REPORT

issued by an Accredited Testing Laboratory

Contact person RISE
Tomas Lennhager
Electronics
+46 10 516 54 09
tomas.lennhager@ri.se

Date
2019-04-08

Reference
9P02411-F27

Testing

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

Radio measurements on Radio 4415 B30 equipment with FCC ID TA8AKRC161769 and IC:287AB-AS161769

Product name: Radio 4415 B30
Product number: KRC 161 769/3

RISE Research Institutes of Sweden AB
Electronics - EMC

Performed by	Examined by
Signed by: Tomas Lennhager Reason: I am the author of this document Date & Time: 2019-04-08 13:39:19 +02:00	Signed by: Monika Fuller Reason: I have reviewed this document Date & Time: 2019-04-08 15:01:46 +02:00
Tomas Lennhager	Monika Fuller

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

Summary

Standard		Compliant
FCC CFR 47 / RSS-195 ISSUE 2		
2.1046 / RSS-195 5.5	RF power output conducted	Yes
2.1049 / RSS-Gen 6.6.	Occupied bandwidth	Yes
2.1051 / RSS-195 5.6	Band edge	Yes
2.1051 / RSS-195 5.6	Spurious emission at antenna terminals	Yes
2.1053 / RSS-195 5.6	Field strength of spurious radiation	Yes
2.1055 / RSS-195 5.4	Frequency stability	Yes

Description of the test object

Equipment:	Radio equipment Radio 4415 B30 Product number KRC 161 769/3 FCC ID: TA8AKRC161769 IC: 287AB-AS161769
HVIN:	AS161769
FVIN:	-
Hardware revision state:	R5C
Tested configuration:	Single RAT LTE
Frequency bands: 3GPP B30:	TX: 2350 –2360 MHz RX: 2305 – 2315 MHz
IBW:	10 MHz
Output power:	Max 25 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),
Channel bandwidths:	5 MHz and 10 MHz
Modulations/ Emission designators:	QPSK, 16QAM, 64QAM and 256QAM
Emission designators:	4M51W7D and 8M95W7D
RF power Tolerance:	+0.6/ -0.5 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 CFR 47, RSS-195 and RSS-Gen.

No modifications of the test object was made during the testing.

Operation modes during measurements

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

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.

EUT Emission= SA reading + Transducer factor(S21) of (Attenuator+CableLosses+FilterLoss) measured with network analazer.

The Transducer factor is stored in the SA and activated as applicable.

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.

EUT Emission= SA reading + (CableLosses – Antenna gain(dBi) + TheoreticalPathloss + FilterLoss – LNAgain)

The correction factors are stored in R&S EMC 32 software as separate files and activated as applicable in the Hardware setup, for each measurement configuration. Emissions close or above the limit is verified with the substitution method where the EUT is replaced by a signal generator and an Antenna with known gain.

References

Measurements were done according to relevant parts of the following standards:
ANSI C63.4-2014
CFR 47 part 2, March 2019
CFR 47 part 27, March 2019

RSS-Gen Issue 5 2018
RSS-195 Issue 2 2014
ANSI C63.26 2015
3GPP TS 36 141 version 13.6.0

Measurement equipment

	Calibration Due	RISE number
Test site Tesla	2019-12	503 881
R&S ESU 40	2019-07	901 385
R&S FSQ 40	2019-07	504 143
R&S FSW 43	2019-07	902 073
Control computer with R&S software EMC32 version 10.20.01	-	BX62351
High pass filter 1-20 GHz	2019-06	901 502
RF attenuator Weinschel WA73-20-11	2020-03	900 691
RF attenuator Weinschel 6905-40-11-LIM	2020-03	902 282
Coaxial cable Sucoflex 102EA	2020-03	BX50237
Coaxial cable Sucoflex 102EA	2020-03	BX50236
Coaxial cable Sucoflex 100	2020-03	BX82296
Teseq BiLog antenna CBL6143A	2021-08	504 079
RF attenuator JFW 50HF	2019-09	BX61531
EMCO Horn Antenna 3115	2021-07	502 175
Flann Standard Gain Horn 16240-20	-	503 939
Flann Standard Gain Horn 18240-20	-	503 900
Flann Standard Gain Horn 20240-20	2021-01	503 674
Flann Standard Gain Horn 22240-20	2021-01	503 674
µComp Nordic, Low Noise Amplifier	2020-01	901 545
Miteq, Low Noise Amplifier, 18-40 GHz	2020-01	503 278
Coaxial cable, 18-40 GHz	2020-01	503 697
Coaxial cable	2019-09	BX62218
Coaxial cable	2019-09	503 508
Coaxial cable	2019-09	503 509
Temperature and humidity meter, Testo 625	2019-06	504 188
Temperature and humidity meter, Testo 635	2019-06	504 203
EAB diplex bandreject filter LPC 107 131/30 R1A	2020-03	BAMS - 1001477268

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: 2019-03-20.

Manufacturer’s representative

Mikael Jansson, Ericsson AB.

Test engineers

Tomas Isbring and Karl Flysjö for radiated tests, RISE
Tomas Lennhager for conducted tests, RISE.

Test participant(-s)

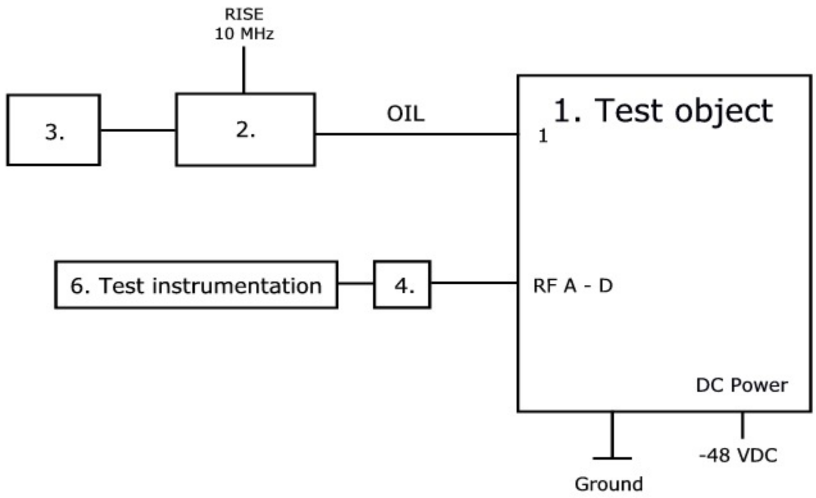
None.

Test frequencies used for radiated and conducted measurements

EARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
9795	2352.5	B_5	TX bottom frequency in 5 MHz BW configuration
9845	2357.5	T_5	TX bottom frequency in 5 MHz BW configuration
9820	2355	M_{10}	TX middle frequency in 10 MHz BW configuration
9795 9845	2352.5 2357.5	$2M_5$	2 carrier TX middle frequency in 5 MHz BW configuration

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

Test setup: conducted measurements



Test object:

1.	Radio 4415 B30, KRC 161 769/3, rev. R5C, s/n: D828772340 With Radio Software: CXP 901 7316/7, rev. R75JC. FCC ID: TA8AKRC161769 and IC: 287AB-AS161769

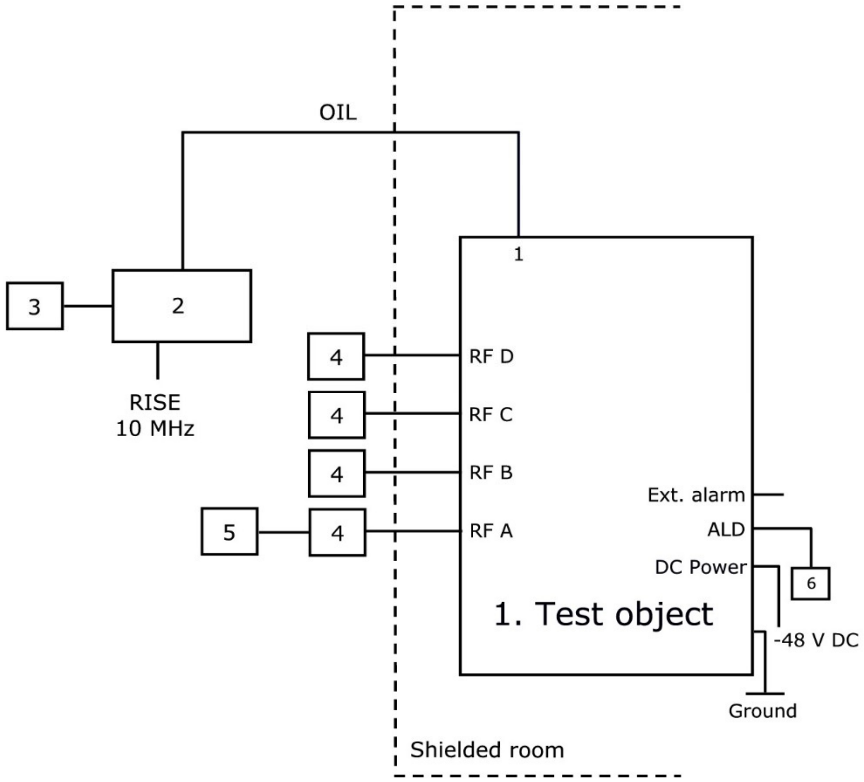
Associated equipment:

2.	Testing Equipment: CT10, LPC 102 467/1, rev. R1C, s/n: T01F375047, BAMS – 1001466801 with software CXA 104 446/1, rev. R9C

Functional test equipment:

3.	Computer, HP EliteBook 8560w, BAMS – 1001236851
4.	RF Attenuator: RISE number: 900 691 and 902282
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



Test object:

1.	Radio 4415 B30, KRC 161 769/3, rev. R5C, s/n: D828772339 With Radio Software: CXP 901 7316/7, rev. R75JC. FCC ID: TA8AKRC161769 and IC: 287AB-AS161769

Associated equipment:

2.	Testing Equipment: CT10, LPC 102 487/1, rev. R1C, s/n: T01F375046, BAMS – 1001466800 with software CXA 104 446/1, rev. R9C

Functional test equipment:

3.	Computer, HP EliteBook 8560w, BAMS - 1001236854
4.	Attenuator
5.	R&S FSQ 40, RISE no: 504 143, for supervision purpose only
6.	Remote Electrical Tilt, Andrew ATM200-A20, Serial: CN10151085145

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 / RSS-195 5.5, conducted

Date	Temperature	Humidity
2019-03-21	23 °C ± 3 °C	28 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.2.3.4. 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
Coaxial cable Sucoflex 102EA	BX50237
Coaxial cable Sucoflex 102EA	BX50236
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 44 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	44.02/ 7.38	43.75/ 7.38	43.67/ 7.36	43.91/ 7.38	49.86
T_5	43.65/ 7.36	43.55/ 7.36	43.50/ 7.34	43.72/ 7.36	49.63
M_{10}	43.66/ 7.38	43.59/ 7.36	43.57/ 7.38	43.69/ 7.36	49.65

[1)]: summed output power according to ANSI C63.26 section 6.4.3.2.4.

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 44 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	44.01/ 7.36	43.88/ 7.36	43.80/ 7.36	43.90/ 7.38	49.92

[1)]: summed output power according to ANSI C63.26 section 6.4.3.2.4.

Single carrier ETM 3.1 64 QAM

Rated output power level at each RF port 1x 44 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	44.01/ 7.38	43.92/7.38	43.75/ 7.38	43.89/ 7.38	49.91

[1)]: summed output power according to ANSI C63.26 section 6.4.3.2.4.

Single carrier ETM 3.1a 256 QAM

Rated output power level at each RF port 1x 44 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	43.96/ 7.38	43.83/ 7.36	43.71/ 7.38	43.95/ 7.36	49.88

[1)]: summed output power according to ANSI C63.26 section 6.4.3.2.4.

Multi carrier ETM 1.1 QPSK

Rated output power level at each RF port 2x 41 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)]
$2M_5$	43.86/ 7.24	43.80/ 7.24	43.61/ 7.24	43.73/ 7.22	49.77

[1)]: summed output power according to ANSI C63.26 section 6.4.3.2.4

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 44 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	37.82	37.57	37.48	37.66	43.65
T_5	37.49	37.38	37.37	37.58	43.48
M_{10}	34.54	34.47	34.44	34.50	40.51

[1)]: summed output power according to ANSI C63.26 section 6.4.3.2.4

Remark

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

Limits

CFR 47 §27.50 (a): The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.
The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB.

SRSP-516 Issue 1: The equivalent isotropically radiated power (e.i.r.p.) of the base and fixed stations shall not exceed 400 watts within any 1 MHz band; and shall not exceed 2000 W within any 5 MHz of bandwidth.

RSS-195 5.5.1: The PAPR of the transmitter output power of base and fixed station equipment shall not exceed 13 dB for more than 0.1% of the time.

Complies?	Yes

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

Date	Temperature	Humidity
2019-03-21	23 °C ± 3 °C	28 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.4.4. 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
Coaxial cable Sucoflex 102EA	BX50237
Coaxial cable Sucoflex 102EA	BX50236
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	B_5	RF A	4.477
2	B_5	RF B	4.483
3	B_5	RF C	4.505
4	B_5	RF D	4.492
5	T_5	RF C	4.502
6	M_{10}	RF C	8.946

Single carrier ETM 3.2 16 QAM

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
7	B_5	RF A	4.475

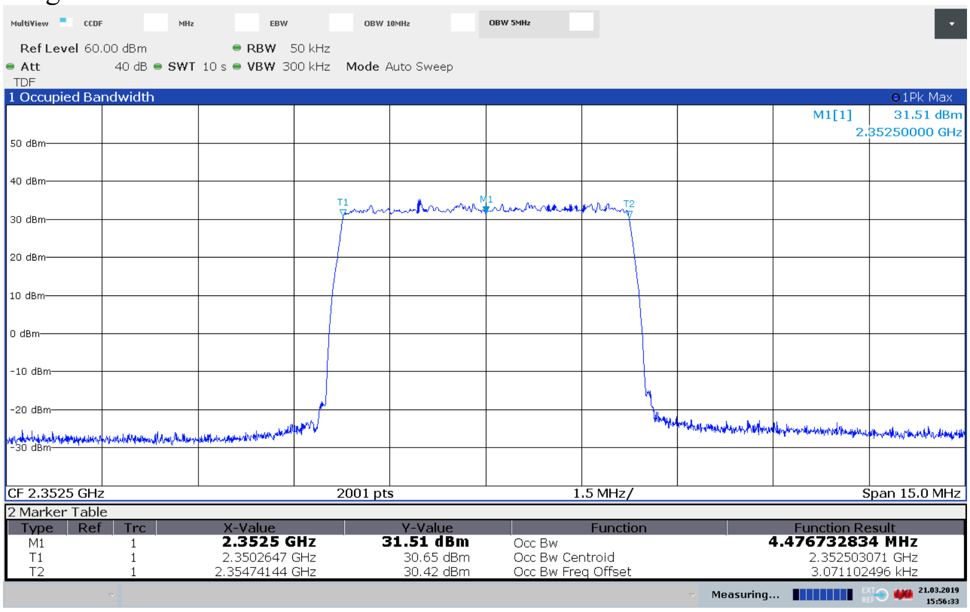
Single carrier ETM 3.1 64 QAM

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
8	B_5	RF B	4.483
9	B_5	RF C	4.499

Single carrier ETM 3.1a 256 QAM

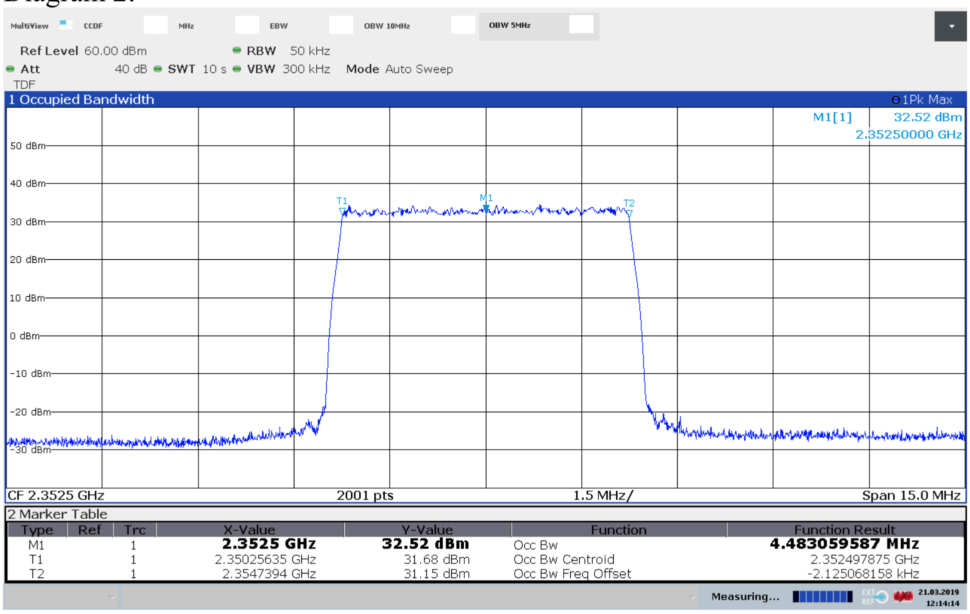
Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
10	B_5	RF D	4.477

Diagram 1:



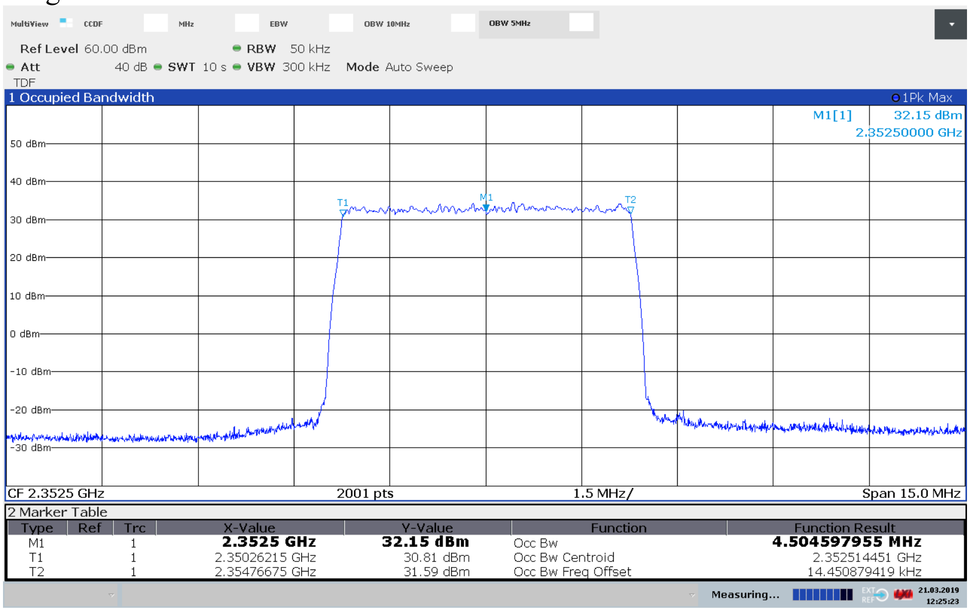
15:56:34 21.03.2019

Diagram 2:



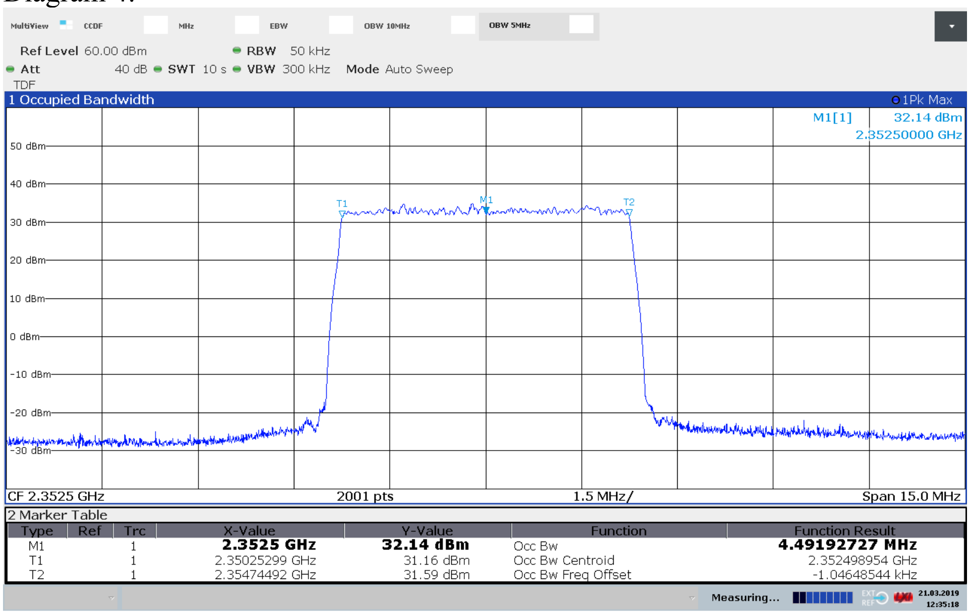
12:14:15 21.03.2019

Diagram 3:



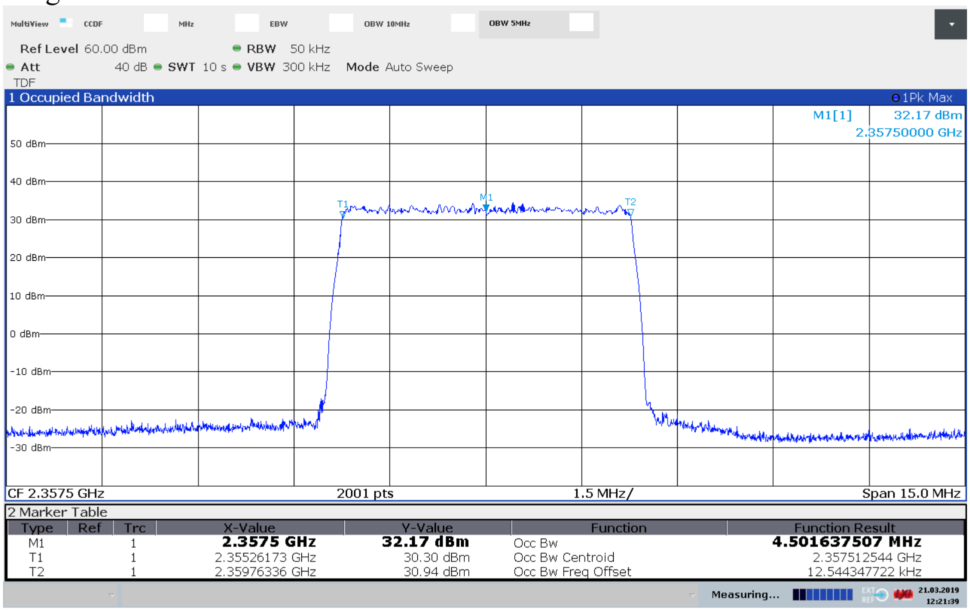
12:25:24 21.03.2019

Diagram 4:



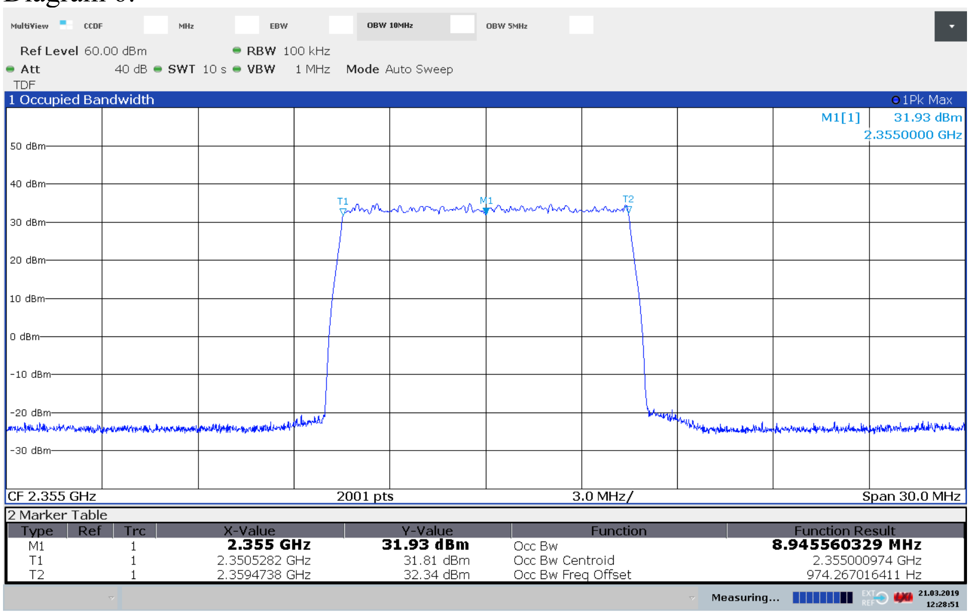
12:35:19 21.03.2019

Diagram 5:



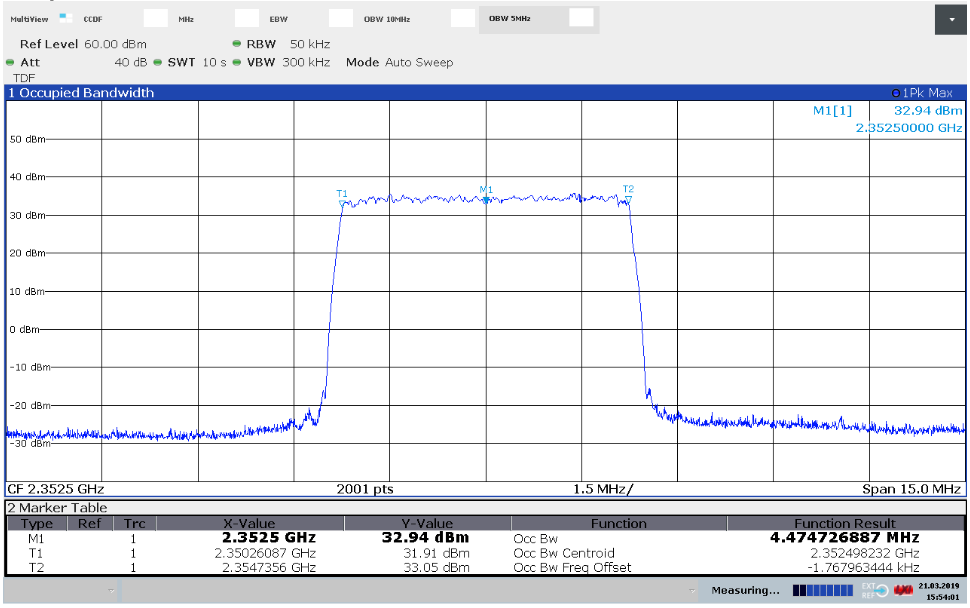
12:21:40 21.03.2019

Diagram 6:



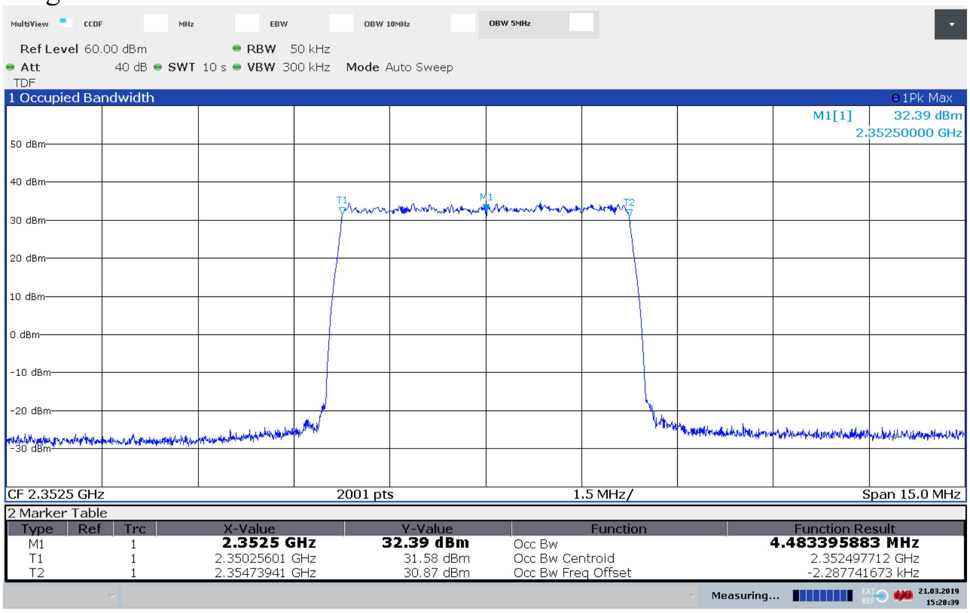
12:28:52 21.03.2019

Diagram 7:



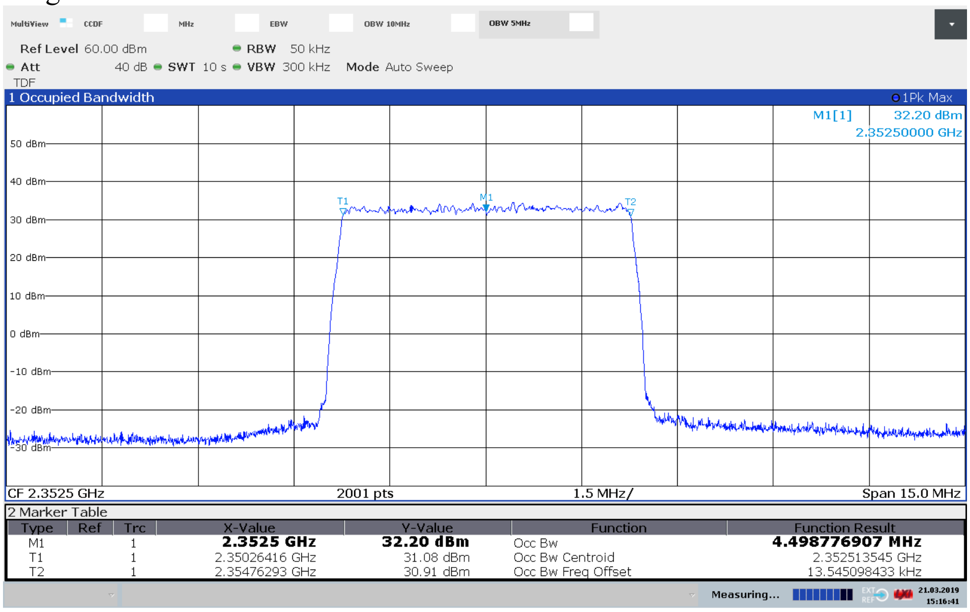
15:54:02 21.03.2019

Diagram 8:



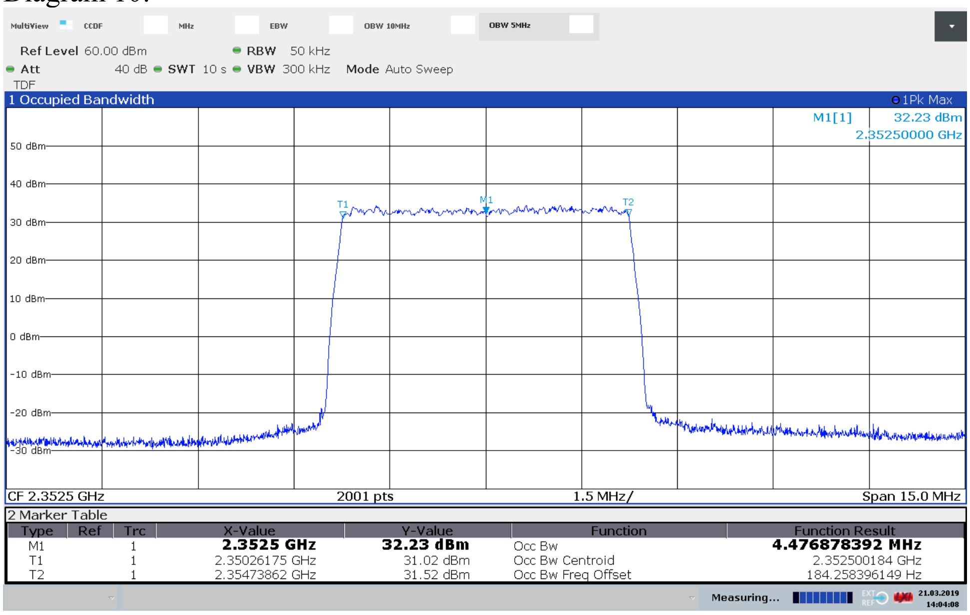
15:28:40 21.03.2019

Diagram 9:



15:16:42 21.03.2019

Diagram 10:



14:04:09 21.03.2019

Band edge measurements according to CFR 47 §27.53(a) / RSS-195 6.6.1

Date	Temperature	Humidity
2019-03-22	22 °C ± 3 °C	21 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.7.3. 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.

The transmitter unwanted emissions shall be measured with a resolution bandwidth of 1 MHz. However, in the 1 MHz bands immediately adjacent to the edges of the frequency range(s) in which the equipment is allowed to operate, a resolution bandwidth of as close as possible to, without being less than 1% of the emission bandwidth (26 dB points), (RSS-195, 1 % of the 99% Occupied bandwidth)

A smaller resolution bandwidth is permitted provided that the measured power is integrated over the full required measurement bandwidth. Where a smaller RBW was used the limit in the plot is adjusted by 10 log ($RBW_{used}/RBW_{specified}$) [dB].

Before comparing the results to the limit, 6 dB [10 log (4)] to cover 4x4 MIMO, should be added according to ANSI C63.26 section 6.4.4.1 c)

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	900 691
Coaxial cable Sucoflex 102EA	BX50237
Coaxial cable Sucoflex 102EA	BX50236
Coaxial cable Sucoflex 100	BX82296
EAB diplex bandreject filter LPC 107 131/30 R1A	BAMS - 1001477268
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Single carrier ETM 1.1

Diagram	BW configuration	Symbolic name	Tested Port
11 a-c	5 MHz	B_5	RF A
12 a-c	5 MHz	B_5	RF D
13 a-c	10 MHz	M_{10}	RF B
14 a-c	5 MHz	$2M_5$	RF C
15 a-e	5 MHz	T_5	RF A
16 a-e	5 MHz	T_5	RF D
17 a-e	10 MHz	M_{10}	RF B
18 a-e	5 MHZ	$2M_5$	RF C

Limits

CFR 47 §27.53(a)

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by the amount indicated in table below, measured with 1 MHz RBW.

Frequency (MHz)	Attenuation (dB)
< 2285	$75 + 10\log_{10}(p)$
2285 - 2287.5	$72 + 10\log_{10}(p)$
2287.5 - 2300	$70 + 10\log_{10}(p)$
2300 - 2305	$43 + 10\log_{10}(p)$
2305 - 2320	$43 + 10\log_{10}(p)$
2320 - 2345	$75 + 10\log_{10}(p)$
2345 - 2360	$43 + 10\log_{10}(p)$
2360 - 2362.5	$43 + 10\log_{10}(p)$
2362.5 - 2365	$55 + 10\log_{10}(p)$
2365 - 2367.5	$70 + 10\log_{10}(p)$
2367.5 - 2370	$72 + 10\log_{10}(p)$
> 2370	$75 + 10\log_{10}(p)$

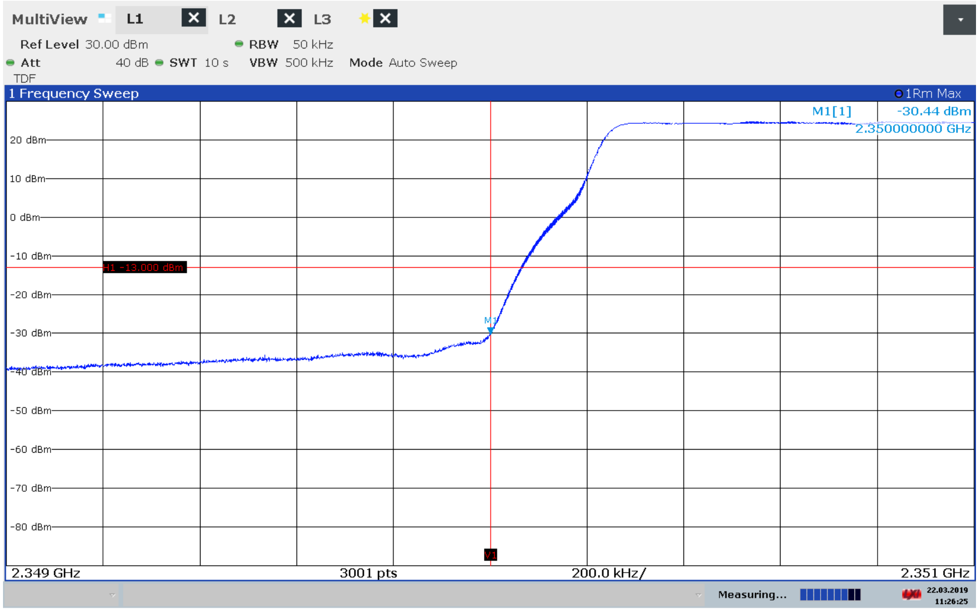
RSS-195 5.6

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by the amount indicated in table below, measured with 1 MHz RBW:

Frequency (MHz)	Attenuation (dB)
<2200	$43 + 10\log_{10}(p)$
2200 - 2285	$75 + 10\log_{10}(p)$
2285 - 2287.5	$72 + 10\log_{10}(p)$
2287.5 - 2300	$70 + 10\log_{10}(p)$
2300 - 2305	$43 + 10\log_{10}(p)$
2305 - 2320	$43 + 10\log_{10}(p)$
2320 - 2345	$75 + 10\log_{10}(p)$
2345 - 2360	$43 + 10\log_{10}(p)$
2360 - 2362.5	$43 + 10\log_{10}(p)$
2362.5 - 2365	$55 + 10\log_{10}(p)$
2365 - 2367.5	$70 + 10\log_{10}(p)$
2367.5 - 2370	$72 + 10\log_{10}(p)$
2370 - 2395	$75 + 10\log_{10}(p)$
>2395	$43 + 10\log_{10}(p)$

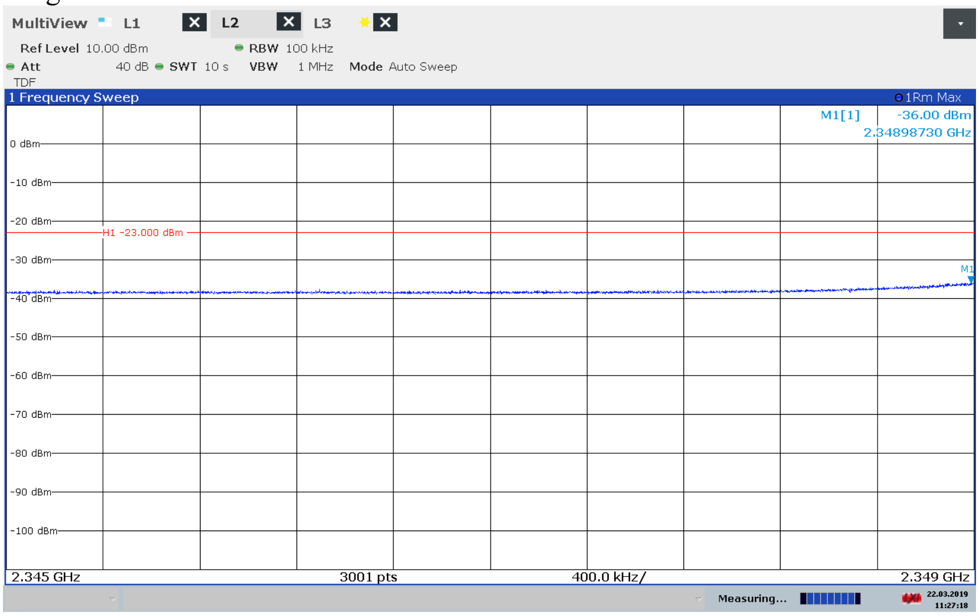
Complies?	Yes

Diagram 11a:



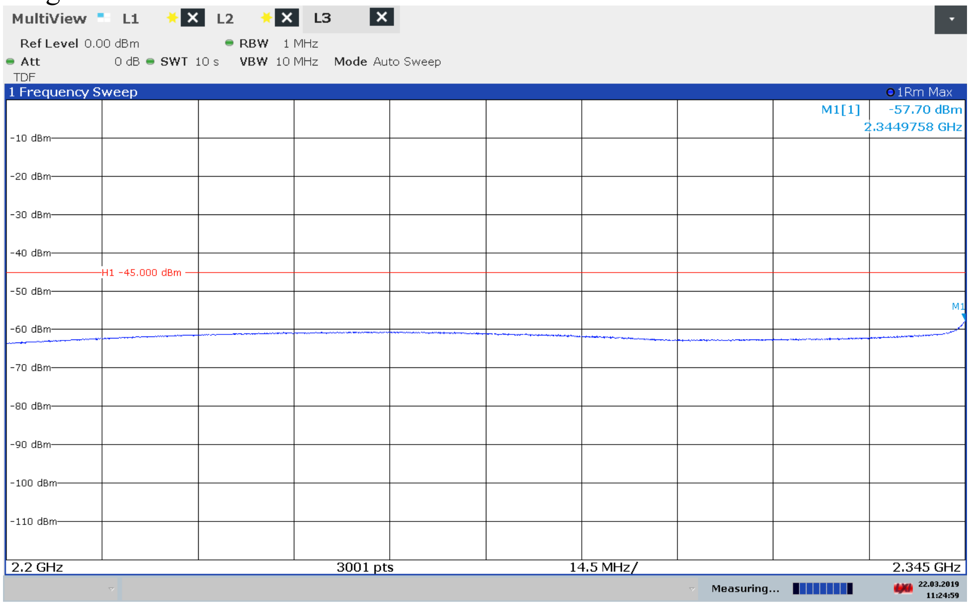
11:26:26 22.03.2019

Diagram 11b:



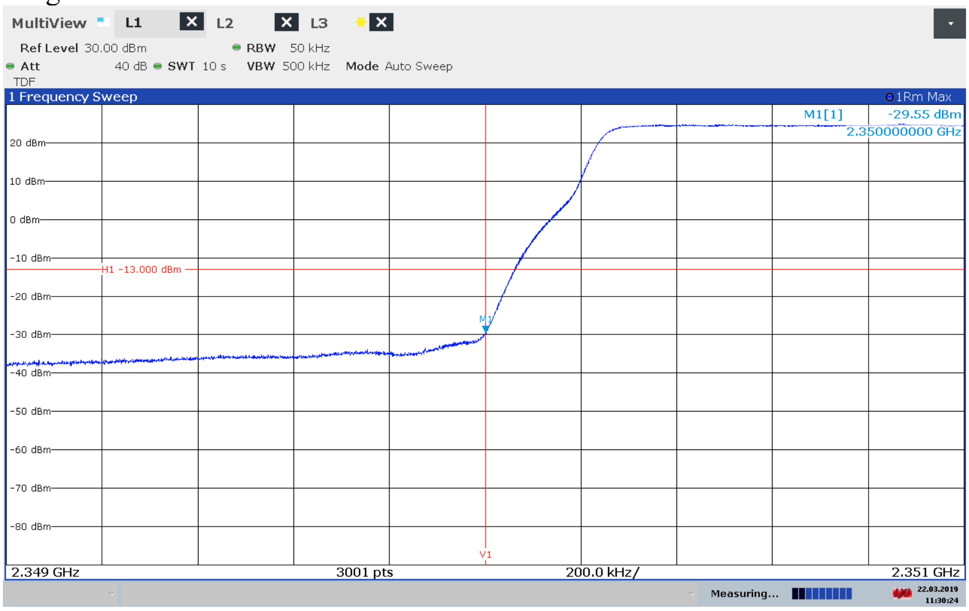
11:27:18 22.03.2019

Diagram 11c:



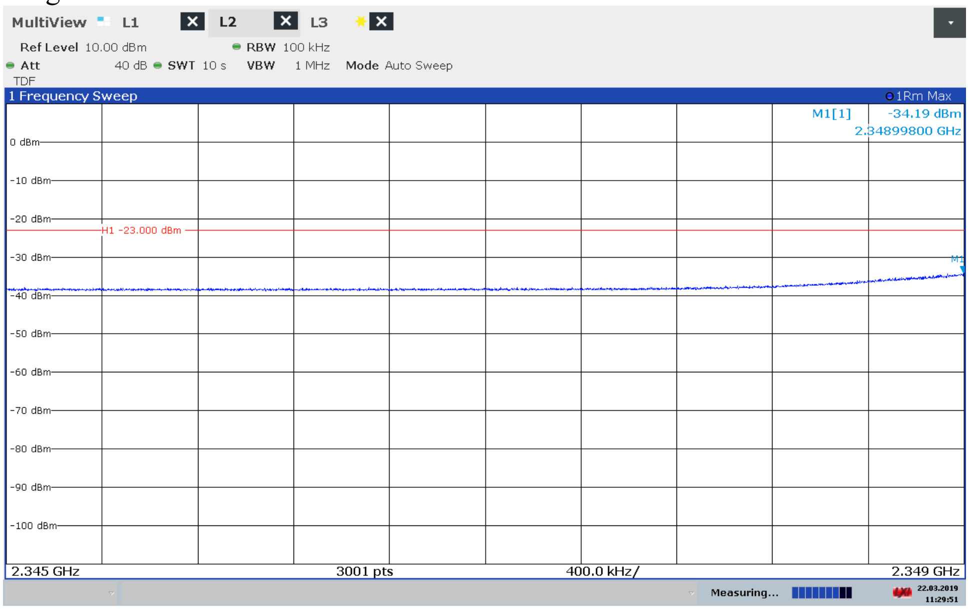
11:24:59 22.03.2019

Diagram 12a:



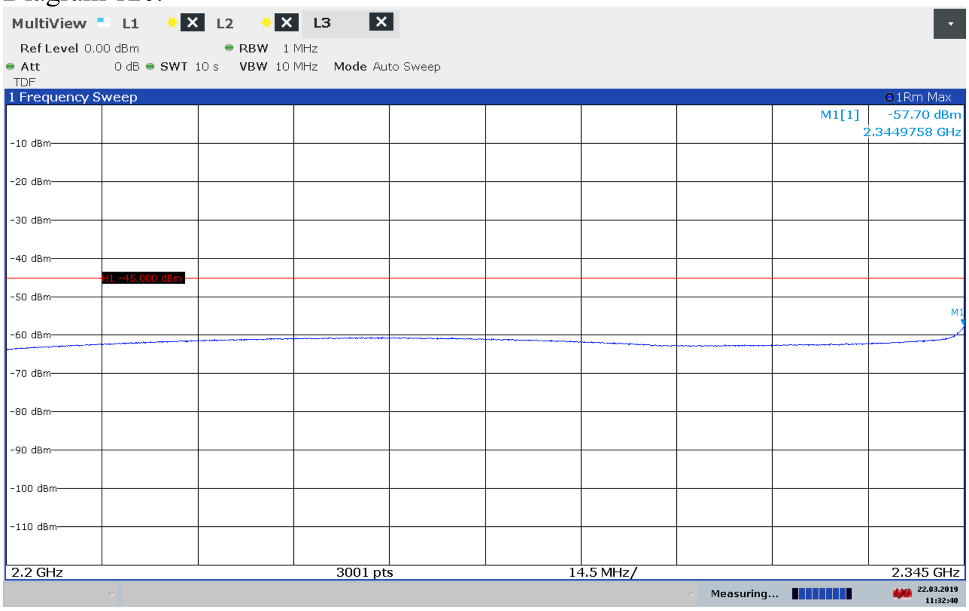
11:30:25 22.03.2019

Diagram 12b:



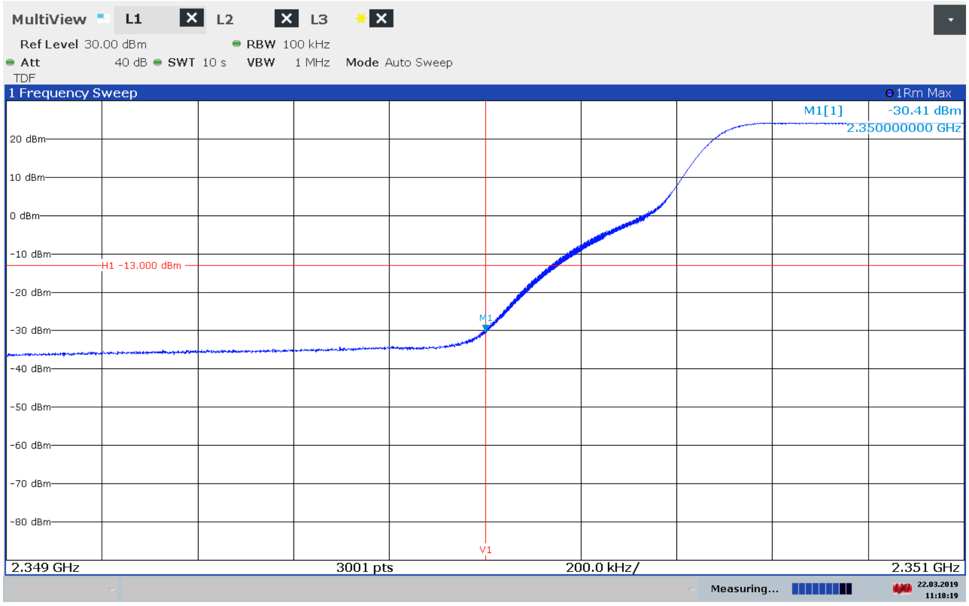
11:29:51 22.03.2019

Diagram 12c:



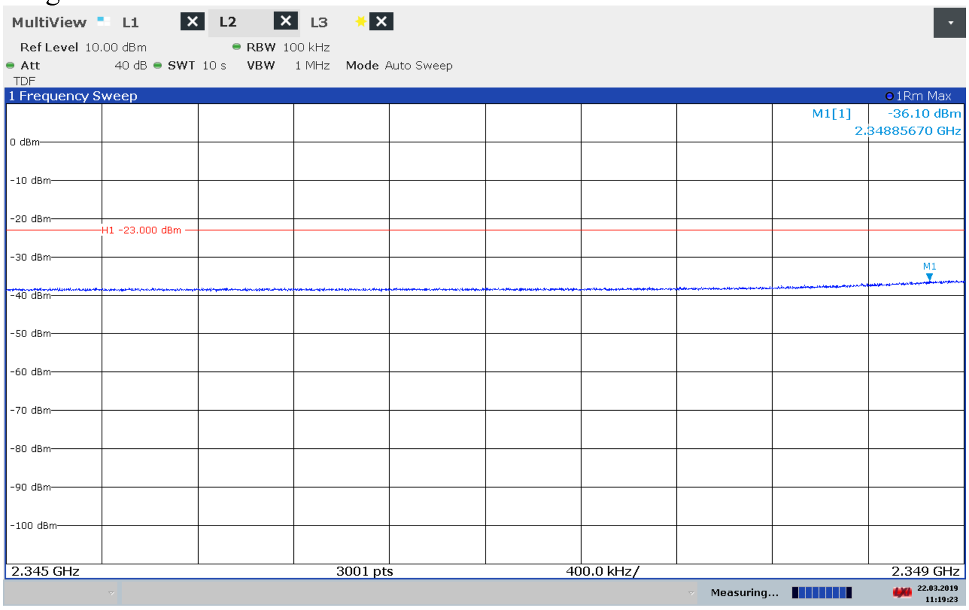
11:32:40 22.03.2019

Diagram 13a:



11:18:20 22.03.2019

Diagram 13b:



11:19:24 22.03.2019

Diagram 13c:

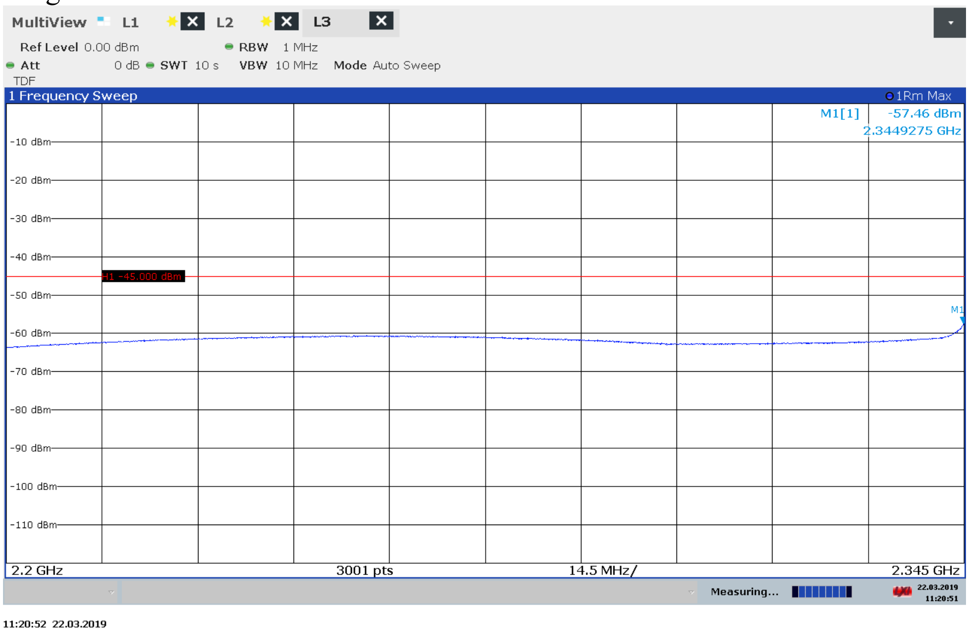


Diagram 14a:

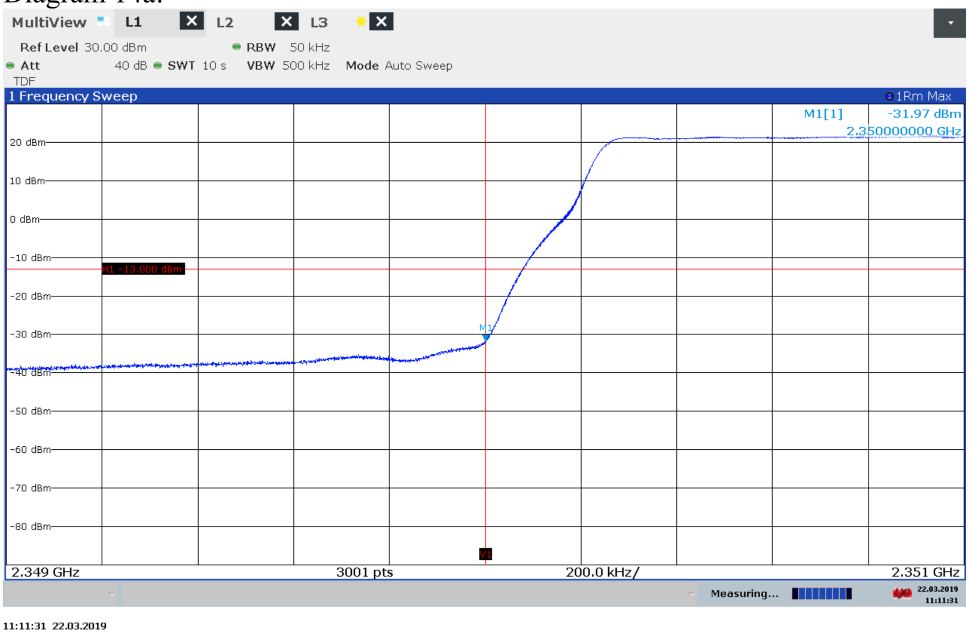
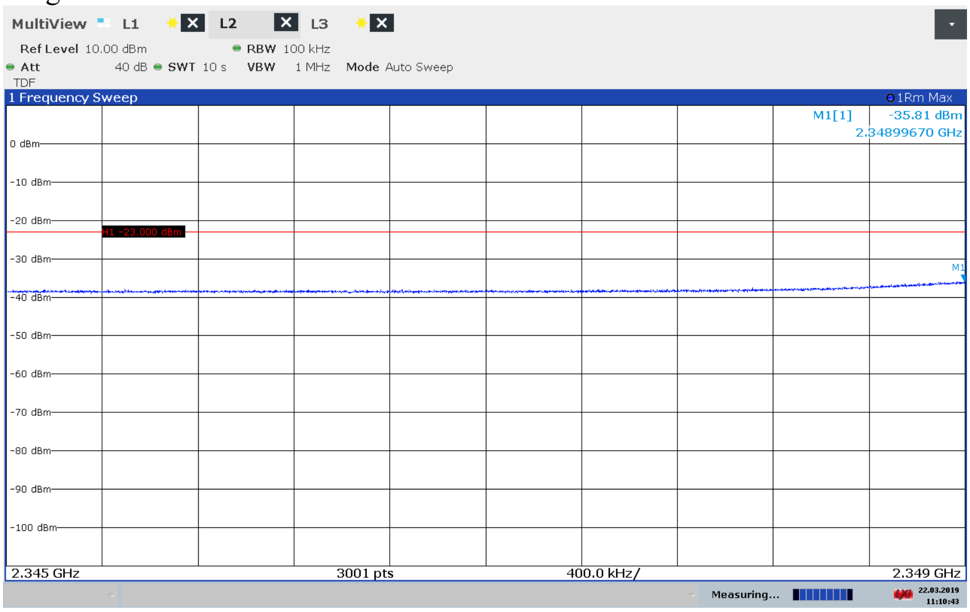
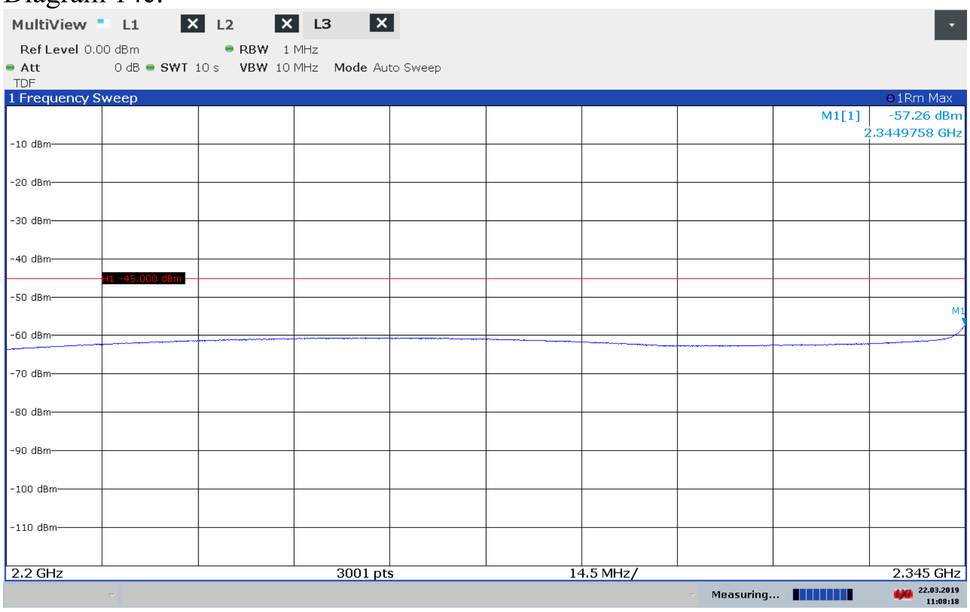


Diagram 14b:



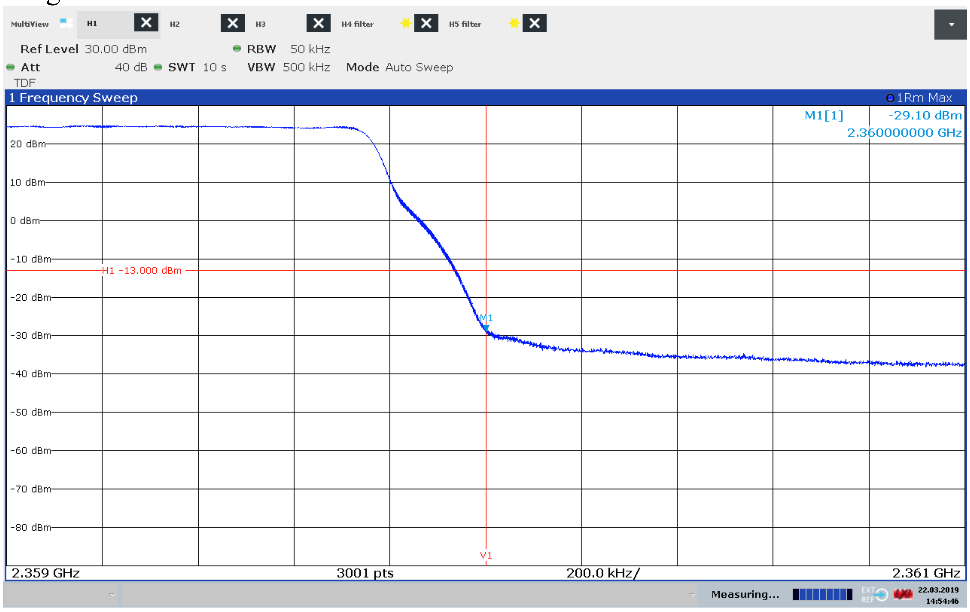
11:10:43 22.03.2019

Diagram 14c:



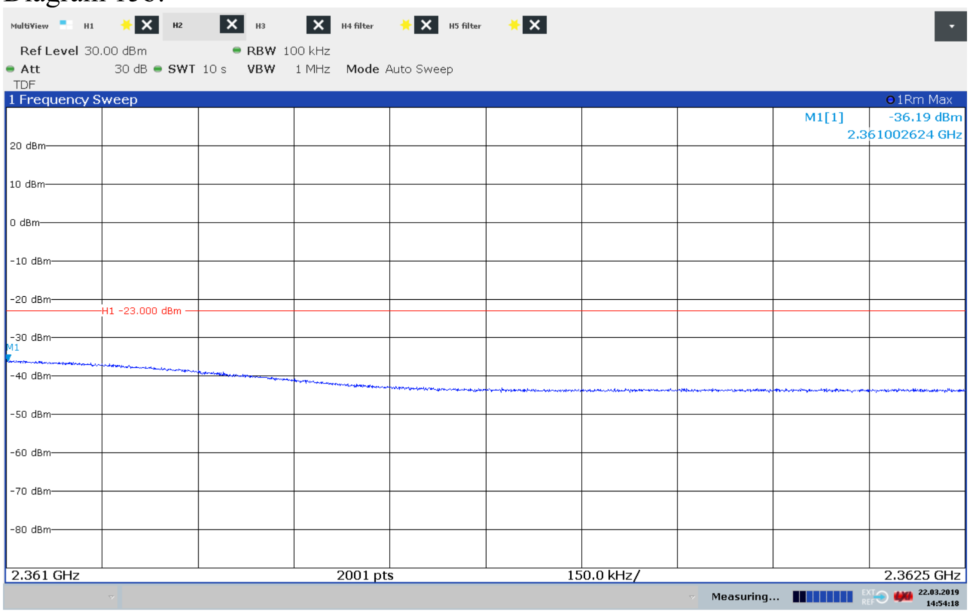
11:08:19 22.03.2019

Diagram 15a:



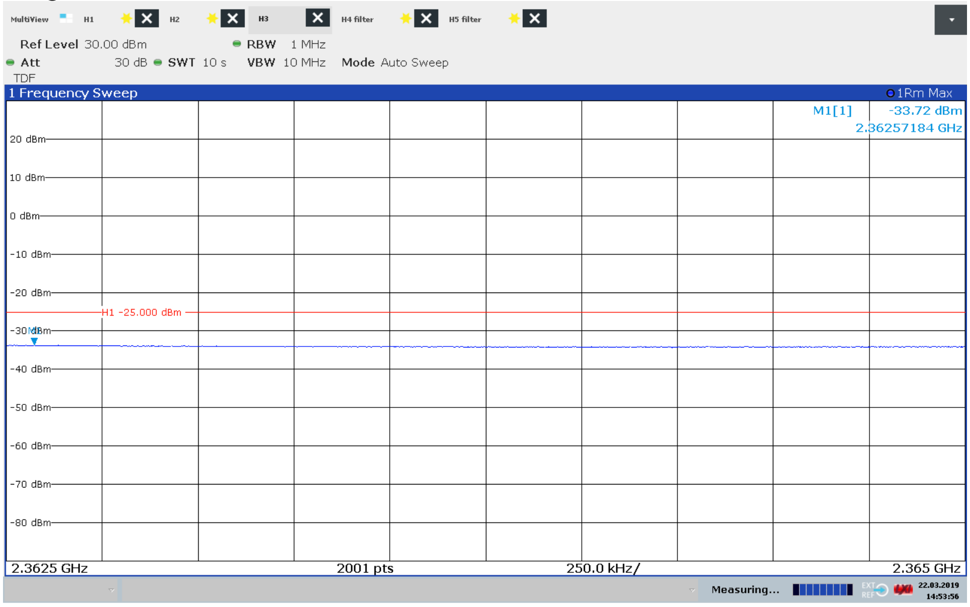
14:54:46 22.03.2019

Diagram 15b:



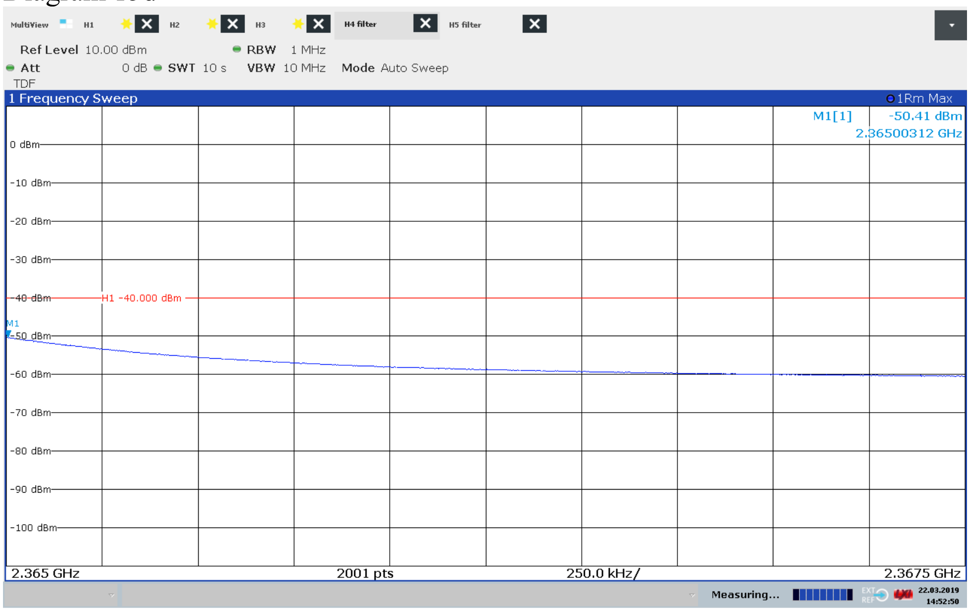
14:54:18 22.03.2019

Diagram 15c:



14:53:57 22.03.2019

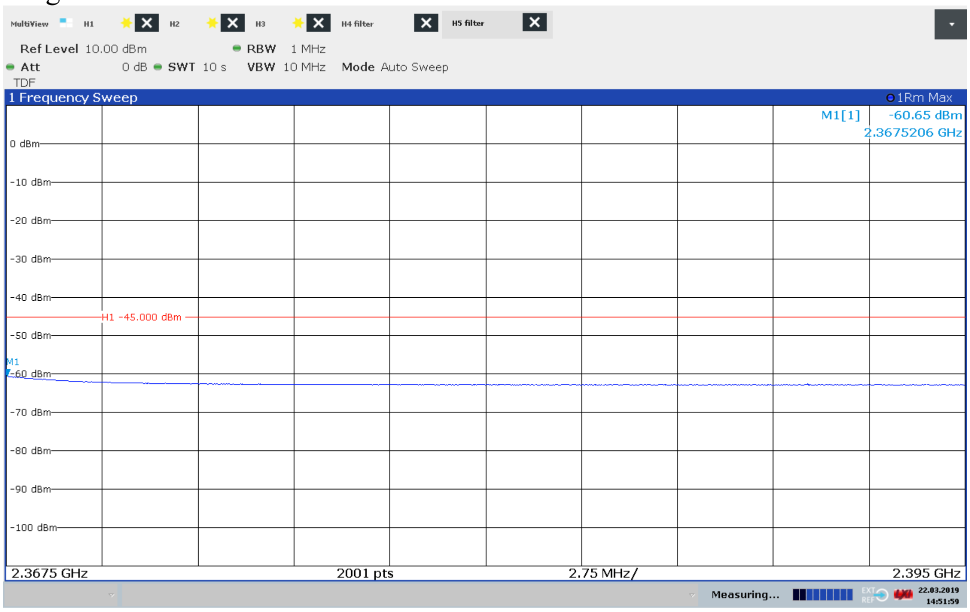
Diagram 15d



14:52:51 22.03.2019

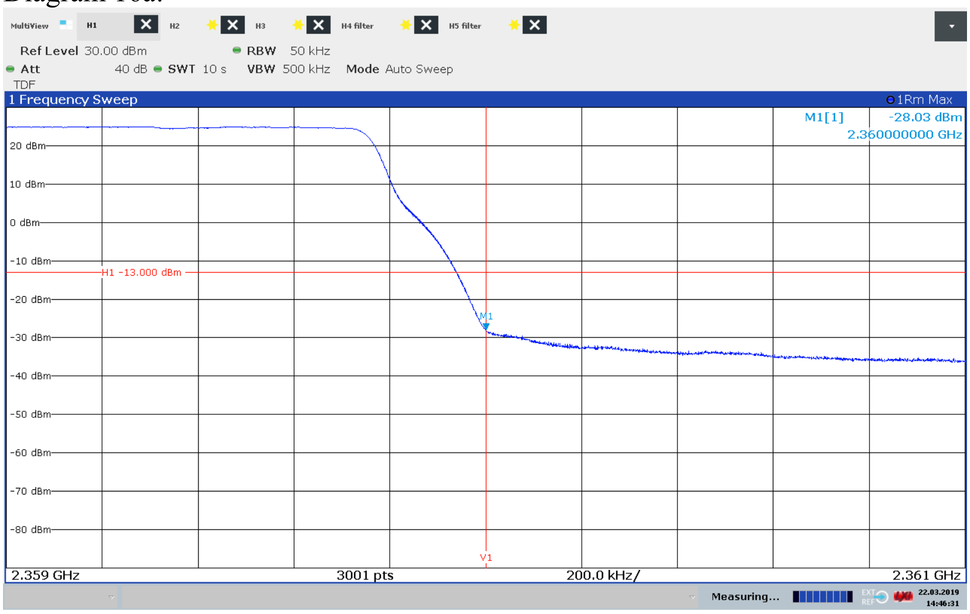
:

Diagram 15e:



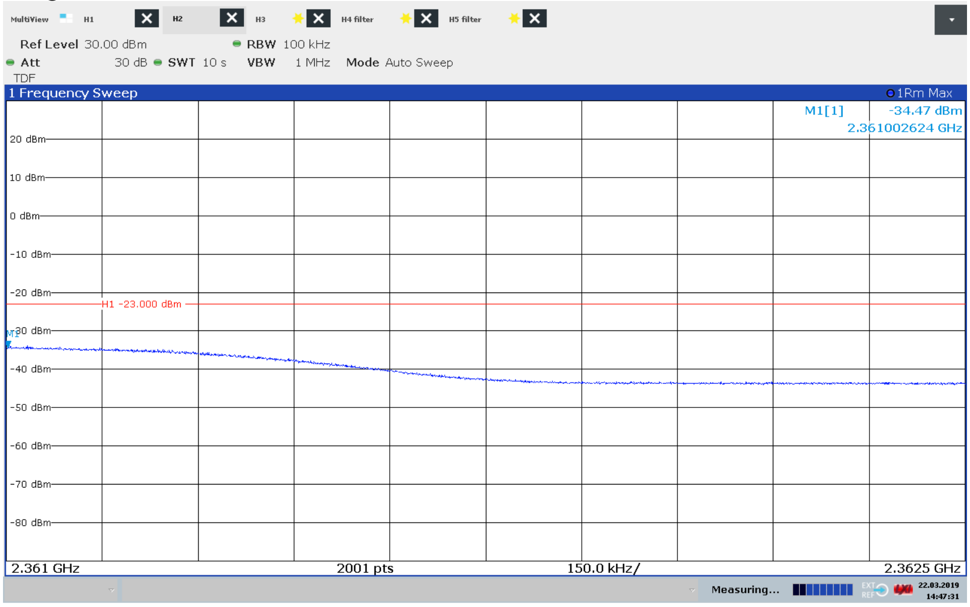
14:51:59 22.03.2019

Diagram 16a:



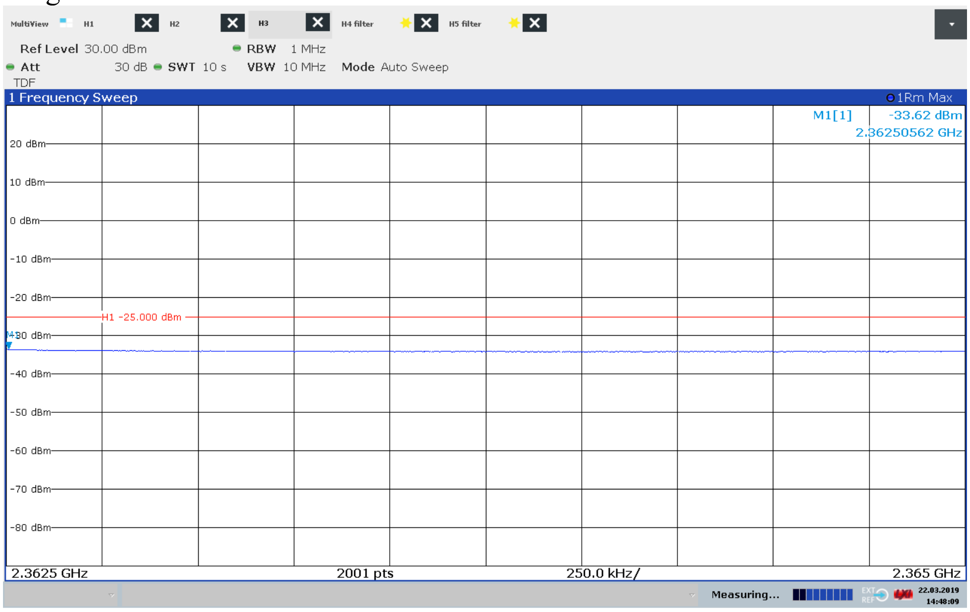
14:46:32 22.03.2019

Diagram 16b:



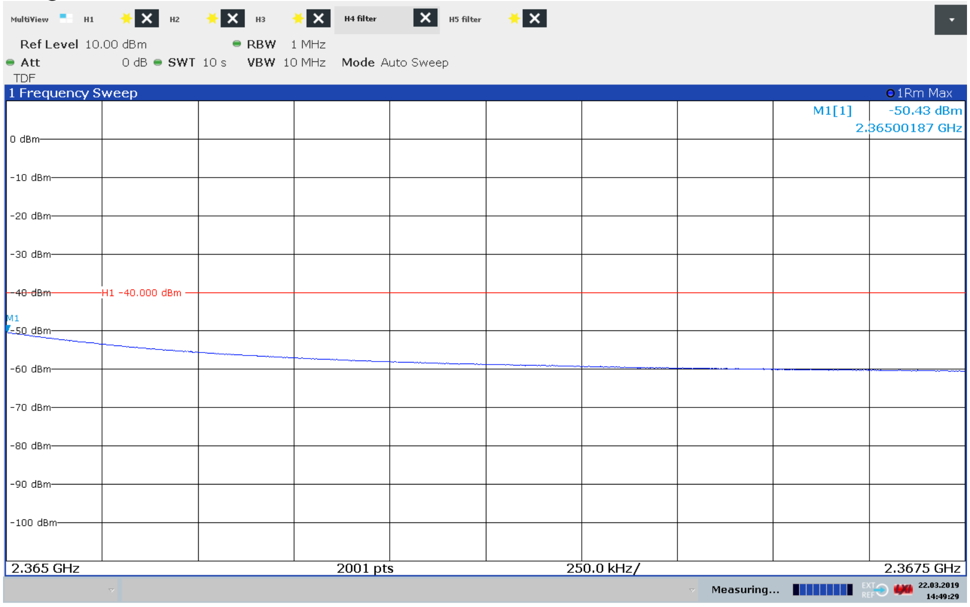
14:47:31 22.03.2019

Diagram 16c:



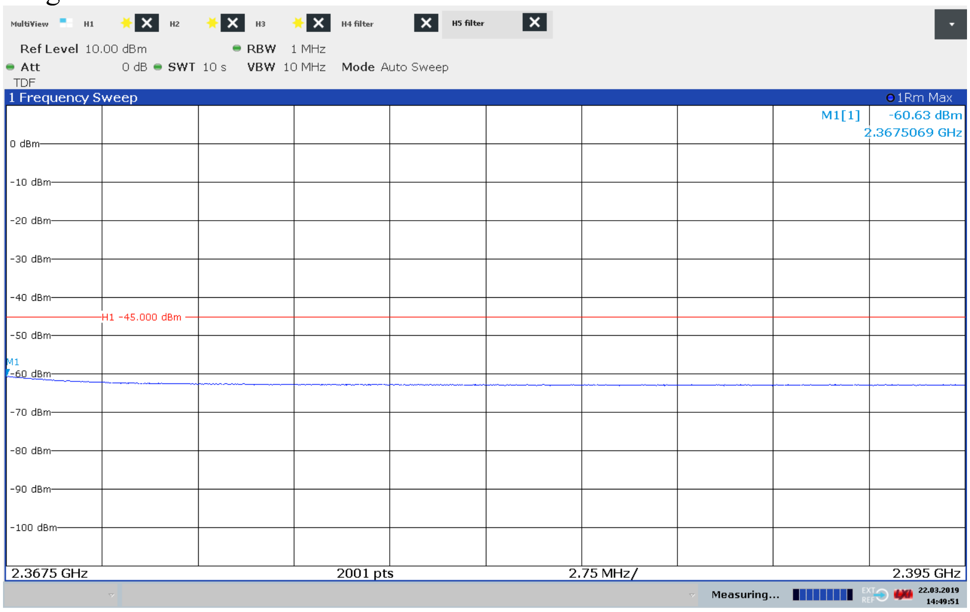
14:48:10 22.03.2019

Diagram 16d:



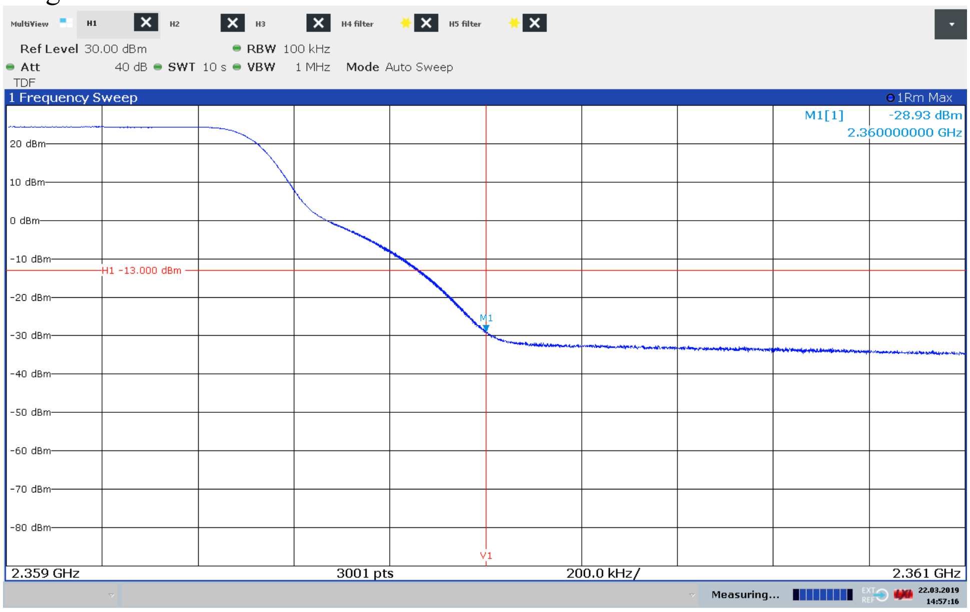
14:49:29 22.03.2019

Diagram 16e:



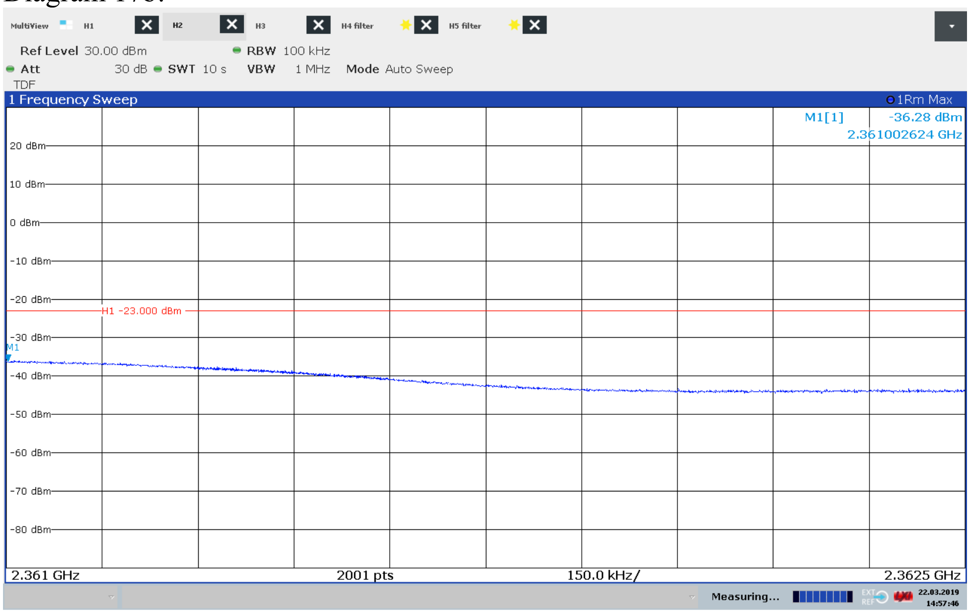
14:49:51 22.03.2019

Diagram 17a:



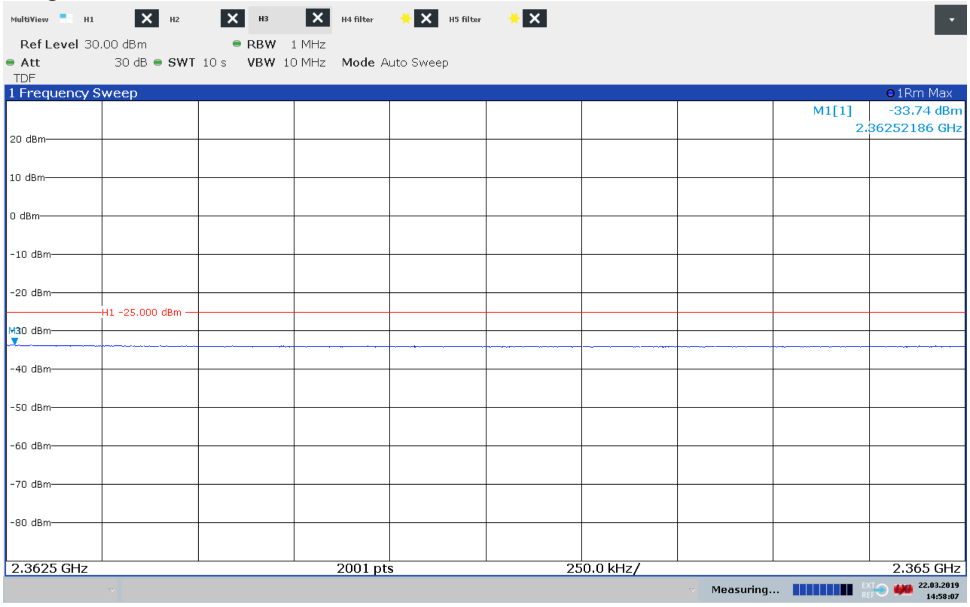
14:57:16 22.03.2019

Diagram 17b:



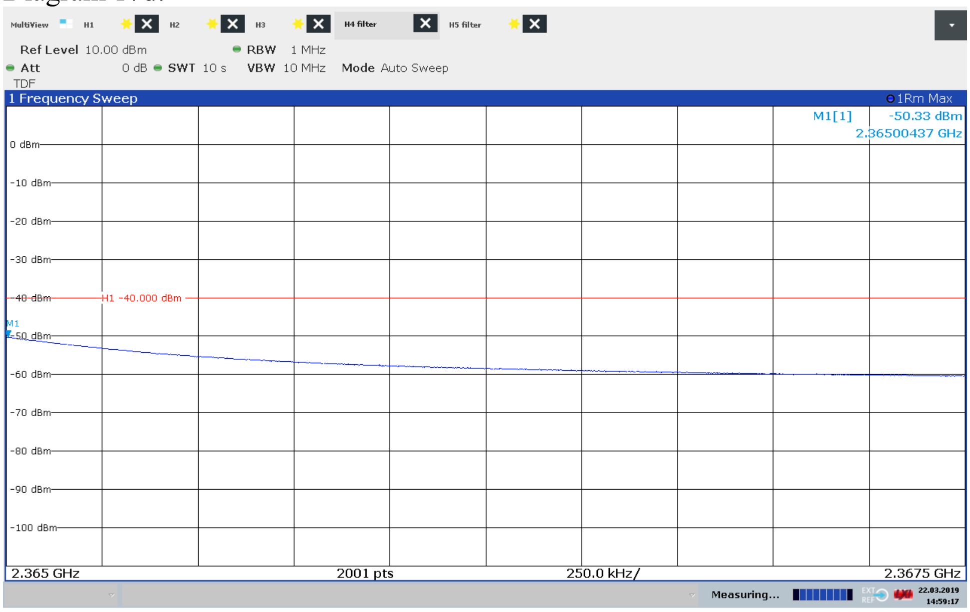
14:57:47 22.03.2019

Diagram 17c:



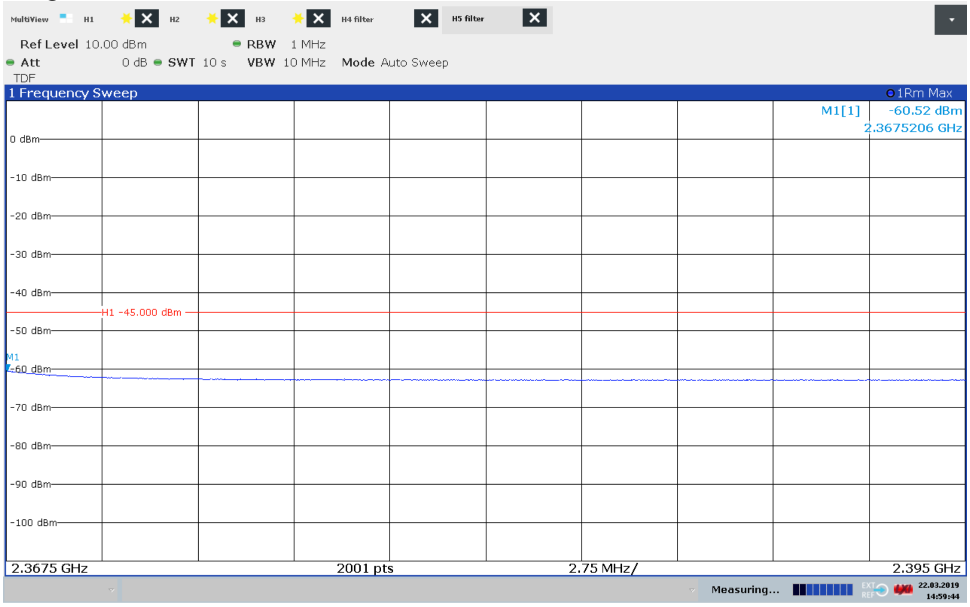
14:58:07 22.03.2019

Diagram 17d:



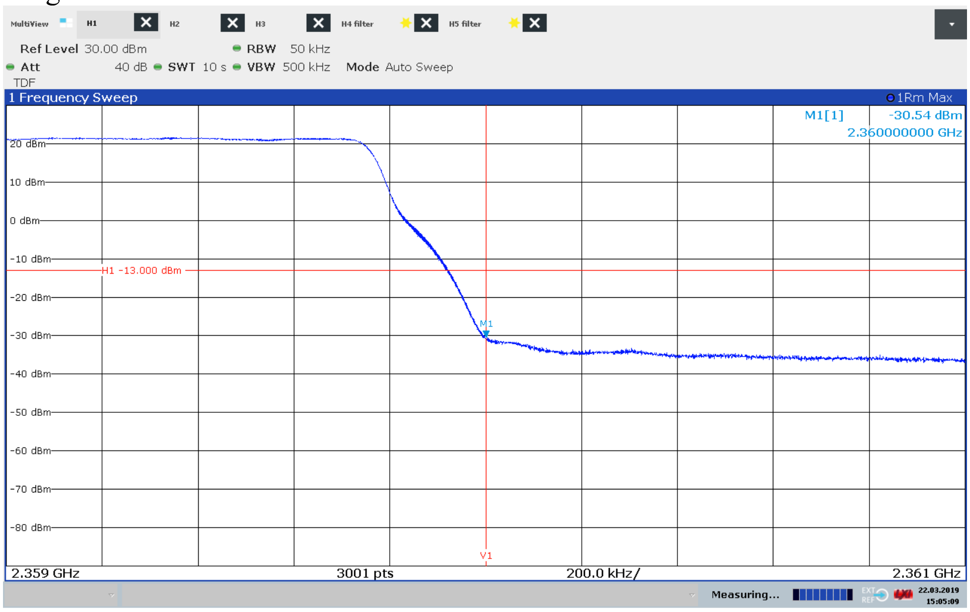
14:59:17 22.03.2019

Diagram 17e:



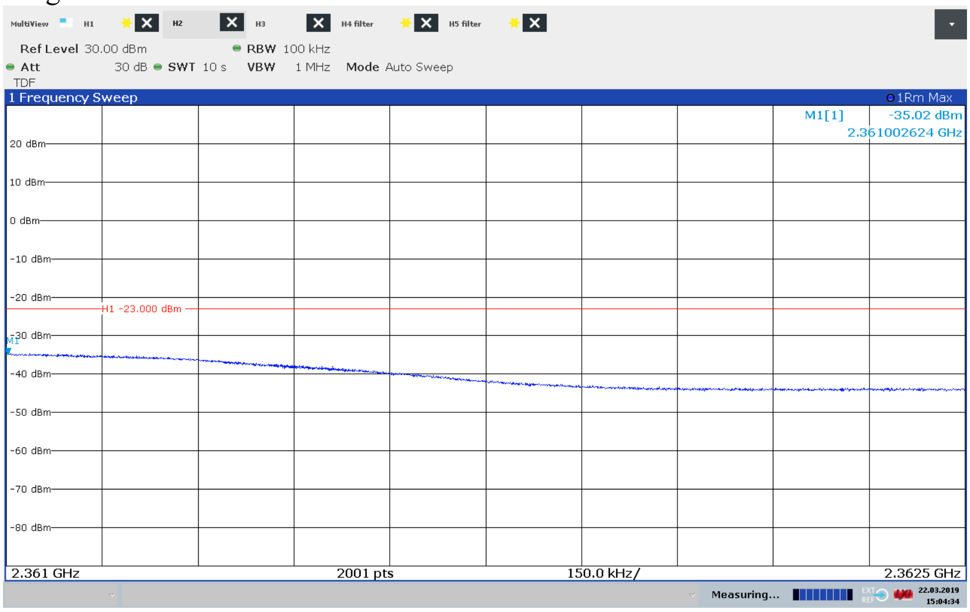
14:59:44 22.03.2019

Diagram 18a:



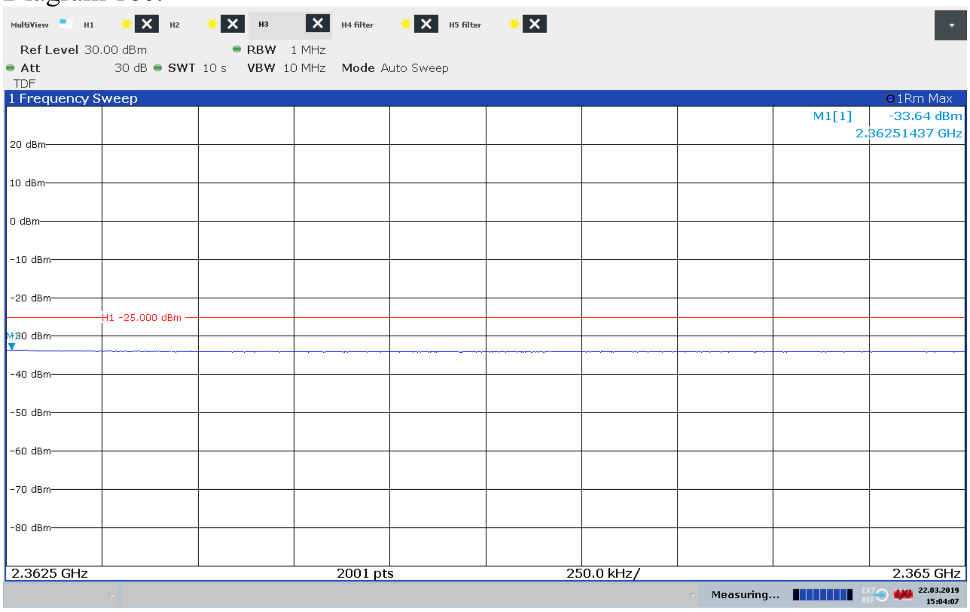
15:05:09 22.03.2019

Diagram 18b:



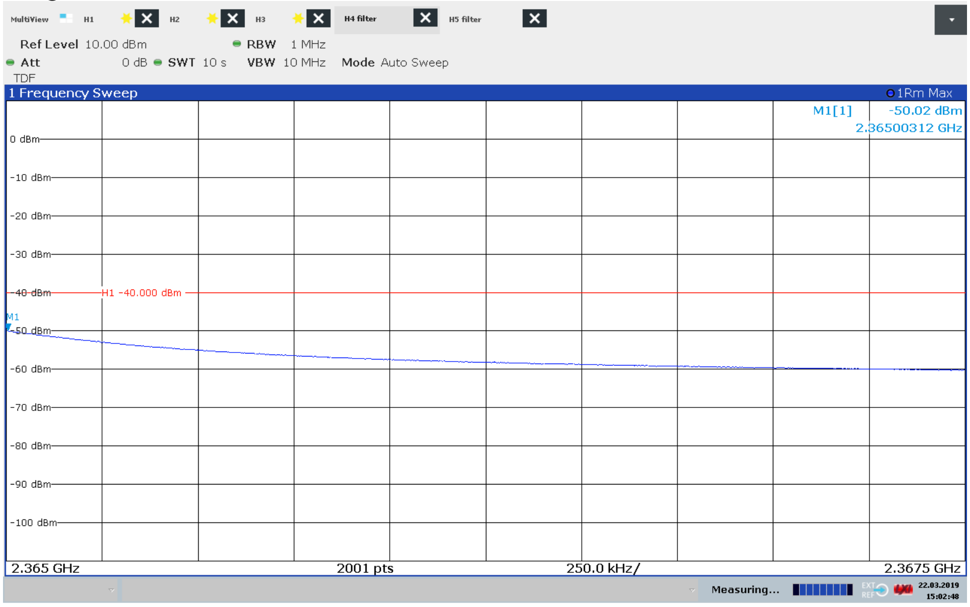
15:04:34 22.03.2019

Diagram 18c:



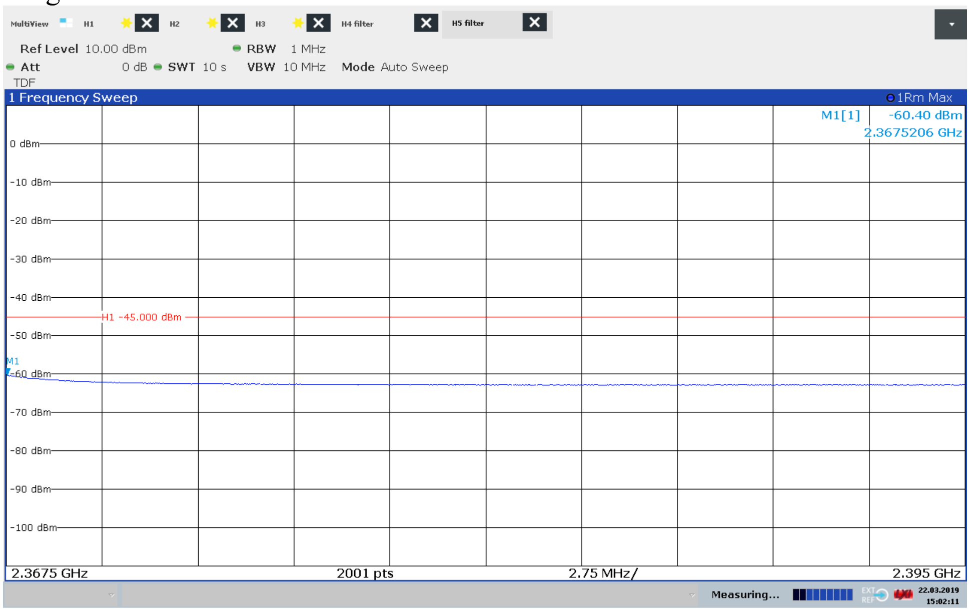
15:04:08 22.03.2019

Diagram 18d:



15:02:49 22.03.2019

Diagram 18e:



15:02:12 22.03.2019

Conducted spurious emission measurements according to CFR 47 §27.53(a) / RSS-195 6.6.1

Date	Temperature	Humidity
2019-03-26	24 °C ± 3 °C	7 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.7.4. 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 ANSI C63.26 section 6.4.4.1 c)

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	900 691
RF attenuator	902 282
HP filter	901 502
Coaxial cable Sucoflex 102EA	BX50237
Coaxial cable Sucoflex 102EA	BX50236
Coaxial cable Sucoflex 100	BX82296
EAB diplex bandreject filter LPC 107 131/30 R1A	BAMS – 1001477268
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
19 a-d	B_5	RF A
20 a-d	T_5	RF A
21 a-d	M_{10}	RF A
22 a-d	B_5	RF B
23 a-d	B_5	RF C
24 a-d	B_5	RF D

Multi carrier E-TM 1.1

Diagram	Symbolic name	Tested Port
25 a-d	$2M_5$	RF A

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 2360 MHz. The measurements were made up to 24 GHz (10x2360 MHz = 23 600 MHz).

Limits

CFR 47 §27.53(a)

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by the amount indicated in table below, measured with 1 MHz RBW.

Frequency (MHz)	Attenuation (dB)
< 2285	$75 + 10\log_{10}(p)$
2285 - 2287.5	$72 + 10\log_{10}(p)$
2287.5 - 2300	$70 + 10\log_{10}(p)$
2300 - 2305	$43 + 10\log_{10}(p)$
2305 - 2320	$43 + 10\log_{10}(p)$
2320 - 2345	$75 + 10\log_{10}(p)$
2345 - 2360	$43 + 10\log_{10}(p)$
2360 - 2362.5	$43 + 10\log_{10}(p)$
2362.5 - 2365	$55 + 10\log_{10}(p)$
2365 - 2367.5	$70 + 10\log_{10}(p)$
2367.5 - 2370	$72 + 10\log_{10}(p)$
> 2370	$75 + 10\log_{10}(p)$

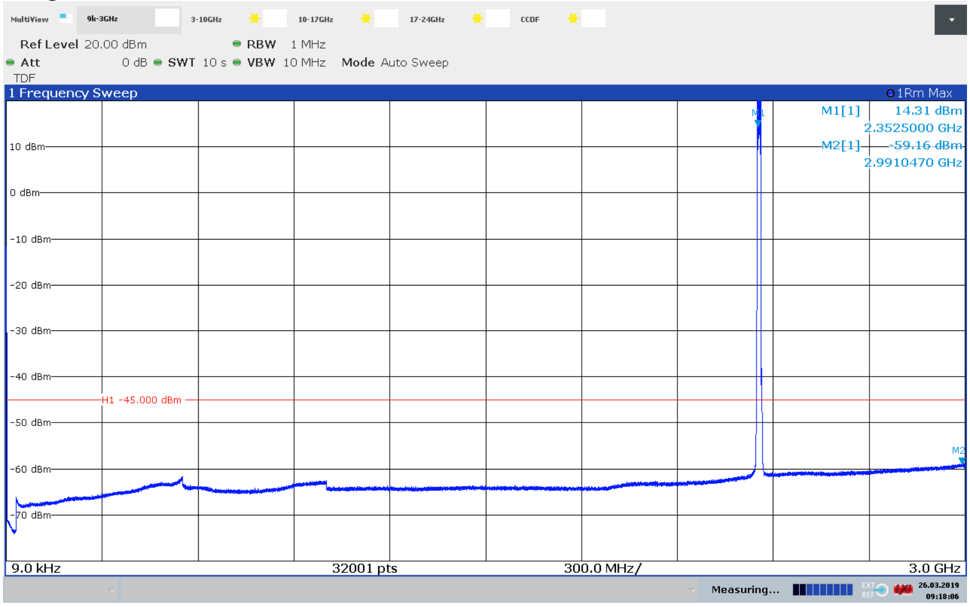
RSS-195 5.6

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by the amount indicated in table below, measured with 1 MHz RBW:

Frequency (MHz)	Attenuation (dB)
<2200	$43 + 10\log_{10}(p)$
2200 - 2285	$75 + 10\log_{10}(p)$
2285 - 2287.5	$72 + 10\log_{10}(p)$
2287.5 - 2300	$70 + 10\log_{10}(p)$
2300 - 2305	$43 + 10\log_{10}(p)$
2305 - 2320	$43 + 10\log_{10}(p)$
2320 - 2345	$75 + 10\log_{10}(p)$
2345 - 2360	$43 + 10\log_{10}(p)$
2360 - 2362.5	$43 + 10\log_{10}(p)$
2362.5 - 2365	$55 + 10\log_{10}(p)$
2365 - 2367.5	$70 + 10\log_{10}(p)$
2367.5 - 2370	$72 + 10\log_{10}(p)$
2370 - 2395	$75 + 10\log_{10}(p)$
>2395	$43 + 10\log_{10}(p)$

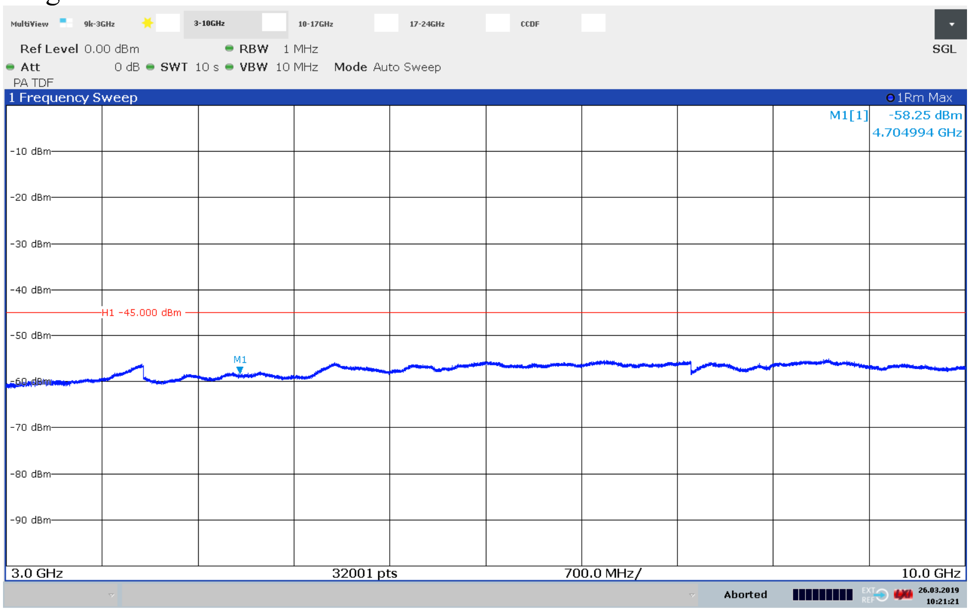
Complies?	Yes

Diagram 19a:



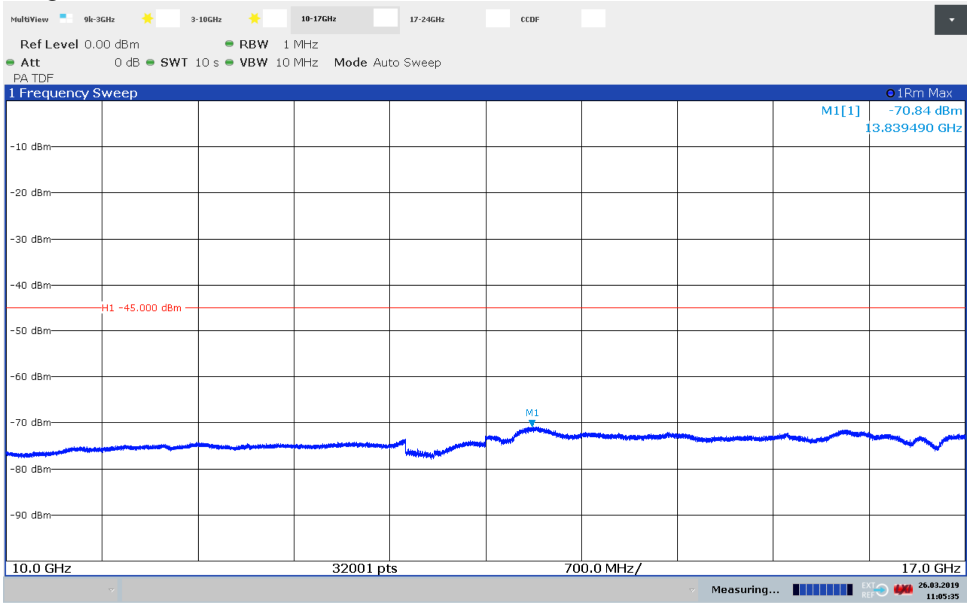
09:18:06 26.03.2019

Diagram 19b:



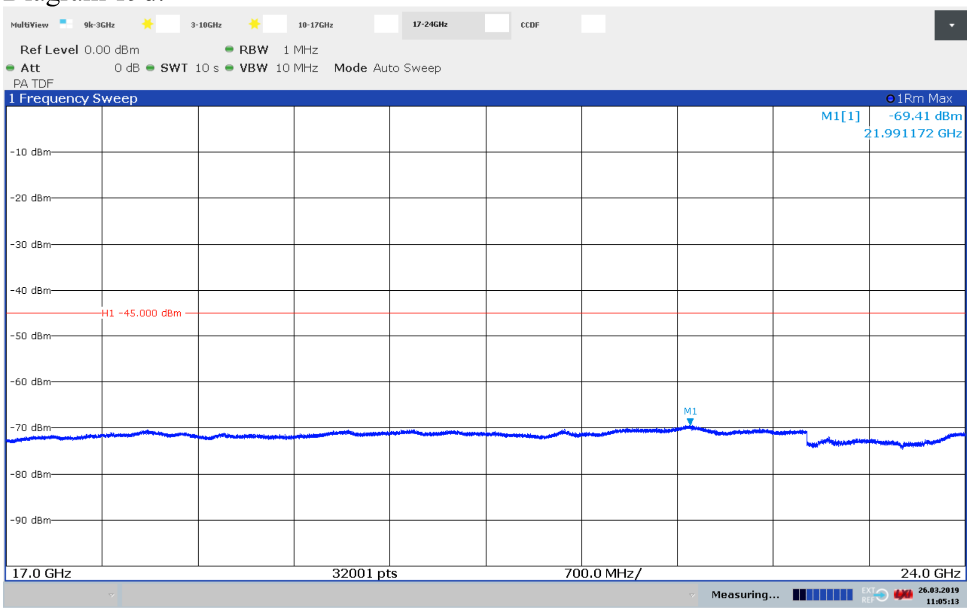
10:21:21 26.03.2019

Diagram 19c:



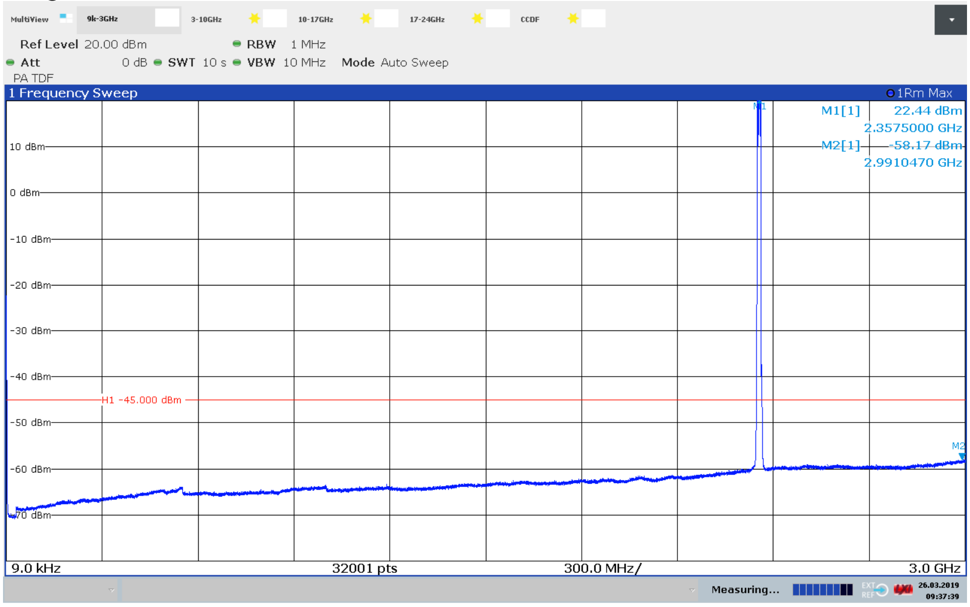
11:05:36 26.03.2019

Diagram 19d:



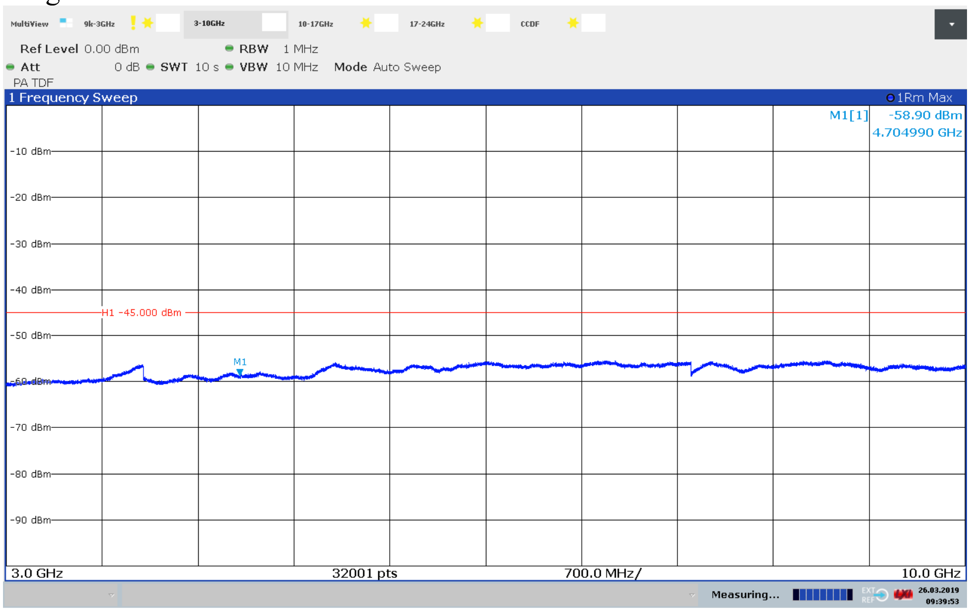
11:05:14 26.03.2019

Diagram 20a:



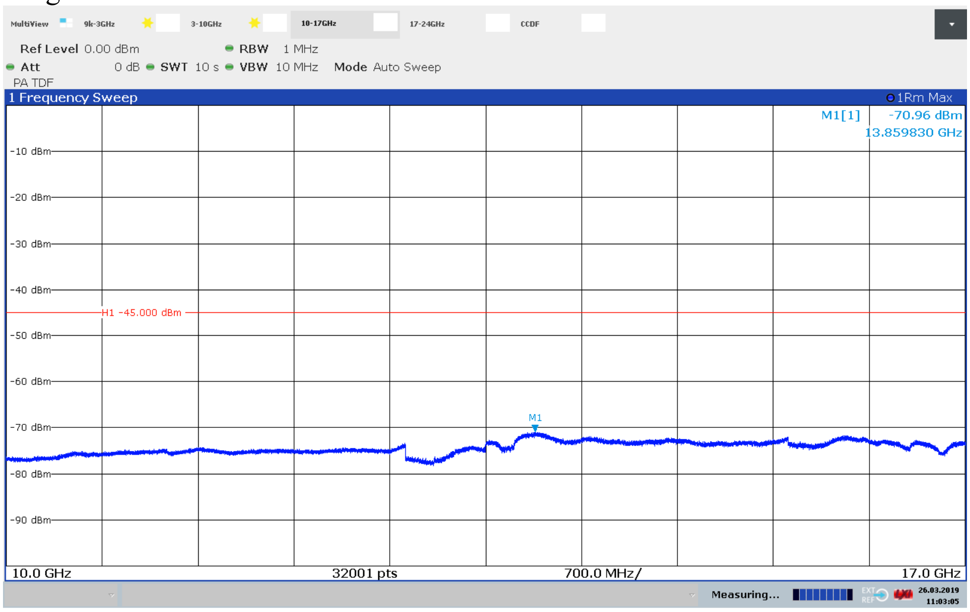
09:37:39 26.03.2019

Diagram 20b:



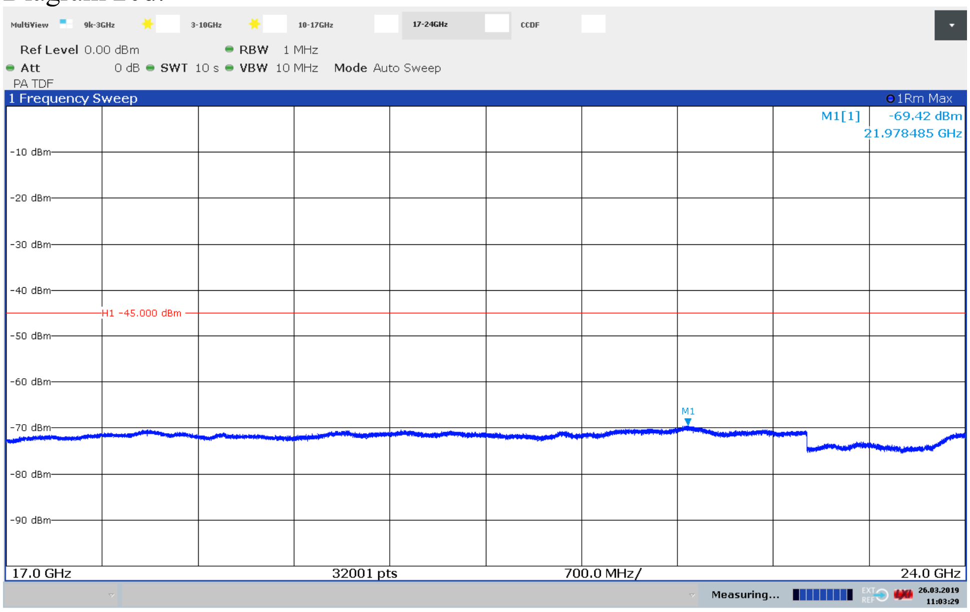
09:39:53 26.03.2019

Diagram 20c:



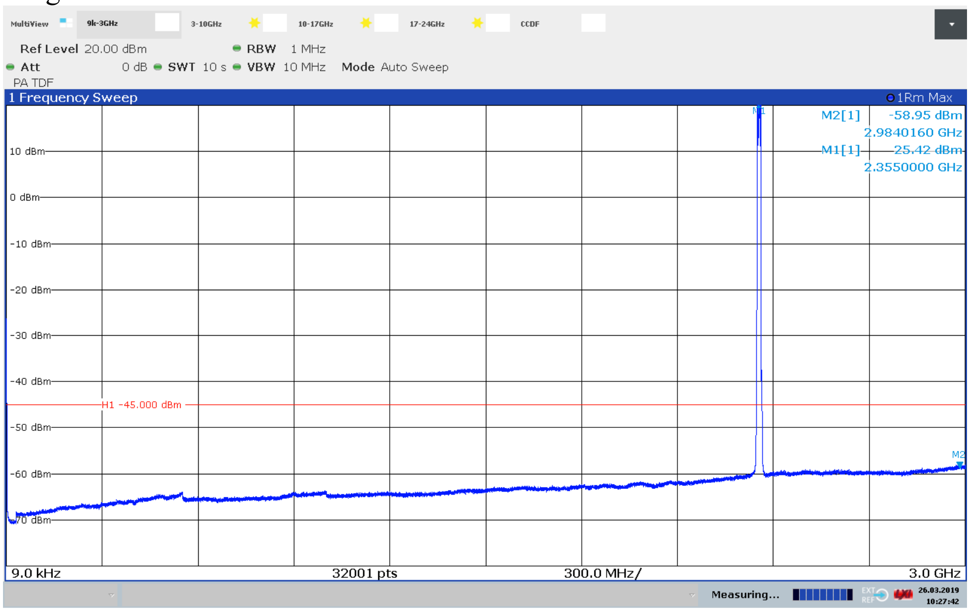
11:03:05 26.03.2019

Diagram 20d:



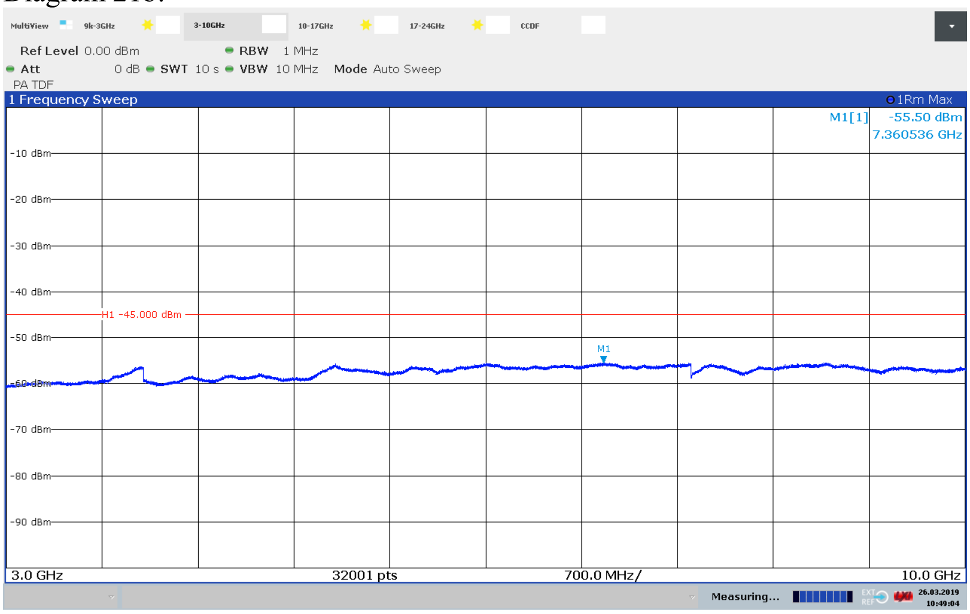
11:03:29 26.03.2019

Diagram 21a:



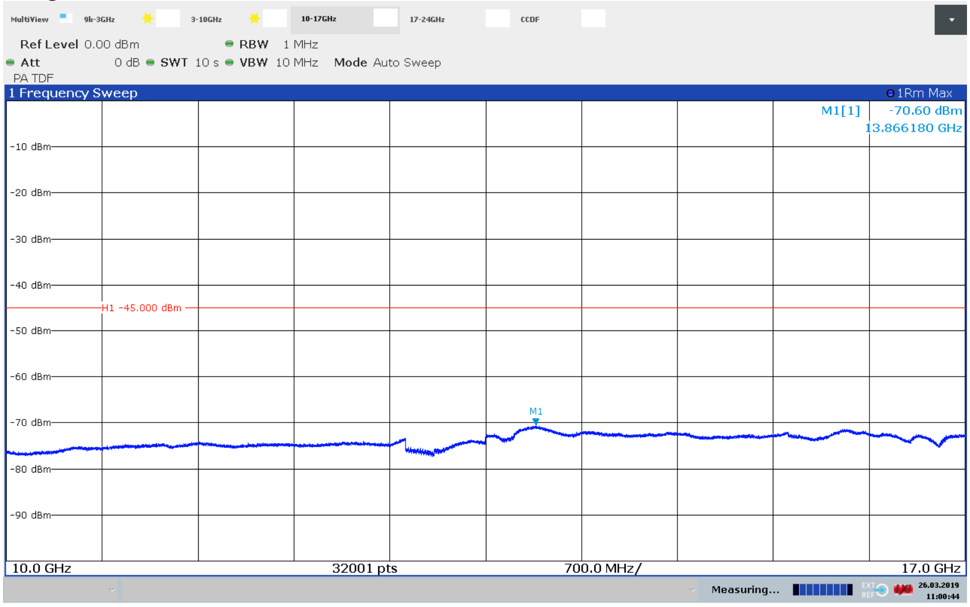
10:27:43 26.03.2019

Diagram 21b:



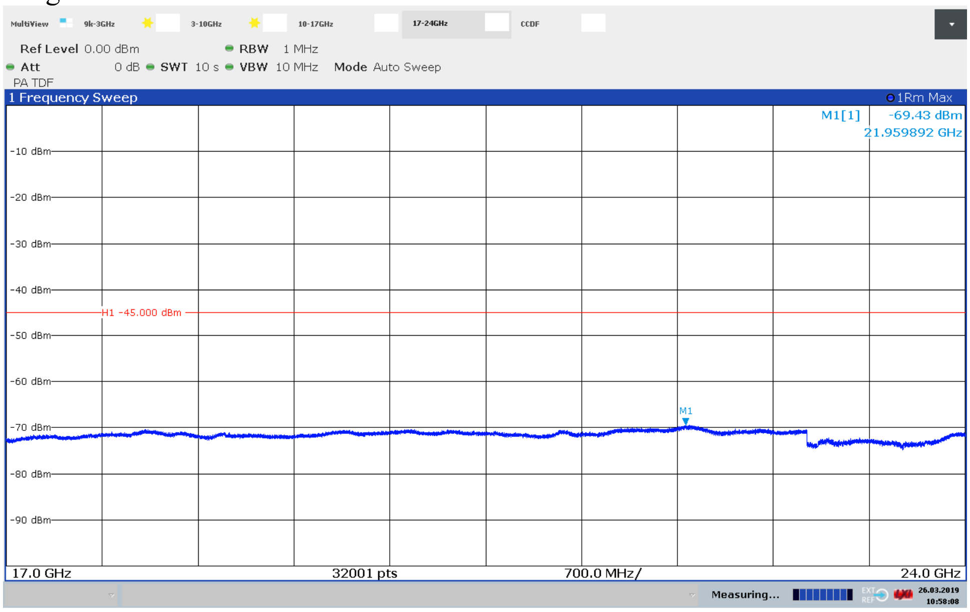
10:49:04 26.03.2019

Diagram 21c:



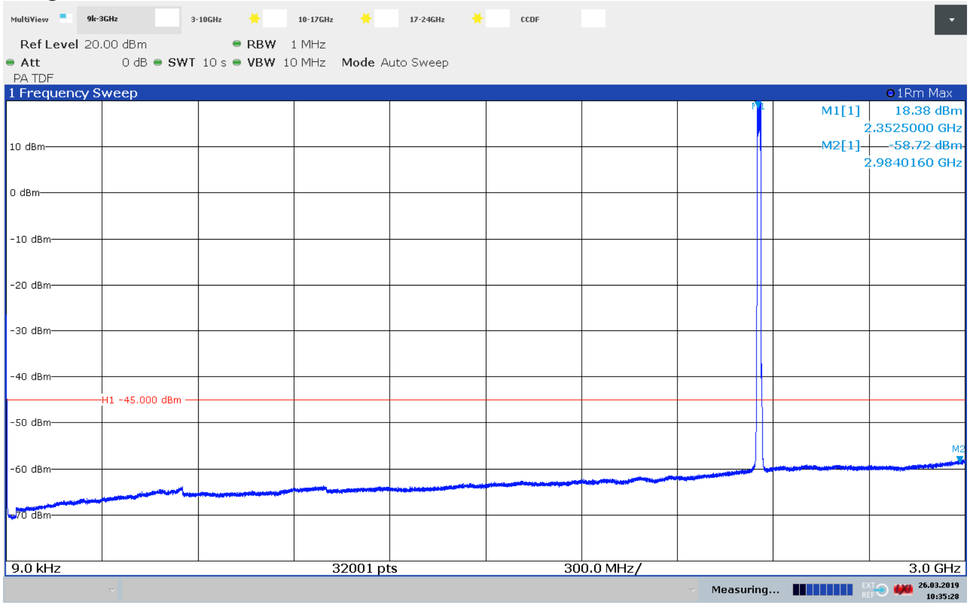
11:00:45 26.03.2019

Diagram 21d:



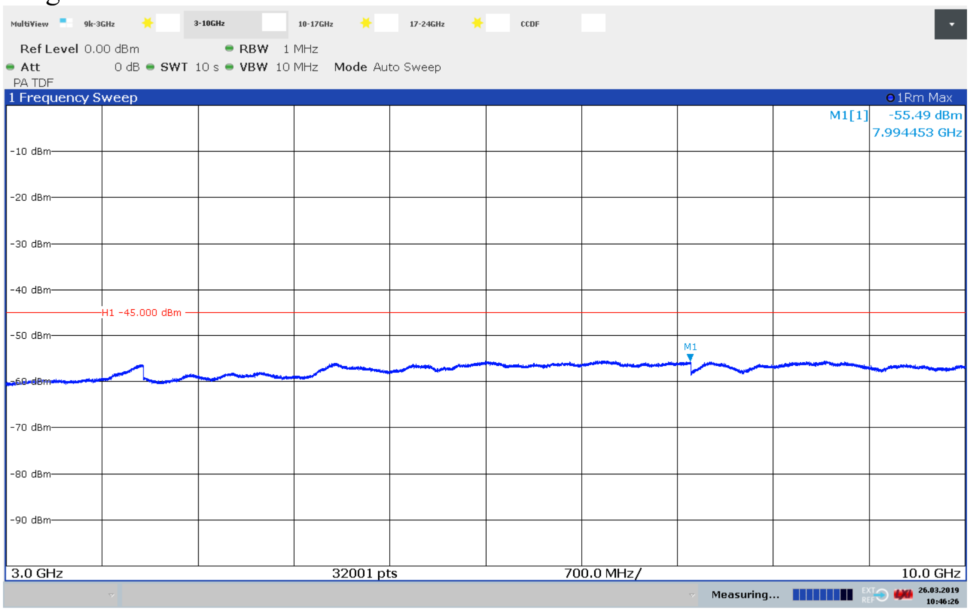
10:58:08 26.03.2019

Diagram 22a:



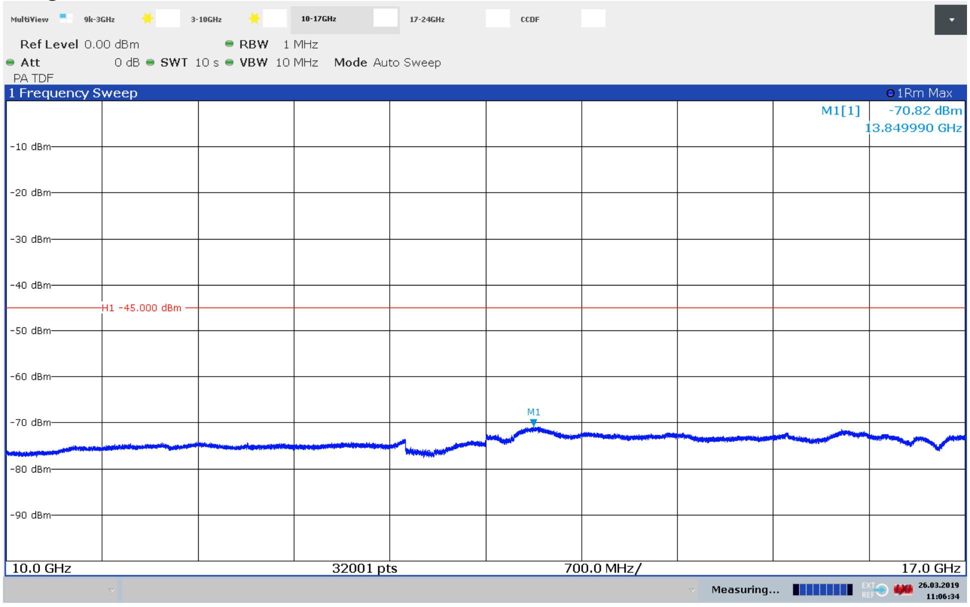
10:35:29 26.03.2019

Diagram 22b:



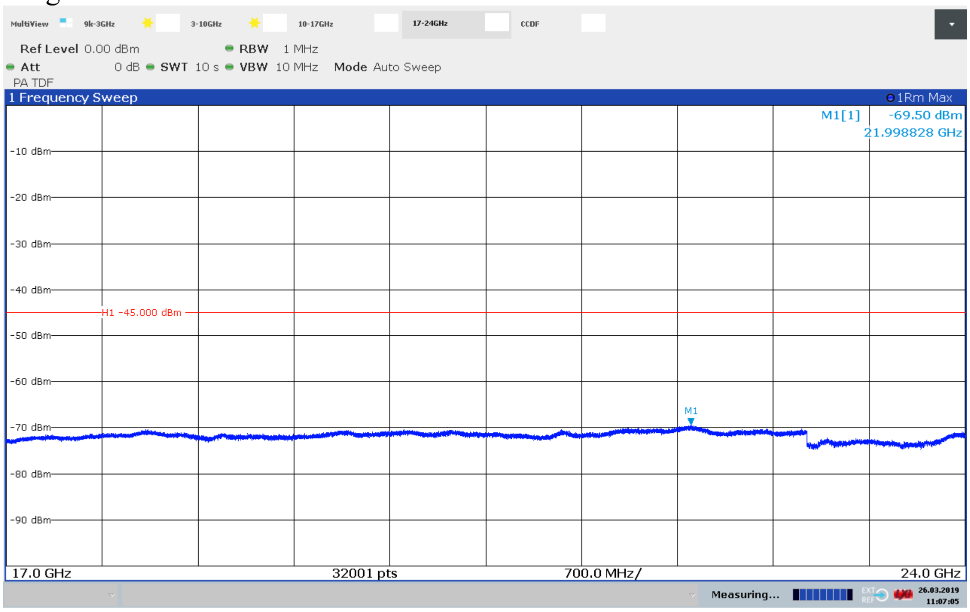
10:46:26 26.03.2019

Diagram 22c:



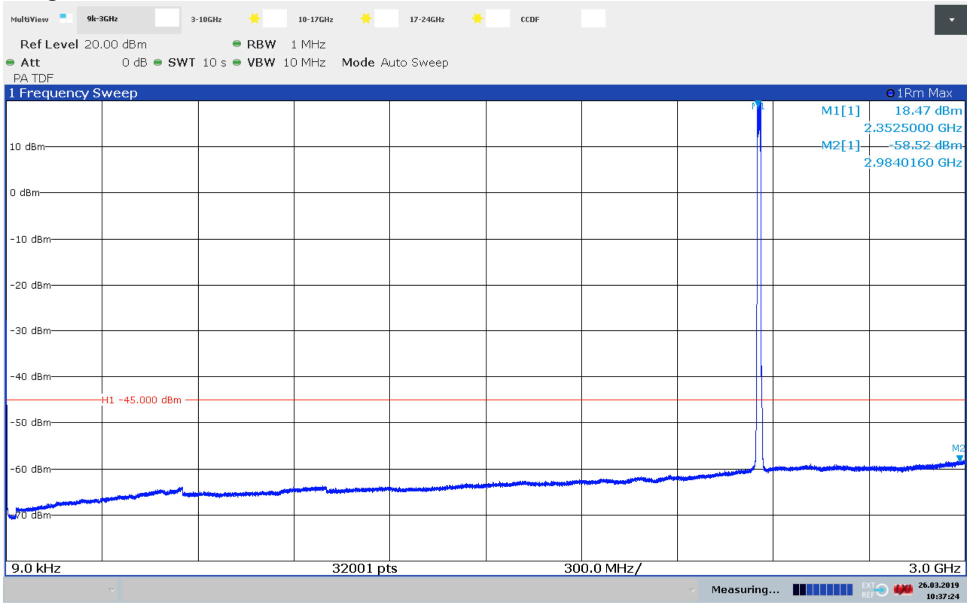
11:06:35 26.03.2019

Diagram 22d:



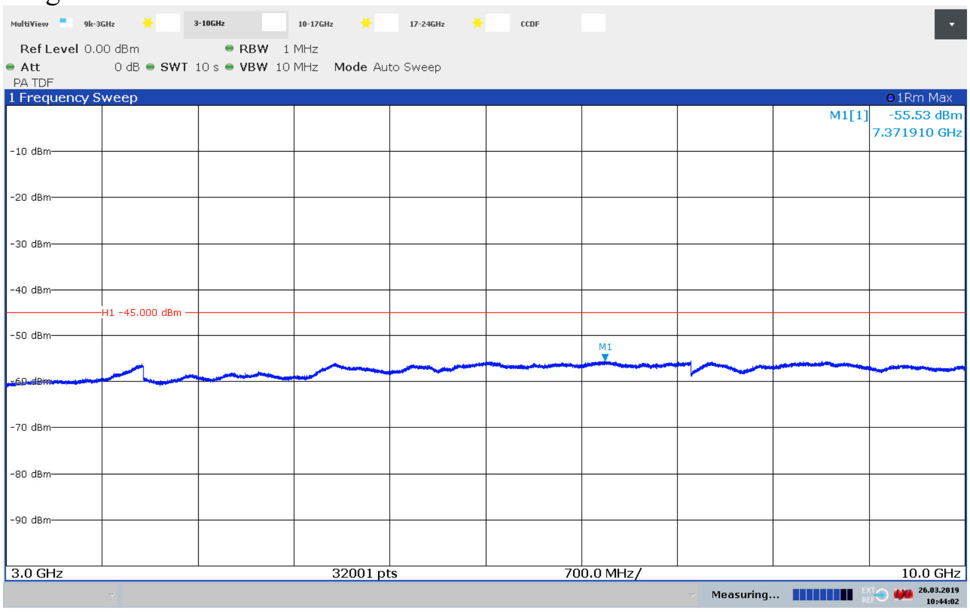
11:07:05 26.03.2019

Diagram 23a:



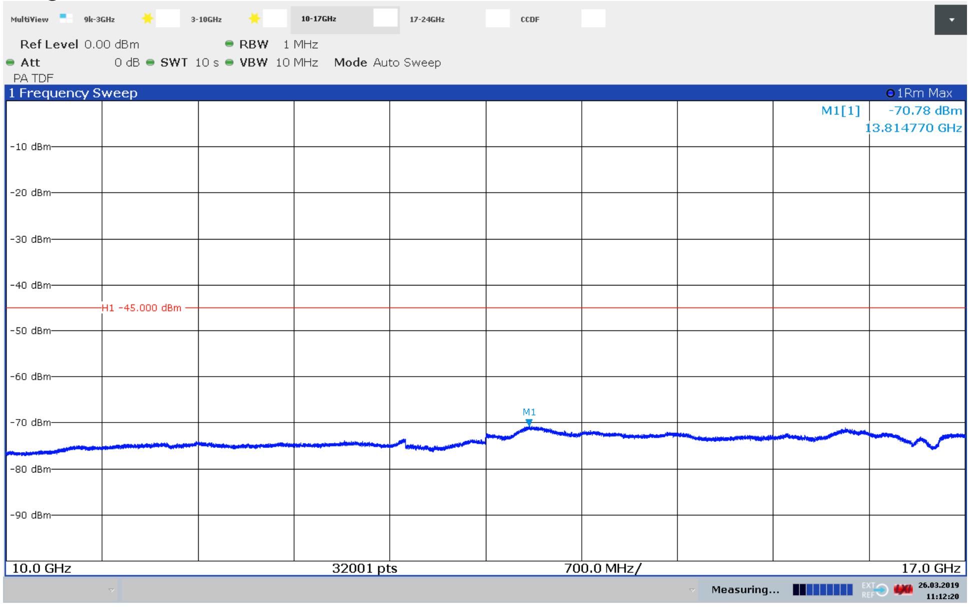
10:37:24 26.03.2019

Diagram 23b:



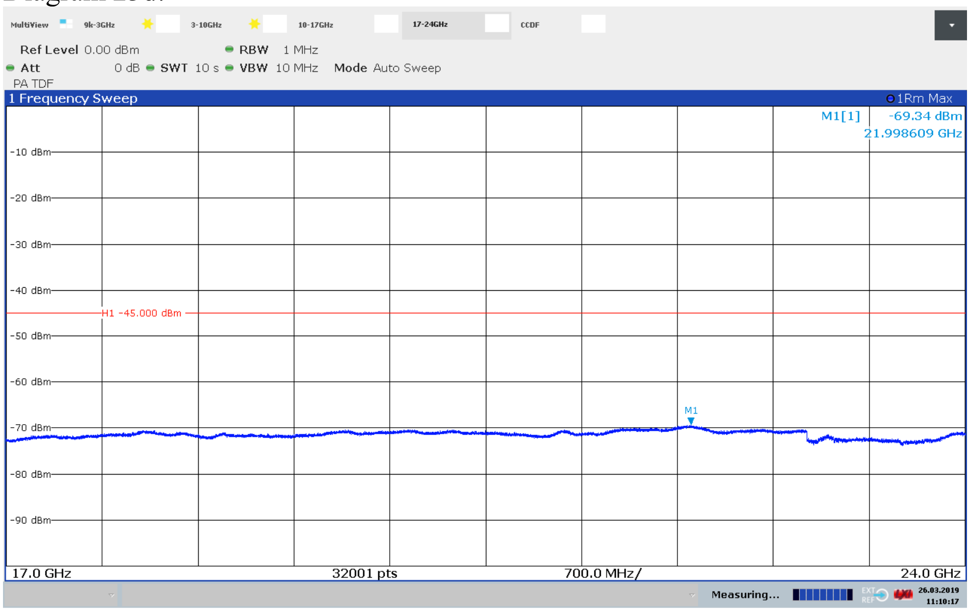
10:44:02 26.03.2019

Diagram 23c:



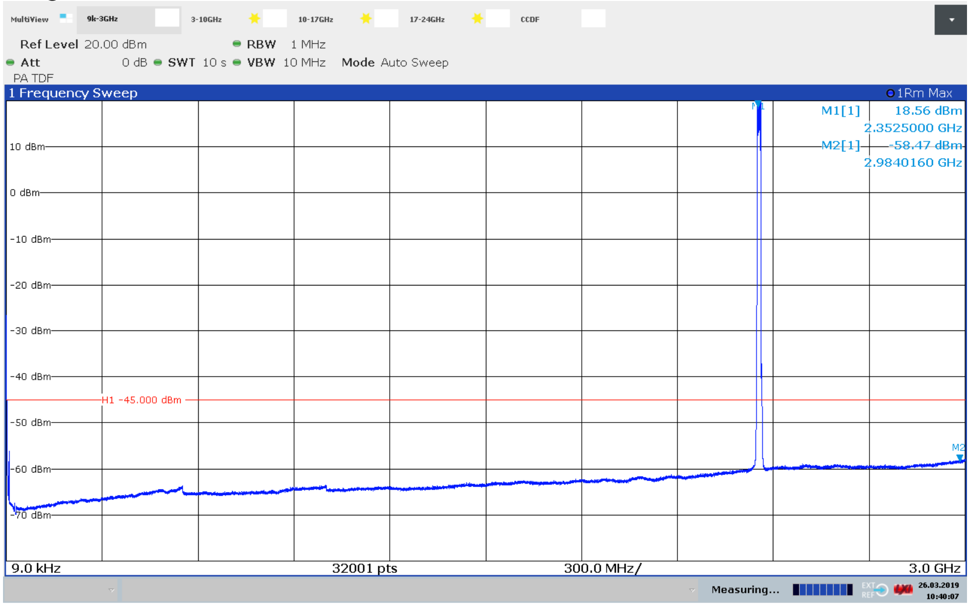
11:12:20 26.03.2019

Diagram 23d:



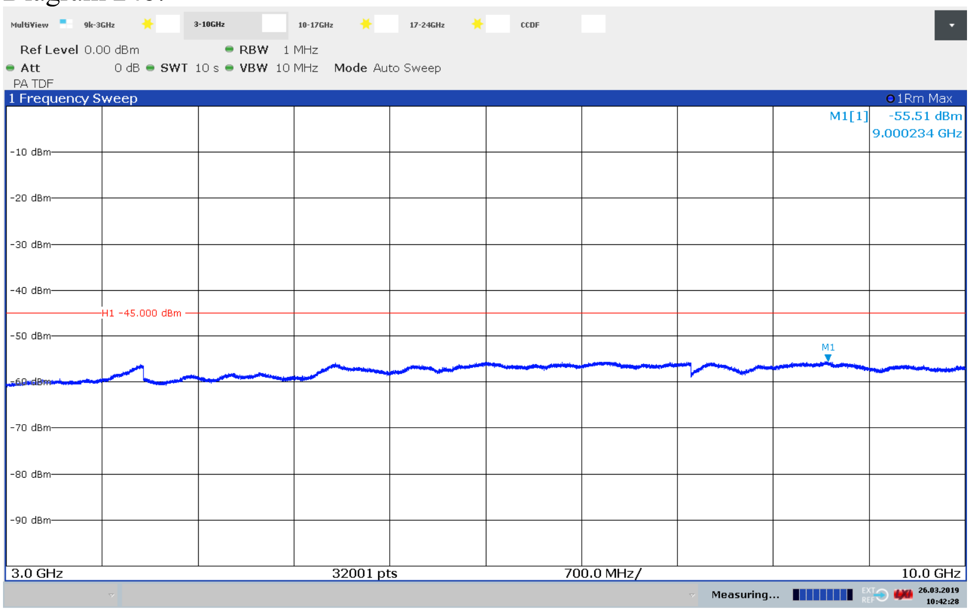
11:10:18 26.03.2019

Diagram 24a:



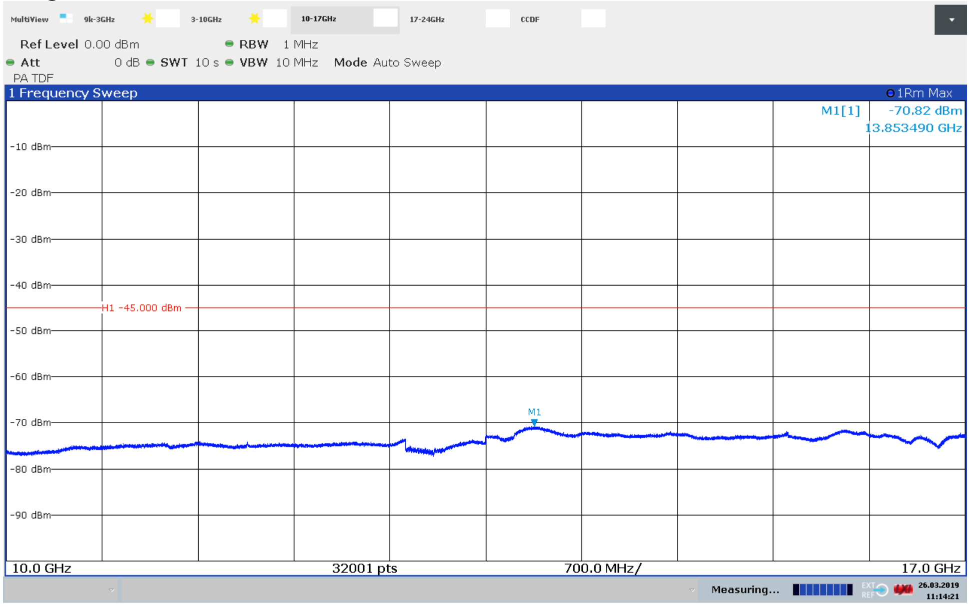
10:40:08 26.03.2019

Diagram 24b:



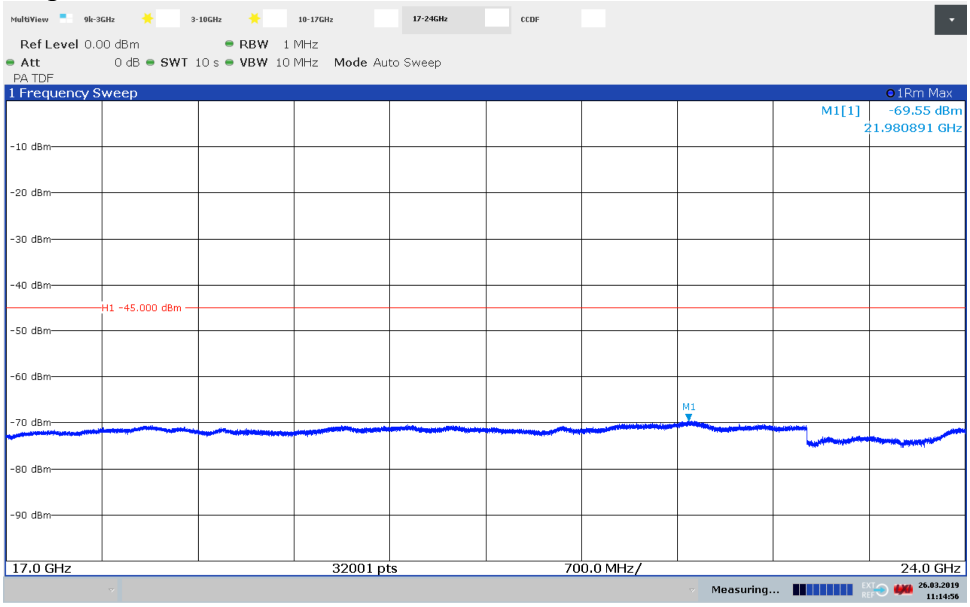
10:42:29 26.03.2019

Diagram 24c:



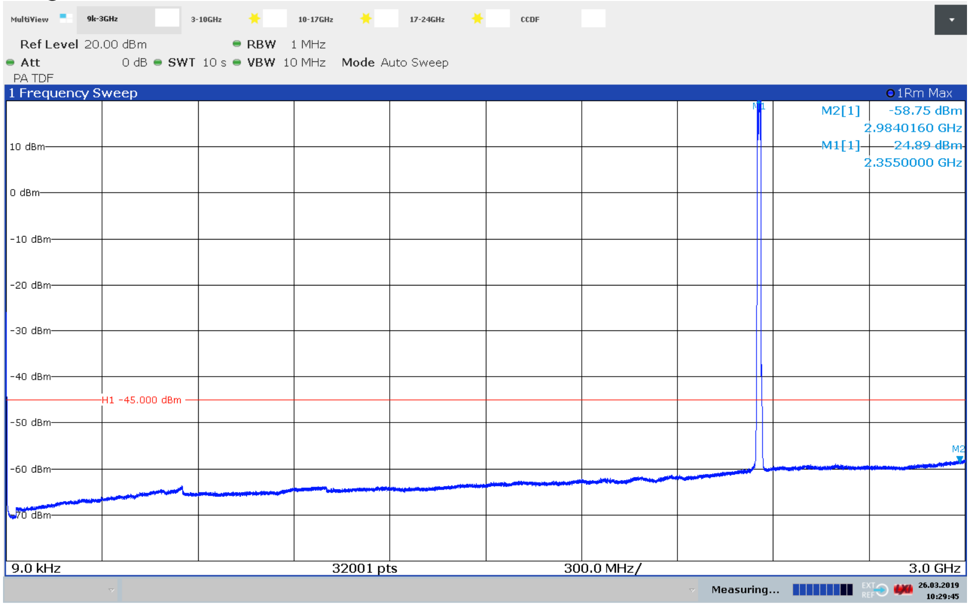
11:14:21 26.03.2019

Diagram 24d:



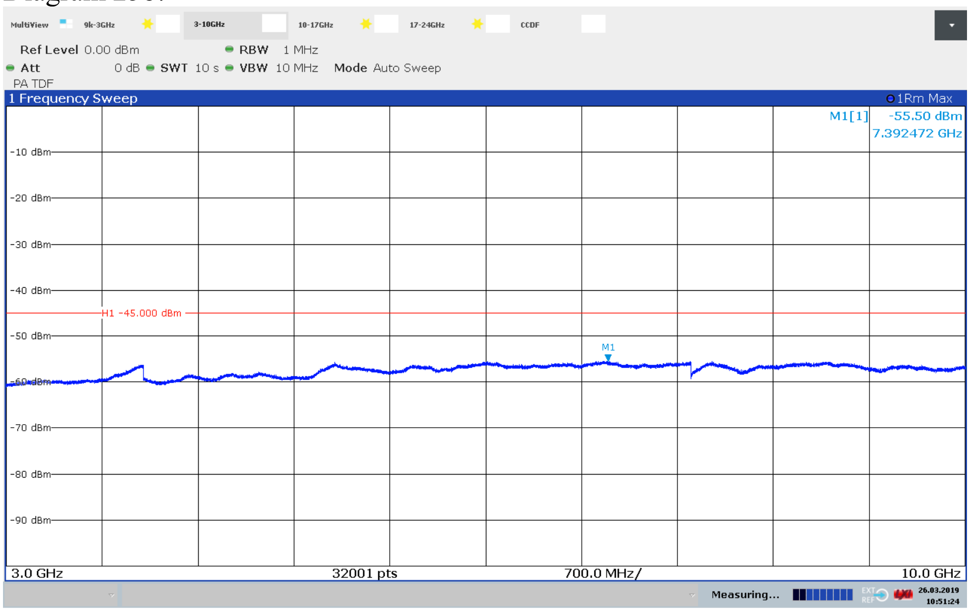
11:14:57 26.03.2019

Diagram 25a:



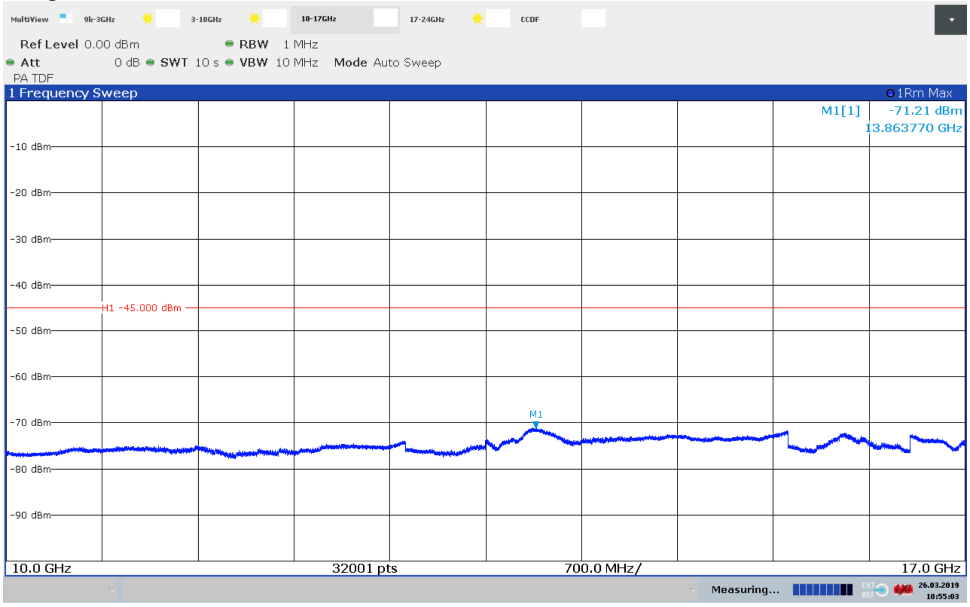
10:29:45 26.03.2019

Diagram 25b:



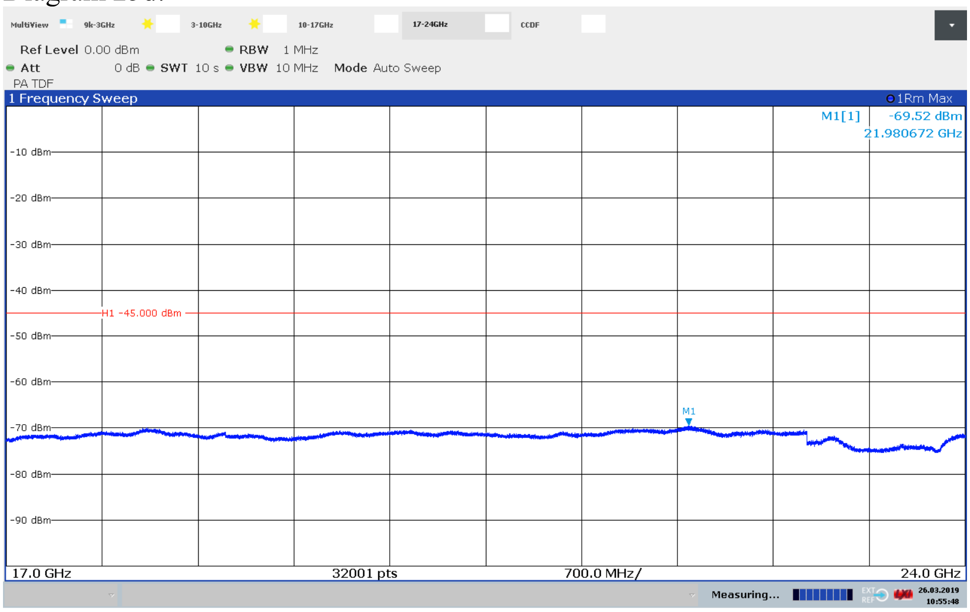
10:51:25 26.03.2019

Diagram 25c:



10:55:03 26.03.2019

Diagram 25d:



10:55:49 26.03.2019

Field strength of spurious radiation measurements according to 47 CFR 27.53 (a) / RSS-195 5.6

Date	Temperature	Humidity
2019-03-21	23 °C ± 3 °C	37 % ± 5 %
2019-03-22	22 °C ± 3 °C	32 % ± 5 %

The test site conform to the site validation criterion specified in ANSI C63.4 2014.

The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 18 GHz and 1 m in the frequency range 18 GHz – 26.5 GHz.

The measurement was performed with a RBW of 1 MHz.

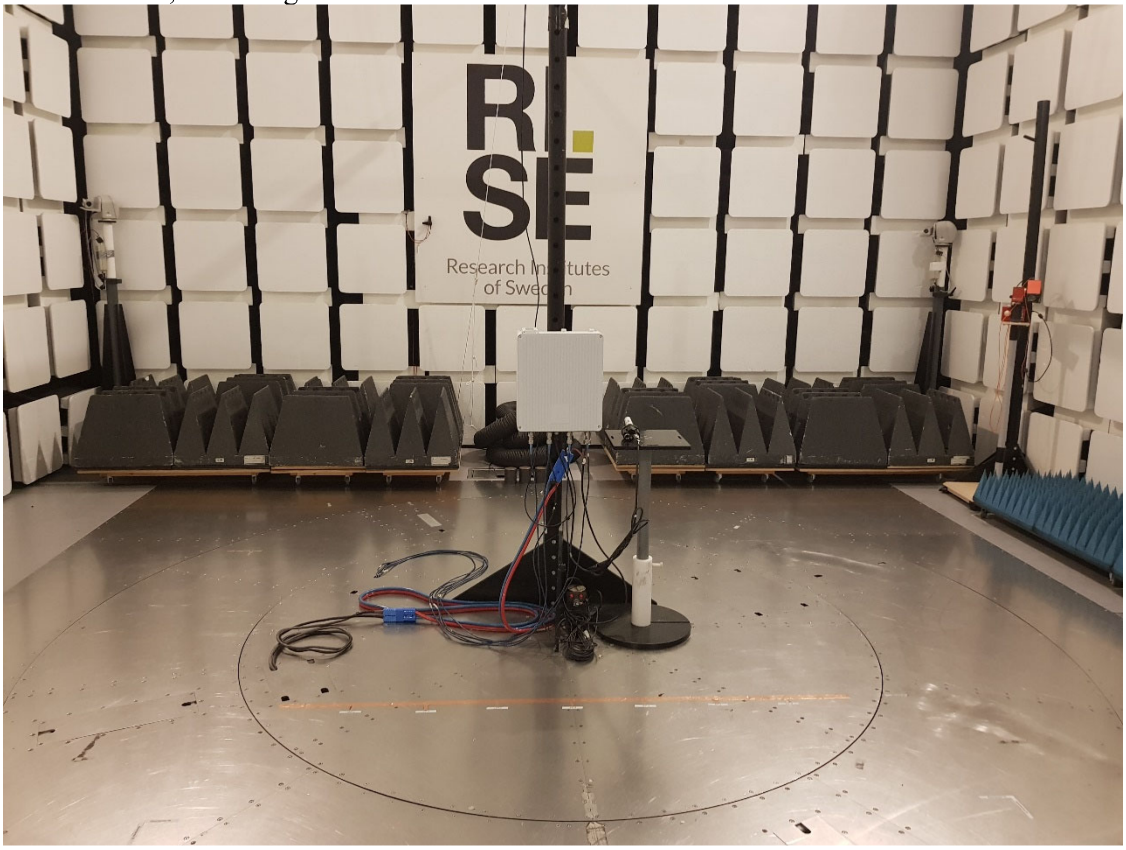
A propagation loss in free space was calculated. The used formula was
$\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

The measurement procedure was as the following:

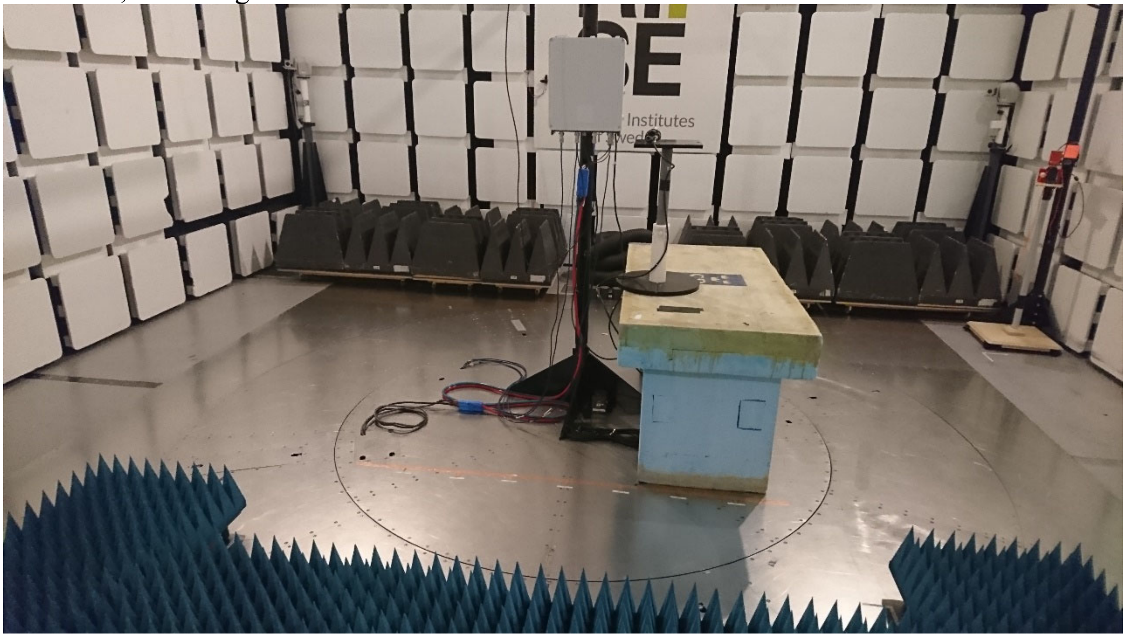
1. A pre-measurement is performed with peak detector. For measurement < 1 GHz the test object was measured in eight directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m. For measurements > 1 GHz the test object was measured in seventeen directions with the antenna height 1.0 m, 1.5 m and 2.0 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 with elevation angle 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 C63.26.

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

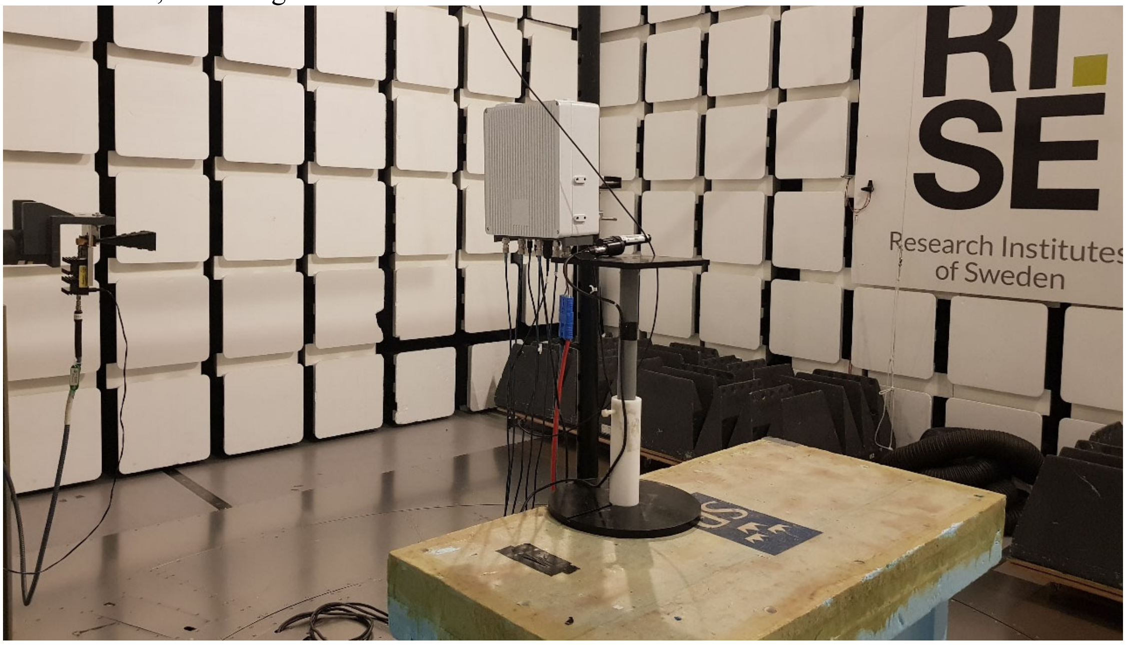
30-1000 MHz, EUT height 0.8m



1-18 GHz, EUT height 1.5m



18-26.5 GHz, EUT height 1.5m



Measurement equipment

Measurement equipment	RISE number
Semi anechoic chamber Tesla	503 881
R&S ESU 40	901 385
EMC 32 ver. 10.20.01	BX62351
Teseq BiLog antenna CBL6143A	504 079
EMCO Horn Antenna 3115	502 175
Flann Standard Gain Horn 16240-20	503 939
Flann Standard Gain Horn 16240-20	503 900
Flann Standard Gain Horn 20240-20	503 674
Flann Standard Gain Horn 22240-20	503 674
µComp Nordic, Low Noise Amplifier	901 545
Miteq, Low Noise Amplifier, 18-40 GHz	503 278
Coaxial cable, 18-40 GHz	503 697
Coaxial cable	BX62218
Coaxial cable	503 508
Coaxial cable	503 509
RF attenuator JFW 50HF	BX61531
Temperature and humidity meter, Testo 625	504 188

Results

representing worst case:

Symbolic name B_5, BW 5 MHz, Diagram 26 a-i

Measurement uncertainty: 3.1 dB

Limits

CFR 47 §27.53(a)

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by the amount indicated in table below, measured with 1 MHz RBW.

Frequency (MHz)	Attenuation (dB)
< 2285	$75 + 10 \log_{10}(p)$
2285 - 2287.5	$72 + 10 \log_{10}(p)$
2287.5 - 2300	$70 + 10 \log_{10}(p)$
2300 - 2305	$43 + 10 \log_{10}(p)$
2305 - 2320	$43 + 10 \log_{10}(p)$
2320 - 2345	$75 + 10 \log_{10}(p)$
2345 - 2360	$43 + 10 \log_{10}(p)$
2360 - 2362.5	$43 + 10 \log_{10}(p)$
2362.5 - 2365	$55 + 10 \log_{10}(p)$
2365 - 2367.5	$70 + 10 \log_{10}(p)$
2367.5 - 2370	$72 + 10 \log_{10}(p)$
> 2370	$75 + 10 \log_{10}(p)$

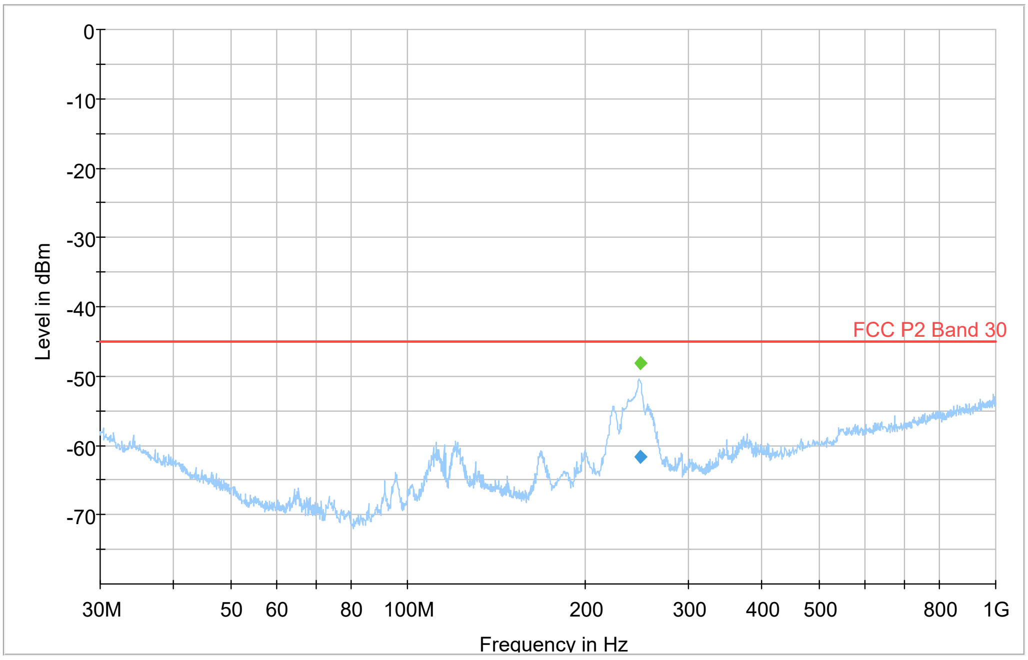
RSS-195 5.6

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by the amount indicated in table below, measured with 1 MHz RBW:

Frequency (MHz)	Attenuation (dB)
<2200	$43 + 10 \log_{10}(p)$
2200 - 2285	$75 + 10 \log_{10}(p)$
2285 - 2287.5	$72 + 10 \log_{10}(p)$
2287.5 - 2300	$70 + 10 \log_{10}(p)$
2300 - 2305	$43 + 10 \log_{10}(p)$
2305 - 2320	$43 + 10 \log_{10}(p)$
2320 - 2345	$75 + 10 \log_{10}(p)$
2345 - 2360	$43 + 10 \log_{10}(p)$
2360 - 2362.5	$43 + 10 \log_{10}(p)$
2362.5 - 2365	$55 + 10 \log_{10}(p)$
2365 - 2367.5	$70 + 10 \log_{10}(p)$
2367.5 - 2370	$72 + 10 \log_{10}(p)$
2370 - 2395	$75 + 10 \log_{10}(p)$
>2395	$43 + 10 \log_{10}(p)$

Complies?	Yes

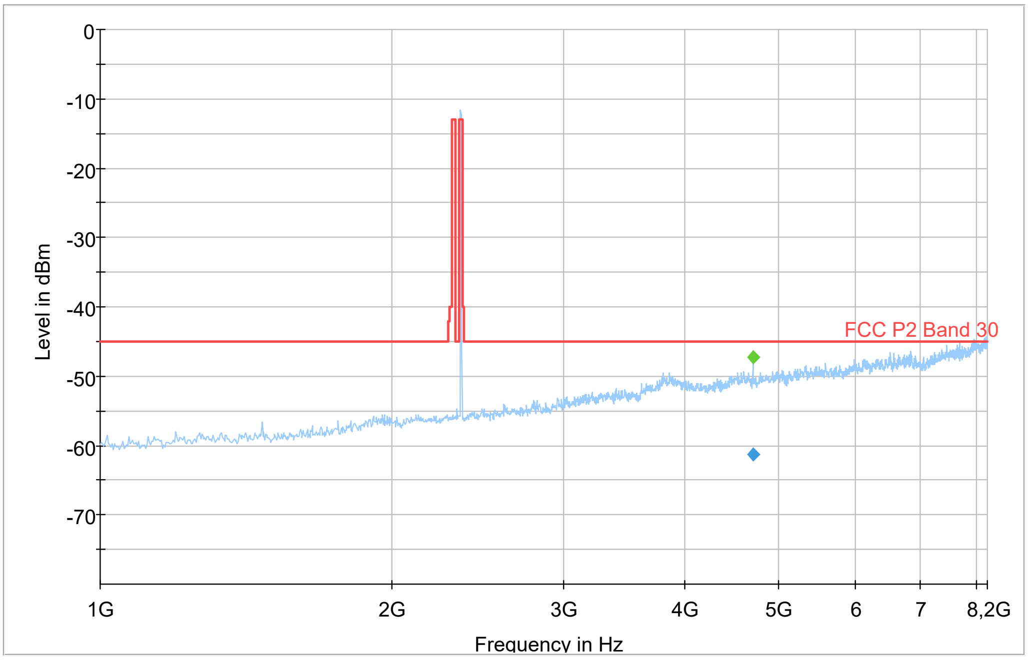
Diagram 26a:



Final result

Frequency (MHz)	RMS (dBm)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
248.180	---	-48.10	---	---	5000.0	1000.000	139.0	H	212.0
248.180	-61.57	---	-45.00	16.57	5000.0	1000.000	139.0	H	212.0

Diagram 26b:



Final result

Frequency (MHz)	RMS (dBm)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
4705.448	---	-47.36	---	---	5000.0	1000.000	340.0	V	90.0
4705.448	-61.36	---	-45.00	16.36	5000.0	1000.000	340.0	V	90.0

Note: In this measurement the noise floor was close to the limit. A verification with 100 kHz RBW shows that there are no spurious emission in the frequency range 1-8.2 GHz, se diagram 1c.

Diagram 26c: pre-measurement with RBW 100 kHz

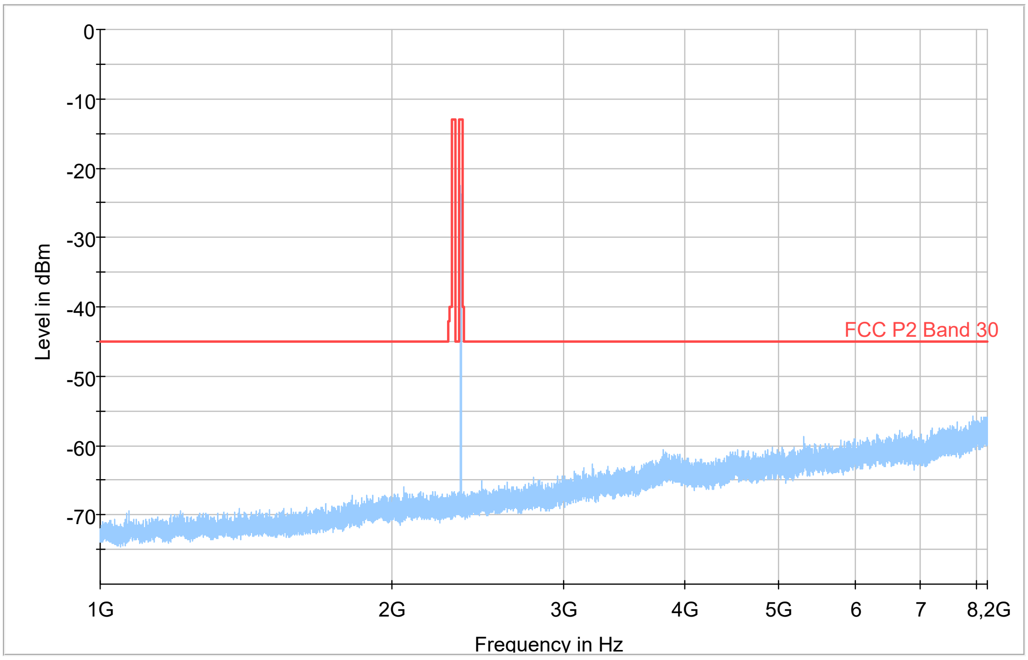


Diagram 26d: (zoom of diagram 26b)

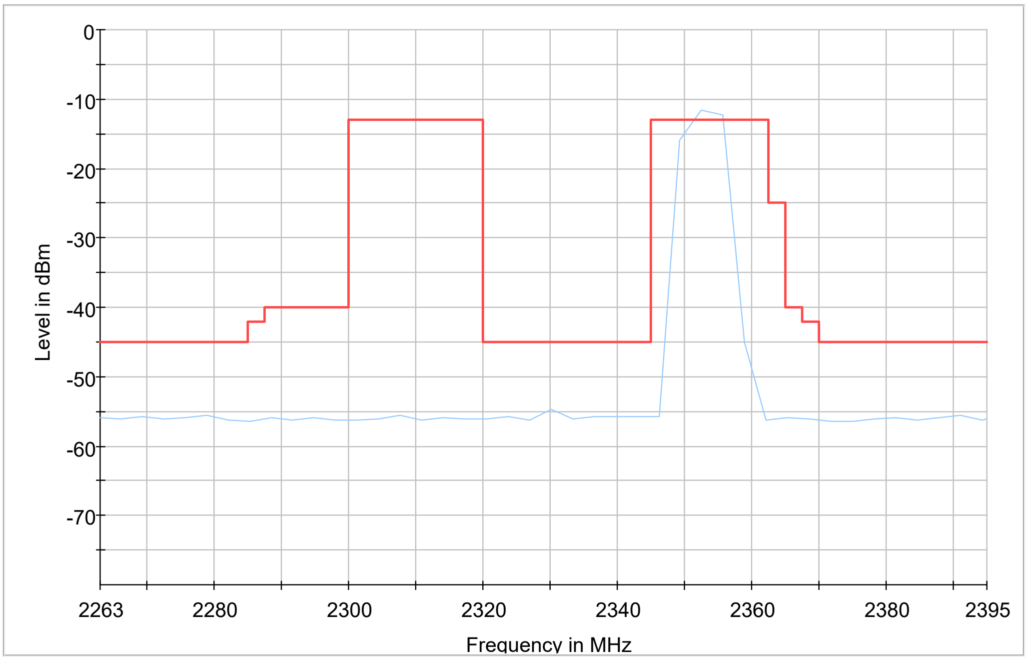
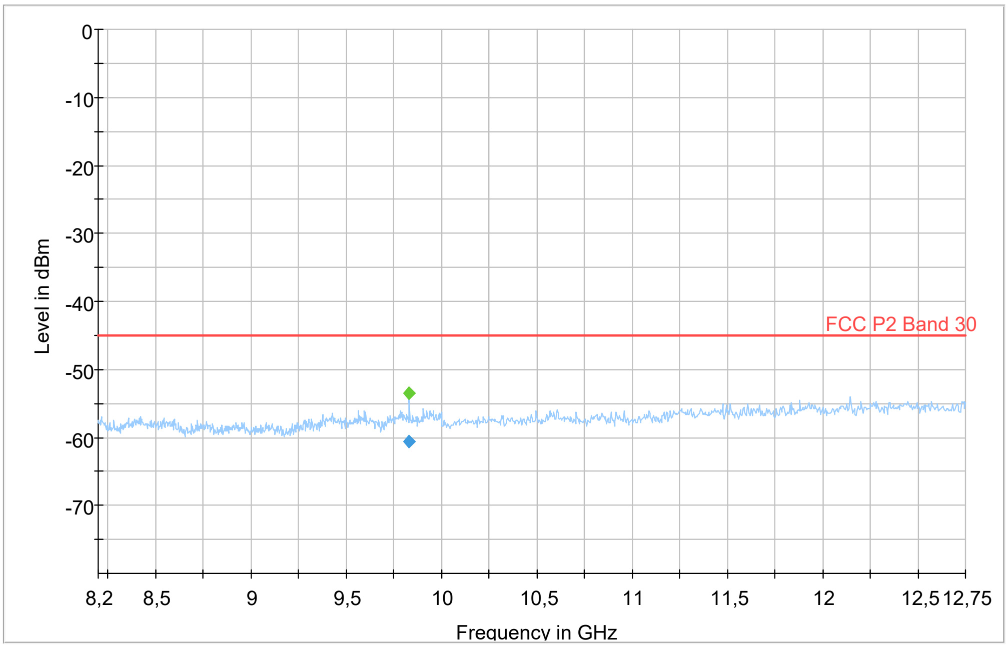


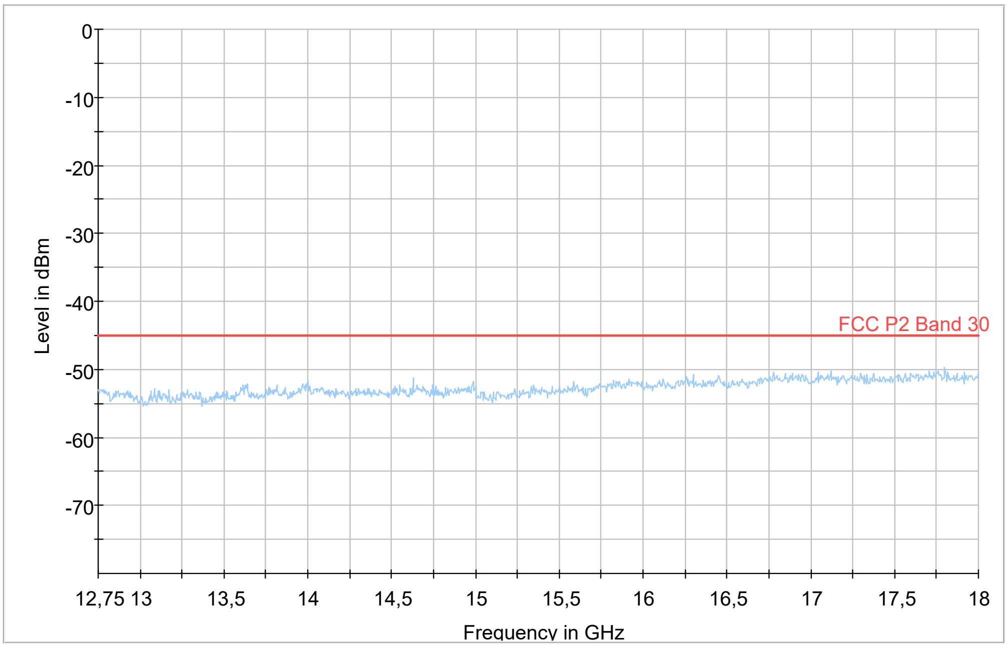
Diagram 26e:



Final result

Frequency (MHz)	RMS (dBm)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
9830.506	---	-53.53	---	---	5000.0	1000.000	148.0	V	165.0
9830.506	-60.66	---	-45.00	15.66	5000.0	1000.000	148.0	V	165.0

Diagram 26f:



Note: In this measurement the noise floor was close to the limit. A verification with 100 kHz RBW shows that there are no spurious emission in the frequency range 12.75-18 GHz, se diagram 1g.

Diagram 26g: pre-measurement with RBW 100 kHz

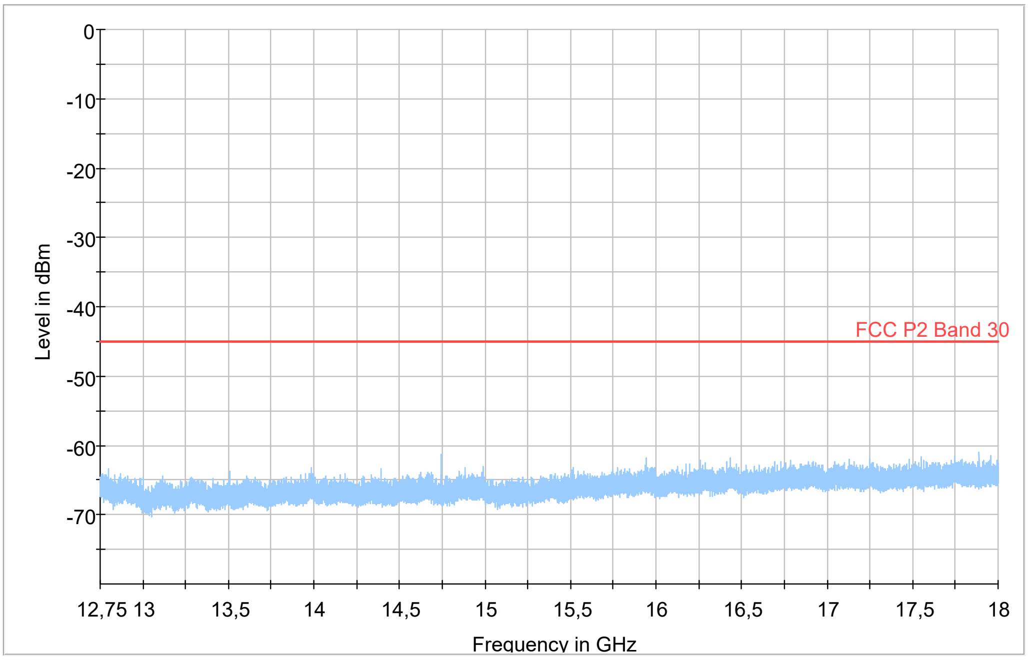
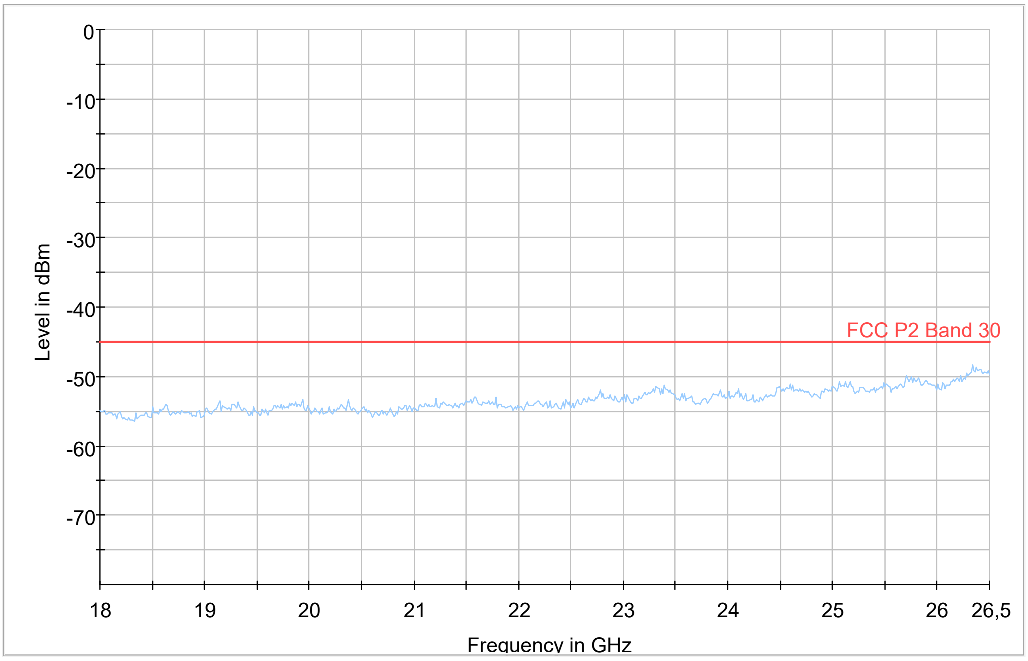
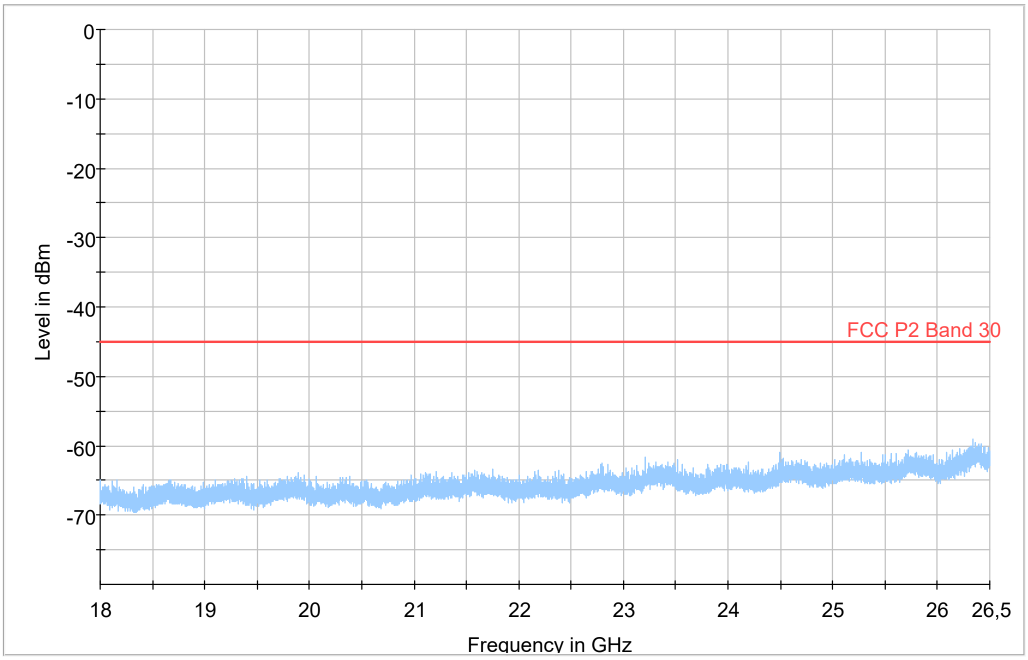


Diagram 26h:



Note: In this measurement the noise floor was close to the limit. A verification with 100 kHz RBW shows that there are no spurious emission in the frequency range 18-26.5 GHz, se diagram 1i.

Diagram 26i: pre-measurement with RBW 100 kHz



Frequency stability measurements according to CFR 47 §27.54 / RSS 195 5.4

Date	Temperature (test equipment)	Humidity (test equipment)
2019-03-26	24 °C ± 3 °C	7 % ± 5 %
2019-03-27	23 °C ± 3 °C	21 % ± 5 %
2019-03-28	24 °C ± 3 °C	23 % ± 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 130 4.3. Using a resolution bandwidth of 1% of the occupied bandwidth, a reference point at the unwanted emission level which complies with the attenuation of 43 + 10 log10 p (watts) (i.e. -13dBm) (for 4x 4MIMO -19dBm) 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 FSW 43	902 073
Rohde & Schwarz signal analyzer FSQ 40	504 143
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 2352.5 MHz (B_5) with a bandwidth of 5 MHz. Rated output power level at connector RF A (maximum): 44 dBm.

Test conditions		Frequency error (Hz) Test model E-TM1.1
Supply voltage DC (V)	Temp. (°C)	
40.8	+20	10
55.2	+20	10
48	+20	11
48	+30	10
48	+40	11
48	+50	11
48	+10	7
48	0	6
48	-10	7
48	-20	7
48	-30	7
Maximum freq. error (Hz)		11
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Rated output power level at connector RF A (maximum): 44 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 (2350 MHz) [kHz]	fH [MHz]	Offset to upper band edge (2360 MHz) [kHz]
-48.0	+20	5	2350.198	198	2350.411	411
-48.0	+20	10	2359.802	198	2359.589	410

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

Remark

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

Limits

CFR 47 §27.54:
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-195 5.4 Frequency:
The frequency stability shall be sufficient to ensure that the emission bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

Complies?	Yes

Photos of test object

Bottom side

Top side

Front side

Rear side

Left side

Right side

Test object label from the Radio used for radiated measurment:

SFP module from the Radio used for radiated measurment::

Test object label from the Radio used for conducted measurment:

SFP module from the Radio used for conducted measurment:

End of report