CERTIFICATION TEST REPORT
FOR
FCC CFR 47, PART 15, SUBPART C
INDUSTRY CANADA RSS-210, ISSUE 8

PRODUCT NAME	Ford SYNC Gen 2
PRODUCT MODEL NUMBER	KMHSYNCG2-L
FCC ID	KMHSYNCG2-L
IC ID	1422A-SYNCG2L
MANUFACTURER	Ford Motor Company
TEST REPORT NUMBER	GND1038AUT219-D
TEST REPORT DATE	16th Mar 2011
TEST REPORT VERSION	1.7
ISSUED TO	**David Orris** **Ford Motor Company** Building 5, 20300 Rotunda Dr., Dearborn, MI 48124, United States Phone: 313-805-5627
ISSUED BY	**TARANG** Wipro Technologies, SJP2, Survey#70,77,78/8A, Dodda Kanelli, Sarjapur road, Bangalore-560 035. Karnataka. India. Tel: +91-80-30292929 Fax: +91-80-30298200 Email: tarang.planet@wipro.com Web: www.wipro.com

REVISION HISTORY

S. No	Version	Date	Change History	Remarks
1	0.01	28th Oct 2010	Initial version for internal review	
2	0.02	3rd Nov 2010	Updated version after internal review	
3	0.03	11th Nov 2010	Updated version after incorporation of additional review comments	
4	0.04	12th Nov 2010	Updated to include the RE measurements for BT channels 40 and 78 as well	
5	0.05	16th Nov 2010	Updated to include additional review comments and updates on PSD measurement, threshold levels for conducted spurious measurement	
6	0.06	18th Nov 2010	Updated to add setup photographs	
7	1.0	23rd Nov 2010	Approved report	
8	1.01	29th Nov 2010	Updated BT peak conducted output power	
9	1.1	29th Nov 2010	Approved report	
10	1.11	06th Dec 2010	Update in Model Number of EUT	
11	1.2	06th Dec 2010	Approved report	
12	1.21	09th Dec 2010	Update in Product Name of EUT	
13	1.3	09th Dec 2010	Approved Report	
14	1.4	09th Feb 2011	Dwell time measurements updated.	
15	1.5	13th Feb 2011	Approved Report	
16	1.6	2nd Mar 2011	Updated to add hops per second in BT interface and unit for limits in band edge measurements. Approved report.	
17	1.7	16th Mar 2011	Report split to show only BT interface results	

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1 TEST DESCRIPTION & RESULT

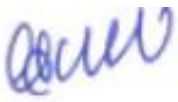
Applicant	David Orris Ford Motor Company, Building 5, 20300 Rotunda Dr., Dearborn, MI 48124, United States. Phone: 313-805-5627; E-Mail: dorris@ford.com
Manufacturer	Ford Motor Company
Equipment Under Test	Ford SYNC Gen 2
Model	KMHSYNCG2-L
Serial Number	XM2J000H
No. of samples tested	One
Date of Test	18th Sep 2010
Date of Submission	14th Mar 2011
Venue of Test	**Tarang** Wipro Technologies, SJP2, Survey#70,77,78/8A, Dodda Kanelli, Sarjapur road, Bangalore-560 035. Karnataka. India.

Applicable Standard	Description	Criteria / Class	Results
FCC	CFR 47, Part 15, Subpart C	NA	Pass
Industry Canada	RSS-210, Issue 8	NA	Pass

Tarang lab tested **Ford SYNC Gen 2** as per the standards that are listed in the table above. Based on the observations during the test and interpretations by Tarang lab, results have been indicated. Any measurement uncertainties listed in this report are for information only and have not been taken into account in the results. The overall test results show that Ford SYNC Gen 2 is capable of demonstrating the compliance requirements of the standards listed above.

The results documented in this report apply only to the product / system tested. The results shall stand invalid, in case there are any modifications / additions / removals to the hardware or software or end use atmosphere to the product tested. Particulars on Manufacturer / Supplier / EUT configuration / Performance criteria, etc given in this report are based on the information given by the customer, along with test request. Tarang does not assume any responsibility for the correctness of that information for the above mentioned equipment under test.

Any change to this document that is not carried out by Tarang is unauthorized and this document shall stand invalid. This report must not be used by the client to claim product certification or approval or endorsement by any agency of the Federal Government or any Government.

Prepared by	Reviewed by	Approved by
Sathesh Kumar L	**Satheesh I**	**Nagaraj C S**
		
Test Engineer	Technical Manager	Technical Manager

2 SUMMARY OF TESTS, FACILITY AND ACCREDITATION

2.1 TEST DETAILS

The tests documented in this report are performed according to the following standards:

- ANSI C63.4-2000
- FCC CFR 47, Part 15
- RSS-210 Issue 8

2.2 TEST FACILITY DETAILS

All the tests were carried out at Tarang –Product Qualification and Compliance Planet located at Wipro Limited, SJP2, Dodda Kanelli, Sarjapur road, Bangalore. Karnataka. India. 560 035.

Following are the accreditation and listing details for Tarang.

Accreditation / Listing body	Registration / Company / Certificate Number
NABL, India	Certificate No: T-1533 http://www.nabl-india.org/
FCC (Federal Communications Commission)	Registration Number: 799247 http://www.fcc.gov/
IC (Industry Canada)	Company Number: 9023A http://www.ic.gc.ca

2.3 CALIBRATION

All measuring instruments used to perform the tests listed and reported in this document are calibrated as per the manufacturer recommendation and are traceable to ISO17025.

2.4 MEASUREMENT UNCERTAINTY

The following measurement uncertainties are applicable to the relevant tests that are mentioned below:

Test	Uncertainty
Radiated Emission (30 MHz to 1 GHz), 3 meter	±4.12 dB (95% confidence)
Radiated Emission (1 GHz to 18 GHz), 3 meter	±4.25 dB (95% confidence)
Radiated Emission (18 GHz to 40 GHz), 3 meter	±4.63 dB (95% confidence)

3 EQUIPMENT UNDER TEST (EUT)

3.1 DESCRIPTION OF THE EUT

Ford SYNC Gen 2 is part of Vehicle (car) Infotainment System. The product allows the driver and passenger to access and control their phone and media devices "hands free" through the use of voice commands and steering wheel controls. The product also provides a rich graphical display to provide touch screen input and present graphical and text information back to the user. An overview of functions that the supports are listed below:

The **Ford SYNC Gen 2** provides a gateway interface to the Vehicle Infotainment System (VIS) for:

- Bluetooth enabled Cellular Phone
- Portable Media Devices
- Wi-Fi Networks(802.11b/g)

Product powers from 12V DC.

3.2 SOFTWARE AND FIRMWARE DETAILS

CCPU Software Version: 4.1.10168
VMCU Software Version: 2.1.28

3.3 PRODUCT CONFIGURATION DETAILS (WORST CASE)

The product is a DC powered unit. A standard bench-top power supply was used during the test. The product has an LCD display unit, which provides the required user interface for this product. The scope of this certification is for the product excluding the display module. Hence the display was not used during the Radiated Emission tests based on customer input. The display was used for the purpose of configuration of the product.

The product supports 802.11b/g modes of operation on the Wi-Fi interface and Bluetooth band as well. The interfaces were configured to:

a. The highest speed that is supported in each band
b. The maximum power that is configurable
c. The product also supported continuous transmit mode, which was enabled for the conducted measurements

3.4 TRANSMIT POWER DETAILS

The peak power output specification of the transmitter as per the device transceiver datasheet provided by the vendor at various modes is as listed below.

Frequency Range	Mode	Output power (dBm)	Output power (W)
2.402 to 2.480 GHz	Bluetooth	9	7.9 mW

3.5 TEST SETUP DETAILS

3.5.1 SUPPORTING EQUIPMENT

Item	Manufacturer	Model Number	Serial Number	FCC ID
Power Supply	Aplab	VSMPS 6010 ODI	710-VSMPS6010-152	NA
Standard keyboard with USB interface	Any	Any	NA	NA

3.5.2 I/O CABLES AND CONNECTORS

Port	No of similar ports	Connector	Cable type	Cable length
USB	2	USB A	Unshielded	3m
Power supply	1	0.1” Header	Unshielded	3m
Display connector	2	Customized	NA (No cable)	NA

3.5.3 TEST SETUP DETAILS

3.5.3.1 RADIATED EMISSION TEST SETUP DETAILS

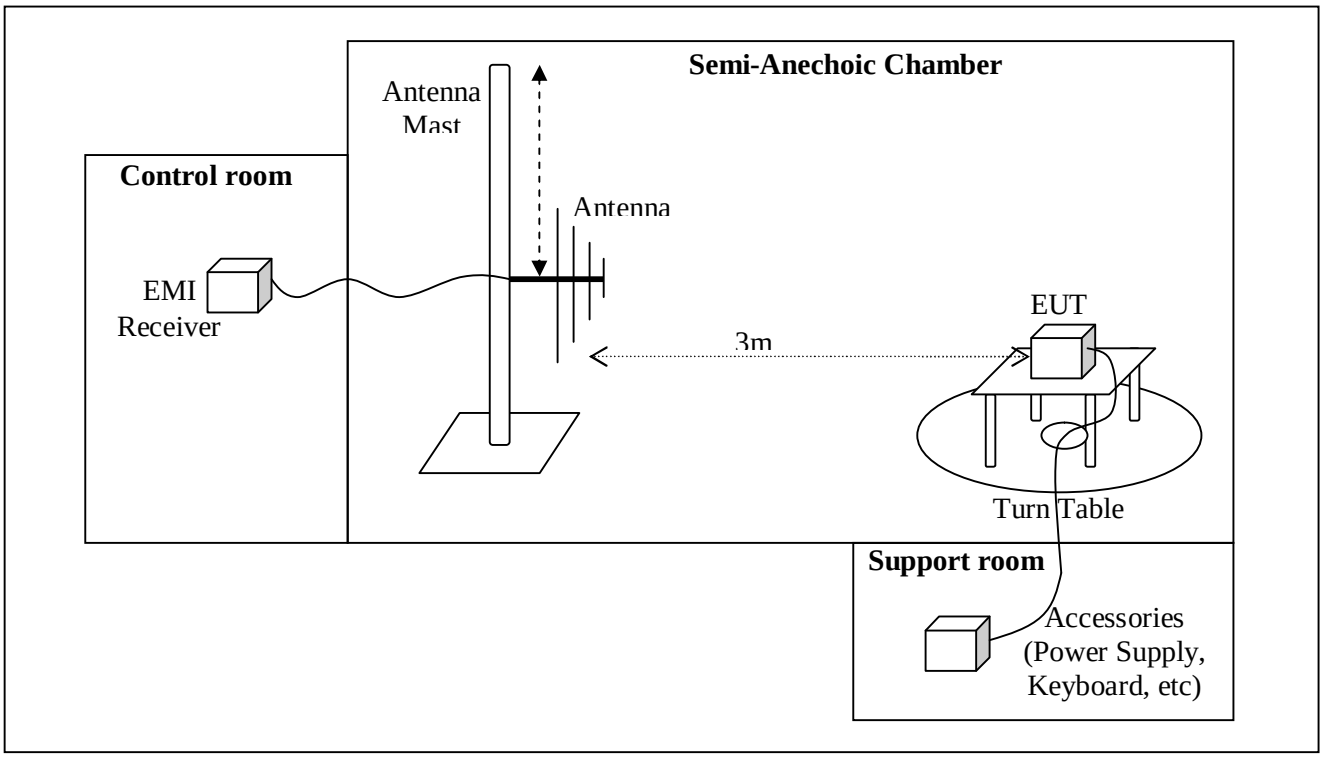


Figure 1: Test setup for Radiated Emission test

3.5.3.2 ANTENNA CONDUCTED MEASUREMENT TEST SETUP DETAILS

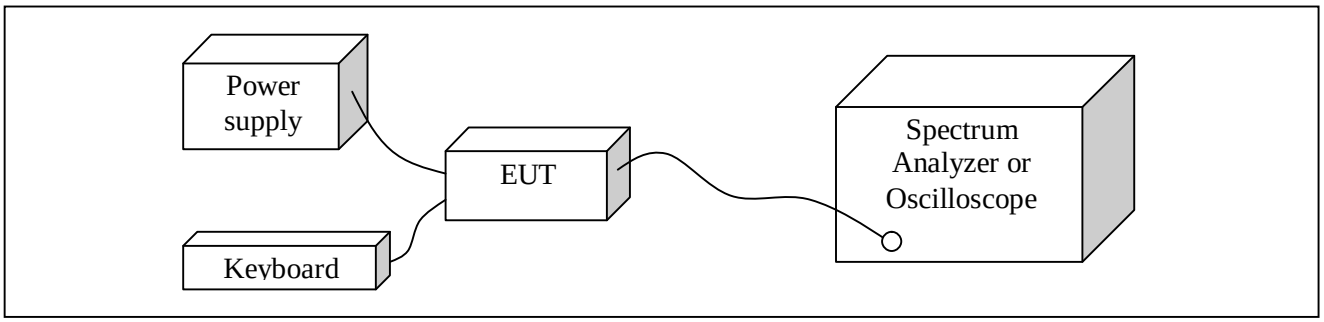


Figure 2: Test setup for Conducted measurements on the Bluetooth ports

4 INSTRUMENTATION AND CALIBRATION

4.1 TEST AND MEASURING EQUIPMENT

The following list contains measuring equipments used for testing. The equipments confirm to the required standards. Calibration of all test and measuring equipments including any accessories that may affect such calibration are checked frequently to ensure the accuracy. Adjustments are made and correction factors are applied in accordance with the instructions contained in the respective manual.

4.2 EQUIPMENTS USED

Name of Equipment	Manufacture	Model No.	Serial No.	Calibration Due
Spectrum Analyzer	Agilent	E4407B	MY45112947	17th Feb 2011
Oscilloscope	Tektronix	DPO71604	B010382	4th Sep 2011
EMI receiver	Rohde & Schwarz	ESIB40	100306	31st Aug 2011
Hybrid Log Periodic Antenna	TDK RF Solutions	HLP-3003C	130334	20th Mar 2011
Broadband Horn Antenna	Schwarzbeck Mess Electronik	BBHA 9170	9170-344	20th Mar 2011
Double Ridge Broad Band Horn Antenna	Schwarzbeck Mess Electronik	BBHA 9120 D	9120D-687	20th Mar 2011
RF Cable	Colemann	M17-84/RG223	NA	NA

5 APPLICABILITY OF TESTS

The following table summarizes and provides reference to the tests that are applicable and carried out for this product.

5.1 APPLICABLE TESTS FOR BLUETOOTH PORT

S. No	Standard	Name of the test	Section of standard	Applicability	Port
1	FCC Part 15	Restricted bands of operation	15.205	Yes	BT
2	FCC Part 15	Conducted Emission	15.207	No (Product is DC powered)	NA
3	FCC Part 15	Radiated Emission	15.209	Yes	Product
4	FCC Part 15	Frequency hop – Carrier separation	15.247 (a) (1)	Yes	BT
5	FCC Part 15	Frequency hop – Dwell time	15.247 (a) (1) (iii)	Yes	BT
6	FCC Part 15	Peak conducted o/p power for hopping systems (<=125 mW)	15.247 (b) (1)	Yes	BT
7	FCC Part 15	Directional antenna gains greater than 6 dBi	15.247 (c)	No (Antenna gain <6dBi)	NA
8	FCC Part 15	Conducted Spurious Emission	15.247 (d)	Yes	BT
9	FCC Part 15	Systems using hybrid modulation	15.247 (f)	No (No hybrid modulation used)	NA

5.2 TEST RESULTS FOR BLUETOOTH PORT

5.2.1 RESTRICTED BAND OF OPERATION

5.2.1.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limits
FCC Part 15, Subpart C	15.205	In the operating range of this product, the limits are: f_L > 2.39 GHz, f_H < 2.4835 GHz
RSS-210	2.2	In the operating range of this product, the limits are: f_L > 2.39 GHz, f_H < 2.655 GHz

f_L = Lower operating frequency range
f_H = Higher operating frequency range

5.2.1.2 TEST PROCEDURE

S. No	Procedure
1	Connect the transmitter output to a Spectrum Analyzer
2	Select the lowest possible channel of the carrier
3	Measure the lower frequency at 20dBm below the peak power at this carrier and record this as f_L
4	Select the highest possible channel of the carrier
5	Measure the higher frequency at 20dBm below the peak power at this carrier and record this as f_L

Note: While it may be sufficient that the center frequency of the carrier is within the limits, the lower and higher frequencies of the carrier envelop have been taken into account for this measurement.

5.2.1.3 RESULT

Parameter	Limit	Measured	Result
f_L	> 2.39 GHz (FCC and RSS-210)	2.40005 GHz	Pass
f_H	< 2.4835 GHz (FCC)	2.48240 GHz	Pass
f_H	< 2.655 GHz (RSS-210)	2.48240 GHz	Pass

5.2.1.4 RESULT (SUPPORTING GRAPHS / DATA)

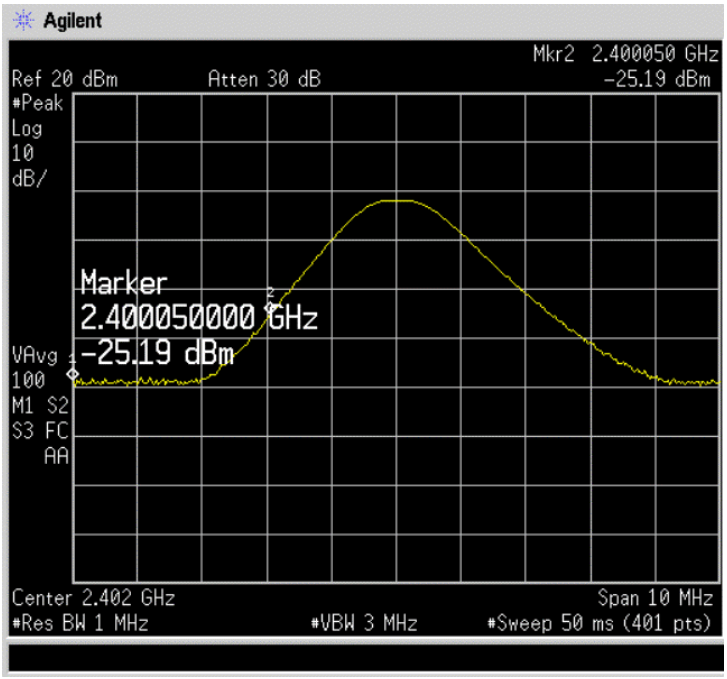


Figure 3: Measured f_L at Channel 0 – Bluetooth

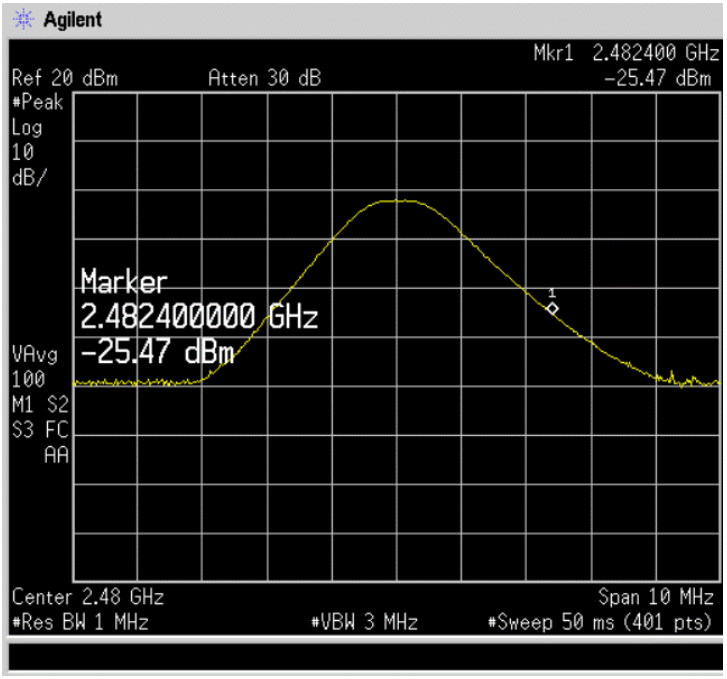


Figure 4: Measured f_H at Channel 78 – Bluetooth

5.2.2 RADIATED EMISSION

5.2.2.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Frequency range	Limit (dBµV/m) at 3 meter
FCC Part 15, Subpart C	15.209	30 MHz to 88 MHz 88 MHz to 216 MHz 216 MHz to 960 MHz 960 MHz to 1 GHz Above 1 GHz	40.0 43.5 46.0 54.0 54.0
RSS-210	2.6	30 MHz to 88 MHz 88 MHz to 216 MHz 216 MHz to 960 MHz 960 MHz to 1 GHz Above 1 GHz	40.0 43.5 46.0 54.0 54.0

5.2.2.2 TEST PROCEDURE

S. No	Procedure
1	Test procedure is as per ANSI C63.4: 2000
2	EUT is placed on a 0.8m non-conductive table. This table is positioned on an automated turn table.
3	Antennas are positioned 3m away from the EUT
4	EUT is configured to function with the normal mode of operation
5	A peak scan was carried out at various azimuth angles and antenna heights ranging from 1m to 4m.
6	The highest level of Radiated Emission was recorded
7	Quasi-peak measurements were carried out at the identified peaks for <1GHz and Average measurements were carried out above 1GHz
8	These values are compared against the limit specified by the standard

5.2.2.3 RESULT

Parameter	Limit	Measured	Result
Radiated Emission	Refer 5.2.2.1	Refer 5.2.2.4	Pass

5.2.2.4 RESULT (SUPPORTING GRAPHS / DATA)

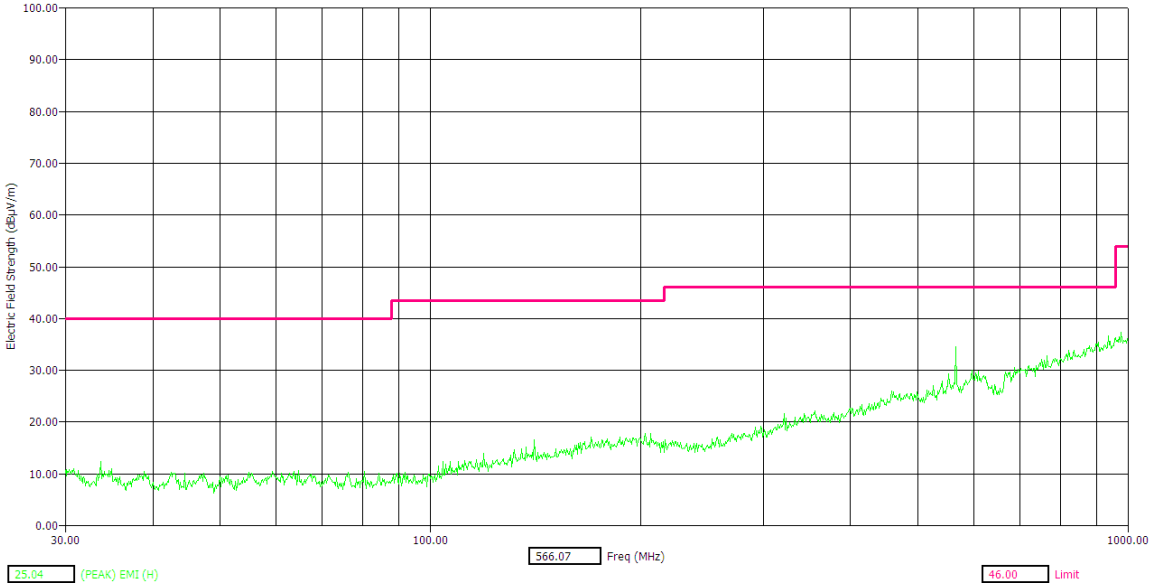


Figure 5: Radiated emission results (Peak) – Horizontal polarization – 30 MHz to 1 GHz – Bluetooth, Channel 0

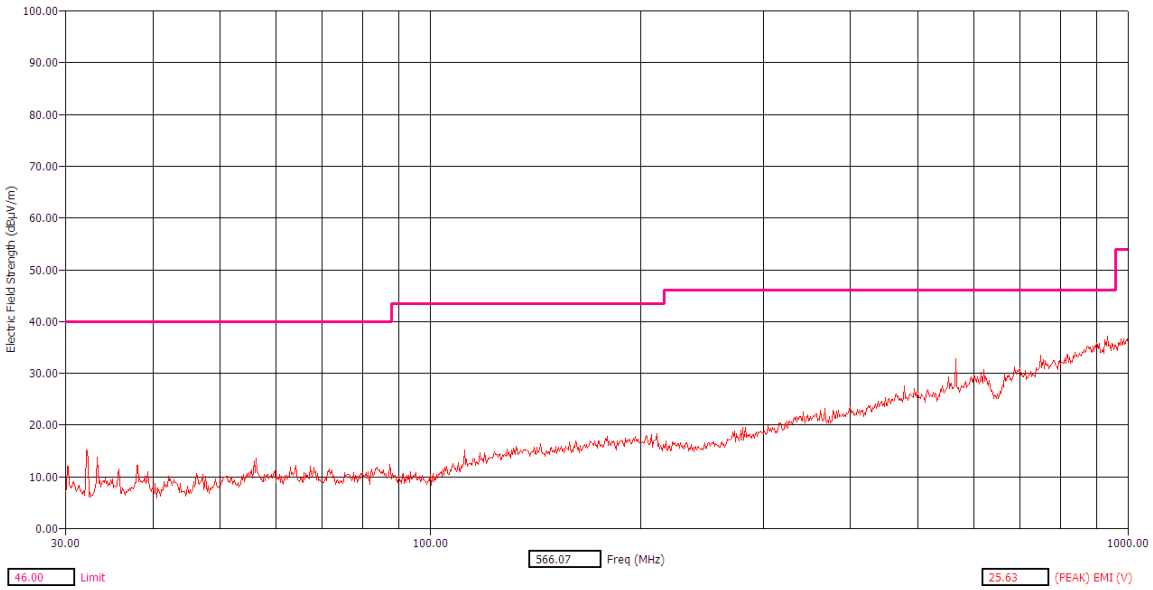


Figure 6: Radiated emission results (Peak) – Vertical polarization – 30 MHz to 1 GHz – Bluetooth, Channel 0

Freq (MHz)	Pol	(QP) EMI (dBµV/m)	Limit (dBµV/m)	(QP) Margin (dB)	EUT Ttbl Agl (deg)	Twr Ht (cm)	(QP) Trace (dBµV)	Cable (dB)	Transducer (dB)	Preamp (dB)	Freq (Max) (MHz)
565.30	H	32.82	46.00	-13.18	221.00	167.00	35.48	10.93	18.62	32.21	565.27
565.35	V	29.41	46.00	-16.59	17.00	154.00	31.67	10.93	19.02	32.21	565.27
620.60	V	27.66	46.00	-18.34	163.40	100.00	28.59	11.22	20.05	32.20	620.56
620.60	H	24.94	46.00	-21.06	180.10	128.00	26.11	11.22	19.82	32.20	620.55

Figure 7: Radiated emission results – Quasi-peak table - 30 MHz to 1 GHz – Bluetooth, Channel 0

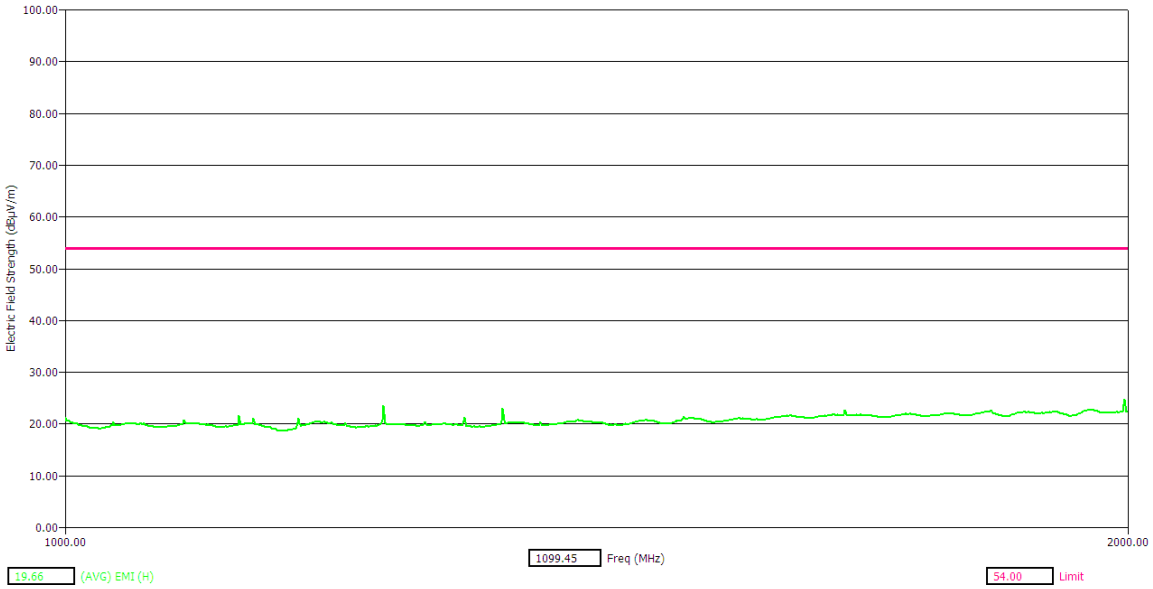


Figure 8: Radiated emission results (Average) – Horizontal polarization – 1 GHz to 2 GHz – Bluetooth, Channel 0

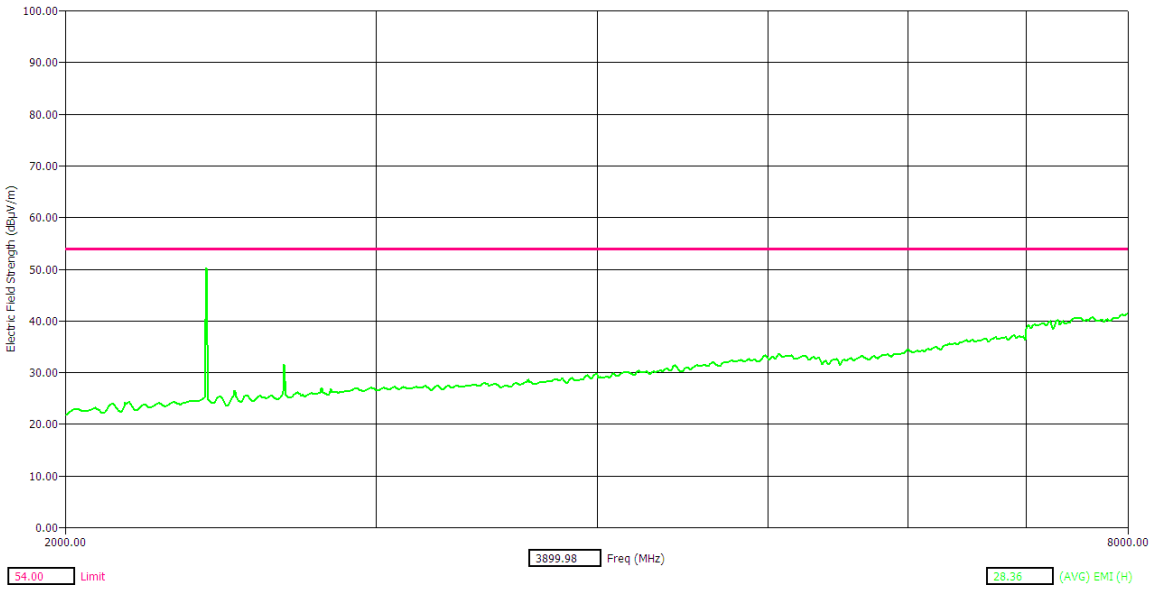


Figure 9: Radiated emission results (Average) – Horizontal polarization – 2 GHz to 8 GHz – Bluetooth, Channel 0

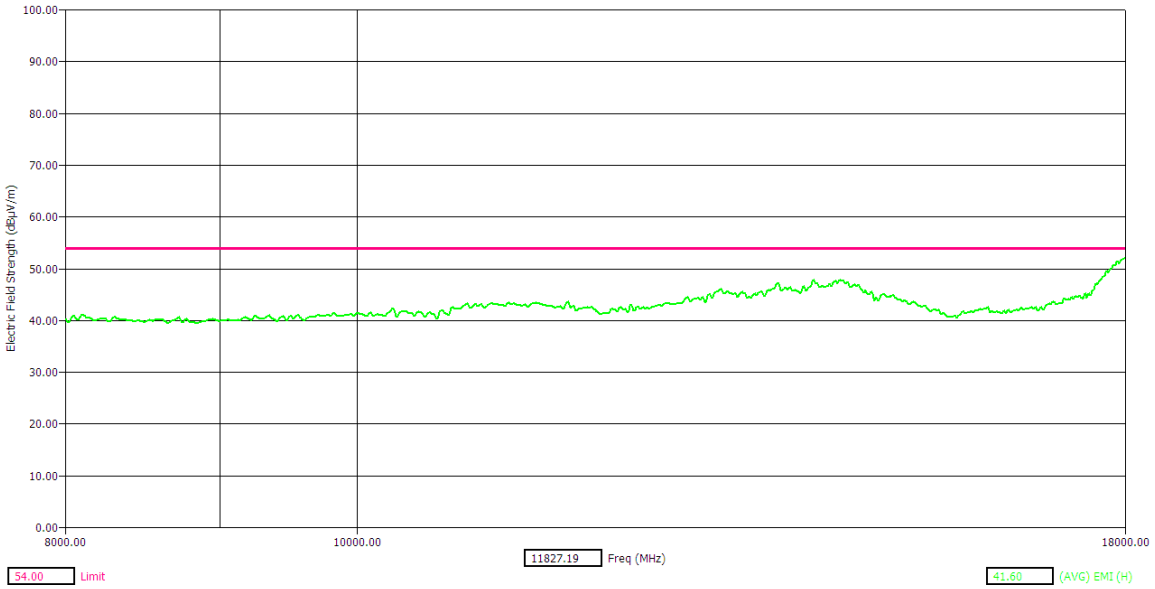


Figure 10: Radiated emission results (Average) – Horizontal polarization 8 GHz to 18 GHz – Bluetooth, Channel 0

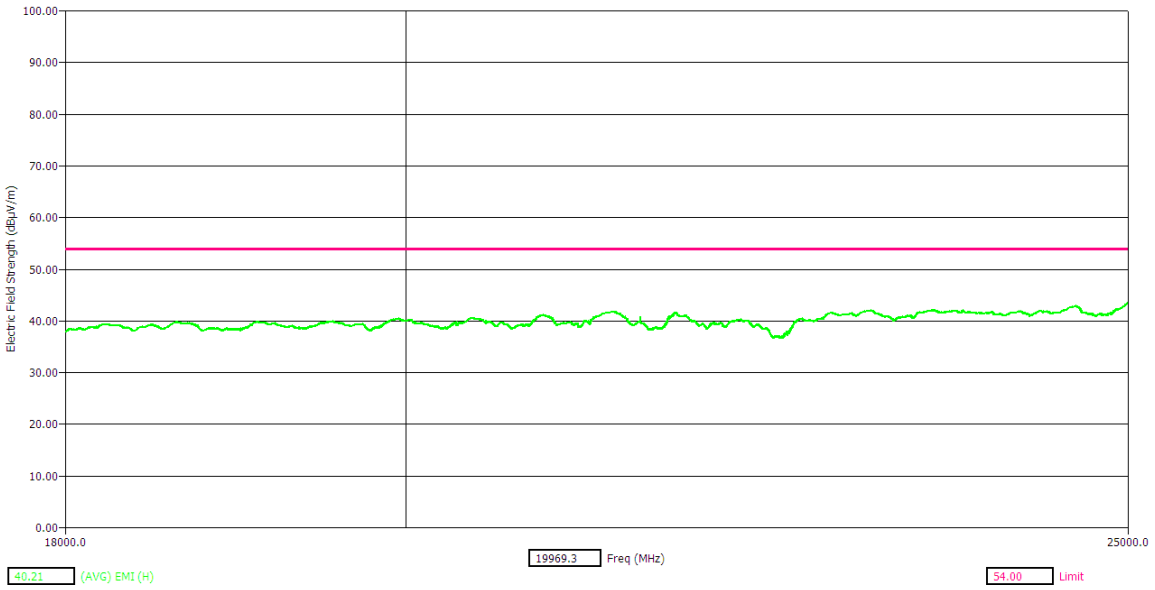


Figure 11: Radiated emission results (Average) – Horizontal polarization – 18 GHz to 25 GHz Bluetooth, Channel 0

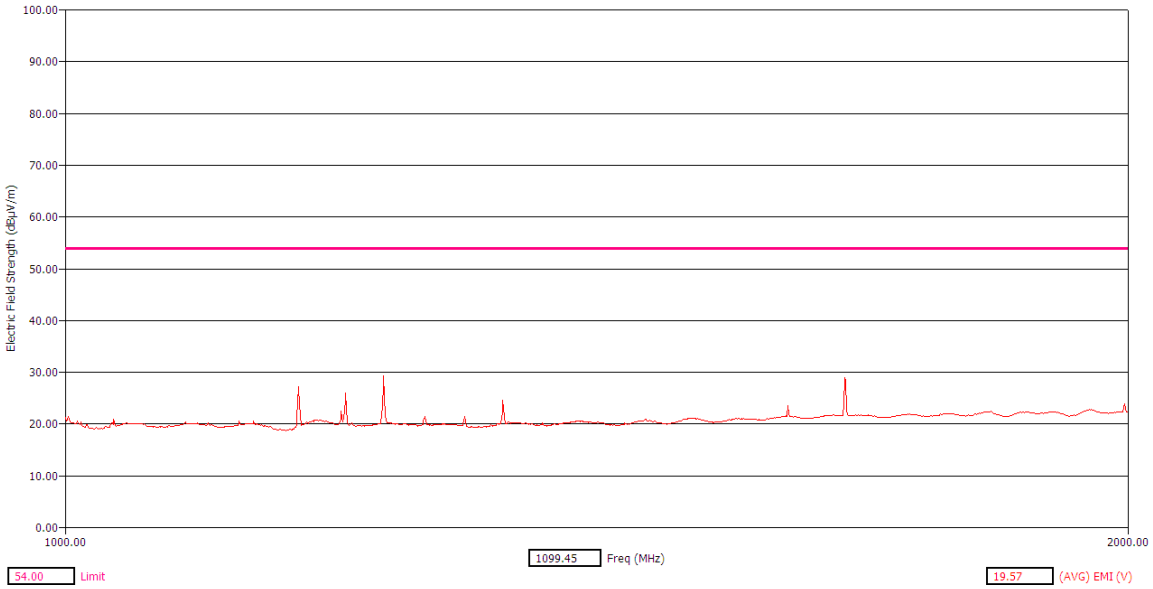


Figure 12: Radiated emission results (Average) – Vertical polarization – 1 GHz to 2 GHz – Bluetooth, Channel 0

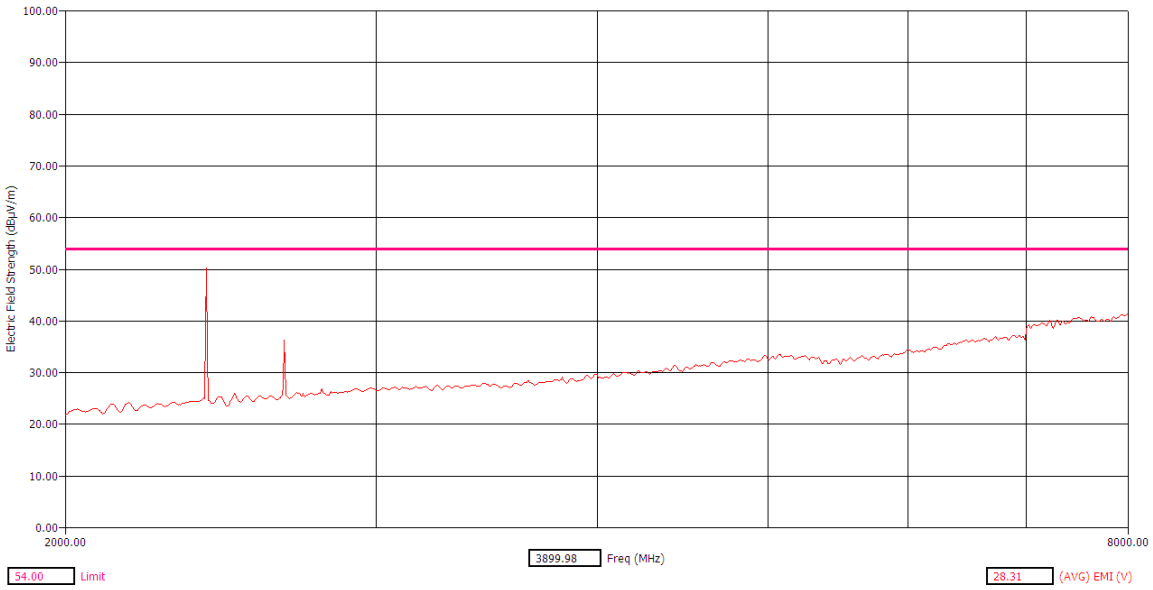


Figure 13: Radiated emission results (Average) – Vertical polarization – 2 GHz to 8 GHz – Bluetooth, Channel 0

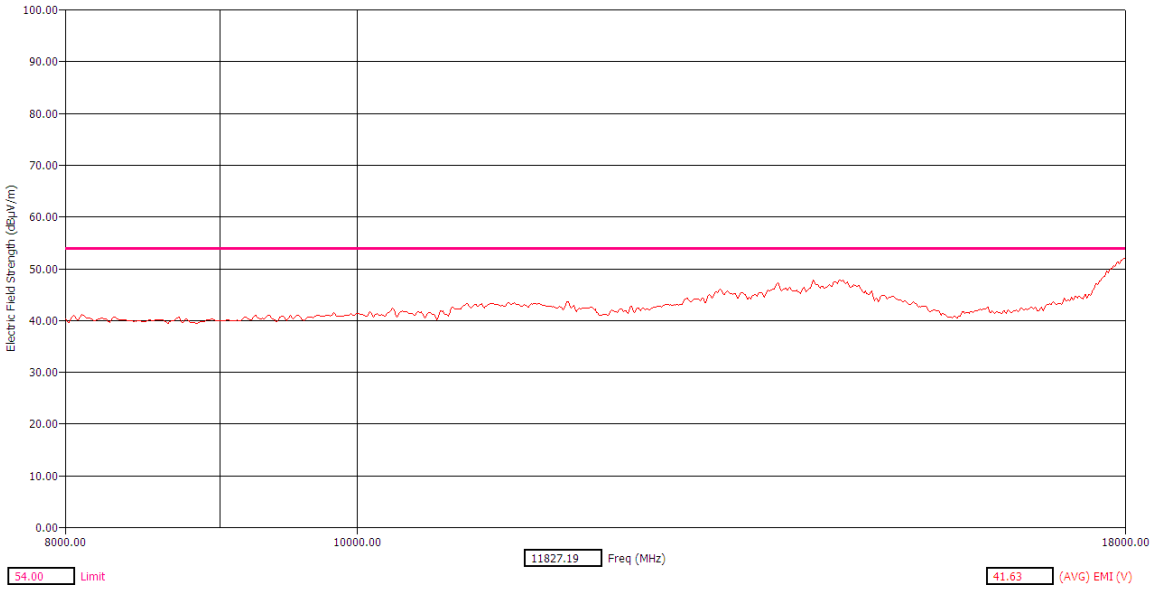


Figure 14: Radiated emission results (Average) – Vertical polarization – 8 GHz to 18 GHz – Bluetooth, Channel 0

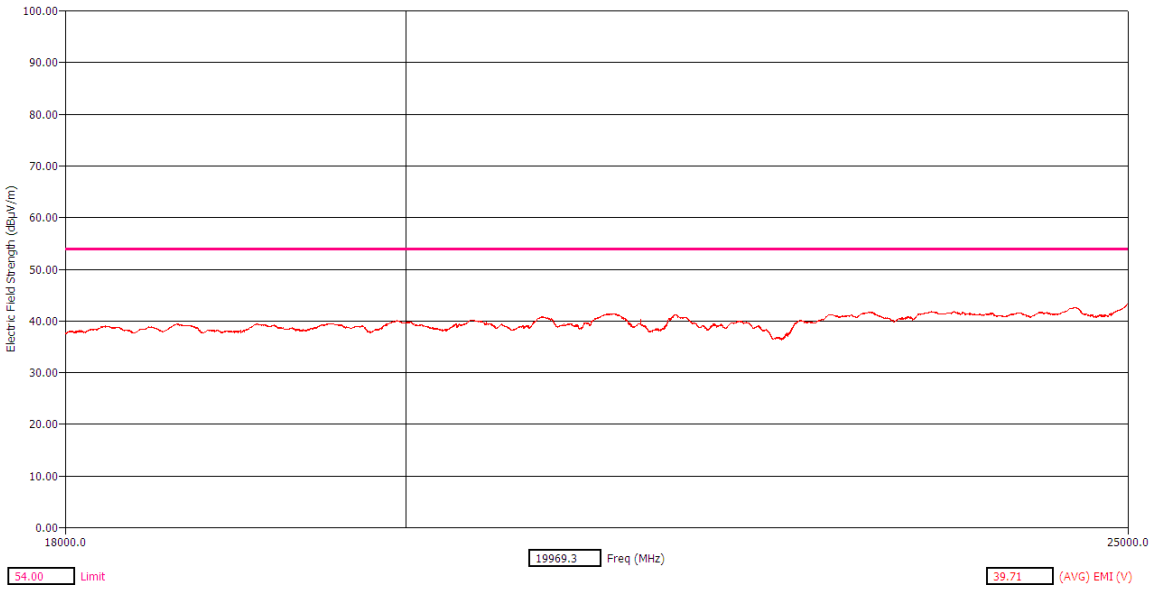


Figure 15: Radiated emission results (Average) – Vertical polarization – 18 GHz to 25 GHz – Bluetooth, Channel 0

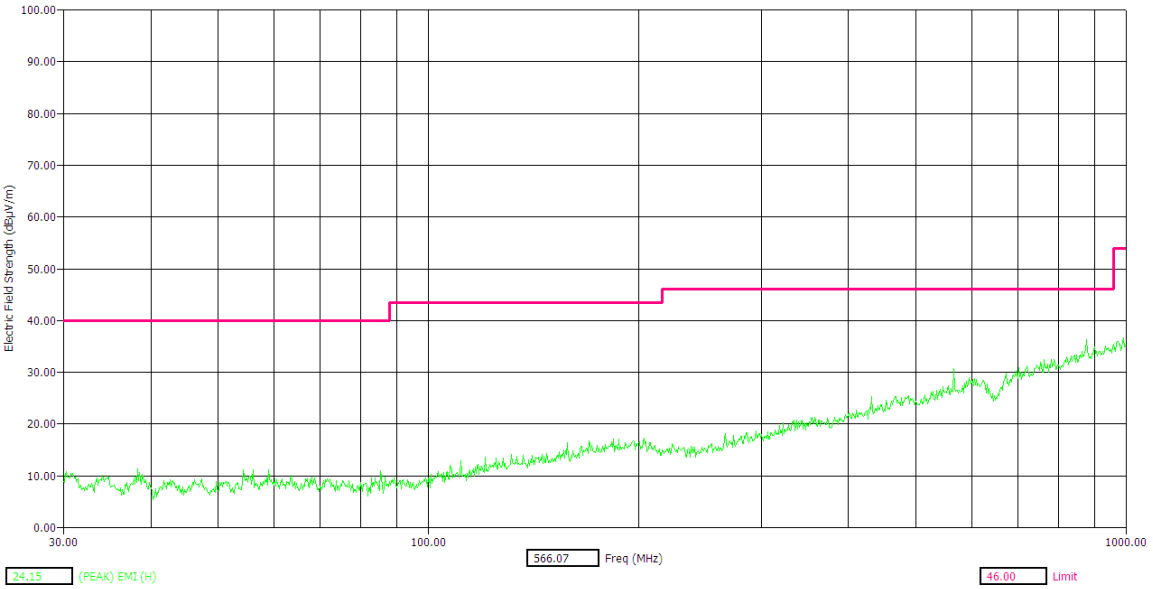


Figure 16: Radiated emission results (Peak) – Horizontal polarization – 30 MHz to 1 GHz – Bluetooth, Channel 40

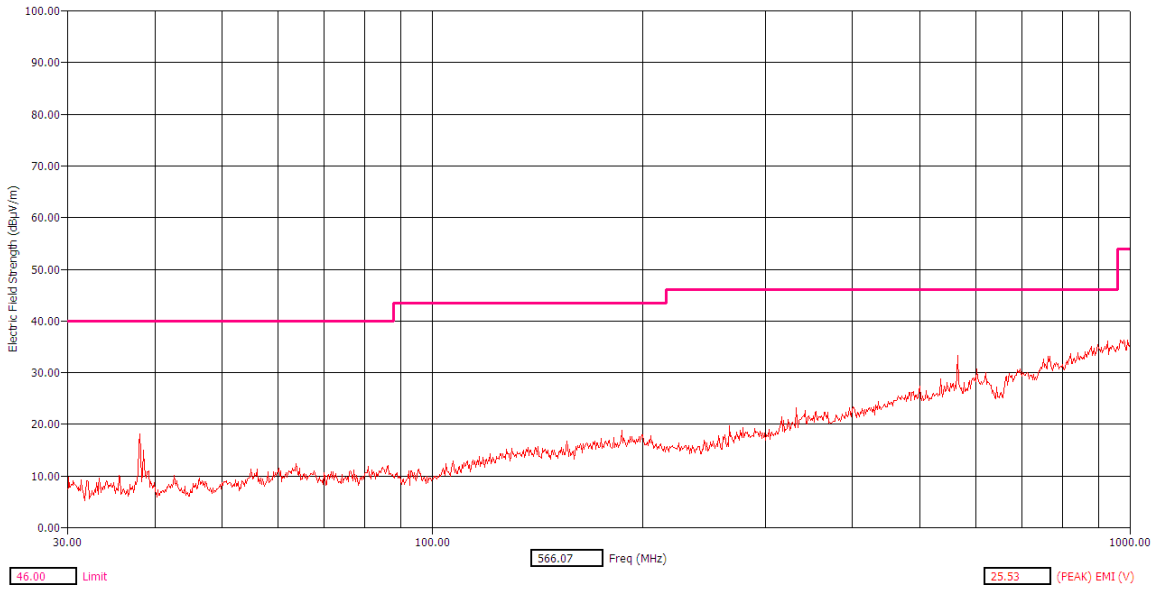


Figure 17: Radiated emission results (Peak) – Vertical polarization – 30 MHz to 1 GHz – Bluetooth, Channel 40

Freq (MHz)	Pol	(QP) EMI (dBµV/m)	Limit (dBµV/m)	(QP) Margin (dB)	EUT Ttbl Agl (deg)	Twr Ht (cm)	(QP) Trace (dBµV)	Cable (dB)	Transducer (dB)	Preamp (dB)	Freq (Max) (MHz)
332.10	H	14.10	46.00	-31.90	78.90	391.00	23.46	8.16	14.70	32.22	332.28
909.35	H	27.22	46.00	-18.78	103.10	341.00	22.74	13.85	22.94	32.31	909.55
Freq (MHz)	Pol	(QP) EMI (dBµV/m)	Limit (dBµV/m)	(QP) Margin (dB)	EUT Ttbl Agl (deg)	Twr Ht (cm)	(QP) Trace (dBµV)	Cable (dB)	Transducer (dB)	Preamp (dB)	Freq (Max) (MHz)
566.00	V	24.02	46.00	-21.98	13.60	236.00	26.27	10.93	19.03	32.21	565.55

Figure 18: Radiated emission results – Quasi-peak table – 30 MHz to 1 GHz – Bluetooth, Channel 40

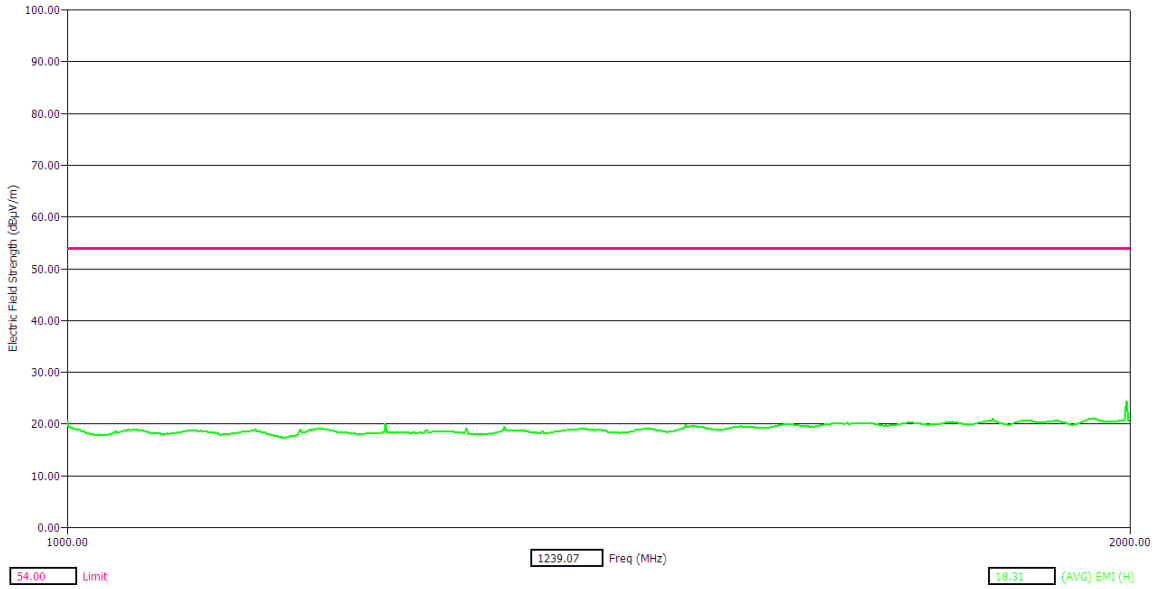


Figure 19: Radiated emission results (Average) – Horizontal polarization – 1 GHz to 2 GHz – Bluetooth, Channel 40

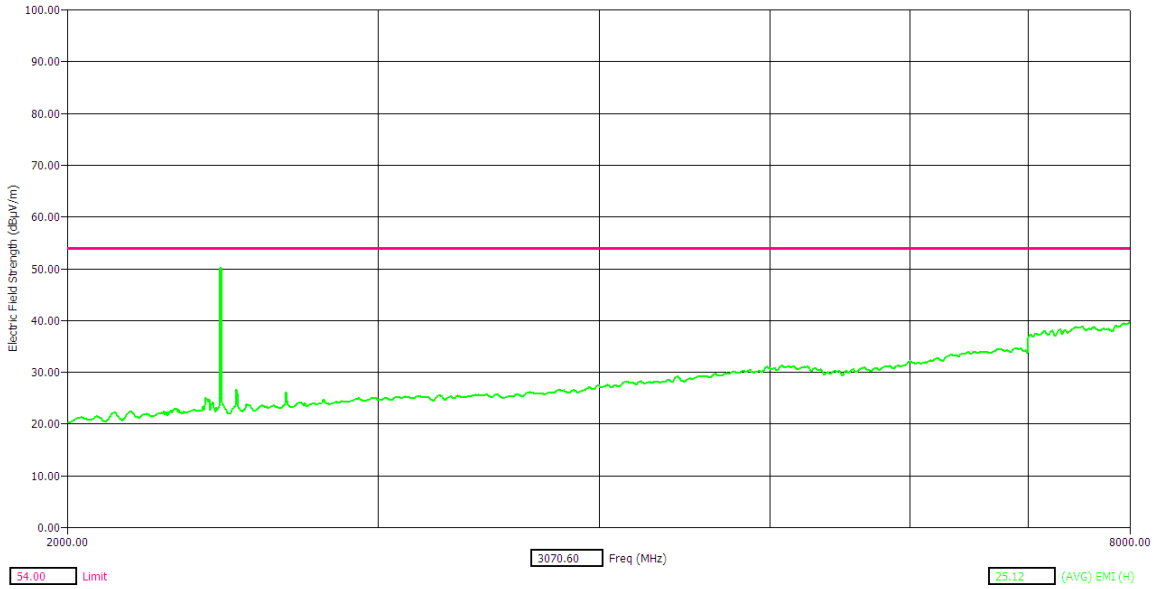


Figure 20: Radiated emission results (Average) – Horizontal polarization – 2 GHz to 8 GHz – Bluetooth, Channel 40

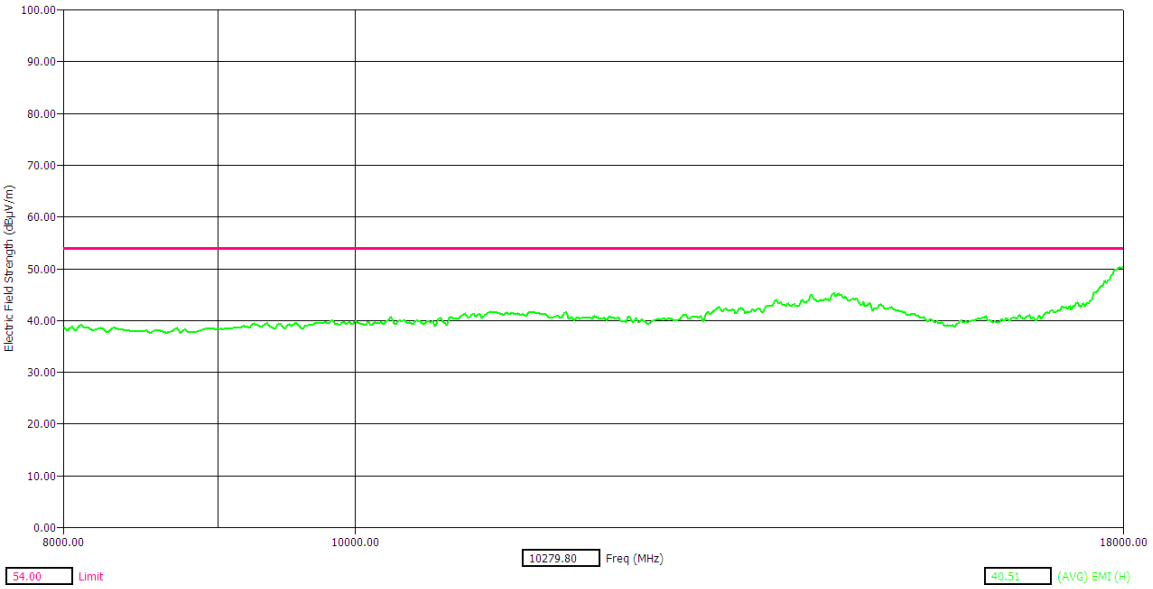


Figure 21: Radiated emission results (Average) – Horizontal polarization – 8 GHz to 18 GHz Bluetooth, Channel 40

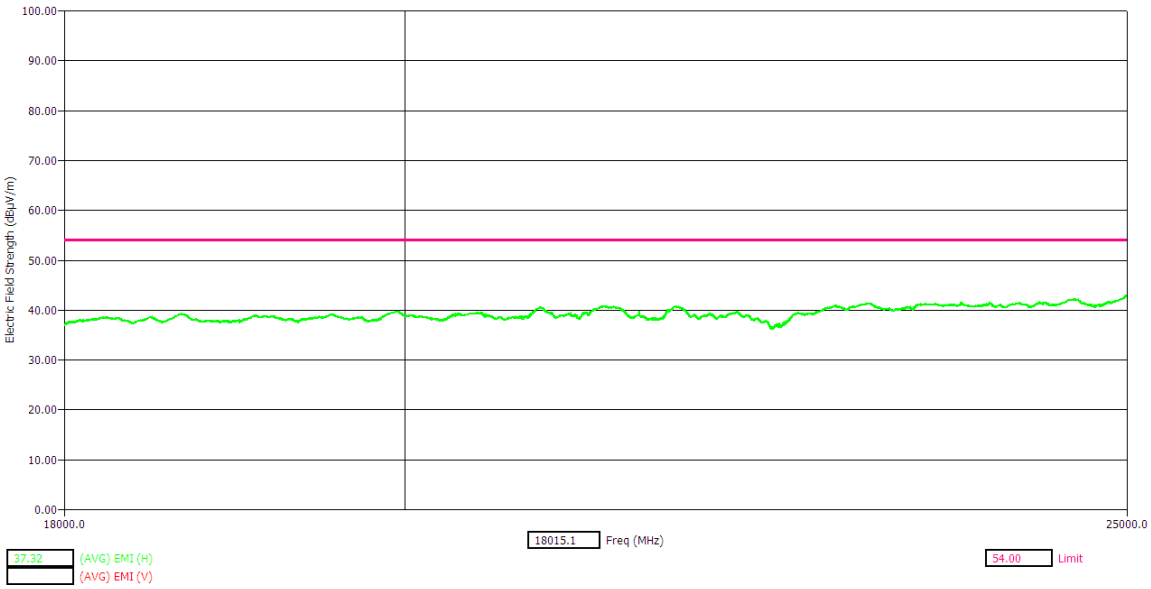


Figure 22: Radiated emission results (Average) – Horizontal polarization – 18GHz to 25GHz Bluetooth, Channel 40

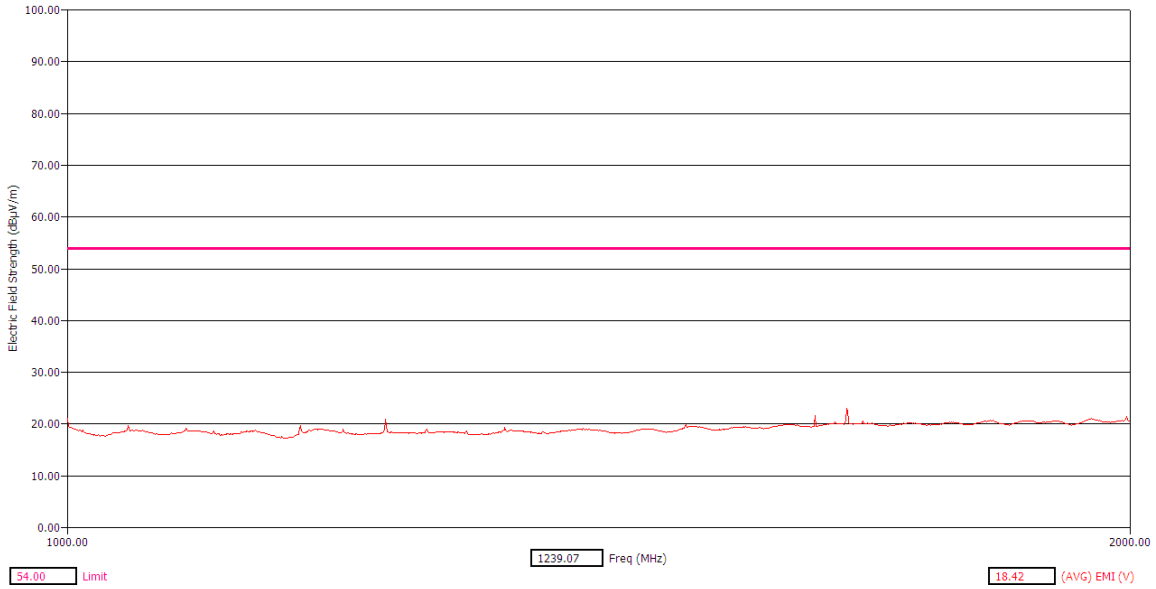


Figure 23: Radiated emission results (Average) – Vertical polarization – 1 GHz to 2 GHz – Bluetooth, Channel 40

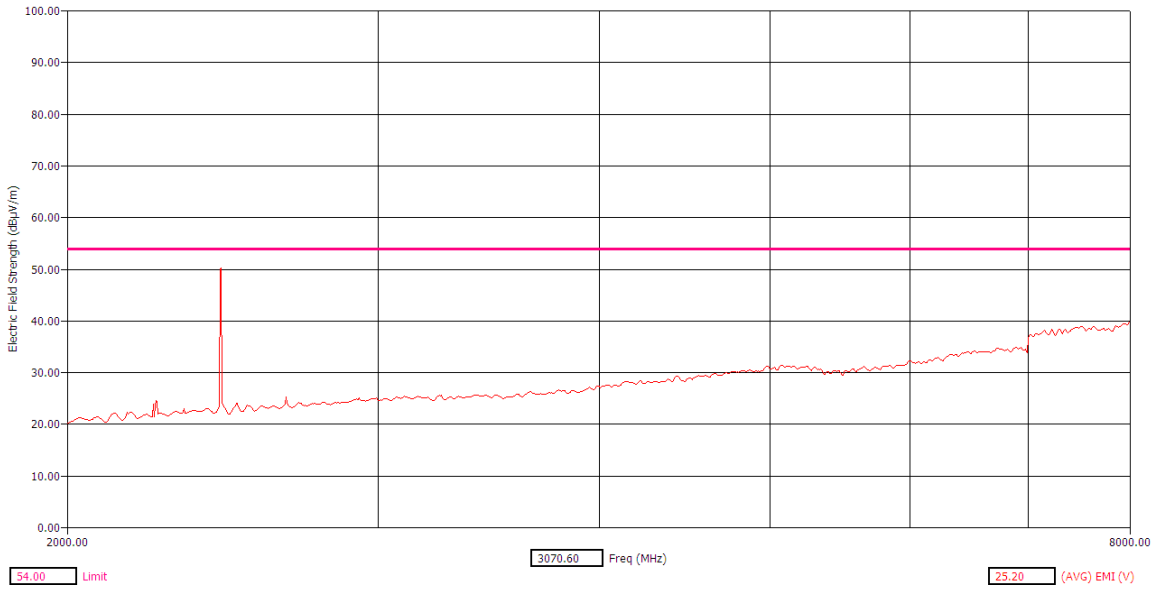


Figure 24: Radiated emission results (Average) – Vertical polarization – 2 GHz to 8 GHz – Bluetooth, Channel 40

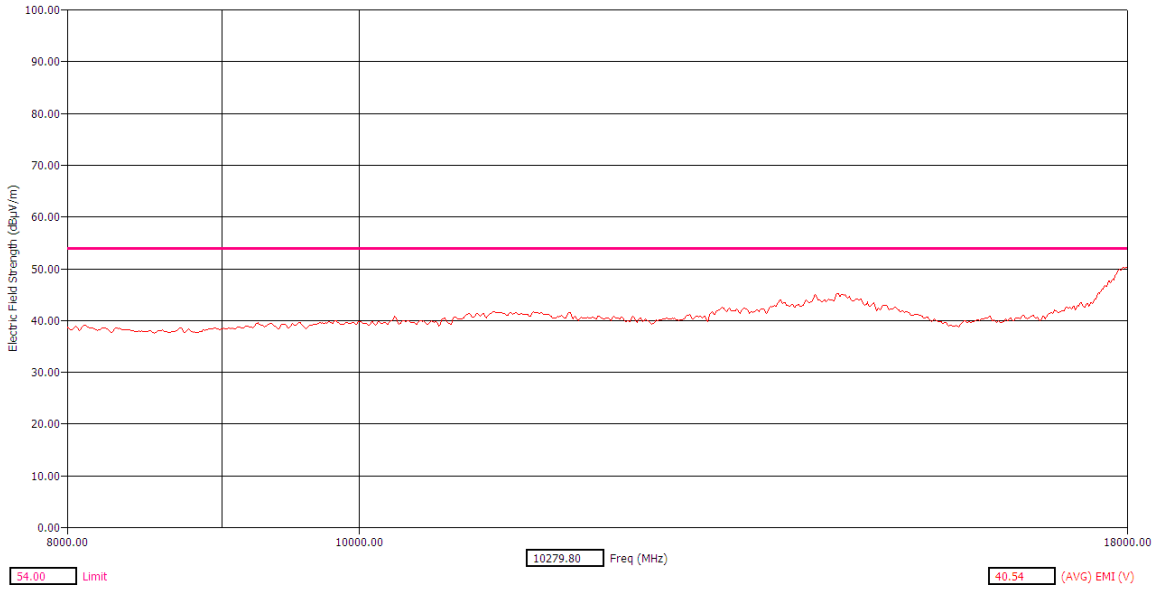


Figure 25: Radiated emission results (Average) – Vertical polarization – 8 GHz to 18 GHz – Bluetooth, Channel 40

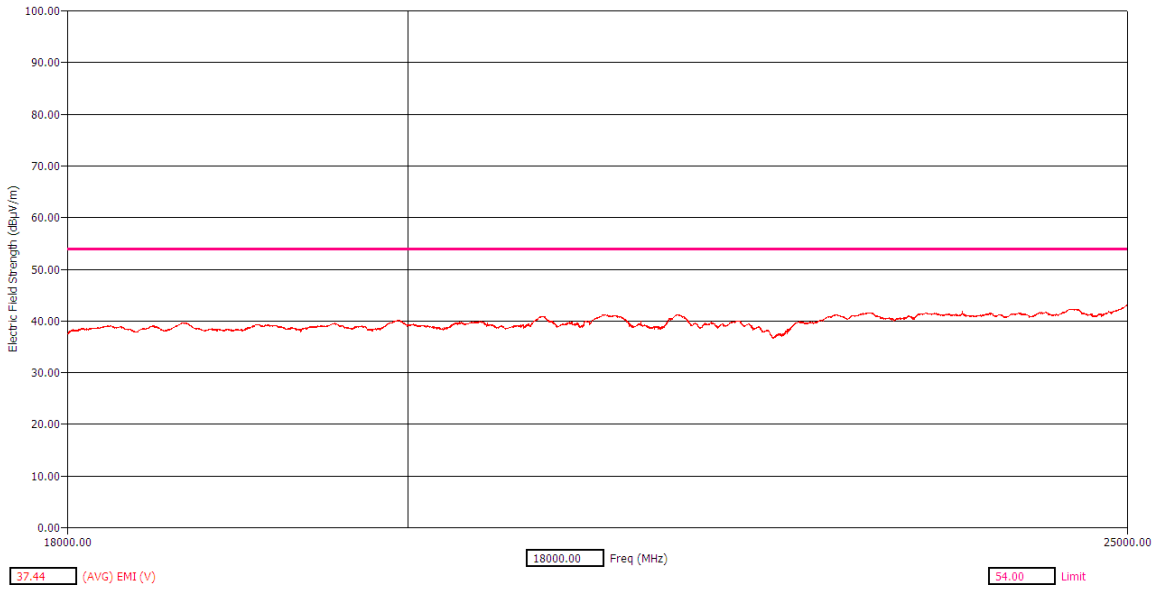


Figure 26: Radiated emission results (Average) – Vertical polarization – 18 GHz to 25 GHz – Bluetooth, Channel 40

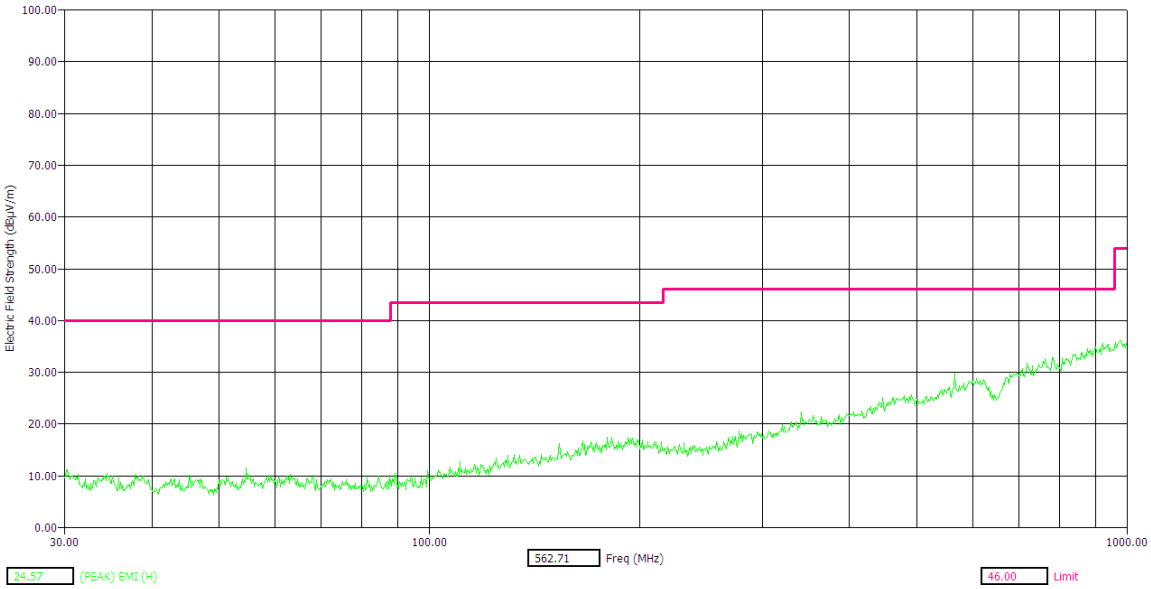


Figure 27: Radiated emission results (Peak) – Horizontal polarization – 30 MHz to 1 GHz – Bluetooth, Channel 78

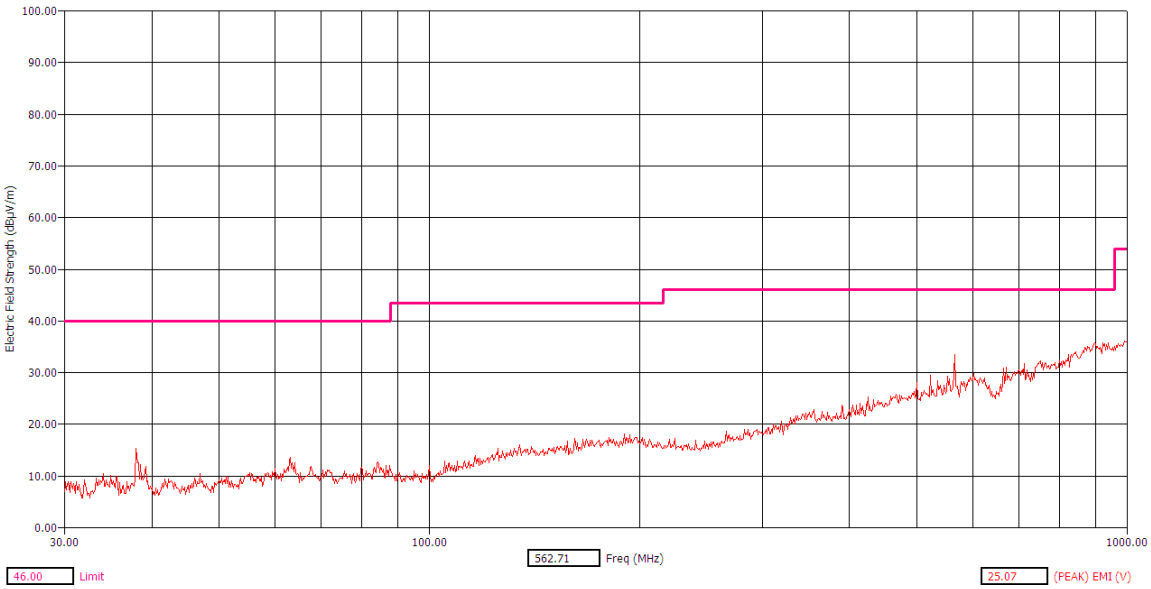


Figure 28: Radiated emission results (Peak) – Vertical polarization – 30 MHz to 1 GHz – Bluetooth, Channel 78

Freq (MHz)	Pol	(QP) EMI (dBµV/m)	Limit (dBµV/m)	(QP) Margin (dB)	EUT Ttbl Agl (deg)	Twr Ht (cm)	(QP) Trace (dBµV)	Cable (dB)	Transducer (dB)	Preamp (dB)	Freq (Max) (MHz)
332.10	V	14.91	46.00	-31.09	50.40	290.00	23.47	8.16	15.50	32.22	332.23
565.25	H	28.98	46.00	-17.02	66.70	182.00	31.64	10.93	18.62	32.21	565.29
565.35	V	29.81	46.00	-16.19	194.30	100.00	32.07	10.93	19.02	32.21	565.25
631.80	H	20.81	46.00	-25.19	254.40	143.00	23.69	11.11	18.96	32.95	631.90

Figure 29: Radiated emission results – Quasi-peak table - 30 MHz to 1 GHz – Bluetooth, Channel 78

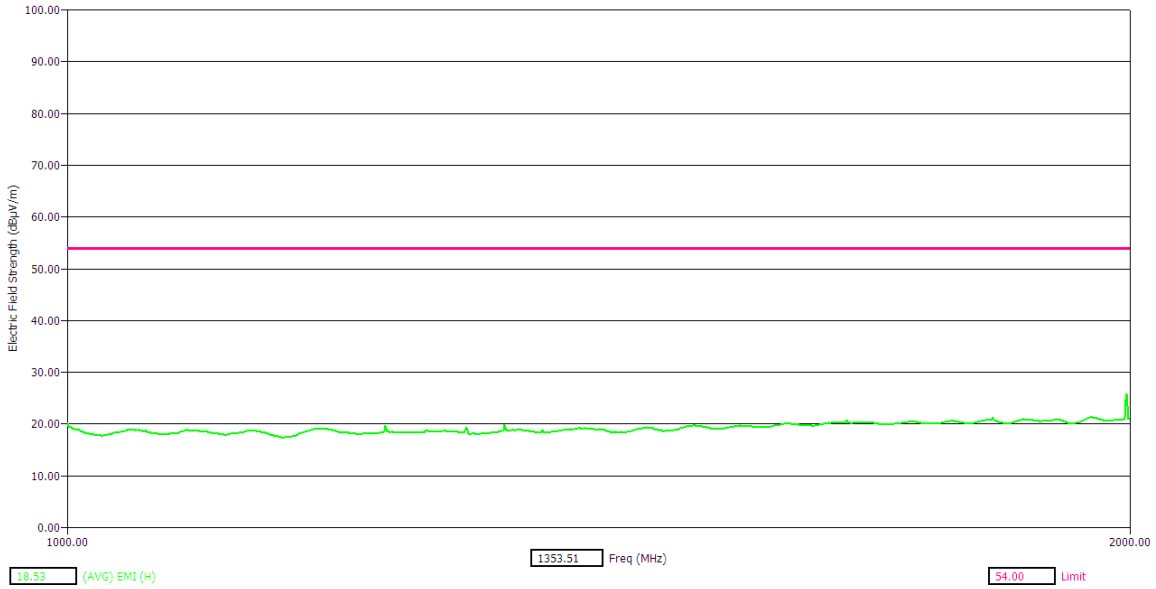


Figure 30: Radiated emission results (Average) – Horizontal polarization – 1 GHz to 2 GHz – Bluetooth, Channel 78

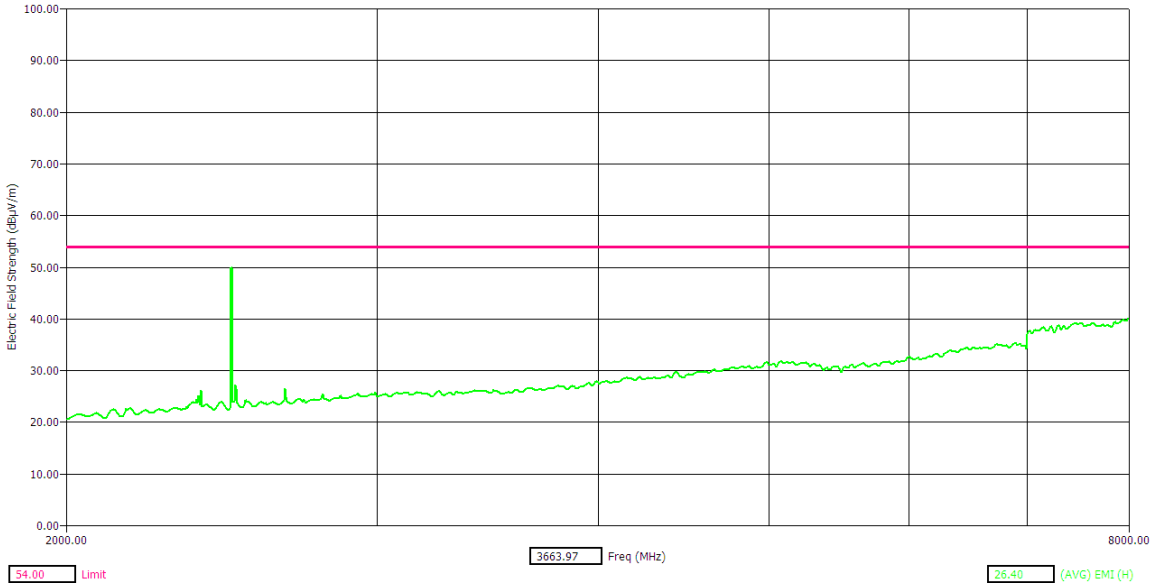


Figure 31: Radiated emission results (Average) – Horizontal polarization – 2 GHz to 8 GHz – Bluetooth, Channel 78

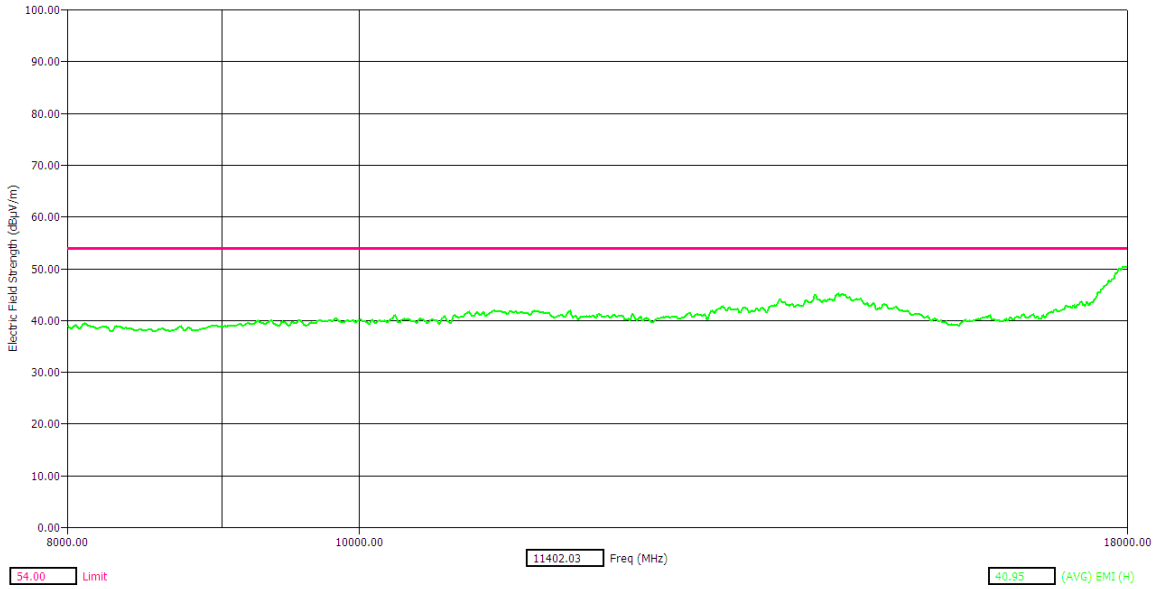


Figure 32: Radiated emission results (Average) – Horizontal polarization – 8 GHz to 18 GHz Bluetooth, Channel 78

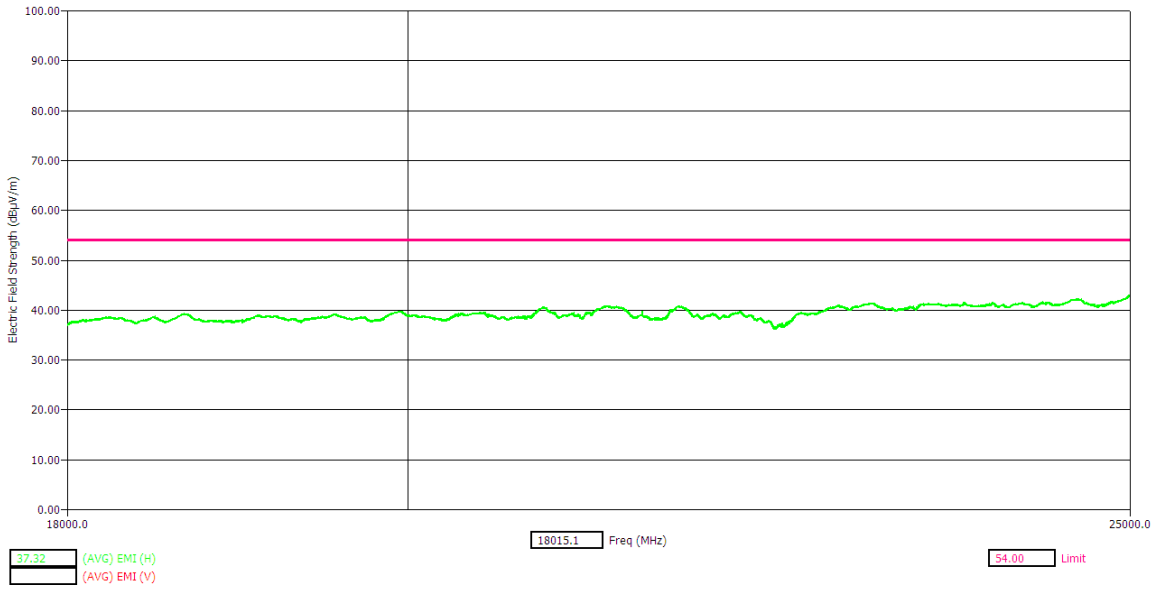


Figure 33: Radiated emission results (Average) – Horizontal polarization – 18GHz to 25GHz Bluetooth, Channel 78

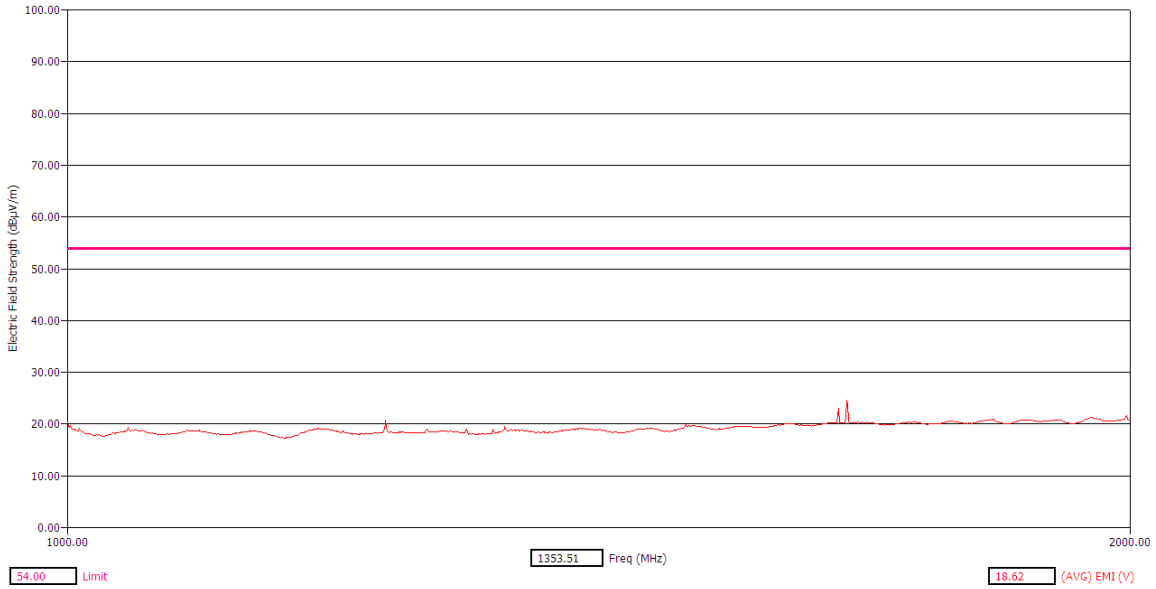


Figure 34: Radiated emission results (Average) – Vertical polarization – 1 GHz to 2 GHz – Bluetooth, Channel 78

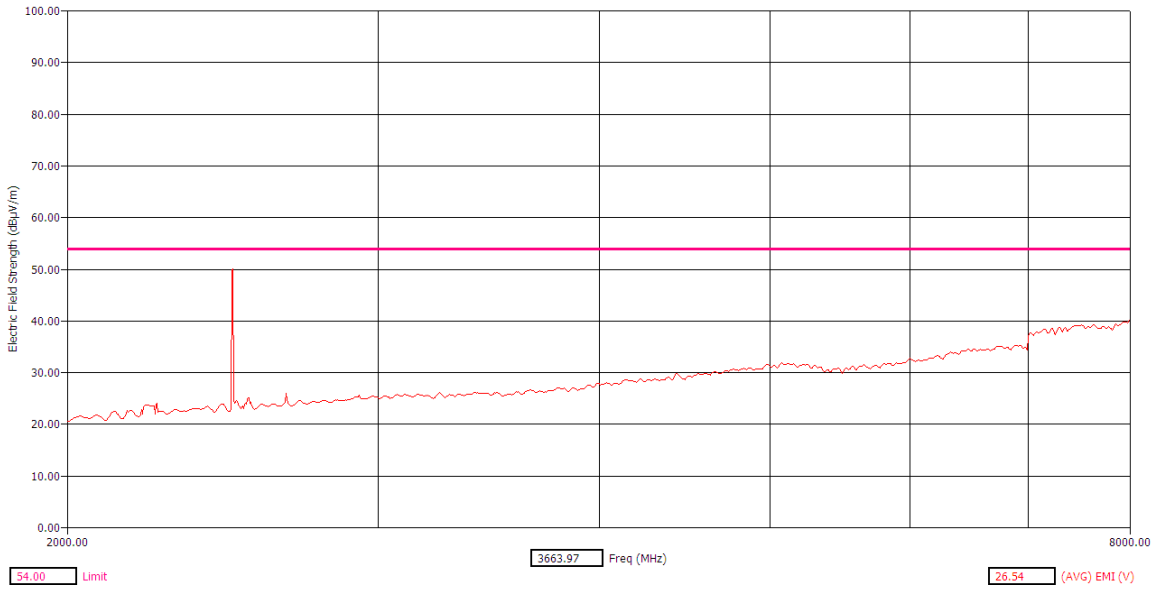


Figure 35: Radiated emission results (Average) – Vertical polarization – 2 GHz to 8 GHz – Bluetooth, Channel 78

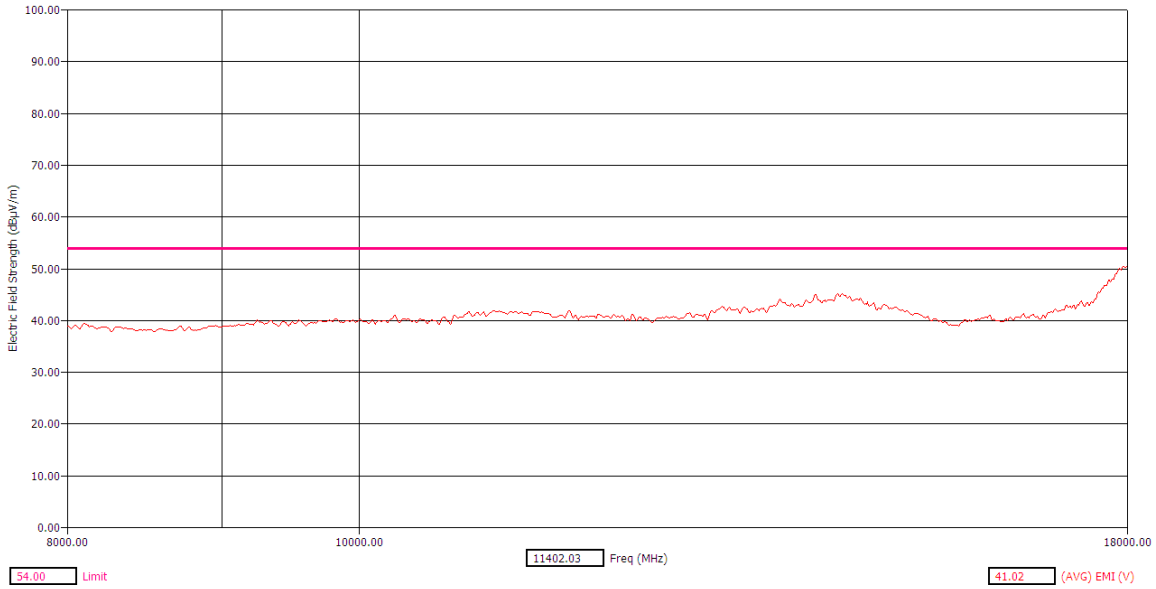


Figure 36: Radiated emission results (Average) – Vertical polarization – 8 GHz to 18 GHz – Bluetooth, Channel 78

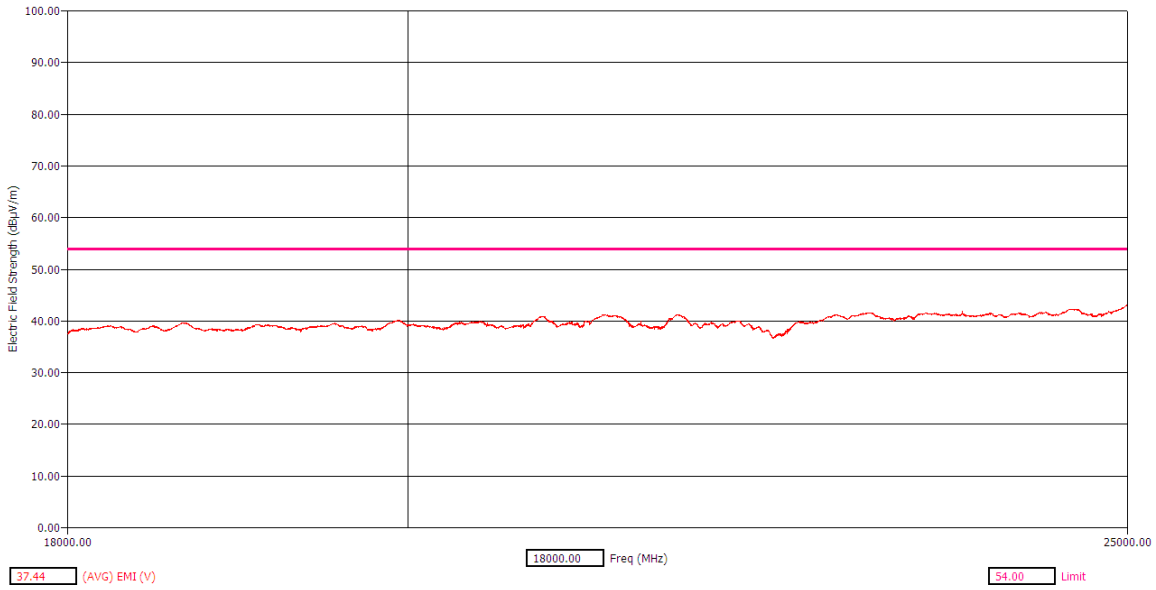


Figure 37: Radiated emission results (Average) – Vertical polarization 18 GHz to 25 GHz – Bluetooth, Channel 78

5.2.3 CARRIER SEPARATION OF HOPPING CHANNELS

5.2.3.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limits
FCC Part 15, Subpart C	15.247 (a) (1)	25 KHz or the 20 dB bandwidth of the hopping channel, whichever is greater
RSS-210	A8.1 (b)	25 KHz or the 20 dB bandwidth of the hopping channel, whichever is greater

5.2.3.2 TEST PROCEDURE

S. No	Procedure
1	Connect the transmitter output to a Spectrum Analyzer
2	Select an identified hop channel (i) and identify the carrier envelop in the Spectrum Analyzer
3	Record the peak frequency and identify the 20db bandwidth of this envelop
4	Select the immediate next hop channel (i+1) of the carrier and identify the carrier envelop in the Spectrum Analyzer
5	Record the peak frequency
6	Calculate the separation between the 2 channels (i and i+1)
7	If the calculated 20dB bandwidth of channel (i) is greater than 25 KHz, then compare the calculated separation between the 2 channels with the 20dB bandwidth and declare the result.
8	If the calculated 20dB bandwidth of channel (i) is less than 25 KHz, then compare the calculated separation between the 2 channels with the 25 KHz and declare the result.

5.2.3.3 RESULT

Hop Carrier (i)	Frequency (GHz)	Carrier (i+1)	Frequency (GHz)	i to i+1 Separation (s)	Measured 20dB B/W of i (b)	Criteria (s > b)	Result
0	2.402	1	2.403	1 MHz	946 KHz	Yes	Pass
9	2.411	10	2.412	1 MHz	951 KHz	Yes	Pass
19	2.421	20	2.422	1 MHz	955 KHz	Yes	Pass
29	2.431	30	2.432	1 MHz	961 KHz	Yes	Pass
39	2.441	40	2.442	1 MHz	981 KHz	Yes	Pass
49	2.451	50	2.452	1 MHz	981 KHz	Yes	Pass
59	2.461	60	2.462	1 MHz	981 KHz	Yes	Pass
69	2.471	70	2.472	1 MHz	971 KHz	Yes	Pass
77	2.479	78	2.480	1 MHz	981 KHz	Yes	Pass

5.2.3.4 RESULT (SUPPORTING GRAPHS / DATA)

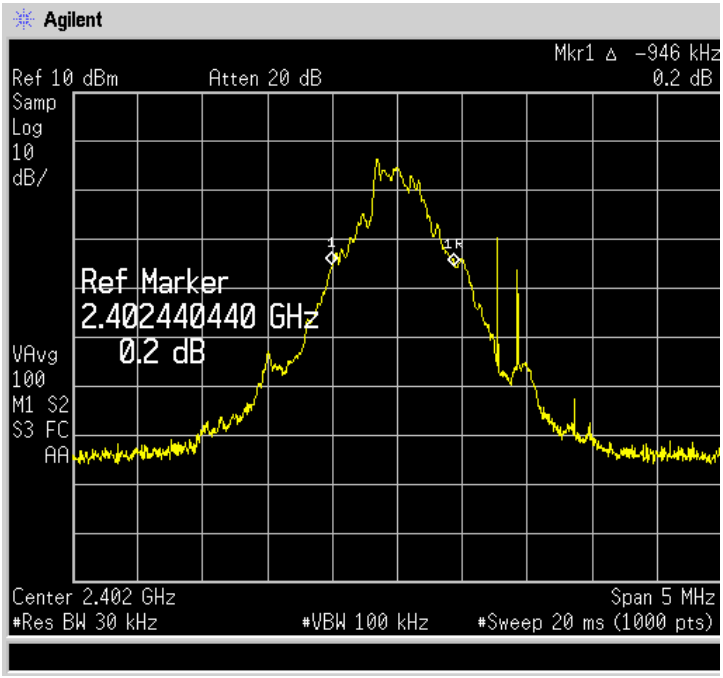


Figure 38: Carrier separation – Hop Channel 0 – Bluetooth

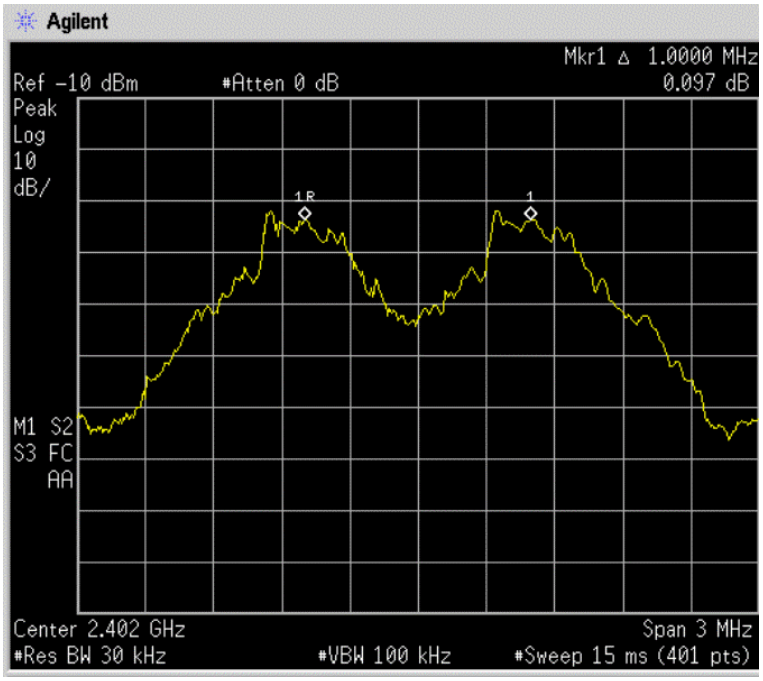


Figure 39: Carrier separation – Hop Channel 0 & 1 – Bluetooth

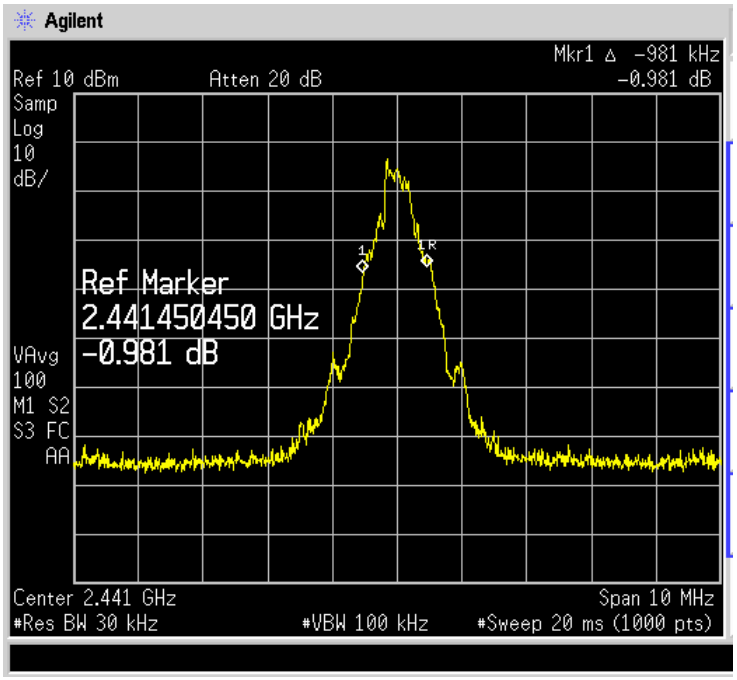


Figure 40: Carrier separation – Hop Channel 39 – Bluetooth

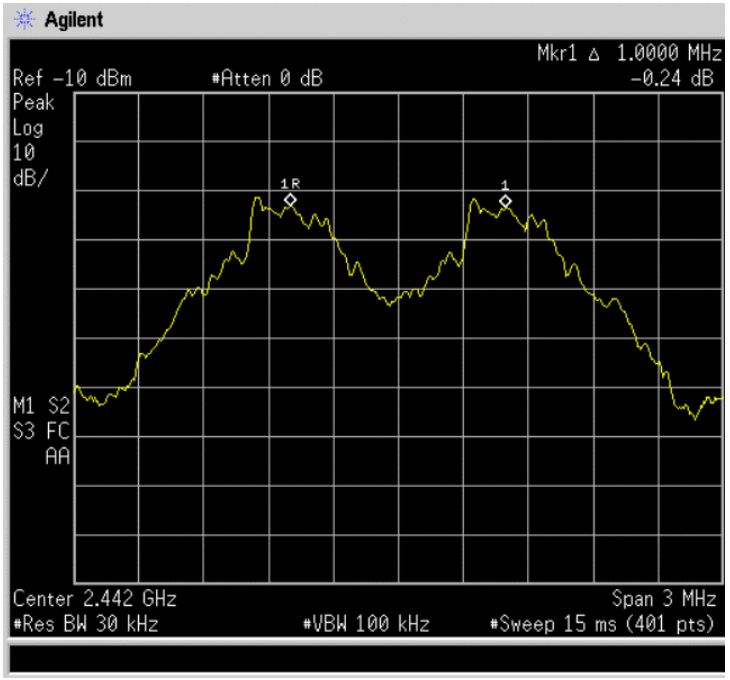


Figure 41: Carrier separation – Hop Channel 39&40 – Bluetooth

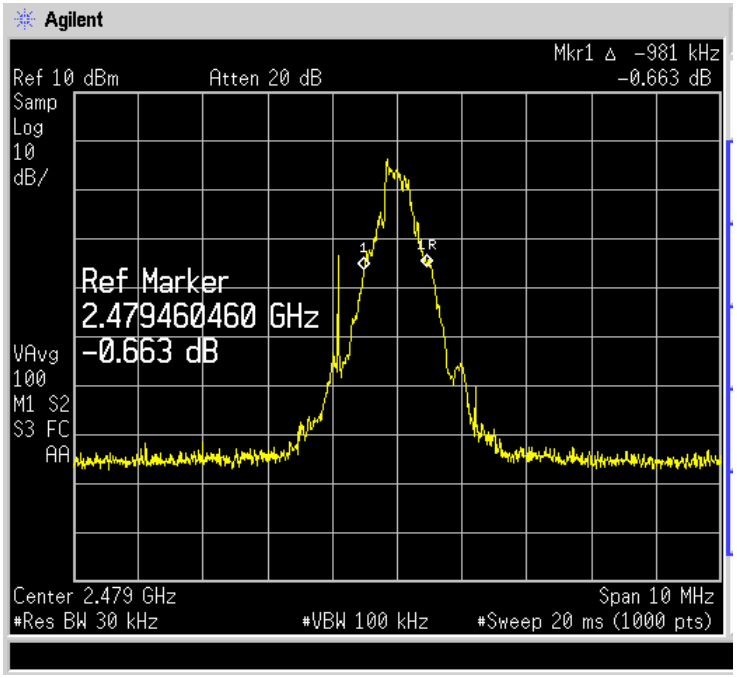


Figure 42: Carrier separation – Hop Channel 77 – Bluetooth

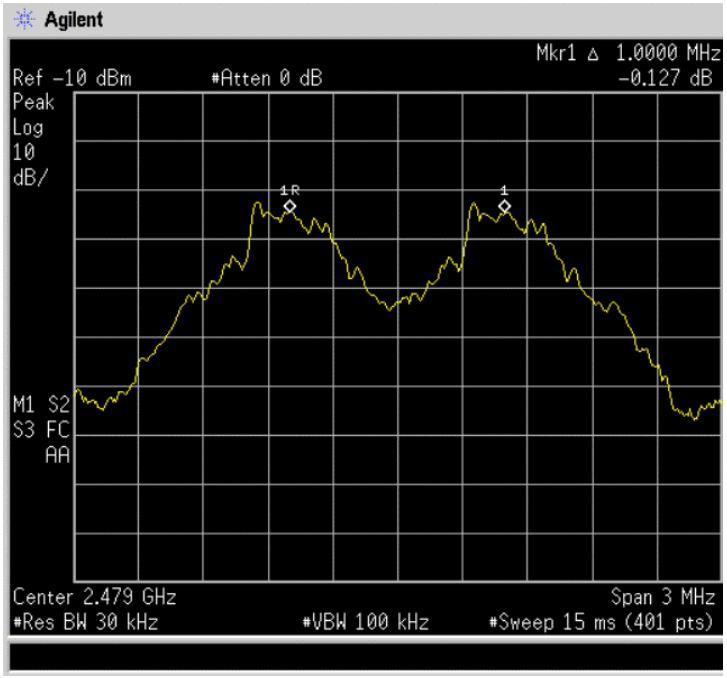


Figure 43: Carrier separation – Hop Channel 77&78 – Bluetooth

5.2.4 DWELL TIME OF HOPPING CHANNELS

5.2.4.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limits
FCC Part 15, Subpart C	15.247 (a) (1) (iii)	Dwell time of each channel < 400ms
RSS-210	A8.1 (d)	Dwell time of each channel < 400ms

5.2.4.2 TEST PROCEDURE

S. No	Procedure
1	Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer
2	Set the center frequency of spectrum analyzer = operating frequency
3	Set the Spectrum analyzer as RBW, VBW=100KHz,Span=0Hz.
4	Measure the length of transmission time and calculate Dwell time by using the equation.

5.2.4.3 RESULT

Channel	Mode	Frequency (GHz)	Length of Transmission time (ms) measured	Limit (ms)	Dwell Time (ms)	Result
Channel 0	DH1	2.402	0.420	t_D < 400	134.4	Pass
Channel 0	DH3	2.402	1.690	t_D < 400	270.4	Pass
Channel 0	DH5	2.402	2.920	t_D < 400	311.4	Pass
Channel 39	DH1	2.441	0.430	t_D < 400	137.6	Pass
Channel 39	DH3	2.441	2.090	t_D < 400	334.4	Pass
Channel 39	DH5	2.441	2.940	t_D < 400	313.6	Pass
Channel 78	DH1	2.480	0.420	t_D < 400	134.4	Pass
Channel 78	DH3	2.480	1.680	t_D < 400	268.8	Pass
Channel 78	DH5	2.480	2.930	t_D < 400	312.5	Pass

t_D is the dwell time of the selected channel
Dwell time = Length of transmission time*hop rate/number of hopping channels*period of time.
Period of time = 0.4(ms)*79=31.6
DH1 Packet permits maximum of 10.12 (1600/79/2) hops per second in each channel
DH3 Packet permits maximum of 5.06 (1600/79/4) hops per second in each channel
DH5 Packet permits maximum of 3.37 (1600/79/6) hops per second in each channel

5.2.4.4 RESULT (SUPPORTING GRAPHS / DATA)

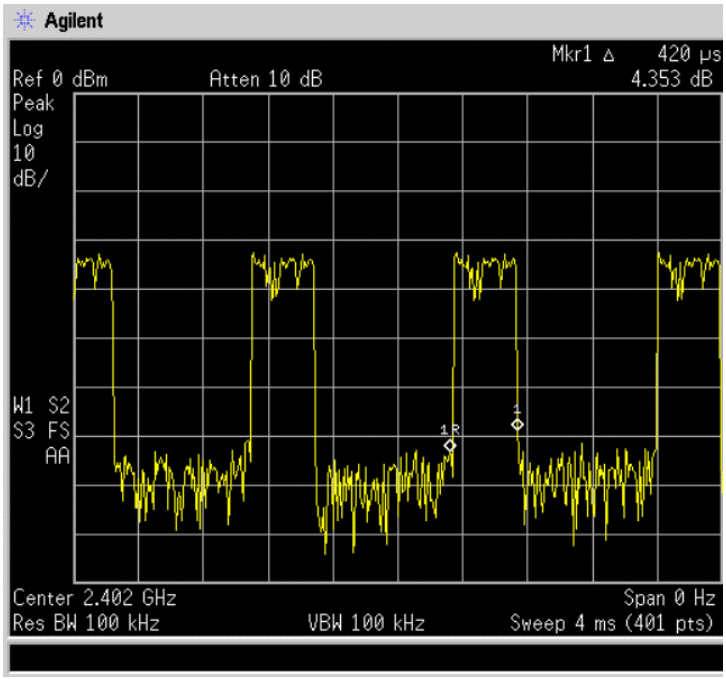


Figure 44: Dwell time – Hop Channel 0 – DH1 mode- Bluetooth

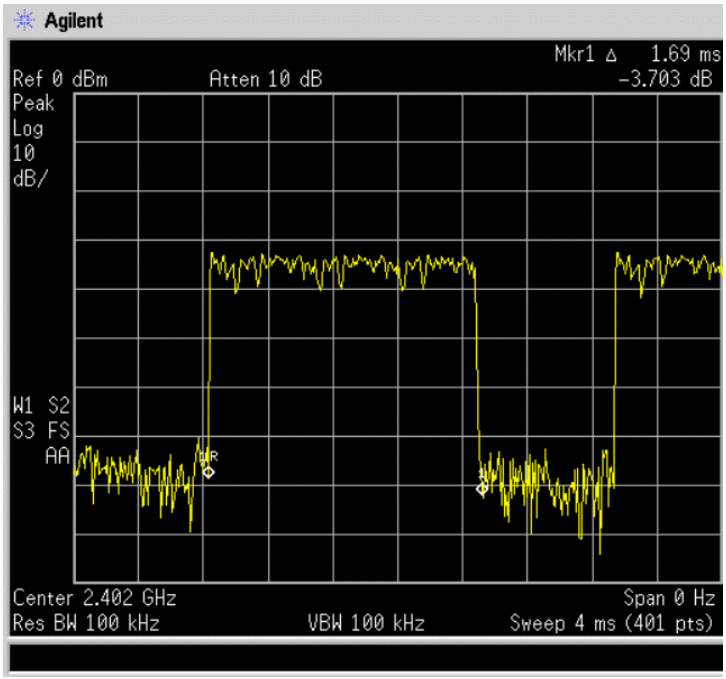


Figure 45: Dwell time – Hop Channel 0 – DH3 mode- Bluetooth

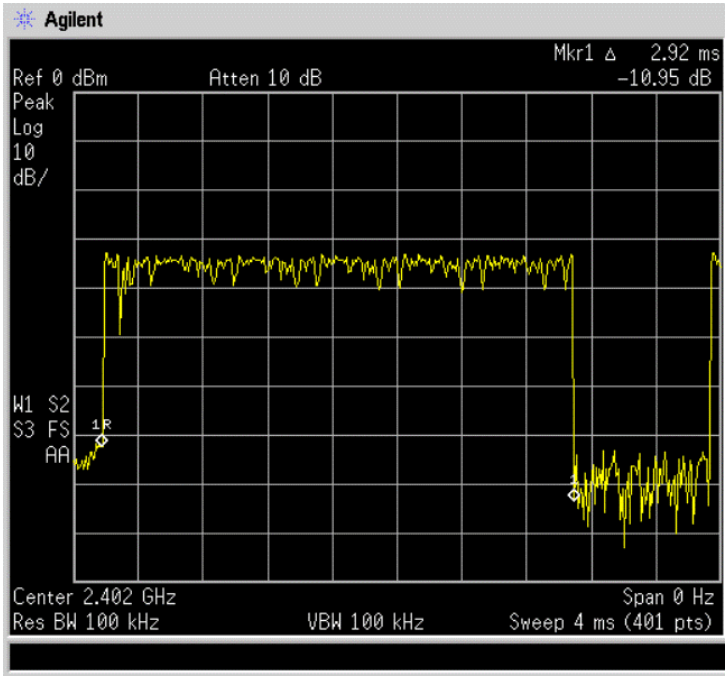


Figure 46: Dwell time – Hop Channel 0 – DH5 mode- Bluetooth

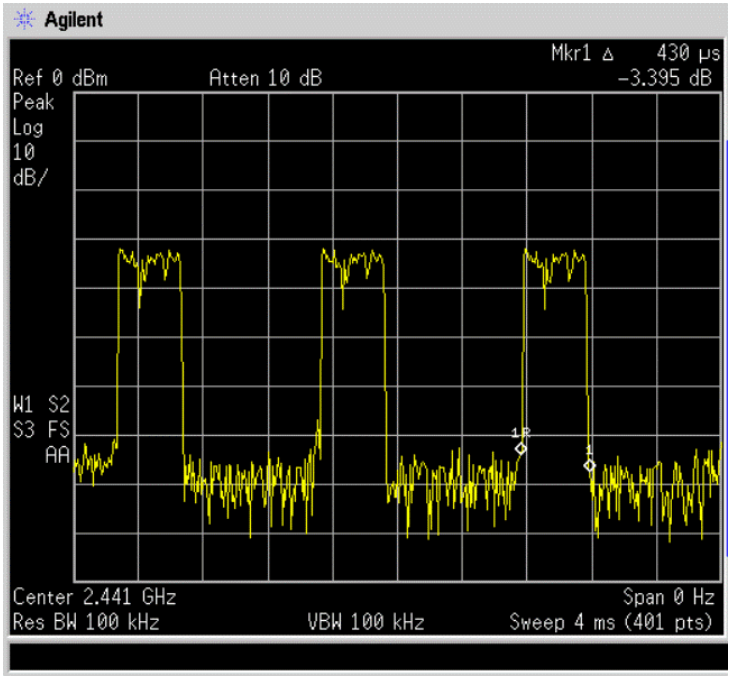


Figure 47: Dwell time – Hop Channel 39 – DH1 mode- Bluetooth

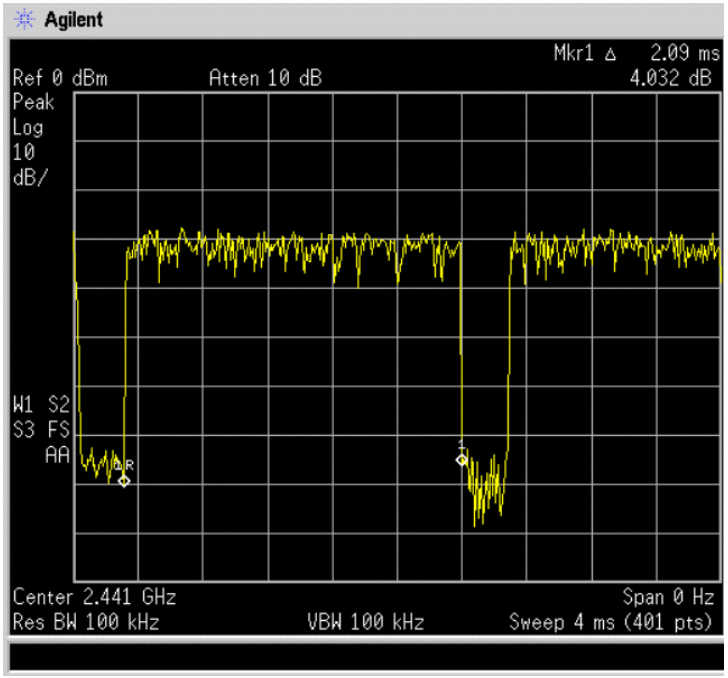


Figure 48: Dwell time – Hop Channel 39 – DH3 mode – Bluetooth

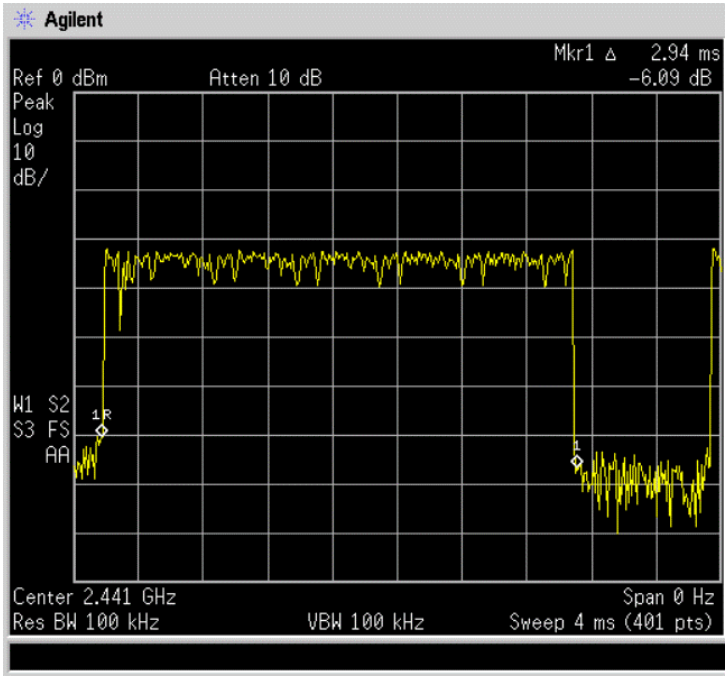


Figure 49: Dwell time – Hop Channel 39 – DH5 mode – Bluetooth

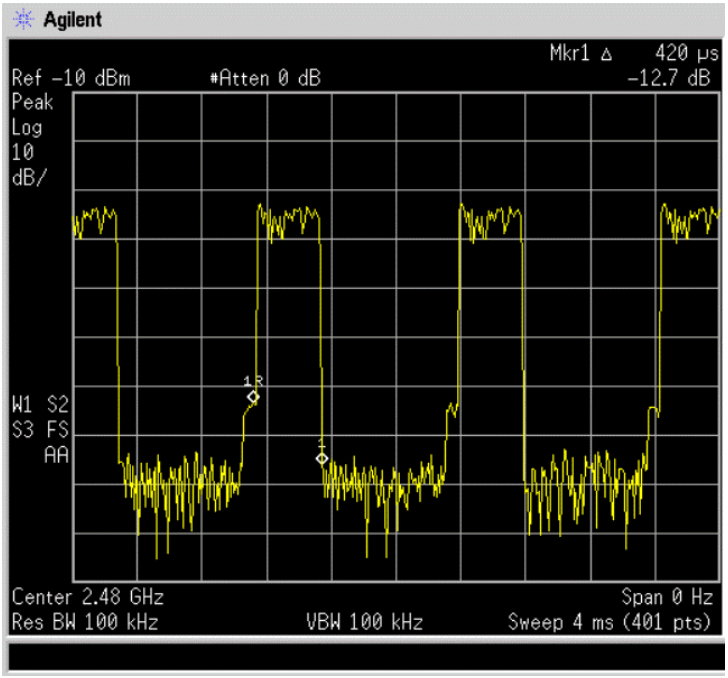


Figure 50: Dwell time – Hop Channel 78 – DH1 mode- Bluetooth

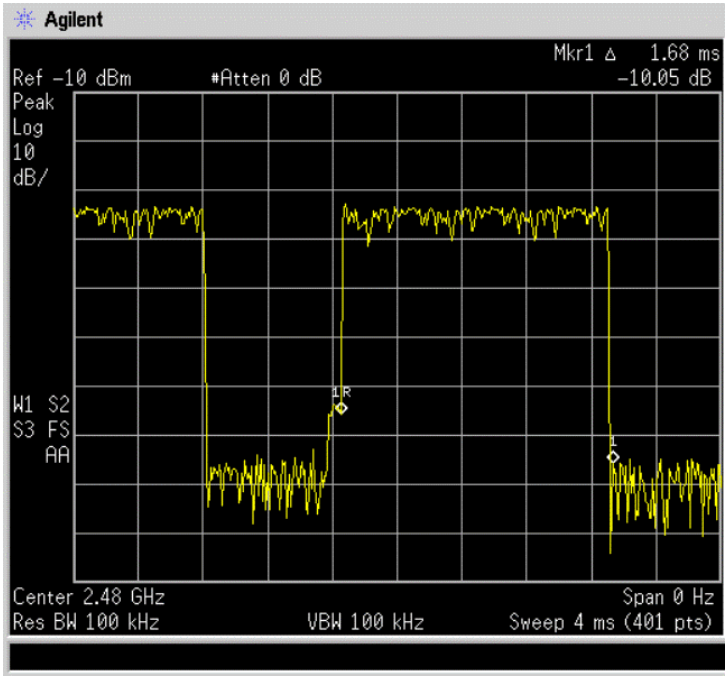


Figure 51: Dwell time – Hop Channel 78 – DH3 mode- Bluetooth

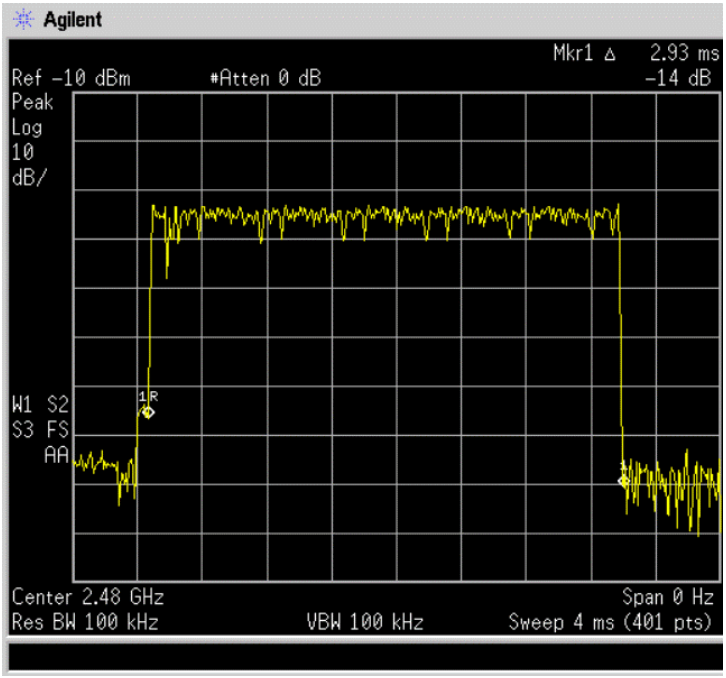


Figure 52: Dwell time – Hop Channel 78 – DH5 mode- Bluetooth

5.2.5 PEAK CONDUCTED OUTPUT POWER

5.2.5.1 REFERENCE SECTION

Standard	Reference section	Limits
FCC Part 15, Subpart C	15.247 (b) (1)	Peak conducted output power of hopping systems using atleast 75 hop channels < 1 W
RSS-210	A8.4 (2)	Peak conducted output power of hopping systems using atleast 75 hop channels < 1 W

5.2.5.2 TEST PROCEDURE

S. No	Procedure
1	This test was carried out for few selected channels of the Bluetooth band
2	Connect the transmitter output to a Spectrum Analyzer. Select an appropriate channel on the EUT.
3	Detect the carrier envelop in the Spectrum Analyzer
4	Measure the peak power of the envelop in the Spectrum Analyzer
5	Add the measured cable loss of the cable that was used for the measurement (1.8dB)
6	This measured value is compared against the limit and the result declared

5.2.5.3 RESULT

Hop Channel	Frequency (GHz)	Measured power (dBm)	Cable loss (dB)	Total power Measured (dBm)	Total power (mW)	Limit (mW)	Result
0	2.402	-2.425	1.8	-0.9115	0.81068	1000	Pass
40	2.442	-2.188	1.8	-0.6745	0.85615	1000	Pass
78	2.480	-1.987	1.8	-0.4735	0.89670	1000	Pass

Note: Transmit duty cycle considered is = 1
No antenna gain is considered as this is conducted measurement without antenna

5.2.5.4 RESULT (SUPPORTING GRAPHS / DATA)

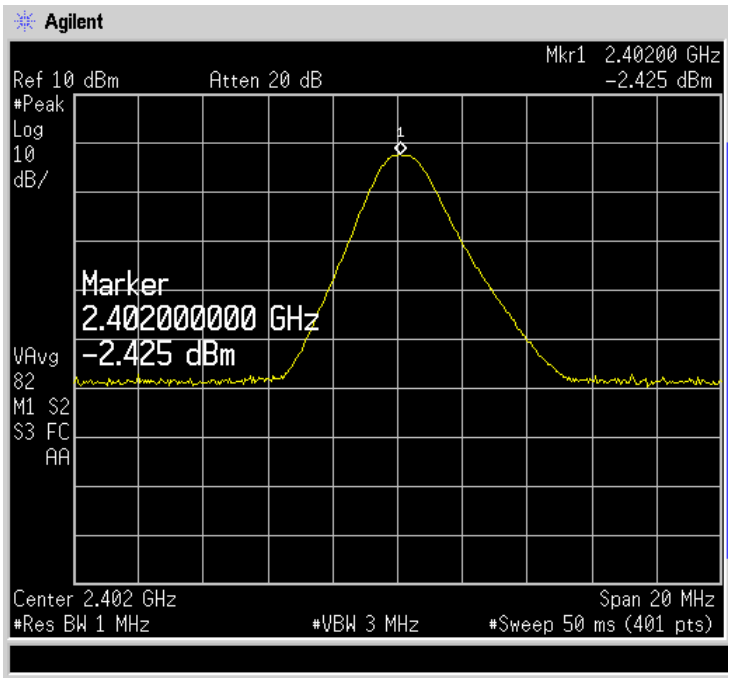


Figure 53: Peak conducted output power – Hop Channel 0 – Bluetooth

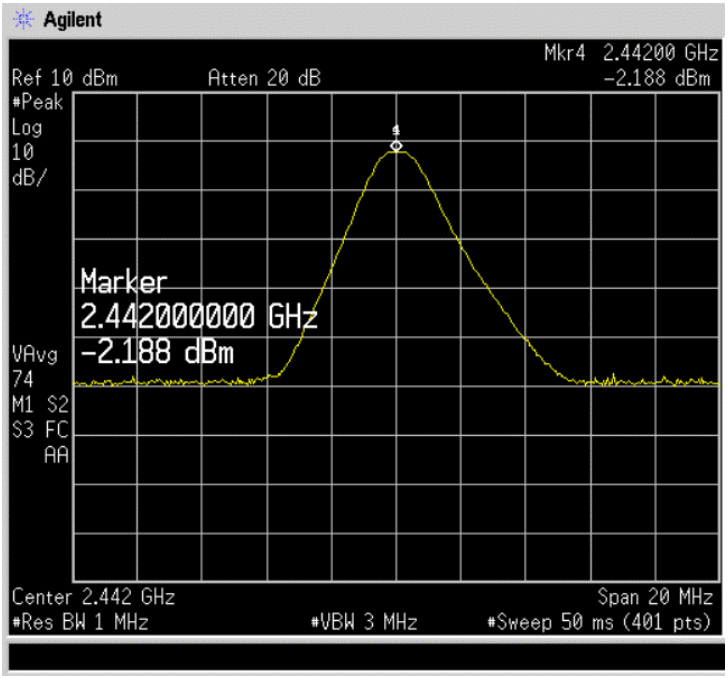


Figure 54: Peak conducted output power – Hop Channel 40 – Bluetooth

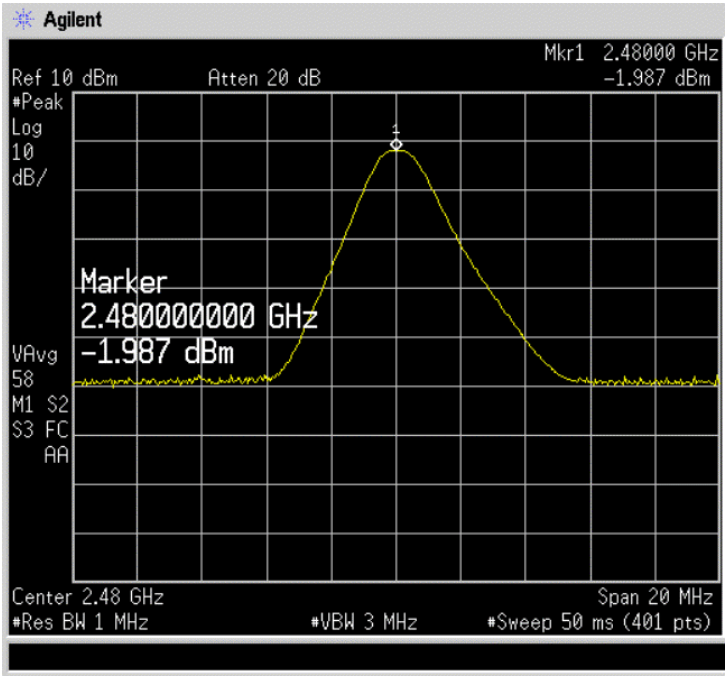


Figure 55: Peak conducted output power – Hop Channel 78 – Bluetooth

5.2.6 CONDUCTED SPURIOUS EMISSION

5.2.6.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limit
FCC Part 15, Subpart C	15.247 (d)	In any 100KHz band outside the intentional band, emissions shall be 20dB below the peak power
RSS-210	A8.5	In any 100KHz band outside the intentional band, emissions shall be 20dB below the peak power

5.2.6.2 TEST PROCEDURE

S. No	Procedure
1	This test was carried out for selected channels of the Bluetooth band
2	Connect the transmitter output to a Spectrum Analyzer. Select an appropriate channel on the EUT.
3	Set the start frequency on the Spectrum Analyzer as 40 MHz
4	Set the start frequency on the Spectrum Analyzer as 26.5 GHz
5	Examine the complete band for any spurious emissions that exceed the value that is 20dB below the peak power in the intentional band
6	Based on the measured spurious emissions outside the intentional band, the result is declared

5.2.6.3 RESULT

Hop Channel	Frequency (GHz)	Measured peak in the intentional band	Limit	Result
0	2.402	-1.939dBm	< 20dB below measured peak (green limit line)	Pass
10	2.412	-2.228dBm	< 20dB below measured peak (green limit line)	Pass
20	2.422	-2.306dBm	< 20dB below measured peak (green limit line)	Pass
30	2.432	-2.318dBm	< 20dB below measured peak (green limit line)	Pass
40	2.442	-2.414dBm	< 20dB below measured peak (green limit line)	Pass
50	2.452	-2.405dBm	< 20dB below measured peak (green limit line)	Pass
60	2.462	-2.609dBm	< 20dB below measured peak (green limit line)	Pass
70	2.472	-2.397dBm	< 20dB below measured peak (green limit line)	Pass
78	2.480	-2.488dBm	< 20dB below measured peak (green limit line)	Pass

5.2.6.4 RESULT (SUPPORTING GRAPHS / DATA)

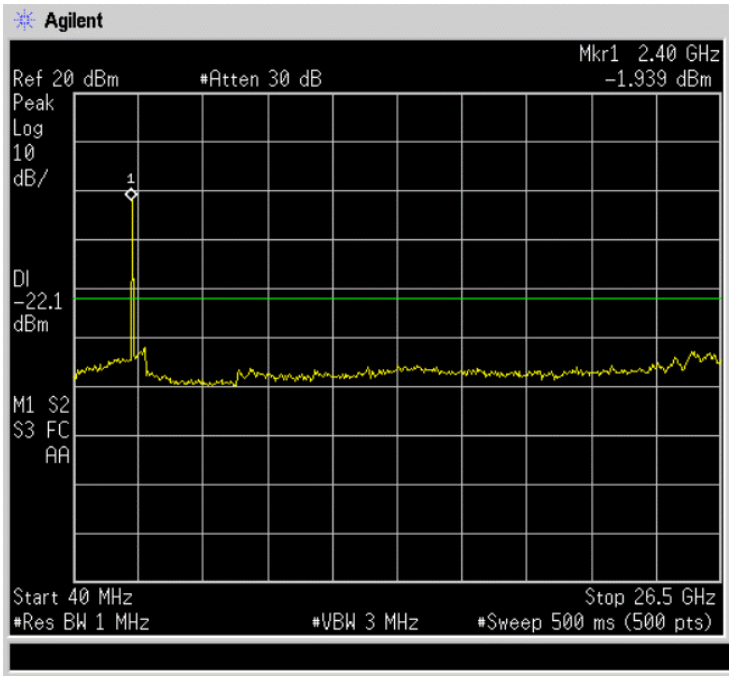


Figure 56: Conducted Spurious Emission – Hop Channel 0 – Bluetooth

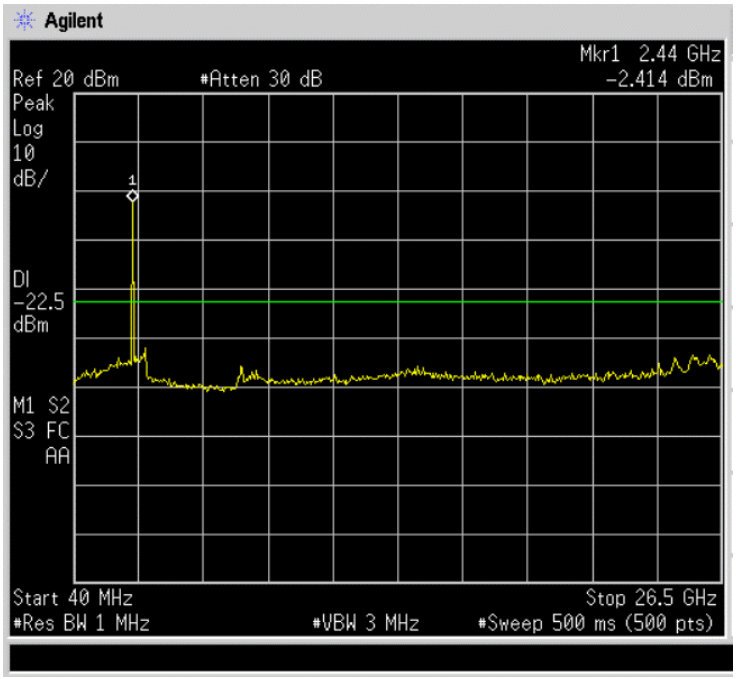


Figure 57: Conducted Spurious Emission – Hop Channel 40 – Bluetooth

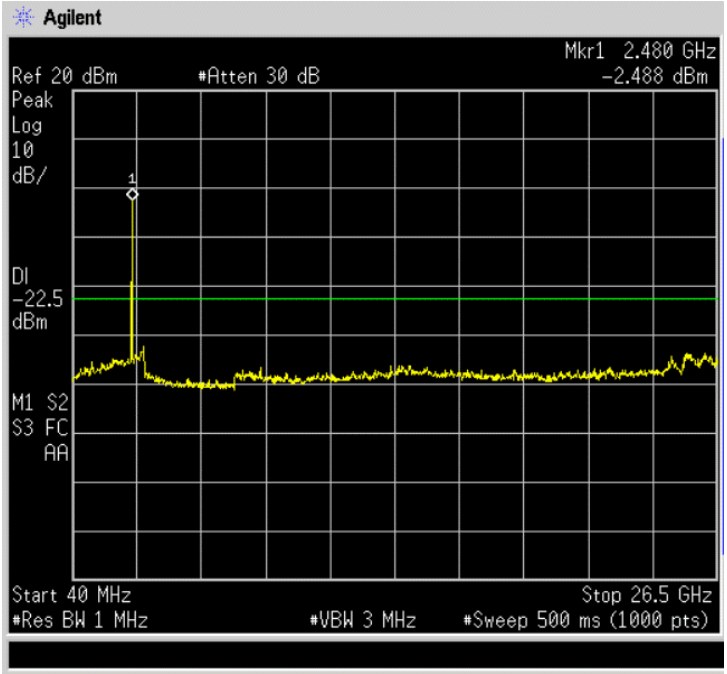


Figure 58: Conducted Spurious Emission – Hop Channel 78 – Bluetooth

5.2.7 BAND EDGE MEASUREMENTS – RADIATED

5.2.7.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Frequency range	Max Average Limit (dBµV/m) at 3 meter	Max Peak Limit (dBµV/m) at 3 meter
FCC Part 15, Subpart C	15.209	30 MHz to 88 MHz	40.0	60.0
		88 MHz to 216 MHz	43.5	63.5
		216 MHz to 960 MHz	46.0	66.0
		960 MHz to 1 GHz	54.0	74.0
		Above 1 GHz	54.0	74.0
RSS-210	2.6	30 MHz to 88 MHz	40.0	60.0
		88 MHz to 216 MHz	43.5	63.5
		216 MHz to 960 MHz	46.0	66.0
		960 MHz to 1 GHz	54.0	74.0
		Above 1 GHz	54.0	74.0

5.2.7.2 TEST PROCEDURE

S. No	Procedure
1	Test procedure is as per ANSI C63.4: 2000
2	EUT is placed on a 0.8m non-conductive table. This table is positioned on an automated turn table.
3	Antennas are positioned 3m away from the EUT
4	EUT is configured to function with the default channel in the selected band
5	A peak scan was carried out at various azimuth angles and antenna heights fixed to 1m.
6	The highest level of Radiated Emission was recorded
7	Peak and Average measurements were carried out above 1GHz
8	These values are compared against the limit specified by the standard

5.2.7.3 RESULT

Frequency (MHz)	Measured Value Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Detector
2399.5	19.92	54	34.08	Pass	Average
2394	19.76	54	34.24	Pass	Average
2386.5	19.13	54	34.87	Pass	Average
2494	20.93	54	33.07	Pass	Average
2488	19.9	54	34.10	Pass	Average
2486	19.74	54	34.26	Pass	Average

Frequency (MHz)	Measured Value Vertical (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Detector
2399.5	19.92	54	34.08	Pass	Average
2394	19.84	54	34.16	Pass	Average
2386.5	19.16	54	34.84	Pass	Average
2494	20.3	54	33.70	Pass	Average
2488	19.9	54	34.10	Pass	Average
2486	19.74	54	34.26	Pass	Average

Frequency (MHz)	Measured Value Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Detector
2394	33.51	74	40.49	Pass	Peak
2398.5	32.97	74	41.03	Pass	Peak
2380.5	31.99	74	42.01	Pass	Peak
2489.5	35.02	74	38.98	Pass	Peak
2493.5	34.34	74	39.66	Pass	Peak
2499.5	32.46	74	41.54	Pass	Peak

Frequency (MHz)	Measured Value Vertical (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Detector
2394	33.15	74	40.85	Pass	Peak
2398.5	32.97	74	41.03	Pass	Peak
2380.5	31.71	74	42.29	Pass	Peak
2489.5	33.37	74	40.63	Pass	Peak
2493.5	33.87	74	40.13	Pass	Peak
2499.5	32.94	74	41.06	Pass	Peak

5.2.8 BAND EDGE MEASUREMENTS – CONDUCTED

5.2.8.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limit
FCC Part 15, Subpart C	15.247 (d)	Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

5.2.8.2 TEST PROCEDURE

S. No	Procedure
1	Connect the transmitter output to a Spectrum Analyzer. Select an appropriate channel on the EUT.
2	In the Spectrum Analyzer set Resolution Bandwidth to 100 KHz and Video Bandwidth to 100KHz
3	Select Span of 115 MHz and Sweep time of 1s in the Spectrum Analyzer
4	Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5	Based on the recorded value, the result is declared

5.2.8.3 RESULT (SUPPORTING GRAPHS / DATA)

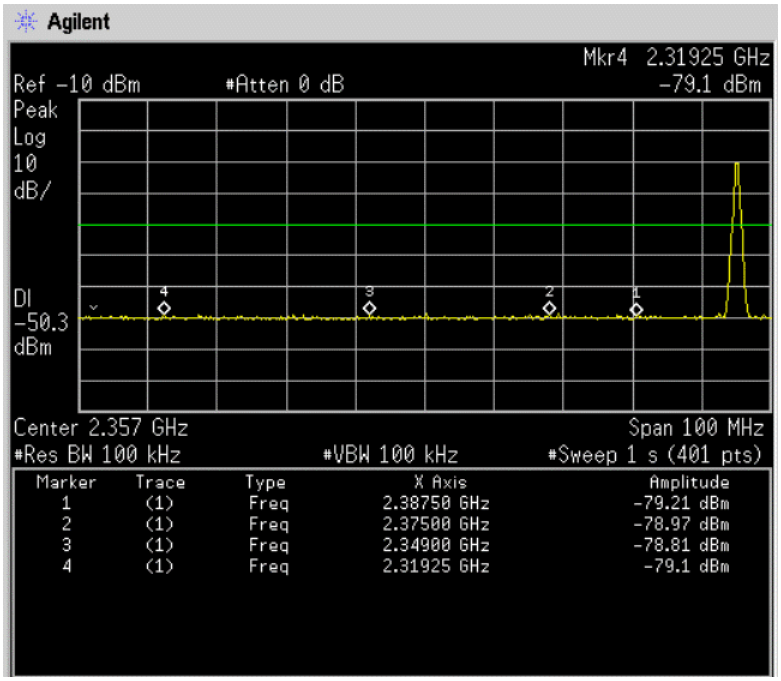


Figure 59: Low Band Edge – Hop Channel 0 – Bluetooth

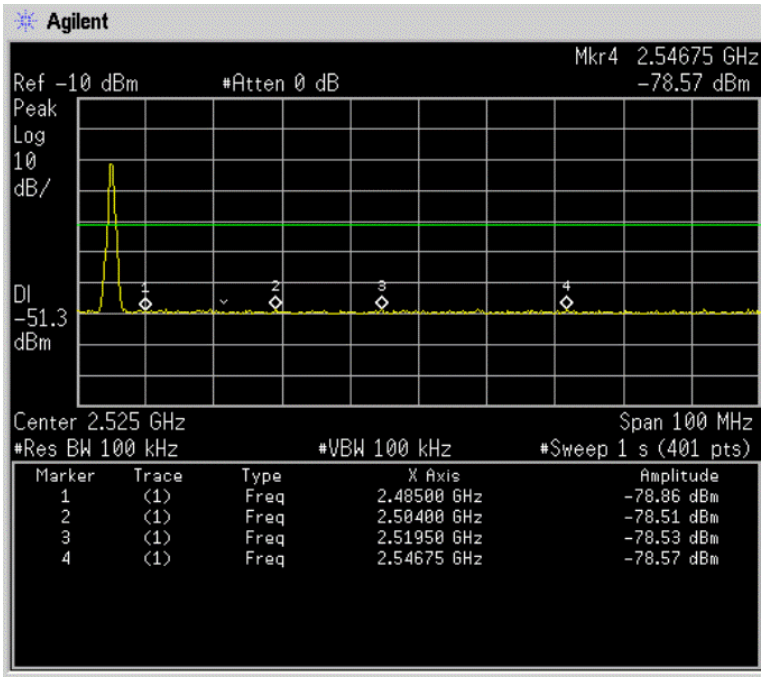


Figure 60: High Band Edge – Hop Channel 78 – Bluetooth

6 APPENDIX 1 – ACRONYMS

WLAN	Wireless Local Area Network
CFR	Code of Federal Regulations
EUT	Equipment Under Test
NABL	National Accreditation Board for Testing and Calibration Laboratories, India
dBm	Decibel milliWatt
mW	milliWatt
WiFi	Wireless Fidelity
dBi	Decibel Isotropic
dbµV	Decibel microVolts
USB	Universal Serial Bus
FCC	Federal Communications Commission
IC	Industry Canada
KHz	Kilo Hertz
MHz	Mega Hertz
GHz	Giga Hertz

7 APPENDIX 2 – PHOTOGRAPH OF TEST SETUPS

Figure 61: Test setup for Radiated Emission (Vertical polarization) – 30MHz to 1GHz

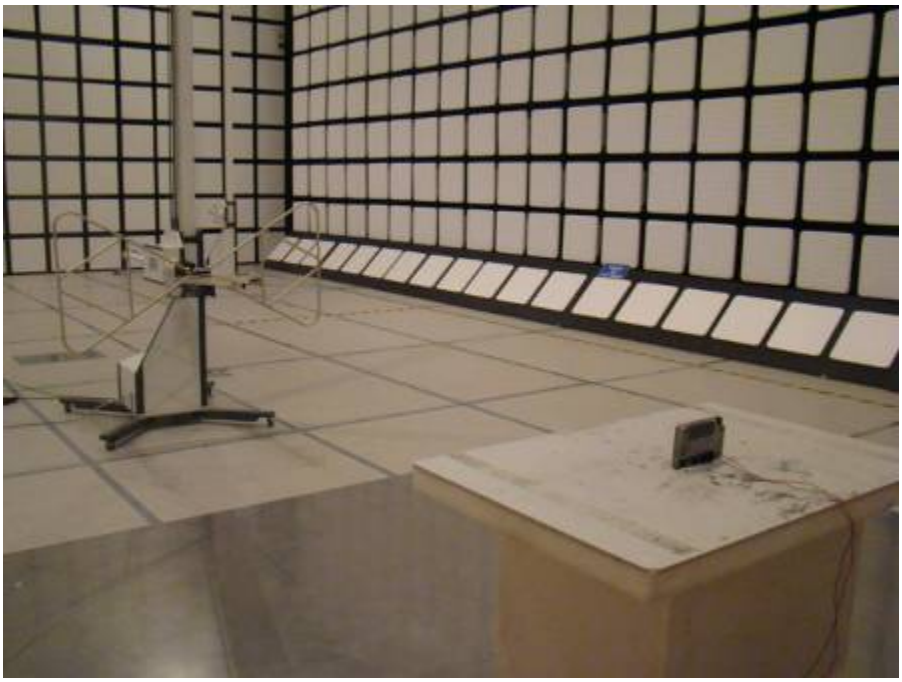


Figure 62: Test setup for Radiated Emission (Horizontal polarization) – 30MHz to 1GHz

Figure 63: Test setup for Radiated Emission (Horizontal polarization) – Above 1GHz

Figure 64: Test setup for Radiated Emission (Vertical polarization) – Above 1GHz

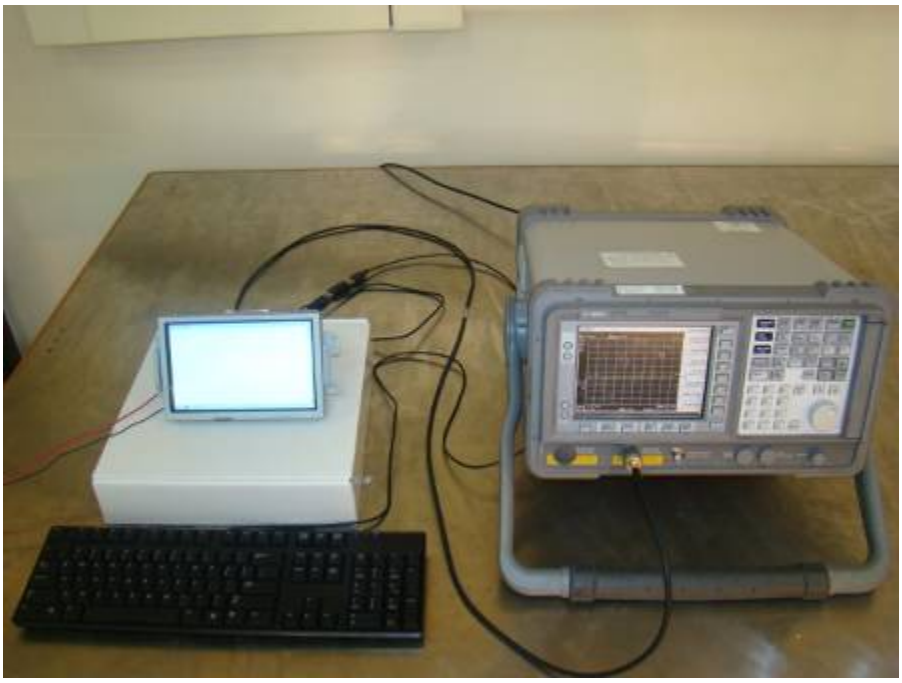


Figure 65: Test setup for Conducted measurements