REPORT

issued by an Accredited Testing Laboratory

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2018-02-21

Reference
8P01074-WL

Testing

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164 80 Stockholm

Radio measurements on Radio 4478 B5 equipment with FCC ID TA8A KRC161689 and IC: 287AB-AS161689

Product name: Radio 4478 B5
Product number: KRC 161 689/1 and KRC 161 689/3

RISE Research Institutes of Sweden AB
Electronics - EMC

Performed by

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Accred. No. 1002
Testing
ISO/IEC 17025

Summary

Standard Listed part of	Compliant
FCC CFR 47 part 22/ IC RSS-132, RSS-Gen	
2.1046/ 5.4 RF power output, conducted	Yes
2.1051/ 5.5 Spurious emission at antenna terminals	Yes
2.1053/ 5.5 Field strength of spurious radiation	Yes

Description of the test object

Equipment:	Radio equipment Radio 4415 B5 Product number KRC 161 689/1 and KRC 161 689/3 FCC ID: TA8AKRC161689 IC: 287AB-AS161689
HVIN:	AS161689
FVIN:	CXP 901 3268/15, R68LT
Hardware revision state:	R2A
Tested configuration:	Multi RAT WCDMA and LTE
Frequency range:	TX: 869 – 894 MHz RX: 824 – 849 MHz
IBW:	25 MHz 20 MHz for BW ≤ 3 MHz
Output power:	Max 40 W/ antenna port
Antenna ports:	4 TX / 4 RX ports
Antenna:	No dedicated antenna, handled during licensing
RF configurations:	LTE: 1-6 carriers/ port WCDMA: 1-5 carriers/ port Max carriers/ port: 6 LTE+WCDMA: TX Diversity, 2x(2x2) MIMO, Contiguous Spectrum (CS), Non-Contiguous Spectrum (NCS)
Channel bandwidths:	LTE: 1.4 MHz, 3 MHz, 5 MHz and 10 MHz WCDMA: 3.8 to 5 MHz
Modulations:	LTE: QPSK, 16QAM, 64QAM and 256QAM WCDMA: QPSK, 16QAM and 64QAM
RF power Tolerance:	+0.6/ -2.0 dB
CPRI Speed	Up to 10.1 Gbit/s
Nominal supply voltage:	-48VDC

The information above is supplied by the manufacturer.

Note: KRC 161 689/1 and KRC 161 689/3 are electrically identical according to the manufacturer. Only KRC 161 689/3 was tested.

Purpose of test

The purpose of this test is to justify a Permissive Change to include the use of multi- standard radio (MSR) for the radio access technologies LTE and WCDMA.

Operation modes during measurements

LTE measurements were performed with the test object transmitting test models as defined in 3GPP TS 36.141. Test model E-TM1.1 was used to represent QPSK, test model E-TM3.2 to represent 16QAM, test model E-TM3.1 to represent 64QAM modulation and E-TM3.1A to represent 256QAM modulation.

WCDMA measurements were performed with the test object transmitting the Test model 1 which are defined in 3GPP TS 25.141. Test model 1 (TM1) represent QPSK modulation. Test model 5 (TM5) includes the 16QAM modulation and Test model 6 (TM6) includes the 64QAM modulation.

All measurements were performed with the test object configured for maximum transmit power. The measured configurations covers worst case settings.

Conducted measurements

The test object was supplied with -48 VDC by an external power supply. Additional connections are documented in the set-up drawings for conducted measurements.

Radiated measurements

The test object was powered with -48 VDC by an external power supply. Additional connections are documented in the set-up drawings for radiated measurements.

References

Measurements were done according to relevant parts of the following standards:
ANSI C63.4-2014
ANSI C63.26-2015
CFR 47 part 2, February 2018
CFR 47 part 22, February 2018
KDB 662911 D01 Multiple Transmitter Output v02r02
KDB 971168 D01 Power Meas License Digital Systems v03
KDB 971168 D03 IM Emission Repeater Amp v01
3GPP TS 25.141, version 13.4.0
3GPP TS 36 141 version 13.6.0
3GPP TS 37.141, version 13.5.0
RSS-Gen Issue 4
RSS-132 Issue 3

Measurement equipment

	Calibration Due	RISE number
Test site Tesla	2019-12	503 881
R&S ESU 40	2018-07	901 385
R&S FSQ 40	2018-07	504 143
R&S FSW 43	2018-08	902 073
Control computer with R&S software EMC32 version 10.20.01	-	BX62351
High pass filter 1-15 GHz	2018-06	504 199
High pass filter 1-20 GHz	2018-06	901 501
RF attenuator Weinschel WA73-20-11	2018-05	900 691
Coaxial cable Sucoflex 102EA	2018-05	BX50191
Coaxial cable Sucoflex 102EA	2018-05	BX50236
ETS Lindgren BiConiLog Antenna 3142E	2019-03	BX61914
EMCO Horn Antenna 3115	2019-12	502 175
µComp Nordic, Low Noise Amplifier	2019-01	901 545
Temperature and humidity meter, Testo 635	2018-06	504 203
Temperature and humidity meter, Testo 625	2018-06	504 188

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation ”SP-QD 10885”. The uncertainties are calculated with a coverage factor k=2 (95% level of confidence).
Compliance evaluation is based on a shared risk principle with respect to the measurement uncertainty.

Reservation

The test results in this report apply only to the particular test object as declared in the report.

Delivery of test object

The test object was delivered: 2018-01-29.

Manufacturer’s representative

Mikael Jansson, Ericsson AB.

Test engineers

Tomas Isbring for radiated tests, RISE
Andreas Johnson for conducted tests, RISE.

Test participant(-s)

None.

Test frequencies used for radiated and conducted measurements

TX test frequencies, conducted measurements:

Symbolic name:2W1L:

	Frequency [MHz]	EARFCN/ UARFCN	Bandwidth [MHz]	Test model
WCDMA	871.4	4357	5	TM5
WCDMA	876.6	4382	5	TM5
LTE	891.5	2625	5	E-TM1.1

The guidance in FCC KDB 971168 D03 has been regarding channel selection

Symbolic name:2L1W:

	Frequency [MHz]	EARFCN/ UARFCN	Bandwidth [MHz]	Test model
LTE	869.7	2407	1.4	E-TM1.1
LTE	871.4	2424	1.4	E-TM1.1
LTE	891.6	2625	5	TM5

Symbolic name:3W3L:

	Frequency [MHz]	EARFCN/ UARFCN	Bandwidth [MHz]	Test model
WCDMA	871.4	4357	5	TM5
WCDMA	876.6	4382	5	TM5
LTE	879.4	2504	1.4	E-TM1.1
WCDMA	888.2	4441	5	TM5
LTE	891.4	2625	1.4	E-TM1.1
LTE	893.3	2643	1.4	E-TM1.1

TX test frequencies, radiated measurements:

Symbolic name: WL

	Frequency [MHz]	EARFCN/ UARFCN	Bandwidth [MHz]	Test model
WCDMA	871.4	4357	5	TM1
LTE	891.5	2625	5	E-TM1.1

Symbolic name: WL_{BIM}

	Frequency [MHz]	EARFCN/ UARFCN	Bandwidth [MHz]	Test model
LTE	869.7	2407	1.4	E-TM1.1
LTE	871.1	2421	1.4	E-TM1.1
WCDMA	891.6	4458	5	TM1

According to FCC KDB 971168 D03

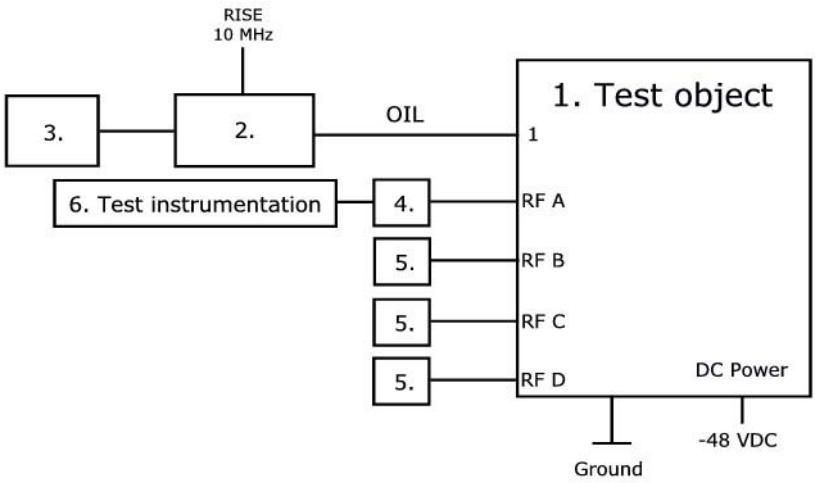
Symbolic name: WL_{TIM}

	Frequency [MHz]	EARFCN/ UARFCN	Bandwidth [MHz]	Test model
WCDMA	871.4	4357	5	TM1
LTE	891.9	2629	1.4	E-TM1.1
LTE	893.3	2643	1.4	E-TM1.1

According to FCC KDB 971168 D03

All RX frequencies were configured 45 MHz below the corresponding TX frequency according the applicable duplex offset for the operating band.

Test setup: conducted measurements



Test object:

1.	Radio 4478 B5, KRC 161 689/3, rev. R2A, s/n: B440820317 With Radio Software: CXP 901 3268/15, rev. R68LT FCC ID: TA8AKRC161689 and IC: 287AB-AS161689

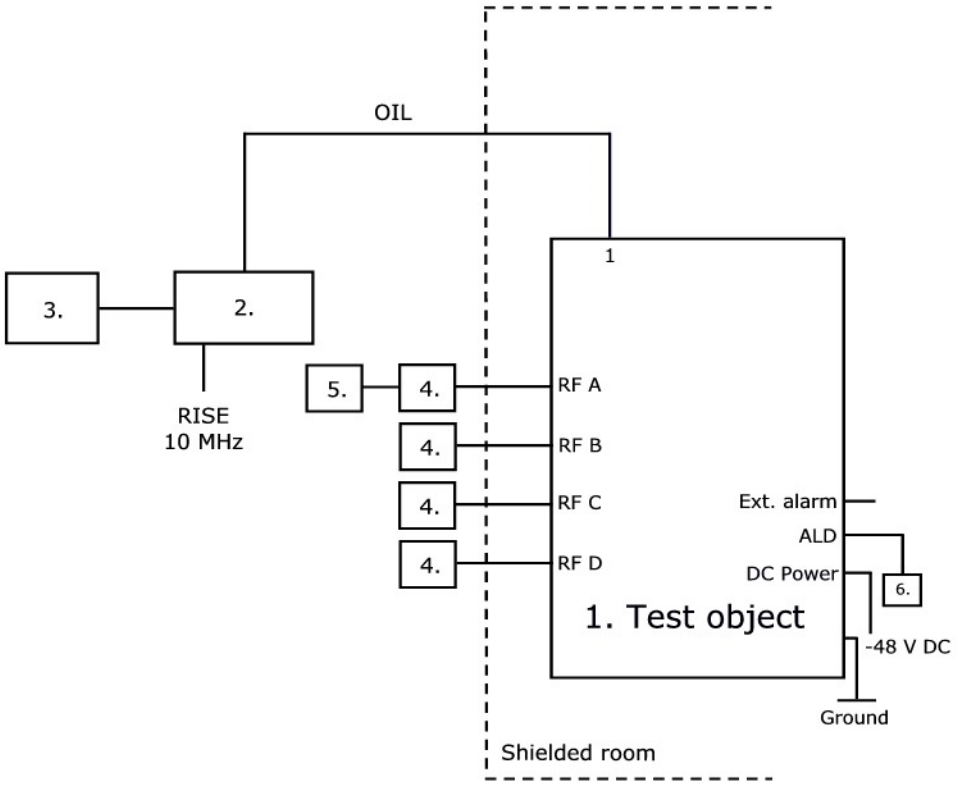
Associated equipment:

2.	Testing Equipment: CT10, LPC 102 487/1, rev. R1C, s/n: T01F375046, BAMS – 1001466800 with software CXA 104 446/1, rev. R8AB/2

Functional test equipment:

3.	Computer, HP EliteBook 8560w, BAMS – 1001236851
4.	RF Attenuator: RISE number: 900 691
5.	Terminator, 50 ohm
6.	RISE Test Instrumentation according to measurement equipment list for each test. The signal 9nalyser was connected to the RISE 10 MHz reference standard during all measurements.

Test setup: radiated measurements



1.	Radio 4478 B5, KRC 161 689/3, rev. R2A, s/n: B440820311 With Radio Software: CXP 901 3268/15, rev. R68LT. FCC ID: TA8AKRC161689 and IC: 287AB-AS161689

Associated equipment:

2.	Testing Equipment: CT10, LPC 102 467/1, rev. R1C, s/n: T01F375046, BAMS – 1001466801 with software CXA 104 446/1, rev. R8AB/2

Functional test equipment:

3.	Computer, HP EliteBook 8560w, BAMS – 1001236854
4.	Attenuator
5.	R&S ESIB 26, RISE no: 503 292, for supervision purpose only
6.	ALD Control, Andrew, model: ATM200-A20, s/n: DESA101412073

Interfaces:

Power input configuration DC: -48 VDC	Power
RF A, 4.3-10 connector, combined TX/RX	Antenna
RF B, 4.3-10 connector, combined TX/RX	Antenna
RF C, 4.3-10 connector, combined TX/RX	Antenna
RF D, 4.3-10 connector, combined TX/RX	Antenna
1, Optical Interface Link, single mode opto fibre	Signal
2, Optical Interface Link, not used in this configuration	Signal
EXT Alarm, shielded multi-wire	Signal
ALD, shielded multi-wire	Signal
Ground wire	Ground

RF power output measurements according to CFR 47 §2.1046 / IC RSS-132 5.4, conducted

Date	Temperature	Humidity
2018-02-08	21 °C ± 3 °C	12 % ± 5 %

Test set-up and procedure

The test object was connected to a signal analyser measuring peak and RMS output power in CDF mode. A resolution bandwidth of 80 MHz was used.

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	900 691
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

Rated output power level at each RF port: 46 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]				
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
1W1L	45.17/ 7.36	45.25/ 7.38	45.16/ 7.36	44.77/ 7.34	51.11
3W3L	44.92/ 7.38	44.98/ 7.34	44.96/ 7.36	44.55/ 7.32	50.88

[1)]: summed output power according to FCC KDB662911 Multiple transmitter output.
Note: The PAR value is the 0.1 % Peak to Average Ratio.

Remark

ERP/EIRP compliance is addressed at the time of licensing, as required by the responsible FCC/IC Bureau(s). Licensee's are required to take into account maximum antenna gain used in combination with above power settings to prevent the radiated output power to exceed the limits.

Limits

CFR47 § 22.913: The effective radiated power ERP shall not exceed 1000 W or 800 W/ MHz (PSD) per sector.
The PAR (0.1%) shall not exceed 13 dB.

RSS-132 5.4: The average equivalent isotropically radiated power (e.i.r.p.) limits in SRSP-503 apply, resulting in a maximum EIRP of 1640 W.
The PAR (0.1%) shall not exceed 13 dB.

Complies?	Yes

Conducted spurious emission measurements according to CFR 47 §2.1051 / IC RSS-132 5.5

Date	Temperature	Humidity
2018-02-08	21 °C ± 3 °C	12 % ± 5 %
2018-02-14	21 °C ± 3 °C	15 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §22.917. The output was connected to a spectrum analyser with the RMS detector activated. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

Before comparing the results to the limit, 6 dB [10 log (4)] to cover 4x4 MIMO, should be added according to method E)2)c) “Measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output.

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	900 691
HP filter	504 199
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Diagram	Symbolic name	Tested Port
1 a-b-c	2W1L	RF B
2 a-b-c	2L1W	RF B
2 a-b-c	3W3L	RF B

Note: Measurements were limited to port RF B due to electrical identical ports as declared by the client.

Remark

The emission at 9 kHz on the plots was not generated by the test object. A complementary measurement with a smaller RBW showed that it was related to the LO feed-through.

The highest fundamental frequency is 894 MHz. The measurements were made up to 9 GHz (10x894 MHz = 8940 MHz).

Limits

CFR 47 § 22.917: Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, resulting in a limit of -13 dBm per 100 kHz RBW below 1 GHz and 1MHz RBW above 1 GHz.

IC RSS-132 5.5: Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB per any 100 kHz RBW.

Complies?	Yes

Diagram 1a:

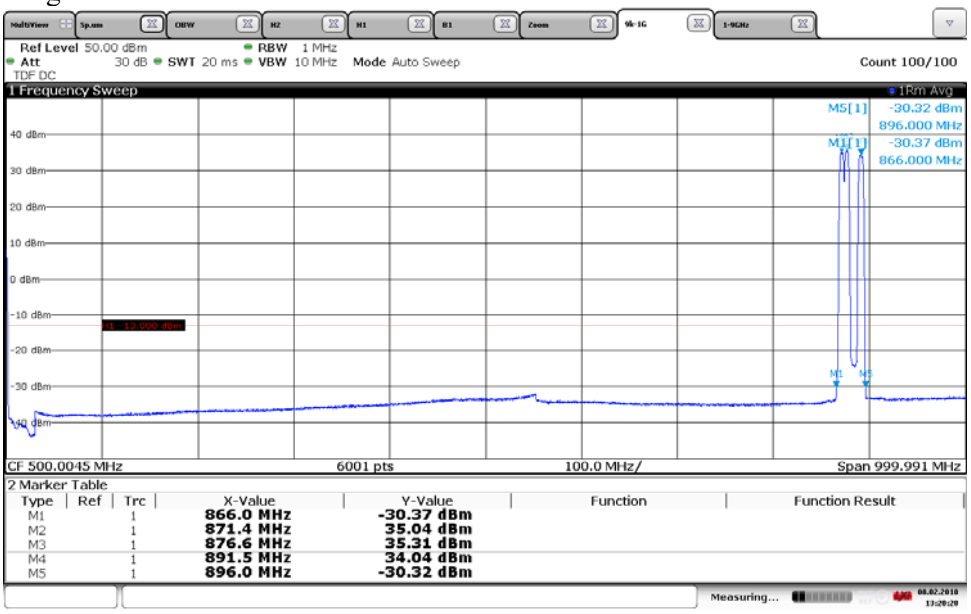


Diagram 1b:

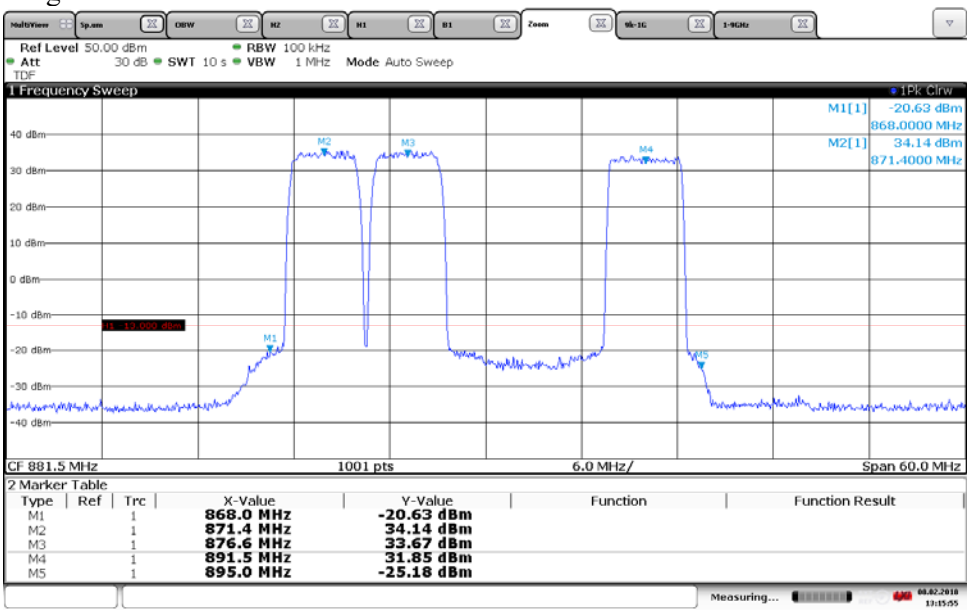


Diagram 1 c:

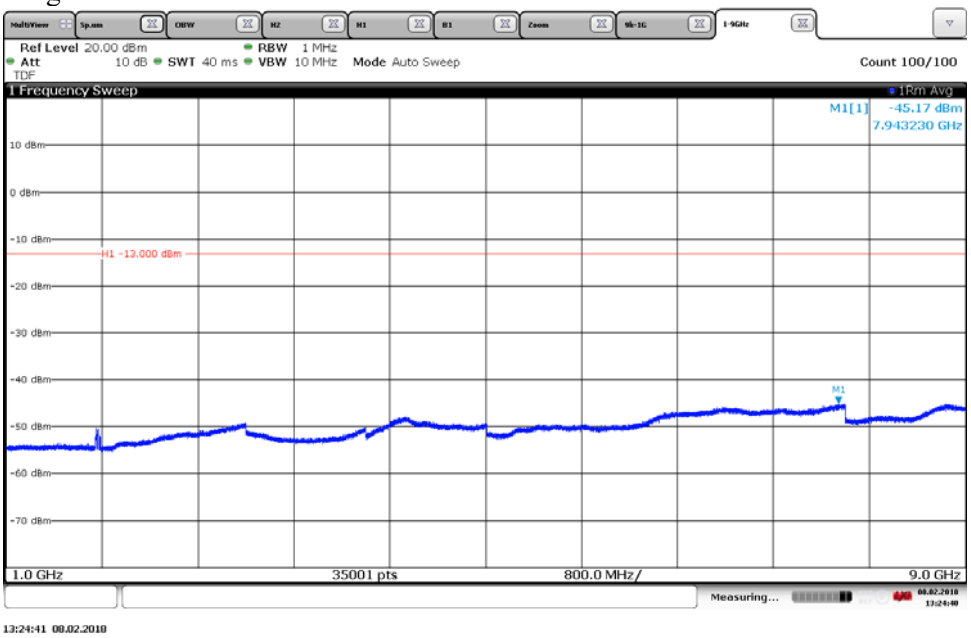
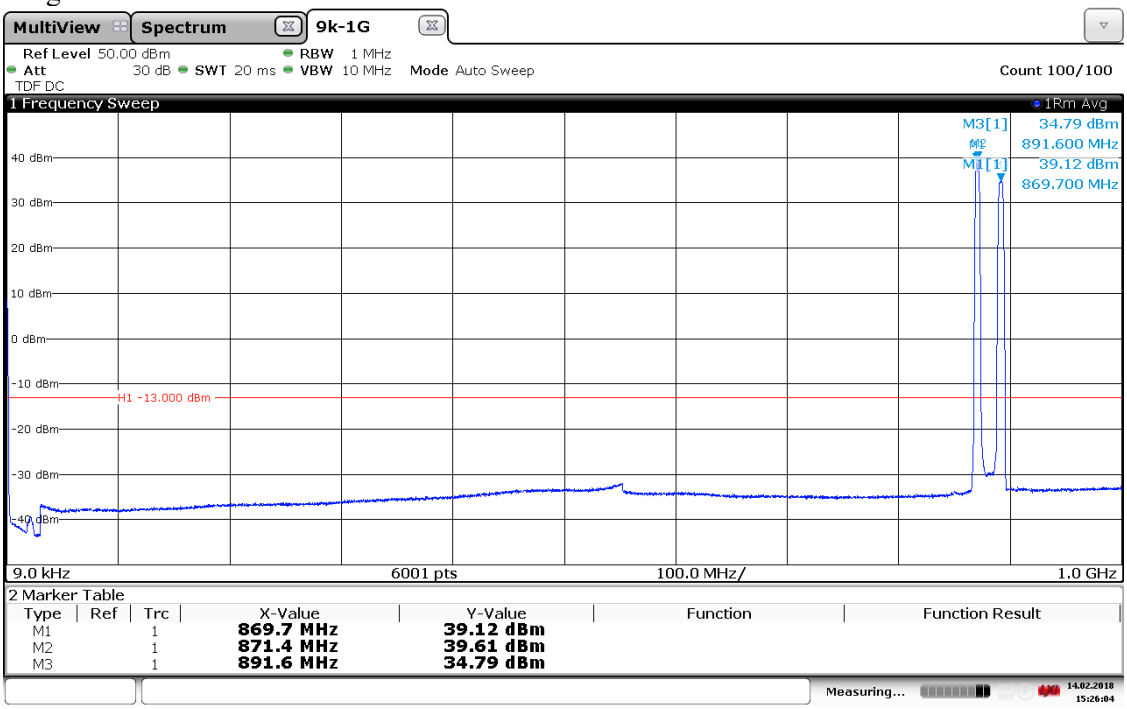
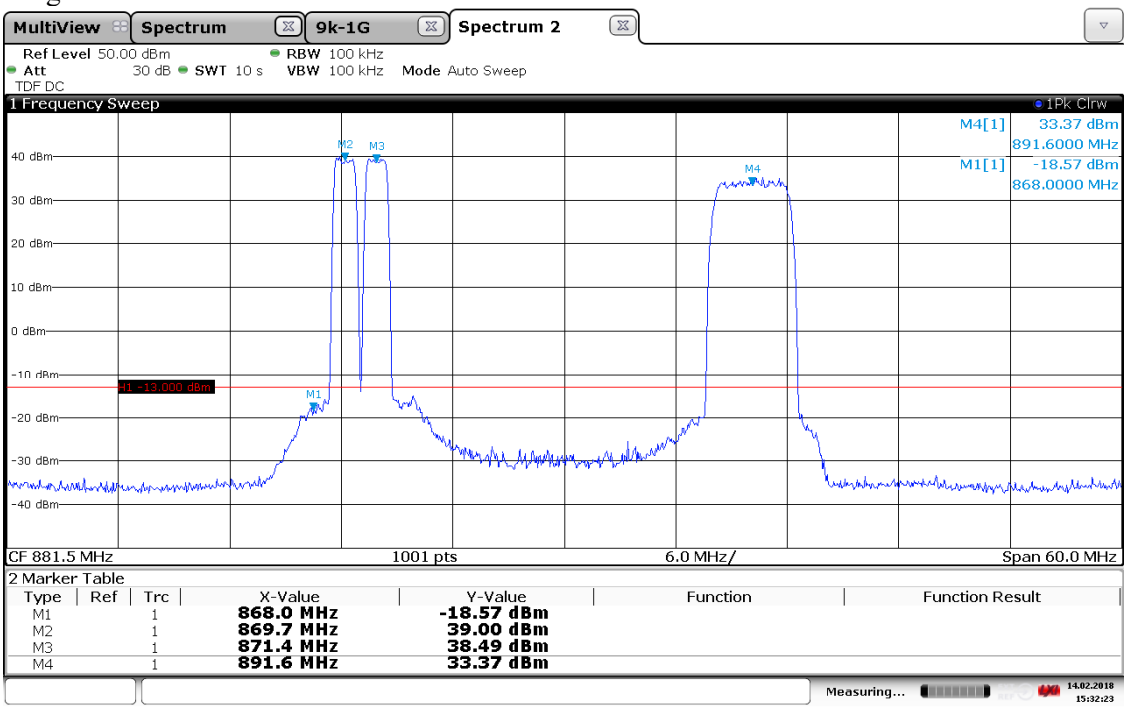

Ref Level 20.00 dBm
RBW 1 MHz
Att 10 dB SWT 40 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -45.17 dBm
7.943230 GHz
10 dBm
0 dBm
-10 dBm
H1 -13.000 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
1.0 GHz
35001 pts
800.0 MHz/
9.0 GHz
Measuring...
13:24:41 08.02.2018

Diagram 2a:



15:26:05 14.02.2018

Diagram 2b:



15:32:24 14.02.2018

Diagram 2c:

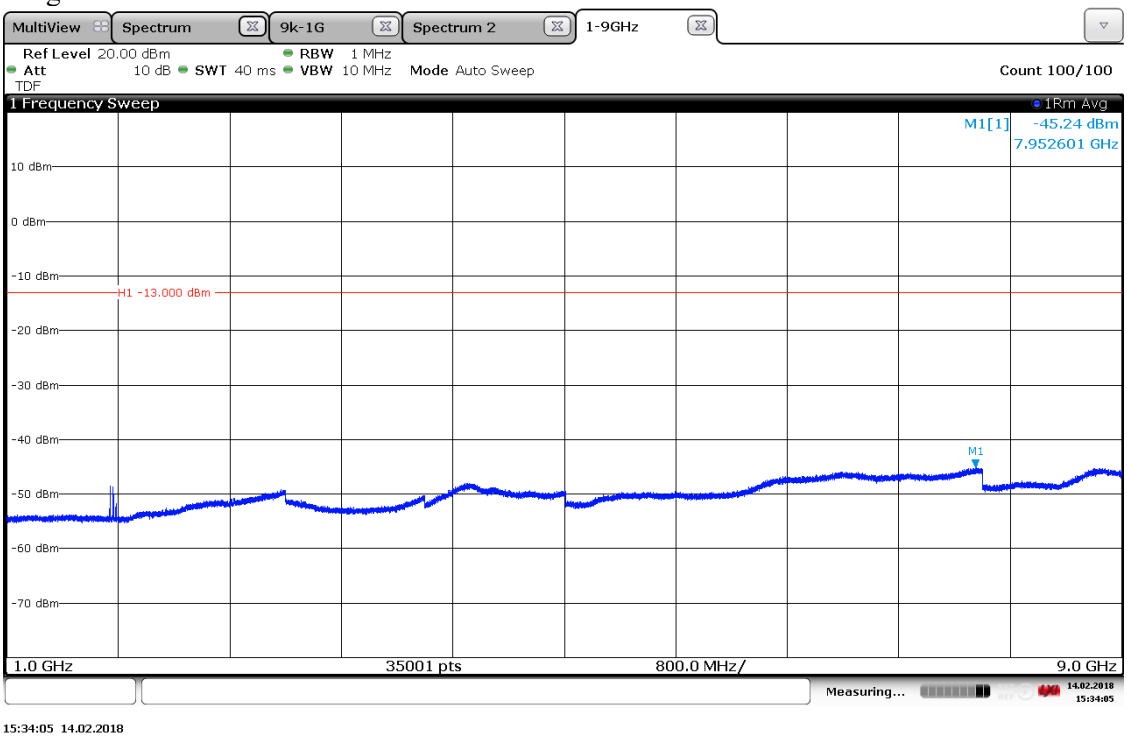

MultiView
Spectrum
9k-1G
Spectrum 2
1-9GHz
Ref Level 20.00 dBm
RBW 1 MHz
Att 10 dB SWT 40 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
TDF
1 Frequency Sweep
1Rm Avg
M1[1] -45.24 dBm
7.952601 GHz
10 dBm
0 dBm
-10 dBm
H1 -13.000 dBm
-20 dBm
-30 dBm
-40 dBm
M1
-50 dBm
-60 dBm
-70 dBm
1.0 GHz
35001 pts
800.0 MHz/
9.0 GHz
Measuring...
14.02.2018
15:34:05
15:34:05 14.02.2018

Diagram 3a:

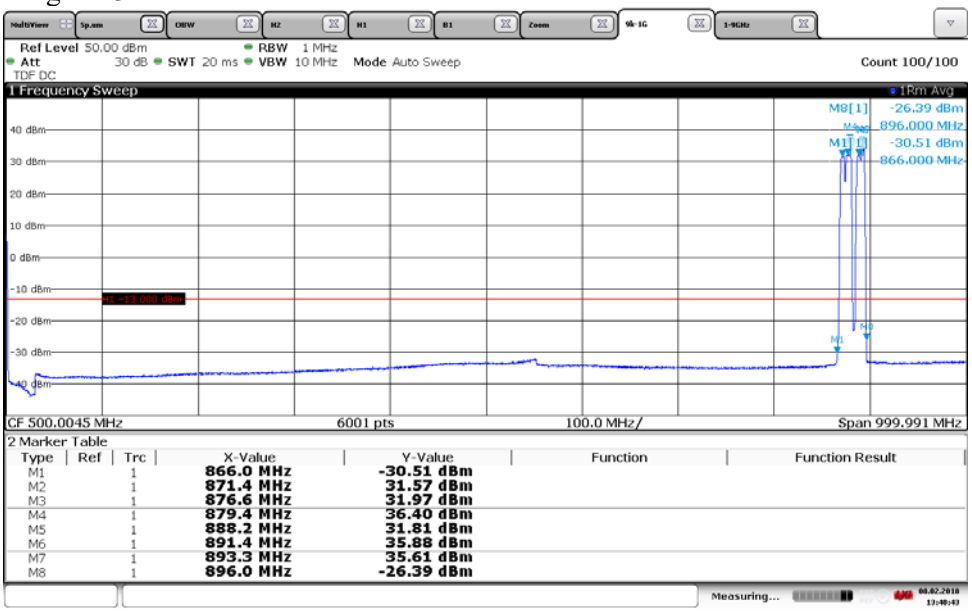


Diagram 3b:

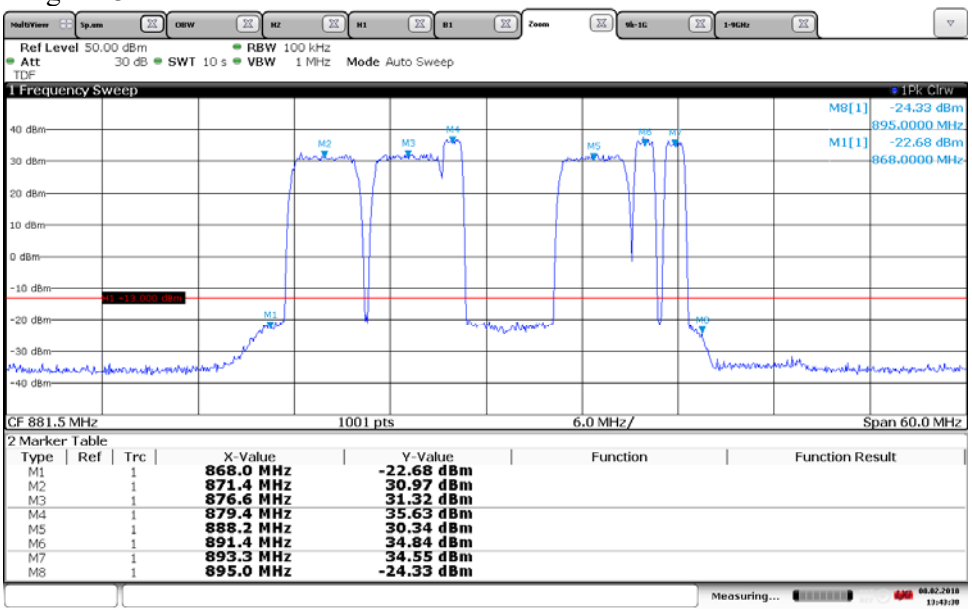
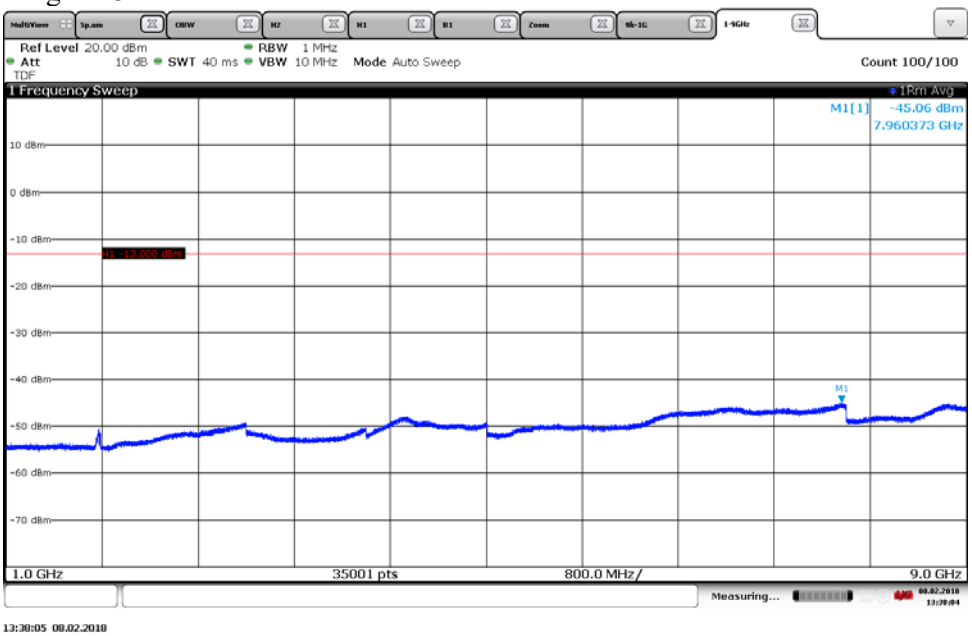


Diagram 3c:


Ref Level 20.00 dBm
RBW 1 MHz
Att 10 dB SWT 40 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -45.06 dBm
7.960373 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
1.0 GHz
35001 pts
800.0 MHz/
9.0 GHz
Measuring...
13:30:05 08.02.2018

Field strength of spurious radiation measurements according to CFR 47 §2.1053 / IC RSS-132 5.5

Date	Temperature	Humidity
2018-01-30	22 °C ± 3 °C	30 % ± 5 %
2018-01-31	21 °C ± 3 °C	27 % ± 5 %

The test site conform to the site validation criterion specified in ANSI C63.4 2014. The test site complies with RSS-Gen, Industry Canada file no. 3482A-1.

The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 9 GHz.

The EUT was placed 0.8 m above reference ground plane in frequency range 30 MHz – 1 GHz and 1.5 m above reference ground plane in frequency range 1 GHz – 9 GHz.

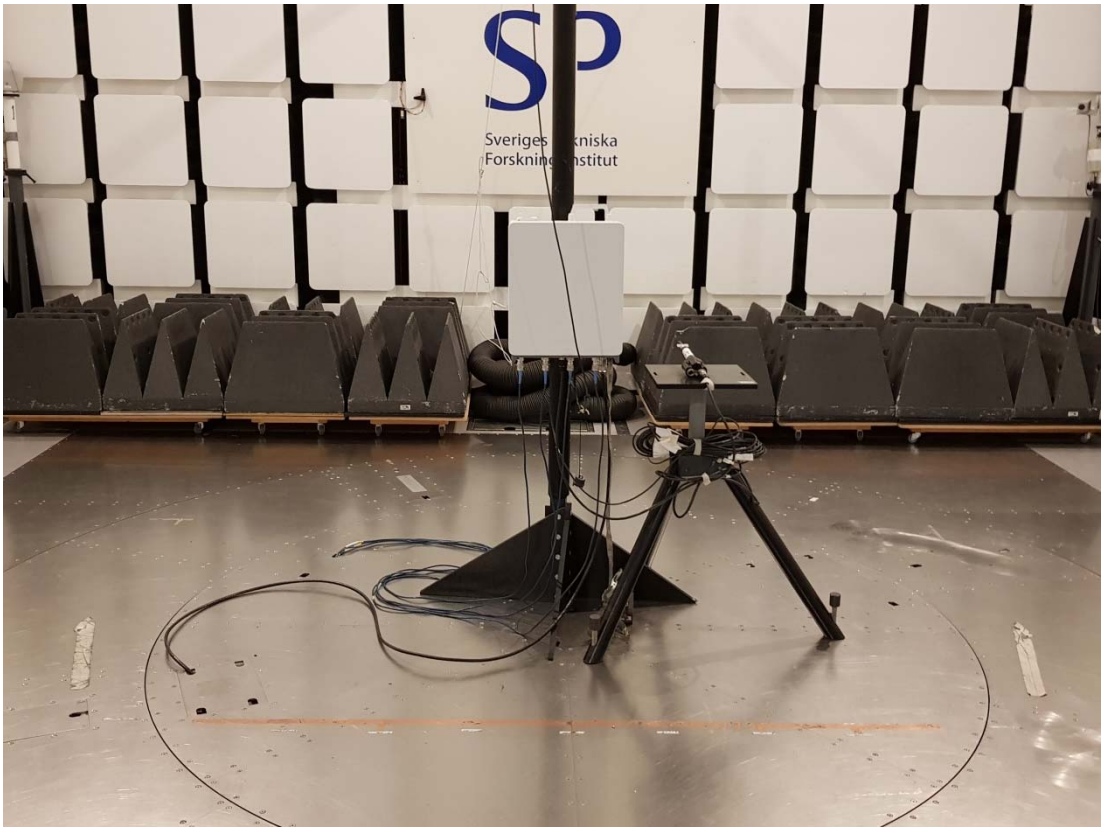
The measurement was performed with a RBW of 1 MHz.

A propagation loss in free space was calculated. The used formula was $\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

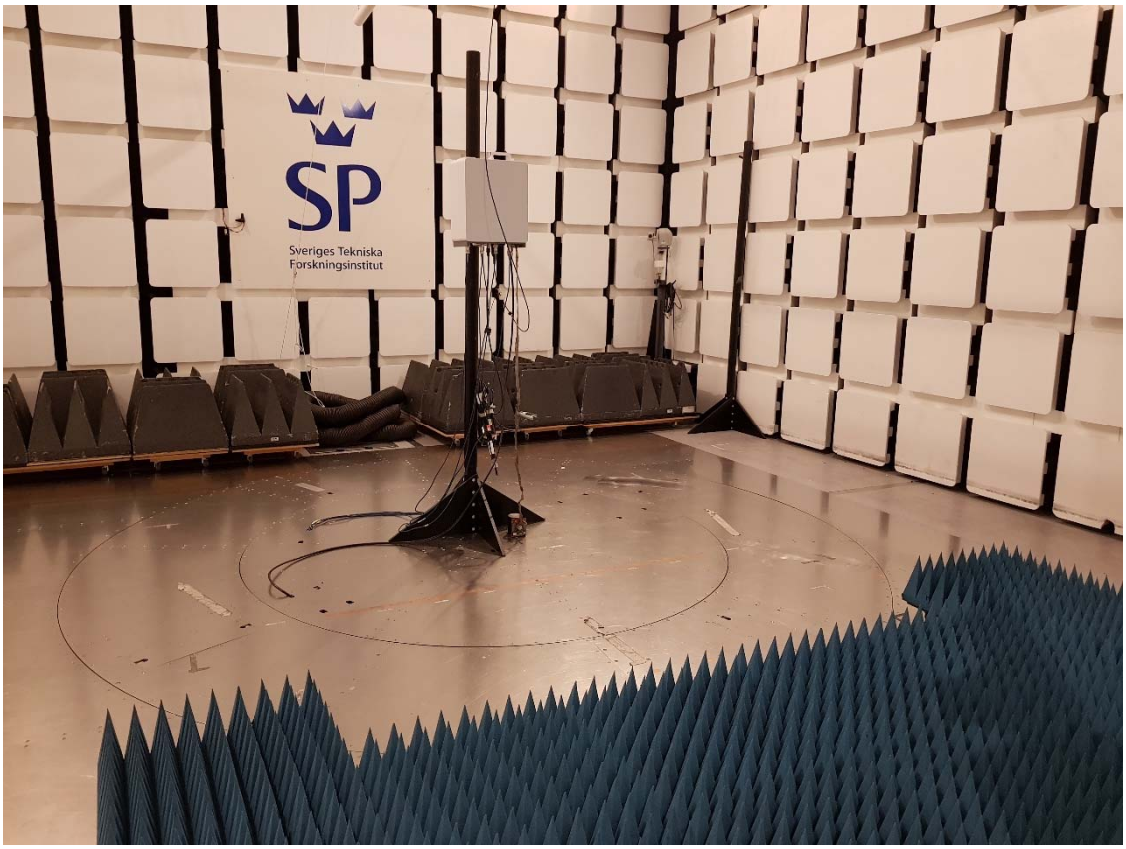
The measurement procedure was as the following:

1. A pre-measurement is performed with peak detector. For measurement < 1 GHz the test object was measured in eight directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m. For measurements > 1 GHz the test object was measured in seventeen directions with the antenna height 1.0 m, 1.5 m and 2m.
2. Spurious radiation on frequencies closer than 20 dB to the limit in the pre-measurement is scanned 0-360 degrees and the antenna is scanned 1- 4 m for maximum response. The emission is then measured with the RMS detector and the RMS value is reported. Frequencies closer than 10 dB to the limit when measured with the RMS detector were measured with the substitution method according to ANSI 63.26.

The test set-up during the spurious radiation measurements is shown in the picture below:
30-1000 MHz



1-9 GHz



Measurement equipment

Measurement equipment	RISE number
Semi anechoic chamber Tesla	503 881
R&S ESU 40	901 385
EMC 32 ver. 10.20.01	BX62351
ETS Lindgren BiConiLog 3142E	BX61914
ETS Lindgren Horn Antenna 3115	502 175
µComp Nordic, Low Noise Amplifier	901 545
HP Filter 1-20 GHz	901 501
Temperature and humidity meter, Testo 625	504 188

Results

Tested configurations: WL, WL_{BIM}, WL_{TIM}

representing worst case: Symbolic name WL, Diagram 1 a-b

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-9000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty: 3.1 dB

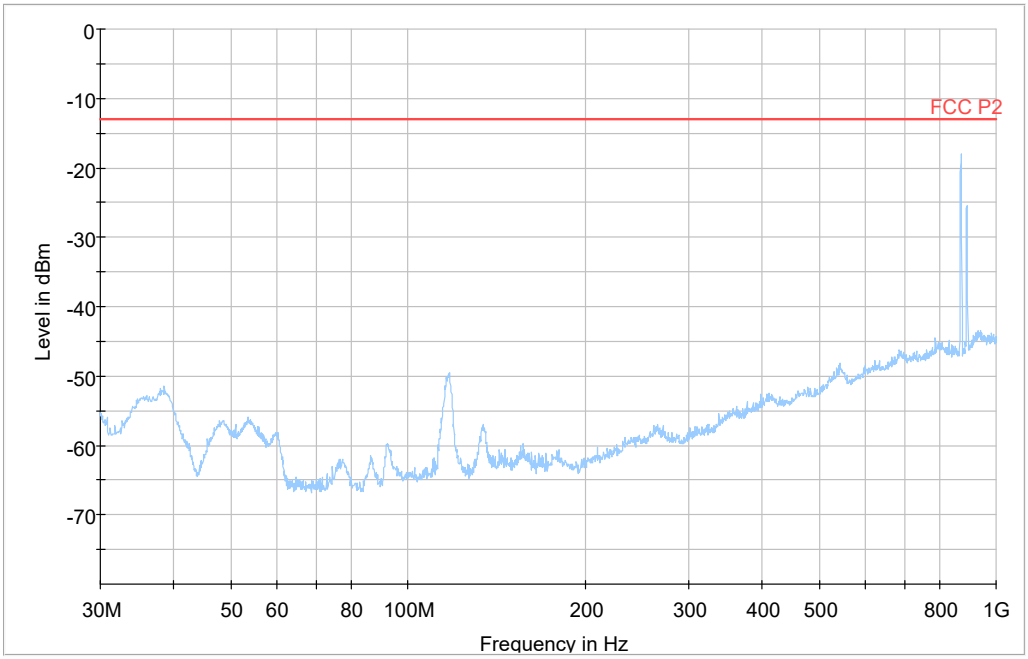
Limits

CFR 47 § 22.917: Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, resulting in a limit of -13 dBm per 100 kHz RBW below 1 GHz and 1MHz RBW above 1 GHz.

IC RSS-132 5.5: Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB per any 100 kHz RBW.

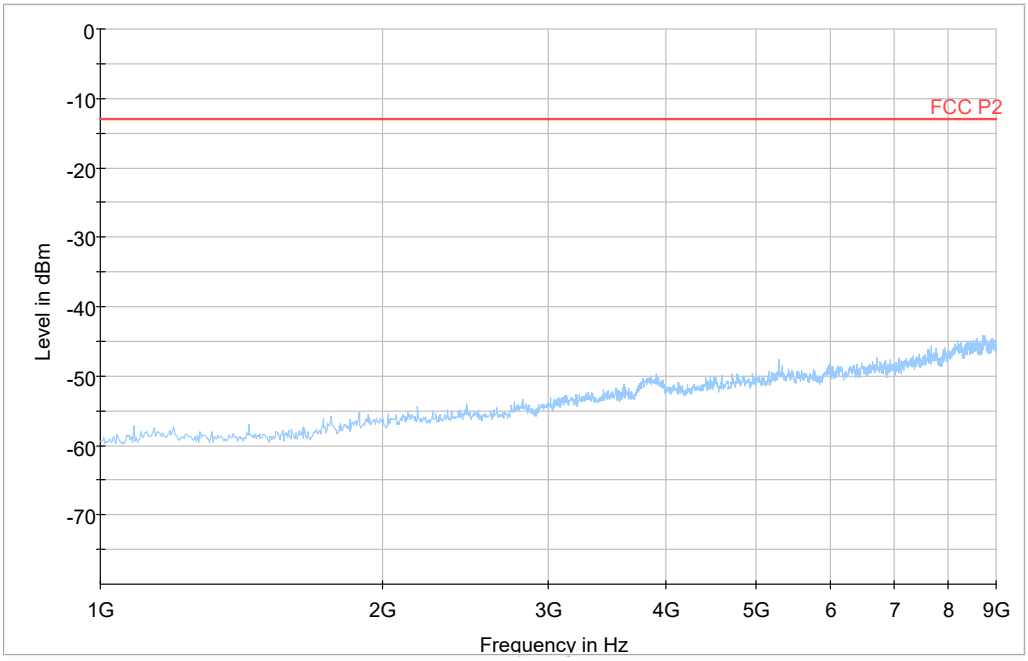
Complies?	Yes

Diagram 1a:



Note: The emission between 869 - 894 MHz are the carrier frequencies and shall be ignored in the context.

Diagram 1b:



Photos of test object

Front side

Rear side

Left side

Right side

Bottom side

Top side

Labels:

Radiated measurements:

Test object:

SFP module:

Conducted measurements:

Test object label:

SFP module: