RADIO TEST REPORT

No. 1718046STO-001, Ed. 2

RF Performance

EQUIPMENT UNDER TEST

Equipment:	Remote head
Type/Model:	DDR-2300
Manufacturer:	Deltanode Solutions AB
Tested by request of:	Deltanode Solutions AB

SUMMARY

Referring to the emission limits, and the operating mode during the tests specified in this report, the equipment complies with the requirements according to the following standards:

47 CFR Part 2, subpart J, 47 CFR Part 27 Subpart C

RSS-131 Issue 3, RSS-195 Issue 3,

RSS-GEN Issue 4 (2014): General requirements of compliance of radio apparatus (2014).

For details, see clause 2 – 4.

Date of issue: 2018-03-02

Tested by: Matti Virkki

Approved by: Stefan Andersson

Revision History

Edition	Date	Description	Changes
1	2017-11-01	First release	
2	2018-03-02		Typing error corrections on pages 8 and 54

CONTENTS

1. CLIENT INFORMATION

The EUT has been tested by request of

Company	Deltanode Solutions AB Hammarby fabriksväg 61 6tr 120 33 Stockholm Sweden
Name of contact	Daniel Kerek

2. EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT

Equipment:	Remote head	
Tested Model:	DDR-2300	
Brand name:	Deltanode	
Serial number:	99995	
Manufacturer:	Deltanode Solutions AB	
Transmitter frequency range:	2350 – 2360 MHz	
Receiver frequency range:	2305 – 2315 MHz	
Frequency agile or hopping:	☐ Yes	☒ No
Antenna:	☐ Internal antenna	☒ External antenna
Antenna connector:	☐ None, internal antenna	☒ Yes, N
Rating RF output power:	+33 dBm rms	
Rated gain	+60 dB	
Type of modulation:	Tested with GMSK, QPSK	
Temperature range:	☐ Category I (General): -20°C to +55°C ☐ Category II (Portable equipment): -10°C to +55°C ☐ Category III (Equipment for normal indoor use): +5°C to +35°C ☒ Other: <-30°C to +55°C	
Power rating:	120 V, 60 Hz	
Transmitter standby mode supported:	☒ Yes	☐ No

2.2 Additional information about the EUT

The EUT consists of the following hardware and firmware:

Unit	Type
PA Type	02:0e Multisystem PA(Ga) 4G 2.3-2.6GHz ver. 0.1 prod. 2016W31 SN:0002-00110
PA HW-version	KS27.9 P1A 2016W31 DH00110
PA Bootloader	BF002003 0.0.1 Boot PA-GaAs 2008-02-20 15:12:39
PA Application	AF002003 0.3.0 PA-GaAs 2014-03-12 12:38:50
PA Loaded ver	AF002003 0.3.0 PA-GaAs 2014-03-12 12:38:50
Available PA upgrade	AF002003 0.3.1 PA-GaAs 2016-02-25 15:33:06
PA SWL Status	Idle
VGA Type	82:9e LTE VGA2 4G 2.3-2.6GHz ver. 0.0 prod. 2016W26 SN:0001-00001
VGA HW-version	KS55.39 P1A 2016w31 LH00110
VGA Bootloader	BF002008 0.0.0p Boot VGA2 2016-01-19 16:38:38
VGA Application	AF002011 0.0.0p VGA2 2016-05-19 09:47:55
VGA Loaded ver	AF002011 0.0.0p VGA2 2016-05-19 09:47:55
Available VGA upgrade	AF002011 0.0.0 VGA2 2016-09-29 10:19:30

2.3 Peripheral equipment

Peripheral equipment is equipment needed for correct operation of the EUT, but not included as part of the testing and evaluation of the EUT.

Equipment	Type / Model	Manufacturer
Fiber Optical Interface	FOI	Deltanode Solutions AB
Ethernet gateway		Deltanode Solutions AB
PC		Dell

2.4 Test signals

Continuous transmission on full power
As requested in KDB 935210 D05 V01r01

Narrow band signal: GSM with GMSK modulation
Wide band signals : AWGN 4.11 MHz 99% OBW

3. TEST SPECIFICATIONS

3.1 Standards

Requirements:
47 CFR Part 2, , Part 27 subpart C
RSS-131 Issue 3, RSS-199 Issue 3

Test methods in:

KDB 935210 D05 Industrial booster Basic measurement

ANSI C63.26-2015 American National Standard for Compliance Testing of Transmitters Used in License Radio Services

3.2 Additions, deviations and exclusions from standards and accreditation

RSS -131 Issue and RSS-195 Issue 3 are not within Intertek Semko AB's scope of accreditation.
No other additions, deviations or exclusions have been made from standards and accreditation.

3.3 Test site

Measurements were performed at:

Intertek Semko AB.
Torshamnsgatan 43,
P.O. Box 1103
SE-164 22 Kista

Intertek Semko AB is a FCC listed test site with site registration number 90913
Intertek Semko AB is a FCC accredited conformity assessment body with designation number SE0002
Intertek Semko AB is an Industry Canada listed test facility with IC assigned code 2042G

Measurement chambers

Measurement Chamber	Type of chamber	IC Site filing #
BJÖRK HALLEN	Semi-anechoic 3 m	2042G-1

3.4 Mode of operation during the test

The EUT was tested with 120 V, 60 Hz.

4. TEST SUMMARY

The results in this report apply only to sample tested:

Standard	Description	Result
	Emission	
§2.1046 **§27.50**	**RF output power, AGC threshold, linearity and amplifier gain**	**PASS**
RSS-GEN 6.12 **RSS-131 5.2.3** **RSS-195**	The EUT complies with the limits.	
§2.1047	**Modulation characteristics input versus output signal comparison**	**PASS**
RSS-131 5.2.2 **RSS-195**	The EUT complies with the limits.	
§2.1049	**Occupied bandwidth**	**PASS**
RSS-GEN 6.6 **RSS-131 5.2.1**	The EUT complies with the limits.	
§2.1051 **§27.53**	**Spurious emissions, Intermodulation and band edge measurements at antenna terminals**	**PASS**
RSS-GEN 6.13 **RSS-195**	The EUT complies with the limits.	
§2.1053 **§27.53**	**Field strength of spurious radiation**	**PASS**
RSS-GEN 6.13 **RSS-195**	The EUT complies with the limits.	
§2.1055 **§27.54**	**Frequency stability**	**PASS**
RSS-GEN 6.11 **RSS-131 5.2.4** **RSS-195**	The EUT complies with the limits.	

1 AGC TRESHOLD, RF OUTPUT POWER AND LINEARITY

Date of test:	2017-10-05	Test location:	EMC Center
EUT Serial:	99995	Ambient temp. ˚C	21˚C
Tested by:	MTV	Relative humidity	37 %
Test result:	Pass	Margin:	22.3 dB

1.1 Requirement

Reference: CFR 47 §2.1049, §27.50(a), KDB 935210 D05 clauses 3.2 and 3.5
RSS-131 Clauses 5.2.3 and 6.2, RSS-195 clause 5.5

1.2 Test set-up

Signal generator was connected to the FOI unit which converted rf signal to optical signal. The optical signal was then fed via fibre to the EUT.
The EUT's output port was connected to signal analyser via rf cables and 30 dB attenuator.
A PC was connected to FOI via Ethernet hub. The PC was then used to control the EUT.

The output power was measured with EUT amplification set to 60 dB and input signal was increased until Automatic Gain Control threshold was reached but did not affect the gain. The EUT output response was monitored when input signal level was increased and the response is linear until AGC threshold is reached.

The test was then repeated with 3 dB higher input signal level so that AGC limited the gain.

The peak power was measured using signal analyser's CCDF measurement function. The value that is exceeded less than 0.1% time is reported.

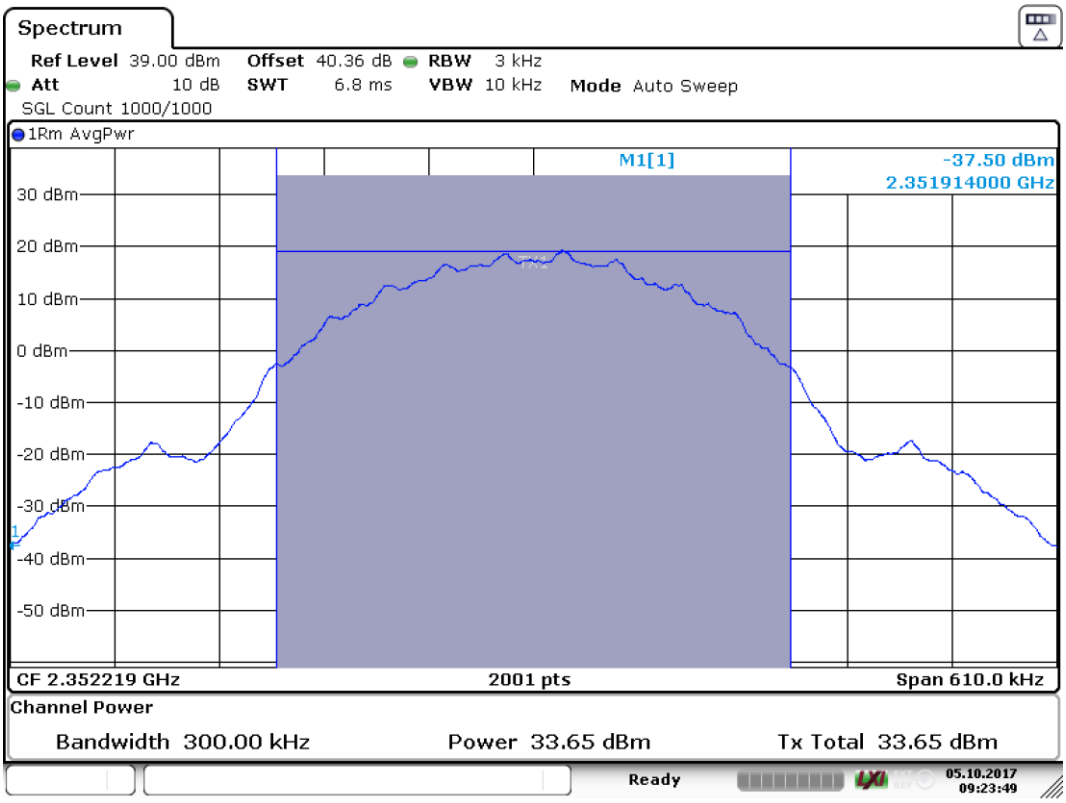
1.3 Test data

AWS GSM

Frequency MHz	Average power dBm	Automatic level control	Limit EIRP dBm	Peak to avg ratio dB	Peak to avg ratio limit dB
2352.22	33.65	off	56 / MHz	0,1	13
2352.22	33.67	on	56 / MHz	0,1	13

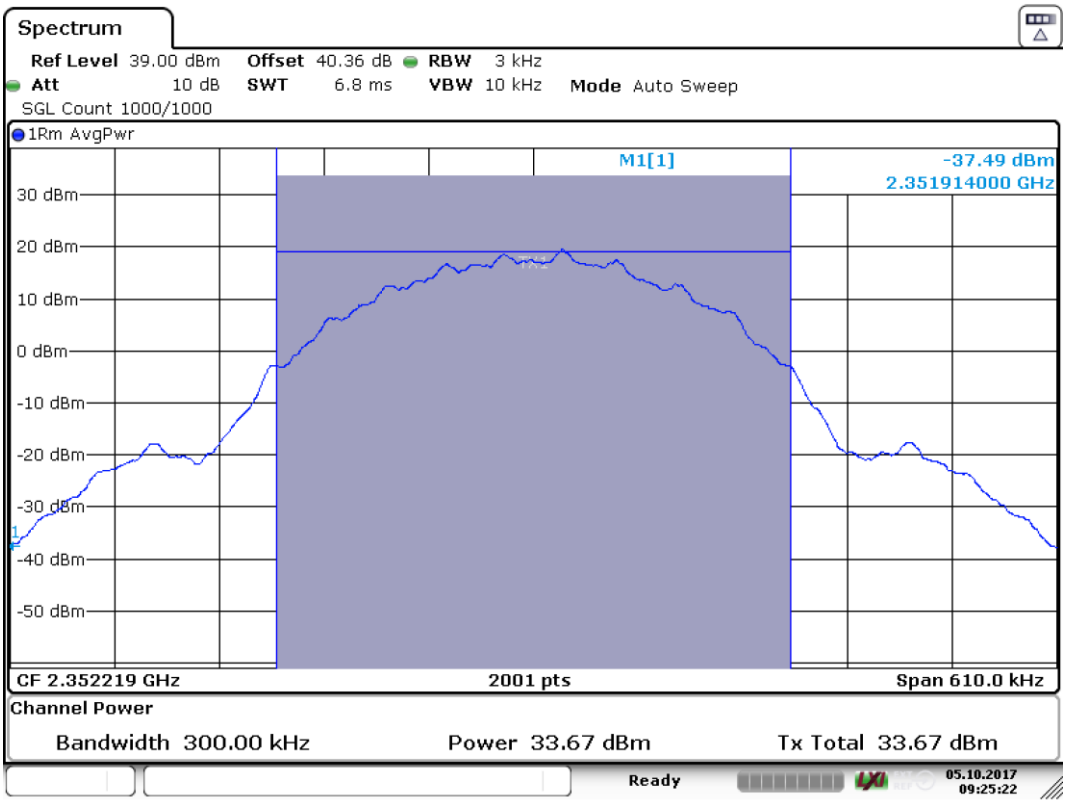
AWS WCDMA

Frequency MHz	Average power dBm	Automatic level control	Limit EIRP dBm	Peak to avg ratio dB	Peak to avg ratio limit dB
2352.22	32.96	off	56 / MHz	6.9	13
2352.22	32.99	on	56 / MHz	6.4	13



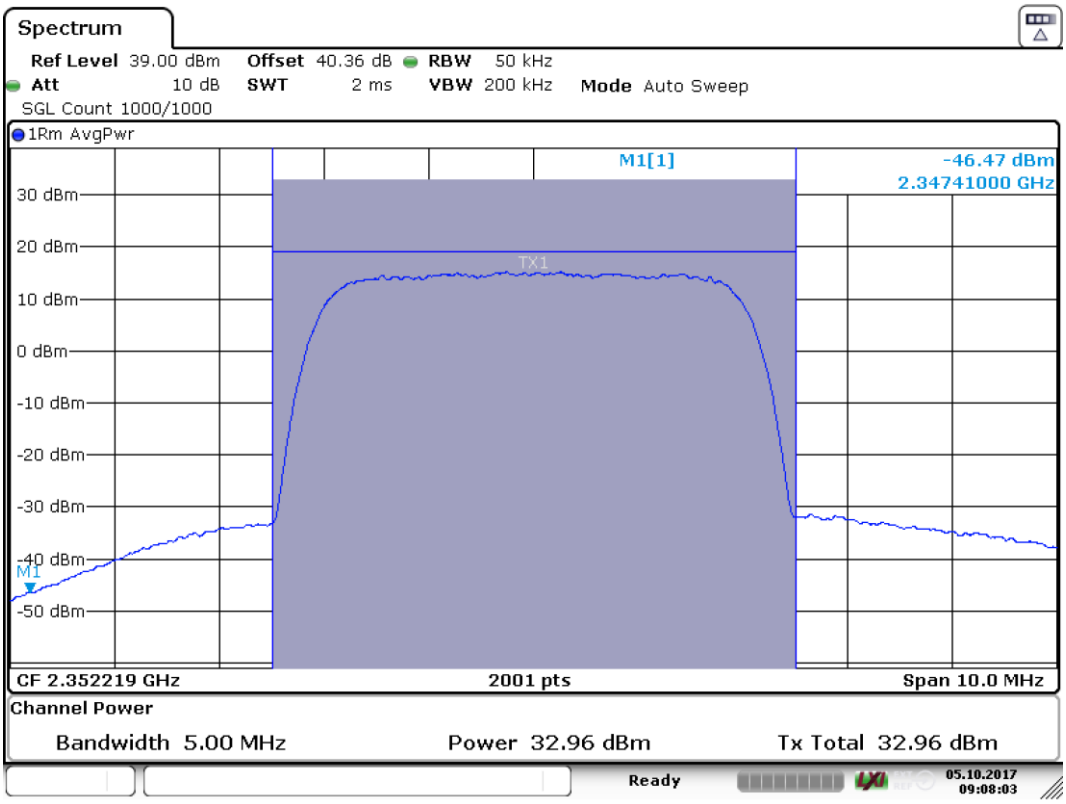
Date: 5.OCT.2017 09:23:49

GSM AGC off



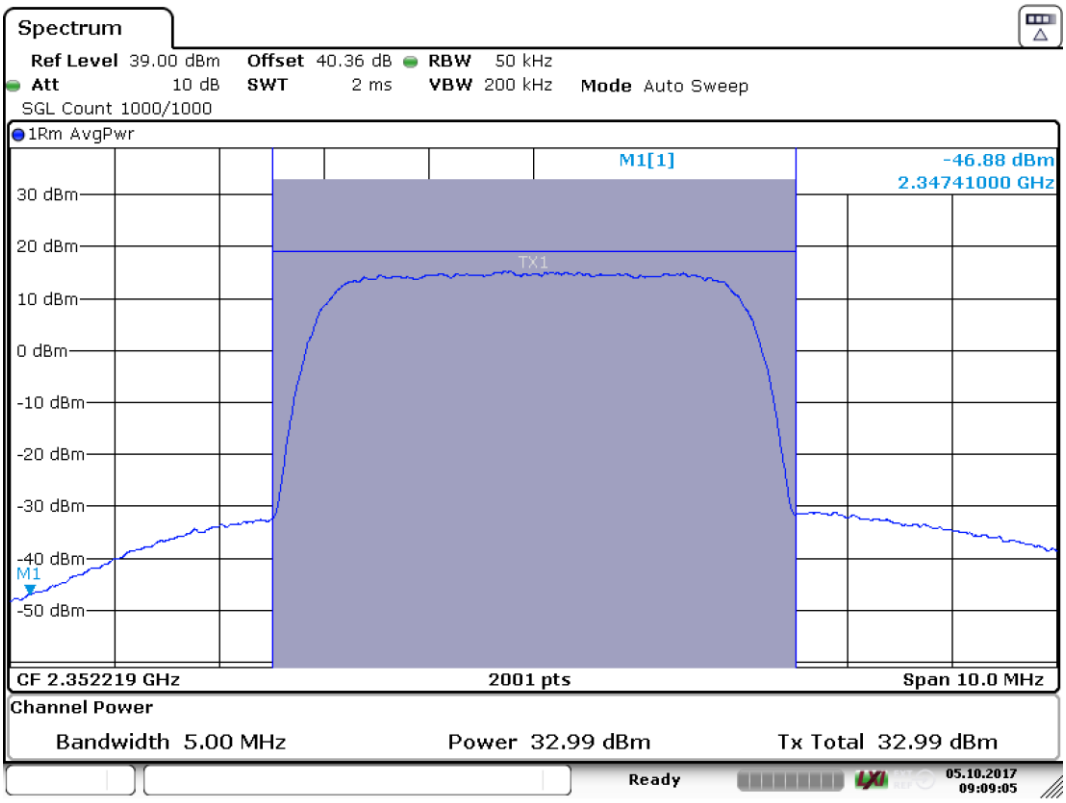
Date: 5.OCT.2017 09:25:22

GSM AGC on



Date: 5.OCT.2017 09:08:04

AWGN AGC off



Date: 5.OCT.2017 09:09:06

AWGN AGC on

4.1 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2018
Rf-attenuator	Narda	776B-10	8337	7/2018
Rf-attenuator	Huber Suhner	5920_N-50-010/199_N	32697	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39076	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39077	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39079	7/2018
Signal generator	Rohde & Schwarz	SMIQ03B	12792	7/2018
Signal generator	Rohde & Schwarz	SMBV100	32593	7/2018
Signal generator	Rohde & Schwarz	SMBV100	32593	

2 OCCUPIED BANDWIDTH INPUT VS OUTPUT COMPARISON

Date of test:	2017-10-05	Test location:	EMC Center
EUT Serial:	99995	Ambient temp. ˚C	21 ˚C
Tested by:	MTV	Relative humidity	37 %
Test result:	Pass	Margin:	--

2.1 Requirement

KDB 935219 D05:
The spectral shape of the rf-output shall look similar to input for all modulations.

RSS-131 5.2.2:
The spectral growth of the 99 % bandwidth of the output signal shall be less than 5% of the input signal spectrum.

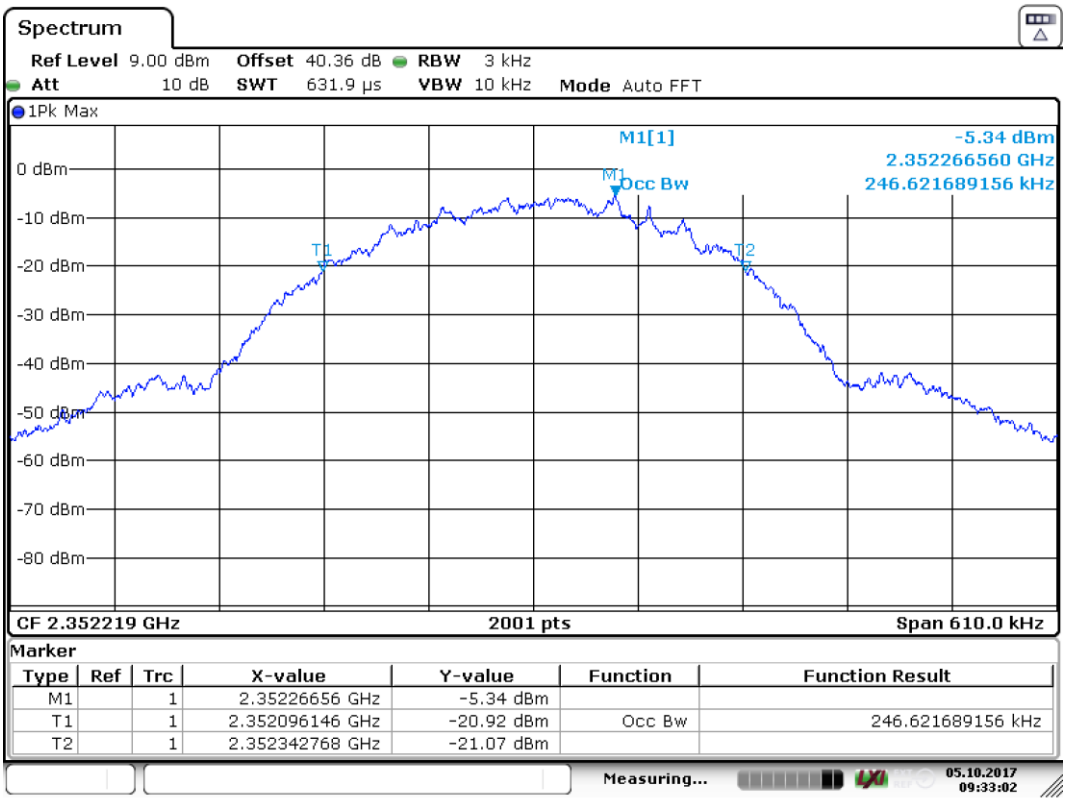
2.2 Test set-up

Signal generator was connected to the FOI unit which converted rf signal to optical signal. The optical signal was then fed via fibre to the EUT.
The EUT's output port was connected to spectrum analyser via rf cables and 30 dB attenuator.
A PC was connected to FOI via Ethernet hub. The PC was then used to control the EUT.

The 99% occupied bandwidth was measured using spectrum analyser's occupied bandwidth function.
The EUT was set to use 60 dB gain and input signal was adjusted so that Automatic Gain Control did not yet limit the output power.
The test was then repeated with higher input signal level so that AGC limited the output power.
Finally occupied bandwidth of signal generator was measured and input signal output was compared to EUT outputs.

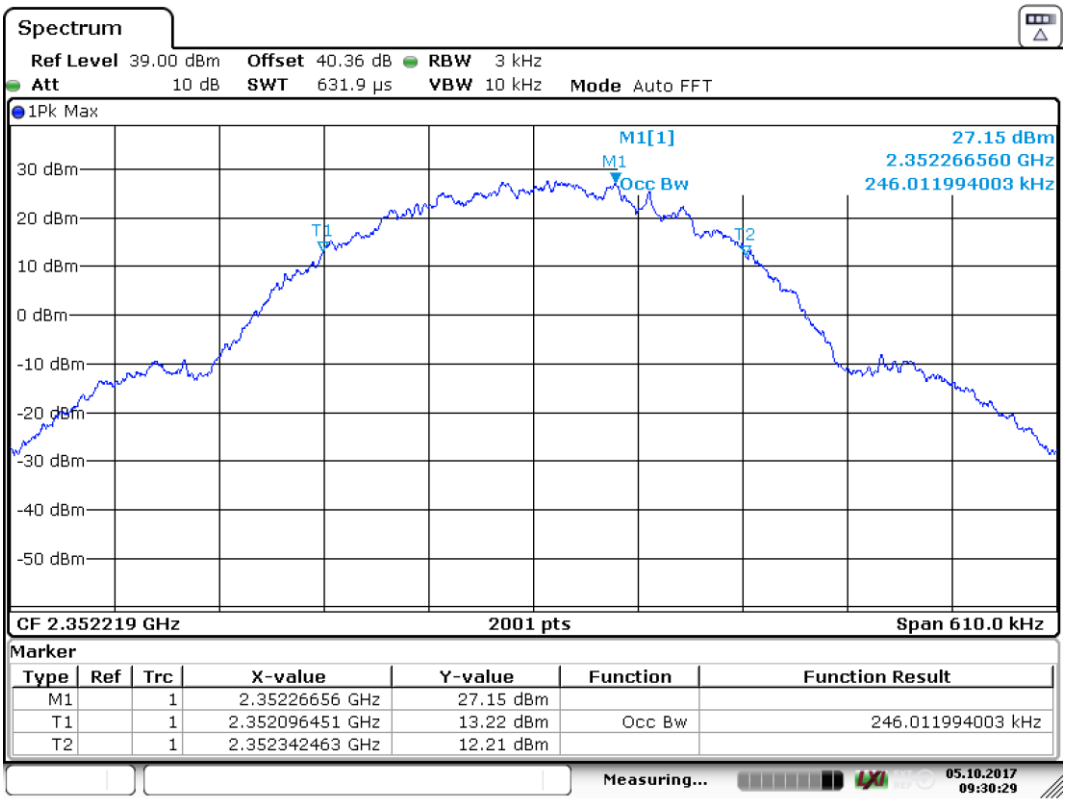
2.3 Test data

Frequency MHz	Signal type	99% Occupied band width Input (kHz)	99% Occupied band width output (kHz)	99% Occupied band width output with AGC (kHz)	Difference %
2352.22	GSM	246.622	246.012	246.622	-0.2
2352.22	WCDMA	4067.97	4047.97	4047.98	-0.5



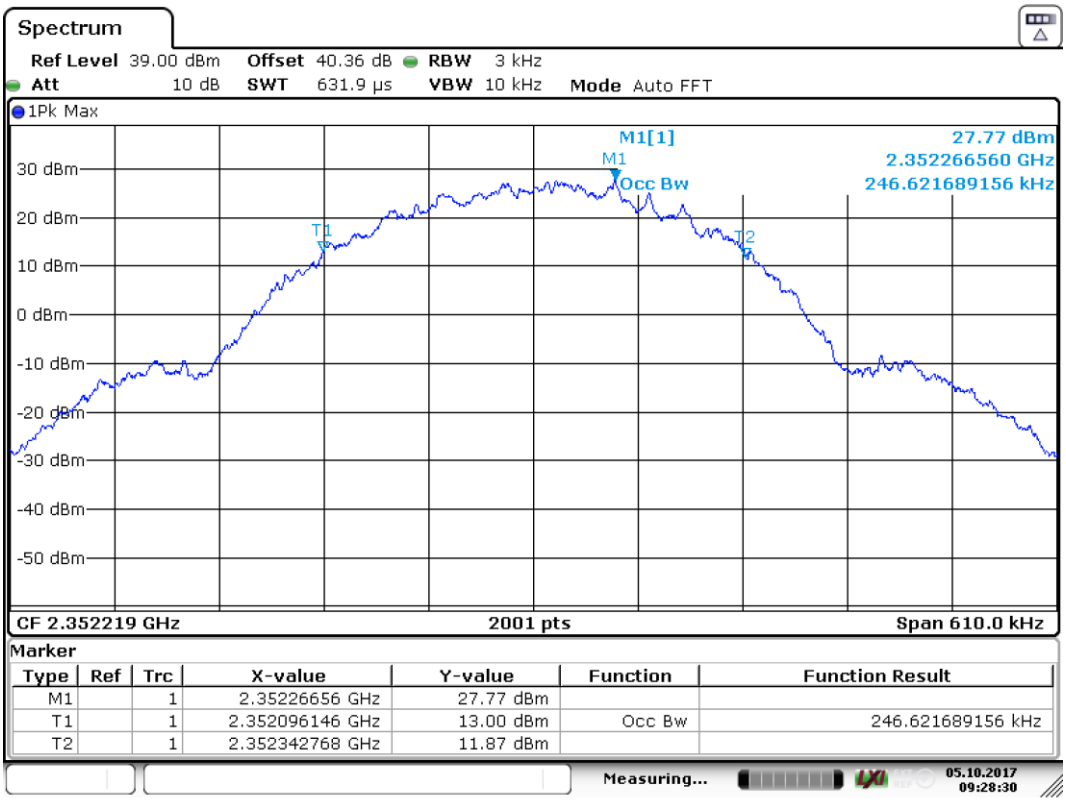
Date: 5.OCT.2017 09:33:03

AWS Occupied bandwidth GSM input



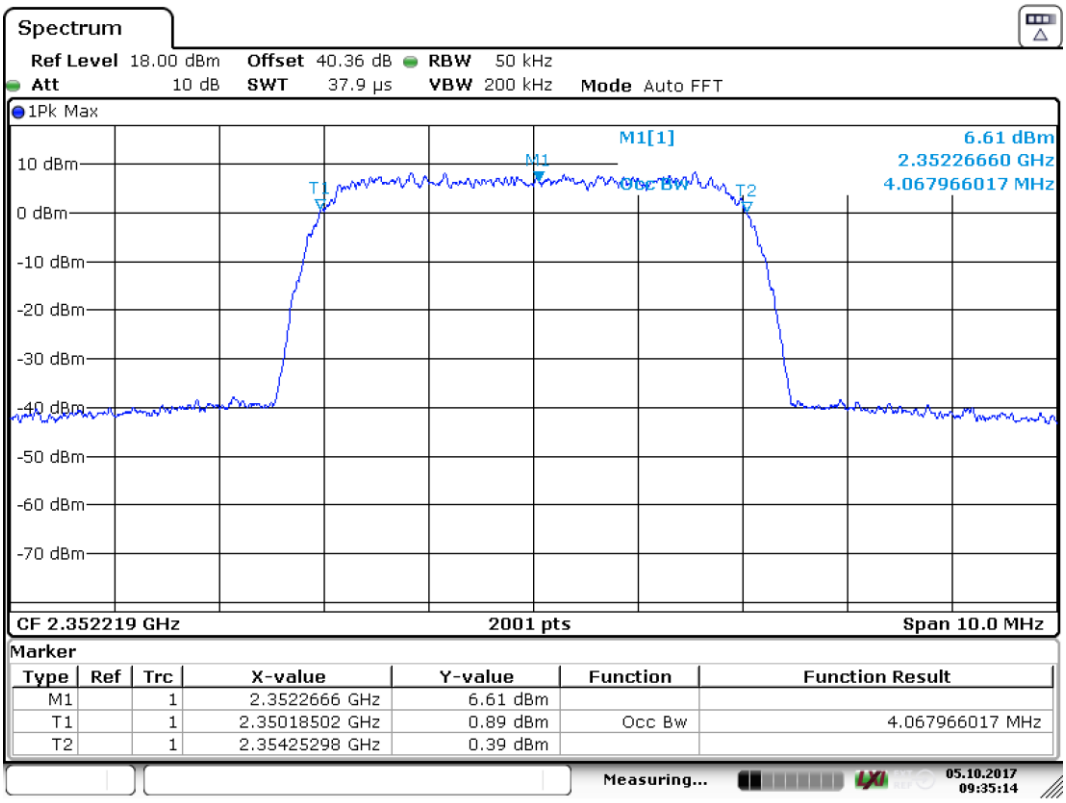
Date: 5.OCT.2017 09:30:29

AWS Occupied bandwidth GSM agc off



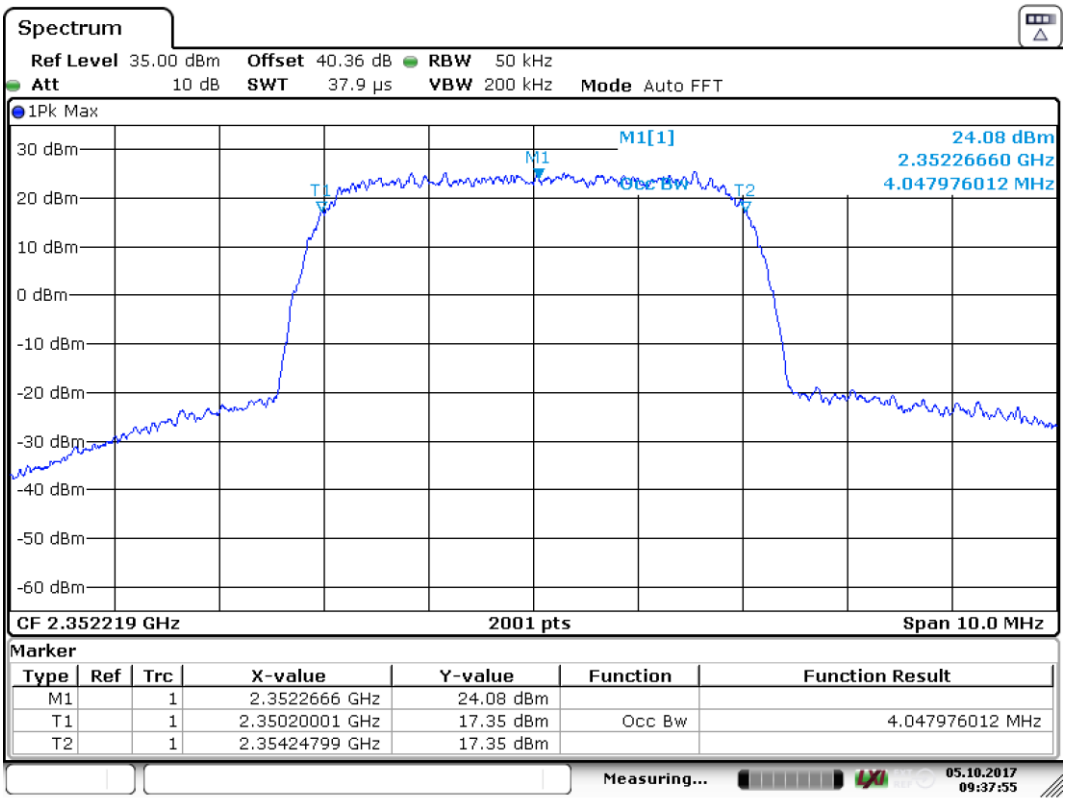
Date: 5.OCT.2017 09:28:31

AWS Occupied bandwidth GSM agc on



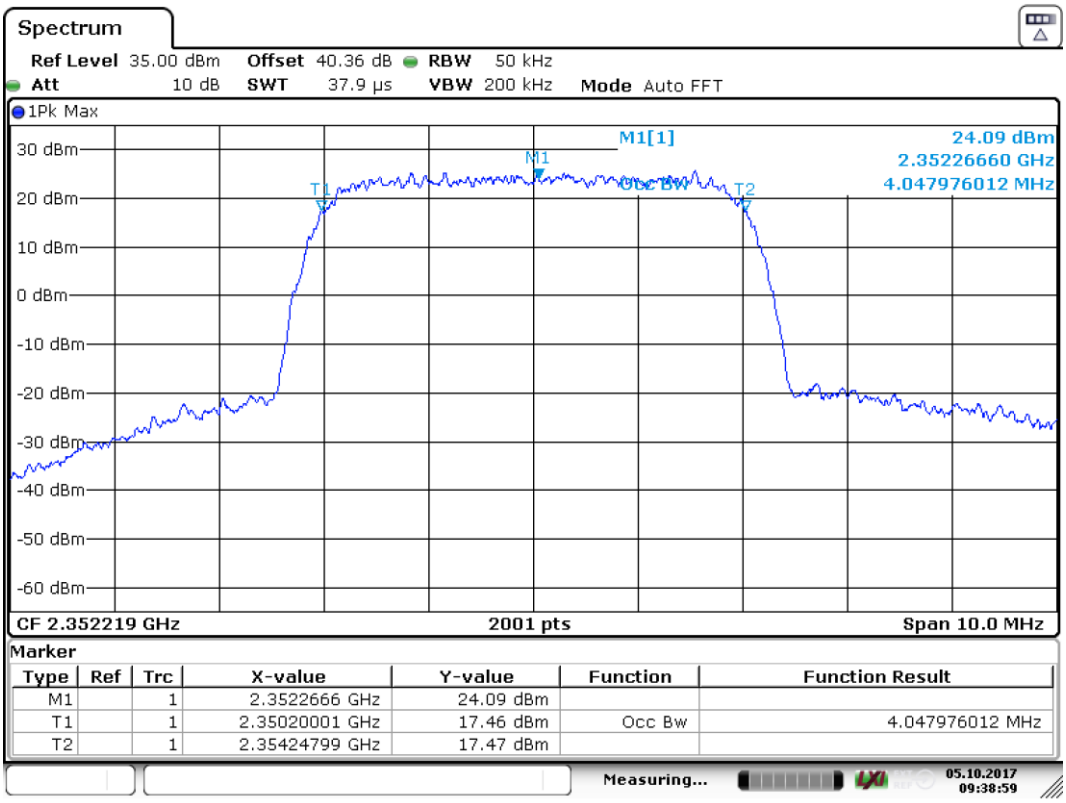
Date: 5.OCT.2017 09:35:15

AWS Occupied bandwidth WCDMA input



Date: 5.OCT.2017 09:37:55

AWS Occupied bandwidth WCDMA agc off



Date: 5.OCT.2017 09:38:59

AWS Occupied bandwidth WCDMA agc on

2.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2018
Rf-attenuator	Narda	776B-10	8337	
Rf-attenuator	Huber Suhner	5920_N-50-010/199_N	32697	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39076	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39077	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39079	7/2018
Signal generator	Rohde & Schwarz	SMIQ03B	12792	7/2018
Signal generator	Rohde & Schwarz	SMBV100	32593	7/2018

3 PASSBAND GAIN AND BANDWIDTH

Date of test:	2017-10-05	Test location:	EMC Center
EUT Serial:	99995	Ambient temp. ˚C	21 ˚C
Tested by:	MTV	Relative humidity	37 %
Test result:	Pass	Margin:	-

3.1 Requirement

RSS-131 clause 6.1

The passband gain shall not exceed the nominal gain by more than 1.0 dB. The 20 dB bandwidth shall not exceed the nominal bandwidth that is stated by the manufacturer. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.

3.2 Test set-up

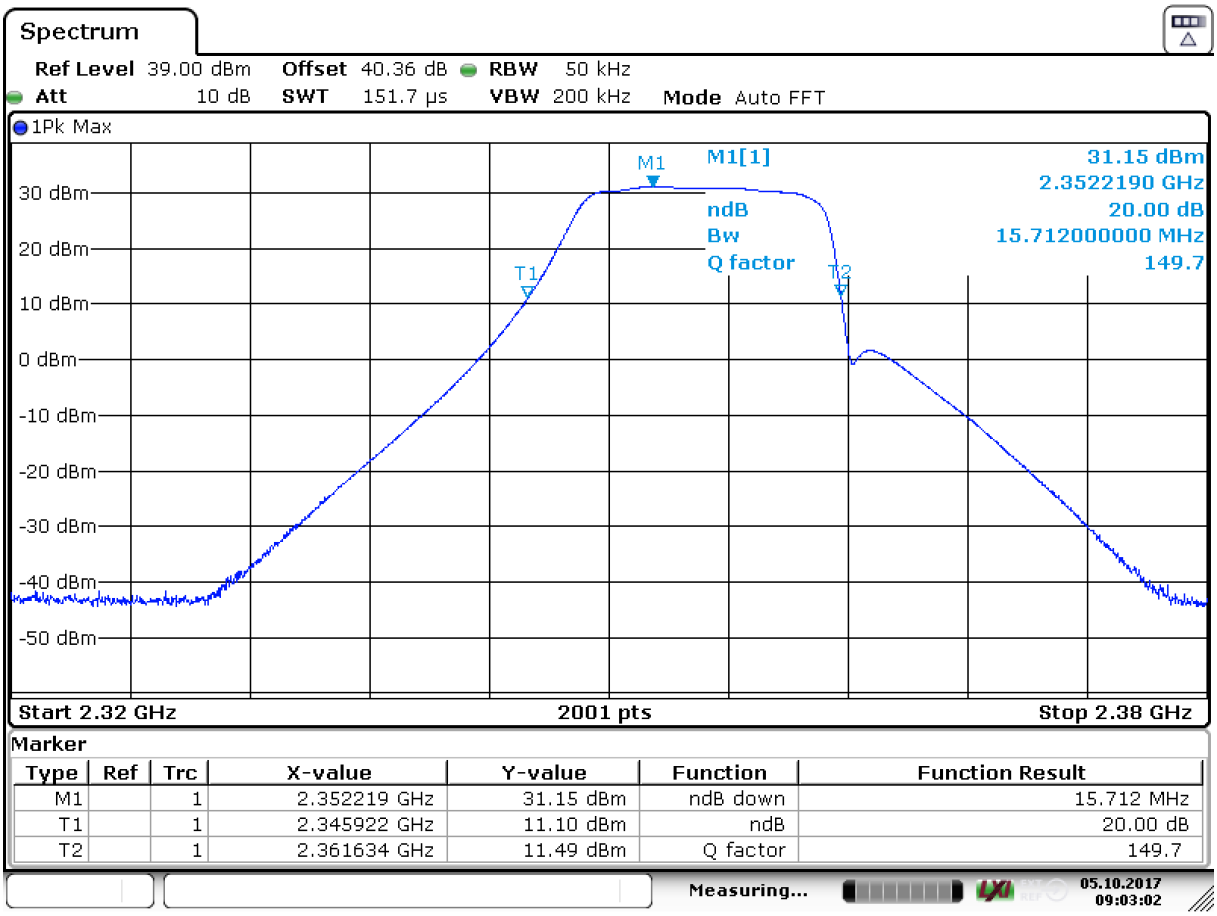
Signal generator was connected to the FOI unit which converted rf signal to optical signal. The optical signal was then fed via fibre to the EUT.
The EUT's output port was connected to spectrum analyser via rf cables and 30 dB attenuator.
The power amplifier gain was set to 60 dB
A PC was connected to FOI via Ethernet hub. The PC was then used to control the EUT.

3.3 Test data

Frequency MHz	Signal type	Occupied 20 dB band width (MHz)
2320 - 2380	CW	15.712

The pass band maximum gain is measured from FOI unit's rf input to EUT output.
This is not same as EUT's power amplifier gain.

Frequency MHz	Gen. out (dBm)	Pathloss (dB)	Measured output (dBm)	Gain dB
2352.2	-32.5	3.5	33.0	69



Date: 5.OCT.2017 09:03:03

Passband bandwidth

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2018
Rf-attenuator	Narda	776B-10	8337	7/2018
Rf-attenuator	Huber Suhner	5920_N-50-010/199_N	32697	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39076	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39077	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39079	7/2018
Signal generator	Rohde & Schwarz	SMIQ03B	12792	7/2018
Signal generator	Rohde & Schwarz	SMBV100	32593	7/2018

4 BAND EDGE EMISSION AND INTERMODULATION

Date of test:	2017-10-24 / 2017-10-30	Test location:	Wireless centre
EUT Serial:	99995	Ambient temp.	21˚C
Tested by:	MTV	Relative humidity	37 %
Test result:	Pass	Margin:	0.8 dB

4.1 Requirement

§27.53 a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:
(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:
(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;
(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;
(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz
RSS-195 clauses 4.2 and 5.6.1

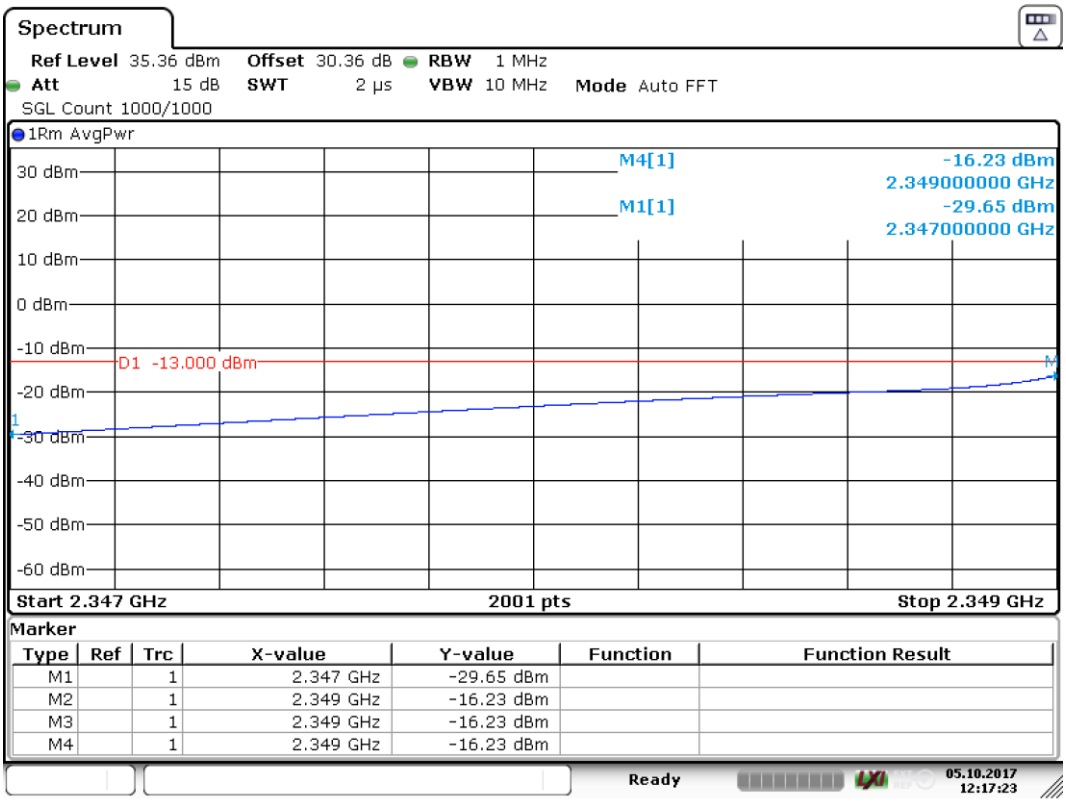
The power of any emission outside the frequency range(s) in which the equipment operates shall be attenuated below the transmitter power, P(dBW), by the amount indicated in Table below, where p is the transmitter output power measured in watts.

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)

4.2 Test set-up

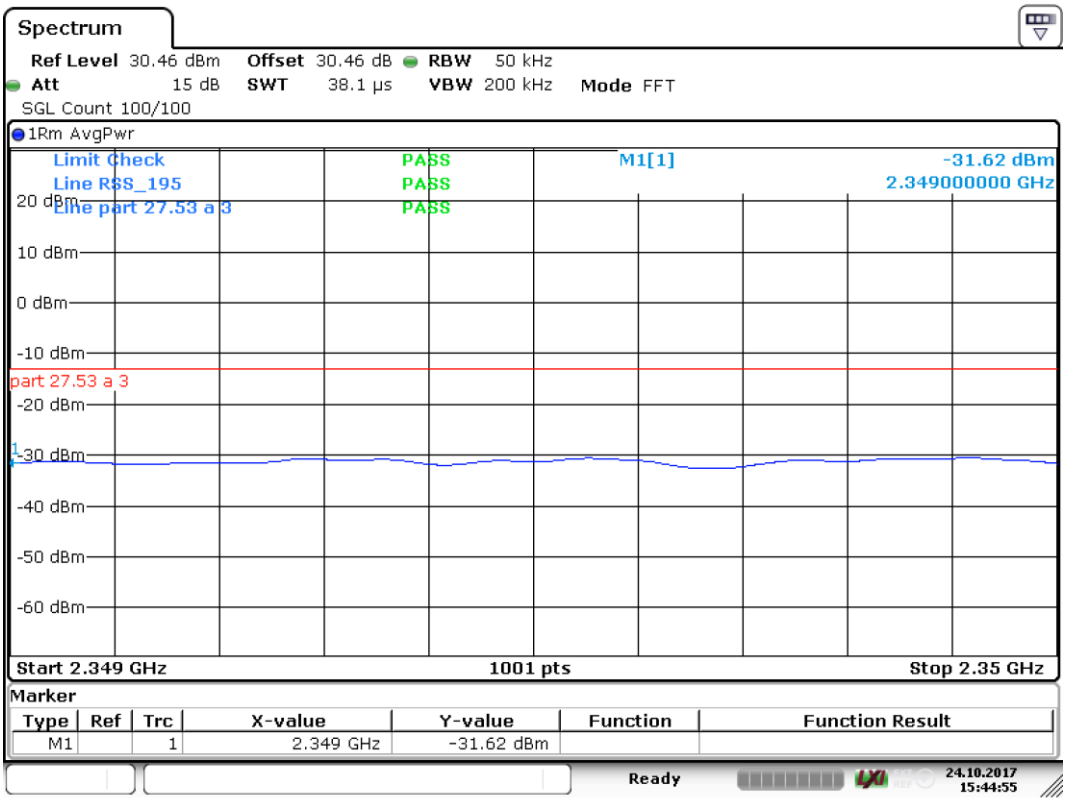
2 Signal generators were connected to power combiner who was then connected to the FOI unit.
Signals were placed on two lowest adjacent channels of the band.
The test was repeated on 2 highest channels.

4.3 Test data



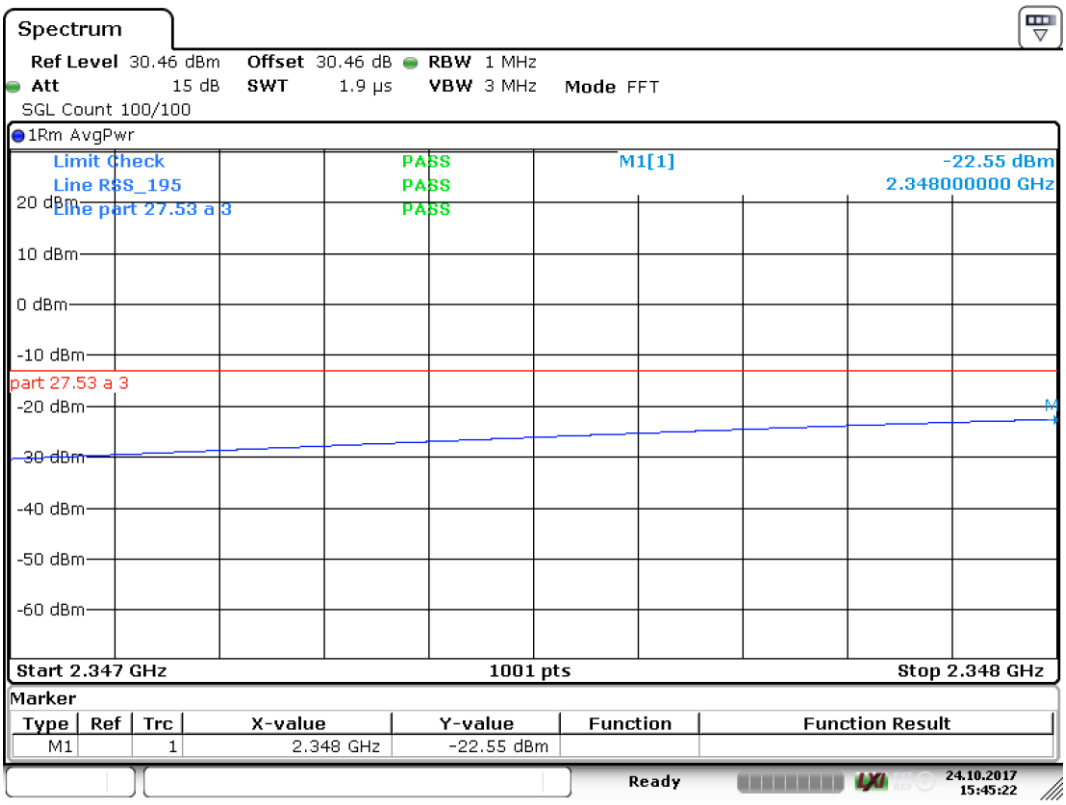
Date: 5.OCT.2017 12:17:24

2 AWGN signals lower band edge AGC off 2347 – 2349 MHz



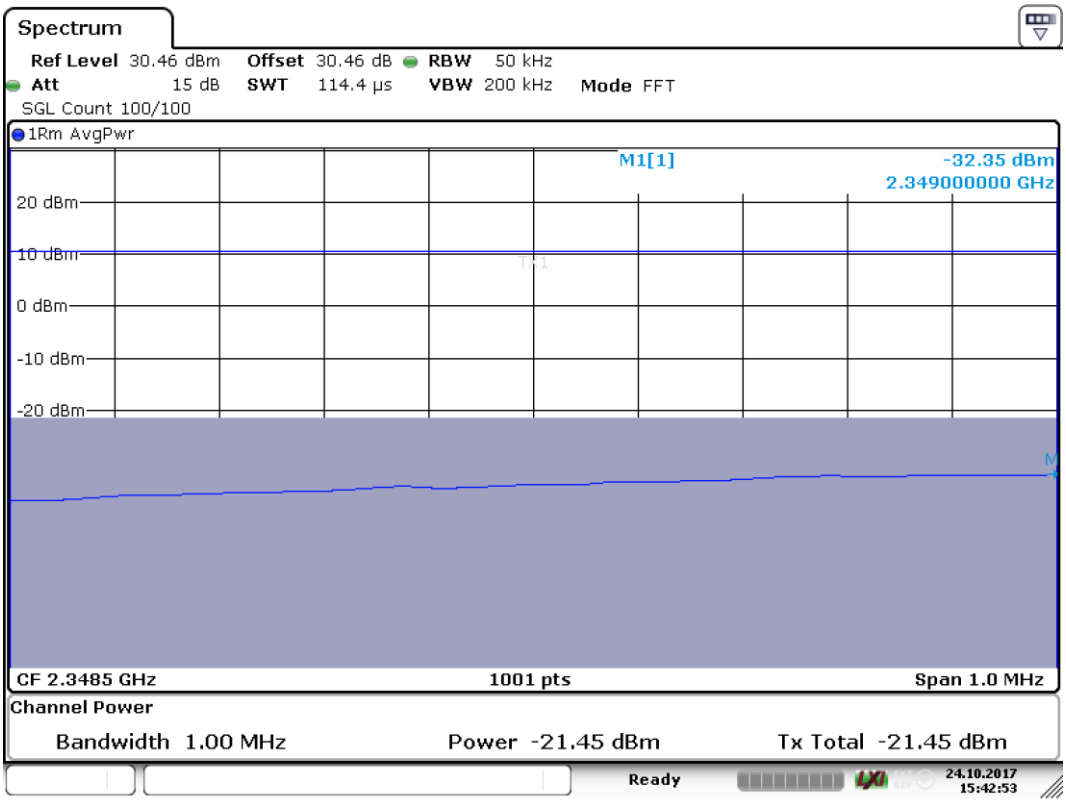
Date: 24.OCT.2017 15:44:55

2 AWGN signals lower band edge AGC off 2349 – 2350 MHz



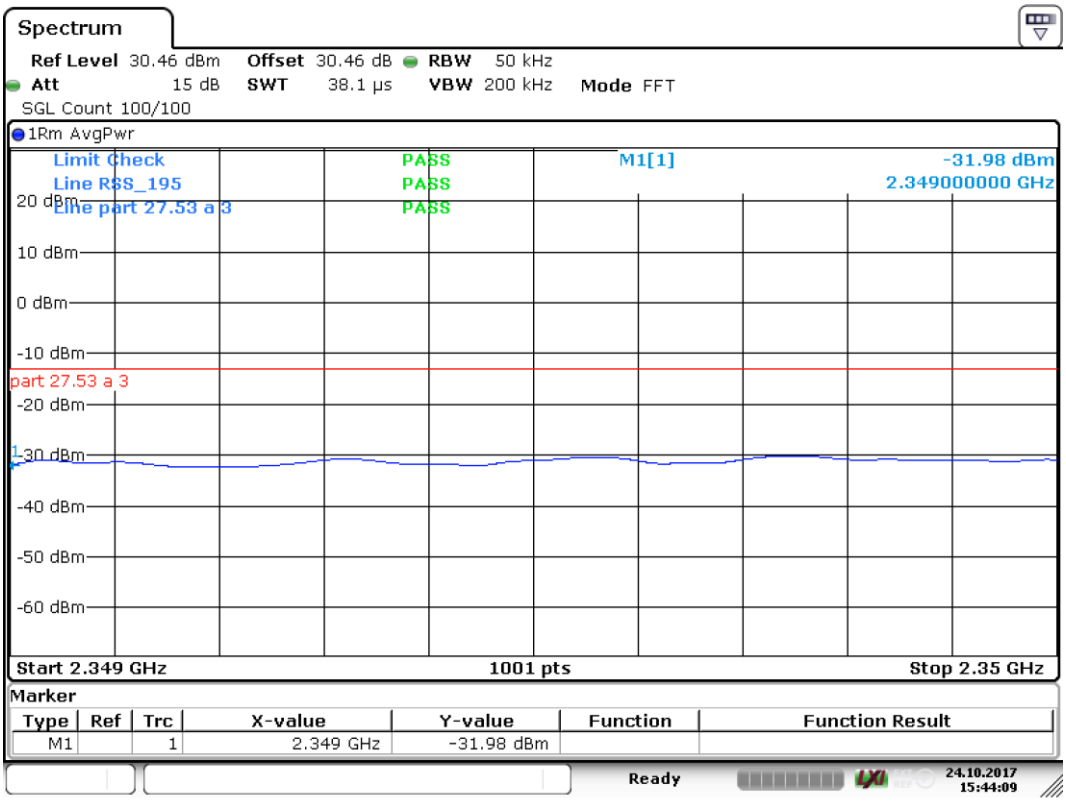
Date: 24.OCT.2017 15:45:23

2 AWGN signals lower band edge 2347 – 2348 MHz AGC on



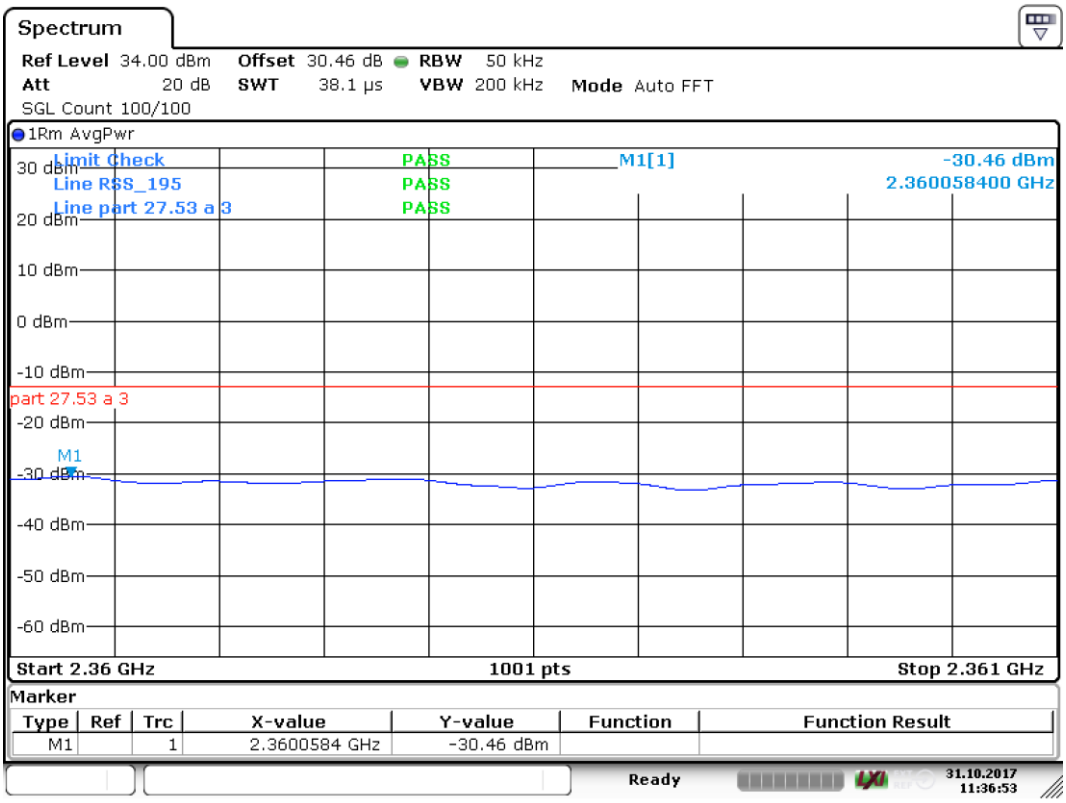
Date: 24.OCT.2017 15:42:54

2 AWGN signals lower band edge 2348 – 2349 MHz AGC on



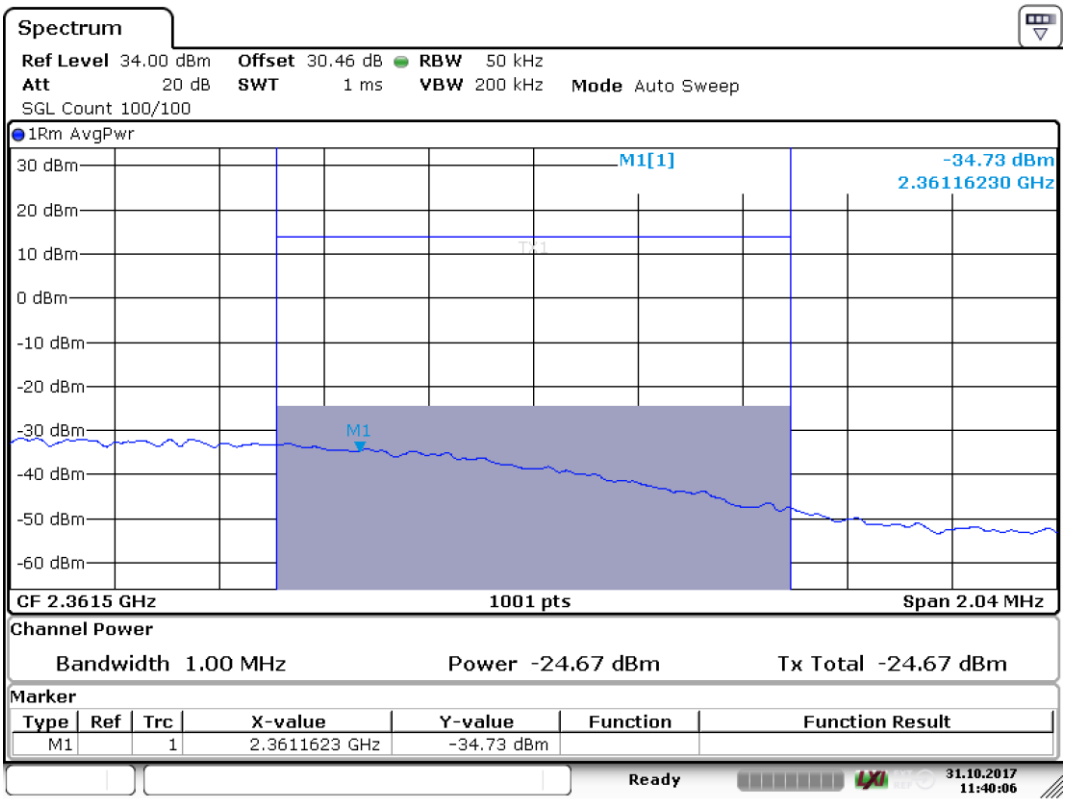
Date: 24.OCT.2017 15:44:10

2 AWGN signals lower band edge 2349 – 2350 MHz AGC on



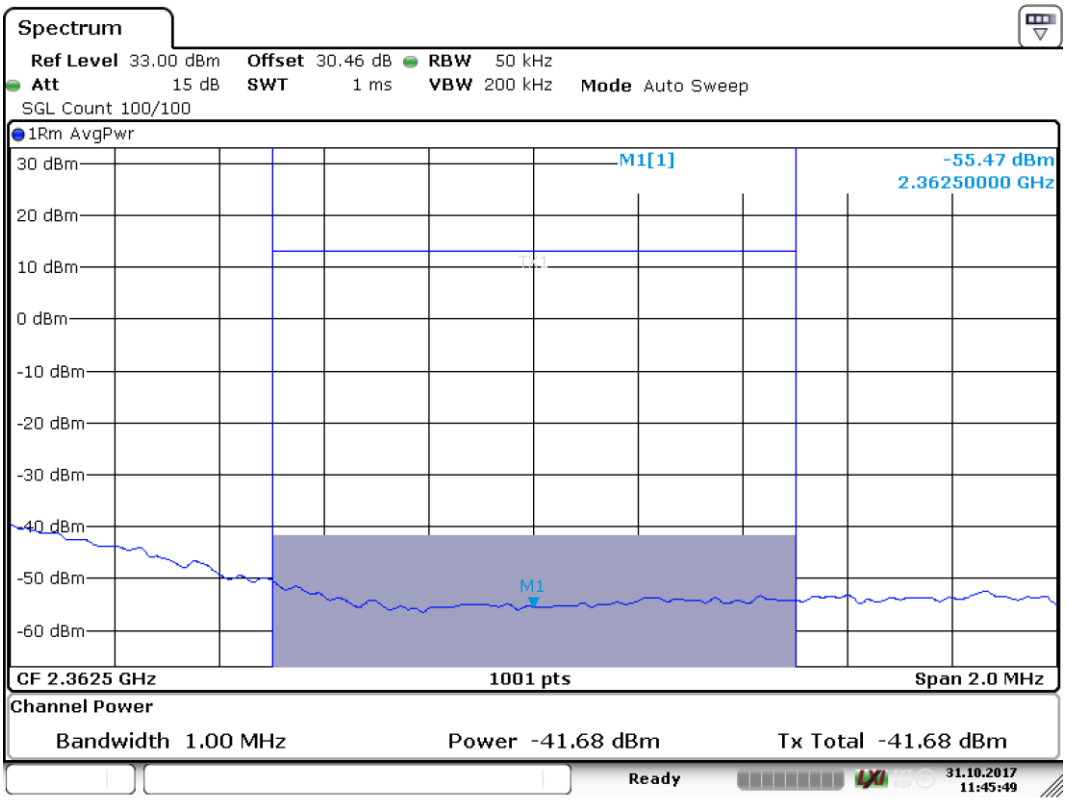
Date: 31.OCT.2017 11:36:53

2 AWGN signals upper band edge AGC off 2360 – 2361 MHz



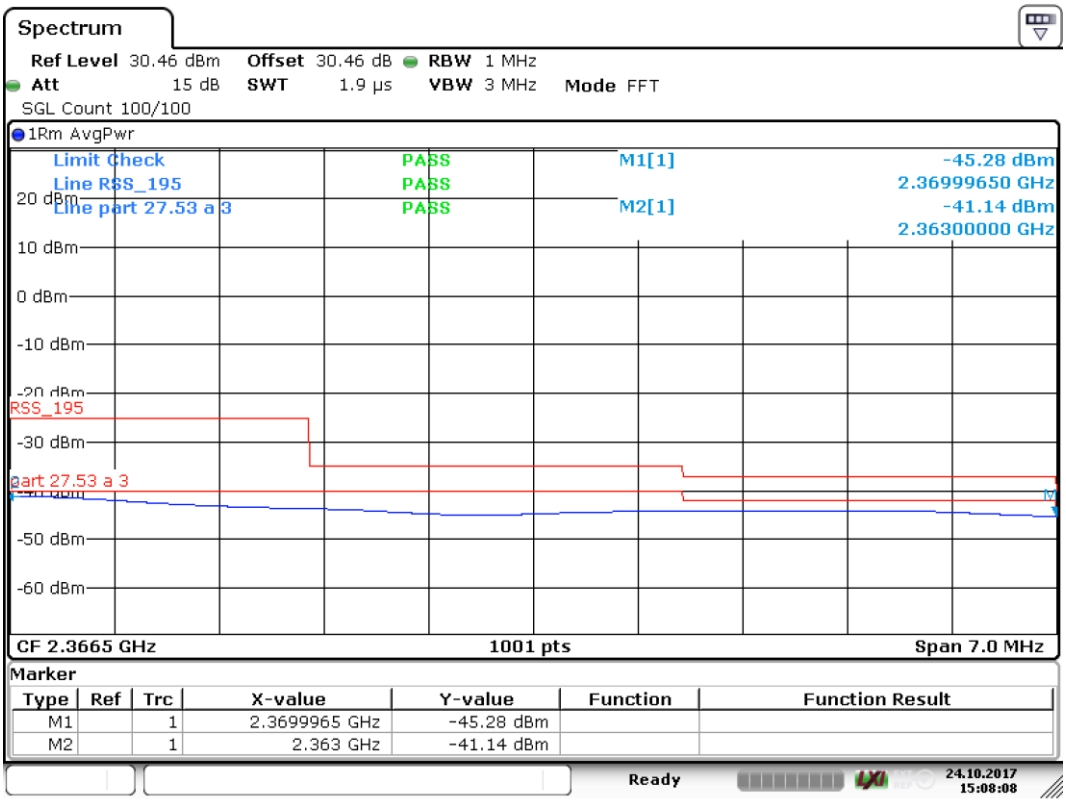
Date: 31.OCT.2017 11:40:07

2 AWGN signals lower band edge AGC off 2361 – 2362 MHz



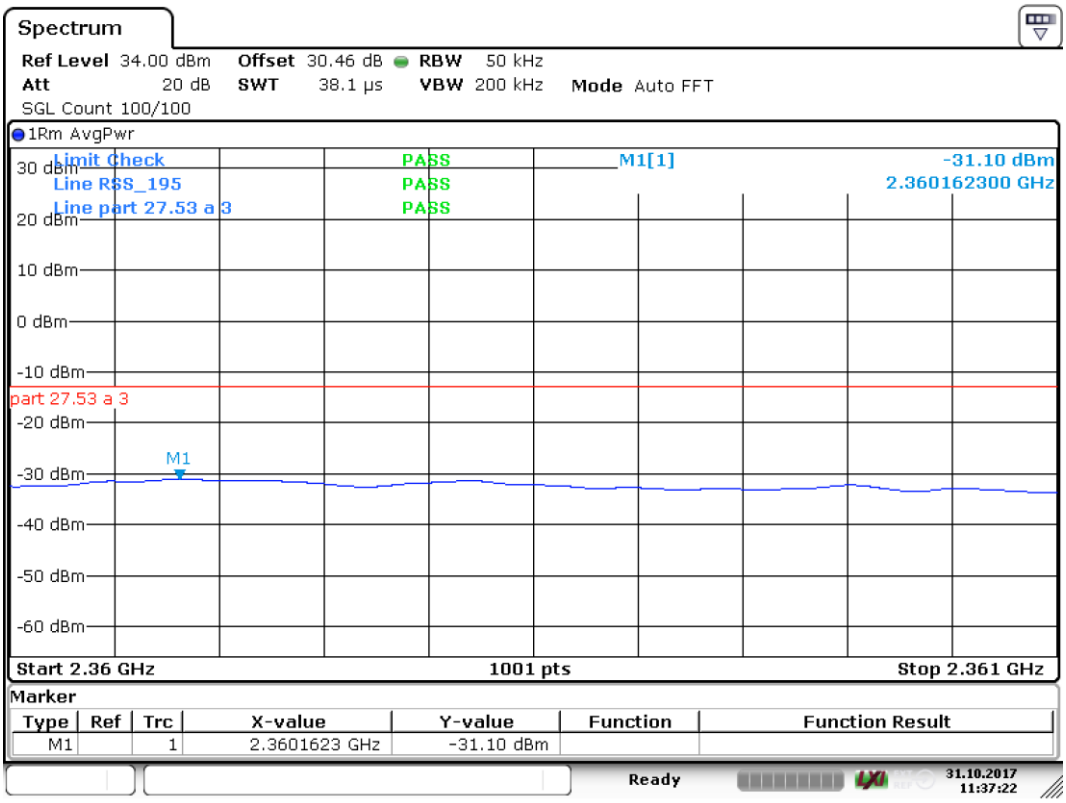
Date: 31.OCT.2017 11:45:50

2 AWGN signals upper band edge AGC off 2362 – 2363 MHz



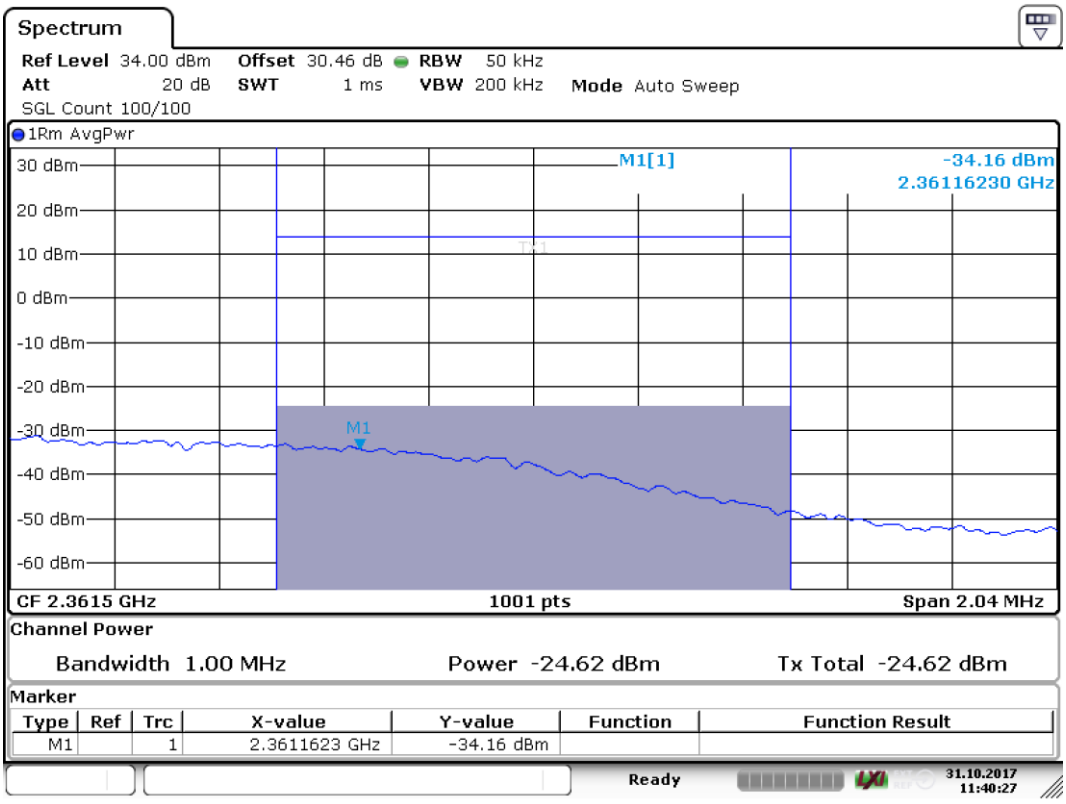
Date: 24.OCT.2017 15:08:09

2 AWGN signals upper band edge AGC off AGC off 2363 – 2370 MHz



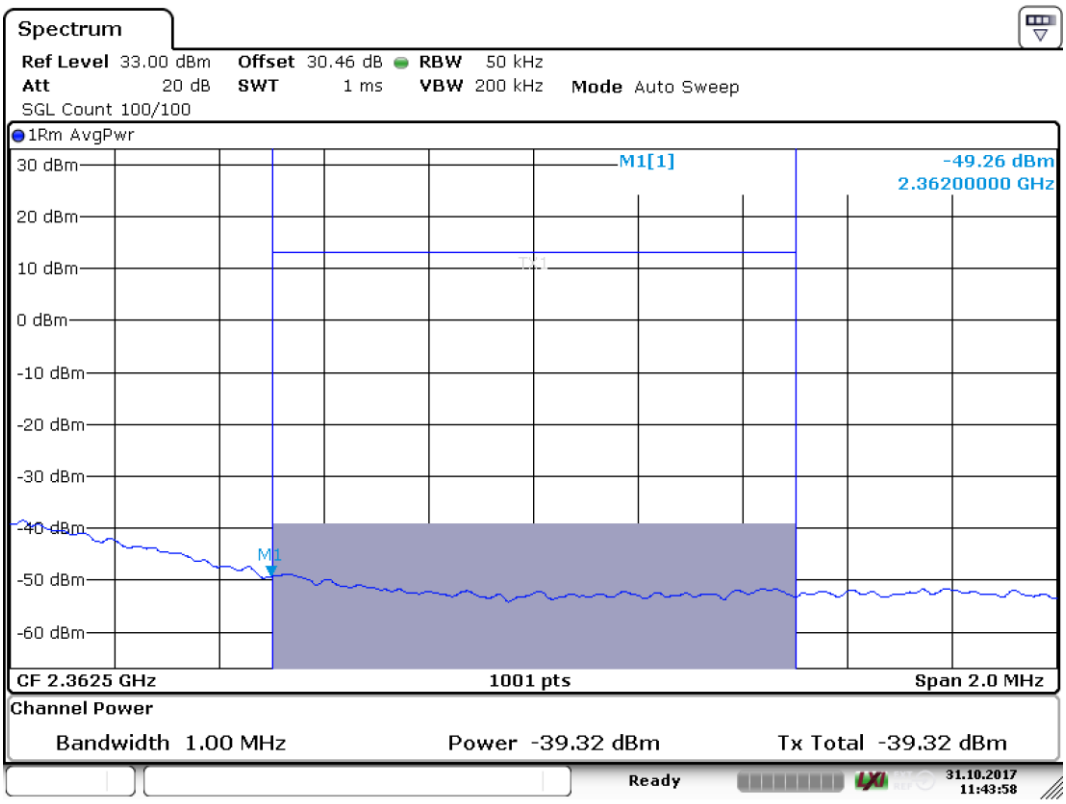
Date: 31.OCT.2017 11:37:22

2 AWGN signals upper band edge AGC on 2360 – 2361 MHz



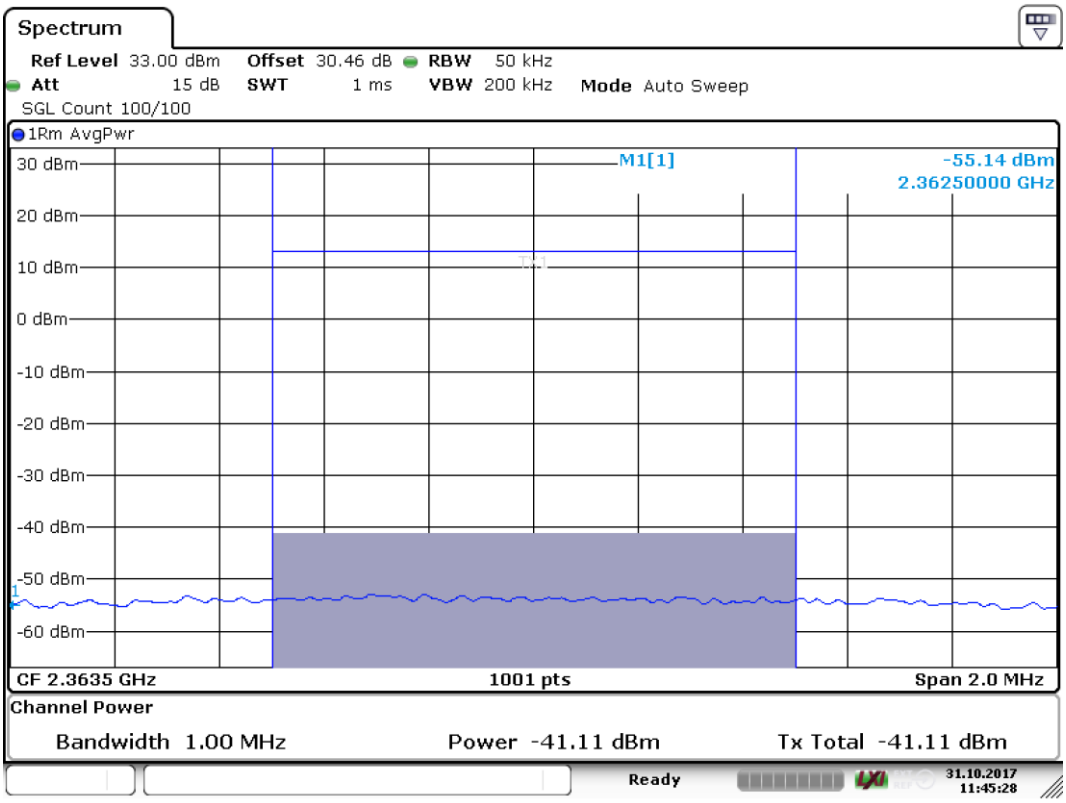
Date: 31.OCT.2017 11:40:27

2 AWGN signals upper band edge AGC on 2361 – 2362 MHz



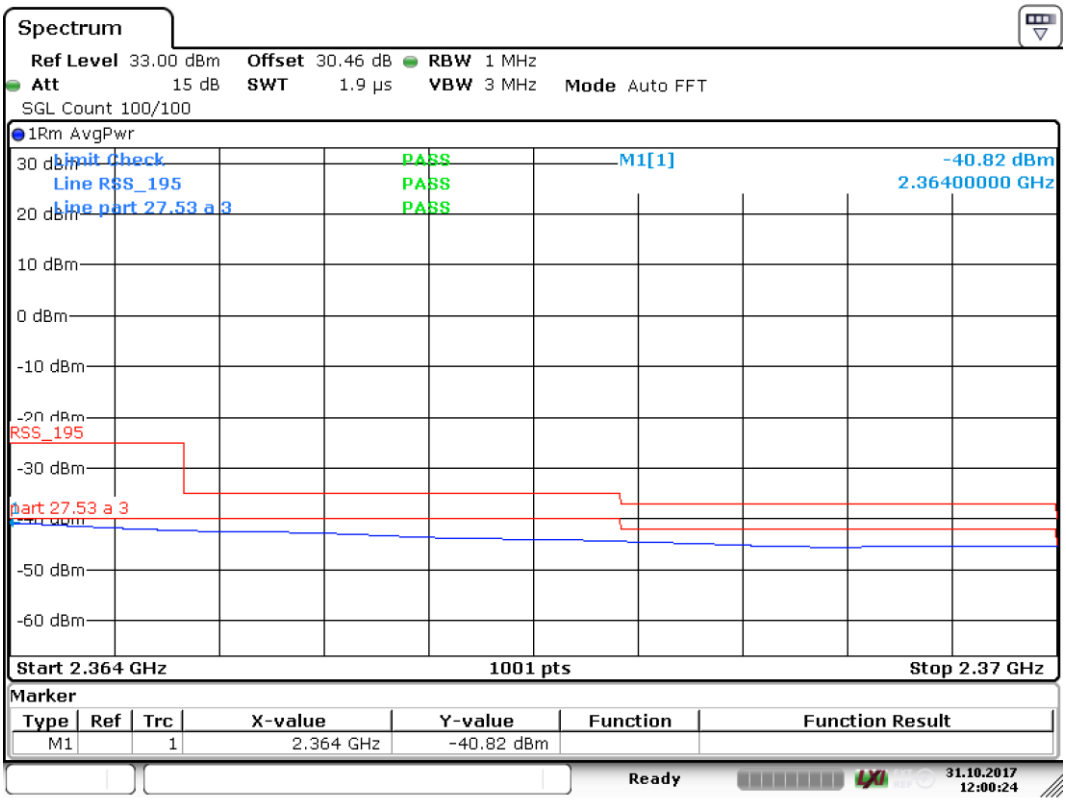
Date: 31.OCT.2017 11:43:58

2 AWGN signals upper band edge AGC on 2362 – 2363 MHz



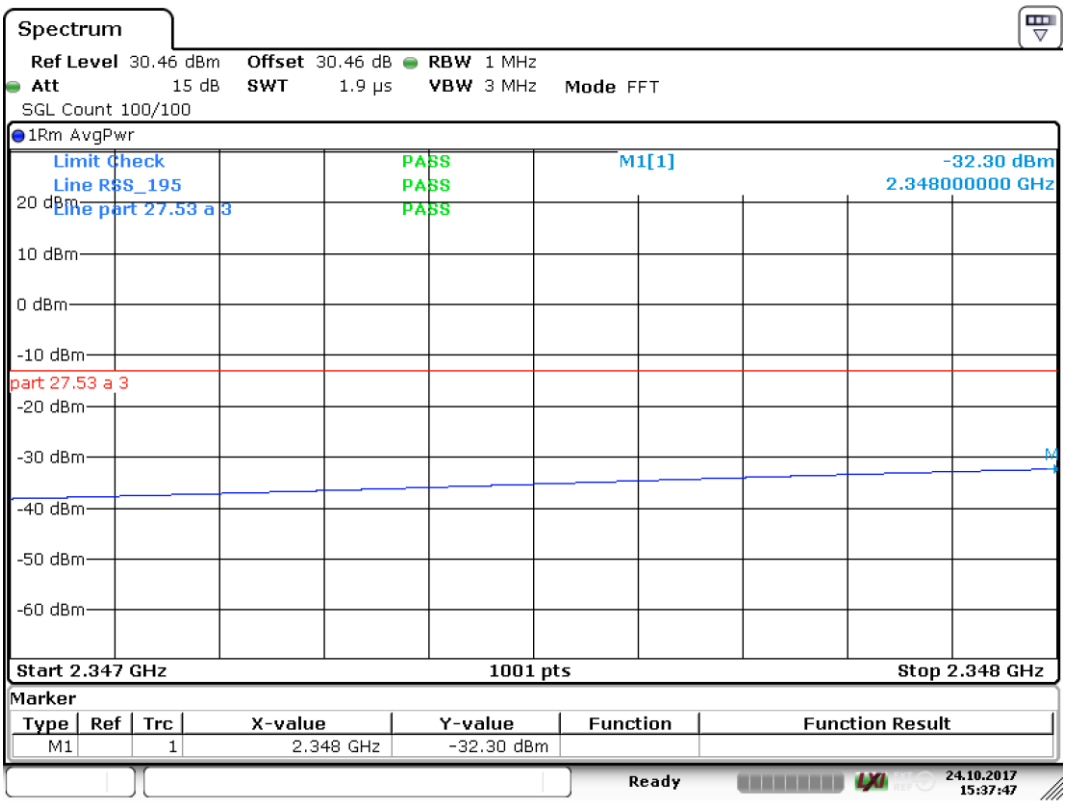
Date: 31.OCT.2017 11:45:28

2 AWGN signals upper band edge 2363 – 2364 MHz AGC on



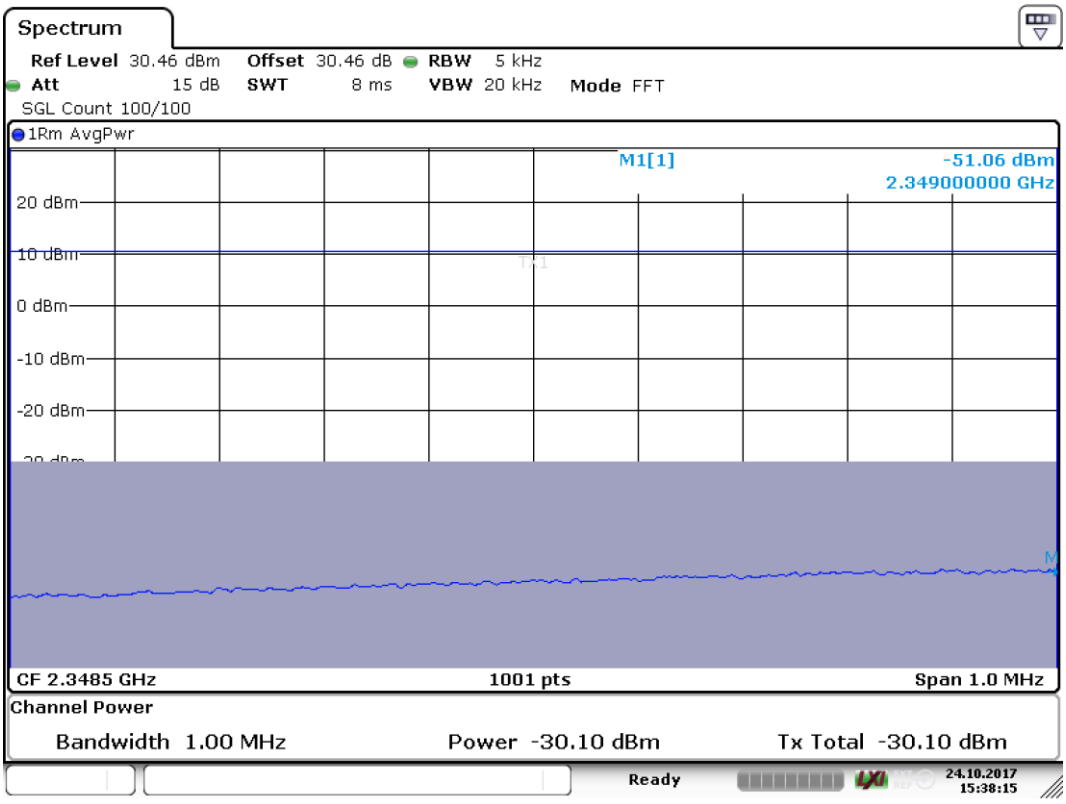
Date: 31.OCT.2017 12:00:24

2 AWGN signals upper band edge 2365 – 2370 MHz AGC on



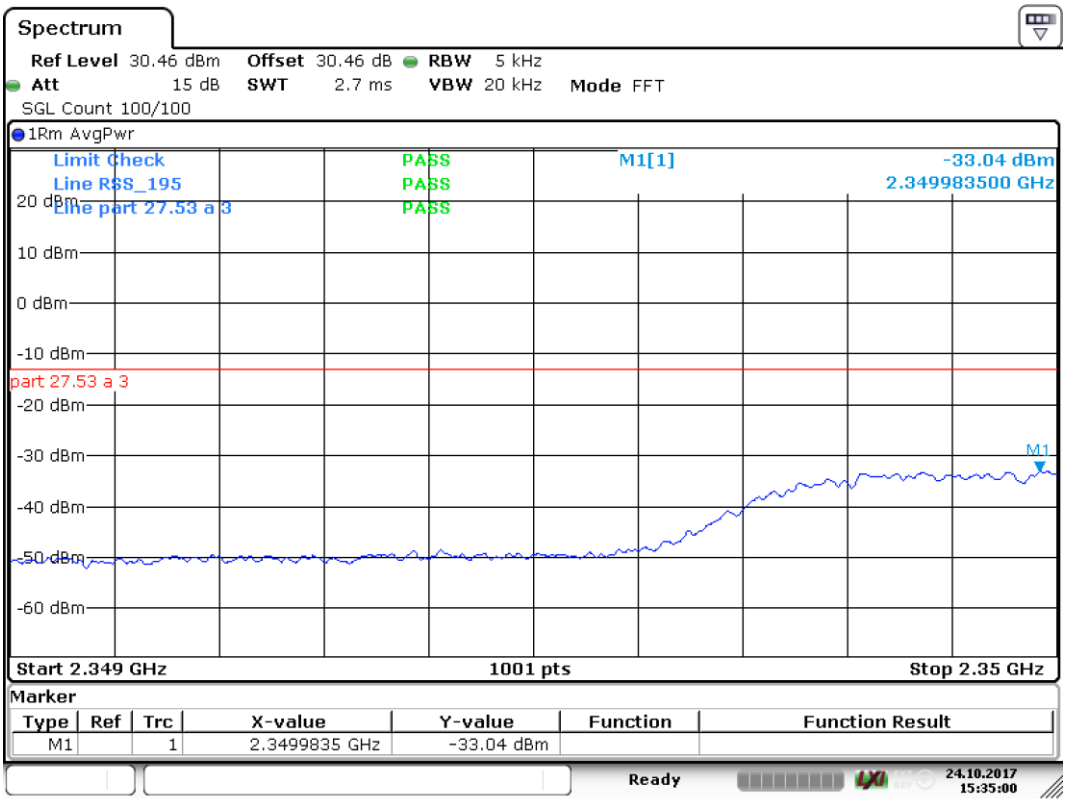
Date: 24.OCT.2017 15:37:47

2 GSM signal on lower band edge 2347 – 2348 MHz AGC off



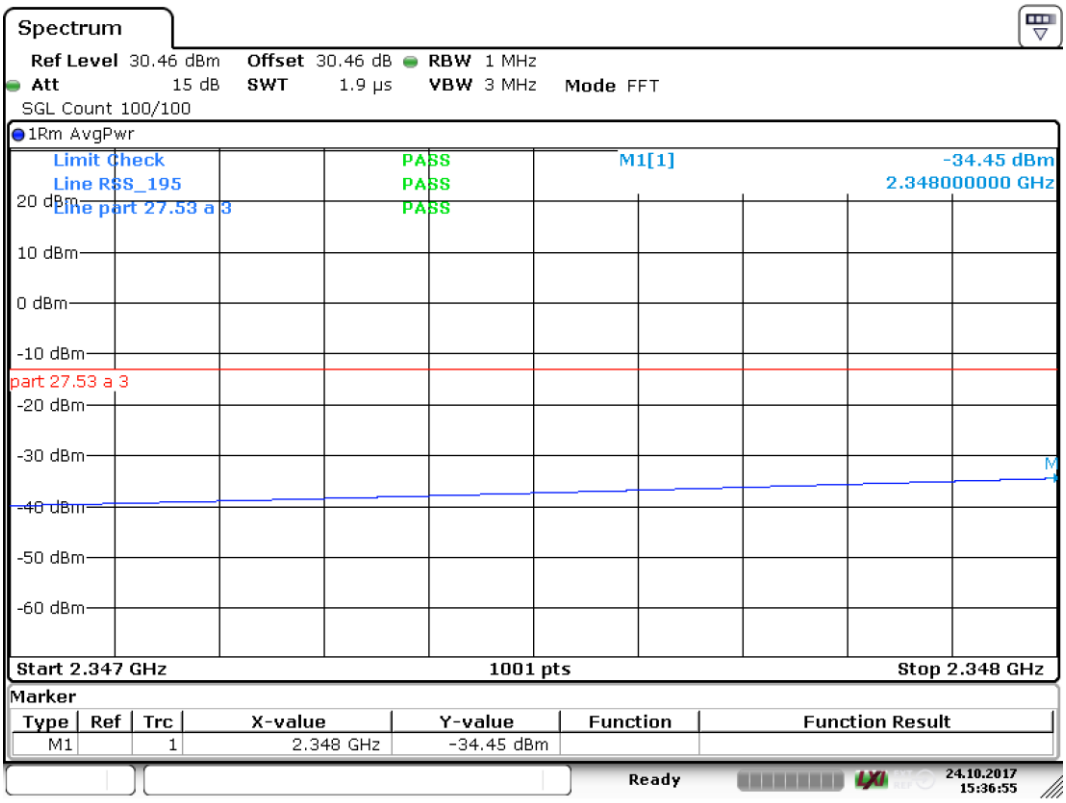
Date: 24.OCT.2017 15:38:16

2 GSM signal on lower band edge 2348 – 2349 MHz AGC off



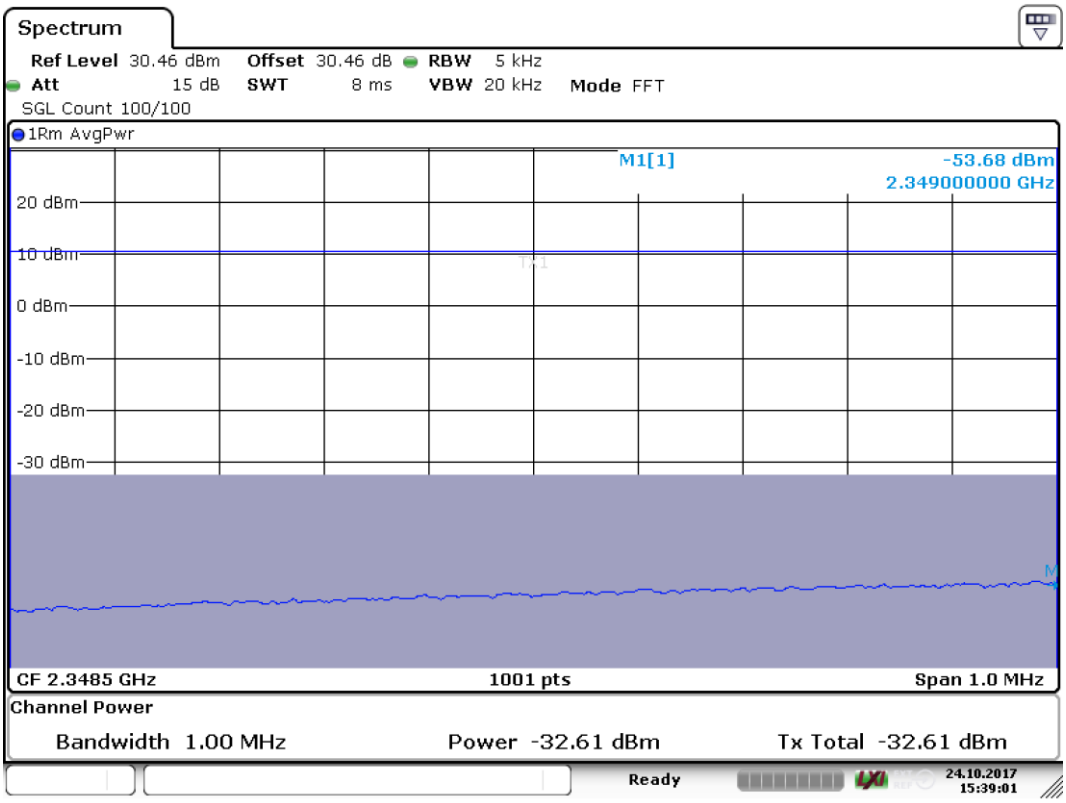
Date: 24.OCT.2017 15:35:00

2 GSM signal on lower band edge 2349 – 2350 MHz AGC off



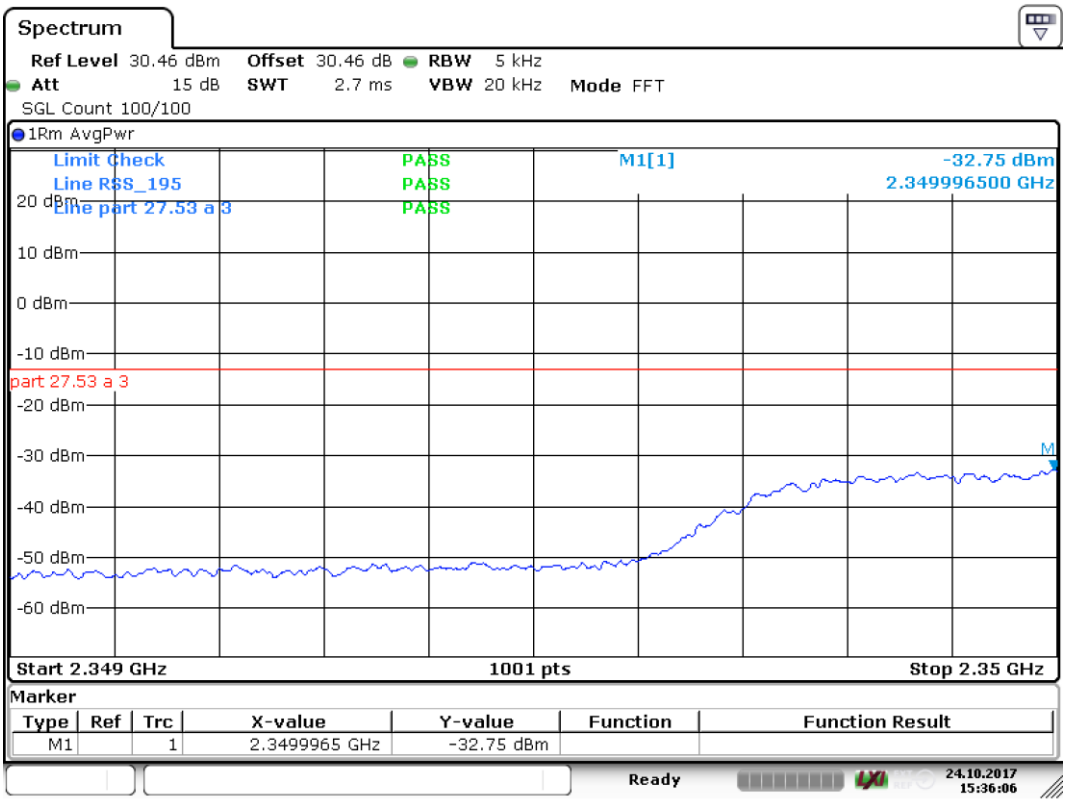
Date: 24.OCT.2017 15:36:56

2 GSM signal on lower band edge 2347 – 2348 MHz AGC on



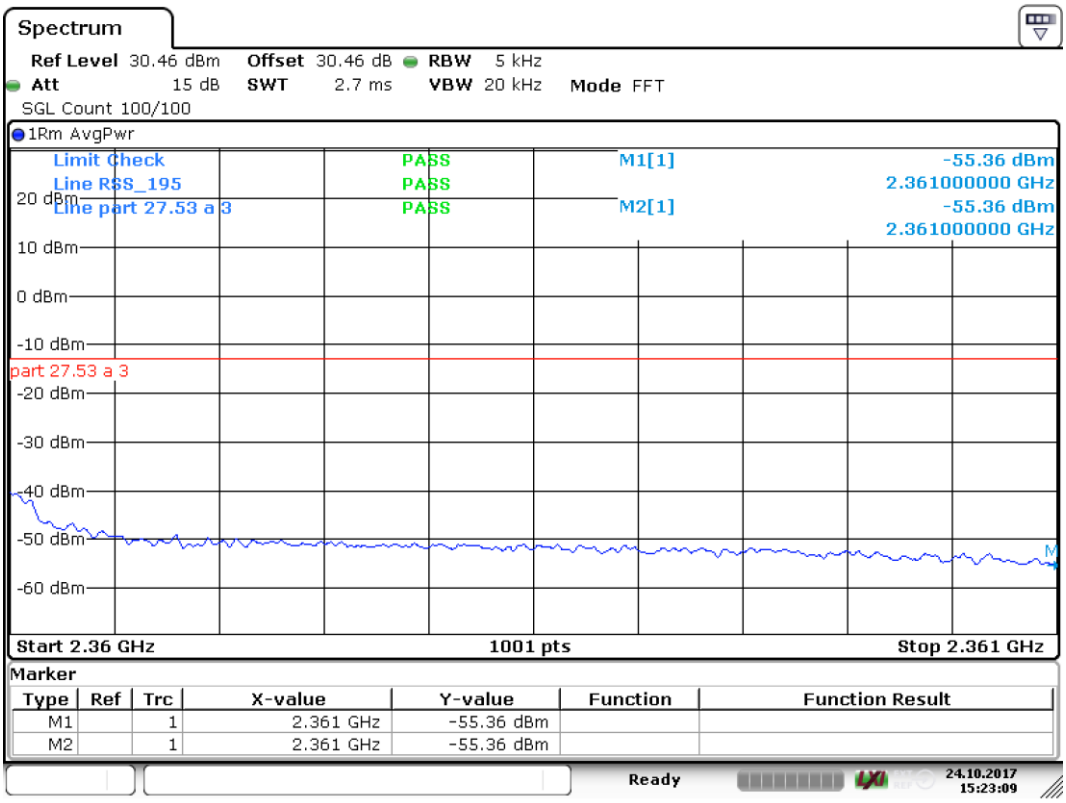
Date: 24.OCT.2017 15:39:01

2 GSM signal on lower band edge 2348 – 2349 MHz AGC on



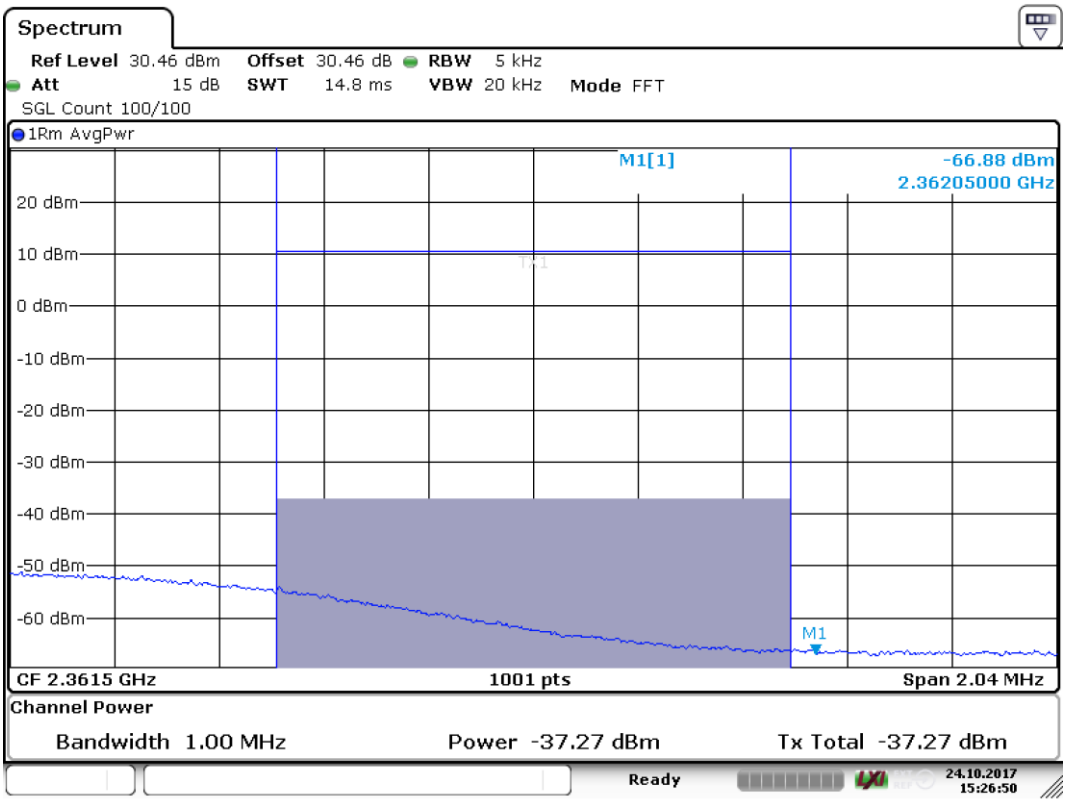
Date: 24.OCT.2017 15:36:06

2 GSM signal on lower band edge 2344 – 2350 MHz AGC on



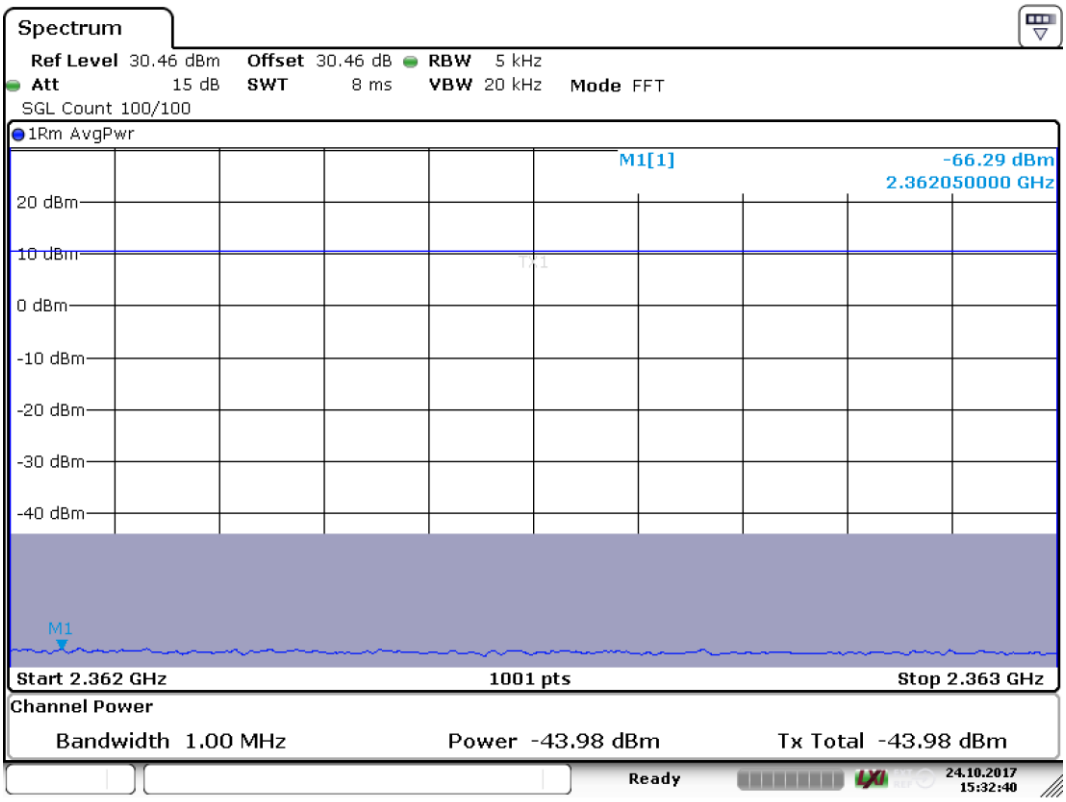
Date: 24.OCT.2017 15:23:09

2 GSM signal on upper band edge 2360 – 2361 MHz AGC off



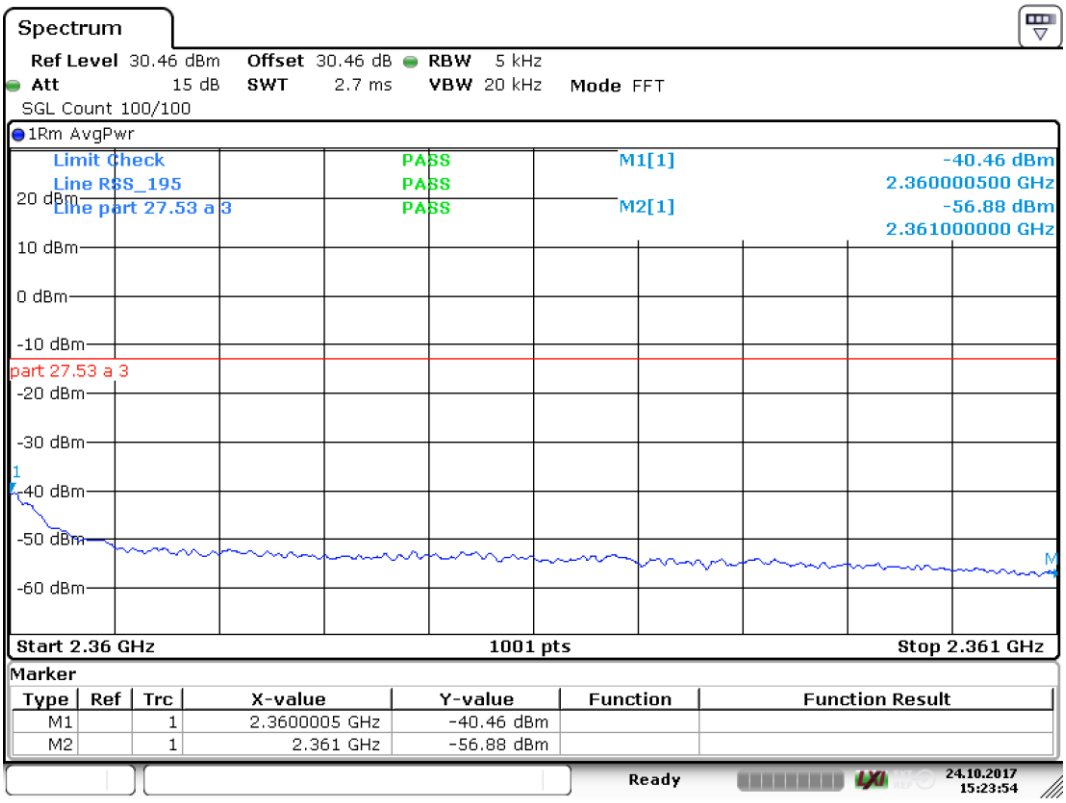
Date: 24.OCT.2017 15:26:50

2 GSM signal on upper band edge 2361 – 2362 MHz AGC off



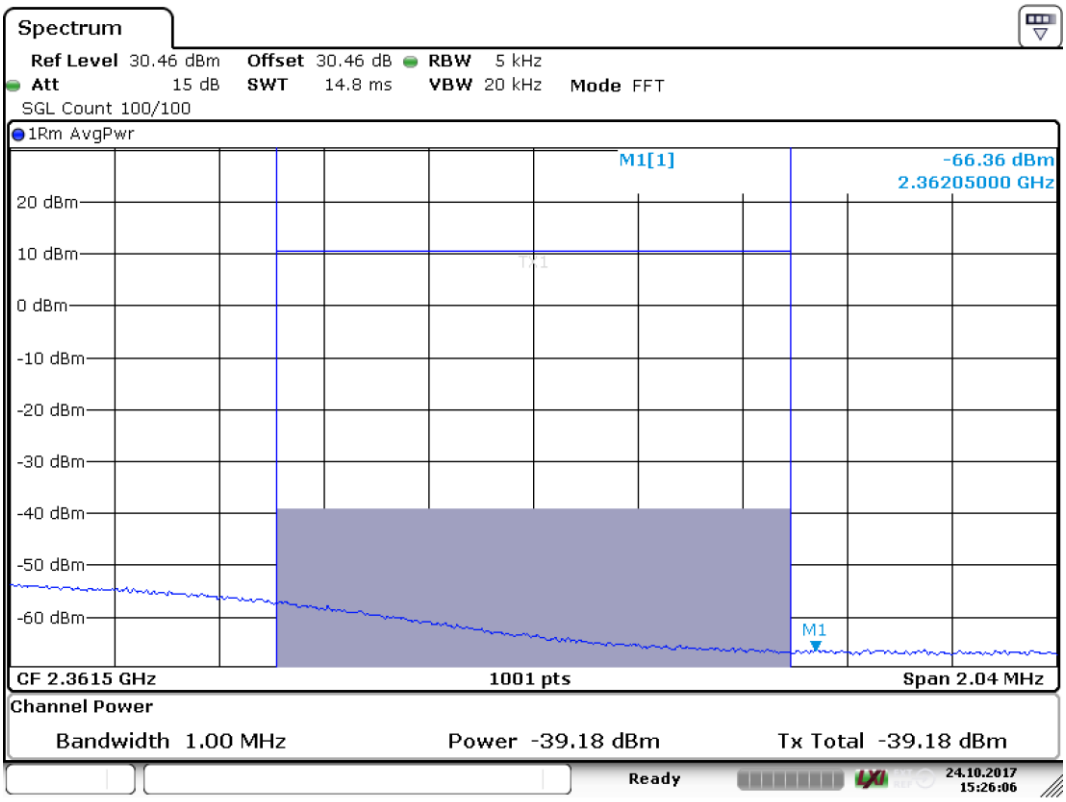
Date: 24.OCT.2017 15:32:41

2 GSM signal on upper band edge 2362 – 2363 MHz AGC off



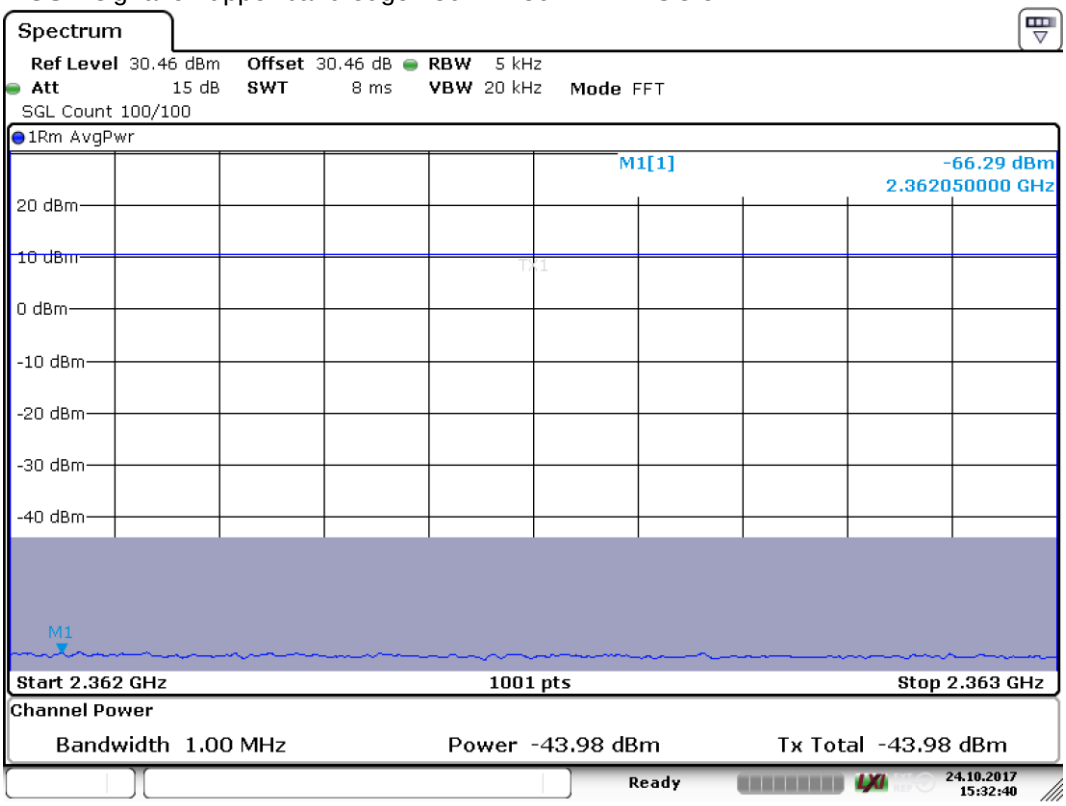
Date: 24.OCT.2017 15:23:54

2 GSM signal on upper band edge 2360 – 2361 MHz AGC on



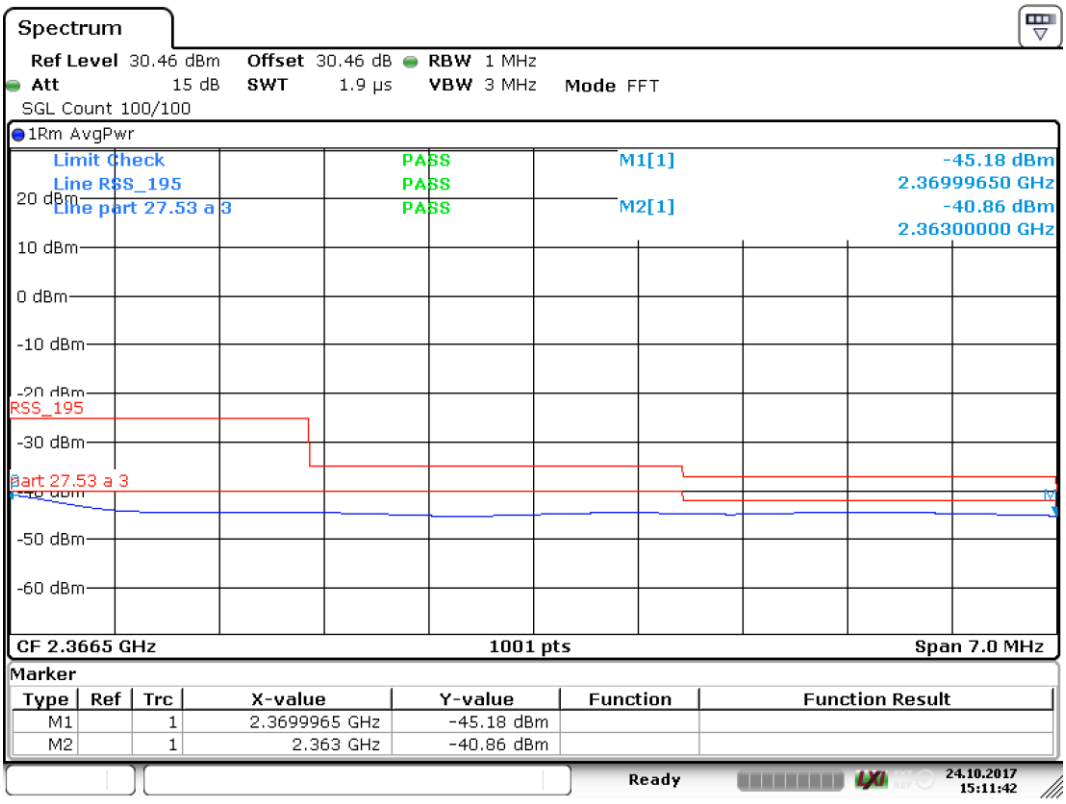
Date: 24.OCT.2017 15:26:07

2 GSM signal on upper band edge 2361 – 2362 MHz AGC on



Date: 24.OCT.2017 15:32:41

2 GSM signal on upper band edge 2362 – 2363 MHz AGC on



Date: 24.OCT.2017 15:11:43

2 GSM signal on upper band edge 2363 – 2370 MHz AGC on

4.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2018
Rf-attenuator	Narda	776B-10	8337	7/2018
Rf-attenuator	Huber Suhner	5920_N-50-010/199_N	32697	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39076	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39077	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39079	7/2018
Signal generator	Rohde & Schwarz	SMIQ03B	12792	7/2018
Signal generator	Rohde & Schwarz	SMBV100	32593	7/2018

5 CONDUCTED SPURIOUS EMISSION FROM ANTENNA PORT

Date of test:	2017-10-27 – 2017-10-30	Test location:	Wireless centre
EUT Serial:	99995	Ambient temp.	21˚C
Tested by:	MTV	Relative humidity	37 %
Test result:	Pass	Margin:	0.6 dB

5.1 Requirement

§27.53 a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz

RSS-195 clauses 4.2 and 5.6.1

The power of any emission outside the frequency range(s) in which the equipment operates shall be attenuated below the transmitter power, P(dBW), by the amount indicated in Table below, where p is the transmitter output power measured in watts.

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)

5.2 Test set-up

Signal generator was connected to the FOI unit which converted rf signal to optical signal. The optical signal was then fed via fibre to the EUT.
The EUT's output port was connected to spectrum analyser via rf cables and band reject or high pass filter.
A PC was connected to FOI via Ethernet hub. The PC was then used to control the EUT.

5.3 Test data

GSM low channel

Frequency MHz	marker (dBm)	Pathloss (dB)	level (dBm)	Margin (dB)
2330	-81.22	12.6	-68.6	23.6
2344.9	-64.2	15.0	-49.2	4.2
2347.3	-59.2	16.6	-42.6	0.6
2361.5	-62.7	24.0	-38.7	25.7
2363.6	-68.6	15.7	-52.9	27.9
2370	-80.1	12.7	-67.4	22.2

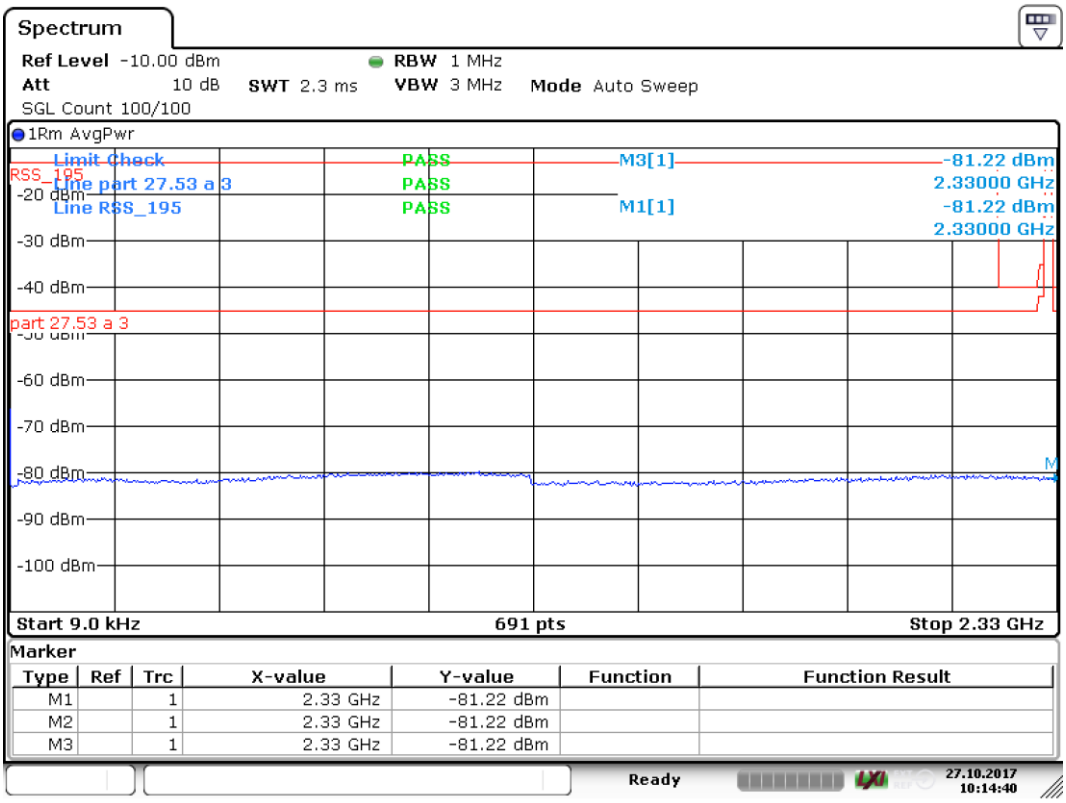
Frequency MHz	marker (dBm)	Pathloss (dB)	level (dBm)	level (dBm)
2330	-81.07	12.6	-68.5	23.5
2344	-64.2	14.9	-49.3	4.3
2347	-59.2	16.6	-42.6	36.3
2362.5	-69.0	16.9	-52.1	39.1
2363.6	-68.2	15.0	-53.2	28.2
2370	-80.3	12.7	-67.6	22.6

WCDMA low channel

Frequency MHz	marker (dBm)	Pathloss (dB)	level (dBm)	Margin (dB)
2330	-81.22	12.6	-68.6	23.6
2344.9	-64.2	15.0	-49.2	4.2
2347.3	-59.2	16.6	-42.6	0.6
2361.5	-62.7	24.0	-38.7	25.7
2363.6	-68.6	15.7	-52.9	27.9
2370	-80.1	12.7	-67.4	22.2

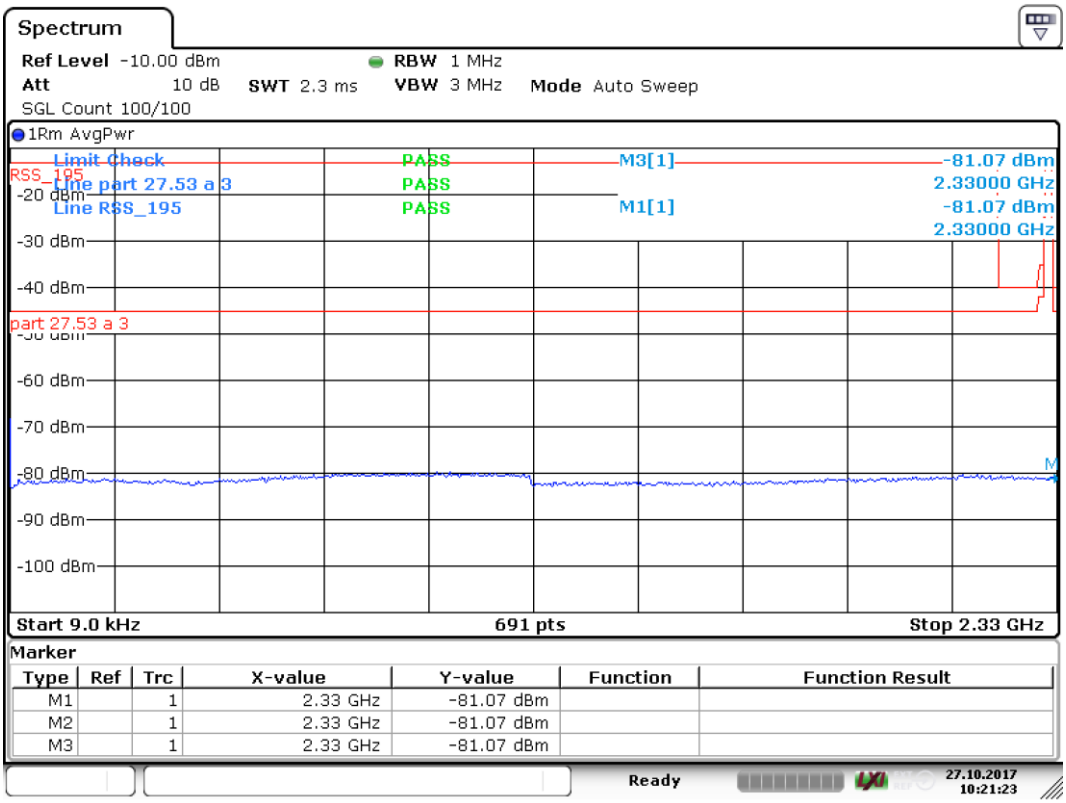
WCDMA high channel

Frequency MHz	marker (dBm)	Pathloss (dB)	level (dBm)	Margin (dB)
2330	-81.22	12.6	-68.6	23.6
2344.9	-64.2	15.0	-49.2	4.2
2347.3	-59.2	16.6	-42.6	0.6
2361.5	-62.7	24.0	-38.7	25.7
2363.6	-68.6	15.7	-52.9	27.9
2370	-80.1	12.7	-67.4	22.2



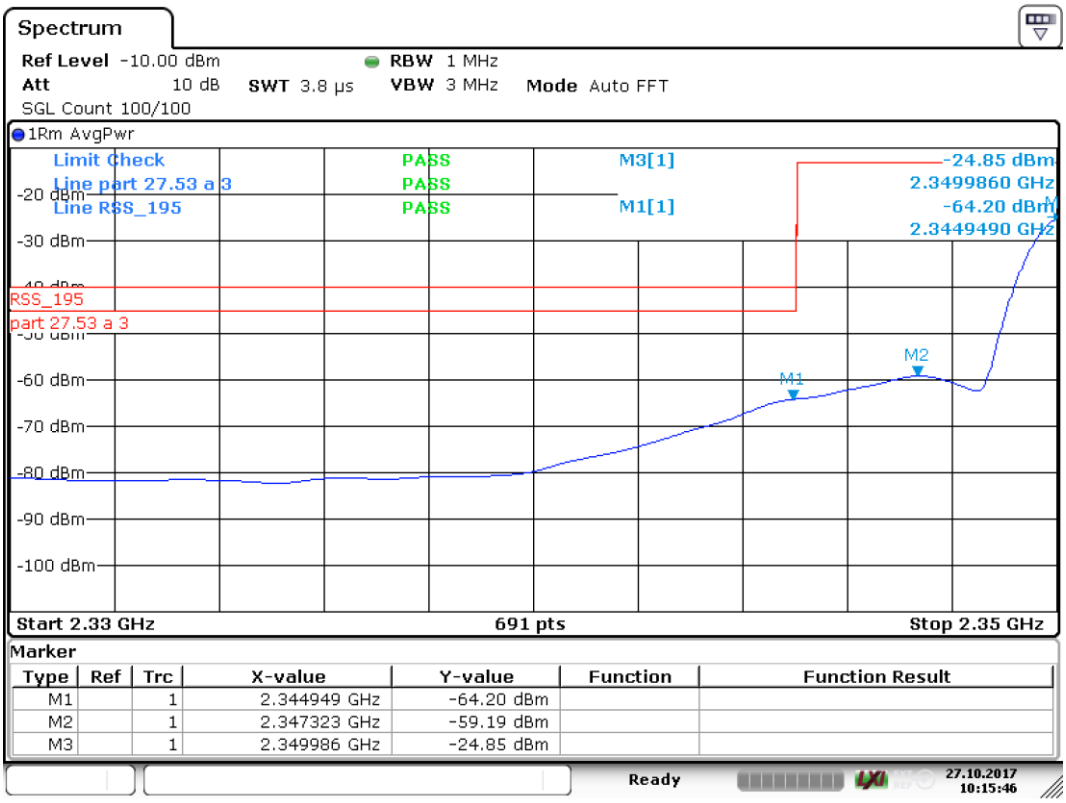
Date: 27.OCT.2017 10:14:41

9 kHz – 2330 MHz GSM low channel



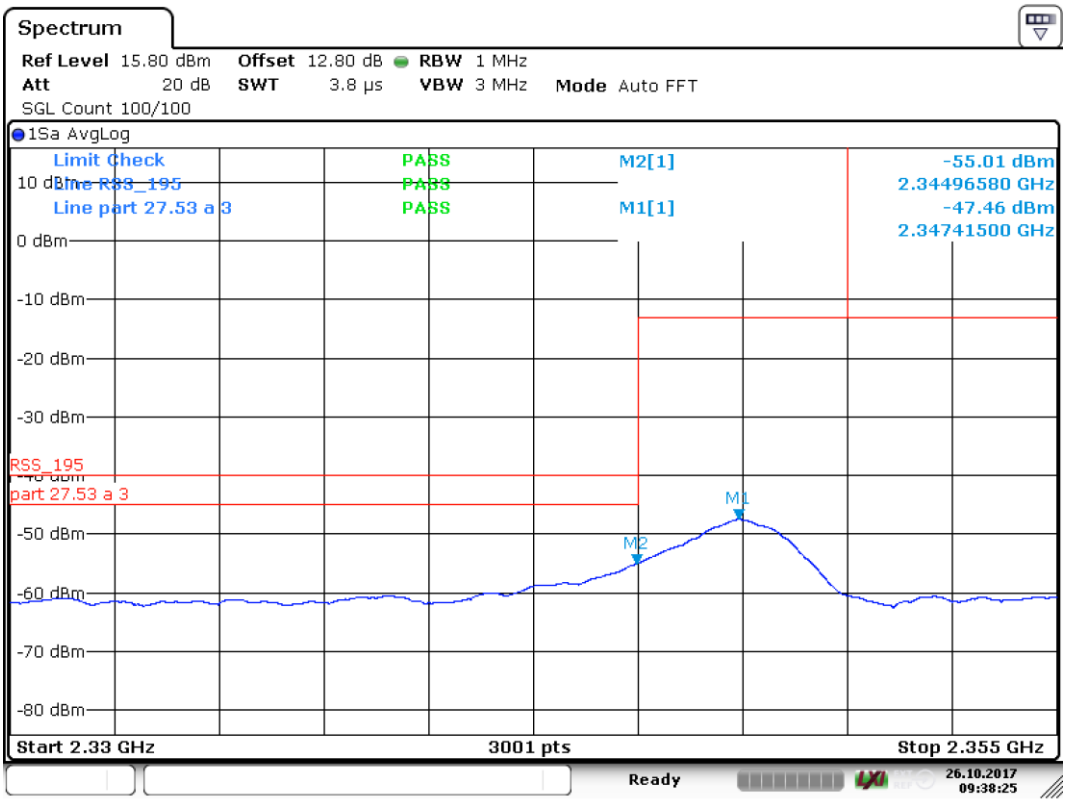
Date: 27.OCT.2017 10:21:24

9 kHz – 2330 MHz GSM high channel



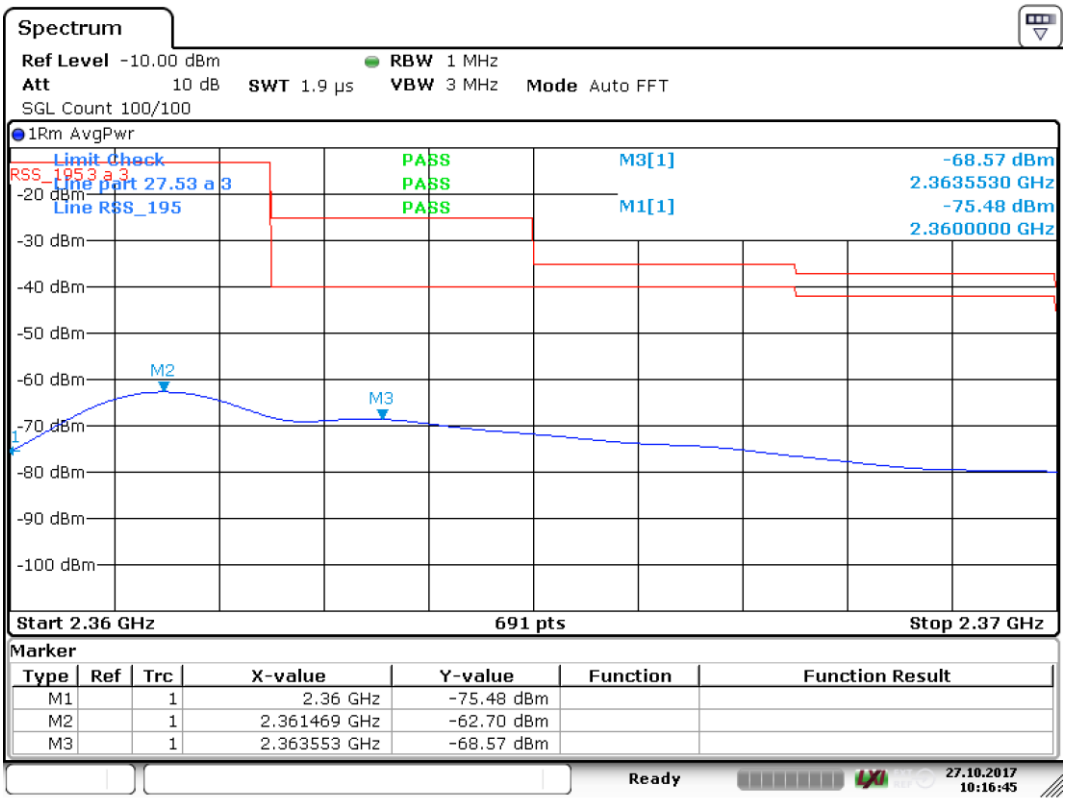
Date: 27.OCT.2017 10:15:46

2330-2350 MHz GSM low channel



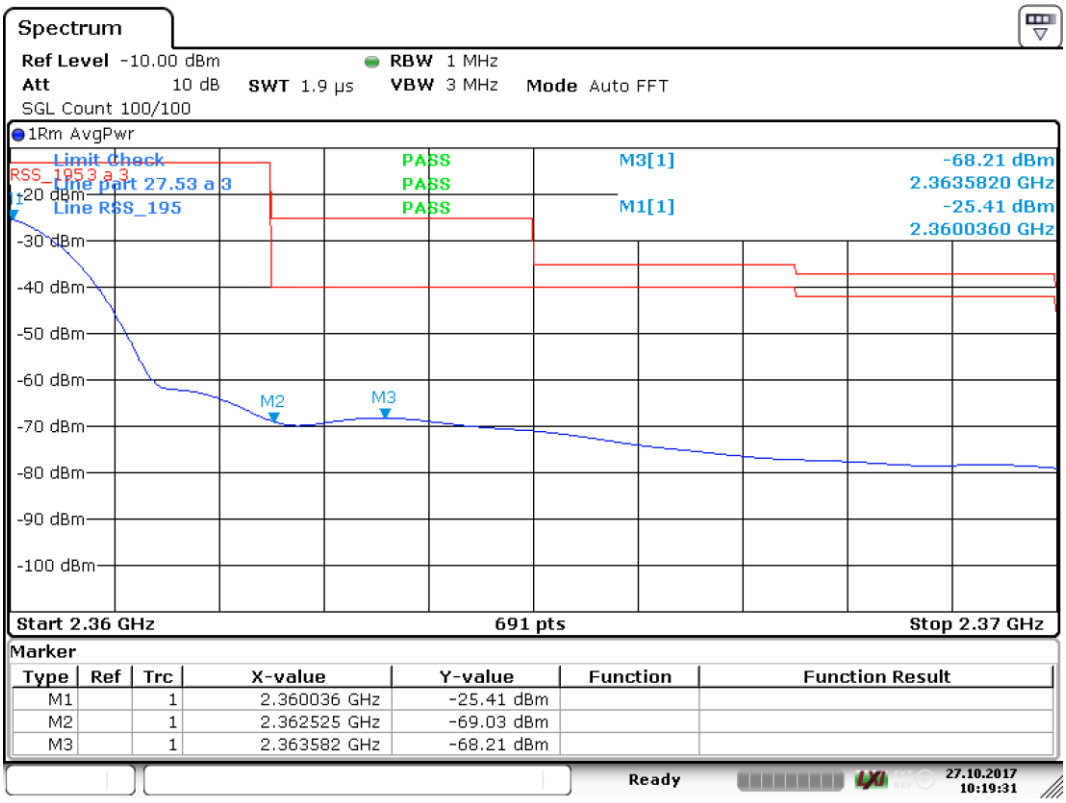
Date: 26.OCT.2017 09:38:26

2330-2350 MHz GSM high channel



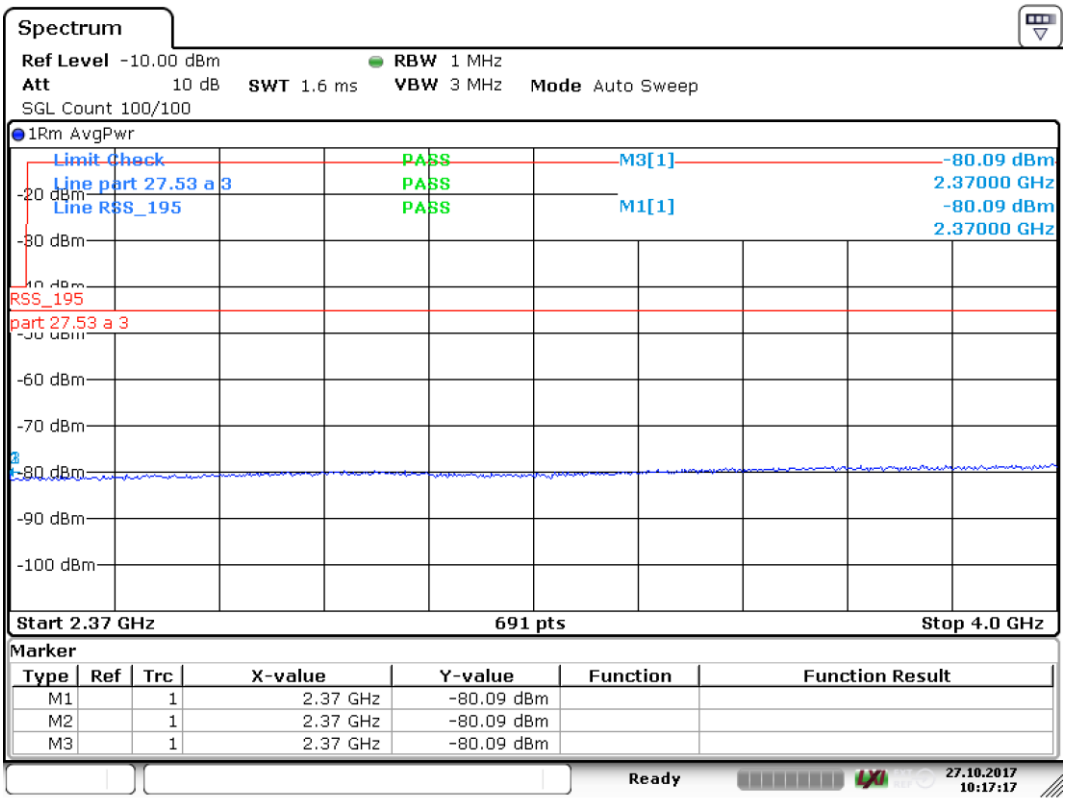
Date: 27.OCT.2017 10:16:45

2360-2370 MHz GSM low channel



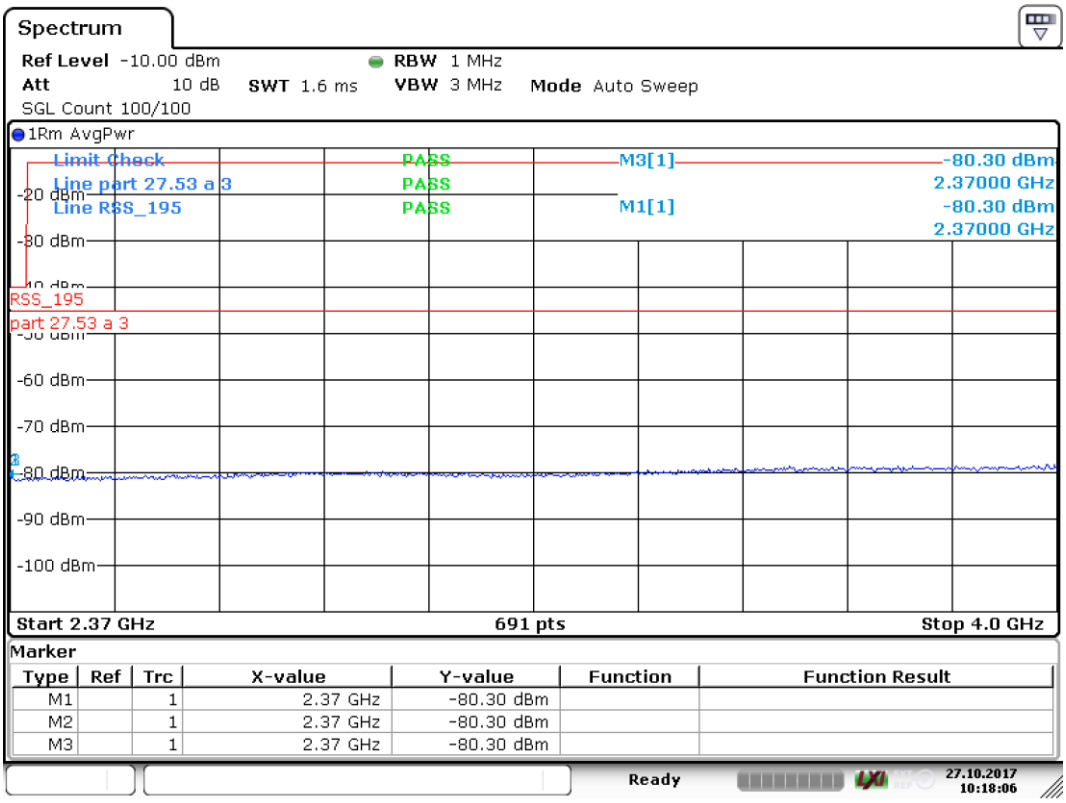
Date: 27.OCT.2017 10:19:31

2360 – 2370 MHz GSM high channel



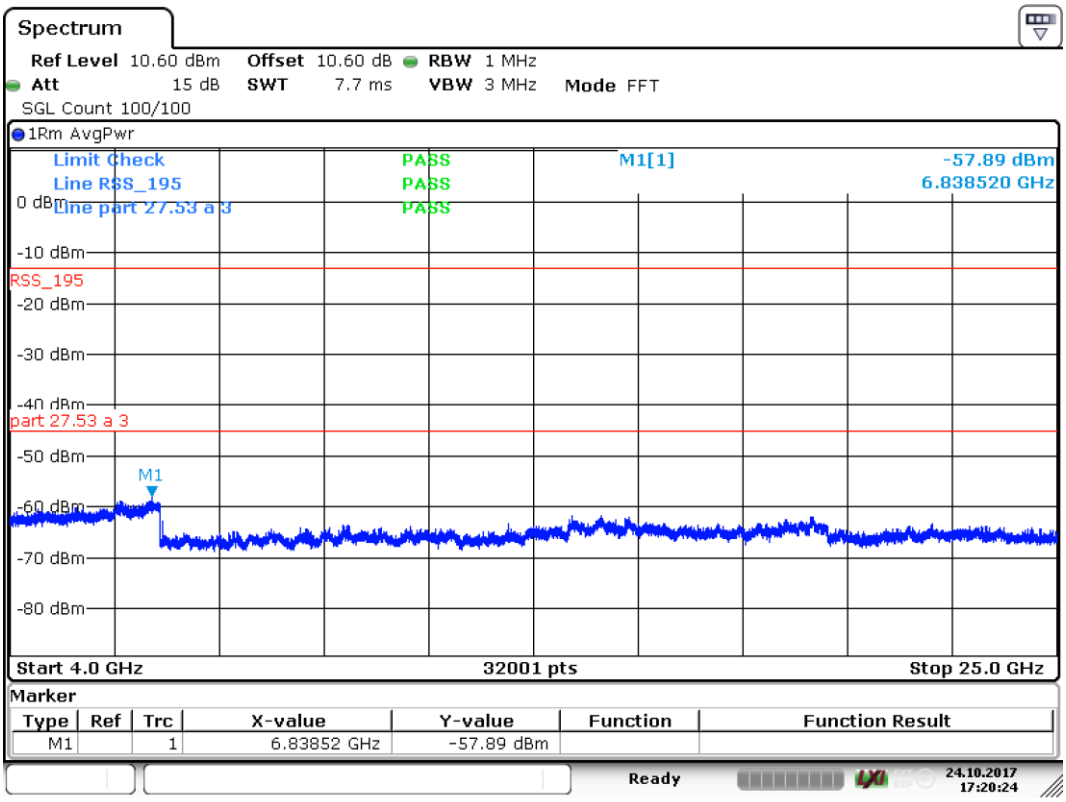
Date: 27.OCT.2017 10:17:18

2370 – 4000 MHz GSM low channel



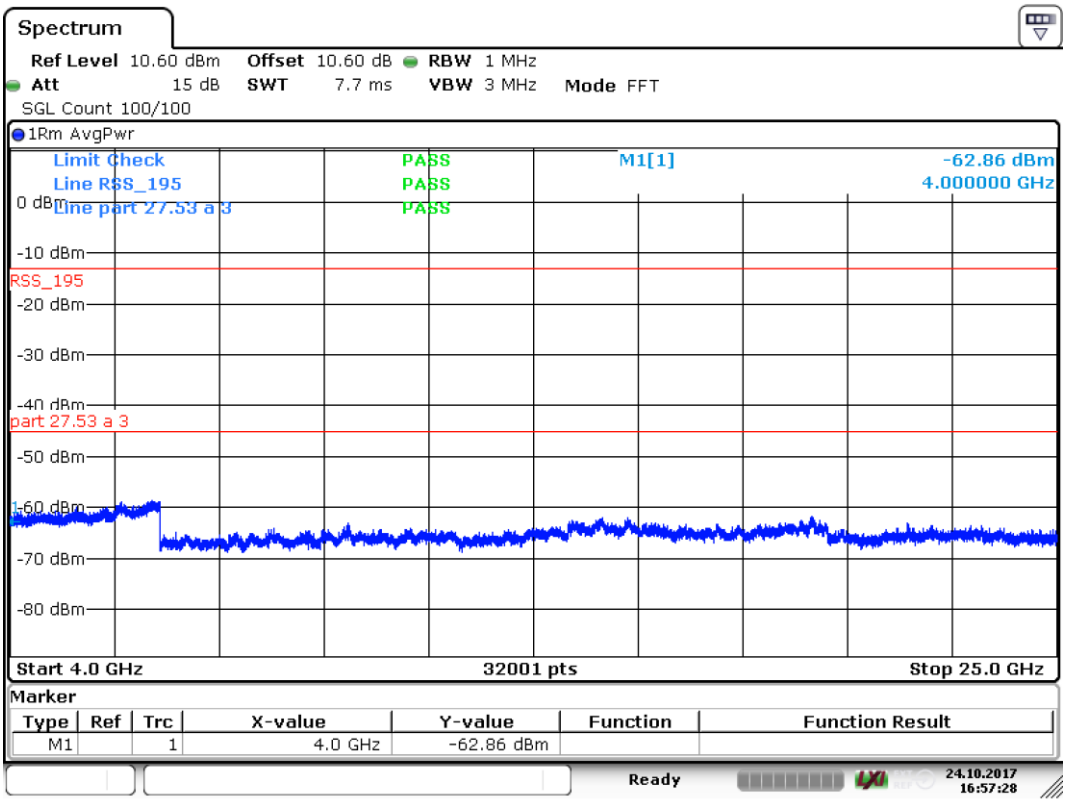
Date: 27.OCT.2017 10:18:06

2370 – 4000 MHz GSM high channel



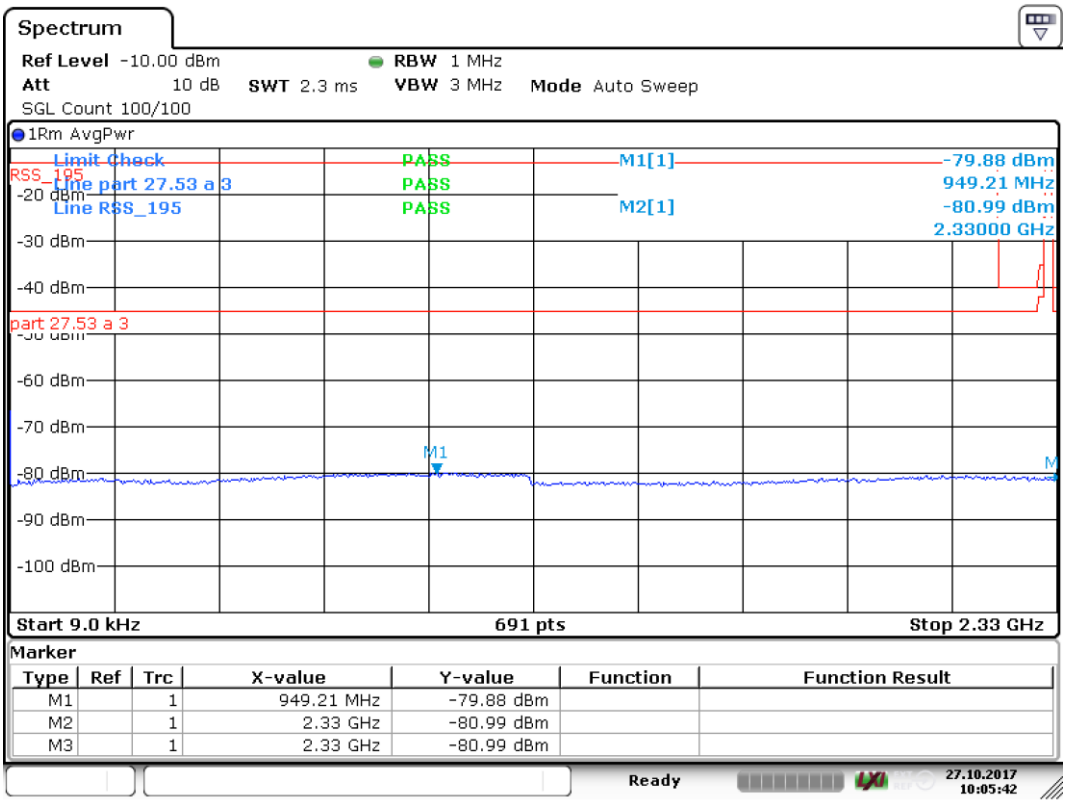
Date: 24.OCT.2017 17:20:24

4 – 25 GHz GSM low channel



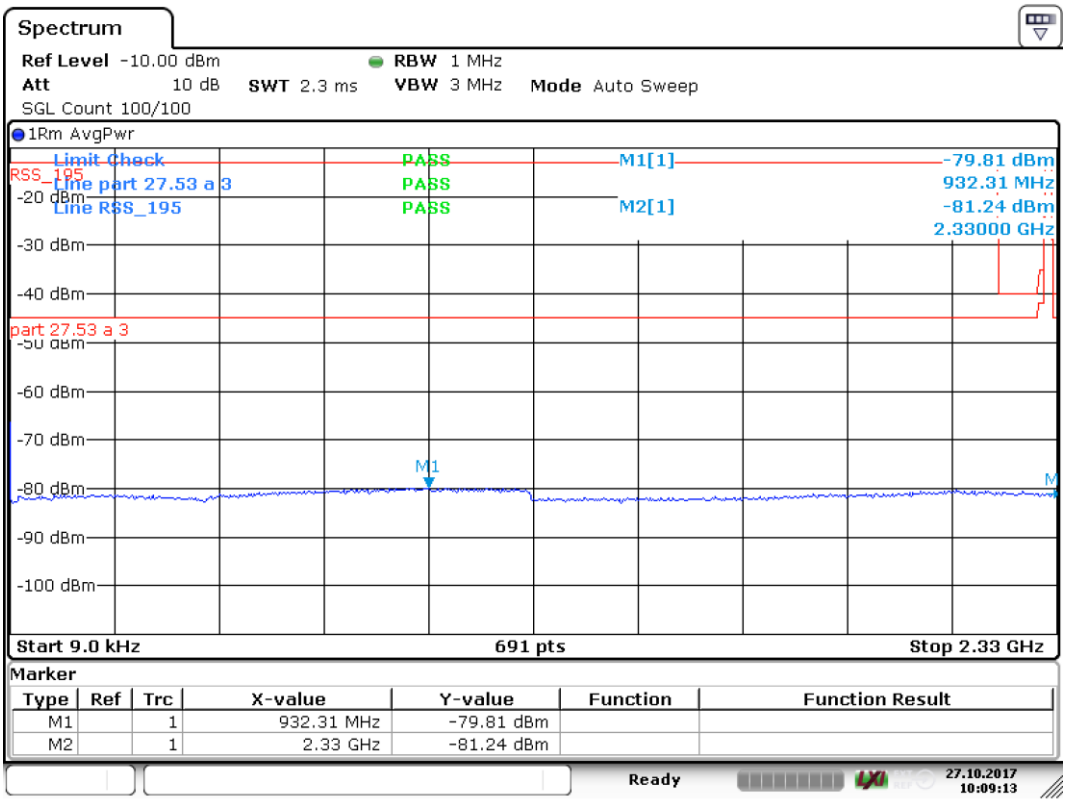
Date: 24.OCT.2017 16:57:28

4 – 25 GHz GSM high channel



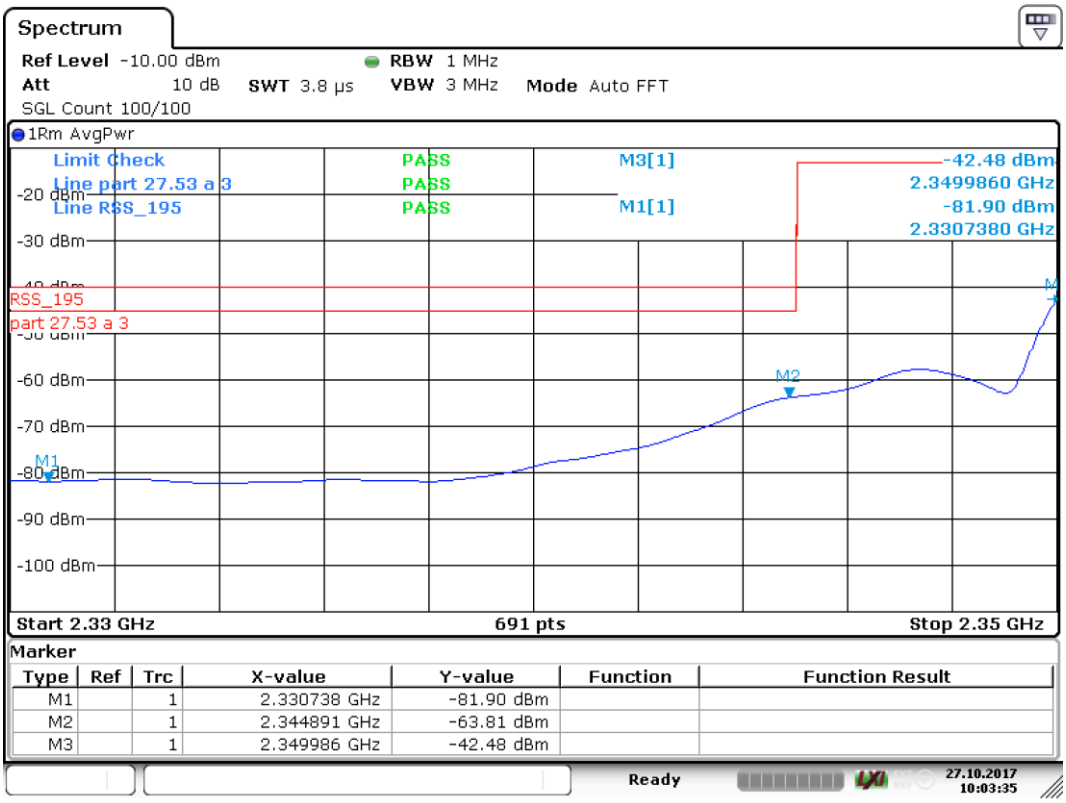
Date: 27.OCT.2017 10:05:43

AWGN low channel 9 kHz – 2330 MHz



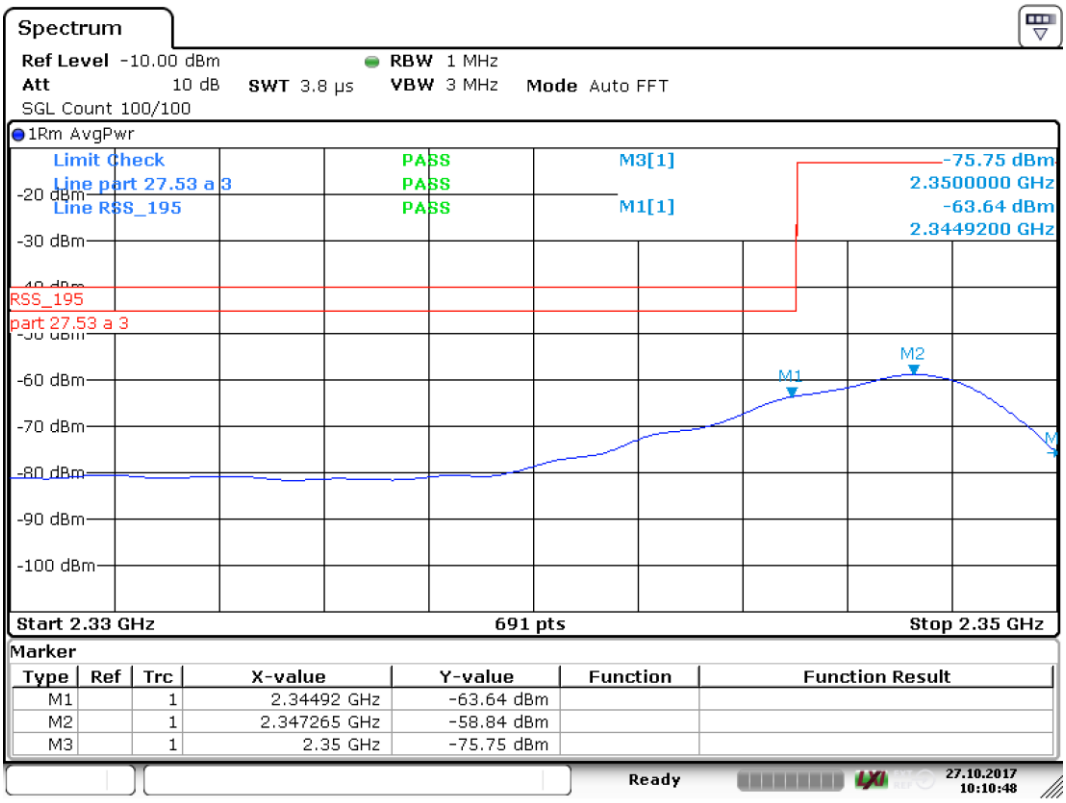
Date: 27.OCT.2017 10:09:13

AWGN high channel 9 kHz – 2330 MHz



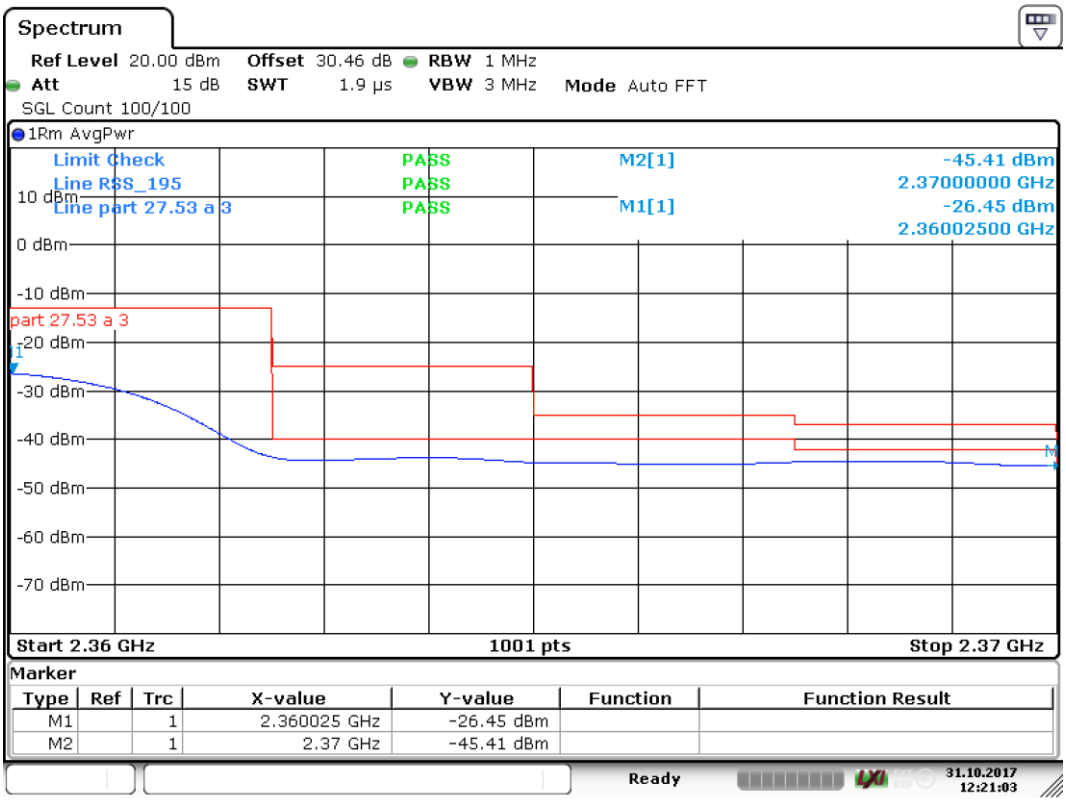
Date: 27.OCT.2017 10:03:35

AWGN low channel 2330 – 2350 MHz



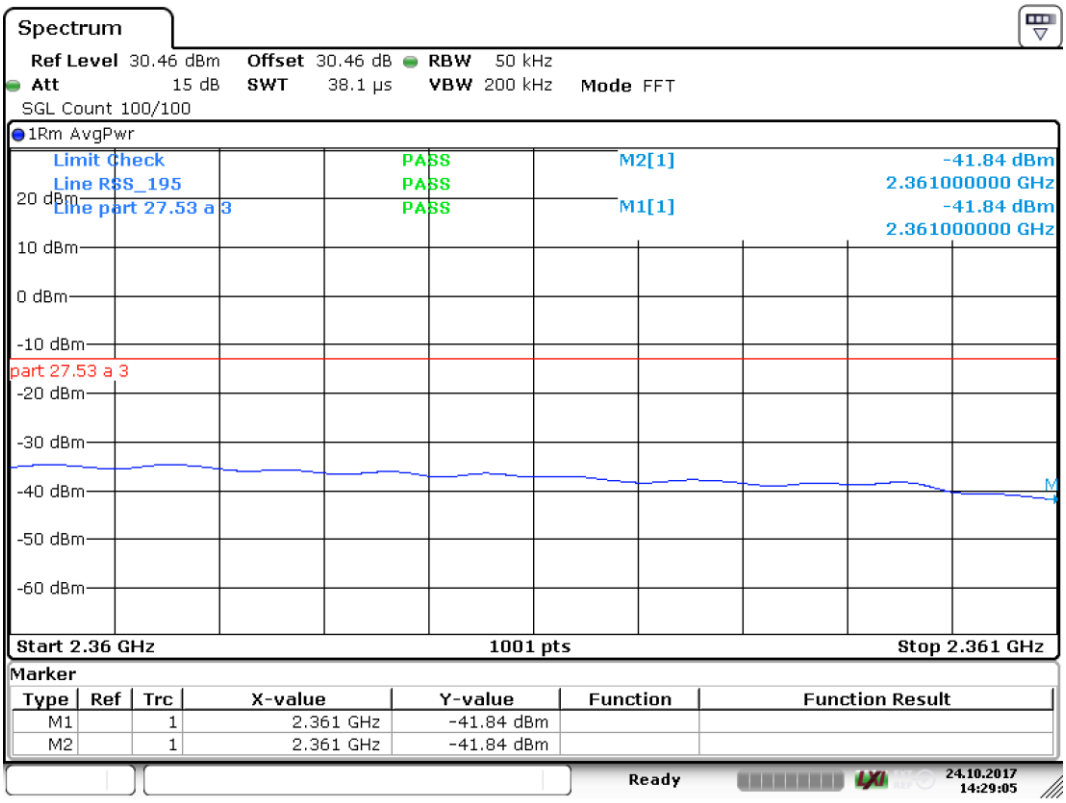
Date: 27.OCT.2017 10:10:48

AWGN high channel 2330 – 2350 MHz



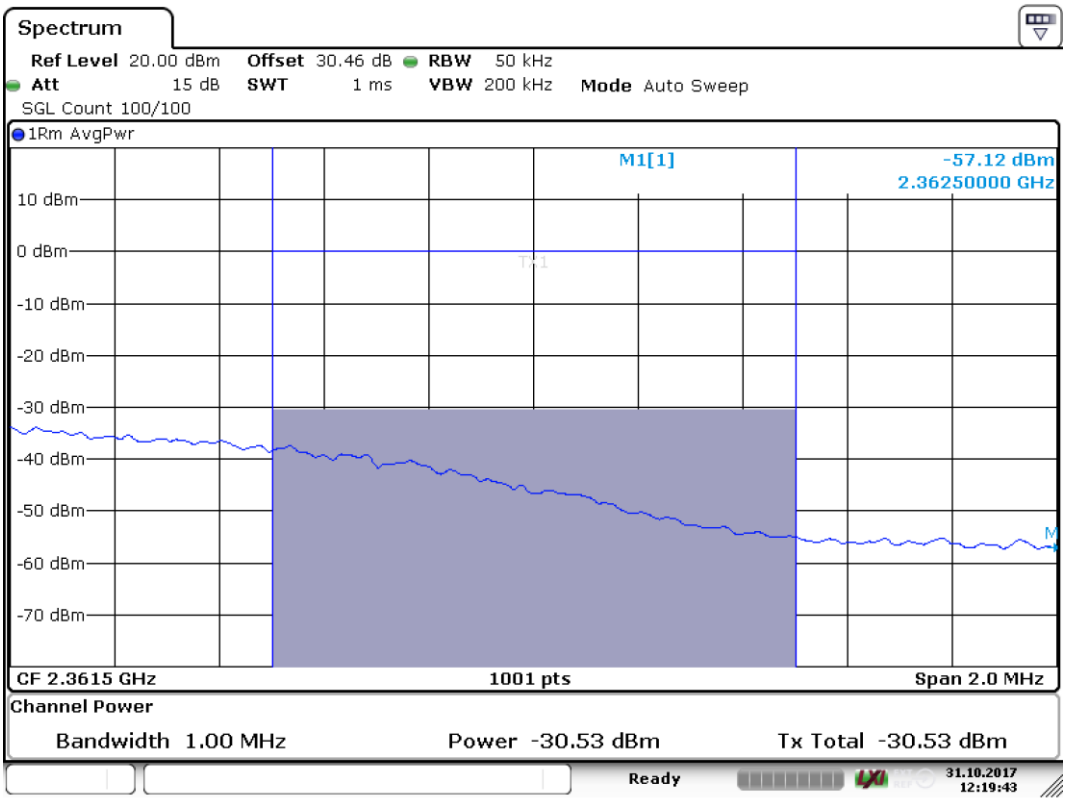
Date: 31.OCT.2017 12:21:04

AWGN low channel 2360 – 2370 MHz



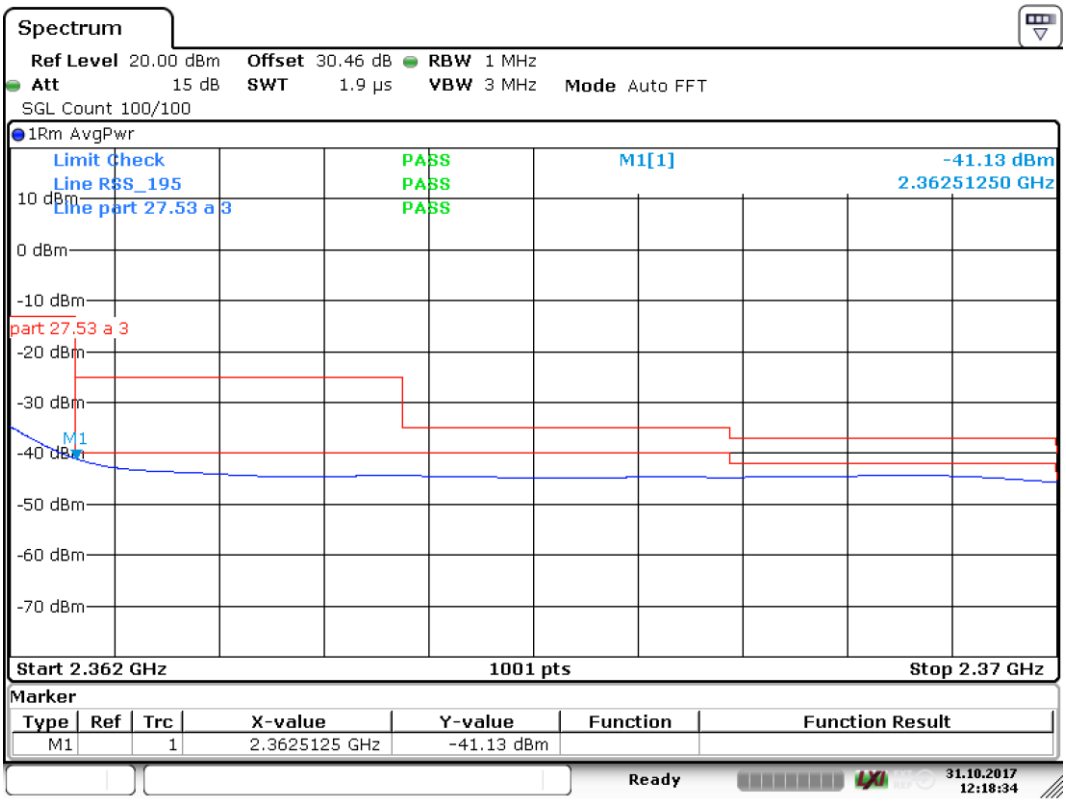
Date: 24.OCT.2017 14:29:05

AWGN high channel 2360 – 2361 MHz



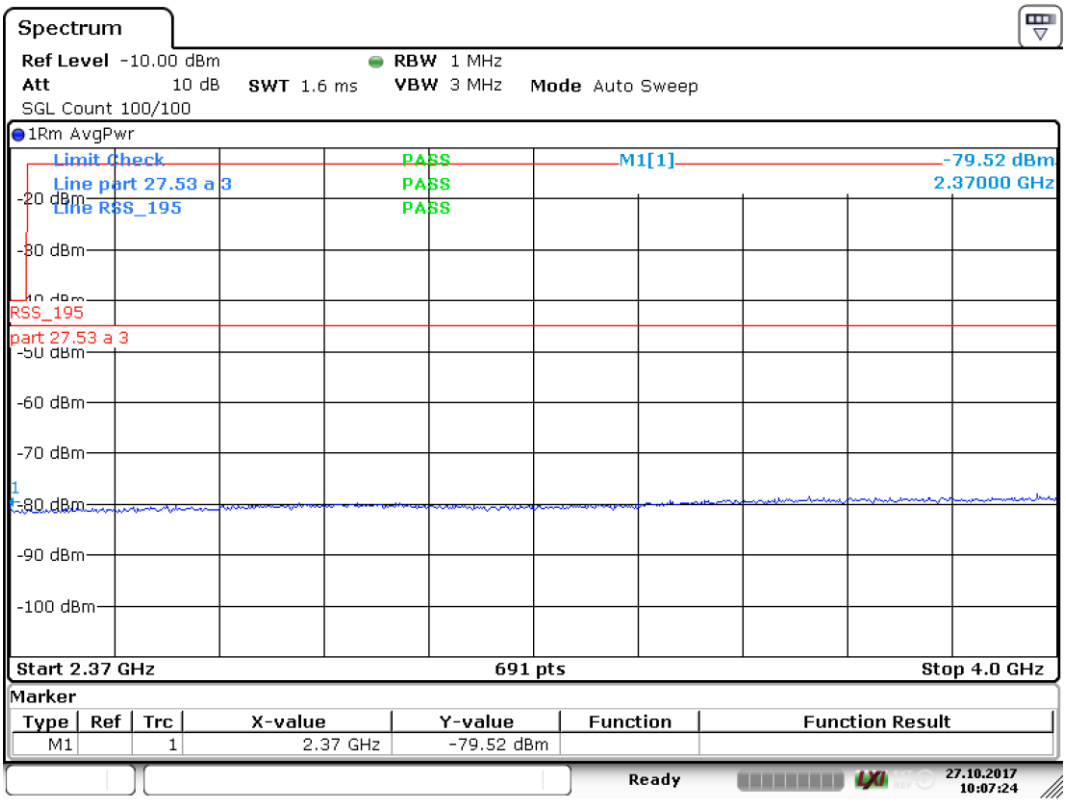
Date: 31.OCT.2017 12:19:43

AWGN high channel 2361 – 2362 MHz



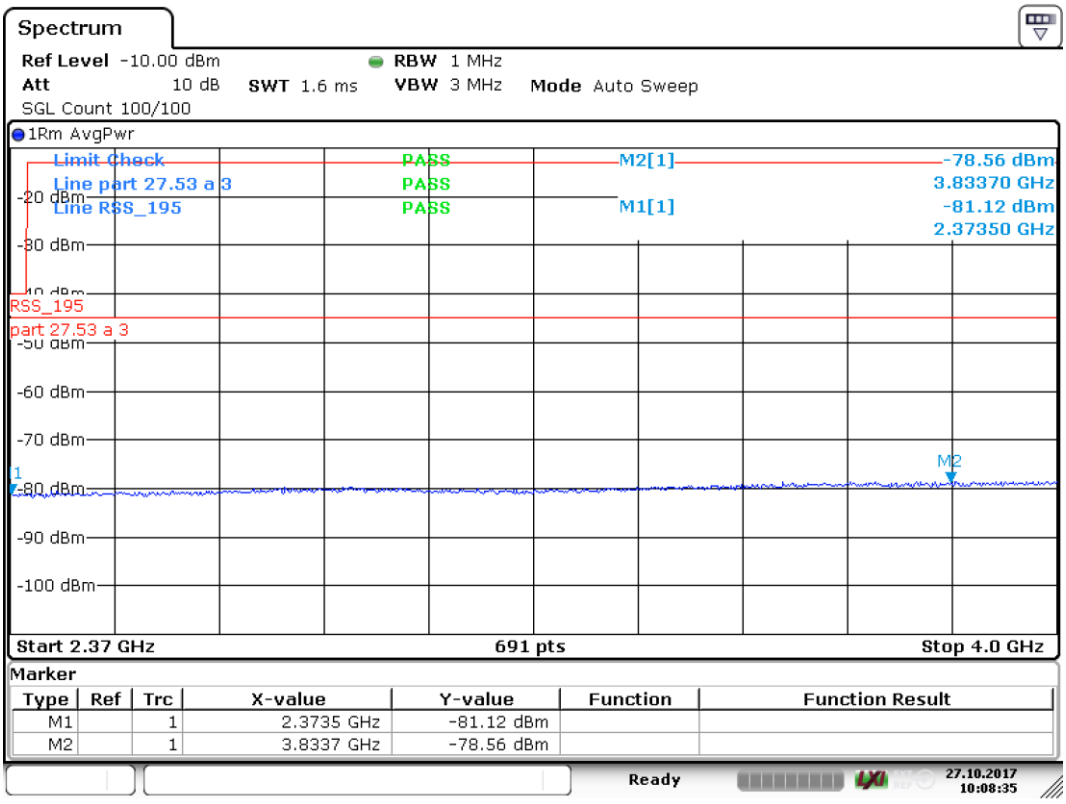
Date: 31.OCT.2017 12:18:34

AWGN high channel 2362 – 2370 MHz



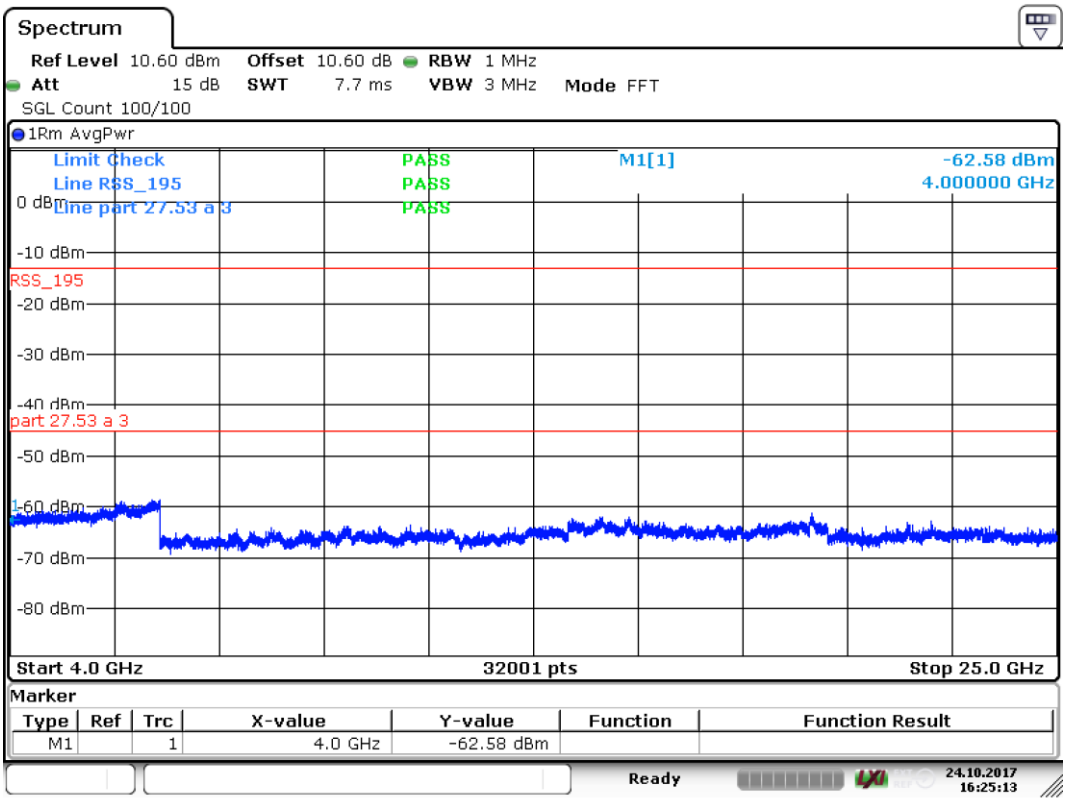
Date: 27.OCT.2017 10:07:24

AWGN low channel 2370 – 4000 MHz



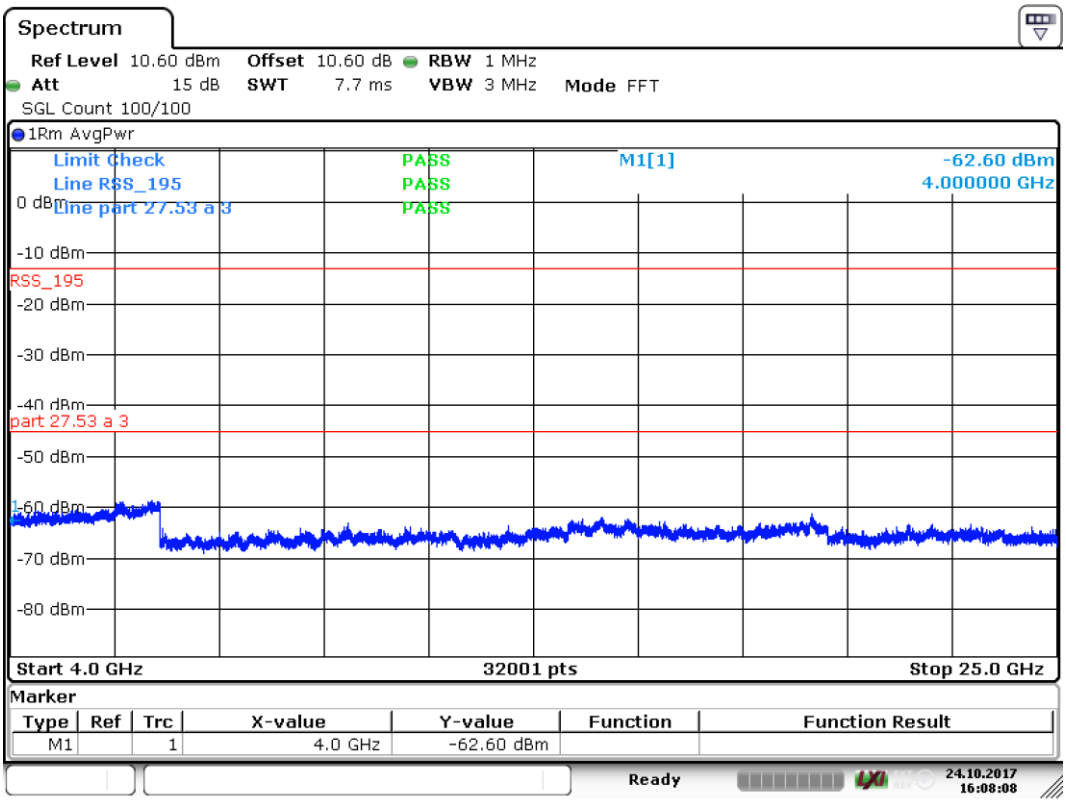
Date: 27.OCT.2017 10:08:35

AWGN high channel 2370 – 4000 MHz



Date: 24.OCT.2017 16:25:13

AWGN low channel 4 – 25 GHz



Date: 24.OCT.2017 16:08:08

AWGN high channel 4 – 25 GHz

5.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2018
Rf-attenuator	Narda	776B-10	8337	7/2018
Rf-attenuator	Huber Suhner	5920_N-50-010/199_N	32697	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39076	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39077	7/2018
Rf cable	Huber Suhner	Sucoflex 104PE	39079	7/2018
Band reject filter	Wainwright instruments			
Signal generator	Rohde & Schwarz	SMIQ03B	12792	7/2018
Signal generator	Rohde & Schwarz	SMBV100	32593	7/2018

6 RADIATED SPURIOUS EMISSION

Date of test:	2017-03-07	Test location:	Björk hallen
EUT Serial:	99992	Ambient temp.	21ºC
Tested by:	MTV	Relative humidity	32 %
Test result:	Pass	Margin:	> 20 dB

6.1 Test set-up

The test method is in accordance with ANSI C63.26 and ANSI-TIA-603-D-2010.
Both receiver and transmitter are active during the tests.
The EUT was placed on an insulating support above the turntable which is part of the reference ground plane.

Overview sweeps were performed with the measurement receiver in max-hold mode and the peak detector activated. Above 1 GHz both peak and average detector is activated.

Signal generator was connected to the FOI unit which converted rf signal to optical signal. The optical signal was then fed via fibre to the EUT.
The EUT's output port was terminated to the 50 Ω terminator.

A PC was connected to FOI via Ethernet hub. The PC was then used to control the EUT.

6.2 Test conditions

Test set-up: **30 MHz to 1000 MHz**
Test receiver set-up:
Preview test: Peak, RBW 120 kHz, VBW 1 MHz
Final test: Quasi-Peak, RBW 120 kHz, VBW 1 MHz
Measuring distance: 3 m
EUT height above ground plane: 0.8 m
Measuring angle: 0 – 359□
Antenna
Height above ground plane: 1 – 4 m
Polarisation: Vertical and Horizontal
Type: Bilog

Test set-up: **1 GHz – 22 GHz**
Test receiver set-up:
Preview test: Peak, RBW 1 MHz, VBW 3 MHz
Average, RBW 1 MHz, VBW 3 MHz
Final test: Average, RBW 1 MHz, VBW 3 MHz
Peak, RBW 1 MHz, VBW 3 MHz
Measuring distance: 3 m
EUT height above ground plane: 1.5 m
Measuring angle: 0 – 359□
Antenna
Height above ground plane: 1 – 4 m
Polarisation: Vertical and Horizontal
Type: Horn
Antenna tilt: Activated

6.3 Requirement

§27.53 a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz

RSS-195 clauses 4.2 and 5.6.1

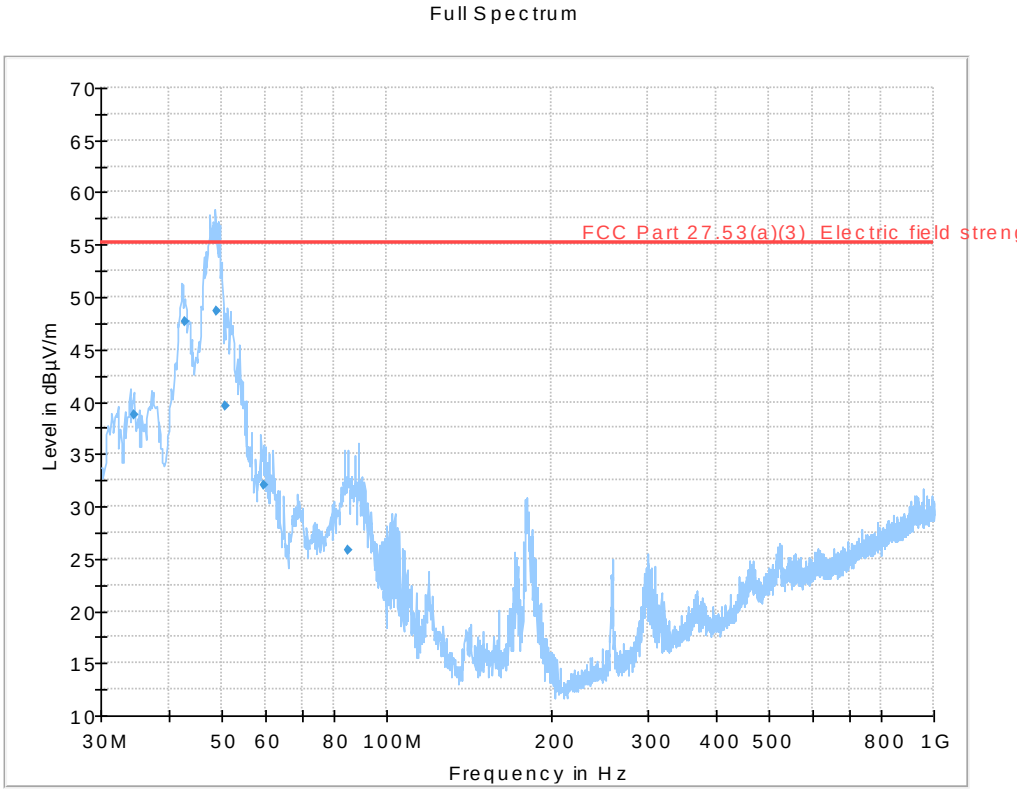
The power of any emission outside the frequency range(s) in which the equipment operates shall be attenuated below the transmitter power, P(dBW), by the amount indicated in Table below, where p is the transmitter output power measured in watts.

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	$43 + 10 \log_{10}(p)$

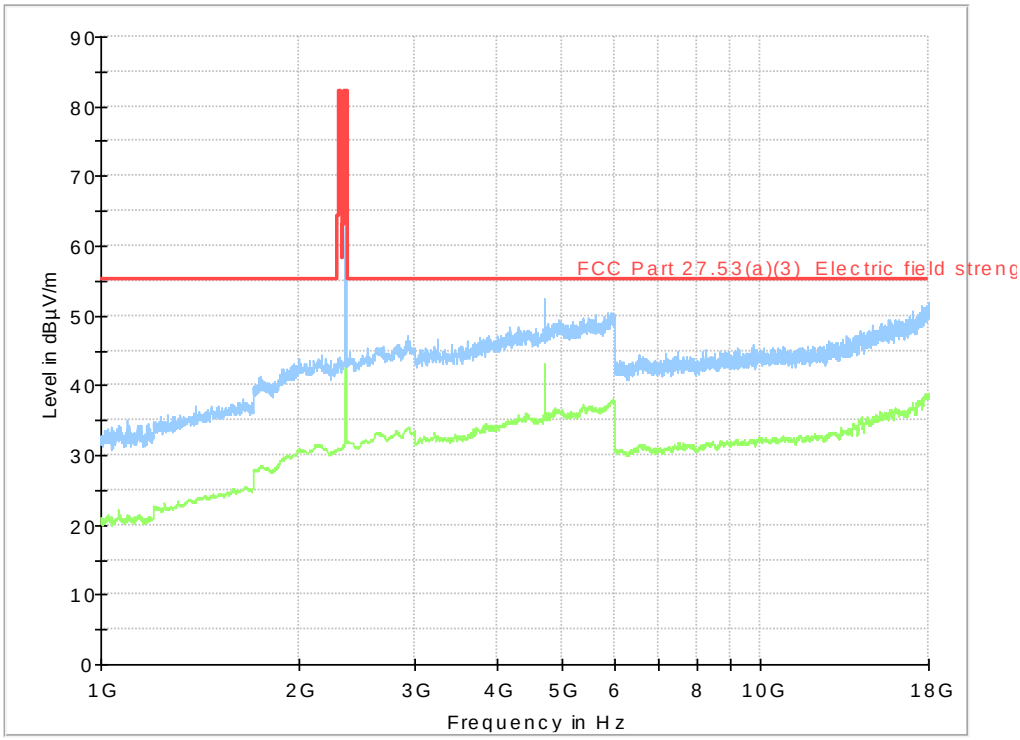
The frequency range to be inspected is up to the tenth harmonics of the highest fundamental frequency according to 47 CFR 2.1057 and RSS-Gen Section 6.13.
The field strength limit is calculated using the plane wave relation.
$GP/4\pi R^2 = E^2 / 120\pi$

G: antenna gain
P: power (W)
R: measurement distance (m)

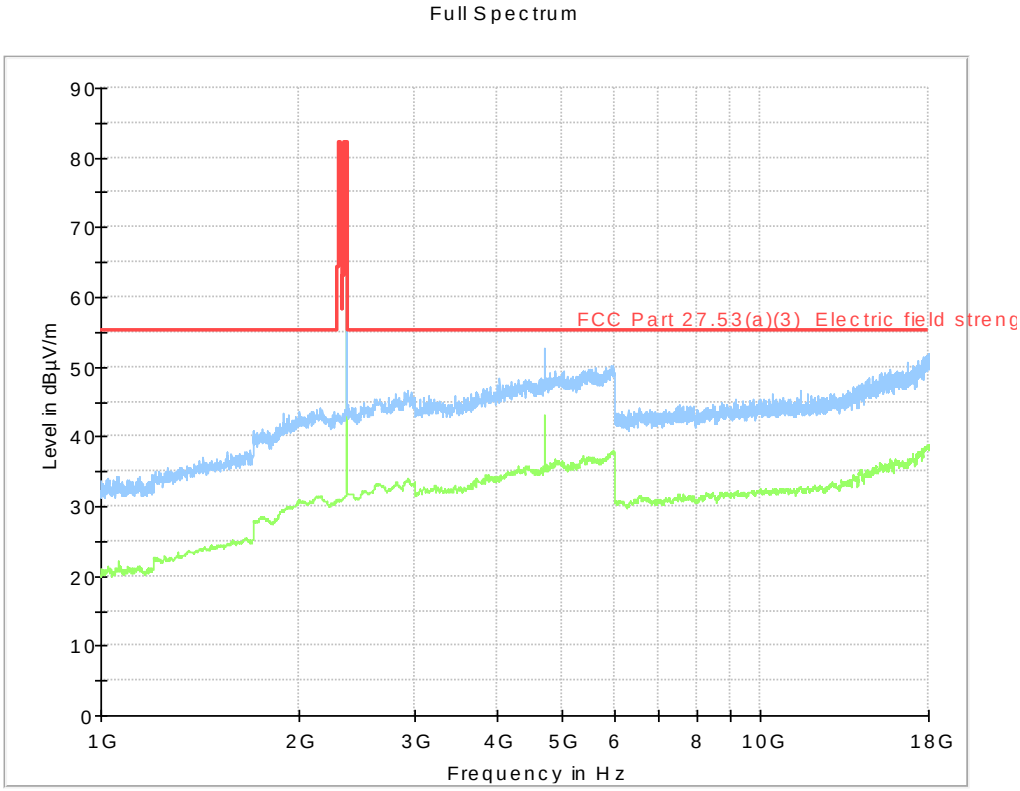
6.4 Test results



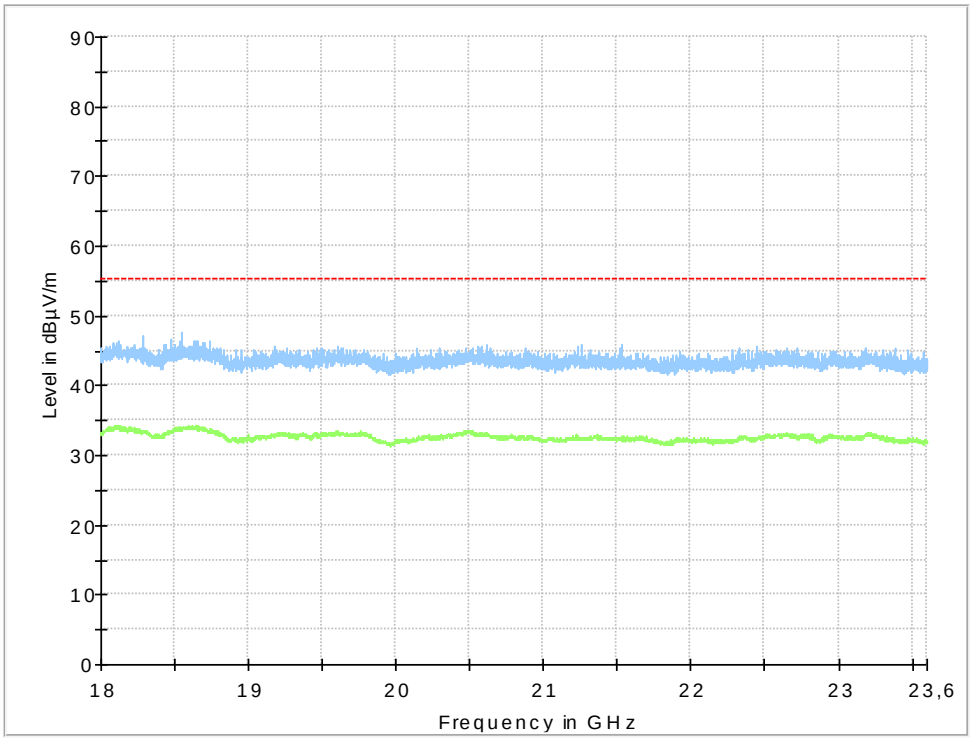
30 MHz – 1000 MHz



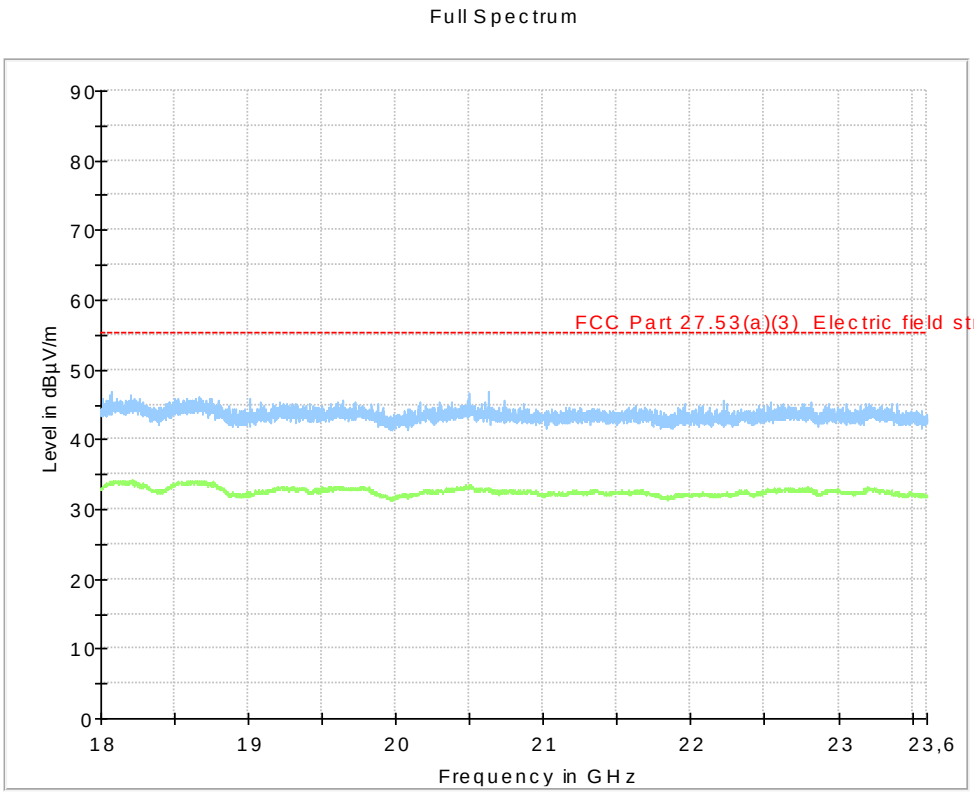
1-18 GHz low channel



1-18 GHz high channel



18-22 GHz low channel



18-22 GHz high channel

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarization
4705	53.8	55.5	1.7	H
4715	53.4	55.5	2.1	V

6.5 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement receiver	Rohde & Schwarz	ESI 26	32291	7/2018
Measurement receiver	Rohde & Schwarz	ESU 40	13178	7/2018
UltraLog antenna	Rohde & Schwarz	HL562	30711	12/2018
Horn antenna	Rohde & Schwarz	HF907	32307	7/2018
Pre amplifier	Rohde & Schwarz	TS-pre1	32306	7/2018
Horn antenna + preamp	Bonn	BLMA 1826-5A	31247	1/2020
Rf cable	Megaphase	GC12-K1K1-315	39127	7/2018

7 FREQUENCY STABILITY

Date of test:	2017-03-29	Test location:	EMC center
EUT Serial:	99995	Ambient temp.	20ºC
Tested by:	MTV	Relative humidity	33%
Test result:	Pass	Margin:	NA

7.1 Requirement

CFR 47 §27.54 and RSS-195 clause 6.4 The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

7.2 Test set-up and test procedure

The frequency stability shall be measured with variation of ambient temperature as follows:(1) From −30° to + 50° centigrade at intervals of not more than 10° centigrade through the range.

The frequency stability shall be measured with variation of primary supply voltage as follows:
Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment

Signal generator generating a CW signal was connected to the FOI unit which converted rf signal to optical signal. The optical signal was then fed via fibre to the EUT.
The EUT's output port was connected to frequency counter via rf cables and 30 dB attenuator.

7.3 Test results

Temperature (ºC)	Voltage	Test signal frequency (Hz)	Output signal frequency (Hz)	Deviation (Hz)	Result
+50	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass
+40	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass
+30	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass
+10	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass
0	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass
-10	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass
-20	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass
-30	120V / 60 Hz	2355 000 000	2355 000 000	0	Pass

Temperature (ºC)	Voltage	Test signal frequency (Hz)	Output signal frequency (Hz)	Deviation (Hz)	Result
+20	120V / 60 Hz	2355 000 000	2355 000 000	0	
+20	100V / 60 Hz	2355 000 000	2355 000 000	0	Pass
+20	276V / 60 Hz	2355 000 000	2355 000 000	0	Pass

7.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Frequency counter	Philips	PM6685R/071	5616	7/2018

5. MEASUREMENT UNCERTAINTY

Measurement uncertainty for radiated disturbance

Uncertainty for the frequency range 0.09 to 30 MHz at 10 m	± 3.2 dB
Uncertainty for the frequency range 30 to 1000 MHz at 3 m	± 5.1 dB
Uncertainty for the frequency range 30 to 1000 MHz at 10 m	± 5.0 dB
Uncertainty for the frequency range 1.0 to 18 GHz at 3 m	± 4.7 dB
Uncertainty for the frequency range 18 to 26 GHz at 3 m	± 4.8 dB
Uncertainty for the frequency range 26 to 40 GHz at 3 m	± 5.7 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2:2011.
The measurement uncertainty is given with a confidence of 95 %.

Measurement uncertainty for antenna port measurements

Uncertainty for conducted spurious emission	± 2,5 dB
Uncertainty for carrier power	± 1,3 dB

Frequency error

Frequency to be measured [MHz]	Expanded (k=1,96) Measurement Uncertainty [Hz]	Expanded (k=1,96) Measurement Uncertainty [%]
25	0,34	$1,36 \times 10^{-8}$
433	3,40	$7,90 \times 10^{-9}$
868	3,40	$3,91 \times 10^{-9}$
1900	33,95	$1,79 \times 10^{-8}$
2483,5	33,96	$1,37 \times 10^{-8}$
5850	34,00	$5,81 \times 10^{-9}$

Measurement uncertainty is calculated in accordance with ETSI TS 100028.
The measurement uncertainty is given with a confidence of 95 %.

6. TEST SET UP AND EUT PHOTOS

EUT photos are in separate document 1718046STO-001 Annex 1.
Test set up photos are in separate document 1718046STO-001 Annex 2.