RADIO TEST REPORT

No. 1713846STO-003, Ed. 2

RF Performance

EQUIPMENT UNDER TEST

Equipment:	Remote head
Type/Model:	DDU-1900
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 24 Subpart E

RSS-131 Issue 3, RSS-133 Issue 6,

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

For details, see clause 2 – 4.

Date of issue: 2018-05-22

Tested by: Matti Virkki

Approved by: Stefan Andersson

Revision History

Edition	Date	Description	Changes
1	2018-01-05	First release	
2	**2018-05-22**	**2na release**	**Change of model name and typing error correction**

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:	DDU-1900	
Brand name:	Deltanode	
Serial number:	999895	
Manufacturer:	Deltanode Solutions AB	
Transmitter frequency range:	1930 – 1990 MHz	
Receiver frequency range:	1850 – 1910 MHz	
Frequency agile or hopping:	☐ Yes	☒ No
Antenna:	☐ Internal antenna	☒ External antenna
Antenna connector:	☐ None, internal antenna	☒ Yes, N
Rating RF output power:	+46 dBm rms	
Rated gain	+67 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	12:04 Multisystem MPI 1900MHz band ver. 0.0 prod. 2014W18 SN:0002-00126
PA HW-version	KS45.6 R1C 2014W18 DH00126
PA Bootloader	BF002005 0.0.0 Boot MPI 2009-11-05 16:05:55
PA Application	AF002005 0.2.2 MPI-BTI/EMP/Tek 2016-04-01 15:36:44
PA Loaded ver	AF002005 0.2.2 MPI-BTI/EMP/Tek 2016-04-01 15:36:44
Available PA upgrade	AF002005 0.2.2 MPI-BTI/EMP/Tek 2016-04-01 15:36:44
VGA Type	82:04 Multisystem VGA2 1900MHz band ver. 0.0 prod. 2016W36 SN:0004-00110
VGA HW-version	KS55.10 P1A 2016W36 BH00110
VGA Bootloader	BF002008 0.0.0 Boot VGA2 2016-04-20 14:58:25
VGA Application	AF002011 0.0.0 VGA2 2016-09-29 10:19:30
VGA Loaded ver	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 24 subpart E
RSS-131 Issue 3, RSS-133 Issue 6

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 3 and RSs-133 Issue 6 are not within Intertek Semko's accreditation scope.
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** **RSS-GEN 6.12** **RSS-131 5.2.3** **RSS-133 6.4**	**RF output power, AGC threshold, linearity and amplifier gain** The EUT complies with the limits.	**PASS**
§2.1047 **RSS-131 5.2.2** **RSS-133 6.2**	**Modulation characteristics input versus output signal comparison** The EUT complies with the limits.	**PASS**
§2.1049 **RSS-GEN 6.6** **RSS-133 5.2.1**	**Occupied bandwidth Out of band rejection** The EUT complies with the limits.	**PASS**
§2.1051 **§27.53** **RSS-GEN 6.13** **RSS-133 6.5**	**Spurious emissions, Intermodulation and band edge measurements at antenna terminals** The EUT complies with the limits.	**PASS**
§2.1053 **§27.53** **RSS-GEN 6.13** **RSS-133 6.5**	**Field strength of spurious radiation** The EUT complies with the limits.	**PASS**
§2.1055 **§27.54 KDB935210 D05 v01r01 3.7** **RSS-GEN 6.11** **RSS-131 5.2.4**	**Frequency stability** The EUT does not have input signal processing capability	**Not Applicable**

5 AGC TRESHOLD, RF OUTPUT POWER AND LINEARITY

Date of test:	2017-11-02	Test location:	EMC Center
EUT Serial:	999895	Ambient temp. ˚C	21˚C
Tested by:	MTV	Relative humidity	43 %
Test result:	Pass	Margin:	15.7 dB

5.1 Requirement

Reference: CFR 47 §2.1049, §24.232(a), KDB 935210 D05 clauses 3.2 and 3.5
RSS-131 Clauses 5.2.3 and 6.2, RSS-133 clause 6.5

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 signal analyser via rf cables and a directional coupler.
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 67 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 as a peak to average ratio.

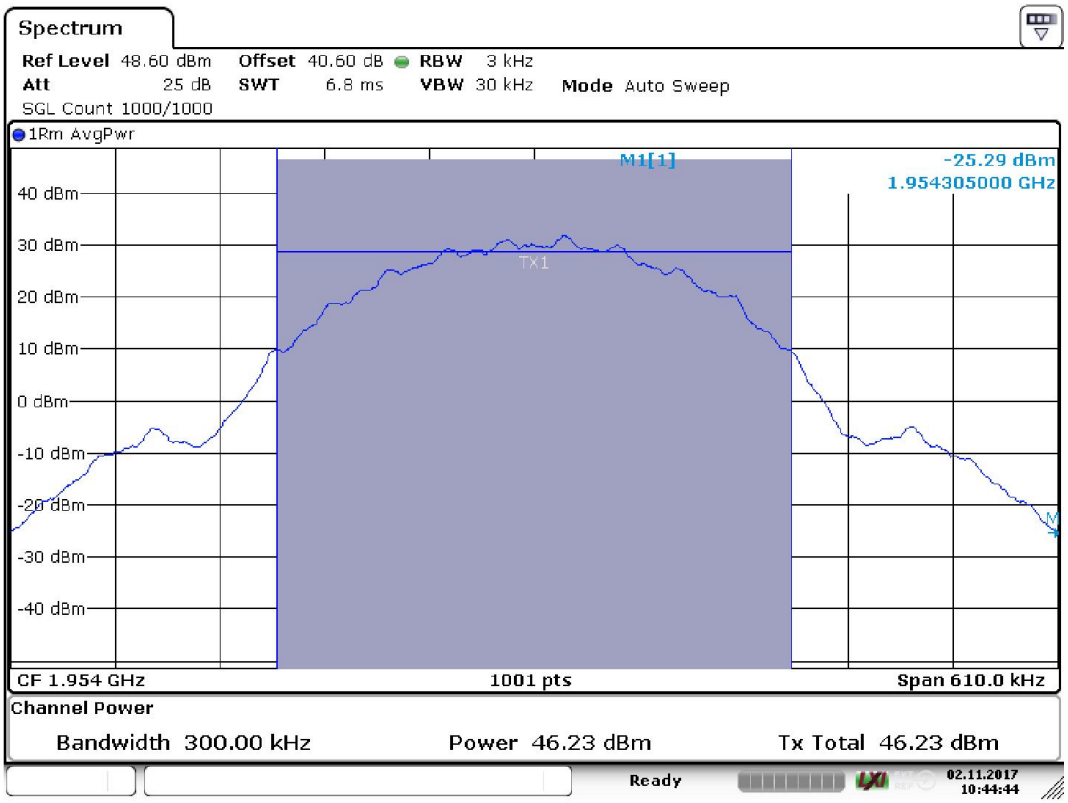
5.3 Test data

AWS GSM

Frequency MHz	Average power dBm	Automatic level control	Limit EIRP dBm / MHz	Peak to avg ratio dB	Peak to avg ratio limit dB
1954	46.2	off	62	0.6	13
1954	46.3	on	62	0.5	13

AWS WCDMA

Frequency MHz	Average power dBm	Automatic level control	Limit EIRP dBm / MHz	Peak to avg ratio dB	Peak to avg ratio limit dB
1954	45.9	off	62	6.9	13
1954	46.0	on	62	6.8	13



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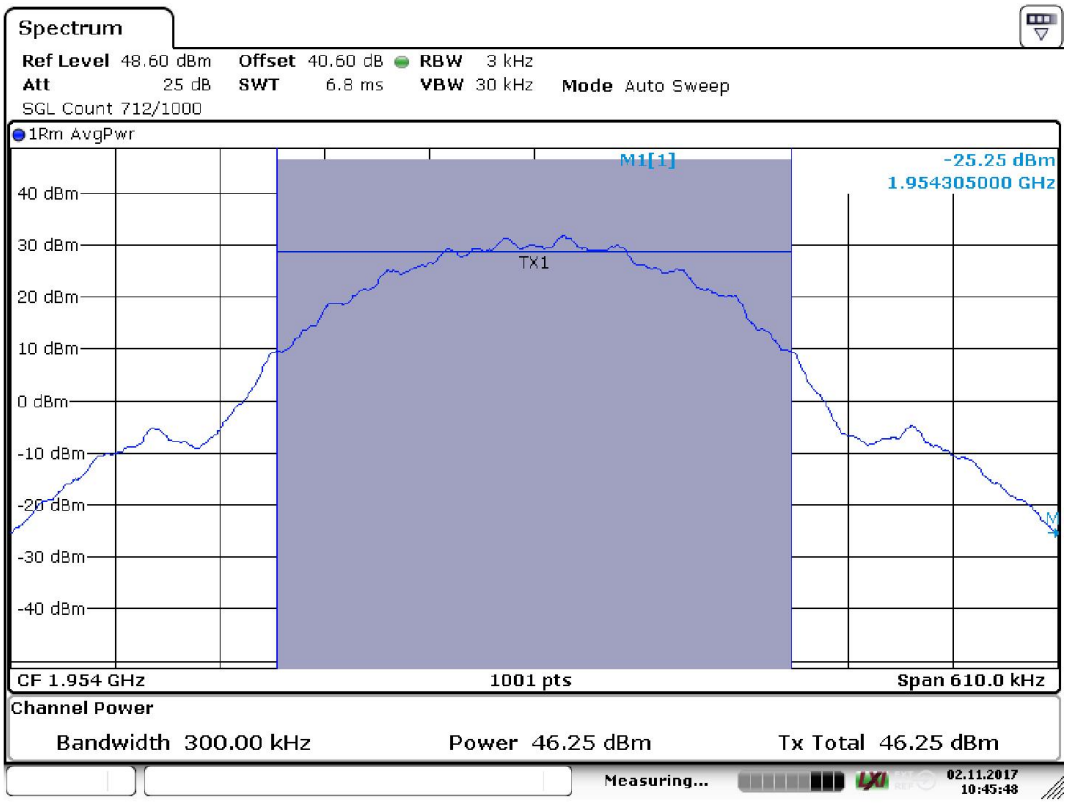
GSM AGC off



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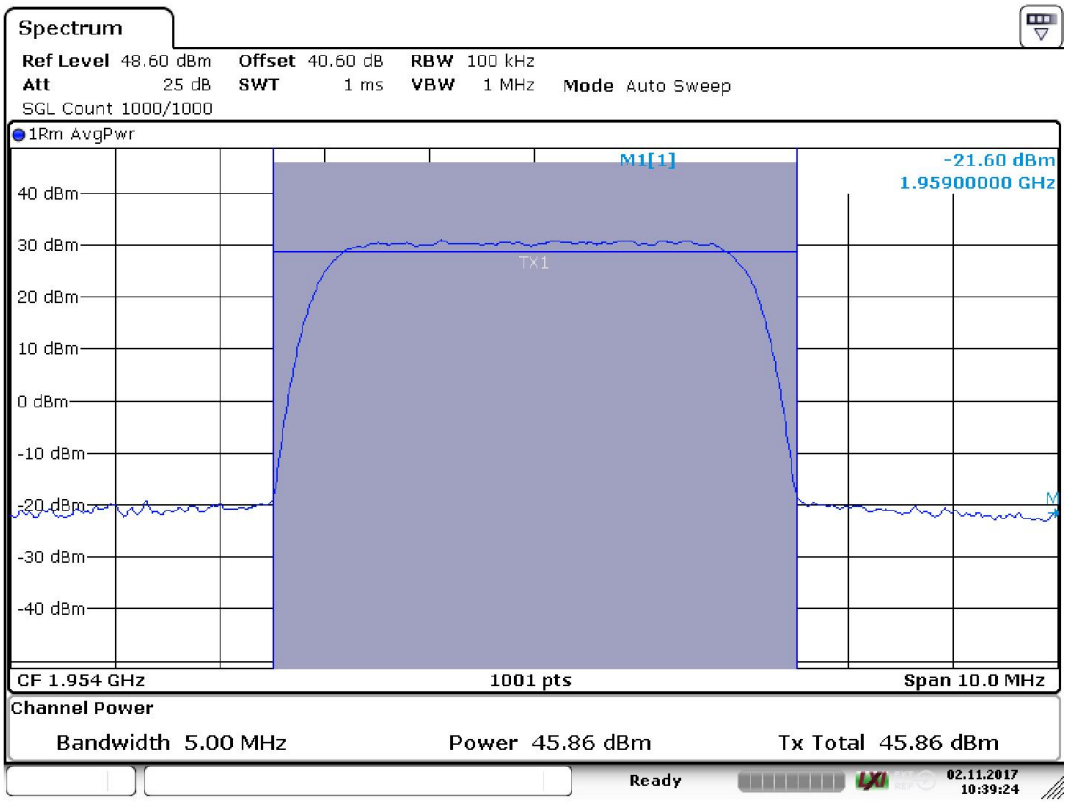

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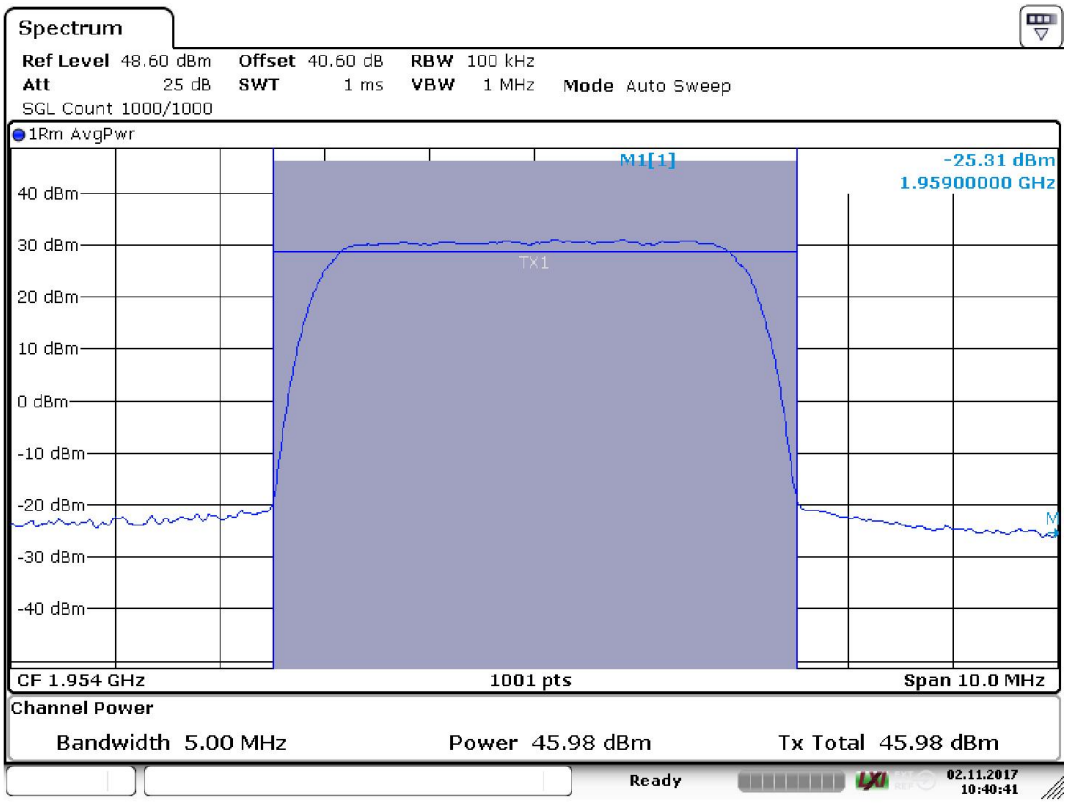
AWGN AGC off



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AWGN AGC on

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
Signal generator	Rohde & Schwarz	SMIQ03B	12792	7/2018
Signal generator	Rohde & Schwarz	SMBV100	32593	7/2018

6 OCCUPIED BANDWIDTH INPUT VS OUTPUT COMPARISON

Date of test:	2017-12-07	Test location:	EMC Center
EUT Serial:	999895	Ambient temp. ˚C	21 ˚C
Tested by:	MTV	Relative humidity	37 %
Test result:	Pass	Margin:	--

6.1 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 26 dB bandwidth of the output signal shall be less than 5% of the input signal spectrum.

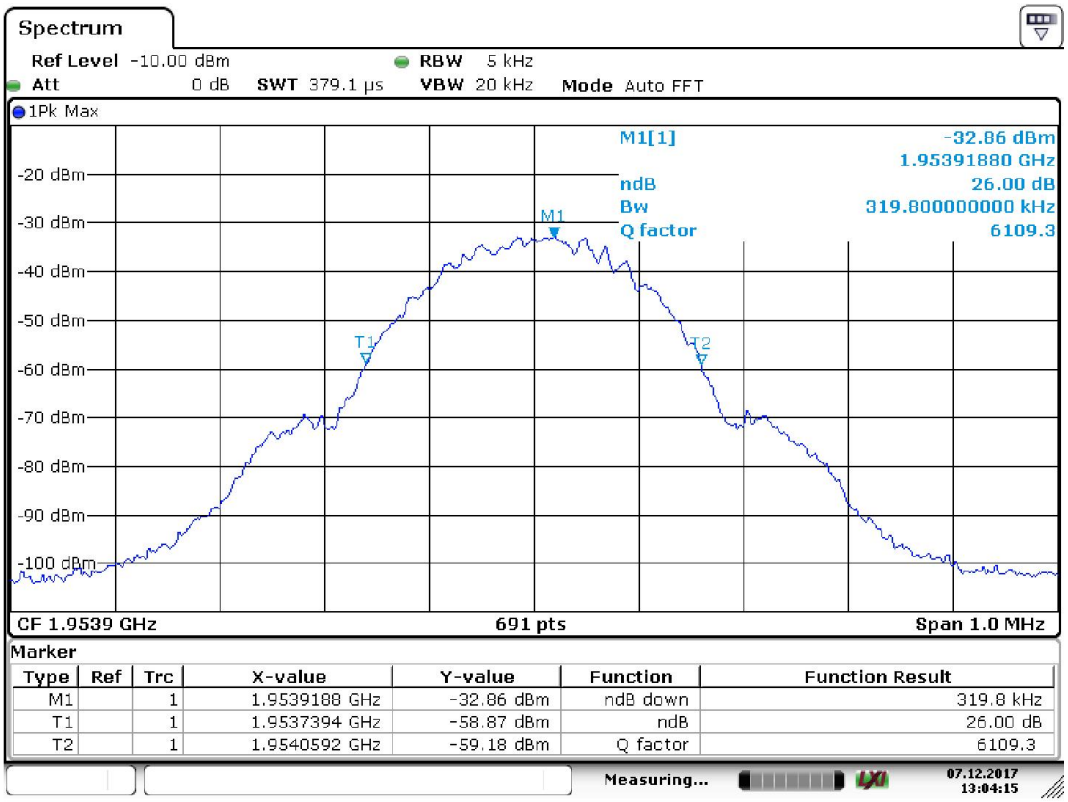
6.2 Test set-up

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 a directional coupler.
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 67 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.

6.3 Test data

Frequency MHz	Signal type	26 dB Occupied band width Input (kHz)	99% Occupied band width output (kHz)	99% Occupied band width output with AGC (kHz)	Difference %
1953.9	GSM	319.8	318.4	315.0	-1.3
1953.9	WCDMA	4645.0	4609.0	4609.0	-0.8



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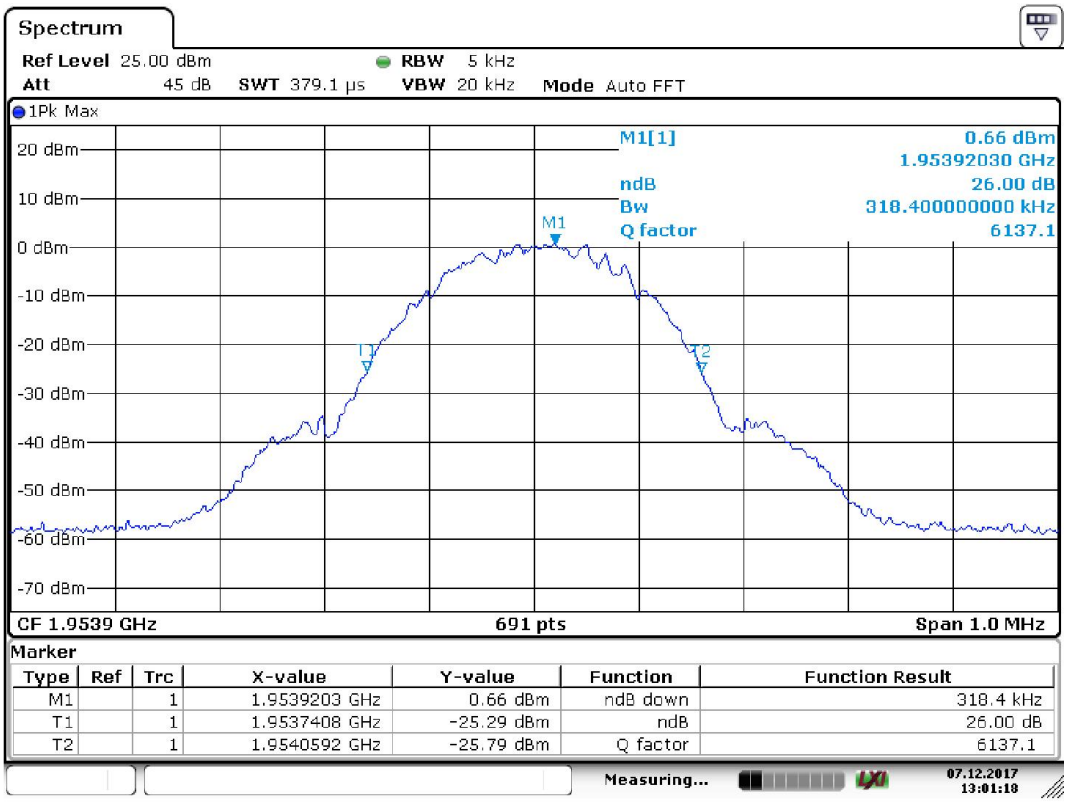
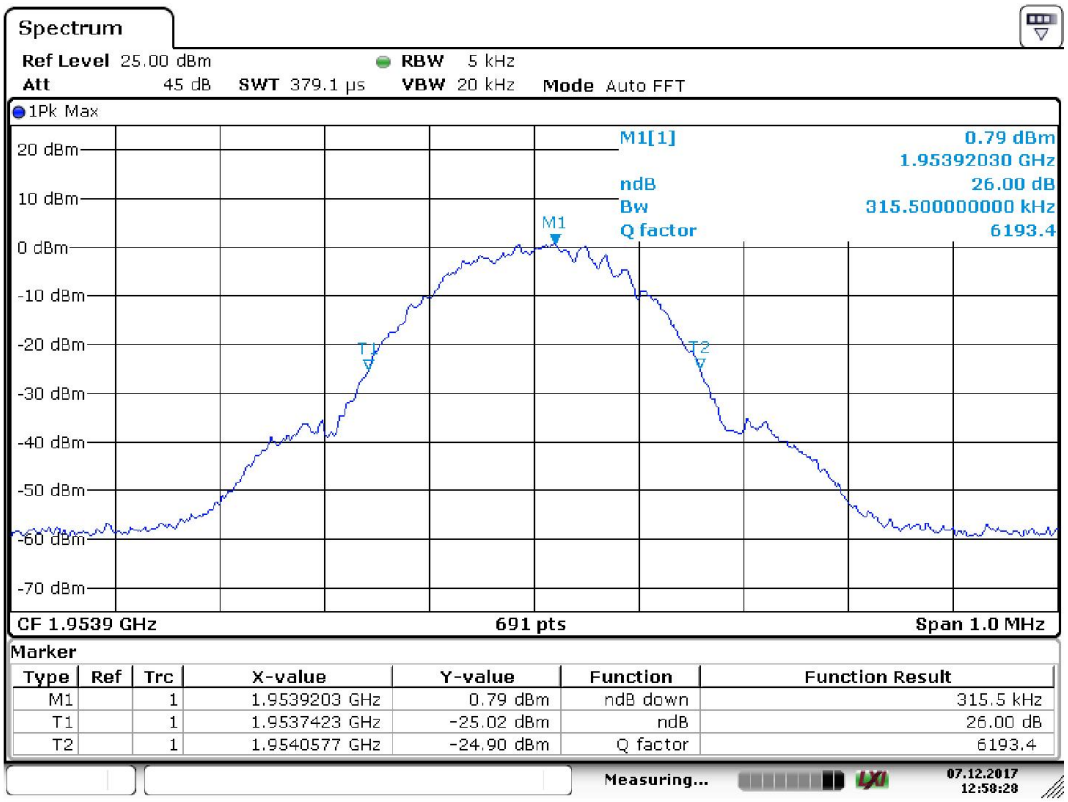
Occupied bandwidth GSM input



Date: 7.DEC.2017 13:01:18

Occupied bandwidth GSM agc off



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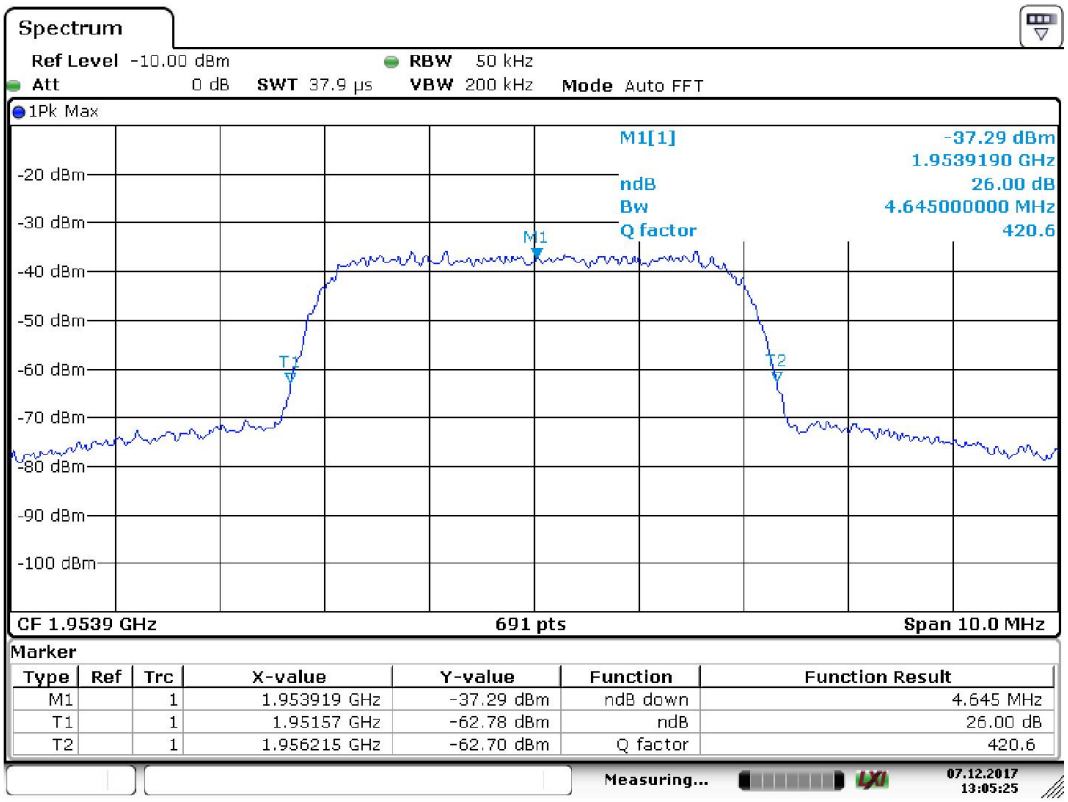
Occupied bandwidth GSM agc on



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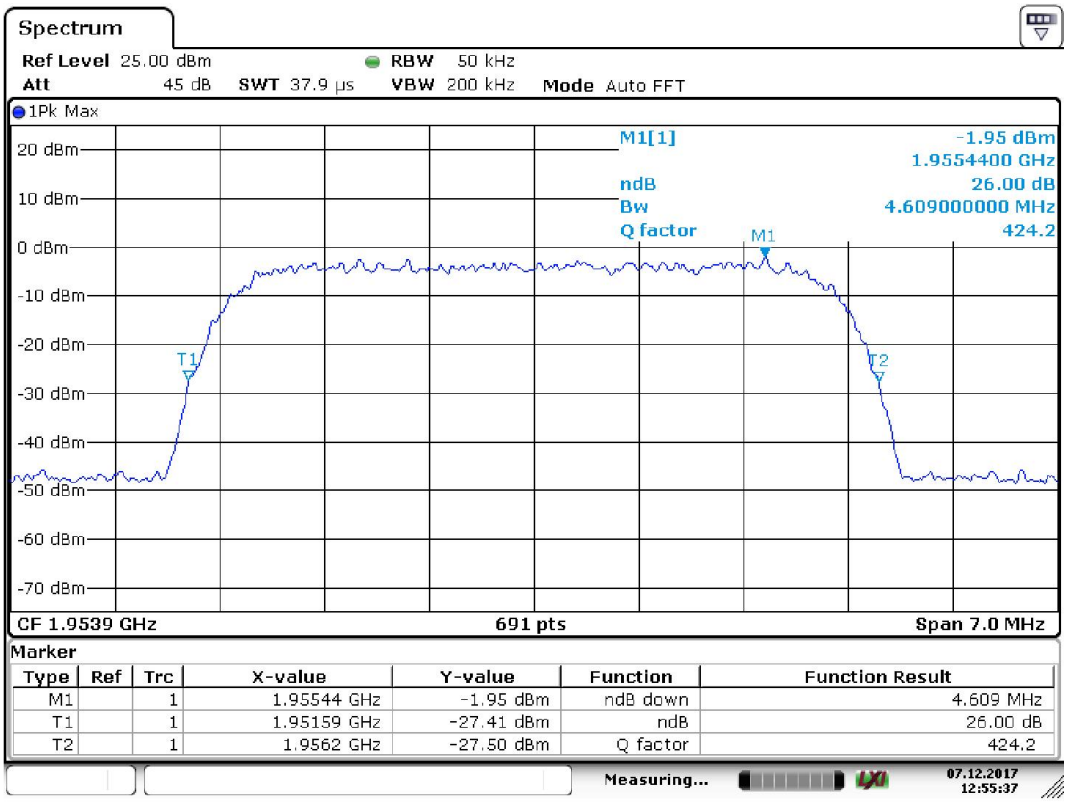
Occupied bandwidth WCDMA input



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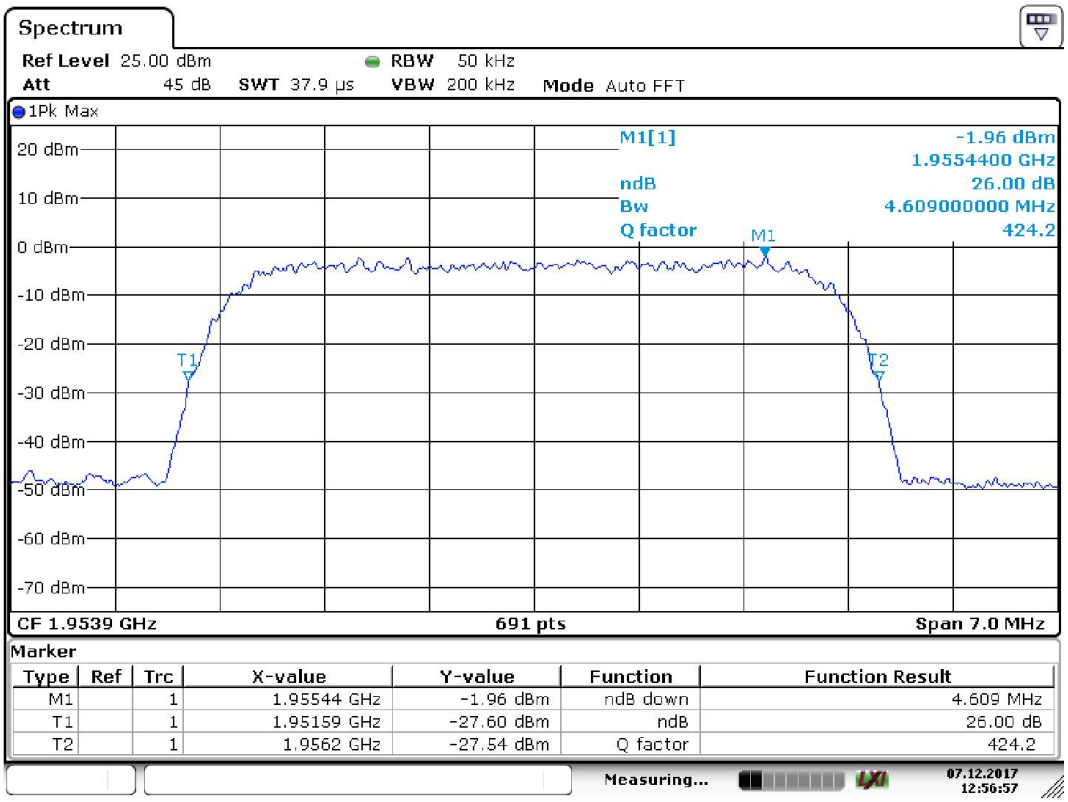
Occupied bandwidth WCDMA agc off



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Occupied bandwidth WCDMA agc on

6.4 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

7 PASSBAND GAIN AND BANDWIDTH

Date of test:	2107-11-02	Test location:	EMC Center
EUT Serial:	999895	Ambient temp. ˚C	21 ˚C
Tested by:	MTV	Relative humidity	37 %
Test result:	Pass	Margin:	-

7.1 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.

7.2 Test set-up

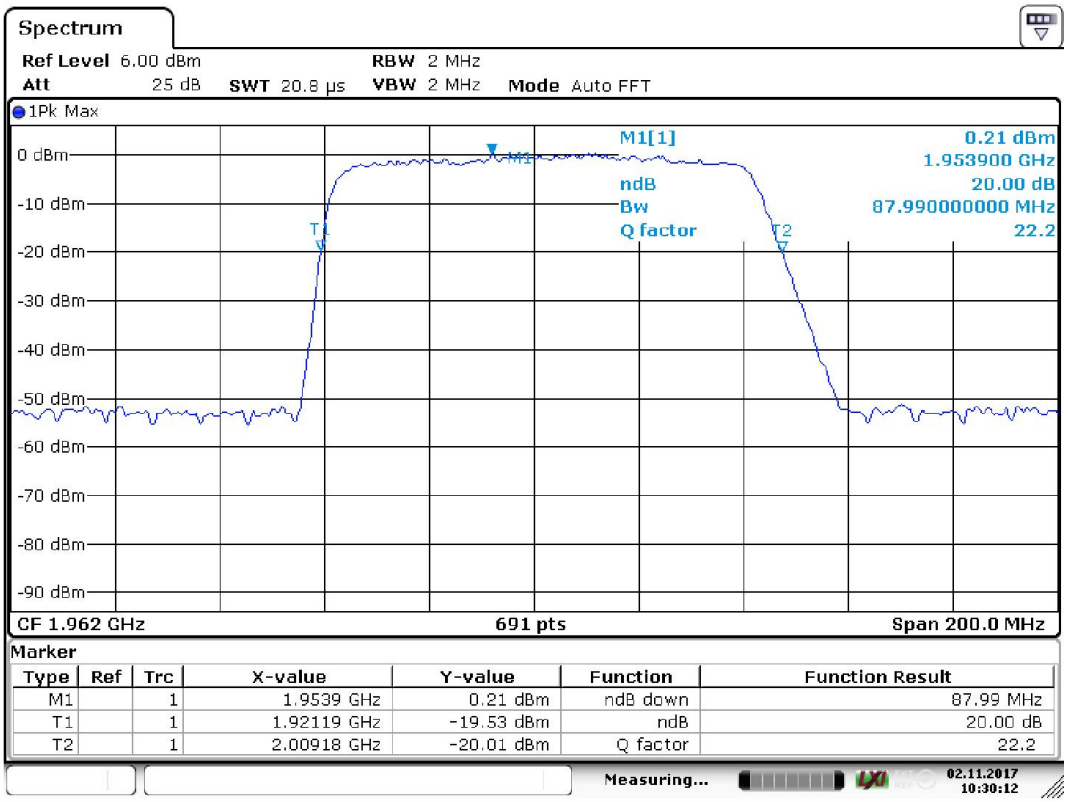
Signal generator was connected to the FOI unit which converted rf signal to optical signal. The optical signal was then fed via fibre to the EUT.
The EUT's output port was connected to spectrum analyser via rf cables and 30 dB attenuator.
The power amplifier gain was set to 67 dB
A PC was connected to FOI via Ethernet hub. The PC was then used to control the EUT.

7.3 Test data

Frequency MHz	Signal type	Occupied 20 dB band width (MHz)
1962	CW	87.99

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.
The EUT requires professional installation and the output power must be tuned by a trained technician.

Frequency MHz	Gen. out (dBm)	Pathloss (dB)	Measured output (dBm)	Gain dB
1954	-28	3	46.3	77.3



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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

8 BAND EDGE EMISSION AND INTERMODULATION

Date of test:	2017-12-08	Test location:	Wireless centre
EUT Serial:	999895	Ambient temp.	22 °C
Tested by:	MTV	Relative humidity	38 %
Test result:	Pass	Margin:	0.8 dB

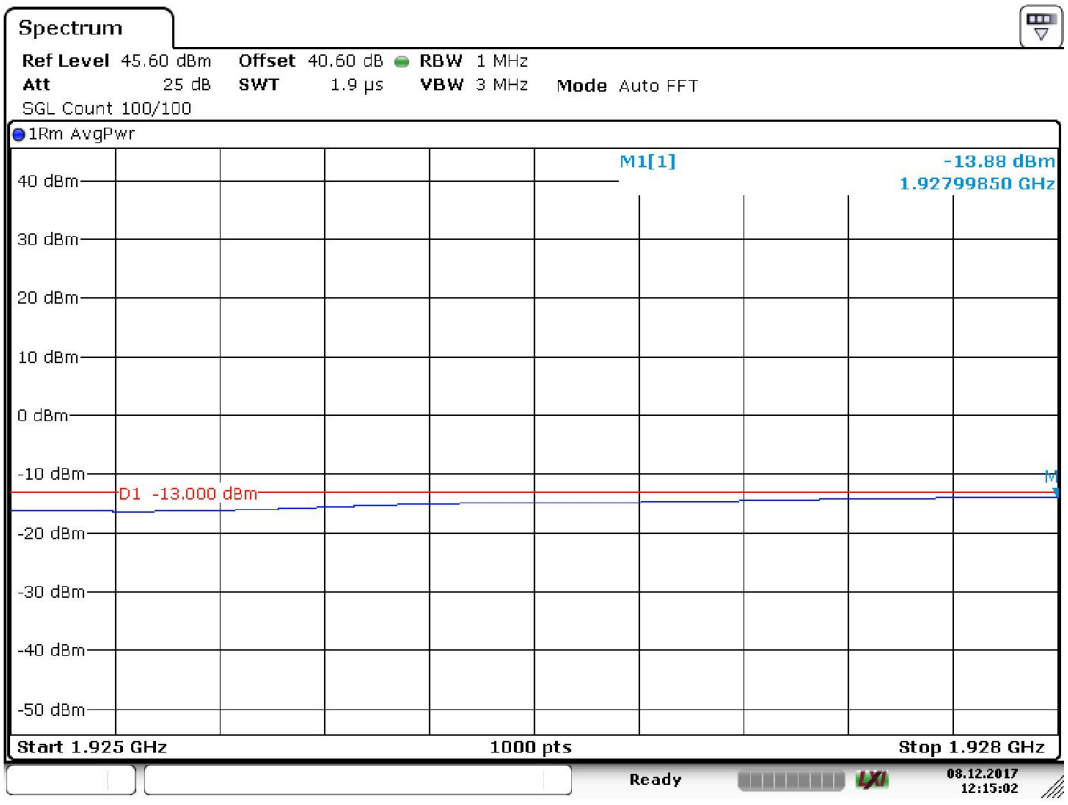
8.1 Requirement

In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.
After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

8.2 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.

8.3 Test data



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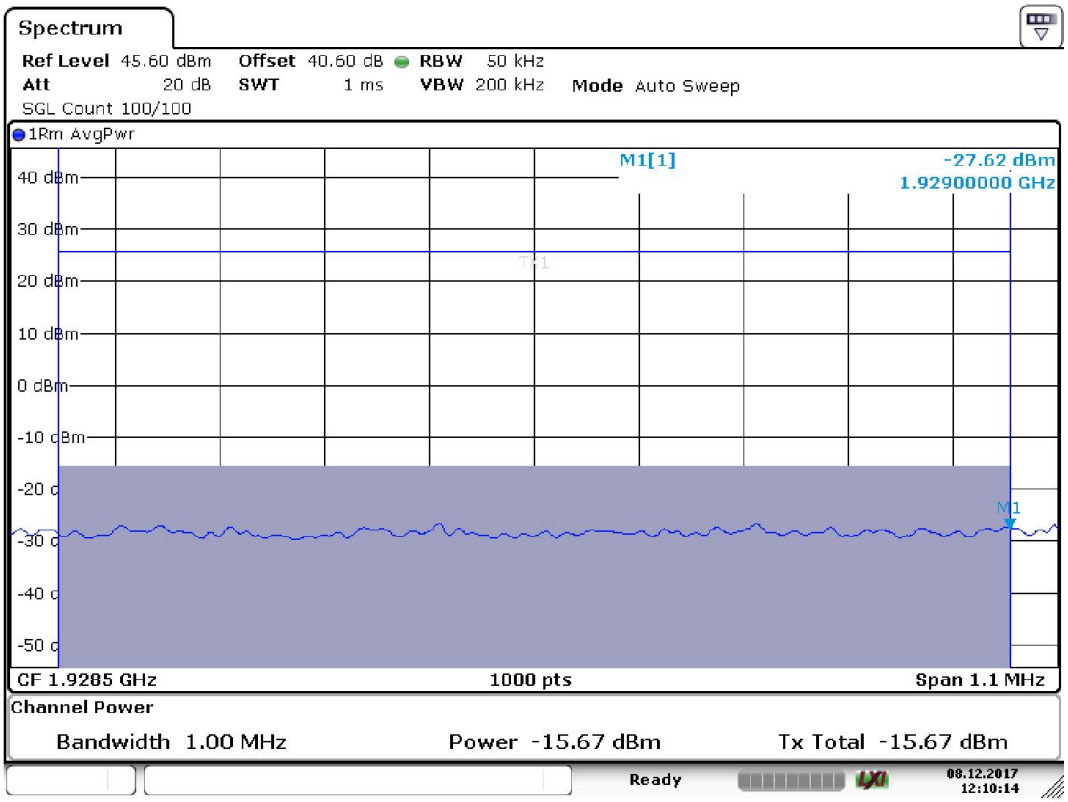
2 AWGN signals lower band edge MHz AGC off 1925 – 1928 MHz



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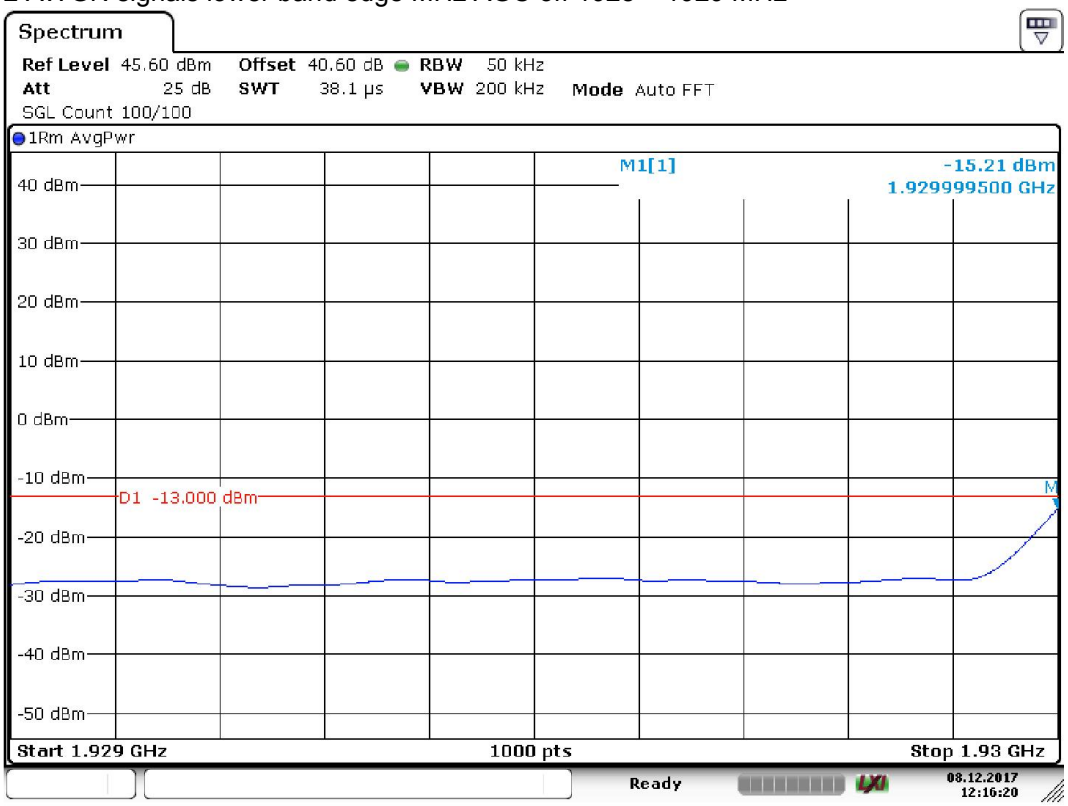
2 AWGN signals lower band edge MHz AGC off 1928 – 1929 MHz



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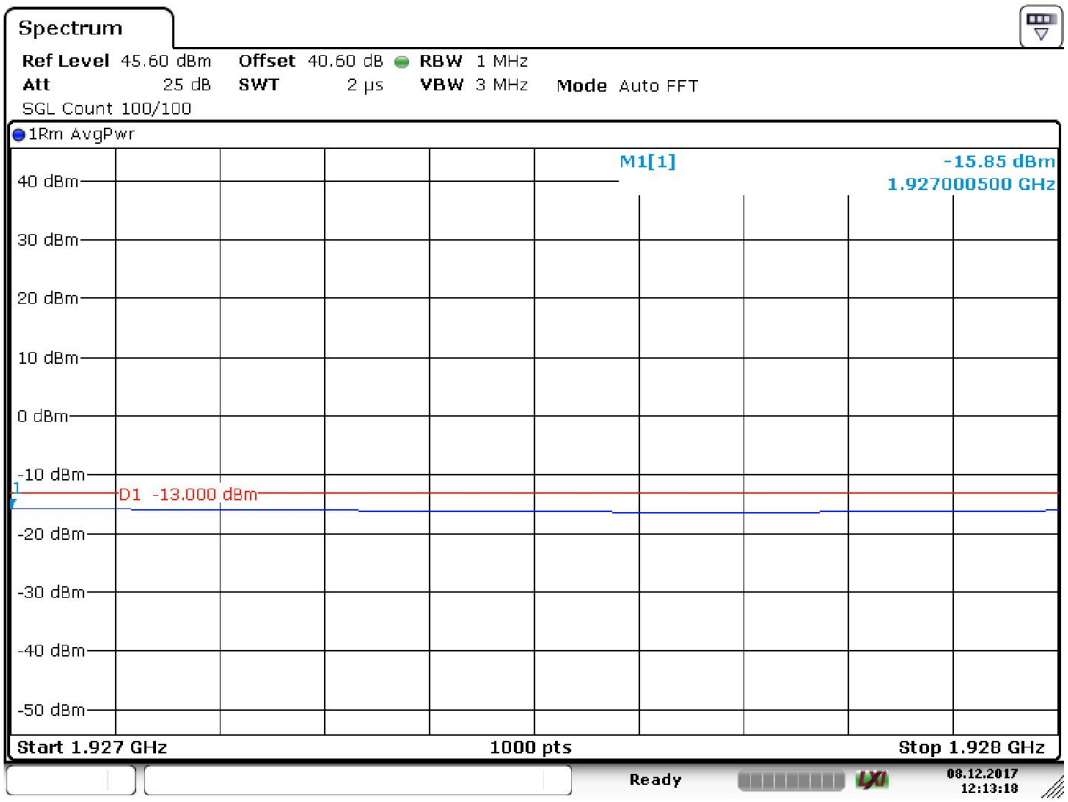
2 AWGN signals lower band edge MHz AGC off 1929 – 1930 MHz



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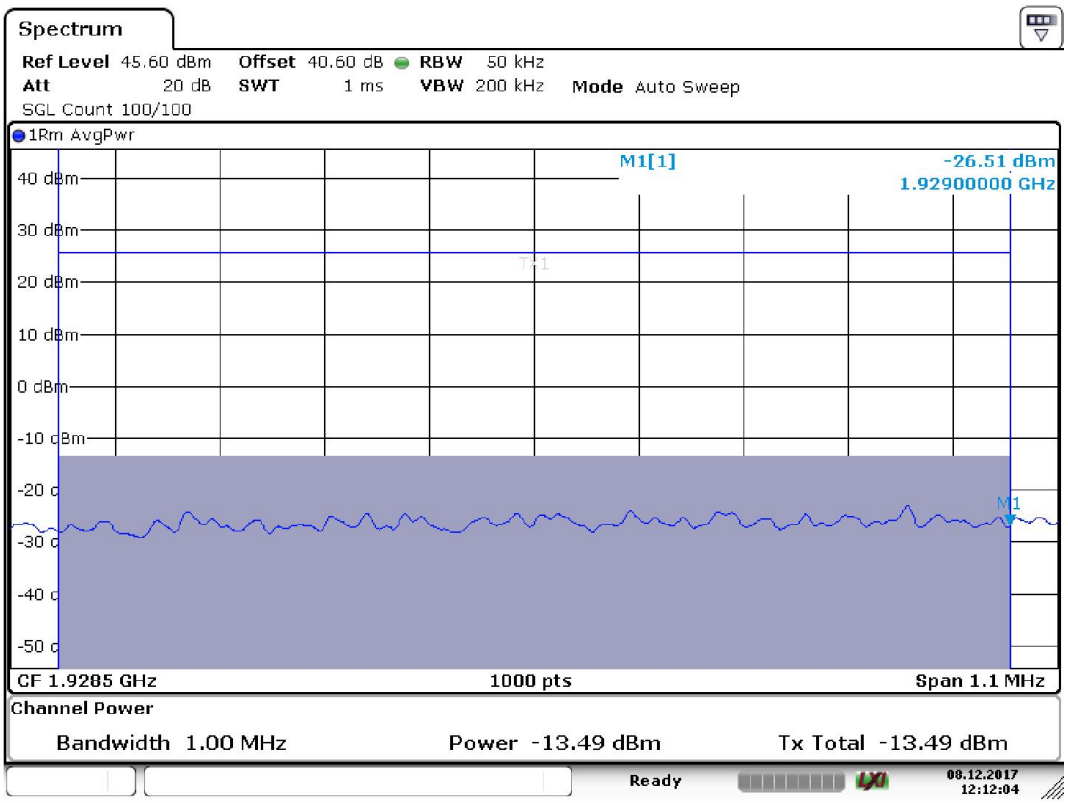
2 AWGN signals lower band edge MHz AGC on 1927 – 1928 MHz



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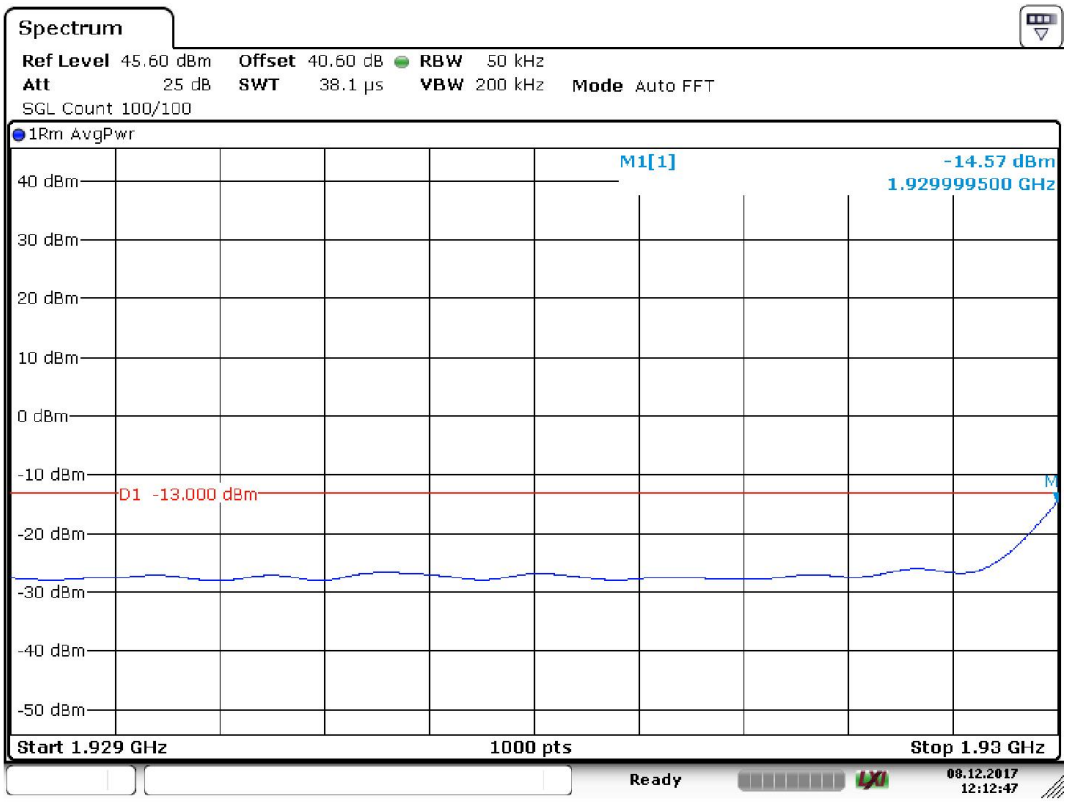
2 AWGN signals lower band edge MHz AGC on 1928 – 1929 MHz



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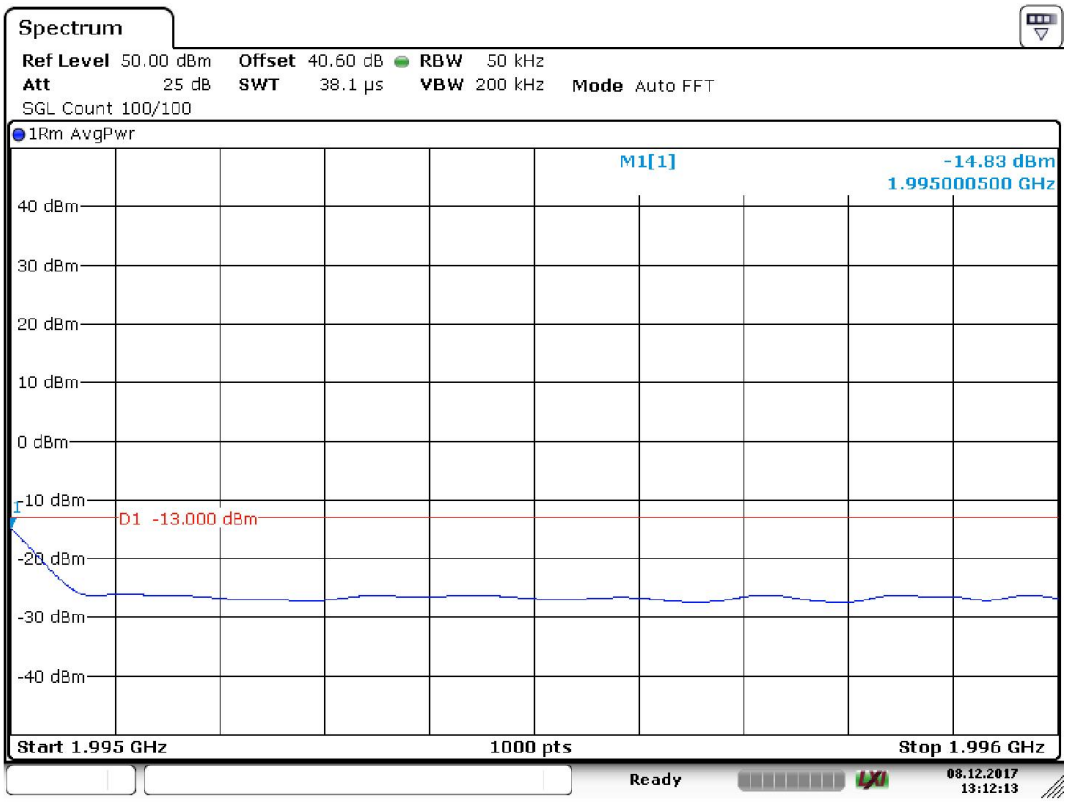
2 AWGN signals lower band edge MHz AGC on 1929 – 1930 MHz



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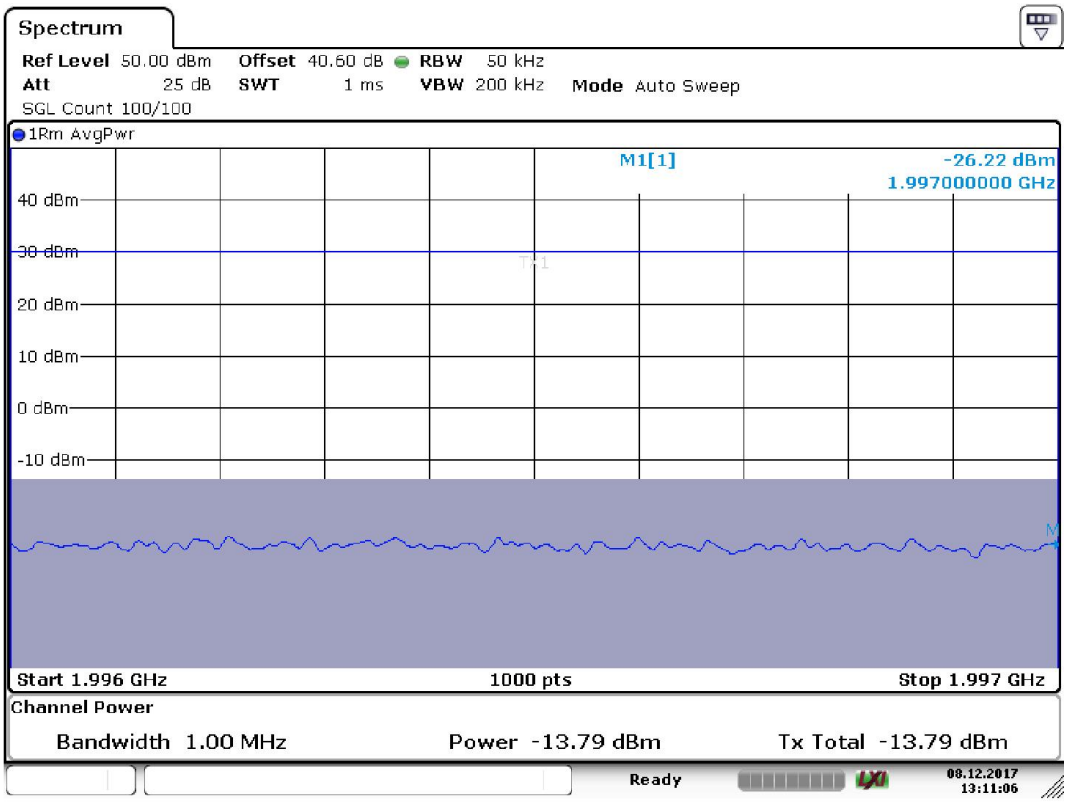
2 WCDMA signal on upper band edge 1995 – 1996 MHz AGC off



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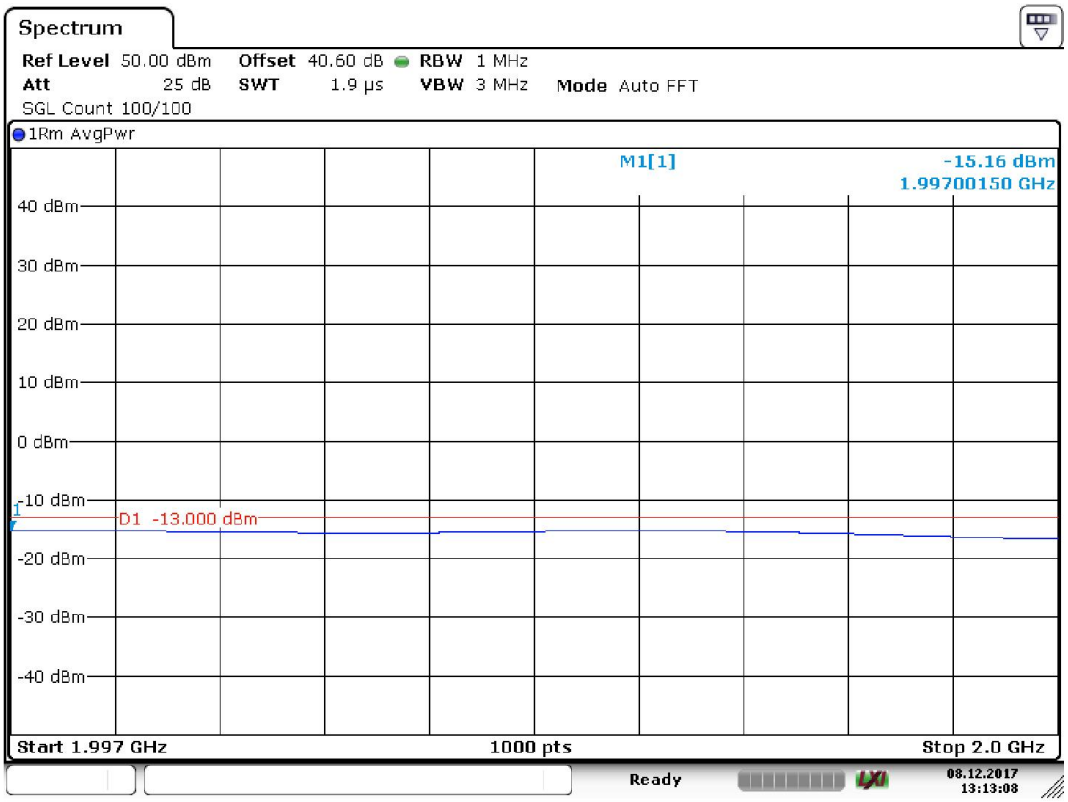
2 WCDMA signal on upper band edge 1996 – 1997 MHz AGC off



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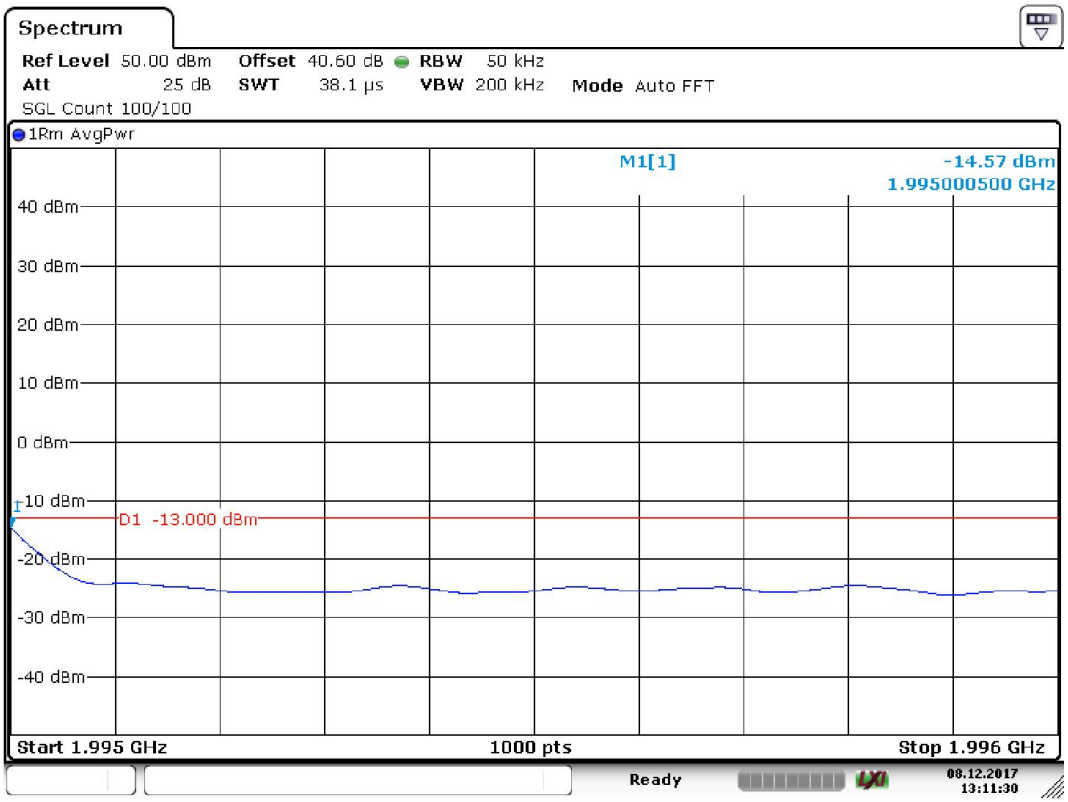
2 WCDMA signal on upper band edge 1997 – 2000 MHz AGC off



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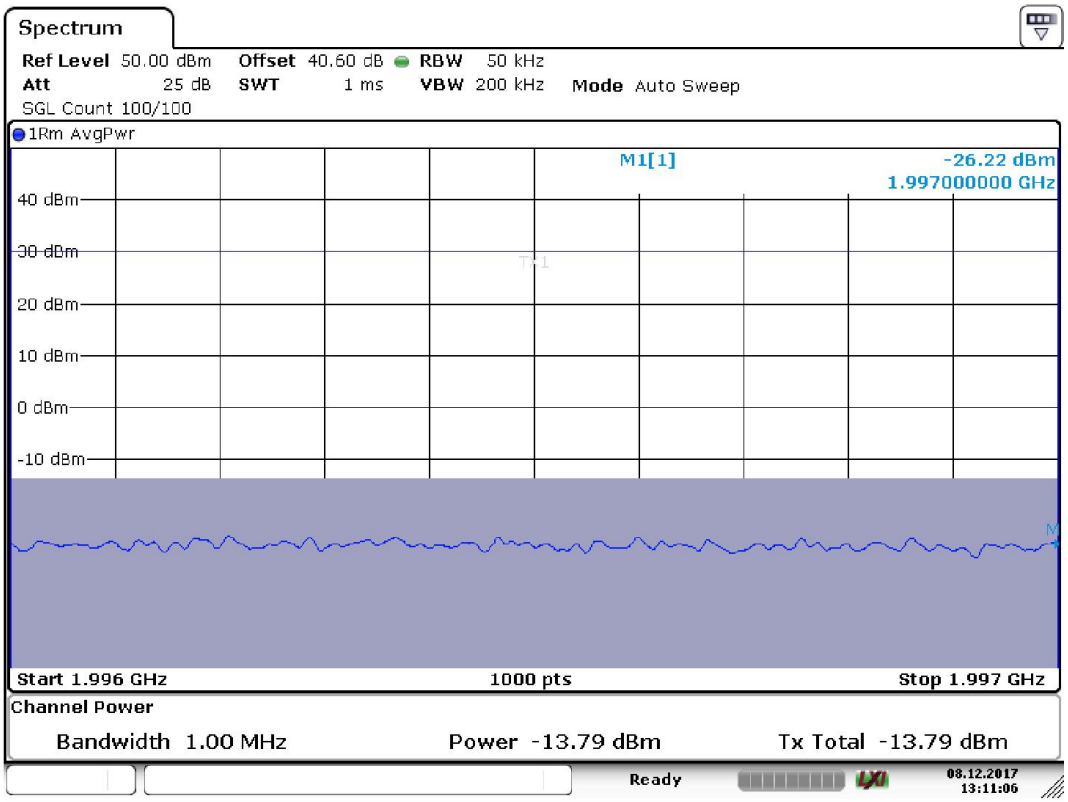
2 WCDMA signal on upper band edge 1995 – 1996 MHz AGC off



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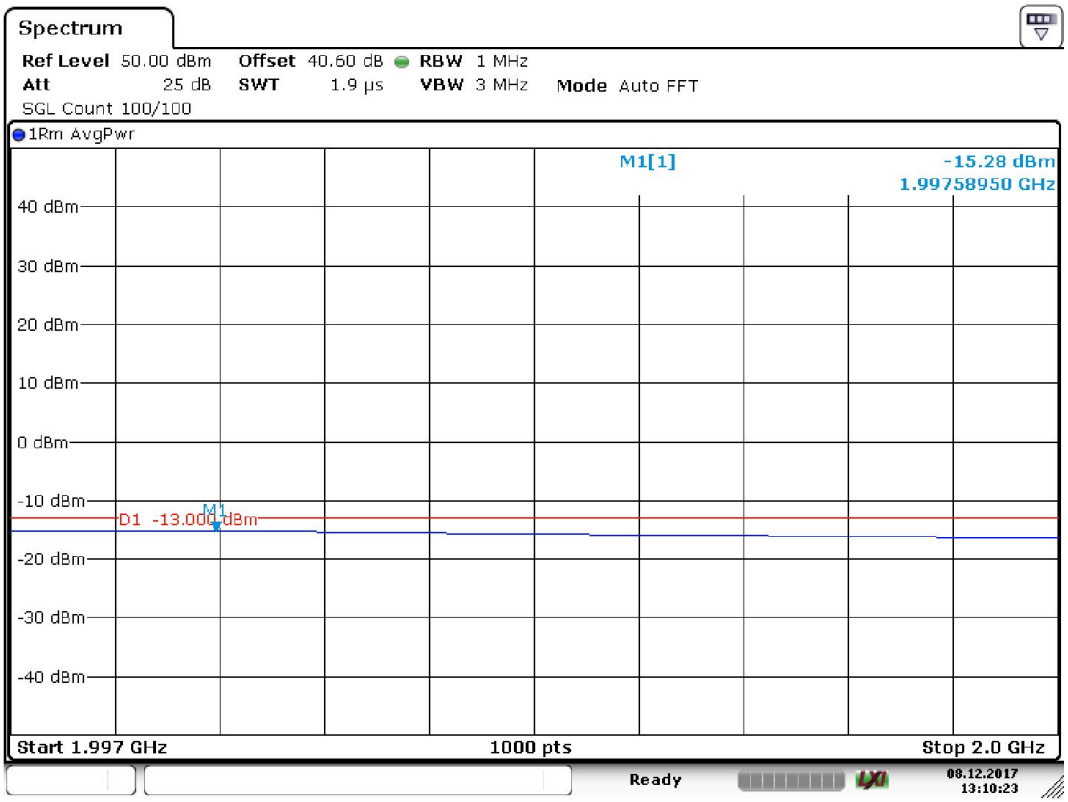
2 WCDMA signal on upper band edge 1996 – 1997 MHz AGC on



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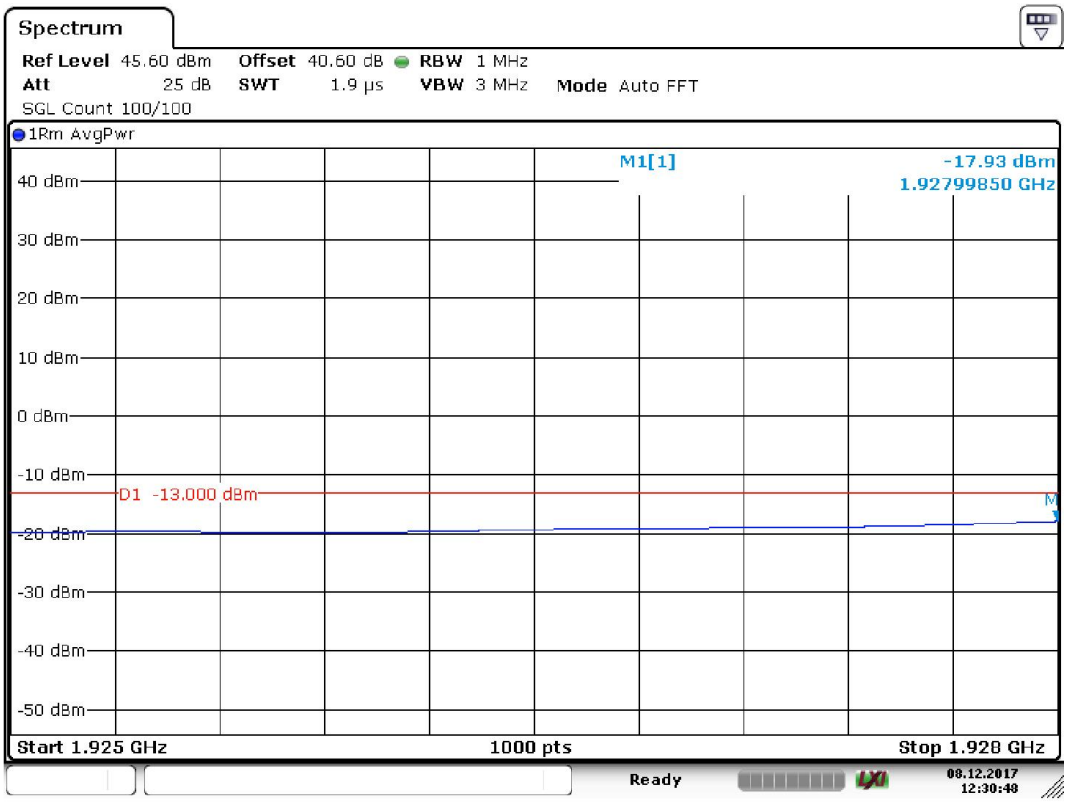
2 WCDMA signal on upper band edge 1997 – 2000 MHz AGC on



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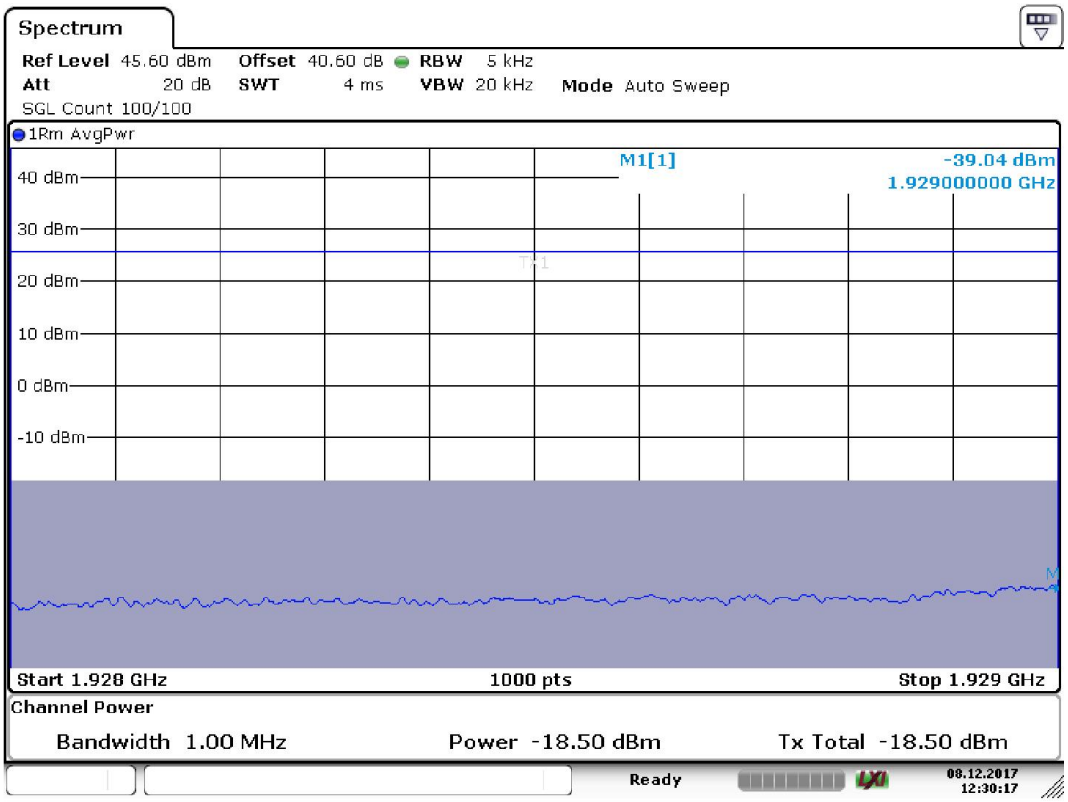
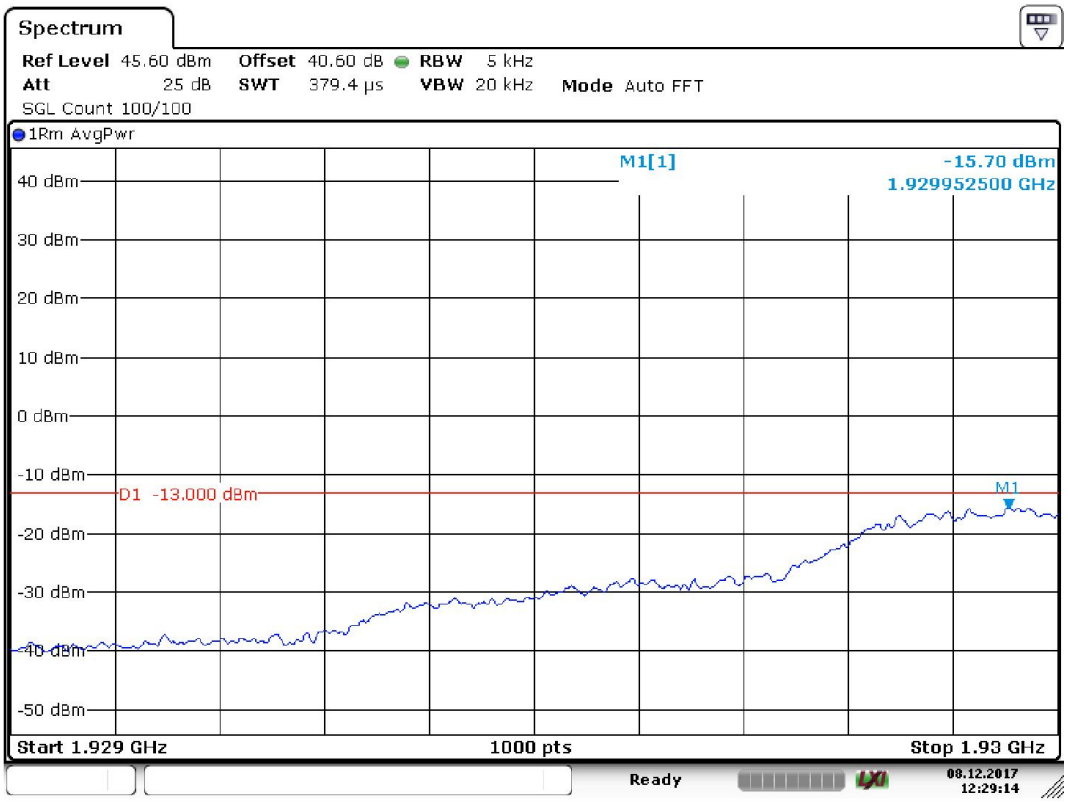
2 GSM signals lower band edge MHz AGC off 1925 – 1928 MHz



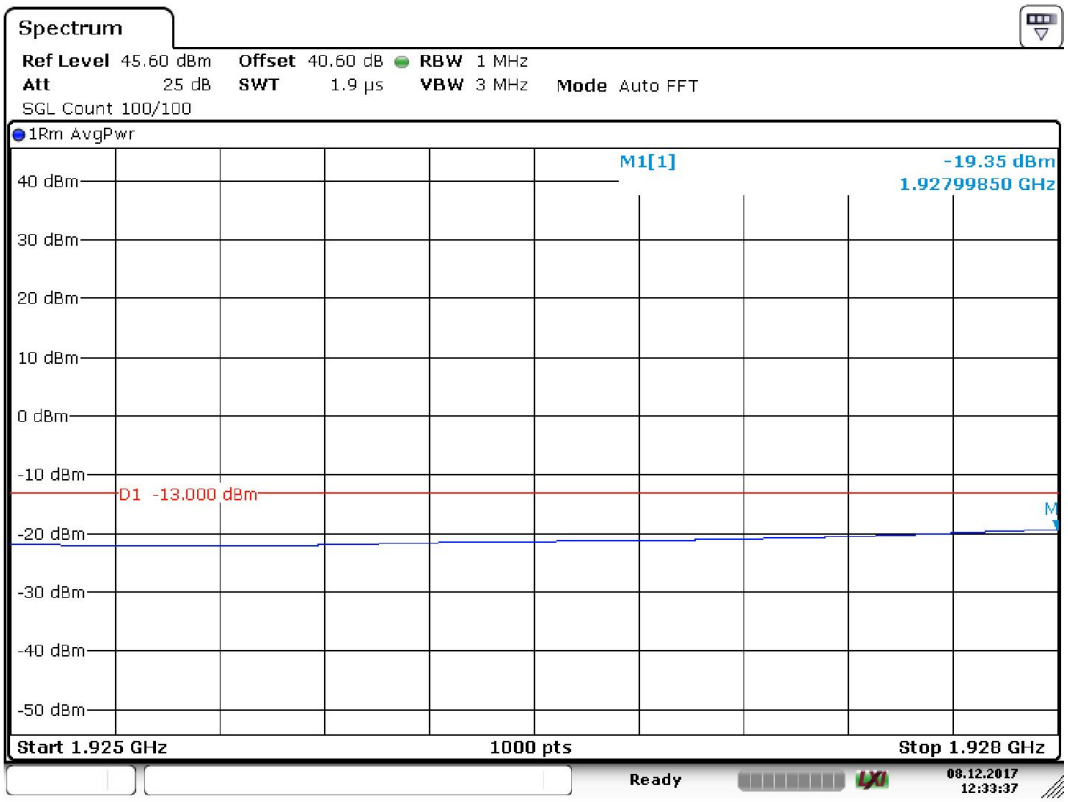
Date: 8.DEC.2017 12:30:18

2 GSM signals lower band edge MHz AGC off 1928 – 1929 MHz



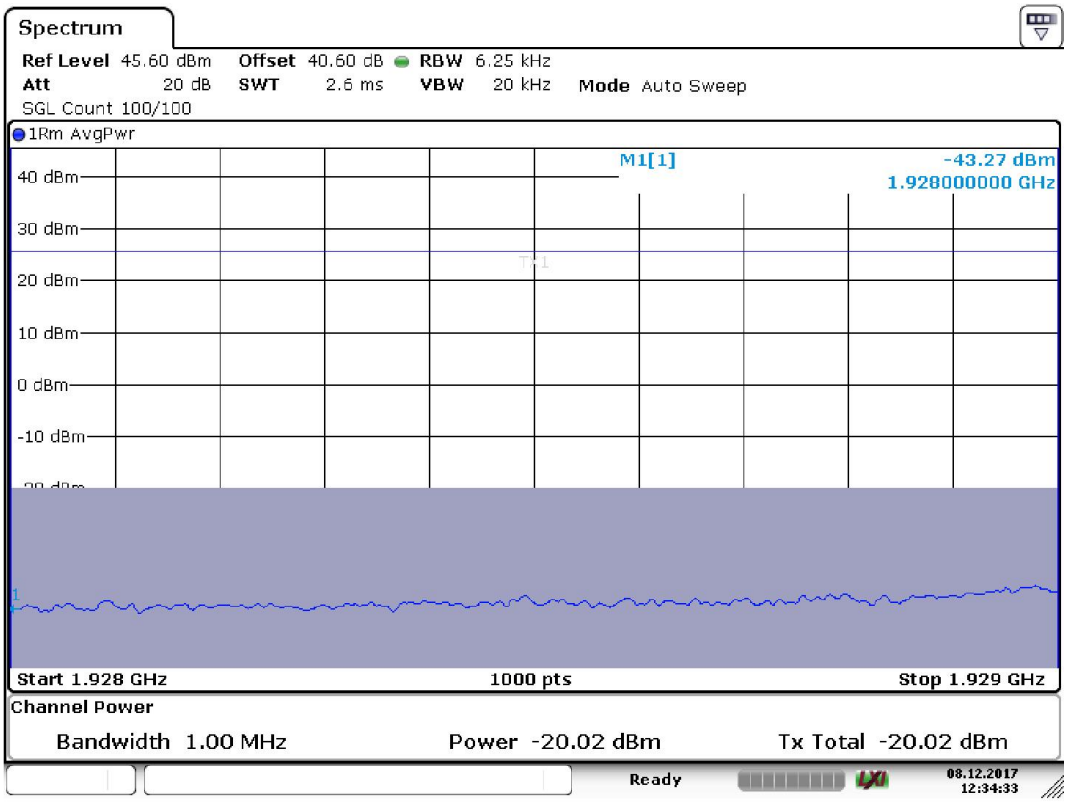
Date: 8.DEC.2017 12:29:13

2 GSM signals lower band edge MHz AGC off 1929 – 1930 MHz



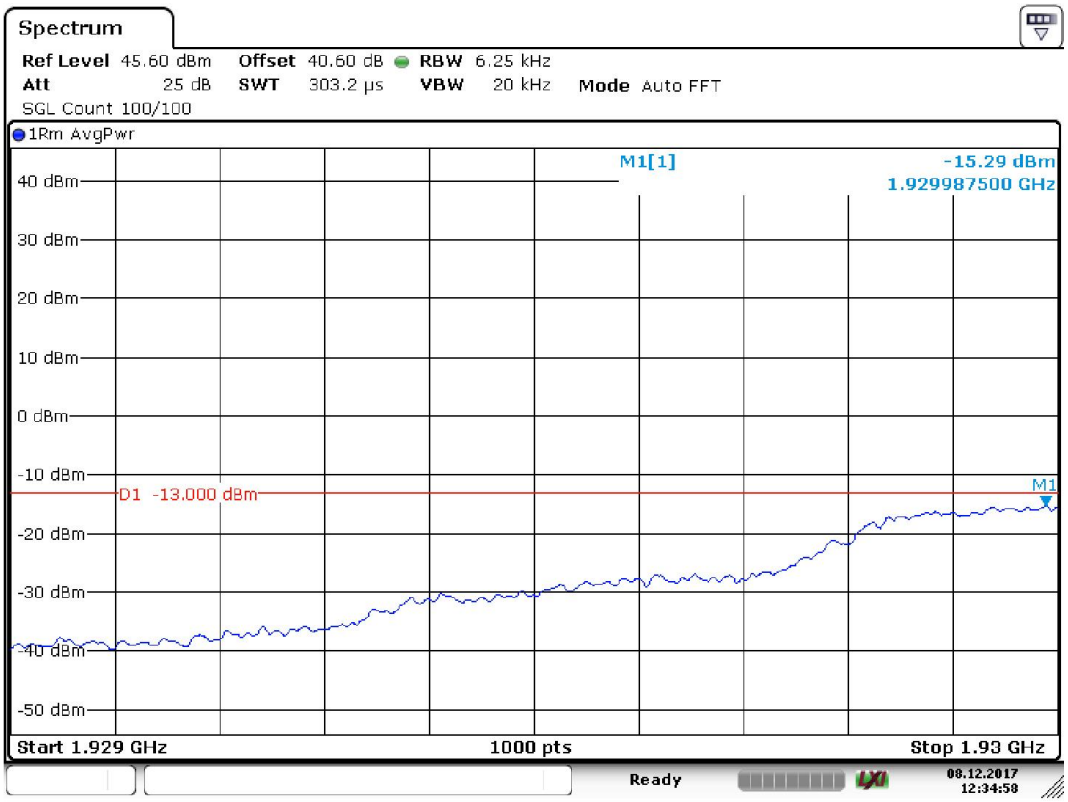
Date: 8.DEC.2017 12:33:37

2 GSM signals lower band edge MHz AGC on 1925 – 1928 MHz



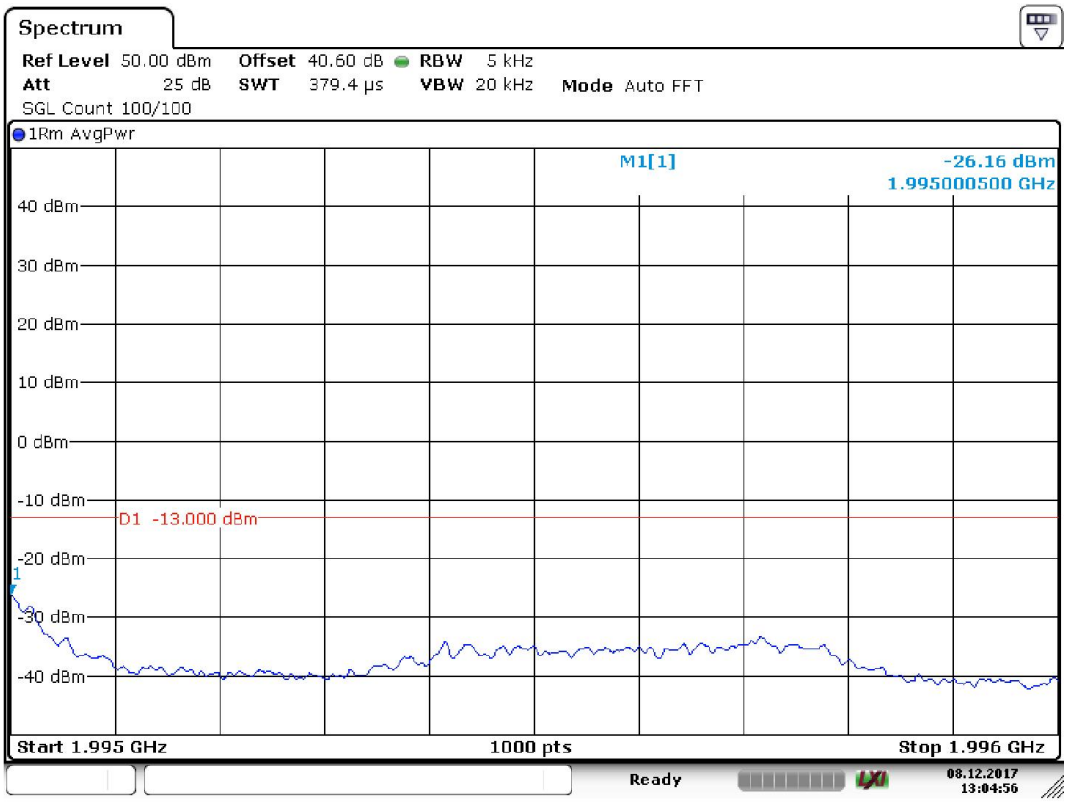
Date: 8.DEC.2017 12:34:34

2 GSM signals lower band edge MHz AGC on 1928 – 1929 MHz



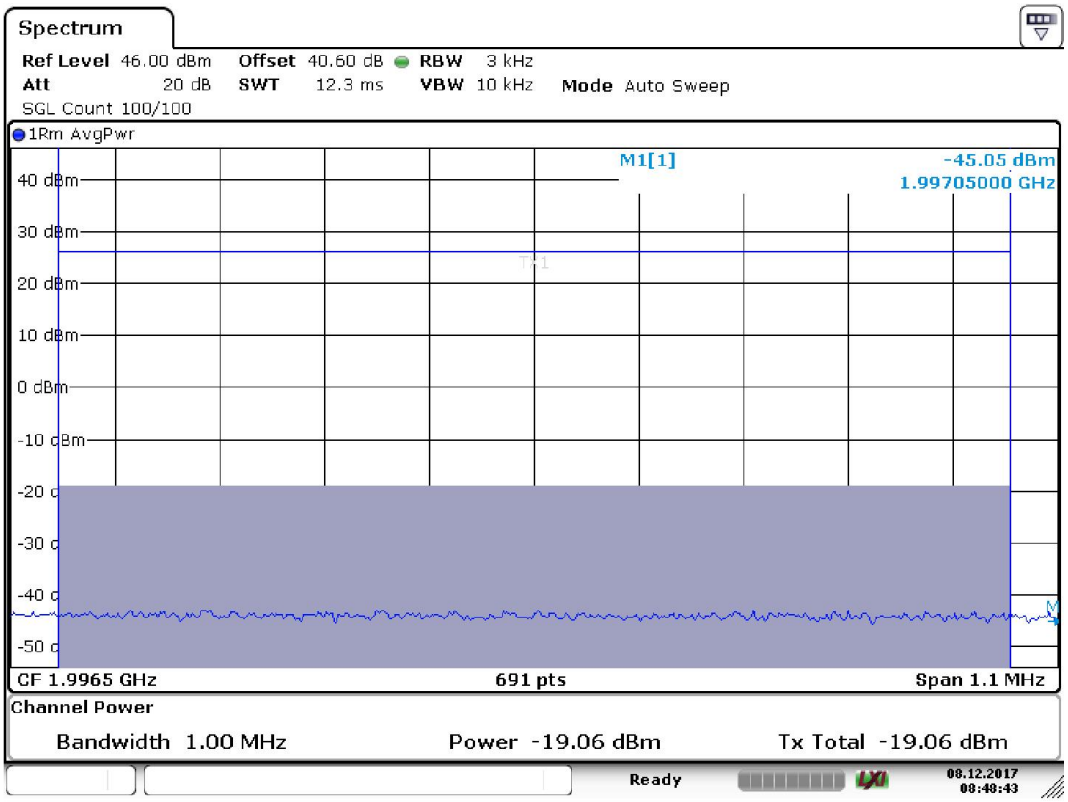
Date: 8.DEC.2017 12:34:59

2 GSM signals lower band edge MHz AGC on 1929 – 1930 MHz



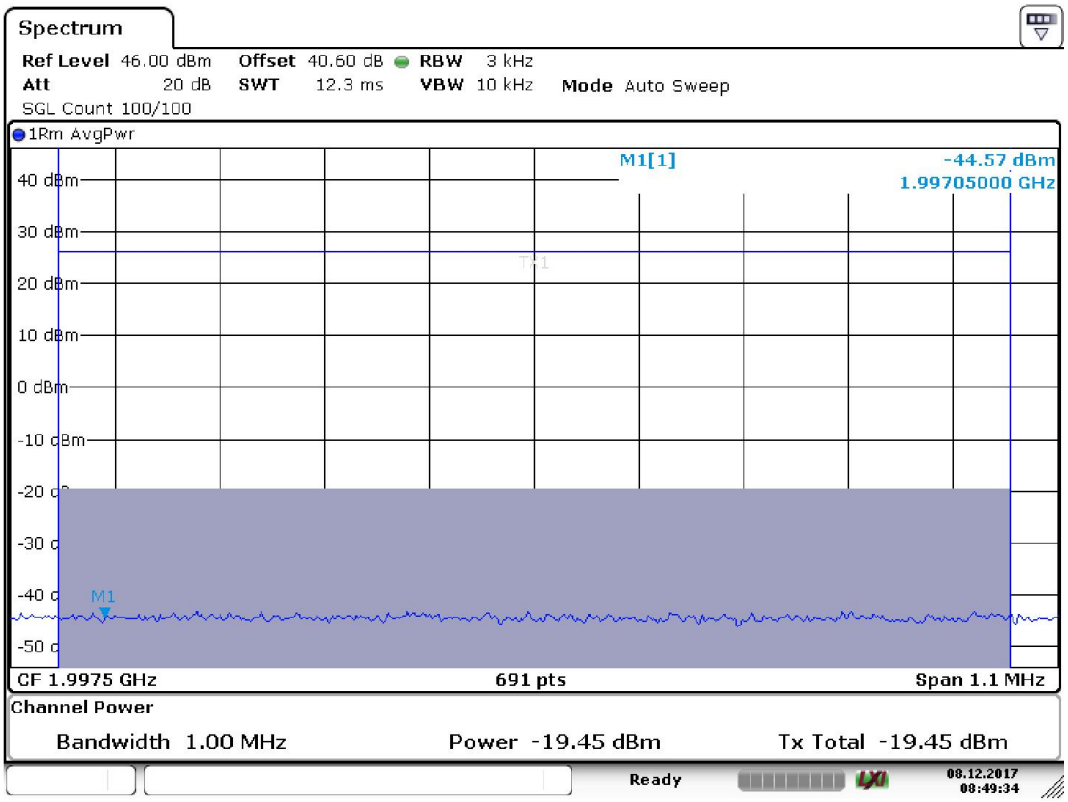
Date: 8.DEC.2017 13:04:57

2 GSM signals upper band edge MHz AGC off 1995 – 1996 MHz



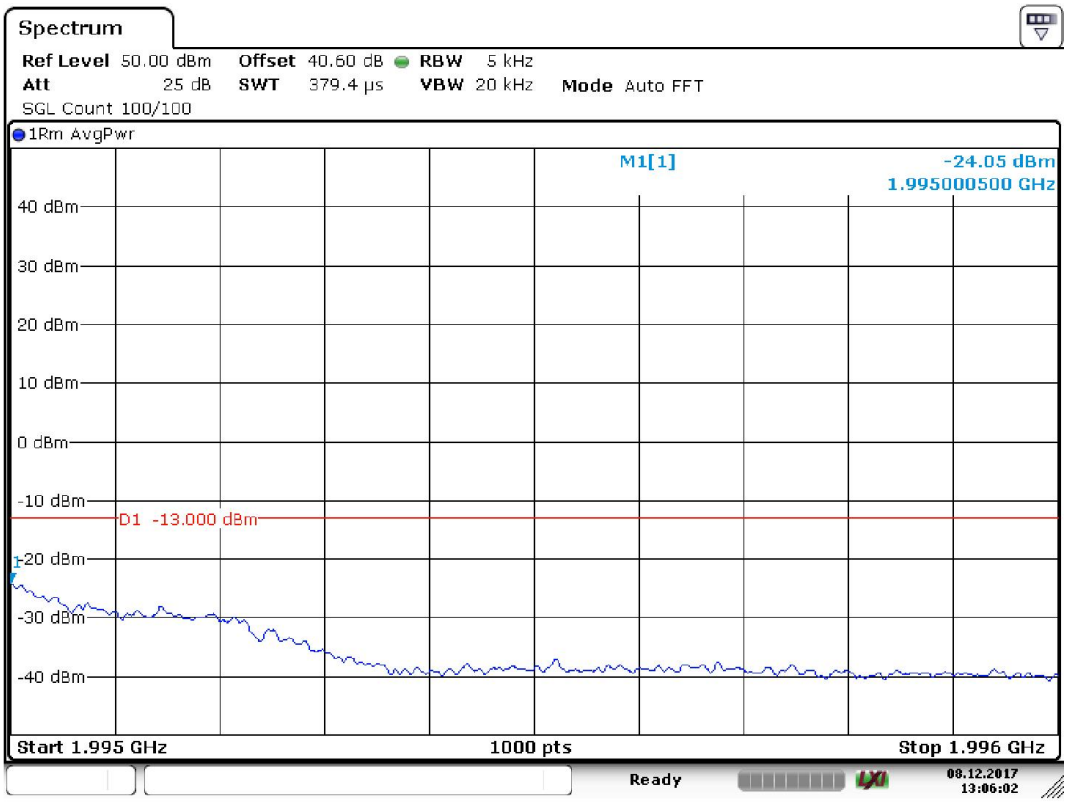
Date: 8.DEC.2017 08:48:44

2 GSM signals upper band edge MHz AGC off 1996 – 1997 MHz



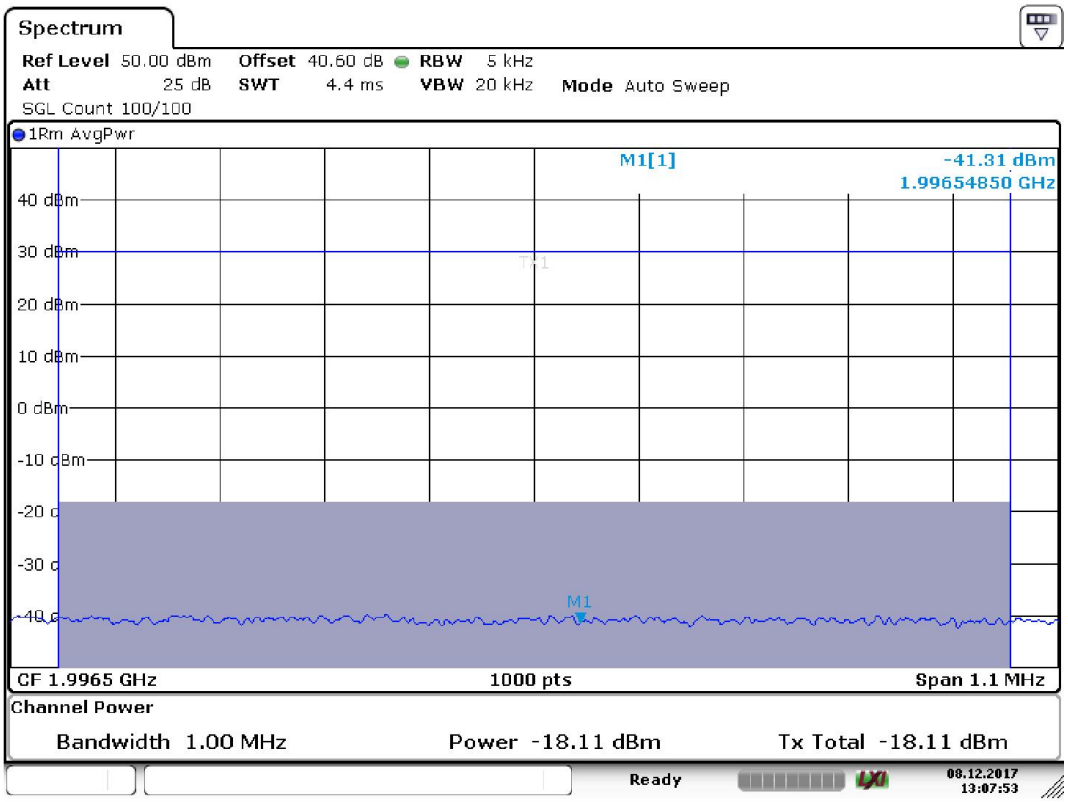
Date: 8.DEC.2017 08:49:34

2 GSM signals upper band edge MHz AGC off 1997 – 1998 MHz



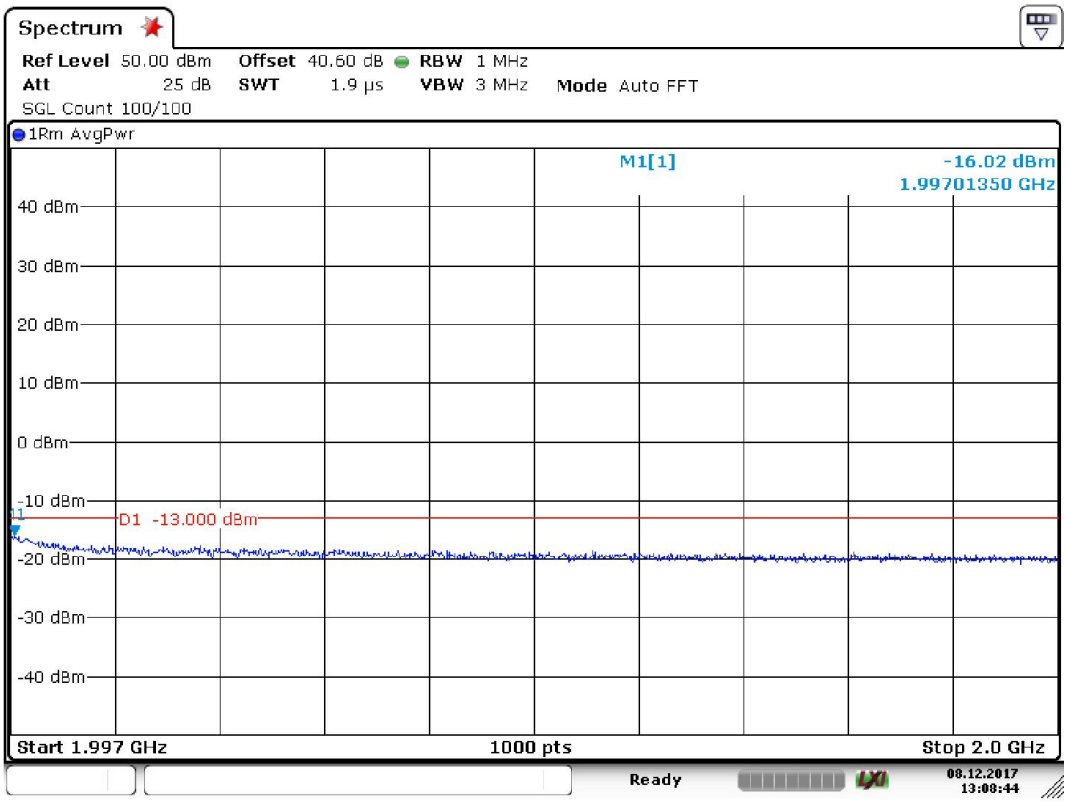
Date: 8.DEC.2017 13:06:03

2 GSM signals upper band edge MHz AGC on 1995 – 1996 MHz



Date: 8.DEC.2017 13:07:53

2 GSM signals upper band edge MHz AGC on 1996 – 1997 MHz



Date: 8.DEC.2017 13:08:44

2 GSM signals upper band edge MHz AGC on 1997 – 2000 MHz

8.4 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