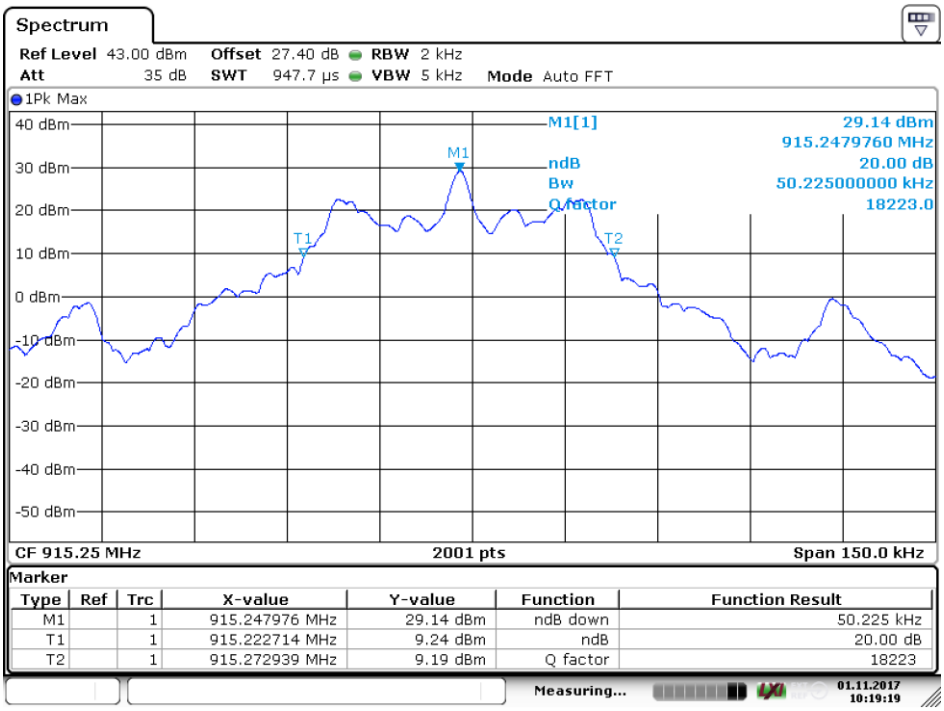
For frequency hopping systems operating in the 902-928 MHz band the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

9.4 Test results



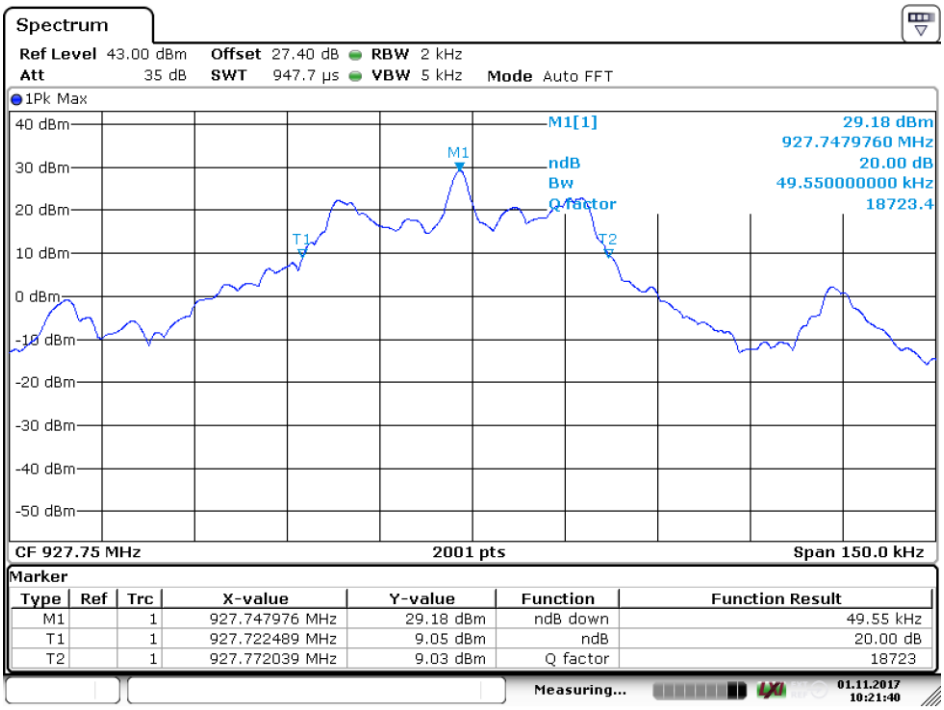
Date: 1.NOV.2017 10:16:15

Screenshot: Occupied bandwidth Measurement, low channel



Date: 1.NOV.2017 10:19:19

Screenshot: Occupied bandwidth Measurement, middle channel



Date: 1.NOV.2017 10:21:40

Screenshot: Occupied bandwidth Measurement, high channel

Test result

Channel [MHz]	20 dB BW [kHz]	Limit [kHz]	Margin [kHz]
902.75	51.3	500	448.7
915.25	50.3	500	449.7
927.75	49.6	500	450.4

10 99 % BANDWIDTH

Date of test:	2017-11-01	**Test location:**	Wireless Center
EUT Serial:	173900004	**Ambient temp:**	21 °C
Tested by:	DNI	**Relative humidity:**	40 %
Test result:	Pass	**Margin:**	-

10.1 Test set-up and test procedure.

The test method is in accordance with RSS-GEN section 6.7.

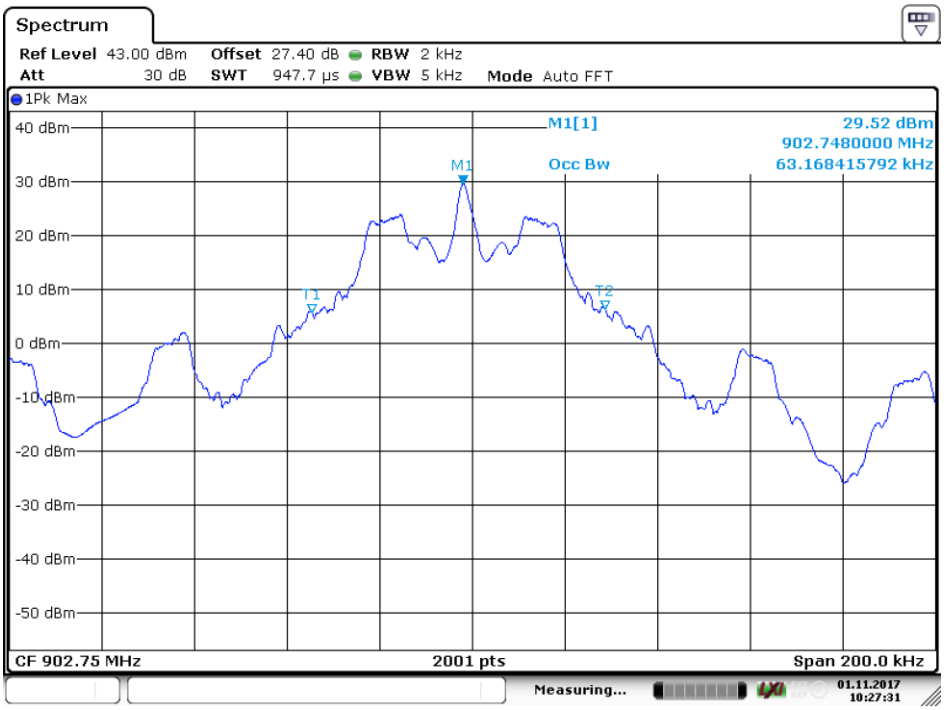
Spectrum analyser with occupied bandwidth measurement function is used to determine the occupied bandwidth. The EUT was connected to spectrum analyser via rf-cable and attenuator.

10.2 Test conditions

Detector: Peak,
RBW: 1 – 5 % of OBW
VBW: 3 x RBW

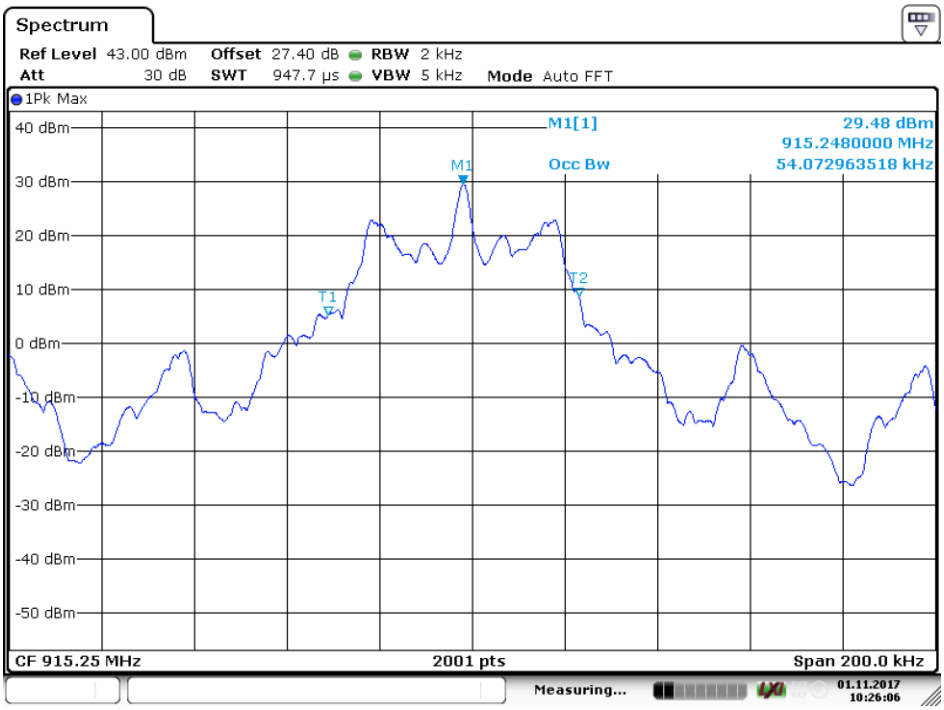
The EUT was set up in order to emit maximum disturbances.

10.3 Test results



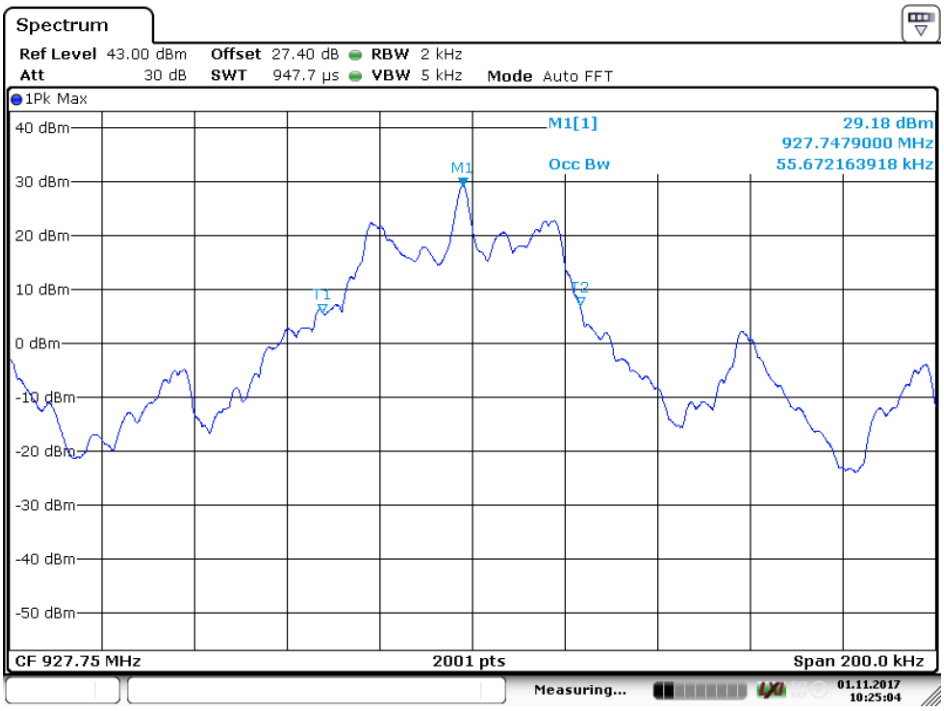
Date: 1.NOV.2017 10:27:31

Screenshot: Occupied bandwidth Measurement, low channel



Date: 1.NOV.2017 10:26:06

Screenshot: Occupied bandwidth Measurement, middle channel



Date: 1.NOV.2017 10:25:04

Screenshot:

Occupied bandwidth Measurement, high channel

Test result

Channel [MHz]	99 % BW [kHz]
902.75	63.2
915.25	54.1
927.75	55.7

11 NUMBER OF HOPPING FREQUENCIES

Date of test:	2017-11-01	**Test location:**	Wireless Center
EUT Serial:	173900004	**Ambient temp:**	21 °C
Tested by:	DNI	**Relative humidity:**	40 %
Test result:	Pass	**Margin:**	--

11.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 7.8.3.

The EUT was connected to spectrum analyser via rf-cable and attenuator

11.2 Test conditions

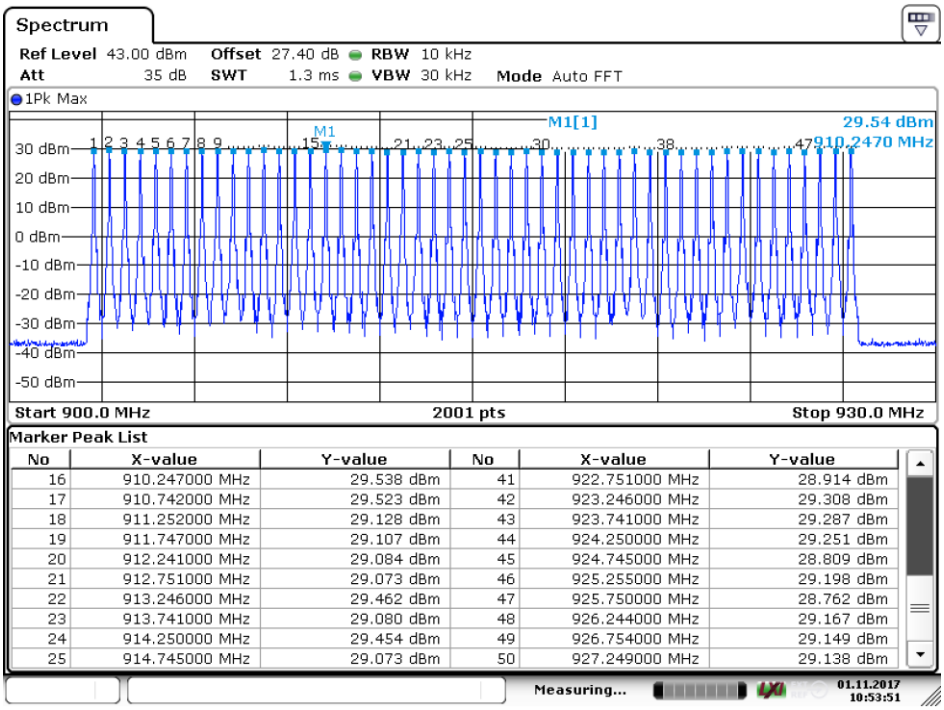
Detector:	Peak
Trace	Max hold
RBW	20 dB BW / 3
VBW	3 x RBW
Span	Frequency band of operation
Sweep	Auto

11.3 Requirements

Reference: CFR 47§15.247(a)(1), RSS-247 5.1

For frequency hopping systems in the band 902–928 MHz: if the -20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels. If the -20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels.

11.4 Test results



No	X-value	Y-value	No	X-value	Y-value
16	910.247000 MHz	29.538 dBm	41	922.751000 MHz	28.914 dBm
17	910.742000 MHz	29.523 dBm	42	923.246000 MHz	29.308 dBm
18	911.252000 MHz	29.128 dBm	43	923.741000 MHz	29.287 dBm
19	911.747000 MHz	29.107 dBm	44	924.250000 MHz	29.251 dBm
20	912.241000 MHz	29.084 dBm	45	924.745000 MHz	28.809 dBm
21	912.751000 MHz	29.073 dBm	46	925.255000 MHz	29.198 dBm
22	913.246000 MHz	29.462 dBm	47	925.750000 MHz	28.762 dBm
23	913.741000 MHz	29.080 dBm	48	926.244000 MHz	29.167 dBm
24	914.250000 MHz	29.454 dBm	49	926.754000 MHz	29.149 dBm
25	914.745000 MHz	29.073 dBm	50	927.249000 MHz	29.138 dBm

Date: 1.NOV.2017 10:53:51

Screenshot: Number of hopping frequencies

Test result

Number of hopping frequencies [#]	Limit [#]
50	≥ 50

12 CARRIER FREQUENCY SEPARATION

Date of test:	2017-11-01	**Test location:**	Wireless Center
EUT Serial:	173900004	**Ambient temp:**	21 °C
Tested by:	DNI	**Relative humidity:**	40 %
Test result:	Pass	**Margin:**	448.0 kHz

12.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 7.8.2.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

12.2 Test conditions

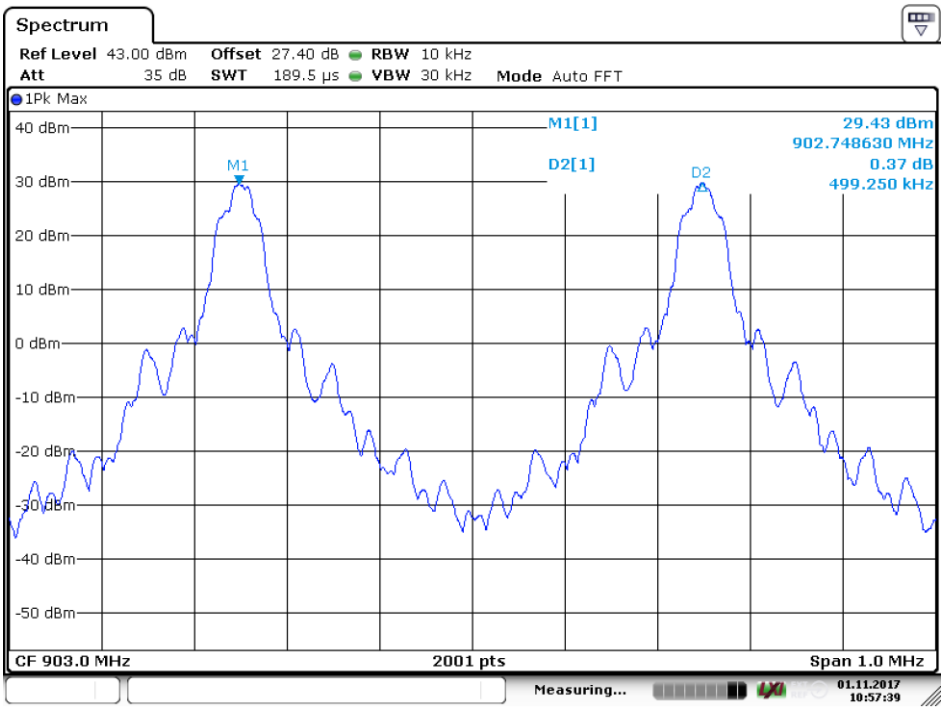
Detector:	Peak
Trace	Max hold
RBW	20 dB bw / 3
VBW	3 x RBW
Span	5 x 20 dB bw
Sweep	Auto

12.3 Requirements

Reference: CFR 47§15.247(a)(1), RSS-247 5.1

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

12.4 Test results



Date: 1.NOV.2017 10:57:39

Screenshot: Carrier frequency separation

Test result

Carrier frequency separation [kHz]	Limit [kHz]	Margin [kHz]
499.3	> 51.3	448,0

13 TRANSMITTER TIME OF OCCUPANCY

Date of test:	2017-11-01	**Test location:**	Wireless Center
EUT Serial:	173900004	**Ambient temp:**	21 °C
Tested by:	DNI	**Relative humidity:**	40 %
Test result:	Pass	**Margin:**	8 ms

13.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 7.8.4.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

13.2 Test conditions

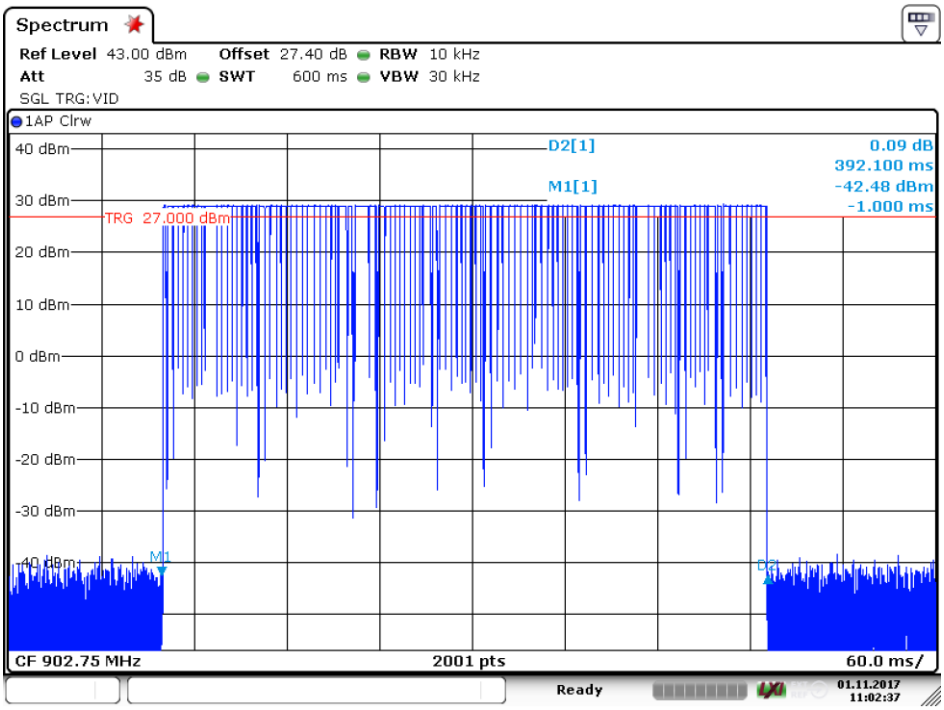
Detector: Peak
RBW 10 kHz
VBW 3 x RBW
Span 0 Hz
Sweep time 600 ms / 20 s

13.3 Requirement

Reference: CFR 47 §15.247(a)(1), RSS-247 5.1

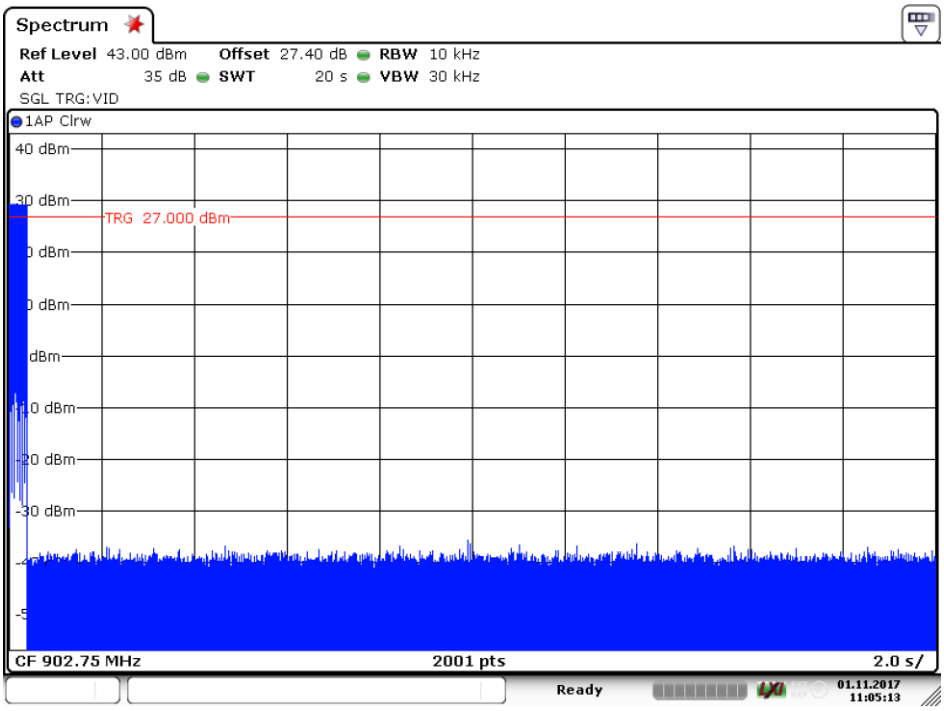
If the -20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period.

13.4 Test results



Date: 1.NOV.2017 11:02:37

Screenshot: Time of one transmission



Date: 1.NOV.2017 11:05:13

Screenshot: Time of occupancy / 20 s

Test result

Number of transmissions	Transmission time [ms]	Time of occupancy / 20 s [ms]	Limit [ms]	Margin [ms]
1	392	392	400	8

14 TEST EQUIPMENT

Conducted emission test site BUR 1

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Receiver	Rohde & Schwarz	ESCI	12741	07-2017	1 year
AMN	Rohde & Schwarz	ESH3-Z5	5875	07-2017	1 year
Pulse limiter	Rohde & Schwarz	ESH3-Z2	32798	07-2017	1 year

Stora Hallen

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Receiver	Rohde & Schwarz	ESR 26	S.N: 101412	09-2017	1 year
BiLog antenna	Chase	CBL6110A	971	06-2016	3 years
Preamplifier					
Horn antenna	Rohde & Schwarz	HF907	31245	12-2016	3 years
Preamplifier	Bonn	BLMA 0118-M	31246	04-2017	1 year
1 GHz high pass filter	Microwave circuits	H1G013G1	13142	08-2017	1 year
Tuneable Notch filter	K&L Microwave	3	7075	Calibrated before use	Calibrated before use

5m SAC

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - 9	--	--	--
Receiver	Rohde & Schwarz	ESU40	13178	July-2017	1 year
Receiver	Rohde & Schwarz	ESIB26	32288	July-2017	1 year
Horn antenna with preamplifier	Bonn	31247	4936	Jan-2017	3 years
Antenna	Rohde & Schwarz	HL562	30711	Jan-2018	3 years
Coaxial cable	Huber + Suhner	Sucoflex 104	39138	July-2017	1 year
Coaxial cable	Huber + Suhner	Sucoflex 104	39131	July-2017	1 year
Preamplifier	Rohde & Schwarz	TS-PRE1	32306	July-2017	1 year
Horn antenna	Bonn	BLMA	31247	Jan-2017	3 years
Coaxial cable	Huber+Suhner	Sucoflex	39057	April-2017	1 year
Coaxial cable	Huber+Suhner	Sucoflex	39054	April-2017	1 year
Coaxial cable	Huber+Suhner	Sucoflex	39057	April-2017	1 year
Horn antenna	Rohde & Schwarz	HF907	32307	July-2017	3 years
Preamplifier	Rohde & Schwarz	TS-Pre1	32306	July-2017	3 years

Wireless Center and 3m FAC

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - Version 10	--	--	--
Signal analyzer	Rohde & Schwarz	ESU 40	13178	jan-2018	1 year
Measurement cable	Huber + Suhner	Sucoflex 104 PE	39138	July-2017	1 year
Measurement cable	Huber + Suhner	Sucoflex 104	5191	July-2017	1 year
Measurement cable	Huber + Suhner	Sucoflex 104	39119	July-2017	1 year
Horn antenna	EMCO	3115	4628	Nov-2015	3 years
Pre amplifier	Sangus	00101400-23-10P -6-S ; AFS44-12002400-32-10P -44	12335	July-2017	1 year
Horn antenna	EMCO	3160-08	30099	Oct-2016	3 years
Horn antenna	EMCO	3160-09	30101	Oct-2016	3 years
2,4 GHz band reject filter:	K&L MICROWAVE INC	6N45-2450/T100-0/0	12389	Mars-2018	1 year
4 GHz high pass filter	K&L MICROWAVE INC	4410-X4500/18000-0/0	5133	August-2017	1 year

15 MEASUREMENT UNCERTAINTY

Measurement uncertainty for Continuous conducted disturbances with AMN	
Uncertainty for the frequency range 9 kHz to 30 MHz	± 3.7 dB
Measurement uncertainty for conducted RF measurements	± 1.3 dB
Measurement uncertainty for radiated disturbance	
Uncertainty for the frequency range 30 to 1000 MHz at 3 m	± 5.1 dB
Uncertainty for the frequency range 30 to 1000 MHz at 10 m	± 5.0 dB
Uncertainty for the frequency range 1.0 to 18 GHz at 3 m	± 4.7 dB
Uncertainty for the frequency range 18 to 26 GHz at 3 m	± 4.8 dB
Uncertainty for the frequency range 26 to 40 GHz at 3 m	± 5.7 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2:2011.
The measurement uncertainty is given with a confidence of 95 %.

16 TEST SET UP AND EUT PHOTOS

EUT photos are in separate document 1711946STO-001 Annex 1.
Test set up photos are in separate document 1711946STO-001 Annex 2.