



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

PRODUCT NAME	Brady Print Server
PRODUCT MODEL NUMBER	BNCBTWIFI
FCC ID	NUC-BNCBTWIFI
IC ID	3287A-BNCBTWIFI
MANUFACTURER	Brady World Wide Inc
TEST REPORT NUMBER	XUC 1042IND246-H
TEST REPORT DATE	19 th May 2011
TEST REPORT VERSION	1.0
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REVISION HISTORY

S. No	Version	Date	Change History	Remarks
1	0.01	17 th Dec 2010	Initial version for internal review	
2	0.02	20 th Dec 2010	Updated after internal review	
3	0.03	05 th Jan 2011	Updated band edge and dwell time measurements for Bluetooth	
4	0.04	06 th Jan 2011	Updated after internal review	
5	0.05	28 th Feb 2011	Updated to show that the potential future upgrade of devices on the Full Featured module are also compatible as per the referred standards	
6	0.06	9 th Mar 2011	Updated after internal review	
7	0.07	11 th Apr 2011	Updated with only Bluetooth results Updated with Occupied Bandwidth measurements	
8	0.08	12 th Apr 2011	Updated after internal review	
9	0.09	21 st Apr 2011	Updated after internal review	
10	0.10	27 th Apr 2011	Updated after internal review, moved setup photos as a separate exhibit, antenna gain details added	
11	0.11	3 rd May 2011	Updated the "Issued To" field in Page 1	
12	0.12	10 th May 2011	Updated the "Issued To" field in Page 1 to include Brady Corporation Asia Pacific Pte Ltd	
13	1.0	19 th May 2011	Approved report by Tarang lab	

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1 TEST DESCRIPTION & RESULT

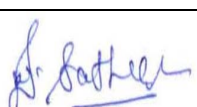
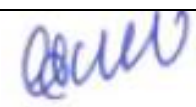
Applicant	Brady World Wide Inc 6555 W Good Hope Road, Milwaukee, WI 53223 Phone: 1-414-228-5940; e-mail: jeff_mueller@bradycorp.com
Manufacturer	Brady World Wide Inc
Equipment Under Test	Brady Print Server
Model	BNCBTWIFI
Serial Number	008
No. of samples tested	1
Date of Test	04 th Dec 2010 to 10 th Apr 2011
Date of Submission	19 th May 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

Brady Print Server was tested by Tarang Lab 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. The test results produced by in this report shall apply only to the sample that has been tested under the specific conditions and modes of testing as described in the report. Any measurement uncertainties listed in this report are for information only and have not been taken into account in the results.

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. This report shall not be modified or in any way revised unless it is expressly permitted and endorsed by Tarang through a duly authorized representative. Particulars on Manufacturer / Supplier / EUT configuration / performance criteria, 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.

Customer acknowledges that this is a precertification test report and shall not be construed valid for product sale nor shall customer attempt to claim product certification or approval or endorsement of any kind by any agency of the Federal Government or any Government. Customer shall have to take appropriate clearance to make the product available to the target market.

Prepared by	Reviewed by	Approved by
Daniel E, Aagiru Vamshi Krishna	Sathesh Kumar L, Satheesh I	Nagaraj CS
		
Test Engineers	Lead Test Engineer, Technical Manager Technical Manager	Technical Manager

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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
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)

2.5 ENVIRONMENTAL CONDITION

All measurements are carried out in controlled environment in the lab as follows:

Temperature (deg C)	22 ± 3
Relative Humidity (% RH)	50 ± 5

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3 EQUIPMENT UNDER TEST (EUT)

3.1 DESCRIPTION OF THE EUT

The product is designed to give additional connectivity interface for Brady printers via Ethernet, Blue tooth or WLAN (full featured). The product gets connected to the printer via USB interface.

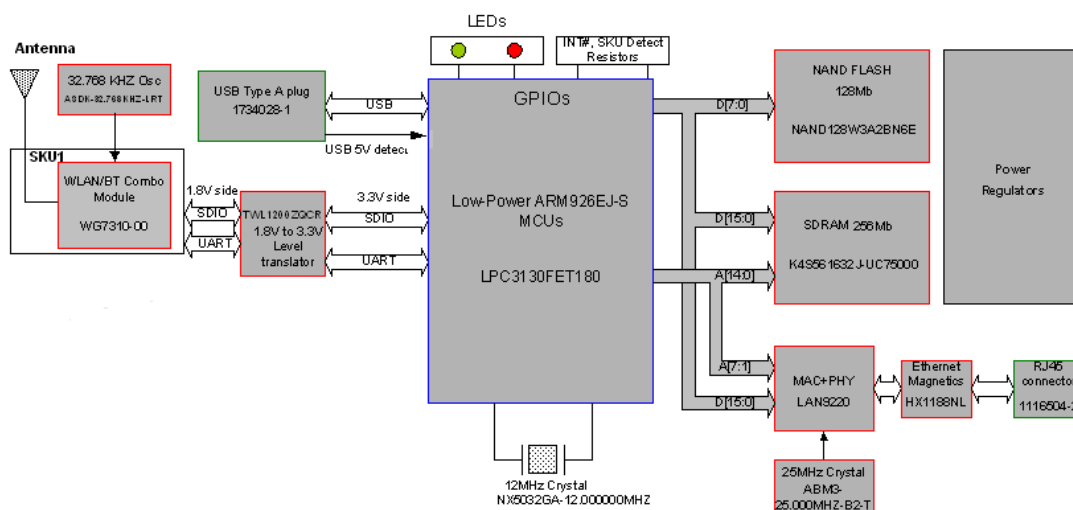
The product has 4 variants in total as follows:

Variant	Description	Regulatory Model Number	Details
SKU1	Brady Network Card - Bluetooth, WIFI, LAN Version	BNCBTWIFI	Full featured version of the product with wired LAN, Bluetooth and Wireless LAN
SKU2	Brady Network Card - Bluetooth and WIFI Version	BNCBTWIFI	Reduced version of SKU1, with Bluetooth and Wireless LAN only (wired LAN removed)
SKU3	Brady Network Card - Bluetooth Version	BNCBT	Contains only Bluetooth interface (Wired LAN and Wireless LAN removed)
SKU4	Brady Network Card - LAN Version	BNCLAN	Reduced version of SKU1, with wired LAN only (Bluetooth and Wireless LAN removed)

3.2 SOFTWARE AND FIRMWARE DETAILS

BPS Firmware Alpha 3.0 was used for the testing.

3.3 PRODUCT CONFIGURATION DETAILS



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Based on the Processor and Memories used onboard, 2 variants as follows were tested and the results furnished below apply to both variants.

Variant	Processor	SDRAM	NAND Flash
Variant 1	NXP LPC3130FET180	Samsung K4S561632J-UC75	ST NAND128W3A2BN6
Variant 2	NXP LPC3141FET180	Hynix H57V2562GTR-75C	ST NAND512W3A2DN6

The above figure shows the block diagram of BPS unit. The BPS unit connected to a laptop which has all the application software via a shielded USB cable not exceeding 3m in length. In the normal setup the laptop's power supply will be connected to mains. We will be using a grounded cable for the laptop power supply. The power supply will be external to the laptop. An Ethernet cable was connected to a PC outside the semi-anechoic chamber for communication during the test. BPS was communicating to a WLAN router or Laptop over wired LAN interface. BPS was communicating through BT port with a laptop. At a time only one of the communication channels (Wired LAN, WLAN and BT) shall be operational.

3.4 TRANSMIT POWER DETAILS

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

Frequency Range	Mode	Output power (dBm)	Output power (W)
2.402 to 2.480 GHz	Bluetooth	9.5	8.91 mW

3.5 DETAILS OF ANTENNA

The details of antenna used on the product is as listed below.

Manufacturer	Model Number	Average Gain (dBi)	Frequency Range (MHz)
Advanced Ceramic X (ACX)	AT8010-E2R9HAA	0.5	2400 to 2500

3.6 TEST SETUP DETAILS

3.6.1 SUPPORTING EQUIPMENT

Item	Manufacturer	Model Number	Serial Number	FCC ID
Laptop PC	DELL	LATITUDE D620	GMXVN1S	NA

3.6.2 I/O CABLES AND CONNECTORS

Item	Connector	Cable type	Cable length
USB cable	Type A Male to Type A Female	Shielded	3m
Ethernet cable	RJ45 to RJ45	Un-shielded	5m

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3.6.3 TEST SETUP DETAILS

3.6.3.1 RADIATED EMISSION TEST SETUP DETAILS

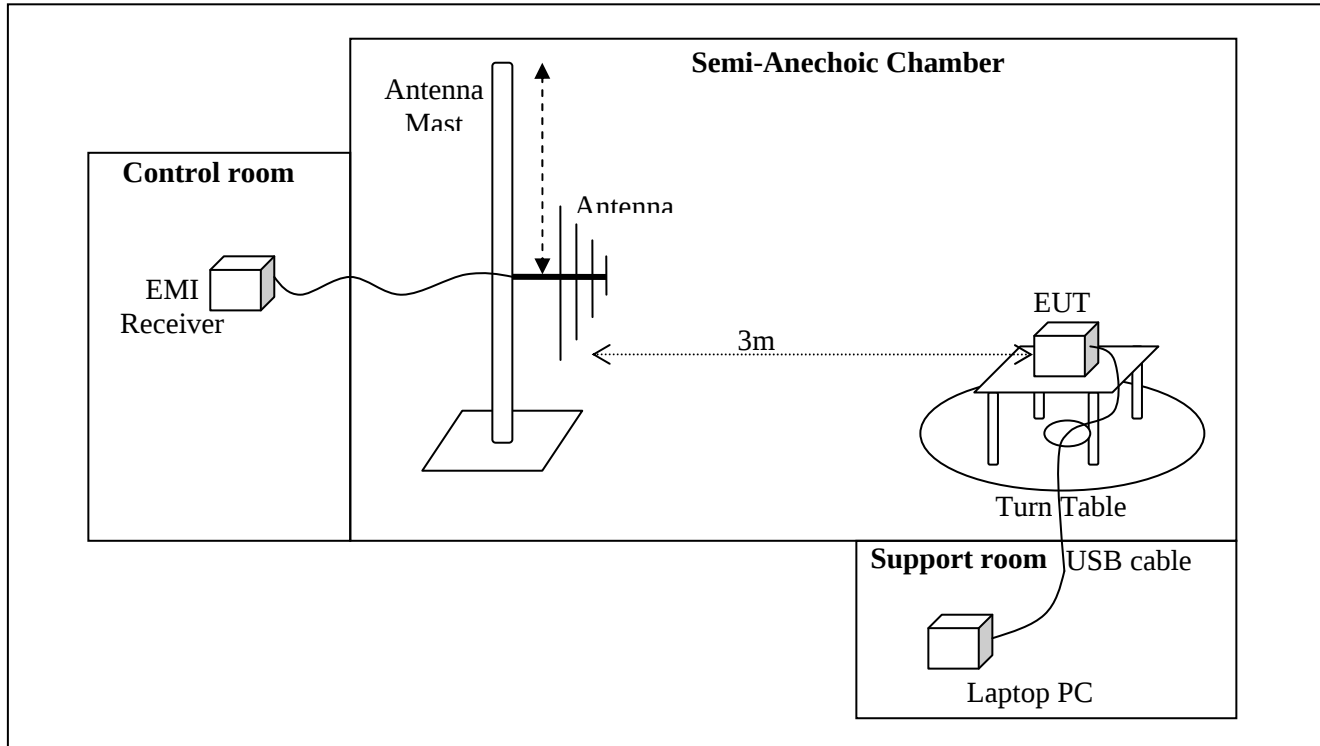


Figure 1: Test setup for Radiated Emission test

3.6.3.2 ANTENNA CONDUCTED MEASUREMENT TEST SETUP DETAILS

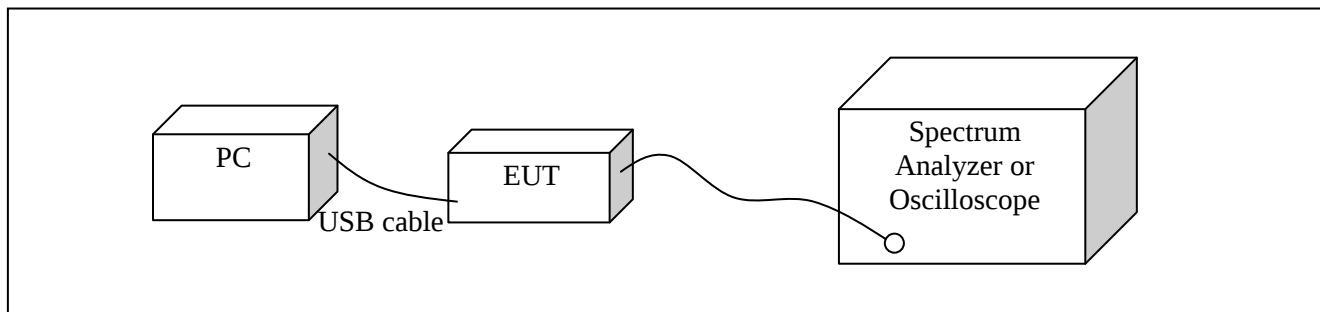


Figure 2: Test setup for Conducted measurements on the wireless ports

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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	22 nd Feb 2012
Oscilloscope	Tektronix	DPO71604	B010382	31 st Aug 2011
EMI receiver	Rohde & Schwarz	ESIB40	100306	30 th Jul 2011
Hybrid Log Periodic Antenna	TDK RF Solutions	HLP-3003C	130334	20 th Mar 2011
Broadband Horn Antenna	Schwarzbeck Mess Elektronik	BBHA 9170	9170-344	20 th Mar 2011
Double Ridge Broad Band Horn Antenna	Schwarzbeck Mess Elektronik	BBHA 9120 D	9120D-687	20 th Mar 2011
RF Cable	Colemann	M17-84/RG223	NA	NA

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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 < 6 dBi)	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
10	FCC Part 15	Band Edge measurement (Radiated and conducted)	15.247 (d)	Yes	WiFi
11	RSS-GEN	Occupied Bandwidth measurement	4.6.1	Yes	WiFi

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Report Number	XUC1042IND246-H

FCC ID	NUC-BNCBTWIFI
IC ID	3287A-BNCBTWIFI

6 TEST RESULTS FOR BLUETOOTH MODE

6.1 RESTRICTED BAND OF OPERATION

6.1.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limits
FCC Part 15, Subpart C	15.205	In the operating range of this product, the limits are: $f_L > 2.39 \text{ GHz}$, $f_H < 2.4835 \text{ GHz}$
RSS-210 (Refers to)	2.2	In the operating range of this product, the limits are: $f_L > 2.39 \text{ GHz}$, $f_H < 2.655 \text{ GHz}$
RSS-GEN	7.2.2	

f_L = Lower operating frequency range

f_H = Higher operating frequency range

6.1.2 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_H

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.

6.1.3 RESULT

Parameter	Limit	Measured	Result
f_L	$> 2.39 \text{ GHz}$ (FCC and RSS-210)	2.401275GHz	Pass
f_H	$< 2.4835 \text{ GHz}$ (FCC)	2.480675GHz	Pass
f_H	$< 2.655 \text{ GHz}$ (RSS-210)	2.480675GHz	Pass

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6.1.4 RESULT (SUPPORTING GRAPHS / DATA)

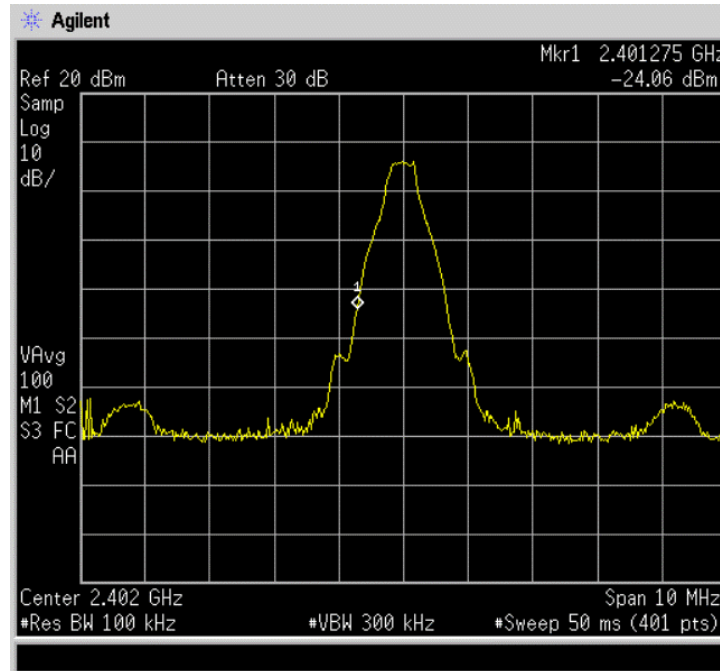


Figure 3: Measured f_L at Channel 0 – Bluetooth

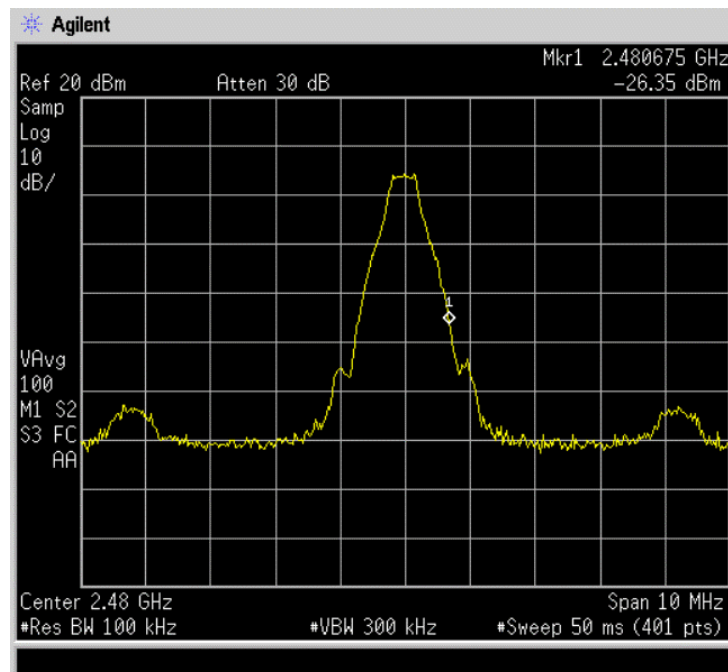


Figure 4: Measured f_H at Channel 78 – Bluetooth

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6.2 RADIATED EMISSION

6.2.1 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	40.0
		88 MHz to 216 MHz	43.5
		216 MHz to 960 MHz	46.0
		960 MHz to 1 GHz	54.0
		Above 1 GHz	54.0
RSS-210 (Refers to) RSS-GEN	2.6 7.2.5	30 MHz to 88 MHz	40.0
		88 MHz to 216 MHz	43.5
		216 MHz to 960 MHz	46.0
		960 MHz to 1 GHz	54.0
		Above 1 GHz	54.0

6.2.2 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

6.2.3 RESULT

Parameter	Limit	Measured	Result
Radiated Emission	Refer 6.2.1	Refer 6.2.4	Pass

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6.2.4 RESULT (SUPPORTING GRAPHS / DATA)

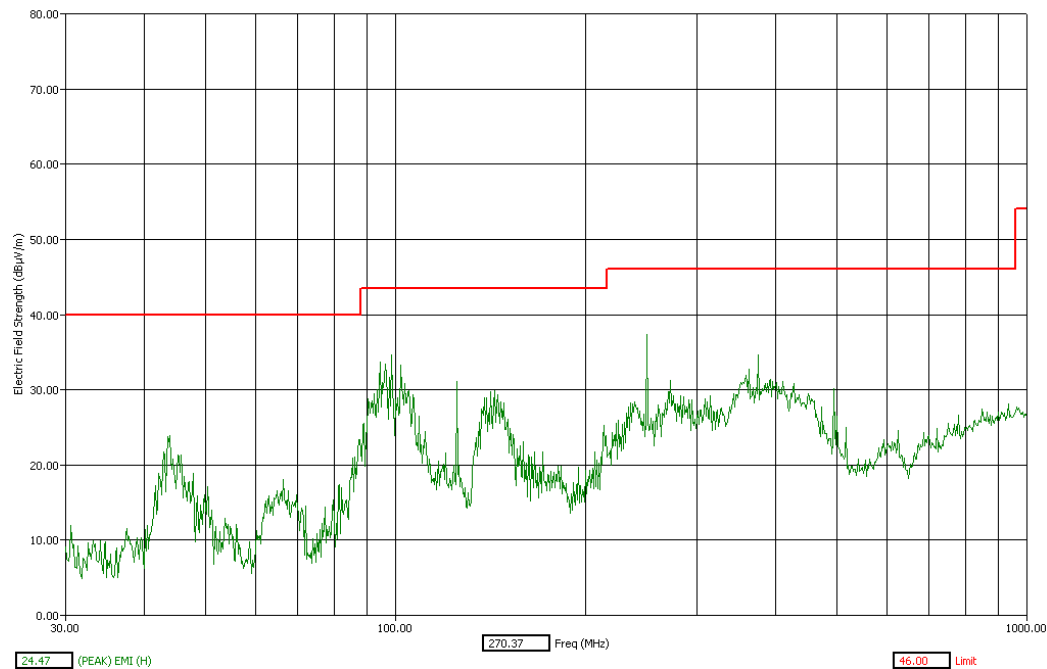


Figure 5: Radiated Emission (Peak) – Horizontal polarization – 30 MHz to 1 GHz – Bluetooth, Channel 0

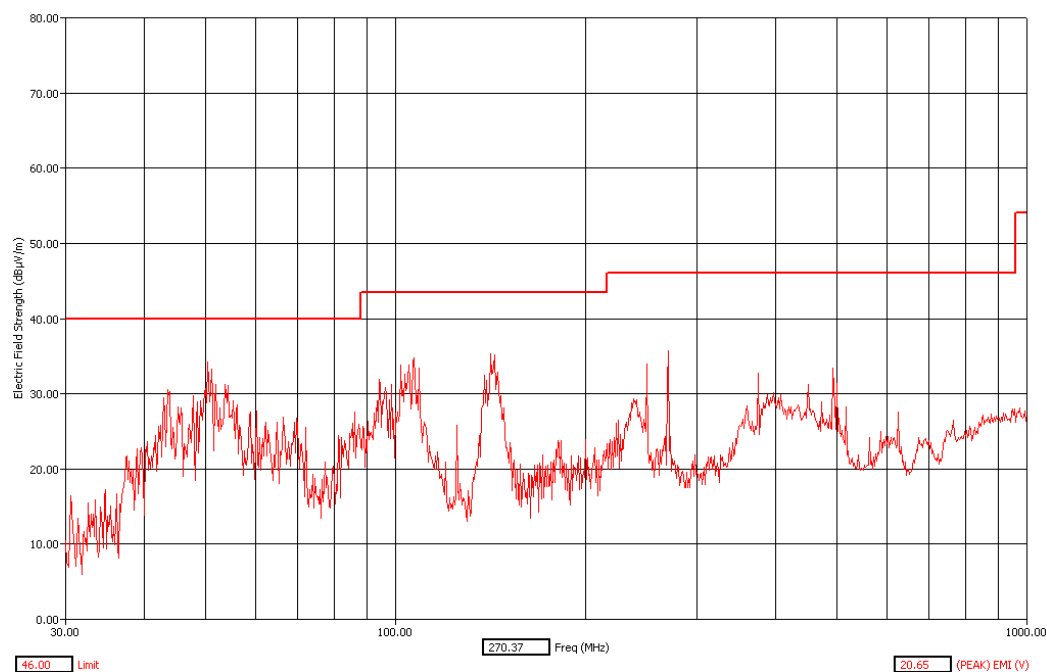


Figure 6: Radiated Emission (Peak) – Vertical polarization – 30 MHz to 1 GHz – Bluetooth, Channel 0

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Freq (MHz)	Pol	(QP) EMI (dBμV/m)	Limit (dBμV/m)	(QP) Margin (dB)	EUT Ttbt Agt (deg)	Twr Ht (cm)	(QP) Trace (dBμV)	Cable (dB)	Transducer (dB)	Preamp (dB)
50.45	V	32.79	40.00	-7.21	153.20	100.00	52.88	2.16	10.13	32.38
98.45	H	33.89	43.50	-9.61	266.60	174.00	54.87	3.03	8.31	32.31
125.00	H	32.95	43.50	-10.55	90.10	291.00	51.13	3.41	10.80	32.39
125.00	V	25.94	43.50	-17.56	149.90	174.00	42.11	3.41	12.80	32.39
143.30	V	35.10	43.50	-8.40	180.00	103.00	50.82	3.66	12.87	32.25
250.00	H	38.24	46.00	-7.76	102.70	137.00	54.36	4.90	11.20	32.23
250.05	H	38.27	46.00	-7.73	102.10	135.00	54.40	4.90	11.20	32.23
270.00	V	29.01	46.00	-16.99	298.30	100.00	43.08	5.09	13.25	32.41

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

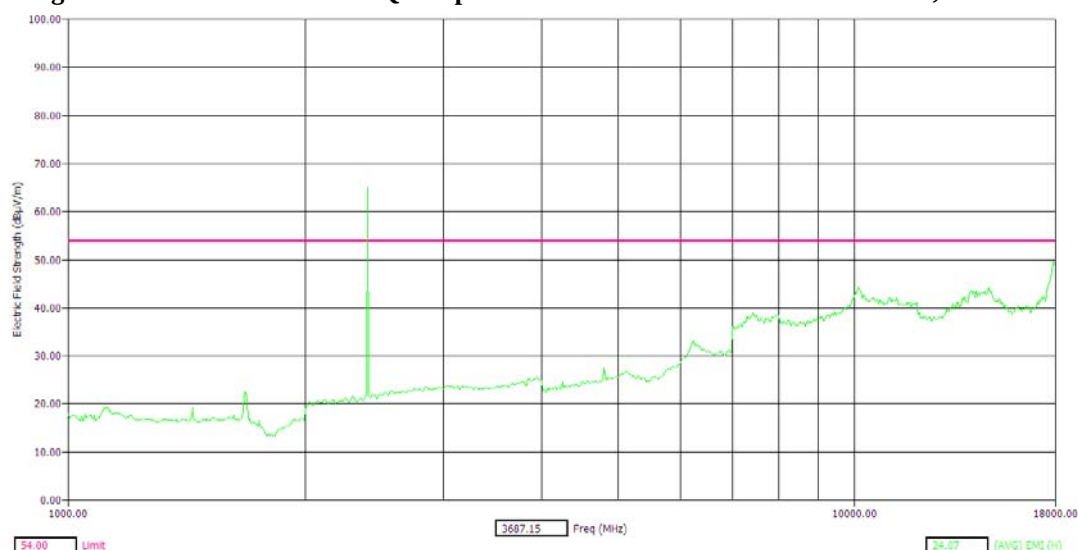


Figure 8: Radiated Emission (Average) – Horizontal polarization 1 GHz to 18 GHz – Bluetooth, Channel 0

Note: The emission seen above the limit line is from the Bluetooth carrier, which is intentional

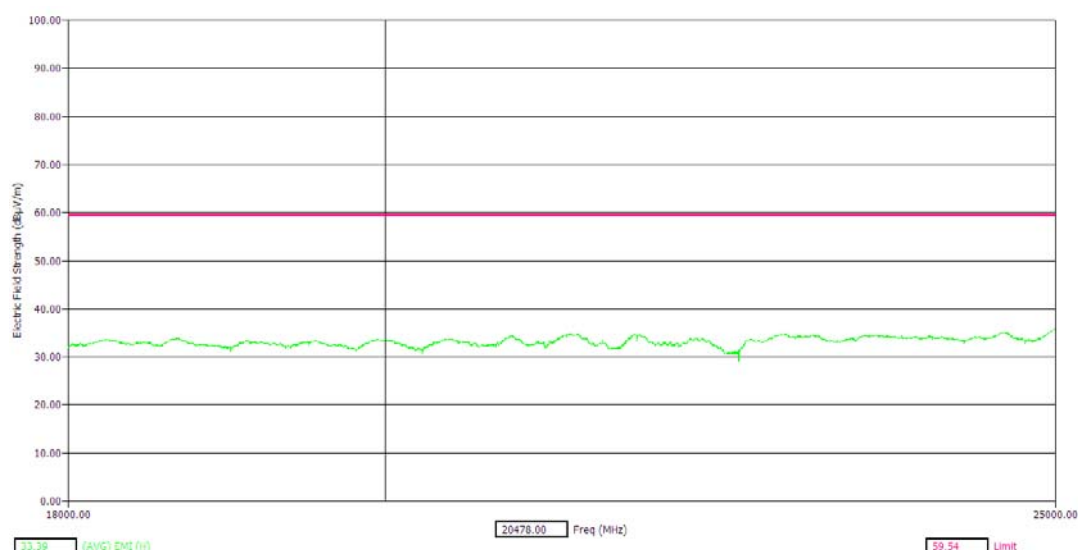


Figure 9: Radiated Emission (Average) – Horizontal polarization 18GHz to 25GHz – Bluetooth, Channel 0

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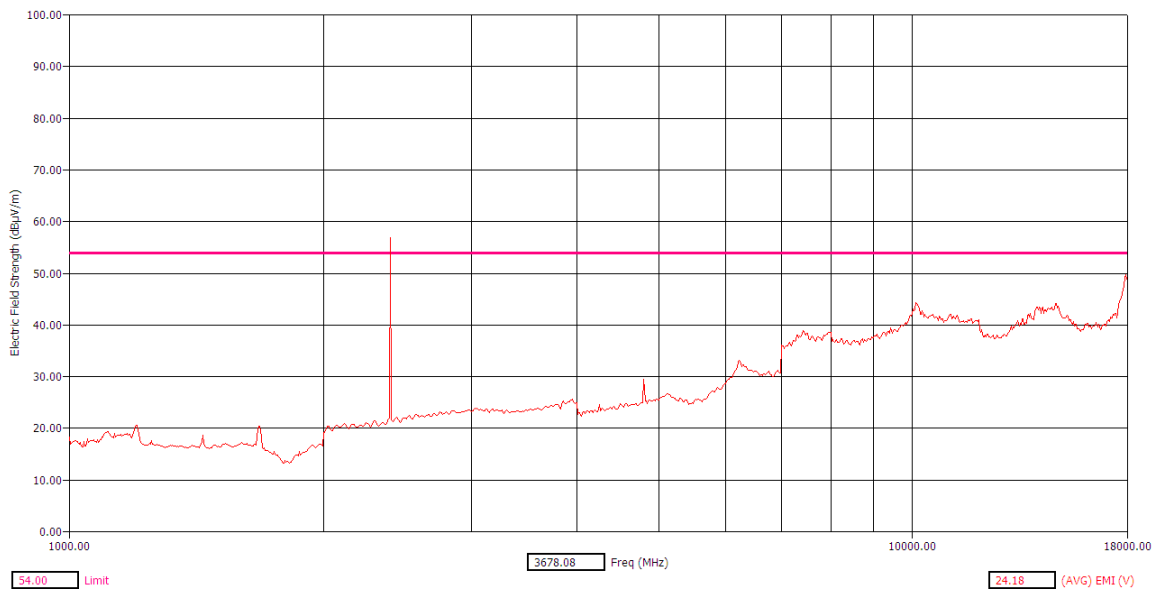


Figure 10: Radiated Emission (Average) – Vertical polarization – 1 GHz to 18 GHz – Bluetooth, Channel 0

Note: The emission seen above the limit line is from the Bluetooth carrier, which is intentional

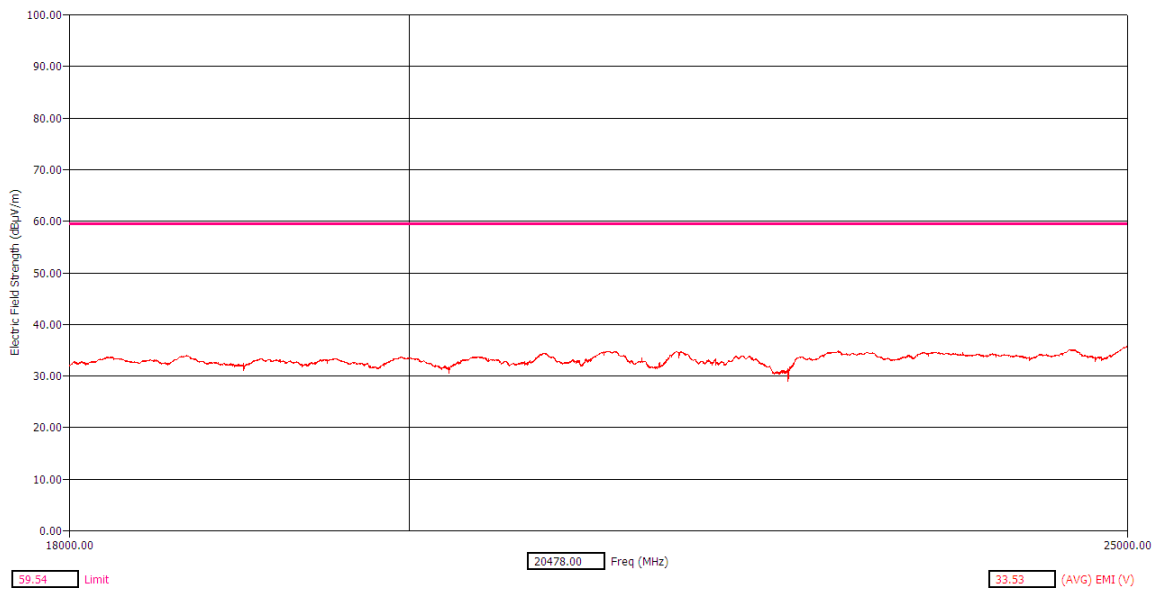


Figure 11: Radiated Emission (Average) – Vertical polarization – 18GHz to 25GHz – Bluetooth, Channel 0

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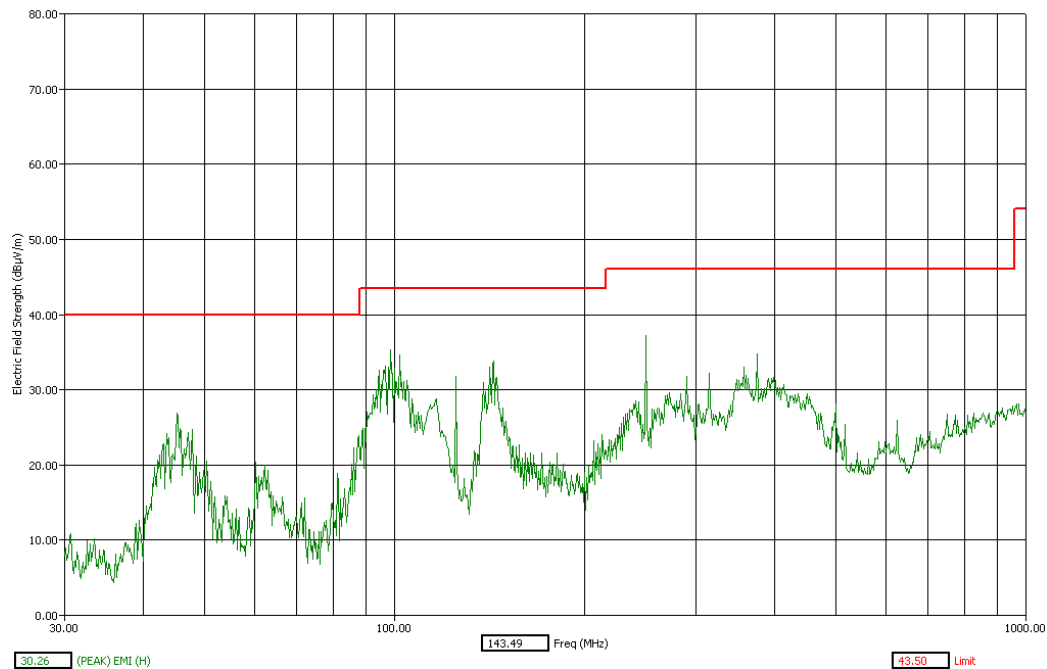


Figure 12: Radiated Emission (Peak) – Horizontal polarization – 30 MHz to 1 GHz – Bluetooth, Channel 40

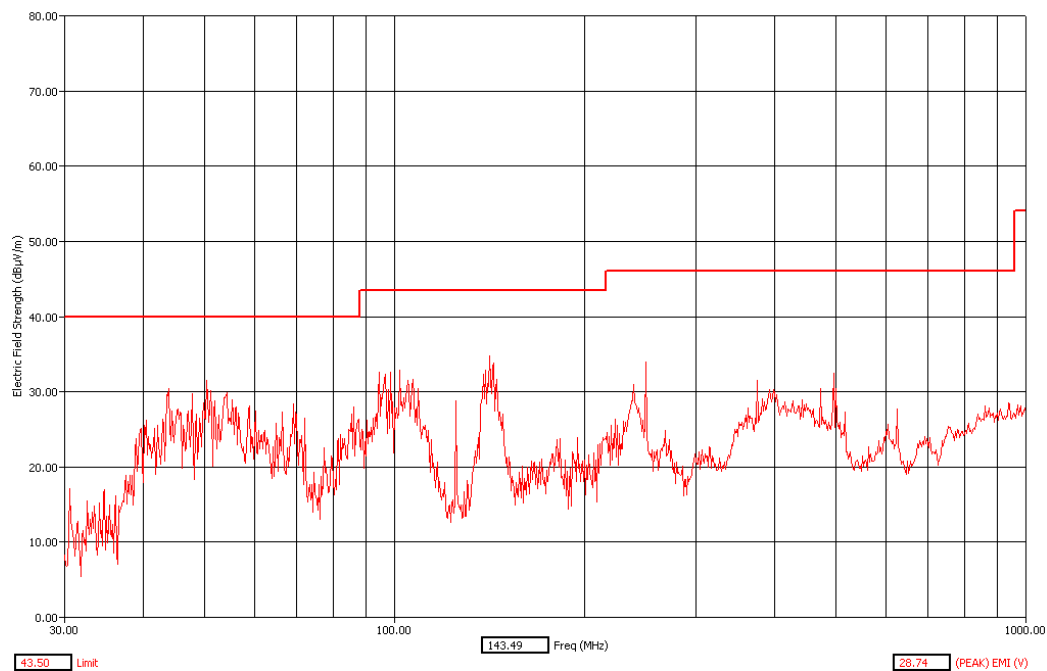


Figure 13: Radiated Emission (Peak) – Vertical polarization – 30 MHz to 1 GHz – Bluetooth, Channel 40

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Freq (MHz)	Pol	(QP) EMI (dBμV/m)	Limit (dBμV/m)	(QP) Margin (dB)	EUT Ttbt Agl (deg)	Twr Ht (cm)	(QP) Trace (dBμV)	Cable (dB)	Transducer (dB)	Preamplifier (dB)
50.44	V	31.22	40.00	-8.78	74.20	134.00	51.31	2.16	10.13	32.38
98.43	H	35.55	43.50	-7.95	263.40	186.00	56.53	3.03	8.31	32.31
125.00	H	32.35	43.50	-11.15	72.90	277.00	50.52	3.41	10.80	32.39
125.00	V	26.68	43.50	-16.82	193.60	110.00	42.86	3.41	12.80	32.39
143.30	V	33.30	43.50	-10.20	177.30	100.00	49.02	3.66	12.87	32.25
143.30	H	34.38	43.50	-9.12	283.00	225.00	51.65	3.66	11.32	32.25
250.00	H	37.14	46.00	-8.86	257.90	137.00	53.26	4.90	11.20	32.23
250.05	H	36.60	46.00	-9.40	257.90	124.00	52.72	4.90	11.20	32.23

Figure 14: Radiated Emission – Quasi-peak table – 30 MHz to 1 GHz – Bluetooth, Channel 40

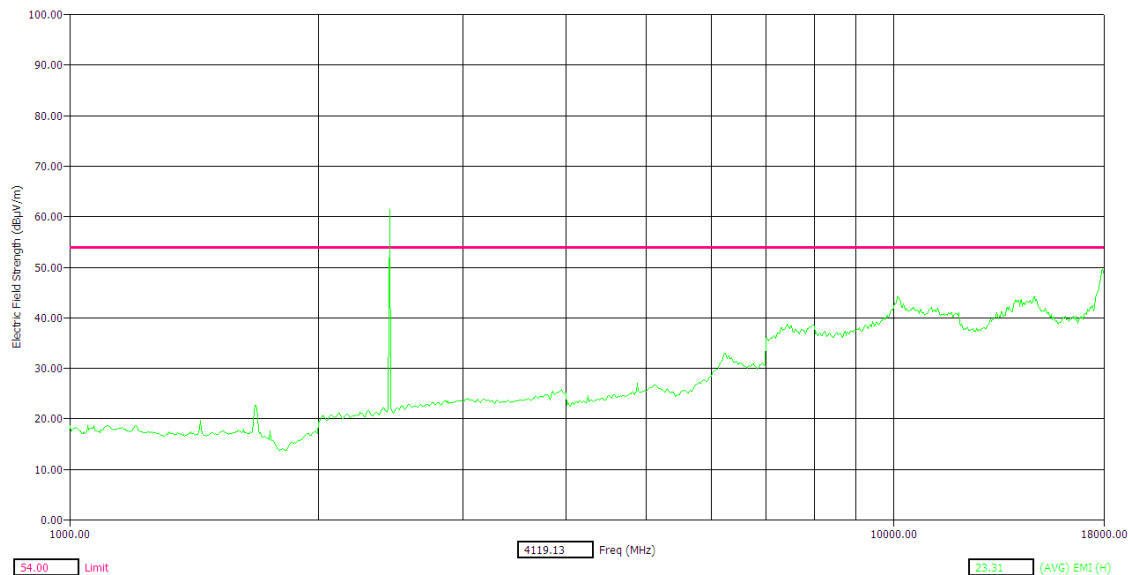


Figure 15: Radiated Emission (Average) – Horizontal polarization - 1GHz to 18GHz – Bluetooth, Channel 40

Note: The emission seen above the limit line is from the Bluetooth carrier, which is intentional

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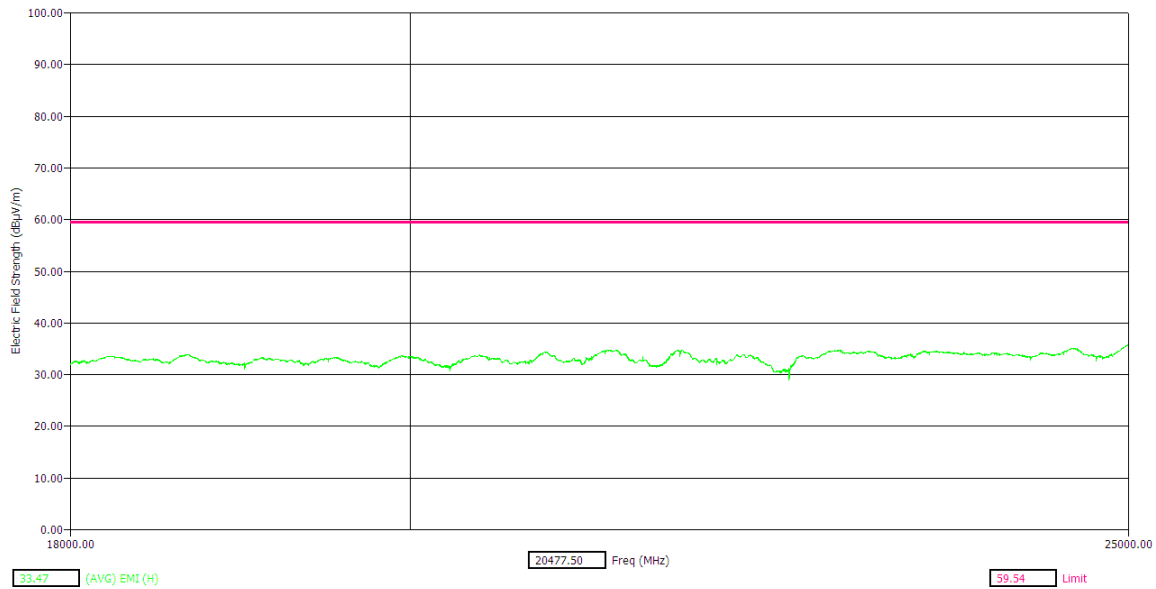


Figure 16: Radiated Emission (Average) – Horizontal polarization – 18GHz to 25GHz – Bluetooth, Channel 40

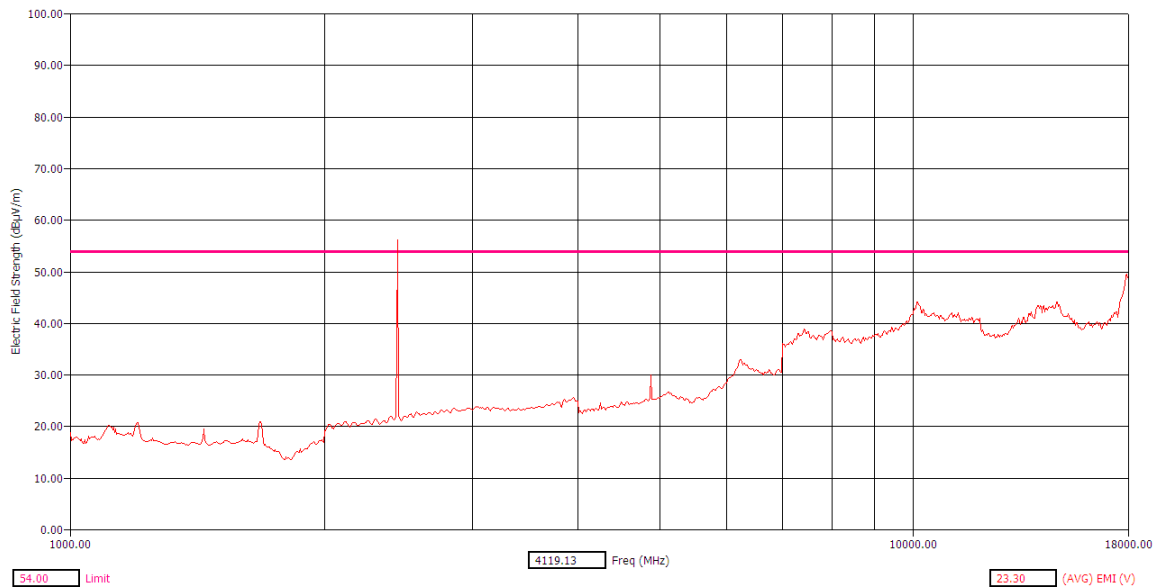


Figure 17: Radiated Emission (Average) – Vertical polarization – 1 GHz to 18 GHz – Bluetooth, Channel 40

Note: The emission seen above the limit line is from the Bluetooth carrier, which is intentional

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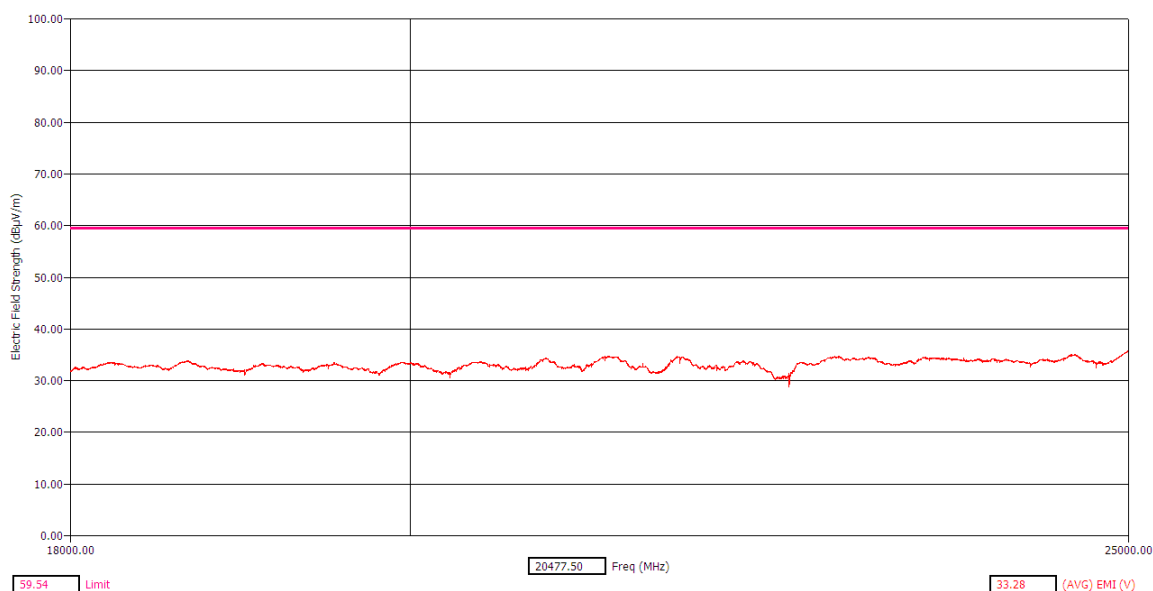


Figure 18: Radiated Emission (Average) – Vertical polarization – 18GHz to 25GHz – Bluetooth, Channel 40

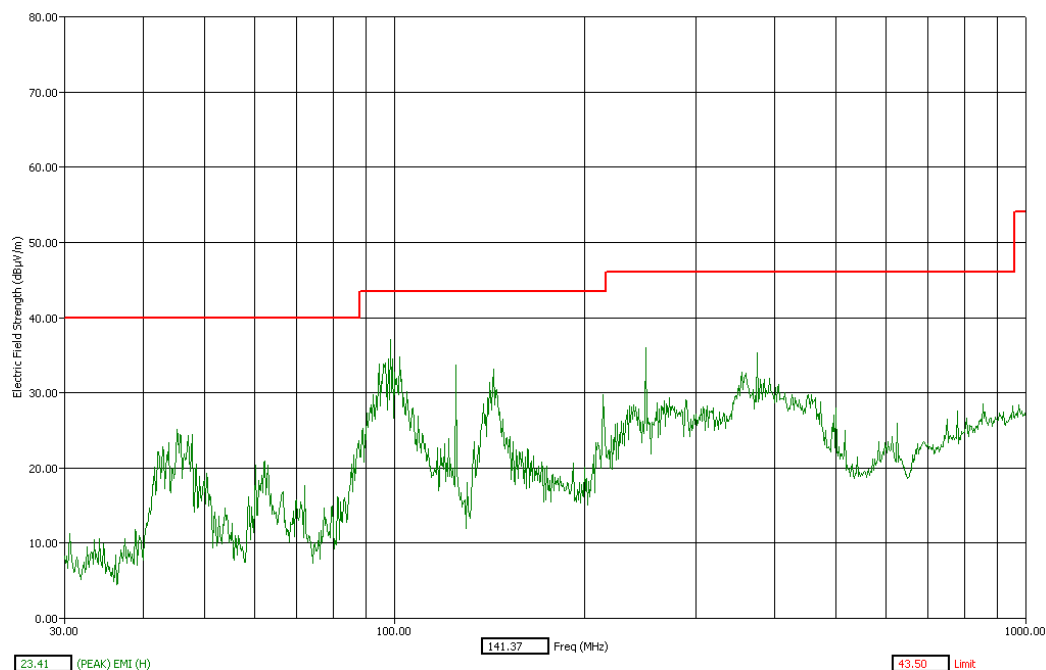


Figure 19: Radiated Emission (Peak) – Horizontal polarization – 30 MHz to 1 GHz – Bluetooth, Channel 78

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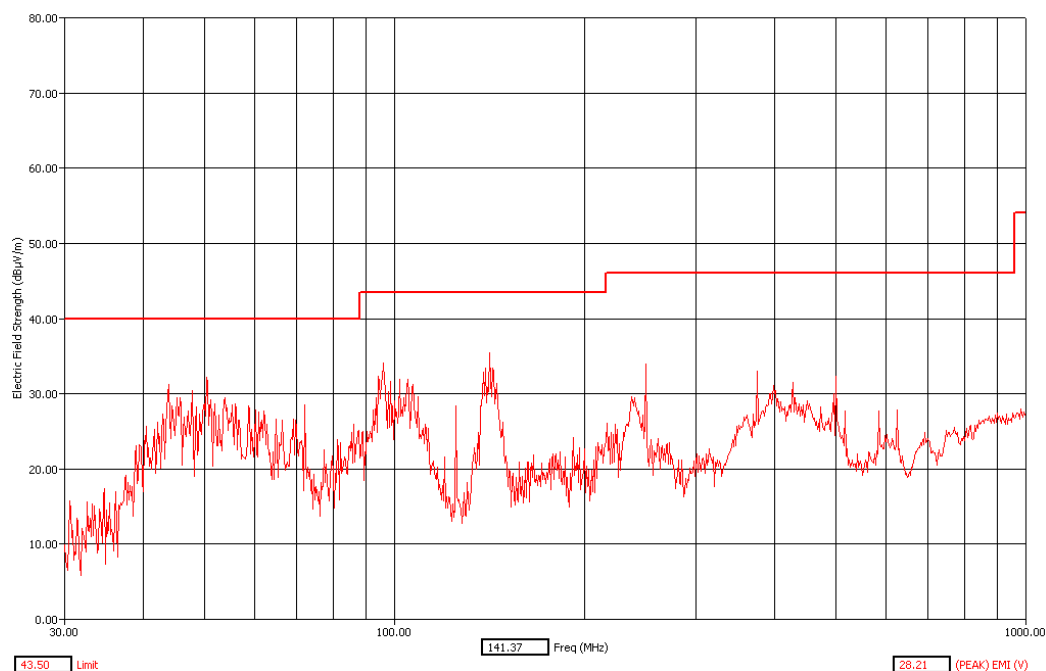


Figure 20: Radiated Emission (Peak) – Vertical polarization – 30 MHz to 1 GHz – Bluetooth, Channel 78

Freq (MHz)	Pol	(QP) EMI (dBμV/m)	Limit (dBμV/m)	(QP) Margin (dB)	EUT Ttbt Agl (deg)	Twr Ht (cm)	(QP) Trace (dBμV)	Cable (dB)	Transducer (dB)	Preamp (dB)
50.55	V	28.25	40.00	-11.75	99.70	189.00	48.34	2.16	10.13	32.38
98.50	H	36.03	43.50	-7.47	265.80	359.00	57.01	3.03	8.31	32.31
101.90	H	36.17	43.50	-7.33	275.00	331.00	56.85	3.08	8.60	32.36
125.00	H	33.25	43.50	-10.25	81.80	267.00	51.43	3.41	10.80	32.39
125.00	V	28.94	43.50	-14.56	193.70	100.00	45.12	3.41	12.80	32.39
141.20	V	34.08	43.50	-9.42	189.80	100.00	49.83	3.64	12.87	32.26
250.00	H	37.15	46.00	-8.85	258.00	124.00	53.28	4.90	11.20	32.23
250.05	H	37.58	46.00	-8.42	257.90	137.00	53.71	4.90	11.20	32.23

Figure 21: Radiated Emission – Quasi-peak table - 30 MHz to 1 GHz – Bluetooth, Channel 78

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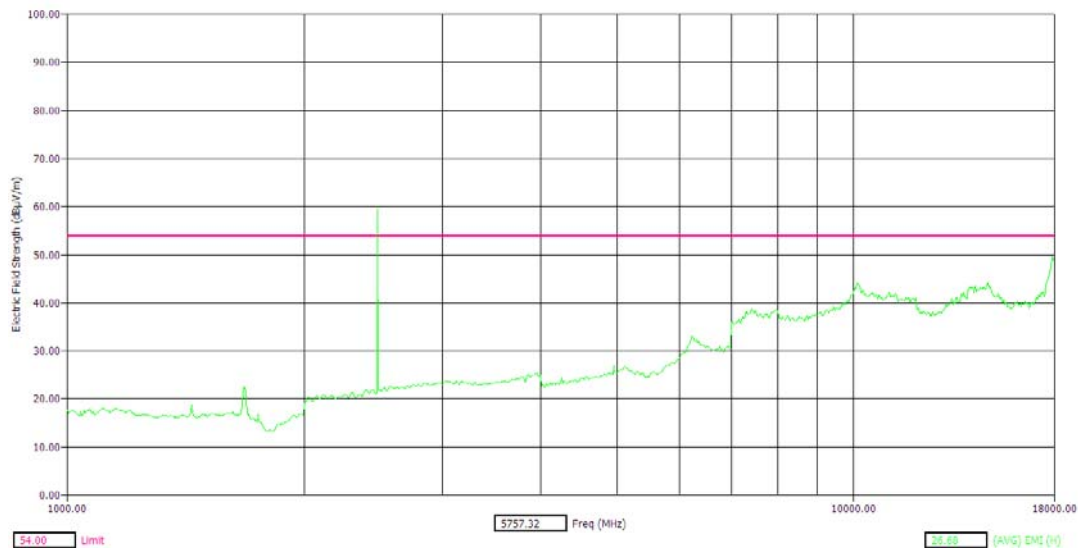


Figure 22: Radiated Emission (Average) – Horizontal polarization 1GHz to 18GHz – Bluetooth, Channel 78

Note: The emission seen above the limit line is from the Bluetooth carrier, which is intentional

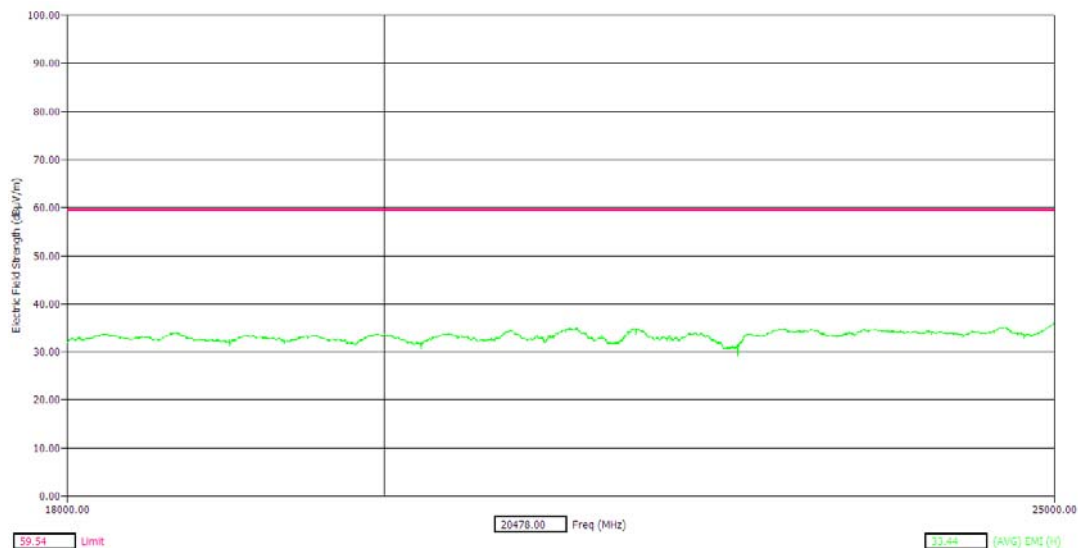


Figure 23: Radiated Emission (Average) – Horizontal polarization 18GHz to 25GHz – Bluetooth, Channel 78

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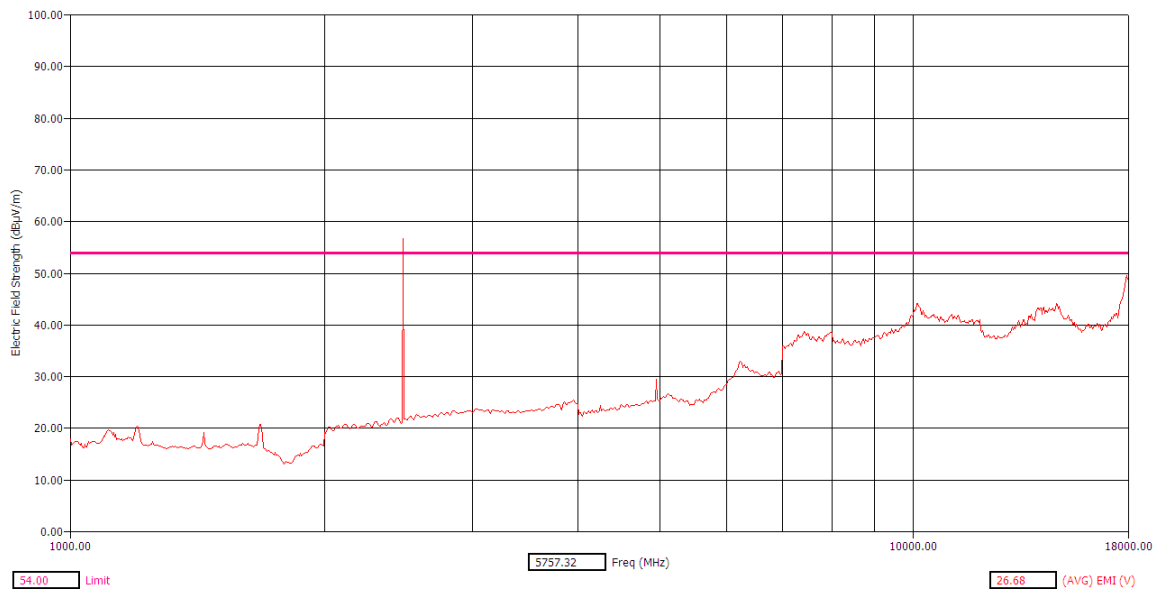


Figure 24: Radiated Emission (Average) – Vertical polarization – 1 GHz to 18GHz – Bluetooth, Channel 78

Note: The emission seen above the limit line is from the Bluetooth carrier, which is intentional

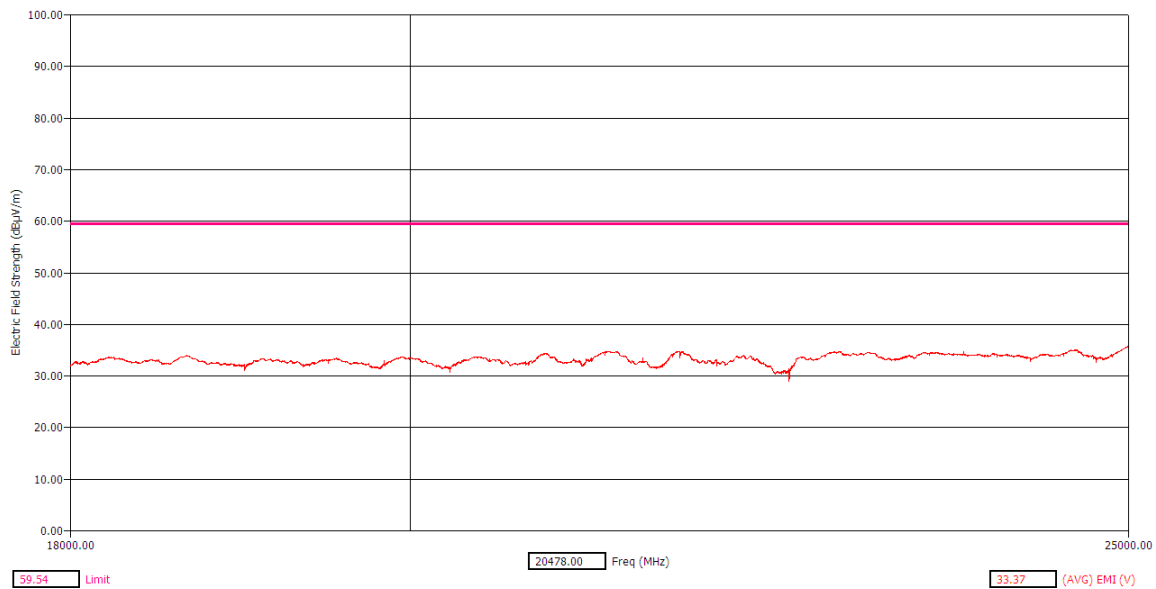


Figure 25: Radiated Emission (Average) – Vertical polarization 18 GHz to 25 GHz – Bluetooth, Channel 78

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6.3 CARRIER SEPARATION OF HOPPING CHANNELS

6.3.1 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

6.3.2 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.

6.3.3 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	975.0 KHz	Yes	Pass
9	2.411	10	2.412	1 MHz	975.0 KHz	Yes	Pass
19	2.421	20	2.422	1 MHz	987.5 KHz	Yes	Pass
29	2.431	30	2.432	1 MHz	987.5 KHz	Yes	Pass
39	2.441	40	2.442	1 MHz	975.0 KHz	Yes	Pass
49	2.451	50	2.452	1 MHz	975.0 KHz	Yes	Pass
59	2.461	60	2.462	1 MHz	975.0 KHz	Yes	Pass
69	2.471	70	2.472	1 MHz	962.5 KHz	Yes	Pass
77	2.479	78	2.480	1 MHz	975.0 KHz	Yes	Pass

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6.3.4 RESULT (SUPPORTING GRAPHS / DATA)

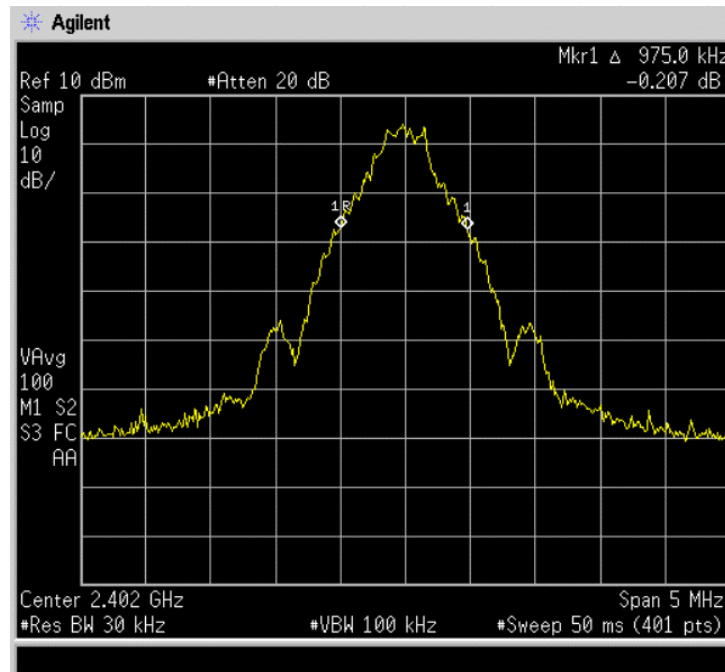


Figure 26: Carrier separation – Hop Channel 0 – Bluetooth

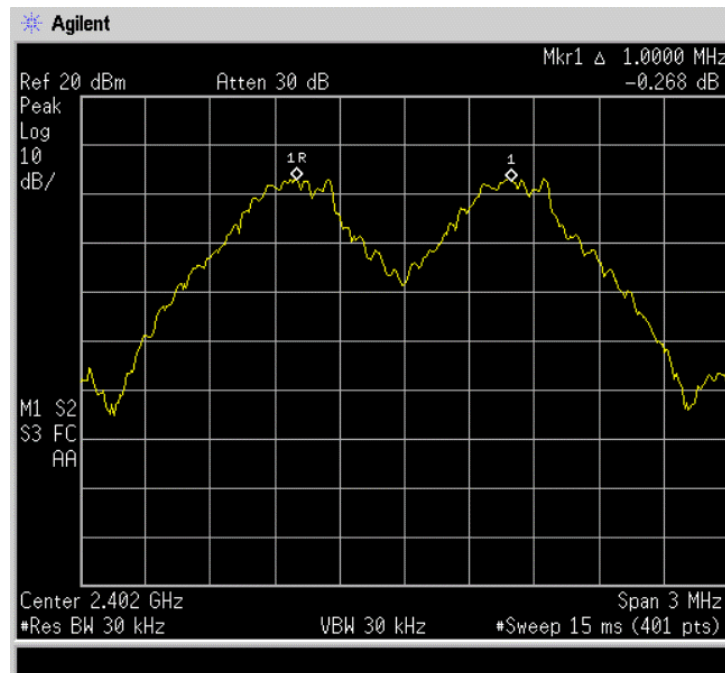


Figure 27: Carrier separation – Hop Channel 0&1 – Bluetooth

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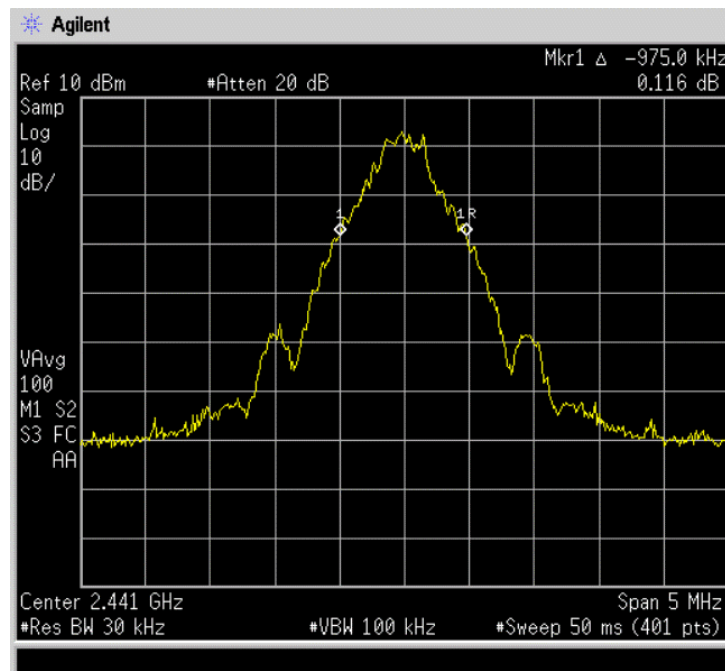


Figure 28: Carrier separation – Hop Channel 39 – Bluetooth

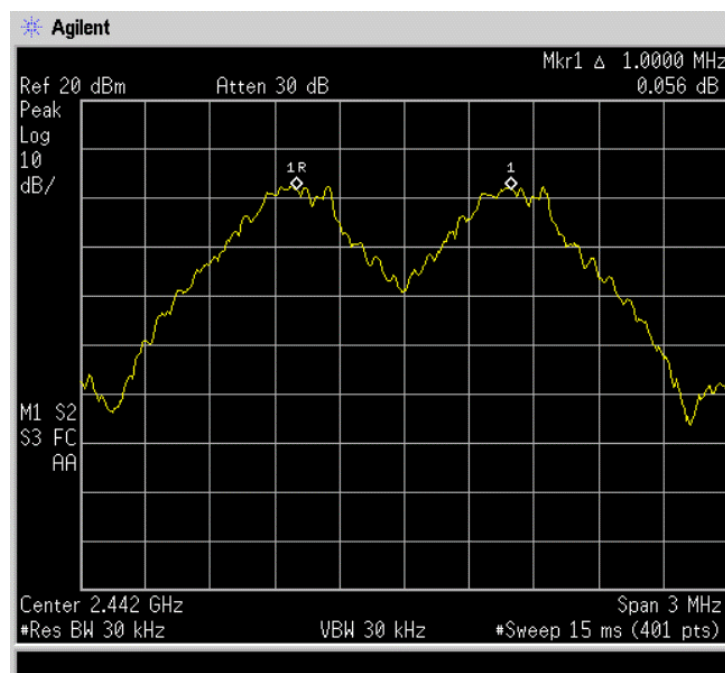


Figure 29: Carrier separation – Hop Channel 39&40– Bluetooth

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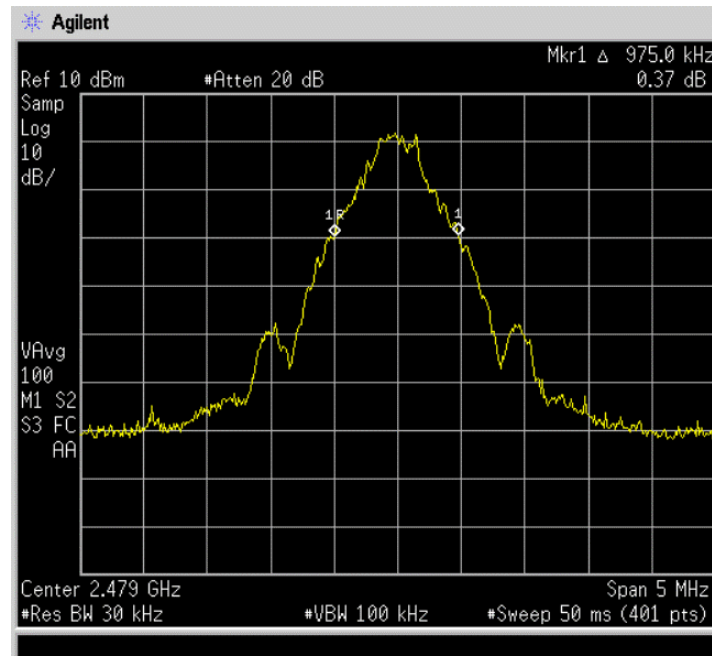


Figure 30: Carrier separation – Hop Channel 77 – Bluetooth

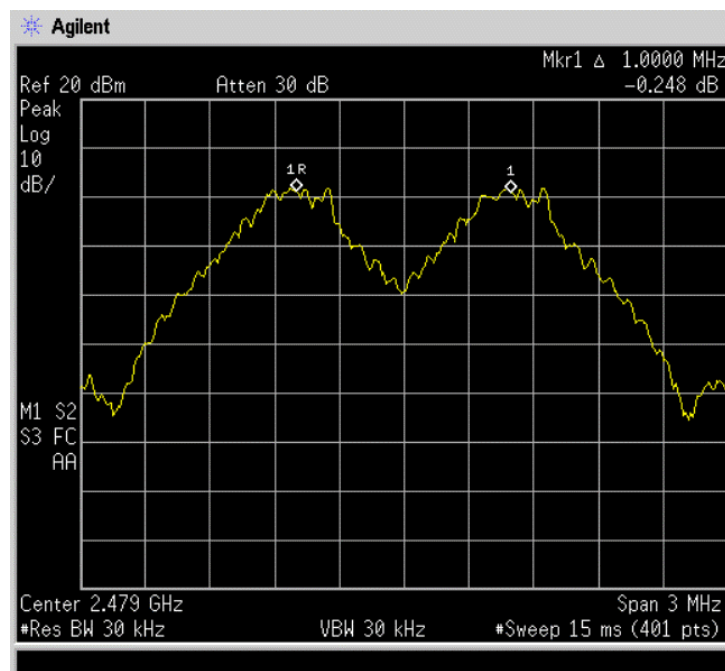


Figure 31: Carrier separation – Hop Channel 77&78 – Bluetooth

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6.4 DWELL TIME

6.4.1 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

6.4.2 TEST PROCEDURE

S. No	Procedure
1	Connect the transmitter output to a Spectrum Analyzer
2	Set the center frequency of spectrum analyzer = operating frequency
3	In the Spectrum analyzer set RBW, VBW=100KHz, Span=0Hz.
4	Measure the length of transmission time and calculate Dwell time by using the below equation. Dwell time = Length of transmission time*hop rate/number of hopping channels*period of time.

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6.4.3 RESULT

Channel	Mode	Frequency (GHz)	Length of Transmission (ms) measured	Limit (ms)	Dwell Time (ms)	Result
Channel 0	DH1	2.402	0.450	$t_D < 400$	144.0	Pass
Channel 0	DH3	2.402	1.713	$t_D < 400$	274.0	Pass
Channel 0	DH5	2.402	2.950	$t_D < 400$	314.6	Pass
Channel 39	DH1	2.441	0.450	$t_D < 400$	144.0	Pass
Channel 39	DH3	2.441	1.700	$t_D < 400$	272.0	Pass
Channel 39	DH5	2.441	2.950	$t_D < 400$	314.6	Pass
Channel 78	DH1	2.480	0.450	$t_D < 400$	144.0	Pass
Channel 78	DH3	2.480	1.700	$t_D < 400$	272.0	Pass
Channel 78	DH5	2.480	2.950	$t_D < 400$	314.6	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 = $0.4(\text{ms}) \times 79 = 31.6$

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6.4.4 RESULT (SUPPORTING GRAPHS / DATA)

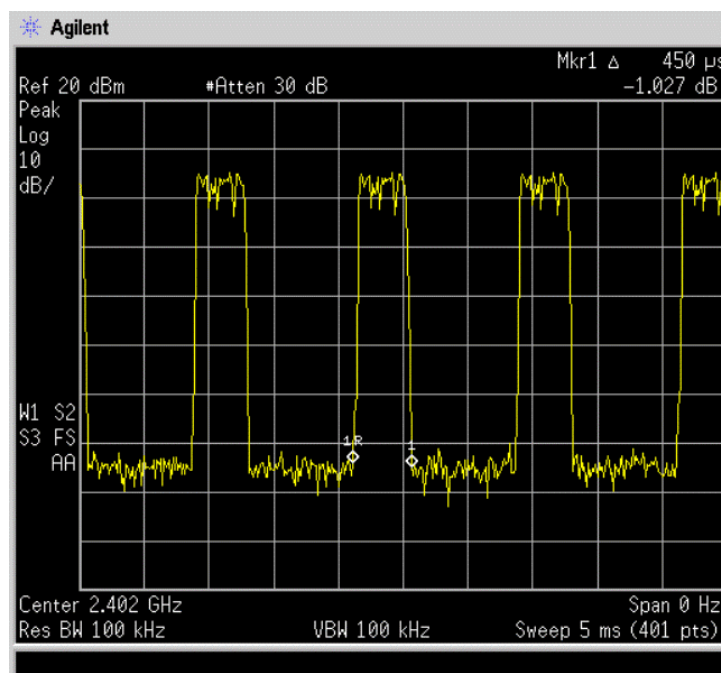


Figure 32: Dwell time – Hop Channel 0 – DH1 mode- Bluetooth

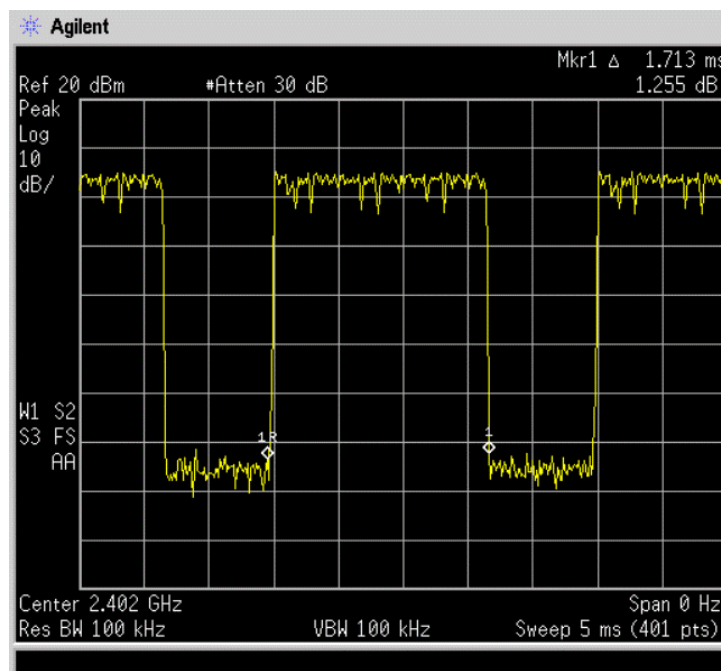


Figure 33: Dwell time – Hop Channel 0 – DH3 mode- Bluetooth

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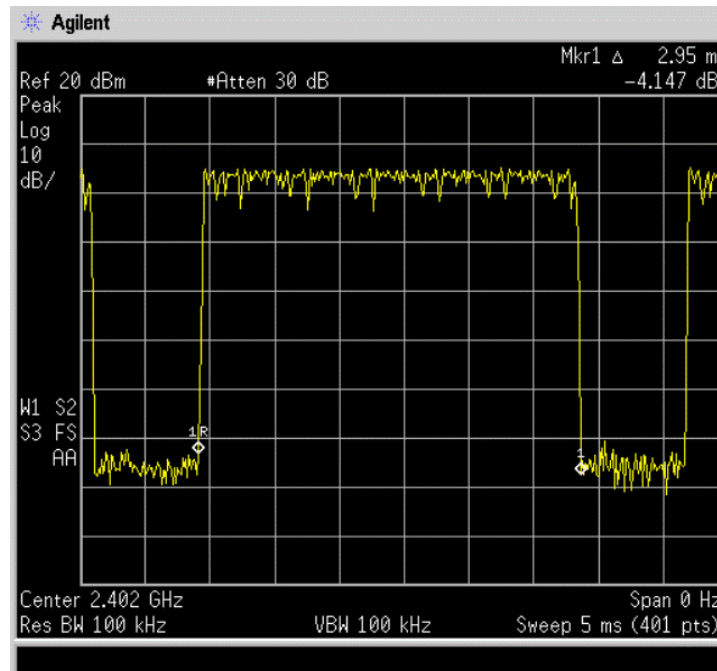


Figure 34: Dwell time – Hop Channel 0 – DH5 mode- Bluetooth

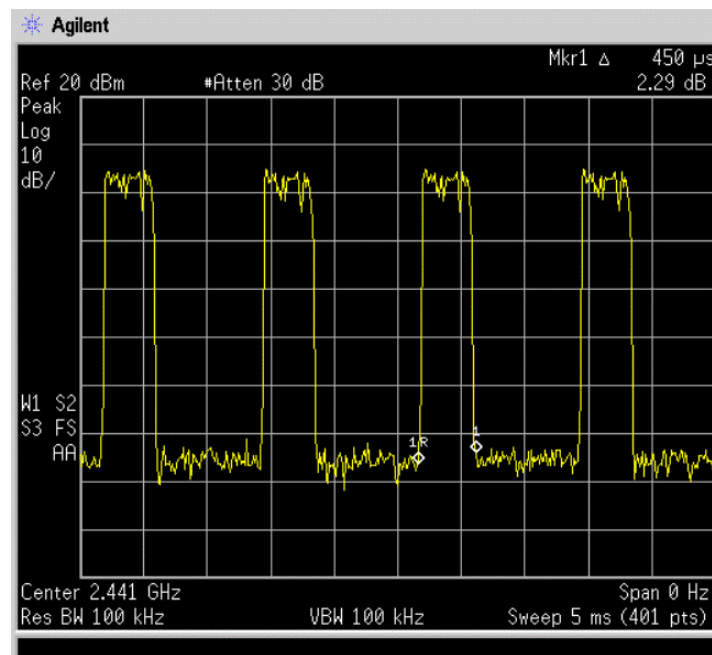


Figure 35: Dwell time – Hop Channel 39 – DH1 mode- Bluetooth

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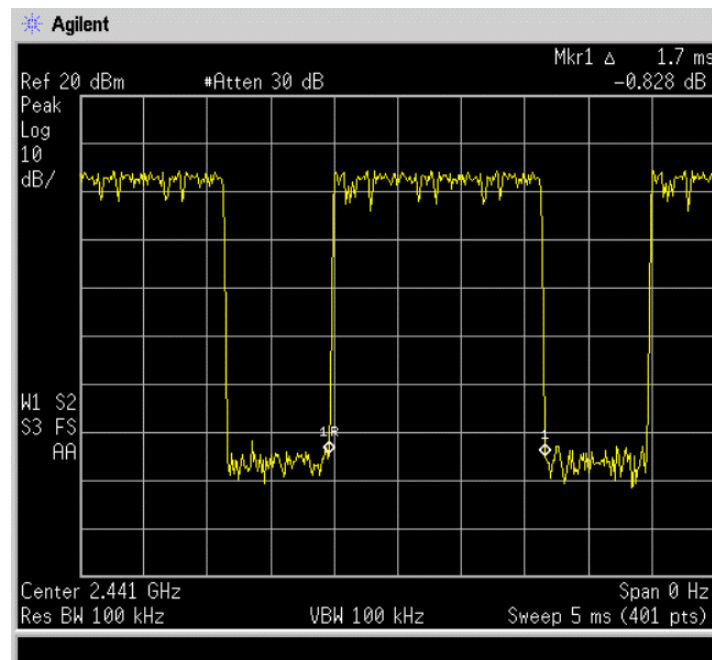


Figure 36: Dwell time – Hop Channel 39-DH3 mode – Bluetooth

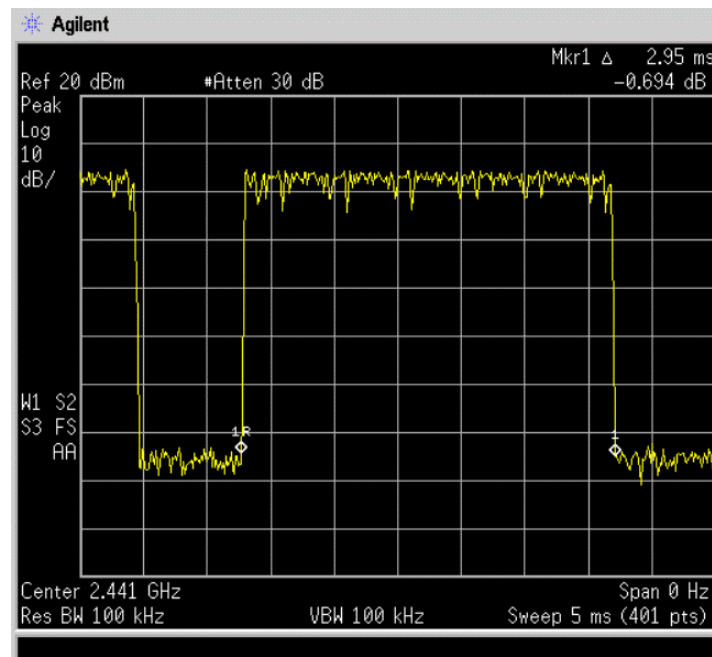


Figure 37: Dwell time – Hop Channel 39-DH5 mode – Bluetooth

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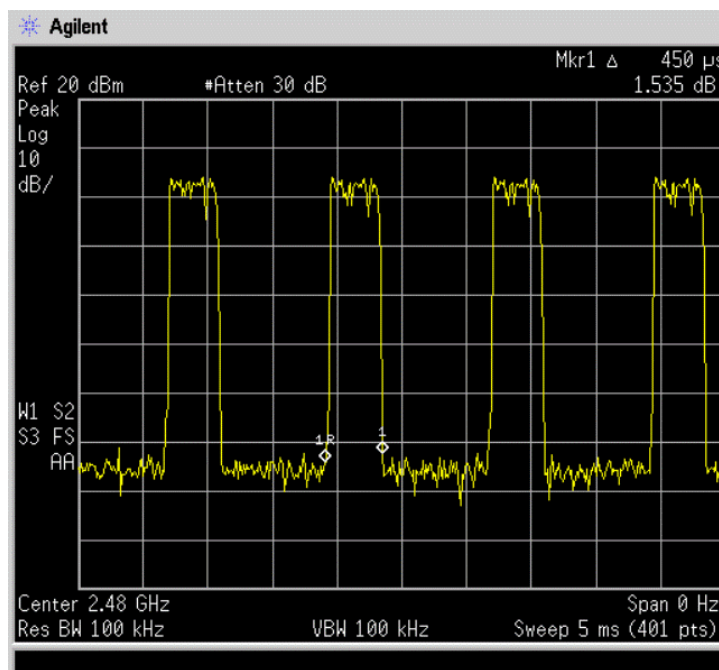


Figure 38: Dwell time – Hop Channel 78 – DH1 mode- Bluetooth

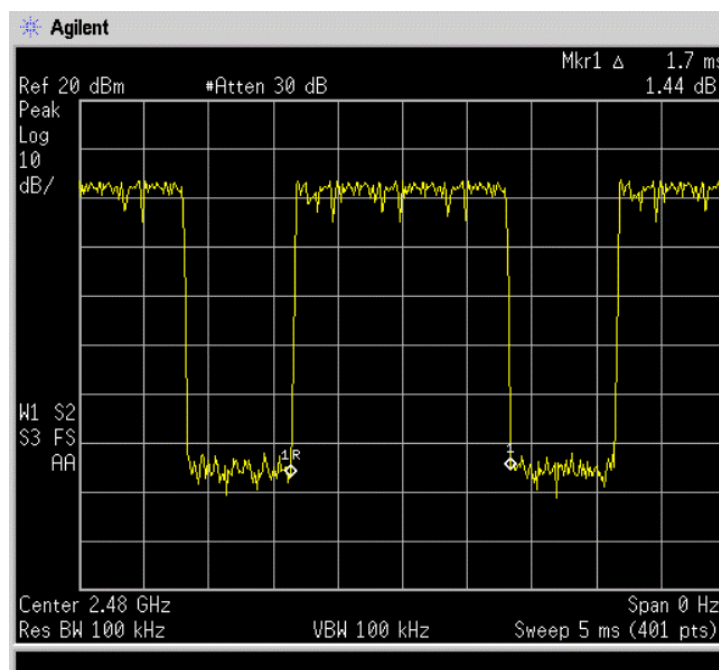


Figure 39: Dwell time – Hop Channel 78 – DH3 mode- Bluetooth

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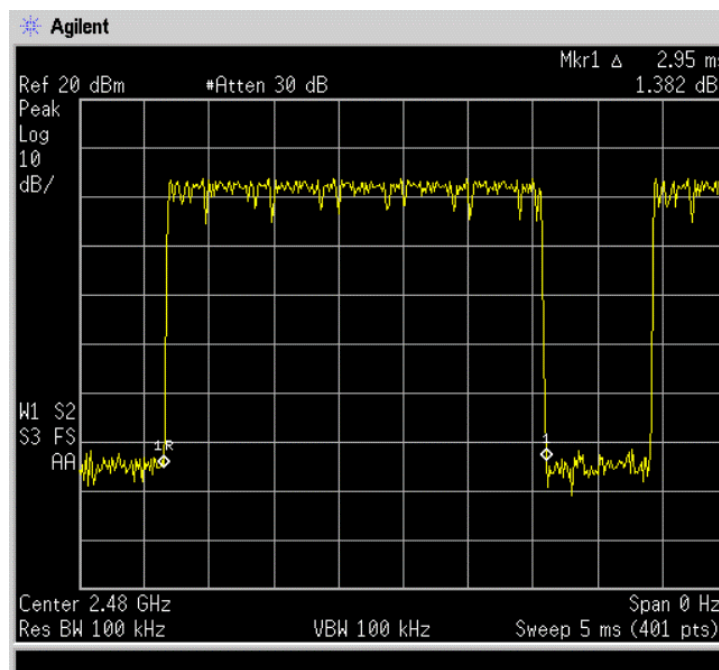


Figure 40: Dwell time – Hop Channel 78 – DH5 mode- Bluetooth

6.5 PEAK CONDUCTED OUTPUT POWER

6.5.1 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 (30dBm)
RSS-210	A8.4 (2)	Peak conducted output power of hopping systems using atleast 75 hop channels < 1 W (30dBm)

6.5.2 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

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6.5.3 RESULT

Hop Channel	Frequency (GHz)	Measured power (dBm)	Cable loss (dB)	Total power (dBm)	Limit (dBm)	Result
0	2.402	5.884	1.80	7.684	30.00	Pass
10	2.412	5.715	1.80	7.515	30.00	Pass
20	2.422	5.625	1.80	7.425	30.00	Pass
30	2.432	5.560	1.80	7.360	30.00	Pass
40	2.442	5.029	1.80	6.829	30.00	Pass
50	2.452	5.124	1.80	6.924	30.00	Pass
60	2.462	4.854	1.80	6.654	30.00	Pass
70	2.472	5.036	1.80	6.836	30.00	Pass
78	2.480	4.142	1.80	5.942	30.00	Pass

Note: Transmit duty cycle considered is = 1

No antenna gain is considered as this is conducted measurement without antenna

6.5.4 RESULT (SUPPORTING GRAPHS / DATA)

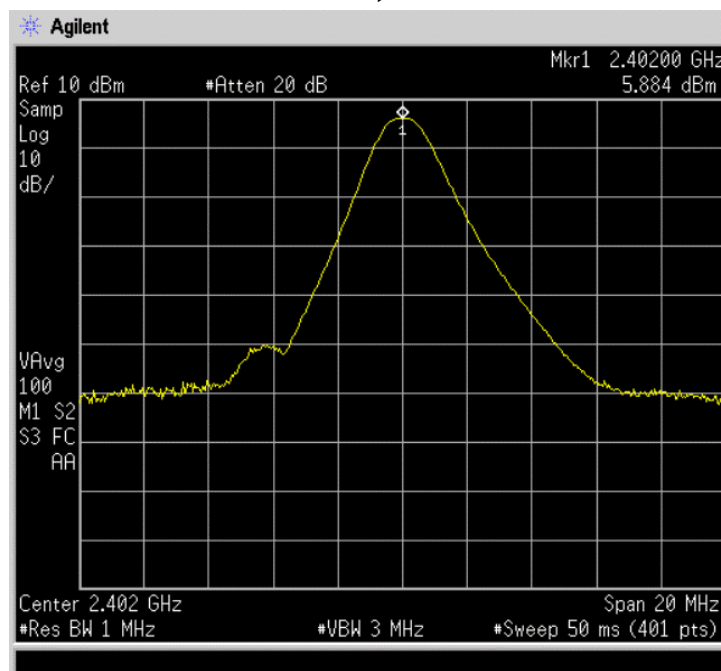


Figure 41: Peak conducted output power – Hop Channel 0 – Bluetooth

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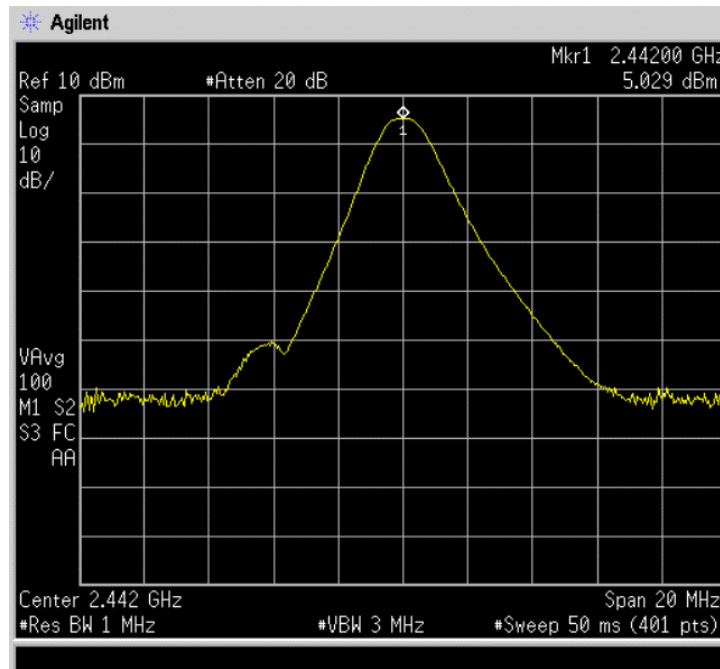


Figure 42: Peak conducted output power – Hop Channel 40 – Bluetooth

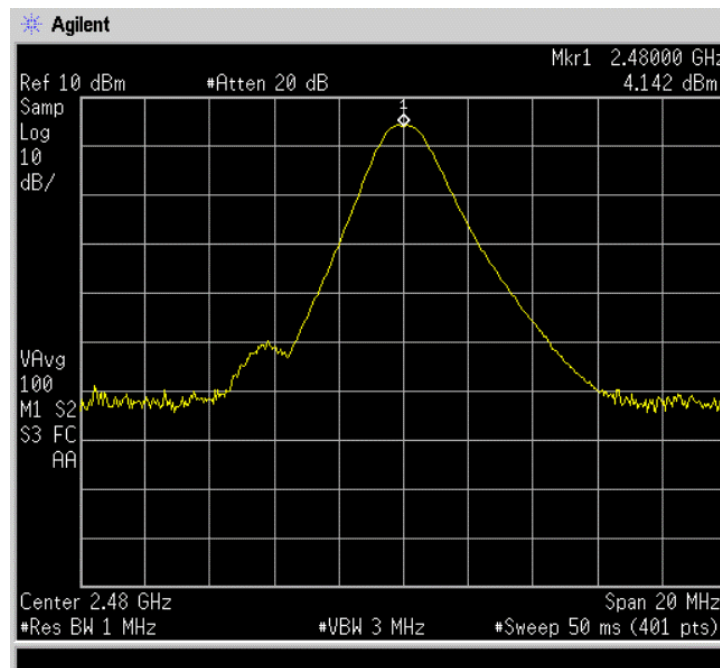


Figure 43: Peak conducted output power – Hop Channel 78 – Bluetooth

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6.6 CONDUCTED SPURIOUS EMISSION

6.6.1 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

6.6.2 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

6.6.3 RESULT

Hop Channel	Frequency (GHz)	Measured peak in the intentional band	Limit	Result
0	2.402	6.248dBm	< 20dB below measured peak (green limit line)	Pass
10	2.412	5.966dBm	< 20dB below measured peak (green limit line)	Pass
20	2.422	5.369dBm	< 20dB below measured peak (green limit line)	Pass
30	2.432	5.012dBm	< 20dB below measured peak (green limit line)	Pass
40	2.442	5.066dBm	< 20dB below measured peak (green limit line)	Pass
50	2.452	4.498dBm	< 20dB below measured peak (green limit line)	Pass
60	2.462	3.981dBm	< 20dB below measured peak (green limit line)	Pass
70	2.472	3.052dBm	< 20dB below measured peak (green limit line)	Pass
78	2.480	3.951dBm	< 20dB below measured peak (green limit line)	Pass

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6.6.4 RESULT (SUPPORTING GRAPHS / DATA)

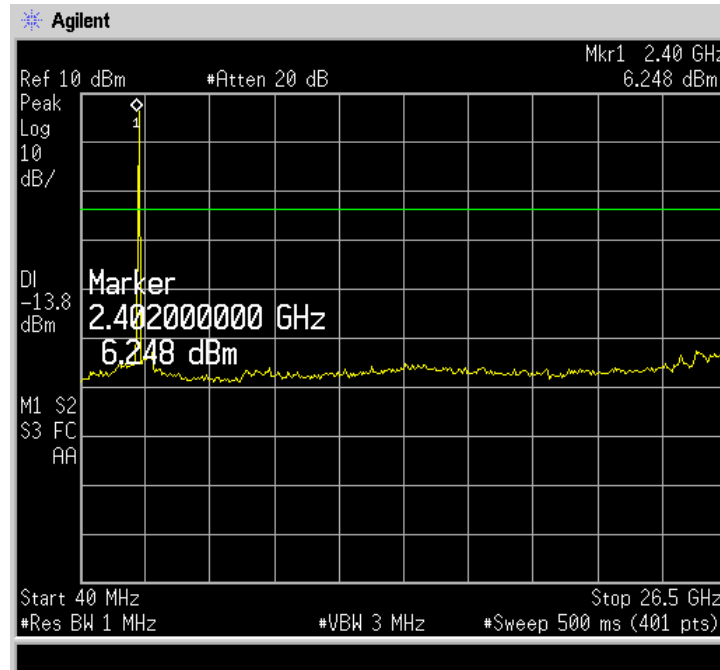


Figure 44: Conducted Spurious Emission – Hop Channel 0 – Bluetooth

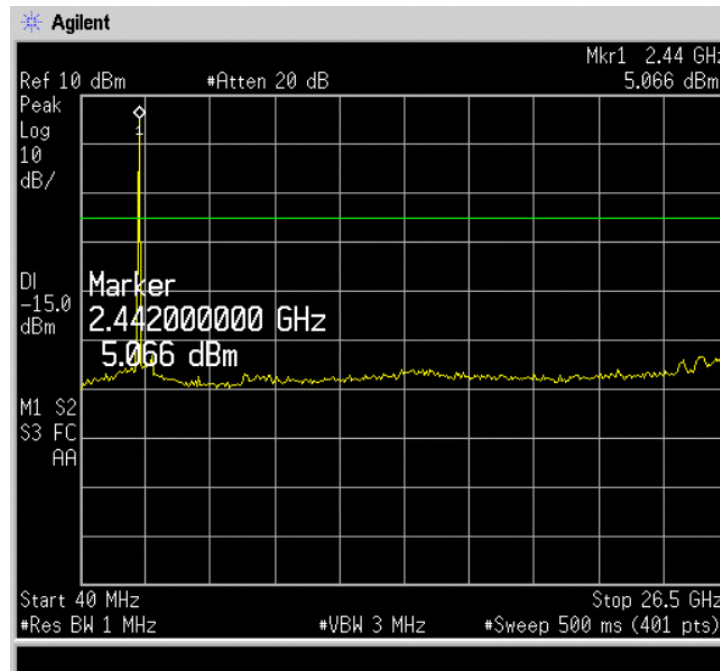


Figure 45: Conducted Spurious Emission – Hop Channel 40 – Bluetooth

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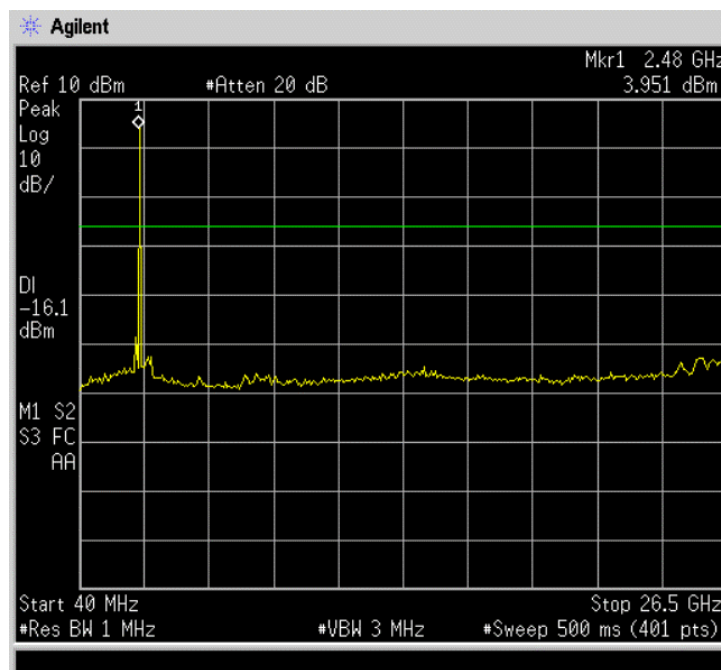


Figure 46: Conducted Spurious Emission – Hop Channel 78 – Bluetooth

6.7 BAND EDGE MEASUREMENTS RADIATED

6.7.1 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 (Refers to) RSS-GEN	A8.5 7.2.5	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

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6.7.2 TEST PROCEDURE

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

6.7.3 RESULT

Frequency (MHz)	Horizontal level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Detector
2399.5	20.02	54	-33.98	Pass	Average
2395.0	19.81	54	-34.19	Pass	Average
2310.0	19.35	54	-34.65	Pass	Average
2491.5	20.07	54	-33.93	Pass	Average
2488.5	19.96	54	-34.04	Pass	Average
2499.5	19.83	54	-34.17	Pass	Average
2349.0	33.82	74	-40.18	Pass	Peak
2338.5	32.61	74	-41.39	Pass	Peak
2315.0	32.81	74	-41.19	Pass	Peak
2485.0	34.15	74	-39.85	Pass	Peak
2488.0	33.84	74	-40.16	Pass	Peak
2499.0	34.15	74	-39.85	Pass	Peak

Frequency (MHz)	Vertical level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Detector
2399.5	20.02	54	-33.98	Pass	Average
2395.0	19.79	54	-34.21	Pass	Average
2310.0	19.37	54	-34.63	Pass	Average
2491.5	20.07	54	-33.93	Pass	Average
2488.5	19.99	54	-34.01	Pass	Average
2499.5	19.77	54	-34.23	Pass	Average
2349.0	31.80	74	-42.20	Pass	Peak
2338.5	32.74	74	-41.26	Pass	Peak
2315.0	32.41	74	-41.59	Pass	Peak
2485.0	32.34	74	-41.66	Pass	Peak
2488.0	33.15	74	-40.85	Pass	Peak
2499.0	33.71	74	-40.29	Pass	Peak

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6.8 BAND EDGE MEASUREMENTS CONDUCTED

6.8.1 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.
RSS-210	A8.5	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.

6.8.2 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 appropriate Span and Sweep time 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

6.8.3 RESULT (SUPPORTING GRAPHS / DATA)

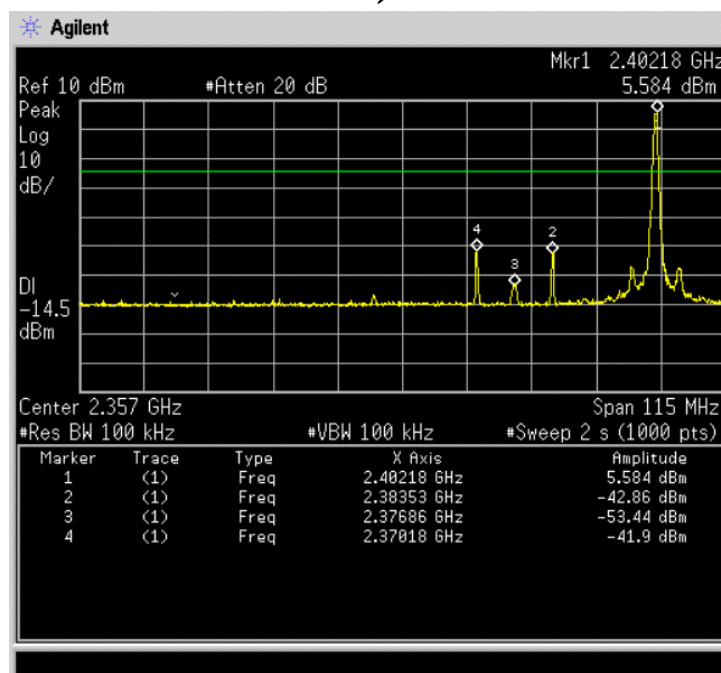


Figure 47: Low Band Edge – Hop Channel 0 – Bluetooth

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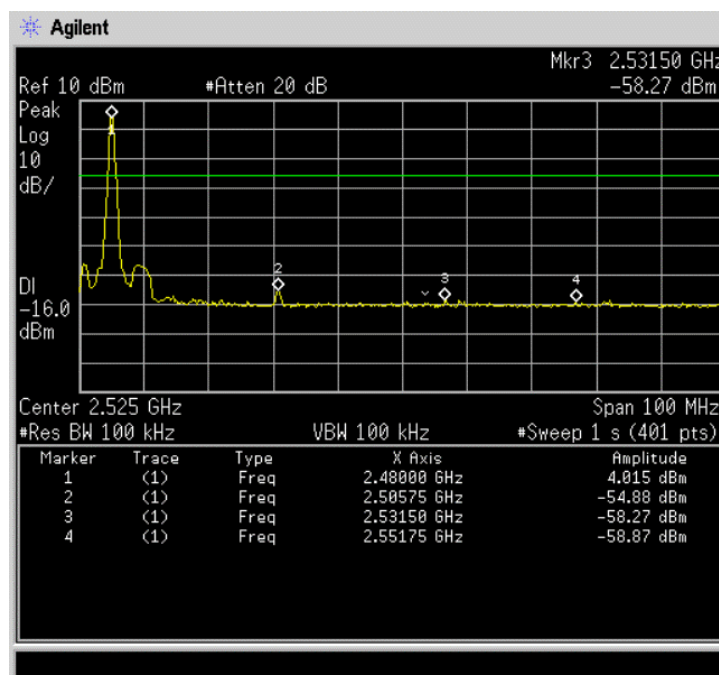


Figure 48: High Band Edge – Hop Channel 78 – Bluetooth

6.9 OCCUPIED BANDWIDTH MEASUREMENTS

6.9.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limit
RSS Gen	4.6.1	Occupied Bandwidth (OBW) is the bandwidth containing 99% of the total integrated power of the transmitted spectrum, centered on the assigned channel frequency.

6.9.2 TEST PROCEDURE

S. No	Procedure
1	This test was carried out for Low(0), Mid(39) and High(78) channels of the Bluetooth band
2	Connect the transmitter output to a Spectrum Analyzer. Select an appropriate channel on the EUT.
3	In the Spectrum Analyzer set Resolution Bandwidth to 100 KHz and Video Bandwidth to 300KHz
4	Select Span of 1.5 MHz and Sweep time of 1s in the Spectrum Analyzer
5	Based on the recorded value, the result is declared

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IC ID	3287A-BNCBTWIFI

6.9.3 RESULT (SUPPORTING GRAPHS / DATA)

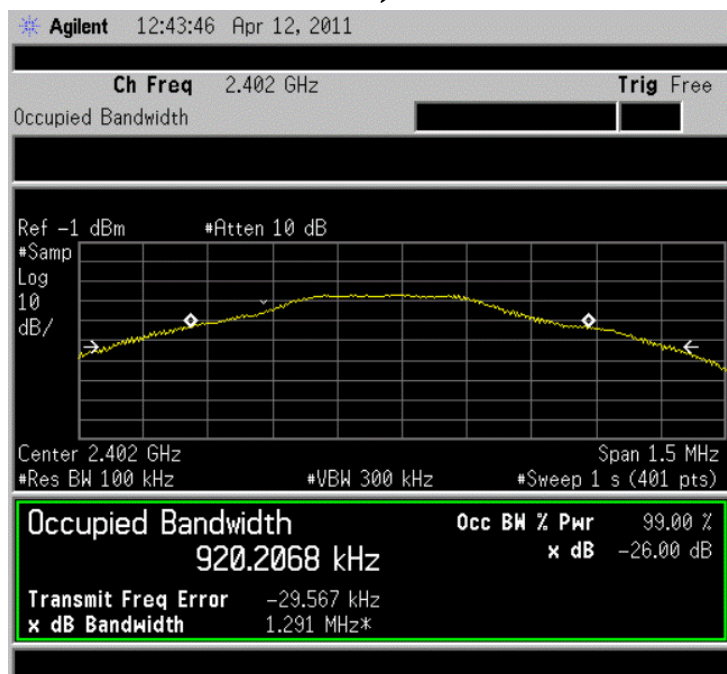


Figure 49: Occupied Bandwidth Measurement – Bluetooth channel (0)

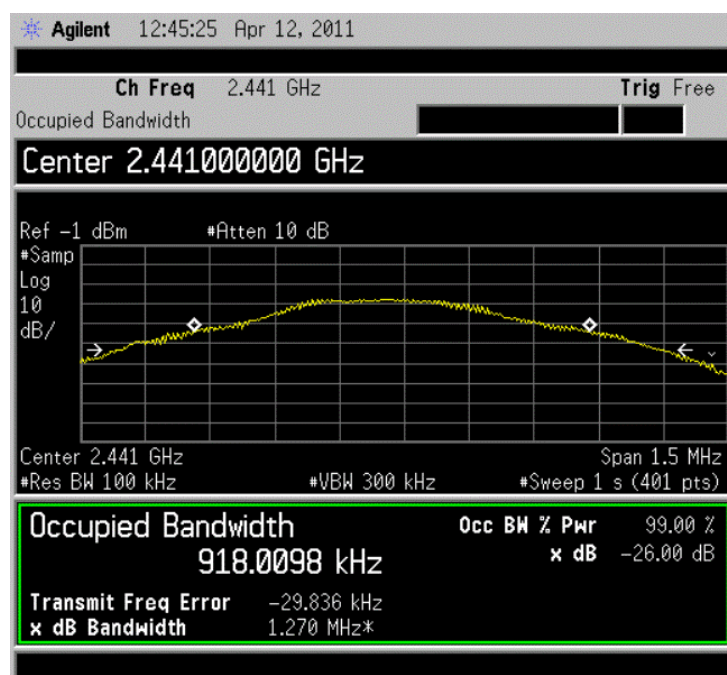


Figure 50: Occupied Bandwidth Measurement – Bluetooth, Mid channel (39)

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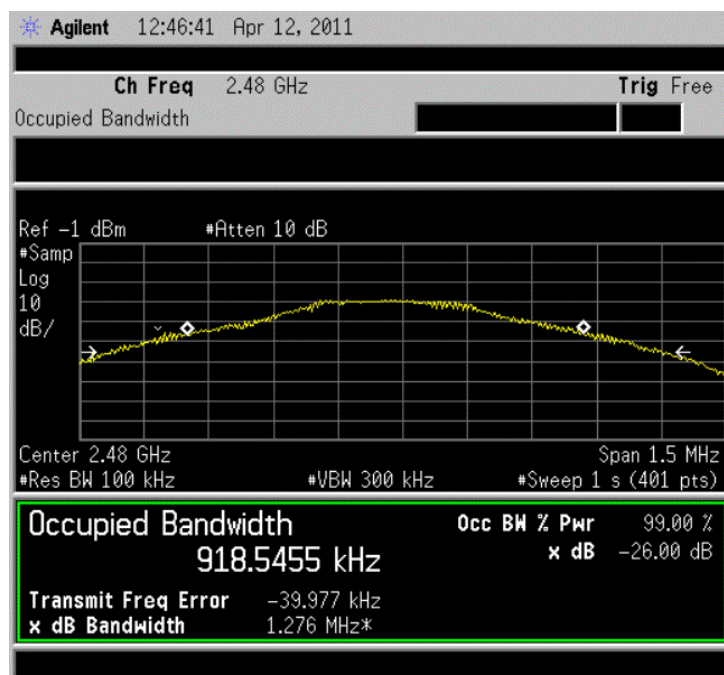


Figure 51: Occupied Bandwidth Measurement – Bluetooth, High channel (78)

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7 APPENDIX 1 – ACRONYMS

WLAN	Wireless Local Area Network
PC	Personal Computer
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
db μ V	Decibel microVolts
USB	Universal Serial Bus
FCC	Federal Communications Commission
IC	Industry Canada
KHz	Kilo Hertz
MHz	Mega Hertz
GHz	Giga Hertz

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