FCC/IC Test Report

FOR:

Teledyne Controls

Wireless Groundlink® – Quick Access Recorder

FCC ID: SYK-WQAR-364-4R
IC ID: 11369A-WQAR3644R
Model Number: 2243800-364

47 CFR Part 2, 22, 24

RSS-GEN Issue 3, RSS-132 Issue 3, RSS-133 Issue 6

TEST REPORT #: EMC_TELED-004-12001_364_WWAN_Rev2
DATE: 2014-02-06

***CETECOM* Inc.**
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1 Assessment

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

Company	Description	Model #
Teledyne Controls	Wireless Groundlink® – Quick Access Recorder	2243800-364

Report reviewed by:

Date	Section	Name	Signature
2014-02-06	Compliance	Franz Engert (Manager of Compliance)	Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Complience, email=franz.engert@cetecom.com Date: 2014.02.07 10:51:35 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2014-02-06	Compliance	Josie Sabado (Test Lab Manager)	

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:	Josie Sabado

2.2 Identification of the Client

Applicant's Name:	Teledyne Controls
Street Address:	501 Continental Boulevard
City/Zip Code	El Segundo, CA 90245
Country	USA
Contact Person:	Fariz Kalim
Phone No.	+1 (847) 962-6126
e-mail:	fkalim@teledyne.com

2.3 Identification of the Manufacturer

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

2.4 Environmental conditions during Test:

Ambient Temperature: 20-25^{o}C
Relative humidity: 40-60%

2.5 Dates of Testing:

Jun 3, 2013-Jul 5, 2013.

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Description:	**Wireless Groundlink® – Quick Access Recorder**
FCC-ID:	**SYK-WQAR-364-4R**
IC certification no.:	**11369A-WQAR3644R**
Model Number (IC model number):	**2243800-364**
Product Description:	3G radio transceiver equipment intended for aircraft on-ground-communication with airline operator back office. The device incorporates 4 identical 3G multiband cellular modules (see details below). It is equipped with 2 external cellular antennas each of which is shared by 2 of the 4 cellular modules over a 2:1 combiner. The 4 modules operate independent, un-coordinated and completely uncorrelated in the sence of KDB662911 D01 Multiple Transmitter Output v02r01 clause F)1). No advanced antenna technology is utilized like (MIMO, beamforming , cross-polarization etc.).
HW / SW Version :	2243800-364 / 711745 D
Technology / Type(s) of Modulation:	see the following spec of the incorporated cellular module:
Integrated Module Info:	Sierra Wireless Airprime MC8705; HW Rev 1.0, SW Rev. T1.0.3.2 FCC ID: N7NMC8705; IC ID: 2417C-MC8705 • 850/900/1800/1900Mhz GSM/GPRS/EDGE; 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); • 2 UFL antenna connectors, one for main and one for rx diversity
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 V: 1852.4 – 1907.6; 103 channels;
Antenna details:	PanguTech LLC, model: JQRD-0018-AGDPU; peak gain: 2dBi nom.; multiple band 800/900/1800/1900/2100MHz; vertical polarized; omni-directional; SMA connector; The documented total loss from the 3G module's UFL connectors to the external antenna over the 2:1-combiner is 3.33dB @ 850MHz and 4.43dB @ 1900MHz;
Rated Operating Voltage:	110VDC (Low) / 116VDC (Nominal) / 122VDC (Max), 360-800Hz
Rated Operating Temperature Range:	–10°C ~ +55°C
Test Sample Status:	Production

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes
1	RA00025	2243800-364	711745 D	-/-

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number
1	Power Supply	Behlman	BL1350A-1-L	04540
2	50µH/50Ω LISN	COM-Power	LI-125	191092
3	50µH/50Ω LISN	COM-Power	LI-125	191093
4	Cellular Antenna	Pangu Tech LLC	JQRD-0018-AGDPU	--

3.4 Other Testing Notes:

1. 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).
2. The EUT is tested on the low, mid and high channel of each of the supported cellular operation modes.
3. The measurements have been applied with the one single out of the 4 identical transmitter modules active which has been determined to produce the highest conducted output power at the external antenna connector.
4. As instructed per related individual KDB inquiry towards FCC relevant principles of the published KDB662911 D01 Multiple Transmitter Output v02r01 have been applied for measurement and presentation of the test results where relevant.
5. 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 #SRTC2010-H024-E0017 and #SRTC2010-H024-E0018, issued by The State Radio Monitoring Center, Testing Center (SRTC), Beijing, China, on 2010-12-02, of the certification of the integrated 3G module (see section 3.1).

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to measure the performance of the EUT as specified by requirements listed in the following test standards:

- 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
- 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

This test report is to support a request for new equipment authorization under the FCC ID **SYK-WQAR-364-4R** and IC ID **11369A-WQAR3644R.**

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 identified above.

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 identified above.

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
IC: RSS-Gen Section 4.8; RSS 132 Section 5.4; RSS 133 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.

(b) Mobile/portable stations are limited to 2 Watts effective isotropic radiated power (EIRP).
(c) 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 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 over the full bandwidth of the channel.

6.1.3.3 RSS-132 Section 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.

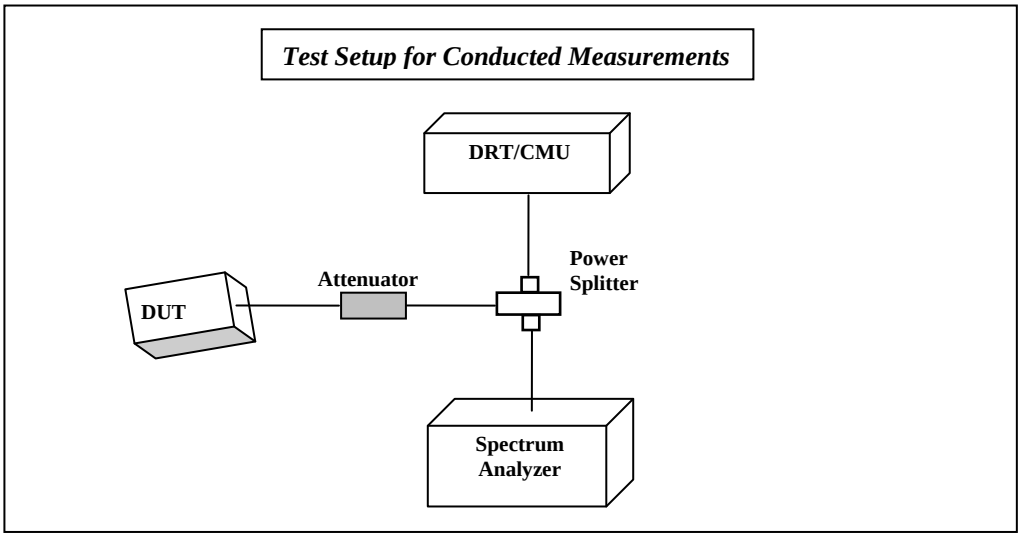
6.1.3.4 RSS-133 Section 6.4

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 continuous transmission.

6.1.4 Conducted Output Power Measurement and ERP/EIRP Determination

6.1.4.1 Measurement Procedure:

Ref: TIA-603C, 2004, cl. 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 output power level (peak and/or average, as appropriate) 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.
6. ERP/EIRP values are calculated from the conducted output power results by adding the rated peak antenna gain.

Measurement Uncertainty= +/- 0.5 dB

6.1.4.2 Test Conditions:

Tnom: 21^{o}C; Vnom: 115 V

6.1.4.3 Results:

ERP/EIRP values in following tables are determined from the conducted output power values measured with the one out of the 4 incorporated identical modules which was determined by pre-measurement to produce the highest output power and by adding the rated peak antenna gain of 2dBi (ERP = EIRP-2.15dB);

For comparison and verification of the conducted output power with the values from pre-certification of the 3G module the documented total path loss (from cable, connectors) of 3.3dB at 850MHz and 4.4dB at 1900MHz is added to the average result as measured at the external SMA antenna connector (see below column „Measured Average Output Power @ SMA connector / @module‘s UFL connector“)
The rated maximum conducted average power given in column “Measured Average Output Power from module‘s test report / rated average max.“ are taken from the „AirPrime MC8705 PCI Express Mini Card Product Specification, Rev. 5 Mar.11“ available from the homepage of the module provider.

The manufacturer has confirmed that the 4 incorporated cellular modules operate independent of each other, un-coordinated and completely uncorrelated in the context of KDB662911 D01 Multiple Transmitter Output v02r01 clause F)1). None of the conditions in clause F)1) is fulfilled in the EUT. Therefore, the array gain from the two available antennas can be assumed to be zero.
Simultaneous transmission data is provided for two transmitters sharing one antenna, which is accomplished by adding the single transmitter EIRP/ERP values for each mode and measured channel to the EIRP/ERP value of the highest output power within the respective band.
The rows in bold letters in the result table below indicate the highest power mode and channel within a band, for which the single and simultaneous transmission ERP/EIRP is additionally provided in Watts.

All output power values in dBm, unless indicated otherwise.

Frequency (MHz)	Measured Average Output Power from module's test report / rated average max.	Measured Average Output Power @ SMA connector / @ module's UFL connector	Measured Peak Output Power @ SMA connector	Calculated Peak EIRP/ERP Single Transmitter	Summed-Up Peak EIRP/ERP for worst case co-transmission over shared antenna
850 GMSK					
824.2*	**32.8 / 33.0**	**28.3 / 31.6**	**28.4**	**30.4 (1.096W) / 28.35 (0.684W)**	**33.4 (2.192W) / 31.35 (1.368W)**
836.6	32.8	28.1 / 31.4	28.3	30.3 / 28.15	33.4 / 31.25
848.8	32.7	27.9 / 31.2	28.1	30.1 / 27.95	33.3 / 31.15
850 8PSK					
824.2	27.3 / 28.0	23.7 / 27.0	26.8	28.8 / 26.65	32.7 / 30.55
836.6	27.2	23.6 / 26.9	26.8	28.8 / 26.65	32.7 / 30.55
848.8	27.2	23.4 / 26.7	26.8	28.8 / 26.65	32.7 / 30.55
FDD V					
826.4	22.5 / 24.0	19.5 / 22.8	22.9	24.9 / 22.75	31.5 / 29.35
836.6	22.6	18.4 / 21.7	21.7	23.7 / 21.55	31.2 / 29.05
846.6	22.2	18.6 / 21.9	21.9	23.9 / 21.75	31.3 / 29.15
1900 GMSK					
1850.2	29.5 / 30.0	25.3 / 29.7	25.7	27.7	30.9
1880	29.7	25.2 / 29.6	25.3	27.3	30.7
1909.8	29.6	25.6 / 30.0	25.8	25.8	30.1
1900 8PSK					
1850.2*	**25.5 / 27.0**	**23.0 / 27.4**	**26.1**	**28.1 (0.646W)**	**31.1 (1.292W)**
1880	25.8	22.7 / 27.1	25.9	27.9	31.0
1909.8	25.8	22.8 / 27.2	25.9	27.9	31.0
FDD II					
1852.4	23.0 / 24.0	19.0 / 23.4	23.0	25.0	29.8
1880	23.0	19.0 / 23.4	22.5	24.5	29.7
1907.6	22.8	19.1 / 23.5	22.4	24.4	29.6

* case of highest peak output power within band

6.1.5 Test Verdict:

Pass

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

6.2 PEAK-AVERAGE Ratio

6.2.1 Limits:

FCC CFR 47 §24.232 (D)
RSS-132(5.4); RSS-133(6.4)
The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

6.2.2 Test Procedure:

For GSM/ EGPRS modes the PAR is calculated as follows:
PAR = Measured Peak Output Power - Measured Average Output Power;
Peak and average power are taken from output power results above.

For UMTS Mode, the PAR determined by CCDF measurement with a Spectrum Analyzer;
The spectrum analyzer's 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.

6.2.2.1 Test Results:

Peak-Average Ratio in 850 MHz band of operation (dB)			
Channel	**GMSK**	**8PSK**	**UMTS**
Low	0.1	3.1	3.71
Mid	0.2	3.2	3.51
High	0.2	3.4	3.97

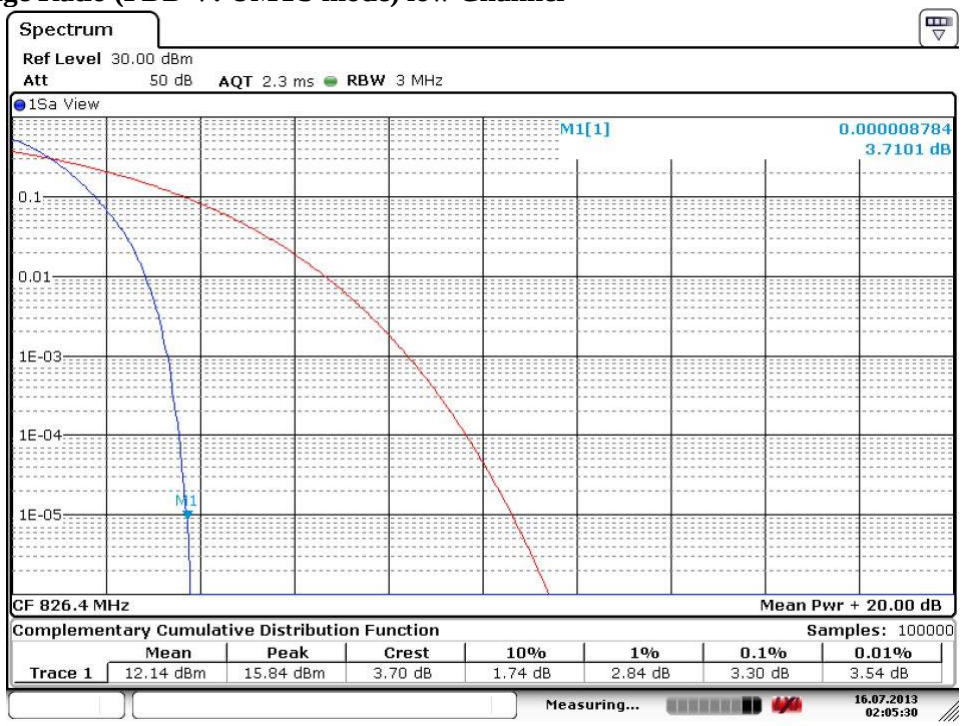
Peak-Average Ratio in 1900 MHz band of operation (dB)			
Channel	**GMSK**	**8PSK**	**UMTS**
Low	0.4	3.1	3.83
Mid	0.1	3.2	3.77
High	0.2	3.1	3.65

6.2.2.2 Test Verdict:

Pass

6.2.2.3 Test Data:

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



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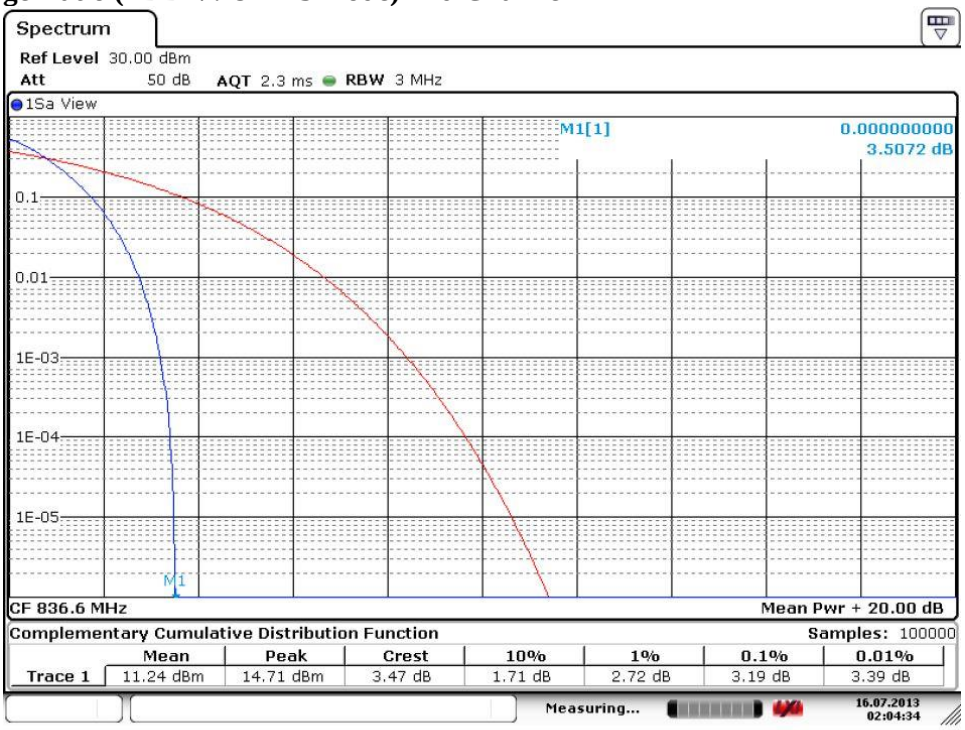
Peak-Average Ratio (FDD V: UMTS mode) mid Channel



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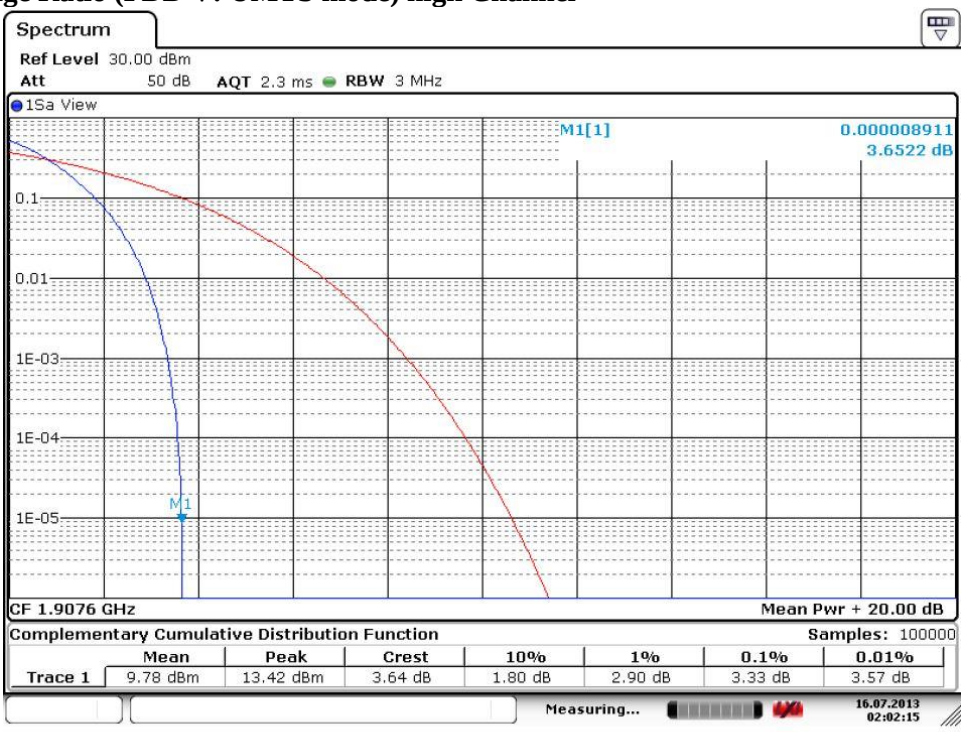
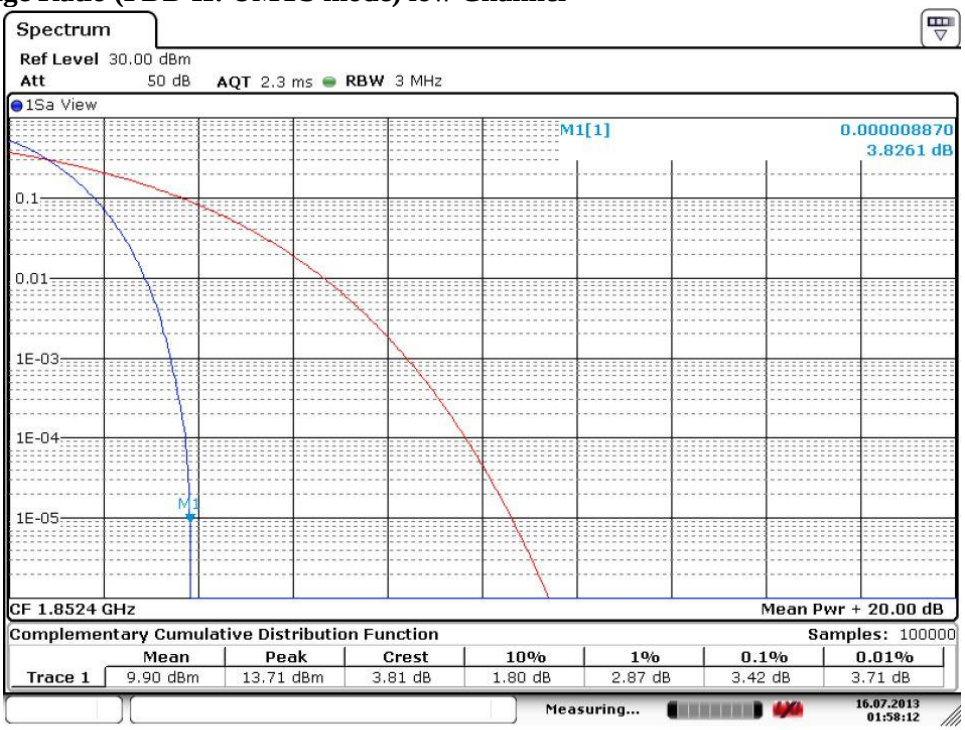
Peak-Average Ratio (FDD V: UMTS mode) high Channel



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



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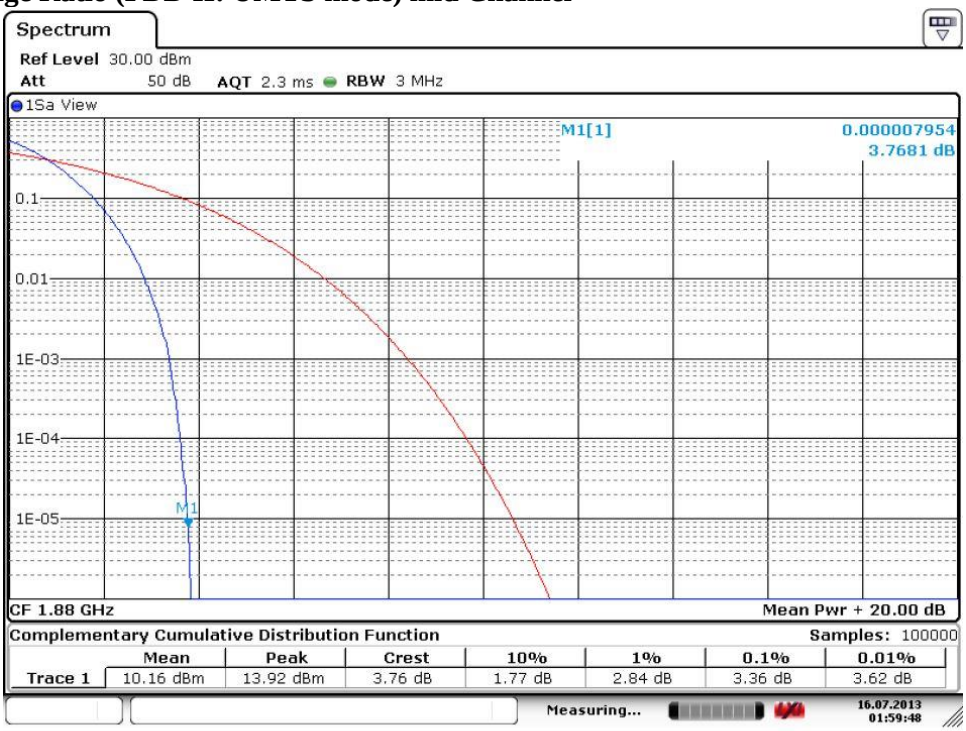
Peak-Average Ratio (FDD II: UMTS mode) mid Channel



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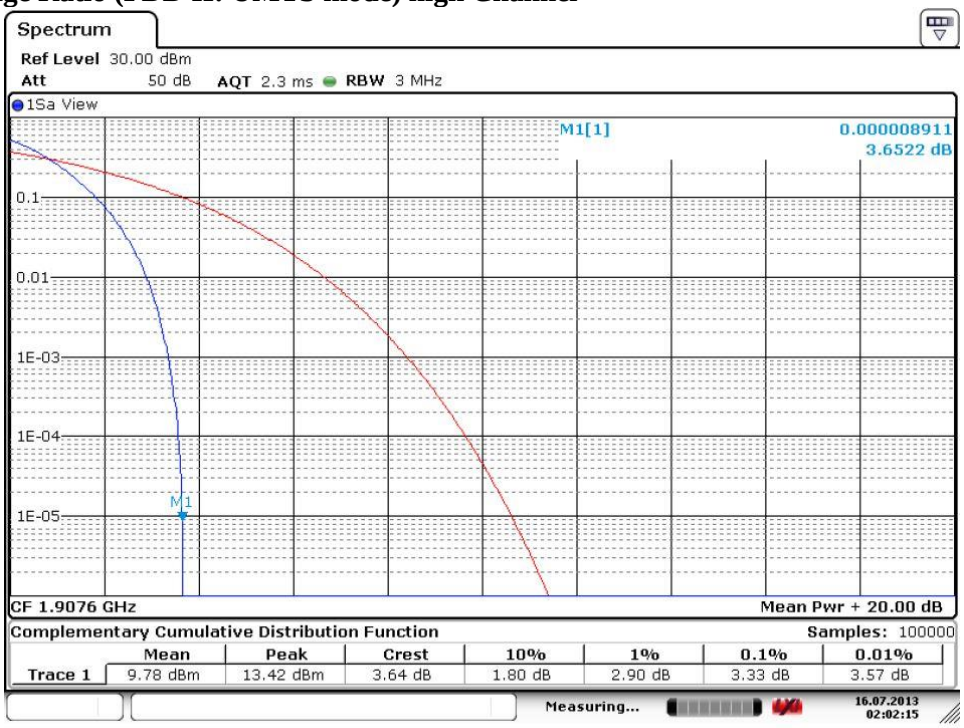
Peak-Average Ratio (FDD II: UMTS mode) high Channel



6.3 Spurious Emissions Radiated

6.3.1 References

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

6.3.2 Measurement requirements:

6.3.2.1 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.

6.3.2.2 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.

6.3.3 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.

6.3.3.1 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.

6.3.3.2 FCC 24.238 Emission limitations for Broadband PCS equipment.

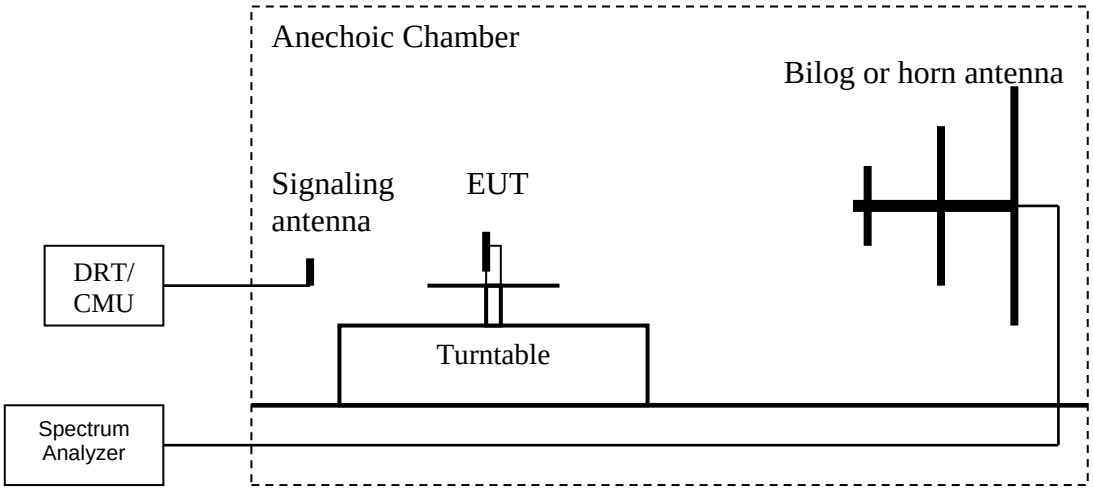
The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.
(b) Measurement procedure. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in 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.

6.3.3.3 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.

6.3.4 Radiated out of band measurement procedure:

Ref: TIA-603C 2004, cl. 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 RadioCommunication 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.)

Spectrum analyzer settings: RBW=VBW=1MHz

6.3.5 Sample Calculations for Radiated Measurements

6.3.5.1 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)
Eg:

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

6.3.6 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 GSM-850 & PCS-1900 bands.
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 & PCS-1900 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 only with Circuit Switched mode GMSK modulation because this mode represents the worse case emission for all the modulations for GSM. All measurements are done in horizontal and vertical antenna polarization; and on three orientations of the EUT. The plots show the worst case where it is not indicated otherwise. Unless mentioned otherwise, the peaks in the plots are from the carrier frequency.

Radiated emissions measurements were made also with UMTS FDD mode.

Radiated emission measurements were made in GMSK and RMC Modes (for UMTS), since these modes operate with the highest output power and hence represents the worst case scenario.

Co-location / simultaneous transmission consideration:
The array gain from the 2 available antennae in the product can be assumed to be zero due to completely uncorrelated transmission of the modules (see related notes in ch. 6.1.4).
Only one of the identical transmitters has been active for this RSE measurement. Since no emissions above noise floor where found in this mode it can be assumed that results from simultaneous transmission measurement would be uncritical.

6.3.7 Test Conditions:

Tnom: 21°C; Vnom: 115 V

6.3.8 Test Verdict:

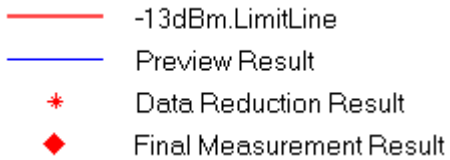
Pass.

6.3.9 Test Results:

6.3.9.1 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**	NF	**836.6**	NF	**848.8**	NF
2	**1648.4**	NF	**1673.2**	NF	**1697.6**	NF
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						

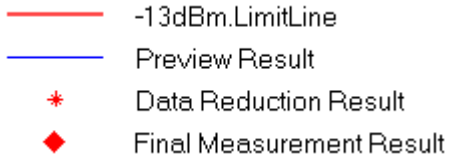
Legend for the plots:



6.3.9.2 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**	NF	**836.6**	NF	**846.6**	NF
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						

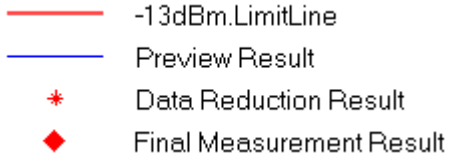
Legend for the plots:



6.3.9.3 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**	NF	**1880.0**	NF	**1909.8**	NF
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						

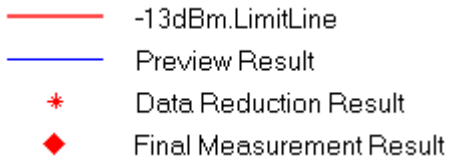
Legend for the plots:



6.3.9.4 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**	NF	**1880.0**	NF	**1907.6**	NF
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						

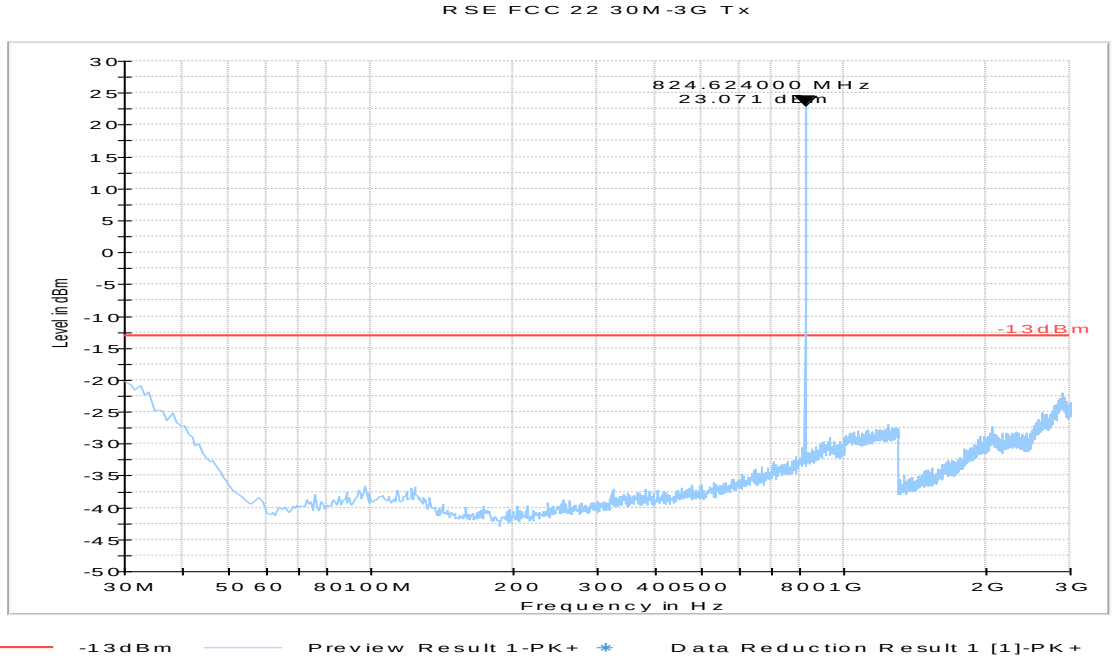
Legend for the plots:



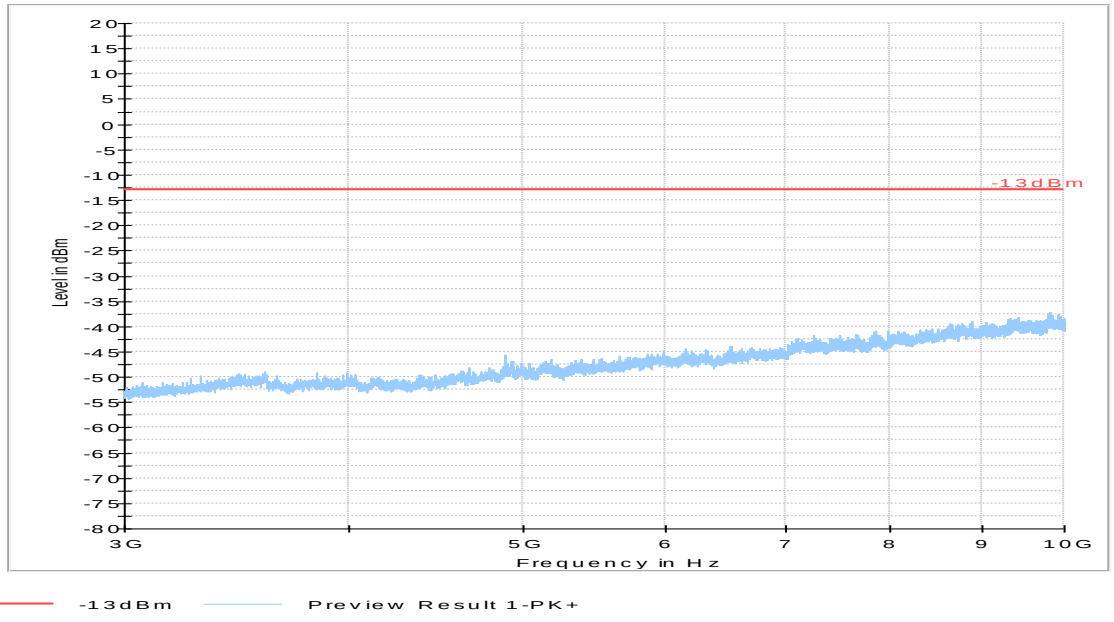
6.3.9.5 Plots:

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

Test results 30M-3GHz

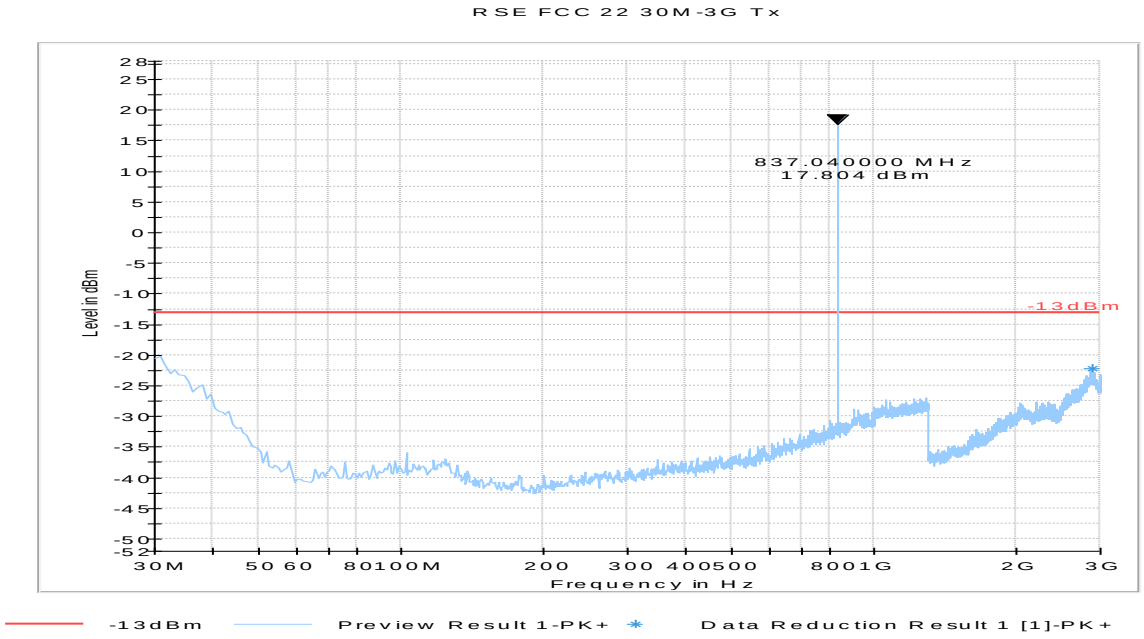


Test results 3GHz-10GHz

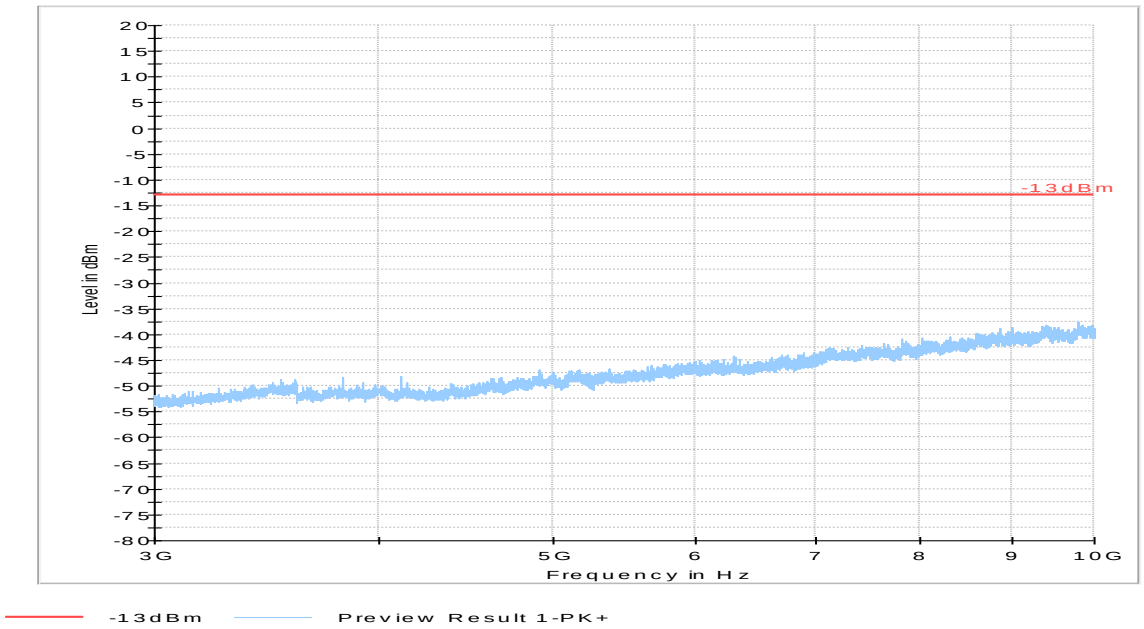


Radiated Spurious Emissions (GSM-850) Tx: Mid Channel

Test results 30M-3GHz

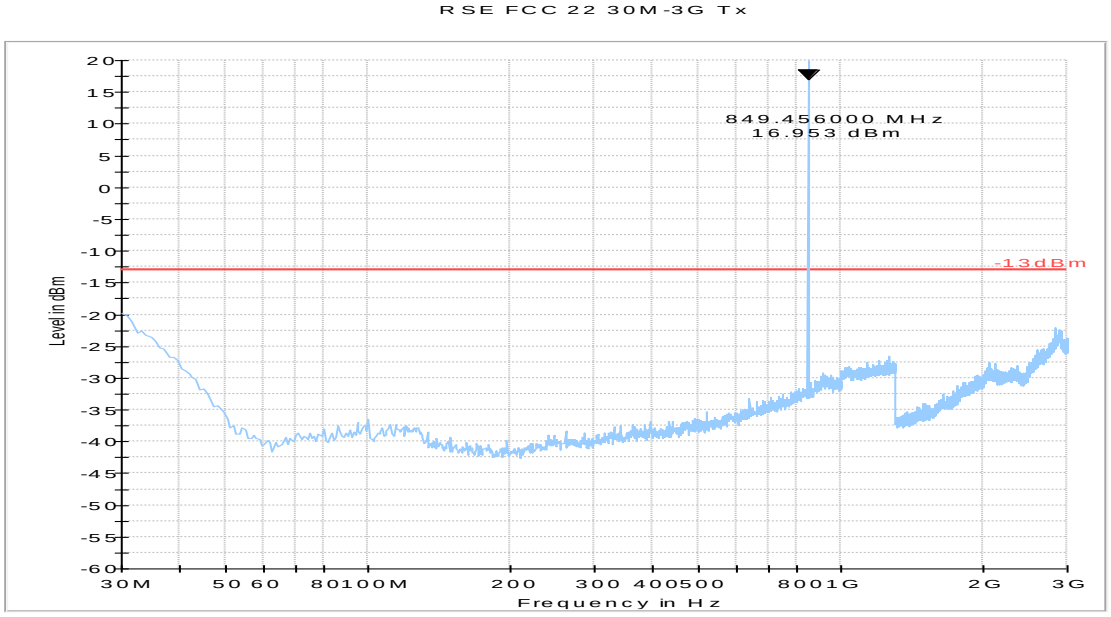


Test results 3GHz-10GHz

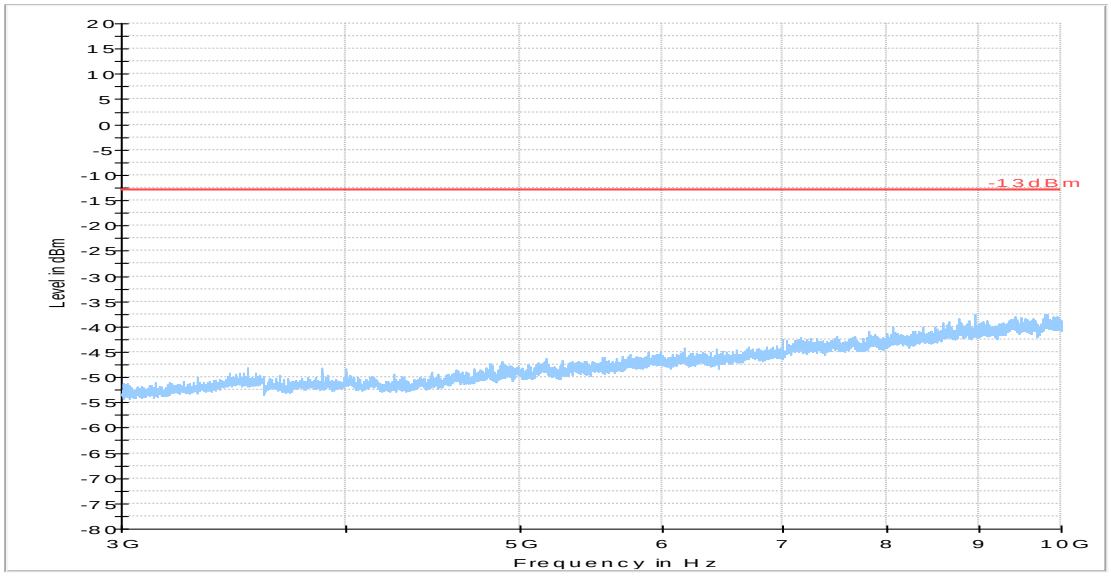


Radiated Spurious Emissions (GSM-850) Tx: High Channel

Test results 30M-3GHz

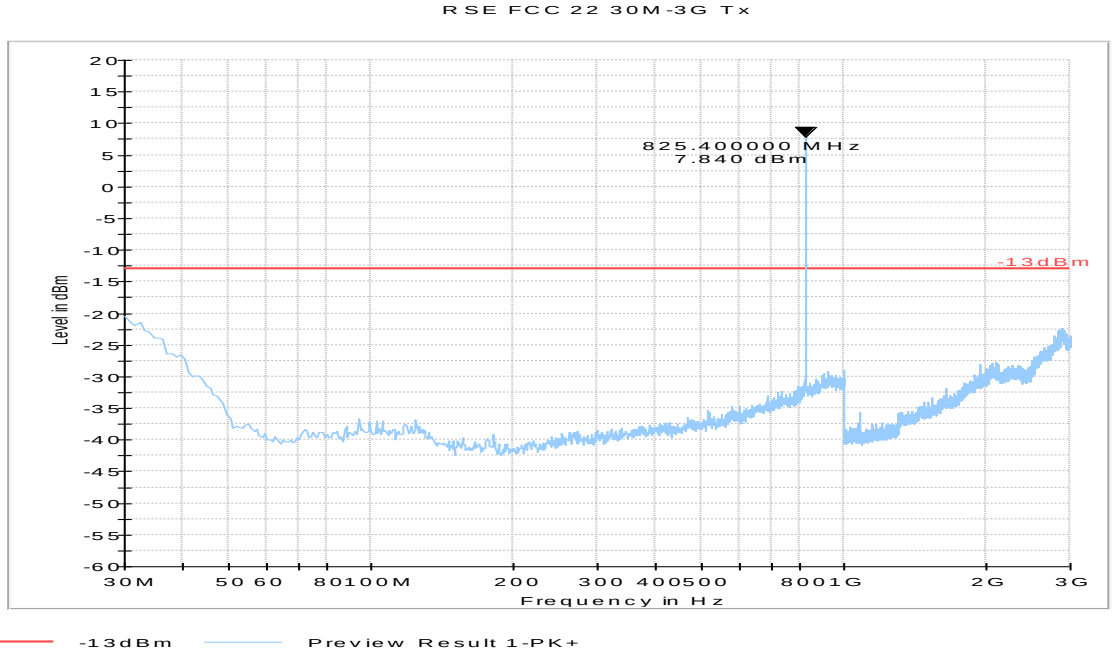


Test results 3GHz-10GHz

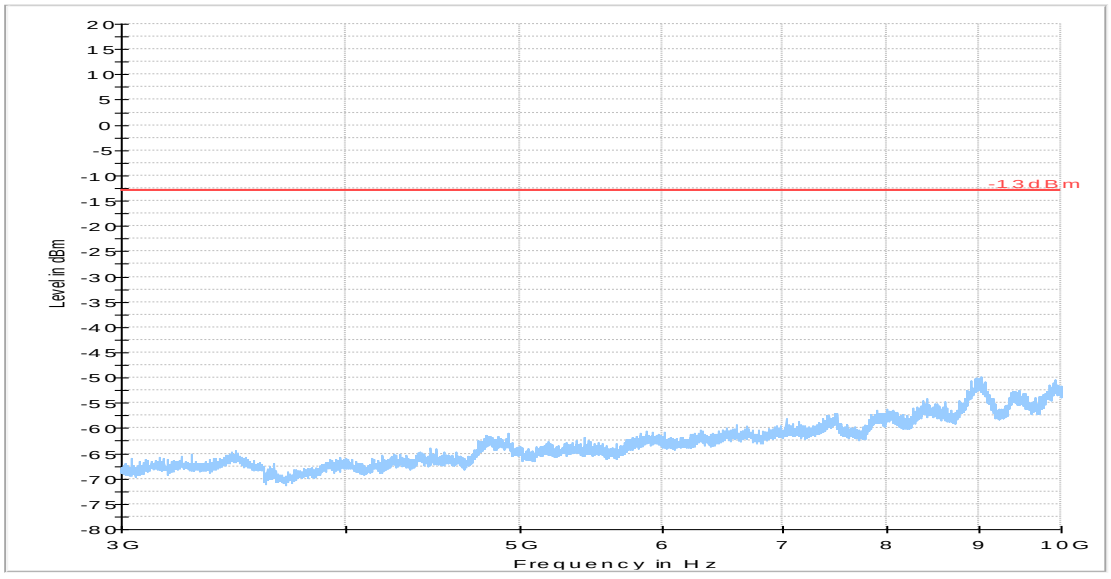


Radiated Spurious Emissions (UMTS Band 5) Tx: Low Channel

Test results 30M-3GHz

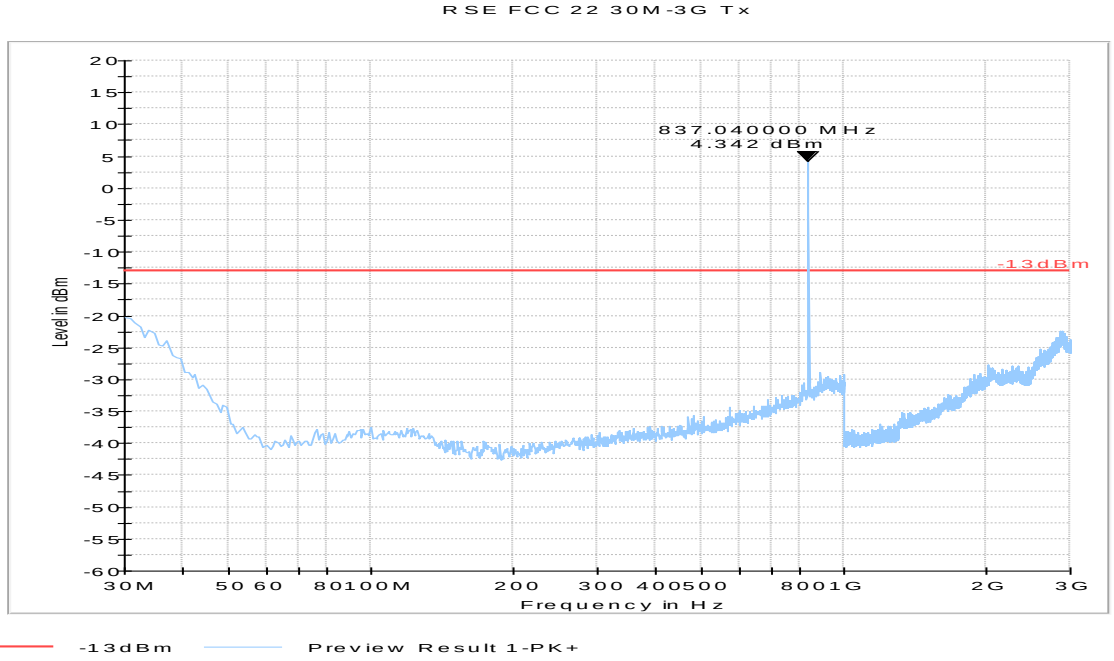


Test results 3GHz-10GHz

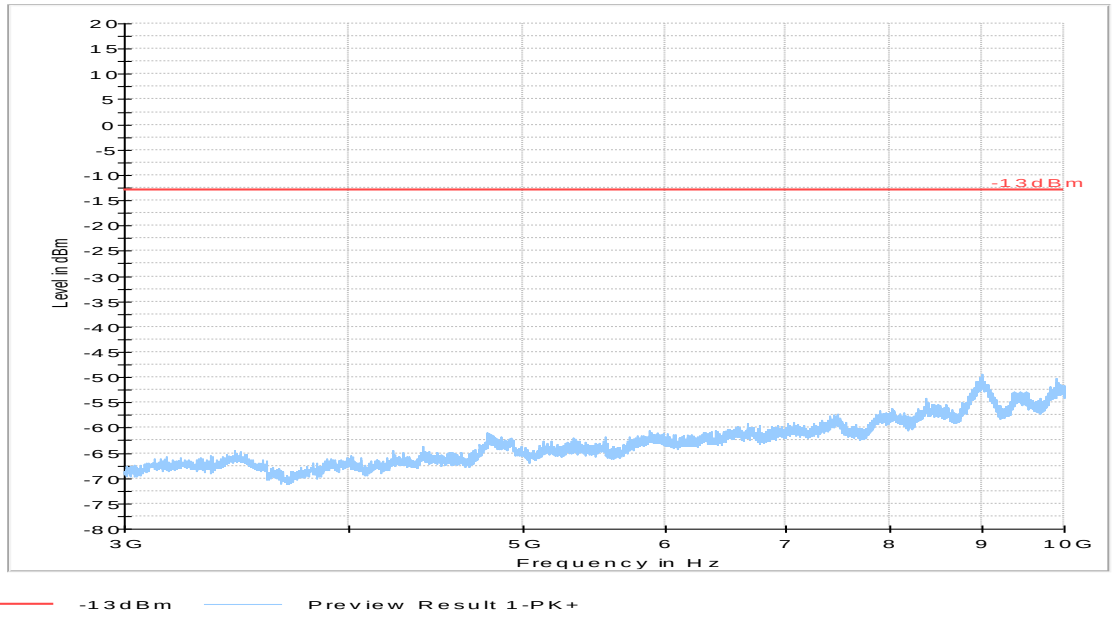


Radiated Spurious Emissions (UMTS Band 5) Tx: Mid Channel

Test results 30M-3GHz

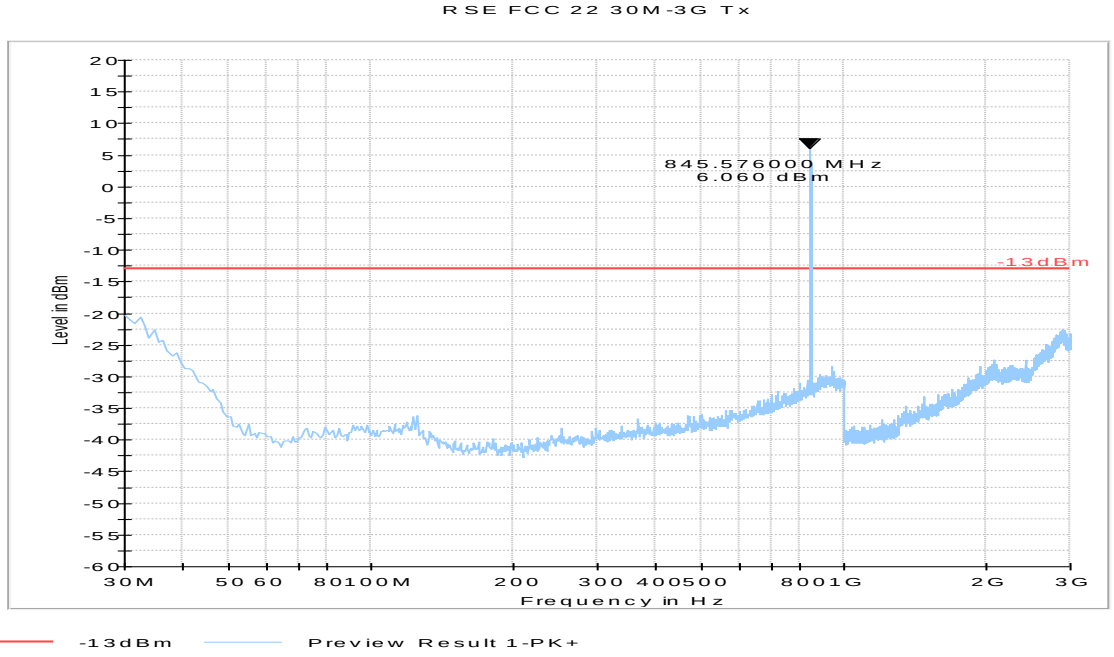


Test results 3GHz-10GHz

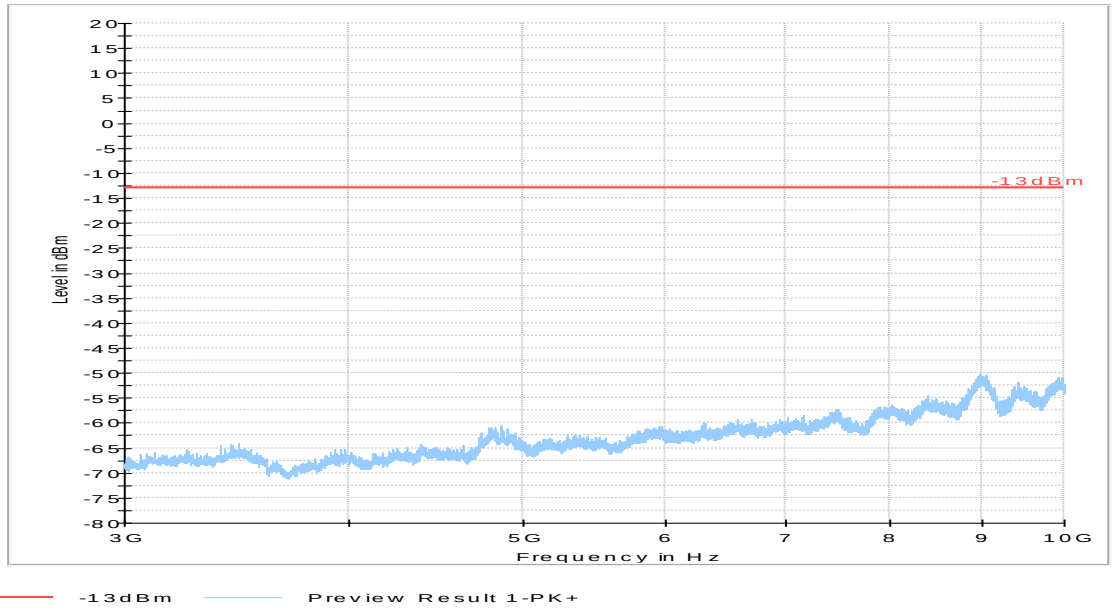


Radiated Spurious Emissions (UMTS Band 5) Tx: High Channel

Test results 30M-3GHz

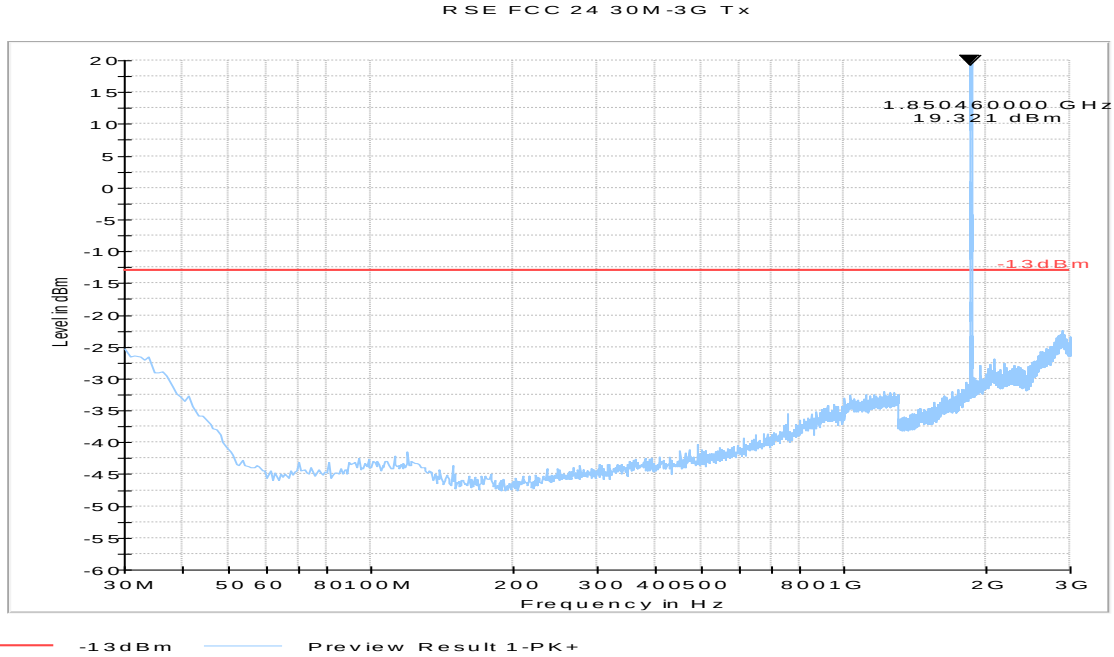


Test results 3GHz-10GHz

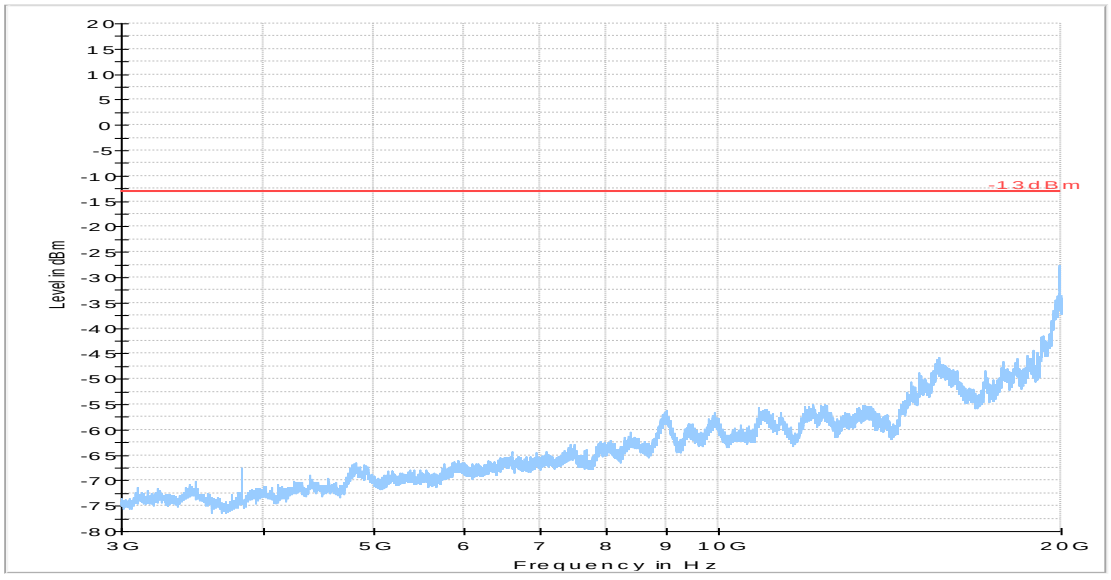


Radiated Spurious Emissions (GSM-1900) Tx: Low Channel

Test results 30M-3GHz

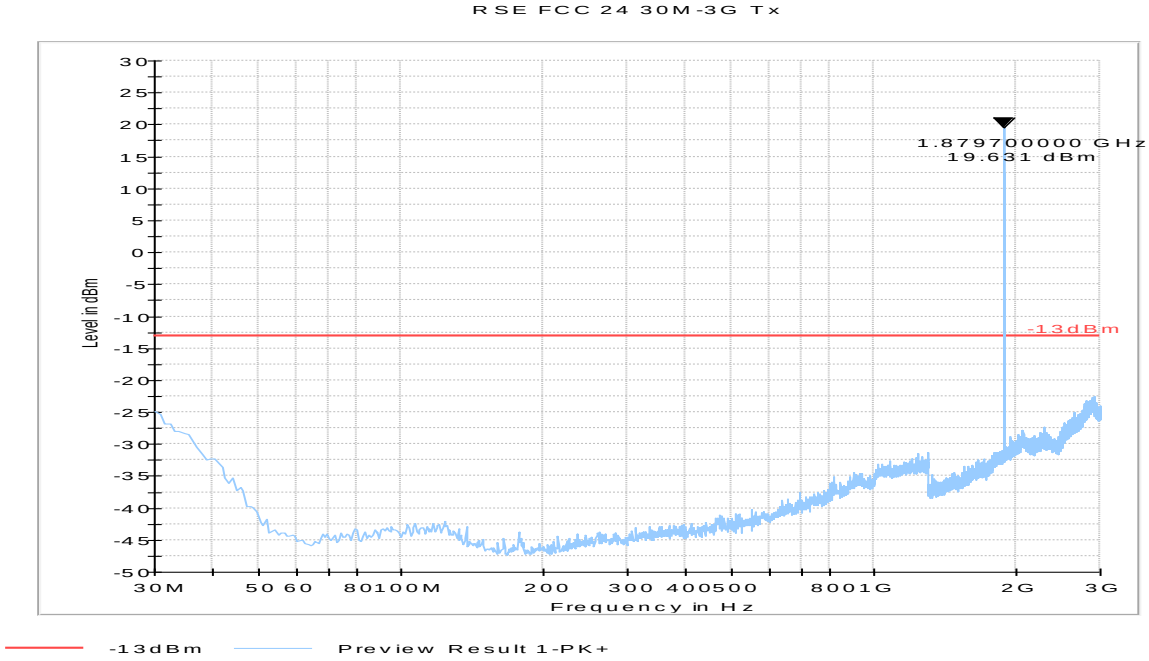


Test results 3GHz-20GHz

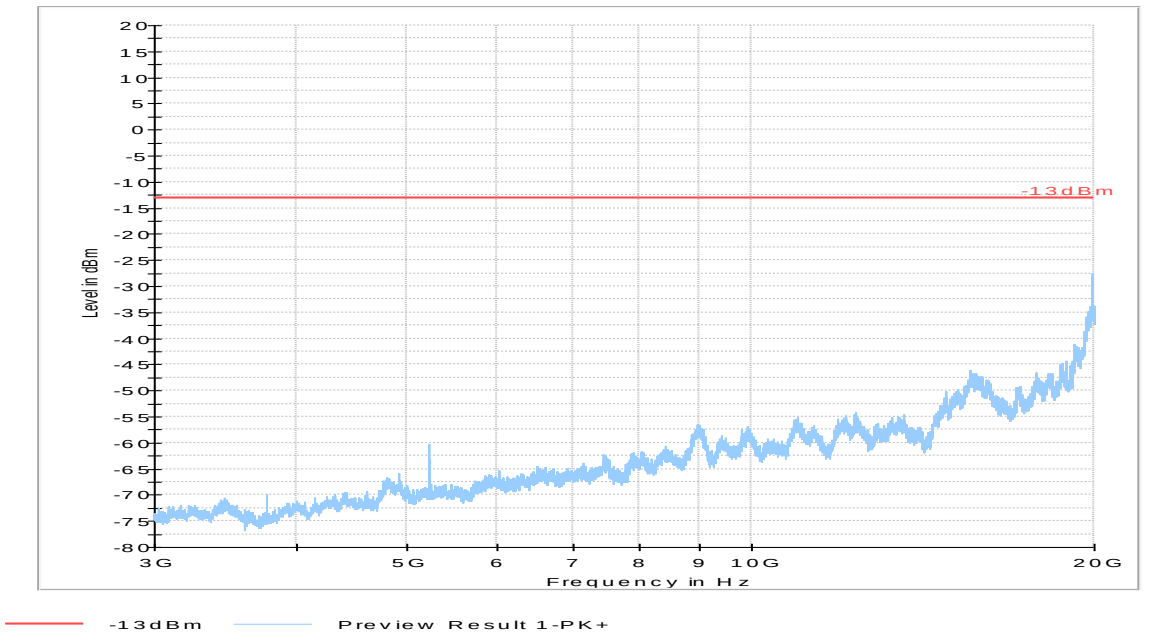


Radiated Spurious Emissions (GSM-1900) Tx: Mid Channel

Test results 30M-3GHz

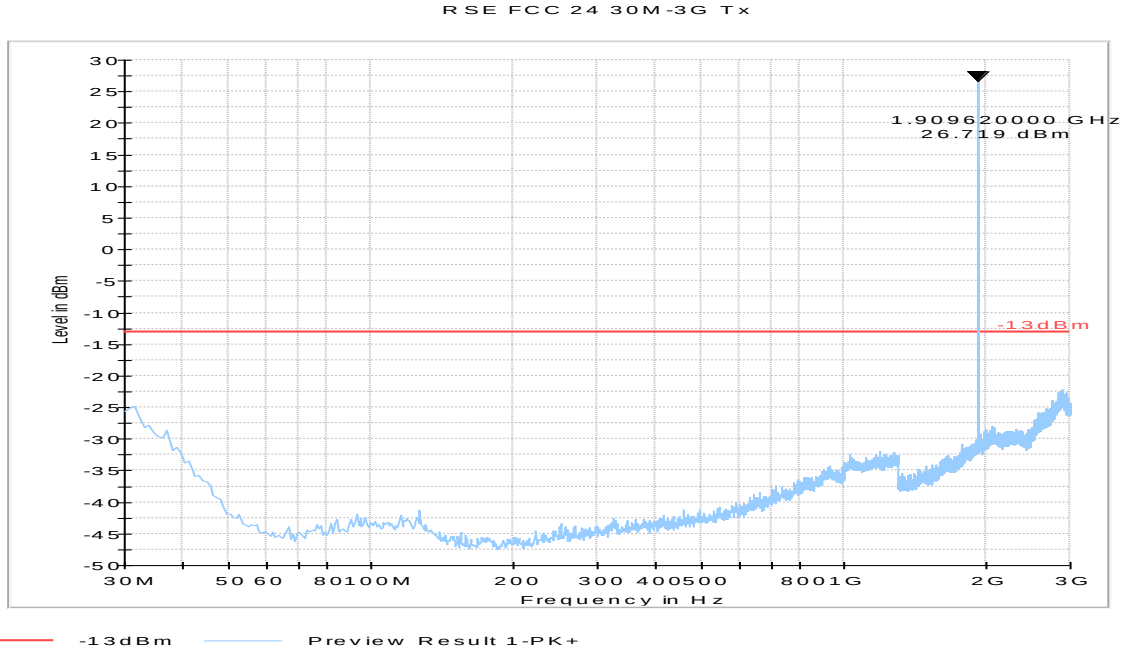


Test results 3GHz-20GHz

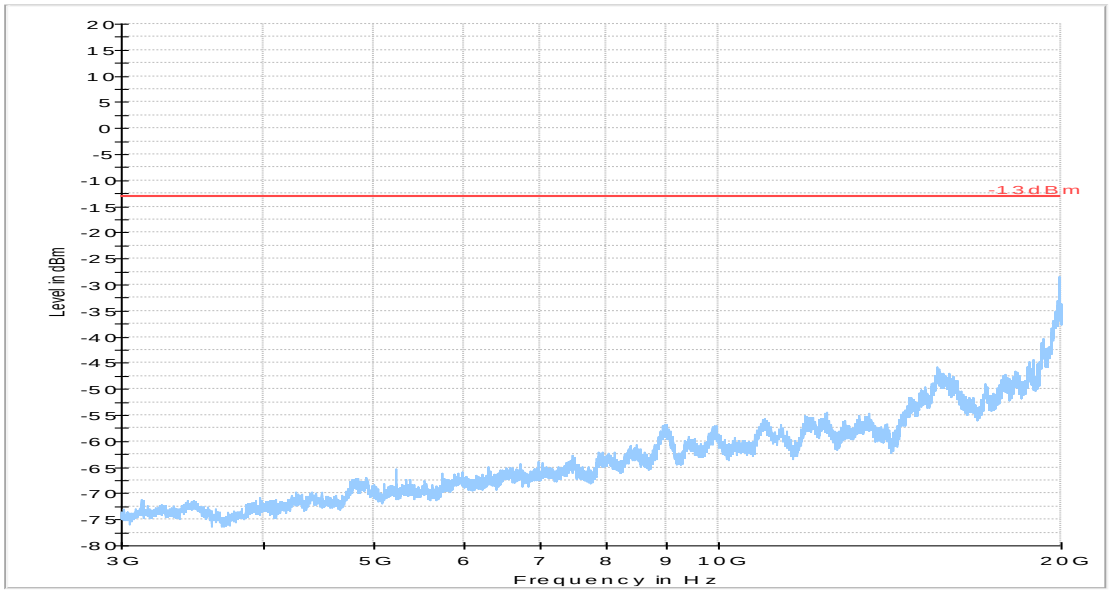


Radiated Spurious Emissions (GSM-1900) Tx: High Channel

Test results 30M-3GHz

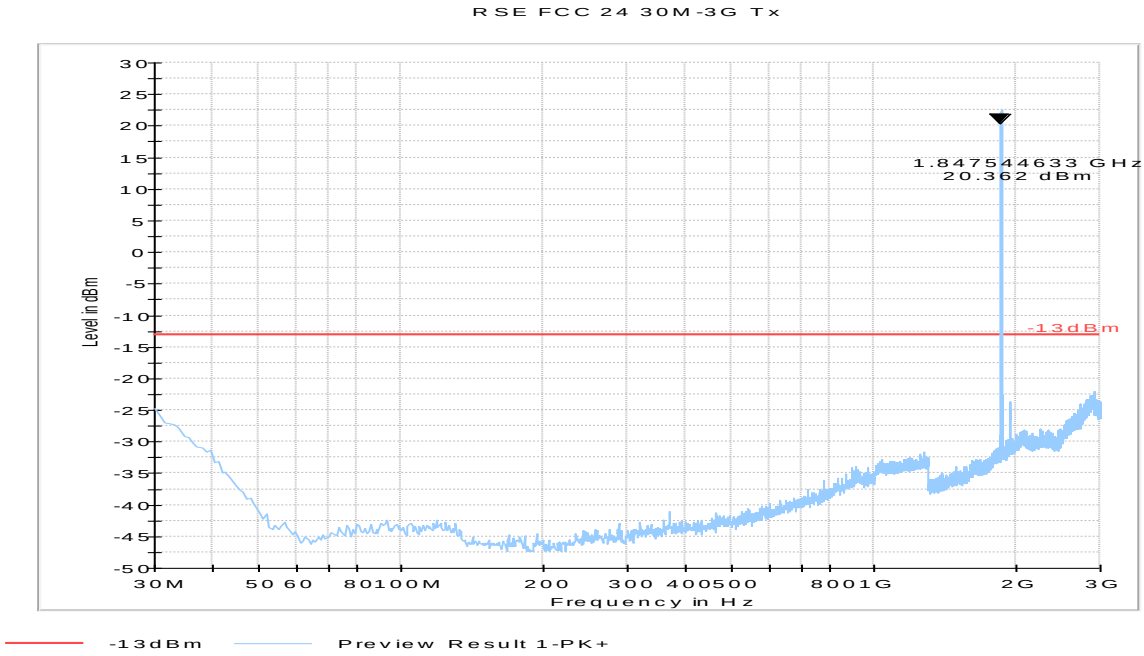


Test results 3GHz-18GHz

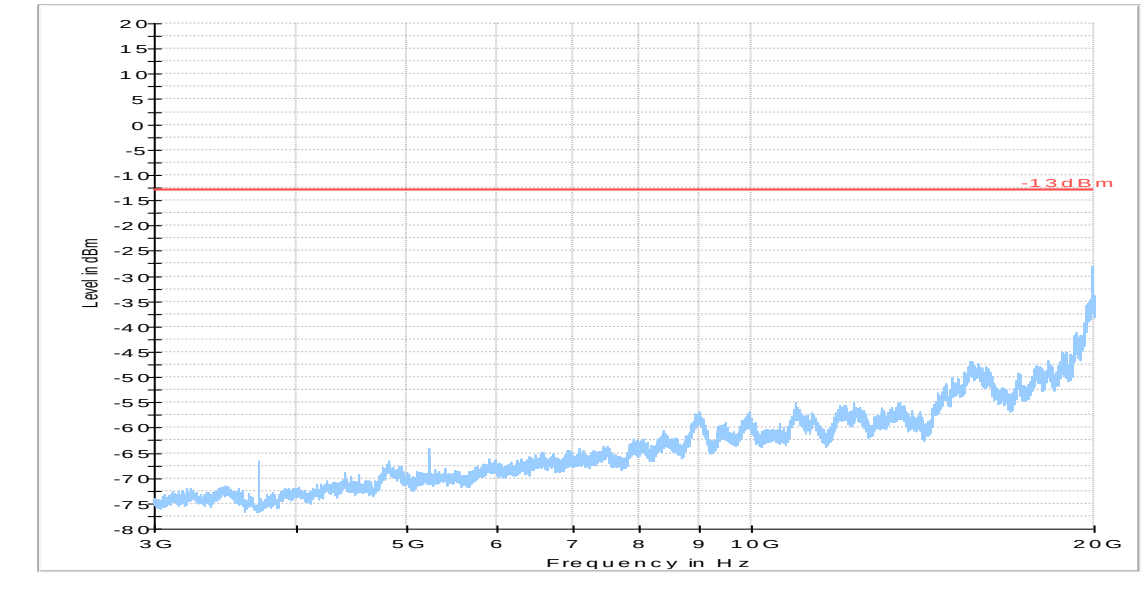


Radiated Spurious Emissions (UMTS Band 2) Tx: Low Channel

Test results 30M-3GHz

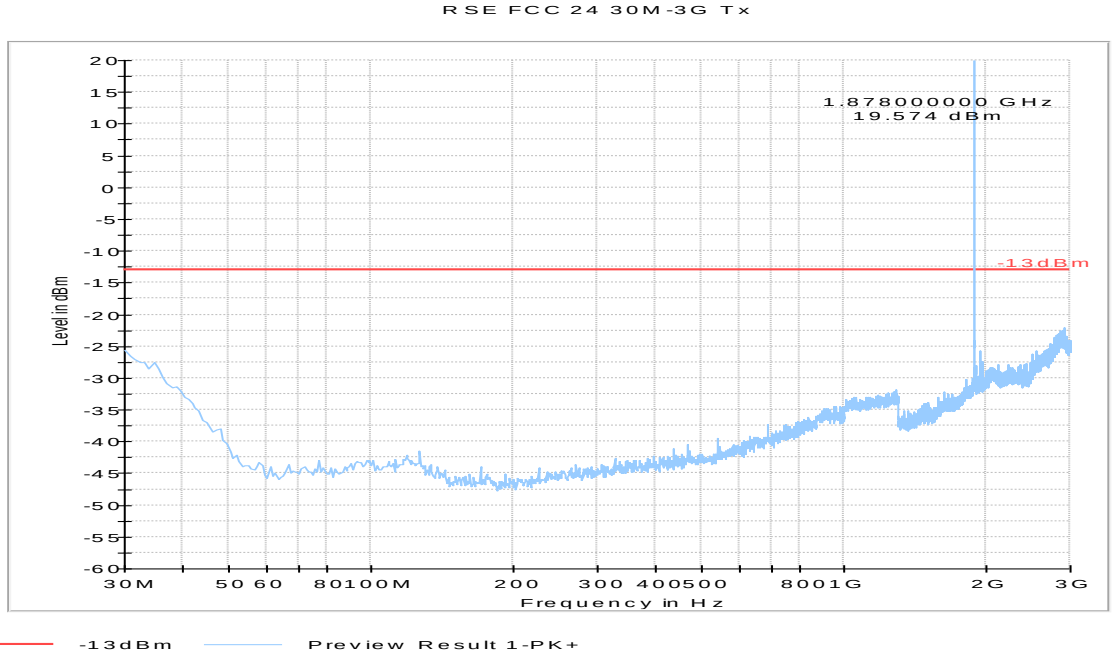


Test results 3GHz-18GHz

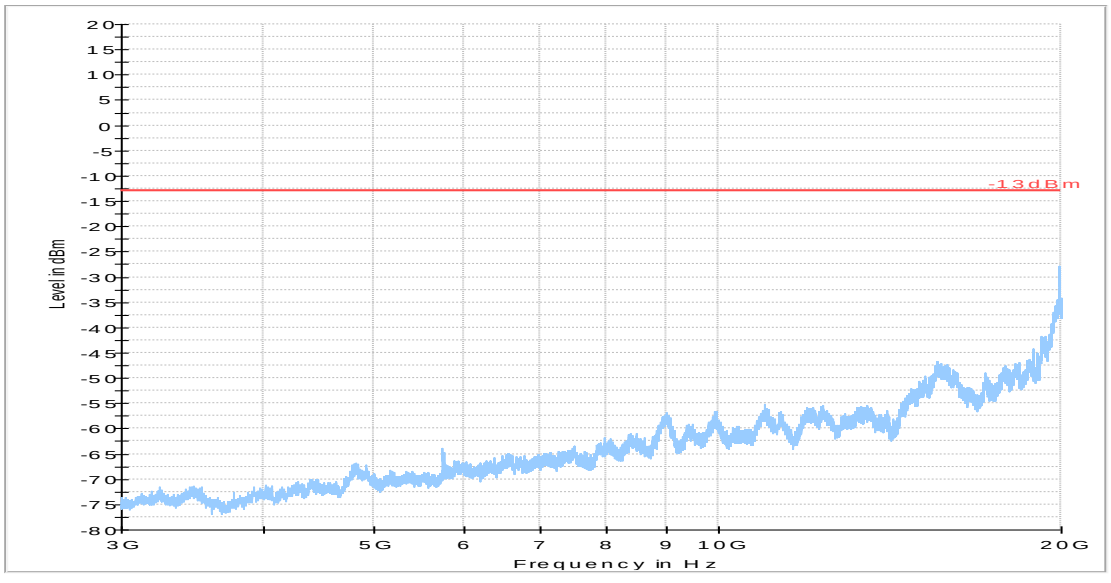


Radiated Spurious Emissions (UMTS Band 2) Tx: Mid Channel

Test results 30M-3GHz

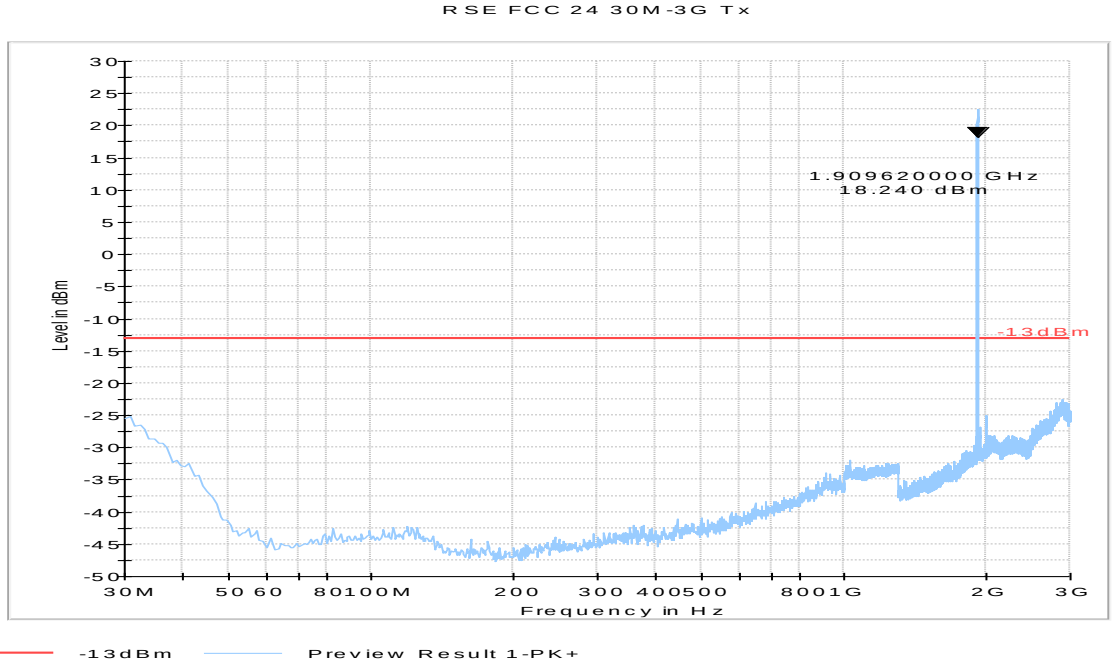


Test results 3GHz-18GHz

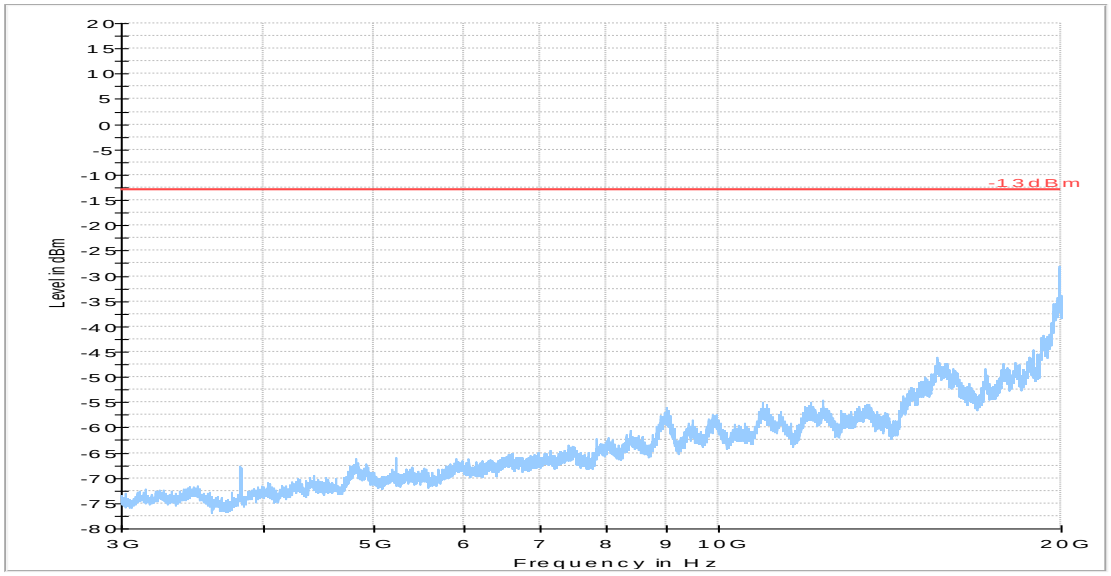


Radiated Spurious Emissions (UMTS Band 2) Tx: High Channel

Test results 30M-3GHz



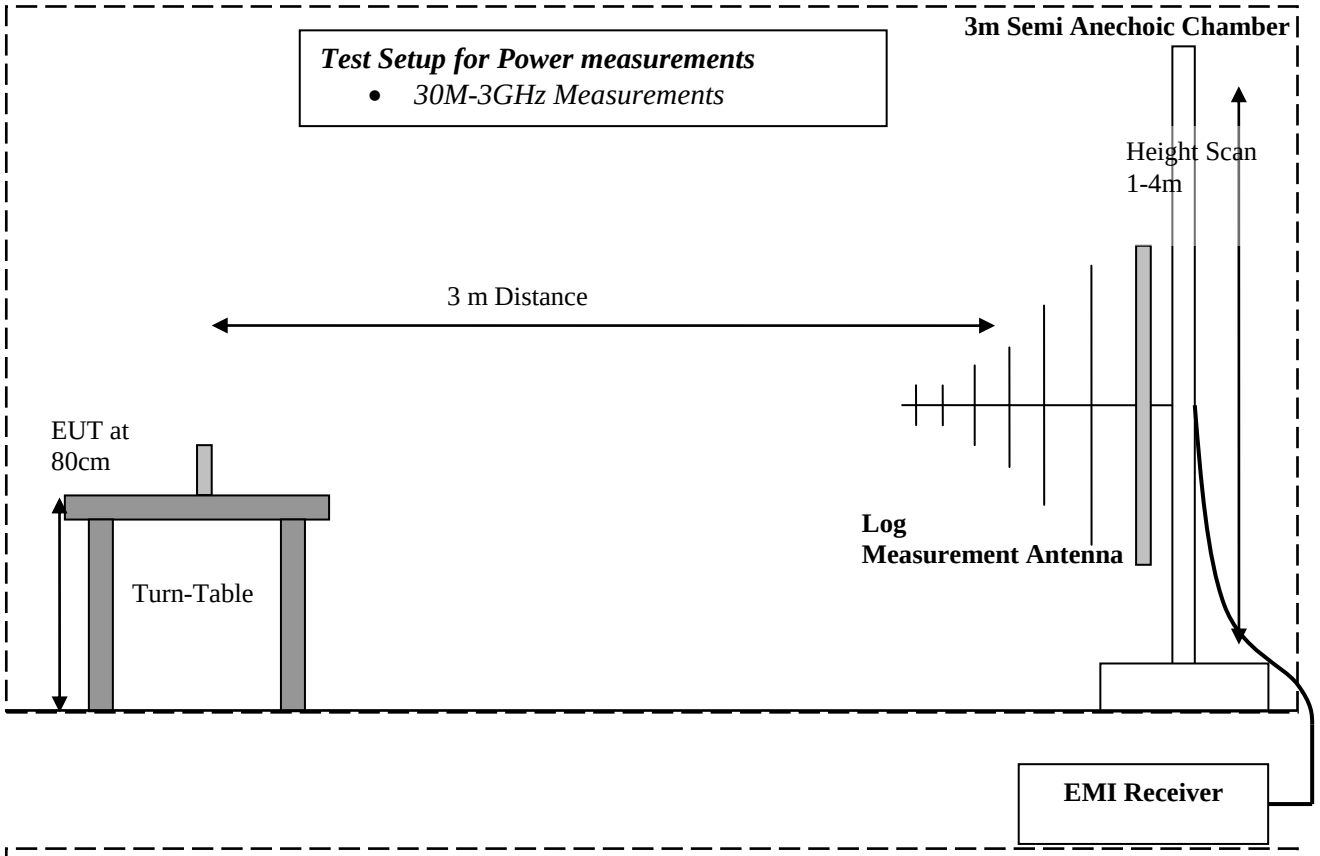
Test results 3GHz-18GHz

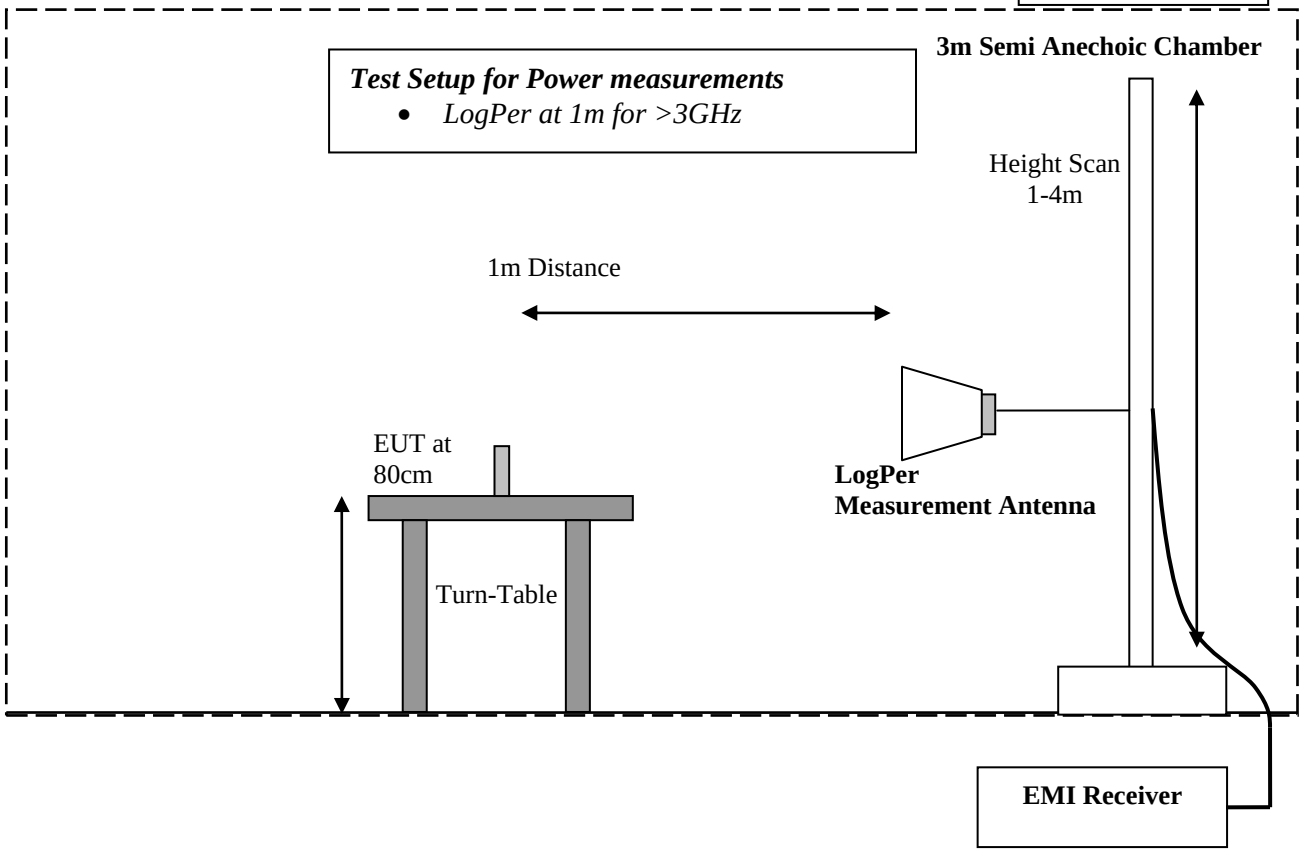


7 Test Equipment and Ancillaries used for tests

Equipment Name	Manufacturer	Type/Model	Serial No.	Cal Date	Cal Interval	Next cal date
3m Semi- Anechoic Chamber:						
Spectrum Analyzer	Rohde und Schwarz	FSU 26	200302	6/2013	2 years	6/2015*
Radiocommunication Tester	Rohde and Schwarz	CMU 200	121672	2/2012	2 years	2/2014
Horn Antenna	ETS Lindgren	3115	35111	4/2012	2 year	4/2014
Log Periodic Antenna	Rohde and Schwarz	HL 050	100515	2/2012	2 year	2/2014
Ultralog Antenna	Rohde and Schwarz	HL 562	100495	2/2012	2 year	2/2014
Open Switch Control Unit	Rohde and Schwarz	OPS 130	10085	n/a		
Extention Unit Open Switch Control Unit	Rohde and Schwarz	OSP 150	10086	n/a		
Signal Generator	Rohde and Schwarz	SMF 100A	101833	2/2012	2 years	2/2014
Turn Table TT	Maturo	1.5 SI	TT 1.5SI/204/60709 10	n/a		
Compact antenna Mast	Maturo	CAM 4.0-P	CAM4.0-P/067/6000910	n/a		
Multiple Control Unit	Maturo	MCU	2140910	n/a		
Pre-Amplifier	Rohde and Schwarz	TS-PR 18	100072	Part of the system calibration		
High Pass Filter	Mini-Circuits	SHP-1200+	RUU11201224	Part of the system calibration		
High Pass Filter	Wainwright Instr.	WHKX 3.0/18	109	Part of the system calibration		
Ancillary equipment:						
Multimeter	Fluke	115 True RMS	21752138	3/2013	2 years	3/2015
Thermometer	Fluke	5411B	17560031	12/2012	2 years	12/2014
Antenna	TECT Electronics	FPA3-0.8-6.0R/1329	408213-0001	n/a		

8 Block Diagrams





9 Revision History

Date	Change Description	Revision
2014-01-08	n.a.	initial
2014-01-27	added summed-up EIRP/ERP in section 6.1.4 to cover co-transmission of modules sharing one antenna within the same band; completed testing notes in section 3.4 corrected some typos, wrong channel numbers;	Rev. 1
2014-02-06	optimized and completed product description in section 3.1; completed section 3.4 with note about consideration of KDB662911 D01 Multiple Transmitter Output v02r01; completed sections 6.1.4 Results(text and table) and 6.3.6 accordingly;	Rev. 2