REPORT

issued by an Accredited Testing Laboratory

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Date	Reference	Page
2017-10-23	7P06127-G	1 (64)

Testing

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Radio measurements on Radio 4415 B2 B25 equipment with FCC ID TA8AKRC161636 and IC: 287AB-AS161636

Product name: Radio 4415 B2 B25
Product number: KRC 161 636/1

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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 24/ RSS 133, RSS-Gen	
2.1046/ 6.4 RF power output, conducted	Yes
2.1049/ 4.6.1 Occupied bandwidth	Yes
2.1051/ 6.6 Band edge	Yes
2.1051/ 6.2 Spurious emission at antenna terminals	Yes
2.1053/ 6.5 Field strength of spurious radiation	Yes
2.1055/ 6.3 Frequency stability	Yes

Description of the test object

Equipment:	Radio equipment Radio 4415 B2 B25 Product number KRC 161 636/1 FCC ID: TA8AKRC161636 IC: 287AB-AS161636
HVIN:	AS161636
Hardware revision state:	R1B
Tested configuration:	Single RAT GSM
Frequency range:	TX: 1930 – 1990 MHz RX: 1850 – 1910 MHz
IBW:	20 MHz
Output power:	Max 40 W/ antenna port Single carrier: 1x 43 dBm (1x 20W) Multi carrier: 2x 43 dBm (2x 20W) 4x 40 dBm (4x 10W)
Antenna ports:	4 TX / 4 RX ports
Antenna:	No dedicated antenna, handled during licensing
RF configurations:	Single and multi-carrier, 1-4 carriers/ port
Modulations:	GMSK, 8PSK and AQPSK
RF power Tolerance:	+0.6/ -2.5 dB
CPRI Speed	Up to 10.1 Gbit/s
Nominal supply voltage:	-48VDC

The information above is supplied by the manufacturer.

Purpose of test

The purpose of the tests is to verify compliance to the performance characteristics specified in applicable items of FCC CFR 47 part 24, Industry Canada RSS-133 and RSS-Gen.

Operation modes during measurements

Measurements were performed with the test object transmitting following modulations: GMSK, AQPSK, 8-PSK.

Unless otherwise stated, all measurements were performed with the test object transmitting pseudorandom data in all timeslots and settings for maximum transmitter output power applicable for each configuration.

All measurements were performed with the test object configured for maximum transmit power if not otherwise noted. At ARFCN 512 and 810 maximum power was reduced by 8 dbm to 38.0 dbm.
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 setup 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 setup drawings for radiated measurements.

References

Measurements were done according to relevant parts of the following standards:
ANSI C63.4-2014
CFR 47 part 2, April 2017
CFR 47 part 24, April 2017
ANSI C63.26-2015
KDB 971168 D03 IM Emission Repeater Amp v01
3GPP TS 37.141, version 13.5.0
RSS-Gen Issue 4
RSS-133 Issue 6

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 3-26.5 GHz	2017-12	BX40074
High pass filter 3-26.5 GHz	2018-06	901 502
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	2017-12	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: 2017-09-07.

Manufacturer’s representative

Mikael Jansson, Ericsson AB.

Test engineers

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

Test participant(-s)

None.

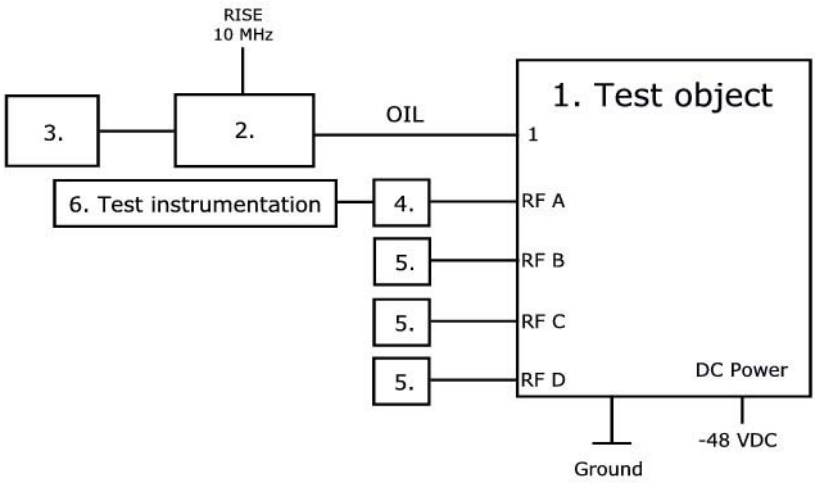
Test frequencies used for radiated and conducted measurements

TX test frequencies, conducted measurements:

ARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
512	1930.2	B	Single carrier TX bottom frequency
513	1930.4	B+1	Lowest carrier frequency supporting full nominal power.
513 516	1930.4 1931.0	B2	2 carrier TX bottom constellation
513 516 519 522	1930.4 1931.0 1931.6 1932.2	B4	4 carrier TX bottom constellation
661	1960.0	M	Single carrier TX mid frequency
660 663	1959.8 1960.4	M2	2 carrier TX mid constellation
657 660 663 666	1959.2 1959.8 1960.4 1961.0	M4	4 carrier TX mid constellation
809	1989.6	T-1	Highest carrier frequency supporting full nominal power.
810	1989.8	T	Single carrier TX bottom frequency
806 809	1989.0 1989.6	T2	2 carrier TX top constellation
800 803 806 809	1987.8 1988.4 1989.0 1989.6	T4	4 carrier TX top constellation
513 516 611	1930.4 1931.0 1950.0	$B_{im\,3}$	3 carrier TX bottom configuration according to KDB 971168 D03
711 806 809	1970.0 1989.0 1989.6	$T_{im\,3}$	3 carrier TX top configuration according to KDB 971168 D03

All RX frequencies were configured 80 MHz below the corresponding TX frequency according the applicable duplex offset for the operating band.

Test setup: conducted measurements



Test object:

1.	Radio 4415 B2 B25, KRC 161 636/1, rev. R1B, s/n: D16W963153 With Radio Software: CXP 901 7316/7, rev. R67HA. FCC ID: TA8AKRC161636 and IC: 287AB-AS161636

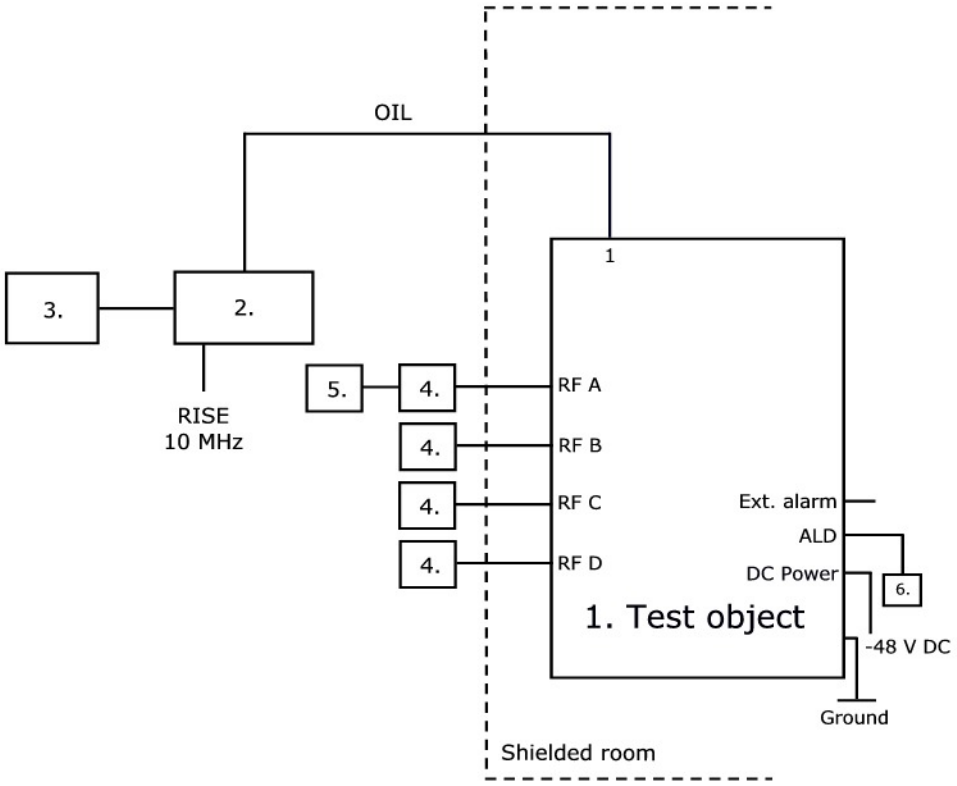
Associated equipment:

2.	Testing Equipment: CT10, LPC 102 467/1, rev. R1C, s/n: T01F375047, BAMS – 1001466801 with software CXA 104 446/1, rev. R8AA

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 analyzer was connected to the RISE 10 MHz reference standard during all measurements.

Test setup: radiated measurements



1.	Radio 4415 B2 B25, KRC 161 636/1, rev. R1B, s/n: D16W963156 With Radio Software: CXP 901 7316/7, rev. R67HA. FCC ID: TA8AKRC161636 and IC: 287AB-AS161636

Associated equipment:

2.	Testing Equipment: CT10, LPC 102 467/1, rev. R1C, s/n: T01F375046, BAMS – 1001466800 with software CXA 104 446/1, rev. R8AA

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 §24.232 / IC RSS-133 6.4, conducted

Date	Temperature	Humidity
2017-10-03	22 °C ± 3 °C	47% ± 5 %
2017-10-04	23 °C ± 3 °C	38% ± 5 %
2017-10-05	22 °C ± 3 °C	30% ± 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

Single carrier

Rated output power level at each RF port 1x 43 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]			
Tested modulation and Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D
GMSK, B+1	42.81/ 0.38	42.98/ 0.30	42.98/ 0.30	42.76/ 0.34
GMSK, M	42.74/ 0.38	42.80/ 0.32	42.79/ 0.32	42.84/ 0.38
GMSK, T-1	42.71/ 0.38	42.80/ 0.38	42.74/ 0.34	42.71/ 0.38
8PSK, B+1	42.65/ 3.46	42.82/ 3.46	42.84/ 3.44	42.67/ 3.46
AQPSK, B+1	42.79/ 3.64	42.97/ 3.60	43.02/ 3.62	42.79/ 3.62
AQPSK, M	42.76/ 3.62	42.89/ 3.60	42.78/ 3.60	42.80/ 3.60
AQPSK, T-1	42.77/ 3.60	42.81/ 3.64	42.74/ 3.62	42.69/ 3.62
GMSK, B+1	42.81/ 0.38	42.98/ 0.30	42.98/ 0.30	42.76/ 0.34
GMSK, M	42.74/ 0.38	42.80/ 0.32	42.79/ 0.32	42.84/ 0.38
GMSK, T-1	42.71/ 0.38	42.80/ 0.38	42.74/ 0.34	42.71/ 0.38

Note: The PAR value is the 0.1 % Peak to Average Ratio.

Reduced output power apply for the channel 512 and 810: 38 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]
Tested modulation and Symbolic name	Port RF C
GMSK, B	38.06/ 0.40
GMSK, T	37.82/ 0.38

Multi carrier

Rated output power 2x 43 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]
Tested modulation and Symbolic name	Port RF C
AQPSK, B2	45.09/ 6.44
AQPSK, M2	45.59/ 6.44
AQPSK, T2	45.58/ 6.42

Multi carrier

Rated output power 4x 40 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]
Tested modulation and Symbolic name	Port RF C
AQPSK, B4	43.85/ 7.36
8PSK, B4	43.52/ 7.24
GMSK, B4	45.09/ 6.08
AQPSK, M4	44.39/ 7.34
8PSK, M4	44.00/ 7.28
GMSK, M4	45.58/ 6.08
AQPSK, T4	44.31/ 7.34
8PSK, T4	44.07/ 7.24
GMSK, T4	45.53/ 6.08

Power Spectrum Density

Single carrier

Rated output power level at RF connector 1x 43 dBm/ port.

	Output power per 1 MHz [RMS dBm]
Tested modulation and Symbolic name	Port RF C
AQPSK, B+1	43.04

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

CFR 47 §24.232

The maximum output power may not exceed 3280 W/MHz (EIRP).
The Peak to Average Ratio (PAR) may not exceed 13 dB.

RSS-133

Base station transmitters operating in the band 1930-1990 MHz shall not have output power exceeding 100 watts. When the transmitter power is measured in terms of average value, the peak-to-average ratio(PAR) of the power shall not exceed 13 dB

There is no EIRP limit specified for base station equipment in the RSS-133.

EIRP compliance is addressed at the time of licensing, as required by the responsible IC Bureau. Licensee's are required to take into account the antenna gain to get the maximum usable power settings to prevent the radiated output power to exceed the EIRP limits specified in SRSP-510

Complies?	Yes

Occupied bandwidth measurements according to CFR47 2.1049 / RSS-Gen 4.6.1

Date	Temperature	Humidity
2017-10-05	22 °C ± 3 °C	30% ± 5 %

Test set-up and procedure

The measurements were made per definition in § 2.1049. The output was connected to a signal analyzer with the Peak detector activated in max hold.

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

Measurement uncertainty: 3.7 dB

Results

Single carrier

Diagram	Modulation	Symbolic name	Tested Port	Occupied BW (99%) [kHz]
1	8PSK	B+1	RF C	245
2	8PSK	M	RF A	245
3	8PSK	M	RF B	245
4	GMSK	M	RF C	245
5	8PSK	M	RF C	245
6	AQPSK	M	RF C	241
7	8PSK	M	RF D	245
8	8PSK	T-1	RF C	245

The diagrams are shown on the following pages.

Diagram 1:

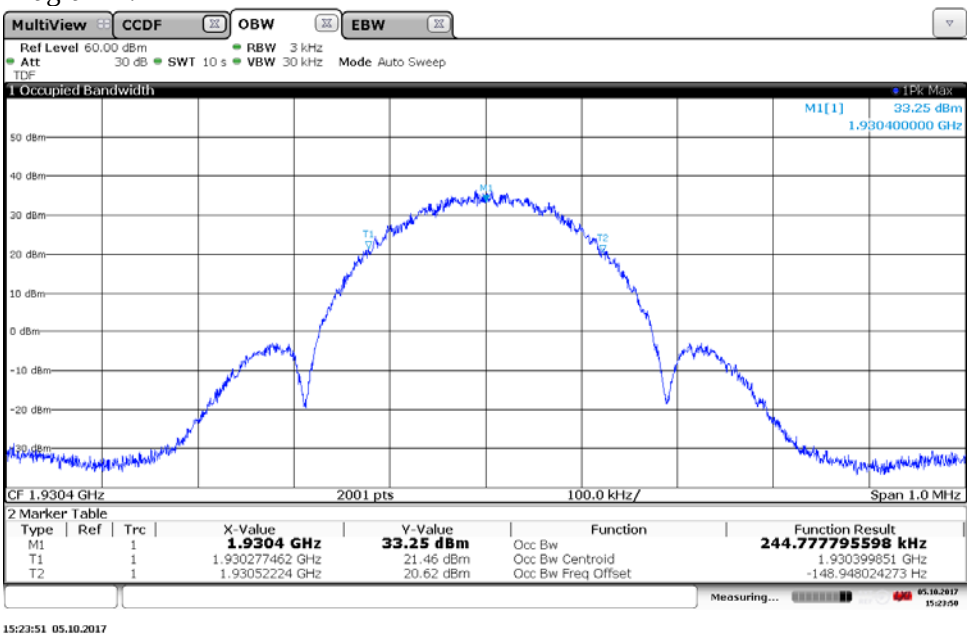


Diagram 2:

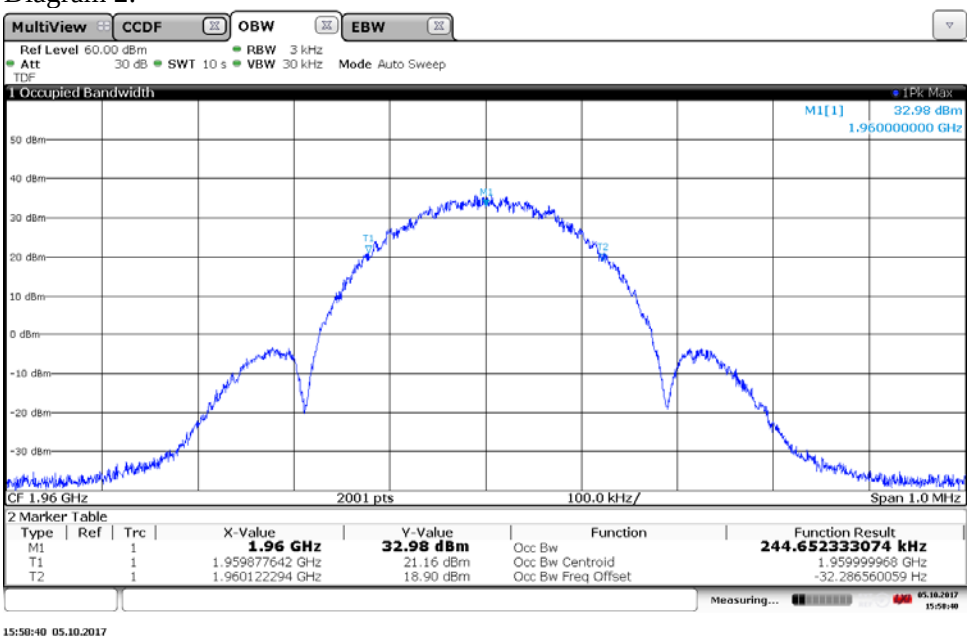


Diagram 3:

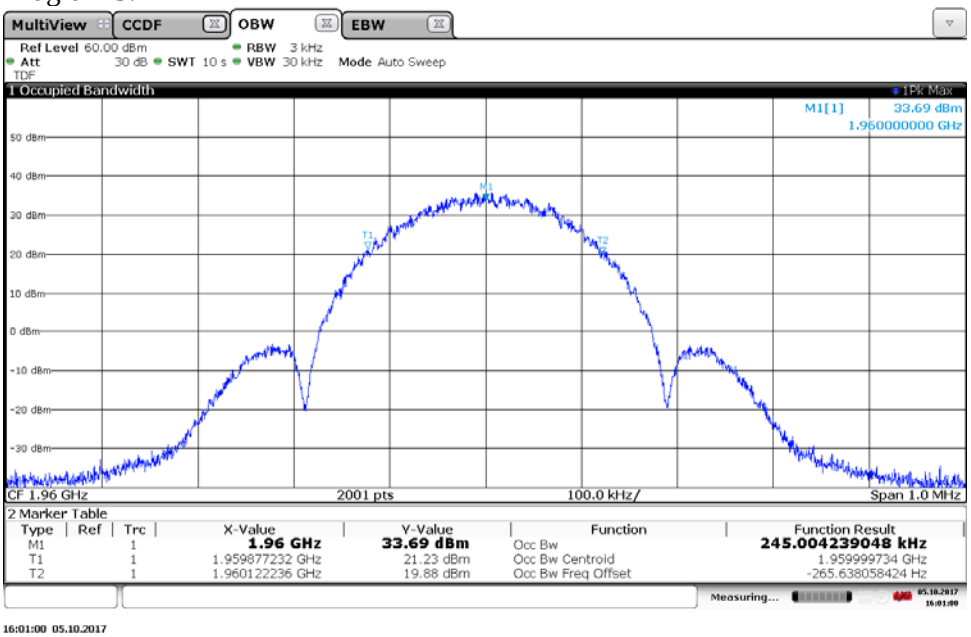


Diagram 4:

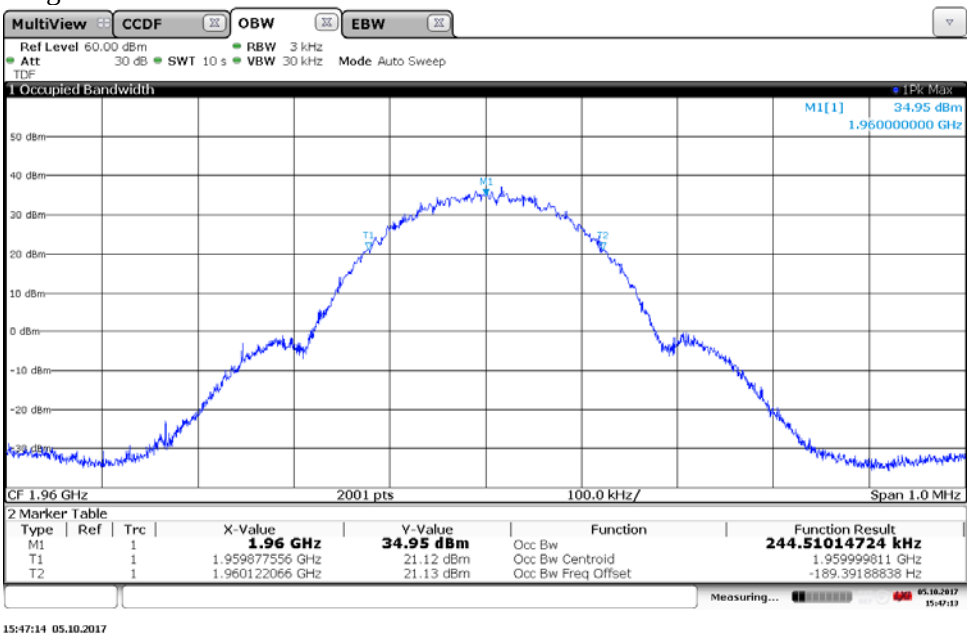


Diagram 5:

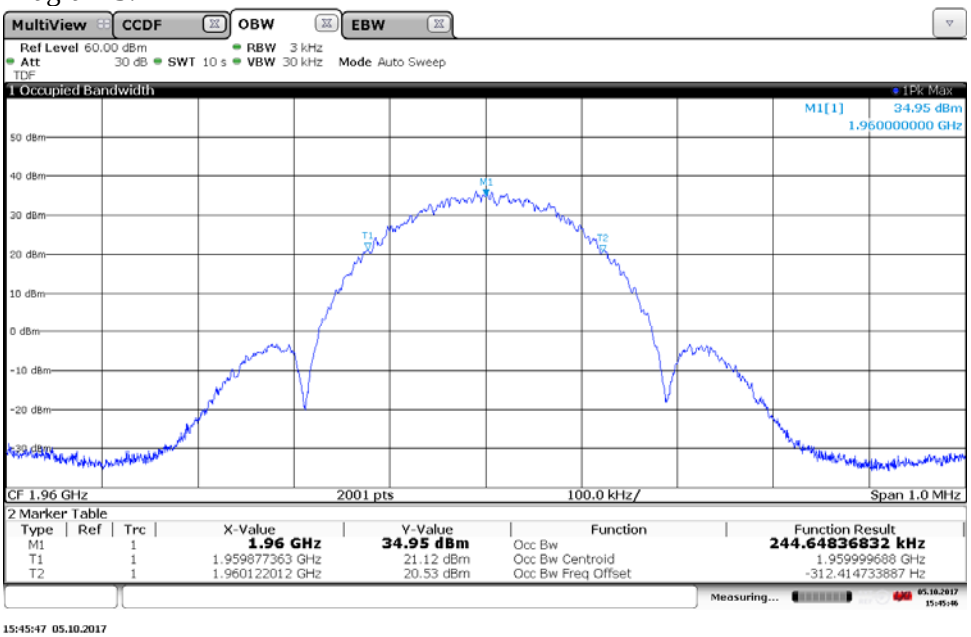


Diagram 6:

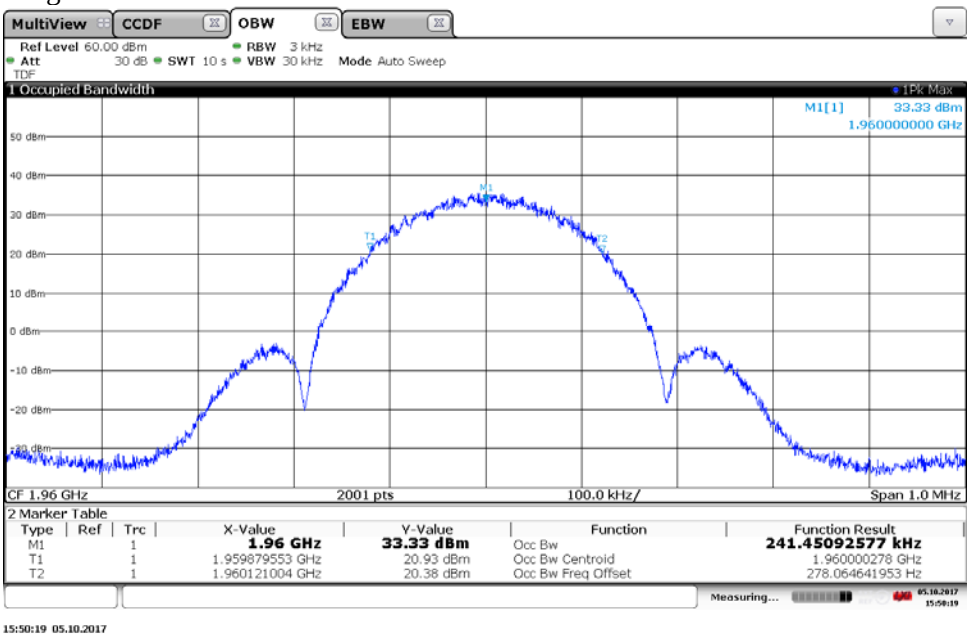


Diagram 7:

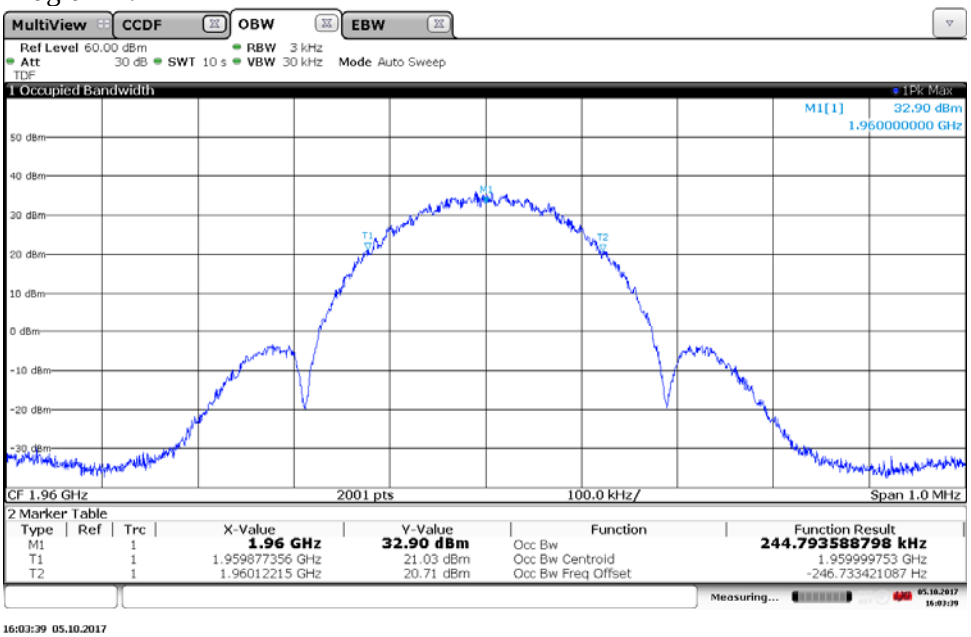
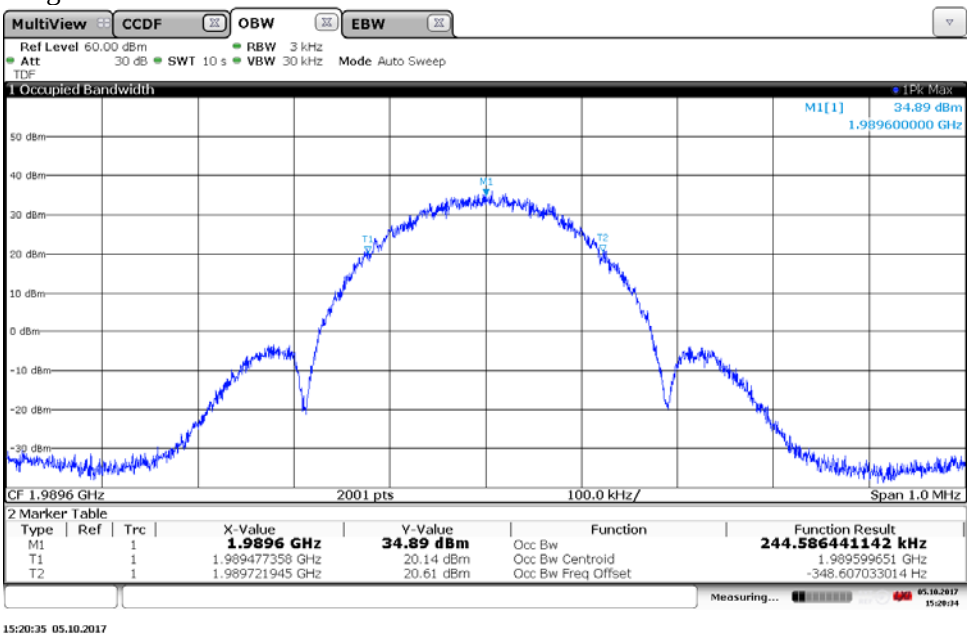


Diagram 8:



Band edge measurements according to CFR 47 §24.238 / IC RSS-133 6.6

Date	Temperature	Humidity
2017-10-06	22 °C ± 3 °C	21% ± 5 %
2017-10-10	22 °C ± 3 °C	22% ± 5 %

Test set-up and procedure

The measurements were made per definition in §24.238. 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. A RBW of 3 kHz (>1% of EBW) was used up to 1 MHz away from the band edges.
From 1 MHz to 30 MHz away from the band edges a RBW of 100 kHz was used. To compensate for the reduced RBW the limit was adjusted by 10 dB to -23 dBm in this frequency range.

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

Measurement uncertainty: 3.7 dB

Results

Singel carrier

Diagram	Modulation	Symbolic name	Tested Port
1 a-b	GMSK	B+1	RF C
2 a-b	8PSK	B+1	RF C
3 a-b	AQPSK	B+1	RF C
4 a-b	GMSK	T-1	RF C
5 a-b	8PSK	T-1	RF C
6 a-b	AQPSK	T-1	RF C
7 a-b	GMSK	B	RF A
8 a-b	GMSK	T	RF A
9 a-b	GMSK	B	RF B
10 a-b	GMSK	T	RF B
11 a-b	GMSK	B	RF C
12 a-b	GMSK	T	RF C
13 a-b	GMSK	B	RF D
14 a-b	GMSK	T	RF D

Multi carrier

Diagram	Modulation	Symbolic name	Tested Port
15 a-b	GMSK	Bim	RF C
16 a-b	GMSK	Tim	RF C

The diagrams are shown on the following pages.

Limits

CFR 47 §24.238 and RSS-133 6.5

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, resulting in a limit of -13 dBm.

Complies?	Yes

Diagram 1 a:

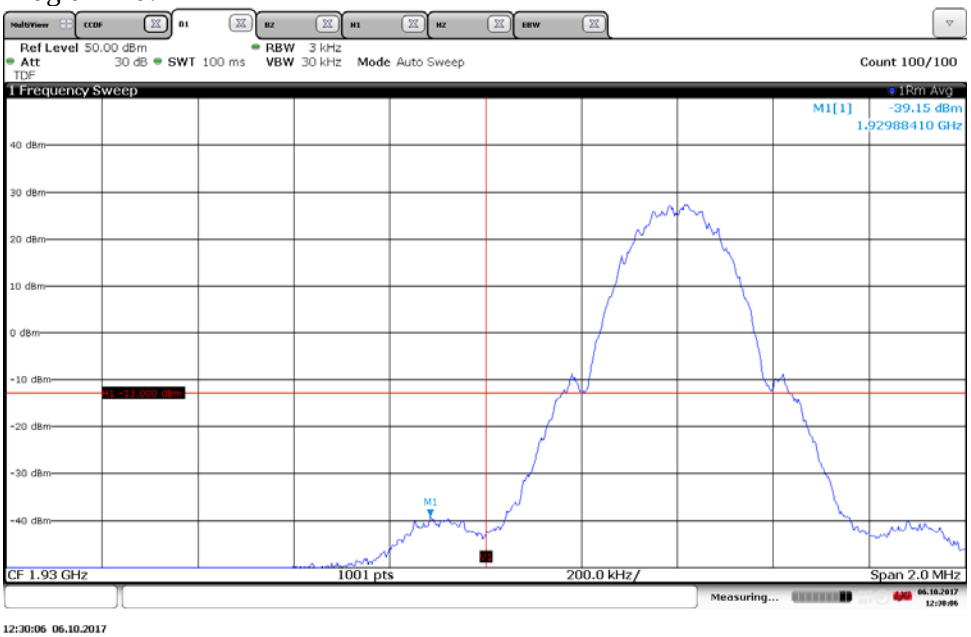


Diagram 1 b:

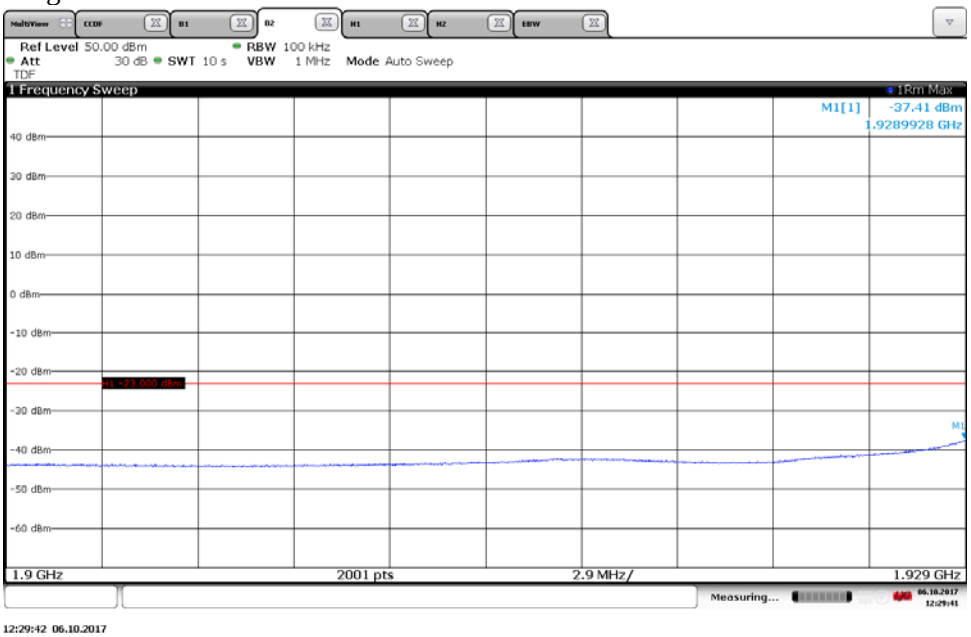


Diagram 2 a:

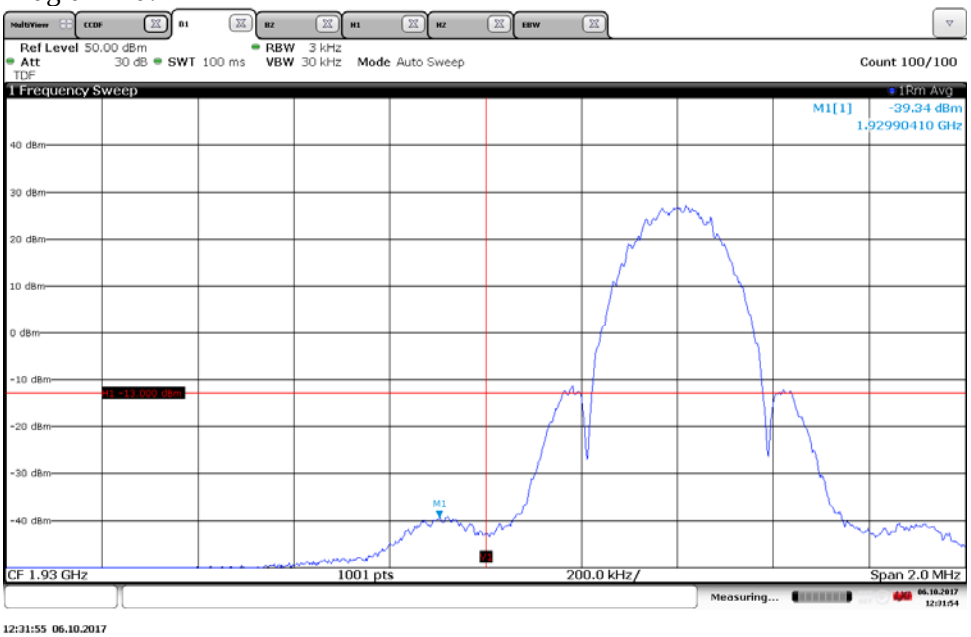


Diagram 2 b:

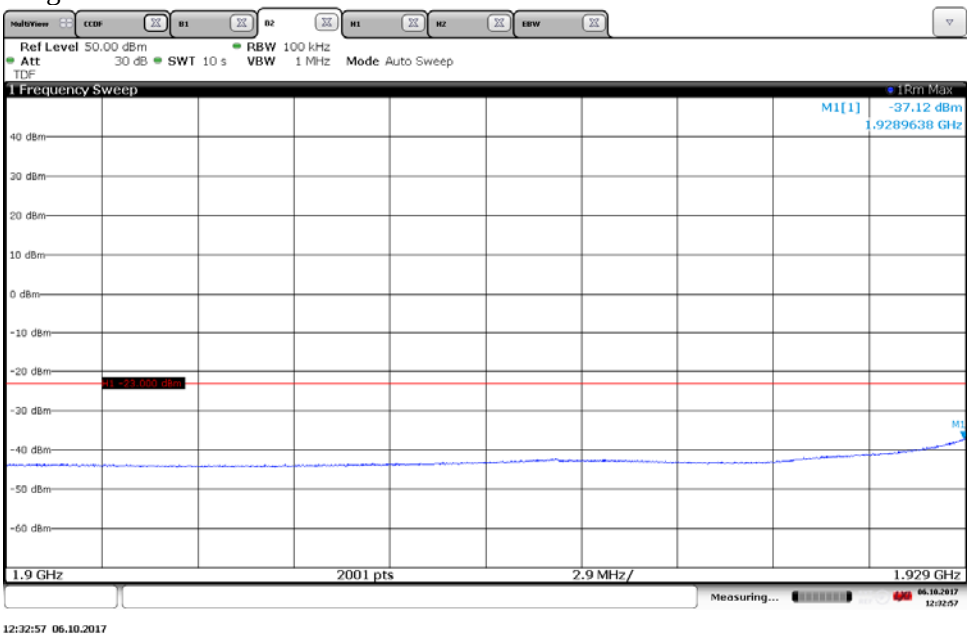


Diagram 3 a:

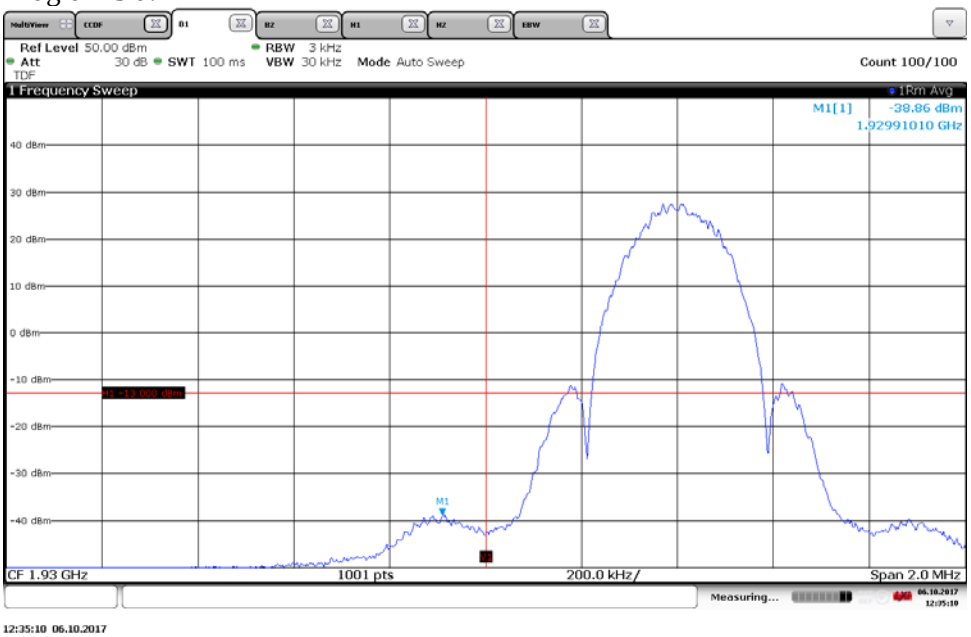


Diagram 3 b:

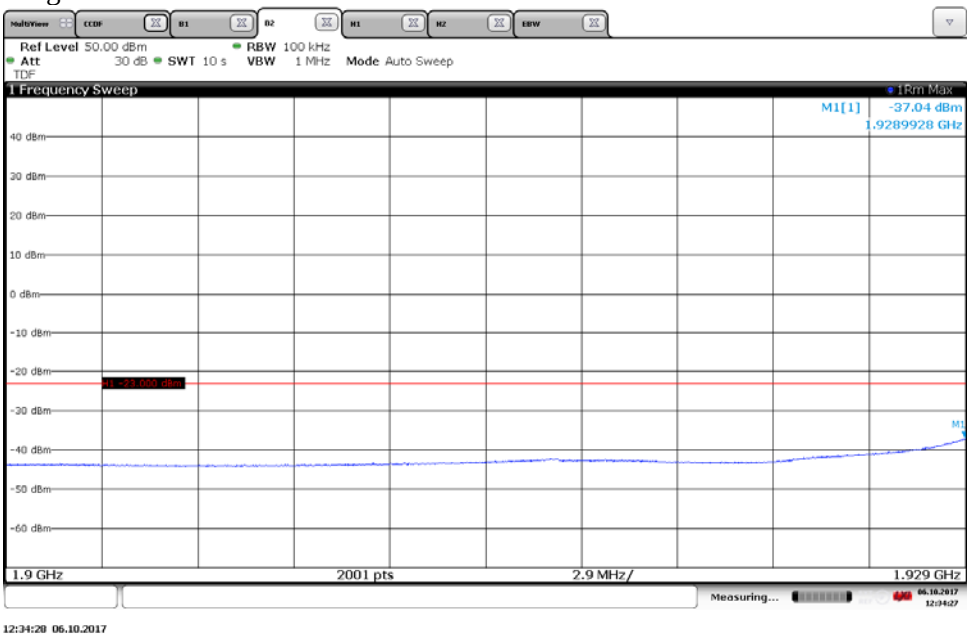


Diagram 4 a:

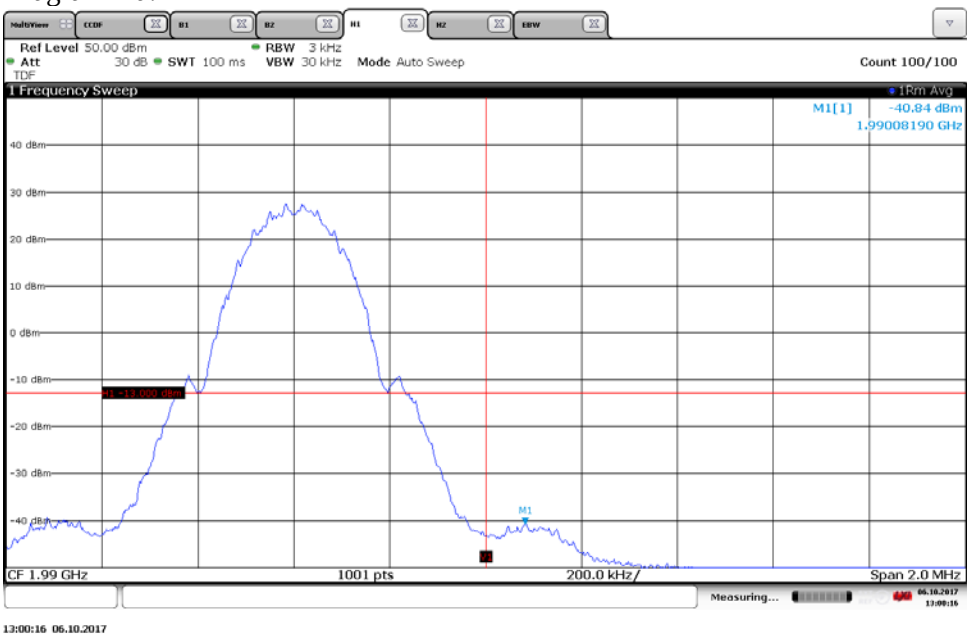


Diagram 4 b:

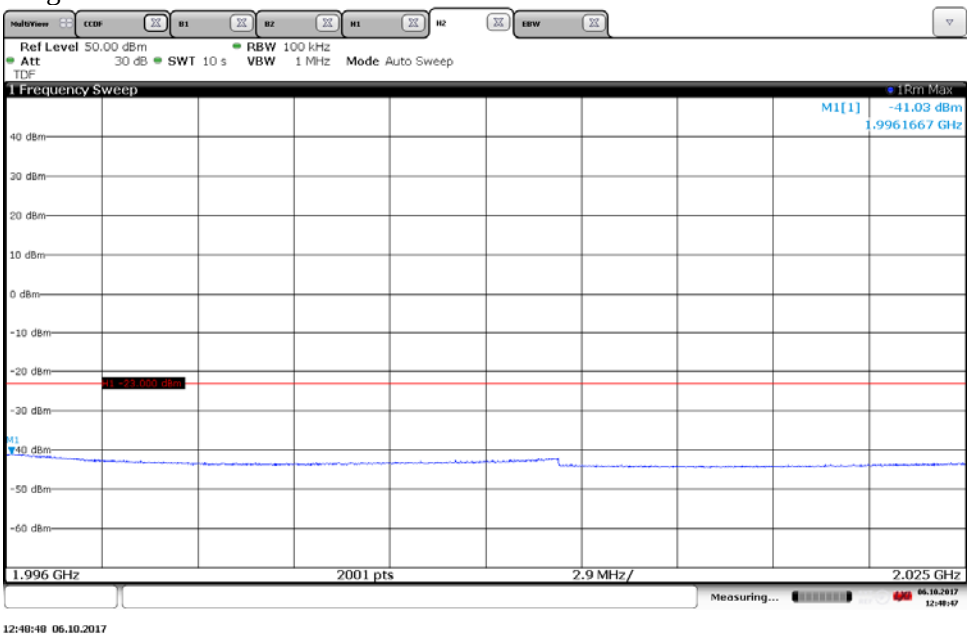


Diagram 5 a:

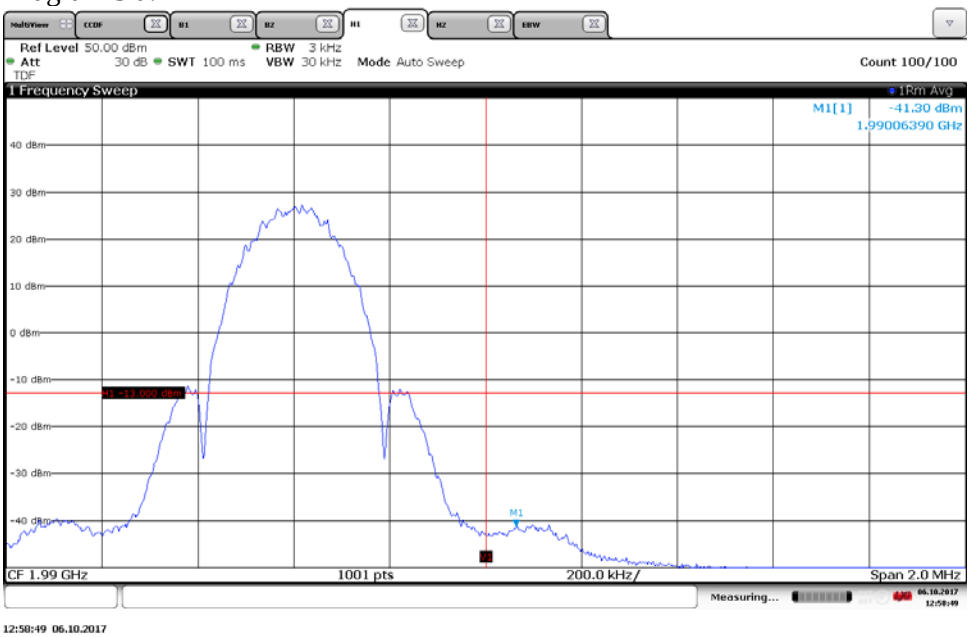


Diagram 5 b:

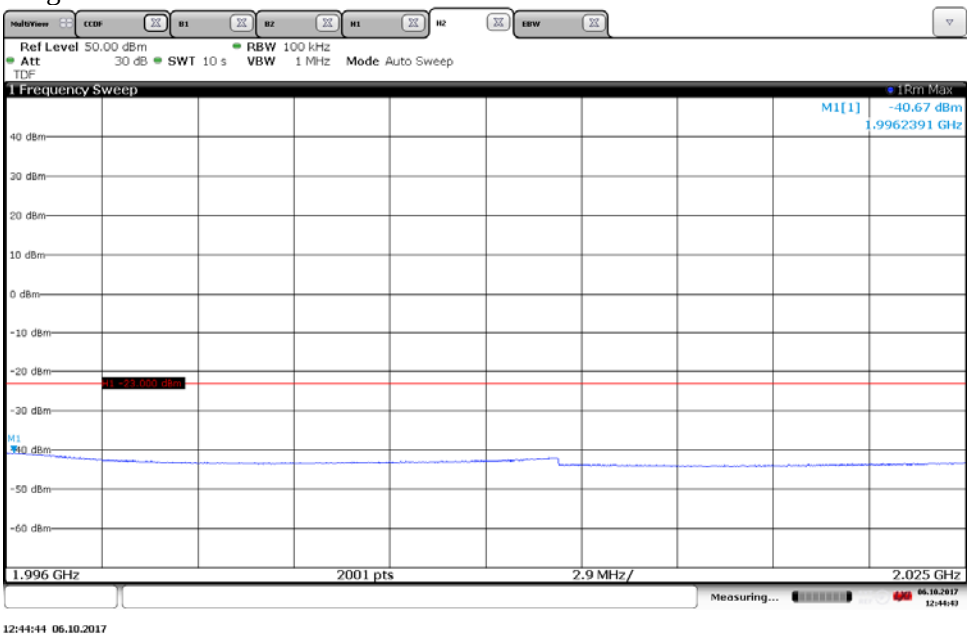


Diagram 6 a:

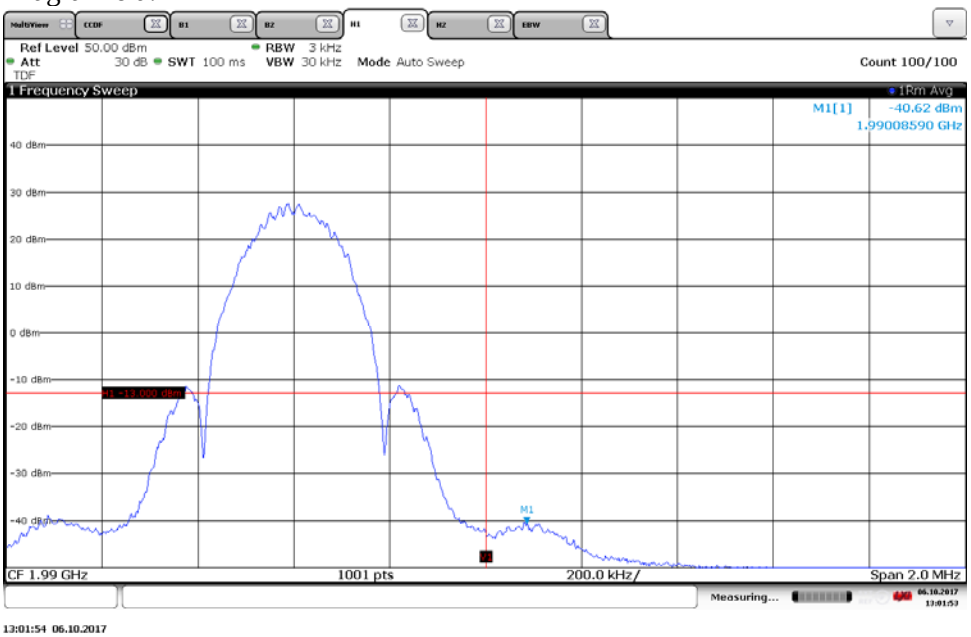


Diagram 6 b:

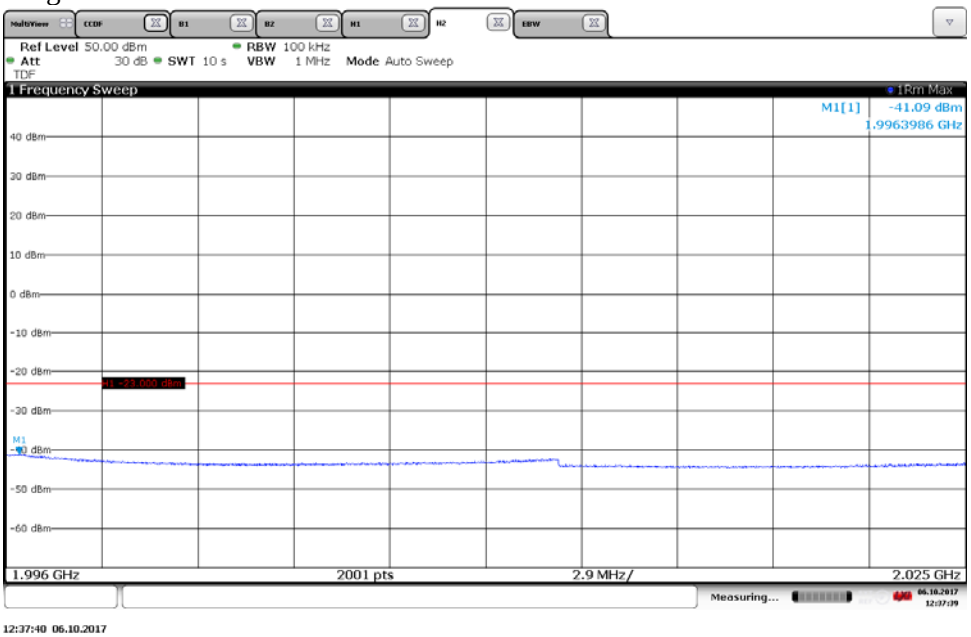


Diagram 7 a:

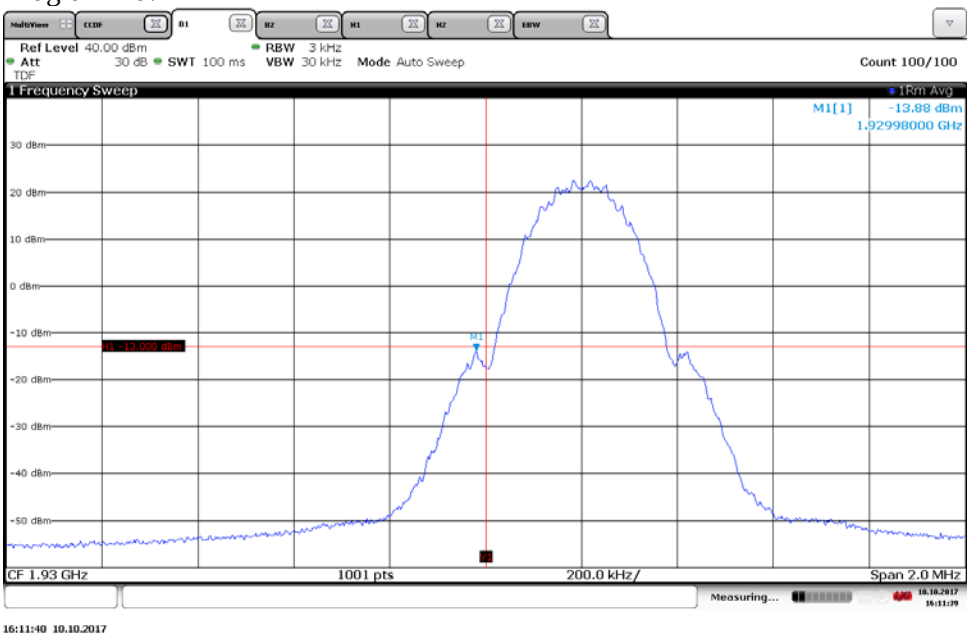


Diagram 7 b:

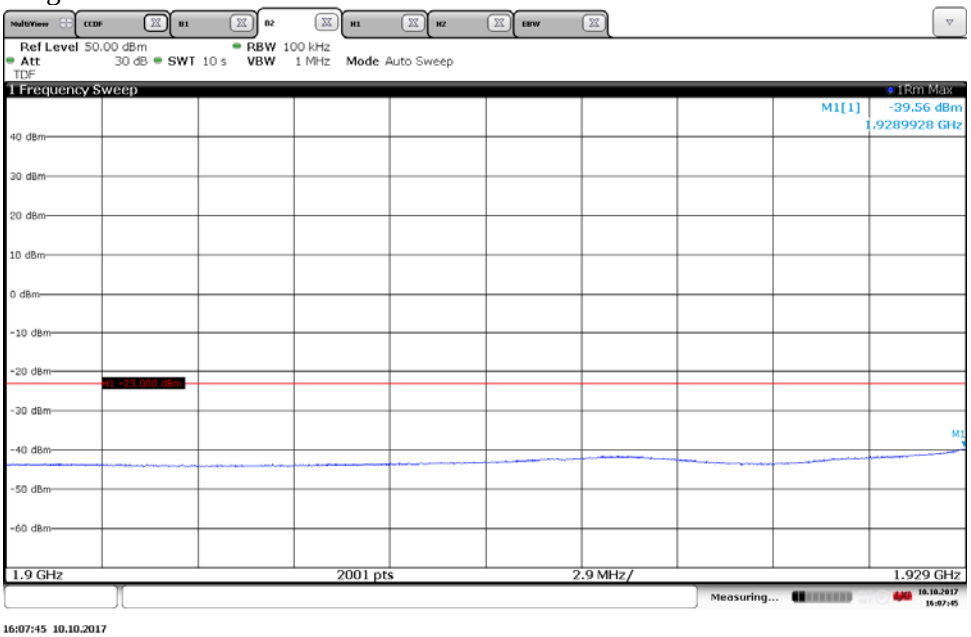


Diagram 8 a:

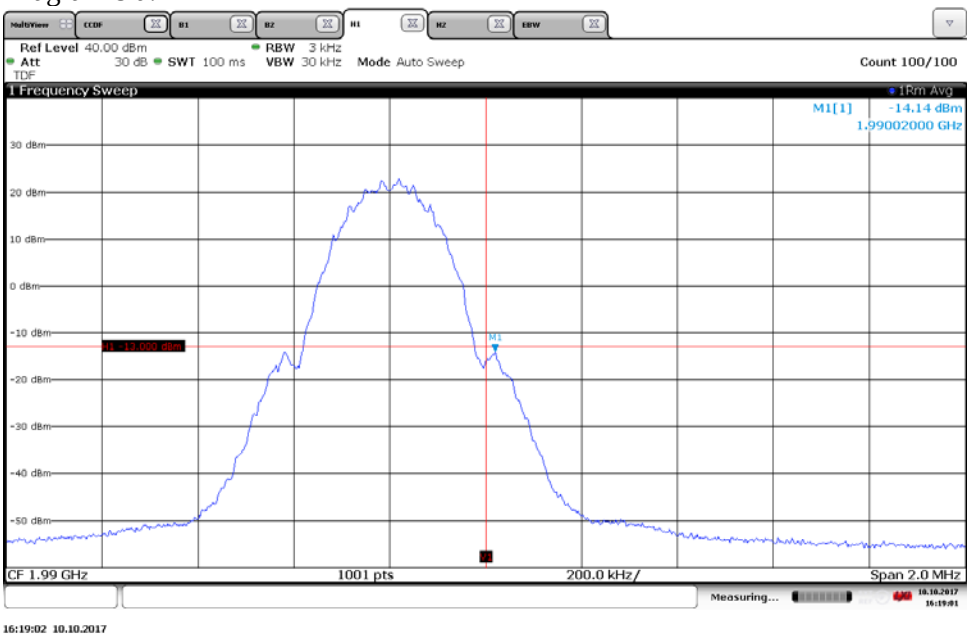


Diagram 8 b:

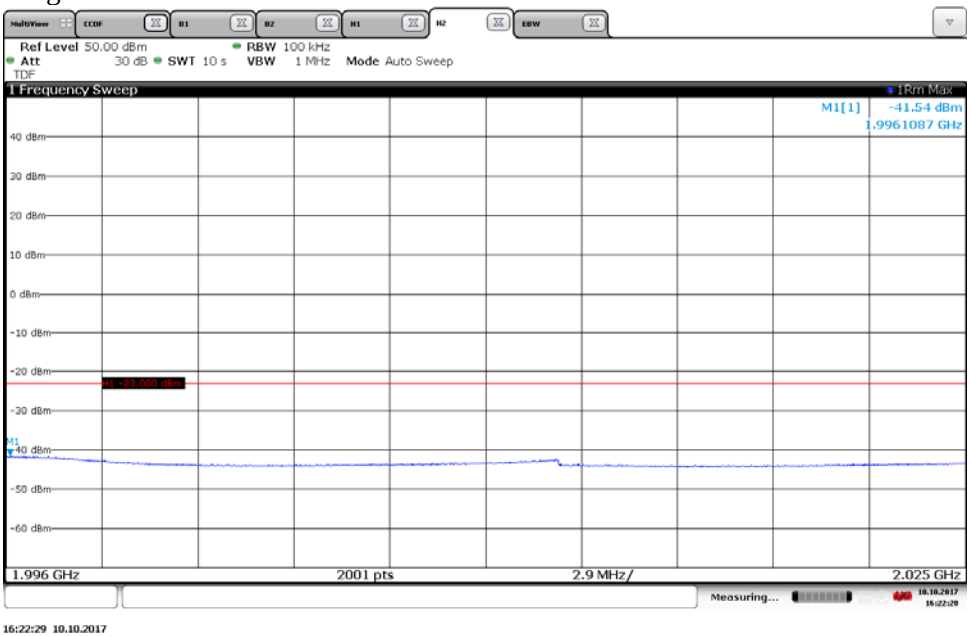


Diagram 9 a:

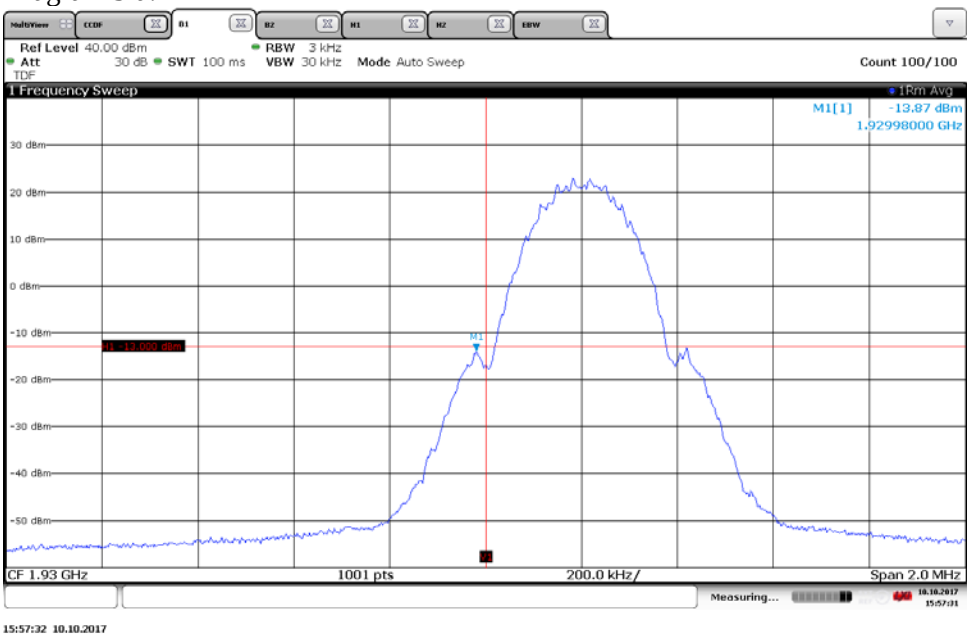


Diagram 9 b:

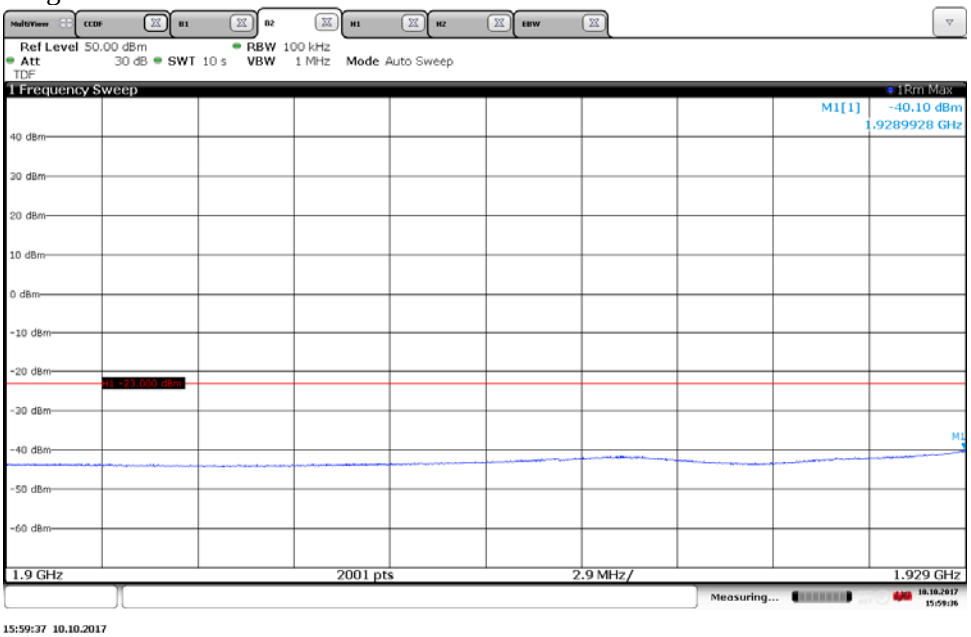


Diagram 10 a:

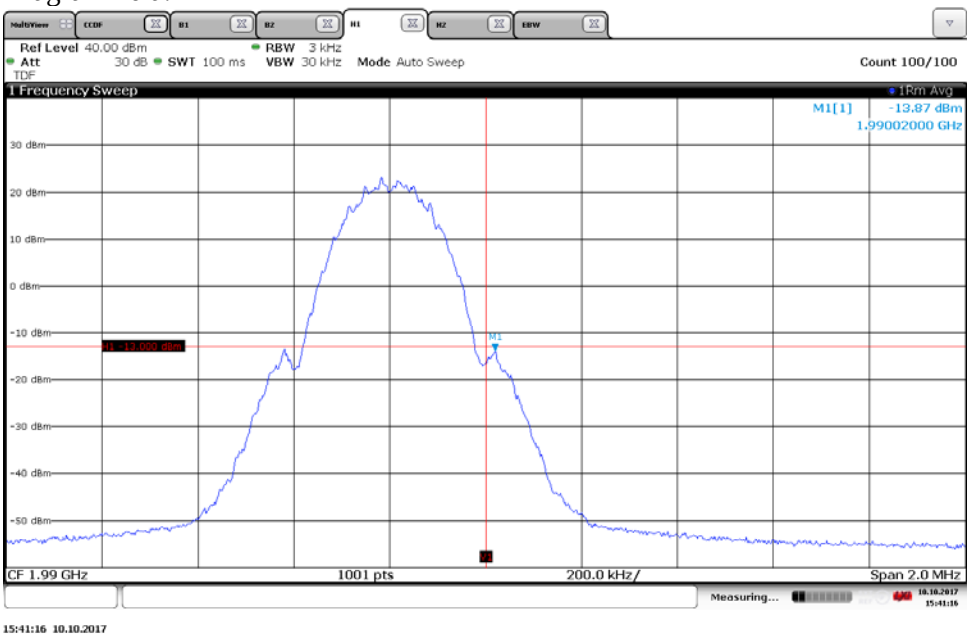


Diagram 10 b:

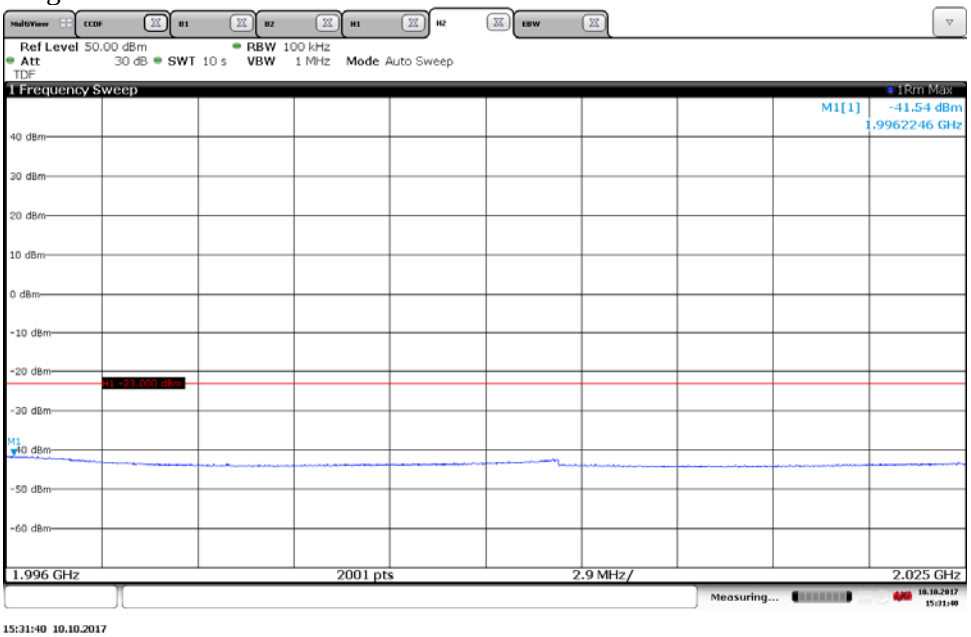


Diagram 11 a:

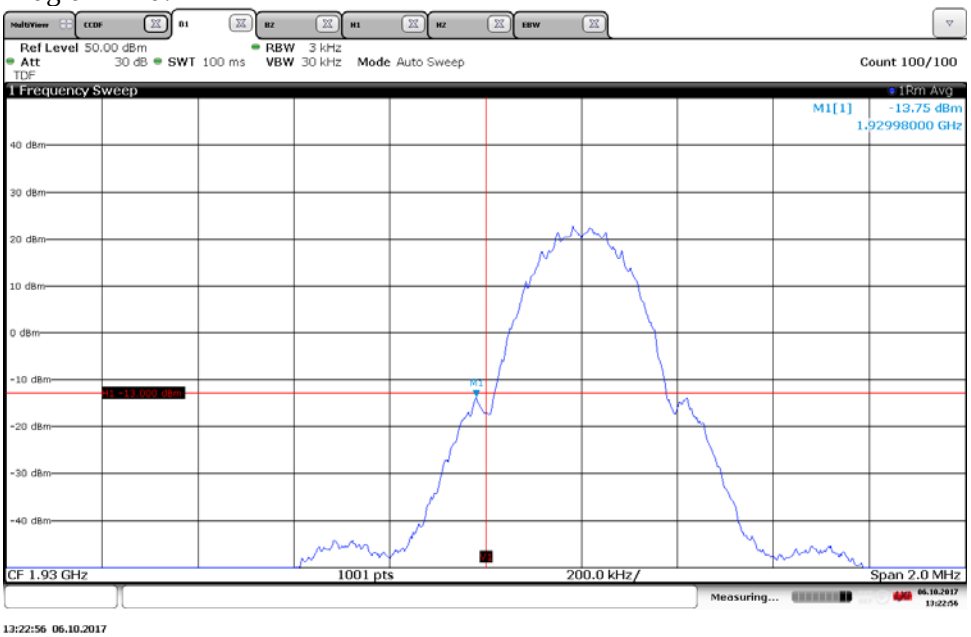


Diagram 11 b:

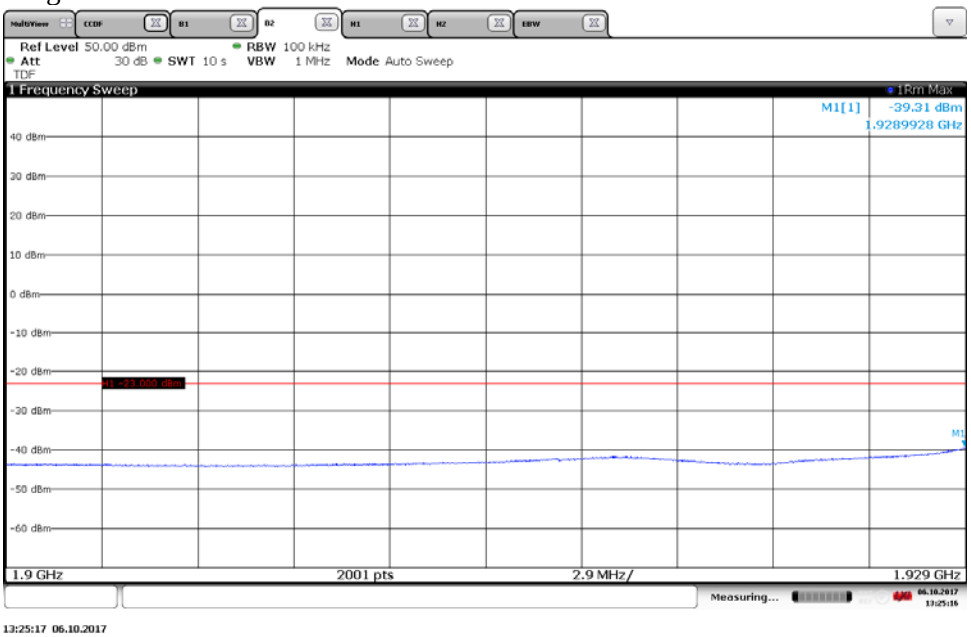


Diagram 12 a:

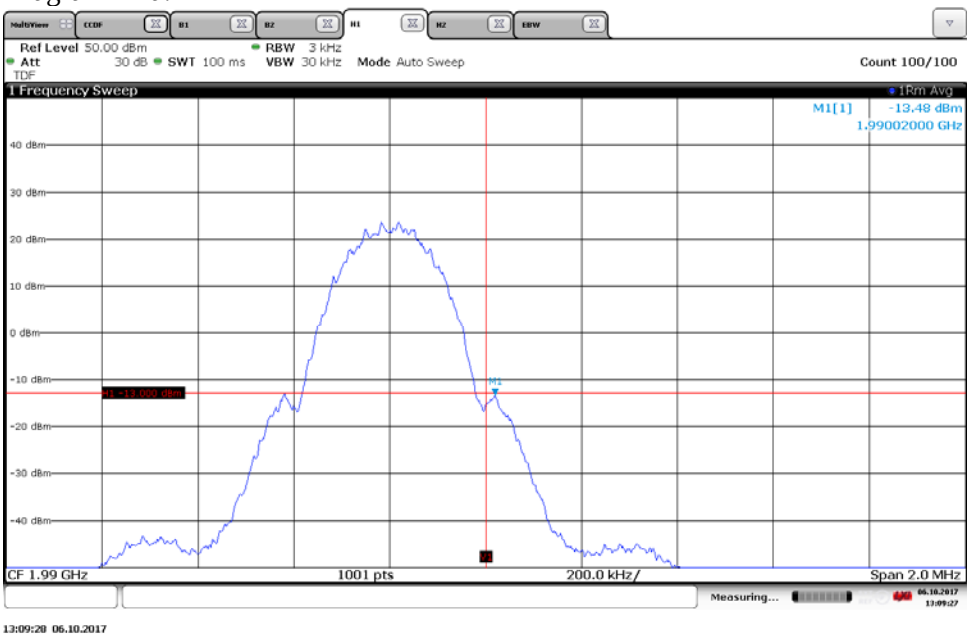


Diagram 12 b:

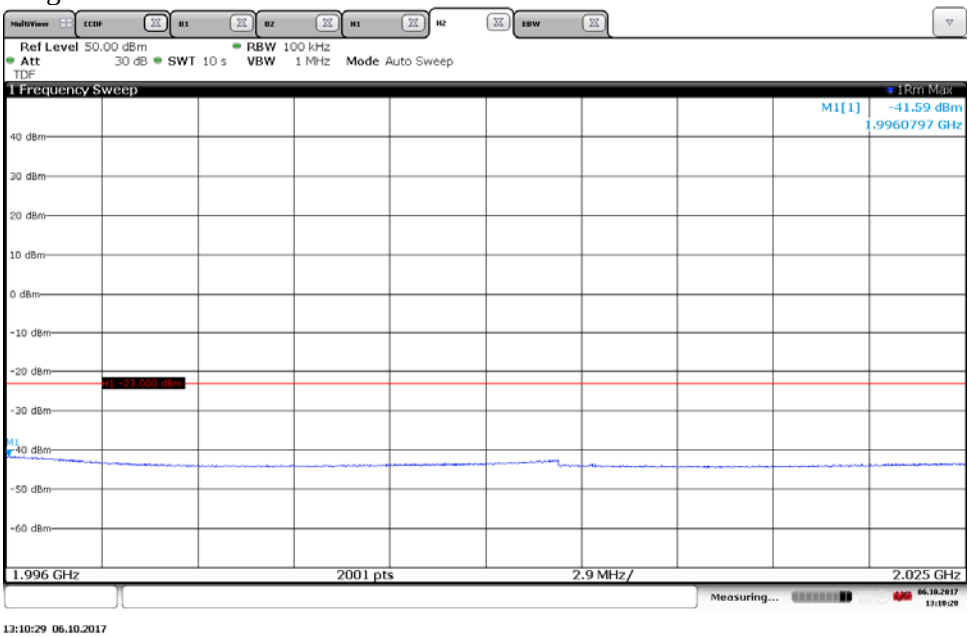


Diagram 13 a:

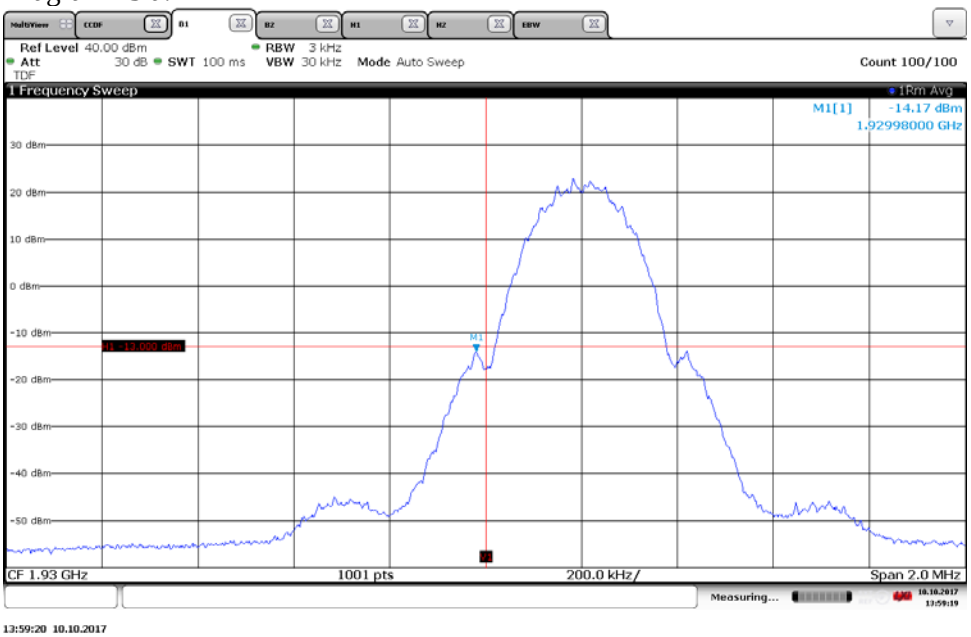


Diagram 13 b:

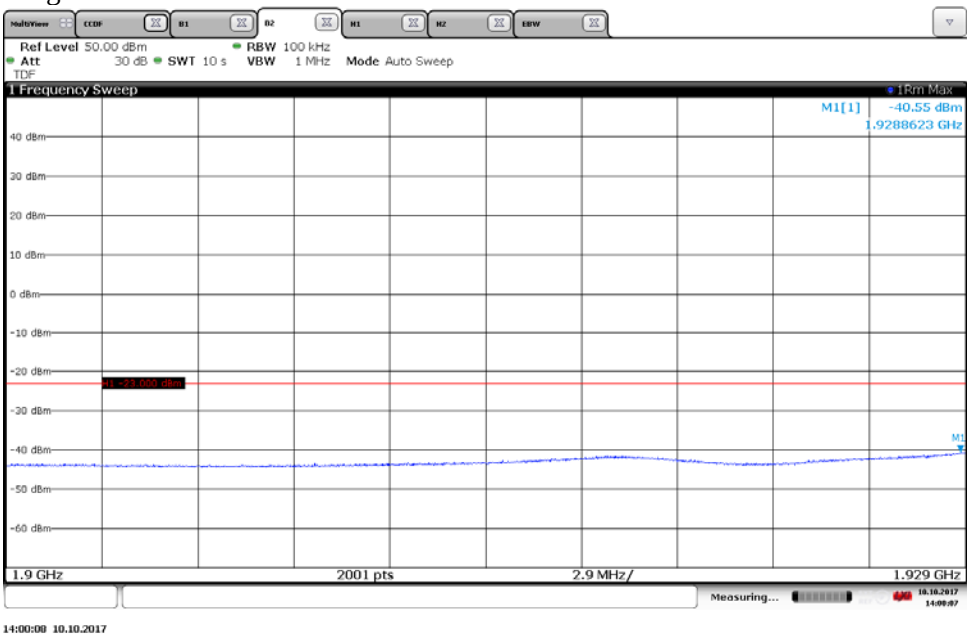


Diagram 14 a:

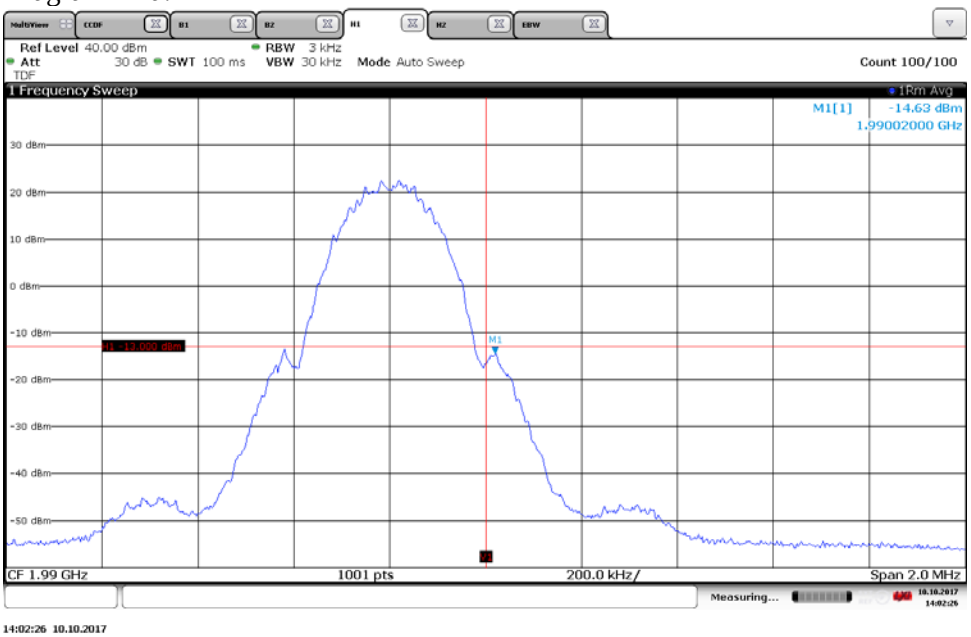


Diagram 14 b:

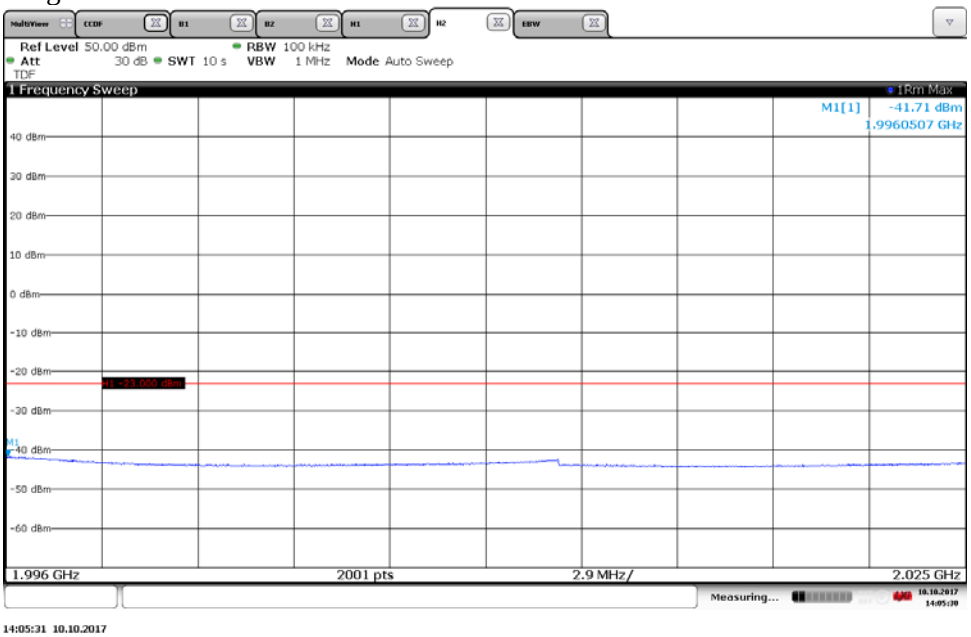


Diagram 15 a:

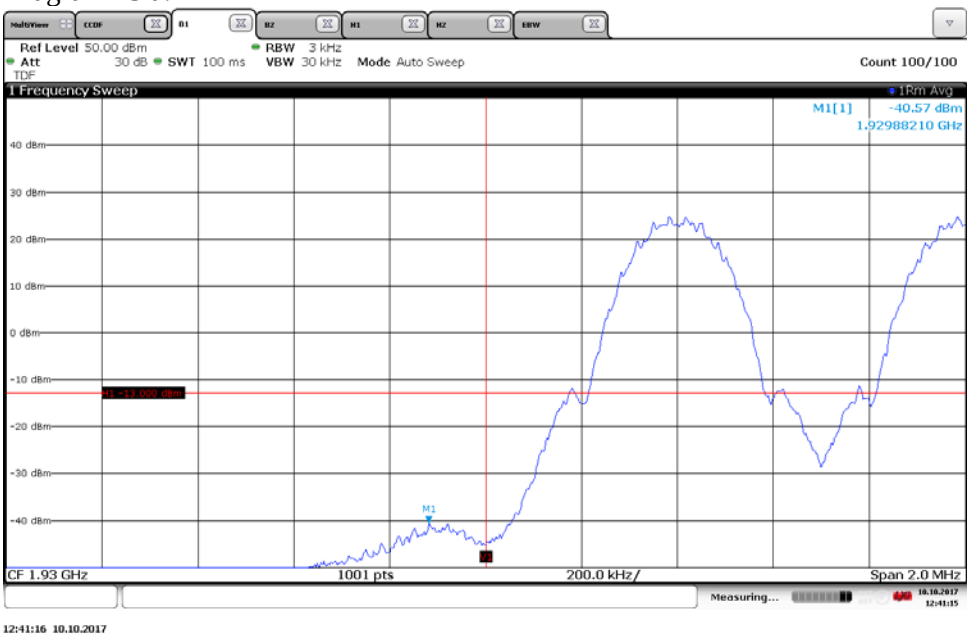


Diagram 15 b:

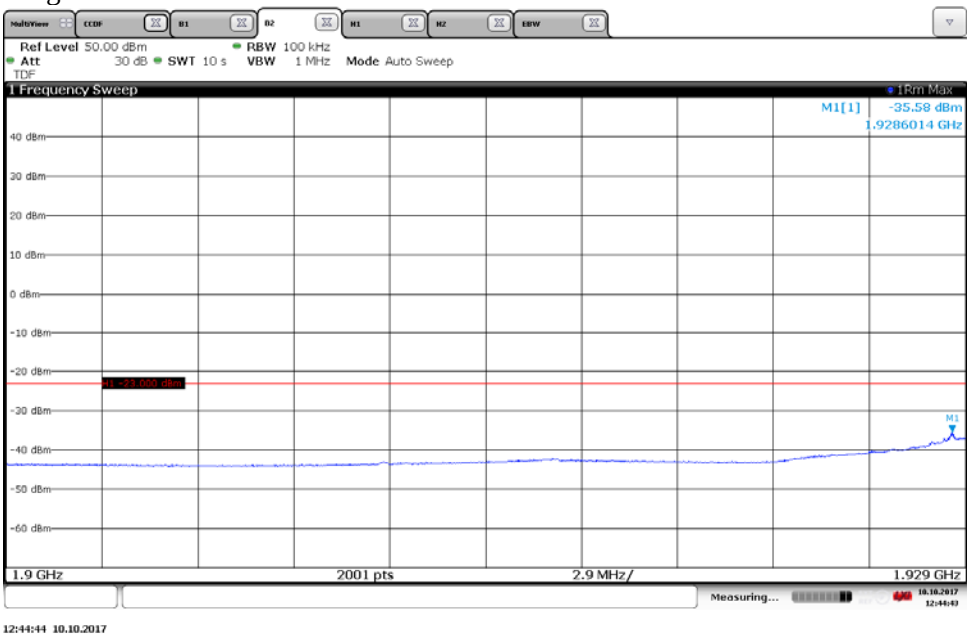


Diagram 16 a:

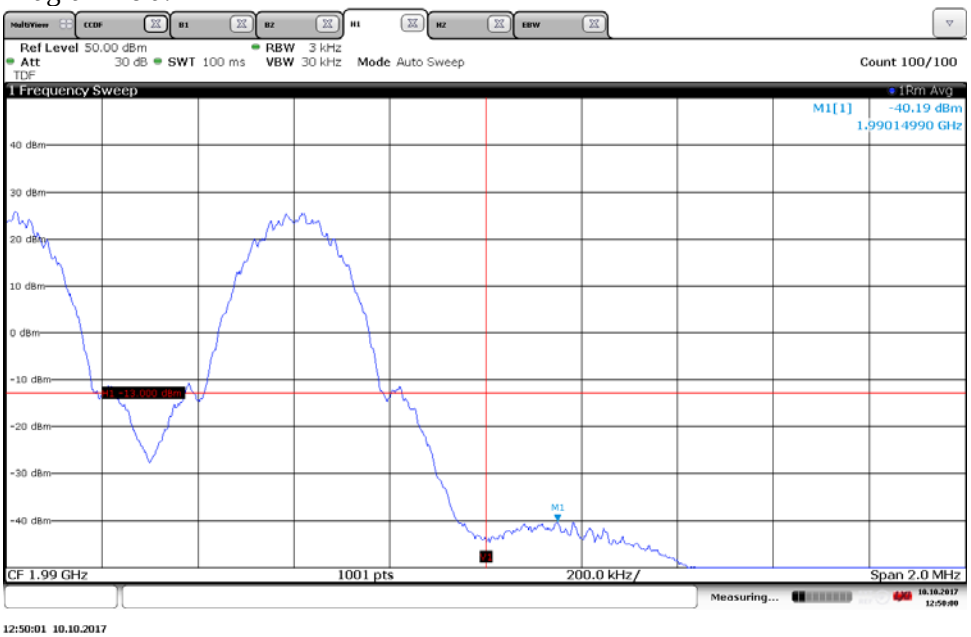
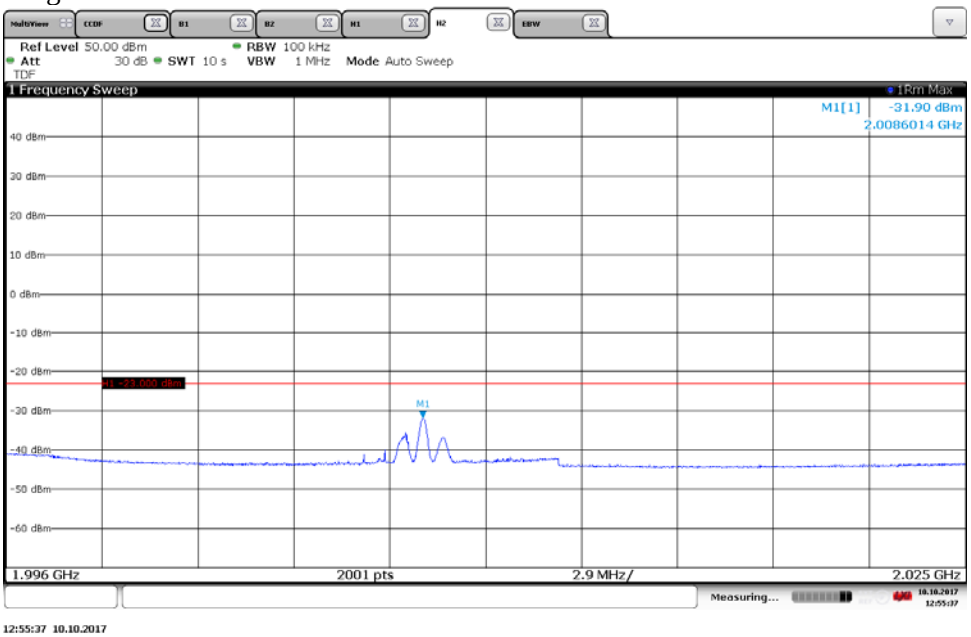


Diagram 16 b:



Conducted spurious emission measurements according to CFR 47 §24.238 / IC RSS-133 6.2

Date	Temperature	Humidity
2017-10-10	22 °C ± 3 °C	22% ± 5 %

Test set-up and procedure

The measurements were made per definition in §24.238. The output was connected to a spectrum analyzer with a RBW setting of 1 MHz and RMS detector activated. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	900 691
HP filter	BX40074
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Single carrier

Diagram	Modulation	Symbolic name	Tested Port
1 a-b	GMSK	B+1	RF C
2 a-b	GMSK	T-1	RF C
3 a-b	GMSK	M	RF C
4 a-b	8PSK	M	RF C
5 a-b	AQPSK	M	RF C
6 a-b	GMSK	M	RF A
7 a-b	GMSK	M	RF B
8 a-b	GMSK	M	RF D

Multi carrier

Diagram	Modulation	Symbolic name	Tested Port
9 a-c	GMSK	M4	RF C
10 a-c	GMSK	Bim	RF C
11 a-c	GMSK	Tim	RF C

Note: Measurements were mainly limited to port RF C due to the measurement result in single carrier mode that shows that the ports are electrical identical
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 upper frequency boundary covers 10x the highest TX fundamental frequency.

Limits

CFR 47 §24.238 and RSS-133 6.5

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, resulting in a limit of -13 dBm per 1 MHz RBW.

Complies?	Yes

Diagram 1a:

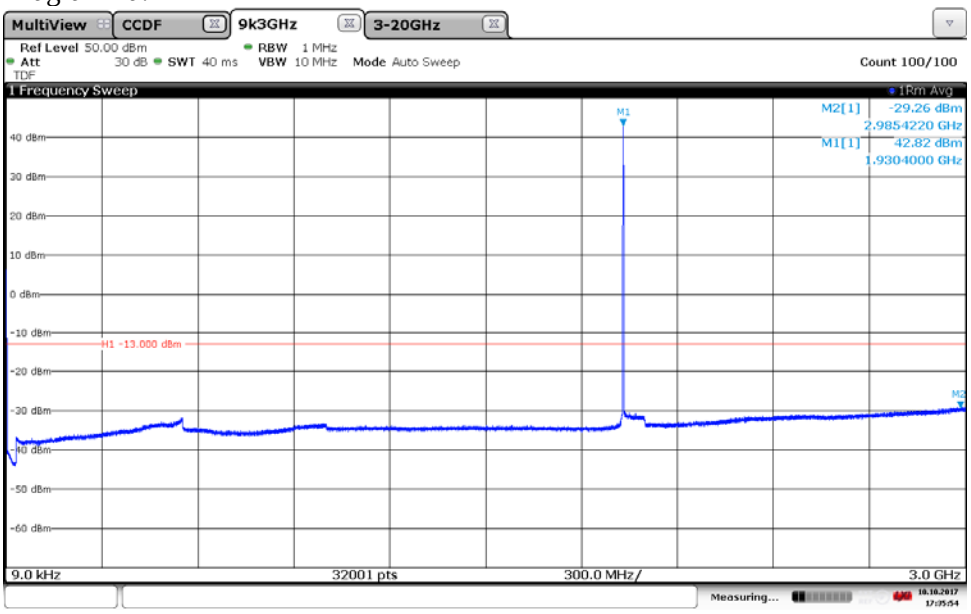


Diagram 1b:

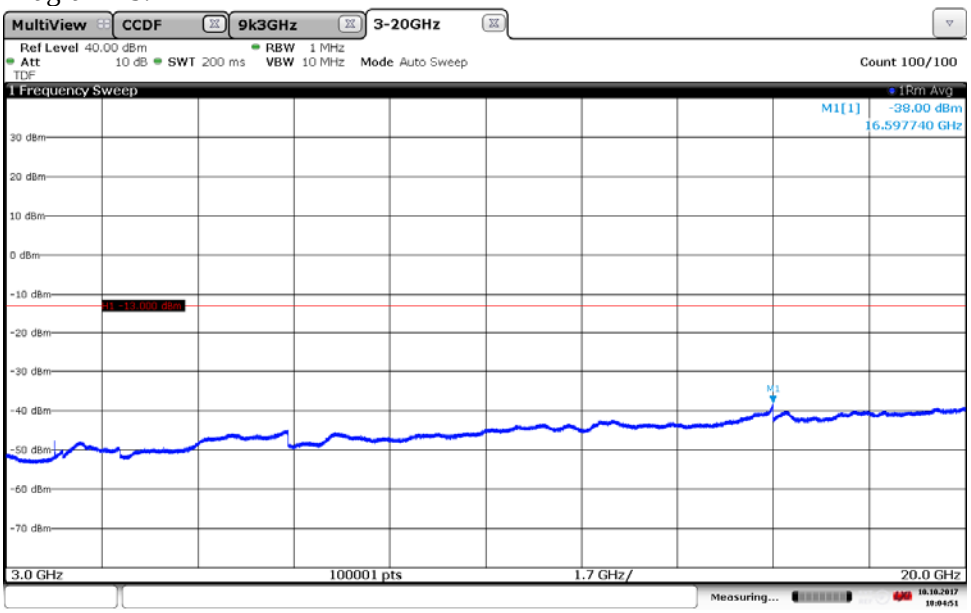


Diagram 2a:

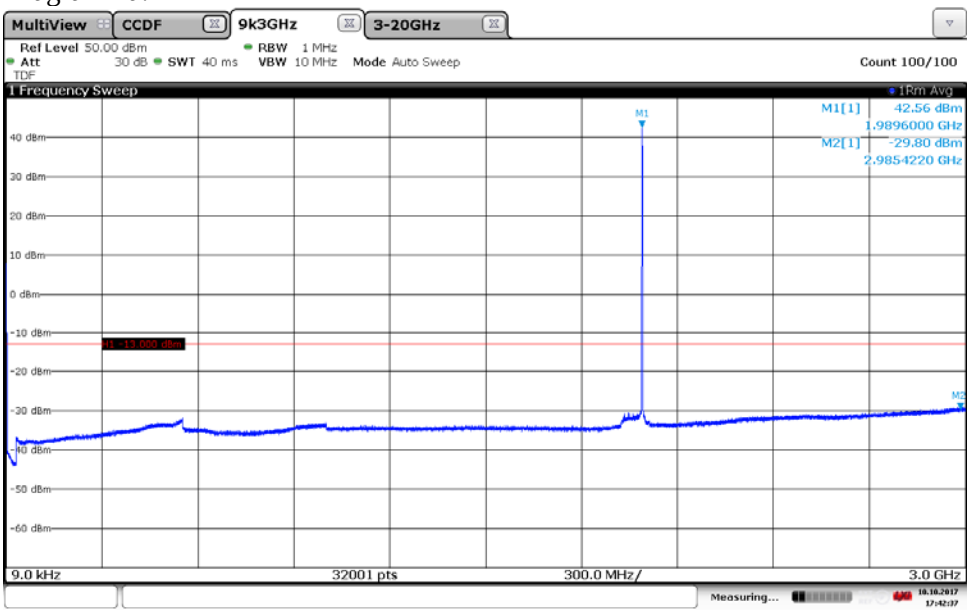


Diagram 2b:

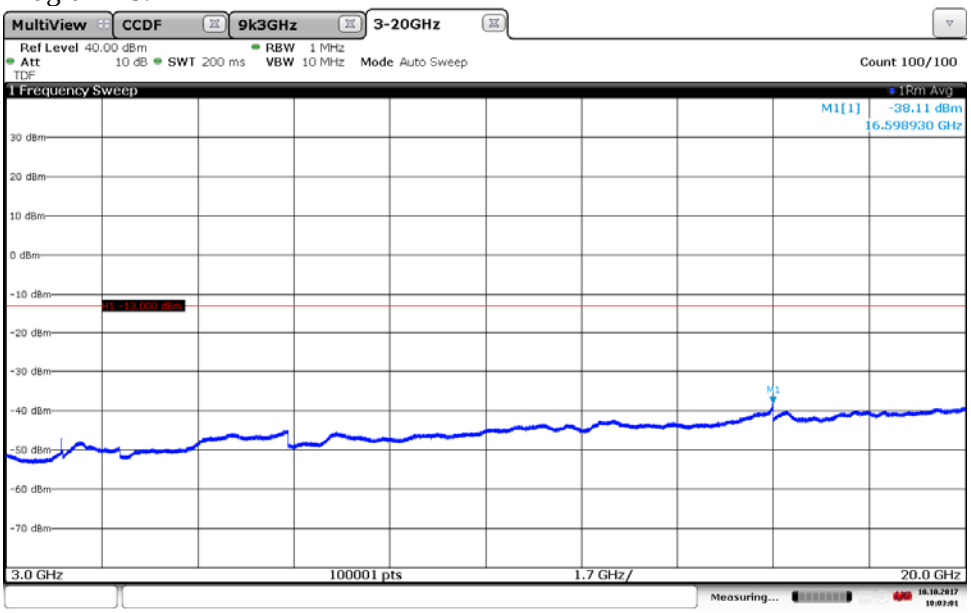


Diagram 3a:

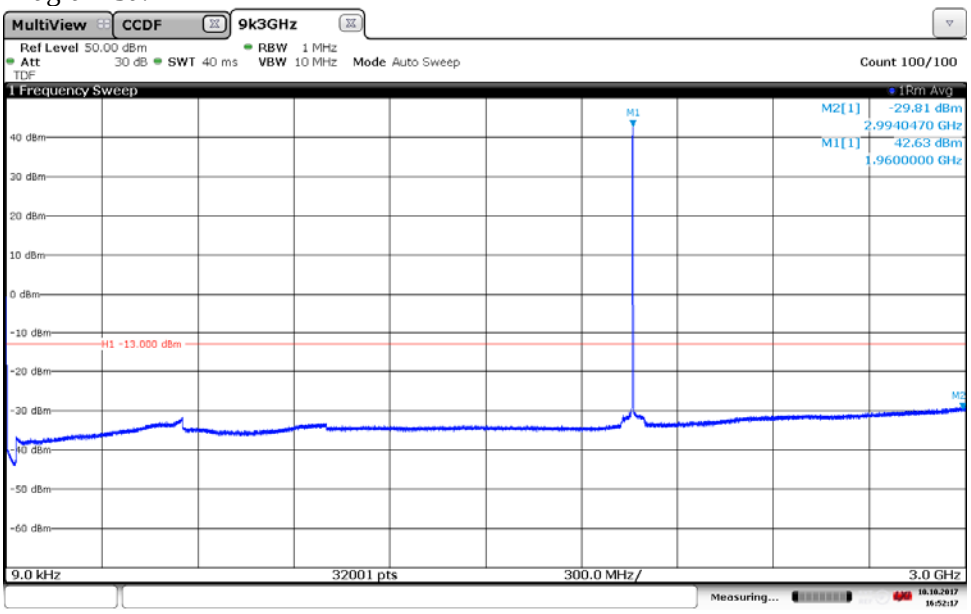


Diagram 3b:

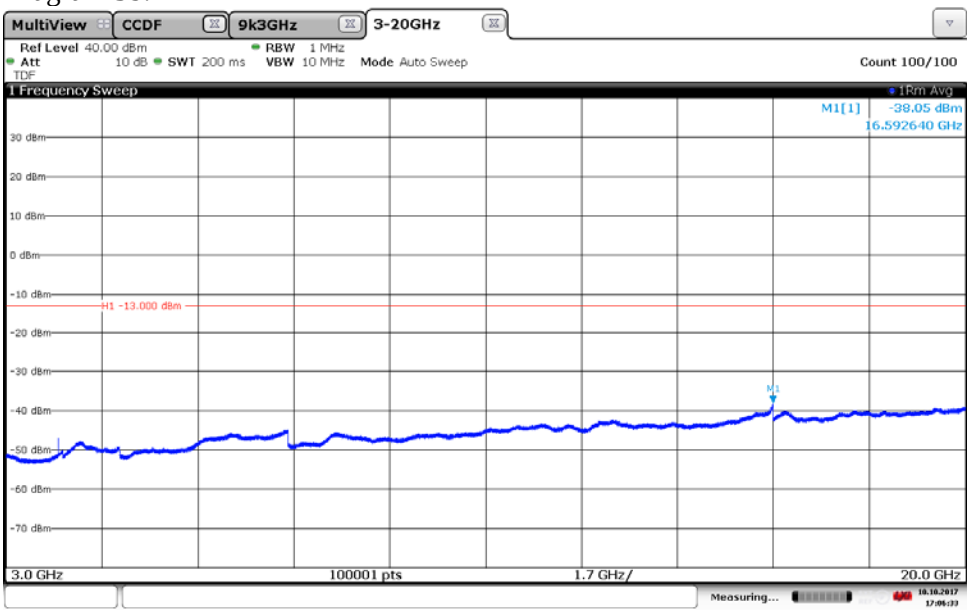


Diagram 4a:

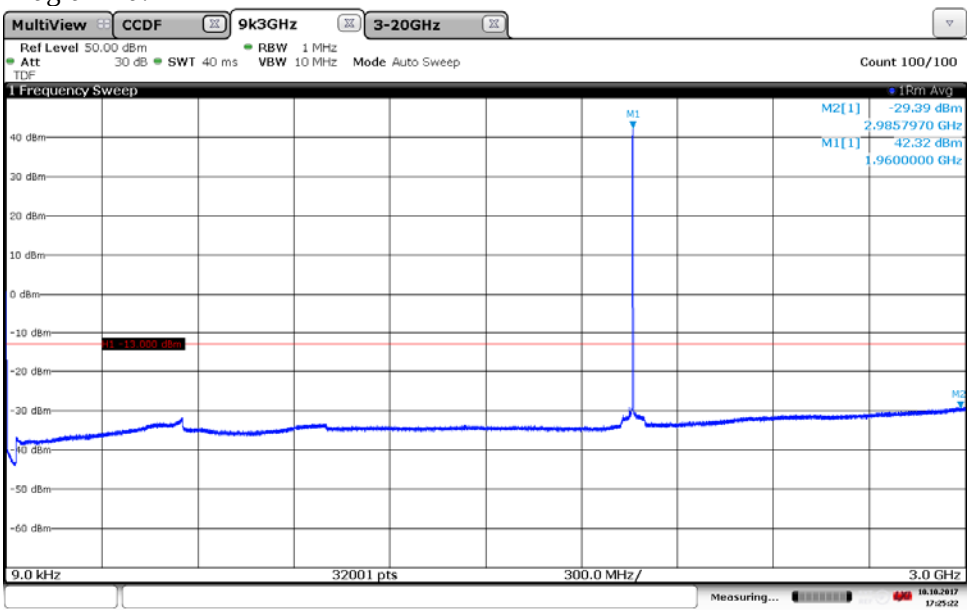


Diagram 4b:

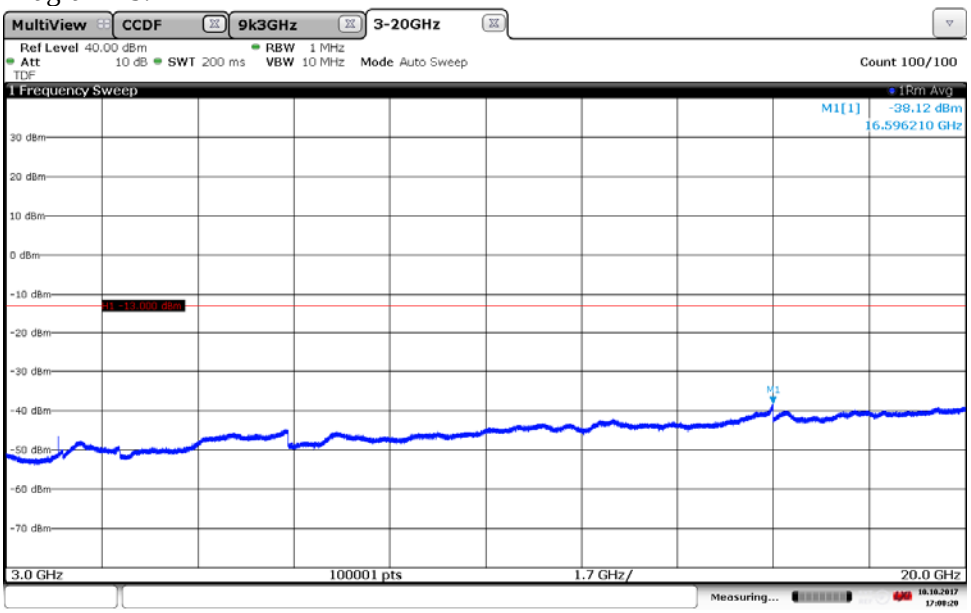


Diagram 5a:

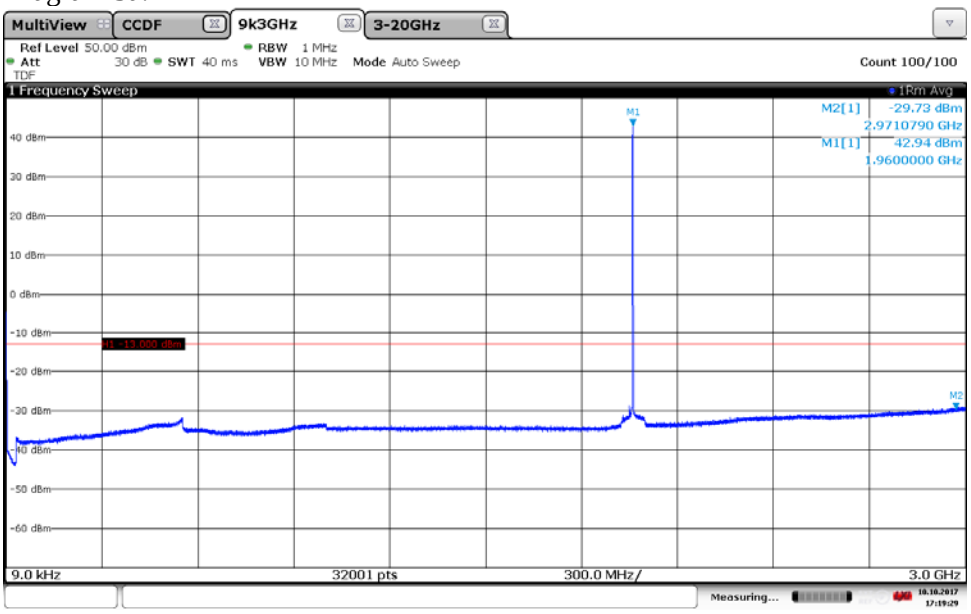


Diagram 5b:

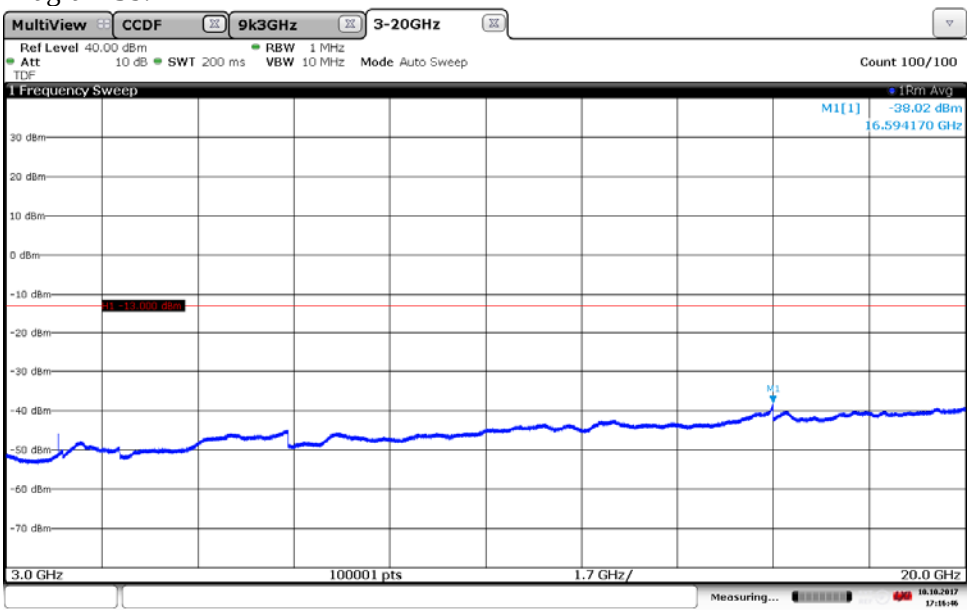


Diagram 6a:

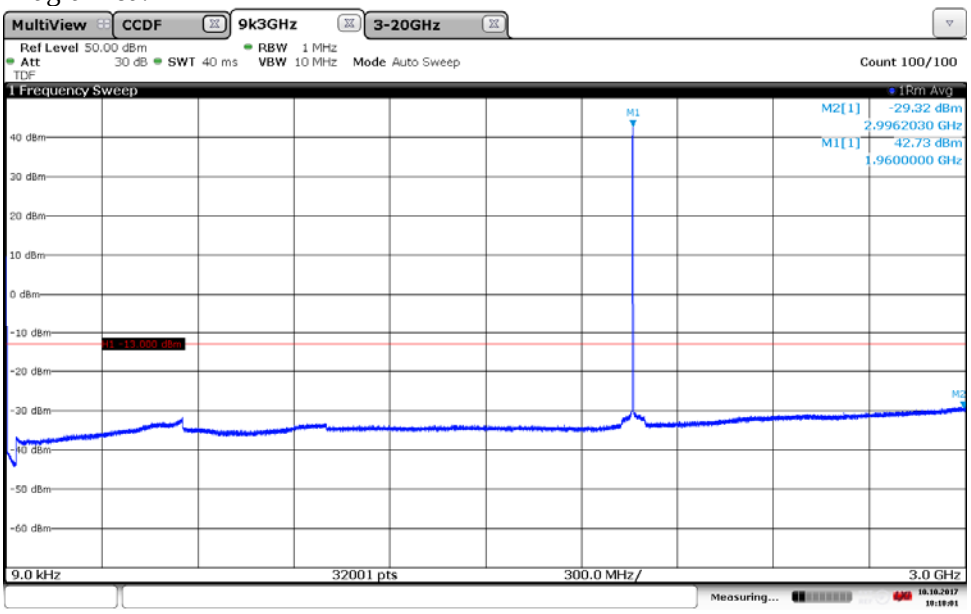


Diagram 6b:

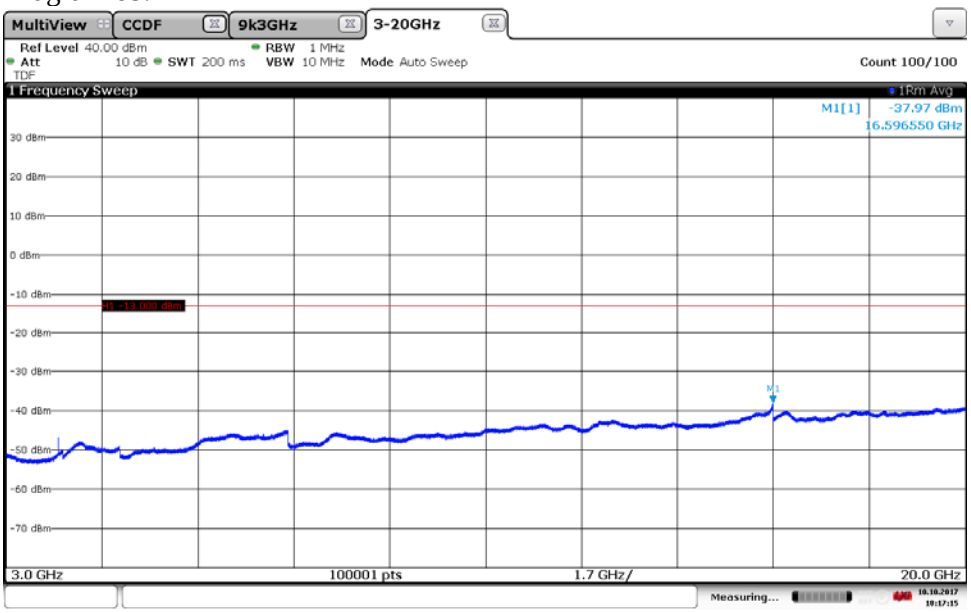


Diagram 7a:

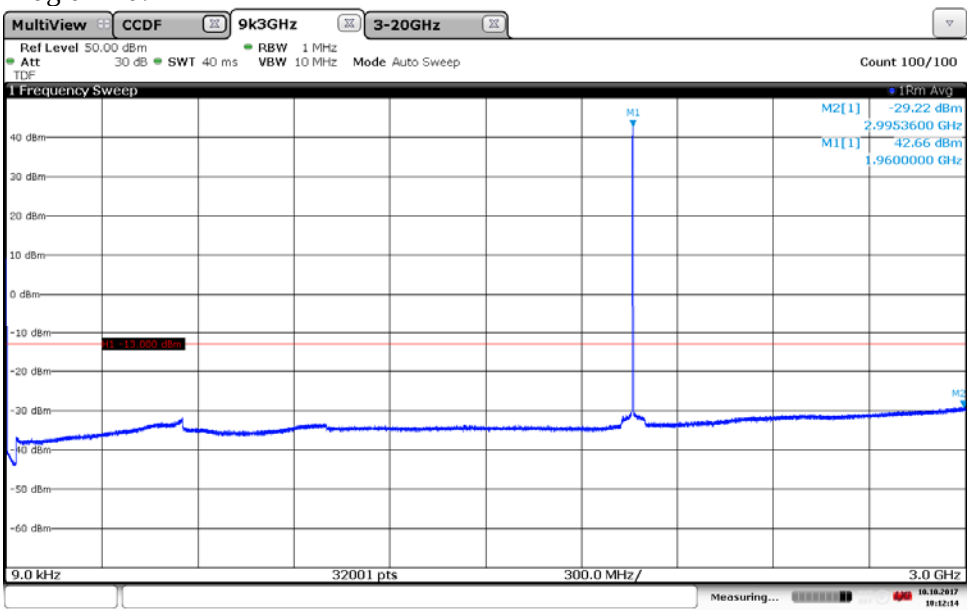


Diagram 7b:

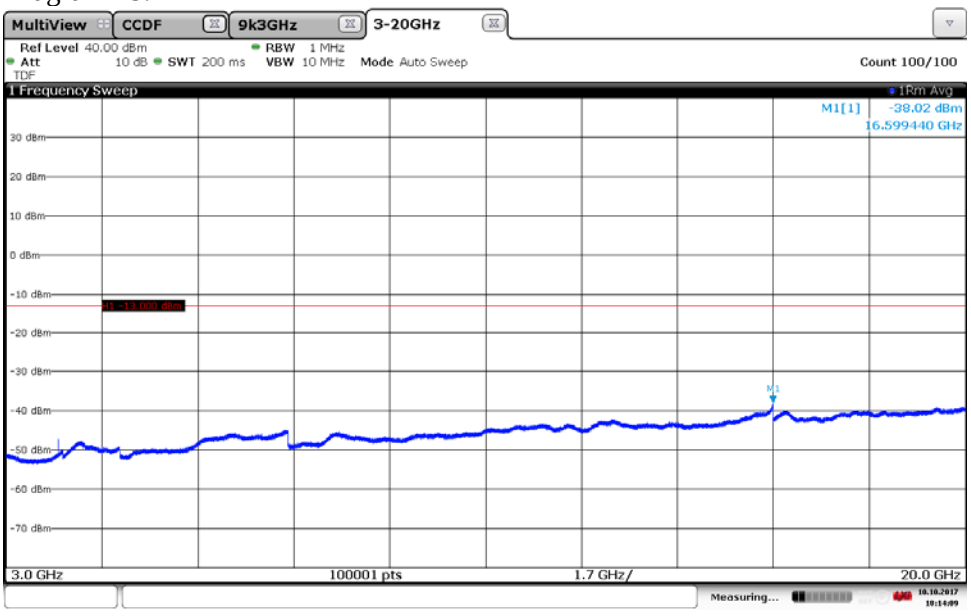
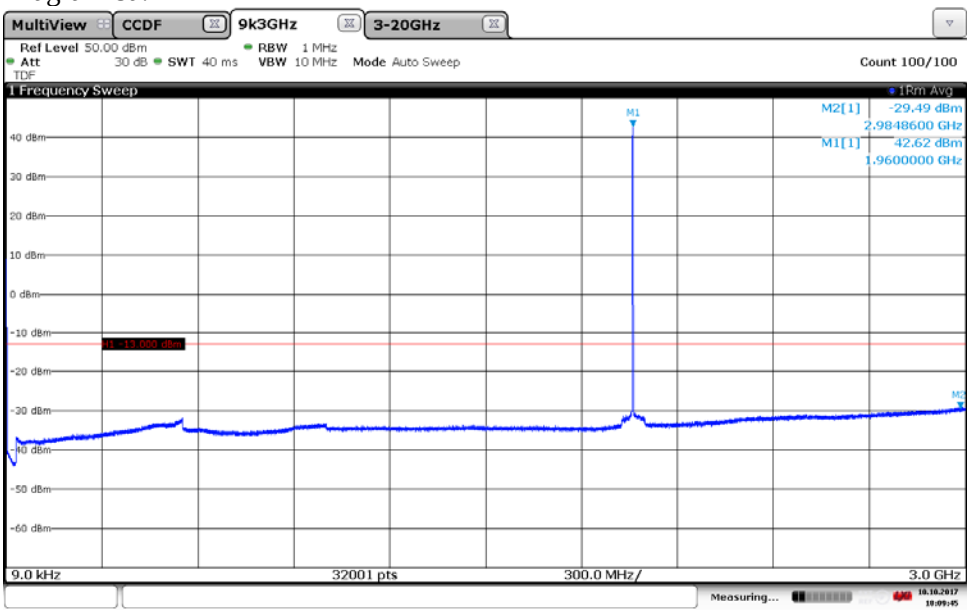


Diagram 8a:



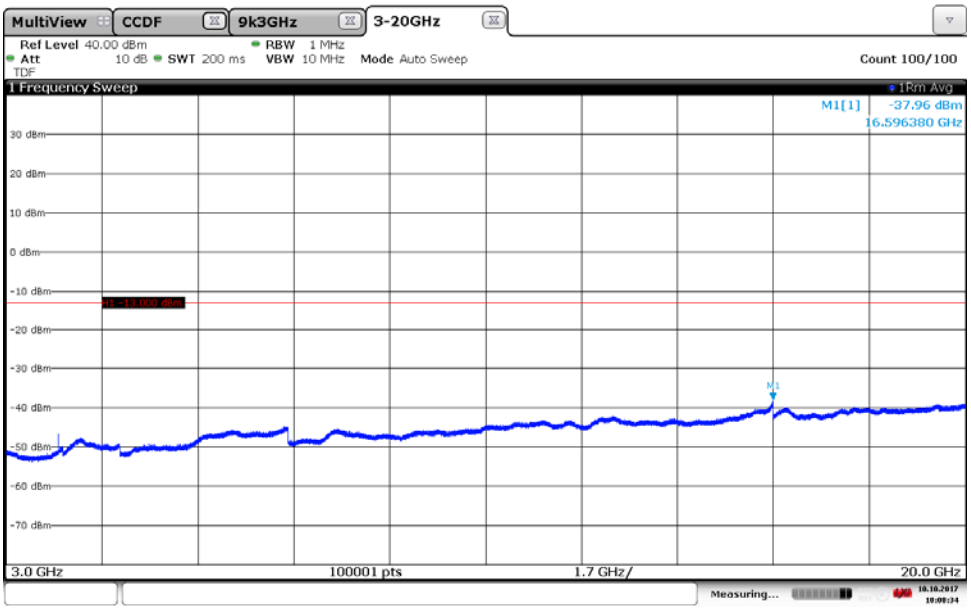


Diagram 8b:

Diagram 9a:

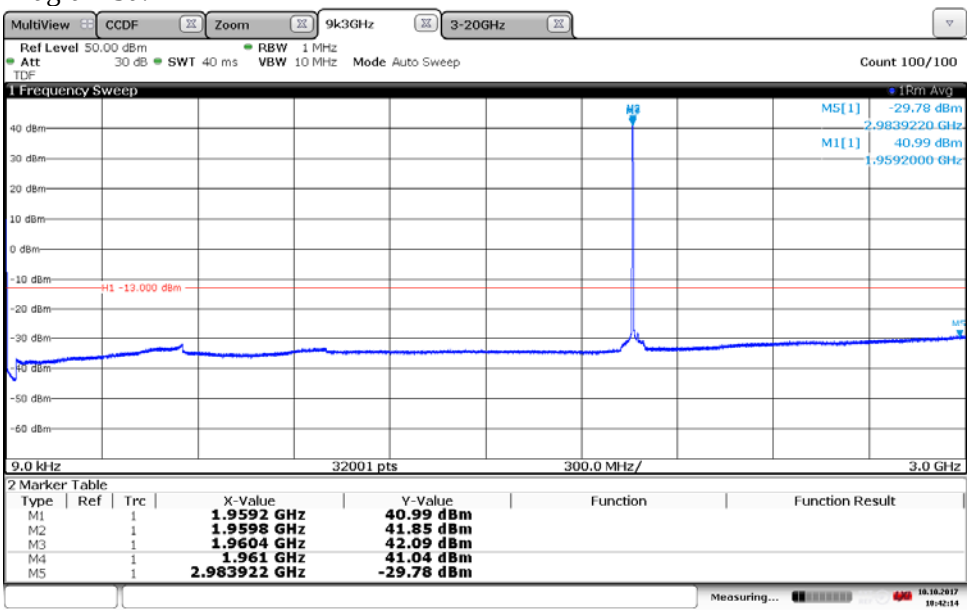
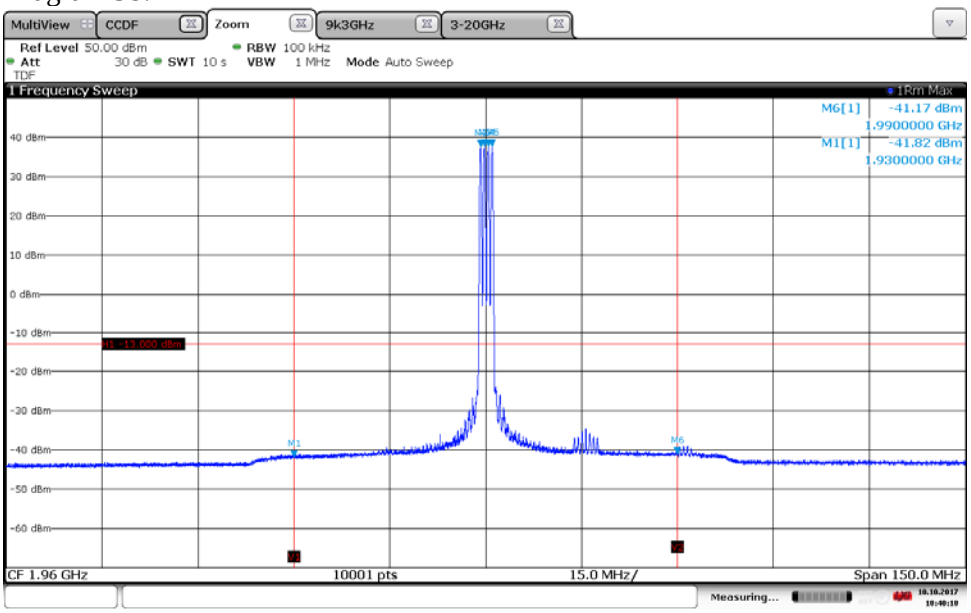


Diagram 9b:



Note: Due to the use of reduced measurement bandwidth the limit should be adjusted by 10 dB to -23 dBm.

Diagram 9c:

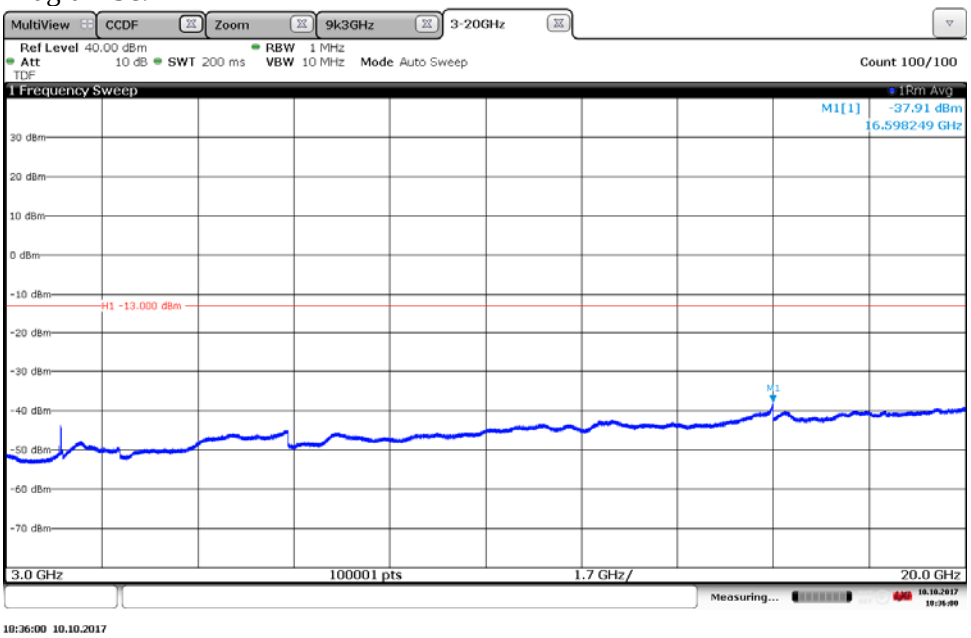

MultiView
CCDF
Zoom
9k3GHz
3-20GHz
Ref Level 40.00 dBm
RBW 1 MHz
Att 10 dB SWT 200 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
TDF
1 Frequency Sweep
1Rm Avg
M1[1] -37.91 dBm
16.598249 GHz
30 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
H1 -13.000 dBm
M1
3.0 GHz
100001 pts
1.7 GHz/
20.0 GHz
Measuring...
10:36:00 10.10.2017

Diagram 10a:

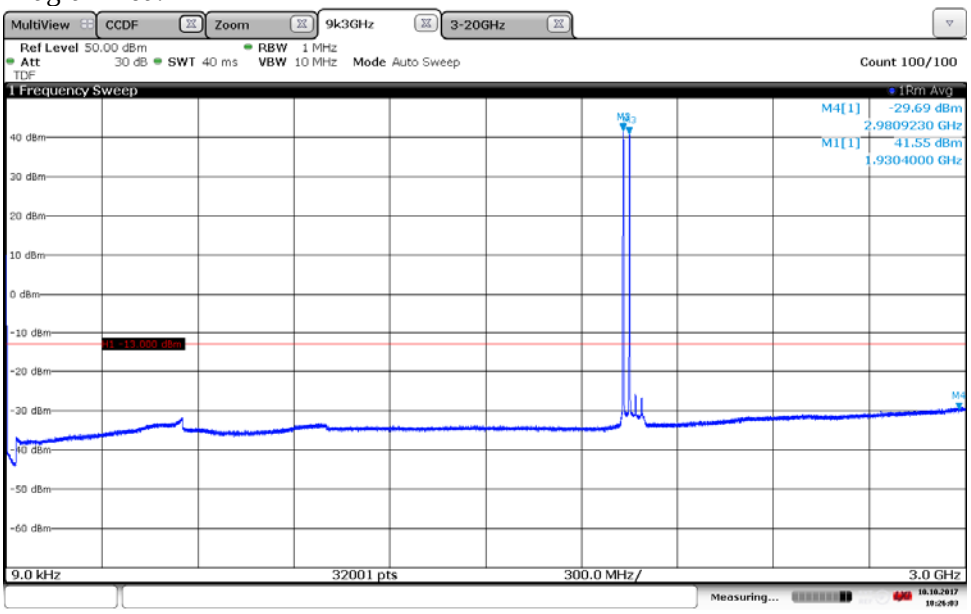
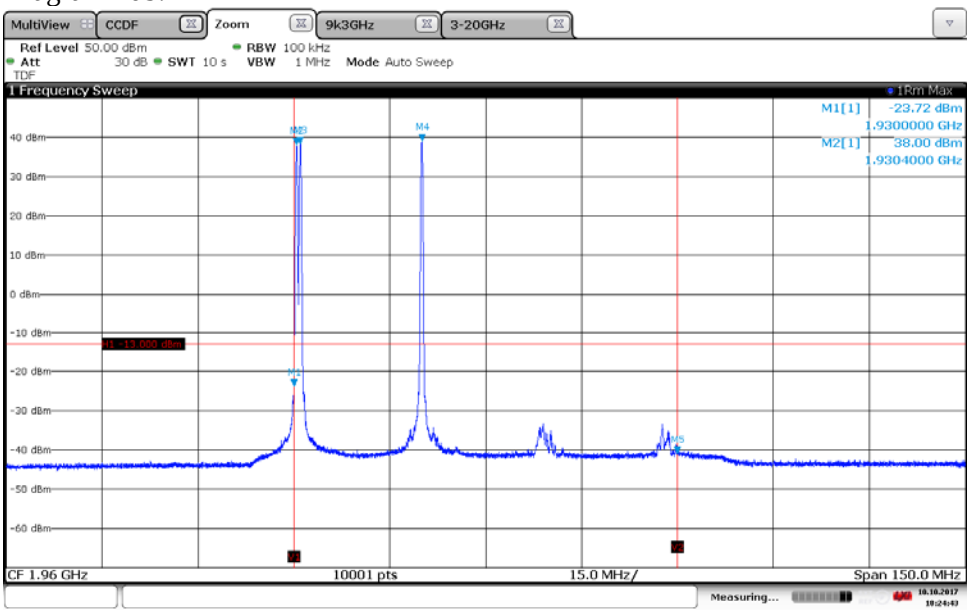


Diagram 10b:



Note: Due to the use of reduced measurement bandwidth the limit should be adjusted by 10 dB to -23 dBm.

Diagram 10c:

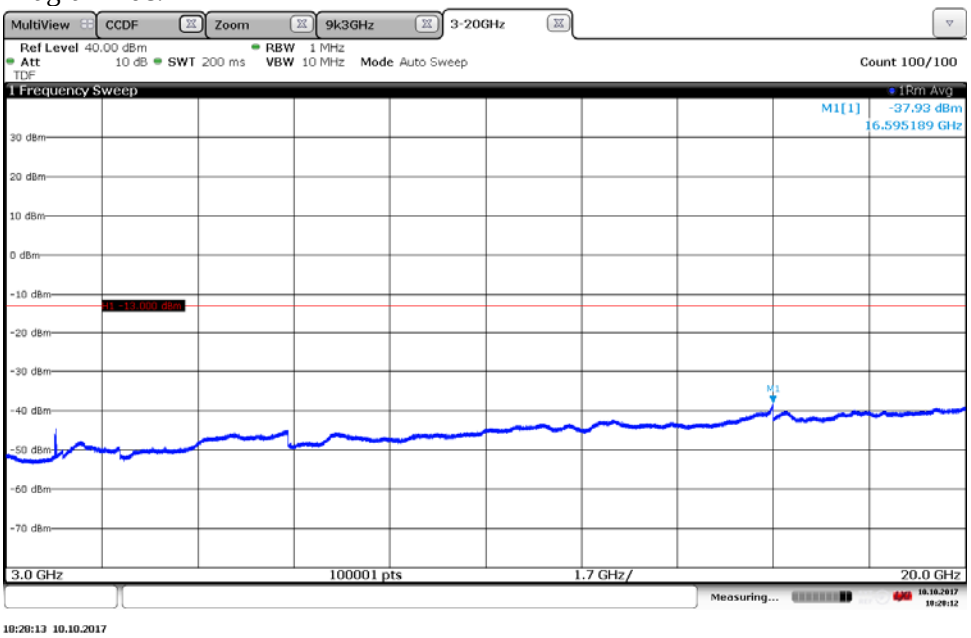

MultiView
CCDF
Zoom
9k3GHz
3-20GHz
Ref Level 40.00 dBm
RBW 1 MHz
Att 10 dB SWT 200 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
TDF
1 Frequency Sweep
1Rm Avg
M1[1] -37.93 dBm
16.595189 GHz
30 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
3.0 GHz
100001 pts
1.7 GHz/
20.0 GHz
Measuring...
10:20:13 10.10.2017

Diagram 11a:

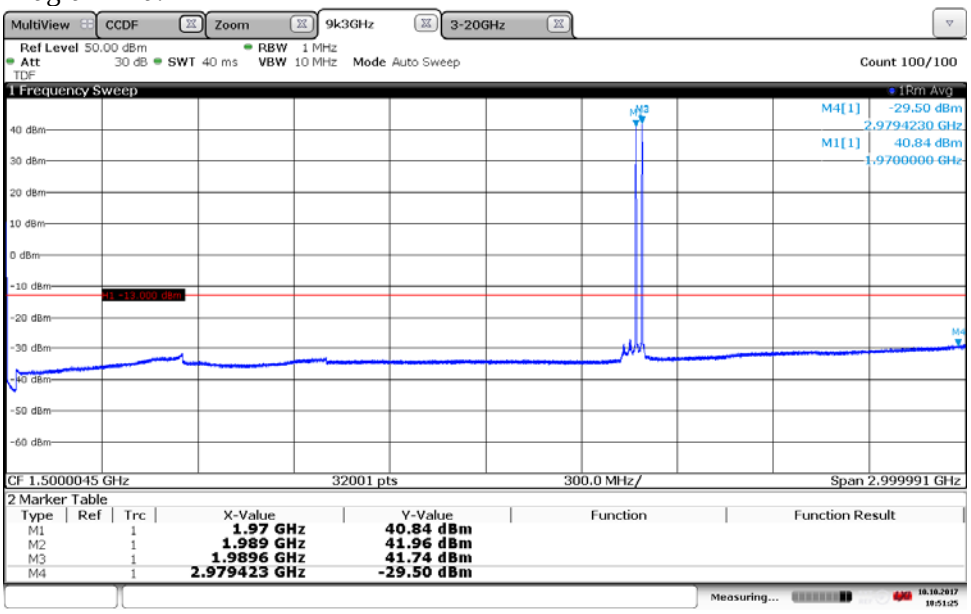
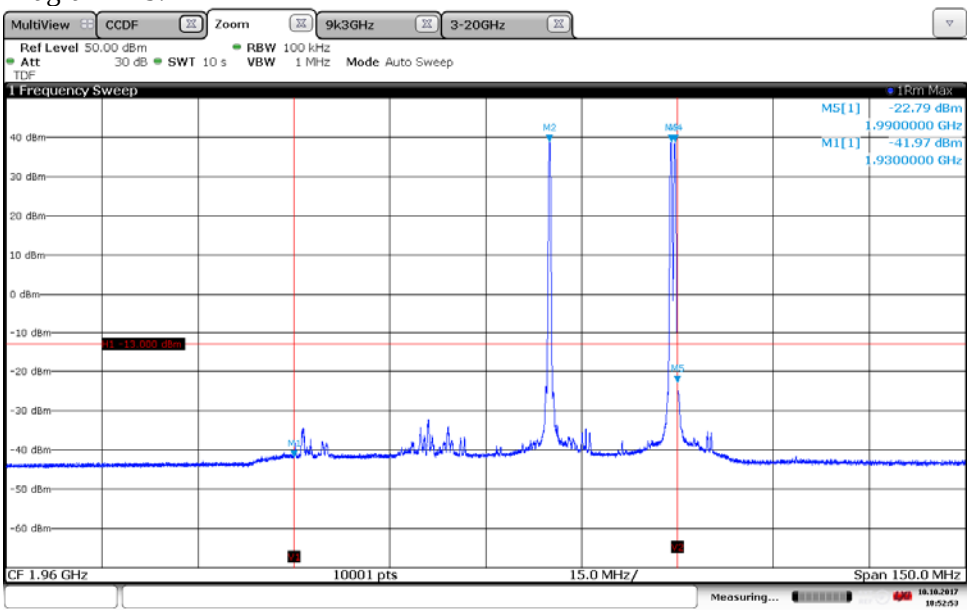
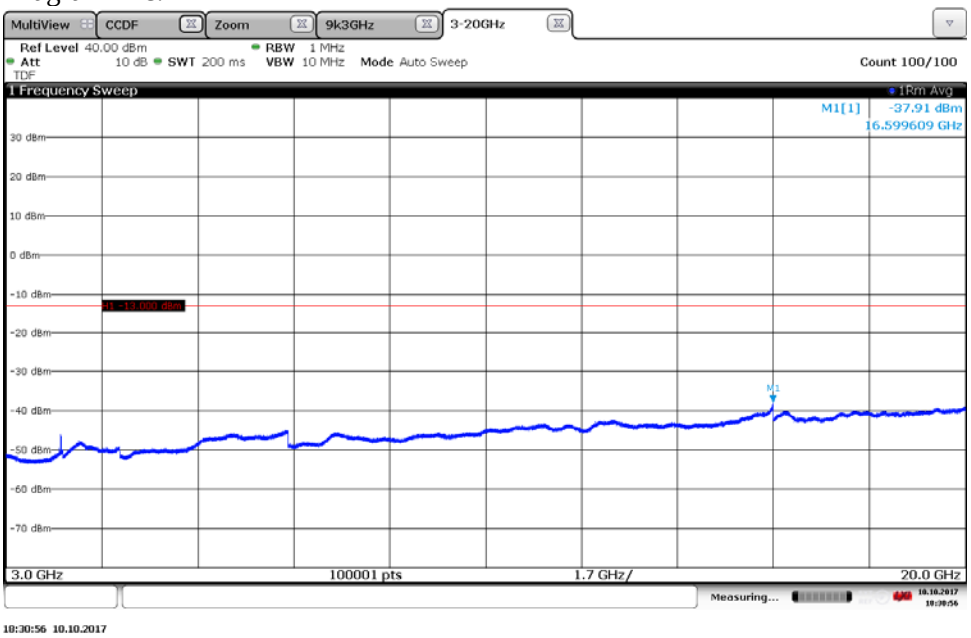


Diagram 11b:



Note: Due to the use of reduced measurement bandwidth the limit should be adjusted by 10 dB to -23 dBm.

Diagram 11c:


MultiView
CCDF
Zoom
9k3GHz
3-20GHz
Ref Level 40.00 dBm
RBW 1 MHz
Att 10 dB SWT 200 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
TDF
1 Frequency Sweep
1Rm Avg
M1[1] -37.91 dBm
16.599609 GHz
30 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
3.0 GHz
100001 pts
1.7 GHz/
20.0 GHz
Measuring...
10:30:56 10.10.2017

Field strength of spurious radiation measurements according to CFR 47 §24.238 / IC RSS-133 6.5

Date	Temperature	Humidity
2017-09-14	22 °C ± 3 °C	45 % ± 5 %
2017-10-03	22 °C ± 3 °C	47 % ± 5 %
2017-10-04	23 °C ± 3 °C	38 % ± 5 %
2017-10-05	22 °C ± 3 °C	34 % ± 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 – 18 GHz and 1 m in the frequency range 18 GHz – 20 GHz.

RF absorbers were covering a floor area in the frequency range 1 GHz – 18 GHz to comply with site validation requirements according to ANSI C63.4-2014.

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 – 20 GHz.

The measurement was performed with a RBW of 1 MHz.

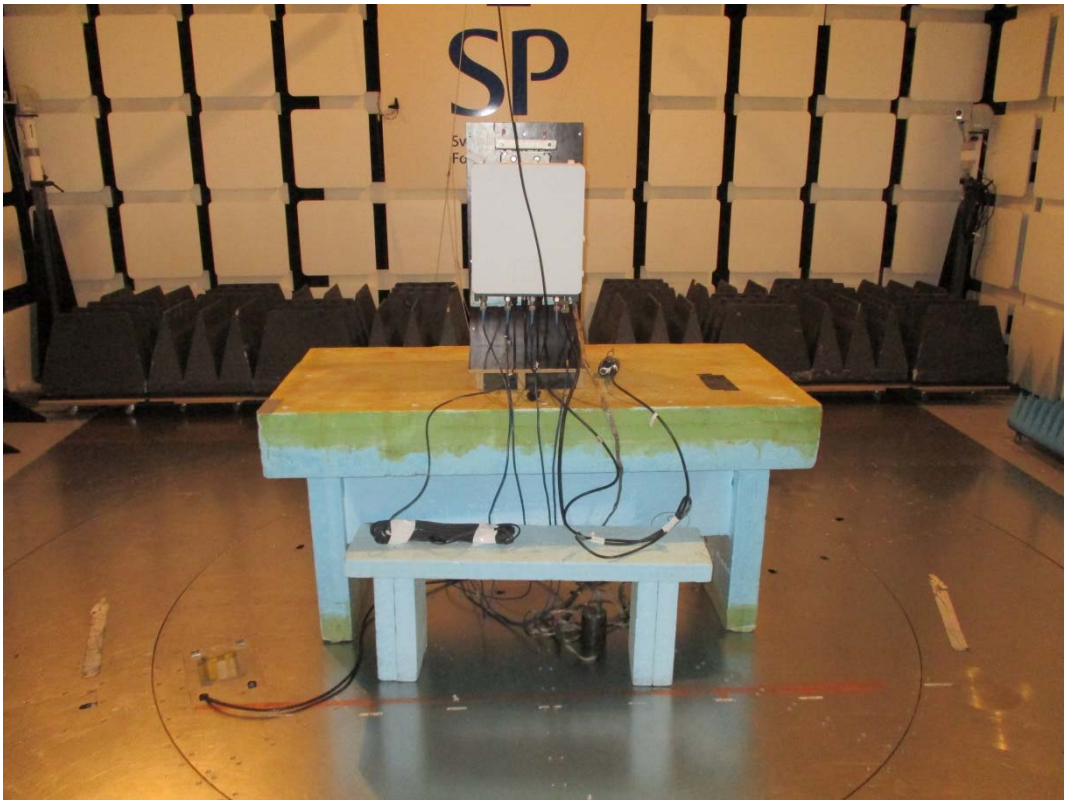
A propagation loss in free space was calculated. The used formula was

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

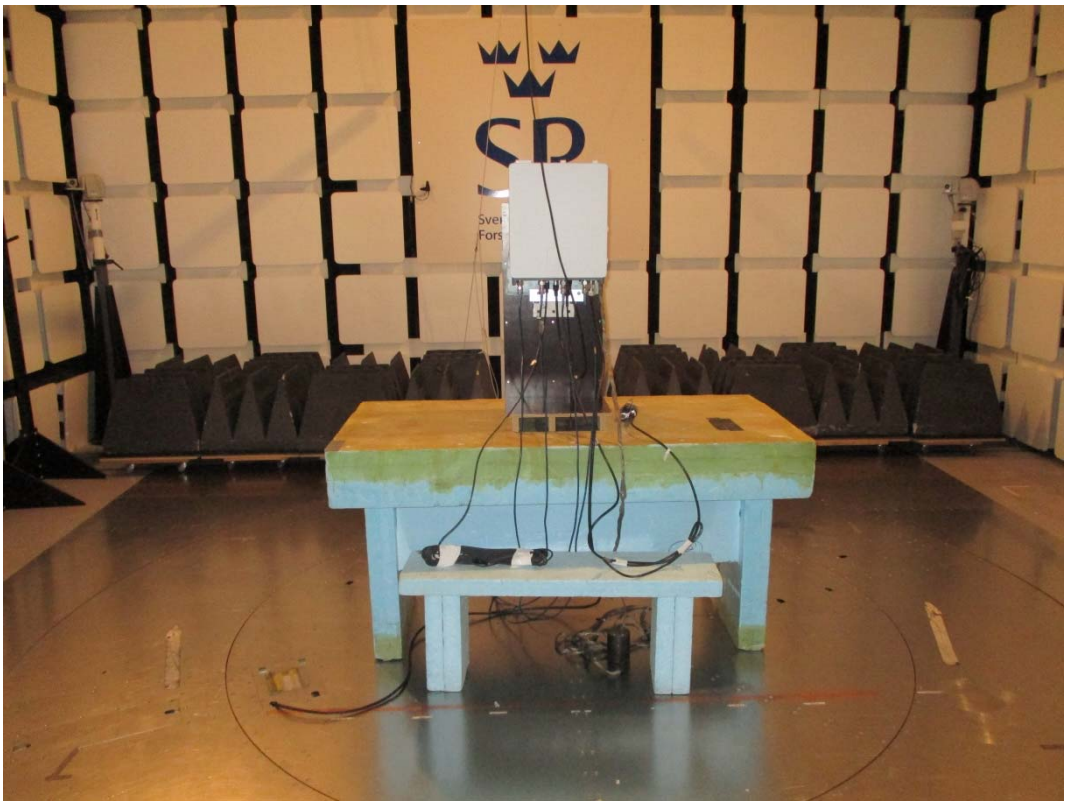
The measurement procedure was as the following:

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



1-18GHz



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
Flann STD Gain Horn Antenna 20240-20	503 674
µComp Nordic, Low Noise Amplifier	901 545
Miteq, Low Noise Amplifier	503 278
HP Filter 3-26.5 GHz	901 502
Temperature and humidity meter, Testo 625	504 188

Results

Tested configurations: M, B2, M2, T2, Bim and Tim

representing worst case: Symbolic name T2, GMSK, Diagram 1 a-d

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-20000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty: 3.1 dB

Limits

CFR 47 §24.238 and IC RSS-133 6.5

(g) 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

Diagram 1a:

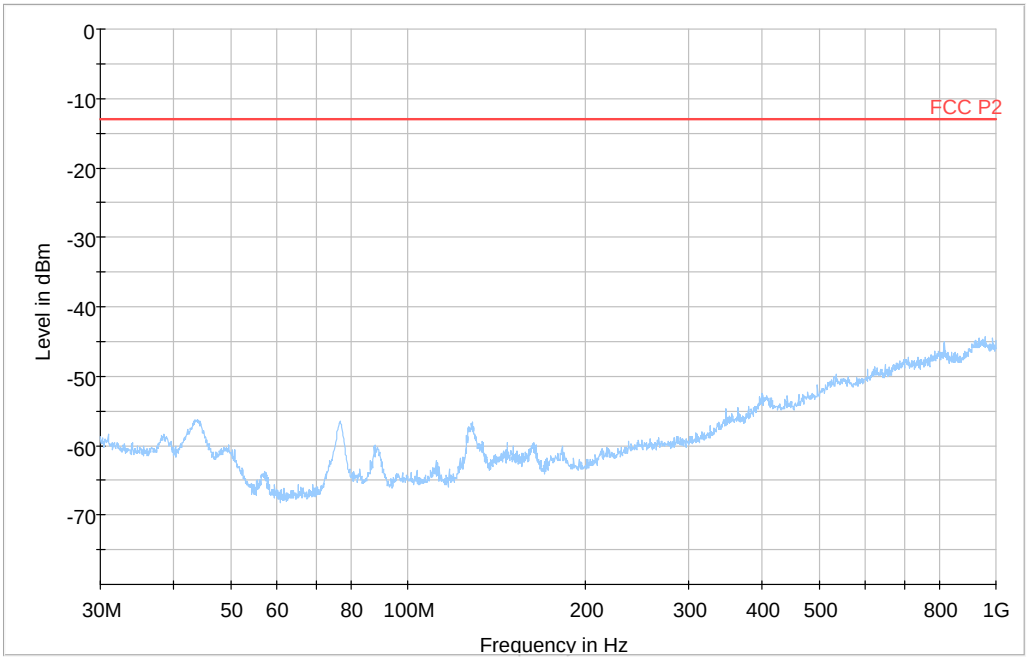
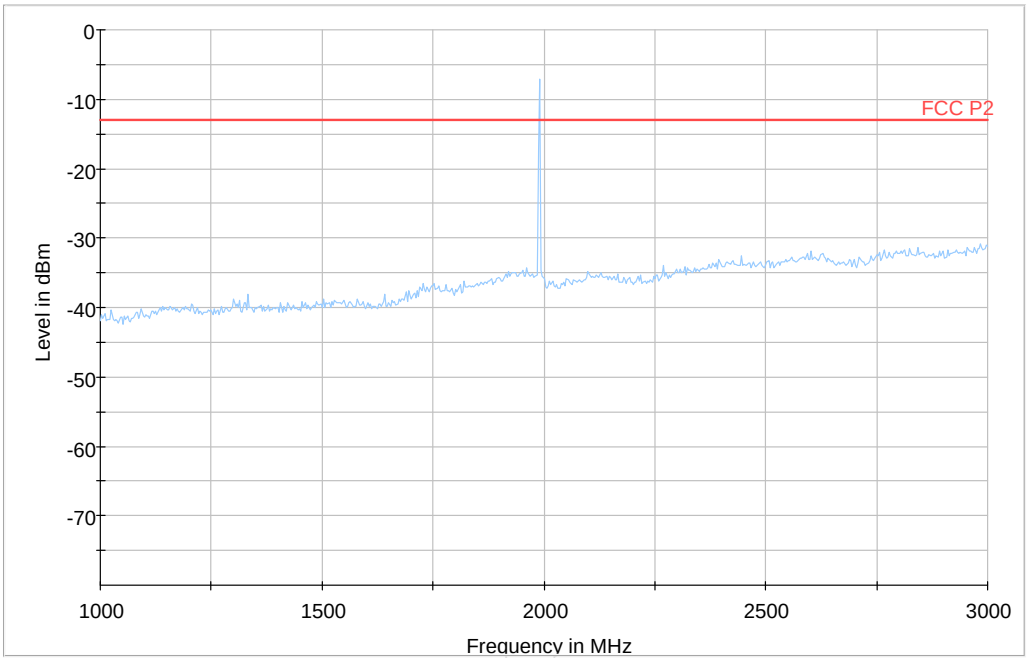


Diagram 1b:



Note: The emission at1989.0 and 1989.6 MHz is the carrier frequency and shall be ignored in the context.

Diagram 1c:

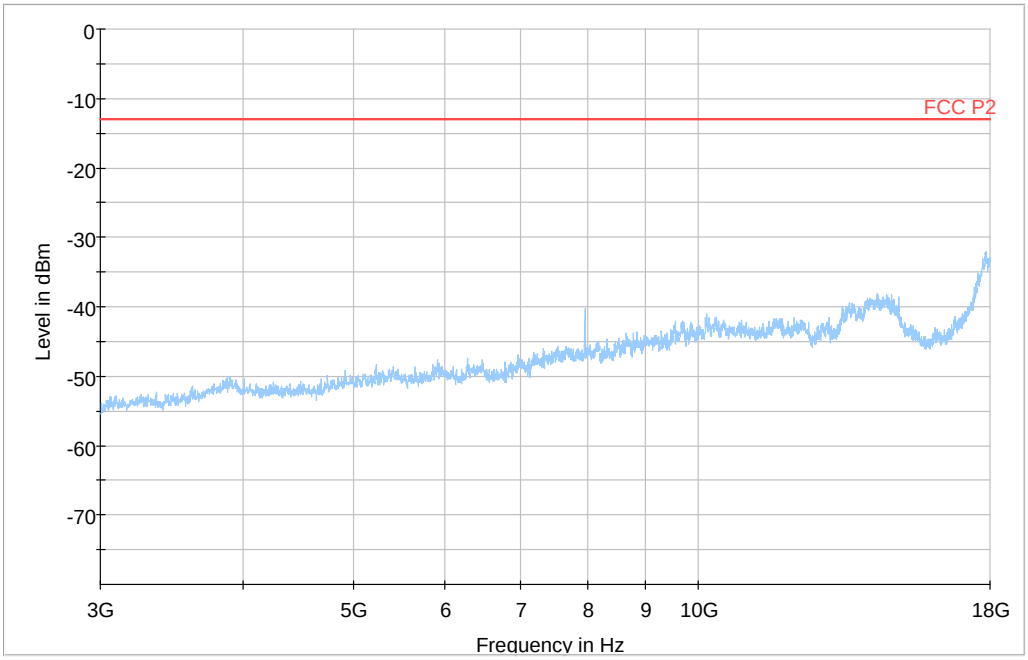
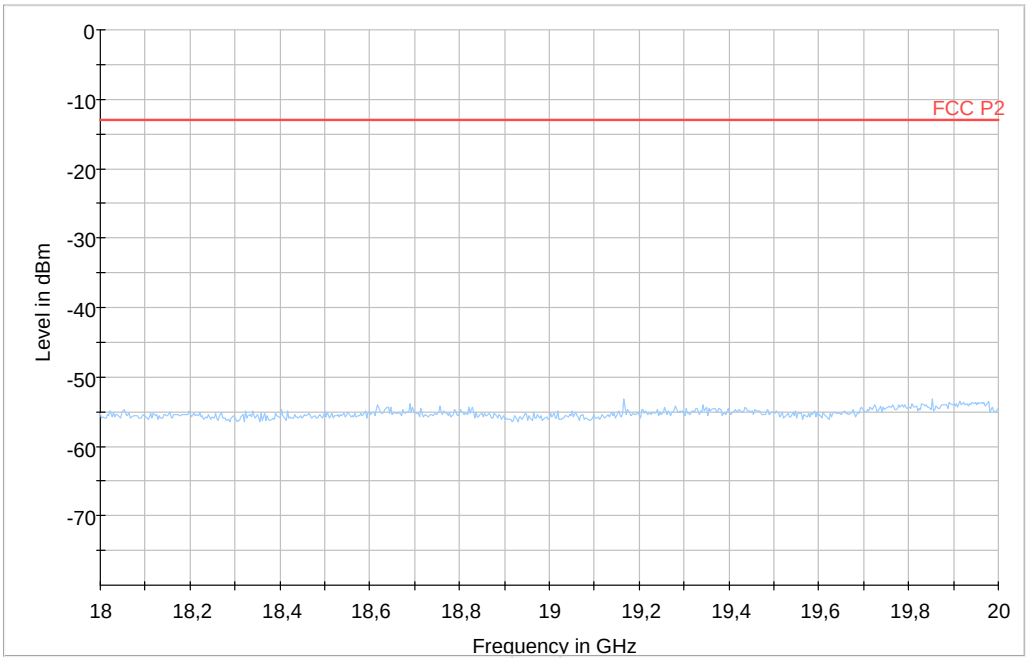


Diagram 1d:



Frequency stability measurements according to CFR 47 § 24.235 / IC RSS 133 6.3

Date	Temperature (test equipment)	Humidity (test equipment)
2017-10-12	23 °C ± 3 °C	35% ± 5 %
2017-10-13	22 °C ± 3 °C	20% ± 5 %
2017-10-15	23 °C ± 3 °C	36% ± 5 %

Test set-up and procedure

The measurement was made per 3GPP TS 37.141. The output was connected to a spectrum analyzer. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

The measurement was also made per IC RSS 199 Issue 3, 4.3. Using a resolution bandwidth of 1% of the emission bandwidth, a reference point at the unwanted emission level which complies with the attenuation of 43 + 10 log10 p (watts) (i.e. -13 dBm) at the band edge of the lowest and highest channel was selected, and the frequency at these points was recorded as fL and fH respectively.

Measurement equipment	RISE number
R&S FSQ 40	504 143
Rohde & Schwarz signal analyzer FSW 43	902 073
RF attenuator	900 691
Temperature Chamber	503 360
Testo 635, temperature and humidity meter	504 203
Multimeter Fluke 87	502 190

Results

Nominal transmitter frequency was 1960 MHz (M). Rated output power level at connector RF A (maximum): 43 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
40.8	+20	15
55.2	+20	16
48	+20	15
48	+30	13
48	+40	17
48	+50	12
48	+10	16
48	0	-17
48	-10	-17
48	-20	16
48	-30	16
Maximum freq. error (Hz)		17
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Rated output power level at connector RF B (maximum): 38.2 dBm

Test conditions			Frequency margin to band edge at -13dBm			
Supply voltage DC [V]	Temp [°C].	Carrier Bandwidth [MHz]	Test frequency Symbolic name Bottom		Test frequency Symbolic name Top	
			fL [MHz]	Offset to lower band edge (1930 MHz) [kHz]	fH [MHz]	Offset to upper band edge (1990 MHz) [kHz]
-48.0	+20	0.2	1930.019	19	1989.975	25

The frequency error results clearly shows that the frequency stability is good enough to ensure that the transmitted carrier stay within the operating band.

Remark

It was deemed sufficient to test one combination of TX frequency, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.

Limits

CFR 47 §24.235
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

RSS-133 6.3 Frequency stability:
The carrier frequency shall not depart from the reference frequency in excess of ± 1.0 ppm (± 1930 Hz) for base stations when tested to the temperature and supply voltage variations specified in RSS-Gen.

Complies?	Yes

Photos of test object

Front side

Rear side

Left side

Right side

Bottom side

Top side

Labels:

Radiated measurements:

Radio label:

SFP module:

Conducted measurements:

Radio label:

SFP module: