

5 Bandwidth and Carried Frequency Separation

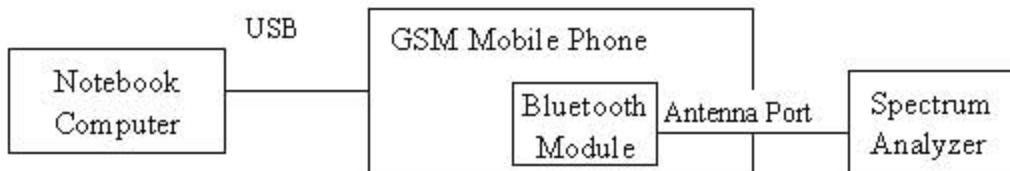
5.1 Definition

According to FCC §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

5.2 Test Procedure

- The EUT temporary antenna port was coupled to the spectrum analyzer. The loss of the cables in the test system is calibrated to correct the reading.
- The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- The resolution bandwidth of the spectrum analyzer was set to at least 1% of the EUT emission bandwidth. RBW=10 kHz, VBW=30 kHz.

5.3 Test Setup



For the actual test configuration, please refer to the related item -Photographs of the Test Configuration.

5.4 EUT Setup and Operating Conditions

The EUT was powered off and connected to a notebook computer. A set of software (provided by the applicant) installed in the computer activated and controlled the Bluetooth module of the EUT. The Bluetooth module was operating at maximum power output and wanted channels.

5.5 Test Results

Operating Frequency (MHz)	20dB Bandwidth(MHz)	Channel Separation
2402	0.938	1.00MHz
2441	0.942	
2480	0.941	

The EUT had hopping channel carrier frequencies separated by the 20 dB bandwidth of the hopping channel.

6 Hopping Sequence

6.1 Requirement of the standard

According to FCC §15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies.

6.2 Test Results

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master. For details refer to the Bluetooth standard.

7 Equal Hopping Frequency Use

7.1 Requirement of the standard

According to FCC §15.247(a)(1), Each frequency must be used equally on the average by each transmitter.

7.2 Test Results

The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.

8 Receiver Input Bandwidth and Hopping Capability

8.1 Requirement of the standard

According to FCC §15.247(a)(1), The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

8.2 Test Results

The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.

9 Time of Occupancy (Dwell Time)

9.1 Requirement of the Standard

According to FCC §15.247(a)(1)(iii), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems which use fewer than 75 hopping frequencies may employ intelligent hopping techniques to avoid interference to other transmissions. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels are used.

9.2 Test Procedure

- The EUT temporary antenna port was coupled to the spectrum analyzer. The loss of the cables in the test system is calibrated to correct the reading.
- The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- The resolution bandwidth of the spectrum analyzer was comparable to the EUT emission bandwidth. RBW=1 MHz, VBW=3 MHz.

9.3 Test Setup

Same as 5.3

9.4 EUT Setup and Operating Conditions

Refer to 5.4. The Bluetooth module was operating at maximum power output and hopping-on mode.

9.5 Test Results

Number of hopping channels is 79.

A channel was used 106 times within $0.4 \times 79 = 31.6$ S.

Dwell time of each occupation in this channel is 2.96mS.

$2.96mS \times 106 = 0.314$ S < 0.4 S

10 Peak Output Power

10.1 Requirement of the standard

According to FCC §15.247(b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band, the maximum peak output power of the intentional radiator shall not exceed 1 Watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts.

10.2 Test Procedure

- a. The EUT was coupled to the spectrum analyzer and the base station simulator through a power divider. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- b. The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- c. The resolution bandwidth of the spectrum analyzer was comparable to the EUT emission bandwidth. RBW=1 MHz, VBW=3 MHz.

10.3 Test Setup

Same as 5.3

10.4 EUT Setup and Operating Conditions

Same as 5.4

10.5 Test Results

Operating Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
2402	5.46	30
2441	5.62	30
2480	5.98	30

11 Band Edge

11.1 Requirement of the standard

According to FCC §15.247(c), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement..

11.2 Test Procedure

- a. The EUT was coupled to the spectrum analyzer and the base station simulator through a power divider. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- b. The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- c. According to the standard requirement, the resolution bandwidth of the spectrum analyzer was set to RBW=100 kHz, VBW=300 kHz.

11.3 Test Setup

Same as 5.3

11.4 EUT Setup and Operating Conditions

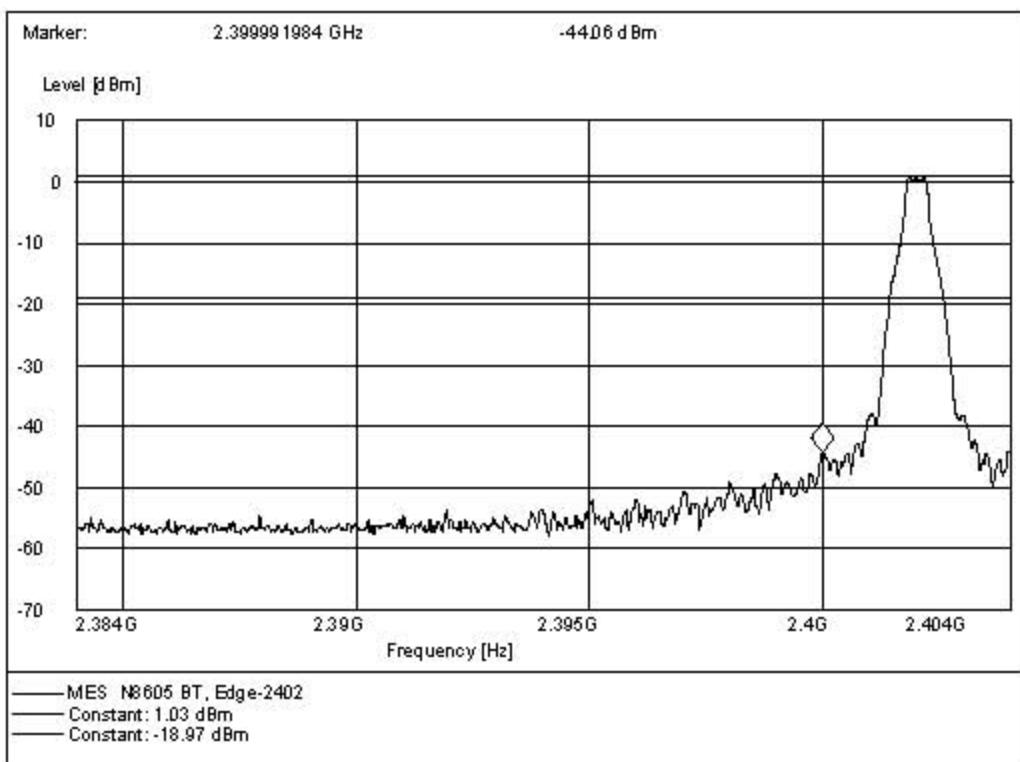
Same as 5.4

11.5 Test Results

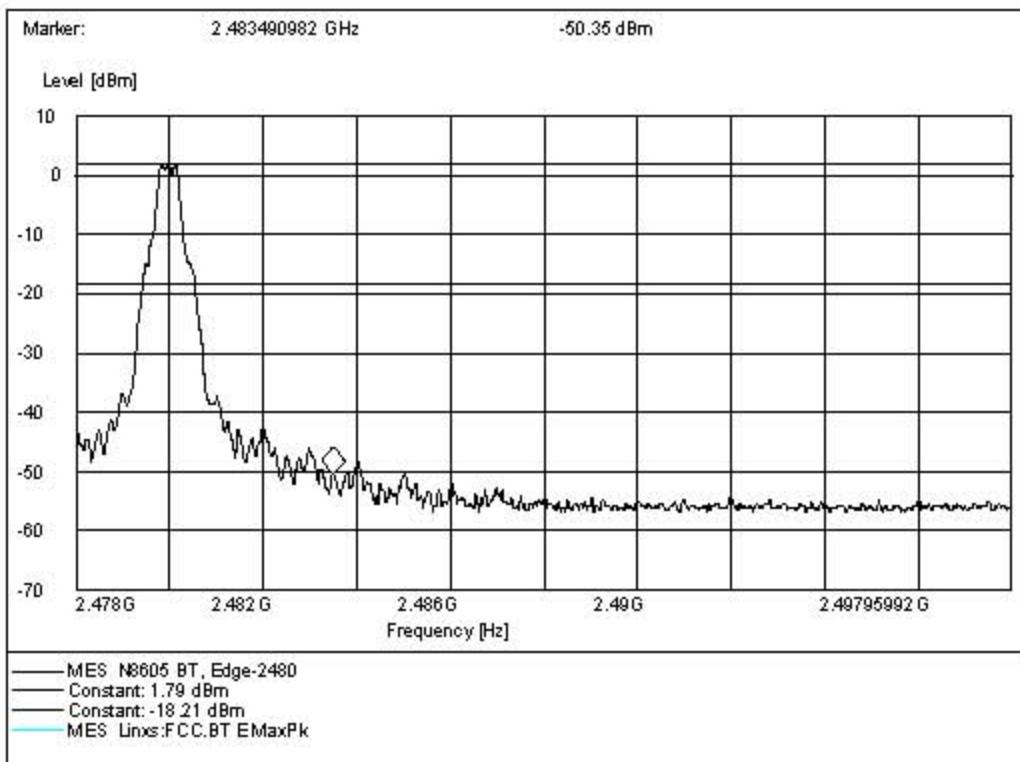
The radio frequency power beyond the band edges 2400 and 2483.5MHz was 20dB below the peak output power, measured with 100 kHz resolution bandwidth. Refer to the following test plots

Band Edge Test Plots

1. Lowest channel, 2402MHz



2. Highest channel, 2480MHz



12 Conducted Spurious Emission

12.1 Requirement of the standard

According to FCC §15.247(c), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement..

12.2 Test Procedure

- a. The EUT was coupled to the spectrum analyzer and the base station simulator through a power divider. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- b. The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- c. According to the standard requirement, the resolution bandwidth of the spectrum analyzer was set to RBW=100 kHz, VBW=300 kHz.

12.3 Test Setup

Same as 5.3

12.4 EUT Setup and Operating Conditions

Same as 5.4

12.5 Test Results

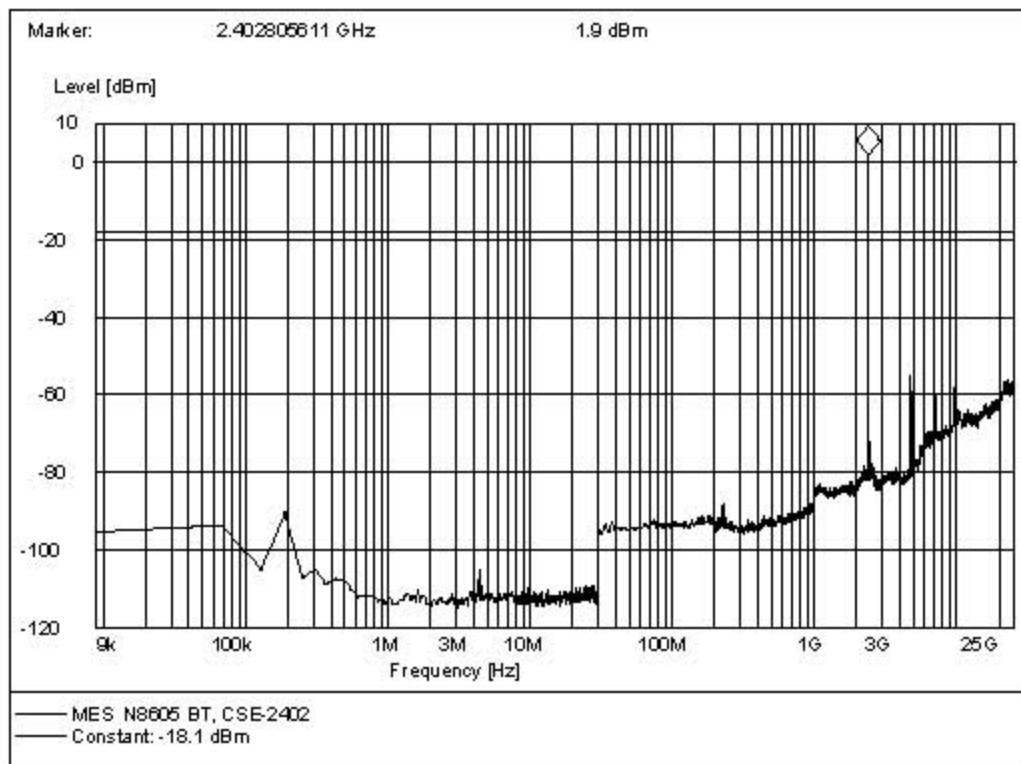
No.	Frequency (MHz)	Level (dBm)	Limit (Ref-20dB)	Margin(dB) (Limit-Level)
2402MHz (Ref=1.90dBm)				
1	4804.00	-55.14	-18.10	37.04
2	7206.00	-59.88	-18.10	41.78
3	9608.00	-58.28	-18.10	40.18
2441MHz (Ref=1.89dBm)				
1	4882.00	-53.75	-18.11	35.64
2	7323.00	-57.23	-18.11	39.12
3	9764.00	-53.23	-18.11	35.12
2480MHz (Ref=1.83dBm)				
1	4960.00	-52.13	-18.17	33.96
2	7440.00	-58.06	-18.17	39.89
3	9920.00	-59.90	-18.17	41.73
4	12400.00	-65.46	-18.17	47.29
5	14880.00	-62.02	-18.17	43.85

NOTE:

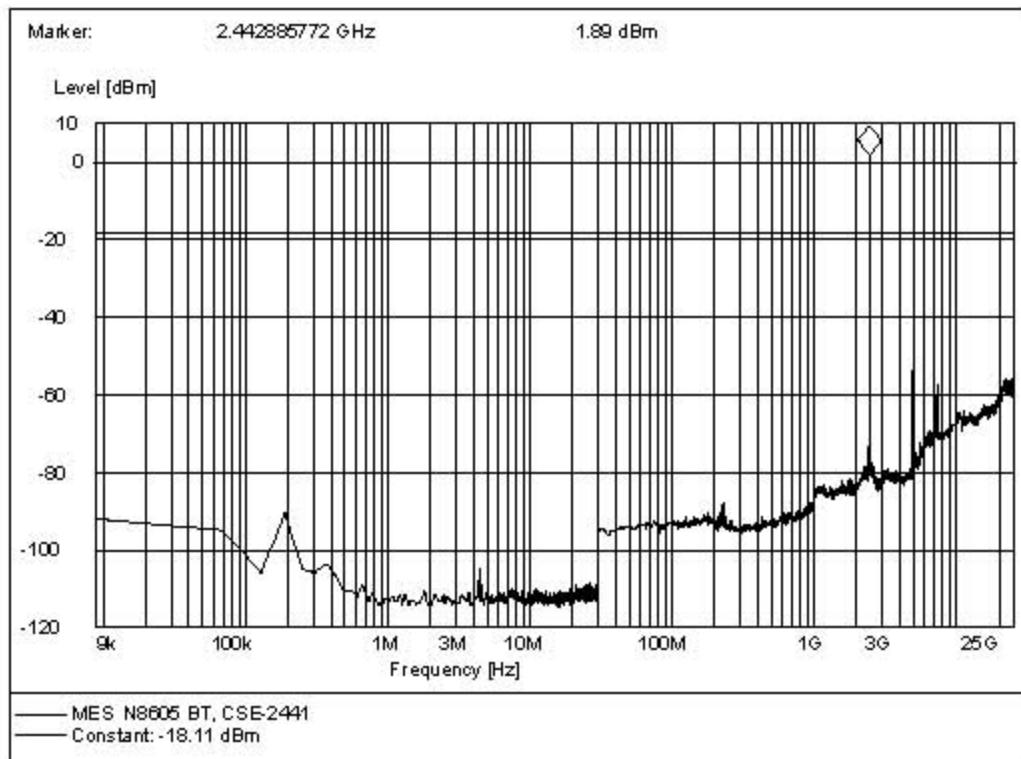
1. The spurious Emissions from 9 KHz to 10th harmonic of the fundamental frequency were researched. Only the larger ones were recorded above.
2. For more details please refer to the following test plots. The marker point is the EUT transmitting frequency which should be ignore

Conducted Spurious Emission Test Plots

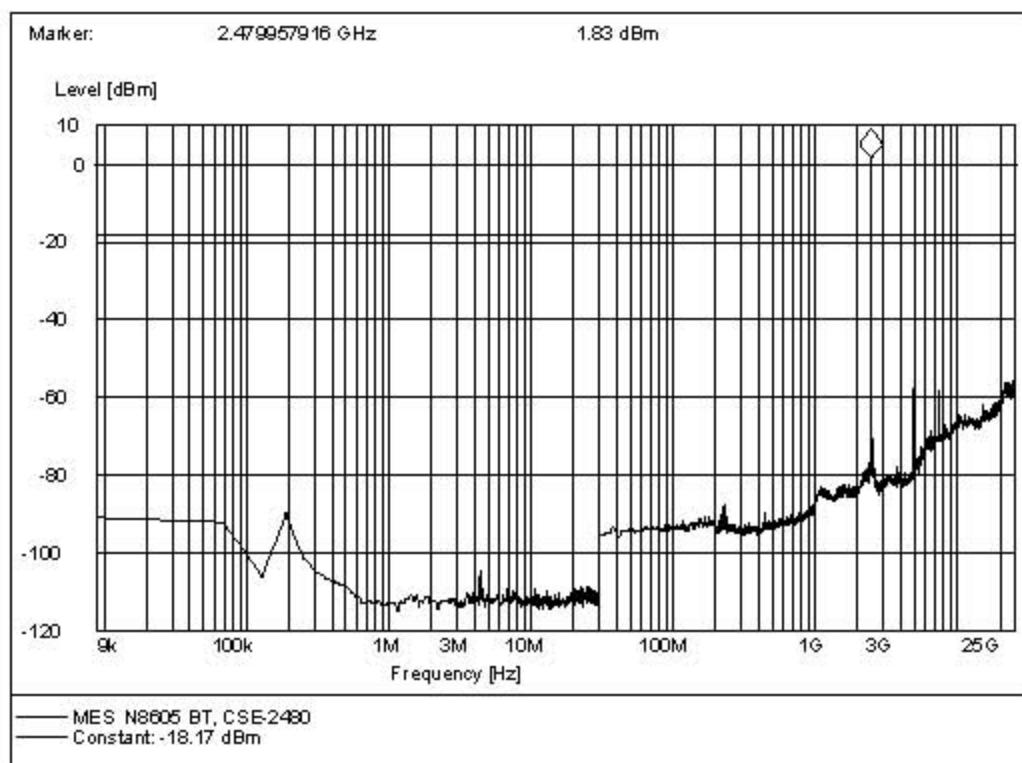
1. Lowest channel, 2402MHz



2. Middle channel, 2441MHz



3. Highest channel, 2480MHz



13 Radiated Spurious Emission

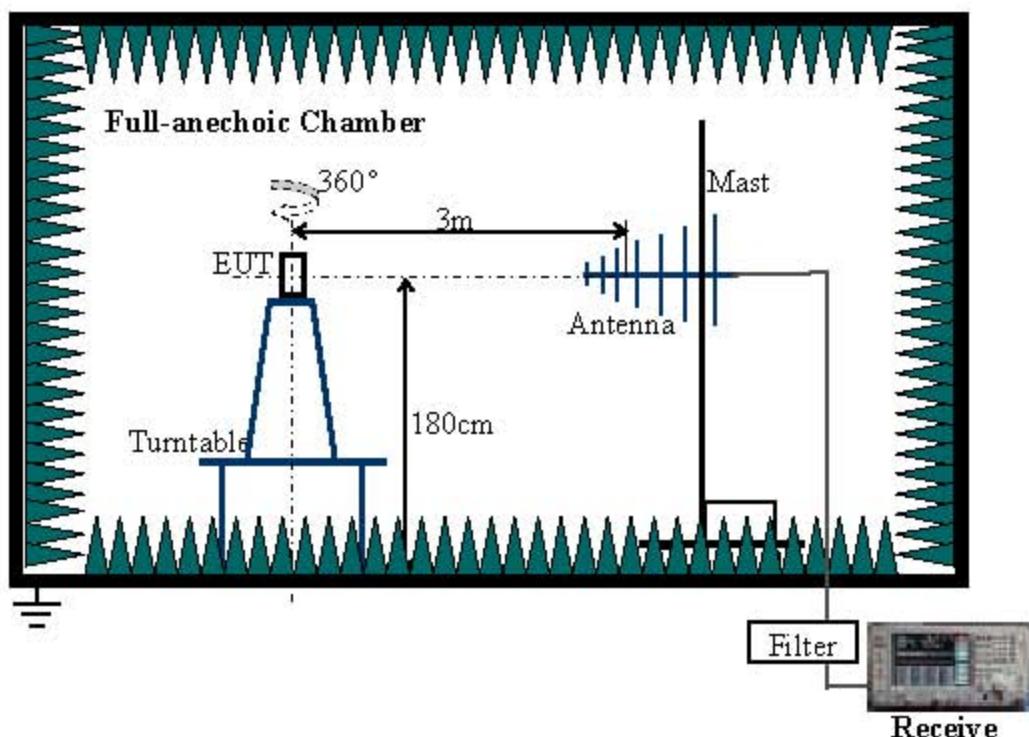
13.1 Requirement of the standard

According to FCC §15.247(c), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

13.2 Test Procedure

- a. The radiated power measurement was performed in a full anechoic chamber. The air lost of the site and the factors of the test system is pre-calibrated using substitution method.
- b. The EUT was placed on the vertical axis of a turntable 1.8 meters above the ground. The table was turned from 0 degrees to 360 degrees to find the maximum reading.
- c. In the frequency range 30 MHz to 3 GHz, ultra-broadband bi-log antenna was used. In the frequency range above 3 GHz, horn antenna was used. The antenna was at the same height as the EUT. Since the there was no reflection from the chamber floor and the site was pre-calibrated, the antenna height need not to be changed as the open site method. The polarization of the receiving antenna was the same as that of the EUT transmitting antenna.
- d. The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- e. According to the standard requirement, the resolution bandwidth of the spectrum analyzer was set to $RBW=100\text{ kHz}$, $VBW=300\text{ kHz}$.

13.3 Test Setup



For the actual test configuration, please refer to the related item-Photographs of the Test Configuration.

13.4 EUT Setup and Operating Conditions

Same as 5.4

13.5 Test Results

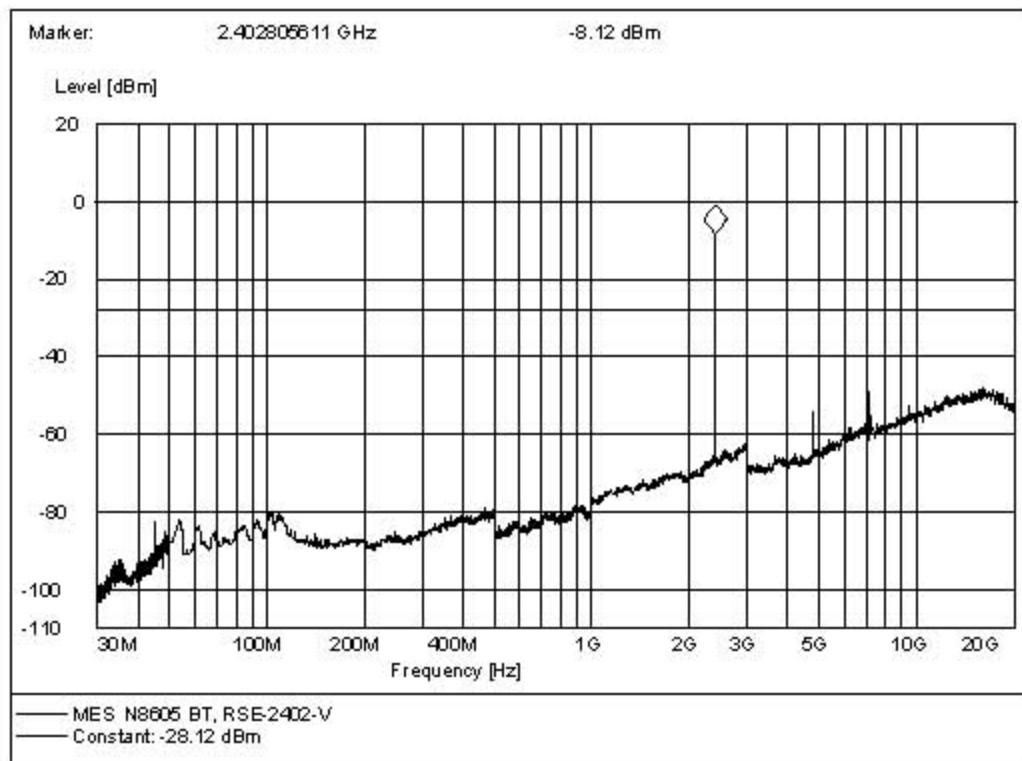
No.	Frequency (MHz)	Level (dBm)	Limit (Ref-20dB)	Margin(dB) (Limit-Level)
2402MHz, Antenna Vertical (Ref=-8.12dBm)				
1	4804.00	-54.25	-28.12	26.13
2	7206.00	-48.84	-28.12	20.72
3	9608.00	-52.82	-28.12	24.70
2402MHz, Antenna Hertical (Ref=-7.43dBm)				
1	4804.00	-52.54	-27.43	25.11
2	7206.00	-51.27	-27.43	23.84
3	9608.00	-53.89	-27.43	26.46
2441MHz, Antenna Vertical (Ref=-8.08dBm)				
1	4882.00	-55.23	-28.08	27.15
2	7323.00	-49.87	-28.08	21.79
2441MHz, Antenna Horizontal (Ref=-9.07dBm)				
1	4882.00	-56.28	-29.07	27.21
2	7323.00	-51.01	-29.07	21.94
2480MHz, Antenna Vertical (Ref=-8.35dBm)				
1	4960.00	-55.87	-28.35	27.52
2	7440.00	-49.74	-28.35	21.39
2480MHz, Antenna Horizontal (Ref=-8.91dBm)				
1	4960.00	-59.95	-28.91	31.04
2	7440.00	-54.03	-28.91	25.12

NOTE:

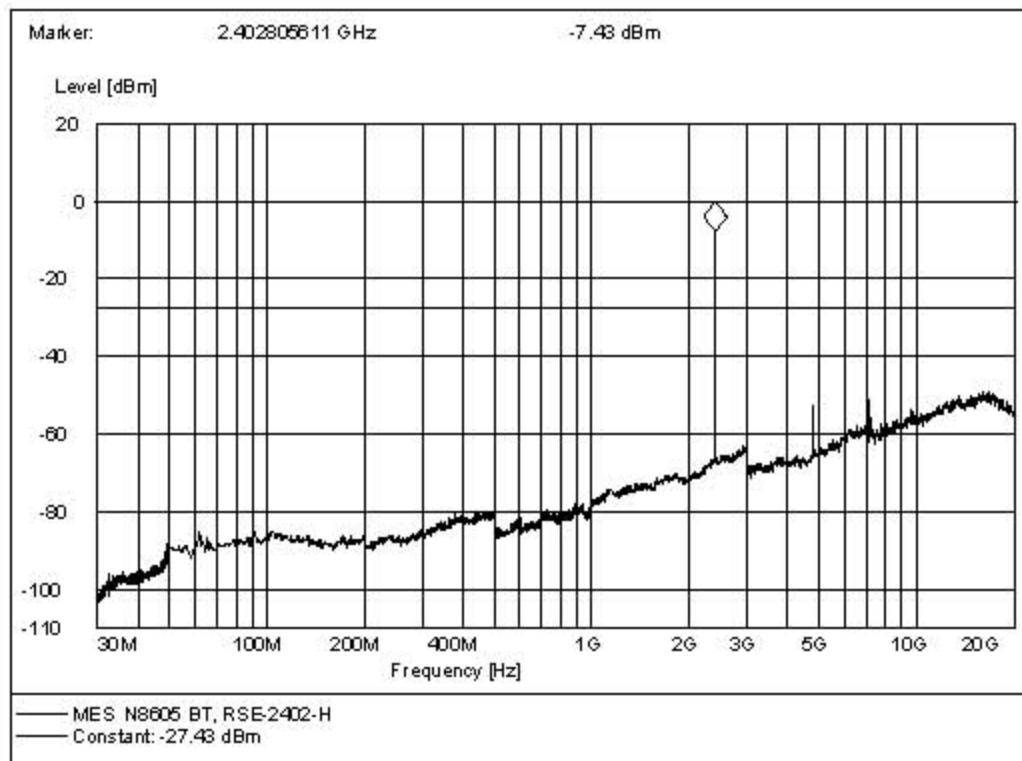
1. The spurious Emissions from 30 MHz to 20GHz were researched. Only the larger ones were recorded above.
2. For more details please refer to the following test plots. The marker point is the EUT transmitting frequency which should be ignore

Radiated Spurious Emission Test Plots

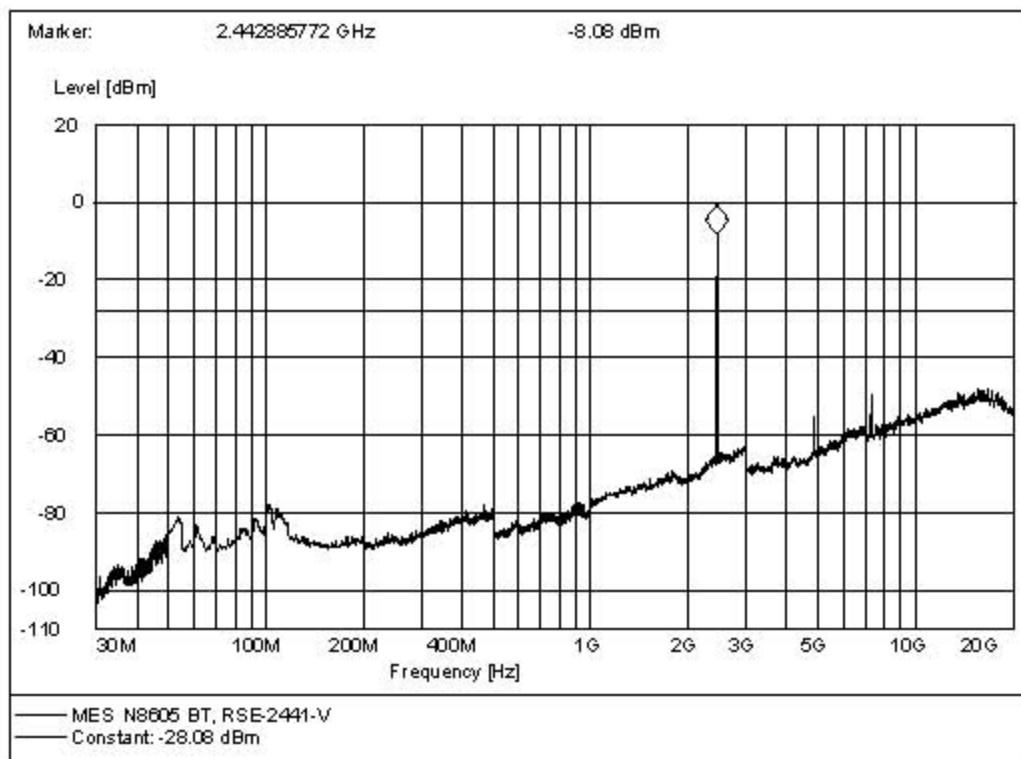
1. Lowest channel, 2402MHz; Antenna Vertical



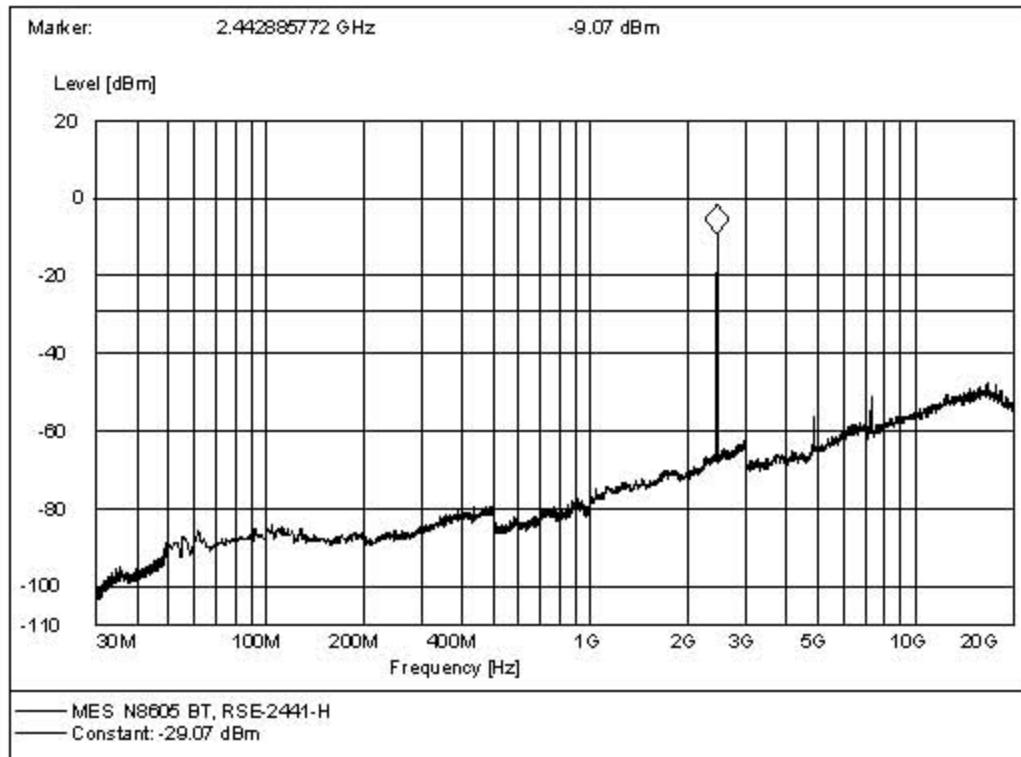
2. Lowest channel, 2402MHz; Antenna Horizontal



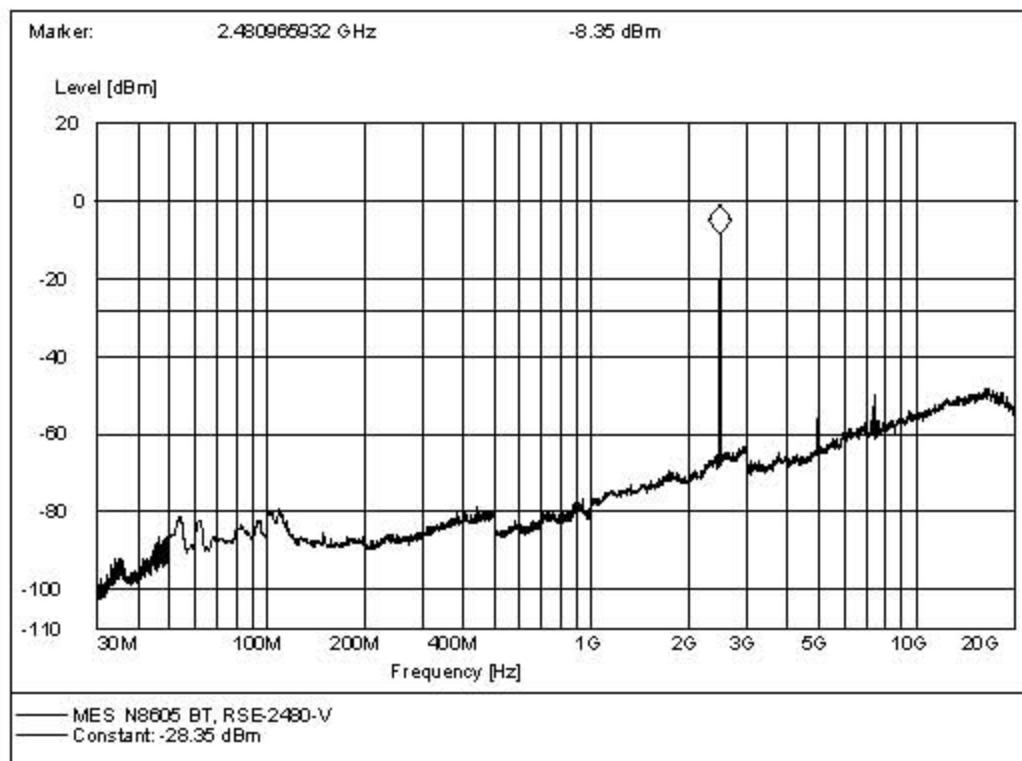
3. Middle channel, 2441MHz; Antenna Vertical



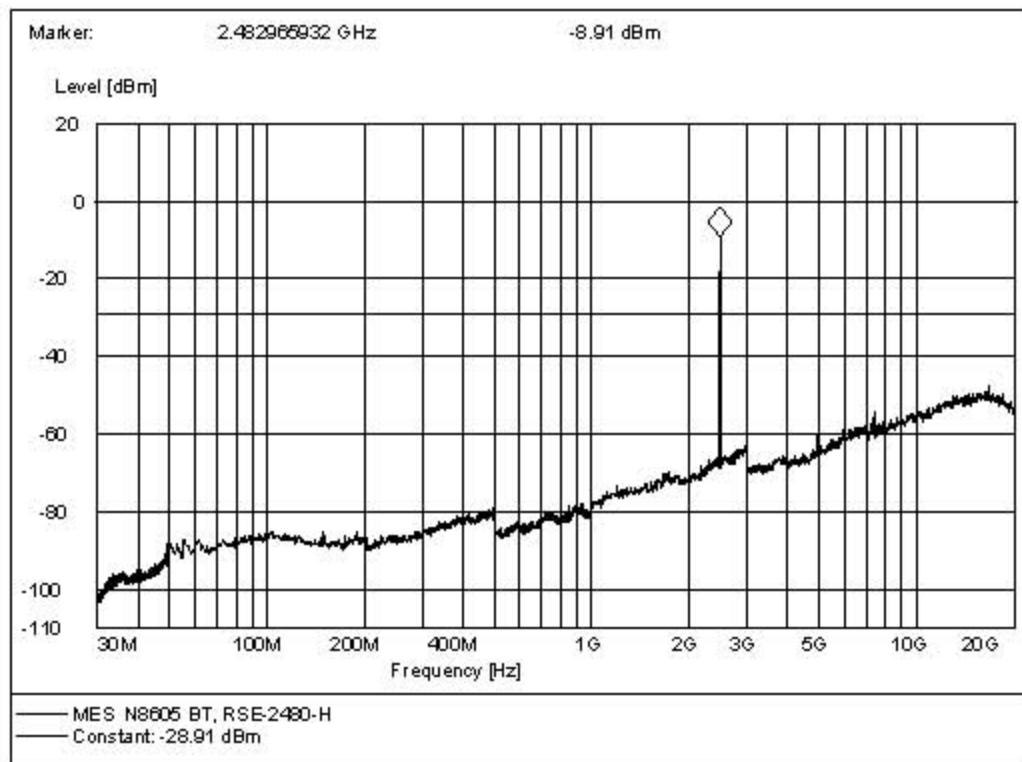
4. Middle channel, 2441MHz; Antenna Horizontal



5. Highest channel, 2480MHz; Antenna Vertical



6. Highest channel, 2480MHz; Antenna Horizontal



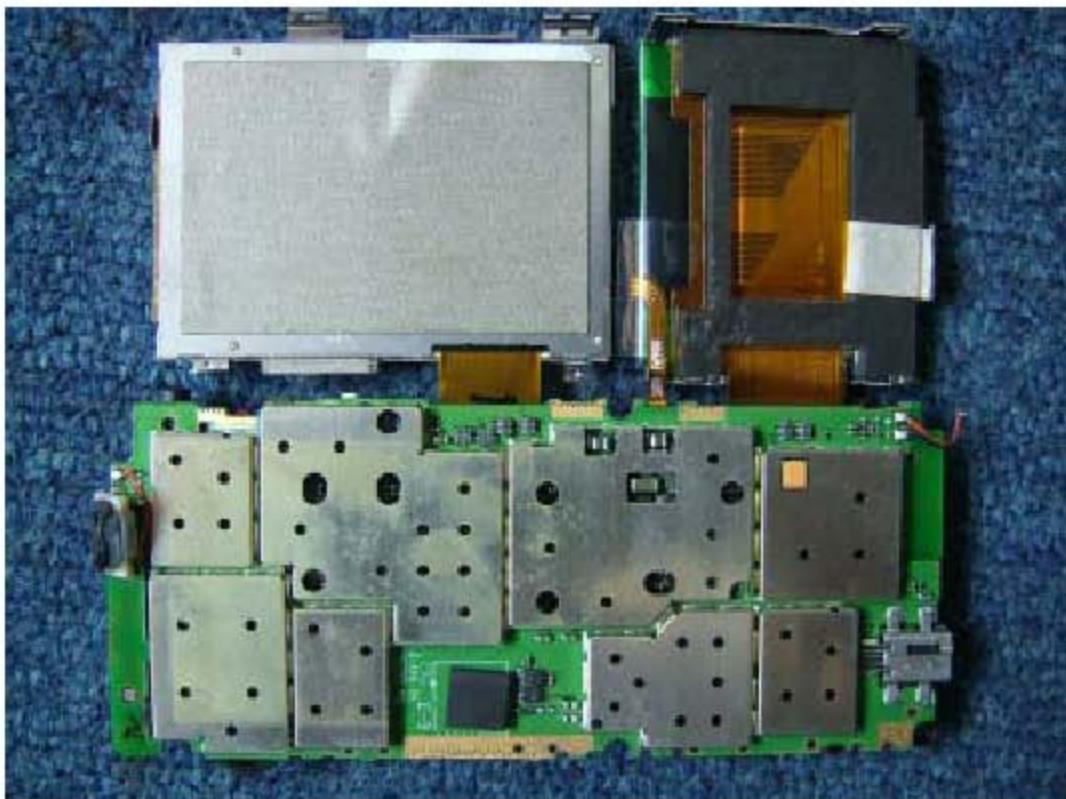
Appendix I: Photographs of the EUT

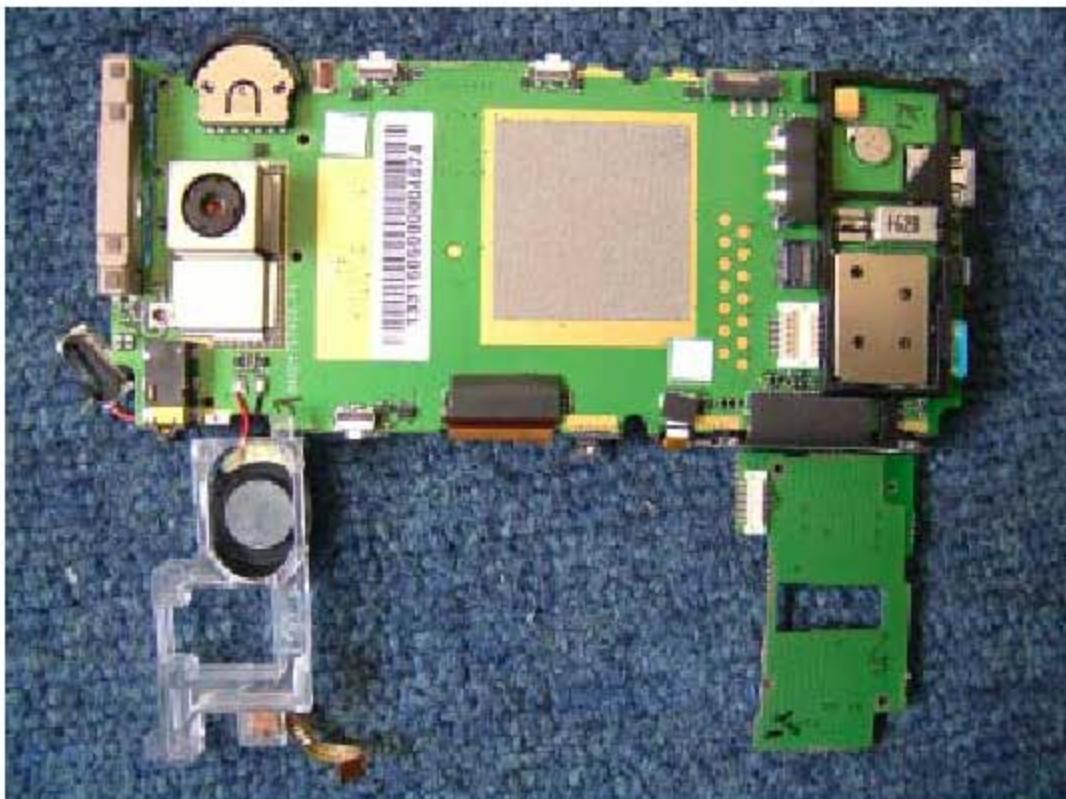
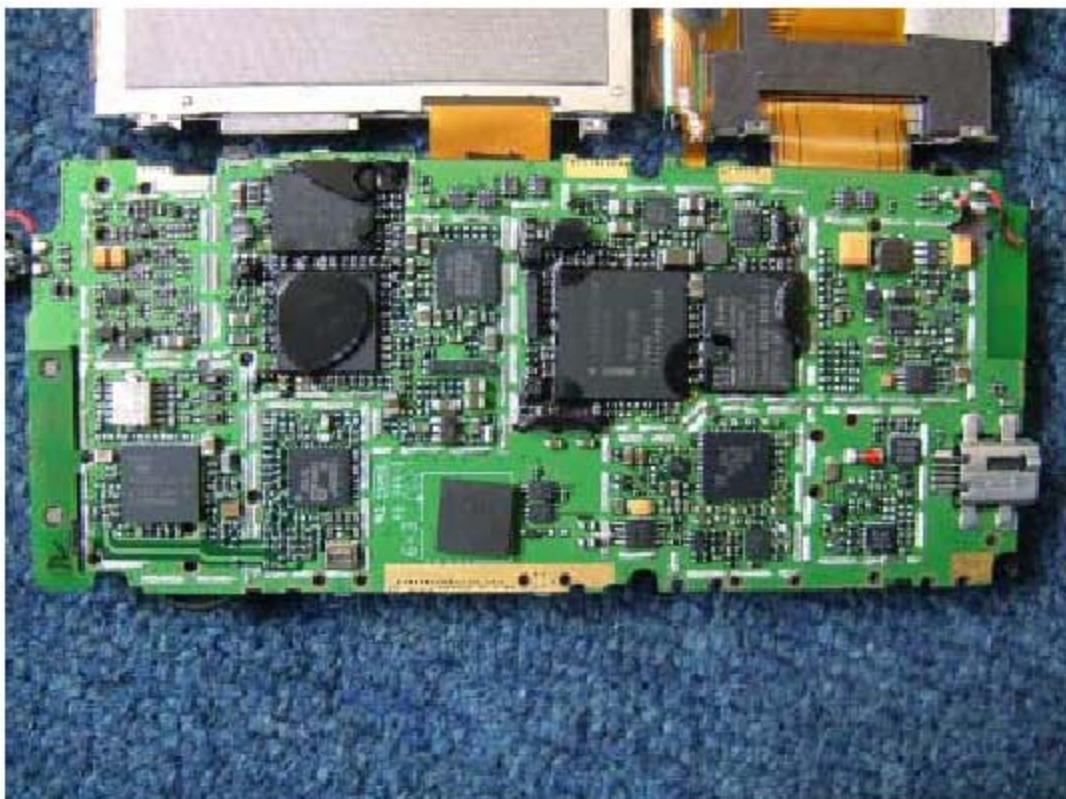
1. Appearance of the MS

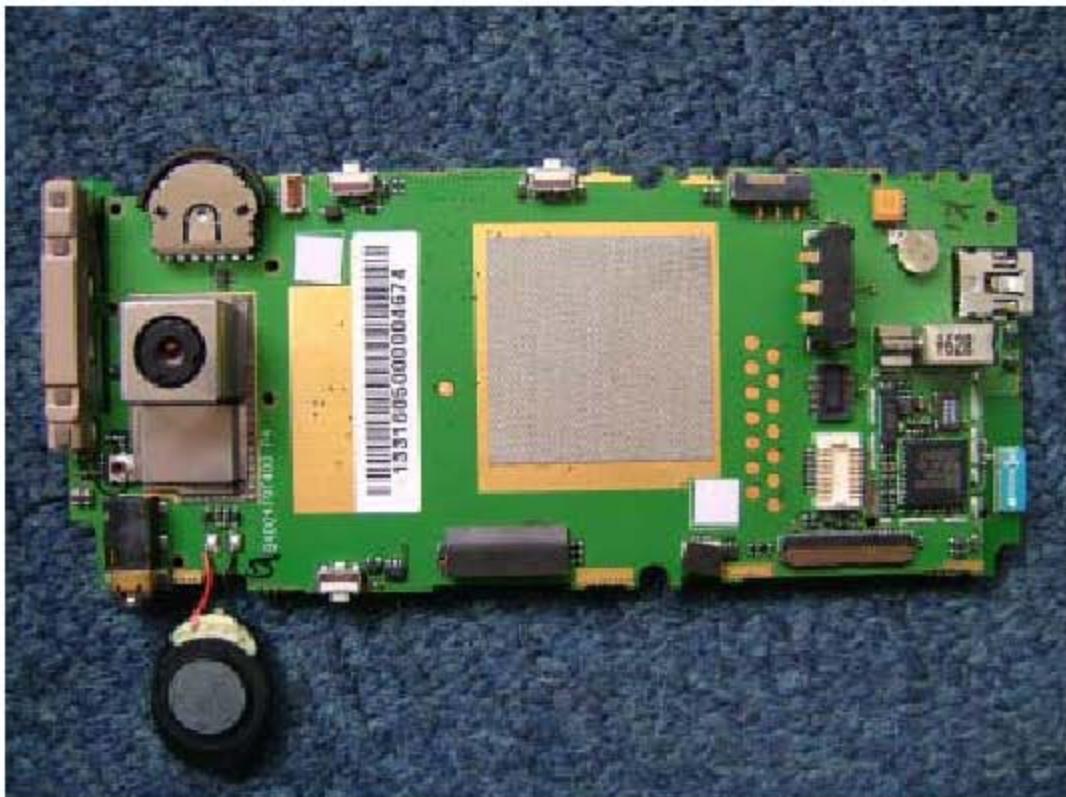


2. Inside of the MS









Appendix II: Photographs of the Test Configuration

1. Conducted Emission Test



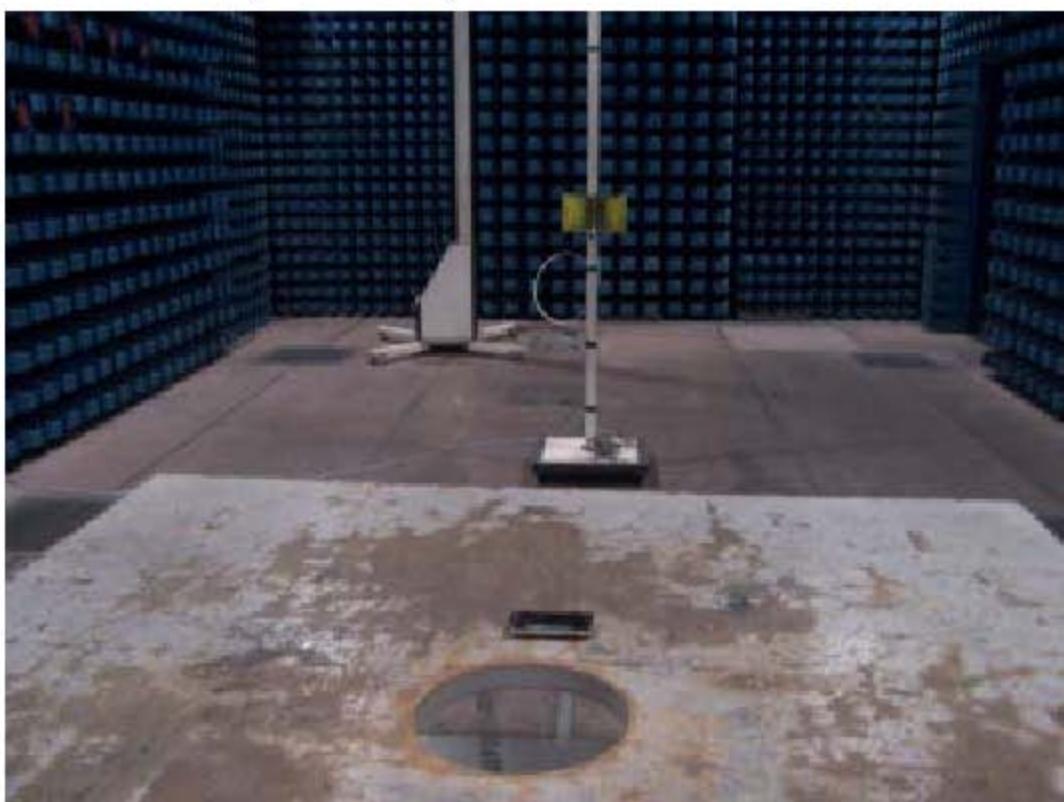
2. Radiated Emission Test (9 kHz -30 MHz)



3. Radiated Emission Test (30 MHz – 1 GHz)



4. Radiated Emission Test (above 1 GHz)



5. Conducted RF Test



6. Radiated RF Test

