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Radio measurements on Radio 2219 B5 radio equipment with FCC ID TA8AKRC161678-1 and IC: 287AB-AS1616781

(5 appendices)

Test object

Product name: Radio 2219 B5
Product number: KRC 161 678/1

Summary

See appendix 1 for details.

Standard	Compliant	Appendix
FCC CFR 47 / IC RSS-132 ISSUE 3		
2.1046 / RSS-132 5.4 RF power output	Yes	2
2.1051 / RSS-132 5.5 Spurious emission at antenna terminals	Yes	3
2.1053 / RSS-132 5.5 Field strength of spurious radiation	Yes	4

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Appendix 1

Description of the test object related to multi RAT LTE + GSM mode

Equipment:	Radio equipment Radio 2219 B5 Product number KRC 161 678/1 FCC ID TA8AKRC161678-1 IC: 287AB-AS1616781
HVIN	AS1616781
Hardware revision state:	R1A
Frequency range:	TX: 869 - 894 MHz RX: 824 - 849 MHz
IBW:	25 MHz
Output power:	Max 80 W/ carrier for LTE ≥ 5 MHz channel bandwidth Max 20 W/ carrier for LTE ≤ 3 MHz channel bandwidth and GSM Max output power 80 W/ antenna port
Antenna ports:	2 TX/RX ports
RF configurations:	LTE: 1-4 carriers/ port (2x 10 MHz, 1x 15 MHz) GSM: 1-4 carriers/ port Total numbers of carriers: 6/ port LTE: TX Diversity, 2x2 MIMO, 4x4 MIMO ¹ and NB IoT in-band operation. GSM: Single antenna, dual TX Contiguous Spectrum (CS), Non-Contiguous Spectrum (NCS), Carrier Aggregation (CA) inter-band ² and intra-band
RF power Tolerance:	+0.6/ - 2.0 dB
CPRI Speed	9.8 Gbit/s
Channel bandwidths:	LTE: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz and 15 MHz GSM: 200 kHz
Modulations:	LTE: QPSK, 16QAM, 64QAM and 256QAM GSM: GMSK, AQPSK and 8PSK
Nominal supply voltage:	-48VDC

¹ 4x4 MIMO requires an additional unit.

² Carrier Aggregation (CA) inter-band requires an additional unit operating on the other band.

The information above is supplied by the manufacturer.

Appendix 1

Operation modes during measurements

LTE measurements were performed with the test object transmitting test models as defined in 3GPP TS 37.141. 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.

GSM measurements were performed with the test object transmitting GMSK, AQPSK and 8PSK modulations as defined in 3GPP TS 37.141.

All measurements were performed with the test object configured for maximum transmit power. The measured configurations covers worst case settings. The settings below were used for all measurements if not otherwise noted.

LTE MIMO mode

E-TM1.1

Channel bandwidth 5 MHz.

GSM dual TX mode, GMSK

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.

Purpose of test

The purpose of the tests is to verify compliance to the performance characteristics specified in applicable items of FCC CFR 47 and Industry Canada RSS-132 and RSS-Gen. Test scope limited to multi RAT LTE + GSM mode.

References

Measurements were done according to relevant parts of the following standards:

ANSI 63.4-2014

ANSI/TIA/EIA-603-D-2010

CFR 47 part 2, April, 2017

CFR 47 part 22, April, 2017

KDB 662911 D01 Multiple Transmitter Output v02r02

KDB 971168 D01 Power Meas License Digital Systems v02r02

KDB 971168 D03 IM Emission Repeater Amp v01

3GPP TS 36.141 V13.6.0

3GPP TS 37.141 V13.5.0

RSS-Gen Issue 4

RSS-132 Issue 3

Appendix 1

Test frequencies used for conducted and radiated measurements

TX test frequencies, conducted measurements:

Symbolic name: L2G4:

	Frequency [MHz]	EARFCN/ARFCN	Bandwidth [MHz]	Test model
GSM	869.4	129	0.2	GMSK
LTE	872.2	2432	5.0	E-TM1.1
GSM	875.0	157	0.2	GMSK
GSM	888.0	222	0.2	GMSK
LTE	890.8	2618	5.0	E-TM1.1
GSM	893.6	250	0.2	GMSK

Symbolic name: L1G2:

	Frequency [MHz]	EARFCN/ARFCN	Bandwidth [MHz]	Test model
LTE	871.5	2625	5.0	E-TM1.1
GSM	893.0	247	0.2	GMSK
GSM	893.6	250	0.2	GMSK

According to FCC KDB 971168 D03.

TX test frequencies, radiated measurements:

Symbolic name: GL1:

	Frequency [MHz]	EARFCN/ARFCN	Bandwidth [MHz]	Test model
GSM	869.2	128	0.2	GMSK
LTE	872.0	2430	5.0	E-TM1.1
GSM	874.8	156	0.2	GMSK
GSM	888.2	223	0.2	GMSK
LTE	891.0	2620	5.0	E-TM1.1
GSM	893.8	251	0.2	GMSK

Symbolic name: GL2:

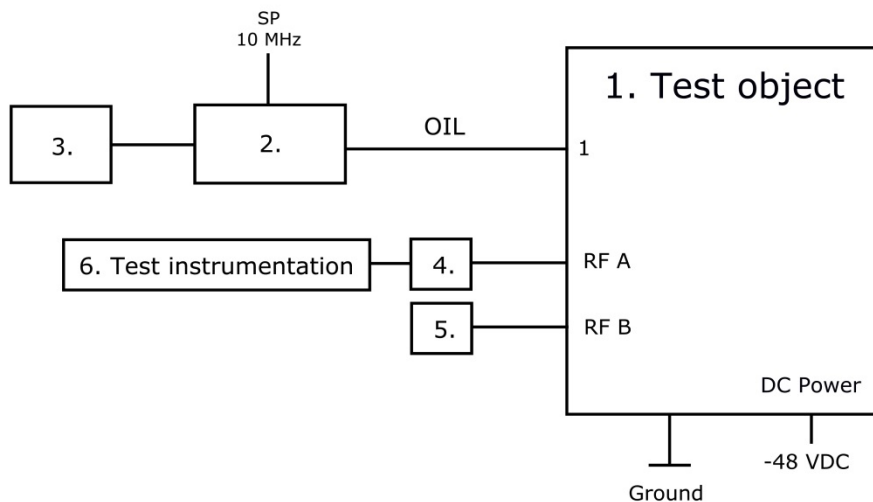
	Frequency [MHz]	EARFCN/ARFCN	Bandwidth [MHz]	Test model
LTE	871.5	2625	5.0	E-TM1.1
GSM	893.6	250	0.2	GMSK
GSM	893.8	251	0.2	GMSK

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.

Appendix 1

Test setup: conducted measurements



Test object:

1.	Radio 2219 B5, KRC 161 678/1, rev. R1A, s/n: D825138266 With Radio Software: CXP 901 7316/2, rev. R64HS. FCC ID TA8AKRC161678-1 and IC: 287AB-AS1616781
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Associated equipment:

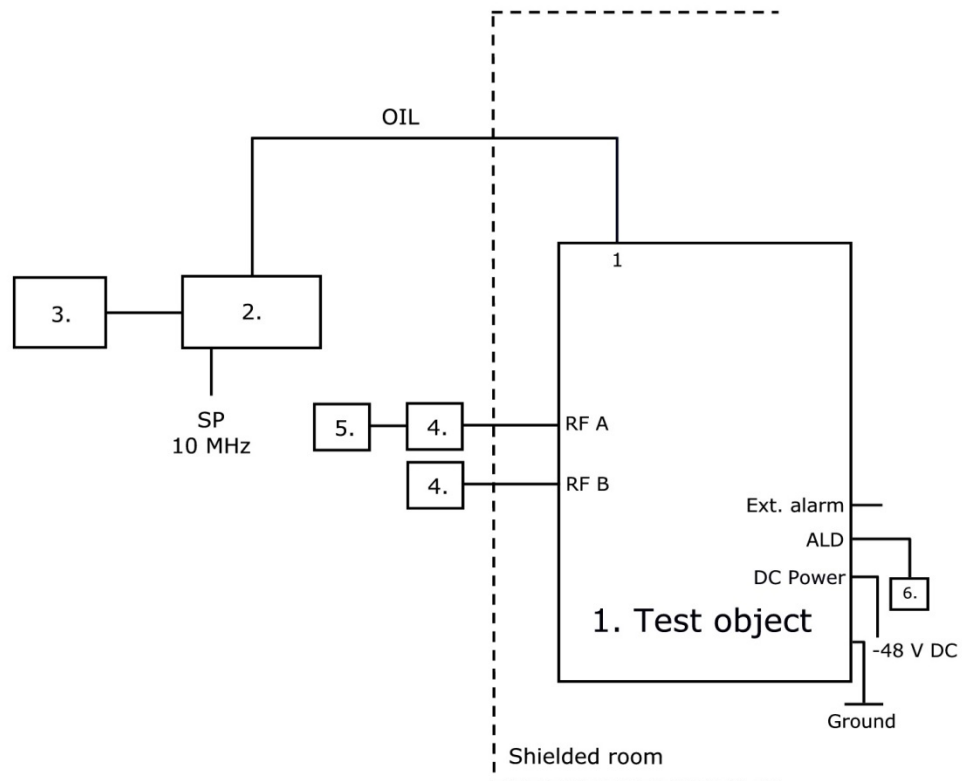
2.	Testing Equipment: CT10, LPC 102 487/1, rev. R1C, s/n: T01F265031, BAMS – 1000797753 with software CXA 104 446/1, rev. R8U
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Functional test equipment:

3.	HP EliteBook 8560w, BAMS – 1001236850
4.	RF Attenuator: SP number: 902 282
5.	Terminator, 50 ohm
6.	SP Test Instrumentation according to measurement equipment list for each test. The signal analyzer was connected to the SP 10 MHz reference standard during all measurements.

Appendix 1

Test setup: radiated measurements



Test object:

1.	Radio 2219 B5, KRC 161 678/1, rev. R1A, s/n: D825138266 With Radio Software: CXP 901 7316/2, rev. R64HS. FCC ID TA8AKRC161678-1 and IC: 287AB-AS1616781
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Associated equipment:

2.	Testing Equipment: CT10, LPC 102 467/1, rev. R1C, s/n: T01F375047, BAMS – 1001466801 with software CXA 104 446/1, rev. R8U
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Functional test equipment:

3.	HP EliteBook 8560w, BAMS – 1001236850
4.	Attenuator/ Terminator
5.	R&S ESIB 26, SP no: 503 292, for supervision purpose only

Interfaces:

Type of port:

Power: -48VDC	DC Power
RF port A, 4.3-10 connector, combined TX/RX	Antenna
RF port B, 4.3-10 connector, combined TX/RX	Antenna
1, optical interface	Signal
2, optical interface, not used in this configuration	Signal
EXT Alarm, shielded multi-wire	Signal
ALD, shielded multi-wire	Signal
Ground wire	Ground

Appendix 1

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2019-12	503 881
R&S ESU 40	2017-07	901 385
R&S FSQ 40	2017-07	504 143
R&S FSW 43	2017-08	902 073
Control computer with R&S software EMC32 version 9.15.0	-	503 899
High pass filter 1-18 GHz	2017-06	901 501
High pass filter 1-20 GHz	2017-06	901 373
RF attenuator Weinschel 6905-40-11-LIM	2018-03	902 282
Coaxial cable Sucoflex 102EA	2018-03	BX50191
Coaxial cable Sucoflex 102EA	2018-03	BX50236
ETS Lindgren BiConiLog Antenna 3142E	2019-03	BX61914
EMCO Horn Antenna 3115	2019-12	502 175
µComp Nordic, Low Noise Amplifier	2017-12	901 545
Temperature and humidity meter, Testo 635	2017-05	504 023
Temperature and humidity meter, Testo 625	2017-06	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 2017-02-14.

Manufacturer's representative

Mikael Jansson, Ericsson AB.

Test engineers

Tomas Lennhager, Tomas Isbring and Andreas Johnson, RISE.

Test participant

None.

Appendix 2

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

Date	Temperature	Humidity
2017-04-11	22 °C ± 3 °C	35 % ± 5 %

Test set-up and procedure

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

Measurement equipment	SP number
Rohde & Schwarz signal analyser FSW 43	902 073
RF attenuator	502 282
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

Rated output power at RF connector 49 dBm/ port.

Symbolic name	Port RFA [RMS dBm/ dB PAR]	Port RFB [RMS dBm/ dB PAR]	Total power ¹⁾ [RMS dBm]
L1G2	47.92/ 7.26	47.99/ 7.28	50.97
L2G4	47.34/ 7.70	47.39/ 7.72	50.38

¹⁾: summed output power according to FCC KDB662911 Multiple transmitter output

Remark

This unit is tested without antenna. 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 allowed 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 PAPR (0.1%) shall not exceed 13 dB.

Complies?	Yes
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Appendix 3

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

Date	Temperature	Humidity
2017-04-11	22 °C ± 3 °C	35 % ± 5 %

Test set-up and procedure

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

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

Measurement equipment	SP number
Rohde & Schwarz signal analyser FSW 43	902 073
RF attenuator	502 282
High pass filter	901 373
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Appendix 3

Results

Diagram	Symbolic name	Tested Port
1 a+b+c	L1G2	RF B
2 a+b+c	L2G4	RF A

Remarks

The upper frequency boundary covers 10x the highest TX fundamental frequency.
The highest fundamental frequency is 894MHz. The measurements were made up to 9 GHz (10x894 MHz = 8.94 GHz).

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 5.5.1.2: 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
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Appendix 3

Diagram 1 a:

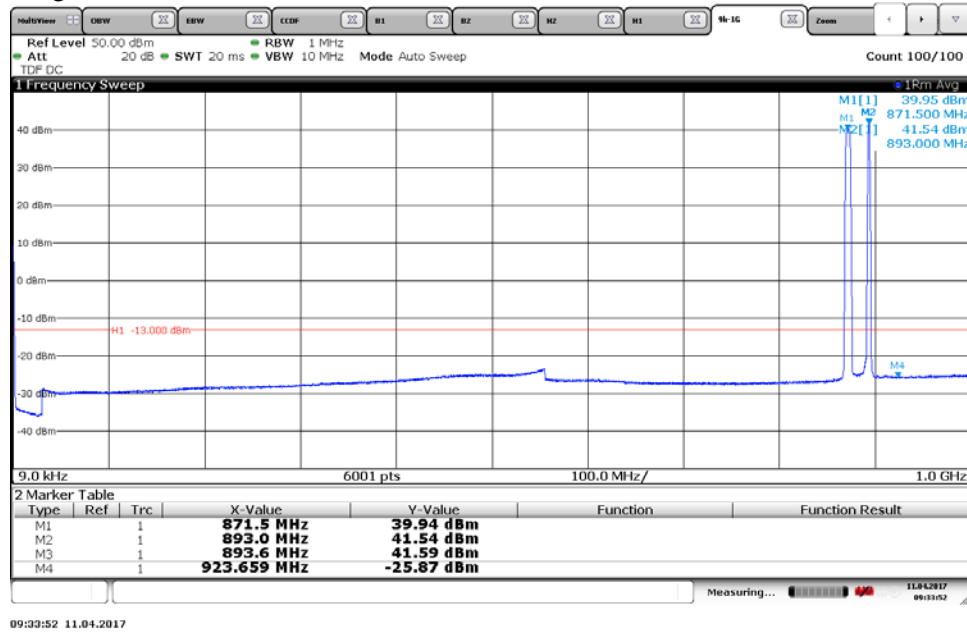
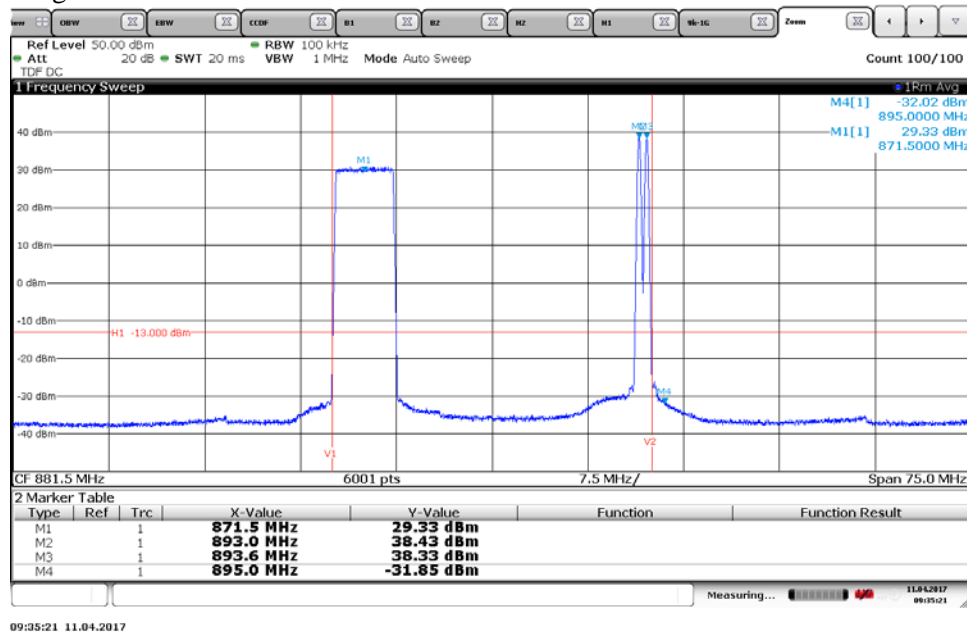
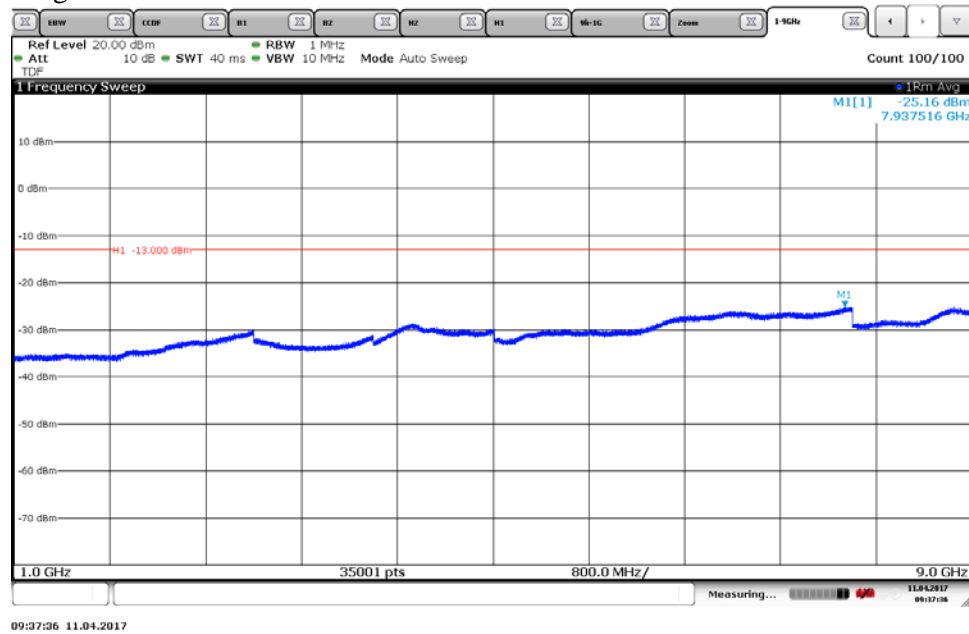


Diagram 1 b:



Appendix 3

Diagram 1 c:



Appendix 3

Diagram 2 a:

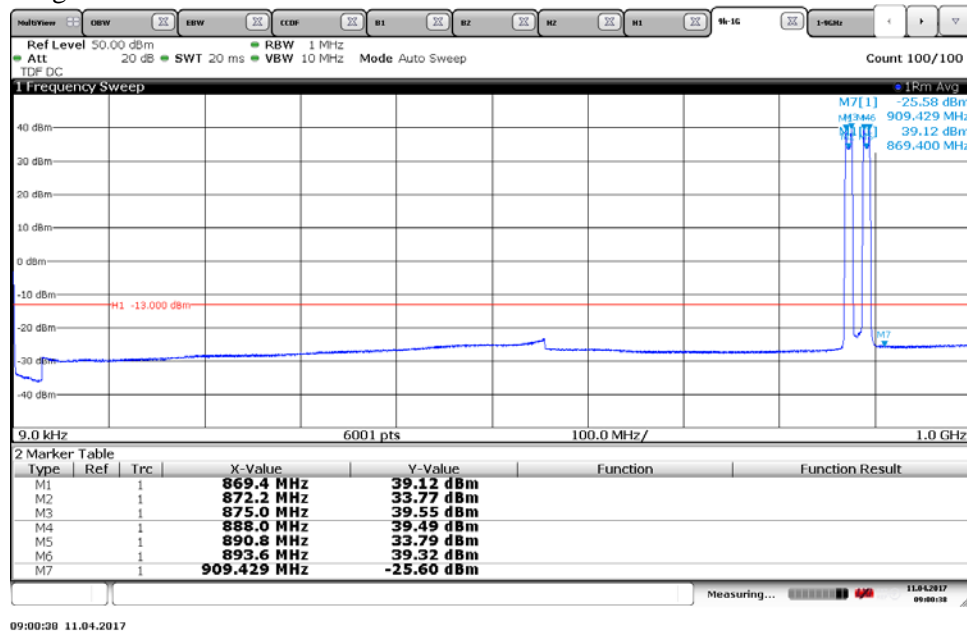
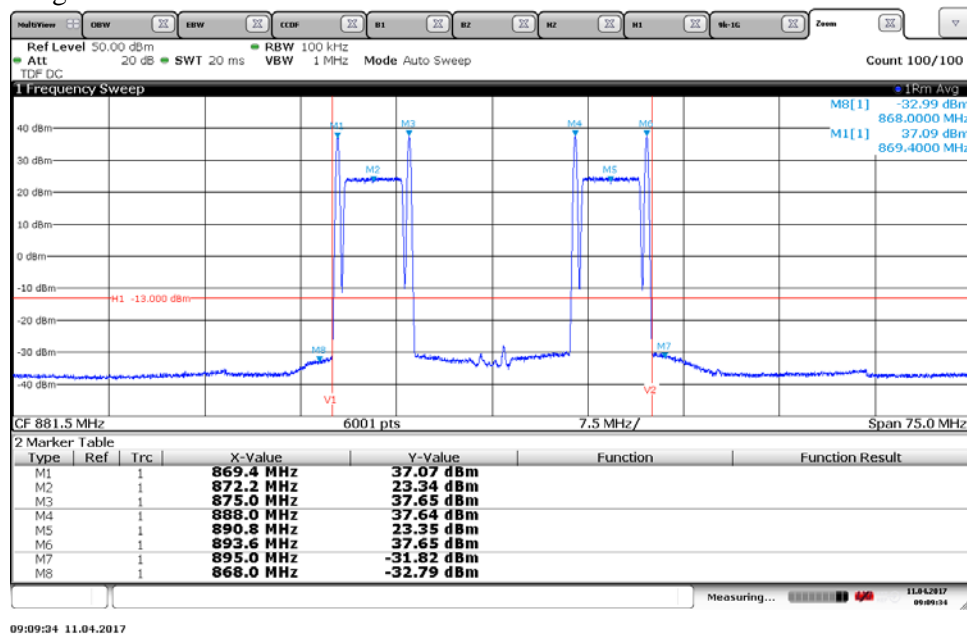
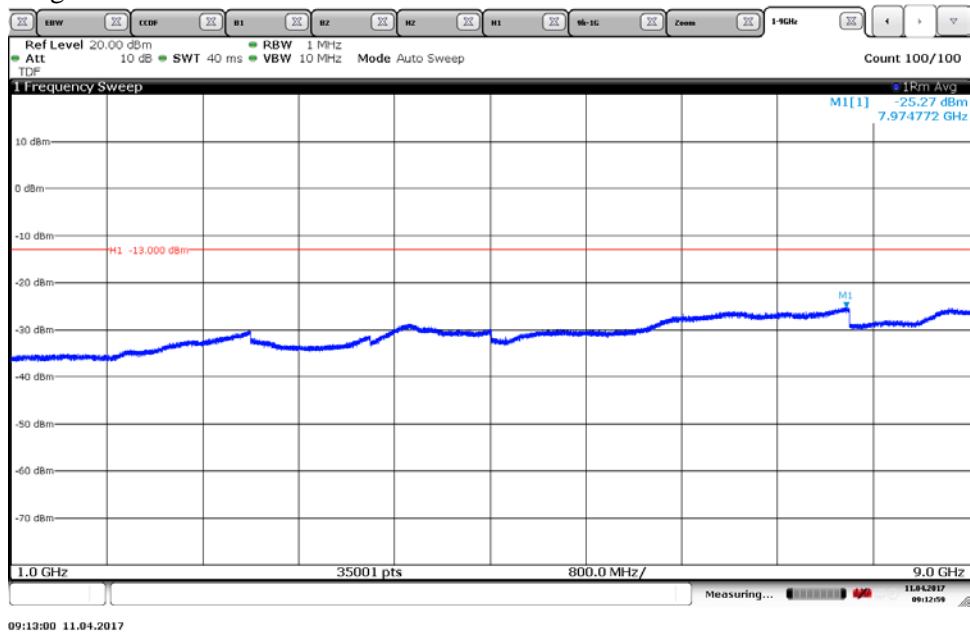


Diagram 2 b:



Appendix 3

Diagram 2 c:



Appendix 4

Field strength of spurious radiation measurements according to 47 CFR 2.1053 / IC RSS-133 5.5

Date	Temperature	Humidity
2017-02-22	22 °C ± 3 °C	31 % ± 5 %
2017-02-24	22 °C ± 3 °C	25 % ± 5 %

The test sites are listed at FCC, Columbia with registration number: 93866. 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 measurement was performed with a RBW of 1 MHz.

A propagation loss in free space was calculated. The used formula was

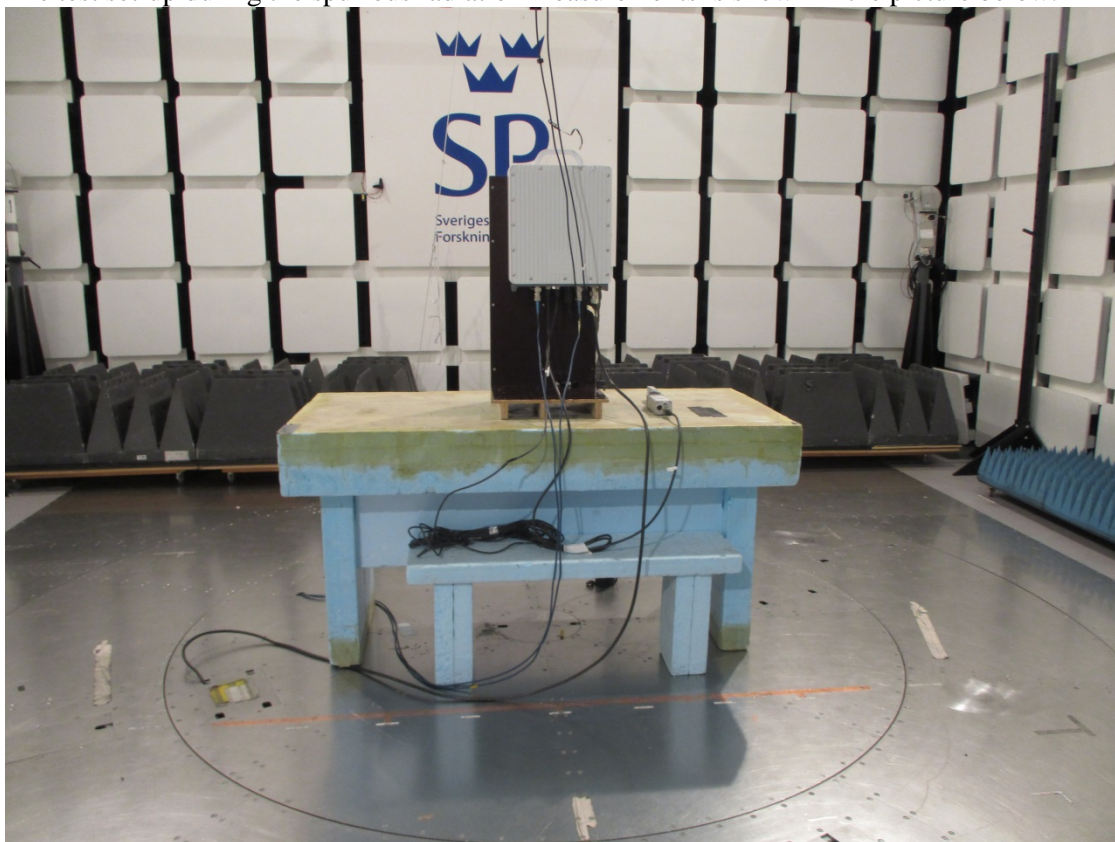
$$\gamma = 20 \log \left(\frac{4\pi D}{\lambda} \right), \gamma \text{ is the propagation loss and } D \text{ is the antenna distance.}$$

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. For measurements > 1 GHz the test object was measured in seventeen directions with the antenna at 1.0 m height.
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/TIA/-603-D-2010.

Appendix 4

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



Measurement equipment

Measurement equipment	SP number
Semi anechoic chamber Tesla	503 881
R&S ESU 40	901 385
EMC 32 ver. 9.15.0	503 899
ETS Lindgren BiConiLog 3142E	BX61914
ETS Lindgren Horn Antenna 3115	502 175
µComp Nordic, Low Noise Amplifier	901 545
HP Filter 1-18 GHz	901 501
Temperature and humidity meter, Testo 625	504 188

Appendix 4

Test frequencies

GSM+LTE
Symbolic name
GL1
GL2

Results

representing worst case:

Multi RAT GSM + LTE, Symbolic name: GL1, 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

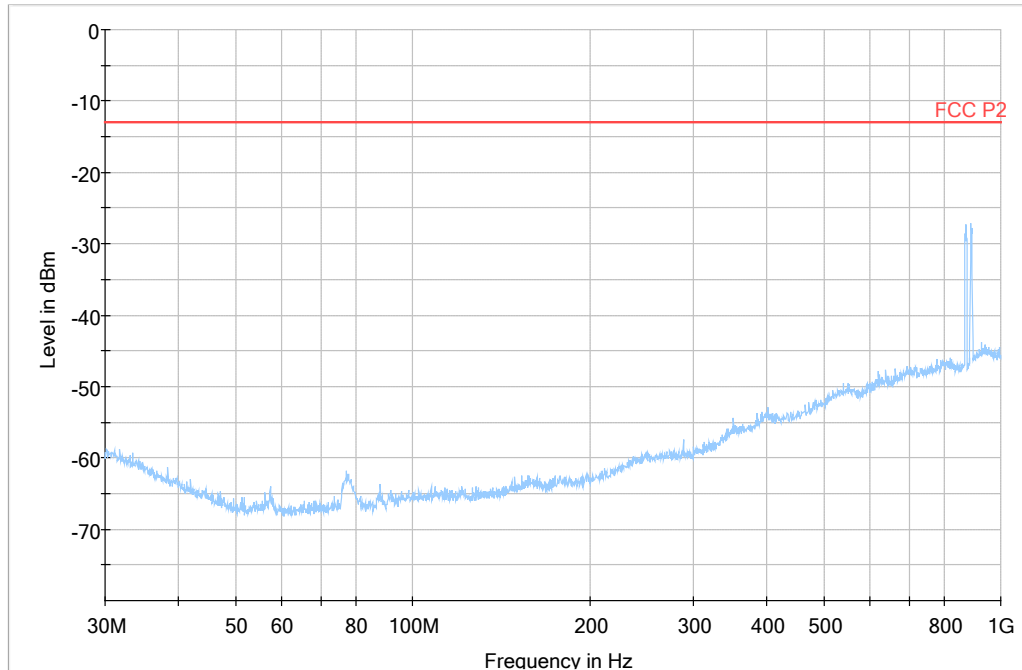
CFR 47 §22.917 and IC RSS-132 5.6

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.

Complies?	Yes
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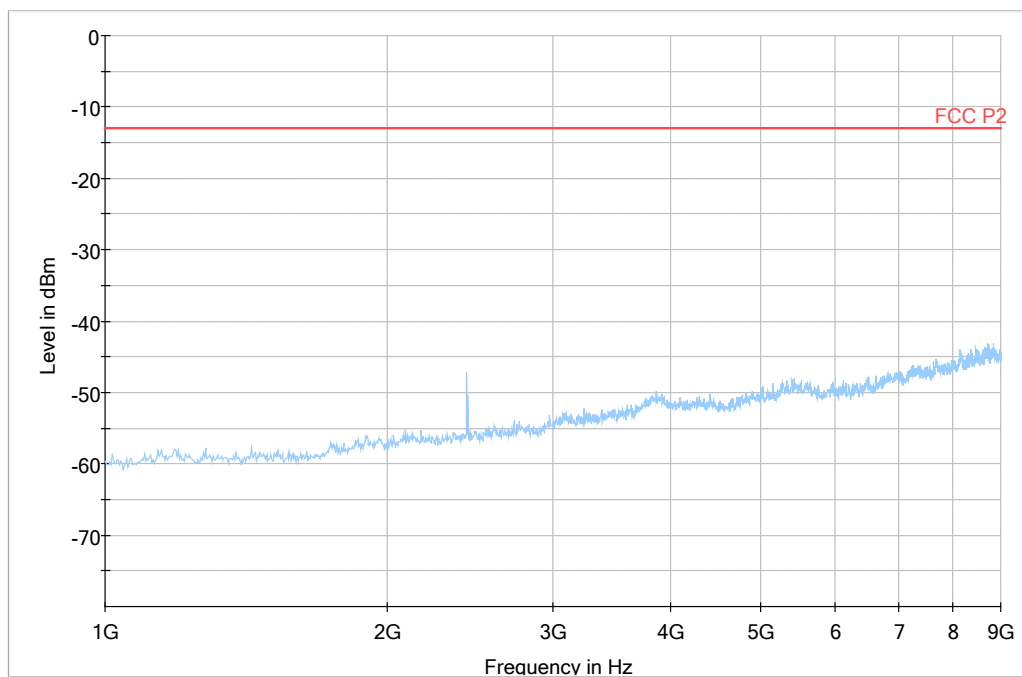
Appendix 4

Diagram 1a:



Note: The emission between 869 MHz to 894 MHz is the carrier frequency and shall be ignored in the context.

Diagram 2b:



Appendix 5

External photos

Front side



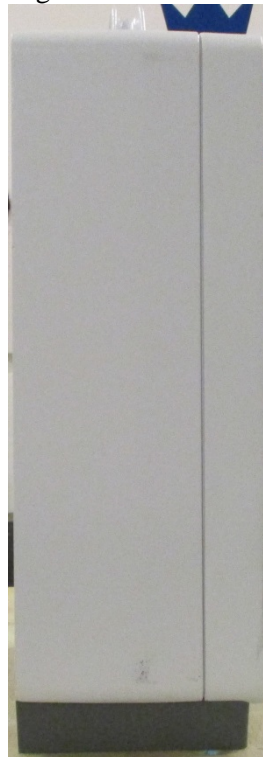
Rear side



Left side



Right side



Appendix 5

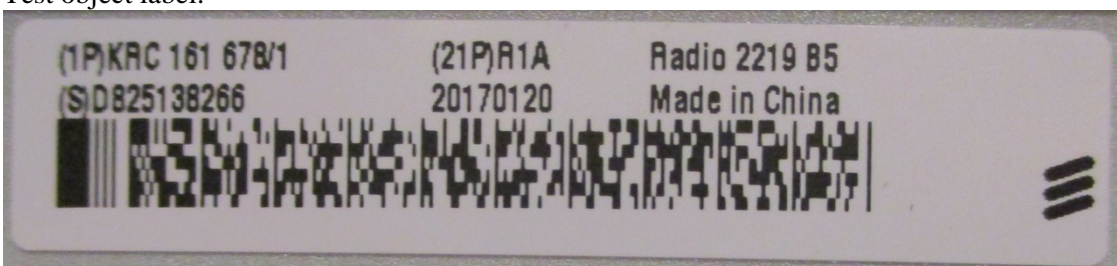
Top side



Bottom side



Test object label:



SFP module:

