FCC Test Report

FOR:

Model Name:A1332
Smart Cellular Telephone with Quad band GSM, UMTS I/II/V/VI/VIII, Bluetooth and WiFi 802.11 b,g,n

FCC ID:BCG-E2380A

47 CFR Part 2, 22, 24

TEST REPORT #: EMC_APPLE_057_09001_FCC22_24_BCG-E2380A_Rev1
DATE: 2010-06-04

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 2135.01

Bluetooth Qualification Test Facility (BQTF)

CTIA Authorized Test Lab
LAB CODE 20020328-00

FCC listed: A2LA accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
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CETECOM Inc. is a Delaware Corporation with Corporation number: 2113686
Board of Directors: Dr. Harald Ansorge, Dr. Klaus Matkey, Hans Peter May

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1 Assessment

The following is in compliance with the applicable criteria specified in FCC rules Parts 2, 22 and 24 of Title 47 of the Code of Federal Regulations.

Company	Description	Model #
Apple Inc.	Smart Cellular Telephone with Quad band GSM, UMTS I/II/V/VI/VIII, Bluetooth and WiFi 802.11 b,g,n	A1332

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2010-06-04	Compliance	Heiko Strehlow (Director)	Heiko Strehlow 2010.06.05 18:54:12 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2010-06-04	Compliance	Sajay Jose (EMC Engineer)	

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC 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
Responsible Test Lab Manager:	Heiko Strehlow
Responsible Project Leader:	Sajay Jose

2.2 Identification of the Client

Applicant's Name:	Apple Inc.
Street Address:	1 Infinite Loop
City/Zip Code	Cupertino, CA 95014
Country	USA
Contact Person:	Bob Steinfeld
Phone No.	408-974-2618
e-mail:	steinfe1@apple.com

2.3 Identification of the Manufacturer

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

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name:	A1332
Model No:	A1332
Product Type:	Smart Cellular Telephone with Quad band GSM, UMTS I/II/V/VI/VIII, Bluetooth and WiFi 802.11 b/g/n. Includes Ipod music, photo, GPS and application functions.
Hardware Revision :	Rev C
Software Revision :	01.50.01/8A224
FCC-ID:	BCG-E2380A
Frequency:	GSM 850: 824.2-848.8MHz; PCS 1900: 1850.2-1909.8MHz FDD V: 826.4-846.6MHz; FDD II: 1852.4-1907.6MHz
Type(s) of Modulation:	GMSK; 8-PSK; Dual BPSK
Number of channels:	GSM850: 125 and PCS 1900: 300 FDD II: 278/ FDD V: 103
Antenna Type:	Internal PIFA
Operating voltage:	Internal battery, 110V AC Adapter; 3.4V (Low)/ 4.2V (Nominal)/ 4.2V (Max)
Temperature Range:	0ºC to 35ºC

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number/IMEI	HW Version	SW Version	Notes
1	880130HMFRZ/ 00107200 292788 5	Rev C	01.48.03/ 8A224	Conducted testing sample.
2	8801202QFRZ/ 00107200 288926 7	Rev C	01.50.01/ 8A224	Radiated testing sample.

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number
1	110V AC Adapter	Flextronics	A1265	N/A
2	Dummy Battery	Apple Inc.	N/A	N/A
3	External Antenna connector	Apple Inc.	N/A	N/A

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

This test report replaces the previously issued report # "EMC_APPLE_057_09001_FCC22_24_BCG-E2380B" issued by Cetecom Inc. on May 30, 2010.

The conducted measurements for this model are leveraged from FCC ID: BCG-E2380B since the hardware is identical. Only radiated testing is performed on this variant.

The conducted measurement test results can be obtained from report # EMC_APPLE_057_09001_FCC22_24_BCG-E2380B_Rev1 issued by CETECOM Inc. on June 4, 2010.

5 Measurements

5.1 RF Power Output

5.1.1 References

FCC: CFR Part 2.1046, CFR Part 22.913, CFR Part 24.232

5.1.2 FCC 2.1046 Measurements required: 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.

5.1.3 Limits:

5.1.3.1 FCC 22.913 (a) Effective radiated power limits.

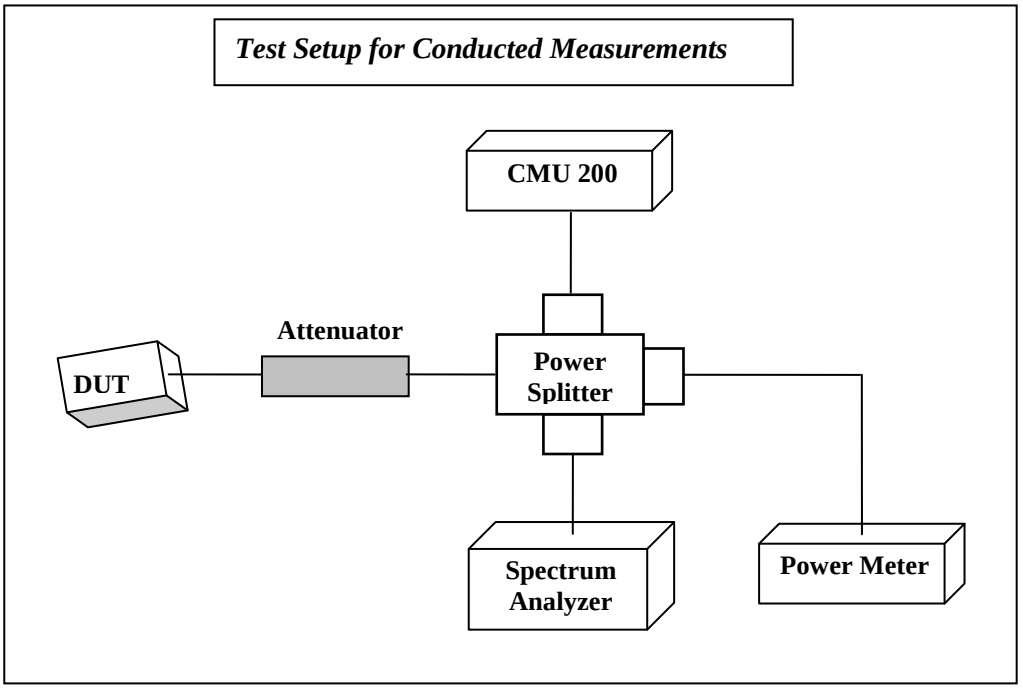
The effective radiated power (ERP) of mobile transmitters must not exceed 7 Watts.

5.1.3.2 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.

5.1.4 Conducted Output Power Measurement procedure

Ref: TIA-603C 2004 2.2.1 Conducted Carrier Output Power Rating

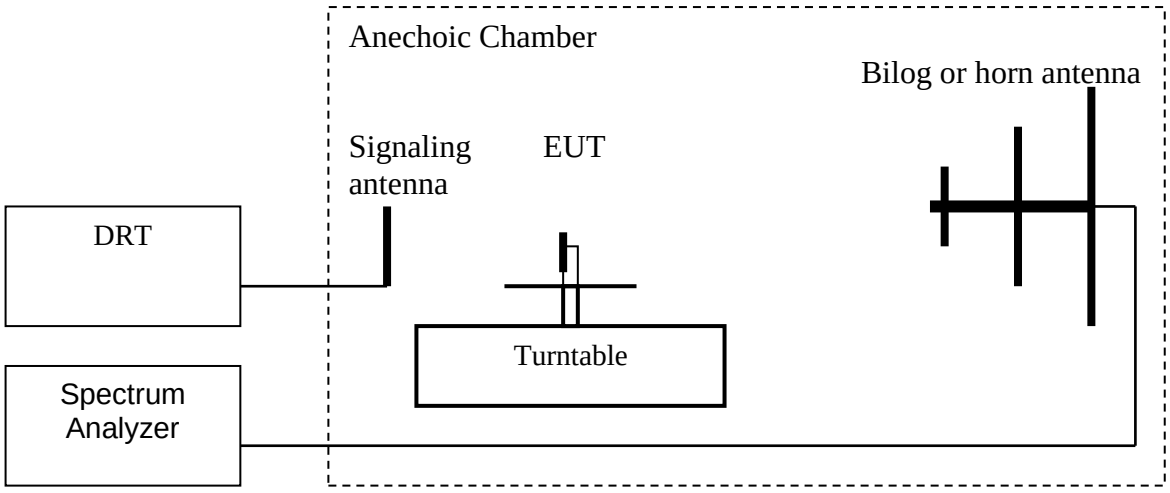


1. Connect the equipment as shown in the above diagram. A Digital RadioCommunication Tester (DRT) is used to enable the EUT to transmit and to measure the output power.
2. Adjust the settings of the DRT to set the EUT to its maximum power at the required channel.
3. Record the output power level measured by the DRT.
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.

Spectrum Analyzer Settings:
GSM: RBW=3MHz; Span=10MHz; Detector: Peak- Max Hold.
UMTS: RBW=5MHz; Span=10MHz; Detector: Peak- Max Hold.
Average measurements performed using RMS detector functionality on the Spectrum Analyzer.

5.1.5 Radiated Output Power Measurement procedure

Ref: TIA-603C 2004 -2.2.17.2 Effective Radiated Power (ERP) or Effective Isotropic Radiated Power (EIRP)



1. Connect the equipment as shown in the above diagram with the EUT's antenna in a vertical 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 the channel frequency. Set the analyzer to measure peak hold with the required settings.
4. Rotate the EUT 360°. Record the peak level in dBm (**LVL**).
5. Replace the EUT with a vertically 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 ERP using the following equation:
   ERP (dBm) = **LVL** (dBm) + **LOSS** (dB)
8. Determine the EIRP using the following equation:
   EIRP (dBm) = **ERP** (dBm) + 2.14 (dB)
9. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.

Spectrum analyzer settings: RBW=VBW=3MHz

(**Note:** Steps 5 and 6 above are performed prior to testing and **LOSS** is recorded by test software. Steps 3, 4, 7 and 8 above are performed with test software.)

5.1.6 RF Power Output 850MHz band

Limit: Nominal Peak Output Power < 38.45 dBm (7W)
Measurement Uncertainty (Conducted): ±0.5 dB
Measurement Uncertainty (Radiated): ±3.0 dB

The conducted measurements for this model are leveraged from FCC ID: BCG-E2380B since the hardware is identical. Only radiated testing is performed on this variant.

The conducted measurement test results can be obtained from report # EMC_APPLE_057_09001_FCC22_24_BCG-E2380B issued by CETECOM Inc. on May 30, 2010.

GSM 850: GMSK Mode				
Frequency (MHz)	Conducted Power			Radiated Power
	Peak Power (dBm)	Av Power (dBm)	Peak-to-Av Ratio (dB)	ERP (dBm)
824.2	32.15	31.98	0.17	30.4
836.6	32.15	31.96	0.19	30.3
848.8	32.09	31.83	0.26	32.2

EGPRS 850: 8PSK Mode				
Frequency (MHz)	Conducted Power			Radiated Power
	Peak Power (dBm)	Av Power (dBm)	Peak-to-Av Ratio (dB)	ERP (dBm)
824.2	30.83	27.0	3.83	28.3
836.6	30.85	27.0	3.85	28.3
848.8	30.80	27.0	3.80	29.6

FDD V: UMTS Mode				
Frequency (MHz)	Conducted Power			Radiated Power
	Peak Power (dBm)	Av Power (dBm)	Peak-to-Av Ratio (dB)	ERP (dBm)
826.4	25.37	22.5	2.87	24.3
836.6	25.46	22.8	2.66	24.9
846.6	25.42	22.61	2.81	25.7

5.1.7 RF Power Output 1900MHz band

Limit: Nominal Peak Output Power < 33 dBm (2W)
PAR many not exceed 13dB
Measurement Uncertainty (Conducted): ±0.5 dB
Measurement Uncertainty (Radiated): ±3.0 dB

The conducted measurements for this model are leveraged from FCC ID: BCG-E2380B since the hardware is identical. Only radiated testing is performed on this variant.

The conducted measurement test results can be obtained from report # EMC_APPLE_057_09001_FCC22_24_BCG-E2380B issued by CETECOM Inc. on May 30, 2010.

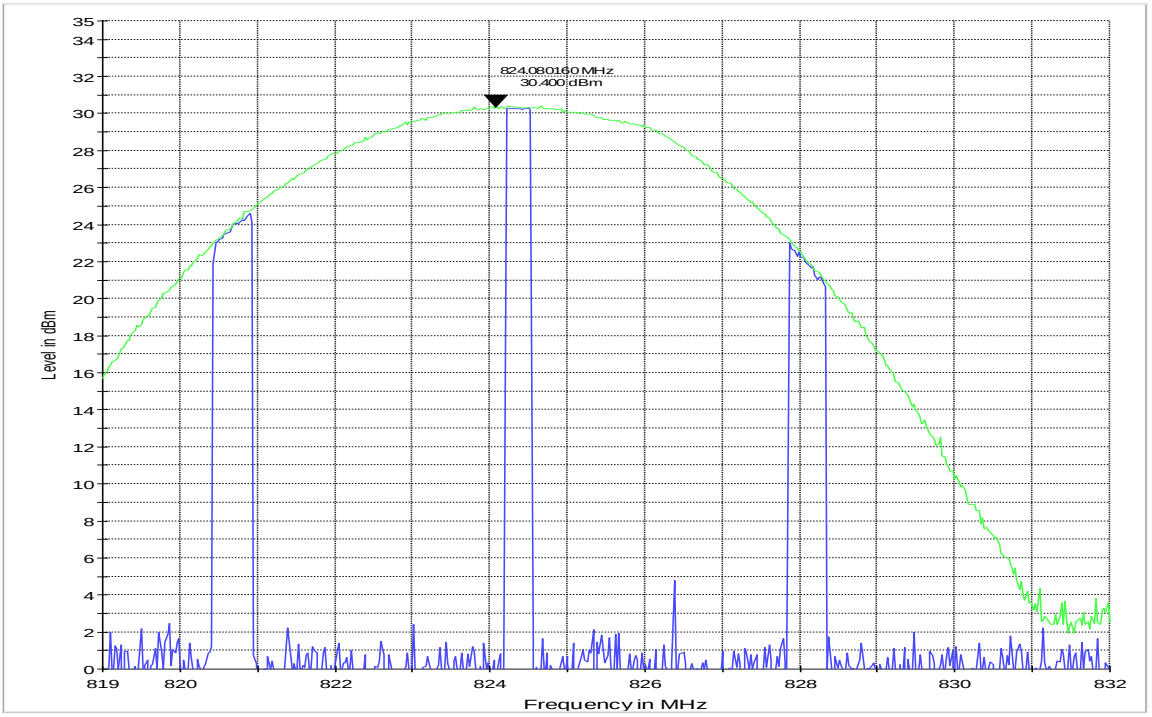
GSM 1900: GMSK Mode				
Frequency (MHz)	Conducted Power			Radiated Power
	Peak Power (dBm)	Av Power (dBm)	Peak-to-Av Ratio (dB)	EIRP (dBm)
1850.2	29.85	29.68	0.17	30.8
1880.0	29.82	29.73	0.09	31.0
1909.8	29.71	29.67	0.04	29.6

EGPRS 1900: 8PSK Mode				
Frequency (MHz)	Conducted Power			Radiated Power
	Peak Power (dBm)	Av Power (dBm)	Peak-to-Av Ratio (dB)	EIRP (dBm)
1850.2	28.26	25.3	2.96	29.7
1880.0	28.28	25.3	2.98	28.7
1909.8	28.18	25.2	2.98	28.0

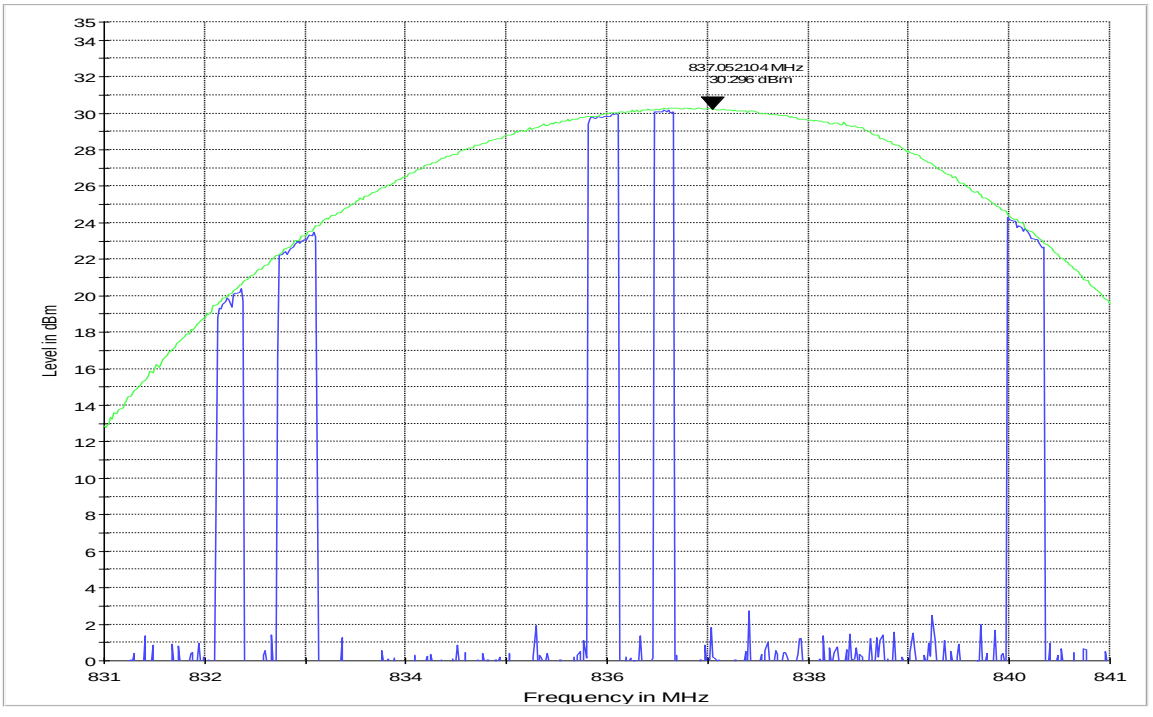
FDD II: UMTS Mode				
Frequency (MHz)	Conducted Power			Radiated Power
	Peak Power (dBm)	Av Power (dBm)	Peak-to-Av Ratio (dB)	EIRP (dBm)
1852.4	24.99	22.62	2.37	27.2
1880.0	25.30	22.71	2.59	26.3
1907.6	25.03	22.92	2.11	25.6

5.1.8 Radiated Results

ERP (GSM 850) CHANNEL 128 §22.913(a)



ERP (GSM 850) CHANNEL 190 §22.913(a)



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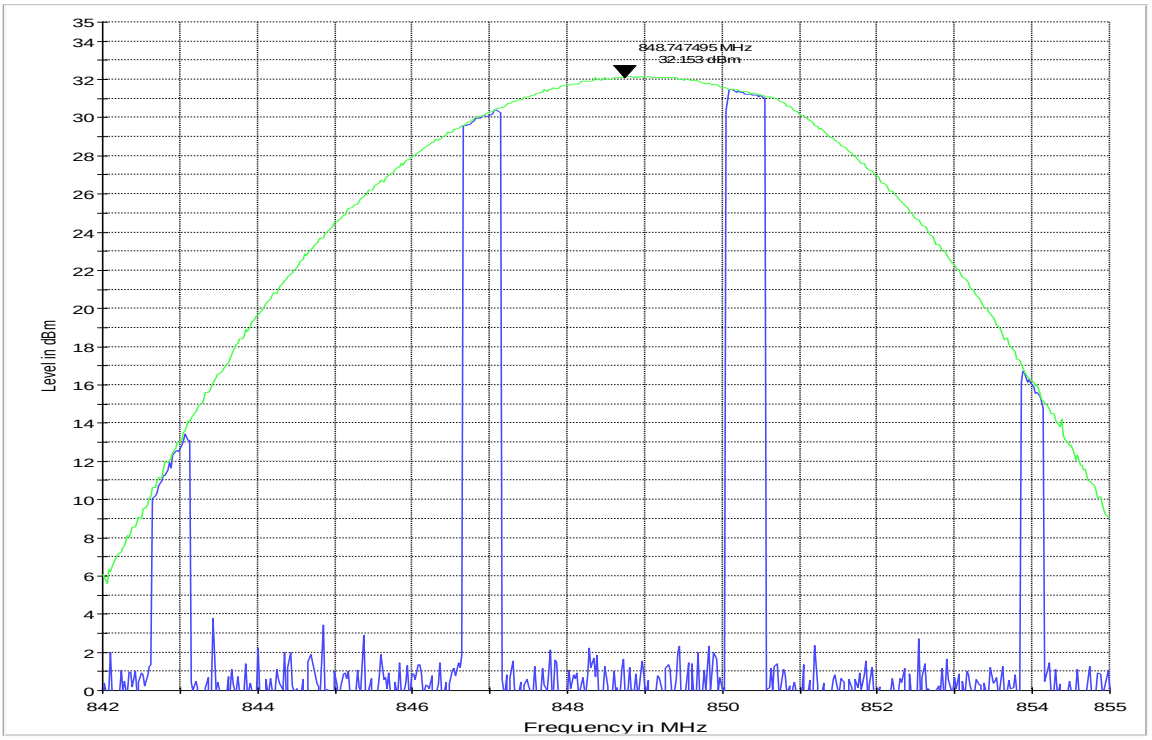

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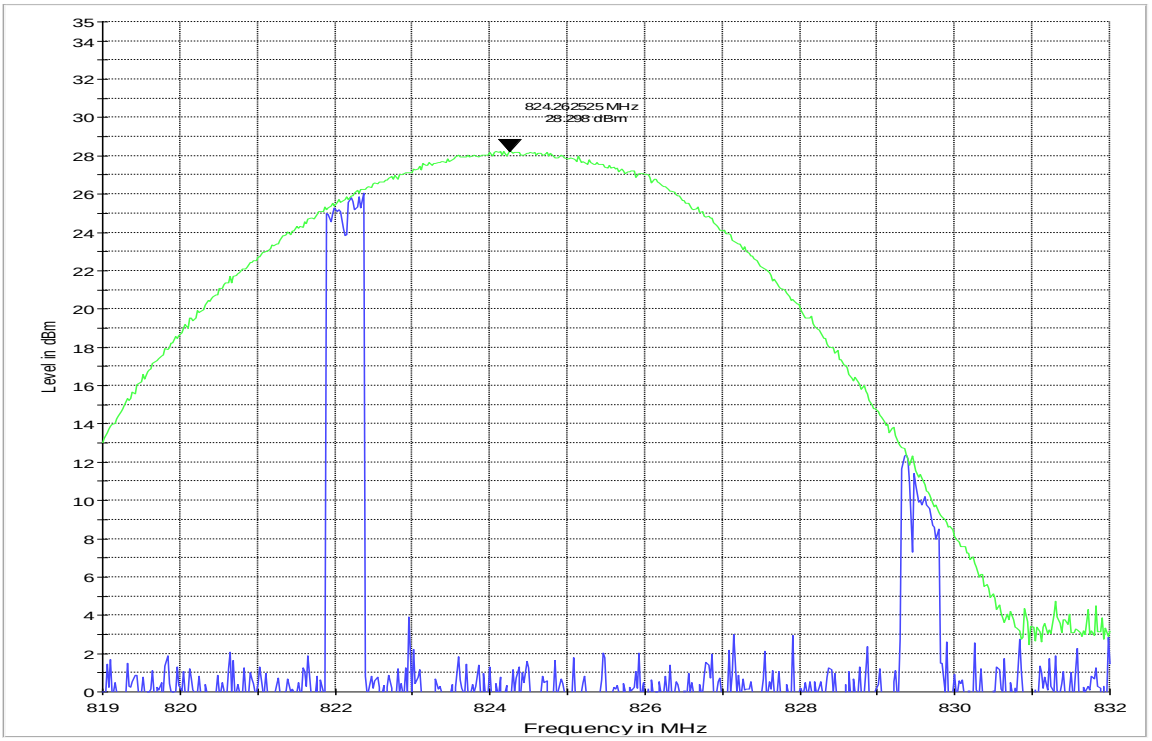

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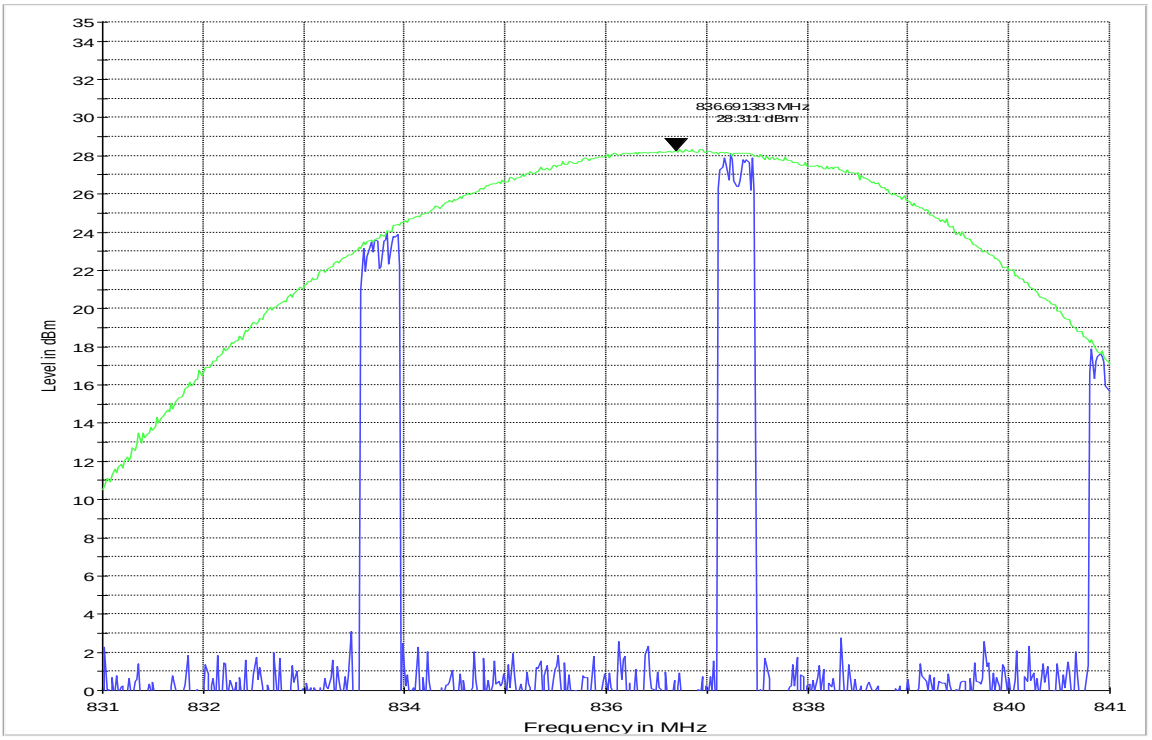

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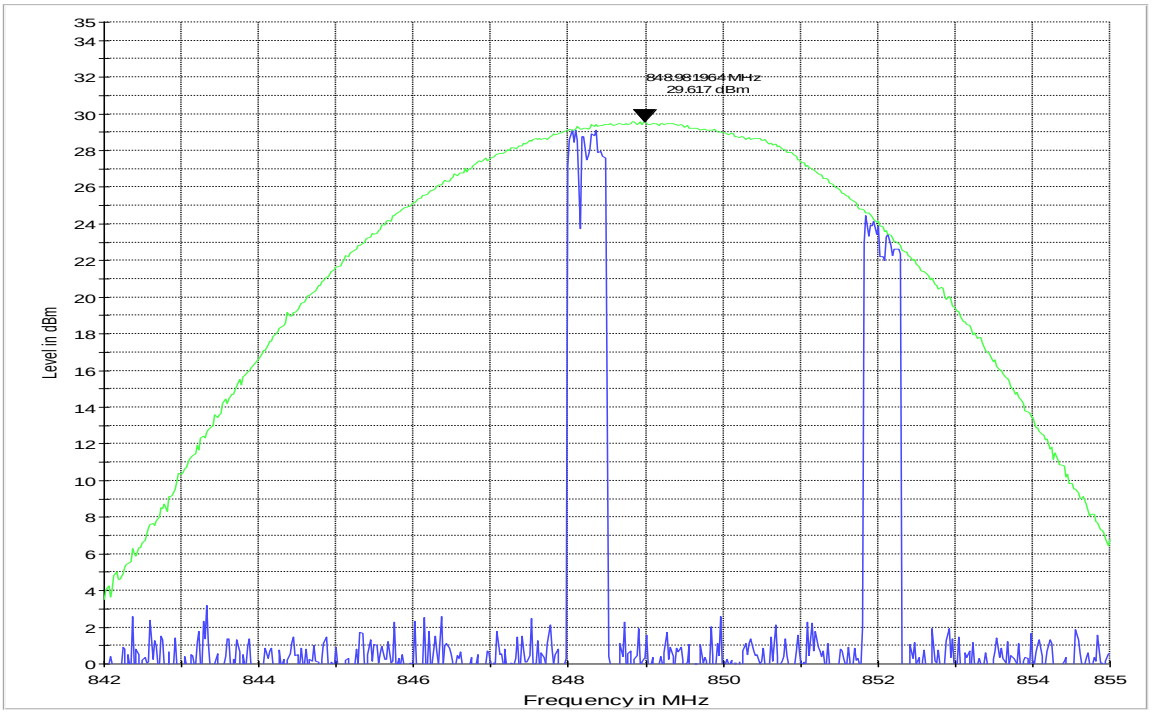
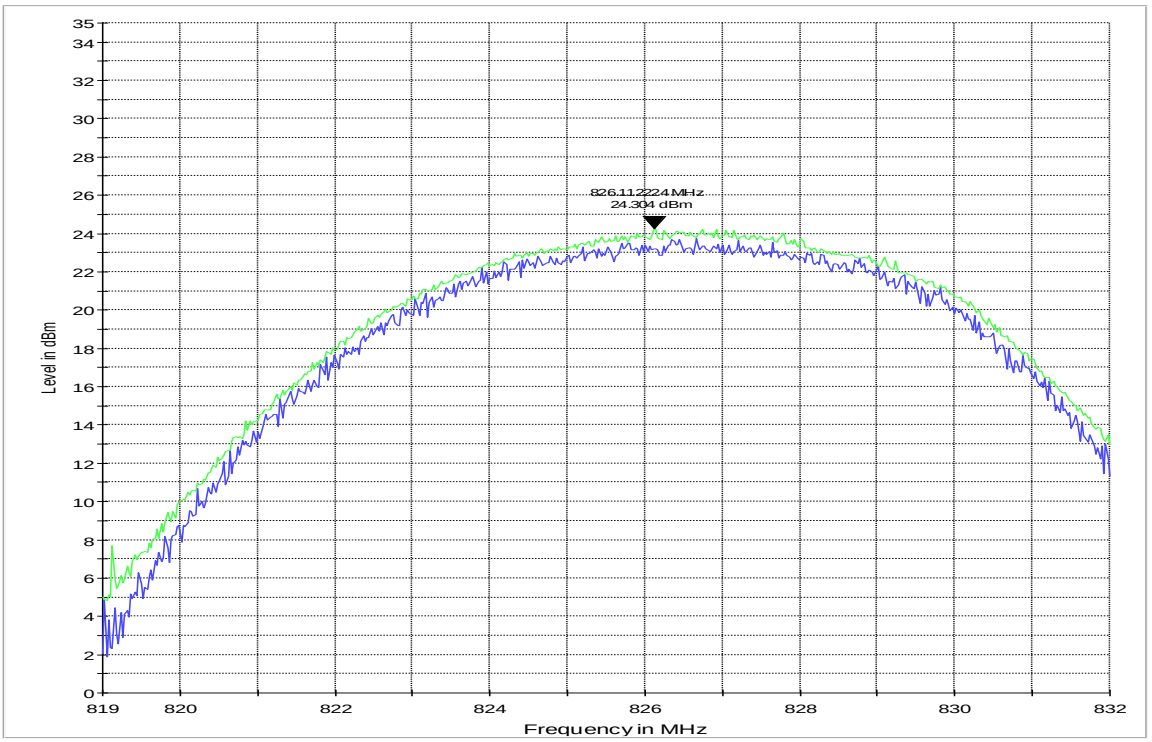
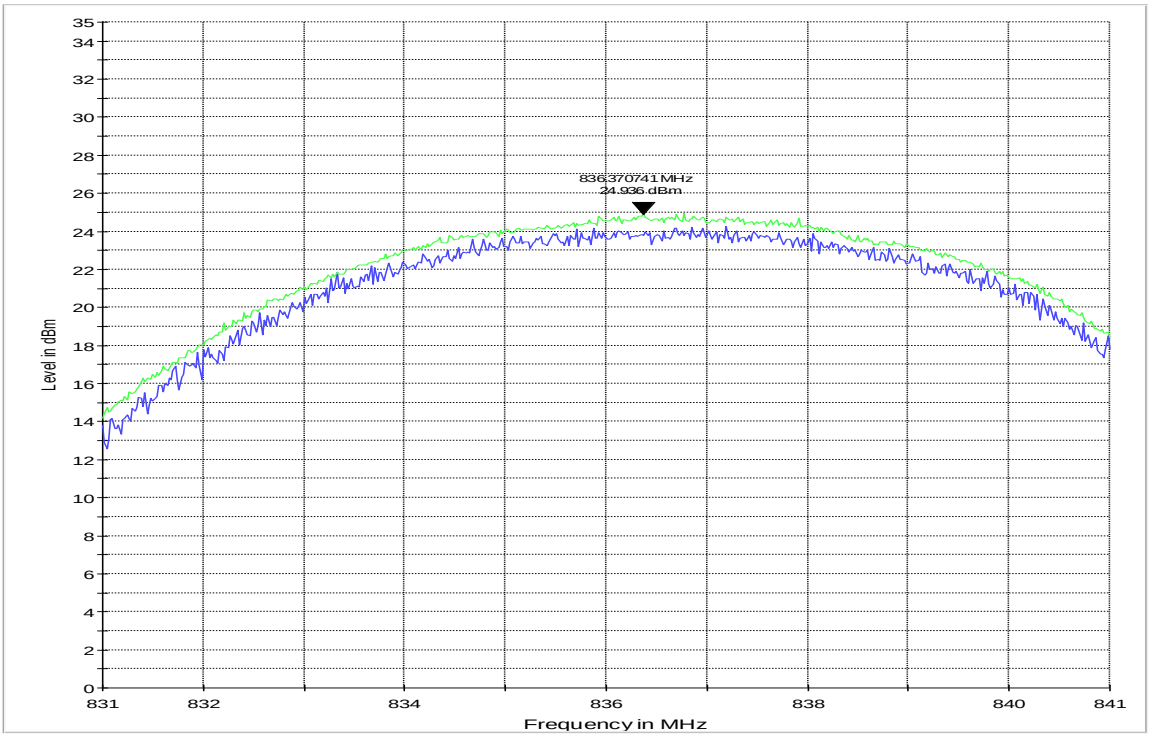


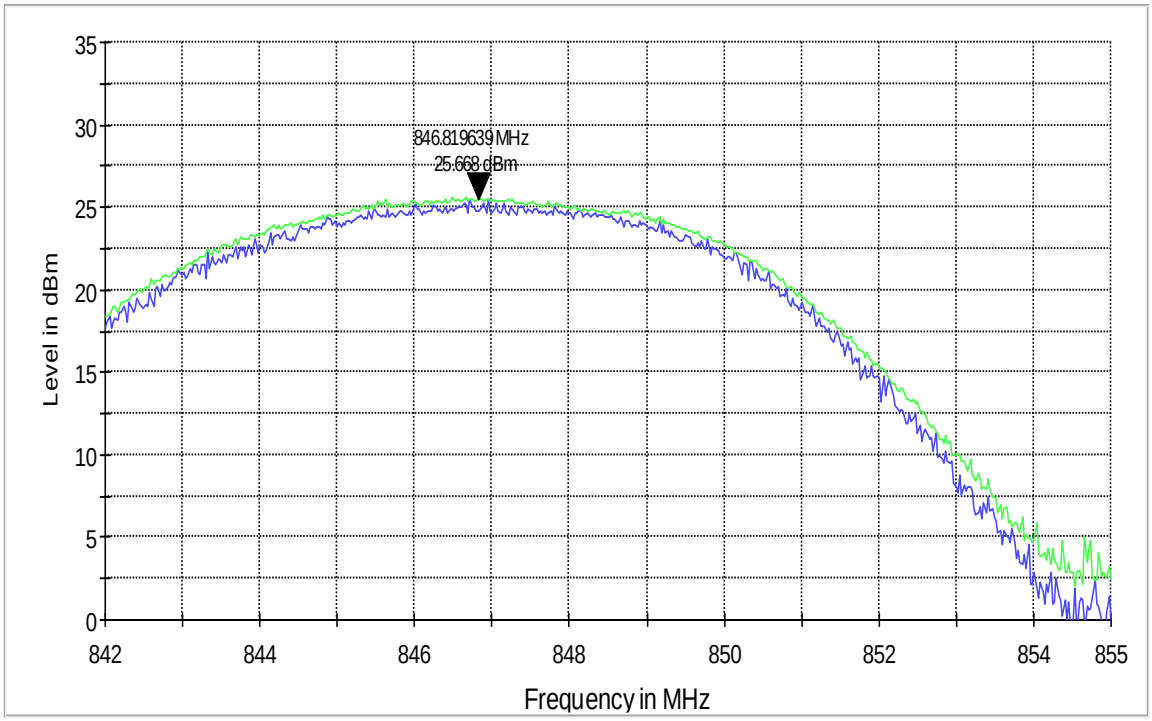
ERP (UMTS FDD5) CHANNEL 4132 §22.913(a)



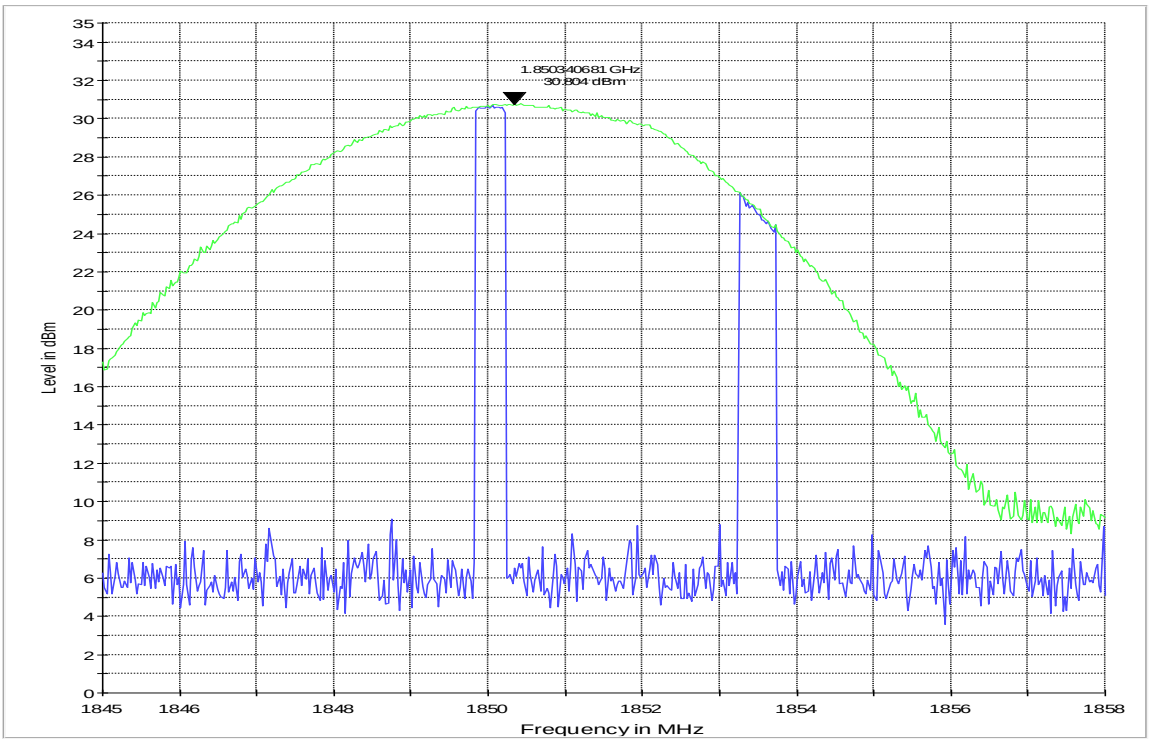
ERP (UMTS FDD5) CHANNEL 4183 §22.913(a)



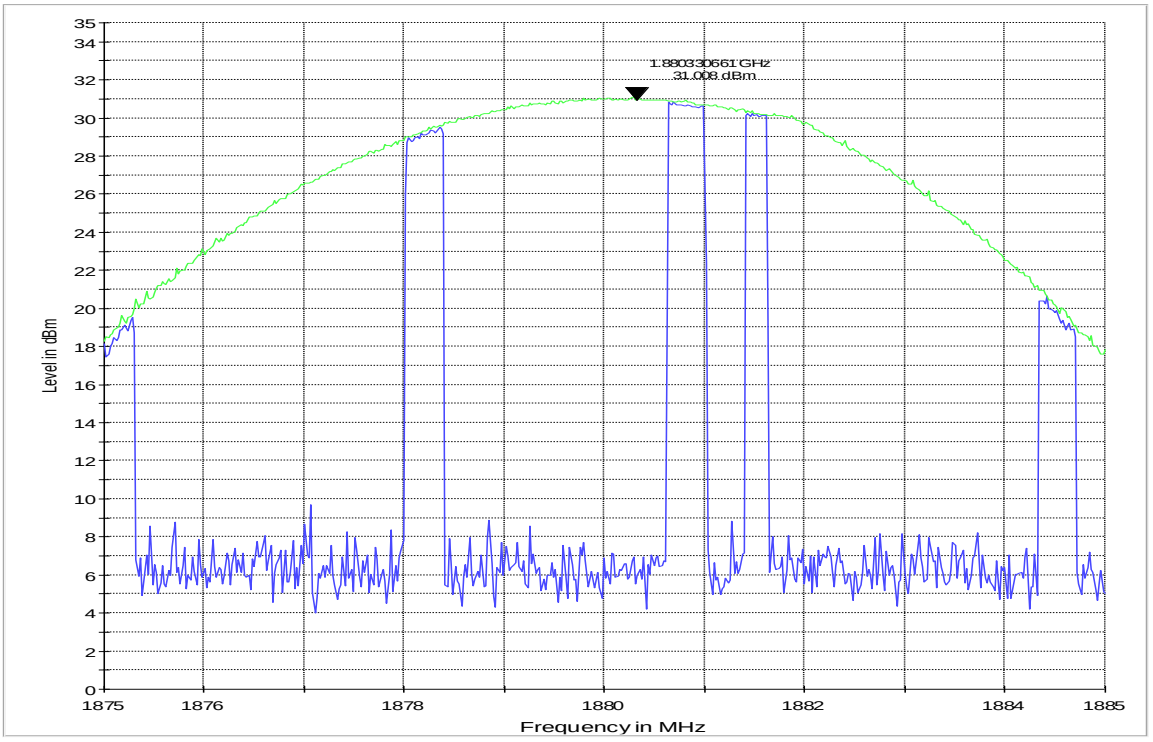
ERP (UMTS FDD5) CHANNEL 4233 §22.913(a)



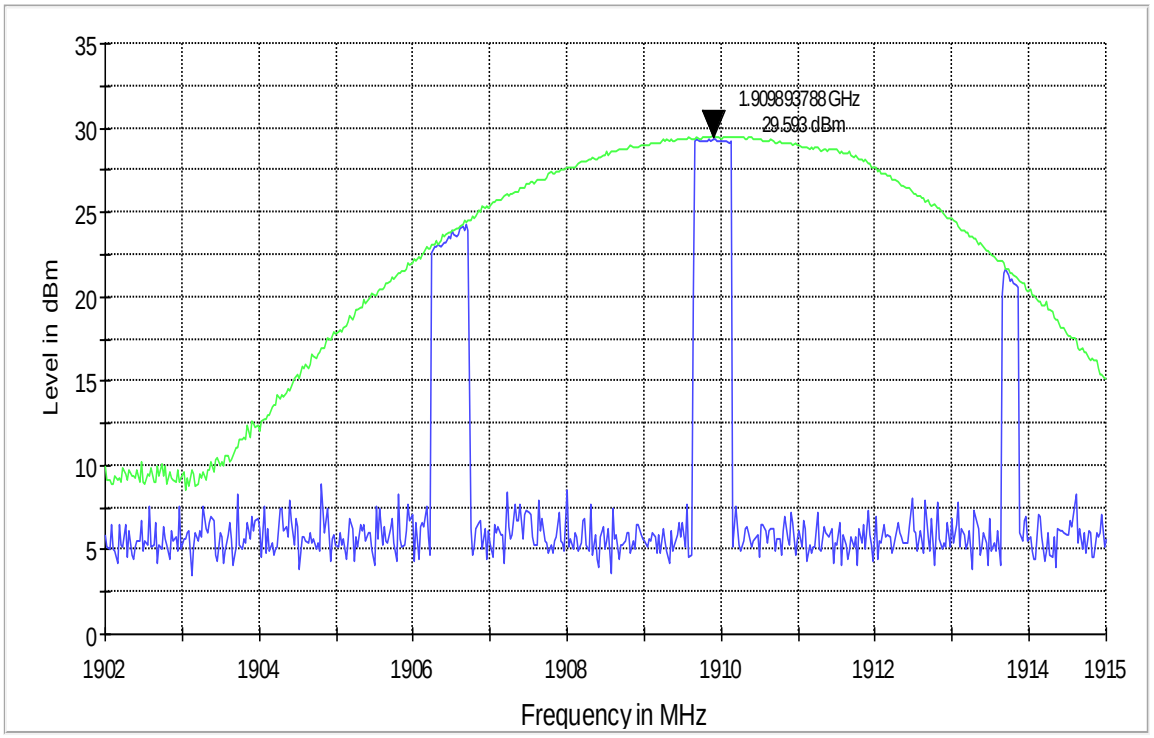
EIRP (PCS-1900) CHANNEL 512 §24.232(b)



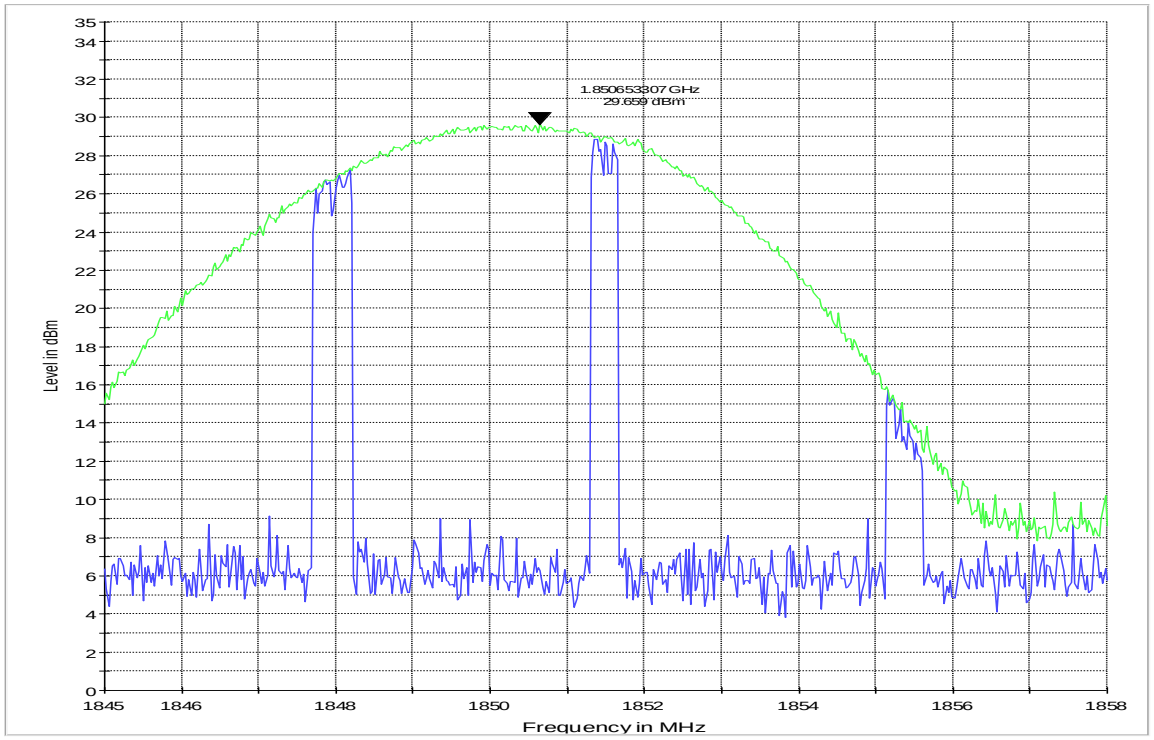
EIRP (PCS-1900) CHANNEL 661 §24.232(b)



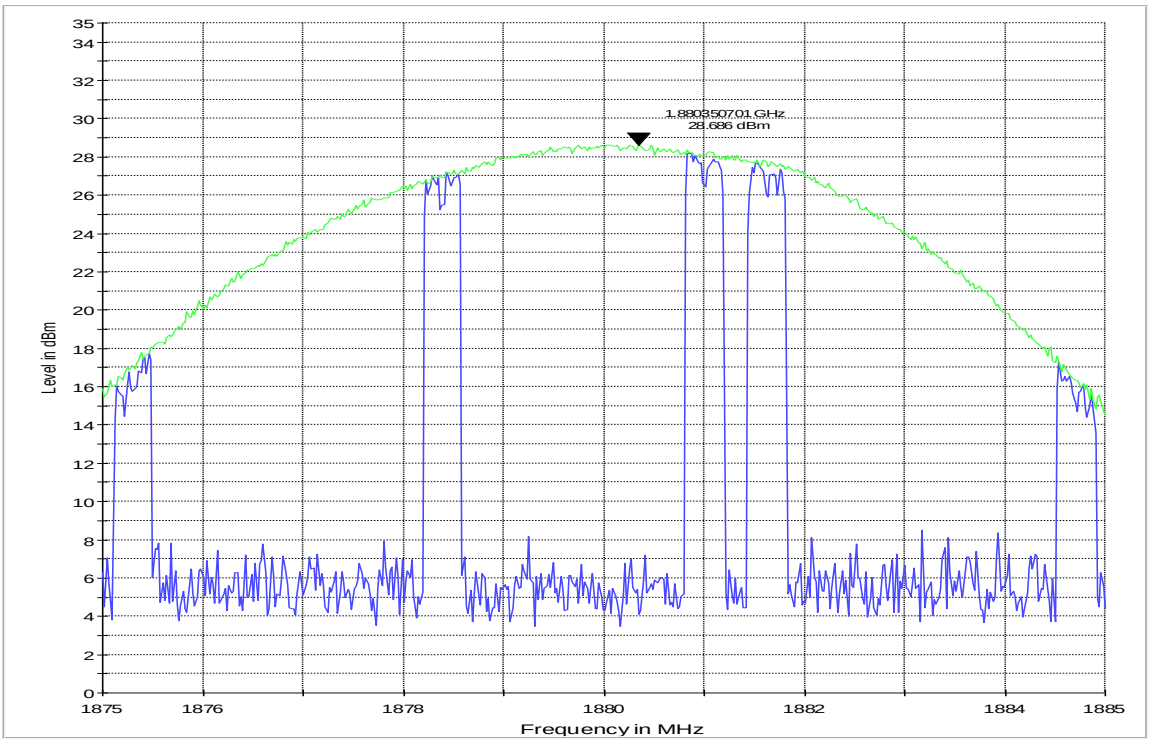
EIRP (PCS-1900) CHANNEL 810 §24.232(b)



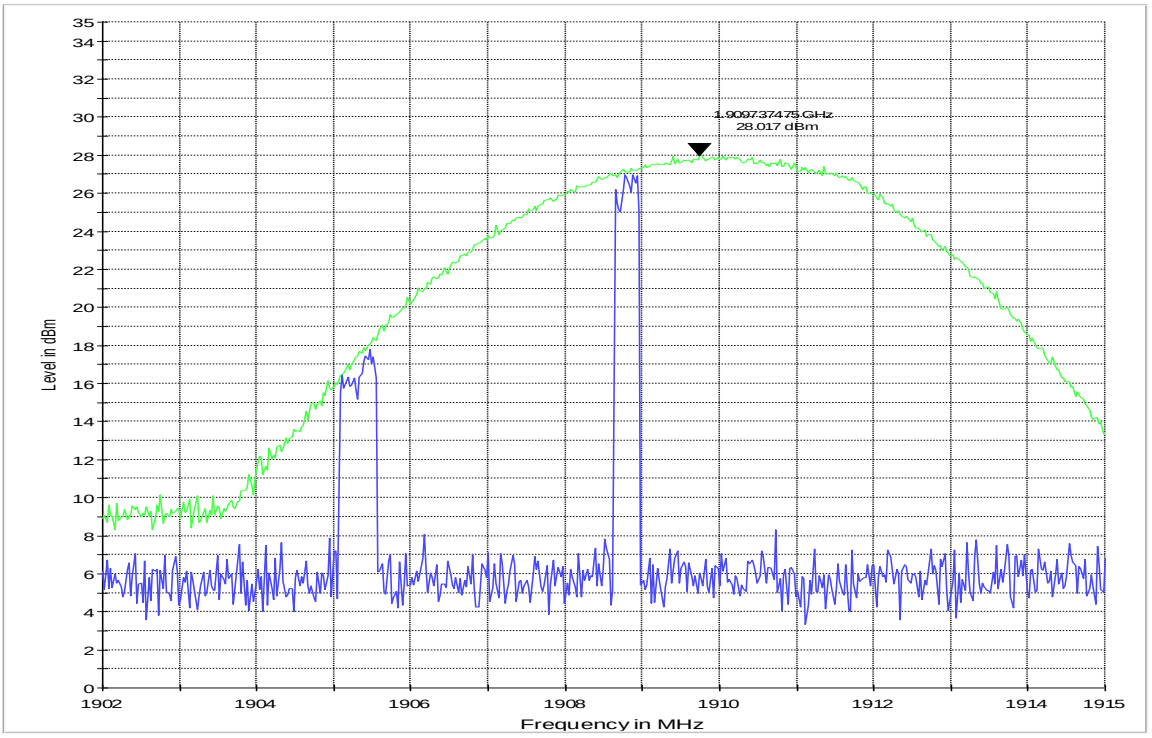
EIRP (EGPRS 1900) CHANNEL 512 §24.232(b)



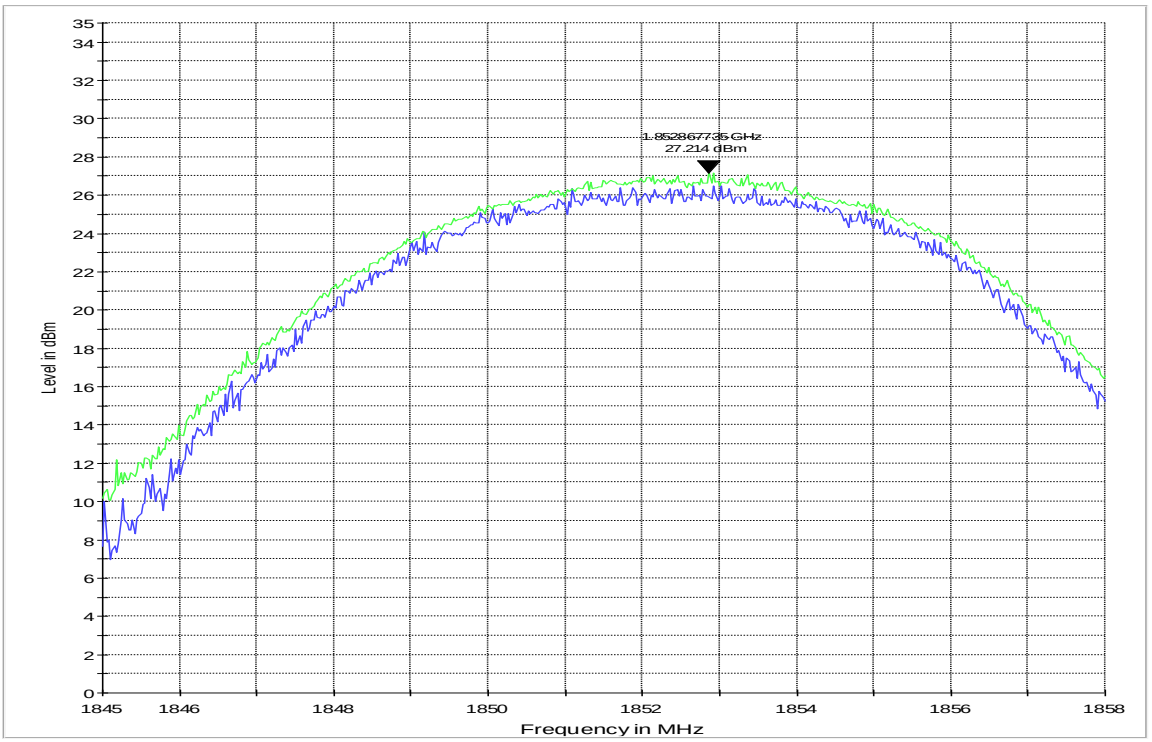
EIRP (EGPRS 1900) CHANNEL 661 §24.232(b)



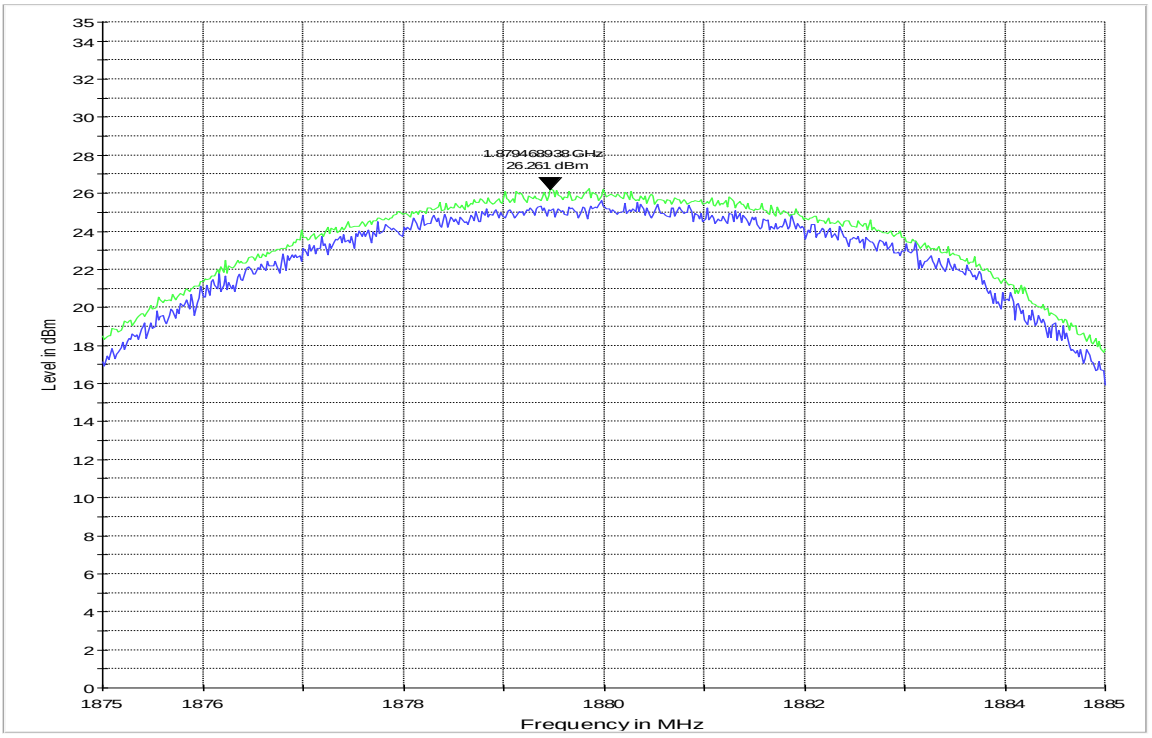
EIRP (EGPRS 1900) CHANNEL 810 §24.232(b)



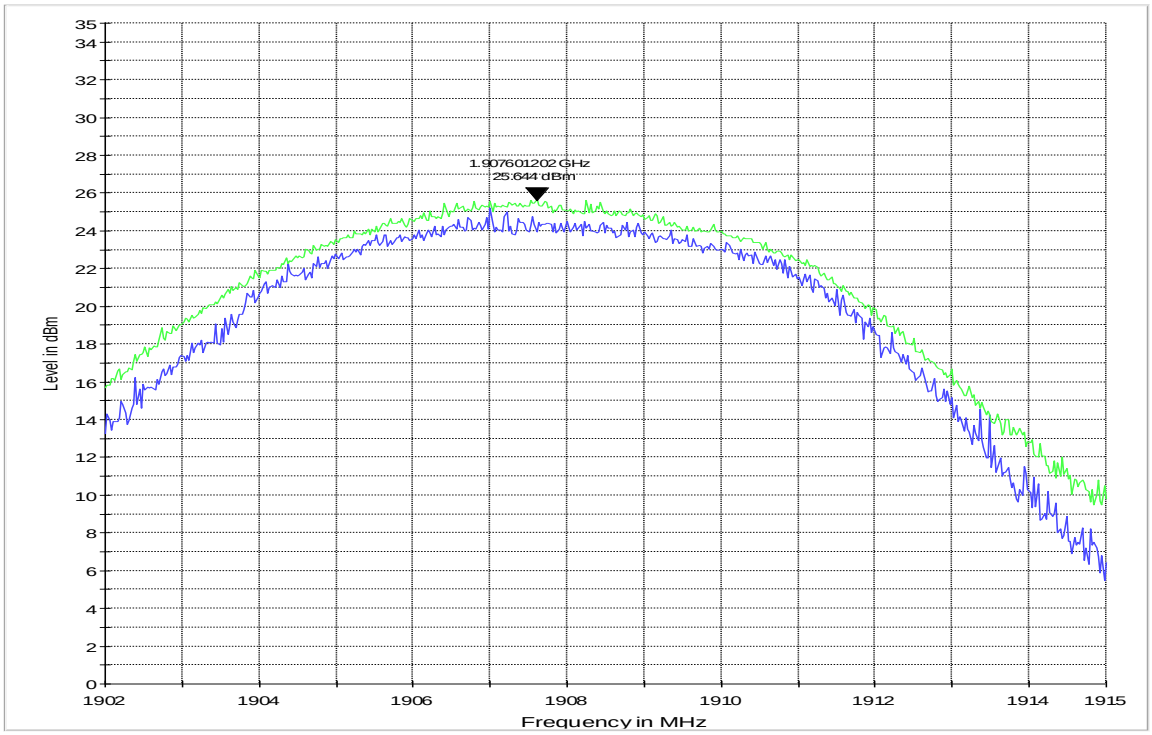
EIRP (UMTS FDD2) CHANNEL 9262 §24.232(b)



EIRP (UMTS FDD2) CHANNEL 9400 §24.232(b)



EIRP (UMTS FDD2) CHANNEL 9538 §24.232(b)



5.2 Occupied Bandwidth/Emission Bandwidth

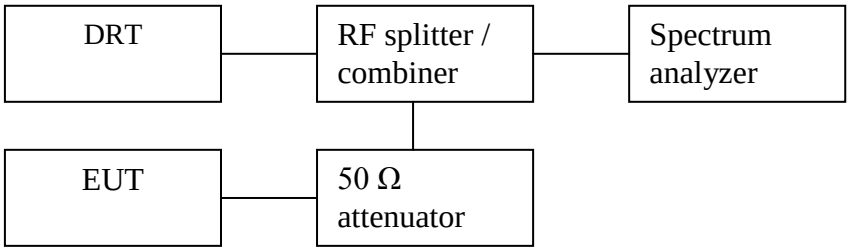
5.2.1 References

FCC: CFR Part 2.1049, CFR Part 22.917, CFR Part 24.238

5.2.2 FCC 2.1049 Measurements required: Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable.
(h) Transmitters employing digital modulation techniques-when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated.

5.2.3 Occupied / Emission bandwidth measurement procedure



1. Connect the equipment as shown in the above diagram.
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 the 99% (-20 dB) occupied bandwidth. Record the value.
4. Set the spectrum analyzer to measure the 99.5% (-26 dB) emission bandwidth. Record the value.
5. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.

Spectrum analyzer settings: Meaasurement bandwidth of atleast 1% of the occupied bandwidth.
GSM: RBW=3kHz; Span=1MHz; Detector: Peak- Max Hold.
UMTS: RBW=50kHz; Span=10MHz; Detector: Peak- Max Hold.

5.2.4 Occupied/Emission Bandwidth- 850 MHz band

This measurement is leveraged from FCC ID: BCG-E2380B since the hardware is identical.

The test results can be obtained from report # EMC_APPLE_057_09001_FCC22_24_BCG-E2380B_Rev1 issued by CETECOM Inc. on June 4, 2010.

GSM 850: GMSK Mode		
Frequency (MHz)	**99% Occupied Bandwidth (kHz)**	**-26dBc Bandwidth (kHz)**
824.2	243.6	314.1
836.6	243.6	302.9
848.8	245.2	317.3

EGPRS 850: 8PSK Mode		
Frequency (MHz)	**99% Occupied Bandwidth (kHz)**	**-26dBc Bandwidth (kHz)**
824.2	245.2	299.7
836.6	242.0	309.3
848.8	246.8	302.8

FDD V: UMTS Mode		
Frequency (MHz)	**99% Occupied Bandwidth (MHz)**	**-26dBc Bandwidth (MHz)**
826.4	4.07	4.60
836.6	4.05	4.56
846.6	4.07	4.53

5.2.5 Occupied/Emission Bandwidth- 1900 MHz band

This measurement is leveraged from FCC ID: BCG-E2380B since the hardware is identical.

The test results can be obtained from report # EMC_APPLE_057_09001_FCC22_24_BCG-E2380B_Rev1 issued by CETECOM Inc. on June 4, 2010.

GSM 1900: GMSK Mode		
Frequency (MHz)	**99% Occupied Bandwidth (kHz)**	**-26dBc Bandwidth (kHz)**
1850.2	243.6	312.5
1880.0	243.6	310.9
1909.8	242.0	312.5

EGPRS 1900: 8PSK Mode		
Frequency (MHz)	**99% Occupied Bandwidth (kHz)**	**-26dBc Bandwidth (kHz)**
1850.2	246.8	306.1
1880.0	246.8	293.2
1909.8	243.6	294.8

FDD II: UMTS Mode		
Frequency (MHz)	**99% Occupied Bandwidth (MHz)**	**-26dBc Bandwidth (MHz)**
1852.4	4.08	4.60
1880.0	4.07	4.60
1907.6	4.07	4.61

5.3 Frequency Stability

5.3.1 References

FCC: CFR Part 2.1055, CFR Part 22.355, CFR Part 24.235

5.3.2 Limits

For Hand carried battery powered equipment:
According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235/22.355 Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.
As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.4VDC and 4.2VDC, with a nominal voltage of 4.2VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. These voltages represent a tolerance of –19% and 0%. For the purposes of measuring frequency stability these voltage limits are to be used.

For equipment powered by primary supply voltage:
According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235/22.355 Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.
For this EUT section 2.1055(d)(1) applies. This requires to vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Method of Measurement:
In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of R&S CMU 200 Universal Radio Communication Tester.
1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30 C.
3. With the EUT, powered via nominal voltage, connected to the CMU 200 and in a simulated call on mid channel (190 for GSM 850 & 4183 for FDD5 & 661 for PCS1900 & 9400 for FDD2), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10 C increments from -30 C to +50 C. Allow at least 1 1/2 hours at each temperature, un-powered, before making measurements.
5. Re-measure carrier frequency at room temperature with nominal voltage. Re-measure carrier frequency at low and high voltage. Pause at nominal voltage for 1 1/2 hours un-powered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +50 C.
7. With the EUT, powered via nominal voltage, connected to the CMU 200 and in a simulated call on mid channel (190 for GSM 850 & 4183 for FDD5 & 661 for PCS1900 & 9400 for

FDD2), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10 C increments from +50 C to -30 C. Allow at least 1 1/2 hours at each temperature, un-powered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5 C during the measurement procedure.

This measurement is leveraged from FCC ID: BCG-E2380B since the hardware is identical.

The test results can be obtained from report # EMC_APPLE_057_09001_FCC22_24_BCG-E2380B_Rev1 issued by CETECOM Inc. on June 4, 2010.

5.3.3 Test Results Frequency Stability (GSM-850): Channel 190 (836.6 MHz)

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Low V: 3.4	-3	-0.0036
High V: 4.2	-5	-0.0060

§2.1055 (a)(1) AFC FREQ ERROR vs. TEMPERATURE

Temperature (^{o}C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	7	0.0084
-20	11	0.0131
-10	6	0.0072
0	5	0.0060
+10	-6	-0.0072
+20	6	0.0072
+30	7	0.0084
+40	-6	-0.0072
+50	-8	-0.0096

§2.1055 (b)(2) Battery end point

Battery End Point (V DC)	Frequency Error (Hz)	Frequency Error (ppm)
3.2	28	0.0335

5.3.4 Test Results Frequency Stability (GSM-1900): Channel 661 (1880.0 MHz)

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Low V: 3.4	-8	-0.0043
High V: 4.2	-16	-0.0085

§2.1055 (a)(1) AFC FREQ ERROR vs. TEMPERATURE

Temperature (^{o}C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	25	0.0133
-20	17	0.0090
-10	-15	-0.0080
0	-17	-0.0090
+10	-12	-0.0064
+20	-17	-0.0090
+30	-15	-0.0080
+40	-21	-0.0112
+50	-18	-0.0096

§2.1055 (b)(2) Battery end point

Battery End Point (V DC)	Frequency Error (Hz)	Frequency Error (ppm)
3.0	67	0.0356

5.3.5 Test Results Frequency Stability (FDD V): Channel 4183 (836.6 MHz)

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Low V: 3.4	-11	-0.0131
High V: 4.2	-12	-0.0143

§2.1055 (a)(1) AFC FREQ ERROR vs. TEMPERATURE

Temperature (^{o}C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-28	-0.0335
-20	-2	-0.0024
-10	16	0.0191
0	-13	-0.0155
+10	-11	-0.0131
+20	-13	-0.0155
+30	-16	-0.0191
+40	-17	-0.0203
+50	-12	-0.0143

§2.1055 (b)(2) Battery end point

Battery End Point (V DC)	Frequency Error (Hz)	Frequency Error (ppm)
3.1	36	0.0430

5.3.6 Test Results Frequency Stability (FDD II): Channel 9400 (1880.0 MHz)

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Low V: 3.4	15	0.0080
High V: 4.2	24	0.0128

§2.1055 (a)(1) AFC FREQ ERROR vs. TEMPERATURE

Temperature (^{o}C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	16	0.0085
-20	20	0.0106
-10	16	0.0085
0	16	0.0085
+10	-18	-0.0096
+20	14	0.0074
+30	16	0.0085
+40	-22	-0.0117
+50	13	0.0069

§2.1055 (b)(2) Battery end point

Battery End Point (V DC)	Frequency Error (Hz)	Frequency Error (ppm)
3.2	64	0.0340

5.4 Conducted Spurious Emissions

5.4.1 References

FCC: CFR Part 2.1051, CFR Part 22.917, CFR Part 24.238

5.4.2 FCC 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in FCC 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

5.4.3 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.*

5.4.3.1 FCC 22.917 Emission limitations for cellular equipment.

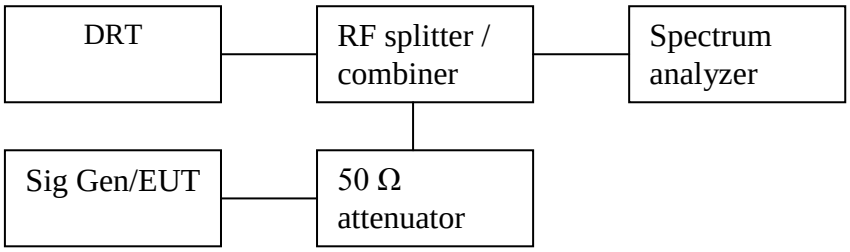
The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.
(b) *Measurement procedure.* Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands 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.

5.4.3.2 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.

5.4.4 Measurement Procedure -Conducted Out of band Emissions

Ref: TIA-603C 2004 2.2.13 Unwanted Emissions: Conducted Spurious



1. Connect the equipment as shown in the above diagram.
2. Set the spectrum analyzer to measure peak hold with the required settings.
3. Set the signal generator to a known output power and record the path loss in dB (**LOSS)** for frequencies up to the tenth harmonic of the EUT's carrier frequency. \
   LOSS = Generator Output Power (dBm) – Analyzer reading (dBm).
4. Replace the signal generator with the EUT.
5. Adjust the settings of the Digital RadioCommunication Tester (DRT) to set the EUT to its maximum power at the required channel.
6. Set the spectrum analyzer to measure peak hold with the required settings. Offset the spectrum analyzer reference level by the path loss measured above.
7. Measure and record all spurious emissions up to the tenth harmonic of the carrier frequency.
8. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.
9. If necessary steps 6 and 7 may be performed with the spectrum analyzer set to average detector.
   (**Note:** Step 3 above is performed prior to testing and **LOSS** is recorded by test software. Steps 2, 6, and 7 above are performed with test software.)

5.4.5 Test Results- Conducted Out of band Emission

This measurement is leveraged from FCC ID: BCG-E2380B since the hardware is identical.

The test results can be obtained from report # EMC_APPLE_057_09001_FCC22_24_BCG-E2380B_Rev1 issued by CETECOM Inc. on June 4, 2010.

5.5 Spurious Emissions Radiated

5.5.1 References

FCC: CFR Part 2.1053, CFR Part 22.917, CFR Part 24.238

5.5.2 FCC 2.1053 Measurements required: 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.

5.5.3 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.

5.5.3.1 FCC 22.917 Emission limitations for cellular equipment.

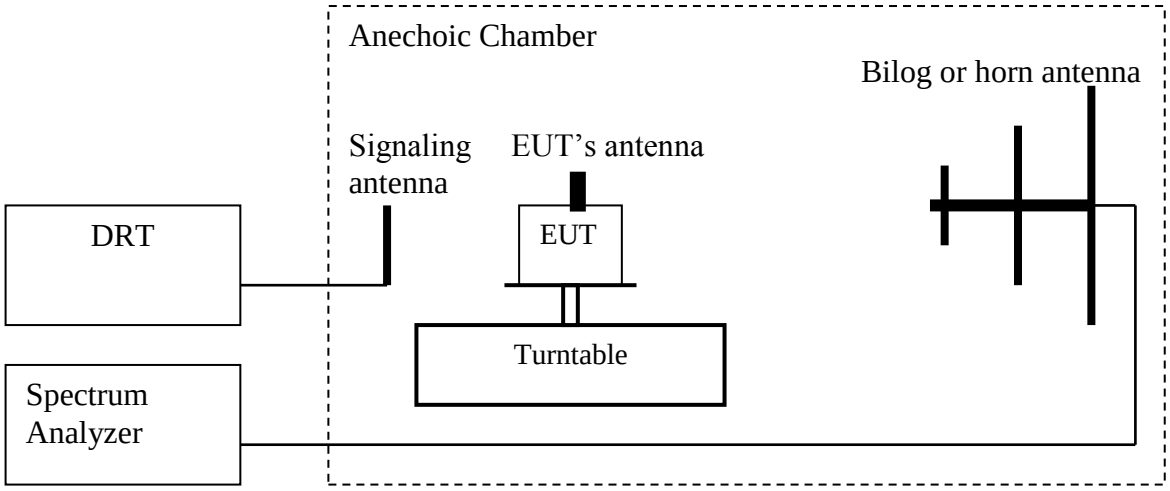
The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.
(b) *Measurement procedure.* Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands 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.

5.5.3.2 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.

5.5.4 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 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

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 for 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.

5.5.5 Radiated out of band emissions results on EUT- Transmit Mode:

5.5.5.1 Test Results Transmitter Spurious Emission GSM850:

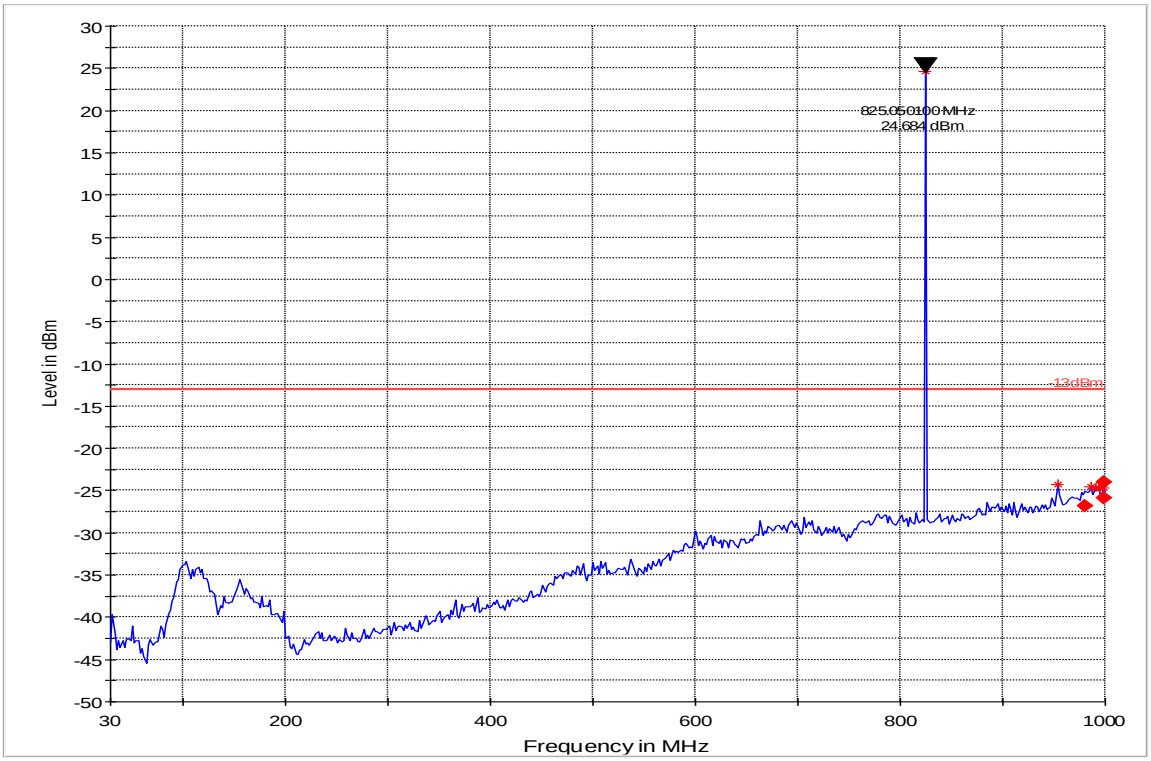
Harmonic	Tx ch-128 Freq. (MHz)	Level (dBm)	Tx ch-190 Freq. (MHz)	Level (dBm)	Tx ch-251 Freq. (MHz)	Level (dBm)
1	**824.2**	-	**836.6**	-	**848.8**	-
2	**1648.4**	NF	**1673.2**	NF	**1697.6**	NF
3	**2472.6**	NF	**2509.8**	NF	**2546.4**	NF
4	**3296.8**	NF	**3346.4**	NF	**3395.2**	NF
5	**4121**	NF	**4183**	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						

Legend for the plots:

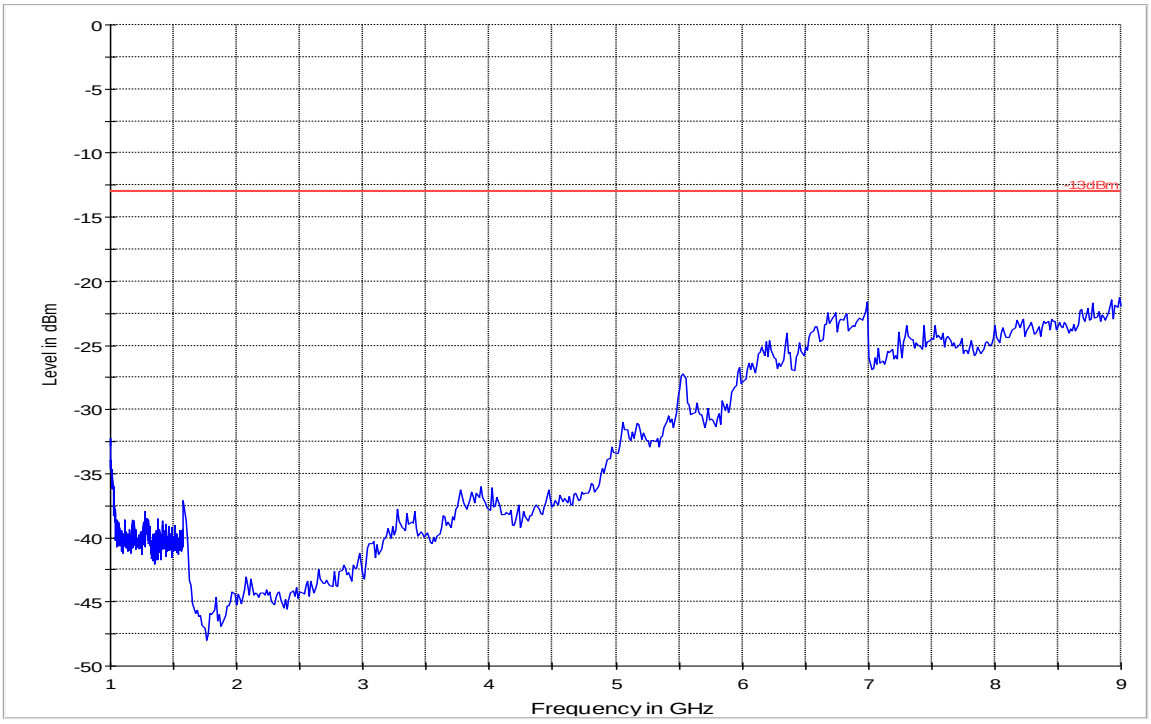
-13dBmLimtLine PreviewResult1

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

Test results 30M-1GHz

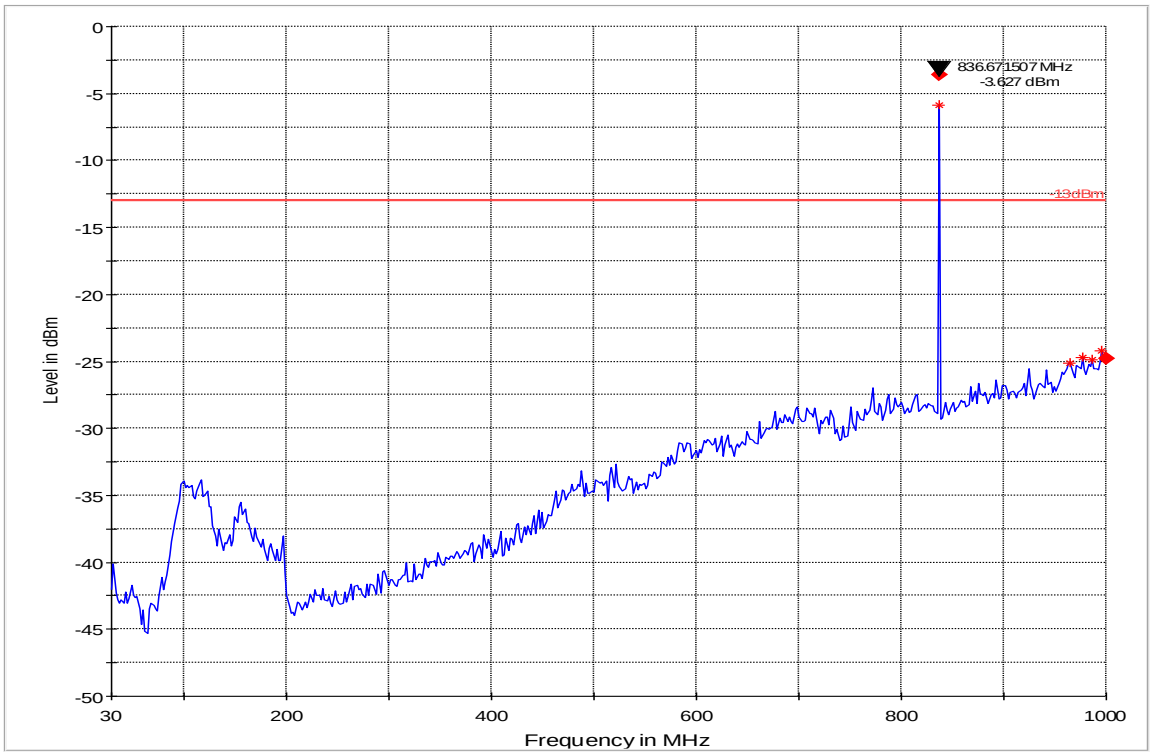


Test results 1GHz-9GHz

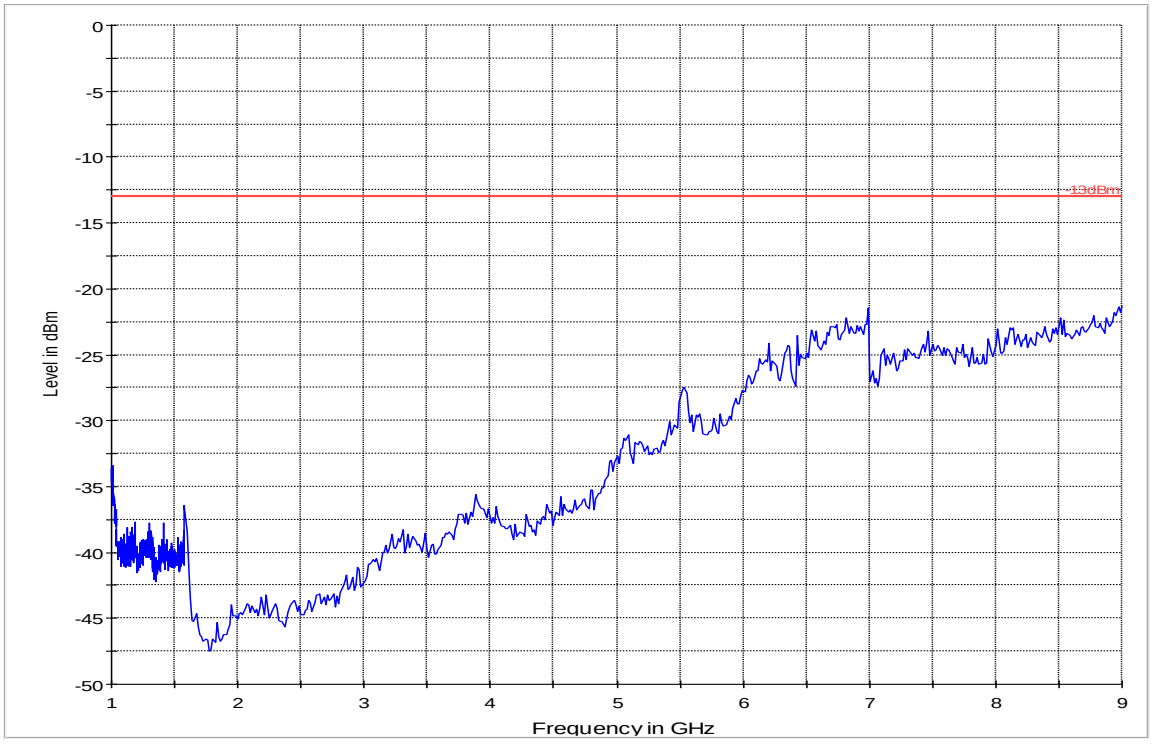


Radiated Spurious Emissions (GSM-850) Tx: Mid Channel

Test results 30M-1GHz

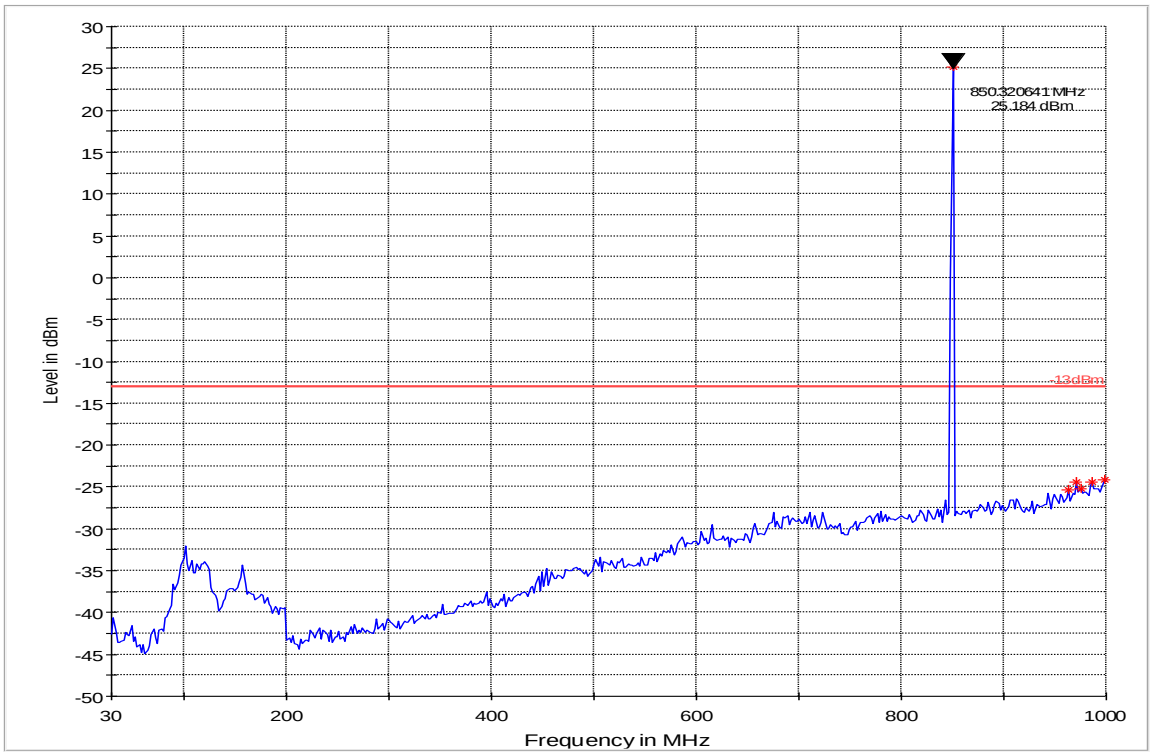


Test results 1GHz-9GHz

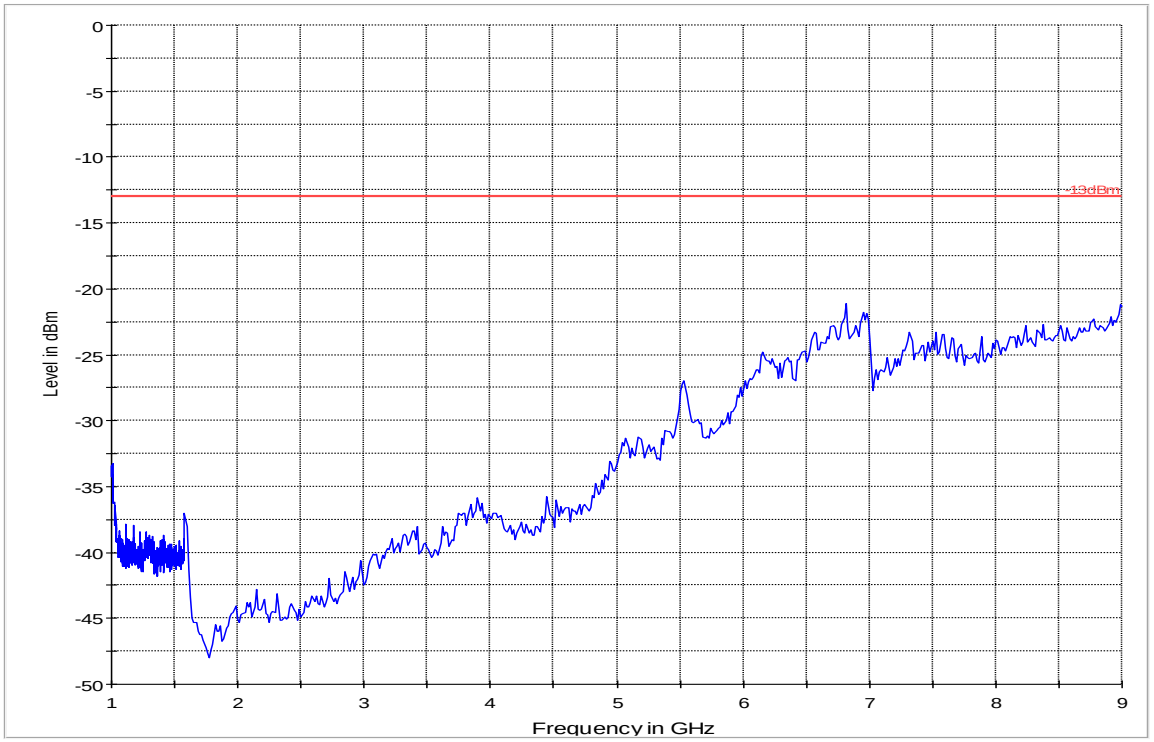


Radiated Spurious Emissions (GSM-850) Tx: High Channel

Test results 30M-1GHz



Test results 1GHz-9GHz



5.5.5.2 Test Results Transmitter Spurious Emission UMTS FDDV

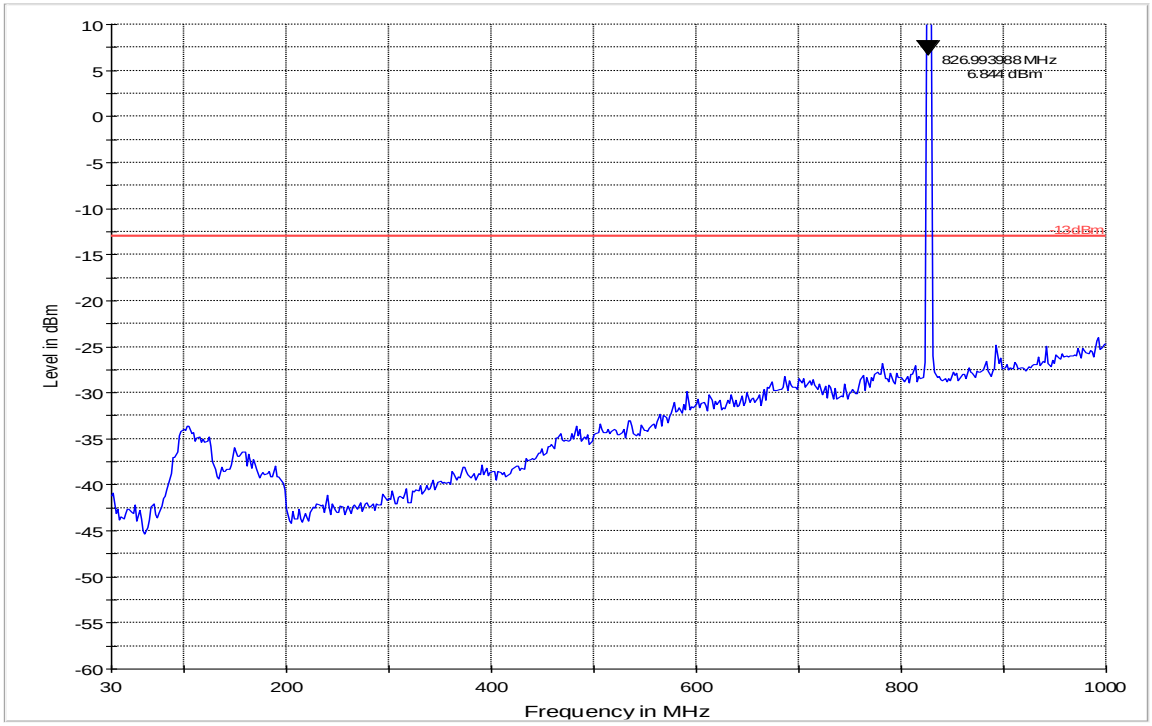
Harmonic	Tx ch-4132 Freq. (MHz)	Level (dBm)	Tx ch-4183 Freq. (MHz)	Level (dBm)	Tx ch-4233 Freq. (MHz)	Level (dBm)
1	**826.4**	-	**836.6**	-	**846.6**	-
2	**1652.8**	NF	**1673.2**	NF	**1693.2**	NF
3	**2479.2**	NF	**2509.8**	NF	**2539.8**	NF
4	**3305.6**	NF	**3346.4**	NF	**3386.4**	NF
5	**4132**	NF	**4183**	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						

Legend for the plots:

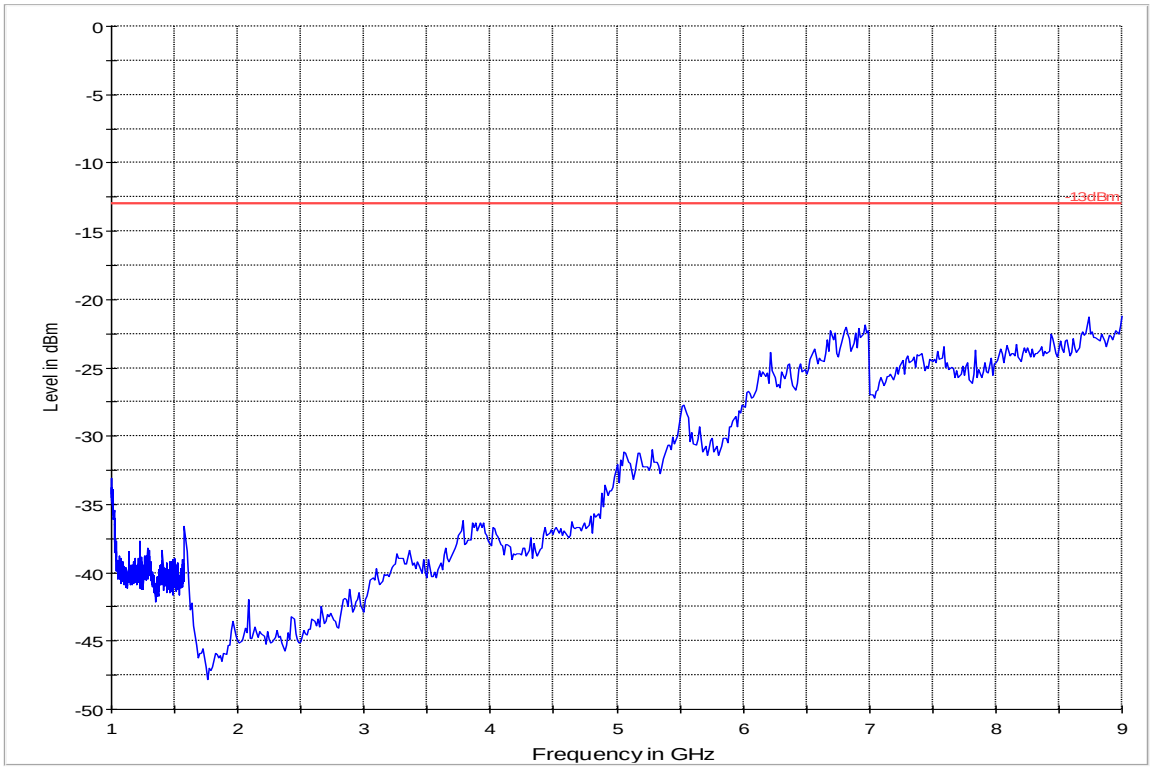
-13dBmLimtLine PreviewResult 1

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

Test results 30M-1GHz

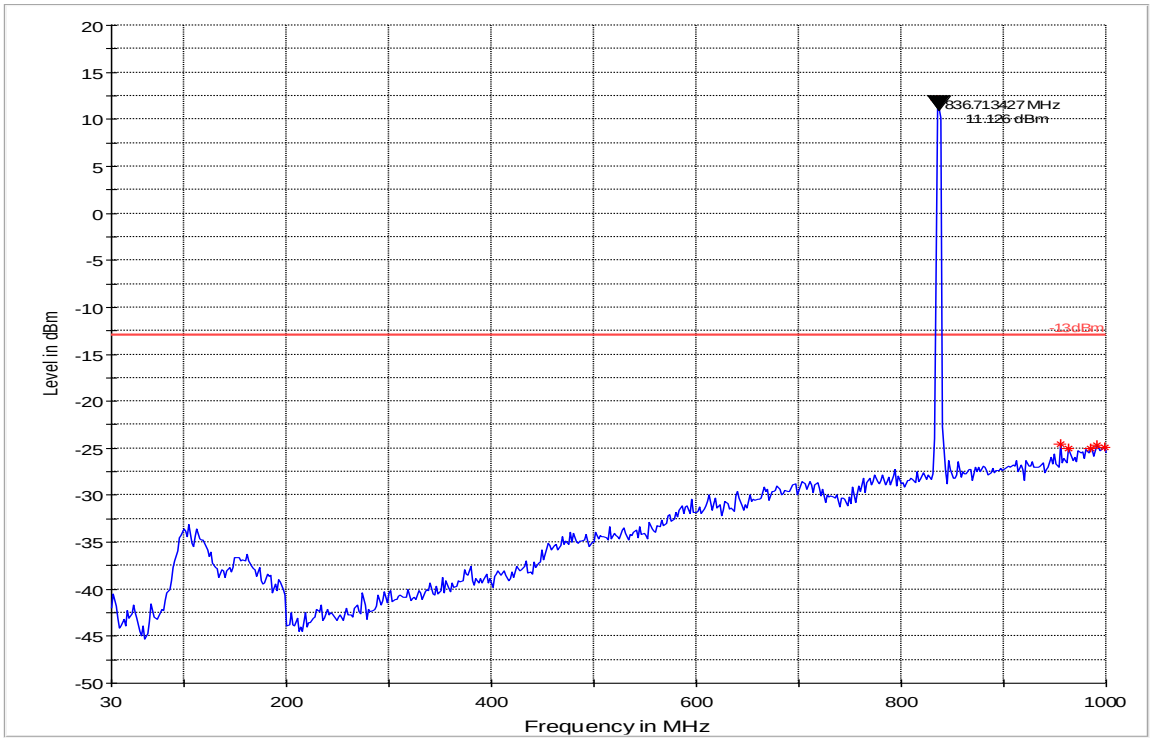


Test results 1GHz-9GHz

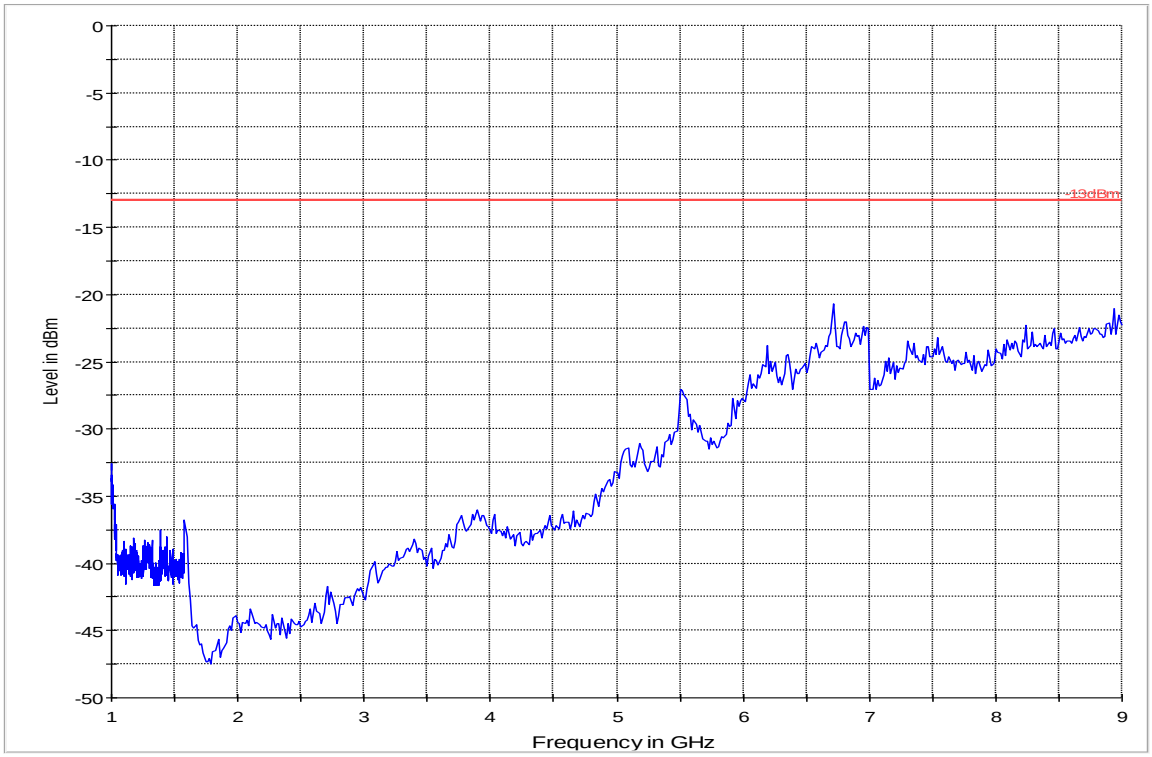


Radiated Spurious Emissions (UMTS Band 5) Tx: Mid Channel

Test results 30M-1GHz

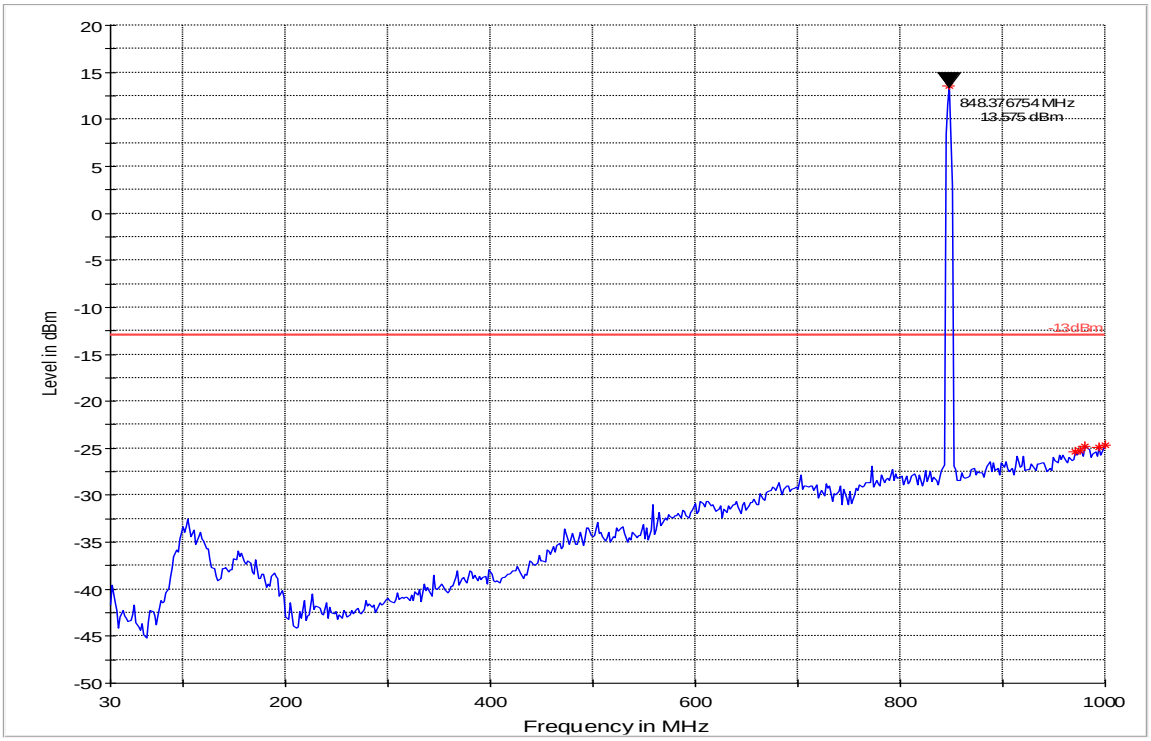


Test results 1GHz-9GHz

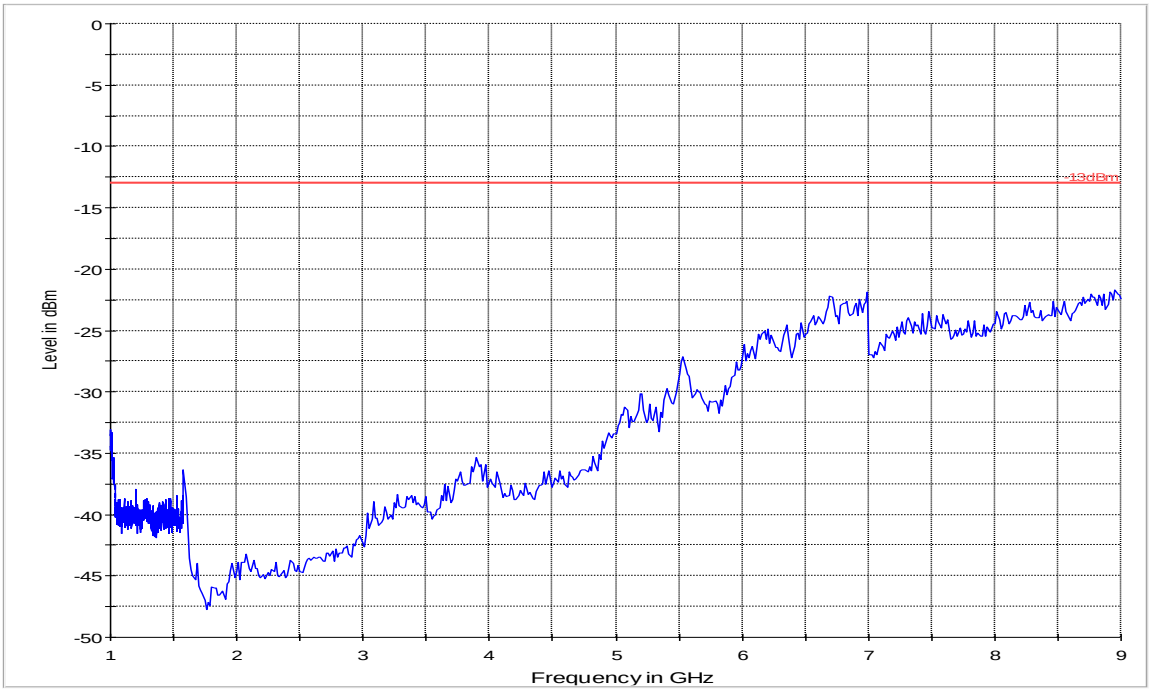


Radiated Spurious Emissions (UMTS Band 5) Tx: High Channel

Test results 30M-1GHz



Test results 1GHz-9GHz



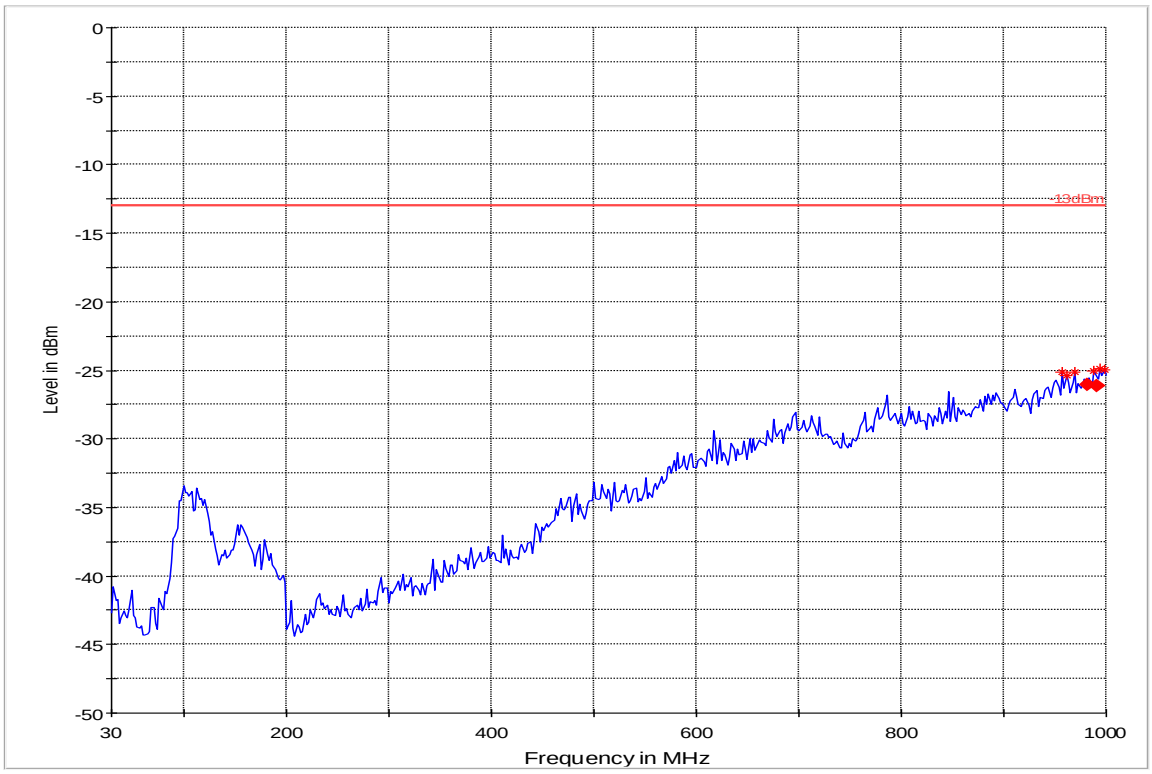
5.5.5.3 Test Results Transmitter Spurious Emission PCS-1900:

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**	-	**1880.0**	-	**1909.8**	-
2	**3700.4**	-41.5	**3760**	-35.5	**3819.6**	-42.0
3	**5550.6**	-42.0	**5640**	-41.5	**5729.4**	-42.0
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						

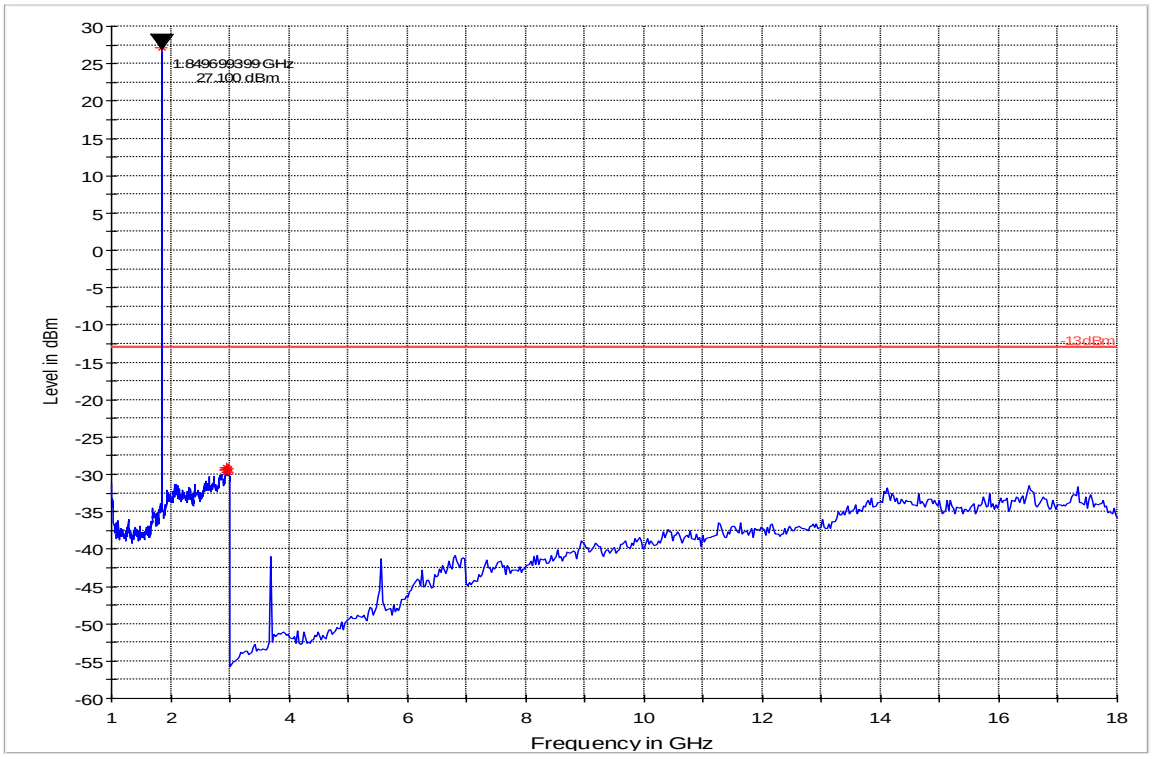
Legend for the plots:

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

Test results 30M-1GHz

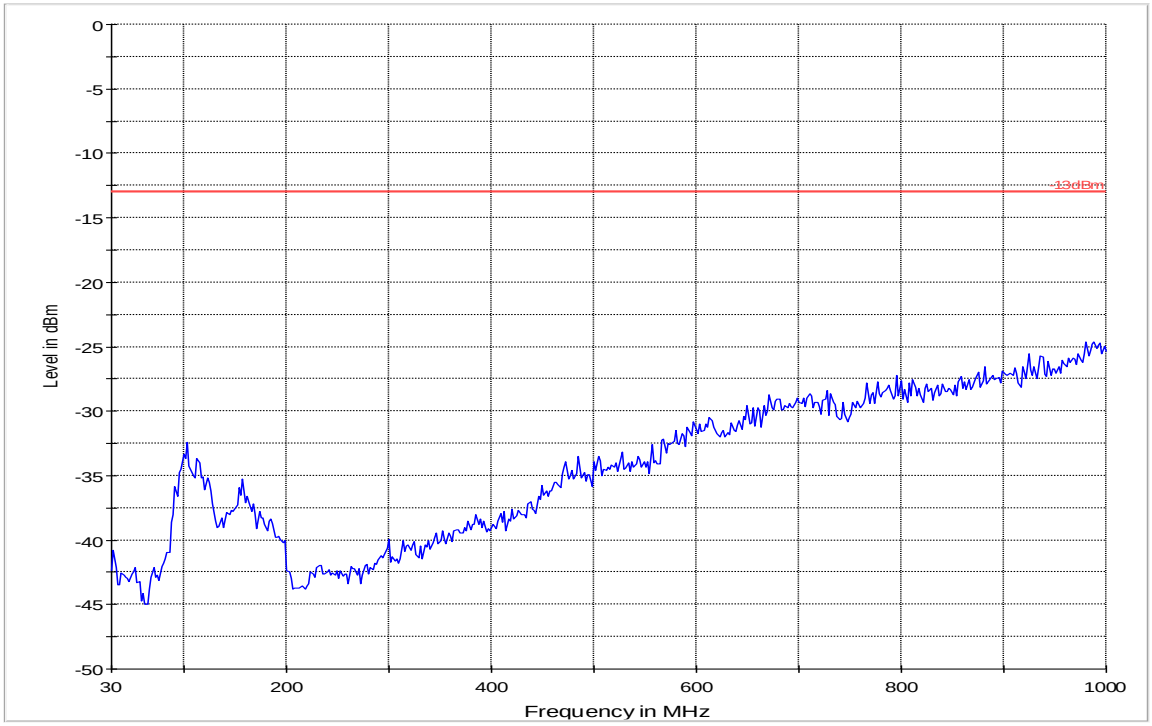


Test results 1GHz-18GHz

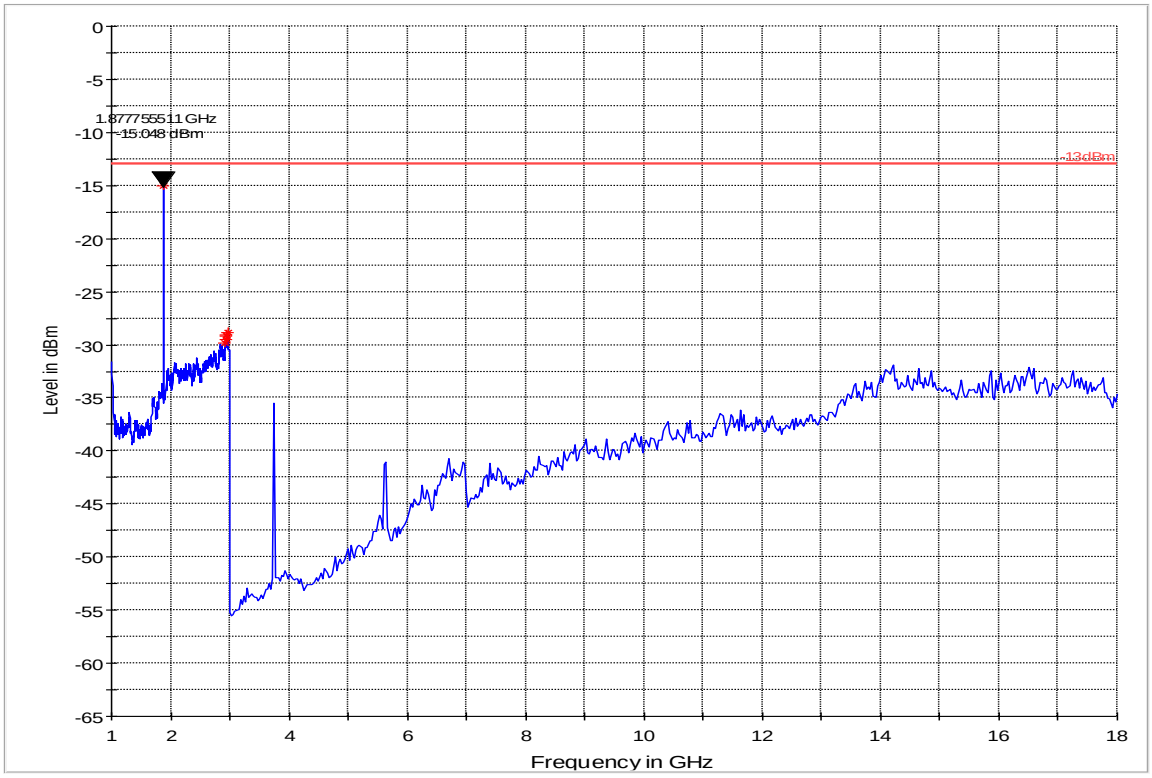


Radiated Spurious Emissions (GSM-1900) Tx: Mid Channel

Test results 30M-1GHz

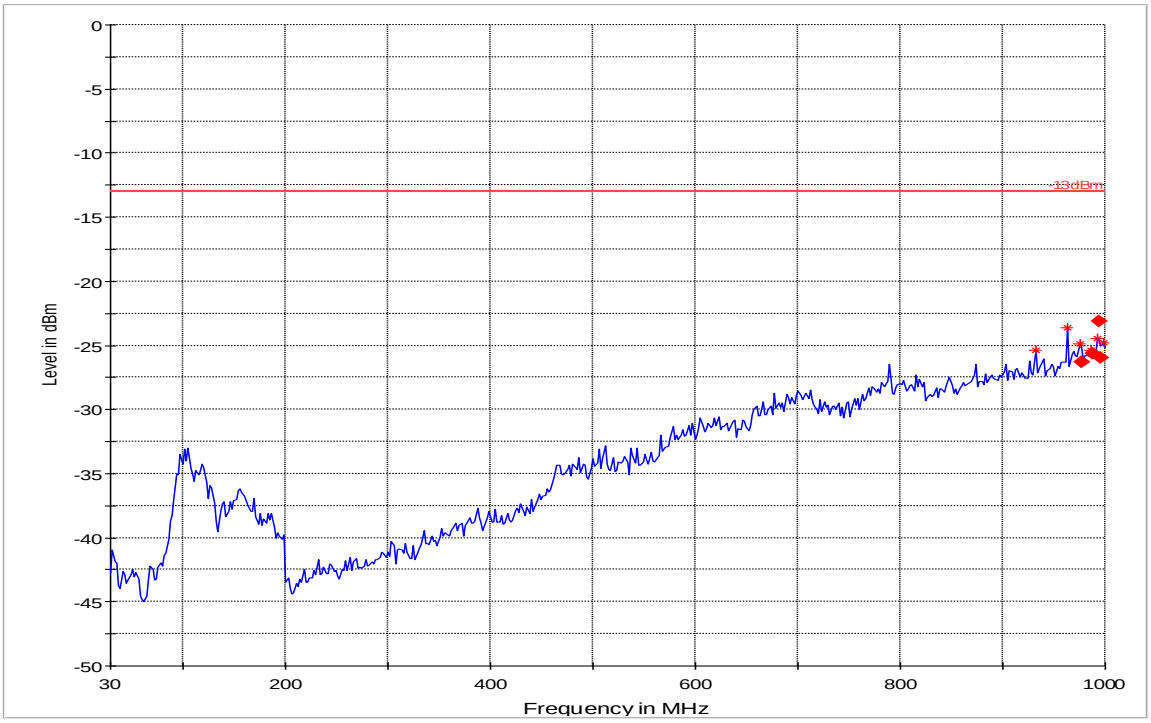


Test results 1GHz-18GHz

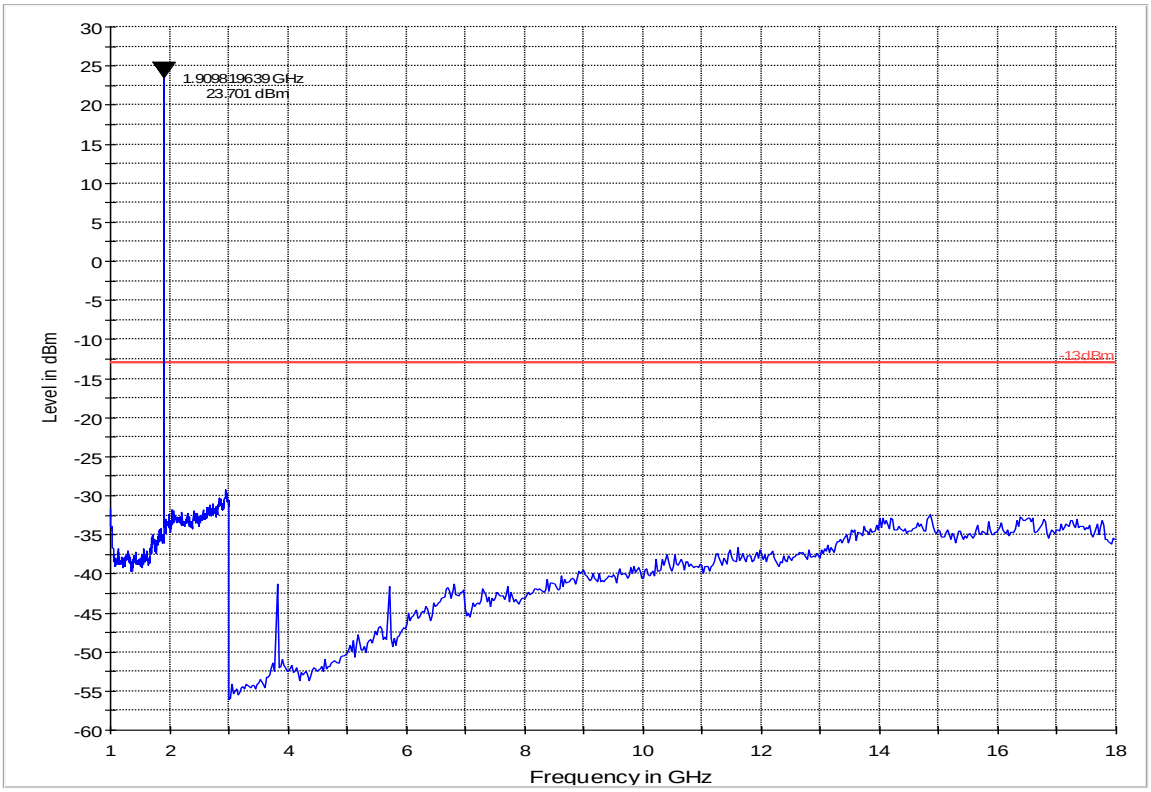


Radiated Spurious Emissions (GSM-1900) Tx: High Channel

Test results 30M-1GHz

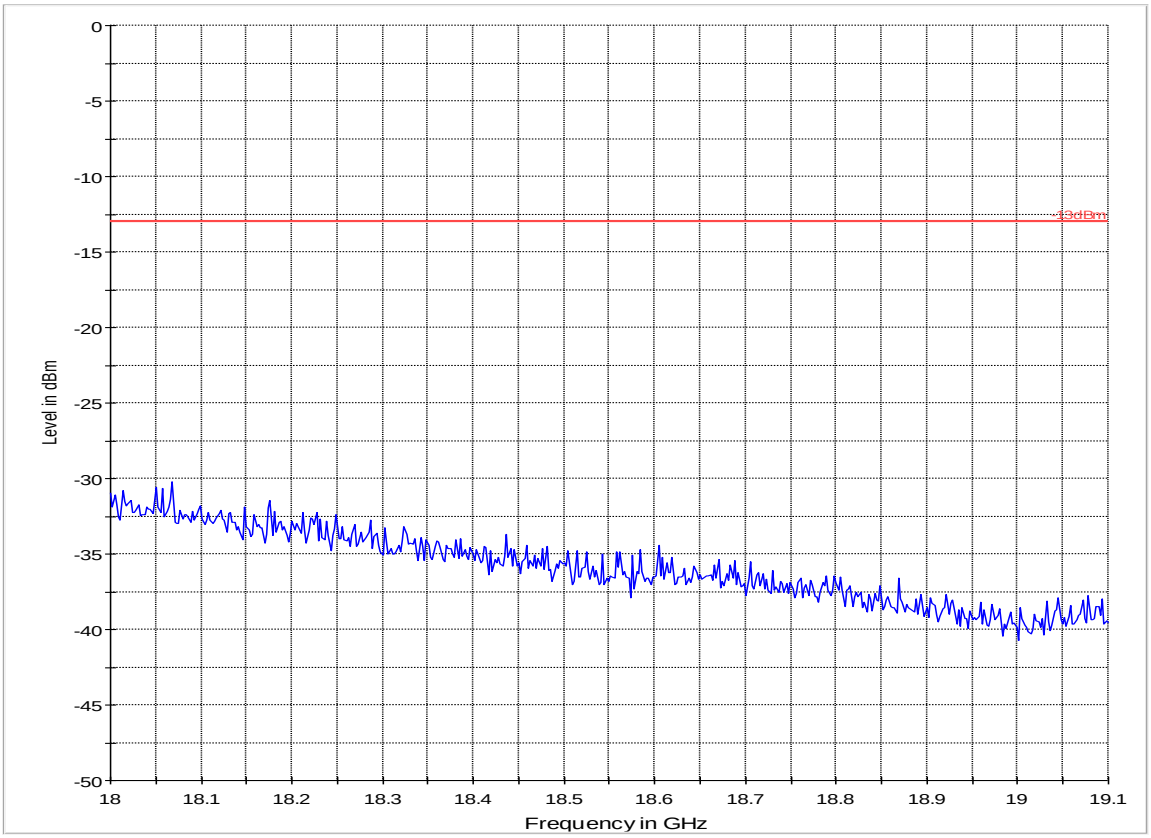


Test results 1GHz-18GHz



Test results 18GHz-19.1GHz

Note: Worst case representation of all channels



5.5.5.4 Test Results Transmitter Spurious Emission UMTS FDD2:

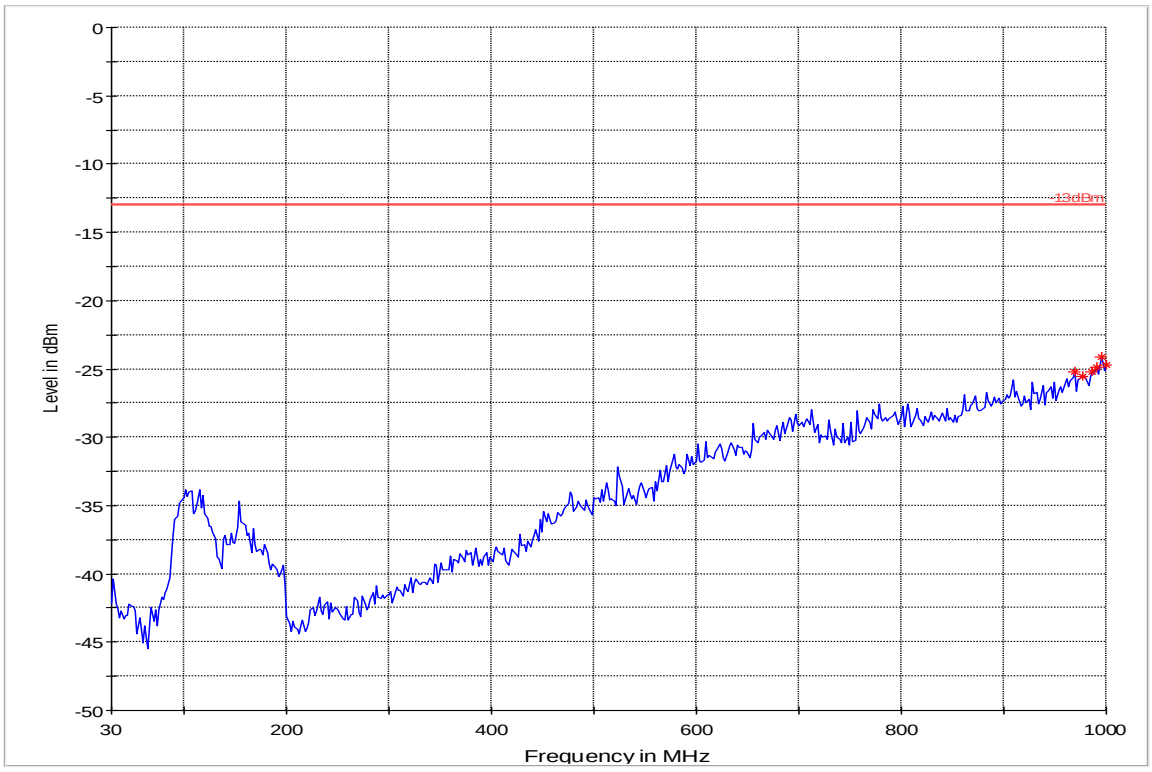
Harmonic	Tx ch-9262 Freq. (MHz)	Level (dBm)	Tx ch-9400 Freq. (MHz)	Level (dBm)	Tx ch-9538 Freq. (MHz)	Level (dBm)
1	**1852.4**	-	**1880.0**	-	**1907.6**	-
2	**3704.8**	NF	**3760**	NF	**3815.2**	NF
3	**5557.2**	NF	**5640**	NF	**5722.8**	NF
4	**7409.6**	NF	**7520**	NF	**7630.4**	NF
5	**9262**	NF	**9400**	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						

Legend for the plots:

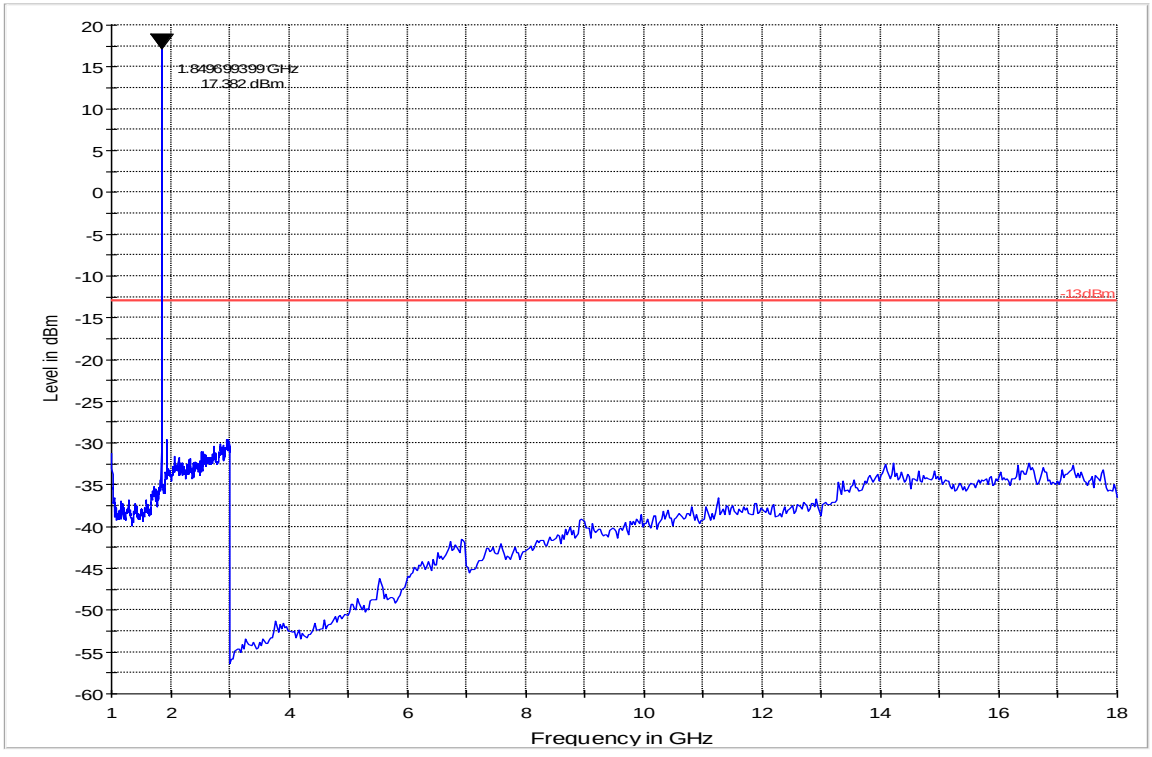
-13dBmLimtLine PreviewResult 1

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

Test results 30M-1GHz

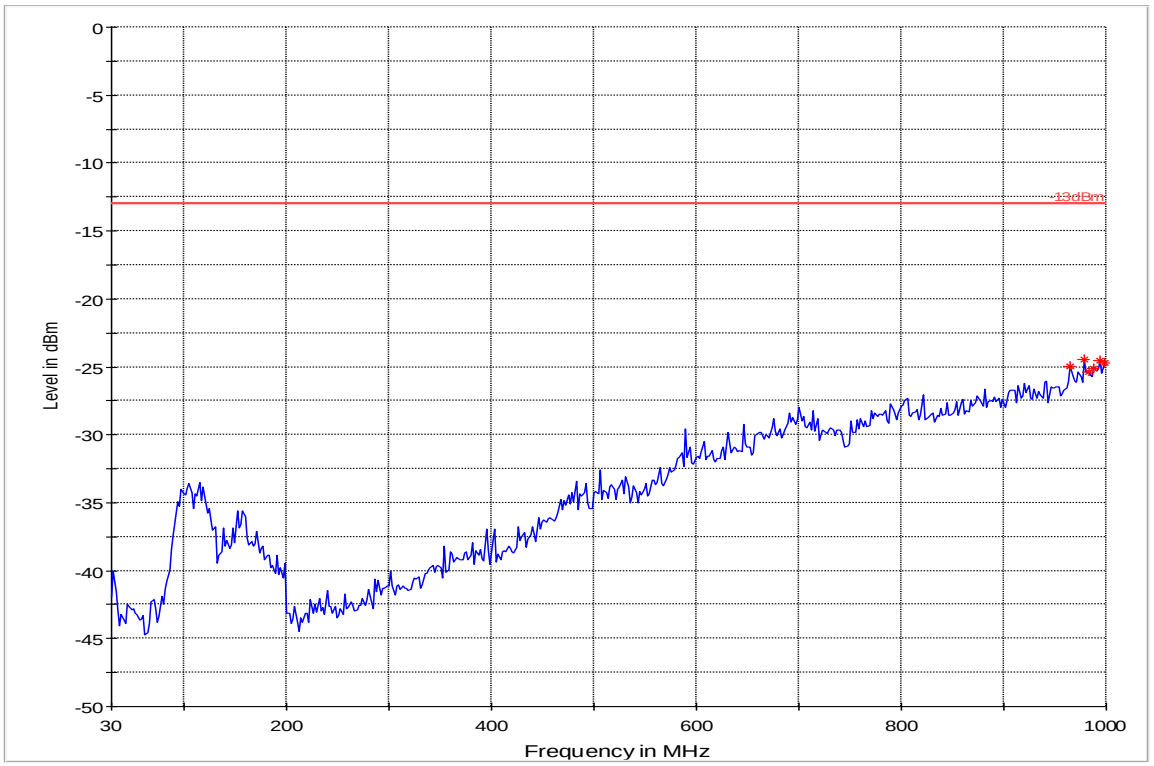


Test results 1GHz-18GHz

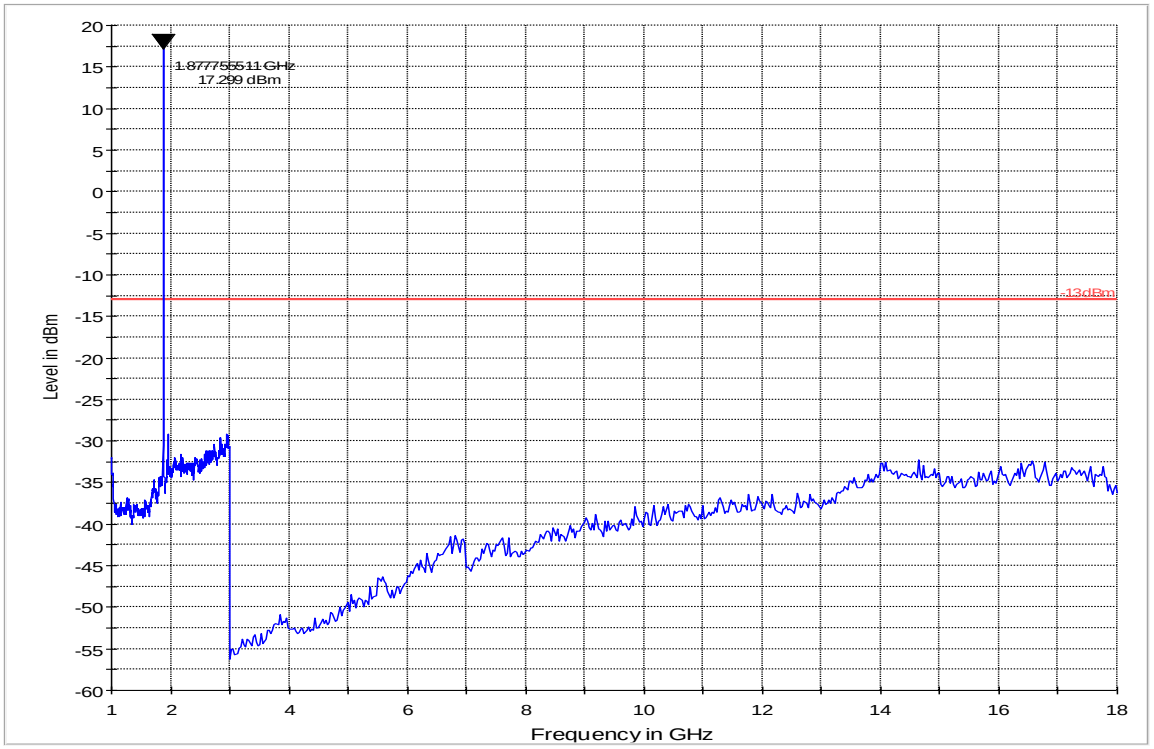


Radiated Spurious Emissions (UMTS Band 2) Tx: Mid Channel

Test results 30M-1GHz

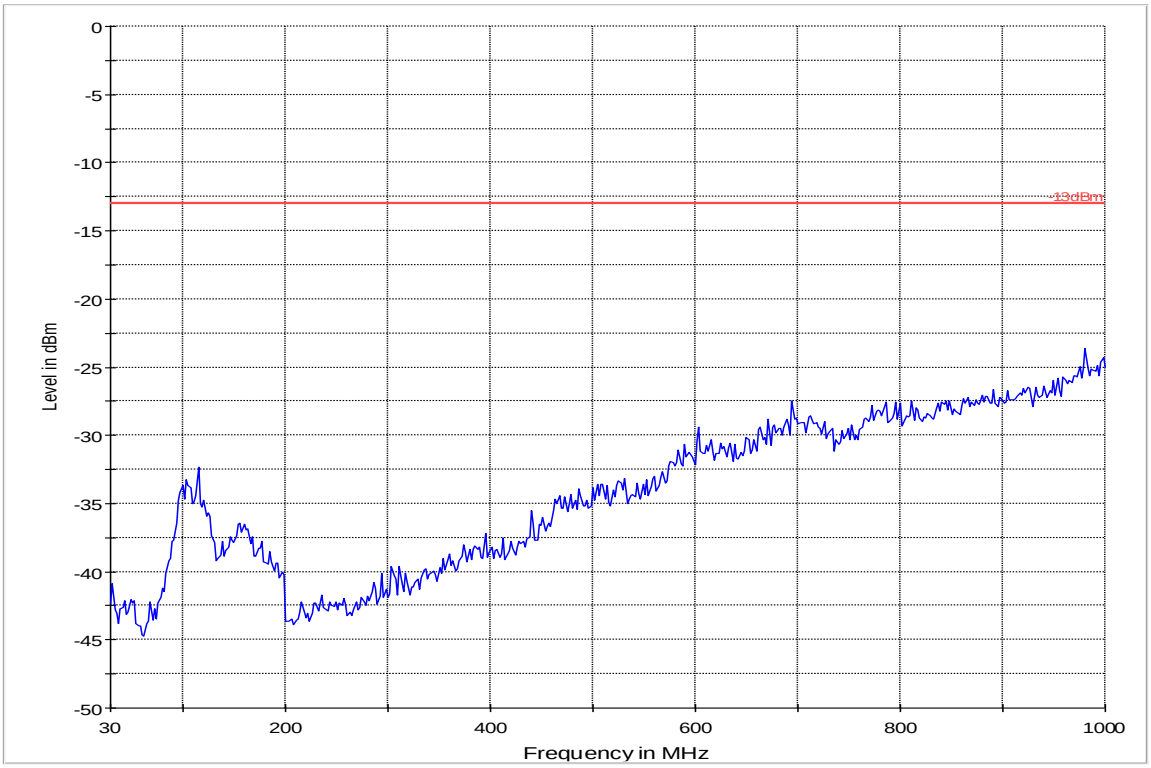


Test results 1GHz-18GHz

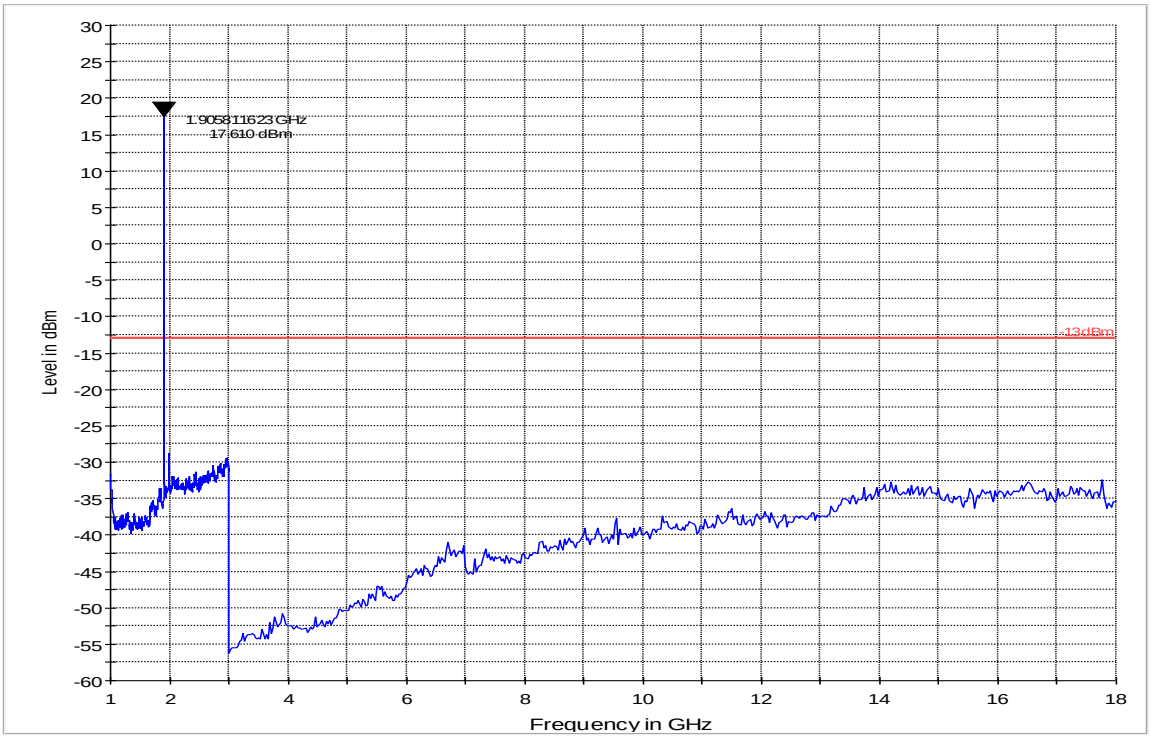


Radiated Spurious Emissions (UMTS Band 2) Tx: High Channel

Test results 30M-1GHz

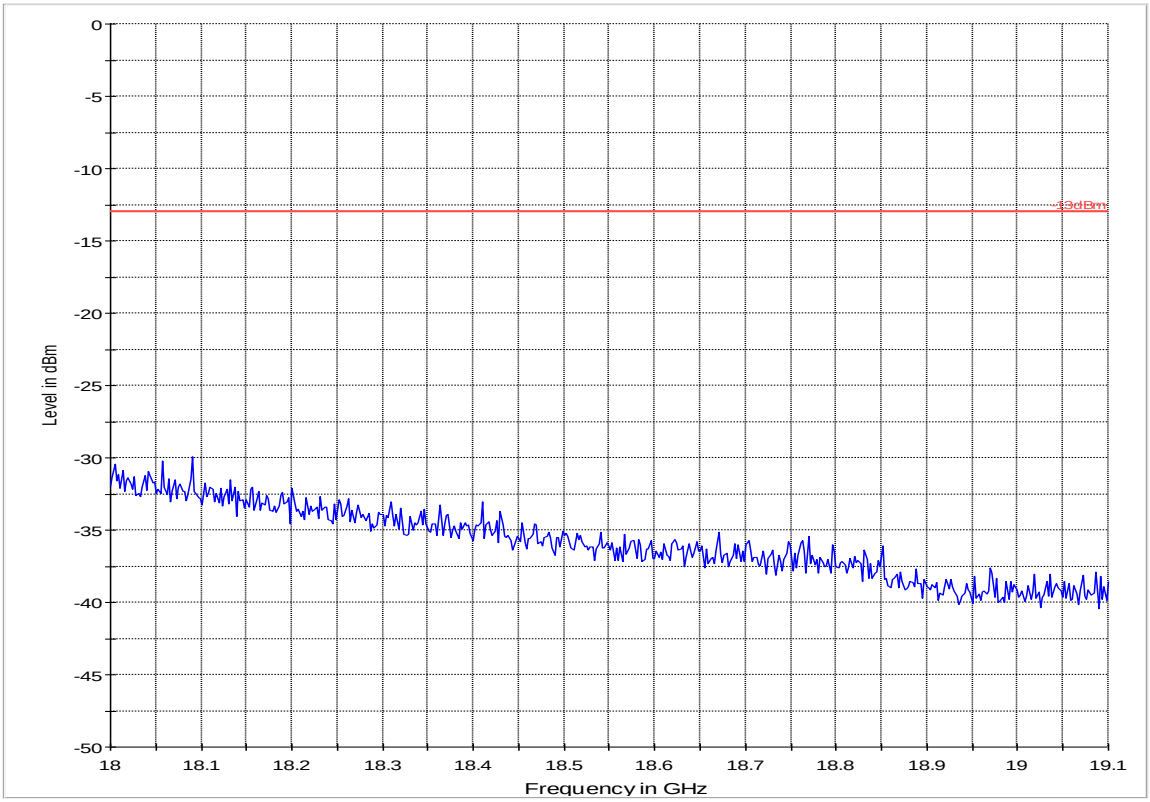


Test results 1GHz-18GHz



Test results 18GHz-19.1GHz

Note: Worst case representation of all channels



5.5.6 Radiated out of band emissions results on EUT- Receive Mode:

5.5.6.1 References

FCC: CFR Part 15.109, 2.1053

5.5.6.2 §15.109 Radiated emission limits- Unintentional Radiators:

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (µV/m)
30–88	100 (40dBµV/m)
88–216	150 (43.5 dBµV/m)
216–960	200 (46 dBµV/m)
Above 960	500 (54 dBµV/m)

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

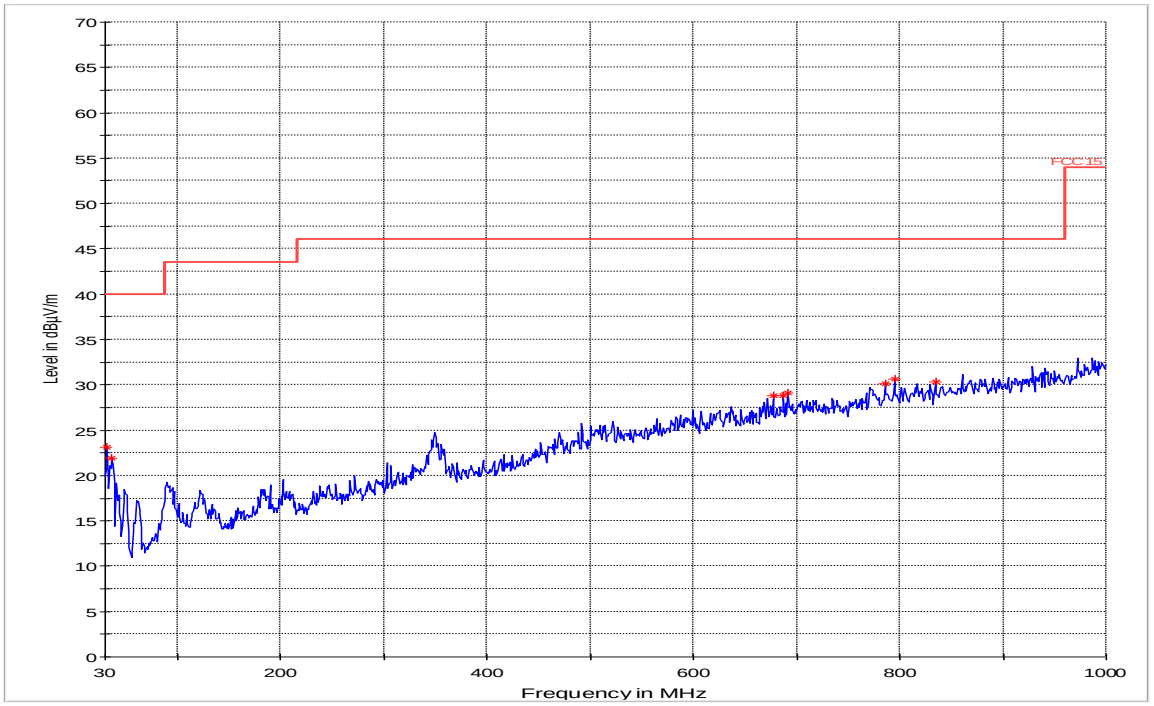
Frequency of emission (MHz)	Field strength (µV/m)
30–88	90
88–216	150
216–960	210
Above 960	300

5.5.6.3 Results

No significant emissions measurable. Plots reported here represent the worse case emissions.

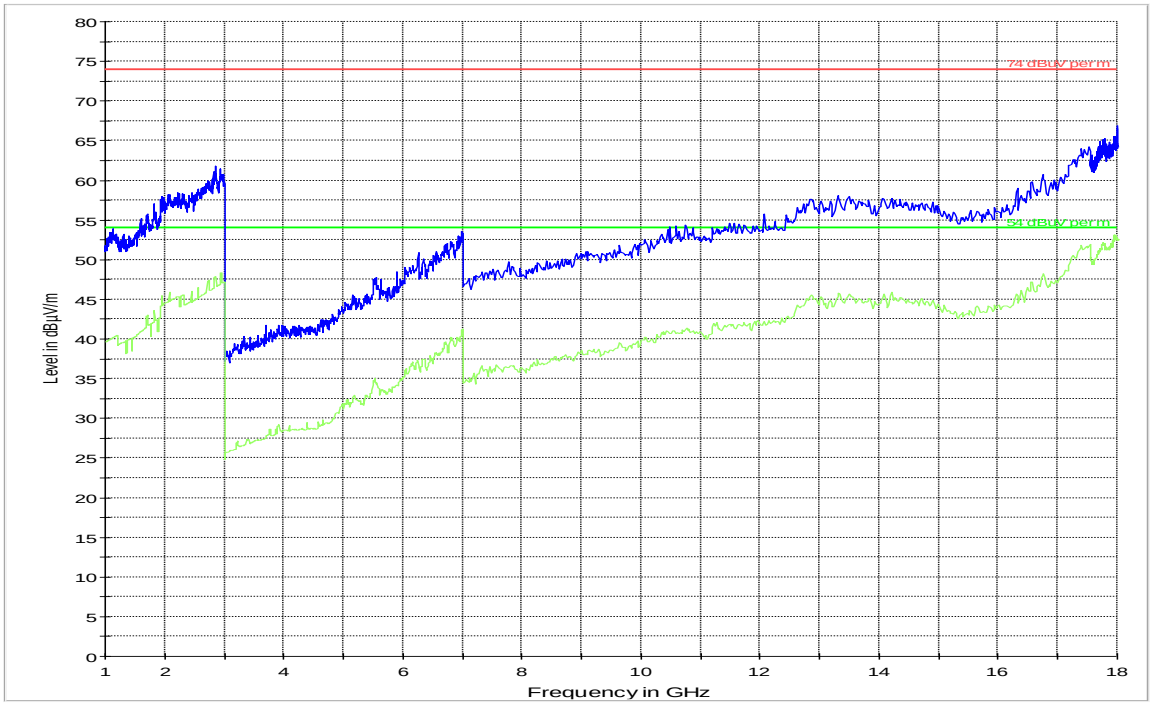
5.5.6.4 Test Results Receiver Spurious Emission

Receive Mode: 30MHz-1GHz



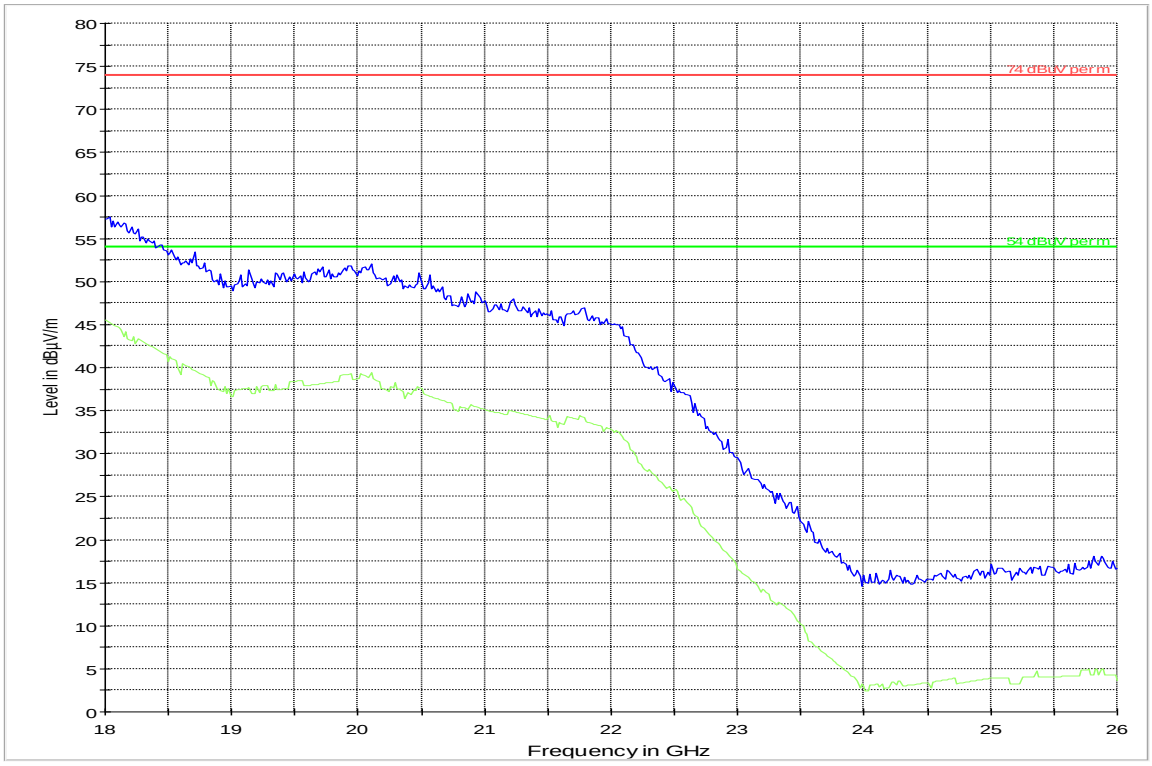
FCC 15 LimitLine Preview Result 1

Receive Mode: 1GHz-18GHz



74 dBµV per m LimitLine 54 dBµV per m LimitLine
Preview Result 1 Preview Result 2

Receive Mode: 18GHz-26.0GHz



5.6 AC Power Line Conducted Emissions

5.6.1 §15.207 Conducted limits- Intentional Radiators:

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

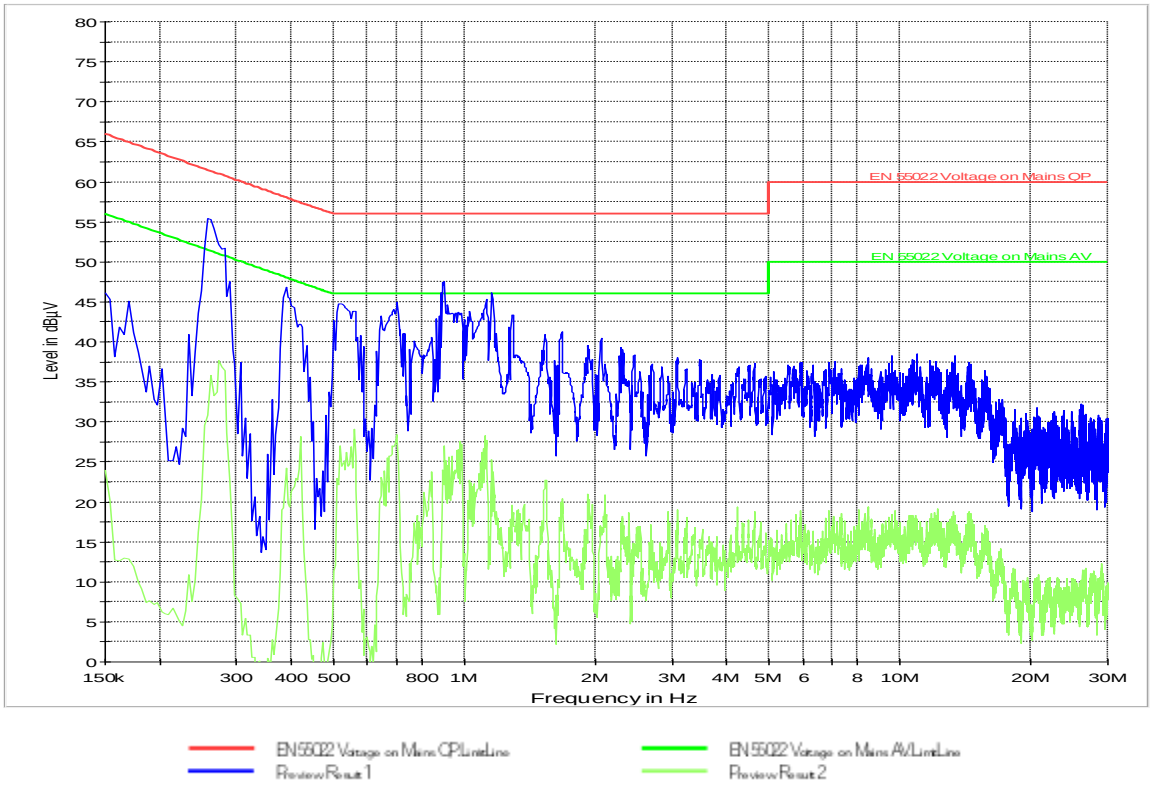
Analyzer Settings: RBW = 10KHz; VBW = 10KHz

5.6.2 Results

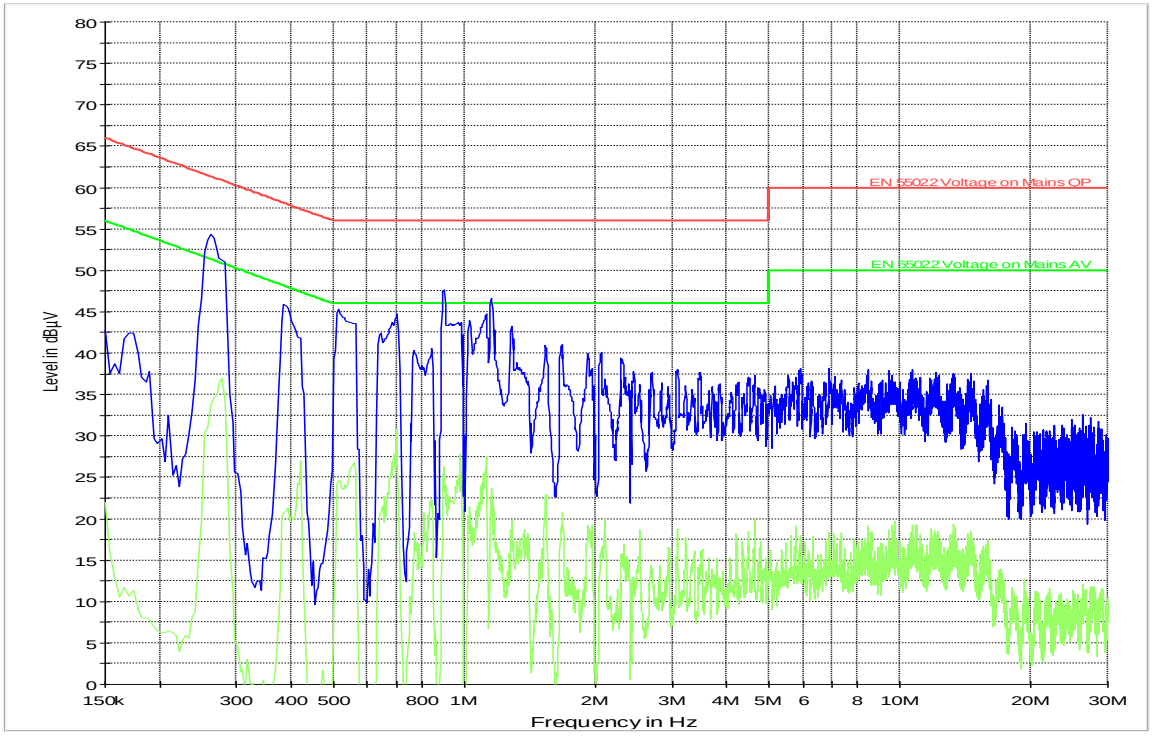
Plots reported here represent the combined worse case emissions for Line and Neutral.

5.6.3 Test Results:

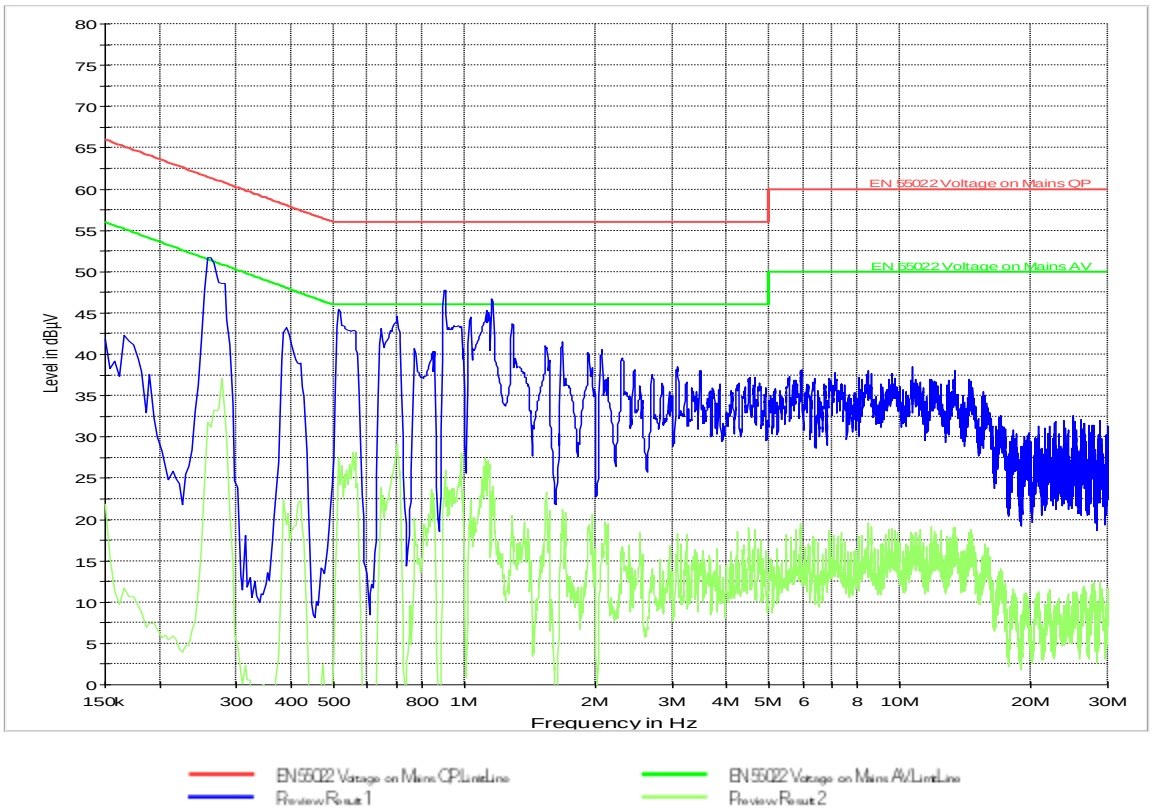
850 TX Mode:



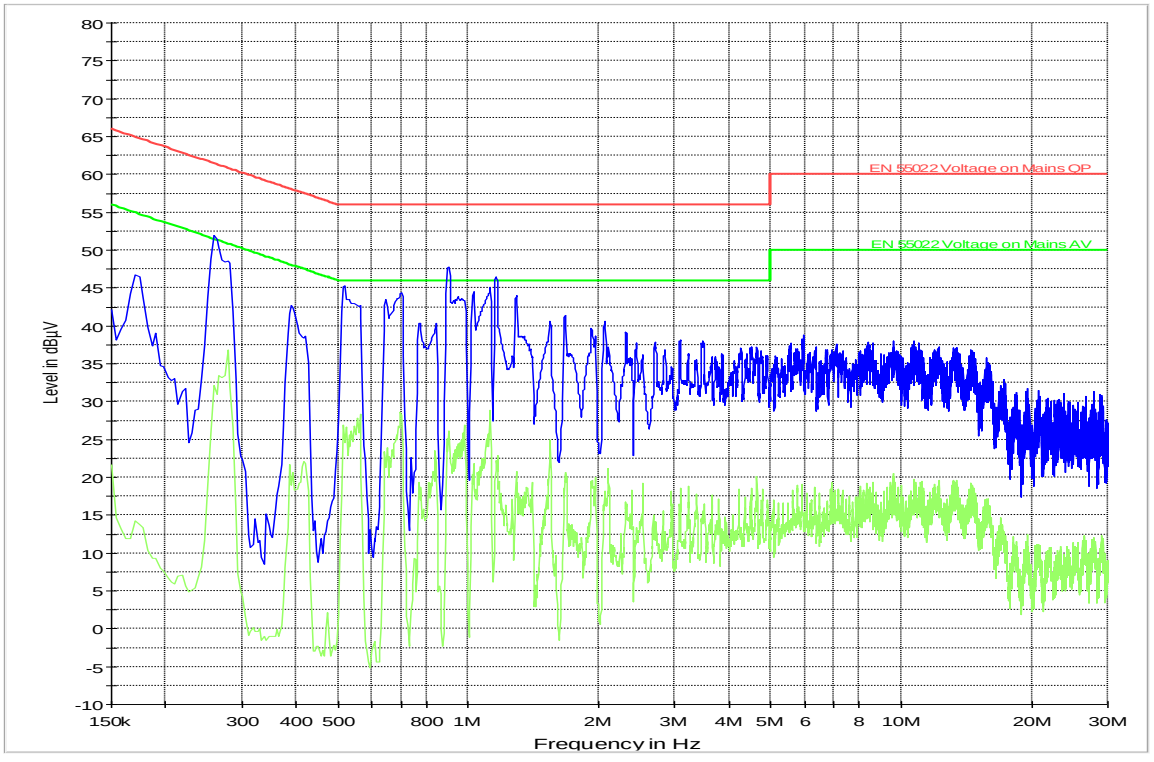
1900 TX Mode:



FDD II TX Mode:



FDD V TX Mode:

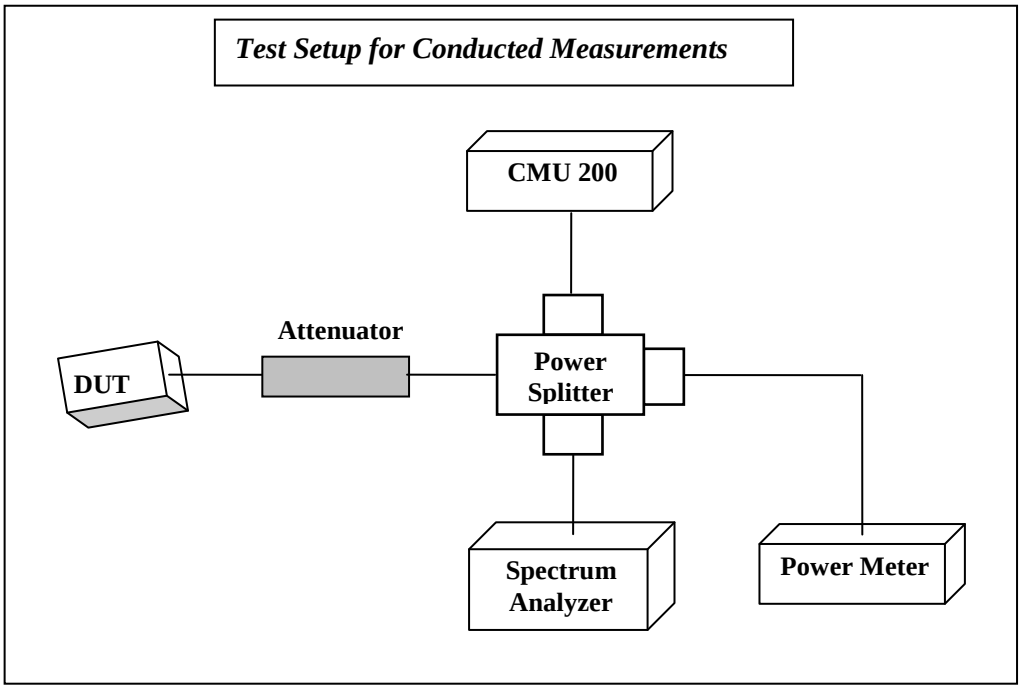


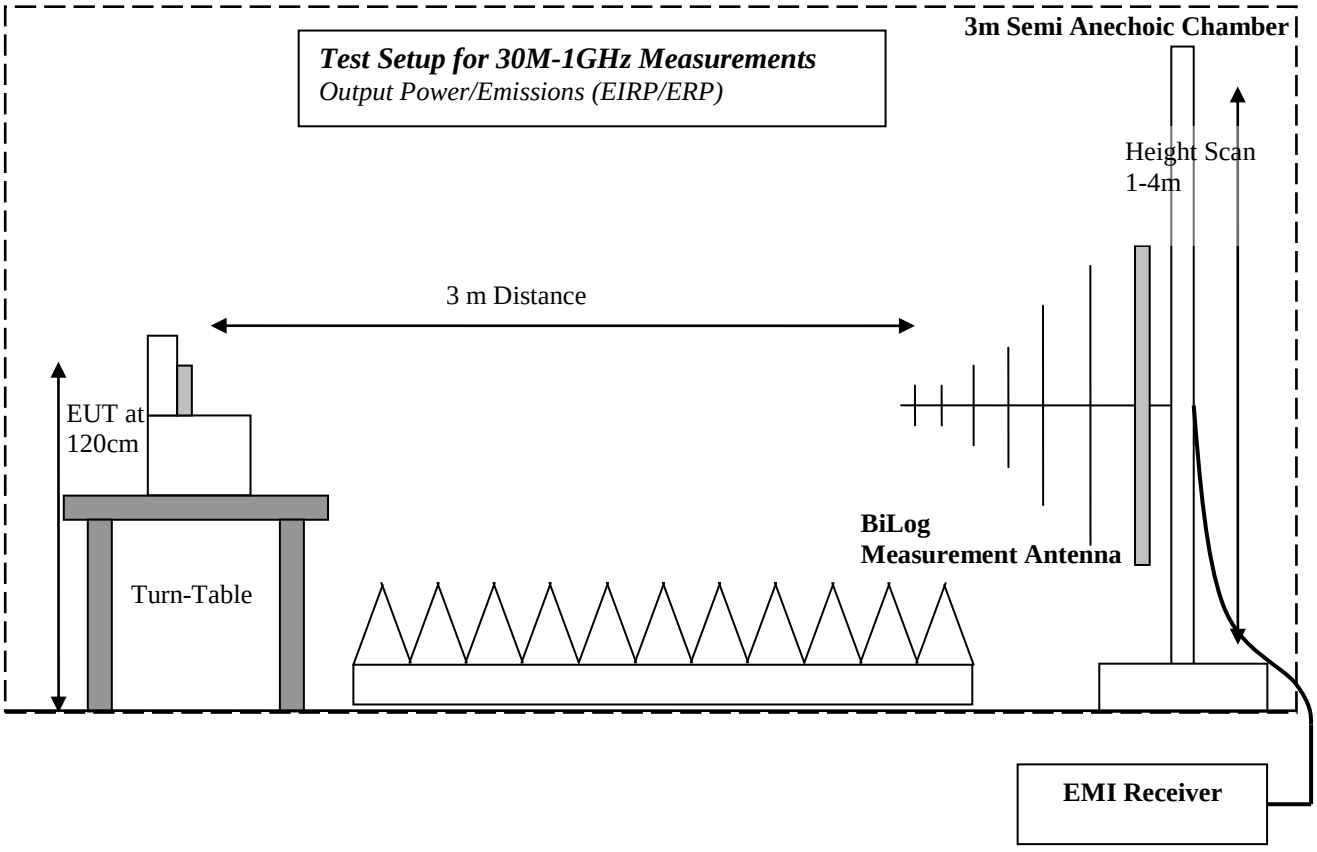
6 Test Equipment And Ancillaries Used For Tests

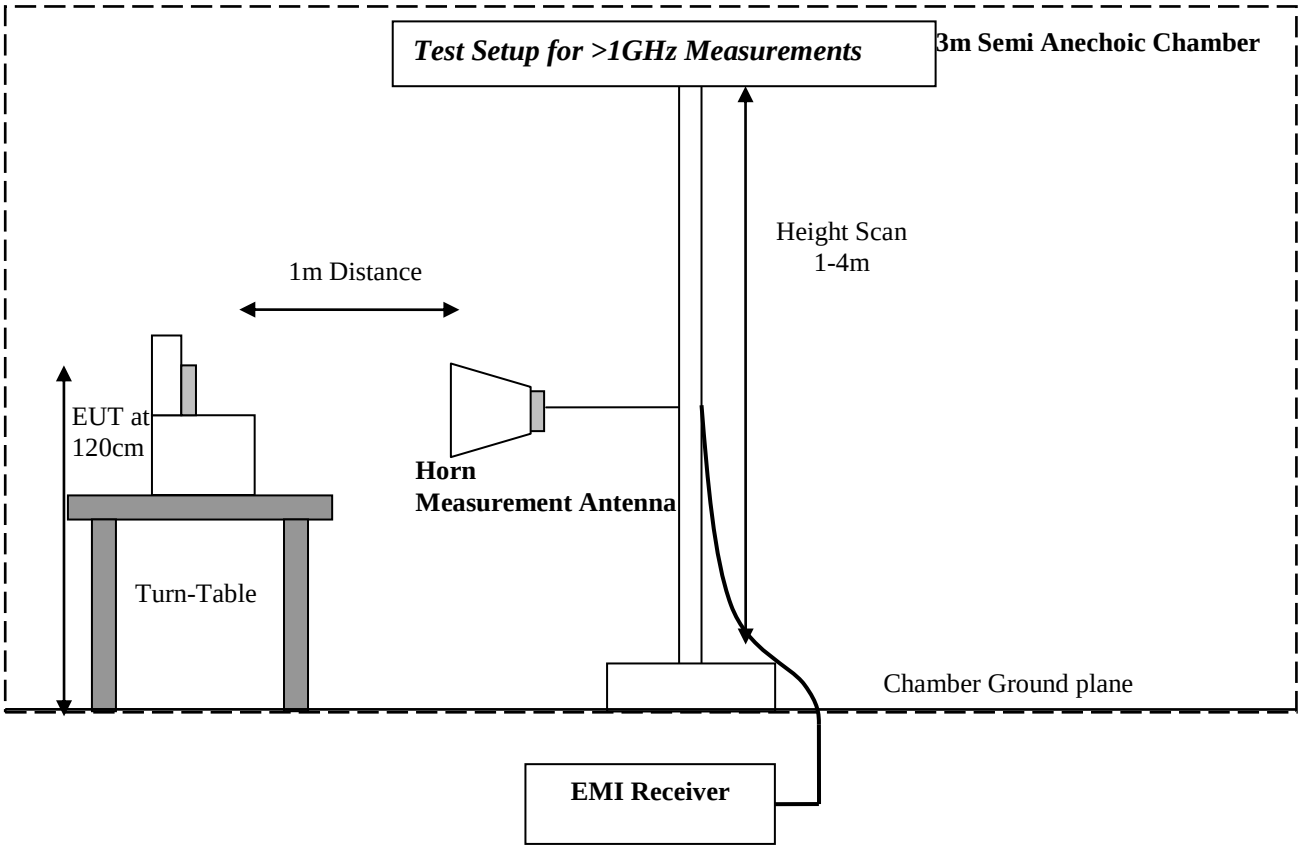
Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
Radio Communication Tester	CMU 200	Rohde & Schwarz	101821	May 2009	1 year
Radio Communication Tester	CMU 200	Rohde & Schwarz	109879	May 2009	1 year
Radio Communication Tester	CMU 200	Rohde & Schwarz	110759	May 2009	1 year
Bluetooth Tester	CBT	Rohde & Schwarz	100212	May 2009	1 year
EMI Receiver/Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2009	1 year
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	Dec 2009	1 year
Loop Antenna	6512	EMCO	00049838	July 2008	2 years
Biconilog Antenna	3141	EMCO	0005-1186	June 2009	2 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Jan 2009	3 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Jan 2009	3 years
Communication Antenna	IBP5-900/1940	Kathrein	n/a	n/a	n/a
High Pass Filter	5HC2700	Trilithic Inc.	9926013	n/a	n/a
High Pass Filter	4HC1600	Trilithic Inc.	9922307	n/a	n/a
6GHz High Pass Filter	HPM50106	Microtronics	001	n/a	n/a
Pre-Amplifier	JS4-00102600	Miteq	00616	May 2009	1 year
LISN	50-25-2-08	FCC	08014	Apr 2009	1 year
Power Smart Sensor	R&S	NRP-Z81	100161	May 2009	1 Year
Power Smart Sensor	R&S	NRP-Z22	100223	May 2009	1 Year
Upconverter	PXI-5610	NI	E93740	Aug 2008	2 years
Waveform Generator	PXI-5421	NI	E965F1	Aug 2008	2 years
10dB attenuator	ATT-0298-10	MidwestMicrowav	n/a	n/a	n/a
Power Splitter	11667B	Hewlett Packard	645348	n/a	n/a
DC Power Supply	E3610A	Hewlett Packard	KR83021224	n/a	n/a
DC Power Supply	E3610A	Hewlett Packard	KR83023316	n/a	n/a
DC Power Supply	6632A	Hewlett Packard	3524A-12822	n/a	n/a
DC Power Supply	6655A	Hewlett Packard	3403A-00487	n/a	n/a
Multimeter	179	Fluke	N/A	Feb 2010	1 Year
Temp Hum Logger	TM320	Dickson	03280063	Feb 2010	1 Year
Temp Hum Logger	TM325	Dickson	5285354	Feb 2010	1 Year
Climatic Chamber	VT4004	Votsch	G1115	May 2009	1 year

Note:
Equipment calibration is performed by an accredited calibration lab according to ISO 17025 requirements.
Calibration intervals are determined from manufacturer recommendation and/or lab discretion.
Cetecom Inc takes all measures to calibrate equipment before the due date; for instances when the equipment has to be used beyond the calibration due date, necessary steps are taken for calibration verification and documented until accredited calibration can be performed- to meet the Quality System requirements.

7 Block Diagrams






Test Setup for >1GHz Measurements
3m Semi Anechoic Chamber
Height Scan
1-4m
1m Distance
EUT at
120cm
Horn
Measurement Antenna
Turn-Table
Chamber Ground plane
EMI Receiver

8 Revision History

Date	Report Name	Changes to report	Report prepared by
2010-05-30	EMC_APPLE_057_09001_FCC22_24_BCG-E2380A	First Version	S Jose
2010-06-04	EMC_APPLE_057_09001_FCC22_24_BCG-E2380A_Rev1	Added Avg measurement procedure- Sec 5.1.4	S Jose