FCC/IC Test Report

FOR

Multi-Tech Systems, Inc.

MultiModem rCell®100 Series Router

FCC ID: AU792U13A16854
IC ID: 125A-0049
Model Numbers: MTR-H5-B10, MTR-H5-B09

47 CFR Part 2, 22, 24, 27

RSS-GEN issue 3, RSS-132 Issue 3, RSS-133 Issue 6, RSS-139 Issue 2

TEST REPORT #: EMC_MULTI_053_MTR_H5-V-BW_WWAN
DATE: 2014-01-27

FCC:
A2LA Accredited

IC recognized #
3462B-1

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecomusa.com ◆ http://www.cetecom.com
CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

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1 Assessment

The following device was tested against the applicable criteria specified in FCC rules parts 2, 22, 24 and 27 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS-GEN issue 3, RSS-132 issue 3, RSS-133 issue 6 and RSS -139 issue 2. No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Multi-Tech Systems, Inc	MultiModem rCell®100 Series Router	MTR-H5-B09, MTR-H5-B10

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2014-01-27	Compliance	Franz Engert (Test Lab Manager)	Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Complience, email=franz.engert@cetecom.com Date: 2014.01.27 13:25:39 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2014-01-27	Compliance	Danh Le (EMC Engineer)	

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Franz Engert
Responsible Project Leader:	Danh Le

2.2 Identification of the Client

Applicant's Name:	Multi-Tech Systems, Inc.
Street Address:	2205 Woodale Drive
City/Zip Code	Mounds View, MN 55112
Country	USA
Contact Person:	Jody Lanes
Phone No.	763 717 5500
Fax:	763-785-9874
e-mail:	jlanes@multitech.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as client.
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Assessment

Marketing Name / Description:	**MultiModem rCell®100 Series Router**
FCC-ID:	**AU792U13A16854**
IC certification no.:	**125A-0049**
Model Numbers (IC model numbers):	**MTR-H5-B10** (tested model), **MTR-H5-B09** (non-tested model variant without GPS; declared to be identical otherwise)
Product Description:	WLAN router incorporating a pre-certified IEEE 802.11bgn / Bluetooth combo module and a 3G module. (details see under "Other Radios" below)
Technology / Type(s) of Modulation:	see the following spec of incorporated cellular module:
Integrated Module Info:	Telit HE910 FCC ID: RI7HE910; IC ID: 5131A-HE910 • 850/900/1800/1900Mhz GSM/GPRS/EDGE; modulation: GSM&GPRS&EDGE(MCS-1-4): GMSK; EDGE(MCS-5-8): 8PSK; • 850/900/1700/1900/2100 MHz WCDMA / HSPA+; HSDPA Category 14 data rate - 21 Mbps; HSUPA Category 6 data rate - 5.76 Mbps; modulation: all QPSK (no QAM in uplink for given data rates);
Operating Frequency Ranges (MHz) / Channels:	GSM 850: 824.2-848.8; 125 channels PCS 1900: 1850.2-1909.8; 300 channels FDD II: 826.4 - 846.6; 278 channels FDD IV: 1712.4 -1752.6; 203 channels FDD V: 1852.4 -1907.6; 103 channels
Antenna:	external screw mount dipole antenna with SMA connector (Laird Hepta-SM MAF94300); 3dBi peak gain;
Rated Operating Voltage:	Vmin: 7.0V/ Vnom: 9.0V/ Vmax: 32V through bundled AC/DC power supply, see accessories below;
Rated Operating Temperature Range:	Tmin: -40°C / Tmax: 80°C
Other Radios included:	1. Murata LBEE5ZSTNC, 802.11bgn 2.4 GHz / Bluetooth 4.0 combo module, FCC-ID: VPYLBTN, IC: 772C-LBTN 2. GPS 1575.42 MHz
Test Sample Status:	Prototype

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	Sample	HW/SW Version
1	16597279	Radiated/Conducted	A/12.00.003

3.3 Accessories of the EUT

AC #	Type	Manufacturer	Model Number	Part Number
1	AC/DC Adapter	GlobTek, Inc	GT-41052-1509	GS-1370
2	Cellular Antenna	Laird Technologies	HEPTA-SM	MAF94300

3.4 Environmental conditions during Test:

The following environmental conditions were maintained during the course of testing:
Ambient Temperature: 20-25°C
Relative Humidity: 40-60%

3.5 Dates of Testing

08/13/2013 – 08/22/2013

3.6 Other Testing Notes

The different cellular operation modes of the EUT as required for testing are controlled through the link with the Digital Radio Communication Tester (R&S CMU200).

All testing has been applied to the EUT with DC (9V nominal) power supplied from it's bundled AC/DC power supply as listed under accessories above.

The EUT is tested on the low, mid and high channel of each of the supported cellular operation modes.

Testing has been applied to model number MTR-H5-B10 only based on the manufacturer's declaration and documentation claiming that model number MTR-H5-B09 is identical except from having the GPS HW depopulated.

Taking into account guidance from FCC KDB 996369 (modular approval) and where relevant test procedures did not change most conducted test results are leveraged from the related test reports #1112FR12-02 and #1201FR11-02, issued by A Test Lab Techno Corp., Taiwan, on February 03, 2012, of the certification of the integrated 3G module (see section 3.1).

4 Subject of Investigation

The objective of the measurements applied by CETECOM Inc. was to establish compliance of the EUT as described under Ch. 3 of this Test Report, with the applicable criteria specified in

- 47 CFR Part 2: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission Frequency allocations and radio treaty matters; general rules and regulations.
- 47 CFR Part 22: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter B- common carrier services; Part 22- Public mobile services
- 47 CFR Part 24: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter B- common carrier services; Part 24- Personal communication services
- 47 CFR Part 27: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter B- common carrier services; Part 27- Miscellaneous wireless communication services
- RSS-GEN- Issue 3: General Requirements and Information for the Certification of Radio Apparatus
- RSS-132- Issue 3: Spectrum management and telecommunication policy- Radio Standards Specifications Cellular telephones employing new technologies operating in the bands 824-849MHz and 869-894MHz
- RSS-133- Issue 6: Spectrum management and telecommunication policy- Radio Standards Specifications- 2GHz personal communication services
- RSS-139- Issue 2: Spectrum management and telecommunication policy- Radio Standards Specifications- Advance wireless services equipment operating in the bands 1710-1755MHz and 2110-2155MHz

This test report is to support a request for new equipment authorization under the
FCC ID: AU792U13A16854
and the
IC ID: 125A-0049
for both
Model Numbers, MTR-H5-B10 and MTR-H5-B09

5 Summary of Measurement Results

GSM and UMTS 850 MHz Band:

Specifications	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046 §22.913 (a) RSS-GEN, 4.8 RSS-132, 5.4	RF Output Power	Nominal	GSM 850	■	☐	☐	☐	Complies
			UMTS Band V	■	☐	☐	☐	Complies
RSS-132 6.4	Peak-to-Average Ratio	Nominal	GSM 850	■	☐	☐	☐	Complies
			UMTS Band V	■	☐	☐	☐	Complies
§2.1055 §22.355 RSS-GEN, 4.7 RSS-132 5.3	Frequency Stability	Nominal	GSM 850	☐	☐	☐	■	Note 1
			UMTS Band V	☐	☐	☐	■	Note 1
§2.1049 §22.917(b) RSS-GEN, 4.6	Occupied Bandwidth	Nominal	GSM 850	☐	☐	☐	■	Note 1
			UMTS Band V	☐	☐	☐	■	Note 1
§2.1051 §22.917 RSS-GEN, 4.9 RSS-132, 5.5	Band Edge Compliance	Nominal	GSM 850	☐	☐	☐	■	Note 1
			UMTS Band V	☐	☐	☐	■	Note 1
§2.1051 §22.917 RSS-GEN, 4.9 RSS-132, 5.5	Conducted Spurious Emissions	Nominal	GSM 850	☐	☐	☐	■	Note 1
			UMTS Band V	☐	☐	☐	■	Note 1
§2.1053 §22.917 RSS-GEN, 4.9 RSS-132, 5.5	Radiated Spurious Emissions	Nominal	GSM 850	■	☐	☐	☐	Complies
			UMTS Band V	■	☐	☐	☐	Complies

Note: NA= Not Applicable; NP= Not Performed.
Note 1: Testing leveraged from test report of incorporated radio module.

GSM and UMTS 1900 MHz Band:

Specifications	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046 §24.232 (a) RSS-GEN, 4.8 RSS-133, 6.4	RF Output Power	Nominal	GSM 1900	■	☐	☐	☐	Complies
			UMTS Band II	■	☐	☐	☐	Complies
§24.232 (d) RSS-133 6.4	Peak-to-Average Ratio	Nominal	GSM 1900	■	☐	☐	☐	Complies
			UMTS Band II	■	☐	☐	☐	Complies
§2.1055 §24.235 RSS-GEN, 4.7 RSS-133, 6.3	Frequency Stability	Nominal	GSM 1900	☐	☐	☐	■	Note 1
			UMTS Band II	☐	☐	☐	■	Note 1
§2.1049 RSS-GEN, 4.6	Occupied Bandwidth	Nominal	GSM 1900	☐	☐	☐	■	Note 1
			UMTS Band II	☐	☐	☐	■	Note 1
§2.1051 §24.238 RSS-GEN, 4.9 RSS-133, 6.5	Band Edge Compliance	Nominal	GSM 1900	☐	☐	☐	■	Note 1
			UMTS Band II	☐	☐	☐	■	Note 1
§2.1051 §24.238 RSS-GEN, 4.9 RSS-133, 6.5	Conducted Spurious Emissions	Nominal	GSM 1900	☐	☐	☐	■	Note 1
			UMTS Band II	☐	☐	☐	■	Note 1
§2.1053 §24.238 RSS-GEN, 4.9 RSS-133, 6.5	Radiated Spurious Emissions	Nominal	GSM 1900	■	☐	☐	☐	Complies
			UMTS Band II	■	☐	☐	☐	Complies

Note: NA= Not Applicable; NP= Not Performed.
Note 1: Testing leveraged from test report of incorporated radio module.

UMTS 1700 MHz Band:

Specifications	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046 §27.50(d)(4) RSS-GEN, 4.8 RSS-139(6.4)	RF Output Power	Nominal	UMTS Band IV	■	☐	☐	☐	Complies
§27.50(d)(5) RSS-GEN, 4.8 RSS-139(6.4)	Peak-to-average Ratio	Nominal	UMTS Band IV	■	☐	☐	☐	Complies
§2.1055 §27.54 RSS-GEN, 4.7 RSS-139(6.3)	Frequency Stability	Nominal	UMTS Band IV	☐	☐	☐	■	See Note1
§2.1049 §27.53(h) RSS-Gen, 4.6	Occupied Bandwidth	Nominal	UMTS Band IV	☐	☐	☐	■	See Note1
§2.1051 §27.53(h) RSS-GEN, 4.9 RSS-139 6.5.1	Band Edge Compliance	Nominal	UMTS Band IV	☐	☐	☐	■	See Note1
§2.1051 §27.53(h) RSS-GEN, 4.9 RSS-139 6.5	Conducted Spurious Emissions	Nominal	UMTS Band IV	☐	☐	☐	■	See Note1
§2.1053 §27.53(h) RSS-GEN, 4.9 RSS-139 6.5	Radiated Spurious Emissions	Nominal	UMTS Band IV	■	☐	☐	☐	Complies

Note: NA= Not Applicable;
Note 1: Testing leveraged from test report of incorporated radio module.

6 Measurements

Testing is performed according to the guidelines provided in *FCC publication (KDB) 971168 D01 Power Meas License Digital Systems v02r01: Measurement Guidance for Certification of Licensed Digital Transmitters7, June 2013* and according to relevant parts of TIA-603C 2004 as detailed below.

6.1 RF Power Output

6.1.1 References

FCC: CFR Part 2.1046, CFR Part 22.913, CFR Part 24.232, CFR Part 27.50
IC: RSS-Gen Section 4.8; RSS-132 Section 5.4; RSS-133 Section 6.4, RSS-139 Section 6.4

6.1.2 Measurement requirements:

6.1.2.1 FCC 2.1046: RF power output.

Power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on circuit elements as specified. The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

6.1.2.2 RSS-Gen 4.8: RF power output.

Transmitter output power measurements shall be carried out before the unwanted emissions test. The transmitter output power value, obtained from this test, serves as the reference level used to determine the unwanted emissions.

6.1.3 Limits:

6.1.3.1 FCC 22.913 (a) Effective radiated power limits.

The effective radiated power (ERP) of mobile transmitters must not exceed 7 Watts.

6.1.3.2 FCC 24.232 (b)(c) Power limits.

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP.

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(6) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, *etc.*, so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

6.1.3.3 FCC 27.50(d)(4) Power limits.

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP.

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(6) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, *etc.*, so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

6.1.3.1 RSS-132, Issue 3, cl. 5.4

The transmitter output power shall be measured in terms of average power. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts.
In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

6.1.3.2 RSS-133, Issue 6, cl. 6.4

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed 2 watts maximum e.i.r.p.
In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of

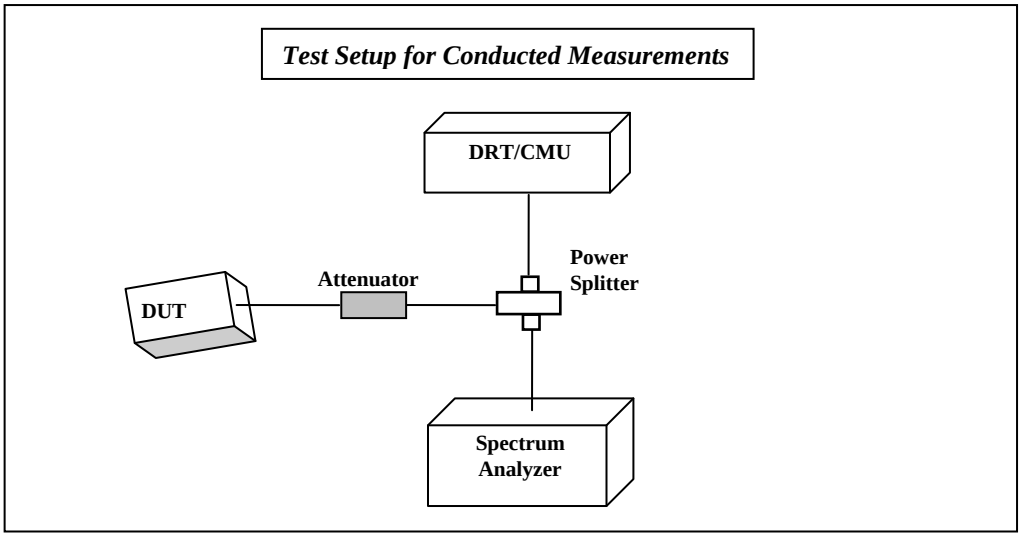
6.1.3.3 RSS-139, Issue 2, cl. 6.4

The average equivalent isotropically radiated power (e.i.r.p.) for fixed, mobile and portable transmitters in the 1710-1755 MHz shall not exceed 1 watt.
In addition, when the transmitter power is measured in terms of average value, the peak-to-average ratio of the power shall not exceed 13 dB.

6.1.4 Conducted Output Power Measurement and ERP/EIRP Determination

6.1.4.1 Measurement Procedure:

Ref: TIA-603C 2004 2.2.1



1. Connect the equipment as shown in the above diagram. A Digital Radio Communication Tester (DRT: R&S CMU200 here) is used to enable the EUT to transmit and to measure the output power.
2. Adjust the settings of the CMU200 to set the EUT to its maximum power at the required channel.
3. Record the Peak and Average Output power level measured by the CMU200.
4. Correct the measured level for all losses in the RF path.
5. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band and for all types of modulation schemes.
    a. GMSK mode measurements are performed in GSM 1 uplink slot configuration.
    b. UMTS mode measurements are performed in RMC 12.2K configuration

6.1.4.2 Measurement Uncertainty

+/- 0.5 dB

6.1.4.3 Test Conditions:

Tnom: 20^{o}C; Vnom: 3.3 V

6.1.4.4 Result:

ERP/EIRP values in following tables are calculated from the conducted output power values with the rated peak antenna gain of 3dBi (ERP = EIRP-2.15dB);
Path loss between the module's RF terminal and the external SMA connector of the host device is not specified and not considered in below table.
The 'Rated Average max." in the table below is taken from the presented module's specifications.
All output power values in dBm.

Frequency (MHz)	Pre-certified Module Output Power Measured Peak / Measured Average / Rated Average max.	Measured Average Output Power @ SMA connector	Measured Peak Output Power @ SMA connector	Calculated Peak EIRP/ERP
850 GMSK				
824.2	32.7 / 32.5 / 33	32.1	32.2	35.2 / 33.05
836.6	32.6 / 32.4 / 33	32.1	32.3	35.3 / 33.15
848.8	32.6 / 32.4 / 33	32.3	32.3	35.3 / 33.15
850 8PSK				
824.2	29.9 / 27.4 / 27.5	26.5	29.2	32.2 / 30.05
836.6	29.8 / 27.2 / 27.5	26.6	29.2	32.2 / 30.05
848.8	29.8 / 27.2 / 27.5	26.7	29.4	32.4 / 30.25
FDD V				
826.4	26.63 / 23.82 / 23.5	22.3	25.4	28.4 / 26.25
836.6	26.43 / 23.70 / 23.5	22.5	25.5	28.5 / 26.35
846.6	26.47 / 23.61 / 23.5	22.3	25.3	28.3 / 26.15
1900 GMSK				
1850.2	29.7 / 29.5 / 30	28.4	28.5	31.5
1880	29.6 / 29.4 / 30	28.3	28.5	31.5
1909.8	29.3 / 29.2 / 30	28.1	28.3	31.3
1900 8PSK				
1850.2	28.6 / 25.8 / 26.5	24.3	27.2	30.2
1880	28.4 / 25.6 / 26.5	24.4	27.3	30.3
1909.8	28.3 / 25.4 / 26.5	24.2	27.1	30.1
FDD II				
1852.4	26.39 / 23.85 / 23.5	21.7	24.3	27.3
1880	25.93 / 23.57 / 23.5	21.0	23.6	26.6
1907.6	25.59 / 23.49 / 23.5	21.8	23.6	26.6
FDD IV				
1712.4	26.40 / 23.54 / 23.5	21.01	23.8	26.8
1732.6	26.30 / 23.48 / 23.5	20.61	23.4	26.4
1752.6	26.32 / 23.46 / 23.5	20.42	23.4	26.4

6.1.4.5 Verification Result

(EIRP/ERP Results within FCC and IC limits and conducted results within range of documented cellular module tune-up tolerances.)

6.1.5 PEAK-AVERAGE Ratio

A Peak to average ratio measurement is performed at the conducted port of the EUT. For CDMA signals, the spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

6.1.5.1 Limits:

FCC CFR 47 §24.232 (d), FCC 27.50 (d);
RSS-132(5.4); RSS-133(6.4); RSS-139(6.4);
Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

6.1.5.2 Test Procedure:

(GSM/ EGPRS modes) = Measured Peak output power- Measured Average Output power
(UMTS Mode)= based on CCDF measurement on Spectrum Analyzer

6.1.5.3 Test Results:

Peak-Average Ratio in 850 MHz band of operation (dB)			
Channel	**GMSK**	**8PSK**	**UMTS**
Low	0.10	2.70	3.21
Mid	0.20	2.60	3.24
High	0.00	2.70	3.21

Peak-Average Ratio in 1900 MHz band of operation (dB)			
Channel	**GMSK**	**8PSK**	**UMTS**
Low	0.10	2.90	3.17
Mid	0.20	2.90	3.33
High	0.20	2.90	3.24

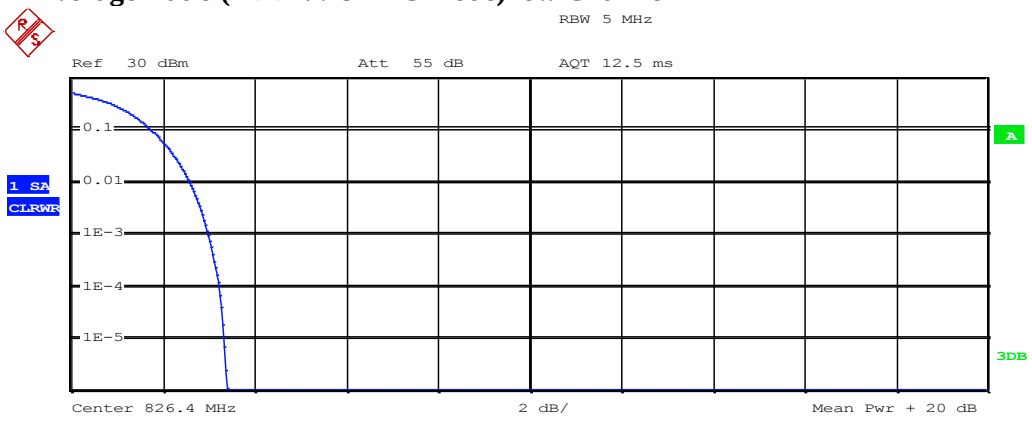
Peak-Average Ratio in 1700 MHz band of operation (dB)	
Channel	**UMTS**
Low	3.30
Mid	3.30
High	3.24

6.1.5.4 Test Verdict:

Pass

6.1.5.5 Test Data:

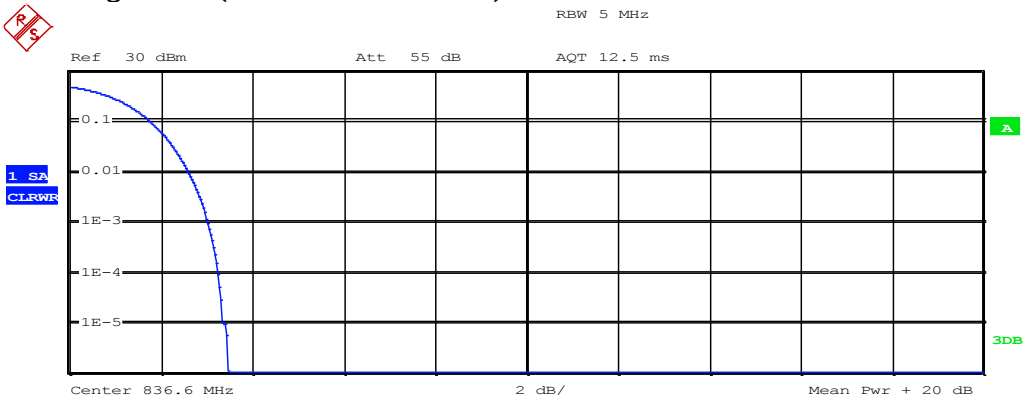
Peak-Average Ratio (FDD V: UMTS mode) low Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	17.11 dBm
Peak	20.48 dBm
Crest	3.38 dB
10 %	1.70 dB
1 %	2.56 dB
.1 %	2.98 dB
.01 %	3.21 dB

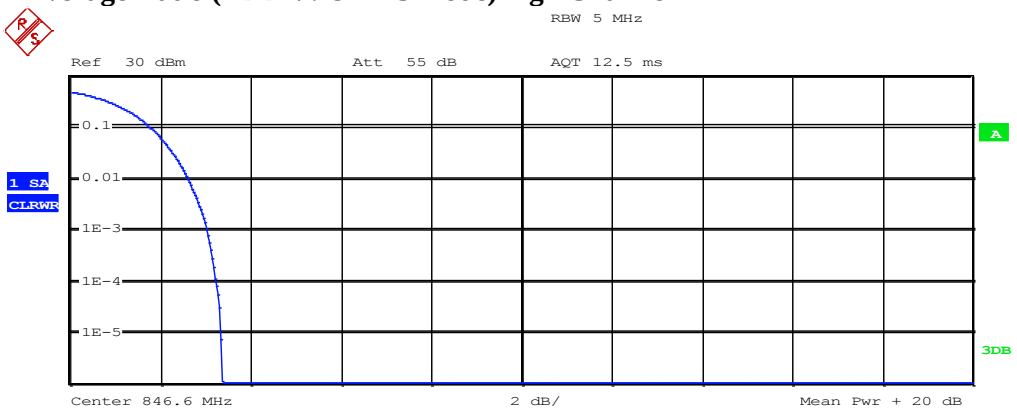
Peak-Average Ratio (FDD V: UMTS mode) mid Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	14.97 dBm
Peak	18.44 dBm
Crest	3.46 dB
10 %	1.73 dB
1 %	2.56 dB
.1 %	3.01 dB
.01 %	3.24 dB

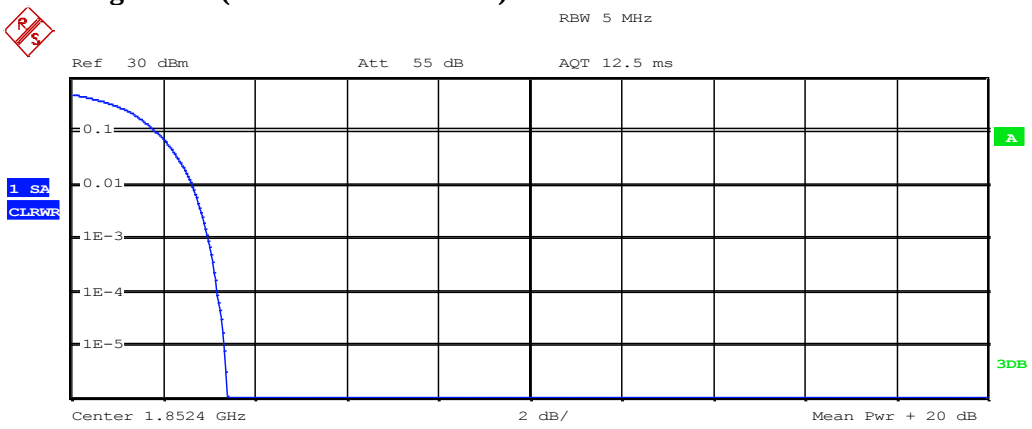
Peak-Average Ratio (FDD V: UMTS mode) high Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	18.35 dBm
Peak	21.68 dBm
Crest	3.34 dB
10 %	1.76 dB
1 %	2.60 dB
.1 %	3.01 dB
.01 %	3.21 dB

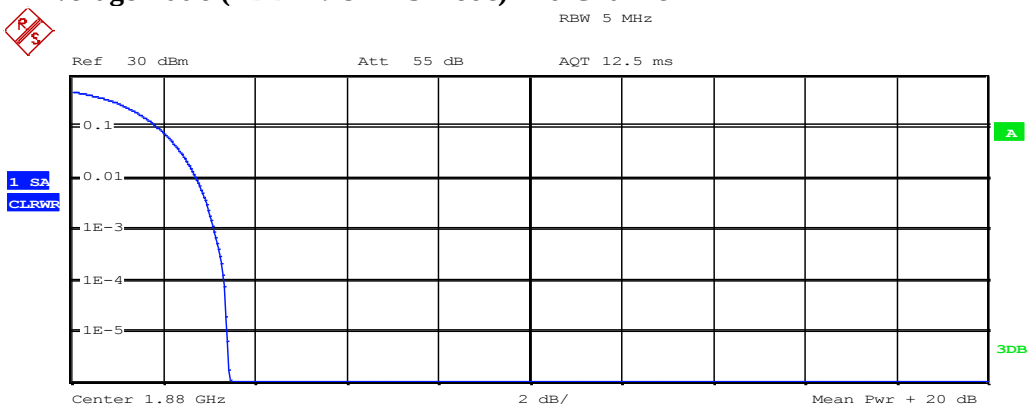
Peak-Average Ratio (FDD II: UMTS mode) low Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	15.97 dBm
Peak	19.36 dBm
Crest	3.38 dB
10 %	1.83 dB
1 %	2.60 dB
.1 %	2.98 dB
.01 %	3.17 dB

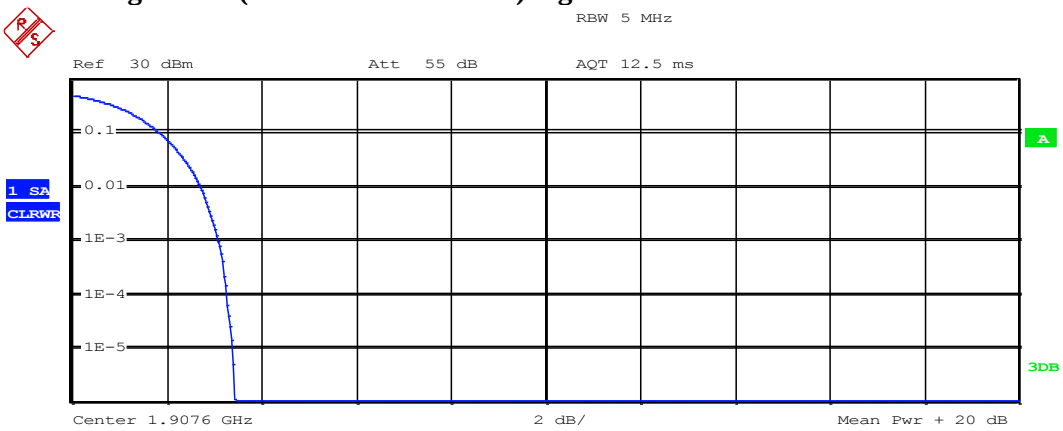
Peak-Average Ratio (FDD II: UMTS mode) mid Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	14.51 dBm
Peak	17.94 dBm
Crest	3.44 dB
10 %	1.86 dB
1 %	2.69 dB
.1 %	3.11 dB
.01 %	3.33 dB

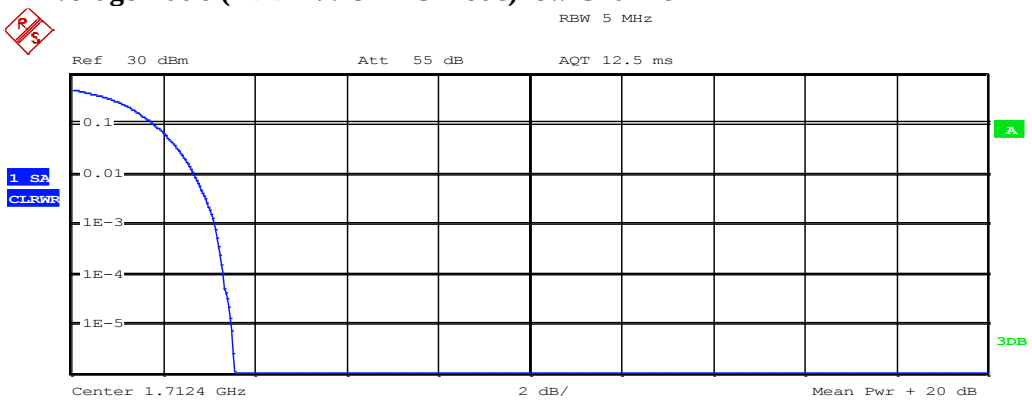
Peak-Average Ratio (FDD II: UMTS mode) high Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	16.65 dBm
Peak	20.06 dBm
Crest	3.41 dB
10 %	1.83 dB
1 %	2.69 dB
.1 %	3.08 dB
.01 %	3.24 dB

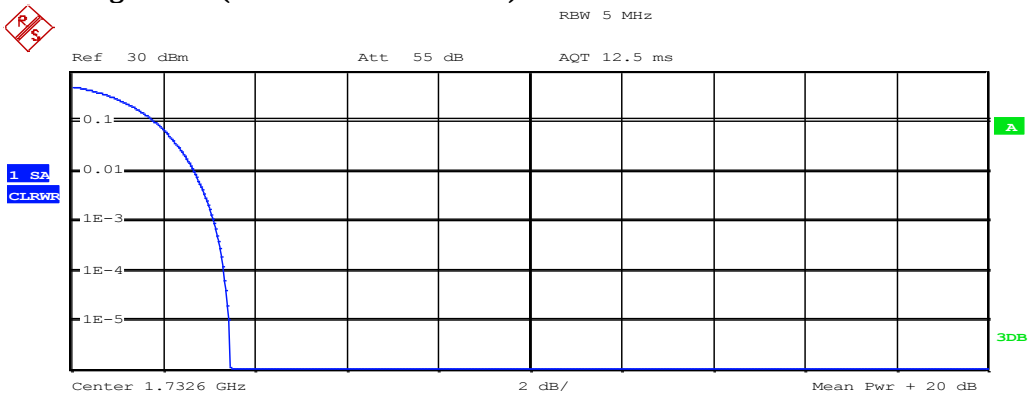
Peak-Average Ratio (FDD IV: UMTS mode) low Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	17.86 dBm
Peak	21.40 dBm
Crest	3.54 dB
10 %	1.76 dB
1 %	2.66 dB
.1 %	3.11 dB
.01 %	3.30 dB

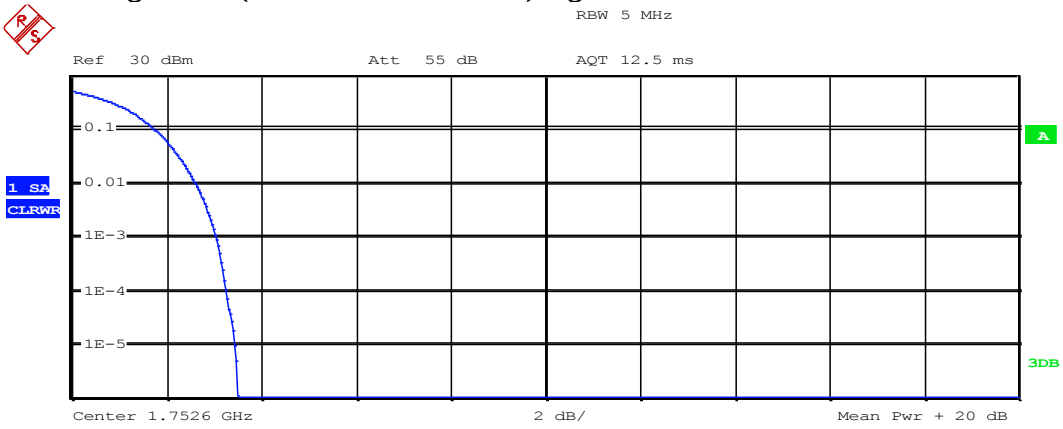
Peak-Average Ratio (FDD IV: UMTS mode) mid Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	16.95 dBm
Peak	20.41 dBm
Crest	3.46 dB
10 %	1.76 dB
1 %	2.66 dB
.1 %	3.08 dB
.01 %	3.30 dB

Peak-Average Ratio (FDD IV: UMTS mode) high Channel



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	15.23 dBm
Peak	18.72 dBm
Crest	3.49 dB
10 %	1.73 dB
1 %	2.60 dB
.1 %	3.01 dB
.01 %	3.24 dB

6.2 Spurious Emissions Radiated

6.2.1 References

FCC: CFR Part 2.1053, CFR Part 22.917, CFR Part 24.238, CFR Part 27.53
IC: RSS-Gen Section 4.9; RSS-132 Section 5.5; RSS-133 Section 6.5, RSS-139 Section 6.5

6.2.2 Measurement requirements:

6.2.2.1 FCC 2.1053: Field strength of spurious radiation.

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission.

6.2.2.2 RSS-Gen 4.9: Transmitter unwanted spurious emissions

The same parameter, peak power or average power, used for the transmitter output power measurement shall be used for unwanted emission measurements.
The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or from 30 MHz, whichever is the lower, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

6.2.3 Limits:

(a) *Out of band emissions*. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.
For all power levels +30dBm to 0dBm, this becomes a constant specification of -13dBm.

6.2.3.1 FCC 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.
(b) *Measurement procedure.* Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 100 kHz of 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

6.2.3.2 FCC 24.238 Emission limitations for Broadband PCS equipment.

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.
(b) Measurement procedure. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the

transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 100 kHz of 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

6.2.3.3 RSS-132 Section 5.5.1.1 and RSS-133 Section 6.5.1

In the first 1.0 MHz band immediately outside and adjacent to the licensee's frequency block, the power of emissions per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in watts) by at least $43 + 10 \log_{10}(P)$, dB. After the first 1.0 MHz, the power of emissions shall be attenuated below the transmitter output power by at least $43 + 10 \log_{10}(P)$, dB, in any 100 kHz bandwidth.
After the first 1.5 MHz, the power of emissions shall be attenuated below the transmitter output power by at least $43 + 10 \log_{10}(P)$, dB, in any MHz of bandwidth.

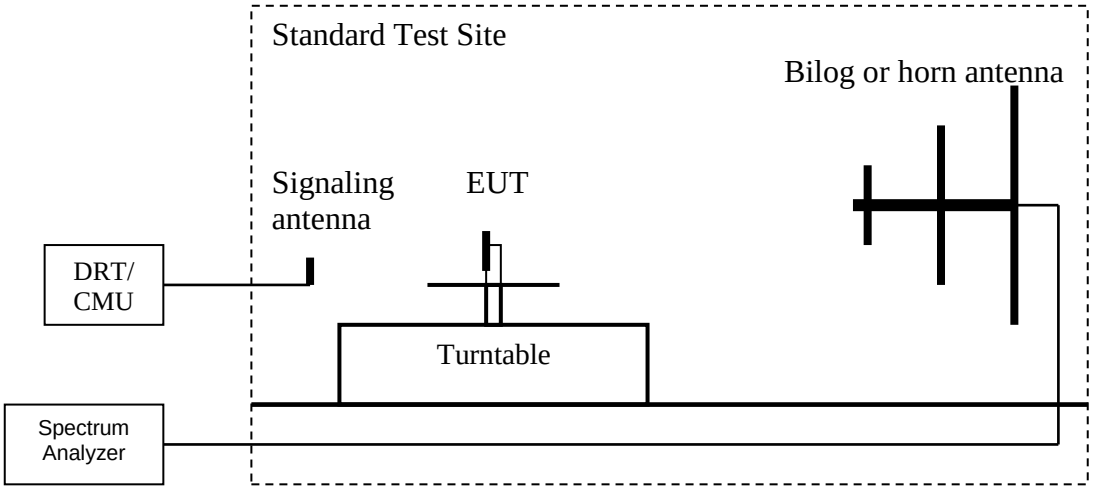
6.2.3.4 RSS-139 Section 6.5

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

After the first 1.0 MHz outside the equipment's operating frequency block, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in watts) by at least $43 + 10 \log_{10}(P)$, dB.

6.2.4 Radiated out of band measurement procedure:

Ref: TIA-603C 2004- 2.2.12 Unwanted emissions: Radiated Spurious



1. Connect the equipment as shown in the above diagram with the EUT's antenna in a horizontal orientation.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to set the EUT to its maximum power at the required channel.
3. Set the spectrum analyzer to measure peak hold with the required settings.
4. Place the measurement antenna in a horizontal orientation. Rotate the EUT 360°. Raise the measurement antenna up to 4 meters in 0.5 meters increments and rotate the EUT 360° at each height to maximize all emissions. Measure and record all spurious emissions (**LVL**) up to the tenth harmonic of the carrier frequency.
5. Replace the EUT with a horizontally polarized half wave dipole or known gain antenna. The center of the antenna should be at the same location as the center of the EUT's antenna.
6. Connect the antenna to a signal generator with known output power and record the path loss in dB (**LOSS)**. **LOSS** = Generator Output Power (dBm) – Analyzer reading (dBm).
7. Determine the level of spurious emissions using the following equation:
   Spurious (dBm) = **LVL** (dBm) + **LOSS** (dB):
8. Repeat steps 4, 5 and 6 with all antennas vertically polarized.
9. Determine the level of spurious emissions using the following equation:
   Spurious (dBm) = **LVL** (dBm) + **LOSS** (dB):
10. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.
    (N**ote:** Steps 5 and 6 above are performed prior to testing and **LOSS** is recorded by test software. Steps 3, 4 and 7 above are performed with test software.)

6.2.5 Sample Calculations for Radiated Measurements

6.2.5.1 Power Measurements using Substitution Procedure:

The measurement on the Spectrum Analyzer is used as a basis for the Substitution procedure.
The EUT is replaced with a Signal Generator and an antenna. The setting on the Signal Generator is varied until the Spectrum Analyzer displays the original reading. EIRP is calculated as-

EIRP (dBm)= Signal Generator setting (dBm)- Cable Loss (dB)+ Antenna Gain (dBi)

Example:

Frequency (MHz)	Measured SA (dBµV)	Signal Generator setting (dBm)	Antenna Gain (dBi)	Dipole Gain (dBd)	Cable Loss (dB)	EIRP (dBm)
1000	95.5	24.5	6.5	0	3.5	27.5

6.2.6 Measurement Survey:

The site is constructed in accordance with ANSI C63.4 requirements and is recognized by the FCC to be in compliance for a 3m site. The spectrum is scanned from 30MHz to the 10th harmonic of the highest frequency generated by the EUT.
Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of the 850 MHz and 1900 MHz bands of operation.
It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the GSM-850 MHz and the PCS-1900 MHz band into any of the other blocks respectively. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

Radiated emission measurements were made in GMSK (1 uplink slot) and UMTS RMC 12.2k. Additional spot checks in mid channel of operation for all modes were performed with the slimmer battery option of the device.

For radiated measurements, all data in this report shows the worst case emissions data between H/V antenna polarizations and for all 3 orthogonal orientations of the EUT.

Unless mentioned otherwise, the emission signals above the limit line in the plots are from the carrier.

6.2.7 Test Conditions:

Tnom: 20^{o}C; Vnom: 3.6 V

6.2.8 Test Results:

6.2.8.1 Test Results Transmitter Spurious Emission GSM850:

Harmonic	Tx ch-128 Freq. (MHz)	Level (dBm)	Tx ch-190 Freq. (MHz)	Level (dBm)	Tx ch-251 Freq. (MHz)	Level (dBm)
1	**824.2**	31.1	**836.6**	20.6	**848.8**	30.8
2	**1648.4**	-20.0	**1673.2**	-20.7	**1697.6**	-20.1
3	**2472.6**	NF	**2509.8**	NF	**2546.4**	NF
4	**3296.8**	NF	**3346.4**	NF	**3395.2**	NF
5	**4121**	NF	**4183**	NF	**4244**	NF
6	**4945.2**	NF	**5019.6**	NF	**5092.8**	NF
7	**5769.4**	NF	**5856.2**	NF	**5941.6**	NF
8	**6593.6**	NF	**6692.8**	NF	**6790.4**	NF
9	**7417.8**	NF	**7529.4**	NF	**7639.2**	NF
10	**8242**	NF	**8366**	NF	**8488**	NF
NF = Noise Floor Measurement Uncertainty: ±3dB						

6.2.8.2 Test Results Transmitter Spurious Emission UMTS FDDV

Harmonic	Tx ch-4132 Freq. (MHz)	Level (dBm)	Tx ch-4183 Freq. (MHz)	Level (dBm)	Tx ch-4233 Freq. (MHz)	Level (dBm)
1	**826.4**	10.6	**836.6**	16.0	**846.6**	17.0
2	**1652.8**	NF	**1673.2**	NF	**1693.2**	NF
3	**2479.2**	NF	**2509.8**	NF	**2539.8**	NF
4	**3305.6**	NF	**3346.4**	NF	**3386.4**	NF
5	**4132**	NF	**4183**	NF	**4233**	NF
6	**4958.4**	NF	**5019.6**	NF	**5079.6**	NF
7	**5784.8**	NF	**5856.2**	NF	**5926.2**	NF
8	**6611.2**	NF	**6692.8**	NF	**6772.8**	NF
9	**7437.6**	NF	**7529.4**	NF	**7619.4**	NF
10	**8264**	NF	**8366**	NF	**8466**	NF
NF= Noise Floor Measurement Uncertainty: ±3dB						

6.2.8.3 Test Results Transmitter Spurious Emission PCS-1900:

Harmonic	Tx ch-512 Freq.(MHz)	Level (dBm)	Tx ch-661 Freq. (MHz)	Level (dBm)	Tx ch-810 Freq. (MHz)	Level (dBm)
1	**1850.2**	30.0	**1880.0**	30.4	**1909.8**	29.2
2	**3700.4**	NF	**3760**	NF	**3819.6**	NF
3	**5550.6**	NF	**5640**	NF	**5729.4**	NF
4	**7400.8**	NF	**7520**	NF	**7639.2**	NF
5	**9251**	NF	**9400**	NF	**9549**	NF
6	**11101.2**	NF	**11280**	NF	**11458.8**	NF
7	**12951.4**	NF	**13160**	NF	**13368.6**	NF
8	**14801.6**	NF	**15040**	NF	**15278.4**	NF
9	**16651.8**	NF	**16920**	NF	**17188.2**	NF
10	**18502**	NF	**18800**	NF	**19098**	NF
NF = Noise Floor Measurement Uncertainty: ±3dB						

6.2.8.4 Test Results Transmitter Spurious Emission UMTS FDD2:

Harmonic	Tx ch-9262 Freq. (MHz)	Level (dBm)	Tx ch-9400 Freq. (MHz)	Level (dBm)	Tx ch-9538 Freq. (MHz)	Level (dBm)
1	**1852.4**	16.5	**1880.0**	20.0	**1907.6**	20.0
2	**3704.8**	NF	**3760**	NF	**3815.2**	NF
3	**5557.2**	NF	**5640**	NF	**5722.8**	NF
4	**7409.6**	NF	**7520**	NF	**7630.4**	NF
5	**9262**	NF	**9400**	NF	**9538**	NF
6	**11114.4**	NF	**11280**	NF	**11445.6**	NF
7	**12966.8**	NF	**13160**	NF	**13353.2**	NF
8	**14819.2**	NF	**15040**	NF	**15260.8**	NF
9	**16671.6**	NF	**16920**	NF	**17168.4**	NF
10	**18524**	NF	**18800**	NF	**19076**	NF
NF= Noise Floor Measurement Uncertainty: ±3dB						

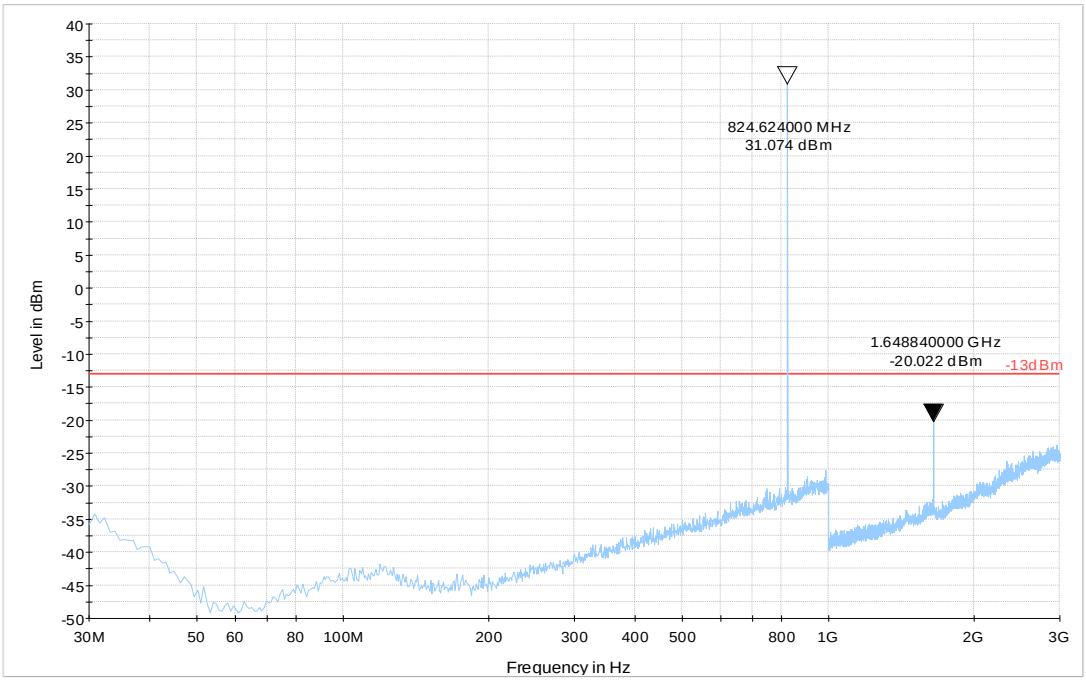
6.2.8.5 Test Results Transmitter Spurious Emission UMTS FDD4:

Harmonic	Tx ch-1312 Freq. (MHz)	Level (dBm)	Tx ch-1413 Freq. (MHz)	Level (dBm)	Tx ch-1513 Freq. (MHz)	Level (dBm)
1	1712.4	NF	1732.6	NF	1752.6	NF
2	3424.8	NF	3465.2	NF	3505.2	NF
3	5137.2	NF	5197.8	NF	5257.8	NF
4	6849.6	NF	6930.4	NF	7010.4	NF
5	8562	NF	8663	NF	8763	NF
6	10274.4	NF	10395.6	NF	10515.6	NF
7	11986.8	NF	12128.2	NF	12268.2	NF
8	13699.2	NF	13860.8	NF	14020.8	NF
9	15411.6	NF	15593.4	NF	15773.4	NF
10	17124	NF	17326	NF	17526	NF
NF= Noise Floor Measurement Uncertainty: ±3dB						

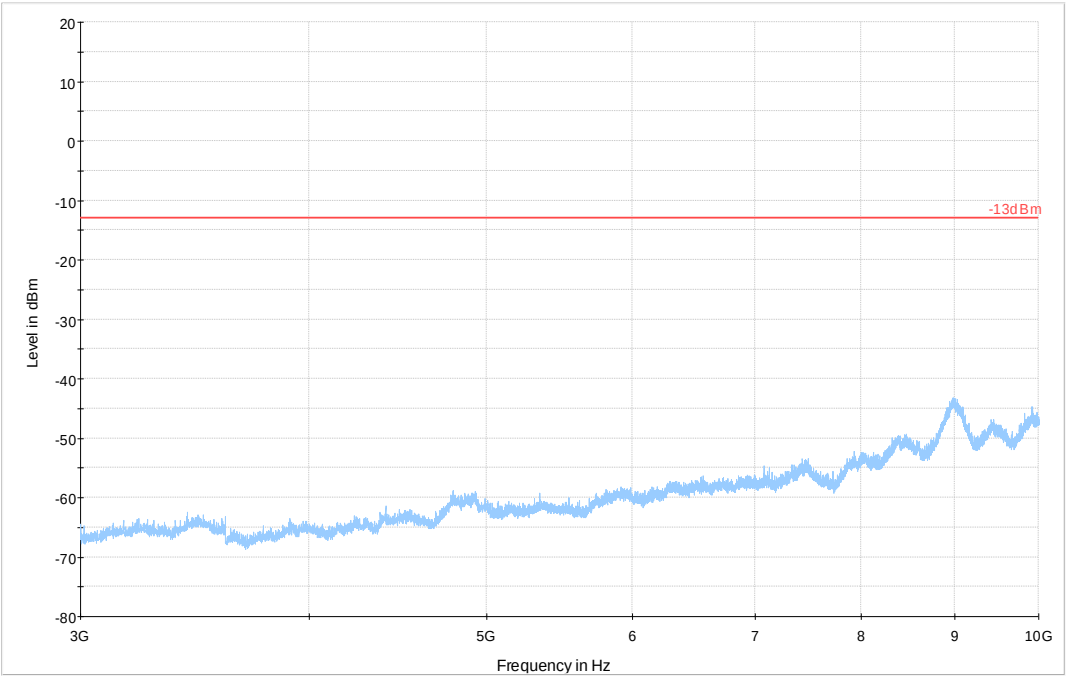
6.2.8.6 Plots:

Radiated Spurious Emissions (GSM-850) Tx: Low Channel

Test results 30MHz-3GHz

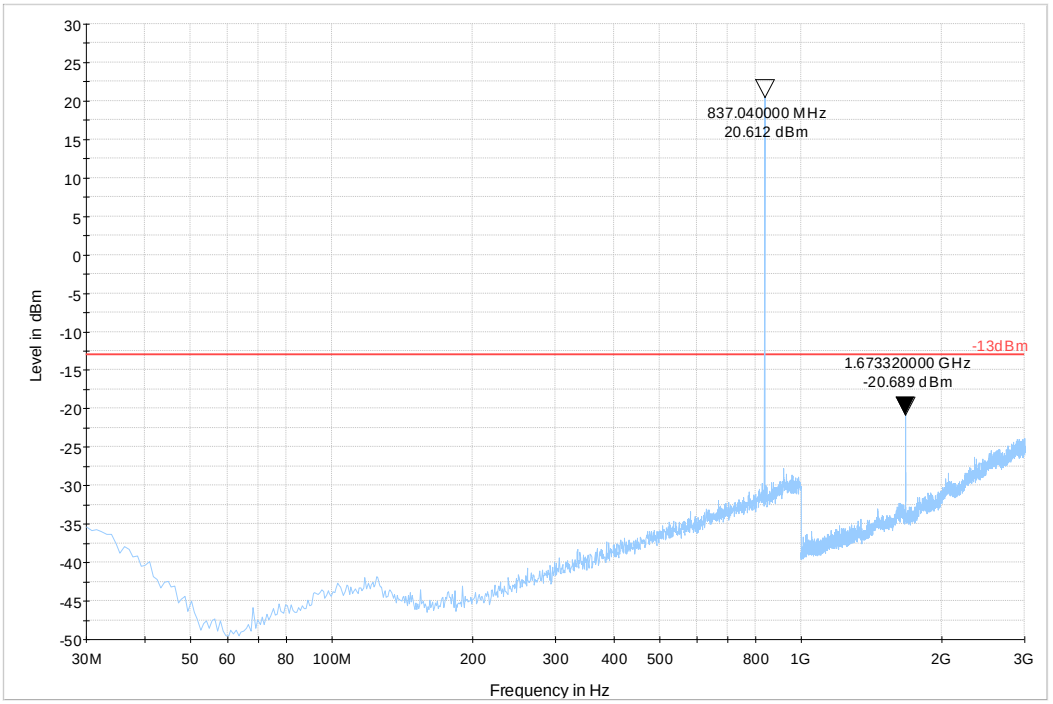


Test results 3GHz-10Hz

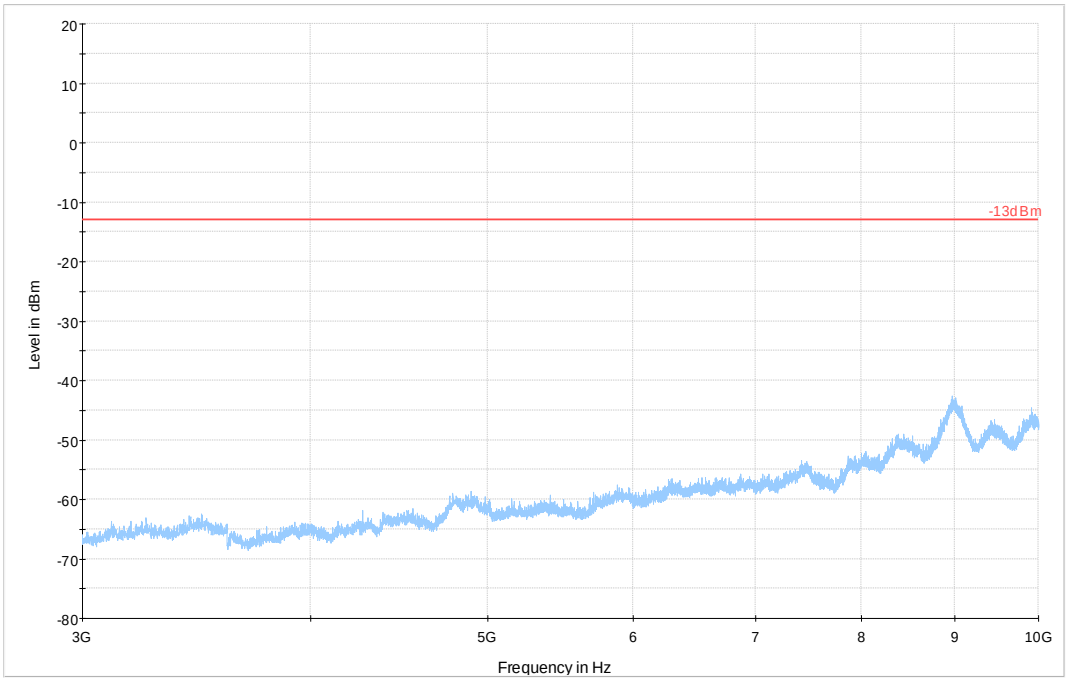


Radiated Spurious Emissions (GSM-850) Tx: Mid Channel

Test results 30MHz-3GHz

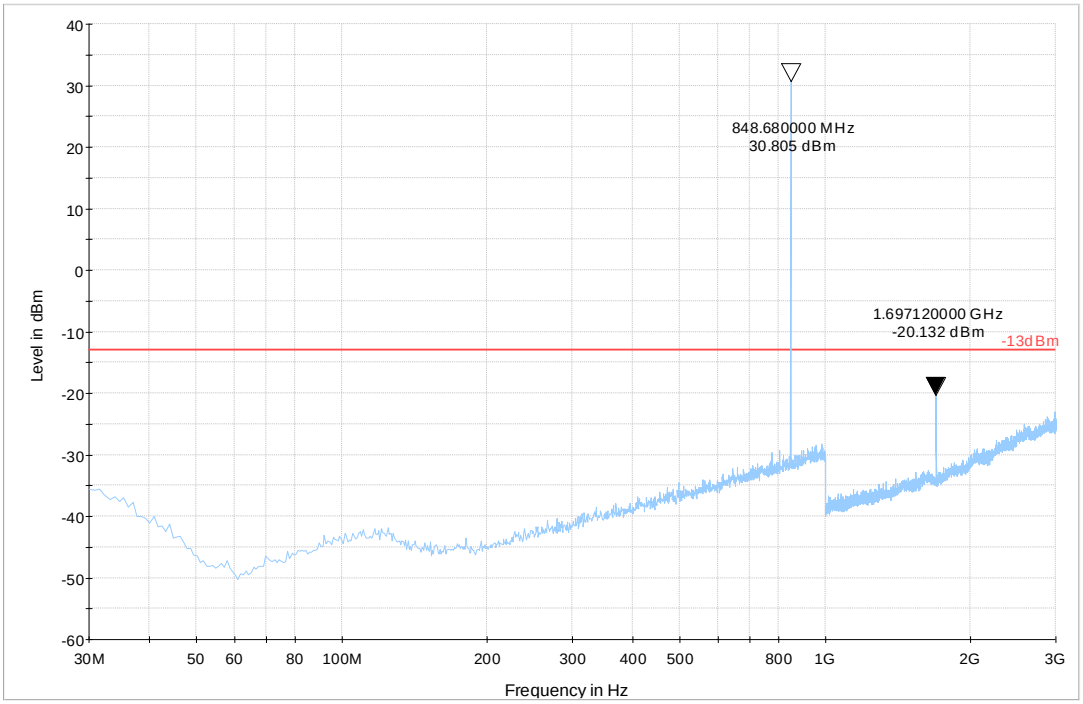


Test results 3GHz-10GHz

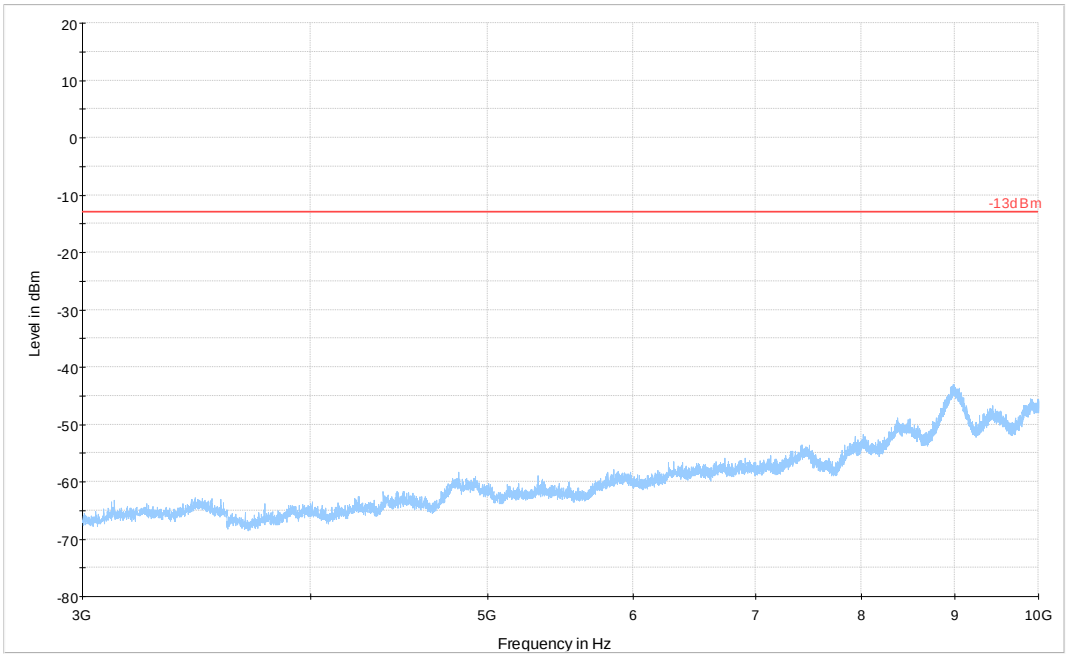


Radiated Spurious Emissions (GSM-850) Tx: High Channel

Test results 30MHz-3GHz

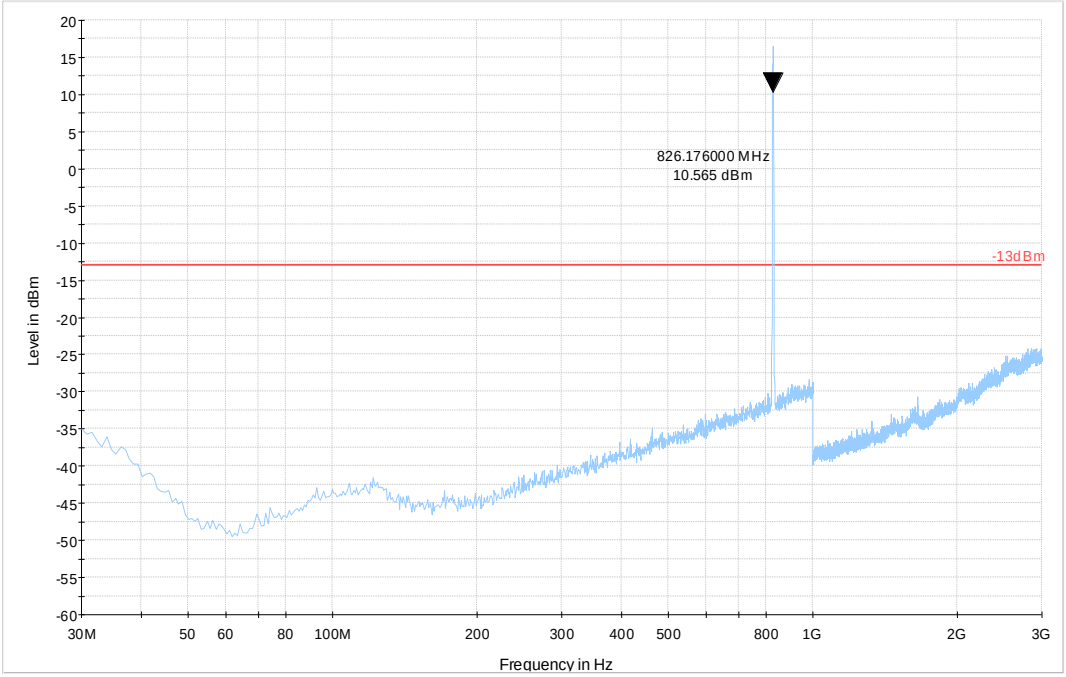


Test results 3GHz-10GHz

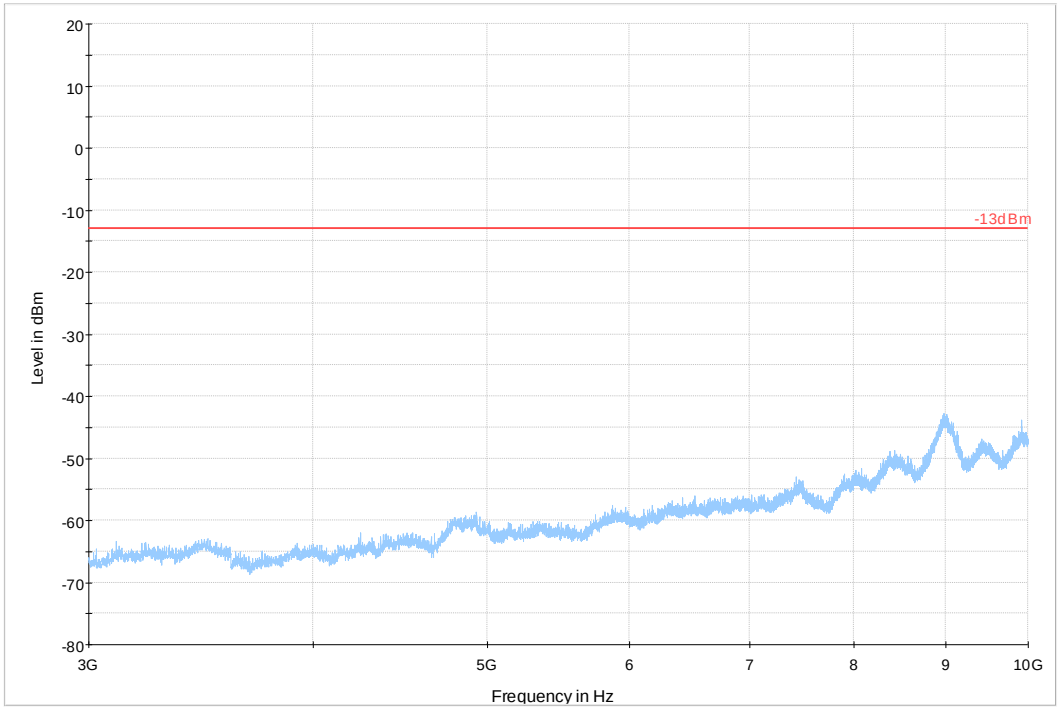


Radiated Spurious Emissions (UMTS Band 5) Tx: Low Channel

Test results 30MHz-3GHz

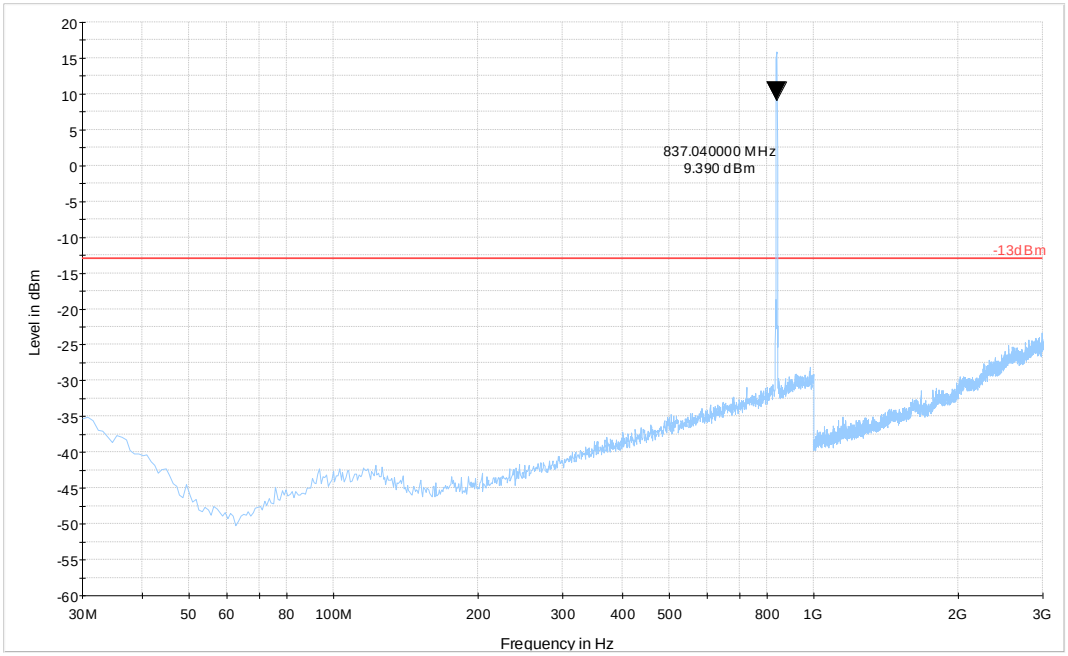


Test results 3GHz-10GHz

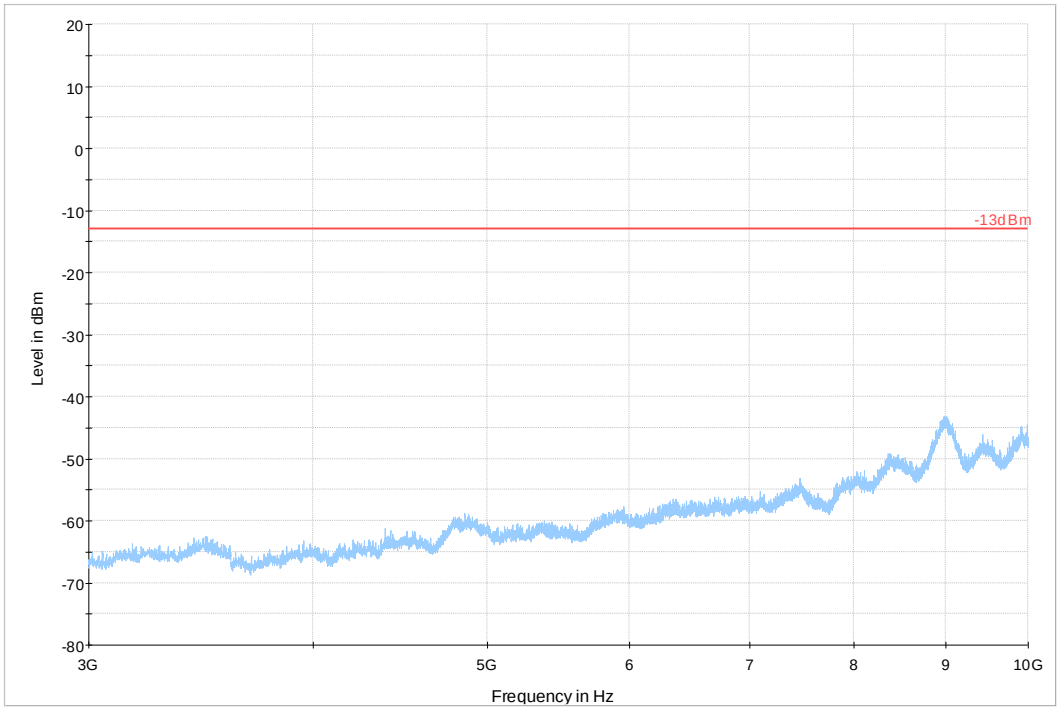


Radiated Spurious Emissions (UMTS Band 5) Tx: Mid Channel

Test results 30MHz-3GHz

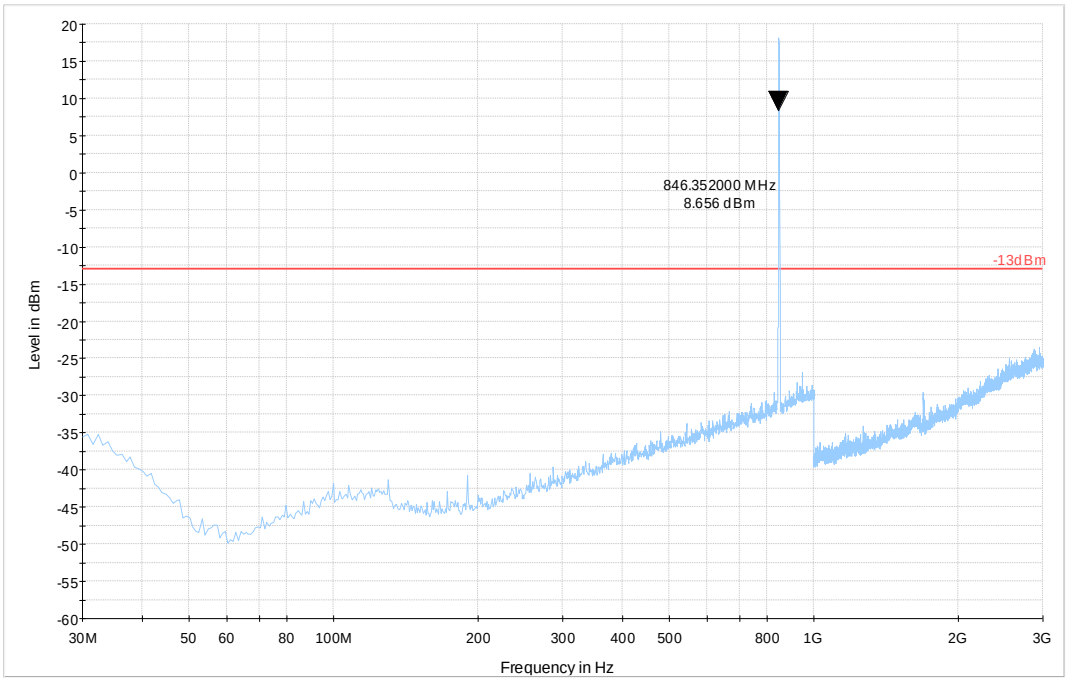


Test results 3GHz-10GHz

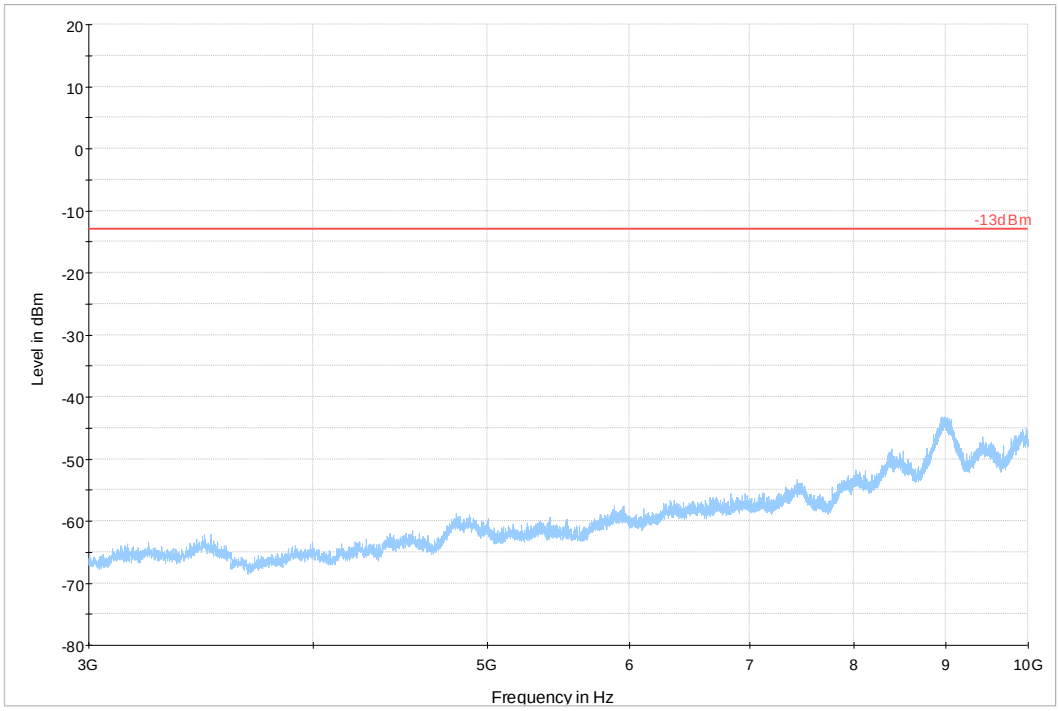


Radiated Spurious Emissions (UMTS Band 5) Tx: High Channel

Test results 30MHz-3GHz

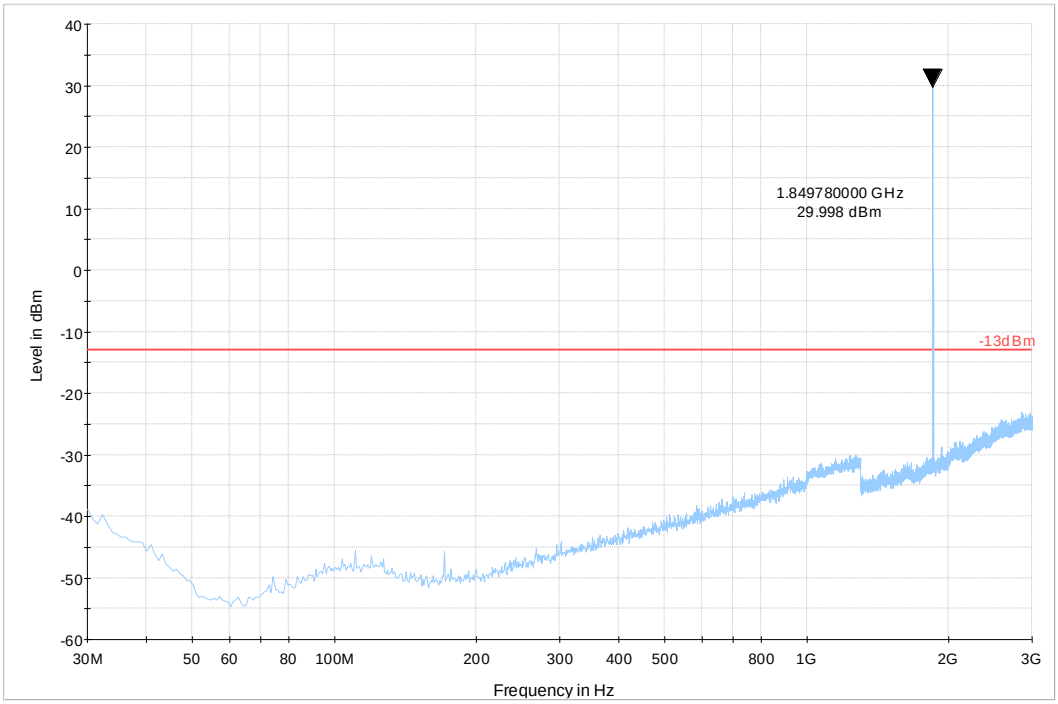


Test results 3GHz-10GHz

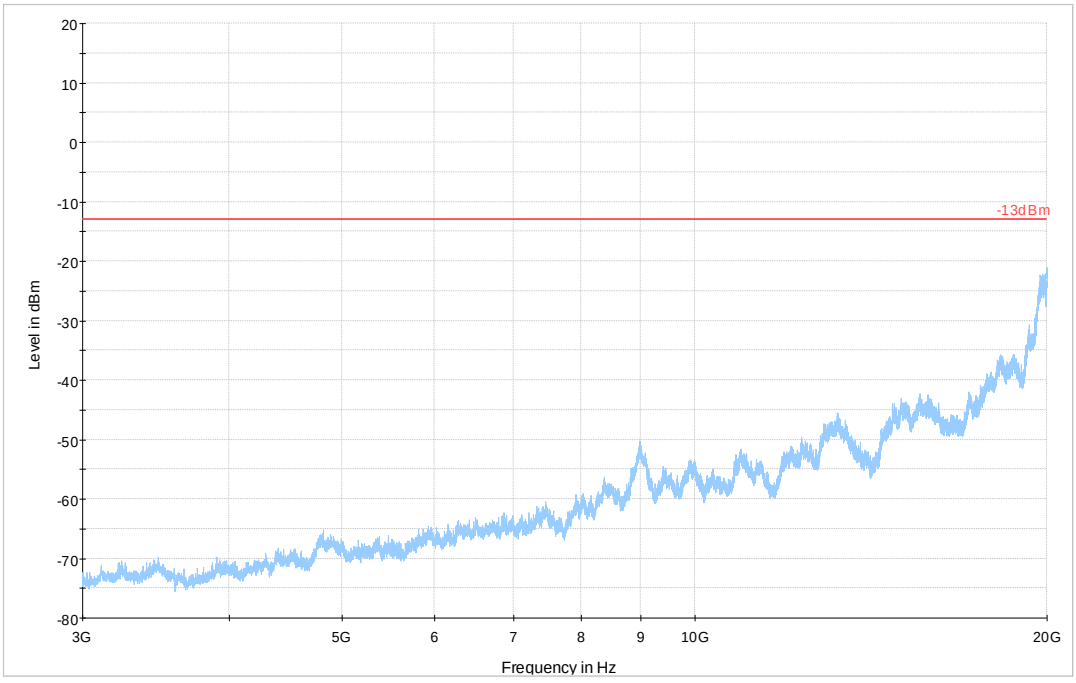


Radiated Spurious Emissions (GSM-1900) Tx: Low Channel

Test results 30MHz-3GHz

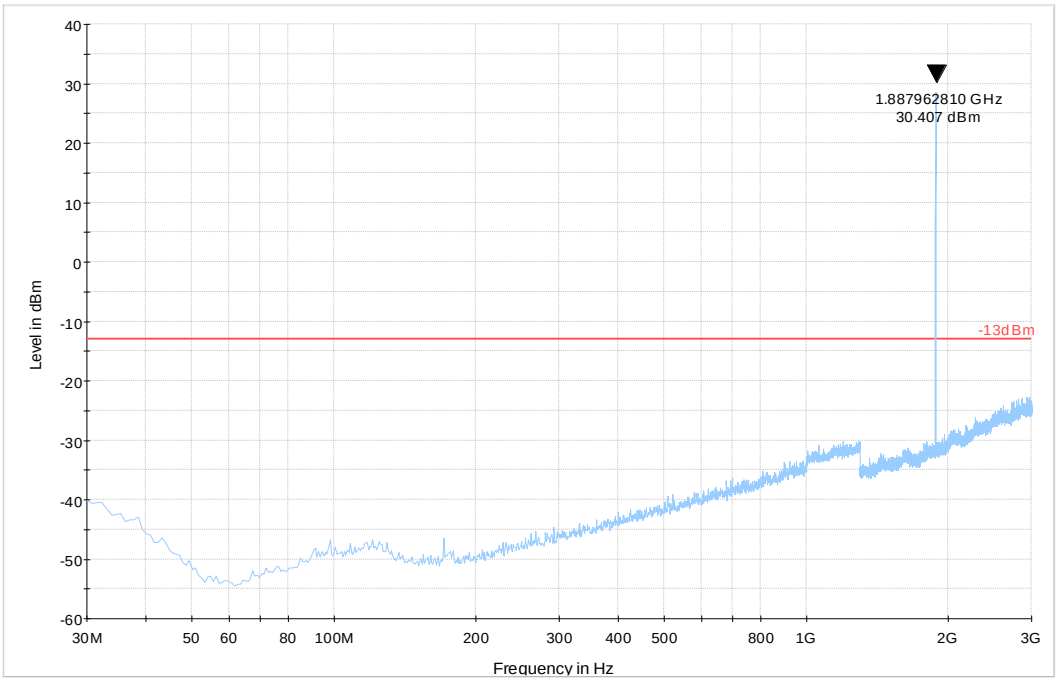


Test results 3GHz-20GHz

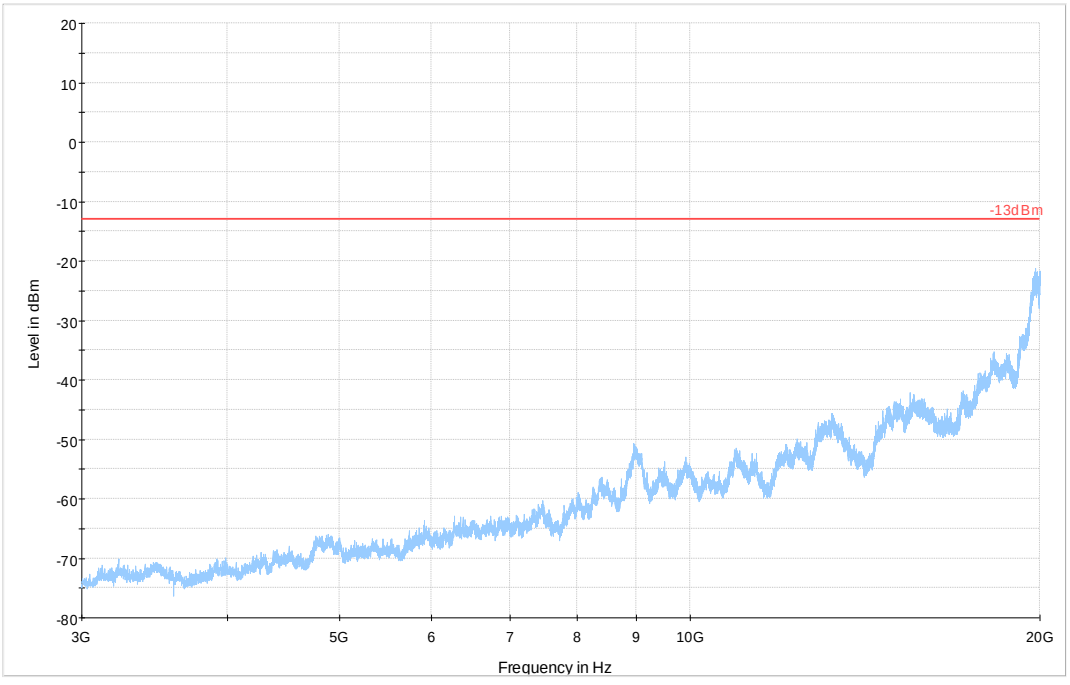


Radiated Spurious Emissions (GSM-1900) Tx: Mid Channel

Test results 30MHz-3GHz

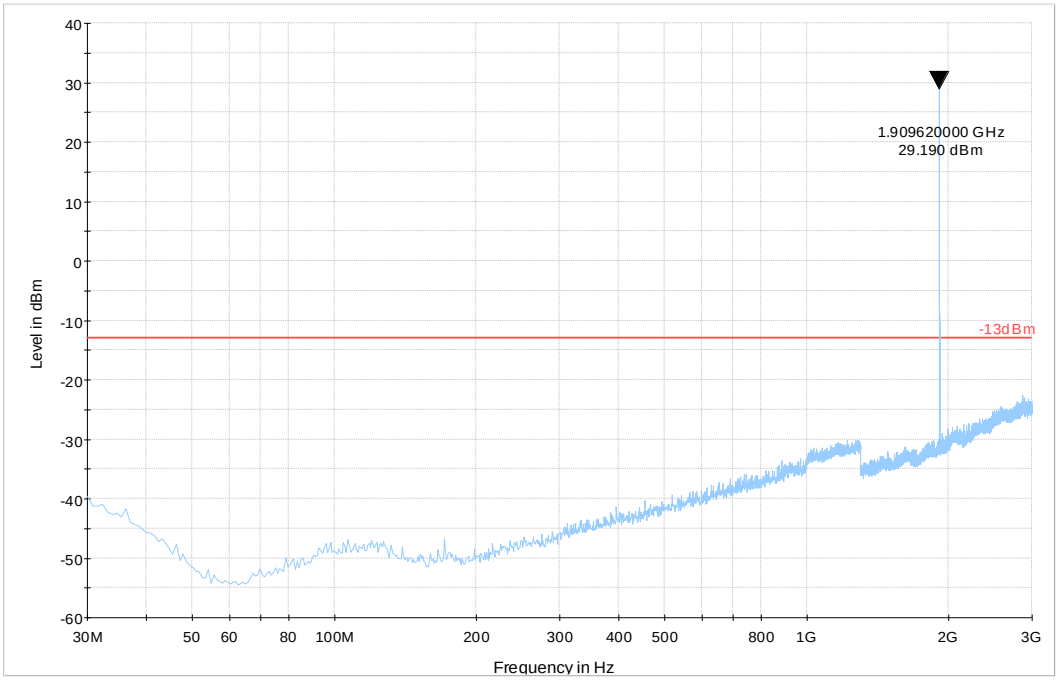


Test results 3GHz-20GHz

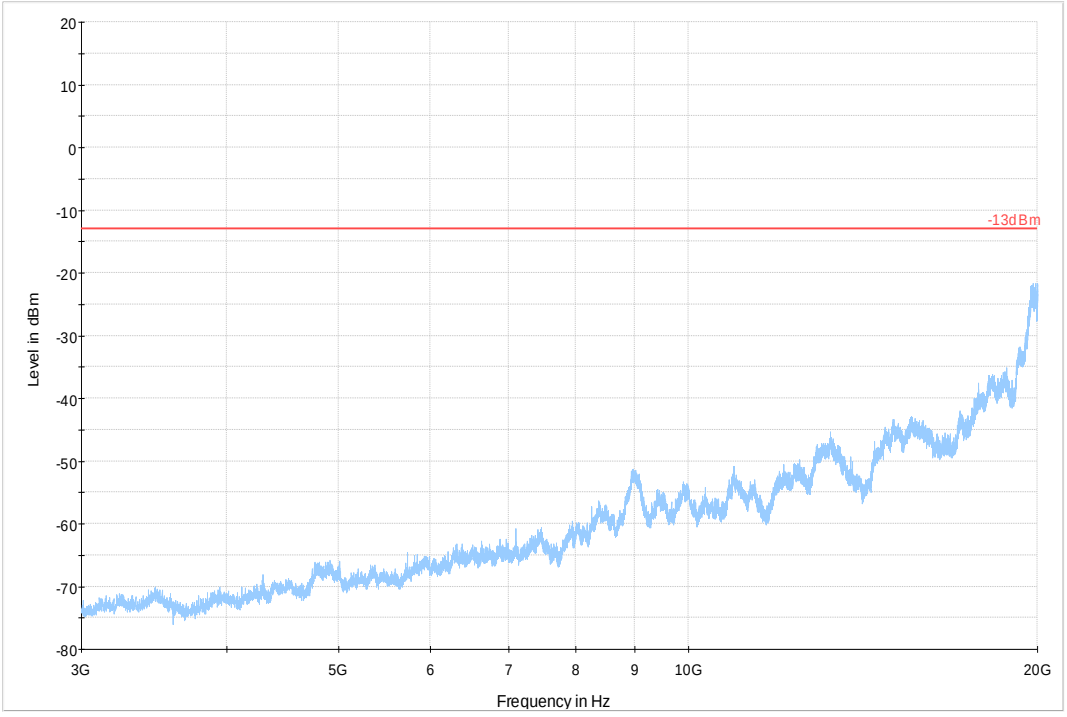


Radiated Spurious Emissions (GSM-1900) Tx: High Channel

Test results 30MHz-3GHz

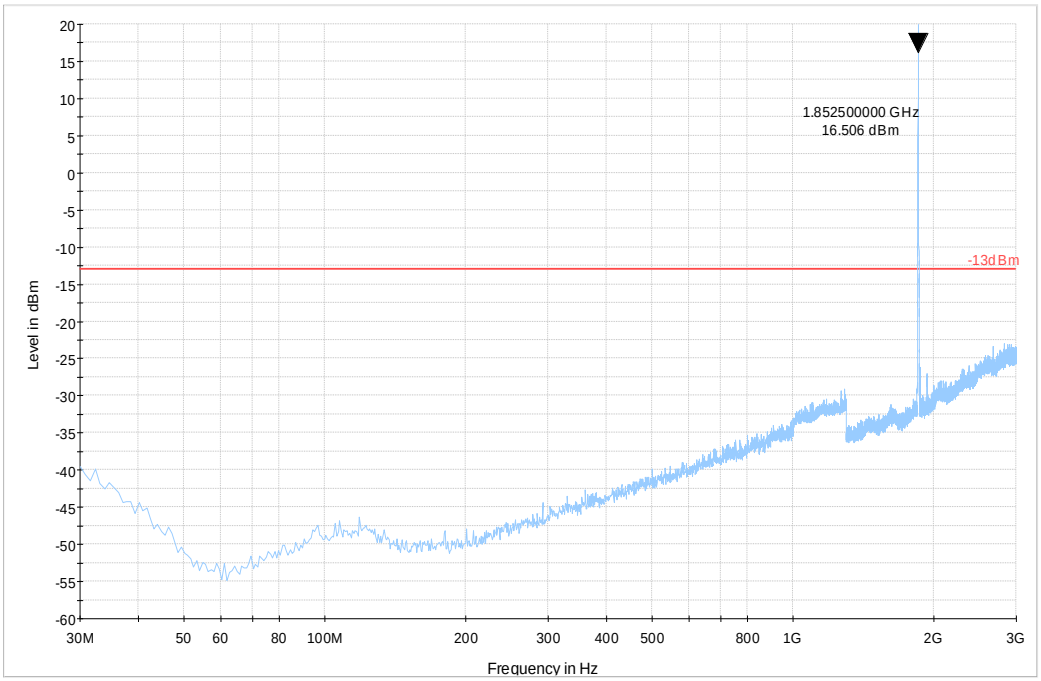


Test results 3GHz-20GHz

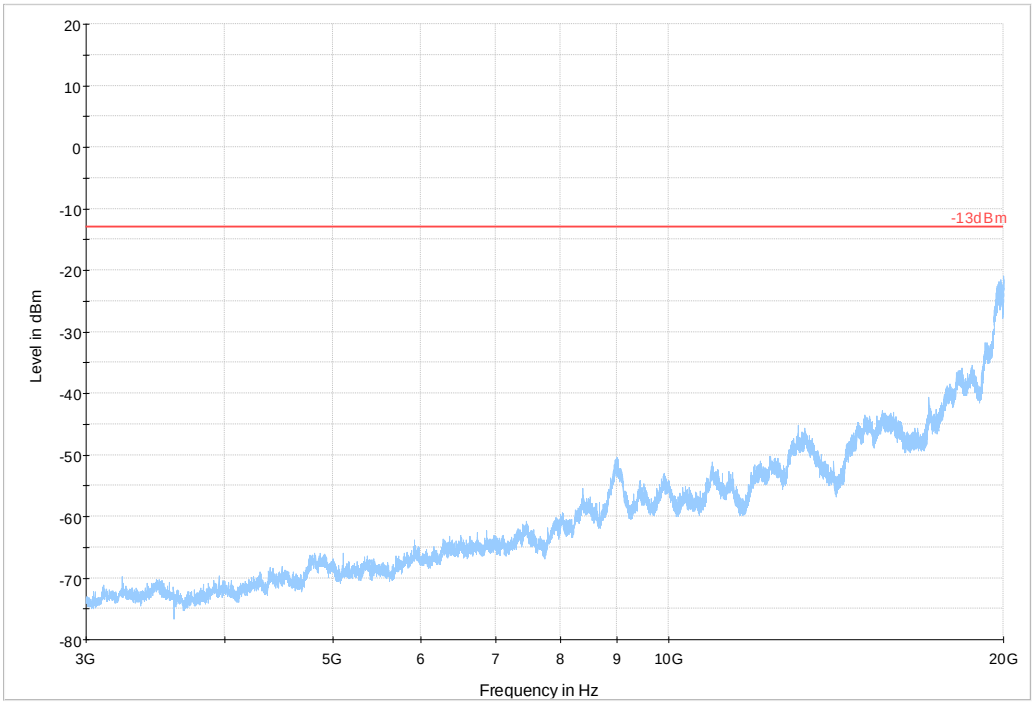


Radiated Spurious Emissions (UMTS Band 2) Tx: Low Channel

Test results 30MHz-3GHz

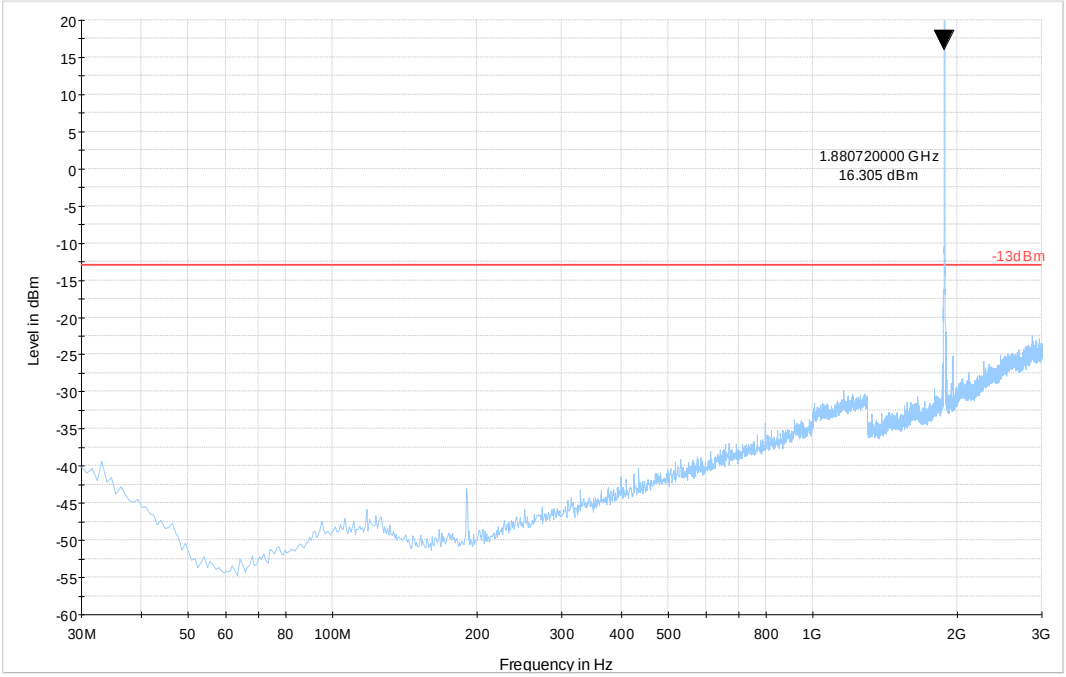


Test results 3GHz-20GHz

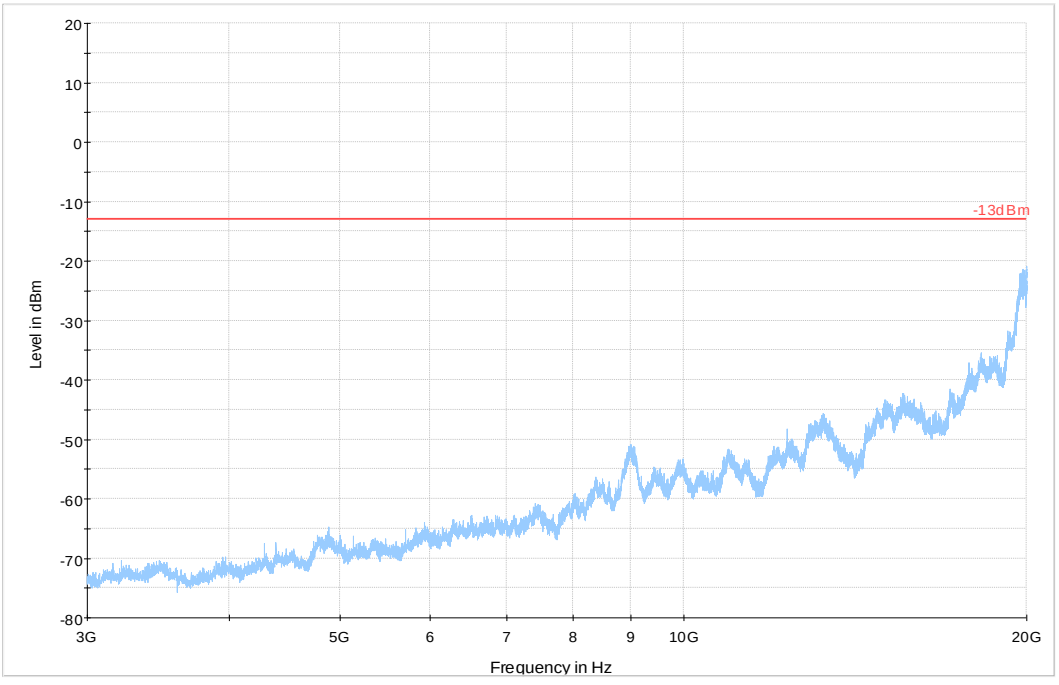


Radiated Spurious Emissions (UMTS Band 2) Tx: Mid Channel

Test results 30MHz-3GHz

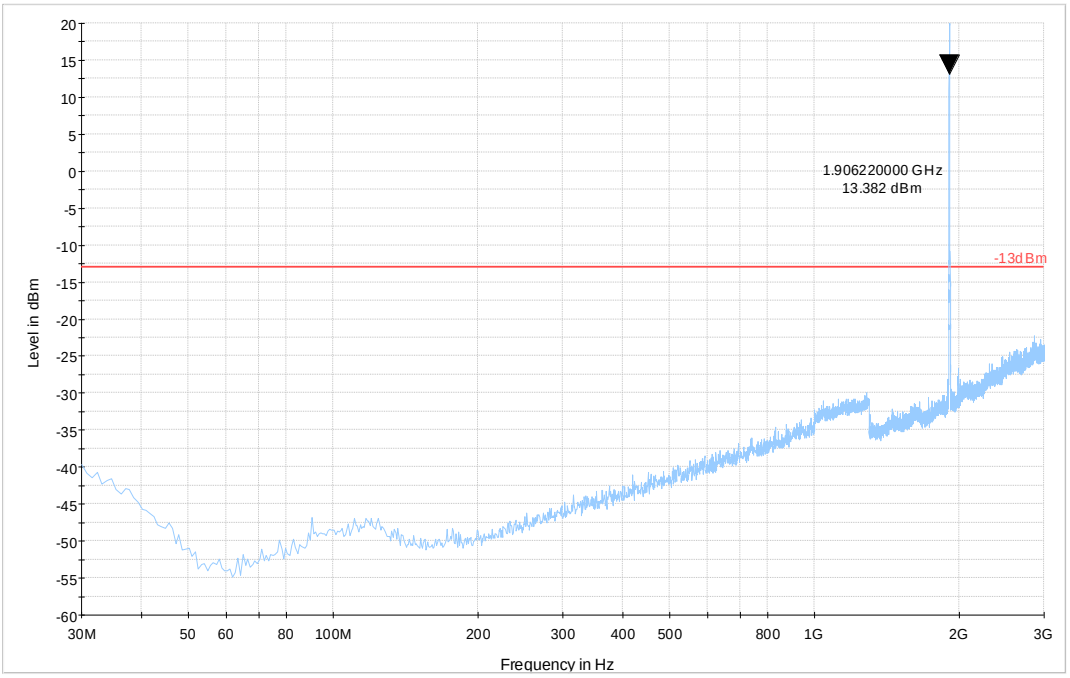


Test results 3GHz-20GHz

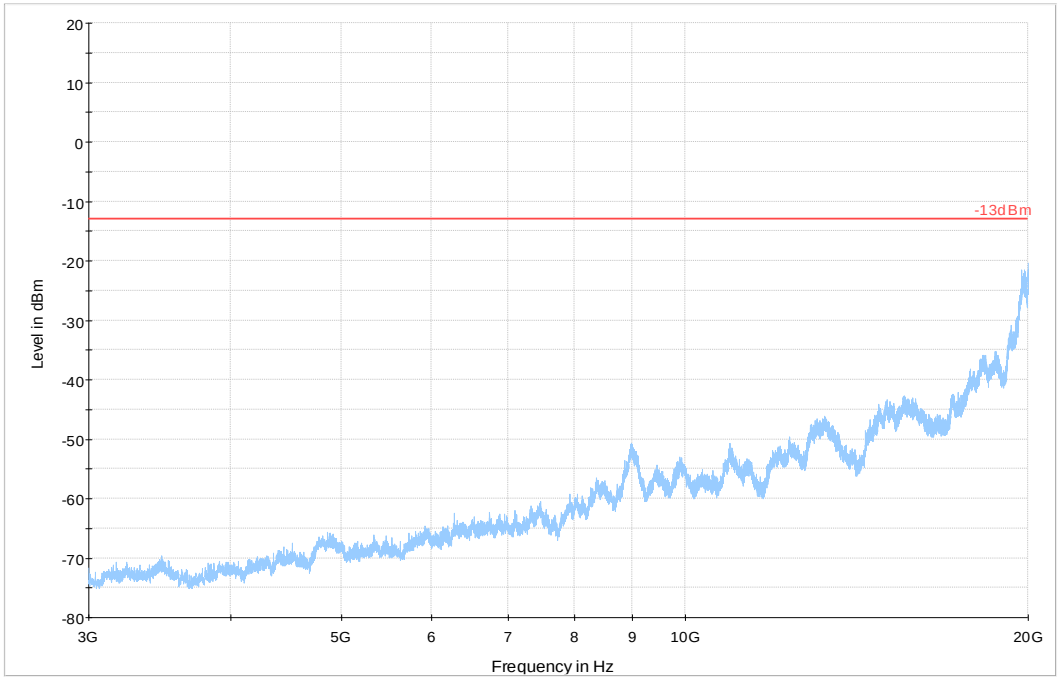


Radiated Spurious Emissions (UMTS Band 2) Tx: High Channel

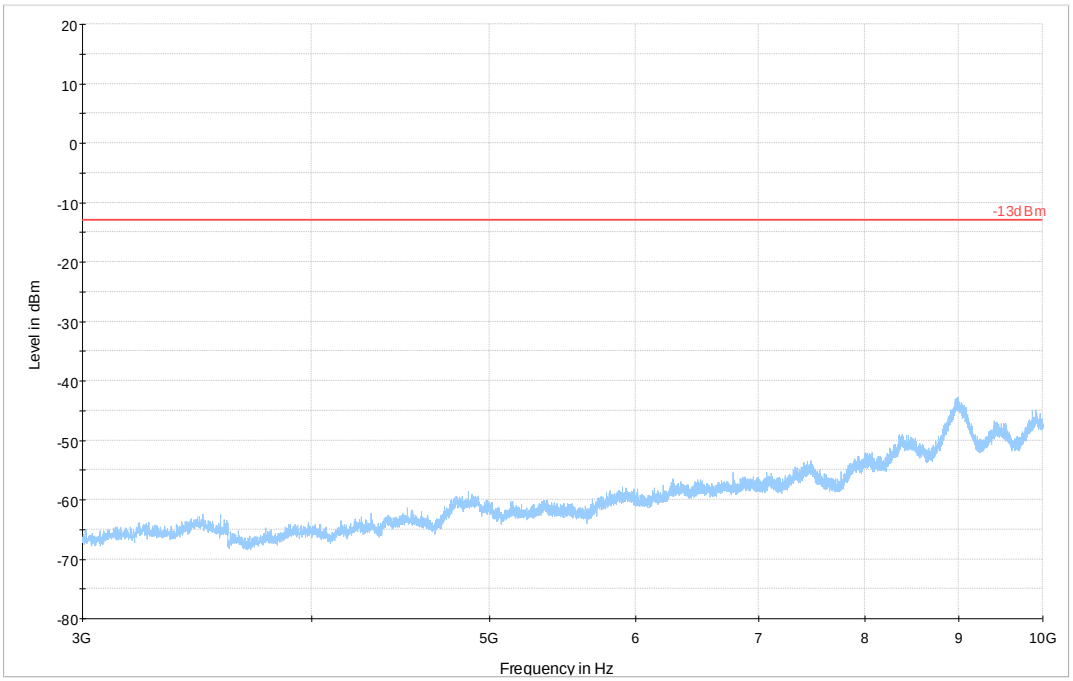
Test results 30MHz-3GHz



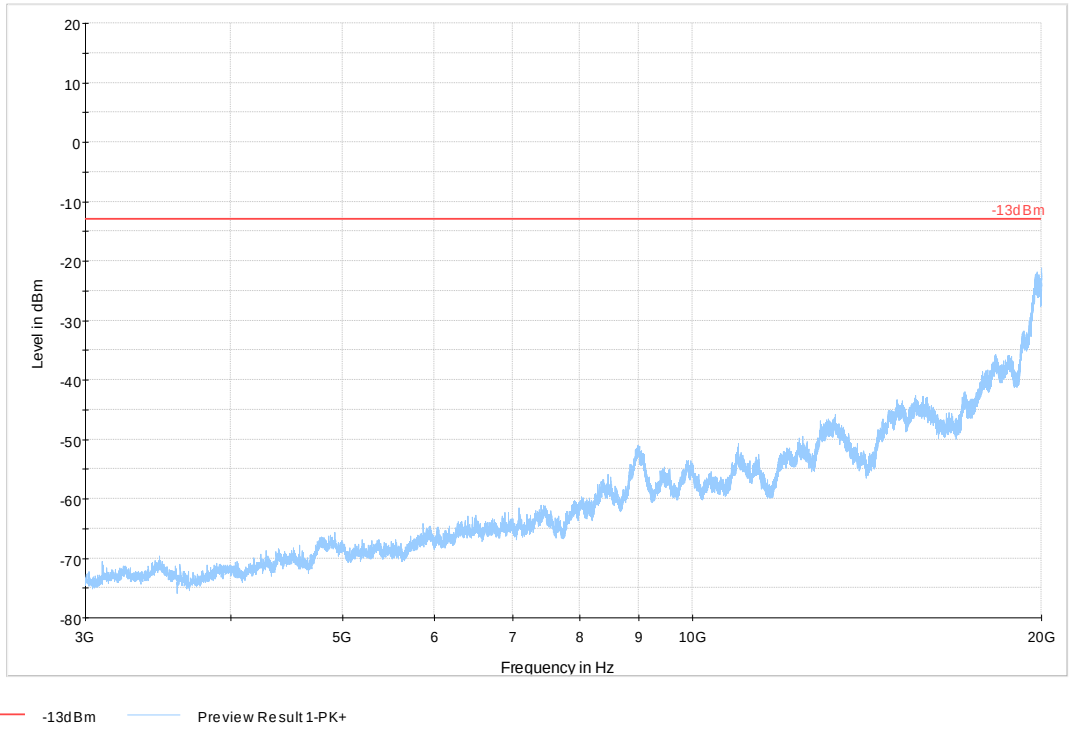
Test results 3GHz-20GHz



Radiated Spurious Emissions (GSM-850) Rx
Test results 3GHz-10GHz



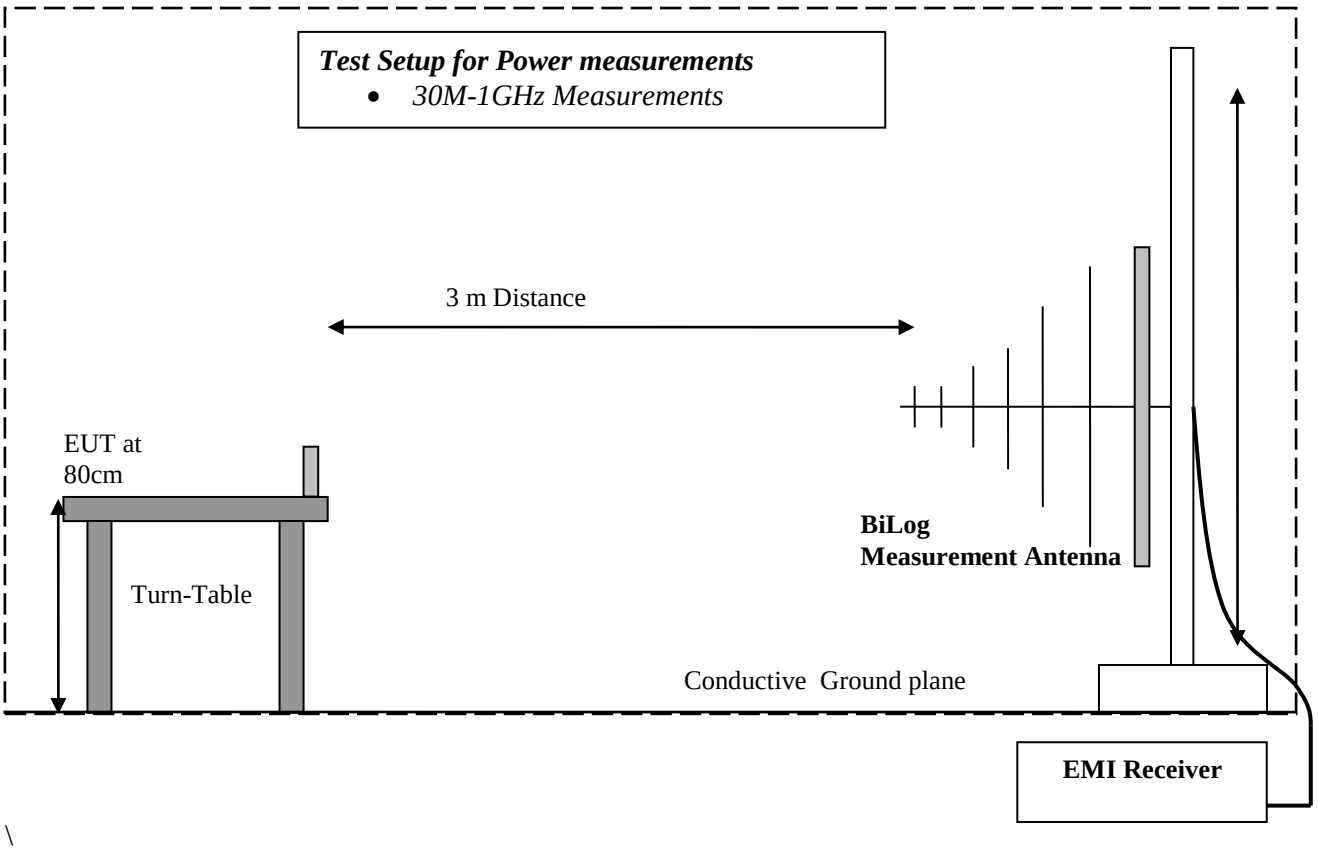
Radiated Spurious Emissions (GSM-1900) Rx
Test results 3GHz-10GHz



7 Test Equipment and Ancillaries used for tests

Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
Radio Communication Tester	CMU 200	Rohde & Schwarz	110759	June 2013	2 Years
EMI Receiver/Analyzer	ESU 40	Rohde & Schwarz	100251	Sept 2013	2 Years
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	June 2013	2 Years
Loop Antenna	6512	EMCO	00049838	Apr 2012	3 years
Biconilog Antenna	3141	EMCO	0005-1186	Mar 2012	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Mar 2012	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035114	Apr 2012	3 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Aug 2011	3 years
Communication Antenna	IBP5-900/1940	Kathrein	n/a	n/a	n/a
High Pass Filter	5HC2700	Trilithic Inc.	9926013	Part of system calibration	
High Pass Filter	4HC1600	Trilithic Inc.	9922307	Part of system calibration	
6GHz High Pass Filter	HPM50106	Microtronics	001	Part of system calibration	
Pre-Amplifier	JS4-00102600	Miteq	00616	Part of system calibration	
LISN	50-25-2-08	FCC	08014	Jan 2013	1 year
Power Smart Sensor	R&S	NRP-Z81	100161	May 2011	2 Years
DC Power Supply	6655A	Hewlett Packard	3403A-00487	n/a	n/a
Multimeter	MM200	Klein	N/A	Apr 2011	2 Years
Temp Hum Logger	TM320	Dickson	03280063	Apr 2013	1 Year
Temp Hum Logger	TM325	Dickson	5285354	Apr 2013	1 Year

8 Test Setup Diagrams



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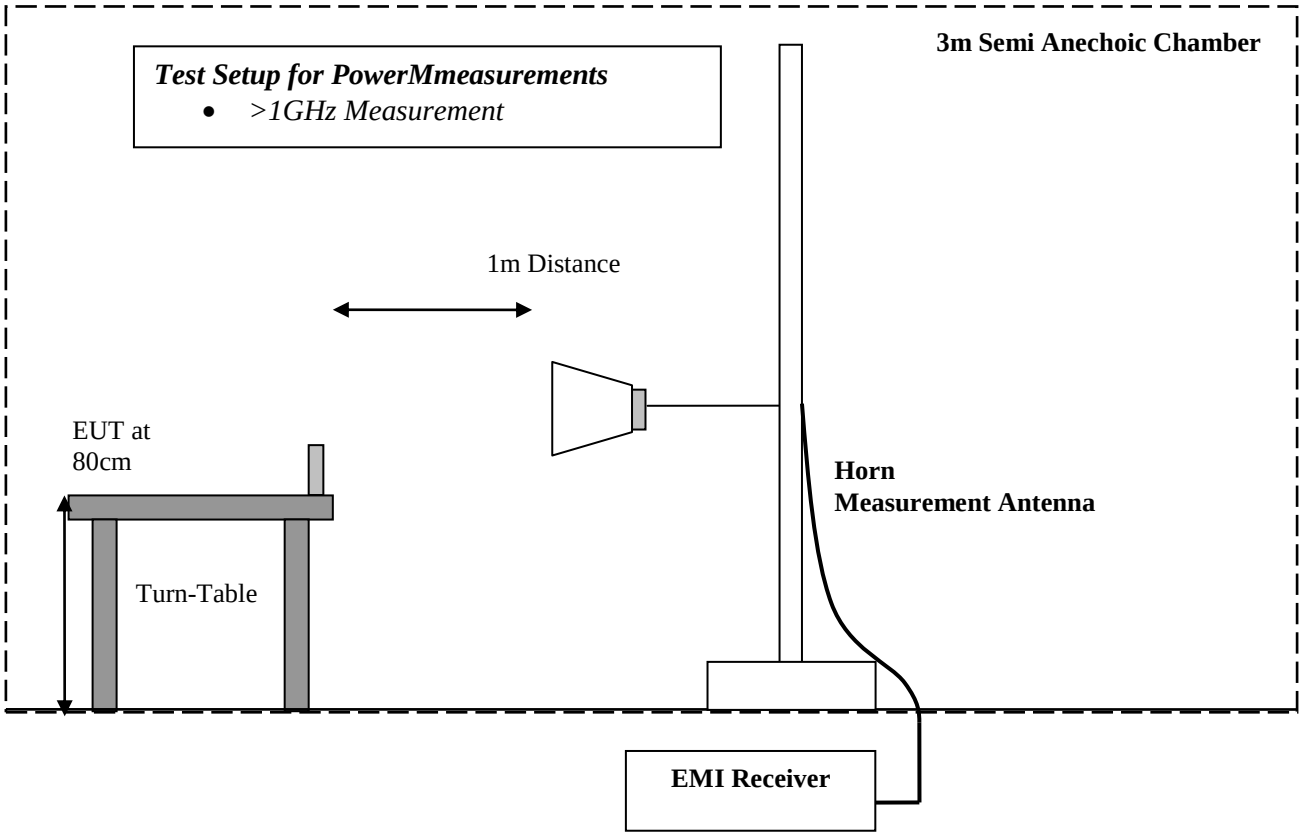
3m Semi Anechoic Chamber
Test Setup for PowerMmeasurements
>1GHz Measurement
1m Distance
EUT at
80cm
Turn-Table
Horn
Measurement Antenna
EMI Receiver

9 Revision History

Date	Change Description	Revision
2014-01-15	n.a.	initial
2014-01-27	minor typo corrections (channel number, etc.)	Rev. 1