REPORT

issued by an Accredited Testing Laboratory

SP Testing

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Date: 2017-06-29

Reference: 7P04388-P90

Ericsson AB
Anders Karlsson
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Radio measurements on Radio 4478 B14 equipment with FCC ID TA8AKRC161669-3

Product name: Radio 4478 B14
Product number: KRC 161 669/3

RISE Research Institutes of Sweden AB
Electronics - EMC

Performed by

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SWEDAC ACKREDITERING
Accred. No. 1002
Testing
ISO/IEC 17025

Summary

Standard Listed part of	Compliant
FCC CFR 47	
2.1046 RF power output, conducted	Yes
2.1049 Occupied bandwidth	Yes
2.1051 Band edge	Yes
2.1051 Spurious emission at antenna terminals	Yes
2.1053 Field strength of spurious radiation	Yes
2.1055 Frequency stability	Yes

Description of the test object

Equipment:	Radio equipment Radio 4478 B14 Product number KRC 161 669/3 FCC ID: TA8AKRC161669-3
Hardware revision state:	R1B
Tested configuration:	Single RAT LTE
Frequency bands: 3GPP B7:	TX: 758 – 768 MHz RX: 788 – 798 MHz
IBW:	10 MHz
Output power:	Max 40 W/ antenna port
Antenna ports:	4 TX / 4 RX ports
Antenna:	No dedicated antenna, handled during licensing
RF configurations:	Single and multi-carrier, 1-2 carriers/ port TX Diversity, 2x2 MIMO, 4x4 MIMO, Contiguous Spectrum (CS), Carrier Aggregation (CA)
Channel bandwidths:	5 MHz and 10 MHz
Modulations:	QPSK, 16QAM, 64QAM and 256QAM
RF power Tolerance:	+0.6/ -2.0 dB
CPRI Speed	Up to 10.1 Gbit/s

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.

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.

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.

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
CFR 47 part 2, April 2017
CFR 47 part 90, June 2017
ANSI/TIA/EIA-603-D-2010
KDB 662911 D01 Multiple Transmitter Output v02r02
KDB 971168 D01 Power Meas License Digital Systems v02r02
3GPP TS 36 141 version 13.6.0
3GPP TS 37.141, version 13.5.0

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	-	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	BX50192
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: 2017-06-02.

Manufacturer’s representative

Mikael Jansson, Ericsson AB.

Test engineers

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

Test participant(-s)

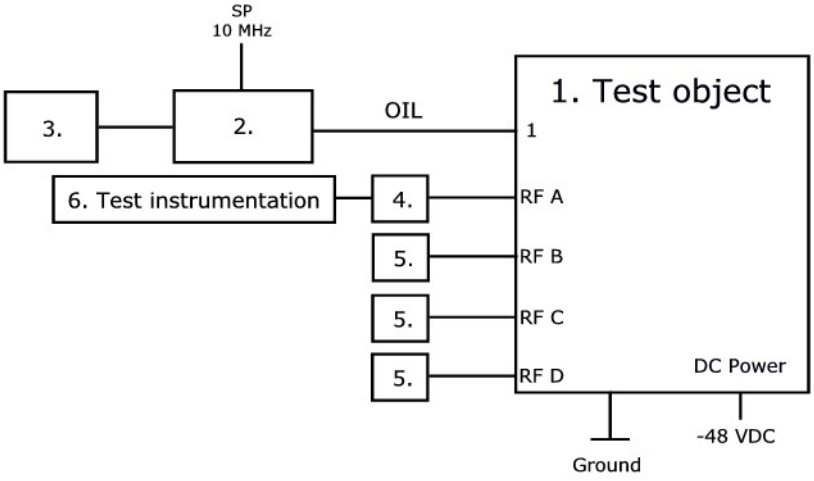
None.

Test frequencies used for radiated and conducted measurements

EARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
5305	760.5	B_5	TX bottom frequency in 5 MHz BW configuration
5355	765.5	T_5	TX top frequency in 5 MHz BW configuration
5330	763.0	M_5	TX mid frequency in 5 MHz BW configuration
5330	763.0	M_{10}	TX mid frequency in 10 MHz BW configuration
5305 5355	760.5 765.5	M2	2 carrier TX 5 MHz configuration

All RX frequencies were configured 30 MHz above the corresponding TX frequency according the applicable duplex offset for the operating band.

Test setup: conducted measurements



Test object:

1.	Radio 4478 B14, KRC 161 669/3, rev. R1B, s/n: D16W655747 With Radio Software: CXP 901 7316/7, rev. R66FT. FCC ID: TA8AKRC161669-3

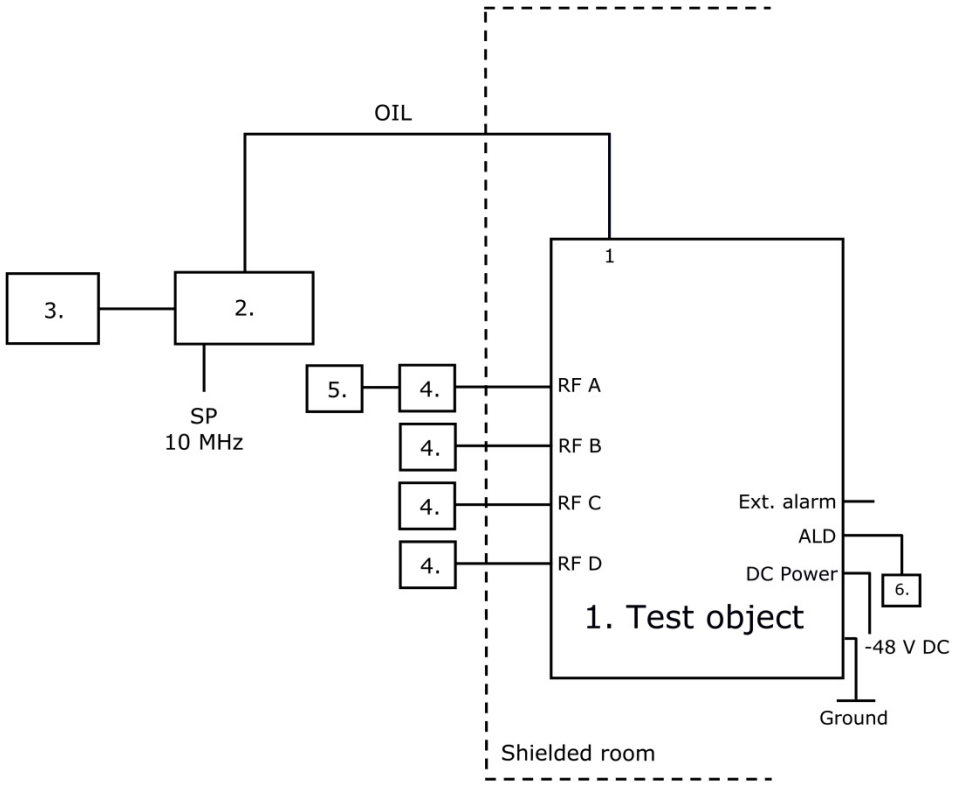
Associated equipment:

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

Functional test equipment:

3.	Computer, HP EliteBook 8560w, BAMS - 1001236850
4.	RF Attenuator: SP number: 900 691
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.

Test setup: radiated measurements



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Functional test equipment:

3.	Computer, HP EliteBook 8560w, BAMS - 1001236850
4.	Attenuator
5.	R&S ESIB 26, SP no: 503 292, for supervision purpose only
6.	Remote Control Unit, Type no: 86010026, s/n: CS61547222

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 §90.542, conducted

Date	Temperature	Humidity
2017-06-21	22 °C ± 3 °C	22 % ± 5 %
2017-06-22	22 °C ± 3 °C	52 % ± 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	SP 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 ETM 1.1 QPSK

Rated output power level at each RF port 1x 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)]
B_5	45.40/ 7.32	45.50/ 7.32	45.42/ 7.32	45.39/ 7.32	51.45
M_5	45.29/ 7.32	45.40/ 7.32	45.34/ 7.32	45.25/ 7.32	51.34
M_{10}	45.26/ 7.52	45.35/ 7.46	45.30/ 7.52	45.29/ 7.42	51.32
T_5	45.16/ 7.46	45.31/ 7.44	45.26/ 7.46	45.24/ 7.38	51.26

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

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

Single carrier ETM 3.2 16 QAM

Rated output power level at each RF port 1x 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)]
B_5	45.36/ 7.30	45.39/ 7.32	45.42/ 7.32	45.37/ 7.32	51.41

Single carrier ETM 3.1 64 QAM

Rated output power level at each RF port 1x 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)]
B_5	45.37/ 7.30	45.48/ 7.32	45.44/ 7.32	45.35/ 7.32	51.43

Single carrier ETM 3.1a 256 QAM

Rated output power level at each RF port 1x 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)]
B_5	45.35/ 7.34	45.44/ 7.34	45.42/ 7.34	45.28/ 7.34	51.39

Multi carrier ETM 1.1 QPSK

Rated output power level at each RF port 2x 43 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)]
M2	45.30/ 7.36	45.36/7.26	45.31/ 7.34	45.24/ 7.18	51.32

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

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

Single carrier ETM 1.1 QPSK

Rated output power level at RF connector 1x 46 dBm/ port.

	Output power per 1 MHz [RMS dBm]				
BW and symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
5 MHz, B	39.22	39.31	39.29	39.19	45.27
10 MHz, M	36.25	36.29	36.27	36.14	42.26

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

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

§90.542:
(a)(4) The maximum effective radiated power (ERP) must not exceed 2000 watts/ MHz and an antenna height of 305 m HAAT. Antenna heights greater than 305 m HAAT is permitted if power levels are reduced below 2000 watts/ MHz provided that the (b) Power flux density does not exceed 3000µW/m^2.

Complies?	Yes

Occupied bandwidth measurements according to CFR47 2.1049

Date	Temperature	Humidity
2017-06-22	22 °C ± 3 °C	42 % ± 5 %
2017-06-27	22 °C ± 3 °C	22 % ± 5 %
2017-06-29	22 °C ± 3 °C	35 % ± 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	SP 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 ETM 1.1 QPSK

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
1	M_5	RF A	4.479
2	M_5	RF B	4.478
3	M_5	RF C	4.478
4	M_5	RF D	4.479

Single carrier ETM 3.2

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
5	M_5	RF D	4.478

Single carrier ETM 3.1

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
6	B_5	RF D	4.495
7	M_5	RF D	4.492
8	M_{10}	RF D	8.944
9	T_5	RF D	4.491

Single carrier ETM 3.1a

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
10	M_{10}	RF D	4.488

Carrier Aggregation ETM 3.1

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
11	M2	RF D	9.427

Diagram 1:

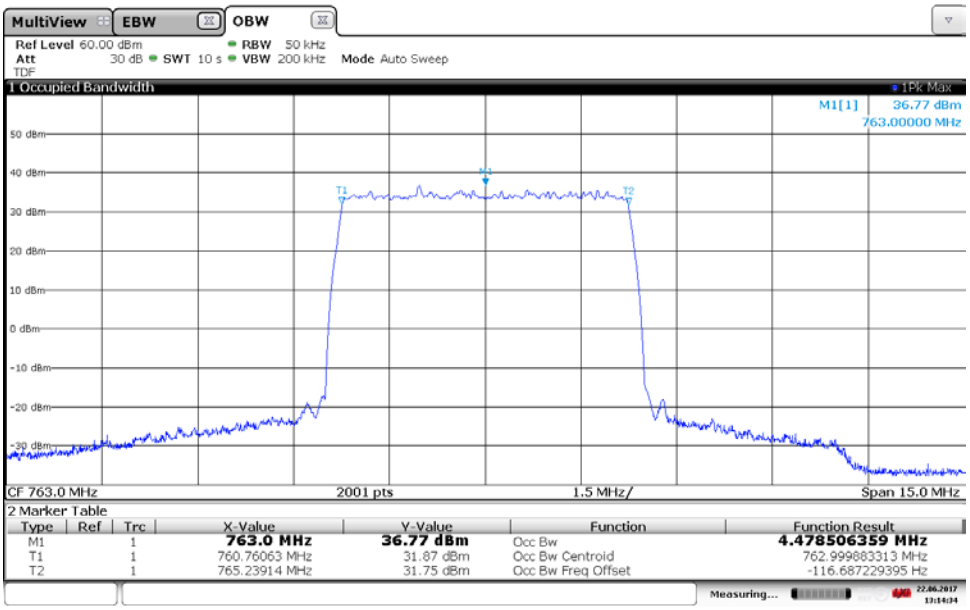


Diagram 2:

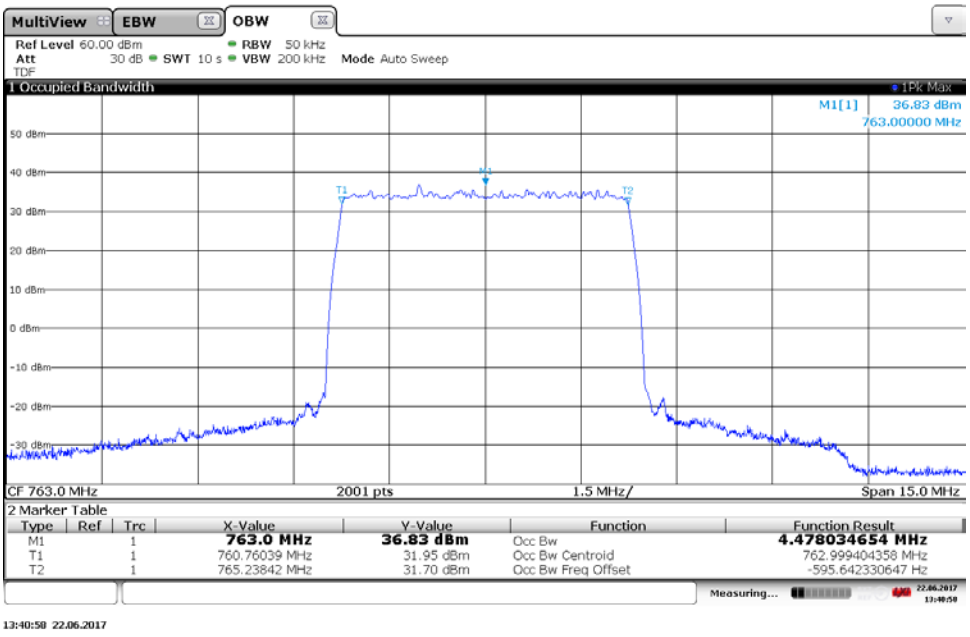


Diagram 3:

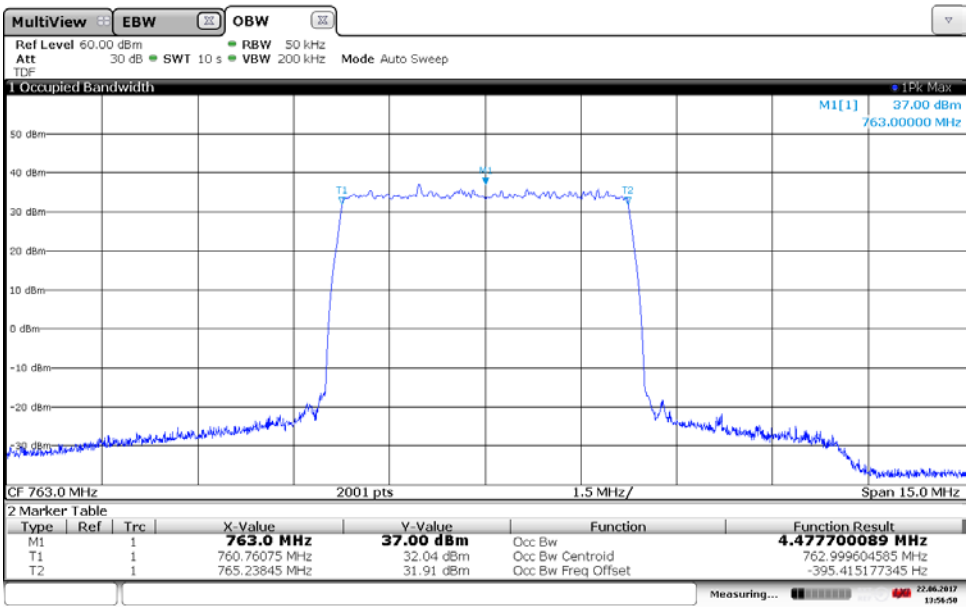


Diagram 4:

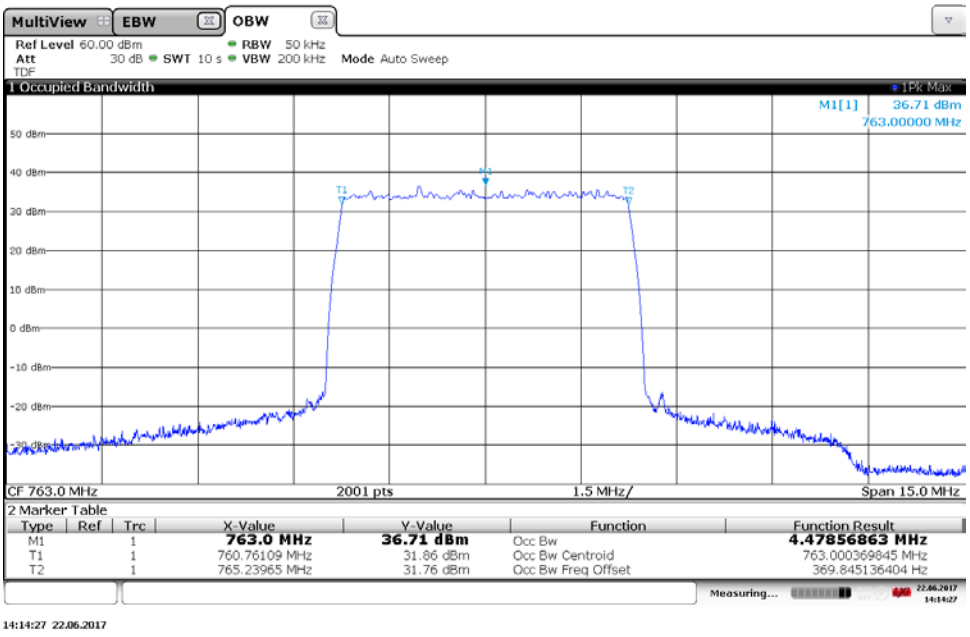


Diagram 5:

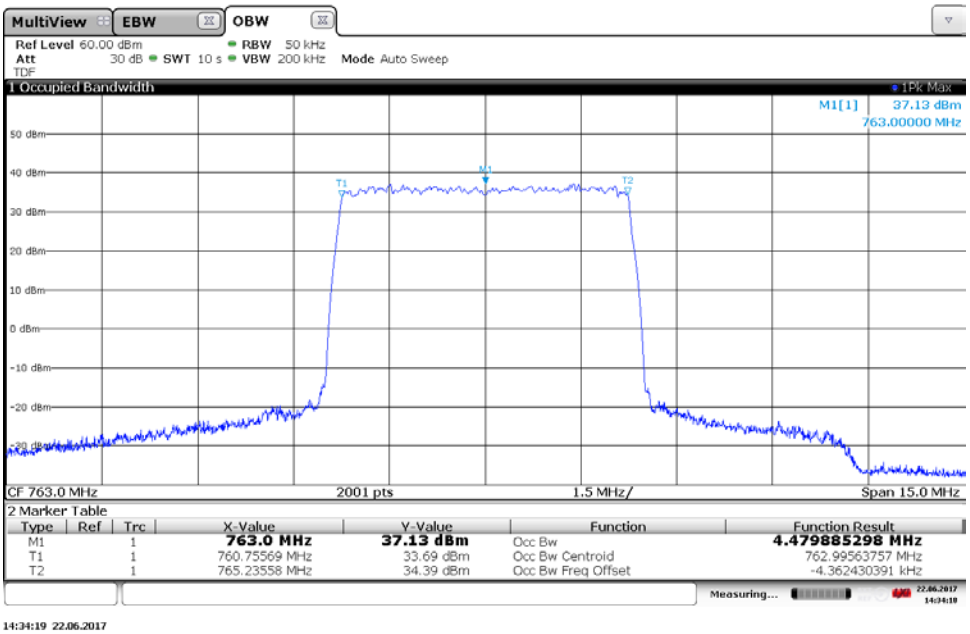


Diagram 6:

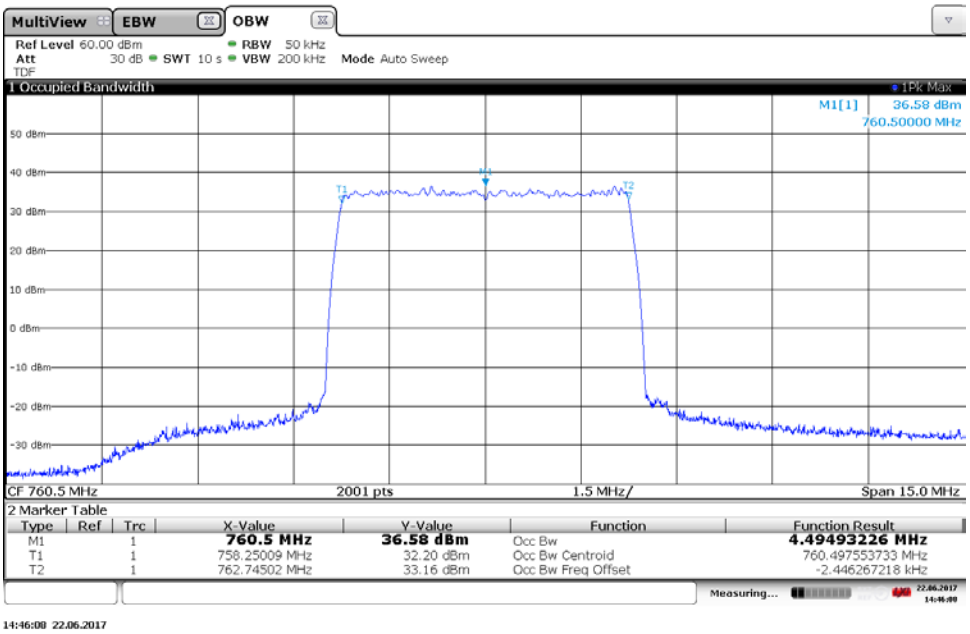


Diagram 7:

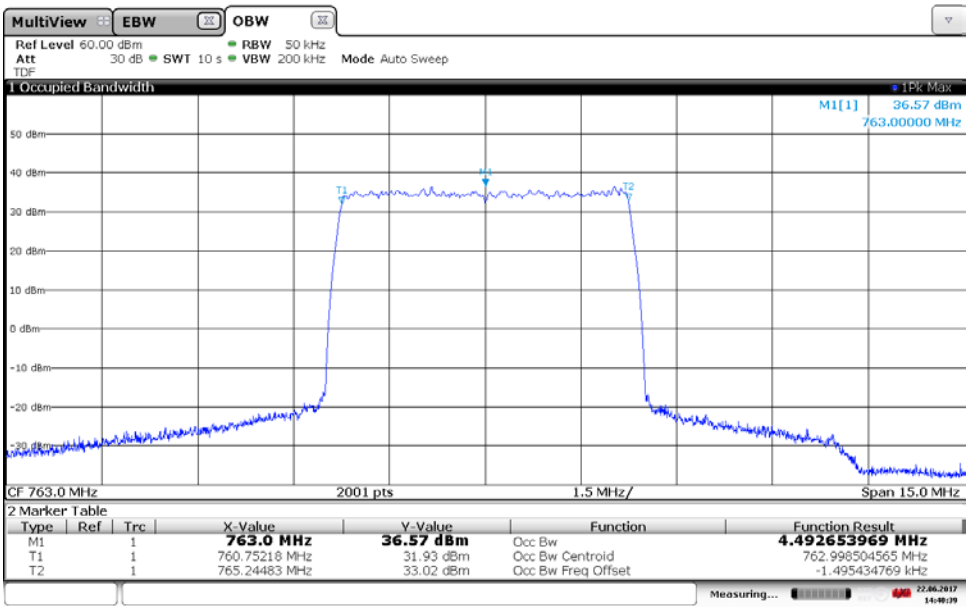


Diagram 8:

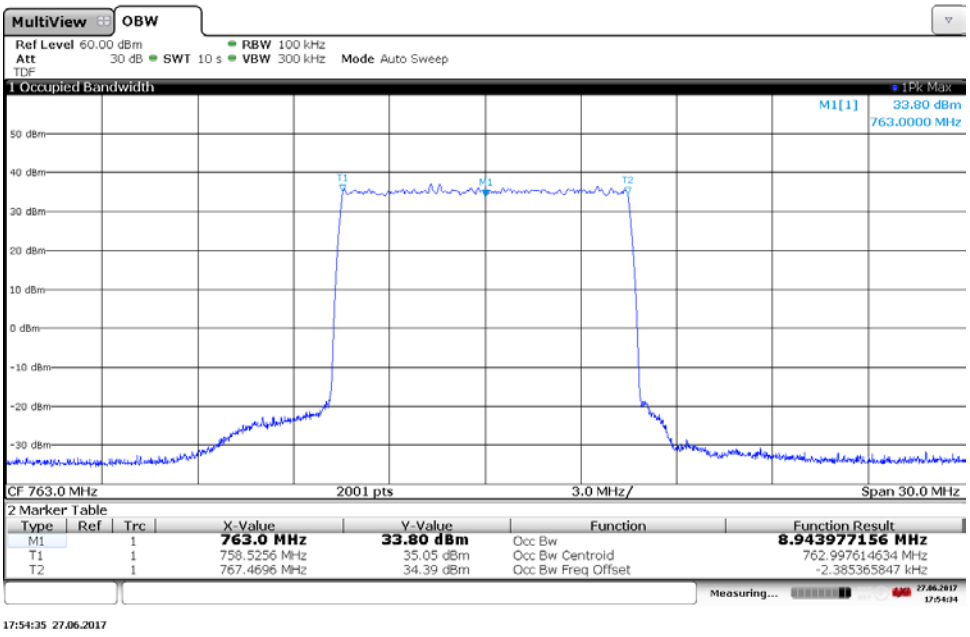


Diagram 9:

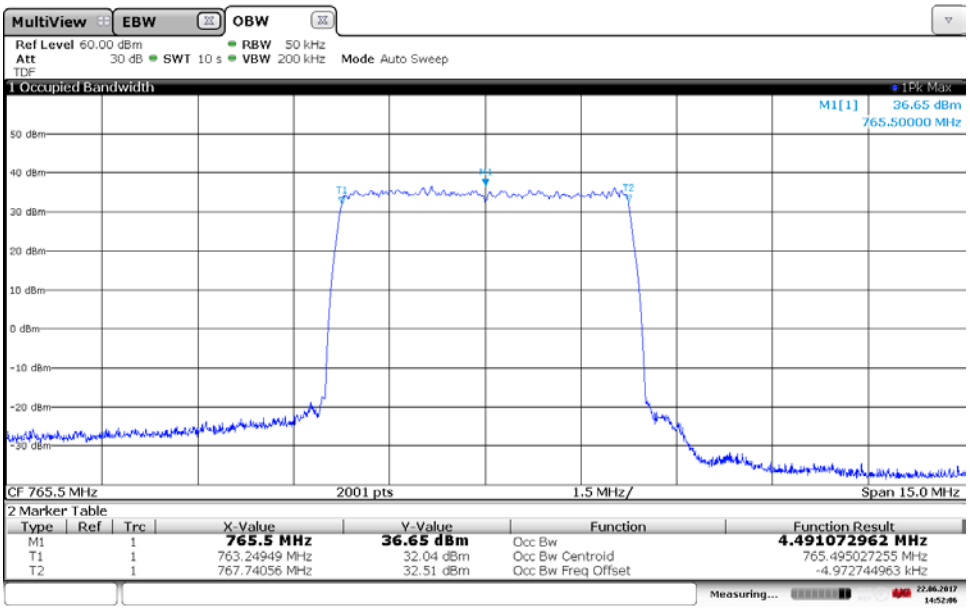


Diagram 10:

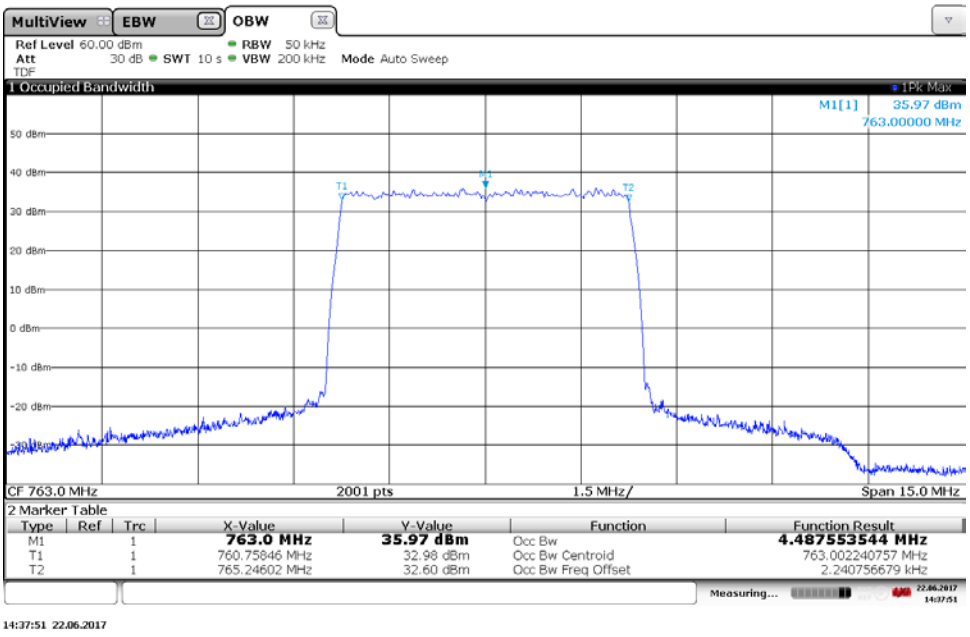
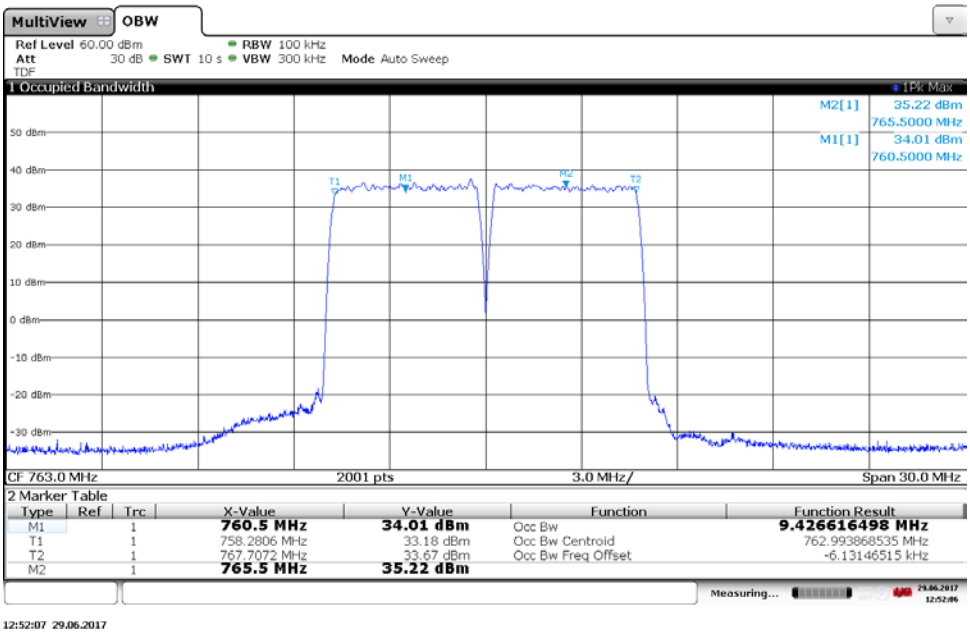


Diagram 11:


MultiView
OBW
Ref Level 60.00 dBm
RBW 100 kHz
Att 30 dB SWT 10 s VBW 300 kHz Mode Auto Sweep
TDF
1 Occupied Bandwidth
1Pk Max
M2[1] 35.22 dBm
765.5000 MHz
M1[1] 34.01 dBm
760.5000 MHz
50 dBm
40 dBm
30 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
CF 763.0 MHz
2001 pts
3.0 MHz/
Span 30.0 MHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 760.5 MHz 34.01 dBm Occ Bw 9.426616498 MHz
T1 1 758.2806 MHz 33.18 dBm Occ Bw Centroid 762.993868535 MHz
T2 1 767.7072 MHz 33.67 dBm Occ Bw Freq Offset -6.13146515 kHz
M2 1 765.5 MHz 35.22 dBm
Measuring...
12:52:07 29.06.2017

Band edge measurements according to CFR 47 §2.1049

Date	Temperature	Humidity
2017-06-22	22 °C ± 3 °C	42 % ± 5 %
2017-06-26	21 °C ± 3 °C	42 % ± 5 %

Test set-up and procedure

The measurements were made per definition in CFR 47 §90.543.The test object 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)] to cover 4x4 MIMO, should be added according to method c “measure and add 10 log(NANT)” of FCC KDB662911 D01 Multiple Transmitter Output.

Measurement equipment	SP 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 TM 1.1

Diagram	BW configuration	Symbolic name	Tested Port
1 a-b	5 MHz	B_5	RF A
2 a-b	5 MHz	B_5	RF B
3 a-b	5 MHz	B_5	RF C
4 a-b	5 MHz	B_5	RF D
5 a-b	10 MHz	M_{10}	RF D
6 a-b	5 MHz	T_5	RF A
7 a-b	5 MHz	T_5	RF B
8 a-b	5 MHz	T_5	RF C
9 a-b	5 MHz	T_5	RF D
10 a-b	10 MHz	M_{10}	RF D

Limits

CFR 47 §90.543
(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Complies?	Yes

Diagram 1a:

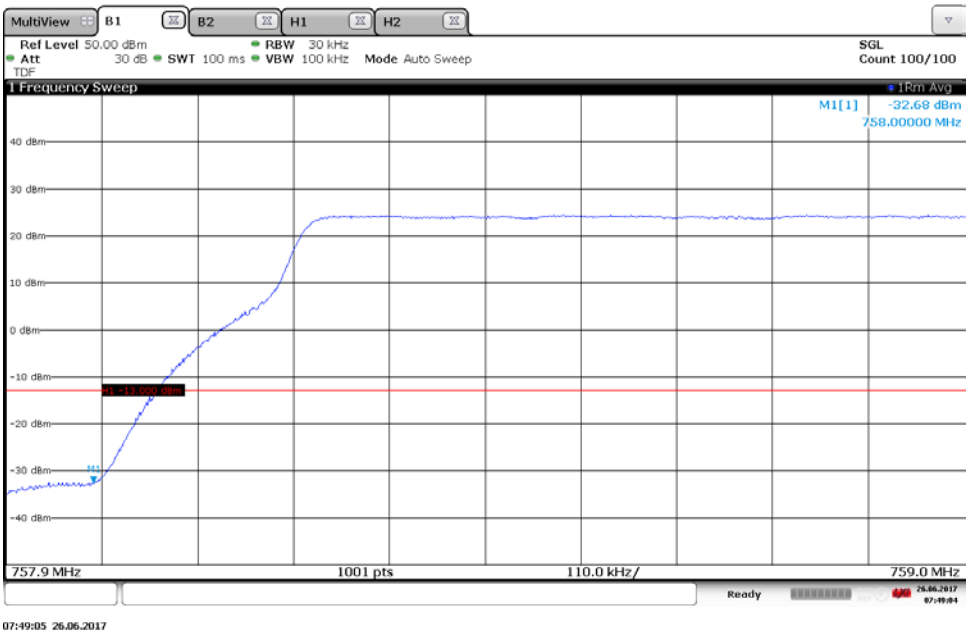


Diagram 1b:

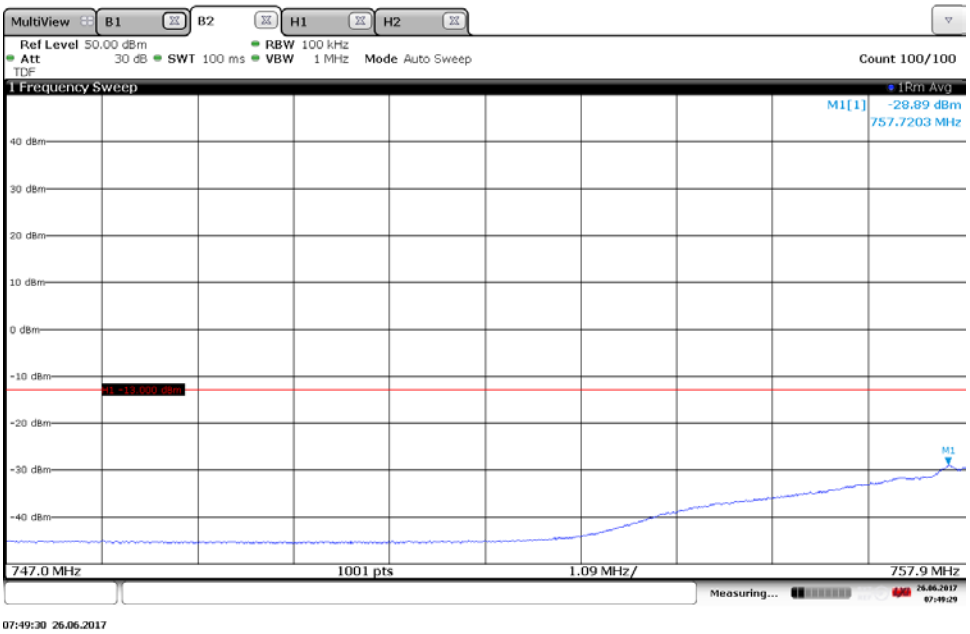


Diagram 2a:

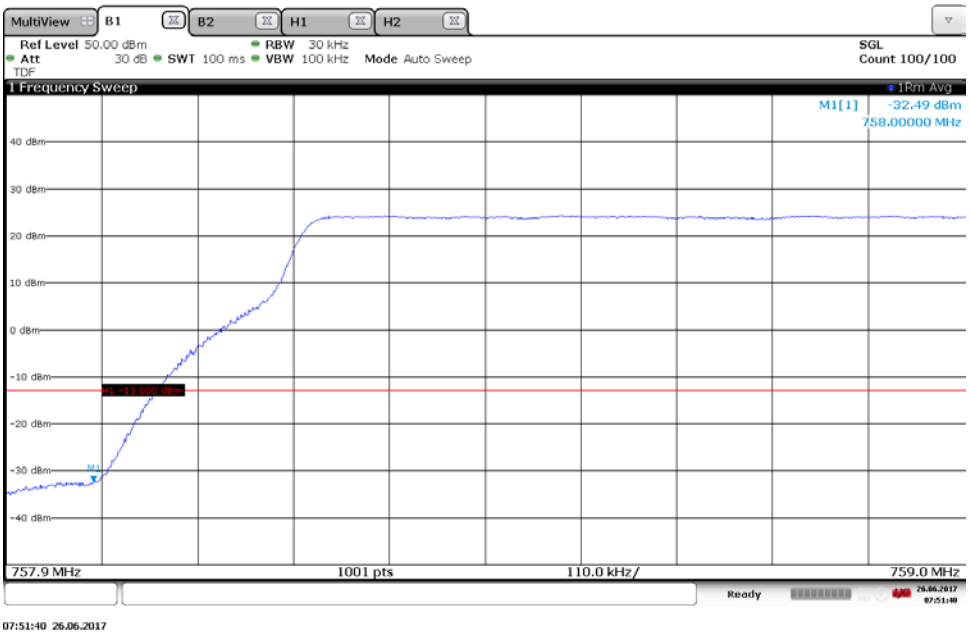


Diagram 2b:

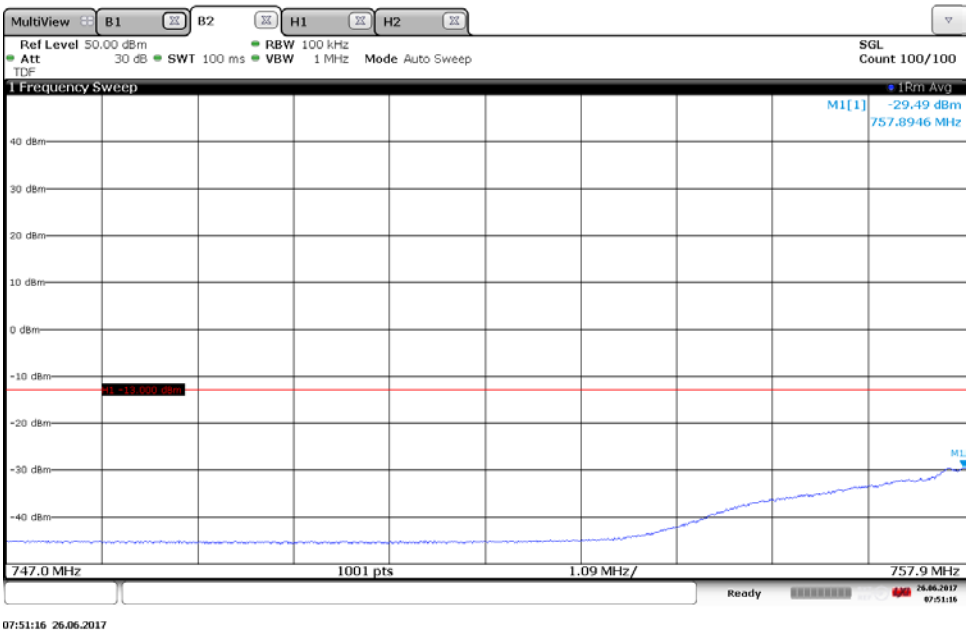


Diagram 3a:

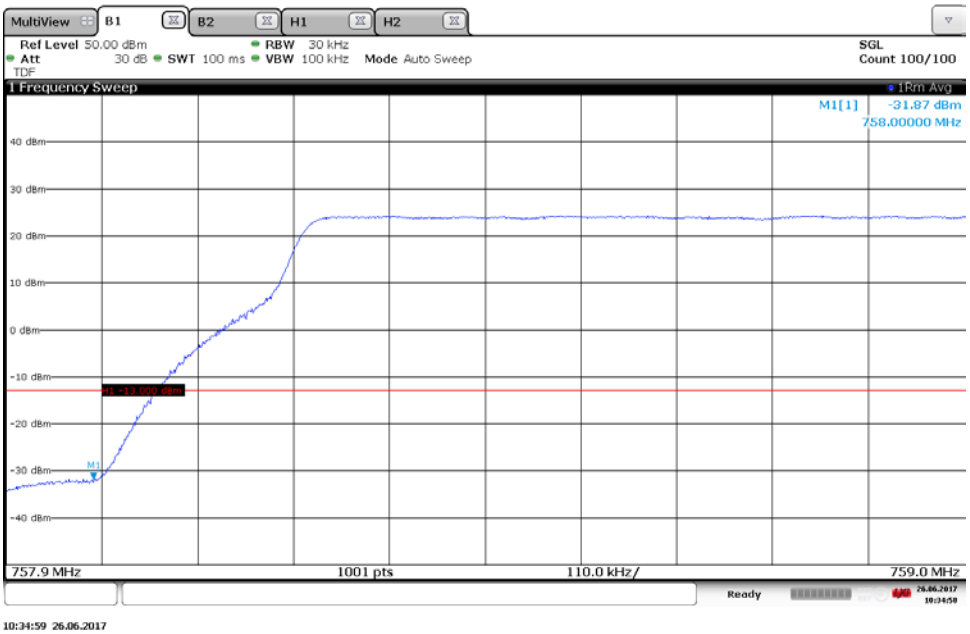


Diagram 3b:

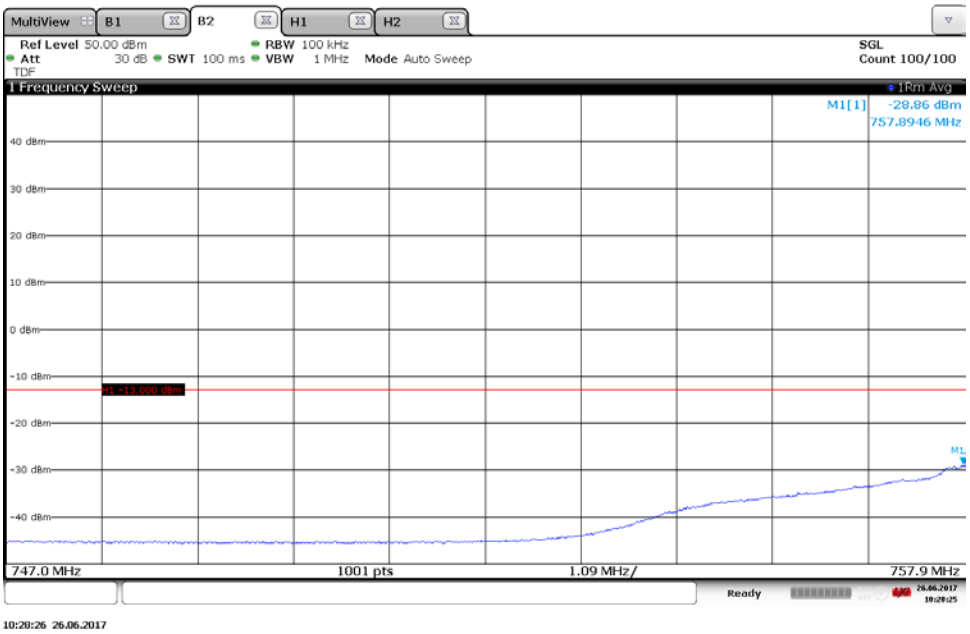


Diagram 4a:

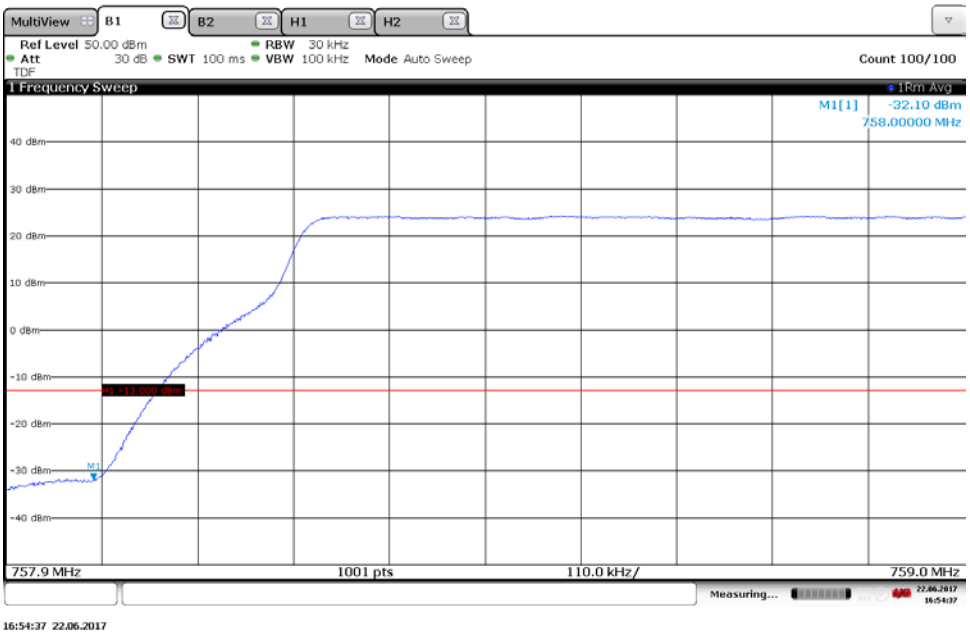


Diagram 4b:

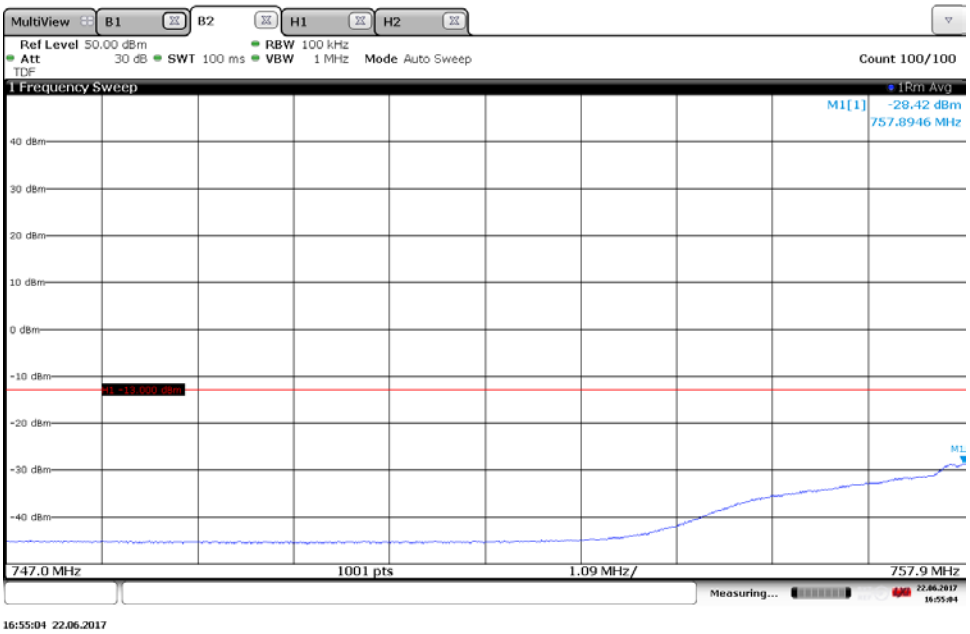


Diagram 5a:

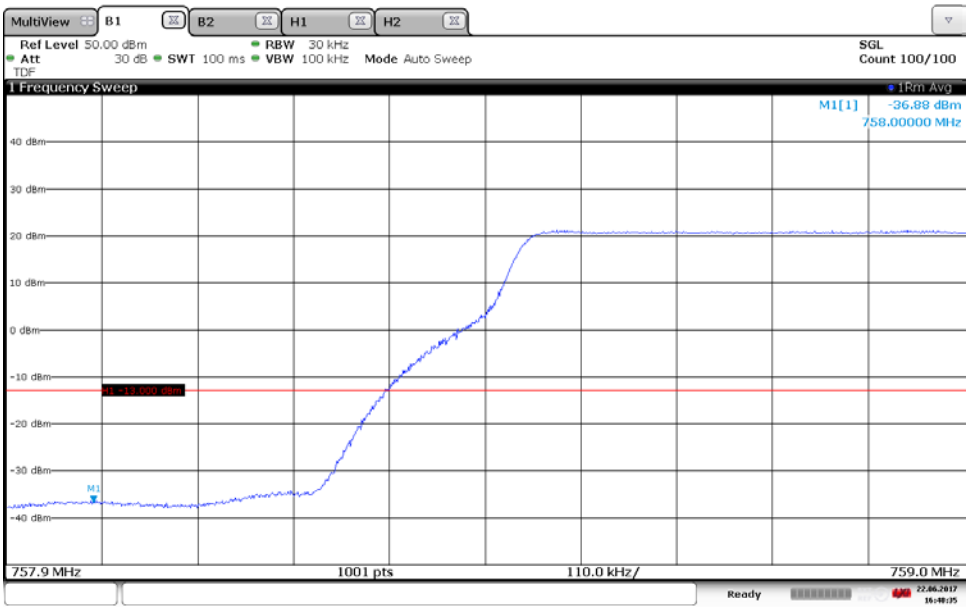


Diagram 5b:

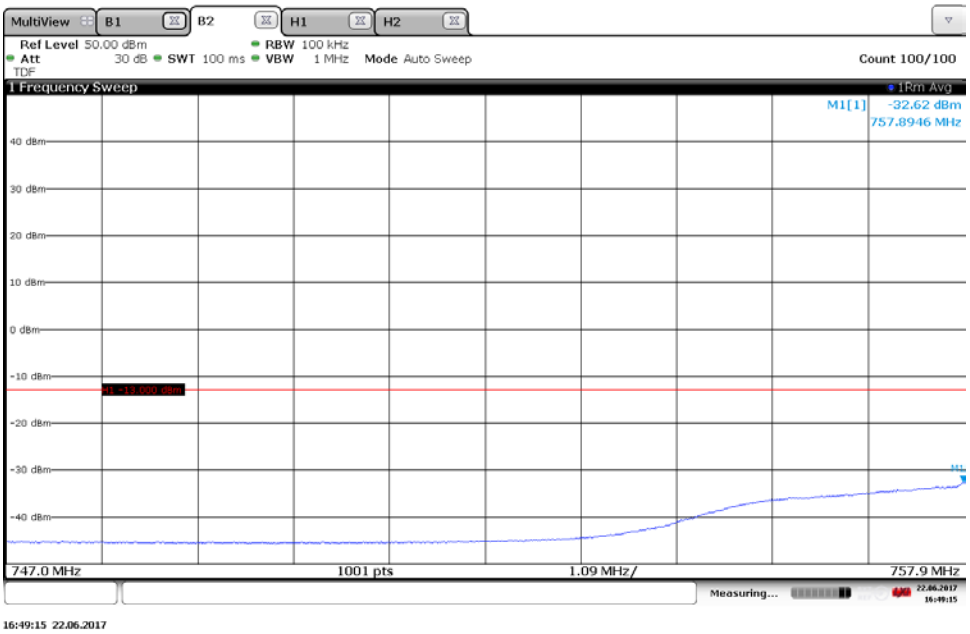


Diagram 6a:

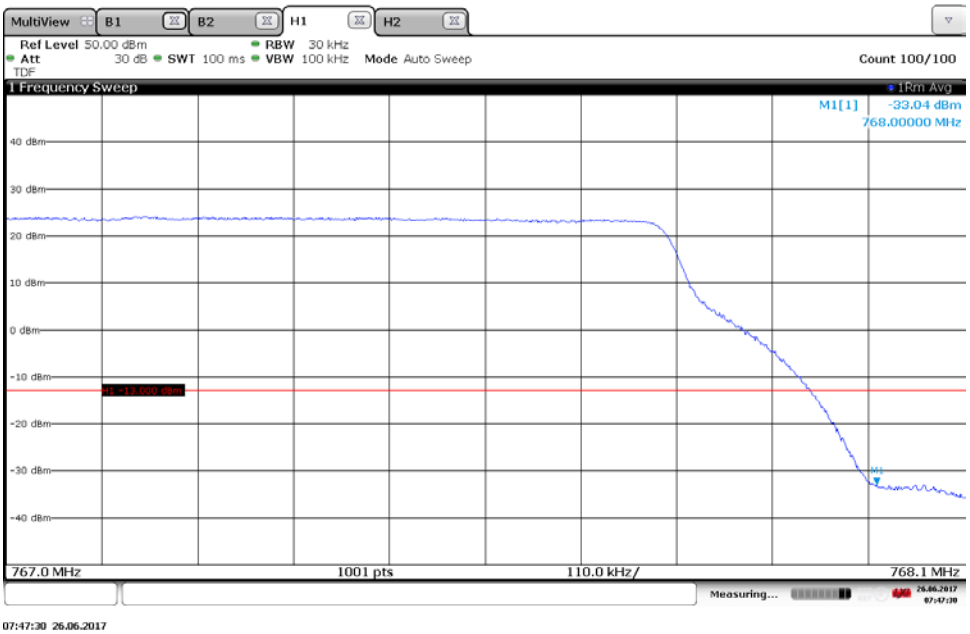


Diagram 6b:

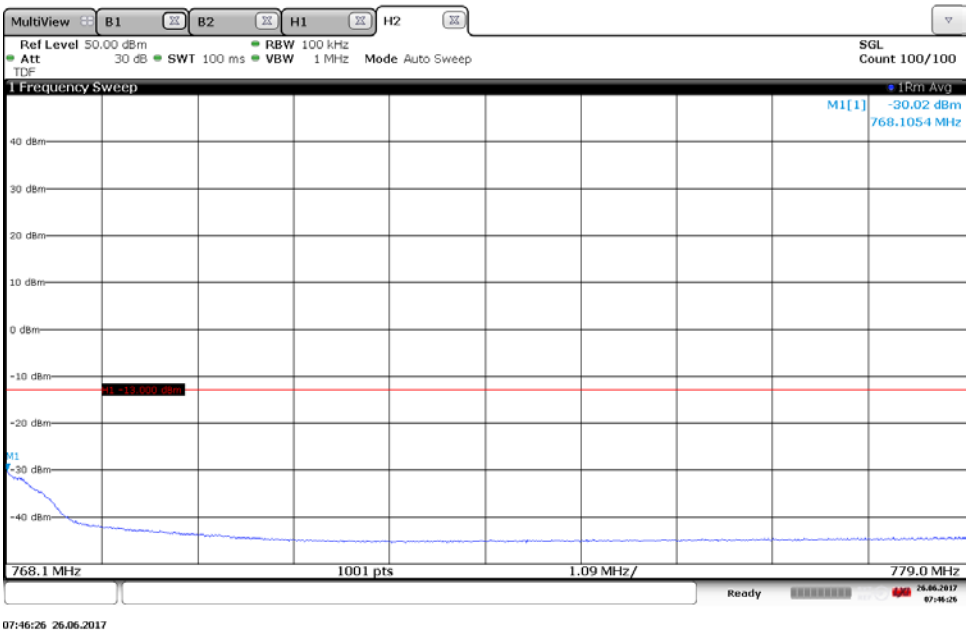


Diagram 7a:

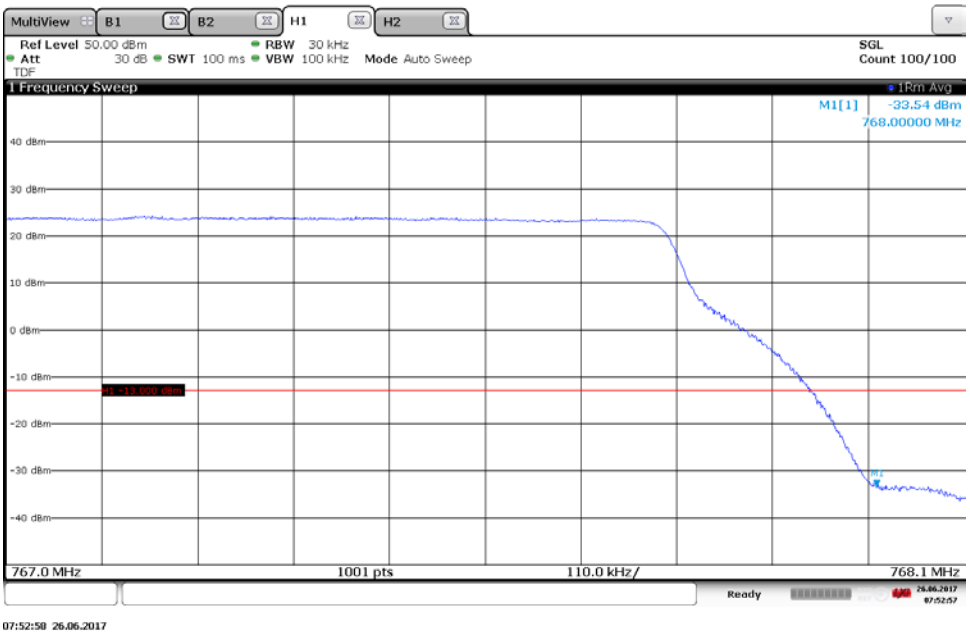


Diagram 7b:

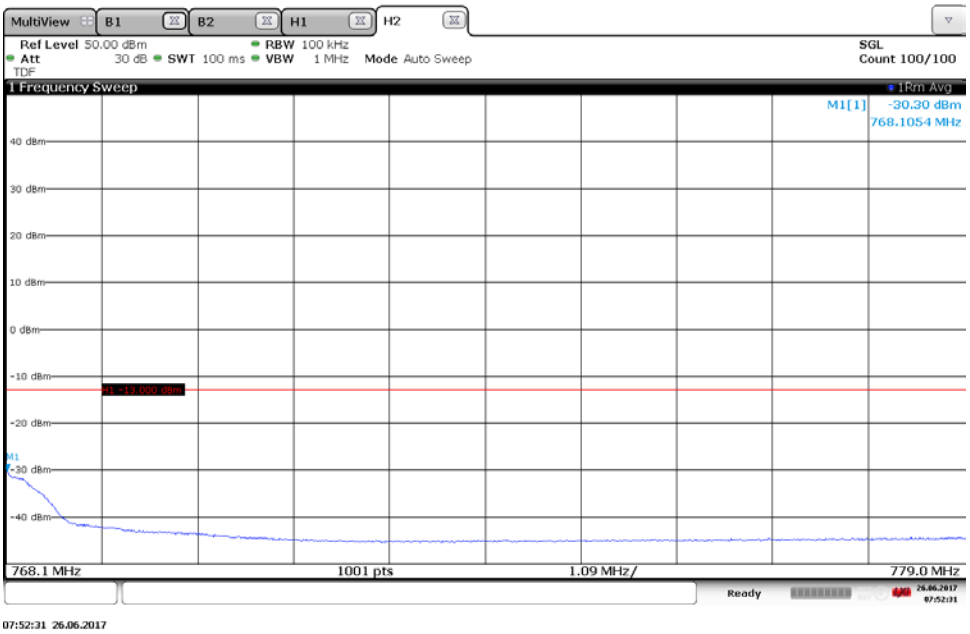


Diagram 8a:

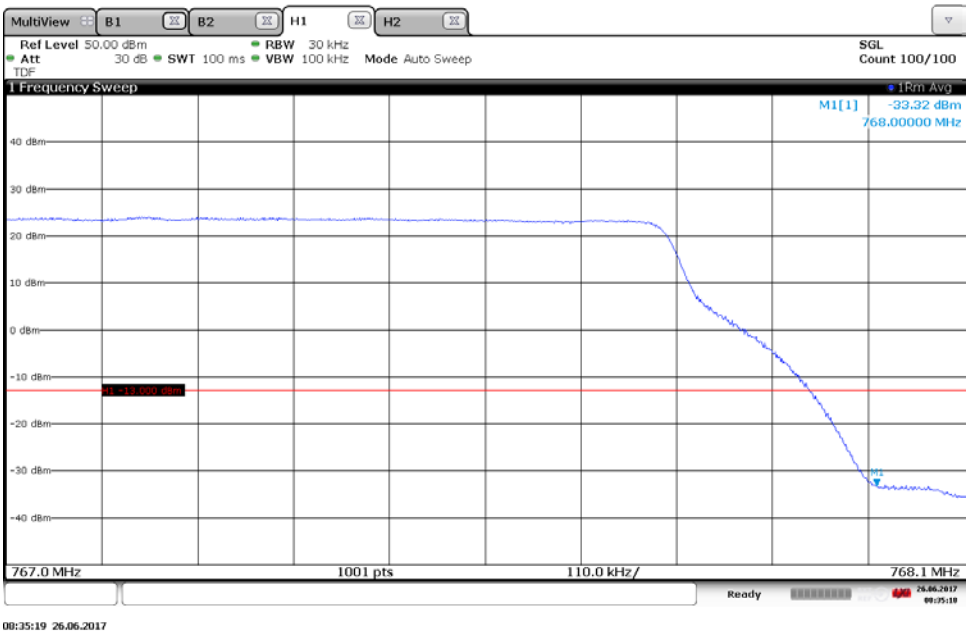


Diagram 8b:

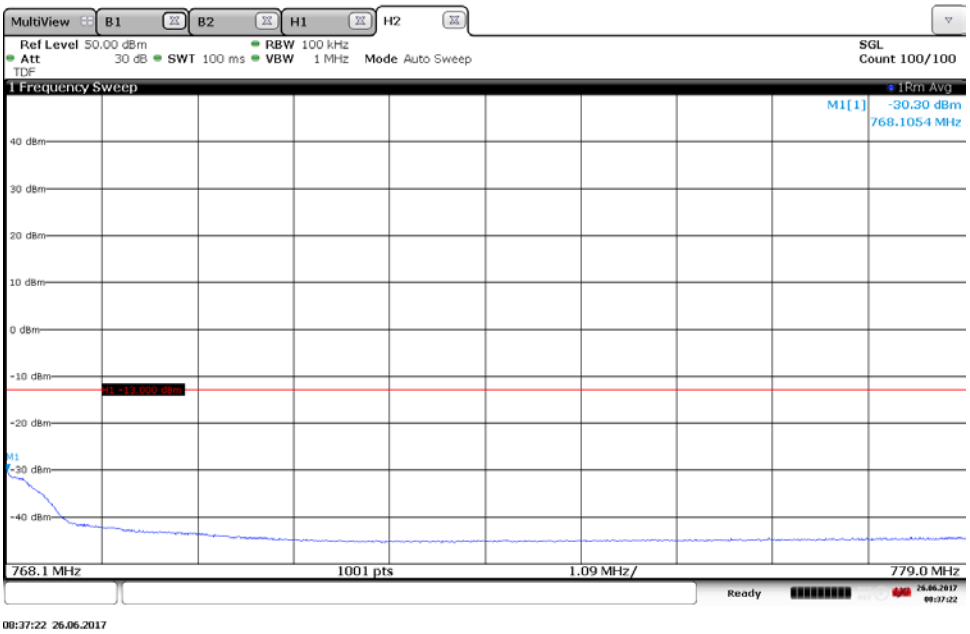


Diagram 9a:

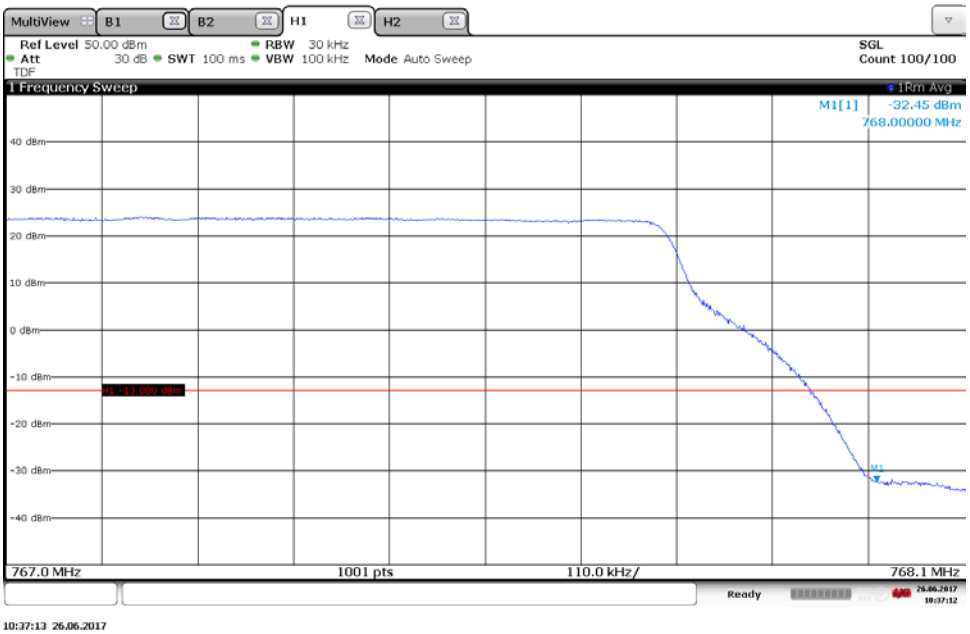


Diagram 9b:

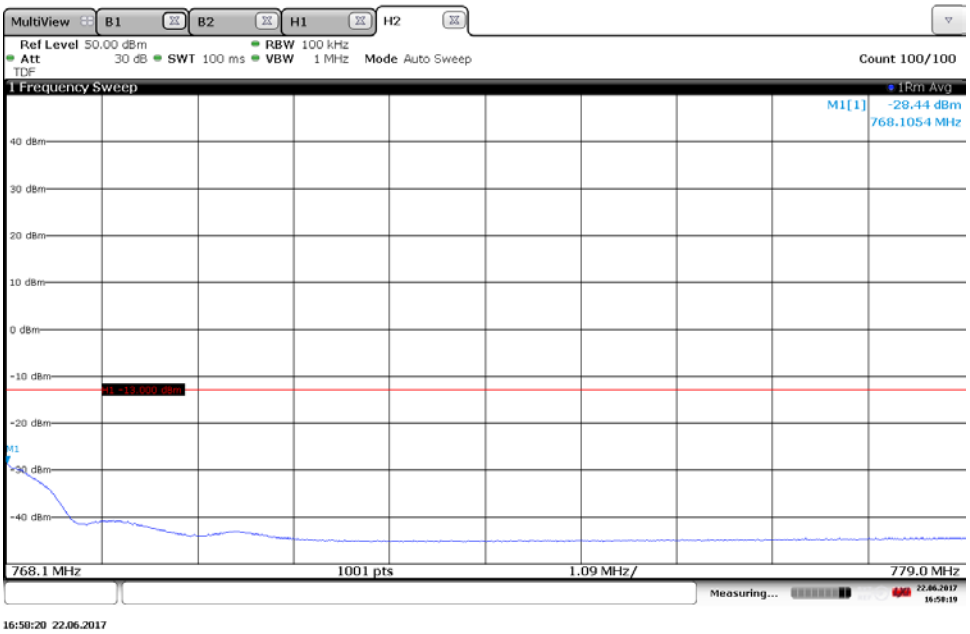


Diagram 10a:

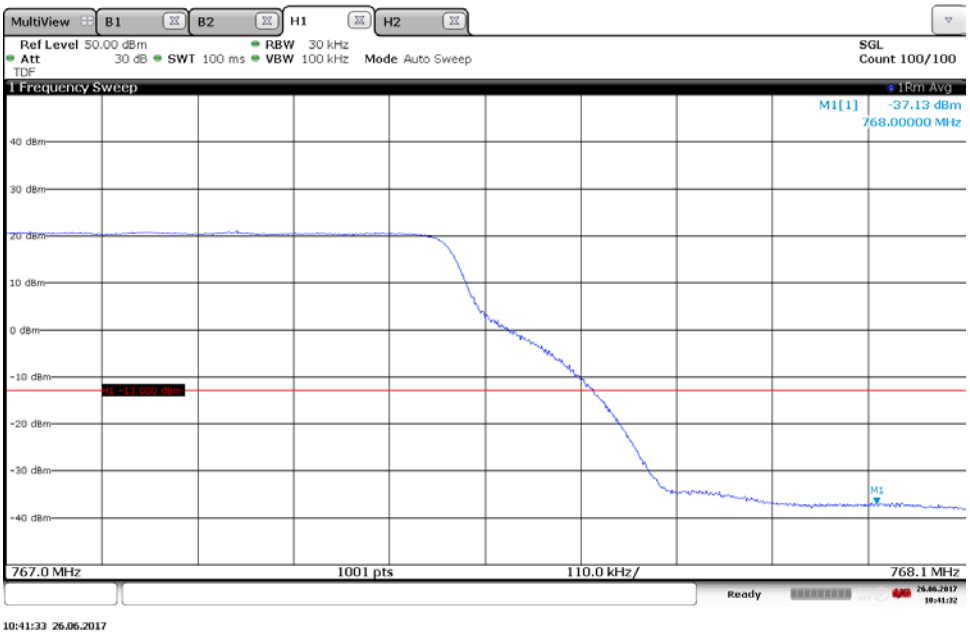
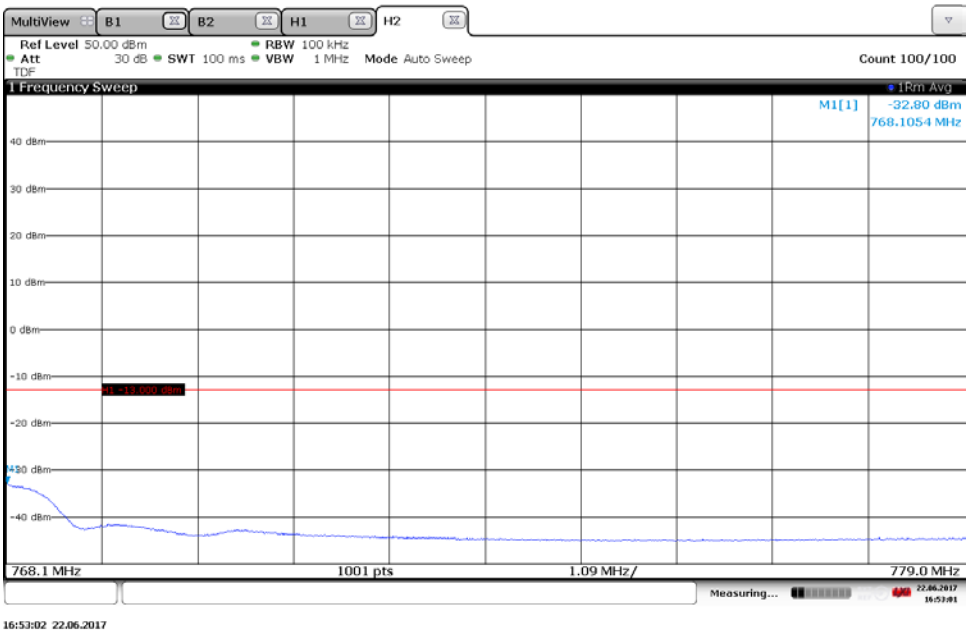


Diagram 10b:



Conducted spurious emission measurements according to CFR 47 §90.543

Date	Temperature	Humidity
2017-06-26	21 °C ± 3 °C	42 % ± 5 %
2017-06-27	22 °C ± 3 °C	22 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §90.543. 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.

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

Measurement equipment	SP number
R&S FSW 43	902 073
RF attenuator	900 691
HP filter	904 199
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Single carrier E-TM 1.1

Diagram	BW configuration	Symbolic name	Tested Port
1 a-e	5 MHz	B_5	RF D
2 a-e	5 MHz	M_5	RF D
3 a-e	5 MHz	T_5	RF D
4 a-e	10 MHz	M_{10}	RF D
5 a-e	5 MHz	T_5	RF A
6 a-e	5 MHz	T_5	RF B
7 a-e	5 MHz	T_5	RF C

Multi carrier E-TM 1.1

Diagram	BW configuration	Symbolic name	Tested Port
8 a-d	5 MHz	M2	RF D

Note: Measurements were mainly limited to port RF D 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 highest fundamental frequency is 768 MHz. The measurements were made up to 8 GHz (10x768 MHz = 7680 GHz).

Limits

CFR 47 §90.543
(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Complies?	Yes

Diagram 1a:

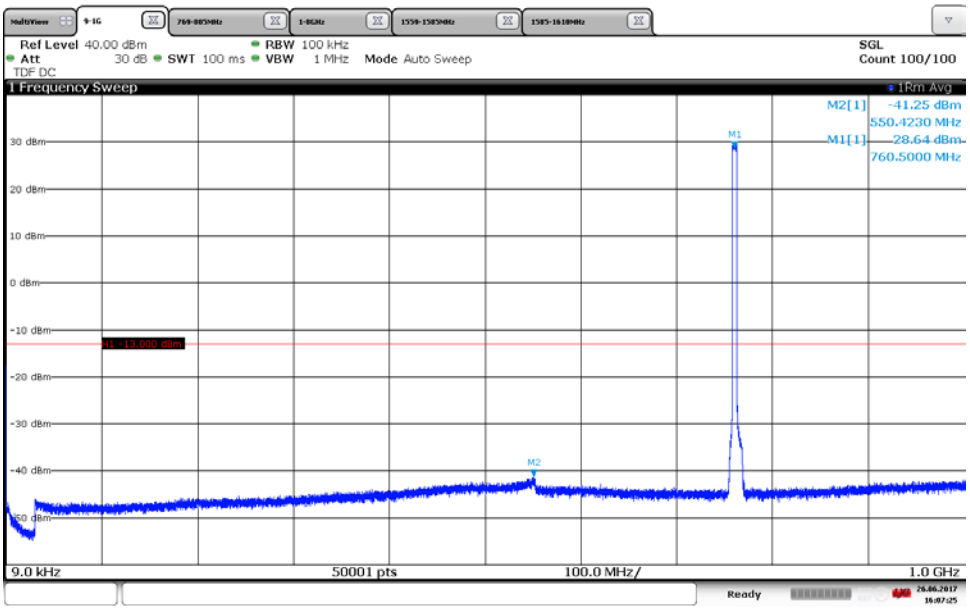


Diagram 1b:

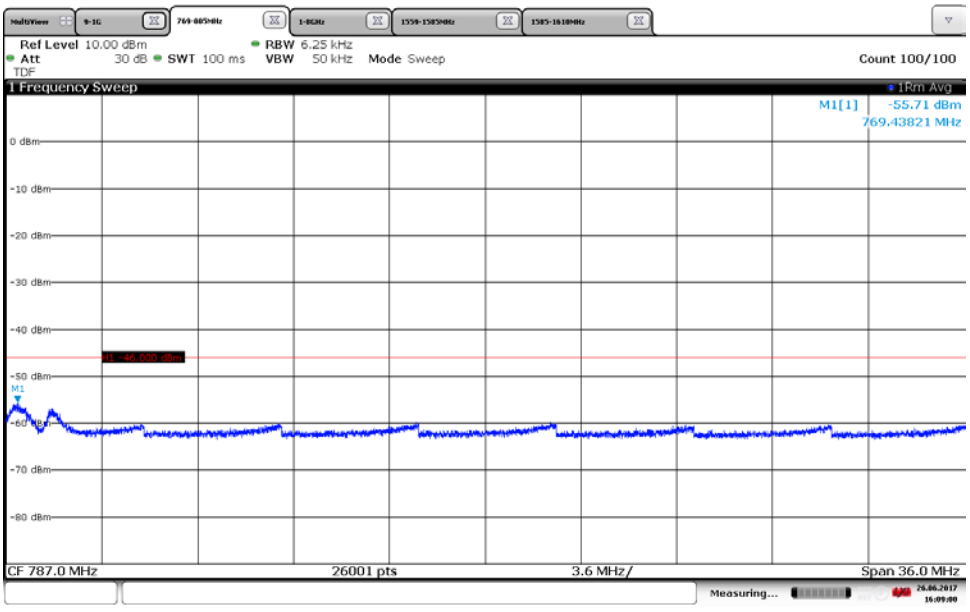


Diagram 1c:

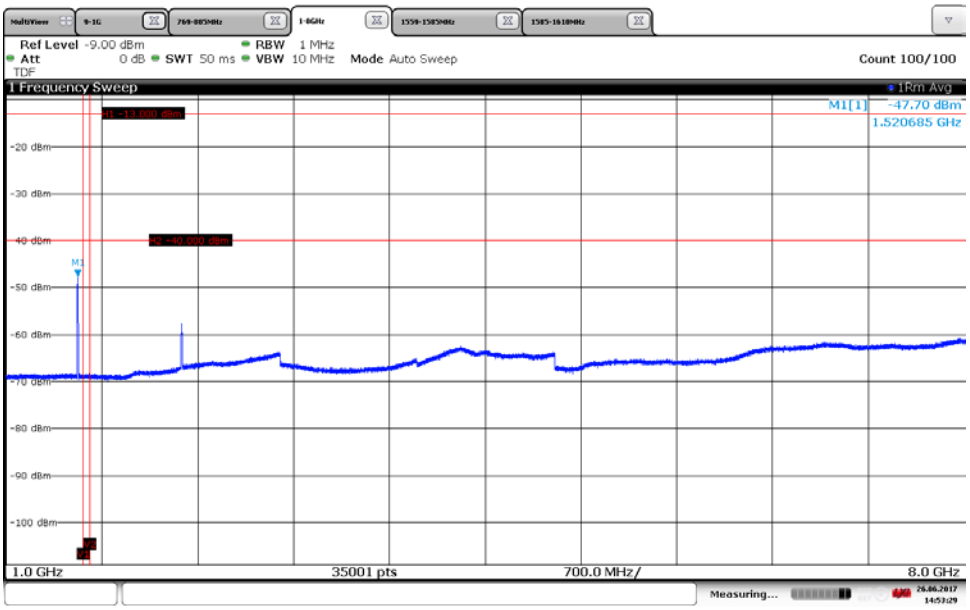


Diagram 1d:

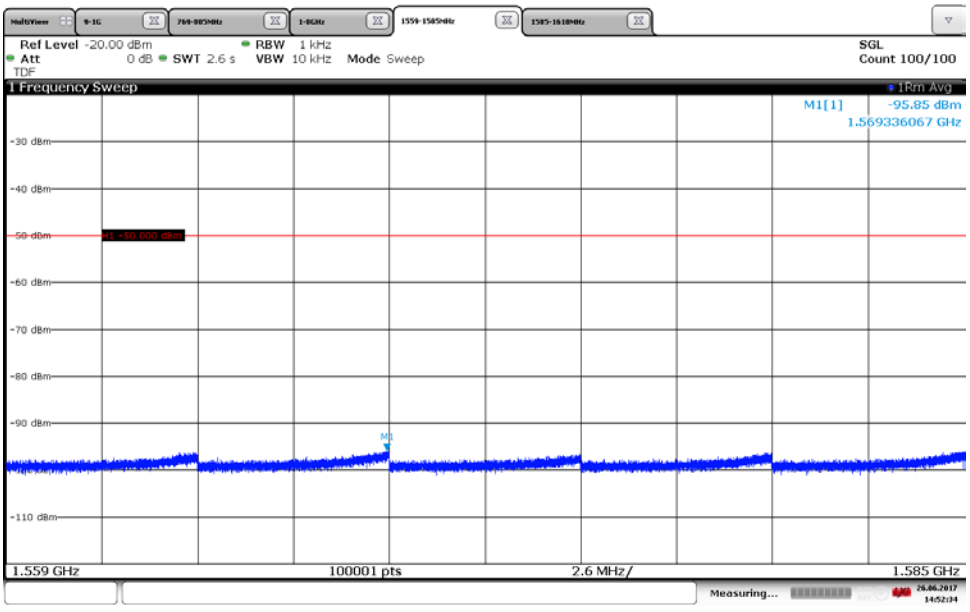


Diagram 1e:

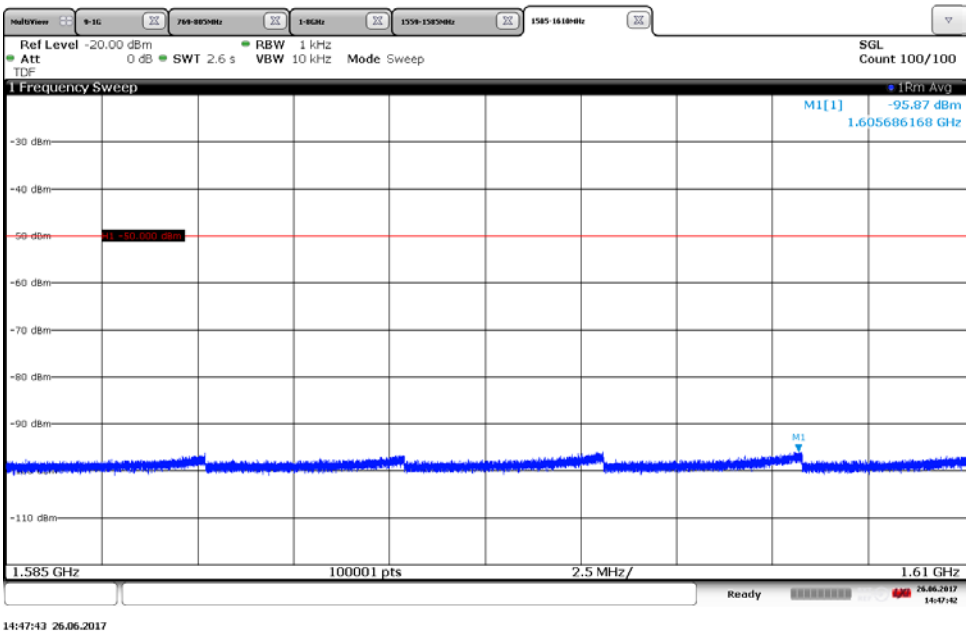

Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -95.87 dBm
1.605686168 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
14:47:43 26.06.2017

Diagram 2a:

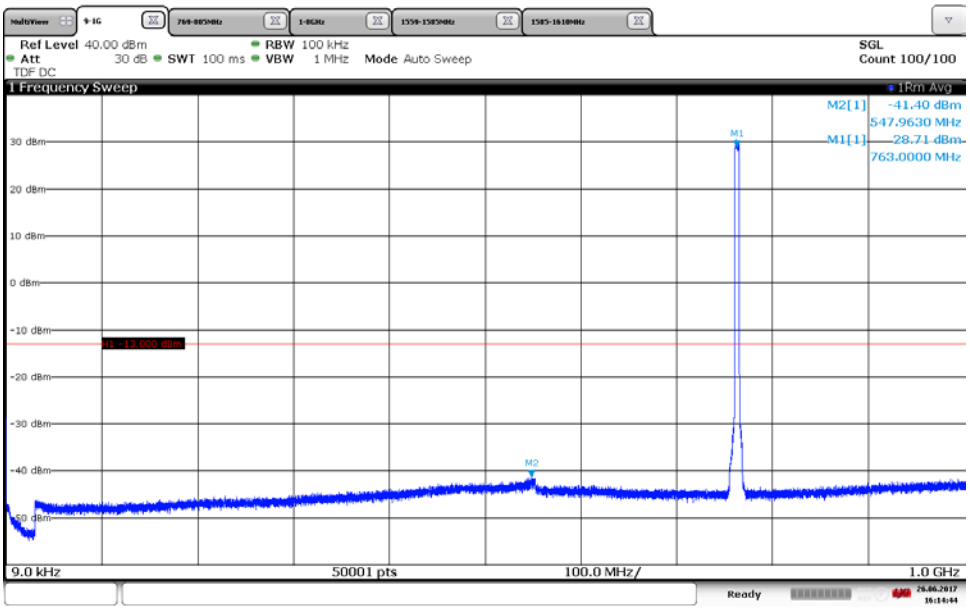


Diagram 2b:

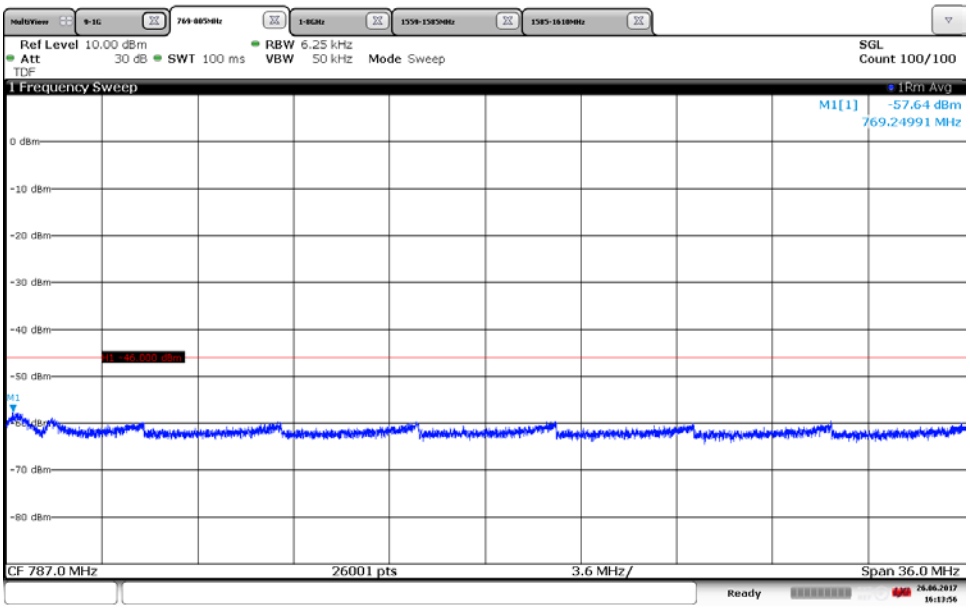


Diagram 2c:

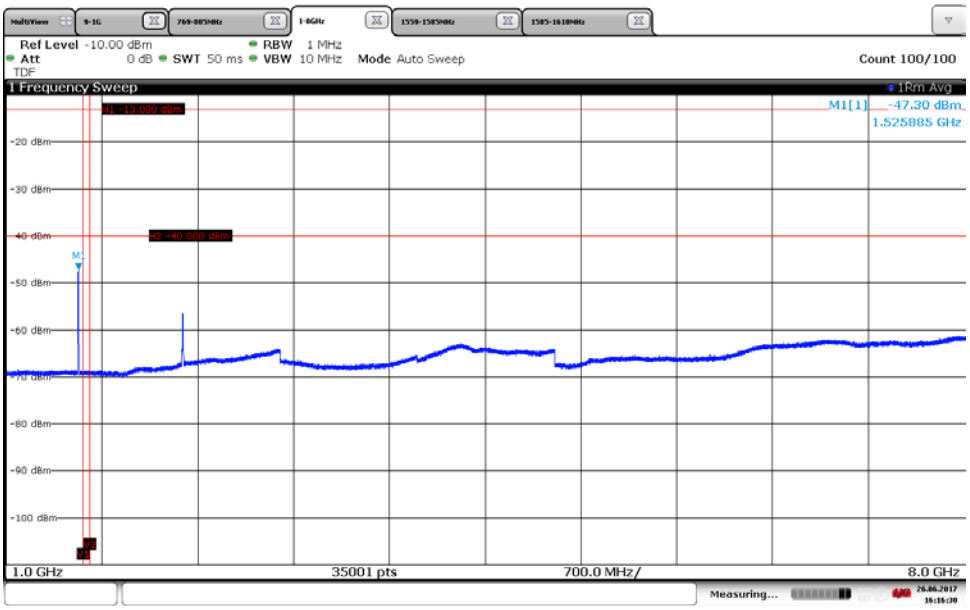


Diagram 2d:

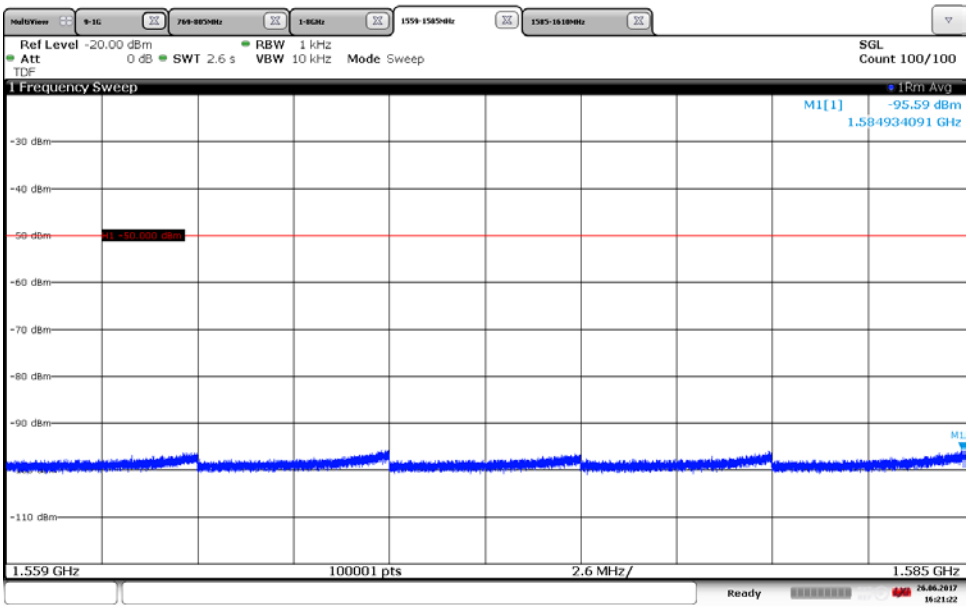


Diagram 2e:

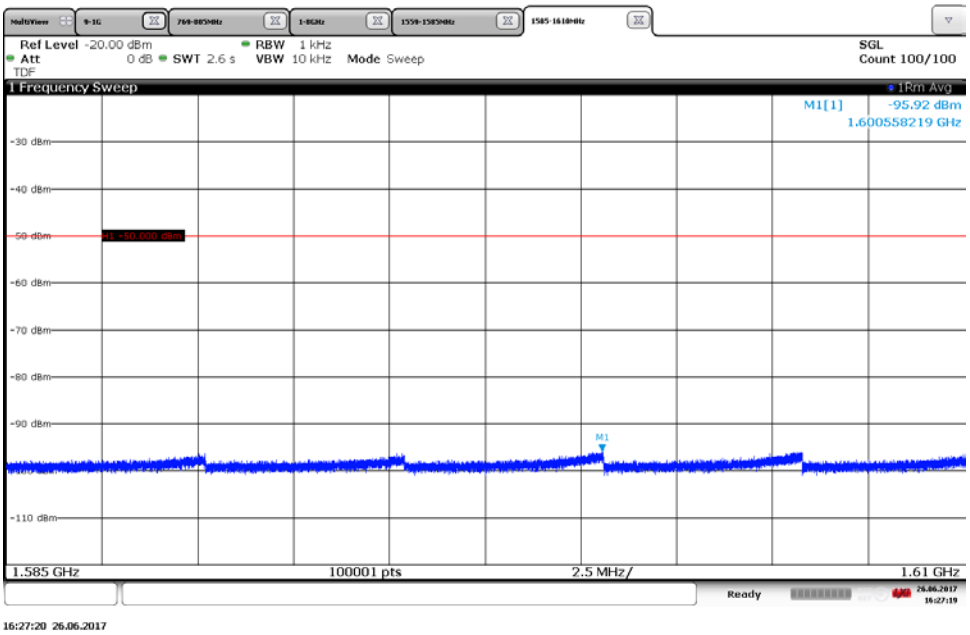

Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -95.92 dBm
1.600558219 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
16:27:20 26.06.2017

Diagram 3a:

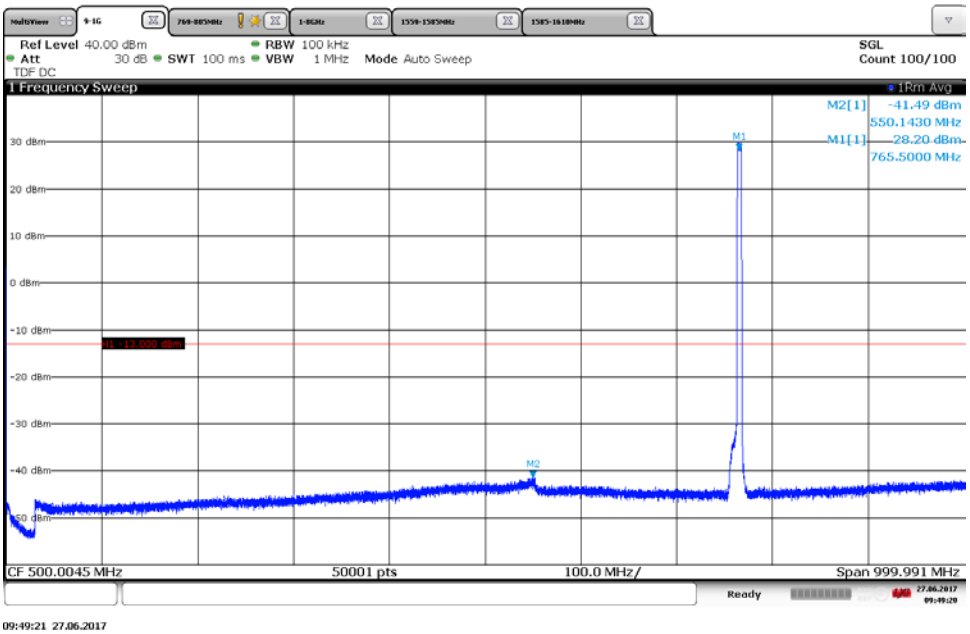


Diagram 3b:

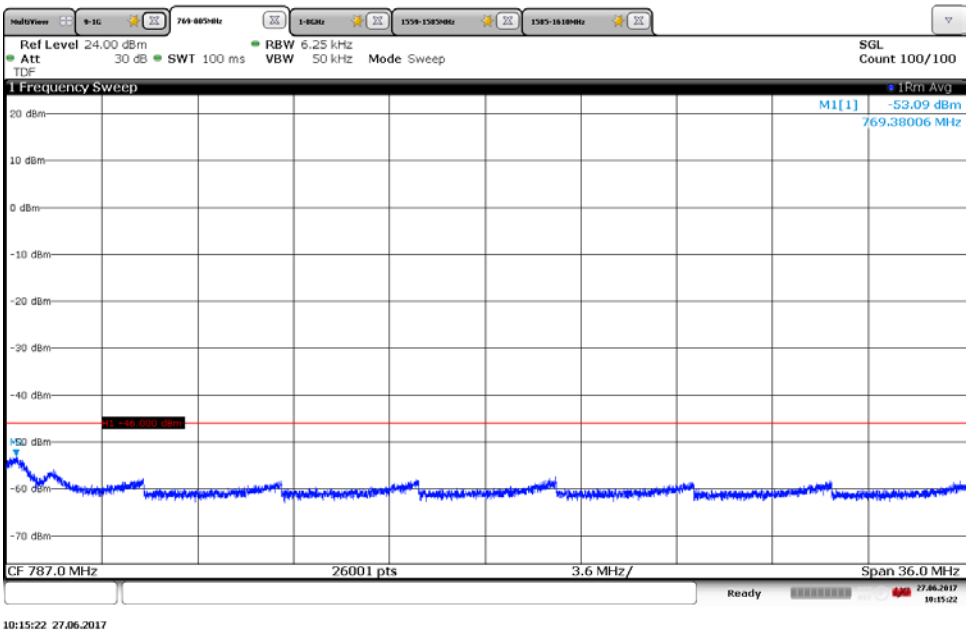


Diagram 3c:

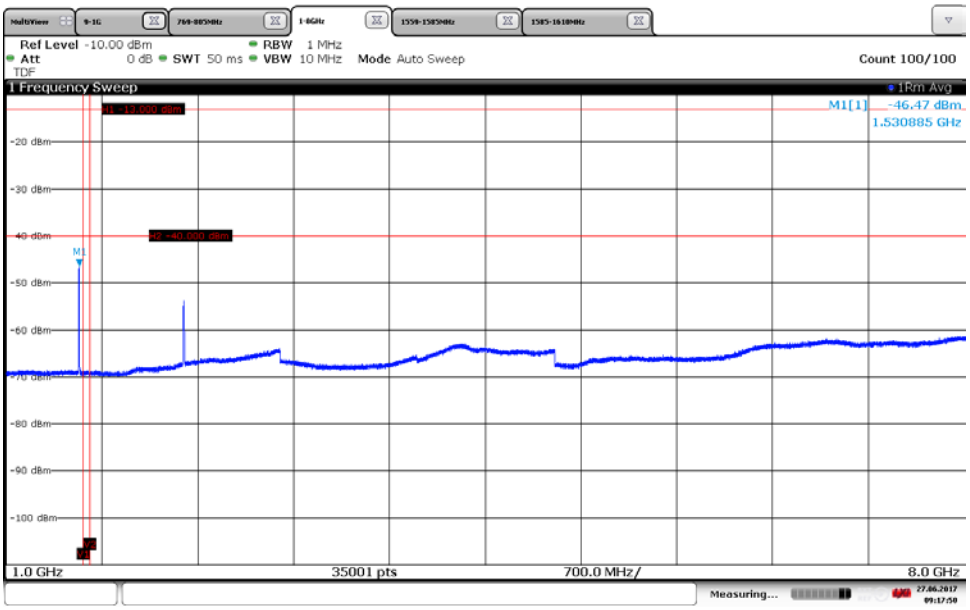


Diagram 3d:

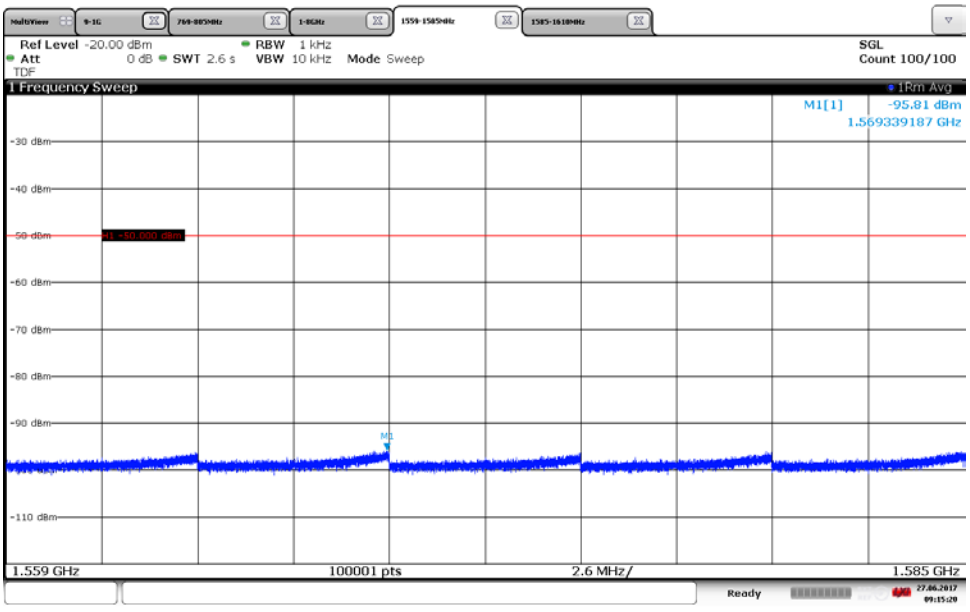


Diagram 3e:

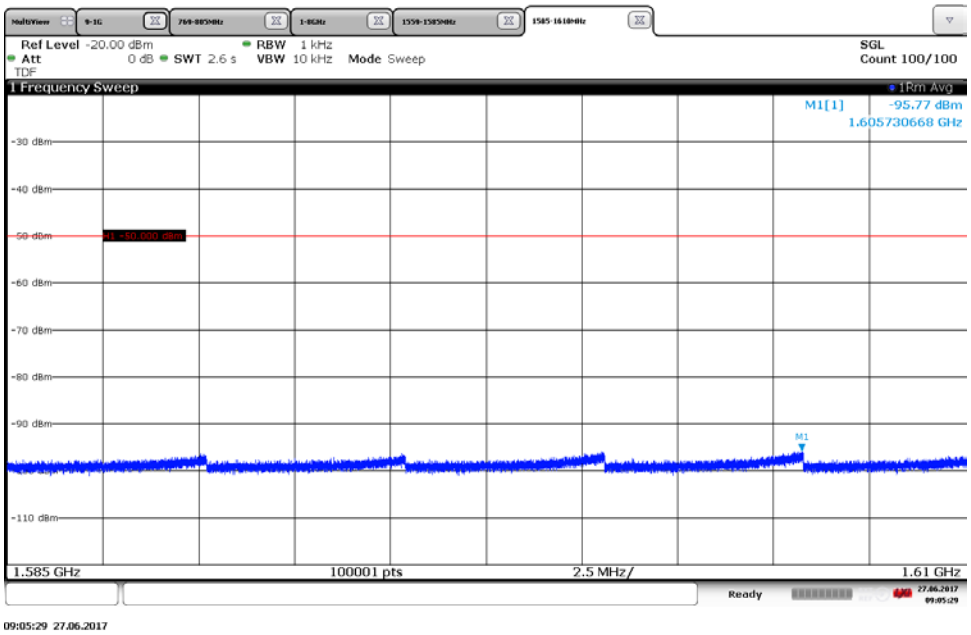

Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -95.77 dBm
1.605730668 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
09:05:29 27.06.2017

Diagram 4a:

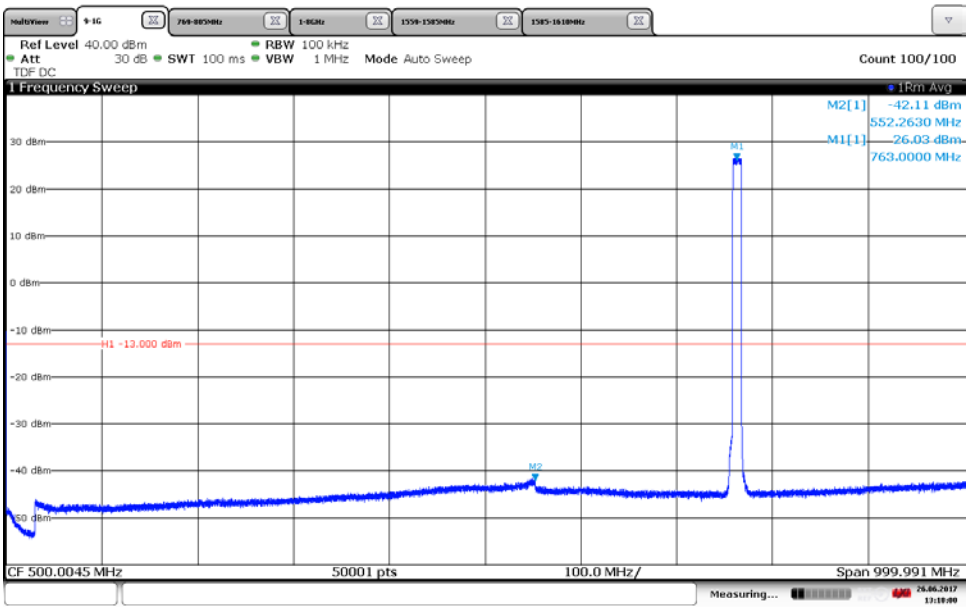


Diagram 4b:

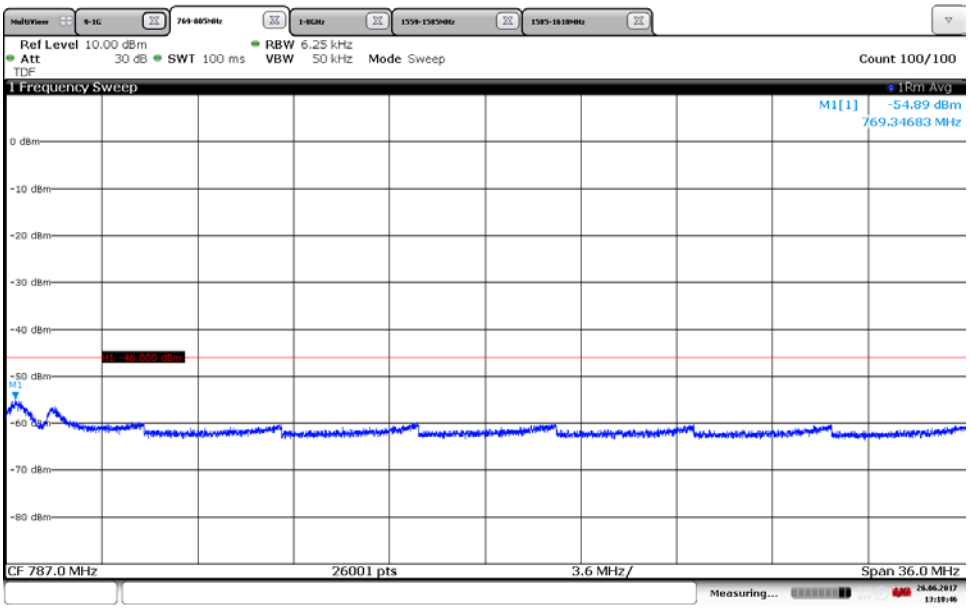
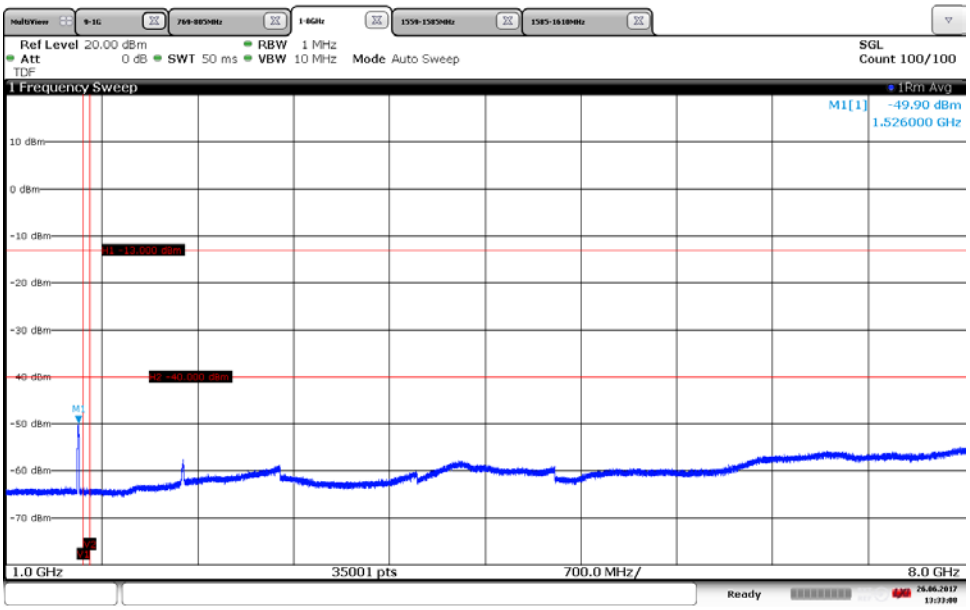
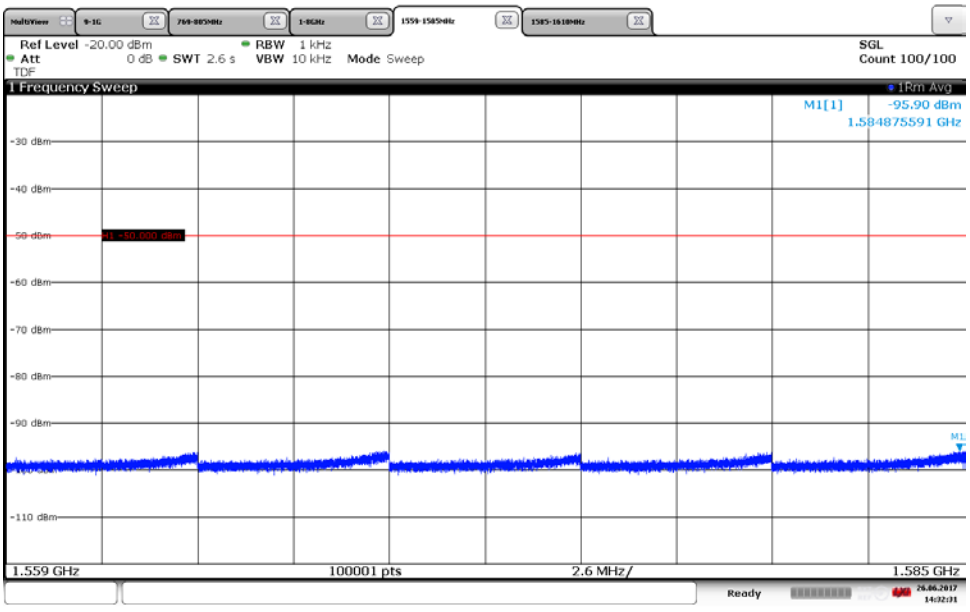


Diagram 4c:



13:33:09 26.06.2017

Diagram 4d:



14:32:32 26.06.2017

Diagram 4e:

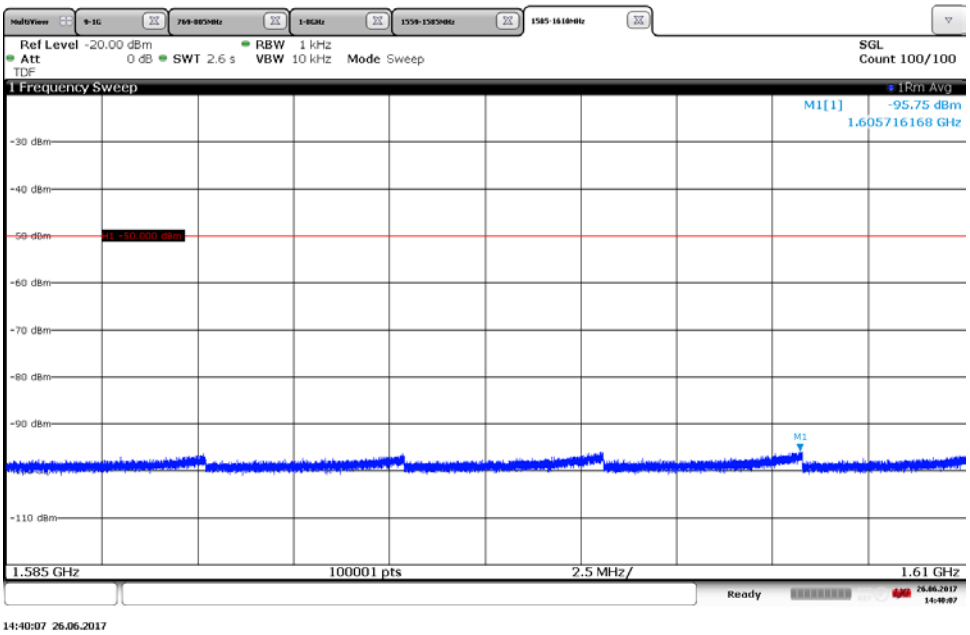

Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -95.75 dBm
1.605716168 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
14:40:07 26.06.2017

Diagram 5a:

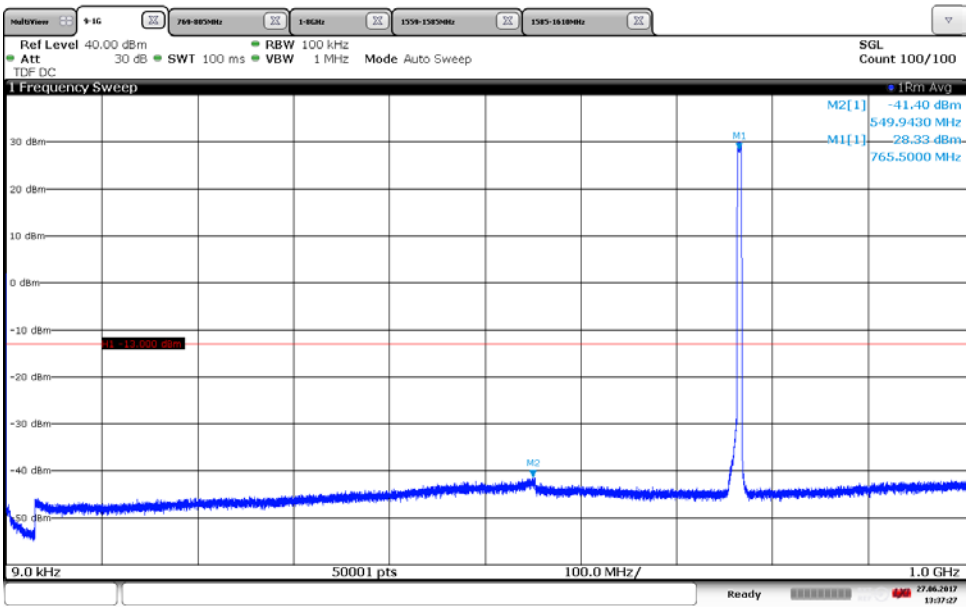


Diagram 5b:

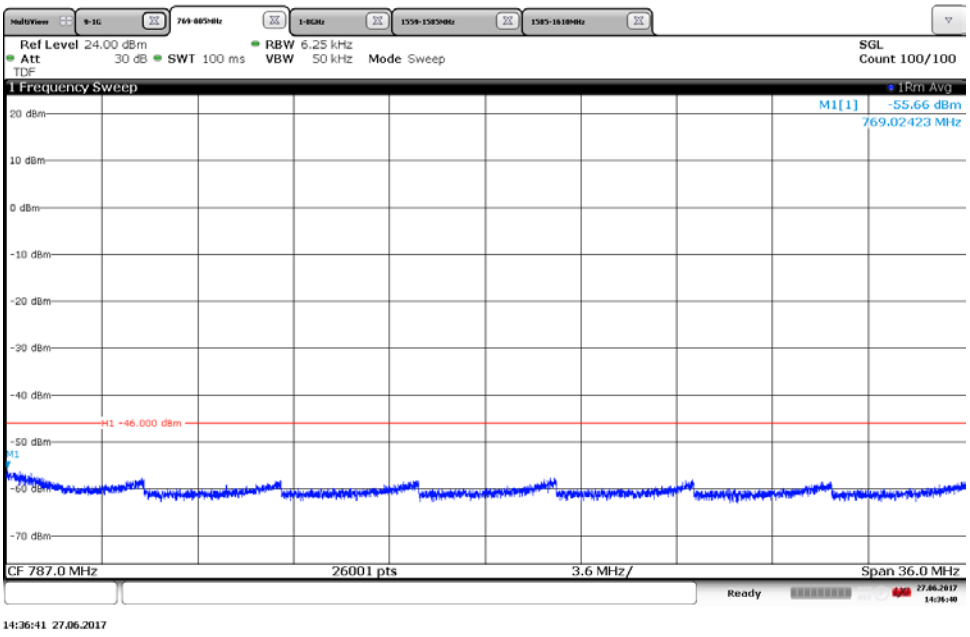
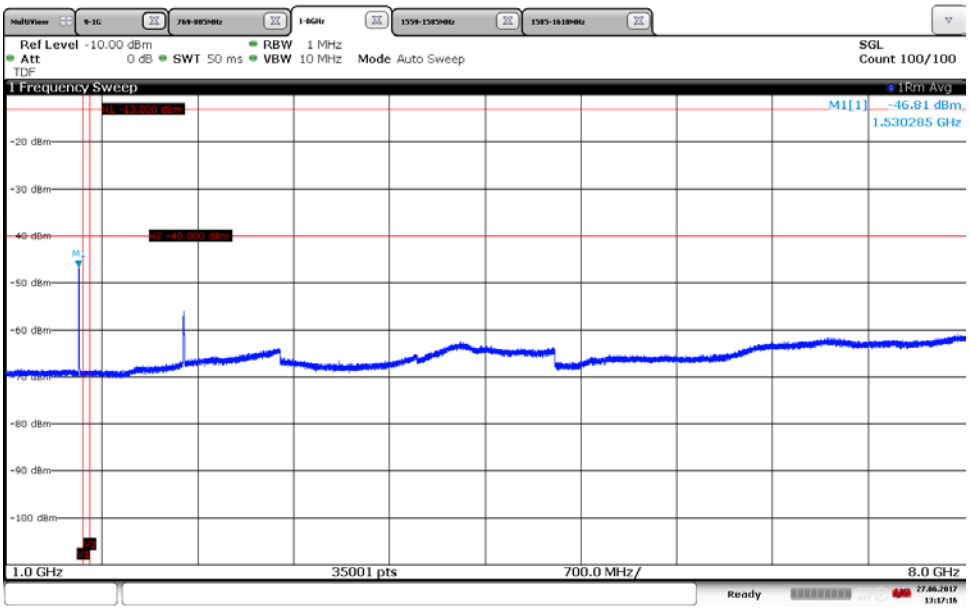
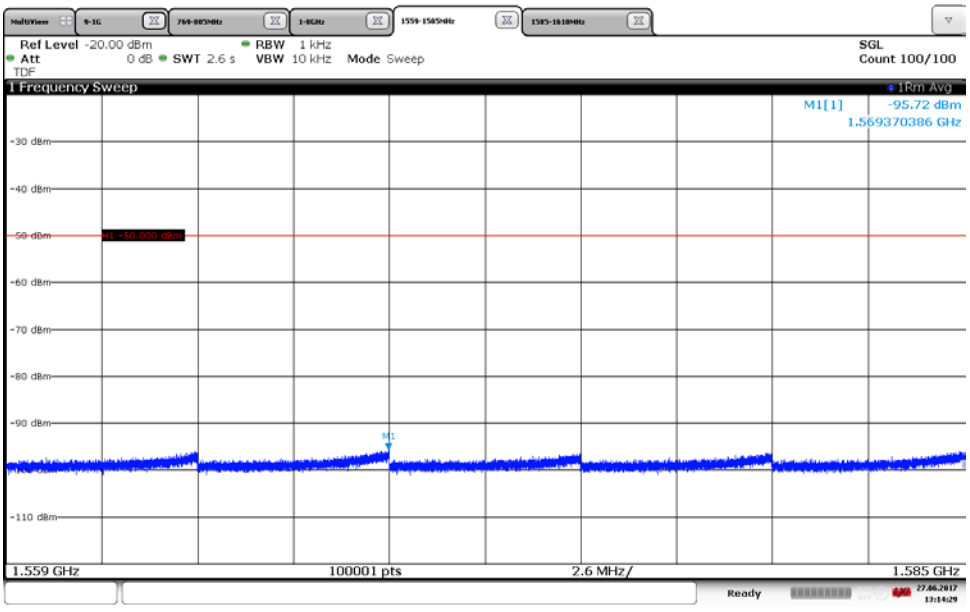


Diagram 5c:



13:17:17 27.06.2017

Diagram 5d:



13:14:30 27.06.2017

Diagram 5e:

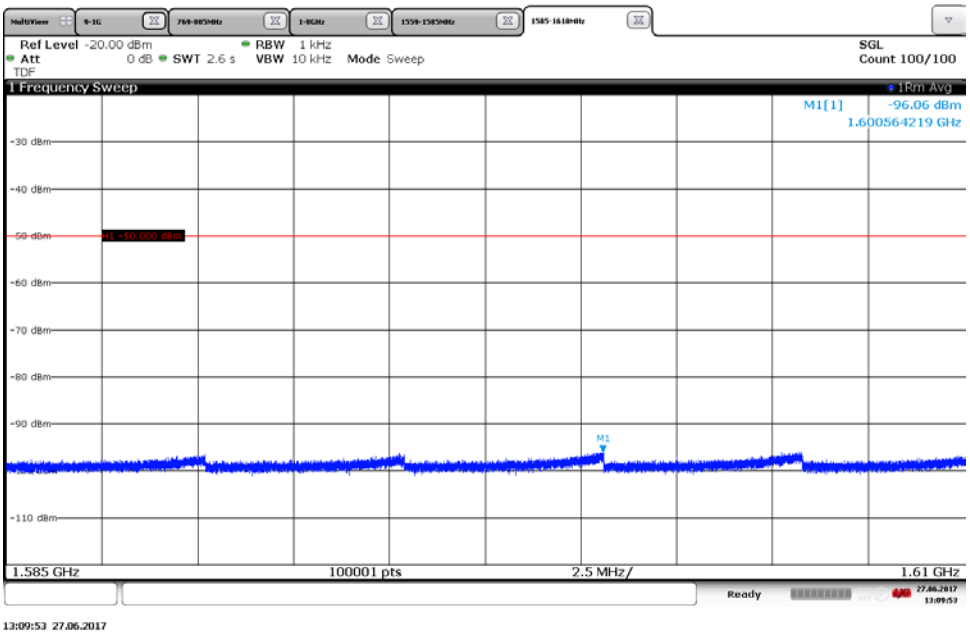

Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -96.06 dBm
1.600564219 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
13:09:53 27.06.2017

Diagram 6a:

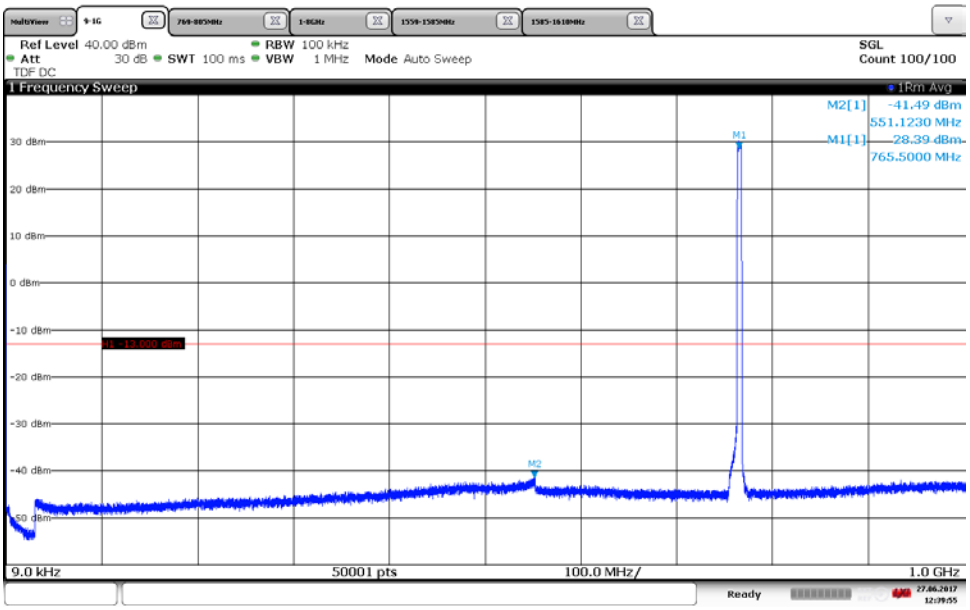


Diagram 6b:

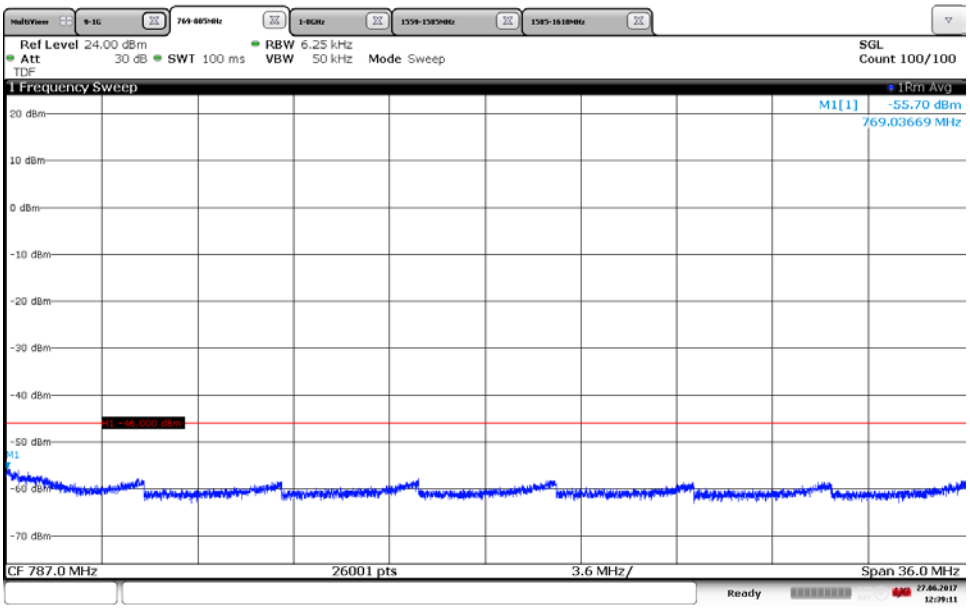
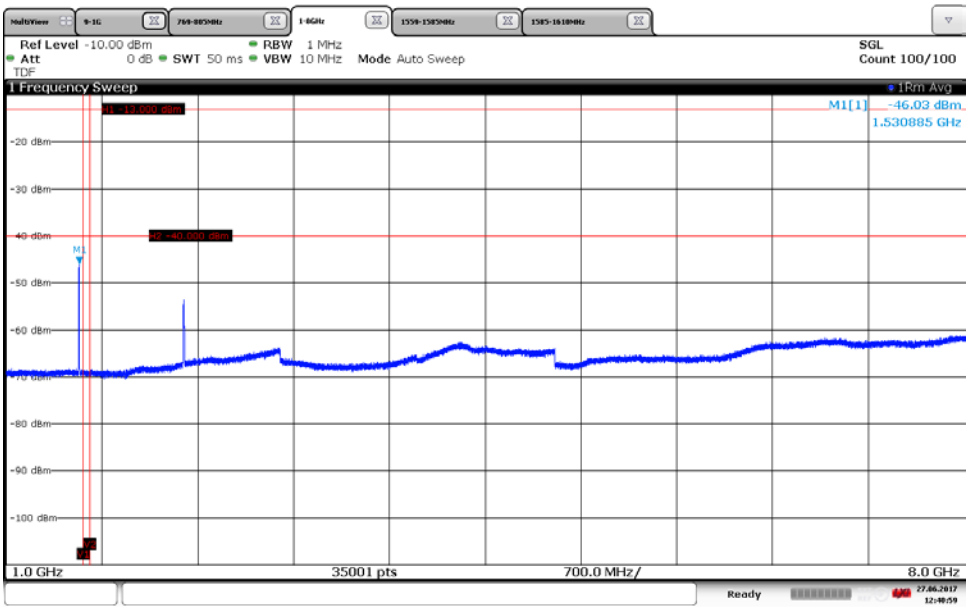
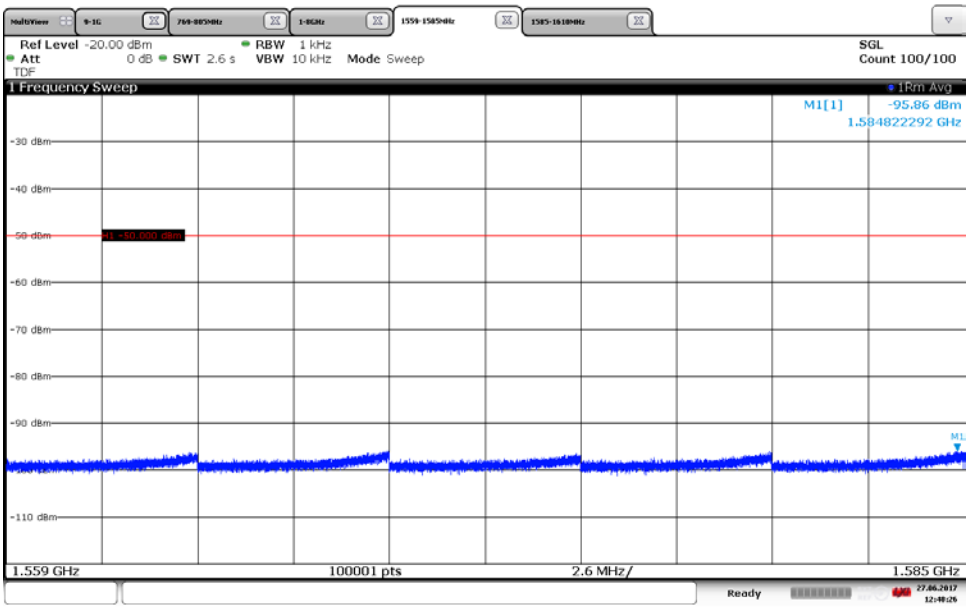


Diagram 6c:



12:41:00 27.06.2017

Diagram 6d:



12:40:26 27.06.2017

Diagram 6e:

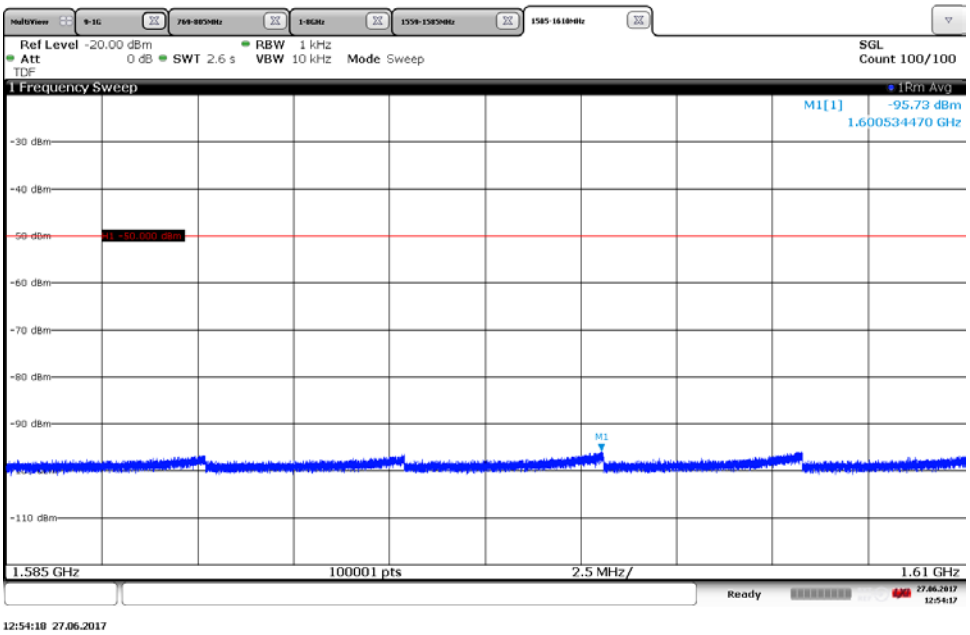

Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -95.73 dBm
1.600534470 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
12:54:10 27.06.2017

Diagram 7a:

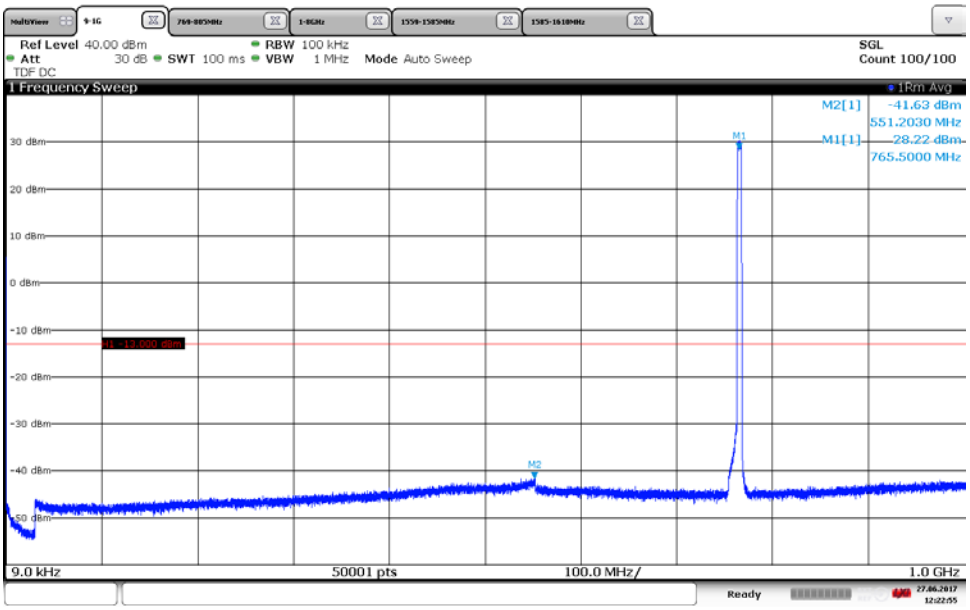


Diagram 7b:

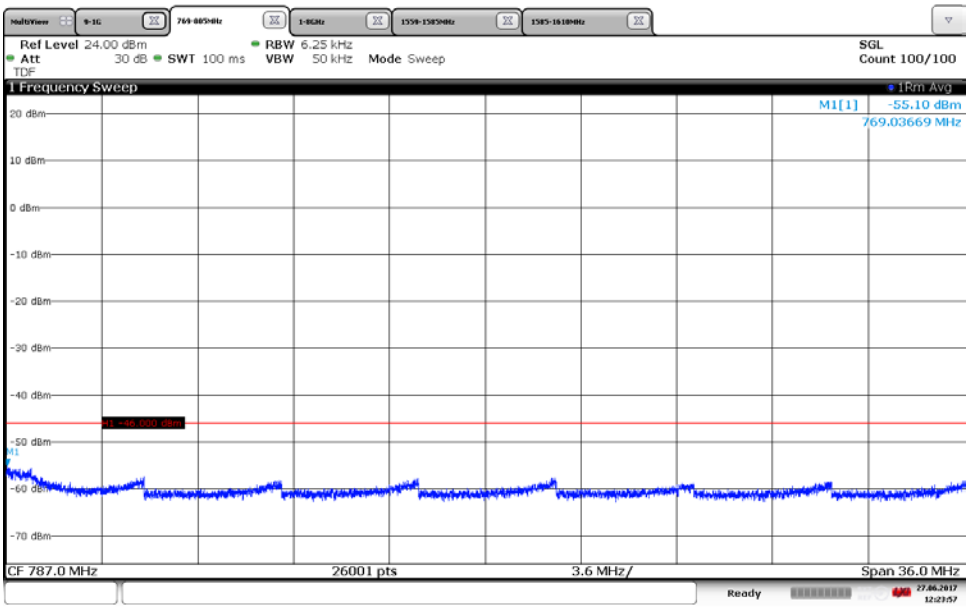
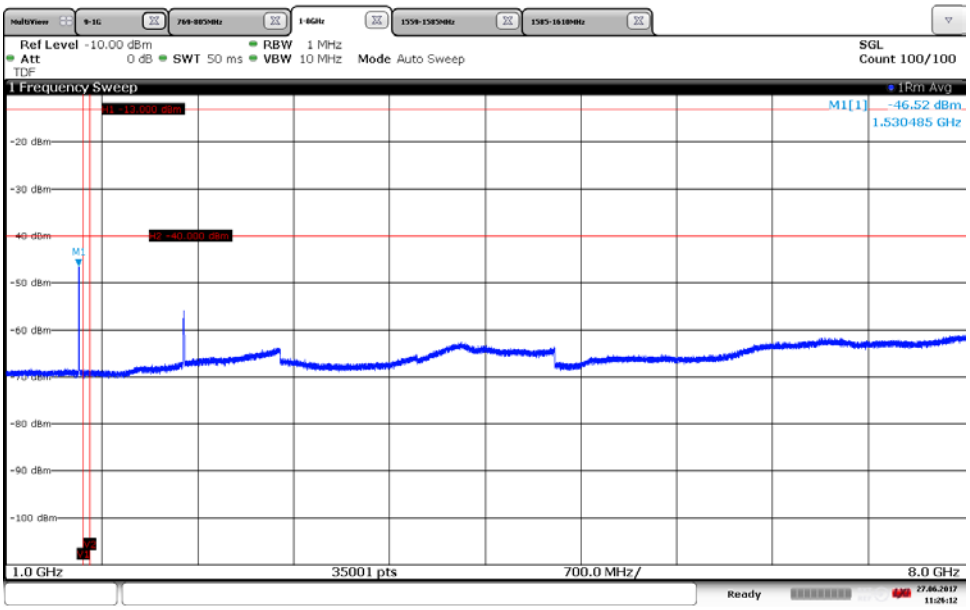
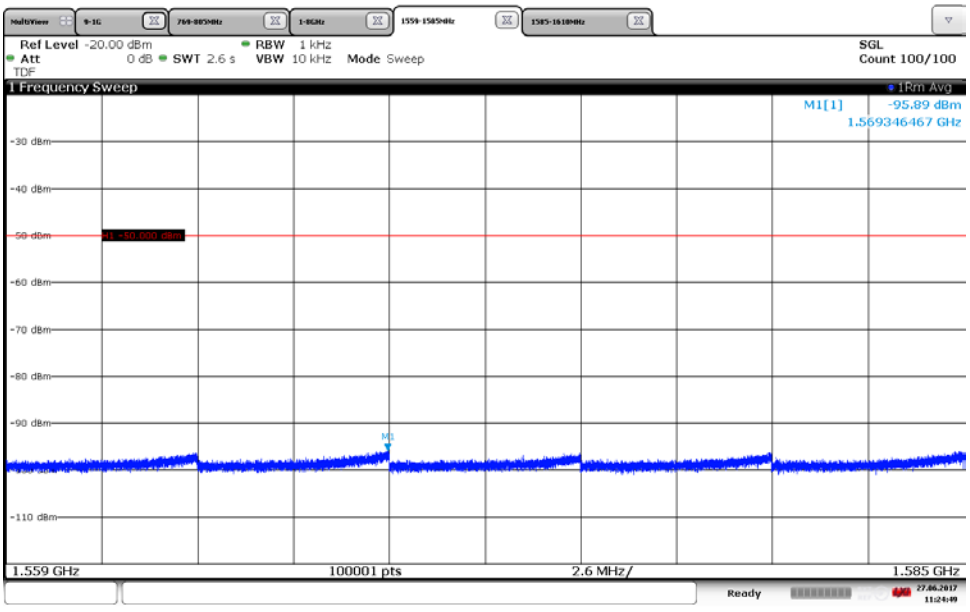


Diagram 7c:



11:26:12 27.06.2017

Diagram 7d:



11:24:49 27.06.2017

Diagram 7e:

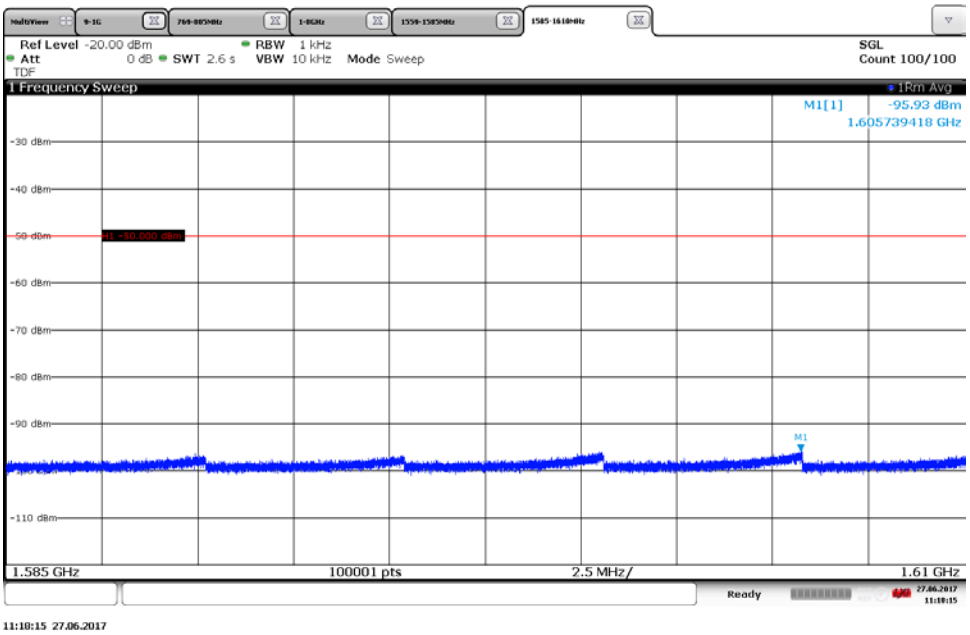

Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -95.93 dBm
1.605739418 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
11:10:15 27.06.2017

Diagram 8a:

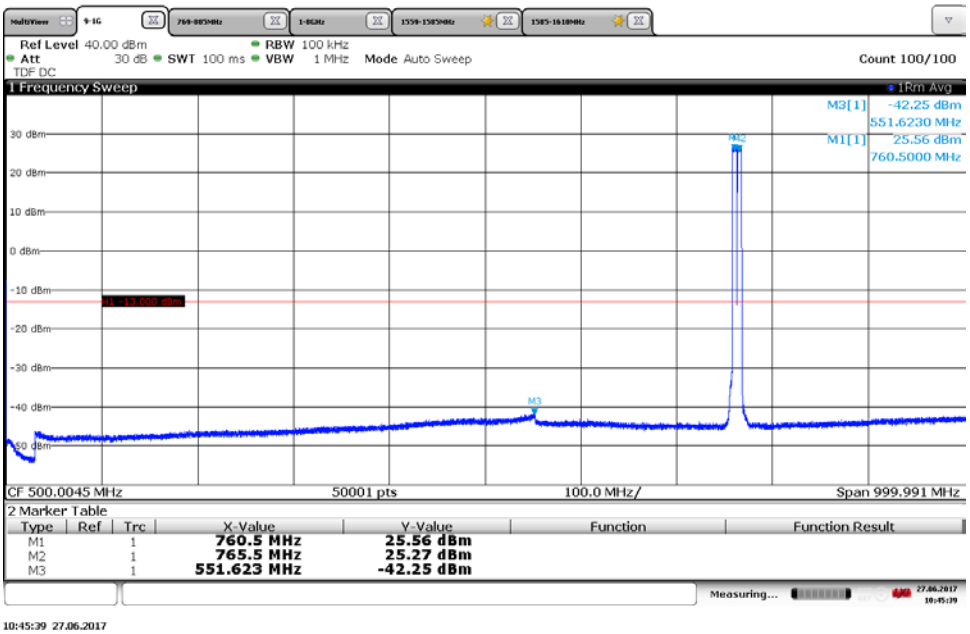


Diagram 8b:

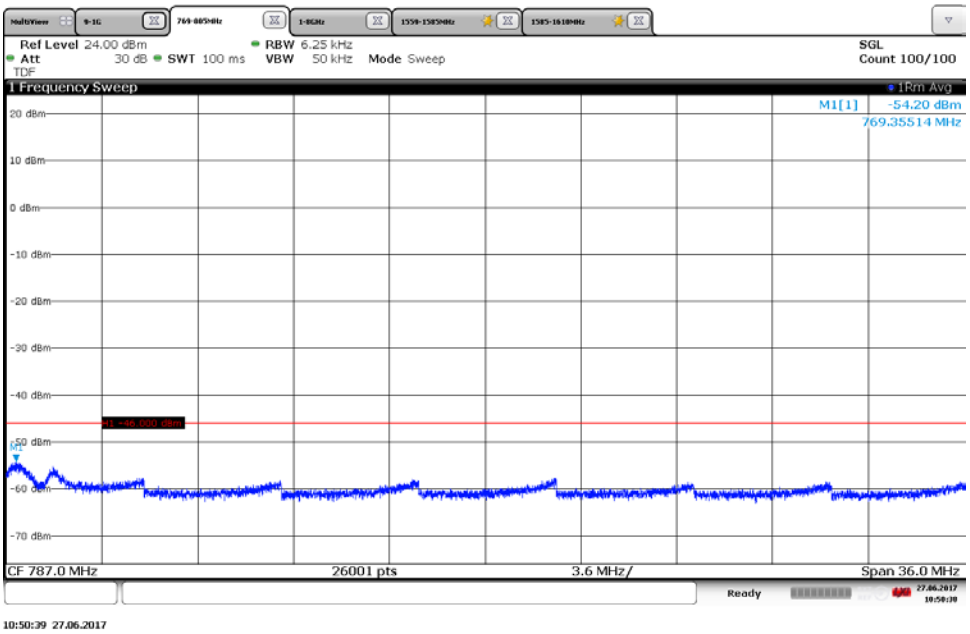


Diagram 8c:

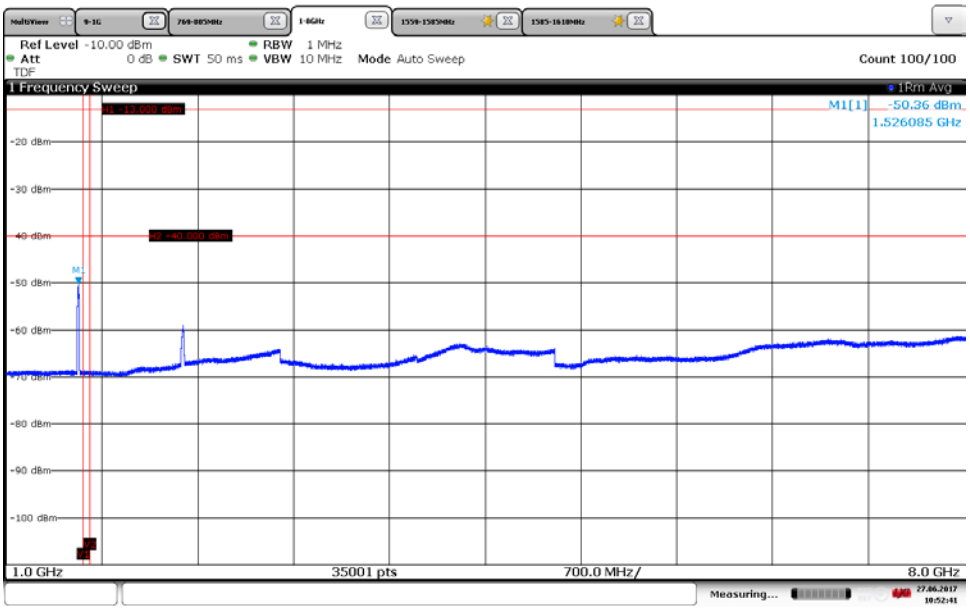


Diagram 8d:

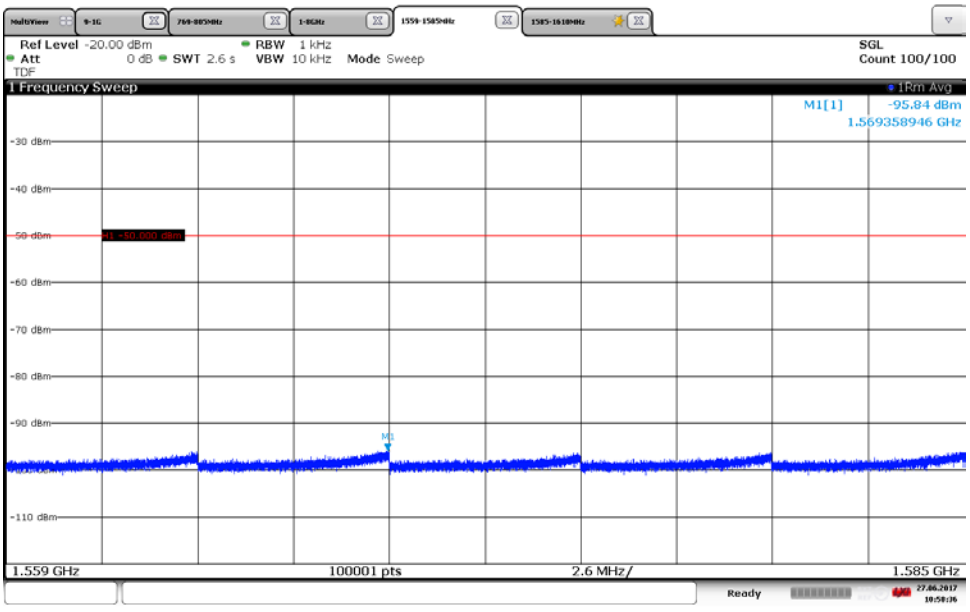
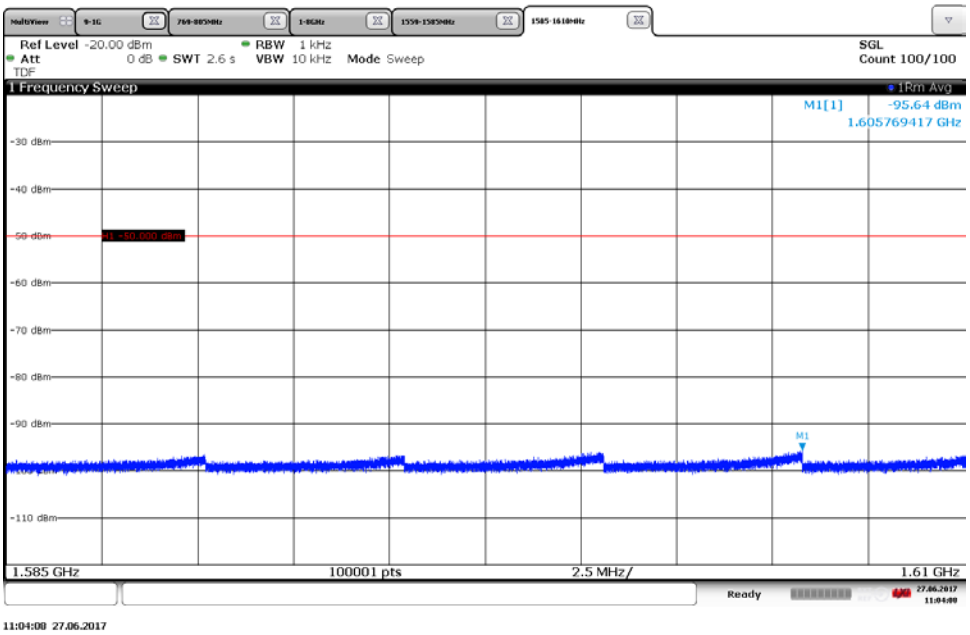


Diagram 8e:


Ref Level -20.00 dBm
RBW 1 kHz
Att 0 dB SWT 2.6 s VBW 10 kHz Mode Sweep
SGL
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -95.64 dBm
1.605769417 GHz
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-110 dBm
M1
1.585 GHz
100001 pts
2.5 MHz/
1.61 GHz
Ready
11:04:00 27.06.2017

Field strength of spurious radiation measurements according to CFR 47 §90.543

Date	Temperature	Humidity
2017-06-09	23 °C ± 3 °C	58 % ± 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.

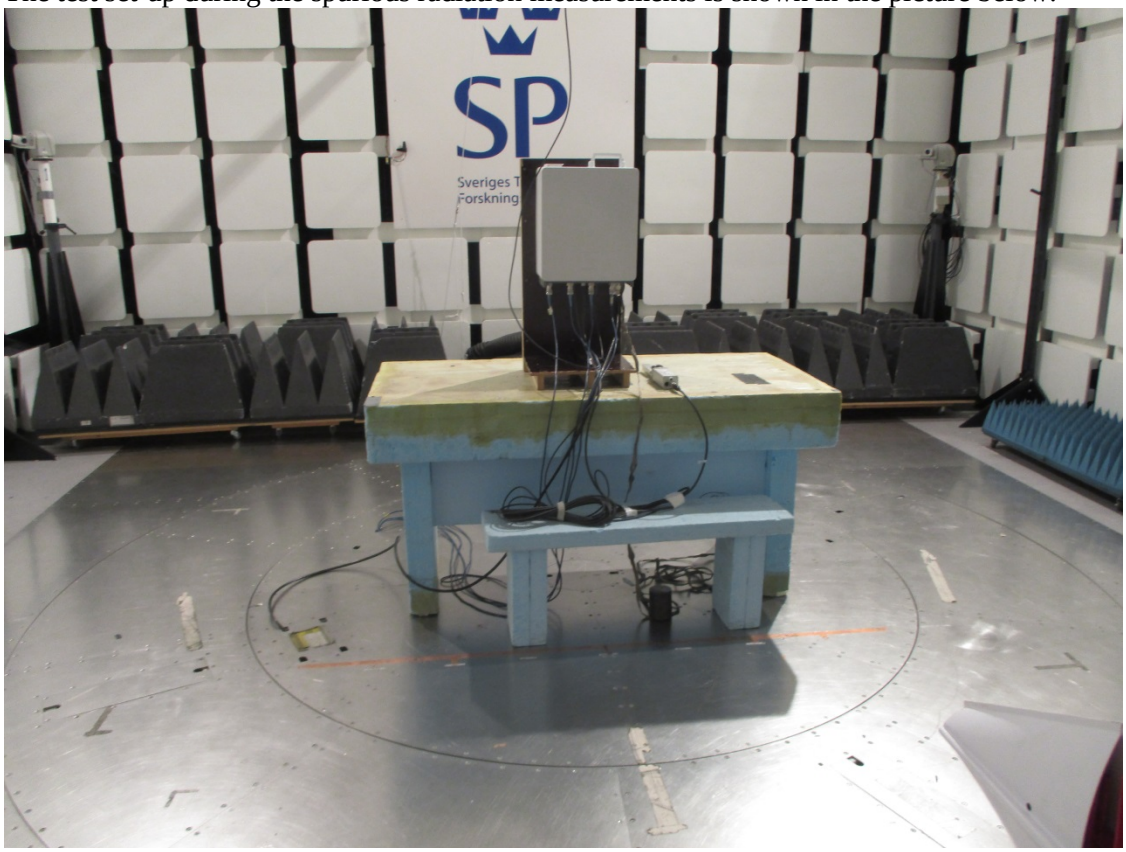
The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 8 GHz.

The measurements in the frequency range 30 – 1000 MHz was performed with a RBW of 100 kHz except in the frequency bands 769 – 775 MHz and 799 – 805 MHz where a RBW of 10 kHz was used.
The measurements in the frequency range 1 – 8 GHz was performed with a RBW of 1 MHz except in the frequency band 1559 – 1610 MHz where a RBW of 10 kHz was used.

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 and 1.5 m. For measurements > 1 GHz the test object was measured in seventeen directions with the antenna height 1.0 m and 1.5 m.
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.

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	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

representing worst case:

Symbolic name B_5, BW 5 MHz, Diagram 1 a-b

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-8000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty: 3.1 dB

Limits

CFR 47 §90.543
(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

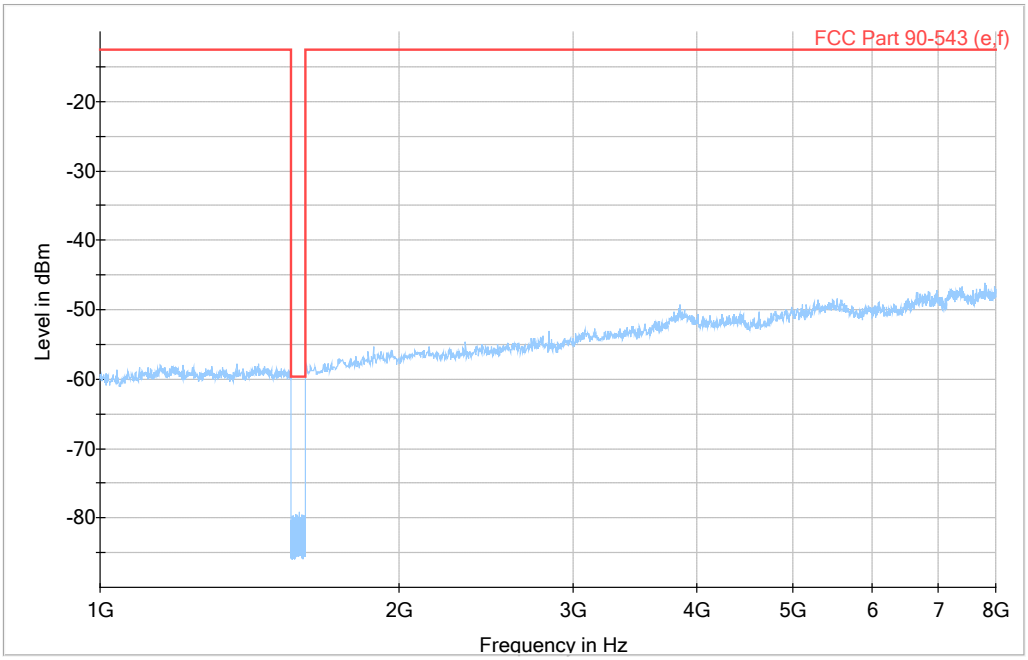
(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

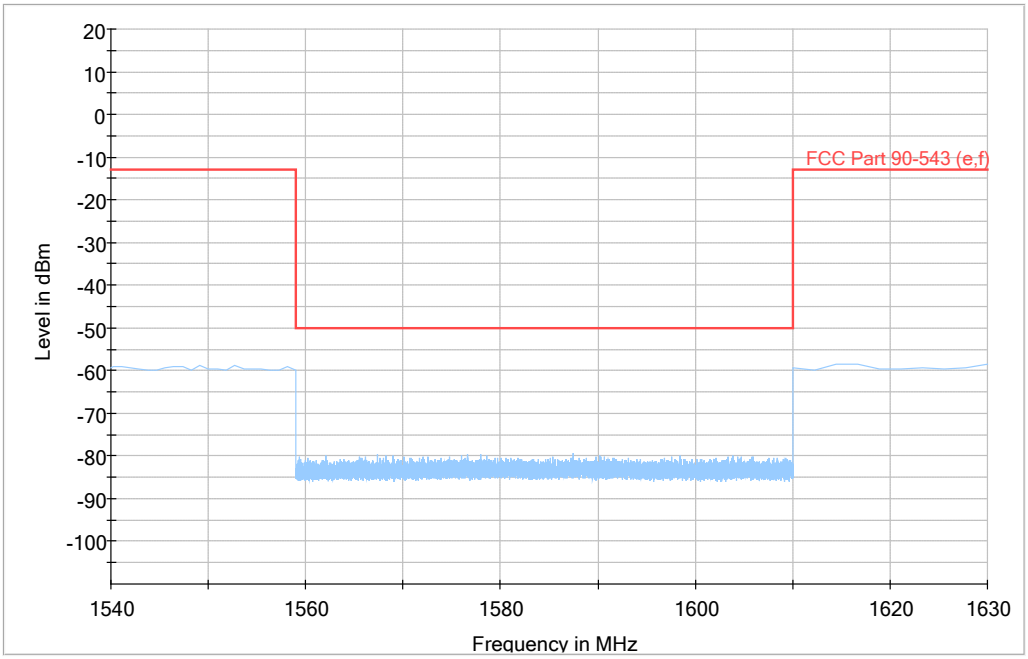
Complies?	Yes

Diagram 1a:



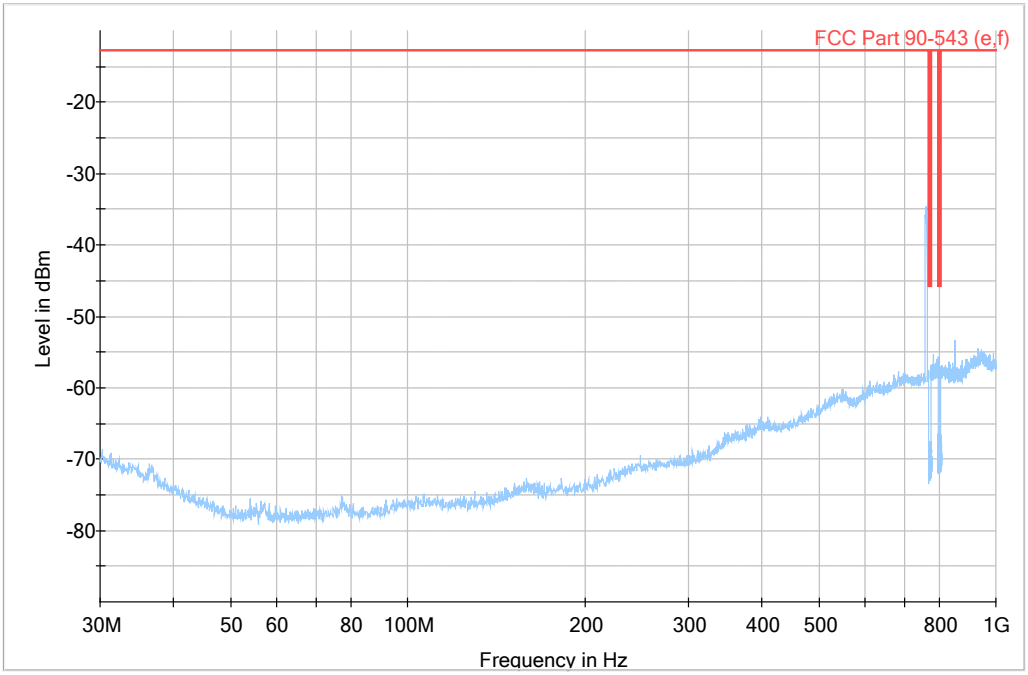
Note: The limit is adjusted with 20 dBm to compensate for the reduced measurement bandwidth.

Diagram 1b:



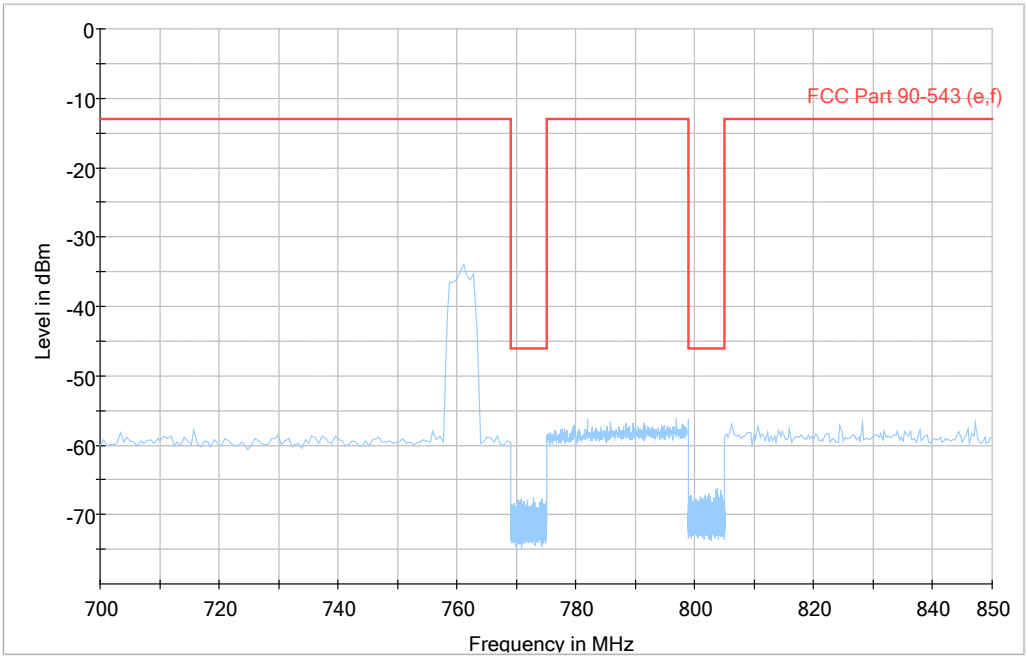
Note: Discrete emission measured with 10 kHz RBW in the frequency range 1559-1610 MHz should be less than -50 dBm.

Diagram 1c:



Note: The emission at 760.5 MHz is the carrier frequency and shall be ignored in the context.

Diagram 1d:



Note: The emission at 760.5 MHz is the carrier frequency and shall be ignored in the context.

Frequency stability measurements according to CFR 47 § 2.1055

Date	Temperature (test equipment)	Humidity (test equipment)
2017-06-16	22 °C ± 3 °C	58 % ± 5 %
2017-06-18	22 °C ± 3 °C	61 % ± 5 %
2017-06-19	22 °C ± 3 °C	31 % ± 5 %
2017-06-20	23 °C ± 3 °C	39 % ± 5 %
2017-06-27	22 °C ± 3 °C	22 % ± 5 %

Test set-up and procedure

The measurement was made per 3GPP TS 36.141. The output was connected to a spectrum analyser. The spectrum analyser 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) (for 4x 4MIMO -19 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	SP 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 763 MHz (M) with a bandwidth of 5 MHz. Rated output power level at connector RF A (maximum): 46 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
40.8	+20	12
55.2	+20	11
48	+20	11
48	+30	14
48	+40	14
48	+50	13
48	+10	12
48	0	13
48	-10	16
48	-20	15
48	-30	14
Maximum freq. error (Hz)		16
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Rated output power level at connector RF A (maximum): 46 dBm

Test conditions			Frequency margin to band edge at -19dBm			
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 (758 MHz) [kHz]	fH [MHz]	Offset to upper band edge (768 MHz) [kHz]
-48.0	+20	5	758.033	33	767.962	38
-48.0	+20	10	758.246	246	767.762	238

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

In Part 90 Subpart R §90.539 there are no Frequency stability requirements defined for equipment operating in the frequency range 758-768 MHz defined, nor in Part 90 Subpart I General Technical Standards §90.213.
The measurements of frequency stability shows that the frequency stability is <0.03 ppm and good enough to guarantee that the transmitted carrier stays within to operating frequency band and the measured

Complies?	Yes

Photos of test object

Front side

Rear side

Left side

Right side

Bottom side

Top side

Test object label:

SFP module: