REPORT

issued by an Accredited Testing Laboratory

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Date	Reference	Page
2017-10-11	7P05637-L	1 (71)

Testing

Ericsson AB
Anders Karlsson
BURA DURA RP QRM
Torshamnsgatan 21
164 80 Stockholm

Radio measurements on Radio 4478 B71 equipment with FCC ID TA8AKRC161699

Product name: Radio 4478 B71
Product number: KRC 161 699/1 and KRC 161 699/3

RISE Research Institutes of Sweden AB
Electronics - EMC

Performed by


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Date & Time: 2017-10-12 11:22:17 +02:00

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Monika Fuller

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

Summary

Standard Listed part of	Compliant
FCC CFR 47 part 27	
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 B71 Product number KRC 161 699/1 and KRC 161 699/3 FCC ID: TA8AKRC161699
Hardware revision state:	R1B
Tested configuration:	Single RAT LTE
Frequency bands: 3GPP B71:	TX: 617 – 652 MHz RX: 663 – 698 MHz
IBW:	35 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, 1-6 carriers/ port TX Diversity, 2x2 MIMO, 4x4 MIMO, Contiguous Spectrum (CS), intra band Carrier Aggregation (CA)
Channel bandwidths:	5 MHz, 10 MHz, 15 MHz and 20 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.

Note: KRC 161 699/1 and KRC 161 699/3 are identical according to 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 27, April 2017
ANSI C63.26-2015
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 version 13.6.0
3GPP TS 37.141, version 13.5.0

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 9.15.0	-	BX62351
High pass filter 1-15 GHz	2018-06	504 199
High pass filter 1-20 GHz	2018-06	901 373
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)

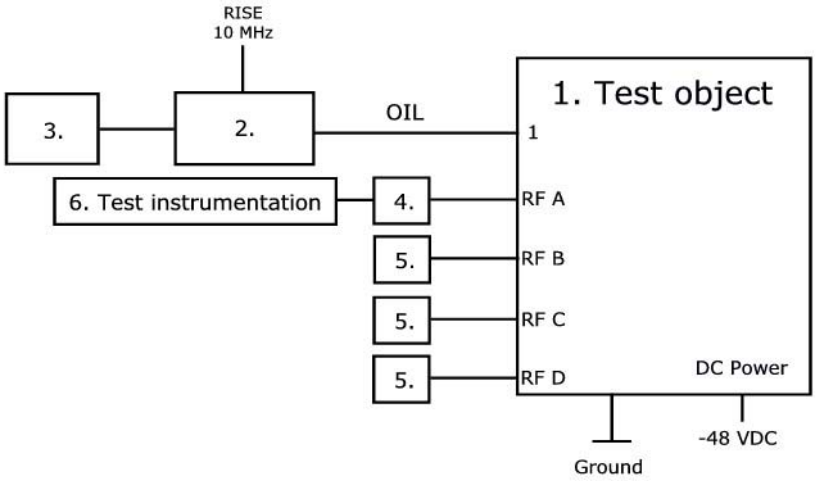
None.

Test frequencies used for radiated and conducted measurements

EARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
68610	619.5	B_5	TX bottom frequency in 5 MHz BW configuration
68635	622.0	B_{10}	TX bottom frequency in 10 MHz BW configuration
68660	624.5	B_{15}	TX bottom frequency in 15 MHz BW configuration
68685	627.0	B_{20}	TX bottom frequency in 20 MHz BW configuration
68760	634.5	$M_{5\text{-}20}$	TX mid frequency in 5-20 MHz BW configuration
68910	649.5	T_5	TX top frequency in 5 MHz BW configuration
68885	647.0	T_{10}	TX top frequency in 10 MHz BW configuration
68860	644.5	T_{15}	TX top frequency in 15 MHz BW configuration
68835	642.0	T_{20}	TX top frequency in 20 MHz BW configuration
68610 68660	619.5 624.5	B2	2 carriers TX 5 MHz configuration
68610 68660 68710 68760 68810 68860	619.5 624.5 629.5 634.5 639.5 644.5	B6	6 carriers TX 5 MHz configuration
68610 68660 68910	619.5 624.5 649.5	Bim	3 carriers TX 5 MHz configuration
68610 68860 68910	619.5 644.5 649.5	Tim	3 carriers TX 5 MHz configuration
68685 68860	627.0 644.5	$CA_{20\text{-}15}$	Carrier Aggregation TX 20 MHz and 15 MHz configuration

All RX frequencies were configured 46 MHz above the corresponding TX frequency according the applicable duplex offset for the operating band.

Test setup: conducted measurements



Test object:

1.	Radio 4478 B71, KRC 161 699/1, rev. R1B, s/n: D16X059364 With Radio Software: CXP 901 7316/7, rev. R67HA. FCC ID: TA8AKRC161699

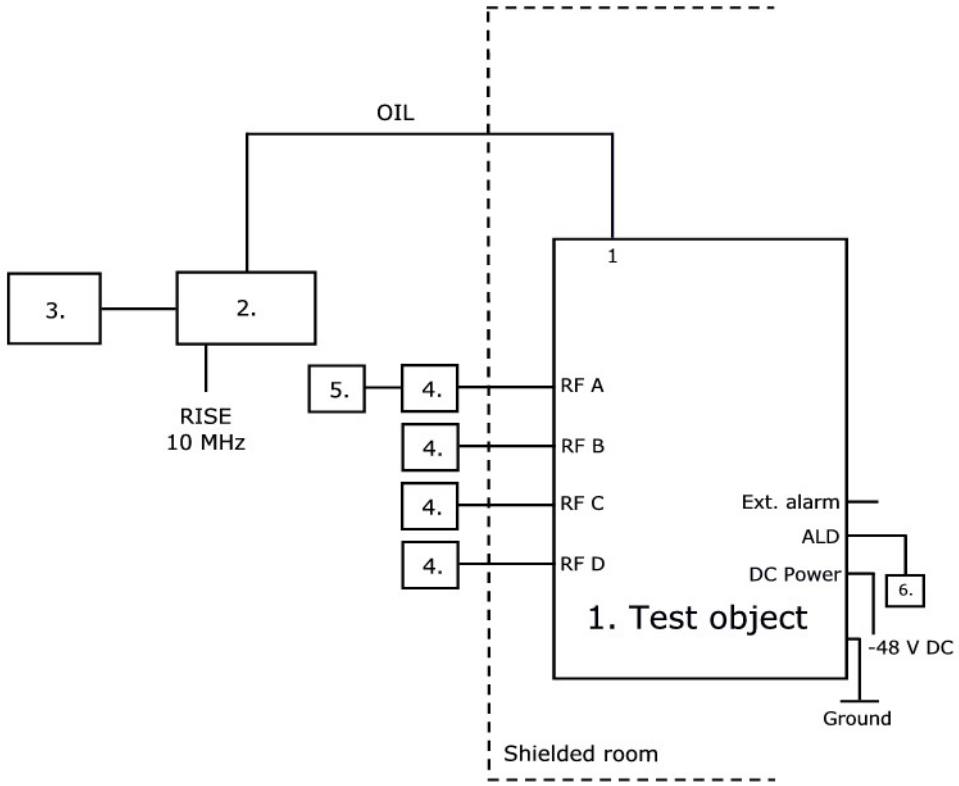
Associated equipment:

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: SP 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 4478 B71, KRC 161 699/1, rev. R1B, s/n: D16X059364 With Radio Software: CXP 901 7316/7, rev. R67HA. FCC ID: TA8AKRC161699

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.	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 §27.50, conducted

Date	Temperature	Humidity
2017-09-22	22 °C ± 3 °C	42 % ± 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 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	45.58/ 7.34	45.71/ 7.34	45.72/ 7.34	45.60/ 7.34	51.67
B_{10}	45.57/ 7.36	45.68/ 7.36	45.66/ 7.36	45.55/ 7.36	51.64
B_{15}	45.53 7.38	45.64/ 7.38	45.61/ 7.38	45.53/ 7.38	51.60
B_{20}	45.50/ 7.38	45.60/ 7.38	45.58/ 7.38	45.49/ 7.38	51.56
M_5	45.50/ 7.32	45.62/ 7.30	45.46/ 7.38	45.49/ 7.32	51.54
T_5	45.37/ 7.38	45.52/ 7.38	45.46/ 7.38	45.37/ 7.38	51.45

[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	45.58/ 7.34	45.69/ 7.34	45.68/ 7.34	45.58/ 7.34	51.65

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	45.56/ 7.34	45.69/ 7.36	45.71/ 7.36	45.60/ 7.36	51.66

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	45.53/ 7.36	45.67/ 7.36	45.65/ 7.36	45.57/ 7.36	51.63

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)]
B2	45.60/ 7.22	45.69/7.22	45.69/ 7.22	45.56/ 7.22	51.66

Multi carrier ETM 1.1 QPSK

Rated output power level at each RF port 6x 38.2 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)]
B6	45.33/ 7.26	45.49/7.38	45.48/ 7.36	45.36/ 7.38	51.44

[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]				
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
B_5	39.29	39.40	39.45	39.32	45.39
B_{10}	36.24	36.43	36.36	36.27	42.35
B_{15}	34.54	34.66	34.64	34.55	40.62
B_{20}	33.24	33.42	33.38	33.29	39.35

[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

§27.50:
(c) (4) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section;

Complies?	Yes

Occupied bandwidth measurements according to CFR47 2.1049

Date	Temperature	Humidity
2017-09-25	22 °C ± 3 °C	42 % ± 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 ETM 1.1

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
1	M_5	RF C	4.477

Single carrier ETM 3.1

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
2	M_5	RF A	4.495
3	M_5	RF B	4.493
4	B_5	RF C	4.493
5	M_5	RF C	4.495
6	M_{10}	RF C	8.973
7	M_{15}	RF C	13.470
8	M_{20}	RF C	17.896
9	T_5	RF C	4.494
10	M_5	RF D	4.494

Single carrier ETM 3.2

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
11	M_5	RF C	4.479

Single carrier ETM 3.1a

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
12	M_5	RF C	4.486

Carrier Aggregation ETM 3.1

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
13	$CA_{20\text{-}15}$	RF C	32.970

Diagram 1:

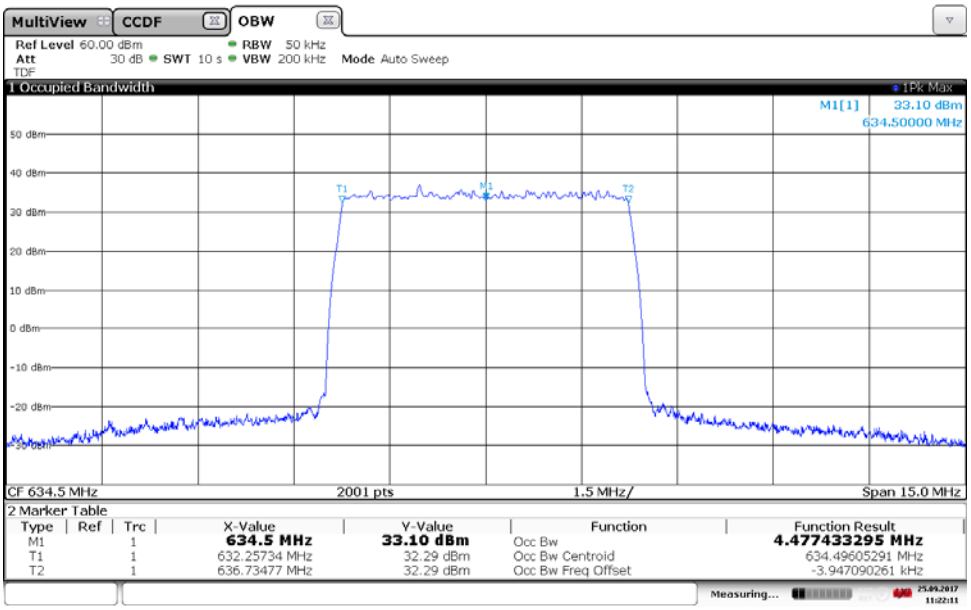


Diagram 2:

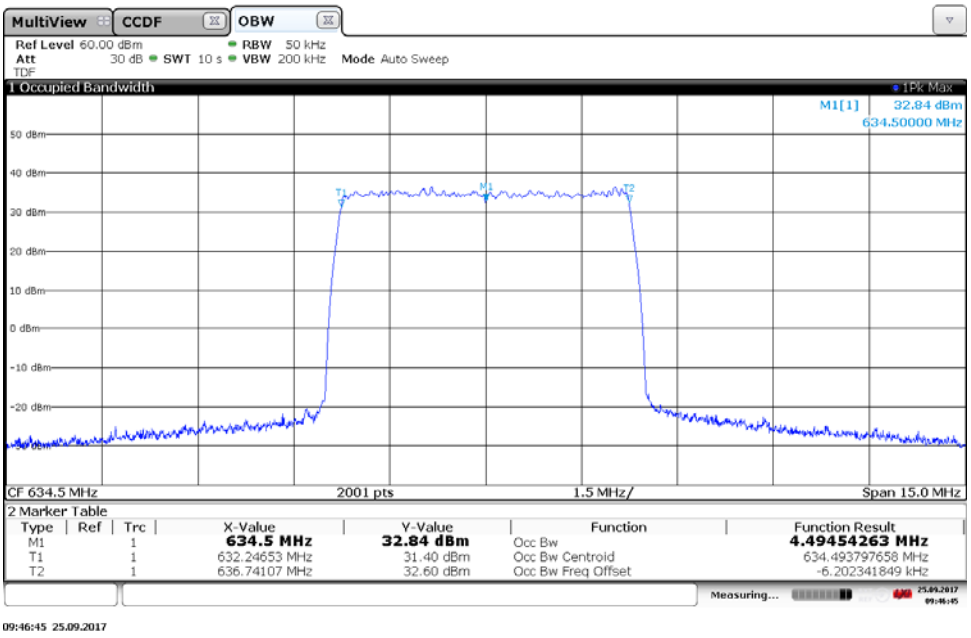


Diagram 3:

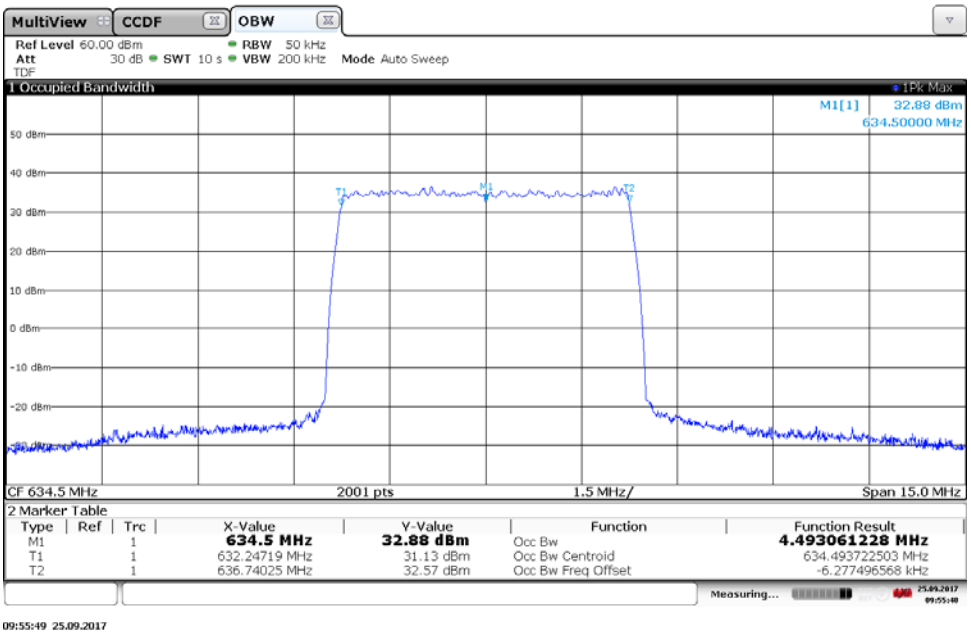


Diagram 4:

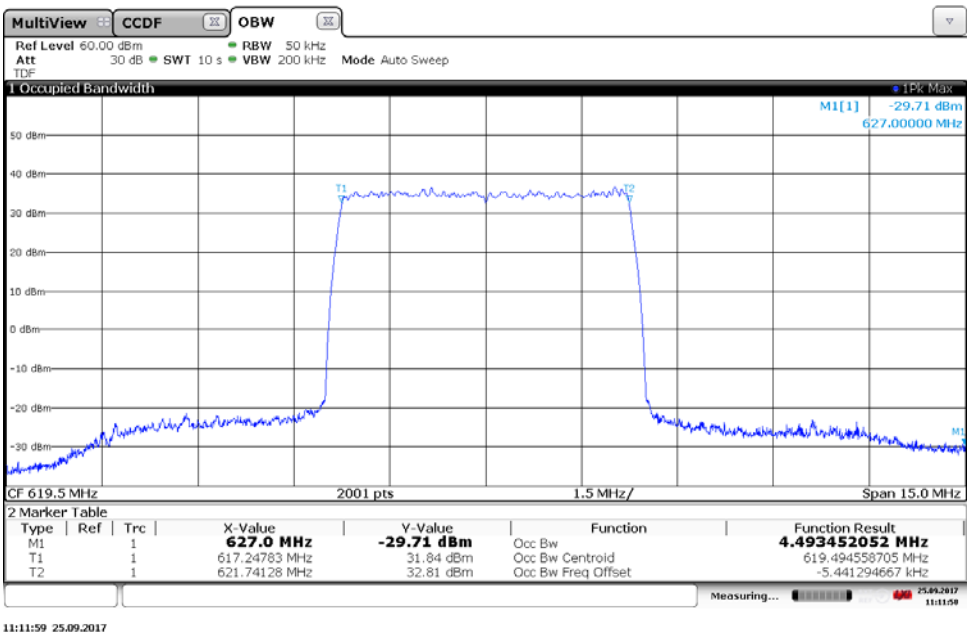


Diagram 5:

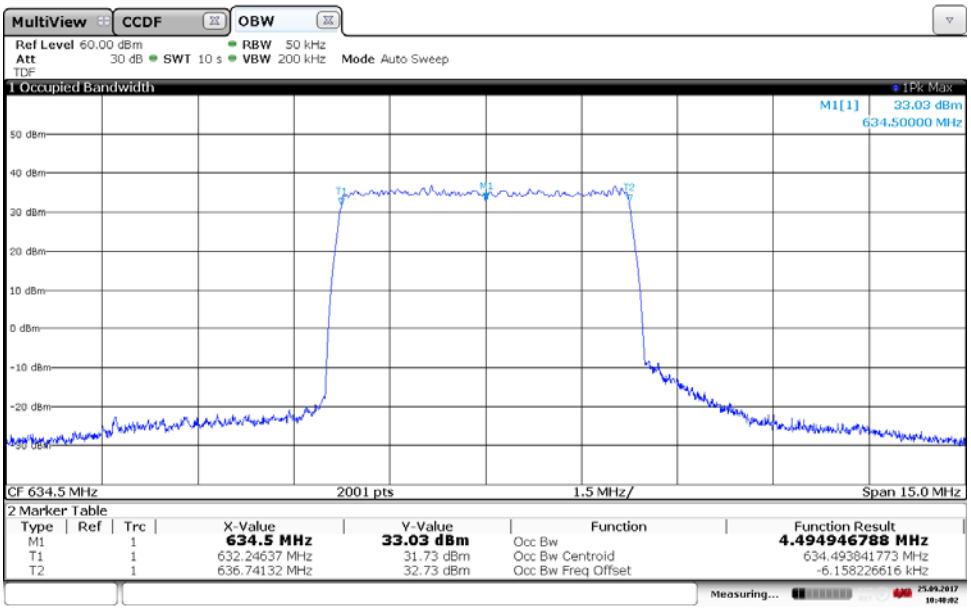


Diagram 6:

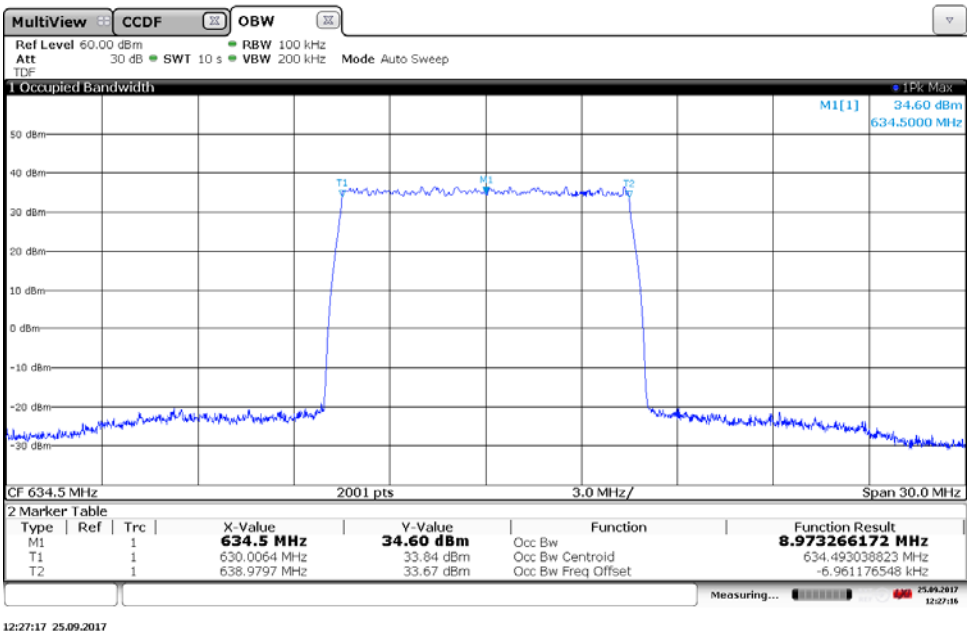


Diagram 7:

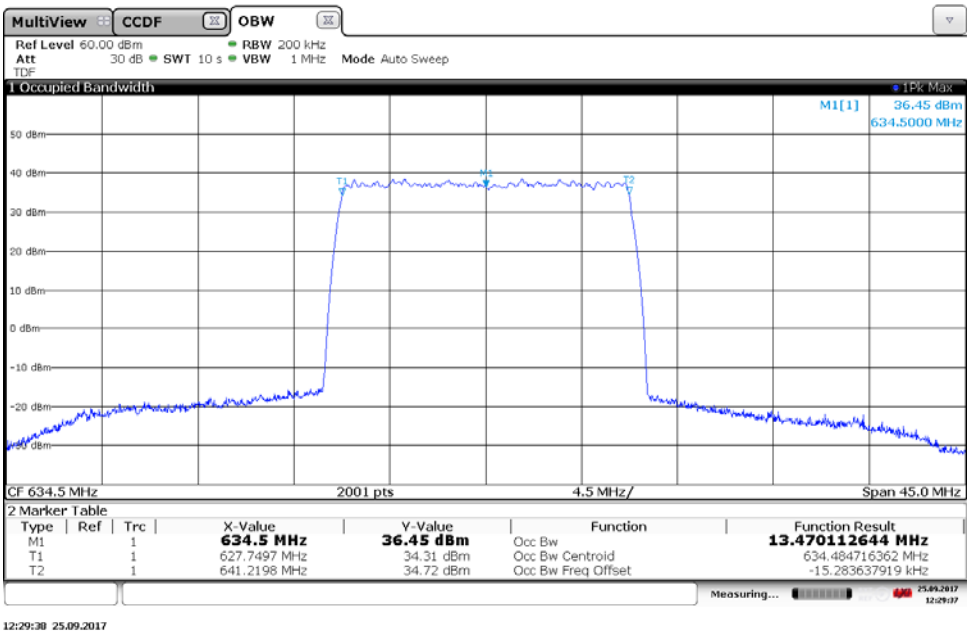


Diagram 8:

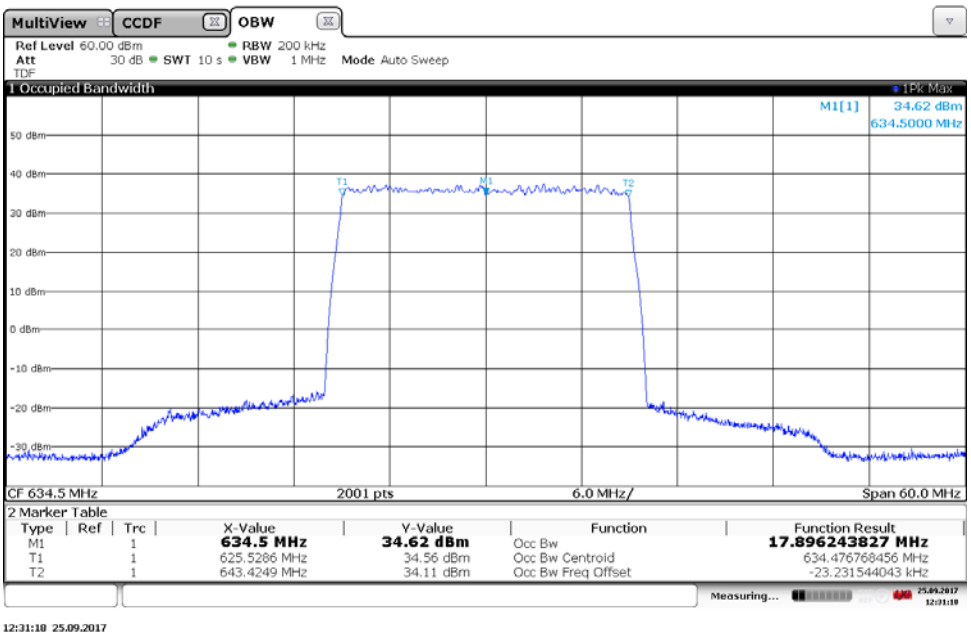


Diagram 9:

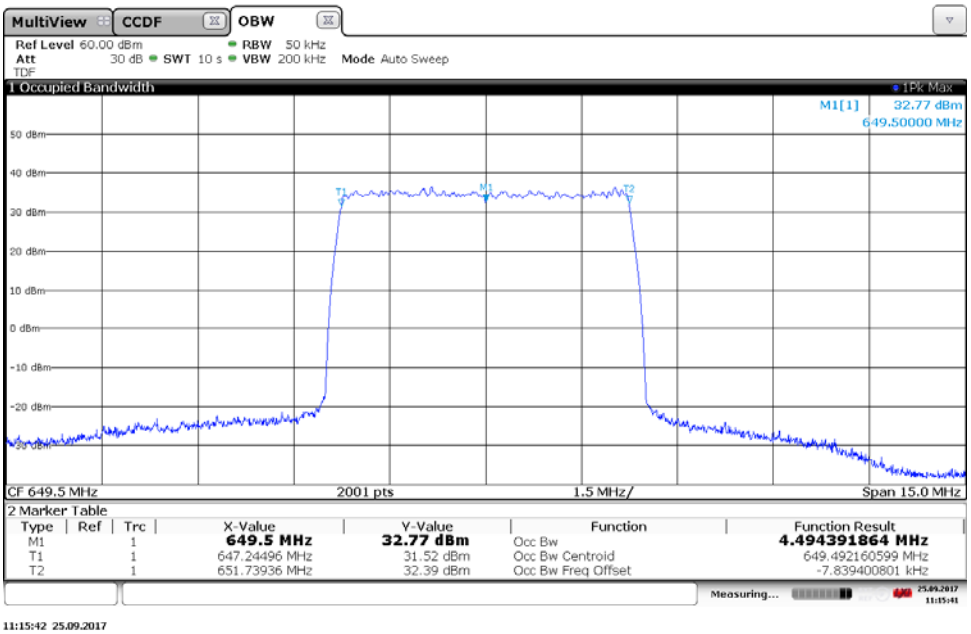


Diagram 10:

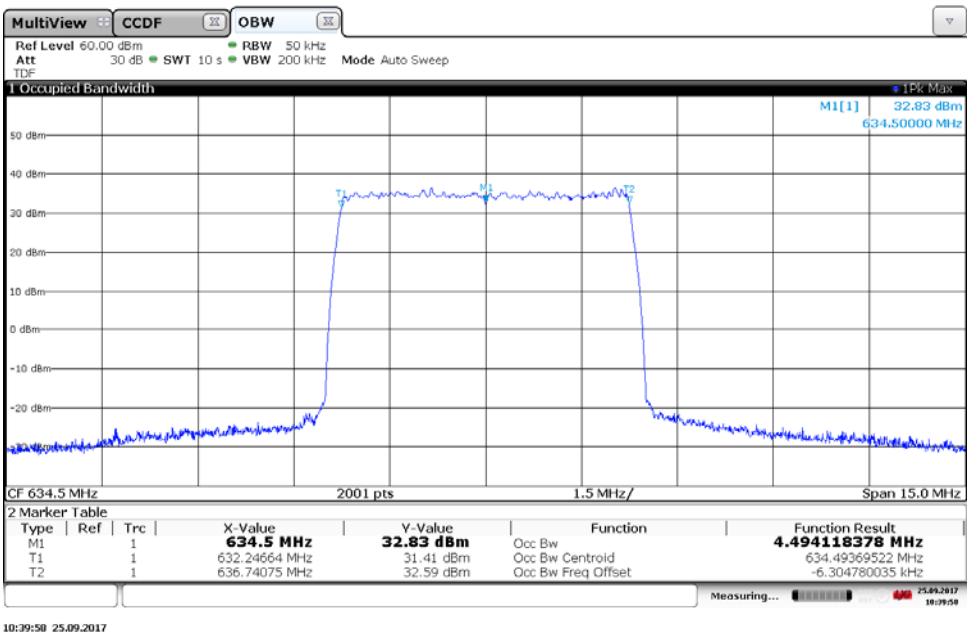


Diagram 11:

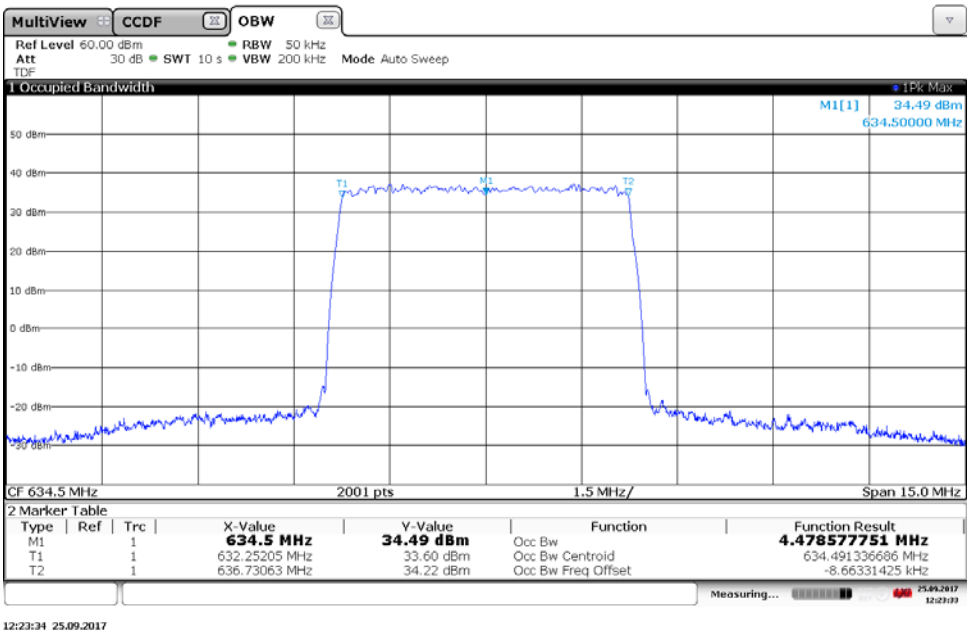


Diagram 12:

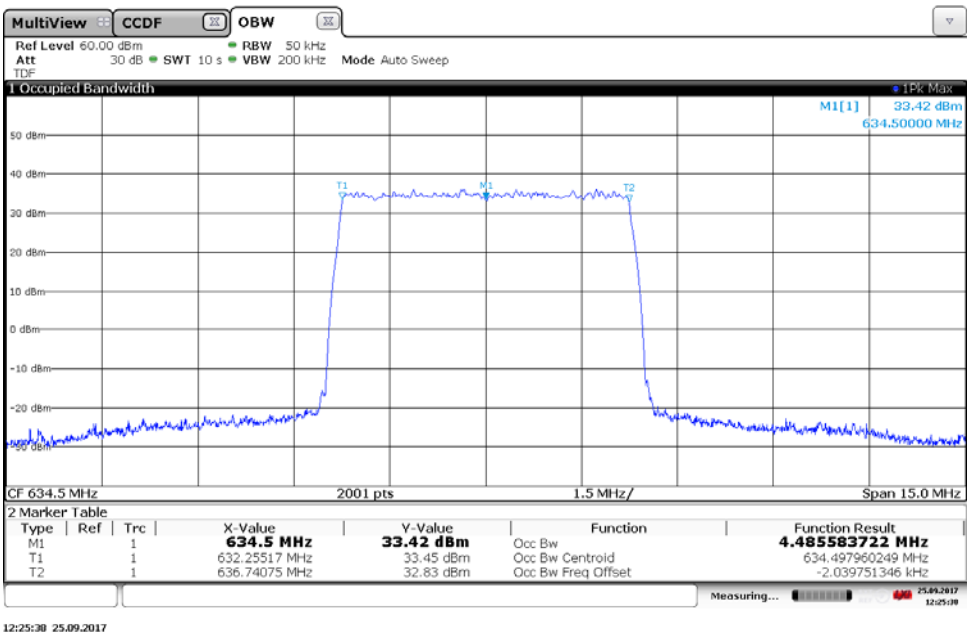
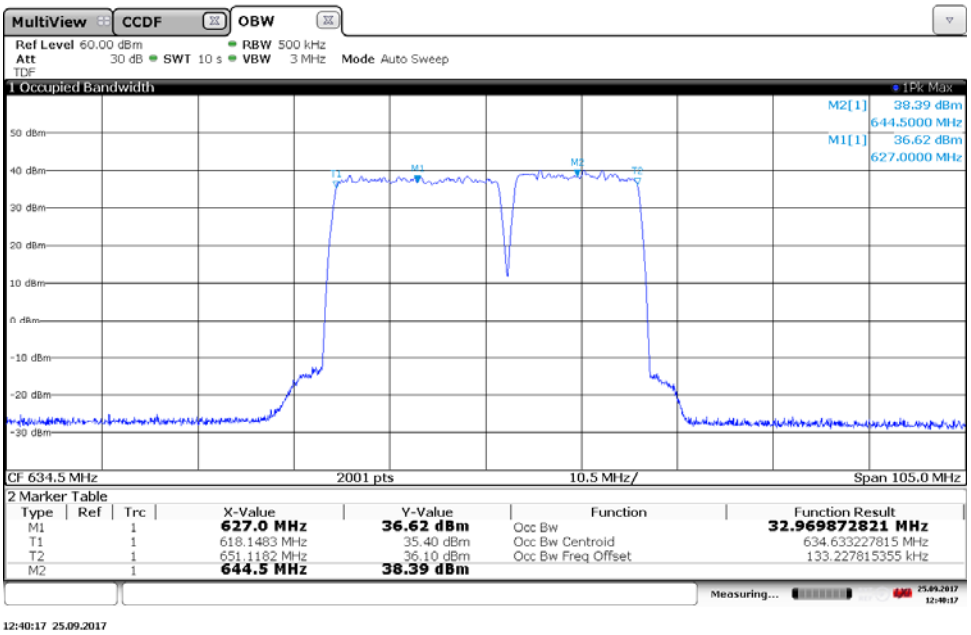


Diagram 13:


MultiView
CCDF
OBW
Ref Level 60.00 dBm
RBW 500 kHz
Att 30 dB SWT 10 s VBW 3 MHz Mode Auto Sweep
TDF
1 Occupied Bandwidth
1Pk Max
M2[1] 38.39 dBm
644.5000 MHz
M1[1] 36.62 dBm
627.0000 MHz
50 dBm
40 dBm
30 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
CF 634.5 MHz
2001 pts
10.5 MHz/
Span 105.0 MHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 627.0 MHz 36.62 dBm Occ Bw 32.969872821 MHz
T1 1 618.1483 MHz 35.40 dBm Occ Bw Centroid 634.633227815 MHz
T2 1 651.1182 MHz 36.10 dBm Occ Bw Freq Offset 133.227815355 kHz
M2 1 644.5 MHz 38.39 dBm
Measuring...
12:40:17 25.09.2017

Band edge measurements according to CFR 47 §2.1049

Date	Temperature	Humidity
2017-09-25	22 °C ± 3 °C	42 % ± 5 %

Test set-up and procedure

The measurements were made per definition in CFR 47 §27.53.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(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output.

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 TM 1.1

Diagram	Symbolic name	Tested Port
1 a-b	B_5	RF A
2 a-b	B_5	RF B
3 a-b	B_5	RF C
4 a-b	B_5	RF D
5 a-b	B_{10}	RF C
6 a-b	B_{15}	RF C
7 a-b	B_{20}	RF C
8 a-b	T_5	RF A
9 a-b	T_5	RF B
10 a-b	T_5	RF C
11 a-b	T_5	RF D
12 a-b	T_{10}	RF C
13 a-b	T_{15}	RF C
14 a-b	T_{20}	RF C

Multi carrier TM 1.1

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

Limits

CFR 47 §27.53
(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a 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, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

Complies?	Yes

Diagram 1a:

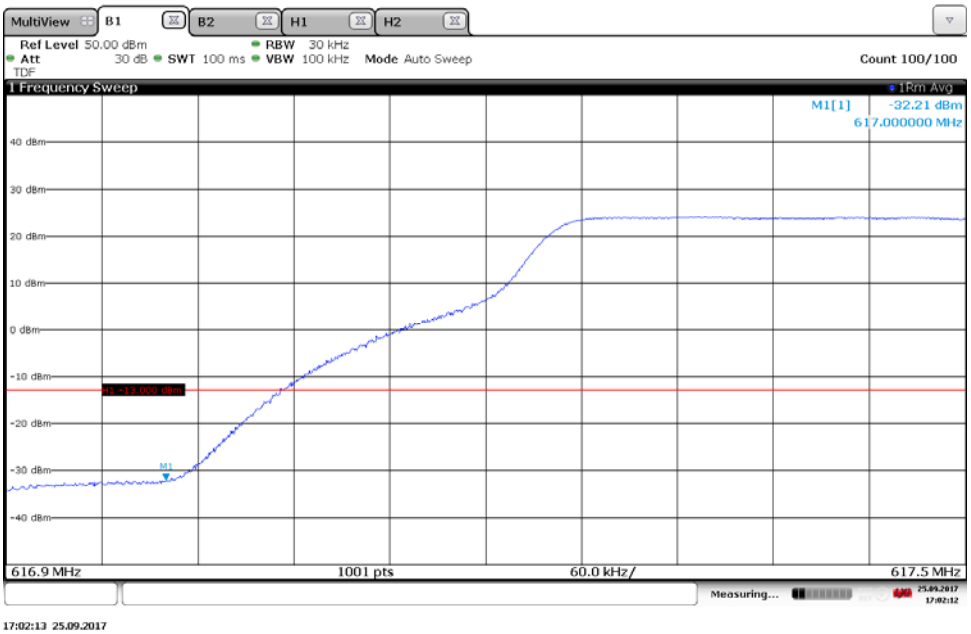


Diagram 1b:

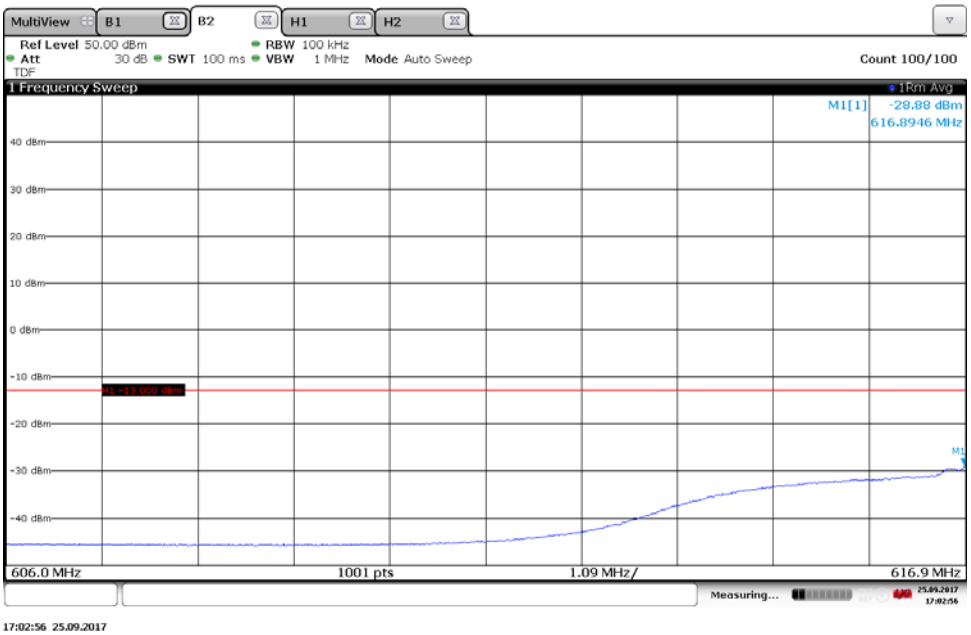


Diagram 2a:

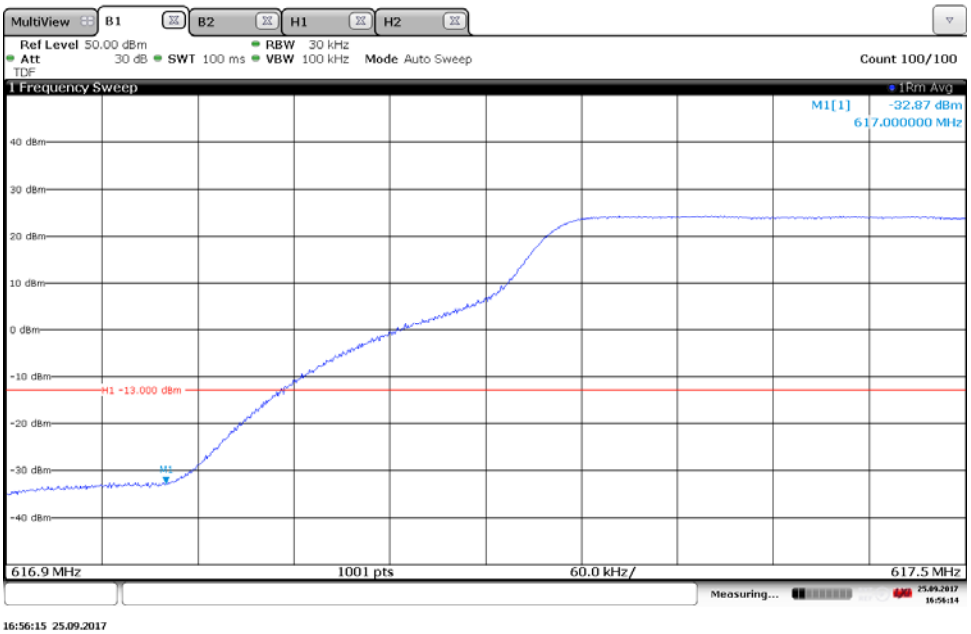


Diagram 2b:

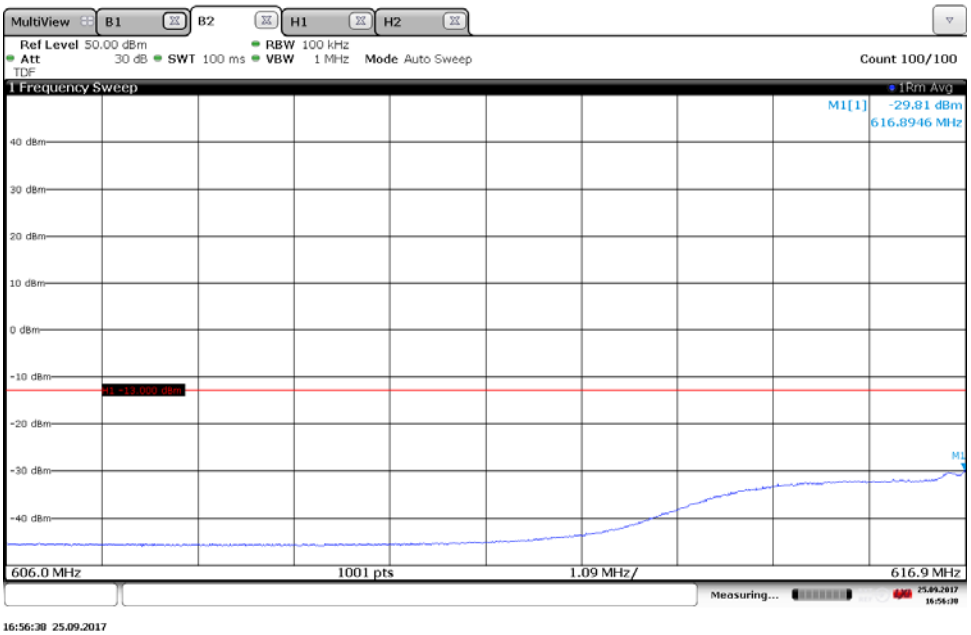


Diagram 3a:

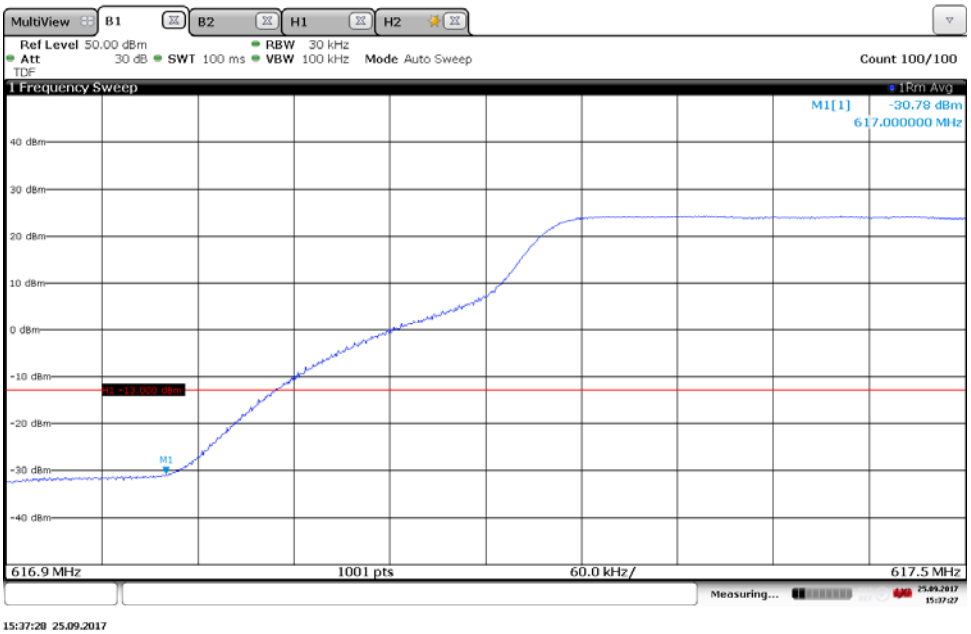


Diagram 3b:

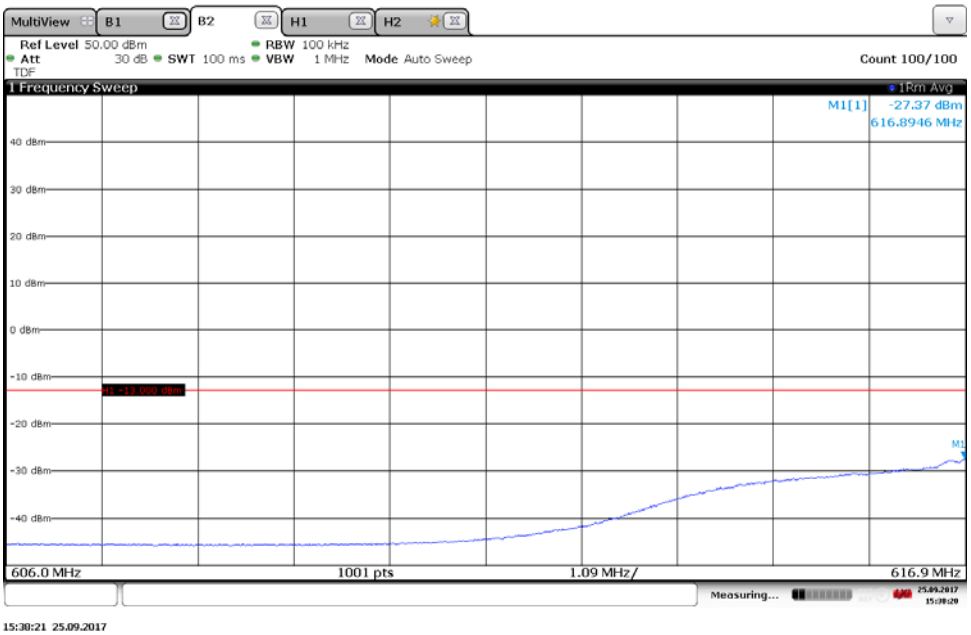


Diagram 4a:

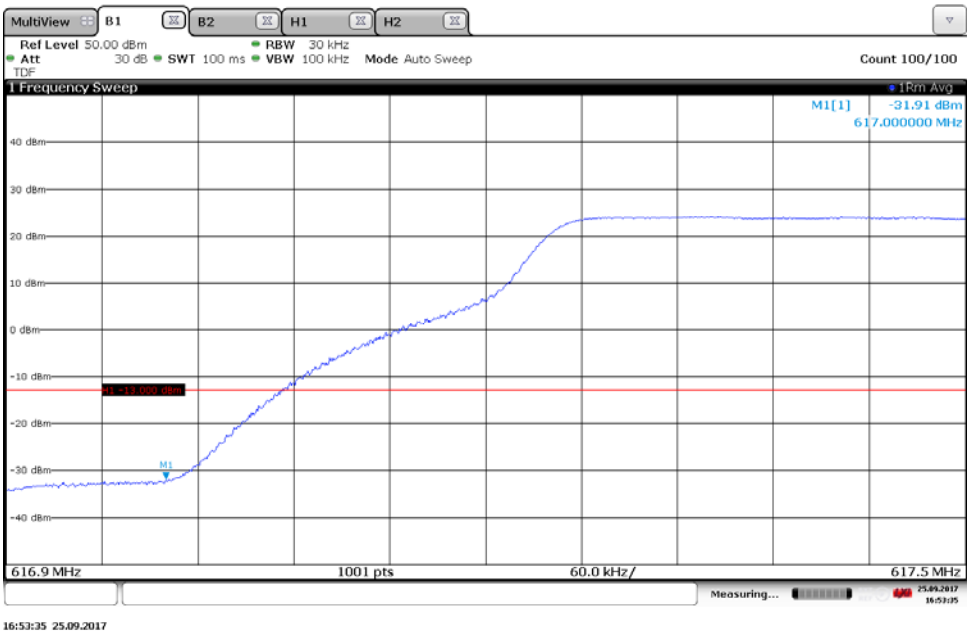


Diagram 4b:

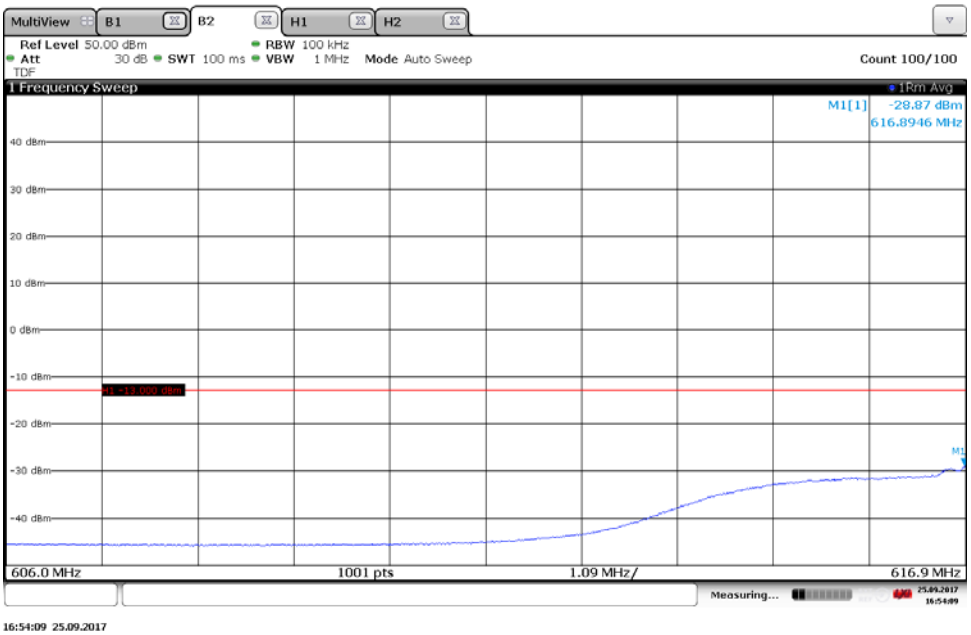
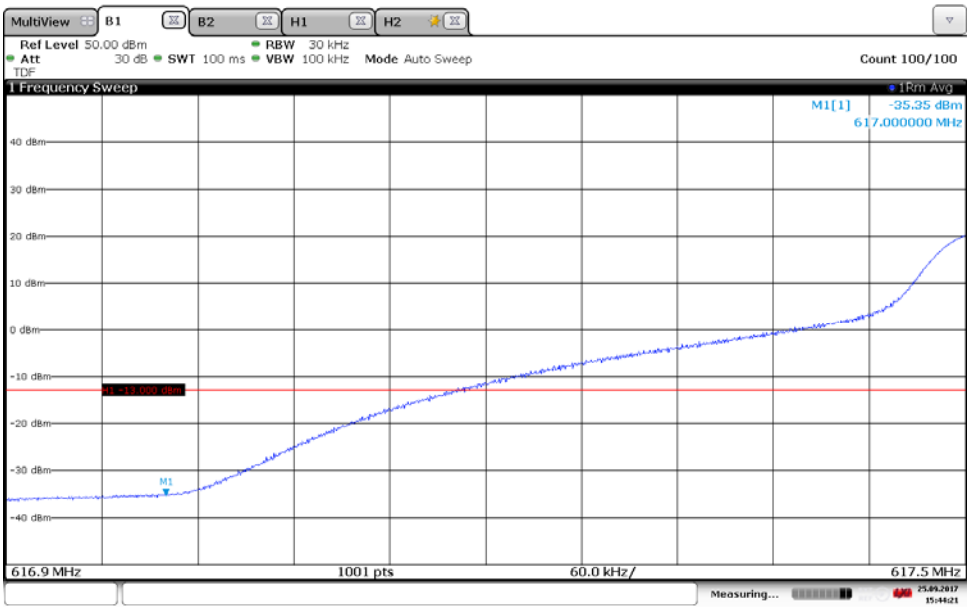
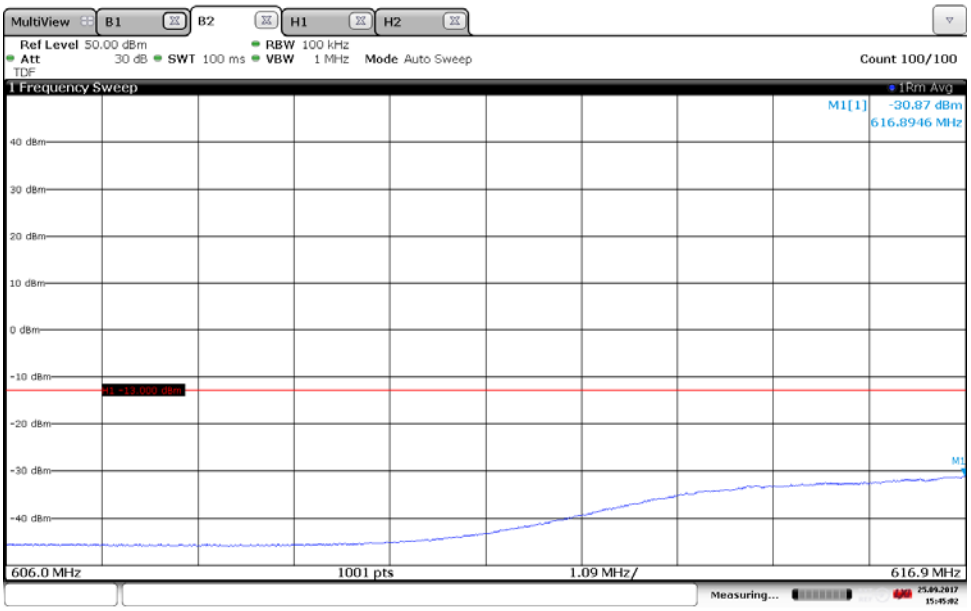


Diagram 5a:



15:44:22 25.09.2017

Diagram 5b:



15:45:02 25.09.2017

Diagram 6a:

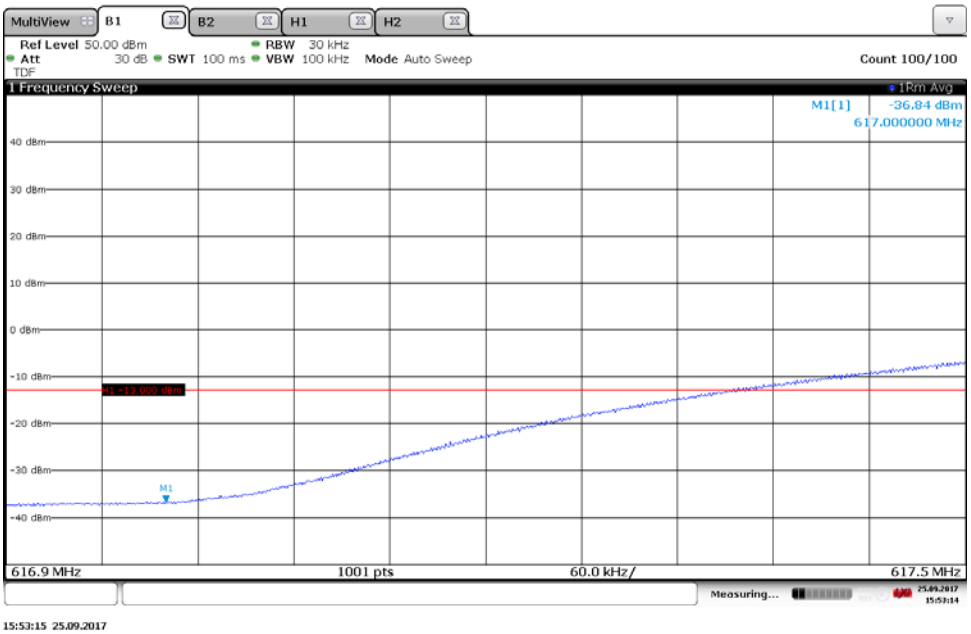


Diagram 6b:

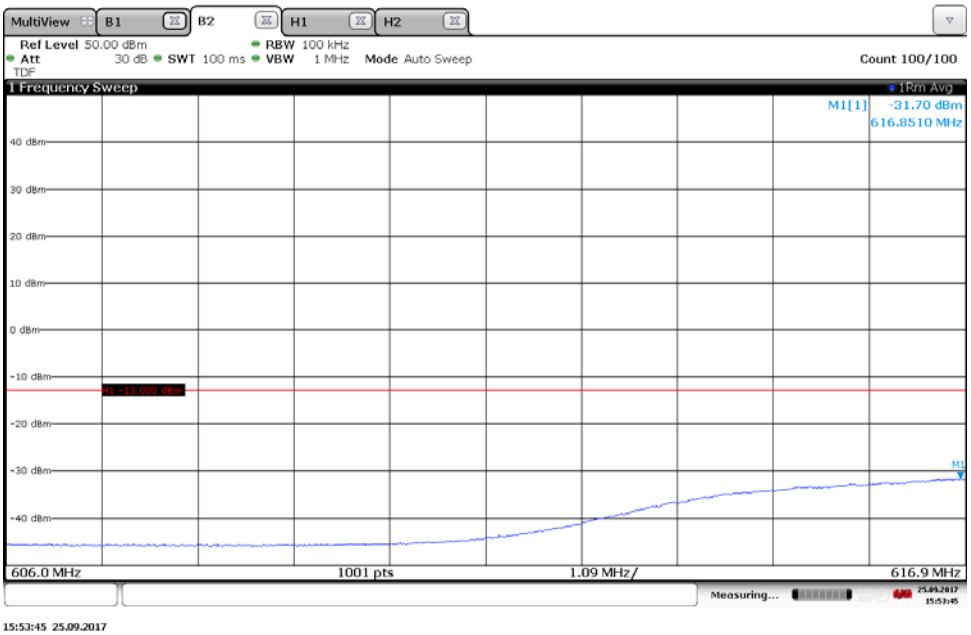


Diagram 7a:

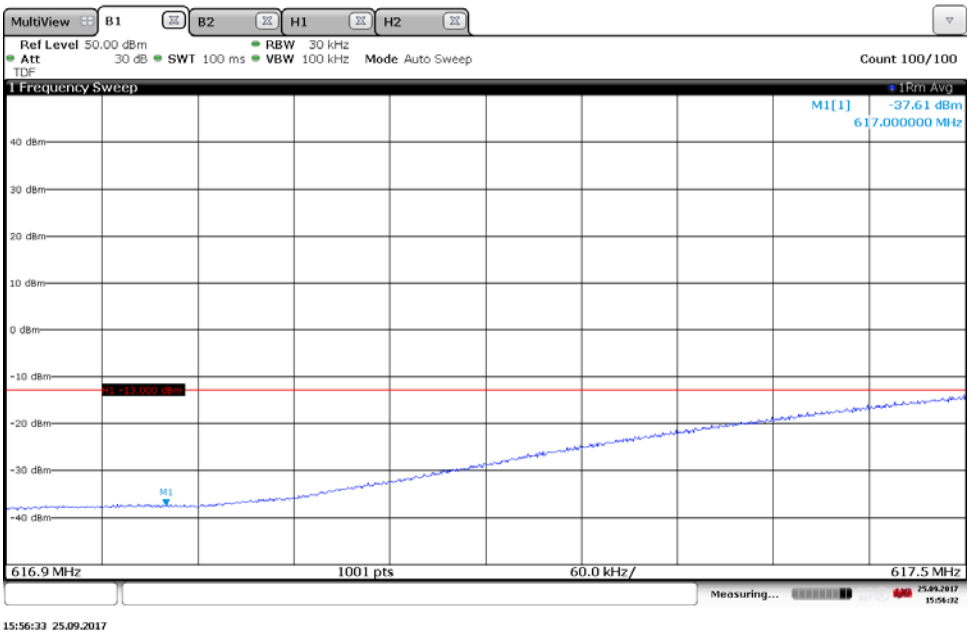


Diagram 7b:

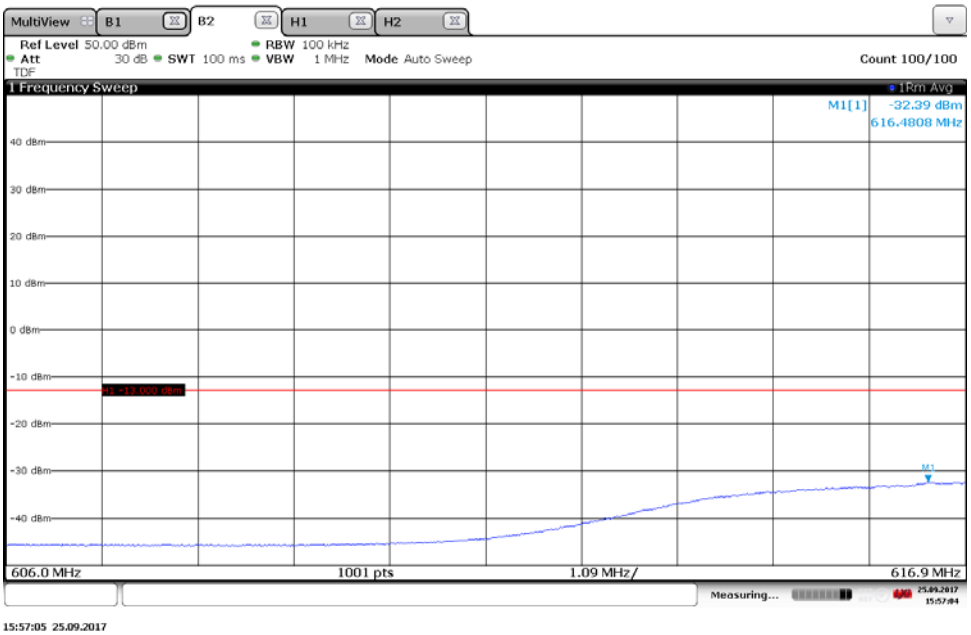


Diagram 8a:

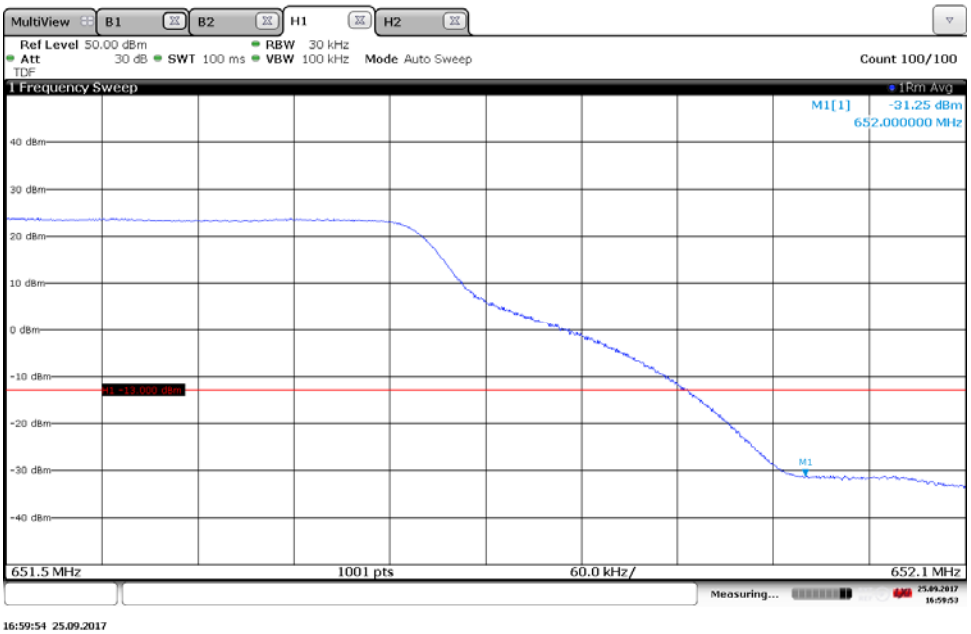


Diagram 8b:

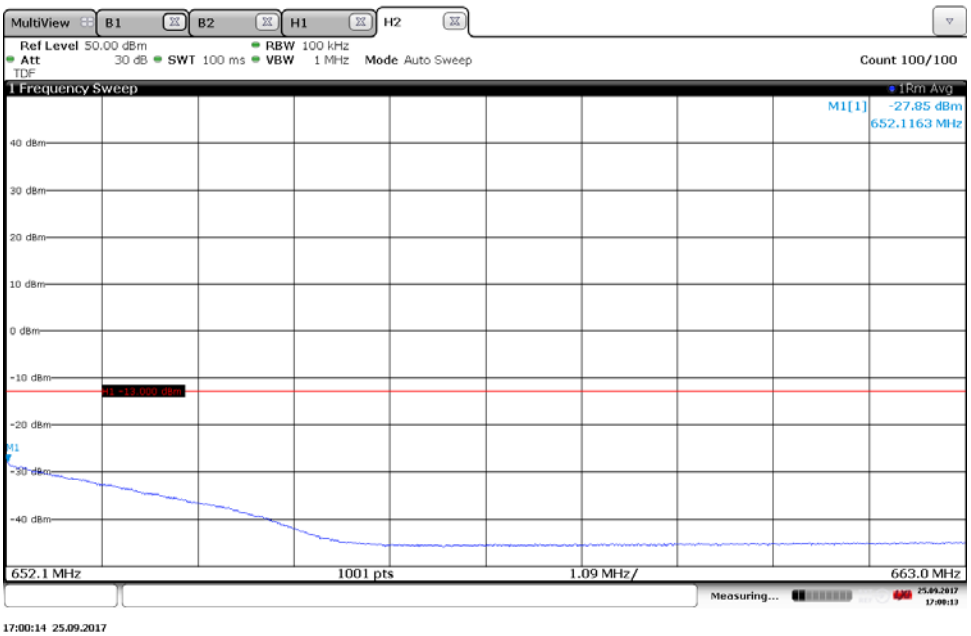


Diagram 9a:

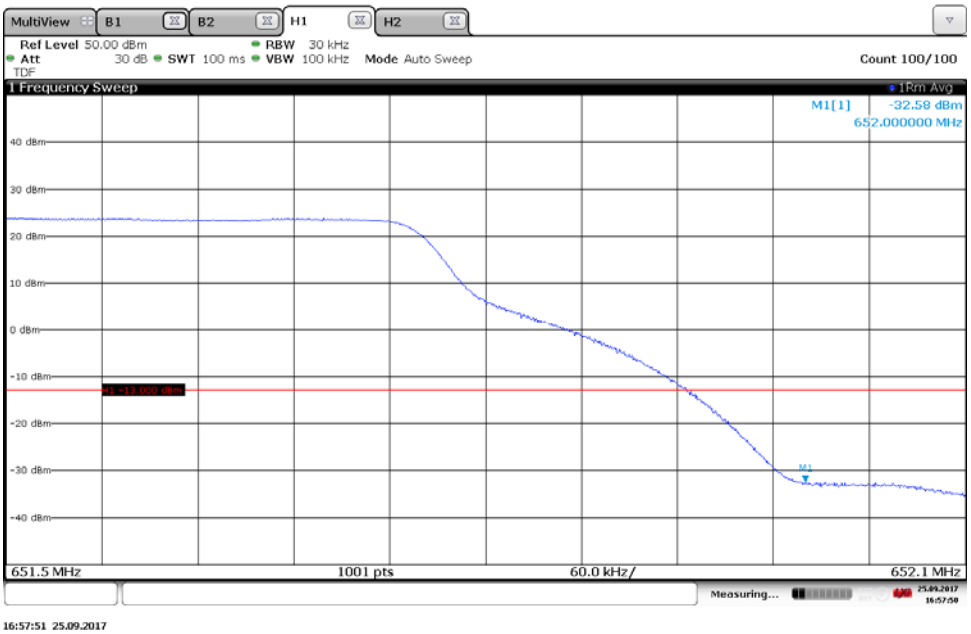


Diagram 9b:

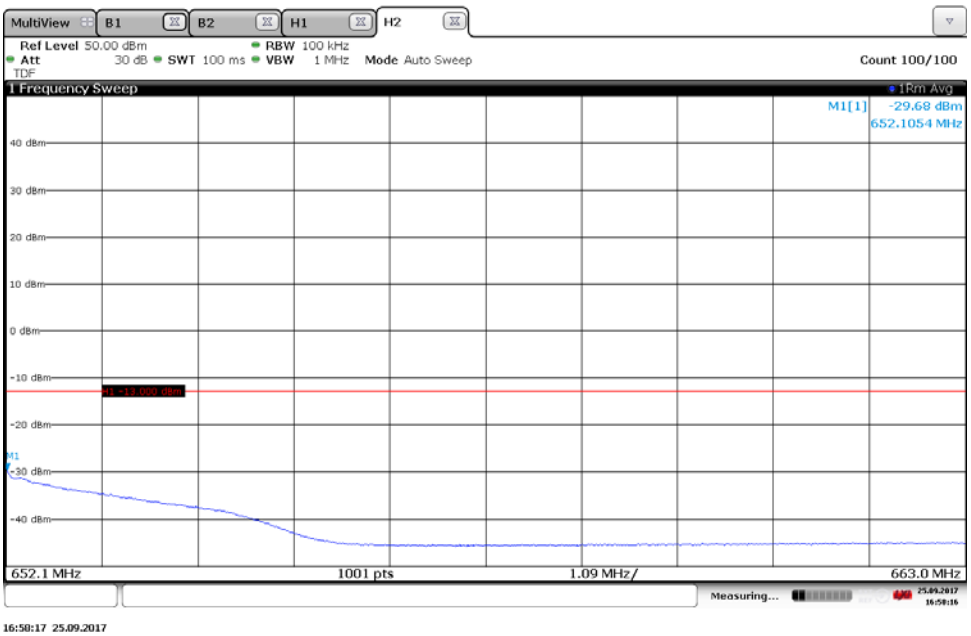
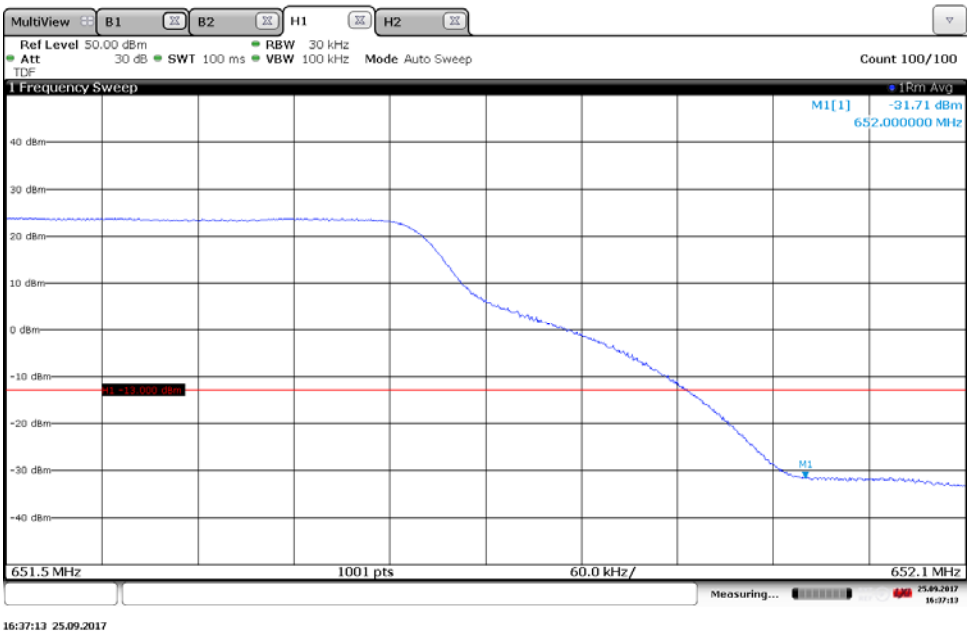
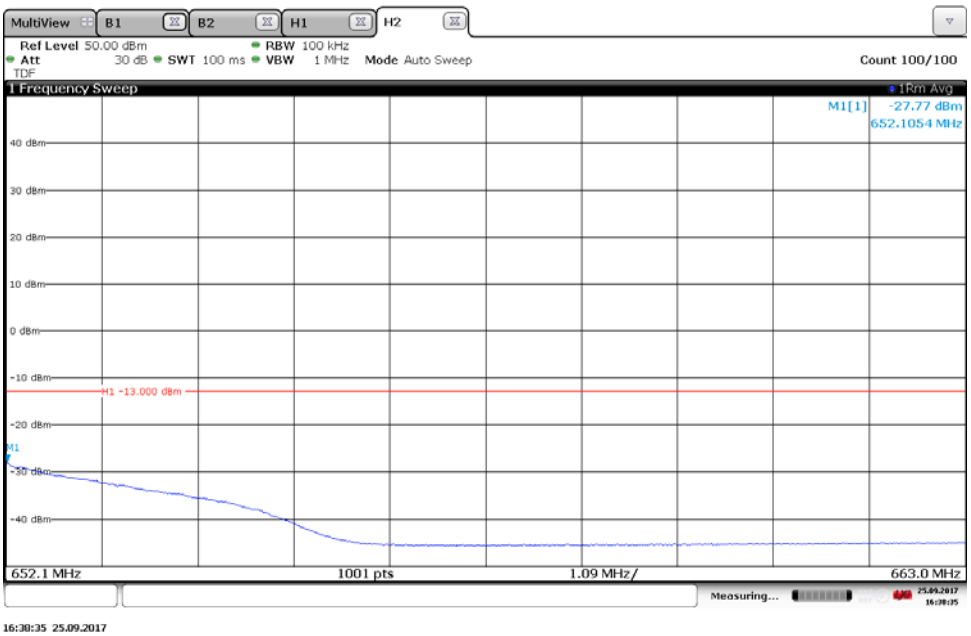


Diagram 10a:



16:37:13 25.09.2017

Diagram 10b:



16:30:35 25.09.2017

Diagram 11a:

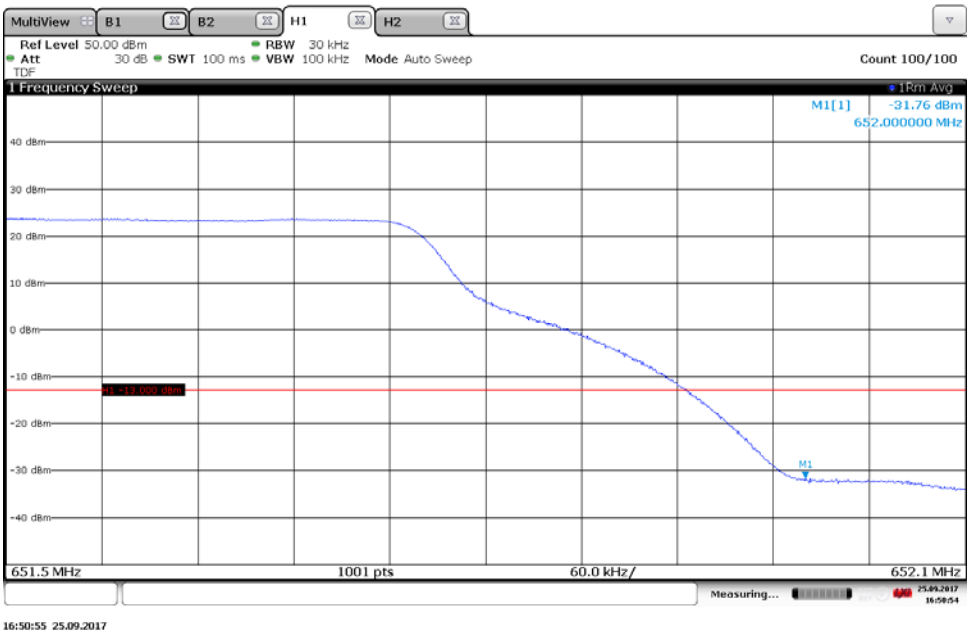


Diagram 11b:

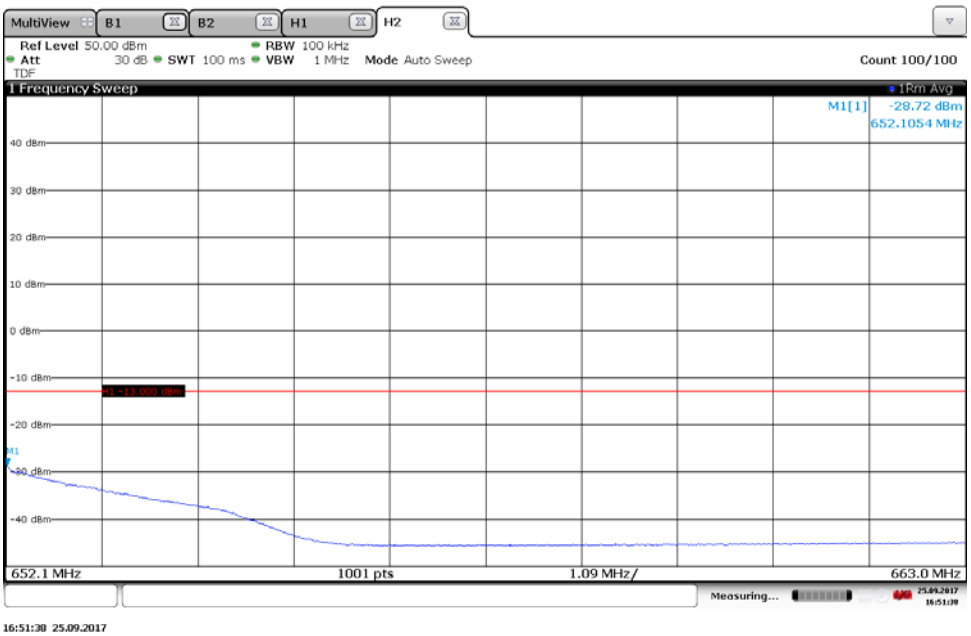


Diagram 12a:

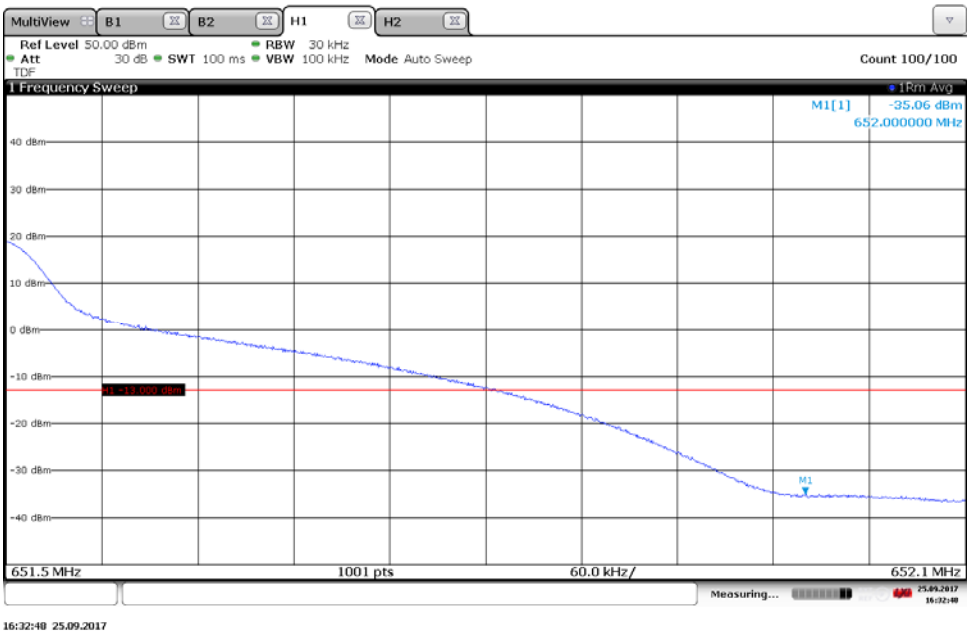


Diagram 12b:

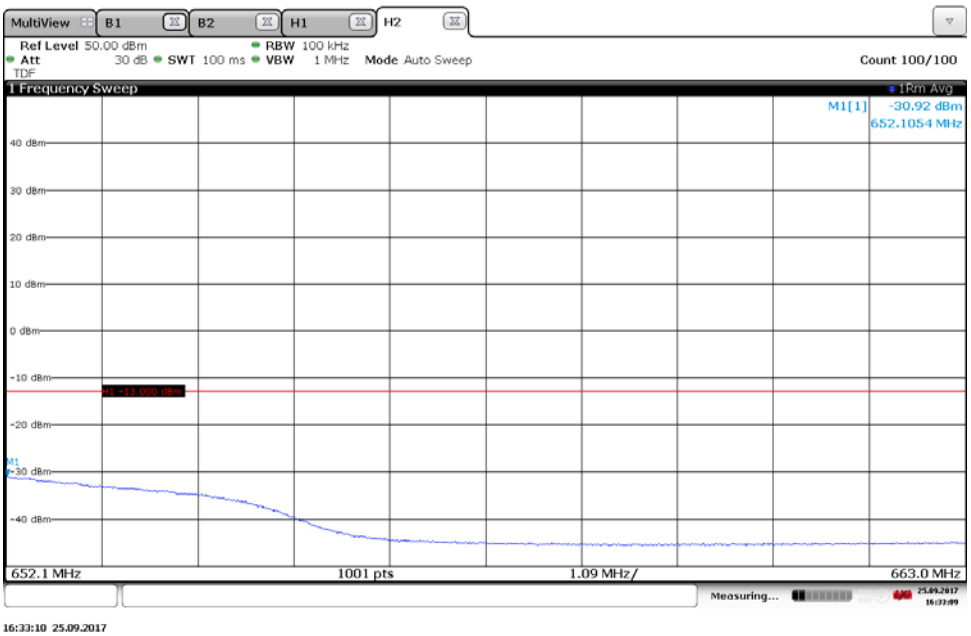


Diagram 13a:

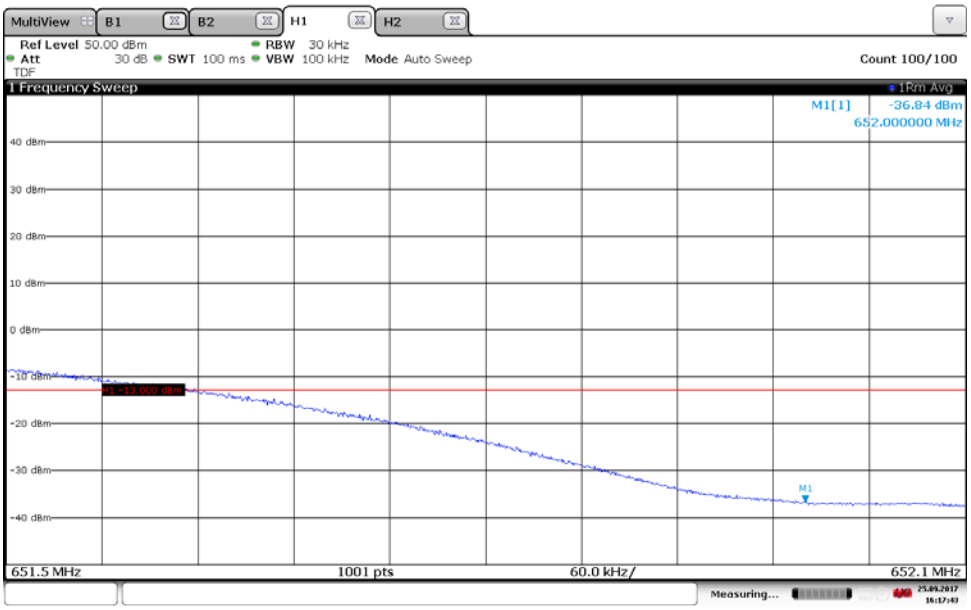


Diagram 13b:

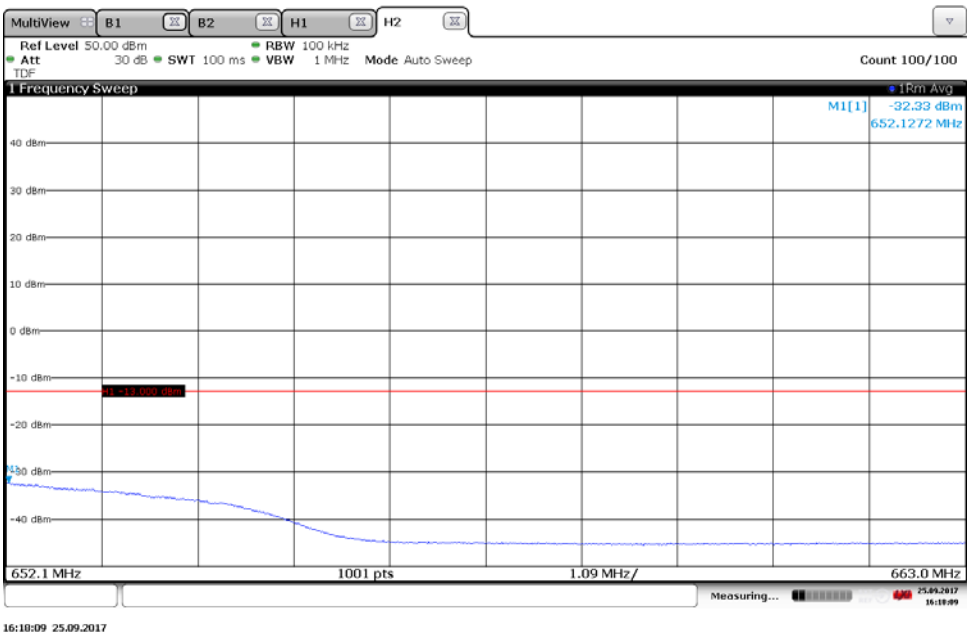


Diagram 14a:

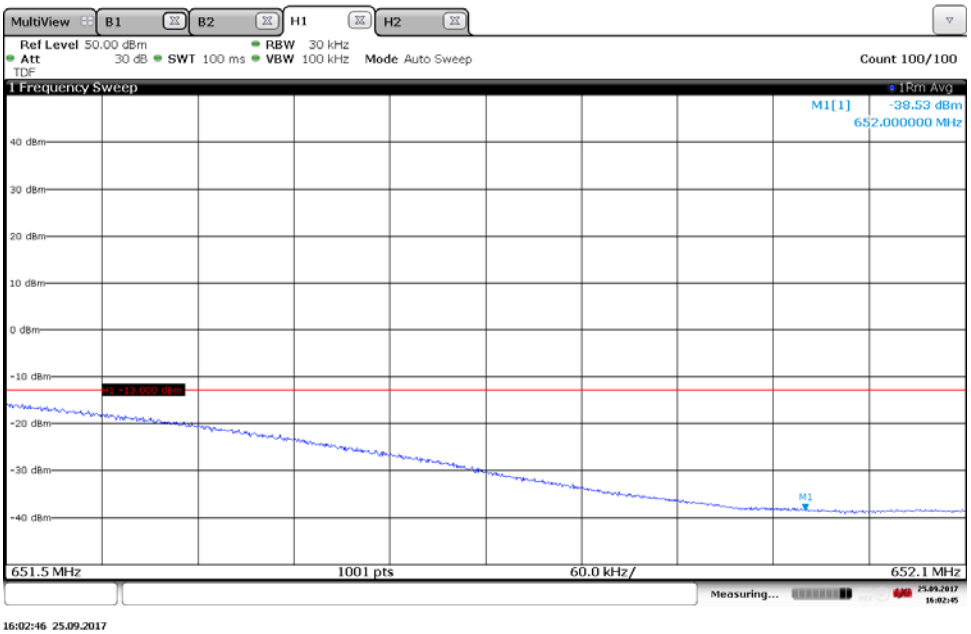
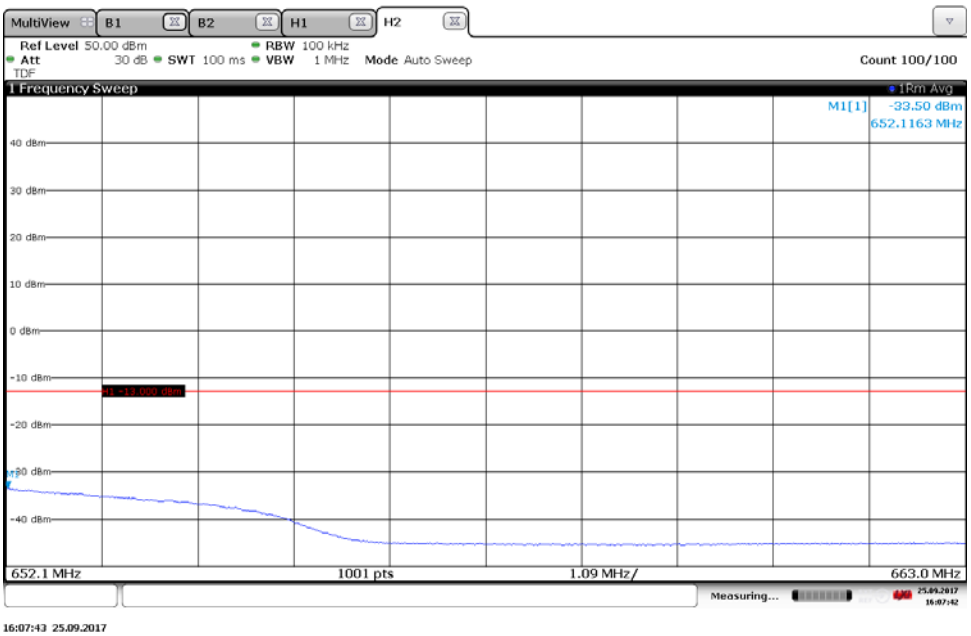


Diagram 14b:



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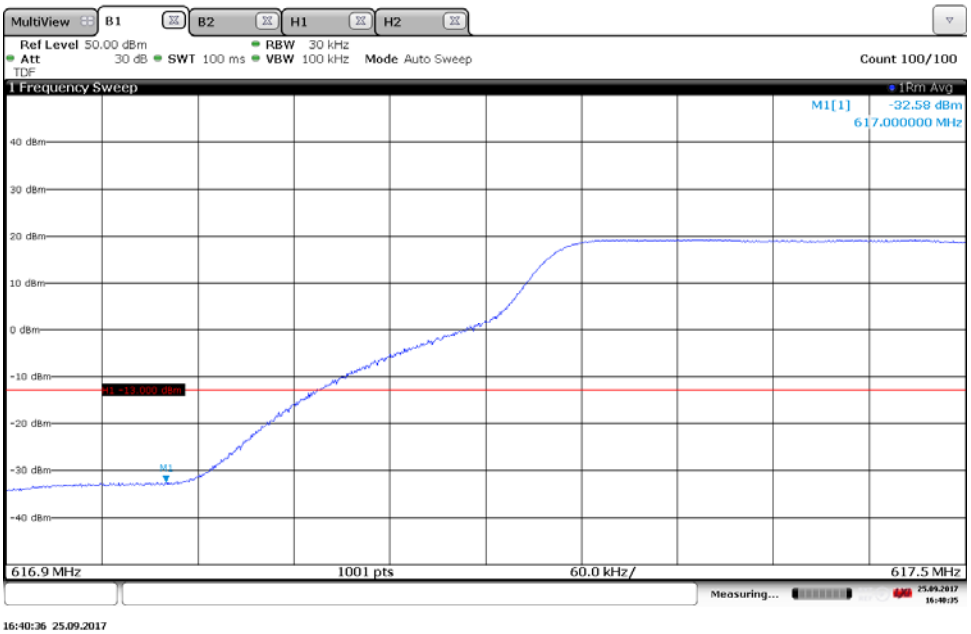

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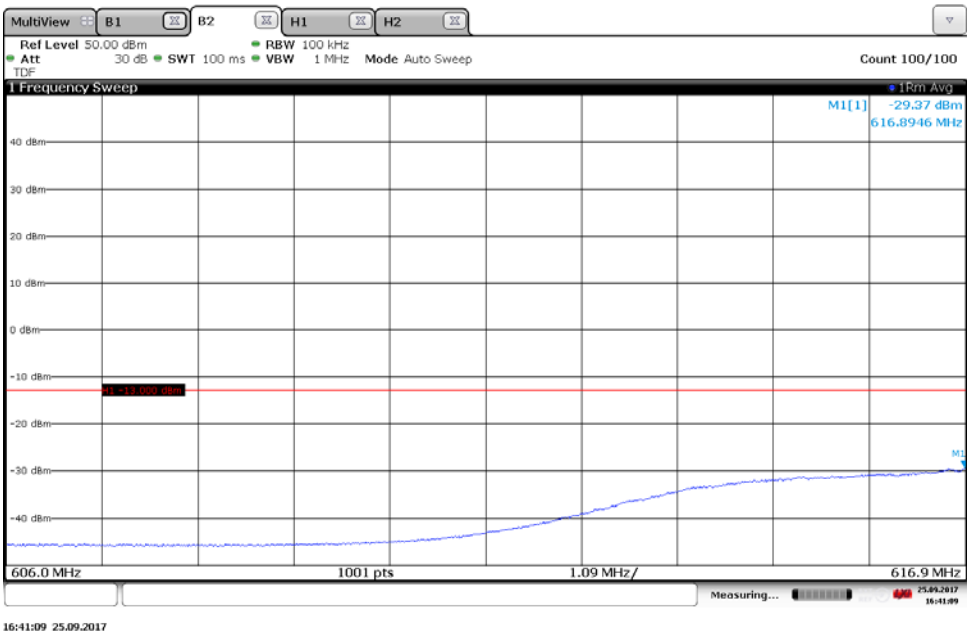
Diagram 15b:



16:41:09 25.09.2017

Diagram 16a:

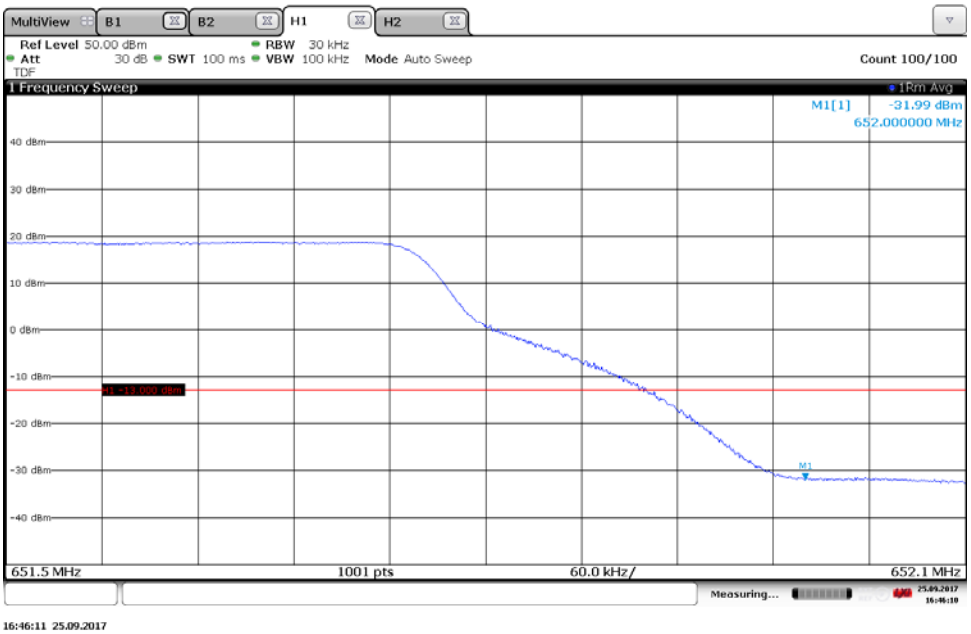
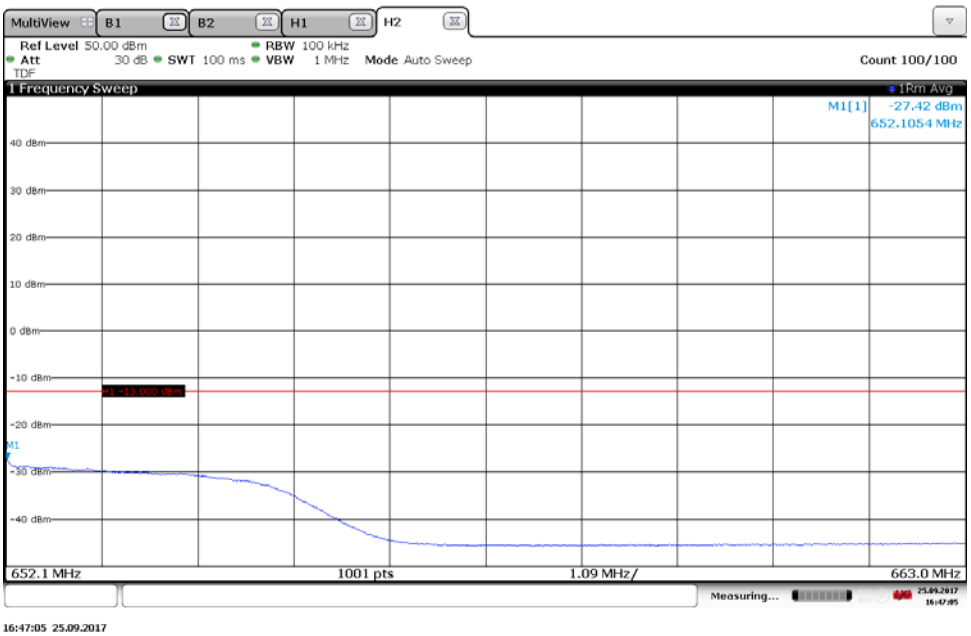


Diagram 16b:



Conducted spurious emission measurements according to CFR 47 §27.53

Date	Temperature	Humidity
2017-09-26	22 °C ± 3 °C	46 % ± 5 %
2017-10-05	22 °C ± 3 °C	30 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53. 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(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output.

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	900 691
HP filter	901 373
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Single carrier E-TM 1.1

Diagram	Symbolic name	Tested Port
1 a-b	B_5	RF C
2 a-b	M_5	RF C
3 a-b	T_5	RF C
4 a-b	M_{10}	RF C
5 a-b	M_{15}	RF C
6 a-b	M_{20}	RF C
7 a-b	M_5	RF A
8 a-b	M_5	RF B
9 a-b	M_5	RF D

Multi carrier E-TM 1.1

Diagram	Symbolic name	Tested Port
10 a-c	B2	RF C
11 a-c	B6	RF C
12 a-c	Bim	RF C
13 a-c	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 highest fundamental frequency is 652 MHz. The measurements were made up to 7 GHz (10x652 MHz = 6520 GHz).

Limits

CFR 47 §27.53
(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a 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, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

Complies?	Yes

Diagram 1a:

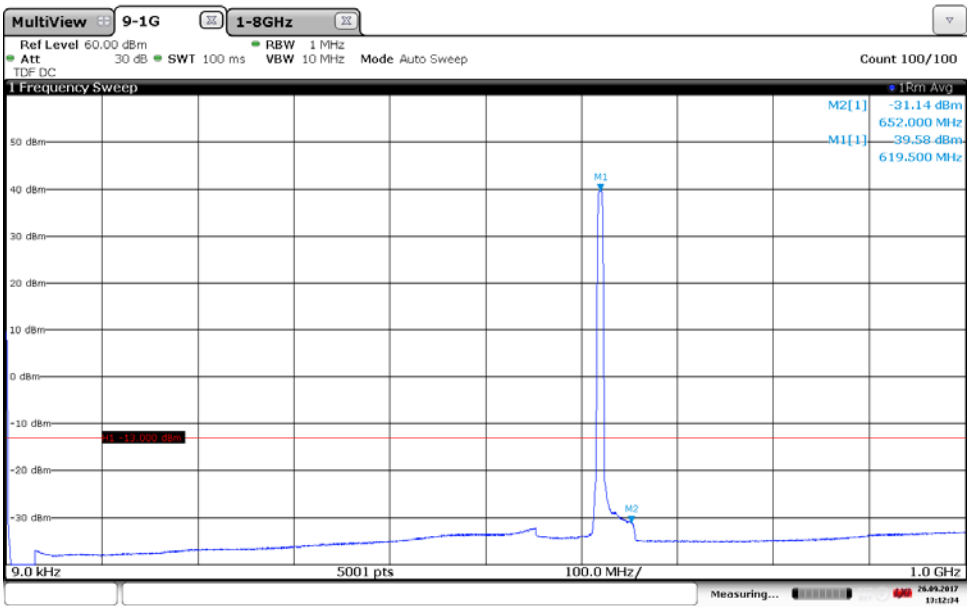


Diagram 1b:

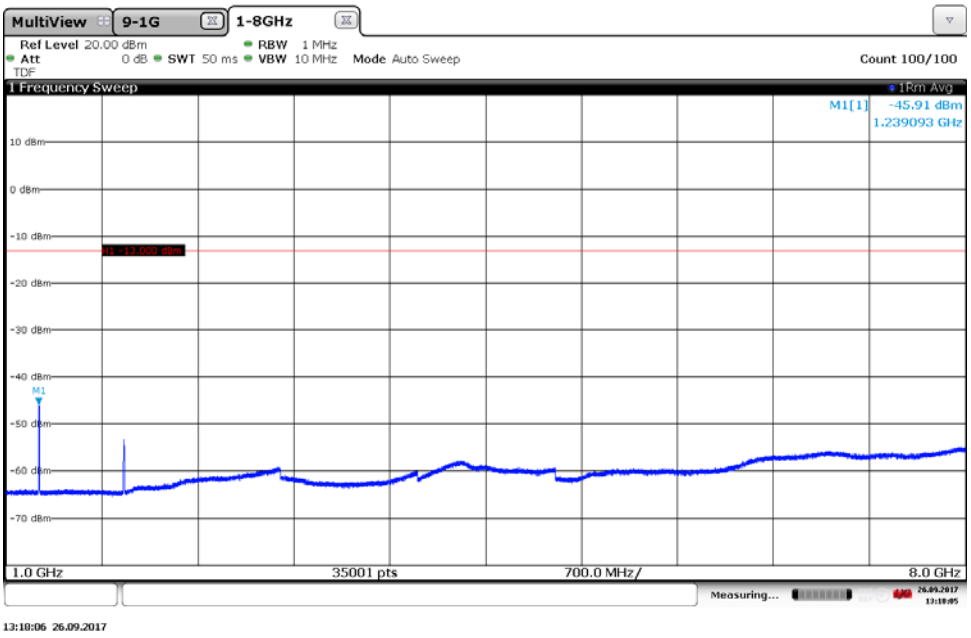


Diagram 2a:

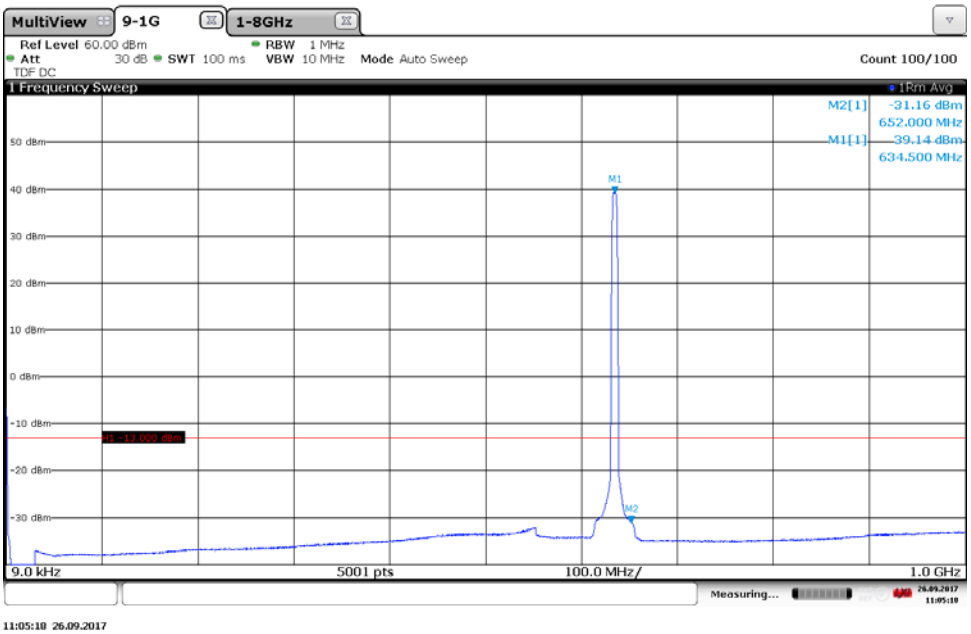


Diagram 2b:

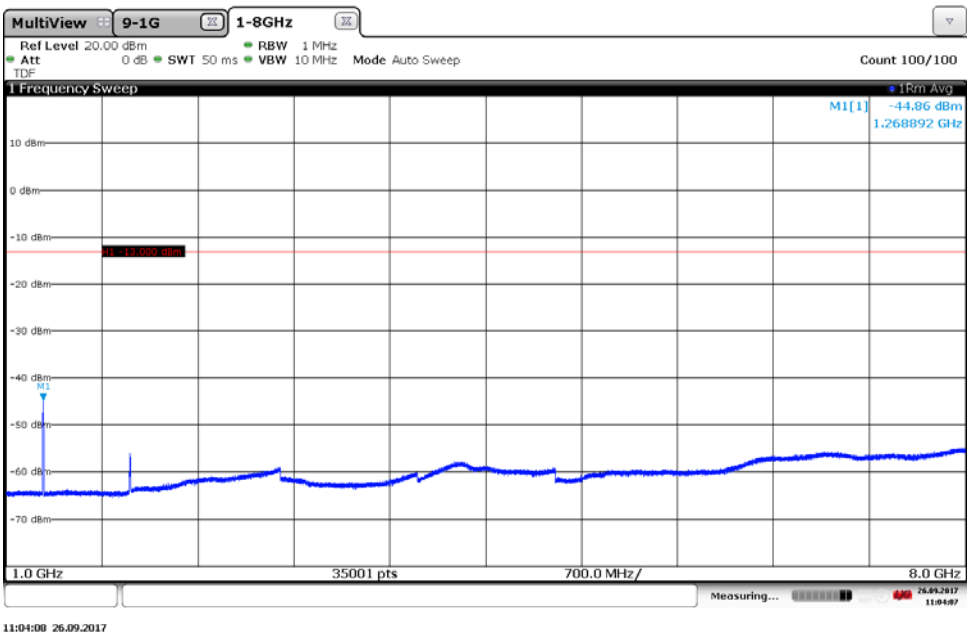


Diagram 3a:

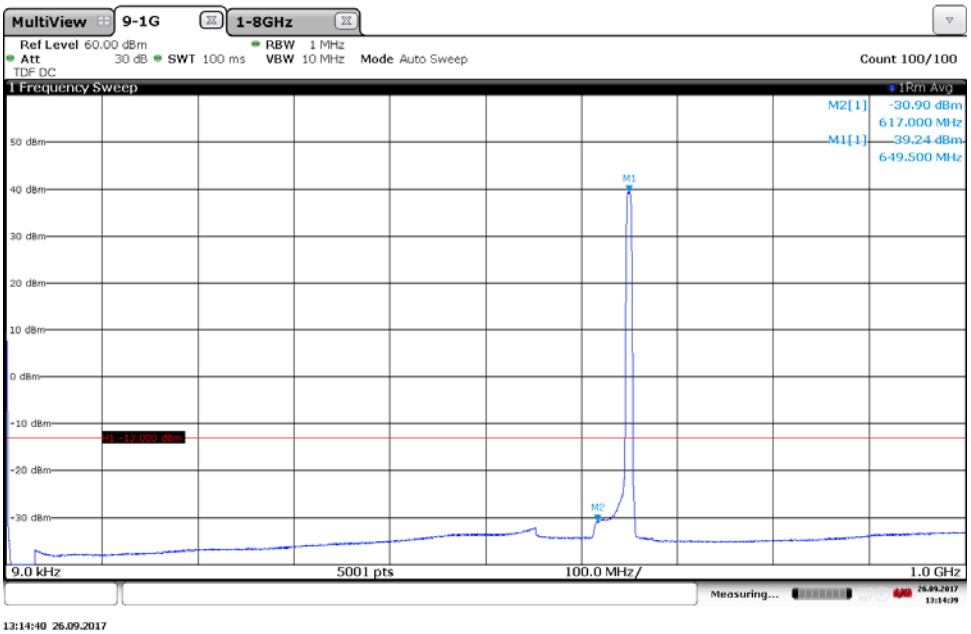


Diagram 3b:

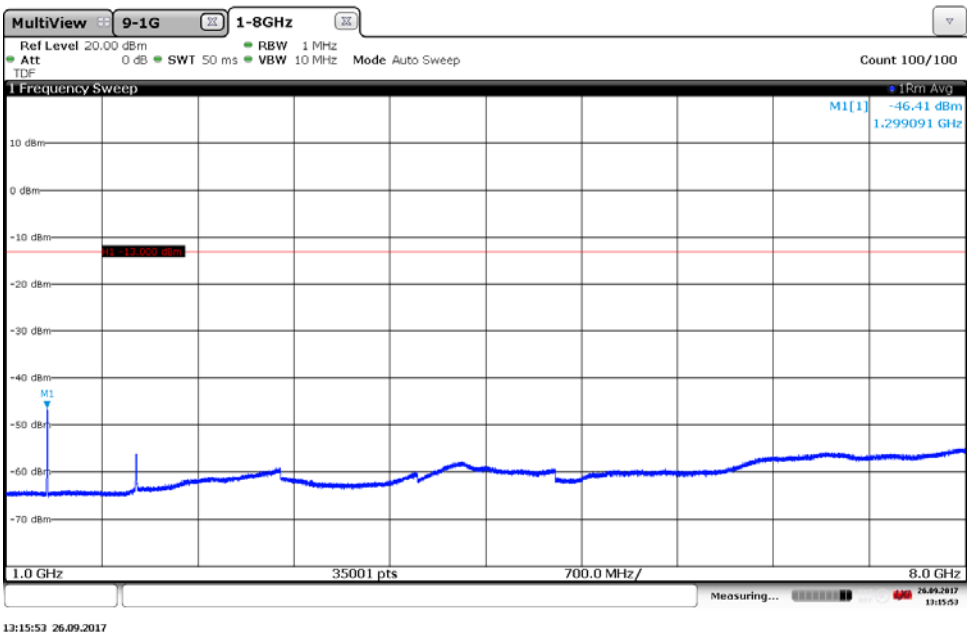


Diagram 4a:

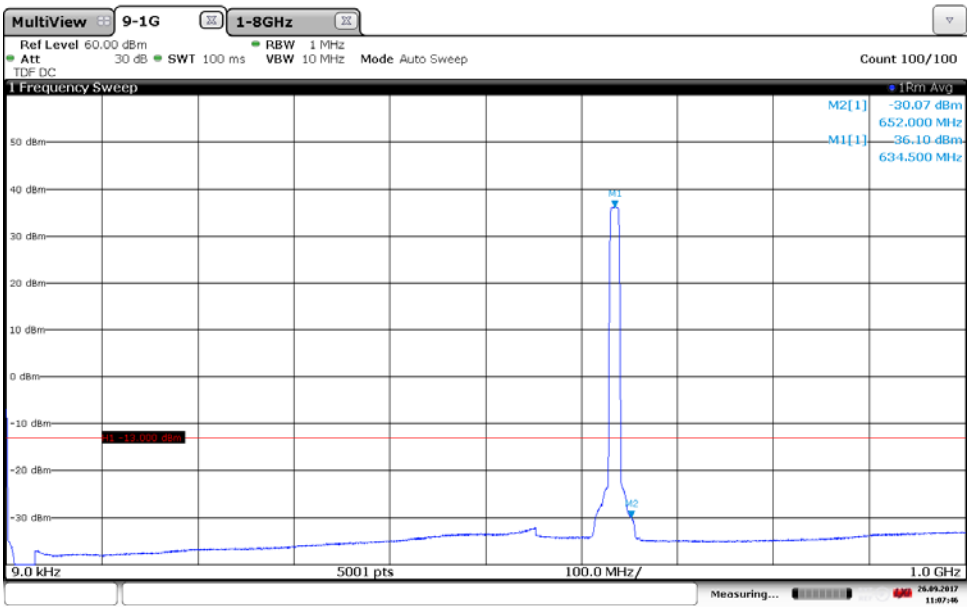


Diagram 4b:

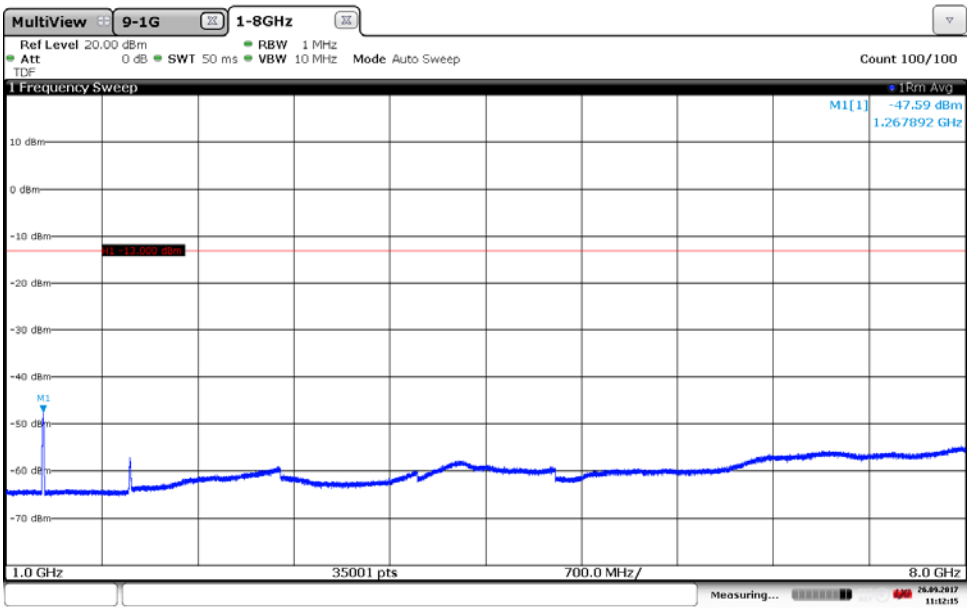


Diagram 5a:

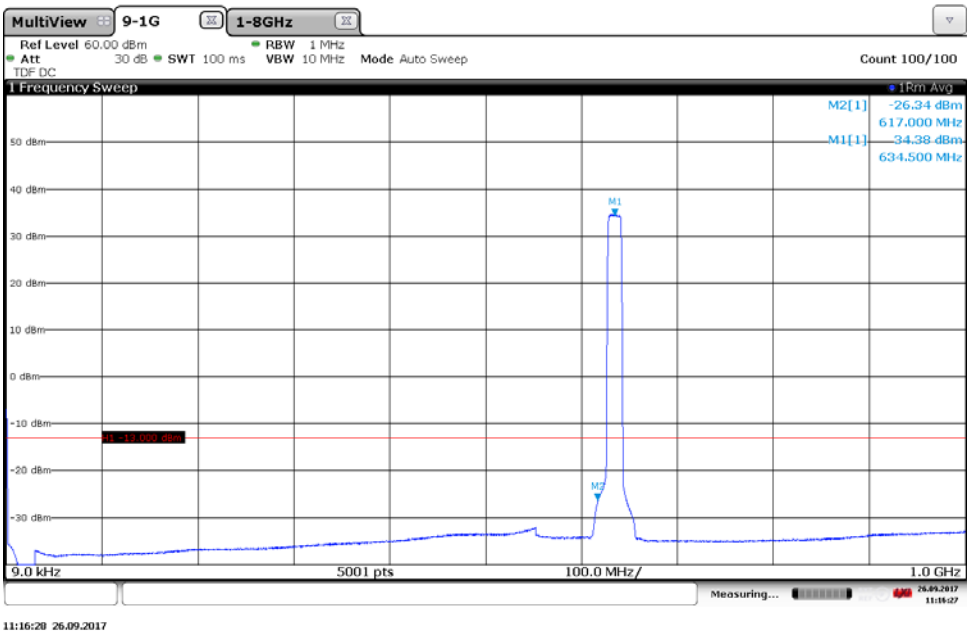


Diagram 5b:

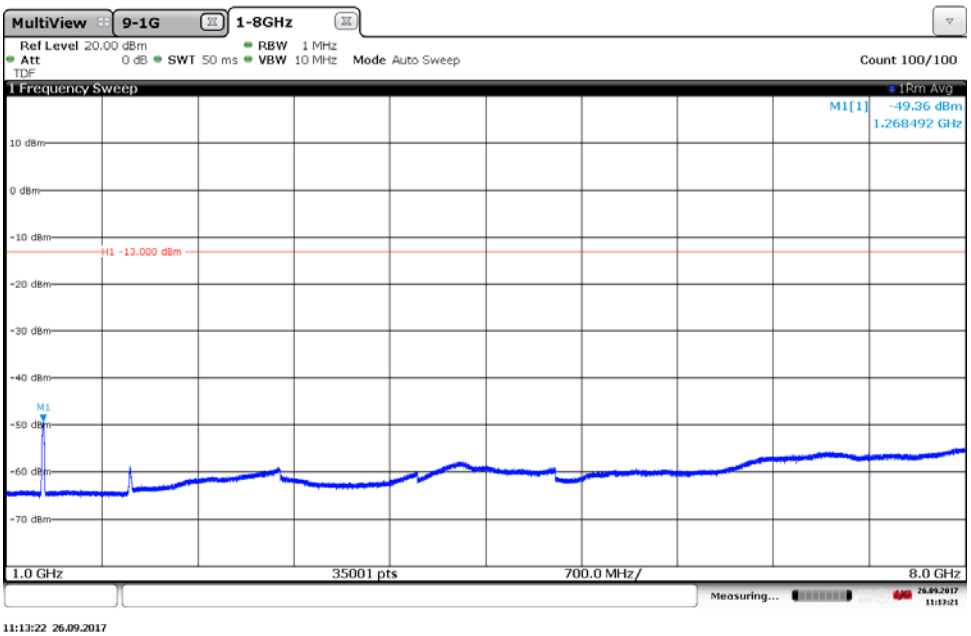


Diagram 6a:

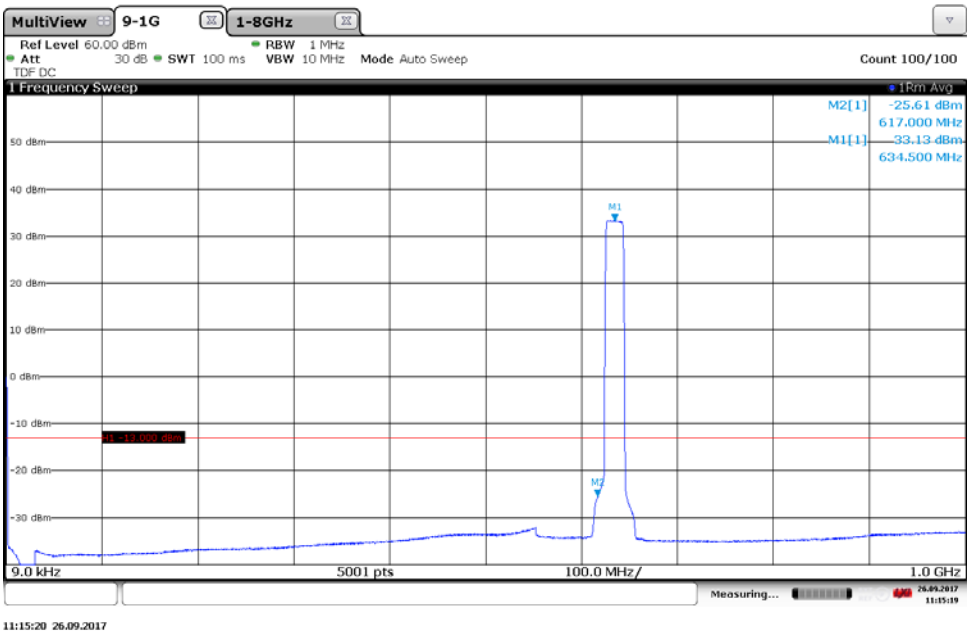


Diagram 6b:

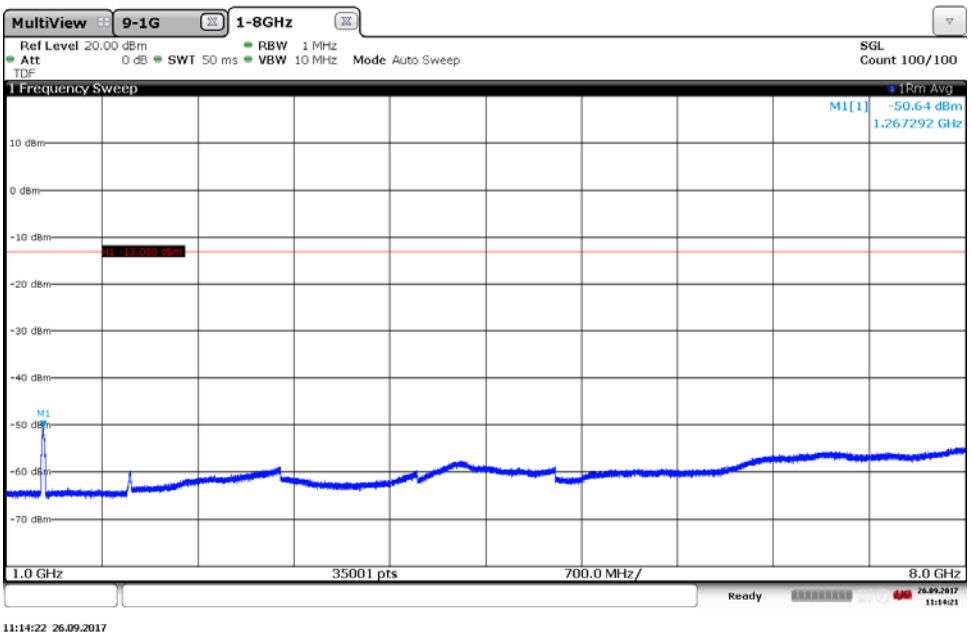


Diagram 7a:

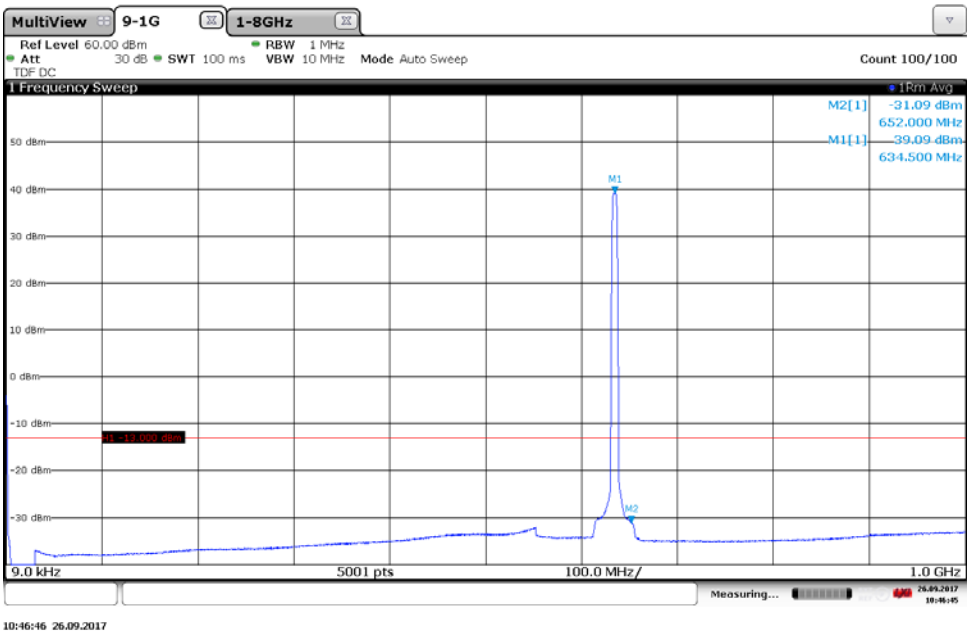


Diagram 7b:

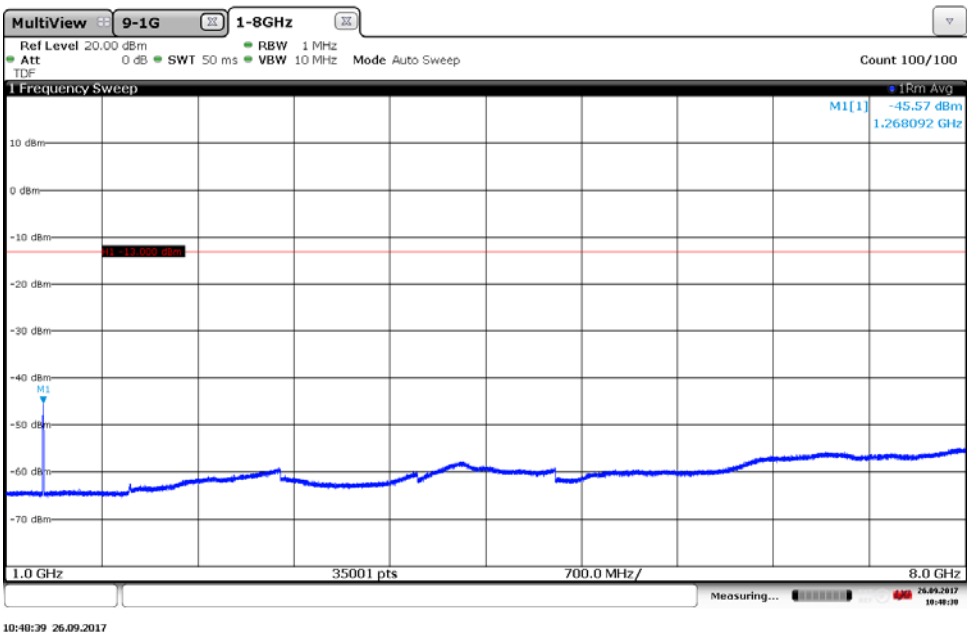


Diagram 8a:

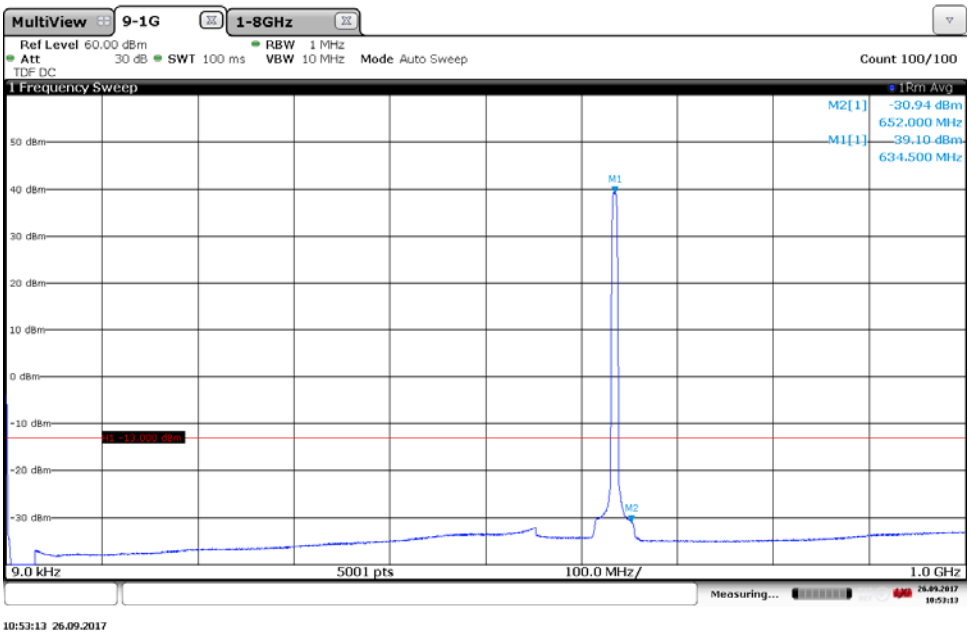


Diagram 8b:

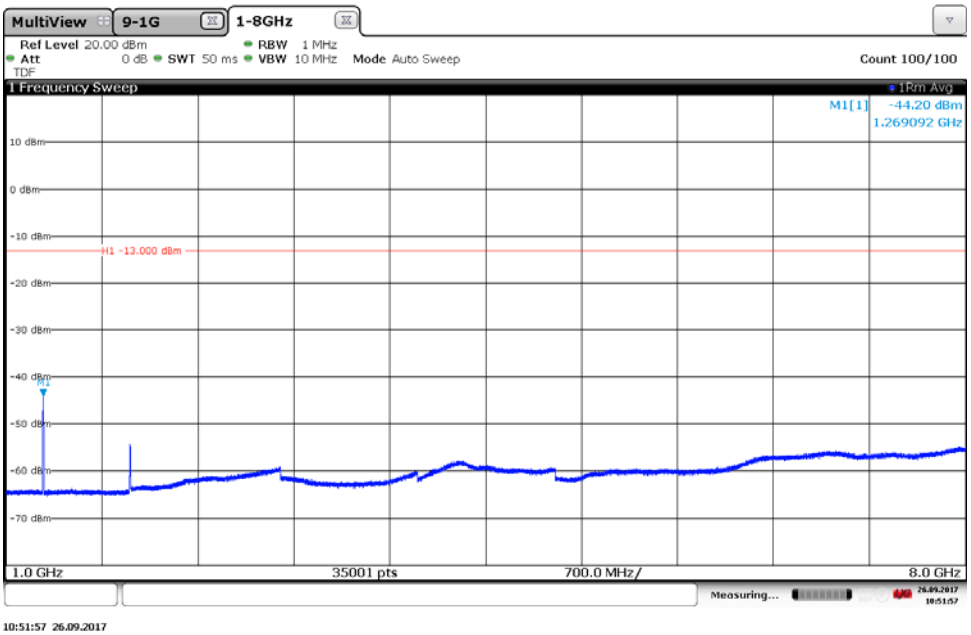


Diagram 9a:

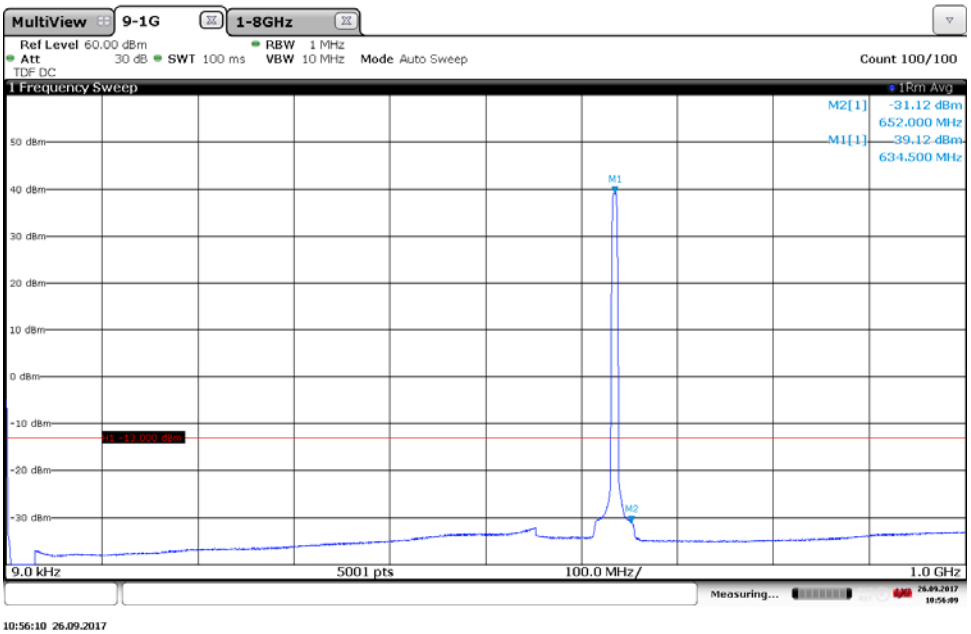


Diagram 9b:

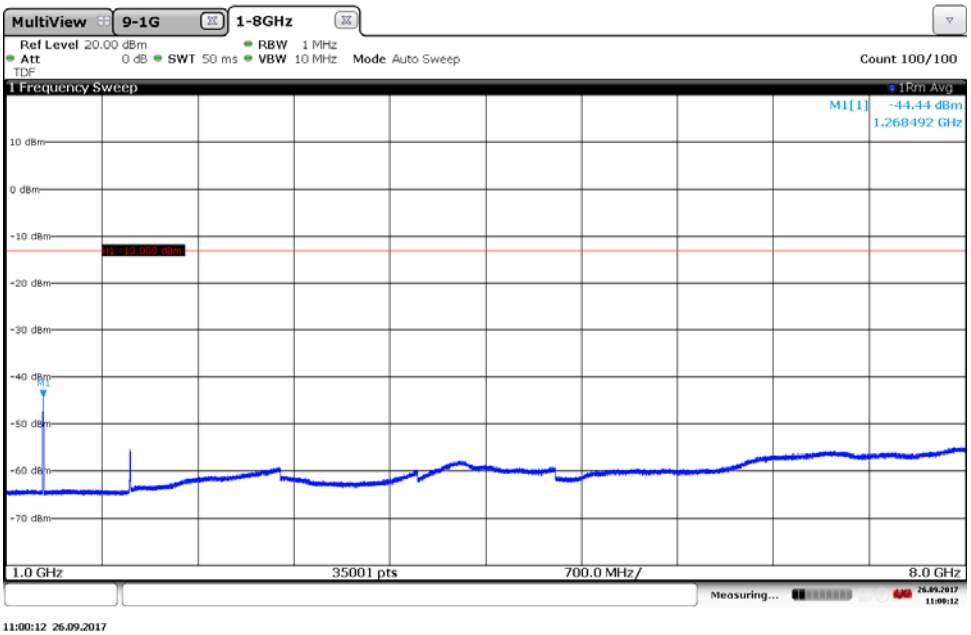


Diagram 10a:

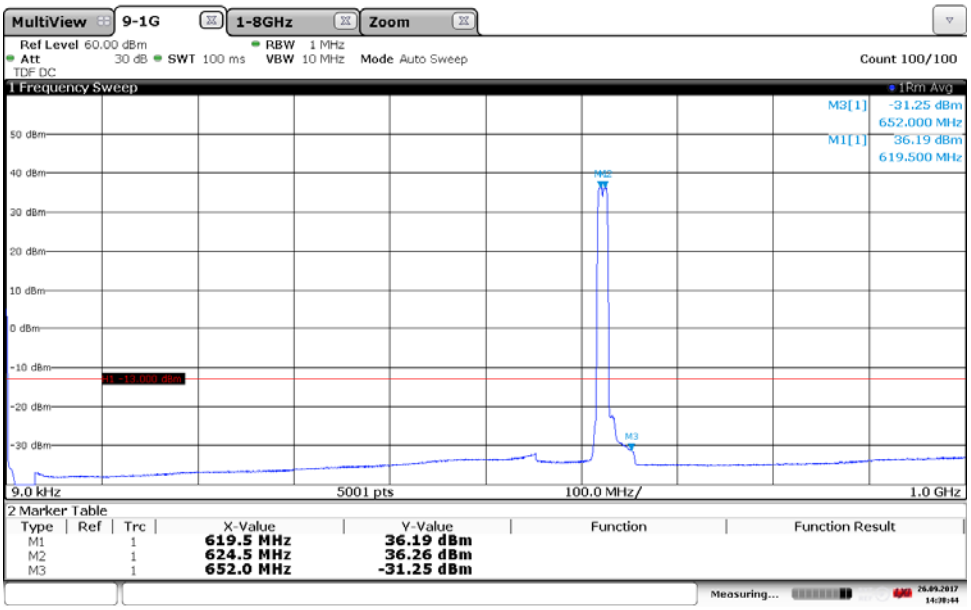


Diagram 10b:

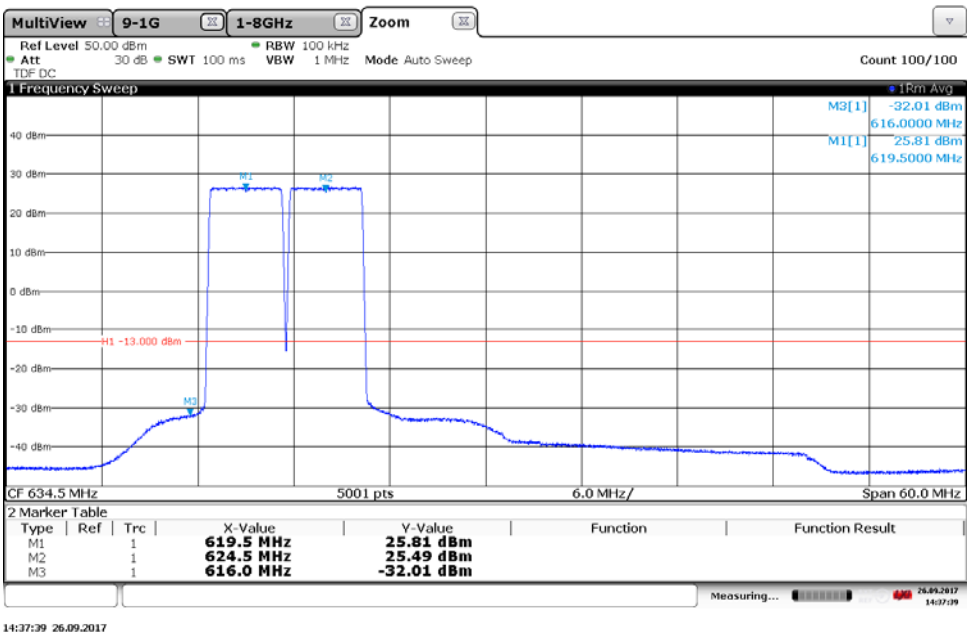


Diagram 10c:

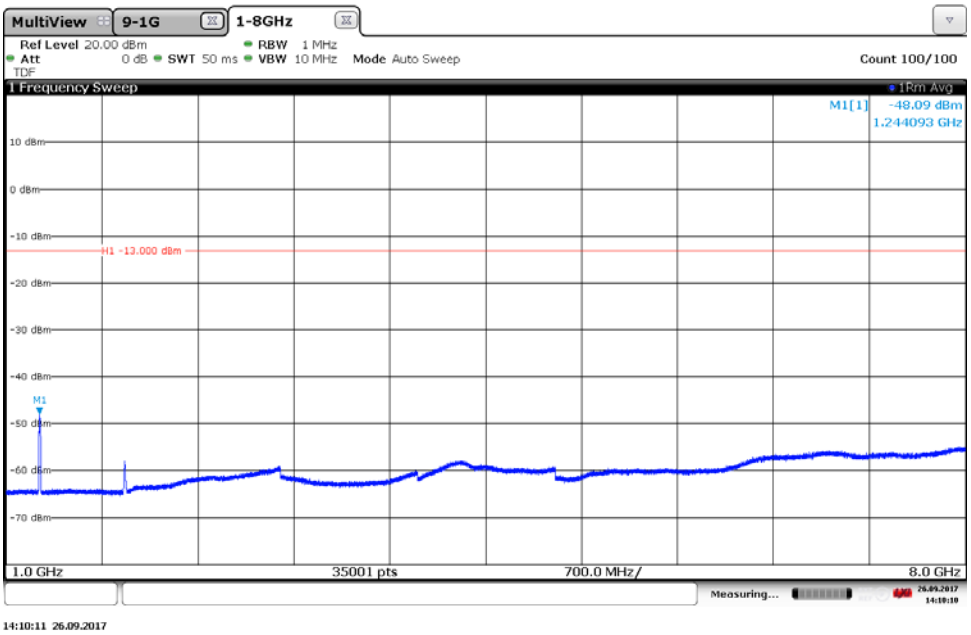

MultiView
9-1G
1-8GHz
Ref Level 20.00 dBm
RBW 1 MHz
Att 0 dB SWT 50 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
TDF
1 Frequency Sweep
1Rm Avg
M1[1] -48.09 dBm
1.244093 GHz
10 dBm
0 dBm
-10 dBm
H1 -13.000 dBm
-20 dBm
-30 dBm
-40 dBm
M1
-50 dBm
-60 dBm
-70 dBm
1.0 GHz
35001 pts
700.0 MHz/
8.0 GHz
Measuring...
14:10:11 26.09.2017

Diagram 11a:

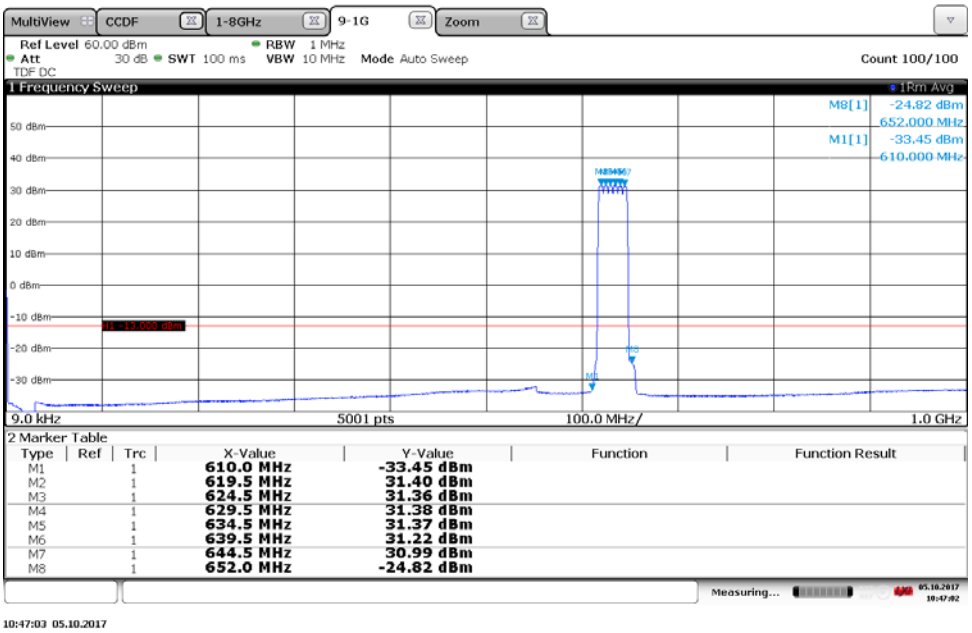


Diagram 11b:

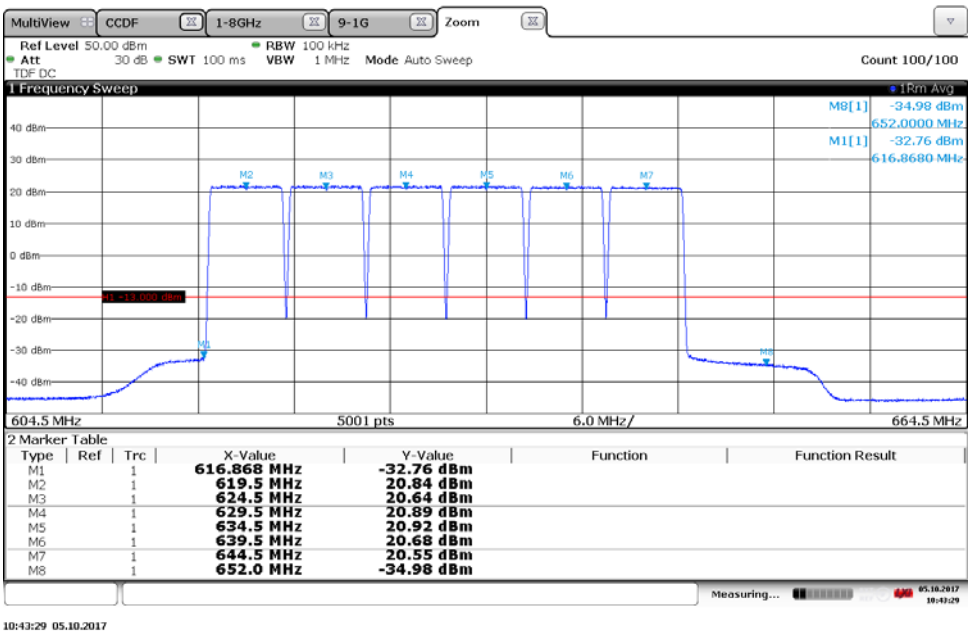


Diagram 11c:

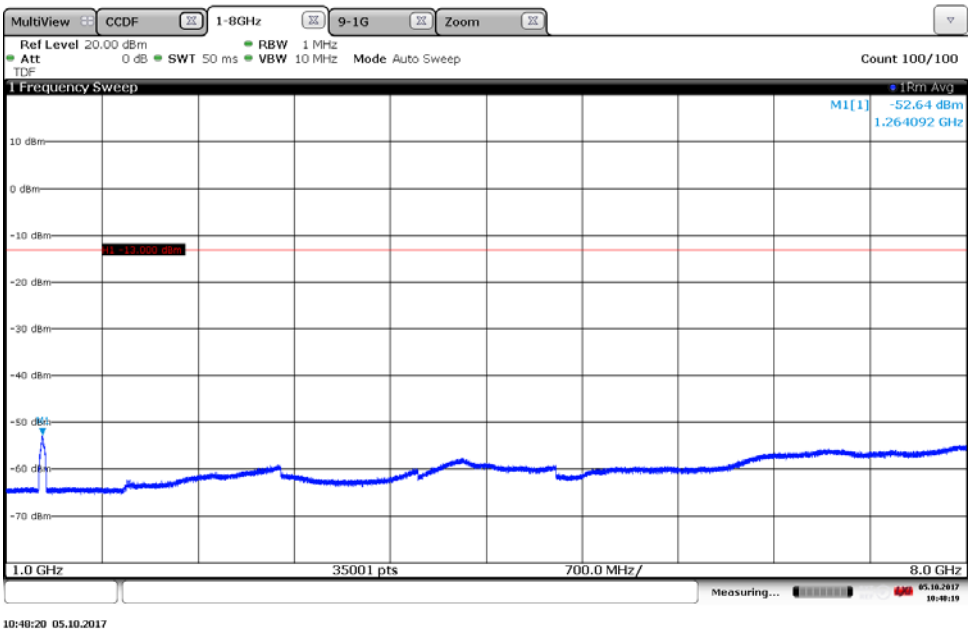

MultiView
CCDF
1-8GHz
9-1G
Zoom
Ref Level 20.00 dBm
RBW 1 MHz
Att 0 dB SWT 50 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
1 Frequency Sweep
1Rm Avg
M1[1] -52.64 dBm
1.264092 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
1.0 GHz
35001 pts
700.0 MHz/
8.0 GHz
Measuring...
10:40:20 05.10.2017

Diagram 12a:

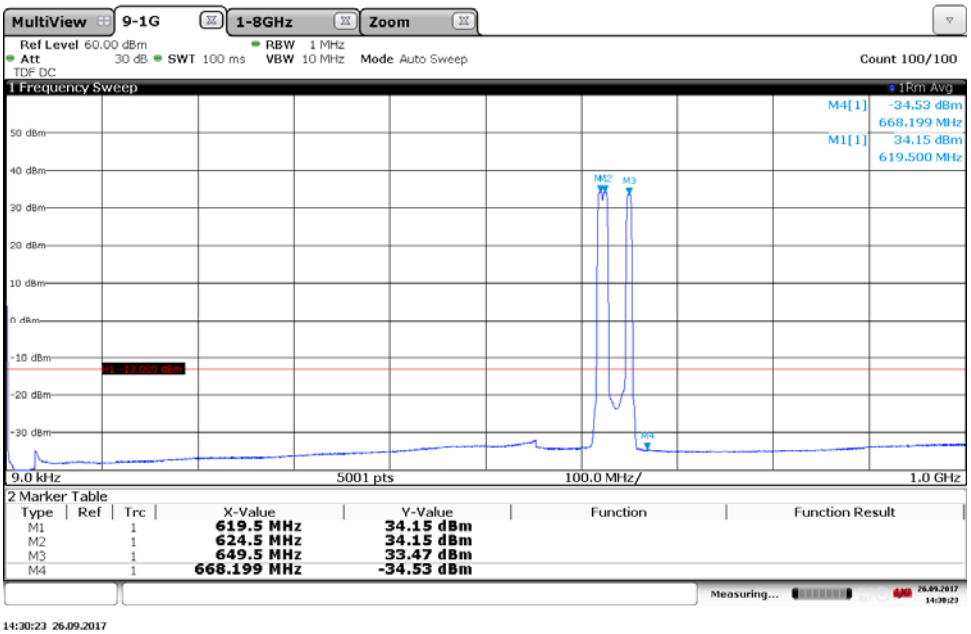


Diagram 12b:

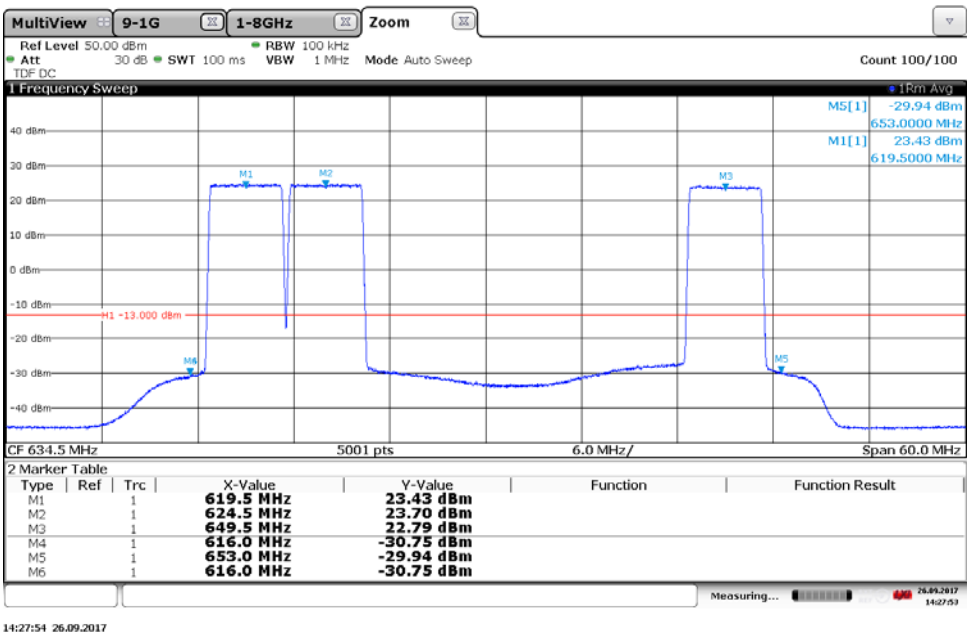


Diagram 12c:

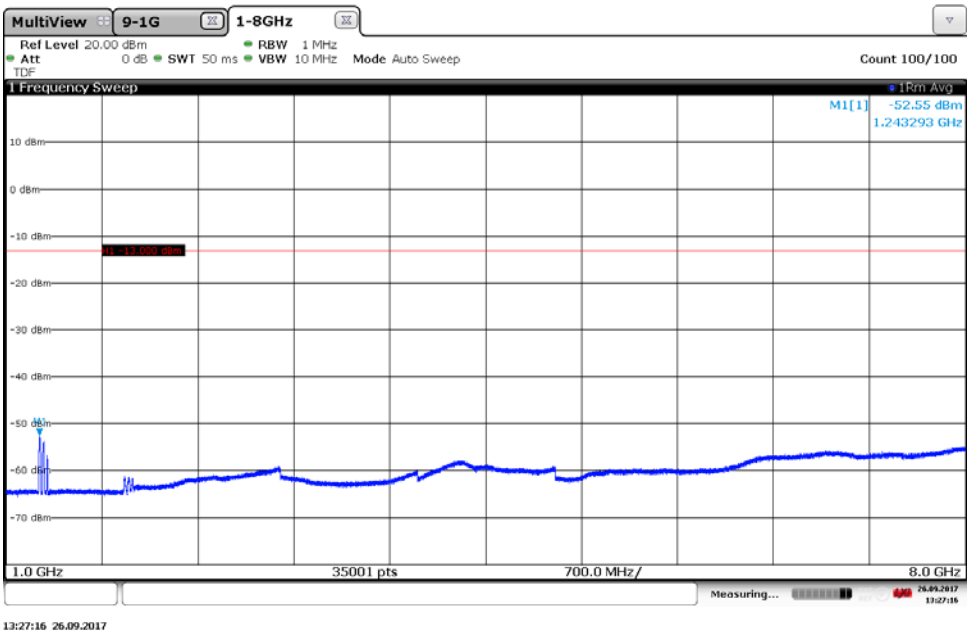

MultiView
9-1G
1-8GHz
Ref Level 20.00 dBm
RBW 1 MHz
Att 0 dB SWT 50 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
TDF
1 Frequency Sweep
1Rm Avg
M1[1] -52.55 dBm
1.243293 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
1.0 GHz
35001 pts
700.0 MHz/
8.0 GHz
Measuring...
13:27:16 26.09.2017

Diagram 13a:

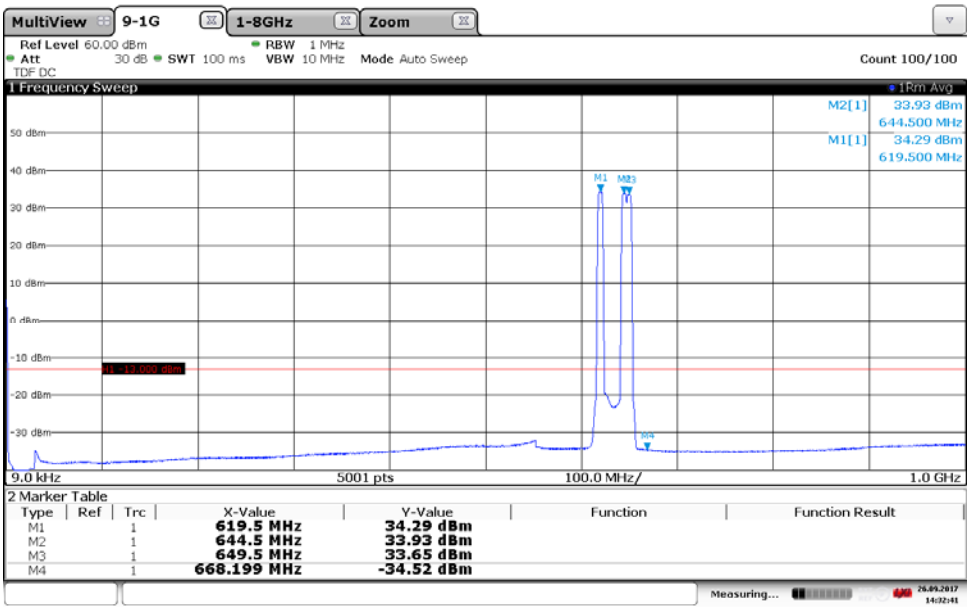


Diagram 13b:

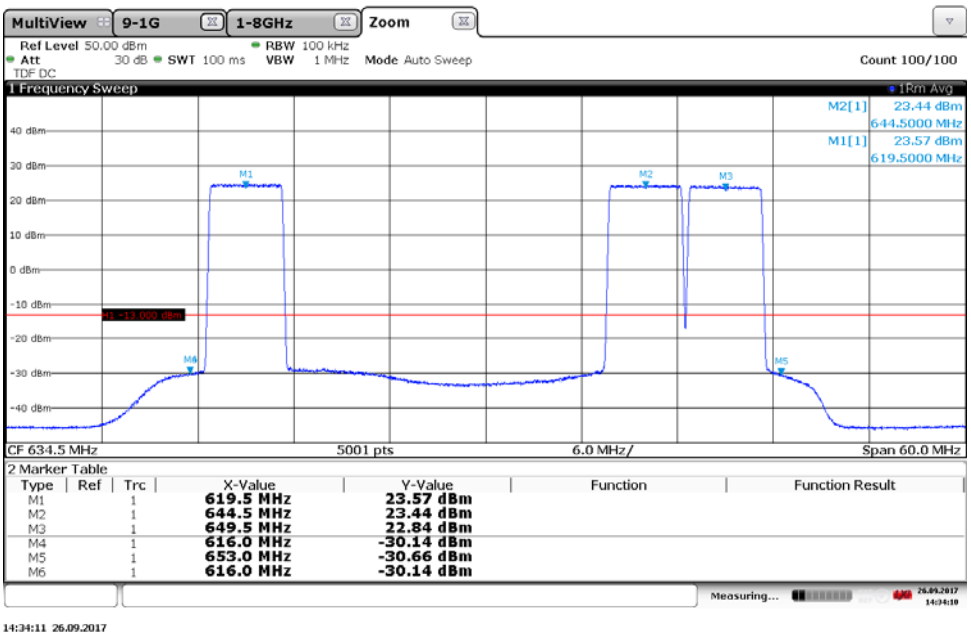
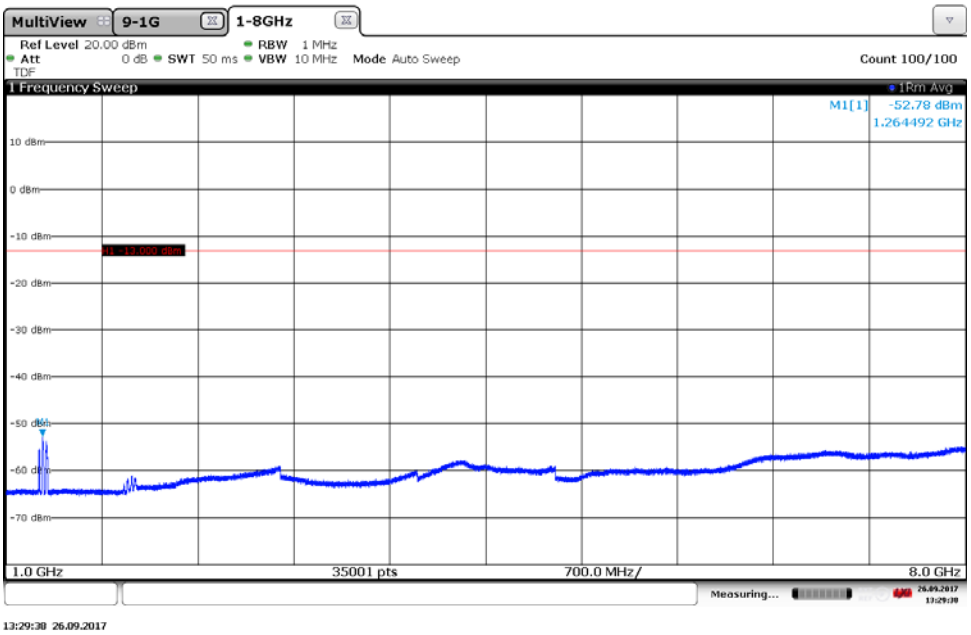


Diagram 13c:


MultiView
9-1G
1-8GHz
Ref Level 20.00 dBm
RBW 1 MHz
Att 0 dB SWT 50 ms VBW 10 MHz Mode Auto Sweep
Count 100/100
TDF
1 Frequency Sweep
1Rm Avg
M1[1] -52.78 dBm
1.264492 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
1.0 GHz
35001 pts
700.0 MHz/
8.0 GHz
Measuring...
13:29:30 26.09.2017

Field strength of spurious radiation measurements according to CFR 47 §27.53

Date	Temperature	Humidity
2017-10-03	22 °C ± 3 °C	48 % ± 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 – 7 GHz.

The measurements in the frequency range 30 – 1000 MHz was performed with a RBW of 100 kHz and EUT at height of 80 cm. The measurements in the frequency range 1 – 7 GHz was performed with a RBW of 1 MHz and EUT at height of 150 cm and absorbents on the floor between EUT and the antenna.

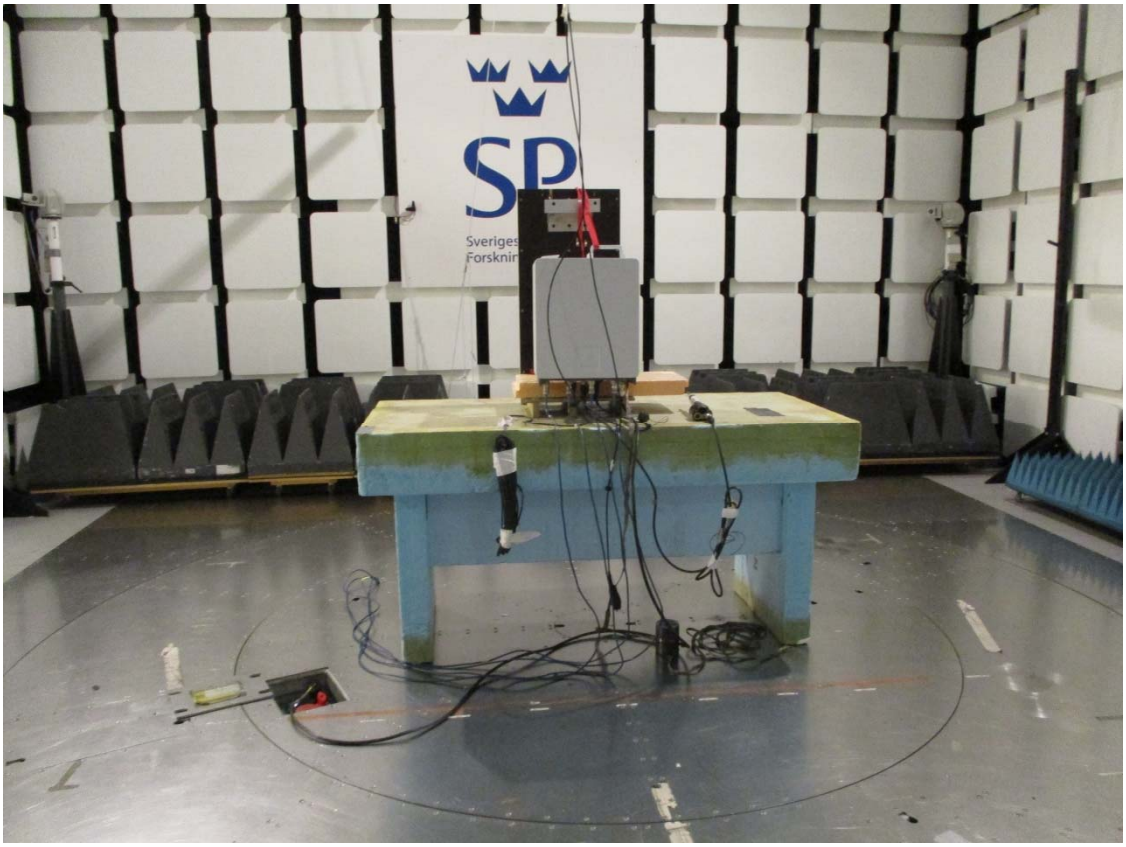
A propagation loss in free space was calculated. The used formula was

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

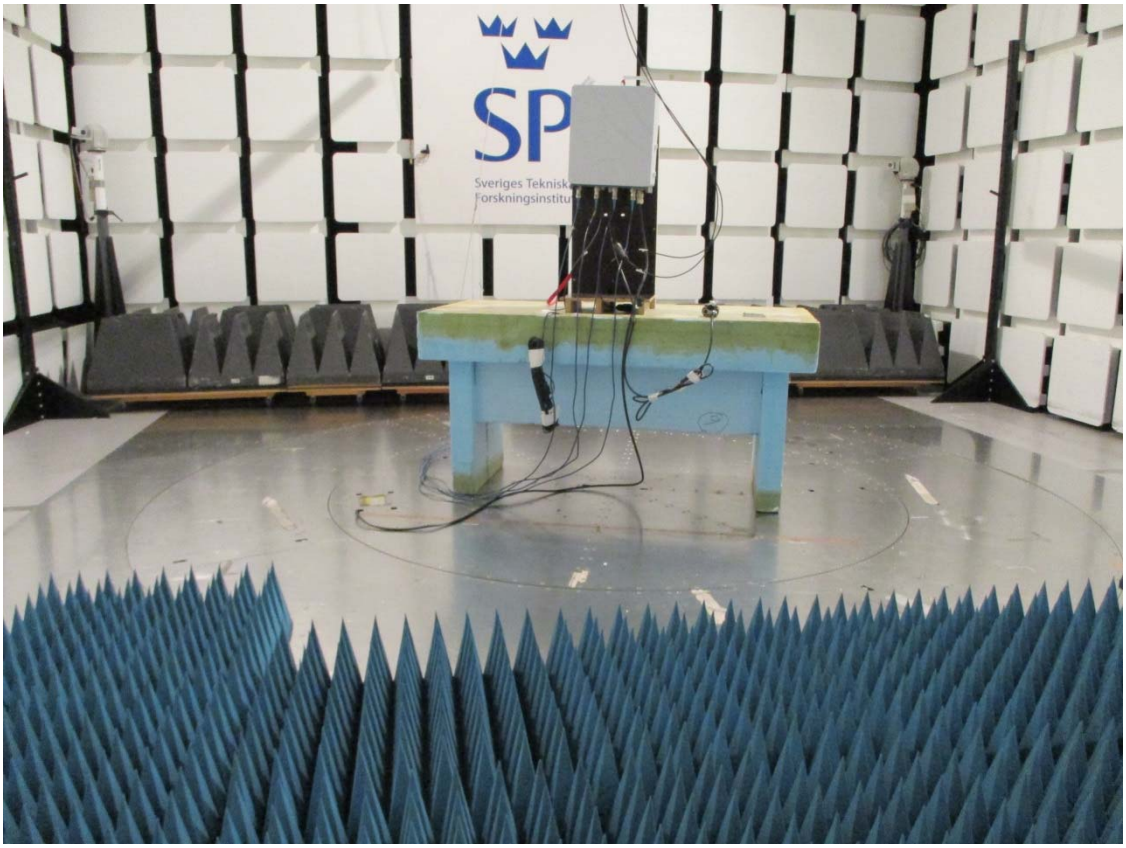
The measurement procedure was as the following:

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 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 63.26.

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



1-8GHz:



Measurement equipment

Measurement equipment	RISE 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 M_5, TX mid frequency, BW 5 MHz, Diagram 1 a-b

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-7000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty: 3.1 dB

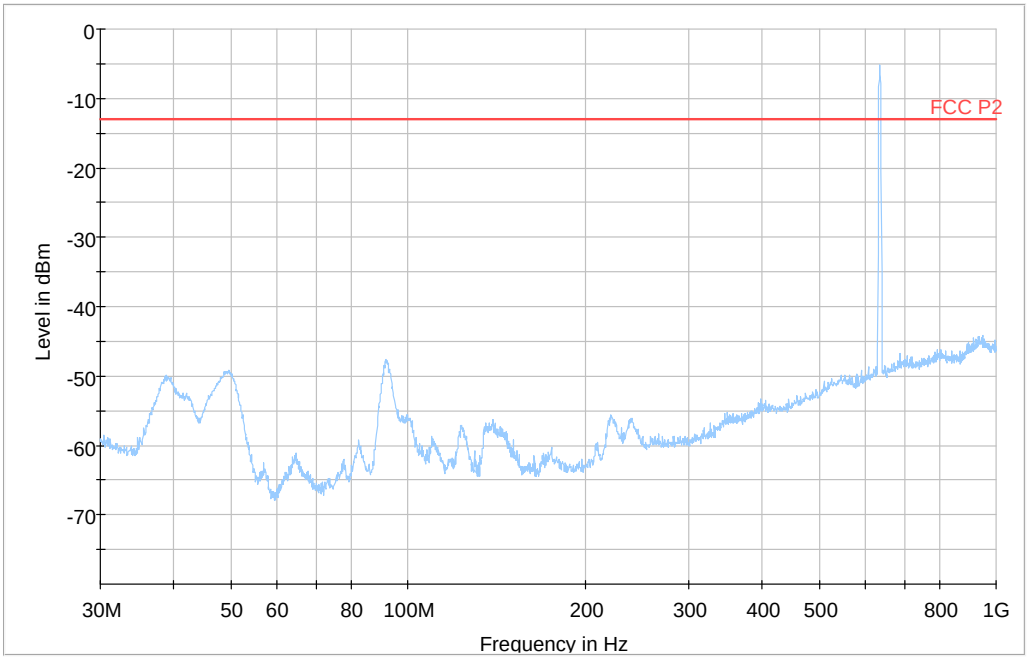
Limits

CFR 47 §27.53

(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.

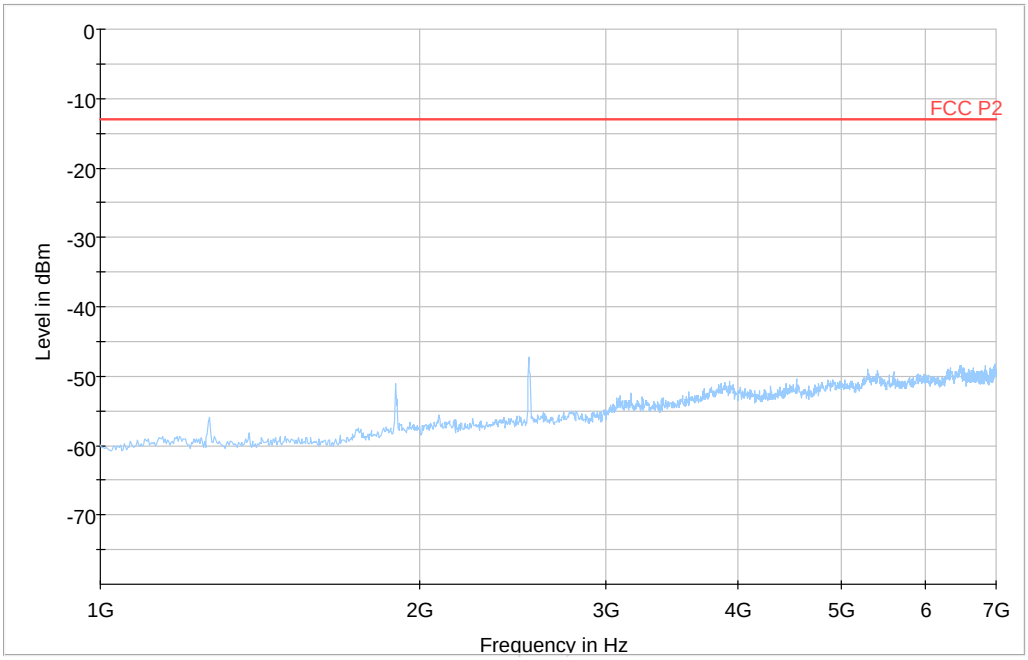
Complies?	Yes

Diagram 1a:



Note: The emission at 634.5 MHz is the carrier frequency and shall be ignored in the context.

Diagram 1b:



Frequency stability measurements according to CFR 47 § 2.1055

Date	Temperature (test equipment)	Humidity (test equipment)
2017-09-26	22 °C ± 3 °C	46 % ± 5 %
2017-10-02	22 °C ± 3 °C	47 % ± 5 %
2017-10-03	22 °C ± 3 °C	48 % ± 5 %
2017-10-04	22 °C ± 3 °C	37 % ± 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	RISE number
Rohde & Schwarz signal analyzer 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 634.5 MHz (M) with a bandwidth of 5 MHz. Rated output power level at connector RF C (maximum): 46 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
40.8	+20	4
55.2	+20	3
48	+20	4
48	+30	4
48	+40	5
48	+50	5
48	+10	4
48	0	4
48	-10	4
48	-20	7
48	-30	5
Maximum freq. error (Hz)		7
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Rated output power level at connector RF C (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 (617 MHz) [kHz]	fH [MHz]	Offset to upper band edge (652 MHz) [kHz]
-48.0	+20	5	617.010	10	651.985	15
-48.0	+20	20	617.064	64	651.921	79

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

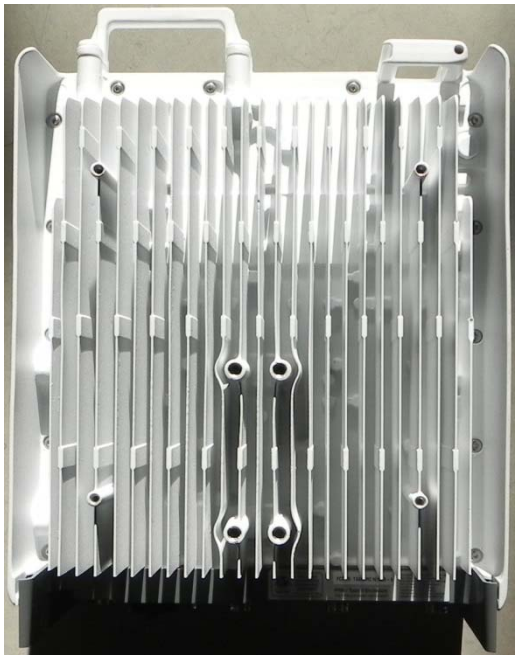
§27.54
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Complies?	Yes

Photos of test object

Front side

Rear side



Left side

Right side

Bottom side

Top side

Test object label:

SFP module: