



EMC TEST REPORT	
PRODUCT NAME	Key Fob
PRODUCT MODEL NUMBER	QL-FND-KF02
MANUFACTURER	QL London
TEST REPORT NUMBER	RMM 1402TEL533-B
TEST REPORT DATE	19 th Feb 2014
TEST REPORT VERSION	1.0
ISSUED TO	QL London, 12-50, Kingsgate house, Kingston –Upon-Thames-KT2-5AA
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



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AMMENDMENT HISTORY

Amendment Number	Amendment Date	Author of Amendment	Previous Report Version	Previous Report Date
Amendment Details				

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1 TEST DESCRIPTION & RESULT

Applicant	QL London, 12-50, Kingsgate house, Kingston –Upon-Thames-KT2-5AA
Manufacturer	QL London
Equipment Under Test	KeyFob
Model	QL-FND-KF02
No. of samples tested	01
Date of Test	08 th Jan 2014 to 29 th Jan 2014
Date of Submission	12 th Feb 2014
Venue of Test	Tarang , Wipro Technologies, SJP2, Survey#70, 77, 78/8A, Dodda Kanelli, Sarjapur road, Bangalore-560 035. Karnataka. India.

Applicable Standard	Description	Results
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.207	Conducted Emission	Pass
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.209	Radiated Emission	Pass
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.247	Operation within the bands 2400 - 2483.5 MHz (Conducted)	Pass
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.249	Operation within the bands 2400 - 2483.5 MHz (Radiated)	Pass
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.247 (b) (1)	Maximum Peak Output Power	Pass
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.247 (c)	Conducted Spurious Emission	Pass
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.247 (c)	Band Edge measurement (Conducted)	Pass
FCC 47 CFR, Part 15, Subpart C, 10.1.11 edition, Section 15.203	Antenna Requirement	Complied

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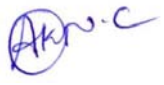
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Applicable Standard	Description	Results
Industry Canada RSS-210, Issue 8 RSS-Gen, Issue 2, Section 7.2.2	Conducted Emission	Pass
Industry Canada RSS-210, Issue 8, Section 2.9 RSS-Gen, Issue 2, Section 6	Radiated Emission	Pass
Industry Canada RSS-210, Issue 8, Section A8.1 (b)	Operation within the bands 2400 - 2483.5 MHz (Conducted)	Pass
Industry Canada RSS-210, Issue 8, Section A2.9	Operation within the bands 2400 - 2483.5 MHz (Radiated)	Pass
Industry Canada RSS-210, Issue 8, Section A8.4 (2)	Peak Conducted Output Power	Pass
Industry Canada RSS-210, Issue 8, Section A8.5	Conducted Spurious Emission	Pass
Industry Canada RSS-210, Issue 8, Section A8.5	Band Edge measurement (Conducted)	Pass
Industry Canada RSS-Gen, Issue 2, Section 4.6.1	Occupied Bandwidth	Pass

KeyFob 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. Other similar equipment may not necessarily reproduce same result due to production tolerances and measurement uncertainties. Any measurement uncertainties listed in this report are for information only.

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 test report and not a certificate to gain market access for the product. To gain market access, Customer needs appropriate clearance from the Government or authorized agency for the target market. For markets that allow self-declaration, customer needs to follow the procedure defined by the target market.

Prepared by	Reviewed by	Approved by
		
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Test Engineer	Test Engineer	Function Head

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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 C63.4-2009
- FCC 47 CFR, Part 15
- RSS-210 Issue 8
- RSS-Gen Issue 2

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
ISO 17025 Accreditation	Certificate Number :T-1533 and T-1534(NABL) 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
TEC Approval	Certificate Number: TEC/MRA/CAB/IND-D/3 CAB Identification: IND003
DGAQA Approval	1415/F-15/DGAQA/Aircraft

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), 10 meter	±4.61475dB (95% confidence)
Radiated Emission (1 GHz to 18 GHz), 3 meter	±4.36 dB (95% confidence)
Radiated Emission (18 GHz to 26 GHz), 3 meter	±4.73 dB (95% confidence)
Conducted Emission (150kHz to 30MHz)	±2.723 dB (95% confidence)



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2.5 ENVIRONMENTAL CONDITION

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

Temperature (deg C)	22°C ± 3°C
Relative Humidity (% RH)	55% ± 5%
Pressure(mbar)	860 to 1060

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3 EQUIPMENT UNDER TEST (EUT)

3.1 DESCRIPTION OF THE EUT

The QL KeyFob alerts your Smartphone/Tablet if you are separated from your house/car keys/bag, via the supporting QL-Find app. The range is extendable from 5 meters up to 20 meters and uses the last seen location service or near/far gauge to locate your valuables. It has a built-in 'FindMe', alert button that will assist if you have misplaced your Smartphone/Tablet.

3.2 SOFTWARE AND FIRMWARE DETAILS

QL-Find I-OS Application

3.3 ANTENNA DETAILS

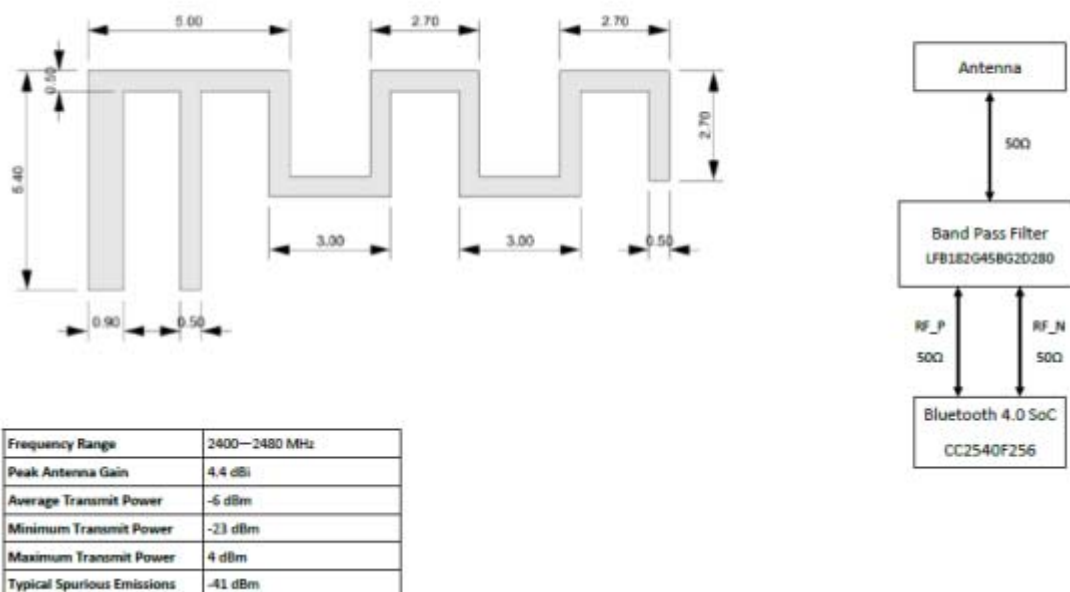


Figure 1: Antenna Specification of key Fob

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3.4 PRODUCT CONFIGURATION DETAILS

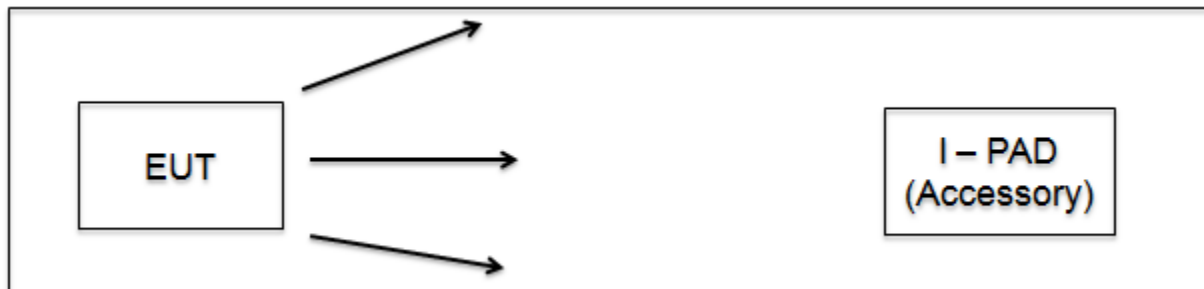


Figure 2: EUT Configuration

[Figure 2](#) shows the product configuration during the tests. EUT (KeyFob) was programmed to continuously communicate with the I-Pad (Accessory). EUT was connected to I-Pad using '**QL-Find**' I-OS Application.

During Radiated Emission measurements, I-Pad was kept away from the Receiving antenna, at a distance of 11 m to 12m from the EUT and connection was established.

During all the other tests, I-Pad was kept in proximity to the EUT and connection was established.

3.5 TEST SETUP DETAILS

3.5.1 SUPPORTING EQUIPMENT

Item	Manufacturer	Model Number	Serial Number	FCC ID
Laptop	Lenovo	S10-3	QB00332921	NA
IPad-3	Apple	MC705B/A	DYVHHMH8DJ8T	NA

3.5.2 I/O CABLES AND CONNECTORS

Item	Connector	Cable type	Cable length
USB cable	Type A to Micro USB	Unshielded	0.8m

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3.5.3 TEST SETUP DETAILS

3.5.3.1 RADIATED EMISSION

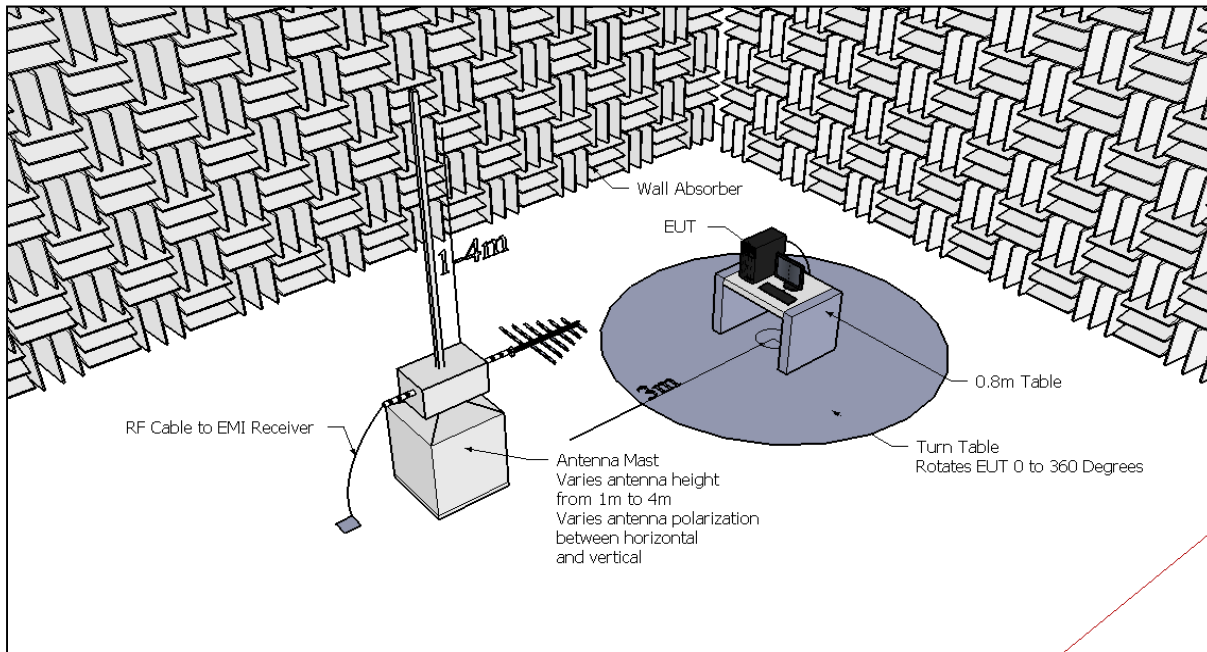


Figure 3: Sample test setup for Radiated measurements

3.5.3.2 CONDUCTED MEASUREMENT

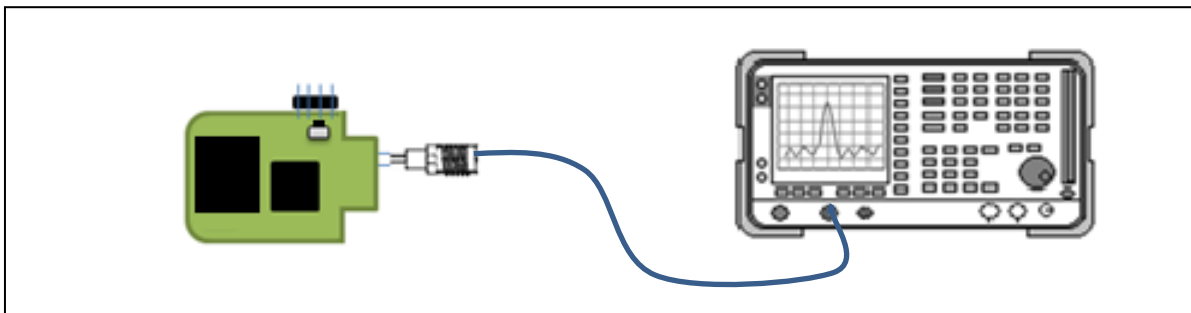


Figure 4: Test setup for Conducted measurements on the EUT antenna port

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3.5.3.3 CONDUCTED EMISSION TEST SETUP

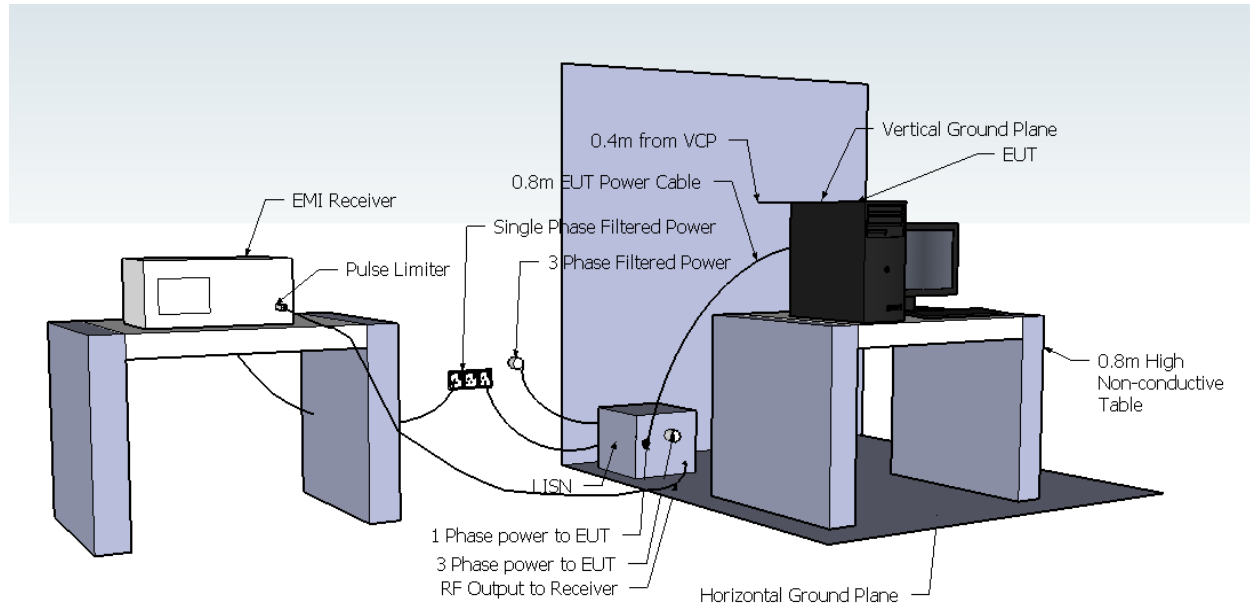


Figure 5: Sample test setup for Conducted Emission measurements

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4 INSTRUMENTATION AND CALIBRATION

4.1 TEST AND MEASURING EQUIPMENT

The following list contains measuring equipment's used for testing. The equipment's confirm to the required standards. Calibration of all test and measuring equipment's 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	Manufacturer	Model No	Serial No	Calibration Due
EMI Test Receiver	R&S	ESIB40	100306	25 th Sep 2014
Spectrum Analyzer	Agilent Technologies	E4407B	MY45112947	01 st Apr 2014
Hybrid Log Periodic Antenna	TDK RF Solutions	HLP-3003C	130334	17 th Jul 2014
Double Ridge Broadband Horn Antenna	Schwarzbeck Mess Elektronik	BBHA9120D	9120D-687	23 rd Jul 2014
Broadband Horn Antenna	Schwarzbeck Mess Elektronik	BBHA9170	9170-344	05 th Apr 2014
Pre-Amplifier	SONOMA	310	270817	30 th May 2014
Pre-Amplifier	TDK RF Solutions	PA-02	100008	30 th May 2014
Pre-Amplifier	TDK RF Solutions	PA-02-2	2007331	05 th Apr 2014
V-LISN	Schwarzbeck Mess Elektronik	NSLK 8128	8128-243	11 th Jul 2014

Table 1: List of equipment used for testing

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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 47 CFR, Part 15	Conducted Emission	15.207	Yes	Product
2	FCC 47 CFR, Part 15	Radiated Emission	15.209	Yes	Product
3	FCC 47 CFR, Part 15	Operation within the bands 2400 - 2483.5 MHz (Conducted)	15.247	Yes	Antenna Port
4	FCC 47 CFR, Part 15	Operation within the bands 2400 - 2483.5 MHz (Radiated)	15.249	Yes	Product
5	FCC 47 CFR, Part 15	Maximum Peak Output Power	15.247 (b) (1)	Yes	Antenna Port
6	FCC 47 CFR, Part 15	Conducted Spurious Emission	15.247 (c)	Yes	Antenna Port
7	FCC 47 CFR, Part 15	Band Edge measurement (Conducted)	15.247 (c)	Yes	Antenna Port
8	FCC 47 CFR, Part 15	Antenna Requirement	15.203	Yes	Complied

S. No	Standard	Name of the test	Section of standard	Applicability	Port
1	RSS-GEN	Conducted Emission	7.2.2	Yes	Product
2	RSS-210, Issue 8 RSS-Gen, Issue 2	Radiated Emission	2.9 6	Yes	Product
3	RSS-210, Issue 8	Operation within the bands 2400 - 2483.5 MHz (Conducted)	A8.1 (b)	Yes	Antenna Port
4	RSS-210, Issue 8	Operation within the bands 2400 - 2483.5 MHz (Radiated)	A2.9	Yes	Product
5	RSS-210, Issue 8	Peak Conducted Output Power	A8.4 (2)	Yes	Antenna Port
6	RSS-210, Issue 8	Conducted Spurious Emission	A8.5	Yes	Antenna Port
7	RSS-210, Issue 8	Band Edge measurement (Conducted)	A8.5	Yes	Antenna Port
8	RSS-GEN	Occupied Bandwidth	4.6.1	Yes	Antenna Port

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6 TEST RESULTS

6.1 CONDUCTED EMISSION

6.1.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Frequency range	Quasi Peak Limit (dB μ V/m)	Average Limit (dB μ V/m)
FCC 47 CFR, Part 15, Subpart C	15.207	150kHz to 500kHz 500kHz to 5MHz 5MHz to 30MHz	66.0 to 56.0* 56.0 60.0	56.0 to 46.0* 46.0 50.0

Standard	Reference section	Frequency range	Quasi Peak Limit (dB μ V/m)	Average Limit (dB μ V/m)
RSS-GEN	7.2.4	150kHz to 500kHz 500kHz to 5MHz 5MHz to 30MHz	66.0 to 56.0* 56.0 60.0	56.0 to 46.0* 46.0 50.0

* indicates the value to be decreasing logarithmically with respect to frequency.

6.1.2 TEST PROCEDURE

S. No	Procedure
1	Test procedure is as per ANSI C63.4: 2009
2	EUT is placed on a 0.8m non-conductive table with vertical & horizontal ground plane bonded together.
3	EUT is powered through USB port of the Laptop connected via LISN (50 Ω /50 μ H), with an AC supply of 230V/50Hz.
4	EUT is configured to function with the normal mode of operation
5	Average & peak scan was carried out from 150 kHz to 30 MHz
6	The highest level of Conducted Emission was recorded
7	Quasi-peak and final Average measurements were carried out at the identified peaks for <30MHz
8	These values are compared against the limit specified by the standard

6.1.3 RESULT

Parameter	Limit	Measured	Result
Conducted Emission	Refer 6.2.1	Refer 6.2.4	Pass

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6.1.1 RESULT (SUPPORTING GRAPHS / DATA)

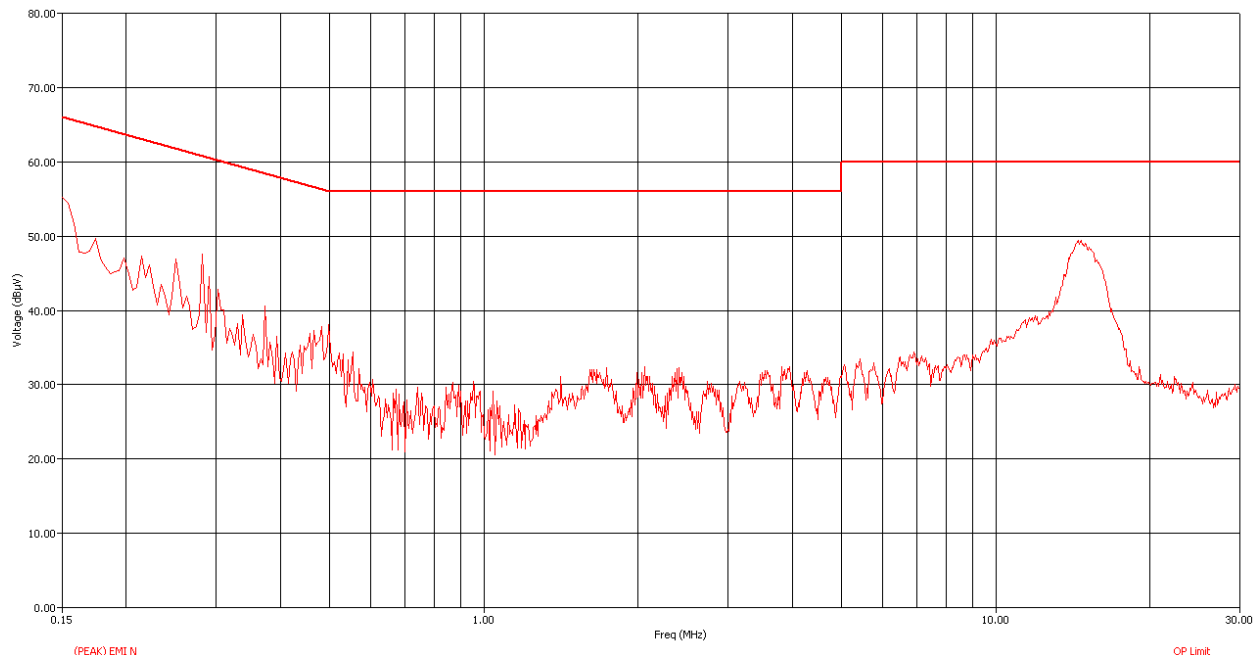


Figure 6: Conducted Emission -Peak – Neutral – 150 kHz to 30 MHz

Freq (MHz)	Freq (Max) (MHz)	Line	(QP) Trace (dBμV)	Cable + Pulse Limiter (dB)	Transducer N (dB)	(QP) EMI (dBμV)	QP Limit (dBμV)	(QP) Margin (dB)
0.15	0.15	N	35.20	9.81	0.15	45.16	65.84	-20.68
0.25	0.25	N	26.99	9.70	0.14	36.83	61.75	-24.92
0.28	0.28	N	21.62	9.69	0.14	31.45	60.89	-29.43
0.29	0.29	N	20.93	9.69	0.14	30.76	60.57	-29.80
0.30	0.30	N	21.95	9.69	0.14	31.78	60.21	-28.42
0.34	0.33	N	17.23	9.76	0.14	27.13	59.41	-32.28
0.37	0.37	N	16.08	9.80	0.14	26.02	58.52	-32.50
0.39	0.40	N	16.14	9.80	0.14	26.08	57.93	-31.85
0.50	0.50	N	25.42	9.86	0.14	35.42	56.05	-20.63
14.67	14.67	N	29.52	10.23	2.66	42.41	60.00	-17.59

Figure 7: Conducted Emission - Quasi Peak Table – Neutral– 150 kHz to 30 MHz

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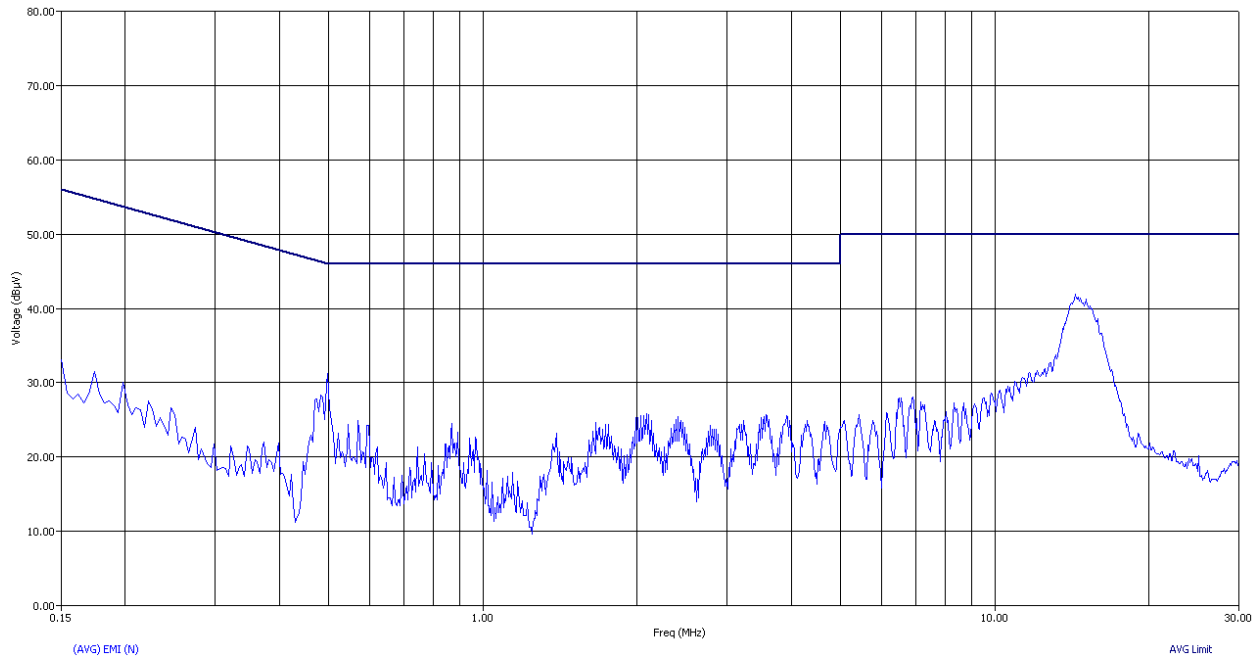


Figure 8: Conducted Emission – Average – Neutral– 150 kHz to 30 MHz

Freq (MHz)	Freq (Max) (MHz)	Line	(AVG) Trace (dBµV)	Cable + Pulse Limiter (dB)	Transducer N (dB)	(AVG) EMI (dBµV)	Avg Limit (dBµV)	(AVG) Margin (dB)
0.15	0.15	N	18.92	9.81	0.15	28.88	55.84	-26.96
0.25	0.25	N	15.61	9.70	0.14	25.45	51.75	-26.30
0.28	0.28	N	9.70	9.69	0.14	19.54	50.89	-31.35
0.29	0.29	N	9.20	9.69	0.14	19.03	50.57	-31.54
0.30	0.30	N	9.03	9.69	0.14	18.86	50.21	-31.35
0.34	0.33	N	7.58	9.76	0.14	17.48	49.41	-31.93
0.37	0.37	N	10.03	9.80	0.14	19.97	48.52	-28.55
0.39	0.40	N	11.73	9.80	0.14	21.67	47.93	-26.25
0.50	0.50	N	22.21	9.86	0.14	32.21	46.05	-13.84
14.67	14.67	N	24.74	10.23	2.66	37.63	50.00	-12.37

Figure 9: Conducted Emission – Average Table – Neutral– 150 kHz to 30 MHz

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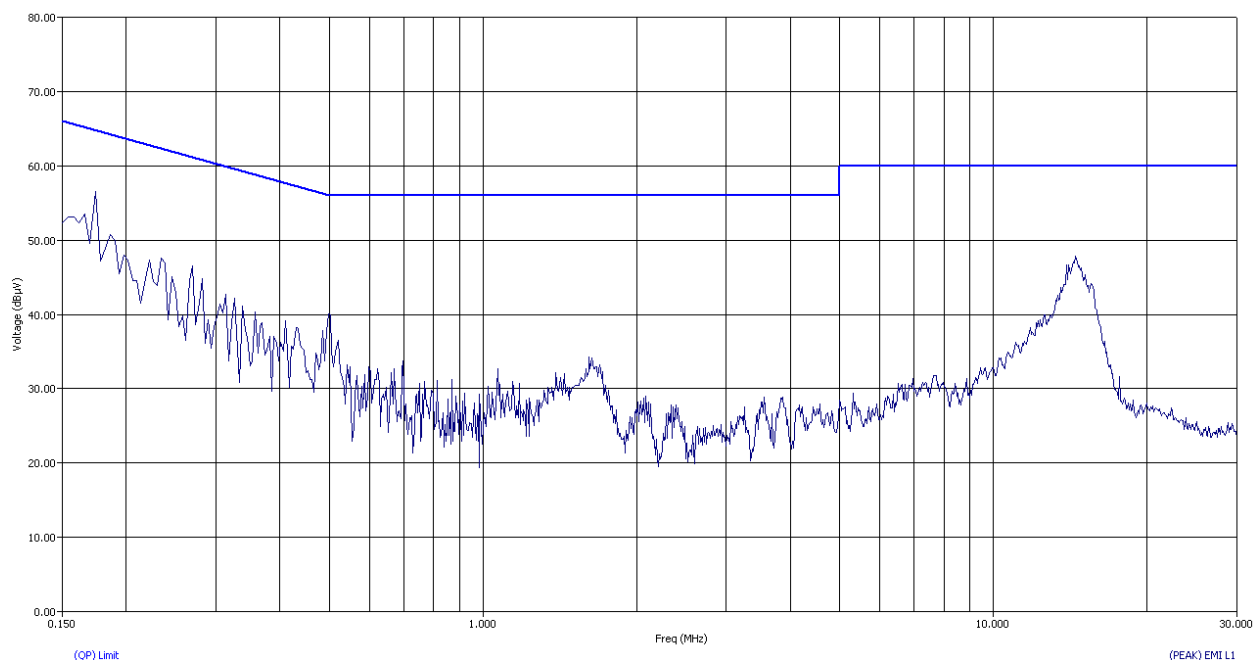


Figure 10: Conducted Emission -Peak – Line– 150 kHz to 30 MHz

Freq (MHz)	Freq (Max) (MHz)	Line	(QP) Trace (dBµV)	Cable + Pulse Limiter (dB)	Transducer L1 (dB)	(QP) EMI (dBµV)	(QP) Limit (dBµV)	(QP) Margin QPL (dB)
0.17	0.18	L1	30.59	9.82	0.09	40.50	64.38	-23.88
0.27	0.28	L1	24.39	9.69	0.08	34.17	60.93	-26.76
0.33	0.31	L1	18.78	9.72	0.08	28.58	59.85	-31.27
0.34	0.33	L1	18.15	9.76	0.08	27.99	59.40	-31.41
0.41	0.41	L1	16.91	9.80	0.08	26.78	57.68	-30.90
0.43	0.42	L1	18.62	9.80	0.08	28.50	57.40	-28.90
0.50	0.50	L1	26.45	9.86	0.09	36.40	56.04	-19.64
0.70	0.70	L1	8.79	9.85	0.09	18.73	56.00	-37.27
1.61	1.61	L1	17.24	9.95	0.13	27.32	56.00	-28.68
14.46	14.47	L1	29.84	10.23	1.03	41.10	60.00	-18.90

Figure 11: Conducted Emission - Quasi Peak Table – Line– 150 kHz to 30 MHz

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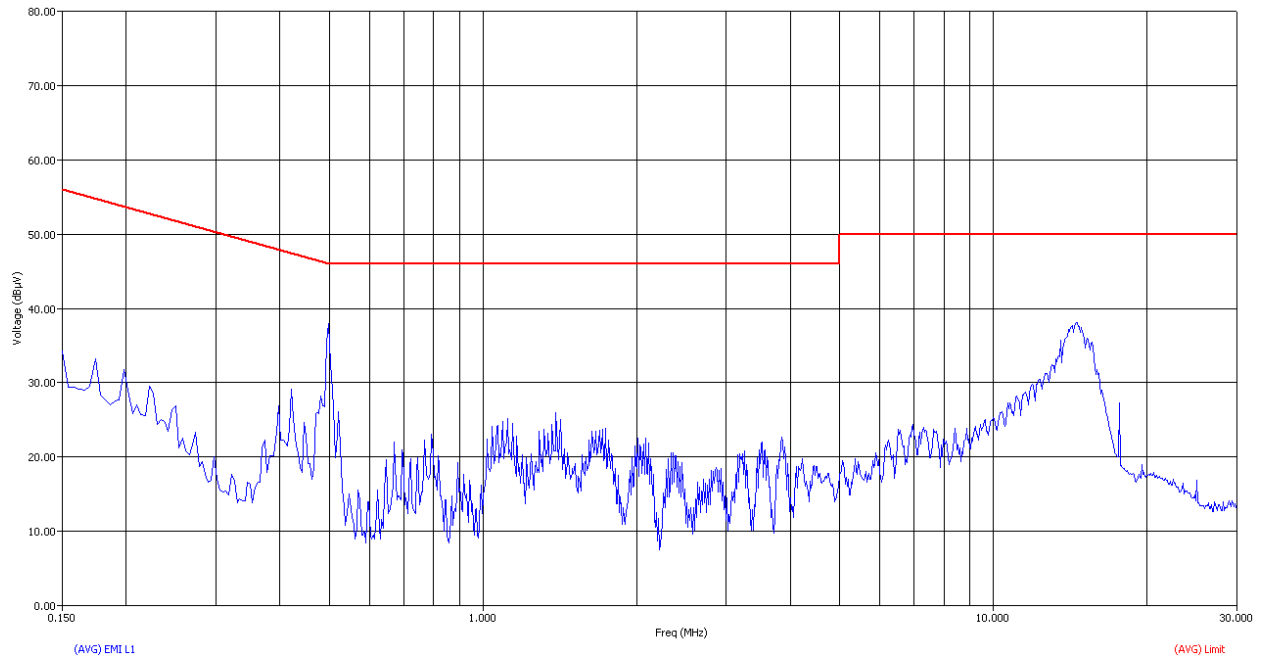


Figure 12: Conducted Emission -Average – Line– 150 kHz to 30 MHz

Freq (MHz)	Freq (Max) (MHz)	Line	(AVG) Trace (dBμV)	Cable + Pulse Limiter (dB)	Transducer L1 (dB)	(AVG) EMI (dBμV)	(AVG) Limit (dBμV)	(AVG) Margin AVL (dB)
0.17	0.18	L1	16.70	9.82	0.09	26.60	54.38	-27.77
0.27	0.28	L1	9.21	9.69	0.08	18.99	50.93	-31.94
0.33	0.31	L1	3.20	9.72	0.08	13.00	49.85	-36.86
0.34	0.33	L1	1.88	9.76	0.08	11.72	49.40	-37.67
0.41	0.41	L1	12.66	9.80	0.08	22.54	47.68	-25.14
0.43	0.42	L1	15.37	9.80	0.08	25.24	47.40	-22.16
0.50	0.50	L1	23.85	9.86	0.09	33.80	46.04	-12.25
0.70	0.70	L1	3.94	9.85	0.09	13.88	46.00	-32.12
1.61	1.61	L1	10.07	9.95	0.13	20.14	46.00	-25.86
14.46	14.47	L1	24.70	10.23	1.03	35.96	50.00	-14.04

Figure 13: Conducted Emission – Average Table – Line– 150 kHz to 30 MHz

Note:

$(QP) \text{ EMI (dB}\mu\text{V)} = (QP) \text{ Trace (dB}\mu\text{V)} + \text{Transducer (dB)} + \{\text{Cable} + \text{Pulse limiter}\} \text{ (dB)}$

$QP \text{ Margin QPL (dB)} = (QP) \text{ EMI (dB}\mu\text{V)} - (QP) \text{ Limit (dB}\mu\text{V)}$

$(AVG) \text{ EMI (dB}\mu\text{V)} = (AVG) \text{ Trace (dB}\mu\text{V)} + \text{Transducer (dB)} + \{\text{Cable} + \text{Pulse limiter}\} \text{ (dB)}$

$AVG \text{ Margin AVL (dB)} = (AVG) \text{ EMI (dB}\mu\text{V)} - (AVG) \text{ Limit (dB}\mu\text{V)}$

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6.2 RADIATED EMISSION

6.2.1 REFERENCE SECTION & LIMITS

6.2.1.1 LIMITS FOR RADIATED EMISSIONS

Standard	Reference section	Frequency range	Limit (dB μ V/m) at 3 meter
FCC 47 CFR, Part 15	15.209	9kHz to 490kHz	128.5 to 93.8
		490kHz to 1.705MHz	73.8 to 62.79
		1.705MHz to 30MHz	69.542

Standard	Reference section	Frequency range	Limit (dB μ V/m) at 3 meter
FCC 47 CFR, Part 15	15.209	30 MHz to 88 MHz	29.55
		88 MHz to 216 MHz	33.05
		216 MHz to 960 MHz	35.55
		960 MHz to 1 GHz	43.55

Standard	Reference section	Frequency range	Limit (dB μ V/m) at 3 meter
FCC 47 CFR, Part 15	15.209	Above 1GHz	54

6.2.1.2 LIMITS FOR RECEIVER SPURIOUS

Standard	Reference section	Frequency range	Limit (dB μ V/m) at 3 meter
RSS-GEN	6	30 MHz to 88 MHz	29.55
		88 MHz to 216 MHz	33.05
		216 MHz to 960 MHz	35.55
		960 MHz to 1 GHz	43.55

Standard	Reference section	Frequency range	Limit (dB μ V/m) at 3 meter
RSS-GEN	6	Above 1GHz	54

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6.2.2 TEST PROCEDURE

S. No	Procedure
1	Test procedure is as per ANSI C63.4: 2009
2	EUT is placed on a 0.8m non-conductive table. This table is positioned on an automated turn table.
3	Antennas are positioned 10m away from the EUT for frequency between 30MHz to 1GHz and at 3m for frequencies above 1GHz and below 30MHz.
4	EUT is configured to function with the normal mode of operation
5	A peak scan and average 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 30MHz to 1GHz and Average measurements were carried out above 1GHz and below 30MHz
8	These values are compared against the limit specified by the standard

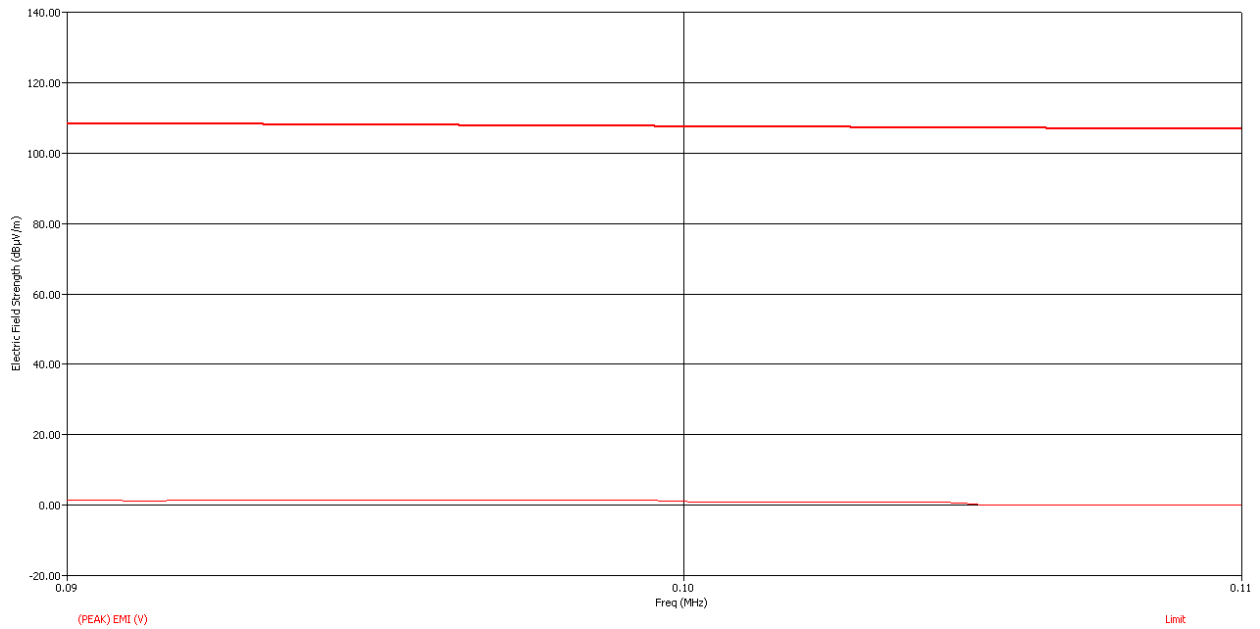
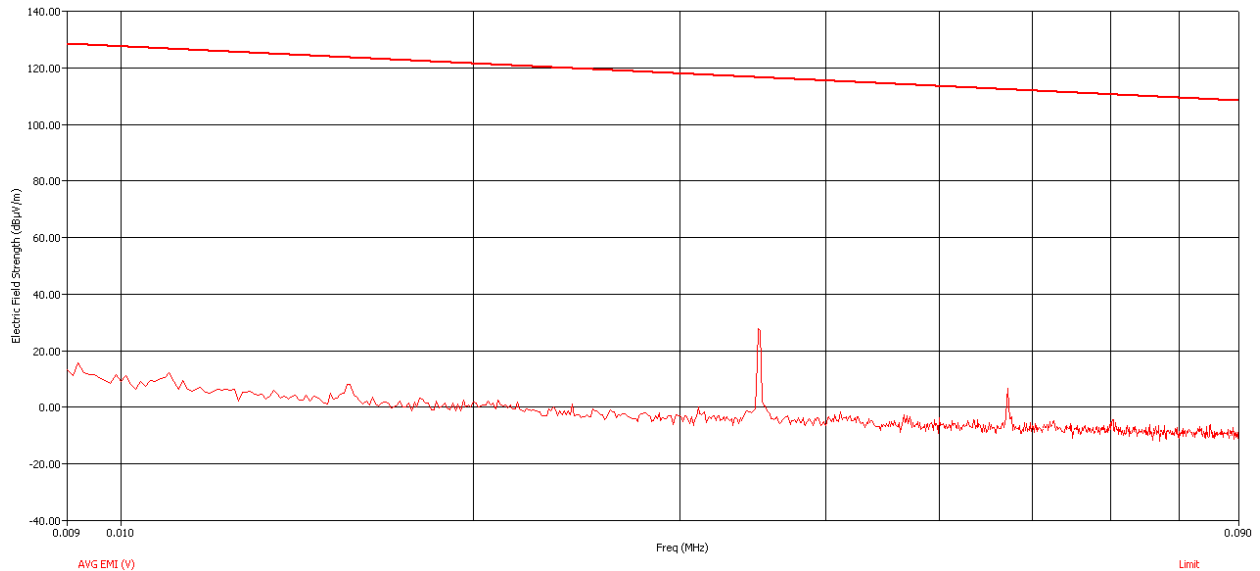
6.2.3 RESULT

Parameter	Limit	Measured	Result
Radiated Emission	Refer 6.3.1	Refer 6.3.4	Pass

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6.2.4 RESULT (SUPPORTING GRAPHS / DATA)



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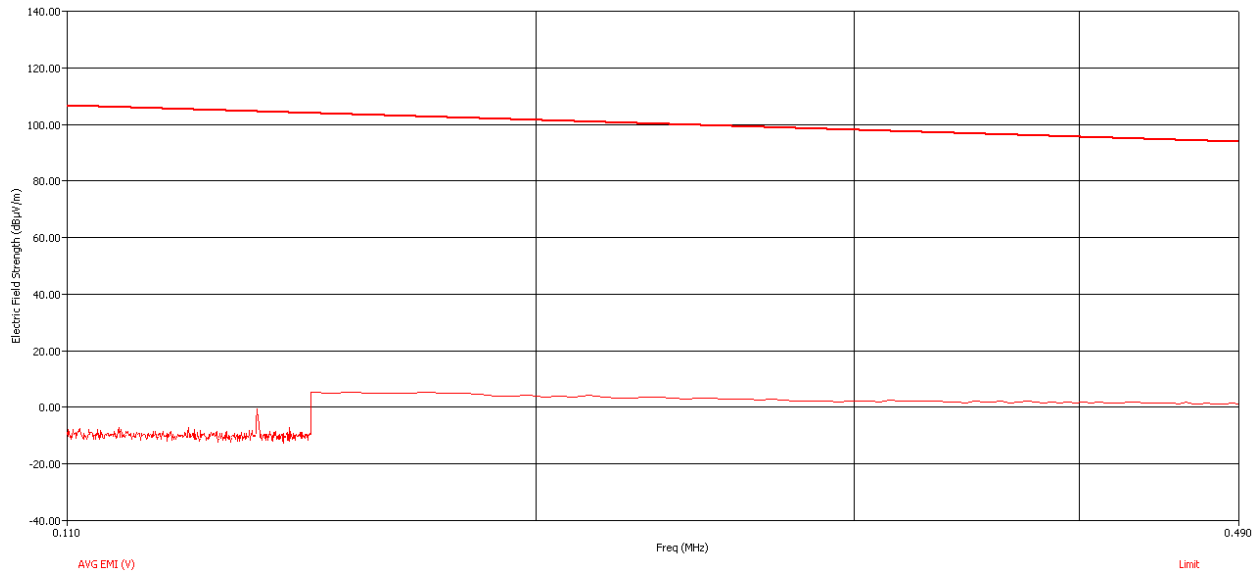


Figure 16: Radiated Emission (Average) – Vertical polarization – 110 kHz to 490 kHz

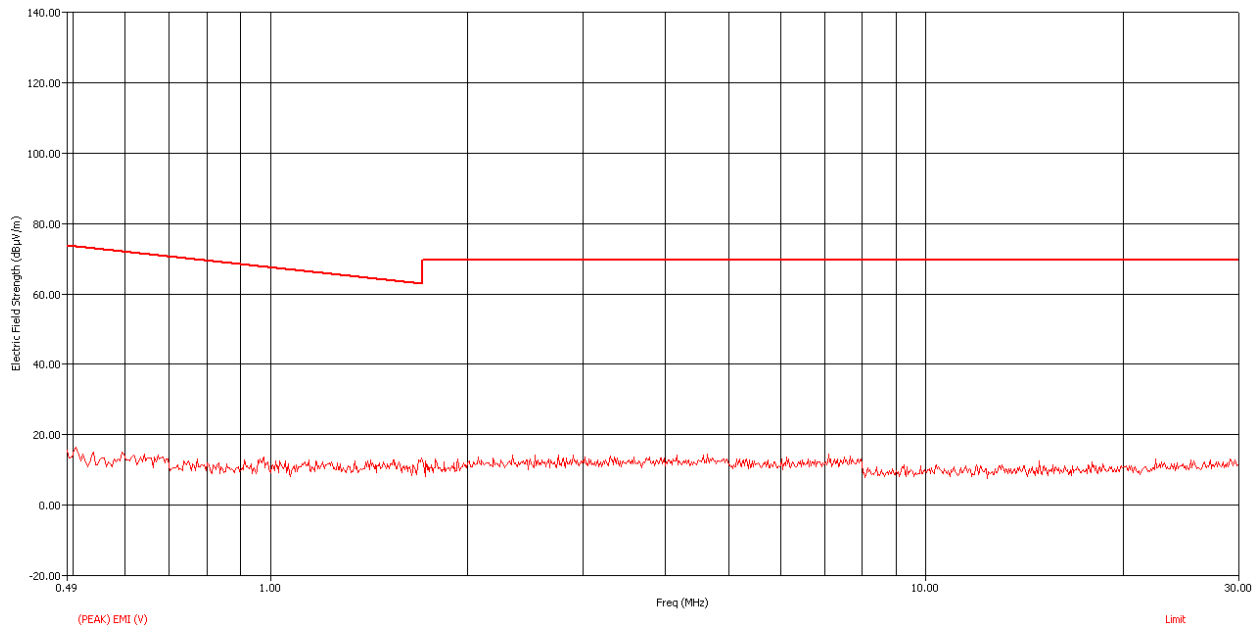


Figure 17: Radiated Emission (Peak) – Vertical polarization – 490 kHz to 30 MHz

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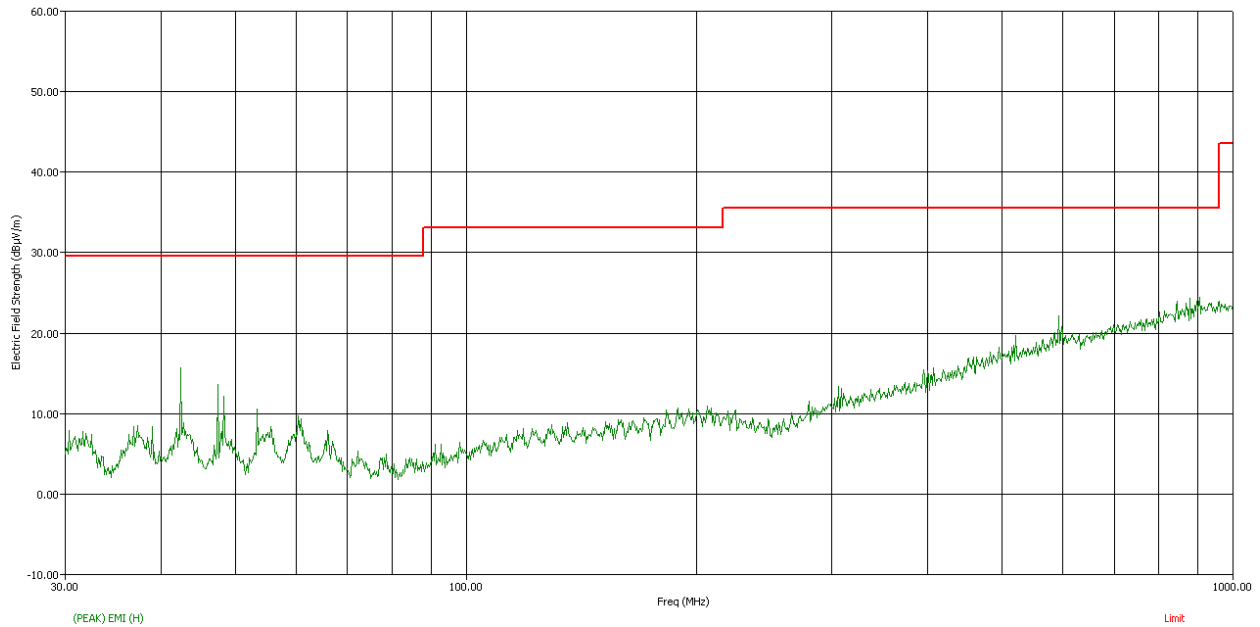


Figure 18: Radiated Emission (Peak) – Horizontal polarization – 30 MHz to 1 GHz

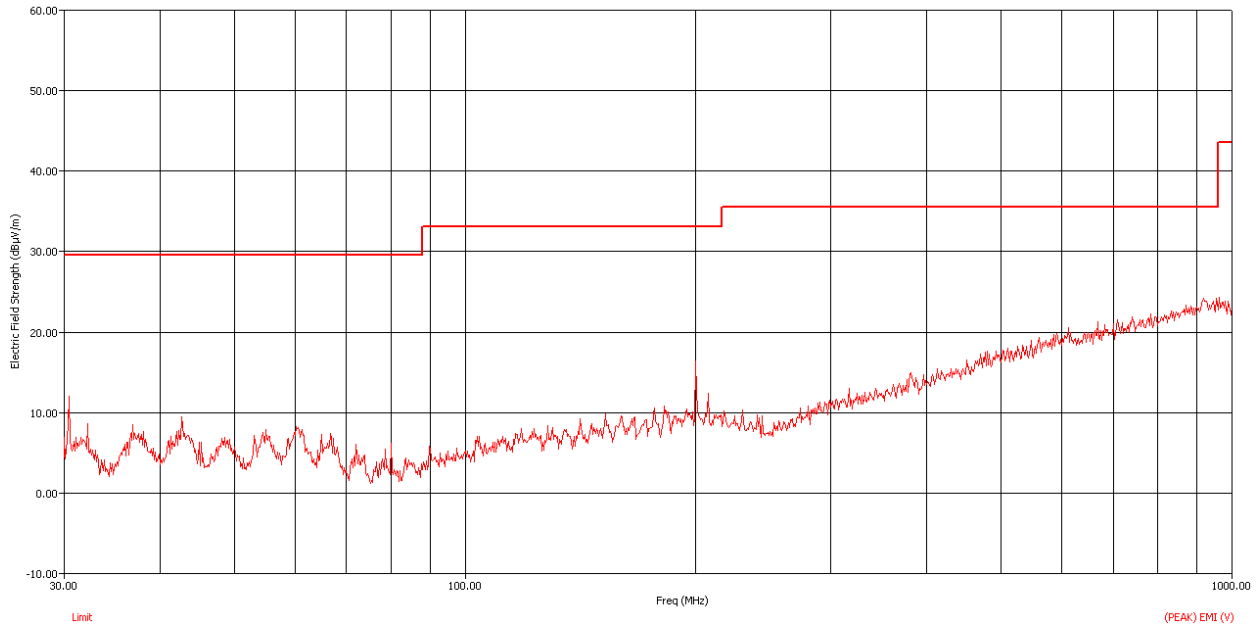


Figure 19: Radiated Emission (Peak) – Vertical polarization – 30 MHz to 1 GHz

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Freq	Freq (Max)	Pol	EUT Ttbl Agl	Twr Ht	(QP) Trace	Cable	Transducer	Preamp	(QP) EMI	Limit	(QP) Margin
(MHz)	(MHz)		(deg)	(cm)	(dBμV)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
30.48	30.56	V	267.60	347.00	25.32	1.07	11.21	32.04	5.56	29.54	-23.98
42.44	42.49	H	31.40	129.00	22.90	1.25	11.73	32.08	3.80	29.54	-25.74
47.52	47.52	H	7.40	111.00	21.88	1.33	10.88	32.09	2.00	29.54	-27.54
48.32	48.33	H	122.10	393.00	24.34	1.34	10.75	32.10	4.33	29.54	-25.21
200.00	200.04	V	313.00	343.00	22.35	2.70	13.07	32.00	6.12	33.06	-26.94
207.24	207.29	V	324.60	298.00	22.54	2.76	12.67	32.00	5.97	33.06	-27.09
592.16	592.08	H	182.60	313.00	25.67	4.68	19.51	32.10	17.76	35.56	-17.80
756.90	756.99	H	317.30	160.00	25.32	5.27	20.73	31.98	19.34	35.56	-16.22

Figure 20: Radiated Emission – Quasi-peak table - 30 MHz to 1 GHz

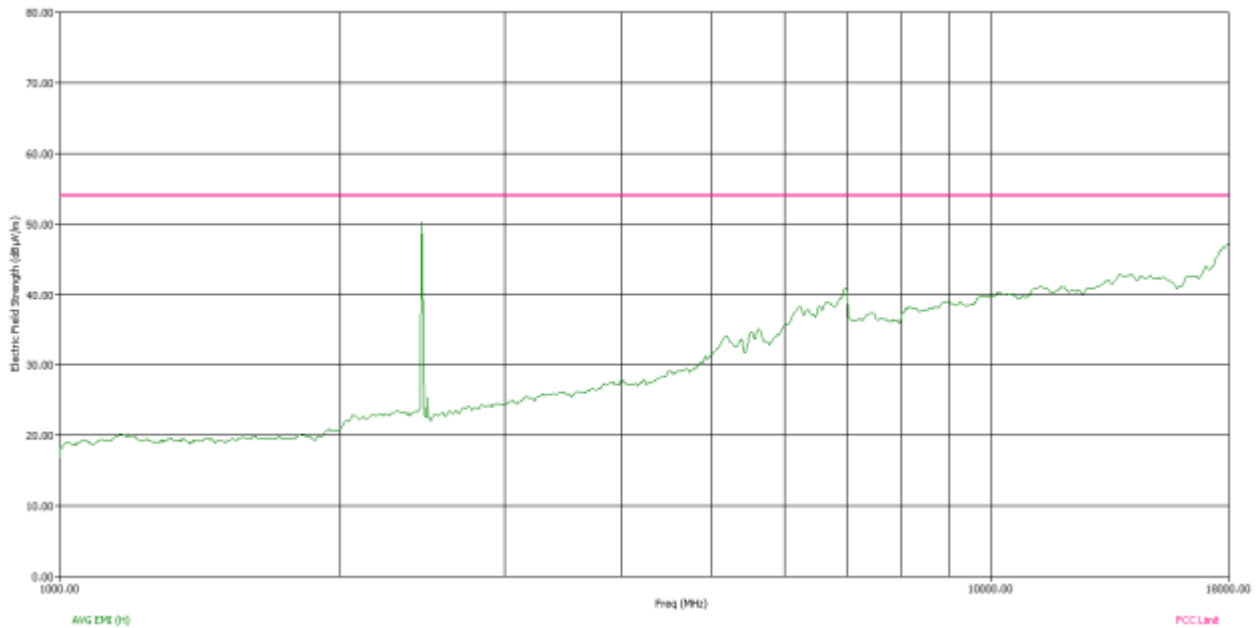


Figure 21: Radiated Emission (Average) – Horizontal polarization 1 GHz to 18 GHz

Note: The peak seen in the above graph is from the Bluetooth carrier, which is intentional

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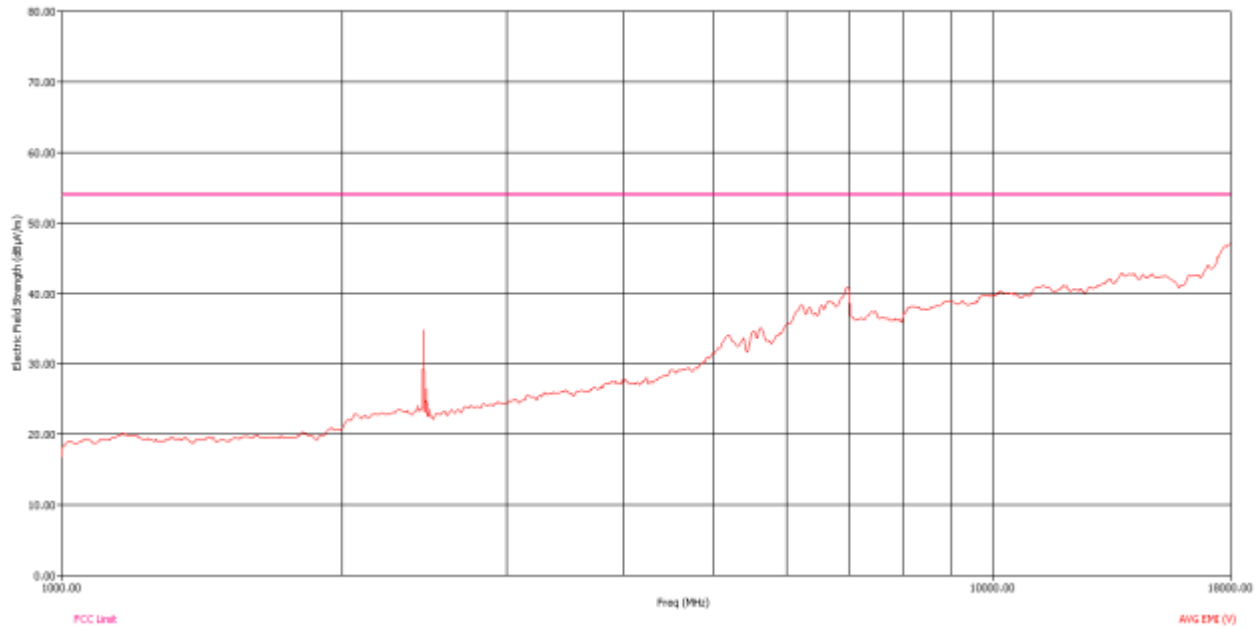


Figure 22: Radiated Emission (Average) – Vertical polarization – 1 GHz to 18 GHz

Note: The peak seen in the above graph is from the Bluetooth carrier, which is intentional

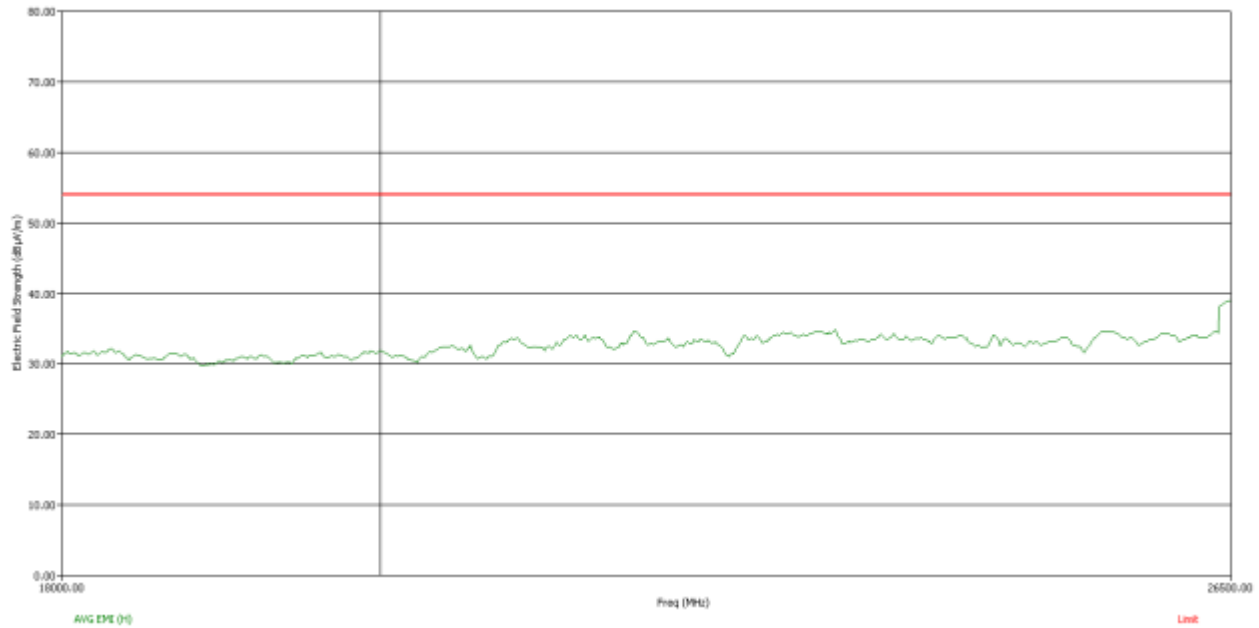


Figure 23: Radiated Emission (Average) – Horizontal polarization 18GHz to 26.5GHz

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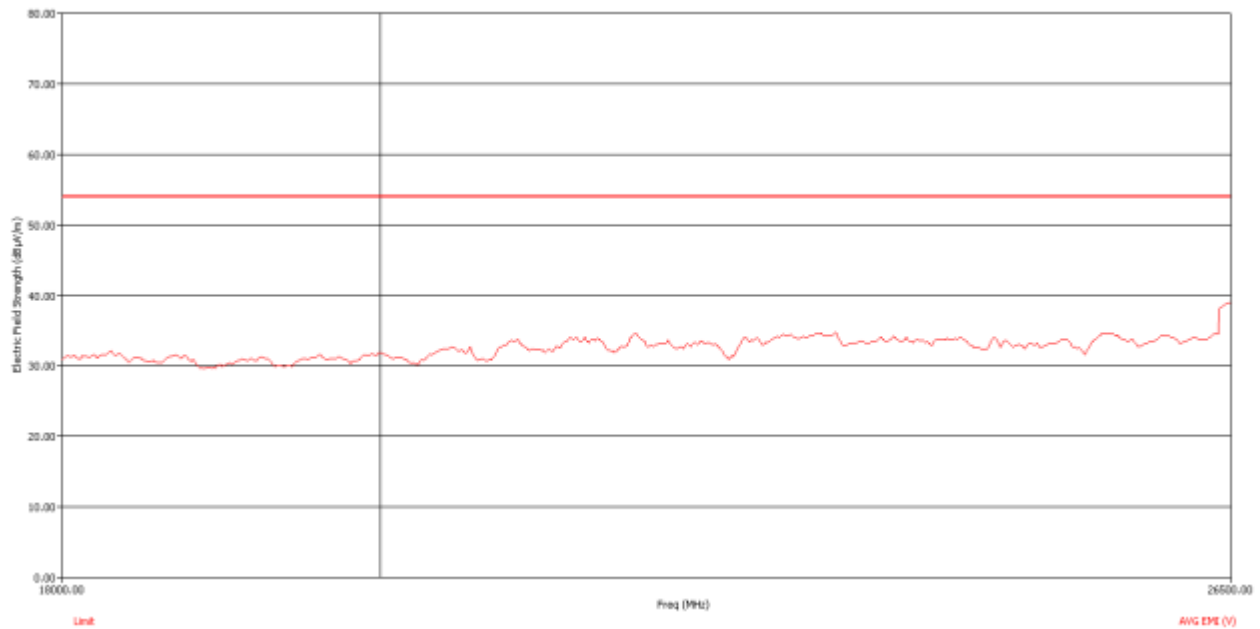


Figure 24: Radiated Emission (Average) – Vertical polarization – 18GHz to 26.5GHz

Note:

$QP\ EMI\ (dB\mu V/m) = QP\ Trace\ (dB\mu V) + Cable\ (dB) + Transducer\ (dB/m) - Preamp\ (dB)$

$QP\ Margin\ (dB) = QP\ EMI\ (dB\mu V) - Limit\ (dB\mu V/m)$

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6.3 OPERATION WITHIN THE BANDS (CONDUCTED)

6.3.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limits
FCC 47 CFR, Part 15	15.247 (a) (1)	25 kHz or two thirds of 20 dB bandwidth of the hopping channel, whichever is greater

Standard	Reference section	Limits
RSS-210	A8.1 (b)	25 kHz or two thirds of 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 and identify the carrier envelop in the Spectrum Analyzer
3	Record the peak frequency and identify the 20db bandwidth of this envelop
4	Record the frequency
5	If the calculated 20dB bandwidth of channel is greater than 25 kHz, then compare the calculated separation between the 2 channels with the 20dB bandwidth and declare the result.

6.3.3 RESULT

Channel no	Lower Frequency (GHz)	Higher Frequency (GHz)	Measured 20dB B/W	Result
37	2.402	2.403	1.1 MHz	Pass
38	2.426	2.412	1.142 MHz	Pass
39	2.480	2.422	1.208 MHz	Pass

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6.3.4 RESULT (SUPPORTING GRAPHS / DATA)

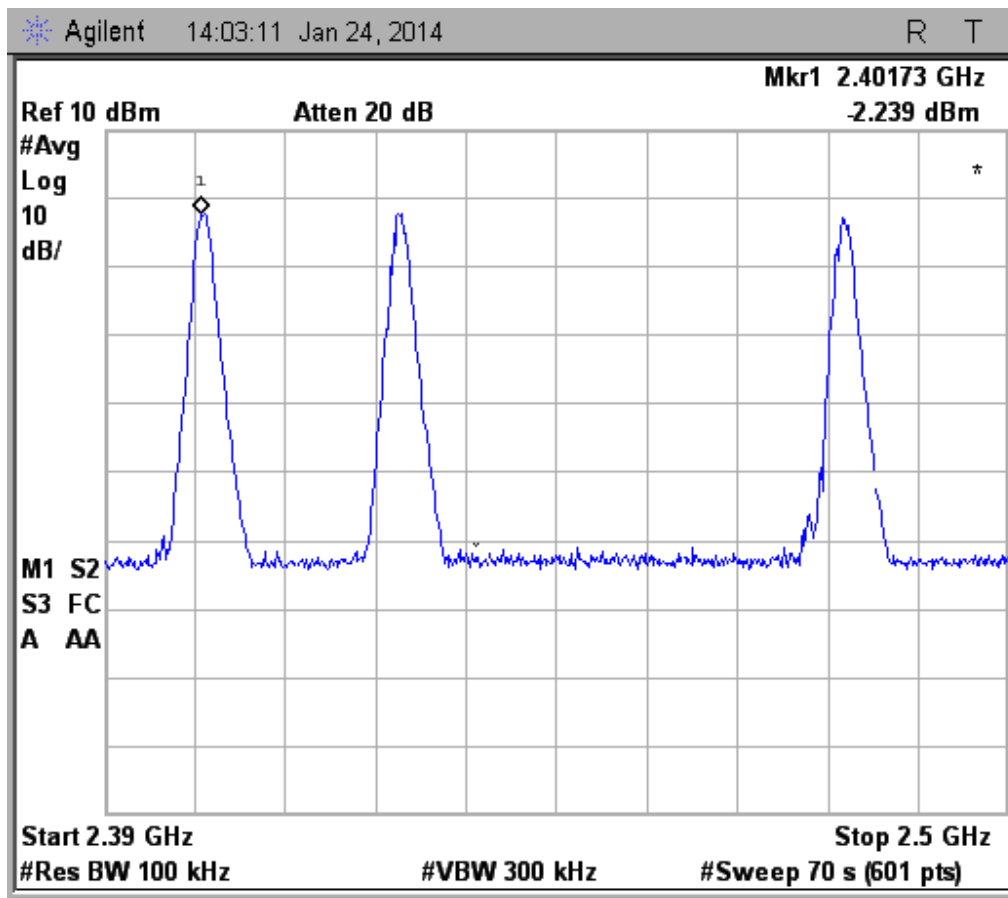


Figure 25: Operation within the Bands - Conducted– Channel 37, 38 & 39

Note: The Equipment uses only 3 advertising channels for hopping and communicating, no data channels are used.

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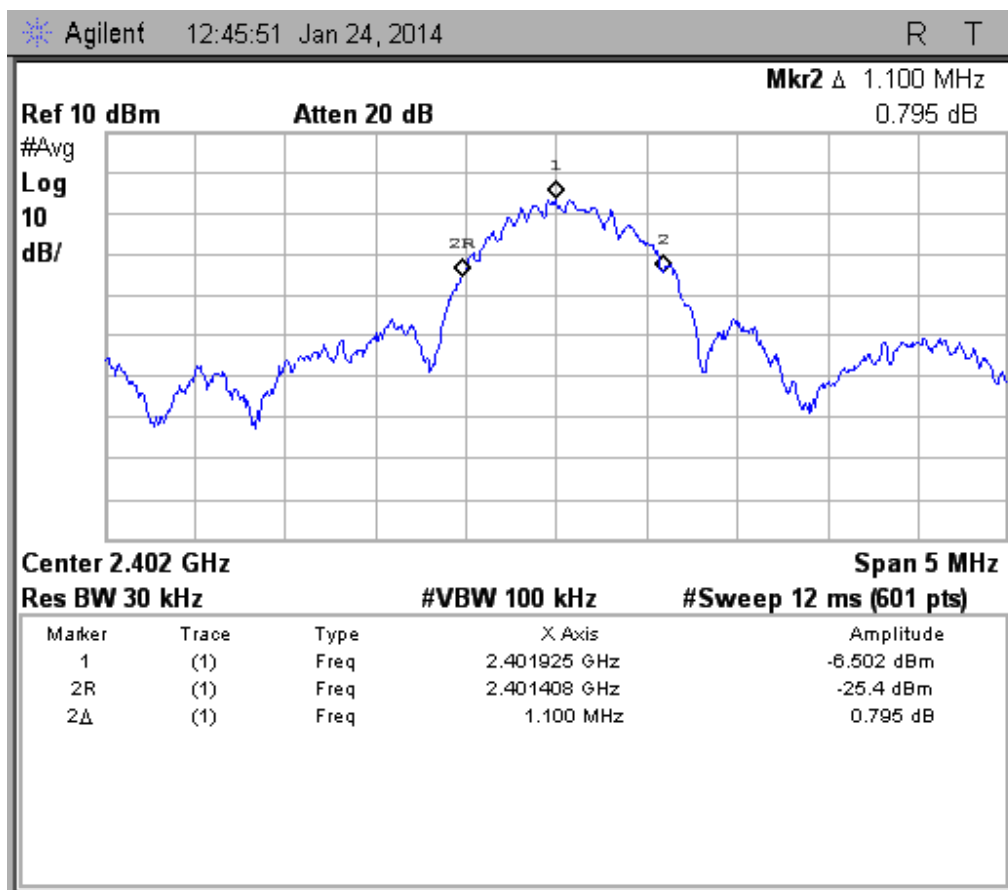


Figure 26: Operation within the Bands - Conducted – Channel 37

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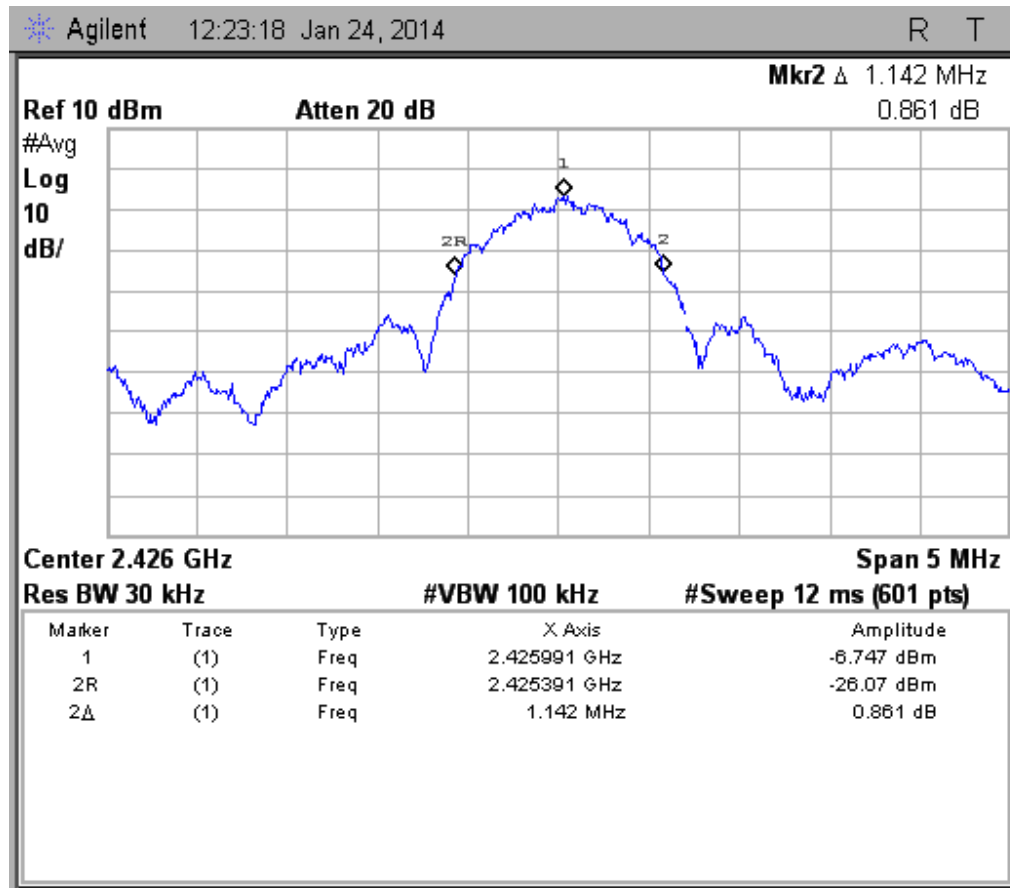


Figure 27: Operation within the Bands - Conducted – Channel 38

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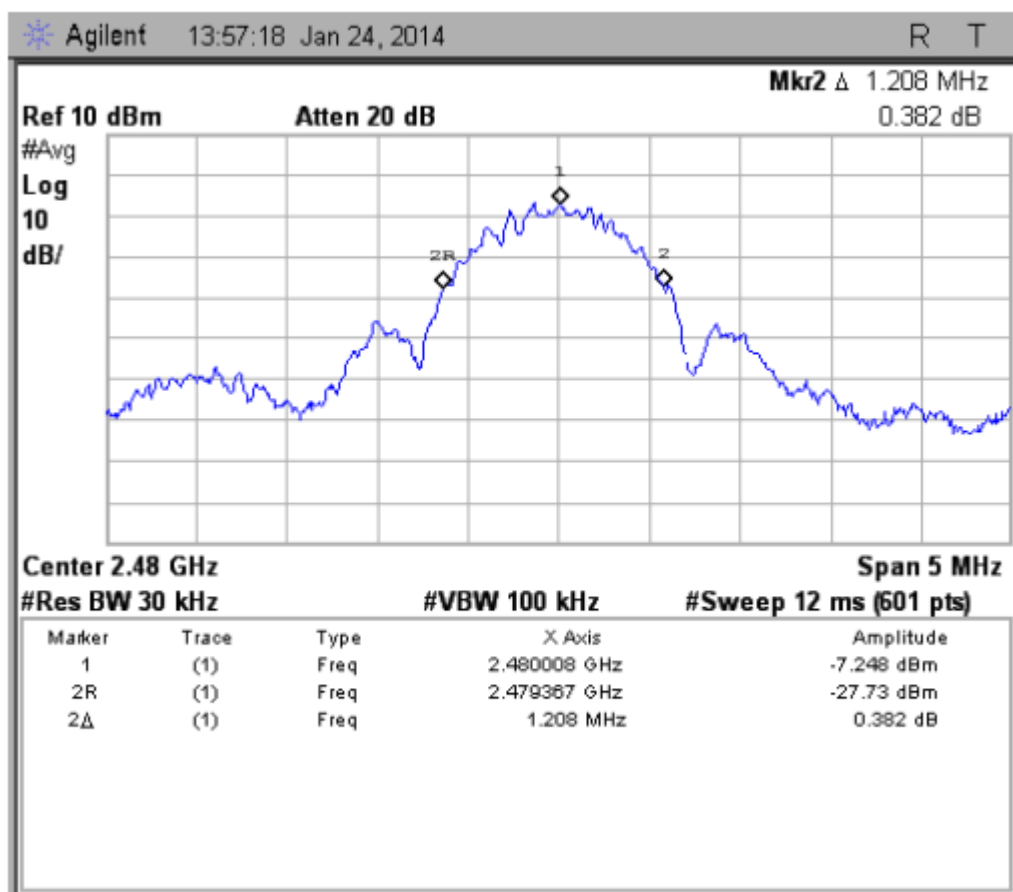


Figure 28: Operation within the Bands - Conducted – Channel 39

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6.4 OPERATION WITHIN THE BANDS (RADIATED)

6.4.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limits
FCC 47 CFR, Part 15	15.249 (a)	50 mV/m (93.97 dB μ V/m) for Fundamental 500 μ V/m (53.97dB μ V/m) for Harmonics.

Standard	Reference section	Limits
RSS-210	A2.9	50 mV/m (93.97 dB μ V/m) for Fundamental 500 μ V/m (53.97dB μ V/m) for Harmonics

6.4.2 TEST PROCEDURE

S. No	Procedure
1	The Radiated Emission test was performed inside a Shielded Semi-Anechoic chamber
2	The EUT was placed on a 0.8m height nonmetallic table on a rotating turn table to enable 0 to 360 degrees rotation
3	The receiving antenna was mounted on an antenna mast to enable height variation from 1 to 2 meter above the ground plane.
4	The EUT is configured via link establishment between EUT and auxiliary equipment
5	The measurement is taken by rotating the turn table from 0 to 360 degree and with the antenna height variation of 1 mtr to 2 meter in both vertical and horizontal polarization
6	Record the peak frequency and identify the level

6.4.3 RESULT

Frequency Range (MHz)	Result
2400 to 2483.5	Pass
Harmonics	Pass (No Harmonics were observed)

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6.4.4 RESULT (SUPPORTING GRAPHS / DATA)



Figure 29: Operation within the Bands (Fundamental radiators) – Radiated – Horizontal



Figure 30: Operation within the Bands (Fundamental radiators) - Radiated – Vertical

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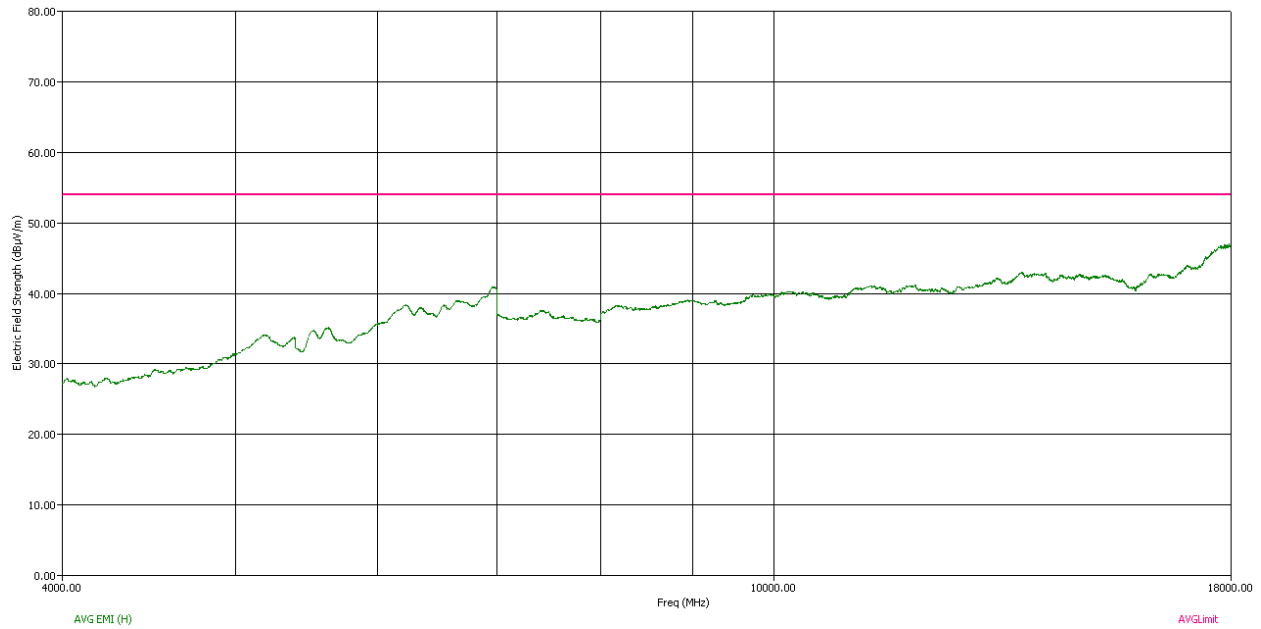


Figure 31: Operation within the bands (Harmonics radiators) – Horizontal Polarization

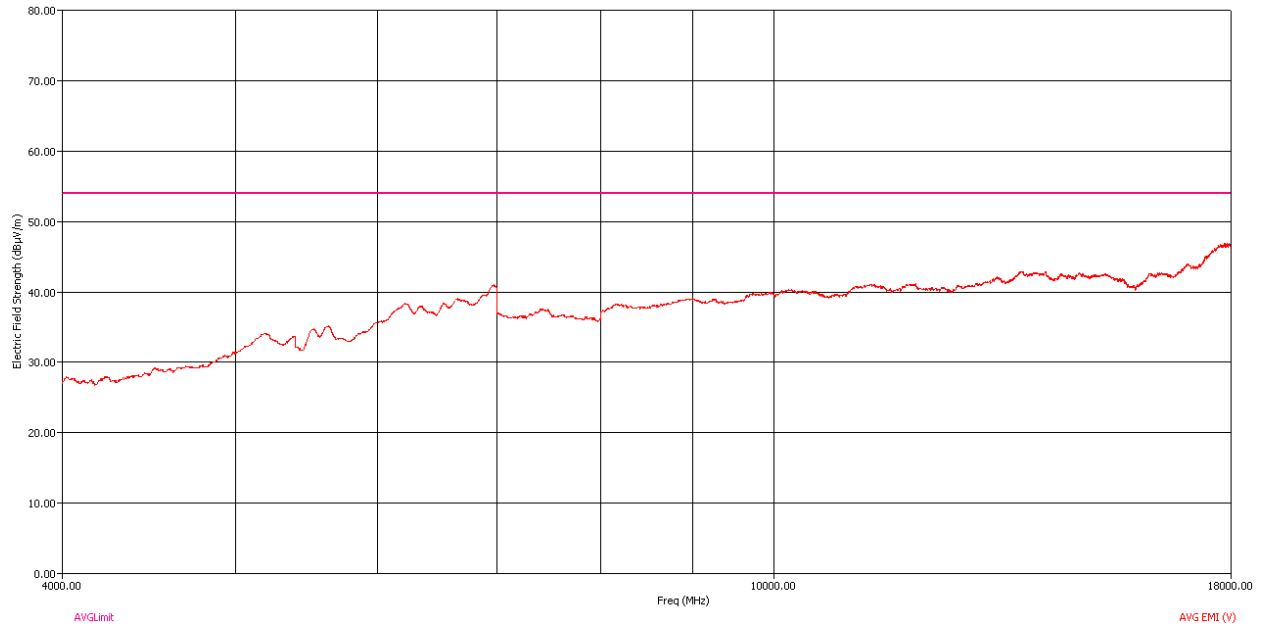


Figure 32: Operation within the bands (Harmonics radiators) – Vertical Polarization

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6.5 PEAK CONDUCTED OUTPUT POWER

6.5.1 REFERENCE SECTION

Standard	Reference section	Limits
FCC 47 CFR, Part 15	15.247 b (1)	Peak conducted output power of hopping systems using less than 50 hop channels < 125 mW

Standard	Reference section	Limits
RSS-210	A8.4 (2)	Peak conducted output power of hopping systems using less than 50 hop channels < 125 mW

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	Cable loss (0.67 dB) correction factor is added in Spectrum Analyzer.
6	This measured value is compared against the limit and the result is declared

6.5.3 RESULT

Channel No	Frequency (GHz)	Measured power (dBm)	Measured power (mW)	Limit (mW)	Result
37	2.402	-2.158	0.608	125	Pass
38	2.426	-1.892	0.646	125	Pass
39	2.480	-2.226	0.598	125	Pass

Note: Transmit duty cycle considered is = 1

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

Cable Loss correction factor is added in Spectrum analyzer

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6.5.4 RESULT (SUPPORTING GRAPHS / DATA)

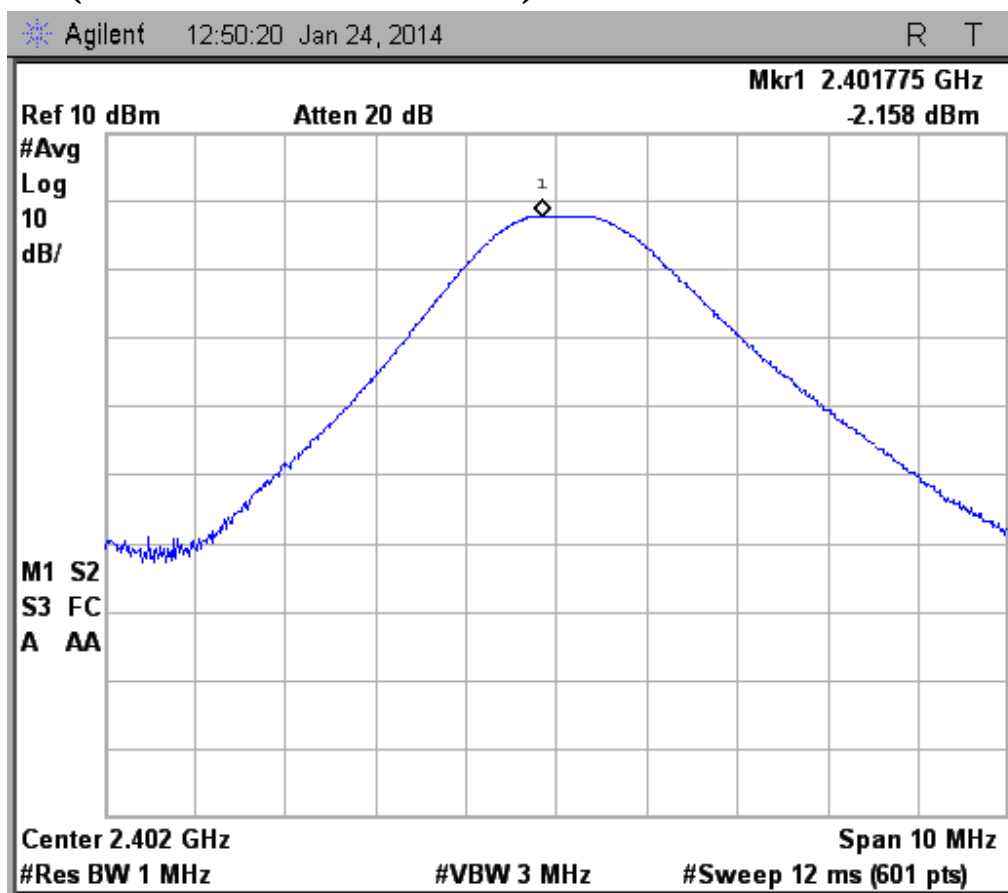


Figure 33: Peak conducted output power – Channel 37

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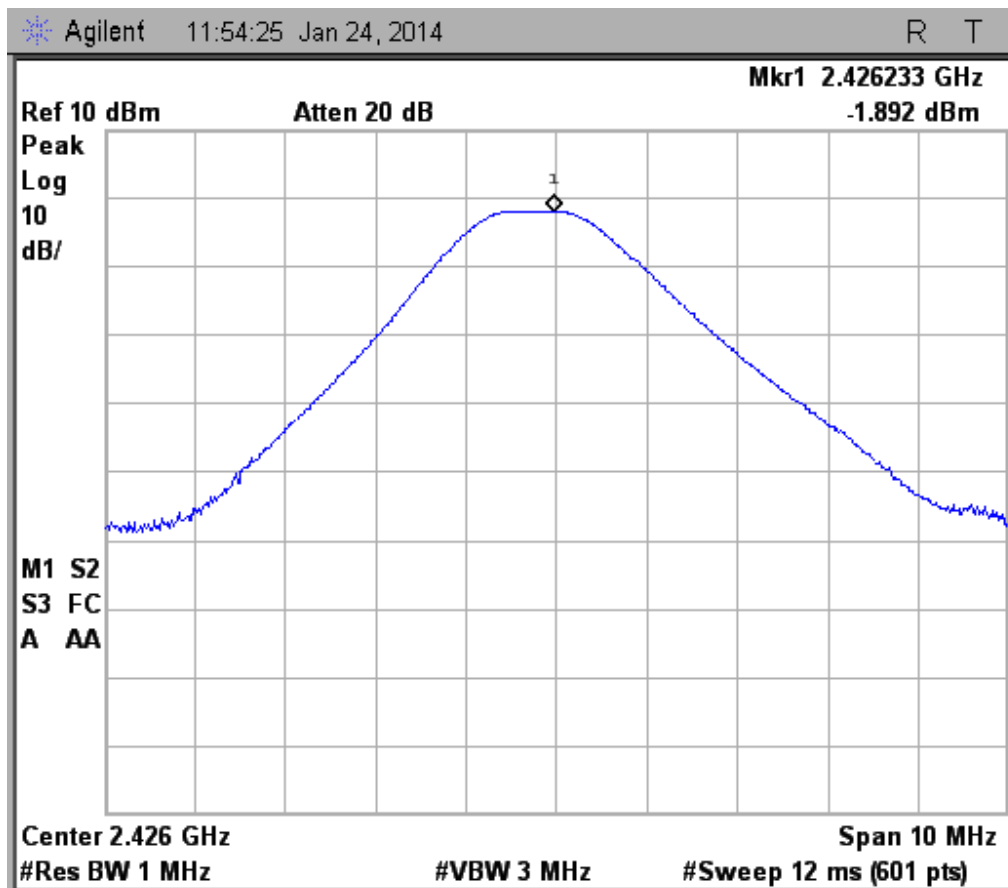


Figure 34: Peak conducted output power – Channel 38

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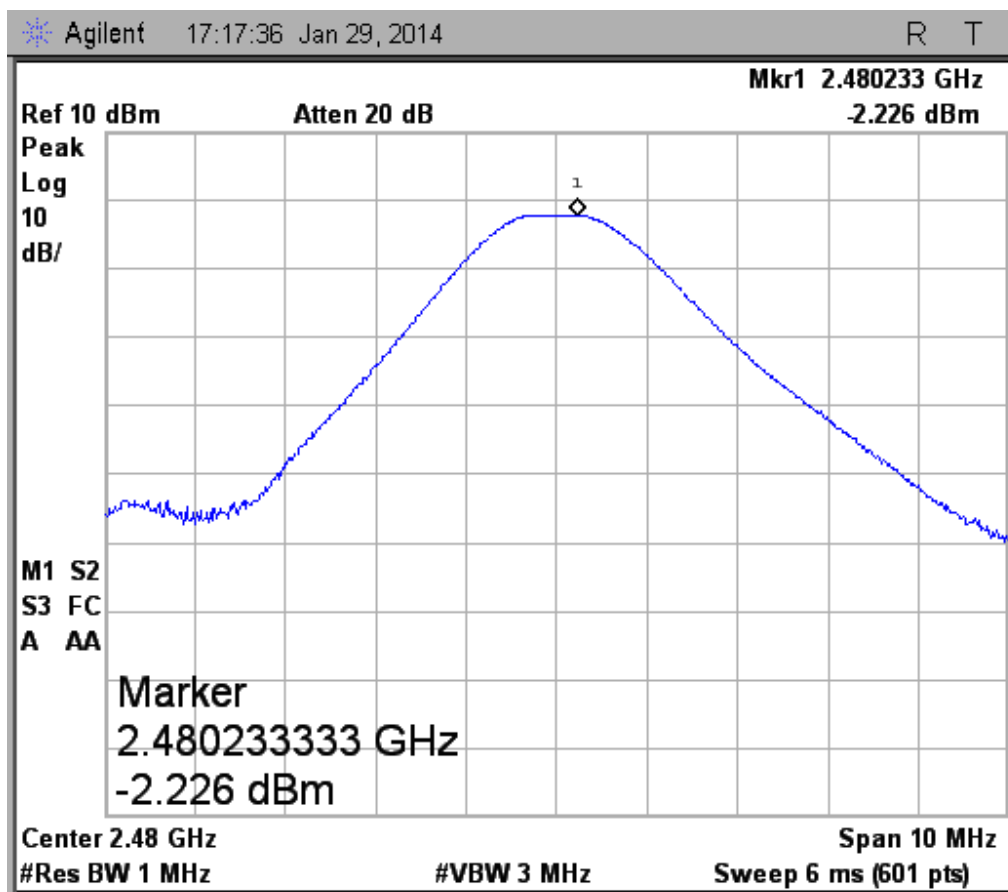


Figure 35: Peak conducted output power – Channel 39

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6.6 CONDUCTED SPURIOUS EMISSION

6.6.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limit
FCC 47 CFR, Part 15	15.247 (d)	In any 100kHz band outside the intentional band, emissions shall be 20dB below the peak power

Standard	Reference section	Limit
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 20 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
37	2.402	-2.747 dBm	< 20dB below measured peak (limit line)	Pass
38	2.426	-2.569 dBm	< 20dB below measured peak (limit line)	Pass

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6.6.4 RESULT (SUPPORTING GRAPHS / DATA)

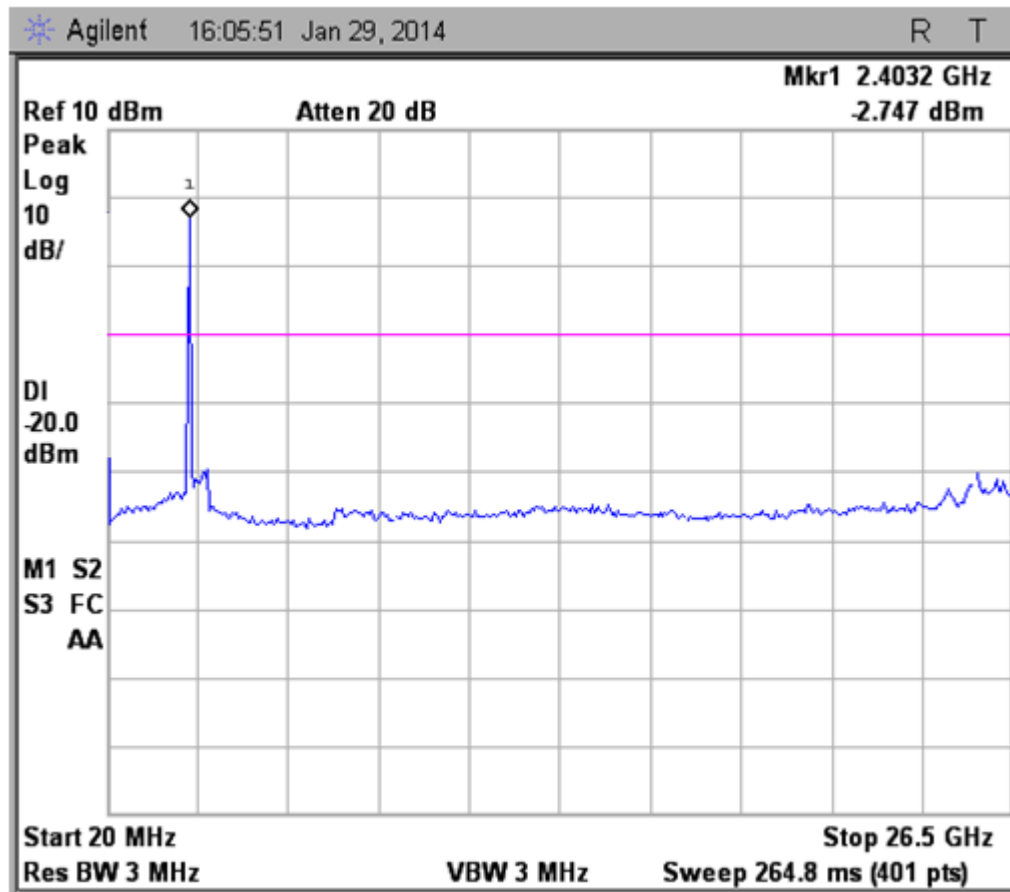


Figure 36: Conducted Spurious Emission – Channel 37

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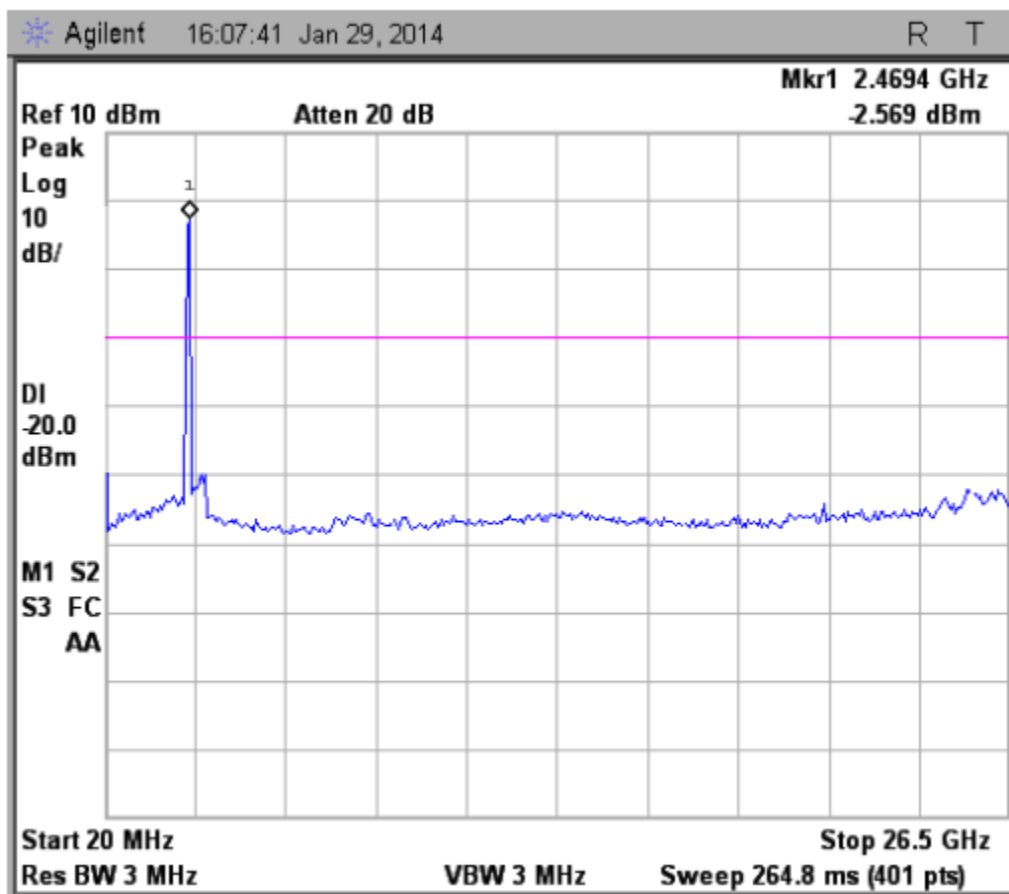


Figure 37: Conducted Spurious Emission – Channel 38

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6.7 BAND EDGE MEASUREMENTS CONDUCTED

6.7.1 REFERENCE SECTION & LIMITS

Standard	Reference section	Limit
FCC 47 CFR, Part 15	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.

Standard	Reference section	Limit
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.

6.7.2 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

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6.7.3 RESULT (SUPPORTING GRAPHS / DATA)

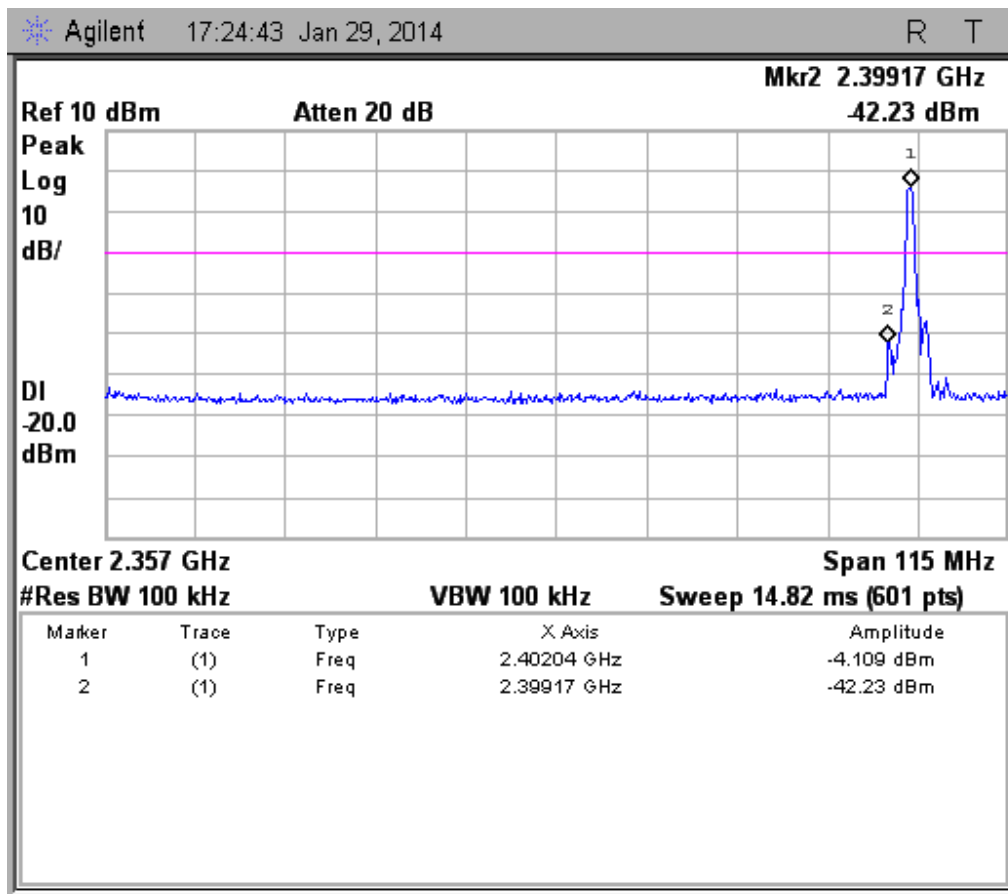


Figure 38: Low Band Edge – Channel 37

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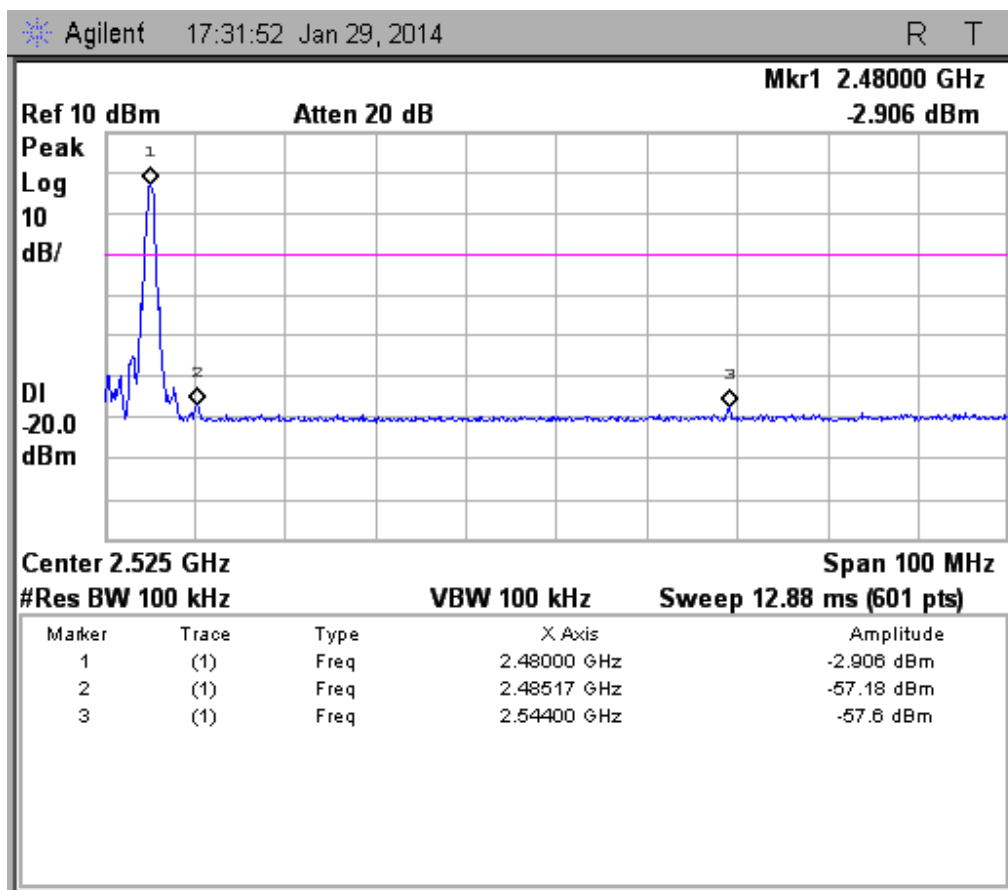


Figure 39: High Band Edge – Channel 39

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6.8 ANTENNA REQUIREMENT

6.8.1 REFERENCE SECTION & LIMITS

Standard	Reference section
FCC 47 CFR, Part 15	15.203

KeyFob uses a permanently fixed onboard antenna, it is a part of the PCB and as shown in figure below:

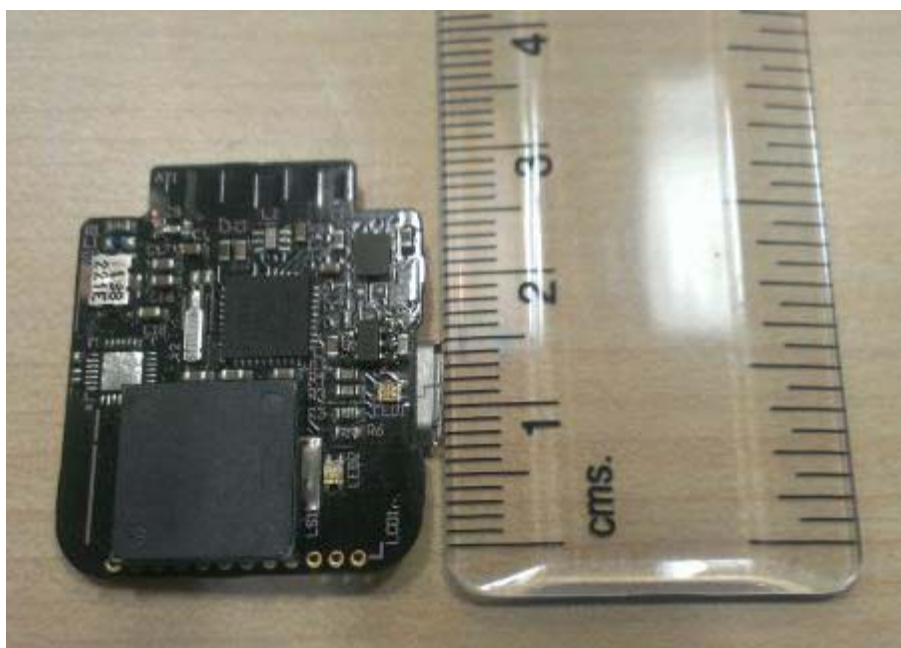


Figure 40: Photograph showing onboard Antenna

6.8.2 RESULT (SUPPORTING GRAPHS / DATA)

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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(37), Mid(38) and High(39) 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 5MHz and Sweep time of 1s in the Spectrum Analyzer and sampling detector should be used.
5	The EUT shall be operated in its maximum carrier power.
6	Based on the recorded value, the result is declared.

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6.9.3 RESULT (SUPPORTING GRAPHS / DATA)

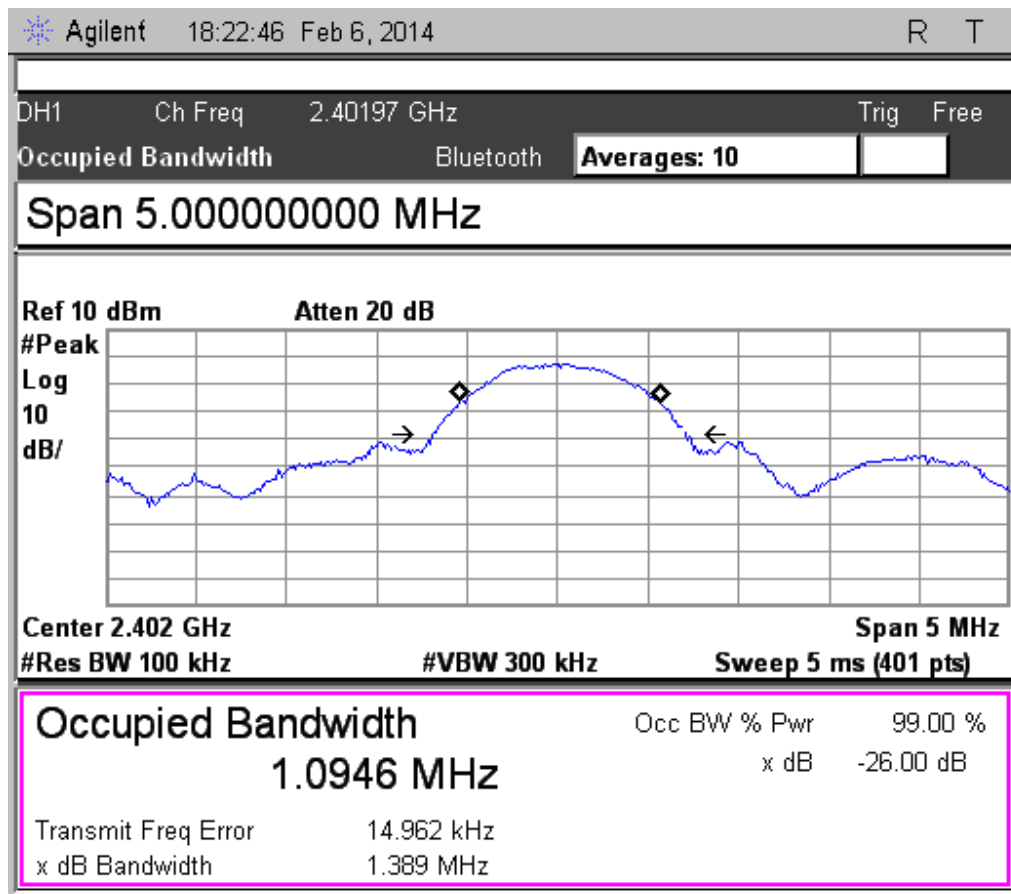


Figure 41: Occupied Bandwidth Measurement – Channel no 37

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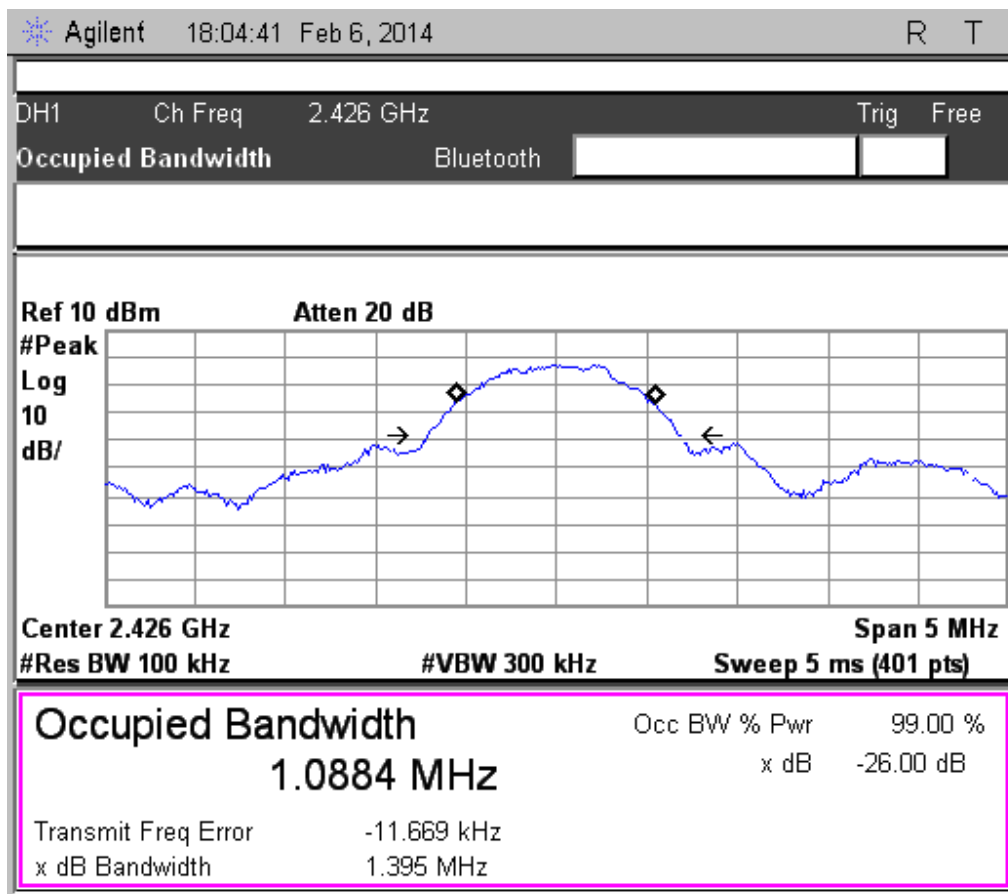


Figure 42: Occupied Bandwidth Measurement – Channel 38

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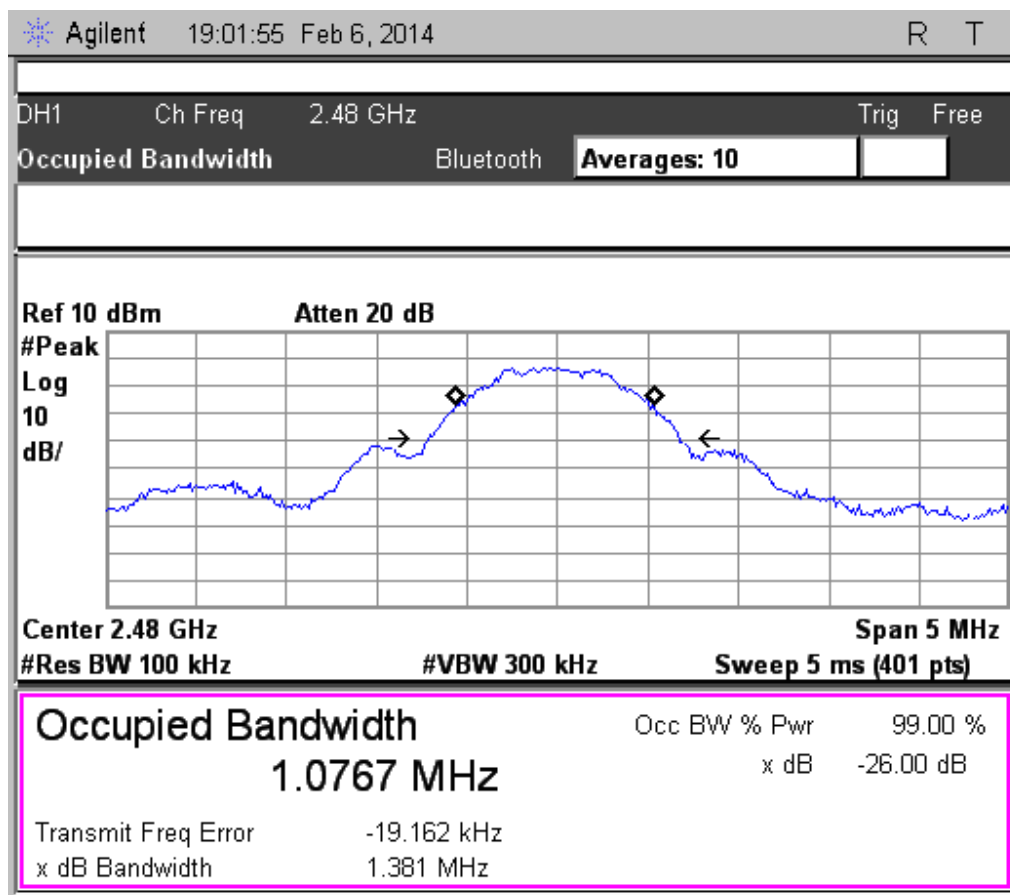


Figure 43: Occupied Bandwidth Measurement – Channel no 39

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7 APPENDIX 1 – ACRONYMS

CFR	Code of Federal Regulations
dBm	Decibel milliWatt
dB _i	Decibel Isotropic
db _μ V	Decibel microVolts
EUT	Equipment Under Test
FCC	Federal Communications Commission
GHz	Giga Hertz
IC	Industry Canada
kHz	Kilo Hertz
MHz	Mega Hertz
mW	milliWatt
NABL	National Accreditation Board for Testing and Calibration Laboratories, India
USB	Universal Serial Bus